150-WATT SINGLE BANDER

**features**
- EXTRA HIGH-C VFO
- TWO-STAGE CIRCUIT
- AUTOMATIC VFO SWITCH

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*A 3.5 Megacycle Transmitter for Field Day or Home Station*

The 3.5-megacycle transmitter described in this issue is one of a series, each with similar panel controls, designed to operate on specific amateur bands. Details on transmitters for the higher frequency bands, plus built-in accessories, will appear in forthcoming issues of G-E HAM NEWS.

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In hundreds of amateur radio clubs, plans for the following year's Field Day participation begins as soon as equipment has been dismantled and hauled back home from the latest Field Day site. In one such club, single-band transmitters similar to that described herein resulted from a study of the conditions under which radio equipment for Field Day must function. The basic single-band transmitter circuit is equally suited for home-station operation on your favorite band—and it will run from existing power supply, keying or modulation equipment in your station.

DESIGN CONSIDERATIONS
The basic objectives about which this simple transmitter was designed are:

1. SINGLE-BAND OPERATION—Circuit constants selected for optimum performance.

2. ADEQUATE POWER OUTPUT—Enough power for a solid signal even with a male-shift antenna.

3. CONVENIENT OPERATION—Few panel controls, plus break-in or single switch changeover from receiver to transmitter operation.

4. TRANSPARENT OR CLAMP OSCILLATOR—And a convenient means for tuning on VFO only to prevent self-oscillation.

5. GOOD SHORT-TERM STABILITY—Negligible drift during contacts of normal duration.

6. COMPLETE METERING—Adaptable in various methods for tuning up and rapid troubleshooting.

7. INTERFERENCE FILTERING—Key-click and harmonic filters to reduce interference to other closely-grouped stations.

8. SINGLE PACKAGED UNIT—Transmitter and all accessories in one easily-carryed cabinet.

9. UNITIZED CONSTRUCTION—Simplifies assembly and alterations, also speeds replacement of accessory in which trouble has occurred.

10. STANDARDIZED CONSTRUCTION—No specialized sheet metal work necessary.

11. INEXPENSIVE COMPONENTS—Low-cost tubes, dials, capacitors, etc., readily available from electronic parts distributors or your junk box.

12. MODULAR CONSTRUCTION—Major electrical and mechanical requirements have been fulfilled, as far as practical, in the resulting transmitter. Further optional construction or operation, immediately overcomes most compromises necessary in most typical homemade or home-built transmitters.

13. DRIVE TUBE IMMUNITY—It is not necessary to drive this transmitter into a grid-plate circuit, with a potential of 150-V or higher, without elaborate tube lineups (such as 6SL7's) to ensure tube life.

14. CONSTRUCTION—Simplifies panel control design and reduces the number of items to be purchased, as a complete 150-watt single-band transmitter costs less than $20.00.

15. FIRST-CLASS OPERATING RANGE—A single 150-watt amplifier stage will handle a full 151-watt input as a class C amplifier in CW service.

16. CIRCUIT DETAILS

Once the tube lineup has been chosen, the remaining transmitter circuit details were worked out, as shown in the schematic diagram, Fig. 1. This particular version is based on a push-pull design with space-consuming shielding and mechanical rigidity problems which must be overcome to obtain a truly stable series-tuned Clapp oscillator, the old parallel-tuned crystal oscillator, and a single-ended or tuned half-wave rectifier (see Technical Tips—HIGH-C OSCILLATORS, on page 6, for details). This oscillator was found to have excellent short-term stability (point 5) without requiring temperature compensation when skillfully constructed from high-quality components. The frequency determining circuit was designed to operate at half the transmitter output frequency to reduce interaction while tuning the final amplifier plate circuit.

To avoid a panel control for tuning the interstage coupling circuit between the 6AG7 plate and 807 control grid circuits, a bandpass coupling (L1-C1, L2-C2) was devised. The 807's were connected in parallel, instead of push-pull, to eliminate a split-plate tuned tank circuit tuning capacitor. A pi-network output circuit was similarly ruled out to reduce the number of panel controls. A physically small tuning capacitor with nominal plate spacing (0.043-0.050 inches) will suffice for the parallel-tuned plate tank circuit (C1-L1), because it eliminates blocking capacitor, C2, isolates it from the high voltage fed to the 807's through RFC. The 807 and RFC are tuned to the grid current and voltages of the oscillator and setting for which the transmitter was first tuned.

A two-section receiver tuning capacitor, C1, was placed in series with the grounded side of the output link coil, L3, for an antenna loading adjustment. This capacitor also helps compensate for any reactance reflected back into the transmitter output coupling circuit from the antenna.

Measurement of the grid, screen and plate currents in the 807 stage, plus RF voltage at the antenna connector, J1, and the power supply high voltage, was included in the metering circuit. Oscillator tube performance can be judged from the 807 grid current, and the desired power output can be controlled by changing the plate supply voltage. A 1-kilowatt meter used as a voltmeter at a 1.6-volt full scale reading, measures the voltage drop across resistors placed in series with the above final amplifier circuits when Si is turned to positions A, B and C. In position D, a portion of the RF output voltage is applied to a diode, D5, changed into direct current and applied to meter through a full-wave rectifier. The 807 plate supply voltage, up to 1600 volts maximum, is measured by watching the milliammeter readings.

150-WATT SINGLE BANDER

The above electrical and mechanical requirements have been fulfilled, as far as possible, in the resulting construction. Further optional construction or operation, immediately overcomes most compromises necessary in most typical homemade or home-built transmitters. By using a push-pull design and a parallel-tuned tank circuit, the transmitter output frequency can be reduced to two-thirds of the transmitter output frequency to reduce interaction while tuning the final amplifier plate circuit.

Fig. 1. Block diagram showing all units which comprise the complete 150-watt single band transmitter.
PARTS LIST—3.5-MEGACYCLE TRANSMITTER

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>300-mfd double-decker variable</td>
</tr>
<tr>
<td>C2</td>
<td>0.002-mfd silvered micro</td>
</tr>
<tr>
<td>C3</td>
<td>100-mfd silvered micro</td>
</tr>
<tr>
<td>C4</td>
<td>200-mfd micro</td>
</tr>
<tr>
<td>C5</td>
<td>15-350-mfd variable, 0.045-inch air gap</td>
</tr>
<tr>
<td>C6</td>
<td>0.001-mfd, 2500-volt working micro</td>
</tr>
<tr>
<td>C7</td>
<td>Two-section 15-345-mfd per section variable</td>
</tr>
<tr>
<td>D1</td>
<td>General-purpose germanium diode (G-E 1N48)</td>
</tr>
<tr>
<td>J1</td>
<td>Closed-circuit phone jack</td>
</tr>
<tr>
<td>J2</td>
<td>Choke coaxial connector</td>
</tr>
<tr>
<td>L1</td>
<td>560-mho, 14 turns, 2% diameter, 1/4.5 inches long</td>
</tr>
<tr>
<td>L2</td>
<td>2.500-mho, 57-ma choke coil (National 80-8)</td>
</tr>
<tr>
<td>RFC1</td>
<td>1.0-ohm, 300-mfd RF choke (National 80-300)</td>
</tr>
<tr>
<td>RFC2</td>
<td>0.005-mfd silvered mica ceramics (National DW-71)</td>
</tr>
<tr>
<td>2A</td>
<td>2-pole, single-throw, push-button switch</td>
</tr>
<tr>
<td>S1</td>
<td>2-pole, 3-position, non-shorting ceramic top switch</td>
</tr>
<tr>
<td>S2A</td>
<td>6-terminal barrier type terminal strip</td>
</tr>
</tbody>
</table>

Fig. 2. Schematic diagram of the RF unit. The metering circuit provides the following readings: “A,” 0-25 ma DC, 807 grid current; “B,” 0-50 ma DC, 807 screen current; “C,” 0-120 ma DC, 807 plate current; “D,” RF output voltage; “E,” 0-1000 volts DC. Any suitable type of power connector can be used in place of TS.

Fig. 3. Schematic diagram of the relay-type screen keyer.

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>2-pole female receptacle</td>
</tr>
<tr>
<td>P1</td>
<td>Octal male plug (Amphenol 86-PM-8)</td>
</tr>
<tr>
<td>RFC3</td>
<td>0.005-mfd, 22-watt adjustable resistor</td>
</tr>
<tr>
<td>RFC4</td>
<td>2.5-ohm RF choke</td>
</tr>
<tr>
<td>RFC5</td>
<td>100-150-moh iron core RF choke</td>
</tr>
<tr>
<td>RFC6</td>
<td>2-ohm, one- or two-position relay, 6.3-volt AC coil</td>
</tr>
<tr>
<td>V1</td>
<td>0-25 volts DC regulator tube</td>
</tr>
</tbody>
</table>
to strong nearby signals (from other closely grouped Field Day transmitters).

Attenuation of harmonic energy (point 7) in the transmitter output was accomplished with a half-wave type filter not shown in the diagram (see The HARMONIZER, G.E. HAM NEWS, November-December, 1949, Vol. 4, No. 6; and May-June, 1957, Vol. 13, No. 5, for details). This type of filter attenuates signals harmonically related to the grid frequency. It thus will help reduce interfering in a receiver which sometimes results from other transmitter harmonics.

The HARMONIZER type filter, plus the steel cabinet, eliminated all traces of interference to both sound and video on television receivers operated only a few feet from the transmitter in an area served by stations on VHF channel 6 and four UHF channels. More elaborate TVI precautions (described in the ARRL Handbook) may be necessary if the transmitter is to be operated in locations served by other channels, especially with a weak TV signal.Shielding and filtering suggestions will be covered in the next issue of G.E. HAM NEWS.

The power requirement for this transmitter is 500 to 750 volts DC at 150 to 200 milliamperes; 250 to 300 volts DC at 50 milliamperes; and 6.3 volts AC at 7 amperes. The model transmitters were operated from a variety of bridge rectifier type power supplies previously described (see DUAL VOLTAGE POWER SUPPLIES, G.E. HAM NEWS, September-October, 1957, Vol. 12, No. 5, for details).

MECHANICAL DETAILS

The complete transmitter—RF unit, power supply, keyer or modulator and output filter—in is easily housed in the 13 x 18 inch area of a standard table relay rack. The chassis provides ample space for everything on one large chassis, each of the units mentioned above was constructed in separate metal chassis or boxes (point 9). The power supply, on a 7 x 13 x 3 inch chassis, was located directly behind the RF unit. The relay type keyer occupies only a portion of the space available for a combined keyer-modulator unit which can be built on a 5 x 13 x 3-inch chassis. The 7 x 13 x 3-inch aluminum chassis (Bud AC-408) for the RF unit (point 10) provided plenty of room for all components without crowding. Locations for all major components are shown on the chassis drilling diagram, Fig. 6. Small holes for fastening hardware should be drilled to match the location of these holes on the parts actually used in building the transmitter. The chassis was constructed of 0.015 inch copper plate, C9, was located on the center line of the 8 x 12-inch relay rack panel on which the RF unit was mounted, as shown in the top view photograph, Fig. 5.

The antenna loading capacitor, C0, shown in the bottom view, Fig. 6, should be fastened beneath the chassis on 1/4-inch long spacer bushings before the RF plate tuning capacitor, C0, is mounted above the chassis. Washers should be placed under the mounting feet on C0 so that its rotor plates will not touch the heads of the screws which hold C0 in place. An extension shaft, noted at the panel end protruding through a panel bearing, provides for adjustment of C0.

Small parts should be securely mounted beneath the chassis with insulated terminal posts or lug-type strips. The silver micro capacitors in the oscillator grid circuit, C1, C2, and C3 must be rigidly supported to insure good oscillator frequency stability.

The National type "K" oscillator tuning dial was selected for a two-fold purpose: first, it is one of the most inexpensive vernier dials available (point 11); and second, the rim-drive tuning knob permits the inclusion of an automatic means for turning on only the oscillator when adjusting its operating frequency. Instead of mounting the push-button switch, S0, on the panel, the lug, S0, was mounted to the chassis. With this arrangement, the crew, by turning the tuning shaft, can simultaneously move C0 and S0 without changing the oscillator frequency. The oscilloscope, O1, was built directly behind the panel bushing which supports the tuning knob shaft. A short length of 1/4-inch-diameter fiber rod was cemented to the switch button, as shown in the detail view of this assembly, Fig. 7. The bracket is adjusted so that the fiber rod rests against the knob.
shaft. When the tuning knob is pushed in while being turned, the knob shaft pushes on the fiber rod. This closes the normally open contacts on S1 and applies screen voltage to the oscillator tube.

To insure that the tuning knob will spring out when it is released, adjust the position of the knob shaft bushing so that the shaft slides freely after lubricating it with powdered graphite. Locate the angle bracket so that S1 closes when the tuning knob is pushed in.

In the 3.5-megacycle transmitter, the push-button switch was replaced by a closed circuit phone jack with the contact blades spread apart. The fiber rod was cemented to one blade and the jack was then mounted on an angle bracket so that the fiber rod contacted the knob shaft. However, this switch was more difficult to adjust properly than the push-button switch.

The 807 plate tank coil, L5, was mounted atop the tuning capacitor with a 14½-inch-high cone insulator at the back end, and a tubular metal spacer the same length at the panel end. The link coil, L8, was wound at the grounded end of L5, using a single length of wire which also forms the twisted leads running down through the chassis to C9 and J4. A small pilot lamp bracket was mounted on the panel directly above the oscillator tuning dial pointer. The milliammeter was centered 23⅛ inches down from the top, and 5 inches in from the side panel edges, respectively.

The relay keyer shown in the photographs was constructed in a 3 x 4 x 5-inch Minibox (Bud CU-3005) and fastened to the panel. Parts may be located wherever convenient in this unit. The connecting cable on P1 was made from insulated hookup wire.

WIRING DETAILS

All leads running between the tube grids and plates to other related components were made from No. 12 tinned copper wire. Insulated hookup wire, rather than the shielded wire usually used for TVI prevention, was used (continued on page 5).
Oscillators are one of the key devices in the amateur radio station. Superhet communications receivers usually contain at least two of them (high-frequency oscillator and beat-frequency oscillator). Simple transmitters usually employ one oscillator, but more complex rigs (and those with parasitics) may have two, or even three oscillators.

Obviously, the stability of these oscillators is of major concern to all persons who use this equipment (and the FCC too), especially in view of increasingly crowded amateur band conditions. More radio amateurs are adopting advanced transmission techniques, such as frequency shift keying for radio teletype, and single sideband or other suppressed-carrier systems. These techniques require oscillators having excellent frequency stability.

Introduction of the Clapp series tuned oscillator circuit several years ago did much to improve oscillator stability in amateur transmitters. This is quite apparent to those of us who have been on the air long enough to see (and hear) the change. In addition, this circuit permitted remote tank circuit placement, which helps to reduce the parasitic elements from the heat producing portions of the equipment. The Clapp circuit is now so widely used that little else appears in amateur radio literature— and there must be quite a few experimenters who are hardly aware that any other oscillator circuit ever existed.

The Clapp circuit does have one weakness which many amateurs have discovered when they first tried constructing this type of oscillator. Best circuit performance requires that relatively large high-Q inductors and low-capacity tuning capacitors be used. With such components, extreme mechanical rigidity is essential. Make no mistake—small mechanical construction is necessary for good frequency stability in any oscillator— it simply is more difficult to achieve with components the size of a 150-watt tank circuit! This is particularly true when compact construction is desired for portable/mobile equipment.

More in the spirit of adventure than anything else, the writer decided to see what could be done with a straight-forward high-capacity Colpitts type oscillator circuit. (The Clapp oscillator as we see it is a derivation of the Colpitts.) Jack Adams has done some amazing figures—the values of capacity in the following circuit indicated by the formulae were about 5 times higher than expected! After checking all the interconnections, the author finally concluded that something was amiss. Digging into the junk box, we pulled out an un-used 0.004-mfd 200-megacycle slug type capacitor with 0.01 and 0.005-mfd micro capacitors (vintage?). When these were replaced, the circuit was built and powered; it worked! This is the oscillator readily with lots of output. Being designed for operation at 1 megacycle, it was then tuned so that the tenth harmonic was zero beat with WWV's 10-megacycle signal.

Several pleasing characteristics became apparent during the next few minutes. First of all, hand capacity extremes were extremely small. In fact, the coil terminals could be touched with the fingers without starting oscillations, and the frequency shift under this abuse was very small (a few kilocycles at the 10-megacycle harmonic). Secondly, a few sharp raps with a screwdriver confirmed that the mechanical stability of the small coil form was very good. Thirdly, radiation of RF energy from the small coil was very low, similarly indicating that it would be a very poor pickup device. Shielding requirements, to keep RF energy from succeeding stages in a transmitter from being inductively coupled back into the oscillator tank circuit, would thus be minimized. In other words, this oscillator had the very features desired for the 150-watt single bander.

Let's compare typical component values for both the series-tuned Clapp and high-C Colpitts oscillators at a signal frequency of 3500 megacycles. As shown in Fig. 1A, a physically large, high-Q inductance is required for best results. To prevent the coil from picking up stray RF energy, it should be housed in a shield box that is large enough to have little effect on the coil Q (Q = x x inches for a 3-inch separation between the box walls and coil).

In contrast, the corresponding 1-microhenry inductance in the high-C Colpitts circuit, Fig 1B, was wound on a 1/4-inch-diameter slug-tuned coil form (National XH-10). This small coil can be backed into a corner of a chassis, or even in an IF transformer shield can.

In the Clapp circuit, a hand-packed capacitor having a capacity range of about 10 mfd will tune the oscillator from 3500 to 3700 megacycles. Comparable handspread in the high-C oscillator requires a capacity adjustment range of about 200 mfd. The latter variable capacitor usually will have better mechanical rigidity.

The 0.001-mfd capacitor connected between the control grid and cathode of the Clapp oscillator is much larger than any likely variation in tube and stray capacities. However, the corresponding 0.004-mfd capacity of the high-C type is likely to be varied in swapping out these variables. In both oscillators, silvered mica or other high-Q capacitors with excellent mechanical characteristics are required.

The results were quite surprising. In the Clapp oscillator practically all capacity variations (with a few exceptions) were taken care of by the crystal controlled oscillators were almost universally used during the 1930's. True, there were problems that the maximum capacity possible in a high-C oscillator circuit is limited by the transconductance of the available tubes; and that present tubes often have a transconductance too small to drive the tubes available twenty years ago. The improvement in oscillator stability has all practical purposes proportional to this improvement in tube transconductance.

The crystal controlled oscillator which results from the application of this "old" circuit to modern tubes is a refreshing change from the ordinary circuit complication which has characterized so many recent designs. The results obtained with the high-C oscillator have equaled or bettered those of the "modern" type.

Perhaps it is time for a long-needed reassessment of some good "old" ideas. Give these "old" circuits a try— when combined with modern components—you'll be delighted with the results.


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**Fig. 1. Schematic diagrams of:**

A—the frequency-determining component in a typical series-tuned Clapp oscillator for 35 megacycles; B—high-C oscillator component values for a high-C parallel-tuned oscillator.
The 1957 Edison Radio Amateur Award program is now in full swing, so don't let that deadline for submitting nominations—set to arrive no later than January 2, 1958—go by without sending your letter to the Edison Award committee. In full, but briefly described as a meritorious public service that has been performed during 1957 by a United States radio amateur while pursuing his hobby, the award is a handsome presentation clock. The Edison Award was also won by a worthy project for public-spirited radio amateurs. In fact, I'll even stick out my glass-encased neck (see picture above) and predict the High-C oscillator is as popular as the "standard" circuits in amateur radio equipment designs.

The following successful application of the newest and honorable Colpitts circuit—High-C, that is—to the transmitters described in this issue, we have continued our experiments with it in other equipment. In due time you'll be seeing the results in future issues of G-E HAM NEWS.

While researching during these experiments, we dug back through our archives of amateur radio journals and found only a few articles which covered this type of oscillator, including: "Remote tuning for the High-C VKO," by N. D. Larkin, W3DWG, on page 36 of the September, 1933 issue of QST, and, " Packaging 35 Watts for 60 and 40," by R. M. Smith, W2FXT, in November, 1952, QST, on page 21. Still another milestone on the path toward rediscovering the High-C oscillator was an article by Captain W. B. Bernard, U.S.N., WH2EL, on page 45 of the October, 1937 issue of QST. It's called, "Let's Increase V.F.O. Stability."

We're sure you will find all these articles on high-C oscillators interesting and informative. In fact, I'll even stick out my glass-encased neck (see picture above) and predict the High-C oscillator is as popular as the "standard" circuits in amateur radio equipment designs!

If you think that the final amplifier tubes in your transmitter are hard workers, take a look at the conditions under which the 6AF4 UHF oscillator tube in this circuit operates. To meet the high impedance requirements, the 6AF4 is operated as a life low-inductance, low-capacitance demand for operation is too low. 6AF4 UHF resonant series inductance of 1000 ohms to 90 megacycles, small electrolytic capacitors with close placement are required. High cathode emission and current flow density five to six times that of other tubes subject the grid and plate to high temperatures. These tube elements must resist gas-forming tendencies that can destroy tube efficiency.

Add more torture from lack of ventilation through necessarily tight UHF oscillator shielding and the decline in efficiency as component ages. Little wonder that the 6AF4 often literally roasts itself to an early demise, accompanied reasonably by a steady drop-off in picture quality.

Even with TVI shielding, operating conditions for the average transmitting tube aren't that tough. But now receiving tube design engineers have combined new materials with new manufacturing and test methods, resulting in an improved 6AF that for the first time is fully efficient and dependable as other tubes. Tests on thousands of tubes have proved that after 2500 hours and more of service, the new R-G 6AFs (S-2AF, S-3AF, and S-4AF) operate efficiently as a UHF oscillator.

With the long awaited 6AF, the High-C oscillator is another example of the unceasing progress in TV receiving tube design and design. In effect, this tube has been compared in performance, life, and operability with the older tubes we featured in the February, 1958, issue of HAM NEWS.

HALLSTON LARRY

7 SWEEPING THE SPECTRUM
150-WATT SINGLE BANDER

(continued from page 5)

used for all power and miscellaneous wiring. However, it was found that by laying the insulated wire flat against the chassis, the capacitance from wire to chassis was nearly as effective as using shielded wire in the transmitter. The longer leads were placed in the corners of the chassis and held in place with short lengths of plastic insulating tape.

The completed transmitter was dressed up with decal lettering to mark the various controls and switch positions. Direct frequency calibration can be added to the oscillator tuning dial with decals, if desired. A rim type lock was placed above the tuning dial for C5, in addition to a shaft lock on C6. These precautions prevent these controls from being retained accidentally during the excitement of constant operation.

OPERATION—3.5-MEGACYCLE TRANSMITTER

First, momentarily apply 6.3 and 115 volts AC, and about 210 volts DC, to J2, and the proper terminals on T2, to check for short circuits and incorrect wiring. If no trouble is found, plug the cable from the keyer into J2, a key into J1, and a dummy antenna into J3. A 100-watt lamp inserted in a porcelain lamp socket, wired to a short length of coaxial cable with connector, is a suitable dummy load at this frequency. Plug in the 6AG7 and OA2 tubes and apply power.

The oscillator should start readily, since the test models worked with as low as 10 volts on the 6AG7 screen grid. The signal should be located by tuning a receiver between 3.3 and 3.9 megacycles. After the oscillator frequency has been determined, adjust the slug in L5 until the oscillator covers the desired 200-kilocycle segment of the 3.3-4.0-megacycle amateur band that can be covered with the 300-mfd tuning capacitor, C3. A two-section broadcast receiver tuning capacitor, with the sections in parallel (same as C3), is required to tune the band without retuning L5.

Remove the power while plugging in the 807 amplifier tubes and again apply power. With the meter selector switch, S3, in position “C,” tune C1 for a dip in plate current (assuming that a plate current reading is obtained). The dummy load lamp may glow when the 807 plate tank circuit is resonated. Set S4 on position “A” to read grid current in the 807 stage and tune LPE for maximum grid current with the oscillator at 3600 kilocycles; and tune LPE for maximum grid current on 3000 kilocycles. Start with minimum spacing between L5 and LPE, then move L5 away from LPE until a fairly uniform 807 grid current reading (1 to 8 milliamperes) can be obtained when tuning the oscillator from 3.3 to 4.0 megacycles.

Check the operating speed of the keying relay, especially if an automatic key will be used with the transmitter. If the relay is mounted in the keyer box so that gravity helps open the contacts, the armature spring tension can be reduced to obtain high-speed operation. The VFO switch, S1, should be adjusted for proper action, as described under MECHANICAL DETAILS.

Apply full DC voltage to the transmitter and set the VFO to the midpoint of the desired 200-kilocycle tuning range. Adjust C5, until the meter reads 200 milliamperes with S3 in position “C,” keeping C1 tuned for a dip on 807 plate current. No retuning of either C3 or C5 should be necessary within the VFO range when the transmitter operates into a well-matched antenna system (standing wave ratio of less than 2 to 1 on the feedline). By contrast, Lighthouse Larry says that he has operated rigs on Field Day on which six kilos had to be retuned when making only a 20-kilocycle change in frequency!