Electronic
TUBES

G-E HAM NEWS

GENERAL ELECTRIC

NOVEMBER–DECEMBER, 1957

VOL. 12—NO. 6

150-WATT SINGLE BANDER

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

—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.

—*Lighthouse Larry*

CONTENTS

150-WATT SINGLE BANDER

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 make-shift antenna.
3. *CONVENIENT OPERATION*—Few panel controls, plus break-in or single switch changeover from receive to transmit.
4. *VARIABLE FREQUENCY OSCILLATOR*—And a convenient means for turning on VFO only to adjust operating frequency.
5. *GOOD SHORT-TERM STABILITY*—Negligible drift during contacts of normal duration.
6. *COMPLETE METERING*—Adequate measurements 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-carried 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.

The above electrical and mechanical requirements have been fulfilled, as far as practical, in the resulting transmitter design. Single-band operation (point 1) immediately overcomes most compromises necessary in multi-band RF circuitry by eliminating unused coils, bandswitches and long leads which often cause undesired resonances and parasitics. It also avoids the conflict between high minimum capacitance in resonant circuits which must reach 30 megacycles, but still have sufficient maximum capacitance for optimum "Q" at 3.5 megacycles.

The 100-watt power class (point 2) is attainable with inexpensive tubes and moderate plate voltages. Two GL-807's (or its 12.6-volt heater counterpart, the GL-1625, having a different base) emerged as the logical choice. A pair of either tubes will handle up to 150 watts input as a class C amplifier in CW service. They are inexpensive and require little driving power, in addition to being reasonably tolerant of variations in driving power and screen voltage.

A transmitter having few necessary panel controls is desirable for convenient operation (point 3) during a contest. The simple two-stage tube lineup shown in the block diagram, Fig. 1, resulted primarily from choosing final amplifier tubes requiring low driving power and an oscillator tube with good power handling capability. A stable variable frequency oscillator (point 4), rather than crystal control, is a must in a contest transmitter. In order to utilize modern VFO techniques, a high transconductance 6AG7 pentode was the obvious choice for the oscillator tube.

CIRCUIT DETAILS

Once the tube lineup had been chosen, the remaining transmitter circuit details were worked out, as shown in the schematic diagram, Fig. 2. Rather than wrestle 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 Colpitts circuit was tried with a new twist (see *Technical Tidbits—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 solidly 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 coupler (L_{2A}-C_5, L_{2B}-C_6) was devised. The 807's were connected in parallel, instead of push-pull, to eliminate a split-stator plate 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 (0.045–0.050 inches) will suffice for the parallel-tuned plate tank circuit (C_7–L_5), because a blocking capacitor, C_8, isolates it from the high voltage fed to the 807's through RFC_3. The small chokes in the 807 plate cap leads, L_3 and L_4, eliminated a parasitic oscillation that appeared when this transmitter was first tested.

A two-section broadcast receiver tuning capacitor, C_9 was placed in series with the grounded side of the output link coil, L_6, 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, J_2, and the power supply high voltage, was included in the metering circuit. Oscillator tube performance can be judged from the 807 grid current. Metering these circuits permits a rapid check if trouble occurs (point 6).

A 0–1 milliameter, used as a voltmeter with a 1.6-volt full scale reading, measures the voltage drop across resistors placed in series with the above final amplifier circuits when S_2 is turned to positions *A*, *B* and *C*. In position *D*, a portion of the RF output voltage is applied to a diode, D_1, changed into direct current and applied to the meter through a filtering circuit. The 807 plate supply voltage, up to 1000 volts maximum, is measured by switching multiplier resistors in series with the meter in position *E*.

For CW operation, keying the screen voltage simultaneously on both the oscillator and amplifier stages

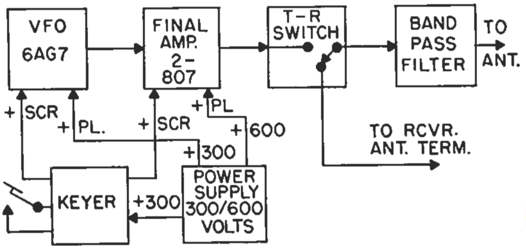


Fig. 1. **Block diagram showing all units that comprise the complete 150-watt single band transmitter.**

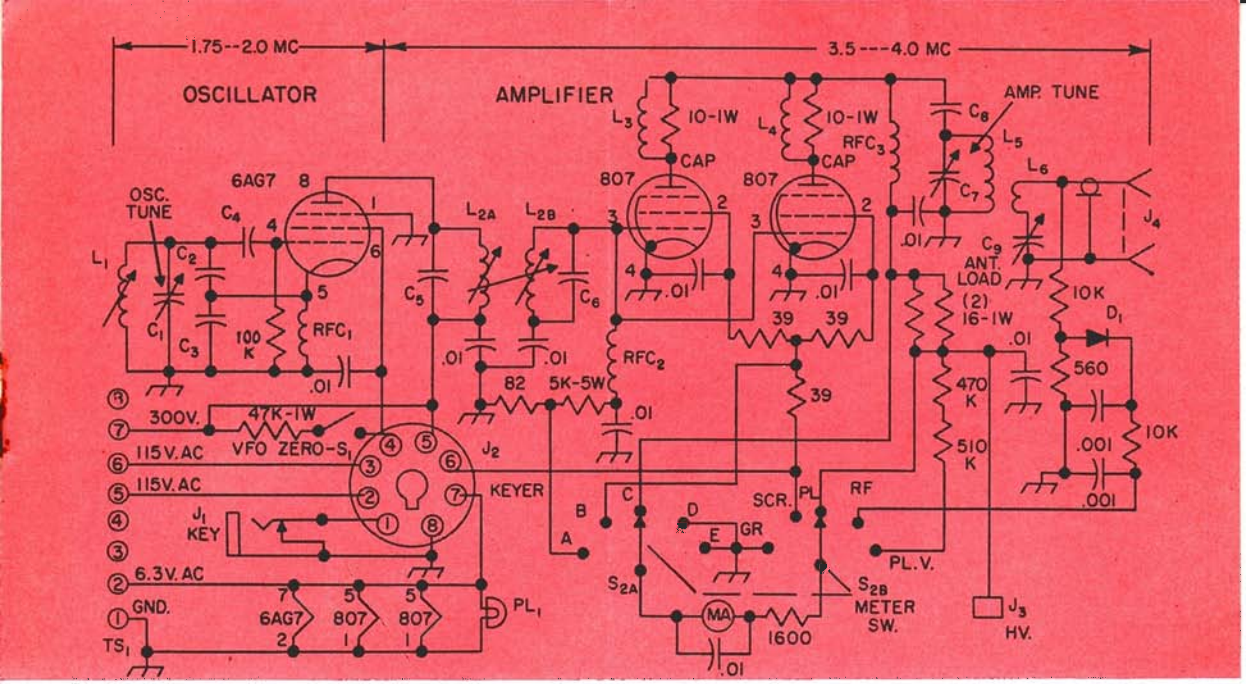


Fig. 2. Schematic diagram of the RF unit. The metering circuit provides the following readings: "A," 0–25 ma DC, 807 grid current; "B," 0–50 ma DC, 807 screen current; "C," 0–250 ma DC, 807 plate current; "D," RF output voltage; "E," 0–1000 volts DC. Any suitable type of power connector can be used in place of TS_1.

PARTS LIST—3.5-MEGACYCLE TRANSMITTER

C_1	300-mmf double bearing variable
C_2, C_3	0.005-mfd silvered mica
C_4	100-mmf silvered mica
C_5, C_6	200-mmf mica
C_7	15–350-mmf variable, 0.045-inch air gap
C_8	0.001-mfd, 2500-volt working mica
C_9	two-section 15–365-mmf per section variable
D_1	general-purpose germanium diode (G-E 1N48)
J_1	closed-circuit phone jack
J_2	octal tube socket
J_3	high-voltage connector (Millen 37001)
J_4	chassis coaxial connector

(L_1, L_{2A} and L_{2B} are wound on National XR-50 iron slug-tuned coil forms, ½-inch in diameter, $\frac{11}{16}$ of an inch winding length for all three coils.)

L_1	2.1 uh, 14 turns, No. 20 enameled wire
L_{2A}, L_{2B}	8.5 uh, 28 turns, No. 24 enameled wire
L_3, L_4	6 turns, No. 16 enameled wire closewound on ¼-inch-diameter, 1-watt resistor
L_5	6.8 uh, 20 turns, No. 16 tinned wire, 1½ inches in diameter, 2½ inches long (air-dux No. 1208)
L_6	5 turns, No. 16 insulated hook-up wire wound over grounded end of L_5
MA	0—1 milliameter (G-E Model DW-71)
PL_1	panel lamp bracket (Johnson 147–330)
RFC_1, RFC_2	0.5-mh, 57-ma RF choke (National R-50)
RFC_3	1.0-mh, 300-ma RF choke (National R-300U)
S_1	single-pole, single-throw, push-button switch
S_2	2-pole, 5-position, non-shorting ceramic tap switch
TS_1	8-terminal barrier type terminal strip

was found to be simple and foolproof. While more elaborate differential and other vacuum tube keying systems are desirable for home station operation, they may not function correctly during the voltage fluctuations which often occur when a transmitter is being powered by an emergency power generator. A push-button switch, S_1, applies screen voltage to only the 6AG7 when setting the oscillator frequency.

The keyer shown in the schematic diagram, Fig. 3, was incorporated into a separate unit having a cable which plugs into an octal socket, J_2, on the transmitter chassis. This facilitates servicing, rapid replacement of a faulty keyer, or the substitution of a more complex keying circuit. Separate sets of contacts on the keying relay, RY_1, permit inclusion of an RF key-click filter for the oscillator. A slower acting lag-type filter reduces key clicks in the 807 screen circuit. The relay coil operates from the 6.3-volt AC heater supply.

One pole of switch S_1 applies 300 volts DC to the keyer and the other applies 115-volt AC power to a small socket, J_1, to which the coil of an antenna change-over relay may be connected. An electronic T-R switch can be used instead of a relay, but some T-R switch circuits will overload and generate spurious interference in receivers to which they are connected when subjected

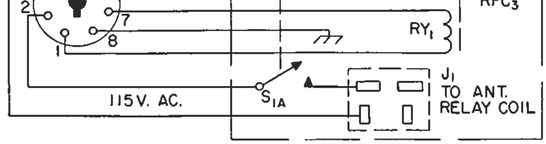


Fig. 3. Schematic diagram of the relay-type screen keyer.

J_1—2-prong female receptacle.
P_1—Octal male plug (Amphenol 86-PM-8).
R_1—25,000-ohm, 25-watt adjustable resistor.
RFC_1, RFC_2—2.5-mh RF choke.
RFC_3—100–150-mh iron core RF choke.
RY_1—2-pole, one- or two-position relay, 6.3-volt AC coil.
S_1—2-pole, single throw toggle switch.
V_1—OA2 voltage regulator tube.

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 HARMONIKER***, G-E HAM NEWS, November–December, 1949, Vol. 4, No. 6; and May–June, 1957, Vol. 12, No. 3; for details). This type of filter attenuates signals both below and above the design frequency. It thus will help reduce overloading in a receiver which sometimes results from other transmitters operating nearby.

The HARMONIKER 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 2.7 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

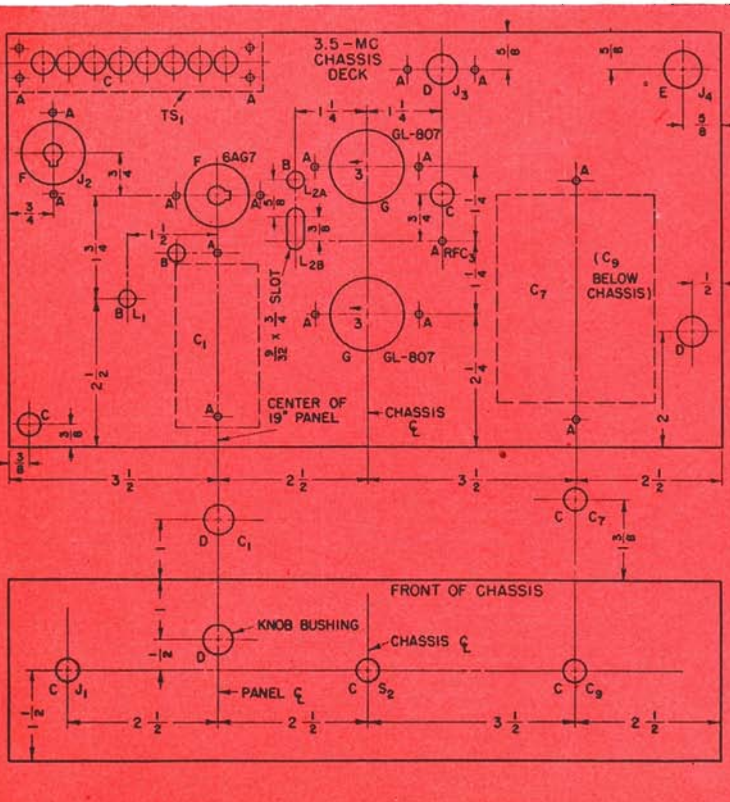
The complete transmitter—RF unit, power supply, keyer or modulator and output filter—is easily housed in the 17- x 14-inch area of a standard table relay rack cabinet (point 8) shown on page 1. Rather than build everything on one large chassis, each of the units mentioned above was constructed in separate metal chassis or boxes (point 9). The power supply, on a 7- x 12- 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 12- 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. 4. Small holes for fastening hardware should be drilled to match the location of these holes on the parts actually used in building the transmitter. Note that the shaft on the oscillator tuning capacitor, C_1, was located on the center line of the 8¾- x 19-inch relay rack panel on which the RF unit was mounted, as shown in the top view photograph, Fig. 5.

The antenna loading capacitor, C_9, shown in the bottom view, Fig. 6, should be fastened beneath the chassis on ¼-inch-long spacer bushings before the 807 plate tuning capacitor, C_7, is mounted above the chassis. Washers should be placed under the mounting feet on C_7 so that its rotor plates will not touch the heads of the screws which hold C_9 in place. An extension shaft, slotted at the panel end protruding through a panel bearing, provides for adjustment of C_9.

Small parts should be securely mounted beneath the chassis with insulated terminal posts or lug-type strips. The silvered mica capacitors in the oscillator grid circuit, C_2, C_3 and C_4, 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, S_1, on the panel, it was fastened to a small angle bracket directly behind the panel bushing which supports the tuning knob shaft. A short length of ¼-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



DRILLING LEGEND

"A" drill—No. 26 for tube socket bolts, etc.
"B" drill—$\frac{9}{32}$ of an inch diameter for small coil forms.
"C" drill—⅜ of an inch in diameter.
"D" drill—½ of an inch in diameter.
"E" drill—⅝ of an inch in diameter.
"F" socket punch—$1\frac{1}{16}$ inches in diameter for octal tube sockets.
"G" socket punch—1¼ inches in diameter for GL-807 tube sockets.

Fig. 4. Drilling diagram for the chassis top deck and front. Positions of C_1 and C_7 on the panel also are shown.

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 S_1 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 S_1 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.

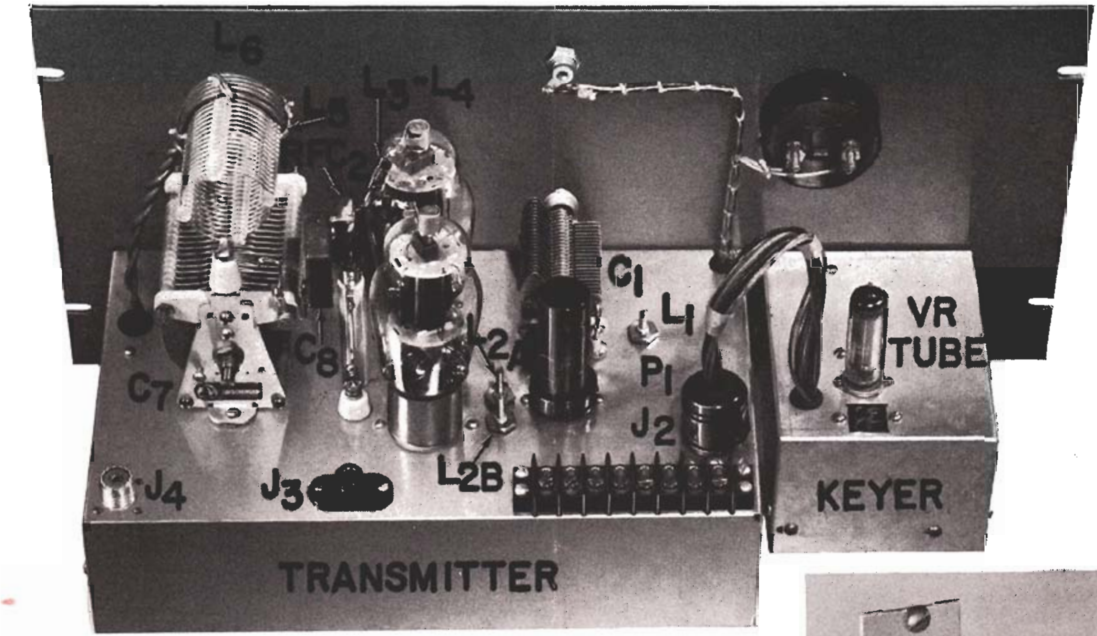
The 807 plate tank coil, L_5, was mounted atop the tuning capacitor with a ⅝-inch-high cone insulator at the back end, and a tubular metal spacer the same ength at the panel end. The link coil, L_6, was wound at the grounded end of L_5, using a single length of wire which also forms the twisted leads running down through the chassis to C_9 and J_4. A small pilot lamp bracket was mounted on the panel directly above the oscillator tuning dial pointer. The milliammeter was centered 2½ 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 P_1 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

(continued on page 8)



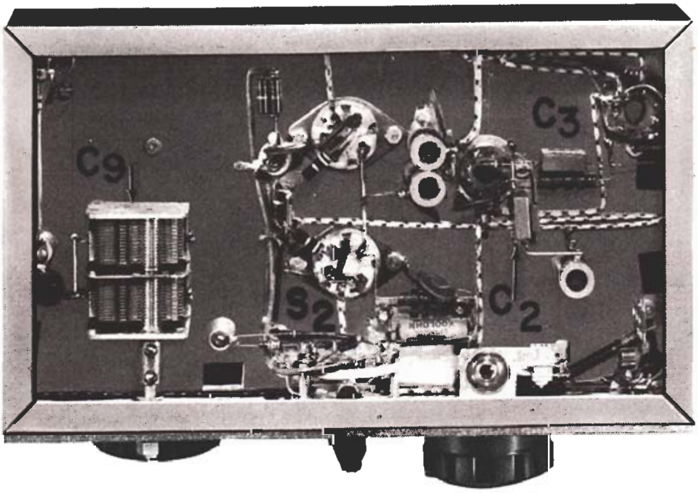


Fig. 5. (Top) Top view of the 3.5-megacycle transmitter chassis. High voltage for the 807 stage reaches RFC_3 through the feed-through insulator next to it.

Fig. 6. (Below, left) Bottom view of the transmitter chassis showing all power wiring lying close to the chassis.

Fig. 7. (Below, right) Detail view of the bracket on which the VFO switch, S_1, is mounted. This assembly can be substituted for the phone jack type switch in the bottom view.

Technical Tidbits

High-C Oscillators

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[1] 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 reduce drift by isolating the frequency controlling 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 newcomers 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—*solid 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 use it is a derivation of the Colpitts circuit.) A little pencil work resulted in some amazing figures—the values of capacity in the frequency determining circuit indicated by the formulae were about 5 times higher than expected! After checking for parasitics in the slide rule, and misplaced decimal points, there was only one thing to do—try it.

Digging into the junk box, we pulled out an unsuspecting 6C4, a small slug-tuned coil, together with 0.01 and 0.005-mfd mica capacitors (vintage?). When the oscillator was built and power was connected, it oscillated 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.

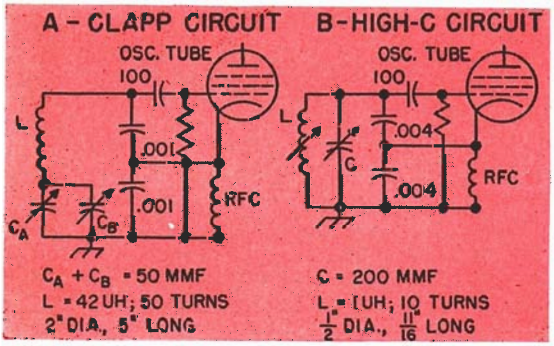


Fig. 1. Schematic diagrams of: A—the frequency-determining components in a typical series-tuned Clapp oscillotor for 3.5 megacycles; and B—circuit and corresponding component values for a high-C parallel-tuned oscillator.

Several pleasing characteristics became apparent during the next few minutes. First of all, hand capacity effects were extremely small. In fact, the coil terminals could be touched with the fingers without stopping 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 frequency of 3.5 megacycles. The Clapp circuit, as shown in Fig. 1A, requires a physically large, high-Q inductance for best results. To prevent this 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 (6 x 6 x 9 inches for a 2-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 ½-inch-diameter slug-tuned coil form (National XR-50). This small coil can be tucked into a corner of a chassis, or even in an IF transformer shield can.

In the Clapp circuit, a bandspread capacitor having a capacity change of about 10 mmf will tune the oscillator from 3500 to 3700 kilocycles. Comparable bandspread in the high-C oscillator requires a capacity adjustment range of about 200 mmf. 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 capacitor in the high-C circuit is even more effective in swamping out these variables. In both oscillators, silvered mica or other stable fixed capacitors should be used in these capacitive voltage dividers.

Why was this once very popular oscillator practically forgotten? It probably was relegated to the past when crystal controlled oscillators were almost universally used during the 1930's. Two things are true; that the maximum capacity possible in a high-C oscillator circuit is limited by the transconductance (gm) of available tubes; and that present tubes often have a transconductance *ten* times higher than the tubes available twenty years ago. The improvement in oscillator stability is, for all practical purposes, proportional to this improvement in tube transconductance.

The circuit and mechanical simplicity which results from the application of this "old" circuit to modern tubes and components is a refreshing change from the circuit complication which has characterized so many recent designs. The results obtained with the high-C oscillator have equalled or bettered those of the "modern" approaches.

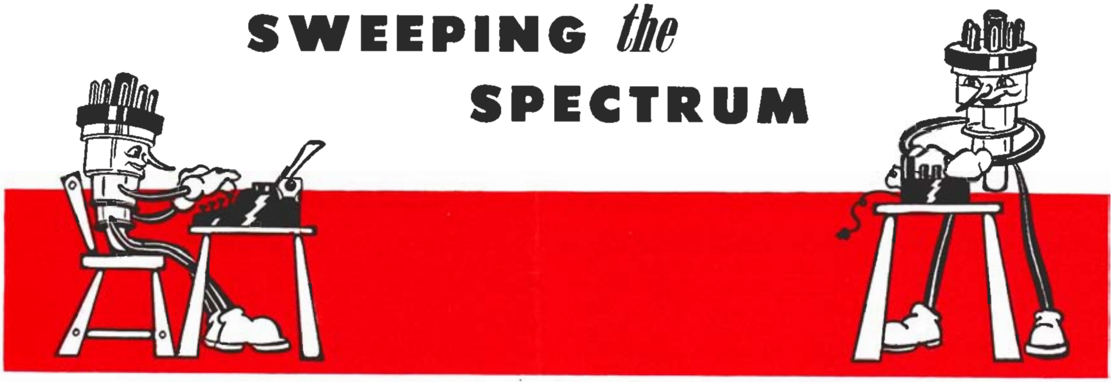
Perhaps it is time for a long-needed renaissance of some good "old" ideas. Give these "old" circuits a try—when combined with modern components—you'll be delighted with the results.

—W2FZW/7

---

[1] Clapp, "An Inductance-capacity Oscillator of Unusual Frequency Stability," *Proc. I. R. E.*, Vol. 36, pages 356–358 (1948). An interesting discussion of the design considerations for the Clapp and other oscillator circuits was published in December, 1955, *QST*; Howson, "Designing the VFO," page 35.

SWEEPING *the* SPECTRUM



MEET THE DESIGNER—W2FZW/7 (now officially K7BGI), S. G. (Ty) Reque, shows herein that you *can* teach an old oscillator circuit new tricks. Of course, Ty is an expert at this, having designed several of the most popular gadgets that have ever appeared in G-E HAM NEWS. These include the original Economy Half Kilowatt, Interpolating Frequency Standard, Emergency—Portable Rig, Mobile Modulator, TVR Hi-pass Filter, Mobile/Portable Power Supply, the Field Meter, and several "Technical Tidbits" items.

Formerly associated with G.E.'s General Engineering Laboratory, Ty now counsels the new G-E Computer Department, in Phoenix, Arizona, as an engineering consultant. His professional background also includes stints with the General Electric Research Laboratory, and the then Transmitter and Tube Divisions.

"FZW" has been Ty's favorite call-letter suffix, having first received W3FZW in 1932 before settling in W2-land. A DX chaser for many years, Ty now finds the 14-megacycle CW band just right for keeping in touch with his many ham friends.

* * *

The 1957 Edison Radio Amateur Award program is now in full swing, so don't let that deadline for submitting nominations—postmarked not later than January 3, 1958—slip by without sending your letter to the Edison Award committee. In it, fully, but briefly describe a meritorious public service that has been performed during 1957 by a United States radio amateur while pursuing his hobby.

Submitting a nomination in behalf of a public-spirited radio amateur is also a worthy project for your radio club or other group. Address all nominating letters to the Edison Award Committee, General Electric Co., Owensboro, Kentucky.

Rules for the 1957 Award were announced in the September, 1957 issues of QST and CQ magazine. Additionol copies may be obtained from the Award committee—or from me—simply by sending a postal card requesting them.

* * *

Wow! My incoming mail sacks have been loaded with postal cards requesting the schematic diagram of a simplified version of the 100-Watt Mobile Power Supply we described in the July-August, 1957 issue of G-E HAM NEWS! I casually mentioned this diagram in the September-October issue, and judging from the response, many mobileers are aiming for greater efficiency in their high-voltage supplies.

We did not profess this circuit to be the ultimate, but rather an improvement over older mobile power supplies. Already newer circuits have been developed that promise efficiencies of better than ninety percent!

At present, however, suitable high-voltage transformers for the new circuit are expensive and scarce (there's always a catch). But we're watching these new mobile power supplies and will publish additional information when the components become available.

Following the successful application of the ancient and honorable Colpitts circuit—high-C, that is—to the transmitter 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 VFO," by N. D. Larkey, W2DGW, on page 36 of the September, 1953 issue of *QST;* and, "Packaging 35 Watts for 80 and 40," by R. M. Smith, W1FTX, 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., W4ELZ, on page 40 of the October, 1957 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-enclosed neck (see picture above) and predict that high-C oscillators will become 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 many television receivers must operate. To meet the low-inductance, low-capacitance demand for operation at frequencies up to 900 megacycles, small electrodes with close spacing are required. High cathode emission and current flow density five to six times that of other triodes 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 circuit components age. Little wonder that the 6AF4 often literally roasts itself to an early demise, accompanied meanwhile by a steady dropoff in picture quality.

Even with TVI shielding, operating conditions for the average transmitting tube aren't that tough. But now our receiving tube design engineers have combined new materials with new manufacturing and test methods, resulting in an improved 6AF4 that for the first time is fully as efficient and dependable as other tubes. Tests on thousands of tubes have proved that after 2500 hours and more of service, the new G-E 6AF4 (2AF4, 2AF4-A, 3AF4-A, and 6AF4-A too) operates efficiently as a UHF oscillator.

Moral: The long-life 6AF4 is another example of the unceasing progress in TV receiver tube design which is in turn reflected in the longer life and increased dependability of the tubes we hams use.

—*Lighthouse Larry*

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 C_7, in addition to a shaft lock on C_9. These precautions prevent these controls from being mistuned accidentally during the excitement of contest operation.

OPERATION—3.5-MEGACYCLE TRANSMITTER

First, momentarily apply 6.3 and 115 volts AC, and about 250 volts DC, to J_3 and the proper terminals on TS_1 to check for short circuits and incorrect wiring. If no trouble is found, plug the cable from the keyer into J_2, a key into J_1 and a dummy antenna into J_4. 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 5.0 megacycles. After the oscillator frequency has been determined, adjust the slug in L_1 until the oscillator covers the desired 200-kilocycle segment of the 3.5–4.0-megacycle amateur band that can be covered with the 300-mmf tuning capacitor, C_1. A two-section broadcast receiver tuning capacitor, with the sections in parallel (same as C_9), is required to tune the band without readjusting L_1.

Remove the power while plugging in the 807 amplifier tubes and again apply power. With the meter selector switch, S_2, in position "C," tune C_7 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 S_2 on position "A" to read grid current in the 807 stage and tune L_{2A} for maximum grid current with the oscillator on 3600 kilocycles; and tune L_{2B} for maximum grid current on 3900 kilocycles. Start with minimum spacing between L_{2A} and L_{2B}, then move L_{2B} away from L_{2A} until a fairly uniform 807 grid current reading (5 to 8 milliamperes) can be obtained when tuning the oscillator from 3.5 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, S_1, 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 C_9 until the meter reads 200 milliamperes with S_2 in position "C," keeping C_7 tuned for a dip in 807 plate current. No retuning of either C_7 or C_9 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 knobs had to be retuned when making only a 20-kilocycle change in frequency!

Electronic
TUBES

G-E HAM NEWS
Available FREE from
G-E Electronic Tube Distributors

Printed in U.S.A.

VOL. 12—NO. 6

published bi-monthly by
ELECTRONIC COMPONENTS DIVISION
GENERAL ELECTRIC
Schenectady 5, N. Y.
In Canada
CANADIAN GENERAL ELECTRIC CO., LTD.
189 Dufferin St., Toronto 3, Ontario

E. A. NEAL, W2JZK—EDITOR

NOVEMBER–DECEMBER, 1957

Form 3547 Requested