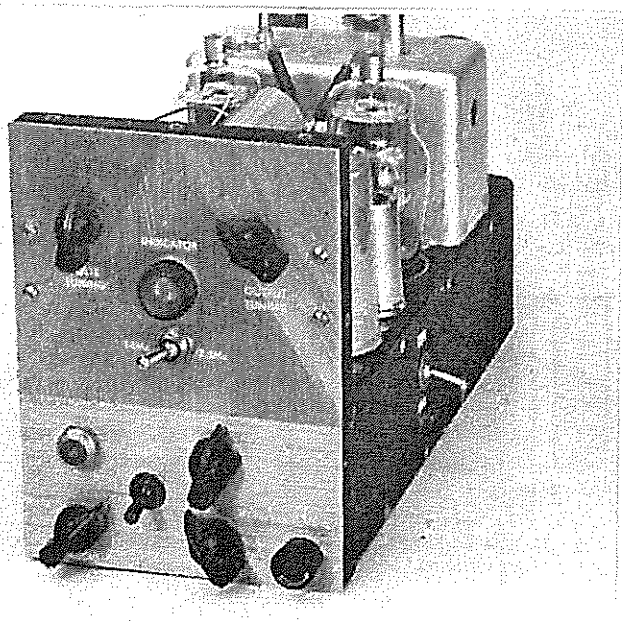


This two-band mobile s.s.b. transmitter is capable of up to 100 watts peak output, depending upon the power supply. Built on the chassis of a BC-458 transmitter, it uses the original VFO portion and the two output tubes. The phasing type of s.s.b. generation is used, and the audio amplifier has adequate gain for use with a crystal microphone.

On the panel, the upper knobs control output stage tuning and loading. The indicator light is used instead of a plate milliammeter, and the upper toggle switch is one of the two band switches. (The other bandswitch can be seen on the right-hand side of the chassis.) The lower left-hand knob is for the audio gain control, the toggle switch selects the sideband, and the two pointer knobs next to the switch are for carrier balance adjustments of the balanced modulator. The remaining knob tunes the VFO.

♦

Cheap and Easy S.S.B.

Sideband Exciter Built Around the BC-458

BY ANTHONY VITALE,* W2EWL

• The following letter, quoted in its entirety, is self-explanatory.

Editor, *QST*:

Several months ago, Tony Vitale, W2EWL, was kind enough to give our radio club, the Ridgewood Amateur Radio Club, a talk on "Single Sideband."

Tony brought along a new exciter which he designed, built on a BC-458 chassis. It created a lot of interest among our members, with its compactness and very low building cost compared with the commercial exciters on the market. I was one of the many members bitten by the s.s.b. bug, and I have built this exciter. Several of our members have built them also, and they are very pleased with the results. Tony's talk was entitled "SSB Cheap and Easy," and it certainly turned out so.

My purpose in writing is to tell how pleased I am with this exciter. I have had many FB QSOs with it on very low power, and it didn't cost me over $35, including the power supply. Most all of the fellows I talked with wanted to know more about this exciter, and I think it would be an excellent article to put in *QST*. We have named it the "W2EWL Special".

73,

Frank Hernandez, W2MOF

Glad to oblige, Frank; here is the "W2EWL Special".

* East Glen Road, Denville, N. J.

MOST AMATEURS have either heard or actually experienced the advantages of single-sideband phone. The author's interests have been directed at mobile s.s.b. operation, because the boost in "talk power" for a given power supply one gets with s.s.b. really works to advantage in mobile work. W2EWL has been on 14-Mc. mobile s.s.b. for over 3 years, and during that time has participated in four-way QSOs involving ZLs and VKs, and a 7-way involving two African countries, one European country and three W call areas. The DX currently stands at WAC and 23 countries.

The exciter/transmitter to be described is not a one-of-a-kind deal, but represents a design that has evolved over the years. It is built around the VFO portion and on the modified chassis of a BC-458 (or T21/ARC-5), which tunes 5.3 to 7.0 Mc. in the original unit. These units sell from $3.95 to $7.95 in the surplus market, depending upon their condition. The design to be described uses the original output stage of the BC-458; the output will vary with the available plate voltage, and will be about 100 watts peak with a 1000-volt supply. The current W2EWL rig uses only one of the two 1625s in the original output stage, with 300 volts on the plate, to drive one 837 that in turn drives four 837s in a grounded-grid amplifier. The exciter hangs under the dash of the car, and the amplifier mounts in the trunk.

The Circuit

The photographs show two different units; one is for 14 Mc. only and the other is switchable to either 14 or 3.9 Mc. If you want only 3.9- or 14-Mc. operation, you can omit the unwanted circuits and a couple of toggle switches, but the rest of the circuit remains unchanged.

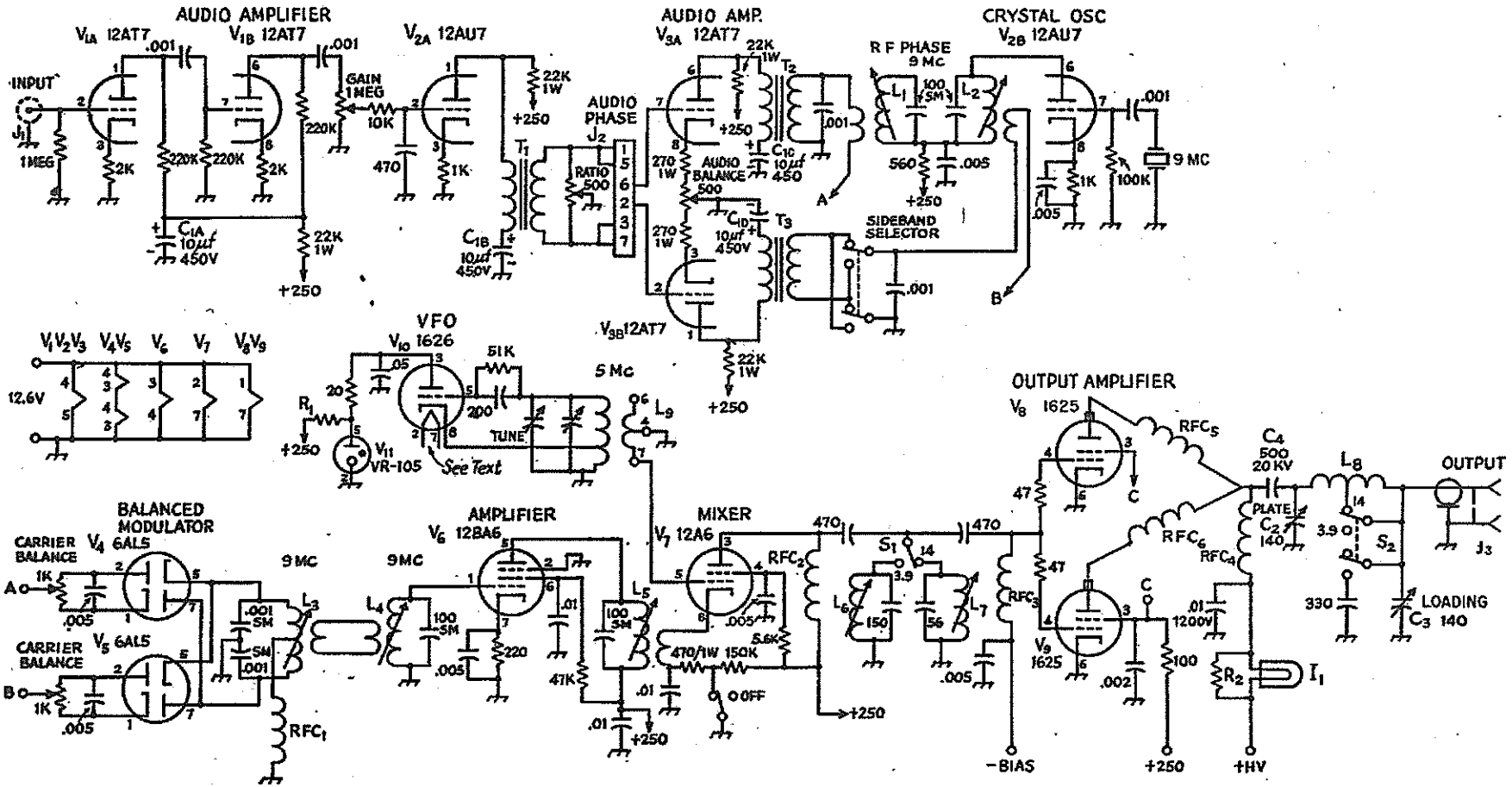
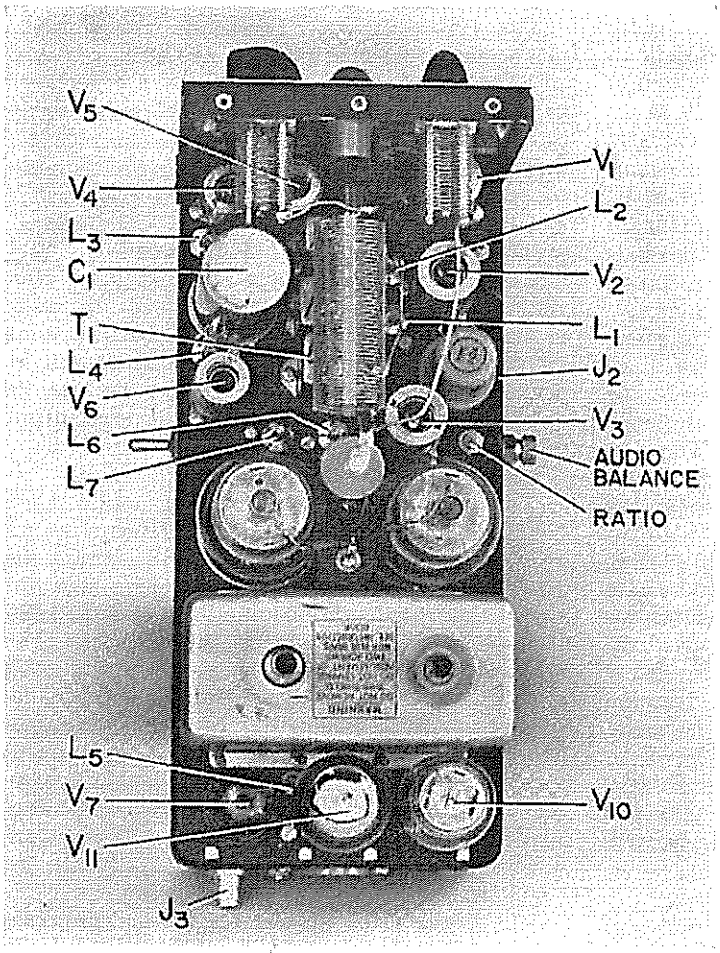


Fig. 1 — Schematic diagram of the mobile s.s.b. transmitter. Resistors are ½ watt unless otherwise noted. Decimal capacitance values are in µf. SM = silver mica.

C_1 — Quadruple electrolytic, 10–10–10–10 µf. at 450 volts.
C_2, C_3 — 140-µf. midget variable (Hammarlund HF-140).
C_4 — 500-µµf. 20-kilovolt ceramic.
R_1, R_2 — See text.
Coils L_1 through L_7 are wound on slug-tuned forms 5/16 inch in diameter. See text.
L_1, L_2, L_4, L_5 — 25 turns No. 22 enam. Link, 4 turns hook-up wire.
L_3 — 8 turns No. 16 enam. 1-turn link.
L_6 — 40 turns No. 26 enam.
L_7 — 25 turns No. 22 enam.
L_8 — 46 turns No. 20 bare, wound 16 turns per inch, 1-inch diam. Tap at 8½ turns from C_2 end. (B & W 3015). For 14 Mc. only, use 12 turns No. 14 wound to occupy 1⅝ inches, 1⅛ diam.
J_1 — Microphone jack.
J_2 — Octal socket.
J_3 — Small coaxial cable receptacle, UG-290/U.
RFC_1, RFC_2, RFC_3 — 500 µh.
RFC_4 — 1 or 2.5 mh. 300 ma.
RFC_5, RFC_6 — 20 turns No. 22 enam., wound on 3/16 inch form (high-value resistor) and spaced to occupy ⅞-inch winding length.
T_1 — 20,000 to 600-ohm transformer. See text.
T_2, T_3 — 20,000 to 200-ohm transformer. See text.



Top view of the two-band exciter. The B & W Phase-Shift network is in the light-colored "tube" plugged in J_2.

for sockets, transformers, coils and potentiometers. Although larger transformers can be crowded into the available space, the small transformers shown in the photographs are very convenient.[2] Holes are also required for the insulator that supports C_4, for the mounting of RFC_4, and for the four-section electrolytic capacitor, C_1.

A new panel of sheet aluminum is used over the old panel. The tuning capacitors C_2 and C_3, the pilot lamp I_1 and the band-change toggle S_2 are mounted on this panel above the level of the chassis deck. On the same panel, below the level of the deck, you will need holes for the two carrier balance potentiometers, the gain control, the microphone jack J_1, the sideband selector switch (toggle) and the VFO tuning.

The ratio potentiometer is mounted on the left-hand side of the chassis (viewed from the front), and the audio-balance potentiometer is mounted on the deck near V_3 and the audio phase-shift network. A CTC "Minipot" (¾-inch diameter) will fit more conveniently here than the standard controls. S_1 is mounted on the right-hand side of the chassis.

At the rear of the chassis, a regular octal socket can be substituted for the original power socket, and a UG-290/U receptacle is added (J_3). The socket for the 9-Mc. crystal can be mounted on a small bracket on the side of the chassis, under the V_2 socket.

[2] The three transformers are available as a set from Electronics Associated, P.O. Box 206, Montclair, N. J. The price is $7.95.

[3] We used coil forms from a surplus unit marked "Z101." The unit, with 12 of the coil forms in it, was obtained for $1.50 from Vet Salco, Paterson, N. J.

Oscillator Wiring

The numbers shown on L_9 in Fig. 1 represent the numerical order of the terminals from the VFO assembly, reading from the rear to the front. The wire from Terminal 1 will have been removed, and the wires from 2 and 3 will be left as is. The black wire from 4 should be grounded to the chassis. The white wire from Terminal 5 ("hot" heater lead) is left connected to the .006-μf. fixed capacitor and the "hot" side of the 12.6-volt heater circuit. The black lead from 6 to the neutralizing capacitor is removed, and the lead from 7 is carried over to Pin 5 of the V_7 socket.

On the oscillator socket, V_{10}, the red lead at Pin 3 that ran to the tuning-eye socket is removed, and the red lead from Pin 4 is run to Pin 5 of the V_{11} socket (old crystal socket). This is the pin to which R_1 is connected; the value of R_1 will be 5000 ohms, 5 watts, if a 250-volt supply is used.

Other Wiring

Not much need be said about the rest of the wiring, since everyone has his own pet tricks. In the construction of the coils L_1 through L_5, the link windings are wound over the "cold" ends (grounded end) with the same wire that is used for the twisted link lines.[3] The single exception is the 1-turn link winding of L_3, and this winding should be dead center on L_3.

Adjustment

As in any transmitter, the initial adjustment is a step-by-step process. To do a good job with this unit, you should have an audio oscillator and a simple oscilloscope, which you may be able to borrow for the occasion if you don't have them in your shack. You will also need a receiver and, if you run into any troubles, a v.t.v.m. or other test meter.

(*Continued on page 110*)

VE2DR 180, LM 71, EC 50, CP 37, GL 32, ATQ 18, FI 16.

ALBERTA — SCM, Sydney T. Jones, VE6MJ — PAM: OD, RM: XG. The new officers of the Calgary Amateur Radio Club are HY, pres.; XB, vice-pres.; QS, treas.; WL, act. mgr. PV reports that the Lethbridge gang is having trouble with "TTV." EA, KF, AS, WO, and MJ are progressing with 144-Mc. equipment. JP is working on a mobile rig. SS has overcome the difficulties in the rig and is heard regularly on 3.8-Mc. phone. KX is building a heterodyne exciter. HM upheld his usual standard in the November Frequency Measuring Test. YE and CE are heard checking the B.C. Net regularly. NX is the new EC for Edmonton. KL has qualified for phone operation. UK is on the lookout for a 3765-kc. crystal. Traffic: VE6HM 321, OD 78, YE 46, PS 10, VE7HD 10, VE6MJ 5, WL 3.

BRITISH COLUMBIA — SCM, Peter M. McIntyre, VE7JT — SEC: DH, Your SEC, Wm. Emerson, VE7DH, of Nanaimo, would welcome applications from ARRL members for EC appointments. With only a minimum of your time being involved and with just a little interest, he could have active ECs in all parts of British Columbia. Hope some of you heeded ASR's request to join RN7 and put British Columbia on the map again. Incidentally, ASR is the new Route Manager for B.C. The boys in Dawson Creek acquired new mobile emergency equipment for the club and still have money in the treasury. Most of the activity from Nanaimo seems to be on 2 meters with everyone building gear and antennas, even to GR's receiver that has no noise. Locally AQW has acquired a car, so needless to say there will be a new mobile on soon. AFP is moving his QTH to Victoria and ZF, ZV, and HC are going East. We wish them all well in their new ventures. Now is the time to get all the stuff ready for all the new antennas as spring is close at hand and the rigors of winter weather have taken their toll. Yours truly would like to thank the BCARA for the honor bestowed on me in giving me the BCARA Cup Award for this year. Traffic: VE7ASR 216, CQ 128, ACS 80, AUF 53, XY 50, ZV 45, JT 31, AIO 24, DH 14, FS 14, AG 8, ABI 4.

SASKATCHEWAN — SCM, Harold R. Horn, VE5HR — BZ has changed his OBS frequency and is now heard on 3795 kc. at 1815 hours Tue., Thurs., and Sat. WW has a new ground plane and works out well with it and a new TBS-50. LT is now all-band phone and uses voice-controlled carrier. JO is now at Kerrobert. BD has a new Viking Ranger and works 21-Mc. mostly. JA now is on phone and does well with 20 watts. BV and GX were heard talking over the best fishing spots and making plans for the coming season. BI puts out a nice signal with a DX-100 after being silent for a few years. LT and WW are new phone net members on 3780 kc. OC has a modified cubical quad for 14 Mc. The Saskatoon Club officers are BD, pres.; TH, vice-pres.; and DU, secy. Moose Jaw officers are WM, pres.; WA, vice-pres.; AV, secy.; and KG, treas. VL has a new 20-meter beam up 70 feet. Has your appointment been sent in for endorsement? If not, please do so right away. Traffic: VE5CW 39, BZ 32, LM 32, RE 30, CI 18, VL 16, DS 15, QL 12, GX 5, HR 5, DD 4, LJ 4, BF 2, BI 2, EQ 2, GO 2, LT 2.

Easy S.S.B.

(Continued from page 20)

When the wiring has been completed and you have determined that the tube heaters light up when 12.6 volts has been applied, remove V_8 and V_9 from their sockets and connect the 250-volt source. Check the oscillation of the VFO by listening on the receiver tuned to 5.3 Mc. If a 9.1-Mc. crystal is to be used, the VFO must tune 5.1 to 5.3 Mc. to cover 3.8 to 4.0 Mc. and 14.2 to 14.4 Mc. The tuning range of the VFO can be shifted with the trimmer capacitor and the tuning slug. If the transmitter is to be built for one-band operation, a crystal frequency can be selected that will require no modification of the BC-458 range.

With the VFO working, plug in the crystal and check for oscillation by listening on the receiver. Some adjustment of the slug in L_2 may be required before the stage oscillates.

Next feed in a 1200-cycle signal at the microphone jack, using a very low-level signal. Peak

(Continued on page 112)

L_3, L_4 and L_5 for maximum signal. This can be checked with a small pick-up loop connected to the receiver through a length of shielded wire. The tuning of L_6 and L_7 and the output amplifier tuning controls can now be checked after the high-voltage supply is connected and the 1625s are plugged in. The correct operating bias must also be added, and it is hardly necessary to point out that the tubes should be plugged in while the power supplies are turned off, if you want to get on with your s.s.b. career. A 60-watt lamp can be used for a dummy load during initial tests, and the pick-up loop for the receiver can be placed near the lamp.

Now turn off the audio signal and adjust the two carrier-balance potentiometers for minimum output.

Next turn on the audio and adjust the ratio and audio-balance controls for minimum ripple on the scope pattern. If you aren't familiar with these "ripple" patterns and the correct way to couple a 'scope for r.f., the information is in the *Handbook*. It will undoubtedly be necessary to adjust L_1 before the ripple can be reduced to a small value, and you will find that you have to go through these adjustments several times before you can get the ripple down. Be sure to keep the audio at a low level so as not to saturate a stage somewhere along the line. The initial sideband alignment checks are best made at 9 Mc., using the output of V_6 link-coupled to a 9-Mc. tuned circuit connected to the vertical plates of the oscilloscope.

Check each sideband position, because in an ideal exciter they should both give the same minimum-ripple pattern. If you have an r.f. probe for your v.t.v.m., you can measure the r.f. voltages at the arms of the carrier balance controls and try to get the values within 10 or 15 per cent of each other. This is done by the tuning of L_1 and L_2 which will, of course, require further monitoring on the 'scope for minimum ripple.

Your objective is to minimize the ripple on the 'scope pattern and to have it similar for either position of the sideband selector switch. Once that has been done, you can connect the microphone and, whenever you need a single tone for tuning C_2 and C_3, you can unbalance one of the carrier balance controls temporarily. If you want to run two-tone test patterns for checking the output-amplifier performance, remove V_4 or V_5 from its socket and use a low-level audio tone into J_1. The two-tone test procedure is outlined in the *Handbook* and the s.s.b. book.[4]

The 1625 bias will depend upon the plate and screen voltage. A fair rule of thumb is to adjust the bias so that the idling plate current (no signal) for the two tubes gives around 35 to 40 watts input for the two tubes. With 750 volts on the plates and 250 on the screens, you can start at a bias of −30 and work down. With higher plate and screen voltages, it will be necessary to start proportionately higher.

(*Continued on page 114*)

[4] *Single Sideband for the Radio Amateur*, published by the A.R.R.L.

Mobile Operation

While the unit is an excellent one for home-station use and "getting your feet wet" in s.s.b., it was designed for mobile operation. The most common question you run into about mobile operation is "What do you use for a receiver," and "Isn't it hard to tune in s.s.b. in motion?" The answer to the first question is "Use a crystal-controlled converter into a BC-453 (190 to 550 kc.)." The answer to the second question is "No, not with a good tuning rate in the receiver," (which the converter/BC-453 combination has).

Voice-controlled break-in? Who needs it in mobile work? The push-to-talk switch is plenty good enough.

6.3-Volt Operation

The tubes specified in the schematic are for 12-volt heater operation, and the unit has been operated in a car with a 12-volt battery. For 6-volt mobile operation, it is suggested that one or two 6146s be substituted for the two 1625 output tubes. The other parts of the circuit remain the same, except that the heater wiring must be revised. A 6BA6 would be used at V_6 and a 6V6 at V_7.

The author expresses his gratitude to Willie Sayor, W2NYY, and Dick Johnson, W2BDL, for their help in compiling information for this article.

Multiband Phone

(*Continued from page 38*)

Adjustment

The bands can be centered on the VFO dial by varying L_1 for the two lowest-frequency ranges, and by varying C_2 on the other ranges. If both ends of any band cannot be covered, C_2 (or C_3) must be decreased, and L_1 increased slightly. On the other hand, if a band is not spread out enough over the dial, C_2 (or C_3) must be increased L_1 decreased.

It should be possible to obtain at least 5 ma. of amplifier grid current on all bands. If the grid current exceeds this value, it can be reduced by detuning the 6AG7 output circuit. Although the 5894 has a rating of 150 ma. at 450 volts for 'phone operation, this is a CCS rating. The ICAS ratings of the Philips QQE06/40 are 600 volts, 180 ma. It is assumed that the 5894 or AX9903 could be safely operated at these ratings in amateur service.

The modulator tube is operated with 250 volts on the screen and 27.5 volts of bias. Idling plate current is 40 ma. rising to 125 ma. on peaks.

In TV areas, the customary practice of using shielded power wiring, power-lead filtering and a shielding enclosure should be followed as described in the ARRL *Handbook*. — Ed