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THIRD BOUND VOLUME COVERING 1956-1960

VOLUME 11 No. 1 THROUGH VOLUME 15 No. 6

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TUBES

HAM NEWS

***presents* HOW-TO-DO-IT IDEAS**
from the 999 radio amateurs at

GENERAL ELECTRIC

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Owensboro, Kentucky, U. S. A. • Editor — E. A. Neal, W4ITC

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First Printing

INTRODUCTION

This G-E HAM NEWS THIRD BOUND VOLUME has been published in answer to many requests for the complete set of issues from January-February, 1956 (Vol. 11, No. 1); to November-December, 1960 (Vol. 15, No. 6). Also, much additional information has been compiled about most of the original articles and combined into a 72-page supplement at the rear of this volume.

This is the third such volume that General Electric has published. The two previous bound volumes contained the issues listed in the CROSS INDEX on the following pages. The supply of both previous volumes has been exhausted for several years. This Third Bound Volume also has been published as a limited edition.

Equipment described in many of the construction articles in the previous volumes may be pretty much obsolete by present-day standards. Thus there is no good reason for reprinting the original articles on obsolete-type equipment. However, certain highly popular construction articles will be modernized and published in future issues.

The pace-setting information that G-E HAM NEWS published on single sideband years ago is still highly pertinent as background material. Thus, the articles on sideband and related subjects are being reprinted in another new volume which we call the G-E HAM NEWS SSB PACKAGE HANDBOOK. Further information may be obtained from the G-E HAM NEWS office.

As G-E HAM NEWS enters its 16th year of publication, the page size has been increased to 8-1/2 x 11 inches. This permits printing two regular-length feature articles in each standard 8-page issue, instead of only one which could be run in the smaller page size. Also, diagrams and pictures can be made larger for greater clarity of detail.

The G-E HAM NEWS staff feels sure that our readers will be enthusiastic over this new page size and format. The new issues also are being punched to fit into a standard 3-ring binder, simplifying their preservation in home libraries.

Thus, just as GENERAL ELECTRIC is a LEADER in the electronics industry, we of the G-E HAM NEWS staff feel that G-E HAM NEWS is a leader among amateur-radio publications.

Many readers have asked about our "staff", which in a sense may be thought of as including the more than 1,000 radio amateurs otherwise employed by General Electric. A number of these amateurs are recognized leaders in their respective fields--and, the articles they write for our readers reflect this capability as applied to amateur radio.

As to coming articles, while we do have some material for the beginner and novice in preparation, a majority of the articles planned for publication are intended for the radio amateur who has at least a year or two of experience, and thus is ready for more advanced equipment construction, and technical discussions on electronics. However, this more advanced equipment and circuits usually contain ideas and suggestions that are applicable to simple equipment.

In short, our aim is to present the best material on the technical side of amateur radio that we can obtain. And, the staff, in turn, hopes that our readers will continue to support G-E HAM NEWS, and thus make it possible to continue this service.

73,

Lighthouse Larry

CROSS INDEX TO G-E HAM NEWS

JANUARY-FEBRUARY, 1956 (Vol. 11, No. 1) to NOVEMBER-DECEMBER, 1960 (Vol. 15, No. 6)

TITLE OF ARTICLE	ISSUE	PAGE	VOL. & NO.
G. E. Transistors--2N107, 2N135, 2N136 and 2N137	May-June, 1956	8	(11-3)
G. E. 6AM4 UHF Triode	July-August, 1956	8	(11-4)
G. E. 6EZ8-9-pin Miniature Triple Triode	July-August, 1959	8	(14-4)
G. E. 6L6-GC Beam Power Pentode	March-April, 1959	8	(14-2)
7077--Micro-Miniature UHF Ceramic Triode	January-February, 1959	8	(14-1)
TEST AND MEASUREMENT EQUIPMENT AND ACCESSORIES:			
Accurate Frequency Measurement with only Receiver Calibration	July-August, 1957	7	(12-4)
Channel Spotter Crystal Calibrator	November-December, 1958	5	(13-6)
Combo-Monitor CW and AM Monitor	September-October, 1958	4	(13-5)
Conelrad Monitor-WWV Converter	September-October, 1958	6	(13-5)
Feedline Test for Transmitter Parasitics	January-February, 1960	8	(15-1)
Hamscope Monitor for AM & SSB Transmitters	September-October, 1956	1	(11-5)
Saving Meter Faces	July-August, 1956	6	(11-4)
Test Adapter for Oscilloscopes	May-June, 1960	6	(15-3)
Test Probes from Plastic Pencils	July-August, 1956	6	(11-4)
Using the Hamscope	September-October, 1956	8	(11-5)
TRANSMITTERS AND TRANSMITTING:			
Bibliography of Articles on Double Sideband	March-April, 1958	8	(13-2)
Compact Triode Kilowatt Amplifier with Paralleled GL-810's	September-October, 1959	1	(14-5)
Double Sideband Junior Transmitter - 20 Watts	March-April, 1958	1	(13-2)
Double Sideband Transmitter-200 Watts-Part I	May-June, 1959	1	(14-3)
Double Sideband Transmitter-200 Watts-Part II	July-August, 1959	5	(14-4)
E-P RIG for Emergency & Portable-15 Watts (Reprinted from March-April, 1950)	May-June, 1957	4	(12-3)
High-C Bandswitching VFO	March-April, 1959	1	(14-2)
Kilowatt Grounded-Grid Linear Amplifier with Paralleled GL-813's	November-December, 1959	1	(14-6)
Kilowatt Mobile Linear Amplifier with Paralleled GL-4D21/4-125A's	November-December, 1960	1	(15-6)
Single Bander Transmitter-150 Watts for 3.5 Mc.	November-December, 1957	1	(12-6)
Single Bander Transmitter--150 Watts, More about - for 7 and 14 Mc.	January-February, 1958	1	(13-1)
Single Bander Random Ideas	November-December, 1957	8	(12-6)
Solid High-C VFO-With Tuning Range Data	July-August, 1959	1	(14-4)
Technical Tidbits--High-C Oscillators	November-December, 1957	6	(12-6)
The Mix-Selector Charts for Sideband	November-December, 1956	1	(11-6)
The TC-75--A Mobile Transmitter/Converter for 3.9 Mc. - 15 Watts	March-April, 1960	1	(15-2)
Transistor VFO's--	May-June, 1956		(11-3)
Capacitive-Tuned Broadcast Band VFO	May-June, 1956	2	(11-3)
Inductive-Tuned Broadcast Band VFO	May-June, 1956	4	(11-3)
Capacitive-Tuned VFO for 3.5 Mc. Band	May-June, 1956	5	(11-3)
Tri-Range VFO and Exciter for 1.8 to 7.3 Mc. - 10 Watts	March-April, 1956	1	(11-2)
What About Mixer Circuits?	November-December, 1956	8	(11-6)
TRICKS AND TOPICS IDEAS:			
Base Insulators for Vertical Antennas	July-August, 1956	6	(11-4)
Making Long-Life Folded Dipole Antennas	July-August, 1956	6	(11-4)
Saving Meter Faces	July-August, 1956	6	(11-4)
Test Probes from Plastic Pencils	July-August, 1956	6	(11-4)
Ventilation Hint for Utility Boxes	July-August, 1956	6	(11-4)
VHF AND MICROWAVE EQUIPMENT:			
Another Low-Noise VHF Converter for 144-148 Mc.	July-August, 1956	1	(11-4)
New Heaterless Miniature Ceramic Triode Tubes	January-February, 1959	2	(14-1)
Packaged VHF Exciters for 50 and 144 Mc. - 3 and 6 Watts	May-June, 1958	1	(13-3)
VHF Exciter/K2DBS for 50 and 144 Mc. - 6 Watts	May-June, 1958	8	(13-3)
7077 Ceramic Tube RF Amplifier/Converter for 432 Mc.	January-February, 1959	3	(14-1)
7077 Ceramic Tube RF Amplifier/Converter for 144 Mc.	January-February, 1959	6	(14-1)

CROSS INDEX TO G-E HAM NEWS

January-February, 1951 (Vol. 6, No. 1), to November-December, 1955 (Vol. 10, No. 6)

Antenna Data

Audio Equipment Data

Construction Practices

Designer's Corner

Edison Radio Amateur Award

Miscellaneous

Operation Crystal (Crystal Radio Ideas)

Power Supplies

Receiving

Technical Information

Technical Tidbits

Testing and Measuring

Transmitting

Tricks and Topics

VHF and Microwaves

CROSS INDEX TO G-E HAM NEWS
May-June, 1946 (Vol. 1, No. 1) to November-December, 1950 (Vol.5, No. 6)

Audio Equipment

Designer's Corner

Miscellaneous

Power Supplies

Questions and Answers

Reception

Technical Tidbits

Test and Measuring Equipment

Transmitting Equipment

Tricks and Topics

Tube Data

VHF Equipment

CHANGES IN ISSUES FROM 1946 TO 1955 (Vol. 1 to 10)

Vol. 1 No. 3 p. 4

Tube basing diagram shown for 50B5 should be used for 12BA6 and vice versa.

Vol. 2 No. 6 p. 5

The circuit diagram as shown shorts the B plus voltage to ground. One switch section has been omitted in the GL-807 plate circuit. The omitted section is S-1I and it is contained on the same switch pie as S-1G. Both leads from the right-hand side of M_2 should be eliminated. The pole of S-1I connects to the right-hand side of M_2 and each of the five switch positions is wired to the bottom end of the corresponding tank coil.

Vol. 3 No. 1

In the circuit diagrams on pages 4 and 5, omit the 0.01 mf condenser which connects between the center of the grid coil and ground.

Vol. 3 No. 3

Fig. 4, page 3, is in error. The lead going from the top of R_6 to C_1 should be removed from C_1 and wired instead to the bottom of the secondary of T_2. The C_1 lead from the bottom of R_6 to the top of R_7 should be replaced with a direct connection. The lead going from R_1 to the bottom of R_6 should be rewired so that it connects R_1 to the top of R_6.

Vol. 3 No. 6

(1) Switch S_2 in Fig. 2 need only be a three-pole four-position switch. To change circuit connect the arm of R_{22} to position 2 on section F. Connect the bottom end of R_{22} to position 3 on section F. Connect the arm of R_{21} to position 4 on section F. Remove wiring from sections C, D and E, making certain that the pole of section F still connects to the grid of the 6C4. (2) In Fig. 2, the "black" wire of L_2 should be marked "green" and the "green" wire marked "black." (3) On page 4, second column, line 16, the 24 mmf condenser mentioned is a mica condenser. Please note that some Millen 60456 transformers do not contain this mica condenser and in this case the transformer should tune as it is. (The tap change described on lines 13 and 14 should still be made.) (4) On page 7, first column, line 23, "50,000 ohm condenser" should read "50,000 ohm resistor."

Vol. 5 No. 2

Under Circuit Constants on page 2, "R_1, R_2, R_2, R_2" should read "R_1, R_2, R_3, R_4."

Vol. 5 No. 6

Under Circuit Constants on page 6, the second line should read "C_2, C_3" not "C_2, C_1."

Vol. 6, No. 5, p. 2

This is more of a clarification than a correction, and it pertains to the circuit diagram on page 2 of the September–October, 1951, HAM NEWS. The connection from the top of S_3 does connect to pin 2 of the 6AL5, despite the fact that no dot is shown at the connection point.

Vol. 7, No. 4, p. 2

In the schematic of the Mobile-Marine Receiver of the July–August, 1952 issue of G-E HAM NEWS two changes should be made: (1) The arm of SW-1A should be grounded; and (2) the connection between the cathode of the 6BE6 mixer and the junction point of R5 and C10 should be eliminated.

Vol. 9, No. 1, p. 6

In the "Designer's Corner" of the last issue of G-E HAM NEWS (Volume 9, No. 1) the formula for the resonant frequency should of course, have read:

$$f = \frac{1}{2\pi\sqrt{LC}}.$$

Vol. 9, No. 5, p. 4

In the 220-megacycle converter in the September-October, 1954, issue of G-E HAM NEWS (Vol. 9, No. 5), coils L_1, L_2, L_4 and L_{10} should be wound on ¼-inch forms instead of ½-inch forms as described in the parts list. Also, RFC_5 should have 15 turns, instead of 5.

Vol. 10, No. 3, p. 4

A Type 6BF5 audio power amplifier tube can be used in place of the 6CA5 shown in the schematic diagram of the Ham Shack Intercom, if that type is not readily available. Reverse socket connections to pins 1 and 2, and change the lead from the output transformer, T_2, from pin 7 to pin 5, to use the 6BF5.

SUPPLEMENTAL INFORMATION To G-E HAM NEWS Issues

From January-February, 1956 (Vol. 11, No. 1)
To November-December, 1960 (Vol. 15, No. 6)

JANUARY - FEBRUARY, 1956 (Vol. 11, No. 1) Issue

--Fourth Revision--

DX LOG Check List for States, Call Areas, Zones, Continents and Official Countries.

The following additions and changes should be noted in the original DX LOG OFFICIAL COUNTRIES listings. These changes are listed even though they since have been incorporated into a fifth revision of the G-E HAM NEWS DX LOG issue, July-August, 1958 (Vol. 13, No. 4). They are, as of August, 1957:

ADDITIONAL COUNTRIES--

FB8	Tromelin Island	Africa
VK9	Nauru Island	Oceania
XE4	Reville Gigedo Island	N. America
YVØ	Aves Island	N. America
OHØ	Aland Island	Europe
ZD4	Ghana	Africa

CHANGES--

Page 2	DU, Philippine Islands, should be Oceania, not Asia.
Page 3.	FI8, French Indo-China, Asia, is no longer classified as French Indo-China as on July 19, 1955. See ''Banned List'' in QST, for details.
Page 3.	FN5, French India, Asia, should have been FN, and the ''5'', a footnote, refers to footnote 5 on page 7.
Page 4.	OD5, Lebanon, should be Asia, not Africa.
Page 5.	PK[2], Republic of Indonesia, Oceania. PK1, 2, 3, Java, Oceania. These two count as one country, not as two separate countries. Also see footnote 2 for both.

NOTE-- As of April 1, 1957, 9S4, Saarland, and I1, Trieste, no longer count as separate countries for DXCC credit, but count as Germany and Italy, respectively.

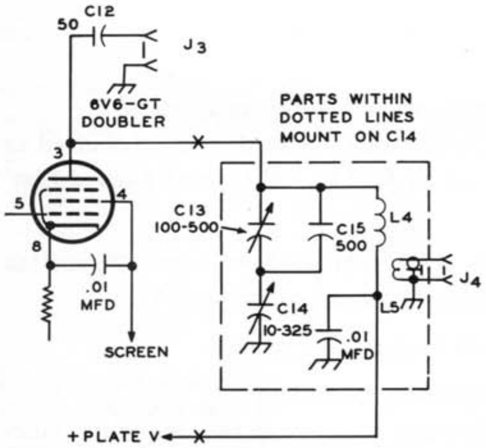
MARCH-APRIL, 1956 (Vol. 11, No. 2) ISSUE--

TRI-RANGE VFO-- A stable transmitter oscillator covering three separate tuning ranges with range 1 tuning the 1.8 to 2.0 and 3.5 to 4.0 megacycle bands; range 2 covering 3.5 to 3.712, to cover the 7.0 to 7.3, 14.0 to 14.4, 21.0 to 21.45, and 28.0 to 29.7-megacycle amateur bands; range 3 covering 8.0 to 9.0 megacycles, to tune the 50 to 54, and 144 to 148-megacycle bands.

CHANGES AND COMMENTS--

1. There is an error in the schematic diagram, Fig. 3, on page 3. The output tuning capacitor for the 6V6 doubler-amplifier stage, C_{14}, has the rotor grounded, as can be seen in the photographs. This would short out the plate voltage if the circuit is wired according to the original diagram.

   The correct circuit is shown below (left). Plate voltage is connected to L_4, and the 0.01-mfd bypass capacitor provides an r. f. ground for the lower end of L_4, taking the place of the direct connection between the lower end of L_4 and the rotor of C_{14}, as shown on the original diagram.
2. A two-range version of this oscillator may be constructed by using a two-gang tuning capacitor similar to C_1 (Hammarlund (MCD-35-SX, or equivalent), plus the same coils specified for L_2 and L_3, to cover the ranges of 3.5 to 3.8 and 3.7 to 4.0 megacycles, respectively.



NEW FIG. 3. SCHEMATIC DIAGRAM WITH CHANGES IN 6V6 PLATE TANK CIRCUIT TO CORRECT ERROR.

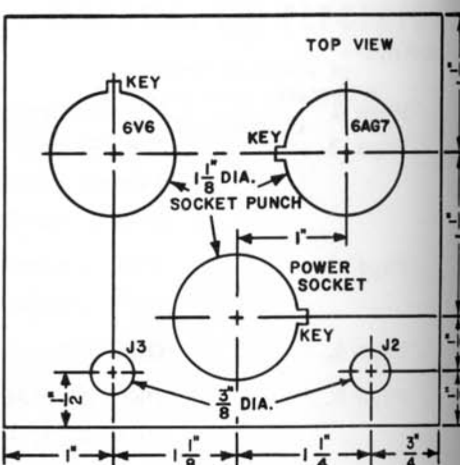


FIG. 5 DRILLING DIAGRAM FOR THE TUBE CHASSIS.

3. The 4.0 to 4.5-megacycle 3rd range can be bandspreaded for easier tuning of the 4.0 to 4.111-megacycle range which multiplies to 144- 48 megacycles, by setting C_7 so that 4.111 megacycles comes at minimum capacitance on C_1. Then, 4.0 to 4.111 megacycles will be spread over about half of the rotation of C_1.

4. Just the remote tuned circuit box shown inside the black cabinet in this issue can be used with a 6AG7, 6AH6, 6EW6 or other high-Gm pentode tube which may already be functioning as a crystal oscillator in a transmitter. Connections to the transmitter oscillator should be the same as those shown for the tube chassis which is part of this VFO.

5. A two-range oscillator, using the L_1 grid circuit on 1.75 to 2.0 megacycles to cover 3.5 to 4.0, and 7.0 to 7.3 megacycles; and, a second oscillator tuned grid circuit on 7 megacycles, can also be constructed. The coil for the 7-megacycle grid circuit should have 30 turns of No. 16 enameled wire close-wound on the same type of 1-inch diameter coil form, and inserted as L_2. Then, the 6V6 plate circuit can be modified to double this 7-megacycle signal to 14 megacycles, or triple it to 21 megacycles.

6. A multi-band tuned circuit can be substituted for L_4, and C_{13}, C_{14} and C_{15}, the 6V6 plate tuned circuit. A schematic diagram, mechanical layout for the coil, and parts list for this tuned circuit appears below. This tuned circuit will cover from 3.3 to 9.0 megacycles with the larger new coil, L_4; and, from 12 to 34 megacycles on the smaller coil, L_6. Note that the two-section variable capacitor, C_{14}, should have the rotor insulated from the chassis. Link coil L_5 couples the output from this tank circuit to the succeeding stage.

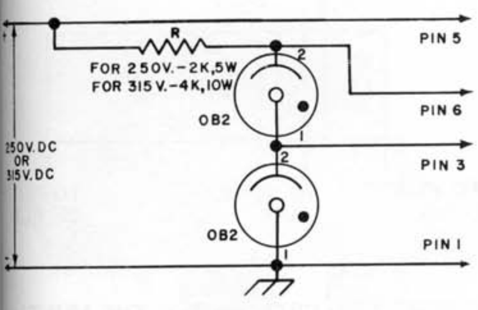


FIG. 7 SUGGESTED VOLTAGE REGULATOR TUBE CIRCUIT FOR THE TRI-RANGE VFO.

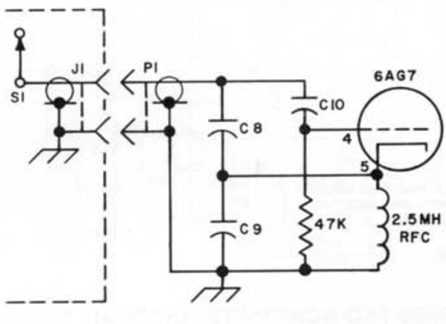


FIG. 8 CIRCUIT CHANGES IN OSCILLATOR GRID CIRCUIT FOR COAXIAL CABLE CONNECTION BETWEEN TUNED CIRCUIT BOX AND THE TUBE CHASSIS.

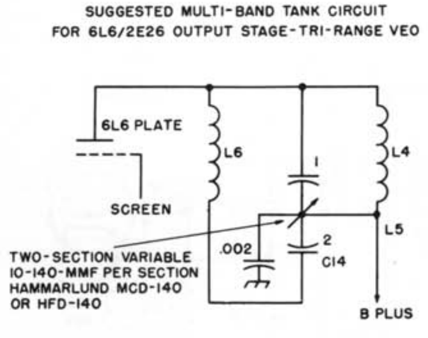
Component values are:

L_4 -- 7 uh, 32 turns, No. 16 wire, 1 inch in diameter, 2 inches long, and 16 turns per inch;
L_5 -- 0.5 uh, 4 turns, same as L_4, placed between L_4 and L_6.
L_6 -- 1.7 uh, 8 turns, same as L_4, 1/2 inch long.

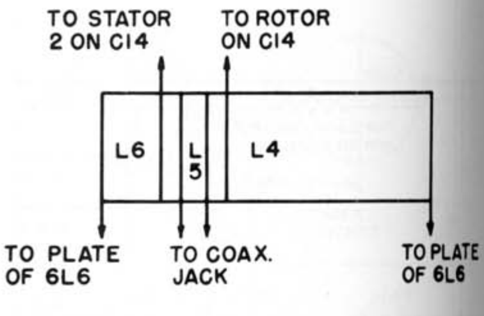
NOTE: L_4, L_5 and L_6 are made from a single length of No. 3015 Miniductor, or No. 816 air-dux, with turns cut and connected as shown in the sketch below.

7. Other tubes may be substituted for the 6V6 in the output stage of this VFO. The 6L6, 6L6-GC, 7581, 2E26 and 6146 may be used, with appropriate socket connections and voltages applied.

8. The three drawings on pages 4 and 5 of this issue, Figs. 5, 7 and 8, may not be read clearly because of their being pinched in the binding of this book. These diagrams are repeated on the two previous pages.



SUGGESTED SCHEMATIC DIAGRAM FOR A MULTI—BAND TUNED CIRCUIT IN THE 6V6 PLATE COVERING 3.3 TO 30 MC.



CONNECTION DRAWING FOR THE MULTI—BAND TANK CIRCUIT COILS MADE FROM A SINGLE 3—INCH LENGTH OF COIL STOCK.

MAY-JUNE, 1956 (Vol. 11, No. 3) ISSUE--

TRANSISTORIZED VFO'S -- Ideas, Circuits and Construction details.

COMMENTS:

1. Many newer types of transistors are available to replace the 2N107, 2N135, 2N136 and 2N137 in the original circuits. However, because of the profusion of transistor types which may work, we make no specific recommendations.

2. The bottom view of the capacitor-tuned broadcast band oscillator, Fig. 6, is pinched into the binding of this book, so this view is repeated below.

3. We have been advised that the Miller No. 2020 transistor oscillator coil has been changed since the article was published. A revised circuit is shown below, with the proper connections for this new type 2020 coil.

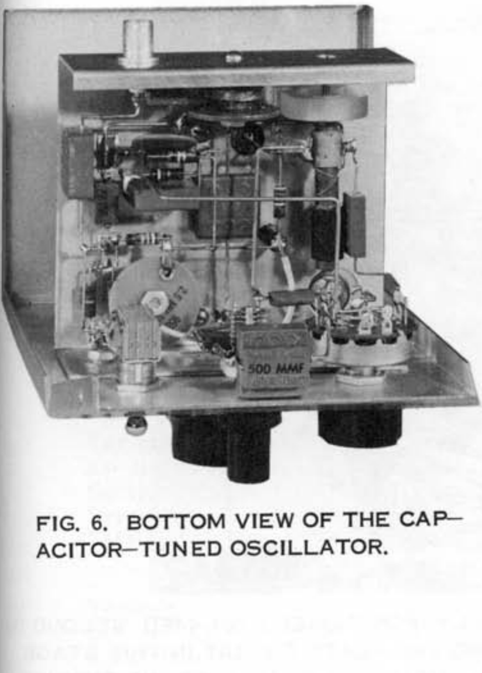
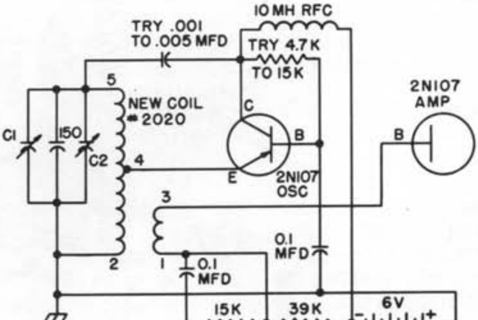


FIG. 6. BOTTOM VIEW OF THE CAPACITOR–TUNED OSCILLATOR.



REVISED OSCILLATOR CIRCUIT FOR THE MILLER NO. 2020 NEW TYPE TRANSISTOR OSCILLATOR COIL.

JULY-AUGUST, 1956 (Vol. 11, No. 4) ISSUE--

ANOTHER LOW-NOISE VHF CONVERTER--for 144-148 Megacycles.

COMMENTS--

1. The 6AM4 miniature triode has been compared with other similar tubes--the 6AJ4 and 6AF4, and found to be somewhat better as to gain and noise figure in this converter. However, the 417A has higher transconductance and will have a lower noise figure when used in the r.f. amplifier stages of this converter--about 3 db.
2. Coils L6 and L_7 were wound on Millen No. 69045 copper-slug tuned ceramic coil forms. These are listed in the Allied Radio Co. catalog. Also, CTC type LS-4 forms, 1/2 inch in diameter and 2 inches long, may be substituted by adding about 5 extra turns to each coil. The CTC type LS-3 3/8-inch diameter blank coil form may be used with about 50 turns of No. 30 enameled wire on each.
3. Other i.f. amplifier tuning ranges may be substituted for the original 10 to 14-megacycle range by changing L_6 and L_7 to cover the proper range, and changing the frequency of the crystal. For 14-18 megacyles, use 130 megacycles (43.333-Mc. crystal) for the injection frequency.
4. Newer crystals for the 3rd and 5th overtones make possible a simplified oscillator circuit. Use one section of the 12AT7 as the oscillator in the circuit the crystal manufacturer recommends, and the other section as a doubler (for 60 to 70-Mc. range crystals), or a tripler (for 40 to 46-Mc. range crystals).

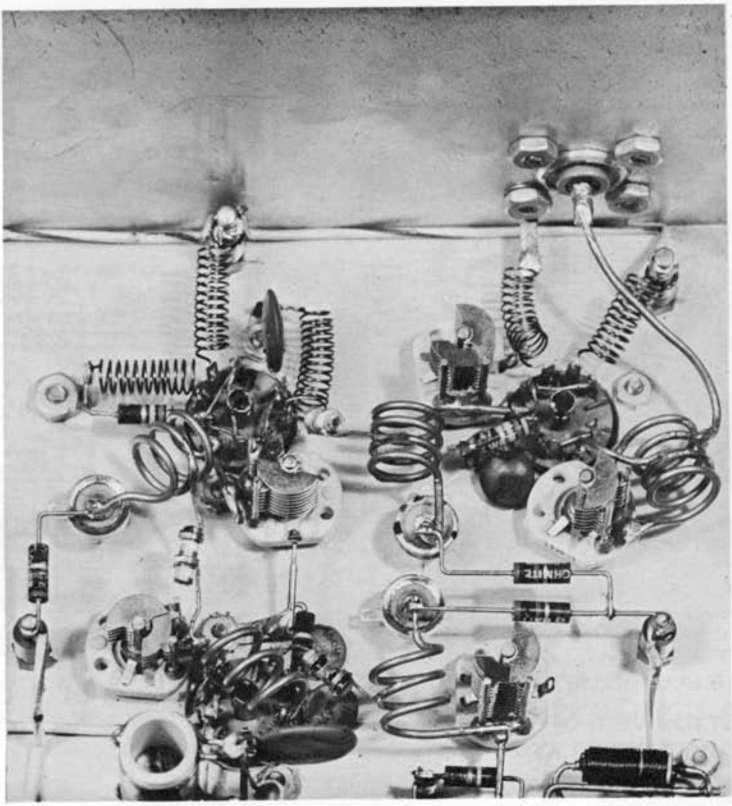


FIG. 4 CLOSE–UP VIEW SHOWING THE VERTICALLY–POSITIONED 0.001–MFD. SECOND RF AMPLIFIER GRID BY–PASS CAPACITOR SHIELDING THE PLATE CIRCUIT IN THIS STAGE FROM THE SMALL–DIAMETER CATHODE COIL, L_3, NEAR THE CENTER OF THE PICTURE.

SEPTEMBER-OCTOBER, 1956 (Vol. 11, No. 5) ISSUE--

THE HAMSCOPE-- Monitors Your AM or SSB Transmitter.

COMMENTS--

1. Several cathode ray tube types other than the 3KP1 tube recommended for the HAMSCOPE may be used if the changes listed below are followed.

2. For cathode ray tubes having the cathode connected internally to one side of the heater, (3AP1, 3CP1, 3EP1, 3GP1, 5AP1, 5BP1, 5GP1, 5HP1, 5JP1, 5NP1)
   a. Connect the end of the 1-megohm resistor shown running to the cathode, pin 3, to one side of the tube heater circuit instead.
   b. The cathode ray tube control grid should be connected to the negative side of the high voltage supply, as shown for the 3KP1, but the negative high voltage circuit should not be connected to one side of the heater circuit. This circuit is shown below.

3. The additional deflection plate shown on the basing diagram for a 3CP1 type cathode ray tube is an accelerating anode and should be operated at the same DC potential as the deflection plates. In the HAMSCOPE, ground this pin.

4. When a 5-inch cathode ray tube is operated in the HAMSCOPE circuit, it is recommended that at least 1000 volts DC be applied across the voltage divider

5. Cathode ray tubes which have one horizontal and one vertical deflection plate connected together and brought out to a common connection require some changes in the HAMSCOPE deflection circuit.
   a. The pair of deflection plates connected to one pin should be grounded.
   b. One end of the secondary winding on T_2 is grounded, and the other end is connected to the remaining horizontal deflection plate.
   c. A single gang 365-mmf variable capacitor is substituted for the two-gang type specified for C_3 and the rotor is grounded. The stator onn C_3 is connected to the remaining vertical deflection plate, and to pin 4 on J_4.
   d. Coil L_1 is wound with no center tap, and is connected between pins 3 and 4 on J_4. The center tap on commercially made coils is not used, and the connection from pin 3 to ground on J_4 is removed from the circuit. Pin 2 on J_4 should then be grounded. This circuit is shown below.

6. In the wiring shown in Fig. 1 on page 3 of the September-October, 1957 issue, the schematic diagram for the plug-in coil form is correct, but the pins are numbered wrong, and should be numbered as shown for J_4 in that diagram.

7. Cathode ray tubes having short persistence green, blue or white screens (P1, P4 and P11) will work best in the HAMSCOPE, but medium and long persistence screens (P7 and P 4) are useful for checking a transmitter modulated by a steady audio tone. The P7 and P14 screens will retain a pattern too long to be very useful for continuously monitoring a voice-modulated transmitter, however.

8. Technical data sheets for several types of G-E cathode ray tubes are available, as listed below. These sheets may be obtained by writing to: Technical Data Section, Cathode Ray Tube Department, General Electric Co., Electronics Park, Syracuse, N. Y. These types are: 2AP1-A, 2BP1, 3AP1-A, 3BP1-A, 3KP1, 3MP1, 5AUP24, 5CP1-A, 5QP4-A, 5UP1, 14UP4.

9. Technical data for the above types, and for other types of cathode ray tubes, can be found in the ARRL Radio Amateur's Handbook. Look in the tube technical data chapter, under "Cathode Ray Tubes."

10. A number of readers have inquired about converting the war surplus BC-929 oscilloscope to the HAMSCOPE circuit. An article has been published in QST magazine for August, 1957, page 32, describing the conversion of this oscilloscope to a modulation monitor similar to the HAMSCOPE, but with more elaborate circuits.

11. Since the side view photo, Fig. 3, and layout drawings Fig. 5 and Fig. 6 in the original issue are pinched in the binding of the bound volume, these illustrations are repeated here.

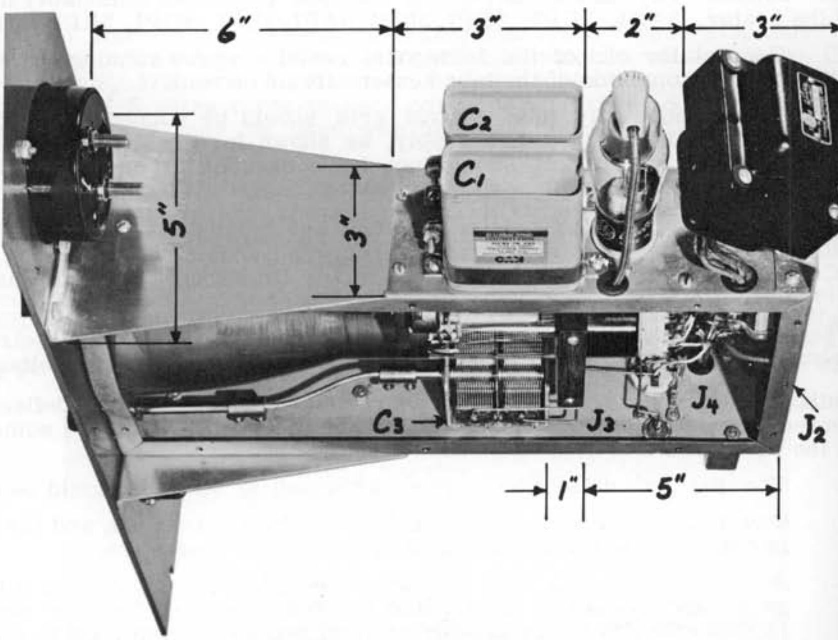
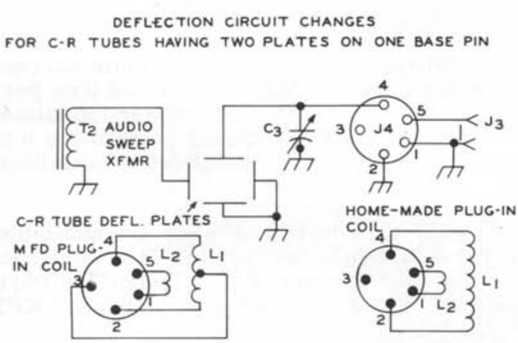


FIG. 3. SIDE VIEW SHOWING APPROXIMATE SPACING OF THE POWER TRANSFORMER, RECTIFIER TUBE AND FILTER CAPACITORS. DIMENSIONS OF THE SIDE BRACKETS ARE EXACT, BUT MAY BE VARIED TO SUIT THE AVAILABLE SPACE.



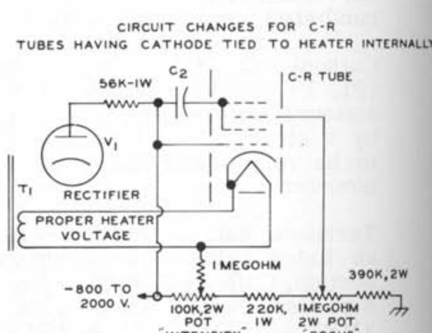


DIAGRAM SHOWING CHANGES IN HAMSCOPE CIRCUIT FOR C–R TUBES WITH CATHODE TIED INTERNALLY TO ONE SIDE OF HEATER.

DIAGRAM SHOWING CHANGES IN DEFLECTION CIRCUIT FOR C–R TUBES HAVING 2 PLATES CONNECTED TOGETHER AND BROUGHT OUT TO ONE BASE PIN.

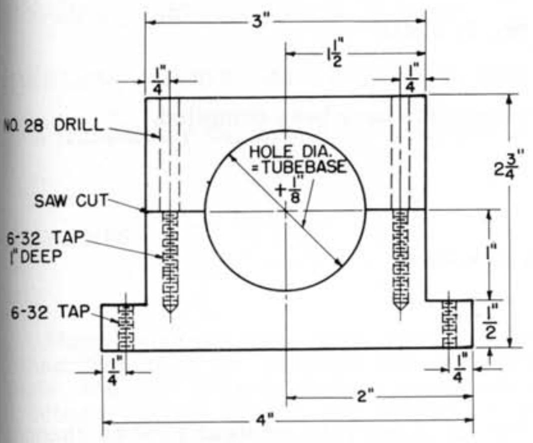


FIG. 5. MOUNTING BRACKET FOR C-R TUBE BASE MADE FROM 1/2-INCH THICK PHENOLIC INSULATING BOARD, OR SIMILAR MATERIAL.

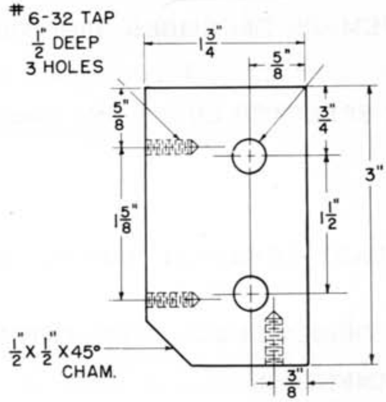


FIG. 6. BRACKET MADE FROM 1/4-INCH THICK INSULATING BOARD TO HOLD THE "FOCUS" AND "INTENSITY" POTENTIOMETERS NEXT TO THE C-R TUBE NECK. MOUNTING HOLES MAY BE FIRST DRILLED IN THE CHASSIS, AND THEN MARKED ON BOTH BRACKETS.

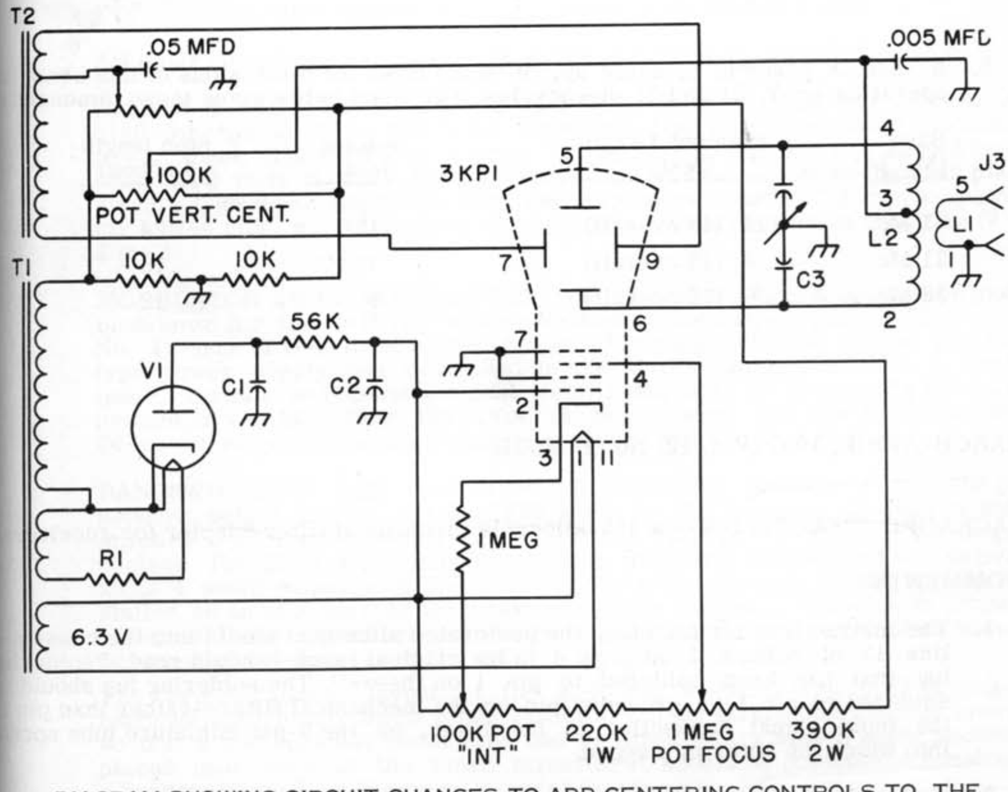


DIAGRAM SHOWING CIRCUIT CHANGES TO ADD CENTERING CONTROLS TO THE HAMSCOPE.

NOVEMBER-DECEMBER, 1956 (Vol. 11, No. 6) ISSUE--

MIX-SELECTOR CHART--No changes or comments have been compiled.

JANUARY-FEBRUARY, 1957 (Vol. 12, No. 1) Issue--

THE DIRECTIONULL BEAM ANTENNA--

COMMENTS--

1. This antenna may be operated on the 21-megacycle amateur band by changing the length of the matching stub shown in Fig. 4 of that issue. However, the beam was dismantled before the proper matching device could be determined. It may be possible to match directly into the feed points "A" and "B" with a 72-ohm twinlead, or 52- or 72-ohm coaxial cable and obtain a low standing wave ratio. Open wire line with an antenna tuner also can be used for any band.

2. This antenna also can be operated on the 28-megacycle band with a matching stub at the feedpoint. The gain will be somewhat higher than at 14 megacycles.

3. It also is possible to scale up, or scale down the dimensions of this beam for operation on 7, 21 and 28 megacycles. The chart below gives these dimensions:

Band (MC.)	Element Length (feet)	Spacing (feet)	Stub length (inches)
7 Mc.	24 (48 overall)	16	24
21 Mc.	8 (16 overall)	7' 4"	16
28 Mc.	6 (12 overall)	5	12

MARCH-APRIL, 1957 (Vol. 12, No. 2) ISSUE--

PACKAGED SELECTIVITY-- a 455-kilocycle mechanical filter adapter for receivers.

COMMENTS--

1. The instructions for fastening the perforated aluminum shield into the chassis--line 13 of column 2 on page 4 in the original issue--should read, "soldering lug that has been soldered to pin 1 on the---". The soldering lug should be soldered to pin 1--a grounded pin on the mechanical filter--rather than pin 2, the input signal connection to the filter, on the 9-pin miniature tube socket into which the filter is plugged.

2. Collins Radio Co., 2700 West Olive Avenue, Burbank, Calif., has since marketed smaller mechanical filters--their "Y" series--which can be used in this adapter.

MAY-JUNE, 1957 (Vol. 12, No. 3) Issue--

EMERGENCY-PORTABLE RIG--a 15-watt VFO transmitter for 3.5 megacycle.

(This transmitter was originally described in the March-April, 1950 issue)

COMMENTS--

Many requests have been received for information on how this 3.5-megacycle transmitter may be modified for operation on the 7-megacycle and 14-megacycle bands, and how a bandswitching transmitter covering these three bands may be constructed from this circuit. The following suggestions will help those persons who wish to try these modifications:

1. COMPONENT VALUES FOR 7-MEGACYCLE BAND-- The E-P Rig may be used as a single band transmitter for 7 megacycles by reducing the values of capacitance across the three tuned circuits, and the inductances, to one-half the values given in the original CIRCUIT CONSTANTS table for the 3.5-megacycle band. They are as follows:

   C_1--200-mmf silvered mica
   C_2--50-mmf variable (Hammarlund HF-50 or equivalent)
   C_3, C_5, C_{10}--50-mmf silvered mica
   C_{11}--50-mmf mica capacitor
   L_1, L_2, L_3--27 turns, No. 24 enameled wire, spacewound to cover 11/16 of an inch winding length on National XR-50 slug-tuned coil form. (L_1 tapped 4 turns from grounded end).

   All other component values are the same as originally specified.

2. HIGHER POWER TUBES IN THE E-P RIG--It is possible to substitute the 6146 for the 2E26 in the final amplifier, thus making possible increased power input. The working voltage rating of C_9, C_{10} and C_{11} should be at least 1500 volts if more than 400 volts DC will be applied to the 6146 plate circuit. The 6AK6 oscillator tube delivers more than enough driving power for a 6146 tube, which requires about the same grid current as the 2E26 (2 to 4 ma.)

3. MODULATOR AND POWER SUPPLY FOR THE E-P RIG--A companion plate modulator for the E-P Rig was described in the July-August, 1950 (Vol. 5, No. 4) issue of G-E HAM NEWS. A high-efficiency 300-volt, 100-ma vibrator type power supply was described in the March-April, 1953 (Vol. 8, No. 2) issue. Circuit and constructional details for both of these units were reprinted in the May-June, 1957 (Vol. 12, No. 3) issue. The new transistorized DC power supplies also will work very nicely with the E-P Rig.

4. BANDSWITCHING THE E-P RIG-- It should be possible to tune the pi-network output circuit in the 2E26 stage to the 7-megacycle band by substituting a 25-mmf silvered mica capacitor for C_{10} (100 mmf on 3.5 megacycles). The 2E26 stage thus becomes a frequency doubler and will deliver about 4 watts output with 300 volts on the plate. A small switch may be installed on an aluminum bracket fastened to the rear of the chassis to connect either of these capacitors across the output circuit. The switch shaft should be extended out the rear of the cabinet.

   The original parts layout of the E-P Rig does not lend itself to ganged bandswitching of all three tuned circuits, but by turning the chassis around so that a switch shaft could turn two or three rotary switch wafer sections placed near each of the tuned circuits, it should be possible to construct a bandswitching E-P Rig on a larger chassis.

JULY-AUGUST, 1957 (Vol. 12, No. 4) ISSUE--

100-WATT MOBILE POWER SUPPLY--

COMMENTS--

1. Many requests have been received for a simplified circuit of this power supply which will deliver only the 450-volts DC high voltage, and 250 volts for a receiver, and without the switching relays included in the original diagram. This information is given below, and the circuit is on the next page.
2. It is possible to connect two of these power supplies, or the high voltage transformers, in series to obtain twice the high voltage DC of one power supply. The rectifiers and filter capacitors should be rated for double the voltages shown in the original article.
3. These power supplies continue to be popular with radio amateurs, since their efficiency approaches that of supplies using solid-state oscillator type circuits. Also, the components used in these vibrator power supplies are readily available in surplus two-way mobile radio equipment.
4. The G-E components--transformers, vibrator, etc.--listed in the parts list, can now be obtained from the Product Service Section, Communication Products Department, General Electric Co., P. O. Box 4197, Lynchburg, Va.

GENERAL INFORMATION

TRANSFORMER---Only the power transformer listed above, or its equivalent in another make, should be used for highest efficiency. If a home-wound transformer is to be used, it should have a core made from high quality audio transformer type iron punchings. Ordinary 60-cycle power transformer punchings are not suitable for this transformer, since they will result in much lower transformer efficiency.

POWER CONNECTORS--LOW VOLTAGE---The terminal strips or power connectors used with this power supply should have low contact resistance and be capable of handling the currents shown on the diagram for the input voltage involved.

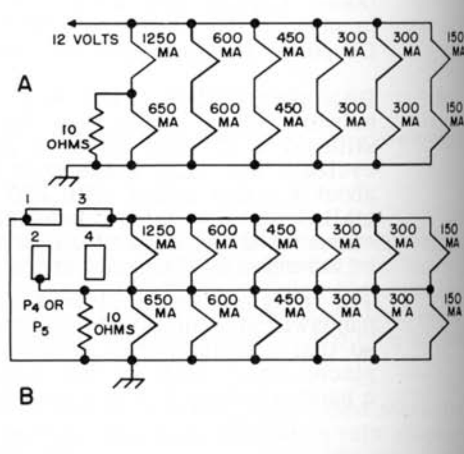
RECTIFIERS---Although commercial grade selenium rectifiers were used in the original power supply model, lower cost replacement type rectifiers are satisfactory. Germanium rectifiers may be used if their lower maximum temperature rating will not be exceeded.

Low current silicon rectifiers also are suitable for this circuit. The General Electric type 1N1694 300 PIV rectifier may be used in place of those specified above for SR_1 to SR_8. Or, one G.E. type 1N1697 600 PIV rectifier will replace the two 300 PIV rectifiers in each leg of the bridge rectifier.

MOBILE TUBE HEATER HINTS--

COMMENTS--

1. "The case of the missing 'O'--in Figure 12," the schematic diagram for the mobile tube heater circuit, the current balancing resistors in the circuits of "A" and "B" should be 10 ohms, and not 1 ohm, as was shown in these diagrams. The correct diagram is repeated at the right.



PARTS LIST FOR SIMPLIFIED SCHEMATIC DIAGRAM
G-E HAM NEWS 100-WATT MOBILE POWER SUPPLY
FROM JULY-AUGUST, 1957 ISSUE

C_1, C_2---100-mfd, 450-volt electrolytic (General Electric XC1-15 or equivalent)

C_3, C_4---80-mfd, 450-volt electrolytic (General Electric XC1-14 or equivalent)

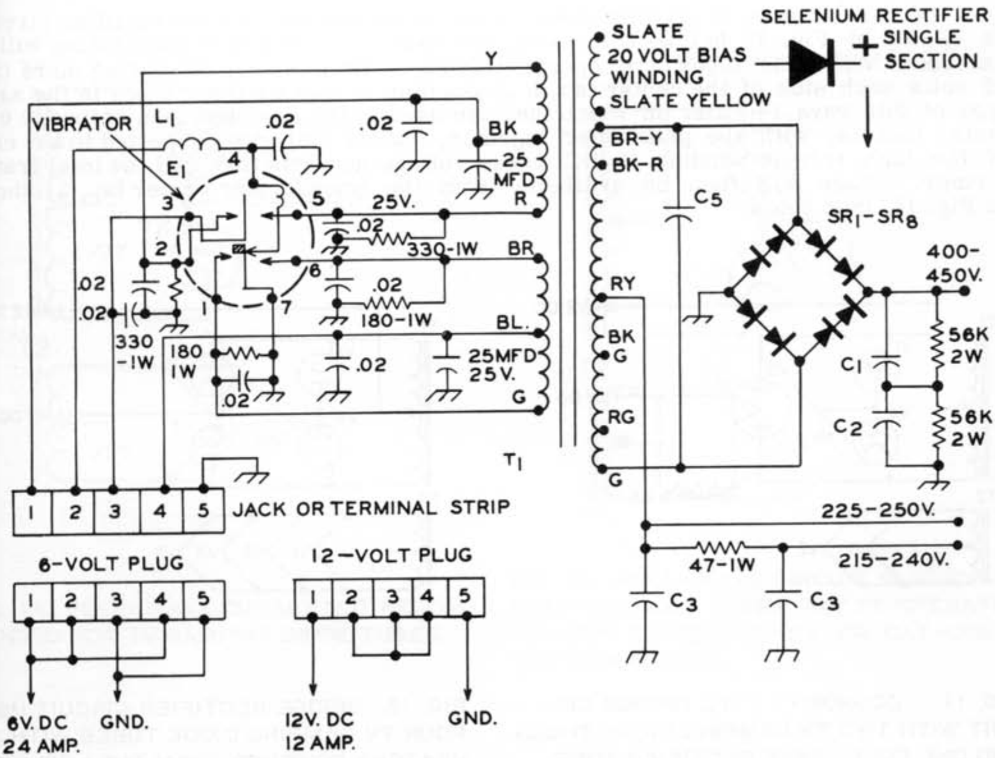
C_5---0.003-mfd, 2500-volt working mica capacitor

E_1---Vibrator, dual interrupter, split reed; 6-volt coil, 115 CPS reed frequency, 7-pin base (Mallory type 1701, Oak No. V-6853, Radiart No. 5722, or G-E Cat. No. A-7141583-P3)

L_1---7-uh, 1-ampere RF choke (Ohmite Z-50)

SR_1--SR_8-- 130-volt, 150-ma replacement type selenium rectifier (FTR-1005A or equivalent)

T_1---Vibrator power transformer, dual center-tapped 6-volt primaries; secondaries: 420 volts, tapped at center and 150 volts each side of center, 300 ma; 20-volt, 150-ma bias winding (G-E B-7486449-Pl or equivalent--see below)



SEPTEMBER-OCTOBER, 1957 (Vol. 12, No. 5) ISSUE--

DUAL-VOLTAGE POWER SUPPLIES--

COMMENTS--

Many requests have been received for information on whether transformers having higher voltage output can be used in the bridge rectifier circuits shown in Figs. 2A, 4 and 5 in the September-October issue; and in the full wave circuit of Fig. 7. In the circuit of Fig. 2A, the maximum total voltage from the transformer secondary we recommend is 750 volts. Otherwise, the maximum heater-to-cathode voltage rating of the tube 6AX5-GT tubes will be exceeded.

Type 6W4-GT, 6AX4-GT or 6AU4-GT single diode tubes used in the horizontal damping circuit of TV receivers have been timed in place of the type 6AX5-GT tubes. However, the 6.3-volt heater supply for these tubes should be connected to the negative side of the high voltage output, as shown in Fig. 11 below, (ground or chassis) instead of to the center tap on the transformer high voltage winding, as was done in Fig. 2A. in that issue.One or two 5U4-GB twin diode tubes, both powered from the same filament transformer, can be used for the other two legs of the bridge.

The TV damping diodes also may be used in all four legs of a bridge rectifier, as shown in Fig. 12 below. All four tube heaters may be powered from the same 6.3-volt heater supply, which should be tied back to the negative side of the high voltage output. Type 6W4-GT and 6AX4-GT tubes will deliver up to 250 ma of DC output current; and type 6AU4-GT's will deliver up to 380 ma.

Do not attempt to operate these tubes in the usual full-wave rectifier circuit, as shown in Fig. 13 below. Otherwise, the heater-to-cathode voltage rating will be exceeded when the tubes are operated from a transformer delivering more than 75 volts each side of the center tap. It is possible to operate these tubes in the same type of full-wave rectifier in which they are used in the grounded legs of bridge circuits; that is, with the plates tied together, and the cathodes connected to the ends of the high voltage winding. A DC output voltage just less than half the total transformer voltage will then be available from the transformer center tap, as shown in Fig. 14. (See below)

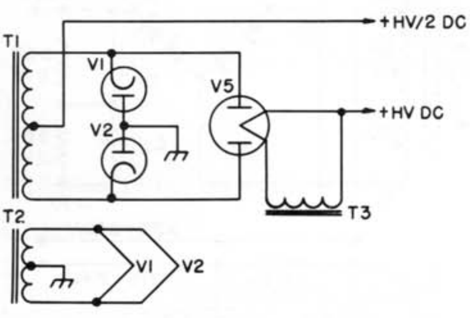


FIG. 11. "ECONOMY" TYPE BRIDGE CIRCUIT WITH TWO TV DAMPING DIODE TUBES AND ONE FULL-WAVE RECTIFIER TUBE.

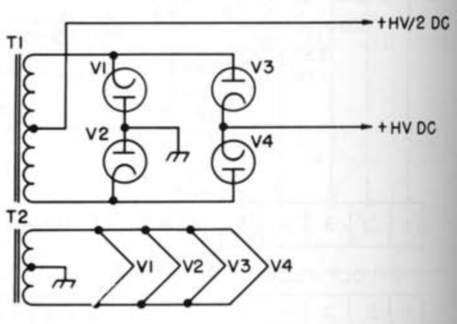


FIG. 12. BRIDGE RECTIFIER CIRCUIT USING FOUR TV DAMPING DIODE TUBES WITH ALL HEATERS POWERED FROM ONE LOW-VOLTAGE TRANSFORMER.

PARTS LIST FOR THESE CIRCUITS - FIGS. 11 TO 17

D - Germanium, Selenium or Silicon semiconductor rectifiers. Sum of maximum peak inverse voltage ratings of rectifiers in each leg of bridge should be approximately equal to, but not less than the total RMS AC output voltage of high voltage winding on power transformer, T_1.

T_1 - Power transformer having total AC high voltage winding about 20 percent higher than desired full load DC output voltage from power supply. Current rating about equal to desired full load output current.

T_2 - Filament transformer, 6.3 volts, current rating equal to total drawn by V_1 through V_4.

T_3 - Filament transformer, 5 volts, 3 amperes for one 5U4-GB or 5R4-GYA; 6 amperes for two such rectifiers.

V_1--V_4--6W4-GT, 6AX4-GT or 6AU4-GT TV damping diode tubes.

V_5--5U4-GB full wave rectifier for transformers having up to 550 volts output per plate; 5R4-GYA for up to 950 volts per plate.

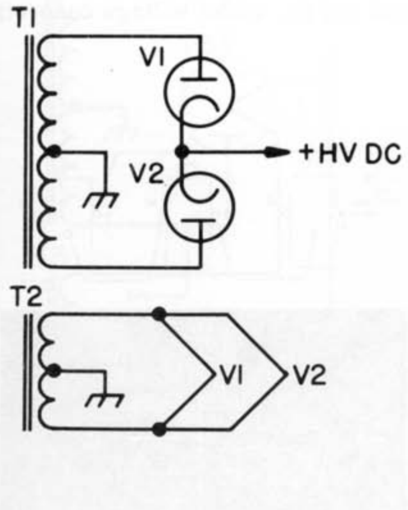


FIG. 13. FULL–WAVE CIRCUIT NOT RECOMMENDED FOR TV DAMPING DIODE TUBES.

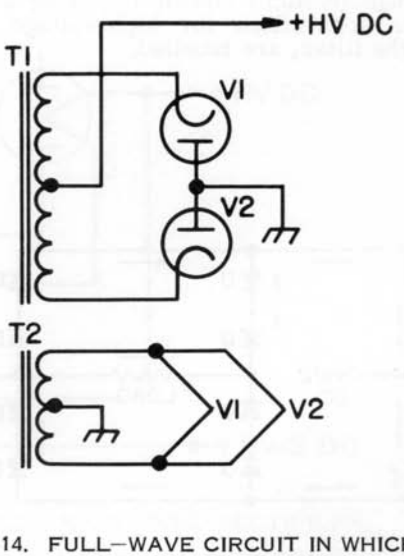


FIG. 14. FULL–WAVE CIRCUIT IN WHICH TV DAMPING DIODE TUBES MAY BE OPERATED WITHOUT EXCEEDING HEATER–CATHODE VOLTAGE RATING.

Some readers have expressed the opinion that we are operating the semiconductor rectifiers above their maximum peak inverse voltage ratings in the bridge circuits of Figs. 4, 5 and 6 of that issue. Note in Fig. 15 below that the current path through a bridge rectifier having two rectifier sections in each leg of the bridge actually flows through four rectifiers, and not two rectifiers, as apparently has been assumed. Thus, when 660 volts AC is applied across a bridge having a total of eight 130-volt RMS, 380-volt peak inverse rectifiers, each rectifier is withstanding a peak inverse voltage of only 234 volts. Even though the applied AC voltage per rectifier is 165 volts RMS, the peak inverse voltage in a bridge rectifier is only half that of a full-wave rectifier to which the same total AC voltage is applied.

The mathematics of this reasoning are as follows: With 660 volts AC (sine wave) applied across the bridge, the total peak inverse voltage will be 660 times 1.414, or about 935 volts. Dividing this across four rectifiers results in a peak inverse voltage per rectifier of only 235 volts. Although it should be possible to apply up to 266 volts RMS per rectifier to this circuit, it is best to be conservative and consider 212 volts RMS per rectifier as the maximum (300 volts peak inverse).

Germanium TV rectifiers produced by General Electric also may be used in these circuits, but they are recommended only for experimental and amateur type usage. The G-E commercial grade rectifiers specified in the G-E HAM NEWS article should be used for commercial applications. The G-E 1N1008 single section rectifier may be operated with up to 380 volts peak inverse, at a total bridge rectifier output current of 800 ma.The G-E 1N1016 two-section doubler type rectifier has two 380-volt peak inverse, 25--ma rectifiers in series. Thus, a single 1N1016 rectifier will replace two single section rectifiers having the same current rating.

Diagrams are shown below in Fig. 16 for connecting the G. E. 1N1016 dual section rectifier in a half-bridge circuit requiring three rectifiers, (top) and full-bridge (bottom) circuit requiring six rectifiers, with three rectifier sections in each leg. Connections for high voltage AC power, and the DC output voltage connections to the filter, are labelled.

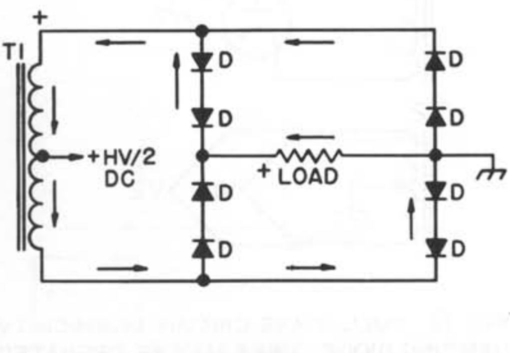


FIG. 15. SEMICONDUCTOR DIODE BRIDGE RECTIFIER CIRCUIT WITH ARROWS SHOWING PATHS OF DC CURRENT FLOW THROUGH RECTIFIERS FOR ONE-HALF OF THE A-C CYCLE. ARROWS REVERSE FOR OTHER HALF OF CYCLE.

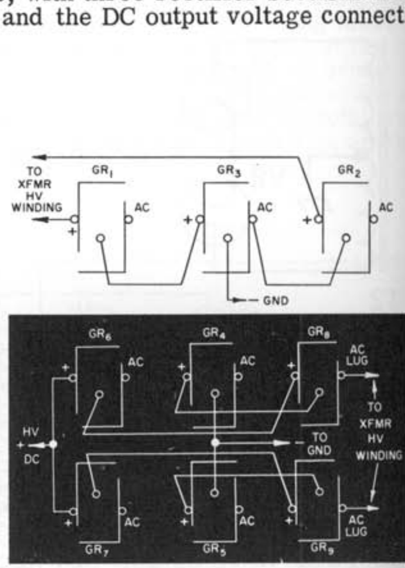


FIG. 16 CONNECTION DIAGRAMS FOR THREE G. E. 1N1016 RECTIFIERS IN HALF-BRIDGE CIRCUIT (TOP), AND SIX 1N1016 RECTIFIERS IN FULL BRIDGE CIRCUIT (BOTTOM).

In the G-E HAM NEWS diagram of Fig. 7 for a two-transformer full-wave rectifier circuit, transformers having higher voltage secondaries may be used, depending upon the ratings of the rectifier tubes used in the circuit. For example, a pair of transformers, each having up to 950 volts total secondary voltage, may be operated into a 5R4-GYA rectifier tube on the higher voltage output section. A 5U4-GB may be used with transformers delivering up to 550 volts each, or when the voltage taken from the center taps for the lower output voltage is less than 550 volts, provided that a choke input filter is used.

Another circuit for a dual-voltage power supply, which we did not publish may be made by connecting the output of two separate full-wave rectifiers in series. One full wave rectifier is operated with the high voltage winding center tap grounded, as shown in Fig. 17. The positive voltage from the cathode of this rectifier is then connected to the center tap on the high voltage winding of a second full-wave rectifier. A total current about one and one-half times the continuous duty current rating of the transformers may be drawn from this power supply when the transformer heater windings are not used.

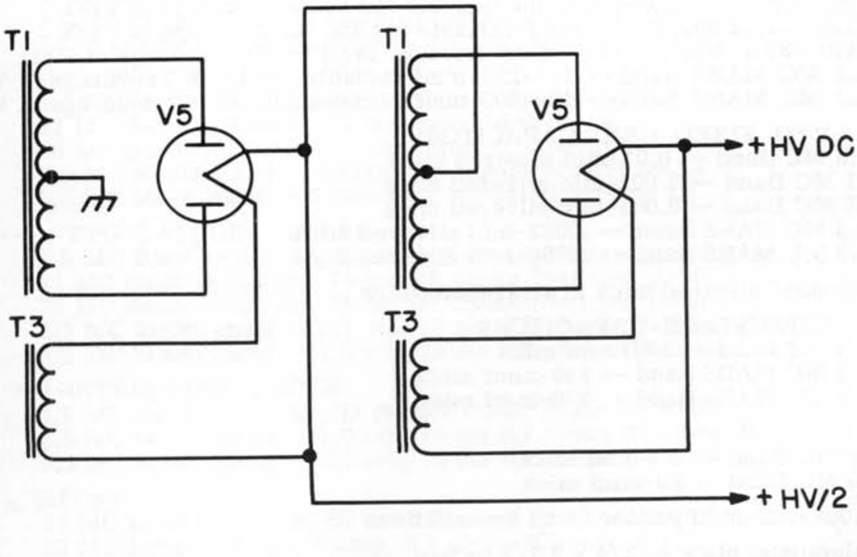


FIG. 17. CIRCUIT FOR CONNECTING TWO FULL–WAVE TUBE RECTIFIERS, EACH FED BY SEPERATE CENTER – TAPPED HIGH VOLTAGE TRANSFORMER WINDINGS, IN THE SERIES TO OBTAIN DOUBLE THE PLATE VOLTAGE OF ONE TRANSFORMER RECTIFIER COMBINATION.

NOVEMBER-DECEMBER, 1957 (Vol. 12, No. 6) ISSUE--

150-WATT SINGLE BANDER--a 3.5 Mc. Transmitter for Field Day or home station.

COMMENTS--

Since the 150-Watt Single Bander Transmitter article was published in the November-December, 1957 issue of G-E HAM NEWS, many requests have been received for information on placing these transmitters on other bands--including 1.8, 7, 14, 21 and 28 megacycles--and the 2258, 2308, 2360, 3275, 3289, 3347, 4020, 4025 and 7540-kilocycle MARS frequencies.

The 7 and 14-megacycle transmitters were described in the January-February, 1958 issue of G-E HAM NEWS. The changes were made simply by scaling down the RF components in the 3.5-megacycle transmitter by 2 to 1 for 7, and 4 to 1 for 14 megacycles. The only exception to this rule occurs in the oscillator grid fixed capacitors (C_2 and C_3) and the grid coil, L_1. In the 3.5-megacycle transmitter, C_2 and C_3 are 0.005 mfd each; in the 7-megacycle rig they are 0.004 mfd each; and 0.002 mfd each in the 14-megacycle rig. Use of 0.008 mfd capacitors for C_2 and C_3 in the 3.5-megacycle rig would require an impractically large bandspread capacitor at C_1 to cover more than a fraction of the band at one setting of the tuning slug in L_1.

On other frequency ranges, we recommend that the oscillator grid circuit operate at one-half the final amplifier output frequency to minimize interaction between the final and oscillator grid circuit. The component values shown in TABLE III are suggested for the RF circuits on the bands listed:

C_1-----VFO TUNING
- 1.8--2.0 MC -- 15--350-mmf variable for 50 KC coverage of VFO.
- 21.0--21.45 MC, 6--75-mmf variable for 450 KC coverage of VFO.
- 28.0--29.7 MC, 10--150-mmf variable for 1700 KC coverage of VFO.
- 2.3 MC MARS Band -- 13--250-mmf variable for 120 KC coverage of VFO.
- 3.3 MC MARS Band -- 10--200-mmf variable for 100 KC coverage of VFO.

C_2, C_3-----VFO FIXED GRID CAPACITORS
- 1.8 MC Band -- 0.01-mfd silvered mica
- 21 MC Band -- 0.002-mfd silvered mica
- 28 MC Band -- 0.001-mfd silvered mica
- 2.3 MC MARS Band -- .0082-mfd silvered mica
- 3.3 MC MARS Band -- .0068-mfd silvered mica

C_4-----100-mmf silvered mica in all transmitters

C_5, C_6-----INTERSTAGE CAPACITORS
- 1.8 MC Band -- 390-mmf mica
- 2.3 MC MARS Band -- 330-mmf mica
- 3.3 MC MARS Band -- 270-mmf mica

C_5
- 21 MC Band -- 50-mmf mica
- 28 MC Band -- 20-mmf mica

C_{6A}-----100--500-mmf padder in all transmitters

C_{6B}-----aluminum plate -- 3/4 x 2 1/2 inches

C_7-----AMPLIFIER PLATE TUNING
- 1.8 MC Band -- 20--490-mmf variable, 0.045-inch gap
- 21 MC Band -- 7--50-mmf variable, 0.045-inch gap
- 28 MC Band -- 6--35-mmf variable, 0.045-inch gap
- 2.3 MC MARS -- 20--490-mmf variable, 0.045-inch gap
- 3.3 MC MARS -- 15--350-mmf variable, 0.045-inch gap

C_9-----ANTENNA LOADING
- 1.8 MC BAND -- 45--1050-mmf variable, 3 section
- 21 & 28 MC BAND -- 15--350-mmf variable, 1 section
- 2.3 MC MARS --45--1050-mmf variable, 3 section
- 3.3 MC MARS -- 30--700-mmf variable, 2 section

L_1-----Oscillator grid coil (All coils specified for L_1 and L_2 are wound 11/16 of an inch long on 1/2-inch diameter National XR-50 iron slug-tuned coil forms.)

1.8 MC Band -- (Osc. grid on 0.9 MC) 4.2 uh, 20 turns, No. 20 enameled wire.
21 MC Band -- (Osc. grid on 10.5 MC) 0.25 uh, 5 turns, No. 16 enameled wire.
28 MC Band -- (Osc. grid on 14 MC) Same as L_1 for 21 MC; use 0.001-mfd each for C_2 and C_3.
2.3 MC MARS Band -- (Osc. grid on 1.15 MC) 3.5 uh, 17 turns, No. 20 enameled wire.
3.3 MC MARS Band -- (Osc. grid on 1.65 MC) 2.5 uh, 15 turns, No. 20 enameled wire.

L_{2A}, L_{2B}-- Interstage coupling circuit, double tuned.
1.8 MC Band -- 17 uh, 40 turns, No. 26 enameled wire.
2.3 MC MARS Band -- 13 uh, 35 turns, No. 24 enameled wire.
3.3 MC MARS Band -- 9.5 uh, 30 turns, No. 24 enameled wire.

L_2-----Interstage coupling circuit, single tuned.
21 MC Band -- 1.4 uh, 12 turns, No. 18 enameled wire.
28 MC Band -- 1.0 uh, 9 turns, No. 18 enameled wire.

L_5-----AMPLIFIER PLATE COIL
1.8 MC Band -- 15 uh, 32 turns, No. 18 wire, 1 1/2 inches in diameter, 3 1/4 inches long, 10 turns per inch (air dux No. 1210)
21 MC Band -- 1.2 uh, 7 turns, No. 14 wire, 1 1/2 inches in diameter, 1 3/4 inches long, 4 turns per inch (air-dux No. 1204)
28 MC Band -- 0.8 uh, 5 turns, No. 14 wire, 1 1/2 inches in diameter, 1 1/4 inches long, 4 turns per inch (air-dux No. 1204)
2.3 MC MARS Band -- 11 uh, 28 turns, No. 16 wire, 1 1/2 inches in diameter, 3 1/2 inches long, 8 turns per inch (air-dux No. 1208)
3.3 MC MARS Band -- 7.6 uh, 21 turns, No. 16 wire, 1 1/2 inches in diameter, 2 5/8 inches long, 8 turns per inch (air-dux No. 1208)

L_6-----ANTENNA COUPLING COIL
1.8 MC Band -- 7 turns HV insulated wire on L_5
21 MC Band -- 2 turns HV insulated wire on L_5
28 MC Band -- 2 turns HV insulated wire on L_5
2.3 MC MARS Band -- 6 turns HV insulated wire on L_5
3.3 MC Mars Band -- 5 turns HV insulated wire on L_5

RFC_1-----VFO CATHODE CHOKE
1.8 MC Band -- 2.5 mh, 75 ma RF choke (National R-50)
21 MC Band -- 0.5 mh, 75 ma RF choke (National R-50)
28 MC Band -- 0.5 mh, 75 ma RF choke (National R-50)
2.3 MC MARS Band -- 2.5 mh, 75 ma RF choke (National R-50)
3.3 MC MARS Band -- 1.0 mh, 75 ma RF choke (National R-50)

RFC_2-----INTERSTAGE CHOKE
1.8 MC Band -- 1.0 mh, 75 ma RF choke (National R-50)
2.3 MC MARS Band -- 1.0 mh, 75 ma RF choke (National R-50)
3.3 MC MARS Band -- 1.0 mh, 75 ma RF choke (National R-50)

RFC_{2A}, RFC_{2B}
21 MC Band -- 100 uh, 50 ma RF choke (National R-33)
28 MC Band -- 21 uh, 1 amp. RF choke (Ohmite Z-28)

RFC_3-----AMPLIFIER PLATE RF CHOKE
1.8 MC Band -- 2.5 mh, 300 ma RF choke (National R-300)
2.3 MC MARS Band -- 2.5 mh, 300 ma RF choke (National R-300)
3.3 MC MARS Band -- 1.0 mh, 300 ma RF choke (National R-300)
21 MC Band -- 30 uh, 500 ma RF choke (Raypar RL-112)
28 MC Band -- 30 uh, 500 ma RF choke (Raypar RL-112)

The inductance values for L_1 and L_2 in the original transmitters were chosen so that the iron tuning slugs were about in the center of their adjustment range when each circuit was resonant at the center of each amateur band. This permits a tuning range of plus or minus 20 percent of the center frequency.

Thus, the parts values given for the 3.5-megacycle transmitter will cover the 4020 and 4025-kilocycle MARS frequencies; and the 7-megacycle values will cover the 7540-kilocycle MARS frequency. The 3.5 megacycle values also will cover the 3275, 3289 and 3347-kilocycle MARS frequencies, but we have included the extra data for these frequencies above for those amateurs who wish to build a specific transmitter for this range.

A bandswitching model of this transmitter to cover three or four amateur bands also has been developed since there has been considerable interest in a model of this type. Of course, this introduces many of the problems which we very nicely avoided by designing the rig for a single band! This model is being tested on the MARS channels as a four-band transmitter (2.3, 3.3, 4.02 and 7.54 MC).

The metal cabinet housing the 3.5-megacycle transmitter on the cover of the November-December, 1957 issue is the new "Prestige" line of cabinets produced by the Bud Radio Co. It is their Cat. No. C-1441, and is listed at a dealer net price of \$32.08. Of course, the less expensive "Deluxe" rack cabinet line may be utilized, such as the Bud Cat. No. CR-1741, for \$16.37. Both cabinets accommodate 8 3/4 inches of panel height.

A three-stage version of the single bander transmitter has been tested on the 21 and 28-megacycle bands. In it, an extra dual-purpose tube (6AU8 pentode-triode) has been added as a combined high-C oscillator--cathode follower isolating stage. The 6AG7 tube then operates as a frequency doubler to drive the final amplifier. A block diagram of this tube lineup is shown in Fig. 1 below. Better frequency stability under keying and plate modulation has resulted, as compared to the original two-stage lineup. However, the 3.5 and 7-megacycle models of the two-stage rig have excellent frequency stability under modulation.

This three-stage circuit also can be adapted to the lower frequency bands, by including the component values shown in the tabulation on page 3 of the January-February, 1958 issue; and, the additional information on components given on the preceding pages of the supplemental information for this transmitter. Coils L_7 and L_8 in the oscillator circuit are 0.5 mh. RF chokes.

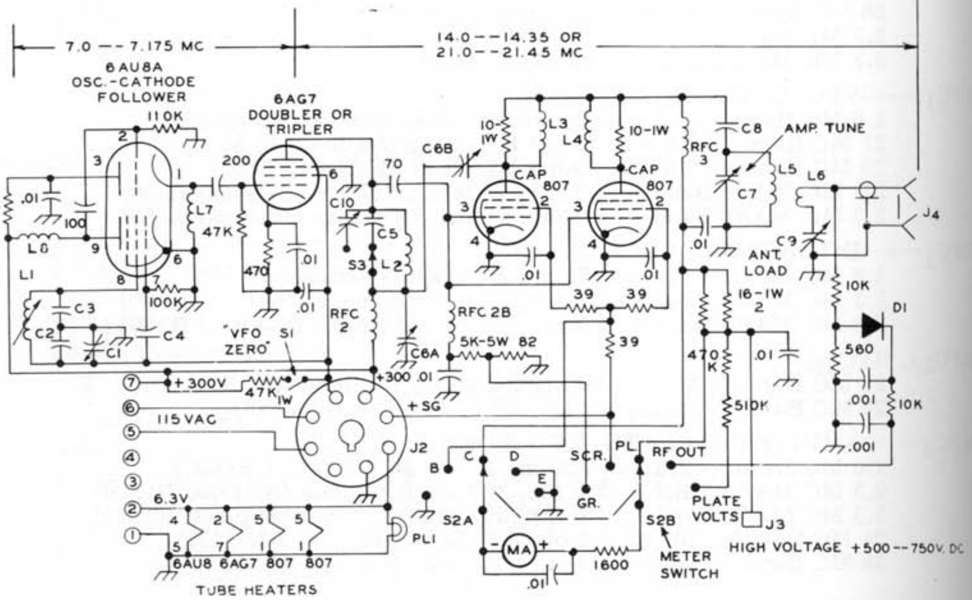


FIG. 1. SCHEMATIC DIAGRAM FOR A THREE–STAGE VERSION OF THE SINGLE BAND TRANSMITTER COVERING BOTH 14 AND 21 MEGACYCLES.

A different mechanical layout for these transmitters has been devised and checked with recently-constructed models. The drawing of Fig. 2 shows the sizes and positions of three chassis which form a complete transmitter: a 7 x 12 x 3-inch chassis at the right, with the 7-inch side toward the panel; a 5 x 13 x 3-inch chassis, with the 5-inch side toward the panel, for a plate modulator, or SSB generator unit; and another 5 x 13 x 3-inch chassis for a dual-voltage power supply unit.

The RF chassis running with the long dimension from front to back makes possible incorporation of a bandswitch to change the single band transmitter design into a multi-band transmitter. An experimental model of a bandswitching transmitter has been constructed and is pictured on the following pages. This model covers the 1.8, 3.5 to 4.0 and 7.0 to 7.3 megacycle bands. Note that the bandswitch flat shaft runs back through the chassis to switch the oscillator and multiplier/driver stages. Then, it turns a pair of miter gears to transmit the bandswitch motion up through the chassis to the switch wafer which changes coils in the amplifier plate circuit. This transmitter is still being tested. More advanced models will be constructed from the information gained from this preliminary model, and published in G-E HAM NEWS during 1962.

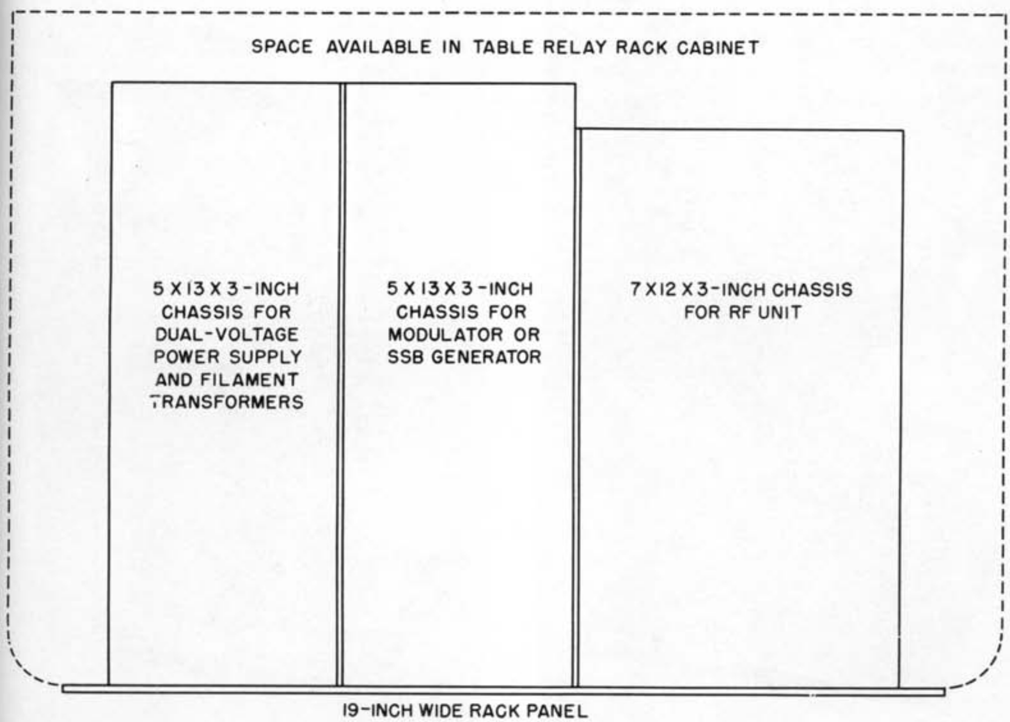
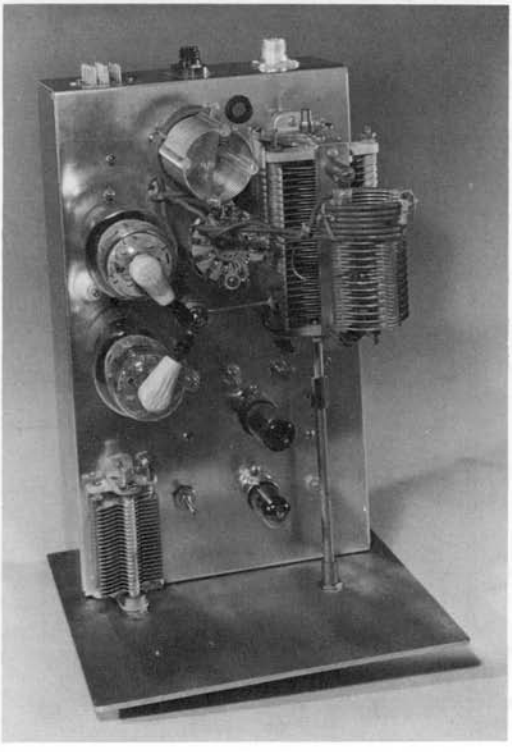


FIG. 2. CHASSIS LAYOUT DIAGRAM OF A UNITIZED TRANSMITTER RF UNIT, MODULATOR AND POWER SUPPLY WITH THE BASIC SINGLE BAND TRANSMITTER DESIGN.

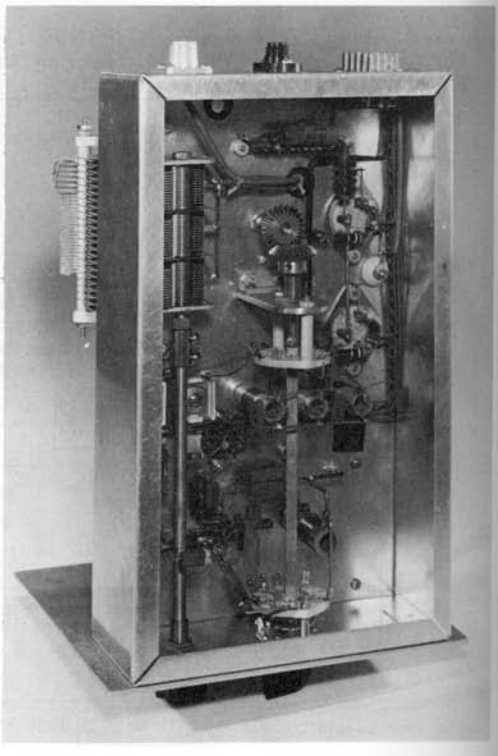
This transmitter uses a Centralab type P-123 tap switch index assembly, plus Centralab type "R-R" 5-position, 2-pole ceramic switch wafers. Other types of Centralab tap switch wafers may be assembled on the same shaft to provide other switching functions. The miter gears are Boston Gear Works No. G-464, about 1 inch in diameter, with a 1/4-inch diameter shaft hole. The gears are mounted on shaft-and-panel bushing assemblies (Bud PS-530, or E. F. Johnson 115-256-2), with one running down through the chassis, and the horizontal shaft mounted on an aluminum angle bracket. Construction details can be obtained from these pictures.

Development work is also progressing on a companion modulator, and power supply, both constructed on 5 x 13 x 3-inch chassis, as described in Fig. 2. Final details on these units will be published in 1962.

Just the 807 amplifier stage in these transmitters can be constructed and used as a power-boosting stage to follow the DX-20, DX-35, DX-40 and other similar transmitters in the 30 to 75-watt power class. For 3.5, 7 and 14 megacycles, a third 807 tube can be added in parallel with the two 807's in parallel, thus providing a power input capability of 200 to 225 watts input for class C CW operation at ICAS ratings. Since the above transmitters are generally designed to work into loads of 50 to 300 ohms, a 300-ohm, 25-watt non-inductive resistor can be used in the 807 control grids, in place of the tuned grid circuit, L_2 or L_{2B}. This provides adequate load for the driving transmitter, and simplifies the circuitry of the 807 stage. The circuit for ths change is shown in Fig. 3 on the next page.



TOP VIEW OF THE EXPERIMENTAL BAND-SWITCHING TRANSMITTER MODEL.



BOTTOM VIEW OF THE BANDSWITCHING MODEL.

There was an error in the schematic diagram, Fig. 1-A, on page 6, showing the typical Clapp circuit for oscillators. There should be NO DOT at the lower end of the grid resistor where the line running down to the chassis connection crosses the horizontal line running from the 0.001-mfd capacitors to the RF choke. This extra dot makes the circuit appear as though the RF choke is shorted out. The circuit is shown correctly below.

The RF voltage indicator circuit connected to the RF output jack, J_4, provides only a relative indication of RF voltage useful for tuning for maximum output, since this RF voltage will change for a change in the standing wave ratio. It will not provide an actual indication of RF watts output except when the transmitter is operated into a non-inductive 50-ohm load, and an RF voltmeter of known calibration is used to establish RF voltage reference points on the scale of the 0--1-ma indicating meter, and then converted to power in watts across the 50-ohm load.

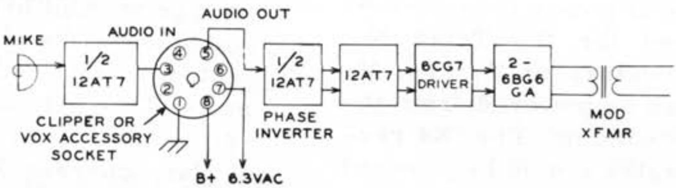
However, this indicating device, with the ratio between the two resistors from the coaxial cable to ground adjusted to suit the amount of RF voltage and the standing wave ratio present, will serve as a useful tuneup meter for transmitters of 5 watts output and up.

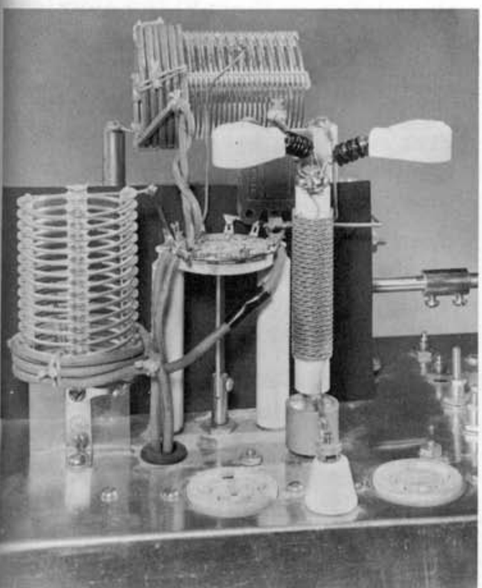
JANUARY-FEBRUARY, 1958 (Vol. 13, No. 1) ISSUE--

MORE ABOUT 150-WATT SINGLE BANDERS--

COMMENTS--

1. The air-dux No. 1206 coil in the PARTS LIST table on page 3, the 7-megacycle plate coil, L_5, for the 807 stage, actually has No. 14 wire, and not No. 16 wire, as was given in this table.
2. The Keyer-modulator unit shown in the picture on page 1 is still being developed. A block diagram of the tentative tube line-up is shown below. Details will be published in 1962.





DETAIL VIEW OF AMPLIFIER PLATE BAND-SWITCH.

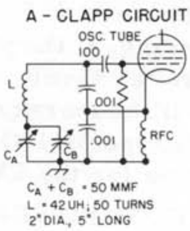


FIG. 1—A. REVISED SCHEMATIC DIAGRAM OF THE CLAPP OSCILLATOR CIRCUIT, ORIGINALLY PUBLISHED ON PAGE 6 OF THE NOVEMBER—DECEMBER, 1957 ISSUE.

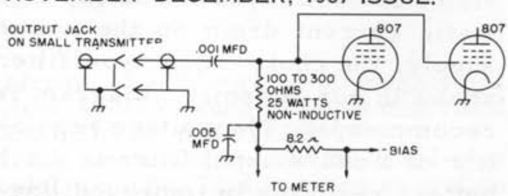


FIG. 3. SUGGESTED SCHEMATIC DIAGRAM OF THE 807 AMPLIFIER GRID CIRCUIT WHEN THIS STAGE IS DRIVEN FROM SMALL 25 TO 75—WATT TRANSMITTERS.

MARCH-APRIL, 1958 (Vol. 13, No. 2) ISSUE--

DOUBLE SIDEBAND JUNIOR--A 20-watt DSB Transmitter for 3.8-4.0 Megacycles

COMMENTS--

The following suggestions have been compiled to aid those persons who may wish to place the Double Sideband Junior transmitter on other bands, connect a VFO to it; or for those who require trouble-shooting information:

1. HEATER CIRCUIT -- The three separate 6.3-volt AC heater windings shown in the schematic diagram, Figure 1, on page 2, happened to be on the power transformer (T_1) actually used on the model transmitter. Of course, if another type of power transformer is substituted for the Triad No. R-70A, the heaters of V_1, V_2, V_3 and V_4 all can be powered from the same heater winding. The 6X4 rectifier tube heater should be powered from a separate 6.3-volt transformer winding. If the power transformer has a 5-volt winding, it probably will be more convenient to substitute a type 5U4-GB full-wave rectifier tube for the 6X4.

2. HIGH VOLTAGE POWER--Although a capacitor-input type filter may be used on the high voltage supply if a fairly low resistance bleeder resistor is used to place a fairly high static current drain on the power supply, the choke-input type filter shown in our schematic diagram is recommended. The voltage regulation of a choke-input filter is much better, resulting in improved linearity in the balance modulator stage.

3. 6AQ5 PLATE VOLTAGE -- The power output from the 6AQ5 balanced modulator stage will drop rapidly as the plate voltage is reduced below 400 volts. Actually, the DSB Jr., will deliver about 35 percent more power output with 500 volts on the plates, than with 400 volts. We cautioned users of this circuit against running more than 400 volts on the 6AQ5's in G-E HAM NEWS, but the tubes will easily handle 500 volts in DSB service. However, we have not tested the 6AQ5 stage at higher voltages -- say 600 volts-- even though they may withstand this voltage without breaking down. The combined plate dissipation of two pentode-connected 6AQ5's is 24 watts. This indicates that the tubes will handle up to 60 milliamperes of plate current with 400 volts on the plates without being overloaded, even though the tubes may not be delivering any RF output power, which might happen with the plate tank circuit tuned far off resonance. The higher-than-normal plate voltage rating follows the usual practice of operating tubes in a DSB balanced modulator at double the plate voltage rating for class C plate modulated RF amplifier service.

4. DUMMY LOADS -- The usual 50-ohm non-inductive resistors, or a 15 or 25-watt, 115-volt lamp bulb will provide a suitable dummy load resistance for the DSB Jr. With 400 volts on the 6AQ5's, a 15-watt lamp should light to nearly full brilliancy before non-linearity occurs in the 6AQ5 stage, especially when several

db of clipping is being employed in the audio circuit. A 25-watt lamp should show about 2/3 of normal brilliancy (about what it would show with 80 volts AC applied to it).

OUTPUT TANK CIRCUIT -- The 6AQ5 plate tank circuit, C_1--L_2, should tune to resonance at 3.8 megacycles with C_1 near maximum capacitance. If it will not tune this low in frequency, add a small padding capacitor -- a 10 mmf, 2000-volt working mica is suitable-- across the ends of L_2 on the plug-in coil base. This tank circuit should tune to the 7-megacycle band with C_1 set near 45 degrees of rotation from minimum capacitance.

OPERATING DSB JR. FROM A VFO -- It was possible to feed the output from a Heathkit VFO directly into the crystal socket of the DSB Jr., on the 3.8 megacycle band, with good results. The connection may be made with a short length of RG-58/U coaxial cable. The triode oscillator circuit, acting as a buffer stage, did not go into oscillation. However, instability in this stage may be encountered with other types of VFO's. Make sure that the outer shield on the coaxial cable connects to the grounded terminal on the crystal socket.

OPERATION DSB, JR. ON OTHER BANDS -- The following coil table has been compiled (using our trusty Lightning Calculator) as a suggested means of operating DSB Jr. on higher frequencies than the 3.8 megacycle band for which it was designed. The recommended crystal frequencies should be used for each band:

7-MC BAND --
- Crystal--7.204 to 7.296 megacycles. (In United States).
- L_1--8.5 uh; 40 turns, No. 28 enameled wire, closewound 5/8 of an inch long on a 3/8-inch diameter CTC LS-3 iron slug-tuned coil form.
- L_2--16 uh; B & W type JVL-40 manufactured coil.

14-MC BAND --
- Crystal--14.204 to 14.296 megacycles.
- L_1--3.7 uh; 27 turns, No. 28 enameled wire, closewound 3/8 of an inch long on an LS-3 form.
- L_2--2.2 uh; B & W JVL-15 coil.

21-MC BAND --
- Crystal--21.254 to 21.446 megacycles.
- L_1--2.2 uh; 18 turns, No. 24 enameled wire, closewound 3/8 of an inch long on an LS-3 form.
- L_2--2.2 uh; B & W JVL-15 coil.

28-MC BAND --
- Crystal--28.504 to 29.696 megacycles.
- L_1--1.2 uh; 10 turns, No. 24 enameled wire, closewound 5/16 of an inch long on an LS-3 form.
- L_2--1.2 uh; B & W JVL-10 coil.

The DSB, Jr. 6AQ5 balanced modulator circuit should work on 50 megacycles when driven by a small crystal controlled exciter, such as those described in the May-June, 1958 issue, under "PACKAGED VHF EXCITERS".
About plus 10 volts should be measured at the junction of C_5 and the 1,500-ohm resistor in the cathode of the 12BH7A modulator tube. This supplies excitation voltage for a carbon microphone, and may drop to about plus 5 volts with a microphone plugged into J_3.

K2GZT'S 6146 DOUBLE SIDEBAND TRANSMITTER

There have been many requests received from radio amateurs for information on the 7-megacycle DSB transmitter using a pair of 6146's, as mentioned on page 8 of the March-April, 1958 issue of G-E HAM NEWS. The schematic diagram below shows the balanced modulator circuit he is using, with the major component values marked thereon. The operating conditions for the 6146 tubes are listed below. Note that the plate voltage--1200 volts--is much higher than the usual maximum rating, but is in line with the usual practice in a DSB balanced modulator of operating the tubes at a DC plate voltage twice the recommended plate voltage for plate-modulated class C amplifier service. Thus, the 1200-volt value is equal to the positive peak modulating voltage.

AUDIO MODULATOR CIRCUIT--A two-stage modulator circuit is shown in Fig. 1. Inverse feedback voltage from the plates of the 12BH7 push-pull output stage is fed into the cathodes of the 12AT7 driver stage to reduce audio distortion. The 12AT7 should be preceded by a phase-splitter stage having about 1 volt peak-to-peak output. Audio clipping and low-pass filtering, as shown in the original DOUBLE SIDEBAND JUNIOR circuit, may be used for increased average power output from the 6146 balanced modulator.

MECHANICAL LAYOUT, 6146 DSB BALANCED MODULATOR--The usual practice of short leads in the RF circuitry should be followed during construction of the modulator stage. The final amplifier layout for any of the popular 100-watt class transmitters (DX-100, Valiant, etc.) may be used as a guide for this circuit.

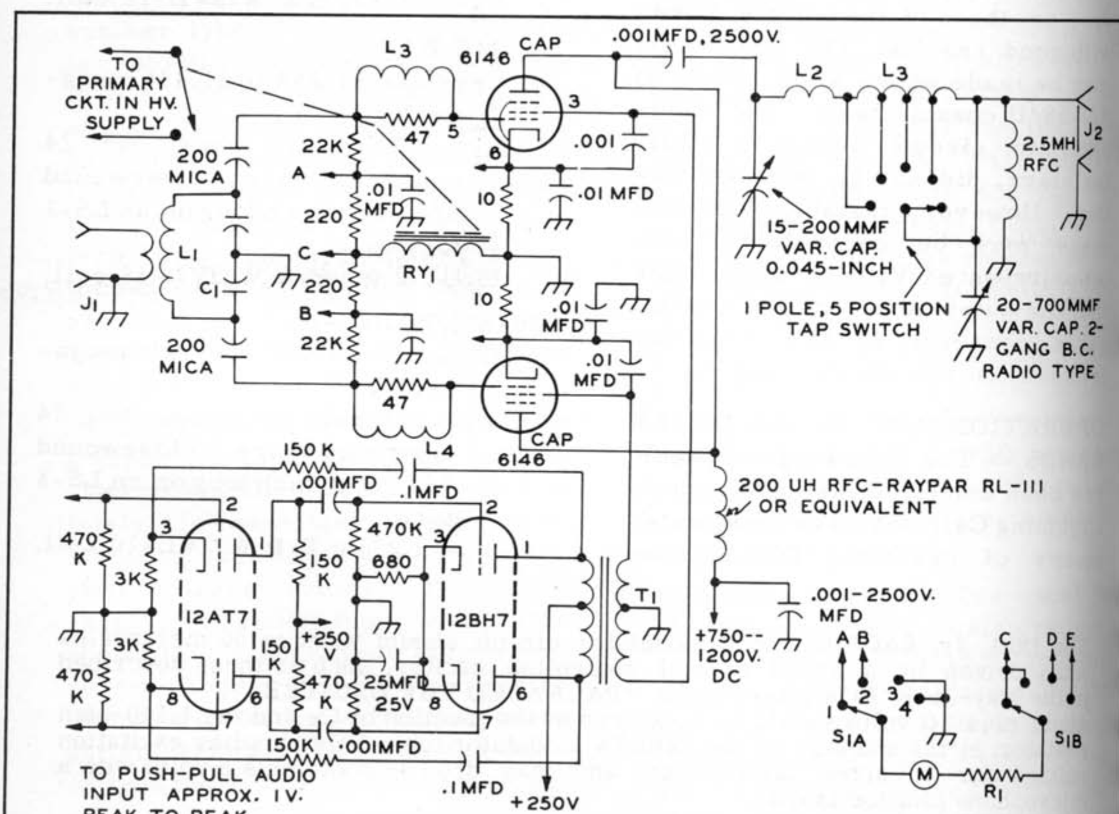


TABLE I — PARTS LIST

-------10--100-mmf per section, two-section receiving type variable.

J_2 ----chassis type coaxial cable connectors.

L_4----VHF parasitic suppressors; 6 turns, No. 16 enameled space wound on 1/4-inch diameter, 47-ohm, 2-watt resistors.

-------low-range milliameter, see TABLE I.

-------Value depends upon full-scale current rating of meter, see TABLE I.

-------SPST relay with 3-ma DC coil.

-------two-pole, four position tap switch.

-------audio driver transformer, turns ratio 5.2 to 1, primary to 1/2 secondary (Thordarson No. 20D79); connect primary as secondary, and secondary as primary.

TABLE II — COIL TABLE

AND	L_1	L_2
MC:	B & W MCL-80 coil:	L_2---6.5 uh, 18 turns, No. 16 wire, spacewound 8 turns per inch, 2 1/4 inches long, 1 1/2 inches in diameter.
MC:	B & W MCL-40 coil:	L_2---3.2 uh, 13 turns, No. 16 wire, spacewound 6 turns per inch, 2 1/6 inches long, 1 1/2 inches in diameter.
MC:	B & W MCL-15 coil:	L_2---1.6 uh, 9 turns, No. 14 wire, spacewound 4 turns per inch, 2 1/4 inches long, 1 1/2 inches in diameter.
MC:	B & W MCL-15 coil:	L_2---1.08 uh, 7 turns, No. 14 wire, spacewound 4 turns per inch, 1 3/4 inches long, 1 1/2 inches in diameter.

TABLE III — METER RANGES

TER RANGE	R_1	FULL SCALE READINGS	
		GRID	CATHODE
0--1 ma.	1000 ohms	4.5 ma.	100 ma.
0--1 ma.	470 ohms	2.2 ma.	50 ma.

TABLE IV — 6146 OPERATING CONDITIONS — DSB MODULATOR

Plate Voltage	1200 volts
Screen Voltage	0 volts
Control Grid Bias	0 volts
Plate Current (no audio signal on screens)	25 milliamperes
Plate Current (maximum for good linearity)	100 milliamperes
ak Envelope Power Input	170 watts
ak Envelope Power Output	125 watts

(Continued on Page S-38)

DSB Considerations and Data

The trend by more and more amateurs to suppressed carrier phone communications is one of the greatest things that has ever happened to amateur radio. It is really a pleasure to operate in the segments of the bands which the sidebanders have pretty well taken over.

DSB offers a very easy way for anyone to try out suppressed carrier operation and it is hoped that this discussion will encourage more of you to try it. Let us not get off into any AM versus SSB versus DSB arguments—those arguments are for the professionals and the average amateur should steer clear.

Several DSB articles have appeared in recent issues of CQ showing the basic tetrode balanced modulator circuits used to suppress the carrier. These circuits may have either of two configurations:

1. Push-pull grids with parallel plates, or
2. Parallel grids with push-pull plates.

In either case, the screens are modulated with push-pull audio. Generally, the first configuration will be the best one to use since the push-pull components will be small and a pi-tank can be used in the output, the advantages of which are well known.

Hi-Level vs Linear

There are two approaches to medium or high power DSB. One is to make your final a high power balanced modulator. The other would be a low-power balanced modulator driving a linear amplifier. Unless you already have a *linear* amplifier (and know how to keep it linear) the high level approach is definitely recommended. If you do use a linear, don't forget that a single audio tone to the DSB exciter is a two-tone signal into the linear amplifier!

Most CW exciters have plenty of output to drive even the big tetrodes in a DSB final. Anyone with a two tube final (either push-pull or parallel) will only have to modify one RF circuit and split the screen grids to put the final on DSB.

Most any tetrodes may be used in the balanced modulator circuit and a tabulation of the recommended variables for the more common tubes is presented later. The general considerations of how to operate different tubes are best discussed one circuit at a time.

Grid Circuit

Each tube should definitely have its own grid bias resistor. Attempts at using a common bias resistor have resulted in aggravating any off-balance tendencies the tubes may have. The grid circuits should be operated as for normal class C Plate Modulated operation. The normal bias resistors for class C are used. The grid current is run up to normal values. It has considerable effect upon the resting plate current.

Bias may be partially from a battery, but should not be all battery bias. Partial battery bias will be found very handy if you want to include voice control operation.

Screen Circuit

The dc bias applied to the screens through the modulation transformer secondary has two effects. Most important is its effect upon the bow tie pattern crossover point. Just enough negative bias should be used to give a clean crossover and limit the resting plate current. Any further negative voltage will cause the two halves of the pattern to separate apart indicating distortion. The screen bias is necessary on some tubes to hold down the resting plate dissipation requirements. The bias battery or supply should have good regulation and should be by-passed heavily with several microfarads of capacitance. The smaller tubes (807's, 6146, etc.) work nicely with zero screen bias.

The screens must be by-passed for rf but not for audio, so the by-pass condensers should not be larger than .001 mfd and should be mica. The audio swing of the screens determines the amount of plate current the tubes can draw. As a conservative estimate of how much audio voltage you will need, take the normal plate modulated screen voltage and double it. Your audio *peaks* should hit this value (from center tap of mod. xfmr to screen) If you really want to run to full tube capability, you can check by heavily loading the final and running up the audio voltage till the RF no longer increases with increasing audio. At this point you are flattening on peaks because of emission limitation. Exceeding that audio voltage will only cause distortion. This maximum screen swing will be the same for a given tube type regradless of what plate voltage you run.

The screen modulator needs relatively small power output, but to modulate the larger tubes, voltage swings of about 800 volts peak are required. This is best accomplished with a step-up transformer. A pair of 6L6's in Class AB1 will modulate most any tubes, but step-up transformers with push-pull primary and secondary are a scarce commodity. The best solution available now seems to be to use a 10 or 20 watt class B driver transformer of 5:1 (pri to ½ sec) step down ratio. Using it backward will give you 1:1.25 primary to one-half secondary.

Before long perhaps the transformer manufacturers will make available more suitable transformers.

Another possibility is to use a single 6L6 into the 117 volt winding of a small power transformer. This will give you roughly a 1:3 step up to half of the HV winding and works quite well.

Clipper-filter

While talking about modulators, it should be pointed out that speech clipping can be used to good advantage in DSB and is a very worthwhile feature to put in the speech amplifier. Clipping will give you a big boost in average talk power. Just remember to reduce low frequency response before the clipper-filter, and preserve both lows and highs after the clipper-filter.

Plate Circuit

As previously mentioned, the plate current of the DSB stage is pretty well determined by the audio swing on the screens. The way to more power then is obviously higher plate voltage. Bearing in mind that on normal AM the plate voltage swings up to twice the dc plate voltage, you can use up to twice the AM plate voltage on your DSB stage, and up to that value, the higher the better. Any given tube will work satisfactorily at its normal plate voltage, but it's a similar situation to linear amplifiers, if you really want to sock them, you must run up the plate and screen voltages.

This means that you have the following choices based on voltages available:

400-600 volts	6L6's, 2E26's, 6V6's, 6Y6's
600-1200 volts	807's, 1625's, 6146's
1200-1600 volts	?
1600-3000 volts	813's
2000-4000 volts	4-125A's, 4-250A's

Paralleling tubes on each side of the balanced modulator offers a powerful little package (four 807's give 300 watts p.e.p. *output*), but the paralleled output capacitances may make it difficult to get above 20 meters with four tubes.

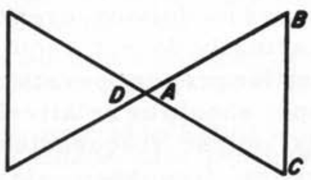
Since the plate current swing depends largely on the screen voltage swing, the best way to tune the DSB stage is not by plate current dip but by tuning for maximum output. With the tank circuit resonated, increase your loading to the maximum output point and stop. That's all there is to it. Some tank circuit conditions will cause greater plate current readings but reduced output.

The plate current meter, of course, does not read peak plate current, so if you want to figure your peak envelope power you must apply a factor. For sine wave modulation, the meter reading should be multiplied by 1.58 (1/.636). This figure and your plate voltage will give you peak envelope power input; you multiply by about 75% efficiency to get your peak envelope power output. If you are running relatively high plate voltage on your tubes you can estimate your peak output as four times the carrier output rating for AM phone service. This is conservative estimating, however, since with the low duty cycle of speech you can get a little better than this before distortion sets in from emission limiting or instantaneous downward plate voltage hits the screen voltage level.

Half of your peak power appears in each sideband which means a 3db disadvantage compared to SSB. The ability to select the best sideband at the receiving end buys some of this back, and clipping buys even more.

Checking Patterns

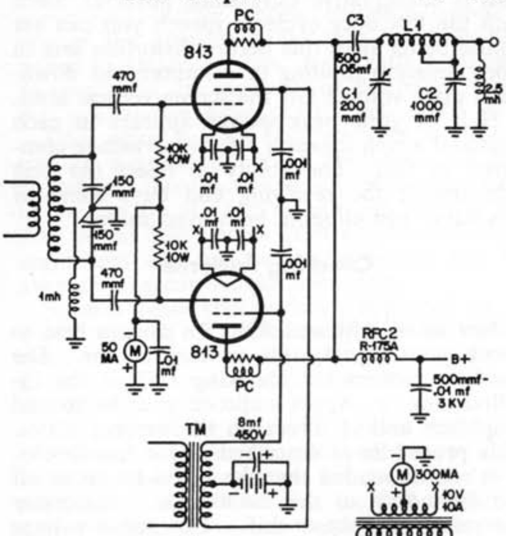
Just as in AM and SSB, it's always best to check your signal with an oscilloscope. The handiest pattern for checking DSB is the familiar bow tie. Apply audio on your horizontal amplifiers and rf direct on the vertical plates. This procedure is described in the handbooks. It is recommended that the audio be taken off the secondary of the modulation transformer for minimum phase shift. The audio voltage here will be way too much for your scope input though, so rig yourself a voltage divider of 1 megohm in series with a 10K resistor and pick audio off across the smaller resistor. Your bow tie should look like *fig. 1*.



Line AB and AC should be nice and straight. The A end of these lines has a tendency to bulge slightly with too much grid drive and may become concave with too little drive, so experiment here. If you have negative bias on the screens, there will probably be a little kink near A where the screen goes through zero, but this does not cause bad distortion. Peaks at B and C should be nice and sharp. If they are rounded you are flattening and probably due to overdriving the screens. If points A and D are separated so the points don't meet, you have too much negative bias on the screens. With high plate voltage you will find it easier to get a good bow-tie pattern. If your tubes are not balanced, one half of the pattern will rise higher on peaks than the other side. One half of the pattern represents each tube, but has no relationship to the upper and lower sideband. The side-bands will be identical in any case.

The bow-tie pattern won't show up audio distortion so you will find it interesting to

	6V6	6BQ6/ 6DQ6	807/ 1625	6146	813	813	813	4-250A
Plate Volts	500	600	1250	1000	1500	2000	2600	4000
Screen Volts	0	0	0	0	–22.5	–67.5	–90	–65
Plate Current Resting	10	25	30	25	100	55	60	80
Plate Current Full Whistle	50	150	100	125	205	245	265	300
PEP Output	30	100	150	150	380	600	840	1500



shift to an rf envelope pattern by switching to internal sweep on your horizontal axis. By using a steady audio note you can synchronize and see how well your audio is doing.

If you have established the proper conditions you will have a good bow-tie shape and you will be pleased to note that the tuning controls don't affect the shape much. If you detune anything, about all that happens is you get less than maximum output.

Fig. 2 is a complete circuit diagram for 813's. Exactly the same circuit is applicable for all tetrodes—you can use lower voltage components for smaller tubes of course.

Table 1 shows DSB operating conditions for some of the more common tubes. Don't worry if you don't have the exact voltages called for, these are the ones tried by W2CRR, W2HNH, W2SBI, and K2KID. Pick out the tubes you want and have a go at DSB. You'll like it!

OPERATIONAL NOTES (Cont'd. from Page S-35)

EXCITER FOR 6146 DSB MODULATOR -- Approximately 4 to 5 watts of driving power should be available for the balanced modulator, even though the 6146's actually do not require all of this power for proper operation. The exciter output should be relatively free of spurious output frequencies, and have excellent frequency stability. Preferably, any variable frequency oscillator used with the DSB modulator should have not more than 1-kilocycle of warmup drift during the first few minutes of operation, and should be capable of staying within 50 cycles of the desired operating frequency after the initial warmup.

AUTHOR OF DSB JR. ARTICLE

MEET THE DESIGNER—John K. Webb, K2GZT, took a busman's holiday from his profession as electrical design engineer on synchronous and other communications systems at our Light Military Electronic Equipment Department in Utica, New York. Result—the DOUBLE SIDEBAND JUNIOR transmitter in this issue!

Some measure of Jack's enthusiasm for double sideband can be garnered from his many presentations on this subject at trade shows, amateur radio conventions, hamfests, and club meetings. Of course, this little transmitter usually accompanies him as his favorite "conversation piece."

First licensed as WφAHM in Kansas during 1947, Jack's association with electronics includes AM broadcasting and the U.S. Army Signal Corps, before joining General Electric. Although he has tried 'em all—CW, FM, AM and SSB—Jack can now be found on 14-megacycle phone pushing a pair of GL-6146's in a—you guessed it—double sideband rig!

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[5] Harris, D. S., "DSB Considerations and Data," CQ, October, 1957.

[6] Webb, J. K., "Modulating the DSB Transmitter," CQ, March, 1958.

Eaton, R. C., "Two Sidebands for Less than the Price of One," CQ, September, 1957.

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MAY-JUNE, 1958 (Vol. 13, No. 3) ISSUE--

PACKAGED VHF EXCITERS--

COMMENTS--

This section has been prepared to answer the many requests for additional information on these exciters, and the dual exciter model constructed by the author, K2DBS, as a test model.

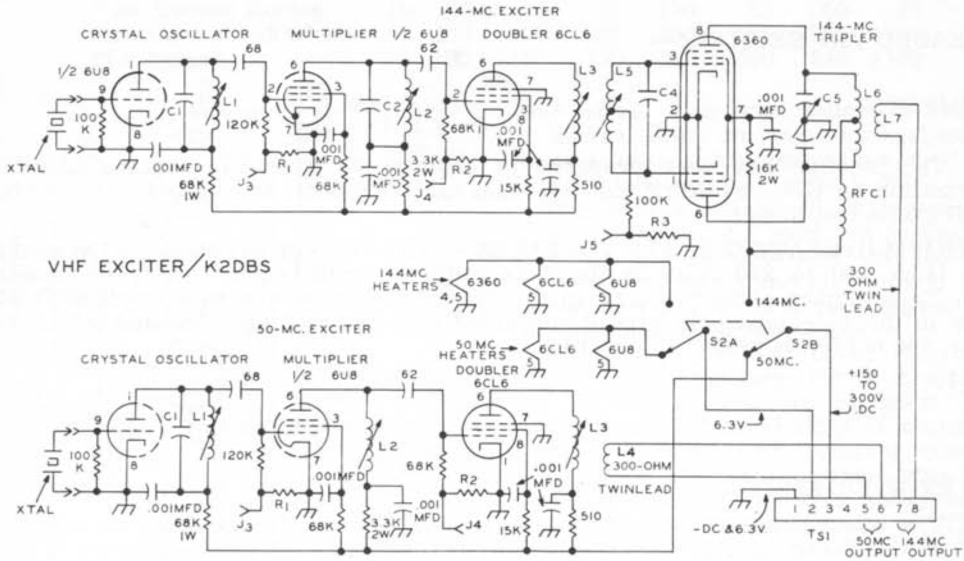
MAXIMUM OPERATING PLATE VOLTAGES -- The exciters were designed to operate with from 150 to 250 volts on the plate voltage terminals (pin 7 on J_1, or terminal 3 on TS_1). Higher plate voltage--up to 350 volts--can be applied to the 6360 tripler stage in the 144-megacycle circuit, provided that this voltage is applied only to that stage, and not to the rest of the exciter.

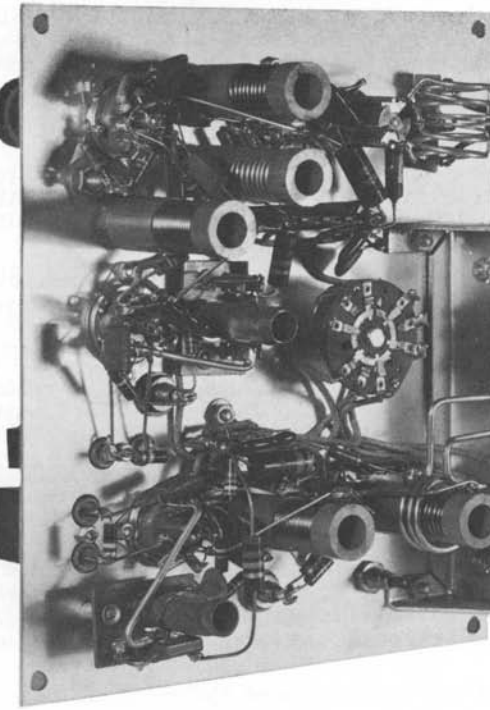
VHF EXCITER/K2DBS --

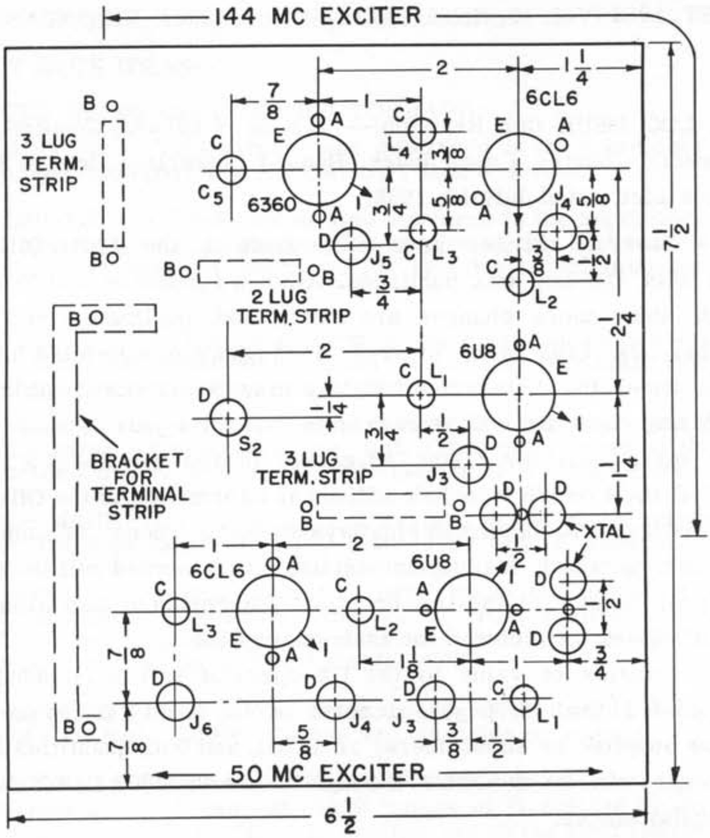
1. The exact schematic diagram used for K2DBS' exciter is shown on page S-40 of this bulletin. The nomenclature for all parts is the same as shown in Figs. 2, 3, and 4 and the PARTS LIST and COIL TABLE, on page 3 of the May-June, 1958 issue of G-E HAM NEWS. An 8-terminal barrier type terminal strip was substituted for J_1 of the packaged exciters. The 50 and 144-megacycle r.f. outputs are connected to terminals 5 and 6, and 7 and 8, respectively. Metering is accomplished by providing insulated phone tip jacks into which the meter leads may be plugged.
2. The chassis layout diagram is shown on page 40 of this bulletin. All hole sizes are the same as those shown in the DRILLING LEGEND on page S-41 of this issue. The terminal strip was mounted on a specially made bracket in K2DBS' exciter, but can be fastened to a pair of small angle brackets.
3. Shielding and filtering of this type of exciter can be accomplished in the usual manner with perforated sheet aluminum forming a box around the circuits both above and below the plate.
4. Since a bottom view photo of the exciter constructed by K2DBS is available, it is printed on the following page of this bulletin. Also, a picture showing the exciter and a Millen type 90811 VHF power amplifier with a GL-829-B twin pentode in it is shown on the following pages.
5. K2DBS recommends the following operating conditions for the combination of the 6360 driver, and GL-829-B amplifier on 144 megacycles:

	6360 Driver	GL-829-B Amplifier
Plate Voltage-CW	260 Volts DC	500 to 750 Volts DC
Plate Voltage-AM	220 Volts DC	450 to 600 Volts DC
Plate Current-Ma.	50 Ma.	220 Ma.
Grid Current-Ma.	2 Ma.	12 Ma.
Screen Current-Ma.	4 Ma.	30 Ma.
Screen Voltage	175 Volts DC	200 Volts DC

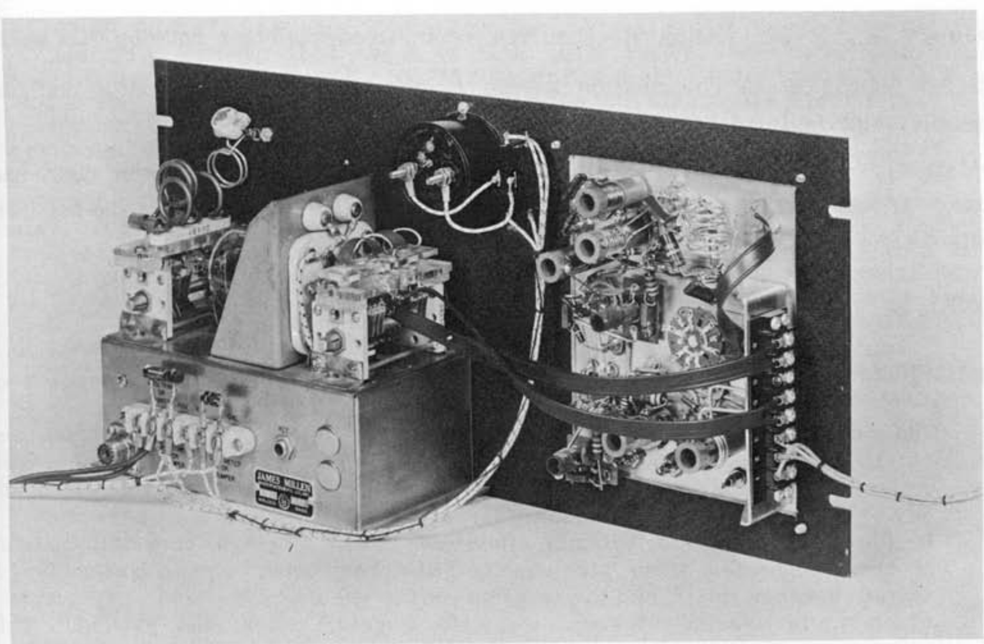
6. A smaller tube than the 6CL6--a 6AH6, 6DB6, 6BC5, or 6AU6A pentodes--can be used in the frequency multiplier stages of the exciter if less power output is required to drive the amplifier stage following the exciter. These smaller tubes will have sufficient output at 50 megacycles to drive a 5763, 2E26, or even a 6146 beam pentode, if the latter is not run near maximum ratings.
7. These exciters are not recommended for operation as modulated output stages since modulation of doubler and tripler stages does not result in as clean a signal as when a straight amplifier stage is modulated.


144-MC. EXCITER
CRYSTAL OSCILLATOR
MULTIPLIER 1/2 6U8
DOUBLER 6CL6
144-MC TRIPLER
1/2 6U8
XTAL
100 K
C1
L1
.001MFD
68K 1W
68
120K
R1
J3
.001 MFD
68K
62
C2
L2
3.3K 2W
.001 MFD
J4
68K
R2
15K
510
L3
6360
L5
C4
100K
R3
J5
.001 MFD
16K 2W
C5
L6
L7
RFC1
VHF EXCITER/K2DBS
144MC HEATERS
144MC.
300 OHM TWIN LEAD
50-MC. EXCITER
50 MC HEATERS
DOUBLER 6CL6
S2A
S2B
50MC.
+150 TO 300V DC
6.3V
L4 300-OHM TWINLEAD
-DC & 6.3V
TS1
50MC OUTPUT
144MC OUTPUT





144 MC EXCITER
2
1 1/4
7/8
1
6CL6
B
3 LUG TERM. STRIP
C
E
A
C
L4
3/8
E
A
C5
6360
3/4
5/8
A
J4
5/8
A
D
J5
C
L3
1
D
1/2
B
B
C
3/8
B
2 LUG TERM. STRIP
3/4
L2
2 1/4
B
6U8
A
2
C
L1
E
D
1 1/4
S2
3/4
1/2
D
A
BRACKET FOR TERMINAL STRIP
3 LUG TERM. STRIP
J3
1 1/4
D
D
B
B
XTAL
1
2
1/2
6CL6
A
6U8
D
C
C
A
1/2
L3
E
L2
E
A
D
A
7/8
1 1/8
1
3/4
D
D
D
C
J6
J4
J3
L1
B
7/8
5/8
3/8
1/2
50 MC EXCITER
6 1/2
7 1/2



JAMES MILLEN

JULY-AUGUST, 1958 (Vol. 13, No. 4) ISSUE--

SPECIAL DX LOG ISSUE (5th Revision)-- Listing of Official Countries, State Check List, Alphabetical Country Cross Index, Banned Countries, Deleted Countries, and Continent Check List, dated July 15, 1958.

COMMENTS-- Several changes have been made in the ARRL Official Countries Listing since this DX Log was published. Also, a number of new "countries" have been included. Since more changes are anticipated, publication of a sixth revision of the SPECIAL DX LOG Issue of G-E HAM NEWS is scheduled for the Spring of 1962. By that time, the 'countries" listing may be stabilized sufficiently to make practical a DX Log issue that will remain up to date for a year or more.

Present plans call for taking advantage of the new 8-1/2 x 11-inch overall page size of G-E HAM NEWS to include additional information in the Official Countries listings. The listings will be turned sideways so that a "Zone" column can be added, and the columns in which logging information is recorded will be repeated twice. This will permit logging of the two principal catagories of operation--one for CW, and one for PHONE--to be included for each country listing.

Other information of value to the DX operator will be included. This special issue is scheduled for 16 pages, instead of the usual 8 pages per issue. Single copies will be supplied to subscribers, as usual, and bulk quantities for radio clubs and other groups will be available through more than 700 G-E Tube Distributors who handle regular issues.

SEPTEMBER-OCTOBER, 1958 (Vol. 13, No. 5) ISSUE--

GADGET RACK for station Accessories--a unitized plan for housing "Gadgets".

COMBO MONITOR--a combination keying monitor, modulation indicator and field strength meter.

COMMENTS--The resistor next to the 6E5 indicator tube in the lower right-hand corner of the Schematic diagram, Fig. 2, should be 2.2 megohms, and not "22" megohms, as marked.

CONEL MONITOR-- a combination Conelrad Monitor and WWV Receiver.

COMMENTS---There are two errors in the schematic diagram, Fig. 1, on page 6 of the original issue:

1. The connection from pin 5 on P_1 to the plate of the 6CX8 triode section, pin 3, should be connected instead to the top end of the 500,000-ohm potentiometer volume control. If connected as shown, the plate voltage of the 6CX8 appears on the headphone circuit.
2. In the WWV converter circuit--the lower 6BE6 tube--the crystal, instead of being connected from pin 1 on the 6BE6 to ground, should instead be connected between pin 1 and the junction of the 40 and 400-mmf. capacitors which run in series between the No. 2 grid, pin 6, and ground. This will not oscillate at all with the original connections.

NOVEMBER-DECEMBER, 1958 (Vol. 13, No. 6) ISSUE--

MORE GADGET RACK IDEAS--

OTHER DEVICES SHOWN IN COVER PHOTOGRAPH:

CONEL MONITOR -- This circuit was published in the September-October, 1958 issue which contained part 1 of the GADGET RACK series.

COMBO MONITOR -- This circuit also appeared in the September-October, 1958 issue. The photo shows a more complex version of this unit with built-in speaker. A publication date has not been set for this device and final details are not yet available.

VOX-O-MATIC -- This is a simple voice-controlled break-in relay circuit which can obtain an audio signal from the AUDIO PREAMP/LIMITER/PATCH, or any similar low-level audio circuit. (See below)

This VOX circuit has been since combined with a limiting type preamplifier and hybrid phone patch circuit into one unit. This unit, known as the OMNIVOX, is described in the January-February, 1961 issue of G-E HAM NEWS.

HAMSCOPE--MARK II - - This is a revised model of the original HAMSCOPE published in the September-October, 1956 issue of G-E HAM NEWS. It includes a bandswitching tuned circuit across the 'scope tube vertical plates and a linear horizontal sweep. Provision also has been made for obtaining the high voltage from a transmitter plate supply instead of from built-in 'scope supply. Final details are not yet available, but some information is contained in the section of the supplement covering the original HAMSCOPE.

HIGH-C BANDSWITCHING VFO: This unit is described in the MARCH-APRIL, 1959 issue of G-E HAM NEWS. Copies are available on request.

200-WATT DOUBLE SIDEBAND TRANSMITTER: This transmitter is described in the May-June and July-August, 1959 issues of G-E HAM NEWS. The circuitry and construction details for the r.f. section are in the first issue; and, constructional information on the main chassis -- containing the power supplies, control circuits and modulator -- is in the second issue.

PLUG-IN SIGNAL SLICER: This is the basic Signal Slicer circuit first described in the July-August, 1951 issue of G-E HAM NEWS, repackaged to fit into the space and socket into which the NBFM adapter fits in the HRO-60 receiver. A B & W Model 450 phase shift network is used and the unit obtains its power from the receiver. A bulletin giving additional information on the original Signal Slicer is available. No publication date has been set yet for the plug-in Signal Slicer.

DETAILS ON ORIGINAL SIGNAL SLICER: The original issue is no longer available, but has been reprinted in the G-E HAM NEWS SSB Package, a 220-page book containing all of the information that has been published in G-E HAM NEWS on single and double sideband, and related subjects. Copies are available for $1.50 from G-E Tube Distributors; or, the book may be ordered directly from the G-E HAM NEWS office in Owensboro, Kentucky. Send $1.50 remittance by check or money order with your order.

CIRCUIT FOR POWER SUPPLIES AND INTERCONNECTION SOCKETS:

The same circuit used for the table model gadget rack built-in power supply in the September-October, 1958 issue of G-E HAM NEWS can be used for this model. Or, modify it to suit the requirements of your own particular station. Transformer-less type power supplies with selenium or other semi-conductor rectifiers are not recommended, because of the shock hazard inherent in this type of circuit if the power line plug is inadvertently reversed.

CHANNEL SPOTTER MARKER GENERATOR:

The schematic diagram, Fig. 1, for this unit specifies a type 12AU7 harmonic generator, while the text of this article specifies a 12AT7 tube. The circuit values are designed for the 12AU7, but tests indicate that the 12AT7 tube will work in most cases, once the 2-megohm potentiometer is properly adjusted.

This 12AU7 circuit is a frequency divider, and not a multivibrator and is designed to pulse at a 20-kilocycle rate when synchronized with the 100-kilocycle crystal oscillator. The 2-megohm potentiometer adjusts the grid bias voltage of the 12AU7, so that the second section conducts only every fifth cycle of the 100-kilocycle oscillator.

The author originally had switch S_1 on the rear of the unit, and the frequency adjusting capacitor, C_1, on the front, as shown in the picture on page 1. However, for improved convenience, he later moved S_1 to the front panel in place of C_1, and moved C_1 to the rear chassis plate.

AUDIO PREAMPLIFIER/LIMITER/PATCH:

This circuit has since been superseded by an improved model audio limiting amplifier called OMNIVOX, and described in the January-February, 1961 (Vol 16, No. 1) issue. However, the following comments should be noted concerning the original limiting amplifier circuit in this issue.

1. Some persons have suggested that a 2,000-ohm resistor be connected from pin 1 on the 6AL5 limiting bias rectifier tube to ground. This helps stabilize the operation of the limiting amplifier, according to correspondents.

2. The jacks, J_5, J_6 and J_7, not identified in the parts list or description, were test points included by the author in his original model. Test points J_5 and J_6 can be used to measure (and balance) the plate voltages on the two 6BA6 limiter amplifier tubes. Jack J_7 is used to check the limiting bias developed at pin 7 of the 6AL5 twin diode.

3. The connections to P_1 can be obtained from the schematic diagram for the bus-bar system used in the gadget rack, Fig. 1, on page 3 of the September-October, 1958 issue.

4. The phone patch switch (S_1) should be labelled as follows: Position 1--OFF; Position 2--TWO-WAY PATCH; Position 3--ONE-WAY PATCH. The positions 2 and 3 were reversed in the description on page 6 of the original article.

5. The phone patch section does have 0.1-mfd. isolating capacitors built into it to prevent a DC circuit through the phone line input winding on T_1. These capacitors are necessary to avoid shunting the ringing circuit on the telephone line, and SHOULD NOT be left out.

6. The resistor from the connection running between J_7 and the grid pin 2 of the 12AX7 meter tube, marked "1 MEG", should be 100,000 ohms.

JANUARY-FEBRUARY, 1959 (Vol. 14, No. 1) ISSUE--

7077 R. F. AMPLIFIERS -- low noise preamplifiers for 144 and 432 megacycles.

COMMENTS -

The 7077 micro-miniature metal-ceramic receiving triode tubes shown in these r. f. amplifiers were the first of a family of metal-ceramic miniature and micro-miniature receiving tubes developed by the General Electric Receiving Tube Department. This "family" now has ten different types, in addition to General Electric's famous family of Lighthouse transmitting tubes.

Additional information on these tubes can be obtained from the G-E HAM NEWS office. A tube similar to the 7077, but with lug type connections suitable for printed circuit board mounting, or soldering directly into a circuit, also is available from G-E Industrial Tube distributors. Both tubes have a suggested user price of $25.00 each.

7077 R. F. AMPLIFIER for the 432-megacycle band--

1. There has been much interest in changing the i.f. output frequency of the 432-megacycle converter from the 26 to 30-megacycle range, to the low-band TV channels (2 to 6). This enables the converter to be used as a UHF converter for a TV receiver which picks up amateur TV signals in the 420 to 450-megacycle band. The IF output coil, L_5, (labelled L_4 on the schematic diagram, Fig. 1), should be reduced in inductance to tune the range from 54 to 72 megacycles. A coil made of about 6 turns of No. 16 tinned copper wire, 1/2-inch in diameter and 1/2-inch long, is substituted for the CTC coil specified for L_5. Turns on this self-supporting coil should be squeezed or stretched so that the pi-network output circuit of the converter will tune to the desired TV channel.
2. The chart below gives suggested frequencies for the crystal oscillator/frequency-multiplier, for converter output on channels 2, 3 and 4. The tuned circuits in the multiplier have sufficient tuning range to cover these frequencies, in addition to those shown for the 406-megacycle injection frequency:
3. The sketches and diagrams on the following two pages cover the crystal oscillator-multiplier unit mentioned in footnote 1 on page 5 of this issue.

OSCILLATOR-MULTIPLIER FREQUENCY CHART FOR TV CHANNELS

Amateur TV Signal Freq. (MC)	TV Receiver Channel No. (MC)	Converter Injection Freq. (MC) (6939 plate)	Doubler plate, Freq. (MC) (5763 plate)	Crystal Freq. (MC) (6AF4 Plate)
440--446	2 (54--60)	386	128.66	64.33
440--446	3 (60--66)	380	126.66	63.33
440--446	4 (66--72)	374	124.66	62.33

PARTS LIST -- COIL TABLE

406-MEGACYCLE LOCAL OSCILLATOR FOR 432-MEGACYCLE CONVERTER

C_1-- 2.6--25-mmf midget variable capacitor (Hammarlund MAPC--25; or Johnson Cat. No. 148-2).

C_2-- 2.3--15-mmf midget variable capacitor (Hammarlund MAPC-15; or Johnson Cat. No. 148-1).

C_3-- midget butterfly type split-stator variable capacitor, 2.7--10.8 mmf per section (Johnson Cat. No. 160-211).

C_4-- 0.5--5.0-mmf midget piston type trimmer capacitor.

J_1-- chassis type coaxial cable connector (BNC type).

L_1-- 2 turns, No. 16 tinned wire, 1/2 inch inner diameter, spacewound 3/16 of an inch long; mounted 1/8 of an inch from plate end of L_2.

L_2-- 5 turns, No. 16 tinned wire, 1/2 inch inner diameter, spacewound 1/2 of an inch long; mounted on terminals of C_1.

L_3-- 2 turns, No. 16 tinned wire, 1/2 inch inner diameter, spacewound 1/4 of an inch long; mounted on terminals of C_2.

L_4-- 6 turns, No. 16 tinned wire, 1/2 inch inner diameter, spacewound 3/4 of an inch long; and centertapped, mounted on pins 2 and 3 of the 6939 tube socket.

L_5-- 1/4-wavelength linear tuned circuit, made from .010- inch thick sheet copper, 1/2-inch wide and 4 3/4 inches long; see Fig. 3 for fabrication details, and Fig 2 for assembly details.

L_6-- coupling loop for L_5, made from 0.030-inch thick sheet copper, 1/4 of an inch wide and 2 3/8 inches long; see Fig. 4 for fabrication details, and Fig. 2 for assembly details.

RFC_1- 1.8-uh r.f. choke, single layer of wire on 1/4-inch diameter form (Ohmite Z-144).

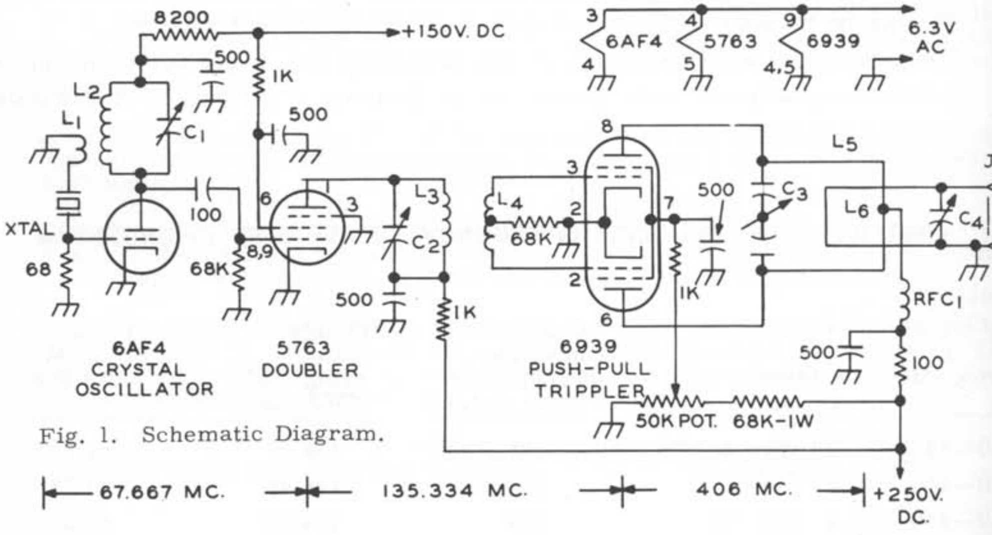


Fig. 1. Schematic Diagram.

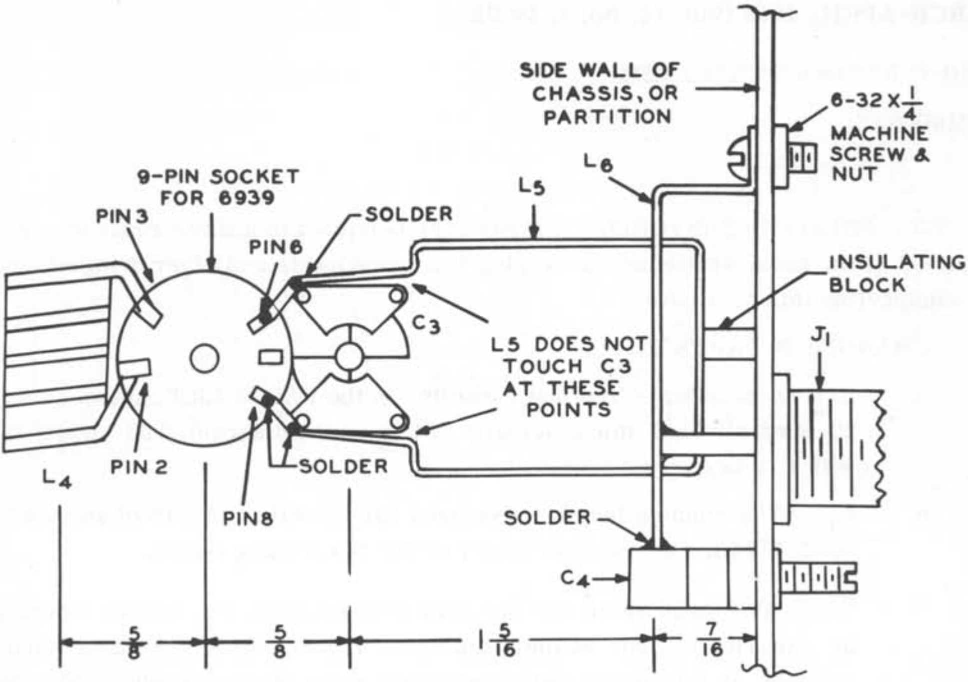
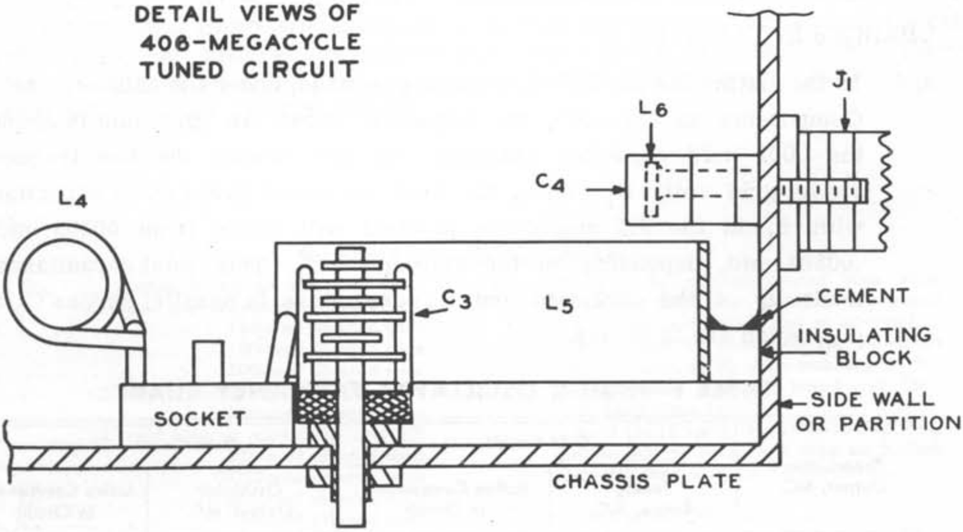
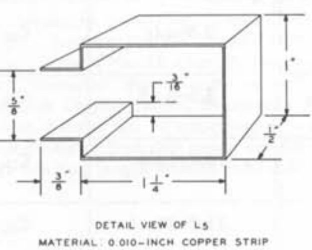


Fig. 2.

DETAIL VIEWS OF 406-MEGACYCLE TUNED CIRCUIT





DETAIL VIEW OF L5
MATERIAL: 0.010-INCH COPPER STRIP
1/2 INCH WIDE 4 3/4 INCHES LONG

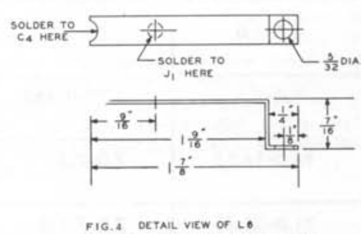


FIG. 4 DETAIL VIEW OF L6
MATERIAL: 0.030-INCH COPPER STRIP
1/4 INCH WIDE 2 3/8 INCHES LONG

MARCH-APRIL, 1959 (Vol. 14, No. 2) ISSUE--

HIGH-C BANDSWITCHING VFO

COMMENTS:

THE FOLLOWING INFORMATION has been compiled to answer requests we have received from radio amateurs concerning the components and other details involved in constructing this oscillator.

1. CHANGES IN PARTS LIST:

   a. C_{13} on diagram - The last capacitor in the PARTS LIST, shown as C_{15}, a 20-mmf silvered mica, actually is C_{13} on the diagram. The "C_{15}" shown with C_{11} is correct.

   b. L_1 - The winding length on National XR-50 coils is 11/16 of an inch long, not 1-1/16 inches long, as specified for the winding length.

   c. R_1 - The best value for the grid bias resistor, R_1, may be determined by experiment, but resistances from 47,000 to 100,000 ohms should be suitable at this point, with the higher value desirable when 200 volts or more is applied to the plate of the 6AH6 tube.

2. CHANGES IN TABLE I:

   a. In the listing for the 3.5--4.0-megacycle band, under the column, ' Active Components in Circuit", the capacitor shown as .022 mfd is actually the .002 - mfd capacitor connected directly across the low frequency range grid coil, L_1. Thus, the total oscillator grid circuit capacitance with S_1 in the 3.5-megacycle position will range from .00303-mfd to .00384-mfd, depending on the setting of C_1. This total capacitance is made up of the .002-mfd and C_1 capacitors in parallel across C_9 and C_{10} which are in series.

TABLE I—HIGH-C OSCILLATOR FREQUENCY CHART

Transmitter Output, MC.	Grid Circuit		Plate Circuit—Output	
	Tuning Range, MC.	Active Components in Circuit	Oscillator Output, MC.	Active Components in Circuit
3.5–4.0	1.75–2.0	.002 mfd, C_{1A}, C_{1B}, C_9, C_{10}, L_1	3.5–4.0	C_{12}, L_3
7.0–7.3	1.75–1.825	.002 mfd, C_{1A}, C_5, C_9, C_{10}, L_1	3.5–3.65	C_{12}, L_3
14.0–14.35	7.0–7.2	C_{1B}, C_2, C_6, C_9, C_{10}, L_2	14.0–14.4	C_{14}, L_5
21.0–21.45	7.0–7.150	C_{1B}, C_3, C_7, C_9, C_{10}, L_2	21.0–21.45	C_{13}, L_4
28.0–29.7	7.0–7.45	C_{1B}, C_4, C_8, C_9, C_{10}, L_2	14.0–14.9	C_{14}, L_5

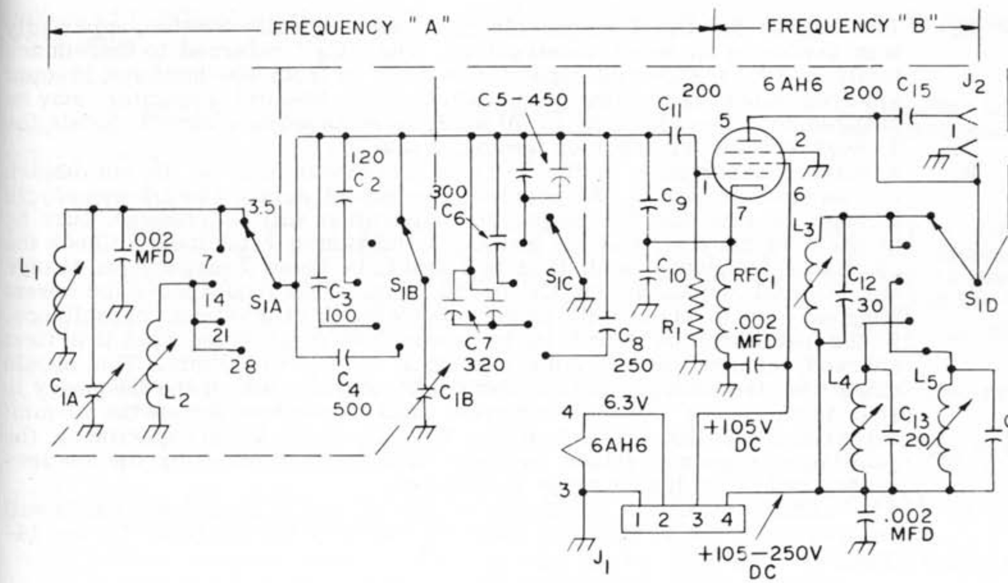


FIG. 1. SCHEMATIC DIAGRAM OF THE BANDSWITCHING HIGH—C VARIABLE FREQUENCY OSCILLATOR VFO. CAPACITORS ACROSS THE OSCILLATOR GRID TUNED CIRCUIT FOR EACH BAND ARE DESCRIBED IN THE TEXT. GRID AND PLATE CIRCUIT FREQUENCIES, "A" AND "B" RESPECTIVELY, ARE LISTED IN TABLE I. ALL CAPACITANCES ARE IN MMF UNLESS OTHERWISE SPECIFIED. CHASSIS GROUNDS SHOULD BE MADE AT POINTS SHOWN.

PARTS LIST—COIL TABLE

C_{1A}, C_{1B} . . . . – section broadcast variable, 15—420-mmf per section (Philmore 9046).
C_2 . . . . 120-mmf silvered mica
C_3 . . . . 100-mmf silvered mica
C_4 . . . . 500-mmf silvered mica
C_5 . . . . 450-mmf silvered mica (400 and 50)
C_5 . . . . 300-mmf silvered mica
C_7 . . . . 320-mmf silvered mica (300 and 20)
C_8 . . . . 250-mmf silvered mica
C_9, C_{10} . . . . 0.002-mfd silvered mica
C_{11}, C_{15} . . . . 200-mmf silvered mica
C_{12}, C_{14} . . . . 30-mmf silvered mica
C_{13} . . . . 20-mmf silvered mica
J_1 . . . . 4-prong male plug (Jones P-304-AB)
J_2 . . . . 1-prong female chassis phono jack
L_1 . . . . 3 uh, 17 turns, No. 18 enameled wire on ½-inch diameter iron slug-tuned coil form, 1 $\frac{1}{16}$-inch winding length. (National XR-50).
L_2 . . . . 0.4 uh, 6 turns, No. 16 enameled wire on ½-inch diameter iron slug tuned coil form, $\frac{11}{16}$-inch winding length (National XR-50).
L_3 . . . . 30—70 uh, scramble-wound iron slug-tuned coil (CTC LS-3, 5-MC ready-wound coil, marked with green dot on winding).
L_4 . . . . 1.0—2.0 uh, 12 turns, No. 24 enameled wire spacewound ⅜ of an inch long on ⅜-inch diameter iron slug-tuned coil form (CTC-LS-3 blank form).
L_5 . . . . 1.5—3 uh, 18 turns, No. 24 enameled wire, closewound ⅜ of an inch long on ⅜-inch diameter form (CTC LS-3 blank form).

R_1 . . . . 47,000 to 100,000-ohms, 1 watt
RFC$_1$ . . 1 mh pi-wound r.f. choke (National R-50).
S_1 . . . . 4 pole, 5 position, steatite rotary tap switch, assembled from the following Centralab 2000 series miniature switch parts: 1—PA-302 index assembly; 1—PA-2007 switch wafer (3 poles, 5 positions, for S_{1A}, S_{1B} and S_{1C}); 1—PA-2001 switch wafer (1 pole, 11 positions; only 5 positions used for S_{1D}).

3. 7--MEGACYCLE TUNEUP CLARIFIED:

a. The tuneup for the 7-megacycle band, as originally written, apparently was confusing to some constructors. The "C_4" referred to therein actually is C_5, a 450-mmf capacitance made up from 400-mmf and 50-mmf silvered mica capacitors in parallel. This 50-mmf capacitor may be changed to either 30 mmf or 70 mmf, as required to correctly locate the 7-megacycle tuning range on the tuning dial.

b. A revised description of the 7-megacycle tuneup follows: Do not disturb the adjustment of L_1, as previously adjusted during the 3.5-megacycle tuneup, or else the 3.5-megacycle calibration will be changed. Turn S_1 to the 7-megacycle position and C_1 to maximum capacitance. Check the oscillator frequency, and, if it is found to be below 7 megacycles change the 50-mmf capacitor on C_5 to 30 mmf. This should move the lowest frequency up to about 7.01 megacycles with C_1 at maximum capacitance. If the oscillator is found to be about 7.05 megacycles when it is first checked, change the 50-mmf capacitor on C_5 to 70 mmf. This should bring the frequency down to about 7.01 megacycles. If the frequency is still high, add a 10-mmf silvered mica capacitor across the 70-mmf capacitor, installed as part of C_5. With C_1 at minimum capacitance, the oscillator frequency should be about 7.35 megacycles after the low frequency end of the tuning range is adjusted.

c. The calibration of the oscillator on the 21 and 28-megacycle bands will be affected if L_2 is changed, once L_2 has been correctly set for the 14-megacycle band.

4. HEAVIER METAL IN CONSTRUCTION:

Several readers have asked our recommendations on heavier metal for the chassis and box. Sheet aluminum 1/8 of an inch thick is the heaviest sheet metal that can be conveniently worked with home-workshop tools. A flat plate type chassis could be mounted into a 6 x 6 x 6-inch box made from 1/8-inch thick aluminum. Reynolds aluminum angle could be used for corner posts and chassis ends.

5. SOLID HIGH-C VFO:

A more mechanically solid version of the high-C oscillator circuit--covering any one of a number of tuning ranges--has been described in the July-August, 1959 issue of G-E HAM NEWS. This article includes a tabulation of coil and capacitance values required to cover several of the popular VFO tuning ranges which radio amateurs use.

6. CAUSES OF OSCILLATOR DRIFT:

We have not temperature compensated this oscillator because individual oscillators usually require different amounts of temperature compensating capacitance, which should be connected across the main tuning capacitor, C_1. Occasionally a silvered mica capacitor will have some change in capacitance with temperature changes. In this oscillator, this may show up in the large 0.002-mfd capacitors across the L_1 coil, and C_8 and C_9. If a drift is noticed where in the oscillator drifts each time plate voltage is applied, and returns to the set frequency after a few minutes of standby, the high r.f. circulating current in the high-C circuit may be causing heating and capacitance drift in one of the .002-mfd capacitors. Try changing these capacitors to reduce this drift.

7. Apparently there has been some confusion that the grid circuit of the oscillator operates on the 14-megacycle band in the "28-MC" position of S_1. No, the oscillator grid circuit tunes from 7.0 to 7.45 megacycles in this switch position, and the oscillator plate components in the circuit on this switch position, L_4 and C_{13}, cover the 14.0 to 14.9-megacycle range. L_4 should be set to 14.35 megacycles for best VFO output from 14.25 to 14.85 megacycles. The oscillator or other stage in the transmitter to which the VFO is connected then works as a frequency doubler to the 28.0 to 29.7-megacycle range.

MAY-JUNE, 1959 (Vol. 14, No. 3) ISSUE--

200-WATT DOUBLE SIDEBANDER--PART I. PART II Appeared in the July-August, 1959 Issue.

COMMENTS--

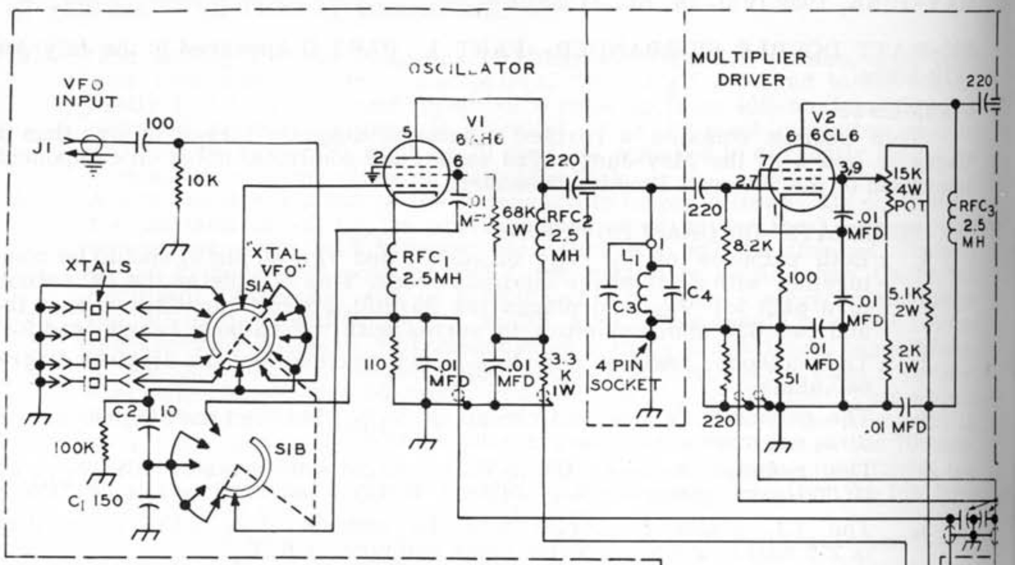
This section contains a revised schematic diagram larger in size than that on pages 4 and 5 of the May-June, 1959 issue, and additional notes on components and operation of the 200-watt Doublesidebander.

A. SCHEMATIC DIAGRAM REVISIONS

1. Both cathodes of V_8 (V_{8A} on pin 3; and V_{8B} on pin 8) should be connected together with a dot where the lines cross. This completes the DC cathode return path for V_{8A} and places the 25-mfd, 25-volt capacitor across the 330, and two 620-ohm resistors in series with the cathode return lead for V_{8B}.
2. The cathode resistor for V_{10B}, not marked on the original diagram, is 680 ohms.
3. The capacitor in the grid circuit of V_{10B}, between the 150,000-ohm resistors, not marked in value, is 0.001 mfd.
4. The resistor between the 2,700-ohm cathode resistor for V_{10A} and the 10,000-ohm potentiometer (TONE FREQ.) not marked, is 43,000 ohms.
5. The r.f. choke in series with the cathode of V_5, RFC_6 on the diagram, is 2.5 millihenries, the same value and type as RFC_1.
6. The resistor between the cathode of V_5 and the "RF OUT" tap on S_{4B}, next to a 0.01-mfd capacitor and not marked, is 39,000 ohms.
7. The resistor in the exciter plate voltage lead between L_9 and the "B + 400 V." tap on S_{4B}, not marked is 200,000 ohms. (two 100,000-ohm, 1/2-watt resistors in series).
8. The full-scale current reading on the meter, M_1, with S_4 in position 3 (Driver Cathode Current) should be 40 ma., with the 51-ohm resistor in series with the cathode of the 6CL6 (V_5). For a full-scale meter reading of 50 ma., change this 51-ohm resistor to 39 ohms.
9. Only two pilot lamps, I_1 and I_2, are shown on the schematic diagram, although three lamps are shown in the front view picture on page 3 of the May-June issue. This extra pilot lamp actually was connected across the primary of T_3 and lit only when power was actually being applied to T_3. The switch S_5 was wired somewhat differently, so that when K_1 closed, I_2 would light in the "TUNE" position, indicating that sufficient grid drive to the 6146's was available to permit application of high voltage when S_5 was turned to the "TRANSMIT" position.

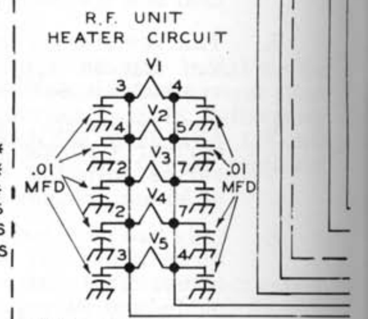
B. COMPONENTS

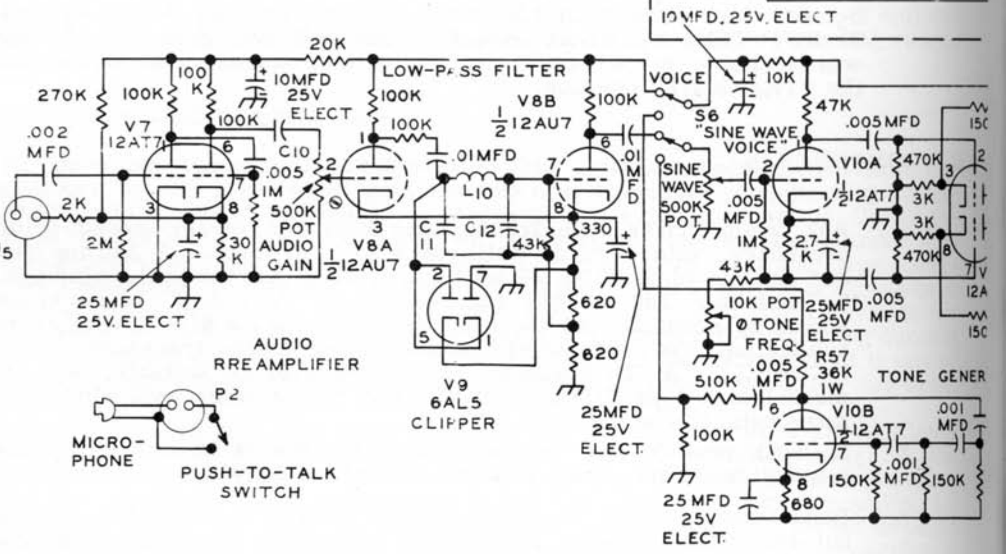
1. Any audio driver type transformer having a center-tapped primary and secondary, with a turns ratio of 4 to 5, primary to 1/2 of the secondary, and capable of handling 25 milliamperes of current in the windings, should be suitable. The winding marked as the "primary' on the transformer should be connected as the secondary, driving the 6146 screen grids in this application. The transformer actually used in this transmitter was a Merit No. A-3123. A Thordarson type 20D80 also is suitable, as is any small multi-match type driver or modulation transformer with which the proper turns ratio can be obtained.
2. A 5763 pentode can be substituted for the 6CL6 driver by changing pin connections on the socket to match those for the 5763.
3. Bandswitching could be added to the exciter instead of the plug-in coils, but this would require a complete revision of the mechanical layout. For single knob bandswitching, layouts similar to those used in some of the commercially built transmitters, with 6146's in the final, could be followed.

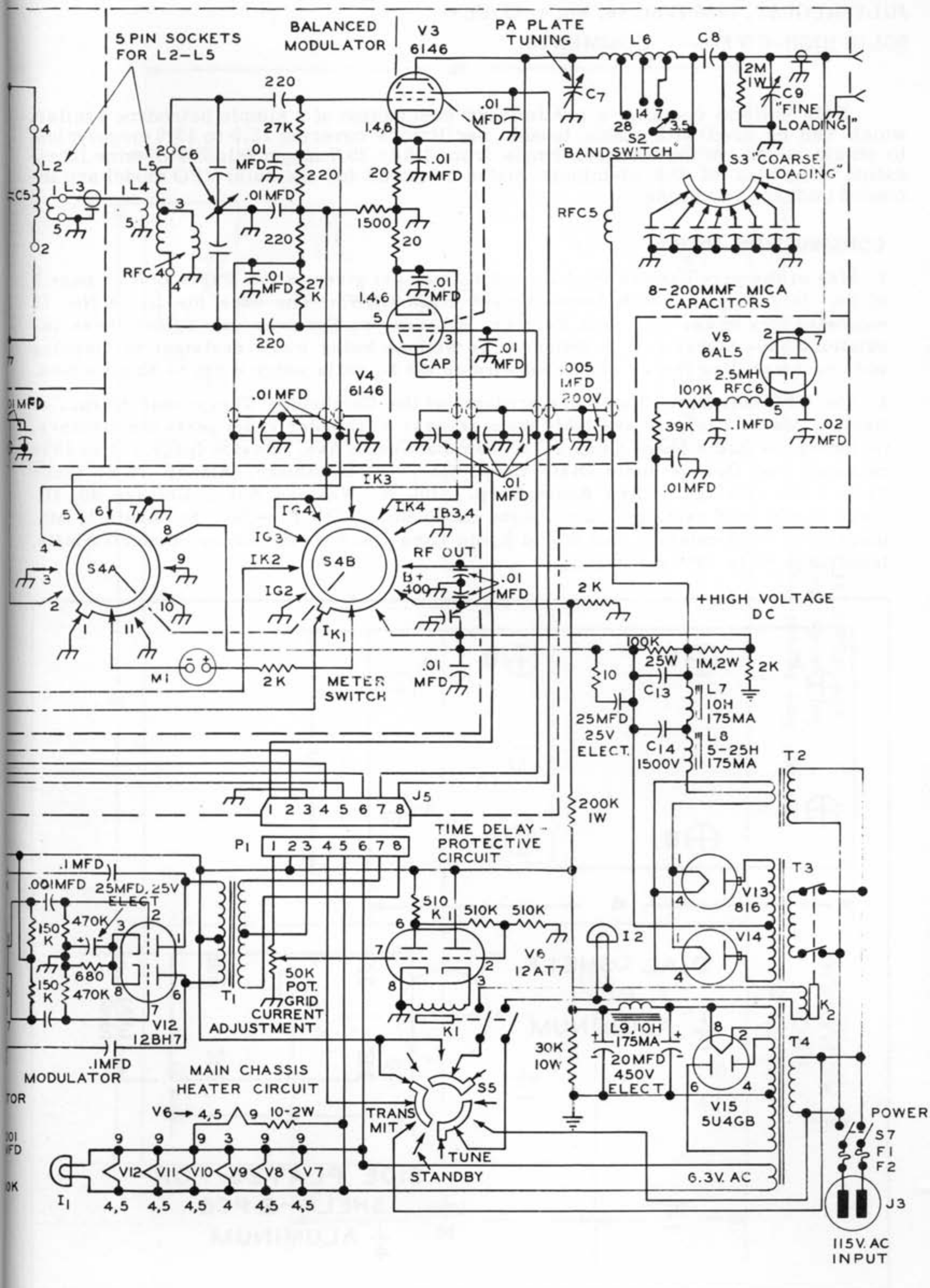


POSITION ON S4	CIRCUIT MEASURED		FULL SCALE READING	NORMAL READING
1	OSCILLATOR CATHODE CURRENT	I_{K1}	20 MA	10 MA
2	DRIVER GRID CURRENT	I_{G2}	10 MA	2 MA
3	DRIVER CATHODE CURRENT	I_{K2}	40 MA	20 MA
4	FINAL GRID CURRENT, V3	I_{G3}	10 MA	3 MA
5	FINAL GRID CURRENT, V4	I_{G4}	10 MA	3 MA
6	FINAL CATHODE CURRENT, V3	I_{K3}	100 MA	80 MA*
7	FINAL CATHODE CURRENT, V4	I_{K4}	100 MA	80 MA*
8	FINAL PLATE CURRENT	$I_{B3,4}$	200 MA	160 MA*
9	R.F. OUTPUT VOLTAGE 9		100 VOLTS RMS	60 VOLTS
10	MEDIUM SUPPLY VOLTAGE SUPPLY		400 VOLTS DC	350 VOLTS
11	HIGH VOLTAGE SUPPLY		2,000 VOLTS DC	1,000 VOLTS

*MEASURED WITH FULL SINE WAVE MODULATION






5 PIN SOCKETS FOR L2-L5
BALANCED MODULATOR
V3 6146
PA PLATE TUNING
L6
C8
C7
C9 "FINE LOADING"
2M 1W
.01 MFD
S2 "BANDSWITCH"
S3 "COARSE LOADING"
RFC5
8-200MMF MICA CAPACITORS
220
27K
L2
L3
L4
L5
C5
C6
RFC4
.01 MFD
1500
20
1,4,6
V4 6146
CAP
V5 6AL5
2.5MH RFC6
100K
39K
.1MFD
.02 MFD
.005 MFD 200V
.01MFD
S4A
S4B
IK3
IK4
IG4
IG3
IB3,4
IK2
IG2
RF OUT
B+ 400
2 K
+HIGH VOLTAGE DC
M1
METER SWITCH
100K 25W
1M,2W
10
C13
L7 10H 175MA
25MFD 25V ELECT.
C14 1500V
L8 5-25H 175MA
T2
J5
P1
200K 1W
TIME DELAY - PROTECTIVE CIRCUIT
.1MFD
.001MFD
25MFD, 25V ELECT
150 K
470K
680
V12 12BH7
T1
50K POT. GRID CURRENT ADJUSTMENT
510 K
510K
V6 12AT7
I2
V13 816
V14
T3
K2
K1
30K 10W
L9, 10H 175MA
20MFD 450V ELECT
V15 5U4GB
T4
.1MFD
MODULATOR
MAIN CHASSIS HEATER CIRCUIT
V6→ 4,5
10-2W
S5
TRANS MIT
TUNE
STANDBY
6.3V. AC
POWER
S7
F1
F2
J3
115V. AC INPUT
I1
V12
V11
V10
V9
V8
V7

JULY-AUGUST, 1959 (Vol. 14, No. 4) ISSUE--

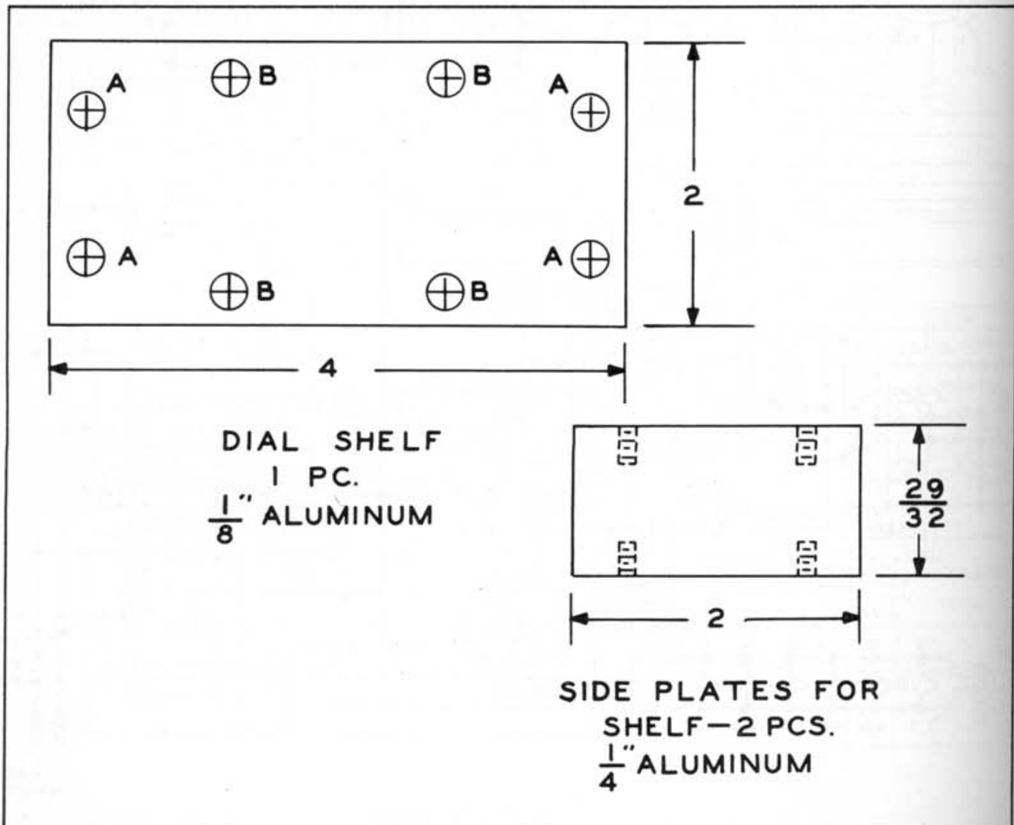
SOLID HIGH-C VFO-- COMMENTS:

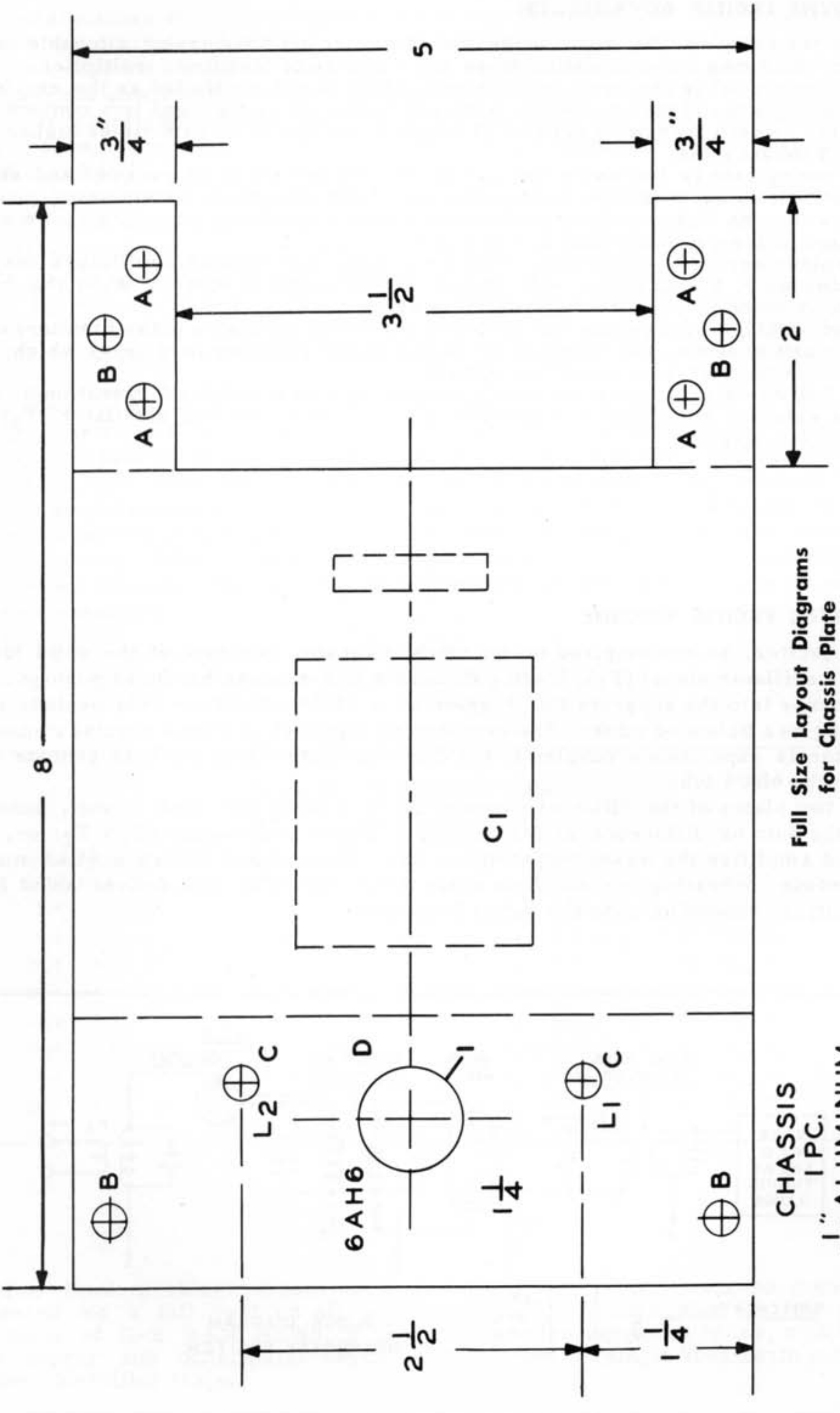
This bulletin contains a preliminary description of a simple hetrodyne exciter, which can be used with stable tunable oscillators covering 12.0 to 12.5 megacycles, to obtain output on the amateur bands from 3.5 to 29.7 megacycles. Full-size fabrication diagrams of the aluminum plates required for the solid VFO model are included on these two pages.

CONSTRUCTION NOTES:

1. Size of the wire used to wind L_1 and L_2 was not given in the Parts List on page 3 of the July-August, 1959 issue of G-E HAM NEWS. The wire for L_1 is No. 18 enameled (try to use wire with Formex, Alkanex, or Formvar insulation; these insulations have higher r.f. resistance, as well as being more resistant to chipping and cracking). Use No. 24 enameled wire on all L_2 coils which must be home wound.

2. The CTC coil forms listed are products of the Cambridge Thermionic Corp., of Boston, Mass. They are available from several mail order radio parts distributors, including the Radio Shack Corp., 730 Commonwealth Ave., Boston (page 139 in 1959 catalog); Fort Orange Radio Dist. Corp. Co., 904 Broadway, Albany, N.Y. (page 79 in 1959 catalog); Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill. (page 114 in 1960 catalog); Walter Ashe Radio Co., 1125 Pine St., St. Louis 1, Mo. (page 69 in 1959 catalog); and World Radio Labs, 3415 W. Broadway, Council Bluffs, Iowa (page 46 in 1959 catalog).





Full Size Layout Diagrams for Chassis Plate Solid High-C VFO

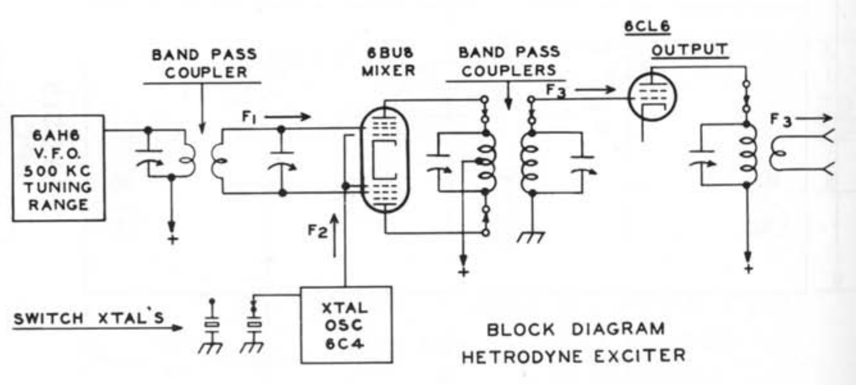
HETRODYNE EXCITER ADVANTAGES:

1. No more complex than many conventional exciter circuits having a tunable oscillator, following by an isolating stage and a series of frequency multipliers.
2. Oscillator drift is the same on all bands. Drift is not multiplied as the exciter is operated on the higher frequency amateur bands, as is the case in a conventional exciter, where frequency drift at 28 megacycles can be up to 8 times higher than at 3.5 megacycles.
3. The tuning rate is the same for all bands. No switching of parallel and series capacitors is necessary in the tunable oscillator frequency determining circuits to prevent the higher frequency amateur bands from being squeezed into a small portion of the oscillator tuning dial scale.
4. Chirpless keying is simplified. Both the crystal and tunable oscillators can run continuously, but no signal will appear at the output frequency when the mixer stage is made inoperative by the keying system.
5. An adjustable negative bias can be fed to the mixer through a potentiometer, making possible setting the "zeroing in" signal in the receiver to a level which does not block or over-ride incoming signals.
6. The hetrodyne exciter can be easily adapted to single sideband operation by adding a sideband generator unit between the crystal controlled oscillator (F_2) and the mixer stage.

HETRODYNE EXCITER CIRCUIT:

The exciter, as summarized in the block diagram, consists of the solid high-c tunable oscillator signal (F_1), feeding through a link-coupled bandpass push-pull r.f. transformer into the separate No. 3 grids of a 6BU8 miniature twin pentode tube, operating as a balanced mixer. The hetrodyning signal (F_2) from a crystal controlled oscillator is capacitance coupled to the common control grid for both pentode sections in the 6BU8 tube.

The two plates of the 6BU8 are connected to a push-pull tank circuit, tuned to either the sum or difference of the two input signal frequencies ($F_1 + F_2$; or, $F_1 - F_2$), and amplifies the mixer output signal (F_3). This signal drives a 6CL6 miniature pentode, operating in class A or class AB_1. The 6CL6 will deliver about 2 to 4 watts output, depending upon the output frequency.



BLOCK DIAGRAM
HETRODYNE EXCITER

The preliminary schematic diagram of the crystal oscillator, mixer and amplifier is shown next page. Note that a ganged bandswitch (S_1A THROUGH S_1F) selects the proper crystal, oscillator plate tank coil, mixer plate circuit, and 6CL6 output circuit for the amateur bands from 3.5 to 29.7 megacycles. For simplicity, only one set of interstage coupling and output circuit coils are shown in the diagram. There are, of course, actually five sets of coils connected to switch sections S_1C, S_1D, S_1E and S_1F.

Parts values for the experimental hetrodyne exciter are given in TABLE I. The chart of tunable oscillator, crystal oscillator and output frequencies for each popular amateur band are given in TABLE II. Coil data for operation of the experimental exciter on the 14-megacycle amateur band is given in TABLE III. Final coil data for L_5, L_6 and L_7, for the other amateur bands has not yet been determined, but persons interested in winding such coils should scale up and down the coil data given for 14 megacycles, keeping approximately the same L/C ratio in each tuned circuit.

The power output from the 6CL6 amplifier stage is sufficient to drive one or two of the popular 20 to 30 watt plate dissipation class beam pentode tubes in class AB_1, class B, or class C as a power amplifier (6CA7/EL34, 6DQ5, 6DQ6B, 6L6-GC, 5881, 6146, 7027, 7581, etc.). Class AB_1 operation of this 50 to 150-watt linear amplifier stage is recommended for those applications where not more than 40 watts of driving power is required by a high power amplifier stage which may follow the complete exciter. This will reduce harmonic output, as compared to operating the 50--150-watt amplifier in class C, and thus help prevent interference to nearby television receivers.

Table II · FREQUENCY CHART

(For 12-Megacycle Tunable Oscillator)

OUTPUT BAND, MC, (F_3)	TUNABLE OSC. RANGE (F_1) MC.	CRYSTAL FREQ. MC (F_2)	MIXER
3.5 - 4.0	12.0 - 12.5	X_1 = 8.5	$F_1 - F_2 = F_3$
7.0 - 7.3	12.0 - 12.3	X_2 = 5.0	$F_1 - F_2 = F_3$
14.0 - 14.35	12.0 - 12.35	X_3 = 2.0	$F_1 + F_2 = F_3$
21.0 - 21.45	12.0 - 12.45	X_4 = 9.0	$F_1 + F_2 = F_3$
28.0 - 28.5	12.0 - 12.45	X_5 = 16.0	$F_1 + F_2 = F_3$
28.5 - 29.0	12.0 - 12.5	X_6 = 16.5	$F_1 + F_2 = F_3$
29.0 - 29.5	12.0 - 12.5	X_7 = 17.0	$F_1 + F_2 = F_3$
29.5 - 29.7	12.0 - 12.2	X_8 = 17.5	$F_1 + F_2 = F_3$

The final working version of this hetrodyne exciter, designed, constructed and tested for a full year on all bands by W2FBS, is published in the July-August, 1961 issue of G-E HAM NEWS. It is a complete transmitter/exciter, with built-in power supply and differential keying system, and a single 7581 beam pentode in the power amplifier stage.

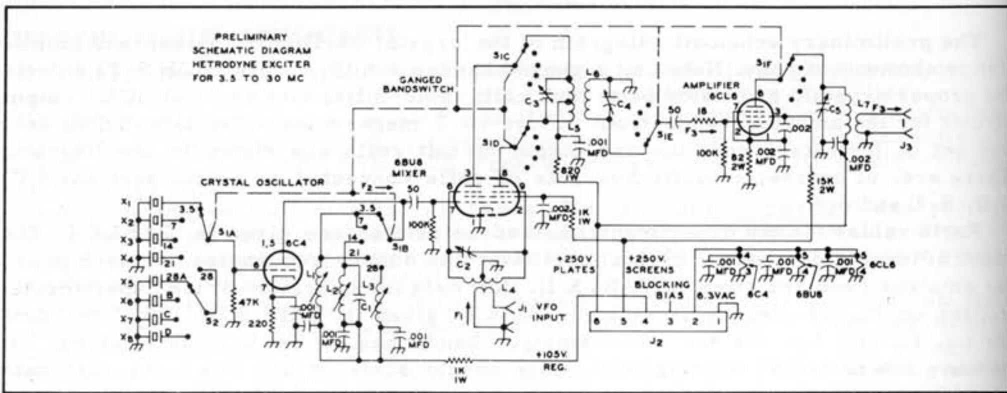


Table I · PARTS LIST

C_1. . . . . 150-mmf mica capacitor[1]

C_2, C_3, C_4. . . . . . 4--40-mmf adjustable mica trimmer capacitor [2] (ICA No. 611).

C_5 . . . . 4--50-mmf air variable capacitor[2] (Hammarlund APC-50, or equivalent).

J_1, J_3. . . . . . . chassis type coaxial cable connector; or, midget phonotype jack.

J_2. . . . . 6-pin power socket; or, 6-lug terminal strip.

L_1 to L_7. . . . . See (Table III) COIL TABLE for details.

S_1. . . . 6-pole, 5 position ceramic insulated rotary tap switch (Made from Centralab P-123 index assembly and three Centralab "R" shorting type wafers spaced to suit parts layout of exciter).

S_2. . . . 1 pole, 4-position ceramic insulated rotary tap switch (Centralab No. 2500 6-position switch with stop set for 4 positions).

X_1 to X_8. . . . . Quartz crystals; frequencies as indicated in Table II.

[1]Value across L_2 for 2-megacycle crystal, for 14-megacycle operation.

[2]Value required for 14-megacycle opeation; capacitance will be larger for 3.5 and 7 megacycles, and smaller for 21 and 28 megacycles.

TABLE III · COIL TABLE

(For 12-megacycle tunable oscillator and 14-megacycle output)

L_1. . . . . 6---13 uh, coil scramble wound on 3/8-inch diameter combination iron/brass slug tuned coil form (Cambion LS-3, 10 MC coil).

L_2. . . . . 30--70 uh coil scramble wound on same form as L_1. (Cambion LS-3, 5-MC coil).

L_3. . . . . . . 1.5--3.0 uh, 18 turns, No. 24 enameled wire closewound 3/8 of an inch long on same form as L_1.

L_4. . . . . 5.4 uh, 32 turns, No. 24 tinned wire spacewound 32 turns per inch, 1 inch long and 1/2 of an inch in diameter (air-dux No. 432) and centertapped with 2-turn link coil at center, wound with No. 20 insulated hookup wire.

L_5. 2.8 uh, 18 turns, same coil stock as L_4, center tap.

L_7. . . . . . . 2.8 uh, same as L_6 with 2-turn link at bypassed end, wound from No. 20 insulated hookup wire.

SSB HETRODYNE VFO:

There has been much interest in our publishing an article on constructing a hetrodyne VFO for 9-megacycle type SSB exciters, so that the proper injection frequencies for output on 1.8, 7, 21 and 28 megacycles (and even 50 megacycles) can be obtained from these exciters. Most persons now have suitable VFO's which they use to provide the proper injection frequencies (5.0 to 5.5 megacycles for operation of the exciter on the 3.9 and 14-megacycle bands.

The block diagram shows a suggested method of taking the output from a stable VFO tuning the 5.0 to 5.5-megacycle range (F_1) and feeding it into another mixer, into which a crystal oscillator signal (F_2) also is fed. The mixer output (F_3), either the sum or difference of the two input frequencies, is used as the injection frequency (F_3) into the SSB exciter. On the block diagram, all blocks above the dashed line are inside the SSB exciter. The signal designated F_4 is from the 9-megacycle SSB generator, and the F_5 signal is the desired output signal on the amateur bands.

An experimental hetrodyning unit for a stable 5-megacycle VFO has been constructed and is being tested on a Central Electronics 20A exciter. Details will be published in a future issue of G-E HAM NEWS.

Block Diagram of Hetrodyne VFO
For SSB Exciters with 9-megacycle Sideband Generator
(CENTRAL ELECTRONICS 10A, 10B and 20A,
Lakeshore and W2EWL Exciters)

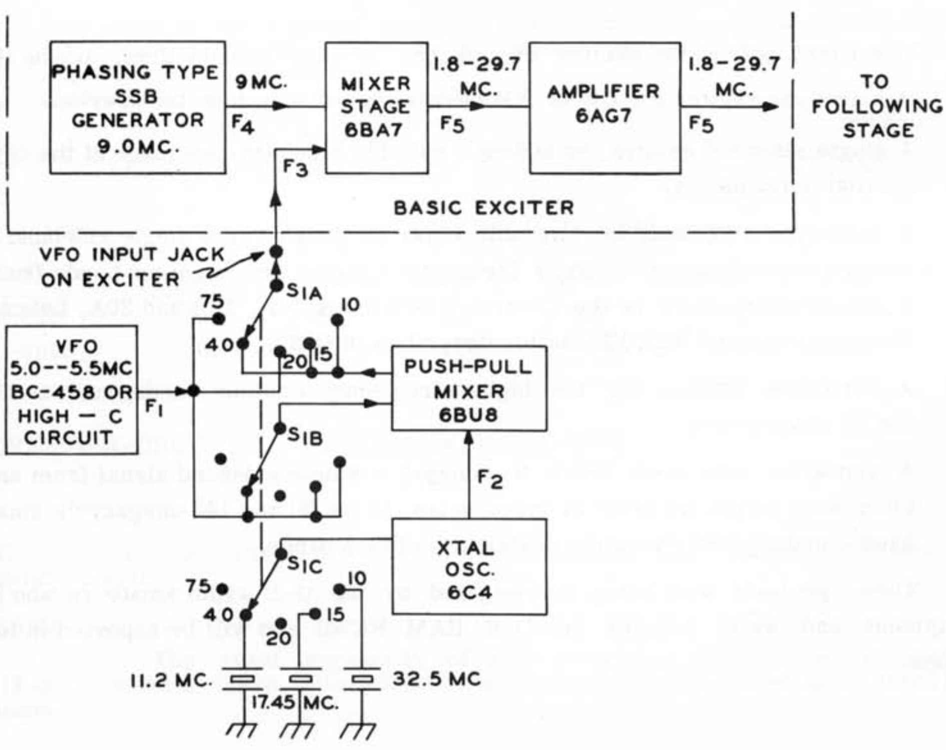


Table IV · FREQUENCY CHART

For Hetrodyne VFO for 9-megacycle Single Sideband Generators

OUTPUT BAND, MC. (F_5)	SSB GEN. FREQ. (F_4)	EXCITER INJECTION FREQ, MC. (F_3)	CRYSTAL OSC. FREQ, MC. (F_2)	TUNABLE OSC. FREQ, MC. (F_1)
3.5 -- 4.0	9.0	5.5 -- 5.0	None	5.5 -- 5.0
7.0 -- 7.3	9.0	16.0 -- 16.3	11.0	5.0 -- 5.3
14.0 -- 14.35	9.0	5.0 -- 5.35	None	5.0 -- 5.35
21.0 -- 21.45	9.0	12.0 -- 12.45	17.0	5.45 -- 5.0
28.0 -- 28.5	9.0	37.0 -- 37.5 (19.0 -- 19.5)	32.0 (24.5)	5.0 -- 5.5 (5.5 -- 5.0)
28.5 -- 29.0	9.0	37.5 -- 38.0 (19.5 -- 20.0)	32.5 (25.0)	5.0 -- 5.5 (5.5 -- 5.0)
29.0 -- 29.5	9.0	38.0 -- 38.5 (20.0 -- 20.5)	33.0 (25.5)	5.0 -- 5.5 (5.5 -- 5.0)
29.5 -- 29.7	9.0	38.5 -- 38.7 (20.5 -- 20.7)	33.5 (26.0)	5.0 -- 5.5 (5.5 -- 5.0)

OTHER IDEAS:

The basic hetrodyne exciter circuit has several possibilities, among them:

1. A hetrodyne exciter for CW or AM operation, as shown on the previous three pages.
2. A single sideband exciter, by adding a suitable sideband generator at the crystal oscillator frequency.
3. A hetrodyne VFO unit for use with filter or phasing type single sideband generators operating on a fixed frequency outside the amateur bands (such as 9 megacycles, used in the Central Electronics 10A, 10B and 20A, Lakeshore Phasemaster, and W2EWL exciter described in QST).
4. A hetrodyne exciter for the higher frequency amateur bands, such as 21, 28 and 50 megacycles.
5. A converter unit with which to convert a single sideband signal from an exciter with output on 14 or 21 megacycles, to the 50 and 144-megacycle amateur bands, making SSB operation practical on those bands.

These projects are being investigated by the G-E radio amateurs who build equipment and write articles for G-E HAM NEWS and will be reported in future issues.

SEPTEMBER-OCTOBER, 1959 (Vol. 14, No. 5) ISSUE--

COMPACT TRIODE KILOWATT--a modern bandswitching triode amplifier with two GL-810's in parallel, covering 3.5 to 30 megacycles.

COMMENTS--

1. A terminal into which fixed bias is applied to the control grids of the GL-810 tubes does not appear in the rear view on page 5, but was added by K2IOW just above the bias adjustment potentiometer, R_1.
2. K2IOW has since converted this amplifier from class C operation into a class B linear simply by shunting the MB-150 grid tank circuit with a 5,000-ohm, 25-watt non-inductive resistor. The resistor was placed between the GL-810 grid connection, and the connection to the neutralization capacitor, C_3, at the lower end of the MB-150 on the schematic diagram, Fig. 1, on page 4 of this issue. Normal bias for class B audio operation is given in the table below. Potentiometer R_1 should be set at minimum resistance.
3. GROUNDED-GRID OPERATION--Either GL-810 or GL-8000 triodes can be operated in a grounded-grid linear amplifier circuit constructed much the same as K2IOW's amplifier, except that the grid tank circuit and neutralizing components are eliminated. Each tube grid is bypassed to ground separately through a 0.005-mfd disc ceramic capacitor with shortest possible leads. Normal class B bias is applied to the grids. A B & W FC-15 filament RF choke is inserted in the filament circuit, following normal grounded-grid techniques, and the r.f. input is fed from the coaxial cable input jack to both sides of each tube filament through 0.001-mfd disc ceramic capacitors.

G-E HAM NEWS SPECIAL MOBILE POWER SUPPLY:

The stock of these power supplies, described on page 11, was exhausted about six weeks after this issue was distributed. No more such power supplies are expected to be available.

TABLE I - CLASS B GRID BIAS FOR GL-810 and GL-8000

Tube Type	Operating Plate Voltage					
	1,500	1,750	2,000	2,250	2,500	Volts
GL-810	-38	-44	-50	-60	-70	Volts
GL-8000	-90	-105	-120	-130	-150	Volts

NOVEMBER-DECEMBER, 1959 (Vol. 14, No. 6) ISSUE--

KILOWATT GROUNDED-GRID LINEAR AMPLIFIER--Two GL-813 Pentodes in a popular circuit.

COMMENTS--

The great popularity of this issue has resulted in our reprinting a 12-page special issue with added information. It is contained in the third bound volume.

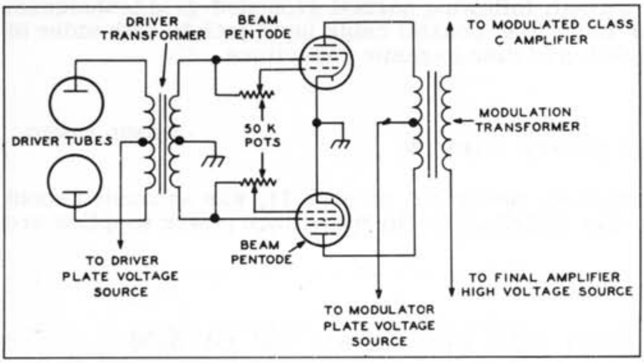
JANUARY-FEBRUARY, 1960 (Vol. 15, No. 1) ISSUE--

OPERATING G-E HI-FI TUBES AS MODULATORS-- COMMENTS--

1. The photo on page 7 showing a 6L6-GB (left) with hot spots cherry-red in color on the plate; and, a new 6L6-GC (right) with 5-ply anode material showing only a uniform dull-red color, also should have shown the tube sockets. The tubes actually were held up from seating in the sockets by round-head machine screws holding the sockets in place on the chassis. These screw heads were removed from the photo by our artist.

2. A number of readers have asked us whether the 6BQ5, 6L6-GC, 7189A, 7355 and 7581 can be operated as push-pull triode-connected (control grid and screen grid tied together) zero-bias class B audio amplifiers for modulator service. This same zero-bias circuit has been published for the 807, and some old timers will recall the famous type 46 being connected and operated in this fashion. We have not tried the triode-connected class B circuit with these new tubes, but suggest the circuit shown on page 2 for those persons who wish to try it out. As connected, the screen grids receive full audio driving voltage, and the audio voltage applied to the control grids is reduced by the resistance of the potentiometer. Once the proper value of resistance for best linearity has been determined, fixed resistors can be substituted for the potentiometers.

   The power output from this class B type amplifier is estimated to be about 10 to 20 percent higher than the figures shown for class AB_1 modulator service in TABLE I on page 7 of the January- February, 1960 issue. This is possible because of the increased efficiency of class B service, but will depend upon the tube type selected for the modulator.



Suggested schematic diagram for a pair of beam pentode audio power amplifier tubes, triode-connected for zero-bias class B amplifier operation. Since the control grids usually require less driving voltage than the screen grids, a potentiometer is inserted in series with each control grid connection and adjusted for best linearity with the amplifier operating at normal ratings and power output.

ALL BAND BALUN COIL:

1. We have received a number of inquiries about data for a balun coil made with RG-8/U and RG-11/U coaxial cable, in place of the RG-59/AU cable in K2HLT's model. In checking with him, K2HLT knows of no one who has constructed a balun coil with the larger coaxial cable, so constructional data is not available at this time.

   The editor tried rolling up some RG-8/U cable into a coil and found that a coil diameter of about 10 inches would be the smallest into which this heavier coaxial cable could be easily wound.

2. We also have been questioned on K2HLT's lighting of two 200-watt lamp bulbs to "full brilliancy" when a bulb was connected from each side of the 72-ohm balanced output of the balun to ground, while running less than 500 watts input to his transmitter.

   It is an often-published fact (QST, ARRL HANDBOOK, etc.) that ordinary lamp bulbs will appear to show full brilliancy while dissipating less r.f. power than their ratings at 60-cycle house power. Thus, K2HLT feels that somewhat less than 200 watts r.f. power was being dissipated by each bulb, and that his actual final amplifier efficiency was in the neighborhood of 70 percent.

   K2HLT was using the 200-watt lamps--each having roughly a 40-ohm impedance at full brilliance--to test the BALANCE of his balun coil by lighting both lamps to EQUAL brilliance. He was not attempting to show his final amplifier to have exceptionally high efficiency.

MARCH-APRIL, 1960 (Vol. 15, No. 2) ISSUE--

THE TC-75: A MOBILE TRANSMITTER/CONVERTER FOR 3.9 MC.

COMMENTS--

1. The three small RF chokes in the schematic diagram, Fig. 1, were not identified in TABLE I -- PARTS LIST. These three chokes are all midget type 1-millihenry 3-pi RF chokes rated at 75 milliamperes current (National R-50, 1-MH, or equivalent.)

2. The crystal for the converter, X_2, can be any frequency in the range of 2,400 to 3,400 kilocycles, depending upon what 200-kilocycle portion of the auto broadcast radio tuning range is to be used as the tunable IF range for the converter. The table below shows a choice of recommended tuning ranges and crystal frequencies. A range should be chosen which does not include any local broadcast stations which may feed through and cause an interfering signal.

3. Standard mobile antennas for the 3.9-megacycle band should be used with the TC-75 transceiver. The Mark Mobile type HW-80 "Heli-Whip" fiberglass antenna, with a continuous-wound loading coil, gives good results with the TC-75. Also, the Master Mobile 2-section whip with their 80-meter loading coil should have good radiation efficiency.

4. Several requests have been received for information on 1.8-megacycle component data for the TC-75, to change it into a "TC-160". Make the following changes:

   a. Make C_1 an 180--690-mmf padder (El Menco 305-M);
   b. Make C_2 an 340--1,070-mmf padder (El Menco 307-M);
   c. Make L_1, L_4 and L_7 either a North Hills PF-120-G slug tuned coil, 64 to 120 microhenries with the 27-mmf capacitors across each; or a CTC LS-3 3-MC wound coil of 45--65 microhenries, and connect 100-mmf silvered mica capacitors across each coil in place of the 27-mmf capacitors shown;
   d. For L_2, use the same 1/2-inch diameter form, but wind 46 turns of No. 24 enameled wire, closewound. Use 100 mmf silvered mica capacitor across L_2 in place of the 47-mmf capacitor for 3.9 Mc.
   e. For link coils L_3, L_5 and L_7, wind 12 turns of same wire instead of 7 turns.
   f. The transmitter crystals, X_1, should be from 1804 to 1821 kilocycles.
   g. The receiver crystals, X_2, should be as follows, depending on the tuning coverage on the auto broadcast receiver: X_2 is 800 Kc. for 1,000 to 1,025 Kc. tuning; X_2 is 1,000 Kc. for 800 to 825 Kc. tuning; X_2 is 1,200 Kc. for 600 to 625 Kc. tuning range.

5. The high voltage vibrator supply in the average 6 to 8-tube auto radio, delivering from 220 to 260 volts, will permit operation of the TC-75 with from 8 to 12 watts input. The connections marked "To Power Supply Relay" on the TC-75 power plug, P_1, should run to SPDT relay in or near the auto radio. This relay should transfer the high voltage from the broadcast receiver to the B plus terminal on P_1, when the K_{1D} contacts close.

TABLE OF CONVERTER CRYSTAL FREQUENCIES

Amateur Band	Broadcast Radio Tuning Range	Converter Crystal (X_2) Freq.
3,800--4,000 Kc.	600 -- 800 Kc.	3,200 Kc.
" "	800 -- 1,000 Kc.	3,000 Kc.
" "	1,000 -- 1,200 Kc.	2,800 Kc.
" "	1,200 -- 1,400 Kc.	2,600 Kc.
" "	1,400 -- 1,600 Kc.	2,400 Kc.

6. Or, a separate vibrator type (Heathkit VP-1-6, or VP-1-12, or equivalent) will supply 260 volts for about 12 watts input. For the full 15 watts input, the Mallory type VP6-325, or VP-12-325 Vibrapacks, or their equivalent, may be used.

7. High voltage type tubes may be used in the converter in place of the 12-volt auto radio types if desired. Several circuit changes will have to be made, as follows:

   a. Remove the connection on the movable contact arm on relay K_{1C} from the 12-volt supply and connect it to the B plus terminal on P_1. Instead of running B-plus directly from P_1 to the plate circuit of the 12AT7, 12AX7 and 6360, run it to the movable arm on K_{1C} instead. Connect the plate circuits for these three tubes to the left-hand contact on K_{1C}.

   b. Relay contacts K_{1D} are not needed; thus, K_1 may be a 3PDT relay, instead of a 4PDT type.

   c. Substitute a 6BA6 or 12BA6 for the 12AF6 r.f. amplifier; and a 6BE6 or 12BE6 for the 12AD6 converter tube. Heater circuits are mentioned in section 8 of this information;

   d. Add 47,000-ohm, 1-watt screen grid dropping resistors in series with the connections to pin 2 on the 12AF6 socket, and pin 6 on the 12AD6 socket.

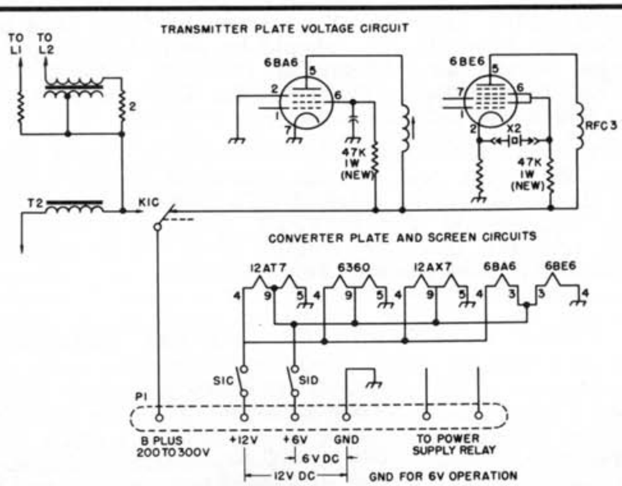
8. The original heater circuit may be changed to a combination 6/12-volt type circuit when high voltage tubes are used in the converter section of the TC-75. This new circuit is shown below.

9. The North Hills and CTC (Cambion) coils specified in the PARTS LIST have been widely used in construction articles in amateur radio publications. They are listed in the catalogs of the larger mail-order radio parts suppliers and can be obtained from them. Or, information on these coils can be obtained from:

   North Hills coils: North Hills Electric Co., 402 Sagamore Avenue, Mineola, L. I., N. Y.

   CTC (Cambion) coils: Cambridge Thermionic Corp. ,445 Concord Avenue, Cambridge 38, Mass.

GENERAL ELECTRIC ENTERS CITIZENS RADIO FIELD -- The special offer described in this article has expired.



SCHEMATIC DIAGRAM OF A COMBINATION 6 AND 12-VOLT HEATER CIRCUIT FOR THE TC-75. HIGH VOLTAGE TUBES MUST BE USED IN THE CONVERTER WITH THIS CIRCUIT.

MAY-JUNE, 1960 (Vol. 15, No. 3) ISSUE--

NEW G-E RECTIFIER TUBES--The "3-ply" tubular cathode material mentioned on page 1 is actually a "2-ply" material. Most power supply circuits have components with sufficiently conservative ratings so that the small increase in DC output voltage from the power supply when substituting a more modern rectifier tube for an older type, will not overload these circuit components. This substitution, plugging in the 5AR4 in place of older types, was suggested on page 7. However, be sure to check the DC voltage after plugging in the 5AR4 to be sure that it is not higher than the ratings of filter and bypass capacitors in the circuit.

PI-NETWORK ANTENNA TUNER IDEAS--

COMMENTS--

1. The question has been raised as to whether the pi-network antenna can be used between the 52 or 72-ohm output of a transmitter, and a coaxial cable which feeds a matched antenna of the same impedance. The pi-network offers little advantage for this 1 to 1 impedance ratio, other than a small amount of ham harmonic attenuation, which could better be obtained with a good low-pass filter, or bandpass filter.

2. Taps on the pi-network coil, L_1, usually should be determined by experiment, but all, or at least a major portion, of the coil will be required for an impedance match at 3.5 megacycles.

3. This tuner also has applications in feeding a wire of random length, or a center-fed dipole antenna cut for an amateur band, where the feedline is connected in parallel and the antenna operated as a long wire, on the MARS frequencies.

4. The reason an ODD number of quarter waves have been suggested for antenna lengths in this article, is that a long wire antenna of an odd number of quarter wavelengths long will be fed at a current maximum. This means that the RF voltage will be at a minumum, and less trouble may be experienced with stray RF voltage inside the ham shack.

4. The ARRL ANTENNA HANDBOOK gives the formula for determining the length of a long-wire antenna as:

$$\text{Length (feet)} = \frac{492\,(N - .05)}{\text{Freq. (Mc.)}}$$

Where N equals the number of half waves on the antenna.

Since we are primarily interested in finding the length of odd-quarter wave length antennas, this formula can be changed to:

$$\text{Length (feet)} = \frac{492\left(\frac{N'}{2} - .05\right)}{\text{Freq. (MC)}}$$

Where N' equals the number of quarter waves on the antenna.

Solving for an antenna length at 3.5 megacycles of 5/4 wavelength,

$$\text{Length} = \frac{492\,\left(\frac{5}{2} - .05\right)}{3.5} = \frac{492\,(2.45)}{3.5} = \frac{1205.4}{3.5} = 344.4 \text{ feet.}$$

5. The pi-network antenna tuner also can be used on wires less than 105 feet long (How short can a long-wire antenna be before it's no longer a long wire?)

The tabulation below gives the information on "short-wire" antennas from 35 to 105 feet long (or short?).

AMATEUR BAND (Mc.)	Lengths in feet for odd quarter wavelength antennas 1	3	5	7	9
3.5	63'	204'	345'	480'	610'
7	33'	105'	173'	243'	313'
14	16'	51'	85'	122'	156'
21	12'	36'	60'	84'	106'

MONITORING ADAPTER FOR OSCILLOSCOPES--

COMMENTS--

1. A more positive check on the linearity of the RF output of a transmitter, can be obtained if the audio signal applied to the horizontal amplifier of the oscilloscope is tapped off from the speech amplifier portion of the transmitter, rather than being obtained from the diode detector, as shown in Fig. 1 of this article. If audio distortion is present in the transmitter output, it also will be applied to the horizontal sweep, and may not show up as distortion in the 'scope pattern.
2. A bibliography of articles on typical modulation waveform patterns, and the methods for connecting test equipment to transmitters to obtain these patterns, is repeated below:

BIBLIOGRAPHY OF MODULATION WAVEFORM PATTERNS

Amplitude-modulated patterns:

1. The Radio Amateur's Handbook, 1960 edition, "Amplitude Modulation" chapter, pages 297 - 301.
2. The Radio Handbook, 15th Edition, "Amplitude Modulation" chapter, page 290; "Sideband Transmission" chapter, page 330.
3. QST, "Some Principles of Radiotelephony", Part I, May, 1954, page 37; Part II, June, 1954, page 13; Part III, July, 1954, page 34; Part IV, October, 1954, page 22.

Single-Sideband patterns:

1. The Radio Amateur's Handbook, 1960 edition, "Sideband" chapter, pages 309, 315-319 (Also, "Single Sideband for the Radio Amateur", pages 109, 112, 132, 135-139, 141).
2. New Sideband Handbook, "Linear Amplifiers" chapter, pages 151, 152.

Double Sideband patterns:

1. CQ, "DSB Considerations and Data," October, 1957, page 64.
2. CQ, "Modulating the DSB Transmitter," March, 1958, page 32.
3. New Sideband Handbook, "Double Sideband" chapter, page 136.

USING THE G-E 6AR8 SHEET BEAM TUBE

In Balanced Modulator, Synchronous Detector and Burst Gate Applications

DESCRIPTION AND RATING

The G-E 6AR8 sheet beam tube has attracted much attention for balanced modulator applications. It has the ability to perform mixing action of two input signals and cancel them in the output to provide an output signal equal to their sum or difference frequencies. Complete technical information is repeated on these pages, along with typical circuits in which radio amateurs have expressed an interest.

GENERAL

Cathode—Coated Unipotential

Heater Voltage, AC or DC	6.3	Volts
Heater Current	0.3	Amperes

Envelope—T-6½, Glass
Base—E9-1, Small Button 9-Pin
Mounting Position—Any

Direct Interelectrode Capacitances, approximate*

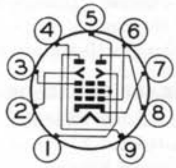
Deflector-Number 1 to All	4.8	μμf
Deflector-Number 2 to All	4.8	μμf
Grid-Number 1 to All Except Plates	7.5	μμf
Plate-Number 1 to All	5.0	μμf
Plate-Number 2 to All	5.0	μμf
Grid-Number 1 to Deflector-Number 1, maximum	0.040	μμf
Grid-Number 1 to Deflector-Number 2, maximum	0.060	μμf
Plate-Number 1 to Plate-Number 2	0.4	μμf
Deflector-Number 1 to Deflector-Number 2	0.38	μμf

MAXIMUM RATINGS

DESIGN-CENTER VALUES

Plate-Number 1 Voltage	300	Volts
Plate-Number 2 Voltage	300	Volts
Accelerator Voltage	300	Volts
Peak Positive Deflector-Number 1 Voltage	150	Volts
Peak Negative Deflector-Number 1 Voltage	150	Volts
Peak Positive Deflector-Number 2 Voltage	150	Volts
Peak Negative Deflector-Number 2 Voltage	150	Volts
Positive DC Grid-Number 1 Voltage	0	Volts
Plate-Number 1 Dissipation	2.0	Watts
Plate-Number 2 Dissipation	2.0	Watts
DC Cathode Current	30	Milliamperes
Grid-Number 1 Circuit Resistance		
With Fixed Bias	0.1	Megohms
With Cathode Bias	0.25	Megohms

BASING DIAGRAM

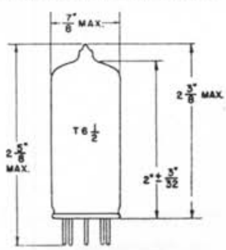


RETMA 9DP
BOTTOM VIEW

TERMINAL CONNECTIONS

Pin 1—Deflector Number 2
Pin 2—Deflector Number 1
Pin 3—Accelerator
Pin 4—Heater
Pin 5—Heater, Internal Shield, and Focus Electrodes†
Pin 6—Grid Number 1 (Control Grid)
Pin 7—Cathode
Pin 8—Plate Number 2
Pin 9—Plate Number 1

PHYSICAL DIMENSIONS



RETMA 6-3

CHARACTERISTICS AND TYPICAL OPERATION

AVERAGE CHARACTERISTICS WITH DEFLECTORS GROUNDED

Plate-Number 1 Voltage	250	Volts
Plate-Number 2, Connected to Plate-Number 1		
Accelerator Voltage	250	Volts
Deflector-Number 1 Voltage	0	Volts
Deflector-Number 2 Voltage	0	Volts
Cathode-Bias Resistor	300	Ohms
Total Plate Current	10	Milliamperes
Accelerator Current	0.4	Milliamperes
Grid-Number 1 Transconductance	4000	Micromhos
Grid-Number 1 Voltage, approximate I_b (total) = 10 Microamperes	−14	Volts

AVERAGE DEFLECTOR CHARACTERISTICS

Plate-Number 1 Voltage	250	Volts
Plate-Number 2 Voltage	250	Volts
Accelerator Voltage	250	Volts
Cathode-Bias Resistor	300	Ohms
Deflector Switching Voltage, maximum‡	20	Volts
Deflector-Bias Voltage for Minimum Deflector Switching Voltage‡	−8	Volts
Voltage Difference between Deflectors for $I_{b1} = I_{b2}$, approximate	0	Volts
Plate-Number 1 Current, maximum $E_{d1} = -15$ Volts, $E_{d2} = +15$ Volts	1.0	Milliamperes
Plate-Number 2 Current, maximum $E_{d1} = +15$ Volts, $E_{d2} = -15$ Volts	1.0	Milliamperes
Deflector-Number 1 Current, maximum $E_{d1} = +25$ Volts, $E_{d2} = -25$ Volts	0.5	Milliamperes
Deflector-Number 2 Current, maximum $E_{d1} = -25$ Volts, $E_{d2} = +25$ Volts	0.5	Milliamperes

* Without external shield.
† Pin 5 should be connected directly to ground.
‡ Deflector switching voltage is defined as the total voltage change on either deflector with an equal and opposite change on the other deflector required to switch the plate current from one plate to the other.
Note: The 6AR8 should be so located in the receiver that it is not subjected to stray magnetic fields.

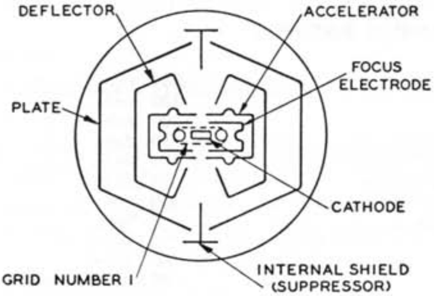


Fig. 1 CROSS-SECTION SCHEMATIC DIAGRAM OF THE 6AR8

OPERATING CONSIDERATIONS FOR THE 6AR8

A cross-section schematic diagram of the construction of the 6AR8 is shown. In this tube, the electrons pass from the cathode to either of the two plates in the form of a planar beam or "sheet." Before the electron stream emerges from the openings in the accelerator structure, it is acted on by the focus electrodes and the control grid. The focus electrode tends to converge the electrons into the required sheet beam, while the conventional grid-number 1 structure which surrounds the cathode serves to control the intensity of the beam.

Between the accelerator and the plates the electron beam passes between the deflector electrodes. Depending on the voltages applied to the deflectors, the beam will be directed entirely to either one or the other of the two plates or proportioned between them. The internal shield, located between the two plates, acts to suppress the interchange of secondary-emission electrons between the plates. The suppressor and the focus electrodes are internally connected to one side of the heater.

In normal operation, positive d-c voltages are applied to the accelerator and plates, and signal voltages are applied to the deflectors and control grid. The frequency of the signal applied to the deflectors determines the rate at which the plate current is switched between the two plates; the grid-number 1 voltage varies the magnitude of the plate current. The interesting tube characteristics which result from the unique construction of the 6AR8 are indicated by the average tube characteristic curves which follow. The tube may be considered as equivalent to a voltage-controlled single-pole double-throw switch through which a current, the magnitude of which is also voltage-controlled, flows.

If both plates and the accelerator are operated at +250 volts and a cathode-bias resistor of 300 ohms is employed, the deflectors require a peak switching voltage of 20 volts (or a peak voltage difference between deflectors of 40 volts) maximum to switch the plate current from one plate to the other. In a practical circuit, however, in which the deflectors are driven in push-pull with the center-tap of the source grounded, a somewhat higher value of deflector drive voltage must be used. The increased drive voltage is required to allow for those tubes in which the switching characteristics are somewhat offset with respect to zero voltage difference between deflectors.

For an accelerator voltage of +250 volts, the minimum deflector switching voltage occurs at a d-c deflector bias of approximately −8 volts; however, the d-c deflector bias is not particularly critical for focus as the deflection sensitivity characteristic exhibits a broad maximum. Care should be exercised, nevertheless, to assure that defocusing effects are not present whenever the tube is operated at conditions other than those recommended.

The circuit diagram for two 6AR8 tubes employed as synchronous detectorsπ in a color television receiver is shown. In this arrangement, positive voltages are applied directly to the accelerator grids and through load resistors R1, R2, R4 and R5 to each of the plates. The chrominance signal is applied to the control grid of each tube. The 3.58-megacycle reference signal is applied in push-pull between the deflectors of each tube. The small coupling capacitor, Cc, between the tuned driving circuits provides the necessary 90-degree phase shift for the I and Q detectors. Also each tube is biased with a cathode resistor, R3 and R6; resistor R6 is variable so that the relative gains of the two demodulators can be adjusted.

In principle, the 6AR8 circuit is a product-demodulator type of synchronous detector; however, because the circuit uses a double-plate sheet-beam tube rather than a dual-control pentode or heptode, certain significant operating features result. First the 6AR8 circuit is capable of delivering relatively large and balanced output voltages which exhibit good linearity. Because output voltages are available of both positive and negative polarities, the need for the incorporation of phase-inverter circuits in the matrix section of the color receiver is completely eliminated. Also, providing the oscillator reference voltage is adequate to switch the plate currents between the two plates, the circuit is insensitive to variations in the amplitude of the oscillator voltage over a wide range. Furthermore, unlike the pentode or heptode synchronous detector circuits in which the third grid is driven positive by the oscillator reference voltage, the deflectors of the 6AR8 require very little excitation power. Consequently, less power is required from the 3.85-megacycle reference oscillator in the sheet-beam tube circuit.

Another feature is that space-charge coupling effects, which are inherently present in dual-control pentodes and heptodes, are unnoticeable in the 6AR8. Also, unlike most dual-control pentodes and heptodes in which the screen current is an appreciable percent of the plate current, the accelerator current of the 6AR8 is less than one-twentieth of its plate current.

π R. Adler and C. Heuer, "Color Decoder Simplifications Based on a Beam-Deflection Tube," Trans. IRE, PGBTR-5, Jan. 1954.

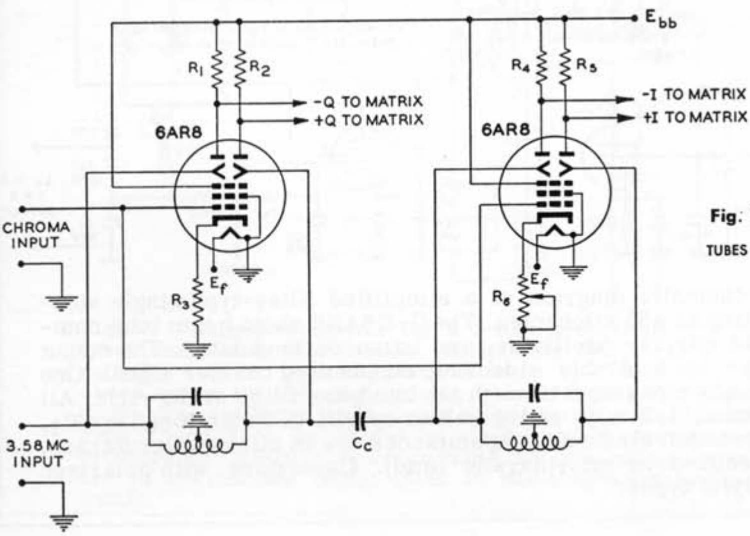


Fig. 2 CIRCUIT DIAGRAM OF TWO 6AR8 TUBES USED AS SYNCHRONOUS DETECTORS

TYPICAL CIRCUITS USING THE G-E 6AR8 SHEET BEAM TUBE IN AMATEUR RADIO APPLICATIONS

The G-E 6AR8 sheet beam tube is, by its very nature, suited for a number of circuit applications in amateur radio single sideband transmitting and receiving equipment. The following circuits illustrate these applications.

Component values as shown will provide normal performance of these circuits in most cases. However, in certain instances, the values of cathode resistances may require lowering to obtain optimum circuit performance. Also, shielding and other r. f. constructional practices, have not been shown.

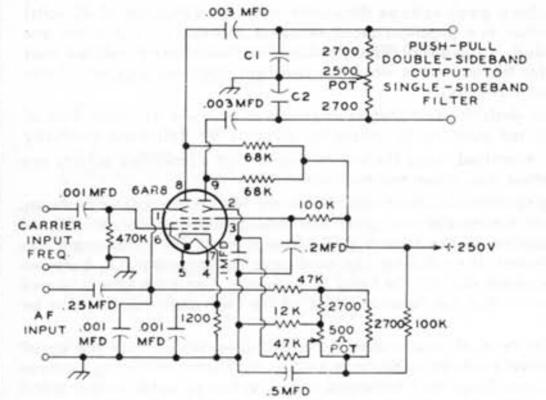


Fig. 3 Suggested circuit for a balanced modulator using the 6AR8 sheet beam tube with the audio signal applied to one beam deflecting plate, and the r.f. signal to be modulated applied to the control grid. All resistances are in ohms, 1/2 watt unless otherwise specified. "K" equals 1,000. Capacitance values are in microfarads (mfd), except where specified. Capacitors C_1 and C_2 should be equal in value, with a total series capacitance of the proper value to resonate the input side of the sideband filter at the operating frequency.

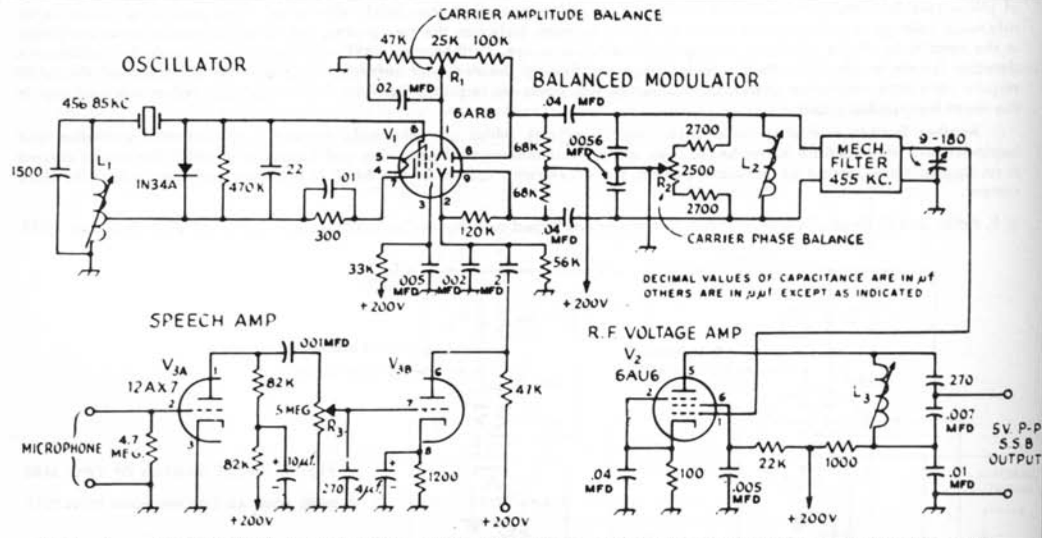


Fig. 4 Suggested schematic diagram of a simplified filter-type single sideband generator operating at 455 kilocycles. The G-E 6AR8 sheet beam tube combines the functions of carrier oscillator, and balanced modulator. The output from the 6AR8 plates is a double sideband, suppressed carrier signal. One sideband is removed after passage through the bandpass filter at the right. All resistances are in ohms, 1/2 watt rating unless specified. Potentiometers R_1, R_2 and R_3 have composition elements. Capacitances are in micro-microfarads, unless value is specified in microfarads (mfd). Capacitors with polarized markings are electrolytic types.

Fig. 5. Suggested schematic diagram of a G-E 6AR8 sheet beam tube operating as a combined tunable oscillator (VFO) and mixer. Circuit values are shown for a tunable oscillator operating at 3.3 to 3.6 megacycles, with a 455-kilocycle SSB signal applied to one beam deflection plate. The sum of the two input frequencies appears in the output circuit, T_1, tuned to the 3.8 to 4.0-megacycle range. The oscillator coil, L_4, has an inductance of 4.7 microhenries. It was wound on a 3/4-inch diameter ceramic coil form, with 21 turns of No. 20 enameled wire spacewound 1 inch long. The cathode tap is 3 turns, and the grid tap 10 turns, from the grounded end.

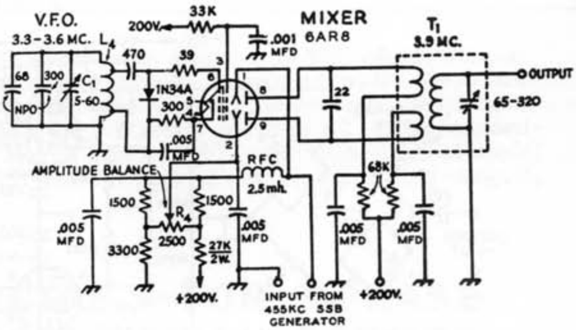
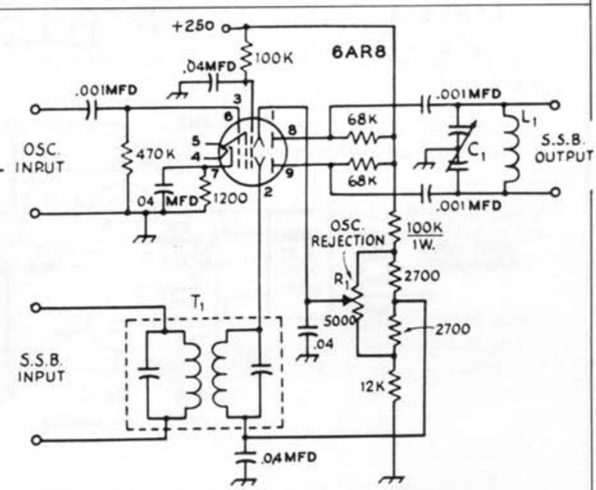


Fig. 6 Suggested schematic diagram for a 6AR8 tube in a balanced mixer circuit. This circuit is suitable for combining two input signals from a SSB generator and tunable oscillator (VFO), and obtaining either the sum or difference signal in the tuned output circuit, C_1--L_1. Conventional tuned circuits may be used here, and in T_1. All resistances are in ohms, 1/2 watt, unless specified. Capacitances are in microfarads (mfd). A linear taper composition potentiometer should be used for R_1.



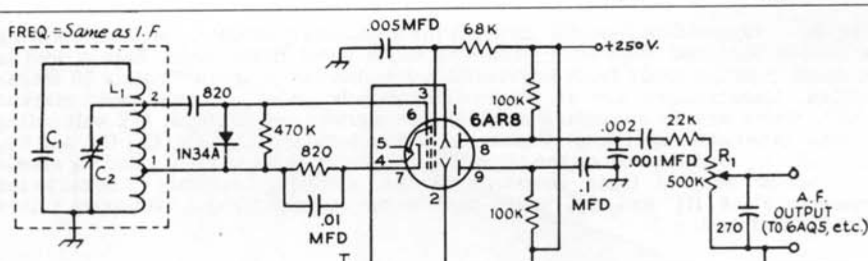


Fig. 7. Suggested circuit for a 1-tube product detector using the G-E 6AR8 sheet beam tube. The circuit contains its own carrier oscillator utilizing the cathode, control grid and number three grid elements. The beam deflecting plates are in the detection circuit, and the audio output signal is taken from the plates. The oscillator tuned circuit should have high capacitance for best stability. Taps 1 and 2 on L_1 should be about 5 and 25 percent, respectively, from the grounded end. Resistances are in ohms, 1/2-watt rating. Capacitances in decimals are in microfarads (mfd); those in whole numbers are in micro-microfarads (mmf).

BALANCED MODULATORS

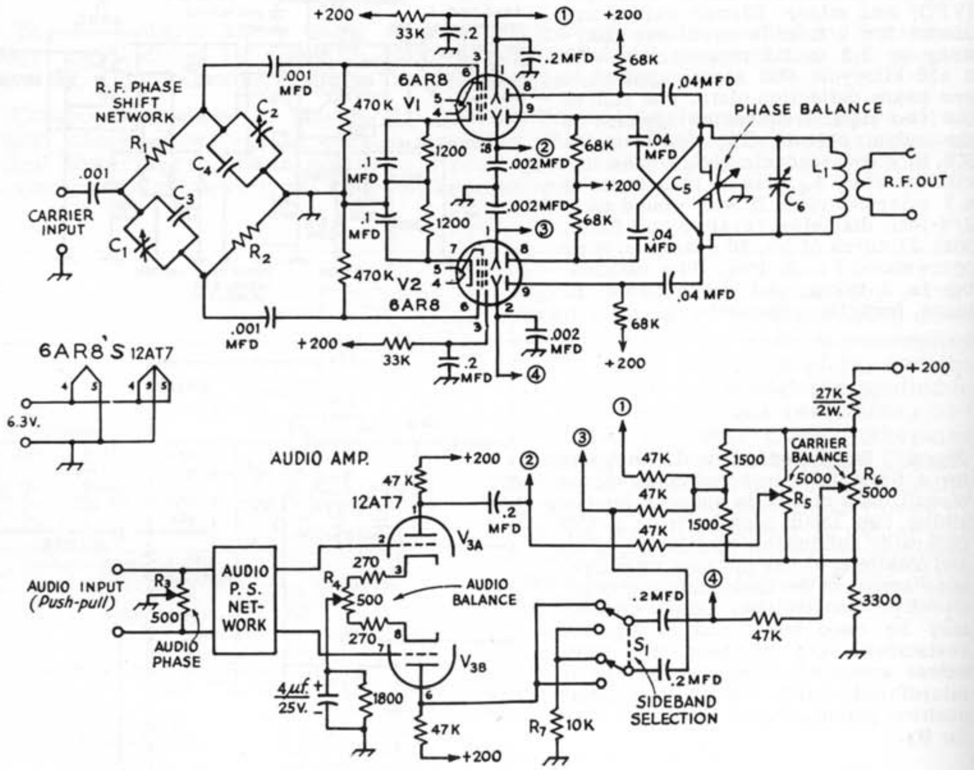


Fig. 8. Suggested schematic diagram for a phasing type SSB generator featuring a double balanced modulator with two 6AR8 sheet beam tubes. This circuit is suitable over the range from intermediate frequencies to approximately 30 megacycles. Capacitances are in micro-microfarads (mmf), except those marked "uf", which are in microfarads (mfd). Resistances are in ohms, 1/2 watt rating unless otherwise specified. Values for capacitors C_1, C_2, C_3, C_4, C_5, and C_6, and coil L_1 will depend on the operating frequency. Values for C_3 and C_4 should be chosen so that their reactance at the operating frequency is equal to the resistance of R_1 and R_2, which should be 100 ohms each, with exact values closely matched.

A SSB exciter construction article with the 6AR8 as a balanced modulator was described in the July, 1956 issue of CQ, on pages 24 to 31. This filter type exciter was designed and constructed by William I. Orr, W6SAI.

Additional material on applications of sheet beam receiving tubes has been published in the March, 1960 issue of QST magazine.

A new article showing the G-E 6AR8 as a balanced modulator in a simple double sideband transmitter, reconstructed from a surplus Command Set transmitter, appears in the May, 1961 issue of CQ magazine, on pages 48 through 51.

A new type of miniature sheet beam tube which has low output capacitances, and thus is capable of operating in balanced modulator circuits well into the VHF region, has just been announced by the General Electric Receiving Tube Department. It is known as the 7763 and will appear in G-E HAM NEWS articles during 1962.

JULY-AUGUST, 1960 (Vol. 15, No. 4) ISSUE--

HIGH-POWER MOBILE RADIO SYSTEMS: In addition to the information on receiving converters and W8WFH's Mobile Linear Amplifier which were described in the September-October, November-December, 1960 issues, respectively, details on a re-constructed version of W8DLD's parallel GL-814 grounded-grid linear amplifier appears in the March-April, 1961 issue. His original model was shown in the photo in the upper left-hand corner of page 6 in the July-August, 1960 issue.

CONSTRUCTION DETAILS FOR 3-PHASE DISTRIBUTION STEPUP TRANSFORMER

An excellent, efficient 3-phase distribution transformer which will step up the 12-volt 3-phase AC output from automotive alternators to 120 volts AC can be constructed using home workshop facilities. This transformer has been designed to use three sets of identical standard "E" and "I" shaped laminations. The iron should preferably be of audio transformer quality for highest efficiency over the wide frequency range of 60 to 1000 cycles delivered by the alternator at various engine speeds.

The unusual design of the windings in "pies" was chosen for high efficiency over the wide frequency range which must be covered. Design data will not be given here, but is based on sound principles. Results achieved in several completed transformers verify the efficiency of this design.

Actually, three separate identical transformers are constructed, and then connected together physically with strips of angle stock, as shown in Fig. 1. The three primaries, and the three secondaries, are connected in a "Delta" circuit, as shown in this view.

FIGURE NO. 1.

COMPLETED TRANSFORMER WITH WINDINGS IMPREGNATED IN INSULATING VARNISH, READY FOR INSTALLATION IN VEHICLE.

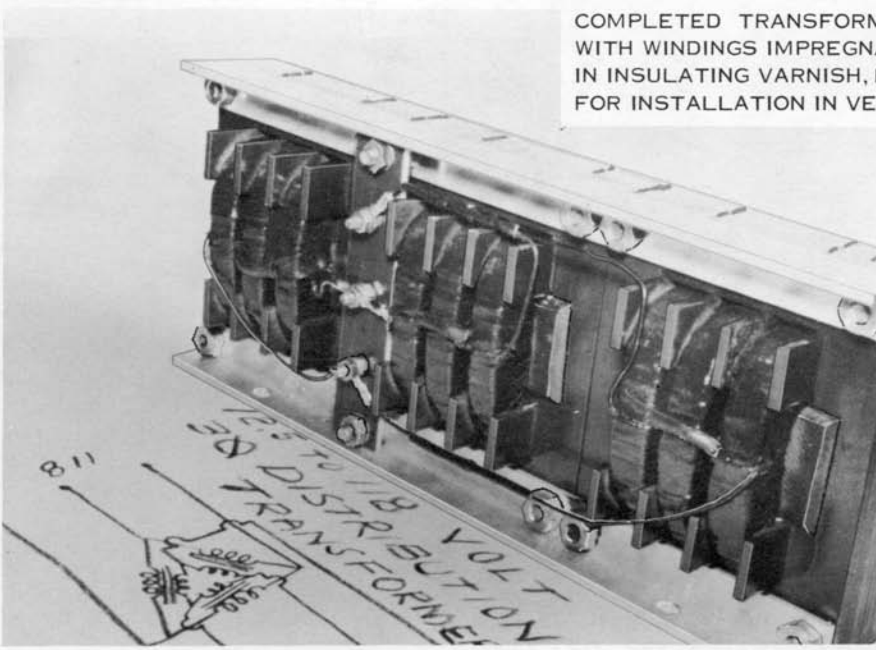


Figure No. 2 shows the winding mandrel. This one is made of brass, but could be made from plywood for the end pieces and clear maple for the split block. The core size will determine the exact size of this mandrel. This photo also shows one primary winding between two secondary windings. This is the way they look when taken off the mandrel. The three heavy wires out each side of the primary winding will later be cleaned and connected together. Obviously the secondary consists of two equal pies.

In Figure No. 3, the heavy wires on the primary have been connected and the windings wound with 1/2-inch wide varnished cambric tape. The core used is a 1-5/8 x 1-1/2 inch stack of good quality transformer iron. The wood spacers also show in the picture.

Note in Figure No. 4 that the primary has had connectors put on the heavy paralleled leads and the core has been assembled. Three of these transformers are then made into one unit with aluminum angle and 1/4-inch x 20 brass bolts. Also, the windings are connected in three phase delta as shown in Figure No. 1. The one foot long rule on top of the transformers shows the size.

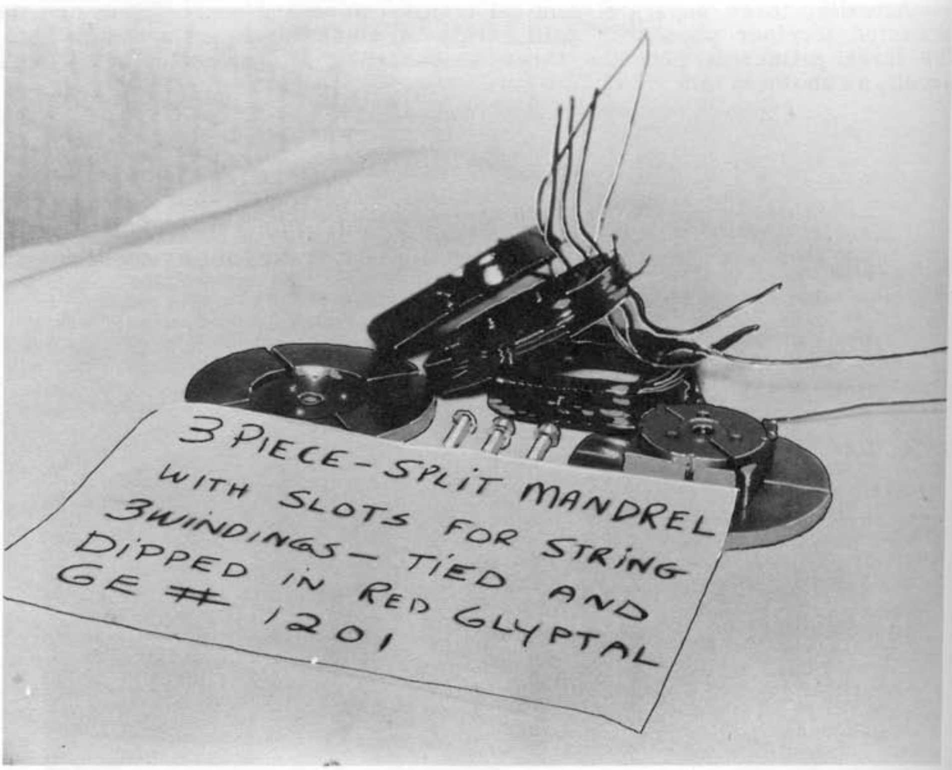


FIGURE NO. 2. VIEW OF WINDING MANDREL AND ONE SET OF COMPLETED COILS.

Material necessary:

1. Three identical transformer cores with "E" and "I" type laminations. Core area should be at least 2 1/4- square inches; this means a cross section of at least 1-1/2 x 1-1/2 inches. The core described measured 1-5/8 x 1-1/2 inches. Obviously the winding information is for this size core, but can be easily adapted to another size through simple arithmetic.
2. Two pounds of No. 14 Formex (type HF) magnet wire for primaries (three windings necessary). Four pounds of No. 16 Formex (type HF) magnet wire for secondary windings (six windings necessary).
3. 24 wood spacers (soft white pine) 1/8 x 5/8 x 3-1/8 inches.
4. 6 wood spacers (soft white pine) 1/8 x 1-1/2 x 3-1/8 inches.
5. One 4-inch diameter roll of 1/2-inch wide varnished cambric tape.
6. 36 feet of good lacing twine (Used to tie windings before removing from mandrel).
7. 1 Gal. No. 1201 GE red glyptal paint (or equivalent good insulating varnish).
8. 4 pieces aluminum angle to mount three transformers in a frame. My unit takes 12-1/4 inches long by 3/4 x 3/4 x 1/8 inches in cross section.
9. 10 BRASS bolts and nuts 2 x 1/4 x 20 inches.
   2 BRASS bolts and nuts 2-1/2 x 1/4 x 20 inches (extra length to mount terminal strip).
10. Terminal strip for 3-phase 120 volt connections, 3/4 x 1 x 1/8 inches (GE textolite, or other insulating board).
11. 3 - 8 x 32 brass bolts, lock washers and six nuts to complete terminal strip.

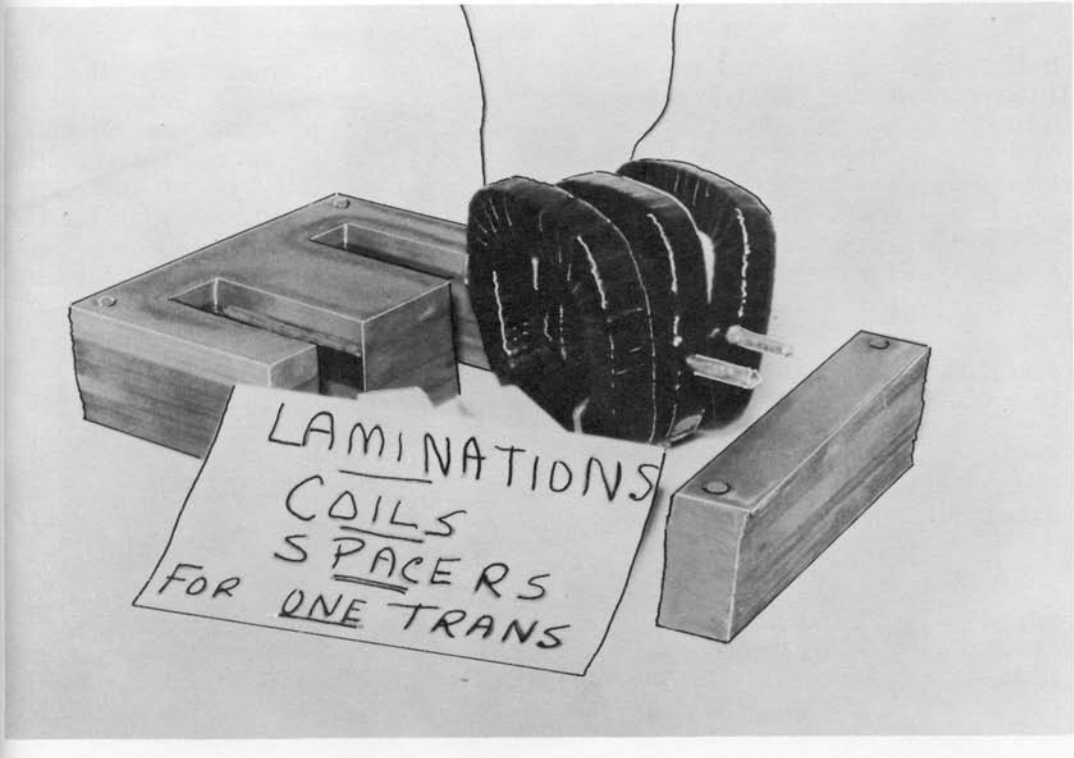


FIGURE NO. 3. VIEW SHOWING THE THREE SETS OF HEAVY WIRES FROM THE 12.6–VOLT PRIMARIES CONNECTED. SECONDARY LEADS SHOW AT TOP.

No terminal strip is necessary for primary of transformer. Connect three #8 flexible GE flaminel wire leads permanently to connect transformer to alternator.

Primary (12.6 volt) 19 turns No. 14 Formex wire. Winding consists of 3 separate wires that are parallel connected after winding is complete. (Tied with string, dipped in 1201 red Glyptal, and taped with varnished cambric). Due to low voltage (12.6 volt) no insulation is used between layers or windings. Wind on first 19 turns, then second 19 turns, then third 19 turns. This completes winding. Try to keep each winding smooth so turns do not pile up or there will not be enough room to get third winding on mandrel.

Secondary: (120 volt) 94 turns No. 16 Formex wire. Wind on two 60 volt windings connected in series. Each half of the secondary has 94 turns or the total primary has 188 turns. Try to keep a smooth winding, layer by layer, or there will be trouble in getting the 94 turns on the mandrel. No insulation is used because the voltage (60 volts) is low and the 1201 red Glyptal and HF type wire give adequate insulation.

The finished transformer can be connected to 115 volt 60 cycle and allowed to run until temperature rises to 180 degrees F. and then given a final dip in 1201 Glyptal. Unless the 12.6 volt primary is loaded, it will take a couple of hours to get the transformer hot running from 115 volt 60 cycle power. Remember it is designed for a minimum of 100 cycles so will eventually get hot running on 60 cycles. You may prefer to heat the transformer in an oven if available.

This transformer bank must be mounted near the alternator. It will probably get wet. Do a good job on the dipping and insulation and you can forget it indefinitely.

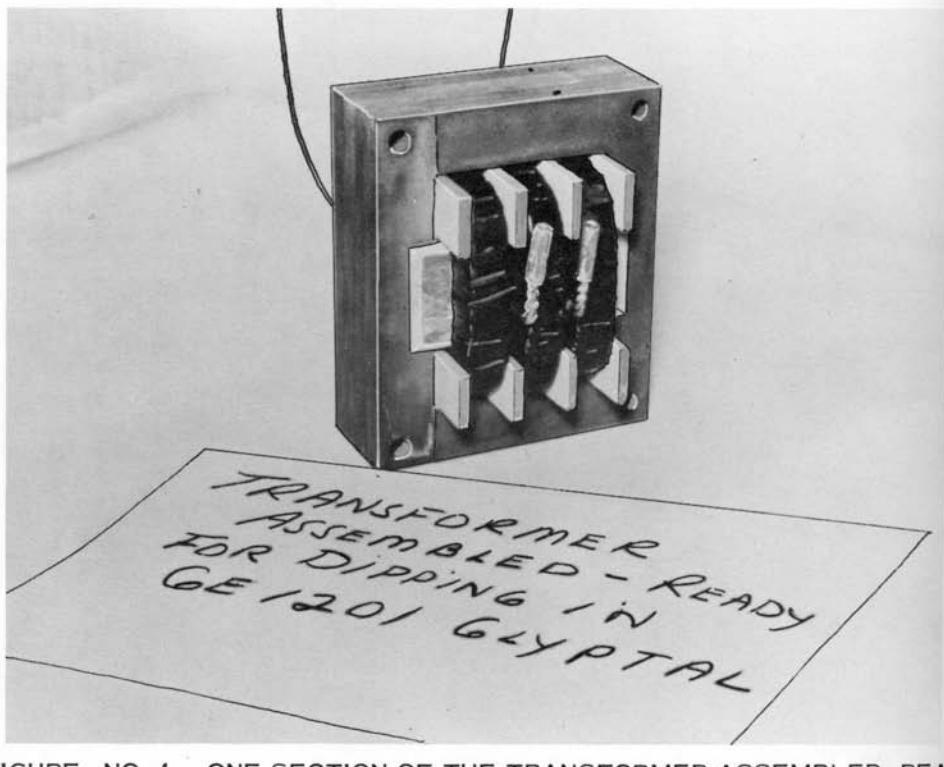


FIGURE NO. 4. ONE SECTION OF THE TRANSFORMER ASSEMBLED, READY FOR FINAL DIP IN INSULATING PAINT OR VARNISH.

It is also possible to use this same transformer design to wind a 3-phase transformer with higher voltage secondaries, rather than the 120-volt secondaries described here. Windings which will deliver several hundred volts can be substituted, thus making it possible to step up the 12-volt alternator output directly to high voltage. When the three transformer secondaries are connected in a 3-phase star fashion to a suitable rectifier, as shown in Figures 7 and 9 on pages 6 and 7 of the July-August, 1960 issue, the DC output voltage from the rectifier will be 2.34 times the voltage across one secondary winding.

For example, if 1,000 volts DC are required, each secondary may be wound to deliver 430 volts AC. Based on the 120-volt winding having two 94-turn coils, a 430 volt winding would have two coils of 340 turns each, or a total of 680 turns on each secondary. This wire size would be smaller, of course, since the output current requirements would be much lower than that of the 120-volt windings. Wire sizes from No. 20 to No. 24 would be chosen. Additional insulation would have to be used around the secondary, because of the higher voltages present.

HINTS AND KINKS

Before mounting anything in the car, get the alternator installed and tested. Complete installation kits are available for most cars. If one is not made for your car - trade the car! Once the alternator installation is complete and the regulator is working properly, holding the battery at 13.5 to 14.00 terminal volts, install the distribution transformer. Connect the primary solidly to the alternator terminals. Do not use fuses or a relay switch in this high current low voltage circuit. The alternator is belt driven so the protection is there if a direct short circuit happens.

Test the transformer regulation in this manner: Get six porcelain lamp sockets, a double pole single throw knife switch, three 60 watt lamps and three 200 watt lamps. Connect as shown in Figure No. 5 on page 5 of the July-August issue. The three 60 watt lamps present a balanced 180 watt load to the alternator. They represent the small load required by your equipment in the "stand-by" condition. Measure the voltage. It should be approximately 120 volts per phase.

Now close the switch and throw on the 600 watt load. Read the voltage. It should be at least 110 volts. This represents a "voice peak" when the transmitter is drawing full load. Try this test at different engine speeds. The carburetor idle adjustment must be set so the voltage will not fall below 100 volts at slowest speed. You may not like this with an automatic transmission but most cars creep a little anyway so yours will creep a bit more. This adjustment is made at full load of 780 watts. (600 180). I refer to the 100 volt idling limit. 110 volts should be just a few RPM's faster.

Summarizing the installation and operation of 3-phase AC power systems in automobiles for more efficient operation of mobile radio equipment, remember the following points:

1. The alternator manufacturer, such as Leece-Neville, puts a rating on the complete system he sells. You buy a 50-ampere, 12 volt system or 100 ampere, 6 volt system. On the surface this looks like the alternator is capable of supplying 600 watts at the battery terminals by way of a rectifier. This is all true. What is left out is that the rectifier carries an exact maximum current limit. It is responsible for the 600 watt limitation. The alternator is capable of delivering much more power. Years of field use indicate the rating of the alternator alone to be well above one KVA. This is under summer 85 degree F. temperature with the normal cooling in a car in motion.
2. Idling speed of an alternator in ordinary car usage is 100 or more cycles. Maximum frequency may go as high as 1000 cycles.
3. Three phase full wave rectification has only 5% ripple before filtering. Ripple frequency from a 3 phase full wave rectifier is six times the AC supply frequency.
4. Filtering a 3 phase full wave DC power supply is extremely easy because the ripple is always 6 times the AC cycle input frequency. (See statement #3) A condenser of 2 to 6 MF is usually adequate when supplying an RF stage. For audio stages a small 4 Henry choke is desirable along with two 4MF condensers in a "brute force" filter.
5. Modern 115 volt 60 cycle transformers work well on 100 to 1000 cycles. Ratings can be exceeded considerably using a minimum of 100 cycles on a 60 cycle transformer design.

Heavy duty filament transformers can be used as step up transformers for high voltage power supplies operated directly from the output of a 12-volt, 3-phase alternator without the distribution transformer described in this bulletin. Simply take three 6.3-volt filament transformers and connect these windings in delta across the alternator supply. Then, each 115-volt secondary can be fed into a star bridge rectifier circuit, as shown on page 7 of the July-August, 1960 issue. The DC output voltage will be 2.34 times the 230-volt output of one secondary, or about 700 volts. Or, doubler type rectifier circuits could be used to obtain 1,000 to 1,400 volts DC.

SEPTEMBER-OCTOBER, 1960 (Vol. 15, No 5) ISSUE--

CRYSTAL CONTROLLED MOBILE CONVERTERS-W8DLD also describes his proven method of converting the BC-453 low-frequency Command Set receiver to operate with these converters. A more powerful audio amplifier, fast-acting AVC and "S" meter circuit, and a sideband selector switch also are described.

NOVEMBER-DECEMBER, 1960 (Vol. 15, No. 6) ISSUE--

MOBILE LINEAR AMPLIFIER--an excellent bandswitching class AB_1 linear amplifier for mobile or home-station service with two GL-4D21/4-125A pentodes. W8WFH, the author has since designed and built an all-band mobile SSB transceiver to drive this linear amplifier. Details will be published in a 1962 issue of G-E HAM NEWS.

USING THE NEW 12-VOLT AUTO RADIO RECEIVING TUBES IN AMATEUR RADIO EQUIPMENT

The line of General Electric receiving tubes designed for operation with the heater, screen grid and plate voltages supplied directly from a source of 12-volt direct current, makes possible amateur radio equipment with reduced power drain for mobile and portable operation. A general list of suggestions has been compiled to aid those persons who wish to convert mobile radio equipment, originally having the older high-voltage tube types, to use these tubes. While we do not have step-by-step instructions for making such a conversion in any specific receivers or transmitters, the following "ground rules" should be observed if the conversion is to be successful, and for best performance.

1. Since the tubes are designed to operate with only 12 volts on the plates and screen grids, it usually will be necessary to short out all series voltage-dropping resistors in these circuits; i.e.: plate voltage decoupling resistors and screen grid voltage dropping resistors. When the screen voltage is obtained from voltage divider resistors, the resistor from the 12-volt source to the screen grid may be shorted out, but one end of the resistor running from the screen grid to the chassis or ground should be disconnected.

2. Since most of the new 12-volt tubes are designed to operate with "contact potential" bias, any cathode bias resistors, connected between the cathode pin on the tube socket and the chassis, should be shorted out.

3. For most 12-volt tubes, insert a high resistance in series with the DC path from the control grid, or signal grid, to the chassis, to provide the "contact potential" bias. This type of bias replaces the cathode biasing system used with most high-voltage tubes. The technical data sheet for each type of 12-volt tube usually specifies the maximum value of this bias resistor.

4. The interstage coupling devices originally designed to work with the high-voltage type tubes--RF, IF and audio transformers; resistance-capacitance networks; etc.--usually will work with the 12-volt line of tubes. In certain circuits, however, the peak-to-peak signal voltages encountered in the original circuits may exceed the signal voltage that can be handled by the 12-volt tubes without encountering distortion. Usually, the smaller signal voltage swings resulting when the entire low-level section of a receiver is converted to use the 12-volt tubes, will overcome the overloading problem.

BACK ISSUES OF G-E HAM NEWS

Single copies of certain back issues are still available--as long as the supply lasts--from the G-E HAM NEWS office at the address given below. However, many of the issues listed in the CROSS INDEX at the front of this supplement are no longer available. The following issues are in stock, or will be after the publication dates:

PACKAGED VHF EXCITERS (for 50 and 144 Mc.)	May-June 1958	(Vol. 13, #3)
SPECIAL DX LOG ISSUE - 5th Revision	July-August 1958	(Vol. 13, #4)
200-WATT DOUBLE SIDEBANDER (Part I) - (6146's-covers 3.5 to 30 Mc.)	May June 1959	(Vol. 14, #3)
SOLID HIGH-C VFO; also 200-WATT DOUBLE SIDEBANDER- (Part II)	July-August 1959	(Vol. 14, #4)
KILOWATT GROUNDED-GRID LINEAR-AMPLIFIER (GL-813's for 3.5 to 30 Mc.)	November-December 1959	(Vol. 14, #6)
NEW AUDIO TUBES-ALL BAND BALUN COIL-SIMPLIFIED COIL DESIGN	January-February 1960	(Vol. 15, #1)
SINGLE BAND MOBILE TRANSCEIVER- (15 Watts on 3.9 Mc.)	March-April 1960	(Vol. 15, #2)
HIGH-POWER MOBILE RADIO SYSTEMS- (3-Phase AC Alternator & Transformer info)	July-August 1960	(Vol. 15, #4)
HIGH-POWER MOBILE LINEAR AMPLIFIERS (pentode GL-4D21/4-125A's for 3.5 to 30 Mc.)	November-December 1960	(Vol. 15, #6)
THE OMNIVOX-(Audio preamp/VOX and phone patch for amateur transmitters)	January-February 1961	(Vol. 16, #1)
POWER CONTROL BOX-(Centralized power source for the station)	" " "	"
SSB 600 LINEAR AMPLIFIER (Compact mobile linear with GL-814's in Grounded Grid Circuit)	March-April 1961	(Vol. 16, #2)
LOW-COST RF WATTMETER - (measures transmitter power output and reflected power)	May-June 1961	(Vol. 16, #3)
TWO-TUBE DIFFERENTIAL KEYER- (Keys screen grid and negative bias voltages for transmitters)	" " "	"
MODERN HETRODYNE EXCITER-(extra length feature article on 5-tube bandswitching exciter with 35 watts output)	July-August 1961	(Vol. 16, #4)
TRANSMITTER PROTECTIVE CIRCUITRY- (Protect valuable transmitting tubes against overload)	September-October 1961	(Vol. 16, #5)
INDUCTIVE TUNING FOR THE HIGH-C OSCILLATOR- (Unusual tuning arrangement for VFO's)	" " "	"
THE LWM-3--A BANDSWITCHING SSB MOBILE TRANSCEIVER PART I - Electrical and Circuit Features	November-December, 1961	(Vol. 16, #6)
PART II - Mechanical Features and Construction	January-February, 1962	(Vol. 17, #1)
G-E HAM NEWS SPECIAL DX LOG ISSUE - 6th Revision (Bigger, complete Official Countries Listing, and other handy information for the DX'er)	March-April, 1962	(Vol. 17, #2)