A 20-WATT DSB TRANSMITTER FOR 3.8-4.0 MEGACYCLES

Get started on rapidly growing double sideband with this simple, junior-sized—but complete—transmitter designed by K2GZT (ex-W6AHM). If this little rig looks familiar, you're one of literally thousands of radio amateurs who have examined it personally at ARRL conventions, and club meetings, during the past several months.

—Lighthouse Larry

CONTENTS

DOUBLE SIDEBAND JUNIOR ........................................ page 2
1957 Edition Award Winner—K5BQT ................................ page 6
G-E HAM NEWS Reader Survey ..................................... page 7
Sweeping the Spectrum ............................................... page 8
To say that radio amateurs have been expressing considerable interest in the double sideband, suppressed carrier system would sound like an understatement of the year. This has been obvious from the soil diet articles on the subject in recent electronics journals (see bibliography on page 8); also from the steady flow of requests for more information on double sideband in Lightbody Larry’s mail box.

1. Double sideband is a suppressed carrier system. This is another step toward eliminating heterodyne interference—and the final amplifier power capability is not wasted on a carrier.

2. Since the output waveform is a replica of the modulating waveform, each clipping may be employed to increase the average intelligence power.

3. A double sideband transmitter is quite insensitive and simple compared to either amplitude modulated or single sideband equipment.

4. Modulation may be accomplished at the operating frequency.

5. Frequency diversity is inherent in the double sideband system. (The receiving operator has his choice of the more modulable of two sides.)

6. Double sideband can be received with either a single sideband or synchronous detection receiver. Therefore, it is compatible with single sideband. The synchronous receiver gains transmitter stability requirements by phasing locking to the double sideband signal.

**CIRCUIT DETAILS**

In a double sideband transmitter, the modulation process occurs in an amplifier using two triode or pentode tubes, called a balanced modulator. Recently published double sideband modulator circuits—a simple, low-cost version among them—require no RF driving signal applied to the control grids in push-pull; the RF driving signal is applied to the screen grids in push-pull. The tube plates are then connected in parallel and the RF carrier, this circuit is particularly suited to high power balanced modulators, since an extremely high voltage supply is required.

A simple, low-cost schematic diagram for the DOUBLE SIDEBAND JUNIOR transmitter. Fig. 2, reveals how the stage stage consists of two Type 6AQ5 pentode tubes (V6 and V10 with the control grids vanced off). Each stage is a push-pull type with a transformer coupled to the push-pull plate circuit.

The RF output is linked, therefore, by the push-pull plate circuit.

The grid are driven by a crystal controlled oscillator, one half of a 11557 twin triode tube (V9). The other half (V0) is the audio modulator stage. The RF output stage is in a second audio transformer coupled from the modulator stage. The tone control of Z is connected backwards to the output of the second audio transformer (V3) and is connected to the plate of V10. The RF output stage is supplied in parallel to the control grids of the 6AQ5 tubes is coupled out in the push-pull plate circuit.

With no modulation the plate current in both final tubes will be high because of the low source voltage. If a sinusoidal audio tone is assumed as the modulating

---

**Fig. 1. Schematic diagram for the balanced modulator circuit used in most double sideband transmitter descriptions. Parts values are dependent on tube type and frequency.**

---

signal, one screen is driven positive during the first half-cycle and the other is driven negative. The 6A55 having positive screen grid conducts and an RF current is supplied to the load by that tube. During the next half of the audio cycle, the other tube supplies RF power to the load and the first tube rests. Note that only one tube is working at any one time, except when there is no audio, then both tubes rest. Neutralization is no problem, as the balanced modulator circuit is self-neutralizing.

A positive bias for the 6A55 driven grids—about 15 volts—is developed across the 2000-ohm resistor in the cathode circuit of the modulator tube (V5). Current for operating a carbon microphone is supplied through the 1500-ohm resistor. The two audio voltage amplifier stages employ a 12AX7 twin triode (V2). The first stage is driven by a single button carbon microphone through a matching transformer (T1). The first audio stage drives a three stage diode clipper circuit which clips both positive and negative audio signals. The clipping level is adjusted by varying the positive bias on the clipping diodes D1 and D2. This bias is obtained from a 1000-ohm potentiometer in series with the cathode-to-chassis circuit of the second audio amplifier stage (V4). A simple pie-selector audio filter (C1, C6 and L1) following the clipper suppresses the audio harmonics ("spatter") generated in the clipping process. The second audio stage then drives the modulator (V0).

Push-to-talk operation of the transmitter is obtained simply by grounding the cathode of the crystal oscillator tube (V9) through a single pole, single throw, normally open push-button switch of the type found on most single button carbon microphones (see surplus 5-137, or Electro-Voice Model 210-1R5). If the push-to-talk feature is not desired, substitute a two conductor phone jack for the three conductor jack (J) shown in Fig. 2.

Additional audio amplification will be required if a low-output crystal, ceramic or dynamic microphone will be used with the transmitter in place of the carbon microphone. This extra gain can be obtained with 12AX7 twin triode tube in a two-stage audio preamplifier. The circuit for this amplifier will add 1000 volts at an output of 1000, is shown in Fig. 2. The 12AX7 tube then gains about 20 volts. The output of the second stage (V4) feeds directly into the grid of the lope transformer. If the push-to-talk phone voltage circuit can thus be eliminated.

The transmitter may be constructed with the high voltage power supply shown in the main schematic
The Rs are used, conventional balanced tank resonant with audio lower delivery diagram; 500 volts working.

Since operation of sideband transmitter, the high voltage power supply, shown within dotted lines, may be eliminated if a suitable supply already is available. The optional audio preamplifier appears in the upper left-hand corner. Capacitances given in whole numbers are micro, 500 volts working; those in decimals are microfarads, 300 volts working. Resistors are 1/2 watt unless otherwise specified.

MECHANICAL DETAILS

The transmitter shown on page 1 was constructed on a 7 x 13 x 3-inch aluminum chassis (Bud AC-408). A smaller chassis, or utility box, will hold the RF and audio components, especially if the power supply is constructed on a separate chassis. Of course, a suitable high voltage supply already is available, utility boxes.

The same relative locations for major parts, as shown in the chassis drilling diagram, Fig. 5, should be followed. If the audio preamplifier for low output microphones is to be included, the tube mounting hole is placed in the location indicated on this diagram. The

No special effort has been made to achieve a high order of carrier suppression. However, laboratory measurements indicated 40 db of suppression in the original model. At least 30 db of carrier suppression should be obtained with reasonably symmetrical wiring in the RF output circuit. In most cases, the audio hum and noise level will be about equal to the carrier level.

No special effort has been made to achieve a high order of carrier suppression. However, laboratory measurements indicated 40 db of suppression in the original model. At least 30 db of carrier suppression should be obtained with reasonably symmetrical wiring in the RF output circuit. In most cases, the audio hum and noise level will be about equal to the carrier level.

No special effort has been made to achieve a high order of carrier suppression. However, laboratory measurements indicated 40 db of suppression in the original model. At least 30 db of carrier suppression should be obtained with reasonably symmetrical wiring in the RF output circuit. In most cases, the audio hum and noise level will be about equal to the carrier level.


**DRILLING LEGEND**

- "A" drill—No. 32 for miniature tube socket hardware.
- "B" drill—No. 26 for fastening terminal strips and larger components.
- "C" drill—1/8 of an inch in diameter for L1.
- "D" drill—1/16 of an inch in diameter for controls, grommets, etc.
- "E" socket punch—3/16 of an inch in diameter for 7-pin miniature tubes.
- "F" socket punch—1/16 of an inch in diameter for 9-pin miniature tubes and grommet under T3.
- "G" socket punch—1/8 inches in diameter for 4-pin miniature tubes and grommet under T3.

"H" drill—1/2 of an inch in diameter for 11/4-inch deep chassis. Tube sockets should be mounted with pin 1 in the position indicated at each socket hole. The socket for the optional audio preamplifier tube (12AU7) and gain control (RA) are located as shown.

Fig. 3. Chassis deck and front panel drilling diagram for the double sideband transmitter. Dimensions are shown from the edges of a 7 x 12 x 3-inch deep chassis. Tube sockets should be mounted with pin 1 in the position indicated at each socket hole. The socket for the optional audio preamplifier tube (12AU7) and gain control (RA) are located as shown.

Fig. 4. Top view of the double sideband transmitter, showing the locations of major parts on chassis deck. Check to see that sufficient space is provided for components which differ in size and shape from those listed. The audio filter inductor (L2) and the microphone transformer (T3) should be oriented in the positions shown to prevent inductive hum pickup from the power transformer (T1).

Fig. 5. Bottom view of the chassis, showing placement of smaller parts on the tube sockets and terminal strips. Power wiring is run in corners and across the center of the chassis. Wires carrying audio and RF voltages should be made as short as possible.
The audio preamplifier stage, which was used for the audio transmitters, was constructed on a chassis with holes. The locations of these holes are shown in Fig. 6.

Once the transmitter has been completed, it should be tested on a dummy load consisting of a 15- or 25-watt, 115-volt incandescent lamp. The test procedure consists of the following steps:

1. Apply power and insert a crystal for the 3.8-4.0-megacycle phone band. Depress the microphone push-to-talk switch.

2. Adjust L3 to resonance while observing the final amplifier grid current at a milliammeter inserted at J1. A grid current of 3 to 4 milliamperes is required for proper operation.

3. Set R7 to its midpoint. Adjust L4 for closest scope. Whistle into the microphone and adjust C10 for maximum output power or maximum brilliance of the dummy load lamp.

4. Observe the RF output voltage with an oscilloscope. Either the bowie or envelope presentation may be used. Whistle into the microphone. Succeedingly adjust the output coupling and clipping level (R3) for maximum output voltage consistent with linearity.

5. Upon successful completion of testing with a dummy load, the transmitter may be connected to a transmitting antenna. The antenna should preferably be a low impedance tuned antenna, such as a dipole or folded dipole. If a long wire antenna is used, an antenna tuner should be used to transform the antenna impedance down to a value suitable for line coupling. When the transmitter is connected to the antenna, step 4 should be repeated to ensure that the output stage is properly adjusted and not overloading on positive peaks. The output of the final transistor should not be measured at J1. The plate current will have a rating value of about 30 ma and will rise to about 40 ma with modulation.

Although the basic transmitter is crystal controlled, the output of a variable frequency oscillator may be fed to the grid of the final stage. Such an oscillator may be built with a 6AQ5 valve and a 3.8-megacycle crystal. A 430-volt filter capacitor in the plate voltage decoupling filter should be placed in the circuit behind J1.

**ADJUSTMENT AND OPERATION**

Once the transmitter has been completed, it should be tested on a dummy load consisting of a 15- or 25-watt, 115-volt incandescent lamp. The test procedure consists of the following steps:

1. Apply power and insert a crystal for the 3.8-4.0-megacycle phone band. Depress the microphone push-to-talk switch.

2. Adjust L3 to resonance while observing the final amplifier grid current at a milliammeter inserted at J1. A grid current of 3 to 4 milliamperes is required for proper operation.

3. Set R7 to its midpoint. Adjust L4 for closest scope. Whistle into the microphone and adjust C10 for maximum output power or maximum brilliance of the dummy load lamp.

4. Observe the RF output voltage with an oscilloscope. Either the bowie or envelope presentation may be used. Whistle into the microphone. Succeedingly adjust the output coupling and clipping level (R3) for maximum output voltage consistent with linearity.

5. Upon successful completion of testing with a dummy load, the transmitter may be connected to a transmitting antenna. The antenna should preferably be a low impedance tuned antenna, such as a dipole or folded dipole. If a long wire antenna is used, an antenna tuner should be used to transform the antenna impedance down to a value suitable for line coupling. When the transmitter is connected to the antenna, step 4 should be repeated to ensure that the output stage is properly adjusted and not overloading on positive peaks. The output of the final transistor should not be measured at J1. The plate current will have a rating value of about 30 ma and will rise to about 40 ma with modulation.

Although the basic transmitter is crystal controlled, the output of a variable frequency oscillator may be fed to the grid of the final stage. Such an oscillator may be built with a 6AQ5 valve and a 3.8-megacycle crystal. A 430-volt filter capacitor in the plate voltage decoupling filter should be placed in the circuit behind J1.
HEROIC TRIOS (UPPER RIGHT)—James E. Harrington (center), K5BQT, winner of General Electric’s 1957 Edison Radio Amateur Award, is shown with his two companions re-enacting their mission of mercy down the Calcasieu River on a fishing boat last June after Hurricane Audrey. With Sgt. Michael J. McDermott, K5CTQ, both of the Lake Charles Air Force Base—Harrington unloaded heavy radio gear (CENTER, RIGHT) through flood waters, set up, and operated for three days at devastated Cameron, La. More than 1,200 emergency messages were handled in the disaster which took more than 500 lives.

At home, K5BQT proudly displays his new call-letter license plate to Mrs. Mae Harrington (CENTER, LEFT); and operates his home station (BOTTOM) while son Bill, 11, looks on.
**READERS!**

**I NEED YOUR HELP!**

Since amateur radio is a rapidly growing and continuously changing hobby, I would like to know more about your current interests. Please take a moment or two to read the questions below and mark your answers on the coupon at the bottom of this page. Then clip the coupon, and return address above it, paste them securely on a postal card, and mail it to me. Your cooperation will help me plan articles on your favorite subjects for future issues of G-E HAM NEWS.

—Lighthouse Larry

(Do not mark boxes on coupon after each question number.)

1. Are you a regular reader of G-E HAM NEWS? If yes, do you obtain your copy from: a. The counter of a G-E Tube distributor? b. By mail from a G-E Tube distributor? (look for his imprint in address space on back page) c. By paid subscription directly from me? Other?


5. What items of your station equipment are: a. Home built? b. Manufactured? (check proper box on answer coupon below)

6. What is your: a. Profession or occupation? b. Name and address of firm?

7. Or are you a student of Electronics? Other?

8. What would you like to see in future issues of G-E HAM NEWS?

9. Please fill in your name and home address if you wish to receive the recent back issues of G-E HAM NEWS.

(clip along dotted lines)

---

**G-E HAM NEWS READER SURVEY**

(clip coupon and return address, paste onto postal card and mail)

1. **Yes** ☐ **No** ☐ a. ☐ b. ☐ c. ☐ d. ☐ Other

2. **Yes** ☐ **No** ☐ a. ☐ b. ☐ c. ☐ d. ☐ Other

3. a. ☐ b. ☐ c. ☐ d. ☐ Other

4. a. ☐ b. ☐ c. ☐ d. ☐ Other

5. a. ☐ b. ☐ c. ☐ d. ☐ Other

6. a. ☐ b. ☐ c. ☐ d. ☐ Other

7. **Yes** ☐ **No** ☐ Other

8. 

9. 

---

G-E HAM NEWS READER SURVEY

General Electric Company
Electronic Components Division
Building 267-2
Schenectady, N.Y., U.S.A.
Sweeping the Spectrum

MEET THE DESIGNER—John R. Webb, K3GET, took a
beam's holiday from his predominate as electrical de-
signer on synchronous and other communica-
tions systems at our Light Military Electronic Equip-
ment Division, Rocky point, N. Y. Result: The
DOUBLE SIDEBAND JUNIOR transmitter in this
issue!

Some measure of Jack's enthusiasm for double side-
band can be garnered from his many presentations
on this subject at trade shows, amateur radio conve-
ventions, hamfests, and club meetings. Of course, his little trans-
mitter usually accompanies him as his favorite "con-
versation piece."

First licensed as Wa3HML in Kansas during 1947,
Jack's association with electronics includes AM broad-
casting 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 phoning a pair of GL-6146's in a—
you guessed it—double sideband rig!

D. H. S.

When the judges for the 1957 Edison Award met late in
January, they not only chose K3QFY as the prin-
cipal winner, but drafted a public service commenda-
tion to be awarded to the following officially nominated
candidates for the 1957 award:

W1MCL, W1FGV, W2JZK, W2RUF, K2AGV, W2JCP,
W3ECP, W3FV, W4BWA, W4SBI, W4GAT, W4SBR,
W5GTV, W5KOB, W5LZW, W5TIE, W5SYL, W5LB,
W5JG, W5JZZ, W5JRA, W5WB, W5XK, W5XCV,
W5DC, W5FAT, W6EMB, W6NPR, W6AHT, W6XH,
W6HKL, W7OEX, W7IOQ, W8RHK, W8HSG, W8IHE,
W8GMN, W8GMQ, W8GMV, W8HSG, W8JUL, W8KQ,
W8LTV, W8CBY, W8CSY, W8HSG, W8KQ, W9BUK,