Our DOUBLE SIDEBAND JUNIOR article a year ago sparked much interest in a more powerful double sideband transmitter with bandswitching. Now several radio amateurs at General Electric have combined their ideas in this transmitter with 200-watt peak power input capability from a pair of 6L46 beam pentodes in the output stage. The complete circuit, and constructional details on the plug-in r.f. unit, is in this issue. Part II, in the July-August, 1959 issue, describes the main chassis containing audio system, power supplies and control circuits.

Lighthouse Larry
TALK ABOUT DX RECORDS—our tiny 7077 microminature ceramic receiving tube has established a "universe record" for long-distance communications—407,000 miles!

And this was accomplished with milliwatts—not kilowatts—of r.f. power at 900.05 megacycles. A 7077 delivered 180 to 250 milliwatts as a class B amplifier in the transmitter of the Pioneer IV satellite now hurtling in orbit about the sun. Strong signals from the transmitter were recorded for more than three days.

The 10- to 15-milliwatt transistorized ex-ser-citer was thus amplified nearly 20-fold by the 7077, producing sufficient power to permit use of 960 megacycles for tracking and telereceiving. This frequency is much less subject to bending and reflection by the Earth's ionized layers than 108 megacycles.

An exact duplicate of the record-breaking transmitter was displayed in General Elec-tric's receiving tube exhibit at the 1959 IRE convention and show in New York City.

The 7077, first in a family of G-E ceramic receiving tubes, also is an excellent r.f. amplifier tube for the VHF and UHF amateur bands. See the January-February, 1959 issue of G-E HA/M NEWS for details on r.f. amplifiers for 144 and 432 megacycles.

From one of our GADGET RACK' articles authors come the hint that a two- or three-foot extension cord is very handy for testing accessory units before installing them in the rack. Simply cut 11 lengths of the same types of wire shown for the basic interconnecting system in the schematic diagram, solder them into an 11-pin male octal plug (Amphenol 86-PM1), and add an 11-pin female socket (Amphenol 78-PP1) on the other end. In fact, it's almost a necessity for clipping our COREL MONITOR receiver. If you're building a GADGET RACK, be sure and make the extension cord too.

'This is a monthly column appearing in the November-December, 1958 (Vol. 15, No. 11) and November-December, 1959 (Vol. 16, No. 11) issues of ELECTRONIC ENGINEERING, published by Electronics Magazine, Inc., 525 Park Avenue, New York 22, N.Y.

A PAIR OF HANDBOOKS—Especially writ-ten for the DX'ers and those interested in building the Amateur Radio Station and Getting Started in Radio, these three books are an inclusive guide to their subject. The authors, Julius Breen, W6KFD; A. A. Smith, W6XQA; and L. Leake, W6ZOH, give complete instructions for building home-brewed transmitters and receivers, and some popular commercial amateur gear is in the first book. The second volume contains complete instructions for learning the code and studying with the help of annotated texts and diagrams. Twenty-seven pages ot excerpts from the U.S. Communications Act of 1912 will answer virtually every question likely to arise concerning regulations and operating procedures. Both books are published by the John F. Rider Publishers, Inc., 130 N. Michigan Avenue, Chicago, Illinois. A description of the books will be available through book stores and many distributors of electronic components, including our G-E Tube distributors.

FOR YOUR ELECTRONIC BOOKSHELF. . .

Here's the latest in reference and instruc-tional publications—packed with useful infor-mation for radio amateurs—which should be in your bookcase and the reference library at your local radio club. The RADIO AMATEUR'S HANDBOOK—The 36th edition of this volume—now well on its way toward a total of four million copies in thirty-five years—now in its 36th edition. All chapters in the book have been updated to include the latest in de-sign and constructional techniques. Published by the American Radio Relay League, its reputation speaks for itself.

ALSO FROM A.R.L.—A second printing of the 8th edition of their Antenna Book includes the latest in mobile and beam antenna systems, in addition to comprehensive background information on antennas and transmission lines. RADIO HANDBOOK—A completely new 15th edition of this renowned handbook by William J. O. Orr, W4XAL, contains, in 800 pages, undoubtedly the most complete collection of constructional projects ever offered the radio amateur. Thus, of course, is in addition to chapters of technical background, excellent circuit design information on both basic and the latest techniques. And if you do not see exactly the gear you wish to build in the 15th edition, try looking in 302's 14th edition. It's still available and has enough, build-it-yourself data to last a lifetime.

FOR SUBSCRIBERS—The New Sideband Handbook, by Don Storer, W6JTM, contains a wealth of information on home constructed and commercial sideband equipment for radio amateurs. Most of the special circuitry from the commercial rigs is explained in detail, making it easy to incorporate these ideas into your own sideband rig. In short, it covers sideband from double down to single sideband, and back again.

A PAIR OF HANDBOOKS—Especially writ-ten for the DX'ers and those interested in building the Amateur Radio Station and Getting Started in Radio, these three books are an inclusive guide to their subject. The authors, Julius Breen, W6KFD; A. A. Smith, W6XQA; and L. Leake, W6ZOH, give complete instructions for building home-brewed transmitters and receivers, and some popular commercial amateur gear is in the first book. The second volume contains complete instructions for learning the code and studying with the help of annotated texts and diagrams. Twenty-seven pages ot excerpts from the U.S. Communications Act of 1912 will answer virtually every question likely to arise concerning regulations and operating procedures. Both books are published by the John F. Rider Publishers, Inc., 130 N. Michigan Avenue, Chicago, Illinois. A description of the books will be available through book stores and many distributors of electronic components, including our G-E Tube distributors.
DOUBLE SIDEBANDER

Part I

THIS DOUBLE SIDEBAND transmitter is packed with ingenious circuitry and construction features. By Frank Langford

THE DOUBLE SIDEBANDER was designed specifically for this mode of transmission; and, in fact, was a prototype for military double sideband and synchronous communications equipment. The frequency coverage is continuous from 2 to 30 megacycles in four bands. It has a peak power output, with sine-wave modulation, of 150 and 120 watts at 2 and 30 megacycles, respectively.

THE R.F. SECTION of the transmitter—a separately shielded and filtered unit—employs an oscillator-driver-final circuit arrangement as shown in the schematic diagram, FIG. 1. All transmitter stages are provided with protective bias to prevent damage to the tubes in the absence of excitation. In the oscillator and driver stages cathode self-bias give the necessary protection. The final-stage protective circuit removes its high voltage if the r.f. drive fails.

Switch S1, in the grid circuit of the 6A6S oscillator stage provides selection of one of the four crystals or the V.F.O. input as the frequency source. With S1 in the V.F.O. position the 6A6S is employed as a Class A amplifier. As input from a V.F.O. of 0.5 to 1 volt r.m.s. will excite the driver stage.

All frequency multiplying is accomplished in the oscillator and the 6CL6 driver always operates as a straight amplifier. Since the pi network in the 6146 balanced modulator plate acts as a low-pass filter, sub-harmonics of the carrier frequency may appear in the transmitter output if the driver stage is operated as a frequency multiplier.

Careful circuit layout and complete r.f. screening stabilize the driver stage. The 15,000-ohm, 4-watt powermeter ("PA GRID DRIVE") adjusts the grid screen voltage and, in turn, the r.f. power output.

The 6146 balanced modulator stage has the usual push-pull control grids, push-pull screen grids and paralleled plates described in several previous double-sideband transmitter articles. The pi-network plate circuit is designed for a 50-ohm output, but will load into impedances up to 300 ohms.

THE MODULATOR SECTION is designed for use with a microphone or a-pickup transformer or microphone (crystal, ceram, or dynamic). Low impedance microphones require a microphone transformer or a microphone. The preamplifier stage (V1h) has a push-to-talk feature that cuts off the second section until closing the microphone switch greatly reduces the cathode bias. A twin diode tube (V1h) serves as an audio peak clipper. The next tube (V1h) is a matching device for the maxi-flat (Butterworth) L/C 3,000-cycle low-pass filter.

A 400-cycle phase-shift B/C sine wave oscillator (V10h) and a split-load phase audio phase inverter (V10h) precede the push-pull driver (V1h). The modulator tube (V1h) provides about 300 volts peak on each screen grid of the 6146 balanced modulator stage. About 8 decibels of inverse feedback in the driver and modulator stages improves balance and linearity in the 6146 stage.

THE TRANSMITTER CABINET is built with the top lid open, showing the shielded r.f. compartment in the front, audio network in the middle and power supplies at the rear. Note the method of securing spare plug-in coils on an aluminum plate, on which 6 and 3½ inch sockets have been mounted. Coils are changed in the enclosure simply by removing four self-tapping screws which hold the shield at left-center in place.

A FRONT VIEW of the TRANSMITTER with cabinet and panel removed. The separate chassis containing the r.f. and metering section plugs into the main chassis, containing the remaining circuits.

See G-E HAM NEWS, March-April, 1939, for a bibliography of articles on double sideband techniques.
After the usual check to see that all circuits have been wired correctly, plug in the power cord, the set of coils for the desired amateur band and turn the pi-network bandwidth (S1) to the same position. Insert a crystal of proper frequency, or connect a stable VFO to J1 and turn S2 to the proper position. Connect a microphone to J3 and a 50-ohm dummy antenna lead to J4.

Turn S6 to the “ON” position and S7 to the “TUNE” position. With S3 in position 2, turn C4 (on the oscillator coil form) with a screwdriver until about 2 to 3 milliamperes of grid current is indicated in the driver stage. Detune this capacitor slightly if the grid current exceeds 3 milliamperes.

Next, turn S6 to position 3 and tune C5 for a dip in driver cathode current. Turn S3 to positions 4 and 5, and adjust C8 for maximum grid current in the 6146 balanced modulator. Adjust the “PA GRID DRIVE” control for a reading of 3 milliamperes in each 6146. Now, turn the "GRID CURRENT ADJUSTMENT” potentiometer until relays K1 and K2 energize, as indicated by L1 lighting. Turn the "PA GRID DRIVE” control until the 6146 grid current decreases to 2 milliamperes and again adjust the "GRID CURRENT ADJUSTMENT” until K1 and K2 open. The 6146 protective circuit is now adjusted.

To tune up the 6146 balanced modulator, set S3 on position 6, R4 on “TRANSMIT” and S5 on "SINE WAVE.” Advance the "MOD. LEVEL” potentiometer (on main chassis) until the 6146 cathode current meter reading increases to 30 milliamperes. Tune C6 for a dip in plate current. Turn S6 to position 4 and adjust the "CATHODE LOADING” (S8) and "FIRE LOADING” (C9) for maximum output voltage on the meter. Readjust C7, as necessary for maximum output.

Further advance the "MOD. LEVEL” control slowly to the setting at which little further increase in power output is indicated on the meter. Note this meter reading at which the balanced modulator begins to "flatten out." Next, turn S6 to the “VOICE” position and adjust the “MOD. LEVEL” control, while talking or whistling into the microphone, until the peak output voltage reading on the meter reaches the maximum level noted with sine wave modulation.

Adjustment of the "AUDIO GAIN" and "CLIPPING LEVEL" controls is best made while listening to the transmitter signal, in addition to checking it for flattening of peaks on an oscilloscope. Too much clipping will introduce serious distortion. The "AUDIO GAIN" control setting will depend upon the sensitivity of the microphone and amount of room background noise in the shack.

(Part II will appear in the July-August, 1959 issue.)
7-FOOT G-E TUBE

At 1959 IRE Show

Many radio amateurs were intrigued by this king-size "miniature" tube—7 feet tall and 4 feet in diameter—at the 1959 IRE convention and electronics show last March at the New York Coliseum. The tube—actually a display of six basic demonstrations of the outstanding characteristics of receiving tubes—was part of General Electric's receiving tube exhibit at the show.

Based on the theme, "Tubes Do the Tough Jobs," the demonstrations included: High temperature tubes—An all-ceramic tube 15-watt audio amplifier featuring types being developed to withstand temperatures of 300 degrees centigrade, and termed "the hottest little Hi-Fi in town" (left); High power tubes—A pair of latest type power output tubes—6L6-DC's—delivering 55 watts output in class AB, audio amplifier service, with less than 2 percent total harmonic distortion (right).

The other four demonstrations were based on receiving tube reliability, high frequency performance, high voltage capability and uniformity. Viewers could actually see each display with handy controls.

BUILD-IT-YOURSELF IDEAS
from the 999 radio amateurs at

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