The SUPER 430
a 6-Tube Converter for Top Performance

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Sometimes we take pride in putting together an hour or so some neat little gadget which, considering its simplicity, does its job amazingly well.

Other times we take our pride in simply building a piece of equipment which will deliver unquestionably superior performance. Such is the Super 430 Converter. It requires some care in mechanical construction, but the effort pays off handsomely in the stability needed to hold a narrow AM signal in the 430-450 mc band.

—Lighthouse Larry

Superior reception is no harder to achieve in the 430-450 mc band than it is on the lower frequencies. However, while on the lower frequencies just any old tube often is good enough, twice their choice ever more limited as they climb higher on the frequency spectrum. At 420 mc and above the lighthouse tube stands as one of the few "bottles" that will give first-rate, dependable performance.

The Super 430 converts signals in the range of 432 to 435 mc—representing the third harmonic of most 2-meter transmitters—to intermediate frequencies between 10 and 13 mc. It is a crystal-controlled converter, and tuning is done with the communications receiver in the IF range.

The crystal-controlled oscillator was chosen after much experimentation showed that self-excited local oscillators, even those working from a third or half of the operating frequency, generally are not stable enough to hold a narrow band AM signal—to any worth of a CW signal—at 432 mc. The Super 430 primarily is meant to receive signals from stabilized in or controlled transmitters. Amateurs who have operated in the VHF and UHF ranges know how vital a low-power stabilized narrow band signal is to many of the power spread over several megacycles. Many picked up lighthouse tubes for the diodes in the surplus market a few years back, yet few of these high-frequency tubes have appeared in published ham radio circuits. The reason apparently is that the fraternity has shied away from constructing the necessary special socket. Actually, however, building this socket requires no more mechanical effort or ingenuity than boards display daily all over the world in devising new ways to put together complicated superheterodynes and wave-busting finals on the lower frequencies.

The Super 430 Converter can be built with bakelite, fiber and hard drill and will be as stable as the proverbial rock. The Super 430 uses two 2CV tubes as ground-grid RF amplifiers, a pair of 6J2's to bring a 20-mc crystal oscillator up to the band, a 6AK5 grounded grid mixer, and a 6AK5 broad-band RF amplifier. A 12 x 7 x 3-inch chassis is divided into compartments as shown in Figure 1. In this picture the crystal oscillator and the RF multipliers are in the large compartment at the upper left. The input and output terminals at the c-f stage are at the upper right, and the second c-f

Fig. 1—The two r-f compartments and "mixing chamber" should be the same size as shown. Sizes of other compartments not critical
parallel with the first to avoid the inducance of input circuit.

The 3/8-inch tubing permits a heater lead to be brought through the second 2C40, while a button feed-through capacitor connects the heater lead of the first 2C40 to the cathode of the first 2C40. The heater and cathode of the first 2C40 are brought above ground by the choke shown in Figures 3 and 7. An additional choke may be added between pins 2 and ground.

The pin connections are made by use of clips removed from an output socket. The cathode-bias resistors are mounted on these clips as shown in the first r-f stage in Figure 3. A similar resistor, not visible in the photograph, is mounted on clips on the pins of the second r-f stage.

Since the 2C40 tubes are operated Class A and no high peak currents are required, considerable life will be added to the tube by operating at reduced filament voltage. This should be the lowest voltage at which performance and noise figure is not impaired—in most cases between 3.2 and 3.7 volts. With the filament supply used on the model shown this was accomplished by the large adjustable resistor at the terminal strip. However, with 6.3-volt supplies, the dropping can be done with a resistance of from 3 to 1.0 ohms rated at 5 watts.

Plate connections on the model illustrated are made with clamps which were specially turned out for this converter. They are made from pieces of 1/8-inch brass, drilled with a 3/4-inch hole for the tube cap, slotted, the corners filed round, and drilled and tapped to take a 4-40 machine screw for clamping. While the clamps shown were made with machine tools, simpler ones can be fashioned with hand tools—or available screw- or bolt-type clamps can be used. The objective here is to make a clamp which will not touch the faceplate unless the tube plate leads are in the proper position.

The tube leads are brought from Gland No. 14, wire shaped to the approximate dimensions shown in Figure 4. In both r-f amplifiers, the cathode "cold" is brought from 1/8-inch copper tubing bent as shown and spaced 1/4 of an inch from the grid planes. Black No. 14 wire is used between the grid and the cathode brackets. Since the r-f amplifiers are operated as Class A, a 150-ohm grid resistor is used to prevent the grid from going out of line should the r-f current rise too high. However, if the circuit seems to tune too low, another similar length of tubing may be placed in parallel with the first to avoid the inducance of input circuit.

**Fig. 3—Details of construction of the r-f stages**

5 and 6 are 2C40's, and the grid shield has been extended to form anode and plate-grid shields to which the grid rings are grounded. These plate lines are spaced against ground (the grid planes of the tubes) and are bypassed at the "cold" end with 500-ohm button condensers. Resistors decouple the loops from the rest of the circuit. The tubes are protected by a Mini Meter on the cap, thus varying the impedance of the plate.
The high-voltage lead to these loops starts at the barrier-type terminal strip and runs along the chassis back panel. It passes from the oscillator compartments to the first r-f compartment through a hole formed by clipping the far corner of the shield separating these compartments, and then is brought through the shield separating the two r-f compartments via a 100-mil button feed-through connector.

From here, a decoupling resistor brings the high voltage to a 500-mil-size button by-pass stand-off condenser which acts as a terminal for the long leads of the first r-f stage. Another lead from the 100-mil feed-through condenser continues around the base pins of the second r-f tube to a terminal lug.

One end of the decoupling resistor of the second r-f tube is supported on this lug and the other end on the shield which separates the second r-f compartment from the mixing compartment. The long leg of the plate tank coil of the second 2CX100 is mounted on the other end of this by-pass condenser.

THE OSCILLATOR

The first section of the first 6J8 operates on the third overtone of the 7810 kc crystal. The second section triples to approximately 78.3 mc. The second 6J8 first doubles to 140.6 mc and then triples to 421.8 mc.

These frequencies are approximate because the third overtone is not necessarily precisely three times the crystal fundamental.

While the lower frequency stages of the oscillator have been described many times in amateur literature and probably are quite familiar to amateurs who have crystal-controlled cascode receivers on 144 or 220 mc, the last triplet circuit needs some explanation and a little care in construction.

Resonance is obtained with a button stand-off condenser, a tiny Johnson variable and a small loop made of a strip of copper 3/4 inch wide and 1/8 inches long. The copper is shaped into a loop with 3/4-inch

Fig. 4.—Outline of the lightwave tube

Fig. 5.—Dimensions of the plate loops of the r-f stages.

Fig. 6.—Construction detail of the final stage of the oscillator
The cathode "coil" of the 6AM4 consists of a strip of flashing copper 3/4 inch wide and 1/32 inches long. It is located in the mixing chamber as shown in Figures 6, 7, and 8. One end goes to pin 3 of the tube socket, and the other is soldered to the shield of the compartment shield. A 100-ohm resistor, also mounted on this conductor and visible in the photograph of the mixing chamber, provides cathode bias.

The shield between mixing chamber and compartment which contains the remainder of the 6AM4 circuits is made with a notch 1/2 inch deep and 3/8 inch long which fits over the 8-pin tube socket and serves to shield the cathode circuit from the plate circuit. The shield is placed so that three of the tube's five grid pins (1, 2, and 4) and the center shield of the tube socket can be grounded directly. The remaining two grid pins (6 and 9) are grounded to the center shield of the tube socket by a small strip of copper.

A similar shield, but with the notch 3/4 of an inch deep, separates the input and output circuits of the 6AK5 i-f amplifier. Both mixer and i-f stages use slug-tuned coils mounted on 1/2 inch grid diodes and loaded with resistance.

Output is taken from the 6AK5 by a six-turn link of insulated wire which feeds to a chassis connector. A short length of RG 11U coaxial cable brings the signals to the communications receiver.

PERFORMANCE

Two of these converters were built in the process of design and development and both operated at first 

-8th. Best performance was obtained by prining and adjusting the various i-f circuits. As neither a suitable tone diode nor signal generator was available for testing, the adjustments were made with a specially built grid dip oscillator covering 400 to 450 mc. The Super 400 has lived up to expectations and is well worth the effort expended in careful construction.

While working with W2HEM, who designed the Super 4th Converter described in this issue of O.E. HAM NEWS, we received a card from W2EKA saying he would like to hear from fellows operating in the 250- and 450-mc bands . . . As W2HEM states that use of a mineral type oil on a rope to lubricate mast pulley line. Tracker and Topos, O.E. HAM NEWS, March-April, 1933 may cause deterioration. He sug-

gests use of a vegetable oil, pointing out that starch canvas buffing is impregnated with vegetable oil.
Once in a while a ham writes asking me to design a final amplifier for him—or sometimes a whole receiver. Of course, most fellows realize we can’t do that, and confine their questions to specific problems—which we are glad to tackle.

But let’s look a minute at what it takes to design a receiver. Assume that the receiver is to have something special about it—that why design something new? That means several weeks of development work, at the very least, to make sure the new twist is feasible. Then comes a period of building and testing which very likely will require the services of a good many people for an indefinite time. Only then are we in a position to answer the letter which asks in a sentence or so for a circuit diagram, a bill of materials, and something else.

You may ask why not just write out a schematic and let it go at that. Well, the answer is that I usually won’t risk my reputation on something that I’m not sure is going to work. I remember once talking with a photographer who is reputed to be one of the best in the business. He confided to me that he makes as many mistakes as the average commercial photographer—but no one ever sees them. For he never shows anyone a poor picture. As a result he has a first-rate reputation. And he deserves it because everything he sends out is perfect. But behind that perfection are untold hours of hard work—taking shots over and over, making print after print until he has precisely what he wants.

Incidentally, that’s a success formula anyone can apply in almost any line of endeavor.

While living temporarily in a room here in Bournemouth, I saw the photo—that’s the editor, W2RBY—set up a peanut whist on 15 meters to work the locator. He reports some of his best contacts are with his neighbor’s TV set. They read his voice and he reads their oscillators. He admits it’s not an ideal two-way communication system.

I was about to bash him out for squiring harmonics all over the street when he took up his hand and said that although neighbors complain, no Tennessee Valley Institute or hole in the wall will stop him. He cut off a switch and transmitter on frequencies assigned by the Federal Communications Commission. Then he went out that his landlord’s TV set—the nearest one to him—does not pick up the transmissions. And he suggested that something must be wrong with the complainant’s TV receiver.

Well, here are four letters from fellows who want to know if they can rely on the mailing list to receive G-E Ham News direct. I’ll write them, as I usually do, to the effect that while the publication is designed to be handed out through authorized G-E tube distributors, we do have a paid subscription plan for those unable to get their copies from a distributor. The cost is $4 a year, payable by check or money order made out to General Electric and mailed to me. I admit a dollar for six copies of a small eight-page magazine is not cheap. But as a matter of fact, we lose money on the paid subscriptions and accept them only to make sure everyone who needs or wants a copy of each issue can get it.

Another letter here comes from the secretary of a radio club who wants to know if we can send him, 45 copies of each issue for the members. I’m sorry that I’ll have to tell him that will not be possible. He will have to make arrangements with the people who are interested in the club to make arrangements to handle the mailing.

Similar requests from clubs, radio societies, or individual members will have to be handled the same way. However, I’ll be very glad to send reasonable quantities of a specific issue of G-E Ham News upon request for group use.

The next seven letters in the pile are from fellows who want specific back copies and some tube data sheets.

A fellow in Texas wants to know the ratings on a G-E transformer he has acquired in a swap. That may take some time. For I have to get the answers to each question from some G-E department or division outside my own Tube Department. That means first finding out who would be most likely to have the answer—a job in itself in a large company like this—and then coaxing them into looking it up for me. And where an obsolete piece of equipment is concerned—like many pieces of surplus—actually finding the information becomes a project in itself.

Interest in SSB is running pretty high as we get requests for information on various points all the time. Here are three right now. W9KJU helps out with such problems in most cases.

Now the complaint department. A fellow writes that he is unable to buy a certain condenser used in a gadget described in G-E Ham News a year ago. Once again, we are faced with the same standard parts that are readily available. But we have no way of guessing that a particular condenser will be available soon. We must rely on manufacturers and suppliers from now when W9J7 decides to build that equipment. Naturally, when we know of condenser difficulties in obtaining a certain make of equipment we shry away from using them in published articles, although sometimes we get fooled this way, too. For it takes sometimes a year to develop an article for G-E Ham News and perhaps by the time the article gets into the radio shop all over the country it is out of date. Believe me, if we could predict what will be available in any particular location on any particular day in any particular year—we’d be wasting our time here.
DR. A. HARRY SHARBAUGH, W2UKL

Once again a ham’s ingenuity goes to work.

DR. A. Harry Sharbaugh, W2UKL, is a chemist at G.E.’s modern Research Laboratory in Schenectady. But with all the advanced facilities available there—from glass blowing to hydrogen on tap in every room—what instrument does he select to test insulation? A rat trap!

Dr. Sharbaugh built the gadget shown at the right. Attached to trap is a carbon contact brush. When the trap is sprung, the brush sweeps across a stationary metal contact. For one thousandth of a second it short-circuits a charged condenser to the insulation to be studied. An oscilloscope is used to measure the amplitude of the generated pulse.

Incidentally, Sharbaugh and E. L. Watters, W2BIL, also at the Research Laboratory, still hold the DX record for two-way phone communication in the 21,000-22,000 megacycle band. They were the first hams to use this band—the highest of the amateur frequencies—establishing their DX record of 800 feet on May 18, 1946.