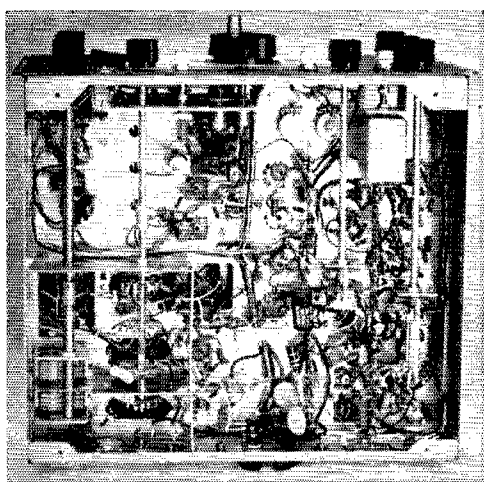
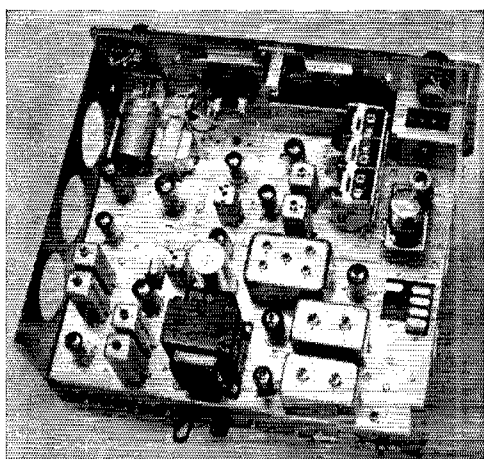




At the left above, a top view of the SX-117 receiver. At the right in the photo are five crystals which determine the various 500-kc. tuning segments, and sockets for additional crystals. Also to the right in this top view, in a small sub-chassis mounted above the main deck, is the 100-kc. crystal calibrator. At the far left, the cylindrical can just behind the panel contains the control for the notch filter. The other two crystals visible to the rear of this and to the right are for upper and lower sideband selection. Terminals along the rear edge of the chassis provide for the usual loudspeaker connection, receiver muting, antenna input (there is a $\frac{1}{8}$ -inch hole punched out so that you can add an SO-259 connector in lieu of the phono plug provided), and grounding. The photo at the right is a bottom view of the SX-117 receiver.

product detector functions as b.f.o. — its pitch is controlled by a front-panel control. Another three-position front-panel switch controls the noise limiter and the calibrate oscillator. The noise limiter consists of a pair of silicon diodes in an i.f.-type limiter which is most effective in reducing impulse noise on c.w. and s.s.b. The calibration oscillator uses a 100-kc. crystal.

One section of V_{11} acts as a.g.c. amplifier and rectifier. A.g.c. functions at all times, even on c.w., there being no way to disable it. Fast-attack, fast-release is automatically selected for a.m., while fast-attack, slow-release is automatically selected for c.w. and s.s.b. operation when the FUNCTION switch is operated.

General coverage may be obtained by plugging additional crystals into the auxiliary oscillator sockets. Between 85 kc. and 3.0 Mc. it is also necessary to couple an external tuned circuit

Hallicrafters SX-117 Receiver

Height: 7 $\frac{3}{4}$ inches.

Width: 15 inches.

Depth: 14 $\frac{3}{4}$ inches.

Weight: 18 $\frac{1}{2}$ lbs.

Power requirements: 105 to 125 volts, 50/60 cycles, 70 watts.

Price class: \$100.

Manufacturer: Hallicrafters Co., Chicago 24, Ill.

(Model HA-10) between the antenna and the ANTENNA jack.

Arranged along the rear apron of the receiver are jacks (phono type) for antenna input, i.f. antenna input, v.f.o. output, and crystal oscillator output, and a terminal strip for speaker connections and receiver muting. — *R.L.B.*

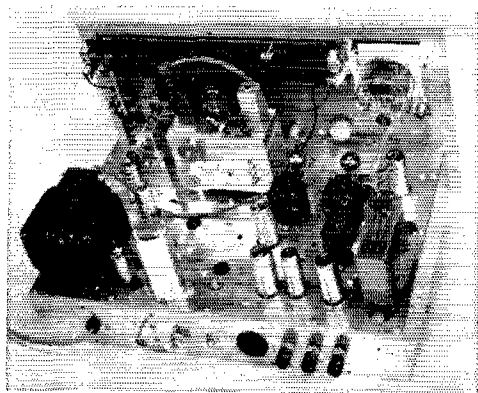


The Heathkit 50-Mc.

S.S.B. Transmitter, Model HX-30

ALMOST from the earliest s.s.b. activity on lower bands, discerning v.h.f. men have known that this mode has great possibilities for extending the reliable working range on 50 Mc.

and higher bands. Real popularity for s.s.b. has been slow in developing on the v.h.f. scene, however, mainly because of the cost and complexity of suitable gear,



Interior of the Heath 50-Mc. s.s.b. transmitter. The "pent-house" just in back of the panel is the v.f.o. assembly. Power supply components are at the lower left. VOX circuits are in the right rear corner, with audio and balanced-modulator stages toward the panel. The 50-Mc. r.f. stages are hidden behind the dial drive, at the upper left.

The would-be v.h.f. sidebander has had two principal roads open: he could build a complete setup himself, or he could make (and more recently, buy) a heterodyne unit that would reproduce on a v.h.f. band the signal generated by a transmitter designed for lower frequencies. Neither way was entirely satisfactory. Building the works was beyond the capabilities of many v.h.f. men, quite a few of whom were just getting into amateur radio. Purchase of a sideband rig for 80 through 10 meters was a pretty expensive approach, especially for the fellow interested only in 50 Mc. or higher bands — and there are thousands of such hams today.

Thus the new Heathkit HX-30 should receive a warm welcome from the many progressive v.h.f. enthusiasts who have been looking for a simpler and less costly way to "go sideband." It is a complete low-powered transmitter for 50 Mc., capable of putting out a high-quality signal on c.w. and a.m., as well as s.s.b. While it is not inexpensive, it costs far less than would the generation of a signal of comparable quality and power, using gear for the h.f. bands as a starter. Construction and adjustment, while far from simple, should be within the capabilities of anyone who understands the use of a simple oscilloscope, and has had some experience in working with advanced kits or other construction projects.

How It Works

In the jargon of the sidebander, the HX-30 is a "phasing rig." For simplicity of construction and permanence of adjustment, much of the transmitter is built on phenolic circuit boards. There are four of these printed circuit assemblies. The largest carries the speech amplifier, audio filter, 90-degree audio phase-shift network, modulator, carrier oscillator, and balanced modulators. In this 5-tube assembly (one 12AX7 and 4 12AT7s) impulses from the microphone are fed through three speech stages, whose frequency response is confined to the useful speech range

between 300 and 3000 cycles. These drive the modulator through a 90-degree audio phase-shift network. The carrier is generated at 11.5 Mc. by a crystal oscillator, and this and the phase-shifted audio are fed to the balanced modulators. Output from this board is 11.5-Mc. energy with c.w., a.m., or s.s.b. characteristics, upper or lower sideband, depending on the setting of the mode switch.

Then follows the heterodyne oscillator and mixer board. Here the signal goes to the grid of a 6U8 pentode, the first mixer. The triode portion of this tube is a crystal-controlled 30.5-Mc. oscillator, whose output beats with the 11.5-Mc. energy to produce a 42-Mc. signal at the grid of a second mixer, a 6CB6. We now have to look at a third circuit board to describe the development of the signal logically. This is a v.f.o. assembly, of which more will be said later. From it comes energy at any frequency between 8 and 9 Mc., which is also applied to the second-mixer grid, where it beats with the 42-Mc. signal to produce output at 50 to 51 Mc. Changing the heterodyne oscillator crystal to 31.5 Mc. gives output between 51 and 52 Mc., and so on.

Energy coming from the second mixer is in the form to be radiated, but it is at a very low power level, so two amplifiers follow. The first is a 6AK6, which is part of the oscillator-mixer circuit board assembly. Then follows a 6360 output stage, which feeds the antenna or an external linear amplifier. Output is 8 to 10 watts s.s.b. or c.w., and 2 to 3 watts a.m. A 61-Mc. series trap in the second mixer grid circuit is tuned to remove the second harmonic of the 30.5-Mc. oscillator, which might otherwise cause spurious signals to be radiated.

A fourth circuit board contains voice control and anti-trip stages. These may be used or not, as the operator prefers. The tendency among v.h.f. men is to not use these features at first, their functions somehow seeming foreign to anyone whose voice operating experience has been confined to the monologue type of communication. Push-to-talk control is also provided for, and this is usually a first step in the direction of full automatic control of the send-receive function for the s.s.b. newcomer in v.h.f. work. Three tubes are used in the VOX and anti-trip circuits.

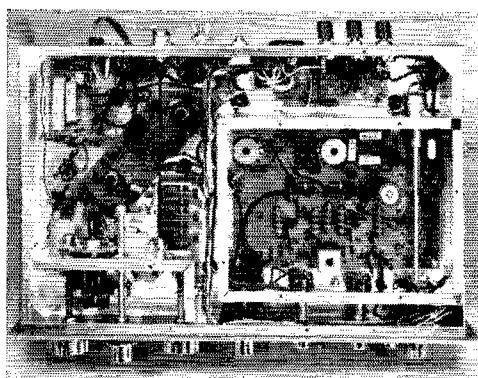
The v.f.o. is perhaps the most interesting part of the HX-30, at least to stability-conscious souls who tend to decry the use of v.f.o. control in v.h.f. work generally. Those who have admired the stability of the v.f.o. used in the Heath Shawnee and Pawnee v.h.f. transceivers will find the ideas used therein developed still further in the HX-30. The principal reason for the superior stability of this transmitter is, however, the fact that one observes the fundamental-frequency characteristics of the oscillator on 50 Mc. Where a frequency control oscillator is used to heterodyne to a v.h.f. band there is no multiplication of frequency instability, a major factor in the drift and mechanical wobbliness of v.h.f. transmitters where frequency multiplication is involved.

The HX-30 v.f.o. is the pentode section of a 6CH8, with its tuned circuit covering 8 to 9 Mc. The triode portion of the tube is a crystal oscillator offering a choice of two crystal frequencies in the same range. Output is taken from its cathode, and the two oscillators share a common bandpass circuit for coupling to the second mixer grid. Both operate at low power level, and are lightly loaded, for optimum stability. The tube and most components are on a circuit board which is mounted on the top of a metal box housing the frequency-controlling elements of the v.f.o. The latter are thus well isolated from the heating effects of the tube. The small enclosure is also completely rigid. The result is a variable oscillator almost immune to vibration, and only slightly affected by heating.

The small amount of heating can be compensated for by adjustment of a differential capacitor in the now familiar circuit used by this manufacturer and others. Each half of the capacitor is in parallel with another capacitor in the frequency-controlling circuit. One has a zero temperature coefficient, the other a negative coefficient. The operator may thus select the amount of temperature compensation to suit the requirements of the circuit and its environment. In practice one has the choice of eliminating initial warmup drift, or that due to environmental heating, which is a longer-term matter. Adjusting for the latter, which begins to show after the first few minutes of operation, will result in substantially no drift in normal use. A warm-up period of at least 10 minutes is desirable for best results.

Construction and Alignment

The builder of this kit should begin by reading the well-written instructions carefully. This is



Bottom view of the HX-30, with its shield plate removed. Three of the printed-circuit boards are visible. The large enclosure at the right houses the audio, carrier oscillator and balanced-modulator stages. A small assembly above it carries the VOX circuitry. At the left are the heterodyne oscillator and mixer circuits. The small compartment, left, is the final plate circuit.

definitely not a beginner's job. Becoming familiar with the functions of the various circuits will pay off later in achieving proper adjustment of the equipment, and the early pages of the book contain a good explanation of the complete rig. Construction time is given as 30 hours, but this does not include sorting and identification of parts (an unnecessarily complex job, it seems to this writer), studying the book, or adjusting the completed rig. The HX-30 was the writer's first major kit job, in more than 40 years of building radio gear of various kinds, and he found it both interesting and instructive. From opening the boxes, to the first 50-Mc. QSO with the HX-30, was something on the order of three times 30 hours, but we enjoyed it the whole way. The few minor troubles encountered were mainly

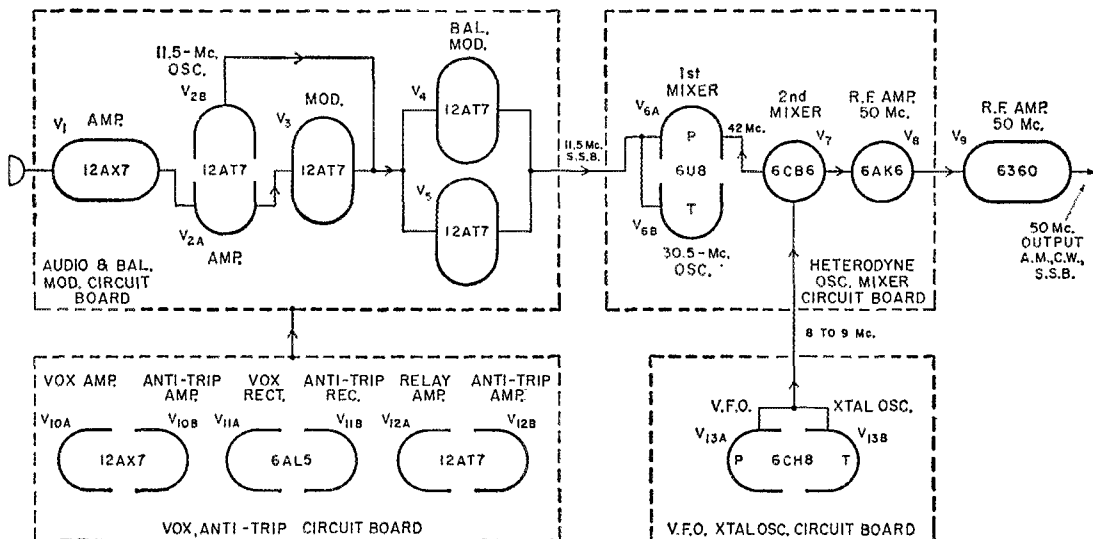


Fig. 1—Block diagram of the HX-30 50-Mc. sideband rig, showing the various circuit-board assemblies in broken lines. The signal is generated at 11.5 Mc. and then heterodyned twice to 50 Mc. Nominal tuning range is 50 to 51 Mc. This can be raised by substituting other crystals for the 30.5 Mc. one used with V6B.

the result of none-too-careful reading of some of the more complex steps in the assembly procedure. We did feel, however, that clarity and understanding would be served if a bit more technical detail were included here and there.

It also seemed to this builder that someone with a mania for fancy drives and linkages designed the layout. At least two examples of this show, where to all intents and purposes direct front-panel knob control would have served at least as well. And some controls that the experimenter type of ham would like to have accessible are not brought out to the front panel at all. Notable examples are the output loading controls, which are merely knob-equipped extension shafts brought up vertically inside the cabinet. (The cabinet lid has no finger hole or other provision for easy lifting.) One of these, the output coupling control, is driven through a string-and-pulley system of true "Rube Goldberg" nature.

The v.f.o. drive and dial are complex mechanically, though here it is more justified, as the end result is a smooth-running drive and a nice-appearing dial scale. Readout of the dial is not particularly accurate, however, and there is nothing that can be done about this. Adjustment of coil inductance and padder capacitance leaves you with a dial that is quite a bit off at several points in its one-megacycle coverage. Perhaps this is just as well, for it serves to remind the user that no dial of this kind should be relied upon entirely.

The writer also found the alignment instructions unnecessarily hard to follow, in that they make no attempt to explain what is supposed to be happening electronically, but merely give a step-by-step process with no more detail than appears in the instructions dealing with assembly. In attempting to work out a procedure that everyone can follow, the instruction writers apparently develop a "Connect red lead to terminal A" philosophy that carries over into alignment. This may be entirely satisfactory where the equipment is a beginner's first transmitter, but some knowledge of operating principles is mandatory if the builder of equipment as complex as s.s.b. gear is to achieve optimum results. The kit makers are not in the electronics teaching business, to be sure, but it would do no harm to have some technical explanation of the tuneup procedure and objectives written into the instructions. The detailed explanation of the circuit, mentioned earlier, is a good start, but more technical information in the alignment instructions would be helpful.

On the credit side, the book stresses over and over that this is a complex business, and that all steps should be followed implicitly. It also emphasizes that an oscilloscope check on performance is highly desirable. In this we heartily concur, and almost every experienced sidebander will agree that a scope is an indispensable tool, if

one would really know what his sideband rig is doing.

Several steps in putting the HX-30 on the air are made simple by proper use of its built-in meter. This is equipped with a dual sensitivity adjustment when it is used to indicate transmitter output. A 500K control and a 270K resistor are connected in series with the meter, when it is connected to Test Point 5, the output indicating position. This enables the operator to set the meter for any convenient range, and a spring-release pushbutton (on the pot control) is available to short out these resistors. This gives a fine indication for carrier rejection adjustments, leaving only the 100 microampere meter to indicate current rectified by the output-indicating diode. The spring release prevents the momentary lapse by the operator that could blow the meter to bits if it were left connected and the mode switch changed over for a.m. or c.w. operation. The four other test positions enable the builder to check operation of the transmitter all along the line.

Routine adjustments can be carried out entirely with this meter, once the equipment is working properly. For initial checks a volt-ohmmeter, a sine-wave audio generator, a dummy load and a scope are needed, and a selective, stable and accurately-calibrated receiver is helpful, too. With these, and some knowledge of their use in sideband work, adjustment is relatively simple and straightforward — even enjoyable.

In use at W1HDQ the HX-30 has done very well indeed. Suppression of unwanted sideband and carrier are good, and the voice quality excellent. Experienced sidebanders pay it the ultimate compliment: "Say, that doesn't *sound* like a phasing rig!" When sideband contacts begin to come hard, as they inevitably do with today's growing but still limited activity, the a.m. mode works out well. On c.w., the HX-30 is superb. Mixer keying and rock-steady v.f.o. control deliver results to please the most discriminating practitioner of the art of communication with the hands. It took only a few hours operation with this rig to sell the writer on the advisability of converting his entire station to heterodyne-type equipment, for 144, 220 and 420 Mc. — but that's another story.

— E. P. T.

Heathkit HX-30 50-Mc. S.S.B. Transmitter

Height: 10 $\frac{1}{8}$ inches.

Width: 16 $\frac{5}{8}$ inches.

Depth: 10 inches.

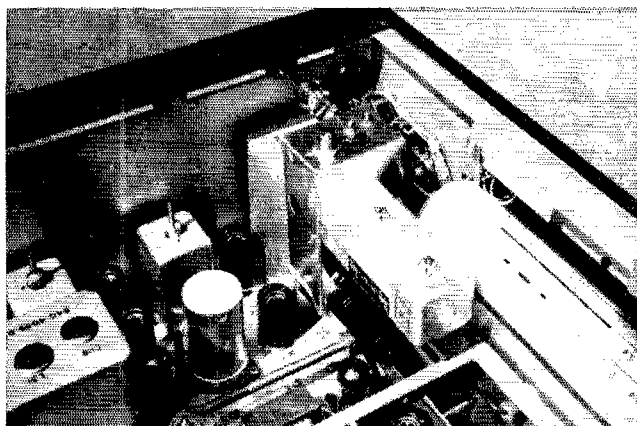
Weight: 40 pounds.

Power requirement: 115 volts a.c., 77 to 95 watts, depending on mode.

Price Class: \$190, in kit form.

Manufacturer: Heath Company, Benton Harbor 9, Mich.

Fig. 1—Here is the filter assembly installed in the Collins 75A-4. It plugs into the V-7 socket in the receiver. The shaft of the selectivity switch, S₁, is carried out through a slot in the end of the receiver case, using a universal-joint shaft coupler and a panel-bearing assembly. Note that all adjustment points are readily accessible.



Improving the C.W. Selectivity of the Collins 75A-4

An Easily-Applied Crystal Filter

BY BRUCE E. MONTGOMERY,* W4BFR

THE need for a high order of c.w. selectivity on the amateur bands is obvious to all who do more than casual operating. The 500-c.p.s. mechanical filter in the Collins 75A-4 receiver provides sufficient selectivity to cope with many interference conditions, but there are still times when a 500-c.p.s. passband seems mighty wide. For example, FB8XX and ZD9AM were recently heard working contest-style simultaneously on 7001 kc. and 7002 kc., respectively.

Old-timers will remember when communications receivers achieved high selectivity with a quartz crystal filter using a single crystal at intermediate frequency in a bridge circuit that made use of the series resonance and high *Q* of the crystal to provide a high degree of selectivity at the peak, but depending on several i.f. transformers to give skirt selectivity. This is in contrast to modern mechanical filters that have a flat-topped selectivity curve with steep sides and good skirt selectivity.

The plug-in crystal-filter assembly described here is of the old-fashioned variety, and adds its sharply-peaked selectivity to the steep-sided mechanical-filter selectivity. The result is a sharply-peaked response with steep sides and improved skirt selectivity, since the crystal filter does add some worthwhile attenuation at the skirt of the selectivity curve. The following table shows the narrowing of the selectivity curve at the 6-db. and 60-db. points in the crystal-filter No. 1 and No. 2 selectivity positions.

The first column shows the selectivity of the F455J-05 mechanical filter alone. A word about these selectivity figures is in order. The data on

Decibels Down from Maximum	Crystal Filter Position — Bandwidth in Kc.		
	Off	No. 1	No. 2
6 db.	0.5	0.14	0.09
60 db.	2.0	1.5	1.3

the 500-c.p.s. mechanical filter is the manufacturer's published specification information. More exact data is given later. The data with the crystal filter in the circuit was taken by careful reading of the 75A-4 kilocycle dial and S meter, so this is subject to some reading and calibration error.

The crystal-filter assembly plugs into the V-7 socket, which is for the 12AX7 slot-rejection tube. The 12AX7 plugs into the assembly and the rejection tuning continues to operate normally. A 6BA6 i.f. tube is added in the assembly to make up for the insertion loss in the crystal-filter circuit. The amplification of this stage is adjusted to produce 0-db. gain when the crystal is out. The gain drops less than 3 db. in the No. 1 position and about 6 db. total in the No. 2 position. This loss of gain is of no consequence since the 75A-4 has ample reserve.

The addition of this adapter results in a combination of the high "nose" selectivity of the crystal filter and the skirt selectivity of the mechanical filter.

*6520 Bridgewood Valley, N.W., Atlanta 5, Georgia.