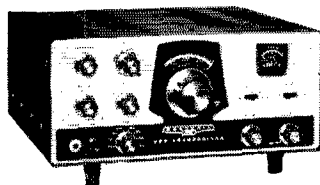


# Recent Equipment



To acquaint you with the technical features of current amateur gear.

## Heath HW-100 Transceiver



THIS five-band s.s.b./c.w. transceiver bridges the gap between the popular HW-series single-band transceivers and the more sophisticated SB-101 package, i.e., five-band operation is offered, but at a price that is somewhat lower than that of the SB-101. Despite the attractive price tag of the HW-100, there is no evidence of mediocre quality in the design, or in the choice of the component parts. In fact, the constructor may scratch his head in wonderment as the assembly of the kit progresses, trying to rationalize how the manufacturer is able to offer such a versatile unit for so modest a price.

Because there is a great deal of similarity between the circuits of the HW-100, and the SB-100<sup>1</sup> described in an earlier issue of *QST*,

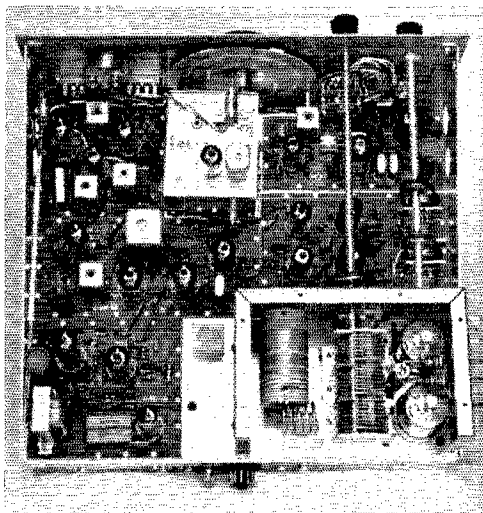
<sup>1</sup>"The Heathkit SB-100 Transceiver," *QST*, September 1966, page 45. The SB-100 was succeeded by the SB-101.

blow-by-blow circuit description will not be repeated here. The significant differences will be treated, and some additional features will be highlighted.

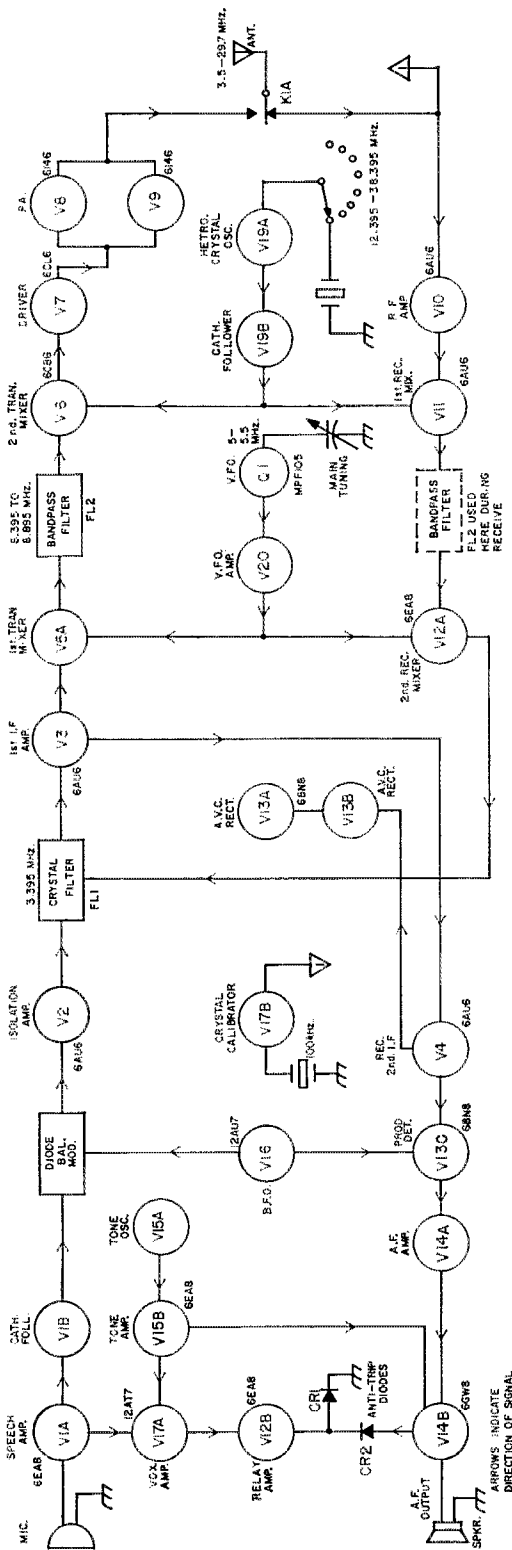
Each amateur band is tuned in 500-kHz. sections except for the 10-meter band which is tuned in four 500-kHz. steps. Each dial division is equal to 5 kHz. Calibration is made possible by a built-in 100-kHz. oscillator and a front-panel zero-set adjuster.

Referring to the block diagram, some component sharing can be observed between the transmitting and receiving channels. The 2.1-kHz. crystal filter has a center frequency of 3.395 MHz. and is used for both transmitting and receiving. A common i.f. amplifier,  $V_3$ , a bandpass filter,  $PL_2$ , and the v.f.o. and its amplifier are shared by the two channels. The driver plate and grid tuned circuits are shared by the receiver's r.f. stage,  $V_{10}$ , during receive, making peaking of the driver a simple task since it may need but slight touching up after peaking its tuned circuits during receive.

It was gratifying, indeed, to note the widespread use of tried and proven circuits in this transceiver. One example of hybridization can be seen in this unit — the v.f.o. It uses an MPF-105 junction FET as an oscillator, Fig. 1. The v.f.o. output is amplified by a 6AU6 buffer which operates class A. This combination results in a practical form of symbiosis since the v.f.o. transistor is powered by the voltage developed in the 6AU6 cathode circuit. This voltage is regulated by a 2N3393 which is connected to act as a Zener diode. The v.f.o. is extremely stable and meets the specifications set forth in the instruction manual. One distinct advantage to the use of a JFET in the oscillator is that there are no filaments to introduce 60-Hz. f.m. on the v.f.o. signal. That undesirable condition is frequently encountered in "hot-cathode" (Clapp and Colpitts) v.f.o.s when the oscillator tube has excessive heater-cathode leakage during a.c. filament operation. Since the HW-100 v.f.o. operates from d.c. only, its signal is pure. It is unlikely that hum modulation will ever be caused by the a.c.-operated buffer-stage filaments of  $V_{20}$ .



Viewing the top area of the chassis, the v.f.o. assembly is at the upper center of the photo. The p.a. compartment is at the lower right. There is plenty of room in the final-amplifier cage to allow the free flow of air, and to eliminate any need to locate the tuned-circuit inductors too close to the compartment walls. This arrangement contributes to better tuned-circuit Q.



Block diagram of the HW-100 five-band s.s.b./c.w. transmitter.

The kit designer has taken advantage of an old technique for obtaining a linear tuning range for the v.f.o. The main tuning capacitor has mechanical stops which prevent the rotor from traveling beyond preset limits. Only a portion of the tuning capacitor's range — center portion — is utilized, and that is the range over which the change in capacitance per degree of dial rotation is practically constant. A unique mechanical arrangement in the dial-drive/knob assembly uses plastic components with spline gears to obtain a tuning range of 500 kHz. for 28 revolutions of the tuning knob. This breaks down to 18 kHz. per revolution, offering excellent bandspread. The moving parts are coated with silicone lubricant and should have long life under normal use.

A choice between VOX or p.t.t. operation is given. Keying during c.w. is accomplished by triggering the VOX circuit with an audio tone. The closed relay in turn permits grid-block keying of V<sub>5A</sub>, V<sub>6</sub>, and V<sub>7</sub> (block diagram). Similarly, a choice between upper- or lower-sideband operation is available. A panel switch selects the proper crystal for the desired sideband while at the same time routes a control voltage to a switching diode in the v.f.o. The switching diode places a frequency-offset trimmer in the circuit, or removes it, so that the output frequency of the transmitter will remain the same when switching sidebands.

The transmitter winds up with a pair of reliable old 6146s in the p.a. compartment. They run at 180 watts p.e.p. input during s.s.b. operation, and operate at 170 watts input for a 50-percent duty cycle on c.w. Something should be said here about this choice of tubes. The 6146s are far less delicate than are most TV sweep tubes, making transmitter tuneup somewhat less precarious than it might otherwise be. Also, 6146s always seem to produce good results with respect to IMD (intermodulation distortion) when equipment using them is checked with the ARRL's spectrum analyzer. Physically, the Heath HW-100's p.a. compartment is well designed. This section is roomy, allowing plenty of air flow around the tubes—an aid to tube life. Also, the p.a. plate inductor is not crammed up against the compartment wall. This means that the circuit Q will not be seriously affected by the proximity of the walls. The main coil is wound on a rugged ceramic form. An air-wound inductor is used for the

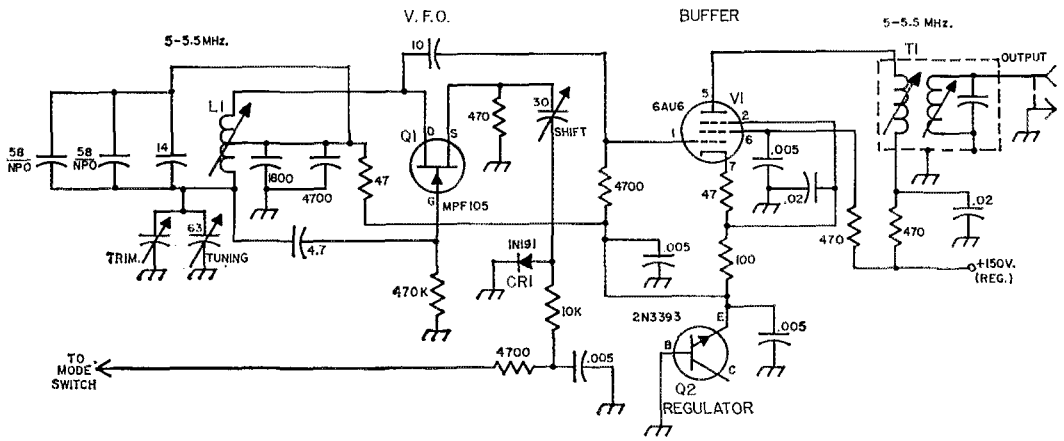


Fig. 1—Schematic diagram of the HW-100 hybrid v.f.o. An MPF105 JFET serves as the v.f.o. and is powered by voltage taken from the cathode circuit of the 6AU6 buffer stage.  $Q_2$  is connected to act as a Zener-diode regulator. CR1 performs as a switch when changing sidebands.

cient for all of the wiring. A 100-watt iron (or larger) will be needed for one step in the assembly—soldering two metal pulleys to a  $\frac{1}{4}$ -inch diameter control shaft.

### Servicing

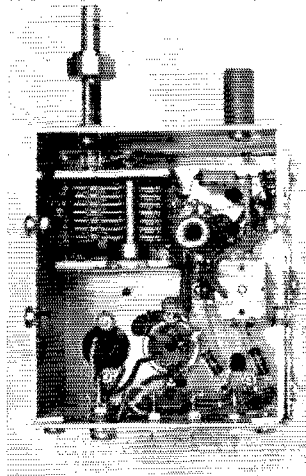
It should not be difficult to maintain the HW-100 if one has a general knowledge of how the circuit functions. There is a rather complete cause-and-effect section in the manual to help isolate any trouble area. Individual schematic diagrams are given for each important section of the transmitter and receiver. To aid in rapid identification of the circuit-board components, an X-ray view of each board is given, showing where each component connects to the foil element it is related to. The book has a complete

10-meter band, and has a suitable diameter-to-winding-length ratio for good  $Q$ . A.l.c. voltage is developed in the p.a. grid circuit and provides 10 db. or more of control at 0.1-ma. of p.a. grid current.

### Building the Kit

It shouldn't take the average builder more than 40 hours to wire this transceiver. The more experienced ham should be able to wrap this project up in 28 or 30 hours, as was true in the writer's case. The use of circuit boards (9) and a wiring harness greatly speeds up the assembly of this kit.

Step-by-step instructions are given in clear language throughout the manual. These instructions are complemented by numerous layout drawings, all of which have good detail. Each circuit board is treated independently, and the parts which mount on a particular board are packaged separately and numbered accordingly. This means that only one set of parts need be unpacked at a time. A standard card table was large enough for use as an assembly bench for the entire project, mainly because only a few components were lying loose at one time. A minimum number of individual hookup wires and coaxial cables require preparation by the builder, making the wiring process a lot less boring than it might ordinarily be. Happily, everything went together well, indicating that care was given to the drilling of the holes and the machining of the various brackets and other metal parts. There were no shortages of parts in this kit. Though several packages of solder are furnished for the project, the amount needed is well calculated. This builder had exactly 6 inches of solder left after the last wire was in place! A 30-watt pencil-type soldering iron was suffi-



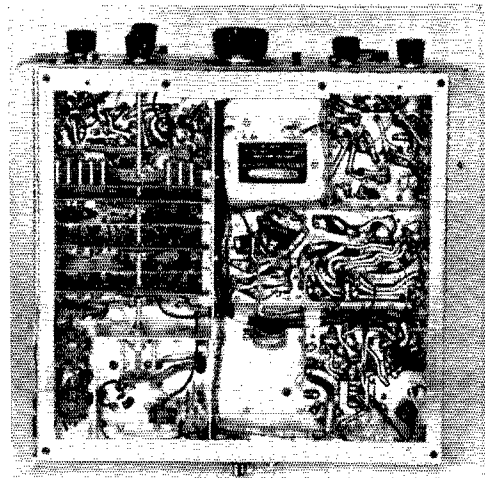
This inside view of the HW-100 v.f.o. box shows the variable capacitor at the upper left. Mechanical stops prevent the capacitor from tuning the upper and lower extremes of its range, thus utilizing only the linear portion of its available capacitance. The MPF105 transistor is attached to the terminal strip at the upper right. The box is made of heavy-gauge aluminum stock. This results in a rigid assembly and assures good mechanical stability.

list of the components used in the transceiver. Each part is numbered and is listed with its individual price at the end of the booklet. These parts can be purchased from Heath should they require replacement.

### Testing and Performance

The final moment of truth comes when the constructor connects the transceiver to its power supply and applies the operating voltages. In this instance a Heathkit HP-23 supply was built (approximately four hours construction and checkout time required) and used. With a certain amount of apprehension the "wick was lit" and, happily, no sparks flew, nor did any thin tendrils of smoke arise from the chassis. Following the step-by-step procedure outlined in the instruction manual, all tests went smoothly except for a slight problem which occurred during tuneup of the 40-meter heterodyne oscillator. It turned out that a defective coil (missing jumper) was supplied with the unit, preventing the heterodyne oscillator from receiving plate voltage on that band. Addition of the missing wire immediately cured the problem. A call to the manufacturer indicated that a few such coils had turned up during a quality-control check of material received from their supplier. Steps were immediately taken to correct the problem. This kit was apparently one of the few in which the defective part was supplied.

All other tests went smoothly except for two minor wiring errors caused by the tired eyes of the builder during a late-hour assembly session



Looking into the bottom half of the chassis, the p.a. grid compartment is at the lower left of the photo. Directly ahead of it are the four circuit boards (vertically mounted) which contain the band switches, heterodyne crystals, and the tuned circuits for the mixer and driver stages. The black box at the upper center of the photo is the crystal bandpass filter. The VOX controls are mounted on the aluminum strip which connects the front and rear aprons of the chassis (far right of photo).

### Heath HW-100 Transceiver

Height:  $6\frac{5}{16}$  inches.

Width:  $11\frac{13}{16}$  inches.

Depth:  $13\frac{3}{8}$  inches.

Weight:  $17\frac{1}{2}$  pounds.

Power Requirements: 700 to 850 volts d.c. at 250 ma., 300 volts d.c. at 150 ma., -115 volts d.c. at 10 ma., 12 volts a.c. or d.c. at 4.75 amperes.

Price Class: \$210.00

Manufacturer: Heath Company, Benton Harbor, Michigan.

one evening—a reversed diode and a shield jumper that didn't quite make it to chassis ground.

The transmitter turned out to be extremely stable on all bands and neither neutralizing capacitor required more than slight adjustment. Plenty of drive is available on all bands and the p.a. runs at full input power with drive to spare. A word of caution: One wafer of the band switch is installed differently than the rest (180 degree rotation from the others), as stated in the instructions. This is the heterodyne oscillator plate circuit switch. A report from a ham who built the HW-100 indicated that he was unable to peak the receiver, and could not obtain any drive during transmit. It turned out that the switch wafer had been improperly installed. Watch for this step during assembly.

On-the-air tests of the receiver showed that it had good immunity to cross talk and overload on all bands, even though the ARRL lab is close to several strong a.m. broadcast stations. No i.f. leakthrough could be detected, and no images were noted during these tests. Receiver sensitivity is good on all bands: a 0.1- $\mu$ v. signal from a generator provided room-volume audio from the transceiver's outboard speaker. A 50- $\mu$ v. signal gave a reading of S9, -3 db., on all bands.

Final proof-of-performance tests came when the HW-100 was connected to the spectrum analyzer. The third- and fifth-order products were well within the manufacturer's specifications --36 db. down from p.e.p. output. This test was made at 100 watts p.e.p. output, though it was discovered that somewhat more power output was possible before objectionable distortion occurred. Carrier suppression was exactly what the book states, 45 db. down from single-tone output.

As far as appearance goes, this equipment has the traditional neat-looking Heath trapping. The cabinet is finished in dark green, and the panel has a contrasting light green paint job. This package should gladden the heart of any radio amateur who elects to use a five-band transceiver for mobile or fixed-station use. For mobile operation a Heath HP-13 d.c. supply can be used. — WICER.