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QST Issue: Jan 1968
Title: Heathkit HW-16 C.W. Transceiver
Author: George Grammer, W1DF

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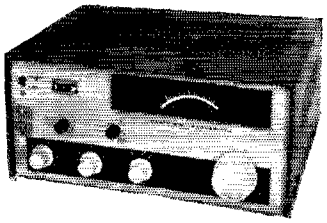
Recent Equipment

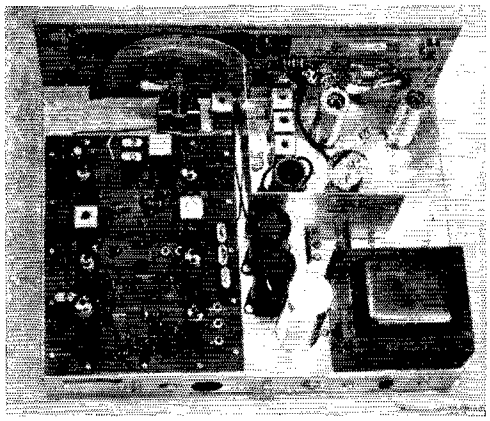
To acquaint you with the technical features of current amateur gear.

Heathkit HW-16
C.W. Transceiver



At least since the early 5-meter days — thirty-some years ago — the word "transceiver" has been taken to mean a combination in which as many circuits as possible are used for both sending and receiving. Also implicit in the term is the idea of sending and receiving on the same frequency, with a single tuning control serving for both. By these definitions the HW-16 is not a transceiver at all. It just happens to combine a separate transmitter and receiver in one box. However, the two are not *completely* separate; they have a common power supply, and the same tank circuit is shared by the transmitting final amplifier and the receiving r.f. amplifier.

Whatever you may wish to call it, the HW-16 is a rather unusual piece of gear. It is an integrated *Novice* station — almost exclusively so, since the self-contained transmitter, c.w. only, crystal controlled, operates in just the 80-, 40- and 15-meter bands, and the receiver covers only the low 250 kc. of each of the same bands. Furthermore, the receiver selectivity — 500-cycle bandwidth at 6 db. down — is too narrow for good phone reception, and there is no provision for detection of a.m. signals. Although an external v.f.o. can be connected to the transmitter for somewhat expanded c.w. work at the "General" stage, the set remains a specialized piece of equipment tailored to fit the Novice — the first station so designed that is available in kit form.



Top view of the HW-16 chassis from the rear. The receiver circuit board is at the left. The transmitter is the semi-enclosed section near the panel at the right. Speaker, phone, key, antenna and (if used) external transmitting v.f.o. all connect through jacks on the rear apron. The octal socket is an accessory outlet for supplying power and keying bias to the external v.f.o.

The overall circuit layout is shown in block form in Fig. 1. The transmitter has three tubes in the usual oscillator-multiplier-final sequence, the final being a neutralized straight-through amplifier on all three bands. The oscillator circuit is the electron-coupled Pierce with a fixed-tune low-*C* 40-meter plate circuit; when an 80-meter crystal is used enough drive gets by the 40-meter tank for exciting the next stage on 80 meters. For 40-meter output from an 80-meter crystal the plate circuit of the second stage is tuned to 40, as is also the final-amplifier tank circuit. A 40-meter crystal can also be used for 40-meter output, in which case all three stages operate on the same frequency. This is the most likely combination for Novice work, since there is no harmonic relationship between the Novice 80- and 40-meter bands. On 15 meters the second stage triples from a 40-meter oscillator frequency (using a 40-meter crystal) to drive the final amplifier on 21 Mc.

The final-amplifier tank circuit is a pi network with constants chosen to fit a 50-ohm resistive load. There is no loading adjustment, so if the antenna-system load doesn't happen to be close to 50 ohms it must be transformed to that value by some means external to the HW-16. The instruction book tells how to adjust the length of a coax-fed dipole for minimum standing-wave ratio in 50-ohm cable, an s.w.r. bridge being required for this. When the user has some other kind of antenna a transmatch is a practical necessity, if the transmitter is to be operated properly. The pi coil is tapped for the three bands, and various amounts of fixed capacitance are switched in in both the loading and tuning positions to obtain the proper network constants. The variable pi tuning capacitor has a maximum capacitance of about 50 pf.

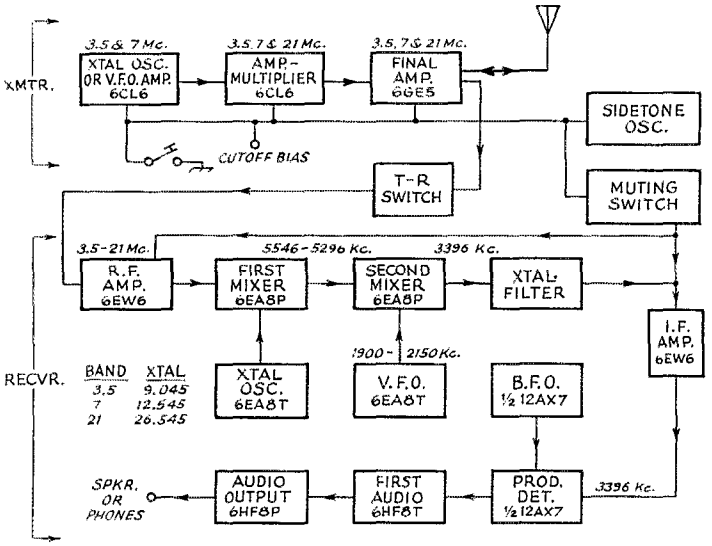


Fig. 1—Block diagram of the HW-16

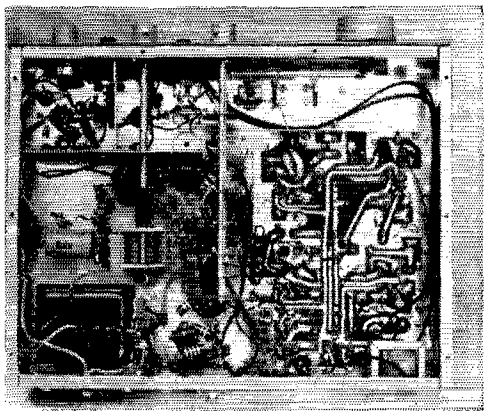
All three tubes in the transmitter are keyed by the blocked-grid method. A negative 150-volt supply furnishes the blocking bias. When the key is closed the bias is removed completely from the first two stages, but the final amplifier is left with a fixed operating bias through a voltage divider. There is no attempt at shaping the keying waveform, other than the regulation of the bias supply and such shaping as may be done by the r.f. bypassing and decoupling. As a result, the keying is a little hard, slightly more so on break than on make, but probably not enough to be remarked particularly by the operator at the other end.

The panel meter reads either relative r.f. output (the usual diode rectifier circuit) or final-amplifier cathode current. A potentiometer in the screen supply permits setting the d.c. input to 75 watts for Novice use. The power can be run up to 90 watts input by a General.

On the receiving side, the r.f. stage gets its signal through the transmitting tank circuit, as mentioned earlier. The built-in TR switch indicated in Fig. 1 is shown in more detail in Fig. 2A. The signal comes off the hot end of the pi network through a small (10 pf.) capacitor, an old scheme which has a new twist in being tied in with the transmitting-amplifier cathode-metering circuit. With the key open the plate current of V_9 is cut off and there is therefore no voltage across the 10,000 ohm resistor. CR_1 is nonconducting and the signal goes through the fixed capacitors to the grid of V_1. On closing the key, there is a voltage drop in the cathode resistor, making its upper end positive and forward-biasing CR_1, so practically all of the cathode current goes through CR_1 and the 15-ohm resistor shunting the meter. This brings point A practically to ground and prevents the transmitting r.f. from damaging V_1.

The receiver uses double conversion, with the first oscillator crystal controlled. The first-mixer output goes through a 250-kc. bandpass circuit in the 5.5 Mc. region to the second mixer, where it is combined with the output of the receiving v.f.o. to give the second intermediate frequency, 3396 kc. A two-crystal half-lattice filter provides the 500-cycle selectivity at this point, after which the signal is amplified by an i.f. stage and then detected. The product detector is a simple triode with the signal applied to the grid and the b.f.o. voltage fed to the cathode. There is then an audio voltage amplifier and finally a power amplifier, the two stages being handled by a multipurpose tube. There is no speaker in the set, but a connector is provided for an external one. The usual headphone jack is there, too.

As further proof that Novice needs are met, there is a built-in sidetone oscillator — the neon-bulb type — which operates whenever the key is pressed, plus the receiver muting system shown



The underside of the receiver board is at the right in this bottom view of the HW-16. The band switch runs down the center of the chassis. The variable capacitor at left center is the tuning control for the transmitting final-amplifier tank.

in Fig. 2B. With the key open the transistor is forward-biased, the transistor conducts, and point *B* is practically at ground, so the receiver gain is normal for the setting of the 200-ohm manual gain control. With the key closed the transistor is cut off, which is equivalent to inserting the 10K resistor between the bottom end of the gain control and ground, thus greatly reducing the receiver gain. The gain control operates on the r.f. and i.f. amplifier cathodes. There is no a.g.c. in the receiver.

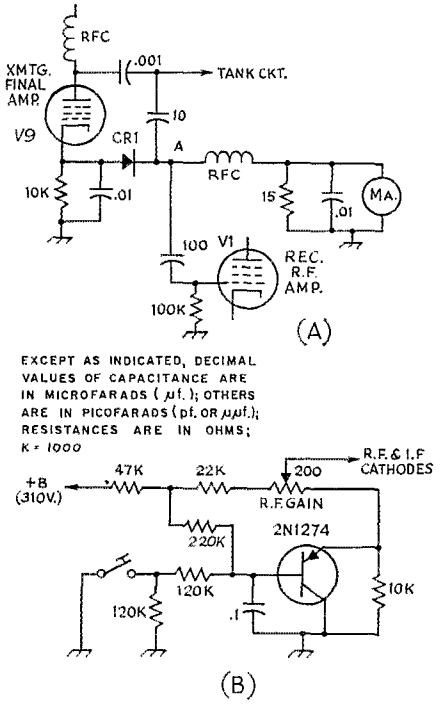


Fig. 2—A—Automatic transmit-receive switching circuit. CR_1 shorts the receiver input to ground when the transmitting final amplifier is operating, but becomes nonconducting while receiving. B—Muting circuit, using a transistor to switch extra cathode bias (voltage drop in the 10K resistor) into two receiver stages when the key is pressed. Point C is connected to the negative keying bias (about 100 volts) and the tone oscillator.

The Heathkit HW-16 C.W. Transceiver

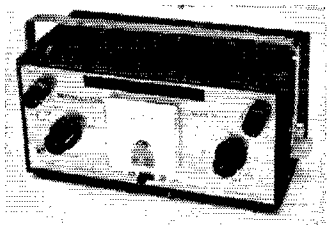
Height: 6½ inches.
Width: 13¾ inches.
Depth: 11½ inches.
Weight: 20 pounds.
Power Requirements: Operates on 120 volts a.c., 50/60 c.p.s.
Price Class: $100.
Optional Accessory: HG-10B v.f.o.
Manufacturer: Heath Company, Benton Harbor, Mich. 49022

The receiver dial is calibrated from 0 to 250 kc. in 5-kc. increments. To read the frequency of a received signal the dial reading is simply added to the frequency of the low edge of the band; i.e., if the set is on 7 Mc. and a signal is tuned in at 180 on the dial the freqcency is 7180 kc. The 250-kc. range is covered with 9½ turns of the knob, making an average of a shade over 25 kc. per turn — good spread for easy tuning.

A Novice who puts one of these kits together can get a taste of both "old-fashioned" chassis construction and printed-circuit wiring. The power supply and transmitter occupy about half the chassis and use conventional mounting and wiring. The receiver, however, is on a printed board — a distinct advantage for the Novice because the receiver is considerably more complex than the transmitter. The kit we tested was assembled by WA1GFW in 35 hours, a time which would hardly be possible had point-to-point wiring been used in the receiver.

A few statistics: Maximum output on either 80 or 40 meters measured just 50 watts, using crystals for the band in use. The 21-Mc. output, where a 7-Mc. crystal is used, was 20 watts. Harmonic suppression appeared to be quite good, the second harmonic from 80 meters being down 45 db. and the third down 55 db. From 40 meters, both the second and third harmonics were down 55 db. Although there is no low-pass filter in the set, there was no interference with a marginal Channel 6 signal with the transmitter on any band. — *W1DF*

The Monarch FSI-4



THE FSI-4 is a transmitter accessory for a.m. and c.w. rigs that put out 50 watts or less on the amateur frequencies below 54 Mc. It will measure power output, modulation percentage and v.s.w.r. The gadget can be used as a field-strength meter or as a modulation monitor. Included in the unit is an r.f. actuated on-the-air sign that will indicate whether or not a transmitter is feeding power to an antenna. To help prevent a transmitter from causing TVI, a multisection low-pass filter with a 55-Mc. cutoff frequency is provided.