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QST Issue: Jan 1964
Title: Heathkit One-Band S.S.B. Transceivers (HW-12)
Author: E. Laird Campbell, W1CUT

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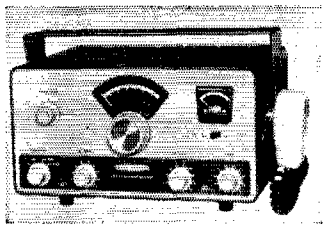
• Recent Equipment —

Heathkit One-Band S.S.B. Transceivers



It is difficult to decide whether the Heath HW-line is primarily mobile or fixed station equipment. It is light in weight, power supplies are available for either 117 volt a.c. or 12 volt d.c. (negative ground only) operation, and the appearance of the unit will suit either the shack table or the family car. If car operation is desired, a gimbal bracket is furnished for under-dash or transmission-hump mounting.

Circuit features of the transceivers include push-to-talk or VOX (voice operated break-in), a.l.c. (automatic level control), and provisions for a 100-kc. crystal calibrator in the receiver. The physical make-up of the transceivers is interesting too. In fact, the HW-series of transceivers can truly be called "wireless" sets since most of the components in the unit are mounted on a printed circuit board, and this includes i.f. transformers, final amplifiers and tank circuit.

The assembly is simply a one-piece steel chassis frame with a few components mounted on it — controls, transformer, tuning capacitor, loading control, and relay — and the printed circuit board with the remaining components. The printed circuit board is, of course, pre-punched and ready to assemble. Component silhouettes with values are printed on the board so that, along with the step-by-step instructions in the manual, the method is practically fool-proof. The printed circuit makes for fast assembly, too, especially when compared to wiring the same circuit using wire and tie-points. Some wiring is, of course, necessary. Heath furnishes a wiring harness which connects up the various sections of the board and the components mounted on the steel frame. One other advantage of the printed circuit is that all of the heat-generating components — tubes, resistors, — are mounted on top of the phenolic board, which makes for good ventilation.

We wired the 75-meter model (HW-12) within the Heath-predicted time of 15 hours. No unusual difficulties were encountered and, when the project was completed, it seemed as though it was one of the most pleasant kit-wiring experiences we had ever had. The printed circuit undoubtedly was responsible for this impression. Alignment, too, was a breeze and will be covered later in this write-up.

The Circuit

The 75-meter transceiver, the HW-12, is the model described here. Except for a few minor circuit differences (an additional mixer), the 40- and 20-meter models are about the same. The outward appearance and operating controls are

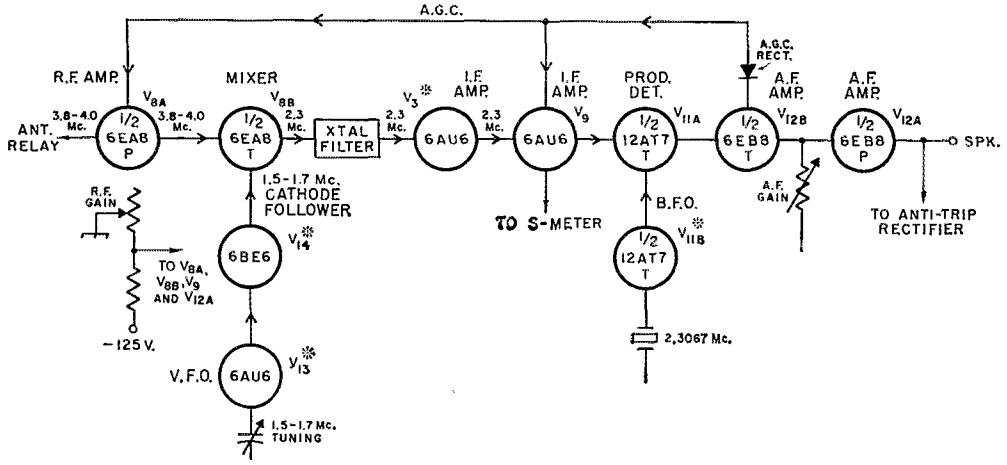


Fig. 1—Block diagram of the receiver section of the HW-12. A star alongside a tube indicates that the tube operates in both transmitting and receiving.

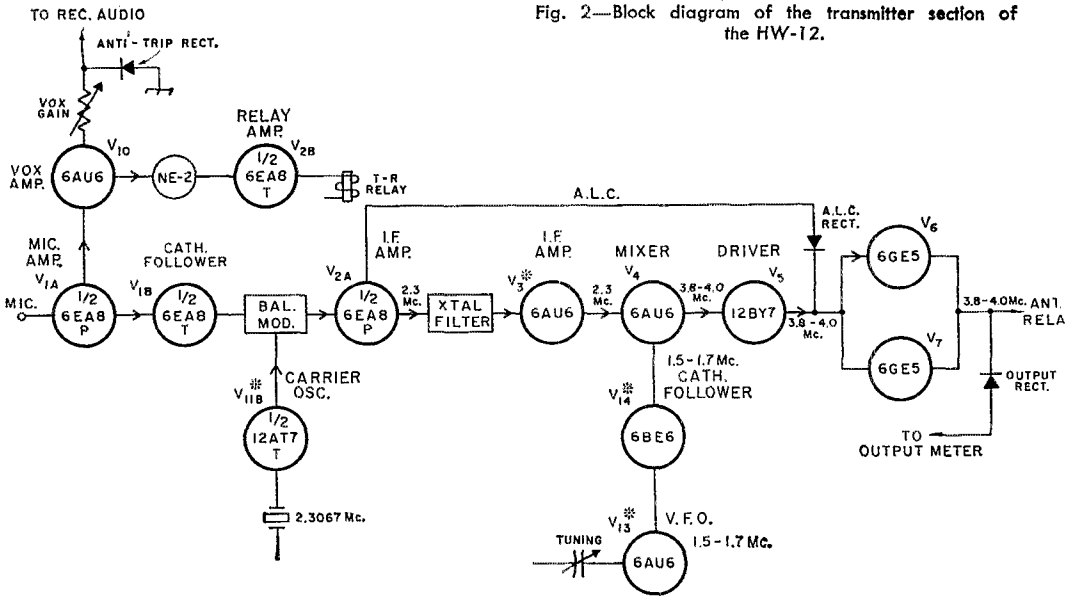


Fig. 2—Block diagram of the transmitter section of the HW-12.

identical for all models. The 80- and 40-meter models operate on lower sideband only, the 20-meter model on upper sideband only. The 40-meter (HW-22) unit covers 7.2 to 7.3 Mc., and the 20-meter (HW-32) unit covers 14.2 to 14.35 Mc.

Receiver Section

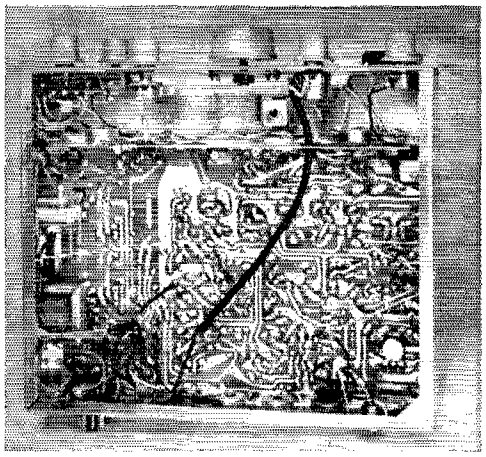
A block diagram of the receiver used in the HW-12 is shown in Fig. 1. It covers the frequency range of 3.8 to 4.0 Mc. Several of the tubes used in the receiver also work during transmission and are so identified in Fig. 1 by a star alongside the tube.

Signals arriving from the antenna system (must be 50 ohms, unbalanced) are switched through relay contacts to the receiver's r.f. amplifier V_{8A}, a 6EA8. This tube is a.g.c. controlled at all times and is completely cut off during transmitting by a bias that is applied through relay contacts. Output from the r.f. amplifier is fed to the triode mixer, V_{8B}, along with energy from the v.f.o. which operates in the 1.5 to 1.7 Mc. range. A 6BE6 is inserted between the v.f.o. and the mixer for isolation and it is this tube that operates as a mixer/oscillator in the 40- and 20-meter models of the transceiver.

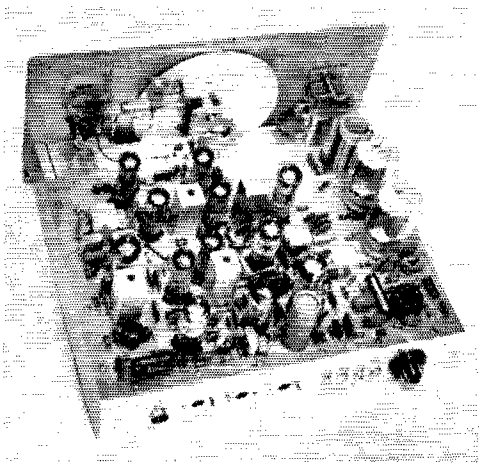
A Colpitts oscillator is used for the v.f.o. and, because of its low frequency of operation, along with temperature compensation, is more than adequately stable. Frequency drift is rated at less than 200 cycles per hour after warmup. The oscillator is capacitor tuned through a 7 to 1 planetary dial drive. The dial, which sits behind an arc-shaped dial window, is calibrated in 2 kc. increments from 3.8 to 4.0 Mc and offers about 6 inches of bandspread. The tuning rate is approximately 55 kc. per knob rotation.

Output from the mixer, which is at 2.3 Mc., feeds into a crystal lattice filter and then into two stages of i.f. amplification. Selectivity for the receiver is rated at 2.7 kc. at 6 db., 6 kc. at 50 db. The second i.f. amplifier, V_9, has its gain controlled by a.g.c. and, along with the r.f. amplifier, mixer and the final a.f. amplifier, is cut off during transmission by a negative bias supplied through the T-R relay contacts. The S-meter is also part of the i.f. amplifier (V_9) circuit.

S.s.b. signals are detected in V_{11A}. Injection is furnished by the crystal-controlled b.f.o., V_{11B}. A.g.c. voltage is derived from audio voltage obtained at the plate of the audio amplifier, V_{12B}. A semiconductor voltage doubler produces the a.g.c. negative bias which is applied to the r.f. amplifier and second i.f. amplifier. Time constants in the a.g.c. circuit are designed for fast response and slow release time.



Bottom view of the HW-12 75-meter s.s.b. transceiver. It should be obvious in this shot that most of the package is printed circuit.



The use of a printed circuit board contributes to the neat appearance of the HW-12. Rear-apron connectors and controls are, from left to right, microphone, microphone gain, tune-level control, final-amplifier bias (all three screwdriver adjusted), speaker, external relay, antenna, and receiver (phono connectors), and octal plug power connector. The carrier-null control knob is adjacent to the transformer can at the lower left of the chassis in this view. The empty socket at the lower right is for the accessory 100-kc. calibrator.

The final audio amplifier, the pentode section of a 6EB8, develops up to 1 watt of audio output to drive an 8-ohm speaker (speaker is not furnished). The power audio stage has built-in shaped frequency response (400 to 3000 cycles) so that the receiver output is peaked to the voice frequencies. This gives the HW-12 receiver a crisp, "communications-quality" sound.

Some of the audio output from V_{12A} is sampled and fed to the anti-trip rectifier, so that signals coming from the speaker will not activate the VOX system.

Transmitter Section

Fig. 2 shows the block diagram of the transmitter portion of the HW-12 s.s.b. transceiver. Output from any high-impedance microphone (no microphone is furnished with the kit) is amplified in V_{1A} and then applied to the audio-frequency cathode follower, V_{1B}. This stage, V_{1B}, has low-impedance output to match the input impedance of the semiconductor ring-diode balanced modulator. Energy from the crystal-controlled carrier oscillator, V_{11B}, (which is the b.f.o. when receiving) is also fed to the modulator. Output from the balanced modulator is double sideband, no carrier. Rated carrier suppression is 45 db. A panel FUNCTION switch, when in the TUNE position, applies a d.c. voltage to the modulator and unbalances it to produce some 2.3-Mc. carrier, which is used to give a sample signal for transmitter tune-up.

Balanced-modulator output is amplified in V_{2A} and fed into the crystal filter. The filter attenuates the upper-sideband frequencies, leaving the lower-sideband signal for further amplification in V_3. Sideband suppression is rated at 45 db.

Output from amplifier, V_3, is at 2.3 Mc. and is fed, along with output from the v.f.o./cathode follower, to the transmitter mixer, V_4. The resulting output is in the 75-meter amateur band, 3.8 to 4.0 Mc. The 12BY7 driver uses broad-band input and output circuits so that there is no necessity for tuning this stage when shifting frequency.

Two Novar television horizontal amplifier tubes, 6GE5s, are operated as linear r.f. amplifiers in the HW-12 for a rated input of 200 watts, p.e.p. If these tubes are driven into grid current, a d.c. signal is developed, fed through the a.l.c. rectifier and applied back to an earlier stage, the i.f. amplifier, V_{2A}, to cut back automatically on the drive. This a.l.c. action provides protection against overdriving the final r.f. amplifiers. Bifilar wound chokes are used in the heater leads of the amplifier tubes to isolate them from the rest of the circuit.

The final-amplifier output circuit is a pi-section arrangement with a fixed-value loading capacitor. The final is tuned by a variable capacitor in the pi circuit. Output impedance of the transmitter is fixed at 50 ohms.

The VOX system used in the HW-12 is similar to that used by Bigler in his popular "Side-Band Package."[1] Some of the output from the microphone amplifier, V_{1A}, feeds the VOX amplifier, V_{10}, which is running at maximum plate current and low plate voltage in the normal condition. The negative portion of the audio signal from V_{1A} biases back the VOX amplifier, reducing its plate current and increasing the plate voltage to a point where the NE-2 in the plate circuit fires. The positive pulses from the neon bulb are amplified in V_{2B} and close the T-R relay which is in the plate circuit of V_{2B}.

All of the switching between transmit and receive is done by the built-in ceramic-insulated T-R relay, and it can be controlled by the VOX circuit or triggered directly with the push-to-talk switch on the mike. As mentioned previously in the receiver section, several tubes in the receiver are biased to cutoff through relay switching during transmission. The final r.f. amplifiers, driver, mixer, first i.f. amplifier and the cathode follower, V_{1B}, are biased off during reception. The R.F. GAIN control is used to adjust a negative bias, which is applied to the same bias line that cuts off the receiver r.f. amplifier, mixer, i.f. amplifier, and a.f. amplifier during transmission. A spare section of the relay can be used to switch external equipment such as a linear amplifier or antenna relay. The spare contacts terminate at a rear-apron phono connector.

Alignment and Testing

Perhaps one of the main reasons (though unjustly so) why do-it-yourself or kit s.s.b. projects are shied away from by some amateurs is fear of a complicated alignment job when the equipment is ready for testing and use. Nothing could be

[1] "A Side-Band Package," Bigler, June 1958, *QST*, p. 24.

further from the truth, especially with the HW-12. Heath has outlined several calibration and alignment procedures, the simplest involving, nothing more than an ordinary broadcast receiver and a VOM. Even the panel meter is used in the process, for setting the final-amplifier operating bias.

Most of the fixed-tuned circuits are factory set and those that aren't need no more than a quarter-turn this way or that to bring them into alignment. The most time-consuming step in the alignment process is the 30-minute wait for the unit to warm up and stabilize so that the balanced modulator carrier null control can be set.

Panel controls on the transceiver include the main tuning (FREQUENCY), FINAL TUNE, FUNCTION (OFF-PTT-VOX-TUNE), R.F. GAIN, A.F. GAIN, and VOX GAIN. Several "set and forget" controls are on the chassis rear apron and the S-METER ADJUST and VOX DELAY control pots are behind small access holes in the front panel (they are screwdriver adjusted).

The HW series of transceivers are finished in two-tone "Heath green." — *E. L. C.*

HEATHKIT HW-12 S.S.B. TRANSCEIVER

Height: 6¼ inches
Width: 12¼ inches
Depth: 10 inches
Weight: 12 pounds
Power Requirements: Transmit: 800 v.d.c. at 250 ma., 250 v.d.c. at 100 ma., -130 v.d.c. at 5 ma., 12.6 v.a.c. or d.c. at 3.75 amps. Receive: 250 v.d.c. at 65 ma., -130 v.d.c. at 5 ma., 12.6 v.a.c. or d.c. at 0.3 amps.
Price Class: $120.
Manufacturer: Heath Company, Benton Harbor, Michigan.

COMING ARRL CONVENTIONS

January 18-19 — Florida State, Miami
April 3-5 — Great Lakes Division, Detroit, Michigan
May 9-10 — New England Division, Swampscott, Massachusetts
June 12-14 — West Gulf Division, Brownwood, Texas
August 21-23 — ARRL National, New York City

FLORIDA STATE CONVENTION

Miami, Florida — January 18-19

Florida's first State ARRL Convention will be held in the Miami Bayfront Park Auditorium and the Biscayne Terrace Hotel, January 18 and 19. Convention activities will be combined with the annual Tropical Hamboree and the first Florida/Inter-American Hamfest.

Registration will officially begin Saturday at 9:00 A.M. A Hospitality Room will be open all day Friday at the Biscayne Terrace as a gathering spot for early arrivals.

Technical speakers include Stuart Meyer, W2GHK; Harold Vance, K2FF; and Bob Ruyle, WØFCH. The MARS program, featuring Chiefs of Navy and Air Force MARS plus the 3rd Army Deputy MARS Director, will be backed up by an extensive exhibit. During the Inter-American meeting, heads of South and Central American clubs will get together with the W/K group to discuss mutual problems and interests as a preliminary to the IARU meeting in Mexico City. The Floridoras will operate a "Kaffee Klatch" room throughout most of the convention and will serve as official hostesses for a YL Sunday morning meeting. The YL International Sidebanders will have a luncheon as major activity. The Florida Sidebanders will start Sunday morning with a group breakfast. Florida DX Club's Ed Cushing will present the story of his trip to Robinson Crusoe Island as CEØZ1 during the DX forum.

The Hamboree exhibit area will include displays of most of the major manufacturers' products, special exhibits by clubs and similar organizations, and a large swap shop.

The ARRL organizational program will include appointee meetings, general membership meeting and exhibit. The League Headquarters' representative will be Bob White, W1WPO (DXCC awards). The ARRL Executive Committee will hold its January meeting there also.

The convention banquet will be held in the Starlite Room of the Biscayne Terrace on Saturday evening and the festivities will be enhanced by a musical program with Leo Meyerson, WØGFQ, at the organ.

Registration for all activities, except the banquet, will be $1.00. The banquet, limited to 300 will be $4.75. Convention rates at the Biscayne Terrace are $8.00 single, $10.00 double. Tickets, hotel reservations and further information may be obtained by writing to Dade Radio Club, P.O. Box 73, Biscayne Annex, Miami, Florida 33152.

New Jersey — The Raritan Bay Radio Amateurs will hold their annual dinner at the Community Hall, Outlook Ave., Sayreville, on January 11. A roast beef dinner is featured, along with prizes and an entertaining program. Reservation deadline is Jan. 3. Contact K2KFE, 23 Reid Street, Sayreville, N. J.

New York — The second annual W.N.Y. Winter Indoor Picnic will be presented by the Six-Meter Mobile Association of Buffalo, at the Club Commodore, Genesee Street, Buffalo, on January 18. The buffet begins at 8:00 P.M., followed by dancing, prizes and more. Tickets are $3.25. For more info, contact Joe Forth, WA2TRT, 123 St. Boniface Road, Checktowaga 25, N. Y.