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QST Issue: Jul 1963
Title: Heathkit HR-10 Receiver
Author: George Grammer, W1DF

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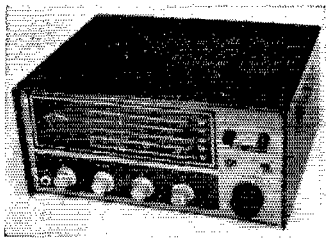
• Recent Equipment —

Heathkit HR-10 Receiver



In calling the HR-10 a "basic" amateur-band receiver kit, the Heath Company probably means that it includes those features that have become practically routine in receivers having any real claim to the "communications" title. There is an r.f. stage, first mixer/oscillator, two i.f. stages, diode detector, b.f.o., a.g.c. rectifier, automatic noise limiter, and two audio stages, the last being a power pentode. The power supply is built in but, as is customary in all receivers above the "SWL" class, the speaker is not, nor is it supplied with the kit. There is provision for a plug-in crystal calibrator, but this, too, is an accessory which must be purchased separately.

Liberal use is made of multipurpose tubes; the seven tube envelopes include three triode-pentodes and a triple diode. Fig. 1 is a block diagram of the set. The unusual feature, for a receiver in this price range, is the two-crystal half-lattice filter in the high-frequency (1681-kc.) i.f. This intermediate frequency is high enough to result in satisfactory suppression of images, and the filter provides adjacent-channel selectivity comparable with that obtainable in a conventional two-stage amplifier at 455 kc., so no further conversion is needed.

The front-end circuits are the familiar ones: an inductively-coupled antenna circuit — with the antenna coupling adjusted for working from coaxial lines — gang-tuned with the mixer grid circuit and high-frequency oscillator. The latter is of the "hot-cathode" type. There is an antenna trimmer, controlled from the panel, across the r.f. grid-tuned circuit. A similar trimmer capacitor is connected between the oscillator cathode and ground, for aligning the band edges on the dial; this is marked "CAL RESET" on the panel. The 3.5- and 7-Mc. mixer tuned circuits are loaded by resistances; these are not explained in the instruction book but presumably help level off the gain as compared with the other bands and perhaps also help broaden the tuning so tracking becomes less critical. All coils are slug-tuned and shunted by fixed capacitors; in the oscillator tuned circuits each fixed capacitance is a combination of silver mica and N750 temperature-compensating capacitors. The coils, fixed capacitors, and band switch are furnished as a preassembled, prewired unit.

Each of the five amateur bands — 3.5 through 28 Mc. — is spread over practically all of the tuning dial. Calibrations are fairly linear, and are marked off at 10-kc. intervals on the four lower bands. The steps are 20 kc. on 28 Mc. The tuning rate is slow enough for easy tuning — 12 turns of the knob to go through a band, corresponding to about 50 kc. per complete knob rotation.

The crystal filter and its input transformer work directly from the plate of the 6EA8 pentode mixer. The frequencies of the two crystals are 1.7 kc. apart, giving an effective bandwidth of 3 kc. at 6 db. down. With proper tuning of the input transformer, the selectivity curve is quite flat for about 2 kc. on top. The rated bandwidth at 40 db. down is 9 kc.

Following the filter are the two i.f. amplifier stages, the second tube of which is a 6EA8 triode-pentode with the triode used as the beat oscillator. The b.f.o. is not coupled directly to any part of the i.f. circuit, but there is enough internal coupling between the triode and the pentode control grid to let the pentode section act as a b.f.o. amplifier. The amplified b.f.o. voltage, along with the i.f. signal, is then applied to a diode detector, one section of a 6BJ7. Thus the b.f.o. voltage at the detector depends on the manual gain setting; the more the gain, the greater the b.f.o. voltage. This works in the right

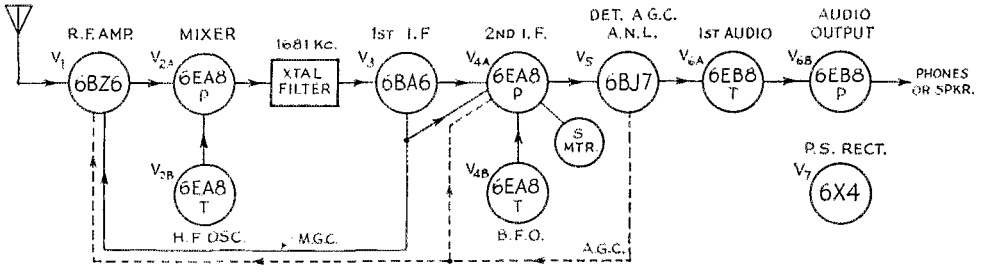


Fig. 1—Block diagram of the HR-10 receiver.

direction, but even so the stray coupling does not give enough b.f.o. voltage to prevent overloading on strong signals when the r.f.-i.f. gain is high. Better c.w. reception resulted by increasing the coupling between the triode and pentode control grids. This was easily done by soldering about an inch of wire to each grid prong on the 6EA8 socket, spacing the wires so the rectified voltage across the detector diode load resistor (Pin 1 to ground) was 15 to 20 volts, as measured by a v.t.v.m., with the manual gain all the way up. There is an equivalent improvement in handling strong s.s.b. signals.

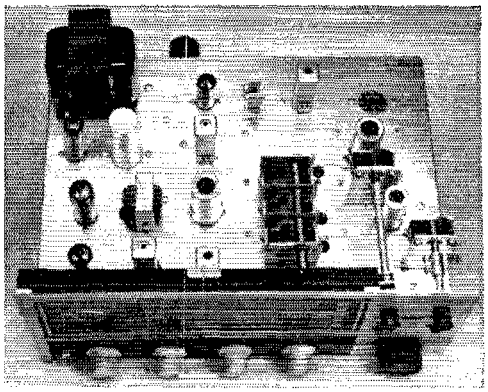
The second diode of the 6BJ7 is used as an a.g.c. rectifier. The automatic gain-control voltage is applied only to the r.f. and second-i.f. amplifier grids, although the manual gain control (variable cathode bias) is applied to the first i.f. in addition to these two. The third diode is a shunt-type automatic noise limiter which, like all limiters of this general type, is useful only when the b.f.o. is off. (Incidentally, the circuit diagram in the instruction book has "on" and "off" reversed on the a.n.l. switch.)

The audio voltage from the detector is amplified in the triode section of a 6EB8. The triode is resistance coupled to the pentode power-amplifier section of the same tube. An 8-ohm audio output is provided for use with a speaker, and a 500-ohm output for headphones. The speaker is disconnected when the headphone plug is in the PHONES jack on the front panel.

The power supply uses full-wave center-tap rectification with a two-section *RC* filter. There is no voltage regulator in the receiver, with the result that the oscillator frequencies change somewhat with various settings of the manual gain control, and with changes in line voltage. The total change is only a few hundred cycles, which is not at all bad for unregulated oscillators. However, it can be annoying, especially in c.w. and s.s.b. reception, if the line voltage is at all sensitive to varying household loads. A VR tube on the oscillators would get rid of it.

Aside from this, the only thing that can be criticized is the hum in headphone reception. This is not a simple matter of plate-supply filtering — more filter was tried with little improvement — but appears to be tied up with a.c. chassis currents arising from the heater wiring. It goes through a minimum at a rather high setting of the audio gain control, at which point it can be fairly well masked by noise and signals at high settings of the r.f. gain control — if your eardrums are built to stand that much volume. An external attenuator for the headphones probably would help in this respect.

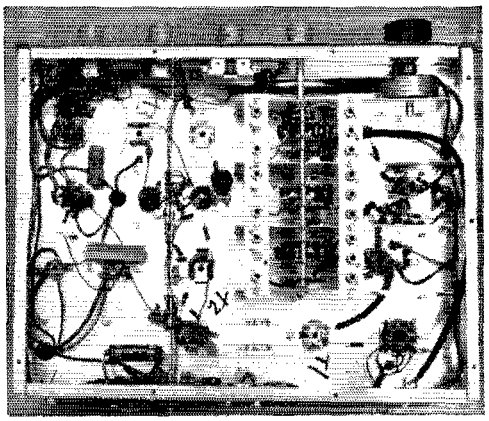
On the plus side, the receiver handles nicely, is easy to tune on any type of emission, has good phone selectivity, and has good temperature stability. A number of drift runs at 21 Mc. showed a maximum excursion of about 2 kc. during the first half hour or so of warm up (from a cold start) after which the frequency moved back, reaching the original setting in about two hours from start. The construction is solid, and the



Chassis layout of the HR-10. The power supply and audio section is along the left side; the i.f. runs from back to front in the center, with the filter crystals at the rear; r.f. section is at the right. The variable capacitor nearest the right-hand edge of the chassis is the antenna trimmer; the one behind it is the calibration reset trimmer.

stability against vibration and shock is very good. Although the set does not have sharp selectivity for c.w., a fairly good single-signal effect can be obtained if the b.f.o. is set off to one side of the selectivity curve.

Miscellaneous features: an octal socket is provided for a plug-in 100-kc. crystal calibrator. The necessary wiring to this socket and a panel on-off switch are part of the receiver, although the calibrator itself is not furnished. An octal "accessory" socket on the rear chassis wall has two pins wired in series with the r.f. gain control; these can be used for an external stand-by switch or relay, but are normally connected together through a jumper in an octal plug. The panel stand-by switch is in series in this same circuit. Thus on stand-by the cathodes of the three tubes on the manual gain control are opened while the



The preassembled r.f. section occupies the upper right section of the chassis in this view. Aside from the bunching of small components that one expects around miniature tube sockets in modern equipment, the bottom of the chassis has an "open" appearance that should make for ease in wiring. The small variable capacitor on the panel at top center is the v.f.o. pitch control.

remainder of the receiver is operative. There are separate a.g.c. and b.f.o. switches; the former also cuts in the S meter when thrown to the "on" position. The S meter is one arm of a d.c. bridge in the plate circuit of the last i.f. stage.

We are unable to comment on any aspect of assembling the kit, as the set was received completely wired. The preassembled r.f. section should save considerable time. So should the wiring harness which is part of the kit. The under-chassis space is not crowded, so assembly and wiring here should offer few mechanical problems. On a "general principles" guess, the only point that might tax the constructor would be the ever-cantankerous dial cord.

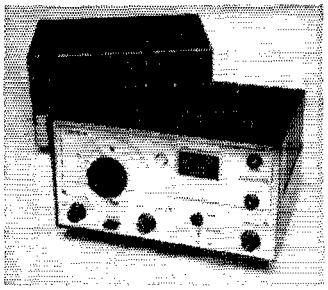
The assembly instructions appear to be done with the usual Heathkit thoroughness, but the book is a little on the sketchy side in explaining the circuit features and in operating instructions.

— *G. G.*

Heathkit HR-10 Receiver

Height: 6½ inches.
Width: 13¾ inches.
Depth: 11½ inches.
Weight: 18 pounds.
Power requirements: 117 volts, 50/60 cycles, 50 watts.
Price class: $80.
Manufacturer: Heath Company, Benton Harbor, Mich.

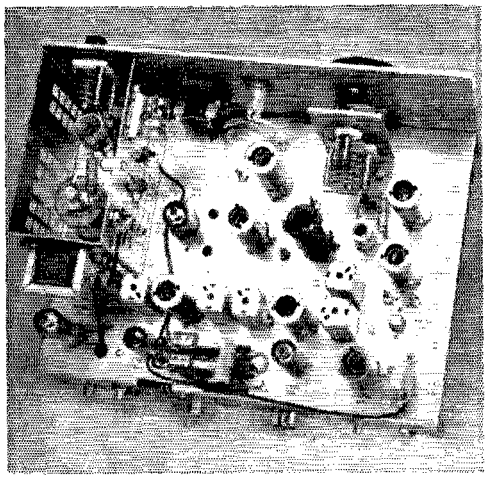
The Clegg "Thor" 50-Mc. Transceiver



LIKE its Greek deity predecessor,[1] the Clegg Laboratories Thor is packed with novel but practical ideas. Obviously it was designed with the special needs of the v.h.f. operator in mind, and it has a number of features that have not been available to the purchaser of v.h.f. gear heretofore.

The Thor is the first v.h.f. transceiver wherein the transmitter frequency can be made to follow the receiving frequency automatically, for example. Separate-frequency operation is also possible. By use of a variable oscillator common to both transmitting and receiving, and eliminating frequency multiplication with v.f.o. control, highly stable signals are produced, coming and going. Transmitter output is over 40 watts, a.m. or c.w. The receiver does an excellent job on all modes, including s.s.b.

[1] Recent Equipment: The Clegg Zeus V.H.F. Transmitter, *QST*, Sept. 1961, p. 55.



Interior of the Thor r.f. unit. The transmitter final amplifier assembly is at the left, v.f.o. tuning at the right.

How It Works

In receiving, the signal is first amplified in a 6CW4 stage, V_1. This r.f. amplifier has three tuned circuits, adjusted for essentially flat response across the desired range, 50 to 52 Mc., with good attenuation of signals above and below. A tunable oscillator and cathode follower, V_6, covers 39.3 to 41.3 Mc., its output beating with the signal in the first mixer, V_2, a 6EH7, to give output at 10.7 Mc. The tunable oscillator is also used as the v.f.o. in transmitting.

The mixer plate circuit has a 10.7-Mc. crystal-lattice filter, for selectivity where it does the most good: up near the front end of the receiver.

A triode-pentode 6BL8, V_3, combines the functions of second mixer and crystal oscillator, the latter on 11.156 Mc. Mixer output is on 455 kc. Two transformers designed for the flat-topped steep-sided response desirable in v.h.f. work are used between the second mixer and a 455-kc. amplifier, V_4, another 6EH7. A 6AL5, V_{14}, and two audio stages in a 6BM8, V_5, complete the receiving lineup.

Receiver selectivity quoted by the manufacturer is 5 kc. at 6 db. down and 12 kc. at 50 db. down. This is not razor-sharp, as c.w. or even sideband operators think of selectivity, but it chops off signals in the 50-Mc. band in a way that will be a revelation to hams accustomed to