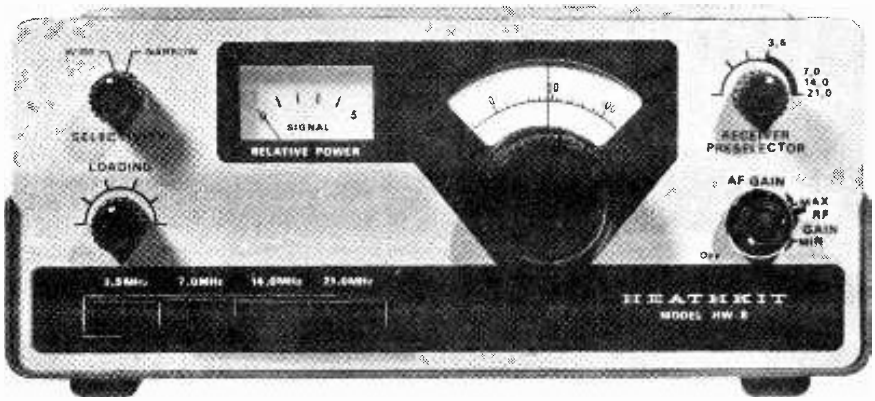
SPECIAL PRODUCT REPORT

HEATHKIT HW8 QRP TRANSCEIVER



Many thousands of radio amateurs were introduced to the thrills of operating with low power CW when Heathkit thought up the earlier HW7 transceiver. However that did not have the 80 metre band available, a sad omission in these days of low sunspot activity. There was no gain control on the RF side and there was separate dial calibration for each of the three bands. On the credit side, it was possible to plug in a crystal for fixed frequency operation, a facility lacking on the HW8.

But what is 'low power'? In the USA, 100W or so is spoken of as low power, which it probably is when one considers their maximum licensed power. I prefer to go along with our ideas over here, which is something below 10W input, although there are many enthusiasts who use, and get good results from, a few hundred milliwatts.

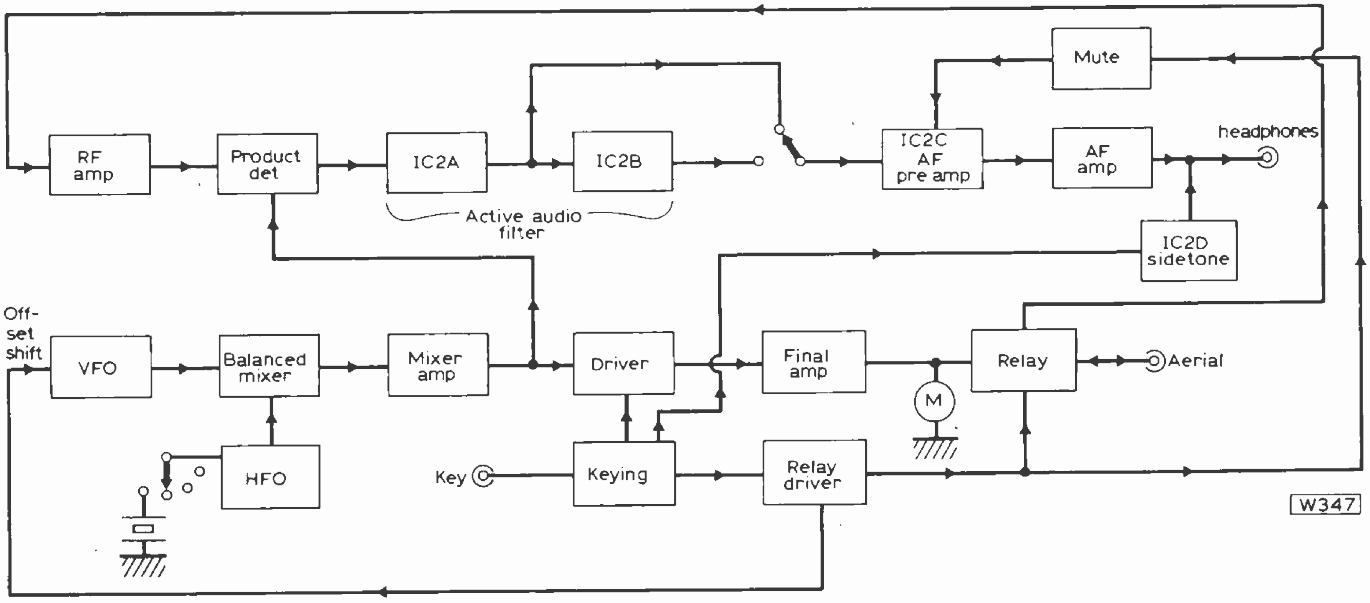
DESCRIPTION

The HW8 transceiver is designed to work from a nominal 12VDC supply, in practice from a car battery if in the field or from a mains unit if at home or in a hotel on vacation. In either case the actual input voltage will be nearer to 13·4V. On transmit the HW8 provides an input of around 3W on CW on the bottom 250kHz portion of the 3·5, 7, 14 and 21MHz bands. The output impedance is fixed at 50Ω with an output loading control on the front panel, coupled with a relative output meter. The receiver uses the direct conversion technique, as did the HW7, and as well as having an RF stage it has a switchable two-stage active filter giving audio bandwidths of 375 and 750Hz (6dB) at 750Hz. In use this means that SSB is just about uncopyable which is rather a pity, although only CW can be transmitted. The two modes are far from incompatible.

THE CIRCUIT

On both receive and transmit the VFO output (8·645 to 8·895MHz) is mixed with the output of an RF oscillator which provides four crystal controlled frequencies, 12·395, 15·895,

This block diagram shows how several of the stages of the HW8 are used on both transmit and receive.



abridged specification

TRANSMITTER	RECEIVER
DC Input 80m 3·5W	Direct conversion, CW only
40m 3·0W	**Sensitivity** 1μV with 0·2μV
20m 3·0W	providing readable signal
15m 2·5W	**Selectivity** Wide:—750Hz @
Output	6dB down. Narrow:—375Hz @
Impedance	6dB down. Passband Freq.
50Ω unbalanced	750Hz
	Output Imp. 1kΩ

Transmit Offset 750Hz lower

GENERAL

Frequency Range MHz	3·5 to 3·750, 7·0 to 7·250 14·0 to 14·250, 21·0 to 21·250
Frequency Stability	Less than 150Hz/hour after 1 hour
Power Required	13·4VDC nominal 90mA/ receive 430mA/transmit
Dimensions	9¼ x 4½ x 8½in. deep overall. (235 x 108 x 216mm)
Weight	4lbs. (1·8kg)

22·895 and 29·895MHz. The difference frequency is selected for each band by tuned circuits, thus giving 3·5 to 3·750, 7·0 to 7·250, 14·0 to 14·250 and 21·0 to 21·250MHz. The dial callbration of 0 to 250 is thus constant for each band. These frequencies are also used as the heterodyne frequencies for the direct conversion receiver.

This is a good point at which to say that there are 20 tuned circuits plus the four crystals all of which are diode switched! The band switch thus operates at DC rather than at RF, except for the PA tuned circuits. It is not surprising then that the main PCB carries some 300 or so components! There are 32 coils, 37 diodes, 92 resistors, 120 capacitors and 16 transistors/IC's. Whether all this sophistication is justified to provide a couple of watts of CW on four bands is a matter of opinion!

On transmit the output of the mixer is amplified and fed to a tuned driver stage into the 2N4427 power amplifier. This stage is protected against excessive SWR conditions or accidental no-load dangers. Keying takes place in the driver stage, also activating the transmit/receive relay, the keying sidetone and the receiver muting circuits. There is an adjustable drop-out time control on the T/R relay.

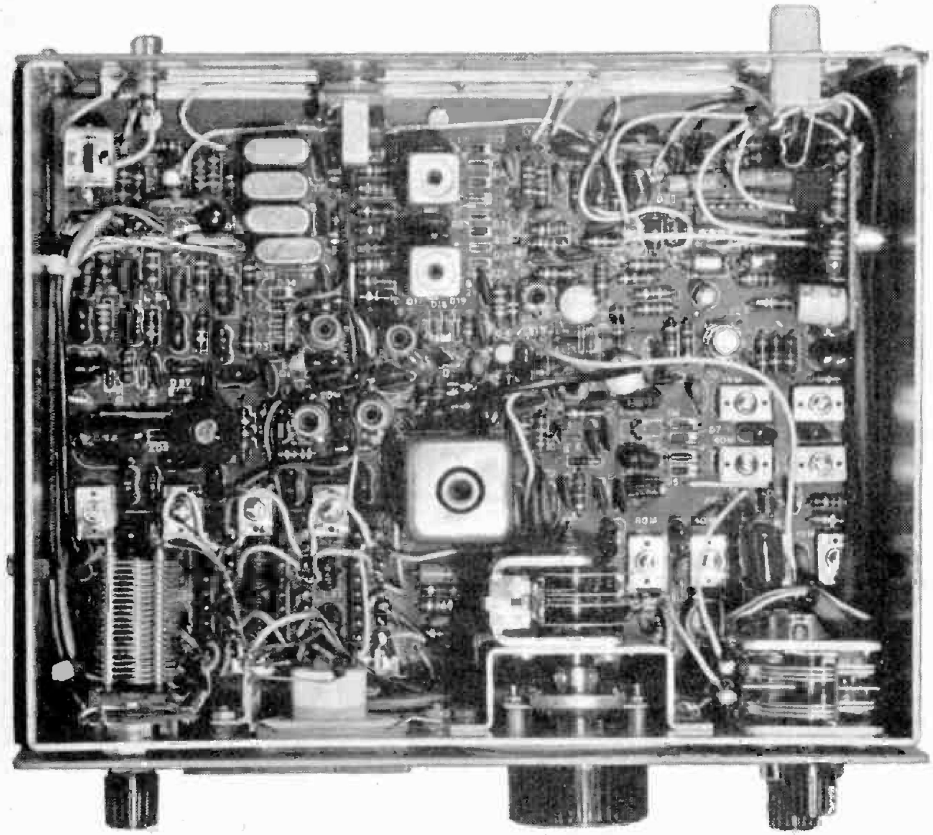
The receiver has an RF stage with the simplest of gain controls, which many amateurs, who complain of cross-modulation on their sets, would do well to copy. Namely, a potentiometer across the input terminals! An MC1496G IC forms the balanced product detector, also fed with a signal from the mixer stage, as previously mentioned. The active audio filter stages have also been covered earlier. Because of the 750Hz peaking effect of the audio filters the carrier has to be offset 750Hz on transmit. This is done automatically when the key is down. In practice this means tuning down from the HF end of a band and tuning a signal right 'on the nose' of the filter giving a 750Hz beat note. The transmitted signal will then be spot on the frequency of the incoming signal.

Two further stages of audio amplification feed a headphone socket at high impedance, nominally 1kΩ, but in practice a stereo low impedance headset performed quite well! But an old pair of Browns diaphragm type of 4kΩ really got the signals pumping out when peaked on the filter frequency!

CONSTRUCTION

As with any kit the components supplied must be checked against the parts list. Every part, down to the nuts and bolts, is illustrated in the Heathkit manual which is an education in itself and even before construction begins a good knowledge of the HW8 is obtained. Personally, I always read the manual right through anyway, before ever lifting the soldering iron! It is time well spent, often explaining points that might otherwise prove mystifying during construction.

The bulk of the work is on the main PCB which carries no



Top view of the finished transceiver. All the cabling round the inside of the cabinet is fitted to the PCB before the cabinet is assembled round the board. The T/R relay is in the top left hand corner close to the aerial socket, with the four HF crystals further to the right. The large screened can in the centre is the VFO unit with the VFO tuning immediately in front on the panel. While the PCB may appear rather cluttered up, the wiring in of the components presented no difficulty at all. There are no components under the PCB which is in the bottom of the cabinet.

less than 308 components! Actually the job of wiring so many resistors and diodes etc. gets boring so give it a break now and again to avoid making errors. The PCB and the associated cabling took nine hours to complete. It is an excellent board on which to work and need not be any cause for apprehension for potential constructors. The PCB was carefully checked for solder 'bridges' with the aid of a watchmaker's eyeglass and all was well.

The simple cabinet, front and rear panels are fitted round the PCB and the wiring completed to the various controls on the front and sockets on the rear panel. The aerial socket is a 'phono' type easily changed to Belling-Lee type or to suit the rest of the station's RF cabling. After completing the PCB a further 5½ hours work saw the transceiver completed. A further check on the PCB underneath and the general wiring was made before tests began.

TESTING

Although the manual did not mention it, it was thought advisable to check the resistance across the 12V input terminals just in case there was a short there! The multimeter red prod (neg polarity) was connected to negative input, giving a reading of 550Ω with the transceiver switched on and on receive. The power unit used for testing was the Heathkit HWA-7-1 giving approx. 13·2V. The initial tests laid down in the manual all proved satisfactory. The relay worked on keying, the sidetone was present and the receiver controls worked but little RF output was present at this stage.

The test equipment required is a receiver, preferably of the communication type, capable of providing accurate checks at 7 and 7·250kHz for checking the VFO, and a high input impedance voltmeter preferably with an RF probe. The alignment is quite clearly described and it is a matter of logical progression which can be completed easily in half an hour.

If one runs into trouble there is plenty of advice in the manual including PCB layout drawings with the voltages to be expected at various points. With a stabilised input voltage of 13VDC the current on receive was 93mA and on transmit 450mA, remaining fairly constant over the four bands. The RF output was measured at the dummy aerial load with the dial set at mid position and the loading control peaked and was found to be 2W on 80m and 40m, 1·8W on 20m and 1·6W on 15m.

Since the accepted segments of the bands on CW are a lot less than the 250kHz coverage available on the HW8 it would seem feasible to align the circuits at, say, 50kHz from the band edge and improve the general performance on both transmit and receive. In practice with the recommended alignment the RF output is remarkably constant over the whole 250kHz.

GENERAL COMMENTS

The transmitted signal was monitored externally on all four bands and found to be clean with excellent keying characteristics. In fact it was possible to get the relay to follow keying up to about 25wpm although some may prefer to increase the relay drop-out time to a second or so. Plenty of DX has been heard on all four bands and the two position audio filter can really sort out the weak ones among the QRM. The RF gain control was most effective especially with some of the powerful signals on 80m.

AERIALS

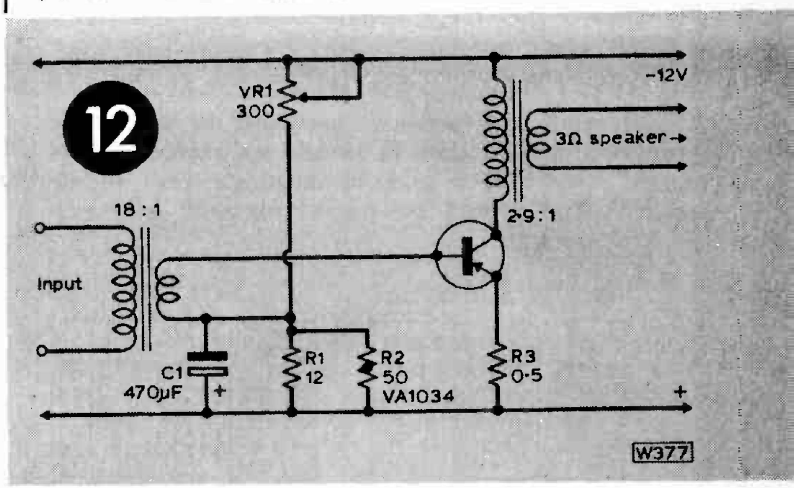
Nothing spectacular has been worked on any band yet due to lack of suitable aerials. It is a problem to get a four band aerial which provides a low impedance feed on all bands, without using a tuning unit. Anything introduced between the aerial and the set is going to absorb some of the precious power. A trapped dipole is the quick answer but it is a compromise and rather 'lossy'. It is hoped to erect a four band ground plane with a coax feeder when a further report on results obtained will be published. *AED*

Heathkit k/HW8 Price £108·19 inc. VAT and post and packing from Heath (Gloucester) Ltd., Gloucester GL2 6EE.

CIRCUITS FOR AUDIO AMPS.—*contd. from page 924*

of supply, that is positive earth for PNP and negative earth for NPN devices. It can be driven by an AC128 (PNP), BC108 (NPN) or similar stage. The transformer ratios are typical and need not be exactly as shown.

Collector current is set by VR1 and this can be the lowest which gives satisfactory performance. Begin with VR1 at maximum value, corresponding to a low collector current. Actual collector current depends on the transistor and performance and should be around 350mA to 900mA. As the DC operating conditions of this stage are isolated from other stages it is useful for experimental circuits and can actually be employed with about 9V to 24V. With the higher voltages, check carefully that the transistor is not over-run.



The load impedance can be around 25Ω but it is not too critical, depending somewhat on the supply voltage. Note that with a Class A stage a loudspeaker can only be connected directly to the collector circuit when it is able to carry the required collector current. This is why a transformer is necessary in Fig. 12.

Thermistor R2 is for stabilisation, as described later, whilst R3 also assists in this direction and can be about 1Ω if the volume is sufficient. Resistor R2 may be omitted for low voltages, or providing a check is kept that the current is not too high.

TO BE CONTINUED