Heathkit HW-9 CW QRP Transceiver

Kit building is a good way to get a high-value rig and learn in the process, as Chris Lorek G4HCL finds out.

Ever since I first became interested in amateur radio, Heathkit equipment held an almost magical fascination for me, and the idea of being able to say 'I built it myself'. However, over the years, even through studying electronics and an eventual career in radio equipment design, I never once got the chance to actually build my own Heathkit rig. Not until a few weeks ago.

People relax in different ways; some make models, others go down to the pub, your truly reads lots of technical books, writes technical articles and the odd book or two, and gives lectures! However when the opportunity came to take some 'time off' to relax by building a Heathkit HW-9 QRP transceiver, I seized it willingly and had a marvellous time.

Homebrew Advantages

The first advantage in building your own rig is often the cost-saving compared to a ready-assembled set, but many people are put off by the question of the set's re-sale value. With Heathkit gear, you get a professional-looking and professionally rated piece of equipment of a known design and origin, that certainly does fetch a decent price when the day comes to sell it on, complete with thorough technical documentation.

Secondly, the self-training aspect of building it yourself can be a great boon to those starting out in the hobby, learning to identify resistors, capacitors and the like, together with the skills of good soldering practice that will stand the newcomer in good stead over the years. Finally, the aspect of aligning the set of optimum performance shows the constructor exactly how tuned circuits and so on operate, and gives real hands-on experience of what is rapidly becoming a 'black box' hobby in some fields.

The HW-9

The HW-9 is a CW QRP (low power) transceiver kit, the completed set operating from an external 12V DC power supply. It gives around 4W output on the 80m, 40m, 20m and 15m bands under vfo control. The kit costs £249.95 all in, including the power supply. An accessory band pack at £44.95 adds the 10m band plus the WARC bands of 30m, 17m and 12m, and can be added later at any time after the kit has been built, allowing the newcomer or budget-conscious amateur to spread the cost over a period in line with needs and interests. Just under £250 for a multi-band transceiver can't be bad.

Heathkit have had a QRP CW rig in their range for some time, showing its popularity. It started many years ago with the HW-7, a three band (40m, 20m and 15m) rig which had a direct conversion receiver and a simple transmitter, with crystal or vfo frequency control. Next came the HW-8, which added wide and narrow audio filtering together with better performance. Finally, the current HW-9 came along, offering a superheterodyne receiver with a four pole crystal filter, wide and narrow active audio filters, rit (receiver incremental tuning), and solid state transmit/receive switching.

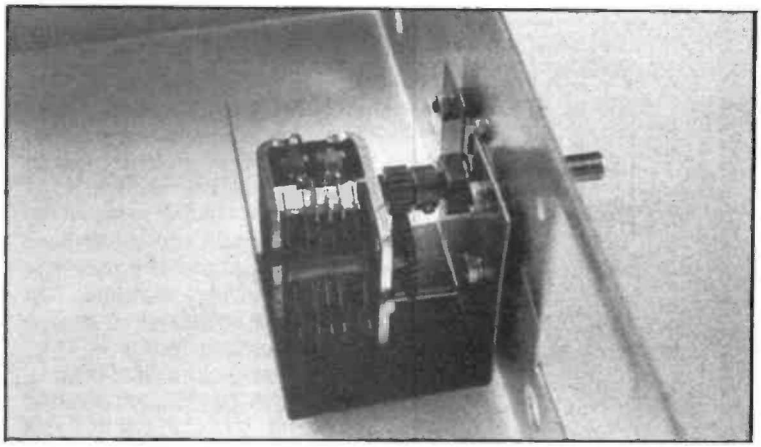
The set measures a compact 108mm (H) × 235mm (W) × 216mm (D) and weighs a light 2.1kg, making it suitable even for holiday or business trips to exercise a 'rare' prefix.

Unpacking

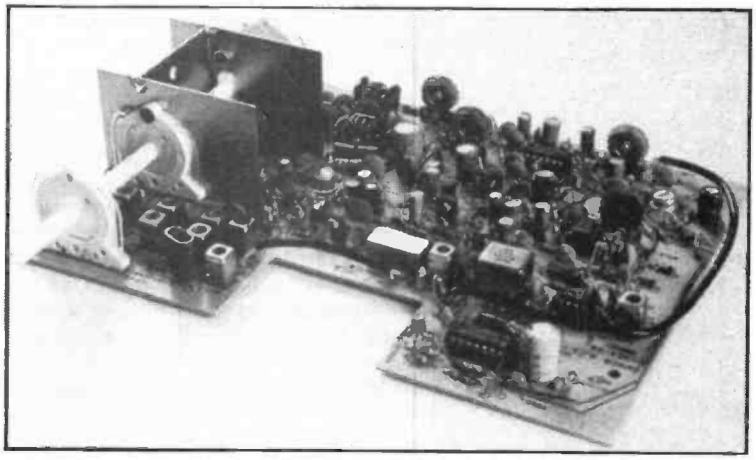
Within a day of being told the kit was on its way, a large well-wrapped parcel came to my door, which I commenced unpacking with glee. After removing the manual and assembly details, the first thing I noticed was a conspicuous label warning me not to unpack anything else until the instructions called for them. This in my opinion is a very sensible measure to make sure that all the small bits and pieces are identified as required and, possibly more important, that they don't get lost in all the packing.

The supplied manual certainly deserves praise. As well as being an assembly and technical manual it contains a complete guide to soldering, electronic construction techniques, component identification and all the necessary information. A comprehensive technical description of the set's operation is given, together with complete circuit and layout diagrams. The final section in the manual gives a well-written guide to fault finding if your

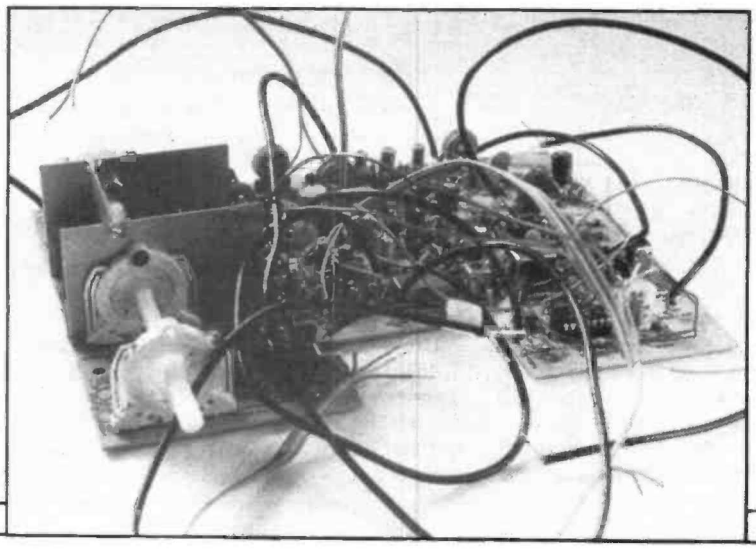
The illustrated pcb and manual.



The difficult bit — the ufo capacitor assembly.



The completed Tx/Rx board.



The slow bit — wiring the Tx/Rx board.

newly-constructed rig doesn't work first time — an essential experience for the new electronics constructor — together with checks and areas to investigate, and Maplin, the UK suppliers of the Heathkit range, even have a 'Get You Working' service at a reasonable rate to fix the completed set if you get completely stuck.

Getting Started

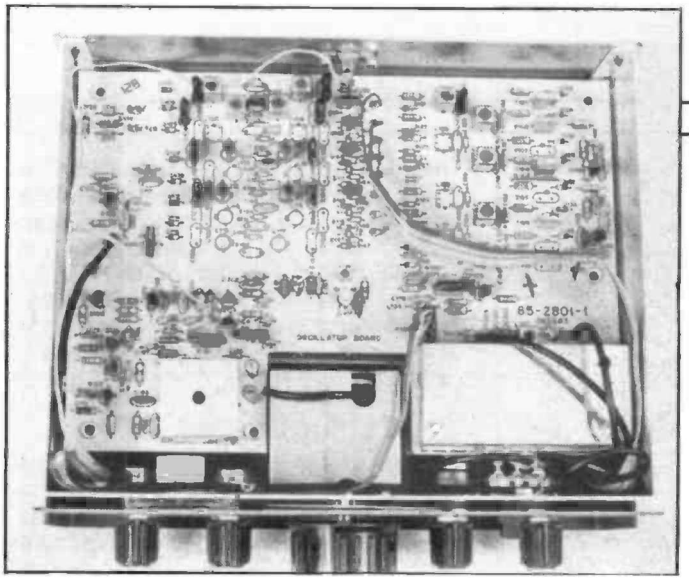
Assembling the set is done in several stages: first the oscillator pcb, then the more complex Tx/Rx pcb, followed by the chassis mounted components. The two pcbs are then actually fitted to the chassis and the panel controls and sockets connected, followed by the alignment of the tuned circuits.

The 100-odd page manual gives excellent step-by-step information on all this, and the accompanying fold-out pictorial guide shows you where each component goes, again stage by stage with many pages having the relevant components highlighted at each stage. A checklist arrangement is used, where you place a tick against each component or construction step as you go along. As well as serving as an 'idiot's guide' this really does allow you to put the part-finished project to one side, to carry on the next day, and be assured of starting off at the exact point you left it. Full marks. Heathkit!

The Oscillator Board

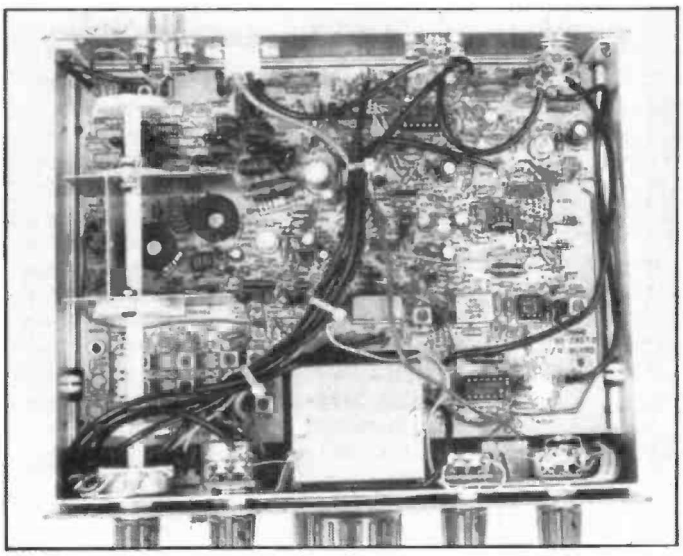
This consists of the crystal oscillators and accompanying tuned circuits, together with the vfo circuitry. As the simpler of the two pcbs it was the first to be detailed in the step-by-step instructions. The majority of the components here were 'taped', ie components with radial leads arranged as a taped 'ladder'. These were arranged in the exact order of assembly, together with a life-size diagram with all the components identified so you can literally Sellotape the component 'ladder' onto this. The resulting assembly is a piece of cake, Heathkit even provide the solder. I wish all kits were this straightforward.

I must admit to having a slight problem though with the identification of some of the ceramic capacitors that weren't taped, seeing 'n470' marked on a capacitor together with just a plain '6' made me think it was an n470 capacitor (0.47nF for those who still live in the old days) rather than the 6p0 capacitor it really was. I attribute this to the American way of marking values. However, reference to the clear instructions resolved the dilemma, and after a few days the oscillator board was finished, followed by a check for dry solder joints, solder bridges, wires not cropped and the like, all these checks being detailed on the check list.



The simpler (oscillator) board wired in.

Final alignment.



Everything in place.

The Tx/Rx Board

This was rather more complex than the oscillator board, but again the instructions made the assembly job very simple, even when the time came for winding the small number of ferrite cored toroids required. The board mounted components were more tightly packed, but again experience from the simpler oscillator board helped to tackle them. This board took me rather longer to finish, and check the soldering, and then the board put aside and the chassis mounted component assembly started.

The Chassis

Here's where my lack of mechanical knowledge required me to pay very close attention to the pictorial instructions. Putting the vfo capacitor assembly together with all the friction drives and the like being a novel experience. Heathkit provide a plastic nut-driver tool, which made assembly a lot easier. I found all the screw fixing descriptions and other dimensions were given in American imperial form, ie inches and so on, and being used to metric types (together with the vast majority of UK youngsters who could be starting out in amateur radio, and will probably not know how to identify a 6-32 x ¼ sheet metal screw) I had to think a little, but this is a very minor criticism indeed. This part of the construction took me the longest.

Alignment

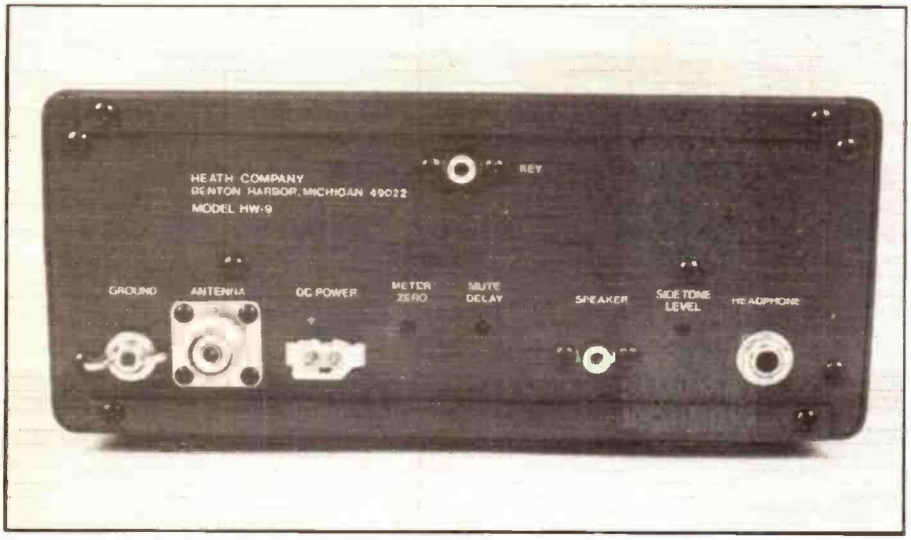
Now for the test: does it work? To align the circuits, a sensitive multimeter and a frequency counter are required, together with the usual requirements of a 12V power supply, loudspeaker or headphones, and CW key that would be needed in use on-air. First of all, the manual goes through a resistance check list before power is applied, and here's where I found my first problem. I must admit this was completely my fault, a tiny solder bridge which I hadn't seen during the visual check, across a couple of close spaced leads on a coil on the oscillator board. This was quickly rectified, and fortunately I found no further errors, so now onto the 'tuning up' process.

This was very straightforward, Heathkit even providing the double-ended plastic trimming tools required. The bandpass filter adjustments were a simple 'tune for maximum meter reading' affair, and the bfo frequency was quickly set with a frequency counter. Then came the vfo adjustment. Here the manual told me to set the vfo scale to exactly 250, tune the vfo coil adjuster for a frequency of 5.7493MHz, and then set the scale to exactly 0 and tune a trimmer capacitor on the side of the main vfo variable capacitor for a frequency of 5.9993MHz. The second adjustment affects the first, so a few re-tunes and re-adjustments were needed to get both spot on, but eventually I got there.

A few straightforward potentiometer adjustments and an RF power check into a dummy load, the alignment was finally complete. The result: a complete and working radio, first time!

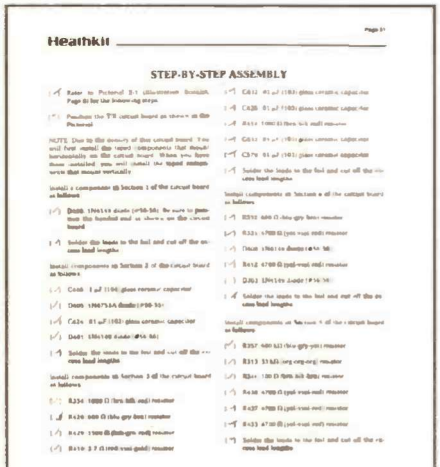
Performance

Although this isn't a full technical review of the final product, many readers will be interested to know what to expect from the set, so a few words about this will not go amiss. The transceiver covers the bottom 250kHz of each of the amateur bands, placing you in the usual CW sub-sections of the international voluntary band plan. Tested on 20m, I found the set gave 3.8W output, with a 0.45μV sensitivity for a 12dB sinad signal. This means that you should easily be able to hear those who can hear you, and QRP enthusiasts will be quick to tell you that 4W output is only a few S-points down on



the usual 100W signal found on the bands, in fact special QRP frequencies are used for low-power operation, to provide a 'common' channel among enthusiasts.

I found the vfo quite stable, and although the knob wasn't quite the heavy flywheel type found on £2000-plus radios it was quite adequate, a couple of finger holes being provided to allow a fast QSY when needed. The narrow CW audio filter was very effective indeed, with absolutely no trace of the hollow ringing found on some sets. In use, I normally tuned around using the 'wide' position then, when I had homed in on a signal I wished to copy, switching in the narrow filter cleaned the background mush up very nicely. For the technically minded, the crystal filter selectivity as measured with my cavity tuned signal generator was 800Hz (−6dB), with skirt, selectivities of 3.5kHz (−20dB), 5.05kHz (−40dB) and 7.2kHz (−60dB). Although understandably not up to the specification of multi-thousand-pound sets, this should be quite satisfactory for a set of this type. The receiver image rejection measured on 20m was good at 73dB, and for those interested in the measured transmit harmonic levels these are given at the end of the Manufacturers Specification section.


Heathkit

STEP-BY-STEP ASSEMBLY

A sample step-by-step page from the manual. There are also detailed illustrations.

Overall Appraisal

The question many readers will be asking is 'How long would it take to build?' This really depends on your previous experience, but by following the instructions carefully and on looking back at my (methodically documented!) timings, I would say that by setting aside one hour every day for construction, it should take the average person, who is capable of following instructions although not necessarily an experienced constructor, around a month in total.

The end result is a radio that in my mind is very good value for money, gives you the sheer pride of being able to say 'I made it myself' as well as giving you a good chance of being able to repair it yourself should it go wrong in the future. But most of all it can give a newcomer to home construction an excellent start in getting to know components, their function, and typical electronic construction and alignment methods, with a satisfying end result. In a forthcoming HRT issue we'll be featuring another Heathkit model, this time the SB1000 1kW linear amplifier for those who'd like to get back to building their own 'afterburner'. Wait and see how we get on with that!

Our thanks go to Maplin Electronics plc, who are the UK Heathkit distributors, for providing the review kit.

TRANSMITTER

RF Power Output:
CW, 4W all bands expect 10m which gives 3W

TX Freq Offset:
700Hz higher on all bands

Harmonic Radiation:
−35dB minimum, at rated output

Spurious Radiation:
−40dB minimum, at rated output

Tx/Rx Operation:
CW, Full break-in

CW Sidetone:
700Hz to speaker or headphones, level internally adjustable.

GENERAL:

Frequency Coverage:
3.5MHz-3.75MHz
7.0MHz-7.25MHz
14.0MHz-14.25MHz
21.0MHz-21.25MHz
OPTIONAL ACCESSORY PACK ADDS:
10.0MHz-10.25MHz
18.0MHz-18.25MHz
24.75MHz-25.0MHz
28.0MHz-28.25MHz

Frequency Stability:
Typically less than 500Hz/hour after a 30 min warm-up period.
Typically less than 150Hz/hour after a 90 min warm-up period.

Power Requirement:
11-16V DC at 1 Amp (12.6V nominal)

Rear Panel Connections:
DC Power, Speaker, Headphones, Aerial, CW Key, Ground.

Operating Temp. Range:
0 deg C to 40 deg C.

RECEIVER

Sensitivity:
Less than 0.5μV for 10dB S+N/N. Less than 0.2μV for a readable signal.

Selectivity — CW Audio Filter.
Narrow — 250Hz max at 6dB
Wide — 1kHz max at 6dB

Passband Centre Freq:
700Hz

Audio Output:
1 Watt into 8 ohm load

Dynamic Range:
85dB, measured in narrow filter mode

Image Rejection:
60dB minimum

RIT Range:
+/− 1kHz

Measured Tx Harmonic Levels

	2nd	3rd	4th	5th	6th	7th	8th
80m	−46dBc	−66dBc	−75dBc	<−85dBc	<−85dBc	<−85dBc	<−85dBc
40m	−45dBc	−63dBc	−72dBc	−83dBc	<−85dBc	<−85dBc	<−85dBc
20m	−42dBc	−62dBc	−59dBc	−62dBc	<−85dBc	<−85dBc	<−85dBc
15m	−46dBc	−66dBc	−62dBc	−78dBc	−82dBc	<−85dBc	<−85dBc