CQ Reviews: The Heathkit SB104A 80 - 10 Meter S.S.B. Transceiver

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While the cost of most amateur radio equipment has been rising rapidly, Heathkit has moved in the opposite direction by announcing a reduction in the price of the SB104A 80-10 Meter s.s.b. transceiver and accessories. Lower cost coupled with changes in design to improve performance tend to make the SB104A a more attractive alternative to purchasing a factory built transceiver.

Heathkit has made a number of changes in the front end of the receiver and is now supplying that circuit board factory built and tested, thus reducing construction time and improving receiver sensitivity. The balance of the transceiver, including the accessory noise blanker, was constructed in just under 55 hours. Another 9 hours was spent aligning and debugging the transceiver. More about some of the problems encountered will be discussed later.

The receiver section of the SB104A is double conversion with a unique front end design. Individual band pass filters are diode switch selected for each band. Two separate circuits are employed to cover the entire 10 meter band.

From the bandpass filter the signal transformer is coupled to a balanced diode mixer, where it is heterodyned with an appropriate crystal controlled oscillator signal to produce the first intermediate frequency in the region of 8.65 MHz. A single transistor provides amplification of this first i.f. frequency prior to injection through a filter network into another balanced diode mixer where heterodyning with the v.f.o. signal (5 MHz region) produces the 3.395 MHz second i.f.

Conversion of the incoming signal prior to amplification contributes a great deal to the high level of immunity to overload and good inter-modulation

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The Heathkit SB104A 80 through 10 meter s.s.b. tranceiver.

performance of the receiver. Heathkit does not state under what conditions they established their performance specifications for intermodulation distortion (–60 db) and I won't attempt to confuse you with a set of numbers in this evaluation. It is sufficient to say that inter-modulation performance is, with one exception, comparable to the better transceivers currently available.

The noise blanker was carefully adjusted for unity gain, as per Heathkit instructions. Signals that measured 9 or better on the S meter and located approximately 10 kHz from the receiver frequency produced IM distortion that was noticeable. Signals of greater magnitude or located closer to the receive frequency produced IM distortion that was severe enough, at times, to require turning the noise blanker off.

Adjusting the noise blanker for less than unity gain did improve the intermodulation distortion considerably. Performance of the blanker on impulse type noise is acceptable, but certainly not as good as one might expect.

Receiver sensitivity is excellent, with .5 micro volt producing a signal plus noise to noise ratio of 10 db or better on all bands.

Selectivity on s.s.b. is specified as 2.1 kHz minimum at the –6 db point and 5 kHz maximum at the –60 db point. On c.w. the optional filter reduces selectivity to 400 Hz at the –6 db point and 2 kHz maximum at the –60 db point. Either filter may be selected while in the c.w. mode. The 400 Hz filter is very effective on c.w. and does not display any tendency for ringing.

Audio output is rated at 2.5 watts into a 4 ohm speaker with less than 10% total harmonic distortion. The matching SB604 speaker and its large cabinet, capable of also holding the PS-1144 power supply, contribute to the fine audio quality of the transceiver.

Tuning of the receiver is smooth with negligible backlash, thanks to the two vernier drive assemblies connected in tandem. Heathkit found a splended solution to the sloppy tuning mechanisms used on their earlier transceivers.

Frequency readout is provided by three large display tubes with two digits each. While they are easy to read, even with high ambient light levels, I would prefer some color other

Heathkit Specifications	Measured Specifications
Carrier Suppression: 50 db down from 100 watt single tone output at 1000 Hz reference.	– 54 db
Unwanted Sideband Suppression: 55 db down from 100 watt single tone output at 1000 Hz reference	– 59 db
Harmonic Radiation: 40 db below 100 watt output	– 45 db or better
Spurious radiation: – 40 db within +/– 4 MHz of carrier.	– 43 db on 10 meters – 50 db 80-15 meters
– 60 db greater than +/– 4 MHz from carriers, except – 50 db on 10 meters	– 55 db on 10 meters – 62 db or better 80-15 meters
Third Order Distortion: 24 db down from single tone of two tone test, referenced at 100 watts p.e.p.	– 24 db, 80-10 meters

than red. The color of the display is achieved by placing a strip of red lucite in front of the display tubes. It should not be too difficult for Heathkit to provide a strip of similar material that is green or blue for those of us who find the color red irritating to the eyes.

The meter has two scales, one S units and the other numerically linear. By pushing the appropriate switch, the meter will indicate d.c. voltage, ALC level or relative power output. Other features include an r.f. gain control and fast, slow or no AGC. Features that are lacking on the SB104A are receiver incremental tuning, built in calibration oscillator and an analog dial for backup in case the digital display should fail.

I find the lack of an RIT control to be a real inconvenience and frankly cannot understand why Heathkit engineers did not include this vital function in their design. The calibration oscillator is not so important since the receiver does have a position for receiving WWV, to which the frequency readout can be calibrated.

Stability of the transceiver is excellent. Drift was measured for a period of five hours from a cold start. The frequency drifted 250 Hz during the first thirty minutes and another 150 Hz over the next four and one half hours.

A number of birdies (internally generated spurious) can be heard at various frequencies, but only at 3.65 MHz and 28.46 MHz were levels sufficiently high to inhibit reception of desired weak signals.

Transmitter operating features include a c.w. sidetone oscillator and front panel controlled VOX circuitry that performs with the best of them. VOX is functional on c.w. allowing semi-breakin operation.

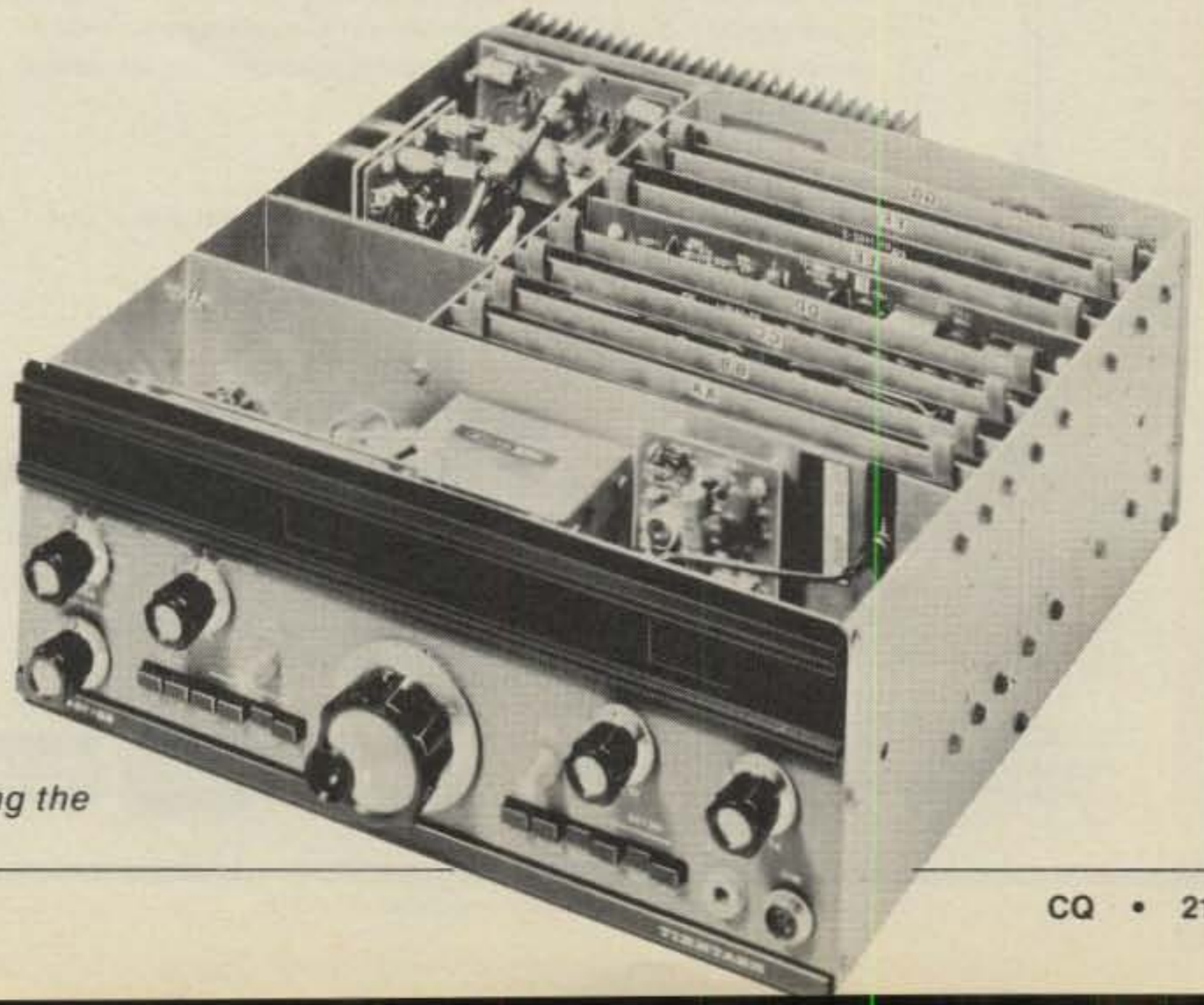
Circuit design of the transmitter section is fairly conventional with regard to single sideband generation and frequency mixing schemes. Balanced diode mixers and good bandpass filter design contribute greatly to the clean signal produced by the SB104A.

The driver amplifier consists of a pair of CD-3342 transistors operating in a push-pull configuration. The output from this amplifier then drives four 2N6456 transistors operating as push-pull pairs in parallel, to produce approximately 100 watts output. Hybrid combiners are used to split the drive power between pairs and to combine the outputs of the two power amplifier pairs.

The broadband characteristics of both the driver and power amplifier stages are better than most solid state units currently available. This is demonstrated by measuring the power output with the transmitter operating into a nonreactive dummy load. Spot checks were made across each band from 80 through 10 meters, in the c.w. mode. The lowest power out was 102 watts and the highest was 107 watts. As with all solid state broad band amplifiers, power will be reduced when operating into loads exhibiting reactance. Power output of the SB104A was reduced to 42 watts when operating into a load with an s.w.r. of 2:1.

Protection bias for the power amplifier transistors is provided by a diode, mounted in the heat sink. Bias increases as the temperature increases, thus preventing thermal runaway and ultimate destruction of the transistors.

The driver amplifier produces between 1 and 2 watts of power out. Provision has been made to bypass the output from this amplifier directly to the antenna through a band pass filter, by merely punching a button, thus allowing for QRP operation. Shortly after completing construction of the SB104A and turning on the primary power, it was discovered that the driver transistors were going into thermal runaway, without any drive being applied to them. Bias voltages were carefully checked and found to be correct. I then substituted some com-



Interior view of the SB104A transceiver showing the vertically mounted circuit boards.

ponents to increase the bias, but still could not stop the thermal runaway. The solution was to replace the transistors with another pair that had been more carefully matched for their operating characteristics. ALC functions extremely well in both high and low power modes.

While making spurious radiation measurements with a spectrum analyzer, it was discovered that some very high level spurious was present when operating in the s.s.b. mode on 15 meters. In the c.w. mode the spurs were not present. Knowing full well the requirement for adequate grounding of solid state rigs to prevent r.f. feedback, considerable effort was made to improve the ground connected to the SB104A. While the spurs were reduced in amplitude, as a result of these efforts, they were not eliminated.

Heathkit has utilized ferrite beads profusely throughout the rig to eliminate problems resulting from the introduction of r.f. at undesired locations. The problem was solved when it was discovered that the IC that functions as an audio amplifier for the microphone was going into oscillation as a result of r.f. on the microphone cable. The ferrite beads on the input of the IC were not enough protection. I then added .01 MFD disc capacitors between chassis ground and the push to talk pin and audio pin on the microphone socket.

Test measurements revealed that the SB104A transmitter met or exceeded all of the specifications claimed by Heathkit and are tabulated in the accompanying chart. It should be noted that the measured level of spurious radiation was achieved only with an adequate ground on the transceiver. Amateurs are cautioned to employ good grounding techniques with any of the solid state rigs to avoid r.f. feedback problems and the high levels of spurious radiation that can result.

The only other problems encountered with the transceiver were a faulty display tube and failure of the 15 meter crystal controlled h.f.o. to oscillate when the circuit board was plugged into the chassis connector. It functioned normally when mounted on the extender board. The problem was a change in circuit capacity created by the metal shields that separate the individual boards. Heathkit has changed some component values to eliminate this problem.

Operating the SB104A on the air has been a real pleasure. The ability to make wide frequency excursions or change bands without tuning a receiver pre-selector or transmitter final are features to which one soon becomes addicted.

The transceiver is a very complex piece of equipment. A total of fourteen circuit boards, upon which are mounted myriad components, make up the bulk of the rig. While Heathkit is noted for assistance in debugging errors committed during construction and insuring that you will eventully have a properly working transceiver, I do not recommend the SB104A as a "first time" construction project. The satisfaction of building it yourself, however, is something you can never experience by opening a box containing the latest factory built "Sooper Blooper" transceiver.

If you decide to purchase the transceiver, remember that the warranty is only good for ninety days from the purchase date on the invoice. Make sure you have sufficient spare time to complete construction prior to warranty expiration. After warranty expiration, Heathkit will repair individual circuit boards for a flat labor fee ranging from $5.00 to $15.00 depending on the board. Parts charges are extra. The flat rate labor charge also applies during warranty if service is required due to causes other than defective parts. For more information contact the Heath Company, Benton Harbor, Michigan 49022.