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Classic Radio

The Heathkit HW-16 Novice Transmitter/Receiver

The Heathkit HW-16's front panel. [George Benson, N8RU, photo]

In the 1950s to early '70s, many Novices had a hard time graduating to General class. One factor was that the equipment they used was limiting, and it discouraged them from getting on the air. Very often, the receiver a Novice could afford lacked the selectivity needed to hear anything through the noise and interference on the crowded Novice bands. Compounding this, station management issues were difficult for beginners. Potentially dangerous problems arose while getting a transmitter and receiver to work together on the same antenna.

No doubt the engineers at Heathkit had all of this in mind when they developed the HW-16. Brought to market in 1968, it was designed specifically for the Novice-class operators as an affordable, self-contained station, housing transmitter and receiver in a single cabinet.

Priced just above $100 when introduced, the HW-16 provided a capable platform for CW communication on the 80-, 40-, and 15-meter Novice bands. It became the radio that opened amateur radio to many aspiring hams.

A Novice Transceiver

At the HW-16's heart is a surprisingly good CW-only receiver with selectivity and narrow filtering emulating the performance of more expensive equipment of the time. The HW-16 also employs internal antenna-switching and muting circuits, allowing seamless transition between transmit and receive on a single antenna. In effect, this made it a rudimentary transceiver. However, the HW-16 only mimics the functions of a true transceiver, because the transmitter and receiver are tuned independently of each other. Until the end of 1972, the FCC required Novice transmitters to be crystal controlled, fixing the HW-16's output to the frequency of the crystal used. Set up this way, the operator tuned the transmitter to the crystal's frequency first and then adjusted the receiver to zero-beat on it. This had to be repeated, of course, each time transmit frequency was changed with a different crystal.

Transmitter, Receiver, and T/R Switching

The HW-16's transmitter consists of three tubes: a 6CL6 for the crystal oscillator, another 6CL6 as a driver, and a 6GE5 final amplifier. Grid-block keying is employed. When not transmitting, a negative bias voltage is applied to the grids of all three tubes, preventing any output. When the key is closed, the bias is removed from the oscillator and driver and reduced at the amplifier, allowing transmission.

The transmitter's pi output circuit requires a 50 Ω antenna load. This simplifies tuning. First setting the **TUNE** control to a maximum meter reading, followed by adjusting the input **POWER LEVEL** over a range of 50 to 90 W.

The receiver is a six-tube, CW-only, double-conversion design, tuning the first 250 kHz of 80, 40, and 15 meters. Signals are broadly tuned at the RF stage and passed on to a heterodyne oscillator/mixer employing a crystal band-pass circuit, converting them to an intermediate frequency (IF) range of 5296 to 5546 kHz. The VFO in the following stage tuned a range from 1900 to 2150 kHz, and when mixed with the signal from the first oscillator/mixer, it produces an IF of 3396 kHz. The signal then passes through a narrow 500 Hz crystal filter, then to the BFO, detector, and audio output.

The chassis layout. The receiver's PC assembly is on the left, the transmitter in the upper right, and the power supply in the lower right. [George Benson, N8RU, photo]

Receiver controls are minimal: **RF GAIN** and **AF GAIN**, as well as some RF-stage preselection by the **TUNE** adjustment shared with the transmitter's pi output circuit. There is no AGC in the receiver and strong signals are attenuated by manual adjustment of the **RF GAIN**.

The pi network output circuit of the HW-16's transmitter does double duty as the receiver's RF input. A diode functions as a transmit/receive switch. When forward biased on transmit, the diode prevents output current from entering the receiver's RF circuit. On key up, it allows incoming signals to pass to the receiver. The result is full-break-in keying (QSK), with switching back to receive in the intervals between dots and dashes.

Design Compromises and Modifications

With so much of the radio's cost concentrated in the receiver, there are some design tradeoffs. These include the lack of an automatic gain control (AGC) circuit, an adjustable filter width in the receiver, and a volume control for the side-tone oscillator. There is also no option to allow semi-break-in keying as an alternative to full QSK.

The HW-16 also has two design flaws worth noting. The first involves the 15-meter loading coil, which is overvalued, not allowing full resonance of the pi output circuit. In this condition, the transmitter can't reach full power output. And with the pi network doubling as the receiver's RF-stage input, it results in less than optimal reception on this band. A less-than-perfect fix is to reduce the coil's inductance by pushing the turns as far apart as possible without shorting them on the adjacent chassis.

The second design flaw is the HW-16's tendency to chirp on key down. This was a common problem of its era, caused by temporary voltage instability in the oscillator when keyed at the same time as the driver and final stages.

There are several possible fixes. Sometimes, it is as simple as switching out crystals. If that's not sufficient, a 100 pF to 220 pF mica capacitor can be placed between the oscillator's screen and ground. A more aggressive cure is to insert a voltage regulator tube between the oscillator's screen and the power supply, or to disconnect the oscillator's screen grid from the voltage it shares with the driver and amplifier, supplying it instead through the receiver's B+.

WB4OMM's HW-16

Steve Szabo, WB4OMM, has fond memories of going with his father to the Heathkit store in New York City in December 1969, returning with an HW-16 as his Christmas present. He had yet to prepare for the Novice-class license and had no experience on a project of this size. But with the promise to get it all done, his father made the investment for him.

Constructing the radio took about 2 months, in short sessions carved out between schoolwork and his part-time job at the neighborhood grocery store. "When I finally switched it on for the first time — my folks looking over my shoulder — there was a flash and loud bang, instantly transforming the HW-16 into a smoking basket case." Having been so patient and methodical putting it together, Steve was crestfallen, and the radio was sent out for repair. The HW-16 came back in perfect condition, and there was a note attached from Heathkit indicating the short was caused by a component failure. It was no fault of his own.

Steve received his Novice license early in 1971, starting out running a 40-meter dipole mounted on the roof of his apartment building. With his Novice license, he was able to work all states and continents before upgrading to General.

Steve said: "The HW-16 had a terrific receiver. While it may not have filtered out all interference, it gave a real edge on the Novice bands. But operating was still a challenge. When calling CQ, you were pretty sure a Novice coming back to you was using a crystal that didn't match your frequency. So, you had to dial the receiver and listen, searching for another station maybe a kilohertz away, somewhere in a bunch of other signals. That's what built my skill as a CW operator."

Steve pulled the HW-16 out about 5 years ago, restored with new PS caps, and is now a regular in the Novice Rig Roundup every March. Steve said each contact brings back the original thrill of a hard-won contact, "like being a 16-year-old again — thanks, Dad."