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The Heathkit SB301 Receiver

The Heathkit SB301 is an updated and improved version of the older SB300 which, in its short history has already earned a well-deserved niche in ham radio. The 301 is a ham-bands-only SSB/AM/CW/RTTY receiver with coverage from 3.5 MHz through 30 MHz, easily extendable to the 2- and 6-meter bands with accessory converters, both of which mount neatly on the receiver's rear apron. A front panel switch concentric with the rf gain control selects either converter and simultaneously switches the input of the receiver from the normal antenna to the converter outputs on 10 meters. Frequency coverage with the converter crystals supplied is from 144 to 146 MHz and 50 to 52 MHz—the tuning range can be increased with accessory crystals.

Power for the converters flows only to the converter which is selected by the panel switch mentioned before. When the receiver is operated on the low bands, no voltages reach the converters.

CIRCUITRY

The incoming signal is amplified by a 6BZ6, the rf stage and capacitance coupled to the grid of the first mixer, a 6AU6, which receives the local oscillator signal from the crystal-controlled 6AB4 heterodyne oscillator. The latter's coils have a small pickup winding which feeds the oscillator output to a jack on the rear apron, where it is available for transceiving with the matching transmitter, the SB401.

The 6AU6 mixer stage mixes the signals, with the sum and difference frequencies being applied to a bandpass coupler having a passband from 8.359 to 8.895 MHz. Emerging from the coupler, the wanted signal is then applied to the grid of the second mixer, another 6AU6. At the same time, the 5.0 to 5.5 MHz output of the LMO is coupled to its cathode. For transceiving, the LMO output is also fed to a jack, through a .01 capacitor.

The second mixer's output at the *if* frequency of 3.395 MHz passes through a crystal filter to the *if* stages (you get one filter with 2.1 kHz bandwidth with the kit; AM and CW filters are available as extra cost accessories).

The *if* amplifiers, 6BA6's are both high gain voltage amplifiers, tuned for maximum gain. The S-meter is connected between the screen of the first *if* and the cathode of the second, with a chassis-mounted zero-adjust potentiometer providing precise settings.

A new feature of the SB301 that didn't appear in the 300 is a self-biasing, full-wave, shunt-type noise limiter which automatically adjusts itself to the degree of modulation of the incoming signal. This system has the advantage of moving the point where limiting begins up and down along with the signal level. The limiter is either in or out of the circuit, depending on a push-pull switch integral with the AF gain control. The degree of limiting cannot be controlled manually. The system operates in all modes and performs effectively.

AGC voltage is obtained by rectifying a portion of the *if* output signal, then passing it through a capacitor-resistor network which applies the voltage to bias the rf amplifier and the *if* amplifiers. This system is of the instantaneous attack type; one of two decay "speeds" is switch selected—slow for SSB, fast for CW and AM. An "off" position is also provided for maximum gain when digging for the weak ones.

A three-section Compactron, a 6AS11, combines the product detector, BFO, and BFO amplifier in one envelope. The BFO oscillates at one of three crystal-controlled frequencies, selected by the mode switch. In the RTTY position, the crystal frequency is 3392.110 kHz, placing the detected signals of 2125 and 2975 kHz in the center of the band pass frequency range of the SSB crystal filter. Narrow band RTTY operation can be had in the CW position of the mode switch. If you're operating SSB and want to change sidebands, here's what happens: the crystal that is switched into the circuit increases the BFO's operating frequency by 2.8 kHz. At the same time, the LMO is automatically shifted 2.8 kHz lower by a diode switch so you've changed sidebands without having to move the dial—you continue to read frequency right off it.

The mixed *if* and BFO frequencies obtained from the product detector are capacitor-coupled to the grid of the first audio stage, one-half of a 6HF8, which drives the second audio; either high impedance headphones or 8-ohm speaker operation is available. Negative feedback from the output transformer to the cathode of the first audio stage provides low distortion audio.

For AM reception, the BFO is switched off and the *if* output is coupled to a diode detector instead of the product detector and thence to the audio stages.

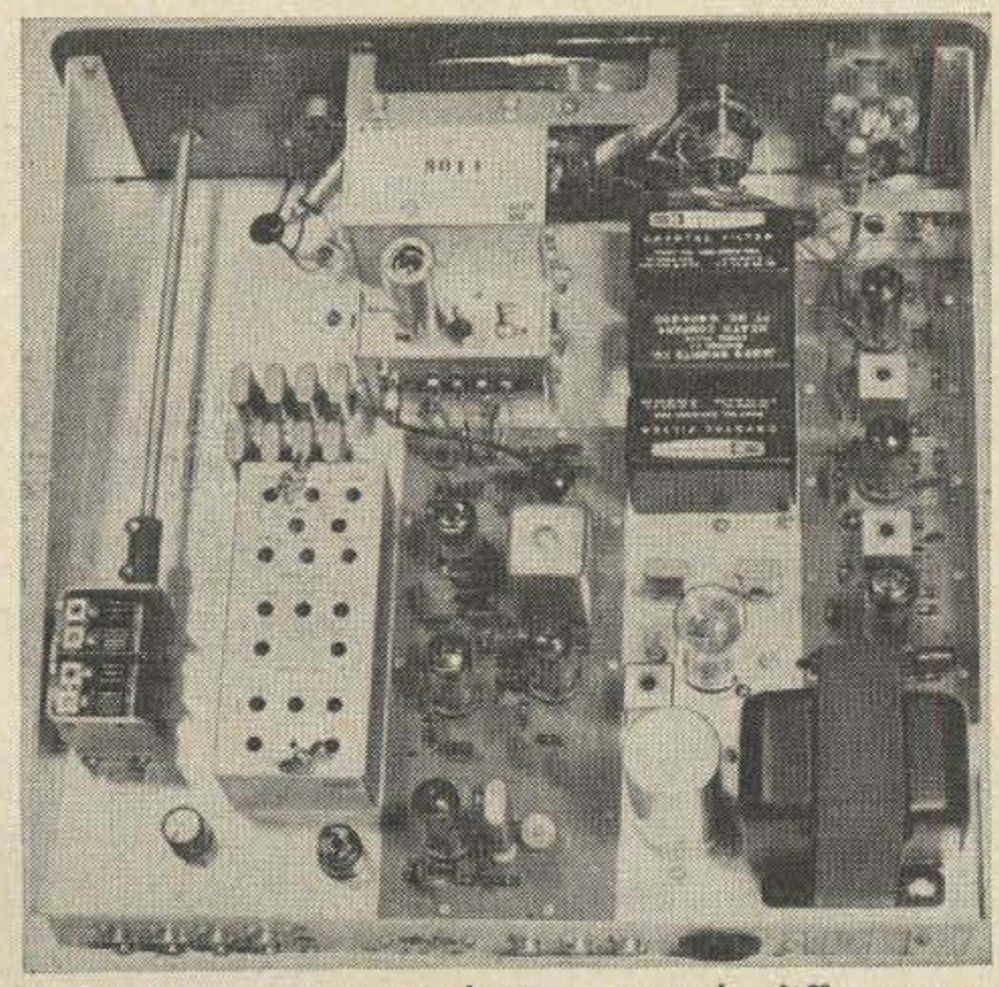
The lineup is completed by a 100 kHz calibrator that can be zeroed against WWV's 15 MHz signal. The band switch has a special position for receiving WWV—another new and welcome feature that was missing from the 300.

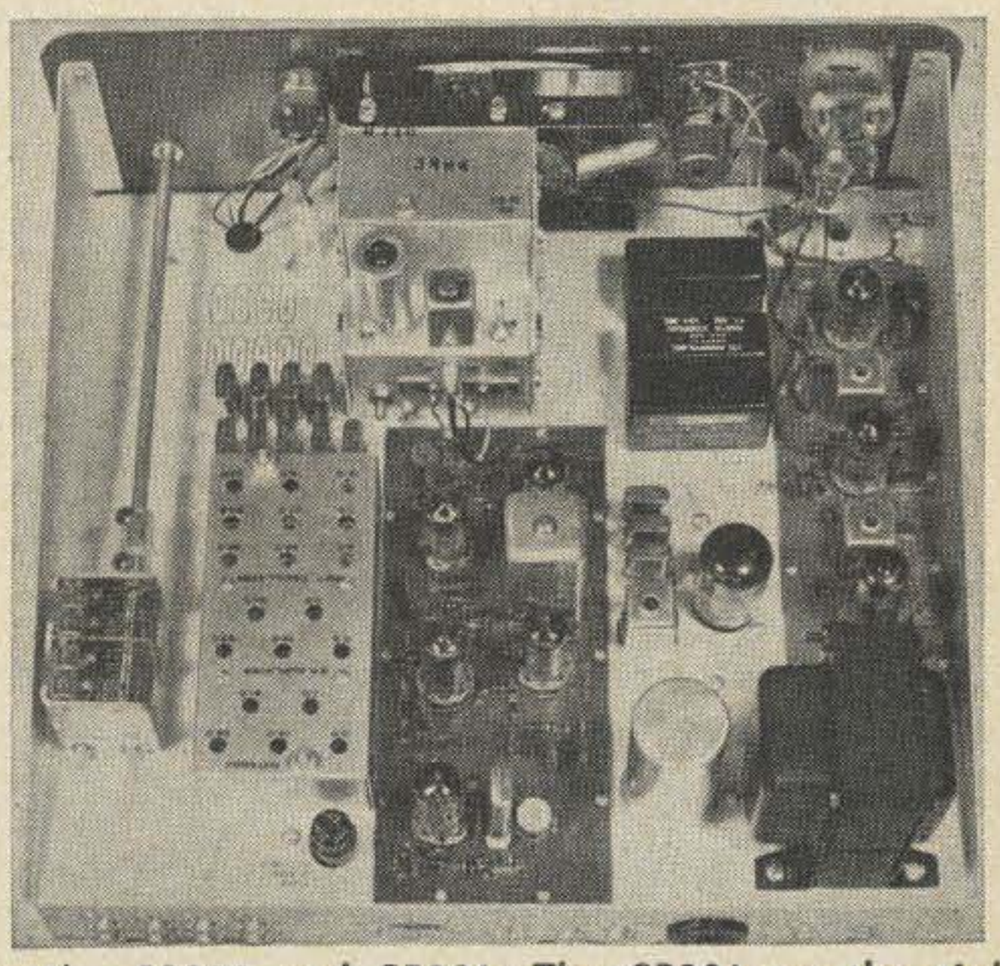
Assembly

No unusual problems were encountered in building the receiver except one of my own making. I did not observe the cardinal rule of kit building—read the instructions first, and follow them exactly. In blind confidence, I unpacked all the parts and sorted them out, but when I began to check them off against the parts list, I discovered that Heath had made another important advance. There were separate numbered "parts packages" that were called for individually as you begin each stage of assembly. The advantage is, of course, that you don't have a lot of small parts floating around long before you need them. Had I read the manual carefully I would have known this. Take warning, do as I say, and not as I do!

Total assembly time was about 24 hours, and alignment with the built-in crystal calibrator and S-meter went very rapidly. Not a single operating difficulty was found, a testimony to the good design, careful engineering and superb manual that makes it possible for anyone who can solder to build this kit successfully.

In case of difficulty, extensive trouble shooting procedures are carefully outlined in the manual, and complete voltage and resistance charts are included. According to Heath, 90% of the troubles that do arise





This bird's eye view shows several differences between the SB300 and SB301. The SB301 on the right has an additional heterodyne oscillator crystal and coil—immediately to the left of the large board. The converter switch which was located on top of the chassis in the SB300 is now located on the front panel. The three crystal filters of the 301 are somewhat smaller; the 6AS11 Compactron (below crystal filters) has been moved a little and is now adjacent to three crystals instead of the two that were used in the SB300.

are traced to poor soldering, so check that first.

Comparing the SB301 to the SB300

Owners of the older model will be interested in the differences between the two; physical changes are quickly apparent. On the front panel, the function switch and the AF gain control have been moved nearer the top. The AF gain knob also pulls out to turn on the ANL. The mode switch now has RTTY position and the band switch, its opposite number in location, includes the WWV 15 MHz position. At the bottom of the panel the converter switch is concentric with the rf gain control. It was formerly located on the top of the chassis and you had to open the lid to get at it.

Examine the top view photos of the two receivers; the holes in the coil cover indicate two things—coil locations have been shifted and an additional heterodyne oscillator coil appears. It is, of course, for the 15 MHz WWV position.

Three crystals appear in the chassis area of the 301 forward of the power transformer, where the 300 had only two. The extra one is for RTTY reception. Further forward in the same area, the three crystal filters are located. The new ones are not only smaller—but better. The 400 Hertz CW filter is now only 2 kHz wide 60 dB down, compared with 2.5 kHz in the old one.

The VFO in the receiver, which Heath calls the LMO (linear master oscillator), is a slightly modified version of the original model. An industrial grade 6BZ6 has been substituted for the original 6AU6, and there are some minor changes in the values of one or two parts. Its stability is excellent; drift is completely unnoticeable from a cold start.

Operation

One of this receiver's outstanding characteristics is its quiet operation, but don't make the mistake of thinking this means it's dead. Far from it—it's got sensitivity to spare. Tuning is smooth and the degree of tension on the dial is adjustable to your own tastes. With the receiver properly calibrated, frequency readout and resetability are outstanding, within a fraction of a kilohertz.

When you wrap the whole works up in the neat two-tone green cabinet Heath favors, you've got a receiver that's an impressive package for the money.

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