

## Heathkit of the Month: #30 by Bob Eckweiler, AF6C



### Heathkit Amateur Radio SB-Line - Overview

#### Introduction:

By the mid sixties single sideband had all but replaced AM as the preferred voice mode on the HF bands. The Heathkit RX-1 Mohawk receiver (See HOM #14, March 2009 RF) was a capable SSB receiver for the day, but the matching AM/CW Apache TX-1 (See HOM #17, July 2009 RF) required the SB-10 adapter to operate on SSB. Thus in 1963 Heathkit started introducing the SB-line. This line continued into the mid 1980s and even longer if you include some later amplifiers and non-kit radios that have the SB designation.

The SB-line can be split into three groups; the early SB-line, which contains the bulk of the products; the late SB-line which is the SB-104, and SB-104A transceivers and their matching accessories; and some miscellaneous equipment that is not related to either of these lines, but has the SB designation (For example the SB-10 mentioned above.)

Unlike other *Heathkit of the Month* columns, this month's column will be an overview of the line and not an in-depth discussion of a particular piece of equipment. Some of these items will be discussed individually in future articles.

#### The Heathkit Early SB-Line:

In the early sixties Collins Radio was selling a high performance amateur station that consists of a separate receiver and transmitter that can operate on one frequency using the receiver VFO or on split frequencies with each unit using its own VFO. This Collins "S-Line", as the set is known, evolved through several updates to become the 75S-3B receiver and the 32S-3 transmitter. A 30L-1 linear amplifier was also

sold, as was a 51B-4 station console. The S-Line was the deluxe station of its time. And even today it commands a high price and is highly sought after. The Collins S-Line didn't go unnoticed by the hams at Heath and appears to have had a major influence on the design of the Heathkit SB-300 and SB-400.

There were some significant differences between the Collins and Heathkit lines as well as many similarities. Two major differences involve the transmitter power supply and the type of filters used. Heathkit managed to fit the transmitter power supply into the transmitter case, while the Collins transmitter has an external power supply that fits inside the external speaker case. Heathkit also uses the less expensive crystal filters instead of the sharper mechanical filters, a Collins product of renown.

The early Heathkit SB-line is styled in a two-tone paint scheme of grey and green. The case is grey and the front panel is green with white lettering. The knobs are dark green with silver inserts and a silver skirt. When used, meters are black faced with white lettering, and the meter trim is dark green. The meters are often backlit.



**Figure 1: The SB-101 HF Transceiver**

Frequency stability of the SB-line is comparable with quality radios of the same era. This is due to the use of a pre-built and pre-calibrated LMO (Linear Master Oscillator) in the tube radios and its solid-state equivalent in the transistor receivers. The LMO tunes from 5,500 down to 5,000 KHz as the radio is tuned from

the low to high end of any of the eight or nine bands. Each band is 500 KHz wide so ten-meters requires four bands to cover 28.0 - 29.7 MHz. All oscillators except the LMO are crystal controlled making them very stable.

All the radios feature the same tuning dial. The frequency is indicated by a slide rule and dial. The slide rule is marked 0 - 5, and the cursor moves one slide rule division for each turn of the dial, which is marked 0 - 100. A 4+ : 1 vernier drive between the tuning knob and the dial allows easy tuning. The frequency is read by adding the MHz from the band switch, the proper 100 KHz from the slide rule and the proper KHz from the dial. This is very straightforward except on the two segments in the 10 meter band (28.5 to 29.0 and 29.5 to 30.0) where you must interpret the slide rule marks as 5 - 10.

The receivers include a 100 KHz crystal oscillator, and the dial cursor is adjustable so you can zero beat the calibration signal at the closest of the 100 KHz spots on the dial and then set the cursor mark right over the zero. The solid-state receivers also include 25 KHz spots for additional calibration points. This might seem primitive today, but you can read out accurately down to less than 200 Hz which was outstanding in the days before digital readouts were common.

Assembling the dial mechanism requires a lot of patience when building the kit to get it to work smoothly. If done right, the dial feels like velvet. I've come across a lot of SB Heathkits where this is not the case. Fortunately you can still go in there and do a readjustment. Alignment of the LMO to the chassis needs to be perfect and the position of the dial parts with respect to each other also needs to be perfect. The manual tells you how to do it. If you are buying a used Heathkit, be sure to check the dial. If it isn't physically broken you should be able to get it working smoothly with a little care.

Figure 2 shows the old, but still operational SB-301 and SB-401 built by the author in 1969. Note that the SB-301 receiver is on the right since the author is left-handed and tunes with the right hand.



Figure 2: SB-401 Transmitter (left) and SB-301 Receiver (right).

**Heathkit Early SB-Line Transmitters, Receivers and Transceivers:**

Heathkit manufactured twelve different receivers, transmitters and transceivers over the life of the series. They are:

- SB-100 HF Transceiver
- SB-101 HF Transceiver
- SB-102 HF Transceiver
- SB-110 VHF (6-Meter) Transceiver
- SB-110A VHF (6-Meter) Transceiver
- SB-300 HF Ham Receiver
- SB-301 HF Ham Receiver
- SB-303 HF Ham Receiver (solid-state)
- SB-310 HF SWL Receiver
- SB-313 HF SWL Receiver (solid-state)
- SB-400 HF Ham Transmitter
- SB-401 HF Ham Transmitter

The SB-300 receiver was the initial SB kit offered, followed closely by the SB-400 transmitter. These appeared in late 1963 and early 1964 respectively. They covered 80 through 10 meters SSB and CW (no WARC bands back then). The SB-400 runs 180 watts input. The SB-300 and SB-400 got to be known as the "Heathkit Twins" and also as "the poor man's Collins" not long after they were introduced.

In 1966 the SB-300 receiver was replaced by the SB-301, and the SB-400 transmitter was replaced by the SB-401. The SB-401 continued in production throughout the remainder of the early SB-line until 1976, but the SB-301 was replaced in late 1970 by the SB-303, a solid-

state receiver. The SB-303 case is a different width than the other radios, measuring 14-7/8" W x 6-5/8" H x 13-3/8" D.

In 1965, after the SB-300/SB-400 twins became popular, the SB-100 transceiver was released. It is styled and performs similarly to the twins but is in one package with just one VFO and requires an external power supply, either the HP-23 AC power supply (See HOM #26, February 2011 RF) or the HP-13 mobile DC power supply.

The SB-100 was updated to the SB-101 in 1967, and to the SB-102 in 1970. Like the SB-401 the SB-102 remained in production until around 1976.

The SB-110 also came on the scene in 1965. It is a 180 watt SSB, 150 watt CW six-meter transceiver that looks similar to the SB-100. In 1969 it was upgraded to the SB-110A and was discontinued in the early seventies. This VHF SSB/CW transceiver covered the lower 2 MHz of the six-meter band.

The SB-301 and SB-303 ham radio receivers also had SWL (shortwave listener) counterparts designated the SB-310 and the SB-313. These were spitting images of their sisters except they covered the major SWL bands instead of the ham bands. They also came with a wider AM crystal filter instead of the SSB filter supplied with the SB-301 and SB-303.

All the SB-3xx receivers came with one filter and space for two additional optional filters.

**Heathkit Early SB-Line Amplifiers:**

Heathkit made two RF linear amplifiers, each with a derivative, to meet FCC rule changes:

SB-200	HF 80-10M 1,200W PEP Amplifier
SB-201	HF 80-15M 1,200W PEP Amplifier
SB-220	HF 80-10M 2,000W PEP Amplifier
SB-221	HF 80-15M 2,000W PEP Amplifier

These linear amplifiers matched the early SB-line. The SB-200 uses a pair of 572B triodes and runs 1,200 watts PEP on SSB and 1000 watts on CW; the SB-220 uses a pair of 3-500Z

tubes and runs 2,000 watts PEP on SSB and 1,000 watts on CW. Both amplifiers have their power supply built-in and both can run off of 120 VAC or 240 VAC with a wiring change.

The SB-200 started production in 1964, while the SB-220 started production in 1970. Both were down-graded in 1978 because the FCC, observing that amateur radio amplifiers were finding their way onto the CB band, required that 10 meter capability be removed from new production amplifiers. Heathkit responded with the SB-201 and SB-221 which removed the ten meter capability. These amplifiers continued in production until 1983. They work with most HF radios and are still popular amplifiers.

**Heathkit Early SB-Line Transverter:**

Between 1969 and 1971 Heathkit offered a two-meter transverter kit.

SB-500	Two-meter Transverter
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The SB-500 allows the SB series radios to operate on 2-meter SSB and CW. It is designed for an IF of 50 - 52 MHz for use with the 6 meter SB-110 series or 28 - 30 MHz for use with the HF SB series of twins and transceivers. Modifications are required to operate on the upper two MHz of two meters.

**Heathkit Early SB-Line Accessory Devices:**

Heathkit made numerous supporting items for the early SB-line that come in their own cabinet and add to the functionality of the line. They appear in the same green - gray style as the rest of the family. They are:

SB-600	Matching Speaker
SB-610	Monitor Scope
SB-620	Panadapter (Spectrum Analyzer)
SB-630	Station Console
SB-640	Remote VFO
SB-650	Digital Frequency Display

These accessories, with the exception of the SB-650, each fit in the same size accessory cabinet (10" W x 10-1/2" D x 6-5/8" H) The dimensions exclude knobs and feet.

The SB-600 is a matching speaker. It is a simple kit and has room and mounting holes to in-

install an HP-23 series AC power supply inside it when using the speaker with one of the SB-100 series transceivers.

The SB-610 is a monitor oscilloscope that allows you to look at your transmitted signal, the received signal and the linearity of your power amplifier.

The SB-620 is a spectrum analyzer that lets you view a segment of the band you are on for nearby signals. It can also be used as a stand-alone spectrum analyzer.

The SB-630 is a station console that includes a (mechanical) 24-hour digital clock, a 10 minute timer, an SWR bridge and a hybrid phone patch, all housed in one cabinet.

The SB-640 is a remote VFO housing a Heathkit LMO with power supply for use with the SB-100, SB-101 and SB-102 transceivers to allow split frequency operation.

The SB-650 is a digital readout that displays the operating frequency on six Nixie tube displays. It is housed in a smaller case (10" W x 10-1/4" D x 4" H)

**Heathkit Early SB-Line Accessories:**

Heathkit also made various accessories for the early SB-line. Some were modification kits for certain pieces of equipment. They are:

- SBA-100-1 Mobile Mount
- SBA-300-3 6-meter converter
- SBA-300-4 2-meter converter
- SBA-310-3 Mod Kit for the SB-310
- SBA-401-1 Crystal Pack for SB-401
- SBM-102-1 Mod Kit for SB-100/101/ early 102

The SBA-100-1 is an inexpensive mobile mount for the SB-100 through SB-102 transceivers.

The SBA-300-3 is a six-meter converter that covers 50-52 MHz as supplied.

The SBA-300-4 is a two-meter converter that covers 144- 146 MHz as supplied.

Both converters mount simultaneously on the rear of the SB-301 and may be selected by a front panel control that switches the antenna and turns on power to the selected converter.

The SB-310-3 is a modification kit that converts the SWL receiver's 26.9 – 27.4 citizen's band to the 21.3 – 21.8 SWL band (and part of the 15 meter ham band). Evidently a lot of people were turned off listening to eleven meters.

The SBA-401-1 is a package of crystals that allows the SB-401 to operate independently of the Heathkit SB-301 receiver. Normally the BFO and heterodyne frequencies are generated in the receiver and used by the transmitter.

The SBM-102-1 is a modification kit for the SB-100, SB-101 and early SB-102 (SN below 5446). It modifies the driver stage to cancel the Miller effect that causes the driver tuning to be different between receive and transmit. All owners of these radios should install this kit to improve receiver sensitivity and transmitter drive. While the kit is no longer available from Heathkit, the parts are common and easily available, and the seven page Heathkit instruction manual can be found on the web.

**Heathkit Early SB-Line Crystal Filters:**

Heathkit made numerous crystal filters for the early SB-line. The filters for the SB-100, SB-300 and SB-400 are physically larger than the later units. The later filters are narrower, but the mounting and terminals are reported to be the same so you should be able to use the smaller filter in an older radio but not the other way around without modification. Watch out for the later CW filter that is used in the late SB-line as it has a slightly different center frequency. Here is a list of known early SB-line filters and the equipment they work in.

Part #(s)	Bandwidth @ 6dB/60dB Kit(s) using filter
404-200	SSB 2.1/5 KHz SB-100/300/400 (Supplied)
404-201	AM 3.5/14 KHz SB-100/300 (Optional)

- 404-202 CW 0.4/2.5 KHz  
SB-100/300 (Optional)
- SBA-310-2 SSB 2.1/5 KHz  
(404-283) SB-101/102/301/303/401 (Supplied)  
SB-310/313 (Optional)
- SBA-301-2 CW 0.4/5 KHz  
(404-284) SB-101/102/301/303 (Optional)  
SB-310/313 (Optional)
- SBA-301-1 AM 3.75/10 KHz  
(404-285) SB-301 (Narrow band Optional)
- 404-314 AM 5/15 KHz  
SB-310/313 (Supplied)  
SB-301/303 (Wide-band Optional)
- SBA-310-1 SSB 2.1/7 KHz  
(404-328) SB-310 Optional

Heath continued production on the early SB-line's SB-303 and SB-401, as well as the SB-201 and SB-221 for a time after the late SB series introduction. The new series is based on a new transceiver, the SB-104. In 1977, as the older series continued being phased out the SB-104 got an update to the SB-104A and remained in production until around 1982. The new SB series continues the green and gray color scheme. Added are two black stripes on the green front panel, thick along the top and thin on the bottom. A meter and a digital readout are in the top strip. The meter labeling and digital readout are lit red and stand out sharply in contrast.

**Heathkit Late SB-Line:**

In 1974 Heathkit added a later series to the SB-line. With this series Heathkit left vacuum tubes behind and went all solid state except for the a CRT and a linear final tube.

- SB-104 HF Solid-state Transceiver
- SB-104A HF Solid-state Transceiver

The SB-104 & the SB-401A "solid-state, no-tune" transceivers run 100 watts out on the 80 - 10 meter bands (no WARC bands) and are the first SB series radios to have a digital readout built in. They requires 13.8 VDC power.

**Heathkit Late SB-Line Linear Amplifier:**  
Heathkit manufactured a linear in the late SB-line style from 1974 to 1978:



**Figure 3: The Later SB-Line**

**Clockwise from the top:** SB-104 HF Transceiver; SB-230 Linear; SB-614 Station Monitor; SB-634 Station Console; SB-644 Remote VFO; SB-604 with HP-1144 AC Power Supply.

SB-230 1,200 W PEP Linear Amplifier

The SB-230 linear amplifier runs 1KW on CW and 1,200 watts PEP on SSB. It uses an Eimac 8873 ceramic tetrode tube that uses conduction cooling instead of a fan.

**Heathkit Late SB-Line Accessory Devices:**

Like the earlier SB series, the later SB series has a host of supporting accessory devices:

- SB-604 Matching Speaker
- SB-614 Monitor Scope
- SB-634 Station Console
- SB-644 Remote VFO
- SB-644A Remote VFO

The SB-104 is the matching speaker for the SB-104/A. The AC power supply for the transceiver (HP-1144/PS-1144) is designed to fit internally to the speaker.

The SB-614 is a solid-state signal monitor for viewing the quality of your signal and the linearity of your amplifier.

The SB-634 is a station console that includes an SWR/power meter, a hybrid phone patch, an electronic digital clock and a ten-minute timer.

The SB-644/644A are remote VFO's that allow the SB-104/104A to operate split frequency.

**Late SB-Line Accessories:**

Heathkit manufactured a couple of accessories for their SB-104/SB-401A line:

- SBA-104-1 Noise Blanker
- SBA-104-2 Mobile Mount

The SBA-104-1 is an internal noise blanker. It is a step up from the earlier noise remedies provided on the SB-line. The SB-300 and SB-303 have no noise control circuitry. The SB-301 includes a simple diode noise limiter of little value. The SBA-104-1 is an effective noise blanker for pulse type noise. Many were bought for use in other receivers including the Collins 75S series receivers.

The SBA-104-2 is a mobile mount for the SB-104/A transceiver.

**Heathkit Late SB-Line Crystal Filters:**

Only one optional filter was manufactured.

Part #(s)	Bandwidth @ 6dB/60dB Kit(s) using filter
404-283	SSB 2.1/5 KHz SB-104/104A (Supplied)
SBA-104-3 (404-548)	CW 0.4/ 2 KHz SB-104/104A (Optional)

The SBA-104-3 is the optional CW crystal filter for the SB-104/SB-401A. Note that while the SSB filter supplied with the SB-104 and SB-104A are the same part used in the early SB-line, this CW filter cannot be used in the earlier SB-line since the late SB-line uses a different CW BFO crystal and a different filter center frequency.

**Miscellaneous Non-SB-Line Products:**

Heathkit made a few kits with the SB prefix that do not fit into the two lines. They are the:

**SB-10 (1959 - 1964):** The SB-10 is a phasing HF SSB adapter for the TX-1 Apache. It also works with a modified DX-100 and DX-100B.

**SB-1000 (1987 - 1992):** Heathkit made a linear amplifier that uses a single 3-500Z tube and runs 1,200 watts PEP. This amplifier uses the later dark and light brown paint scheme that matches the later SS-9000 transceiver.

**SB-1400 (1988 - 1991):** This transceiver is not even a kit; it is a Yaesu FT-747GX in Heathkit livery.

73, from AF6C



A special thanks to reader Art Coates (call?) for a manual that will help me with updating the Heath GH-17A article.

*Remember if you come across any old Heathkit Manuals or Catalogs that you do not need, please pass them along to me. I'm especially looking for mid-to-late 1960's catalogs or readable pdfs of those catalogs.*

*Thanks - AF6C*

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