

Heath SB-1000 HF Linear Amplifier

Reviewed by Paul K. Pagel, N1FB

My first Heathkit® was a DX-40, a simple transmitter using a single 6146 RF amplifier stage running about 90 W input on CW. Here I am, 27 years later, with another one of many Heathkits I've built—this one an amplifier that runs almost 10 times the DX-40's input level in the same mode.

Latest in a line of amplifiers offered by Heath, the SB-1000 employs a single 3-500Z triode in class AB₂ grounded-grid service. An internal voltage-doubler supply produces 3100 V dc at rest, and 2700 V under a load of about 500 mA. Heath rates the SB-1000 for output powers of 1000 W PEP on SSB and 850 W on CW. Also, a continuous-carrier power-output rating of 500 W is specified for a maximum of 30 minutes. (That's what RTTY, SSTV and packet-radio operators can expect to have at their disposal.)

The front panel of the Heath SB-1000 is shown in the title photo. The left-hand panel meter is used as a multimeter to monitor high voltage, plate current, power output and ALC level. Two rocker switches, PWR/OFF and OPR/STBY, are used, respectively, to switch ac-line voltage on and off, and place the amplifier in standby or operational modes. Reduction drives are used on the PLATE and LOAD controls to provide smooth tuning. The BAND switch has six positions, though only five are marked on the front panel (more on this later). Additional views of the amplifier are shown in Figs 1 and 2.

The '1000 can be operated from a 120 or 240 V ac line. Changing the input voltage requires the installation of the proper fuse size, a minor wiring change on an internal barrier (terminal) strip, and the use of the correct ac line plug (a 120-V line-cord/plug combination is supplied).

Construction

First, I made the several necessary changes to the assembly/operations manual and illustration booklet. Then, I built the manual binder (!). In lieu of providing a bound assembly/operations manual, Heath provides a cover, a plastic three-ring binder spine and hardware to assemble the cover. The pre-punched pages of the assembly/operations manual—and the illustration booklet—fit in the binder.

A modular approach is used in the construction of the SB-1000; this makes overall construction easy to handle. There are four circuit boards to assemble: the power-supply rectifier, power-supply filter, ALC and metering-circuit boards.

Input-network assembly follows. Be-

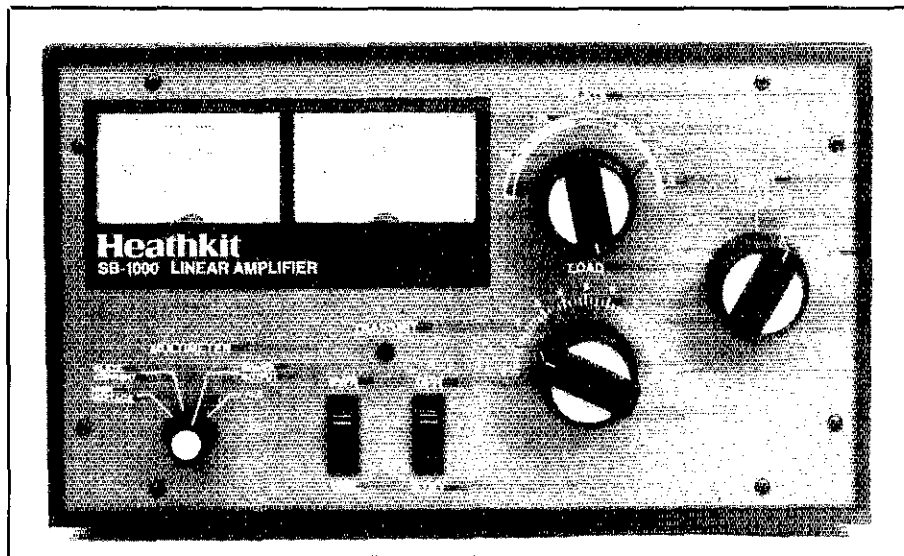


Table 1

Heath SB-1000 HF Linear Amplifier, Series no. 01 71112

| Manufacturer's Claimed Specifications | Measured in ARRL Lab |
|--------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| Frequency coverage: 160, 80, 40, 20 and 15 meters. (Also operable on MARS and WARC bands, where applicable.) | As specified, plus 10 meters. See text. |
| Driving power required: 100 W (85 W typical). | As specified. |
| Maximum power output: SSB, 1 kW PEP; CW, 850 W. | As specified. |
| Duty cycle: SSB, continuous voice modulation; CW, 50%; 30 minutes of continuous carrier at 500 W. | As specified. |
| ALC: 0-20 V, adjustable, negative-going. | As specified. |
| Spurious emissions: -30 dB or better. | See Fig 3. |
| Keying: Requires contact closure or keying circuit capable of sinking 100 mA at 12 V dc. | |
| Primary power requirements: 15 A at 120 V; 7.5 A at 240 V. | |
| Color: Two-tone gray with black trim. | |
| Size (height, width, depth): 8¼ × 14½ × 15½ inches. | |
| Weight: 48 lb. | |

cause of the small size of the enclosure, this is relatively close work—but it is easily managed.

Two numbers appear on each envelope containing an input-network coil; be careful not to misread them. Also, watch closely the numbering of the input-network switch contacts; it's easy to miscount them. (I feel that an exploded view of the switch wafer should be added to the manual for clarification.) Inspect the input-network coil wire terminations at the lugs. Note that they are *not* soldered to the lugs (Heath mentions this). I found one wire termination (on the 160-m coil) that had not been

stripped of its insulation and would not take solder. If you find a suspicious-looking termination, carefully unwind most of the wrap—leave a half or full turn on the lug so as not to loosen the coil winding—scrape the insulation from the wire and rewrap it. (I opted to presolder the coil terminations at the lugs to eliminate the possibility of a poor connection.)

Tune-Up

This exercise should take no longer than an hour. Basically, all you have to do is touch up the tuning of the input-network coils (you'll need a wattmeter for this). The

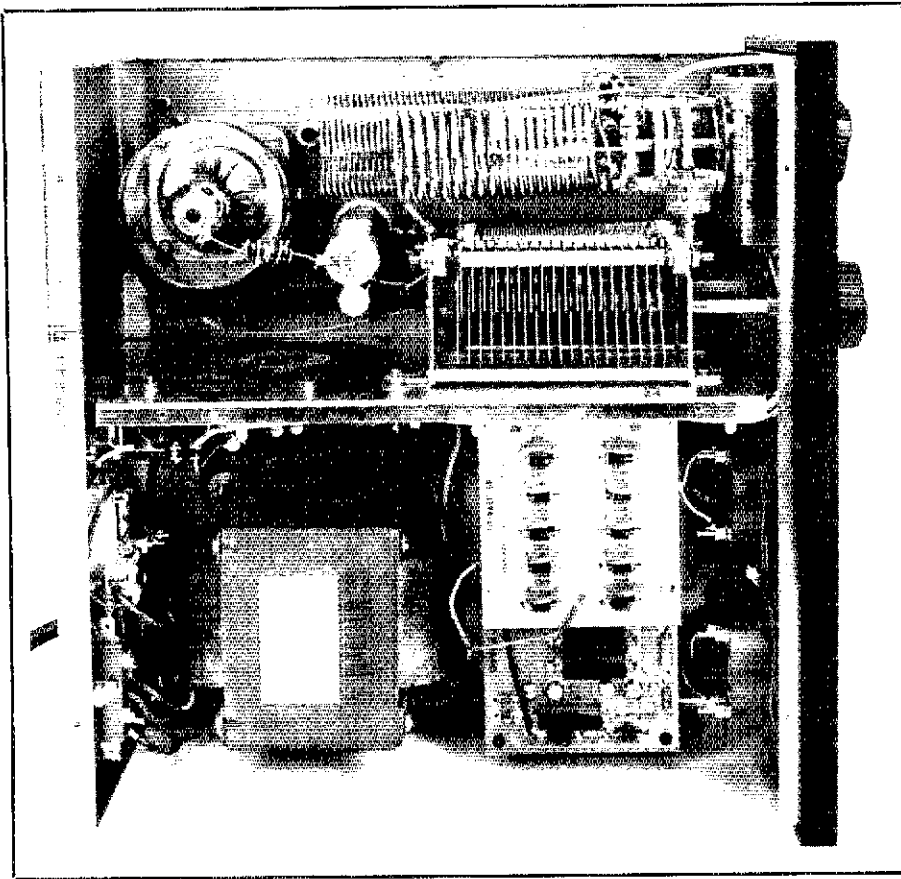
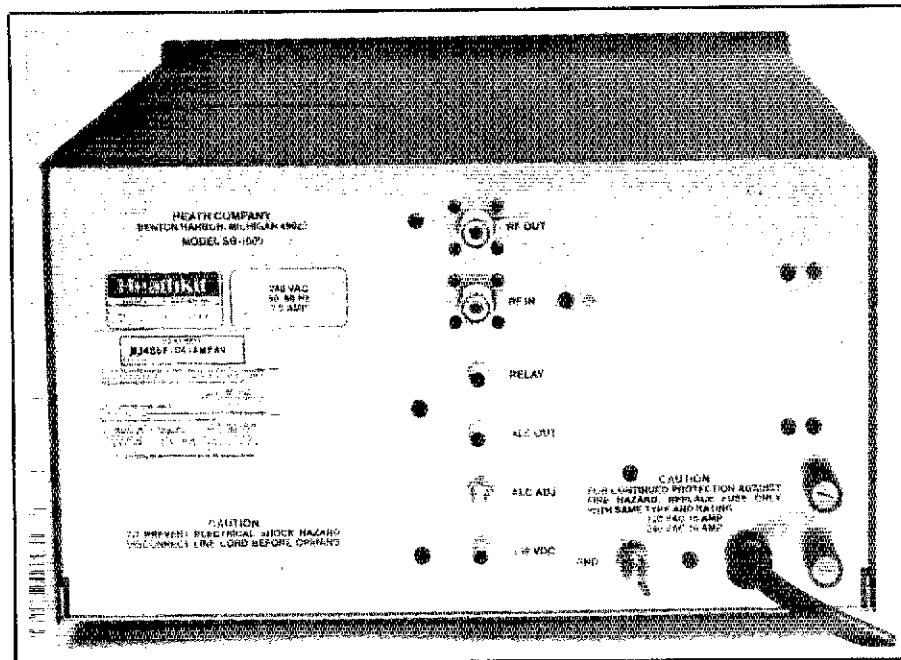


Fig 1—An inside view of the SB-1000. Here's where it all happens. In this photo, the amplifier is resting on its left side. The power supply, meters and metering circuit PC board (hidden beneath the meters) and cooling fan are contained in the left-hand compartment (at the bottom in this view) of the amplifier. High-voltage supply rectifiers and transient-suppression capacitors are mounted on a PC board supported by standoffs above another PC board that supports the filter capacitors and voltage-equalizing/bleeder resistors. The safety interlock switch is at the bottom left, mounted on the rear panel along with the power-supply primary circuit control relay. The amplifier TR relay is mounted at the left of the center shield, just above the fan. Next to it (not visible) is the ALC circuit PC board.

In the RF section (top of the photo), the input-network subassembly can be seen mounted behind the front panel. The long, black object barely visible between the fan and the 3-500Z is the filament RF choke.



slugs in the coils of my amplifier were already close to the optimum setting as supplied.

Before applying power to the amplifier, you're instructed to place the cabinet cover on the amplifier and slide it back slightly to gain access to the input-network coils. (They're located at the *front* of the amplifier on the right-hand side, immediately behind the front panel.) Resting the cover on the cabinet this way closes the safety interlock and simultaneously helps to keep tools and fingers from touching high-voltage areas.

After checking and double-checking to make sure everything was in order, I placed my finger on the PWR switch and rocked it upward to apply power to the amplifier for the first time. *KE-WANG!*... I was paralyzed!... After I picked my teeth and eyes up off the floor, and swallowed my heart to its proper position, I realized what had happened. The interlock relay is mounted on the rear panel, so it makes a metallic *whack* when it closes. But the cover, resting loosely on the amplifier, added enormously to the din by rattling noisily as the power supply came alive for the first time. With the wattmeter placed on top of the cover, the power-on noise was reduced to a dull *thunk*.

Once I'd convinced myself that the amplifier had suffered no damage, I proceeded with the tune-up. It was during the second touch-up of the 160-m coil that I heard an arcing noise and saw some sparking that appeared to be coming from the base of the plate RF choke. I could find no damage to any component or anything that looked amiss. Another try at 160-m tune-up, and another noise and sparks. Because of the position of the cabinet cover, I couldn't be sure just where the arcing was occurring.

Though I didn't care to do so, I had to completely remove the cover and jumper the safety interlock switch. (Caution: This exposes the high-voltage areas of the amplifier!) Not surprisingly, I was then able to complete the entire tune-up procedure without another incident of arcing. During subsequent full-power tests, the amplifier never again spit at me on 160 meters.

10-M and WARC-Band Coverage

During assembly, you'll install a 10-meter input-network coil, and the

Fig 2—Rear panel of the SB-1000 (left). RF IN accepts the exciter's output; the RF OUT jack is connected to the antenna circuit. The exciter's TR control and ALC connections are made to the RELAY and ALC OUT jacks. The ALC ADJ potentiometer is adjusted for proper ALC interaction between the exciter and amplifier. You can power ancillary equipment (requiring +12 V dc at 100 mA or less) from the +12 vdc jack. The GND bolt is equipped with a wing nut. Two fuse holders are mounted to the right of the ac line cord.

illustration manual refers to one of the output network coils being used for 40, 20, 15 and 10 meters. Also, the specifications say: "(also operable on MARS and WARC bands, where applicable)." But that's it—there's no additional information in the manual telling you how to use the amplifier on these bands. Also, you won't find the 10-meter input coil in the schematic diagram! A call to Heath's Technical Service quickly brought the answers.

Enabling Operation on 10 M

This is a snap because everything is already in place for 10-meter operation: the input and output network coils, and the required position on the BAND switch. (The 10-meter position is not marked on the front panel, however.) All you have to do to get the SB-1000 working on 10 meters is to cut the black wire that exits the input-network enclosure and is attached to the ground lug secured by the PLATE tuning capacitor reduction-drive mounting screw. You can see this wire clearly on p 38 of the illustration book. When you're going to operate the SB-1000 on 10 meters, just remember to turn the BAND switch past the 15-meter position, or place a label on the panel as a reminder.

WARC-Band Operation

Using the SB-1000 on the 12- and 17-meter WARC bands is somewhat of a compromise. There are no input network coils supplied specifically for those bands, and the output network is not tapped for these bands. As you can imagine, there also are no BAND switch positions assigned for these frequencies. But, you can operate the amplifier on 12 meters by placing the BAND switch in the 10-meter position and on 17 meters by using the 15-meter position of the BAND switch.

With my TS-430S driving the SB-1000, I could obtain rated amplifier power output on 17 meters, but had to be satisfied with a maximum of 500 W of power output on 12 meters. I chose not to modify the amplifier in any way to acquire greater power output on 12 meters.

ALC Provisions

ALC voltage is available at the ALC OUT phono jack on the rear panel. The ALC ADJ control, immediately beneath the phono jack, enables you to vary the amplitude of the negative-going ALC voltage between 0 and 20 V. Instructions on setting the ALC ADJ control are given in the SB-1000 manual.

Comments

Total construction time (including 2½ hours for the four circuit boards) amounted to about 22 hours, spread over a period of several days. I encountered only two minor mechanical faults. The ground lug wing nut and one of the pi-network output coil nylon spacers were improperly machined. The

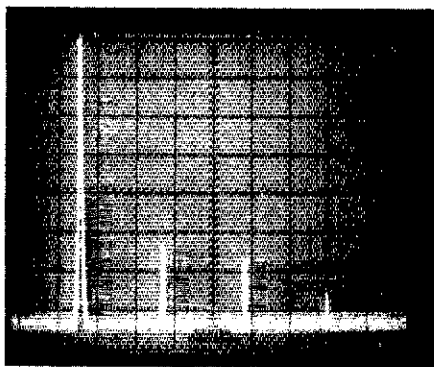


Fig 3—Worst-case spectral display of the Heath SB-1000 amplifier operating at 21 MHz with approximately 800 W output power. Vertical divisions are each 10 dB; horizontal divisions are each 10 MHz. All spurious emissions are at least 54 dB below peak fundamental output. The SB-1000 complies with current FCC specifications for spectral purity.

wing nut was drilled off-center and incorrectly threaded. One end of the nylon spacer had been drilled out oversize, untapped, and wouldn't accept the no. 8-32 hardware. So, I used a no. 10-32 tap and screw and a larger lockwasher scrounged from my junk box. Of course, replacement items can be obtained from Heath, but I didn't want to stop assembly of the amplifier for something I could work around.

Though the power-supply rectifier assembly has transient-suppression capacitors across each diode, no voltage-equalizing resistors are used.¹

The ac line cord supplied is designed for use with standard 120-V outlets. If you're going to power the SB-1000 from a 240 V ac line, the male plug on the supplied line cord must be removed and a proper connector (not supplied by Heath) installed. Prepare for this by buying the proper plug in advance.

When the plate-circuit parasitic choke is installed, the instructions call for placing the 3-500Z tube in its socket. Though you're also warned to be careful in handling the amplifier from that point on, I chose to remove the "bottle" and return it to its carton. I did this because at that point, there's still a bit of construction to be undertaken, including the installation of the rather heavy power transformer. I felt safer handling the chassis without the tube in place.

Some may consider the SB-1000 to be a bit dated in that it is not specifically designed with additional input-network coils, output network coil taps and BAND switch positions for the WARC frequencies. But all you need to do to get the amplifier running on those bands amounts

to a bit of interpolation.

I find the SB-1000 to be a smooth-tuning, quiet and stable amplifier. The amplifier never exhibited any signs of taking off for the nearest neighboring nebula during protracted periods of testing. I like the fact that the SB-1000 has a relatively small footprint and uses a proven, readily obtainable and inexpensive output tube. The amplifier goes together easily, operates well, looks good and has Heath's legendary support. You can't ask for much more than that.

The SB-1000 is available from the Heath Company, Benton Harbor, MI 49022, tel 800-253-0570. Price class: \$740.

KENWOOD R-5000 GENERAL-COVERAGE RECEIVER

Reviewed by David Newkirk, AK7M

"Sure, I've seen the ads for that R-5000 receiver. It's just the receiver section of the TS-440 transceiver!" Is this true? Because just about every new ham transceiver includes a general-coverage receiver nowadays, you've probably heard this statement—or one just like it about the general-coverage receivers offered by other ham-equipment manufacturers—yourself. If you buy an R-5000, are you getting the receiver section of a TS-440, more or less?

Yes—and no. A no-options-added R-5000 and the receiver in the TS-440 do cover the same range: 100 kHz to 30 MHz. (Both radios actually tune down to 30 kHz, although their sensitivity drops off below 100 kHz.) They both do have 100 memories, dual digital VFOs, and keypad and rotary tuning. A no-options-added R-5000 can hear the same signals a stock TS-440 can hear, and maybe a few more: The manufacturer's specifications for the R-5000 give it a slight edge over the TS-440 in FM sensitivity, and in AM sensitivity above 150 kHz.

Because the R-5000 and the TS-440 receiver section are so similar, I'll concentrate on their differences in this review. I suggest that you refer to QST's TS-440S Product Review for a rundown of TS-440 features.² Our test R-5000 includes two optional IF filters: the YK-88C (BW 500 Hz at -6 dB) and the YK-88A-1 (BW 6 kHz at -6 dB). The R-5000's optional 108-174 MHz VHF converter—the VC-20—was not tested.

Receiving Scheme

The R-5000 is a multiconversion superheterodyne receiver. For all modes except FM, it uses double conversion (IFs of 58.1125 and 8.83 MHz). During FM reception, triple conversion is used (IFs of 58.1125 and 8.83 MHz, and 455 kHz). (The

¹See p 6-6 of the 1988 Handbook for information on voltage-equalizing resistors.

²T. Miller, "Trio-Kenwood TS-440S HF Transceiver," Product Review, QST, Dec 1986, pp 41-43 and 47.