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Heath SB-1000 HF Linear Amplifier

Kenwood R-5000 General-Coverage Receiver

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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 AB_2 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).

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.	

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 prepunched 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. Because 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

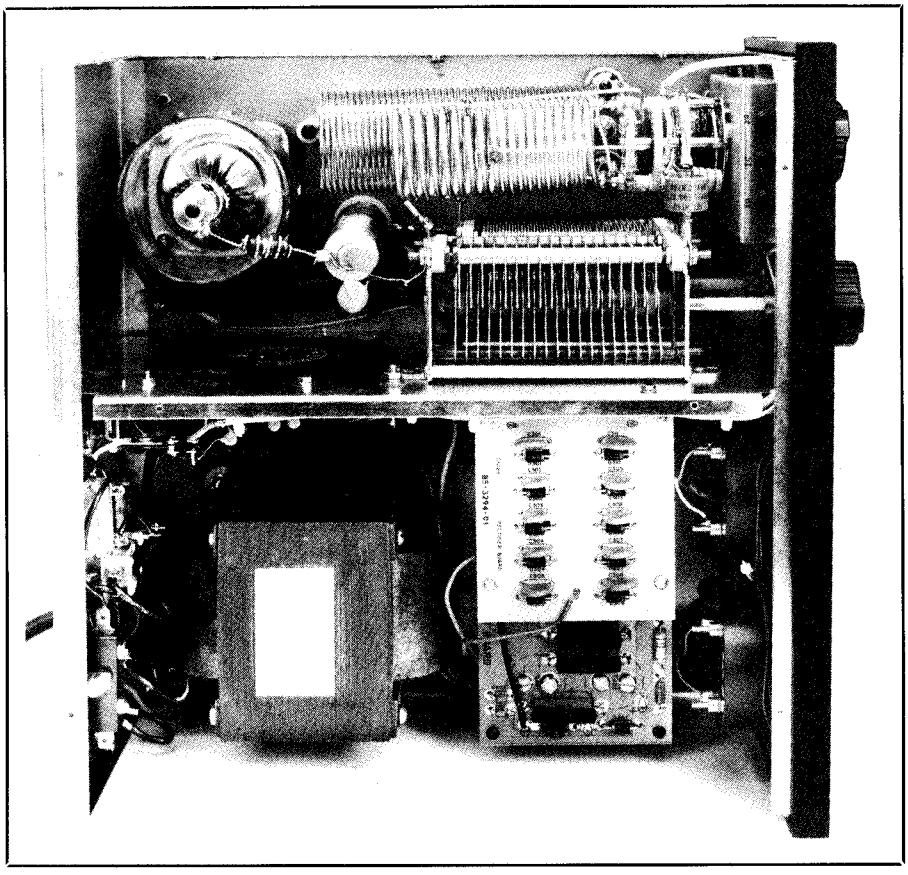

Fig 1—An inside view of the SB-1000. Here's where it all happens. In this photo, the amplifier is resting on its left side. The power supply, meters and metering circuit PC board (hidden beneath the meters) and cooling fan are contained in the left-hand compartment (at the bottom in this view) of the 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.

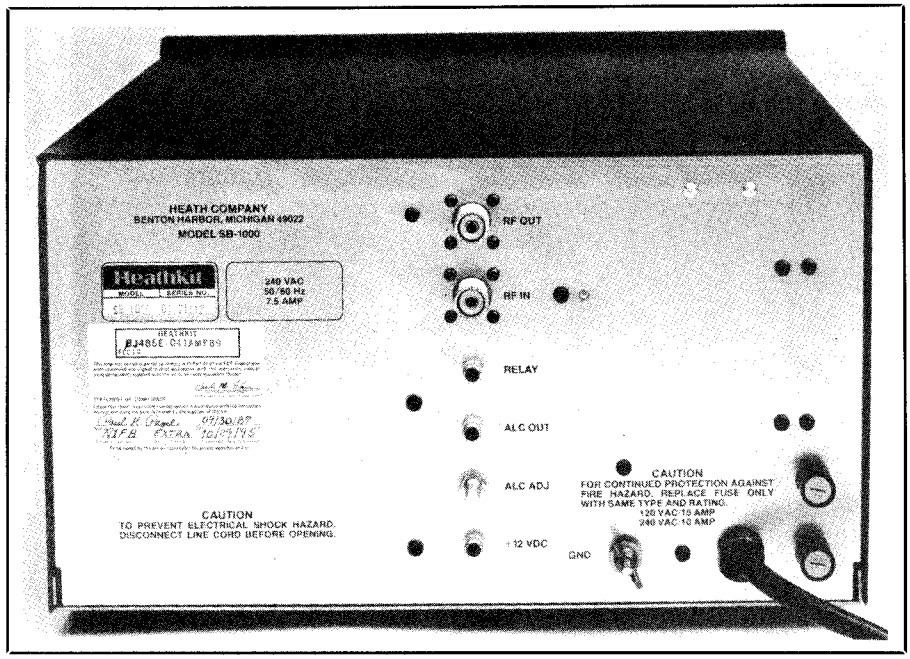

Fig 2—Rear panel of the SB-1000 (left). RF IN accepts the exciter's output; the RF OUT jack is connected to the antenna circuit. The exciter's TR control and ALC connections are made to the RELAY and ALC OUT jacks. The ALC ADJ potentiometer is adjusted for proper ALC interaction between the exciter and 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.

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

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 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.

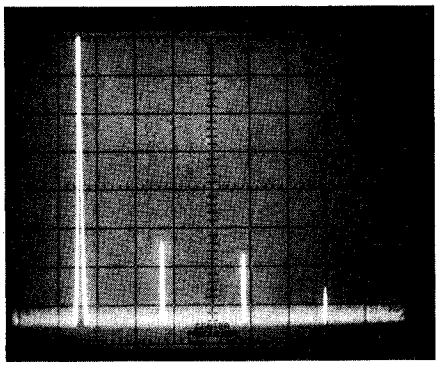

Fig 3—Worst-case spectral display of the Heath SB-1000 amplifier operating at 21 MHz with approximately 800 W output power. Vertical divisions are each 10 dB; horizontal divisions are each 10 MHz. All spurious emissions are at least 54 dB below peak fundamental output. The SB-1000 complies with current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

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.

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

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

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

Table 2

R-5000 Step Span and Tuning Rate versus Mode

Mode	*AM*		*USB/LSB/CW/FSK*		*FM*	
STEP key	*off*	*on*	*off*	*on*	*off*	*on*
Tuning step	1 kHz	100 Hz	10 Hz	100 Hz	5 kHz	2.5 kHz
Per rev of tuning knob	20 kHz	50 kHz	10 kHz	50 kHz	100 kHz	50 kHz

TS-440 uses triple conversion for all modes; its IFs are 45.05 and 8.83 MHz, and 455 kHz.) Aside from a few small modules that use surface-mount devices, most of the R-5000's components are through-hole mounted on single- and double-sided circuit boards.

Tuning Methods and Mode Selection

The TS-440 and R-5000 are billed as having "dual digital VFOs" and 100 memories. In fact, their VFOs—neither dual nor digital, as explained earlier in *QST*[3]—are actually far more flexible than mere dual VFOs could ever be: They are *tunable memories* that store frequency, mode and antenna selection. The remaining 100 memories also store frequency, mode and antenna selection, but they are *not* tunable.[4] The R-5000's MODE/KEY keypad and M>V, SCAN, CLEAR, VFO/M, M IN and ENT keys function identically to those on the TS-440 transceiver. Unlike the TS-440, the MODE/KEY keypad also allows selection between two antennas.

The span of the R-5000's tuning steps varies with mode and with the status of STEP (see Table 2). In the TS-440, the tuning-step span is fixed at 10 Hz for LSB, USB, CW and FSK, and 100 Hz for AM and FM. Unlike the TS-440, the R-5000 does not include a receiver-incremental-tuning (RIT) control.

In both the R-5000 and the TS-440, switching between LSB and USB does not require retuning. The R-5000 and TS-440 control programs differ somewhat in how they handle sideband selection across the HF range, however. The R-5000 does not interfere with your choice of LSB or USB, no matter where you tune. Not so with the TS-440: If you have selected LSB below 9500 kHz, the TS-440 switches to USB as you tune across 9500 kHz from below. If you have selected USB above 9500 kHz, the '440 changes to LSB as you tune across 9500 kHz from above! In practice, this quirk causes no hardship: You need only switch the '440 back to the desired mode and keep tuning. (Curiously, this mode shift doesn't occur if you rock back and forth across 9500 kHz with the '440's RIT control.)

Second-IF Filtering

In both the R-5000 and TS-440, second-IF filtering begins at 8.83 MHz with a monolithic crystal filter (6 kHz wide at −6 dB; shape factor of 3).[5] No factory option is available to improve this filter in the TS-440, but the R-5000 allows replacement of this filter with the optional YK-88A-1 (same −6 dB bandwidth, but a shape factor of 2). Adding the YK-88A-1 makes the R-5000's 6-kHz selectivity considerably tighter than that of the TS-440. This is particularly important when listening to shortwave broadcast stations, which operate on channels spaced 5 kHz apart.

The TS-440 does its CW filtering, and some SSB and AM filtering, at 8.83 MHz. All of its FM filtering, and the remainder of its SSB and AM filtering, is done at 455 kHz. The R-5000 completes its CW, AM and SSB filtering at 8.83 MHz, using 455-kHz filtering for FM only.

The R-5000's 8.83-MHz filtering scheme is unusual in that narrower filters are brought into operation *in series* with wider filters. The narrower the bandwidth, the more filters there are in series. In addition to the YK-88A-1, three optional filters are available for the R-5000. These are the YK-88SN (1.8 kHz), YK-88C (500 Hz) and the YK-88CN (270 Hz). The R-5000 has space for mounting *any two* of these latter three filters. The *R-5000 Instruction Manual* warns us to refer installation of optional filters to qualified service personnel. If you want to find out how to install the filters, you have to buy the *R-5000 Service Manual.*

RF Inputs

The R-5000 allows selection between two antennas by means of ANT 1 and ANT 2 buttons on the MODE/KEY keypad. The ANT 1 input is an SO-239 coaxial jack intended for use with antennas fed by means of 50-ohm coaxial cable. The ANT 2 input is a set of three binding posts that allows wire connection to a 50- *or* 500-ohm antenna (not both at the same time). The TS-440 has only a 50-ohm antenna input; it's an SO-239.

The R-5000's RF attenuator is an expansion over that of the TS-440. The '5000 offers relay-switched attenuation values of 10, 20 and 30 dB; the TS-440 includes only a one-step (20-dB) attenuator.

AF Outputs

Like the TS-440, the R-5000 has an internal top-mounted speaker, and external-speaker and headphone jacks. In the panel position occupied by the MIC jack on the TS-440, the R-5000 has a fixed-level REC jack for connection to a tape recorder. (This function is duplicated, although not so handily, by the TS-440's AFSK OUT jack, and pins 3 and 4 of its ACC 2 jack.)

Clock/Timer

The R-5000 is billed as having two clocks on board. Because setting one of these clocks can affect the time displayed by the other—and because only *one* clock can be displayed at a time—it's probably more accurate to say that the R-5000 has two programmable displays for one clock. Clock 1 can be used as a timer to turn an outboard device on and off. The timer's

[3]D. Newkirk, "View: DigiVFO," Technical Correspondence, *QST*, Sep 1987, p 43.

[4]The R-5000's 100 nontunable memories can store an additional datum: Whether or not a particular memory channel is to be "locked out"—passed over—during memory scanning.

[5]Both radios use wide (tens of kHz) "roofing" filters at their first IFs; adjacent-channel selectivity is achieved by filtering at their second and third IFs.

Table 3

Kenwood R-5000 Receiver, Serial No. 8020070

Manufacturer's Claimed Specifications	*Measured in ARRL Lab*
Frequency range: 100 kHz to 30 MHz.	30 kHz to 30 MHz, with reduced sensitivity below 100 kHz.
Modes of operation: A3E (AM), J3E (LSB, USB), A1A (CW), F3E (FM), F1B (FSK).	As specified.
Receiver sensitivity (USB/LSB/CW/FSK for a 10-dB [signal + noise]/noise ratio, 2.4-kHz filter):	
100-150 kHz: less than 2.5 μV.	Not measured.
150-500 kHz: less than 1 μV.	0.5 μV at 450 kHz.
500-1800 kHz: less than 4 μV.	1.3 μV at 1000 kHz.
1.8-30 MHz: less than 0.25 μV.	0.19 μV at 3500 kHz. 0.15 μV at 14 MHz.
	Receiver Dynamic Testing
	Minimum discernible signal (noise floor), (dBm), 500-Hz filter: 450 kHz: −129.0 1000 kHz: −119.0 3500 kHz: −136.5 14000 kHz: −139.0
Receiver dynamic range: Not specified.	Blocking dynamic range (dB): 450 kHz: 129.0 1010 kHz: 131.5 3520 kHz: 126.5 14020 kHz: 129.0
	Two-tone, 3rd-order intermodulation distortion dynamic range (dB): 450 kHz: 96.0 1000 kHz: 95.5 3520 kHz: 98.5 14020 kHz: 99.0
	Third-order input intercept (dB): 450 kHz: 15.00 1000 kHz: 24.25 3520 kHz: 11.25 14020 kHz: 9.50
Receiver sensitivity (AM for a 10-dB [signal + noise]/noise ratio with 6-kHz filter and a test signal 30% modulated by a 1000-Hz tone):	
100-150 kHz: less than 25 μV.	Not measured.
150-500 kHz: less than 10 μV.	1.1 μV at 450 kHz.
500-1800 kHz: less than 32 μV.	2.5 μV at 1000 kHz.
1.8-30 MHz: less than 2 μV.	0.39 μV at 3500 kHz. 0.29 μV at 14 MHz.
Receiver sensitivity (FM for 12-dB SINAD):	
1.8-30 MHz: less than 0.5 μV.	0.26 μV at 29 MHz.
First IF rejection:	
100-1800 kHz: More than 60 dB.	86.5 dB at 1 MHz.
1.8-30 MHz: More than 80 dB.	91 dB at 14 MHz.
Notch filter attenuation: More than 25 dB from 500-2600 Hz.	35 dB at 750 Hz.
Squelch sensitivity, 1.8-30 MHz:	
AM/USB/LSB/CW/FSK: less than 2 μV.	Not measured.
FM: less than 0.32 μV.	At 29 MHz: min 0.1 μV, max 0.65 μV
Frequency display error: Less than ±10 PPM.	As specified.
S-meter calibration: S9 = 25 μV.	μV for S9 reading: 450 kHz: 90 1000 kHz: 228 3500 kHz: 32 14 MHz: 22
Audio outputs:	
External speaker, 1.5 W into 8-Ω load, (10% distortion).	2.23 W at 10% total harmonic distortion.
REC jack, 300 mV across 4.7-kΩ load (at 1 mV input with 30% modulation in AM or 3 kHz deviation in FM).	Not tested.
Clock accuracy: Better than ±60 s per month.	As specified.
Color: Gray	
Size (height, width, depth): 4.2 × 11 × 12 inches (includes projections).	
Weight: 12.3 lb.	

normally-open and normally-closed relay contacts are accessible via the 7-pin DIN REMOTE connector on the R-5000's rear panel. As the timer cycles, it turns the receiver on and off; there's no way of defeating this, short of modifying the timer circuit.

Multifunction Display

As it comes from the factory, the R-5000's fluorescent-tube display resolves frequencies to 10 Hz. (The display on a stock TS-440 resolves frequencies to 100 Hz; you must cut a wire to enable its 10-Hz display.) Where the TS-440 displays RIT or XIT offset, the R-5000 can display the time (HH:MM) of one of its clocks. (This part of the display is switchable between Clock 1, Clock 2 and off.) The R-5000's fluorescent tube also displays memory channel numbers (an added dot here indicates that a given channel is locked out of scanning); scan, timer and step status; and which VFO (A or B) is in use. Even with the R-5000 turned off, the time kept by one or the other of the two clocks can be displayed. If clock display is enabled with the R-5000 off, the memory-channel digit field indicates which clock has been selected (C1 or C2).

Two degrees of display/S-meter-lamp brightness can be selected with the R-5000's DIM switch. The brightness of the receiver's various LED status indicators is not adjustable.

Power Supply

Unlike the TS-440, the R-5000 comes with an ac-operated power supply—inboard. Its power consumption is 40 W at 120 V, and the operating voltage is not adjustable. An optional dc connector kit is available to allow energizing the receiver from a 13.8-V (nominal), 2-A dc source.

The R-5000 preserves its clock, VFO and memory information by means of a rechargeable NiCd battery. (The TS-440 uses a lithium cell for backup.) The *R-5000 Instruction Manual* says that the fully charged battery should last for about 10 days without recharging.

Additional Rear-panel Connections

In addition to the ANT 1 and ANT 2 connectors discussed earlier, the R-5000's rear panel also contains a REMOTE connector, an ACC jack (for use with the optional IF-232C computer interface unit), cutouts for VHF antenna and dc power connectors, and the external-speaker jack. The R-5000's REMOTE connector, a 7-pin DIN jack, allows connection of an external device (for example, a tape recorder) to the receiver's timer-relay contacts. Receiver muting can be accomplished by grounding a pin at this connector. (Did you ever try to find a 7-pin DIN plug at your local electronics store? The R-5000 package includes a receiver, a power cord, an

instruction manual and a warranty card. The TS-440 package includes a transceiver, a dynamic microphone, a dc power cable assembly, a calibration cable, a 20-A fuse, a knob, an instruction manual, a warranty card—*and* a 7-pin DIN plug.)

Additional Options

In addition to the crystal filters, VHF converter and dc connector kit mentioned earlier, optional accessories for the R-5000 include an IF-232 RS-232-C interface, a mobile mount, several choices of headphones and a voice synthesizer unit. According to the *R-5000 Instruction Manual,* the voice synthesizer announces only the frequency shown on the R-5000's display.

Instruction Manual

If the mission of an instruction manual is to provide detailed instructions to a purchaser on how to run an appliance, the R-5000 instruction manual is excellent. If, as many hams are, you're interested in what goes on *inside* the radio, forget it! The manual includes neither a block diagram nor schematic of the R-5000, and you're told to refer all servicing—including the installation of IF filters and other inboard options—to qualified service personnel. The *R-5000 Service Manual* covers the innards of the R-5000 in great detail, but a sticker on the front of the book enjoins you *not* to install any inboard options, including crystal filters, yourself: Have the job done by qualified service personnel. On the other hand, the TS-440 manual contains quite a bit of information on internal modifications performable by a TS-440 owner. In my opinion, hams who purchase an R-5000 should be able to obtain crystal-filter-installation information *without* buying a service manual: Kenwood obviously considers radio amateurs qualified to take the covers off their transceivers!

Rough Edges

Although the R-5000 can be muted for operation with a transmitter, no means are provided for injecting CW sidetone into the audio chain! During CW reception, you're stuck with an 800-Hz receiving pitch if you want the R-5000's frequency display to be accurate with a signal tuned at IF center. In the TS-440, this pitch can be lowered to 400 Hz by cutting a diode; neither the R-5000 instruction nor service manuals hints that there may be a similar diode in the R-5000.

As does the stock TS-440, the stock R-5000 emits beeps (or Morse letters) when any of its momentary-contact control buttons is pressed. The *R-5000 Instruction Manual* says nothing about adjusting the level of this noise; the TS-440 manual does. The *R-5000 Service Manual* shows qualified service personnel how to adjust VR8 (on the IF board) to vary the level of (or, as in my case, eliminate) the beep.

The R-5000 runs *very* warm. There *are* ventilation holes on the cabinet top and bottom, but communication between these is poor. After several hours of receiver operation, all metal parts inside the receiver are hot to the touch, including the IF filters. Even the tuning knob gets warm!

The R-5000 comes with a detachable, two-wire, polarized ac cord. This cannot be replaced with a three-wire cord because the chassis connector has only two pins. Both replaceable fuses—inside the box—in the R-5000 appear *after* the power transformer; if one of these blows, who you gonna call? You guessed it: qualified service personnel! The *R-5000 Service Manual* shows what appears to be a fusible link in the power-transformer primary—in the neutral side of the ac line!

On-the-Air Use

Having had experience with receivers (ICOM IC-R71A, Japan Radio Company NRD-525) in which all memories are *tunable,* I thought—before turning on the R-5000—that Kenwood's non-tunable memory scheme might drive me to distraction. Guess again! The R-5000's provisions for VFO/memory agility are well-thought-out. The non-tunability of the memories comes across merely as a design variation—not as a hindrance.

The R-5000's AGC switch has two positions: FAST and SLOW. The R-5000's AGC attack is fast enough to be reasonably free of popping on strong CW signals (test signal: W1AW, 0.6 mile away). Especially at the SLOW setting, noise pops and strong signals occasionally cause overly long AGC *recovery,* however. (The circuit can be reset by switching briefly to FAST.) Because of this, the *R-5000 Instruction Manual* recommends the FAST AGC setting for rapid band scans.

The R-5000's S meter is calibrated in S units (to 60 dB over S9!), microvolts and millivolts. Despite the *Service Manual's* statement that "the S meter of the R-5000 is superior in accuracy and linearity to previous models in the 1.8 MHz to 30 MHz range...," meter calibration varied significantly (see Table 3). Despite this variation in absolute accuracy, the *relative* accuracy of the S meter is good. For indications above S9, a 10-dB signal increase produced a 10-dB increase in the meter indication with little error. The S meter reading varies greatly *with modulation* during AM (rectification) detection of full-carrier signals—an undesirable characteristic even in a relative S meter. During heterodyne reception, however, the meter works just fine.

The R-5000 has two noise blankers: one for short-duration pulses (such as those common to certain species of line noise), and the other for longer pulses (the Soviet over-the-horizon radar, for example). Blanker threshold is adjustable. Both blankers *do* suppress or reduce their intended targets under some conditions, but results vary with the characteristics of the interference.

Using AM detection with the optional YK-88A-1 filter, the R-5000 sounds great during reception of medium- and short-wave broadcasters. Narrow-band FM reception is solid, too. With its stock 2.4 kHz (YK-88S) filter selected, the R-5000 also does a first-rate job on CW, SSB, and AM signals received as SSB. During weak-signal CW reception with the YK-88C (500-Hz) filter, however, I hear what seems to be significant intermodulation distortion somewhere in the audio chain. This results in fuzzy audio during reception of CW signals close to the background noise level, making them harder—and unpleasant—to copy.

On HF, only one station caused noticeable overloading effects in the R-5000: W1AW, 0.6 mile away from my location. Within ±10 kHz of W1AW, I heard obtrusive blocking (desensitization). Within +1.5 and −0.75 kHz of W1AW, blocking was masked by hiss—possibly because of phase noise. RF IMD products were minimal compared to these blocking and noise effects.

Conclusion

Table 3 lists the results of how the R-5000 fared on the test bench. Uncritical ears may find the basic receiving performance of a stock R-5000 to be nearly identical with that of the stock TS-440 transceiver. The addition of the same optional IF filters to both radios improves their performance more or less equally. Adding the YK-88A-1 filter puts the R-5000 in the lead for reception of AM signals. Beyond this selectivity improvement, the R-5000 pulls farther into the lead with features not included in the TS-440: a clock/timer, dual noise blankers, antenna and tuning-step selection, and an optional VHF converter. Bottom line: The R-5000 takes the already good TS-440 receiver and significantly increases its utility.

Manufacturer: Kenwood USA Corp, 2201 E Dominguez St, Long Beach, CA 90810, tel 213-639-4200. Price class: R-5000, $950; YK-88C filter, $80; YK-88A-1 filter, $80.