73 Tests The Heathkit HA-10 Linear

Al Brogdon W4UWA/K3KMO
316 West Fairmount Avenue
State College, Pennsylvania

HEATH has come through again with a real deal—where else can you get a kilowatt for $230? The Heath HA-10 sells for $230 in kit form or (for the Citizens Band crowd) $330 wired and tested. The kit takes about ten hours to wire, so if you want to brag about the time you did a job for ten bucks an hour, buy the kit and wire it yourself. As with all Heathkits, you need no knowledge of radio or electronics—all you need is a reaonable ability in reading plain English, and a hot soldering iron for where it says (S).

The HA-10 circuit is the "tried and the true" 811A grounded grid circuit that has been described a great number of times in the various amateur radio publications. This particular kit uses four of the 811A's in parallel to run 1000 watts PEP on sideband, 1000 watts CW, 400 watts AM linear, or 500 watts with a controlled-carrier exciter. A neat little neutralizing circuit is used that makes use of a third winding on the filament choke for the necessary feedback.

The HA-10 has an untuned input circuit that matches the 50-75 ohm output of most exciters, and a bandswitching tank circuit for 80 through 10 meters that uses a pi-section to match 50-75 ohm loads. Any antenna outside this impedance range should be fed through an antenna tuner. The instruction manual recommends that "every effort be made to get the SWR of the antenna down to less than 2 to 1." Of course, this is no problem, since most modern hams think it is impossible to "get out" with an SWR higher than 1.5:1, and have their feedlines perfectly flat. Personally, I would rather "get out" well than have a pretty reading on a "vizwaar" meter, but some hams prefer the pretty reading. But I digress.

Condensed Specifications

Driving power required—50 to 75 watts, repending on frequency in use.
Maximum power input—1000 watts PEP SSB, 1000 watts CW, 400 watts AM (500 watts controlled carrier).
Input circuit—approximately 70 ohms, untuned.
Output circuit—Pi-network, 80 through 10 meters, 50 to 75 ohms.
Tube complement—four 811A, two 866A.
Power requirements—117 v ac, 50-60 cps, 1250 watts maximum.
Cabinet size—19½" wide x 11⅝" high x 16" deep.
Weight—90 pounds actual, 100 pounds shipping.

The HA-10's plate power supply is a husky full-wave rectifier with a pair of 866A's delivering nominal voltages of 1600 key-up and 1350 key-down. (A note of explanation is in order here. "Key-up" and "key-down" are archaic phrases that allude to ancient times when amateurs used telegraph keys for communications. These conditions are equivalent to "no load" and "full load" respectively.) The bias supply delivers a stiff 4.5 volts to the grids of the 811A's, with provision on the rear panel for connecting 45 to 150 volts of cut-off bias during receiving periods. A cooling fan is mounted directly behind the 811A compartment and comes on when the filaments are turned on to insure adequate cooling.

A single 1 ma meter is used for metering, being switched to read (full-scale) 200 ma grid current, 1000 ma plate current, 2000 volts plate voltage, and an arbitrary scale (0-1000) relative power output. The relative power output position is valuable for "on-the-nose" tuning, since maximum output does not always coincide with minimum plate current. (As a note of historical interest, it should be mentioned that the phrase "on-the-nose" is a tribute to one of our contemporaries in amateur radio, and a great operator—Mr. K. Nose, KH6IJ. Many such phases may be found in ham radio, such as the CW operators' favorite expressions of "FB" and "73," referring, of course, to the grand old man of telegraphy, Samuel F. B. Morse, and their favorite magazine, respectively.)

In addition to the panel meter, an adjustable oscilloscope take-off is provided on the rear apron of the chassis. The instruction manual gives full details on hook-up for monitoring of your signal on a scope, a worth-while feature for proper linear operation.

The rf section of the HA-10 is placed along the front half of the chassis, with the power supply components along the rear half. The rf section is provided with a full shield around it. This, plus the added shielding of the cabinet itself, does an excellent job of shielding which aids in TVI reduction. The packaging job on the HA-10 is very nice, with the whole linear weighing in at 90 pounds and taking up less than two cubic feet. Indeed, this is a far cry from the 75 meter phone kilowatts of ten years ago, which were built in seven-foot relay racks and required a dozen husky men to move

around.

The instruction manual gives full information on operation of the linear, including description of pads to be used if your exciter runs more than 100 watts output, or if the linear is to be used for extensive AM operation. The HA-10 is designed for use with the common 50 to 100 watt exciters, but may be run at reduced input with less than 50 watts. A statement appears in the manual saying that "the HA-10 should not be used to amplify AM signals in excess of 100 watts, as a worthwhile increase in power will not be realized." I admire Heath's honesty in making this statement, since there are many of our fellow amateurs today who do not realize that the S-unit scale is not linear, but requires a *four times* power boost to read one S unit higher. But nowadays, the kilowatt is a status symbol, and a lot of the fellows will run the HA-10 behind their Apaches, DX-100's and Viking II's with the only indication of the power increase being the increased electric bill each month. Speaking of electric power, the HA-10 manual mentions no less than three times that wiring to the outlet feeding the HA-10 115 vac input should be no smaller than #14. This advice should be heeded, since the Warrior draws over 10 amps under full load.

The front-panel controls include bandswitch, tuning, loading, meter switch, relative power sensitivity, filament switch and plate switch. Also on the front panel are the meter and the two king-size pilot lamps. Across the rear apron of the HA-10 are the following connections: rf input, rf output, ground lug, AC input, bias terminals, scope output, and scope amplitude adjustment.

W3JZF, now in Florida awaiting his new "four" call, was kind enough to allow his Warrior to be used in some efficiency measurements. Table 1 shows the results of this effort. The Warrior was driven by an HT-32A exciter, and the output was fed to a 50 ohm dummy load. The rf voltage was measured at the load with a Hewlett-Packard model 410B VTVM. Input was adjusted to 700 ma indicated plate current on all bands except 10 meters, where the HT-32A could only drive the Warrior to 660 ma plate current. As noted in the instruction manual, 30 ma of bleeder current is included in the current indicated on the plate meter, so this amount was discounted from the meter reading. The efficiency as shown in Table 1 is called "indicated efficiency," since part of the HT-32A output will appear in the Warrior output. It would have required far more time than was available for measurements, to measure the actual efficiency, so the figures are labeled apparent efficiency and the heck with it.

The apparent efficiency on all bands is 50% or better, so this is fair efficiency. There are some purists in the crowd who by now are screaming, "I can get 75% efficiency with a class C stage!" True, but let us mull this over a bit. Assume we have two one-KW amplifiers, one of which is 50% efficient, the other, 75%. So one puts out 500 watts, and the other, 750. So what? This is only 1½ db, or a quarter of an S unit. If you are so bad off that this quarter of an S unit will kill you—take up stamp collecting. Worrying about that last db is somewhat akin to the fellow who worked for months in finding compass directions from his location to any point in the world—within one half of one degree. Then he used these figures to aim his four element beam—you know, the one with a beamwidth of 15 degrees.

It should be pointed out to owners and prospective owners of the Warrior or any other linear amplifier that the FCC defines input power with grounded grid amplifiers to be the input to all stages supplying power to the antenna. This means that the input power with the combination used in the tests mentioned above, according to FCC definition, would be the sum of the input power to the HT-32A and that of the Warrior. And this sum should not exceed 1000 watts. The 1000 watts was exceeded during the efficiency tests, but this was into a dummy load, so it was OK. But be careful not to exceed the limit when you're on the air, else a friendly FCC representative might catch you at it some day.

All in all, the Warrior is a very attractive, lightweight (considering), and compact package that is well worth the asking price. In fact, if you will check catalog prices of comparable components, you will see that it would be difficult to copy the Warrior for $230. And an added feature as far as economy goes is that the 811A final tubes may be bought on the surplus market for as little as $3.65 each. This beats having to buy a $35 tube in case of a failure.

. . . K3KMO

Frequency (kc)	Plate Current	Plate Voltage	Output* (rf volts)	Power Input	Power Output	Apparent Efficiency
3900	670	1350	165	905	545	60%
7250	670	1390	170	930	580	62%
14330	670	1460	162	980	525	54%
21300	670	1450	156	970	490	51%
28900	670	1420	158	895	500	56%

*Output measured across a 50 ohm dummy load.