

## Heath Model AR-1500 AM-FM Stereo Receiver

### MANUFACTURER'S SPECIFICATIONS

**Fm Tuner Section.** IHF Sensitivity: 1.8  $\mu\text{V}$ . Selectivity: 90 dB. Image Rejection: 100 dB. IF Rejection: 100 dB. Capture Ratio: 1.5 dB. AM Suppression: 50 dB. Harmonic Distortion: Less than 0.5% (Mono and Stereo). IM Distortion: 0.1% or less (mono). Spurious Rejection: 100 dB. S/N Ratio: 60 dB or better. Stereo Separation: Better than 40 dB at mid-frequencies. 19 kHz, 38 kHz and SCA Suppression: 55 dB or better.

**AM Tuner Section.** Sensitivity: 50  $\mu\text{V}$  (external input); 300  $\mu\text{V}$ /meter (radiated input). Alternate Channel Selectivity: 60 dB. Image Rejection: 70 dB (at 600 kHz). IF Rejection: 70 dB (at 1000 kHz). THD: Less than 2.0%. S/N Ratio: 40 dB.

**Amplifier Section.** Power Output (IHF Music Power): 90 watts/channel at 8 ohm load; 120 watts/channel at 4 ohm load. RMS Power: 60 watts/channel, 8 ohm load; 100 watts/channel 4 ohm load. Rated THD at Full Power Output: 0.25%. Power Bandwidth: From at least 8 Hz to beyond 30 kHz. Frequency Response: Within 1 dB from 7 Hz to 80 kHz. IM Distortion: Less than 0.1% all levels up to 60 watts/channel, 8 ohm load. Damping Factor: Greater than 60. Input Sensitivity: Phono, 1.8 mV; Tape, Aux and Tape Mon, 140 mV. Overload Sensitivity: Phono, greater than 145 mV; Tape, Aux and Tape Mon, greater than 10 volts. Hum and Noise: Phono, -63 dB (10 mV reference); Tape and Aux, -75 dB (0.25 V input reference).

**General.** Dimensions: 18½ inches W. x 5⅞ in. H. x 13⅞ in. D. Weight: 32 lbs. Retail Price: \$349.95 kit; walnut cabinet ARA-1500-1, optional: \$24.95.

The problem of "what to do for an encore" has bothered many high fidelity component manufacturers for several years now, especially since solid-state designs have reached a level of performance and reliability that often approaches theoretical and practical limits. When the Heath Company introduced their Model AR-15 receiver back in 1967 it was regarded by a great many audiophiles (including this reviewer) as one of those rare "standards" by which competitive products were to be gauged. Small wonder, then, that we opened the carton of the new AR-1500 with mixed emotions—hoping that even better performance standards might be set but afraid that the AR-1500 might be another "cost saving" design to counter inflationary price tendencies. After "living with" and testing the AR-1500 for nearly one month we are happy to report that the AR-1500 outperforms the near-perfect AR-15 in almost every important specification. A glance at the listed specifications shown above will reveal that the AR-1500 has more power output, much better FM selectivity, lower distortion in FM stereo, lower IM and THD at rated output and noticeably better AM performance than its predecessor. Actually, the listed specs don't tell the entire story either, for as we will show shortly, the new specs, impressive as they are, are much more conservatively stated than were the specs of the AR-15. For example, our unit produced a big 77.5 watts

per channel (8 ohm loads) as against the "rated" power output of 60 watts per channel and we measured an IHF sensitivity of 1.5  $\mu\text{V}$  as against the stated 1.8  $\mu\text{V}$ .

While we did not have an opportunity to build the AR-1500 from a kit, we were supplied with the 245-page manual which the kit-builder would use in assembling the AR-1500. As always, construction instructions are lucid enough for the inexperienced kit-builder and there is enough technical and theoretical information to satisfy even the most knowledgeable audio/rf engineer. The completed AR-1500 front panel layout looks "less busy" in our opinion (and therefore more elegant) than did the AR-15. The righthand three-quarters of the panel is treated in "blackout" plastic, interrupted by a single tuning knob at the extreme right. The left corner of the panel, treated in gold anodized material, contains the master volume, balance, bass and treble controls. The dial area, which becomes illuminated when power is applied to the receiver, also contains illuminated signal strength and tuning meters and, centered above the dial scale, an FM stereo indicator lamp which illuminates the words FM STEREO when stereo FM transmissions are received. Fourteen slim push buttons, located below the "blackout" area, help establish the "low profile" look while affording every conceivable switching facility you might require. Starting at the left, the first pair of buttons control deactivation of the TONE control circuits (for absolutely flat response when tone controls are not desired) and introduction of the loudness-compensation circuits. A BLEND button follows (used to decrease noise when weak-signal stereo FM is received), plus buttons for MONO/STEREO and TAPE MONITOR. The next six buttons select signal sources such as TAPE, AUX, PHONO, AM and FM. There are actually two FM buttons, one labelled FM AUTO (when depressed, all FM stations are tunable) and another called FM STEREO (which electronically screens received FM signals, permitting only those received in stereo to come through). Finally, a cluster of three more buttons select main or remote speakers and turn the power on and off. Along the lower edge of the panel, somewhat set back from the front surface, are a pair of headphone jacks (you need no longer be out of communication with your wife) and a SQUELCH control which varies the muting threshold of FM reception.

The rear panel of the receiver, shown in Fig. 1, is almost completely covered with rugged heat sinks for the output transistors, whose protective plastic covers can be seen clearly in the photo. Below the heat sink area are binding posts for speaker connections, antenna connection terminals for 300 ohm, 75 ohm, and external AM antennas (obscured in the photo by the pivoting built-in AM antenna bar), the various input and tape output jacks, a pair of jacks for connection to the horizontal and vertical inputs of an oscilloscope (for multipath and antenna orientation observations) and a series of input and output jacks which are intended for separating the preamplifier from the power amplifier sections of the receiver. The preamp-amp interruption jacks are internally

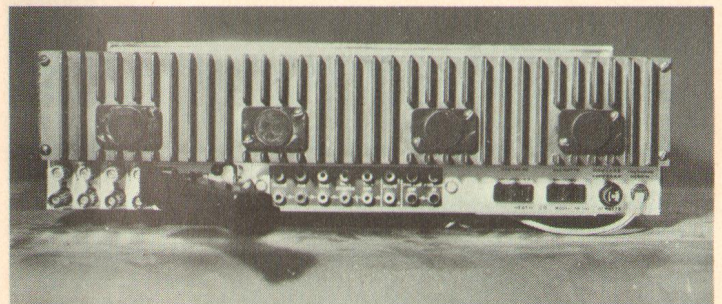


Fig. 1—Back view of the Heath AR-1500. The AM antenna is swung away from its closed position to show input and output jack panel.

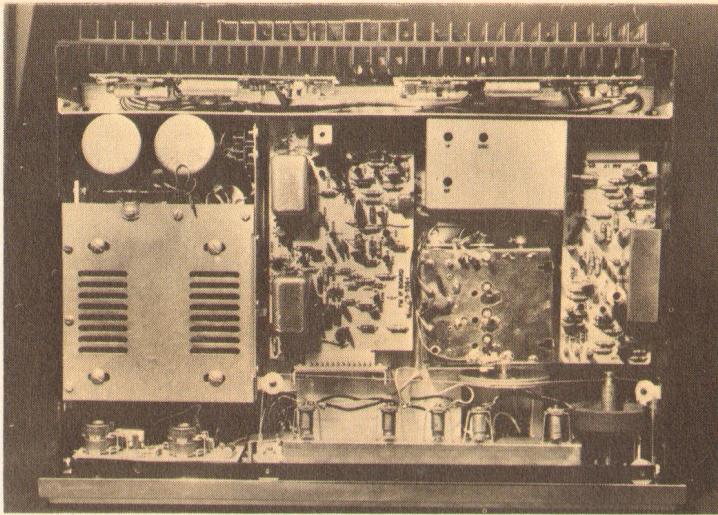


Fig. 2—Top view of open chassis.

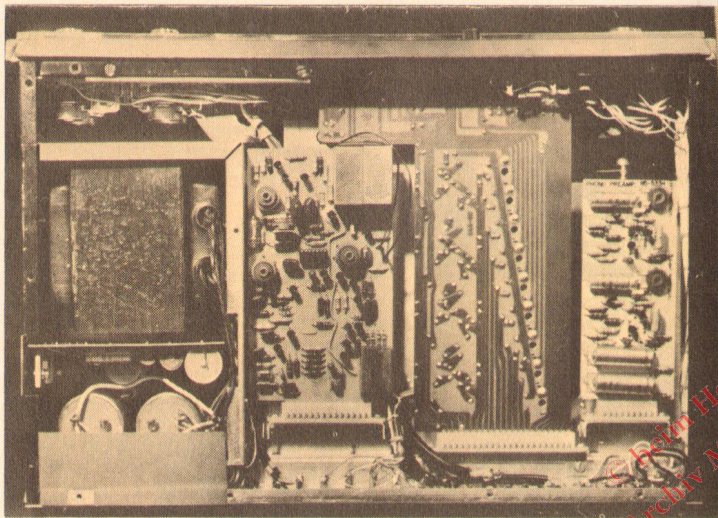


Fig. 3—Bottom view of chassis.

wired together by means of jumpers and, although the kit-builder could easily disconnect these jumpers for using the preamplifier and amplifier separately (as in bi-amp applications), it would be a bit more convenient if external jumpers with the usual pin plugs had been provided instead. Switched and unswitched a.c. receptacles and a replaceable line fuse complete the rear panel layout.

The views shown in Figs. 2 and 3 of the inside layout of the wired chassis cannot really do justice to the well thought out arrangement of modular circuit boards and chassis interwiring. There are 10 plug-in circuit boards and two pre-assembled wiring harnesses which combine to make for easy servicing and mistake-proof assembly. The plug-in board modules are inserted into pivoting connectors, which means that in most cases both top and bottom surfaces of each p.c. board can be examined, measured, and traced (in the event of trouble) without having to disconnect or remove the particular board from the rest of the circuitry. In Fig. 3 you can observe a p.c. board which has a series of nine small holes (in a straight line at an angle of about 15 degrees to the perpendicular). These give access to a series of individual potentiometers for input level adjustment of *all* signal sources, including FM and AM internal levels. The bottom cover has corresponding access holes for these level adjust functions, properly labelled for identification. We stress the importance of the level adjust controls of even the AM and FM circuits because we have never seen this feature provided in an all-in-one receiver before. The very best receivers will sometimes feature level adjust controls for equalizing the level between *outside* signal sources and internal radio levels, but with speaker efficiencies varying as greatly as they do from one type to another, the user is often confronted with the problem of either having to restrict master volume control settings to a fraction of their full rotation (when using high efficiency speakers) or having to rotate the control almost fully clockwise to attain respectable listening levels. Thus, equalizing all signal source levels is not really the entire answer, unless each source (including the built-in radio signals) can be adjusted to provide optimal use of the volume control

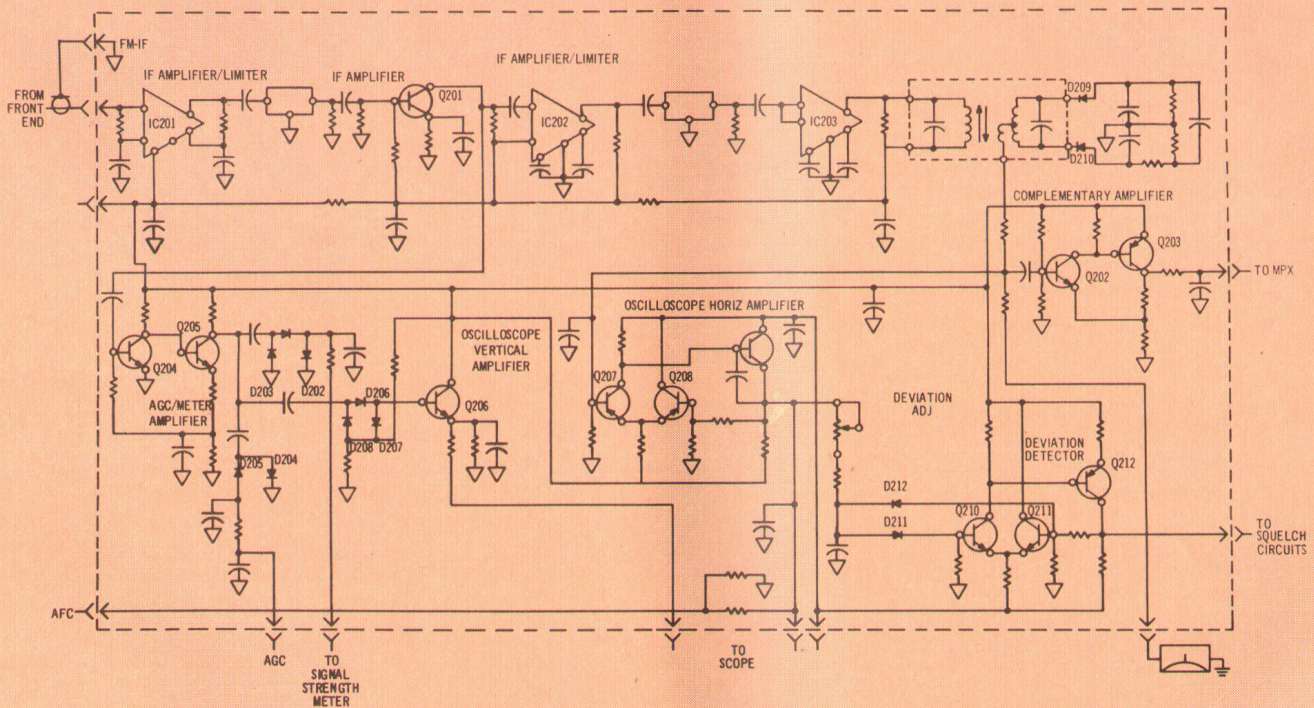


Fig. 4—Partial schematic of AR-1500 shows FM i.f. section and derivation of 'scope horizontal and vertical inputs.

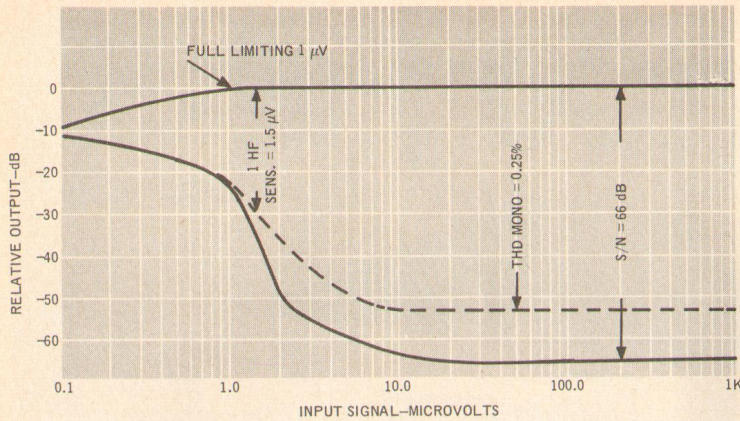


Fig. 5—FM (mono) characteristics.

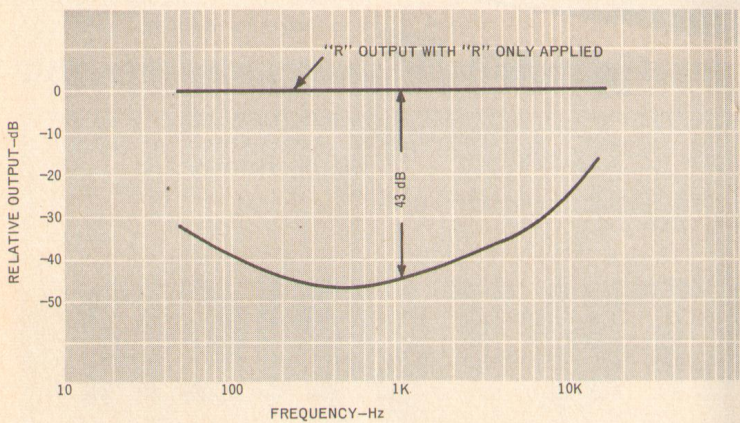


Fig. 6—Stereo FM separation.

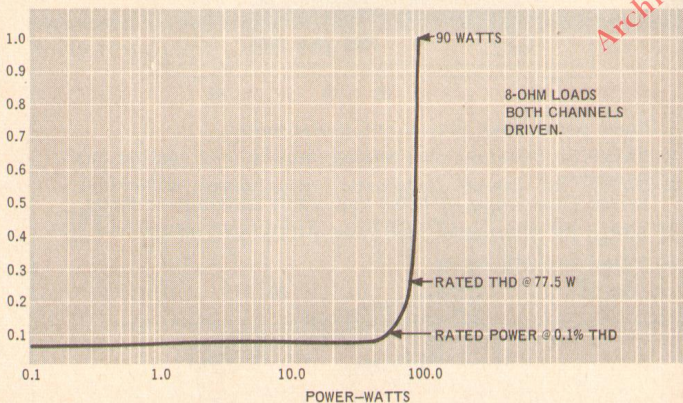


Fig. 7—Power output vs. distortion (THD).

(and, thereby, enable the loudness circuits to provide useful compensation when required). The Heath AR-1500 is the first receiver we have ever seen that provides *all* these niceties, thanks to the multiplicity of input level controls.

### The Circuits

The power amplifier sections feature direct coupling to the loudspeakers and utilize positive and negative 43 volt supplies. Differential input amplifier stages are used and a pair of "dissipation limiter" transistors serve as a protective circuit against overloads and possible short circuits at the speaker terminals. The FM front-end features six tuned circuits and utilizes three FET's, while the AM r.f. section has two dual-gate MOSFET's (for r.f. and mixer stages) and an FET

oscillator stage. The AM i.f. section features a 12-pole LC filter and a broad band detector. The FM i.f. section is shown schematically in Fig. 4 and is worthy of special comment. Three IC stages are used and there are two 5-pole LC filters. The lower portion of the partial schematic serves as the a.g.c. circuit, the tuning meter circuit and the 'scope output circuits. A part of the 10.7 MHz signal from Q-201 is amplified by Q-204 and Q-205, rectified by D204 and D205 and then applied as a.g.c. to the r.f. stage of the FM front-end (not shown). The amplified signal from Q205 is also coupled to full wave rectifiers D-201, D-203. Diode D-202 acts to protect the signal meter against damage from high signal levels. The rectified voltage thus formed is coupled through resistor R225 to the signal meter (not shown). The signal from Q205 is also coupled to the rectifier circuit consisting of D206 and D208. The rectified output is coupled to the base of Q206 where after amplification it is applied to the "Scope Vertical" jack. A part of the audio signal at the ratio detector (T-201) is fed back to the base of Q-207. This transistor together with Q208 and Q209 form a differential amplifier circuit that amplifies a.c. as well as d.c. and the amplified signal from this circuit is coupled to the "Scope Horizontal" jack. The "Deviation Adjustment" control shown in the schematic has to do with settings for the very effective "squelch control" circuit (not shown) which is sensitive both to incorrect tuning and noise in the FM signal.

A great deal more could be said about the various circuit modules used in the AR-1500 but since most readers are probably more interested in performance, we shall go on to actual measurements.

### Electrical Performance

As has been noted, IHF FM sensitivity (depicted in Fig. 5) turned out to be  $1.5 \mu\text{V}$  as opposed to the  $1.8 \mu\text{V}$  claimed. Furthermore, it was *identical* at 90 MHz and 106 MHz (the IHF spec requires a statement only for IHF sensitivity at 98 MHz but we always measure this important spec at three points on the dial). Notice that at just over 2 microvolts of input signal S/N has already reached 50 dB. Ultimate S/N measured was 66 dB and consisted of small hum components rather than any residual noise. THD in Mono measured 0.25%, exactly twice as good as claimed! Stereo THD (not shown) was identical, at 0.25%, which is quite a feat when you consider what additional "tortures" the recovered composite signal has to go through to become "L" and "R" recovered signals. Stereo FM separation, shown in Fig. 6, was as good as we have ever measured in a complete receiver. Happily, we now have the use of a new piece of equipment made by Sound Technology, Inc., of California. This combination FM-Stereo generator comes just in the nick of time and enables us to "guarantee" measurements of THD in FM down to 0.1% and stereo separation figures to 50 dB! With the kinds of specifications now listed for the current generation of high fidelity components, such as the AR-1500, this new equipment will finally allow us to abandon our old "excuse" of "not being able to confirm or deny because of generator limitations." In any event, the separation of the multiplex section of the AR-1500 reaches about 45 dB at mid-band and is still 32 dB at 50 Hz and 25 dB at 10 kHz (can your phono cartridge do as well?).

Figure 7 plots THD versus power output per channel for the AR-1500. Rated distortion is reached at a power output of 77.5 watts per channel with 8 ohm loads (both channels driven). At rated output (60 watts per channel) THD was a mere 0.1% and at lower power levels there was never a tendency for the THD to "creep up" again, which indicates the virtually complete absence of any "crossover distortion" components. No so-called "transistor sound" from this receiver, you can be sure. We tried to measure IM distortion

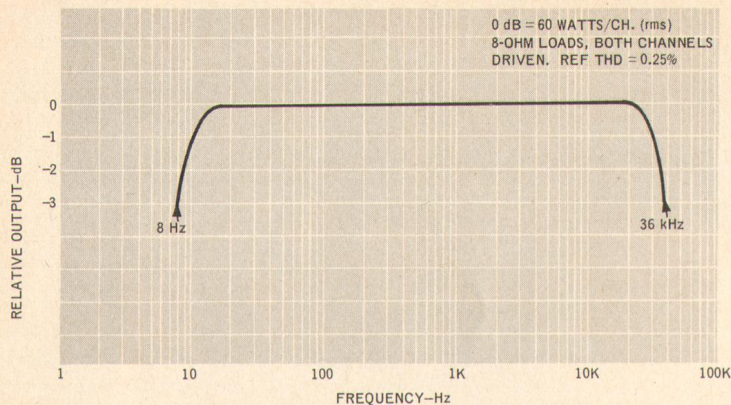


Fig. 8—Power bandwidth.

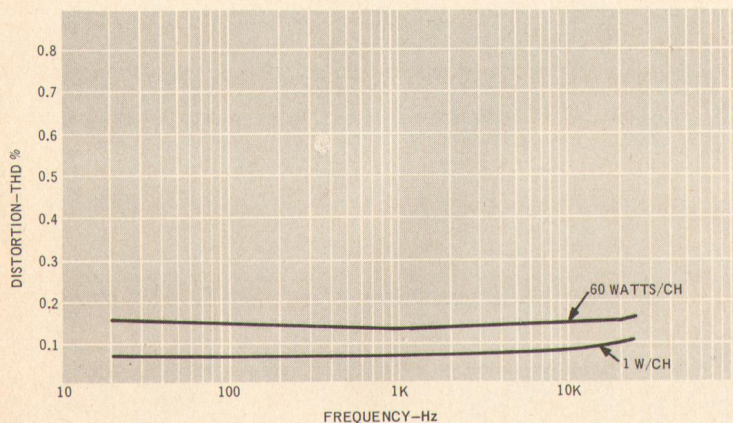


Fig. 9—Distortion vs. frequency at 1 watt and 60 watts per channel output, 8 ohm loads, both channels driven.

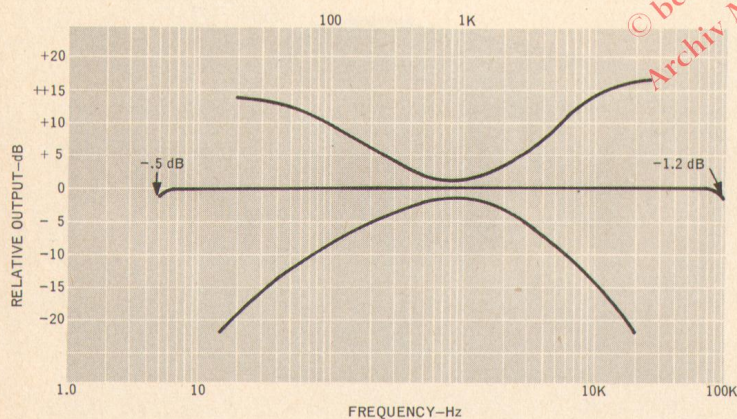


Fig. 10—Frequency response and tone control characteristics.

but kept getting readings of 0.05% no matter what we did. Since that happens to be the “limit” of our test equipment and since the rated IM stated by Heath is “less than 0.1% at all power levels up to rated power output” there isn’t much more we can say except that, again, the unit is better than the specification—we just don’t know *how much* better.

Power bandwidth, shown in Fig. 8, extended from 8 Hz to 36 kHz and, while we have shown the “0 dB line” at 60 watts, the amplifier did much better than that for 0.25% THD at all frequencies from 20 Hz to about 30 kHz. We also plotted THD versus frequency at 1 watt and 60 watt levels and, as you can see, in Fig. 9, the two lines are virtually *straight*, never even approaching *rated* distortion at any audible frequency. Finally, frequency response curves and tone control range are plotted in Fig. 10. Hum and noise in phono exceeded published specifications by about 3 to 4 dB while hum and

noise figures for other signal source inputs agreed closely with published figures.

### Using the AR-1500 Receiver

When you get down to the kinds of sensitivity and selectivity we’re talking about in the case of the AR-1500 and receivers of its ilk, it’s almost impossible to differentiate between the performances of some of these products. As we remember it, the FM performance of the earlier AR-15 was great and so is that of the AR-1500. The squelch action of the newer unit does seem to be a bit more effective, however, in that we can set it for a threshold of about 2  $\mu$ V (range is from about 1  $\mu$ V to 5  $\mu$ V) and receive every station worth listening to and yet enjoy complete interstation silence. The FM STEREO ONLY button is a joy to use and simplified our “station logging”—we received 26 very listenable stereo stations with outdoor medium-gain Yagi array. Total count (without use of a rotator) of all FM signals was 53 at our near-New York location. Alignment was *perfect* as between signal strength and center-of-channel meters across the entire dial and there were no false stereo light indications. FM sound, particularly in stereo, is so clean that in the few instances when we were able to listen to “live” broadcasts (yes, there are still a few on FM) we truly realized what the potential of FM can be in terms of high fidelity medium.

The real surprise came when we spent some time listening to AM. The AM section of the older AR-15 had been, frankly, just adequate. This new AM design is *superb*. We still have one classical music station that has some simultaneous broadcasting on its AM and FM outlets and that gave us a good opportunity to A-B between the AM and FM performance of the AR-1500. There was some high-frequency roll-off to be sure but BOTH signals were virtually noise-free and we were hard pressed to detect more THD from the AM than from the FM equivalent. Given AM circuits like this (and a bit of care on the part of broadcasters), AM may not be as dead as FM advocates would have us believe!

As for the amplifier and preamplifier sections, we just couldn’t hear them—and that’s a commendation. All we heard was program material (plus some speaker coloration, regrettably) unencumbered by audible distortion, noise, hum or any other of the multitude of afflictions which beset some high fidelity stereo installations. The controls are easy to use and quickly become familiar. About the only ones we wish might have been included are a pair of low and high frequency filters with 12 dB per octave roll-off characteristics to take care of the minute amount of turntable rumble we still have and to “clean up” some of our older recordings. No doubt Heath feels that anyone who assembles their best receiver ought to know enough to use equally top-notch source material and associated equipment—and with that, we blushing agree.

We cannot comment on the construction aspects of this kit, since ours came fully wired, but from the looks of it (and the completeness of the manual) we would guess that it does not present any undue hazards. As of this writing, we don’t believe that Heath is offering the receiver in “wired” form and that is indeed a pity, since not everyone who wants a receiver of this quality is ambitious enough to undertake home construction. On the other hand, if you *do* spend the \$349.95 for the kit and put in the necessary time to assemble it, you will not only have the “pride of accomplishment” which the people at Heath talk about, you’ll have a stereo receiver easily worth *twice* the cost (or perhaps even more) judging by what’s available in “ready to plug in” high priced, high-quality stereo receivers.

EDITOR’S NOTE: *Heath informs us that they will shortly be making a wired version available.*

Check No. 58 on Reader Service Card

# We believe the Heathkit AR-1500 to be the world's finest stereo receiver. The experts seem to agree.

"The AR-1500 is the most powerful and sensitive receiver we have ever measured..."

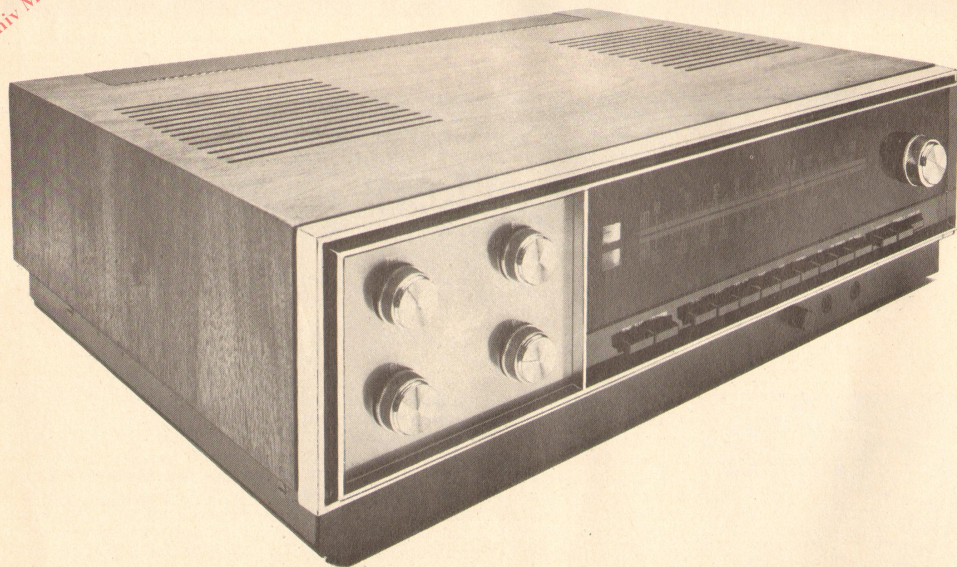
— JULIAN HIRSCH, *Stereo Review*.

"... a stereo receiver easily worth twice the cost (or perhaps even more)..."

— *Audio Magazine*.

"Great new solid-state stereo receiver kit matches the demands of the most golden of golden ears..."

— *Radio Electronics*.



The Heathkit AR-1500 AM/FM/FM-Stereo Receiver... 349.95\* (kit, less cabinet)

Mr. Hirsch goes on to say: "The FM tuner section of the AR-1500 was outstandingly sensitive. We measured the IHF sensitivity at 1.4 microvolts, and the limiting curve was the steepest we have ever measured... The FM frequency response was literally perfectly flat from 30 to 15,000 Hz... Image rejection was over 100 dB (our measurement limit)..."

"The AM tuner was a pleasant surprise... It sounded very much like the FM tuner, with distinct sibilants and a quiet background, and was easily the best-sounding AM tuner we have had the pleasure of using..."

"... all input levels can be matched and set for the most effective use of the loudness compensation. This valuable feature is rarely found on high-fidelity receivers and amplifiers..."

"The phono equalization was perfectly accurate (within our measuring tolerances)... The magnetic phono-input sensitivity was adjustable from 0.62 millivolt to about 4.5 millivolts, with a noise level of -66 dB, which is very low... When properly set up, it would be impossible to overload the phono inputs of the AR-1500 with any magnetic cartridge..."

"... it significantly bettered Heath's conservative specifications. Into 8-ohm loads, with both channels driven, the continuous power at clipping level was 81.5 watts per channel. Into 4 ohms it was 133 watts per channel, and even with 16-ohm loads the receiver delivered 46.5 watts per channel. Needless to say, the AR-1500 can drive any speaker we know of, and with power to spare..."

"At 1,000 Hz, harmonic distortion was well under 0.05 per cent from 1 to 75 watts per channel... The IM distortion was under 0.05 per cent at levels of a couple of watts or less, and gradually increased from 0.09 per cent at 10 watts to 0.16 per cent at 75 watts... The heavy power transformer is evidence that there was no skimping in the power supply of the AR-1500, and its performance at the low-frequency extremes clearly sets it apart from most receiver's..."

"Virtually all the circuit boards plug into sockets, which are hinged so that boards can be swung out for testing or servicing without shutting off the receiver. An 'extender' cable permits any part of the receiver to be operated in the clear—even the entire power-transistor and heat-sink assembly! The 245-page manual has extensive tests charts that show all voltage and resistance measurements in key circuits as they should appear on the receivers built-in test meter..."

"With their well-known thoroughness, Heath has left little to the builder's imagination, and has assumed no electronic training or knowledge on his part. The separate packaging of all parts for each circuit board subassembly is a major boon..."

"In sound quality and ease of operation, and in overall suitability for its intended use, one could not expect more from any high-fidelity component."

#### From the pages of Audio Magazine:

"... the AR-1500 outperforms the near-perfect AR-15 in almost every important specification..."

"The FM front end features six tuned circuits and utilizes three FETs, while the AM RF section has two dual-gate MOSFETs (for RF and mixer stages) and a FET oscillator stage. The AM IF section features a 12-pole LC filter and a broad band detector. The FM IF section is worthy of special comment. Three IC stages are used and there are two 5-pole LC filters..."

#### HEATHKIT ELECTRONICS CENTERS

ARIZ.: Phoenix, 2727 W. Indian School Rd.; CALIF.: Anaheim, 330 E. Bail Rd.; El Cerrito, 6000 Potrero Ave.; Los Angeles, 2309 S. Flower St.; Redwood City, 2001 Middlefield Rd.; San Diego (La Mesa), 3363 Center Dr.; Woodland Hills, 22504 Ventura Blvd.; COLO.: Denver, 5940 W. 38th Ave.; FLA.: Miami (Hialeah), 4705 W. 16th Ave.; GA.: Atlanta, 5285 Roswell Rd.; ILL.: Chicago, 3462-66 W. Devon Ave.; DEWENERS GROVE, 224 Ogden Ave.; KANSAS: Kansas City (Mission), 5960 Lamar Ave.; MD.: Rockville, 5542 Nicholson Lane; MASS.: Boston (Wellesley), 165 Worcester St.; MICH.: Detroit, 18645 W. Eight Mile Rd. & 18149 E. Eight Mile Rd.; MINN.: Minneapolis (Hopkins), 101 Shady Oak Rd.; MO.: St. Louis, 9296 Gravois Ave.; N.J.: Fair Lawn, 35-07 Broadway (Rte. 4); N.Y.: Buffalo (Amherst), 3476 Sheridan Dr.; New York, 35 W. 45th St.; Jericho, L.I., 15 Jericho Turnpike; ROCHESTER, Long Ridge Plaza; OHIO: Cincinnati (Woodlawn), 10133 Springfield Pike; CLEVELAND, 5404 Pearl Rd.; PA.: Philadelphia, 6319 Roosevelt Blvd.; PITTSBURGH, 3482 Wm. Penn Hwy.; TEXAS: Dallas, 2715 Ross Ave.; Houston, 3705 Westheimer; WASH.: Seattle, 2221 Third Ave.; WIS.: Milwaukee, 5215 Fond du Lac.

"... IHF FM sensitivity... turned out to be 1.5 uV as opposed to the 1.8 uV claimed. Furthermore, it was identical at 90 MHz and 106 MHz (the IHF spec requires a statement only for IHF sensitivity at 98 MHz but we always measure this important spec at three points on the dial). Notice that at just over 2 microvolts of input signal S/N has already reached 50 dB. Ultimate S/N measured was 66 dB and consisted of small hum components rather than any residual noise. THD in Mono measured 0.25%, exactly twice as good as claimed! Stereo THD was identical, at 0.25%, which is quite a feat... "... the separation of the multiplex section of the AR-1500 reaches about 45 dB at mid-band and is still 32 dB at 50 Hz and 25 dB at 10 kHz (Can your phono cartridge do as well?)"

"The real surprise came when we spent some time listening to AM... This new AM design is superb. We still have one classical music station that has some simultaneous broadcasting on its AM and FM outlets and that gave us a good opportunity to A-B between the AM and FM performance of the AR-1500. There was some high-frequency roll-off to be sure, but BOTH signals were virtually noise-free and we were hard pressed to detect more THD from the AM than from the FM equivalent. Given AM circuits like this (and a bit of care on the part of broadcasters), AM may not be as dead as FM advocates would have us believe!..."

"Rated distortion [0.25%] is reached at a [continuous] power output of 77.5 watts per channel with 8 ohm loads (both channels driven). At rated output (60 watts per channel) THD was a mere 0.1% and at lower power levels there was never a tendency for the THD to 'creep up' again, which indicates the virtually complete absence of any 'crossover distortion' components. No so-called 'transistor sound' from this receiver, you can be sure. We tried to measure IM distortion but kept getting readings of 0.05% no matter what we did. Since that happens to be the 'limit' of our test equipment and since the rated IM stated by Heath is 'less than 0.1% at all power levels up to rated power output' there isn't much more we can say except that, again, the unit is better than the specification — we just don't know how much better..."

"As for the amplifiers and preamplifier sections, we just couldn't hear them — and that's a commendation. All we heard was program material (plus some speaker coloration, regrettably) unencumbered by audible distortion, noise, hum or any other of the multitude of afflictions which beset some high fidelity stereo installations. The controls are easy to use and quickly become familiar..."

"As always, construction instructions are lucid enough for the inexperienced kit-builder and there is enough technical and theoretical information to satisfy even the most knowledgeable audio/RF engineer."

#### And Radio Electronics had this to say:

"As you know, the original, the AR-15, has been widely acclaimed as one of the very best stereo receivers that has ever been made. Therefore, it's hard to imagine that anyone has gone ahead and built a better one. But spec for spec, the AR-1500 is ahead of the AR-15..."

Kit AR-1500, less cabinet, 53 lbs. .... 349.95\*  
ARA-1500-1, walnut cabinet, 8 lbs. .... 24.95

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