

Heathkit of the Month #57:
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STEREO HI-FI EQUIPMENT
Heathkit AA-32
Tube-type Stereo Hi-Fi Amplifier

Introduction:

Over the years Heathkit has manufactured a large number of Hi-Fi kits including tuners, amplifiers, receivers (combined tuner and amplifier), speakers, tape decks and turntables. In 1964 they introduced a new line of lower-cost tube Hi-Fi equipment that they called the *Designer-Styled* series. This equipment came in a “mocha brown and beige with black accents” color scheme. Two kits were originally introduced, the AJ-13 FM/FM Stereo tuner and the AA-32 Stereo Amplifier. They appeared, marked as NEW, in the July 1964 Heathkit catalog 800/47. The kits originally sold for \$49.95 and \$39.95 respectively. Later in 1964, four more Hi-Fi kits were introduced with the same styling, the AJ-53 Hi-Fi AM Tuner, the AJ-63 FM Mono Tuner, the AA-13 14-watt Mono Amplifier and the AA-23 25-watt Mono Amplifier. The AA-13 was noted as “LAST CALL”



Fig. 1: Heathkit AA-32 Stereo Amplifier

in the Summer 1969 catalog. The remainder of this series evidently stopped production in the early 1970s. I could find no reference to them in any of my later catalogs. What makes this series of interest is **it is believed to be the last tube Hi-Fi/stereo equipment Heathkit produced.**

Table I shows the various kits in this family, their basic specs and prices. Unfortunately, while I have an AA-32 with its original manual, and a schematic of the AA-13, I have not been able to find much, other than the partial specifications given in the catalogs, on the other four kits.

The Heathkit AA-32 Stereo Amplifier:

The kit I have was originally built and used by our club member Ken - W6HHC. When he upgraded to a new stereo system he passed it, along with a defunct solid-state AJ-14 tuner, to me. The tuner is a story to be covered in a future article; let me just say that it was not defunct due to a problem originating with the kit

<u>Amplifiers</u>									
Model	Type	Power	IHF Power	Intro. Date	New Price	Exit Date	Last Price	Notes	
AA-13	Mono	14W	16W	Late '64	\$29.95	1969	\$24.95	120/240 volt operation	
AA-23	Mono	25W	30W	Late '64	\$42.95	1971	\$42.95	Mic input, rear AC outlet	
AA-32	Stereo	8W/ch	10W/ch	Jul. '64	\$39.95	1971	\$39.95	Featured kit	

<u>Tuners</u>									
Model	Type	Band	AFC	Intro. Date	New Price	Exit Date	Last Price	Notes	
AJ-13	Stereo	FM	Yes	Jul. '64	\$49.95	1971	\$47.00	Front panel Phase control	
AJ-53	Mono	AM	N/A	Late '64	\$27.95	1971	\$26.50	Dual Bandwidth	
AJ-63	Mono	FM	Yes	Late '64	\$39.95	1971	\$37.50	AC-11B Stereo Mpxer compatible	

Table I - Heathkit Designer Styled Tube Hi-Fi Kits

Power Output:	8 watts
IHF Power Output:	10 watts
Freq. Response:	±2 dB 20 to 40,000 cps ±1 dB 30 to 30,000 cps
Input Sensitivity:	Mag Phono: 6 mV Others: 250 mV
Input Impedance:	Mag Phono: 47KΩ Cer Phono: 2.2MΩ Others: 470KΩ
Channel Separation:	> 30 dB at 15,000 cps > 45 dB at 1,000 cps > 42 dB at 30 cps
Output Impedance:	4Ω, 8Ω and 16Ω
Harmonic Distortion: (at rated output)	> 2% at 15,000 cps. > 0.7% at 1,000 cps > 2% at 30 cps
Hum and Noise:	Mag Phono: < -46 dB Others: < -65 dB
Feedback:	18 dB
Damping Factor:	9
Mag Phono Equalization:	RIAA.
Power Requirements:	105 - 125 VAC 60 cps (85 watts at 120 volts)

Table II: AA-32 Amplifier Specifications

builder! The amplifier itself was in good working condition when I got it, as I remember.

The AA-32 is specified as a 16-watt amplifier. That means 8-watts per channel. Heathkit, like many manufacturers, rated their amplifier power in two different ways. The AA-32 is rated 8-watts per channel of continuous stereo power, or 10-watts per channel IHF (Institute of High Fidelity) dynamic power. This is a measure of the amplifier's capacity to deliver audio peak power - kind of an audiophile's PEP. The amplifier measures 13-1/2" W x 4-11/16" H x 9-1/4" D

and weighs 13-1/4 lbs. net. Additional specifications are given in Table II.

The Kit uses seven tubes; all of them are dual section tubes. The tubes and their functions are given in Table III. The power supply uses silicon diodes. Both amplifier sections are identical and share a common power supply.

The front panel controls are simple with a rotary input **SELECTOR** switch, dual tandem pots for the **VOLUME** control, dual concentric pots for **BASS** and **TREBLE** controls, slide switches for **MONO - STEREO** and **ON - OFF** and a red neon pilot light. The **BASS** and **TREBLE** pots are each on a single shaft that adjust together; the **VOLUME** pots have separate concentric shafts with inner and outer knobs that are clutch-coupled so normally they turn together but can be adjusted separately if need be. The front panel control layout is given in Table IV.

The rear panel contains the power cord exit, a **HUM** adjustment pot, two speaker terminal strips, and two sets of four RCA input jacks. Their use and location are given in Table V.

#	Tube	Type	CH	Purpose
V1A	1/2 6EU7	Triode	Left	Mag Preamp
V1B	1/2 6EU7	Triode	Right	Mag Preamp
V2A	1/2 6EU7	Triode	Left	1st Preamp
V2B	1/2 6EU7	Triode	Right	1st Preamp
V3A	1/2 6EU7	Triode	Left	2nd Preamp
V3B	1/2 6EU7	Triode	Right	2nd Preamp
V4A	1/2 6GW8	Triode	Right	Tone Amp
V4B	1/2 6GW8	Pentode	Right	Power Amp A
V5A	1/2 6GW8	Triode	Right	Phase Splitter
V5B	1/2 6GW8	Pentode	Right	Power Amp B
V6A	1/2 6GW8	Triode	Left	Tone Amp
V6B	1/2 6GW8	Pentode	Left	Power Amp A
V7A	1/2 6GW8	Triode	Left	Phase Splitter
V7B	1/2 6GW8	Pentode	Left	Power Amp B

Qty 3: 6EU7 dual triode
Qty 4: 6GW8 (ECL86) triode / power pentode

Table III - Heathkit AA-32 Tube Line Up

From Left to Right:**SELECTOR** Switch (4-pos. rotary)**MAG**netic **PHONO****CER**amic **PHONO****TUNER****AUX****VOLUME** Dual concentric clutched pots**LEFT** (Outside knob)**RIGHT** (Inside knob)

11 marks over 330°

Mode Switch (Slide switch)

MONO (Up)**STEREO** (Down)

Pilot Light (Red Neon)

Above the two slide switches

Power Switch

ON (Up)**OFF** (Down)**BASS** Dual tandem potentiometers

11 marks over 330°

TREBLE Dual tandem potentiometer

11 marks over 330°

Table IV - AA-32 Front Panel Layout**AA-32 Setup & Operation:**

Setting up and operating the AA-32 Stereo Amplifier is straightforward. First speakers are attached to the two speaker terminal strips on the rear of the unit; one strip is for the left speaker and the other is for the right speaker. Three impedances are available depending on the speakers chosen: 4, 8 or 16Ω. The hot (+) terminal of each speaker goes to its appropriate terminal and the neutral (-) lead goes to the C or common terminal. It is wise to use lugs on the ends of the speaker leads that go on the strip's screw terminals for reliability. Speaker impedance is usually given on the speaker or in its documentation, as are polarity markings. It is important to have the polarity right so the speakers are properly phased. Be sure the speakers are attached before turning on the amplifier. Operating without a load can damage the power tubes and possibly the output transformer. The

From Left to Right (Rear view):

Power cord entry

Heyco type strain relief

HUM pot

Screwdriver adjustment

RIGHT SPEAKER 4-screw terminal strip**Common****4Ω****8Ω****16Ω****LEFT SPEAKER** 4-screw terminal strip**Common****4Ω****8Ω****16Ω**

The following input jacks are located left above right

LEFT Inputs (Quad RCA Jacks)**AUX**illary**TUNER****CER**amic **PHONO****MAG**netic **PHONO****RIGHT** Inputs (Quad RCA Jacks)**AUX**illary**TUNER****CER**amic **PHONO****MAG**netic **PHONO****Table V - AA-32 Rear Apron Layout**

speakers should be rated to handle the amplifier's rated power. Heathkit recommended their AS-18, AS-37 (both 8Ω 25W) or their mini AS-81 (8Ω 6W) as appropriate.

Three sources of input may then be attached as desired. A phono turntable (remember them for playing LP records?) may be attached to either the **MAG**netic or **CER**amic inputs depending on which type of cartridge your turntable uses. (Variable reluctance cartridges use the magnetic input and crystal cartridges use the ceramic input). Your tuner connects to the **TUNER** inputs. If you have a second tuner, a tape deck or a CD player, it connects to the



Fig. 2: Heathkit AA-32 Stereo Amplifier - Rear View

AUX connectors. these connectors are all RCA type phono jacks. Once the AC line is connected your unit is ready for use.

Operation is simple. Turn the AA-32 on, along with the source you are going to listen to; let it all warm up (younger folk may not be familiar with that step!); then advance the volume to the desired listening level, taking in consideration whether you like or dislike your neighbors. Then adjust the BASS and TREBLE controls to your liking. A good place to start with these two controls is near the middle. Depending on the source, you may select MONO or STEREO. If your source is a tuner and the signal is a bit noisy the mono mode often will reduce the noise at the cost of losing the stereo affect.

Feedback and Damping Factor:

You may have noticed in the specifications Feedback: 18 dB and Damping Factor: 9. Let's take a quick look at what these mean. To delve deeply requires many pages. You may search on the web for more detail.

Feedback refers to negative feedback. By sending some of the amplified energy back to the input of a stage, or series of stages, the gain is reduced but the linearity is improved. Good linearity means the amplified signal represents a truer image of the original. Two types of feedback are used in the Heathkit AA-32.

The first is cathode feedback applied to an individual stage. By not bypassing (or partially bypassing) the cathode with a large capacitor, the cathode voltage varies with the amplified signal, changing the grid to cathode voltage

and creating negative feedback. This is used on the stages of V1A, V2A, V3A and V7A. (Note: since the left and right amplifiers are identical, we will only refer to the left channel in this article, except where otherwise necessary.)

Another way to provide feedback is over multiple stages. The stages of V7A, and V6A drive the Class B output stage composed of V6B and V7B. A signal taken from the 16Ω tap of the output transformer is fed back to the cathode three stages back through a parallel combination of C37 and R59. This improves the overall linearity of these stages at the cost of gain. In the case of the AA-32, this gain reduction is 18 dB, yet it leaves plenty of audio power to drive the speakers to full rated output.

Damping Factor is another important aspect of a Hi-Fi amplifier. When a speaker voice coil is moved by a signal it doesn't just come to a stop, it oscillates like most other mechanical things. This oscillation induces a signal that is fed back to the amplifier (The speaker is a magnet moving in a coil). The amplifier's damping factor is its capability to quickly dampen the speaker coil's self oscillations. The damping factor is given as the ratio between the load impedance (typically 8Ω) and the amplifier's source impedance. New transistor amplifiers can have a very low source impedance and a very high damping factor. Tube amplifiers with their higher plate impedances have lower damping factors. Other things like speaker lead resistance also play a factor.

Heathkit AA-32 Circuit Description:

The AA-32 circuitry (Figure 4) is straight forward. Each amplifier channel has three stages of triode pre-amplification, followed by a class A triode power amplifier, a triode phase splitter and a class B push-pull power amplifier. Before we look at the preamplifier and power amplifier stages, lets look at the power supply.

Power Supply:

The power supply is transformer based. The primary is only operable on 105 - 120 VAC and is fused at 1-amp (slow-blow). A simple slide switch in the primary provides on-off function, and a small neon bulb in series with a 100K Ω resistor provides pilot light function. The 120V secondary drives a full-wave voltage doubler that uses silicon diodes and 30 μ F capacitors. A four-section can-capacitor provides voltages to the various circuits: 290 volts to each output stage, 250 volts @ 6 ma to the first power amplifiers and the phase splitters, 230 volts @ 4 ma to the second and third preamplifiers and 200V @ 2 ma to the magnetic phono preamplifiers.

A second winding on the transformer provides 6.3 volts to the tube filaments. Neither side of the filament chain is directly grounded. All the filament (and AC power) leads are twisted together to reduce AC pickup that results in hum. The filament chain is also attached to a 2K Ω pot (R104) that has its center arm grounded. Any hum picked up from the AC chain should be able to be nulled by adjustment of this pot.

Preamp & Amplifier Stages:

The initial preamplifier V1A is only used for the magnetic phono input. It is a simple amplifier that is followed by the RIAA de-emphasis network. Records recorded in the RIAA (Recording Industry Ass'n of America) standard are pre-emphasized by raising the level of the higher frequencies to improve the ability to record them on records. This network removes the emphasis. If you are interested, more information may be found on the Internet.

The function switch selects either the pre-amplified magnetic phono input, the ceramic phono input, the tuner input or the auxiliary input and feeds it to the second preamplifier. Preamplifier stages two and three (V2A and V3A) further amplify the audio signal. The volume control is located between these stages. When in monaural mode, the tops of the two volume controls are connected by the MONO STEREO slide switch. These stages amplify the

signal to a level where it can be fed into the tone control network. This network is built in a sealed P.E.C. (Packaged Electronic Circuit), perhaps an early integrated circuit. Since the tone network is a common circuit in audio amplifiers, this P.E.C. has found its way into a lot of amplifiers. It, in conjunction with a bass and treble potentiometers, allows the bass pot to adjust the audio from +14 dB to -18 dB at 30 cps and the treble audio from +15 dB to -17 dB at 15 kcs (kHz).

The first power amplifier V7A is the first stage in the multi-stage feedback loop. It amplifies the signal to a level that can drive the phase splitter.

The phase splitter V6A is a triode circuit. It is both a cathode follower and a unitary gain amplifier. Signals capacitively coupled from the tube's plate and cathode are basically identical except they are out of phase by 180°. They are fed to the grids of the two tubes of the class B push pull power amplifier, V6B and V7B. There is no cathode feedback in this circuit - the cathode bias resistor is bypassed by large electrolytic capacitor C43. The push-pull stage is where the real power is developed. Negative feedback is provided by the multi-stage feedback discussed previously.

The Heathkit AJ13 Stereo FM Tuner:

Heathkit released the AJ-13 Stereo FM Tuner along with the AA-32. This release made the cover of the July 1964 catalog (Figure 3). This tube tuner has a built-in multiplexer to allow stereo reception. It also has AFC (automatic frequency control). The AJ-13 incorporates 7 tubes, including three dual-function tubes and a triple function tube. An indicator lights when a stereo FM signal is being received. The lighted tuning dial covers below 88 to 108 mc. A separate 0 - 100 logging scale is also present.

The Heathkit AJ-63 Monaural FM Tuner:

Shortly after the AJ-13 tuner was released Heathkit released a monaural version of the same tuner. Except for the model number on the front panel and no stereo indicator, it looks identical to the AJ-13. Surprisingly, the left



Figure 3: Heathkit's New AJ-13 FM Stereo Tuner on the Cover of the July 1964 Catalog

control is a volume control instead of the power and mode switch. The AJ-63 uses 5 tubes and has a connector on the back so it can be used with the AC-11B Stereo Multiplex Converter (See HOM #45). While the AJ-43 sells for \$10 less than the AJ-13 the AC-11B costs \$24.95. The 'B' signifies a tan cabinet which matches the AJ-63; ('A' is black).

The Heathkit AJ-53 Hi-Fi AM Tuner:

Along with the AJ-63, Heathkit also introduced an AM Tuner designated the AJ-53. It looks identical to the AJ-63 except for the AM scale. This 4-tube tuner features an RF stage and a voltage doubling detector. A slide switch on the front selects either of two bandwidths; for normal listening 7 kc and for Hi-Fi listening 16 kc. Since broadcast signals on the AM band are spaced at 10 kc, a whistle filter is incorporated to remove any 10 kc beat note that might reach the detector.

The Heathkit AA-13 Monaural Amplifier:

While stereo was all the rage in the mid-sixties, some audiophiles still preferred monaural, others preferred to use two separate amplifiers for stereo. The AA-13 is a 14 watt (16 watt IHF) monaural amplifier Heathkit came out with shortly after the AA-32 and in the same style. The AA-13 looks similar to the AA-32 except the two slide switches (MONO-STEREO and ON-OFF) of the AA-32 are missing; so is the dual concentric volume control with concentric knobs, replaced by a single pot and knob. The power switch appears to have been moved to the treble pot. The selector switch switches three inputs; the AUX position is missing. This amplifier uses six tubes including a EZ81/6CA4

rectifier tube; no silicon diode rectifiers! The output uses a pair of EL84/6BQ5 tubes in push-pull. Other tubes are a 6EU7 dual triode for magnetic phono preamp and first preamp, a 6AU6 second preamp, a 6AN8 1st power amp and phase splitter.

The Heathkit AA-23 Monaural Amplifier:

The final product of the Designer Styled series is a more powerful monaural amplifier designated the AA-23. This amplifier is rated at 25 watts (30 watts IHF). The front of the AA-32 looks identical to the AA-13; you have to read the nomenclature to tell which model it is. The AA-32 also has a few differences including a microphone input (1/4 in. Phone jack on the rear panel), an un-switched AC outlet (two prong style, also on the rear panel). The tube lineup is a pair of dual triode 6EU7s in the pre-amplifier stages, a 12AU7 dual triode phase splitter, a pair of 7591 pentodes in the push-pull power amplifier and a 5AR4 rectifier.

Comments:

After cleaning up my AA-32 amplifier I used it with an AJ-14 solid state FM tuner and a Sony cassette tape deck for many years. Shortly before I retired I found an AA-14 solid-state amplifier that matches the AJ-14 tuner, and it replace the AA-32 that is now sitting below the shelf.

On a side note, this amplifier was being built in October of 1965. Ken, W6HHC made some corrections to the schematic which he dated and initialed!

Next month I'll include a review of Chuck Pearson - WA7ZZE's excellent new book *Heathkit Test Equipment Products*. It is definitely worth owning for Heathkit aficionados.

73, from AF6C

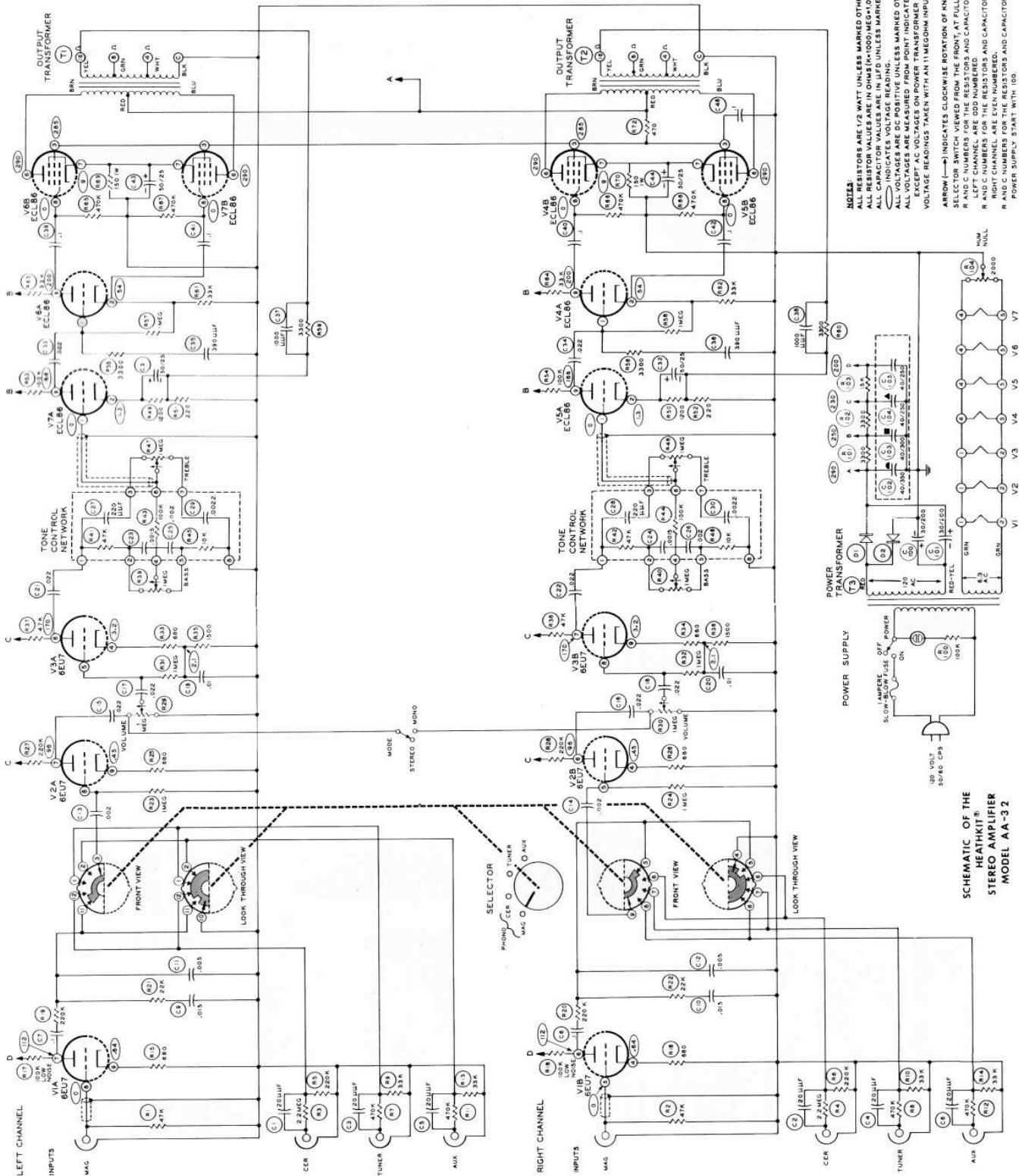


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Remember, if you are getting rid of any old Heathkit Manuals or Catalogs, please pass them along to me for my research.

Thanks - AF6C

The Heathkit AA-13 Monaural Amplifier Schematic



NOTES
RESISTORS ARE 1/2 WATT UNLESS MARKED OTHERWISE.
ALL CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
ALL VOLTAGE READINGS ARE IN AC UNLESS OTHERWISE SPECIFIED.
ALL VOLTAGE READINGS ARE TAKEN FROM POINT INDICATED TO CHASSIS GROUND, EXCEPT AC VOLTAGES ON POWER TRANSFORMER WINDINGS.
VOLTAGE READINGS TAKEN WITH AN 11 MEGOHM INPUT VTVM AND MAY VARY ± 10%.
ARROW (→) INDICATES CLOCKWISE ROTATION OF KNOB.
SELECTOR SWITCH VIEWED FROM THE FRONT AT FULL COUNTERCLOCKWISE ROTATION.
R AND C NUMBERS FOR THE RESISTORS AND CAPACITORS IN THE LEFT CHANNEL ARE ODD NUMBERED.
R AND C NUMBERS FOR THE RESISTORS AND CAPACITORS IN THE RIGHT CHANNEL ARE EVEN NUMBERED.
R AND C NUMBERS FOR THE RESISTORS AND CAPACITORS IN THE POWER SUPPLY START WITH 100.

SCHEMATIC OF THE HEATHKIT® STEREO AMPLIFIER MODEL AA-32