BENCHMARK MEDIA SYSTEMS, INC.

HPA-1 Headphone Amplifier Instruction Manual

HPA-1 Installation

The HPA-1 is intended for installation in existing audio electronic equipment, blank rack panels or any application requiring a very high quality, general-purpose headphone monitor.

Physical Installation

Installation of the HPA-1 requires two (2) mounting holes; one 3/8" diameter hole for the stereo volume /control and one 7/16" diameter hole for the headphone jack.

Center to center distance between the holes should not exceed 3". Clearance behind the panel mounting location should be 3-3/8" minimum. Caution should be used when tightening the two mounting nuts so as not to twist the interconnecting wires or strip the plastic threads on the headphone jack.

Electrical Installation In General

As a precaution, do not connect power to the HPA with a set of headphones connected. Additionally the HPA-1 was designed for used with headphones whose impedance is 60 Ω or greater.

All input and power connections are made via a 7-position connector strip at the rear of the HPA-1 amplifier PC board. The seven pins are 0.025" square posts on 0.1" centers, which may be terminated using wire wrap tooling, or by using the 7 pin female mating connector. The use of the 7 pin mating connector is generally preferable because of the inherent flexibility.

Terminating Wires to the Mating Connector

1. Strip the wire leads 3/32"
2. Lightly tin the lead and connector tab.
3. Solder the lead to the side of the tab, being careful not to create a solder bridge between adjacent connections. Once the solder connections are made cover the connections with heat shrink tubing.

Additionally, connections may be made using either AMPMODU® or Molex SL® connectors if you prefer.

Power Supply

Determine the power supply availability from the host equipment. The HPA-1 is capable of a peak current drain of over 600 mA. We recommend that a supply with a current capacity of 600 mA be used to allow the HPA-1 to run without the possibility of being current starved. If your internal supply does not have enough power available, you will need to design your own outboard power supply. Alternately a BENCHMARK PS-1 supply may be used to power the HPA-1 if high impedance (600 Ω) headphones will be used.

Once your source of power has been selected, locate or install three supply wires, +V, -V and G (ground). We recommend the following color code; +V = red, -V = blue, G = black. Connect the three power supply wires to the three center tabs of the seven-pin connector as shown in figure 1.0. We strongly recommend that 0.25 Amp normal blow fuses be added in series with the power supply lines to each HPA-1 to help prevent catastrophic failure of output drivers should there be a loss of one of the power supply voltages. Remember that the HPA-1 is a relatively high current DC coupled device. While there is internal current limiting, incorrect power conditions can and *will* destroy the device! Benchmark Media Systems, Inc. will not be responsible for incorrectly installed or powered HPA-1s.

!!! Warning !!!

Inadvertent power supply polarity reversal at installation will cause the failure of the HPA -1. Loss of a single supply will cause the failure of the output line buffers, and any connected headphones. Power down the system before making any additions of adjustments to the wiring.

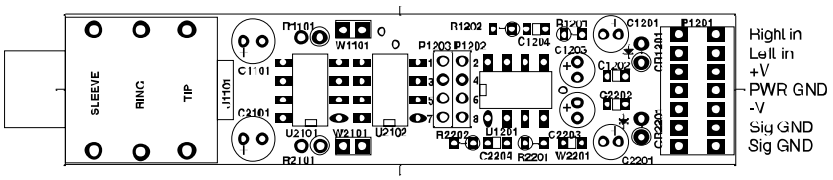

Fig 1.0 Connections to the HPA-1.

Input Connections

Locate and install two wires for each input from your unbalanced audio source. Referring to component assembly drawing for connector pinout designations, install the audio inputs using the techniques described under electrical installation.

Volume Control Knob

The HPA-1 is designed to use standard 1/4" knobs provided by the user. While the shaft length is ≈1", it can be shortened to accommodate shallow collet knobs. Once the desired shaft length has been marked, secure the pot in a bench vise by clamping to the shaft portion to be removed. Then carefully cut the pot shaft using a hacksaw. This technique eliminates stress on the pot itself.

Please note that this shaft modification should take place before installation in chassis or panel.

Headphone Application

Any STEREO headphone whose actual impedance is 60 ohms or greater can be used with the HPA-1. We find the performance of the Sennheiser HD540 exceptionally fine. High impedance headphones, such as the 600 Ω AKG 240 series, have the advantage of lower current drain.

HPA-1 Specifications

INPUT:	Two (2) 10K ohms unbalanced
INPUT CLIP:	= Output clip minus Amplification factor.
OUTPUT:	Stereo, for use with Tip/Ring/Sleeve plugs ***only***.
OUTPUT Z:	30 Ω.
LOAD Z:	60 Ω or greater.
OUTPUT LEVEL:	up to +20 dBu into 60 ohms or greater, dependent upon power supply and load.
OUTPUT CONTROL:	Dual 100K ohm linear taper pot (log taper action).
GAIN RANGE:	off to +20 dB
BANDWIDTH:	20 Hz to 50 kHz min.
THD:	Determined by output level and load Z.
NOISE FLOOR:	Better than -75 dBu at maximum gain
POWER:	(Bipolar) ± 9 to ± 18 volts.
PHYSICAL:	Amp length behind panel = 3.65", width = 0.8" Volume control; length behind panel = 0.8", width = .525", shaft length = .625", dia. = 1/4".

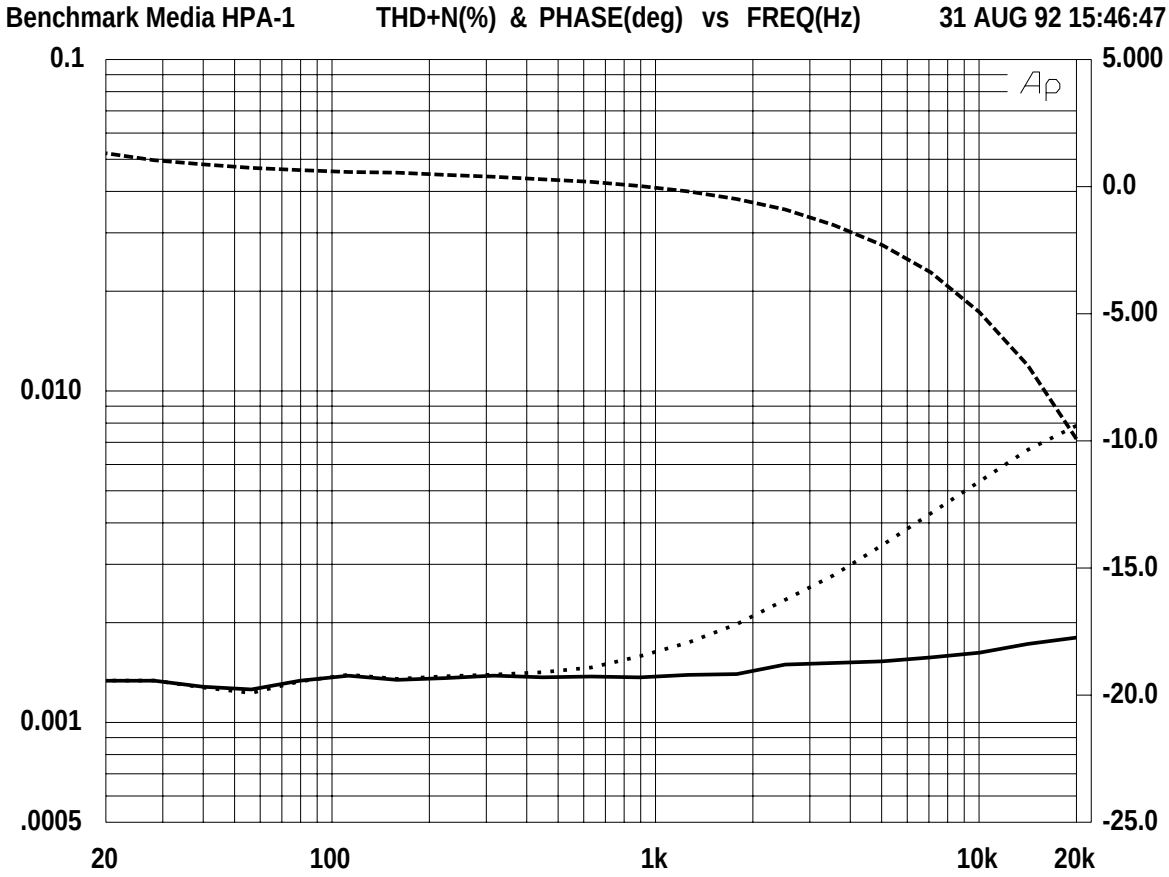

Fig 2.0 - HPA-1 60 • (Dotted) and 200 • (Solid) THD & Phase

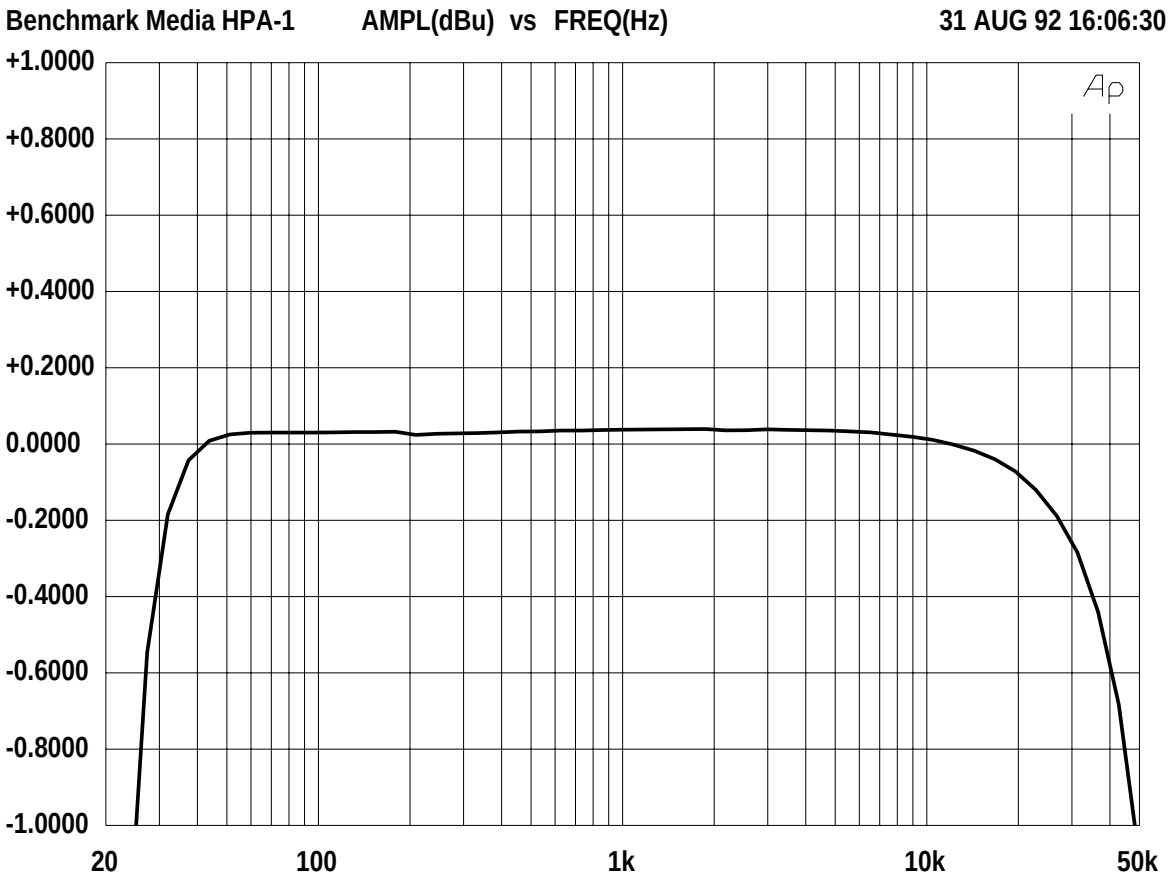

Fig 3.0 - HPA Minus 1 dB Bandwidth Points

Applications

The applications of the HPA-1 are numerous. The following suggestions are a few of the more common applications, and one or two not so common.

Unbalanced Line Driver

Occasionally it is necessary to feed one or a group of unbalanced inputs, such as VCRs. The HPA-1 makes an ideal unbalanced stereo line driver with its variable output, and high current drive capability. A pair of DIA-1 input amplifiers are necessary to make the transition from balanced to unbalanced. Single 100 kΩ potentiometers may be ordered to allow gain control over the individual amplifiers.

Talk-Show Round Table

In a group setting where headphones are used, it is very desirable to give each participant individual control over their own headphone volume. Any number of HPA-1s may be used in parallel when sufficient current is available from the power supply.

When building a talk-show round table system, we recommend the use of a linear open frame power supply such as those made by Power One. When using low impedance headphones (not recommended) the size of the power supply may be decreased from the normal requirement of "# of stations times the Peak current drain of each". This is done by adding a pair of large electrolytic capacitors at the output of the power supply. These capacitors will store current to be available for peak load requirements. The capacitor size may be chosen by

$$C = \frac{I_L \times 6 \times 10^{-3}}{\Delta V} \qquad [1.0]$$

C is in Farads. Let delta V be 0.5 volt or less, and IL is the total peak load current from all the HPA-1s. Using this method you can size the supply that you use at 40% of the original current requirement since the average "peak to average ratio" of most audio is 8 dB.

A pair of DIA-1 balanced input amplifiers will most likely need to be used ahead of the group of HPA-1s. The HPA-1 has an unbalanced input, and a pair of the balancing devices is necessary to make the transition. We recommend using a gain of -6 dB at the DIA-1s to maximize the headroom of the system.

The impedance that the DIAs must drive is the input Z of the HPA-1 (5K ohms) divided by the number of paralleled units. If more than five HPA-1s are to be driven from a standard DIA-1, or more than fifteen HPA-1s from a low noise DIA-1, then an additional HPA-1 should be used as an unbalanced line driver to handle the low impedance load.

Patch Bay Monitoring

By using the HPA-1 and two DIA-1 differential input amplifiers you have the ability to listen to the signals at a patch bay. The DIA-1s have an input impedance of 10K ohms and will generally not load the lines being monitored.

Portable Test Box

One of the handiest items in any tool kit is a portable test box. The test box should consist of at least a pair of balanced inputs, two unbalanced outputs to feed an oscilloscope or unbalanced AC voltmeter, and a stereo headphone amplifier. Again, this can be implemented using two DIA-1s from Benchmark, as well as the HPA-1 stereo headphone amplifier. Four 9 volt "transistor" batteries wired to give +/- 18 volts will work fine. We recommend using high impedance headphones (600 Ω) to reduce the current drain on the batteries. BNC output (after the DIA-1 input) connectors are desirable to feed either a scope or meter. Use a power switch to avoid changing batteries often. Enhancements to the box could be VU meters with the Benchmark RPM-1 PPM/VU card (the combination available from Benchmark) a phase meter and, perhaps, even a built-in frequency counter.

Theory of Operation

The HPA-1 consists of a dual operational amplifier with current boosted outputs. The circuit topology is that of an inverting amplifier with the current boost stages included in the feedback loop.

The output current boost stages are integrated circuit buffers that have unique characteristics, which ideally suit it to this application. They have an output current limit of 300 mA, a very low crossover distortion, a 50 MHz bandwidth, and a slew rate of 500 v/µS. These characteristics allow it to be included in the feedback loop of the TLO72 and maintain stability.

The gain of the amplifiers is controlled by a dual 100K ohm linear taper potentiometer that is in the feedback loop of the composite amplifier. The advantage of this is that the noise floor is always optimum for any given amplification factor since the amplitude control is a true gain control. In this configuration the gain range is from full Off to +20 dB, usually more than adequate for most applications.

Troubleshooting

Since the unit uses plug in devices trouble shooting should begin with replacement of the ICs beginning with the TLO72 until the offending device is found. Very rarely will a passive component become defective.

Soldering Technique

Printed circuit boards are very easy to damage by excessive heat. Unless you have developed the specialized skills necessary to remove and replace components, we suggest that you leave the task to someone skilled in these techniques.

When servicing printed circuit boards we strongly recommend the use of a vacuum de-soldering station, such as the Pace MBT-100. The proper technique with these stations is to apply the tip to the area to be de-soldered and wait for the solder to thoroughly melt. You can be sure of a thorough melt by observing the top side of the board. When the solder there has become liquid, apply the vacuum while moving the hollow tip with the component lead in a circular motion. By rotating the lead, with the tip against the board, but without applying pressure to the pad, you are able to most thoroughly remove solder in the plated-through hole. In turn the component will often drop out of the board when you are finished. If the solder is not thoroughly removed from the plated-through hole, attempting to remove the component will bring with it plating from inside the hole. This may destroy the usefulness of the board. If you find that your attempt to completely remove the solder from the hole and pads has failed, do not attempt to re-heat the area with the de-soldering tool, as this will overheat the pad, and not the area that is in need. As a result the board is usually damaged. Rather, re-solder the joint, and then go back and apply the proper technique, by allowing the solder in the joint to thoroughly melt before applying vacuum. This technique uses new solder as an efficient heat conductor to the total area, eliminating hot spots.

Circuit Board Re-Soldering

NASA has developed an effective technique that ensures highly reliable solder joints. It involves first heating the component lead, since it usually has the higher mass, by applying a small amount of solder to the tip of the soldering iron at almost the same time as you apply the iron to the component lead. This will allow some flux to make it to the component lead. The iron should be approximately 1/8" above the board. When the lead has come up to temperature so that it melts the solder when placed against it and has good wetting, slide the soldering iron down the lead and heat the printed circuit board pad while applying a controlled amount of solder to the joint. All of this should take no more than a couple of seconds. If the component that is to be installed has leads that are oxidized, it will be necessary to clean them. This may be done with either a Scotch Bright® abrasive pad or fine bristle fiberglass brush, among other methods.

This completes the service procedure. Rev 061301

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