

Specs

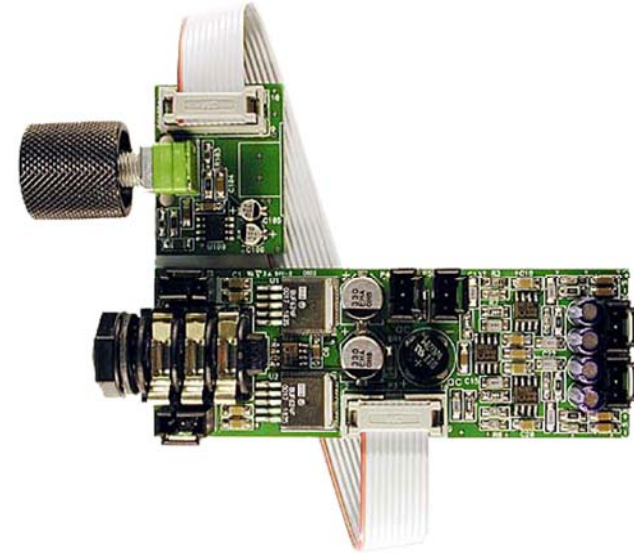
| | |
|------------------|---|
| Input | Stereo 200 k Ω Balanced Inputs |
| Input Clip | +26.5 dBu with ± 15 volt supplies |
| Output | Stereo, for use with 1/4" Tip/Ring/Sleeve plugs only, other panel connectors may be wired to the amplifier by way of on-board output connectors |
| Output Impedance | "0 Ω " |
| Output Clip | Dependant upon power voltage and load [+20 dBu @ ± 15 V and 60 Ω load] |
| Load Impedance | 30 Ω or higher |
| Output Level | Up to +20 dBu into 60 Ω [dependent upon power source] |
| Output Control | Dual log taper response |
| Gain Range | Off to +20 dB |
| Bandwidth | 0.1 Hz to 300 kHz minimum |
| THD+N | 0.0003% typical at headphone inputs - under load! |
| Noise Floor | Better than -75 dBu at maximum gain |
| Power | (Bipolar) ± 9 to ± 18 volts, maximum peak current needed = 1.1 Amp at maximum peak output into 30 Ω |
| Peak Output | 7.5 watts [± 18 volt supplies. 30 Ω load] |
| Max Avg Output | 1.35 watts [-8 dB peak to average ratio] |
| Amplifier Board | Length behind panel = 3.760", width = 1.335", mounting hole diameter = 0.437" [7/16"] |
| Gain Ctrl Board | Length behind panel = 1.025", width = 1.335", mounting hole diameter = 0.275" [J drill or 9/32 (0.281)], shaft length = 0.385", shaft diameter. = 0.235" [16-star spline] |
| Spacing | Minimum spacing between Gain Control Board mounting hole and 1/4" jack = 7.5" Minimum spacing between Amplifier Board and Gain Control Board = 0.75" [both boards mounted vertically], Maximum panel thickness = 0.1". Knob diameter = 0.75", length = 0.75" |
| Knob | Volume control knob included |

HPA-2 Instruction Manual, Revision 1
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HPA-2

Audiophile Grade Stereo Headphone Amplifier Module

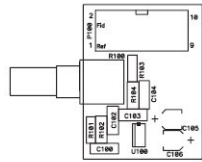


The Benchmark HPA-2 is a high-power audiophile-grade stereo headphone amplifier module that can be mounted in virtually any location. One of the most popular uses of the HPA-2 is with custom constructed radio talk show round tables. The HPA-2 features sonic purity that fulfills even the most demanding headphone applications. The HPA-2 is designed to power all headphones that have a load impedance of 30 Ω or higher. It is not designed to power headphones that have 8 Ω load impedance.

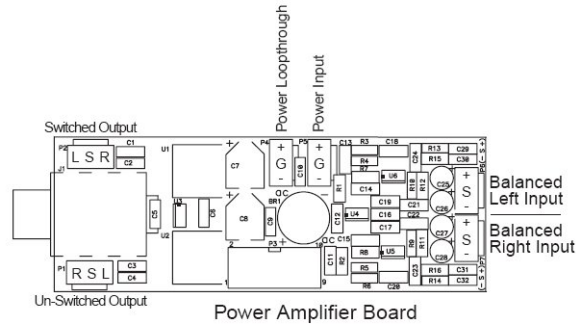
The HPA-2 requires a bipolar power supply using voltages from a recommended minimum of ± 9 volts to an absolute maximum of ± 18.7 volts. The higher the power supply voltages the higher the possible output level from the headphones. The higher the output current from the external power supply the greater the number of HPA-2s and headphones that may be used in the system.

Benchmark

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Gain Potentiometer Board



Power Amplifier Board

Installation

Mount the power amplifier board to a metal plate using a 7/16" (11.11 mm) diameter mounting hole. Mount the gain control pot and its board into a panel having a maximum thickness of 0.086" (2.20 mm) and a mounting hole diameter of 9/32" (7.14 mm). The interconnect cable allows the pot board to be mounted within a radius of about 5 inches from the main power amplifier board.

All connections are made with Molex SL connectors. A kit of latching and polarized mating Molex SL connectors as well as an appropriate crimp tool is available from Benchmark.

Connect the signal input lines to the input connectors. These connectors are located at the extreme end of the module. Whether feeding from a balanced source or an unbalanced source, you should wire the input as though it were receiving its signal from a balanced source. Use the "forward reference" technique outlined in the Benchmark Media Systems application note – "A Clean Audio Installation Guide". This application note is available for download from the Benchmark web site. Using this wiring technique will help eliminate hum pickup from the system.

As previously noted, the HPA-2 must be powered from a bi-polar power supply with a recommended minimum power voltage of ±9 volts and an absolute maximum power voltage of ±18.7 volts. Voltages that are less than ±9 will generally not provide adequately high output volume from the headphones. Voltages that are higher than ±18.7 may cause catastrophic failure of the HPA-2.

Connect power to the power input connector location that is approximately the middle of the board. There are two connectors that may be used for power connections. Actually, one may be used for power input, whereas the second may be used for a power loopthrough to another HPA-2. The polarity of the power connections is shown on the diagram. The main board has a bridge rectifier that prevents polarity reversal with the power from destroying the board. However it is critical that the "ground" connection be made properly. Ground (earth, common) must be connected to the center pin of the connector.

Additional Output Connectors

The current capability of the output amplifier allows it to provide current feed to at least two simultaneous headphones. This makes the amplifier convenient for simultaneous listening by two people for sonic comparisons. There are two additional outputs. The first is the parallel output noted above. The second is a switched output which is muted when a headphone plug is inserted.

Power Sourcing

The power requirements of the HPA-2 are directly dependent upon the load impedance of the headphones. If a second set of headphones are used in parallel with the main headphones, then the following the lowest specified load impedance of 30 Ω will have a total load of $Z = 15 \Omega$ (two channels) and therefore with a ±15 volt power supply voltage ($E_{\text{peak}} = +15 \text{ Volts}$), a peak current requirement will be 1 Amp from the HPA-2.

$$I = E/Z$$

$$I = 15/15$$

$$I = 1 \text{ Amp}$$

Higher impedance headphones or using only one pair of headphones will require a lower peak current and is easily calculated from Ohms law as above.

Since current is stored in the on-board 330 μF capacitors, the actual peak current requirement is somewhat reduced from the above specification. Additional external filter capacitors may be added to a power supply for the purpose of bringing the peak current requirement closer to the average power supply current rating needed.

Circuit Design

Input Stage

The input stage of the HPA-2 features balanced 200 kΩ input impedance and over-voltage protection. The balanced input provides both common mode rejection to interfering signals and allows input polarity selection for proper acoustic output polarity. This is true whether fed from a balanced or an unbalanced source. This input is a very high input impedance buffer amplifier which in turn feeds a standard differential amplifier.

The following discussion assumes power supply voltages of ±15 volts. The higher the power supply voltage the greater the input signal level it can tolerate.

The differential amplifiers gain is -6.02 dB. This allows the input to accept signals that are as high as +27 dBu balanced. Since the input buffers will only accept a maximum signal level of +21 dBu by taking this gain loss after the buffers the diff amp will accept the combined signal swings from the buffers at the + 27 dBu level.

0.1% tolerance gain determining resistors, provide a common mode rejection of approximately 60 dB without trim being required. The bandwidth of the differential amplifier is set by the 180 pF feedback capacitors in conjunction with the feedback resistors of 2.49 k Ω resistors. The bandwidth is 356 kHz.

Volume Control Stage

The volume control stage of the HPA-2 is a separate PCB with the volume control potentiometer attached to the board. The signal that is fed to the board has a "zero" Ω impedance source and the return signal also has a "zero" Ω impedance. This technique provides both immunity from interfering signals and virtually eliminates crosstalk from the interconnect wiring. This stage is an inverting amplifier with a minimum bandwidth of 731 kHz.

The gain range of the volume control circuit is from off to +26 dB. Since the differential amplifier has a gain of -6 dB the overall gain of the HPA-2 is from "off" (- infinity) to +20 dB.

Output Stage

The output stage consists of a current buffer driven from a non-inverting operational amplifier. The buffer is included within the feedback loop of the operational amplifier. The buffer is a low distortion device to begin with. Placing it within the feedback loop of the operational amplifier further reduces the distortion produced by the circuit. The buffer provides output current of up to 0.5 amp. This current capability is sufficient to most adequately drive modern headphones. The "0 Ω" output of the amplifier stage is taken directly to drive and control the diaphragms of the headphones. As such, the HPA-2 has a very high damping factor and excellent high frequency, transient, and distortion performance.