Specifications, High-Efficiency Headphone Amplifier

Parameter	Min	Typ	Max	Units	Comment
Input Characteristics:					
Input Impedance		10 k		Ω	
Input level		–10	0	dBV	0 dBV = 1 V_{RMS}
Connector		1/8" stereo mini-jack			3-conductor
Output Characteristics:					
Maximum Output Level	100			mW	Without clipping
Rated Load Impedance		32		Ω	Typ. headphone Z
Output Impedance			3.2	Ω	Damping factor of 10
Connector		1/8" stereo mini-jack			3-conductor
Overall Characteristics (End-to-end measurement):					
Frequency Range	20		20 k	Hz	
Frequency Response			±1.0	dB	
Nominal Gain		20		dB	See note 1
Gain Adjustment Range	30			dB	See note 1
*THD			0.1	%	At 10 mW; see note 2
			1.0	%	At 100 mW; see note 2
Noise Density at output			–128	dBV/ $\sqrt{\text{Hz}}$	See note 3
Power Requirements:					
Power Source		2 AAA cells			Alkaline batteries
Input Voltage			3	VDC	Consider voltage variation vs. time
*Power Consumption			400	mW	See note 4
*Battery Life	90			hours	See note 5
Cost:					
*Materials cost			$40		

Notes:

1. Nominal gain of the circuit with the gain control set at maximum. The gain control should be capable of reducing the gain by at least 30 dB from this value; i.e. from –10 dB to +20 dB. Being able to reduce the gain of the circuit below –10 dB is even better.
2. THD is to be measured with the circuit driven by a –10 dBV sinusoid at 1 kHz. Adjust the gain until the stated output power is achieved while driving a 32 Ω load. Measure with 3.0 VDC power supplied to the circuit.
3. Based on 80 dB SNR in a 20 kHz bandwidth with an average program level of 10 dB below full output. Noise is to be measured with the circuit gain adjusted to 20 dB and the inputs terminated with 1 kΩ resistors and the outputs terminated with 32Ω resistors. Measure the spot noise in a 1 Hz bandwidth at f = 1 kHz at the output. A plot of spot noise density vs. frequency measured from 20 Hz to 20 kHz will be most informative.
4. Power consumption is to be measured as follows. Drive both inputs simultaneously with a –10 dBV 1 kHz sinusoid and terminate both outputs with 32 Ω. Adjust the gain control for an output signal of 100 mW into each load resistor. Measure the total DC current supplied to the circuit when the circuit is powered by a 3.0 V power supply. Compute average power as V_{DC} x I_{DC}.
5. Estimate the battery life in hours based on the use of AAA alkaline batteries. Look up their capacity in mA-hr. Use an average current that is determined by assuming an average power consumption 10 dB below the maximum found in note 4 above. An actual measurement of the time needed for your circuit to discharge the battery down to 0.8 V per cell while operating is an even more valuable data point. Do this if you have the time needed to conduct the test.