Headphone driver

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1 Audio headphone amplifier

A magnetodynamic headphone with a typical impedance of 32Ω at 1kHz produces a sound pressure level of 98dBSPL at 1mW electrical input power. Over the audio frequency range (20Hz−20kHz) the impedance may vary between 30Ω and 100Ω. For a flat frequency characteristric the headphone should be driven by a voltage.

A high-performance single-ended voltage output DAC delivers an open circuit voltage of $0.2V_{pp}$. Its small-signal output impedance is less than 10Ω. It may maximally sink and source a current of 10μA to a load that is connected to $0.9V_{DC}$ when supplied from 1.8V. Its output voltage noise spectral density at midscale output is below $4nV/\sqrt{Hz}$.

1.1 The amplifier

A high-performance audio amplifier should drive this headphone such as to produce a sound pressure level of 110dBSPL at full-scale DAC output with a signal to noise ratio of at least 96dB. The total harmonic distortion for sinusoidal input signals from 20Hz to 5kHz and from 60dBSPL to 110dBSPL output level should be below 0.03%. For frequencies above 5kHz, this figure should be met for power levels from 60dBSPL to 90dBSPL.

1.2 Environmental conditions

The audio amplifier should operate from 0 to 70 degrees Celsius.

1.3 Design task

Design the audio amplifier drives the headphone according to the specifications above. You can use CMOS18 devices. The circuit should operate from at 1.8V±5%. The quiescent power dissipation should be below 2mW.