

Keywords: audio amplifiers, nonlinear transfer functions, gain compression

APPLICATION NOTE 4551

Simple Circuit Limits Amplifier's Output

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Abstract: To enable an audio amplifier to accommodate both loud and soft-spoken voices without clipping the loud waveforms, you can implement a nonlinear transfer function by adding a few components to a standard application circuit.

A similar version of this article appeared in the August 16, 2007 issue of *Electronic Design* magazine.

Amplifying the human voice presents tough challenges. One of the toughest is providing enough amplification to make a soft-spoken person understood while allowing sufficient headroom for people who speak loudly. If the amplification is too high, a loud voice or noise causes clipping of the audio waveform, which makes the subsequent signal unintelligible and harsh to the ears.



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One response to this dilemma is to limit the signal with a nonlinear transfer function (**Figure 1**), implemented by adding a few components to a standard application circuit. When a positive or negative peak of the audio input exceeds the turn-on voltage for one of the back-to-back diodes (D1), the diode conducts and attenuates any further increase in the signal amplitude. Resistors R1 and R2 add a series impedance that prevents excessive loading of the audio source.

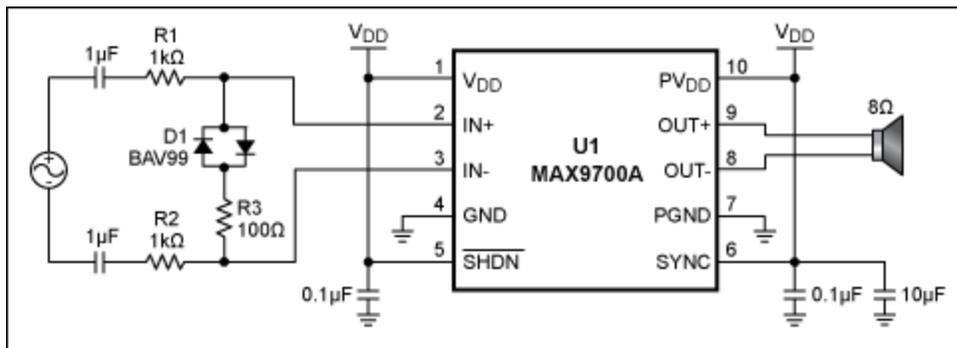


Figure 1. A small-signal diode network limits an amplifier's output voltage.

During normal operation, the incoming audio sees little attenuation by the diode network, and the high input impedance of U1 (MAX9700A) prevents attenuation due to the higher source impedance. As input amplitudes increase the transfer function shifts, as shown in a plot of output amplitude vs. input amplitude (**Figure 2**). As you can see, the output tracks the input for low-level signals, and above input

levels of $0.5V_{RMS}$ the circuit gain decreases. Gain compression is independent of the peak output voltage, as illustrated by the responses for various supply voltages.

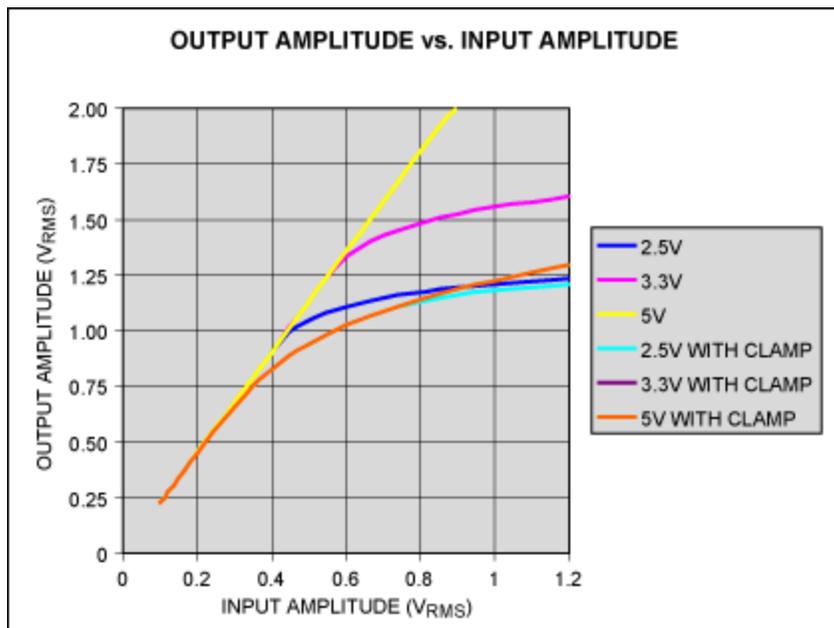


Figure 2. Signal attenuation by the diode network in Figure 1 prevents output clipping by causing a nonlinear transfer of the higher-amplitude inputs. Note that "3.3V with clamp" and "5V with clamp" have the same response and are therefore superimposed. Also, "2.5V" and "3.3V" show compression due to swing limits, even though no clamp is present.

Related Parts

MAX9700

1.2W, Low-EMI, Filterless, Class D Audio Amplifier

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