National Semiconductor

August 2000

LM4860 Boomer® Audio Power Amplifier Series
Series 1W Audio Power Amplifier with Shutdown Mode

General Description

The LM4860 is a bridge-connected audio power amplifier capable of delivering 1W of continuous average power to an 8Ω load with less than 1% THD+N over the audio spectrum from a 5V power supply.

Boomer audio power amplifiers were designed specifically to provide high quality output power with a minimal amount of external components using surface mount packaging. Since the LM4860 does not require output coupling capacitors, bootstrap capacitors or snubber networks, it is optimally suited for low-power portable systems.

The LM4860 features an externally controlled, low-power consumption shutdown mode, as well as an internal thermal shutdown protection mechanism. It also includes two headphone control inputs and a headphone sense output for external monitoring.

The unity-gain stable LM4860 can be configured by external gain setting resistors for differential gains of up to 10 without the use of external compensation components. Higher gains may be achieved with suitable compensation.

Key Specifications

- THD+N at 1W continuous average output power into 8Ω: 1% (max)
- Instantaneous peak output power: >2W
- Shutdown current: 0.6µA (typ)

Features

- No output coupling capacitors, bootstrap capacitors, or snubber circuits are necessary
- Small Outline (SO) packaging
- Compatible with PC power supplies
- Thermal shutdown protection circuitry
- Unity-gain stable
- External gain configuration capability
- Two headphone control inputs and headphone sensing output

Applications

- Personal computers
- Portable consumer products
- Cellular phones
- Self-powered speakers
- Toys and games

Typical Application

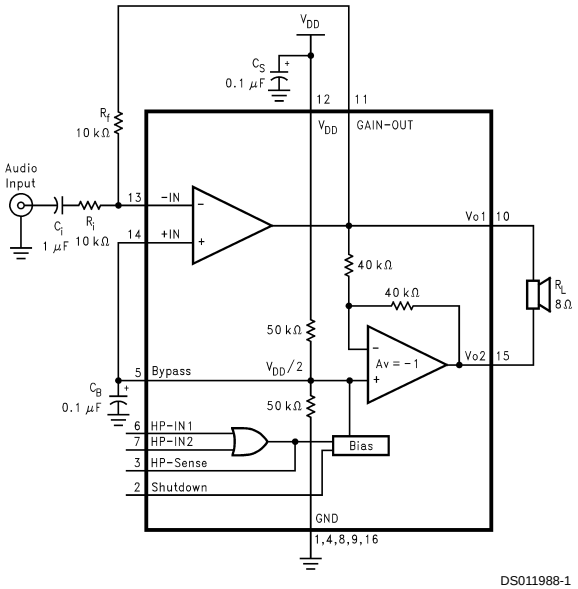
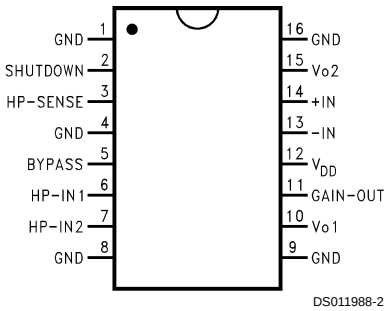


FIGURE 1. Typical Audio Amplifier Application Circuit

Connection Diagram

Small Outline Package



Top View
Order Number LM4860M
See NS Package Number M16A

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Patents pending.

Absolute Maximum Ratings (Note 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Supply Voltage	6.0V
Storage Temperature	−65˚C to +150˚C
Input Voltage	−0.3V to V_{DD} + 0.3V
Power Dissipation	Internally limited
ESD Susceptibility (Note 4)	3000V
ESD Susceptibility (Note 5)	250V
Junction Temperature	150˚C
Soldering Information	
Small Outline Package	
Vapor Phase (60 sec.)	215˚C
Infrared (15 sec.)	220˚C

See AN-450 *"Surface Mounting and their Effects on Product Reliability" for other methods of soldering surface mount devices.*

Operating Ratings

Temperature Range	
$T_{MIN} \le T_A \le T_{MAX}$	−20˚C ≤ T_A ≤ +85˚C
Supply Voltage	2.7V ≤ V_{DD} ≤ 5.5V

Electrical Characteristics

(Notes 1, 2) The following specifications apply for V_{DD} = 5V, R_L = 8Ω unless otherwise specified. Limits apply for T_A = 25˚C.

Symbol	Parameter	Conditions	LM4860		Units (Limits)
			Typical (Note 6)	Limit (Note 7)	
V_{DD}	Supply Voltage			2.7	V (min)
				5.5	V (max)
I_{DD}	Quiescent Power Supply Current	V_O = 0V, I_O = 0A (Note 8)	7.0	15.0	mA (max)
I_{SD}	Shutdown Current	V_{pin2} = V_{DD} (Note 9)	0.6		µA
V_{OS}	Output Offset Voltage	V_{IN} = 0V	5.0	50.0	mV (max)
P_O	Output Power	THD+N = 1% (max); f = 1 kHz	1.15	1.0	W (min)
THD+N	Total Harmonic Distortion + Noise	P_O = 1 Wrms; 20 Hz ≤ f ≤ 20 kHz	0.72		%
PSRR	Power Supply Rejection Ratio	V_{DD} = 4.9V to 5.1V	65		dB
V_{od}	Output Dropout Voltage	V_{IN} = 0V to 5V, V_{od} = (V_{o1} − V_{o2})	0.6	1.0	V (max)
V_{IH}	HP-IN High Input Voltage	HP-SENSE = 0V to 4V	2.5		V
V_{IL}	HP-IN Low Input Voltage	HP-SENSE = 4V to 0V	2.5		V
V_{OH}	HP-SENSE High Output Voltage	I_O = 500 µA	2.8	2.5	V (min)
V_{OL}	HP-SENSE Low Output Voltage	I_O = −500 µA	0.2	0.8	V (max)

Note 1: All voltages are measured with respect to the ground pins, unless otherwise specified.

Note 2: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits. Electrical Characteristics state DC and AC electrical specifications under particular test conditions which guarantee specific performance limits. This assumes that the device is within the Operating Ratings. Specifications are not guaranteed for parameters where no limit is given, however, the typical value is a good indication of device performance.

Note 3: The maximum power dissipation must be derated at elevated temperatures and is dictated by T_{JMAX}, θ_{JA}, and the ambient temperature T_A. The maximum allowable power dissipation is $P_{DMAX} = (T_{JMAX} - T_A)/\theta_{JA}$ or the number given in the Absolute Maximum Ratings, whichever is lower. For the LM4860, T_{JMAX} = +150˚C, and the typical junction-to-ambient thermal resistance, when board mounted, is 100˚C/W.

Note 4: Human body model, 100 pF discharged through a 1.5 kΩ resistor.

Note 5: Machine Model, 200 pF–240 pF discharged through all pins.

Note 6: Typicals are measured at 25˚C and represent the parametric norm.

Note 7: Limits are guaranteed to National's AOQL (Average Outgoing Quality Level).

Note 8: The quiescent power supply current depends on the offset voltage when a practical load is connected to the amplifier.

Note 9: Shutdown current has a wide distribution. For Power Management sensitive designs, contact your local National Semiconductor Sales Office.

High Gain Application Circuit

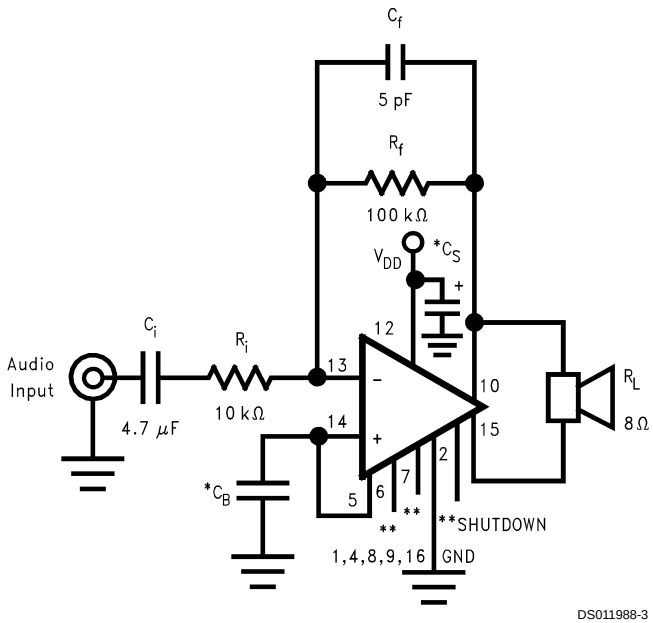
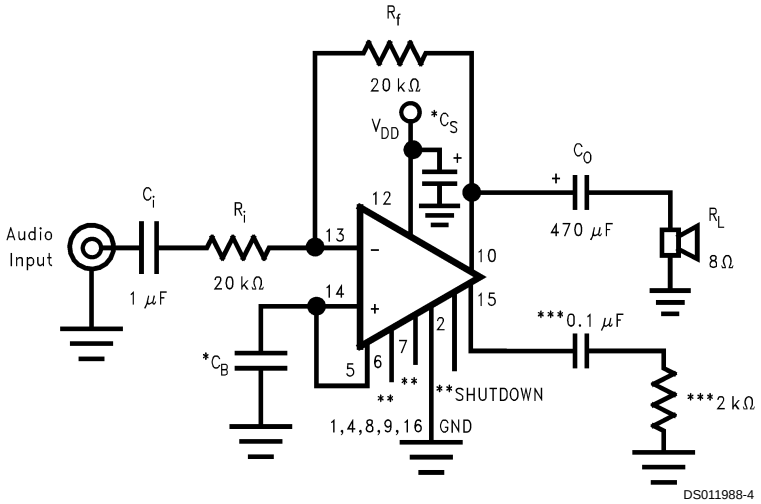


FIGURE 2. Stereo Amplifier with A_{VD} = 20

Single Ended Application Circuit



*C_S and C_B size depend on specific application requirements and constraints. Typical values of C_S and C_B are 0.1 μF.
**Pin 2, 6, or 7 should be connected to V_{DD} to disable the amplifier or to GND to enable the amplifier. These pins should not be left floating.
***These components create a “dummy” load for pin 8 for stability purposes.

FIGURE 3. Single-Ended Amplifier with A_V = −1

External Components Description

(*Figures 1, 2*)

Components	Functional Description
1. R_i	Inverting input resistance which sets the closed-loop gain in conjunction with R_f. This resistor also forms a high pass filter with C_i at $f_C = 1/(2\pi R_i C_i)$.
2. C_i	Input coupling capacitor which blocks DC voltage at the amplifier’s input terminals. Also creates a highpass filter with R_i at $f_C = 1/(2\pi R_i C_i)$.
3. R_f	Feedback resistance which sets closed-loop gain in conjunction with R_i.
4. C_S	Supply bypass capacitor which provides power supply filtering. Refer to the **Application Information** section for proper placement and selection of supply bypass capacitor.