AN-1441 LM4962 Evaluation Board

1 Introduction

The LM4962 Evaluation Board is designed to evaluate both mono and stereo applications. The LM4962 integrates a switching boost converter with an audio power amplifier. For stereo applications an external audio amplifier is needed. The LM4962 Evaluation Board presents the LM4962 along with the LM4951 audio power amplifier. For more information on the LM4962 or LM4951, see the device-specific data sheet.

The LM4962 is an audio power amplifier primarily designed for driving ceramic speaker in cell phones, Smart Phones, PDA's and other portable applications. It is capable of driving 15Vpp (typ) BTL, per channel, to a 2 µF + 30 Ω load with less than 1% THD + N from a 3.2VDC power supply. The LM4962 features a low power consumption shutdown mode, an internal thermal shutdown protection mechanism, over current protection (OCP) and over voltage protection (OVP).

2 Operating Conditions

- Temperature Range

  $-40°C \leq T_A \leq +85°C$

- Boost Converter Supply Voltage (V_{DD})

  $3.0V < V_{DD} < 5.0V$

- Amplifier Supply Voltage

  $2.7V < V_{AMP} < 8.5V$

3 Demo Board Schematic

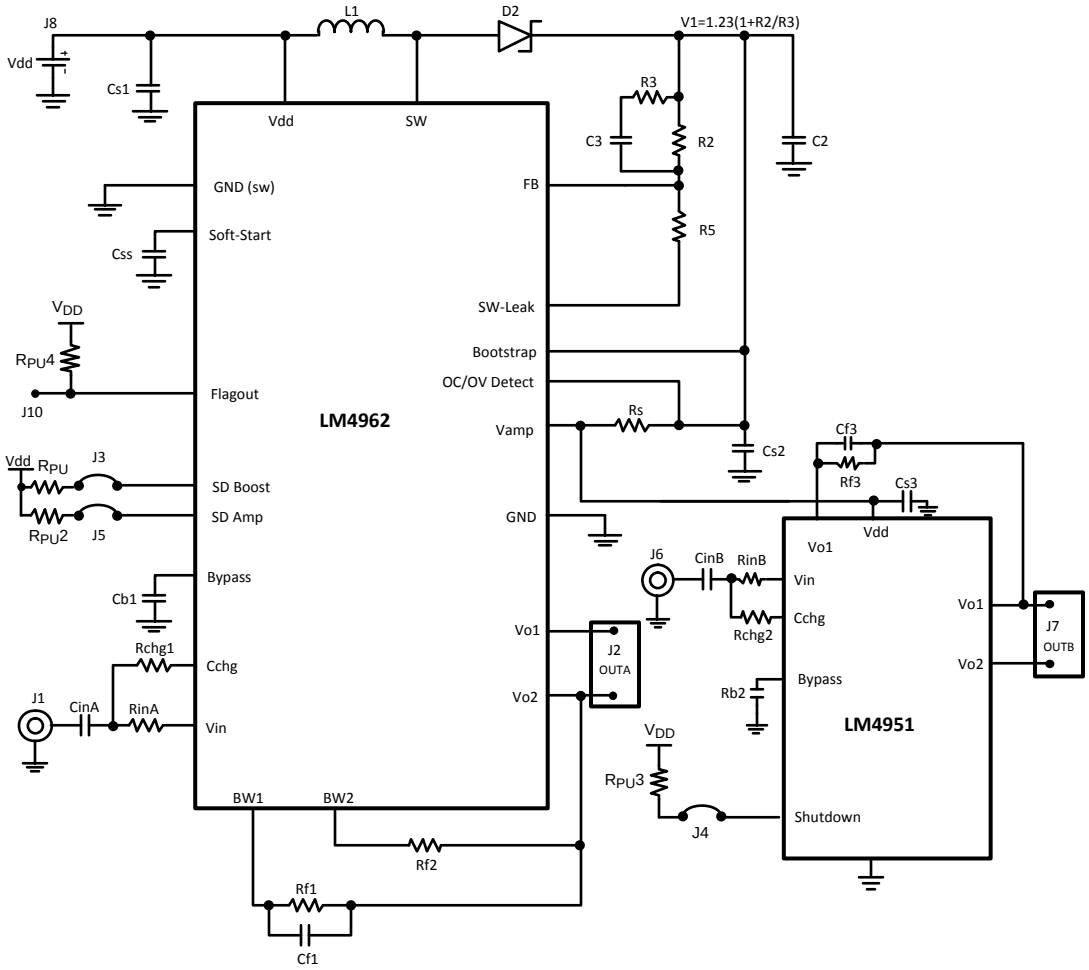

Figure 1. Demo Board Schematic

Table 1. Demo Board Connections

Designator	Label	Function
J1	IN A	Single Ended Audio Input Signal A (LM4962)
J2	OUTA	BTL Audio Output Signal A (LM4962)
J3	SD Boost	Boost Converter Shutdown J3 open = Shutdown J3 shorted = Active
J4	SD AmpB	Amplifier B Shutdown (LM4951) J4 open = Shutdown J4 shorted = Active
J5	SD AmpA	Amplifier A Shutdown (LM4962) J5 open = Shutdown J5 shorted = Active
J6	IN B	Single Ended Audio Input Signal B (LM4951)
J7	OUTB	BTL Audio Output Signal B (LM4951)
J8	GND VDD	Power Supply Connection
J9		Stereo/Mono select J9 Shorted = Stereo J9 Open = Mono
J10	Flagout	Flagout pin to monitor Over Voltage or Over Current conditions

4 Start-Up Sequence

For the LM4962 correct start-up sequencing is important for optimal device performance. Using the correct start up sequence will improve click/pop performance as well as avoid transients that could reduce battery life. For ringer/loudspeaker mode, the supply voltage should be applied first and both the boost and the amplifier should be in shutdown (J3 and J5 open). Then the boost converter can be activated (J3 shorted) followed by the amplifier (J5 shorted). If the boost converter shutdown is toggled while the amplifier is active an audible pop will be heard.

5 Setting the Output Voltage (V1) of Boost Converter

The output voltage is set using the external resistors R2 and R5 (see Figure 1). A value of approximately 25 kΩ is recommended for R2 to establish the open loop gain of the boost converter. The output voltage of the boost converter can be calculated using Equation 1.

$$V_1 = V_{FB} [1 + (R2 / R5)] \quad (1)$$

6 Feed-Forward Compensation For Boost Converter

Although the LM4962's internal Boost converter is internally compensated, an external feed-forward capacitor, Cf, is required for stability (see Figure 1). Adding this capacitor puts a zero in the loop response of the converter. The recommended frequency for the zero's –3dB point should be approximately 60 kHz. C3 can be calculated using the formula in Equation 2.

$$C3 = 1 / (2\pi \times R2 \times f_z) \quad (2)$$

7 PCB Layout Guidelines

High frequency boost converters require very careful layout of components in order to get stable operation and low noise. All components must be as close as possible to the LM4962 device. It is recommended that a 4-layer PCB be used so that internal ground planes are available. See Figure 1 for demo board reference schematic and layout. Some additional guidelines to be observed:

- Keep the path between L1, D2, and C2 extremely short. Parasitic trace inductance in series with D2 and C2 will increase noise and ringing.
- If internal ground planes are available (recommended) use vias to connect directly to ground at the GND (SW) and GND pins of U1, as well as the negative sides of capacitors Cs1 and C2
- To ensure correct operation of this device, it is essential that the GND (SW) pin (A3), GND pin (D1), and the negative side of Cs2 be connected to the same GND plane. Cs2 should be placed as close as possible to these two GND planes

8 General Layout Recommendations

This section provides practical guidelines for PCB layouts. Designers should note that these are only "rule-of-thumb" recommendations and the actual results will depend heavily on the final layout.

8.1 Power and Ground Circuits

For multi-layer boards, it is important to isolate the switching power and ground trace paths from the amplifier power and ground trace paths. Star trace routing techniques (bringing individual traces back to a central point rather than daisy chaining traces together in a serial manner) can have a major impact on low level signal performance. Star trace routing refers to using individual traces to feed power and ground to each circuit or even device. This technique requires a greater amount of design time but will not increase the final price of the board.

8.2 Avoiding Typical Design and Layout Problems

Avoid ground loops or running digital and analog traces parallel to each other (side-by-side) on the same PCB layer. When traces must cross over each other do it at 90°. Running digital and analog traces at 90° to each other from the top to the bottom side as much as possible will minimize capacitive noise coupling and crosstalk.

Table 2. LM4962 Evaluation Board Bill of Materials

Item	Description	Package	Value	Notes
U1	Ceramic Speaker Driver	DSBGA		
U2	Audio Power Amplifier	DSBGA		
Cf1, Cf3	Ceramic Capacitor	1210	82 pF, 50V	50V
C3	Ceramic Capacitor	1210	100 pF, 50V	50V
CinA, CinB	Ceramic Capacitor	1210	0.39 µF, 50V	
C2, Cs1, Cs2, Cs3	Ceramic Capacitor	1210	4.7 µF, 16V	low ESR, ESR < 50 Ω
Css	Ceramic Capacitor	1210	10 nF, 16V	
Cb1, Cb2	Tantalum Capacitor	1210	1 µF, 16V	
D2	Schottky Diode	SOD-123	20V, 0.5A	On Semi MBR0520
L1	Inductor	4.3mm X 4.8mm X 3.5mm	10 µH, 1.04A	Sumida CR43–100
R3	Resistor	0603	1.6 kΩ	1/10W, 5%
R2	Resistor	0603	25 kΩ	1/10W, 5%
Rpu, Rpu2, Rpu3, Rchg1, Rchg2,	Resistor	0603	1 kΩ	1/10W, 5%
Rpu4	Resistor	0603	100 kΩ	1/10W, 5%
RinA, RinB, Rf2	Resistor	0603	20 kΩ	1/10W, 5%
Rf1, Rf3	Resistor	0603	200 kΩ	1/10W, 5%
Rchg1, Rchg2	Resistor	0603	1 kΩ	1/10W, 5%
R4	Resistor	0603	4.9 kΩ	1/10W, 5%
R3	Resistor	0603	100 mΩ	1/10W, 5%

9 PCB Layout

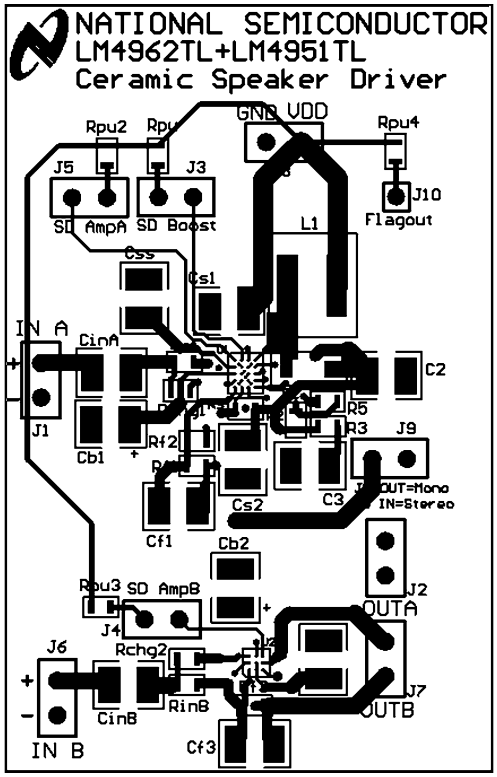

Figure 2. Top Layer
(Shown With Top Silkscreen visible)

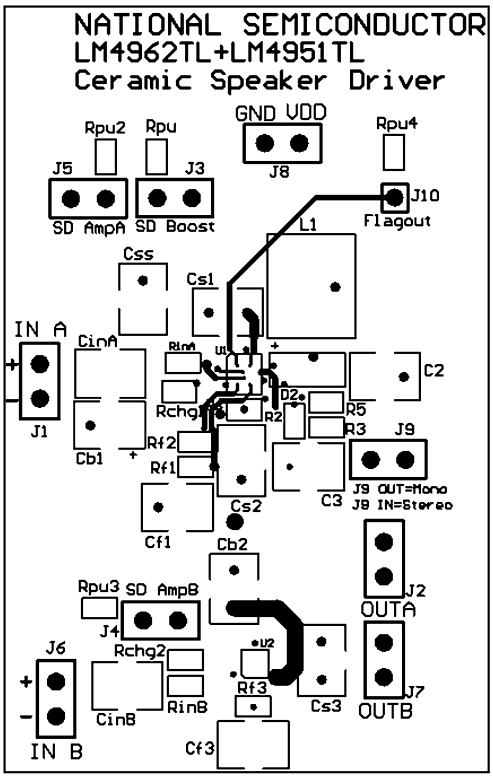

Figure 3. Mid Layer 1
(Shown With Top Silkscreen visible)

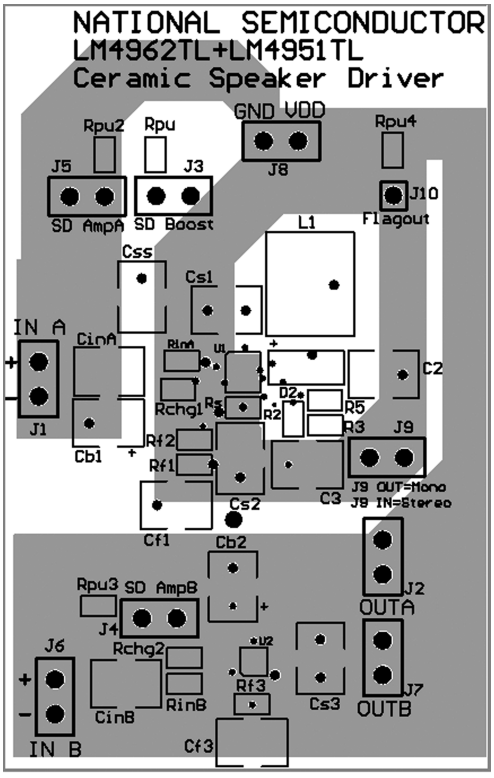

Figure 4. Mid Layer 2
(Shown With Top Silkscreen visible)

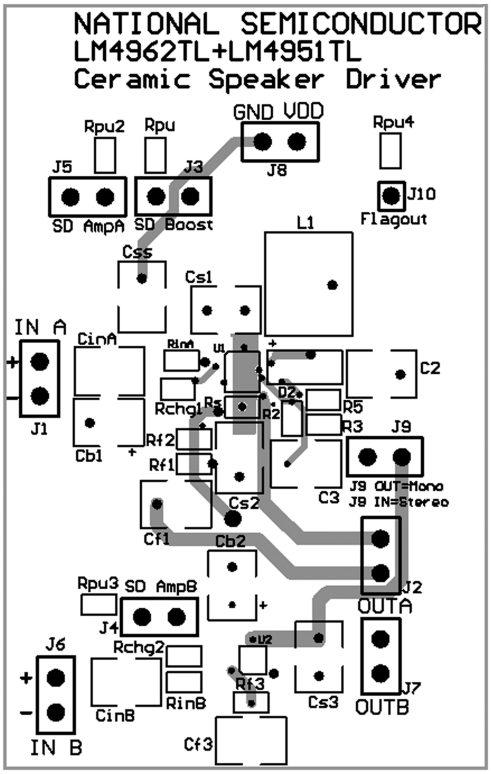

Figure 5. Bottom Layer
(Shown With Top Silkscreen visible)

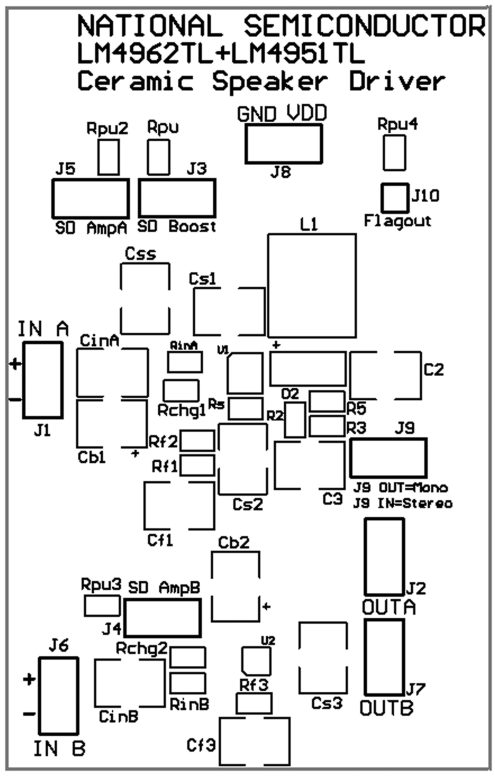

Figure 6. Top Silkscreen

10 Revision Table

Rev	Date	Description
0.1	04/20/06	Initial release.

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