LMV1090 Noise Suppression Microphone Amplifier Evaluation Kit User's Guide

National Semiconductor
Application Note 1948
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Overview

The LMV1090TL evaluation kit contains the following:

- LMV1090TL Demonstration Board, 551600317–001
- Mini USB Board, 551600192–002
- Control Software
- Microphone board
- Microphone cable
- I²C cable

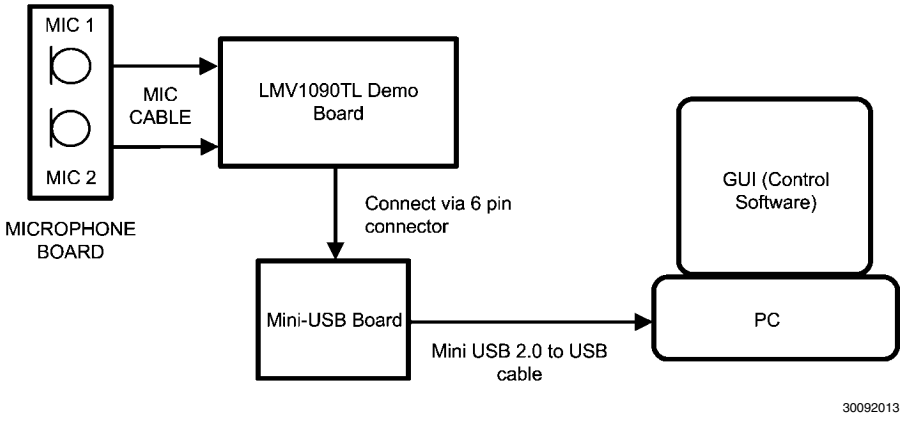

FIGURE 1. Basic Evaluation System

Introduction

The LMV1090 demo board offers the means for easy evaluation of the LMV1090 Dual input, Far Field Noise Suppression (FFNS) Microphone Amplifier with Differential Outputs. This board has the LMV1090TL mounted on the PCB together with surrounding components ready for evaluation. This board offers interfaces for connecting two microphones and an I²C interface for controlling the settings of the LMV1090.

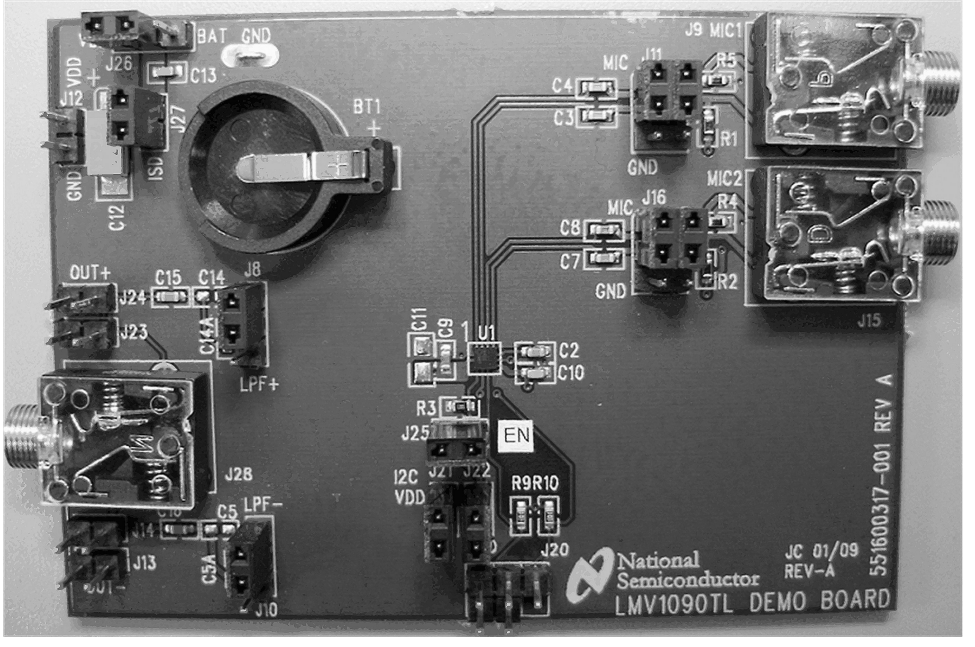

FIGURE 2. The LMV1090TL Demo Board

General Description

The LMV1090 is a fully analog dual input, differential output, microphone array amplifier designed to reduce background acoustic noise, while delivering superb speech clarity in voice communications applications. The LMV1090 has two differential input microphone amplifier channels plus far-field noise suppression (FFNS) circuitry. The LMV1090 preserves near-field wire signals within 4cm of the microphones. While rejecting far-field acoustic noise greater than 50cm from the microphones. Up to 20dB of far-field rejection is possible in a properly configured and using ±0.5dB matched microphones.

Operating Conditions

- Temperature Range $-40°C \leq T_A \leq 85°C$
- Power Supply Voltage $2.7V \leq V_{DD} \leq 5.5V$
- I²C supply voltage $1.7V \leq I^2CV_{DD} \leq 5.5V$

LMV1090 Demo Board

The LMV1090TL Demonstration Board takes analog inputs from two microphones and performs the Far Field noise cancellation process. It outputs an analog differential signal. This output can be connected to a recording device, such as a personal computer sound card through its LINE IN/MIC IN input or mobile phone through its MIC IN input, for evaluation purposes.

The LMV1090TL contains programmable pre and post gain amplifiers, which can be adjusted through I²C commands and the software GUI. See Control Software GUI section.

The LMV1090TL has four (4) operating modes:

- Noise cancellation
- Mic1 enabled
- Mic2 enabled
- Mic1 + Mic2

The operating modes can all be controlled through I²C commands and the software GUI. See Control Software GUI section.

Power Supply of the LMV1090 Demo Board

The LMV1090 demo board provides three (3) possible sources for the power supply. The first one is using the external supply via header J12 for V_{DD} and GND. I^2CV_{DD} pin can get its supply from the V_{DD} pin by placing a jumper across J21 and J22. See Figure 3.

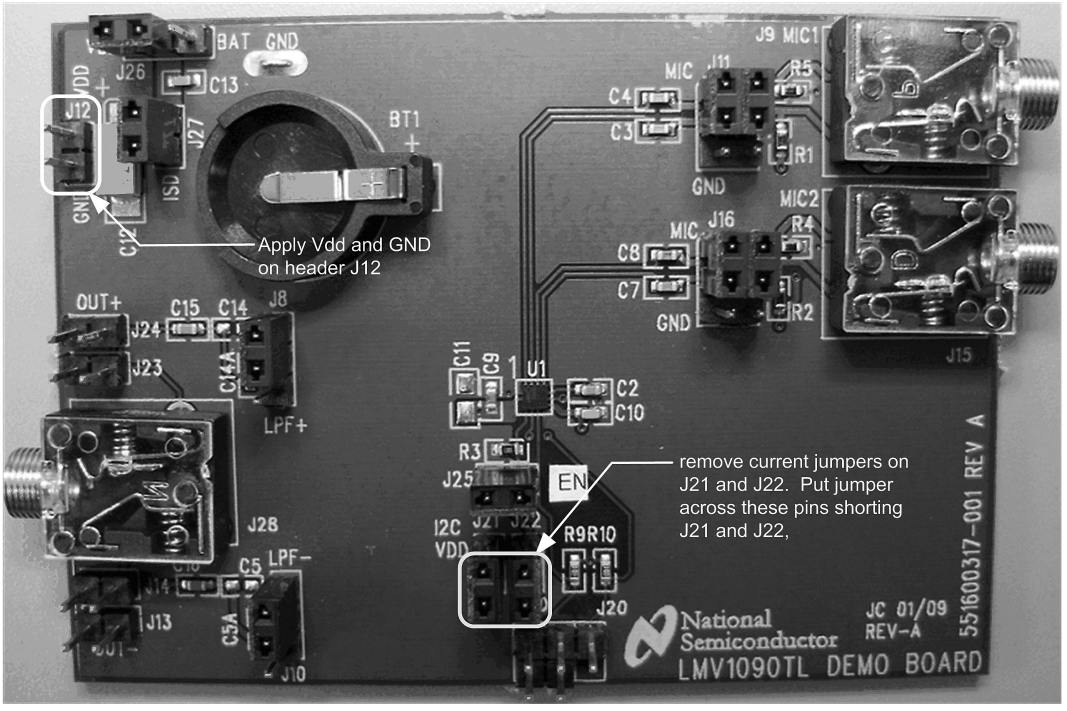

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FIGURE 3. Power Supply Connectors and Headers

The second source of power supply is a small battery placed in battery holder mounted on the PCB. See Figure 4. For a limited time, the demo board can be operated from the board battery (CR1220 placed in the battery holder BT1). To operate the board using a battery, the following jumpers: J26, J21, and J22 must be configured as shown in Figure 4.

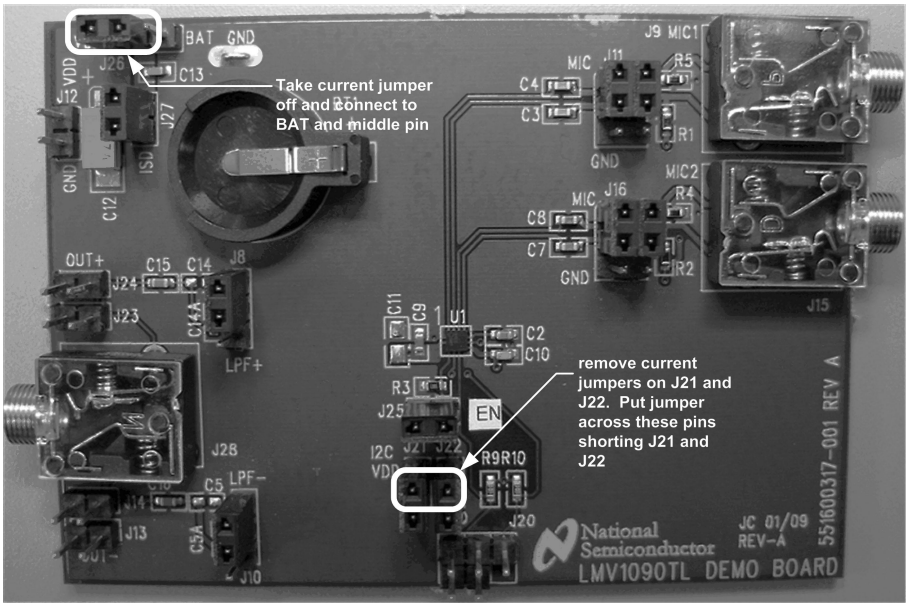

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FIGURE 4. Battery Power Supply

The third source of power is via the I²C interface header J20. See Figure 5. This is the default configuration of the LMV1090TL demonstration board when received by customer. Using this configuration and a mini USB board eliminates the need for a separate power supply for evaluation. Supplying the demo board is possible by generating jumpers on headers J21 nad J22.

ENABLE PIN

The enable pin must be logic high for operating the on board LMV1090. This is done by placing a jumper on header J25 (see Figure 5).

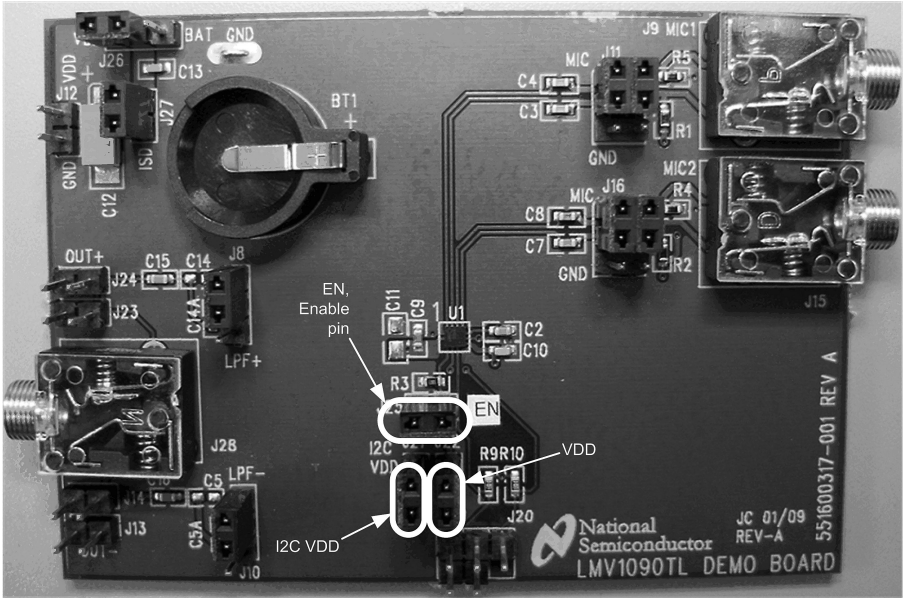

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FIGURE 5. I²C Power Supply

The On Board I²C Compatible Interface

The I²C Compatible Interface that is available on the LMV1090 demo board is located at the header J20 (see Figure 6). The signals on this header are described in Table 1.

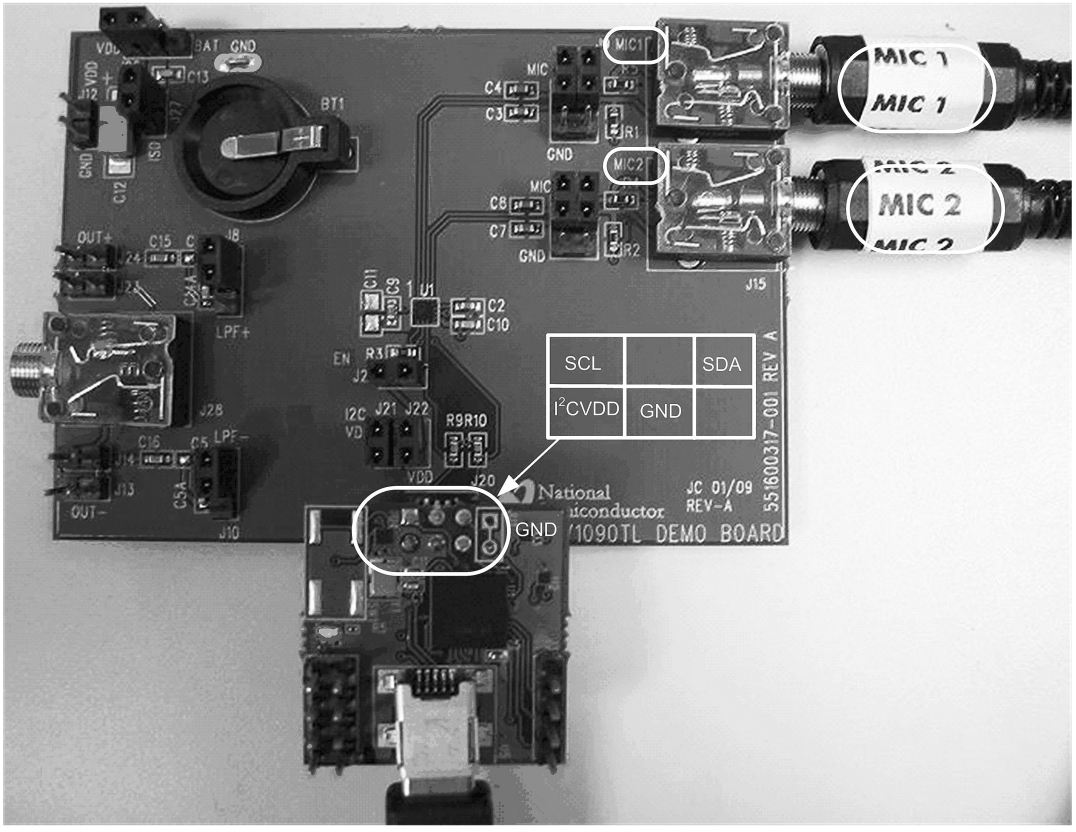

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FIGURE 6. Demo board I²C Mic Inputs

TABLE 1. I²C connector

PIN	Function
1	SCL
2	I²CVDD
3	NC
4	GND
5	SDA
6	NC

The SCL pin and the SDA pin both have a 10kΩ pull-up resistor to I^2CV_{DD}mounted on the PCB.

Figure 6 shows how the mini USB board should be connected to the LMV1090TL demo board. Note the USB cable should be connected away from the board. The supply voltage for the I²C interface of the LMV1090 can be selected with the jumper J22. To avoid possible damages to the LMV1090 part, the I^2CV_{DD} voltage should not exceed the V_{DD} voltage.

LMV1090 Control Demo Software

Together with the LMV1090 demo board, there is a software package available that can assist in evaluation, programming, and testing of the LMV1090 chip via the I²C Interface. This software is operated via the graphical user interface as shown in Figure 7. This software provides two groups of functions.

There are four buttons in the top of the screen that allows the following:

- Enable and Disable the microphone amplifiers
- Muting the microphone input amplifier
- Default button for resetting part on the left side of the screen is the mode

The 4 buttons on the side lets you select the 4 modes: Noise cancellation Mode / Only Mic 1 on / only Mic 2 on / and Mic 1 + Mic 2

On the right side of the screen are 2 slide bars that allow you to control the pre and post amplifier gains.

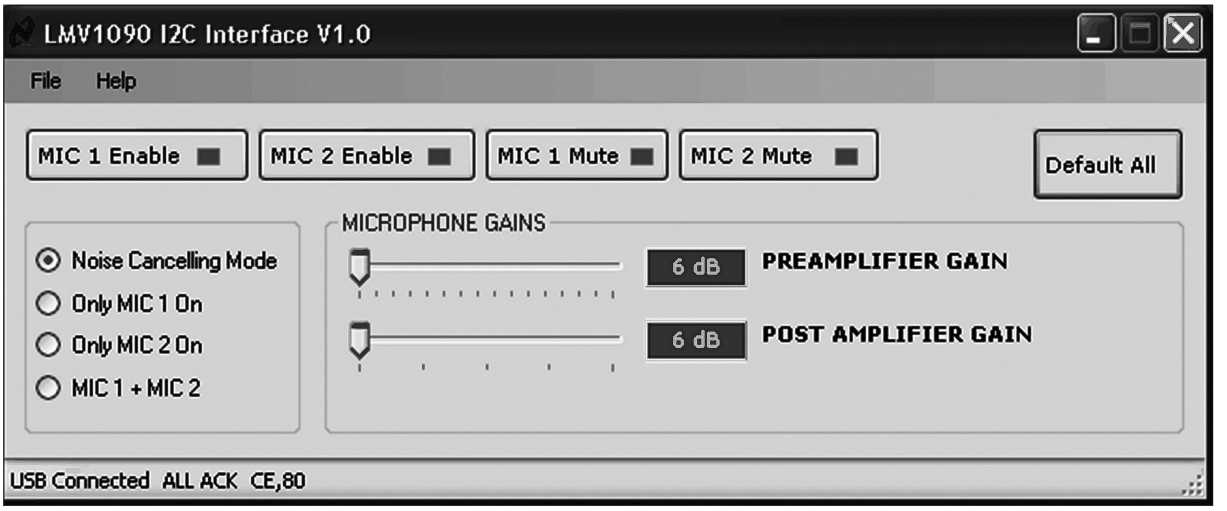


FIGURE 7. Control Demo Software GUI

Connecting Microphones to the LMV1090 Demo Board

The demo board can be used to connect a set of two microphones to the LMV1090 to evaluate the performance of the LMV1090 in a customer application. To enable these microphone input connectors, the jumpers on header J11 and J16 (see Figure 10) must be placed between pin 3–5 and pin 4–6 of both headers. Microphones can also be connected to 3.5mm connectors J9 and J15 (see Figure 6).

For a optimal performance of the Far Field Noise Reduction system it is important to find the correct placement of the microphones. In many applications the microphones are placed next to each other with a distance of 1.5cm to 2.5cm between the microphones. The best noise cancelling performance will occur in systems where the far field signals comes from a source orthogonal to the plane of the microphones and where the desired signal is close to the microphones and is located in line with the microphones as shown in *Figure 8*.

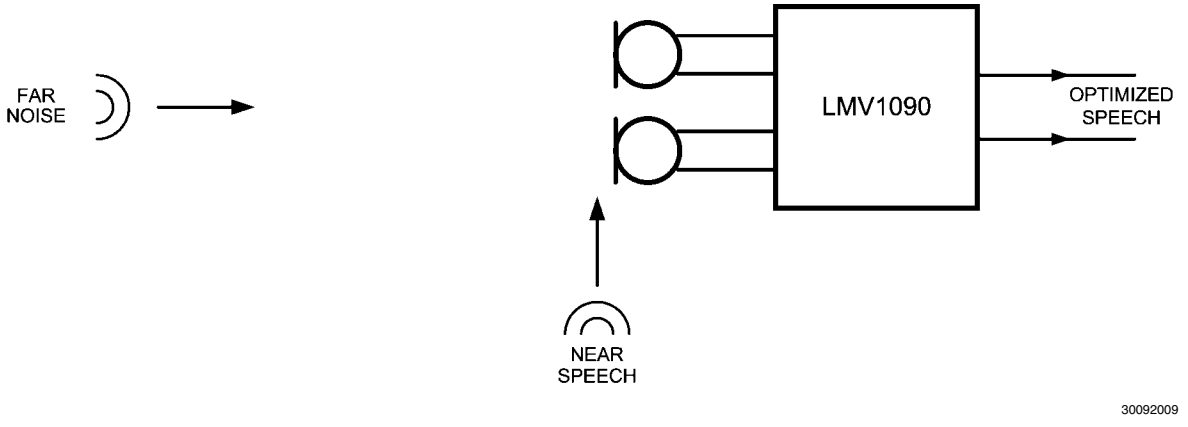


FIGURE 8. Orientation of Microphones and Sound Sources

Microphone Placement in the Application

Because the LMV1090 is a microphone array Far Field Noise Reduction solution, proper microphone placement is critical for optimum performance. Two things need to be considered: The spacing between the two microphones and the position of the two microphones relative to near field source.

If the spacing between the two microphones is too small, near field speech will be canceled along with the far field noise. Conversely, if the spacing between the two microphones is large, the far field noise reduction performance will be degraded. The optimum spacing between Mic 1 and Mic 2 is 1.5-2.5cm. This range provides a balance of minimal near field speech loss and maximum far field noise reduction. The microphones should be in line with the desired sound source 'near speech' and configured in an endfire array orientation from the sound source (see *Figure 10*). If the 'near speech' (desired sound source) is equidistant to the source like a broadside array (see *Figure 9*) the result will be a great deal of near field speech loss.

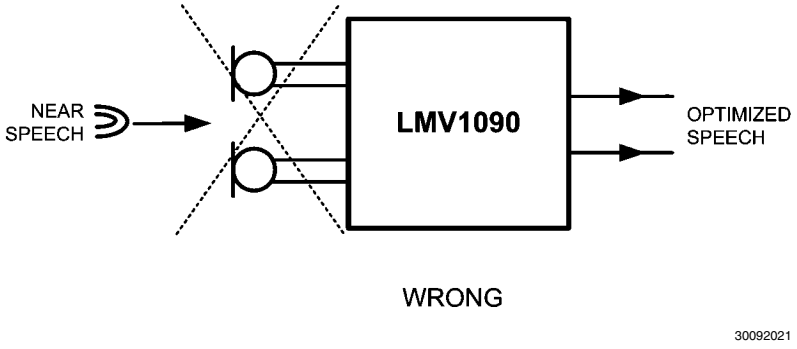


FIGURE 9. Broadside Array (WRONG)

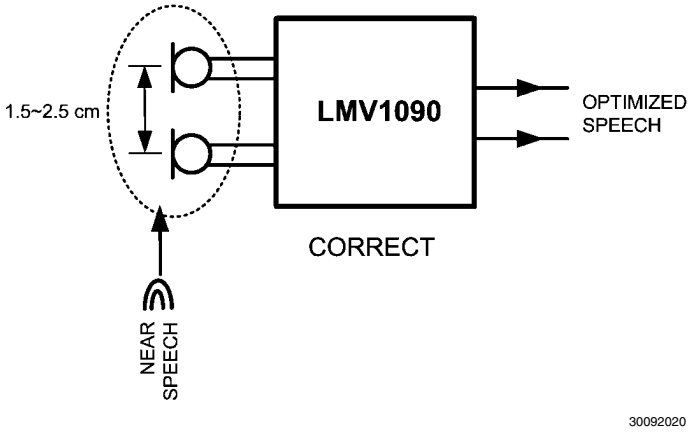


FIGURE 10. End fire Array (CORRECT)

PCB Layout Guidelines

This section provides general practical guidelines for PCB layouts that use various power and ground traces. Designers should note that these are only "rule-of-thumb" recommendations and the actual results are predicated on the final layout.

DIFFERENTIAL SIGNALS

Keep both signals coupled by routing them closely together and keeping them of equal length. Keep all impedances in both traces of the signal equal.

POWER AND GROUND

Connect all ground pins together under the part forming a star point. Keep the current for the de-coupling capacitor of the REF pin B4and the accompanying ground pin B1separated from the other currents. Keep the location of the supply de-coupling capacitor close to V_{DD} pin C1 and ground.

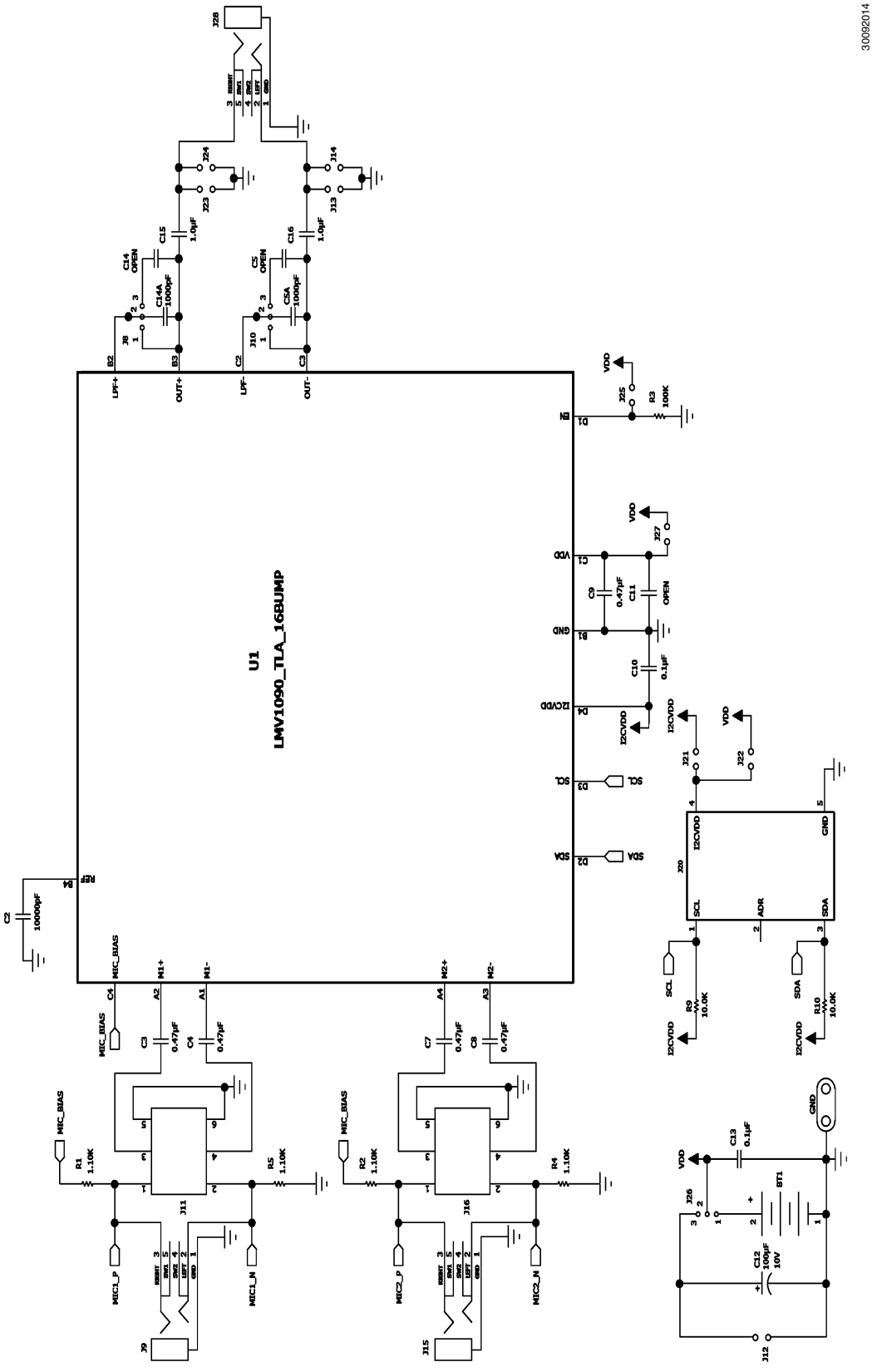
Description of Headers and Connectors of the LMV1090 Demo Board

The LMV1090 demo board provides many headers and connectors for connecting test equipment and controlling the settings of the part. The function that is controlled by the jumpers on the LMV1090 demo board is also indicated on the PCB in silk screen as shown in *Figure 11* (The name in parenthesis is as shown in the silk screen).

Connector and Header Functions

Designator	Function or Use	Comment
J12	Power supply connector for external supply	
J26	Supply select pin external (V_{DD}) or battery (BAT)	
J11, J16	Connection for input of electrical test signals at pin 4+5	Pin 3+4 differential input with ground at Pin 5+6
J8, J10	Low pass filter selection (LPF+, LPF-)	Pin 1+2 to connect to an external LPF capacitor. Pin 2+3 select the on board LPF capacitor C5, C14 (a minimum of 1nF is always mounted on the board)
J25	Enable pin	
J21	I^2CV_{DD} connect to I^2C interface	
J22	V_{DD} connect to I^2C interface	
J25	Enable pin	
J26	Supply select pin external (V_{DD}) or battery (BAT)	
J27	Connects Supply to V_{DD} pin	

Schematic



Layout

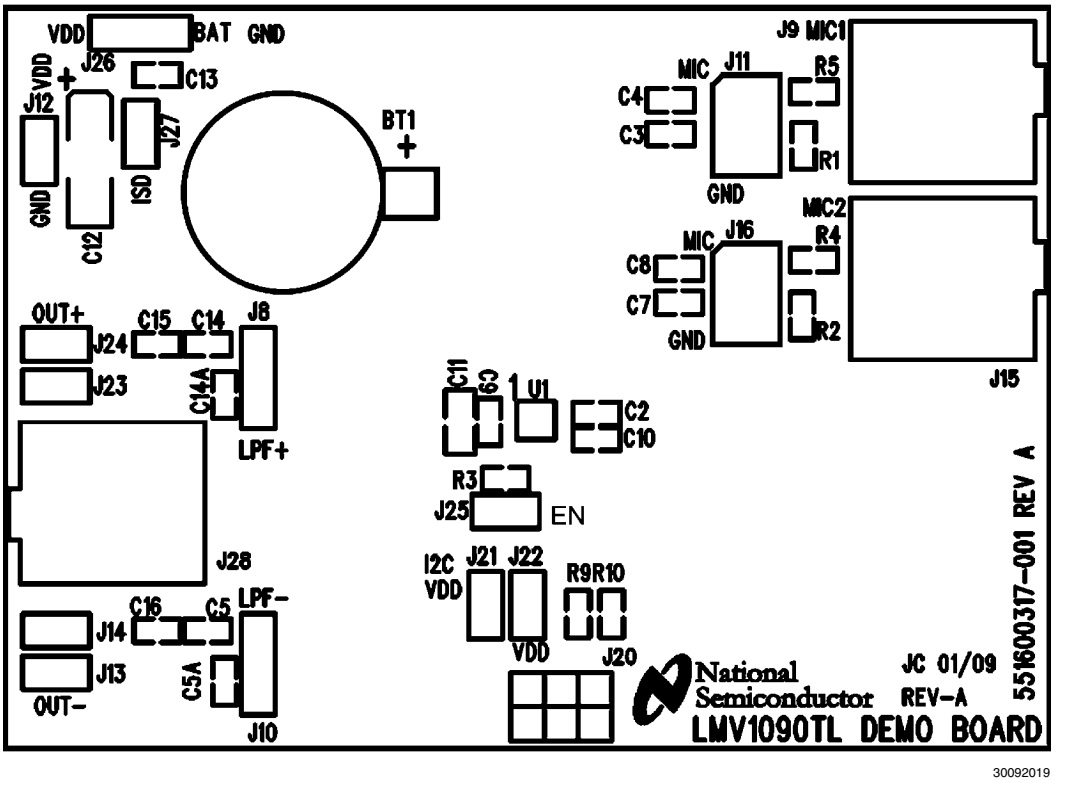


FIGURE 11. Layout, Silk Screen

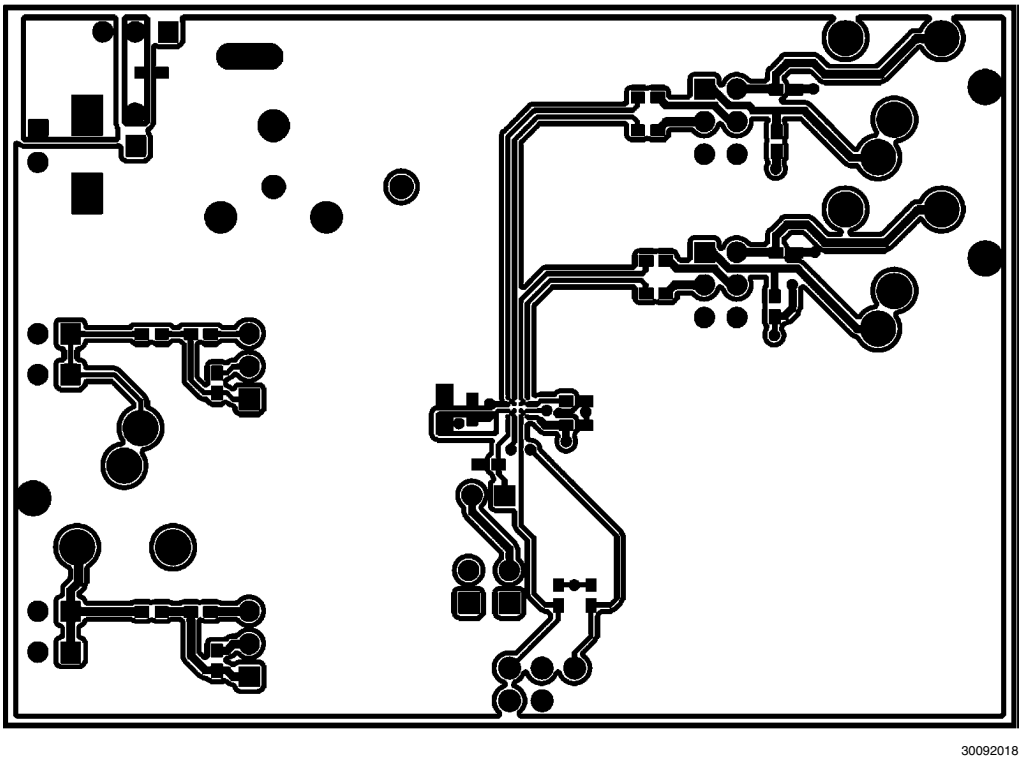


FIGURE 12. Layout, Top Layer

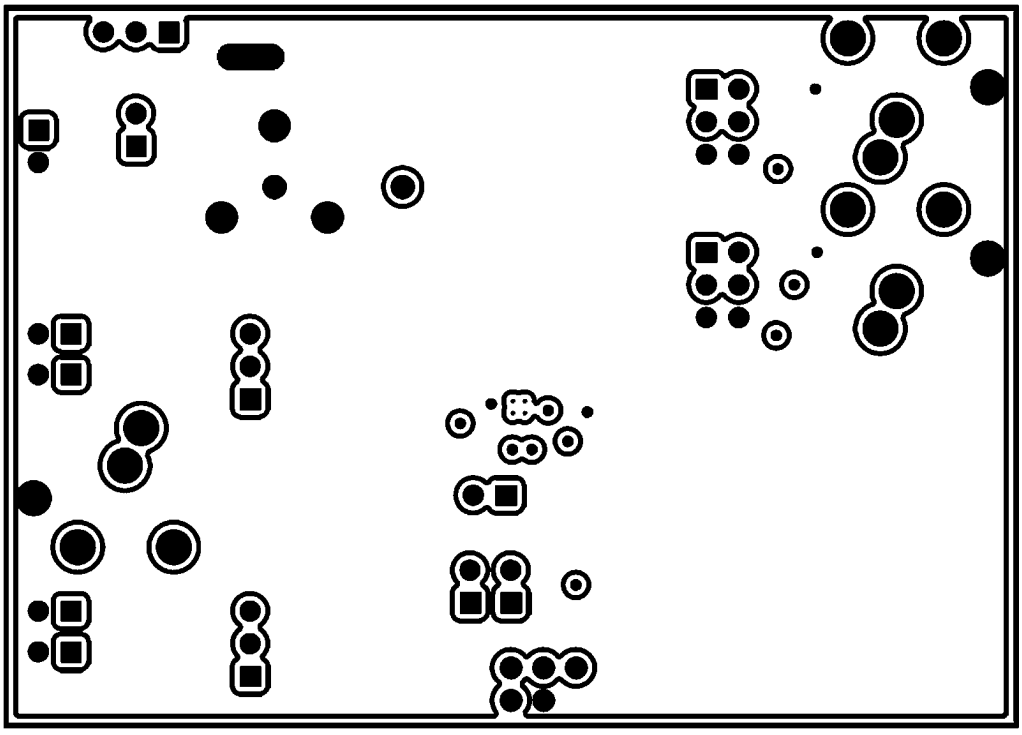


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FIGURE 13. Layout, Top Inner Layer

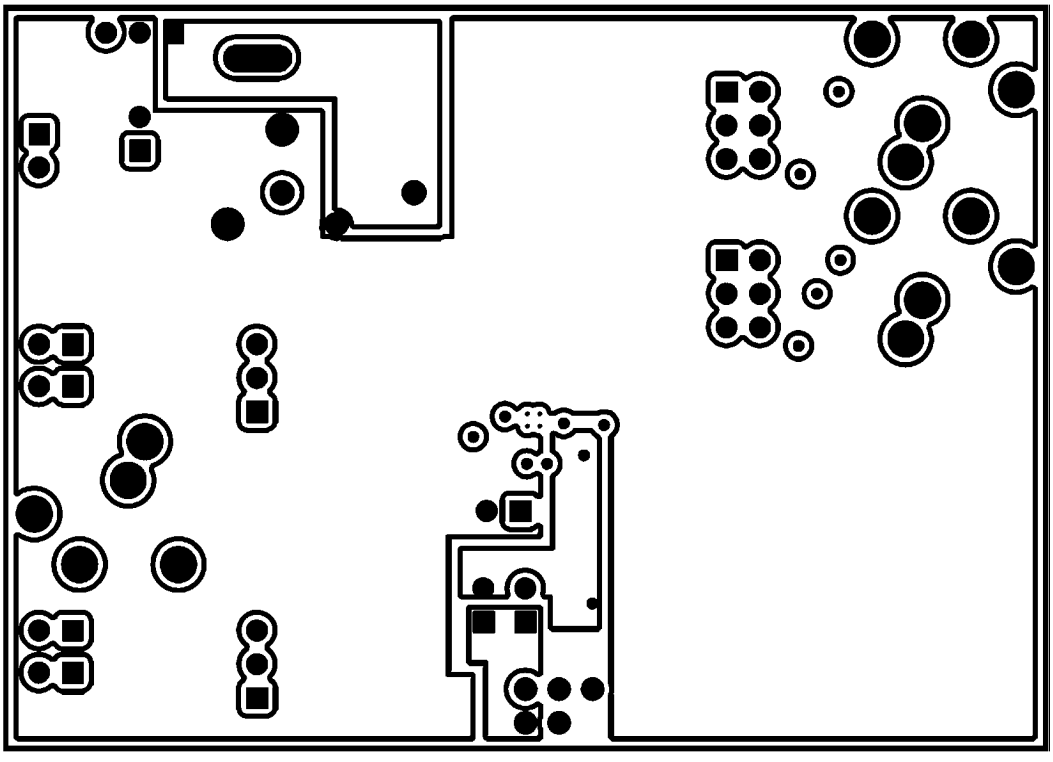

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FIGURE 14. Layout, Bottom Inner Layer

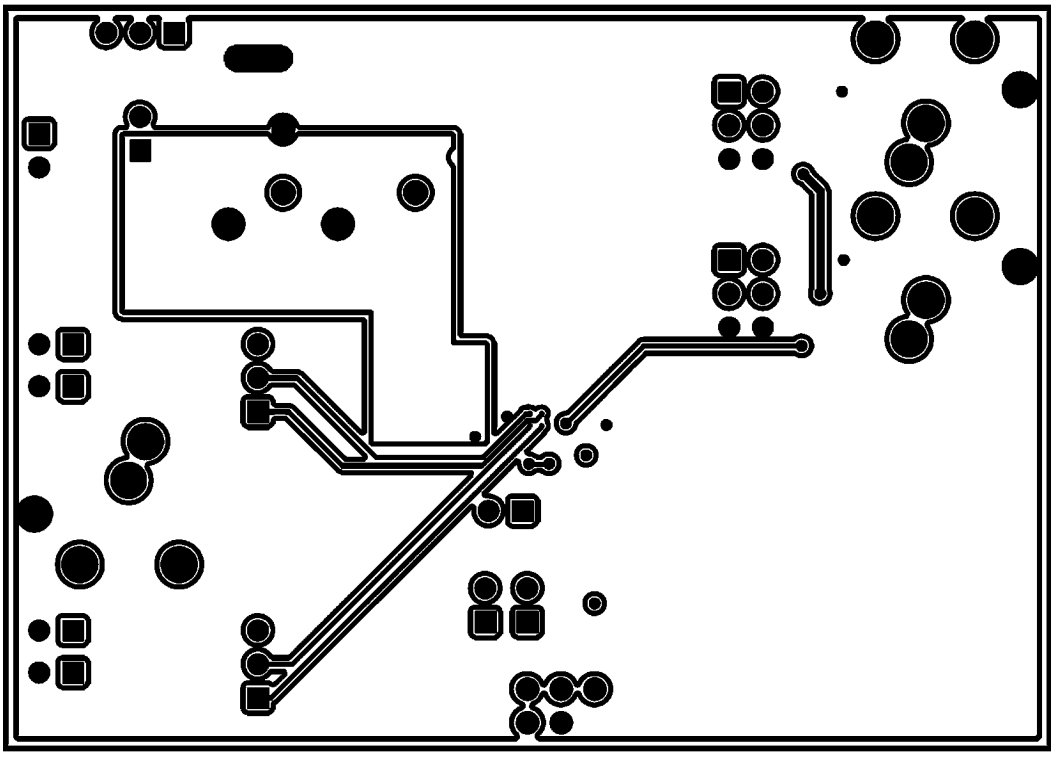

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FIGURE 15. Layout, Bottom Layer

Bill of Materials

Designator	Component	Value	Tolerance	Rating	Package Type
U1	LMV1090TL				
C15, C16	Capacitor Ceramic	1.0µF	10%	16V	0603
C2	Capacitor Ceramic	10000pF	10%	50V	0603
C3, C4, C7, C8, C9	Capacitor Ceramic	0.47pF	10%	16V	0603
C5, C14	No Load	No Load			
C5A, C14A	Capacitor Ceramic	1nF	10%	100V	0603
C10, C13	Capacitor Ceramic	1µF	10%	16V	0603
C11	No Load	No Load			
C12	Capacitor Tantalum	100µF	10%	10V	Case C
R1, R2, R4, R5	Resistor	1.1k	1%	1/10W	0603
R3	Resistor	100k	1%	1/10W	0603
R9, R10	Resistor	10k	1%	1/10W	0603
J12, J13, J14, J20, J21, J22, J23, J24, J25, J27	Connector Header Brkway .100 02POS STR				
J8, J10, J20, J26	Connector Header Brkway .100 06POS STR				
J11, J16	Connector Header Brkway .100 06POS VERT				
J9, J15, J28	5 Pole Headphone conn jack stereo 3.5mm horizontal				
GND	Ground hook jumper 5mm high mount				
BT1	Battery holder CR1220, 1 cell 12mm				
J8_SH, J10_SH, J11_SH1, J11_SH2, J16_SH2, J21_SH, J22_SH, J25_SH, J26_SH, J27_SH	Jumper Shunt 0.100” 30µin AU (no handle)				

Revision History

Rev	Date	Description
1.0	05/21/09	Initial release.
1.01	06/30/09	Corrected graphic 30092061.

Notes

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