

TPA302

Audio Power Amplifier

Evaluation Module

DATA MANUAL: SLOU006

Date: July 1997



IMPORTANT NOTICE

Texas Instruments and its subsidiaries (TI) reserve the right to make changes to their products or to discontinue any product or service without notice, and advise customers to obtain the latest version of relevant information to verify, before placing orders, that information being relied on is current and complete. All products are sold subject to the terms and conditions of sale supplied at the time of order acknowledgement, including those pertaining to warranty, patent infringement, and limitation of liability.

TI warrants performance of its semiconductor products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are utilized to the extent TI deems necessary to support this warranty. Specific testing of all parameters of each device is not necessarily performed, except those mandated by government requirements.

CERTAIN APPLICATIONS USING SEMICONDUCTOR PRODUCTS MAY INVOLVE POTENTIAL RISKS OF DEATH, PERSONAL INJURY, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE ("CRITICAL APPLICATIONS"). TI SEMICONDUCTOR PRODUCTS ARE NOT DESIGNED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. INCLUSION OF TI PRODUCTS IN SUCH APPLICATIONS IS UNDERSTOOD TO BE FULLY AT THE CUSTOMER'S RISK.

In order to minimize risks associated with the customer's applications, adequate design and operating safeguards must be provided by the customer to minimize inherent or procedural hazards.

TI assumes no liability for applications assistance or customer product design. TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right of TI covering or relating to any combination, machine, or process in which such semiconductor products or services might be or are used. TI's publication of information regarding any third party's products or services does not constitute TI's approval, warranty or endorsement thereof.



TRADEMARKS

TI is a trademark of Texas Instruments Incorporated.

Other brands and names are the property of their respective owners.



Contents

I. Quick Start for Use with P-N-P Kit	7
1. Overview	8
1.1 Introduction	8
1.2 Layout	8
1.3 Operation Notes	9
2. User's Guide.....	11
2.1 Schematic	11
2.2 Input/Output Connections – Stereo	12
2.2.1 Key Features:	12
2.3 Input/Output Connections – Mono.....	13
2.4 Controls	14
2.6 Bill of Materials	17

Figures

Figure 1 TPA 302 EVM Circuit Component Placement	8
Figure 2 TPA 302 EVM Circuit Board Layout	9
Figure 3 Schematic Diagram of the TPA302 Evaluation Module.....	11
Figure 4 TPA302 EVM Connections Diagram for Stereo Operation (Single-Ended)	12
Figure 5 TPA302 EVM Connections Diagram for Mono Operation	13



If You Need Assistance

If You need Assistance...

If You Want to...	Do This...
Request more information about Texas instruments Mixed Signal Products	Call the PIC† hotline: (972) 644-5580 or send a fax to the PIC: (972) 480-7800 or write to: Texas Instruments Incorporated Product Information Center, MS 3123 P.O. Box 660246 Dallas, Texas 75266
Order Texas Instruments documentation	Call the PIC† hotline: (972) 644-5580
Ask questions about product operation or report suspected problems	Call the PIC† hotline: (972) 644-5580
Report mistakes in this document or any other TI Mixed Signal Products documentation	Send a fax to MSP Marketing Documentation Correction: (214) 480-3160 or send your comments to: Texas Instruments Incorporated MSP Marketing Documentation Correction, MS 8710 P.O. Box 660199 Dallas, Texas 75266-0199

† Texas Instruments Product Information Center

TPA302 300-mW Stereo Audio Power Amplifier Evaluation Module

Abstract

The purpose of this document is to serve as a reference manual for the TPA302 300mW Stereo Audio Power Amplifier Evaluation Module (SLOP100). This document provides information on the optimal setup and operation of this product.

How to Use this Manual

This document contains the following chapters:

Chapter 1 Overview

A general description of the TPA302, its key features, operating specifications, and design notes.

Chapter 2 Hardware

A description of the TPA302, hardware including board schematic, connections, layout and bill of materials.



I. Quick Start for Use with P-N-P Kit

Included below is a quick checklist of setup steps to get the TPA302 up and running fast.

1. Set S1 to the “off” position.
2. Align the TPA302 with socket U5, such that the side with 5 pins is adjacent to socket U1, and firmly connect it to the P-N-P board.
3. Check the power supply jumper setting on the P-N-P board. To use battery power select JP3, to select wall mount AC/DC power select JP2, or to use a bench type DC power supply select JP1 **Note: be sure only one of these three jumpers is connected by a shorting block.**
4. Check the mode/mute jumper circuitry (JP6, JP7, JP8). To begin with, set JP7 to Lo, JP8 to Hi and JP6 to mute. This arrangement causes the TPA302 to be active when headphones are present. In the future refer to Table 1 in the P-N-P board Application Report (SLOU001) to adjust these settings.
5. Check the Audio Input Path Selection Circuitry, if there is no EVM present in U1, then set S2 to the “off” position
6. Set S3 to the “U5” position.
7. Connect a mono audio source to either J3 or J5 (or both), or connect a stereo audio source to J4.
8. Connect 8Ω speakers or 32Ω headphones to headphone jack (J10)
9. Connect your power supply to the P-N-P board.
10. Push S1 to the “on” position, and activate your audio source.

Step 10 will activate the EVMs present on the P-N-P. If you do not hear sound, please consult the troubleshooting section of the P-N-P Board application report (SLOU001).

To use power from J1, J2, B1, a DC/DC converter must be used in U6. If no converter is present use DC power at J6.



1. Overview

1.1 Introduction

The TPA302 Sample EVM is designed to provide the circuitry required to evaluate the TPA302 performance without having to invest in PCB layout or assembly. Refer to the application note in the TPA302 data sheet (SLOS174) for a description of the circuit configuration and selection of components.

1.2 Layout

Figure 1 TPA 302 EVM Circuit Component Placement

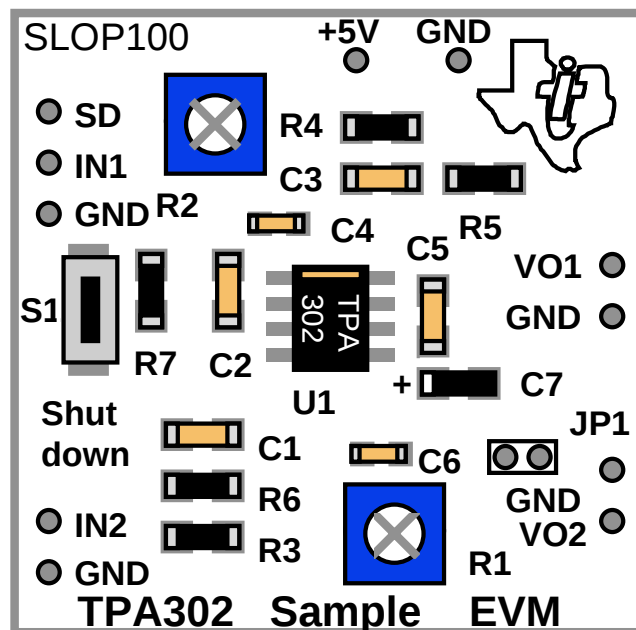


Figure 2 TPA 302 EVM Circuit Board Layout

	U1 - TPA302D Stereo 300mW Audio Amplifier
	C1, C3 - Capacitor, 1.0 μ F Ceramic
	C2, C5 - Capacitor, 2.2 μ F Ceramic
	C4, C6 - Capacitor, 5 pF Ceramic
	C7 - Capacitor, 10 μ F Electrolytic
	R1, R2 - Potentiometer, 200 k Ω 3/4 Turn
	R3, R4, R5 - Resistor, 20 k Ω Carbon
	R6, R7 - Resistor, 20 k Ω Carbon
	S1, - Switch, Normally Open, Momentary
	JP1, - x mm Header, Leave Open for normal operation, Closed for VO2 = Virtual GND

1.3 Operation Notes

The TPA302 EVM (SLOP100) was designed to plug into TI's Plug-n-Play Audio Evaluation Platform (SLOP097). Slot U5 on the Plug-n-Play is compatible with the TPA302 EVM. No soldering is required for use in the Plug-n-Play system. Standard speaker jacks, RCA jacks and 1/8" headphone jacks are provided on the Plug-n-Play for quick and easy evaluation of all TI audio power amplifiers. The TPA302 is normally used for driving headphone and line outputs on notebook computers but it has very robust output stages which are well suited to drive stereo 8 ohm speakers up to 300 mW.

The connection pins of the TPA302 EVM are on a 0.1" grid for easy interface to standard plugboard based prototype systems.

The thermal layout of the EVM is important. Linear Audio Power Amplifiers dissipate large amounts of heat during operation. The data sheet for the TPA302 (SLOS174a) details heat dissipation for 5 V and 3.3 V applications. The GND pin should be connected to as much copper area as possible on the surface of the PCB. This copper area should then be connected with vias to ground plane layers inside the PCB. This becomes more important in high ambient temperature applications.

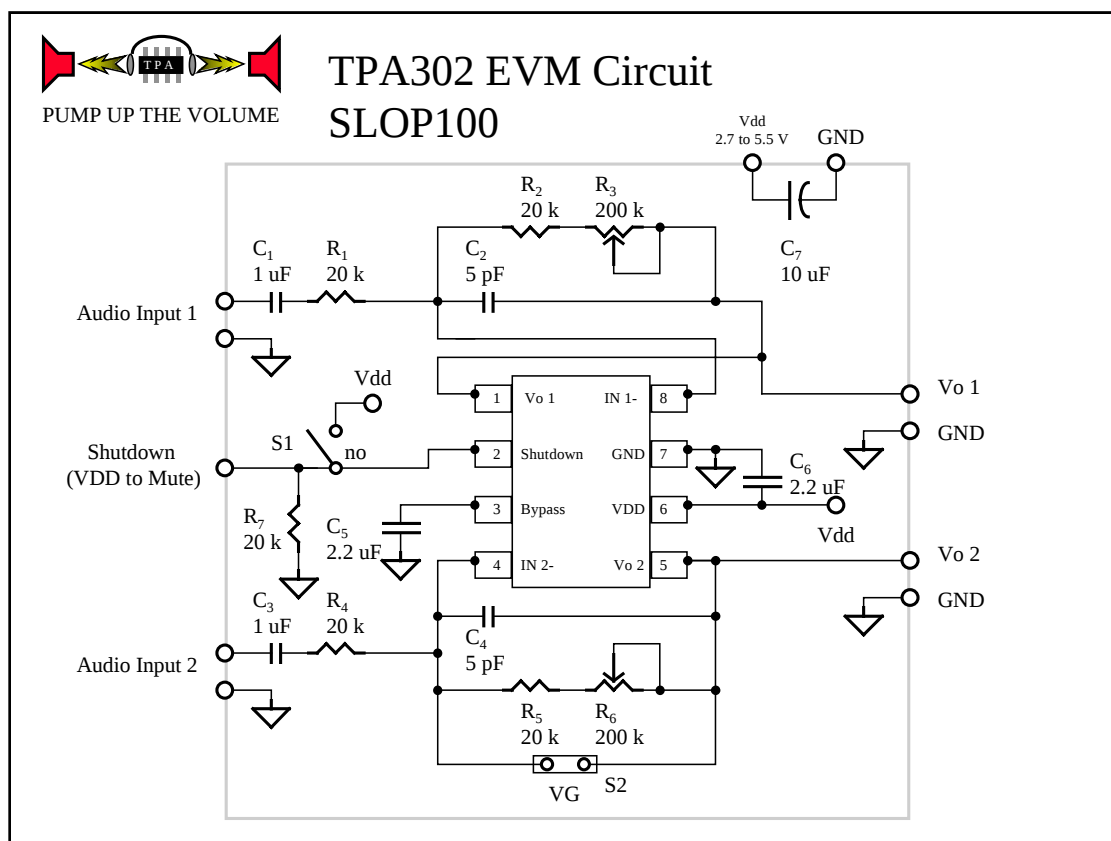


The 8-pin SOIC package is adequate for most room temperature applications. A thermal layout will enhance the performance. The TPA302 SOIC package is specially designed to enhance thermal performance when pin 7 (GND) is tied to a copper area. Special consideration should be given to the thermal layout due to the effect on maximum ambient temperature operation. It is recommended to place a copper area under the IC equal to the flat area of the IC body. This copper area should then be connected to the ground plane layer by vias. The vias should not use WEBed connections but should have a solid connection to the copper areas. The solid connections makes a much better thermal connection.

2. User's Guide

2.1 Schematic

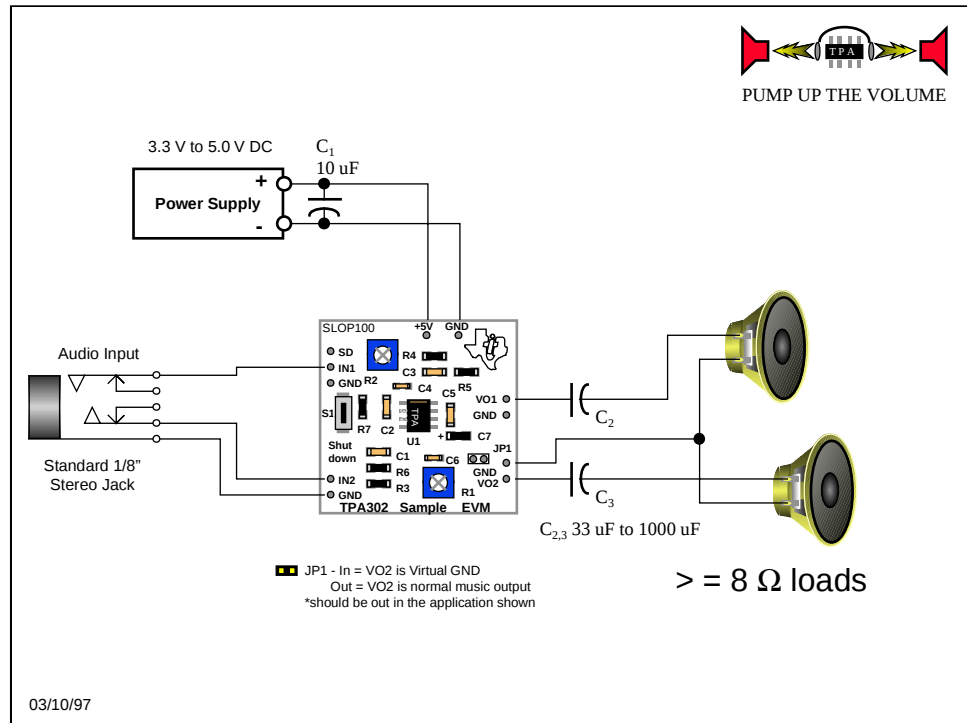
Figure 3 Schematic Diagram of the TPA302 Evaluation Module





2.2 Input/Output Connections – Stereo

Figure 4 TPA302 EVM Connections Diagram for Stereo Operation (Single-Ended)



The connections diagram shows a TPA302 EVM (SLOP100) configured to drive stereo speakers. A standard 1/8" stereo input jack is shown providing a convenient connection to CD players and other commercial sources of audio signals. The speakers in this configuration could easily be replaced by a standard 1/8" stereo jack for headphone operation.

2.2.1 Key Features:

The key features of the TPA302 EVM are:

- ❑ Stereo drive of 8 ohm speakers or 32 ohm headphones.
- ❑ Shutdown - The shutdown input on the EVM can be controlled from an external TTL source or a switch. The shutdown switch will mute the speakers when pushed and place the IC in an ultra-low current mode.
- ❑ Gain Control Pots R1 and R2 - Each of the gain control pots should be adjusted to the same level as they act as a balance control in a stereo application. As can be seen by referring to the data sheet for the TPA302, lower gains produce better distortion

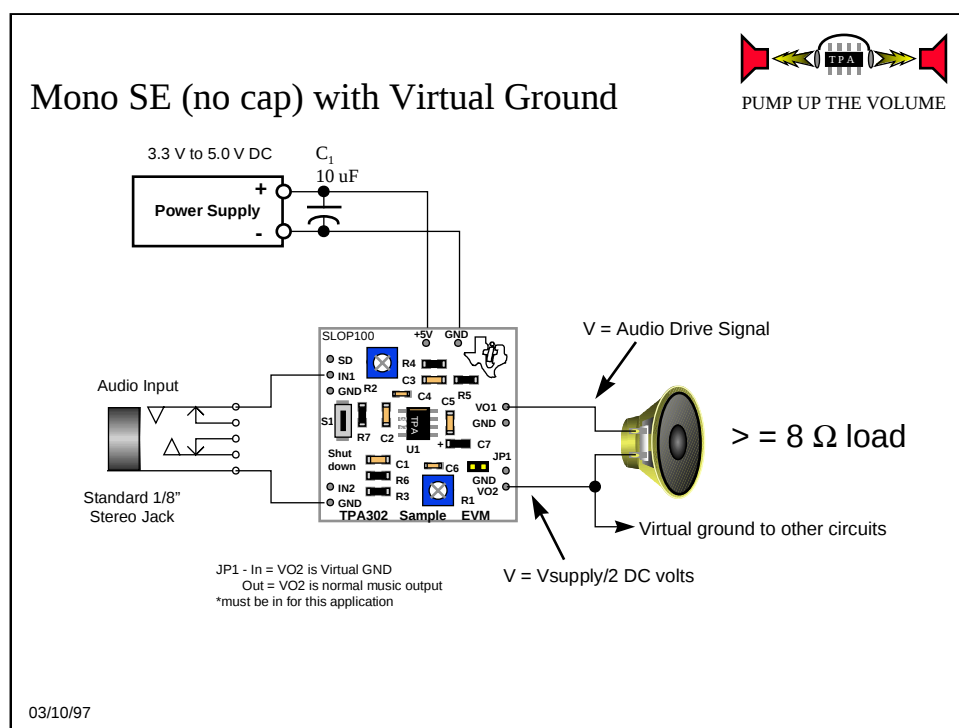
performance. Gain Vs THD should be considered in each application. The gain is adjustable from 1 to 11 on the EVM.
 NOTE: Most speakers have significantly worse distortion than the TPA302 will have at max gain in the EVM.

With 8 Ω speakers, 250 mW rms power levels are possible at less than 0.1% Total Harmonic Distortion with a steady-state sine wave input. Real music power will vary according to the type of music. Peak to average ratios vary greatly among different types of music. A 9 to 12 dB peak to average ratio is a good figure for rough calculations. In terms of power this means 250 mW peaks would come from an average power of 16 mW for 12 dB and 32 mW for 9 dB.

$$\text{Headroom}_{\text{dB}} = 10 \log (P_{\text{max}}/P_{\text{avg}})$$

2.3 Input/Output Connections – Mono

Figure 5 TPA302 EVM Connections Diagram for Mono Operation



The TPA302 EVM can be used in a special mono mode that eliminates the need for the output coupling cap. This would primarily be used in an application where a single small (250 mW or less) speaker or mono earphone drive is required.

Jumper JP1 shorts the the feed back of the VO2 amplifier creating a gain of 0 in that path:

$$G = - R_F/R_I .$$



This locks the output to midrail creating a virtual ground. “Virtual Ground” is a term used to describe a midrail voltage which is common to single supply applications. The low output impedance and high current rating of the TPA302 outputs makes the virtual ground configuration ideal for connection to other parts of the analog circuitry for signal biasing etc.

In this configuration R1 is bypassed and has no effect on circuit operation. Control Pot R2 is used to adjust the gain of the amplifier from 1 to 11.

2.4 Controls

The TPA302 Sample EVM is designed to provide the basic circuitry required to evaluate TPA302 performance without having to invest in PCB layout and assembly. Refer to the application note in the TPA302 data sheet (SLOS174) for a description of the basic circuit configuration and selection of components.

Power: 2.7 to 5.5 Vdc, 500 mA max.

Audio Inputs: Stereo, Cap Coupled (1.0 μ F), 4 Vpp Max @ G = 1

Speaker Outputs: SE 8 Ω drive, 250 mW rms continuous
SE 32 Ω drive, 70 mW rms continuous

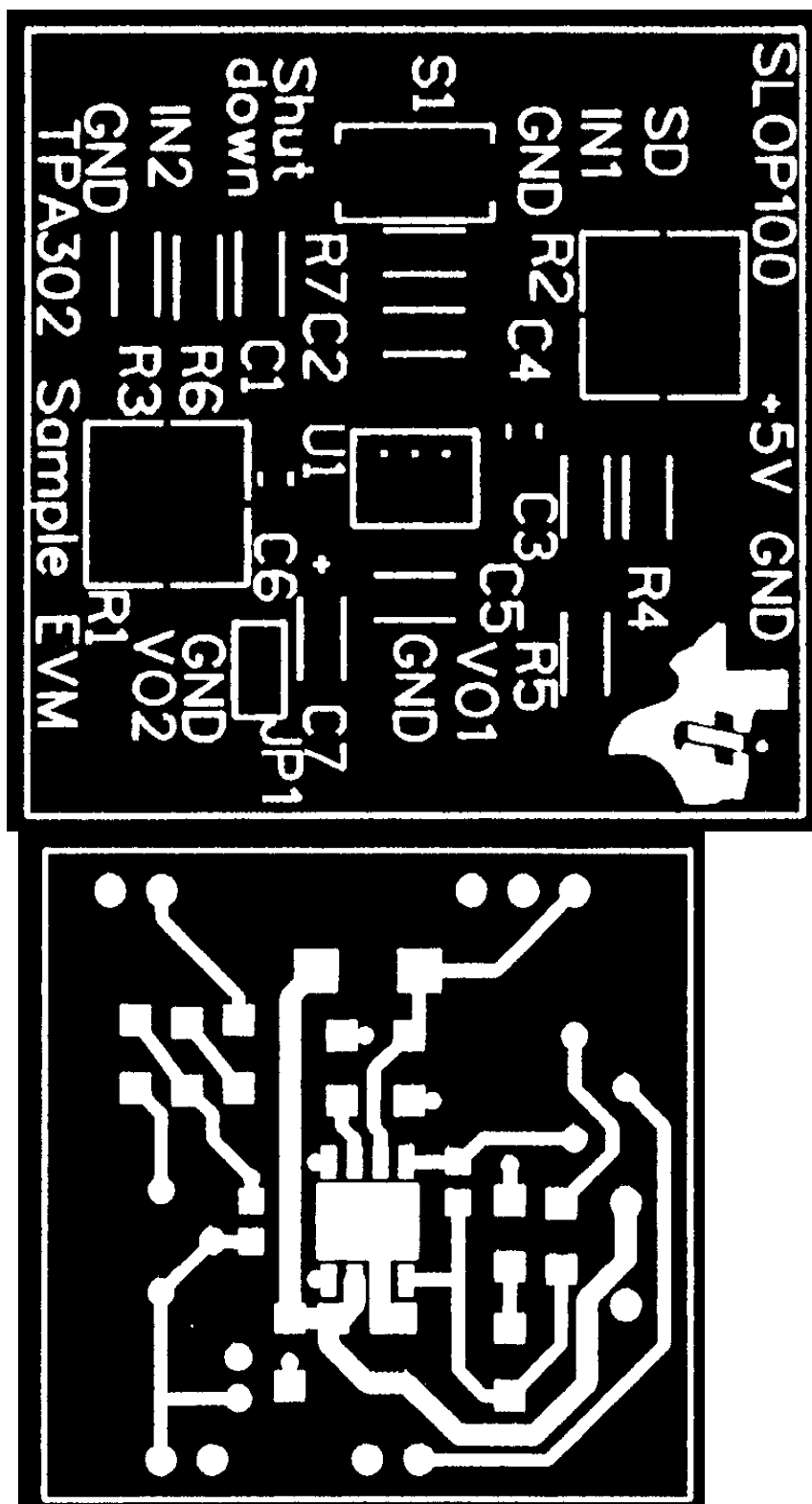
Shutdown Input/Switch: High places amplifier in ultra-low current state. Outputs are muted. Switch is a momentary action push button. Press S1 to mute.

Virtual Ground (JP1): The virtual ground feature disables amp 2 for AC operation and locks its output at $V_{DD}/2$. Connect JP1 for Virtual ground operation. Remove JP1 for normal operation.

R1/R2 Gain Control Pots: 3/4 turn adjusts amplifier gain from 1 to 11. Clockwise increases gain.

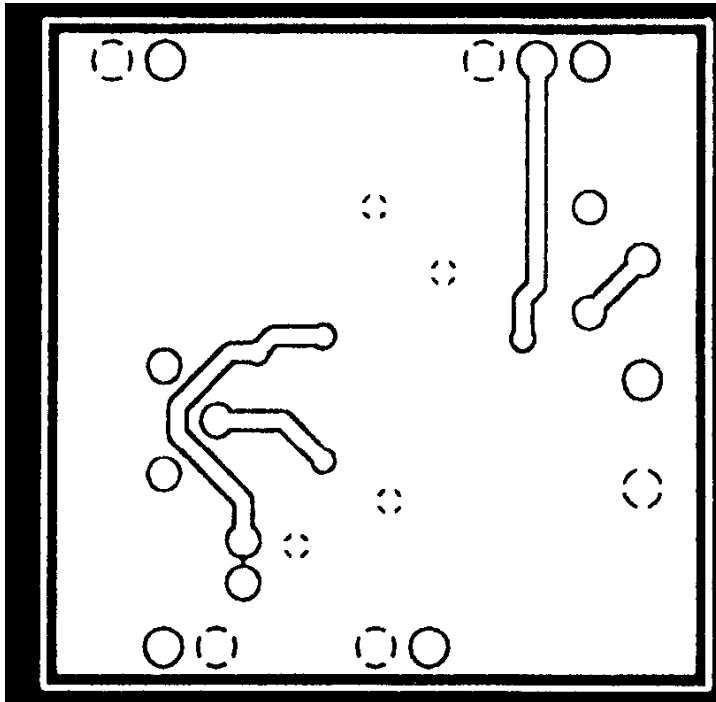
2.5 Layout

NOTE: Layouts are not to scale.





NOTE: Layouts are not to scale.





2.6 Bill of Materials

DESCRIPTION	REFERENCE	QUANTITY	MANUFACTURER'S	MANUFACTURER'S
	DESIGNATOR		PART NUMBER	PART NUMBER
POTENTIOMETER, 200K OHM, CERMET ST SL, THRU HOLE	R1,R2	2	(BOURNS)	(DIGI-KEY)
CAPACITOR, 10UF, 6.3V, SMD, SIZE "A"	C6	1	3323P-1-204 (PANASONIC)	3323P-204-ND (DIGI-KEY)
CAPACITOR, 1.0UF, +80/-20%, NON POLARIZED, SMD SIZE 1206	C1,C3	2	ECS-TOJY106R (MURATA) GRM42-	PCS1106CT-ND (NEWARK)
CAPACITOR, 2.2UF,20%, NON- POLARIZED, SMD SIZE 1206	C2,C5	2	6Y5V105Z16BL (TDK) C3216X5R1A225	93F2254
CAPACITOR, 5.0 PF, SMD, SIZE 0805	C4,C6	2	(PANASONIC)	(DIGI-KEY)
RESISTOR, 20 K OHM, 1/8W, 5%, SMD, SIZE 1206	R3,R4,R5,R6,R7	5	ECU-V1H050CCN (PANASONIC)	PCC050CNCT-ND (DIGI-KEY)
SWITCH, MOMENTARY, SMD	S1	1	ERJ-8GEYJ203 (PANASONIC)	P20KECT-ND (DIGI-KEY)
INTEGRATED CIRCUIT, TP302, AUDIO AMPLIFIER, 300mW, 2 CHANNEL,SMD, SOIC-8	U1	1	P8048SCT-ND	P8048SCT-ND
PRINTED CIRCUIT BOARD, TPA302 SAMPLE EVM	PCB1	1	(COMPURROUTE) TOOL # 008051	