# TPA302
# Audio Power Amplifier Evaluation Module

*DATA MANUAL: SLOU006*

*Date: July 1997*

TEXAS INSTRUMENTS

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# 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*

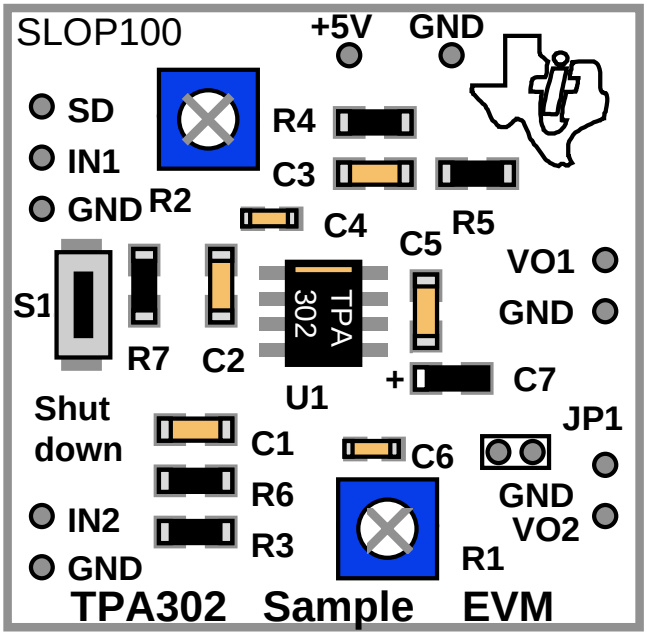
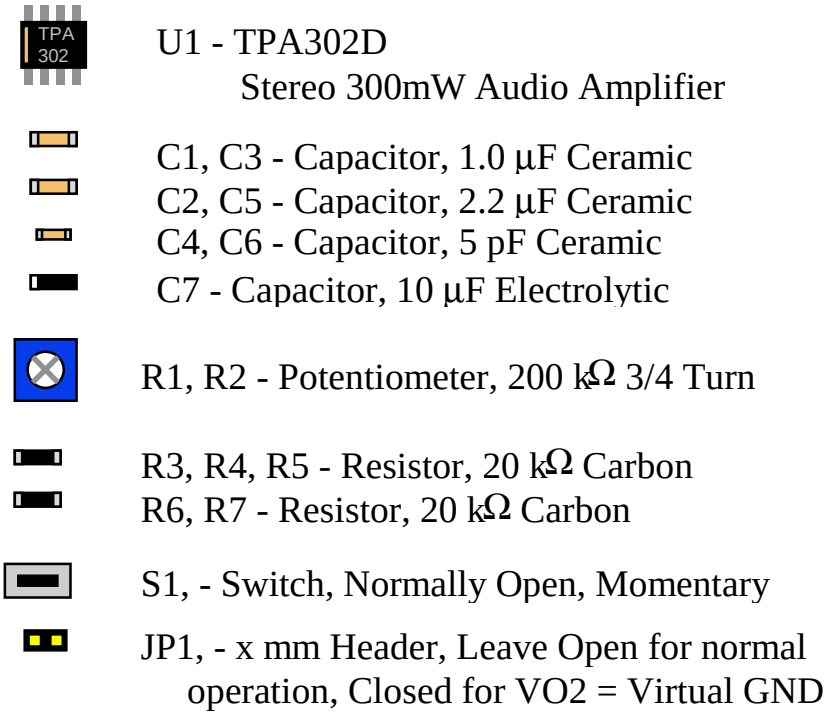


*Figure 2 TPA 302 EVM Circuit Board Layout*




## 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 ouput 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.

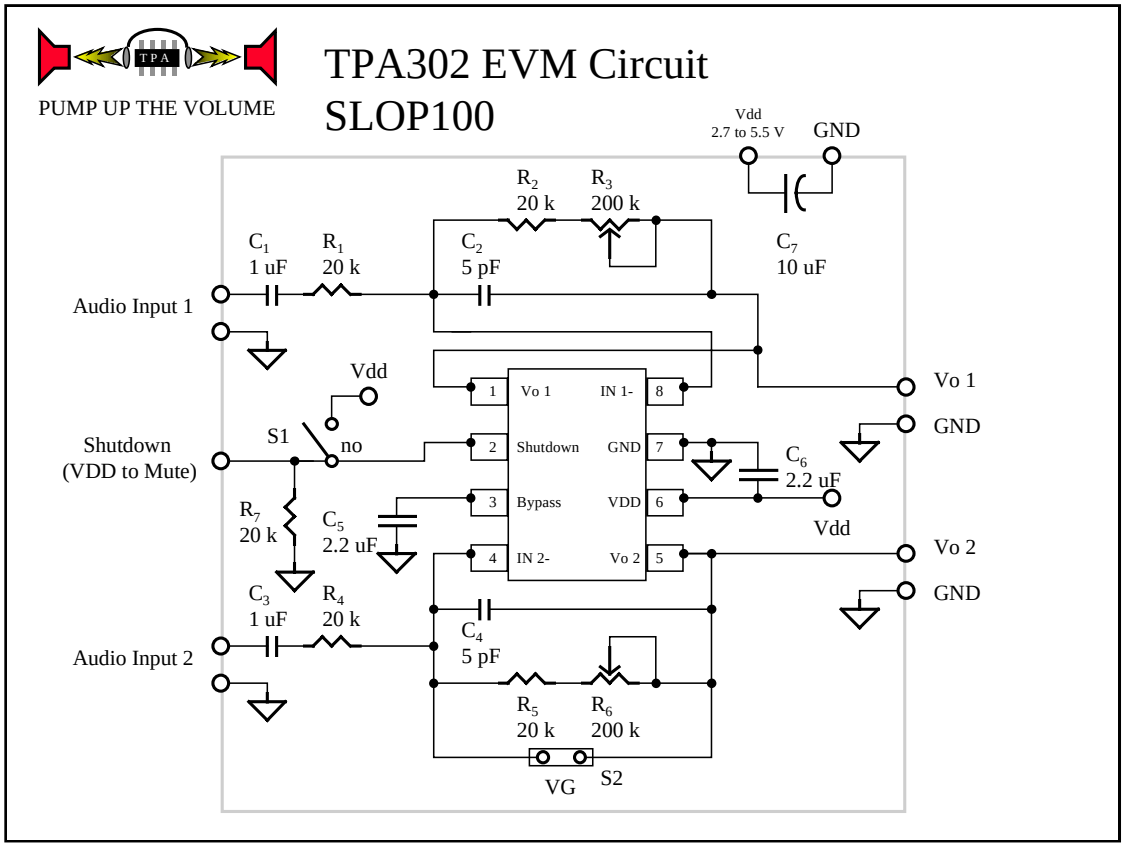
The thermal layout of the EVM is important. Linear Audio Power Amplifiers dissipate large amounts of heat during operation. The data sheet for the TPA302 (SLOS174a) details heat dissipation for 5 V and 3.3 V applications. The GND pin should be connected to as much copper area as possible on the surface 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

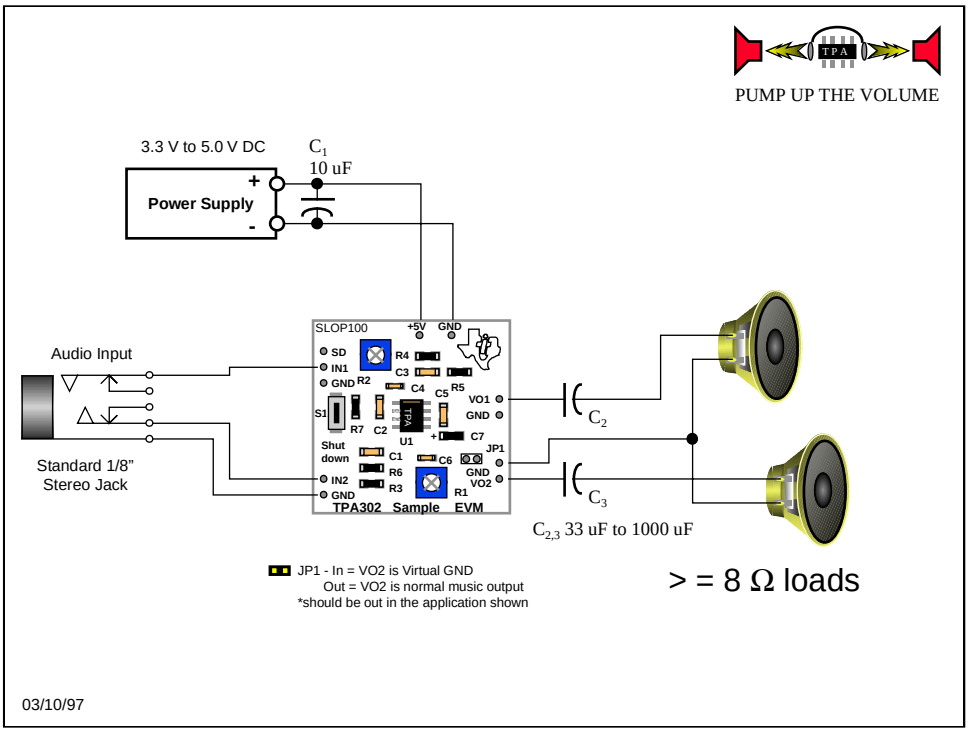
## 2.1 Schematic

*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

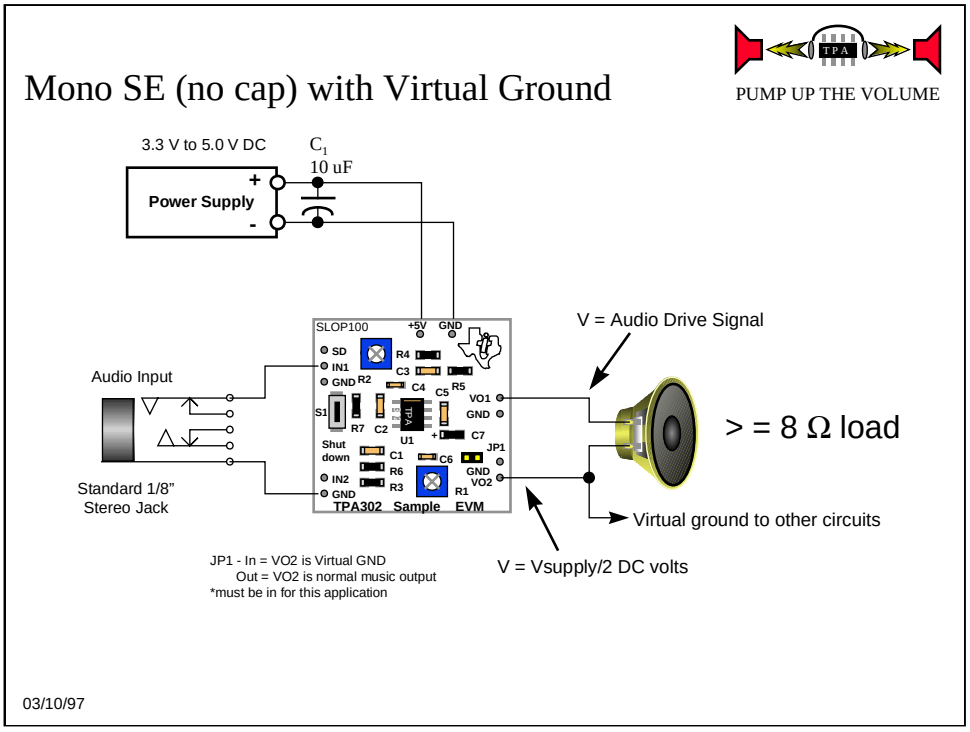
performance. Gain Vs THD should be considered in each application. The gain is adjustable from 1 to 11 on the EVM. NOTE: Most speakers have significantly worse distortion than the TPA302 will have at max gain in the EVM.

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.

$Headroom_{dB} = 10 \text{ Log } (P_{max}/P_{avg})$

## 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 uF), 4 Vpp Max @ G = 1

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

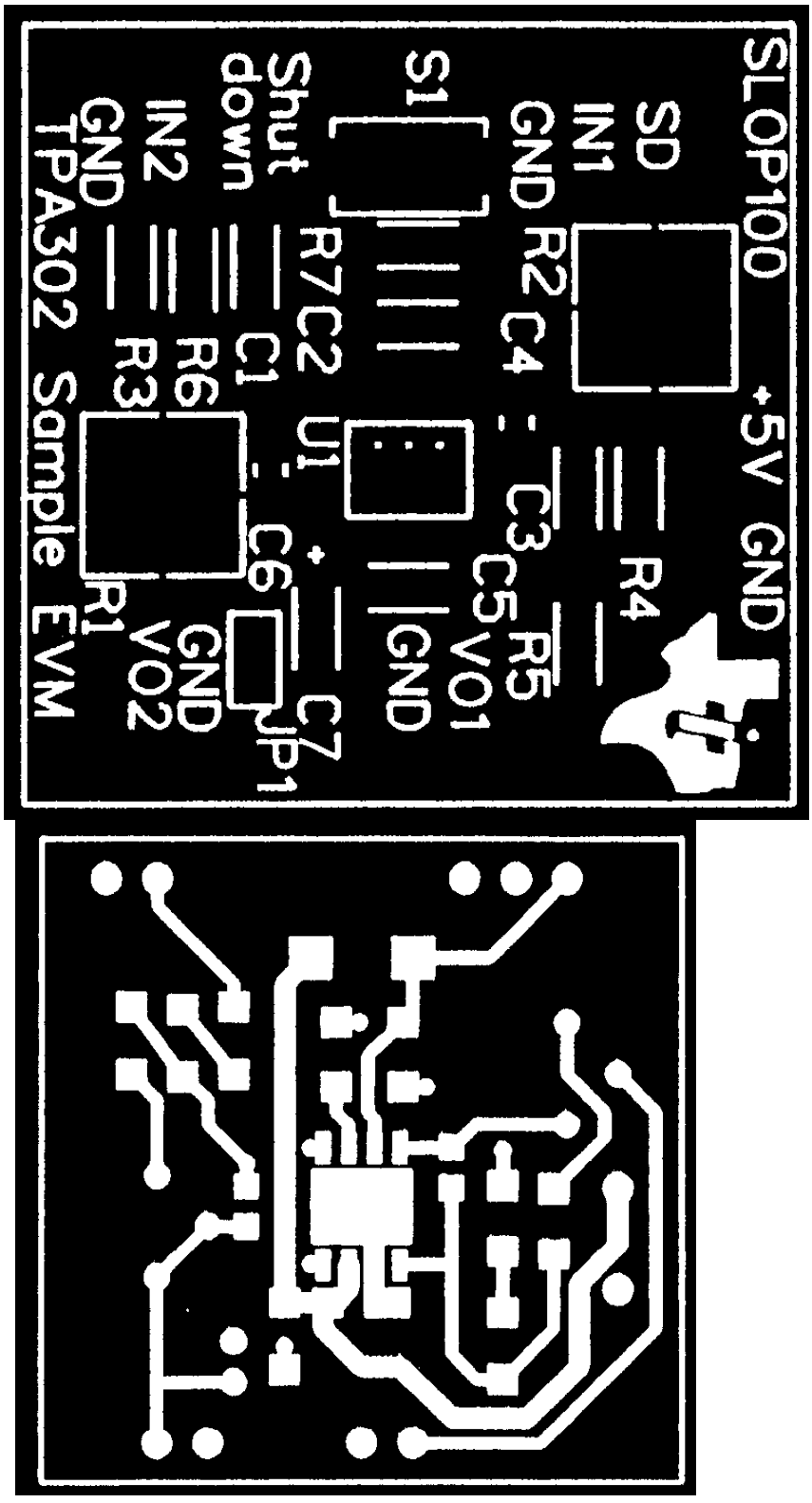
Shutdown Input/Switch: High places amplifier in ultra-low current state. Outputs are muted. Switch is a momentary action push button. Press S1 to mute.

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.

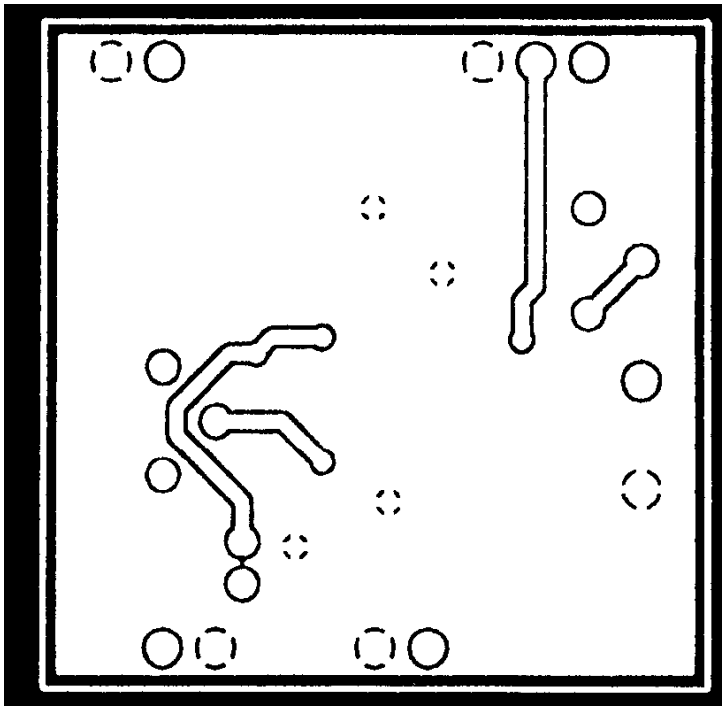
**R1/R2 Gain Control Pots: 3/4 turn adjusts amplifier gain from 1 to 11. Clockwise increases gain.**

## 2.5 Layout

**NOTE:** Layouts are not to scale.



**NOTE:** Layouts are not to scale.



## 2.6 Bill of Materials

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