

TPA4860

Audio Power Amplifier

Evaluation Module

DATA MANUAL: SLOU003

Date: July 1997



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Operating the TPA4860 Audio Power Amplifier Sample EVM (SLOP098)

Abstract

The Texas Instruments (TI™) TPA4860 audio power amplifier sample evaluation module (EVM) (SLOP098) incorporates the circuitry required for designers of notebook, cellular, and other hand-held audio systems to evaluate the performance of the TPA4860 audio power amplifier without investing in a PC board layout and assembly (see the application note in the TPA4860 data sheet (SLOS164) for a description of the circuit configuration and selection of components).

The TPA4860 EVM plugs into TI's Plug-N-Play Audio Amplifier Evaluation Platform (SLOP097). The platform is a convenient evaluation vehicle incorporating the required circuitry to power and test all of its compatible audio power amplifier EVMs and thus eliminate the need for external implementation.

The TPA4860 EVM can be used with the TPA4861 EVM (SLOP099) to derive various drive configurations.



I. Quick Start

Included below is a quick checklist of setup steps to get the TPA4860 up and running fast.

1. Set S1 to the “off” position.
2. Align the TPA4860 with either socket U3 or U4, such that the side with 4 pins is adjacent to the speaker connections, 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 and JP8 to Hi, and JP6 to mute. This arrangement causes the TPA4860 to be active when no 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 (only if a headphone EVM is connected to U5).
7. Connect a mono audio source to either J3 (U3) or J5 (U4) (or both), or connect a stereo audio source to J4.
8. Connect an 8 ohm speaker(s) to either (or both of) the RCA jacks at J7 (U3) and J9 (U4) or to the wire clips at J8.
9. Connect your power supply to the P-n-P board.
10. Push S1 to the “on” position. Activate your audio source

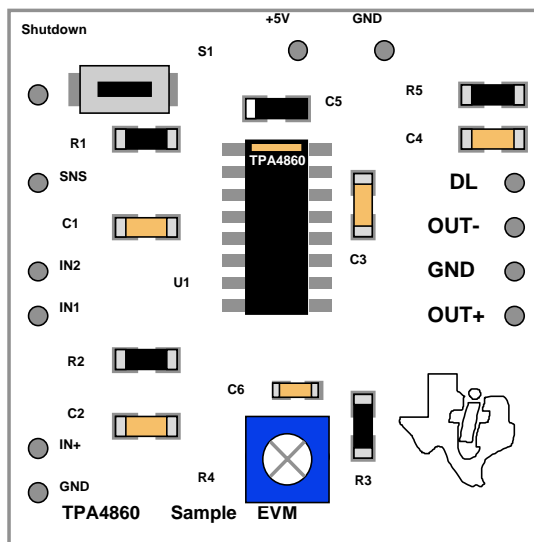
Step 10 will activate the EVMs present on the P-n-P. If you do not hear sound, please consult the troubleshooting section of the P-n-P Board application report (SLOU001).

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











1. Layout Definition

The TPA4860 is a CMOS device designed primarily for bridge tied load (BTL) operation (please consult the TPA4860 data sheet, SLOS164) in notebook, cellular, and other hand-held audio systems. The typical supply current of 3.5 mA at 5 V makes the TPA4860 an ideal upgrade for battery powered applications. The TPA4860 also includes headphone interface logic circuitry to facilitate headphone applications. Figure 1 shows The TPA4860 audio amplifier EVM layout.

Figure 1. TPA4860 Audio Amplifier EVM Circuit Component Placement



Legend:

-  U1 - TPA4860D Mono 1 W Audio Amplifier
-  C1, C3 - Capacitor, 2.2 μ F Ceramic
-  C2 - Capacitor, 1.0 μ F Ceramic
-  C4 - Capacitor, 0.1 μ F Ceramic
-  C5 - Capacitor, 10 μ F Electrolytic
-  C6 - Capacitor, 5 pF Ceramic
-  R1, R2, R3 - Resistor, 20 k Ω Carbon
-  R4 - Potentiometer, 200 k Ω 3/4 Turn
-  R5 - Resistor, 51 Ω Carbon
-  S1, - Switch, Normally Open, Momentary



The TPA4860 sample EVM offers the following key features:

- ❑ Mono Bridge Tied Load (BTL) drive for 8 ohm speakers and above
- ❑ SNS output and shutdown input
- ❑ The SNS output follows the logical OR combination of HP1 and HP2. Such that IN1, IN2 headphone sense inputs used as mute switch inputs
- ❑ Shutdown Input
- ❑ Gain Control Pot R4

Lower gains produce better distortion performance (see the TPA4860 data sheet for more information). Gain vs total harmonic distortion (THD) should be considered in each application. The gain adjustment range on the EVM is 2 to 22.

NOTE:

Most speakers have significantly worse distortion than the TPA4860 at high gain settings.

The TPA4860 is packaged in a 16-pin small-outline integrated circuit (SOIC), which is adequate for most room-temperature applications.

The thermal layout of the EVM is important because linear audio power amplifiers dissipate large amounts of heat during operation (see the TPA4860 data sheet (SLOS164) for details on heat dissipation for 5 V and 3.3 V applications). All GND pins must be connected to as much copper area as possible on the surface of the PC board. These copper areas should then be connected with vias to ground plane layers inside the PC board. These connections become even more important in high ambient temperature applications.

The connection pins of the TPA4860 EVM are on a 0.1" grid for easy interface to standard plugboard-based prototype systems.



2. Operation

The TPA4860 EVM is compatible with the TI Plug-N-Play Audio Amplifier Evaluation Platform slots U3 and U4.

No soldering is required for use in the plug-and-play (PnP) system. The evaluation platform includes standard speaker jacks, RCA jacks, and 1/8" stereo input jacks for quick and easy evaluation of all TI TPA series audio power amplifiers.

The TPA302 EVM (SLOP100) is recommended for use as the headphone drive.

For standalone use, connections diagrams are shown in figures 3 and 4.



3. Input/Output Connections

Figure 2. TPA4860 EVM Schematic

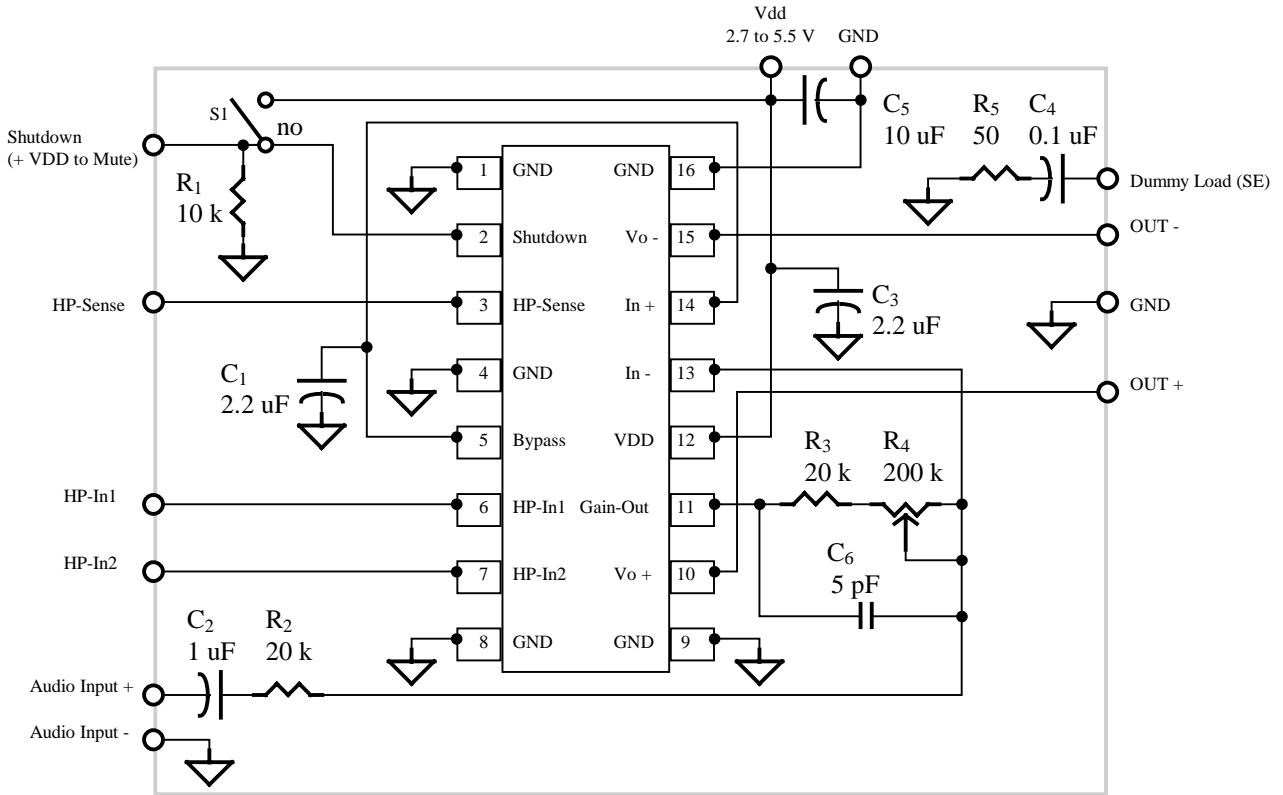
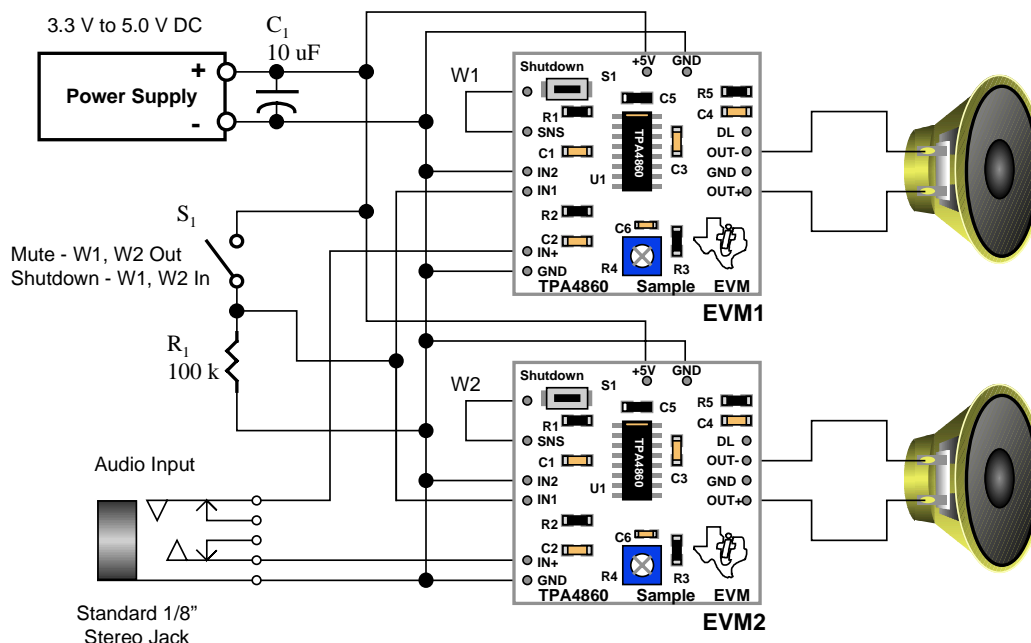


Figure 3 shows the TPA4860 connections diagram for stereo BTL drive configuration. The BTL configuration eliminates the large output coupling capacitors and quadruples the available output power when compared to single-ended (SE) solutions. As a result, the total PC board space required is much smaller than SE configurations of the same output power. A standard 1/8" stereo input jack provides a convenient connection to CD players and other commercial sources of audio signals.

Figure 3. TPA4860 Circuit Application Connections Diagram, BTL Drive

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TPA4860 Sample EVM Circuit



EVM1 drives the right channel and EVM2 drives the left channel. Power levels of 1 W rms are possible with 8 ohm speakers and a steady-state sine wave input. Real music power and peak-to-valley ratios vary according to the type of music played. A 9 to 12 dB peak to average ratio is a good figure for rough calculations. In terms of power, this means 1 W peaks come from an average power of 63 mW for 12 dB and 126 mW for 9 dB as described in the following equation:

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

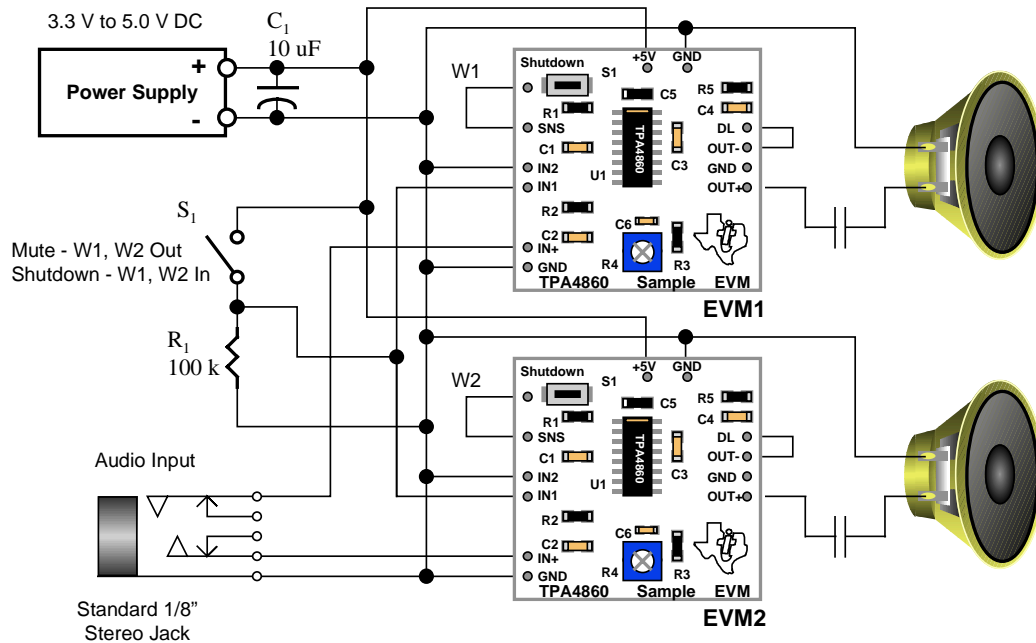
Figure 4 shows the TPA4860 connections diagram for stereo SE drive configuration. The SE drive configuration requires the output from Out- to be connected to the Dummy Load (DL) input to prevent the unused output from becoming unstable and possibly oscillating during operation. Oscillations cause unwanted noise that can couple into other circuits (see the TPA4860 data sheet for details).



For SE mode, to prevent DC currents from flowing into the speaker output coupling, capacitors are required. Output power using the SE drive is reduced by a factor of four (see the applications section in the TPA4860 data sheet for details of the tradeoffs between BTL and SE operation).

Figure 4. TPA4860 Circuit Application Connections Diagram, SE Drive

TPA4860 Sample EVM Circuit





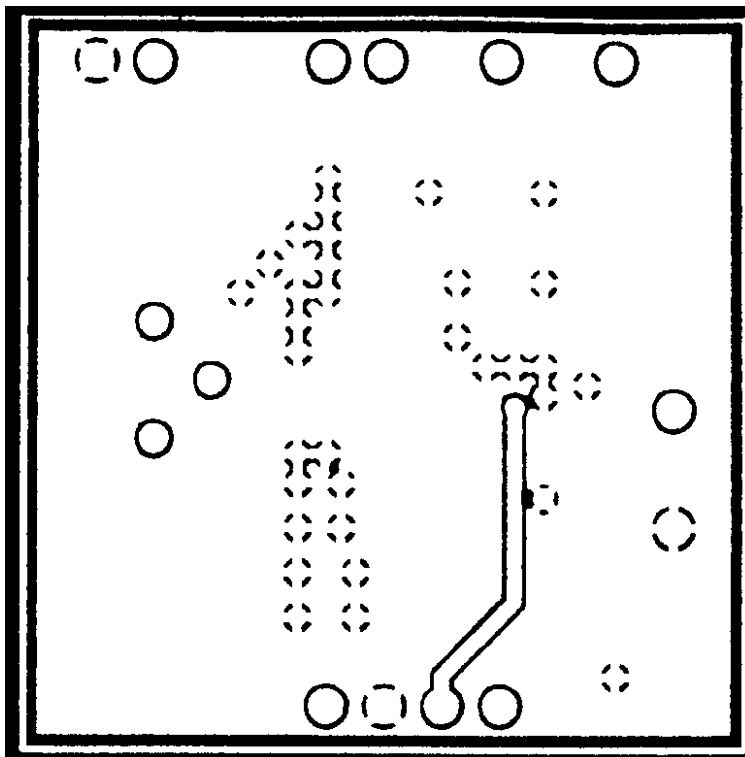
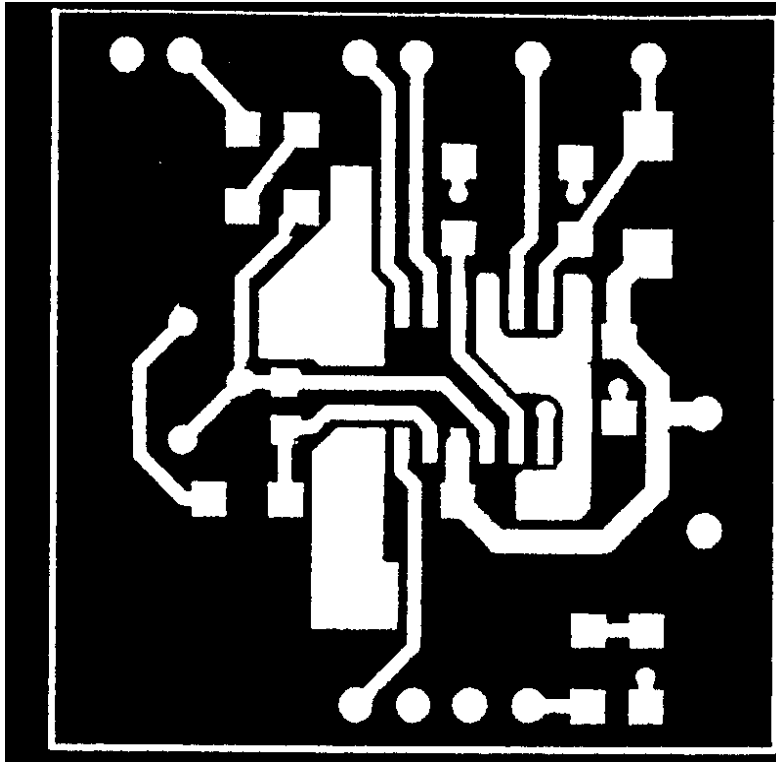
4. Specifications

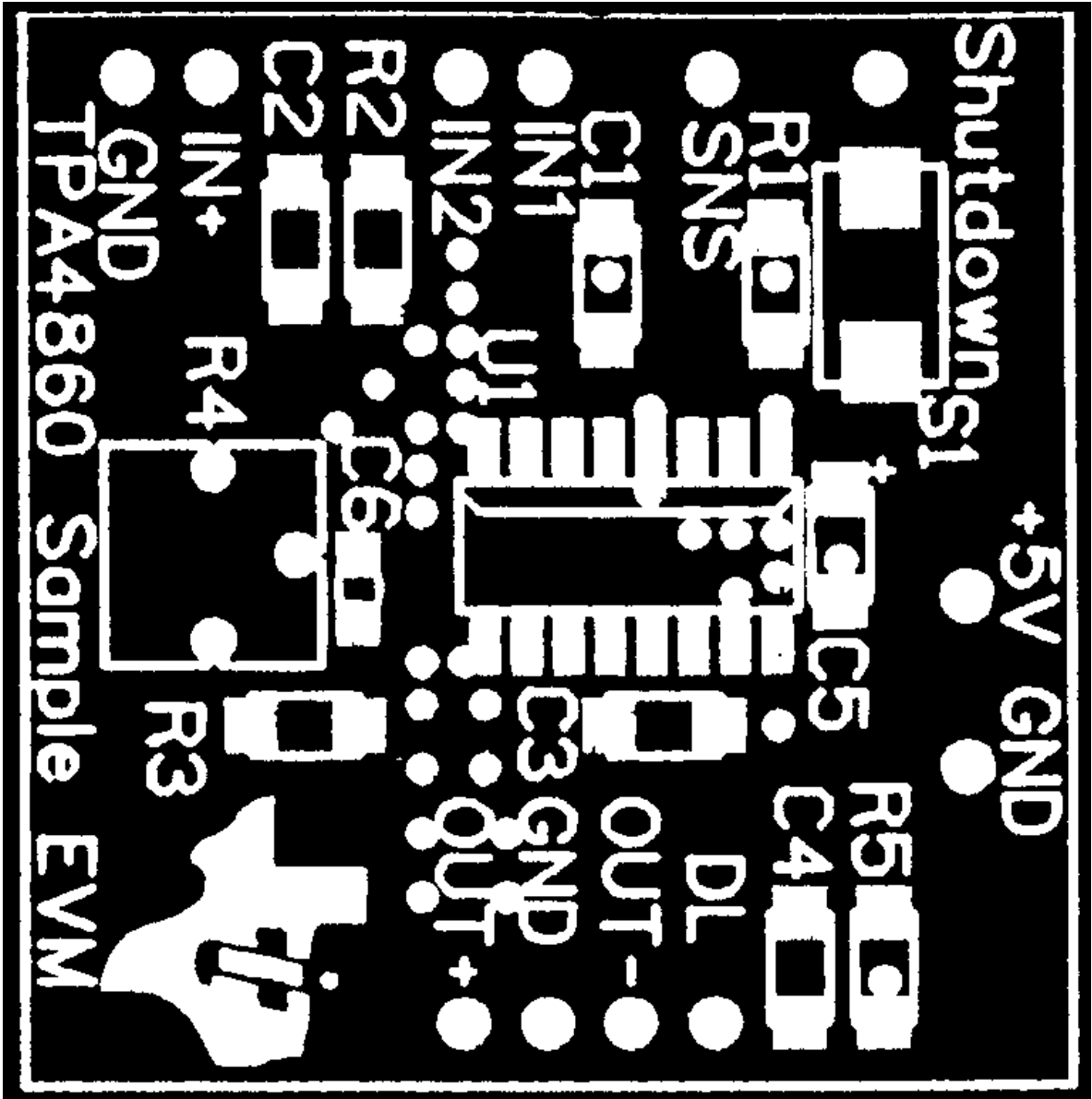
Power	2.7 to 5.5 Vdc, 500 mA max.
Audio Input	Mono, Cap Coupled (1.0 μ F), 4 Vpp Max @ G = 1
Speaker Outputs	BTL 8 ohm drive, 1 W rms continuous SE 8 ohm drive, 250 mW rms continuous SE 32 ohm drive, 70 mW rms continuous
Dummy Load Input (DL)	Recommended tie to Out- when operating in SE mode
Shutdown Input/Switch	High places amplifier in ultra-low current state. Outputs are muted. Switch is a momentary action push button. Press to mute.
HPIn1, HPIn2 Inputs	High on either input places amplifier in low current mute state.
HP Sense Output	Logic level follows OR logic of HPIn1, HPIn2.
R4 Gain Control Pot	3/4 turn adjusts amplifier gain from 2 to 20 BTL, 1 to 10 SE. Clockwise increases gain.



5. Layout

NOTE: Layouts are not to scale.





NOTE: Layouts are not to scale.



6. Bill of Materials

Description	Ref. Desig.	PCBA Qty	Manufacturer Part Number	Digi Key Part Number
Pot., 200 K Ohm Cermet ST SL, Thru Hole	R4	1	Bourns 3323P-1-204	Digi-Key 3323P-204-ND
Cap., 10 μ F/6.3 V,SMD,Size "A"	C5	1	Panasonic ECS-TOJY106R	Digi-Key PCS1106CT-ND
Cap., 1.0 μ F, +80/-20%, Non-Polarized, SMD Size 1206	C2	1	Murata GRM42-6Y5V105Z16BL	Newark 93F2254
Cap., . μ F/16 V,SMD,Size 1206	C4	1	Panasonic ECS-H1CY104R	Digi-Key PCT104BCT-ND
Cap., 5.0 pF, SMD, SIZE 0805	C6	1	Panasonic ECU-V1H050CCN	Digi-Key PCC050CNCT-ND
Cap., 2.2 μ F,20%, Non- Polarized, SMD Size 1206	C1,C3	2	TDK C3216X5R1A225	
Res., 20 K Ohm, 1/8 W, 5%, SMD, Size 1206	R1, R2, R3	3	Panasonic ERJ-8GEYJ203	Digi-Key P20KECT-ND
Res., 510 Ohm, 1/8 W, SMD, Size 1206	R5	1	Panasonic ERJ-8GEYJ511	Digi-Key P510ECT-ND
Switch, Momentary, SMD	S1	1	Panasonic P8048SCT-ND	Digi-Key P8048SCT-ND
IC., TPA4860, Audio Amplifier, $\frac{1}{2}$ W, Mono,SMD, SOIC-8	U1	0	TI TPA4860	
PCB, TPA4680 Sample EVM	PCB1	1	Compuroute Tool # 007696	