TEXAS INSTRUMENTS

TPA0252
Audio Power Amplifier
Evaluation Module

User's Guide

2001

Mixed-Signal Products

SLOU102

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Preface

How to Use This Manual

This document contains the following chapters:

- ❑ Chapter 1—Introduction
- ❑ Chapter 2—Operation

Information About Cautions and Warnings

This book may contain cautions and warnings.

This is an example of a caution statement.

A caution statement describes a situation that could potentially damage your software or equipment.

This is an example of a warning statement.

A warning statement describes a situation that could potentially cause harm to you.

The information in a caution or a warning is provided for your protection. Please read each caution and warning carefully.

Related Documentation From Texas Instruments

- ***TI Plug-N-Play Audio Amplifier Evaluation Platform*** (literature number SLOU011) provides detailed information on the evaluation platform and its use with TI audio evaluation modules.
- ***TPA0252 Stereo 2-W Audio Power Amplifier With Digital Volume Control*** (literature number SLOS288) This is the data sheet for the TPA0252 audio amplifier integrated circuit.

FCC Warning

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

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Chapter 1

Introduction

This chapter provides an overview of the Texas Instruments TPA0252 audio amplifier evaluation module (SLOP333). It includes a list of EVM features, a brief description of the module illustrated with a pictorial diagram, and a list of EVM specifications.

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1.1 Feature Highlights

The TI TPA0252 audio amplifier evaluation module and the TI plug-n-play audio amplifier evaluation platform include the following features:

- TPA0252 stereo 2-W audio power amplifier evaluation module
  - Internal depop circuitry to minimize transients in outputs
  - Powers up at mute volume level to avoid pop
  - Dual channel, bridge-tied load (BTL) or single-ended operation
  - 2 W per channel output power into 3 Ω at 5 V, BTL
  - Low current consumption in shutdown mode (150 μA)
  - Internal input MUX selects among two sets of stereo inputs
  - Digital volume control from 20 dB to –40 dB
  - Internal memory restores volume setting after shutdown or power down
  - Microprocessor mode volume control
  - Differential stereo inputs
  - PC beep input

- Quick and easy configuration with the TI plug-n-play audio amplifier evaluation platform
  - Evaluation module is designed to simply plug into the platform, automatically making all signal, control, and power connections
  - Platform provides flexible power options
  - Jumpers on the platform select power and module control options
  - Switches on the platform route signals
  - Platform provides quick and easy audio input and output connections

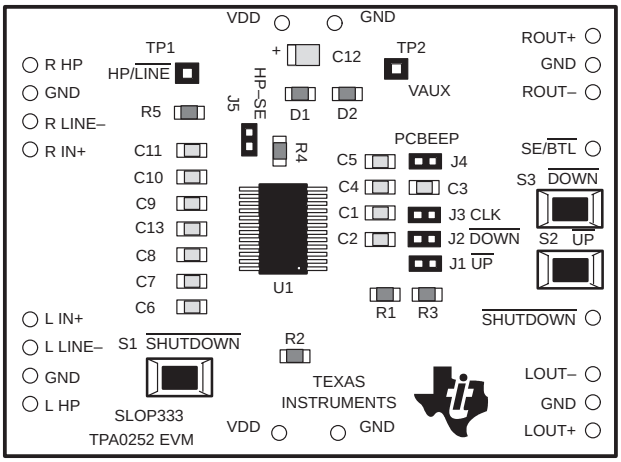
- Platform power options
  - External 5-V – 15-V DC V_{CC} supply inputs
  - External regulated V_{DD} supply input
  - Socket for onboard 5-V/3.3-V V_{DD} voltage regulator EVM
  - Onboard overvoltage and reverse polarity power protection

- Platform audio input and output connections
  - Left and right RCA phono jack inputs
  - Miniature stereo phone jack input
  - Left and right RCA phono jack outputs
  - Left and right compression speaker terminal outputs
  - Miniature stereo headphone jack output

1.2 Description

The TPA0252 stereo 2-W audio amplifier evaluation platform is a complete, 2 W per channel stereo audio power amplifier. It consists of the TI TPA0252 stereo 2-W audio power amplifier IC along with a small number of other parts mounted on a circuit board that measures approximately 2 1/4 inches by 1 1/2 inches (see Figure 1–1).

Figure 1–1. The TI TPA0252 Audio Amplifier Evaluation Module



Single in-line header pins extend from the underside of the module circuit board to allow the EVM to be plugged into the TI plug-n-play audio amplifier evaluation platform, or to be wired directly into existing circuits and equipment when used stand-alone.

The platform has room for a single TPA0252 evaluation module and is a convenient vehicle for demonstrating TI's audio power amplifier and related evaluation modules. The EVMs simply plug into the platform, which automatically provides power to the modules, interconnects them correctly, and connects them to a versatile array of standard audio input and output jacks and connectors. The easy-to-use configuration controls allow the platform and EVMs to quickly model many possible end-equipment configurations.

There is nothing to build, nothing to solder, and nothing but the speakers included with the platform to hook up.

1.3 TPA0252 EVM Specifications

Supply voltage range, V_{DD} . . . . . 4.5 V to 5.5 V
Supply current, I_{DD} . . . . . 2 A max
Continuous output power per channel, P_O: 3-Ω BTL, V_{DD} = 5 V . . . . . 2 W
Audio input voltage, V_I: HP input . . . . . 5 Vpp max
Line input . . . . . 5 Vpp max
PC beep input . . . . . 5 Vpp max
Minimum load impedance, R_L . . . . . 3 Ω

Chapter 2

Operation

Quick start lists in this chapter contain steps that can be followed to quickly prepare the TI plug-n-play audio amplifier evaluation platform for use with the TPA0252 audio amplifier EVM, or to connect the TPA0252 audio amplifier EVM for stand-alone operation.

Using the TPA0252 audio amplifier evaluation module with the TI evaluation platform is a quick and easy way to connect power, signal and control inputs, and signal outputs to the EVM, using standard connectors.

The TPA0252 audio amplifier evaluation module can also be used stand-alone by making connections directly to the module pins, and it can be wired directly into existing circuits or equipment. A stand-alone connection diagram appears below.

A schematic, parts list, and PCB and layer illustrations for the EVM are included in the Reference section of this chapter.

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2.1 Precautions

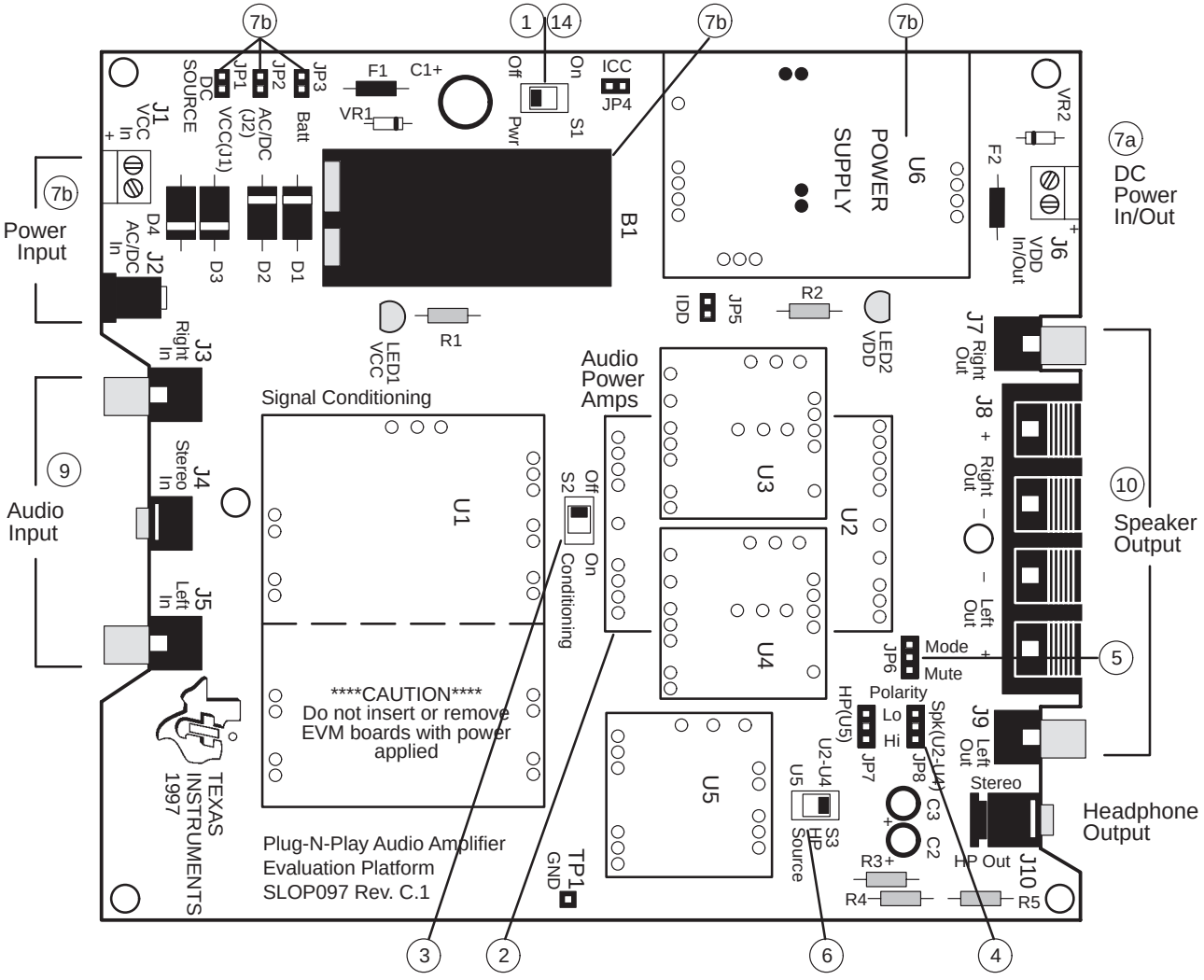
Power Supply Input Polarity and Maximum Voltage

Always ensure that the polarity and voltage of the external power connected to V_{CC} power input connector J1, J2, and/or V_{DD} power input connector J6 are correct. Overvoltage or reverse-polarity power applied to these terminals can open onboard soldered-in fuses and cause other damage to the platform, installed evaluation modules, and/or the power source.

Inserting or Removing EVM Boards

Do not insert or remove EVM boards with power applied—damage to the EVM board, the platform, or both may result.

Figure 2–1. Quick Start Platform Map



2.2 Quick Start List for Platform

Use the following steps when using the TPA0252 EVM with the TI plug-n-play audio amplifier evaluation platform (see the platform user's guide, literature number SLOU011, for additional details). Typical platform switch and jumper settings are shown in Table 2–1 and typical EVM settings are shown in Table 2–2. Numbered callouts for selected steps are shown in Figure 2–1 and Figure 2–2.

❑ **Platform preparations**

1) Ensure that all external power sources are set to OFF and that the platform power switch S1 is set to OFF.
2) Install a TPA0252 module in platform socket U2, taking care to align the module pins correctly.
3) Use switch S2 to select or bypass the signal conditioning EVM (U1).
4) Set control signal polarity jumper JP8 to Hi.
5) Set jumper JP6 to select the mode control input. This causes the TPA0252 to switch to the single-ended output mode if a plug is inserted into platform headphone jack (J10).
6) If the headphone jack (J10) output will be used, set headphone source switch S3 to U2–U4.

Table 2–1. Platform Jumper and Switch Settings for the TPA0252

EVM	JP6	JP7	JP8	S2	S3
P-N-P Platform	Mode	X	Hi	Note 2	U2–U4

Notes: 1) X = Don't care
2) Set S2 to ON when signal conditioning board is installed in U1; set S2 to OFF when no signal conditioning board is installed.

❑ **Power supply**

7) Select and connect the power supply (ensure power supply is set to OFF):
   a) Connect an external regulated power supply, set to 5 V, to platform VDD power input connector J6 taking care to observe the marked polarity,
      or
   b) Install a voltage regulator EVM (SLVP097 or equiv.) in platform socket U6. Connect a 7-V – 12-V power source to the platform V_{CC} power input J1 or J2 and jumper the appropriate power input (see the platform user's guide).

❑ **Inputs and outputs**

8) Ensure that the audio signal source level is set to minimum.
9) Connect the audio source to the left and right RCA phono jacks J3 and J5 or the stereo miniature phone jack J4.
10) Connect speakers to the left and right RCA jacks J7 and J9 or to the stripped wire speaker connectors J8.

❑ **Evaluation module preparations**

Figure 2–2. Module Preparation

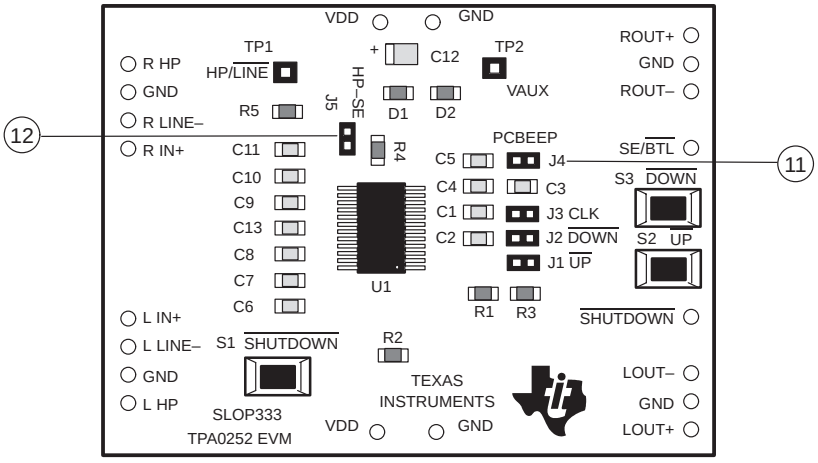


Table 2–2. Typical TPA0252 EVM Jumper Settings

EVM	J1	J2	J3	J4	J5
TPA0252	ON	ON	ON	ON	ON

Note: ON = Shunt installed, OFF = Open

11) To use the PCBEEP input, set J4 to OFF and drive a 1-Vp–p, 1-kHz squarewave into the capacitor side of the jumper. If the PCBEEP input is not being used, set jumper J4 to ON.

12) To allow the EVM amplifier IC to switch from the line inputs to the HP inputs when the output mode switches from BTL to SE (and vice versa), set jumper J5 to ON. To allow the input and output modes to switch independently, set jumper J5 to OFF.

13) When the module powers up or comes out of shutdown, the volume is set at the –85 dB level. Press the UP pushbutton (S2), until the desired volume level is reached.

❑ **Power up**

14) Verify the correct voltage and input polarity and set the external power supply to ON. If V_{CC} and an on-board regulator EVM are used to provide V_{DD}, set the platform power switch S1 to ON.

Platform LED2 should light indicating the presence of V_{DD}, and the evaluation modules installed on the platform should begin operation.

15) Adjust the signal source level as needed.

2.3 Quick Start List for Stand-Alone

Follow these steps to use the TPA0252 EVM stand-alone or when connecting it into existing circuits or equipment. Connections to the TPA0252 module header pins can be made via individual sockets, wire-wrapping, or soldering to the pins, either on the top or the bottom of the module circuit board. Typical EVM jumper settings are shown in Table 2–3. Numbered callouts for selected steps are shown in Figure 2–3.

❑ **Power supply**

1) Ensure that all external power sources are set to OFF.

2) Connect an external regulated power supply, set to 5 V, to the module VDD and GND pins taking care to observe the marked polarity.

❑ **Inputs and outputs**

3) Ensure that audio signal source level adjustments are set to minimum.

4) Connect the right (left) positive lead of the audio source to the module R LINE– (L LINE–) pins and the negative lead to the R IN+ (L IN+) pins. If using the headphone inputs, connect the positive audio source to the module R HP (L HP) and the negative lead to R IN+ (L IN+). The inputs can be used with a differential or a single-ended audio source, but the headphone and line have common positive inputs.

5) Select output mode:

   a) For BTL output, connect a speaker to the module OUT+ and OUT– pins of each channel,
      or

   b) For single-ended output, connect a headphone or a speaker to the module OUT+ and GND pins of each channel through a 33-μF to 1000-μF output-coupling capacitor.

❑ **Evaluation module preparations**

Figure 2–3. Stand-Alone Module Preparation

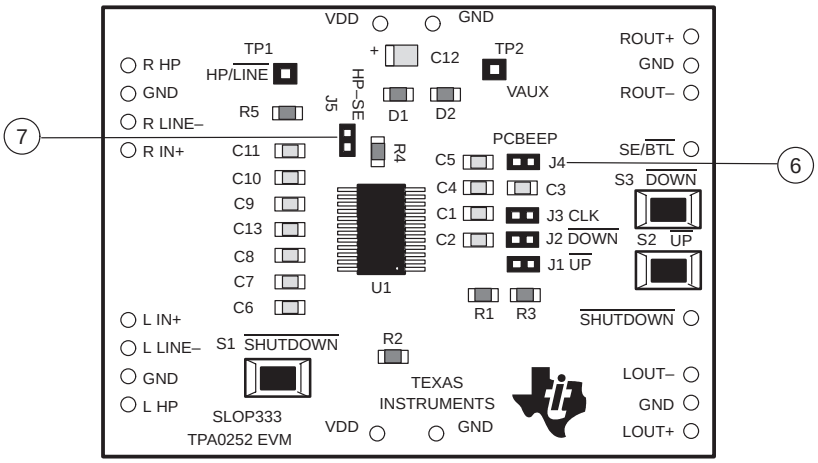


Table 2–3. Typical TPA0252 EVM Jumper Settings

EVM	J1	J2	J3	J4	J5
TPA0252	ON	ON	ON	ON	ON

Note: ON = Shunt installed, OFF = Open

6) To use the PCBEEP input, set J4 to OFF and drive a 1-Vp–p, 1-kHz squarewave into the capacitor side of the jumper. If the PCBEEP input is not being used, set jumper J4 to ON.

7) To allow the EVM amplifier IC to switch from the line inputs to the HP inputs when the output mode switches from $\overline{\text{BTL}}$ to SE (and vice versa), set jumper J5 to *ON*. To allow the input and output modes to switch independently, set jumper J5 to *OFF*.

8) When the module powers up or comes out of shutdown, the volume is set at the –85 dB level. Press the UP pushbutton (S2), until the desired volume level is reached.

❑ **Control Inputs**

9) Connect control lines to the various module control input pins as needed:

   a) SE/$\overline{\text{BTL}}$: A high selects the single-ended (SE) output mode; a low or float selects the bridge-tied load (BTL) output mode.

   b) HP/$\overline{\text{LINE}}$: A high selects the HP inputs; a low selects the LINE inputs.

   c) $\overline{\text{SHUTDOWN}}$: A low shuts down the amplifier IC on the module; a high or float allows normal operation.

❑ **Power-up**

10) Verify the correct voltage and input polarity and set the external power supply to ON.

The EVM should begin operation.

11) Adjust the signal source level as needed.

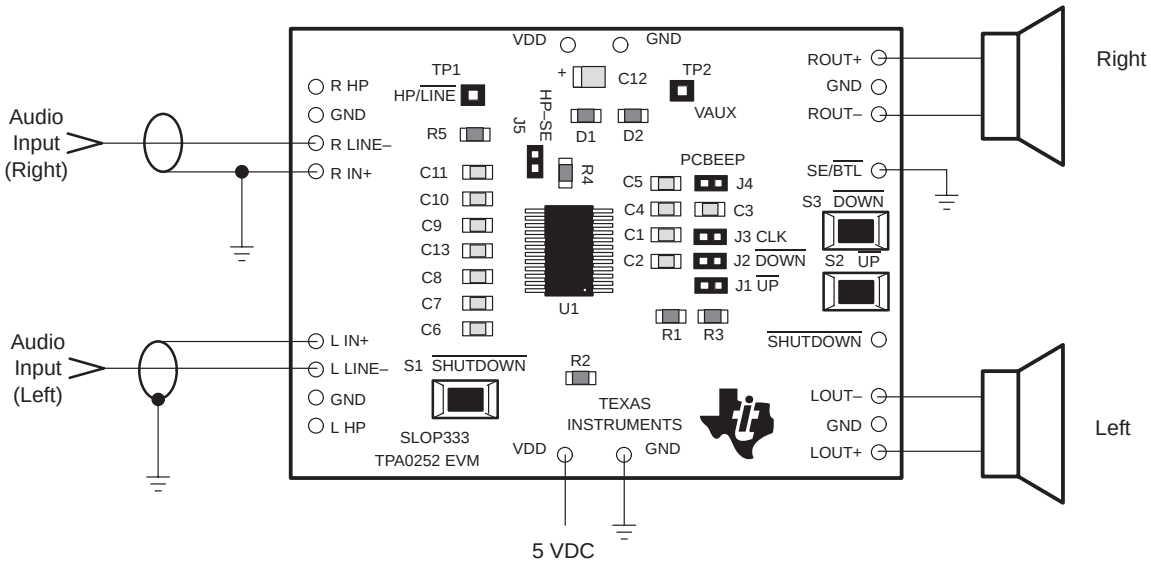
2.4 Stand-Alone Connection Diagram

Using the TPA0252 audio power amplifier evaluation module stand-alone is much the same as using it with the platform. The same 4.5-V to 5.5-V power supply range and the isolated OUT+ and OUT– lines for BTL operation requirement exists.

Note that the source of any control signals applied to the EVM control pins must be able to source or sink the current flowing through the pulldown or pullup resistors on the module (100 kΩ).

Figure 2–4 shows a TPA0252 EVM connected for stereo BTL operation.

Figure 2–4. TPA0252 EVM Connected for Stereo BTL Output



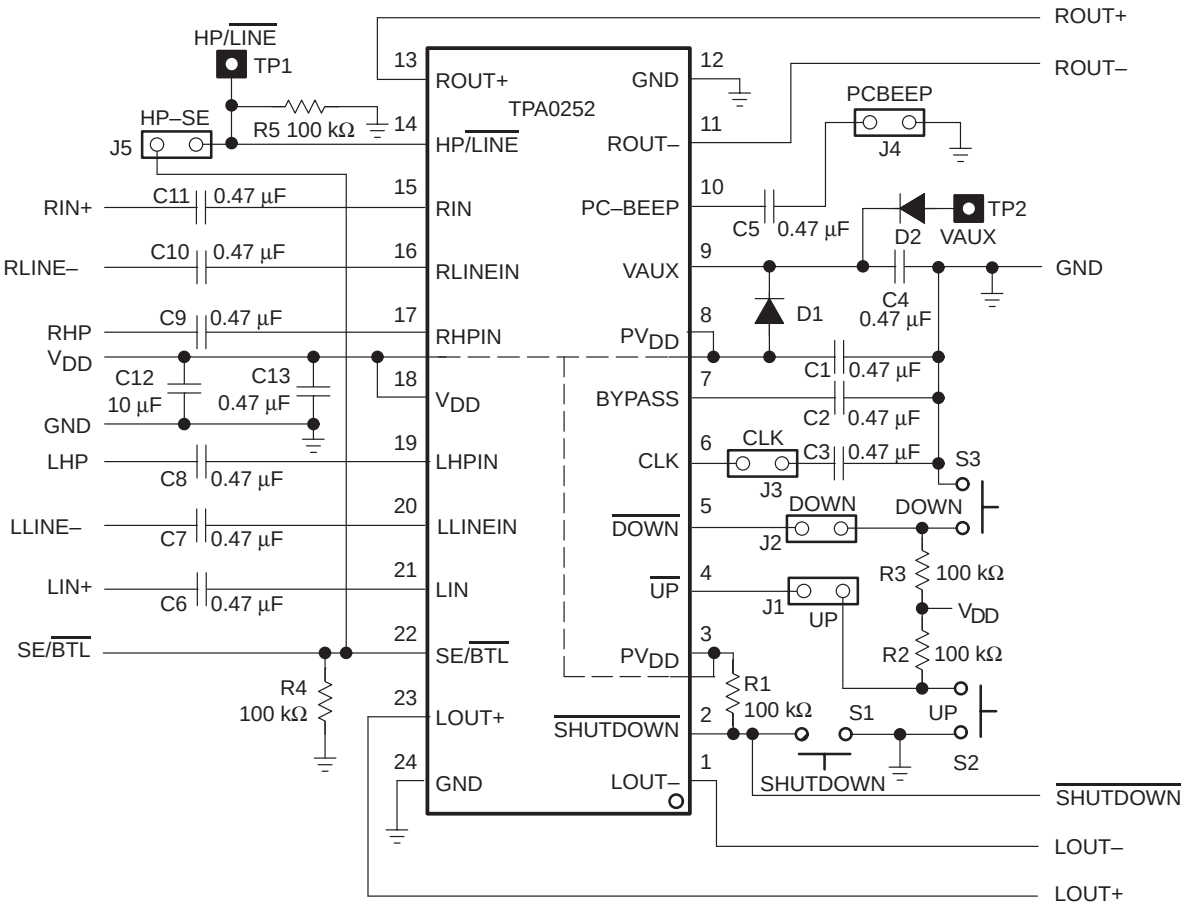
2.5 Reference

This section includes the TPA0252 EVM schematic, the EVM parts list, and the module PCB layers.

2.5.1 EVM Schematic

Figure 2–5 shows the TPA0252 EVM schematic.

Figure 2–5. TPA0252 EVM Schematic



2.5.2 EVM Parts List

Table 2–4 is the TPA0252 EVM parts list.

Table 2–4. TPA0252 EVM Parts List

Ref.	Description	Size	EVM Qty.	Manufacturer/ Part Number	Digi-Key Number
C1, C2, C14, C4–C11	Capacitor, 0.47 μF, 15 V, +80%/–20%, Y5V	0805	11	Panasonic 2VF1C474Z	Digi-Key PCC1847TR–ND
C3	Capacitor, 0.47 μF, 50 V, +80%/–20%, X7R	0805	1	Murata GRM40-X7R473K050BL	Arrow GRM40-X7R473K 050BL
C12	Capacitor, 10 μF, 16 V, +80%/–20%, Y5V	1210	1	Murata GRM235–Y5V106Z16	Arrow GRM235–Y5V106 Z16
R1–R5	Resistor, 100 kΩ, 1/10 W, 5%	0805	5	Panasonic ERJ-6GEYJ104V	Digi-Key P100KACT-ND
D1, D2	Diode, 1N4148, MINIMELF	SMD	2	MicroSemi DL4148	Digi-Key DL4148MSCT–ND
S1, S2, S3	Switch, momentary	SMD	3	Panasonic EVQ–PJX04K	Digi-Key P8050SCT-ND
TP1, TP2	Test points, red		2	Farnell 240–345	
J1–J5	Header, 2 position	2 mm	5	Norcomp	Digi-Key 2163S-02-ND
	Shunts	2 mm	5	2JM–G	Digi-Key SPE1302–ND
	Terminal posts, 0.1” centers		9	Sullins PTC36SABN	Digi-Key S1022–36–ND
U1	IC, TPA0252, audio amplifier, 2 W, 2 channel	24 pin TSSOP	1	TI TPA0252PWP	

2.5.3 Module PCB Layers

The following illustrations depict the TPA0252 EVM PCB layers and silkscreen. These drawings are not to scale. Gerber plots can be obtained from any TI Sales Office.

Figure 2–6. TPA0252 EVM PCB

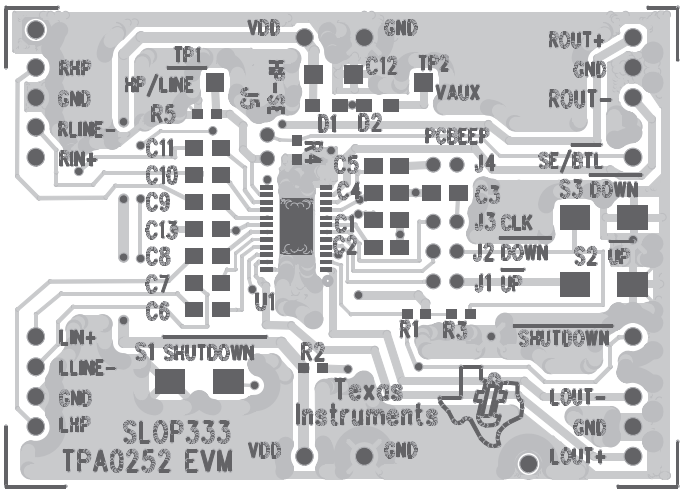


Figure 2–7. TPA0252 EVM Silkscreen

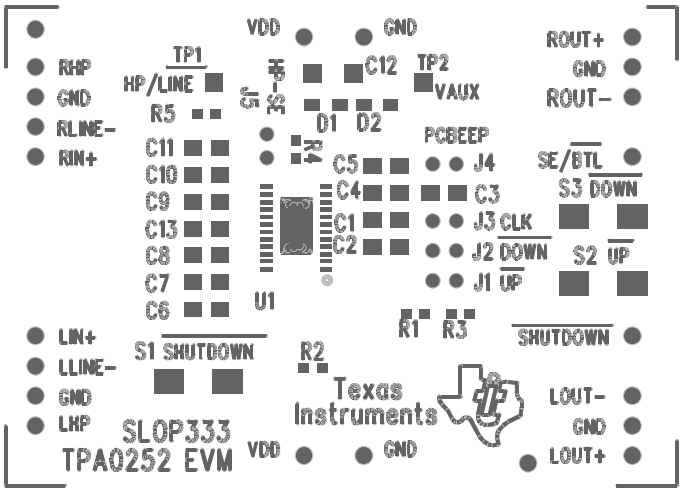


Figure 2–8. TPA0252 EVM Bottom Layer

