TEXAS INSTRUMENTS

TPA2001D1 Filterless Class-D Audio Power Amplifier EVM

User's Guide

2001

Mixed-Signal Products

SLOU090B

Read This First

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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.

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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.
- ***TPA2001D1 1-W Mono Class-D Audio Power Amplifier*** (literature number SLOS338) is the data sheet for the TPA2001D1 audio amplifier integrated circuit.

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Contents

1 Introduction 1-1
1.1 Feature Highlights 1-2
1.2 Description 1-3
1.3 TPA2001D1 EVM Specifications 1-4

2 Operation 2-1
2.1 Precautions 2-2
2.2 Quick Start List for Platform 2-3
2.3 Quick Start List for Stand-Alone 2-5
2.4 Reference 2-7
2.4.1 TPA2001D1 Filterless Class-D EVM Schematic 2-7
2.4.2 TPA2001D1 Audio Power Amplifier Evaluation Module Parts List 2-8
2.4.3 TPA2001D1 Filterless Class-D EVM PCB Layers 2-9

Figures

1–1 The TI TPA2001D1 Audio Amplifier EVM Without Output Filter—Top View 1-3
2–1 Quick Start Platform Map 2-2
2–2 Module Preparation 2-4
2–3 Quick Start Module Map 2-5
2–4 TPA2001D1 Class-D EVM Schematic Diagram 2-7
2–5 TPA2001D1 Filterless Class-D EVM Top Layer 2-9
2–6 TPA2001D1 FIlterless Class-D EVM Bottom Layer 2-9

Tables

2–1 Typical TI Plug-N-Play Platform Jumper and Switch Settings for the TPA2001D1 2-1
2–2 Typical TPA2001D1 EVM Jumper Settings 2-1
2–3 Platform Jumper and Switch Settings for the TPA2001D1 2-3
2–4 Typical TPA2001D1 EVM Jumper Settings 2-4
2–5 TPA2001D1 EVM Gain Settings 2-6
2–6 TPA2001D1 EVM Parts List 2-8

Chapter 1

Introduction

This chapter provides an overview of the Texas Instruments (TI) TPA2001D1 filterless class-D audio amplifier evaluation module (SLOU090). It includes a list of EVM features, a brief description of the module illustrated with a pictorial diagram, and a list of EVM specifications.

Topic **Page**

1.1 Feature Highlights 1–2

1.2 Description 1–3

1.3 TPA2001D1 EVM Specifications 1–4

1.1 Feature Highlights

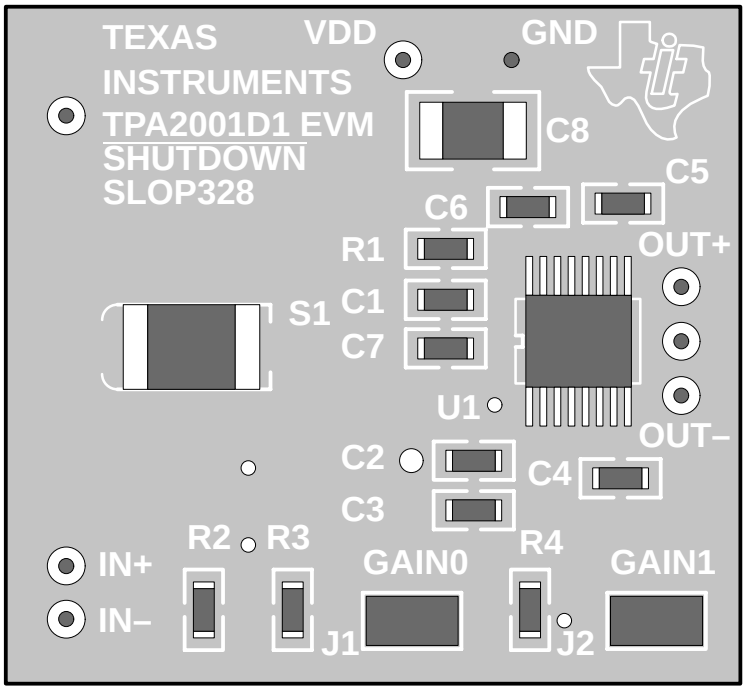
The TI TPA2001D1 audio amplifier evaluation module and the TI plug-n-play audio amplifier evaluation platform include the following features:

- TPA2001D1 Mono 1-W Filterless Class-D Audio Power Amplifier Evaluation Module
  - Class-D without output filter
  - 2.7-V to 5.5-V supply voltage range
  - Internal depop circuitry to minimize transients in outputs
  - High efficiency
  - Low distortion
  - Low-supply current (5 mA)
  - 1-W output power into 8 Ω at 5 V
  - Low current consumption in shutdown mode
  - Four selectable gain settings: 6, 12, 17.5, and 23.5 dB
  - Differential stereo input
  - 16-pin TSSOP PWP package
- 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 TPA2001D1 filterless class-D mono audio power amplifier evaluation module is a complete, 1-W class-D audio power amplifier that can operate without an output filter. It consists of the TI TPA2001D1 class-D mono 1-W audio power amplifier IC along with a small number of other parts mounted on a circuit board that measures approximately 1-1/4 inches by 1-1/4 inches (see Figure 1–1.

Figure 1–1. The TI TPA2001D1 Audio Amplifier EVM Without Output Filter—Top View



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 two TPA2001D1 evaluation modules 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. 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 TPA2001D1 EVM Specifications

Supply voltage range, V_{DD}	2.7 V to 5.5 V
Supply current, I_{DD}	1 A max
Continuous output power per channel, P_O: 8 Ω, V_{DD} = 5 V	1 W
Minimum load impedance, R_L	8 Ω

Chapter 2

Operation

Follow the steps in this chapter to quickly prepare the TPA2001D1 filterless class-D audio amplifier EVM for use. Using the TPA2001D1 with the TI plug-n-play audio amplifier evaluation platform is a quick and easy way to connect power, signal and control inputs, and signal outputs to the EVM using standard connectors. However, the audio amplifier evaluation module can be used stand-alone by making connections directly to the module pins and can be wired directly into existing circuits or equipment.

The platform switch and jumper settings shown in Table 2–1 are typical for the TPA2001D1 EVM and will cause the TPA2001D1 to shut down when a plug is inserted into platform headphone jack J10.

Table 2–1. Typical TI Plug-N-Play Platform Jumper and Switch Settings for the TPA2001D1

EVM	JP4	JP5	JP6	JP7	JP8	S2	S3
P-N-P Platform	X	ON	Mute	X	Lo	See Note 2	U5

Notes: 1) ON = Jumper installed, OFF = Jumper *NOT* Installed, 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.

Table 2–2. Typical TPA2001D1 EVM Jumper Settings

EVM	GAIN0	GAIN1
TPA2001D1	ON	ON

Note: ON = Jumper installed, OFF = Jumper *NOT* Installed, X = Don't care

Topic **Page**

2.1 Precautions 2–2
2.2 Quick Start List for Platform 2–3
2.3 Quick Start List for Stand-Alone 2–5
2.4 Reference 2–7

2.1 Precautions

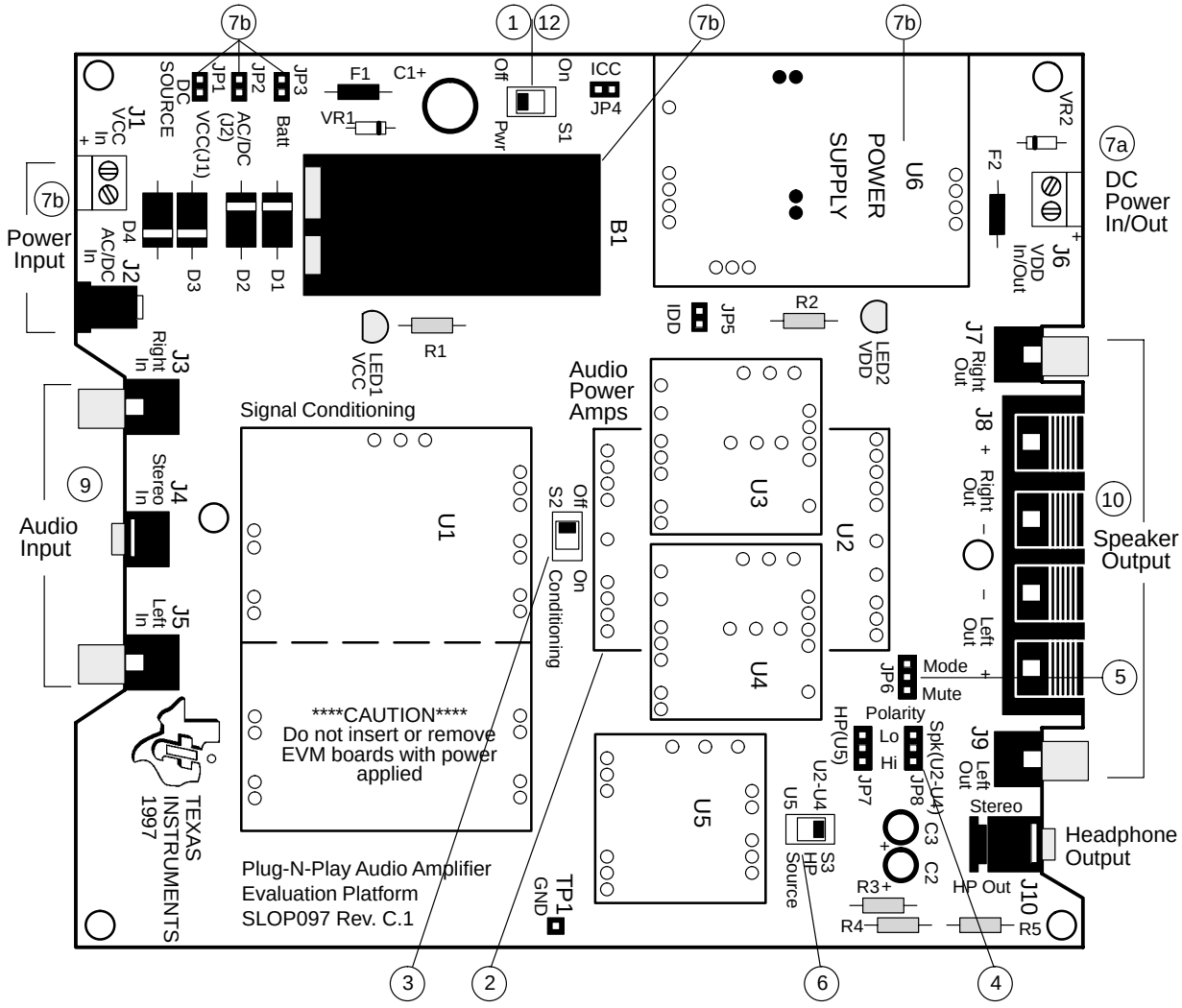
Power Supply Input Polarity and Maximum Voltage

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

Follow these steps when using the TPA2001D1 EVM with the TI plug-n-play audio amplifier evaluation platform (see the platform user's guide, literature number SLOU011, for additional details). 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 TPA2001D1 module in platform socket U3 or U4, 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 *Lo*.
5) Set jumper JP6 to select the Mute control input (causes the TPA2001D1 to shut down if a plug is inserted into platform headphone jack J10).
6) If a headphone amplifier is to be installed in U5, set the headphone source switch S3 to U5.

Table 2–3. Platform Jumper and Switch Settings for the TPA2001D1

EVM	JP4	JP5	JP6	JP7	JP8	S2	S3
P-N-P Platform	X	ON	Mute	X	Lo	Note 2	U5

Notes: 1) ON = Jumper installed, OFF = Jumper *NOT* Installed, 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 a 5-V external regulated power supply to platform V_{DD} power input connector J6, taking care to observe marked polarity,
      or
   b) Install a voltage regulator EVM (SLVP097 or equivalent) in platform socket U6. Connect a 7-V – 12-V power source to a platform V_{CC} power input J1 or J2 and jumper the appropriate power input (see platform user's guide). If using J1, J2, or B1, set S1 to ON to supply power to the EVM.

❑ **Input and outputs**

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

❑ **Evaluation module preparations**

11) Use jumpers GAIN0 and GAIN1 to set the gain (see Figure 2–2 and Table 2–4).

Figure 2–2. Module Preparation

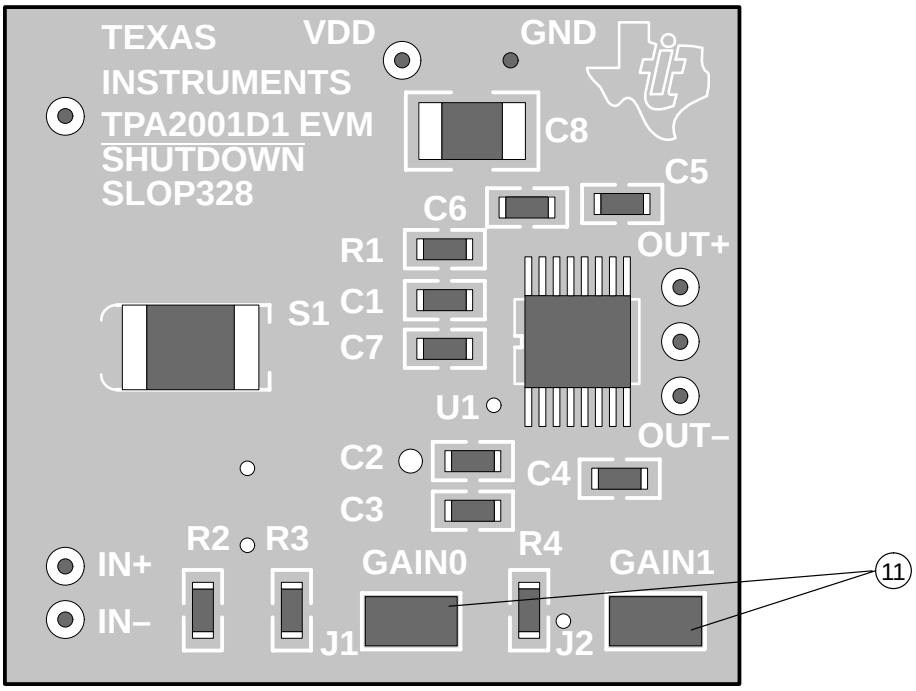


Table 2–4. Typical TPA2001D1 EVM Jumper Settings

GAIN1	GAIN0	GAIN (dB)
ON	ON	6
ON	OF	12
OFF	ON	17.5
OFF	OFF	23.5

Note: ON = Jumper installed, OFF = Open, X = Don't care

❑ **Power up**

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

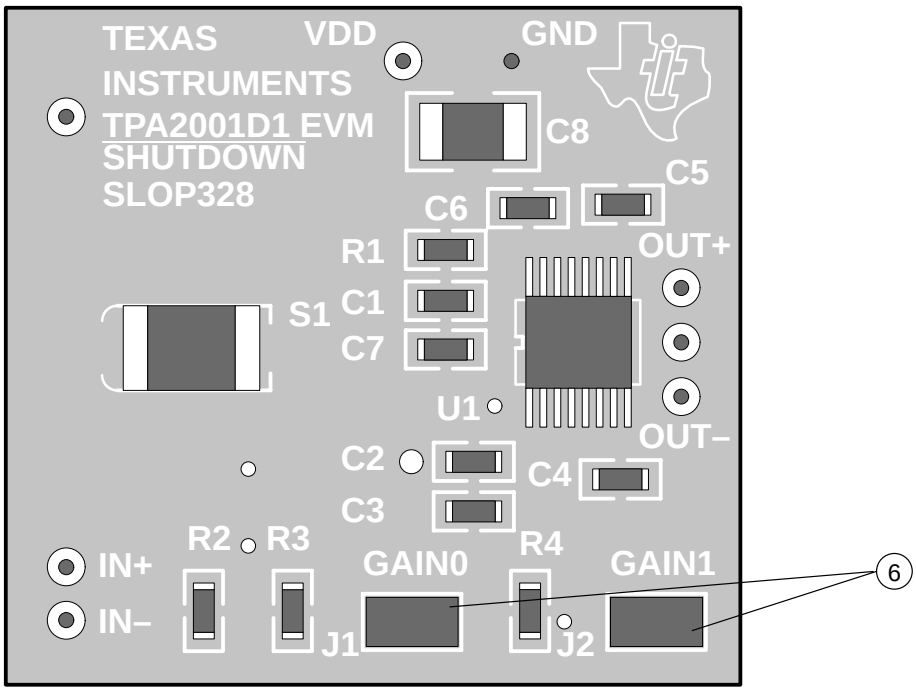
Platform LED2 lights, indicating the presence of V_{DD}, and the evaluation modules installed on the platform begins operation.

13) Adjust the signal source level as needed.

2.3 Quick Start List for Stand-Alone

Follow these steps to use the TPA2001D1 EVM stand-alone or when connecting it into existing circuits or equipment. Connections to the TPA2001D1 module header pins can be made via individual sockets, wire-wrapping, or by soldering to the pins, either on the top or the bottom of the module circuit board. Numbered callouts for selected steps are shown in Figure 2–3.

Figure 2–3. Quick Start Module Map



❑ **Power supply**

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

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

❑ **Inputs and outputs**

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

4) Connect the positive lead of the audio source to the module IN+ pins and the negative lead to the IN– pin.

5) Connect a speaker to OUT+ and OUT–.

❑ **Evaluation module preparations**

6) Use jumpers GAIN0 and GAIN1 to set the gain as shown in Table 2–5.

Table 2–5. TPA2001D1 EVM Gain Settings

GAIN1	GAIN0	GAIN (dB)
ON	ON	6
ON	OF	12
OFF	ON	17.5
OFF	OFF	23.5

Note: ON = Jumper installed, OFF = Open, X = Don't care

❑ **Control inputs**

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

❑ **Power up**

8) Connect a 5-V external power supply across EVM VDD and GND pins.

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

The EVM begins operation.

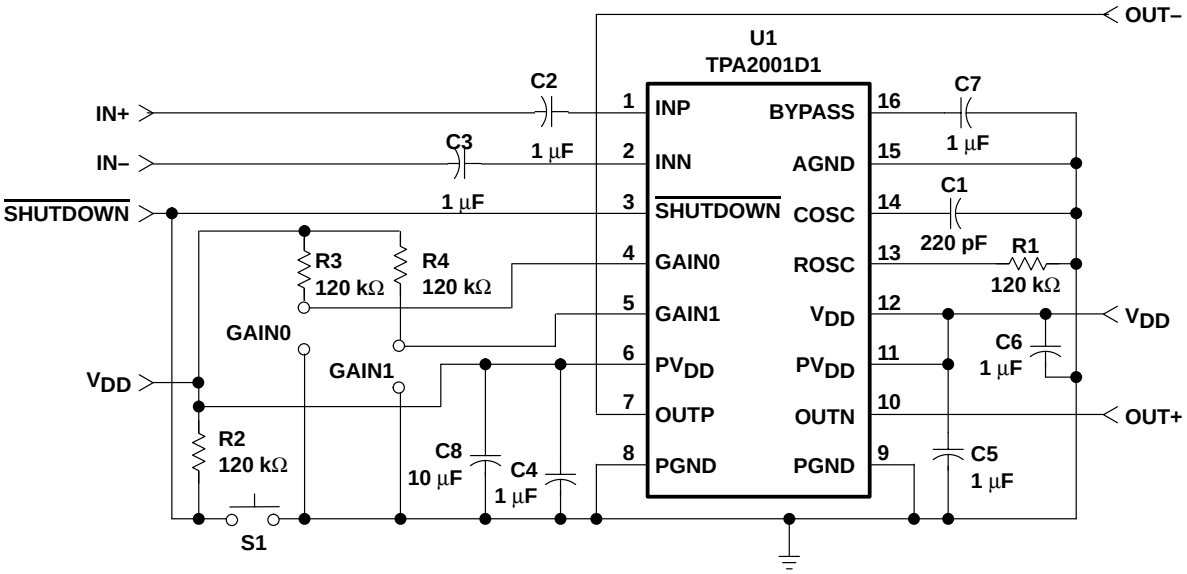
10) Adjust the signal source level as needed.

2.4 Reference

2.4.1 TPA2001D1 Filterless Class-D EVM Schematic

The TPA2001D1 filterless class-D EVM schematic is shown in Figure 2–4.

Figure 2–4. TPA2001D1 Class-D EVM Schematic Diagram



2.4.2 TPA2001D1 Audio Power Amplifier Evaluation Module Parts List

Table 2–6. TPA2001D1 EVM Parts List

Reference	Description	Size	EVM Qty.	Manufacturer/ Part Number
C1	Capacitor, ceramic, 220 pF, ±5%, X7R, 50 V	603	1	Phillips 06032R221K9B20D
C2–7	Capacitor, ceramic, 1.0 µF, 80%/–20%, Y5V, 16 V	603	6	Panasonic ECJ–1VF1A105Z
C8	Capacitor, ceramic, 10 µF, 80%/–20%, Y5V, 16 V	1210	1	Murata GRM235-Y5V106Z16
R1–R4	Resistor, chip, 120 kΩ, 1/10 W, 5%, XICON	0805	4	Mouser 260–120K
J1, J2	Header, 2 position	2 mm	2	Norcomp 2163–02–ND(Digi–Key)
	Shunts	2 mm	2	3M 2163–02–ND(Digi–Key)
	Headers, 0.100 inch centers, 1/2 length, 0.1 inch center	0.5”, 0.25”, 0.1”	8	Samtec TSW–19–8–G–S
U1	IC, 1 W, class–D audio power amp	16-pin TSSOP	1	TI TPA2001D1PW
PCB	PCB, 2 layer, 1.32”(L) x 1.22”(W) x 0.062”(T) fits U3 on PnP		1	TI SLOP328

2.4.3 TPA2001D1 Filterless Class-D EVM PCB Layers

The following illustrations depict the TPA2001D1 filterless class-D EVM PCB layers. These drawings are not to scale. Gerber plots are available from any TI sales office.

Figure 2–5. TPA2001D1 Filterless Class-D EVM Top Layer

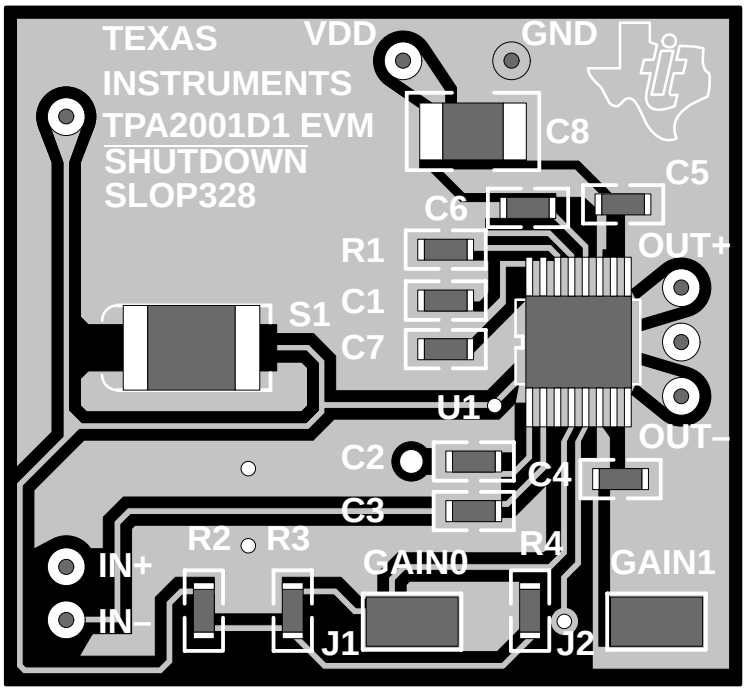
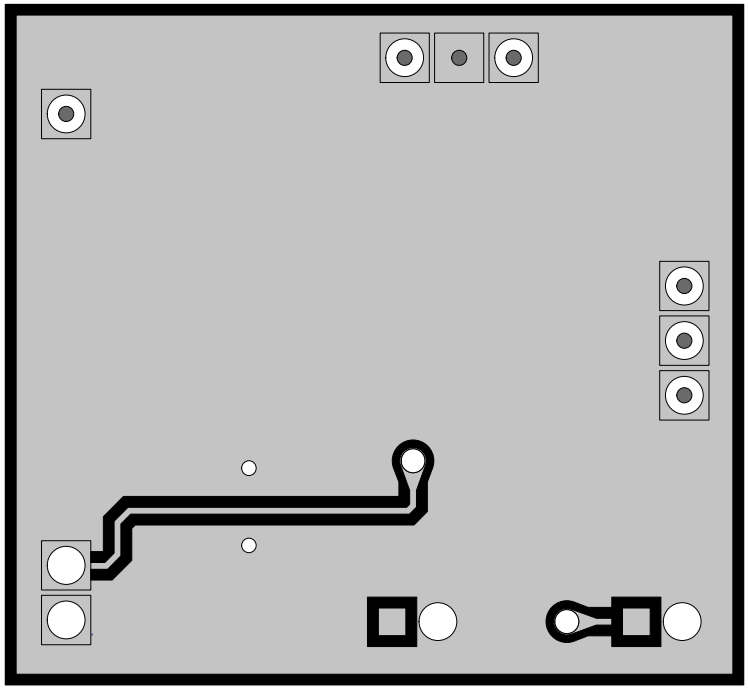


Figure 2–6. TPA2001D1 Filterless Class-D EVM Bottom Layer (Top View)



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