

# ***TPA3001D1EVM***

## ***20-W Mono Class-D Audio Power Amplifier***

# *User's Guide*

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## **EVM WARNINGS AND RESTRICTIONS**

It is important to operate this EVM within the supply voltage range of 8 V to 18 V.

Exceeding the specified supply voltage range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the supply voltage range, please contact a TI field representative prior to applying power to the device under test (DUT).

Applying loads outside of the specified load impedance may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than 65°C. The EVM is designed to operate properly with certain components above 65°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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# Read This First

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### ***About This Manual***

This user's guide describes the characteristics, operation, and use of the TPA3001D1EVM. The user's guide includes a schematic diagram, bill of materials (BOM), and board layout diagrams.

### ***How to Use This Manual***

This document contains the following chapters:

- Chapter 1—Introduction
- Chapter 2—Quick Start
- Chapter 3—Bill of Materials, Schematic, and PCB Layers

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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.**

**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.

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# Introduction

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This chapter provides an overview of the Texas Instruments (TI) TPA3001D1EVM class-D audio amplifier evaluation module. It includes a list of EVM features, a brief illustrated description of the module, and a list of EVM specifications.

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## 1.1 Description

The TPA3001D1 evaluation module (EVM) is a 20-W class-D mono audio power amplifier complete with a small number of external components mounted on a circuit board measuring approximately 2 1/4 inches by 1 1/2 inches (Figure 1–1 and Figure 1–2).

Figure 1–1. The TI TPA3001D1 Audio Power Amplifier EVM—Top View

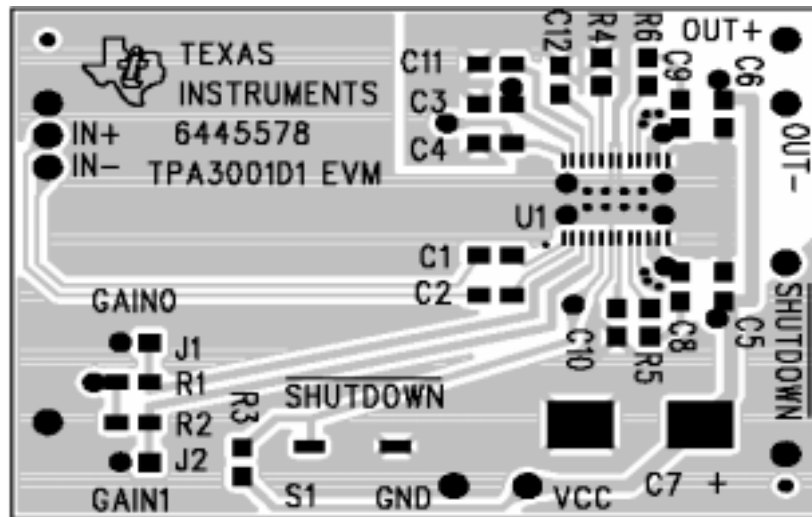
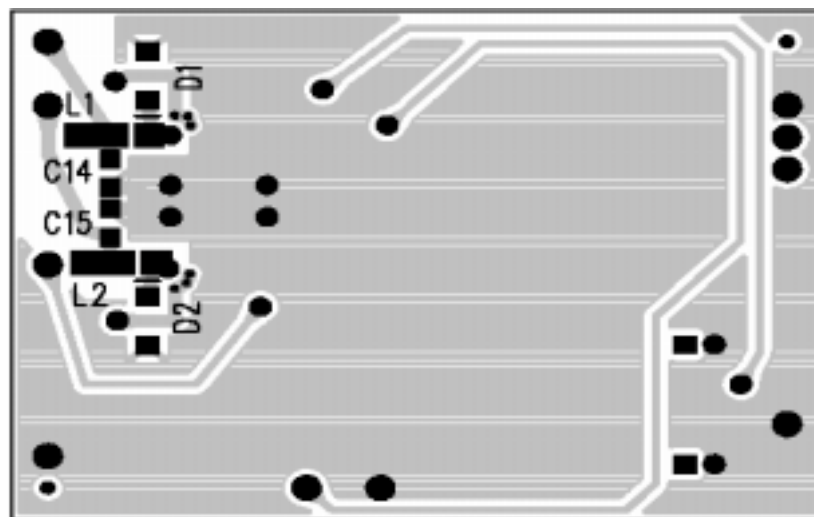


Figure 1–2. The TI TPA3001D1 Audio Power Amplifier EVM—Bottom View

**Note:**

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 operation.

The platform, which has room for a single TPA3001D1EVM, 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.

## 1.2 TPA3001D1EVM Specifications

Supply voltage range, $V_{CC}$ .....	8 V to 18 V
Supply current, $I_{CC}$ .....	2 A max
Continuous output power, $R_L = 8 \Omega$ , $V_{DD} = 18$ V, THD+N = 10%, $P_O$ .	20 W
Minimum load impedance, $R_L$ .....	4 $\Omega$ †

† Refer to the TPA3001D1 data sheet for recommendations on the maximum output power when driving a 4- $\Omega$  load.



# Quick Start

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Follow the steps in this chapter to quickly prepare the TPA3001D1EVM for use. Using the TPA3001D1EVM 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 in stand-alone operation by making connections directly to the module pins, and it can be wired directly into existing circuits or equipment.

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## 2.1 Configuration

The platform switch and jumper settings shown in Table 2–1 are typical for the TPA3001D1EVM and cause the TPA3001D1 to shut down when a plug is inserted into platform headphone jack J10 (see Note 3 in Table 2–1).

Table 2–1. Typical TI Plug-N-Play Platform Jumper and Switch Settings for the TPA3001D1

Power Type	JP1	JP2	JP3	JP4	JP5	JP6	JP7	JP8	S1	S2 (Note 2)	S3
VCC (J1)	ON	OFF	OFF	ON	X	Mode	X	X	ON	OFF	U5
AC/DC (J2)	OFF	ON	OFF	ON	X	Mode	X	X	ON	OFF	U5

- Notes:**
- 1) ON = Jumper installed, OFF = Jumper **NOT** Installed, X = Don't care
  - 2) Set to ON when tone control board SLOP109 is installed in U1, otherwise set to OFF.
  - 3) R3 must be removed from the TPA3001D1EVM to allow the headphone jack to control the shutdown of the TPA3001D1.

Table 2–2. Typical TPA3001D1EVM Jumper Settings

EVM	GAIN0	GAIN1
TPA3001D1	ON	ON

**Note:** ON = Jumper installed, OFF = Jumper **NOT** Installed

## 2.2 Precautions

### Power Supply Input Polarity and Maximum Voltage

Always ensure the polarity and voltage of the external power connected to V<sub>CC</sub> power input connector J1, J2, and/or V<sub>DD</sub> 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.

## 2.3 Quick Start List for the Platform

Follow these steps when using the TPA3001D1EVM with the TI plug-n-play audio amplifier evaluation platform (see the platform user's guide, SLOU011, for additional details).

### Platform Preparations

- 1) Ensure all external power sources and platform power switch S1 are set to OFF.
- 2) Install a TPA3001D1 module in platform socket U2, taking care to align the module pins correctly (EVM power pins engage sockets U2 and U3).
- 3) Set switch S2 to OFF.
- 4) Set switch S3 to U5.
- 5) Set jumper JP6 to select the Mode control input.

Table 2–3. Platform Jumper and Switch Settings for the TPA3001D1EVM

Power Type	JP1	JP4	JP5	JP6	JP7	JP8	S1	S2 (Note 2)	S3
VCC (J1)	ON	ON	X	Mode	X	X	ON	OFF	U5

**Notes:** 1) ON = Jumper installed, OFF = Jumper **NOT** Installed, X = Don't care  
 2) Set to ON when tone control board SLOP109 is installed in U1.

### Power Supply

**CAUTION**

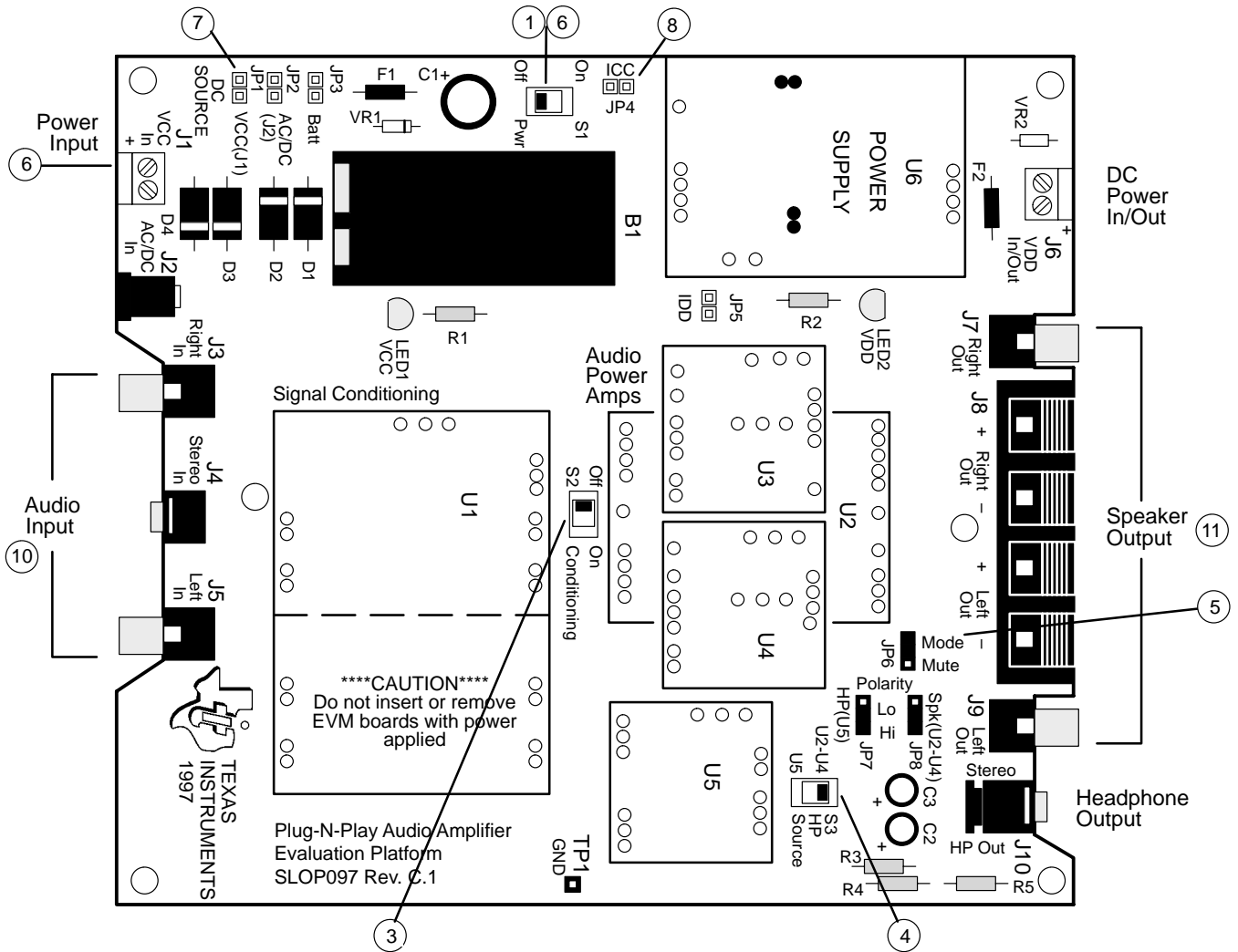
Do not exceed 15 V on the plug-n-play platform, or Zener diode VR1 may fail. If a power supply greater than 15 V is to be used, VR1 must be removed.

- 6) Ensure power switch S1 is set to OFF. Connect a regulated power supply with an output of 8 V to 15 V to J1, taking care to observe marked polarity.
- 7) Set jumper JP1 for DC source to be from input J1.
- 8) Set jumper JP4 for VCC power to EVMs.

### Inputs and Outputs

- 9) Ensure that the audio signal source level is set to minimum.
- 10) Connect the audio source to the right RCA phono jack J3 or the mono miniature phone jack J4.
- 11) Connect speakers to the right RCA jack J7 or to the stripped wire speaker connectors J8.

Figure 2–1. Quick Start Platform Map





### Evaluation Module Preparations

- 12) Use jumpers GAIN0 and GAIN1 to set the gain (Table 2–4).

Table 2–4. Typical TPA3001D1EVM Jumper Settings

GAIN1	GAIN0	GAIN (dB)
ON	ON	12
ON	OFF	18
OFF	ON	23.6
OFF	OFF	36

**Note:** ON = Jumper installed, OFF = Jumper REMOVED

### Power Up

- 13) Verify correct voltage and input polarity and set the external power supply and platform power switch S1 to ON.

**Note:**

Platform LED1 should light indicating the presence of VCC, and the evaluation module(s) installed on the platform should begin operation.

- 14) Set switch S2 to ON if tone control board SLOP109 is installed in U1.  
15) Adjust the signal source level as needed.

## 2.4 Quick Start List for Stand-Alone Operation

Follow these steps to use the TPA3001D1EVM as a stand-alone unit, or when connecting it into existing circuits or equipment. Connections to the TPA3001D1 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.

### Power Supply

- 1) Ensure that all external power sources are set to OFF.
- 2) Connect an external regulated power supply set from 8 V to 18 V to the module VCC and GND pins taking care to observe marked polarity. It is only necessary to use the ground pins adjacent to the module power pins.

### Inputs and Outputs

- 3) Ensure that audio signal source level adjustments are set to minimum.
- 4) Connect the audio source across the module IN+ and IN– pins, taking care to observe marked polarity. For single-ended input, the negative input pin (IN–) should be connected to the ground of the audio signal source.
- 5) Connect a speaker to the module OUT+ and OUT– pins, taking care to observe marked polarity.

### Evaluation Module Preparations

- 6) Adjust the source signal level as needed.
- 7) Use jumpers GAIN0 and GAIN1 to set the gain as shown in Table 2–5.

Table 2–5. TPA3001D1EVM Gain Settings

GAIN1	GAIN0	GAIN (dB)
ON	ON	12
ON	OFF	18
OFF	ON	23.6
OFF	OFF	36

**Note:** ON = Jumper installed, OFF = Jumper NOT installed

### Control Inputs

**Note:**

The control signals applied to the EVM shutdown inputs must have sufficient current capability to overcome the 120-kΩ pullup resistor on each input.

Holding down S1 places the amplifier in the shutdown state. Releasing S1 returns the amplifier to the active state.

Refer to the TPA3001D1 data sheet (SLOS398) for logic threshold voltage ratings.

- 8) **SHUTDOWN**: This pin is active low. A low on this pin shuts down the amplifier; a high on this pin places the amplifier in an active state. Leaving this pin floating also allows normal amplifier operation.

### Power Up

- 9) Verify correct voltage and input polarity and set the external power supply to ON. The EVM should begin operation.
- 10) Adjust the signal source level as needed.

# Bill of Materials, Schematic, and PCB Layers

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This chapter contains the bill of materials, schematic, and board layout for the TPS3001D1EVM.

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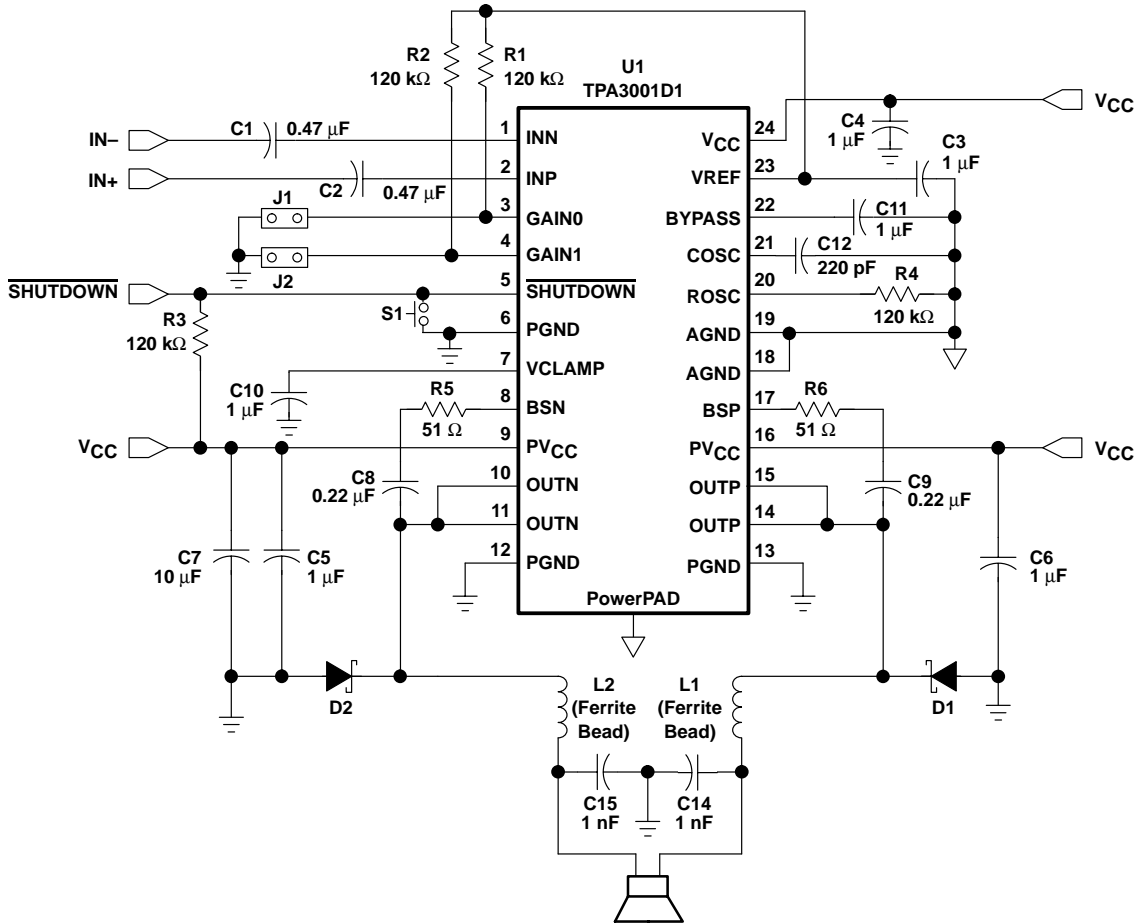
### 3.1 TPA3001D1EVM Bill of Materials

Table 3–1. TPA3001D1EVM Bill of Materials

Reference	Description	Size	Qty	MFG.	Part Number
C1, C2	Capacitor, ceramic, 0.47 $\mu$ F, 80%/–20%, Y5V, 16 V	0805	2	Panasonic	ECJ–2VF1C474Z
C3–C6, C10, C11	Capacitor, ceramic, 1 $\mu$ F, 80%/–20%, Y5V, 25 V	0805	7	Panasonic	ECJ–2FF1E105Z
C7	Capacitor, electrolytic, 10 $\mu$ F, 35 V, SMD	D	1	Panasonic	ECS–T1VD106R
C8,C9	Capacitor, ceramic, 0.22 $\mu$ F, 80%/–20%, Y5V, 16V	0805	2	Panasonic	ECJ–2VF1C224Z
C12	Capacitor, ceramic, 220 pF, $\pm$ 10%, X7R, 50 V	0805	1	Panasonic	ECU–V1H221KBN
C14,C15	Capacitor, ceramic, 1000 pF, $\pm$ 10%, X7R, 50 V	805	2	Panasonic	ECJ–2VB1H102K
L1, L2	Ferrite Bead, 0.05 $\Omega$ DCR, 70 $\Omega$ at 100 MHz, 3 A	1206	2	Fair–Rite	2512067007Y3
R1, R2, R3, R4	Resistor, chip, 120 k $\Omega$ , 1/10 W, 5%	0805	4	Panasonic	ERJ–6GEYJ124V
R5	Resistor, chip, 0 $\Omega$ , 1/10W, 5%	805	1	Panasonic	ERJ–6GEY0R00V
R6, R7	Resistor, chip, 51 $\Omega$ , 1/10 W, 5%	0805	2	Panasonic	ERJ–6GEYJ510V
D1, D2	Schottky diode, Vf <sub>m</sub> = 0.5 V at 1 A, Vr = 30 V	SMA	2	Diodes, Inc.	B130–13
J1(GAIN0), J2(GAIN1)	Header, 2 position, male	2mm	2	Norcomp	2163–36–01–P2
	Shunts	2mm	2	Specialty Electronics	2JM–G
S1 (SHUTDOWN)	Switch, momentary pushbutton, 12 V, 50 mA		1	Panasonic	EVQ–PJS04K
PnP pins	Headers, 0.1 inch centers, 1/2 inch long		10	Sullins	PZC36SABN
U1	TPA3001D1PWP	24-pin TSSOP	1	TI	TPA3001D1PWP

### 3.2 TPA3001D1EVM Schematic

Figure 3–1. TPA3001D1EVM Schematic Diagram



### 3.3 TPA3001D1EVM PCB Layers

The following illustrations depict the TPA3001D1EVM PCB assembly and layers. These drawings are not to scale.

Figure 3–2. TPA3001D1EVM Top Layer

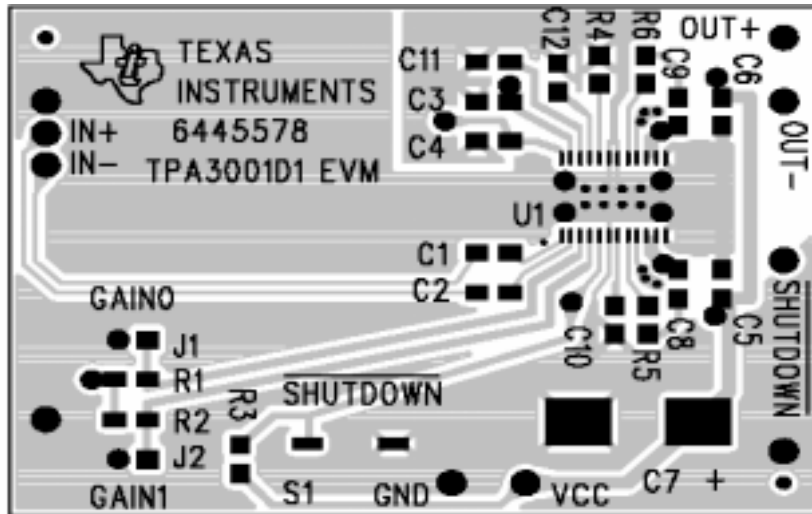


Figure 3–3. TPA3001D1EVM Bottom Layer

