

# ***TPA321 MSOP Audio Power Amplifier Evaluation Module***

## *User's Guide*

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# Read This First

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**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.**

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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.
- ***TPA321 350-mW Low-Voltage Audio Power Amplifier*** (literature number SLOS312) This is the data sheet for the TPA321 audio amplifier integrated circuit.

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# Introduction

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This chapter provides an overview of the Texas Instruments (TI) TPA321 audio amplifier evaluation module (SLOP341). 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 TPA321 audio amplifier evaluation module and the TI plug-n-play audio amplifier evaluation platform include the following features:

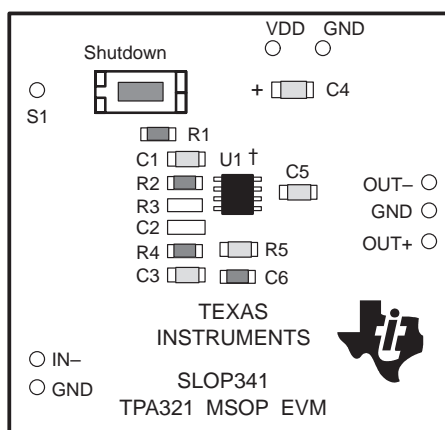
- TPA321 Low-Voltage Audio Power Amplifier Evaluation Module
  - Single channel, bridge-tied load (BTL) or single-ended operation
  - 2.5-V and 5.5-V operation
  - 350 mW output power into 8  $\Omega$  at 5 V, BTL
  - Ultralow current consumption in shutdown/mute mode
  - Internal thermal and short-circuit protection
- 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
  - Onboard 9-V battery
  - External 5-V–15-V dc  $V_{CC}$  supply inputs
  - External regulated  $V_{DD}$  supply input
  - Socket for on-board 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 TPA321 audio power amplifier evaluation module is a complete, low power single-channel audio power amplifier. It consists of the TI TPA321 350-mW low-voltage audio power amplifier IC along with a small number of other parts mounted on a circuit board that is approximately one and a quarter inches square (see Figure 1–1).

Figure 1–1. The TI TPA321 Audio Amplifier Evaluation Module



Single in-line header pins are mounted to the underside of the module circuit board. These pins 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 pair of TPA321 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 TPA321 EVM Specifications

|                                                                      |                         |
|----------------------------------------------------------------------|-------------------------|
| Supply voltage range, $V_{DD}$ .....                                 | 2.5 V to 5.5 V          |
| Supply current, $I_{DD}$ .....                                       | 250 mA, max             |
| Continuous output power, $P_O$ : 8- $\Omega$ BTL, $V_{DD}=5$ V ..... | 350 mW                  |
| 32- $\Omega$ BTL, $V_{DD}=5$ V .....                                 | 75 mW                   |
| Audio input voltage, $V_I$ .....                                     | 2 V <sub>pp</sub> , max |
| Minimum load impedance, $R_L$ .....                                  | 8 $\Omega$              |



## Operations

Follow the steps in this chapter to quickly prepare the TPA321 audio amplifier EVM for use. The TPA321 and the TI plug-n-play audio amplifier evaluation platform provide 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 TPA321 EVM. These settings cause the TPA321 to mute 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 TPA321*

| EVM    | JP6  | JP7 | JP8 | S2         | S3 |
|--------|------|-----|-----|------------|----|
| TPA321 | Mute | X   | Hi  | See Note 2 | X  |

- 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.

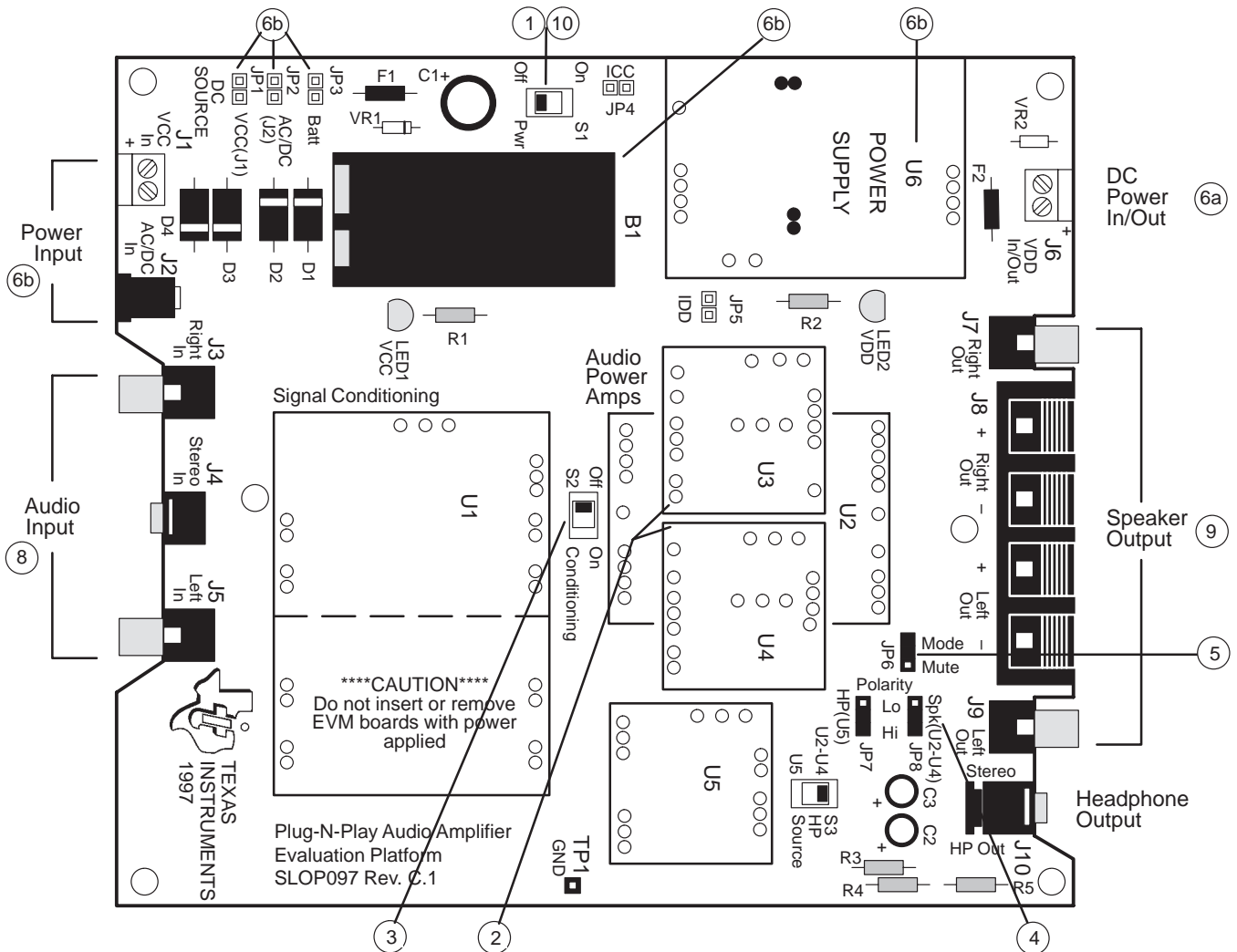
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## 2.1 Precautions

**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 on-board 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 TPA321 EVM with the TI plug-n-play audio amplifier evaluation platform (see the platform user's guide, SLOU011, for additional details). Numbered callouts for selected steps are shown in Figure 2–1 and details appear in Chapter 3.

### □ 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 TPA321 module in platform sockets U3 and U4 for stereo operation (or a module in either U3 or U4 for single channel operation), 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 mute control input (which causes the TPA321 to shut down if a plug is inserted into platform headphone jack J10).

Table 2–2. Platform Jumper and Switch Settings for the TPA321 MSOP EVM

| EVM    | JP6  | JP7 | JP8 | S2         | S3 |
|--------|------|-----|-----|------------|----|
| TPA321 | Mute | X   | Hi  | See Note 2 | X  |

**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

- 6) Select and connect the power supply:
  - Connect an external regulated power supply set to a voltage between 2.5 V and 5.5 V to platform  $V_{DD}$  power input connector J6, taking care to observe marked polarity,
  - or
  - Install a voltage regulator EVM (SLVP097 or equivalent.) in platform socket U6. Install a 9-V battery in B1 or 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).

### □ Inputs and outputs

- 7) Ensure that signal source level is set to minimum.
- 8) Connect the audio source to left and right RCA phono jacks J3 and J5 or to stereo miniature phone jack J4.
- 9) Connect 8- $\Omega$ –32- $\Omega$  speakers to left and right RCA jacks J7 and J9 or to stripped wire connector J8.

### □ Power Up

- 10) Verify 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 platform power switch S1 to ON.

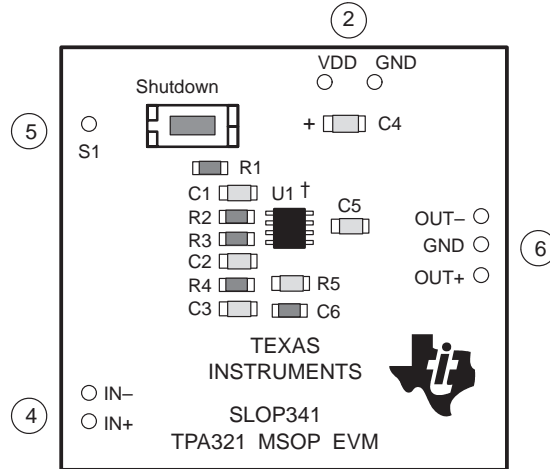
Platform LED2 lights, indicating the presence of  $V_{DD}$ , and the evaluation modules installed on the platform begin operation.

- 11) Adjust the signal source level as needed.

## 2.3 Quick Start List for Stand-Alone

Follow the steps in this section to use the TPA321 EVM stand-alone or when connecting it into existing circuits or equipment. Connections to the TPA321 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. Numbered callouts for selected steps are shown in Figure 2–2 and details appear in Chapter 3.

Figure 2–2. Quick Start Module Map



### □ 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 V<sub>DD</sub> and GND pins, taking care to observe marked polarity.

### □ Inputs and outputs

- 3) Ensure that the signal source level is set to minimum.
- 4) Connect the positive lead from the audio source to the module IN+ pin and the negative lead to the IN– pin.
- 5) Connect the S1 pin to V<sub>DD</sub> through a normally open switch.
- 
- 6) Select the proper output and perform one of the following:
  - For BTL output, connect an 8-Ω–32-Ω speaker to the module OUT+ and OUT– pins.
  - For single-ended output, connect a headphone or an 8-Ω–32-Ω speaker to the module OUT+ and GND pins through a 33 μF to 1000 μF output-coupling capacitor (See Figure 2–4).

### □ Power Up

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

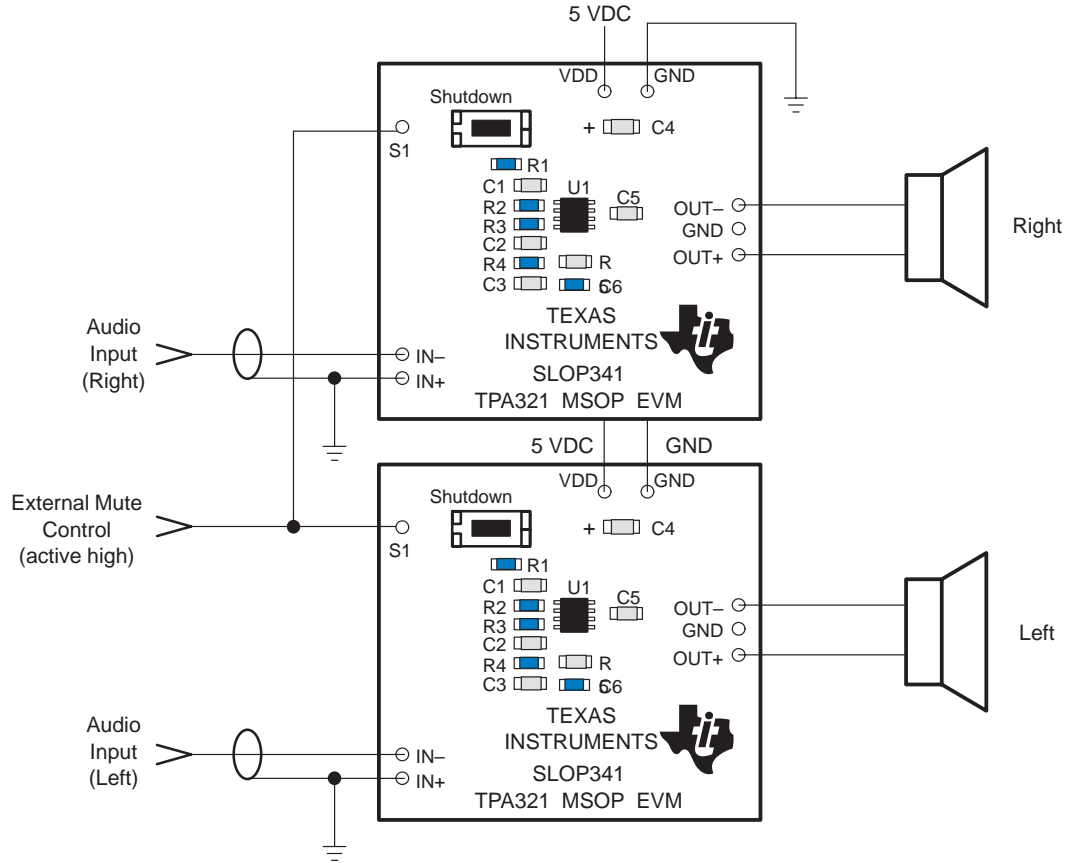
The EVM begins operation.

- 8) Adjust the signal source level as needed.

## 2.4 References

### 2.4.1 TPA321 EVM Connected for Stereo BTL Output

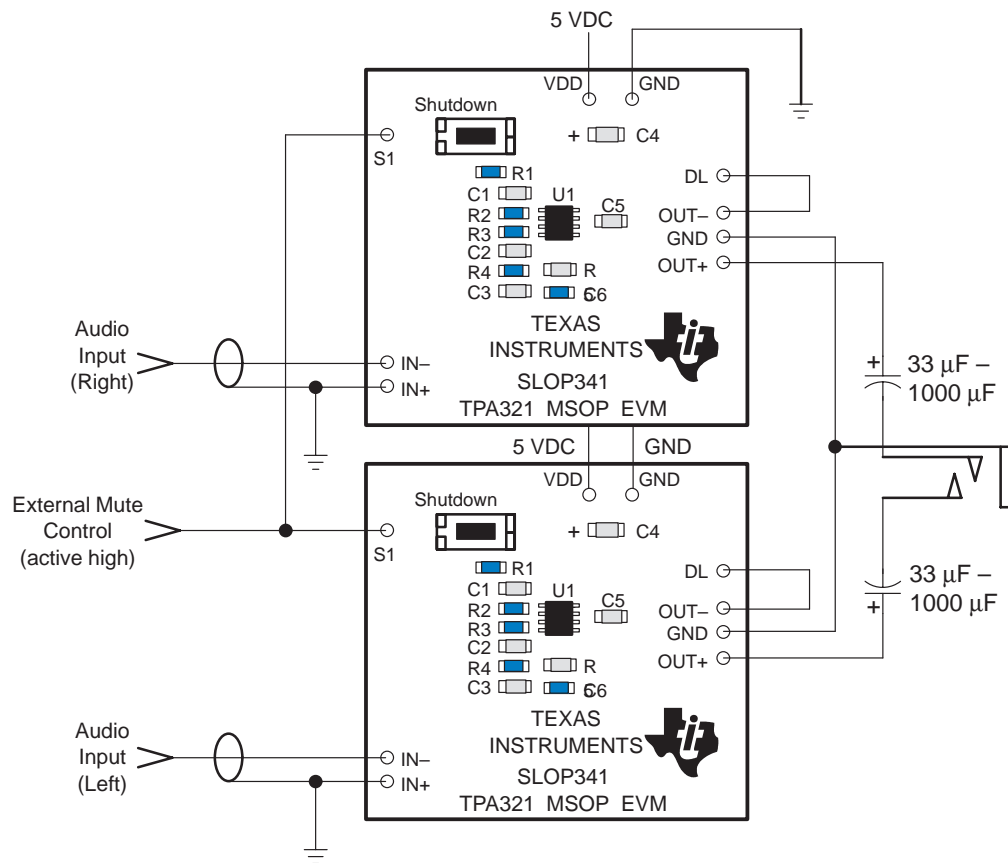
Figure 2–3. TPA321 EVM Connected for Stereo BTL Output





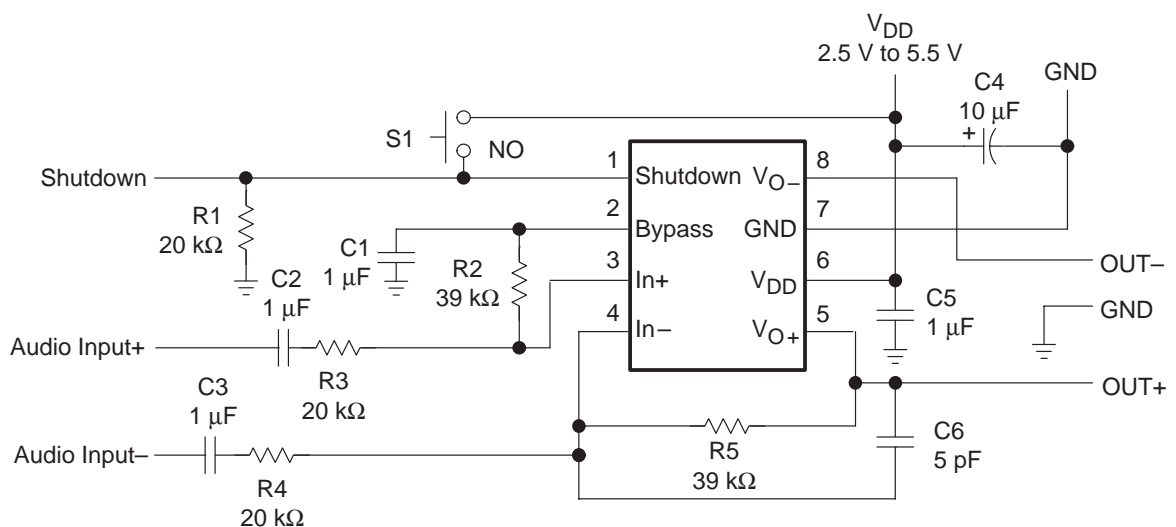
## 2.4.2 TPA321 EVM Connected for Stereo Single-Ended Output

Figure 2–4. TPA321 EVM Connected for Stereo Single-Ended Output



## 2.4.3 TPA321 EVM Schematic Diagram

Figure 2–5. TPA321 EVM Schematic Diagram



## 2.4.4 TPA321 MSOP Audio Power Amplifier Evaluation Module Parts List

Table 2–3. TPA321 MSOP EVM Parts List

| Reference         | Description                                                   | Size   | Qty. | Manufacturer/<br>Part Number | Digi-Key<br>Number       |
|-------------------|---------------------------------------------------------------|--------|------|------------------------------|--------------------------|
| C4                | Capacitor, 10 $\mu$ F, 6.3 V                                  | A      | 1    | Panasonic<br>ECS-TOJY106R    | Digi-Key<br>PCS1106CT-ND |
| C1, C2,<br>C3, C5 | Capacitor, 1 $\mu$ F, 80%/–20%,<br>nonpolarized               | 0603   | 4    | Murata<br>GRM39-Y5V105Z10PT  |                          |
| C6                | Capacitor, pad only                                           | 0603   | 0    |                              |                          |
| R1, R3, R4        | Resistor, 20 k $\Omega$ , 1/16 W, 5%                          | 0603   | 4    | Panasonic<br>ERJ-3GSYJ203    |                          |
| R5, R2            | Resistor, 39 k $\Omega$ , 1/16 W, 5%                          | 0603   | 1    | Panasonic<br>ERJ-3GSYJ393    |                          |
| S1                | Switch, momentary                                             |        | 1    | Panasonic<br>P8048SCT-ND     | Digi-Key<br>P8048SCT-ND  |
|                   | Terminal Post Headers                                         |        | 9    | Sullins<br>PTC36SABN         | Digi-Key<br>S1022-36-ND  |
| U1                | IC, TPA321DGN <sup>†</sup> , audio<br>amplifier, 350 mW, mono | MSOP-8 | 1    | TI<br>TPA321DGN              |                          |
| PCB1              | PCB, TPA321 MSOP EVM                                          |        | 1    |                              |                          |

<sup>†</sup> Due to the very small size of the MSOP IC package, the standard part number TPA321 is replaced with the code TIAJB.

**Note:** All items are SMD except as noted.

### 2.4.5 TPA321 MSOP EVM PCB Layers

The following illustrations depict the TPA321 EVM PCB layers and silkscreen. These drawings are not to scale. Gerber plots can be obtained from any TI sales office.

Figure 2–6. TPA321 EVM PCB

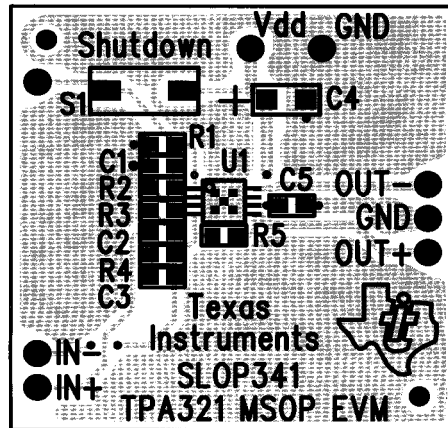


Figure 2–7. TPA321 EVM Silkscreen

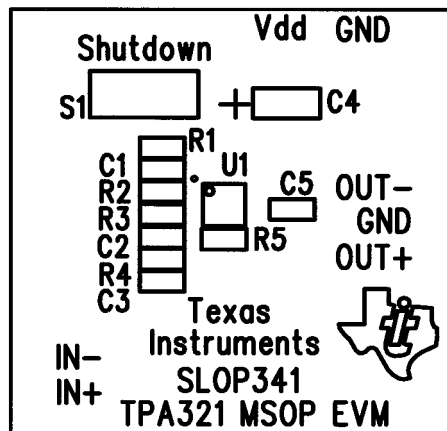


Figure 2–8. TPA321 EVM Top Layer

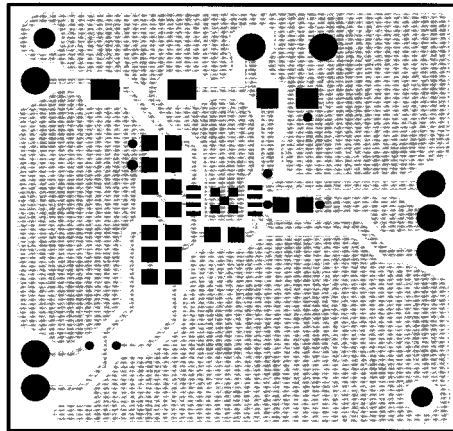


Figure 2–9. TPA321 EVM Bottom Layer

