TEXAS INSTRUMENTS

TPA0103
Audio Power Amplifier
Evaluation Module

User's Guide

August 1998

Mixed-Signal Products

SLOU015

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Preface

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.

- ***TPA0103 3-CHANNEL AUDIO POWER AMPLIFIER STEREO SINGLE-ENDED 500-mW AND MONO BTL 1.75-W*** (literature number SLOS167) This is the data sheet for the TPA0103 audio amplifier integrated circuit.

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Chapter 1

Introduction

This chapter provides an overview of the Texas Instruments (TI™) TPA0103 Audio Amplifier Evaluation Module (SLOP103). 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 TPA0103 Audio Amplifier Evaluation Module and the TI Plug-N-Play Audio Amplifier Evaluation Platform include the following features:

- TPA0103 Low-Voltage Audio Power Amplifier Evaluation Module
  - 535-mW single-ended into 4 Ω at 5 V L/R channels
  - 1.75-W bridge-tied load (BTL) into 4 Ω at 5 V center channel
  - 3.3-V and 5-V operation
  - Low distortion (< 0.25% THD+N at full power)
  - Ultra-low current consumption in full shutdown mode
  - Two sets of stereo inputs with internal MUX
  - Module gain adjustable between approximately 2 and 22

- 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

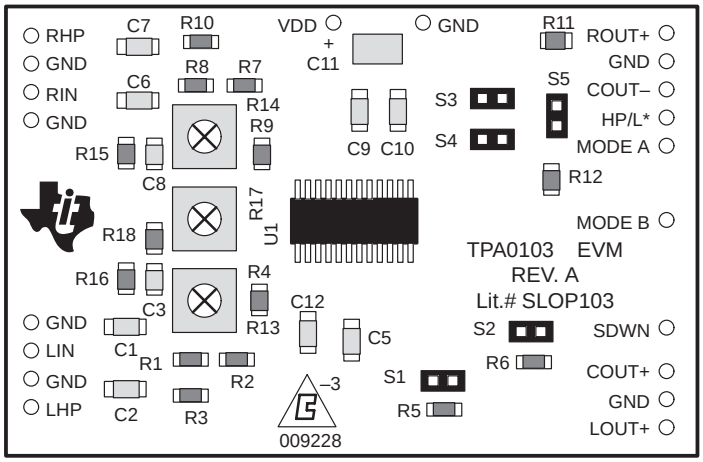
- Platform Power Options
  - Onboard 9-V battery
  - External 5-V – 15-V DC V_{CC} supply inputs
  - External regulated V_{DD} supply input
  - Socket for onboard 5 V/3.3 V V_{DD} voltage regulator EVM
  - Onboard overvoltage and reverse polarity power protection

- 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 TPA0103 Audio Power Amplifier Evaluation Module is a complete, low-power three-channel audio power amplifier. It consists of the TI TPA0103 3-Channel Audio Power Amplifier IC along with a small number of other parts mounted on a circuit board that measures approximately 2¼ inches by 1½ inches (Figure 1–1).

Figure 1–1. The TI TPA0103 Audio Amplifier Evaluation Module



Single in-line header pins are mounted to 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 TPA0103 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. 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 TPA0103 EVM Specifications

Supply voltage range, V_{DD}		3 V to 5.5 V
Supply current, I_{DD}		1.5 A, max
Continuous output power, P_O:	center channel, THD = 0.2%, 4-Ω BTL, V_{DD}=5 V:	1.75 W
	L/R channels, THD = 0.2%, 4-Ω SE, V_{DD}=5 V:	535 mW
	L/R channels, THD = 0.2%, 32-Ω SE, V_{DD}=5 V:	100 mW
Audio input voltage, V_I:	L/R IN, gain = 2 – 22 BTL	0.75 V_{PP}, max
	L/R IN HP, gain = 1	4 V_{PP}, max
Minimum load impedance, R_L		4 Ω

Chapter 2

Quick Start

The steps in this chapter can be followed to quickly prepare the TPA0103 audio amplifier EVM for use. Using the TPA0103 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. The 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.

The platform switch and jumper settings shown in Tables 2–1 and the TPA0103 EVM jumper settings shown in Table 2–2 are typical for the TPA0103 EVM.

Table 2–1. Typical TI Plug-N-Play Platform Jumper and Switch Settings for the TPA0103

OUTPUT MODE	JP6	JP7	JP8	S2	S3
Center Only	OFF	X	X	Note 2	U2-U4
Center or L/R	Mode	X	Hi	Note 2	U2-U4
3-Channel	OFF	X	X	Note 2	U2-U4

Notes: 1) X = Don't care, OFF = Open, ON = Closed

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 TPA0103 EVM Jumper Settings

OUTPUT MODE	S1	S2	S3	S4	S5
Center Only	ON	ON	OFF	OFF	OFF
Center or L/R	ON	ON	OFF	OFF	OFF
3-Channel	ON	OFF	OFF	OFF	OFF

Note: OFF = Open, ON = Closed

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2.1 Precautions

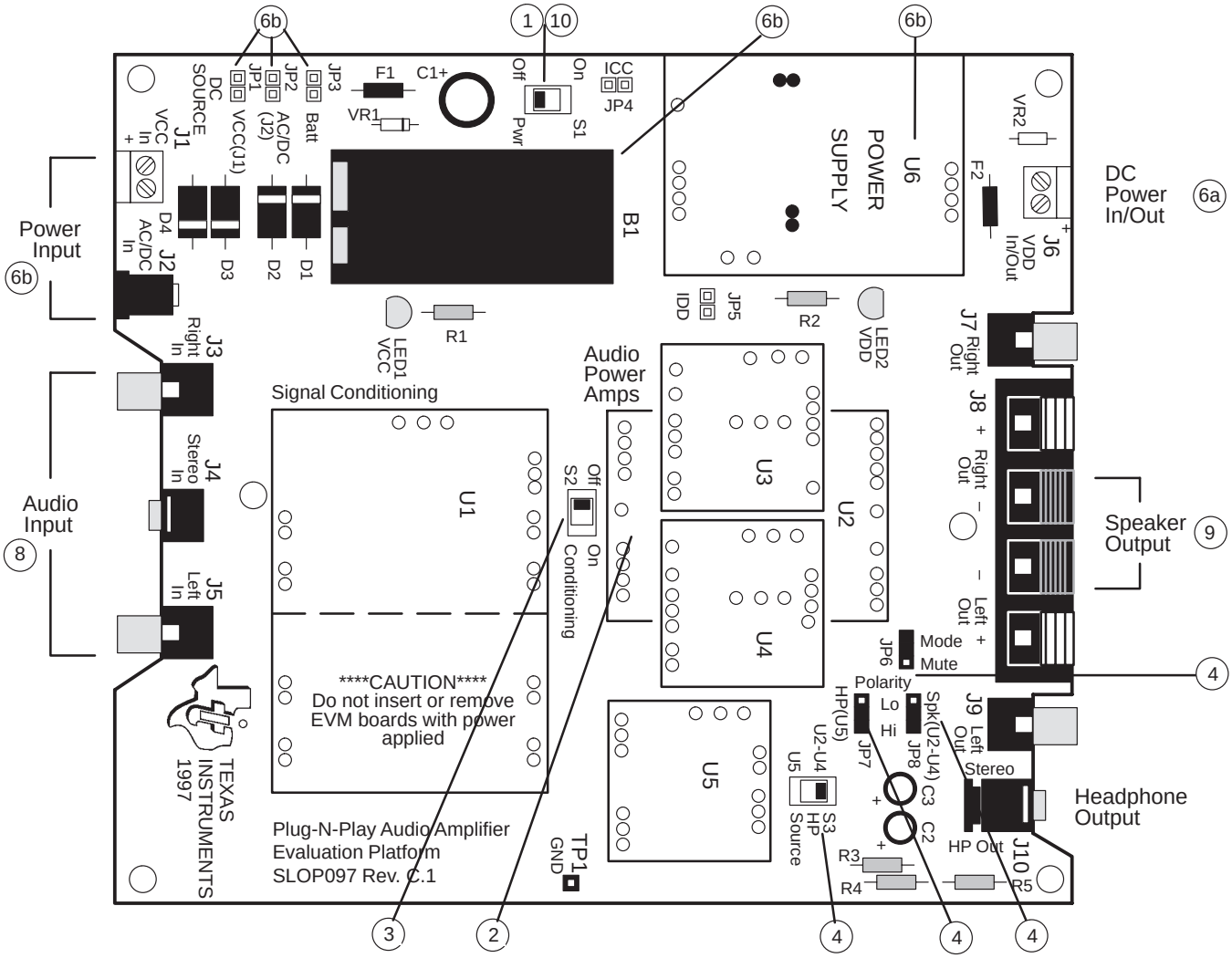
Power Supply Input Polarity and Maximum Voltage

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

Follow these steps when using the TPA0103 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 and TPA0103 EVM 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 TPA0103 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**).

Setting the platform and the EVM for **Center or L/R,** as indicated in the tables below, will cause the EVM to operate in the center channel mode BTL (speaker) when no plug is present in headphone jack J10 and in the L/R single-ended mode (headphone) when a plug is inserted into platform headphone jack J10.

4) Set the jumpers on the **platform** as indicated in Table 2–3.

Table 2–3. TI Plug-N-Play Platform Jumper and Switch Settings for the TPA0103

OUTPUT MODE	JP6	JP7	JP8	S2	S3
Center or L/R	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.

5) Set the jumpers on the **TPA0103 EVM** as indicated in Table 2–4.

Table 2–4. TPA0103 EVM Jumper settings

OUTPUT MODE	S1	S2	S3	S4	S5
Center or L/R	ON	ON	OFF	OFF	OFF

Note: OFF = Open, ON = Closed

❑ **Power supply**

6) Select and connect the power supply:
   a) Connect an external regulated power supply set to a voltage between 3 V and 5.5 V to platform V_{DD} power input connector **J6** taking care to observe marked polarity, or
   b) Install a voltage regulator EVM (SLVP097 or equiv.) 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 adjustments and the EVM gain controls, **R13, R14,** and **R17**, are set to minimum.
8) Connect the audio source to left and right RCA phono jacks **J3** and **J5** or stereo miniature phone jack **J4.**
9) Connect a 4-Ω to 8-Ω speaker to the left and right ***BLACK*** speaker connectors of **J8.** ***DO NOT USE RED CONNECTORS OF J8.***

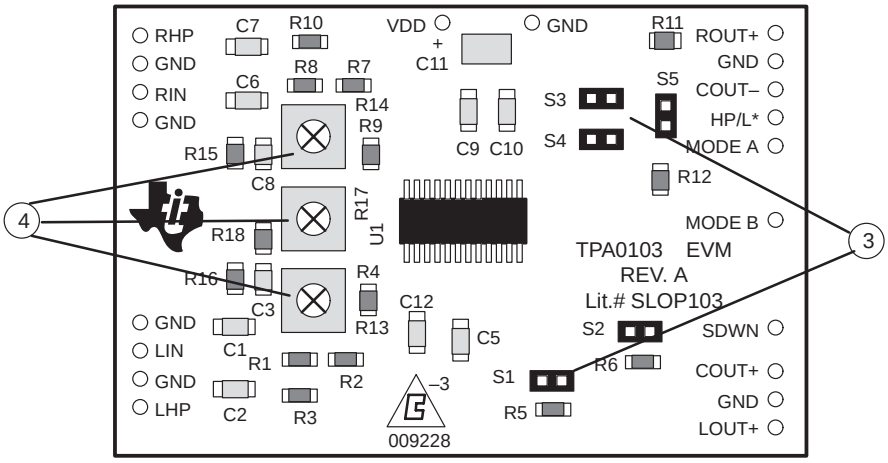
❑ **Power-up**

10) 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 platform power switch **S1** to ***ON.***
11) Adjust the signal source level and EVM gain levels (**R13, R14,** and **R17**) as needed.

2.3 Quick Start List for Stand-Alone

Follow these steps to use the TPA0103 EVM stand-alone or connect it into existing circuits or equipment. Connections to the TPA0103 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 **VDD** and **GND** pins taking care to observe marked polarity.

❑ **TPA0103 EVM jumpers**

Setting the EVM for **Center or L/R** as indicated in the table below will cause the EVM to operate in the center channel BTL mode (speaker).

3) Set the jumpers on the **TPA0103 EVM** as indicated in Table 2–5.

Table 2–5. TPA0103 EVM Stand-Alone Jumper settings

EVM OUTPUT MODE	S1	S2	S3	S4	S5
Center or L/R	ON	ON	OFF	OFF	OFF

Note: OFF = Open, ON = Closed

❑ **Inputs and outputs**

4) Ensure that signal source level adjustments and EVM gain controls, **R13, R14,** and **R17**, are set to minimum.
5) Connect the audio source to the module **IN+** and **GND** pins, taking care to observe marked polarity.
6) Connect the **SDWN** pin to V_{DD} through a Normally Open switch.
7) Connect a 4-Ω to 8-Ω speaker to the module **COUT+** and **COUT–** pins.

❑ **Power-up**

8) Verify correct voltage and input polarity and set the external power supply to ***ON.***
9) Adjust the signal source level and EVM gain levels as needed.

Chapter 3

Details

This chapter provides details on the TPA0103 IC, the evaluation module, and the steps in the Quick-Start List, additional application information, and a parts list for the TPA0103 evaluation module.

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3.1 Precautions

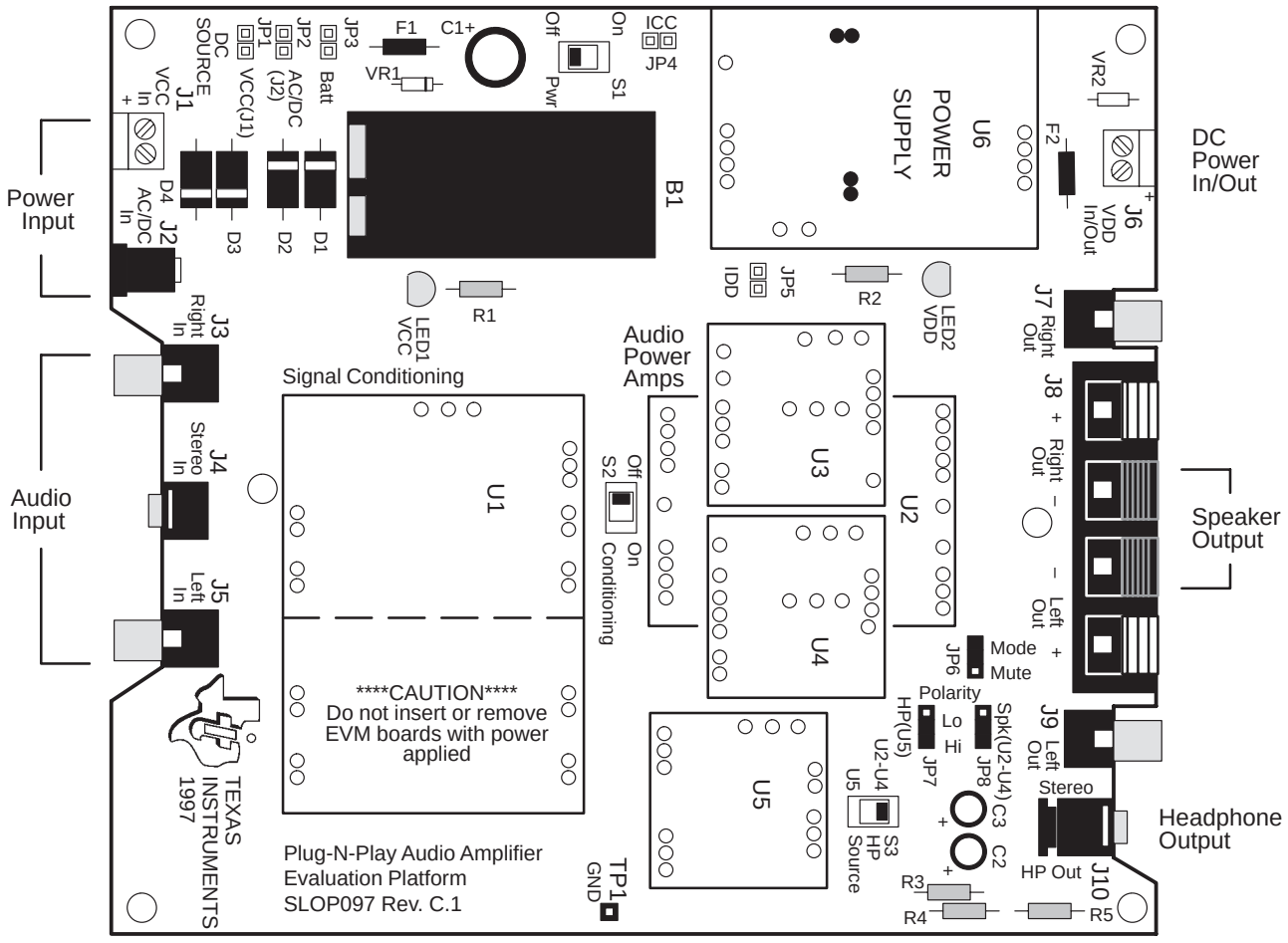
Power Supply Input Polarity and Maximum Voltage

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 3–1. The TI Plug-N-Play Audio Amplifier Evaluation Platform



3.2 The TPA0103 Audio Power Amplifier Evaluation Module

The TPA0103 Audio Power Amplifier Evaluation Module is powered by a TPA0103 3-channel audio power amplifier capable of delivering 535 mW of continuous power to each of the left and right single-ended 4-Ω speaker loads, and 1.75 W of continuous power (BTL) to a center channel 4-Ω load. The amplifier IC can be configured for center channel only, center or L/R channels, or three channel operation via two mode terminals. The evaluation module includes jumpers for setting modes and control inputs for shutdown, selection between two sets of stereo inputs, and switching between output modes.

The module can be used with the TI Plug-N-Play Audio Amplifier Evaluation Platform (Figure 3–1) or wired directly into circuits or equipment. The module has single in-line header connector pins mounted to the under side of the board. These pins allow the module to be plugged into the TI platform, which automatically makes all the signal input and output, power, and control connections to the module.

The module connection pins are on 0.1-inch centers to allow easy use with standard perf board and plug board-based prototyping systems. Or, the EVM can be wired directly into existing circuits and equipment when used stand-alone.

The module appears in Figure 3–2 and its schematic is shown in Figure 3–3.

Figure 3–2. TPA0103 EVM

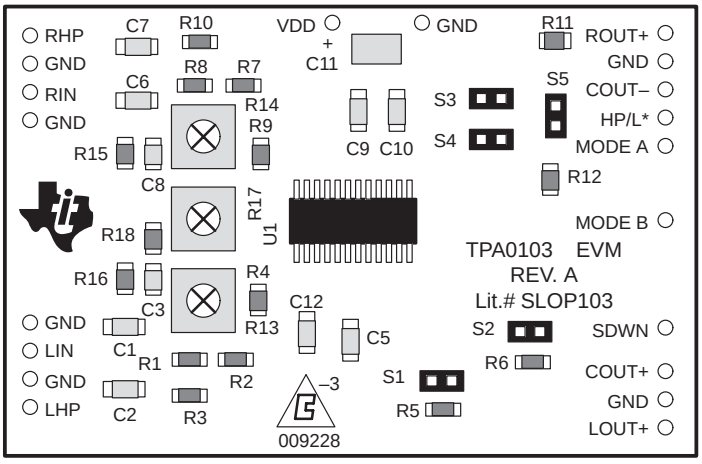
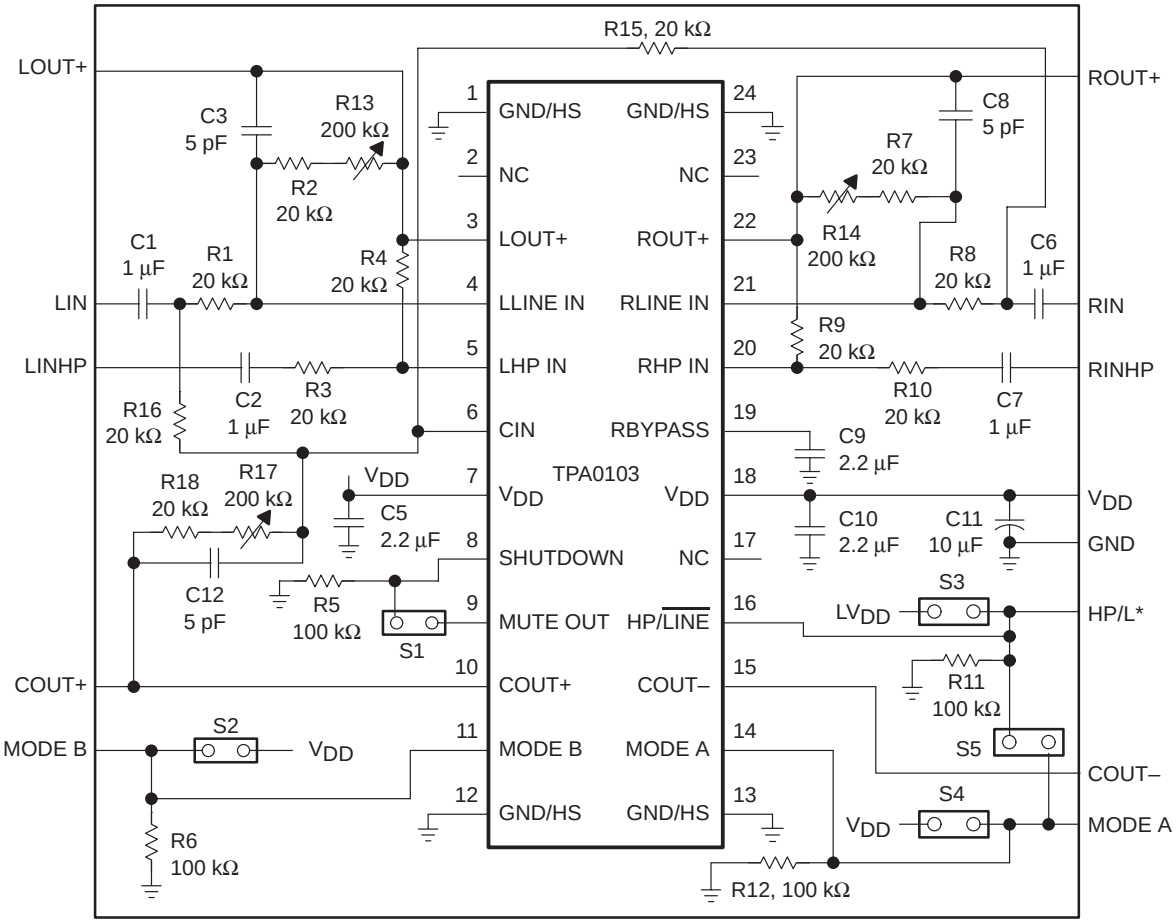


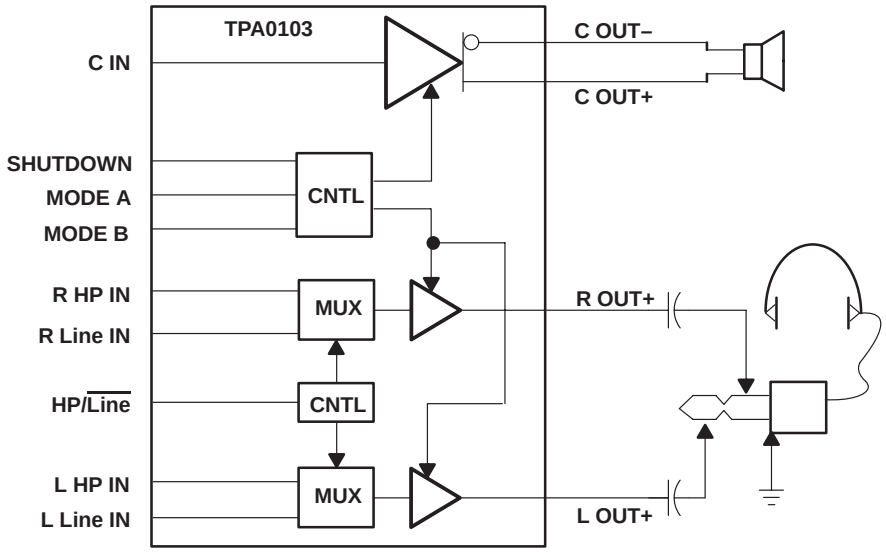
Figure 3–3. TPA0103 EVM Schematic Diagram



3.2.1 TPA0103 Audio Amplifier IC

The TPA0103 audio amplifier IC is a low-voltage CMOS device intended primarily for desktop and notebook PCs. In the typical application, the center channel amplifier is driven from a mix of the L/R inputs to produce a monaural representation of the stereo signal. The center channel amplifier can be shut down independently of the L/R output for speaker muting in headphone applications. The TPA0103 also features a full shutdown function for power sensitive applications reducing current consumption to 5 µA. It is supplied in a very small 24-pin TSSOP thermal surface-mount package and has been designed to operate from low supply voltages (between approximately 3 V and 5.5 V) and deliver full power at distortion levels of less than 0.25% THD+N from a 5-V supply (Figure 3–4).

Figure 3–4. TPA0103 Amplifier IC



The IC includes three separate amplifier channels: a left and right stereo pair (single-ended) and a bridged-tied load (BTL) center channel. In the BTL mode, the two output lines of the center channel operate 180° out-of-phase with each other for increased power. The center channel speaker load is connected directly across COUT+ and COUT–, and neither line is connected to ground. BTL operation provides many benefits, including quadruple the output power of single-ended operation and no need for bulky output coupling capacitors.

The left and right stereo channels operate in the single-ended mode, the speaker load is connected between the OUT+ terminal through an output coupling capacitor, to system ground. For more information, see the TPA0103 amplifier IC data sheet, TI Literature Number SLOS167.

3.2.2 Output Modes

The TPA0103 amplifier operates in any of three output modes or mutes according to the status of the two control terminals MODE A and MODE B as shown in Table 3–1.

Table 3–1. TPA0103 Output Modes

TERMINAL	3-Channel	Mute	Center Only	L/R Only
MODE A	L	H	L	H
MODE B	L	L	H	H

Note: L = logic low, H = logic high

3.2.3 Inputs and Gain

The left and right single-ended channels remain separate from input to output. On the TPA0103 EVM board, the left and right channel inputs are mixed to produce a monaural representation of the stereo signal and applied to the amplifier IC center channel input.

Each of the left and right channels has two separate signal inputs. They are called *line* and *headphone* (*HP*) and are pin-selectable. The line inputs and the center channel input are adjustable between approximately 2 and 22, and the headphone inputs are fixed at a gain of 1. In the typical application in which the TPA0103 powers left and right speakers until headphones are plugged in, the line input gain can be set so that the two inputs provide approximately the same perceived listening level in the headphones as from the speakers. An input multiplexor in the amplifier IC selects between the two inputs according to the state of the HP/$\overline{\text{LINE}}$ IC pin.

The TPA0103 amplifier IC, like most other amplifiers, exhibits its best distortion and noise performance at lower gain levels (see the TPA0103 data sheet). Gain versus total harmonic distortion (THD) should be considered in each application. Both the module input signal level and the TPA0103 module gain should be adjusted to obtain the lowest overall distortion level for a particular overall gain. A quick rule of thumb (everything else being equal): the module input signal level should be as high as possible without clipping or overloading the TPA0103 input, and the TPA0103 gain should be kept as low as possible.

3.3 Using The TPA0103 EVM With the Plug-N-Play Evaluation Platform

The TPA0103 Audio Amplifier Evaluation Module was designed to be used with the TI Plug-N-Play Audio Amplifier Evaluation Platform. It simply plugs into socket U2.

The following paragraphs provide additional details for using the TPA0103 EVM with the platform.

3.3.1 Installing and Removing EVM Boards

TI Plug-N-Play evaluation modules use single-in-line header pins installed on the underside of the module circuit board to plug into sockets on the platform. The EVM pins and the platform sockets are keyed such that only the correct type of EVM can be installed in a particular socket, and then only with the proper orientation.

Evaluation modules are easily removed from the platform by simply prying them up and lifting them out of their sockets. Care must be taken, however, to prevent bending the pins.

3.3.1.1 EVM Insertion

1) Remove all power from the evaluation platform.
2) Locate socket U2 on the platform.
3) Orient the module correctly.
4) Carefully align the pins of the module with the socket pin receptacles.
5) Gently press the module into place.
6) Check to be sure that all pins are seated properly and that none are bent over.

3.3.1.2 EVM Removal

1) Remove all power from the evaluation platform.
2) Using an appropriate tool as a lever, gently pry up one side of the module a small amount.
3) Change to the opposite side of the module and use the tool to pry that side up a small amount.
4) Alternate between sides, prying the module up a little more each time to avoid bending the pins, until it comes loose from the socket.
5) Lift the EVM off of the platform.

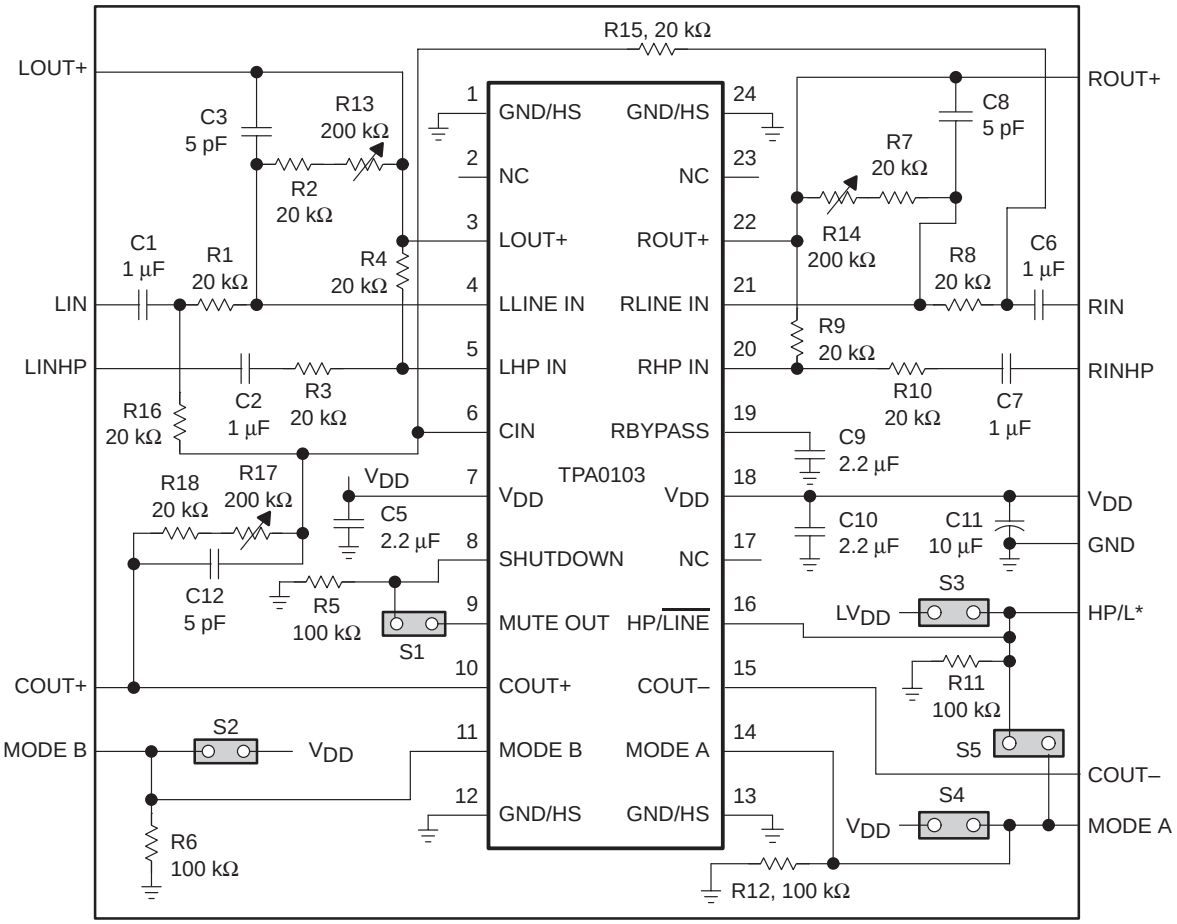
3.3.2 TPA0103 Module Jumper Settings

The TPA0103 EVM is equipped with several jumpers that act like SPST switches to allow module operation to be modified to suit various requirements. In the following discussion, setting a jumper to ***ON*** means that a shunt is installed across the two pins of the jumper. Setting a jumper to ***OFF*** means that no shunt is installed on the jumper. See Figure 3.5.

In typical applications, some or all of the jumper functions are controlled by the system microcontroller or external logic.

Note that jumpers S2 through S5 tie various amplifier control input pins directly to V_{DD}. When one of these EVM jumpers is set to ON, the signal on the associated EVM control input pin will have no effect. In addition, V_{DD} appears on that EVM control input pin. Care should be taken to ensure that low-impedance paths to ground are not provided through the circuitry that applies control signals to the EVM control input pins or that external circuits will not be upset by V_{DD} appearing on the EVM control input lines.

Figure 3–5. TPA0103 EVM Jumpers



3.3.2.1 S1 — Shutdown Jumper

To have the module amplifier IC enter the shutdown mode when the module mute control input is activated, set shutdown jumper S1 to ON.

The mute control output pin on the TPA0103 amplifier IC goes high when the mute mode is selected by the output mode jumpers (S2 and S4). Jumper S1 connects the mute output pin to the shutdown control input pin of the IC so that when S1 is ON, the IC is forced into shutdown mode instead of mute mode when the mute mode is selected. When S1 is OFF, a pulldown resistor on the module holds the IC shutdown control input pin low, keeping the IC out of the shutdown mode.

The shutdown mode reduces IC current consumption to approximately 5 μA compared to approximately 1.5 mA in the mute mode. It takes longer, however, to resume normal operation from the shutdown mode (approx. 1 s to 2 s) than it takes to resume normal operation from the mute mode (approx. 100 ms to 500 ms).

3.3.2.2 S2 and S4 — Output Mode Control Jumpers

Two IC amplifier output mode control pins select among three output modes and mute. These pins, Mode A and Mode B, are brought out to module pins and also have jumpers that can hardwire the IC amplifier control inputs high. Table 3–2 shows the relationship between the IC amplifier control inputs and the output modes.

Table 3–2. TPA0103 Output Modes

TERMINAL	3-Channel	Mute	Center Only	L/R Only
MODE A	L	H	L	H
MODE B	L	L	H	H

Note: L = logic low, H = logic high

Jumper S2 connects the Mode B output mode control input pin on the amplifier IC directly to V_{DD} regardless of the state of the Mode B module control input. When S2 is OFF, a pulldown resistor on the module holds the Mode B output mode control input pin low. The Mode B control input pin is not directly controlled by anything on the platform — the platform socket for that module pin is N/C.

Jumper S4 connects the Mode A output mode control input pin on the amplifier IC directly to V_{DD} regardless of the state of the Mode A module control input, or the input select module control input (HP/L*), or the status of jumper S3 when autosense jumper S5 is set to ON. When S4 is OFF, a pulldown resistor on the module holds the amplifier IC Mode A output mode control input pin low.

3.3.2.3 S3 — Input Select Jumper

To select the line inputs, set input select jumper S3 to OFF. To select the headphone inputs, set input select jumper S3 to ON.

The TPA0103 amplifier IC has two separate inputs for each of the left and right stereo channels. An internal multiplexor selects which input will be connected to the amplifier based on the state of the HP/$\overline{\text{LINE}}$ pin on the IC. However, the EVM HP/L* control input pin is not directly controlled by anything on the platform — the platform socket for that module pin is N/C. The amplifier IC HP/$\overline{\text{LINE}}$ control pin can be tied high manually via jumper S3 or connected to the amplifier IC Mode A control pin via jumper S5 so that it follows that control signal.

For manual control, jumper S3 connects the HP/L* module control input pin to V_{DD}, so that when S3 is ON, the headphone inputs are selected. When S3 is OFF, a pulldown resistor on the module holds the IC shutdown control input pin low, selecting the line inputs.

3.3.2.4 S5 — Autosense Jumper

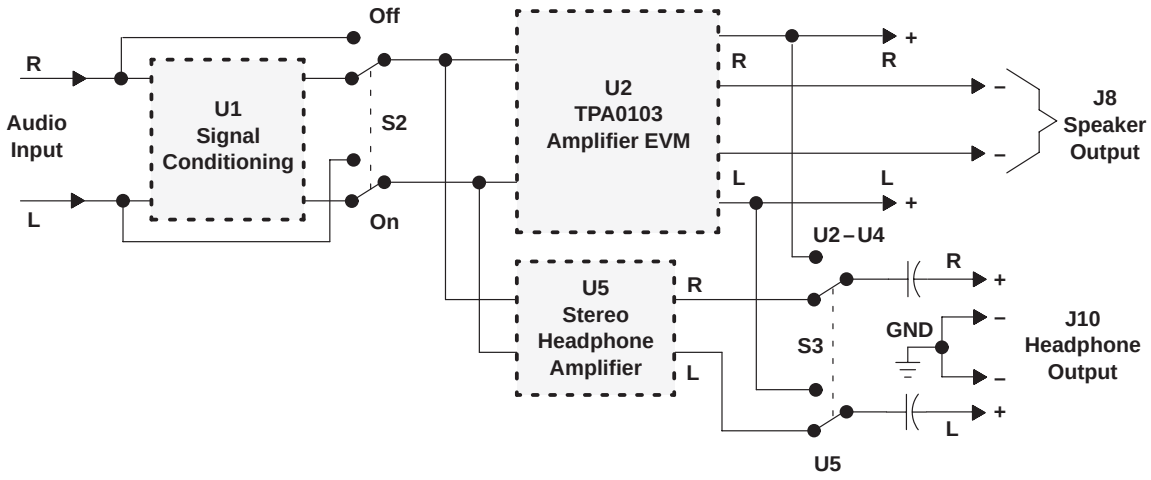
To have the IC amplifier input select control input pin (HP/$\overline{\text{Line}}$) follow the state of the Mode A IC output mode select pin, set autosense jumper S5 to ON. This automatically selects the headphone inputs when the Mode A control input goes high.

Note that when autosense jumper S5 is set to ON, amplifier IC control input pins HP/$\overline{\text{Line}}$ and Mode A are tied to V_{DD}, and the Mode A control signal will have no effect if ***either*** jumper S3 or jumper S4 are set to ON.

3.3.3 Signal Routing

Signal flow on the platform is controlled by two signal routing switches, as shown in Figure 3–5.

Figure 3–6. Platform Signal Routing and Outputs



3.3.3.1 Signal Conditioning

The audio signal from the input jacks can be applied to the signal conditioning socket (U1) if an EVM is installed there, or socket U1 can be bypassed and the audio input signal applied directly to the inputs of the TPA0103.

- ❏ Switch **S2** selects signal conditioning or bypasses it.

3.3.3.2 Headphone Output Jack

Switch S3 is the source select for the stereo headphone output jack, J10. The headphone jack is capacitively coupled (via 470 μF electrolytics) and can output either the signal from the headphone amplifier in socket U5, or the signal from the TPA0103 power amplifier installed in socket U2, as determined by the setting of headphone source select switch S3.

When S3 is set to the power amplifier position (U2 – U4), the headphone jack is connected to the TPA0103 left and right OUT+ output lines. When a plug is inserted into the jack, signals output through J10 are returned to platform ground, requiring single-ended power amplifier operation. A switch inside the headphone jack produces a control signal that can be routed to the power amplifier socket to shut down the TPA0103 EVM or switch it to stereo single-ended headphone output mode when a plug is inserted.

Source select switch S3 connects the headphone jack to the output lines of either the headphone amplifier socket U5 or the power amplifier sockets (U2 – U4).

- ■ To route the TPA0103 single-ended stereo headphone amplifier outputs to the headphone output jack (**J10**), set switch **S3** to the power amplifier position (***U2 – U4***).

3.3.4 Mode Control

The TPA0103 EVM is equipped with a mode control input pin that receives a control signal from the platform. This EVM pin is connected to the amplifier IC Mode A output mode control input pin. The state of this input, in conjunction with the state of the Mode B output mode control input pin, controls the output mode of the amplifier IC on the EVM.

When the EVM mode control input pin (Mode A) is high, the TPA0103 amplifier IC on the module either enters the mute mode and dissipates very little power when Mode B jumper S2 on the EVM is set to OFF. When S2 is set to ON, a high on the EVM mode control input pin causes the amplifier IC to enter the L/R stereo outputs only mode.

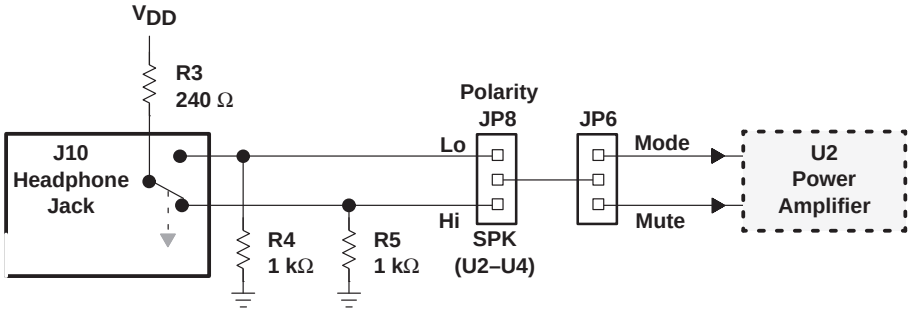
When the EVM mode control input is tied to GND or allowed to float, the 3-channel output mode is selected if S2 is set to OFF and the center channel only output mode is selected if S2 is set to ON.

In the typical application, output mode switching allows the TPA0103 to operate the BTL center channel to drive a speaker and then switch to stereo left and right single-ended mode to drive headphones when a plug is inserted into the headphone jack.

3.3.4.1 Headphone Jack Control Signals

The platform headphone output jack (J10) contains an internal switch that changes the state of a pair of control lines when a plug is inserted (Figure 3–7). Each control line is pulled down by a 1-kΩ resistor to ground (R4 and R5). The switch in the headphone jack pulls one line or the other up to V_{DD} through a 240-Ω resistor (R3), depending on whether a plug is inserted in J10 or not.

Figure 3–7. Mute/Mode and Polarity Control



3.3.4.2 Mute/Mode Select (JP6)

A 3-pin jumper header (JP6) on the platform, functioning as an SPDT switch, routes the control signal from the headphone jack to either the mute control input pin or the mode control input pin of the evaluation module.

- To switch the TPA0103 amplifier module between center channel speaker and stereo headphone modes using the control signal from the platform headphone jack, jumper **JP6** to ***MODE***
- For center channel only or 3-channel output modes (as selected by EVM jumper S2) leave **JP6** *open.*

3.3.4.3 Mute/Mode Polarity Select (JP8)

A second 3-pin jumper header (JP8) on the platform selects the control signal polarity by connecting either the active-high or the active-low line from the headphone jack to jumper JP6.

- When JP6 is set to Mode, set **JP8** to ***Hi***.
- When JP6 is open, JP8 settings are ignored.

3.3.5 Power Requirements

The TPA0103 Audio Power Amplifier Evaluation Module can operate from any voltage between approximately 3 V and 5.5 V; however, the TPA0103 amplifier IC on the module is characterized for operation at 3.3 V and 5 V. For best performance (highest output power with lowest distortion), the module should be operated at approximately 5 V unless there is a specific reason for operating it from a lower voltage.

The TI Plug-N-Play Audio Amplifier Evaluation Platform with a voltage regulator EVM installed on it can provide a regulated V_{DD} supply from a wide variety of unregulated V_{CC} voltage inputs between approximately 5.5 V and 12 V, including an on-board 9-V battery. Or, an external regulated power source can be used to supply V_{DD} voltage to the platform and the TPA0103 evaluation module installed on it.

Although the TPA0103 amplifier IC draws approximately 0.9 A from the power supply during continuous full power output, peak current draw can be as high as 1.5 A. Any power supply connected to the platform should be capable of providing 1.5 A of current to avoid clipping the output signal during peaks. Current consumption driving speakers at normal listening levels is typically 0.5 A or less.

The platform is equipped with overvoltage and reverse-polarity supply voltage input protection in the form of fused crowbar circuits.

- V_{DD} voltage applied to platform screw terminals J6 *MUST NOT* exceed the absolute maximum rating for the TPA0103 amplifier IC installed on the evaluation module (6 V) or damage to the IC may result. In no case should V_{DD} voltage of the incorrect polarity or in excess of 6.1 V be applied to screw terminals J6 of the platform, or the power protection circuit on the V_{DD} line will trip.
- V_{CC} voltage applied to the platform *MUST NOT* exceed the maximum voltage input specified for the voltage regulator module installed in socket U6 (12 V for the SLVP097), or damage to the voltage regulator module may result. In no case should V_{CC} voltage applied to the platform exceed 15 V, or the overvoltage protection circuit on the V_{CC} bus will trip.

3.3.6 Inputs and Outputs

The TI Plug-N-Play Audio Amplifier Evaluation Platform is equipped with several standard conectors for audio inputs and outputs.

3.3.6.1 Inputs

In most cases, audio signals enter the platform through either a pair of RCA phono jacks (J3 and J5) or a miniature (1/8″) stereo phone jack (J4). Certain signal conditioning and amplifier EVMs, however, may have additional signal input connectors mounted on the module circuit board.

The platform audio signal input jacks (J3, J4, and J5) are of the closed-circuit type, grounding the signal input lines when no plugs are inserted.

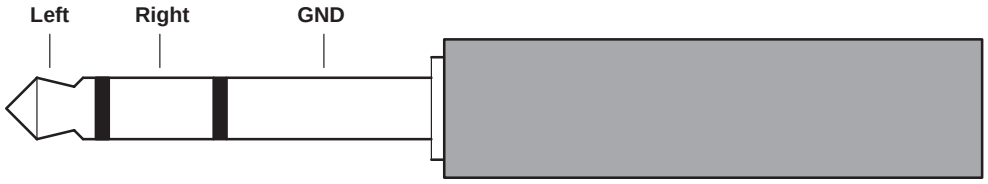
3.3.6.2 Outputs

When the TPA0103 EVM is installed, amplified audio output signals leave the platform through the negative left and right compression connectors for stripped speaker wires (J8) and through a miniature (1/8″) stereo phone jack (J10), for headphones.

The TPA0103 EVM BTL center channel audio output from amplifier IC leave the platform via the left and right negative (black) compression connectors of J8. *The positive (red) connectors of J8 are not used.* Each output is isolated from system ground allowing the TPA0103 center channel power amplifier to operate in the highly-efficient bridge-tied load configuration for driving a speaker.

The platform headphone jack (J10) is capacitively coupled to source select switch S3, which connects J10 to the output lines of either the headphone amplifier socket or the power amplifier sockets (Figure 3–6). When the TPA0103 single-ended left and right stereo headphone output signals are routed to J10 by S3, signals output via J10 are returned to platform ground when a plug is inserted (Figure 3–8).

Figure 3–8. Typical Headphone Plug



3.4 Using The TPA0103 EVM Stand-Alone

Using the TPA0103 Audio Power Amplifier Evaluation Module stand-alone is much the same as using it with the platform. The same 3-V to 5.5-V power supply range and the isolated OUT+ and OUT– lines for BTL operation requirement exists.

Note that the mute signal applied to the EVM Mode A pin must be able to supply enough current to overcome the pulldown resistor on the module (100 kΩ), possibly in parallel with a second pulldown resistor (100 kΩ).

3.4.1 TPA0103 EVM Connected for Center Channel BTL Output

Figure 3–9. TPA0103 EVM Connected for Center Channel BTL Output

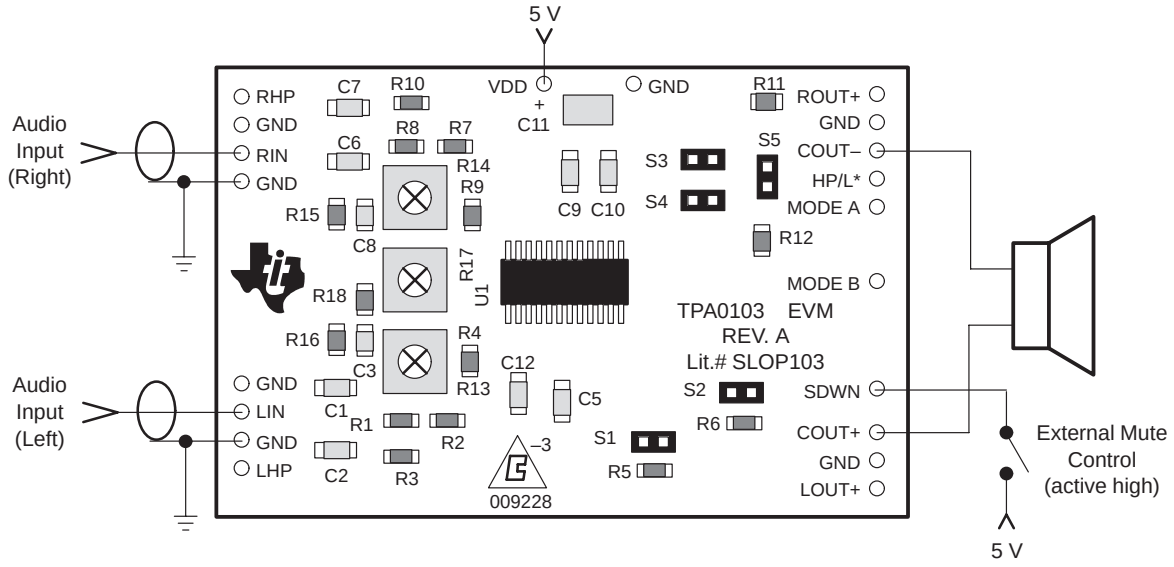


Table 3–3. Typical TPA0103 EVM Jumper Settings for Center Channel BTL Stand-Alone

EVM	S1	S2	S3	S4	S5
TPA0103	ON	ON	OFF	OFF	OFF

Note: ON = shunt installed, OFF = open, X = don't care

3.4.2 TPA0103 EVM Connected for Stereo Headphones Output

Figure 3–10. TPA0103 EVM Connected for Stereo Headphones Output

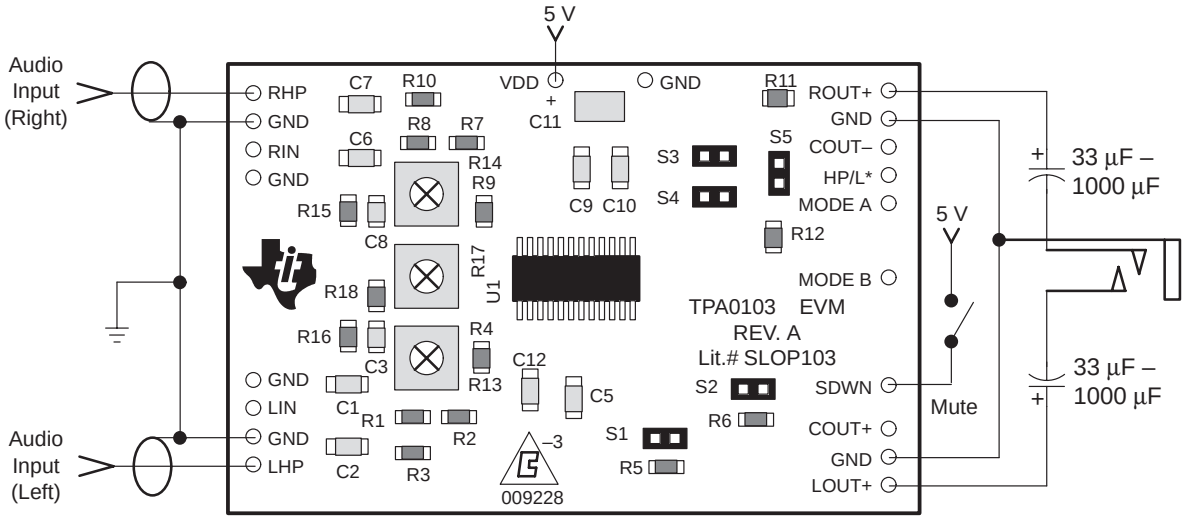


Table 3–4. Typical TPA0103 EVM Jumper Settings for Stereo Headphone Output

EVM	S1	S2	S3	S4	S5
TPA0103	ON	ON	ON	ON	OFF

Note: ON = shunt installed, OFF = open, X = don't care

3.5 TPA0103 Audio Power Amplifier Evaluation Module Parts List

Table 3–5. TPA0103 EVM Parts List

Ref.	Description	Size	EVM Qty.	Manufacturer/ Part Number	Digi-Key Number
C1, C2, C6, C7	Capacitor, 1 μF, +80% –20%, nonpolarized	1206	4	Murata GRM42-6Y5V105Z16BL	Newark 93F2254
C5, C9, C10	Capacitor, 2.2 μF, 20%, nonpolarized	1206	3	TDK C3216X5R1A225	
C3, C8, C12	Capacitor, 5 pF	0805	3	Panasonic ECU-V1H050CCN	Digi-Key PCC050CNCT-ND
C11	Capacitor, 10 μF, 6.3 V	A	1	Panasonic ECS-TOJY106R	Digi-Key PCS1106CT-ND
R1 – R4, R7 – R10, R15, R16, R18	Resistor, 20 kΩ, 1/8 W, 5%	0805	11	Panasonic ERJ-8GEYJ203V	Digi-Key P20KKABK-ND
R5, R6, R11, R12	Resistor, 100 kΩ, 1/8 W, 5%	0805	4	Panasonic ERJ-6GEYJ104V	Digi-Key P100KABK-ND
R13, R14, R17	Pot, 200 kΩ, 1/8 W, 20%, Thru-hole		3	Bourns 3323P-1-204	Digi-Key 3323P-1-204ND
S1 – S5	Header, 2 position	2 mm	5	Norcomp	Digi-Key 2163-02-ND
	Shunts	2 mm	5	3M	Digi-Key 953170-30-ND
U1	IC, TPA0103, 3-channel audio amplifier	24 pin TSSOP	1	TI TPA0103PWP	
PCB1	PCB, TPA0103 EVM		1	TI SLOP103	