

# TPA5051EVM

## Contents

1	Introduction .....	1
2	Software .....	2
3	Operation .....	6
4	Reference.....	9
5	TPA5051EVM Schematic Diagram .....	12

## List of Figures

1	TPA5051 in I <sup>2</sup> S Mode With Separate Delays for Left and Right Channels .....	3
2	TPA5051 in I <sup>2</sup> S Mode With Frame Delay.....	4
3	TPA5051 in Right-Justified Mode .....	5
4	TPA5051 in I <sup>2</sup> S Mode – Unable to Communicate.....	6
5	Top Layer of the TPA5051EVM .....	7
6	Bottom Layer of the TPA5051EVM .....	8
7	TPA5051EVM Top Layer .....	9
8	TPA5051EVM Second Layer .....	9
9	TPA5051EVM Third Layer .....	10
10	TPA5051EVM Bottom Layer.....	10

## List of Tables

1	Bill of Materials .....	11
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## 1 Introduction

### 1.1 Description

The TPA5051 evaluation module (EVM) consists of a single TPA5051 audio delay device, along with other external components mounted on a printed-circuit board (PCB) that can be used to independently delay two digital audio streams. Each digital audio stream consists of a left and right channel, both of which can be delayed up to 4095 samples (with a 48-kHz sampling rate, that equates to more than 85ms of delay).

The TPA5051EVM is designed to work seamlessly with the TI Input USB board, but can function as a stand-alone board for pass-through testing in any system. All that is required is an I<sup>2</sup>S audio source, an I<sup>2</sup>C controller, and a 5-V supply.

The TPA5051EVM also includes an onboard digital-to-analog controller (DAC), the PCM1606, which can convert I<sup>2</sup>S or left-justified data to an analog out. The analog out is filtered on the board and can be viewed with a scope probe.

## 1.2 TPA5051EVM Specifications

+5 V	Supply Voltage	5 V
I <sub>DD</sub>	Supply current	150 mA maximum
I <sub>DD</sub> (with TI Input USB board connected)	Supply current	500 mA maximum

## 2 Software

The included compact disk (CD) has all the software and drivers necessary to properly operate the TPA5051EVM with the TI Input USB board. This software is designed to work only with personal computers (PC). The installation software consists of *TPA505x Interface SAA*, *Command Tool*, and *.Net Framework 1.1*.

### 2.1 Installation

1. Open up the CD, and browse the directory named *TPA505x HD GUI Installer*.
2. Click on **setup.exe**. The installer will then initialize.
3. Next, the user must choose the directories in which to install the software. The default directory for the TPA505x Interface SAA software is *C:\Program Files\Texas Instruments Inc\*, and the default directory for the National Instruments™ files is *C:\Program Files\National Instruments\*. Other directories may be used, but for purposes of convenience, the default directories are recommended.
4. Once the directory selection has been made, click **next** to proceed.
5. The National Instruments™ License Agreement appears. It is necessary to read and accept this agreement to continue with the installation.
6. Once the National Instruments™ License Agreement has been accepted, another window indicating which components are to be installed appears. It should read *Adding or Changing - TPA505x Interface SAA Files*. Click **next** to proceed.
7. The TPA505x SAA Interface program then installs the necessary files.
8. Once the TPA505x SAA Interface program has been installed, the setup program begins installing Command Tool 6.0. The Command Tool License Agreement must be read and accepted for installation to continue.
9. On acceptance of the Command Tool License Agreement, .Net Framework 1.1 is installed. This installation procedure may take a while. When it is finished, click **ok**.
10. Command Tool 6.0 proceeds to configure the new software. When it is finished, click **Finish**.
11. Power up the TI Input USB Board (see the Operation section in this document), and then connect the USB cable from the computer to the TI Input USB Board. A message pops up stating that the computer has found new hardware. Shortly after that message appears, the computer finds and installs the correct drivers for it.

### 2.2 Software Use

The TPA5051 software graphical user interface (GUI) is designed to allow the user to control the TPA5051 by an I<sup>2</sup>C bus.

1. Select the I<sup>2</sup>C address of the EVM by entering the address number under the *I2C Address (0-7)* section. The default for the program is 0. The default for the EVM is also 0. The number in the program corresponds to the last three digits of the I<sup>2</sup>C address of the device (ADD2, ADD1, and ADD0), which can be controlled by installing or removing jumpers J5, J4, or J3.
2. Select the mode of operation by clicking on the appropriate circle under *Stream Type*.
3. The right and left delays can be adjusted by turning the knob to the desired number of delay samples, or simply entering the number in the box provided (see [Figure 1](#)). The maximum number of delay samples per channel for the TPA5051 is 4095. The TPA505x software, however, allows for programming up to 8191 samples per channel. This is because the software is designed to work for both the TPA5050 and TPA5051. **A delay set above 4095 samples is not valid for the TPA5051.**
4. The right and left delays can be tied together by clicking on the *R Track L 1 OFF/ON* box to the right of the *Right Delay* knob.

5. The delay also can be controlled with the *Frame Delay* option. Simply click on the *Frame Delay Mode 1 ON/OFF* box, and the frame delay options become available. Frame delay mode affects both left and right channels simultaneously (see [Figure 2](#)).
6. Clicking on the Right Justified mode under *Stream Type* brings up a hidden window, called *Packet Length*. Through this, the number of packet lengths to be delayed can be entered (see [Figure 3](#)).
7. The option Bypass simply sets the TPA5051 to pass the data through, without doing any manipulation to it.
8. The *I2C Status* display at the bottom right indicates whether the device and the computer are communicating properly. A red status bar indicates a problem. A green status bar indicates the device and computer are talking (see [Figure 4](#)). Possible solutions to the red status bar problem are to depress and release the **reset** button on the TI Input USB board, check to see that all cables are properly connected, restart the TPA5051 GUI, remove and then re-insert the USB cable into the computer, reboot the computer, or re-install the software.
9. The list of registers on the right side of the screen (0x01...0x10) indicate what values were last written to that particular register. The TPA5051 has eighteen registers, however the two **Complete Update** registers are not shown on the GUI. Therefore, only registers (0x01...0x07) and (0x09...0x0F) are shown.
10. The channel selection tab is designed for use with the TPA5051, which has two independent digital audio inputs. Selecting the *Channel 1* tab allows control of the registers for digital audio input 1 (DATA1 of the device). Selecting the *Channel 2* tab allows control of the registers for digital audio input 2 (DATA2 of the device). See [Figure 2](#)

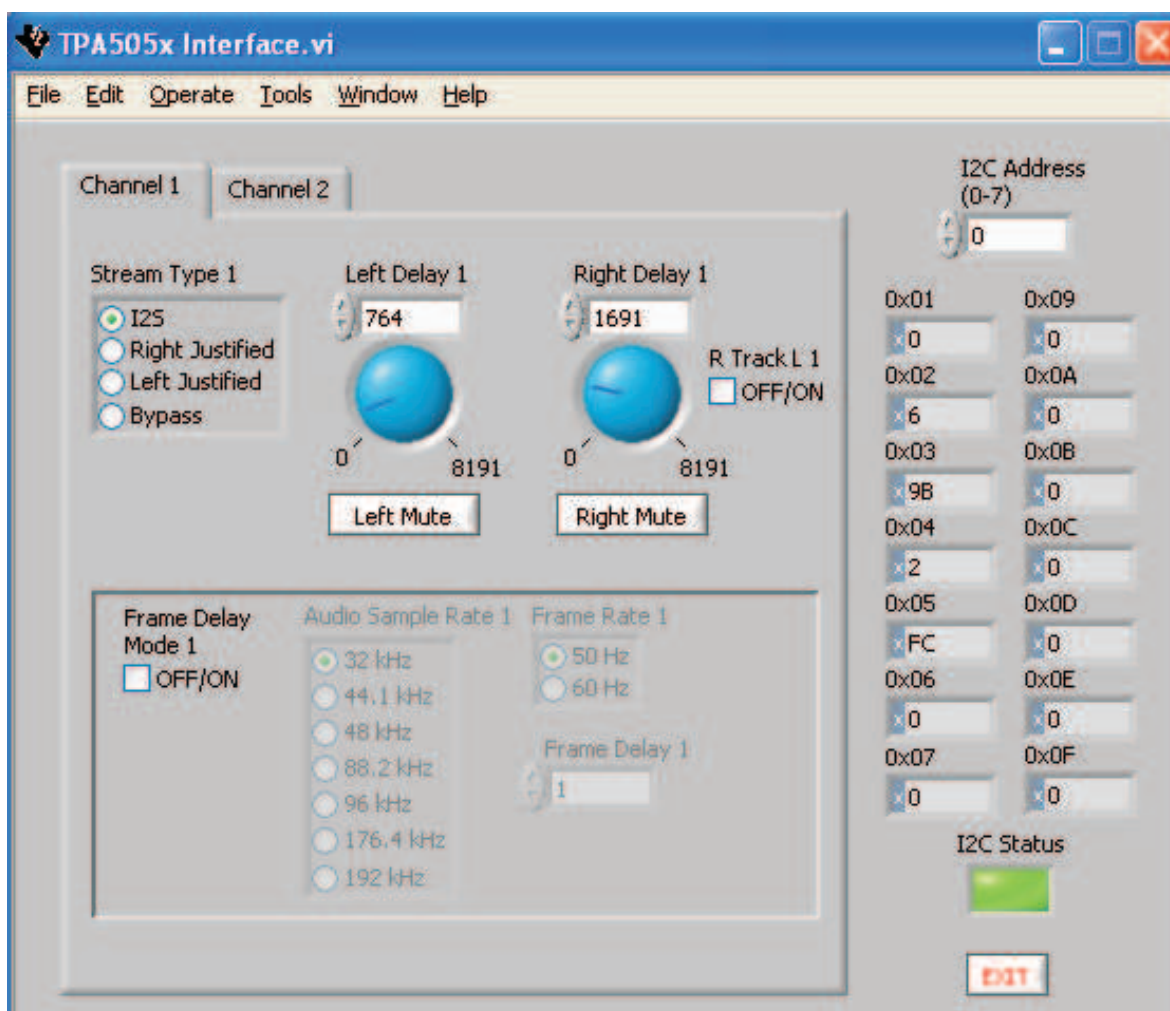


Figure 1. TPA5051 in I<sup>2</sup>S Mode With Separate Delays for Left and Right Channels

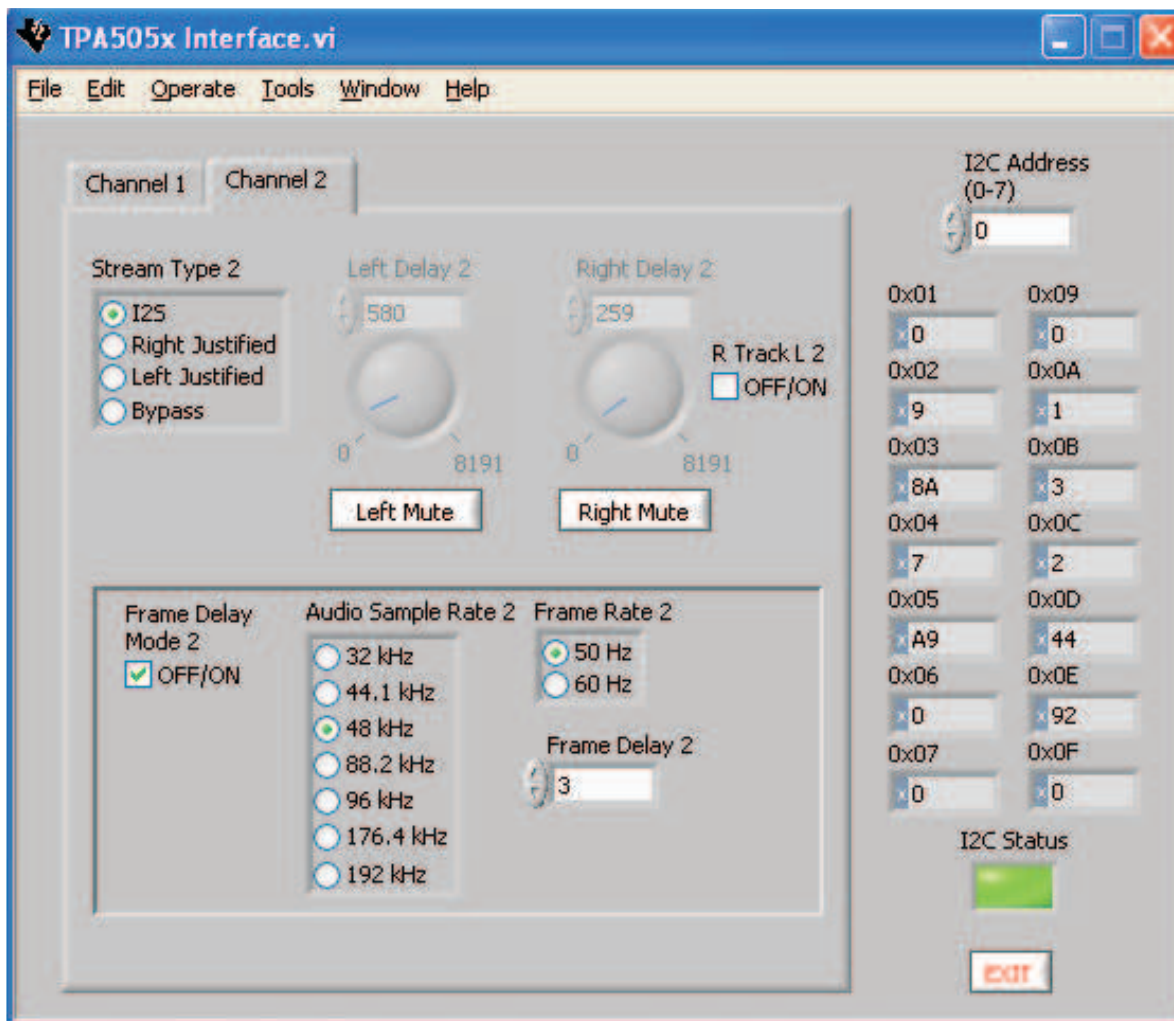


Figure 2. TPA5051 in I<sup>2</sup>S Mode With Frame Delay

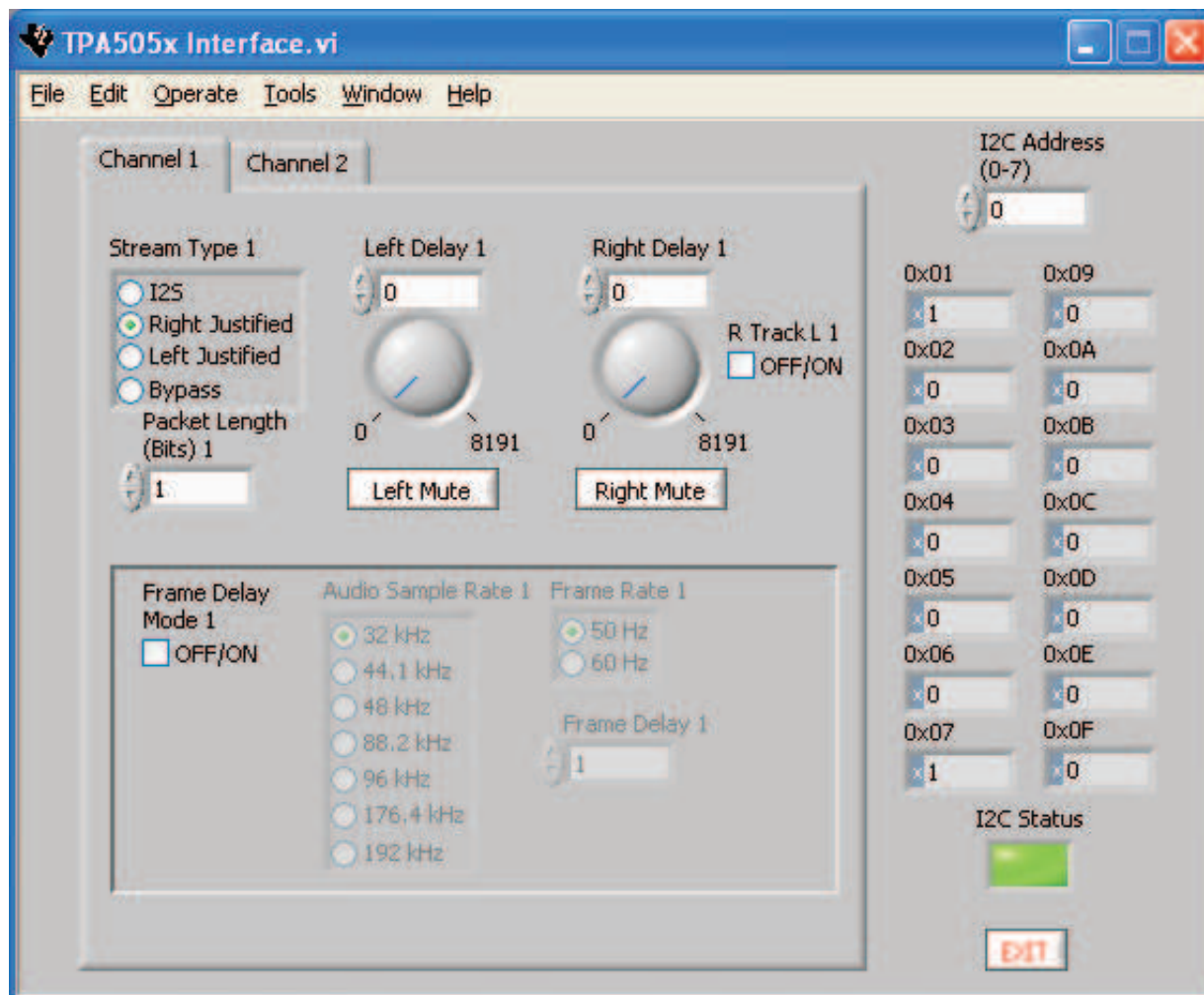


Figure 3. TPA5051 in Right-Justified Mode

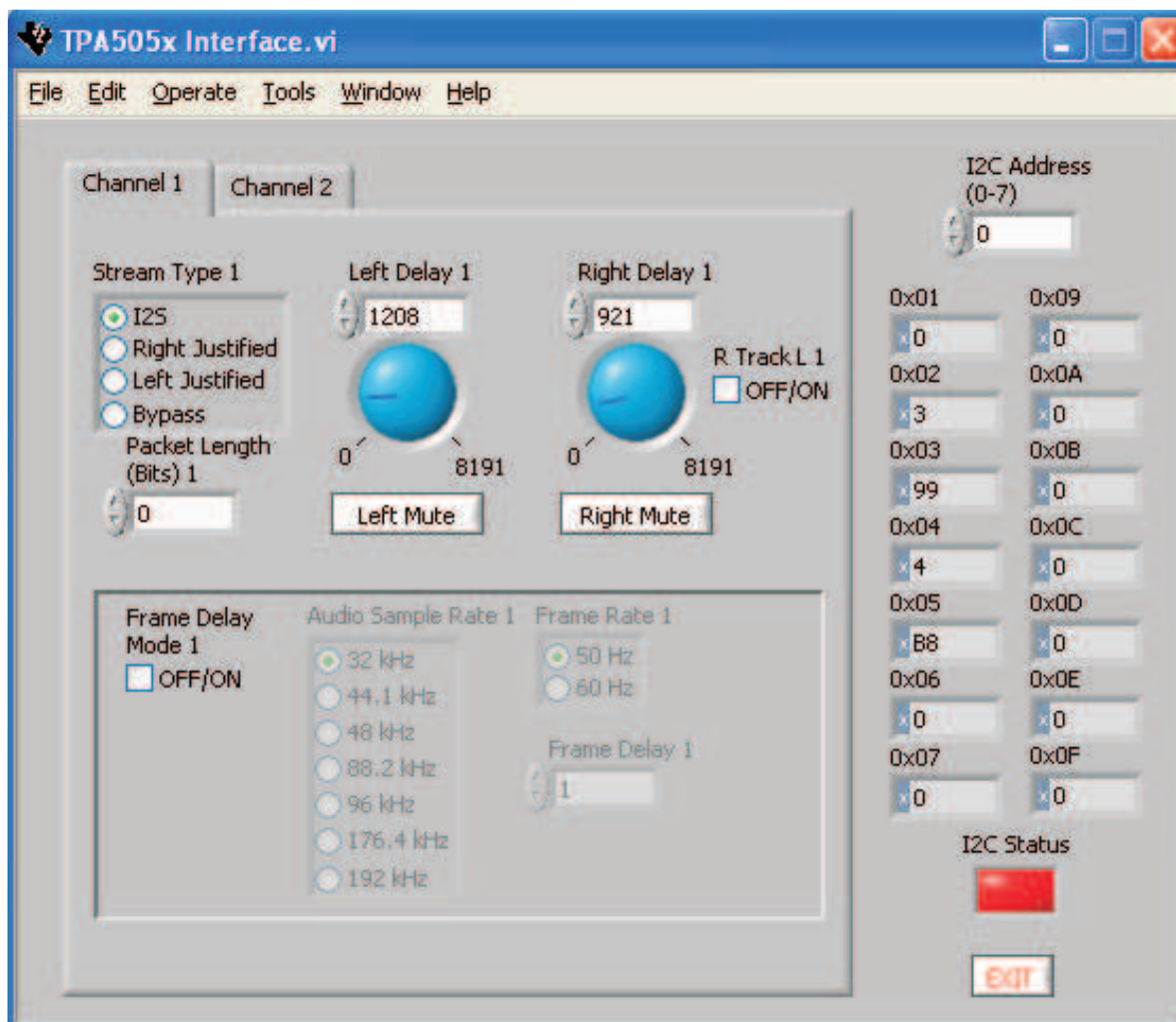


Figure 4. TPA5051 in I<sup>2</sup>S Mode – Unable to Communicate

### 3 Operation

#### 3.1 Quick Start List for Use With the TI Input USB Board

Follow these steps to use the TPA5051EVM with the TI Input USB board. This requires a digital or analog audio source, a 5-V power supply, and the included USB and ribbon cables.

#### 3.2 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 +5V (J7) and GND (J6), taking care to observe marked polarity.

#### 3.3 EVM Preparation

1. Ensure that the shunts are fully installed on jumpers **J1** and **J2**. This jumper setting sets the operating mode of the PCM1606 to I<sup>2</sup>S.
2. Install the shunts across **J3**, **J4**, or **J5**, to set the I<sup>2</sup>C address of the TPA5051. **J3**, **J4**, and **J5** correspond to ADD0, ADD1, and ADD2, respectively. Installing the shunt across a given jumper pulls

that pin high. The default is 000. Installing a shunt across **J3** sets the address to 001.

3. Connect the 34-pin ribbon cable between header J800 on the TI Input USB board and header H1 on the TPA5051EVM.
4. Connect the 16-pin ribbon cable between header J850 on the TI Input USB board and header H3 on the TPA5051EVM.
5. Connect the USB cable from the USB jack on the PC to the J350 USB Interface on the TI Input USB board.
6. For additional delay, another TPA5051EVM can be added in series using the 16-pin and 34-pin ribbon cables.
7. Install shunts across **J6** and **J7**. For stand alone evaluation, the shunts may be removed allowing for separate LRCLK and BCLK signals for DATA1 and DATA2.

**Note:** No pullup resistors are installed on the TPA5051EVM. Doing so interferes with the initialization of the TI Input USB board in certain circumstances. However, the pads for the pullup resistors, including SDA and SCL (**R13** and **R14**, respectively), are available on the EVM for populating if the EVM is to be used in a stand-alone fashion

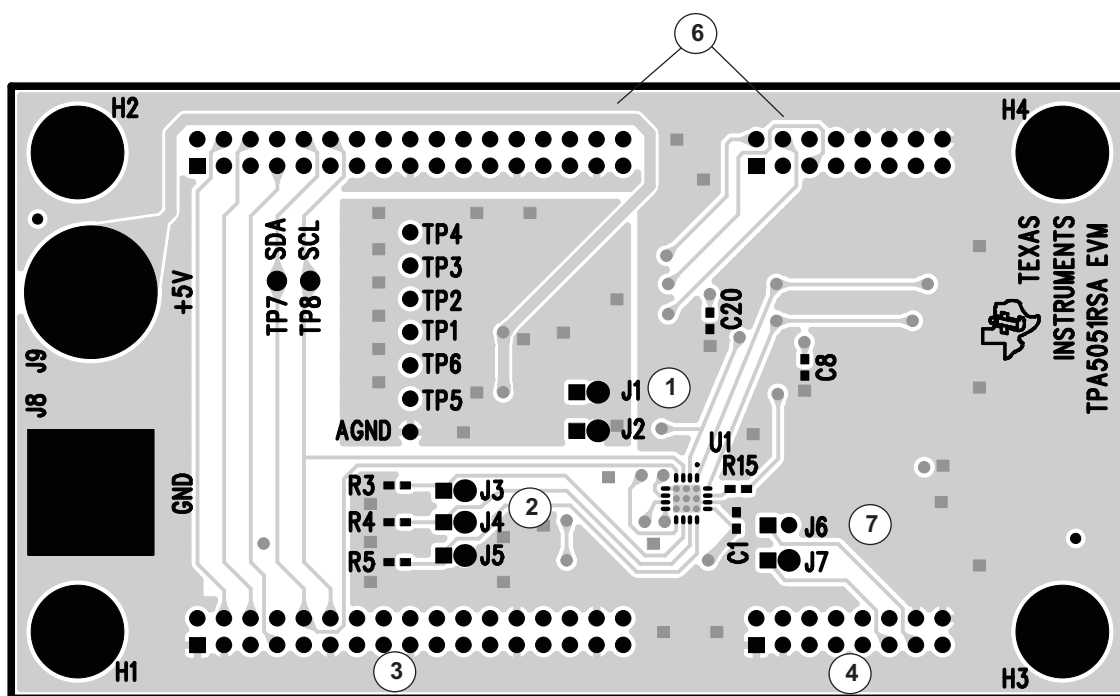


Figure 5. Top Layer of the TPA5051EVM

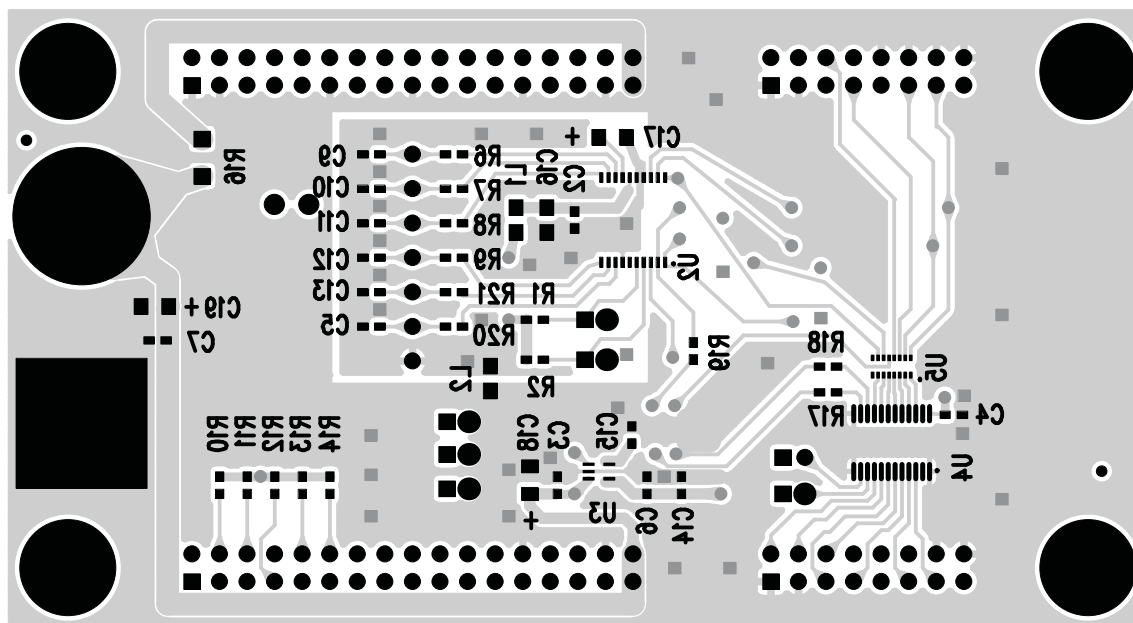


Figure 6. Bottom Layer of the TPA5051EVM

### 3.4 Operation

1. Turn on the power supply for the TPA5051EVM.
  2. Start the TPA505x software.
  3. Depress the reset button on the TI Input USB board.
  4. To play to music through digital audio input 1 (DATA1), insert a signal source into the TI Input USB board. If it is an analog source, insert it into the jack labeled **CH1+2**.
  5. To play to music through digital audio input 2 (DATA2), insert a signal source into the TI Input USB board. If it is an analog source, insert it into the jack labeled **CH3+4**.
  6. If the source is digital, insert it into either the RCA jack or the optical jack, and ensure that the switch between them is selected properly.
  7. Play the music or other source.
  8. Use the GUI to mute the left or right channels, and to delay them.
- Note: The TI Input USB board is designed to output I<sup>2</sup>S only.**
9. Use scope probes to view both delayed and nondelayed signals via the DAC. TP1 and TP2 (left and right, respectively) are the delayed signals from DATA\_OUT1 of the TPA5051. TP3 and TP4 (left and right, respectively) are the original signals input to DATA1. TP5 and TP6 are the delayed signals from DATA\_OUT2 of the TPA5051. The EVM is not configured to allow the PCM1606 to display the original signals input to DATA2.
  10. External amplifiers can be connected to the output of the PCM1606; however, the supplied AGND test point should be used as the ground reference for external amplifiers. Consult the PCM1606 data sheet for more information regarding this topic.

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**Note:** TP7 and TP8 (SDA and SCL, respectively), are placed for convenient viewing of the I<sup>2</sup>C signals only. If it is necessary or desired to manually control the TPA5051 with independent software, the 34 pin connector of the TI Input USB Board must first be removed.

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4 Reference

4.1 TPA5051EVM PCB Layers

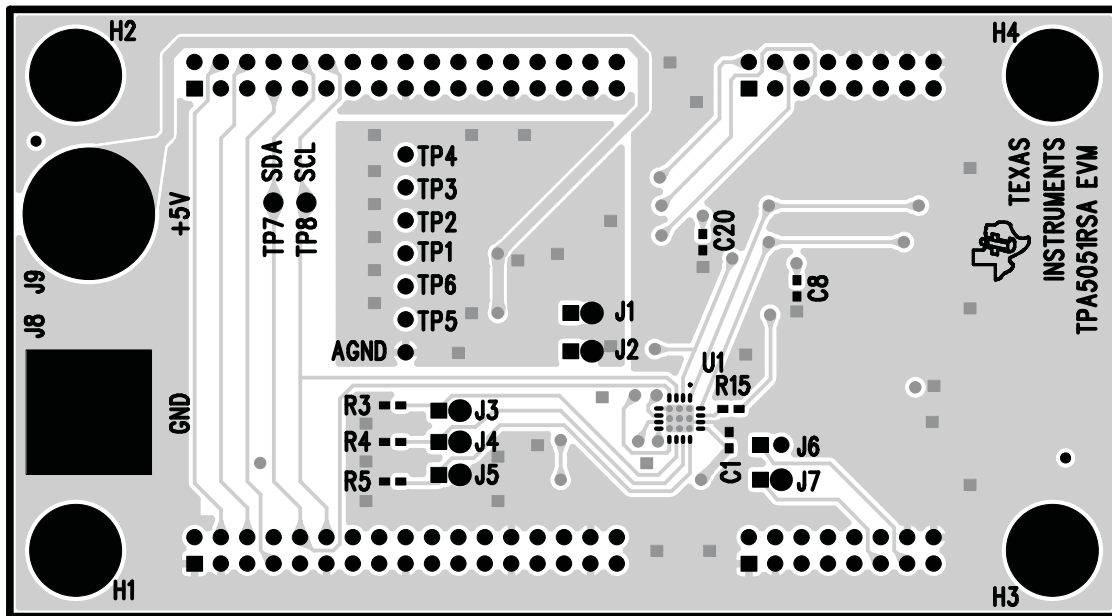


Figure 7. TPA5051EVM Top Layer

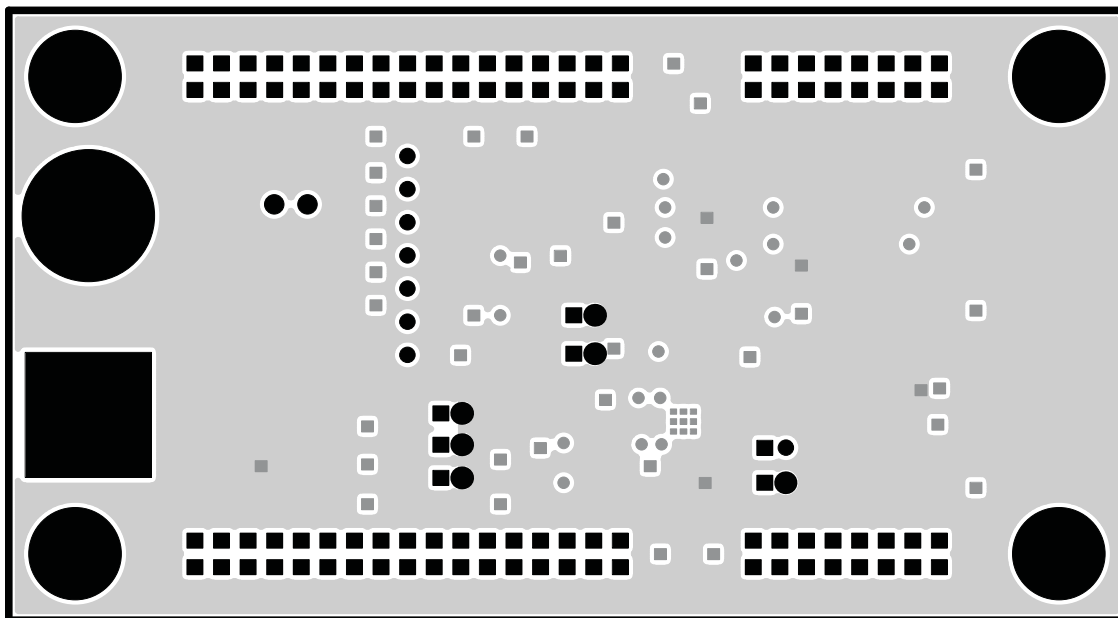


Figure 8. TPA5051EVM Second Layer

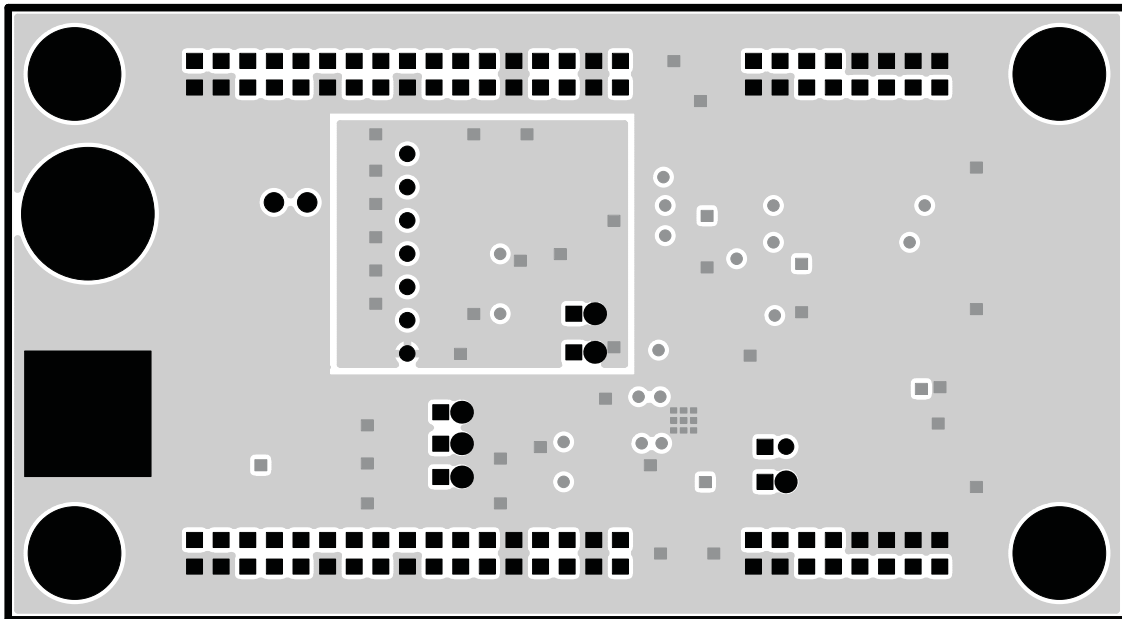


Figure 9. TPA5051EVM Third Layer

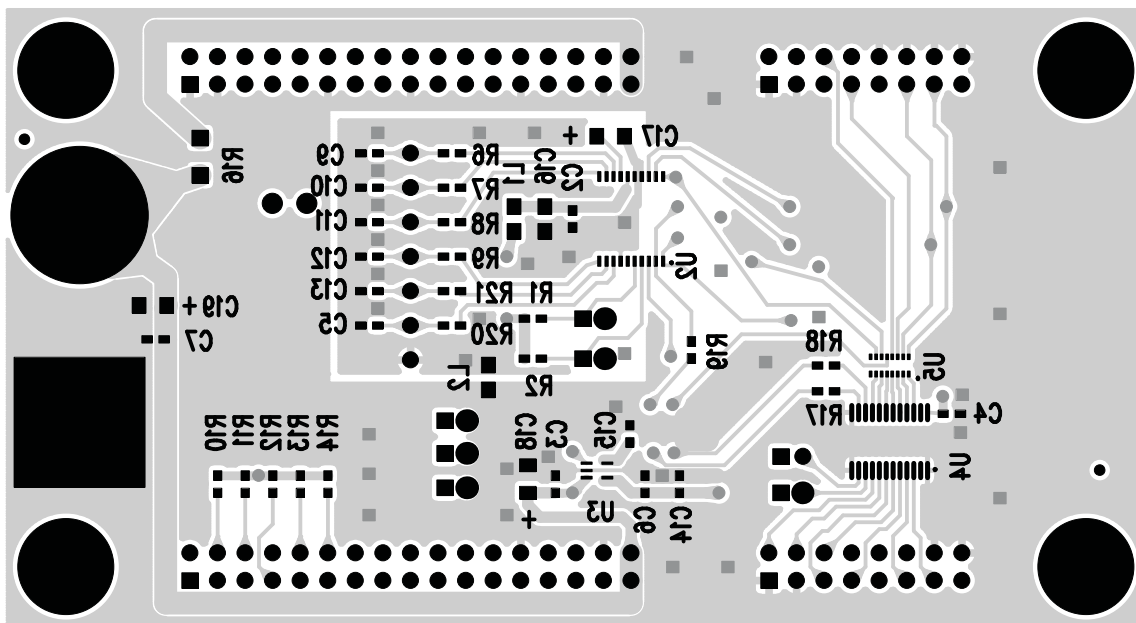


Figure 10. TPA5051EVM Bottom Layer

## 4.2 TPA5051EVM Bill of Materials

**Table 1. Bill of Materials**

Part No.	QTY	Value	Description	Distributor No. <sup>(1)</sup>	Manufacturer Part No.
R1, R2, R3, R4, R5	5	100k	100K, 1/10W, 0603, 5%	P100KGCT-ND	Panasonic ERJ-3GEYJ104V
R6, R7, R8, R9, R20, R21	6	10k	10k, 1/10W, 0603, 5%	P10KGCT-ND	Panasonic ERJ-3GEYJ103V
R10, R11, R12, R13, R14	DNP	2k	2k, 1/10W, 0603, 5%	P2.0KGTR-ND	Panasonic ERJ-3GEYJ202V
R15, R17, R18, R19	4	39	39-Ω, 1/10W, 0603, 1%	311-39.0HRCT-ND	Yageo RC0603FR-0739RL
R16	1	0Ω Jumper	0-Ω, 1/4W, 1206, 5%	P0.0ETR-ND	Panasonic ERJ-8GEY0R00V
C1, C2, C3, C4, C6, C7, C8, C20	8	0.1μF	0.1μF, X7R, ±10%, 10V, Ceramic, 0603	399-1095-1-ND	Kemet C0603C104K8RACTU
C5, C9, C10, C11, C12, C13	6	560pF	560pF, NPO, ±5%, 50V, Ceramic, 0603	PCC2148CT-ND	Panasonic ECJ-1VC1H561J
C14, C15	2	1μF	1μF, X5R, ±10%, 10V, Ceramic, 0603	399-3118-1-ND	Kemet C0603C105K8PACTU
C16	1	1μF	1μF, X5R, ±10%, 16V, Ceramic, 0805	478-1411-2-ND	AVX 0805YD105KAT2A
C17, C18, C19	3	10μF	10μF, Tantalum, ±20%, 16V, Size A	399-3105-1-ND	Kemet T494A106M016AS
L1	1	600-Ω Ferrite Bead	600-Ω Ferrite Bead, 0805, 500mA, 200 mΩ DCR	445-1554-2-ND	TDK MMZ2012R601A
L2	1	0-Ω Jumper	0-Ω Jumper, 1/8W, 0805, Ceramic	P0.0ACT-ND	Panasonic ERJ-6GEY0R00V
H1, H2	2	34 Pin Header	34 Pins, 2 Rows, 2,54mm Pitch Vertical Male, Center Slot Polarized		Molex 87834-3411 OR AMP 104338-7
H3, H4	2	16 Pin Header	16 Pins, 2 Rows, 2,54mm Pitch, Vertical Male, Center Slot Polarized		Molex 87834-1611
TP1, TP2, TP3, TP4, TP5, TP6	DNP		Test Points		
TP7, TP8	2	Loop Test Connectors	Test Points		Farnell InOne 8731128 OR Vero 20-2137
J1, J2, J3, J4, J5, J6, J7	7		Jumper, Position, 2mm Header	2163S-36-ND	Norcomp 2163-36-01-P2
J1, J2, J3, J4, J5, J6, J7	7	Shunts	2mm Shunts	SPE1302-ND	Delphi 2JM-G
J8, J9	2		Banana Jack with Knurled Thumbnut	J587	Johnson 111-2223-001
U1	1	TPA5051	Audio Delay, 16 Pin QFN, RSA Designation		Texas Instruments
U2	1	PCM1606	DAC, 20 Pin, SSOP		Texas Instruments
U3	1	TPS73233 OR TPS73633	LDO, 5 pin, SOT-23, DBV designation		Texas Instruments
U4	1	SN74ABT827	10-bit buffer, 24 pin, PW package		Texas Instruments

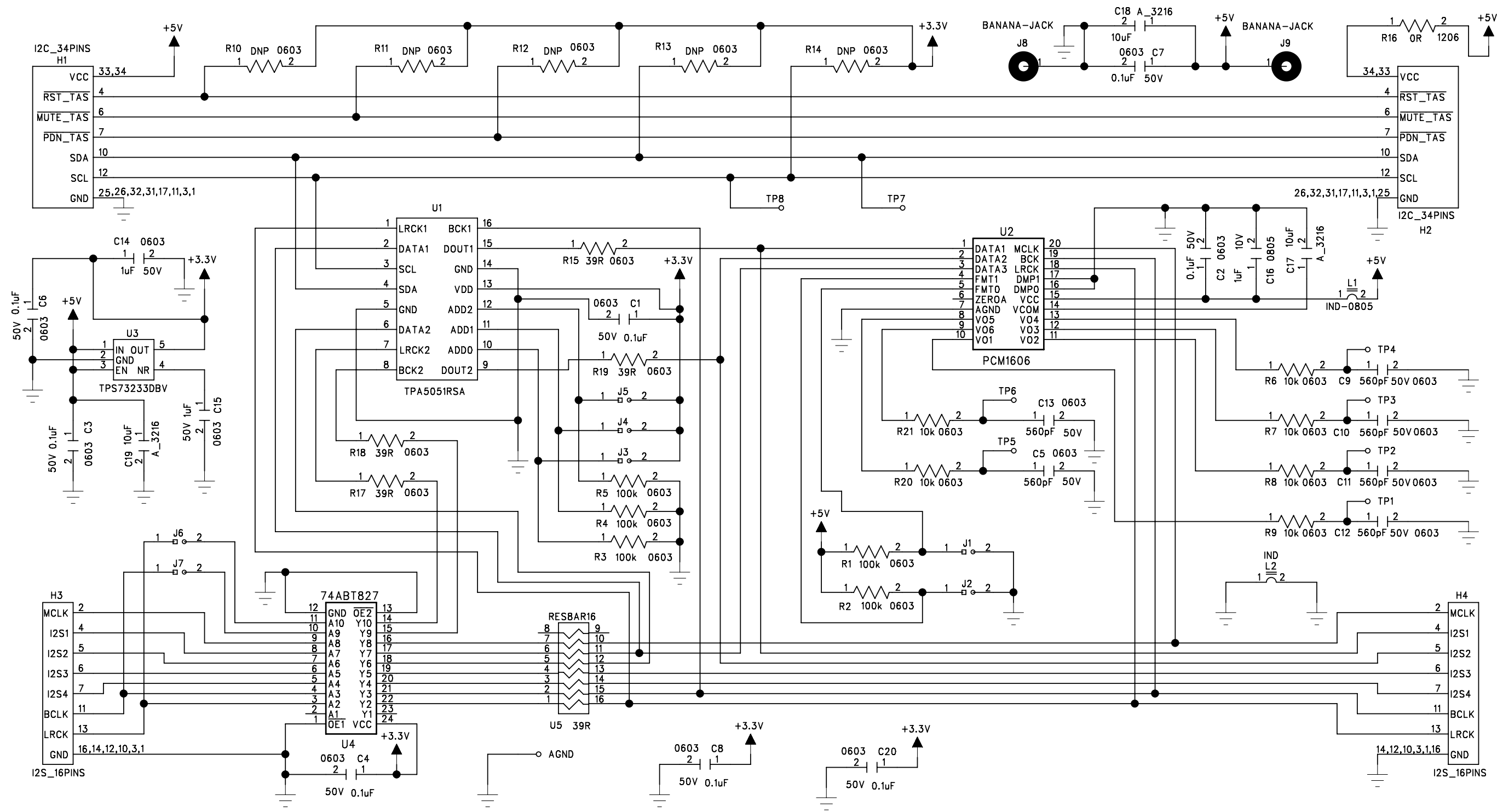
<sup>(1)</sup> Distributor is Digikey, unless otherwise specified.

**Table 1. Bill of Materials (continued)**

<b>Part No.</b>	<b>QTY</b>	<b>Value</b>	<b>Description</b>	<b>Distributor No.<sup>(1)</sup></b>	<b>Manufacturer Part No.</b>
U5	1	EXB-2HV390JV	8 Resistor array, 39-Ω, 5%, 1/16W	Y1390TR-ND	Panasonic EXB-2HV390JV

## 5 TPA5051EVM Schematic Diagram

The TPA5051EVM schematic diagram is appended to this page.



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### EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the voltage supply range of 4.5 V to 5.5 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range 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 85°C. The EVM is designed to operate properly with certain components above 85°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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Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>	Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>	Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>	Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>	Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>	Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>	Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>	Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
Low Power Wireless	<a href="http://www.ti.com/lpw">www.ti.com/lpw</a>	Video & Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
		Wireless	<a href="http://www.ti.com/wireless">www.ti.com/wireless</a>

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