

## **PCM5122EVM-U and PCM5142EVM-U**

The PCM5122/42 families of ICs are advanced segment, high-performance, software-programmable stereo digital-to-analog converters (DACs). The PCM512x family employs fixed-function audio processing, while the PCM514x family employs miniDSP audio processing. These devices employ internal line drivers together with an internal PLL and BCLK reference, so that a serial clock signal (SCK) can be derived. The advanced segment architecture enables excellent dynamic performance and an improved tolerance to clock jitter, and the 2.1- $V_{RMS}$  ground-centered outputs eliminate the need for output dc blocking capacitors. The PCM5122/42EVM-U is designed to support the PCM5121 ([SLAS763](#)), PCM5122 ([SLAS763](#)), PCM5141 ([SLAS759](#)), and PCM5142 ([SLAS759](#)) DACs. The PCM5122/42EVM-U also employs the [TAS1020B](#) USB controller and the [SRC4392](#) asynchronous sample rate converter.

This User's Guide describes the operation of the PCM5122/42EVM-U and the Texas Instruments CodecControl software. CodecControl provides a graphical user interface for supported TI audio codecs. The software is compatible with Microsoft® Windows® XP, Windows Vista, and Windows 7.

### **Contents**

1	Introduction .....	2
2	PCM5122/42EVM-U .....	3
3	CodecControl Software .....	11
4	Schematics and Bill of Materials (BOM) .....	16

### **List of Figures**

1	PCM5122/42EVM-U .....	3
2	PCM5122/42EVM-U Block Diagram .....	5
3	EVM Software Window .....	11
4	Command Dialog .....	13
5	PCM512xEVM-U Schematic .....	16
6	PCM512xEVM-U Power and USB Controller .....	17
7	PCM512xEVM-U Digital I/O and Source .....	18
8	PCM514xEVM-U Schematic .....	21
9	PCM514xEVM-U Power and USB Controller .....	22
10	PCM514xEVM-U Digital I/O and Source .....	23

### **List of Tables**

1	PCM5122/42EVM-U Headers, Test Points, Jumpers, and Switches .....	5
2	SW3 Clock Selection .....	7
3	PCM512xEVM-U Bill of Materials .....	19
4	PCM514xEVM-U Bill of Materials .....	24

PurePath is a trademark of Texas Instruments.  
 Microsoft, Windows are registered trademarks of Microsoft Corporation.  
 I<sup>2</sup>C is a trademark of NXP Semiconductors.  
 All other trademarks are the property of their respective owners.

## 1 Introduction

CodecControl software is intended to facilitate user evaluation of TI audio codecs. It includes a wide range of features, depending on the specific codec capabilities. The PCM5122/42EVM-U works together with the CodecControl software. It connects to a PC via an available USB port and enumerates as a USB-class audio device. Once configured with the CodecControl software, the EVM acts as a sound card that can play back audio from the PC, depending on how the device is set up.

For a more detailed description of the [PCM512x and PCM514x product line](#), refer to the product data sheet available from the Texas Instruments web site at <http://www.ti.com/>.

Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the PCM5122/42EVM-U. Unless otherwise noted, all references to the PCM5122/42 indicate complete functionality of all four related devices (PCM5121, PCM5122, PCM5141 and PCM5142).

### 1.1 Information About Cautions and Warnings

This document contains caution statements.

#### CAUTION

This is an example of a caution statement. A caution statement describes a situation that could potentially damage your software or equipment.

The information in a caution or a warning is provided for your protection. Please read each caution and warning carefully.

### 1.2 Related Documentation from Texas Instruments

The following document provides information regarding TI's integrated circuits used in the assembly of the PCM5122/42EVM-U. These documents are available from the [TI web site](#). The last character of the literature number corresponds to the document revision that is current at the time of the writing of this document. Newer revisions are available from the TI web site at <http://www.ti.com/>.

Data Sheet	Literature Number
PCM5121/22	<a href="#">SLAS763</a>
PCM5141/42	<a href="#">SLAS759</a>
<a href="#">TAS1020B</a>	<a href="#">SLES025A</a>
<a href="#">SRC4392</a>	<a href="#">SBFS029C</a>

### 1.3 Applications Questions

If you have questions regarding either the use of this evaluation module or other TI evaluation modules, post a question in the Audio Converters forum at <http://e2e.ti.com>. Include the product in which you are interested in the subject heading.

### 1.4 FCC Warning

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense is required to take whatever measures may be required to correct this interference.

## 2 PCM5122/42EVM-U

### 2.1 Electrostatic Discharge Warning

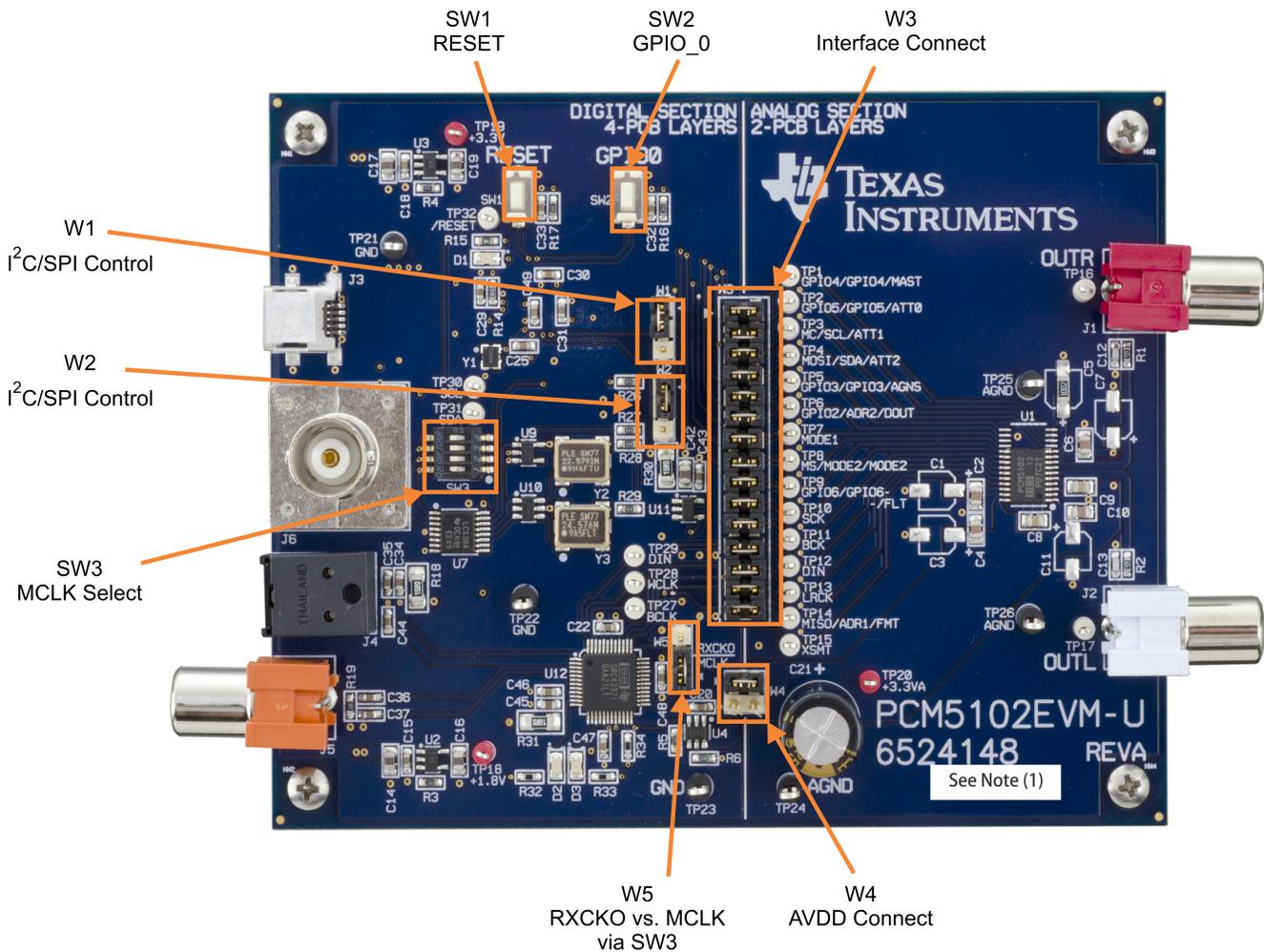
Many of the components on the PCM5122/42EVM-U are susceptible to damage by electrostatic discharge (ESD). Customers are advised to observe proper ESD handling precautions when unpacking and handling the EVM, including the use of a grounded wrist strap at an approved ESD workstation.

**CAUTION**

Failure to observe ESD handling procedures may result in damage to EVM components.

### 2.2 Overview

The PCM5122/42EVM-U is an easy to use, USB-interface, multi-functional system allowing for digital optical/SPDIF, line or external I<sup>2</sup>S input with varying options for clock sources and clock frequencies. Along with onboard sample rate conversion, this architecture allows for versatile use and testing of the PCM5122/42 family of parts. Figure 1 shows the PCM5122/42EVM-U with the jumper and switch locations noted.



- (1) The silkscreen label shown on the board may be different to indicate a specific device. Otherwise, the EVM is identical to the one shown here.

Figure 1. PCM5122/42EVM-U

The PCM5122/42EVM-U is divided into two sections. The left half contains the digital and USB interface, sample rate conversion, optical/SPDIF and RCA digital inputs, clock circuitry, and reset logic. The right half contains the PCM5122/42 device and the analog circuitry accompanying it. Note that this half of the PCM5122/42EVM-U is the portion required on a potential customer application. The left half is intended to emulate a wide variety of testing options and scenarios for the PCM5122/42 device.

The digital interface section, or left half of the PCM5122/42EVM-U, is a four-layer design. However, the PCM5122/42 device and analog circuitry, or right half of the EVM board, consists only of two layers.

For the analog circuitry surrounding the PCM5122/42 device, certain components can be removed at the cost of higher performance. This configurability allows for optimal ratio between board space and performance. Components such as C1, C3, C7, and C11 can all be removed for additional board space.

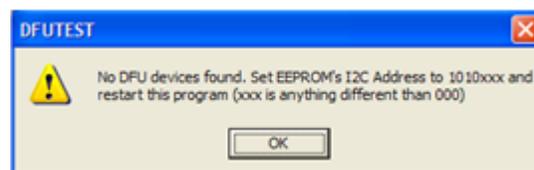
The PCM5122/42EVM-U features:

- USB Interface
- Analog output
- TX output (J5)
- Optical/SPDIF input
- I<sup>2</sup>S input
- Hardware- and software-programmable options
- Digital audio interface test points
- Control interface test points
- PurePath™ Studio Software Functionality

### 2.3 EVM Connection Issues

Use the following steps to correct any connection issues between the host computer and EVM:

1. Download the latest TAS1020 USB firmware from the [PCM5122EVM-U](#) or [PCM5142EVM-U](#) product pages.
2. Remove the USB cable from the EVM.
3. Short the SDA and SCL lines together by shorting the SDA and SCL EEPROM pins (pins 5 and 6 on device U5 on the underside of EVM).
4. With SDA and SCL shorted, plug in the USB to the computer and wait 5 seconds.
5. In the computer's "Device Manager" the drive should now be recognized as "DFUDevice" or similar title.
6. In the firmware folder downloaded in step 1, run "DFUTEST.exe". If the following message appears, repeat steps 2-5.



7. Click the "Program EVM" button in the DFUTEST GUI. Browse for "DFUEE.bin" located in the "image" folder directory downloaded with the firmware. Click on the "DFUEE.bin" file once so it runs.
8. The following message should appear. Click the "OK" button.



9. "Device was successfully reset" message will appear. Follow the on-screen instruction and wait when prompted to do so.

10. After a few prompts, the “DFUTEST” automatically opens a second browser. Here, navigate to “USB-xxx\_441KHZ.bin” in the “Image” folder and click on it once.
11. A similar set of prompts should display. Follow the instructions.
12. After the program has completed, remove the EVM from USB and then reconnect.
13. The EVM is now ready for use.

**EVM Block Diagram**

Figure 2 shows the block diagram for the PCM5122/42EVM-U.

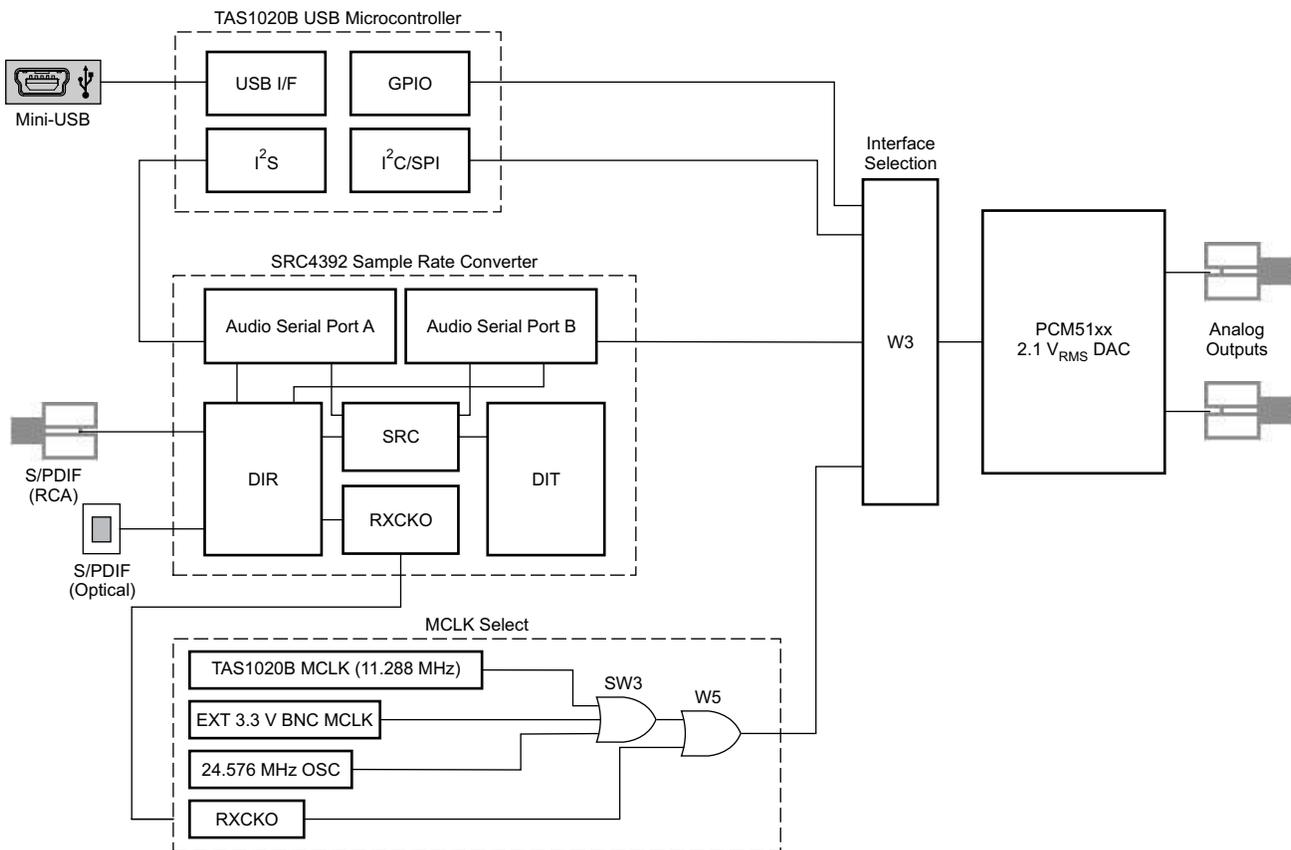


Figure 2. PCM5122/42EVM-U Block Diagram

**Jumpers, Connectors, Test Points, Switches**

Table 1 summarizes the connectors, test points, jumpers, and switches on the PCM5122/42EVM-U. When running PurePath Studio ROM process flows, the correct jumper and switch setting will be displayed in the main PurePath Studio window, once a process flow is opened.

Table 1. PCM5122/42EVM-U Headers, Test Points, Jumpers, and Switches

Connectors/Switch/Jumper/Test Point	Description
<b>Headers</b>	
W1	I <sup>2</sup> C/SPI Selection. Shunt pins 1-2 for SPI, 2-3 for I <sup>2</sup> C™ control mode
W2	I <sup>2</sup> C/SPI Selection. Shunt pins 1-2 for SPI, 2-3 for I <sup>2</sup> C control mode
W3	Interface Connection. Shunt respective headers to send digital signals to PCM5122/42.
W4	AVDD power. Shunt pins 1-2 or 3-4 for AVDD.
W5	MCLK/RXCKO select
<b>Test Points</b>	

**Table 1. PCM5122/42EVM-U Headers, Test Points, Jumpers, and Switches (continued)**

Connectors/Switch/Jumper/Test Point	Description
TP1	GPIO4/GPIO4/MAST
TP2	GPIO5/GPIO5/ATT0
TP3	MC/SCL/ATT1
TP4	MOSI/SDA/ATT2
TP5	GPIO3/GPIO3/AGNS
TP6	GPIO2/ADR2/DOUT
TP7	MODE1
TP8	MS/MODE2/MODE2
TP9	FLT
TP10	SCK
TP11	BCK
TP12	DIN
TP13	LRCK
TP14	FMT
TP15	XSMT
TP16	PCM5122/42 analog output (R)
TP17	PCM5122/42 analog output (L)
TP18	1.8 V
TP19	3.3 V
TP20	3.3 VA
TP21	GND
TP22	GND
TP23	GND
TP24	AGND
TP25	AGND
TP26	AGND
TP27	BCLK (TAS1020B)
TP28	WCLK (TAS1020B)
TP29	DIN (TAS1020B)
TP30	SCL (TAS1020B)
TP31	SDA(TAS1020B)
TP32	RESET
<b>Jumpers</b>	
J1	PCM5122/42 RCA analog output (R)
J2	PCM5122/42 RCA analog output (L)
J3	Mini-USB connection
J4	Optical S/PDIF input
J5	Coaxial S/PDIF input
J6	BNC external MCLK input
<b>Switches</b>	
SW1	EVM reset
SW2	Select EVM application
SW3	MCLK select
<b>LEDs</b>	
D2	RX lock
D3	SRC ready

## 2.4 Clock Circuitry

SW3 allows for MCLK selection from multiple sources. The PCM5122/42EVM-U contains an external BNC jack, J6, as well as one programmed oscillator that provides a clock frequency of 24.576 MHz. The TAS1020B also provides a MCLK output; by default, this clock is used as the master clock for the PCM5122/42EVM-U. Depending on the application requirements, the SRC4392 is also able to derive a received clock output (RXCKO) output based on the input clock frequency, and this derived clock output can be used as the MCLK input for the PCM5122/42 as well. This option is enabled by setting a shunt in position 1-2 (RXCKO) on the 3-pin jumper W5. If W5 has a shunt in position 2-3, then setting SW3 determines which MCLK source is used, as summarized in [Table 2](#).

**Table 2. SW3 Clock Selection**

Setting	A	B	C
Onboard MCLK from TAS1020B	Low	Low	Low
External MCLK 3.3-V BNC Input	High	Low	Low
24.576-MHz MCLK from PLL Y3	High	High	High

### 2.4.1 MCLK Source Matching

The SRC4392 is equipped with two audio serial data ports, each of which generates BCLK and LRCLK signals. When the SRC4392 receives an S/PDIF input, it automatically derives the MCLK of the input, which is sent to the RXCKO pin. Dividers are used to send the generated BCLK and LRCLK from the audio ports (if they are in master mode). For certain use cases, the SRC4392 is set up so that these ports are used. When routing through the audio serial ports on the SRC4392, it is important to use RXCKO as the master clock source for the PCM5122/42. In order to ensure proper operation, the master clock source must be synchronized to the bit and word clock supplied to the PCM5122/42. Therefore, the master clock source for the PCM5122/42 must also be replicated from the digital input source, which is why RXCKO must be chosen. If the master clock source for the PCM5122/42 is the onboard MCLK from the TAS1020B USB controller, for example, then there is potential for synchronization mismatch between the master clock supplied to the PCM5122/42 and the bit and word clocks being supplied to the PCM5122/42. For use cases routing through the SRC4392 audio serial ports, look to jumper W5 for selecting RXCKO as the master clock source, as opposed to one of the options chosen by adjusting SW3. The [SRC4392 product data sheet](#) has additional routing information.

The PCM5122/42 devices contain an internal PLL and BCLK reference, so that the MCLK can be generated internally. When using external I<sup>2</sup>S input directly into the W3 jumper, a MCLK can be derived from the BCLK input. Refer to the [PCM5122/42 product data sheet](#) for more details.

## 2.5 Use Cases

### PurePath Studio

The PCM512x and PCM514x are software programmable, and can be programmed using either CodecControl software or PurePath Studio. For more information on enabling the audio processing capabilities of the PCM512x with PurePath, see the ([SLAA541](#)). This application note provides a great starting point regarding the usage of PurePath with PCM512x and PCM514x devices. Note that while the PCM512x employs fixed-function audio processing, the PCM514x has full miniDSP processing, enabling configurable process flows. However, the PCM514x can still run the ROM process flows used for the PCM512x.

- *PCM5122 with PurePath Application Note* ([SLAA541](#))

### 2.5.1 Scripts and Setup

Most of the I/O routing and clock frequency selection on the PCM5122/42 evaluation module is performed by the SRC4392. [Section 2.5.2](#) and [Section 2.5.3](#) are two example scripts that adjust the SRC4392 registers accordingly, as well as set the proper jumper configurations.

There are several use cases where the PCM5122/42EVM-U can be used. Depending on whether it is USB playback, or optical/SPDIF input, for example, there may need to be changes made in the scripts and jumper configuration to accommodate these cases. Likewise, the shunts on header W3 may need to be installed accordingly. [Section 2.5.2](#) and [Section 2.5.3](#) are some example use cases for USB playback and optical/SPDIF input, respectively.

## 2.5.2 USB Playback

```
# The following script is used for playback via USB
# RESET RESET THIS IS MASTER RESET FOR SRC (48kHz)
# Page 0 = DEFAULT for Control
# Write to page 0
w E0 7F 00
# Register 01, Bit 7 = 1 resets to default
d 100
w E0 01 80
# Delay 0.1 sec to allow part to reset
d 100
# Register 01, Bit 7 = 0 for normal operation
w E0 01 00
d 100
# w E0 7F 00
# Register 01, Bit 7 = 1 resets to default

#----- Setup Port A -----#

# 24bit I2S, Master mode, DIR source, at mute
# Divide by 256, MCLK input source
# Unmute Port A Output
# power on port A and B
w E0 01 38
# set up port A as master, 24 bit I2S sourced from port B
w E0 03 19
# select MCLK as source at 256fs
w E0 04 01
# port B slave, 24 bit I2S
w E0 05 01

#----- Setup DIR -----#

#DIR Config 1
# Input source: RX2 - S/PDIF RCA (default)
#w E0 0D 01
# Input source: RX4 - S/PDIF optical, RX_MUX = RX1
w E0 0D 08
#DIR Config 2 - default
w E0 0E 01

#----- Setup DIT -----#

# DIT Config 1
# Port A data in, Div 256
w E0 07 80
# DIT Config 2
# Default is to output to RCA
# Comment out RCA and uncomment Optical for optical outputs
#Output to RCA
# TX - ON, TX MUTE - ON, Optical disabled
#w E0 08 06
# TX Mute - OFF
#w E0 08 04
#Output to Optical
# TX - OFF, TX MUTE - ON, optical disabled
w E0 08 03
# TX MUTE - OFF
```

```

w E0 08 01

#----- PLL Configuration -----#

# Set P=2, J=8, D=0
w E0 0F 22
w E0 10 1B
w E0 11 A3
# GPIO1 Config
# GPIO1 = RCVR non-audio data
w E0 1B 06
# GPIO2 Config
# GPIO2 = RCVR non-valid data
w E0 1C 07
# Power Status
# Disable RCVR (/PDRX) and Port B(/PDPB) power down and enable All Function power down
#w E0 01 14
#w E0 03 29
  
```

### 2.5.3 Optical/SPDIF Input via J4 (48 kHz, RXCKO Master Clock)

```

# RESET RESET THIS IS MASTER RESET FOR SRC
# SW3 (2-7) turned on, rest turned off
# Page 0 = DEFAULT for Control
# Write to page 0
w E0 7F 00
# Register 01, Bit 7 = 1 resets to default
d 100
w E0 01 80
# Delay 0.1 sec to allow part to reset
d 100
# Register 01, Bit 7 = 0 for normal operation

w E0 01 00
d 100
# w E0 7F 00
# Register 01, Bit 7 = 1 resets to default

#----- Setup Port A -----#

# 24bit I2S, Master mode, DIR source, at mute
# Divide by 256, MCLK input source
w E0 03 69
w E0 04 0B

#----- Setup DIR -----#

#DIR Config 1
# Input source: RX2 - S/PDIF RCA (default)
#w E0 0D 01
# Input source: RX4 - S/PDIF optical, RX_MUX = RX1
w E0 0D 08
#DIR Config 2 - default
w E0 0E 01

#----- Setup DIT -----#

# DIT Config 1
# Port A data in, Div 256
w E0 07 80
# DIT Config 2
# Default is to output to RCA
# Comment out RCA and uncomment Optical for optical outputs
#Output to RCA
# TX - ON, TX MUTE - ON, Optical disabled
  
```

```
#w E0 08 06
# TX Mute - OFF
#w E0 08 04
#Output to Optical
# TX - OFF, TX MUTE - ON, optical disabled
w E0 08 03
# TX MUTE - OFF
w E0 08 01

#----- PLL Configuration -----#

# Set P=2, J=8, D=0
w E0 0F 22
w E0 10 1B
w E0 11 A3

# GPIO1 Config
# GPIO1 = RCVR non-audio data
w E0 1B 06
# GPIO2 Config
# GPIO2 = RCVR non-valid data
w E0 1C 07

# Power Status
# Disable RCVR (/PDRX) and Port B(/PDPB) power down and enable All Function power down
#w E0 01 14

# Unmute Port A Output
w E0 03 29

# Disable All Function power down (all blocks set by local control)
w E0 01 3F
```

### 3 CodecControl Software

This section explains how to use the CodecControl software together with the PCM512x and PCM514x devices. For characteristic performance graphs, refer to the PCM512x ([SLAS763](#)) and PCM514x ([SLAS759](#)) data sheet.

#### 3.1 Control Software

The CodecControl software exposes most of the features of a supported TI audio codec EVM through an intuitive graphical user interface.

**NOTE:** Before a PC running Windows can use the TI audio converter EVM as a sound card, the EVM must be properly configured (sampling rate, audio routing, internal amplifier settings, etc.) with the CodecControl software. This configuration occurs automatically once an EVM is detected by the CodecControl software.

Figure 3 illustrates the CodecControl software with the PCM5122/42EVM-U window as an example of the CodecControl software in operation.

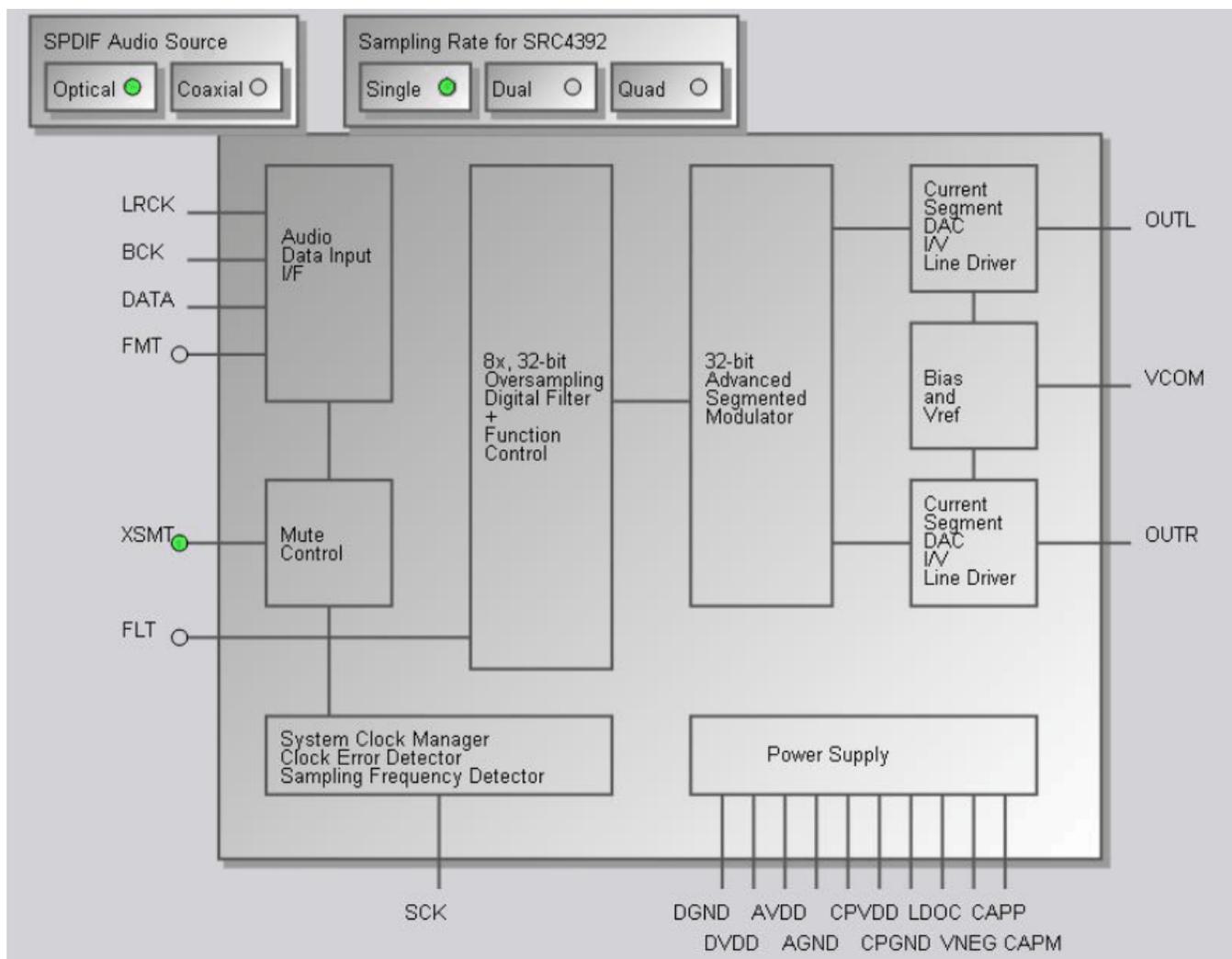


Figure 3. EVM Software Window

## 3.2 Installation

Download the CodecControl software from the [PCM5122/42EVM-U](#) audio codec product folder and launch the program. The file is a self-extracting archive that is downloaded in a compressed format.

The default target folder is:

*C:\Program Files\Texas Instruments\CodecControl*

Click the **Unzip** button to complete the installation. The CodecControl software is now available in the target folder. The name of the executable is *CodecControl.exe*.

To launch the CodecControl software, navigate to the target folder and double-click the CodecControl.exe file.

## 3.3 Concepts

The CodecControl software presents a block diagram view of a supported TI audio codec EVM, such as that shown in [Figure 3](#).

The block diagram consists of active objects that respond to user input (for example, switches or amplifiers with variable gain that show a volume control when a user clicks on the component with a mouse).

---

**NOTE: Active Objects:** Each active object changes color to **red** if the cursor is placed over the object. Clicking the object triggers its function.

---

Some active objects are linked to control register(s) of the particular TI audio codec. The CodecControl software updates the appropriate register(s) whenever an active object is triggered. If a register that is linked to an active object is changed through other components (for example, the script interpreter or the register inspector), the active object changes its state accordingly.

The CodecControl software automatically detects a supported TI audio codec EVM once it is connected to an available USB port of the PC.

If no TI audio codec EVM is connected to the PC, the control software also supports an EVM simulation mode, where it is possible to retrieve script commands based on user input within the block diagram.

Simulation mode is only available if no TI audio codec EVM is attached to the PC. Choose *File->New EVM simulation...* and select an EVM from the list of supported TI audio codec EVMs.

## 3.4 Dialogs and Active Objects

The CodecControl software contains several dialog windows that provide access to additional features. Most dialogs are linked to active objects and are opened by clicking on the active object.

Several dialogs are not linked to active objects and are opened instead using the View menu.

### 3.4.1 Initialization Script Dialog

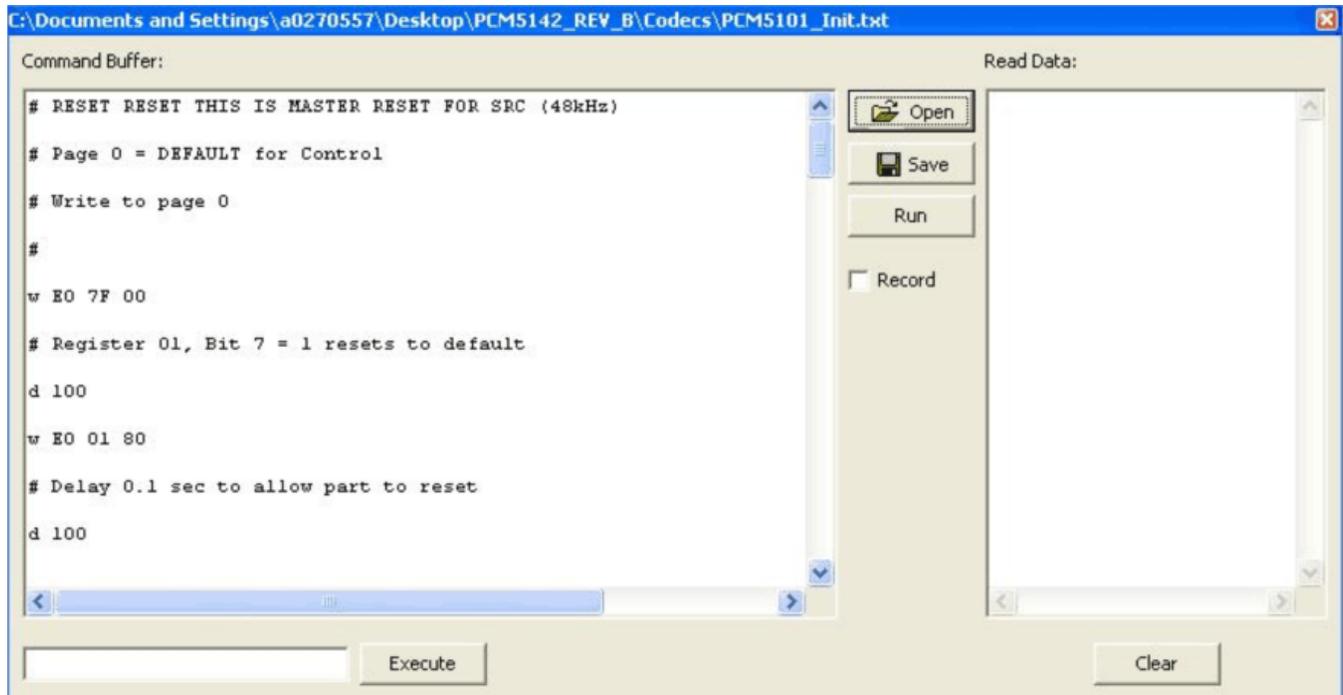
The CodecControl software executes an initialization script when a supported TI audio codec is detected.

To show or edit the initialization script, choose *View->Init Script...* from the main window menu bar.

Click the **Run** button to run the script again.

### 3.4.2 Command Dialog

Open the command dialog (*View->Command...*) to write, edit, load, save, and run command scripts. Command scripts are text files that contain commands to communicate with the TI audio codec. The syntax is described in [Section 3.5](#). The command dialog is shown in [Figure 4](#).



**Figure 4. Command Dialog**

- The primary area of the command dialog is the command buffer (editable text) which contains the command script. Clicking the **Run** button runs the command script.
- The smaller, read-only text area on the right side of the command dialog displays control data read from the TI audio codec. The **Clear** button clears the Read Data field.
- The one-line text edit field on the left bottom allows single command execution.
- The *Record* check box enables recording of commands generated by the control software.

### 3.4.3 Register Inspector

The register inspector dialog (*View->Register Inspector...*) gives access to all registers of the TI audio codec. The register inspector displays the content of the connected TI audio codec device registers. Clicking the **Refresh** button triggers reading the content of one page.

- The *addr* column shows the address of the registers in decimal notation.
- The *description* column contains a description for each register. If the register has no function assigned, it is declared *Reserved*.
- The data columns show the data of each register (one byte). The first data column uses decimal notation, and the second uses hexadecimal notation. It is possible to change the register value by clicking into one of the data fields and typing the new value (either decimal or hexadecimal).
- The numbered columns show the register content in binary notation. Read/write bits are shown solid black or red; read-only bits are gray or dark red. Red numbers represent bits that recently changed. Change a single writable bit by clicking on the bit and it flips.

The coefficients may be used for a specific customer filter implementation. The format is compatible with the TI audio codec that was detected by the CodecControl software.

**NOTE:** This feature is not used for the PCM510x, which are hardware programmable only.

### 3.4.4 Firmware Update

TI may publish new firmware for TI audio codec EVMs. Program the new firmware to a TI audio codec EVM by choosing *File->Update Firmware...* and select the new firmware file.

The update process takes a few seconds (there is no progress bar) and is completed once the update firmware dialog disappears. The EVM must be disconnected and reconnected to finish the firmware update process.

## 3.5 Script Syntax

A script is a text file that contains data to send to a device.

Each line in a script file is one command. No provision is made for extending lines beyond one line, except for the `>` command. A line is terminated by a carriage return.

The first character of a line is the command. Commands are:

- r** Read from the serial control bus
- w** Write to the serial control bus
- >** Extend repeated write commands
- #** Comment
- l** Set interface bus to use
- b** Break
- d** Delay
- f** Wait for Flag

Command: **r** <address> <register> <length>

<address> is the device address in hexadecimal format. For example, `30` for device address `0x30`.

<register> is the register that is read from in hexadecimal format.

<length> is the number of bytes that are read from <register> in auto-increment mode.

The result is displayed in the right-side output window of the command interpreter dialog.

Command: **w** <address> <register> <data ...>

<address> is the device address in hexadecimal format. For example, `30` for device address `0x30`.

<register> is the register that is written to in hexadecimal format.

<data...> is a sequence of bytes that are written to the <register> in auto-increment mode. Each byte is in hexadecimal format.

Command: **>** <data ...>

This command continues a write sequence in a new line.

<data...> is a sequence of bytes that is written in auto-increment mode. Each byte is in hexadecimal format.

Command: **#** [optional comment]

This command indicates a comment.

Command: **I**<interface>

<interface> is i2c for I<sup>2</sup>C or spi for SPI.

Command: **b**[optional comment]

[optional comment] is a string of characters. The command interpreter shows a modal dialog with the optional comment. Script execution resumes once the dialog is closed.

Command: **d**<time>

This command suspends script execution by at least <time> milliseconds.

Command: **f** <address> <register> <mask> [optional timeout]

This command suspends script execution until the value read from <address> <register> matches <mask>.

<address> is the device address in hexadecimal format. For example, 30 for device address 0x30.

<register> is the register that is read from in hexadecimal format.

<mask> is a 8-bit binary format mask that is compared with the data from the device. Each bit can be 0, 1, or X.

For example: <mask> = 010XX01X tests, if the data from the device has D7 = 0, D6 = 1, D5 = 0, D4 = don't care, D3 = don't care, D2 = 0, D1 = 1, D0 = don't care.

[optional timeout] specifies how long (milliseconds) the command interpreter polls the device if the data do not match the <mask>.

## 4 Schematics and Bill of Materials (BOM)

### 4.1 PCM512xEVM-U

#### 4.1.1 PCM512xEVM-U Schematics

Figure 5 through Figure 7 show the schematics for the PCM512xEVM-U.

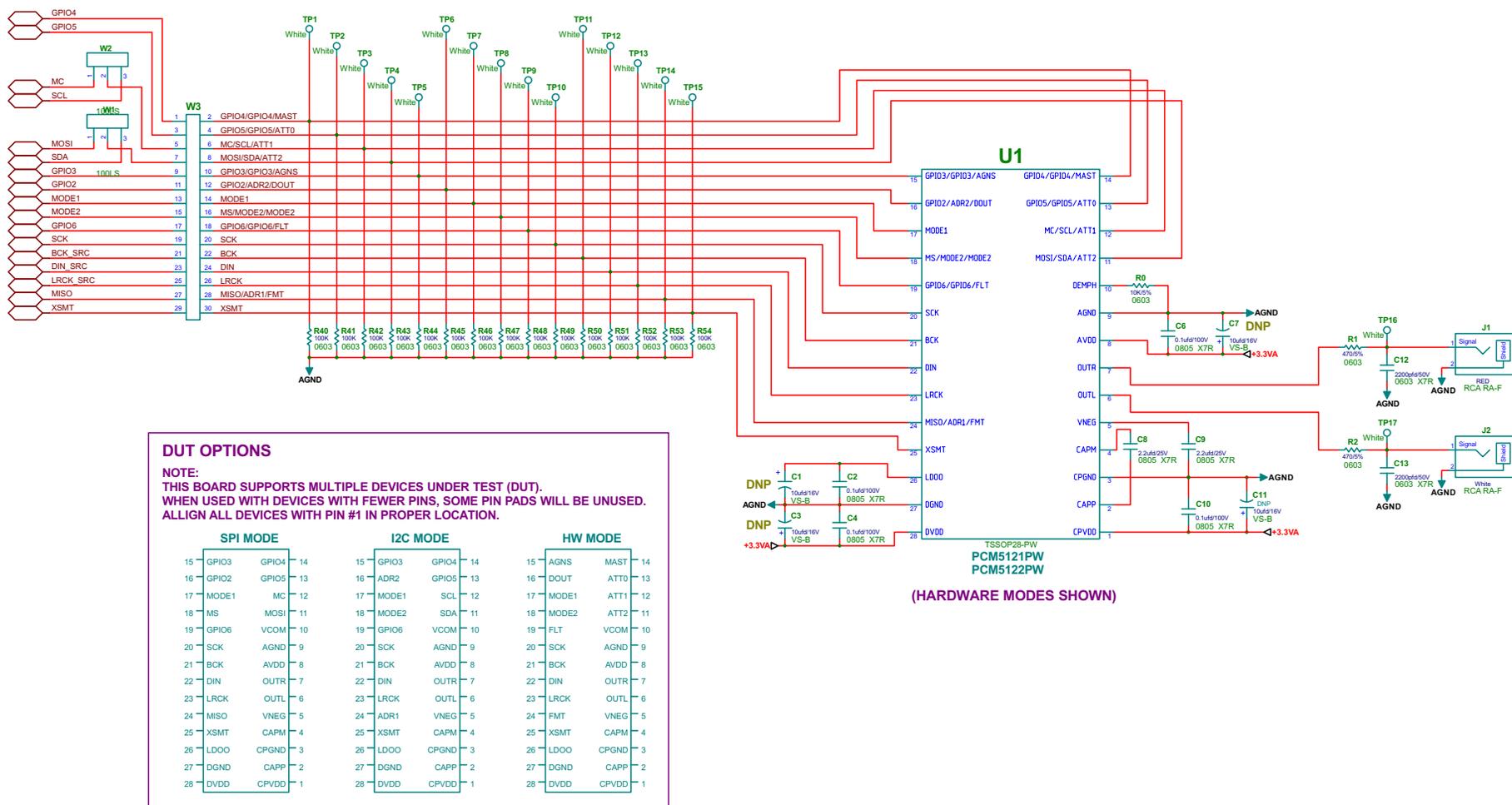


Figure 5. PCM512xEVM-U Schematic

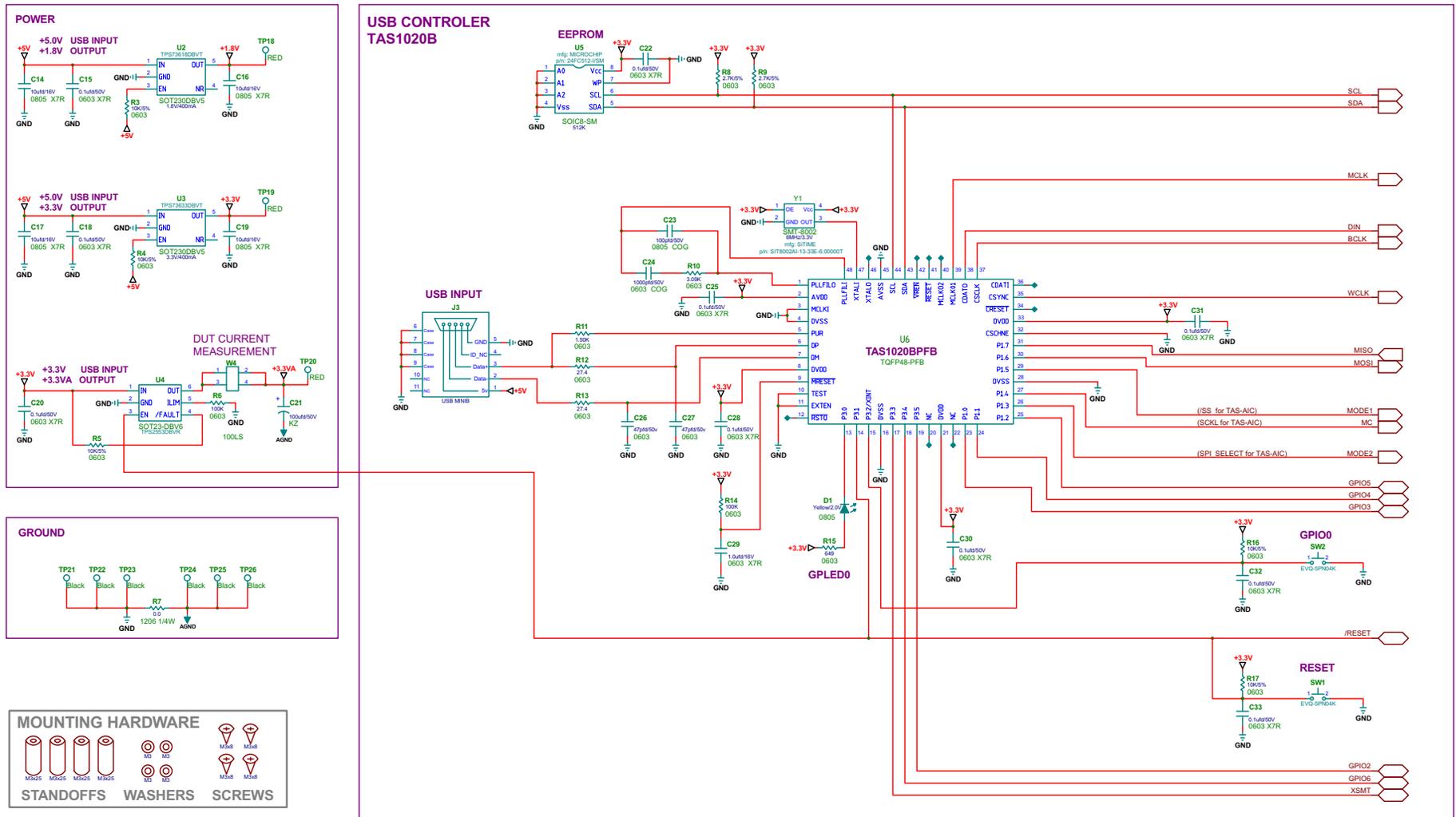


Figure 6. PCM512xEVM-U Power and USB Controller

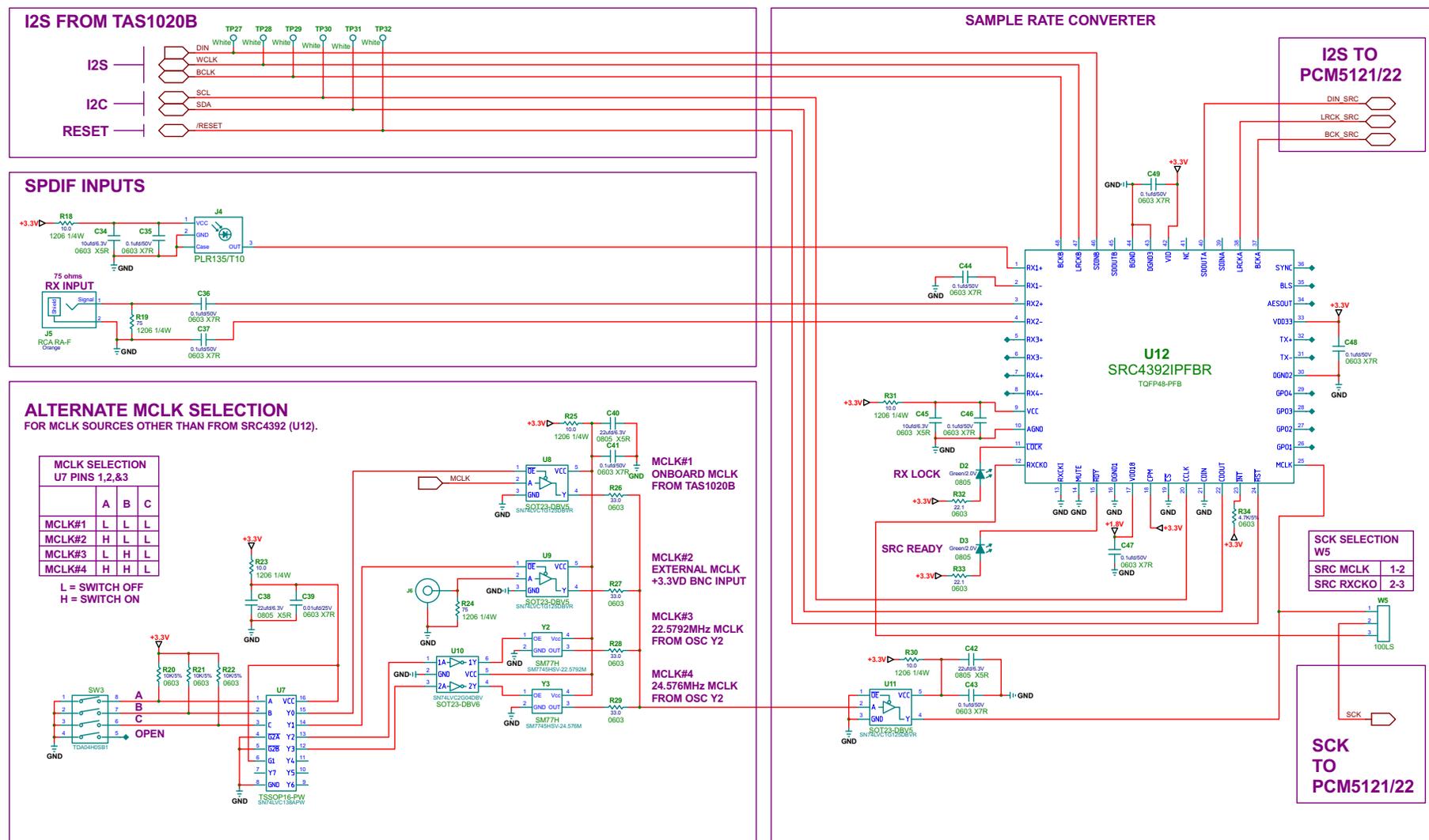


Figure 7. PCM512xEMV-U Digital I/O and Source

### 4.1.2 PCM512xEMV-U Bill of Materials

Table 3 is the BOM for the PCM512xEMV-U.

**Table 3. PCM512xEVM-U Bill of Materials<sup>(1)(2)(3)</sup>**

Item	MFG Part Number	MFG	QTY	Ref Designators	Description
1	PCM5122PW	TEXAS INSTRUMENTS	1	U1	24-BIT 384KHz AUDIO STEREO DAC w/MINI DSP TSSOP28-PW ROHS
2	TPS73618DBVT	TEXAS INSTRUMENTS	1	U2	VOLT REG 1.8V 400MA LDO CAP FREE NMOS SOT23-DBV5 ROHS
3	TPS73633DBVT	TEXAS INSTRUMENTS	1	U3	VOLT REG 3.3V 400MA LDO CAP FREE NMOS SOT23-DBV5 ROHS
4	TPS2553DBV	TEXAS INSTRUMENTS	1	U4	Adj.,Active High,Pwr-Dist Switch,SOT23-DBV6,ROHS
5	TAS1020BPFB	TEXAS INSTRUMENTS	1	U6	USB STREAMING CONTROLLER TQFP48-PFB ROHS
6	SN74LVC138APWR	TEXAS INSTRUMENTS	1	U7	3-LINE TO 8-LINE DECODER/DEMULTIPLEXER TSSOP16-PW ROHS
7	SN74LVC1G125DBVR	TEXAS INSTRUMENTS	3	U8, U9, U11	SINGLE BUS BUFFER GATE WITH 3-STATE OUTPUT SOT23-DBV5 ROHS
8	SN74LVC2G04DBVR	TEXAS INSTRUMENTS	1	U10	DUAL INVERTER GATE SOT23-DBV6 ROHS
9	SRC4392IPFBR	BURR-BROWN	1	U12	2 CHAN,ASYNC,SAMPLE RATE CONV W/DIG AUDIO REC/XMTR ROHS
10	24FC512-I/SM	MICROCHIP	1	U5	512K (64Kx8) I2C SERIAL EEPROM SOIC8-SM ROHS
11	PLR135/T10	EVERLIGHT ELECTRONICS	1	J4	PHOTOLINK FIBER OPTIC RECEIVER 2.4-5.5V 15MB PCB-RA SHUTTER ROHS
12	SML-LXT0805YW-TR	LUMEX OPTO	1	D1	LED, YELLOW 2.0V SMD0805 ROHS
13	SML-LXT0805GW-TR	LUMEX OPTO	2	D2, D3	LED, GREEN 2.0V SMD0805 ROHS
14	SIT8002AI-13-33E-6.00000T	SITIME	1	Y1	OSCILLATOR SMT 6MHz 3.3V OUT-ENABLE ROHS
15	SM7745HSV-22.5792M	PLETRONICS	1	Y2	OSCILLATOR SMT 3.3V SM77H SERIES 22.5792MHz ROHS
16	SM7745HSV-24.576M	PLETRONICS	1	Y3	OSCILLATOR SMT 3.3V SM77H SERIES 24.576MHz ROHS
17	EEE1CA100SR	PANASONIC	0	C1, C3, C7, C11	CAP SMD ELECT 10ufd 16V 20% VS-B ROHS
18	C2012X7R2A104K	TDK	4	C2, C4, C6, C10	CAP SMD0805 CERM 0.1UF 100V 10% X7R ROHS
19	GCM21BR71E225KA73L	MURATA	2	C8, C9	CAP SMD0805 CERM 2.2UF 25V 10% X7R ROHS
20	GRM188R71H222KA01D	MURATA	2	C12, C13	CAP SMD0603 CERM 2200PFD 50V 10% X7R ROHS
21	GRM21BR61C106KE15L	MURATA	4	C14, C16, C17, C19	CAP SMD0805 CERM 10UF 16V 10% X5R ROHS
22	C1608X7R1H104K	TDK	20	C15, C18, C20, C22, C25, C28, C30, C31, C32, C33, C35, C36, C37, C41, C43, C44, C46, C47, C48, C49	CAP SMD0603 CERM 0.1UF 50V 10% X7R ROHS
23	UKZ1E101MPM	NICHICON	1	C21	CAP ALUM ELEC KZ RADIAL 100UF 50V 20% ROHS
24	GRM2165C1H101JA01D	MURATA	1	C23	CAP SMD0805 CERM 100PFD 50V 5% C0G ROHS
25	C1608C0G1H102J	TDK CORP.	1	C24	CAP SMD0603 CERM 1000PFD 50V 5% COG ROHS
26	GRM1885C1H470JA01D	MURATA	2	C26, C27	CAP SMD0603 CERM 47PFD 50V 5% COG ROHS
27	C1608X7R1C105K	TDK	1	C29	CAP SMD0603 CERM 1.0UF 16V 10% X7R ROHS
28	GRM188R60J106ME47D	MURATA	2	C34, C45	CAP SMD0603 CERM 10UF 6.3V 20% X5R ROHS
29	C2012X5R0J226M	TDK	3	C38, C40, C42	CAP SMD0805 CERM 22UF 6.3V 20% X5R ROHS
30	06031C103JAT2A	AVX	1	C39	CAP SMD0603 CERM 0.01UF 25V 5% X7R ROHS
31	ERJ-3GEYJ103V	PANASONIC	9	R0, R3, R4, R5, R16, R17, R20, R21, R22	RESISTOR SMD0603 10K 5% 1/10W ROHS
32	ERJ-3GEYJ471V	PANASONIC	2	R1, R2	RESISTOR SMD0603 470 OHMS 5% 1/10W ROHS
33	ERJ-3EKF1003V	PANASONIC	17	R6, R14, R40, R41, R42, R43, R44, R45, R46, R47, R48, R49, R50, R51, R52, R53, R54	RESISTOR SMD0603 100K OHM 1% THICK FILM 1/10W ROHS
34	ERJ-8GEY0R00V	PANASONIC	1	R7	RESISTOR SMD1206 0.0 OHM 5% 1/4W ROHS
35	ERJ-3GEYJ272V	PANASONIC	2	R8, R9	RESISTOR SMD0603 2.7K OHMS 5% 1/10W ROHS
36	ERJ-3EKF3091V	PANASONIC	1	R10	RESISTOR SMD0603 3.09K OHM 1% THICK FILM 1/10W ROHS

- (1) These assemblies are ESD sensitive, observe ESD precautions.
- (2) These assemblies must be clean and free from flux and all contaminants. Use of no-clean flux is not acceptable.
- (3) These assemblies must comply with workmanship standards IPC-A-610 Class 2.

**Table 3. PCM512xEVM-U Bill of Materials<sup>(1)(2)(3)</sup> (continued)**

Item	MFG Part Number	MFG	QTY	Ref Designators	Description
37	ERJ-3EKF1501V	PANASONIC	1	R11	RESISTOR SMD0603 1.50K OHM 1% THICK FILM 1/10W ROHS
38	ERJ-3EKF27R4V	PANASONIC	2	R12, R13	RESISTOR SMD0603 27.4 OHMS 1% 1/10W ROHS
39	RC0603FR-07649RL	YAGEO	1	R15	RESISTOR SMD0603 THICK FILM 649 OHMS 1% 1/10W ROHS
40	ERJ-8ENF10R0	PANASONIC	5	R18, R23, R25, R30, R31	RESISTOR SMT1206 10.0 OHM 1% 1/4W ROHS
41	MCR18EZPF75R0	ROHM SEMICONDUCTOR	2	R19, R24	RESISTOR SMD1206 75 OHMS 1% 1/4W ROHS
42	ERJ-3EKF33R0V	PANASONIC	4	R26, R27, R28, R29	RESISTOR SMD0603 33.0 OHMS 1% 1/10W ROHS
43	CRCW060322R1FKEA	VISHAY	2	R32, R33	RESISTOR SMD0603 22.1 OHMS 1% 1/10W ROHS
44	ERJ-3GEYJ472V	PANASONIC	1	R34	RESISTOR SMD0603 4.7K OHMS 5% 1/10W ROHS
45	RCJ-042	CUI STACK	1	J1	RCA JACK THRU RA-FEMALE RED ROHS
46	RCJ-043	CUI STACK	1	J2	RCA JACK THRU RA-FEMALE WHITE ROHS
47	UX60-MB-5ST	HIROSE	1	J3	JACK USB MINIB SMT-RA 5PIN ROHS
48	RCJ-047	CUI STACK	1	J5	RCA JACK THRU RA-FEMALE ORANGE ROHS
49	5227699-2	TYCO ELECTRONICS	1	J6	JACK BNC SQUARE 50 OHMS ROHS
50	PBC03SAAN	SULLINS	3	W1, W2, W5	HEADER THRU MALE 3 PIN 100LS 120 TAIL GOLD ROHS
51	PBC15DAAN	SULLINS	1	W3	HEADER THRU MALE 2X15 100LS 120 TAIL GOLD ROHS
52	PBC02DAAN	SULLINS	1	W4	HEADER THRU MALE 2X2 PIN 100LS 120 TAIL GOLD ROHS
53	5002	KEYSTONE ELECTRONICS	23	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP27, TP28, TP29, TP30, TP31, TP32	PC TESTPOINT, WHITE, ROHS
54	5000	KEYSTONE ELECTRONICS	3	TP18, TP19, TP20	PC TESTPOINT, RED, ROHS
55	5011	KEYSTONE ELECTRONICS	6	TP21, TP22, TP23, TP24, TP25, TP26	PC TESTPOINT BLACK 063 HOLE ROHS
56	EVQ-5PN04K	PANASONIC	2	SW1, SW2	SWITCH MOM 240G SMD 6x3.5MM ROHS
57	TDA04H0SB1	CK COMPONENTS	1	SW3	SWITCH SMT DIP8 4POS ROHS
58	95947A018	MCMaster-CARR	4	STANDOFFS	STANDOFF M3x25mm 4.5mm DIA HEX ALUM F-F ROHS
59	92148A150	MCMaster-CARR	4	STANDOFF WASHERS	WASHER SPLIT-LOCK M3 6.2mm OD 0.7mm THICK STAINLESS STEEL ROHS
60	92000A118	MCMaster-CARR	4	STANDOFF SCREWS	SCREW M3x8 PHILIPS PANHEAD STAINLESS STEEL ROHS
61	969102-0000-DA	3M	4	W1(2-3), W2(2-3), W4(1-2), W5(1-2)	SHUNT BLACK AU FLASH 0.100LS OPEN TOP ROHS
62	969102-0000-DA	3M	12	W3: 1-2, 3-4, 5-6, 7-8, 9-10, 15-16, 17-18, 19-20, 21-22, 23-24, 25-26, 29-30	SHUNT BLACK AU FLASH 0.100LS OPEN TOP ROHS
		TOTAL	186		
X1	DO NOT POPULATE		4	C1, C3, C7, C11	

## 4.2 PCM514xEVM-U

### 4.2.1 PCM514xEVM-U Schematics

Figure 8 through Figure 10 show the schematics for the PCM5122EVM-U.

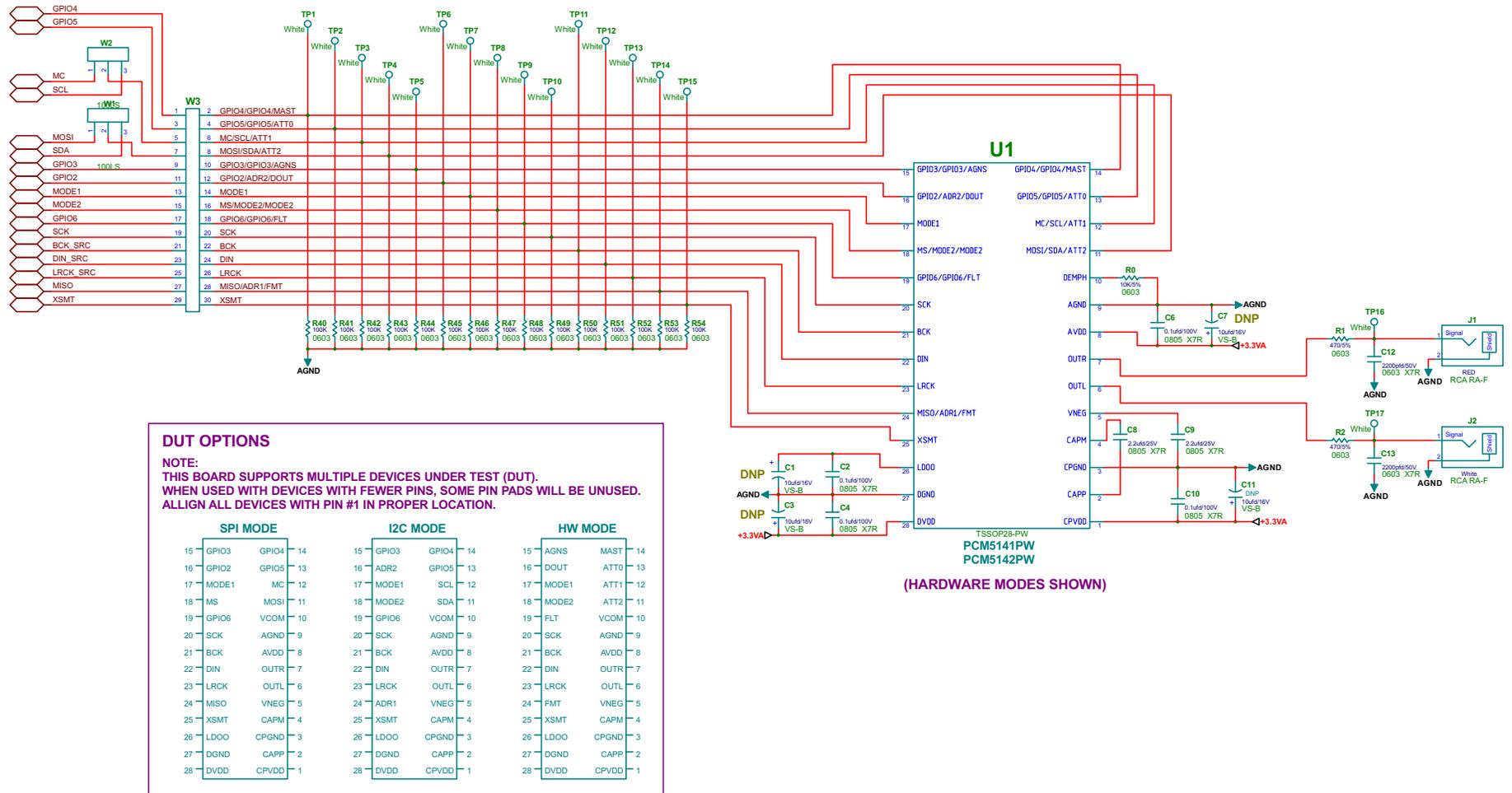


Figure 8. PCM514xEVM-U Schematic

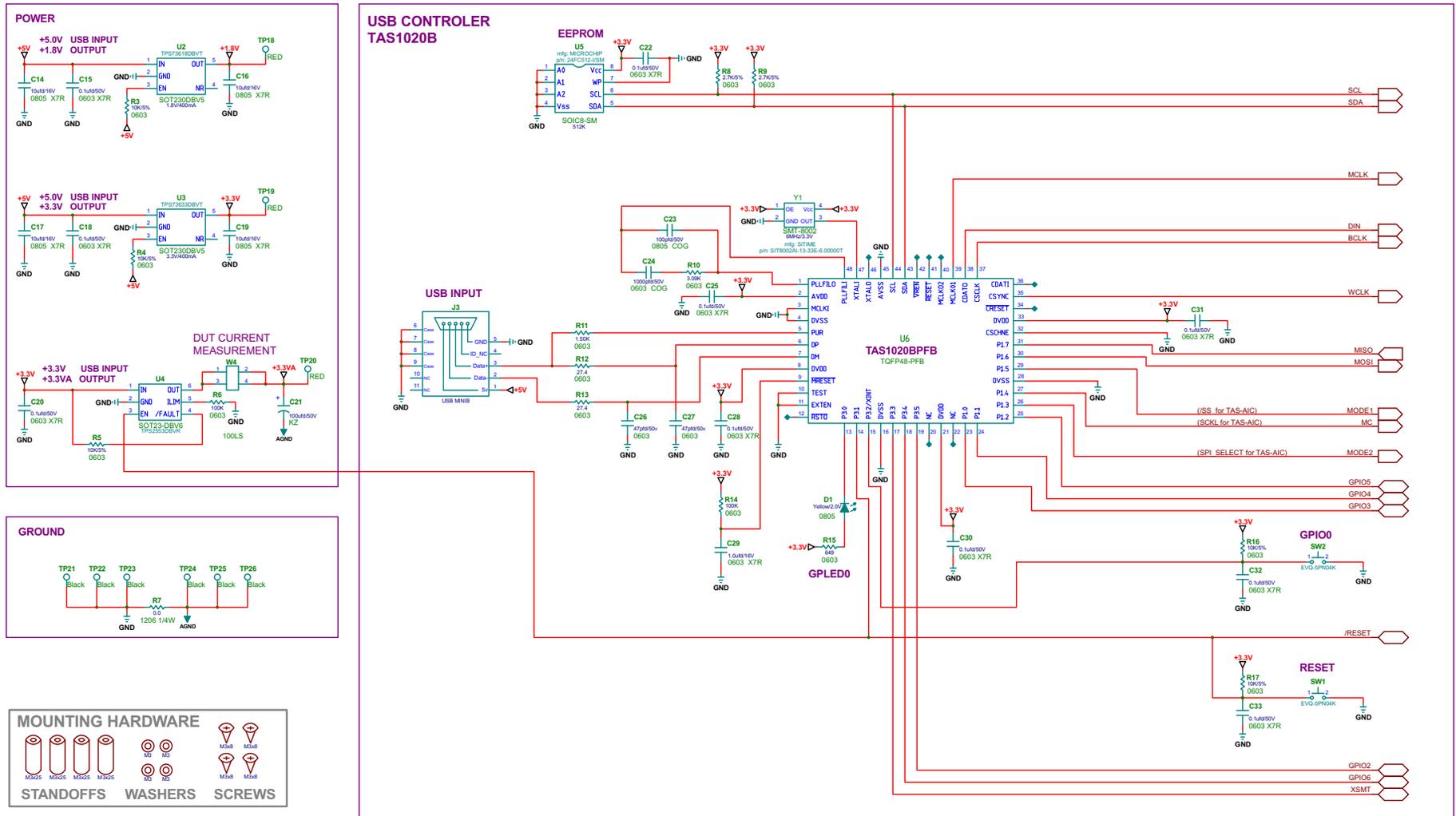


Figure 9. PCM514xEVM-U Power and USB Controller



**Table 4. PCM514xEVM-U Bill of Materials<sup>(1)(2)(3)</sup>**

Item	MFG Part Number	MFG	QTY	Ref Designators	Description
1	PCM5142PW	TEXAS INSTRUMENTS	1	U1	24-BIT 384KHz AUDIO STEREO DAC w/MINI DSP TSSOP28-PW ROHS
2	TPS73618DBVT	TEXAS INSTRUMENTS	1	U2	VOLT REG 1.8V 400MA LDO CAP FREE NMOS SOT23-DBV5 ROHS
3	TPS73633DBVT	TEXAS INSTRUMENTS	1	U3	VOLT REG 3.3V 400MA LDO CAP FREE NMOS SOT23-DBV5 ROHS
4	TPS2553DBV	TEXAS INSTRUMENTS	1	U4	Adj.,Active High,Pwr-Dist Switch,SOT23-DBV6,ROHS
5	TAS1020BPFB	TEXAS INSTRUMENTS	1	U6	USB STREAMING CONTROLLER TQFP48-PFB ROHS
6	SN74LVC138APWR	TEXAS INSTRUMENTS	1	U7	3-LINE TO 8-LINE DECODER/DEMULPLEXER TSSOP16-PW ROHS
7	SN74LVC1G125DBVR	TEXAS INSTRUMENTS	3	U8, U9, U11	SINGLE BUS BUFFER GATE WITH 3-STATE OUTPUT SOT23-DBV5 ROHS
8	SN74LVC2G04DBVR	TEXAS INSTRUMENTS	1	U10	DUAL INVERTER GATE SOT23-DBV6 ROHS
9	SRC4392IPFBR	BURR-BROWN	1	U12	2 CHAN,ASYNCR,SAMPLE RATE CONV W/DIG AUDIO REC/XMTR ROHS
10	24FC512-I/SM	MICROCHIP	1	U5	512K (64Kx8) I2C SERIAL EEPROM SOIC8-SM ROHS
11	PLR135/T10	EVERLIGHT ELECTRONICS	1	J4	PHOTOLINK FIBER OPTIC RECEIVER 2.4-5.5V 15MB PCB-RA SHUTTER ROHS
12	SML-LXT0805YW-TR	LUMEX OPTO	1	D1	LED, YELLOW 2.0V SMD0805 ROHS
13	SML-LXT0805GW-TR	LUMEX OPTO	2	D2, D3	LED, GREEN 2.0V SMD0805 ROHS
14	SIT8002AI-13-33E-6.00000T	SITIME	1	Y1	OSCILLATOR SMT 6MHz 3.3V OUT-ENABLE ROHS
15	SM7745HSV-22.5792M	PLETRONICS	1	Y2	OSCILLATOR SMT 3.3V SM77H SERIES 22.5792MHz ROHS
16	SM7745HSV-24.576M	PLETRONICS	1	Y3	OSCILLATOR SMT 3.3V SM77H SERIES 24.576MHz ROHS
17	EEE1CA100SR	PANASONIC	0	C1, C3, C7, C11	CAP SMD ELECT 10ufd 16V 20% VS-B ROHS
18	C2012X7R2A104K	TDK	4	C2, C4, C6, C10	CAP SMD0805 CERM 0.1UF 100V 10% X7R ROHS
19	GCM21BR71E225KA73L	MURATA	2	C8, C9	CAP SMD0805 CERM 2.2UF 25V 10% X7R ROHS
20	GRM188R71H222KA01D	MURATA	2	C12, C13	CAP SMD0603 CERM 2200PFD 50V 10% X7R ROHS
21	GRM21BR61C106KE15L	MURATA	4	C14, C16, C17, C19	CAP SMD0805 CERM 10UF 16V 10% X5R ROHS
22	C1608X7R1H104K	TDK	20	C15, C18, C20, C22, C25, C28, C30, C31, C32, C33, C35, C36, C37, C41, C43, C44, C46, C47, C48, C49	CAP SMD0603 CERM 0.1UF 50V 10% X7R ROHS
23	UKZ1E101MPM	NICHICON	1	C21	CAP ALUM ELEC KZ RADIAL 100UF 50V 20% ROHS
24	GRM2165C1H101JA01D	MURATA	1	C23	CAP SMD0805 CERM 100PFD 50V 5% COG ROHS
25	C1608C0G1H102J	TDK CORP.	1	C24	CAP SMD0603 CERM 1000PFD 50V 5% COG ROHS
26	GRM1885C1H470JA01D	MURATA	2	C26, C27	CAP SMD0603 CERM 47PFD 50V 5% COG ROHS
27	C1608X7R1C105K	TDK	1	C29	CAP SMD0603 CERM 1.0UF 16V 10% X7R ROHS
28	GRM188R60J106ME47D	MURATA	2	C34, C45	CAP SMD0603 CERM 10UF 6.3V 20% X5R ROHS
29	C2012X5R0J226M	TDK	3	C38, C40, C42	CAP SMD0805 CERM 22UF 6.3V 20% X5R ROHS
30	06031C103JAT2A	AVX	1	C39	CAP SMD0603 CERM 0.01UF 25V 5% X7R ROHS
31	ERJ-3GEYJ103V	PANASONIC	9	R0, R3, R4, R5, R16, R17, R20, R21, R22	RESISTOR SMD0603 10K 5% 1/10W ROHS
32	ERJ-3GEYJ471V	PANASONIC	2	R1, R2	RESISTOR SMD0603 470 OHMS 5% 1/10W ROHS
33	ERJ-3EKF1003V	PANASONIC	17	R6, R14, R40, R41, R42, R43, R44, R45, R46, R47, R48, R49, R50, R51, R52, R53, R54	RESISTOR SMD0603 100K OHM 1% THICK FILM 1/10W ROHS
34	ERJ-8GEY0R00V	PANASONIC	1	R7	RESISTOR SMD1206 0.0 OHM 5% 1/4W ROHS
35	ERJ-3GEYJ272V	PANASONIC	2	R8, R9	RESISTOR SMD0603 2.7K OHMS 5% 1/10W ROHS

<sup>(1)</sup> These assemblies are ESD sensitive, observe ESD precautions.

<sup>(2)</sup> These assemblies must be clean and free from flux and all contaminants. Use of no-clean flux is not acceptable.

<sup>(3)</sup> These assemblies must comply with workmanship standards IPC-A-610 Class 2.

**Table 4. PCM514xEVM-U Bill of Materials<sup>(1)(2)(3)</sup> (continued)**

Item	MFG Part Number	MFG	QTY	Ref Designators	Description
36	ERJ-3EKF3091V	PANASONIC	1	R10	RESISTOR SMD0603 3.09K OHM 1% THICK FILM 1/10W ROHS
37	ERJ-3EKF1501V	PANASONIC	1	R11	RESISTOR SMD0603 1.50K OHM 1% THICK FILM 1/10W ROHS
38	ERJ-3EKF27R4V	PANASONIC	2	R12, R13	RESISTOR SMD0603 27.4 OHMS 1% 1/10W ROHS
39	RC0603FR-07649RL	YAGEO	1	R15	RESISTOR SMD0603 THICK FILM 649 OHMS 1% 1/10W ROHS
40	ERJ-8ENF10R0	PANASONIC	5	R18, R23, R25, R30, R31	RESISTOR SMT1206 10.0 OHM 1% 1/4W ROHS
41	MCR18EZPF75R0	ROHM SEMICONDUCTOR	2	R19, R24	RESISTOR SMD1206 75 OHMS 1% 1/4W ROHS
42	ERJ-3EKF33R0V	PANASONIC	4	R26, R27, R28, R29	RESISTOR SMD0603 33.0 OHMS 1% 1/10W ROHS
43	CRCW060322R1FKEA	VISHAY	2	R32, R33	RESISTOR SMD0603 22.1 OHMS 1% 1/10W ROHS
44	ERJ-3GEYJ472V	PANASONIC	1	R34	RESISTOR SMD0603 4.7K OHMS 5% 1/10W ROHS
45	RCJ-042	CUI STACK	1	J1	RCA JACK THRU RA-FEMALE RED ROHS
46	RCJ-043	CUI STACK	1	J2	RCA JACK THRU RA-FEMALE WHITE ROHS
47	UX60-MB-5ST	HIROSE	1	J3	JACK USB MINIB SMT-RA 5PIN ROHS
48	RCJ-047	CUI STACK	1	J5	RCA JACK THRU RA-FEMALE ORANGE ROHS
49	5227699-2	TYCO ELECTRONICS	1	J6	JACK BNC SQUARE 50 OHMS ROHS
50	PBC03SAAN	SULLINS	3	W1, W2, W5	HEADER THRU MALE 3 PIN 100LS 120 TAIL GOLD ROHS
51	PBC15DAAN	SULLINS	1	W3	HEADER THRU MALE 2X15 100LS 120 TAIL GOLD ROHS
52	PBC02DAAN	SULLINS	1	W4	HEADER THRU MALE 2X2 PIN 100LS 120 TAIL GOLD ROHS
53	5002	KEYSTONE ELECTRONICS	23	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP27, TP28, TP29, TP30, TP31, TP32	PC TESTPOINT, WHITE, ROHS
54	5000	KEYSTONE ELECTRONICS	3	TP18, TP19, TP20	PC TESTPOINT, RED, ROHS
55	5011	KEYSTONE ELECTRONICS	6	TP21, TP22, TP23, TP24, TP25, TP26	PC TESTPOINT BLACK 063 HOLE ROHS
56	EVQ-5PN04K	PANASONIC	2	SW1, SW2	SWITCH MOM 240G SMD 6x3.5MM ROHS
57	TDA04H0SB1	CK COMPONENTS	1	SW3	SWITCH SMT DIP8 4POS ROHS
58	95947A018	MCMaster-CARR	4	STANDOFFS	STANDOFF M3x25mm 4.5mm DIA HEX ALUM F-F ROHS
59	92148A150	MCMaster-CARR	4	STANDOFF WASHERS	WASHER SPLIT-LOCK M3 6.2mm OD 0.7mm THICK STAINLESS STEEL ROHS
60	92000A118	MCMaster-CARR	4	STANDOFF SCREWS	SCREW M3x8 PHILIPS PANHEAD STAINLESS STEEL ROHS
61	969102-0000-DA	3M	4	W1(2-3), W2(2-3), W4(1-2), W5(1-2)	SHUNT BLACK AU FLASH 0.100LS OPEN TOP ROHS
62	969102-0000-DA	3M	12	W3: 1-2, 3-4, 5-6, 7-8, 9-10, 15-16, 17-18, 19-20, 21-22, 23-24, 25-26, 29-30	SHUNT BLACK AU FLASH 0.100LS OPEN TOP ROHS
		TOTAL	186		
X1	DO NOT POPULATE		4	C1, C3, C7, C11	

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer’s risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

**Products**

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

**Applications**

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

**TI E2E Community**
[e2e.ti.com](http://e2e.ti.com)

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2014, Texas Instruments Incorporated

## STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, or documentation (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.
  - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms and conditions that accompany such Software
  - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
2. *Limited Warranty and Related Remedies/Disclaimers:*
  - 2.1 These terms and conditions do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
  - 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for any defects that are caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.
  - 2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.
3. *Regulatory Notices:*
  - 3.1 *United States*
    - 3.1.1 *Notice applicable to EVMs not FCC-Approved:*

This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.
    - 3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

### CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

### FCC Interference Statement for Class A EVM devices

*NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.*

## **FCC Interference Statement for Class B EVM devices**

*NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:*

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

### 3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210

#### **Concerning EVMs Including Radio Transmitters:**

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

#### **Concernant les EVMs avec appareils radio:**

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

#### **Concerning EVMs Including Detachable Antennas:**

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

#### **Concernant les EVMs avec antennes détachables**

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

### 3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see [http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page) 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。  
[http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page)

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan are NOT certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

**【無線電波を送信する製品の開発キットをお使いになる際の注意事項】**

本開発キットは技術基準適合証明を受けておりません。

本製品のご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。

日本テキサス・インスツルメンツ株式会社

東京都新宿区西新宿 6 丁目 2 4 番 1 号

西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see [http://www.tij.co.jp/llds/ti\\_ja/general/eStore/notice\\_02.page](http://www.tij.co.jp/llds/ti_ja/general/eStore/notice_02.page)

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。[http://www.tij.co.jp/llds/ti\\_ja/general/eStore/notice\\_02.page](http://www.tij.co.jp/llds/ti_ja/general/eStore/notice_02.page)

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user 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, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*
- 6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY WRITTEN DESIGN MATERIALS PROVIDED WITH THE EVM (AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.
- 6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS AND CONDITIONS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT MADE, CONCEIVED OR ACQUIRED PRIOR TO OR AFTER DELIVERY OF THE EVM.
7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS AND CONDITIONS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.
8. *Limitations on Damages and Liability:*
- 8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS AND CONDITIONS OR THE USE OF THE EVMS PROVIDED HEREUNDER, REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN ONE YEAR AFTER THE RELATED CAUSE OF ACTION HAS OCCURRED.
- 8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY WARRANTY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS AND CONDITIONS, OR ANY USE OF ANY TI EVM PROVIDED HEREUNDER, EXCEED THE TOTAL AMOUNT PAID TO TI FOR THE PARTICULAR UNITS SOLD UNDER THESE TERMS AND CONDITIONS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM AGAINST THE PARTICULAR UNITS SOLD TO USER UNDER THESE TERMS AND CONDITIONS SHALL NOT ENLARGE OR EXTEND THIS LIMIT.
9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.
10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2014, Texas Instruments Incorporated

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)