

## **TAS5612L-TAS5614LDDVEVM**

This user's guide provides specifications for the evaluation module (EVM) for TAS5612L and TAS5614L Digital Input Class-D Power Stages with the TAS5558 Digital Audio Processor with PWM output from Texas Instruments. The user's guide also describes operation of the EVM and provides design information including schematic, bill of materials, and PCB layout.

### **Contents**

1	Introduction .....	3
2	Quick Setup Guide.....	8
	2.1 Electrostatic Discharge Warning.....	8
	2.2 Unpacking the EVM .....	8
	2.3 Speaker Connection .....	9
	2.4 Output Configuration BTL and PBTL .....	9
3	GUI Software Installation and Startup .....	10
	3.1 Software Installation .....	10
	3.2 Software Quick-Start Guide.....	10
	3.3 Using the EVM Software .....	10
	3.4 Self-Protection and Fault Reporting .....	14
4	Related Documentation from Texas Instruments .....	14
	4.1 Additional Documentation .....	14
5	Design Information .....	15
	5.1 EVM Custom Component Vendors .....	18
	5.2 TAS5612L-TAS5614LDDVEVM PCB SPECIFICATION .....	18
	5.3 EVM PCB Layers.....	19
	5.4 EVM and Input-USB Board 3 Schematics .....	20

### **List of Figures**

1	TAS5612L-TAS5614LDDVEVM .....	4
2	Input-USB Board3 .....	5
3	Integrated PurePath Digital Amplifier System.....	6
4	Physical Structure of the TAS5612L-TAS5614LDDVEVM (Approximate Layout) .....	7
5	PBTL Mode Configuration .....	9
6	Main Tab .....	11
7	Process Flow Tab .....	12
8	Direct I <sup>2</sup> C Access .....	13
9	Registers Tab (Selecting Biquad GUI) .....	14
10	Top Composite PCB Layer.....	19
11	Bottom Composite PCB Layer.....	19
12	TAS5612L-TAS5614LDDV Evaluation Board Digital Audio Processor I/O .....	20
13	TAS5612L-TAS5614LDDV Evaluation Board Power Amplifier.....	21
14	TAS5612L-TAS5614LDDV Evaluation Board Power Supply, Status Monitors, On and Off Control .....	22
15	TAS5612L-TAS5614LDDV Evaluation Board Revision History .....	23
16	TAS5612L-TAS5614LDDV Evaluation Board Disclaimer .....	24
17	Input - USB Board Schematic, USB Interface Reset .....	25

18	Input - USB Board Schematic, SPDIF Interface .....	26
19	Input - USB Board Schematic, PSIA Inputs, Data Select, and EVM Connector .....	27
20	Input - USB Board Schematic, Power Inputs and Supplies .....	28
21	Input - USB Board Schematic, Revision History .....	29
22	Input - USB Board Revision History .....	30
23	USB Board Schematic Disclaimer .....	31

#### List of Tables

1	TAS5612L-TAS5614LDDVEVM Specification .....	3
2	Recommended PVDD Power Supply Voltages .....	8
3	Bill of Materials for TAS5614LDDVEVM .....	16

## 1 Introduction

The TAS5612L-TAS5614LDDVEVM PurePath™ EVM demonstrates the current version of TAS5612LDDV or TAS5614LDDV integrated circuit power stage with TAS5558 from Texas Instruments (TI).

The TAS5612L and TAS5614L are high-performance, integrated Stereo Feedback Digital Amplifier Power Stages designed to drive 4-Ω speakers at up to 150 W per channel for TAS5614LDDV and 125 W per channel for TAS5612LDDV. They require only a passive demodulation filter to deliver efficient high quality audio amplification.

The TAS5558 is a high-performance 32-bit (24-bit input) multi channel PurePath Digital Pulse Width Modulator (PWM) with fully symmetrical AD modulation scheme. The device also has Digital Audio Processing (DAP) that provides 48 bit signal processing, advanced performance and a high level of system integration.

This EVM can be configured as 2 BTL channels for stereo evaluation or 1 PBTL (parallel BTL) channel for subwoofer evaluation. Together with a TI Input-USB Board 3, it provides a complete stereo digital audio amplifier system which includes digital input (S/PDIF), analog inputs, interface to PC and DAP features like digital volume control, input and output mixers, automute, tone controls, loudness, EQ filters and dynamic range compression (DRC). There are configuration options for power stage failure protection.

---

**NOTE:** TAS5612L-TAS5614LDDVEVM is shipped with the current version of the TAS5614L installed. Evaluate the current version of TAS5612L by visiting the product folder at [www.ti.com](http://www.ti.com) and requesting a free sample. Replace the TAS5614L with the TAS5612L.

---

**Table 1. TAS5612L-TAS5614LDDVEVM Specification**

Key Parameters	Values
TAS5614L Power Supply Voltage	12–38 Vdc
TAS5612L Power Supply Voltage	12–34 Vdc
Number of Channels	2 × BTL or 1 × PBTL
Load Impedance BTL	4–8 Ohm
Load Impedance PBTL	2–4 Ohm
TAS5614L Output power BTL	150 W / 4 Ohm / 10% THD+N
TAS5614L Output power PBTL	300 W / 2 Ohm / 10% THD+N
TAS5612L Output power BTL	125 W / 4 Ohm / 10% THD+N
TAS5612L Output power PBTL	250 W / 2 Ohm / 10% THD+N
Dynamic Range (DNR)	> 105 dB
PWM Processor	TAS5558
Output Stage	TAS5614LDDV or TAS5612LDDV

---

**NOTE:** The heatsink in TAS5612L-TAS5614LDDVEVM is designed to comply with time requirements of the “Amplifier Rule”, US Federal Trade Commission 16 CFR 432, when the EVM is operated at power levels specified above. If continuous operation at specified output power is required it is necessary to provide forced air flow through the heatsink.

(The FTC regulation specifies operation in 25°C ambient temperature for one hour at 1/8 specified output power (18.75W per channel for TAS5614LDDVEVM, 15.63W per channel for TAS5612LDDVEVM) and then for 5 minutes at specified output power (150W per channel for TAS5614LDDVEVM, 125W per channel for TAS5612LDDVEVM). Then distortion vs. output power can be measured. TAS5612L-TAS5614LDDVEVM provides specified output power for several minutes or more without thermal shutdown. THD is not specified for this test but is typically near 10%.)

---

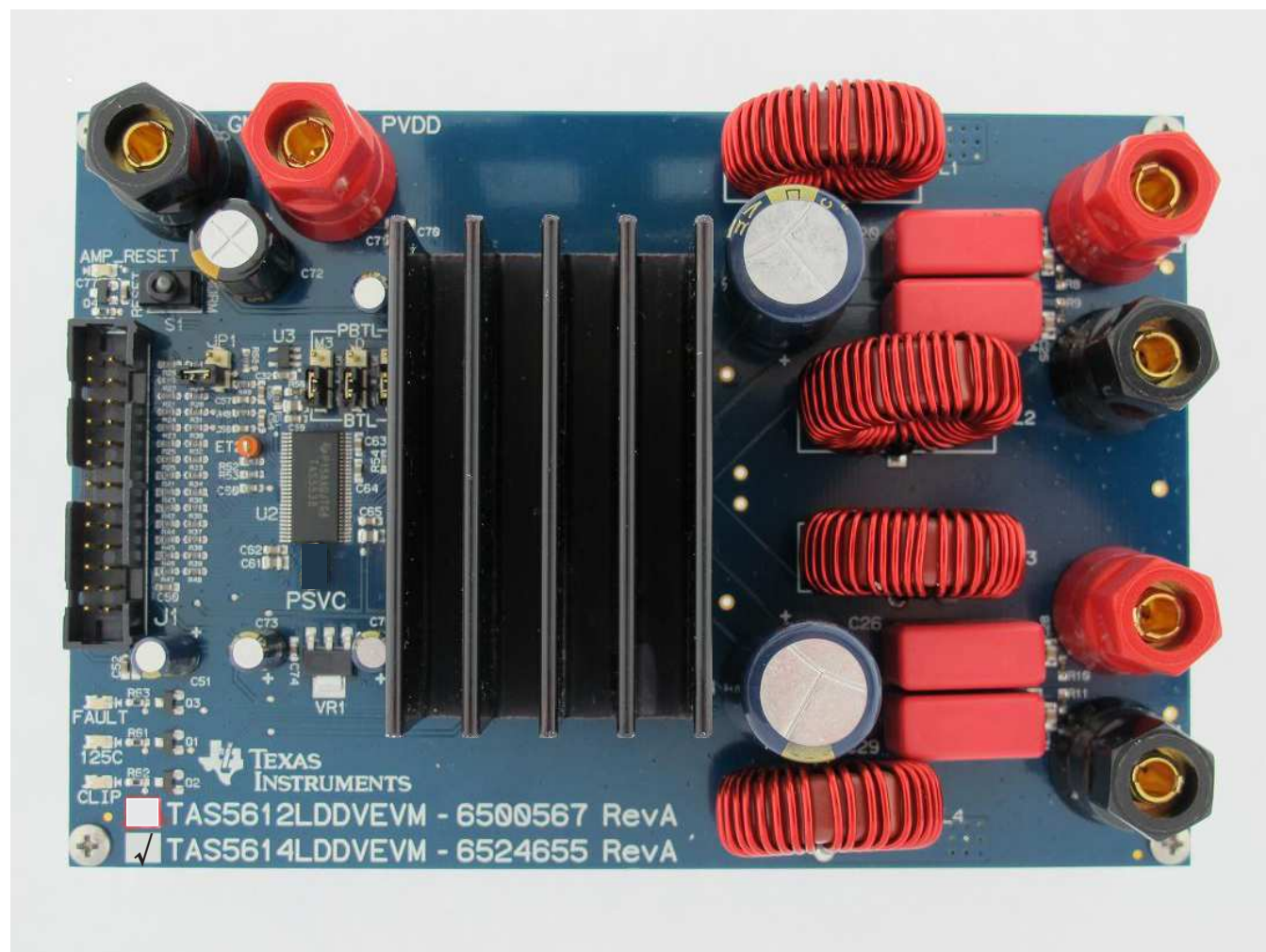
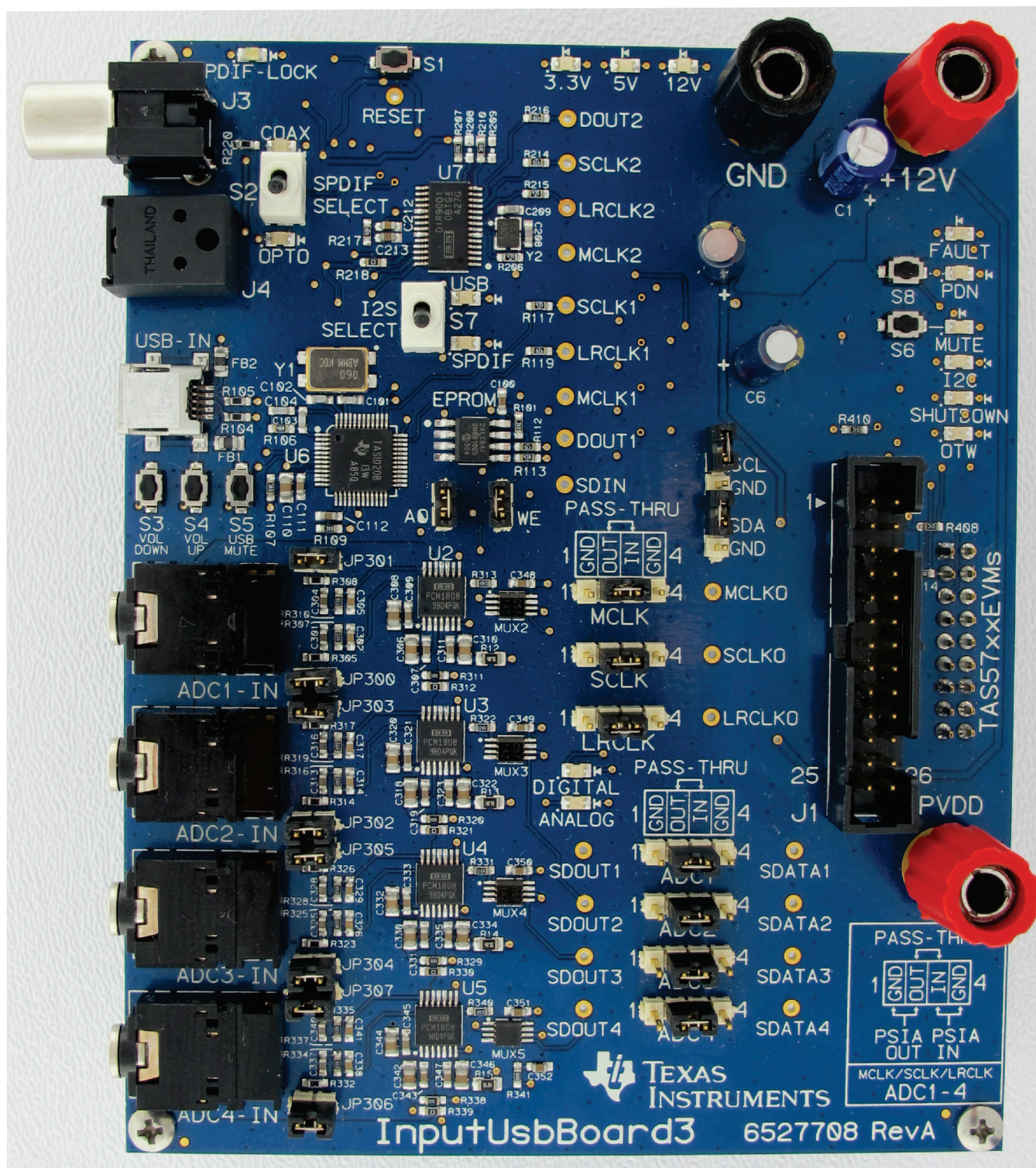


Figure 1. TAS5612L-TAS5614LDDVEVM





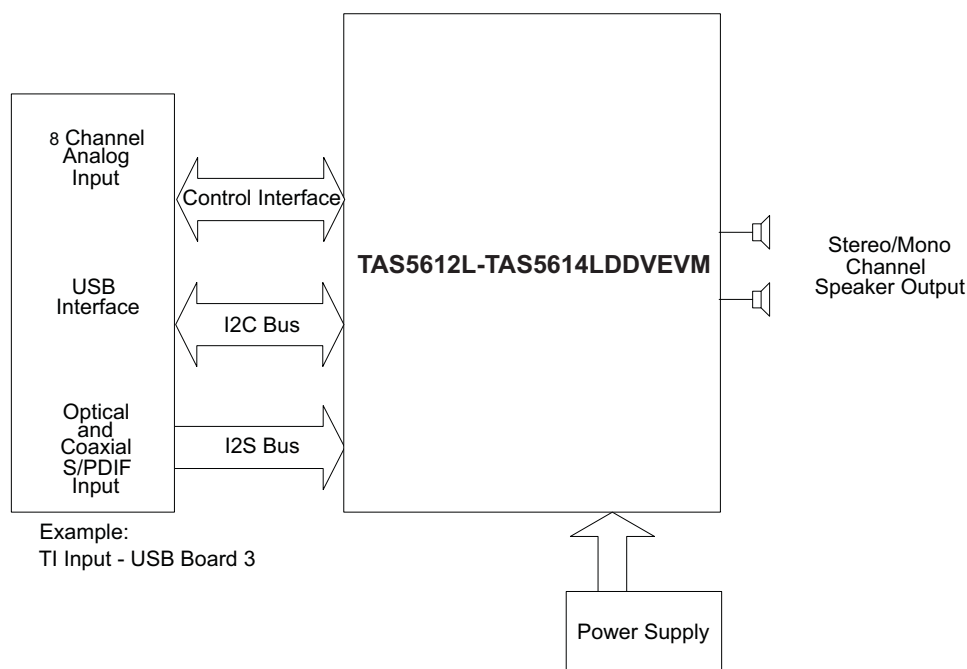
**Figure 2. Input-USB Board3**

Gerber (layout) files are available at: <http://www.ti.com>.

The EVM is delivered with a TI Input-USB Board 3 to connect to an input source and to a PC for control. Refer to [Unpacking the EVM](#).

## TAS5612L-TAS5614LDDVEVM Features

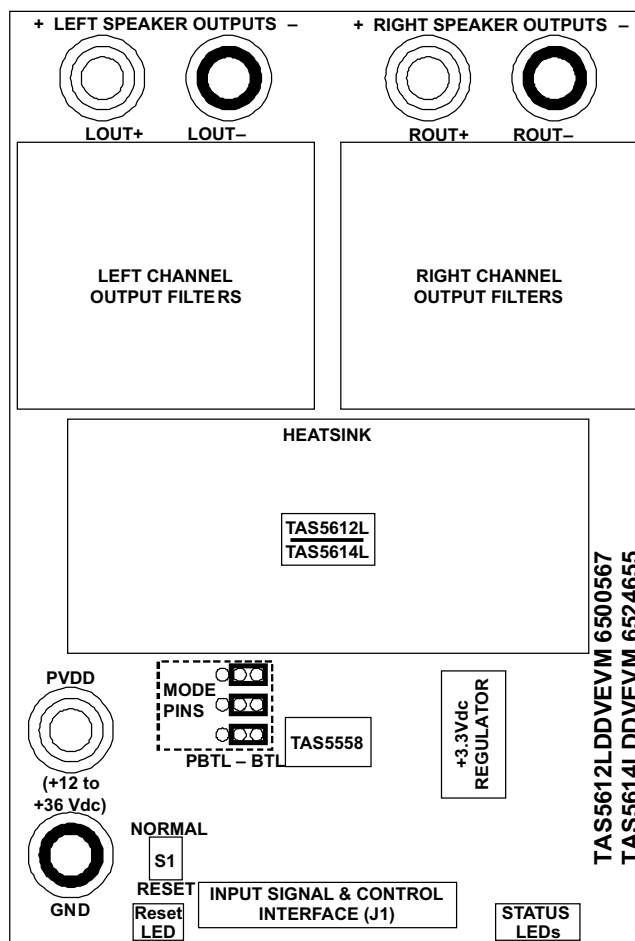
- Stereo PurePath Digital evaluation module.
- Self-contained protection system (overcurrent, overtemperature, undervoltage and missing PWM input).
- Standard I<sup>2</sup>S and I<sup>2</sup>C / Control connector for TI input board
- Double-sided plated-through PCB layout.



**Figure 3. Integrated PurePath Digital Amplifier System**

## EVM Physical Structure

Physical structure of the TAS5612L-TAS5614LDDVEVM is illustrated in [Figure 4](#).



**Figure 4. Physical Structure of the TAS5612L-TAS5614LDDVEVM (Approximate Layout)**



## 2 Quick Setup Guide

This section describes the TAS5612L-TAS5614LDDVEVM power supplies and system interfaces. It provides information regarding handling and unpacking, absolute operating conditions, and switch and jumper positions. It also provides a step-by-step guide to setting up the TAS5612L-TAS5614LDDVEVM for device evaluation.

### 2.1 Electrostatic Discharge Warning

Many of the components of the TAS5612L-TAS5614LDDVEVM 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 can result in damage to EVM components.

### 2.2 Unpacking the EVM

Upon opening the TAS5612L-TAS5614LDDVEVM package, check to make sure that the following items are included:

- 1 pc. TAS5612L-TAS5614LDDVEVM using 1 TAS5558 and 1 TAS5612LDDV or TAS5614LDDV.
- 1 pc. TI Input-USB Board 3 for interfacing TAS5612L-TAS5614LDDVEVM to SPDIF/analog sources and PC for control.
- 1 pc. Signal and Control Interface IDC cable for connection to an I<sup>2</sup>S front-end like the Input-USB Board 3.
- If any of these items are missing, contact the nearest Texas Instruments Product Information Center to inquire about a replacement.

Connect the Input-USB Board 3 to the TAS5612L/14LDDVEVM using the delivered IDC cable.

### Power Supply Setup

Two power supplies are needed to power the TAS5612L-TAS5614LDDVEVM. Voltage and current requirements for the PVDD power supply are shown in the table below. Connect this power supply to the EVM using banana cables or wires secured to the power supply binding posts PVDD and GND. A second power supply, 12Vdc at 500mA, is required to power Input-USB Board 3. Connect the 12V power supply to the Input-USB Board 3 using banana cables or wires secured to the power supply binding posts +12V and GND.

**Table 2. Recommended PVDD Power Supply Voltages**

Description	Voltage Range	Current Requirements	Binding Post
TAS5614L Power Supply Voltage	12–38 Vdc	16 A	PVDD
TAS5612L Power Supply Voltage	12–34 Vdc	14 A	PVDD

#### CAUTION

NOTE: Applying voltages above specifications in [Table 2](#) can cause permanent damage to the hardware. Verify polarity of power supply connections before powering the EVM.

**NOTE:** The length of the power supply cable must be minimized. Increasing length of PSU cable is likely to increase distortion for the amplifier at high output levels and low frequencies.



## 2.3 Speaker Connection

### CAUTION

Both positive and negative speaker outputs are floating and cannot be connected to ground (that is, through an oscilloscope). To measure a BTL output connect an oscilloscope probe to each side of the output, connect both ground clips to EVM ground and use the oscilloscope math functions to show the difference between the 2 probe signals.

## 2.4 Output Configuration BTL and PBTL

When changing mode from BTL to PBTL, make sure that the AMP\_RESET switch is set to RESET before changing shunts on Mode headers M3, D and C.

- For BTL mode place a shunt on pins 1 and 2 of each header, at the positions marked BTL.
- For PBTL mode place a shunt on pins 3 and 2 of each header, at the positions marked PBTL.

In PBTL mode the load must be connected according to [Figure 5](#):

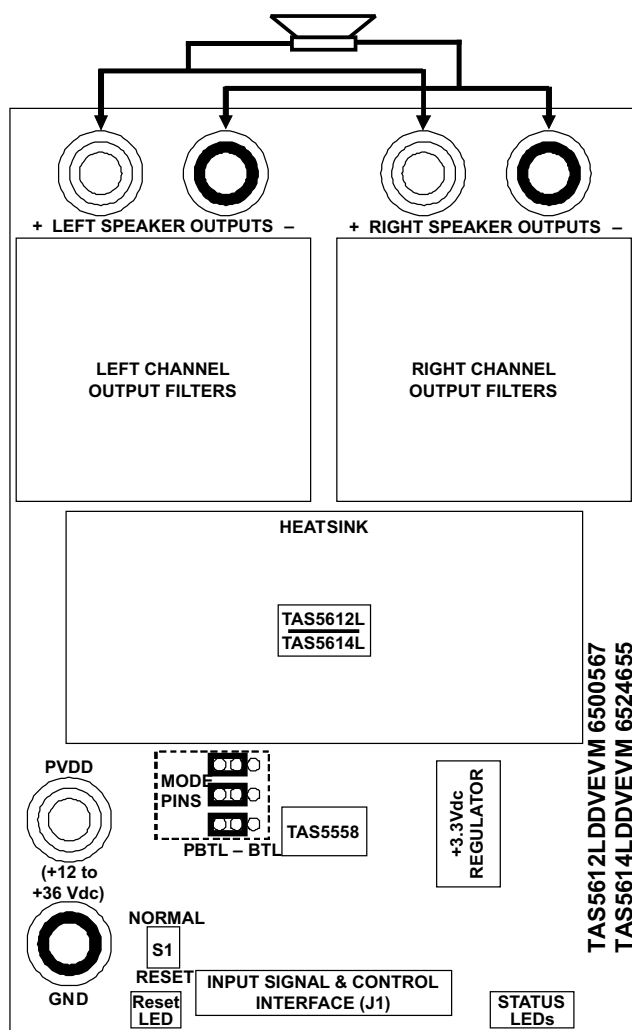


Figure 5. PBTL Mode Configuration

### 3 GUI Software Installation and Startup

The TAS5612L-TAS5614LDDVEVM is controlled by the Input-USB Board 3 the PurePath Console GUI and TAS5612 plug-in. The TAS5612 GUI provides control of all registers in the TAS5558. Connect the USB cable (not supplied) between the host PC and jack USB-IN on the Input-USB Board 3. Then turn on the 12-V power supply and the PVDD power supply in that order.

#### 3.1 Software Installation

Download the PurePath Console GUI from the TI Web site (<http://cc.ext.ti.com>). The TI Web site always has the latest release and any updates to versions of the GUI. A request must be submitted to download the software.

Execute the GUI install program, setup\_PurePathConsole\_Main\_vxx\_revxx.exe. Once the program is installed, the program group and shortcut icon is created in Start → Program → Texas Instruments Inc → PurePathConsole → Choose Target. When the GUI comes up, select TAS5612.

#### 3.2 Software Quick-Start Guide

The EVM is initialized upon PurePath Console GUI startup. Audio is streaming to the headphones if Window Media (or similar program) is playing and mini-USB EVM is selected in the sound playback properties. The following indicators show both PurePath Console GUI and EVM are operating correctly:

- On the EVM, the VALID LED (green) is on
- On the PurePath Console GUI, both green LEDs on the bottom left corner are on

#### 3.3 Using the EVM Software

##### 3.3.1 Main Tab

[Figure 6](#) illustrates the main tab when the GUI starts up. Clicking the TAS5612 icon directs you to the device block diagram.

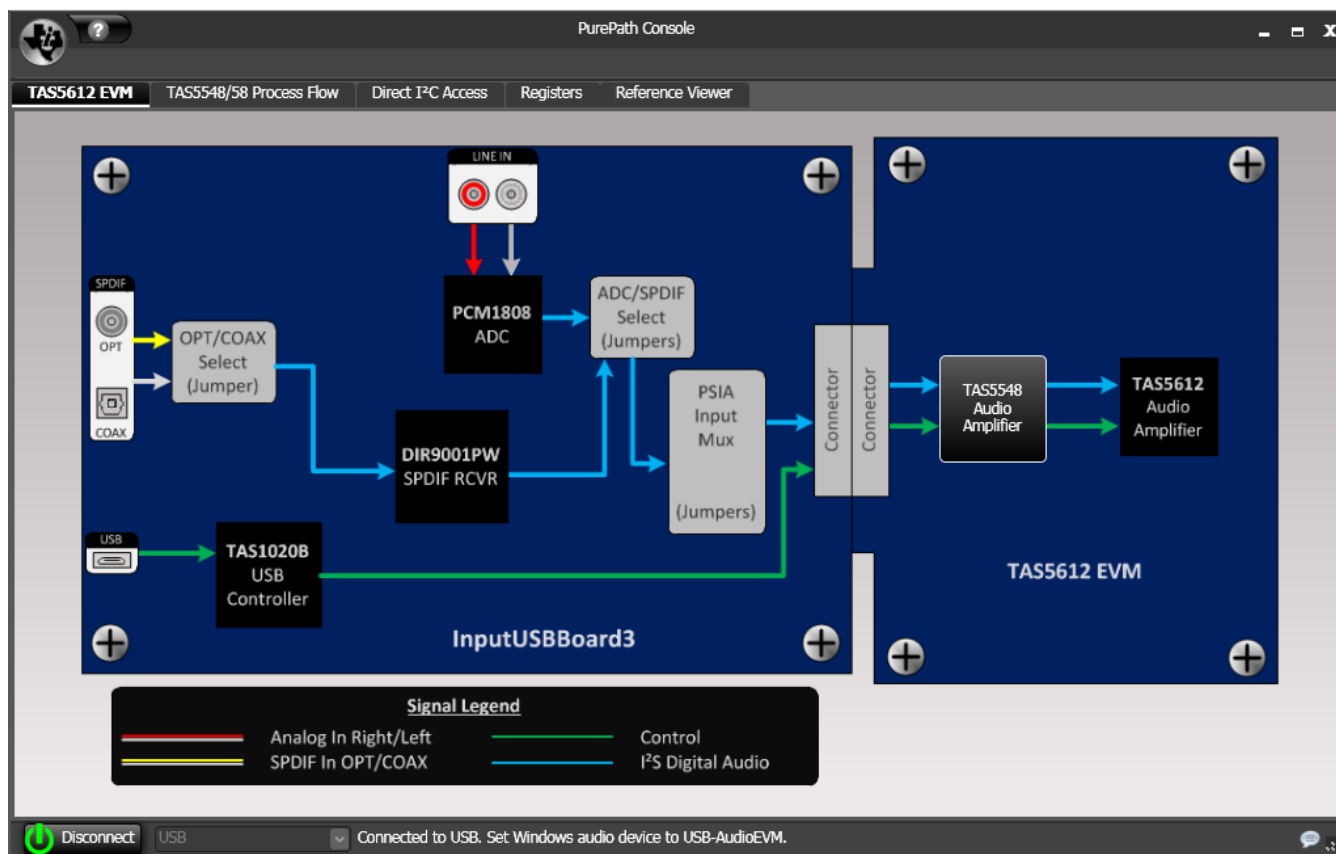


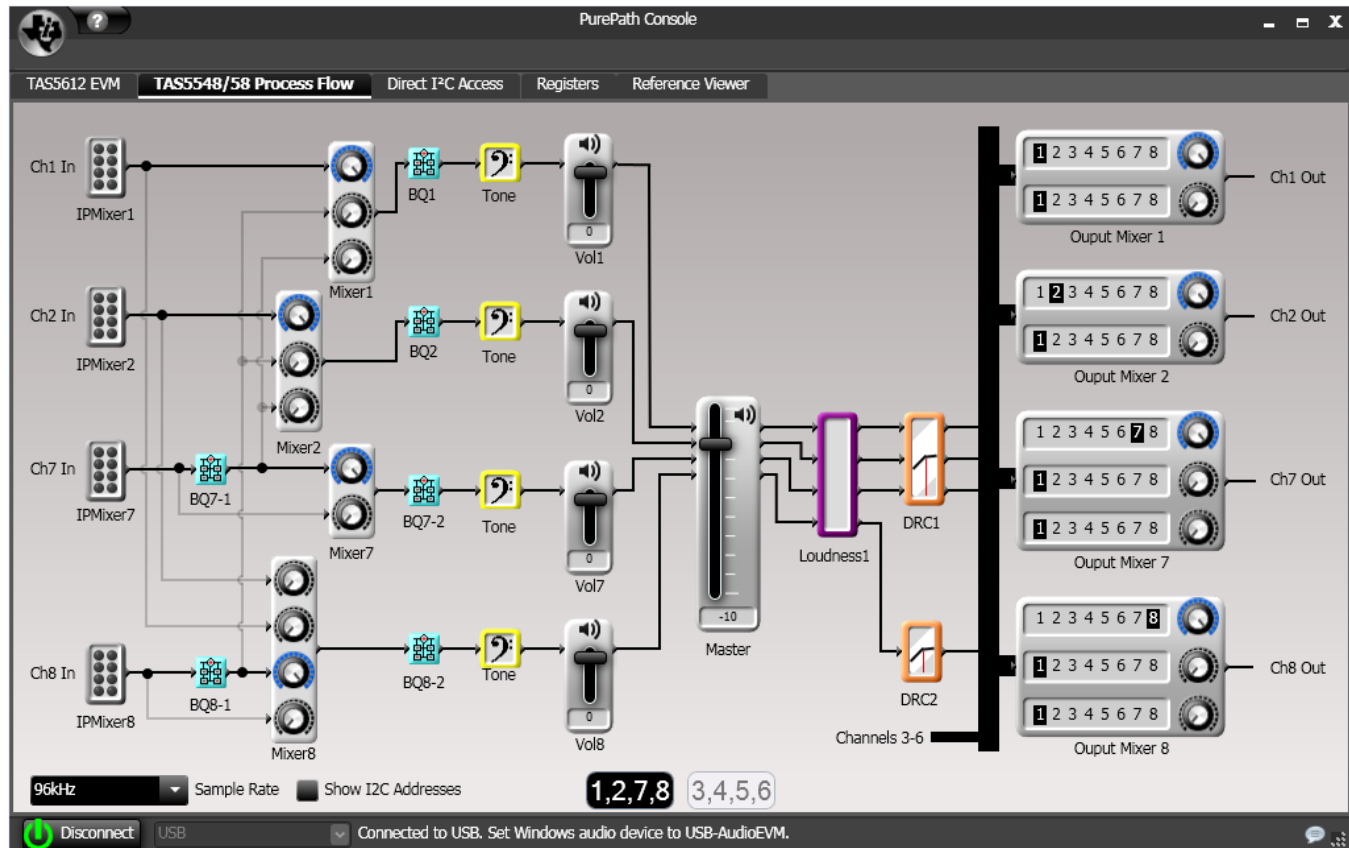
Figure 6. Main Tab

### 3.3.2 Block Diagram Tab

This tab shows major blocks of the device. To control the device, click on the digital audio processor (DAP) bringing up the TAS5558 process flow tab.

### 3.3.3 Process Flow Tab

The process flow tab, [Figure 7](#), controls the TAS5558 main functions: EQ, DRC, input and output mixing, tone, and volume.

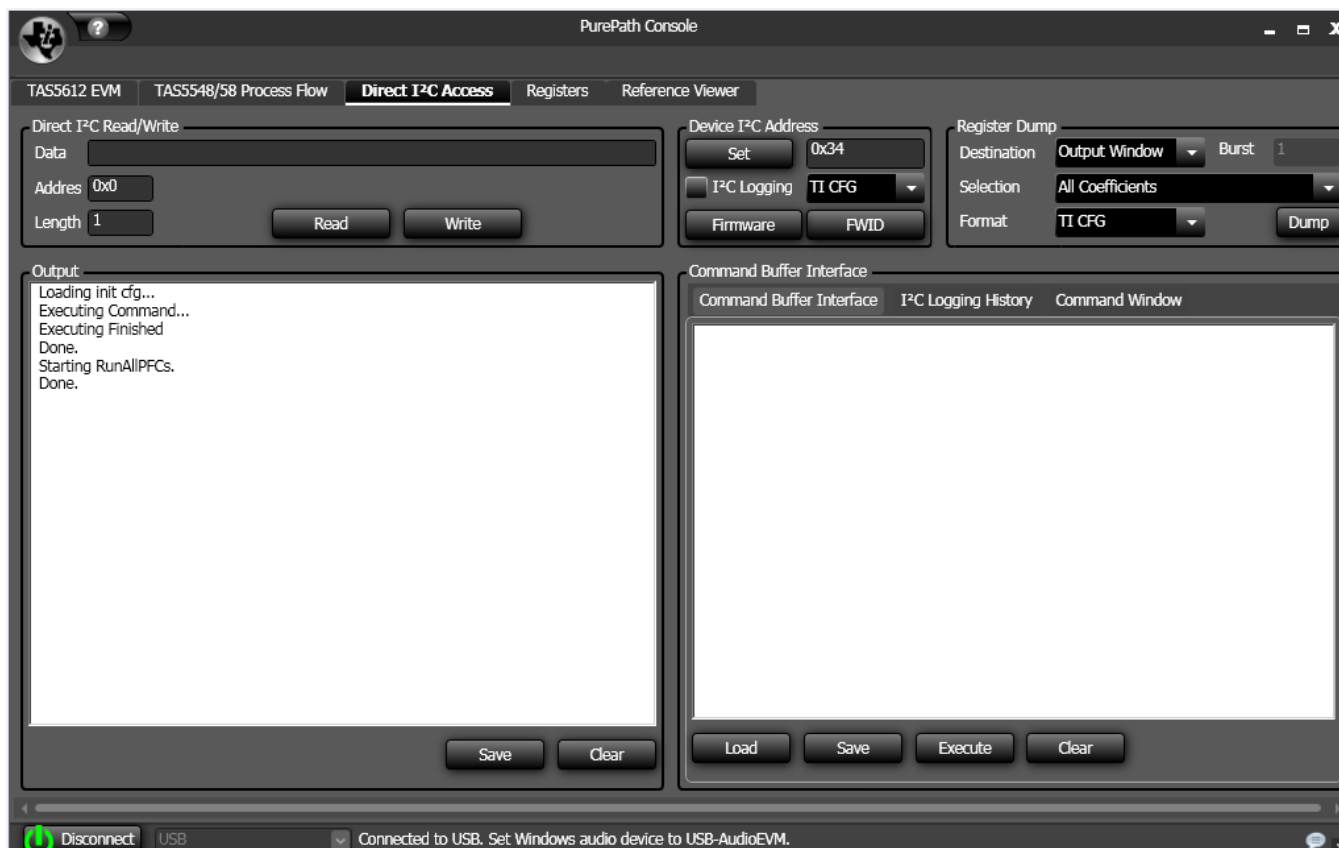


**Figure 7. Process Flow Tab**



### 3.3.4 Direct I<sup>2</sup>C Access Tab

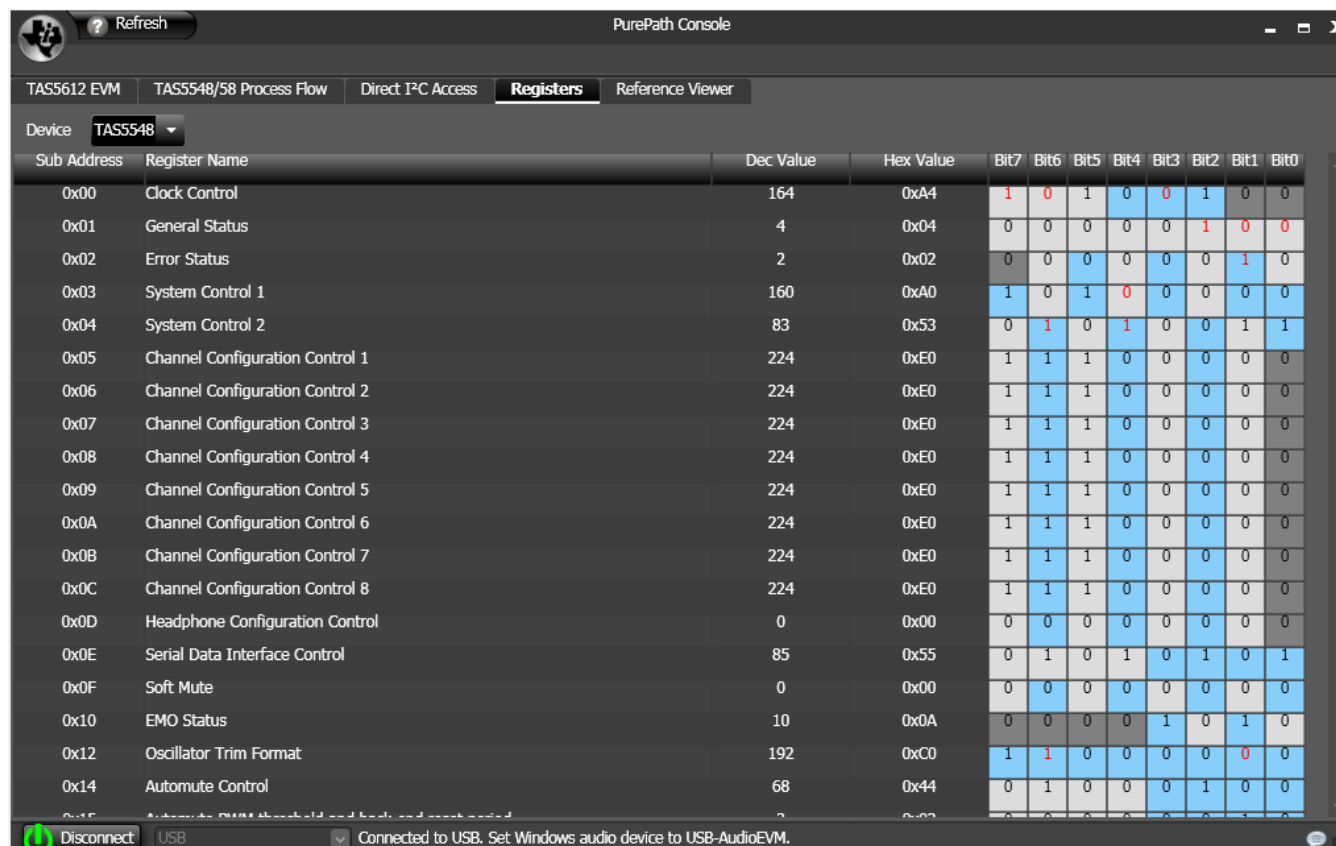
Reading and writing I<sup>2</sup>C registers is performed on the tab illustrated in [Figure 8](#).



**Figure 8. Direct I<sup>2</sup>C Access**

### 3.3.5 TAS5558 Registers Tab

The TAS5558 registers tab, illustrated in [Figure 9](#), shows the current I<sup>2</sup>C register values (hexadecimal and decimal).



**Figure 9. Registers Tab (Selecting Biquad GUI)**

### 3.4 Self-Protection and Fault Reporting

The TAS5612L and TAS5614L are self-protecting devices that provide overtemperature, overcurrent, undervoltage and missing-PWM-input protection, with extensive fault reporting. For full descriptions of these functions consult data sheet SLAS847 for TAS5612LA and data sheet SLAS846 for TAS5614LA.

## 4 Related Documentation from Texas Instruments

The following table lists data sheets that provide detailed descriptions of integrated circuits from TI that are used in the TAS5612L-TAS5614LDDVEVM. These data sheets can be obtained at <http://www.ti.com>.

**Related Documentation from Texas Instruments**

Part Number	Literature Number
TAS5558	<a href="#">SLES273</a>
TAS5612LA	<a href="#">SLAS847</a>
TAS5614LA	<a href="#">SLAS846</a>
TPS3825-33	<a href="#">SLVS165</a>
TLV1117-33C	<a href="#">SLVS561</a>

### 4.1 Additional Documentation

1. System Design Considerations for True Digital Audio Power Amplifiers ([SLAA117](#))
2. Digital Audio Measurements ([SLAA114](#))
3. PSRR for PurePath Digital Audio Amplifiers ([SLEA049](#))

4. *Power Rating in Audio Amplifier* ([SLEA047](#))
5. *PurePath Digital AM Interference Avoidance* ([SLEA040](#))
6. *Click & Pop Measurements Technique* ([SLEA044](#))
7. *Power Supply Recommendations for DVD-Receivers* ([SLEA027](#))
8. *Implementation of Power Supply Volume Control* ([SLEA038](#))

## 5 Design Information

This appendix includes design information for the TAS5612L-TAS5614LDDVEVM. This information is presented in the following order.

- [Table 3](#) Bill of Materials for TAS5614LDDVEVM
- [Section 5.1](#) EVM Custom Component Vendors
- [Section 5.2](#) TAS5612L-TAS5614LDDVEVM PCB SPECIFICATION
- [Section 5.3](#) EVM PCB Layers
- [Section 5.4](#) EVM and Input-USB Board 3 Schematics

**Table 3. Bill of Materials for TAS5614LDDVEVM**

Manu Part No.	Qty.	Ref Des	Vendor Part No.	Description	Vendor	Manu.
<b>TI-SEMICONDUCTORS</b>						
TAS5614LDDV	1	U1	TAS5614LDDV	150W-STEREO/300W-MONO PUREPATH DIGITAL AMP HTSSOP44-DDV ROHS	Texas Instruments	Texas Instruments
TAS5558	1	U2	TAS5558	8 CHANNEL HD COMPATIBLE AUDIO PROCESSOR TAS5558-DGG ROHS	Texas Instruments	Texas Instruments
TPS3825-33DBVT	1	U3	296-2636-1	PROCESSOR SUPERVISORY CIRCUITS 2.93V 200ms SOT23-DBV5 ROHS	Digi-Key	Texas Instruments
TLV1117-33CDCYR	1	VR1	296-21112-1-ND	VOLT REG LDO 3.3V 800mA SOT223-DCY ROHS	Digi-Key	Texas Instruments
<b>SEMICONDUCTORS</b>						
2N7002	4	Q1, Q2, Q3, Q4	2N7002NCT	N-FET 60V 115mA 200mW 7.5 OHM@10V SOT23-DBV3 ROHS	Digi-Key	Fairchild
SML-LXT0805SRW-TR	3	125C, FAULT, AMP_RESET	67-1555-1	LED, RED 2.0V SMD0805 ROHS	Digi-Key	Lumex Opto
SML-LXT0805YW-TR	1	CLIP	67-1554-1	LED, YELLOW 2.0V SMD0805 ROHS	Digi-Key	Lumex Opto
<b>CAPACITORS</b>						
C1206C102K1RACTU	4	C21, C24, C27, C30	399-1222-1	CAP SMD1206 CERM 1000PFD 100V 1% C0G ROHS	Digi-Key	Kemet
GRM188R71H472KA01D	2	C54, C55	490-1506-1	CAP SMD0603 CERM 4700PFD 50V 10% X7R ROHS	Digi-Key	Murata
GRM21BR72A103KA01L	5	C22, C25, C28, C31, C70	490-1652-1	CAP SMD0805 CERM 0.01UFD 100V 10% X7R ROHS	Digi-Key	Murata
GRM188R71H333KA61D	4	C16, C17, C18, C19	490-3286-1-ND	CAP SMD0603 CERM 0.033UFD 50V 10% X7R ROHS	Digi-Key	Murata
GRM188R71C473KA01D	2	C56, C57	490-1529-1	CAP SMD0603 CERM 0.047UFD 16V 10% ROHS	Digi-Key	Murata
GRM188R71C104KA01D	17	C2, C3, C4, C7, C32, C50, C52, C53, C59, C60, C62, C63, C64, C65, C74, C76, C77	490-1532-1-ND	CAP SMD0603 CERM 0.1UFD 16V 10% X7R ROHS	Digi-Key	Murata
MKP4 -.68/250/20	4	C20, C23, C26, C29	MKP4 -.68/250/20	CAP POLYPRO FILM MKP4 0.68UFD 250V 20% ROHS	WIMA	WIMA
C1608X7R1C105K	2	C5, C6	445-1604-1	CAP SMD0603 CERM 1.0UFD 16V 10% X7R ROHS	Digi-Key	TDK
GRM21BR71H105KA12L	5	C8, C9, C10, C11, C71	490-4736-1-ND	CAP SMD0805 CERM 1.0UFD 50V 10% X7R ROHS	Digi-Key	Murata
GRM21BR61C106KE15L	3	C58, C61, C66	490-3886-1	CAP SMD0805 CERM 10UFD 16V 10% X5R ROHS	Digi-Key	Murata
<b>CAPACITORS</b>						
EEU-FC1C470	4	C1, C51, C73, C75	P11196	CAP 47UFD 16V RAD ALUM ELEC FC ROHS	Digi-Key	Panasonic
UKZ1H470MPM	1	C72	493-3194	CAP ALUM ELEC KZ RADIAL 47UFD 50V 20% ROHS	Digi-Key	Nichicon
EEU-FC1H102	2	C12, C14	P10333-ND	CAP ALUM ELEC FC RADIAL 1000UFD 50V 20% ROHS	Digi-Key	Panasonic
<b>RESISTORS</b>						
RMCF0402ZT0R00	2	R12, R13	RMCF0402ZT0R00CT	ZERO OHM JUMPER SMT 0402 0 OHM 1/16W,5% ROHS	Digi-Key	Stackpole Electronics
ERJ-3GEY0R00V	1	R51	P0.0GCT	RESISTOR SMD0603 0.0 OHM 5% THICK FILM 1/10W ROHS	Digi-Key	Panasonic
ERJ-3GEYJ1R0V	1	R50	P1.0GCT	RESISTOR SMD0603 1.0 OHMS 1% THICK FILM 1/10W ROHS	Digi-Key	Panasonic
ERJ-3GEYJ3R3V	8	R1, R7, R8, R9, R10, R11, R14, R60	P3.3GCT	RESISTOR SMD0603 3.3 OHMS 5% 1/10W ROHS	Digi-Key	Panasonic
ERJ-3GEYJ470V	19	R27, R28, R29, R30, R31, R32, R33, R34, R35, R36, R37, R38, R39, R40, R54, R55, R56, R57, R58	P47GCT	RESISTOR SMD0603 47 OHMS 5% 1/10W ROHS	Digi-Key	Panasonic
CRCW0603100RFKEA	3	R4, R5, R6	541-100HCT	RESISTOR SMD0603 100 OHM 1/10W 1% ROHS	Digi-Key	Vishay
ERJ-3GEYJ471V	2	R48, R49	P470GCT	RESISTOR SMD0603 470 OHMS 5% 1/10W ROHS	Digi-Key	Panasonic
ERJ-3GEYJ472V	4	R61, R62, R63, R65	P4.7KGCT	RESISTOR SMD0603 4.7K OHMS 5% 1/10W ROHS	Digi-Key	Panasonic



**Table 3. Bill of Materials for TAS5614LDDVEVM (continued)**

Manu Part No.	Qty.	Ref Des	Vendor Part No.	Description	Vendor	Manu.
ERJ-3EKF1002V	14	R20, R21, R22, R23, R24, R25, R26, R41, R42, R43, R44, R45, R46, R47	P10.0KHCT	RESISTOR SMD0603 10.0K 1% THICK FILM 1/10W ROHS	Digi-Key	Panasonic
RMCF0603FT15K0	1	R52	RMCF0603FT15K0CT	RESISTOR SMD0603 15.0K OHMS 1% 1/10W ROHS	Digi-Key	Stackpole Electronics
RC0603FR-0718KL	1	R53	311-18.0KHRCT	RESISTOR SMD0603 THICK FILM 18.0K OHMS 1% 1/10W ROHS	Digi-Key	Yageo
RC0603FR-0730KL	1	R2	311-30.0KHRCT	RESISTOR SMD0603 THICK FILM 30.0K 1% 1/10W ROHS	Digi-Key	Yageo
ERJ-3GEYJ473V	1	R3	P47KGCT	RESISTOR SMD0603 47K OHMS 5% 1/10W ROHS	Digi-Key	Panasonic
<b>INDUCTORS</b>						
MA5172-AE	4	L1, L2, L3, L4	MA5172-AE	SHIELDED POWER INDUCTOR 10uH 10A ROHS	Coil Craft	Coil Craft
<b>HEADERS</b>						
N2526-6002-RB	1	J1	MHC26K-ND	HEADER SHROUDED 100LS MALE GOLD 2X13 PINS ROHS	Digi-Key	3M
PBC02SAAN	1	JP1	S1011E-02-ND	HEADER THRU MALE 2 PIN 100LS GOLD ROHS	Digi-Key	Sullins
PBC03SAAN	3	C, D, M3	S1011E-03-ND	HEADER THRU MALE 3 PIN 100LS GOLD ROHS	Digi-Key	Sullins
<b>TESTPOINTS AND SWITCHES</b>						
5003	1	ET2	5003K	PC TESTPOINT, ORANGE, ROHS	Digi-Key	Keystone Electronics
G12AP-RO	1	S1	360-1758	SWITCH THRU SPDT STRAIGHT ULTRA MINIATURE ROHS	Digi-Key	NKK
<b>BINDING POSTS</b>						
5018-0	3	GND, LOUT-, ROUT-	565-5018-0	BINDING POST, BLACK 60V 30A GOLD ROHS	Mouser	Pomona
5018-2	3	PVDD, LOUT+, ROUT+	565-5018-2	BINDING POST, RED 60V 30A GOLD ROHS	Mouser	Pomona
<b>SHUNTS</b>						
SPC02SYAN	4	JP1, C(1-2), D(1-2), M3(1-2)	S9001	SHUNT, BLACK AU FLASH 0.100LS	Digi-Key	Sullins
<b>HEAT SINKS AND HARDWARE</b>						
ATSTI10P-563-C1-R0	1	HS1	ATSTI10P-563-C1-R0	HEATSINK ALUMINUM ATS 36x54mm 36.8mm PITCH ROHS	ATS	ATS
92000A118	2	HS1	92000A118	PHILIPS PANHEAD SCREW M3x8mm STAINLESS STEEL ROHS	McMaster- Carr	McMaster- Carr
92148A150	2	HS1	92148A150	SPLIT WASHER M3 STAINLESS STEEL ROHS	McMaster- Carr	McMaster- Carr
<b>STANDOFFS AND HARDWARE</b>						
94868A178	4	NA	94868A178	STANDOFF M3x25mm 4.5mm DIA HEX STAINLESS STEEL F-F ROHS	McMaster- Carr	McMaster- Carr
92000A118	4	NA	92000A118	PHILIPS PANHEAD SCREW M3x8mm STAINLESS STEEL ROHS	McMaster- Carr	McMaster- Carr
92148A150	4	NA	92148A150	SPLIT WASHER M3 STAINLESS STEEL ROHS	McMaster- Carr	McMaster- Carr
Component Count:	163					
<b>COMPONENTS NOT ASSEMBLED</b>						
CR1, CR2, CR3, CR4, L+, L-, OA, OB, OC, OD, R+, R-, PVDD_AB, PVDD_CD, M1, M2, GNDx2, PSVC						

## 5.1 EVM Custom Component Vendors

TAS5612LDDVEVM and TAS5614LDDVEVM include inductors and heatsinks from 2 custom component vendors designed specifically for the EVMs. These vendors carry stock for small orders on their shelves.

Advanced Thermal Solutions (ATS), in Norwood, MA, USA, provide a heatsink optimized for these EVMs, ATS-TI1OP-563-C1. Information on this heatsink can be obtained from Leonard Alter at [alter@qats.com](mailto:alter@qats.com). ATS design and manufacture a large line of off-the-shelf and patented high performance heatsinks. They also design and manufacture research quality thermal test and measurement equipment and offer thermal evaluation and design services. Information about their products and services is available at [www.qats.com](http://www.qats.com).

Coilcraft, in Cary, IL, USA, provide a 10µH inductor optimized for these EVMs, MA5172-AE. Information on this component can be found in the data sheet for the MA5172 inductor family at [www.coilcraft.com](http://www.coilcraft.com). Coilcraft make a variety of other inductors for Class D amplifiers, most of which are AEC-Q200 Grade 1 certified for automotive applications. Free evaluation samples and on-line ordering are available at [www.coilcraft.com](http://www.coilcraft.com).

## 5.2 TAS5612L-TAS5614LDDVEVM PCB SPECIFICATION

PCB IDENTIFICATION:	TAS5612L-TAS5614LDDVEVM_RevA
PCB TYPE:	DOUBLE-SIDED PLATED-THROUGH
PCB SIZE:	142 x 96 mm
LAMINATE TYPE:	FR4
LAMINATE THICKNESS:	1.6mm
COPPER THICKNESS:	70 µm (2 ounce) (INCLUDING PLATING EXTERIOR LAYER)
COPPER PLATING IN HOLES:	70 µm (2 ounce)
MINIMUM HOLE DIAMETER:	0.3 mm (12 mils)
SILKSCREEN:	WHITE - REMOVE SILKSCREEN FROM SOLDER & PRE-TINNED AREAS
SOLDER MASK:	BLUE
APPROX. HOLE COUNT:	570
PROTECTIVE COATING:	ENIG (ELECTROLESS NICKEL / IMMERSION GOLD)
ELECTRICAL TEST:	PCB MUST BE ELECTRICAL TESTED
COMMENTS:	FAB NOTES ARE IN THE DRILL DRAWING FILE

### 5.3 EVM PCB Layers

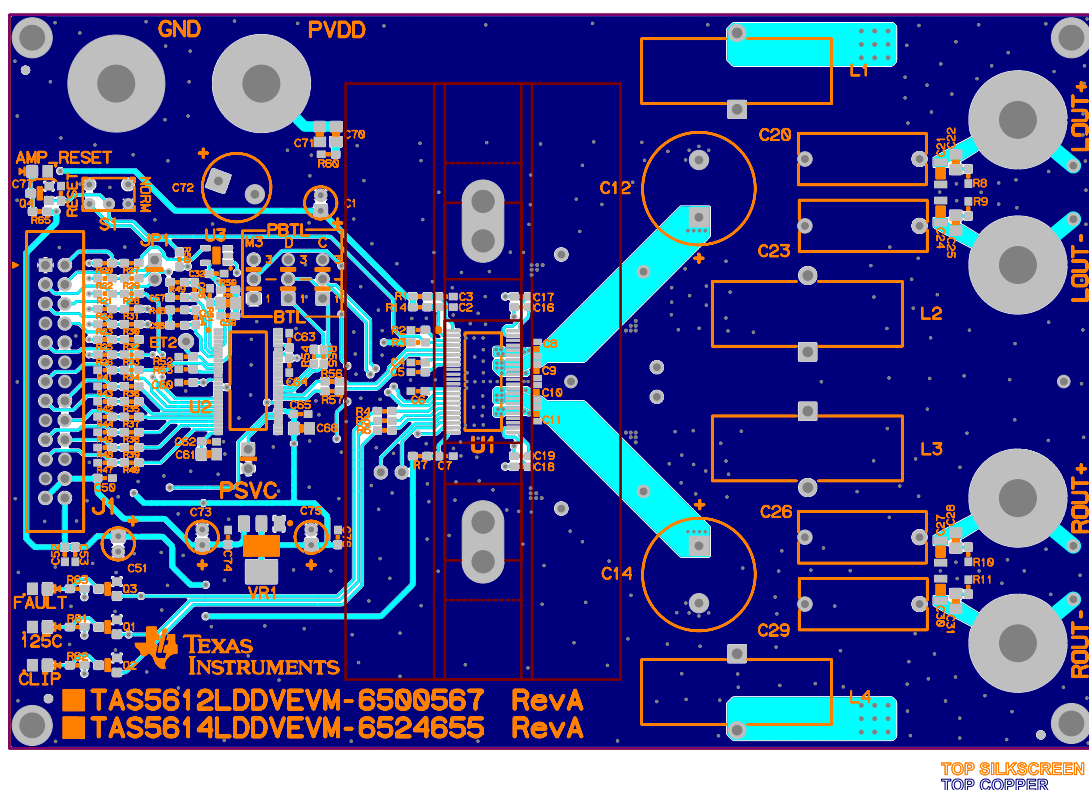


Figure 10. Top Composite PCB Layer

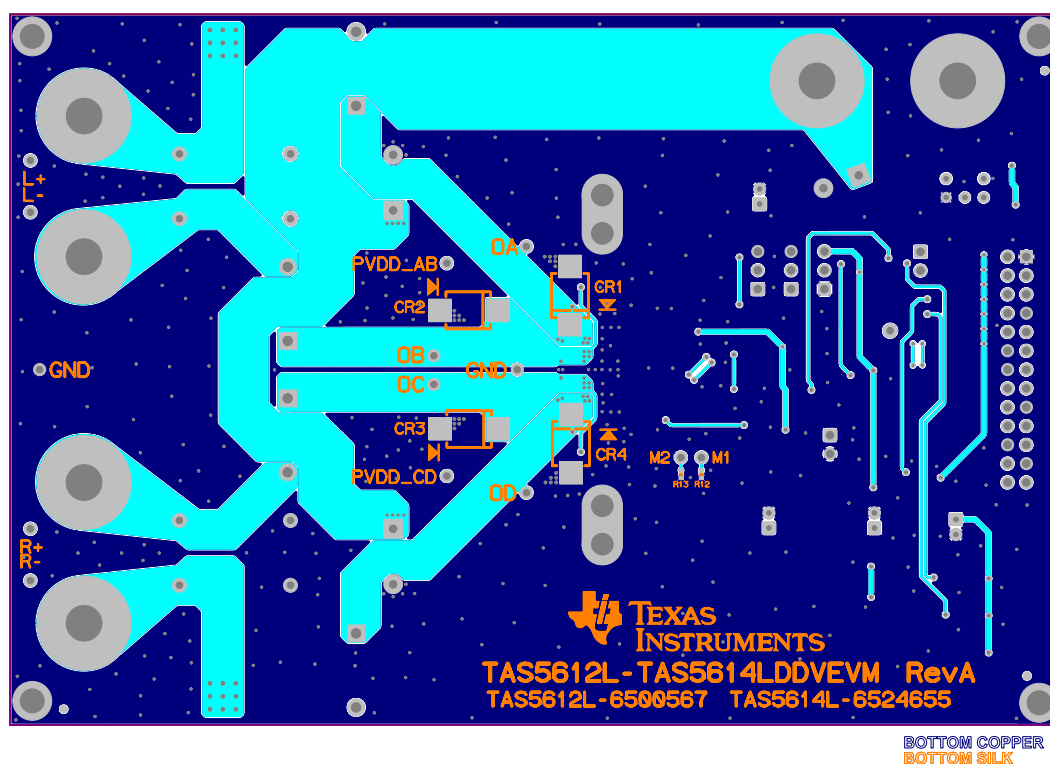


Figure 11. Bottom Composite PCB Layer

## 5.4 EVM and Input-USB Board 3 Schematics

The EVM and Input-USB Board 3 schematics are illustrated in Figure 12 through Figure 22.

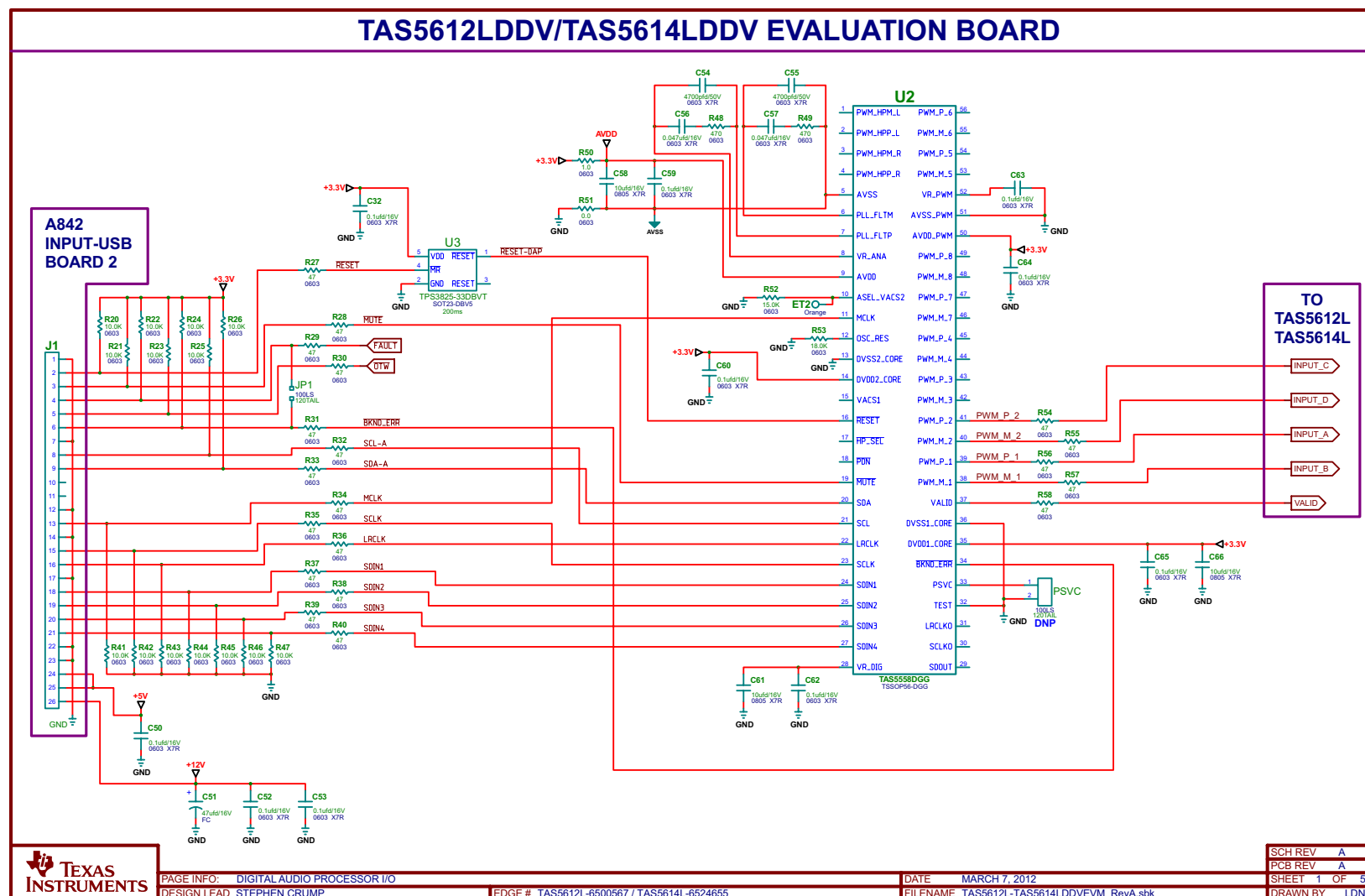


Figure 12. TAS5612L-TAS5614LDDV Evaluation Board Digital Audio Processor I/O



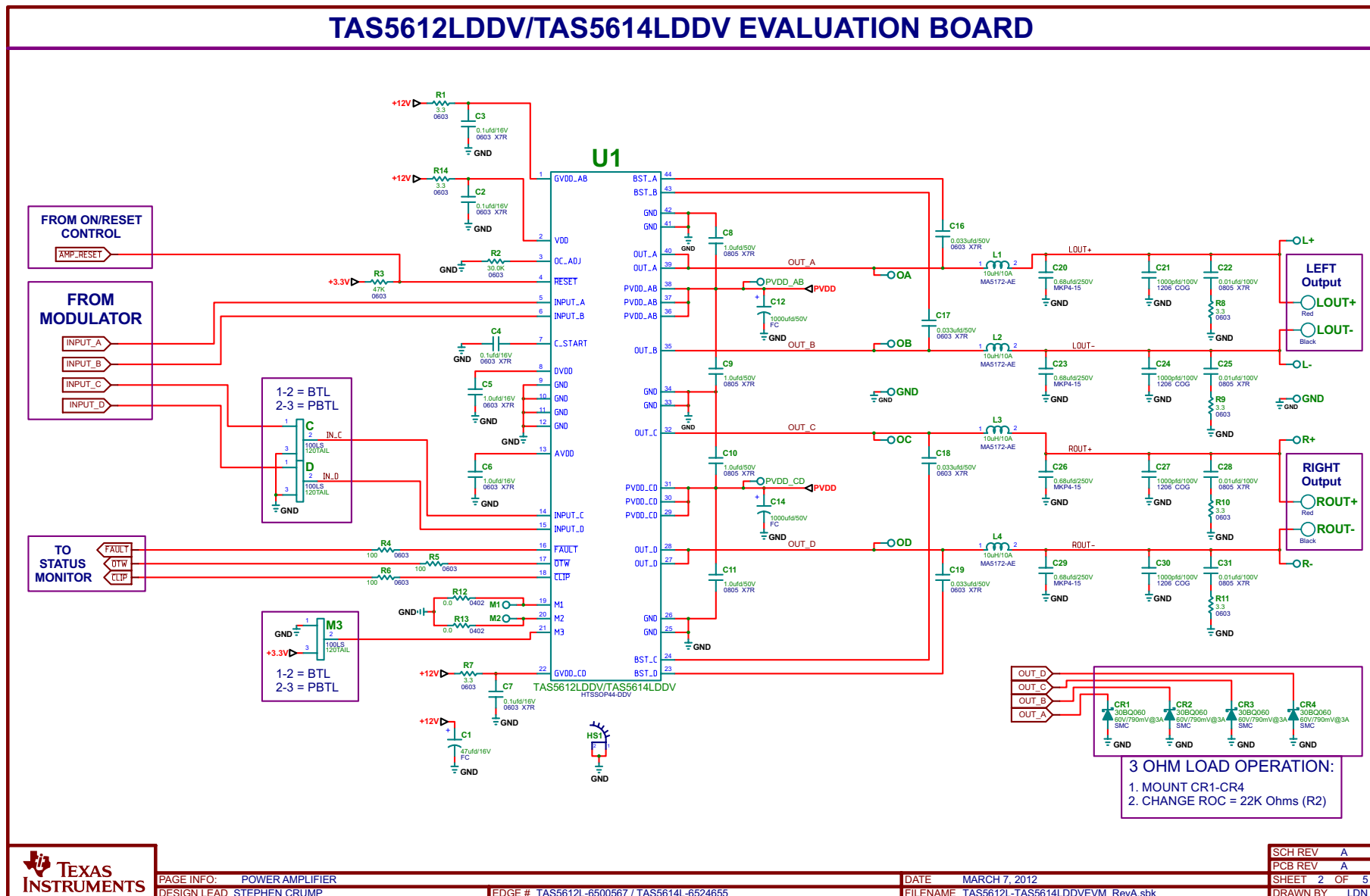


Figure 13. TAS5612L-TAS5614LDDV Evaluation Board Power Amplifier

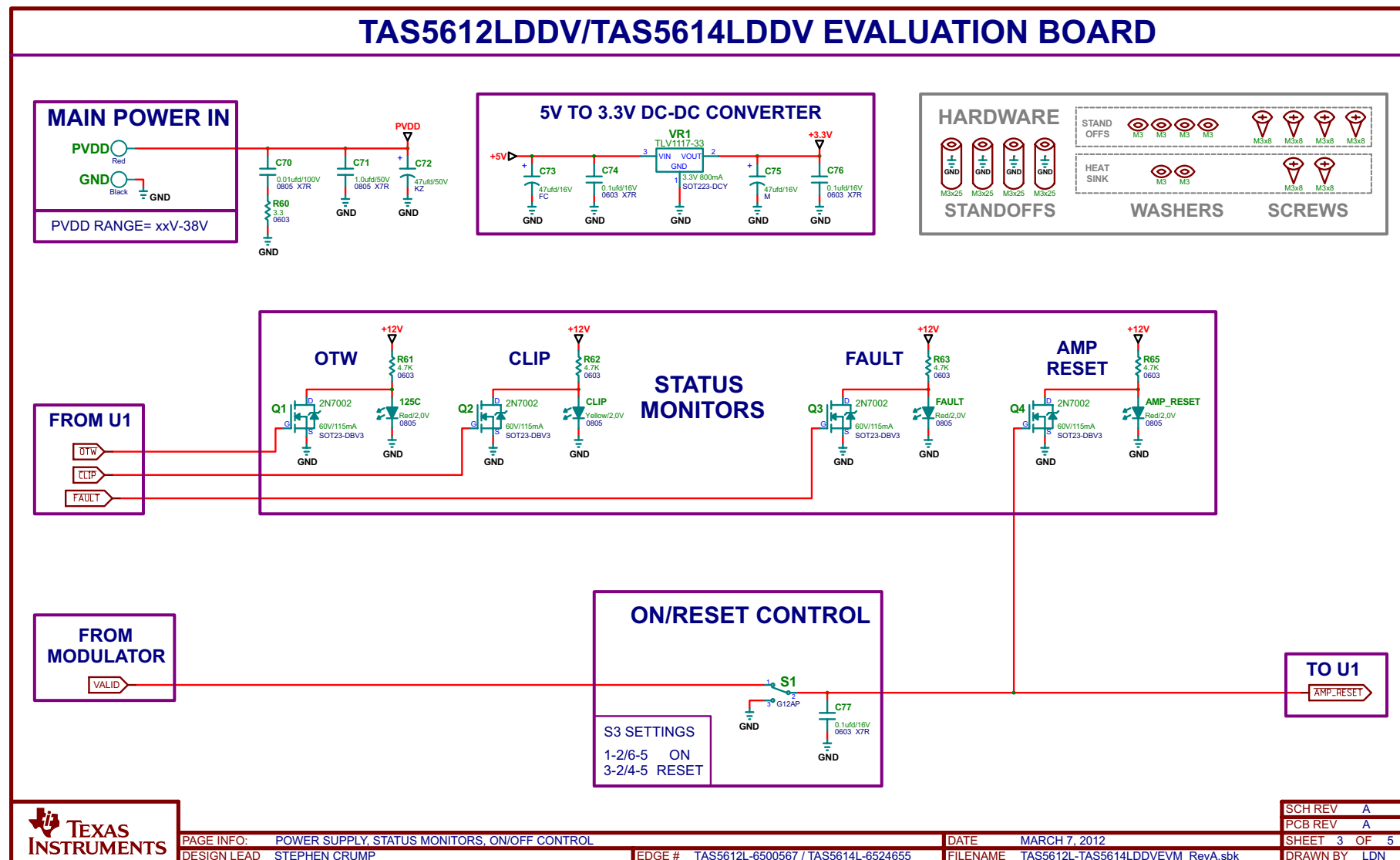


Figure 14. TAS5612L-TAS5614LDDV Evaluation Board Power Supply, Status Monitors, On and Off Control

## TAS5612LDDV/TAS5614LDDV EVALUATION BOARD

### REVISION HISTORY

REVISION	DESCRIPTION	DATE	APPROVAL
A	INITIAL RELEASE	MARCH 7, 2012	SC



PAGE INFO: REVISION HISTORY

DESIGN LEAD STEPHEN CRUMP

EDGE # TAS5612L-6500567 / TAS5614L-6524655

DATE MARCH 7, 2012

FILENAME TAS5612L-TAS5614LDDVEVM\_RevA.sbk

SCH REV A

PCB REV A

SHEET 4 OF 5

DRAWN BY LDN

**Figure 15. TAS5612L-TAS5614LDDV Evaluation Board Revision History**

## TEXAS INSTRUMENTS DISCLAIMER

The information and materials ("Materials") provided here are provided by Texas Instruments Incorporated ("TI") as a service to its customers and/or suppliers, and may be used for informational purposes only, and only subject to the following terms. By downloading or viewing these Materials, you are signifying your assent to these terms.

- 1.) These preliminary evaluation schematics are intended for use for PRELIMINARY ENGINEERING DEVELOPMENT AND EVALUATION PURPOSES ONLY and are not considered by Texas Instruments to be fit as a basis for establishing production products or systems. This information may be incomplete in several respects, including but not limited to information relating to required design, marketing, and/or manufacturing-related protective considerations and product safety measures typically found in the end-product incorporating the goods.
- 2.) Accordingly, neither TI nor its suppliers warrant the accuracy or completeness of the information, text, graphics, links or other items contained within the Materials. TI may make changes to the Materials, or to the products described therein, at any time without notice. TI makes no commitment to update the Materials.
- 3.) TI assumes no liability for applications assistance, customer product design, software performance, or services that may be described or referenced in the Materials. The user assumes all responsibility and liability for proper and safe design and handling of goods. Accordingly, the user indemnifies TI from all claims arising from its use of the Materials.
- 4.) TI currently deals with various customers for products, and therefore our arrangement with the user will not be exclusive. TI makes no representations regarding the commercial availability of non-TI components that may be referenced in the Materials.
- 5.) No license is granted under any patent right or other intellectual property right of TI covering or relating to any combination, machine, or process in which such TI products or services might be or are used. Except as expressly provided herein, TI and its suppliers do not grant any express or implied right to you under any patents, copyrights, trademarks, or trade secret information.
- 6.) Performance tests and ratings, to the extent referenced in the Materials, are measured using specific computer systems and/or components and reflect the approximate performance of TI products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing.
- 7.) Resale of TI's products or services with statements different from or beyond the parameters stated by TI for that product or service in official TI data books or data sheets voids all express and any implied warranties for the associated TI product or service, and is an unfair and deceptive business practice, and TI is not responsible for any such use.
- 8.) The Materials are copyrighted and any unauthorized use may violate copyright, trademark, and other laws. You may only download one copy for your internal use only, unless you are specifically licensed to do otherwise by TI in writing. This is a license, not a transfer of title, and is subject to the following restrictions: You may not:
  - (a) modify the Materials (including any associated warranties, conditions, limitations or notices) or use them for any commercial purpose, or any public display, performance, sale or rental;
  - (b) decompile, reverse engineer, or disassemble software Materials except and only to the extent permitted by applicable law;
  - (c) remove any copyright or other proprietary notices from the Materials;
  - (d) transfer the Materials to another person. You agree to prevent any unauthorized copying of the Materials. TI may terminate this license at any time if you are in breach of the terms of this Agreement. Upon termination, you will immediately destroy the Materials.
- 9.) THE MATERIALS ARE PROVIDED "AS IS" WITHOUT ANY EXPRESS OR IMPLIED WARRANTY OF ANY KIND INCLUDING WARRANTIES OF MERCHANTABILITY, NONINFRINGEMENT OF INTELLECTUAL PROPERTY, OR FITNESS FOR ANY PARTICULAR PURPOSE. IN NO EVENT SHALL TI OR ITS SUPPLIERS BE LIABLE FOR ANY DAMAGES WHATSOEVER (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF PROFITS, BUSINESS INTERRUPTION, LOSS OF INFORMATION) ARISING OUT OF THE USE OF OR INABILITY TO USE THE MATERIALS, EVEN IF TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.



Figure 16. TAS5612L-TAS5614LDDV Evaluation Board Disclaimer



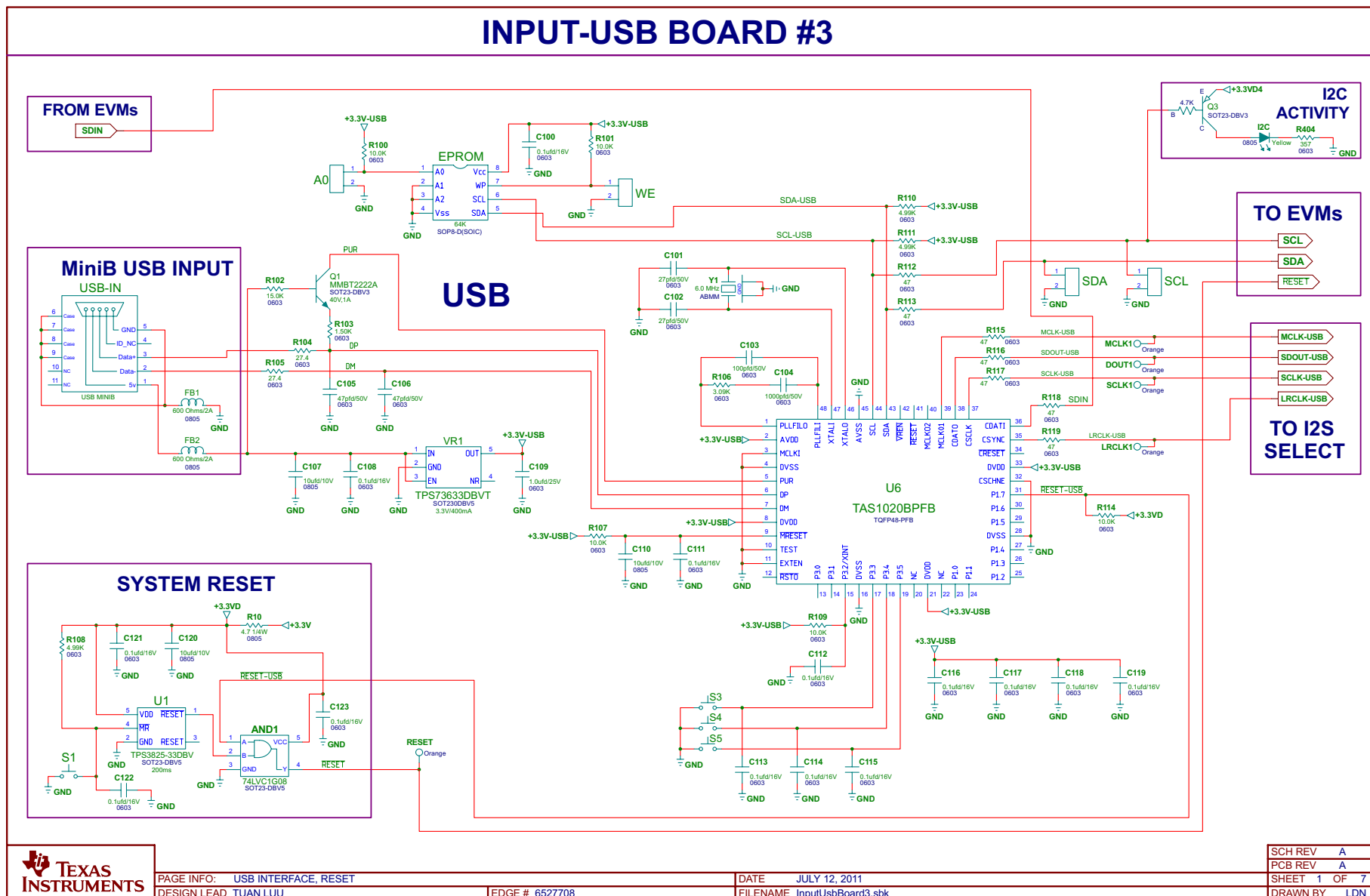


Figure 17. Input - USB Board Schematic, USB Interface Reset

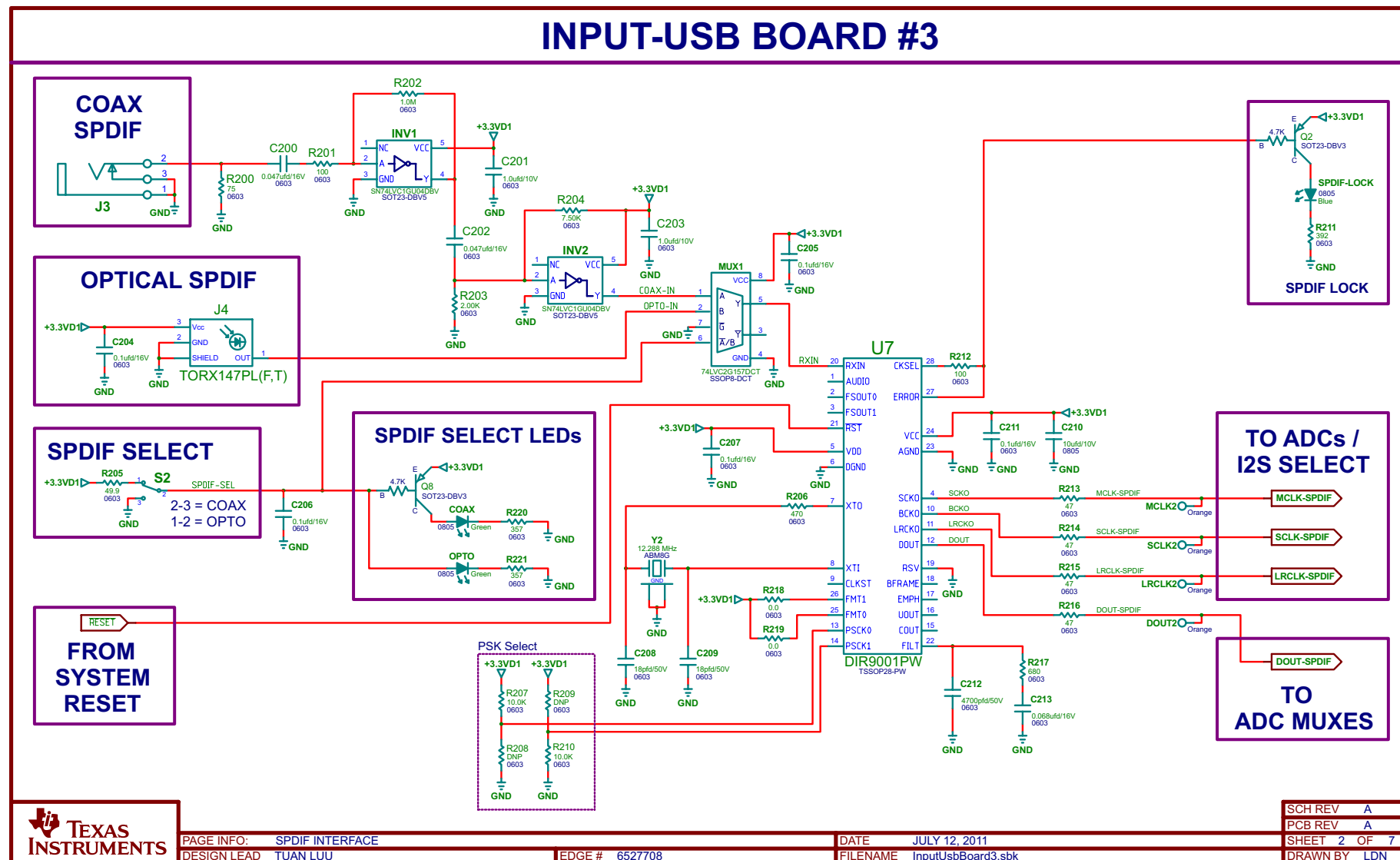
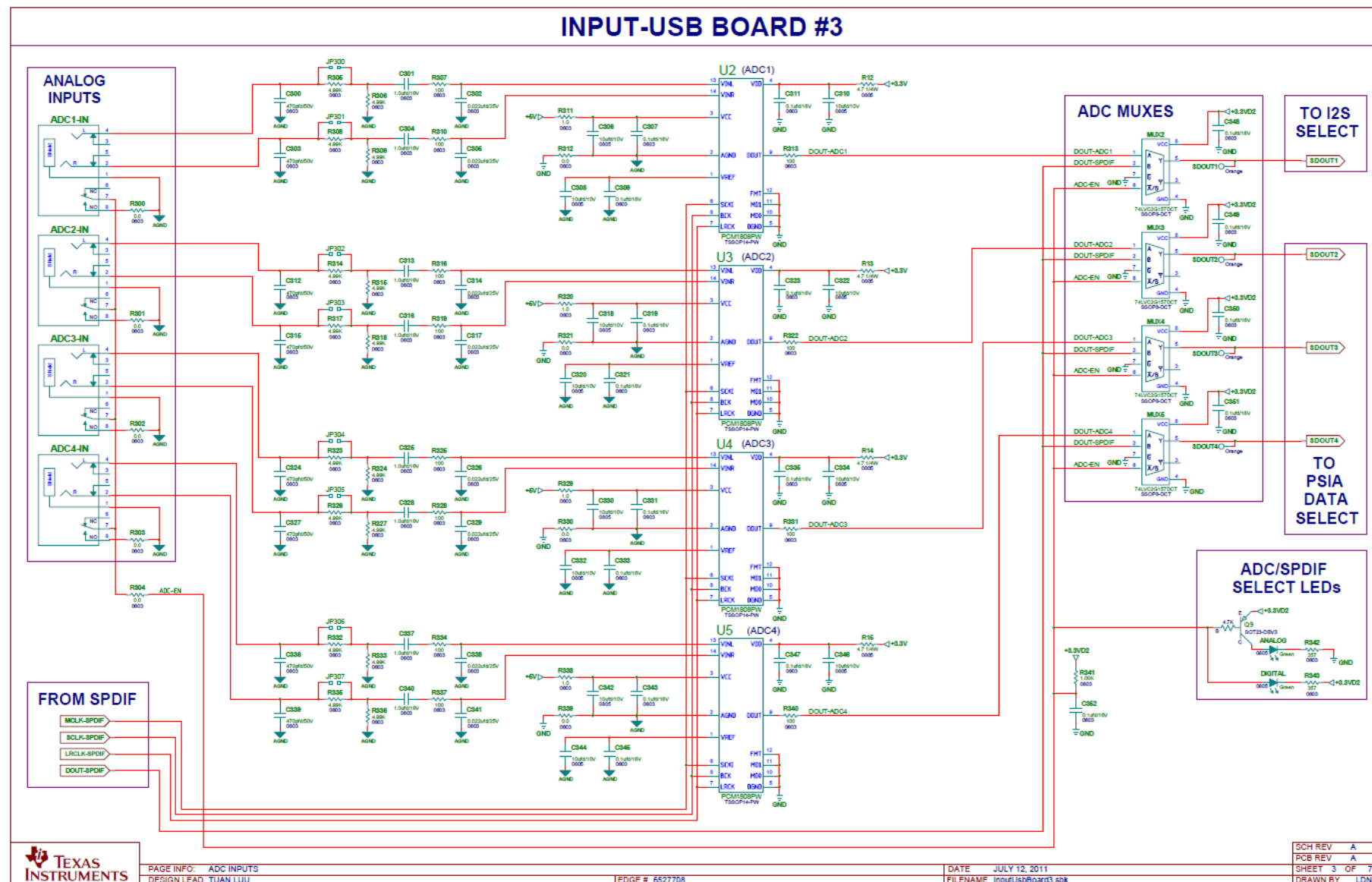


Figure 18. Input - USB Board Schematic, SPDIF Interface

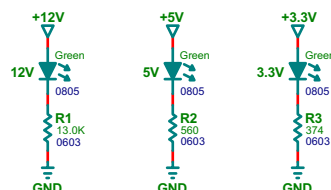
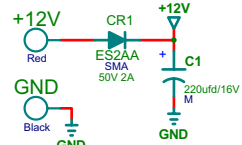


**Figure 19. Input - USB Board Schematic, PSIA Inputs, Data Select, and EVM Connector**

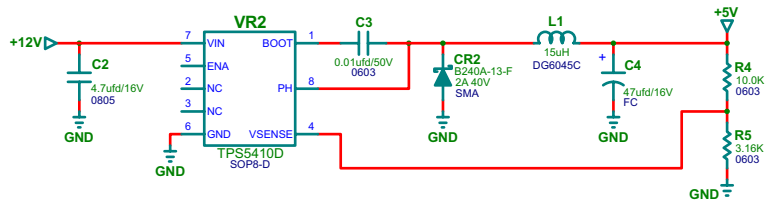


## INPUT-USB BOARD #3

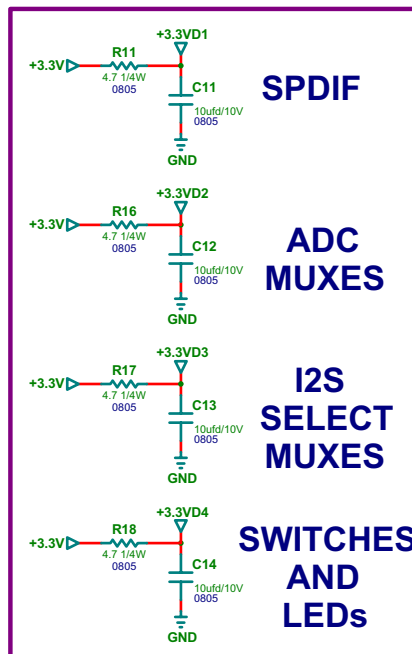
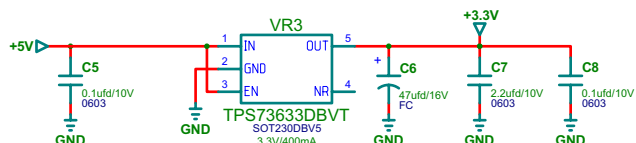
### MAIN POWER IN



### PVDD TO 5V SWITCHER



### 5V TO 3.3V DC-DC CONVERTER



### BOM ONLY

### STANDOFFS

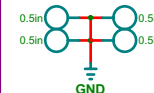


Figure 21. Input - USB Board Schematic, Revision History

## INPUT-USB BOARD #3

### REVISION HISTORY

REVISION	DESCRIPTION	DATE	APPROVAL
A	INITIAL RELEASE	JULY 12, 2011	TL



PAGE INFO: REVISION HISTORY  
DESIGN LEAD TUAN LUU

EDGE # 6527708

DATE JULY 12, 2011  
FILENAME InputUsbBoard3.sbk

SCH REV A  
PCB REV A  
SHEET 6 OF 7  
DRAWN BY LDN

Figure 22. Input - USB Board Revision History



## TEXAS INSTRUMENTS DISCLAIMER

The information and materials ("Materials") provided here are provided by Texas Instruments Incorporated ("TI") as a service to its customers and/or suppliers, and may be used for informational purposes only, and only subject to the following terms. By downloading or viewing these Materials, you are signifying your assent to these terms.

- 1.) These preliminary evaluation schematics are intended for use for PRELIMINARY ENGINEERING DEVELOPMENT AND EVALUATION PURPOSES ONLY and are not considered by Texas Instruments to be fit as a basis for establishing production products or systems. This information may be incomplete in several respects, including but not limited to information relating to required design, marketing, and/or manufacturing-related protective considerations and product safety measures typically found in the end-product incorporating the goods.
- 2.) Accordingly, neither TI nor its suppliers warrant the accuracy or completeness of the information, text, graphics, links or other items contained within the Materials. TI may make changes to the Materials, or to the products described therein, at any time without notice. TI makes no commitment to update the Materials.
- 3.) TI assumes no liability for applications assistance, customer product design, software performance, or services that may be described or referenced in the Materials. The user assumes all responsibility and liability for proper and safe design and handling of goods. Accordingly, the user indemnifies TI from all claims arising from its use of the Materials.
- 4.) TI currently deals with various customers for products, and therefore our arrangement with the user will not be exclusive. TI makes no representations regarding the commercial availability of non-TI components that may be referenced in the Materials.
- 5.) No license is granted under any patent right or other intellectual property right of TI covering or relating to any combination, machine, or process in which such TI products or services might be or are used. Except as expressly provided herein, TI and its suppliers do not grant any express or implied right to you under any patents, copyrights, trademarks, or trade secret information.
- 6.) Performance tests and ratings, to the extent referenced in the Materials, are measured using specific computer systems and/or components and reflect the approximate performance of TI products as measured by those tests. Any difference in system hardware or software design or configuration may affect actual performance. Buyers should consult other sources of information to evaluate the performance of systems or components they are considering purchasing.
- 7.) Resale of TI's products or services with statements different from or beyond the parameters stated by TI for that product or service in official TI data books or data sheets voids all express and any implied warranties for the associated TI product or service, and is an unfair and deceptive business practice, and TI is not responsible for any such use.
- 8.) The Materials are copyrighted and any unauthorized use may violate copyright, trademark, and other laws. You may only download one copy for your internal use only, unless you are specifically licensed to do otherwise by TI in writing. This is a license, not a transfer of title, and is subject to the following restrictions: You may not:
  - (a) modify the Materials (including any associated warranties, conditions, limitations or notices) or use them for any commercial purpose, or any public display, performance, sale or rental;
  - (b) decompile, reverse engineer, or disassemble software Materials except and only to the extent permitted by applicable law;
  - (c) remove any copyright or other proprietary notices from the Materials;
  - (d) transfer the Materials to another person. You agree to prevent any unauthorized copying of the Materials. TI may terminate this license at any time if you are in breach of the terms of this Agreement. Upon termination, you will immediately destroy the Materials.
- 9.) THE MATERIALS ARE PROVIDED "AS IS" WITHOUT ANY EXPRESS OR IMPLIED WARRANTY OF ANY KIND INCLUDING WARRANTIES OF MERCHANTABILITY, NONINFRINGEMENT OF INTELLECTUAL PROPERTY, OR FITNESS FOR ANY PARTICULAR PURPOSE. IN NO EVENT SHALL TI OR ITS SUPPLIERS BE LIABLE FOR ANY DAMAGES WHATSOEVER (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF PROFITS, BUSINESS INTERRUPTION, LOSS OF INFORMATION) ARISING OUT OF THE USE OF OR INABILITY TO USE THE MATERIALS, EVEN IF TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.



Figure 23. USB Board Schematic Disclaimer

## Revision History

Changes from A Revision (September 2013) to B Revision	Page
• Changed paragraph immediately before the section titled <i>TAS5612L-TAS5614LDDVEVM Features</i> . . . . .	5
• Deleted one bullet from the <i>Unpacking the EVM</i> section. . . . .	8
• Added <i>(not supplied)</i> to the first paragraph in Section 3, <i>GUI Software Installation and Startup</i> . . . . .	10

## Revision History

Changes from B Revision (May 2014) to C Revision	Page
• Changed page 3 of the schematic, <a href="#">Figure 19</a> . . . . .	27

## 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/llds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/llds/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/llds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/llds/ti_ja/general/eStore/notice_01.page)

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

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of 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】 開発キットの中には技術基準適合証明を受けていないものがあります。技術適合証明を受けていないもの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 © 2015, 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)