User's Guide
SLOU280–January 2009

TAS5711EVM Evaluation Module

This manual describes the operation of the TAS5711EVM to evaluate the performance of the TAS5711 integrated digital audio power amplifier. The main contents of this document are:

- Details on how to properly connect a TAS5711 Evaluation Module (EVM) and the details of the EVM
- Details on how to install and use the GUI to program the TAS5711EVM
- Quick-Start Guide for the common modes in which the TAS5711EVM can be used
- Details on how to use the audio processing features like EQ and DRC

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1 Overview

The TAS5711 evaluation module demonstrates the TAS5711 device from Texas Instruments. The TAS5711 combines a high-performance PWM processor with a class-D audio power amplifier. This EVM can be configured with two single-ended speakers with a BTL subwoofers (2.1) or two bridge-tied speakers (BTL) (2.0). For detailed information about the TAS5711 device, review the device data sheet (SLOS600). The pulse width modulator (PWM) is based on TI's Equibit™ technology. The TAS5711 has additional audio processing features such as surround sound (3D).

The EVM software with its graphic user interface (GUI) facilitates evaluation by providing access to the TAS5711 registers through a USB port. See the *Using the EVM Software* section for further details.

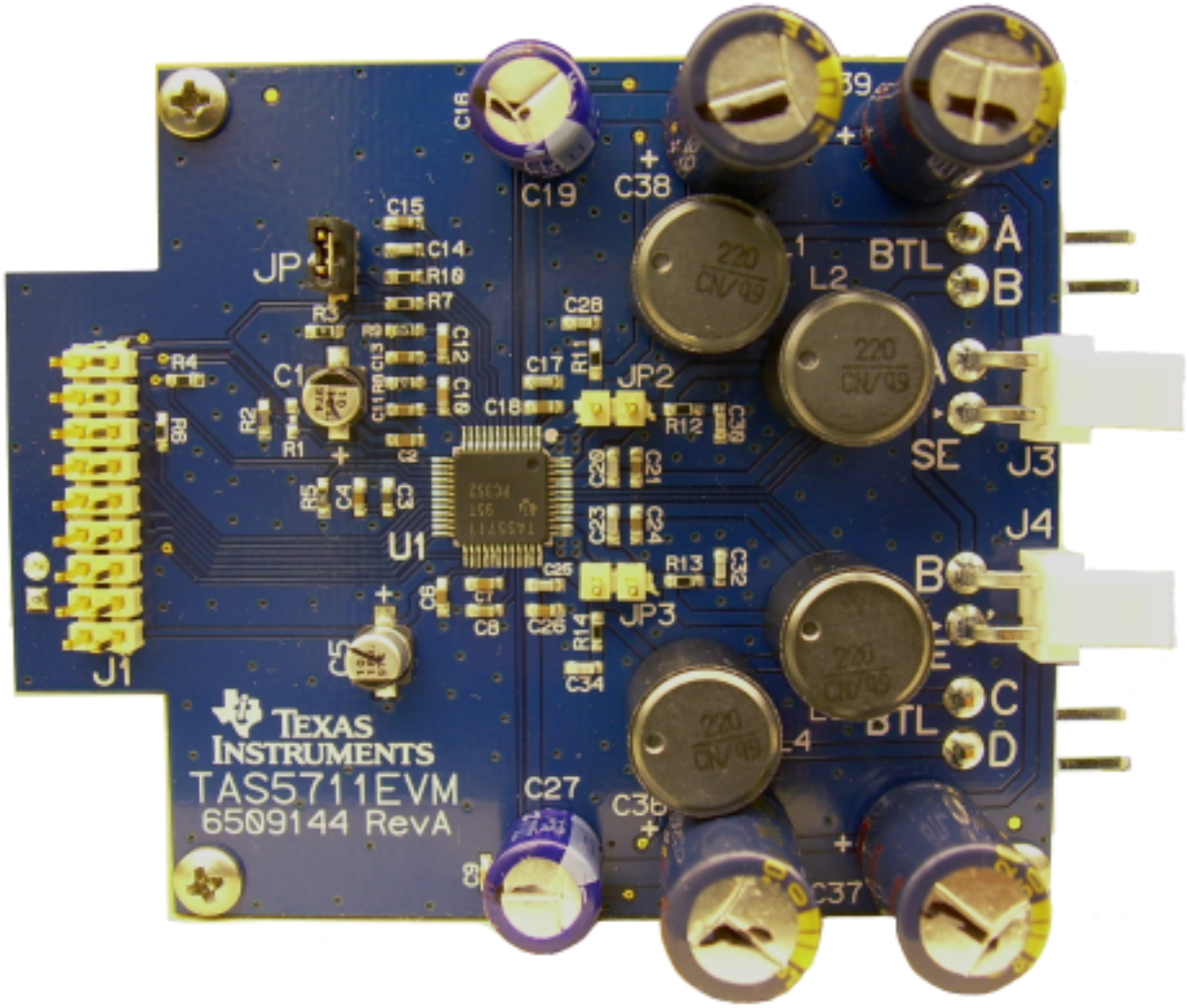

Figure 1. TAS5711EVM Printed-Circuit Board

The EVM, together with other TI components on this board, is a complete 2.1-channel digital audio amplifier system. The MC57XXPSIA Controller board includes a USB interface, a digital input (SPDIF), analog inputs via the ADC, power inputs, and other features like a mute function and power down.

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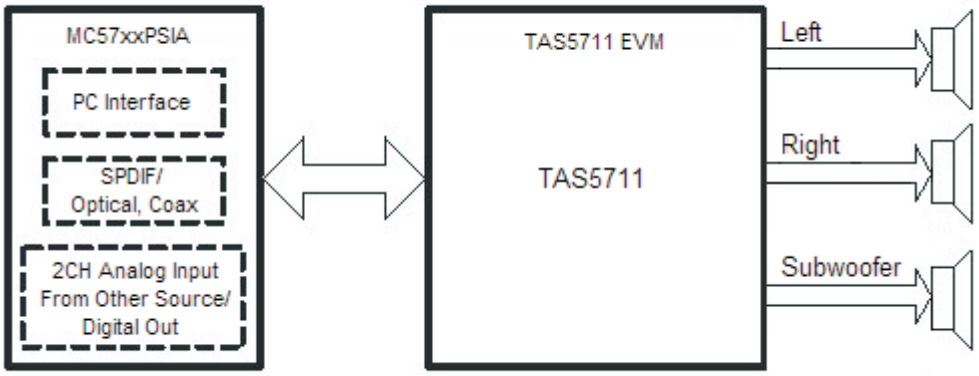

Figure 2. Complete System and EVM Signal Path Overview

1.1 TAS5711EVM and MC57xxPSIA Features

- Channel evaluation module design
- Self-contained protection systems and control pins
- USB interface
- Standard I^2S data input using optical or coaxial inputs
- Analog input through analog-to-digital converter
- Double-sided, plated-through PCB, 1-oz copper, 2 mm
- Access to control signal gain and data format through EVM-software GUI

2 Installation

This section describes the EVM and software installation.

2.1 EVM Installation

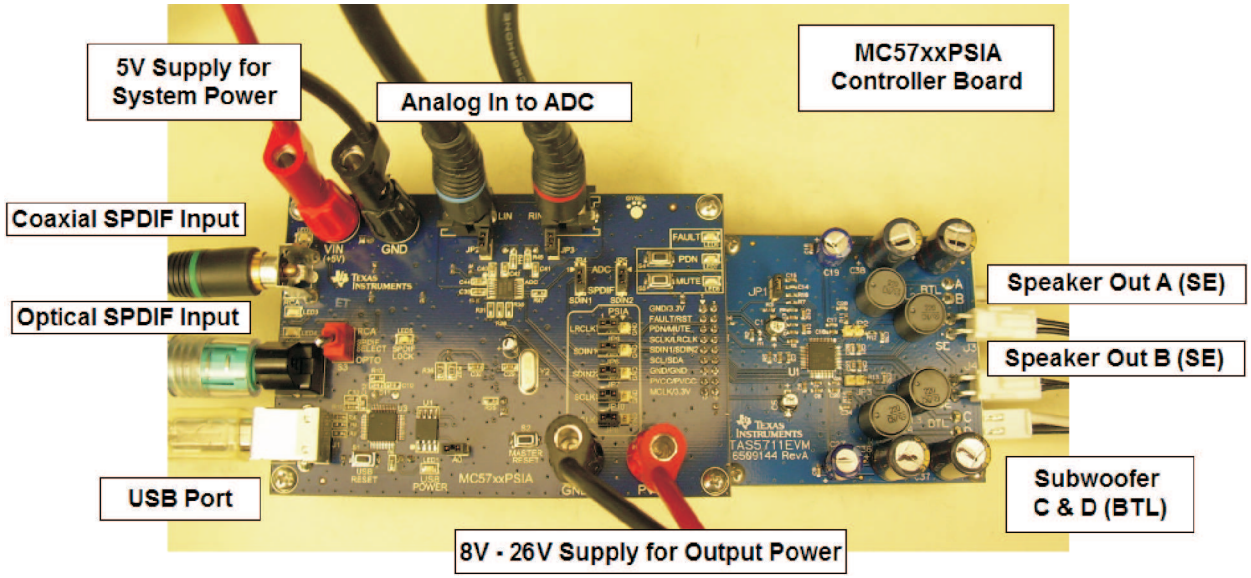

Figure 3. General Connection Picture

The following are the basic tools for the initial EVM power up.

- 5-V, 1-A power supply (VIN)

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- 8–26-V, 4-A power supply (PVDD)
- Banana-style test leads for power supplies and speakers
- Optical or coaxial cable for SPDIF interface based on signal source
- USB cable
- EVM software
- Two 4-Ω, one 8-Ω speakers or loads (for 2.1); two 8-Ω speakers or loads (for BTL)

The following sections describe the TAS5711EVM board in regards to power supply (PSU) and system interfaces.

2.1.1 Connecting the TAS5711EVM to MC57xxPSIA

On the right side of the MC57xxPSIA is a terminal block and another is located on the left of the TAS5711EVM (labeled J1). Carefully place the MC57xxPSIA block above the TAS5711EVM block and gently push down.

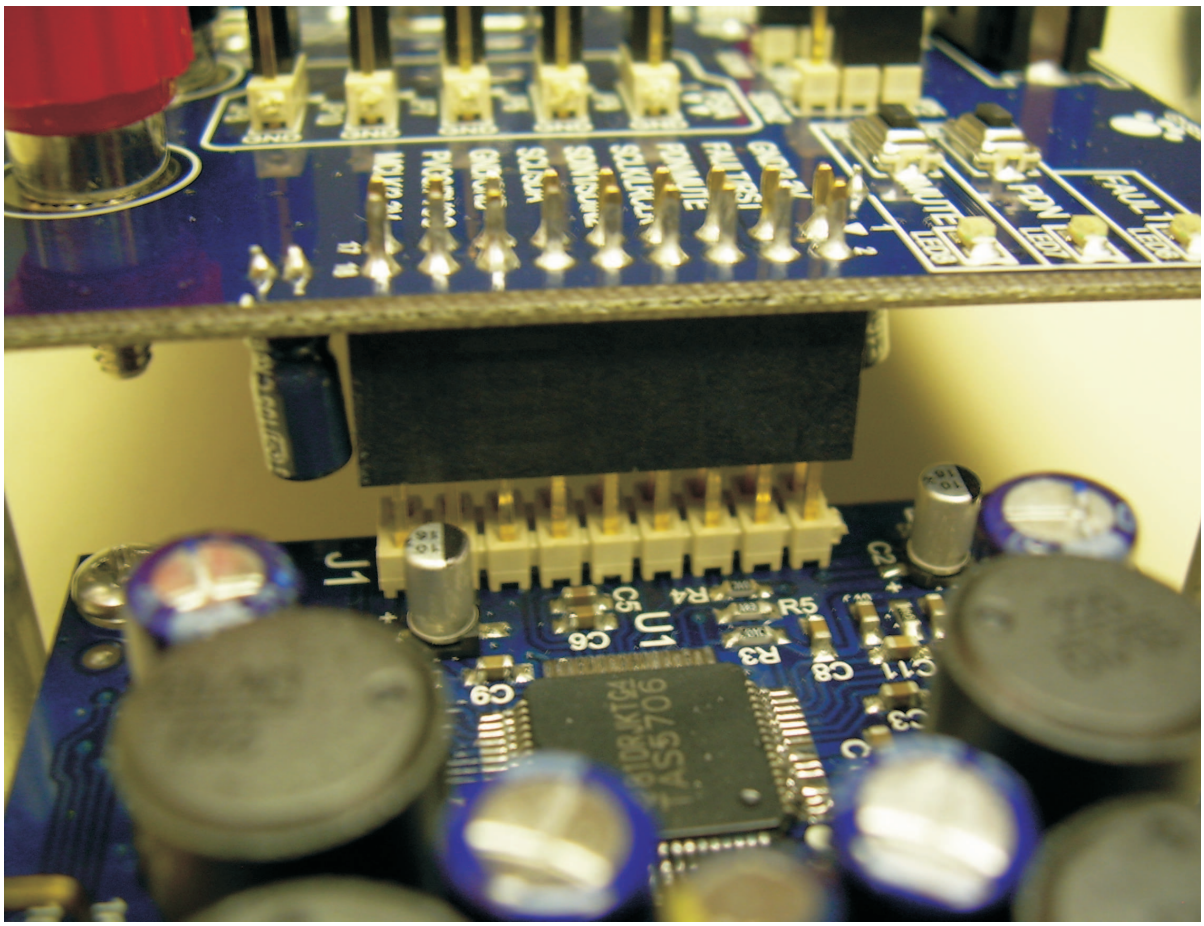

Figure 4. Connecting TAS5711EVM to MC57xxPSIA

2.1.2 PSU Interface

The TAS5711EVM is powered by two power supplies connected to the MC57xx controller board: a 5-V power supply (VIN), and a 8-V to 26-V (PVDD) power supply. The 3.3-V level is generated on the board by a voltage regulator from the 5-V supply.

NOTE: The power-supply cable length must be minimized. Increasing the length of the PSU cable increases the distortion of the amplifier at high output levels and low frequencies

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The maximum output-stage supply voltage depends on the speaker load resistance. Check the recommended maximum supply voltage in the TAS5711 data sheet.

Table 1. Recommended Power Supplies

Description	Voltage Limitations	Current Recommendations
System power supply	5 V	1 A
Output power stage supply	8–26 V	4 A(1)

(1) The rated current corresponds to three channels, full scale.

2.1.3 Loudspeaker Connectors

CAUTION

All BTL speaker outputs are biased at Vcc/2 and must not be connected to ground (e.g., through an oscilloscope ground).

Loudspeaker connections vary by device setup. When connecting a speaker in single-ended mode, connect the positive terminal to one output on the TAS5711EVM (A, B, C, or D), and connect the negative terminal to ground. When connecting a speaker in BTL mode, connect the speaker's two terminals across two outputs on the TAS5711EVM (A and B or C and D).

Speakers or loads can be connected to the outputs A-D with clip leads, or cables can be made with female connectors (JST VHR-2N) that can mate to male connectors on the EVM board.

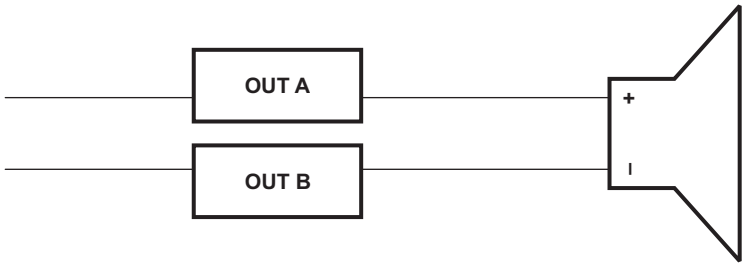

Figure 5. BTL Connection

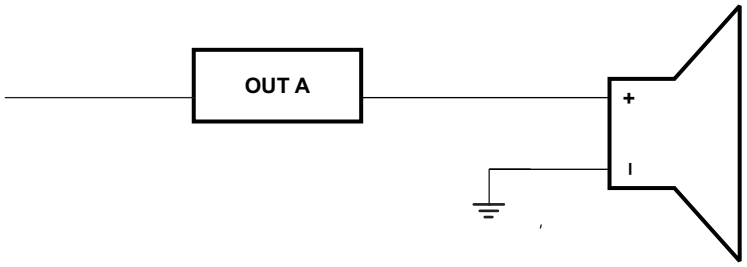

Figure 6. SE Connection

2.1.4 USB Interface

The TAS5711 registers are accessed through I^2C™ bus lines SDA and SCL. The USB circuit and USB connector on the MC57xxPSIA board facilitates the connection between a host computer and the device. The EVM USB circuit is powered by the 5-V USB line of the host PC and is independent of the power supplies available on the board. The USB device that is used is a TAS1020B from Texas Instruments.

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2.1.5 Digital Audio Interface SPDIF

The Digital Audio Interface SPDIF (RCA/OPTO) accepts digital audio data using the I^2S protocol. See the TAS5711 data sheet for more information.

The RCA connector and the OPTO connector are the two SPDIF interfaces on the MC57xxPSIA board. The switch S3 toggles between the OPTO and RCA connector to accommodate the signal source. When the RCA cable or optical cable is connected and the signal source is powered up, verify that the SPDIF lock indicator (blue LED5) illuminates, confirming that a viable signal is available to the device. Install a jumper on JP4 across the middle pin and the pin marked SPDIF to connect the digital source to SDIN1. Install a jumper on JP5 to connect the digital source to SDIN2.

For detailed information on how the data and clocks are provided to the TAS5711, see the schematic appearing at the end of this document and the DIR9001 device data sheet (SLES198).

2.1.6 ADC Interface

In the absence of a digital signal source, the PCM1808 ADC can be used to convert an analog audio signal to a digital signal to the TAS5711. The DIR9001 still provides clock signals to the ADC in this process. A 12-MHz crystal is installed on the MC57xxPSIA board. The ADC is an additional feature of this board to provide flexibility in sourcing an audio signal to the TAS5711. Review the PCM1808 data sheet (SLES177) for a detailed description of the ADC on this EVM. Install the jumper on JP4 and J5 across the middle pin and the pin marked ADC to select ADC as the source for SDIN1 and SDIN2.

2.1.7 Board Power-Up General Guidelines

Connect the MC-57xx and the TAS5711EVM boards by locating pin 1 on each board, indicated by a small white triangle. The MC-57xx plugs down onto the TAS5711EVM board (i.e., the TAS5711EVM board fits underneath the MC57xxPSIA board). Pin 1 on each board must be connected to each other.

Install the EVM software on the PC before powering up the board. After connecting the loudspeakers or other loads, power supplies, and the data line, power up the 5-V power supply first; then power up the PVDD power supply. It is recommended initially to set the PVDD level to 10 V, then ramp it up to 20 V to verify cable connections.

2.2 Software Installation

Download the TAS570x GDE from the TI Web site, located on the TAS5711EVM product page. The TI Web site always has the latest release and any updates to versions of the GUI.

Execute the GUI install program, Setup.exe. Once the program is installed, the program group and shortcut icon is created in Start → Program → Texas Instruments Inc → TAS570X GDE. THE GUI comes up as shown in Figure 7.

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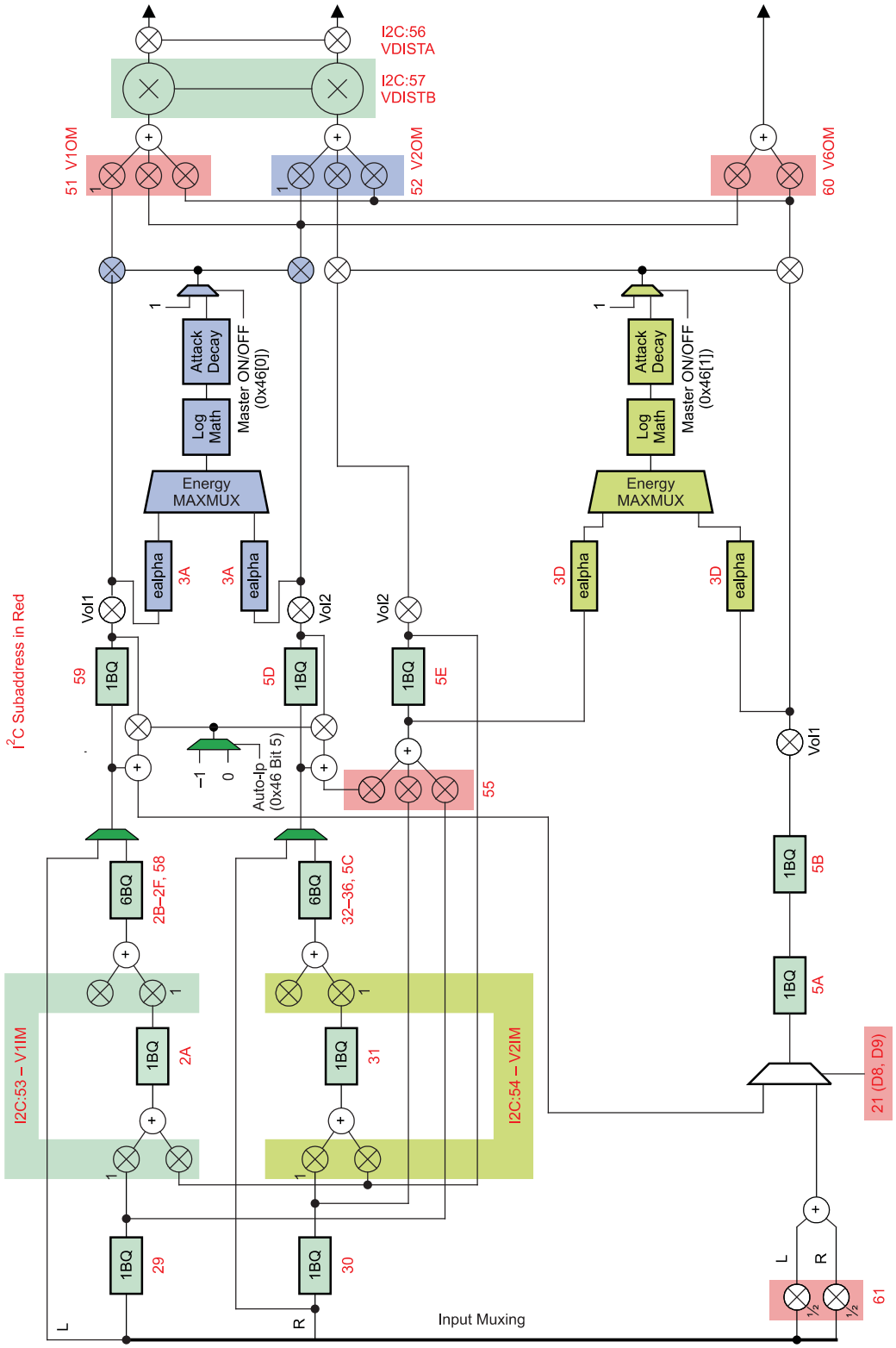

Figure 7. Process Flow for TAS5711 UG

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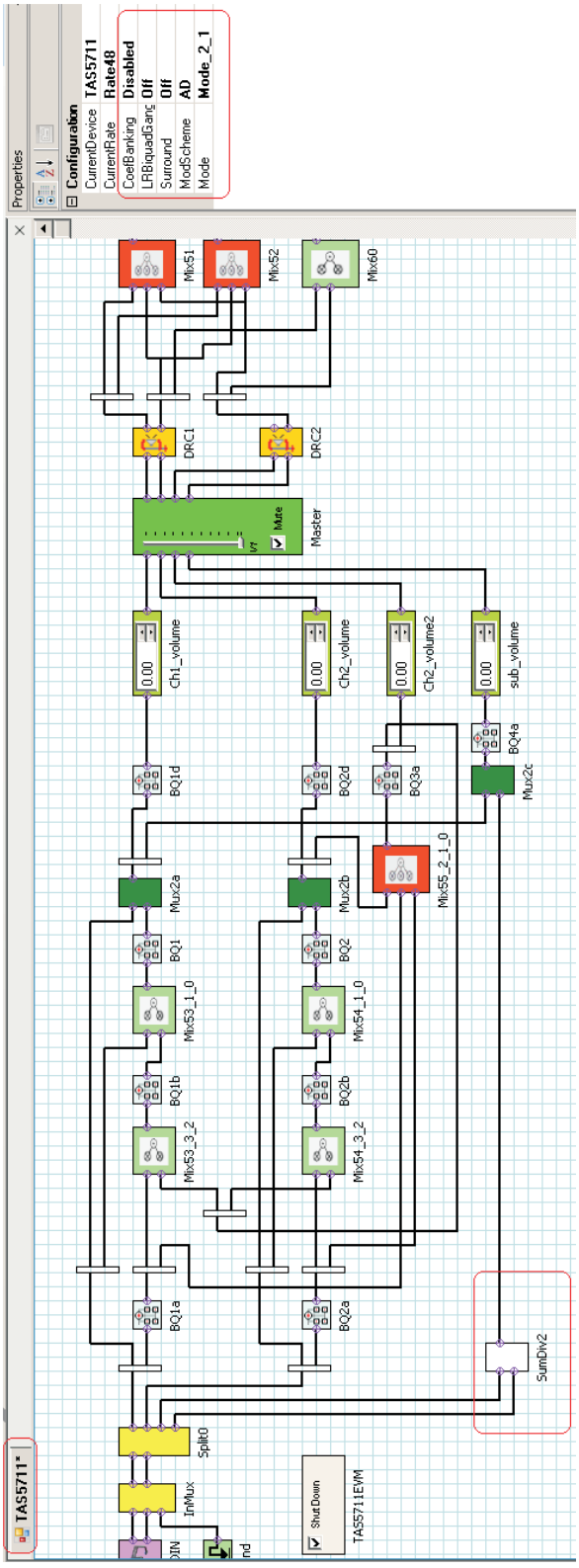

Figure 8. GUI Main Window

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3 Software Quick-Start Guide

To initialize the TAS5711EVM in its default state of 2.1, AD mode operation, perform the following steps.

1. Open the TAS570X GDE by clicking Start → All Programs → Texas Instruments Inc → TAS570x GDE → TAS570X GDE.
2. Select the TAS5711 tab.
3. If the mode is 2.0 or PBTL, select accordingly on the mode menu in the properties window.
4. If the modulation scheme is not AD, select that also. In 2.1 mode, the SE channels are always AD.
5. Jumper JP1 must be left open when used in SE or BTL mode. Jumper JP1 must be IN for PBTL mode.

See Section 4 for information on how to manipulate the more advanced features of the TAS570x GDE, such as the I2C Memory Tool, the Biquad GUI, and the DRC GUI.

4 Using the EVM Software

4.1 Initial Steps

Select the appropriate tab; in this case, select the TAS5711_10 tab. It has two subwindows. One shows the Process Flow window. From the Process Flow window, each of the signal processing function tools can be selected by clicking on it. The Biquad GUI (labeled as BQ1, BQ2, etc.) and the DRC GUI (labeled as DRC1, DRC2, etc.) can be opened by using the right mouse button. This window also shows Input select, Mode select, Channel, and Master Volume. All functions are arranged visually in the order that they are in the device.

The other subwindow, Properties, has the properties that a user can view or update by selecting from the available options. The properties available change with the device selected. From the main window, the user must set three properties before connecting to the EVM.

Set the Current Device field to TAS5711, adjust the sampling rate (in the Current Rate Field) and enable or disable the autobank switch function (in the Coef Banking Field). The TAS5711 automatically detects sample rates; however, setting the sample rate in the GUI allows optimal synchronization with the device.

4.2 Connect the GUI to the EVM

Once the properties window selections have been made, go to the menu Target → Connect.

This sends the initialization commands to the device. Master volume is in mute by default. Select the master volume function. Type the required volume in the properties window. At this time, audio, if connected properly, plays through the device. If no audio is heard, ensure that the All channel shutdown is unchecked. When the Connect command is issued, if an error appears indicating a USB problem, check the connections, and press the USB RESET button on the controller board. Then disconnect and re-connect the EVM from the Target menu.

4.3 I2C Memory Tool

This tool can be opened from GDE (Tools → I2C Memory Tool) or independent of GDE from Start → Program → Texas Instruments Inc → Memory Tool.

Select I2C as show in Figure 9.

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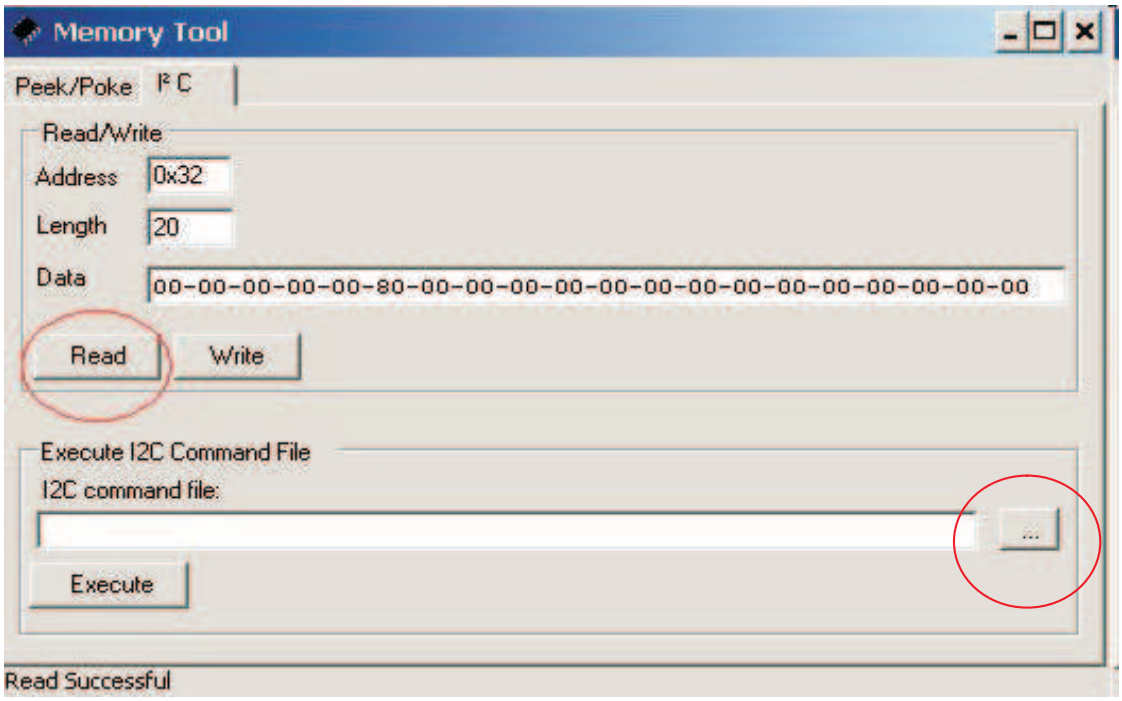

Figure 9. Memory Tool Window

I2C registers can be written or read using this tool. The I2C command file can be sent by selecting the command file and *Execute* command.

4.4 Volume Function

The Individual channel volume and Master volume can be selected, and the required volume value can be typed into the property Window after selecting the function with the mouse (see Figure 10).

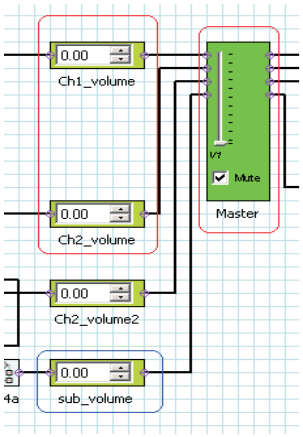

Figure 10. Volume Control

4.5 Biquad GUI

Using the right button of mouse, select Biquad GUI (Figure 11).

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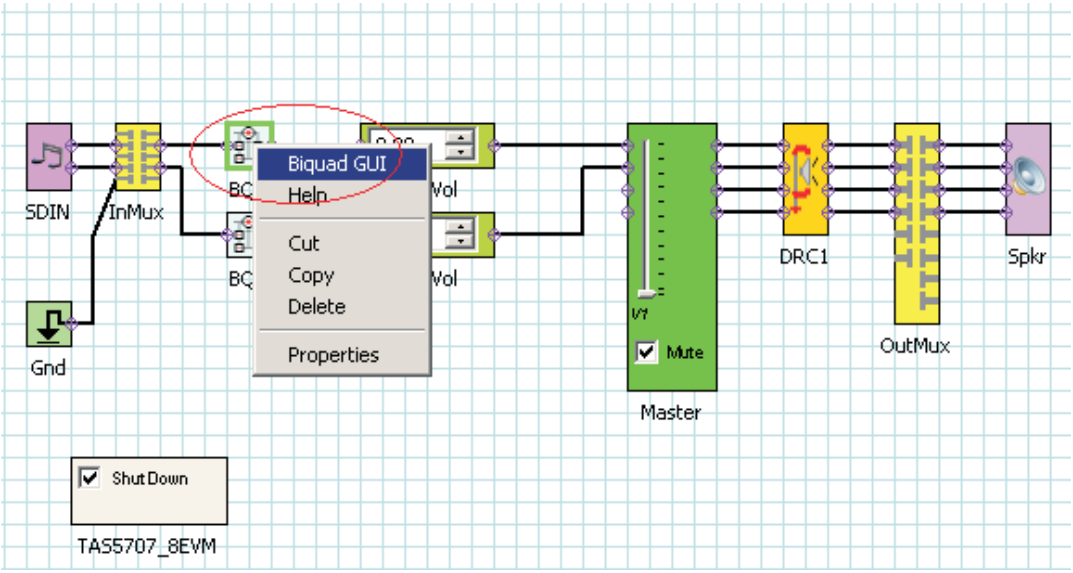

Figure 11. Selecting Biquad GUI

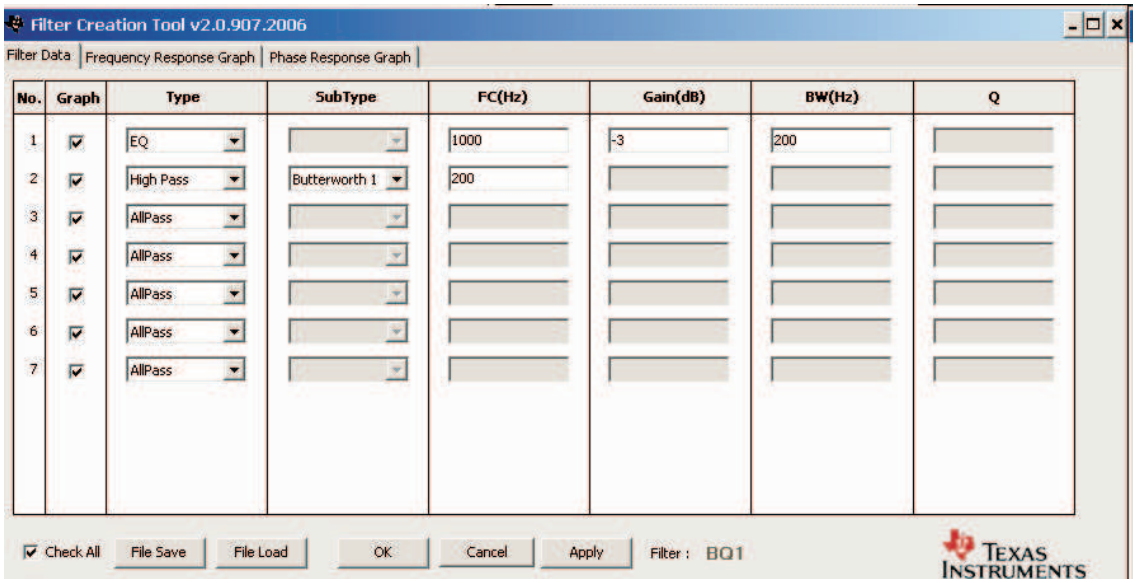

Figure 12. Filter Creation Tool Window

A check mark selects the Biquad. If not selected, the Biquad is in ALL PASS Mode.

The frequency response for the current settings can be viewed and adjusted in **Frequency Response Window** Tab (Figure 12). The Individual Biquad Gains must be within ±12 db.

Clicking **Apply** from the filter data window sends all the three banks of coefficients (providing auto bank is enabled).

4.6 DRC GUI

The DRC GUI has two DRC blocks. One is for L, R channels, and the other one is for a subchannel. To set DRC, open the window and change the thresholds to match the required power output. The other parameters can be changed if necessary as explained in the following section.

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Clicking on the function selects DRC GUI (Figure 13). Click on the DRC function, and check to see if DRC is enabled in the property window.

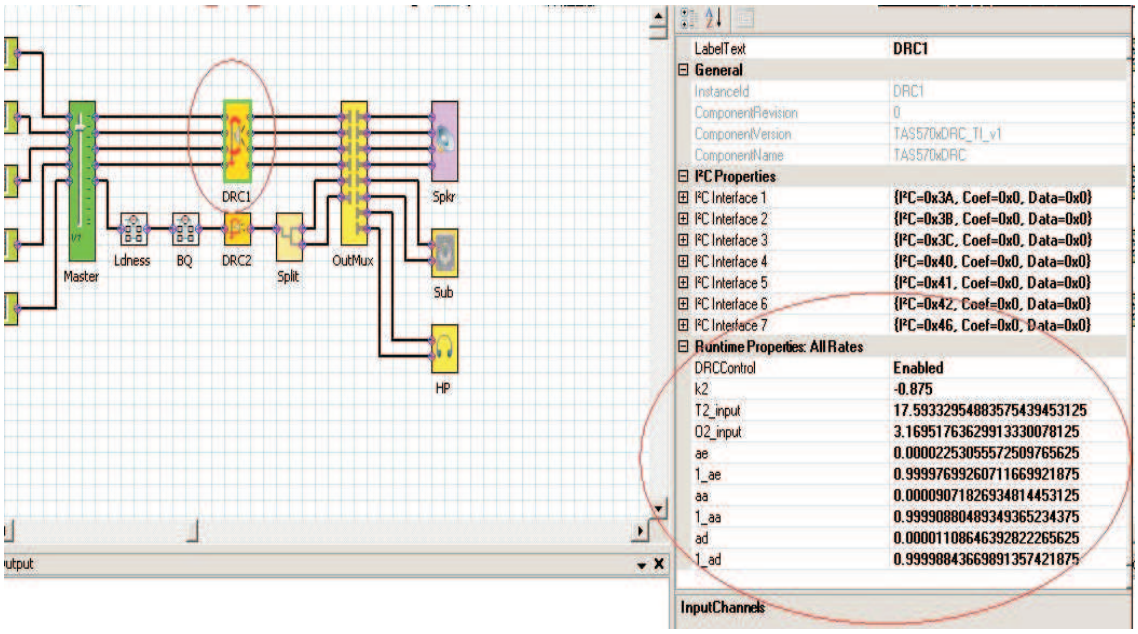

Figure 13. DRC Parameters

Next, using the right mouse button, select **Activate DRC GUI** (Figure 14).

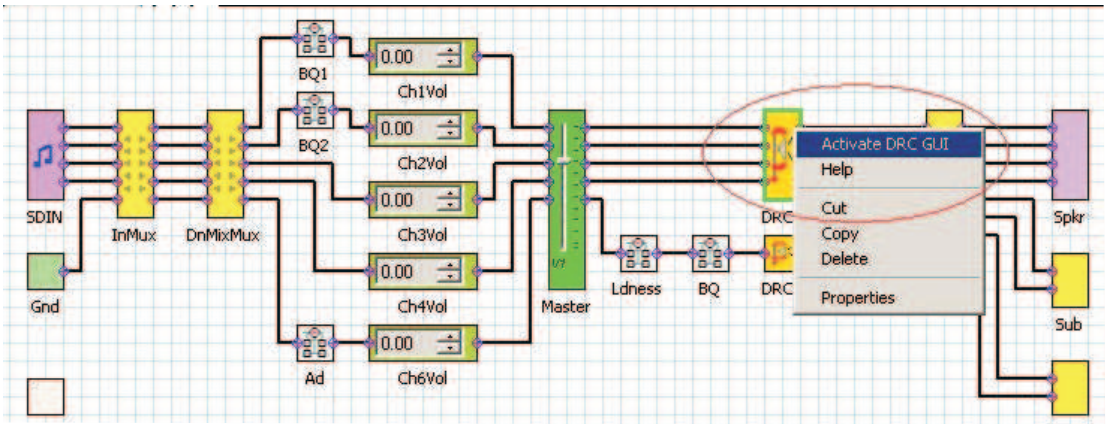

Figure 14. Activating the DRC GUI

Set the **compression ratio** to a value between 1 and 50.

The **offset** has a range at ±6 dB. If no offset is required, set the offset to 0. Offset is generally not required in a DRC application because is just provides a gain.

Threshold is selected with a value of 0 to –72 dB.

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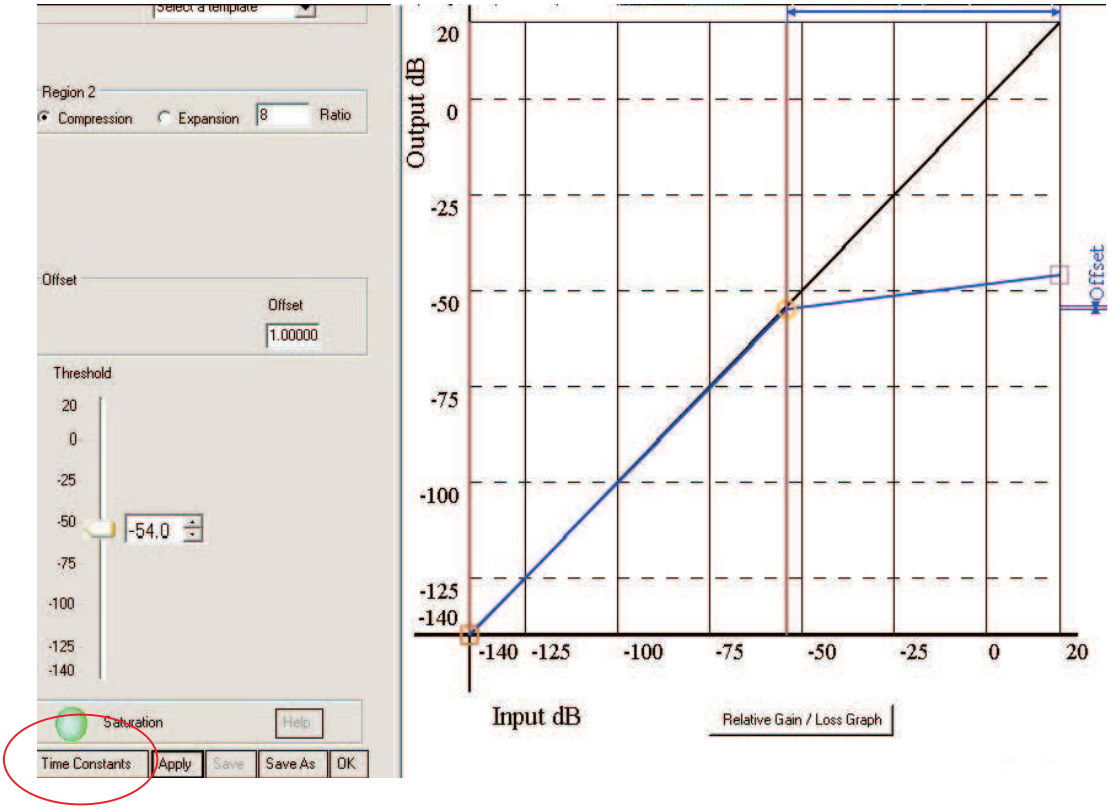

Figure 15. Time Constants Button

Time constants: Select the time constants to adjust the energy, attack, and decay filters (Figure 15).

4.6.1 MODULATION SCHEMES

Common Configurations:

1. 2.1 SE AD + BTL AD
2. 2.1 SE AD + BTL BD

Note:

AD : AD Modulation-Outputs are 180° out of phase
BD : BD Modulation
BTL : Bridge-Tied Load

4.6.1.1 2 .1 AD (Default)

1. Set up the hardware, and select the TAS5711 tab.
2. GDE: **Target > Connect**.
3. Check the 2.1 box in GUI.
4. Finally, uncheck the **shutdown** box to bring the device out of Shutdown mode, and adjust the **Master Volume** as desired.

4.6.1.2 2.1 SE AD + BTL BD

1. Set up the hardware, and select the TAS5711 tab .
2. Select the Input MUX from GDE. In the properties window, select BD Mode

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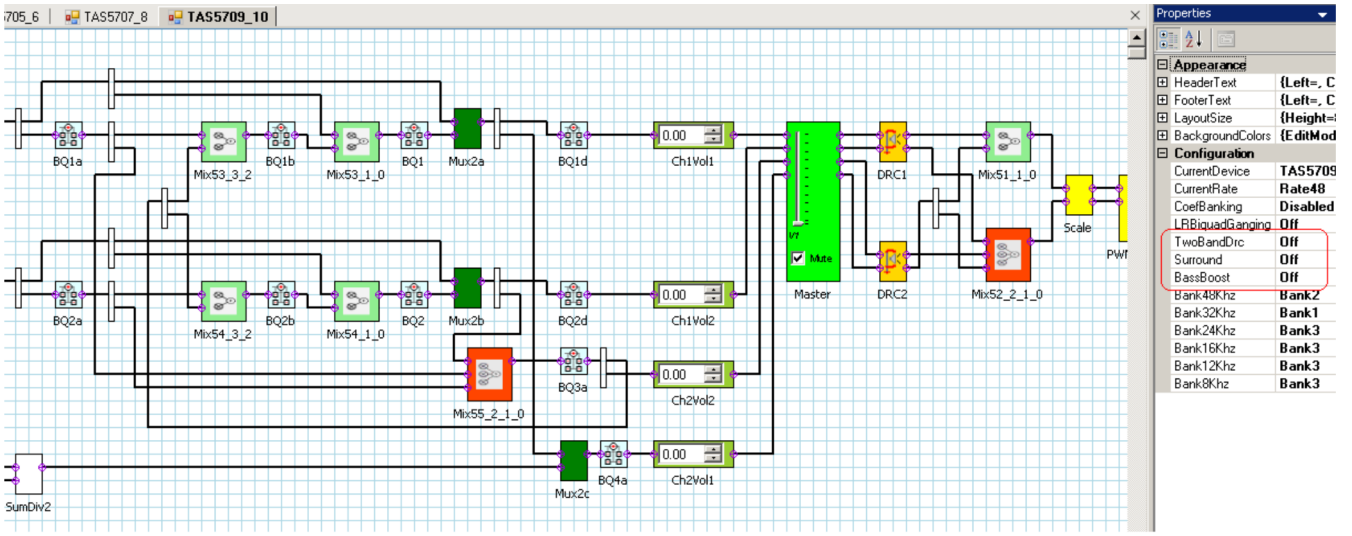
3. GDE: **Target > Connect**.
4. Finally, uncheck the **shutdown** box to bring the device out of Shutdown mode, and adjust the **Master Volume** as desired.

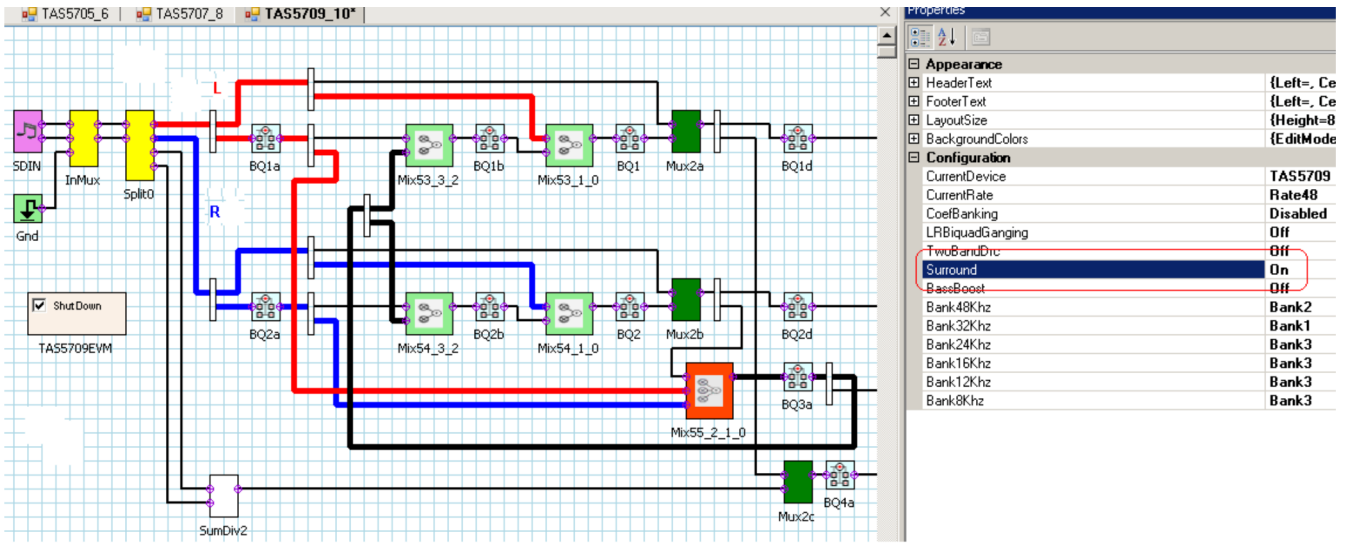
5 Advanced Audio Processing Features in TAS5711

TAS5711 Process Structure as shown in GDE:



C001

1. **Surround (3D): ON/OFF**
   Turn it ON. Then L-R terms gets mixed with raw L and R after band-pass filtering. L-signal is RED, R-signal is BLUE and L-R-signal is BLACK.



C002

Biquads and mixers can be adjusted to fine-tune 3D.

6 Jumpers and Control Utilities on MC57xxPSIA board

6.1 RCA/OPTICAL Jumpers

Select the jumper to reflect the source whether it is RCA or OPTICAL.

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6.2 Switches

Reset is an active-low function. Pressing the master reset switch (S2) resets the TAS5711 device; USB RESET (S1) resets the USB bus. Pressing PDNZ (S4) powers down the TAS5711, and pressing MUTE (S5) mutes (volume mute) the TAS5711.

6.3 LED Indicators

LED1 : USB Power connector installed at J1.

LED2 : 3.3V Power is valid.

LED3: RCA connection made

LED4: Optical connection made

LED5: SPDIF signal locked

LED6: FAULT. Ignore the FAULT LED until the FAULT pin is programmed to be an output via an I2C write to reg0X05.

LED7: PDN switch (S4) is depressed.

LED8: MUTE switch (S5) is depressed.

7 Board Layouts, Bill of Materials, and Schematic

7.1 TAS5711EVM Board Layouts

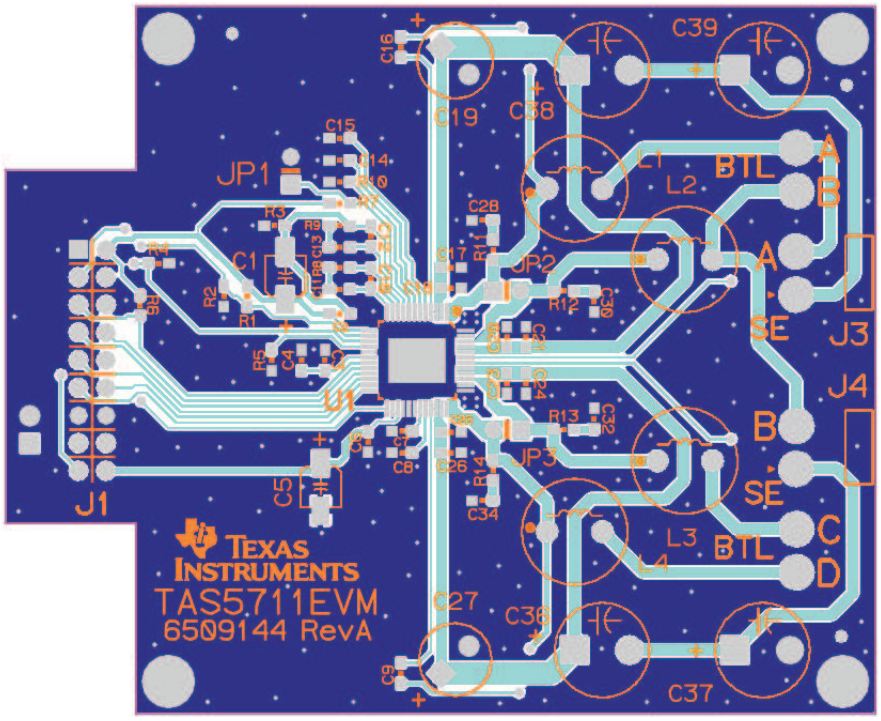

Figure 16. TAS5711EVM Top Composite Assembly

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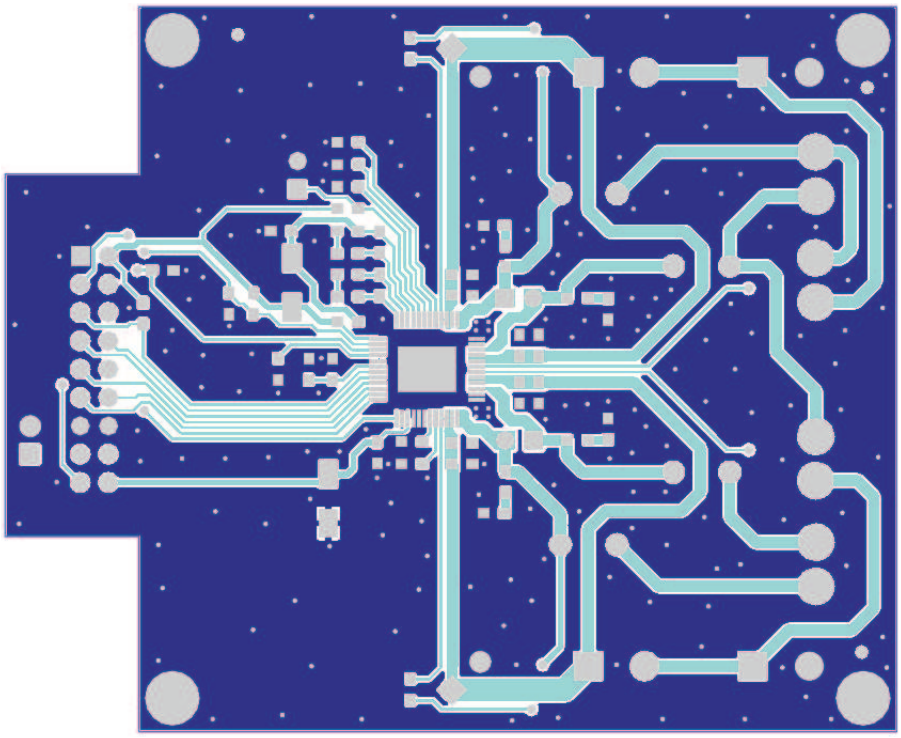

Figure 17. TAS5711EVM Top Copper Assembly

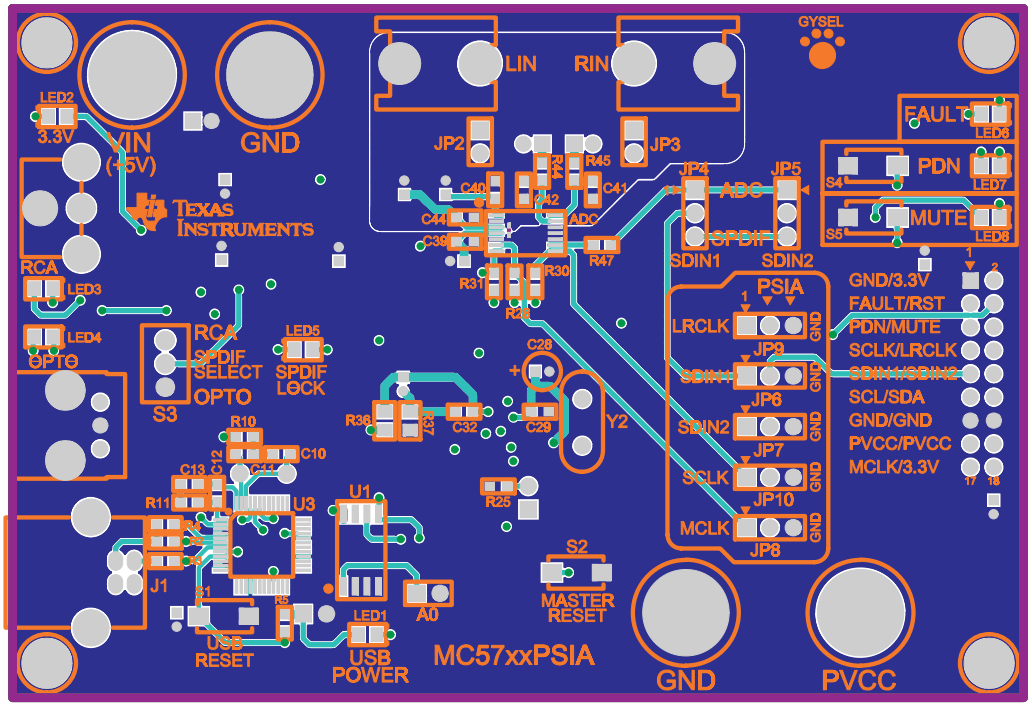

Figure 18. MC57xxPSIA Top Assembly

7.2 Bill of Materials

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Table 2. Bill of Materials for TAS5711EVM

MANU Part No.	QTY	REF DES	Vendor Part No.	Description	Vendor	MANU
TI-SEMICONDUCTORS						
TAS5711PHP	1	U1	TAS5711PHP	15W DIGAMP WITH DAP HTQFP48-PHP ROHS	Texas Instruments	Texas Instruments
CAPACITORS						
ECJ-1VC1H331J	4	C28,C30,C32,C34	PCC331ACVCT	CAP SMD0603 CERM 330PFD 50V 5% COG ROHS	DIGI-KEY	PANASONIC
C1608C0G1H102J	4	C17,C20,C23,C25	445-1293-1	CAP SMD0603 CERM 1000PFD 50V 5% COG ROHS	DIGI-KEY	TDK CORP.
GRM188R71H222KA01D	1	C14	490-1500-1	CAP SMD0603 CERM 2200PFD 50V 10% X7R ROHS	DIGI-KEY	MURATA
ECJ-1VB1H472K	2	C10,C12	PCC1780CT	CAP SMD0603 CERM 4700PFD 50V 10% X7R ROHS	DIGI-KEY	PANASONIC
ECJ-1VB1H333K	4	C9,C16,C22,C45	PCC2284CT	CAP SMD0603 CERM 0.033UFD 50V 10% X7R ROHS	DIGI-KEY	PANASONIC
ECJ-1VB1E473K	2	C11,C13	PCC1771CT	CAP SMD0603 CERM 0.047UFD 25V 10% X7R ROHS	DIGI-KEY	PANASONIC
ECJ-1VB1C104K	4	C2,C4,C6,C7	PCC1762CT	CAP SMD0603 CERM 0.1UFD 16V 10% X7R ROHS	DIGI-KEY	PANASONIC
ECJ-1VB1H104K	4	C18,C21,C24,C26	PCC2398CT	CAP SMD0603 CERM 0.1UFD 50V 10% X7R ROHS	DIGI-KEY	PANASONIC
C1206C684K5RACTU	4	C29, C31, C33, C35	399-3500-1	CAP SMD1206 CERM 0.68UFD 50V 10% X7R ROHS	DIGI-KEY	KEMET
TMK107BJ105KA	2	C8,C15	587-1248-1	CAP SMD0603 CERM 1.0UFD 25V 10% X5R ROHS	DIGI-KEY	TAIYO YUDEN
C1608X5R0J475M	1	C3	445-1417-1	CAP SMD603 CERM 4.7UFD 6.3V 20% X5R ROHS	DIGI-KEY	TDK
EEE1CA100SR	2	C1,C5	PCE3878CT	CAP SMD ELECT 10ufd 16V 20% VS-B ROHS	DIGI-KEY	PANASONIC
ECA-1VM101	1	C44	P5165	CAP ALUM ELEC M RADIAL 100UFD 35V 20% ROHS	DIGI-KEY	PANASONIC
ECA-1VM221BJ	2	C19,C27	P10419TB	CAP ALUM ELEC M RADIAL 220UFD 35V 20% ROHS	DIGI-KEY	PANASONIC
EEU-FC1H221S	4	C36, C37, C38, C39	P10326	CAP THU ELE FC 220ufd 50V 20% ROHS	DIGI-KEY	PANASONIC
RESISTORS						
ERJ-3GEY0R00V	1	R3	P0.0GCT	RESISTOR SMD0603 0.0 OHM 5% 1/10W ROHS	DIGI-KEY	PANASONIC
ERJ-3GEYJ180V	4	R11,R12,R13,R14	P18GCT	RESISTOR SMD0603 18 OHMS 5% 1/10W ROHS	DIGI-KEY	PANASONIC
ERJ-3GEYJ471V	2	R8,R9	P470GCT	RESISTOR SMD0603 470 OHMS 5% 1/10W ROHS	DIGI-KEY	PANASONIC
ERJ-3EKF1002V	7	R4, R6, R7, R15, R16, R17, R18	P10.0KHCT	RESISTOR SMD0603 10.0K 1% THICK FILM 1/10W ROHS	DIGI-KEY	PANASONIC
RC0603FR-0718K2L	1	R5	311-18.2KHRCT	RESISTOR SMD0603 THICK FILM 18.2K 1% 1/10W ROHS	DIGI-KEY	YAGEO
CRCW060322K1FKEA	1	R10	541-22.1KHCT	RESISTOR SMD0603 22.1K OHMS 1% 1/10W ROHS	DIGI-KEY	VISHAY
ERJ-3GEYJ104V	1	R2	P100KGCT	RESISTOR SMD0603 100K OHM 5% THICK FILM 1/10W ROHS	DIGI-KEY	PANASONIC
INDUCTORS						
A7503AY-220M	4	L1–L4	A7503AY-220M	INDUCTOR, SERIES 11RHBP/A7503AY, 22UH/2.3A ROHS	Toko	Toko
HEADERS, JACKS AND TERMINAL BLOCKS						
PBC02SAAN	3	JP1,JP2,JP3	S1011E-02	HEADER THRU MALE 2 PIN 100LS GOLD ROHS	DIGI-KEY	SULLINS
PBC09DAAN	1	J1	S2011E-09	HEADER THRU MALE 2X9 100LS GOLD ROHS	DIGI-KEY	SULLINS
B2PS-VH(LF)(SN)	1	J2, J3, J4, J5	455-1648	JACK JST-VH RA 2-PIN 3.96mmLS ROHS	DIGI-KEY	JST
SHUNTS						
SPC02SYAN	3	JP1, JP2, JP3	S9001	SHUNT, BLACK AU FLASH 0.100LS	DIGI-KEY	SULLINS
STANDOFFS AND HARDWARE						
2027	4	NA	2027K	STANDOFF ,4-40 0.5IN 3/16IN DIA ALUM RND F-F	DIGI-KEY	KEYSTONE ELECTRONICS
PMS 440 0025 PH	4	NA	H342	4-40 SCREW, STEEL 0.250 IN	DIGI-KEY	BUILDING FASTENERS
Component Count:	62					
COMPONENTS NOT ASSEMBLED						
R1						

7.3 Schematic

The schematic for TAS5711EVM appears on the following page.

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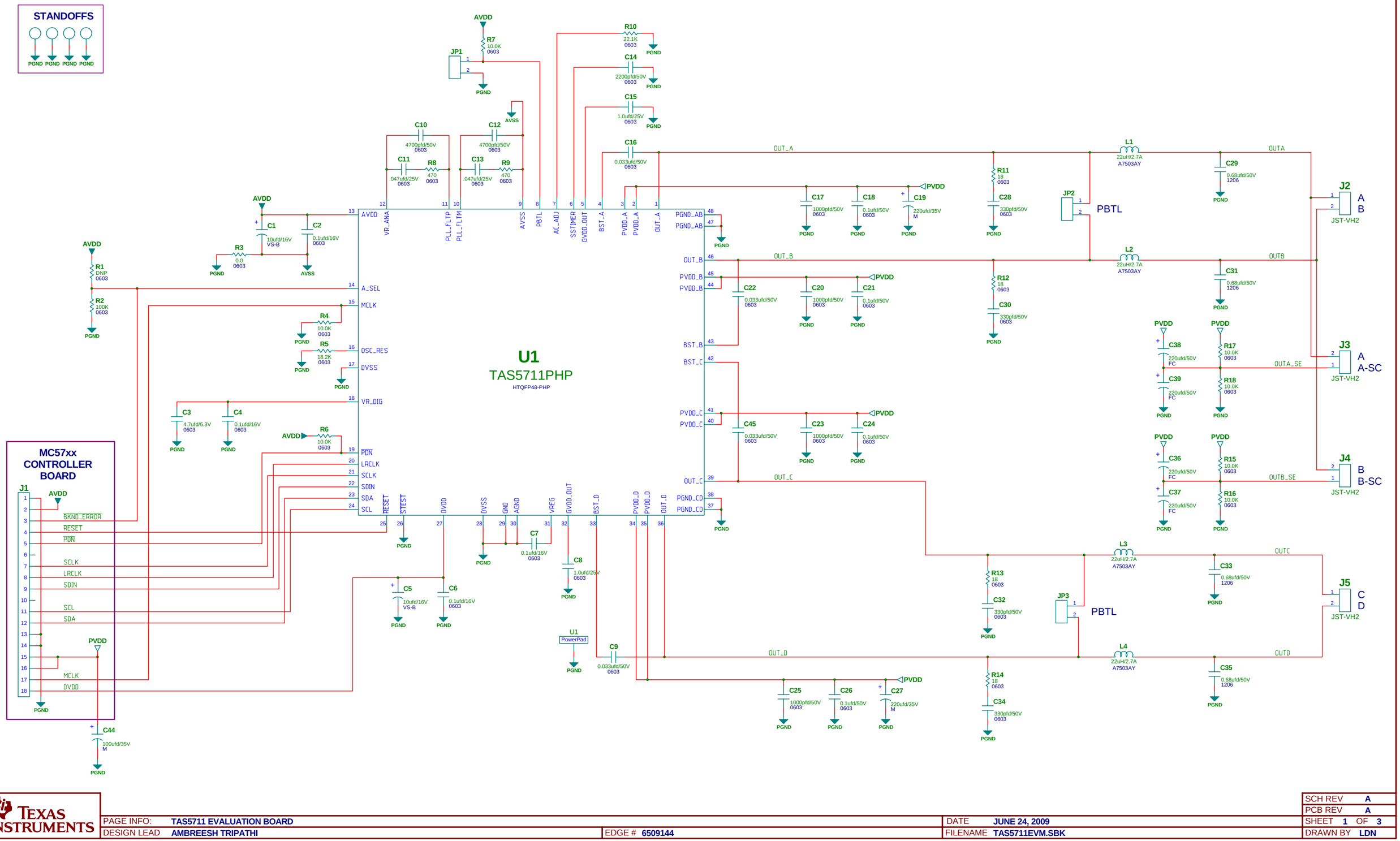
TAS5711PHP EVALUATION BOARD



PAGE INFO: TAS5711 EVALUATION BOARD		DATE JUNE 24, 2009	SCH REV A
DESIGN LEAD AMBREESH TRIPATHI	EDGE # 6509144	FILENAME TAS5711EVM.SBK	PCB REV A
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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of -0.5 V to 4.1 V and the output voltage range of 1 Vrms.

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

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than 85°C. The EVM is designed to operate properly with certain components above 85°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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