TAS5731EVM Evaluation Module

This manual describes the operation of the TAS5731EVM to evaluate the performance of the TAS5731 integrated digital audio power amplifier. The main contents of this document are:

- Details on how to properly connect a TAS5731 Evaluation Module (EVM) and the details of the EVM.
- Details on how to install and use the GUI to program the TAS5731EVM.
- Quick-start guide for the common modes in which the TAS5731EVM can be used.
- Details on how to use the audio processing features like EQ and DRC.

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1 Overview

The TAS5731 evaluation module demonstrates the TAS5731 device from Texas Instruments. The TAS5731 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 TAS5731 device, review the device data sheet on TI's webpage. The TAS5731 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 TAS5731 registers through a USB port.

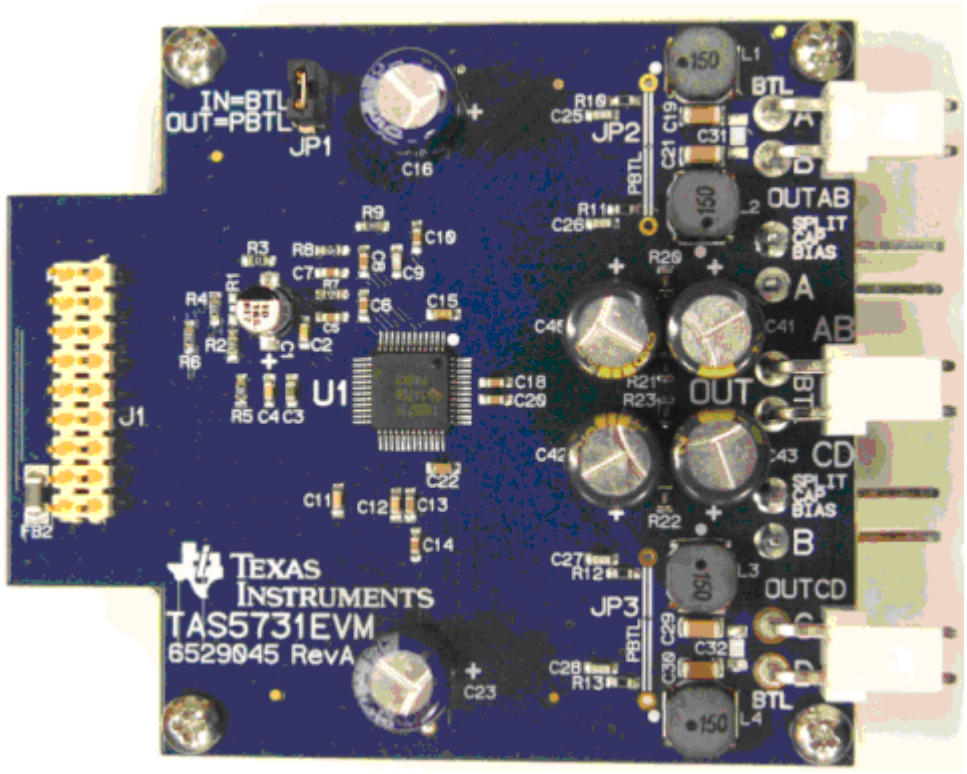


Figure 1. TAS5731EVM Printed-Circuit Board

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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

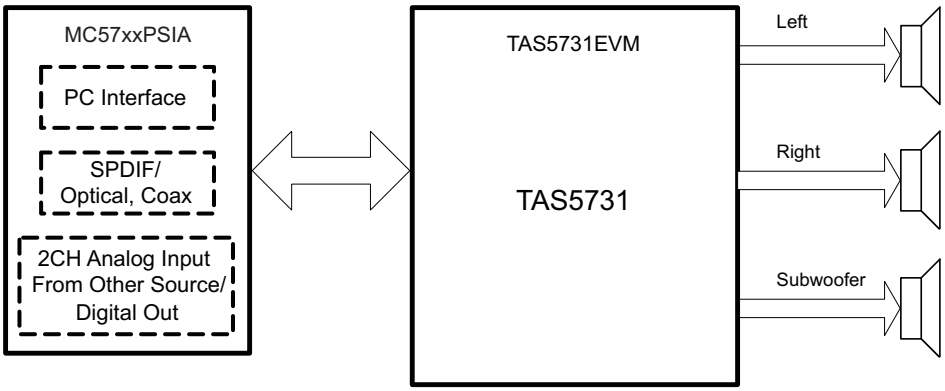


Figure 2. Complete System and EVM Signal Path Overview

1.1 TAS5731EVM 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
- Subwoofer connection—the PWM terminal provides the PWM signal and power to an external subwoofer board
- Double-sided, plated-through PCB, 1oz copper, 2mm
- Access to control signal gain and data format through EVM-software GUI

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2 Installation

This section describes the EVM and software installation.

2.1 EVM Installation

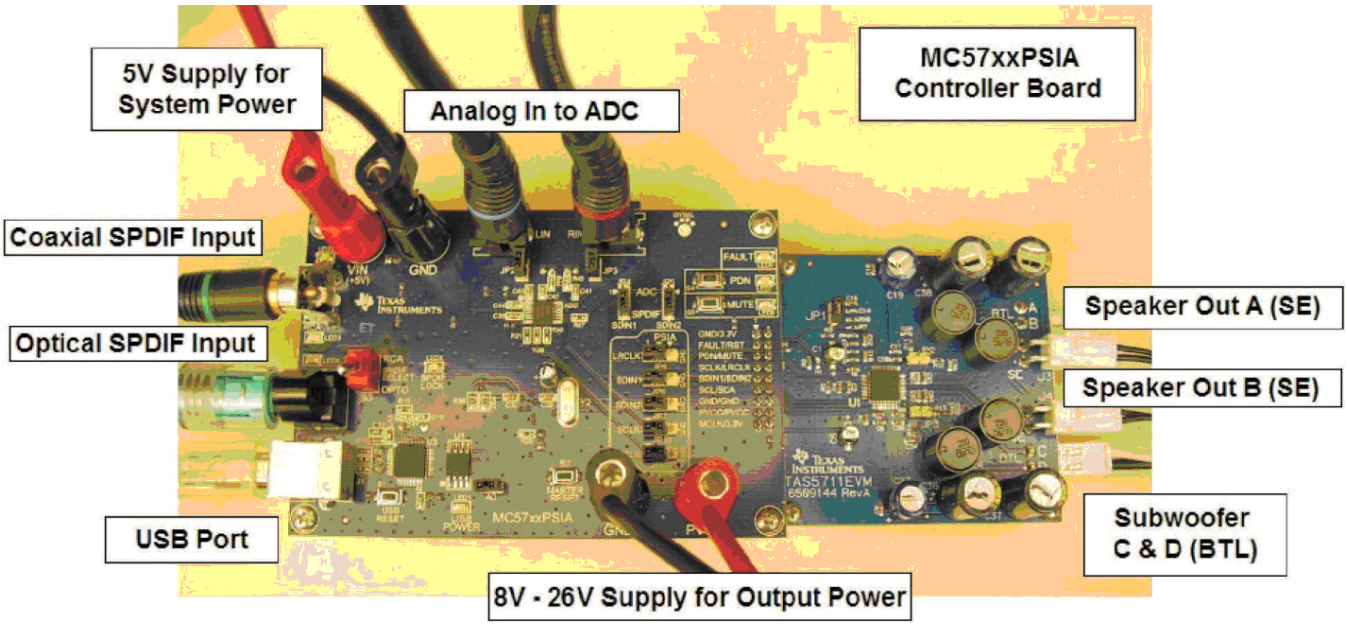


Figure 3. General Connection Picture

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

- Power Supply for Digital Supply (5-V
- Power Supply (PVDD)
- Banana-plug test leads for power supplies and speakers
- Optical or coaxial cable for SPDIF interface based on signal source
- USB cable
- EVM software
- Speakers or Loads for outputs

The following sections describe the TAS5717LEVM board in regards to power supply (PSU) and system interfaces.

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2.1.1 Connecting the TAS5731EVM to MC57xxPSIA

On the right side of the MC57xxPSIA is a terminal block and another is located on the left of the TAS5731EVM (labeled J1). Carefully place the MC57xxPSIA block above the TAS5731EVM block and gently push down.

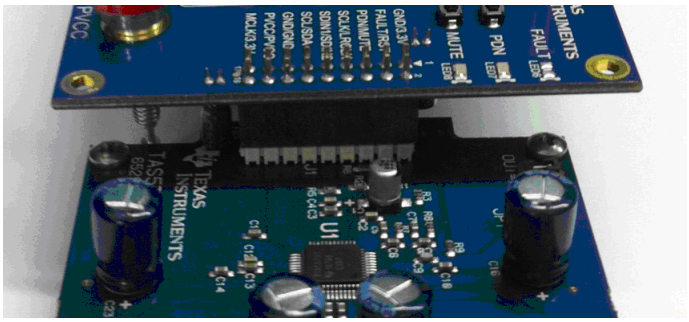


Figure 4. Connecting TAS5731EVM to MC57xxPSIA

2.1.2 PSU Interface

The TAS5731EVM is powered by two power supplies connected to the MC57xx controller board: a 5-V power supply (VIN), and 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.

The maximum output-stage supply voltage depends on the speaker load resistance. Check the recommended maximum supply voltage in the TAS5731 data sheet (SLOS726).

2.1.3 Loudspeaker Connectors

CAUTION

All speaker outputs are biased at $V_{CC}/2$ 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 TAS5731EVM (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 TAS5731EVM (A and B or C and D). Note that the EVM is setup to use only channels A and B in the SE mode, for a real application; however, any of the channels can be setup for SE mode operation.

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.

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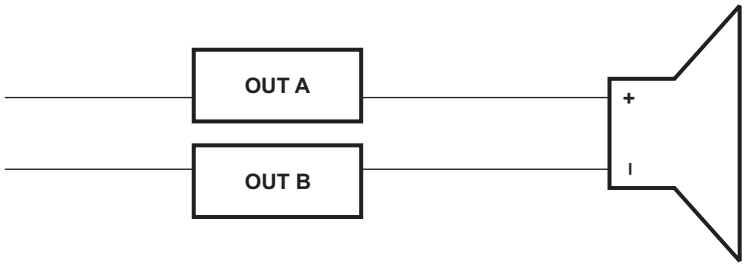


Figure 5. BTL Connection

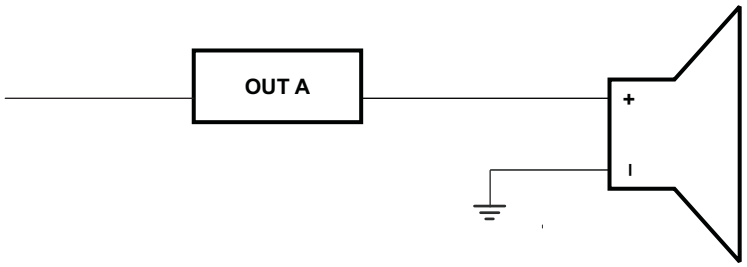


Figure 6. SE Connection

2.1.4 USB Interface

The TAS5731 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 5V 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.

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 TAS5731 data sheet for more information.

The RCA connector and the OPTO connector are the two SPDIF interfaces on the MC57xxPSIA board. The jumper JP11 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 TAS5717L, 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 TAS5717L. 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 TAS5731. 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, and finally, install JP2 and JP3.

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2.1.7 Board Power-Up General Guidelines

Connect the MC57xxPSIA and the TAS5717LEVM boards by locating pin 1 on each board, indicated by a small white triangle. The MC57xxPSIA plugs down onto the TAS5731EVM board (that is, the TAS5731EVM 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.

2.2 Software Installation

Download the TAS57X1 GDE from the TI Web site, located on the TAS5731EVM 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 → TAS57X1 GDE.

The TAS5717L tab opens when the GUI starts. The TAS5717L tab has two subwindows. One shows the Process Flow window. This window also shows Input select, Mode select, Channel, and Master Volume. All functions are shown in the same order as in the device.

The other subwindow, the Properties window, has the properties that a user can update by selecting from the available options. The properties available depend on the device selected.

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3 Using the GUI Software

This section describes the details of using the TAS57xx Graphical User Interface (GUI) software tool to interface with the TAS5731 device. The software is available for download at the TAS5731 product page on www.ti.com. The main function of the GUI is to provide the user an easy way to manipulate the device register space for attaining the required signal processing flow. The block diagram of the Digital Audio Processing (DAP) flow of the TAS5731, taken from the TAS5731 data sheet is shown in Figure 7.

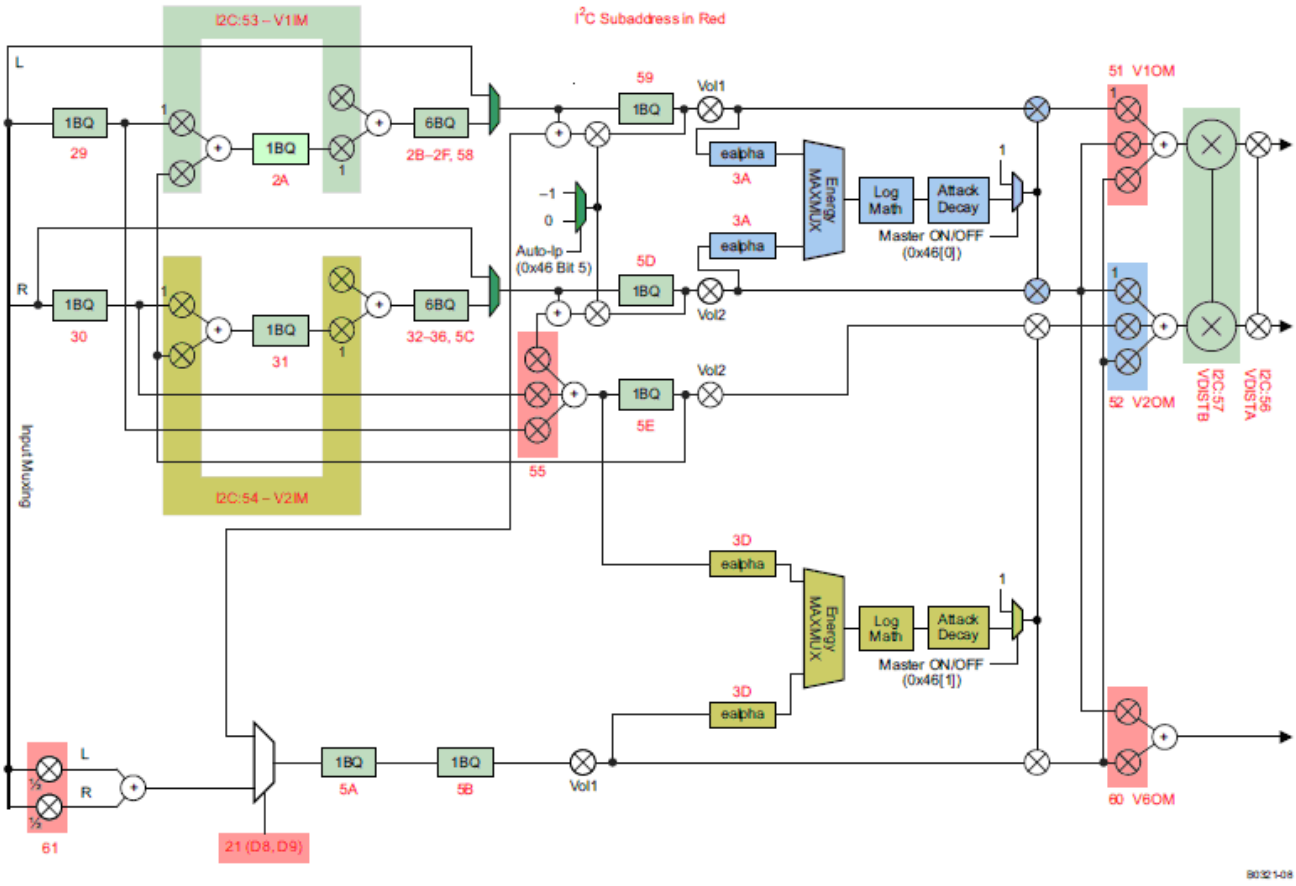


Figure 7. TAS5731 DAP Block Diagram

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3.1 Setting the PPSI2C Environment Variable

The I²C slave address of TAS5731 can either be 0x34 or 0x36 depending on the state of Pin-14 (A-SEL). Slave address is 0x34 when A-SEL is low and 0x36 when it is high. Slave-address information for GUI control is set using an environment variable, as described in the following steps:

1. Open the System-Properties window (right-click on My Computer Icon and click Properties). This brings up the properties window. Select the Advanced tab and click on Environment variables as shown in Figure 8.

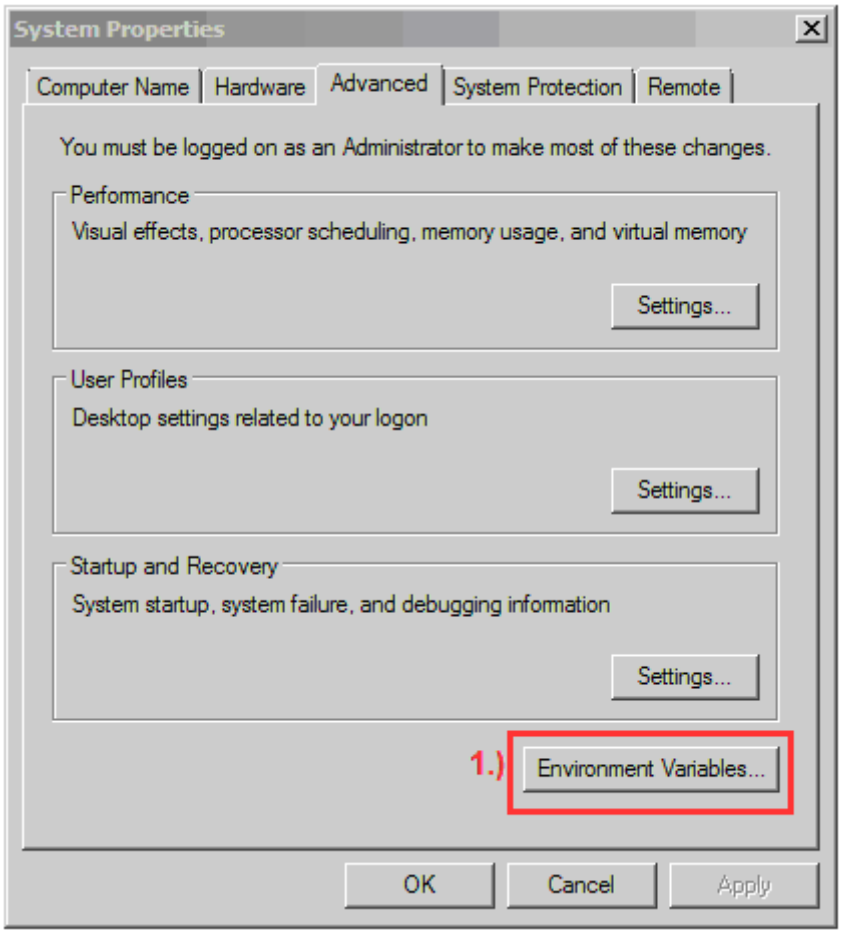


Figure 8. System Properties Window

2. In the Environment Variables window, click on 'NEW' in the user variable section.
3. In the New User Variable Window, enter the text PPSI2C as variable name, and 34 as the variable value.

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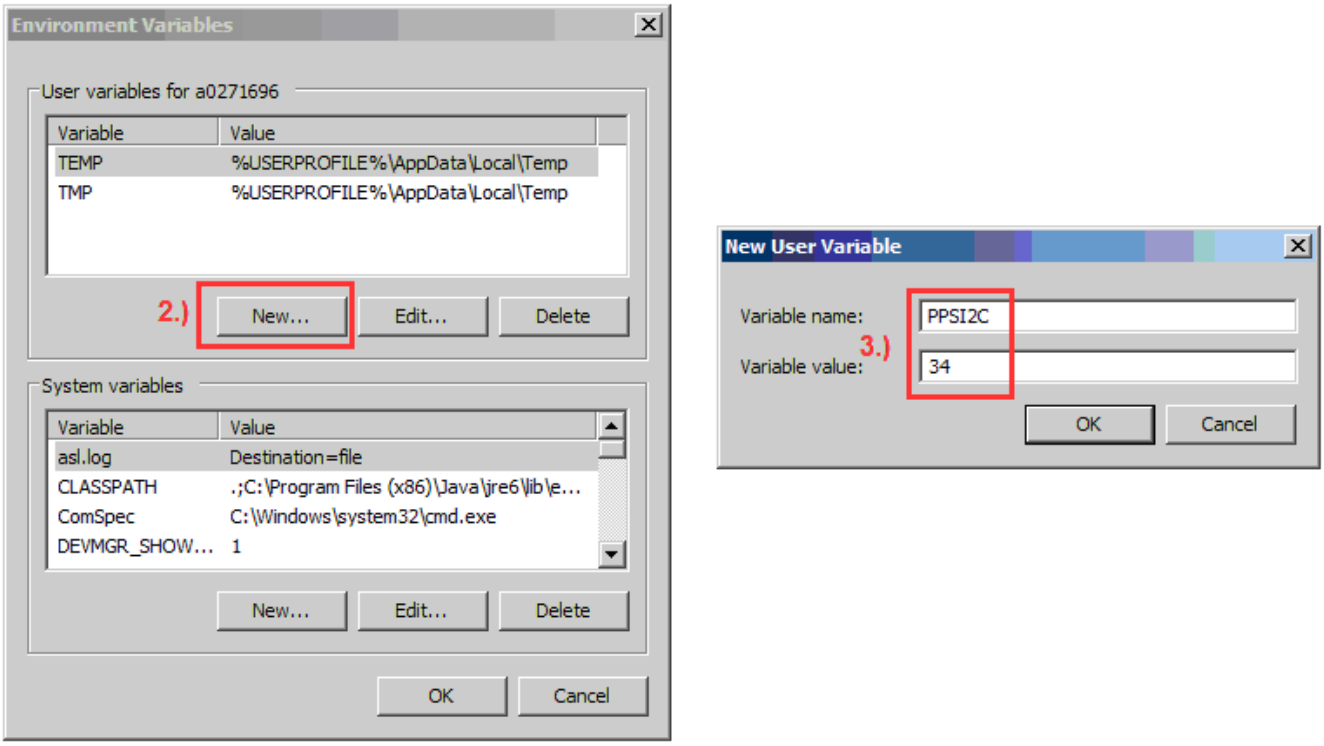


Figure 9. Environment Variable and User Variable Window

3.2 Launching the GUI interface

The GUI interface can be opened by clicking on the 'TAS57X1 GDE' icon under the Texas Instruments Inc title in the start program menu.

NOTE: PPSI2C variable should be set before the GUI interface (or the memory tool) is opened. If the GUI was opened prior to setting the environment variable (Step-1), the GUI interface should be closed and re-opened.

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3.3 Initializing the Device

Figure 10 shows a snap-shot of the GUI when it is first launched. The different blocks seen on the GUI window are defined functions that can each be used to set the register space to desired value. (For example, the volume block shown in Green, can be used to set the desired master-volume level. Changes made to this block, update the master-volume register with the corresponding hex value).

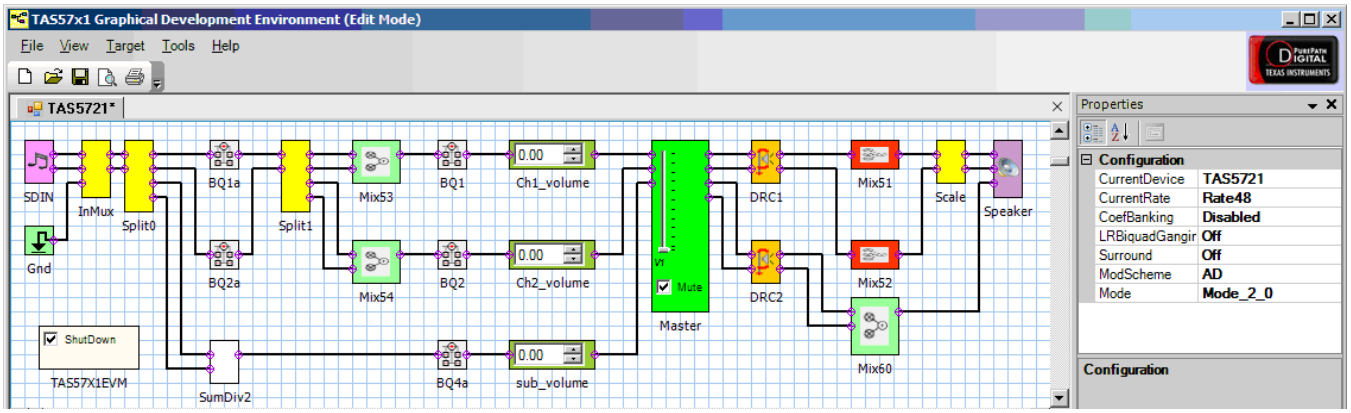


Figure 10. Default GUI Interface on Start-up

The drop-down properties menu seen on the right-hand side of the GUI window (Figure 10) is used to specify the device to be used. A zoomed snap-shot of the properties menu is shown in Figure 11. Select TAS5731 from the 'Current-Device' option menu. Other settings like modulation scheme (AD/BD), operation mode (2.0/2.1) etc. can also be specified using this menu.

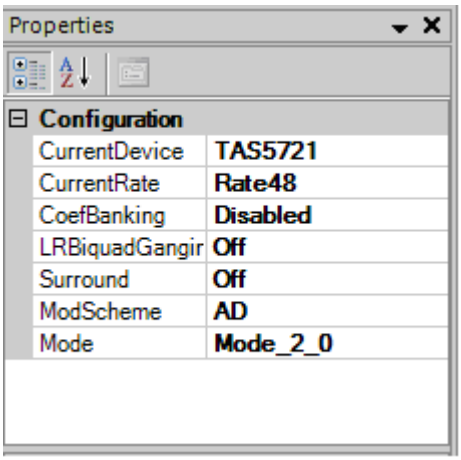


Figure 11. Zoomed-In Snapshot of the Configuration Drop-Down Menu

To initiate the GUI control, the first step is to 'Connect' the GUI. To do this, scroll to the 'Target' section of the menu and click on Connect (as shown in Figure 12)

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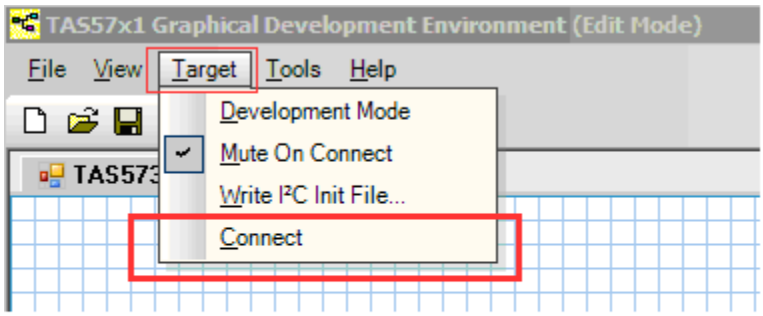


Figure 12. Initiating Connect from the Target Menu

After the Target-Connect operation, the GUI window background changes from white (with grid) to a solid light-green. All the blocks seen in the GUI window are now active and any updates made on these blocks updates the corresponding register space. Also, note that the configuration menu options on the right-hand side (highlighted with blue-box in fig-13 below) are now grayed out and can't be updated. The Target-Connect operation automatically updates the trim register (0x1B) to factory-trim mode, now the device can be set to stream audio output with only two additional operations: exit-shutdown and un-mute

The device shut-down mode can be toggled through the Shutdown-Checkbox (highlighted with a red-box in Figure 13). Uncheck this box to bring the device out of shut-down. Similarly, the mute state of master-volume can be toggled using the Mute-Checkbox (highlighted with a red-box in Figure 13). After un-muting the master-volume, the volume slider should be used to set the volume to the desired level. The current volume level will be displayed in the menu-area on the right-hand side of the GUI window. After completing these basic operations, the device should now be streaming audio.

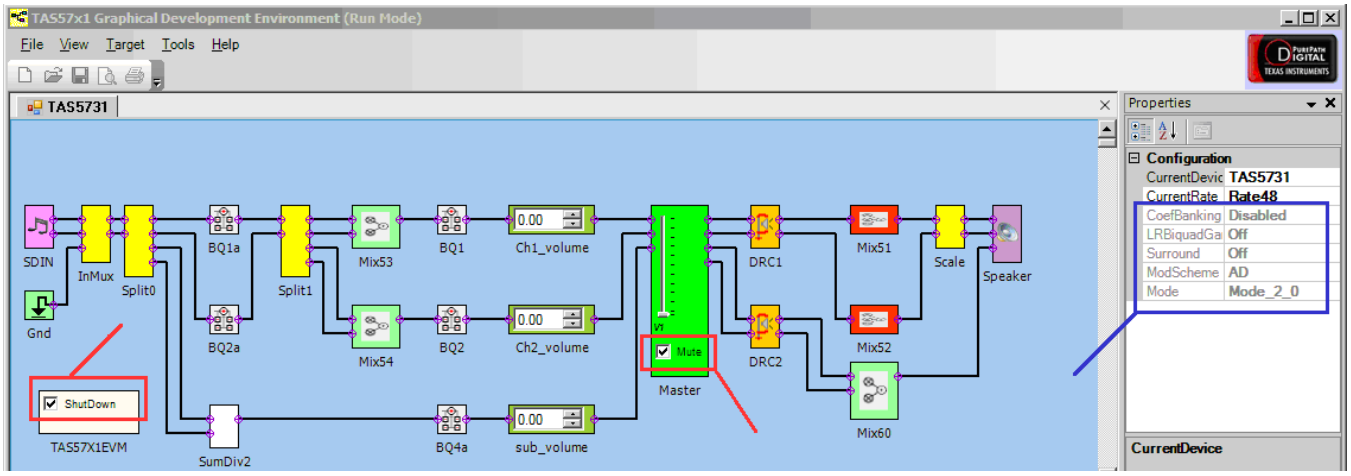


Figure 13. Toggling Shut-Down and Mute States

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3.4 Using EQ Function

The Bi-Quad registers in the TAS5731 can be programmed for EQ and other signal processing applications using the BQ blocks on the GUI. Commonly used signal processing functions are EQ, Treble-Shelf, Bass-Shelf, Low-pass and high-pass filters. In particular, the EQ function can be used to equalize (hence the name EQ) a speaker's non-ideal frequency response. The BQ blocks on the GUI are highlighted in the Figure 14.

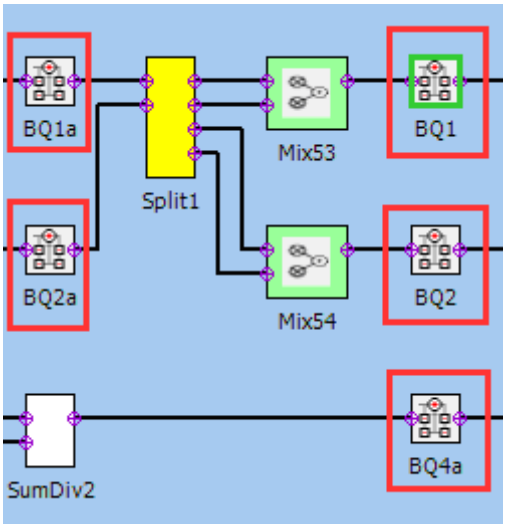


Figure 14. TAS57xx GUI EQ Blocks

When a BQ-block is selected on the GUI by using a single mouse click, the device registers associated with that particular BQ block are displayed in the properties window. Double-Clicking on the BQ-block, opens up the 'Filter creation tool' window. The Figure 15 shows the filter-creation window corresponding to block BQ1, where eight Bi-Quad registers are available for programming. Each of these can be independently programmed by using the corresponding entry fields. The default setting for all Bi-Quads is All-Pass mode. The different filter options available are seen in the drop-down menu in Fig 15. The frequency and phase response of the filters can be viewed using the frequency and phase response tabs of the filter tool. Finally, when the APPLY button is clicked, the Bi-Quad registers of the device are updated with the programmed settings.

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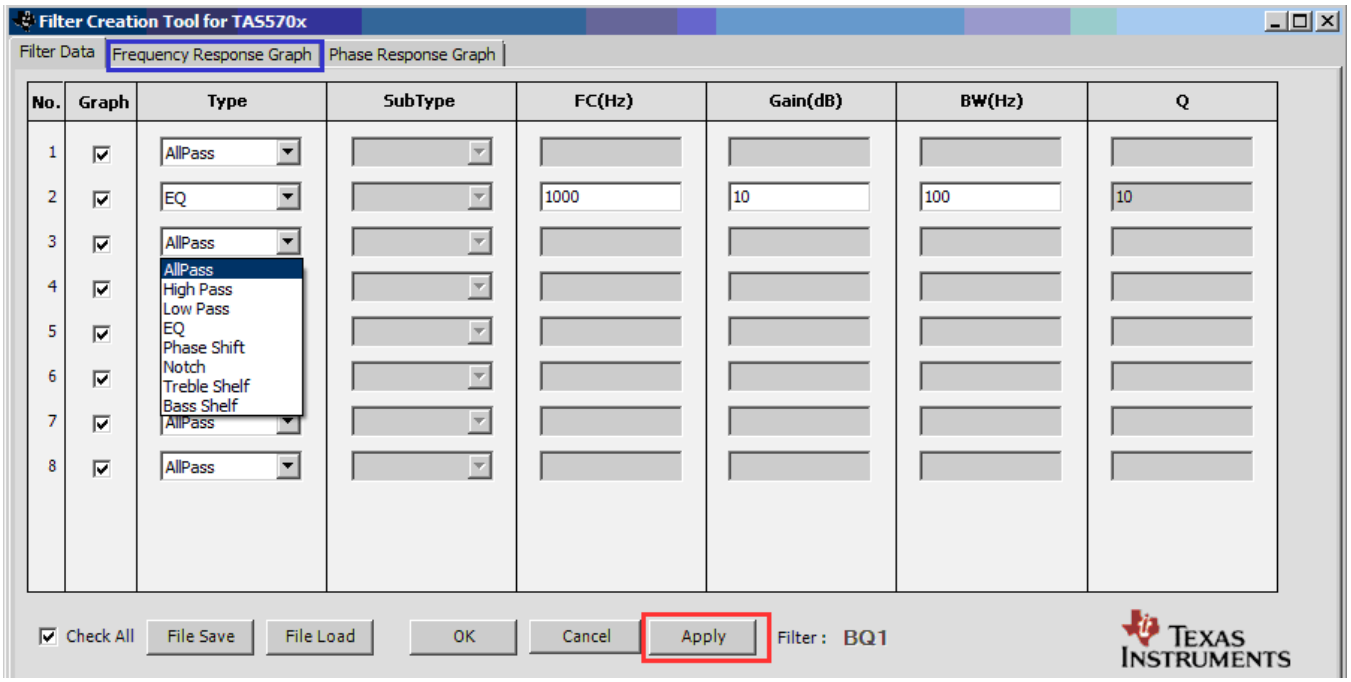


Figure 15. EQ-Tool Filter Creation Window

3.5 *Using the DRC Function:*

TAS5731 has two DRC blocks DRC-1 and DRC-2. Left and Right channels are processed using DRC-1, and the sub-channel is processed via DRC-2. The DRC blocks on the TAS57X1 GUI are highlighted in Fig-16 below. A single-click on the DRC block brings up the I2C register information in the properties window as seen in Figure 16. The default state of the DRC control is in disabled state, as seen in the runtime properties section of Figure 16. To use the DRC function in the GUI, the DRC control should be updated to the Enabled state. Note that the DRC-1 and DRC-2 have independent enable/disable controls.

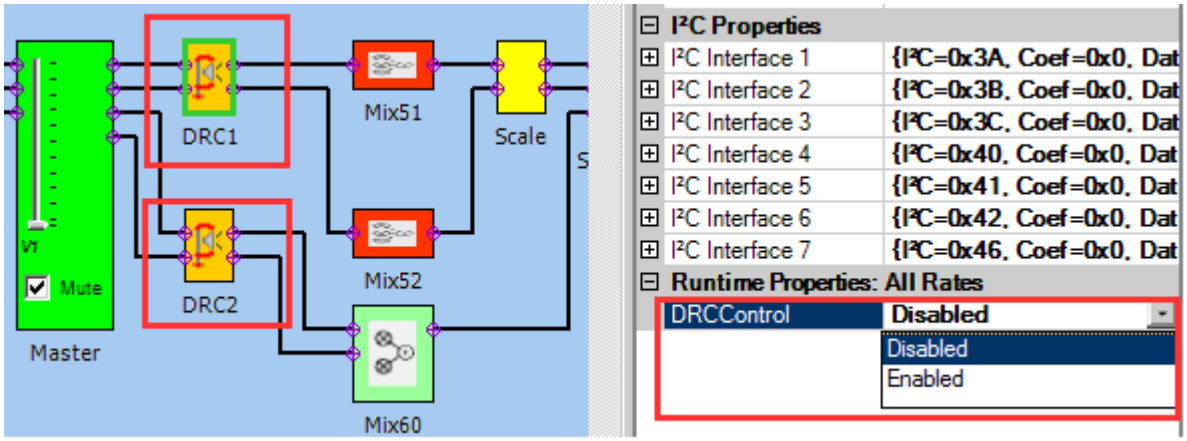


Figure 16. TAS57X1 GUI DRC Blocks

The different parameters of the DRC such as Threshold, Compression, Offset and attack/decay time constants can be programmed using the DRC customization tool, which is opened by double clicking the DRC block on the GUI window. Figure 17 shows the controls for DRC-1, with the user programmable inputs highlighted. The plot on the right estimates the output vs. input level corresponding to the user input(s).

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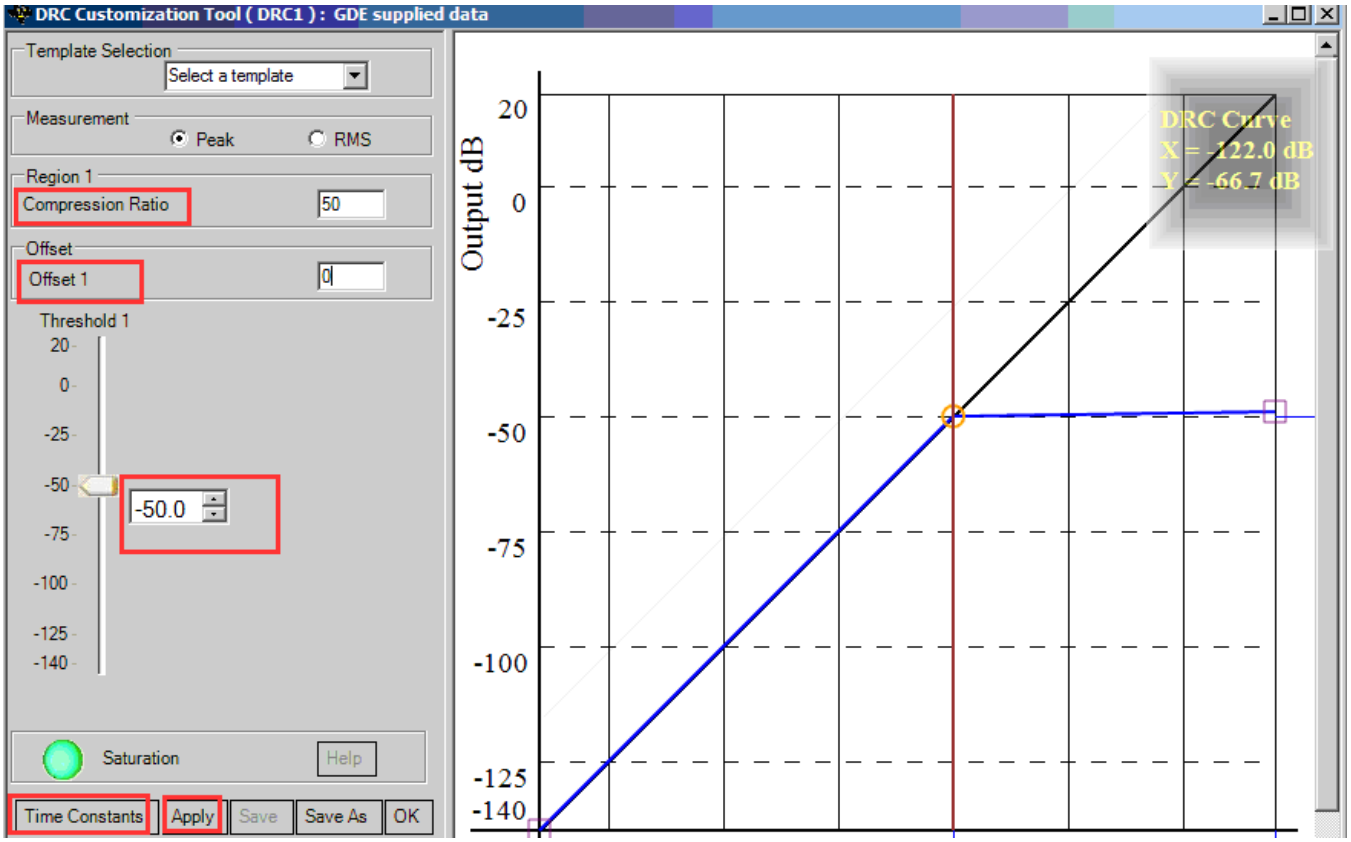


Figure 17. TAS57xx GUI DRC Customization Tool

The DRC time-constants can be programmed via the Time Constants window, that can be opened, by clicking on the 'Time Constants' in DRC customization tool. The time-constant window snap-shot is shown in Figure 18.

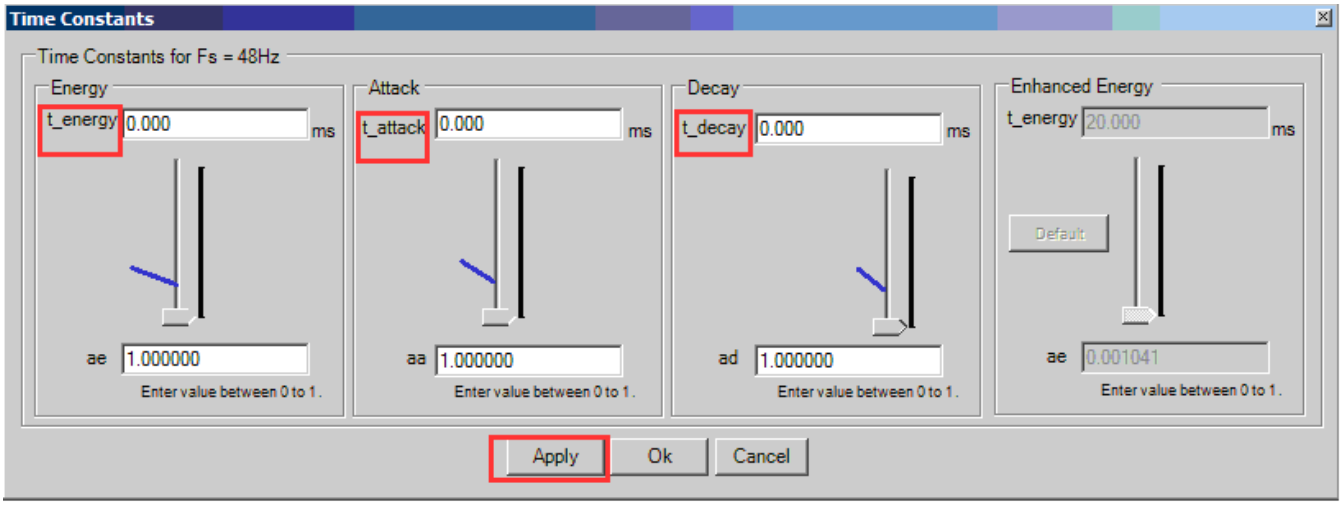


Figure 18. DRC Time Constants Window

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3.6 Using the Mixer and Scaler Nodes

Figure 19 below shows a snap-shot of the different mixer and scaler blocks from the GUI. The mixer nodes can be used to mix the contents of the different channels. The input mixer can be used to mix the channels before they are processed by the Bi-Quads and DRC, while the output mixer nodes are used to mix the channels after they are processed through these blocks. The scaler blocks at the output can be used to scale the outputs.

Clicking on any of these blocks displays their configuration option's in the properties window. Figure 19 shows an example where the output-mixer 0x51 is selected. The mixer configuration can be updated by changing the values in the properties window.

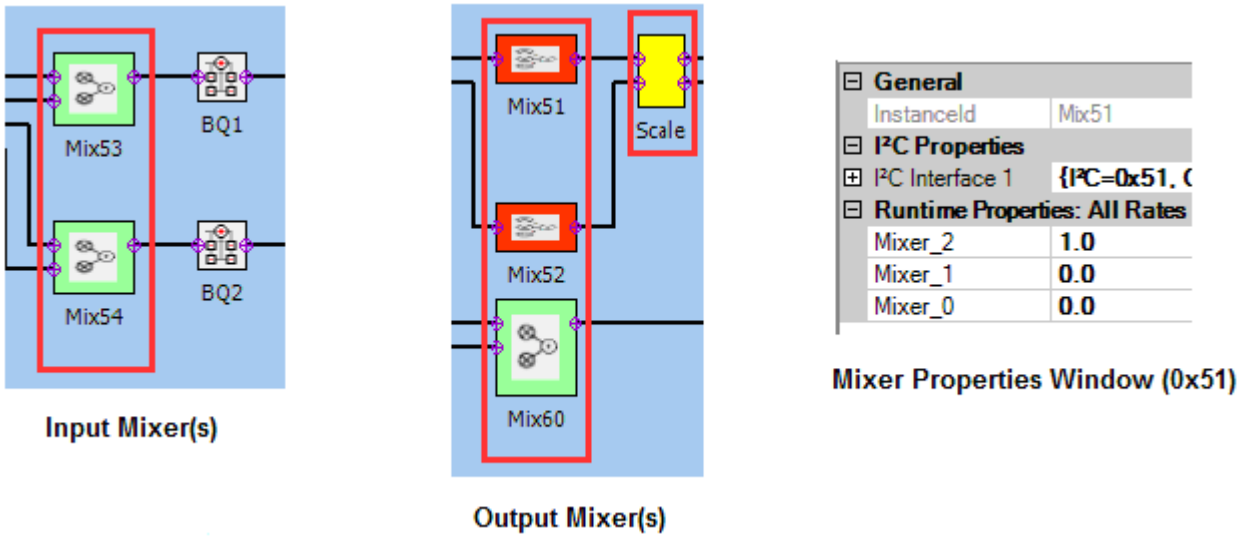


Figure 19. Input, Output Mixer and Scaler Nodes

3.7 Using I2C Memory Tool

The GUI installation includes an I2C read-write interface, 'called the Memory Tool'. Using the Memory tool, the device registers can manually be read or written to. The tool can either be opened using the GUI menu (as shown in Figure 20), or can also be launched stand-alone even when the GUI window is not opened, through the Windows → All-Programs → Texas Instruments Inc → I2C Memory tool option. The stand-alone capability is especially convenient when an existing I2C file needs to loaded to update device registers or when performing I2C debug.

Figure 20 shows a snap-shot of the Memory Tool window. The I2C tab at the top should be clicked to view the Read/Write and I2C command file options. For Read operation, register sub-address and register size (length) in bytes should be provided. Clicking on the Read button, displays the register's contents in the Data window. For a Write operation, the data to be written should be provided in the Data field, and then the Write button should be clicked

The Memory tool can also be used to load a pre-defined I2C register file. Clicking the browse button on the bottom-right allows the user to browse to the location of the I2C script file, after selecting the desired file, clicking the Execute button, implements the register write operations specified in the file

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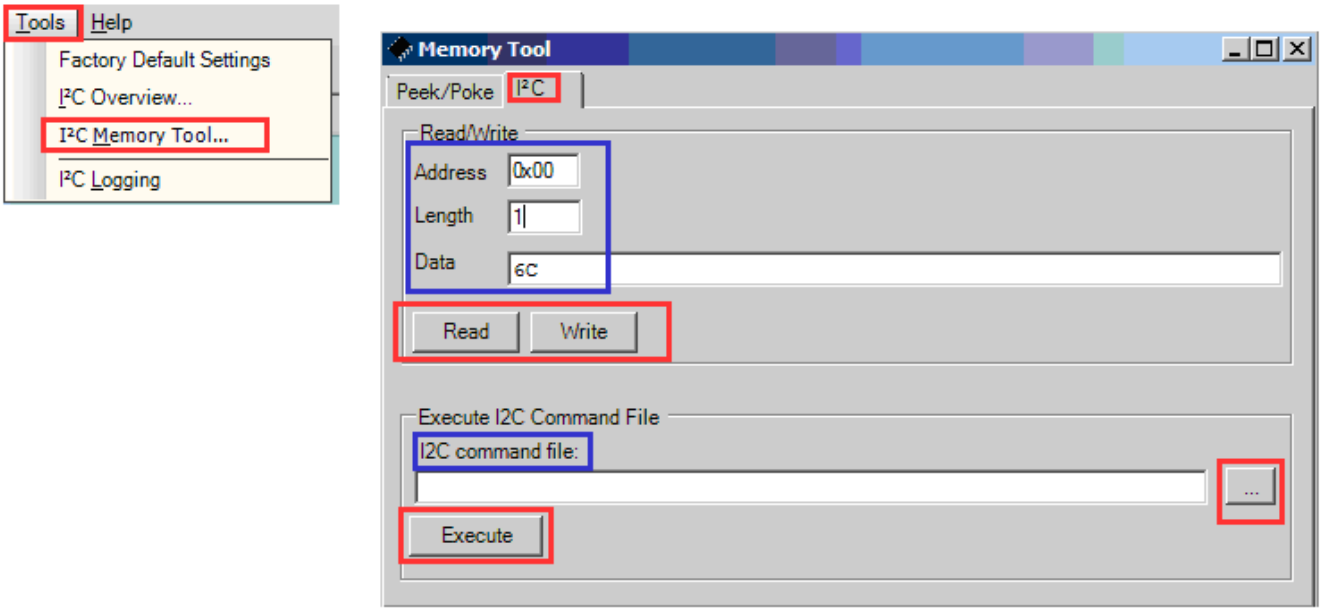


Figure 20. I2C Memory Tool

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4 Jumpers and Control Utilities on MC57xxPSIA board

4.1 RCA/OPTICAL Jumpers

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

4.2 Switches

Reset is an active-low function. Pressing the master reset switch (S2) resets the TAS5731 device; USB RESET (S1) resets the USB bus. Pressing PDN (S4) powers down the TAS5731.

4.3 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: Not Populated

LED7: PDN switch (S4) is asserted

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5 Board Layouts, Schematic, and Bill of Materials

This section contains the TAS5731EVM board layouts, schematic, and the bill of materials (BOM).

5.1 TAS5731EVM Board Layouts

Figure 21 illustrates the TAS5731EVM top composite assembly.

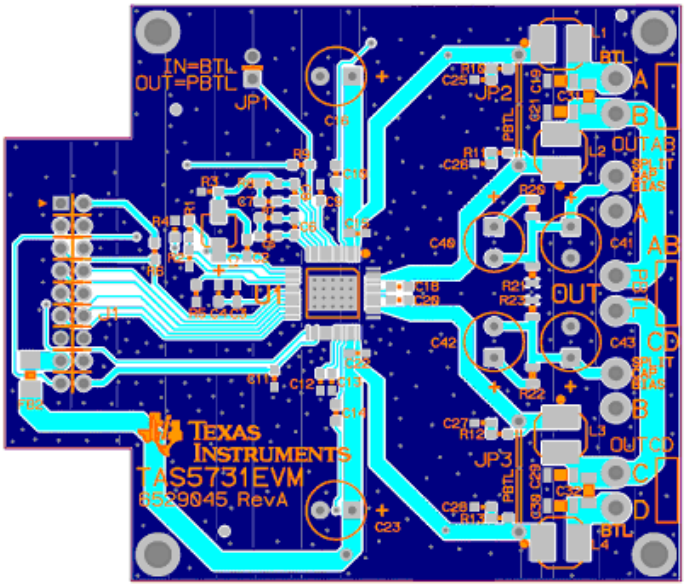


Figure 21. TAS5731EVM Top Composite Assembly

5.2 TAS57xx PSIA Board Layout

Figure 22 shows the TAS57xxPSIA top composite assembly.

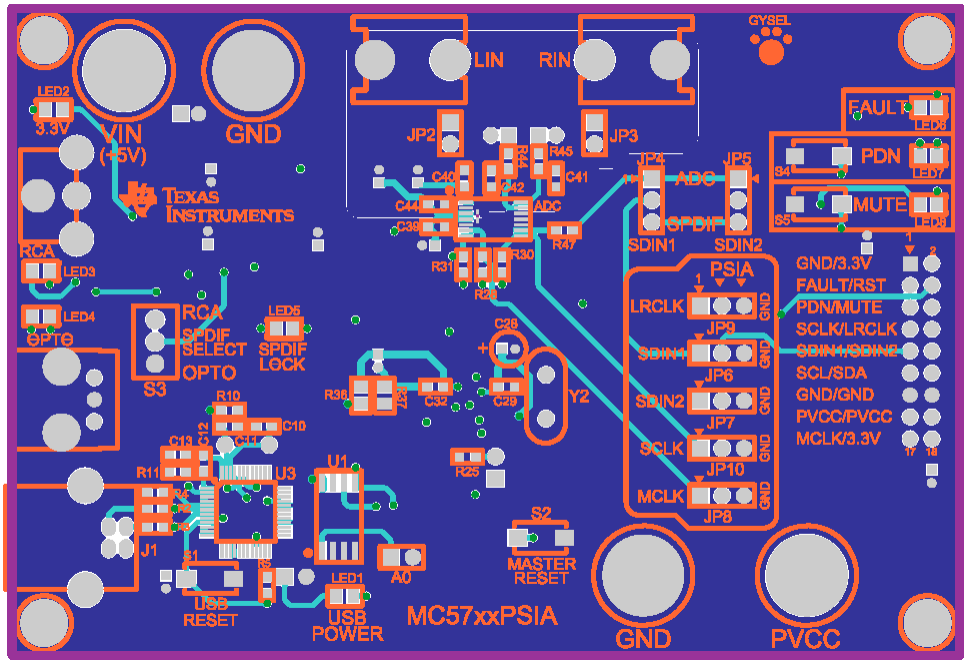


Figure 22. TAS57xxPSIA Top Composite Assembly

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5.3 TAS5731EVM Schematic

Figure 23 illustrates the TAS5731EVM schematic.

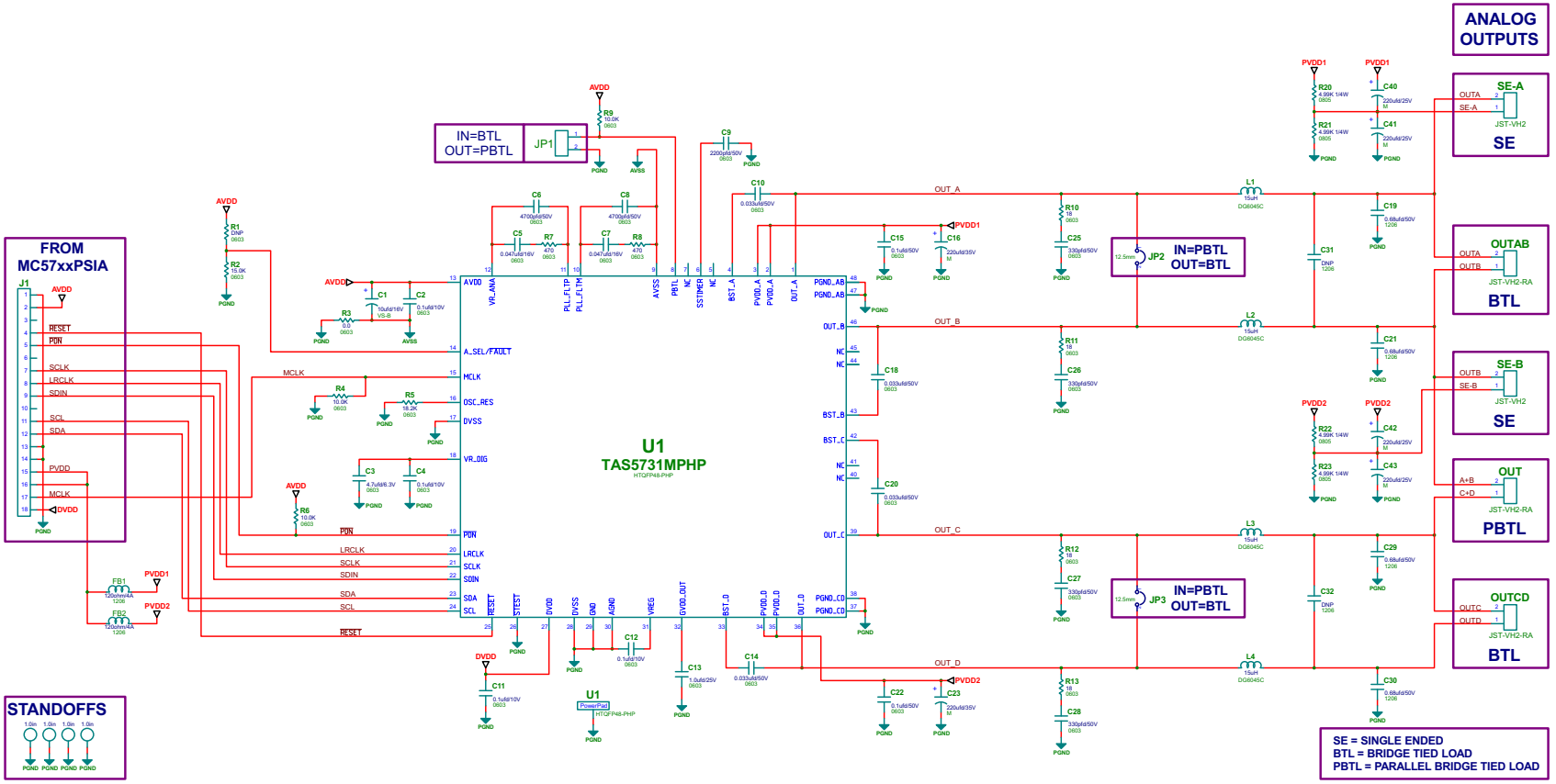


Figure 23. TAS5731EVM Schematic

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5.4 Bill of Materials

Table 1 lists the BOM for this EVM.

Table 1. TAS5731EVM Bill Of materials (BOM)

Item	Manu Part Num	Qty	Ref Designators	Vendor Partnum	Description	Vendor	Manu
1	TAS5731MPHP	1	U1	TAS5731MPHP	20W DIGAMP WITH DAP HTQFP48-PHP ROHS	TEXAS INSTRUMENTS	TEXAS INSTRUMENTS
2	GRM1885C1H331JA01D	4	C25, C26, C27, C28	490-1439-1	CAP SMD0603 CERM 330PFD 50V 5% COG ROHS	DIGI-KEY	MURATA
3	GRM188R71H222KA01D	1	C9	490-1500-1	CAP SMD0603 CERM 2200PFD 50V 10% X7R ROHS	DIGI-KEY	MURATA
4	GRM188R71H472KA01D	2	C6, C8	490-1506-1	CAP SMD0603 CERM 4700PFD 50V 10% X7R ROHS	DIGI-KEY	MURATA
5	GRM188R71H333KA61D	4	C10, C14, C18, C20	490-3286-1	CAP SMD0603 CERM 0.033UFD 50V 10% X7R ROHS	DIGI-KEY	MURATA
6	GRM188R71C473KA01D	2	C5, C7	490-1529-1	CAP SMD0603 CERM 0.047UFD 16V 10% ROHS	DIGI-KEY	MURATA
7	C0603C104K8RACTU	4	C2, C4, C11, C12	399-1095-1	CAP SMD0603 CERM 0.1UFD 10V 5% X7R ROHS	DIGI-KEY	KEMET
8	GRM188R71H104KA93D	2	C15, C22	490-1519-1	CAP SMD0603 CERM 0.1UFD 50V 10% X7R ROHS	DIGI-KEY	MURATA
9	TMK107BJ105KA	1	C13	587-1248-1	CAP SMD0603 CERM 1.0UFD 25V 10% X5R ROHS	DIGI-KEY	TAIYO YUDEN
10	C3216X7R1H684K	4	C19, C21, C29, C30	445-4013-1	CAP SMD1206 CERM 0.68UFD 50V 10% X7R ROHS	DIGI-KEY	TDK
11	C1608X5R0J475M	1	C3	445-1417-1	CAP SMD603 CERM 4.7UFD 6.3V 20% X5R ROHS	DIGI-KEY	TDK
12	EEE1CA100SR	1	C1	PCE3878CT	CAP SMD ELECT 10ufd 16V 20% VS-B ROHS	DIGI-KEY	PANASONIC
13	ECA-1EM221BJ	4	C40, C41, C42, C43	P10414TB-ND	CAP ALUM ELEC M RADIAL 220UFD 25V 20% ROHS	DIGI-KEY	PANASONIC
14	ECA-1VM221BJ	2	C16, C23	P10419TB	CAP ALUM ELEC M RADIAL 220UFD 35V 20% ROHS	DIGI-KEY	PANASONIC
15	ERJ-3GEY0R00V	1	R3	P0.0GCT	RESISTOR SMD0603 0.0 OHM 5% THICK FILM 1/10W ROHS	DIGI-KEY	PANASONIC
16	ERJ-3GEYJ180V	4	R10, R11, R12, R13	P18GCT	RESISTOR SMD0603 18 OHMS 5% 1/10W ROHS	DIGI-KEY	PANASONIC
17	ERJ-3GEYJ471V	2	R7, R8	P470GCT	RESISTOR SMD0603 470 OHMS 5% 1/10W ROHS	DIGI-KEY	PANASONIC
18	RNCP0805FTD4K99	4	R20, R21, R22, R23	RNCP0805FTD4K99CT-ND	RESISTOR SMD0805 4.99K OHMS 1% 1/4W ROHS	DIGI-KEY	STACKPOLE ELECTRONICS
19	ERJ-3EKF1002V	3	R4, R6, R9	P10.0KHCT	RESISTOR SMD0603 10.0K 1% THICK FILM 1/10W ROHS	DIGI-KEY	PANASONIC
20	RMCF0603FT15K0	1	R2	RMCF0603FT15K0CT	RESISTOR SMD0603 15.0K OHMS 1% 1/10W ROHS	DIGI-KEY	STACKPOLE ELECTRONICS
21	RC0603FR-0718K2L	1	R5	311-18.2KHRCT	RESISTOR SMD0603 THICK FILM 18.2K 1% 1/10W ROHS	DIGI-KEY	YAGEO
22	HI1206P121R	2	FB1, FB2	240-2410-1	FERRITE SMD1206 120 OHM@100MHz 4A ROHS	DIGI-KEY	STEWARD
23	DG6045C-150M	4	L1, L2, L3, L4	DG6045C-150M	INDUCTOR SMT 15uH X.XA X.X mOHMS 20% DG6045C ROHS	TOKO JAPAN	TOKO JAPAN
24	PBC02SAAN	1	JP1	S1011E-02	HEADER THRU MALE 2 PIN 100LS GOLD ROHS	DIGI-KEY	SULLINS
25	PBC09DAAN	1	J1	S2011E-09	HEADER THRU MALE 2X9 100LS GOLD ROHS	DIGI-KEY	SULLINS
26	B2PS-VH(LF)(SN)	5	OUT, OUTAB, OUTCD, SE-A, SE-B	455-1648	JACK JST-VH RA 2-PIN 3.96mmLS ROHS	DIGI-KEY	JST
27	SPC02SYAN	1	JP1(2-3)	S9001	SHUNT, BLACK AU FLASH 0.100LS	DIGI-KEY	SULLINS
28	PMSSS 440 0025 PH	4	NA	H703-ND	4-40 SCREW STEEL 0.250 IN ROHS	DIGI-KEY	B&F FASTENER SUPPLY
29	2029	4	NA	2029K-ND	STANDOFF 4-40 0.75IN 3/16IN DIA ALUM RND F-F	DIGI-KEY	KEYSTONE ELECTRONICS

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Revision History

Changes from Original (December 2011) to A Revision	Page
• Changed schematic for revision A.	20
• Changed contents of the BOM.	21

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

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- 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.

Industry Canada Compliance (English)

For EVMs Annotated as IC – INDUSTRY CANADA Compliant:

This Class A or B digital apparatus complies with Canadian ICES-003.

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

Concerning EVMs Including Radio Transmitters

This device complies with Industry Canada licence-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.

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.

Canada Industry Canada Compliance (French)

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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.

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.

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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.

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