The purpose of the TAS5412-Q1 evaluation module (EVM) is to demonstrate the capabilities of the TAS5412-Q1 device. Access for all the device features is available through the hardware and the software graphical user interface (GUI) supplied. This user’s guide contains a description of the EVM and the GUI. Included are the EVM schematics, bill of materials, and the board layout.

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1 Quick-Start Guide
This section provides a guide to set up and power up the EVM without the details in its operation. For more detailed operation, read the complete guide.

1.1 Overview
The EVM consists of a single printed-circuit board (PCB) mounted inside a metal chassis for EMC testing. The EVM must have an external I^2C controller board to function. The USB-to-I^2C controller board connects to a personal computer (PC) through a USB cable. The EVM connects to the I^2C controller through a supplied 6-pin DIN cable. The PC needs the graphical user interface (GUI) software to control the EVM. See Figure 1 for the device connections.

Hardware provided in the EVM modules consists of the EVM, an I^2C controller board, a USB cable, a 6-pin DIN cable, and speaker cables.
1.2 Software Installation

The software is available on the TI Web site. Run the setup.exe program to install the GUI. For more details, read Section 2.2, Graphical User Interface.

1.3 Connections

The connections are for an analog signal for the input, speaker loads, power, and I²C. Connect the audio inputs through the two RCA connectors. Connect the power and speakers using the six-pin connector.

Make the I²C connections using a 6-pin DIN connector. The provided cable and adapter PCB connect the EVM to the PC. The adapter PCB is an I²C-to-USB converter, which is an HID device which the PC automatically recognizes when connected. Therefore, there is no need for drivers.

The basic connections are: PVDD or power connects to the EVM through the supplied six-pin connector with the twisted red and black wires. The speakers or loads also connect through the same six-pin connector with the twisted red and white wires. The six-pin DIN connects to the I²C-to-USB adapter board. See Figure 2 and Figure 3 for EVM connection details.

![Figure 1. EVM Connections](image)

![Figure 2. End Panel for Input and Output Connections](image)
1.4 **Initial Power Up**

Before applying power, check to make sure the Standby control switch is in the Standby Off position, as shown in Figure 3. If the switch is in the Standby On position, then at power up the I²C LED indicator on the GUI is red (see Section 2.2.4.3, **Connection Status Panel**, for more details).

![Figure 3. End Panel for I²C Connections](image)

Apply power: the Standby, Mute, and Power LEDs should be on. The Fault LED may also be on, but not necessarily. This indicates that the unit is powered, and the TAS5412-Q1 is in standby mode and mute mode. The fault indicated is an undervoltage fault during power up. This is normal and is cleared by reading the I²C Register 0x00 (clicking the Read Faults button) twice. Reading the faults once clears the faults, and the second read is to ensure the clearing of all the faults.

1.5 **Basic Graphical User Interface Controls**

The default state for the device is mute. To un-mute, click the Play All button at the top left of the window. To mute, click the Mute All button. Figure 4 shows the main EVM window.

![Figure 4. Main Window](image)
2 EVM Description

2.1 Description of Input

2.1.1 Analog Inputs

Analog inputs are unbalanced, with connections to the EVM through the two RCA jacks. The unbalanced inputs have the shield of the RCA jacks connected to ground.

2.1.1.1 Power

The EVM requires one dc power connection. The connection is made through a six-pin supplied connector. The black wire is ground and the red wire connection is to PVDD, which can range from 6 to 24 Vdc. The power-supply voltage must exceed 7 Vdc for proper turnon, but can then dip to 6 Vdc and maintain operation.

2.1.2 Description of Outputs

2.1.2.1 Speaker and Power Connections

The six-pin connector on the EVM (and consequently the cables) can be divided into two groups: the power connector and the speaker channel connectors. The power connector consists of a pair of red and black twisted wires which correspond to the plus (+) output and minus (–) output, respectively. This pair of wires must connect to a power supply.

The speaker channel connectors consist of the remaining two pairs of red and white twisted wire. Each pair of red and white wires corresponds with a channel. The red wire corresponds to the plus (+) output and the white wire corresponds to the minus (–) output. These wires must terminate to a speaker load or resistive load.

See Figure 1 for the location for the power connector, Figure 5 for more details about the speaker cables, and Figure 2 for the speaker-cable connections to the EVM.

NOTE: Do not connect any of these outputs to ground. The TAS5412-Q1 has bridged outputs; connecting to ground triggers a fault.

Figure 5. Wiring Harness for Power and Speaker Connections

One can parallel the outputs can be paralleled by connecting the plus (+) of one channel to the plus (+) of the other channel. Connect the minus (–) connection of one channel and the minus (–) connection of the other channel together also. See the data sheet (SLOS685) for more details on parallel outputs (PBTL).

2.1.3 Controls

2.1.3.1 Standby

The Standby switch is located next to the six-pin DIN I²C input connector. The switch is in the Standby On position with the toggle positioned downward. In this position, the switch forces the TAS5412-Q1 into the standby mode. This is the same as a Power-On Reset (POR). POR shuts down the device, and I²C is not functional.

With the switch moved to the Standby Off position, the TAS5412-Q1 is in its default power-up mode. The I²C registers are at their default settings. The amplifier output is in Hi-Z mode.
2.1.4 Indicator Description

There are five LED indicators on the chassis next to the Standby switch. The LED farthest away from the Standby switch is for the 3.3-Vdc supply. The 3.3-V supply is for the LEDs and the Standby circuit. The other four LEDs indicate the four non-I\(^2\)C output pins: FAULT, CLIP_OTW, STANDBY, and MUTE. The FAULT and CLIP_OTW signals also go to the six-pin DIN connector for the GUI. In normal play mode, these four LEDs should not light.

2.2 Graphical User Interface

2.2.1 Introduction

The TAS5412-Q1 GUI software design is for demonstrating the features of the TAS5412-Q1. The software is also able to assist the applications programmer in generating and saving the desired operating characteristics.

The TAS5412-Q1 GUI has a feature by which it can log the I\(^2\)C data being sent to the device. This can be helpful to the programmer in understanding the I\(^2\)C commands needed for proper function.

2.2.2 Software Installation

The GUI software is available on www.ti.com. Search for literature number SLOC296 and download the zip file. Run the setup.exe program on a personal computer (PC) with the Windows™ OS to install the GUI.

The software is currently supported on Windows XP and Windows 7. The GUI requires the Microsoft .NET environment. If it is not already installed on the PC, it can be downloaded from www.microsoft.com.

2.2.3 Hardware Installation

In the EVM package is a small PCB labeled USB2IIC-2. This is the USB-to-I\(^2\)C converter used to communicate with the EVM. Connect the USB cable to the PC and the PCB. Connect one end of the six-pin cable to the socket labeled I\(^2\)C on the converter PCB. Connect the other end to the six-pin socket on the EVM. The USB connection provides power for this card. The PC should automatically connect to the USB-connected PCB. See Figure 1 for more details.

2.2.4 Using the GUI

2.2.4.1 The Main Window
2.2.4.1.1 TAS5412-Q1 Control Panel

The control panel consists of six buttons that perform basic functions on all four channels.

**Reset:** This button sends a software reset to the device via I²C. Clicking the button is equivalent to sending 0x9F to register 0x0C. All the I²C defaults are restored.

**Read Faults:** This button reads the two fault registers 0x00 and 0x01 and reports the data to the Device Status panel.

**Load Diag:** This button runs a script to perform the built-in load diagnostics and reports any faults to the Device Status panel. The details are displayed for each channel.

**Play All:** This button uses I²C to write 0x09 to register 0x0C, which places all four channels into play mode.

**Mute All:** This button uses I²C to set all channels to mute mode by writing 0x10 to register 0x0C. All channels switch at 50% duty cycle, and no signal passes from the input to the output.

**Hi-Z All:** This button places all four channel outputs into a high-impedance state by writing 0x1F to register 0x0C. This action first places the device in mute, then invokes the Low-Low state, and lastly places the outputs in Hi-Z.

2.2.4.2 Device Status Panel

**Device Panel Title:** The title at the top of the Device Status panel shows the device to which the GUI is set to communicate. The four options are: Master, Slave1, Slave 2, and Slave 3. Use the Device Select menu item to change this option.

**Global:** This provides fault feedback from the device. If a fault occurs, a red Fault is indicated. Read the fault detail in registers 0x00 and 0x01.

**Temperature:** This shows the temperature of the device. When the device is below 125ºC, the color is green. At Level 1 OTW, the color is yellow. At Level 2 OTW, the color is orange. At Level 3 OTW, the color is red.

**Channel 1 and Channel 2:** These two items provide individual-channel output states: Hi-Z, Mute, Low-Low, and Play. The display shows the gain setting with the play indication.

**Fsw:** This item provides the switching frequency of the outputs.

2.2.4.3 Connection Status Panel

There are two LED indicators to provide connection status.

**USB:** The indicator is Green when a connection is good. This indicator is Gray when there is no USB connection to the USB2I2C PCB. The I²C LED is off.

**I2C:** A Green indicator shows that I²C communication is functioning properly. It is Red when there is no I²C connection, but a USB connection. If the LED is off, then there is no USB connection.

2.2.4.4 I2C Log Panel

All the I²C commands that are sent or received by the TAS5412-Q1 are shown in this panel except for I²C polling information. The displayed data can be copied to the clipboard for a programming aid.

This type of information can be controlled by the I2C Log menu item. An R indicates a value read from the device and a W indicates a value sent to the device. Valuable comments are also provided. Polled I²C reads are not shown to prevent over-running the panel with background reads. See Section 2.2.4.7, Menu → I2C Log, for further details on each tab.
2.2.4.5 Register Overview Panel

This panel provides the hexadecimal (hex) data for each I2C register. One can directly change the hex data control registers here and send the settings to the device with the Apply button. Clicking the Cancel button clears any changes made to the data. Either changing the register’s hex value directly or clicking on the register and changing the specific bit in the Register Detail panel updates the Register Detail panel (see Section 2.2.4.6, Register Detail Panel).

2.2.4.6 Register Detail Panel

This panel provides a detailed view of each register. By clicking on a register in the Register Overview panel, the details of that register are shown. Each bit has its description and its value shown by the checkbox. A checkbox with a check mark indicates a logical 1 and an unchecked checkbox indicates a logical 0. One can change any bit by clicking on its checkbox. Clicking on the Apply button in the Register Overview panel sends the changes to the device.

2.2.4.7 Menu

File: In this menu, the Exit function is at the bottom of the drop-down menu.

Device Select: One can change he I2C device-select value in the menu. For the EVM, use the default value, which is Master.

Macros: This menu allows the use of macros. TI has not implemented the use of macros at this time.

Custom Macros: This will allow the users to create then save their own macros for later use.

Preloaded Macros: This menu item will provide a list of built-in macros to perform typical I2C routines.

Read: This menu contains the Read panel controls.

Fault Registers: When selected, the I2C log displays the values of the fault registers. Note that reading fault registers is different from reading faults.

Load Diagnostic Registers: When selected, the values of the load diagnostic registers are read and displayed in the I2C log.

Status Registers: When selected, the values of the status registers are read and displayed in the I2C log.

Control Registers: When selected, the values of the control registers are read and displayed in the I2C log.

All Registers: When selected, the values of all the registers are read and displayed in the I2C log.

Options: This menu contains the Options panel controls.

Crosstalk Compensation Enabled: Selection of this option optimizes crosstalk. With this option disabled, the standard operation optimizes PSRR.

180 Phase Difference: When selected, the channels switch at 180° phase difference.

Switching Frequency: When selected, one can set the switching frequency for AM avoidance to 357 kHz or 500 kHz.

All Channels Gain: Selecting this option allows changing the gain on all the channels to 12 dB, 20 dB, or 32 dB.

I2C Log: This menu contains the I2C Log panel controls.

Enabled: When selected, this menu option shows the I2C Log panel. Deselecting hides the I2C Log panel.

Show I2C Reads: When selected, this menu option shows the value read from the device. An R indicates read values.

Show I2C Writes: When selected, this menu option shows the values sent to the device. A W indicates written values.

Show Comments: When selected, this menu option shows the comments. Deselecting hides the comments.

Clear: The menu item clears the log data. The data is lost.

I2C Polling: This menu contains the I2C Polling panel controls.
3 TAS5412-Q1 EVM Schematics, Board Layouts, and Bill of Materials

3.1 TAS5412-Q1PHD EVM Schematic

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**Enabled:** When selected, the I²C actively samples the status registers specifically. With I²C Polling disabled, there is no assurance that the register readings are valid.

**Rate:** When selected, one can change the poll rate (in ms). The default setting is 250 ms.

**Help:**

**About:** This provides the revision level of the software.
3.2 Board Layouts

Figure 8. TAS5412-Q1PHD Top Layer

Figure 9. TAS5412-Q1PHD Mid Layer Level 1
Figure 10. TAS5412-Q1PHD Mid Layer Level 2

Figure 11. TAS5412-Q1PHD Bottom Layer
Figure 12. TAS5412-Q1PHD Top Silkscreen Overlay

Figure 13. TAS5412-Q1PHD Bottom Silkscreen Overlay
### 3.3 Bill of Materials

#### Table 1. Bill of Materials for TAS5412-Q1 PHD EVM

<table>
<thead>
<tr>
<th>Designator</th>
<th>Value</th>
<th>Description</th>
<th>Manufacturer, P/N</th>
<th>P/N (DIGIKEY)</th>
<th>QTY</th>
</tr>
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<tbody>
<tr>
<td>C1, C2</td>
<td>4.7 µF</td>
<td>Ceramic capacitor</td>
<td>TDK, C2012X5R1E475K</td>
<td>445-4116-1-ND</td>
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<td>Panasonic, ECJ-2YB1H823K</td>
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<td>Nichicon, UVR1V331MPD</td>
<td>493-1083-ND</td>
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<td>TDK,C3216X7R1H105K,</td>
<td>445-1423-1-ND</td>
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<td>TDK, C3216X7R1H105K</td>
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<td>J1, J2</td>
<td>RCA phono jack, right-angle, thru-hole, snap-in</td>
<td>CUI, RCJ-011</td>
<td>CP-1400-ND</td>
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<td>Inductor</td>
<td>Coilcraft, SER2918H-223KL</td>
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<td>L2, L3</td>
<td>Dual inductor</td>
<td>Dual inductor</td>
<td>Toko, HEAW</td>
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<td>LP1</td>
<td>LIGHTPIPE 5 POS</td>
<td>Horizontal, LED light pipe</td>
<td>Lumex, LPF-C051303S</td>
<td>67-1856-ND</td>
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<td>P1</td>
<td>F Connect</td>
<td>Female Mini-DIN connector</td>
<td>CUI, MD-60S</td>
<td>CP-2460</td>
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<td>N MOS</td>
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<td>IR, IRLMS5703TRPBF</td>
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<td>Panasonic, ERJ-3EKF2002V</td>
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<td>P4.70KHC-ND</td>
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<td>Panasonic, ERJ-3EKF47R0V</td>
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<td>Amplifier, 2 channel</td>
<td>TI., TAS5421TQ1PHDR</td>
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<td>TI., UA78M33CDCYR</td>
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IMPORTANT NOTICE

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