# ANALOG DEVICES

# Evaluation Board for Audio Codec
# EVAL-SSM2604

## FEATURES

**USB connectivity to host PC**
**External connectivity to DSP/MCU for digital audio signals (available through general-purpose 2.54 mm pitch connector)**
**2 audio jacks: stereo line input, stereo line output**
**Multiple test points (TP) across the board for monitoring signals**
**Master/slave mode selectivity**

## GENERAL DESCRIPTION

The SSM2604 is a low power, high quality stereo audio codec for portable digital audio applications with one set of stereo programmable gain amplifier (PGA) line inputs. The SSM2604 can operate as a master or slave and supports various clock frequencies. The SSM2604 software-programmable stereo output options provide many application possibilities because the device can be used as a headphone driver or as a speaker driver. Its volume control functions provide a large range of gain control of the audio signal. Included in this data sheet is a detailed setup and user guide for the SSM2604 evaluation board hardware and software. Read the Evaluation Board Quick Setup section to ensure that proper communication is established from the host PC to the SSM2604 evaluation board.

This data sheet describes how to configure and use the SSM2604 evaluation board. It is recommended that the SSM2604 evaluation board data sheet be read in conjunction with the SSM2604 data sheet, which provides more detailed information about the specifications, internal block diagrams, and application guidance for the codec IC.

## EVALUATION BOARD DESCRIPTION

The SSM2604 evaluation board carries a complete application circuit for the SSM2604. The board features a USB connection to a host PC. This serves as the power supply, digital audio data, and control/status data link, making it a plug-and-play USB audio device that can communicate with the software under the Microsoft® Windows® operating system. The board also has a general-purpose 2.54 mm pitch connector to connect to an external DSP/MCU for digital audio signals.

Figure 1 shows the top view of the PCB. Figure 2 shows the bottom view of the board. The complete schematic of the board is illustrated in Figure 23 to Figure 27. Figure 28 and Figure 29 show the top layer layout and the bottom layer layout, respectively, of the PCB. The bill of materials is shown in Table 1.
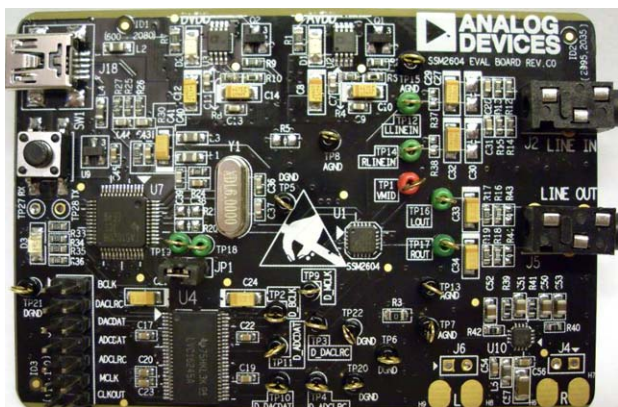


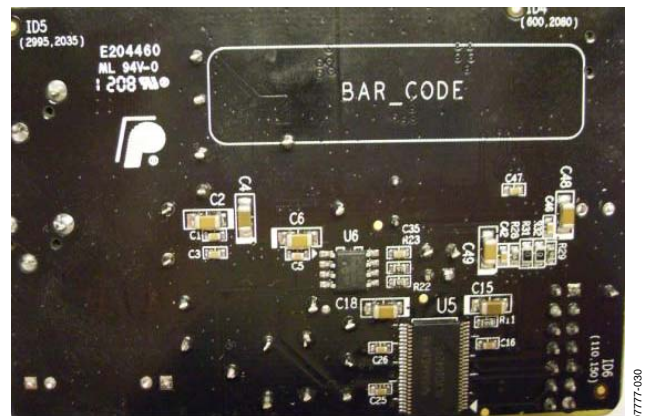*Figure 1. Top View of the SSM2604 Evaluation Board*



*Figure 2. Bottom View of the SSM2604 Evaluation Board*

# EVAL-SSM2604

## TABLE OF CONTENTS

## REVISION HISTORY

**12/08—Revision 0: Initial Version**

# EVALUATION BOARD HARDWARE

## HARDWARE DESCRIPTION

The SSM2604 evaluation board can be divided into several segments: the microcontroller unit (MCU) with USB interface, power supplies, analog input/output circuitry, the SSM2604 device, and the digital audio interface and bidirectional digital buffer.

### MCU with USB Interface

The on-board microcontroller (MCU) with USB interface is located on the top left portion of the evaluation board.

- The MCU has two functions: transmitting the SSM2604 registers control word between the host PC and the SSM2604 I²C port and transmitting digital audio data between the host PC and the SSM2604 digital audio interface.
- Use SW1 to reset the MCU.
- When the MCU is working correctly, LED D4 is blinking.
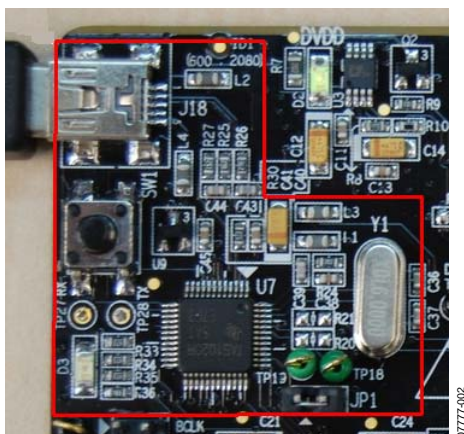- J8 is a mini Type B USB connector.

*Figure 3. USB Interface Microcontroller*

### Power Supplies

The power supplies are located on the top center portion of the board. The entire board is powered through the USB connector. There are two on-board low dropouts (LDOs) deriving 3.3 V from the USB 5 V supply. LED D1 and LED D2 indicate power supply status.

- The output from LDO U3 provides the voltage for the digital supply, DVDD. By default, the LDO output is set to 3.3 V. If a voltage other than 3.3 V is needed for DVDD, the user must remove Resistor R8 and apply the desired external voltage to the power supply pads, DCVDD and DGND, on the top center of the board.
- The output from LDO U2 provides the voltage for the analog supply, AVDD. By default, the LDO output is set at 3.3 V. If a voltage other than 3.3 V is needed for AVDD the user must remove Resistor R3 and apply the desired external voltage to the power supply pads, AVDD and AGND, on the top center portion of the board.
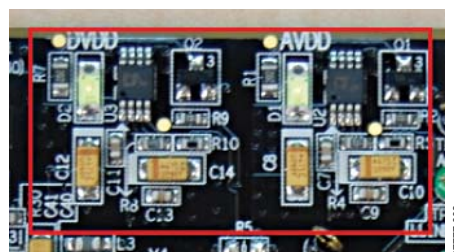
*Figure 4. Power Supply Circuitry*

### Analog Input/Output Circuitry

The right portion of the SSM2604 board includes analog input and output circuitry for SSM2604. From top to bottom, these are:
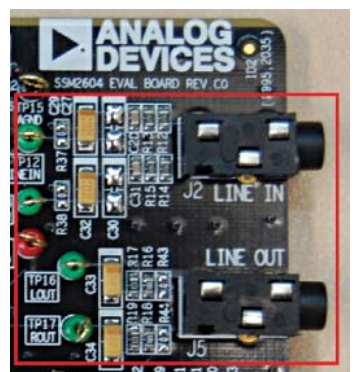
- Stereo line input jack
- Stereo line output jack

*Figure 5. Analog Input/Output Circuitry*

### SSM2604 Device

The SSM2604 device is located in the center of the SSM2604 eval-
uation board.



Figure 6. SSM2604 Device

### Digital Audio Interface and Bidirectional Digital Buffer

On the bottom left of the evaluation board are the general-purpose
digital audio interface, J1, and the bidirectional digital buffer for
digital audio signals.

J1 is for connecting the SSM2604 digital audio interface signals
to/from the external DSP or MCU. One column of J1 is DGND
and the other column is marked with the name of the digital audio
signal (BCLK, DACLRC, DACDAT, ADCDAT, ADCLRC, MCLK,
and CLKOUT). These signals are routed to the corresponding
SSM2604 digital audio interface signals through the digital buffer.

The buffer is bidirectional. Its direction is controlled in the software.
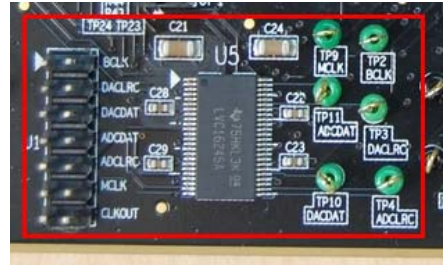


Figure 7. General-Purpose Digital Audio Interface and Buffer

# EVALUATION BOARD SOFTWARE

## EVALUATION BOARD QUICK SETUP

Follow these five steps to quickly set up the evaluation board:

1. Make sure Jumper JP1 is applied.
2. Connect the board to the host PC with a mini Type B USB cable. The first time the board is connected, the Windows system reports that new hardware has been found. The PC installs drivers for the new hardware automatically. **SSM2604/ 03/04 Eval Board** appears on the status bar of the **Speaker** control panel when installation is complete.
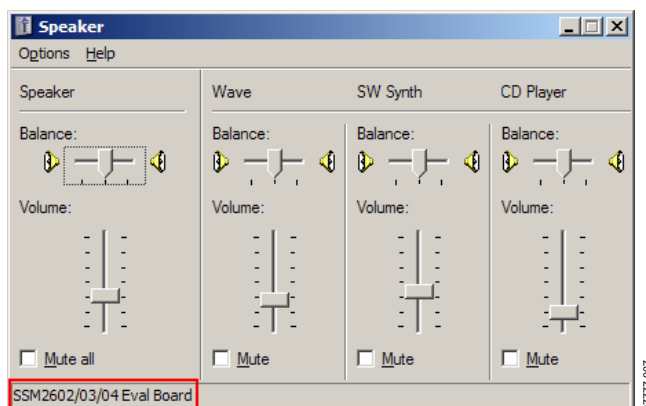


*Figure 8. Speaker Control Panel Setting*

3. Install the SSM2604 evaluation board control software from **SSM2604 Eval Board.msi**.
4. From the **Start** menu, select **Programs**, then **ADI**, then **SSM2604 Eval Board**, and then **SSM2604.exe** to run the control software. If the USB cable is not connected or Jumper JP1 is not applied before running the software, an error message box appears. Close the software, check the hardware connectivity, and rerun the software until the message box no longer appears.
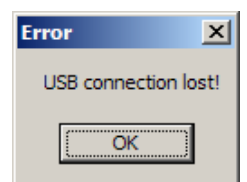


*Figure 9. Error Message When USB Connection Is Not Established*

5. When installation is complete, the software GUI appears. Click the **DAC** button to play music files in media player. You should be able to hear the music from the headphone or from the active speaker connected to the headphone output jack of the evaluation board. Note that only music files with a 48 kHz or 44.1 kHz sample rate are supported in this mode.
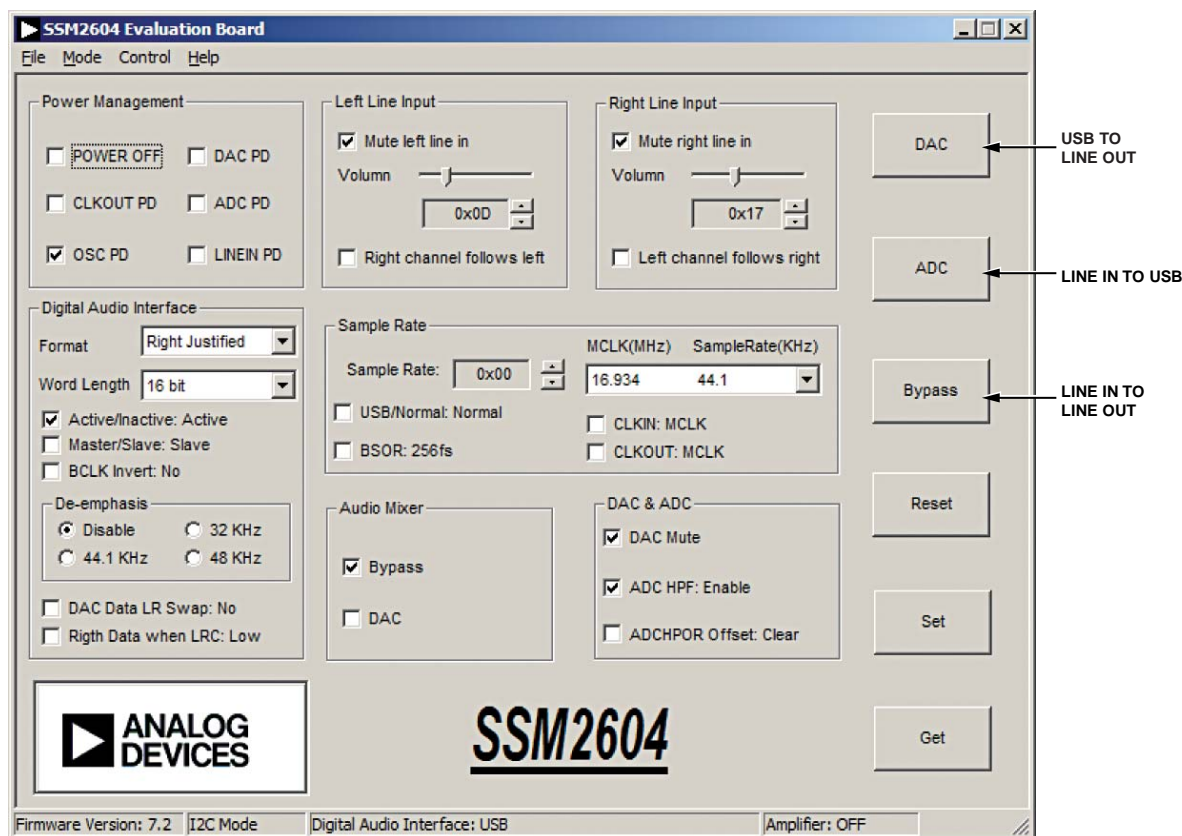


*Figure 10. SSM2604 Control Software GUI*

## GUI FUNCTIONAL BLOCKS

The software GUI is logically split into menu items, command buttons, and the register control panel. The menu is for setting up the software and hardware working mode. The command buttons are for register access. The register control panel is for viewing and modifying each register.

The SSM2604 supports the I²C standard for the register control interface. This is selected under the **Mode** menu. For I²C mode, you can select between two device addresses in the **I2C mode** submenu.
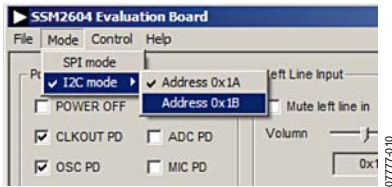
*Figure 11. Control Interface Selection*

There are two available digital audio interfaces for the SSM2604 on-board. One is the USB MCU. This is used to play back music on the host PC and transmit to the SSM2604 DAC, or to record music with the SSM2604 ADC and transmit to the host PC through a USB connection. The other digital audio interface is the general-purpose connector, J1. This is used to connect to your DSP or MCU. Only one interface can communicate with the SSM2604 at one time, and this is selected under the **Control** menu (see Figure 12).

*Figure 12. Digital Audio Interface Selection*

The **Import** and **Export** utilities, selected from the **File** menu, are for reading/writing the SSM2604 registers in batch mode. The file import utility reads the register setting from a .txt file and then writes to the SSM2604 internal registers. The file export utility reads the SSM2604 internal registers back and then writes to a .txt file.
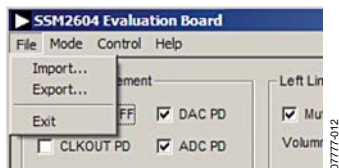
*Figure 13. File Import/Export Utility*

The .txt file used for SSM2604 register configuration contains multiple lines and each line is for one register. The first word of a line is a 7-bit register address entry, which is in two-digit hexadecimal format. The second word of a line is a 9-bit register value entry, which is in three-digit hexadecimal format. When using the import utility, use the export utility first to generate the software .txt file as a template and then add, remove, or modify the register entries in the template file.

*Figure 14. Register Configuration File Format*

After setting the registers in the SSM2604 control software GUI (see Figure 10), and clicking the **Set** button, the settings are configured to the corresponding SSM2604 registers. If the **Set** button is not clicked, the SSM2604 registers are not configured.

The I²C is a read and write protocol, so in I²C mode, when the **Get** button is clicked, the SSM2604 registers are read back and reflected in the SSM2604 GUI window.

The **Reset** button corresponds to SSM2604 Register R15. When it is clicked, all SSM2604 registers are set to the power-on reset value.

There are three short-cut buttons: **DAC**, **ADC**, and **Bypass**. These are used to quickly set the panel for the DAC path, the ADC path, and the analog line-in to analog line-out loopback path, respectively.

The SSM2604 GUI window is logically split into several different functional blocks. Each functional block represents the underlying internal register of the SSM2604 that corresponds to the block.

### Power Management Control

This section controls SSM2604 Register R6. If an option is checked, the power for that corresponding module is turned off; otherwise, the power is turned on for that part. For example, selecting **POWER OFF** shuts down the chip.
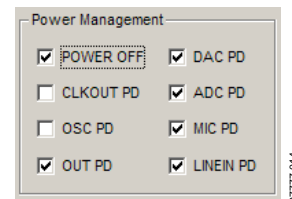
*Figure 15. Power Management Control Section*

## Line Input Control

This section controls SSM2604 Register R0 and Register R1 for the left and right line input channel, respectively. Note that the **Right channel follows left** option and the **Left channel follows right** option are mutually exclusive.
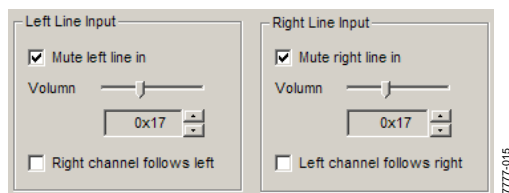
Figure 16. Line input Control section

## Headphone Output Control

This section controls SSM2604 Register R2 and Register R3 for the left and right headphone output channel, respectively. Note that the **Right channel follows left** option and **Left channel follows right** option are mutually exclusive.
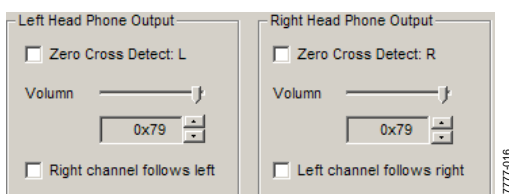
Figure 17. Headphone Output Control Section

## Analog and Digital Audio Path Control

This section controls SSM2604 Register R4 and Register R5 for the analog and digital audio path, respectively. **MIC Input** corresponds to D[8:6] and D[1:0] of R4. **DAC & ADC** corresponds to D[4:3] and D0 of R5 and D2 of R4. **Audio Mixer** corresponds to D[5:3] of R4.
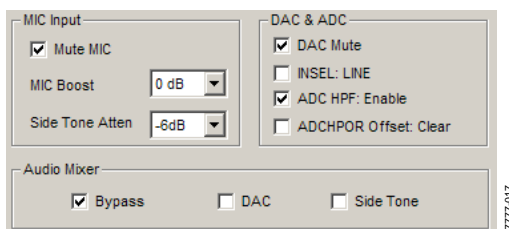
Figure 18. Analog and Digital Audio Path Control Section

## Digital Audio Interface Control

This section controls SSM2604 Register R7 and D[2:1] of Register R5. Specifically, the **Active/Inactive** option corresponds to R9.
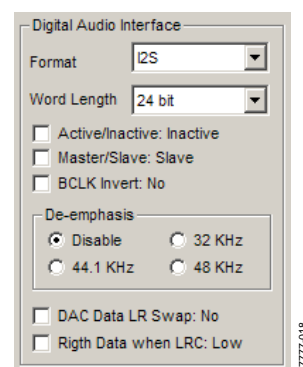
Figure 19. Digital Audio Interface Control Section

## Sample Rate Control

This section controls SSM2604 Register R8.

Figure 20. Sample Rate Control Section
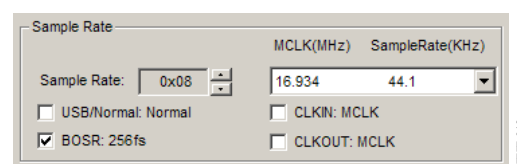
## ALC Control

This section controls SSM2604 Register R16 and Register R17.
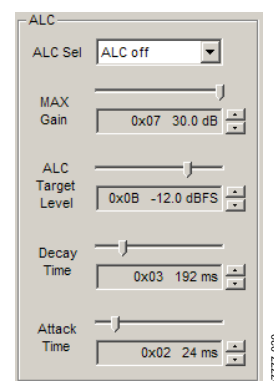
Figure 21. ALC Control Section

## Noise Gate Control

This section controls SSM2604 Register R18.
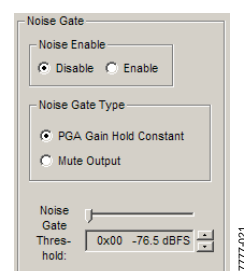
Figure 22. Noise Gate Control Section

# EVALUATION BOARD SCHEMATICS AND ARTWORK
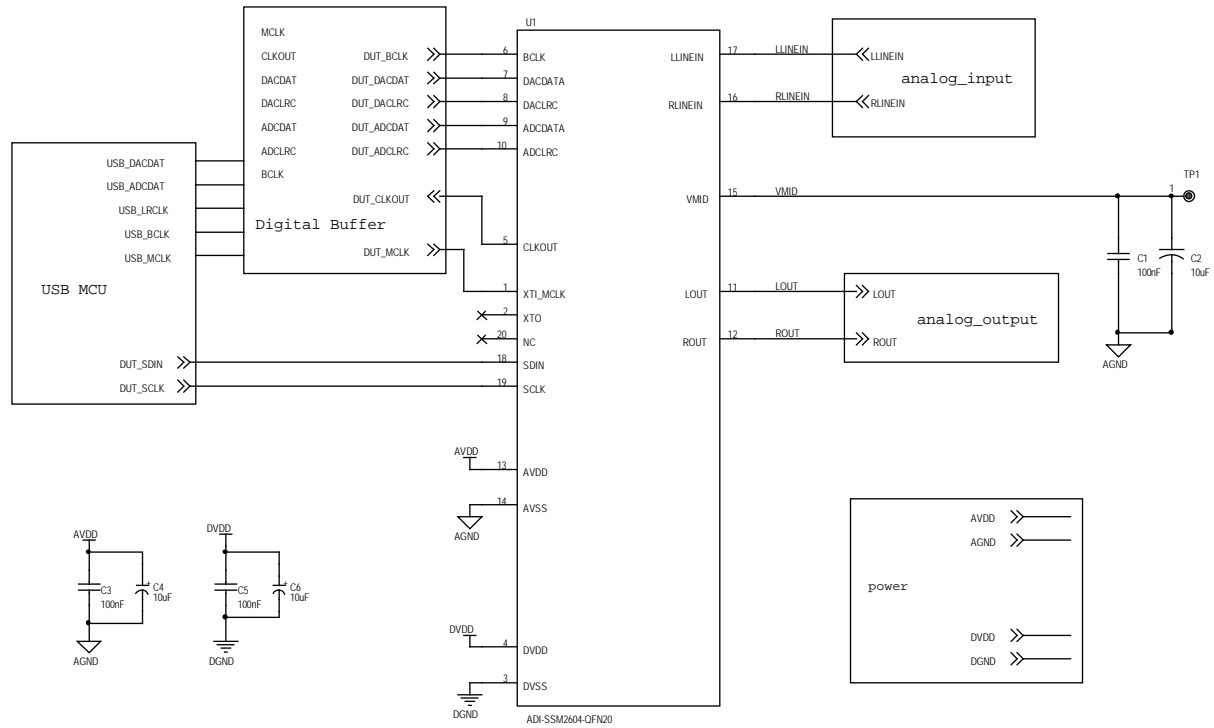


*Figure 23. Schematic of SSM2604 Evaluation Board, SSM2604 Chip*



*Figure 24. Schematic of SSM2604 Evaluation Board, Power Supply*

Figure 25. Schematic of SSM2604 Evaluation Board, Digital Buffer
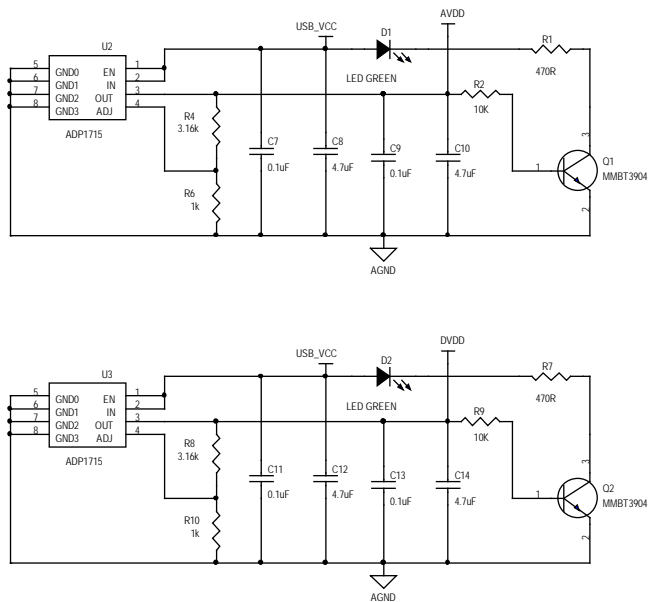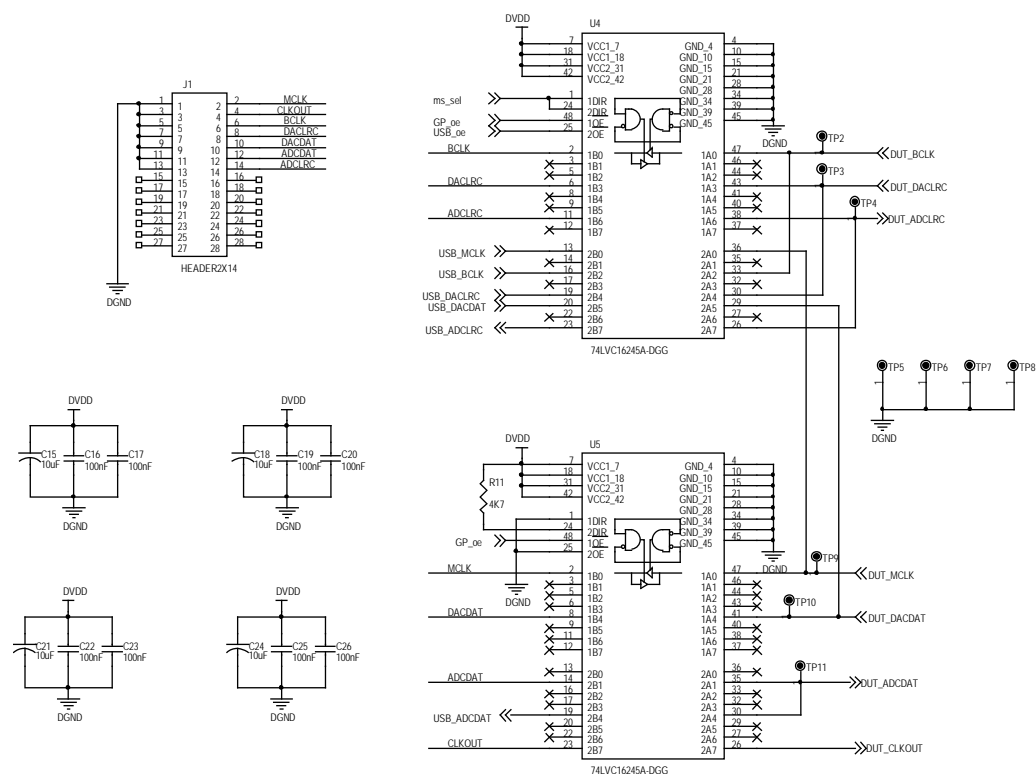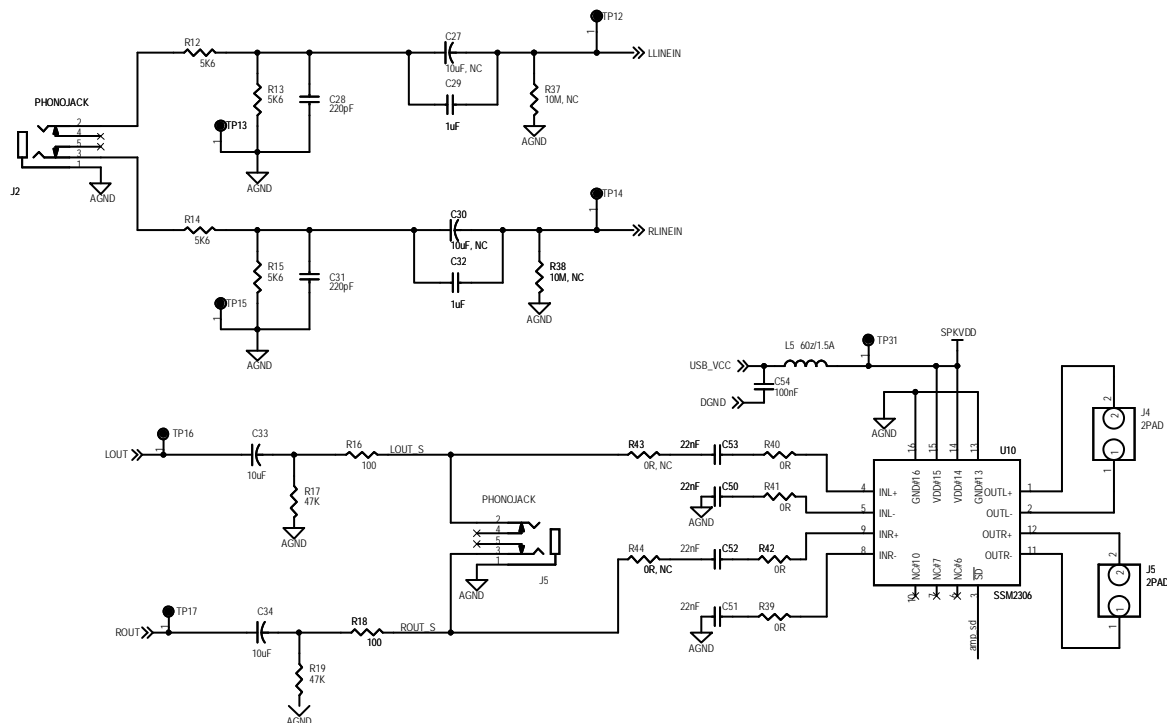


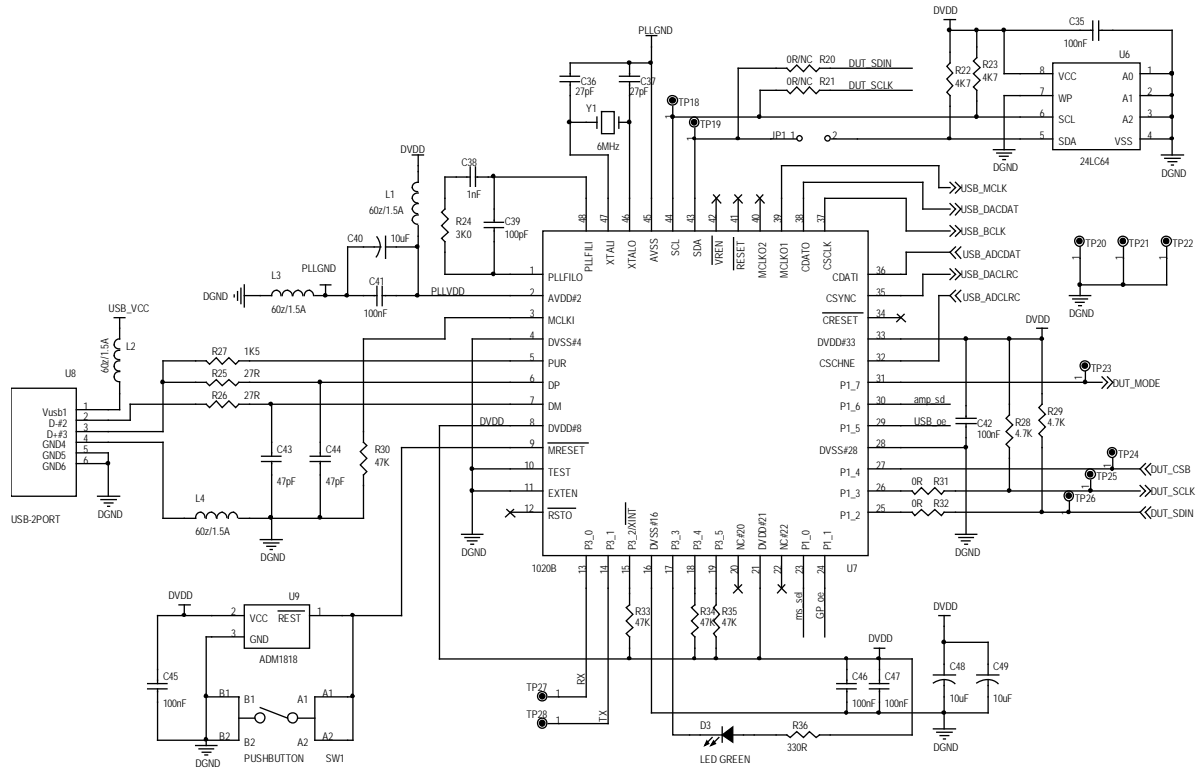Figure 26. Schematic of SSM2604 Evaluation Board, Analog Input and Output
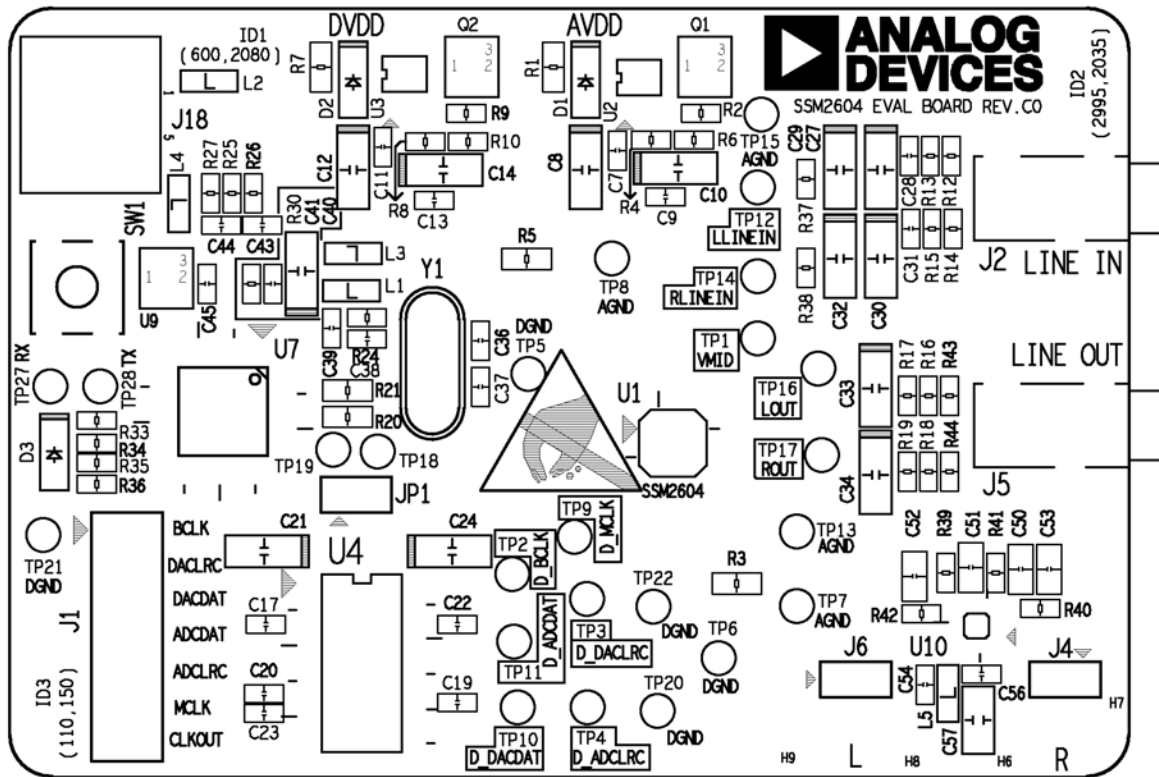
Figure 27. Schematic of SSM2604 Evaluation Board, USB MCU



Figure 28. Layout of SSM2604 Evaluation Board, Top Layer

Figure 29. Layout of SSM2604 Evaluation Board, Bottom Layer

# ORDERING INFORMATION

## BILL OF MATERIALS

**Table 1.**

| Qty | Reference Designator | Description | Manufacturer | Part Number |
|---|---|---|---|---|
| 2 | C29, C32 | 1 µF capacitor, 3216 | TDK | C3216CH1H105J |
| 13 | C2, C4, C6, C15, C18, C21, C24, C33, C34, C40, C48, C49, C57 | 10 µF capacitor, 3216 | TDK | C3216CH1H106J |
| 4 | C8, C10, C12, C14 | 4.7 µF capacitor, 3216 | TDK | C3216CH1H475J |
| 23 | C1, C3, C5, C7, C9, C11, C13, C16, C17, C19, C20, C22, C23, C25, C26, C35, C41, C42, C45, C46, C47, C54, C56, | 0.1 µF capacitor, 0603 | TDK | C0603CH1E104J |
| 2 | C27, C30 | 10 µF capacitor, not populated, 3216 | TDK | C3216CH1H106J |
| 2 | C28, C31 | 220 pF capacitor, 0603 | TDK | C0603CH1E221J |
| 2 | C36, C37 | 27 pF capacitor, 0603 | TDK | C0603CH1E270J |
| 1 | C38 | 1 nF capacitor, 0603 | TDK | C0603CH1E102J |
| 1 | C39 | 100 pF capacitor, 0603 | TDK | C0603CH1E101J |
| 2 | C43, C44 | 47 pF capacitor, 0603 | TDK | C0603CH1E470J |
| 4 | C50, C51, C52, C53 | 22 nF capacitor, 0805 | TDK | C0805CH1E223J |
| 3 | D1, D2, D3, D4 | LED, 1206 | Digi-Key | 597-3311-407 |
| 2 | J4, J6 | Header 1 × 2 | Digi-Key | A26508-02-ND |
| 1 | JP1 | Header 1 × 2 | Digi-Key | A26508-02-ND |
| 1 | J1 | Header 2 × 7 | Digi-Key | A26508-07-ND |
| 2 | J2, J5 | Audio jack | Kycon | STX-3500-3 |
| 1 | U8 | Mini USB, 1734035-1 | AMP/Tyco Electronics | 1734035-1 |
| 5 | L1, L2, L3, L4, L5 | Ferrite bead, 0805 | Murata | BLM21PG600SN1 |
| 2 | Q1, Q2 | SOT-23 transistor | Fairchild | MMBT3904 |
| 2 | R1, R7 | 470 Ω resistor, 0805 | Royalohm | 0805S4J0474T3E |
| 2 | R2, R9 | 10 kΩ resistor, 0603 | Royalohm | 0603S4J0103T3E |
| 2 | R3, R5 | 0 Ω resistor, 0805 | Royalohm | 0805S4J0000T3E |
| 2 | R4, R8 | 3.16 kΩ resistor, 0603 | Royalohm | 0603S4J3161T3E |
| 2 | R6, R10 | 1 kΩ resistor, 0603 | Royalohm | 0603S4J0102T3E |
| 5 | R11, R22, R23, R28, R29 | 4.7 kΩ resistor, 0603 | Royalohm | 0603S4J0472T3E |
| 4 | R12, R13, R14, R15 | 5.6 kΩ resistor, 0603 | Royalohm | 0603S4J0562T3E |
| 2 | R16, R18 | 100 Ω resistor, 0603 | Royalohm | 0603S4J0101T3E |
| 6 | R17, R19, R30, R33, R34, R35 | 47 kΩ resistor, 0603 | Royalohm | 0603S4J0473T3E |
| 1 | R24 | 3.0 kΩ resistor, 0603 | Royalohm | 0603S4J0303T3E |
| 2 | R25, R26 | 27 kΩ resistor, 0603 | Royalohm | 0603S4J0270T3E |
| 1 | R27 | 1.5 kΩ resistor, 0603 | Royalohm | 0603S4J0153T3E |
| 9 | R20, R21, R31, R32, R39, R40, R41, R42, R43 | 0 Ω resistor, 0603 | Royalohm | 0603S4J0000T3E |
| 1 | R36 | 330 Ω resistor, 0603 | Royalohm | 0603S4J0331T3E |
| 2 | R37, R38 | 10 MΩ resistor, 0603, not populated | Royalohm | 0603S4J0106T3E |
| 1 | SW1 | Pushbutton | Panasonic | EVQ-PHP03T |
| 1 | TP1 | Red test point, Header 1 | | N/A |
| 15 | TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP13, TP15, TP20, TP21, TP22 | Black test point, Header 1 | | N/A |
| 8 | TP12, TP14, TP16, TP17, TP18, TP19, TP27, TP28 | Green test point, Header 1 | | N/A |
| 1 | U1 | 20-lead stereo audio codec | Analog Devices | SSM2604CPZ |
| 2 | U2, U3 | SOP8-26-195 | Analog Devices | ADP1715 |
| 2 | U4, U5 | SOP48-20-320 | NXP | 74LVC16245A-DGG |

| Qty | Reference Designator | Description | Manufacturer | Part Number |
|---|---|---|---|---|
| 1 | U6 | SOP8-50-235 | Microchip | 24LC64 |
| 1 | U7 | QFP48-20-355 | TI | TAS1020B |
| 1 | U9 | SOT-23 | Analog Devices | ADM1818 |
| 1 | U8 | Mini USB, 1734035-1 | AMP/Tyco Electronics | 1734035-1 |
| 1 | U10 | SSM2306 | MLF16-20-120A | SSM2306 |
| 1 | Y1 | 6 MHz OSC2-190-430175 | ECS | ECS-60-32-4X |

## ORDERING GUIDE

| Model | Description |
|---|---|
| SSM2604-EVALZ[1] | Evaluation Board |

[1] Z = RoHS Compliant Part.

## ESD CAUTION

**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

## NOTES

# NOTES

NOTES

**ANALOG
DEVICES**

www.analog.com