Click here to ask an associate for production status of specific part numbers.

Evaluates: MAX98380 (WLP)

MAX98380 Evaluation System

General Description

The MAX98380 evaluation system (EV system) is a fully assembled and tested system that evaluates the MAX98380 boosted Class-D audio amplifier. The EV system consists of the MAX98380 Development Board (DEV board), Analog Devices Audio Interface Board III (AUDINT3), and a USB cable.

It is recommended that the DEV board be evaluated with the AUDINT3 board, as an EV system. The MAX98380 supports standard I²S, left-justified, and TDM digital audio interfaces.

The AUDINT3 board provides a USB-to-PCM interface in addition to a 1.8V VDD supply needed to evaluate the DEV board. The MAX98380 DEV board requires one additional supply input, 2.5V to 5.5V (VBAT) when evaluating using the AUDINT3 board. Figure 1 details the DEV board and the AUDINT3 board.

Features

- 2.5V to 5V Single-Supply Operation
- USB Audio Streaming (EV System)
- I²S, Left-Justified, or TDM Input
- Capacitive Charge Pump Boost Circuitry
- Fully Assembled and Tested

EV System Contents

- MAX98380 Development Board
- Audio Interface Board III
- Micro-USB Cable

***Ordering Information* appears at end of data sheet.**

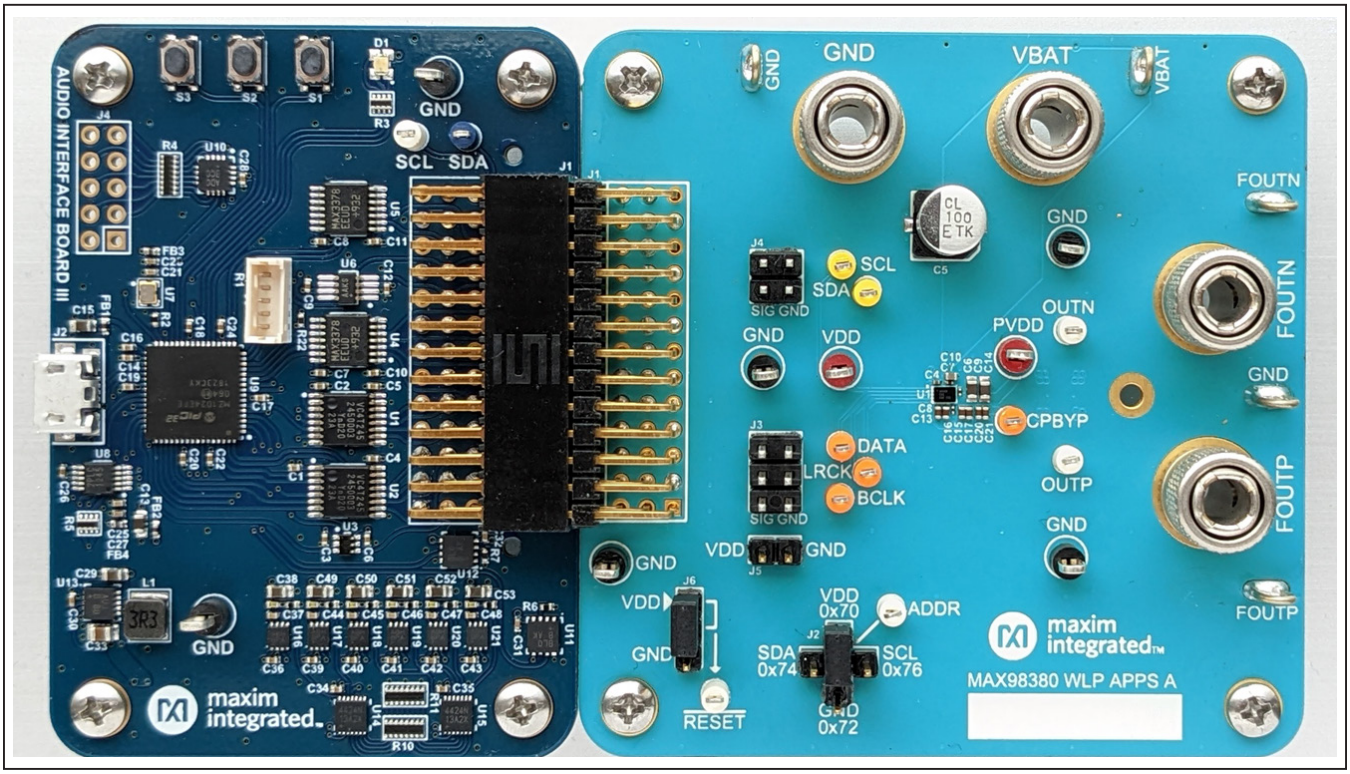

Figure 1. MAX98380 Evaluation System

319-100921; Rev 0; 5/22

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Quick Start

Required Equipment

- MAX98380 EV System
  - MAX98380 Development Board (DEV Board)
  - Audio Interface Board III (AUDINT3 Board)
  - Micro-USB Cable
- DC Power Supply (2.5V-5.5V, 4A)
- 6Ω to 8Ω speaker
- PC with Windows® 7 or Windows 10 with available USB port
- USB audio source (e.g., Windows Media Player® or iTunes®)

Required Software

- MAX98380 evaluation software (see Table 1)
  Installer: MAX98380EVSwSetupVxx.exe

Note: In the following sections, software-related items are identified by bolding. Text in **bold** refers to items directly from the evaluation software. Text in **bold and underlined** refers to items from the Windows operating system.

Table 1. MAX98380 Evaluation Software Folder

ITEM	DECRIPTION
MAX98380.exe	MAX98380 Evaluation software
Uninstaller.exe	Software uninstaller
USBDriver/FTDI	USB driver installer and help file
USBDriver/Device Manager	Shortcut to the computer's device manager

Reference Material

- MAX98380 IC data sheet

Procedure

The EV kit is fully assembled and tested. Follow the steps below to verify board operation.

Software Installation:

1) Visit **www.maximintegrated.com/products/MAX98380** under the Design Resources tab to download the latest version of the MAX98380 EV kit software. Save the EV kit software to a temporary folder and unpack the ZIP file.
2) Install the software and USB driver on your computer by running the MAX98380EVSwSetupVxx.exe program. Program files are copied, and icons are created in the **Windows Start** | **Programs** | **Maxim Integrated** | **MAX98380** | **Evaluation Software** menu. During software installation, Windows may display a message indicating that this software is from an unknown publisher. This is not an error condition, and it is safe to proceed with the installation.
3) The USB driver should be automatically installed at the same time as the evaluation software. If the driver needs to be manually installed, navigate to the FTDI folder located in the installation directory, **Program Files (x86)** | **Maxim Integrated** | **MAX98380** | **Evaluation Software** | **USBDriver** | **FTDI**, and run the CDMxxxxx.exe application.

AUDINT3 Board Setup:

4) Connect the MAX98380 DEV board (3 row J1 connector) to the AUDINT3 board (3 row J1 connector). To avoid damage, it is important to make sure the connectors of the two boards are properly aligned. The bottom row of both J1 connectors should be lined up so the standoffs on the corners of the AUDINT3 and DEV board are level.
5) With the audio source disabled, connect the Micro-USB cable from your computer to the USB port (J2) on the AUDINT3 board. The AUDINT3 board provides the BCLK and LRCLK signals as well as the power for VDD, sourcing 1.8V to the DEV board through the J1 connector.
6) The multi-color LED D1 initially flashes blue and then should change to slow flashing magenta when the computer successfully registers the AUDINT3 as a USB audio playback device.

DEV Board Setup:

7) Set the ENABLE jumper, J6, to VDD.
8) Load default config file through the MAX98380 evaluation software.
9) Connect the speaker. Connect the speaker leads across the FOUTP and FOUTN binding posts.
10) Connect VBAT. With the DC supply not powered, connect the 2.5V to 5.5V power supply across the VBAT and GND binding posts.

iTunes is a registered trademark of Apple Inc.
Windows is a registered trademark and registered service mark of Microsoft Corporation.
Windows Media is a registered trademark and registered service mark of Microsoft Corporation.

USB Audio Playback Test:

11) Enable the VBAT supply voltage (2.5V to 5.5V, 4A).
12) Open the Windows' **Sound** dialog and select the **Playback** tab. A **Speakers** item such as Figure 2 should be listed as an available playback device.
13) Verify that the **Speakers** item is set as the default device. Once this is done, the AUDINT3 board outputs PCM data to the DIN pin on the DEV board.
14) Adjust the audio source volume to a low level.
15) Enable the audio source and verify that audio is heard through the connected speaker. Adjust the audio source volume as needed.
16) Quick Start for USB Audio Playback is now complete.
17) For details on how to connect in a standalone mode to audio test equipment, such as Audio Precision, see the *Detailed Description of Hardware* section.



Figure 2. Playback Device

Detailed Description of Software

The MAX98380 evaluation software is designed to be used only with the MAX98380 EV system. The software provides an intuitive graphical user interface (GUI) for programming the MAX98380 device and includes a handful of features that are intended to aid evaluation.

The MAX98380 evaluation software main window (Figure 3) is composed of four main sections: a menu bar, communication toolbar, tabbed pages, and a status bar. The menu bar provides additional features to aid evaluation, the toolbar provides basic functionality for communicating with the device, and the status bar provides information about hardware connectivity and communication status. The tabbed pages make up the bulk of the GUI and provide the controls for programming the MAX98380 device registers.

The **Block Diagram** tab provides access to all device registers using dialog windows, which contain GUI controls for configuring the device. The dialog windows are opened by clicking on the blocks in the block diagram. The **Control Registers** tab provides access to the valid registers in the range from 0x2000 thru 0x210F as well as to the revision ID register, 0x21FF.

The MAX98380 evaluation software is compatible with Windows 7 and Windows 10 and can be downloaded from **www.maximintegrated.com/evkitsoftware**. Refer to the MAX98380 IC data sheet for device register information.

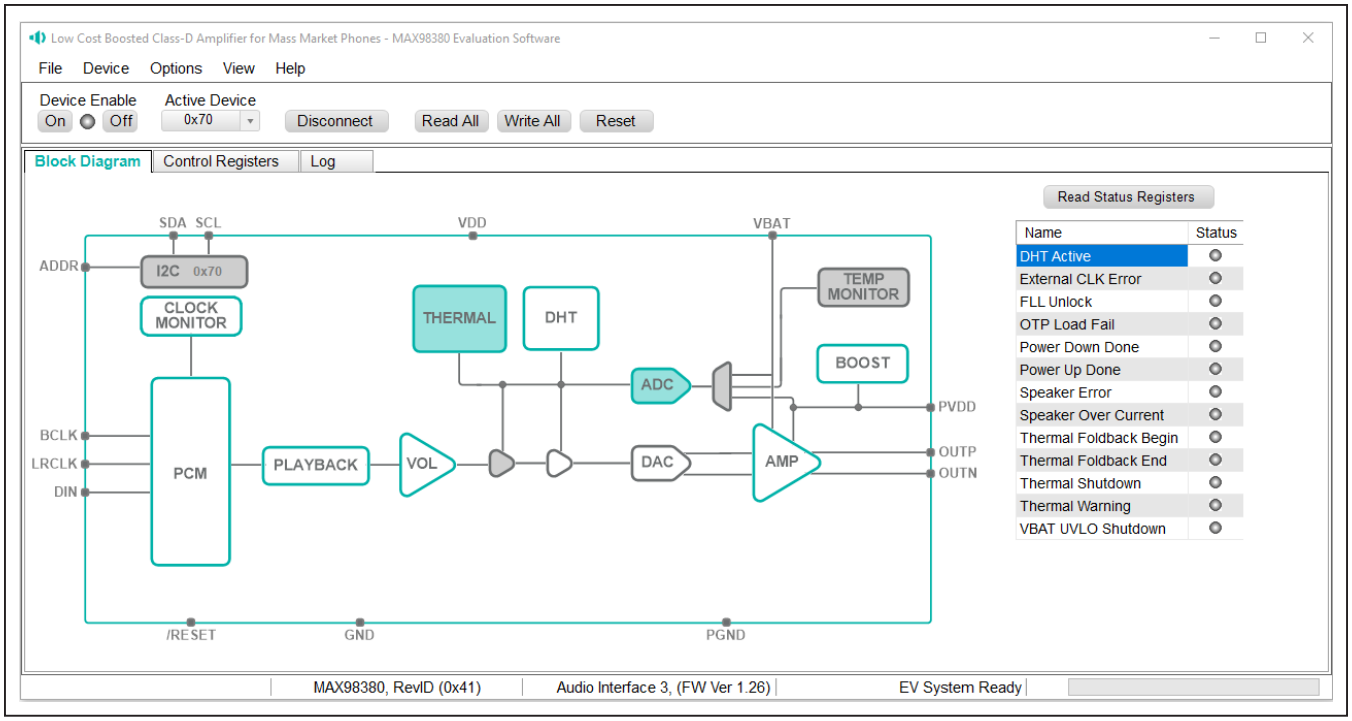


Figure 3. MAX98380 Evaluation Software—Main Window

Communication Toolbar

The toolbar consists of six buttons and a drop-down combo box. These controls are always accessible, regardless of the active tabbed page. The toolbar shown in Figure 4 and Table 2 provides details about each control.

Connect Sequence

When the evaluation software starts for the first time, the program attempts to automatically connect to the EV system. It first attempts to connect to the USB Control (USB1) interface on the AUDINT3 board. Once that connection is established, it searches for all the I²C addresses associated with the MAX98380 device and populates all detected device addresses in the **Active Device** drop-down list. During this sequence, the text on the **Connect** button automatically changes from **USB** to **Device** to **Disconnect** and the status bar also is updated to reflect the current state of the hardware connection.

Once the EV system is fully connected, the button displays **Disconnect**, and when pushed, it disconnects the software from the hardware. The software can also be disconnected from the hardware by selecting **Options | Disconnect** from the menu bar.

There are two methods to re-establish a connection with the hardware. The first is by selecting **Options | Auto Connect** from the menu bar. This instructs the program to automatically connect to the EV system, just as was done when the software first started. The second method is to manually push the **Connect** button until it displays **Disconnect**, which signifies that the EV system is fully connected.

Status Bar

The **Status** bar is divided into three sections. From left to right, the device part number and revision ID, AUDINT3's firmware version, and the EV system status.

Status Panel

The **Status** panel (not to be confused with the **Status** bar) displays the **STATUS** values of the device's status registers. This data is read from the Live Status registers (0x2001 thru 0x2002).

A text string is displayed in the **STATUS** column to report the state of each status bit and an image is displayed in the **STATE** column to indicate the setting of the associated state bit. When the image is visible, it indicates that the associated state bit has been set.

Table 2. Toolbar Controls

CONTROL	FUNCTION
On	Press to set the Global Enable bit (EN). This enables the device.
Off	Press to clear the Global Enable bit (EN). This disables the device. **Note:** The software can communicate with a disabled device, being that its I²C interface remains active.
Active Device	Provides a list of detected I²C addresses. The displayed address is the active device.
Connect/Disconnect	See the *Connect Sequence* section for additional details.
USB	Press to connect to the USB Control (USB1) interface on the AUDINT1 board.
Connect	Detected addresses are shown in the **Active Device** drop-down list.
Disconnect	Press to disconnect from the USB Control (USB1) interface.
Read All	Press to initiate a read of all device registers. The **Control Registers** and **Block Diagram** tabs are updated to reflect the read data.
Write All	Press to initiate a write to all device registers using the settings shown on the **Control Registers** tab.
Reset	Press to reset device registers to their Power-On-Reset (POR) state



Figure 4. Communication Toolbar

Block Diagram Tab

The evaluation software uses an interactive block diagram to facilitate the programming of the MAX98380 device. The block diagram also provides a visual representation of the device's functions and current configuration.

There are two types of blocks in the block diagram, and they are identified by the cursor image. The cursor changes to a hand when over a block that has an associated dialog window. If the cursor does not change (i.e., remains an arrow) then that block does not have an associated dialog window. Clicking on a dialog block opens a dialog window, containing the controls for that functional block.

The color of a diagram block changes depending on the enabled state of the device function(s) associated with that block. A disabled block is grey, and an enabled block is teal. Figure 5 shows the block diagram with the MAX98380 configured for DAI (USB audio) input and speaker output.

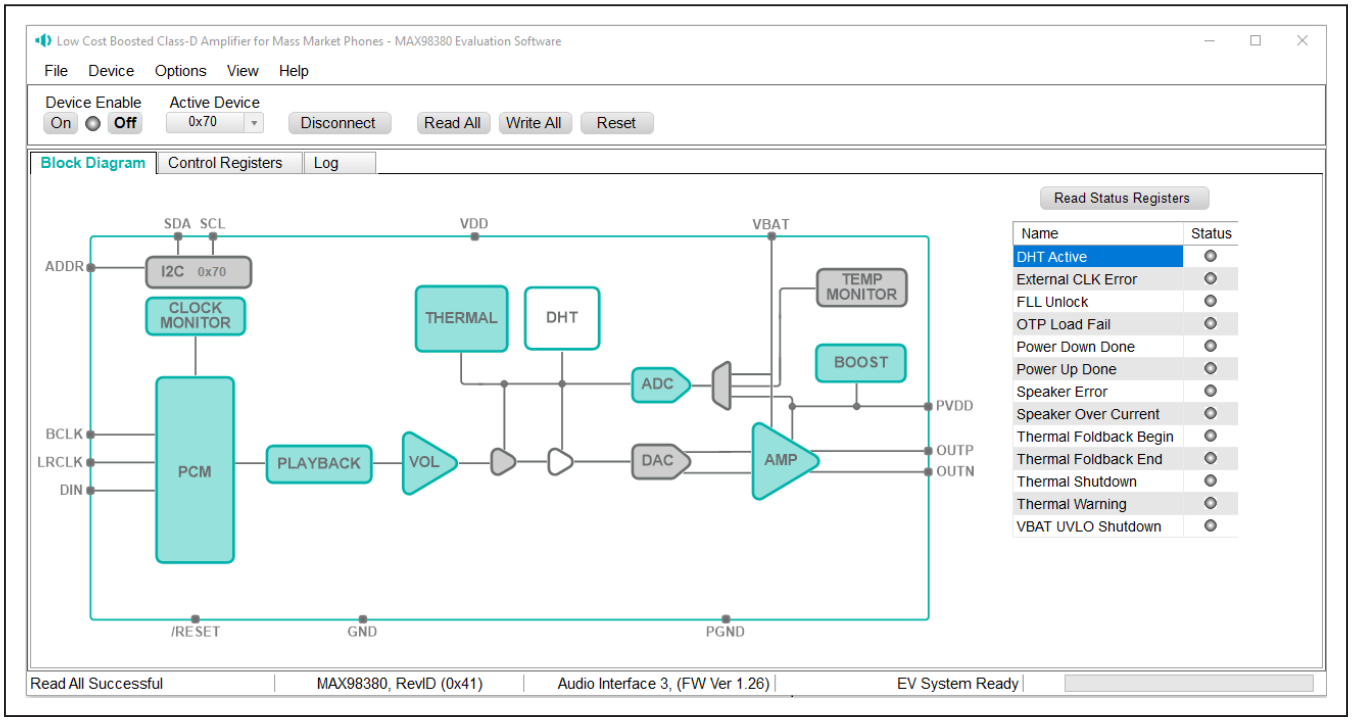


Figure 5. MAX98380 Block Diagram—USB Audio Input to Speaker Output

Dialog Windows

Dialog windows are associated with specific blocks in the block diagram, and they contain the controls for configuring the registers associated with that functional block. A dialog window is opened by clicking on a dialog block. Figure 6 shows the typical GUI controls that are found on a dialog window.

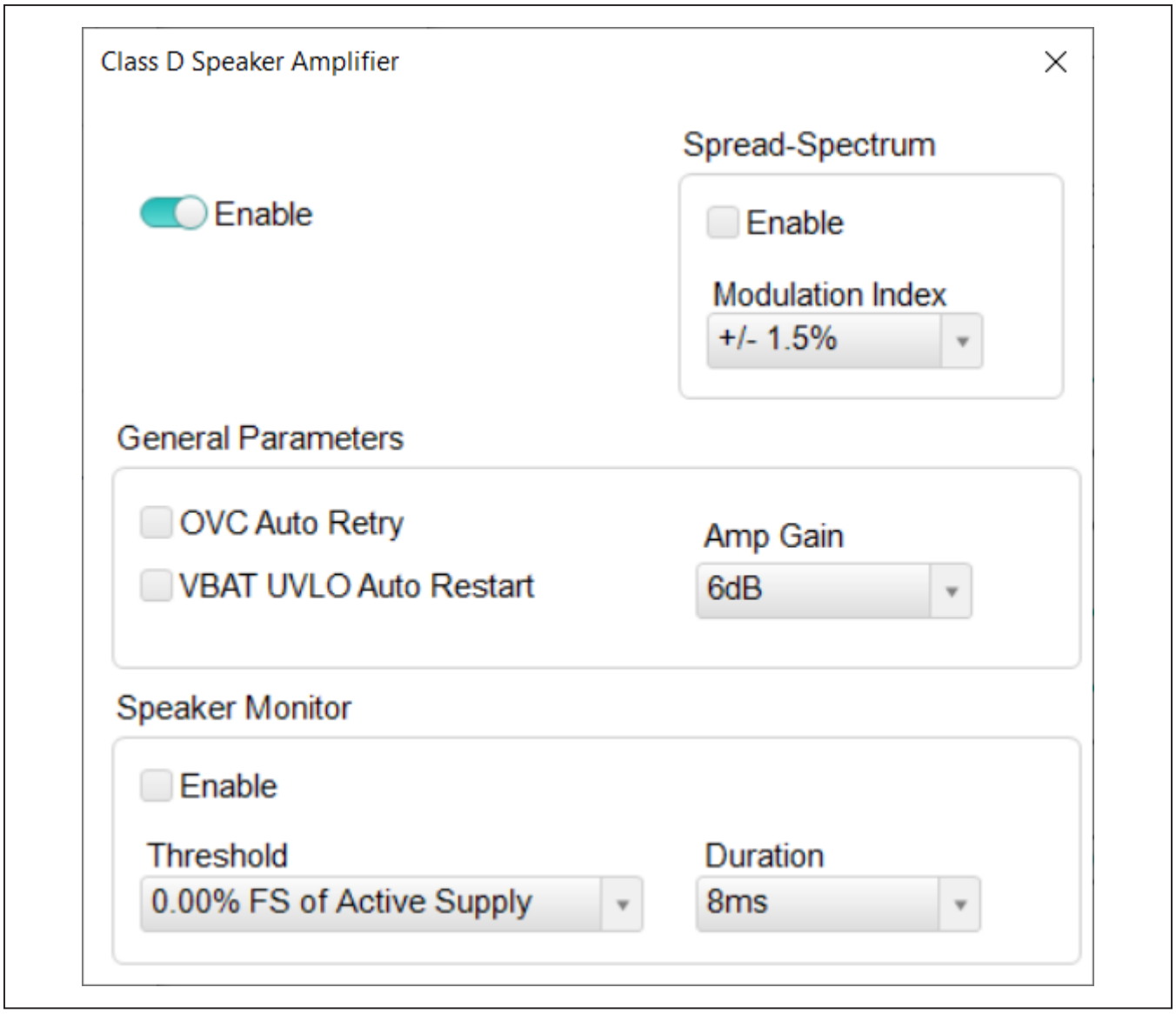


Figure 6. Typical GUI Controls

Control Registers Tab

The **Control Registers** tab provides two methods for configuring the device. As an example, Figure 7 shows the elements of the DAI registers.

The first configuration method involves clicking on the register's bit labels. A greyed-out bit label indicates that the bit is currently set low. A bold bit label indicates that the bit is currently set high. Clicking on a bit toggles its state and results in a write to that register. This action also updates the value displayed in the register's edit box, located to the right of the bit labels.

The second configuration method involves entering a hexadecimal value in the register's edit box and then pressing the **Enter** key. The software automatically configures the device register once the **Enter** key is pressed. The state of the bit labels also is updated to reflect the value shown in the edit box.

Note: Trying to write to a read-only bit, by clicking/toggling its label or entering a hex value in its edit box, updates the GUI, but it does not affect the bit's value in the device. All read-only bits are updated, to reflect their current value in the device, by performing a read-all operation.

All changes made on this tab are reflected on the **Block Diagram** tab and any open dialog windows.

Menu Bar

All menu bar items are described in Table 3. Additional information for some menu items is provided in the following sections.

Table 3. Menu Bar Items

MENU ITEM	DESCRIPTION
File	
Load Register Settings	Loads a configuration file (as saved by the **Save Settings** option).
Save Control Register Settings	Saves a configuration file containing the current device settings.
Exit	Closes the MAX98380 evaluation software.
Device	
Connect	Select to have the software automatically connect to the evaluation system.
Disconnect	Disconnects the PC from the evaluation system.
Reset	Resets registers 0x2000 through 0x210F to their Power-On-Reset states.
Read All	Performs a read from all registers and updates the GUI.
Write All	Performs a write to all writeable registers using the values shown on the **Control Registers** tab and then updates the GUI.
Read REV ID	Reads the device's revision ID register and updates the status bar.
Options	
Interface Selection	Selects the I^2C hardware interface.
Configuration Mode F4	Opens a dialog that allows multiple MAX98380 devices to be selected for configuration through the software. **Note:** This feature is not yet supported.
Demo Mode	Puts the software in demo mode.
Help	
View Help F1	Provides details on where to find help.
About	Provides information about the MAX98380 evaluation software.

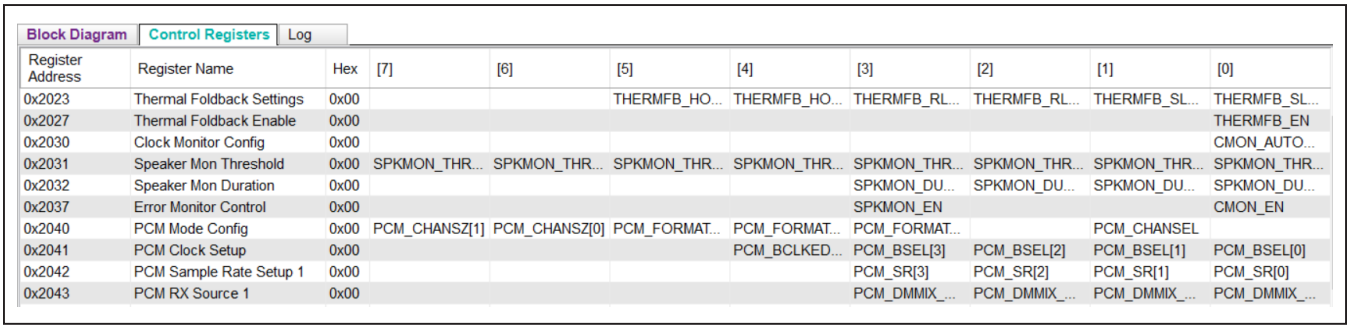


Figure 7. Control Registers Tab

File I/O

The software's save and load features are accessed from the **File** menu. The **Save** feature saves the data currently displayed on the **Control Registers** tab.

A configuration file's main purpose is to capture the current state of the MAX98380's registers, as displayed on the **Registers** tab. This feature makes it easy to program a device to a saved/known state and allows for the sharing of configuration files between users. To facilitate usage, use descriptive file names when saving the configuration file.

The save and load features are functional even when the hardware is not connected. This allows configuration files to be created and opened when the hardware is not available. Since the configuration file is automatically generated by the software, it is not meant to be manually formatted, and doing so can cause file loading issues. To open a configuration file for viewing purposes, use a plain text editor.

Select **File | Save Settings Ctrl + S** to create a configuration file. The register address and its data are saved as tab-delimited values and the file is saved with a .98380 extension.

Detailed Description of Hardware

The MAX98380 EV system is designed to allow for a thorough evaluation of the MAX98380 digital input Class-D audio amplifier IC. The EV system includes the MAX98380 Development Board (DEV board), the Audio Interface Board III (AUDINT3), and a Micro-USB cable.

To simplify evaluation, the MAX98380 DEV board can be used together with the AUDINT3 and only one external power supply for VBAT. The AUDINT3 supplies 1.8V for VDD and a plug-and-play USB-to-I^{2}S interface, allowing any computer to become a 48kHz digital audio source. The AUDINT3 board provides a fast and easy-to-use method for exercising the main capabilities of the device with no additional audio equipment.

The AUDINT3 board automatically senses the MAX98380 DEV board and configures its LDO regulators to power the MAX98380 DEV board's VDD pin through connector J1. The USB-to-PCM converter accepts a USB audio stream from a USB-connected computer and converts it to an I^{2}S stream, allowing for USB audio playback through the MAX98380 device. The AUDINT3 board should not be used to deliver audio input when directly driving the DEV board's PCM interface with external audio test equipment. The Digital Audio Interface (DAI) pins on the DEV board and AUDINT3 digital audio outputs are connected through the J1 header, creating a signal conflict. Disable all DAI signals using the AUDINT3 software if using external audio stimuli. However, the AUDINT3 can still provide VDD if an external power supply is not available.

For maximum flexibility, the MAX98380 DEV board can also be evaluated as a standalone board, with two external power supplies (VBAT and VDD), and the digital audio signal is driven directly by specialized audio test equipment (Audio Precision, etc.)

Power Supplies

When evaluated as a standalone board, the MAX98380 DEV board requires two external power supplies: VBAT, which is the supply voltage for the main Class-D power stage, and VDD, which supplies low-level system power to the IC.

The voltage applied to VDD determines the logic level of the EN pin when J6 is in the ENABLE position. The power supplies and their ranges are listed in Table 4. The external supply voltages can be connected at the respective supply test points and/or binding posts.

The AUDINT3 board, when properly connected to the DEV board, senses, and automatically provides 1.8V to VDD of MAX98380 DEV board through jumper J1, when active USB power is supplied. Note that with the AUDINT3 board connected, VDD is automatically provided, but an external VBAT is still required.

Table 4. Power Supplies

POWER SUPPLY	RANGE (V)
VDD	1.71 to 1.89
VBAT	2.5 to 5.5

Jumper Selection

Shutdown Mode

The DEV board includes header J6 for device enable. The MAX98380 device features a hardware shutdown mode that is activated by setting the J6 shunt in the DISABLE position. This is the lowest power state, where all device registers are returned to their PoR values and the I²C control interface is disabled. To exit the hardware shutdown mode, place the J6 shunt to the ENABLE position, and initialize the device. See Table 5 for reference.

DAI Headers

The DAI headers provide access to MAX98380's I²S bus: BCLK, LRCLK, and DATA. This DAI header facilitates evaluation with audio equipment I/O. See Table 6 for the pin-out of the DAI headers. Figure 8 shows a close-up image of the MAX98380 DAI interface header (J3) to be used if connecting external DAI inputs, such as those provided by Audio Precision or other audio test equipment.

Speaker Output

The MAX98380 audio output is routed to the FOUTP and FOUTN connections on the DEV board. The DEV board is, by default, assembled to allow the MAX98380 output to connect directly to a speaker load without the need for filtering.

Table 5. Jumper Configuration

HEADER	SHUNT POSITION	DESCRIPTION
J6	EN to VDD	Normal Operation
	EN to GND	Shutdown

Table 6. DAI Headers (J3)

SIGNAL	PIN	PIN	SIGNAL
GND	1	2	DATA
GND	3	4	LRCLK
GND	5	6	BCLK

EMI Filter

When long speaker cables are used with the MAX98380 output (exceeding ≈12in (30 cm)), a ferrite bead plus capacitor filter can be installed to prevent excessive EMI radiation. Although it is best to choose filter components based on EMI test results, the combination of 100pF capacitors (C11, C12) and ferrite beads (L1, L2) generally work well. Before adding the filters to the design, first, remove the small PCB traces shorting the pads of L1 and L2 (see the *MAX98380 WLP EV Kit Development Board Schematic* and the *MAX98380 WLP EV Kit Development Board PCM Layout Diagrams*).

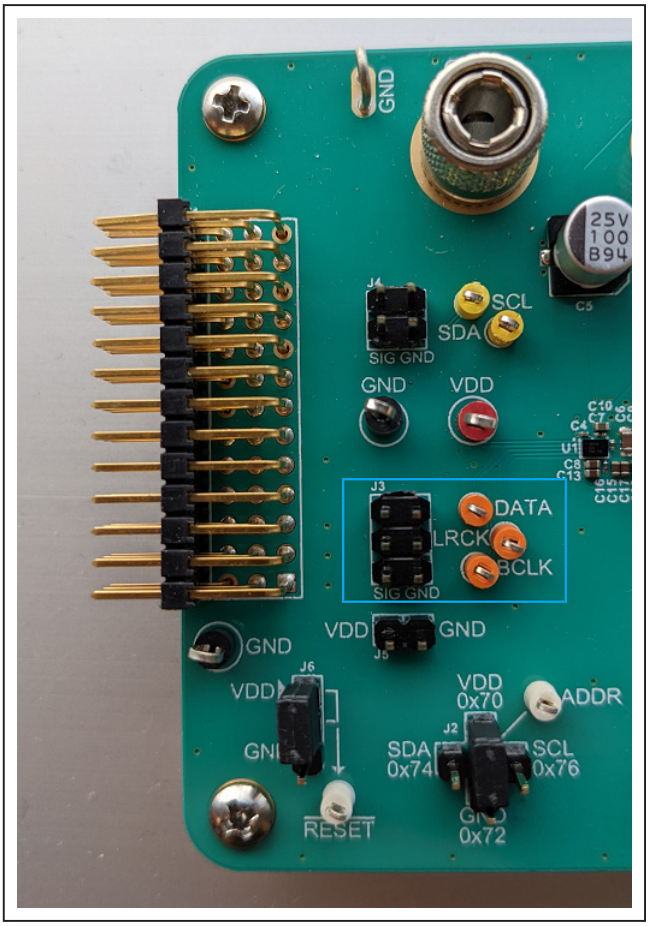


Figure 8. MAX98380 DAI Interface Headers

Audio Interface Board III (AUDINT3 Board)

Analog Devices AUDINT3 board facilitates the evaluation of the DEV board by providing a set of features that can be used to exercise the capabilities of the DEV board without the need for additional audio equipment. The main components of the AUDINT3 board are its LDO supply voltages and its USB-to-PCM interface. The supply voltages allow the DEV board to be evaluated with a minimal number of external supplies. The USB-to-PCM converter allows any computer to be used as an audio source for the DEV board's digital audio PCM interface.

The MAX98380 DEV board connects to the AUDINT3 board through connector J1. The physical connections made between the DEV board and the AUDINT3 board are listed in Table 7.

Table 7. AUDINT3 Connector (J1)

SIGNAL	PIN	SIGNAL	PIN	SIGNAL	PIN
—	1	MCLK	2	GND	3
BCLK2	4	BCLK1	5	GPIO1	6
LRCLK2	7	LRCLK1	8	GPIO2	9
DAC2	10	DAC1	11	GPIO3	12
ADC2	13	ADC1	14	GPIO4	15
—	16	ID	17	3.3V	18
AVDD	19	DVDD	20	GND	21
HPVD	22	VDDUI	23	GND	24
GND	25	SDA	26	5V	27
—	28	SCL	29	5V	30
GND	31	IRQ	32	RST	33
—	34	—	35	—	36
GND	37	—	38	—	39

USB Audio Input

To use the USB streaming feature of the AUDINT3 board, ensure that the AUDINT3 board is connected to the DEV board, then connect the USB cable from your computer to the USB connector J2 on the AUDINT3 board. Configure the desired audio signal inputs using the **Audio Controls** panel of the AUDINT3 interface software (Figure 9). As described earlier, a computer can be used to supply audio inputs over a USB interface in several selectable formats, found under the **DAI Mode** drop-down menu. The AUDINT3 board can also generate test signal tones of various types, frequencies, and amplitude as shown in Figure 10.

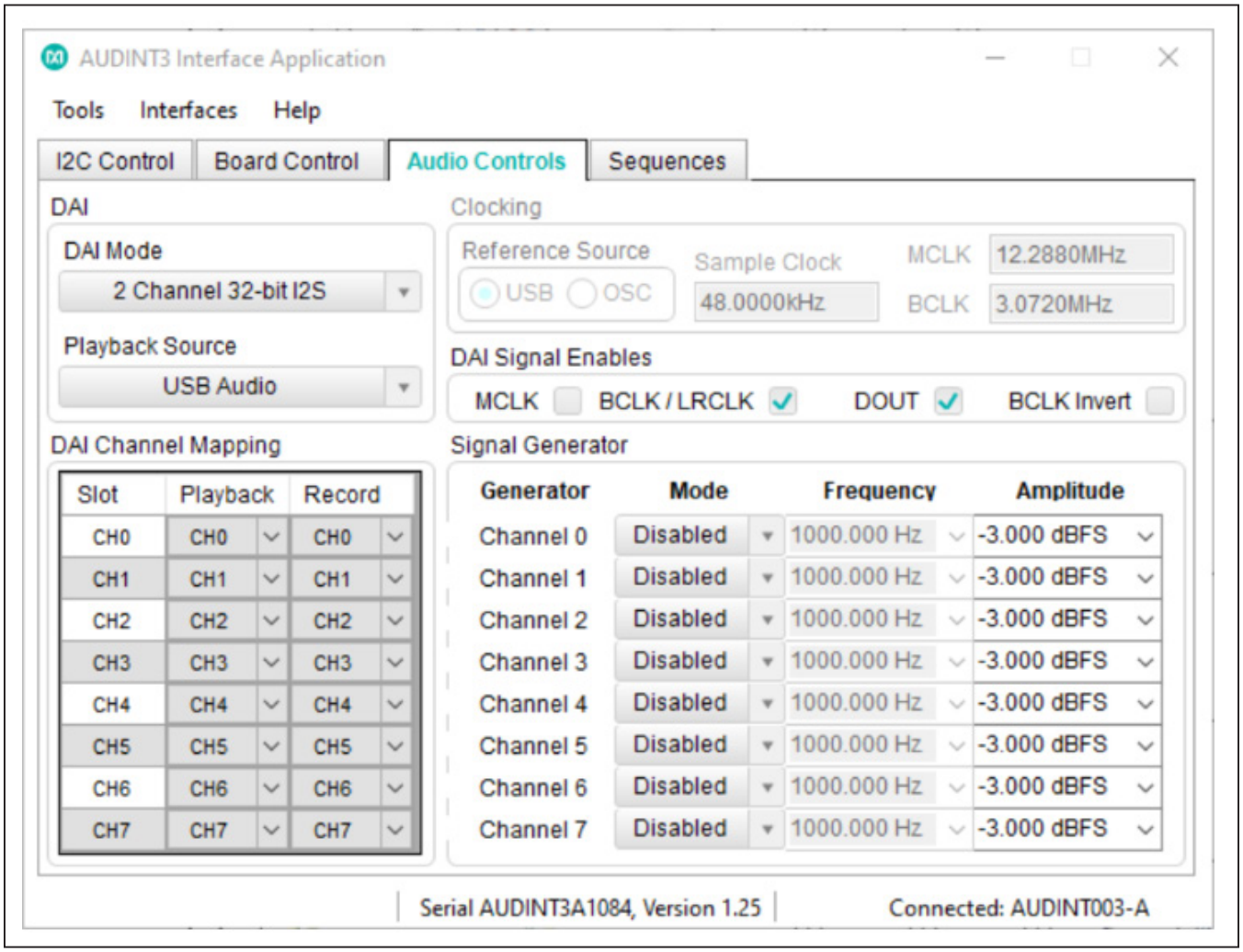


Figure 9. AUDINT3 Configured for Computer Audio Input Over USB

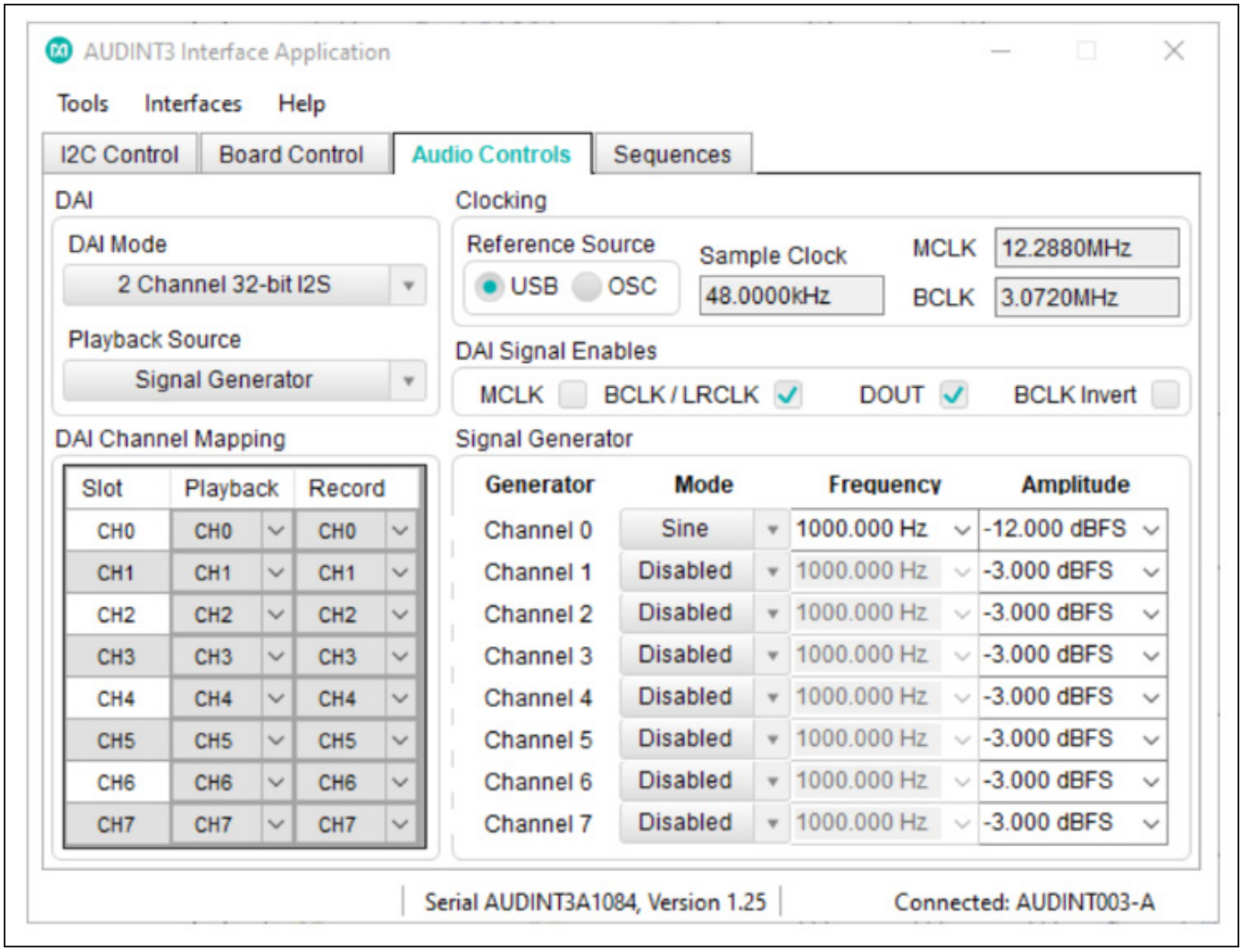


Figure 10. AUDINT3 Configured for a -12dBFS 1kHz Sine Input using an Internal Signal Generator

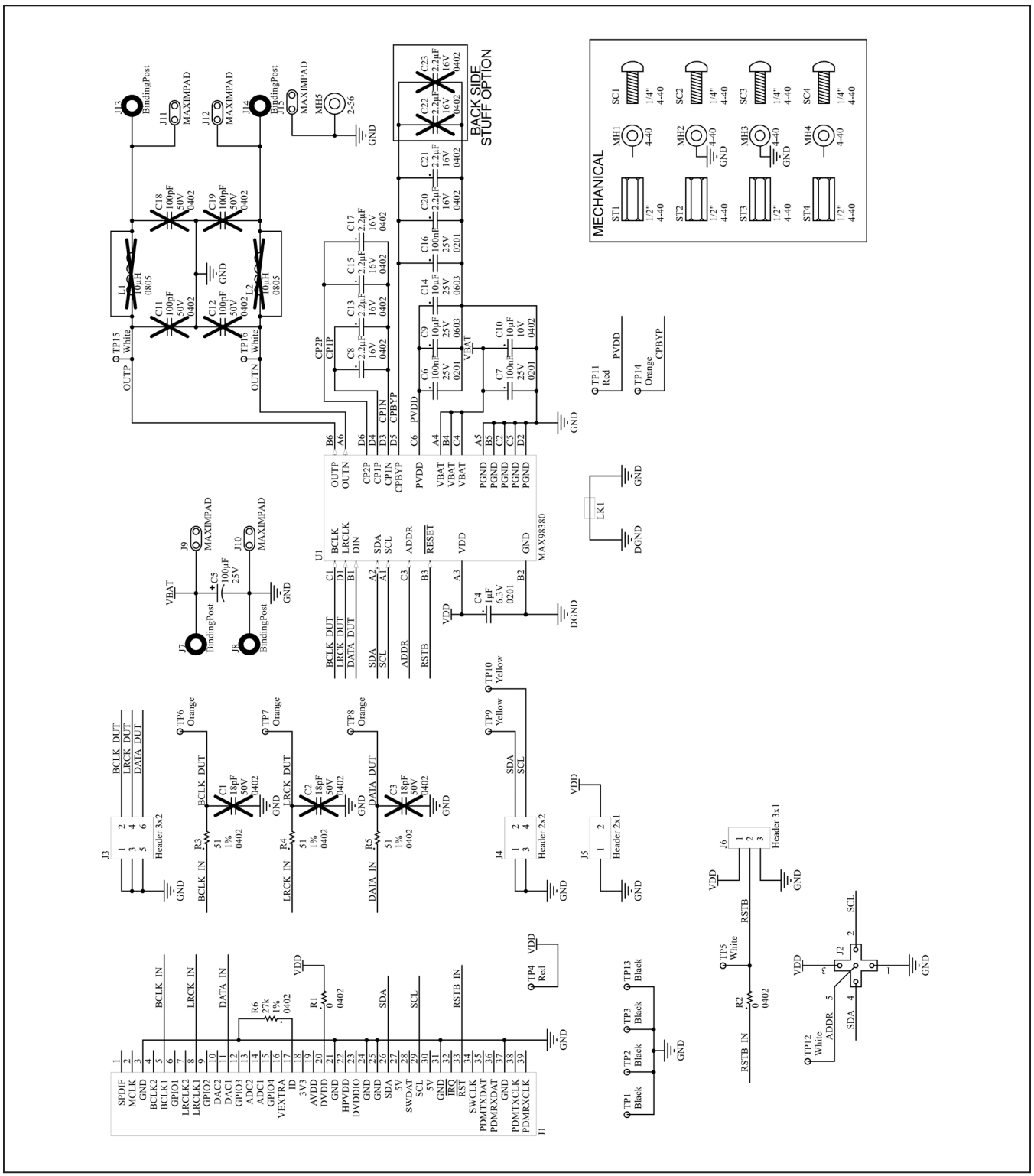
Ordering Information

PART	TYPE
MAX98380EVSYS#	Evaluation System

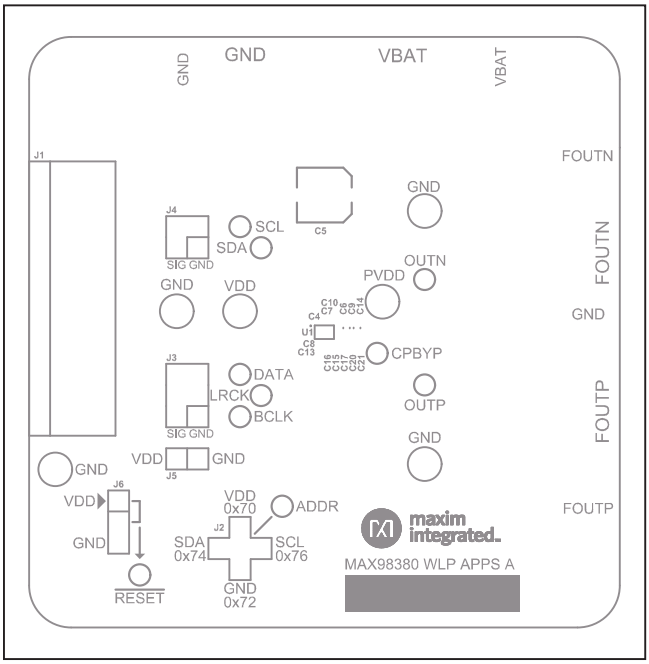
MAX98380 WLP EV Kit Development Board Bill of Materials

#	QTY	DESIGNATOR	DESCRIPTION	VALUE	VOLTAGE	TOLERANCE	POWER	DIELECTERIC	PACKAGE	MANUFACTURER	MANUFACTURER PN	MOUSER	DigiKey
1	1	C4	Capacitor / Ceramic / 1µF / 6.3V / 20% / X5R / 0201	1µF	6.3V	20%		X5R	201	Murata	GRM033R60J105MEA2D	81-GRM033R60J105ME2D	490-7229-1-ND
2	1	C5	Capacitor / Electrolytic / 100µF / 25V / 20% / 6.3mm x 6.1mm	100µF	25V	20%		Electrolytic	6.3 x 6.1	United Chemi-Con	EMZR250ARA101MF61G	661-EMZR250ARA101MF6	565-5142-1-ND
3	3	C6, C7, C16	Capacitor / Ceramic / 100nF / 25V / 10% / X5R / 0201	100nF	25V	10%		X5R	201	Murata	GRM033R61E104KE14J	81-GRM033R61E104KE4J	490-14571-1-ND
4	6	C8, C13, C15, C17, C20, C21	Cap / 2.2µF / 16V / 10% / X5R / 0402	2.2µF	16V	10%		X5R	402	Murata	GRM155R61C225KE11J	81-GRM155R61C225KE1J	490-14600-1-ND
5	2	C9, C14	Cap / 10µF / 25V / 20% / X5R / 0603	10µF	25V	20%		X5R	603	Murata	GRM188R61E106MA73D	81-GRM188R61E106MA3D	490-7202-1-ND
6	1	C10	Cap / 10µF / 10V / 20% / X5R / 0402	10µF	10V	20%		X5R	402	AVX	0402ZD106MAT2A	581-0402ZD106MAT2A	478-10052-1-ND
7	1	J1	Updated EVkit Daughter Card Header							Samtec	TSW-113-08-G-T-RA		
8	1	J2											
9	1	J3	Header, 3x2 Position, 0.1" Pitch							Samtec	TSW-103-07-G-D	200-TSW10307GD	SAM1028-03-ND
10	1	J4	Header, 2x2 Position, 0.1" Pitch							Samtec	TSW-102-07-G-D	200-TSW10207GD	SAM1028-02-ND
11	1	J5	Header, 2x1 Position, 0.1" Pitch							Samtec	TSW-102-07-G-S	200-TSW10207GS	SAM1029-02-ND
12	1	J6	Header, 3x1 Position, 0.1" Pitch							Samtec	TSW-103-07-G-S	200-TSW10307GS	SAM1029-03-ND
13	4	J7, J8, J13, J14	Binding Post							Johnson	111-2223-001		J587-ND
14	5	J9, J10, J11, J12, J15	Wire Loop / 20AWG / Tinned Copper / 25mm Length								20TCW		2328-20TCW-ND
15	2	R1, R2	Resistor / 0Ω / 1% / 1/16W / 0402	0		1%	1/16W		402	Yageo	RC0402FR-070RL	603-RC0402FR-070RL	311-0.0LRCT-ND
16	3	R3, R4, R5	Resistor / 51Ω / 1% / 1/16W / 0402	51		1%	1/16W		402	Yageo	RC0402FR-0751RL	603-RC0402FR-0751RL	311-51.0LRCT-ND
17	1	R6	Resistor / 27kΩ / 1% / 1/16W / 0402	27k		1%	1/16W		402	Yageo	RC0402FR-0727KL	603-RC0402FR-0727KL	311-27.0KLRCT-ND
18	4	SC1, SC2, SC3, SC4	Screw / 4-40 x 1/4" / Phillips / Pan Head							McMaster-Carr	91772A106		
19	4	ST1, ST2, ST3, ST4	Standoff / 4-40 x 1/2" / Female-Female / 1/4" Hex							McMaster-Carr	91780A164		
20	4	TP1, TP2, TP3, TP13	Test Point / Multi-Purpose / Black							Keystone Electronics	5011	534-5011	5011K-ND
21	2	TP4, TP11	Test Point / Multi-Purpose / Red							Keystone Electronics	5010	534-5010	5010K-ND
22	4	TP5, TP12, TP15, TP16	Test Point / Miniature / White							Keystone Electronics	5002	534-5002	5002K-ND
23	4	TP6, TP7, TP8, TP14	Test Point / Miniature / Orange							Keystone Electronics	5003	534-5003	5003K-ND
24	2	TP9, TP10	Test Point / Miniature / Yellow							Keystone Electronics	5004	534-5004	5004K-ND
25	1	U1	Small, Cost-Effective, Boosted Digital Class-D Amplifier						WLP24	Analog Devices	MAX98380		
26	1	PCB	PCM-MAX98380_WLP_APPS_P3	PCB						Analog Devices			

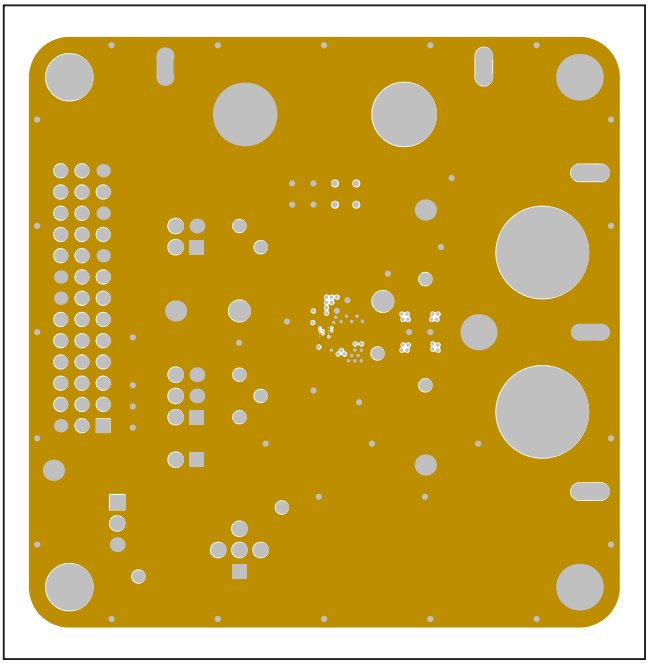
MAX98380 WLP EV Kit Development Board Schematic



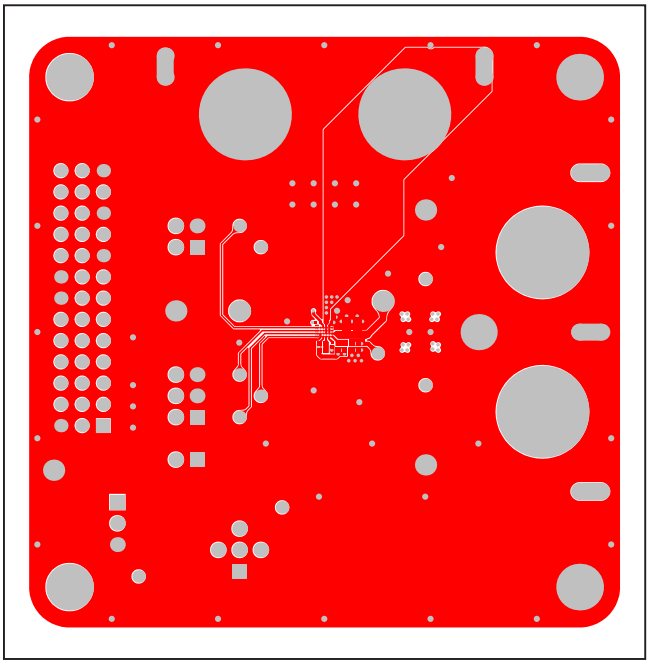
MAX98380 WLP EV Kit Development Board PCB Layout Diagrams



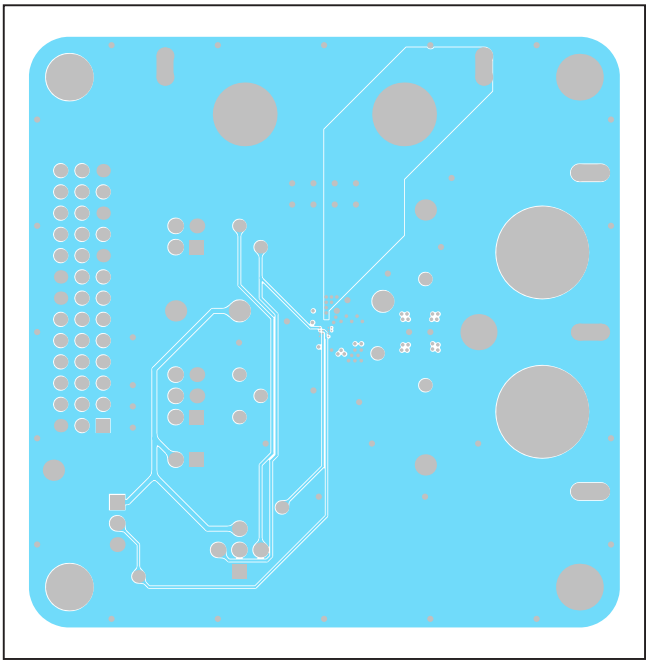
MAX98380 EV Kit Component Placement Guide—Top Silkscreen



MAX98380 EV Kit PCB Layout—Layer 2

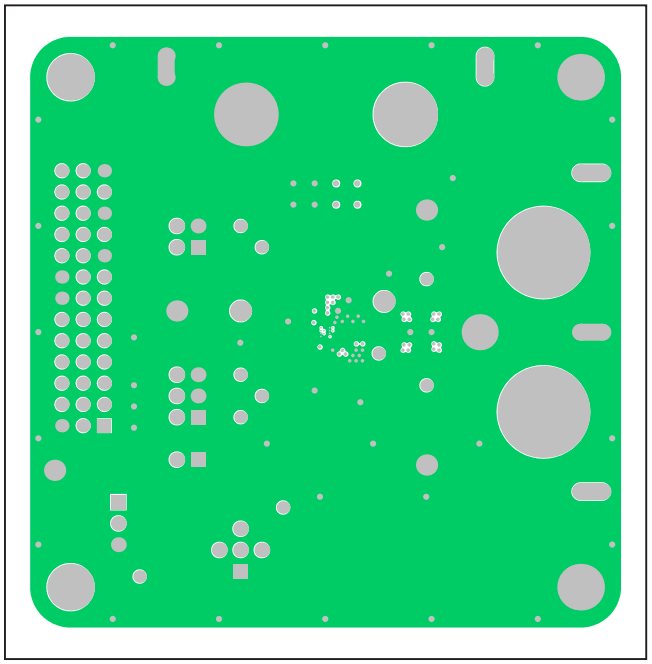


MAX98380 EV Kit PCB Layout—Top Layer

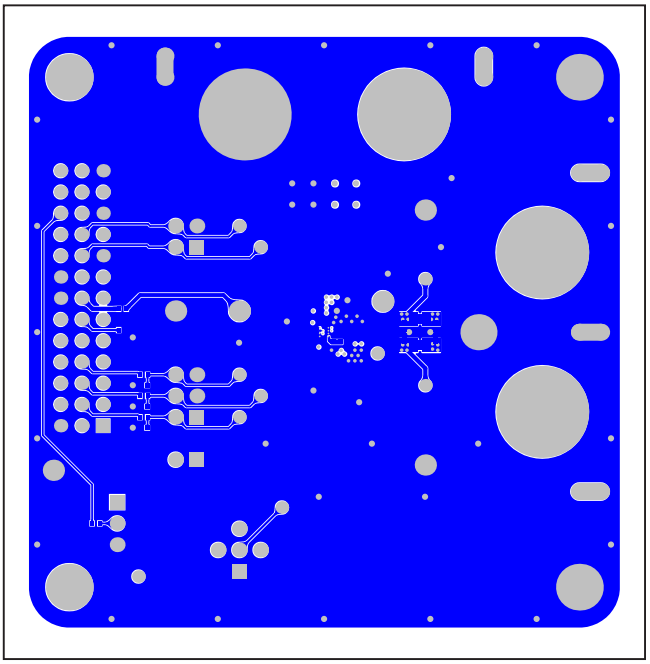


MAX98380 EV Kit PCB Layout—Layer 3

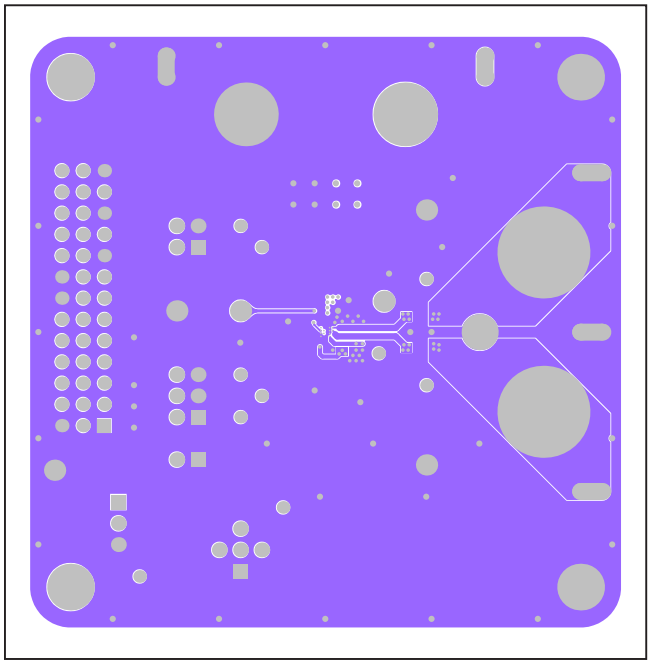
MAX98380 WLP EV Kit Development Board PCB Layout Diagrams (continued)



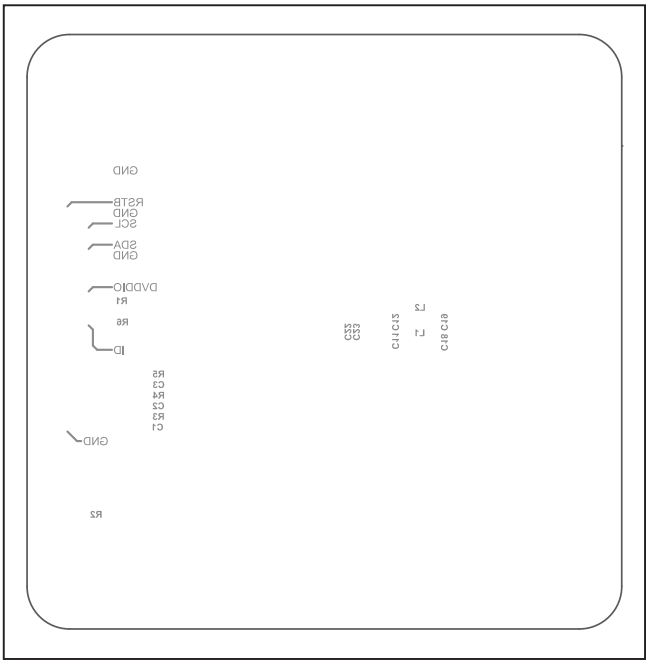
MAX98380 EV Kit PCB Layout—Layer 4



MAX98380 EV Kit PCB Layout—Bottom Layer



MAX98380 EV Kit PCB Layout—Layer 5



MAX98380 EV Kit Component Placement Guide—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	5/22	Initial release	—

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