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

Evaluates: MAX98365A/MAX98365B/ MAX98365C/MAX98365D

MAX98365 Evaluation Systems

General Description

The MAX98365 evaluation system (EV system) is a fully assembled and tested system that evaluates the MAX98365A/B/C/D mono Class-D audio amplifier. The EV system consists of the MAX98365 Development Board (DEV board), Maxim's 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. MAX98365A and MAX98365C support the standard I²S interface, and MAX98365B and MAX98365D support standard left-justified mode. All MAX98365 variants support an 8-channel TDM digital audio interface.

The AUDINT3 board provides a USB-to-PCM interface in addition to a 1.8V VDD supply needed to evaluate the DEV board. The MAX98365 DEV board requires one additional supply input, 3V to 14V (PVDD) when evaluating using the AUDINT3 board. Figure 1 details the DEV board and the AUDINT3 board.

Features

- 3V to 14V Single-Supply Operation
- I²S, Left-Justified, or TDM Input
- Five Selectable Gains (9.5dB, 12.5dB, 15.5dB, 18.5dB, and 21.5dB)
- Audio Channel Select (Left, Right, and Mono Mix)
- Filter-Less Operation
- Low EMI
- Complete Hardware System with Easy Setup; No Tools or Special Software Required

EV System Contents

- MAX98365 Development Board
- Audio Interface Board III
- Micro-USB Cable

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

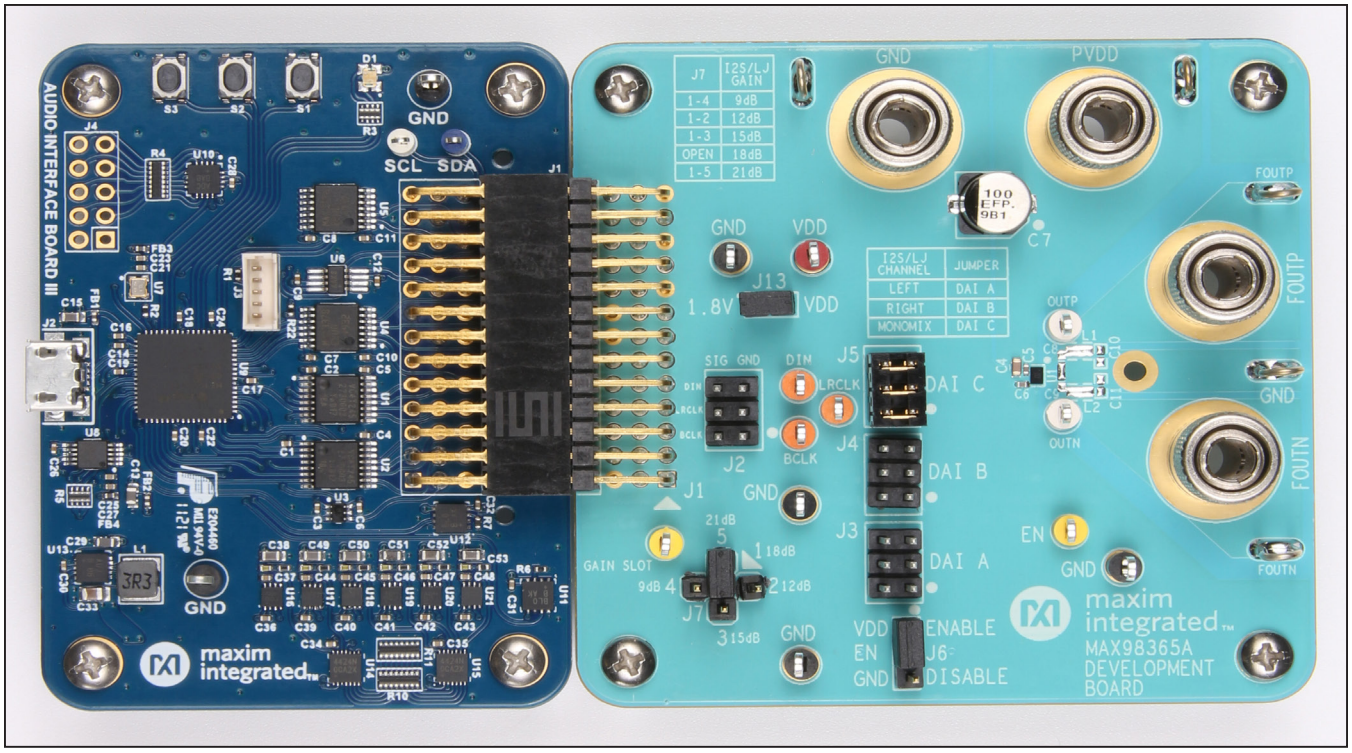

Figure 1. MAX98365 Evaluation System

319-100884; Rev 0; 2/22

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Quick Start Guide

Required Equipment

- MAX98365 EV system
  - MAX98365 development board (DEV board)
  - Audio Interface Board III (AUDINT3 board)
  - Micro-USB cable
- DC power supply (3V to 14V, 3A)
- 4Ω to 8Ω speaker
- PC with Windows® 7 or Windows 10 with available USB port
- USB audio source (e.g., Windows Media Player® or iTunes®)

Reference Material

- MAX98365 IC data sheet

Procedure

The MAX98365 and AUDINT3 boards are fully assembled and tested. Follow the steps below to set up the EV system for device evaluation.

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.

AUDINT3 Board Setup:

1) Connect the MAX98365 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.
2) 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 VDDIO, sourcing 1.8V to the DEV board through the J1 connector.
3) 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:

1) Connect the AUDINT3 VDD jumper. Place one shunt on jumper J13 across pins labeled 1.8V and VDD. This allows the AUDINT3 to provide 1.8V to the VDD pin on MAX98365.
2) Configure I²S channel jumper. Place triple shunt on jumper J5, DAI C for mono-mix. Remove any shunts from J4, J3, and J2.
3) Set the gain jumper. Place one shunt on jumper J7 for desired gain (can use 21dB for PVDD = 14V).
4) Enable the IC jumper. Place the shunt on jumper J6 across pins VDD and EN.
5) Connect the speaker. Connect the speaker leads across the FOUTP and FOUTN binding posts.
6) Connect PVDD. With the DC supply not powered, connect the 3V to 14V power supply across the PVDD and GND binding posts.

USB Audio Playback Test:

1) Enable the PVDD supply voltage (3V to 14V, 3A).
2) 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.
3) 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.
4) Adjust the audio source volume to a low level.
5) Enable the audio source and verify that audio is heard through the connected speaker. Adjust the audio source volume as needed.
6) Quick Start for USB Audio Playback is now complete.
7) 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

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.

Detailed Description of Hardware

The MAX98365 EV system is designed to allow for a thorough evaluation of the MAX98365 digital input Class-D audio amplifier IC. The EV system includes the MAX98365 Development Board (DEV board), the Audio Interface Board III (AUDINT3), and a micro-USB cable.

To simplify evaluation, the MAX98365 DEV board can be used together with the AUDINT3 and only one external power supply for PVDD. 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 MAX98365 DEV board and configures its LDO regulators to power the MAX98365 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 to I^{2}S (MAX98365A/C) or left-justified (MAX98365B/D) data stream, allowing for USB audio playback through the MAX98365 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 MAX98365 DEV board can also be evaluated as a standalone board, with two external power supplies (PVDD 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 MAX98365 DEV board requires two external power supplies: PVDD, 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 1. 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 MAX98365 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 PVDD is still required. If an external VDD is desired with AUDINT3 still connected to the DEV Board, jumper J13 (DEV board) can be used to disconnect the AUDINT3's 1.8V. See Table 2 for the J13 jumper selection.

Jumper Selection

Shutdown Mode

The DEV Board includes header J6 for device enable. The MAX98365 device features a low-power shutdown mode that is activated by setting J6 shunt in the "DISABLE" position. To exit shutdown mode, place J6 shunt to the "ENABLE" position. When the PCM master is disabled and J6 is in the "ENABLE" position, the device is in standby mode. Enabling the PCM interface while J6 is in the "ENABLE" position puts the device in active playback mode, and the device output begins switching. See Table 3 for reference.

Table 1. Power Supplies

POWER SUPPLY	RANGE (V)
VDD	1.71 to 5.5
PVDD	3 to 14

Table 2. J13 Jumper Selection (VDD) Supplies

SHUNT POSITION	INPUT VOLTAGE (VDD)
1-2	VDD supplied by AUDINT3 board connected to J1 header
OPEN	User-supplied external power supply applied at VDD and GND test posts

Table 3. Jumper Configuration

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

Gain and Channel Selection (I²S/Left-Justified Mode)

The MAX98365's GAIN_SLOT pin is connected to the center pin (pin 1) of the J7 header. When operating the device in I²S or left-justified mode, shunting pin 1 to the adjacent pins of the J7 header controls the PCM gain. Table 4 shows the available gain settings in I²S and left-justified modes.

In I²S and left-justified modes, channel selection is controlled by placing three shunts across the DAI configuration headers J3, J4, or J5. Each of the DAI configuration headers represent one valid mapping of the DAI pins to the PCM input signals. See Table 5 for the valid jumper settings for the DAI configuration headers. Only one DAI configuration may be used at a time. Figure 3 shows the shunt positions used for DAI configuration A.

Channel Selection (TDM Mode)

In TDM mode, the MAX98365 has a fixed gain of 21.5dB and the GAIN_SLOT pin becomes repurposed for TDM channel selection. The MAX98365 accepts 8-channel TDM data with either 16-bit or 32-bit data. The GAIN_SLOT pin and DAI configuration are used to select which of the 8 channels of TDM data the part responds to, as shown in Table 6.

Table 4. J7 Jumper Selection (GAIN_SLOT)

GAIN (dB)	J7 SHUNT POSITION	GAIN_SLOT
21.5	1-5	Connected to GND
18.5	Not Installed	Unconnected
15.5	1-3	Connected to VDD
12.5	1-2	Connected to VDD through 100kΩ resistor R1
9.5	1-4	Connected to GND through 100kΩ resistor R2

Table 5. J3-J5 Header Selection (DAI Configuration)

I²S/LJ CHANNEL	SHUNT HEADER	DAI CONFIGURATION
Left	J3	A
Right	J4	B
Mono-mix (Left/2 + Right/2)	J5	C

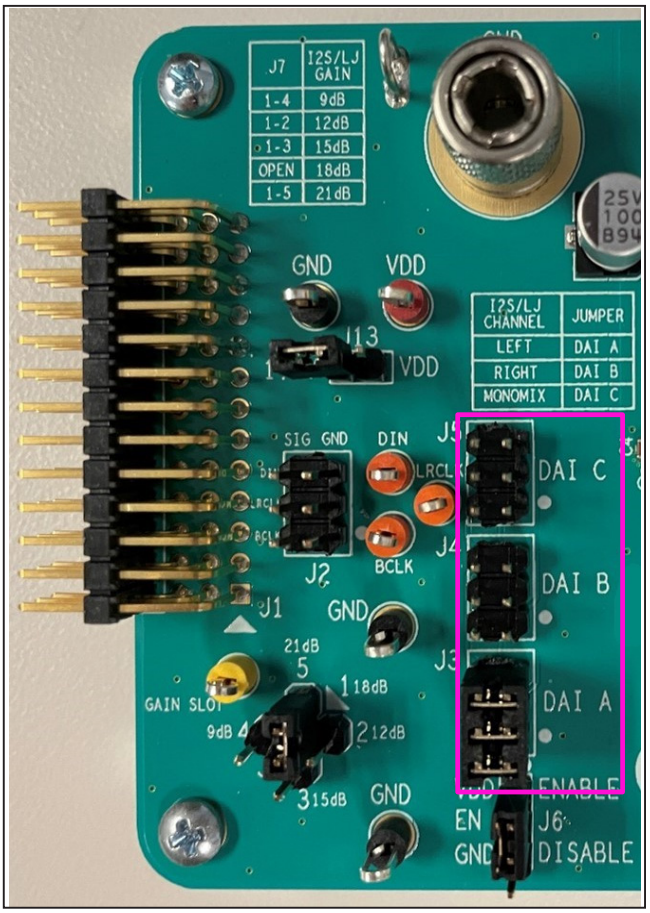


Figure 3. DAI Configuration A (Left-Channel for I²S/Left-Justified Operation)

DAI Header

The DAI header J2 provides access to MAX98365's PCM bus (BCLK, LRCLK, and DIN). This DAI header facilitates evaluation with audio equipment I/O. See Table 7 for the pinout of the DAI header. Figure 4 shows a close-up image of the MAX98365 DAI interface header (J2) to be used if connecting external DAI inputs, such as those provided by Audio Precision or other audio test equipment.

Speaker Output

The MAX98365 audio output is routed to the FOUTP and FOUTN connections on the DEV board. The DEV board is, by default, assembled to allow the MAX98365 output to connect directly to a speaker load without the need for filtering.

EMI Filter

When long speaker cables are used with the MAX98365 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 (C8, C9) 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 *MAX98365 DEV Board PCB Schematic* and the *MAX98365 DEV Board PCB Layout* diagrams).

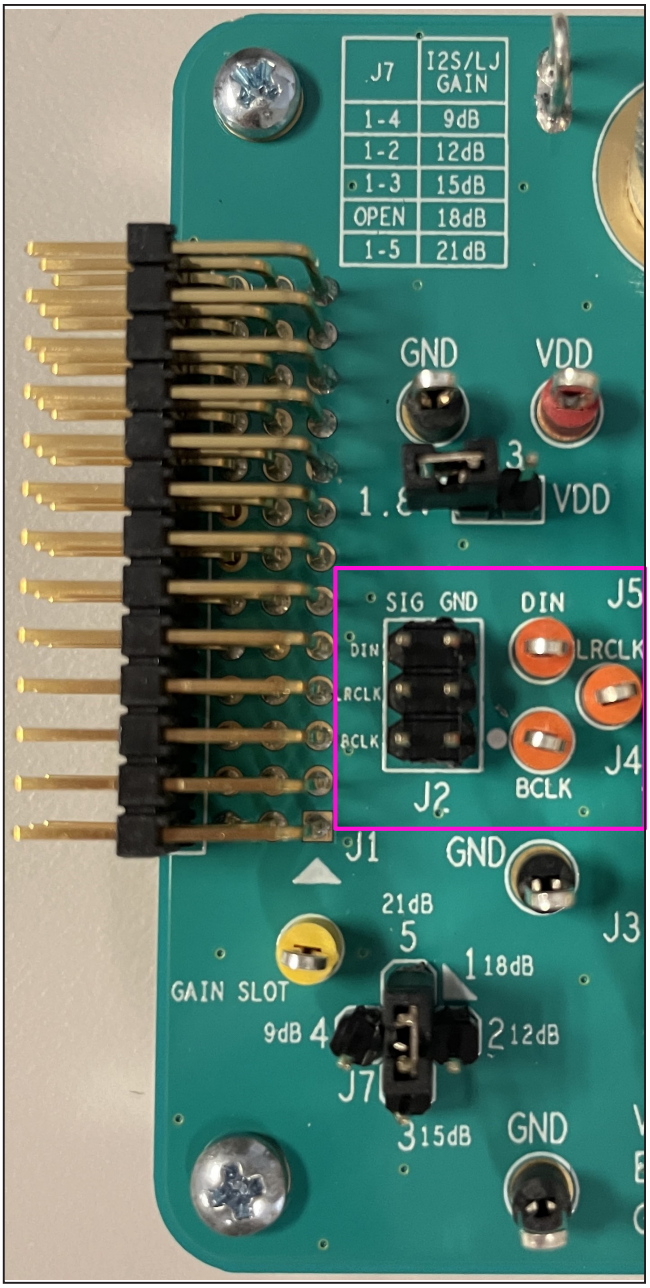


Figure 4. MAX98365 DAI Interface Headers (PCM)

Table 6. TDM Mode Channel Selection

TDM CHANNEL	J4 SHUNT POSITION	DAI CONFIGURATION
0	1-5	A
1	1-3	A
2	Open	A
3	1-3	B
4	1-5	B
5	1-5	C
6	Open	C
7	1-3	C

Table 7. DAI Header (J2)

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

Audio Interface Board III

Maxim's Audio Interface Board III (AUDINT3) 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 minimal amount 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 MAX98365 DEV board connects to the AUDINT3 board through connector J1. The physical connections made between the DEV board and AUDINT3 board are listed in Table 8.

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 5). As described earlier, a computer can be used to supply audio inputs over 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 type, frequency, and amplitude as shown in Figure 6.

Table 8. 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	VDDIO	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

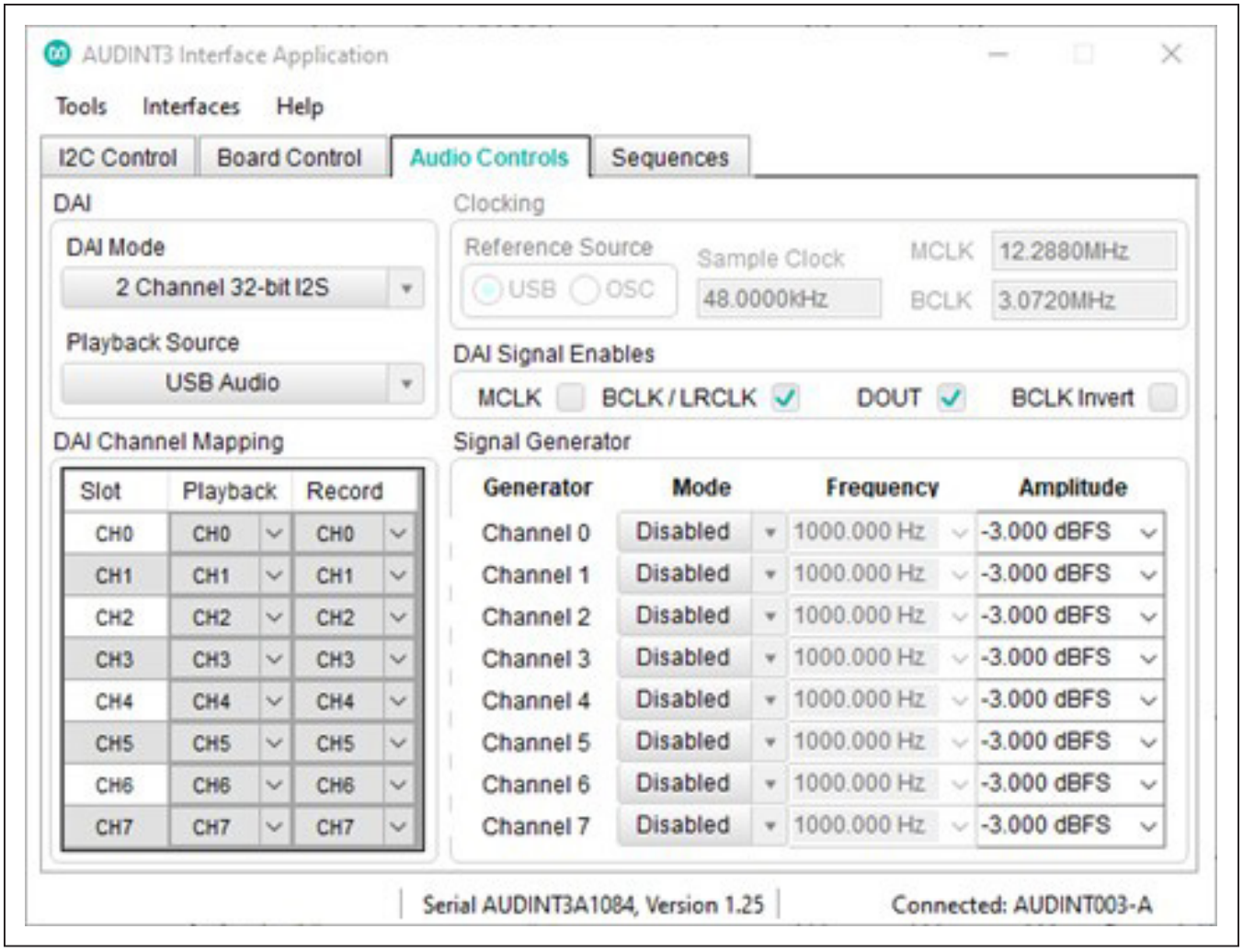


Figure 5. AUDINT3 Configured for Computer Audio Input Over USB

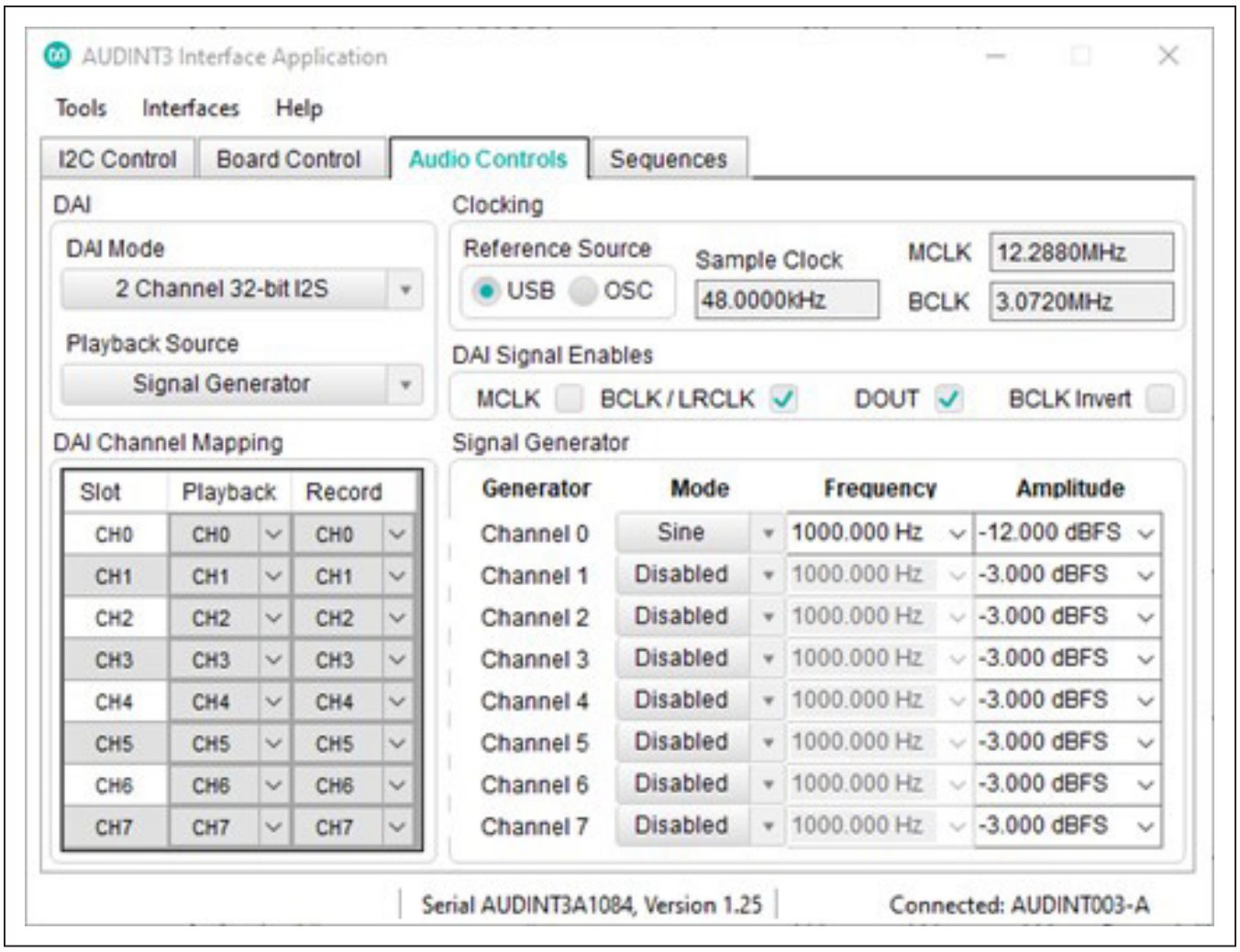


Figure 6. AUDINT3 Configured for a -12dBFS 1kHz Sine Input Using Internal Signal Generator

Ordering Information

PART	TYPE
MAX98365AEVSYS#	Complete I^2S evaluation system with no volume ramping
MAX98365BEVSYS#	Complete left-justified evaluation system with no volume ramping
MAX98365CEVSYS#	Complete I^2S evaluation system with volume ramping
MAX98365DEVSYS#	Complete left-justified evaluation system with volume ramping

#Denotes RoHS compliant.

MAX98365 DEV Board Bill of Materials

ITEM	QTY	REF DES	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
1	1	C4	GMC10X5R106K25NT	CAL-CHIP ELECTRONIC INC	10UF	CAP; SMT (0603); 10UF; 10%; 25V; X5R; CERAMIC ;NOTE:SPECIAL ORDER ONLY
2	1	C5	C1005X5R1V105K050BC	TDK	1UF	CAP; SMT (0402); 1UF; 10%; 35V; X5R; CERAMIC
3	1	C6	CL05A105KO5NNN	SAMSUNG	1UF	CAP; SMT (0402); 1UF; 10%; 16V; X5R; CERAMIC
4	1	C7	EEE-FPE101XAP	PANASONIC	100UF	CAP; SMT (CASE_D8); 100UF; 20%; 25V; ALUMINUM-ELECTROLYTIC ;NOTE:PURCHASE DIRECT FROM THE MANUFACTURER
5	1	C12	CL21B106KOQNNN; GRM21BZ71C106KE15; GMC21X7R106K16NT	SAMSUNG;MURATA;CAL-CHIP	10UF	CAP; SMT (0805); 10UF; 10%; 16V; X7R; CERAMIC
6	1	J1	TSW-113-08-G-T-RA	SAMTEC	TSW-113-08-G-T-RA	EVKIT PART; CONNECTOR; MALE; THROUGH HOLE; 0.025IN SQ POST HEADER; RIGHT ANGLE; 39PINS; MODIFY PIN NUMBERING ARRANGEMENT
7	4	J2-J5	PEC03DAAN	SULLINS ELECTRONICS CORP.	PEC03DAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 6PINS; -65 DEGC TO +125 DEGC
8	1	J6	PCC03SAAN	SULLINS	PCC03SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 3PINS; -65 DEGC TO +125 DEGC
9	1	J7	TSW-105-07-L-S	SAMTEC	TSW-105-07-L-S	EVKIT PART-CONNECTOR; THROUGH HOLE; TSW SERIES; SINGLE ROW; STRAIGHT; 5PINS
10	5	J8, J9, J12, J14, J15	9020 BUSS	WEICO WIRE	MAXIMPAD	EVK KIT PARTS; MAXIM PAD; WIRE; NATURAL; SOLID; WEICO WIRE; SOFT DRAWN BUS TYPE-S; 20AWG
11	1	J13	PCC02SAAN	SULLINS	PCC02SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 2PINS; -65 DEGC TO +125 DEGC
12	4	MTH1-MTH4	91772A108; PHILLIPS-PAN_4-40X3/8IN; PMSSS4400038PH; 9901	GENERIC PART	N/A	MACHINE SCREW; PHILLIPS; PAN; 4-40; 3/8IN; 18-8 STAINLESS STEEL; NOTE: SET TO OBSOLETE FOR PART NUMBER CORRECTION. KINDLY REFER TO PART NUMBER 91772A108;9901
13	4	MTH1-MTH4	MCH_SO_F_HEX_4-40X1/2	GENERIC PART	N/A	STANDOFF; FEMALE-THREADED; HEX; 4-40; 1/2IN; ALUMINUM
14	1	R1	ERJ-2RKF1782	PANASONIC	17.8K	RES; SMT (0402); 17.8K; 1%; +/-100PPM/DEGC; 0.1000W
15	5	R2-R5, R7	ERJ-2GE0R00	PANASONIC	0	RES; SMT (0402); 0; JUMPER; JUMPER; 0.1000W
16	2	R8, R9	CRCW0402100KFK; RC0402FR-07100KL	VISHAY;YAGEO	100K	RES; SMT (0402); 100K; 1%; +/-100PPM/DEGC; 0.0630W
17	1	SU1	C33-GAG1-2X3-G	VALCON	C33-GAG1-2X3-G	CONNECTOR; FEMALE; 2.54MM MULTI-POSITION JUMPER LINK; WIREMOUNT; 6PINS
18	2	SU2, SU4	S1100-B;SX1100-B; STC02SYAN	KYCON;KYCON;SULLINS ELECTRONICS CORP.	SX1100-B	TEST POINT; JUMPER; STR; TOTAL LENGTH=0.24IN; BLACK; INSULATION=PBT;PHOSPHOR BRONZE CONTACT=GOLD PLATED
19	1	SU3	M7687-05	HARWIN	M7687-05	CONNECTOR; FEMALE; CLOSED-BOX JUMPER SOCKET WITH HANDLE; BLUE; STRAIGHT; 2PINS
20	4	TP1, TP6, TP7, TP16	5011	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; BLACK; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH; RECOMMENDED FOR BOARD THICKNESS=0.062IN; NOT FOR COLD TEST
21	3	TP2-TP4	5008	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.35IN; BOARD HOLE=0.063IN; ORANGE; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH; RECOMMENDED FOR BOARD THICKNESS=0.062IN; NOT FOR COLD TEST
22	2	TP5, TP8	5009	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.35IN; BOARD HOLE=0.063IN; YELLOW; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH; RECOMMENDED FOR BOARD THICKNESS=0.062IN; NOT FOR COLD TEST
23	4	TP9, TP10, TP13, TP14	111-2223-001	EMERSON NETWORK POWER	111-2223-001	MACHINE SCREW; THUMBSCREW; BANANA; 1/4-32IN; 11/32IN; NICKEL PLATED BRASS
24	2	TP11, TP12	5007	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.35IN; BOARD HOLE=0.063IN; WHITE; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH; RECOMMENDED FOR BOARD THICKNESS=0.062IN; NOT FOR COLD TEST
25	1	TP15	5010	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.445IN; BOARD HOLE=0.063IN; RED; PHOSPHOR BRONZE WIRE SIL; NOT FOR COLD TEST
26	1	U1	MAX98365A	MAXIM	MAX98365A	EVKIT PART - IC; MAX98365; WLP9; PACKAGE CODE: W121D1+1; PACKAGE OUTLINE: 21-100536
27	1	PCB	MAX98365A_WLP_APPS_P1	MAXIM	PCB	PCB:MAX98365A_WLP_APPS_P1
TOTAL	56					

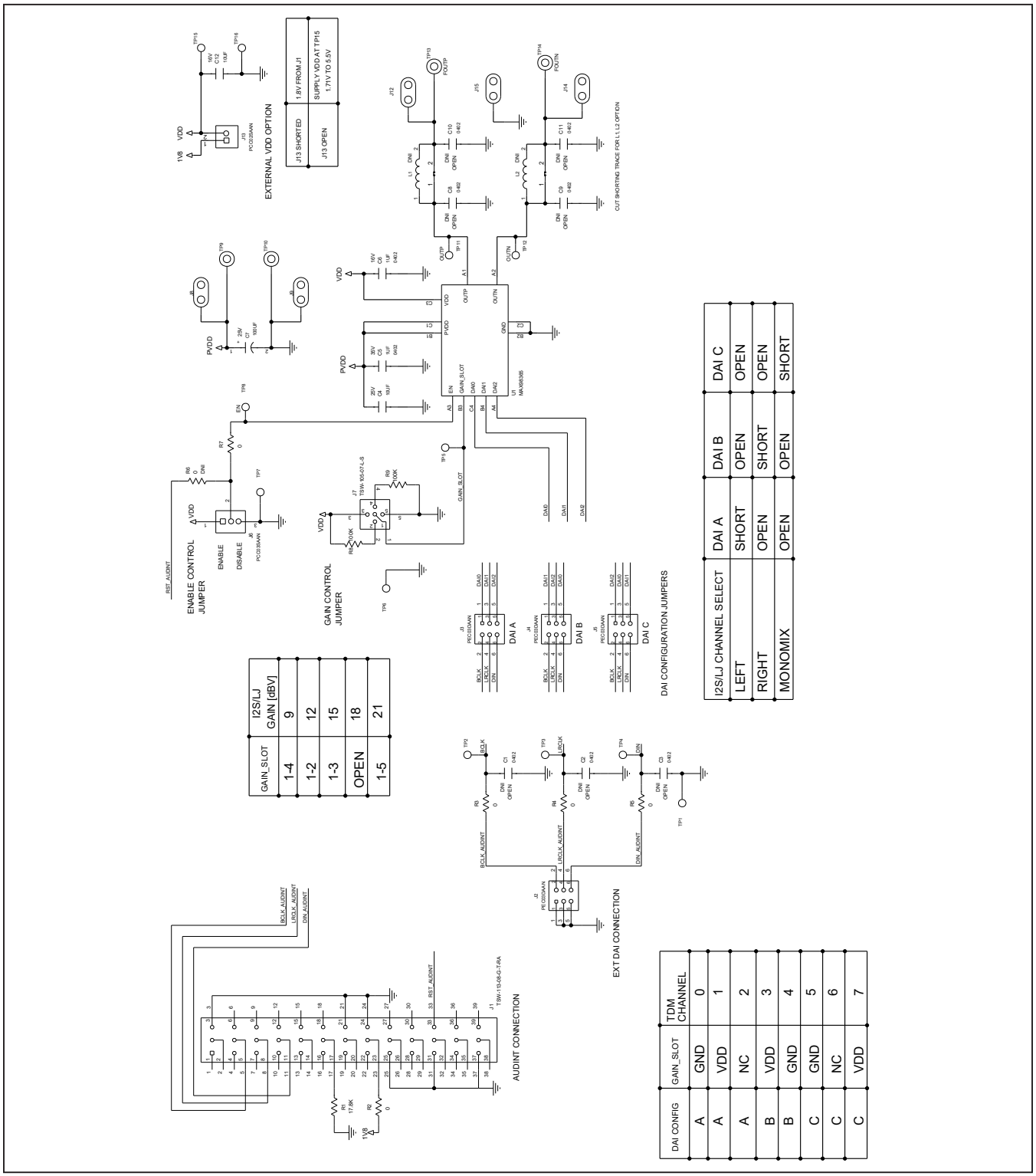
DO NOT PURCHASE(DNP)

ITEM	QTY	REF DES	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
1	7	C1-C3, C8-C11	N/A	N/A	OPEN	PACKAGE OUTLINE 0402 NON-POLAR CAPACITOR - EVKIT
2	2	L1, L2	RC1608J000CS	SAMSUNG ELECTRONICS	0	RESISTOR; 0603; 0 OHM; 5%; JUMPER; 0.10W; THICK FILM
3	1	R6	ERJ-2GE0R00	PANASONIC	0	RES; SMT (0402); 0; JUMPER; JUMPER; 0.1000W
TOTAL	10					

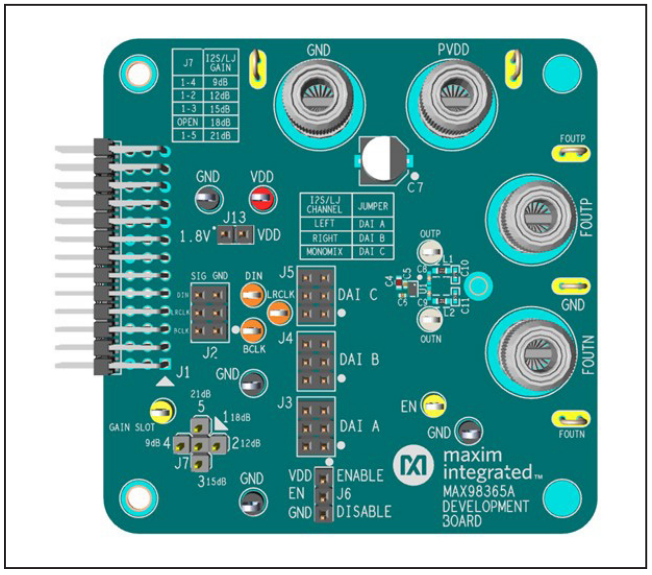
PACKOUT (These are purchased parts but not assembled on PCB and will be shipped with PCB)

ITEM	QTY	REF DES	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
TOTAL	0					

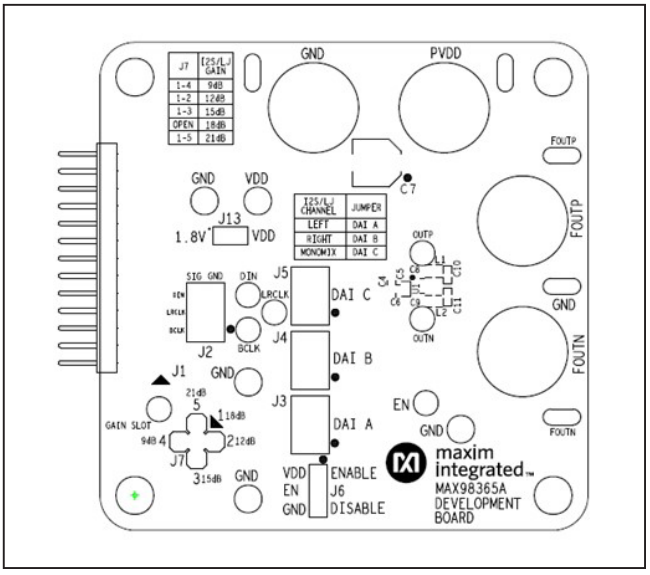
MAX98365 DEV Board PCB Schematic



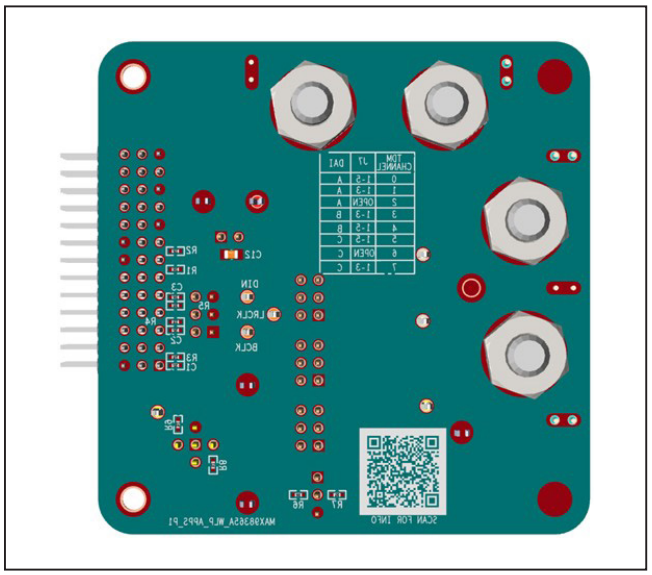
MAX98365 DEV Board PCB Layout



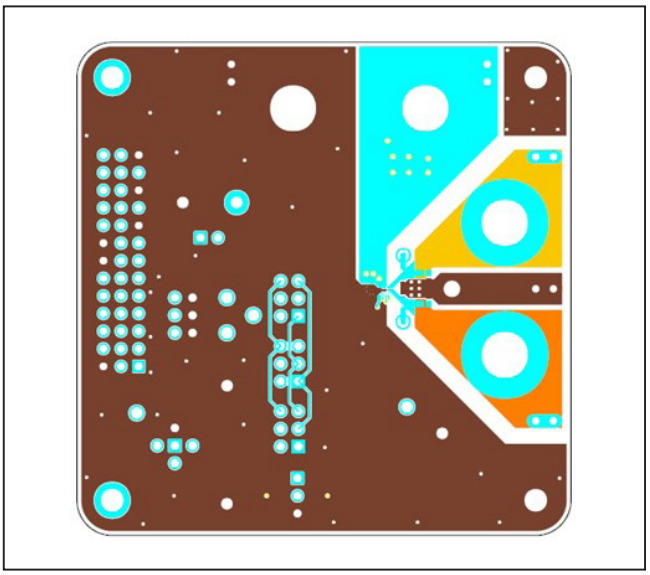
MAX98365A DEV Board—Top Side



MAX98365A DEV Board—Top Silkscreen

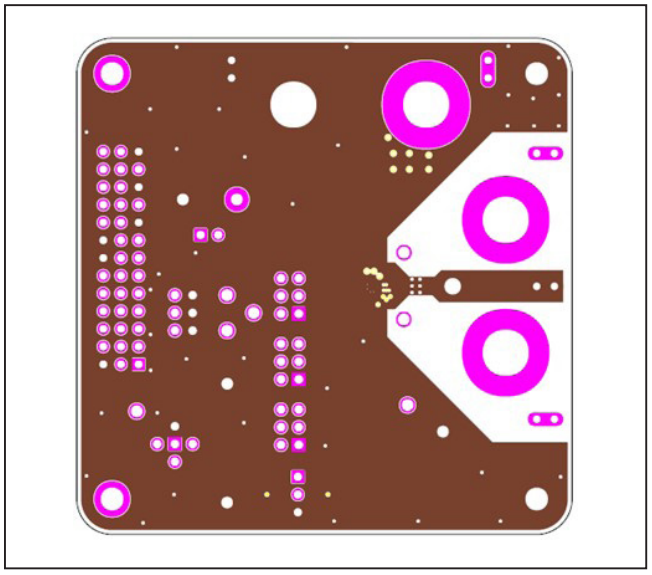


MAX98365A DEV Board—Bottom Side

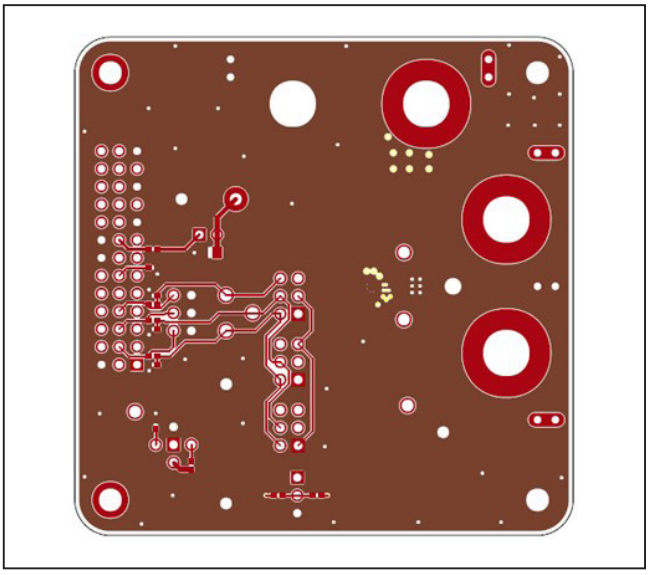


MAX98365A DEV Board—Top

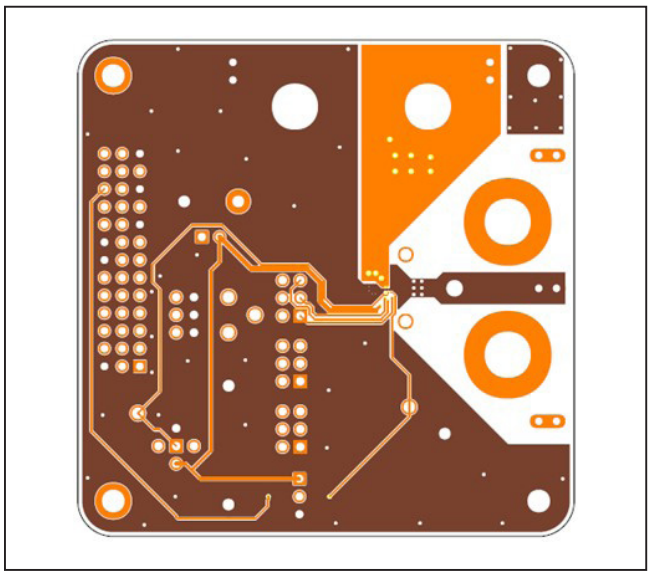
MAX98365 DEV Board PCB Layout (continued)



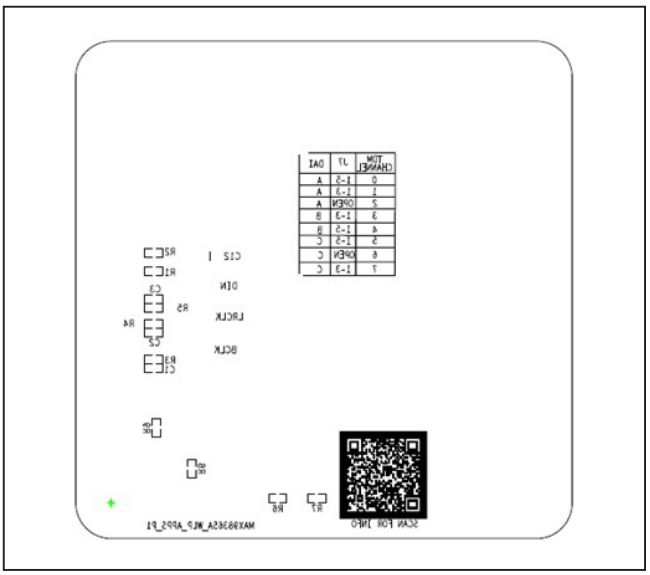
MAX98365A DEV Board—Inner 1



MAX98365A DEV Board—Bottom



MAX98365A DEV Board—Inner 2



MAX98365A DEV Board—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	2/22	Initial release	—

ANALOG DEVICES

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