Evaluation Board User Guide

MAX98366 Evaluation System

Evaluates: MAX98366A/MAX98366B/MAX98366C/MAX98366D

General Description

The MAX98366 evaluation system (EV system) is a fully assembled and tested system that evaluates the MAX98366A/B/C/D mono Class-D audio amplifier with ultrasound support. The EV system consists of a MAX98366 Development Board (DEV board), an 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. MAX98366A and MAX98366C support the standard I²S interface, and MAX98366B and MAX98366D support standard left-justified mode. All MAX98366 variants support an 8-channel TDM digital audio interface.

The AUDINT3 board provides a USB-to-PCM interface and a 1.8V VDD supply needed to evaluate the DEV board. The MAX98366 DEV board requires one additional supply input, 3V to 15V (PVDD) when evaluating using the AUDINT3 board. *Figure 1* details the DEV board and the AUDINT3 board.

Features

- Simple Plug-and-Play Design—No I²C Register Programming Required
- Wide Amplifier Supply Range (3V to 15V)
- Wideband Filters for Sample Rates ≥ 50kHz, Enabling Ultrasound Applications
- Sample Rates of 8kHz to 192kHz
- 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

- MAX98366 Development Board
- Audio Interface Board III (AUDINT3)
- Micro-USB Cable

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

EV System Photo

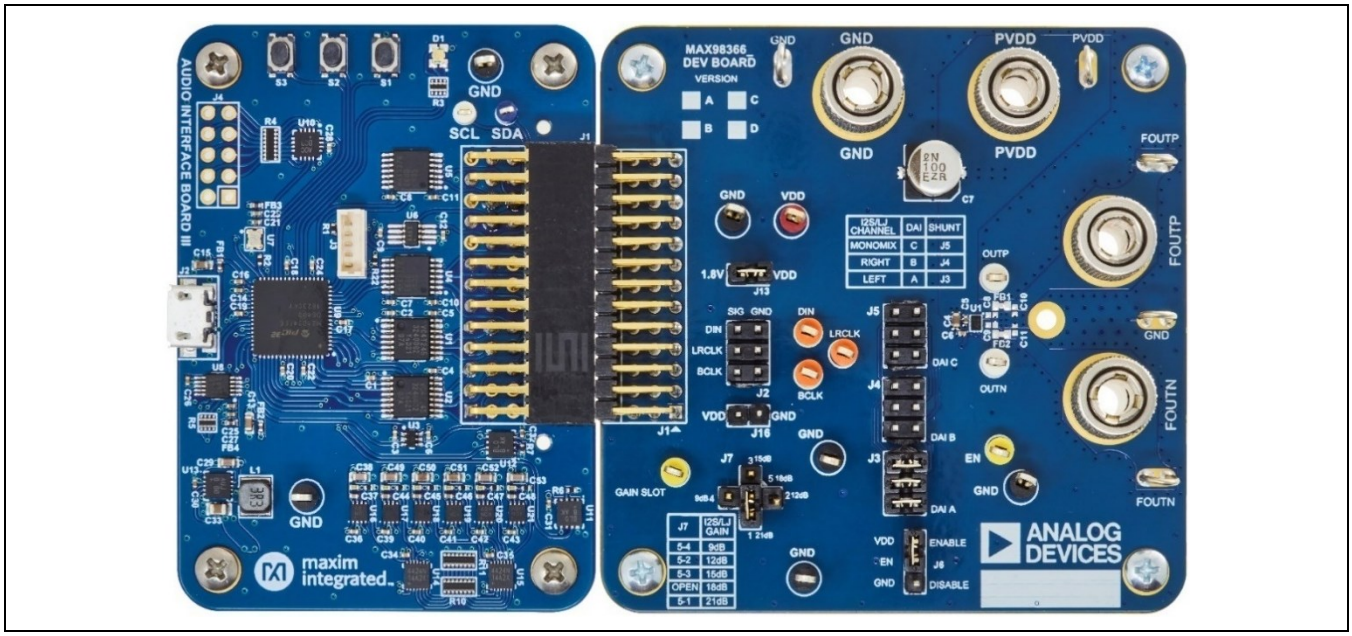

Figure 1. MAX98366 Evaluation System

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Quick Start

Note: In the following sections, text in **bold and underlined** refers to items from the Windows operating system.

Required Equipment

- MAX98366 EV System
  - MAX98366 Development Board (DEV Board)
  - Audio Interface Board III (AUDINT3 Board)
  - Micro-USB Cable
- DC Power Supply (3V to 15V, 4A)
- 4Ω to 8Ω Speaker
- PC with Windows® 7 or Windows 10 with Available USB Port
- USB Audio Source (e.g., Spotify®, YouTube®, iTunes®)

Reference Material

- MAX98366 IC data sheet

Procedure

The MAX98366 and AUDINT3 boards are fully assembled and tested. Follow the steps below to set up the EV system for device evaluation.

AUDINT3 Board Setup:

1. Connect the MAX98366 DEV board (J1 connector) to the AUDINT3 board (J1 connector). It is important to ensure the two boards' connectors are properly aligned to avoid damage. 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 MAX98366.
2. Configure the I^2S channel jumper. Place a triple shunt on jumper J5, DAI C for mono-mix. Remove any shunts from J4, J3, and J2.
3. Set the GAIN_SLOT jumper. Place one shunt on jumper J7 for desired gain (can use 21.5dB for PVDD = 15V).
4. 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 15V power supply across the PVDD and GND binding posts.

USB Audio Playback Test:

1. Enable the PVDD supply voltage (3V to 15V, 4A).
2. In the Window's **Sound Settings** set the "Maxim AUDINT003 ADC1.0" option as your output device, as seen in *Figure 2*.
3. Once 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.

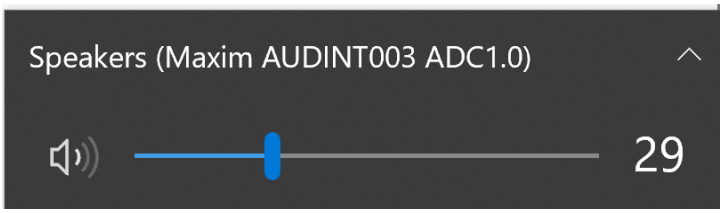


Figure 2. AUDINT3 as Playback Device

Detailed Description of Hardware

The MAX98366 EV system is designed to thoroughly evaluate the MAX98366 digital input Class-D audio amplifier IC. The EV system includes the MAX98366 Development Board (DEV board), the Audio Interface Board III (AUDINT3), and a micro-USB cable.

To simplify evaluation, the MAX98366 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 MAX98366 DEV board and configures its LDO regulators to power the MAX98366 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 (MAX98366A/C) or left-justified (MAX98366B/D) data stream, allowing for USB audio playback through the MAX98366 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.

For maximum flexibility, the MAX98366 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 MAX98366 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.

Table 1. Power Supplies

POWER SUPPLY	VOLTAGE RANGE (V)
VDD	1.71 to 5.5
PVDD	3 to 15

The AUDINT3 board, when properly connected to the DEV board, senses, and automatically provides 1.8V to VDD of MAX98366 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.

Table 2. VDD Supply Selection Jumper J13

J13 SHUNT POSITION	DESCRIPTION
1-2	VDD supplied by AUDINT3 (through J1)
OPEN	External power supply applied at VDD and GND test posts

Jumper Selection

ENABLE/DISABLE Selection (Shutdown Mode)

The DEV board includes header J6 for device enable. The MAX98366 device features a low-power shutdown mode that is activated by setting the J6 shunt in the “DISABLE” position. To exit shutdown mode, place the J6 shunt in 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 3. EN Selection Jumper J6

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

Gain and Channel Selection (I^2S/Left-Justified Mode)

The MAX98366’s GAIN_SLOT pin is connected to the center pin (pin 1) of the J7 header. When operating the device in I^2S 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 I^2S and left-justified modes. In I^2S 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 represents 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 can be used at a time. *Figure 3* shows the shunt positions used for DAI configuration A.

Table 4. GAIN_SLOT Selection Jumper J7

GAIN (dB)	J7 SHUNT POSITION	GAIN_SLOT
21.5	1-5	Connected to GND
18.5	Open	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 R1

Table 5. DAI Configuration Selection Jumper J3 to J5

I^2S/LJ CHANNEL	JUMPER	DAI CONFIGURATION
Left	J3	A
Right	J4	B
Mono-mix (Left/2 + Right/2)	J5	C

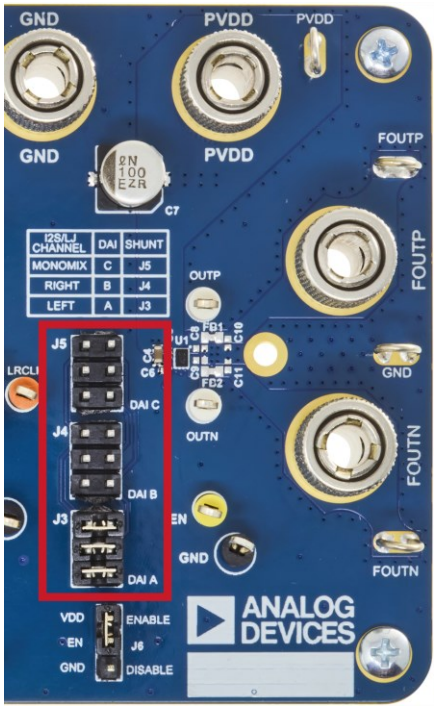


Figure 3. DAI Configuration A (Left-Channel for I²S/Left-Justified Operation)

Channel Selection (TDM Mode)

In TDM mode, the MAX98366 has a fixed gain of 21.5dB and the GAIN_SLOT pin becomes repurposed for TDM channel selection. The MAX98366 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 6. TDM Mode Channel Selection Jumper J4

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

DAI Header

The DAI header J2 provides access to MAX98366'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 MAX98366 DAI interface header (J2) to be used if connecting external DAI inputs, such as those provided by Audio Precision or other audio test equipment.

Table 7. DAI Header J2

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

Figure 4. MAX98366 DAI Interface Headers (PCM)

Speaker Output

The MAX98366 audio output is routed to the FOUTP and FOUTN connections on the DEV board. The DEV board is, by default, assembled to allow the MAX98366 output to connect directly to a speaker load without the need for filtering.

EMI Filter

When long speaker cables are used with the MAX98366 output (exceeding ≈12in (30 cm)), a ferrite bead plus a 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 works well. Before adding the filters to the design, first, remove the small PCB traces shorting the pads of L1 and L2 (see the *MAX98366 DEV Board PCB Schematic* and the *MAX98366 DEV Board PCB Layout* diagrams).

Audio Interface Board III

The 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 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 MAX98366 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 8*.

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

Ordering Information

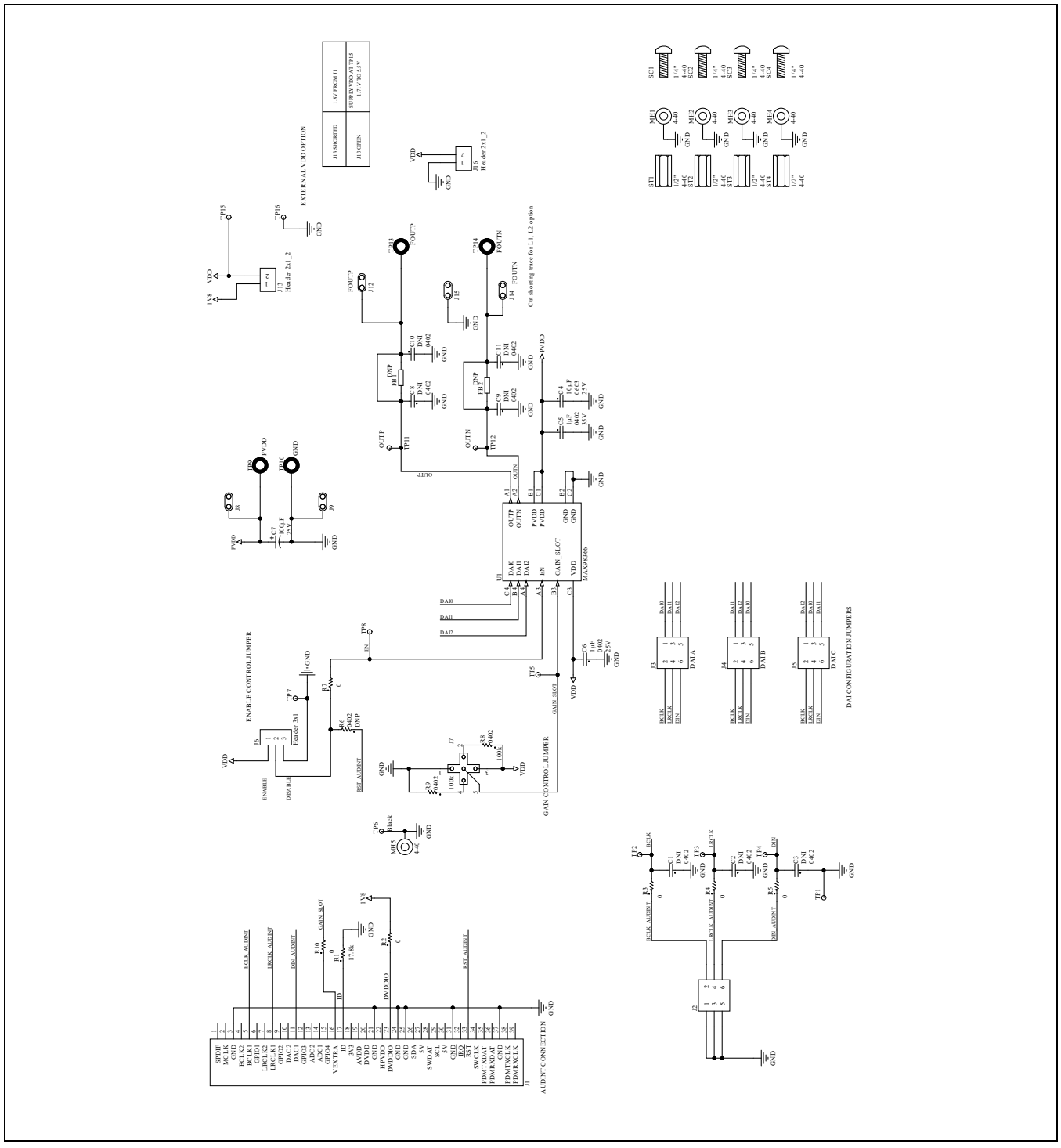
PART	TYPE
MAX98366AEVSYS#	I²S evaluation system with no volume ramping
MAX98366BEVSYS#	Left-justified evaluation system with no volume ramping
MAX98366CEVSYS#	I²S evaluation system with volume ramping
MAX98366DEVSYS#	Left-justified evaluation system with volume ramping

#Denotes RoHS-compliant.

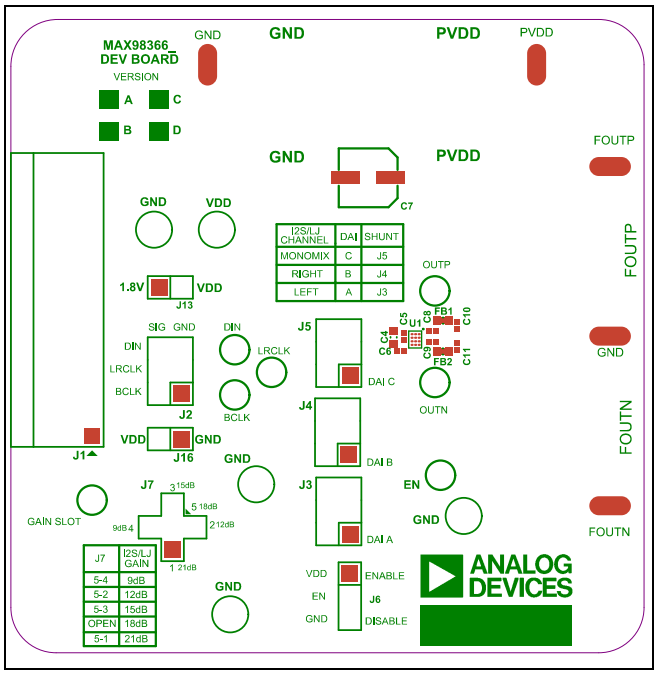
MAX98366 DEV Board Bill of Materials

ITEM	QTY	DESIGNATOR	MANUFACTURER PN	MANUFACTURER	VALUE	DESCRIPTION
1	1	C4	GRM188R61E106MA73D	Murata	10µF	Cap / 10µF / 25V / 20% / X5R / 0603
2	1	C5	C1005X5R1V105K050BC	TDK	1µF	Cap / 1µF / 35V / 10% / X5R / 0402
3	1	C6	GRM155R61E105KA12D	Murata	1µF	Cap / 1µF / 25V / 10% / X5R / 0402
4	1	C7	EMZR250ARA101MF61G	United Chemi-Con	100µF	Capacitor / Electrolytic / 100µF / 25V / 20% / 6.3mm x 6.1mm
5	1	J1	TSW-113-08-G-T-RA	Samtec	39 Pin Header	Updated EVkit Daughter Card Header
6	4	J2, J3, J4, J5	TSW-103-07-G-D	Samtec	6 Pin Header	Header, 3x2 Position, 0.1" Pitch
7	1	J6	TSW-103-07-G-S	Samtec	3 Pin Header	Header, 3x1 Position, 0.1" Pitch
8	1	J7	TSW-105-07-F-S	Samtec	5 Pin Header	CONN HEADER VERT 5POS 2.54MM
9	5	J8, J9, J12, J14, J15	20TCW	Weico Wire	MAXIMPAD	Wire Loop / 20AWG / Tinned Copper / 25mm Length
10	2	J13, J16	TSW-102-07-G-S	Samtec	2 Pin Header	Header, 2x1 Position, 0.1" Pitch
11	1	R1	RC0402FR-0717K8L	Yageo	17.8k	Resistor / 17.8kΩ / 1% / 1/16W / 0402
12	6	R2, R3, R4, R5, R7, R10	RC0402FR-070RL	Yageo	0	Resistor / 0Ω / 1% / 1/16W / 0402
13	2	R8, R9	RC0402FR-07100KL	Yageo	100k	Resistor / 100kΩ / 1% / 1/16W / 0402
14	4	SC1, SC2, SC3, SC4	91772A106	McMaster-Carr	N/A	Screw / 4-40 x 1/4" / Phillips / Pan Head
15	4	ST1, ST2, ST3, ST4	91780A164	McMaster-Carr	N/A	Standoff / 4-40 x 1/2" / Female-Female / 1/4" Hex
16	4	TP1, TP6, TP7, TP16	5011	Keystone Electronics	N/A	Test Point / Multi-Purpose / Black
17	3	TP2, TP3, TP4	5008	Keystone Electronics	N/A	Test Point / Compact / Orange
18	2	TP5, TP8	5009	Keystone Electronics	N/A	Test Point / Compact / Yellow
19	4	TP9, TP10, TP13, TP14	111-2223-001	Johnson	N/A	Binding Post
20	2	TP11, TP12	5007	Keystone Electronics	N/A	Test Point / Compact / White
21	1	TP15	5010	Keystone Electronics	N/A	Test Point / Multi-Purpose / Red
22	1	U1	MAX98366AEWC+	Analog Devices	N/A	15V Plug-and-Play Class-D Amp with Ultrasound
DO NOT PURCHASE OR POPULATE						
ITEM	**QTY**	**DESIGNATOR**	**MANUFACTURER PN**	**MANUFACTURER**	**VALUE**	**DESCRIPTION**
23	7	C1, C2, C3, C8, C9, C10, C11	N/A	N/A	DNP	Cap / Do Not Populate / 0402
24	2	FB1, FB2	N/A	N/A	DNP	Ferrite Bead / Do Not Populate / 0603
25	1	R6	N/A	N/A	DNP	Resistor / Do Not Populate / 0402

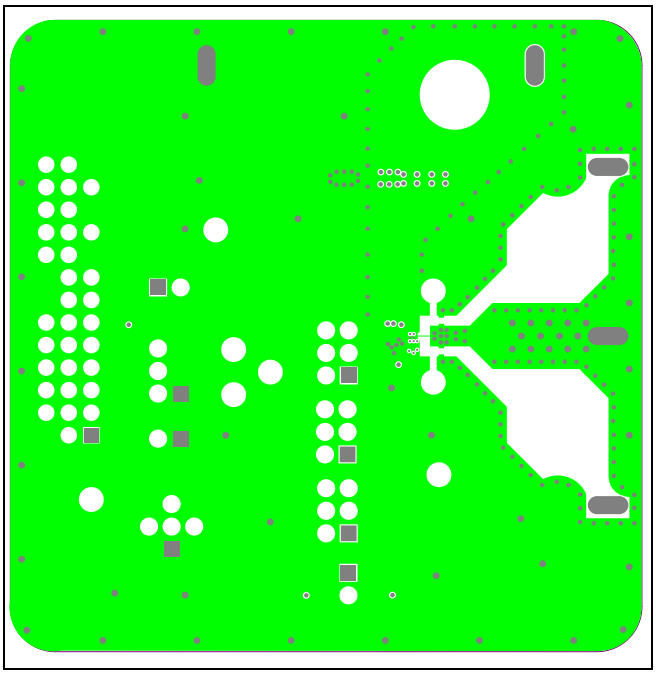
MAX98366 DEV Board Schematic



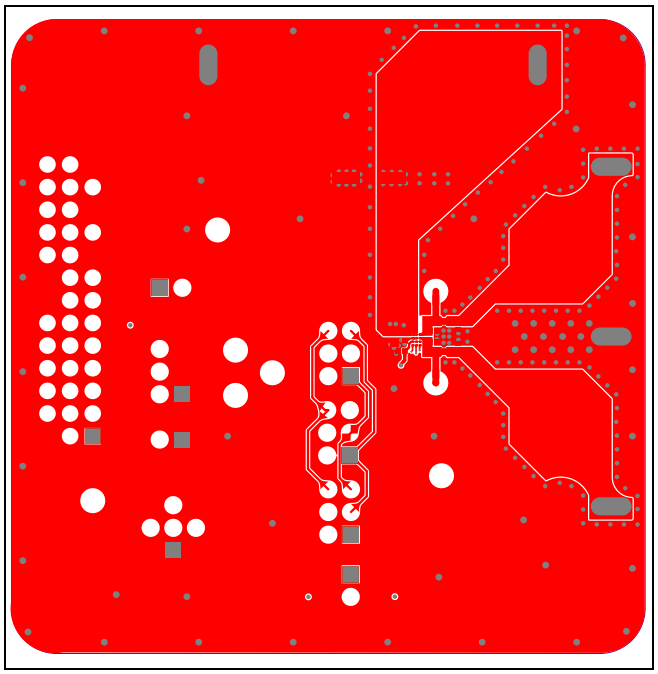
MAX98366 DEV Board PCB Layout



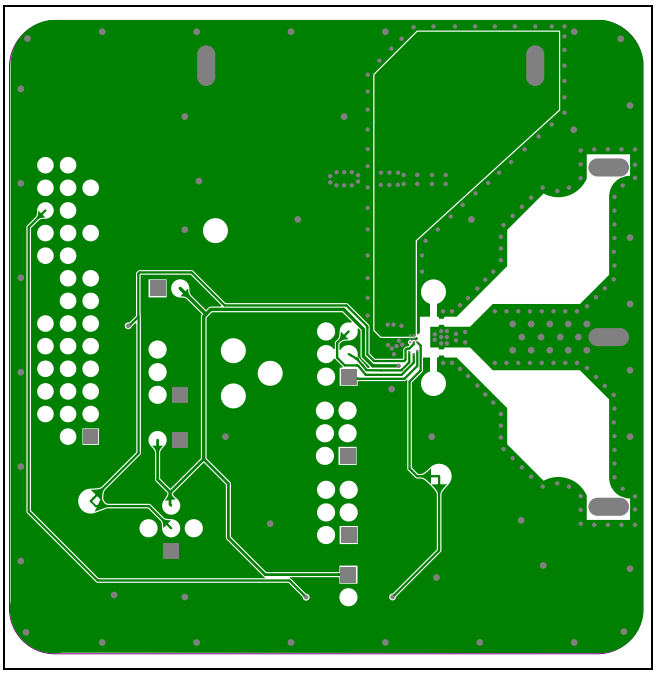
MAX98366 DEV Board PCB Layout—Top Silkscreen



MAX98366 DEV Board PCB Layout—Layer 2

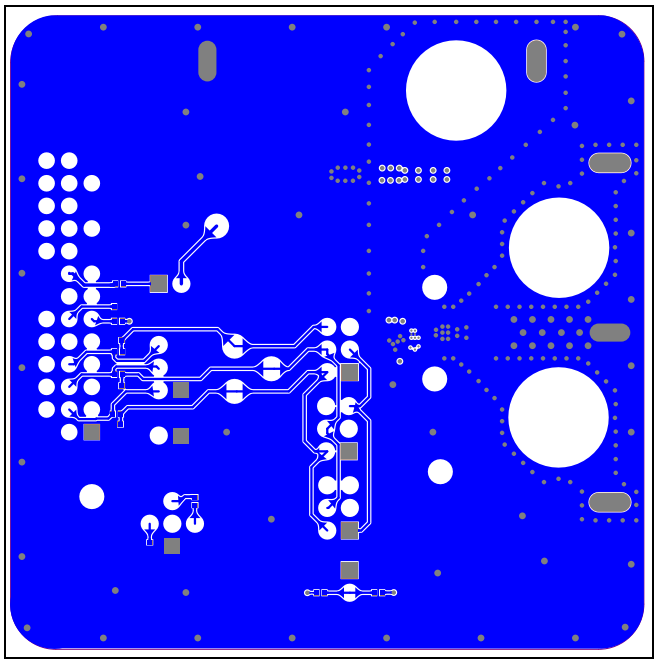


MAX98366 DEV Board PCB Layout—Top Layer

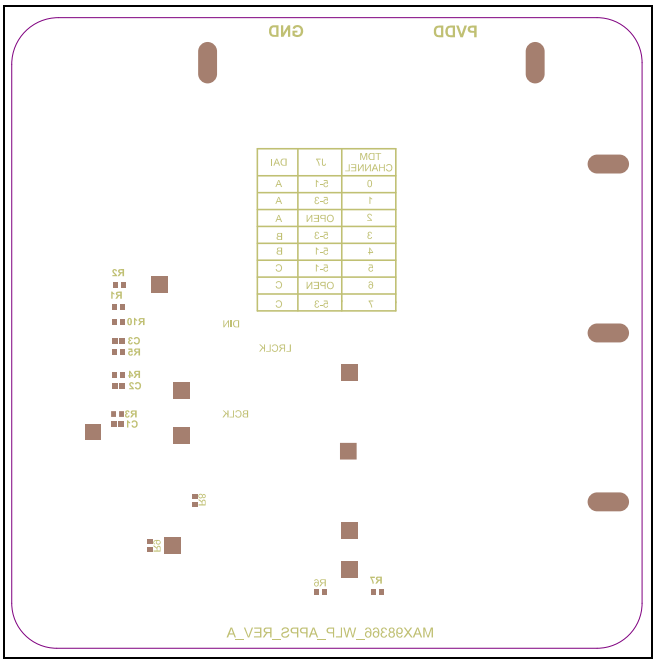


MAX98366 DEV Board PCB Layout—Layer 3

MAX98366 DEV Board PCB Layout (continued)



MAX98366 DEV Board PCB Layout—Bottom Layer



MAX98366 DEV Board PCB Layout—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	3/24	Initial release	—

Notes