



# MAX9726 Evaluation Kit/Evaluation System

## General Description

The MAX9726 evaluation system (MAX9726EVCMAQU) consists of the MAX9726 evaluation kit (EV kit) and the Maxim CMAXQUSB command module. Windows® 98/2000/XP-compatible software is also available for use with the MAX9726EVCMAQU system and can be downloaded from Maxim's website ([www.maxim-ic.com/evkitsoftware](http://www.maxim-ic.com/evkitsoftware)).

The MAX9726 evaluation kit is a fully assembled and tested PCB that evaluates the MAX9726 stereo DirectDrive™ headphone amplifier. The MAX9726 consists of two Class AB amplifiers designed to operate from a 2.7V to 5.5VDC power supply and deliver 100mW into a 32Ω stereo headphone. The EV kit includes a 3.5mm stereo headphone jack and an I<sup>2</sup>C/SMBus™-compatible interface that allows for software control of the BassMax (bass-boost), shutdown, and output volume setting features.

The Maxim CMAXQUSB command module provides the I<sup>2</sup>C/SMBus interface and is connected to the computer through the universal serial bus (USB) port. The MAX9726 EV kit software provides a graphical user interface (GUI) for exercising the MAX9726 features.

## Features

- ◆ 2.7V to 5.5V Single-Supply Operation
- ◆ 100mW DirectDrive Headphone Amplifier
- ◆ Integrated 64-Level Volume Control
- ◆ Hardware/Software Shutdown Control
- ◆ Software Enabled BassMax (Bass-Boost)
- ◆ I<sup>2</sup>C/SMBus-Compatible Interface
- ◆ Fully Assembled and Tested

## Ordering Information

PART	TEMP RANGE	IC PACKAGE	COMMAND MODULE
MAX9726EVKIT+	0°C to +70°C	20 TQFN (4mm x 4mm)	Not included
MAX9726EVCMAQU	0°C to +70°C	20 TQFN (4mm x 4mm)	CMAXQUSB

+Denotes a lead-free and RoHS-compliant EV kit.

**Note:** The Maxim CMAXQUSB command module is required when using the MAX9726 EV kit software.

## Component List

DESIGNATION	QTY	DESCRIPTION
C1–C5, C8, C9	7	1μF ±10%, 10V X7R ceramic capacitors (0603) TDK C1608X7R1A105K Taiyo Yuden LMK107BJ105KA
C6, C7	2	0.1μF ±10%, 16V X7R ceramic capacitors (0603) TDK C1608X7R1C104K Taiyo Yuden EMK107BJ104KA
C10	1	10μF ±20%, 6.3V X5R ceramic capacitor (0603) TDK C1608X5R0J106M
J1	1	3.5mm stereo jack
J2	1	2 x 10 right-angle receptacle

DESIGNATION	QTY	DESCRIPTION
JU1	1	2-pin header
R1, R3	2	47kΩ ±5% resistors (0603)
R2, R4	2	22kΩ ±5% resistors (0603)
R5, R6	0	Not installed, resistors (0603)
R7–R10	4	10kΩ ±1% resistors (0603)
R11	1	100kΩ ±5% resistor (0603)
TP1, TP2	2	Miniature test points
U1	1	MAX9726AETP+ (20-pin TQFN, 4mm x 4mm)
—	1	Shunt
—	1	MAX9726EVKIT+ PCB

## Component Suppliers

SUPPLIER	PHONE	WEBSITE
Taiyo Yuden	408-573-4150	<a href="http://www.t-yuden.com">www.t-yuden.com</a>
TDK	847-803-6100	<a href="http://www.component.tdk.com">www.component.tdk.com</a>

**Note:** Indicate that you are using the MAX9726 when contacting these component suppliers.

Windows is a registered trademark of Microsoft Corp.

SMBus is a trademark of Intel Corp.



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**For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at [www.maxim-ic.com](http://www.maxim-ic.com).**

Evaluate: MAX9726

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## Quick Start

### Recommended Equipment

- Computer running Windows 98/2000/XP
- Available USB port
- 6V/0.5ADC power supply (VDD)
- One pair of stereo headphones (16Ω or 32Ω)
- Stereo audio source

**Note:** In the following sections, software-related items are identified by bolding. Text in **bold** refers to items directly from the EV kit software. Text in **bold and underlined** refers to items from the Windows 98/2000/XP operating system.

### Procedure

The MAX9726 EV kit is fully assembled and tested. Follow these steps to verify board operation. **Caution:** Do not turn on the power supply until all connections are completed.

- 1) On the CMAXQUSB command module, ensure that the shunt on jumper JU1 is in the 3.3V position.
- 2) To enable the MAX9726 outputs, ensure that a shunt is not installed on jumper JU1.
- 3) Carefully connect the boards by aligning the 20-pin connector of the MAX9726 EV kit with the 20-pin header on the CMAXQUSB interface board. Gently press them together.
- 4) Connect the headphones to the stereo headphone jack (J1) provided on the MAX9726 EV kit.
- 5) Connect the right channel of the stereo audio source to INR.
- 6) Connect the left channel of the stereo audio source to INL.
- 7) Connect the positive terminal of the DC power supply to the VDD pad and the ground terminal to the GND pad next to VDD.
- 8) Visit the Maxim website ([www.maxim-ic.com/evkit-software](http://www.maxim-ic.com/evkit-software)) to download the most recent version of the EV kit software, 9726xx.ZIP. Save the EV kit software to a temporary folder and uncompress the ZIP file.
- 9) Install the EV kit software on your computer by running the INSTALL.EXE program inside the temporary folder. The program files are copied and icons are created in the Windows **Start | Programs** menu.
- 10) Connect the USB cable from the PC to the CMAXQUSB board. A **Building Driver Database** window pops up in addition to a **New Hardware Found** message if this is the first time the EV kit board is con-

nected to the PC. If you don't see a window that is similar to the one described above after 30 seconds, remove the USB cable from the CMAXQUSB and reconnect it. Administrator privileges are required to install the USB device driver on Windows 2000/XP. Refer to the TROUBLESHOOTING\_USB.PDF document included with the software if you have any problems during this step.

- 11) Follow the directions of the **Add New Hardware Wizard** to install the USB device driver. Choose the **Search for the Best Driver for your Device** option. Specify the location of the device driver to be **C:\Program Files\MAX9726** (default installation directory) using the **Browse** button.
- 12) Turn on the power supply and set it to +5V.
- 13) Enable the stereo audio source.
- 14) Start the MAX9726 program by opening its icon in the **Start | Programs** menu.
- 15) Normal device operation is verified when "CMAXQUSB HW: Connected. MAX9726 device connected" is displayed at the bottom left of the MAX9726 EV kit window.

## Detailed Description of Software

### User-Interface Panel

The program's main window (see Figure 1) is operated by using a mouse or a combination of the Tab and Arrow keys. The MAX9726 EV kit software provides controls for software-configurable features: **Shutdown**, **BassMax**, and output **Volume Setting**. Changes to the controls result in a write operation that updates the command register of the MAX9726. All changes to the 8-bit command register are also reflected on-screen under the **B7** to **B0** labels. A status box is also provided at the bottom of the program's main window and is used to verify command module and device connectivity, as well as confirm write operations.

### Software Shutdown Control

The MAX9726 is placed in a low-power shutdown mode by checking the **Shutdown** checkbox. The shutdown feature can also be toggled by clicking the **B7** label, bit 7 of the MAX9726 command register. When in shutdown, the I<sup>2</sup>C/SMBus interface is active, allowing commands to be sent to the MAX9726 device.

### BassMax Control

The MAX9726 BassMax feature is enabled by checking the **BassMax** checkbox. This feature can also be toggled by clicking the **B6** label, bit 6 of the MAX9726 command register. By enabling BassMax, the amplifier's

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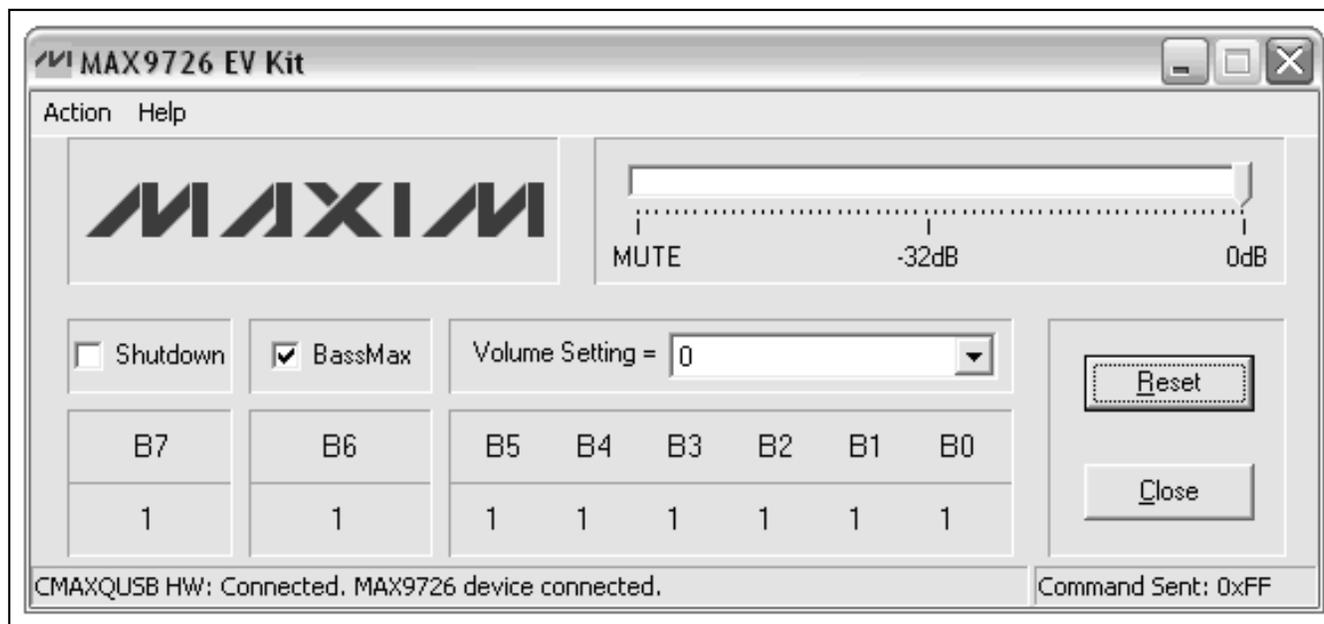


Figure 1. MAX9726 EV Kit Software Main Window

low-frequency gain is increased, compensating for the headphone's poor bass response. Refer to the MAX9726 IC data sheet for more details on the BassMax feature.

## Output Volume Setting

The MAX9726 amplifier is configured for a maximum output gain ( $A_V$ ) of 0dB and is attenuated by writing the appropriate code to the command register, bits [5:0]. The program provides two controls (Figure 2) for adjusting the output volume of the amplifier with 64 possible attenuation levels ( $ATTEN_{dB\_VOL}$ ). With 0dB resulting in maximum output gain ( $A_V-0dB$ ) and MUTE resulting in minimum output gain ( $A_V-MUTE$ ). The first method for adjusting the output volume involves selecting the desired attenuation level from the **Volume Setting** combo box. The second method involves dragging the trackbar's slider to the desired attenuation level. All attenuation level changes are reflected in the **Volume**

**Setting** combo box, on the trackbar, and under the **B5** to **B0** labels. Refer to the MAX9726 IC data sheet for a list of the 64 possible attenuation levels.

## Simple I<sup>2</sup>C/SMBus Commands

There are two methods for communicating with the MAX9726: through the normal user-interface panel (Figure 1) or through the SMBus commands available by selecting the **Interface Diagnostic Window** item from the **Action** pulldown menu. The **Maxim Command Module Interface** window pops up and includes a **2-wire interface** tab that allows for execution of the **SMBusSendByte()** and **SMBusQuick()** commands.

The SMBus dialog boxes accept numeric data in binary, decimal, or hexadecimal. Hexadecimal numbers should be prefixed by \$ or 0x. Binary numbers must be exactly eight digits. See Figure 3 for an illustration of this tool.

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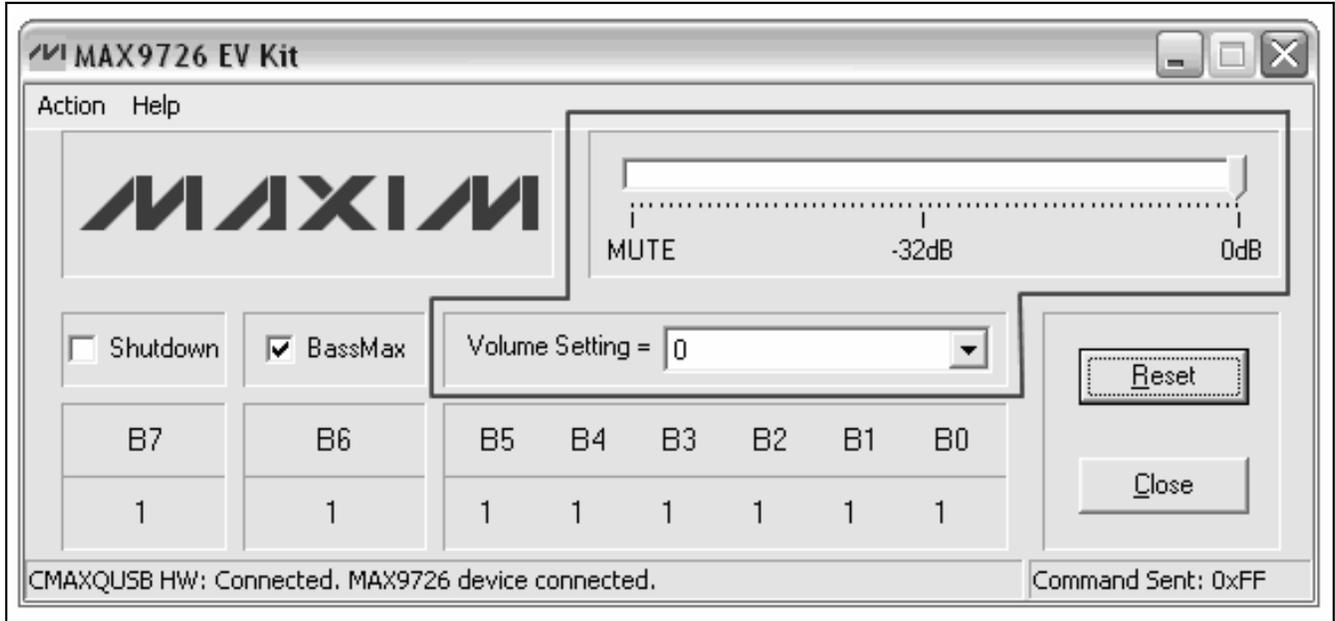


Figure 2. Output Volume Setting Controls

## Detailed Description of Hardware

The MAX9726 evaluation system consists of the MAX9726 EV kit and the Maxim CMAXQUSB command module. The EV kit evaluates the MAX9726 DirectDrive stereo headphone amplifier and the CMAXQUSB provides the I<sup>2</sup>C/SMBus-compatible interface for software control of the MAX9726's BassMax (bass-boost), shutdown, and output volume setting features.

The EV kit is powered by a 2.7V to 5.5VDC power supply and is driven by a stereo audio source. The output of the audio source is connected between GND and the INR (input right channel) and INL (input left channel) input pads. The outputs are provided at OUTR and OUTL, as well as at the stereo headphone jack, J1.

The output of the MAX9726 headphone amplifier is designed to deliver 100mW into a 32Ω load and features low 0.03% THD+N. As configured, the EV kit provides a bass-boosted frequency response (8.8dB, f<sub>c</sub> = 72Hz) and a 0dB max output gain, provided that BassMax is enabled.

## Hardware Shutdown Control

The MAX9726 can also be placed in a low-power shutdown mode through jumper JU1 (see Table 1). While in shutdown, the amplifiers are disabled, the output resistance is set to 50kΩ, and the I<sup>2</sup>C/SMBus interface remains active, allowing the command module to write to the MAX9726 command register.

Table 1. Jumper JU1 Functions

SHUNT LOCATION	SHDN PIN	MAX9726 OUTPUT
Not installed (default)	Connected to VDD through R11	Enabled
Installed	Connected to GND	Disabled

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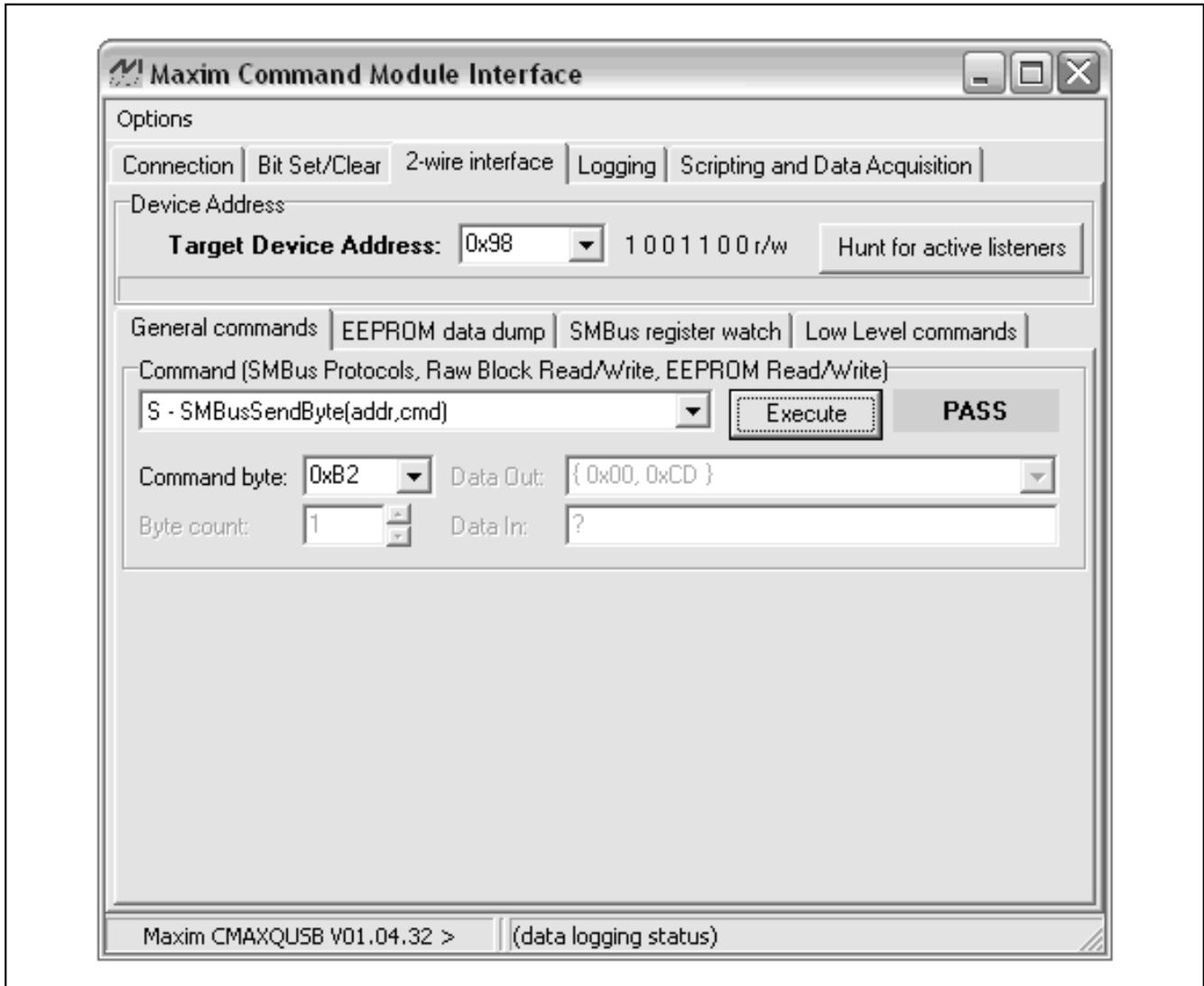


Figure 3. Interface Diagnostic Window

### Maximum Output Gain

With BassMax disabled, the maximum gain ( $A_V$ ) of the MAX9726 amplifier is set to 0dB. To configure the maximum output gain, adjust resistors R7 and R8 (left channel) and R9 and R10 (right channel):

$$A_{V,L,R} = 20 \times \log\left(\frac{R_{8,10}}{R_{7,9}}\right) \text{ (dB)}$$

### BassMax Configuration

The MAX9726 EV kit includes circuitry to increase the low-frequency (bass) response. As configured, the EV

kit provides an 8.8dB ( $A_{BOOST}$ ) bass-boosted frequency response with a 72Hz cutoff frequency ( $f_C$ ). The bass response can be adjusted by changing R1–R4, C6, and C7. Refer to the *Gain-Setting Components* section in the MAX9726 IC data sheet for details on component selection.

### User-Supplied I<sup>2</sup>C Interface

To use the MAX9726 EV kit with a user-supplied I<sup>2</sup>C interface, install 10k $\Omega$  resistors on pads R5 and R6. Connect the SDA, SCL, and GND lines from the I<sup>2</sup>C interface to the corresponding pads on the MAX9726 EV kit board.

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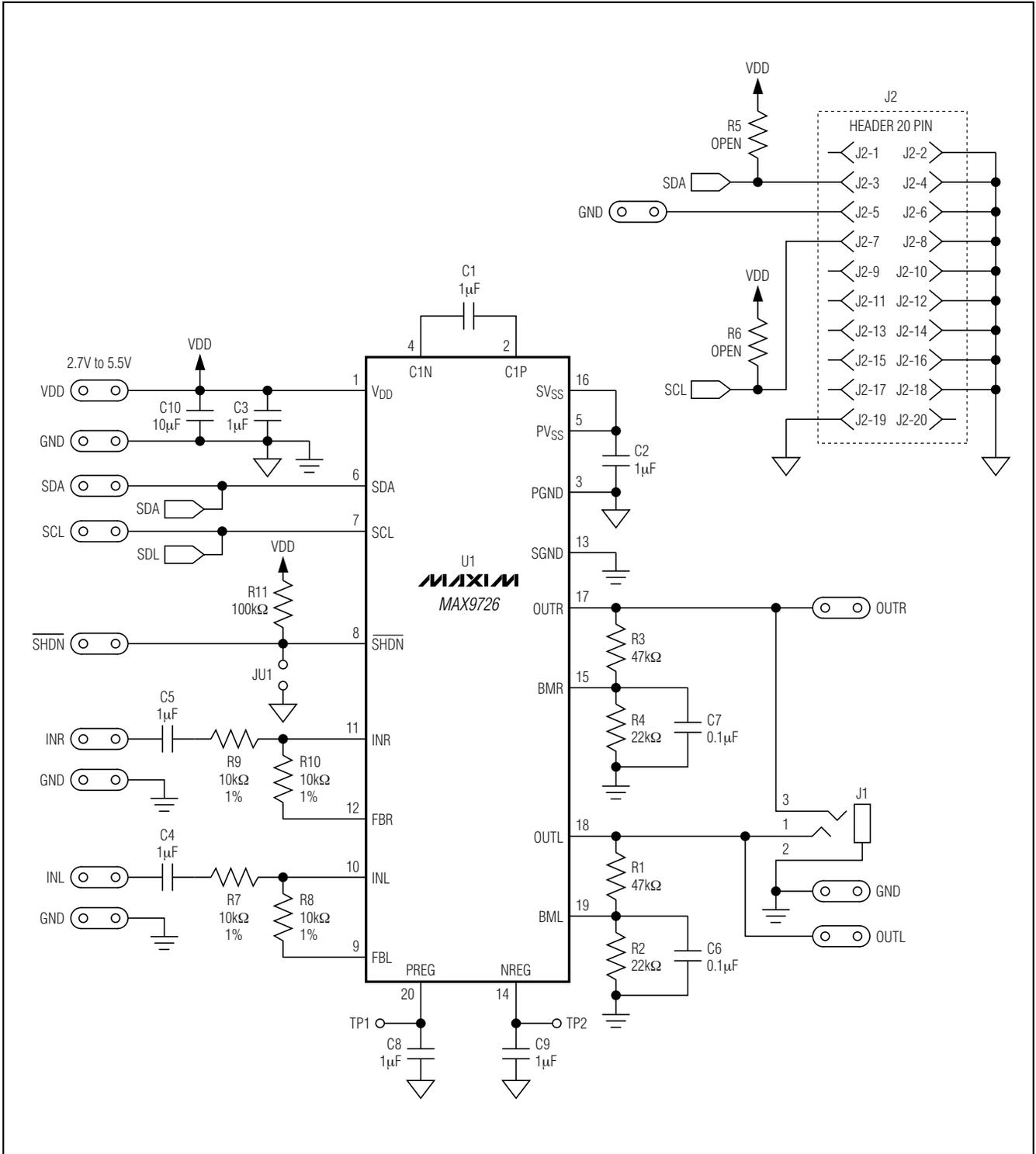


Figure 4. MAX9726 EV Kit Schematic

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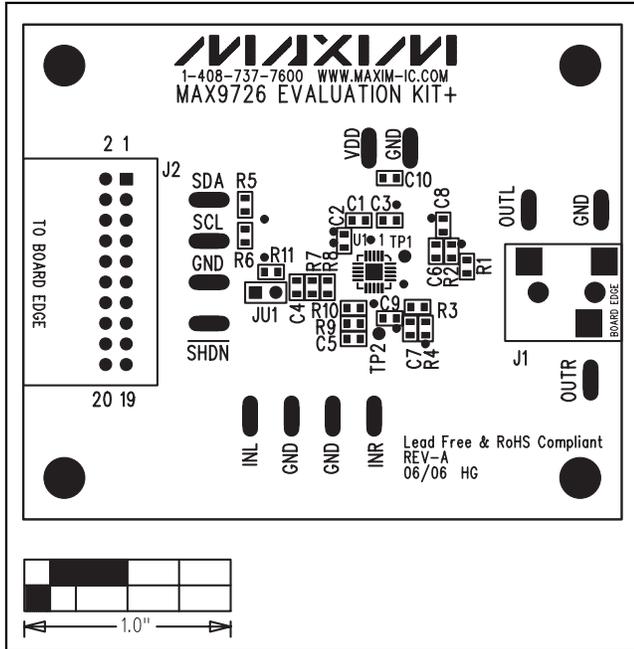


Figure 5. MAX9726 EV Kit Component Placement Guide—Component Side

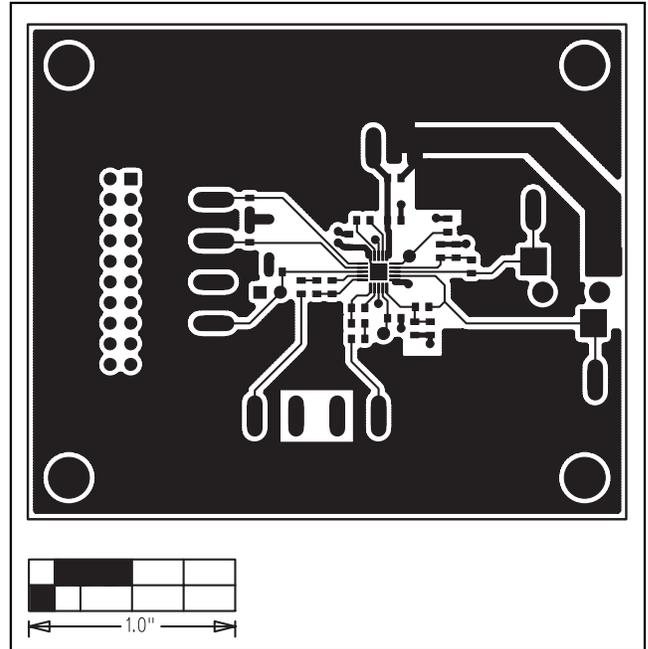


Figure 6. MAX9726 EV Kit PCB Layout—Component Side

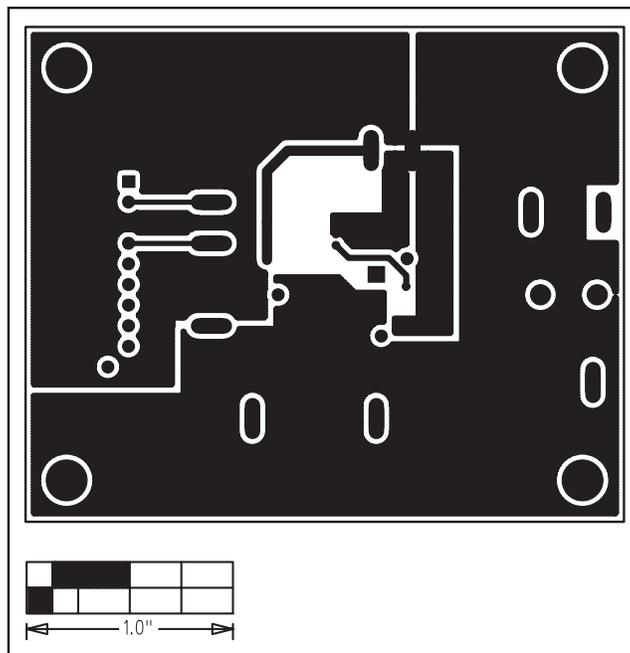


Figure 7. MAX9726 EV Kit PCB Layout—Solder Side

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