19-0776; Rev 0; 3/07

MAX9776 Evaluation Kit

Evaluates: MAX9776

General Description

The MAX9776 evaluation kit (EV kit) is a fully assembled and tested printed circuit board (PCB) that evaluates the MAX9776 ultra-low EMI, 1.5W filterless Class D audio power amplifier with 80mW DirectDrive™ headphone amplifier. The MAX9776 EV kit offers highly programmable and flexible input and output routing, which allows many combinations of balanced and single-ended signals to be connected. The MAX9776 EV kit also includes Windows® 98SE/2000/XP-compatible software, which provides a simple graphical user interface (GUI) for exercising the MAX9776's features.

Windows is a registered trademark of Microsoft Corp.

Features

- **1.5W Speaker Output (4Ω, V_{DD} = 5V)**
- **80mW DirectDrive Headphone Amplifier**
- **Highly Programmable Input and Output Modes**
- **Controlled Through USB**
- **Proven PCB Layout**
- **Windows 98SE/2000/XP-Compatible Evaluation Software**
- **Fully Assembled and Tested**

Component Suppliers

SUPPLIER	PHONE	WEBSITE
AVX	843-946-0238	www.avxcorp.com
TDK	847-803-6100	www.component.tdk.com
TOKO	847-297-0070	www.tokoam.com

Note: *Indicate that you are using the MAX9776 when contacting these component suppliers.*

Ordering Information

PART	TYPE	INTERFACE
MAX9776EVKIT+	EV kit	USB interface

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

Component List

DESIGNATION	QTY	DESCRIPTION
C1–C6	6	100pF ±5%, 10V C0G ceramic capacitors (0603) TDK C1608C0G1H101K
C11	1	0.01µF ±10%, 25V X7R ceramic capacitor (0603) TDK C1608X7R1H103J
C12, C28, C29, C41–C48, C58	12	0.1µF ±10%, 25V X7R ceramic capacitors (0603) TDK C1608X7R1E104J
C13–C23, C49, C50	13	1.0µF ±10%, 16V X5R ceramic capacitors (0603) TDK C1608X5R1C105M
C24, C25	2	33µF ±10%, 10V tantalum capacitors (C-case) AVX TAJC336K010R
C26	1	0.47µF ±10%, 10V X7R ceramic capacitor (0603) TDK C1608X7R1C474K
C32, C33	2	0.033µF ±10%, 10V X7R ceramic capacitors (0603) TDK C1608X7R1H333K
C36, C37	0	Not installed (0603)
C40	1	3300pF ±10%, 10V X7R ceramic capacitor (0603) TDK C1608X7R1H332K
C51, C52, C53	3	10µF ±10%, 16V X5R ceramic capacitors (1206) TDK C3216X5R1C106M
C54, C55	2	22pF ±5%, 10V C0G ceramic capacitors (0603) TDK C1608C0G1H220J
C56, C57	2	10pF ±5%, 10V C0G ceramic capacitors (0603) TDK C1608C0G1H100J
D1	1	Green LED (0603)
D2	0	Not installed (0603)
D3	1	Red LED (0603)
FB1–FB6, FB13	7	0Ω resistors (0603)
FB7, FB8	2	0Ω resistors (1206)
FB11, FB12	2	Ferrite beads, 3A (1206)
HPJK	1	3.5mm surface-mount stereo headphone jack
J1	1	USB series "B" right-angle PC mount receptacle
J2	0	Not installed
JU1–JU5	5	2-pin single-row headers
JU6	1	3-pin single-row header
L1, L2	2	33µH ±20%, 1.4A inductors TOKO B1000AS-330M

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.

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
R1, R2, R18	0	Not installed, resistors
R3, R4	2	22Ω ±5% resistors (0603)
R7–R10	4	27Ω ±5% resistors (0603)
R11	1	220Ω ±5% resistor (0603)
R12	1	470Ω ±5% resistor (0603)
R13, R14, R15	3	1.5kΩ ±5% resistors (0603)
R16	1	2.2kΩ ±5% resistor (0603)
R17	1	10kΩ ±5% resistor (0603)
R19	1	1kΩ ±5% resistor (0603)
U1	1	MAX9776ETJ+ (32 TQFN, 5mm x 5mm x 0.8mm)
U2	1	MAXQ2000-RAX+ (68-pin QFN-EP)
U3	1	93C46 type 3-wire EEPROM (8-pin SO)
U4	1	FTDI FT232BL (TQFP-32L, 7mm x 7mm)
U5	1	MAX8511EXK33+T (SC70-5)
U6	1	MAX8511EXK25+T (SC70-5)
Y1	1	16MHz crystal
Y2	1	6MHz crystal
Y3	0	Not installed
—	6	Shunts
—	1	PCB: MAX9776 Evaluation Kit+
—	1	USB high-speed A-to-B cable (1.5m)

Quick Start

Recommended Equipment

- 5V, 1.5A power supply
- Stereo audio source (i.e., CD player, MP3 player)
- One 4Ω (or 8Ω) speaker
- The MAX9776 EV kit (included with USB cable)
- A user-supplied Windows 98SE/2000/XP PC with a spare USB port

Note: In the following section(s), 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 98SE/2000/XP operating system.

Procedure

Do not turn on the power supply until all connections are made:

1) Visit the Maxim Integrated Products website (www.maxim-ic.com/evkitsoftware) to download the latest version of the EV kit software, 9776Rxx.ZIP. Save the EV kit software to a temporary folder and unzip the 9776Rxx.ZIP file.
2) Install the MAX9776 evaluation software on your computer by running the INSTALL.EXE program. The program files are copied and icons are created in the Windows **Start | Programs** menu.
3) Make sure the shunts of all jumpers on the MAX9776 EV kit are in the following default positions.
   - JU1: (Open) INA is stereo input
   - JU2: (Open) INB is stereo input
   - JU3: (Open) INC is stereo input
   - JU4: (1-2) SDA connected to on-board microcontroller
   - JU5: (1-2) SCL connected to on-board microcontroller
   - JU6: (1-2) Normal operation
4) Connect the speaker across FOUT+ and FOUT- pads.
5) Connect the positive terminal of the 5V power supply to the VDD pad and the ground terminal of the power supply to the GND pad.
6) Connect the stereo audio source across the INA1, INA2, and GND pads.
7) Turn on the audio sources, and then turn on the power supply.
8) Connect the USB cable from the PC to the MAX9776 EV kit 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 connected to the PC. If you do not see a window that is similar to the one described above after 30s, remove the USB cable from the MAX9776 EV kit 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.

9) 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\MAX9776** (default installation directory) using the **Browse** button.

10) Start the MAX9776 EV kit software by opening its icon in the **Start** menu.

11) Check the **Power Up** checkbox in the **Control Register** panel.

12) Ensure the audio signal is audible in the speaker. The EV kit software automatically detects the MAX9776 EV kit, enables the mono Class D speaker amplifier, and mixes the stereo input signal to a mono signal. The mono signal is sent to the mono Class D output.

Detailed Description of Software

The MAX9776 EV kit GUI software provides an easy user interface (Figure 1) to control the programmable features of the MAX9776. To start the MAX9776 EV kit GUI software, double-click the MAX9776 EV kit icon created during installation. The user will have to wait approximately 2s while the software detects the MAX9776 EV kit.

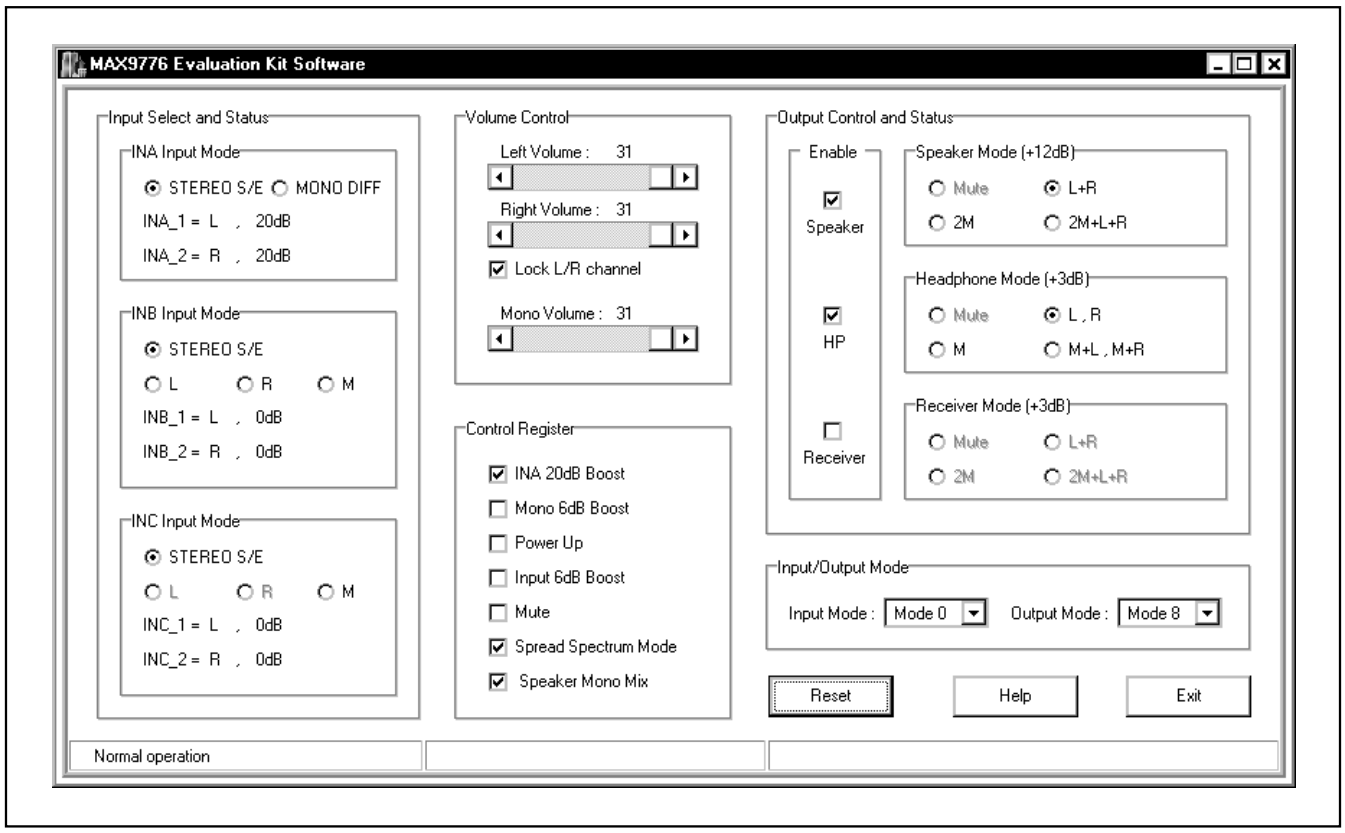


Figure 1. MAX9776 EV Kit Software GUI Window

Input Select and Status

The **Input Select and Status** panel gives the capability to select the input mode between single-ended stereo, right-channel differential, left-channel differential, and mono differential for input channels INA, INB, and INC.

The **Input Select and Status** panel also displays the current volume settings for INA, INB, and INC. INA can be configured to accept a stereo single-ended signal or a differential mono signal. Click the **STEREO S/E** radio button to configure INA for a stereo single-ended signal. Click the **MONO DIFF** radio button to configure INA for a mono differential input signal.

INB and INC can be configured to accept a stereo single-ended signal or a differential signal. Check the **L**, **R**, or **M** radio buttons to configure the input to accept a differential signal and route that signal to either the right, left, or mono mixer. Refer to the functional diagram in the MAX9776 IC data sheet for details.

The input mode is also selectable using the **Input Mode** pulldown menu inside the **Input/Output Mode** panel. Refer to the MAX9776 IC data sheet for details.

Output Select and Status

The output mode of the speaker, headphone, and receiver amplifiers can be controlled within the **Output Control and Status** panel.

The output mode of the speaker, headphone, and receiver amplifiers can also be selected using the **Output Mode** pulldown menu inside the **Input/Output Mode** panel. Refer to the MAX9776 IC data sheet for details.

Input/Output Mode

The input and output modes are selectable using the pulldown menus inside this panel. Refer to the MAX9776 IC data sheet for details.

Volume Control

The scroll bars inside the **Volume Control** panel individually control the volume setting of the MAX9776's left channel, right channel, and mono channel. If the **Lock L/R channel** checkbox is checked, the volume of both left and right channels will be equal and change simultaneously.

The current volume settings for INA, INB, and INC inside the **Input Select and Status** panel will be updated automatically as the volume control scroll bar is moved.

Control Register

The **Control Register** panel contains checkboxes for the remaining settings. These checkboxes control the INA gain boost, receiver gain boost, power up, 6dB input gain boost, mute control, and Class D oscillator mode. Check the **INA 20dB Boost** checkbox to apply an extra 20dB of gain to the INA path. Checking the **Mono 6dB Boost** checkbox applies 6dB of gain to the mono channel. Check the **Power Up** checkbox to enable the MAX9776 EV kit, clear the checkbox to shut down the kit. **Input 6dB Boost** applies an additional 6dB of gain to all the input paths. Check **Mute** to mute the MAX9776 outputs. Check **Spread Spectrum Mode** to enable the low-EMI spread-spectrum mode. Check **Speaker Mono Mix** to enable mono mixing for the speaker amplifier. If this box is not checked, only the left channel will play at speaker output.

Reset, Help, and Exit Buttons

There are three buttons at the bottom-right corner of the MAX9776 EV kit software GUI window: **Reset**, **Help**, and **Exit**.

Press the **Reset** button to reestablish the connection between the PC and the EV kit, and return the MAX9776 EV kit to its power-on-reset setting.

The **Help** button displays the current software version. It also provides information on how to obtain the latest MAX9776 EV kit software and data sheet.

Press the **Exit** button to quit the MAX9776 EV kit software.

Detailed Description of Hardware

The MAX9776 EV kit board provides a proven layout for evaluating the MAX9776. The EV kit comes with MAX9776ETJ+.

Input Mode Setting

The audio input terminals on the MAX9776 EV kit are flexible and can be configured as mono single-ended inputs, stereo single-ended inputs, or differential inputs. Any of the inputs can be routed to left, right, or mono input mixers. Jumpers JU1–JU3 can be used to ground INA2, INB2, and INC2, respectively.

Outputs

The MAX9776 EV kit allows connection of stereo headphones, a mono receiver speaker, and a mono loudspeaker. A 3.5mm headphone jack is provided to connect stereo headphones. The mono receiver speaker output is labeled OUTRX. Connect the receiver speaker between OUTRX and one of the adjacent GND pads.

Connect the mono loudspeaker between the FOUT+ and FOUT- pads.

Class D and EMI Filtering

Two types of filters are available on the Class D output. One filter is an LCR filter intended to be used to connect the Class D output to an audio analyzer or oscilloscope. The output of this filter is between FOUT+ and FOUT-.

The second filter is an EMI filter consisting of ferrite beads and capacitors. The ferrite beads and capacitors are included in the MAX9776 EV kit's shipping box. Install the EMI filter by removing the 0Ω resistors from pads FB7 and FB8 and installing the ferrite beads. Also install the included capacitors on pads C36 and C37. Be sure to remove inductors L1 and L2 before EMI testing is started. Connect the load across test points OUT+ and OUT-.

MAX9776 I²C Address

The MAX9776 is an I²C/SMBus slave device that can only be written to. The slave address is fixed to 1001101x in binary.

Power Supply

The MAX9776 EV kit board is powered from both a user-supplied +2.7V to +5.5V supply, and the +5V USB supply. U1 is powered by a user-provided DC power supply connected between the VDD and GND pads. All other support devices are powered from the USB supply.

Hardware Shutdown Control

Jumper JU6 controls the hardware shutdown function of the MAX9776 EV kit. This will shut down the entire MAX9776 and reset all the registers to their power-on defaults. See Table 1 for shutdown shunt positions.

Table 1. Hardware Shutdown Selection (JU6)

POSITION	FUNCTION
1-2*	Normal operation
2-3	Power-down mode

**Default position.*

User-Supplied I²C Interface

To use the MAX9776 EV kit with a user-supplied I²C interface, remove the shunts on jumper JU4 and JU5. Connect SDA, SCL, and GND lines from the user-supplied I²C interface to the corresponding pads on the MAX9776 EV kit board. Depending on the configuration of the user-supplied I²C interface, it may be necessary to install I²C pullup resistors R1 and R2.

MAX9776 Evaluation Kit

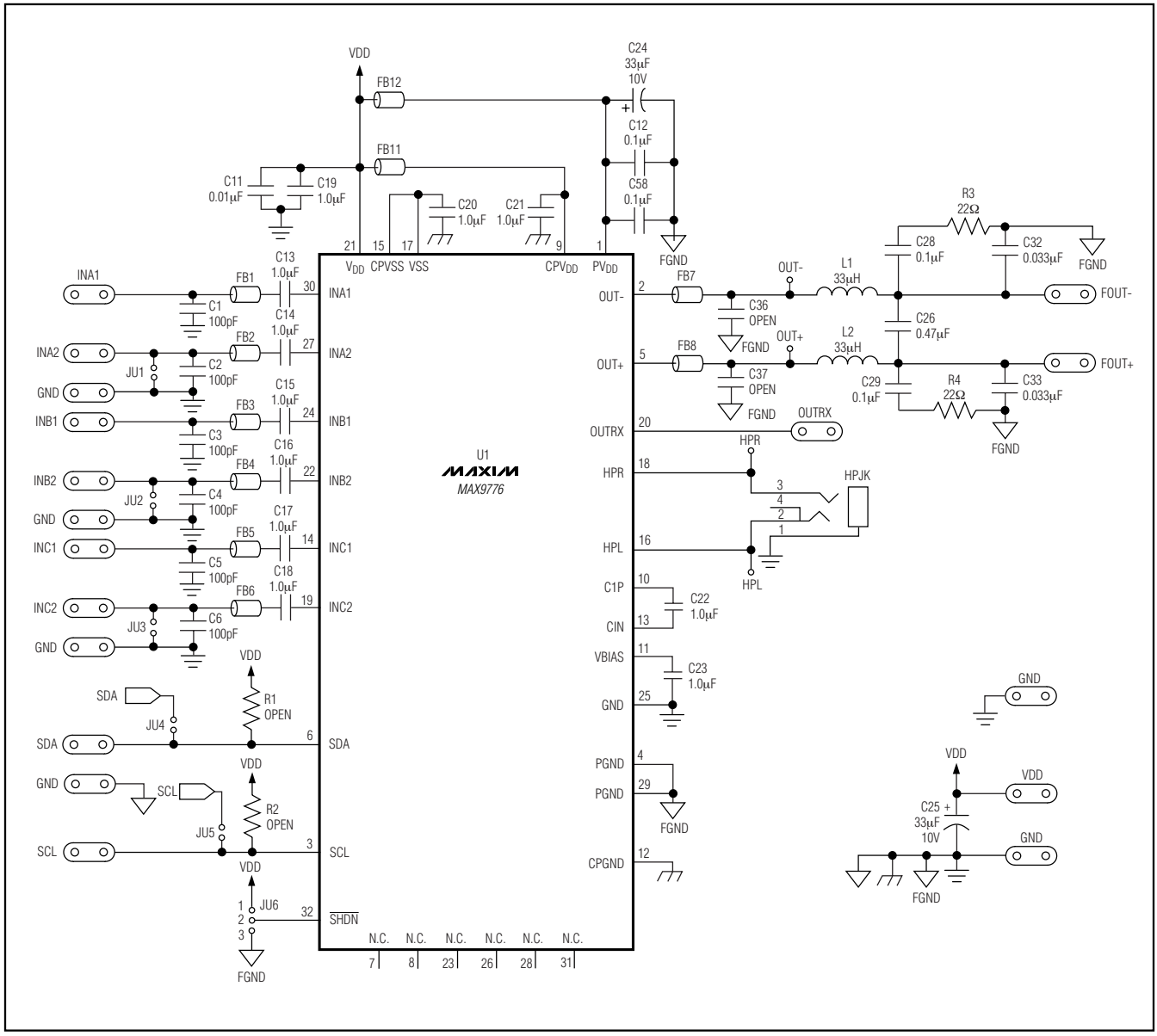


Figure 2a. MAX9776 EV Kit Schematic (Sheet 1 of 3)

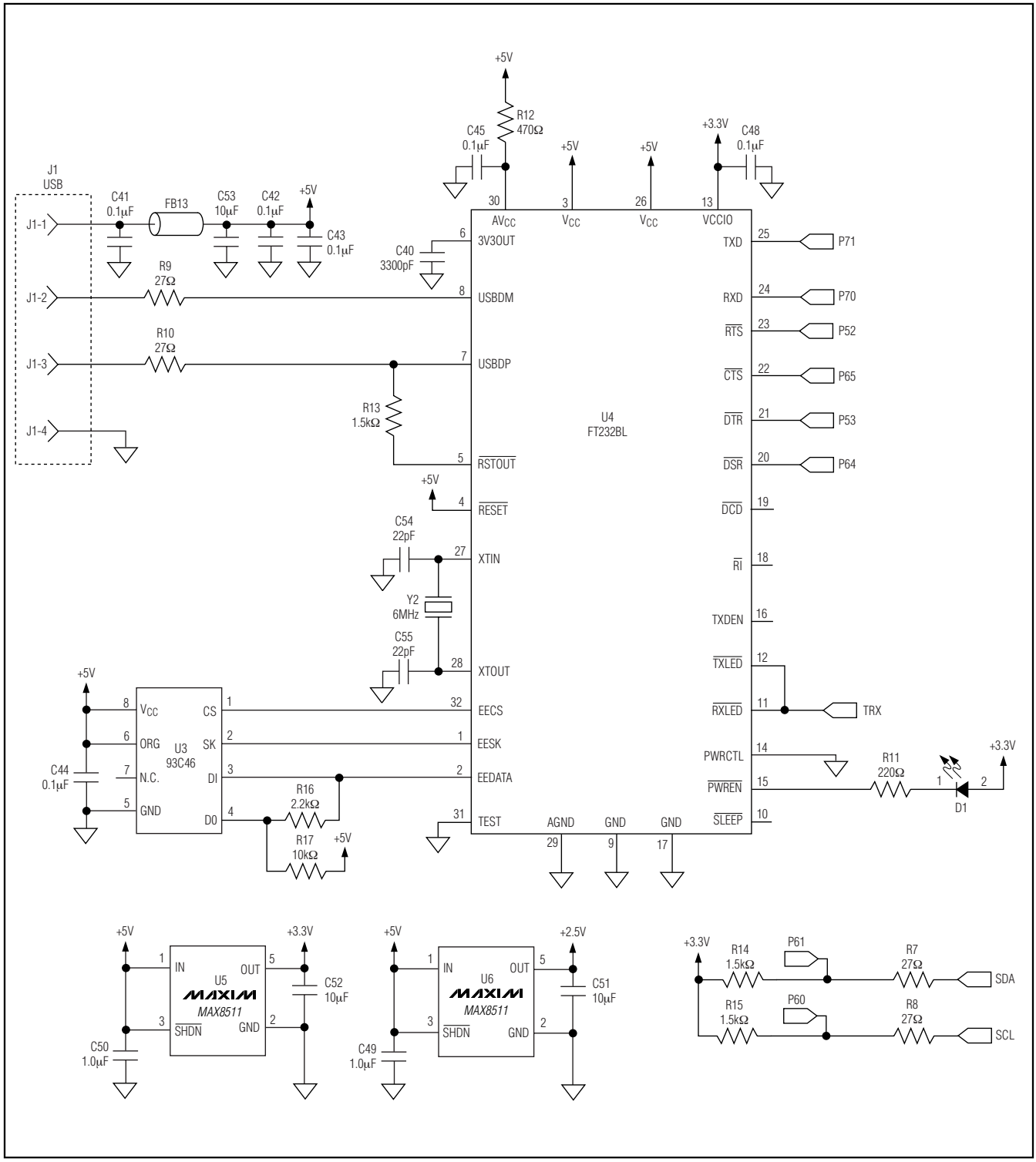


Figure 2b. MAX9776 EV Kit Schematic (Sheet 2 of 3)

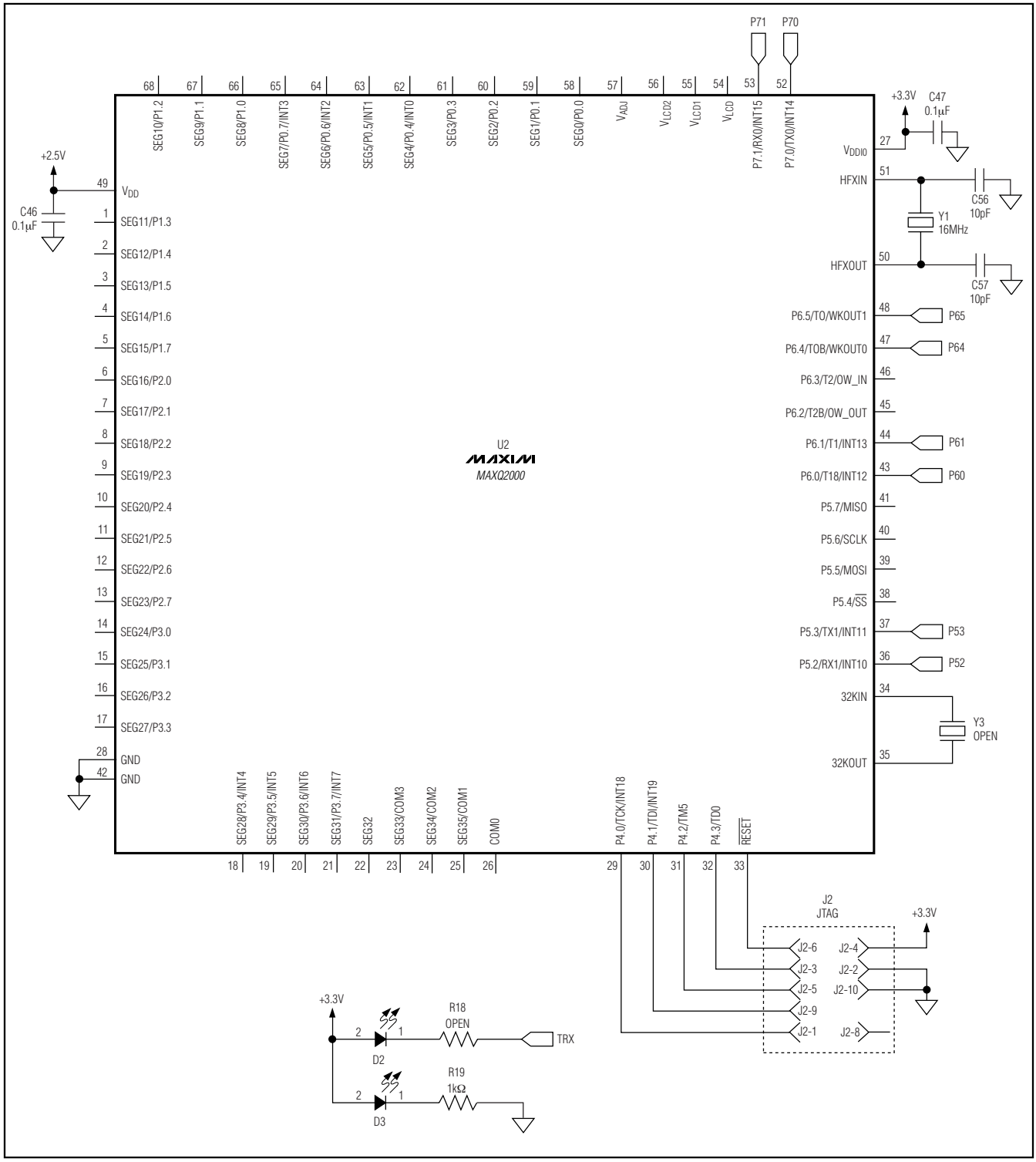


Figure 2b. MAX9776 EV Kit Schematic (Sheet 3 of 3) (continued)

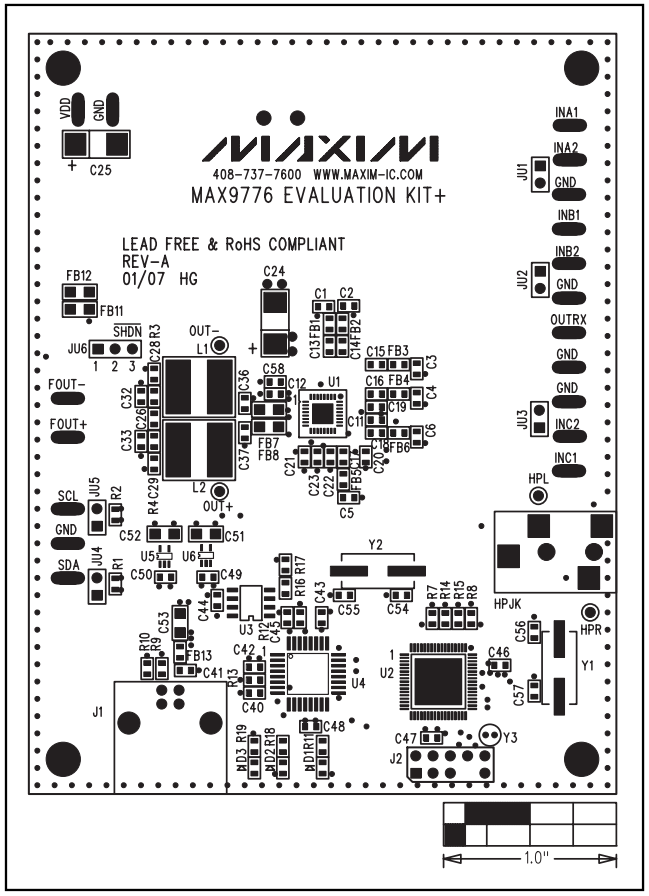


Figure 3. MAX9776 EV Kit Component Placement Guide—Component Side

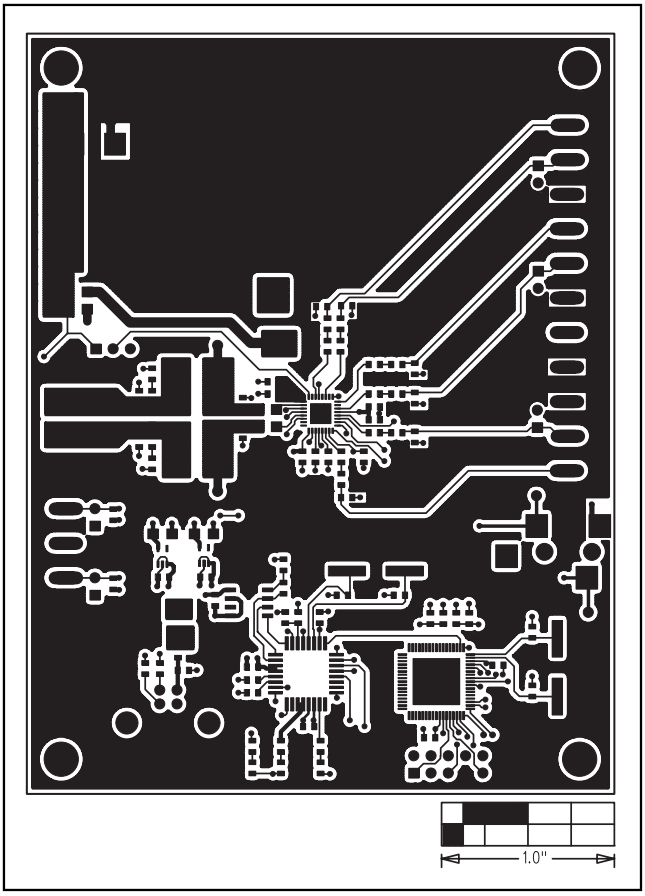


Figure 4. MAX9776 EV Kit PCB Layout—Component Side

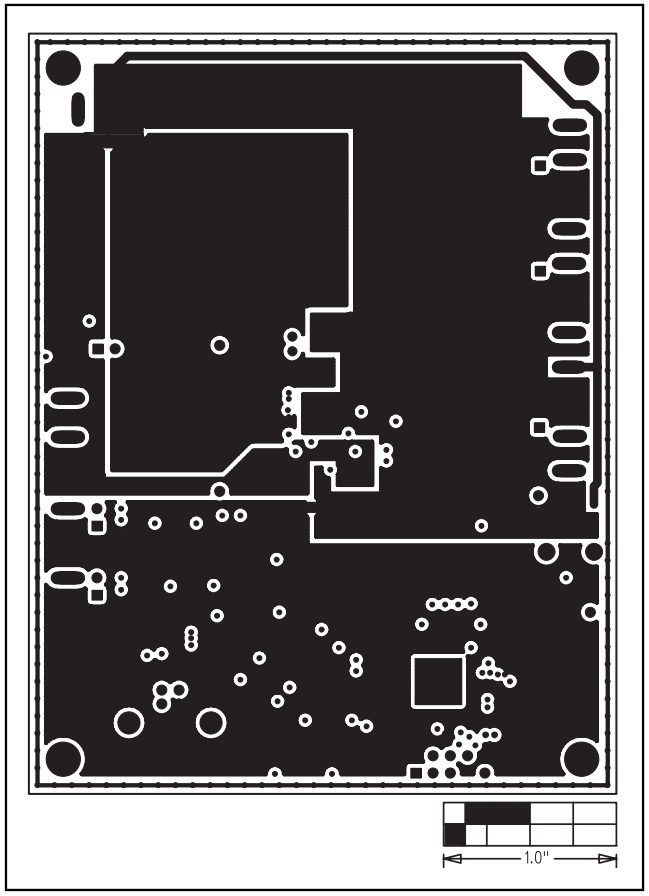


Figure 5. MAX9776 EV Kit PCB Layout—Layer 2 (GND)

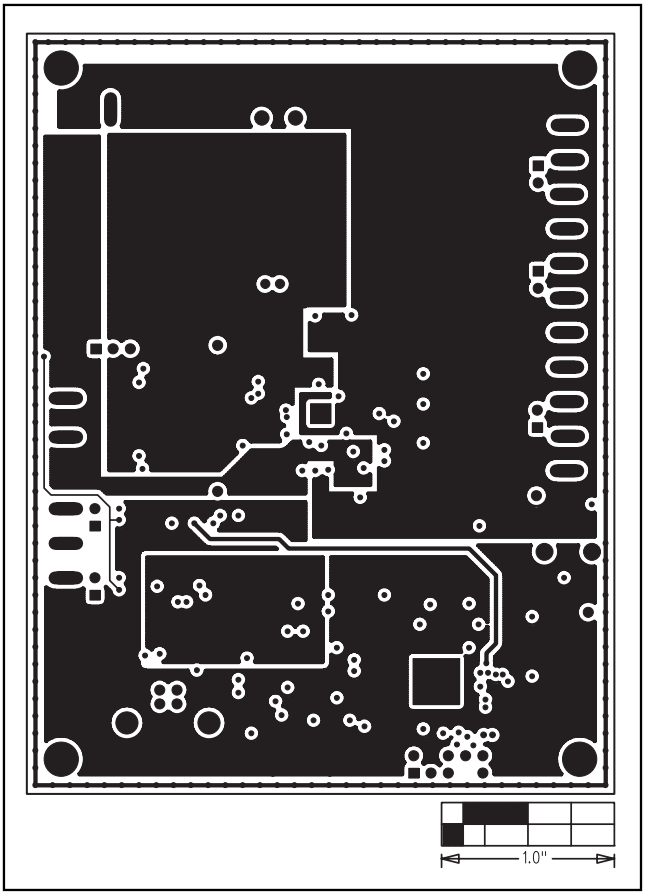


Figure 6. MAX9776 EV Kit PCB Layout—Layer 3 (Power)

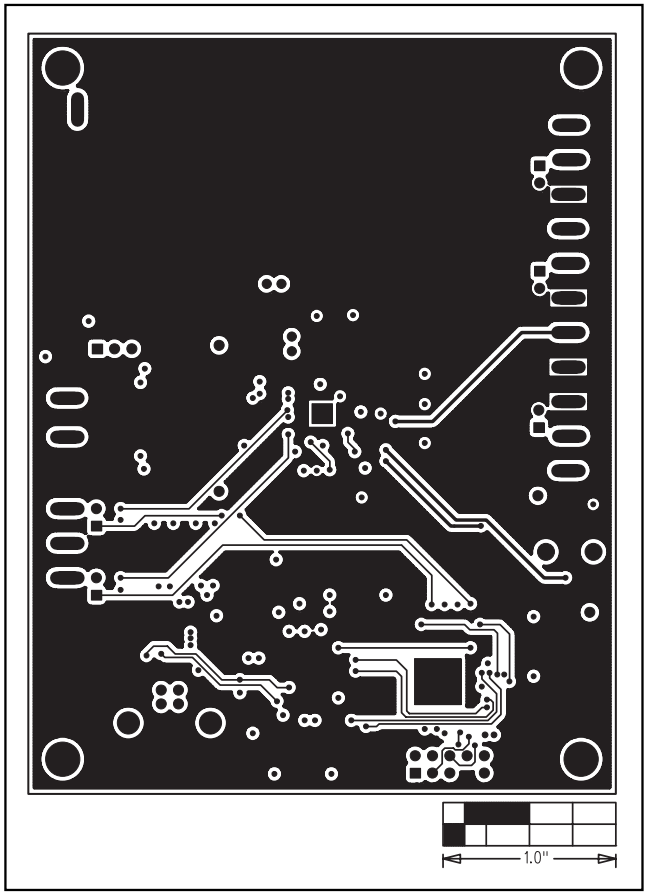


Figure 7. MAX9776 EV Kit PCB Layout—Solder Side

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