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MAX9744 Evaluation Kit/ Evaluation System

Evaluate: MAX9744

General Description

The MAX9744 evaluation kit (EV kit) is a fully assembled and tested circuit board that contains the MAX9744 highly efficient 2 x 20W Class D stereo speaker amplifier. The MAX9744 EV kit also includes Windows® 98SE/2000/XP-compatible software that provides a simple graphical user interface (GUI) for exercising the MAX9744's features.

The MAX9744 evaluation system (EV system) includes a MAX9744 EV kit and a Maxim CMAXQUSB serial-interface board.

The CMAXQUSB board connects to a PC's USB port and allows the transfer of I2C commands to the MAX9744 EV kit.

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Features

♦ **20W Stereo Output (at 10% THD+N, $R_L = 4\Omega$, V_{CC} = 13V)**

♦ **Wide Power-Supply Operation (4.5V to 14V)**

♦ **Integrated Volume Control (I2C or Stand-Alone Operation)**

♦ **Optional Control Through USB**

♦ **Proven PCB Layout for Thermal Performance and EMC**

♦ **Windows 98SE/2000/XP-Compatible Evaluation Software**

♦ **Fully Assembled and Tested**

Ordering Information

PART	TYPE	INTERFACE
MAX9744EVKIT+	EV Kit	Stand-alone operation or user-supplied I2C interface
MAX9744EVCMAXQU	EV System	CMAXQUSB board

+*Denotes lead-free and RoHS compliant.*

Note: *The MAX9744 EV kit software is included with the MAX9744 EV kit but is designed for use with the complete EV system. The EV system includes both the Maxim CMAXQUSB board and the EV kit. If the Windows software will not be used, the EV kit board can be purchased without the Maxim CMAXQUSB board.*

Component Lists

MAX9744 EV System

PART	QTY	DESCRIPTION
MAX9744EVKIT+	1	MAX9744 EV kit
CMAXQUSB	1	Serial-interface board

MAX9744 EV Kit

DESIGNATION	QTY	DESCRIPTION
REQUIRED COMPONENTS		
C4, C5	2	0.47µF ±10%, 16V X7R ceramic capacitors (0805) Murata GRM21BR71E474K
C7, C17–C20	5	1µF ±10%, 16V X5R ceramic capacitors (0603) Murata GRM188R61E105K

DESIGNATION	QTY	DESCRIPTION
C8–C13	6	0.1µF ±10%, 16V X7R ceramic capacitors (0603) TDK C1608X7R1E104K
C23, C24	2	330µF ±20%, 16V electrolytic capacitors Panasonic EEUFM1C331
C25, C46	2	10µF ±20%, 16V X7R ceramic capacitors (1206) Murata GRM318R71C106M
R1–R4	4	20kΩ ±1% resistors (0603)
U1	1	Class D stereo amplifier (44 TQFN) Maxim MAX9744ETH+

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Evaluate: MAX9744

Component Lists (continued)

DESIGNATION	QTY	DESCRIPTION
OPTIONAL COMPONENTS		
C1, C2	2	100pF ±5%, 16V C0G ceramic capacitors (0603) TDK C1608C0G1H101K
C3, C6, C14, C15, C16	5	0.1µF ±10%, 16V X7R ceramic capacitors (0603) TDK C1608X7R1E104K
C21, C22	2	10µF ±20%, 10V electrolytic capacitors (A5) SANYO 10SVP10M
C26–C29	0	Not installed, ceramic capacitors (0805)
C30–C39	10	0.47µF ±10%, 16V X7R ceramic capacitors (0805) Murata GRM21BR71E474K
C44, C45	0	Not installed (0603)
FB1, FB2	2	0Ω resistors (0603)
FB3–FB6	4	0Ω resistors (1206)
FB7	1	Ferrite bead, 6A (1206)
GND, SPK_L-, SPK_R-	3	Black banana jacks
INL	1	White RCA jack
INR	1	Red RCA jack

DESIGNATION	QTY	DESCRIPTION
J1	1	Dual-row (2 x 10) 20-pin right-angle female receptacle
J2	0	Not installed
JU1–JU5	5	3-pin headers
JU6	1	5-pin, 4-way header
JU7	0	Not installed, 2-pin header
JU8, JU9	2	2-pin headers
L1–L4	4	10µH inductors, 3A, 65mΩ Sumida CDRH127-100
R5, R6	2	1.2kΩ ±5% resistors (0603)
R7	1	10kΩ thumbwheel potentiometer
R8	0	Not installed, resistor (0805)
R9	1	47kΩ ±5% resistor (0805)
R10	1	49.9Ω ±1% resistor (0805)
R11–R14	4	6.8Ω ±1% resistors (0805)
R15	1	47Ω ±5% resistor (0603)
SPK_L+, SPK_R+, VCC	3	Red banana jacks
U2	1	Linear regulator (5 SOT23) Maxim MAX1615EUK+
—	7	Shunts
—	1	PCB: MAX9744 Evaluation Kit

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
SANYO Electric Co., Ltd.	619-661-6835	www.sanyodevice.com
Sumida Corp.	847-545-6700	www.sumida.com
TDK Corp.	847-803-6100	www.component.tdk.com

Note: *Indicate that you are using the MAX9744 when contacting these component suppliers.*

MAX9744 EV Kit Files

FILE	DESCRIPTION
INSTALL.EXE	Installs the EV kit files on your computer
MAX9744.EXE	Application program
UNINST.INI	Uninstalls the EV kit software
TROUBLESHOOTING_USB.PDF	USB driver installation help file

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Quick Start (for EV Kit Stand-Alone Operation)

Recommended Equipment

Before beginning, the following equipment is needed:

- MAX9744 EV kit
- One 12V, 5A power supply
- Stereo audio source (i.e., CD player)
- A pair of 4Ω (or 8Ω) loudspeakers

Procedure

1) For the MAX9744 EV kit, make sure the shunts of all jumpers are in the following default positions:

JU1:	(2-3)	Thumbwheel potentiometer controls speaker volume
JU2:	(2-3)	I^{2}C interface disabled
JU3:	(2-3)	I^{2}C interface disabled
JU4:	(1-2)	Normal operation (powered up)
JU5:	(2-3)	Normal operation (not muted)
JU6:	(1-2)	FFM mode with f_{SW} = 300kHz
JU8:	(Open)	No terminator for SYNC_IN pad
JU9:	(Open)	Classic PWM modulation

2) Turn the thumbwheel potentiometer clockwise all the way to minimize speaker volume.

3) Connect the left and right speakers across the SPK_L+/SPK_L- and SPK_R+/SPK_R- banana jacks, respectively.

4) Connect the positive terminal of the 12V power supply to the VCC banana jack, and the ground terminal of the power supply to the GND banana jack.

5) Connect the audio source to the INL and INR RCA jacks.

6) Turn on the audio source, then turn on the power supply.

7) Turn the thumbwheel potentiometer counterclockwise to increase the volume; the audio signal should be audible in the speakers.

Quick Start (for EV System)

Recommended Equipment

Before beginning, the following equipment is needed:

- The MAX9744 EV system:

    MAX9744 EV kit

    Maxim CMAXQUSB board

    USB cable (included with CMAXQUSB)

- One 12V, 5A power supply
- Stereo audio source (i.e., CD player)
- A pair of 4Ω (or 8Ω) loudspeakers
- A user-supplied Windows 98SE/2000/XP PC with a spare USB port

Note: In the following section, 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 operating system.

Procedure

1) Visit **www.maxim-ic.com/evkitsoftware** to download the latest version of the EV kit software, 9744Rxx.ZIP. Save the EV kit software to a temporary folder and uncompress the ZIP file.

2) 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.

3) On the CMAXQUSB board, ensure that the shunt of JU1 is in the 3.3V position.

4) Enable the I^{2}C pullup resistors on the CMAXQUSB board by setting the DIP switches at SW1 to the on position.

5) For the MAX9744 EV kit, make sure the shunts of all jumpers are in the following default positions:

JU1:	(1-2)	Using I^{2}C interface control MAX9744
JU2:	(1-2)	ADD1 = 1
JU3:	(1-2)	ADD2 = 1
JU4:	(1-2)	Normal operation (powered-up)
JU5:	(2-3)	Normal operation (not muted)
JU6:	(1-2)	FFM mode with f_{SW} = 300kHz
JU8:	(Open)	No terminator for SYNC_IN pad
JU9:	(Open)	Classic PWM modulation

6) Carefully connect the boards by aligning the MAX9744 EV kit's 20-pin connector with the CMAXQUSB board's 20-pin connector. Gently press them together. The two boards should be flush against each other.

7) Connect the left and right speakers across the SPK_L+/SPK_L- and SPK_R+/SPK_R- banana jacks, respectively.

8) Connect the positive terminal of the 12V power supply to the VCC banana jack, and the ground terminal of the power supply to the GND banana jack.

9) Connect the audio source to the INL and INR RCA jacks.

10) Turn on the audio source, then turn on the power supply.

11) Connect the USB cable from the PC to the CMAXQUSB board. A **Building Driver Database** window should pop up in addition to a **New Hardware Found** message if this is the first time this board is connected to the PC. If you do not see a window that is similar to the one described above after 30s, try removing the USB cable from the CMAXQUSB and reconnect it. Administrator privileges are required to install the USB device driver on Windows 2000 and XP. Refer to the TROUBLESHOOTING_USB.PDF document included with the software if you have any problems during this step.

12) 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\MAX9744** (default installation directory) using the **Browse** button.

13) Start the MAX9744 EV kit software by opening its icon in the **Start** menu.

14) The EV kit software automatically detects the MAX9744 I²C slave address and resets the MAX9744. Using the mouse to drag the **Volume Control** scroll bar to increase the volume, the audio signal should be audible in the speakers.

__Detailed Description of Software

The MAX9744 EV kit software provides an easy user interface (see Figure 1) to control the programmable features of the MAX9744. To start the MAX9744 EV kit software, double-click the MAX9744 EV kit icon created during installation. The user must wait approximately 2s while the MAX9744 EV kit software connects to the CMAXQUSB board.

Volume Control Group Box

Inside the **Volume Control** group box is the volume control track bar, which corresponds to the speaker volume register. By dragging the track bar, the correct I²C/SMBus write operation is generated to update the speaker volume register of the MAX9744.
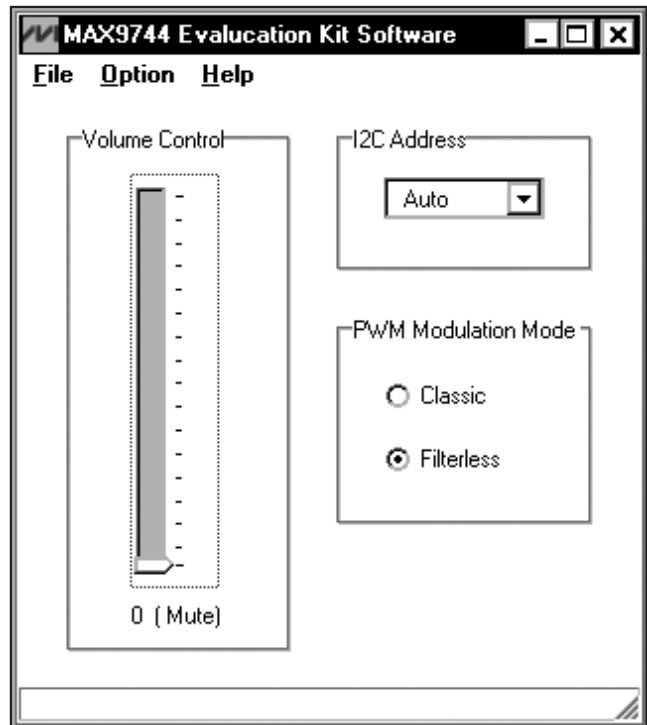

Figure 1. MAX9744 EV Kit Software GUI Window

The I2C Address Group Box

The **I2C Address** group box drop-down list selects the MAX9744's I²C slave address. If multiple devices are connected to the I²C bus, the user can use this drop-down list to manually change the device's I²C slave address according to the settings of JU2 and JU3, as shown in Table 3.

PWM Modulation Mode Group Box

The Class D modulation mode can be controlled through two radio buttons (**Classic** and **Filterless**), which represent the classic PWM modulation and filterless PWM modulation.

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_Detailed Description of Hardware

The MAX9744 EV kit board provides a good thermal performance and EMC proven layout for evaluating the MAX9744. The EV kit evaluates the MAX9744ETH+.

The MAX9744 EV kit is a 2 x 20W highly efficient Class D speaker amplifier system. The EV kit can be driven by any stereo audio source. The audio input impedance is 20kΩ.

MAX9744 EV Kit

MAX9744 EV Kit Stand-Alone Operation

The MAX9744 EV kit can be operated without the CMAXQUSB command module. To do so, make sure all the shunts on JU1, JU2, and JU3 are in the 2-3 position. For more information, see Tables 1 and 3. While in stand-alone operation mode, the user can rotate the thumbwheel potentiometer R7 to adjust the speaker volume.

Table 1. JU1 Function Description

JU1	FUNCTION
1-2	I2C interface control speakers' volume
2-3*	Thumbwheel potentiometer control speakers' volume

*Default position.

Under stand-alone operation the user can use JU9 to control the modulation mode, as shown in Table 2. Remove the shunt of JU9 if using I2C/SMBus to control the EV kit.

Power Supply

The MAX9744 EV kit board should be powered by a user-supplied DC power supply connecting to VCC and GND. The power supply voltage can range widely from 4.5V to 14V.

Table 2. PWM Mode Configuration Under Stand-Alone Operation

JU2	JU3	JU9	PWM MODE
1-2	1-2	Open	Controlled by I2C/SMBus interface
1-2	2-3	Open	
2-3	1-2	Open	
1-2	1-2	1-2	Invalid
1-2	2-3	1-2	
2-3	1-2	1-2	
2-3*	2-3*	Open*	Classic PWM modulation
2-3	2-3	1-2	Filterless modulation

*Default position.

MAX9744 I2C Address Selection

There are three possible I2C/SMBus addresses (see Table 3). Note that the I2C/SMBus interface is disabled if both JU2 and JU3 are set in the default position (2-3).

Hardware Shutdown Control

Table 3. The I2C Address Configuration

JU3	JU2	I2C ADDRESS
1-2	1-2	1001011x
1-2	2-3	1001010x
2-3	1-2	1001001x
2-3*	2-3*	I2C/SMBus interface disabled

*Default position.

Jumper JU4 controls the hardware shutdown function of the MAX9744 EV kit. This shuts down the entire MAX9744 and resets all the registers to their power-on default state. See Table 4 for shunt positions.

Hardware Mute Control

Table 4. Hardware Shutdown ($\overline{SHDN}$) Function

JUMPER	SHUNT POSITION	$\overline{SHDN}$ HARDWARE INPUT PIN LOGIC LEVEL
JU4	1-2*	High (normal operation)
	2-3	Low (hardware shutdown)

*Default position.

Jumper JU5 controls the speaker mute function of the MAX9744 EV kit and it overrides the I2C interface setting. See Table 5 for shunt positions.

Table 5. Hardware Mute Function

JUMPER	SHUNT POSITION	MUTE HARDWARE INPUT PIN LOGIC LEVEL
JU5	1-2	High (mute)
	2-3*	Low (normal operation)

*Default position.

MAXIM _____ 5

Modulation-Mode Control and Synchronization Input/Output

The MAX9744 features four modulation-frequency operating modes, which include two fixed-frequency modes, one spread-spectrum mode, and one external clock mode. Table 6 shows how to use jumper JU6 to configure these four operating modes.

Table 6. Modulation-Frequency Operating Modes

JUMPER	SHUNT POSITION	SYNC	MODE
JU6	1-2*	GND	FFM with f_{SW} = 300kHz
	1-3	Unconnected	FFM with f_{SW} = 360kHz
	1-4	VDD	SSM with f_{SW} = 300kHz ±6kHz
	1-5	External clocked	FFM with f_{SW} = (external clock frequency)/4

Default position.

When using the external clocked mode, the external clock should be applied to the SYNC_IN pad. The MAX9744 EV kit provides a SYNC_OUT pad to allow synchronization of multiple amplifiers. The SYNC_IN clock should be four times the modulation frequency.

The MAX9744 EV kit also provides an option to terminate the external clock input with a 50Ω resistor. See Table 7 to use this option.

Table 7. External Clock Termination

JUMPER	SHUNT POSITION	FINCTION
JU8	1-2	Terminated with 50Ω resister
	Open*	Not terminated

Default position.

CMAXQUSB Command Module

The CMAXQUSB uses a proprietary design to provide SPI- and I2C-compatible interfaces to demonstrate various Maxim devices. Maxim reserves the right to change the implementation of this module at any time with no advance notice.

CMAXQUSB Power Supply

The CMAXQUSB board provides three output voltage level options. Jumper JU1 selects the output voltage level between 5V, 3.3V, and 2.5V. Set the CMAXQUSB jumper JU1 at the 3.3V position to evaluate the MAX9744 EV kit.

CMAXQUSB I2C Pullup Resistors

The CMAXQUSB board provides an option to enable or disable the I2C pullup resistors on SDA and SCL signals. Enable the I2C pullup resistors on the CMAXQUSB board by setting the DIP switches at SW1 to the on position to evaluate the MAX9744 EV kit.

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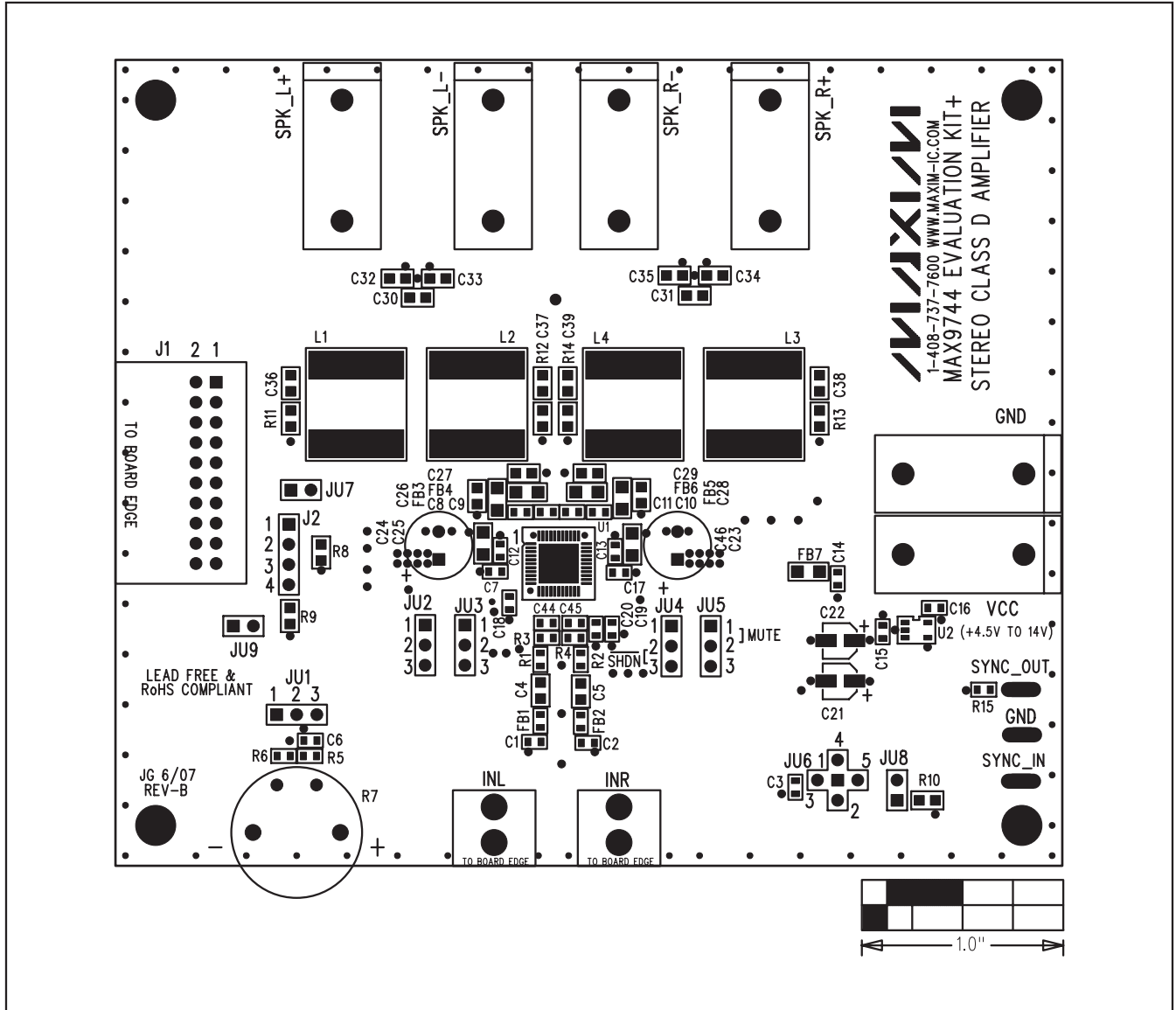Figure 2. MAX9744 EV Kit Schematic

MAX9744 Evaluation Kit/
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Evaluate: MAX9744

Figure 3. MAX9744 EV Kit Component Placement Guide—Component Side

8

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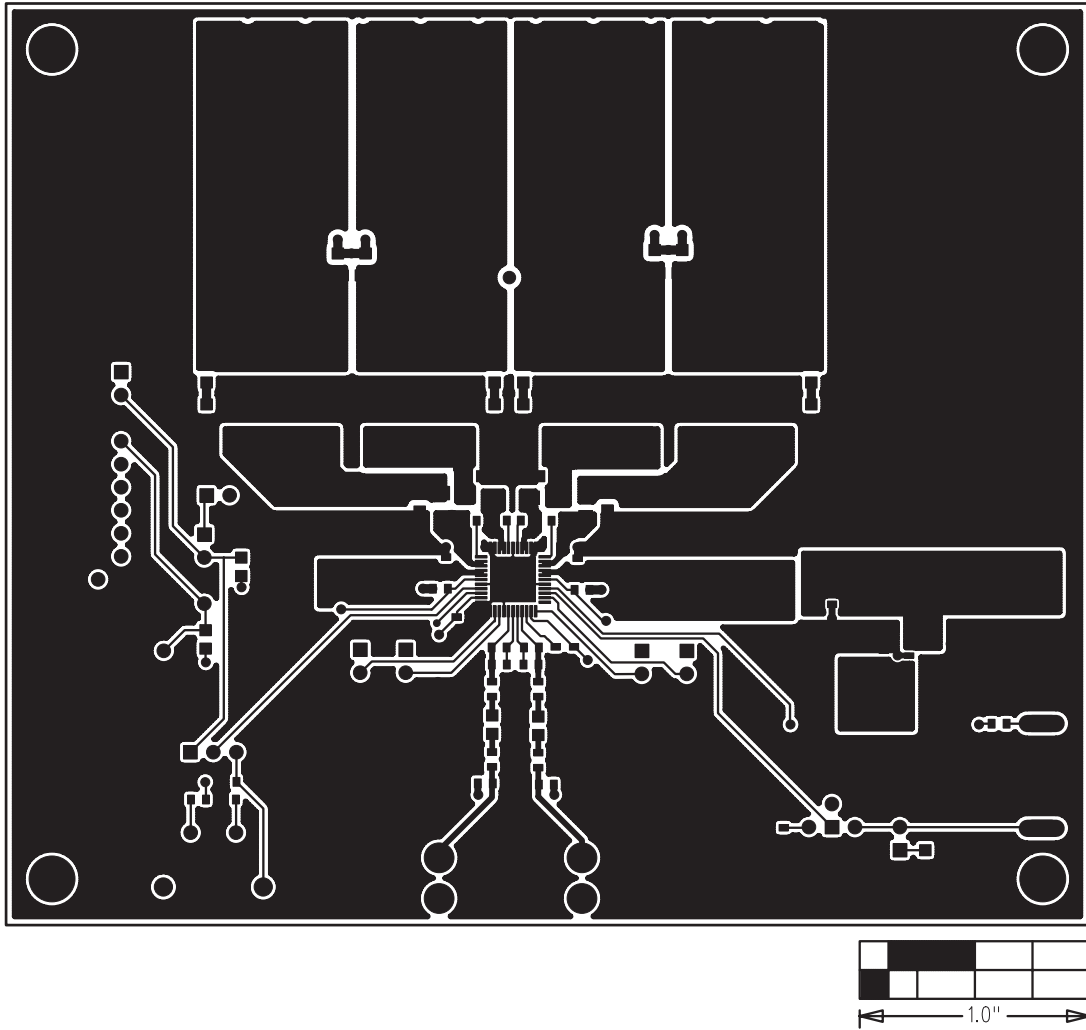
Figure 4. MAX9744 EV Kit PCB Layout—Component Side
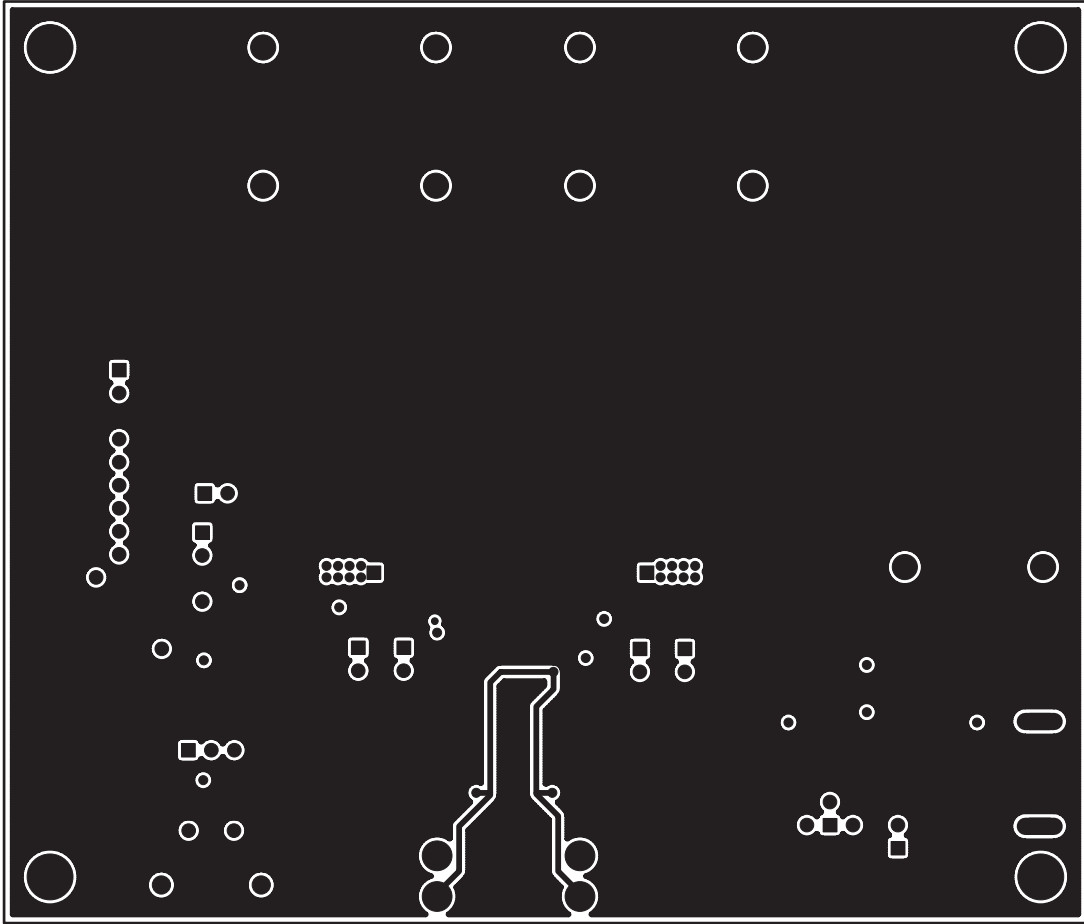
Evaluate: MAX9744

Figure 5. MAX9744 EV Kit PCB Layout—Layer 2 (GND)
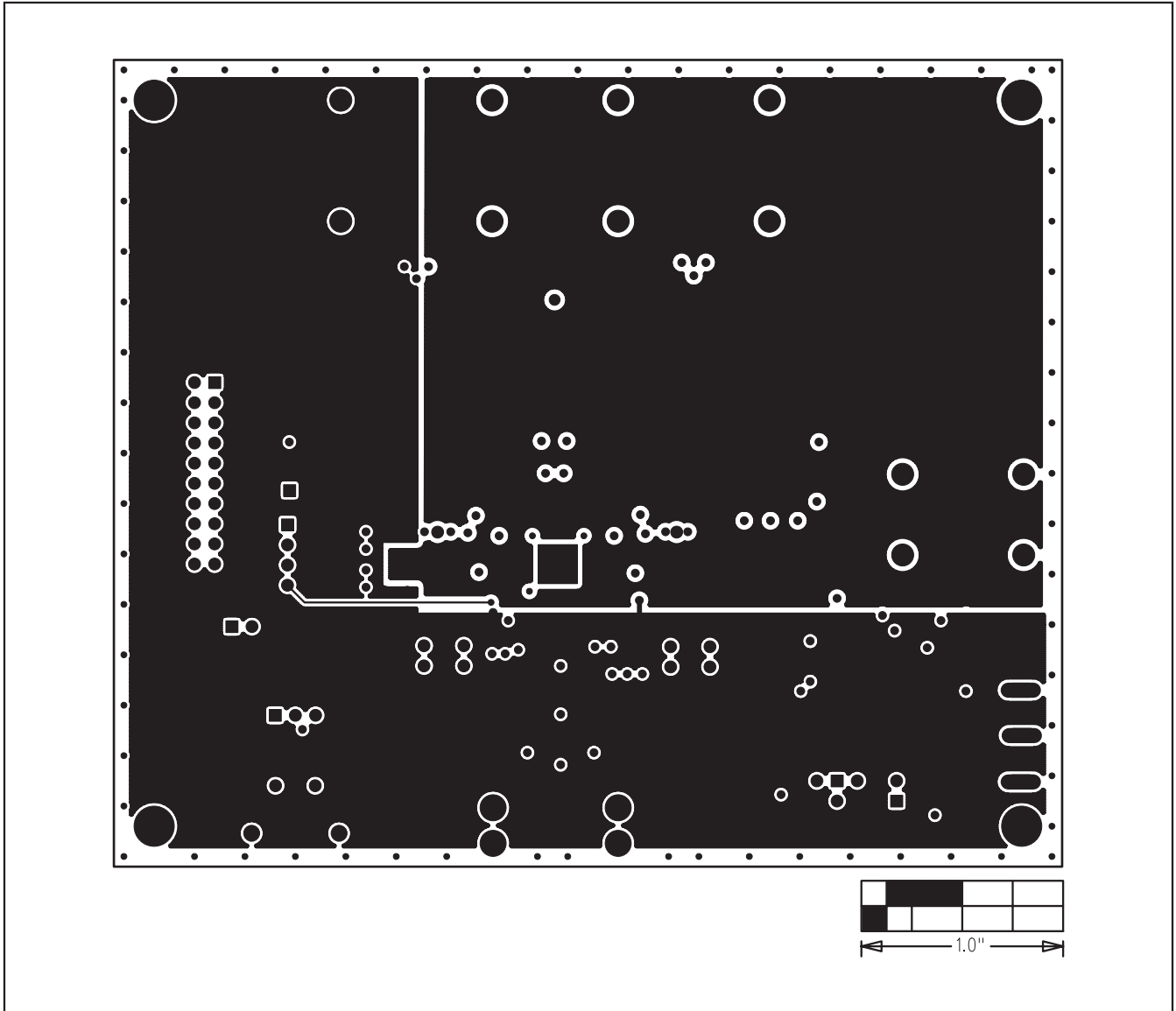
Figure 6. MAX9744 EV Kit PCB Layout—Layer 3 (Power)

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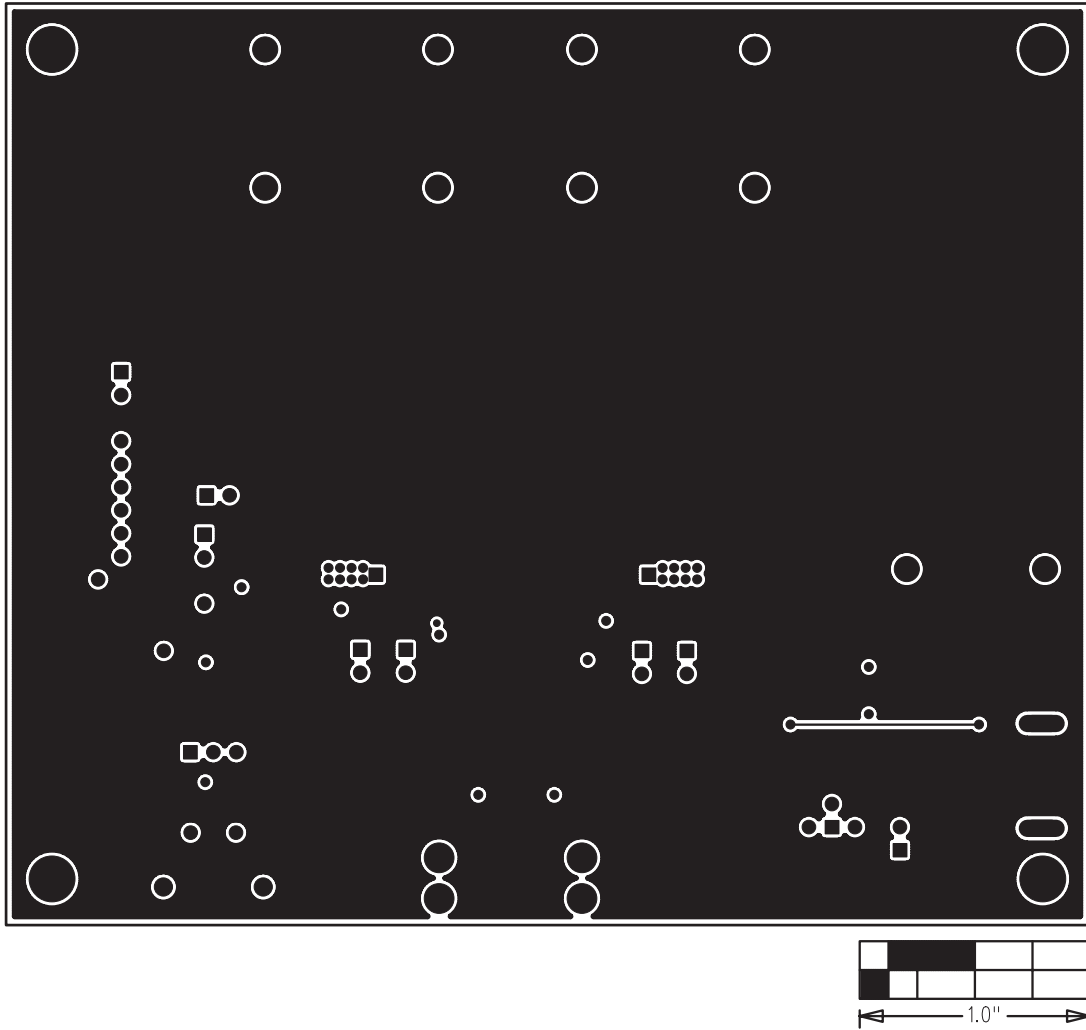
Figure 7. MAX9744 EV Kit PCB Layout—Solder Side

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