

# MAX13335E Evaluation Kit

## Evaluates: MAX13335E/MAX13336E

### General Description

The MAX13335E evaluation kit (EV kit) is a fully assembled and tested PCB that evaluates the MAX13335E automotive audio receiver. The IC features a dual automotive differential audio receiver with I<sup>2</sup>C control and diagnostics. The EV kit features an on-board microcontroller for communicating with the I<sup>2</sup>C interface of the device. PCB pads are provided for accessing the analog inputs/outputs and the diagnostic I/O ports.

The EV kit operates from a +3.3V or +5V power supply that provides 100mA of current. The EV kit can also operate from the on-board USB +5V supply. The EV kit delivers the audio outputs with programmable gain between -14dB and +16dB. The EV kit can also evaluate the MAX13336E after IC replacement of U1.

Windows XP®, Windows Vista®, and Windows® 7-compatible software is provided to facilitate configuration. The EV kit software controls the on-board microcontroller over the USB, which generates I<sup>2</sup>C commands.

### Features

- ◆ +3.3V or +5V Single-Supply Operation
- ◆ Proven Audio PCB Layout
- ◆ On-Board USB Interface Circuit Generates I<sup>2</sup>C-Compatible Signals
- ◆ PCB Pads for User-Supplied I<sup>2</sup>C-Compatible Signals
- ◆ Surface-Mount Components
- ◆ Evaluates the MAX13336E After IC Replacement
- ◆ Windows XP-, Windows Vista-, and Windows 7-Compatible Software
- ◆ Fully Assembled and Tested

[Ordering Information](#) appears at end of data sheet.

### Component List

DESIGNATION	QTY	DESCRIPTION
C1–C4	4	4.7μF ±10%, 25V X7R ceramic capacitors (1206) Murata GRM31CR71E475K
C5, C6, C7	3	1μF ±10%, 25V X7R ceramic capacitors (0805) Murata GRM21BR71E105K
C8, C102, C113, C115	4	10μF ±20%, 6.3V X5R ceramic capacitors (0805) Murata GRM21BR60J106M
C9	1	0.1μF ±10%, 50V X7R ceramic capacitor (0603) Murata GRM188R71H104K
C10–C17, C117	0	Not installed, ceramic capacitors (0603)
C101, C103–C110, C121	10	0.1μF ±10%, 16V X7R ceramic capacitors (0603) Murata GRM188R71C104K
C111, C112	2	10pF ±5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H100J

DESIGNATION	QTY	DESCRIPTION
C114, C122–C125	5	1μF ±10%, 10V X5R ceramic capacitors (0603) Murata GRM188R61A105K
C116	1	2.2μF ±10%, 6.3V X5R ceramic capacitor (0603) Murata GRM188R60J225K
C118, C119	2	22pF ±5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H220J
C120	1	3300pF ±10%, 50V X7R ceramic capacitor (0603) Murata GRM188R71H332K
D1	1	Bidirectional quad TVS (SOT563) ON Semi NUP4102XV6
D101	1	Green LED (0603)
FB101	0	Not installed, ferrite bead—short (PC trace) (0603)
JU1	1	3-pin header
JU2–JU5	4	2-pin headers
P101	1	-20V, -2.4A p-channel MOSFET (3 SuperSOT) Fairchild FDN304P_NL

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### Component List (continued)

DESIGNATION	QTY	DESCRIPTION
R1–R4	4	1k $\Omega$ $\pm$ 1% resistors (0603)
R5, R6, R11, R12, R19–R22, R103, R104, R109	0	Not installed, resistors (0603)
R7, R23, R24, R25	4	20 $\Omega$ $\pm$ 1% resistors (0603)
R8, R9, R10	3	4.7k $\Omega$ $\pm$ 5% resistors (0603)
R13–R16	4	100k $\Omega$ $\pm$ 1% resistors (0603)
R17, R18, R101	3	0 $\Omega$ $\pm$ 5% resistors (0603)
R102	1	220 $\Omega$ $\pm$ 5% resistor (0603)
R105	1	1.5k $\Omega$ $\pm$ 5% resistor (0603)
R106, R107	2	27 $\Omega$ $\pm$ 5% resistors (0603)
R108	1	1k $\Omega$ $\pm$ 5% resistor (0603)
U1	1	Auxiliary input audio amplifier with I <sup>2</sup> C (16 QSOP) Maxim MAX13335EGEE/V+
U101	1	32-bit microcontroller (68 QFN-EP*) Maxim MAXQ2000-RAX+
U102	0	Not installed EEPROM (8 SO)

DESIGNATION	QTY	DESCRIPTION
U103	1	UART-to-USB converter (32 TQFP, 7mmx7mm)
U104	1	3.3V, 300mA regulator (5 SOT23) Maxim MAX8888EZK33+T
U105	1	2.5V, 120mA regulator (5 SC70) Maxim MAX8511EXK25+T
U106, U107	2	Level translators (10 $\mu$ MAX®) Maxim MAX1840EUB+
USB	1	USB type-B, right-angle female connector
Y101	1	16MHz crystal Hong Kong X'tals SSM16000N1HK188F0-0
Y102	1	6MHz crystal Hong Kong X'tals SSL60000N1HK188F0-0
—	1	USB-A male to USB-B male cable, 6ft
—	5	Shunts
—	1	PCB: MAX13335E EVALUATION KIT

\*EP = Exposed pad.

### Component Suppliers

SUPPLIER	PHONE	WEBSITE
Fairchild Semiconductor	888-522-5372	www.fairchildsemi.com
Hong Kong X'tals Ltd.	852-35112388	www.hongkongcrystal.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
ON Semiconductor	602-244-6600	www.onsemi.com

**Note:** Indicate that you are using the MAX13335E when contacting these component suppliers.

### MAX13335E EV Kit Files

FILE	DESCRIPTION
Install.exe	Installs the EV kit files on your computer
MAX13335E.exe	Application program
CDM20600.exe	Installs the USB device driver
Uninstall.exe	Uninstalls the EV kit software
USB_Driver_Help_200.pdf	USB driver installation help file

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# MAX13335E Evaluation Kit

## Evaluates: MAX13335E/MAX13336E

### Quick Start

#### Recommended Equipment

- MAX13335E EV kit (USB cable included)
- Function generator
- Oscilloscope
- User-supplied Windows XP, Windows Vista, or Windows 7 PC with an available USB port

**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 operating system.

#### Procedure

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

- 1) Visit [www.maxim-ic.com/evkitsoftware](http://www.maxim-ic.com/evkitsoftware) to download the latest version of the EV kit software, 13335ERxx.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 on the desktop and in the Windows **Start | Programs | Maxim EVKIT Software** menu.
- 3) Verify that all jumpers are in their default positions, as shown in Table 1.
- 4) Set the function generator output to high impedance and to output a 1kHz, 10VP-P, sine wave with 0V offset. Disable the function generator.
- 5) Connect the function generator output to the INPUTL+ and INPUTR+ PCB pads.
- 6) Connect the function generator ground to the GND PCB pad.
- 7) Connect the INPUTL- and INPUTR- PCB pads to the GND PCB pad.
- 8) Connect the oscilloscope channel 1 to the OUTL PCB pad.
- 9) Connect the oscilloscope channel 2 to the OUTR PCB pad.
- 10) Connect a USB cable between the PC and the Mini-USB port on the EV kit. A **New Hardware Found** window pops up when installing the USB driver for the first time. If a window that is similar to the one described above is not seen after 30s, remove the USB cable from the board and reconnect it. Administrator privileges are required to install the USB device driver on Windows.
- 11) Follow the directions of the **Found New Hardware** window to install the USB device driver. Refer to the USB\_Driver\_Help\_200.PDF document included with the software for additional information.
- 12) Start the EV kit software by opening its icon on the desktop or in the **Start | Programs | Maxim EVKIT Software** menu. The EV kit software main window appears, as shown in Figure 1.
- 13) Wait while the software connects to the EV kit. Once the connection is established, the bottom-left status bar displays **Hardware: Connected**.
- 14) Enable the function generator.
- 15) Verify that the oscilloscope channels 1 and 2 each output a 1kHz, 2VP-P, sine wave with 0V offset.

### Detailed Description of Software

#### Graphical User Interface (GUI)

The MAX13335E EV kit software GUI provides a convenient way to test the features of the MAX13335E IC. Figure 1 shows the EV kit software's main window. The EV kit software main window divides the EV kit functions into logical blocks. Actions on this software window generate I<sup>2</sup>C commands to update the IC's internal memory registers.

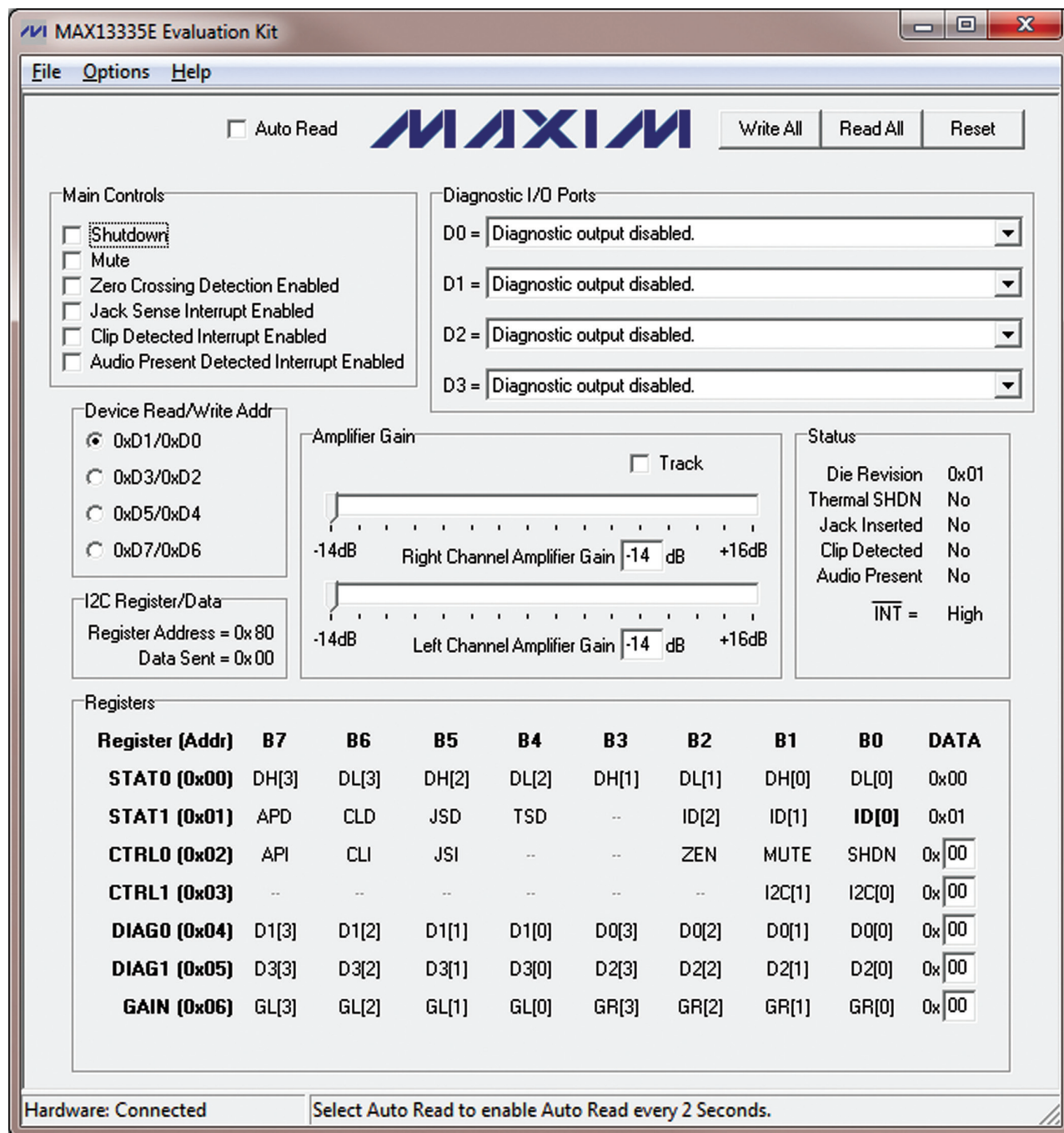
**Table 1. Jumper Positions (JU1–JU5)**

JUMPER	SHUNT POSITION	DESCRIPTION
JU1	1-2*	On-board VDD supply. Connects the on-board USB +5V to VDD.
	2-3	External VDD supply. Externally supply VDD with +3.3V or +5V.
JU2	1-2*	On-board VL supply. Connects the on-board VDD to the logic-level translator output supply VL.
	Pin 1	External VL supply. Externally supply VL with +3.3V or +5V.
JU3	1-2*	On-board I <sup>2</sup> C. Connects the IC's $\overline{\text{INT}}$ output to the on-board microcontroller.
	Pin 1	User-supplied I <sup>2</sup> C. Connects the IC's $\overline{\text{INT}}$ output to the user-supplied microcontroller.
JU4	1-2*	On-board I <sup>2</sup> C. Connects the on-board SDA signal to the SDA PCB pad.
	Pin 1	User-supplied I <sup>2</sup> C. Open the jumper and apply the SDA signal to the SDA PCB pad.
JU5	1-2*	On-board I <sup>2</sup> C. Connects the on-board SCL signal to the SCL PCB pad.
	Pin 1	User-supplied I <sup>2</sup> C. Open the jumper and apply the SCL signal to the SCL pad.

\*Default position.

# MAX13335E Evaluation Kit

## Evaluates: MAX13335E/MAX13336E



The software window is titled "MAX13335E Evaluation Kit" and features a menu bar with "File", "Options", and "Help". Below the menu bar is a toolbar with an "Auto Read" checkbox, the MAXIM logo, and "Write All", "Read All", and "Reset" buttons.

**Main Controls:**

- ☐ Shutdown
- ☐ Mute
- ☐ Zero Crossing Detection Enabled
- ☐ Jack Sense Interrupt Enabled
- ☐ Clip Detected Interrupt Enabled
- ☐ Audio Present Detected Interrupt Enabled

**Device Read/Write Addr:**

- ☒ 0xD1/0xD0
- ☐ 0xD3/0xD2
- ☐ 0xD5/0xD4
- ☐ 0xD7/0xD6

**I2C Register/Data:**

Register Address = 0x80  
Data Sent = 0x00

**Amplifier Gain:**

Right Channel Amplifier Gain: -14 dB (range: -14dB to +16dB)

Left Channel Amplifier Gain: -14 dB (range: -14dB to +16dB)

☐ Track

**Diagnostic I/O Ports:**

D0 = Diagnostic output disabled.

D1 = Diagnostic output disabled.

D2 = Diagnostic output disabled.

D3 = Diagnostic output disabled.

**Status:**

Die Revision: 0x01  
Thermal SHDN: No  
Jack Inserted: No  
Clip Detected: No  
Audio Present: No  
INT = High

**Registers:**

Register (Addr)	B7	B6	B5	B4	B3	B2	B1	B0	DATA
STAT0 (0x00)	DH[3]	DL[3]	DH[2]	DL[2]	DH[1]	DL[1]	DH[0]	DL[0]	0x00
STAT1 (0x01)	APD	CLD	JSD	TSD	--	ID[2]	ID[1]	ID[0]	0x01
CTRL0 (0x02)	API	CLI	JSI	--	--	ZEN	MUTE	SHDN	0x00
CTRL1 (0x03)	--	--	--	--	--	--	I2C[1]	I2C[0]	0x00
DIAG0 (0x04)	D1[3]	D1[2]	D1[1]	D1[0]	D0[3]	D0[2]	D0[1]	D0[0]	0x00
DIAG1 (0x05)	D3[3]	D3[2]	D3[1]	D3[0]	D2[3]	D2[2]	D2[1]	D2[0]	0x00
GAIN (0x06)	GL[3]	GL[2]	GL[1]	GL[0]	GR[3]	GR[2]	GR[1]	GR[0]	0x00

**Hardware: Connected**      Select Auto Read to enable Auto Read every 2 Seconds.

Figure 1. MAX13335E EV Kit Software Main Window

# MAX13335E Evaluation Kit

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### Software Startup

Upon starting the program, the EV kit software automatically searches for the USB interface circuit and then for the IC's device address. The EV kit enters the normal operating mode when the USB connection is detected and has found the device address. If the USB connection is not detected, the software prompts the user to retry or enter the demo mode.

### Demo Mode

The EV kit software enters demo mode when the USB connection is not detected, or by selecting the **Options | Demo Mode** menu item in the main window. When in demo mode, all software communication to the EV kit circuit is disabled; however, most of the software GUI is functional. Demo mode allows the user to evaluate the software without hardware connectivity.

### Main Controls

The EV kit software's **Main Controls** group box provides checkboxes to control the IC's **Shutdown**, **Mute**, **Zero Crossing Detection Enabled**, **Jack Sense Interrupt Enabled**, **Clip Detected Interrupt Enabled**, and **Audio Present Detected Interrupt Enabled** features.

### I<sup>2</sup>C Interface

The EV kit software's **Device Read/Write Addr** radio group box selects the device address to perform read or write functions. The device's I<sup>2</sup>C read and write addresses are internally set to 0xD1 and 0xD0, respectively.

The **I<sup>2</sup>C Register/Data** group box contains the **Register Address** to display the last register that was read from or written to and the **Data Sent**, which displays the last data that was sent or received.

### Status

The **Status** group box displays the IC's **Die Revision**, **Thermal SHDN** status, **Jack Inserted** status, **Clip Detected** status, **Audio Present** status, and **INT** interrupt output logic level.

### Amplifier Gain

The **Amplifier Gain** group box provides the **Right Channel Amplifier Gain** track bar/edit box and the **Left Channel Amplifier Gain** track bar/edit box to configure the IC's amplifier output gain. The **Track** checkbox locks the **Right Channel Amplifier Gain** track bar/edit box to the **Left Channel Amplifier Gain** track bar/edit box when it is checked. The IC's amplifier gain range is between -14dB and +16dB.

### Diagnostic I/O Ports

The EV kit software **Diagnostic I/O Ports** group box provides combo boxes to configure the IC's diagnostic I/O ports (**D0–D3**). Refer to the *Detailed Description*,

*Diagnostics*, *Applications Information*, and *Diagnostic Configurations* sections in the MAX13335E/MAX13336E IC data sheet for additional details.

### Write All/Read All/Reset

The **Write All** button writes the current settings to all the registers on the GUI. The EV kit software GUI performs I<sup>2</sup>C write commands as changes occur on the GUI. The **Read All** button changes the GUI settings to match the IC register settings. To change settings one time, enter demo mode by selecting the **Options | Demo Mode** menu item, change the GUI to the required settings, exit demo mode by selecting **Options | Demo Mode**, and then press the **Write All** button. To obtain the IC settings, press the **Read All** button and the GUI is updated to reflect the current register states of the IC. In addition, the EV kit software can be set to automatically read back the IC registers every two seconds by selecting the **Auto Read** checkbox. The **Reset** button clears the EV kit software GUI and reprograms the IC to the default values.

### Registers

The EV kit software **Registers** group box displays each register's individual bit logic-level status. A data bit in bold indicates a logic-high, while a data bit that is not bold indicates a logic-low. Clicking on the individual data bit toggles the bit and performs a write command. The new command is shown in the edit box at the right. Alternatively, write commands can be written to the registers by typing a hex value in the edit box and pressing the Enter key on the keyboard.

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

There are three methods for communicating with the EV kit, through the GUI components in the software main window, the **Registers** group box in the main window, or by using low-level SMBus commands available in the **Advanced User Interface** window (Figure 2). Select **Options | Interface (Advanced Users)** to display the **Advanced User Interface** window that allows I<sup>2</sup>C operations, such as **SMBusReadByte** and **SMBusWriteByte**.

## Detailed Description of Hardware

The MAX13335E EV kit evaluates the MAX13335E dual automotive differential audio receivers with diagnostics that communicate over I<sup>2</sup>C. The EV kit demonstrates the IC's features, such as user-defined amplifier gains, interrupt enables, and diagnostic I/O configurations. The EV kit uses the IC in a 16-pin QSOP package on a proven, four-layer PCB design. The EV kit operates from a +3.3V or +5V, 100mA DC power supply. The EV kit can also operate from the on-board USB +5V available from a PC.



# MAX13335E Evaluation Kit

## Evaluates: MAX13335E/MAX13336E

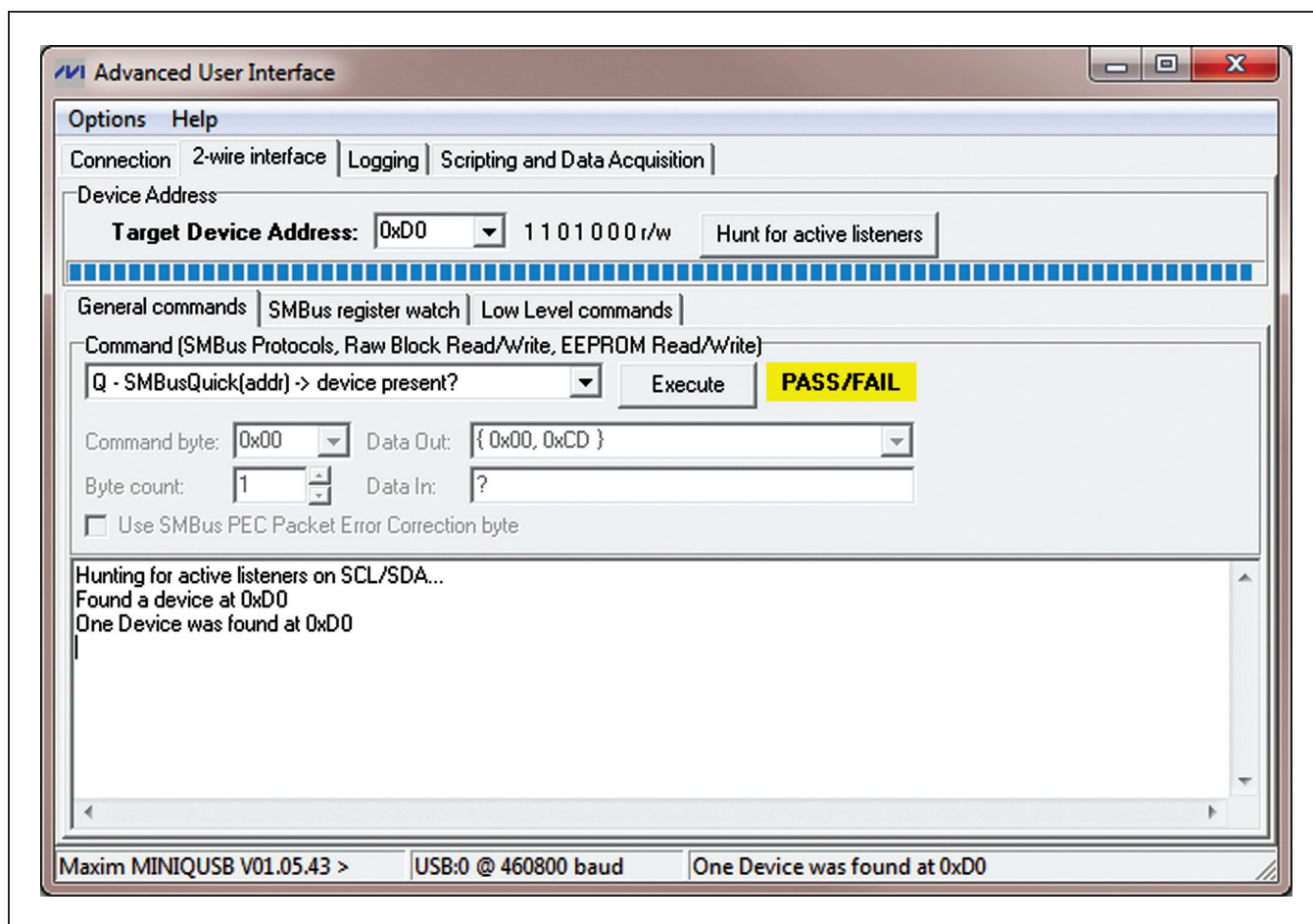


Figure 2. MAX13335E EV Kit Software (Advanced User Interface)

### Amplifier Inputs/Outputs

The EV kit provides PCB pads for connecting the amplifier I/O signals to the EV kit. The EV kit accepts fully differential inputs up to 7VRMS, and quasi-differential inputs up to 3.5VRMS. The EV kit delivers the amplified outputs with programmable gain between -14dB to +16dB.

### Diagnostic I/O Ports

The IC's diagnostic I/O ports (D0–D3) are accessible at the INPUTL-, INPUTL+, INPUTR-, and INPUTR+ PCB pads, respectively. Each diagnostic I/O port is connected to its respective input PCB pad through a resistor-divider

network. The diagnostic I/O ports can be configured to perform jack-sense detection, short-to-ground, short-to-battery, open load, and short between channels when configured correctly. Refer to the *Detailed Description*, *Diagnostics*, *Applications Information*, and *Diagnostic Configurations* sections in the MAX13335E/MAX13336E IC data sheet for additional details.

### Evaluating the MAX13336E

The EV kit can also be used to evaluate the MAX13336E after IC replacement. To evaluate the MAX13336E, replace U1 with the MAX13336E IC and refer to the MAX13335E/MAX13336E IC data sheet for additional details.

# MAX13335E Evaluation Kit

## Evaluates: MAX13335E/MAX13336E

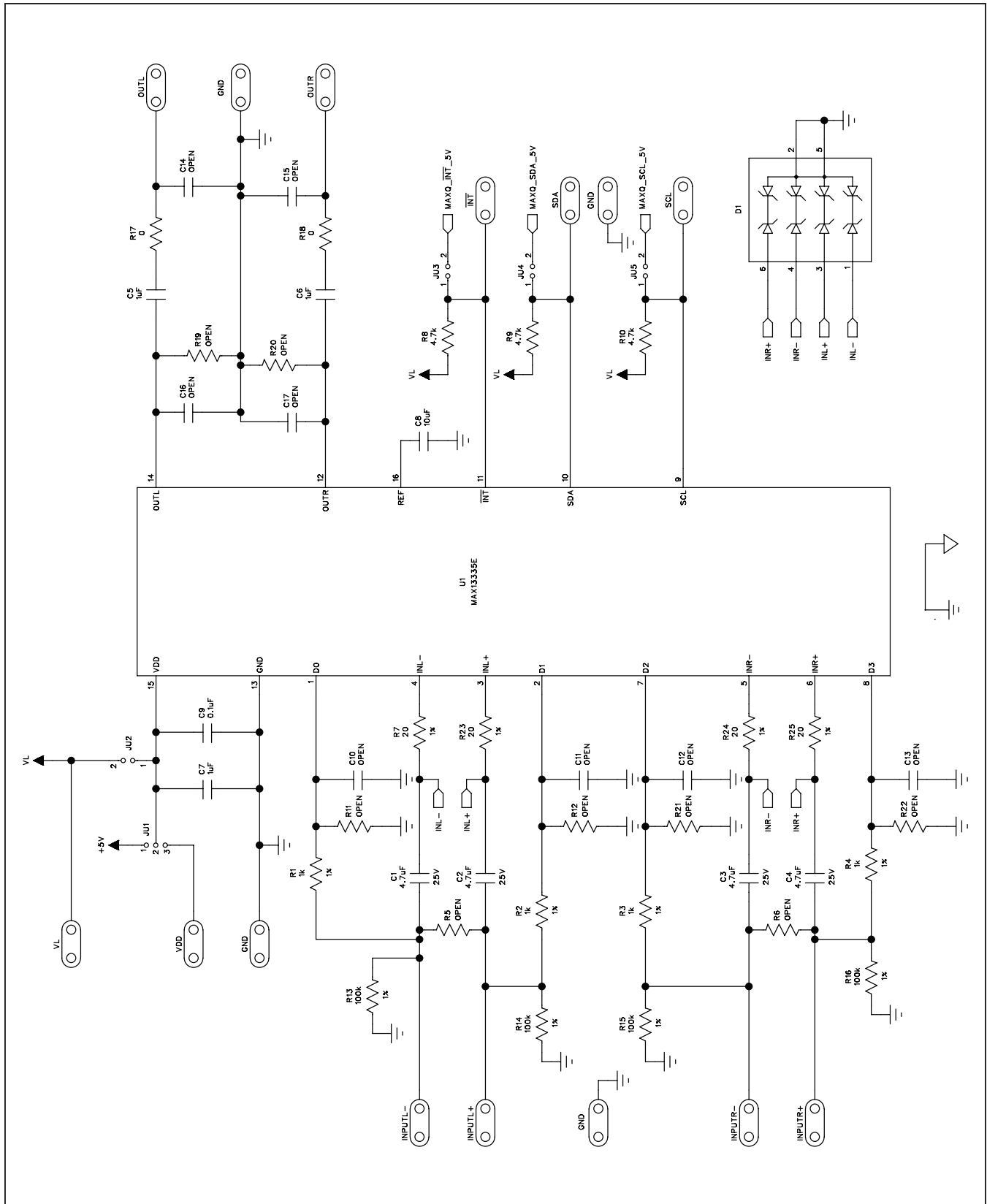


Figure 3a. MAX13335E EV Kit Schematic (Sheet 1 of 2)

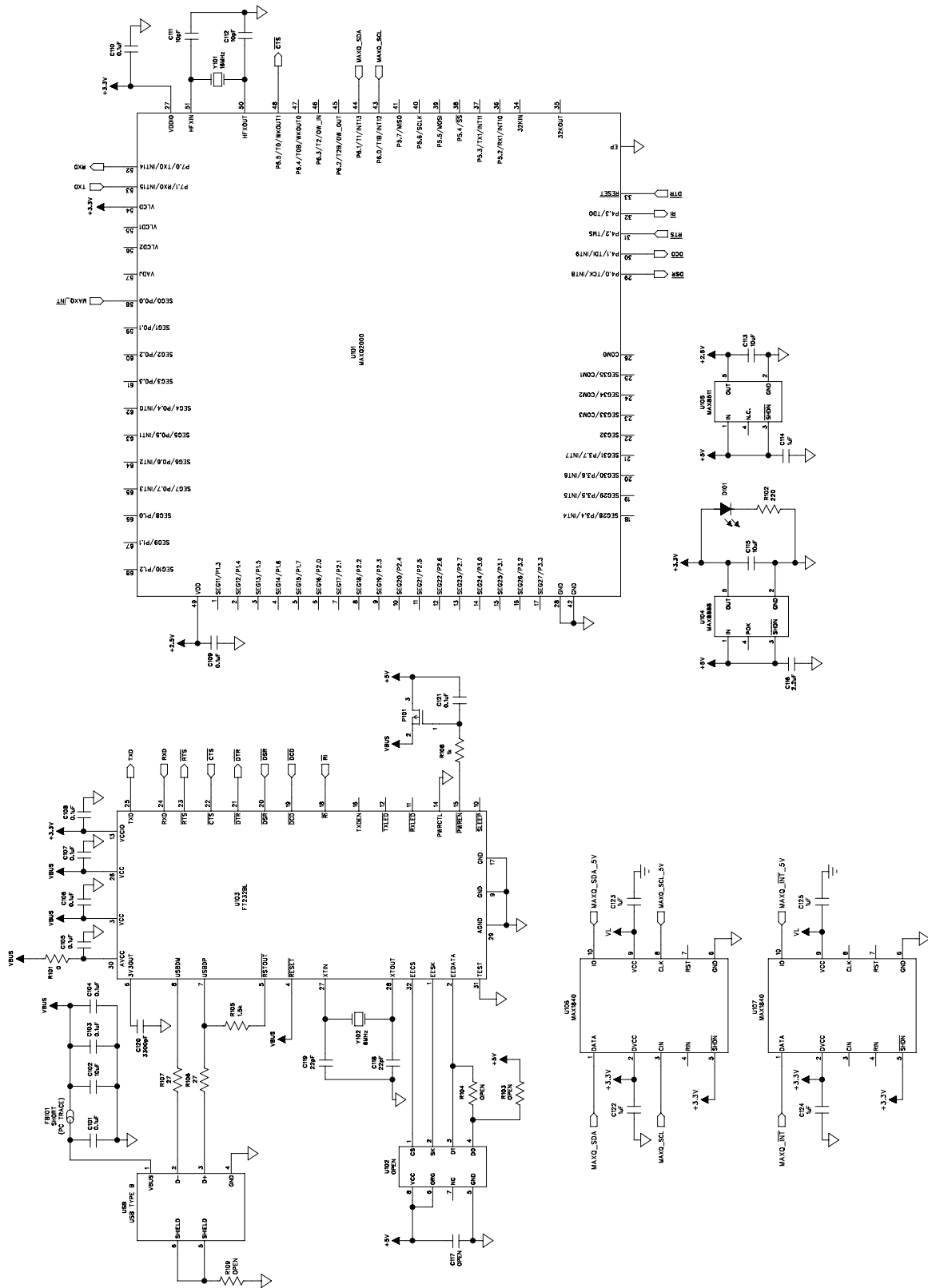
**Evaluates: MAX13335E/MAX13336E**

Figure 3b. MAX13335E EV Kit Schematic (Sheet 2 of 2)



# MAX13335E Evaluation Kit

## Evaluates: MAX13335E/MAX13336E

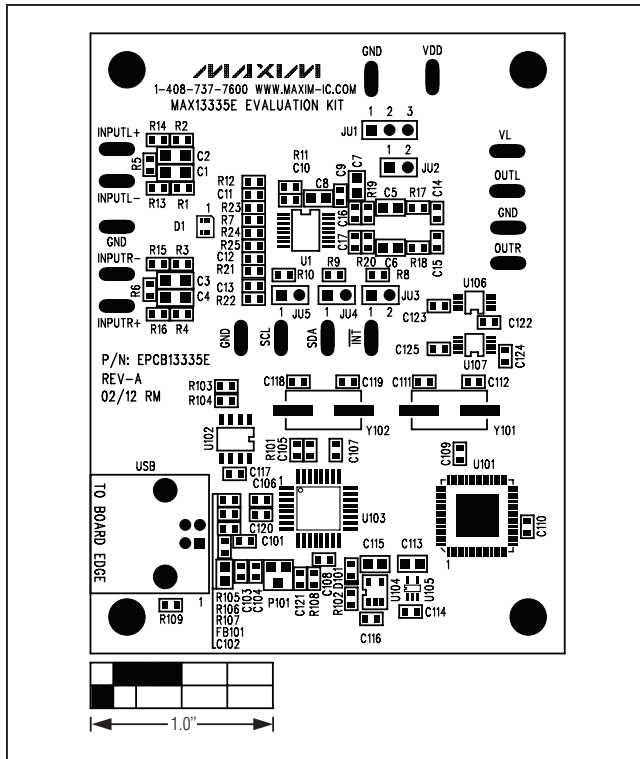


Figure 4. MAX13335E EV Kit Component Placement Guide—Component Side

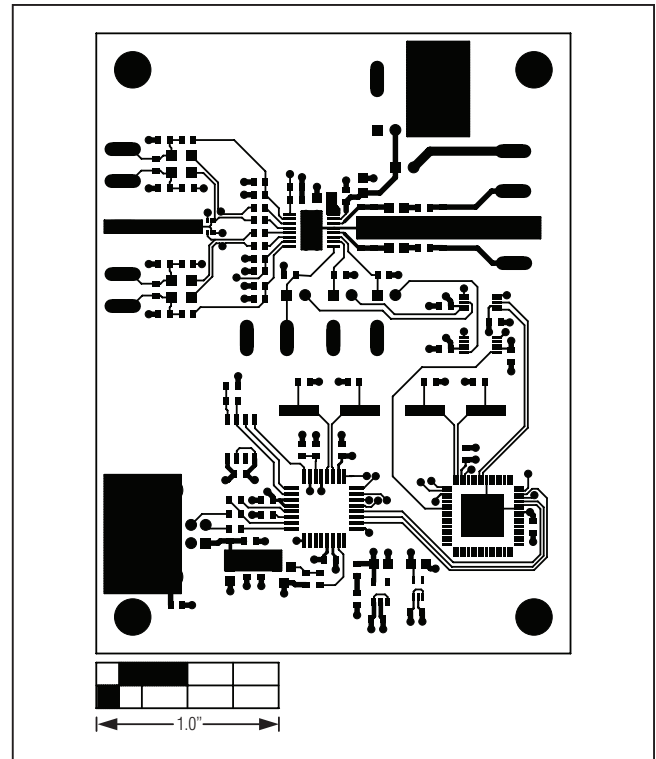


Figure 5. MAX13335E EV Kit PCB Layout—Component Side

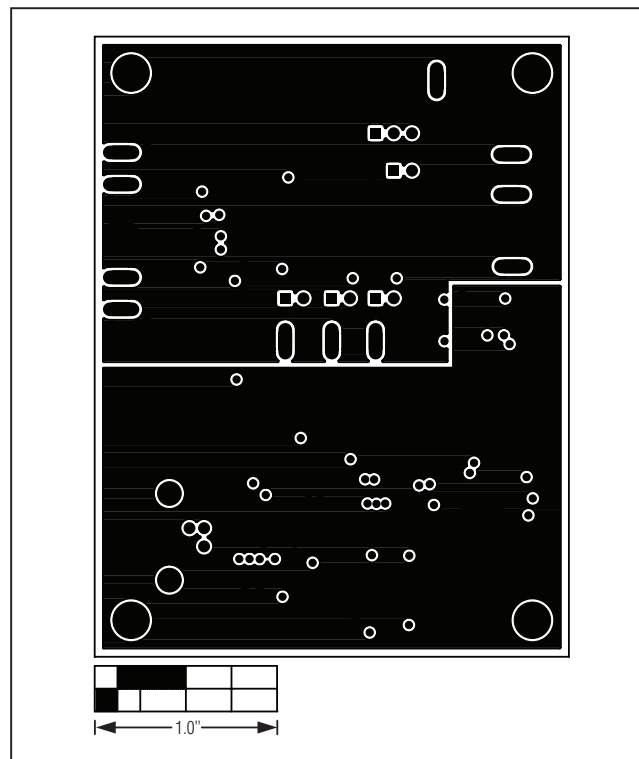


Figure 6. MAX13335E EV Kit PCB Layout—GND Layer 2

# MAX13335E Evaluation Kit

## Evaluates: MAX13335E/MAX13336E

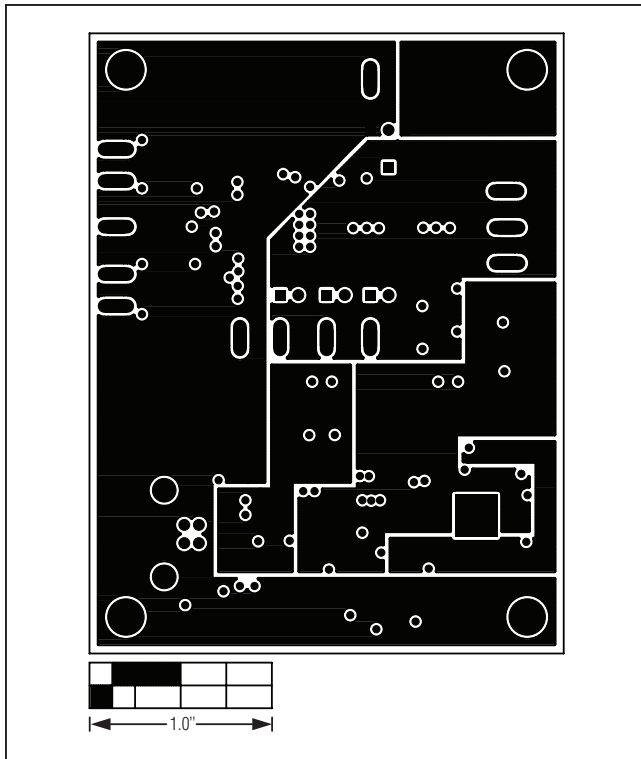


Figure 7. MAX13335E EV Kit PCB Layout—PWR Layer 3

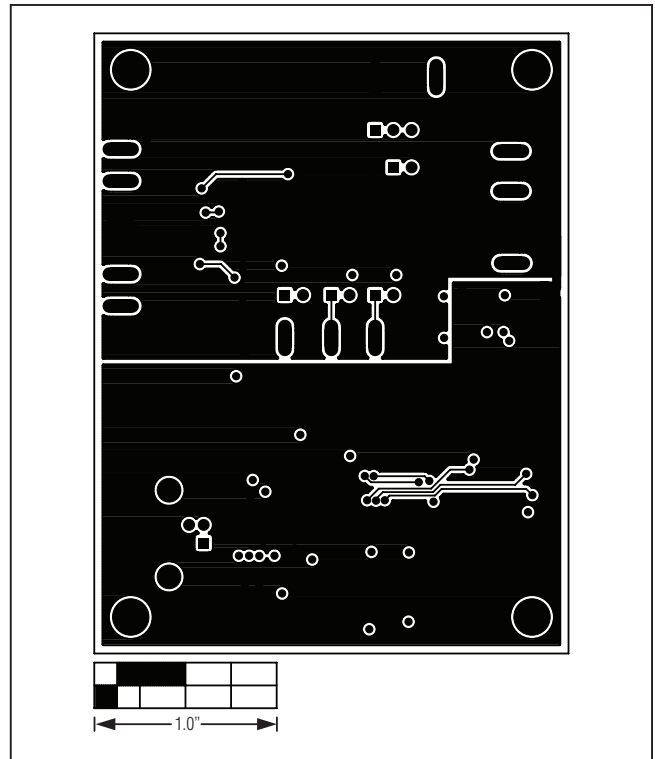


Figure 8. MAX13335E EV Kit PCB Layout—Solder Side

# MAX13335E Evaluation Kit

## Evaluates: MAX13335E/MAX13336E

### ***Ordering Information***

PART	TYPE
MAX13335EEVKIT#	EV Kit

#Denotes RoHS compliant.

# MAX13335E Evaluation Kit

## Evaluates: MAX13335E/MAX13336E

### Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	4/12	Initial release	—

Maxim cannot assume responsibility for use of any circuitry other than circuitry entirely embodied in a Maxim product. No circuit patent licenses are implied. Maxim reserves the right to change the circuitry and specifications without notice at any time.

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