19-5739 Rev 0; 1/11

MAX14886 Evaluation Kit

Evaluates: MAX14886

General Description

The MAX14886 evaluation kit (EV kit) provides a proven design to evaluate the MAX14886. This high-speed, low-skew, active redriver multiplexer is ideal for switching between outputs of dual-graphics systems and signal conditioning to meet High-Definition Multimedia Interface (HDMI™) v1.4 compliance up to 2.25Gbps at an external HDMI output connector. The EV kit contains three sections: an application circuit, characterization circuit, and calibration traces.

The application circuit is designed to demonstrate the device in multiplexing and redriving TMDS® formatted dual-mode DisplayPort™ signals into an HDMI output connector. This section of the EV kit operates from a +5V USB supply that is regulated by an on-board +3.3V LDO regulator, which powers the U1 device and companioned DDC logic (U3). All signal traces in the application circuit are 100Ω differential controlled-impedance traces.

The characterization circuit is provided for eye diagram evaluation using SMA connectors, controlled-impedance traces, and output bias-Ts to interface with standard 50Ω test equipment. This section is powered by an external +3.3V power supply.

The calibration traces match the length and shape of the input traces in the characterization circuit (U4) for further high-frequency analysis.

Features

- **One HDMI Output Connector**
- **Two DisplayPort Input Connectors**
- **Mini-USB Power Supply**
- **Application Circuit with TMDS and DDC Sections**
- **Characterization Circuit with SMA Inputs/Outputs and Output Bias-Ts**
- **Calibration Traces (50Ω Load Trace)**
- **Proven PCB Layout**
- **Fully Assembled and Tested**

Ordering Information

PART	TYPE
MAX14886EVKIT+	EV Kit

+Denotes lead(Pb)-free and RoHS compliant.

HDMI is a trademark of HDMI Licensing, LLC.

TMDS is a registered trademark of Silicon Image, Inc.

DisplayPort is a trademark of the Video Electronics Standards Association (VESA).

Component List

DESIGNATION	QTY	DESCRIPTION
C1–C4, C9–C24, C26, C29, C30, C35, C36, C38–C44	32	0.1µF ±10%, 16V X5R ceramic capacitors (0402) Murata GRM155R61C104K
C5–C8, C31–C34	8	4.7µF ±10%, 6.3V X5R ceramic capacitors (0603) Murata GRM188R60J475K
C25, C27, C37	3	10µF ±10%, 16V X5R ceramic capacitors (0805) Murata GRM21BR61C106K
C28	1	1µF ±10%, 16V X5R ceramic capacitor (0603) Murata GRM188R61C105K
D1	1	30V, 200mA Schottky diode (3 SOT23) Fairchild BAT54
D2	1	Green LED (0603)
D3	1	75V, 300mA diode (3 SOT23) Diodes Inc. BAS16-7-F
JU1–JU5	5	3-pin headers
L1, L2	2	470nH, 75mA inductors (0603) Murata LQW18ANR47J00
P1, P2	2	DisplayPort video connectors Molex 47272-0001
P3	1	HDMI type-A receptacle connector
P4–P9	6	50Ω SMA edge-mount receptacles
R1, R4, R15	3	100kΩ ±1% resistors (0402)
R2, R5	2	27kΩ ±5% resistors (0402)
R3, R6, R29	0	Not installed, resistors (0402)
R7, R9–R12, R18	6	3.3kΩ ±1% resistors (0402)

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Component List (continued)

DESIGNATION	QTY	DESCRIPTION
R8	1	1.5Ω ±5% resistor (0402)
R13, R14	2	2kΩ ±1% resistors (0402)
R16	1	10kΩ ±1% resistor (0402)
R17	1	220Ω ±5% resistor (0402)
R19–R28	10	49.9Ω ±1% resistors (0402)
U1, U4	2	DisplayPort to HDMI switches (40 TQFN-EP) Maxim MAX14886CTL+

DESIGNATION	QTY	DESCRIPTION
U2	1	3.3V LDO (6 SOT23) Maxim MAX6329TPUT+
U3	1	Quad 2:1 multiplexer/ demultiplexer switch (16 VQFN)
USB1	1	Mini-USB type-B receptacle connector
—	5	Shunts (JU1–JU5)
—	1	PCB: MAX14886 EVALUATION KIT+

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Diodes Incorporated	805-446-4800	www.diodes.com
Fairchild Semiconductor	888-522-5372	www.fairchildsemi.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com

Note: *Indicate that you are using the MAX14886 when contacting these component suppliers.*

Quick Start

Required Equipment

- MAX14886 EV kit
- PC with dual-mode DisplayPort output
- Mini-USB cable
- DisplayPort cable
- HDMI cable
- HDMI capable monitor

Procedure

The EV kit is fully assembled and tested. Follow the steps below to verify board operation:

1) Verify that jumpers JU1, JU2, JU3, and JU5 are in their default positions, as shown in Table 1.
2) Connect the mini-USB cable from the PC to the mini-USB connector (USB1) on the EV kit.
3) Connect the DisplayPort cable from the PC to the DisplayPort connector (P2) on the EV kit.
4) Connect the HDMI cable from the monitor to the HDMI connector (P3) on the EV kit.
5) Turn on the monitor.
6) Turn on the PC.
7) Move the shunt on jumper JU2 to the 1-2 position.
8) Verify that the video is present on the monitor.

Detailed Description of Hardware

The MAX14886 EV kit provides a proven design to evaluate the MAX14886 high-speed, low-skew, active redriver multiplexer. The device is ideal for switching between outputs of dual-graphics systems and signal conditioning to meet HDMI v1.4 compliance up to 2.25Gbps at an external HDMI output connector. The EV kit contains three sections: an application circuit, characterization circuit, and calibration traces.

The application circuit utilizes 100Ω differential controlled-impedance traces and provides two DisplayPort input connectors (P1, P2) allowing for evaluation of the IC in a DisplayPort/HDMI environment.

The characterization circuit utilizes a combination of 100Ω differential and 50Ω single-ended controlled-impedance traces, and SMA connectors and output bias-Ts. This allows evaluation of eye diagrams, return loss, and other frequency measurements. A separate +3.3V power supply needs to connect between the VCC1 and GND PCB pads.

The lower half of the EV kit provides a set of calibration traces, all of which are matched to the trace's length and shape of the characterization circuit input traces. These traces provide a reference for determining the input return loss of only the U4 device, when evaluated in the characterization circuit.

Table 1. Jumper Descriptions (JU1–JU5)

JUMPER	SHUNT POSITION	DESCRIPTION
JU1	1-2*	Connects the SEL pin of the U1 device to VCC, which selects the D_B_ and CKB_ signals of the device.
	2-3	Connects the SEL pin of the U1 device to GND, which selects the D_A_ and CKA_ signals of the device.
JU2	1-2	Connects the EN1 pin of the U1 device to VCC for normal operation.
	2-3*	Connects the EN1 pin of the U1 device to GND for shutdown.
JU3	1-2*	Uses the supply of the +3.3V LDO regulator (U2) to power the U1 device.
	2-3	Uses the supply applied at the VCC and GND PCB pads on the EV kit to power the U1 device.
JU4	1-2	Connects the EN1 pin of the U4 device to VCC1 for normal operation.
	2-3*	Connects the EN1 pin of the U4 device to GND for shutdown.
JU5	1-2*	Uses the USB supply to power the LDO regulator (U2).
	2-3	Uses the supply applied at the VCC5V and GND PCB pads on the EV kit to power the LDO regulator (U2).

**Default position.*

Application Circuit

The application circuit section provides an easy way to demonstrate the switching between the two dual-mode DisplayPort sources and redriving the signals to an HDMI output connector. The application circuit consists of the TMDS and DDC sections.

Application Supplies

The TMDS and DDC sections must be powered by +3.3V. There are two ways to get this voltage, through the on-board LDO regulator (U2) or by directly connecting a +3.3V power supply. When JU3 is in the 1-2 position, the application circuit is powered by the on-board LDO regulator. If JU3 is in the 2-3 position, apply a +3.3V supply at the VCC and GND PCB pads on the EV kit.

The LDO regulator and DDC sections of the application circuit can be powered by the USB when JU5 is in the 1-2 position, or by a +5V external supply connected to the VCC5V and GND PCB pads when JU5 is in the 2-3 position. When using the on-board LDO regulator to supply power, there is an LED (D2) to indicate that power is present.

The EV kit is fully assembled and factory tested. Follow the instructions in the *Quick Start* section for proper device evaluation.

Switching DisplayPort

By placing jumper JU1 in the 1-2 position, the U1 device switches and redrives the TMDS signal, and the multiplexer/demultiplexer (U3) switches the DDC/HPD signals from the DisplayPort input connector (P2) to the HDMI output connector (P3) of the U1 device. By placing JU1 in the 2-3 position, the U1 device switches and redrives the TMDS signal, and the multiplexer/demultiplexer (U3) switches the DDC/HPD signals from the DisplayPort input connector (P1) to the HDMI output connector (P3) of the U1 device.

Enable

The U1 device is enabled when placing a shunt in the 1-2 position on jumper JU2. Place the shunt on JU2 in the 2-3 position to enter shutdown. Before enabling the device, always power up and connect the monitor.

Characterization Circuit

The characterization circuit is provided as a separate test circuit for high-frequency evaluation of the device. The characterization circuit section allows for detailed analysis on a single channel pair of inputs. All channel inputs have similar performance by design. This circuit provides differential SMA inputs and outputs, with a combination of controlled-impedance traces and high-frequency output bias-Ts.

Input Supply (VCC1)

The characterization circuit is powered by an external +3.3V power supply connected between the VCC1 and GND PCB pads. The GND in the application circuit is not continuous with the GND in the characterization circuit section.

Enable

The U4 device is enabled when placing a shunt in the 1-2 position on jumper JU4. Place the shunt on JU4 in the 2-3 position to enter shutdown.

Testing

The device outputs are open-collector differential switches, steering currents through the connector and cables into a 50Ω HDMI load biased at +3.3V. A high-bandwidth DC-coupled probe with a 50Ω load biased at +3.3V (e.g., Tektronix P7313) is therefore best suited to evaluate the device's performance. If such a probe is not available, a common AC-coupled 50Ω instrument with SMA connectors, such as a scope or vector network analyzer (VNA), can still be used to evaluate the device's performance in the characterization circuit.

In the default configuration of the characterization circuit section, a high-frequency bias-T (250MHz to 1GHz), consisting of RF inductors (L1, L2) and low-ESR capacitors (C38, C39), is connected to the U4 device outputs. The bias-T produces a 50Ω DC impedance biased at VCC and high impedance in the 250MHz to 1GHz high-frequency range. When a 50Ω SMA instrument is AC-coupled, the device load closely resembles the HDMI monitor. In practice, frequencies below 250MHz (e.g., HDMI clock) result in "sloping top waveforms" due to the termination-impedance frequency dependence and cannot be evaluated here.

For the best evaluation results, and to measure the device's performance at HDMI clock frequencies below 250MHz, use a high-bandwidth DC-coupled probe with a 50Ω load biased at +3.3V (e.g., Tektronix P7313). Start by removing L1 and L2 and replace C38 and C39 with 0Ω 0402 resistors. Use the same DC-coupled probe to evaluate the device's performance with double HDMI termination. Reconfigure the EV kit as follows: replace L1/L2 with 200Ω 0603 resistors, R25/R26 and C38/C39 with 0Ω 0402 resistors, and R18 with a 3kΩ 0402 resistor.

Always bias the DC-coupled probe at +3.3V first and then connect it to P6 and P7 on the EV kit with the SMA cables. Next apply a +3.3V supply to the VCC1 and GND PCB pads on the EV kit and enable the U4 device by positioning jumper JU4 in the 1-2 position. Consult the probe manual for proper measurement procedures.

Calibration Traces

The bottom half of the EV kit provides a set of calibration traces that can be used for further analysis. The lengths and shapes of the calibration traces from the SMA connectors (P8, P9) are matched to the traces going from the SMA connectors (P4, P5) to the U4 device of the inputs of the characterization circuit. Each calibration trace includes a 0.1µF 0402 DC-blocking capacitor and a 50Ω load termination exactly matching the characterization circuit section components.

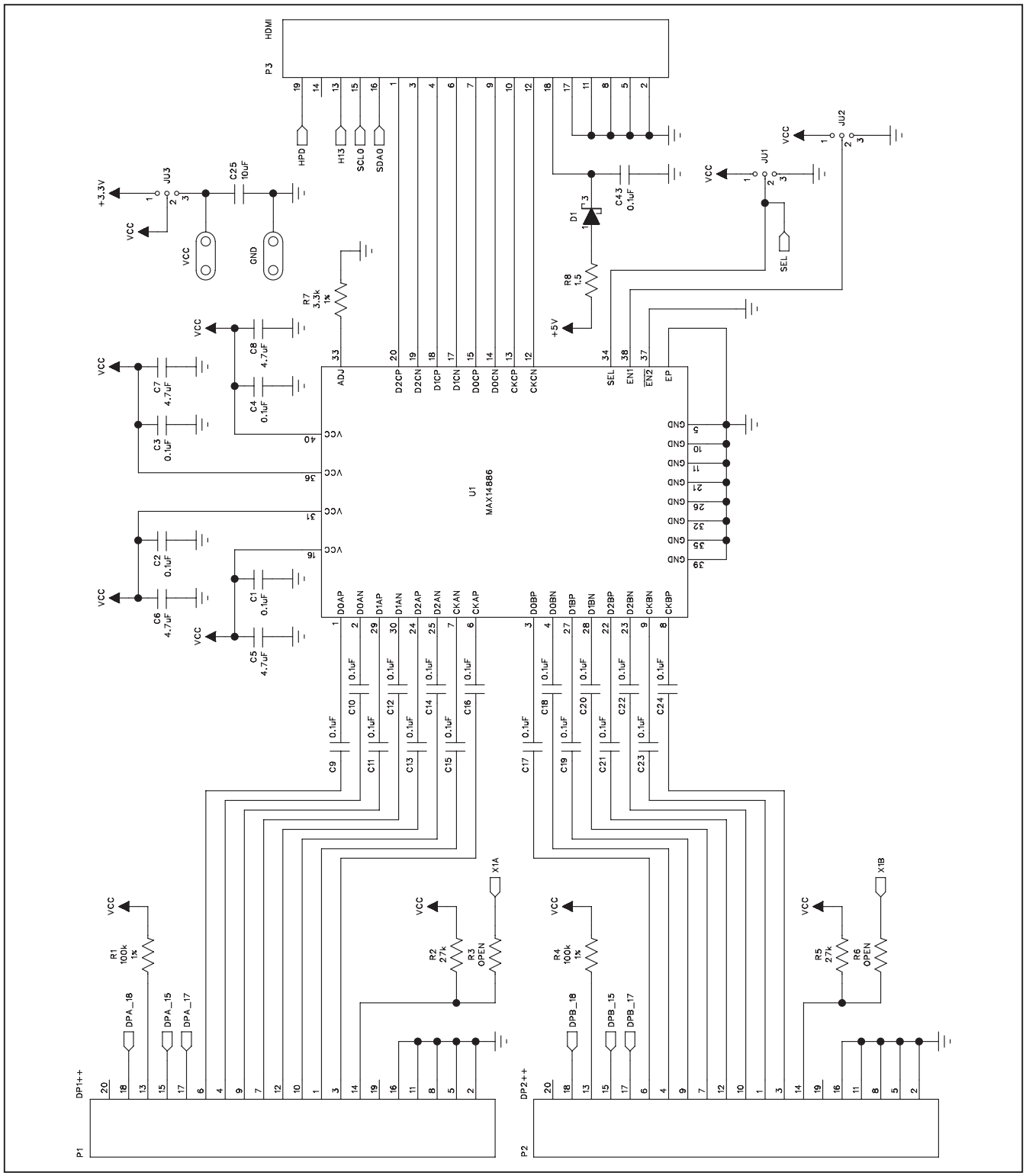

Figure 1a. MAX14886 EV Kit Schematic (Sheet 1 of 3)

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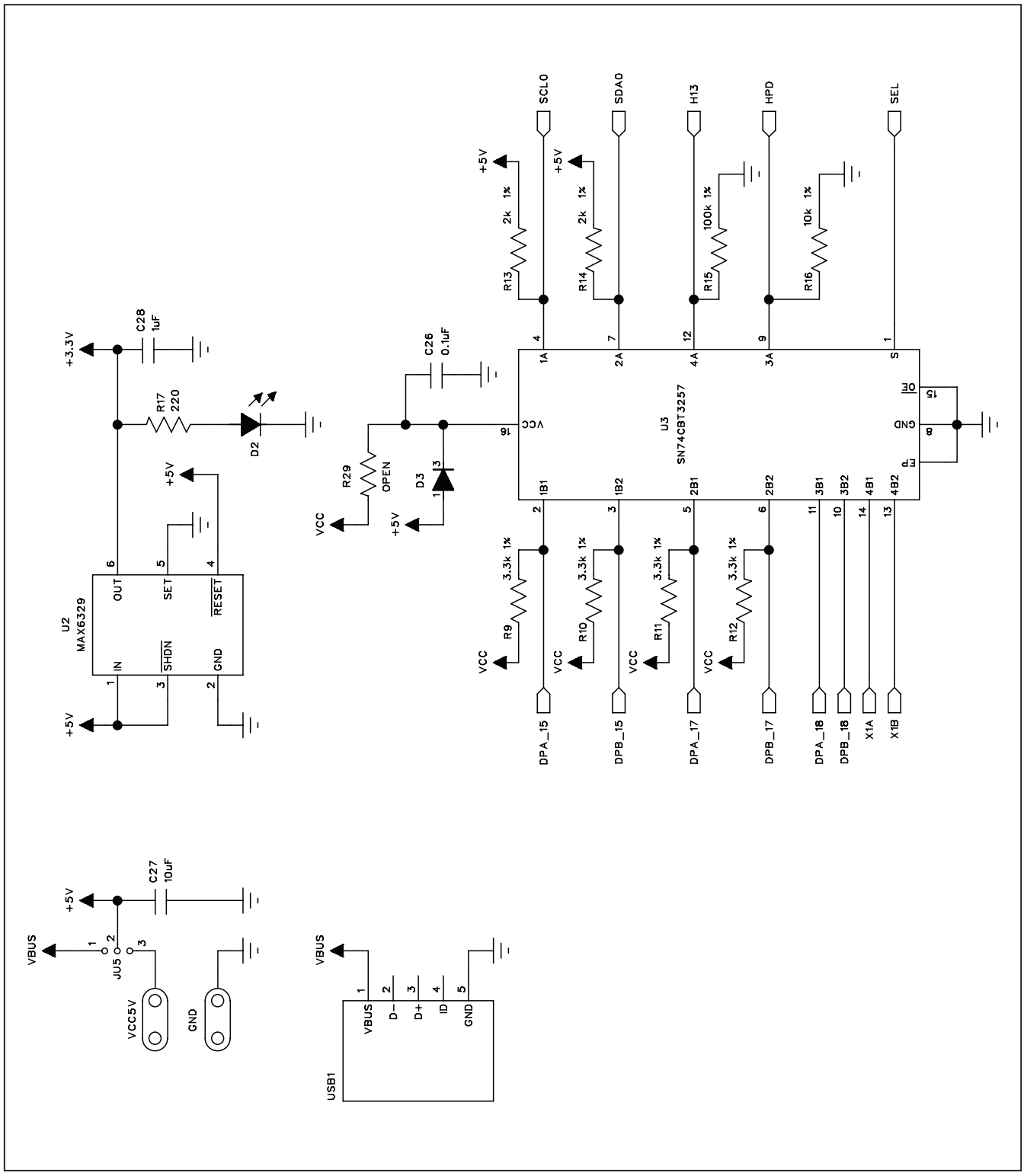

Figure 1b. MAX14886 EV Kit Schematic (Sheet 2 of 3)

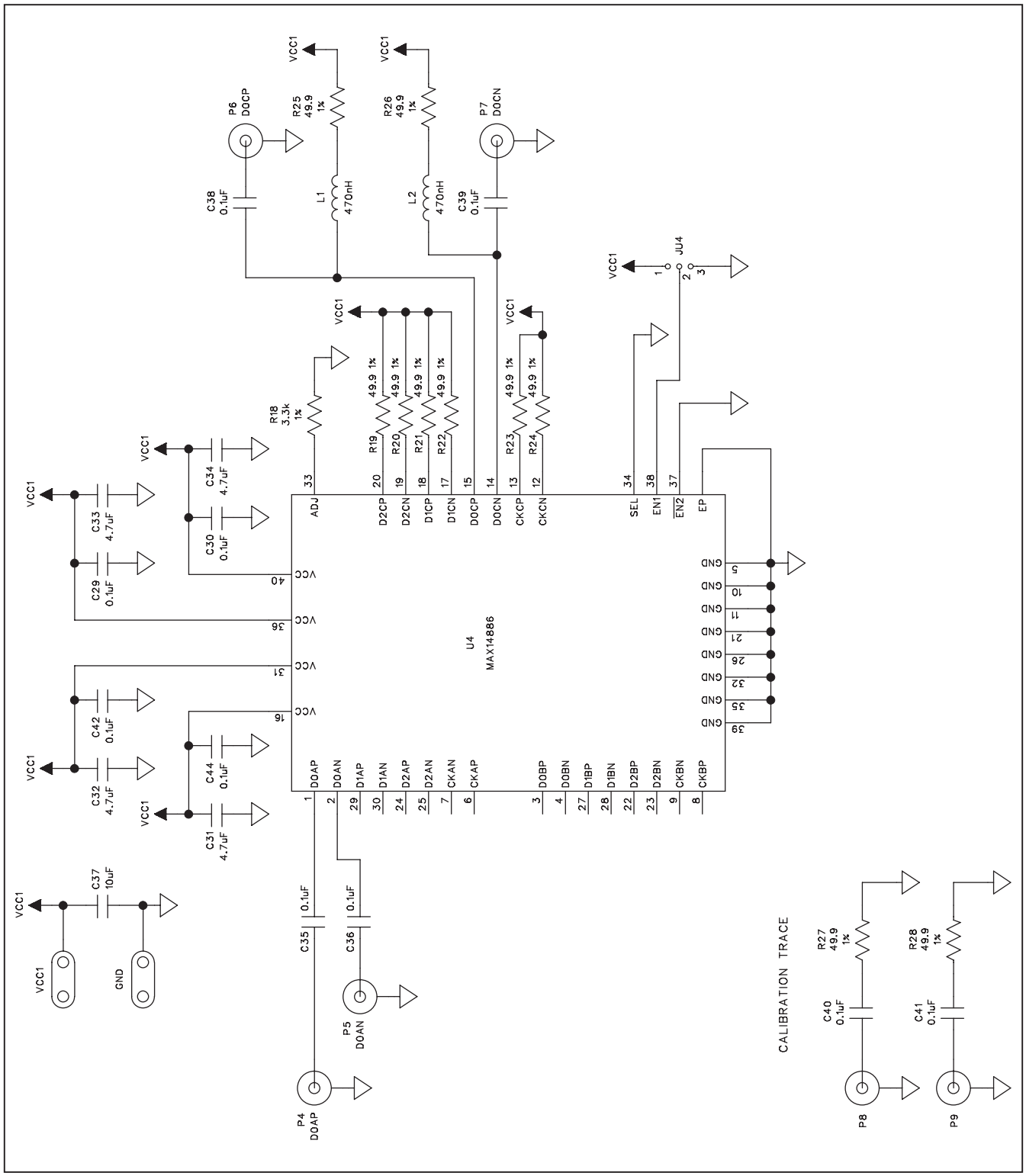

Figure 1c. MAX14886 EV Kit Schematic (Sheet 3 of 3)

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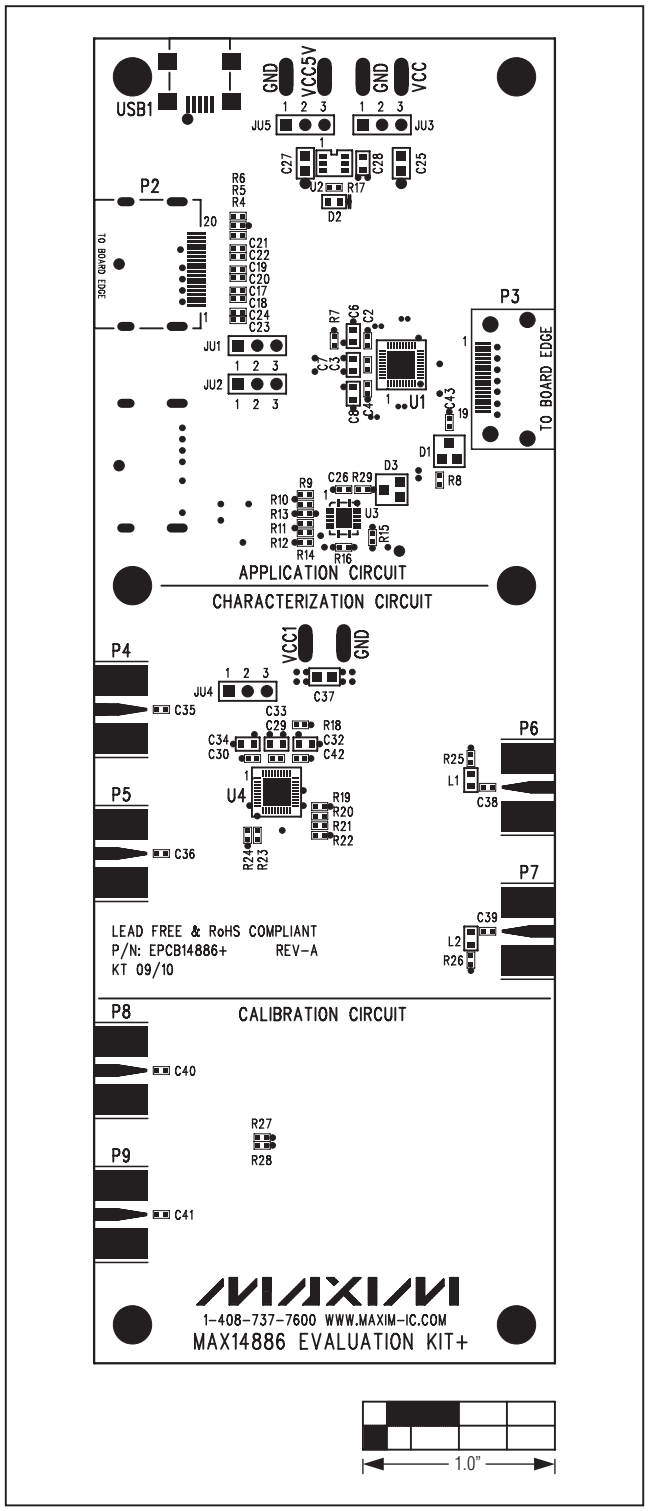

Figure 2. MAX14886 EV Kit Component Placement Guide—Component Side

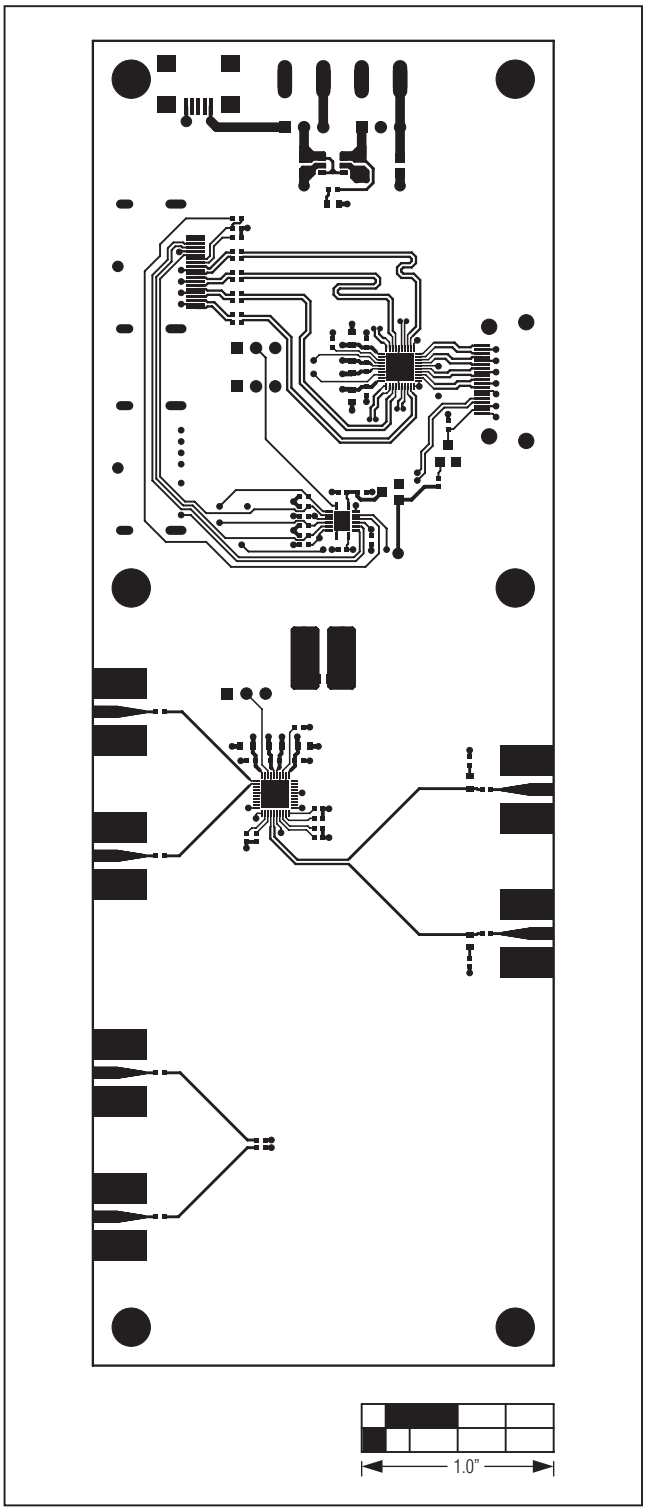

Figure 3. MAX14886 EV Kit PCB Layout—Component Side

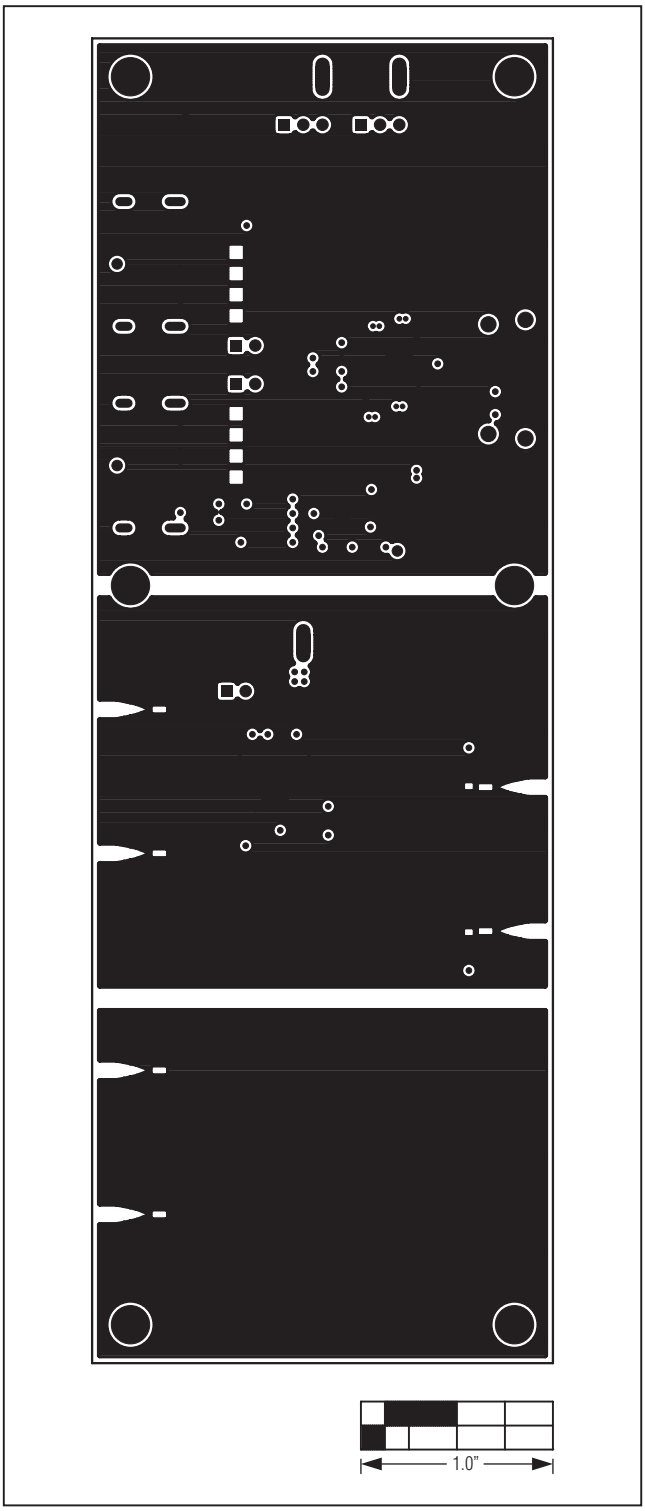

Figure 4. MAX14886 EV Kit PCB Layout—Inner Layer 2

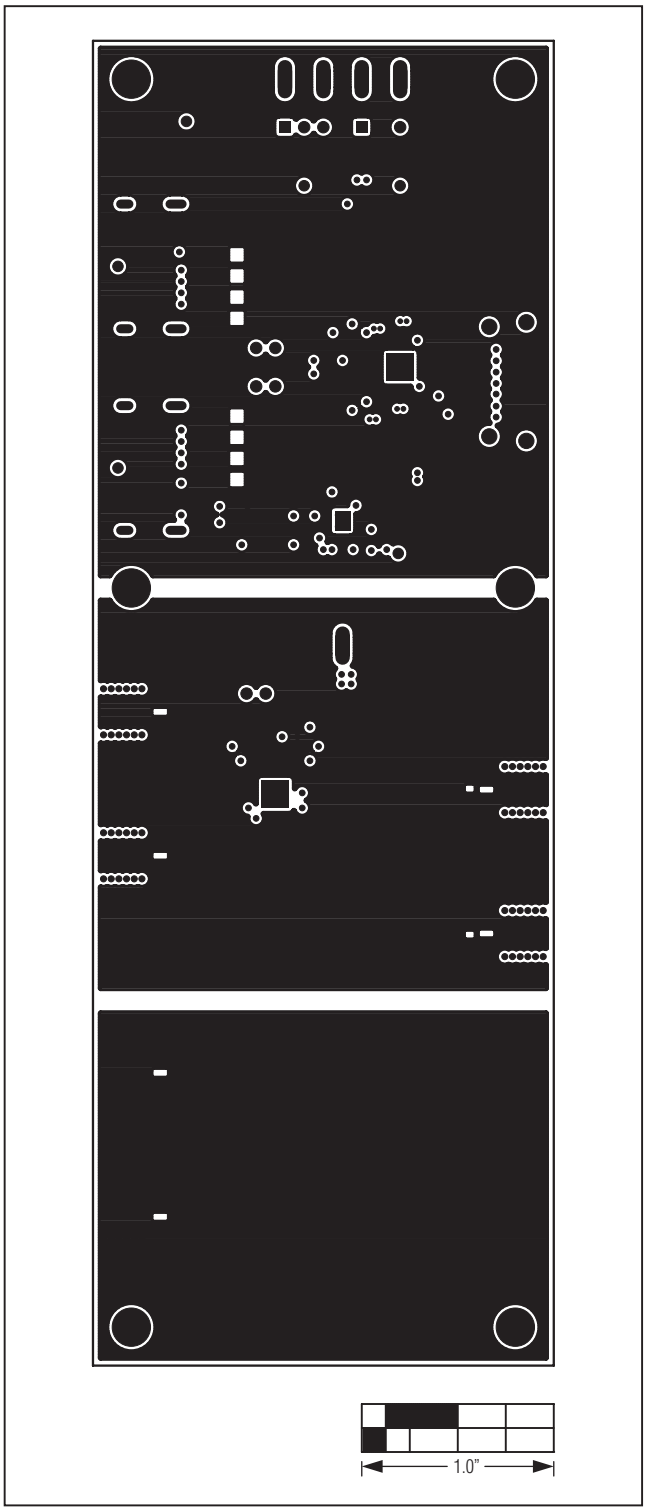

Figure 5. MAX14886 EV Kit PCB Layout—Inner Layer 3

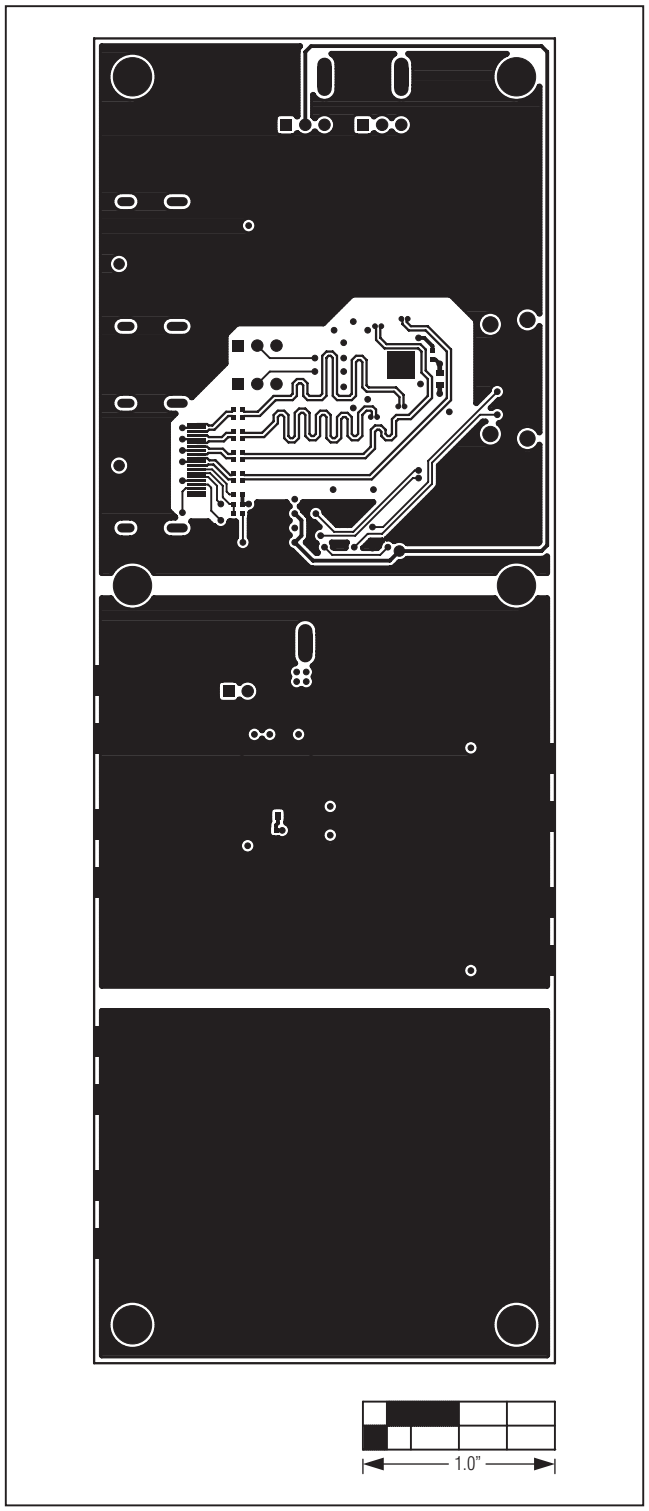

Figure 6. MAX14886 EV Kit PCB Layout—Solder Side

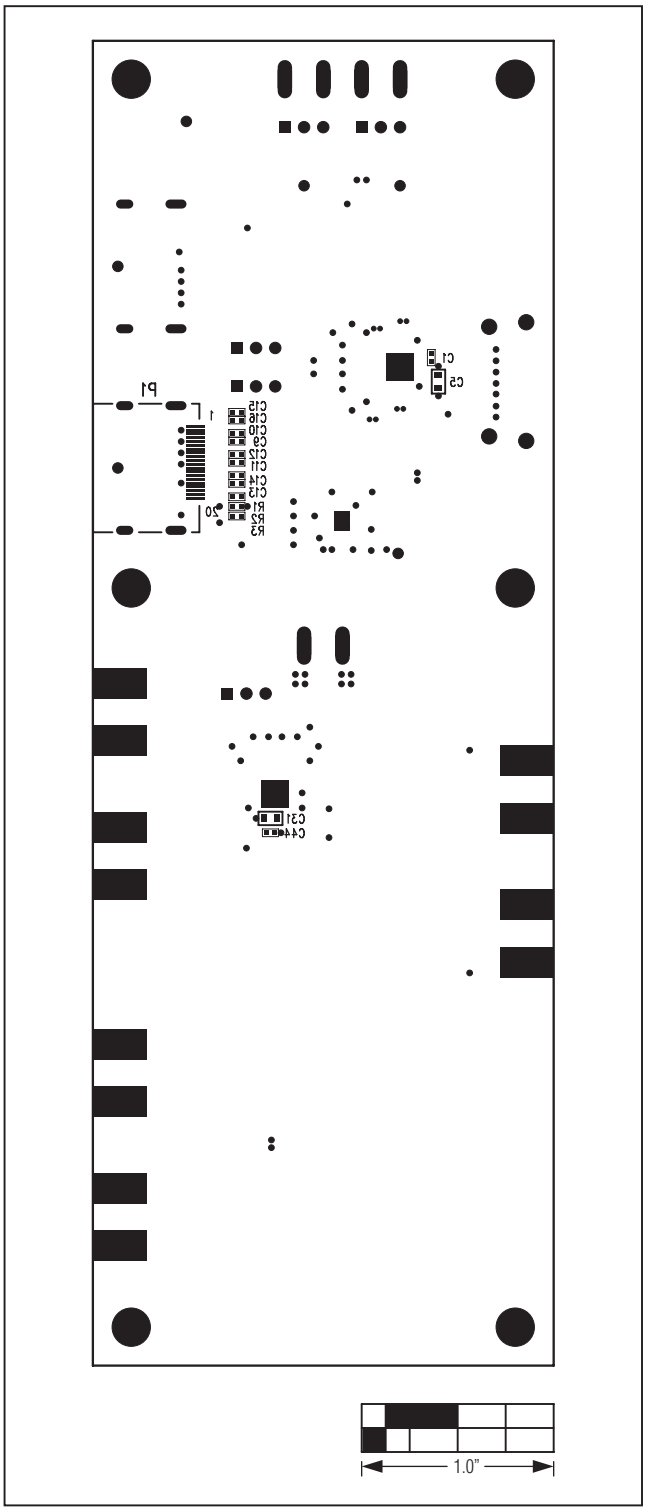

Figure 7. MAX14886 EV Kit Component Placement Guide—Solder Side

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	1/11	Initial release	—