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MAX16831 Evaluation Kit

Evaluates: MAX16831

General Description

The MAX16831 evaluation kit (EV kit) demonstrates the MAX16831 current-mode, high-brightness LED (HBLED) driver IC. The MAX16831 EV kit is configured as a step-down/step-up (buck-boost) topology circuit with peak inductor current and average LED current control for external LEDs. The MAX16831 EV kit operates from a DC supply voltage of 9V to 40V and is configured to deliver 1A of current. The maximum output voltage of the LED string can be up to 28V.

The MAX16831 EV kit can be configured for analog-control PWM or digital PWM dimming operation using either an analog linear DC voltage or a digital PWM input signal to control the LEDs' brightness. This EV kit has an undervoltage lockout (UVLO) feature that disables the EV kit and overvoltage protection that protects the circuit under no-load conditions. The EV kit circuit also features a clock output and features an input for synchronizing to an external clock. The MAX16831 EV kit is a fully assembled and tested surface-mount printed-circuit board (PCB).

Caution: Do not power up the MAX16831 EV kit without connecting a load to the LED+ and LED- PCB pads.

Warning: Voltages exceeding 42V may exist on the LED+ and LED- output pads.

Features

♦ **9V to 40V Wide Supply Voltage Range**

♦ **1A Output Current**

♦ **Analog-Control PWM Dimming**

♦ **PWM Dimming Control**

♦ **Output Overvoltage Protection**

♦ **Buffered Clock Output**

♦ **Lead-Free and RoHS Compliant**

♦ **Fully Assembled and Tested**

Ordering Information

PART	TYPE
MAX16831EVKIT+	EV Kit

+Denotes lead-free and RoHS-compliant.

Component List

DESIGNATION	QTY	DESCRIPTION
C1, C3, C4, C5, C15	5	0.1µF ±10%, 50V X7R ceramic capacitors (0603) Murata GRM188R71H104K
C2	1	1µF ±10%, 16V X7R ceramic capacitor (0603) Murata GRM188R71C105K
C6, C14	2	1000pF ±10%, 50V X7R ceramic capacitors (0603) Murata GRM188R71H102K
C7	1	10µF ±10%, 16V X7R ceramic capacitor (1206) Murata GRM31CR71C106K
C8	1	100µF ±20%, 50V electrolytic capacitor (10.3mm x 10.3mm) Panasonic EEVFCIH101P
C9	1	10µF ±10%, 50V X7S ceramic capacitor (1210) Taiyo Yuden UMK325C7106KM
C10, C11, C12	3	4.7µF ±10%, 100V X7R ceramic capacitors (2220) Murata GRM55DR61H106K

DESIGNATION	QTY	DESCRIPTION
C13	1	0.047µF ±10%, 50V X7R ceramic capacitor (0603) TDK C1608X7R1H473K
C16, C17	2	100pF ±5%, 50V C0G ceramic capacitors (0603) Murata GQM1885C1H101J
D1	1	300mA, 100V diode (SOD123) Diodes Inc. 1N4148W-7-F
D2	0	Not installed, diode (SOD123)
D3	1	3A, 100V Schottky diode (PowerDI) Diodes Inc. PDS3100
D4	1	1A, 100V Schottky diode (SMA) Diodes Inc. B1100-13-F
JU1	1	2-pin header
L1	0	Not installed, inductor
L2	1	10µH, 9.2A inductor Sumida CDEP147NP-100MC-95
N1	1	60V, 3.2A n-channel MOSFET (6-pin TSOP) Vishay Si3458DV-E3

MAXIM _____ ***Maxim Integrated Products* 1**

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.

MAX16831 Evaluation Kit

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
N2	1	100V, 42A n-channel MOSFET (D-Pak) International Rectifier IRLR3110Z
N3	0	Not installed, MOSFET (D-Pak)
R1	1	73.2kΩ ±1% resistor (0603)
R2	1	12.4kΩ ±1% resistor (0603)
R3	1	0.1Ω ±1%, 500mW sense resistor (1206) IRC/TT LRC-LR-1206LF-01-R100-F
R4	1	100Ω ±5% resistor (0603)
R5	1	1Ω ±5% resistor (0603)
R6, R7	2	0.04Ω ±1%, 2W sense resistors (2512) IRC/TT LRC-LR-2512LF-01-R040-F

DESIGNATION	QTY	DESCRIPTION
R8	0	Not installed, resistor (0805)
R9	1	280kΩ ±1% resistor (0603)
R10, R15	2	4.99kΩ ±1% resistors (0603)
R11	1	1kΩ ±1% resistor (0603)
R12	1	3.32kΩ ±1% resistor (0603)
R13	1	42.2kΩ ±1% resistor (0603)
R14	1	100kΩ potentiometer (single turn)
U1	1	Current-mode HBLED driver (32 TQFN-EP*) Maxim MAX16831ATJ+
—	1	Shunt (JU1)
—	1	PCB: MAX16831 Evaluation Kit+

EP = Exposed pad.

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Diodes, Inc.	805-446-4800	www.diodes.com
International Rectifier	310-322-3331	www.irf.com
IRC, Inc.	361-992-7900	www.irctt.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
Panasonic Corp.	800-344-2112	www.panasonic.com
Sumida Corp.	847-545-6700	www.sumida.com
TDK Corp.	847-803-6100	www.component.tdk.com
Vishay	402-563-6866	www.vishay.com

Note: *Indicate that you are using the MAX16831 when contacting these component suppliers.*

Quick Start

Recommended Equipment
Before beginning, the following equipment is needed:

- 9V to 40V, 4A power supply
- Two digital voltmeters
- A series-connected LED string rated at 1A (28V max)
- A current probe to measure LED current

Procedures
The MAX16831 EV kit is fully assembled and tested. Follow the steps below to verify board operation. **Caution: Do not turn on the power supply until all connections are completed and do not power up the MAX16831 EV kit without connecting a load to the LED+ and LED- PCB pads.**

Warning: Voltages exceeding 42V may exist on the LED+ and LED- output pads.

1) Verify that a shunt is installed across jumper JU1 (analog dimming control).

2) Connect the power supply's positive terminal to the V_{IN} PCB pad on the EV kit. Connect the power supply's ground terminal to PGND PCB pad.

3) Connect the digital voltmeters across the V_{IN} and PGND PCB pads and the LED+ and LED- PCB pads.

4) Connect the anode of the LED string to the LED+ pad.

5) Connect the cathode of the LED string to the LED- pad.

MAXIM

6) Clip the current probe across the LED+ wire to measure the LED current.

7) Turn on the power supply and increase the input voltage to 9V.

8) Adjust potentiometer R14 to obtain the desired LED current duty cycle.

9) Measure the voltage between the LED+ and LED-PCB pads.

Detailed Description

The MAX16831 evaluation kit (EV kit) demonstrates the MAX16831 current-mode HBLED driver IC. The MAX16831 EV kit is configured in a step-down/step-up (buck-boost) topology with peak current control and average current control for a string of user-supplied external HBLEDs. The MAX16831 EV kit operates from a DC supply voltage of 9V to 40V and requires up to 4A. The circuit is configured to deliver 1A of current into series LED string with a maximum 28V forward voltage.

The EV kit sets the maximum series inductor current to 8.3A using parallel resistors R6 and R7. The average LED current is set to 1A using resistor R3. A CLKOUT PCB pad is available to monitor the oscillator frequency. A DIM PCB pad is also provided for PWM dimming operation of the external LEDs and to monitor the analog DC voltage applied at the MAX16831 IC DIM pin.

Undervoltage Lockout (UVLO)
The MAX16831 EV kit's UVLO threshold is configured to 8.3V using resistors R1 and R2. The UVEN PCB pad can be used to disable the EV kit circuit by connecting UVEN to AGND. To configure the circuit to a different UVLO threshold, refer to the *Setting the UVLO Threshold* section in the MAX16831 IC data sheet.

Peak Inductor Current-Limit Setting
The parallel combination of current-sense resistors R6 and R7 sets the EV kit's peak inductor current limit to 8.3A. Use the following equation to calculate the total resistance needed to reconfigure the inductor peak current limit:

$$R_{TOTAL} = \frac{160mV}{I_{PEAK}}$$

where I_{PEAK} is the inductor peak current and R_{TOTAL} is the total parallel resistance placed at the R6 and R7 PCB pads.

Refer to *the ILIM and HICCUP Comparator* section in the MAX16831 IC data sheet for additional information on setting the peak current-limit threshold.

Setting External LED Current
Resistor R3 sets the MAX16831 EV kit average LED current to 1A. Use the following equation to calculate R3 when reconfiguring the LED current:

$$R3 = \frac{107mV}{I_{LED}}$$

where I_{LED} is the LED current.

LED Dimming Control
LED dimming can be achieved on the MAX16831 EV kit by applying a digital PWM signal or an analog DC voltage at the DIM PCB input pad. Jumper JU1, potentiometer R14, resistor R15, and capacitor C15 configure the MAX16831 EV kit for analog-control PWM dimming operation.

Place a shunt across jumper JU1 to set the EV kit for analog-control PWM dimming and adjust potentiometer R14. The analog DC voltage at the DIM PCB pad sets the duty cycle of the LED current, which controls the external LED brightness. The MAX16831 IC DIM pin voltage can be monitored by placing a voltmeter across the DIM and AGND PCB pads.

Use the following equation to calculate the voltage at the DIM PCB pad, which is necessary to program the LED output current duty cycle, D:

$$DIM \cong (D \times 2.6V) + 0.2V$$

where DIM is the analog DC voltage at the MAX16831 EV kit DIM PCB pad in volts, and D is the duty cycle of the LED output current.

When operating the MAX16831 EV kit with analog-control PWM dimming, the LED dimming frequency is internally set by the MAX16831 IC to 200Hz.

Remove the shunt at jumper JU1 to control LED dimming using a digital PWM signal at the DIM PCB pad. Apply a digital PWM signal with a 3.2V to 15V logic-high level in the 80Hz to 2kHz frequency range and adjust the duty cycle to adjust the LED brightness. See Table 1 for jumper JU1 setting for LED dimming operation.

Table 1. MAX16831 LED Dimming Operation (Jumper JU1)

SHUNT POSITION	EV KIT DIMMING OPERATION
Not installed	PWM signal applied at DIM PCB pad
Installed	Analog DC voltage adjusted using R14

MAX16831 Evaluation Kit

CLK OUTPUT

The MAX16831 EV kit features a buffered digital clock output, CLKOUT. The MAX16831 PWM clock frequency is programmed to 300kHz by resistor R13. To synchronize the MAX16831 EV kit to an external clock signal, connect a clock signal with a 2.8V to 5.5V logic level and 125kHz to 500kHz square wave at the RTSYNC PCB pad. Refer to the *Oscillator, Clock, and Synchronization* section in the MAX16831 IC data sheet for information on setting the MAX16831 IC PWM frequency.

Output Overvoltage Protection

The maximum voltage on the LED+ PCB pad is limited to 70.8V, with respect to GND, by a feedback network formed by resistors R9 and R10. When the voltage at LED+ exceeds the programmed 70.8V threshold, PWM switching is terminated and no further energy is transferred to the load connected between LED+ and LED-. Refer to the *Setting the Overvoltage Threshold* section in the MAX16831 IC data sheet for setting the overvoltage threshold.

If the EV kit is turned on with no load, the voltage at LED+ may rise to unsafe levels. Even though the EV kit has overvoltage protection, connect the specified load before powering up the EV kit.

MAX16831 Evaluation Kit
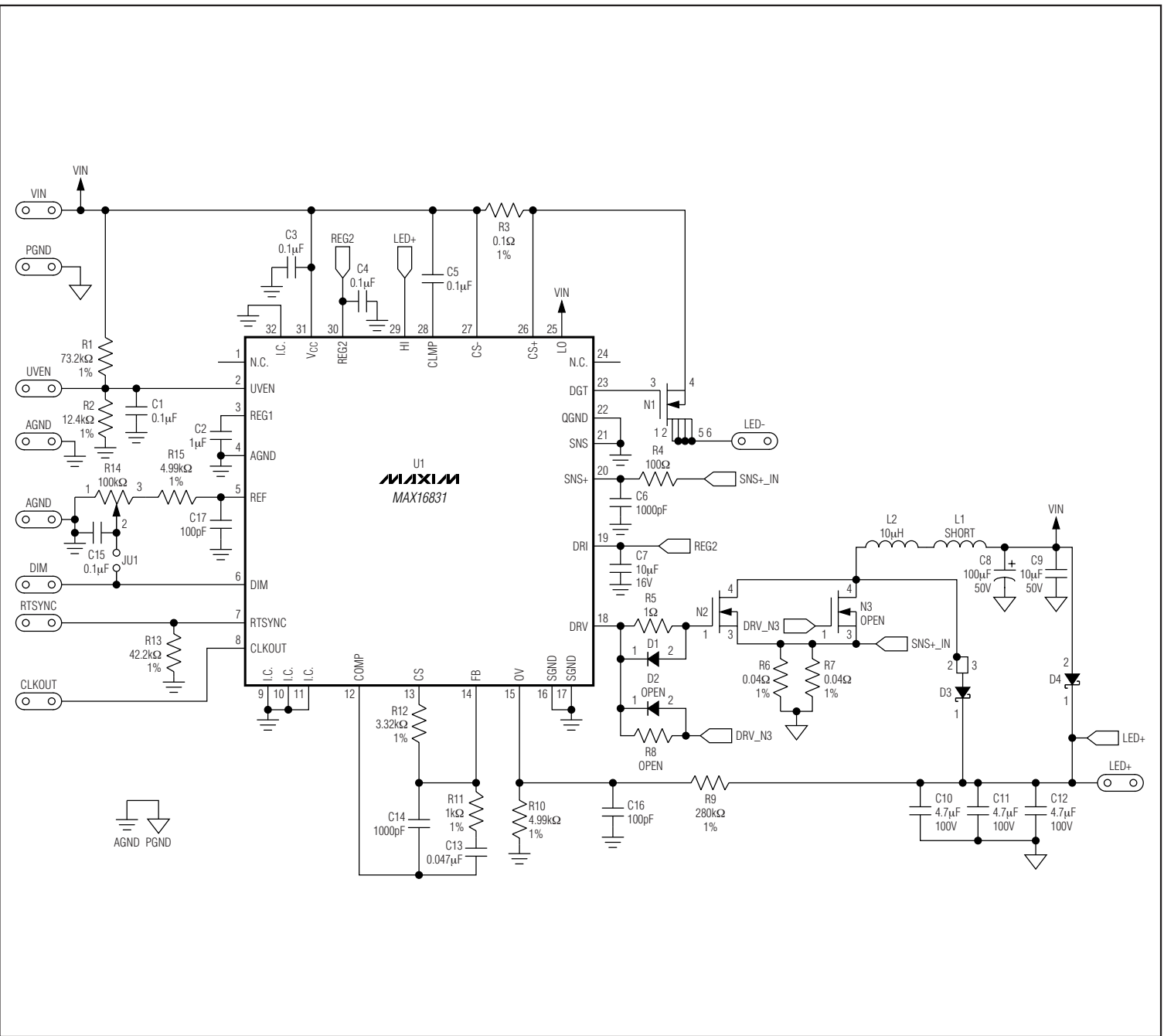
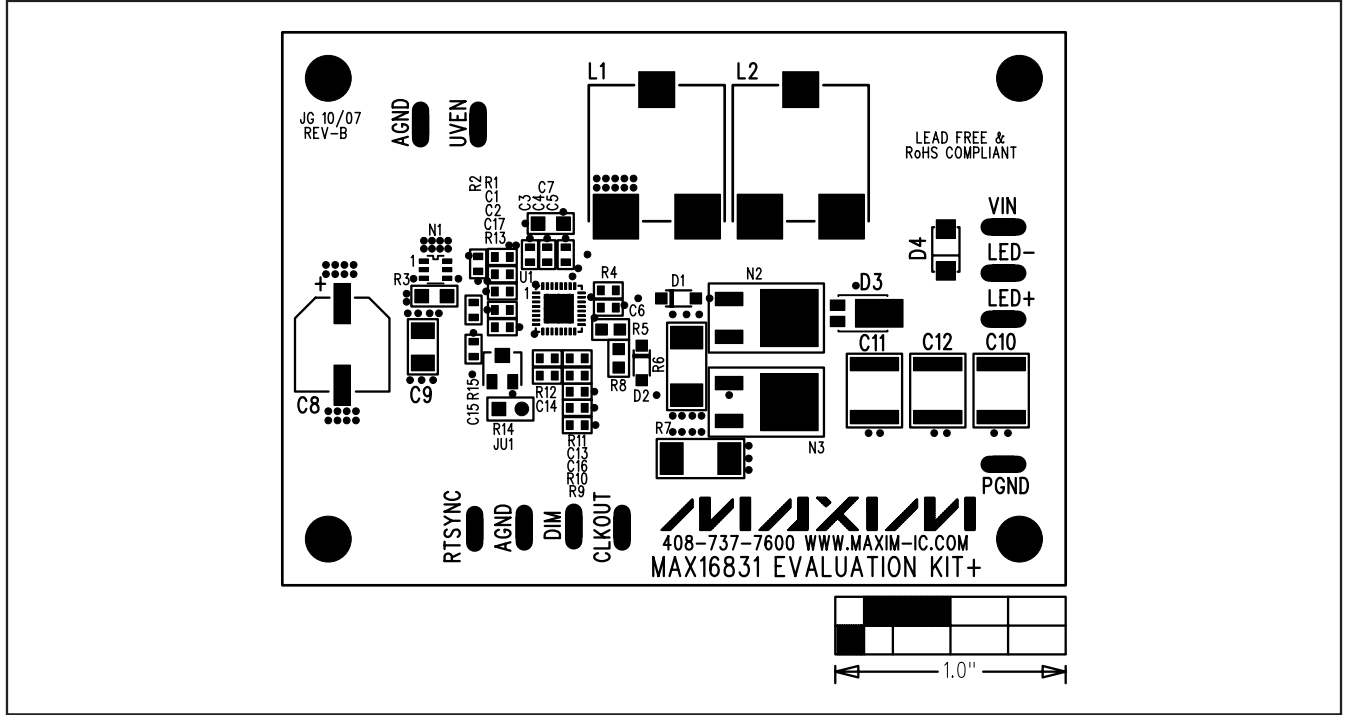*Figure 1. MAX16831 EV Kit Schematic*

MAX16831 Evaluation Kit

Figure 2. MAX16831 EV Kit Component Placement Guide—Components Side

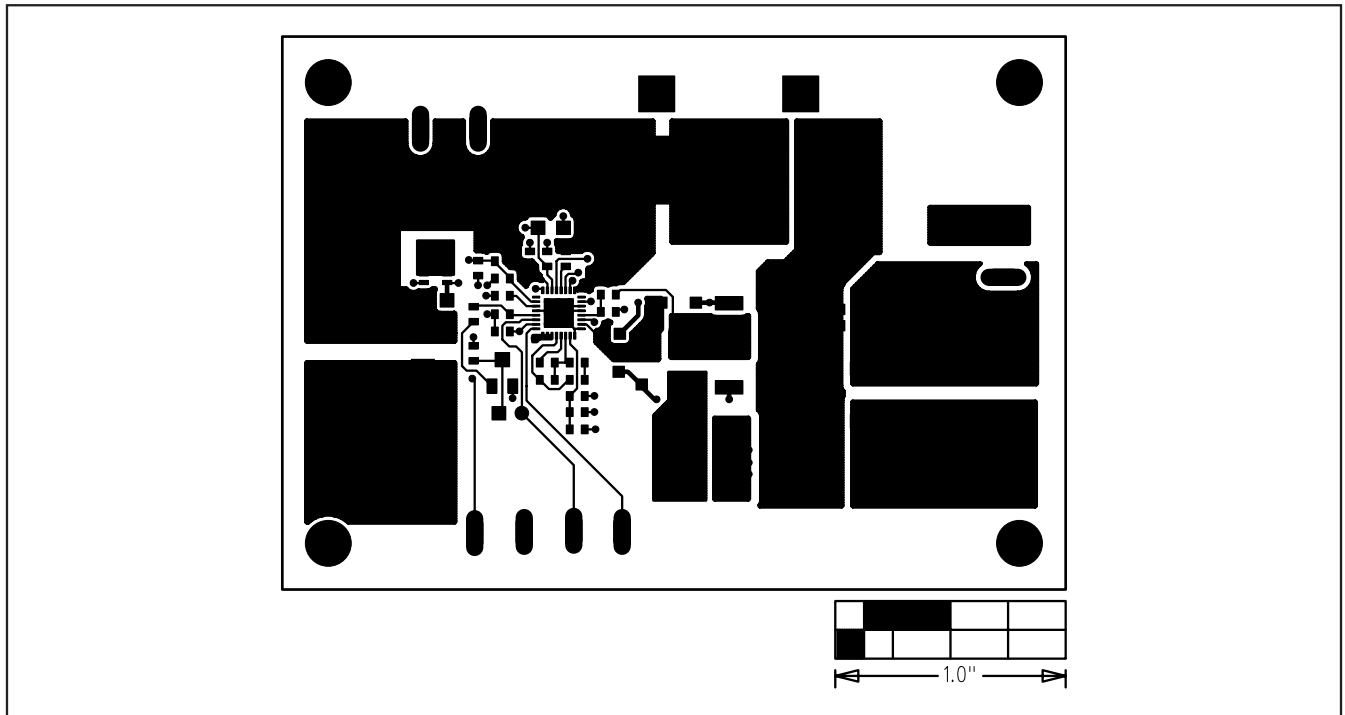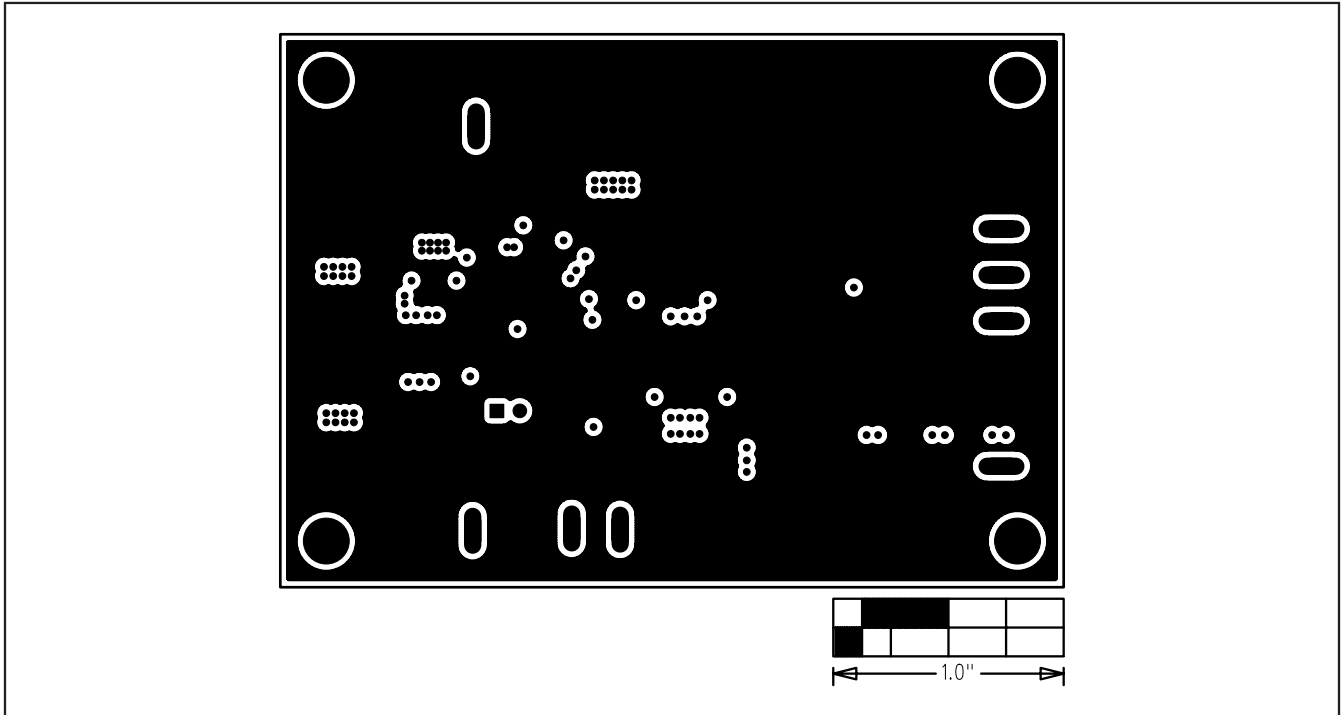Figure 3. MAX16831 EV Kit PCB Layout—Component Side

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Figure 4. MAX16831 EV Kit PCB Layout—GND Layer 2
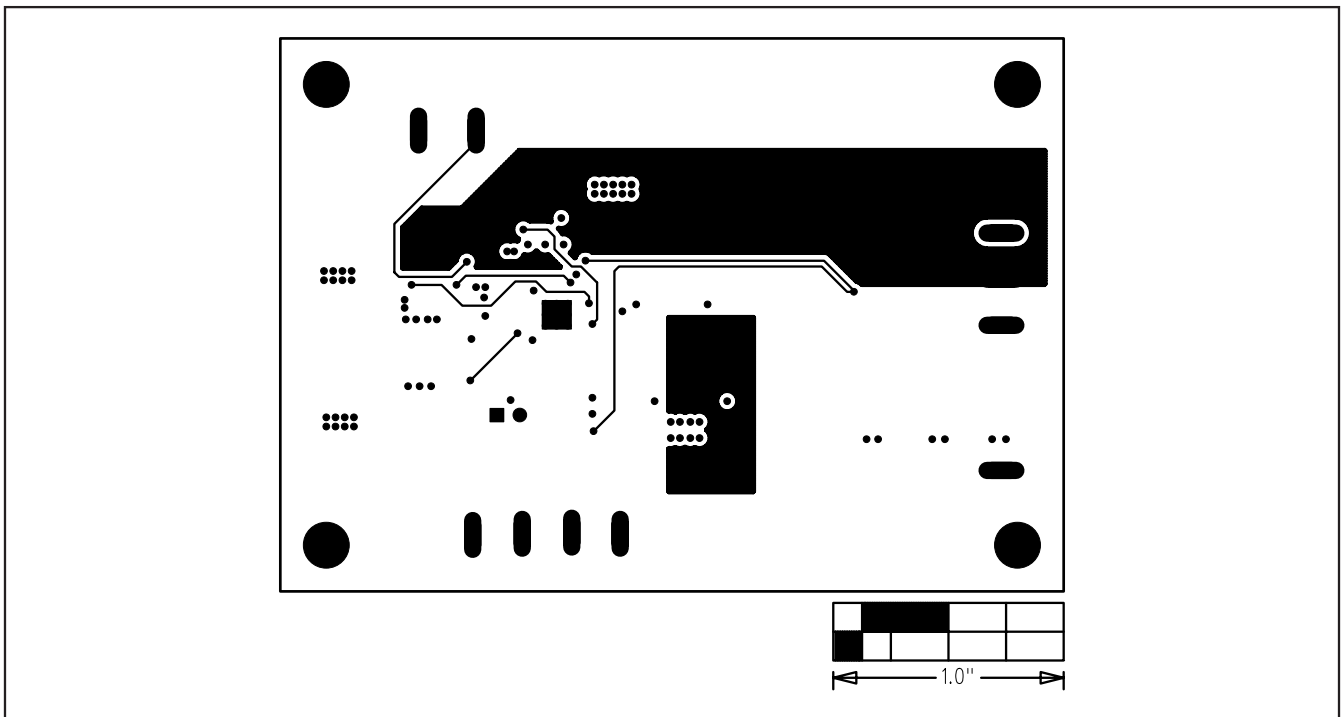
Figure 5. MAX16831 EV Kit PCB Layout—VCC Layer 3
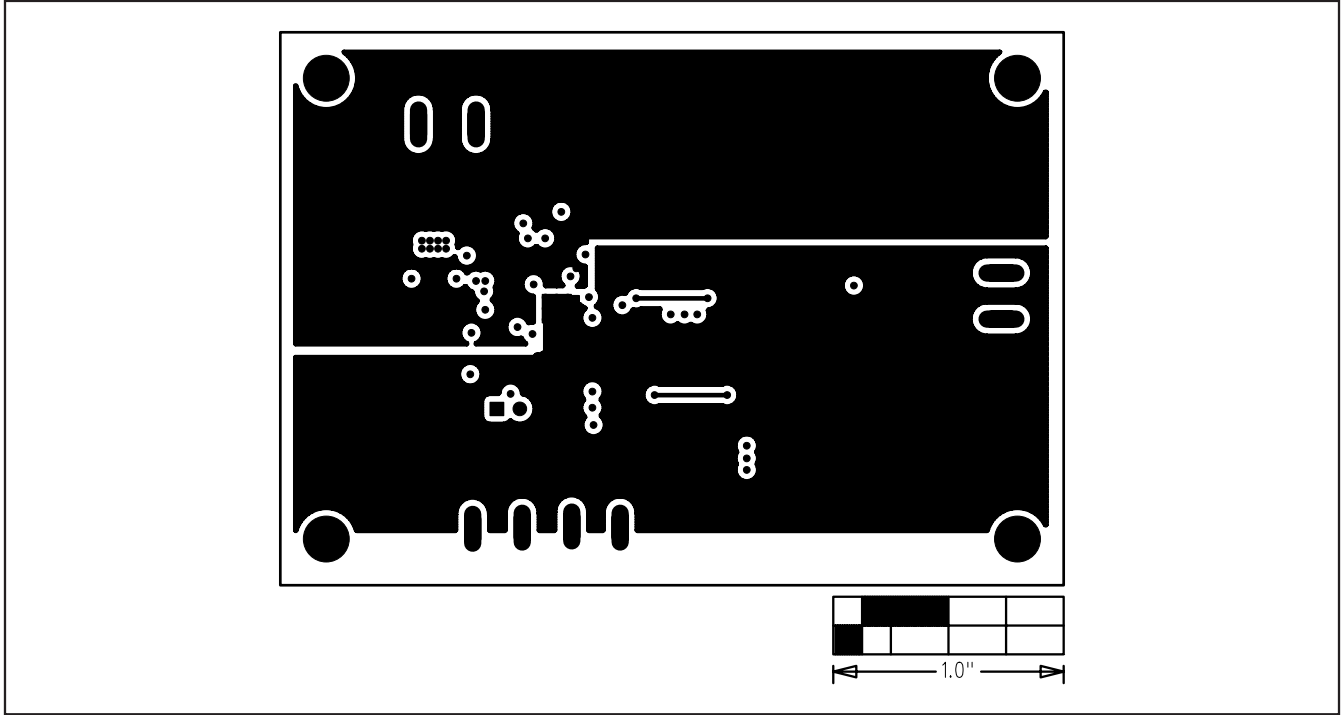
MAXIM _____ 7

Figure 6. MAX16831 EV Kit PCB Layout—Solder Side

MAX16831 Evaluation Kit

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	11/07	Initial Release	—
1	10/08	Component C9 part number change.	1

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