



# MAX16834 Evaluation Kit

## General Description

The MAX16834 evaluation (EV kit) is a fully assembled and tested surface-mount PCB designed to evaluate the MAX16834 pulse-width modulated (PWM) HB LED driver controller in a step-up (boost) configuration and optional step-up/step-down (buck-boost) operation.

The MAX16834 EV kit operates from a DC supply voltage of 7V to 28V and requires up to 5A. The MAX16834 EV kit circuit is configured to deliver up to 1A of current into series LEDs with a maximum forward voltage of 28V.

The MAX16834 EV kit features two different types of dimming control using either an analog linear input voltage or digital PWM input signal to control the LED 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 also features a  $\overline{\text{FLT}}$  PCB pad to monitor for open or short-circuit LED conditions at the LED+ and LED- PCB pads. The MAX16834 EV kit is a fully assembled and tested surface-mount board.

## Features

- ◆ 7V to 28V Wide Supply Voltage Range
- ◆ Configured for Boost Operation
- ◆ Configurable for Buck-Boost Operation
- ◆ 1A Output Current
- ◆ Analog Linear Dimming Control
- ◆ PWM Dimming Control
- ◆ Open/Short-Circuit LED Fault Indicator ( $\overline{\text{FLT}}$ )
- ◆ Demonstrates Output Overvoltage Protection
- ◆ Optional Load Dump Circuit
- ◆ Fully Assembled and Tested

## Ordering Information

PART	TYPE
MAX16834EVKIT+	EV Kit

+Denotes lead-free and RoHS compliant.

## Component List

DESIGNATION	QTY	DESCRIPTION
C1	0	Not installed, ceramic capacitor (10.3mm x 10.3mm)
C2, C7, C8	3	10 $\mu$ F $\pm$ 10%, 50V X7S ceramic capacitors (1210) Taiyo Yuden UMK325BJI06KM
C3	1	0.1 $\mu$ F $\pm$ 10%, 50V X7R ceramic capacitor (0805) Murata GRM21BR71H104K
C4	0	Not installed, ceramic capacitor (0805)
C5, C14, C15, C16	4	0.1 $\mu$ F $\pm$ 10%, 25V X7R ceramic capacitors (0603) Murata GRM188R71E104K
C6, C17, C19	0	Not installed, ceramic capacitors (0603)
C9, C10	0	Not installed, ceramic capacitors (1210)
C11	1	10 $\mu$ F $\pm$ 10%, 16V X7R ceramic capacitor (1206) Murata GRM31CR71C106K

DESIGNATION	QTY	DESCRIPTION
C12	1	0.22 $\mu$ F $\pm$ 10%, 25V X7R ceramic capacitor (0603) Murata GRM188R71E224K TDK C1608X7R1E224K
C13, C18	2	1000pF $\pm$ 5%, 50V COG ceramic capacitors (0603) Murata GRM1885C1H102J
D1	0	Not installed, diode (SOD323)
D2	1	60V, 3A Schottky diode (SMB) Diodes Inc. B360B-13-F
D3, D5	0	Not installed, diodes (SOD123)
D4	1	100V, 300mA diode (SOD123) Diodes Inc. 1N4148W-7-F
JU1	1	2-pin header
L1	1	9.5 $\mu$ H, 11.2A inductor Sumida CDEP147NP-9R5M-95
N1	1	60V, 3.2A n-channel MOSFET (6 TSOP) Vishay Si3458DV-E3 (Top Mark: 58)

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## Component List (continued)

DESIGNATION	QTY	DESCRIPTION
N2	1	60V, 4.2A n-channel MOSFET (8 SO) International Rectifier IRF7478
Q1	0	Not installed, transistor (3 SOT23)
R1	1	34k $\Omega$ $\pm$ 1% resistor (0603)
R2, R12	2	10k $\Omega$ $\pm$ 1% resistors (0603)
R3, R21	0	Not installed, resistors (0805)
R4, R8, R22	3	0 $\Omega$ $\pm$ 5% resistors (0805)
R5	1	0.1 $\Omega$ $\pm$ 1%, 500mW sense resistor (1206) IRC/TT Electronics LRC-LR-1206LF-01-R100-F
R6, R19	0	Not installed, resistors (0603)
R7	0	Not installed, resistor (1206)
R9	1	0.04 $\Omega$ $\pm$ 1%, 2W sense resistor (2512) IRC/TT Electronics LRC-LR-2512LF-01-R040-F

DESIGNATION	QTY	DESCRIPTION
R10	1	499 $\Omega$ $\pm$ 1% resistor (0603)
R11	1	232k $\Omega$ $\pm$ 1% resistor (0603)
R13	1	5.1k $\Omega$ $\pm$ 5% resistor (0603)
R14	1	10k $\Omega$ $\pm$ 5% resistor (0603)
R15	1	8.25k $\Omega$ $\pm$ 1% resistor (0603)
R16	1	23.2k $\Omega$ $\pm$ 1% resistor (0603)
R17	1	10k $\Omega$ potentiometer (single turn)
R18	1	Not installed, resistor (0805)
R20	1	100k $\Omega$ $\pm$ 5% resistor (0603)
TP1, TP2	2	PC mini red test points
U1	1	Current control HB LED driver (20 TQFN-EP*) Maxim MAX16834ATP+
—	1	Shunt (JU1)
—	1	PCB: MAX16834 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
Sumida Corp.	847-545-6700	www.sumida.com
Taiyo Yuden	800-348-2496	www.t-yuden.com
TDK Corp.	847-803-6100	www.component.tdk.com
Vishay	402-563-6866	www.vishay.com

**Note:** Indicate that you are using the MAX16834 when contacting these component suppliers.

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## Quick Start

### Required Equipment

Before beginning, the following equipment is needed:

- 7V to 28V, 5A power supply
- Two digital voltmeters
- A series-connected LED string rated at 1A (28V max)
- A current probe to measure LED current

### Procedure

The MAX16834 EV kit is fully assembled and tested. Follow the steps below to verify operation. **Caution: Do not turn on the power supply until all connections are completed.**

- 1) Verify that a shunt is installed at jumper JU1 (linear dimming control).
- 2) Connect the power supply's positive terminal to the VIN PCB pad on the EV kit. Connect the power supply's ground terminal to the PGND PCB pad.
- 3) Connect the digital voltmeters across the VIN 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.
- 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 7V.
- 8) Adjust potentiometer R17 clockwise for the desired LED current.
- 9) Measure the voltage between the LED+ and LED- PCB pads.

## Detailed Description of Hardware

The MAX16834 EV kit demonstrates the MAX16834 current mode HB LED driver IC. The MAX16834 EV kit is configured as a step-up (boost) topology circuit with peak inductor current and average current control for external HB LEDs. The MAX16834 EV kit operates from a DC supply voltage of 7V to 28V and requires up to 5A. The EV kit circuit is configured to deliver up to 1A of current into a series LED string with a maximum forward voltage of 28V.

The EV kit sets the minimum peak inductor current-limit threshold to 5A using resistor R9. The MAX16834 EV kit can be configured for either an analog linear input voltage or digital PWM input signal to control the LED brightness using jumper JU1. The average LED current is set to a maximum of 1A by resistor R5 and can be adjusted using potentiometer R17. A PWMDIM PCB pad is provided for PWM dimming operation of the external LEDs.

The EV kit switching frequency is set to 600kHz using resistor R15 and can also be synchronized to an external clock source by applying a digital signal at the RT/SYNC PCB pad. Refer to the *Internal Oscillator* section in the MAX16834 IC data sheet for information on setting other switching frequencies. This EV kit features a UVLO set to 6.4V using resistors R1 and R2. The EV kit also features an active-low FLT PCB pad to monitor for open or short-circuit LED fault conditions at the LED+ and LED- PCB pads, or an overtemperature IC fault condition.

The MAX16834 EV kit can also be configured for buck-boost operation by changing various components. See the *Reconfiguring the MAX16834 EV Kit for Buck-Boost Operation* section for additional information.

### Undervoltage Lockout (UVLO)

The MAX16834 EV kit's undervoltage lockout threshold is configured to 6.4V using resistors R1 and R2. The UVEN PCB pad can be used to disable the EV kit circuit by connecting UVEN to SGND. To configure the circuit to a different UVLO threshold, refer to the *Setting the UVLO Threshold* section in the MAX16834 IC data sheet.

### Peak Inductor Current-Limit Setting

Current-sense resistor R9 sets the EV kit's minimum peak inductor current limit to 5A. Use the following equation to calculate a new R9 value when reconfiguring the inductor peak current limit:

$$R9 = \frac{250\text{mV}}{(I_{\text{PEAK}} \times 1.25)\text{A}}$$

where 250mV is the MAX16834 minimum peak current-sense threshold,  $I_{\text{PEAK}}$  is the inductor peak current in amps, and R9 is the sense resistor in milliohms.

Refer to the *Peak Current-Sense Resistor (R8)* section in the MAX16834 IC data sheet for additional information on setting the peak current-limit threshold.

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## LED Dimming Operation

Jumper JU1 configures the MAX16834 EV kit for analog linear dimming or PWM dimming control of the external LEDs. Install a shunt across jumper JU1 to control the LED brightness using a linear voltage applied at the MAX16834 REFI pin. Remove the shunt at jumper JU1 to control the LED brightness using a PWM signal applied at the PWMDIM and SGND PCB pads. See Table 1 for jumper JU1 settings for LED dimming operation.

**Table 1. JU1 Jumper Selection**

SHUNT POSITION	PWMDIM PIN	EV KIT DIMMING OPERATION
Installed	Connects to R14/R20 network	Linear dimming control
Not installed	Connects to external PWM signal	PWM dimming control

### Linear Dimming Control

The MAX16834 EV kit offers analog linear dimming of the external LEDs connected between the LED+ and LED- PCB pads. Resistor R5 and potentiometer R17 set the external LEDs' maximum average current to 1A by adjusting the voltage at the MAX16834 REFI input. Vary the MAX16834's REFI voltage using potentiometer R17 to adjust the LEDs' brightness. LED brightness increases when the voltage at REFI is increased and vice versa. The MAX16834 REFI pin voltage can be monitored by placing a voltmeter across the REFI and SGND PCB pads. The LED string dimming current can be adjusted using the following equation:

$$V_{REFI} = 9.9 \times I_{LED} \times R5$$

where  $V_{REFI}$  is the voltage at the REFI PCB pad,  $I_{LED}$  is the LED current in amperes, and R5 is the sense resistor, in ohms, connected between N1's source and the MAX16834 LV pin.

### Digital PWM Dimming Operation

LED dimming can be achieved on the MAX16834 EV kit by applying a digital PWM signal at the EV kit's PWMDIM and SGND PCB pads. Connect a PWM signal with a 1.5V to 5V logic-high level and frequencies from DC to 20kHz. Vary the PWM signal duty cycle to adjust the LEDs' brightness.

### Fault Indicator ( $\overline{FLT}$ )

The MAX16834EV kit features an output pad ( $\overline{FLT}$ ) to monitor the  $\overline{FLT}$  output logic signal.  $\overline{FLT}$  is low when any of the following conditions occur:

- Open-circuit condition across the LED+ and LED- PCB pads

- Short-circuit condition across the LED+ and LED- PCB pads
- MAX16834 IC overtemperature fault condition

When the LED+ voltage drops below the programmed overvoltage set point minus the MAX16834 hysteresis,  $\overline{FLT}$  deasserts. During a short-circuit condition,  $\overline{FLT}$  deasserts when dimming MOSFET N1 is on. The  $\overline{FLT}$  signal is the inverse of the PWMDIM signal during an overtemperature fault condition ( $T_J > 140^\circ\text{C}$ ).

### Output Overvoltage Protection

The maximum voltage on the LED+ pin is limited to 34.7V with respect to LV by a feedback network formed by resistors R11 and R12. When the LED+ to LV voltage difference exceeds the programmed 34.7V threshold, PWM switching is terminated,  $\overline{FLT}$  asserts low, and no further energy is transferred to the load connected between the LED+ and LED- PCB pads. Refer to the *Setting the Overvoltage Threshold* section in the MAX16834 IC data sheet for setting the overvoltage threshold.

### Optional Automotive Load Dump Protection (Boost Mode Only)

The MAX16834 EV kit provides PCB component footprints for an optional load dump protection circuit (C19, D5, Q1, and R21). This limits the MAX16834 IN pin voltage below its absolute maximum 30V rating when operating the EV kit circuit in boost-mode operation under load dump conditions.

When configuring the MAX16834 EV kit for load dump operation, remove resistor R3. NPN transistor Q1 should have a 75V/100mA (min) rating. Zener diode D5 should have a 24V/100mA rating.

### Reconfiguring the MAX16834 EV Kit for Buck-Boost Operation

The MAX16834 EV kit can be reconfigured for buck-boost operation by removing and adding the following components:

- Remove resistors R4 and R8.
- Install a 0 $\Omega$  resistor at R3.
- Install components at D1 (6V zener) and R7 (2.7k $\Omega$ ).

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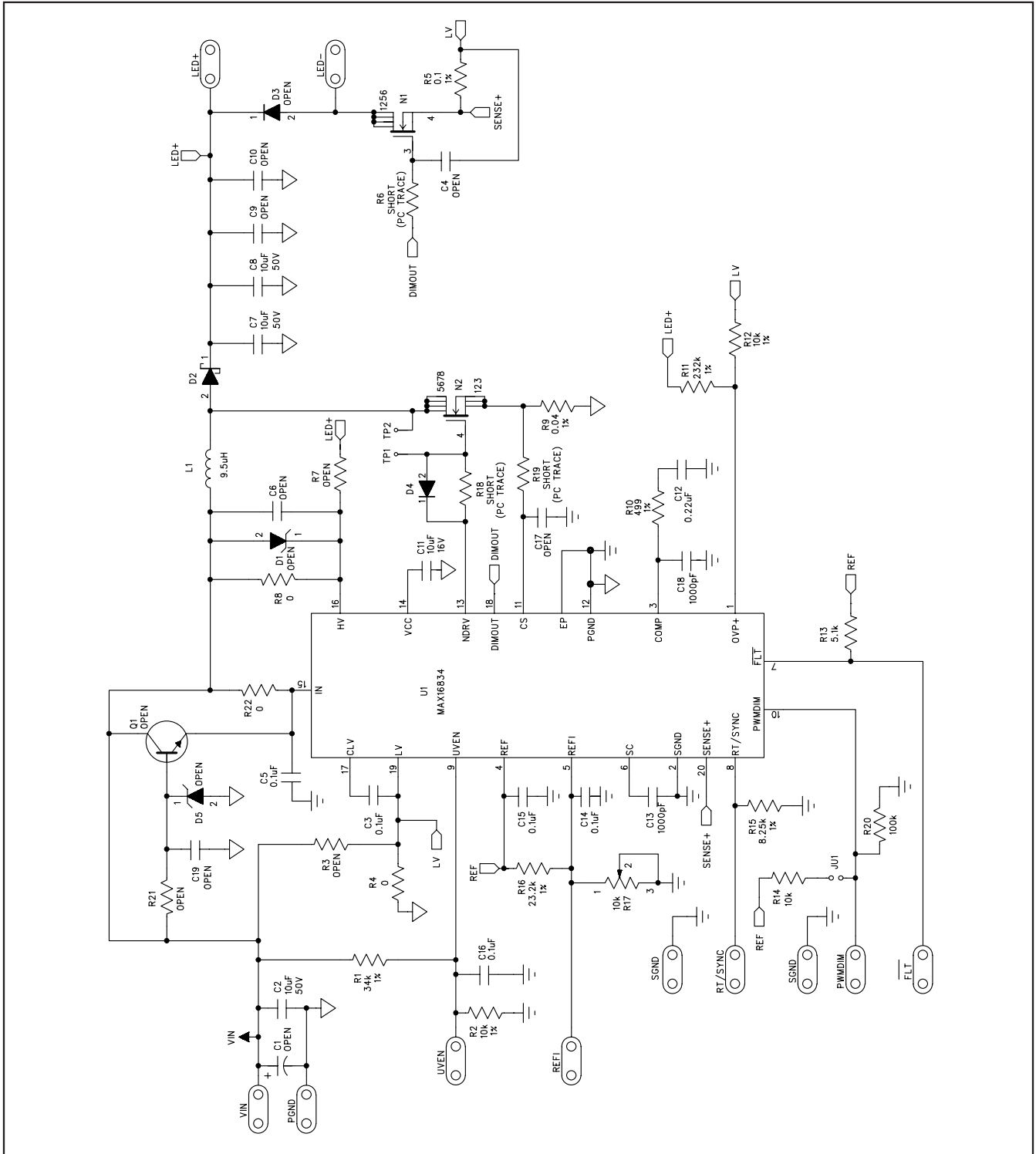


Figure 1. MAX16834 EV Kit Schematic

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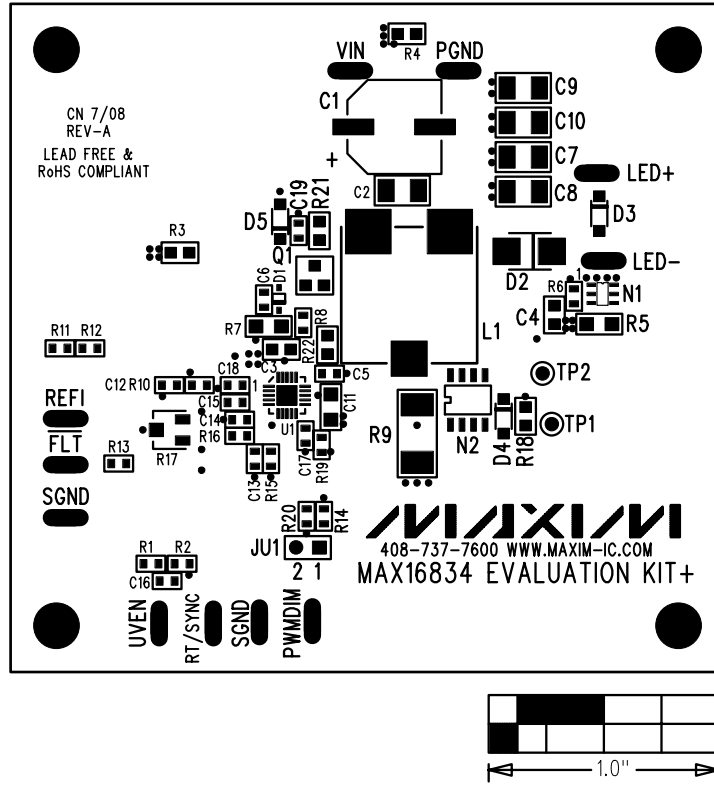


Figure 2. MAX16834 EV Kit Component Placement Guide—Component Side

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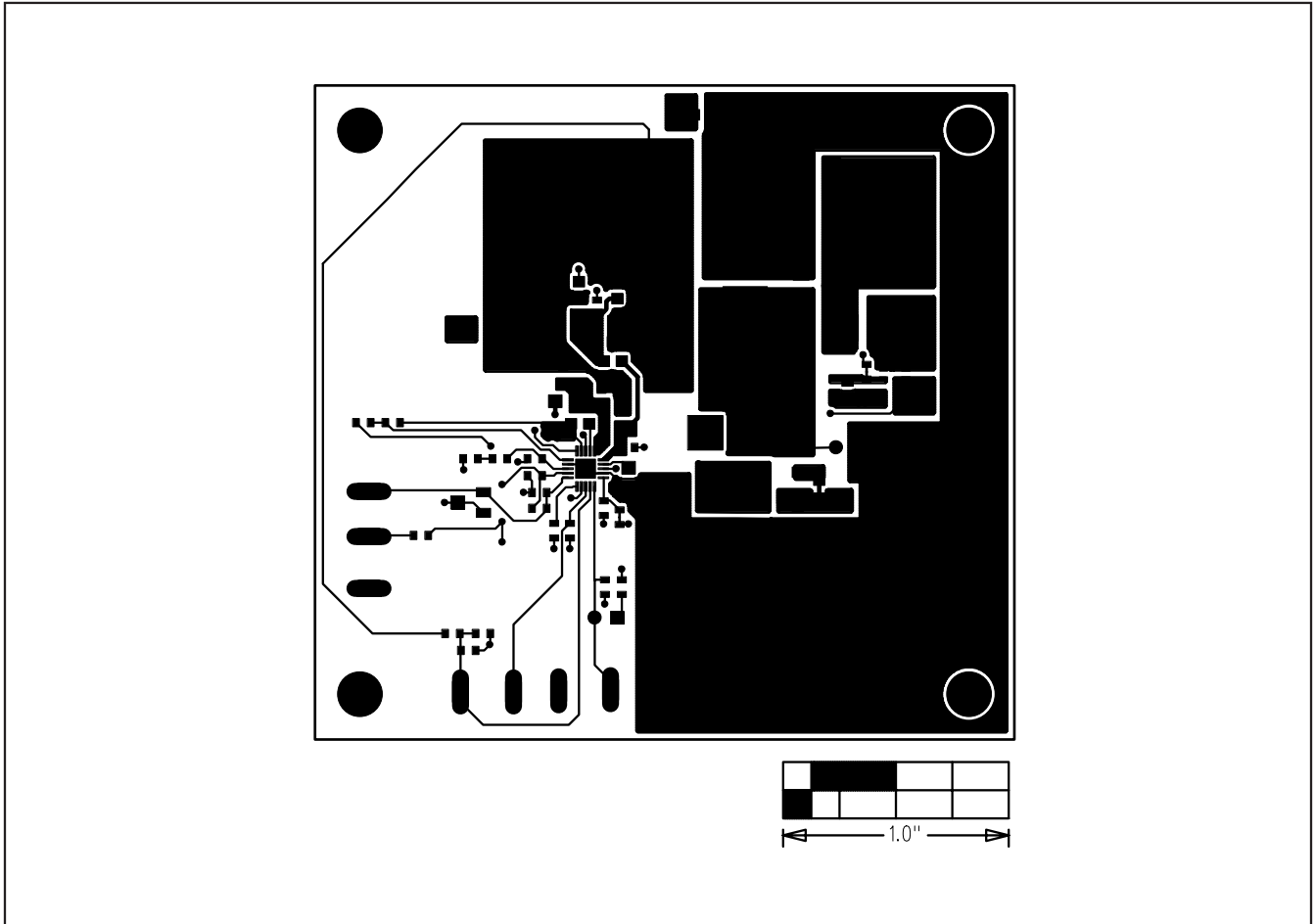


Figure 3. MAX16834 EV Kit PCB Layout—Component Side

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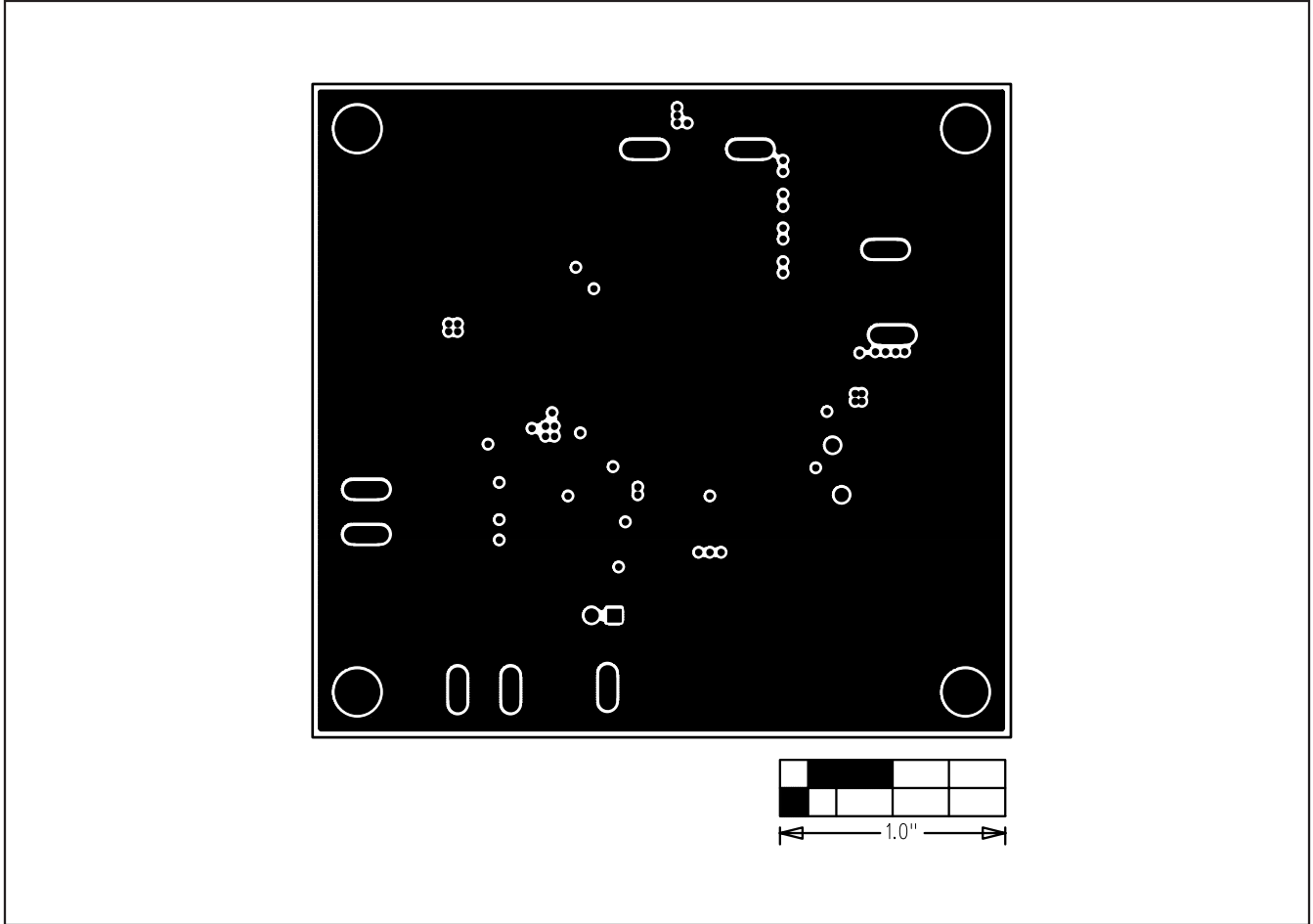


Figure 4. MAX16834 EV Kit PCB Layout—GND Layer 2



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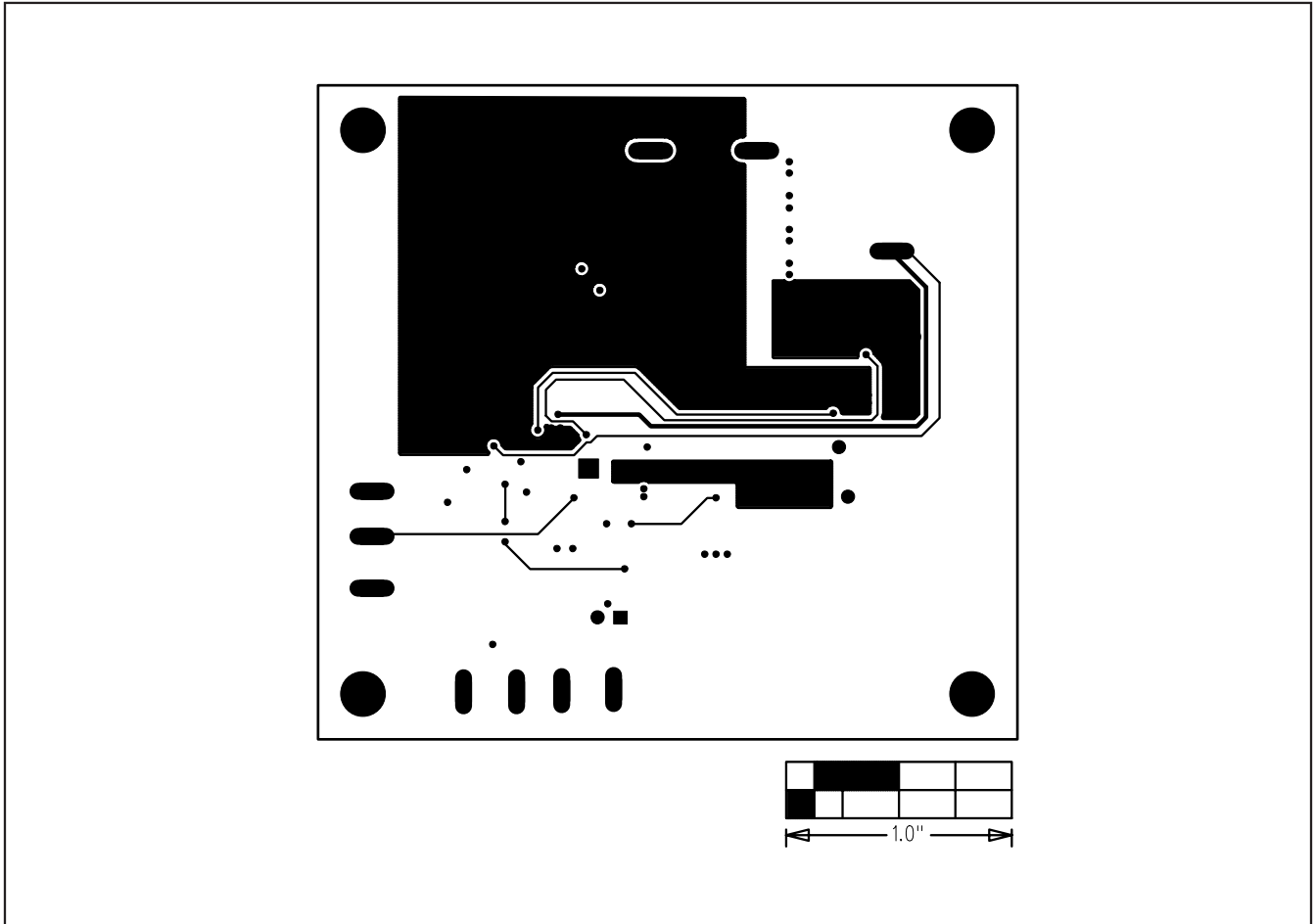


Figure 5. MAX16834 EV Kit PCB Layout—VCC Layer 3

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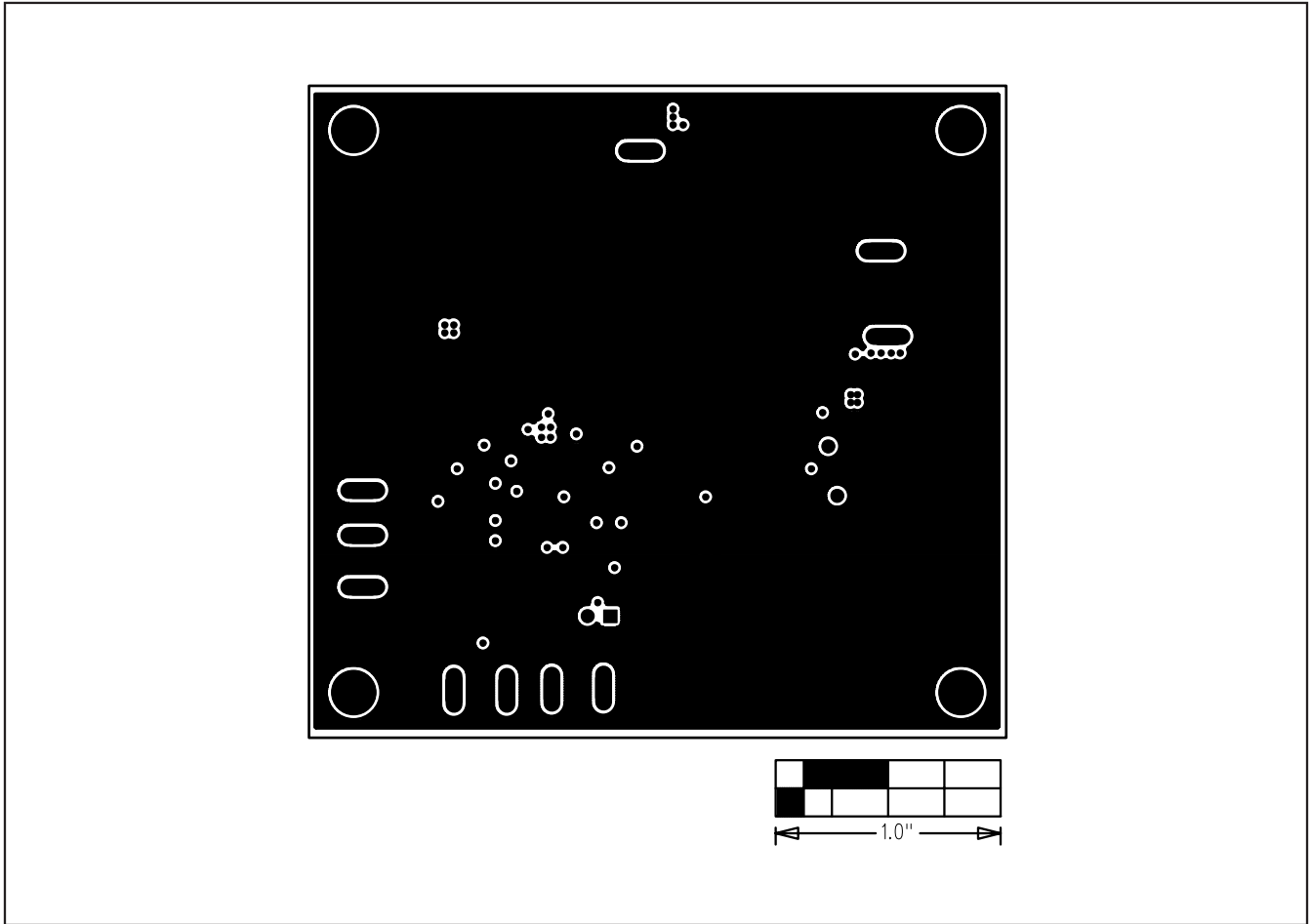


Figure 6. MAX16834 EV Kit PCB Layout—Solder Side

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