19-4364; Rev 0; 11/08

# MAX8857A Evaluation Kit

## General Description

The MAX8857A evaluation kit (EV kit) is a fully assembled and tested PCB for evaluating the MAX8857A power-management IC (PMIC). The MAX8857A PMIC is ideal for use in digital still cameras (DSCs) and digital video cameras (DVCs). The MAX8857A improves performance, component count, and board space utilization compared to currently available solutions for 2 AA cell and dual-battery designs. On-chip power MOSFETs provide up to 95% efficiency for critical power supplies. The CCD inverter can operate directly from 2 AA/NiMH batteries without the use of any additional external components.

## Ordering Information

| PART | TYPE |
|---|---|
| MAX8857AEVKIT+ | EV Kit |

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

## Features

- **95% Efficient Synchronous-Rectified DC-DC Converters**
- **90% Efficient Boost-Buck Operation**
- **Up to 85% Efficient, DC-DC Converters for CCD, LCD, WLED, and/or OLED**
- **Inverter Operates Directly from 2 AA Batteries**
- **Internal Compensation on All Channels**
- **True Shutdown™ on All Step-Up Converters**
- **Overload Protection**
- **Startup into Short Protection**
- **Soft-Start for Controlled Startup Current**
- **100% Duty Cycle on Step-Down Converters**
- **Regulated Current Output for Up to 4 White LEDs**
- **PWM Dimming of WLED Current**
- **Adjustable LED Overvoltage Protection Up to 27V**
- **Transformerless Inverting Converter for CCD**
- **2MHz ±2.5% Switching Frequency**
- **1µA Shutdown Supply Current**
- **CCD Voltage Sequencing**
- **All Internal Power MOSFETs**
- **SDOK Power-OK Indicator**
- **Lead-Free and RoHS Compliant**
- **Fully Assembled and Tested**

**Evaluates: MAX8857A**

## Component List

| DESIGNATION | QTY | DESCRIPTION |
|---|---|---|
| C1–C4, C6, C7 | 6 | 22µF ±10%, 6.3V X5R ceramic capacitors (1206)<br>AVX 12066D226K<br>KEMET C1206C226K9P<br>Taiyo Yuden JMK316BJ226KL or equivalent |
| C5, C8, C9, C10, C12, C13 | 6 | 10µF ±10%, 6.3V X5R ceramic capacitors (0805)<br>Murata GRM219R60J106KE<br>Taiyo Yuden JMK212BJ106KG<br>TDK C2012X5R0J106K or equivalent |
| C11 | 1 | 1µF ±10%, 6.3V X5R ceramic capacitor (0603)<br>TDK C1608X5R0J105K<br>Murata GRM188R60J105K |
| C14, C16, C18 | 3 | 1µF ±10%, 6.3V X5R ceramic capacitors (0402)<br>Murata GRM155R60J105K |
| C15 | 1 | 3.3µF ±20%, 16V NeoCapacitor capacitor (1206)<br>NEC/TOKIN PSLA1C335M |

*True Shutdown is a trademark of Maxim Integrated Products, Inc.*

# MAX8857A Evaluation Kit

## Component List (continued)

| DESIGNATION | QTY | DESCRIPTION |
|---|---|---|
| C17 | 1 | 2.2µF ±10%, 25V X5R ceramic capacitor (0805)<br>Taiyo Yuden TMK212BJ225K |
| C19 | 1 | 10µF ±10%, 16V X5R ceramic capacitor (0805)<br>Taiyo Yuden EMK212BJ106M<br>Murata GRM21BR61C106K |
| C20, C21 | 2 | 0.1µF ±10%, 10V X5R ceramic capacitors (0402)<br>Taiyo Yuden LMK105BJ104KV<br>TDK C1005X5R1C104K |
| C22, C23 | 0 | Not installed, capacitors (0402) |
| C24 | 1 | 100pF ±10%, 50V C0G ceramic capacitor (0402)<br>Taiyo Yuden UMK105CG101KV |
| D1, D2, D3 | 3 | 40V, 500mA Schottky diodes (SOD123)<br>Central Semi CMHSH5-4 |
| D4, D5 | 2 | White surface-mount LEDs<br>Nichia NCSW215T |
| D6, D7 | 0 | Not installed—PCB short |
| JU1, ONBST, ONINV, ONLED, ONM, ONSD, ONSU, ONZ | 8 | 2-pin headers, 0.1in<br>Sullins PEC36SAAN or equivalent |
| L1 | 1 | 2µH, 2.47A power inductor (6.3mm x 6.2mm x 2mm)<br>TOKO A918CY-2R0M (D62LCB series) |
| L2 | 1 | 1µH, 2.3A power inductor (4.1mm x 4.1mm x 1.2mm)<br>TOKO A1101AS-1R0M (DEA4012CK series) |

| DESIGNATION | QTY | DESCRIPTION |
|---|---|---|
| L3, L4, L5 | 3 | 4.7µH, 0.95A power inductors (3mm x 3.2mm x 1.8mm)<br>TOKO 1072AS-4R7M (DE2818C series) |
| L6 | 1 | 2.2µH, 1.35A power inductor (3mm x 3.2mm x 1.8mm)<br>TOKO 1072AS-2R2M (DE2818C series) |
| L7 | 1 | 10µH, 0.65A power inductor (3mm x 3.2mm x 1.8mm<br>TOKO 1072AS-100M (DE2818C series) |
| R1 | 1 | 402kΩ ±1% resistor (0402) |
| R2, R6, R8, R10, R12, R14, R16 | 7 | 100kΩ ±1% resistors (0402) |
| R3 | 1 | 23.2kΩ ±1% resistor (0402) |
| R4 | 1 | 10kΩ ±1% resistor (0402) |
| R5 | 1 | 80.6kΩ ±1% resistor (0402) |
| R7 | 1 | 150kΩ ±1% resistor (0402) |
| R9 | 1 | 1.6MΩ ±1% resistor (0402) |
| R11 | 1 | 1.4MΩ ±1% resistor (0402) |
| R13 | 1 | 604kΩ ±1% resistor (0402) |
| R15 | 1 | 10Ω ±1% resistor (0402) |
| R17 | 1 | 100Ω ±1% resistor (0402) |
| U1 | 1 | Power-management IC (PMIC) (40 TQFN-EP*)<br>Maxim MAX8857AETL+ |
| — | 1 | PCB: MAX8857A Evaluation Kit+ |

*EP = Exposed pad.

## Component Suppliers

| SUPPLIER | PHONE | WEBSITE |
|---|---|---|
| AVX Corporation | 843-946-0238 | www.avxcorp.com |
| Central Semiconductor Corp. | 631-435-1110 | www.centralsemi.com |
| KEMET Corp. | 864-963-6300 | www.kemet.com |
| Murata Electronics North America, Inc. | 770-436-1300 | www.murata-northamerica.com |
| NEC/TOKIN America, Inc. | 408-324-1790 | www.nec-tokinamerica.com |
| Nichia Corp. | 248-352-6575 | www.nichia.com |
| Sullins Electronics Corp | 760-744-0125 | www.sullinselectronics.com |
| Taiyo Yuden | 800-348-2496 | www.t-yuden.com |
| TDK Corp. | 847-803-6100 | www.component.tdk.com |
| TOKO America, Inc. | 847-297-0070 | www.tokoam.com |

***Note:*** *Indicate that you are using the MAX8857A when contacting these component suppliers.*

## Quick Start

### Recommended Equipment

Before beginning, the following equipment is needed:

- Variable 6V power supply
- Voltmeters
- Loads

### Procedure

The MAX8857A EV kit is a fully assembled and tested surface-mount board. Follow the steps below to verify board operation:

1) Enable outputs SU, MAIN, SD, SDZ, CCDBST, CCDINV, and LEDBST by installing shunts on jumpers ONSU, ONM, ONSD, ONZ, ONBST, ONINV, and ONLED, respectively.
2) Verify that the shunt of JU1 is installed to connect the LED string to the LEDBST converter.
3) Preset the power supply to 2.4V. Turn the power supply off. **Caution: Do not turn on the power supply until all connections are completed.**
4) Connect the 2.4V power supply across the BATT and GND pads.
5) Turn on the 2.4V power supply.
6) Verify that the voltage across the VSU and GND pads is 5V. Connect a load, if desired, from VSU to GND. See Table 1 for output current.
7) Verify that the voltage across the VM and GND pads is 3.3V. Connect a load, if desired, from VM to GND. See Table 1 for output current.
8) Verify that the voltage across the VSDZ and GND pads is 2.5V. Connect a load, if desired, from VSDZ to GND. See Table 1 for output current.
9) Verify that the voltage across the VSD and GND pads is 1.8V. Connect a load, if desired, from VSD to GND. See Table 1 for output current.
10) Verify that the voltage across the VCCDBST and GND pads is 15V. Connect a load, if desired, from VCCDBST to GND. See Table 1 for output current.
11) Verify that the voltage across the VCCDINV and GND pads is -7.5V. Connect a load, if desired, from VCCDINV to GND. See Table 1 for output current.
12) Verify that the white LEDs (D4, D5) are on.

# MAX8857A Evaluation Kit

## Detailed Description of Hardware

The MAX8857A EV kit accepts inputs from a variety of sources including 1-cell Li+ batteries, 2-cell alkaline or NiMH batteries, and systems designed to accept either battery type. The MAX8857A provides seven DC-DC converter channels to build a multiple-output DSC power-supply system: SU, MAIN, SDZ, SD, CCDBST, CCDINV, and LEDBST. Table 1 lists the output voltages and currents for each channel. The EV kit incorporates jumpers ONSU, ONM, ONZ, ONSD, ONBST, ONINV, and ONLED to enable or disable each channel, respectively. Table 2 shows the details of the jumper functions.

### SU Step-Up Converter (VSU)

The SU step-up converter (VSU) powers the internal circuitry of the MAX8857 and must reach its regulation voltage (5V) before any other output is allowed to turn on. Install the shunt on jumper ONSU to enable VSU. Without VSU enabled, all outputs are shut down and the IC is in a low-current shutdown mode.

### MAIN Step-Up Converter (VM)

The MAIN step-up converter (VM) is set to 3.3V. To enable VM, install a shunt on jumper ONM. To disable VM, remove the shunt.

### SD Step-Down Converter (VSD)

The SD step-down converter (VSD) is set to 1.8V. To enable VSD, install a shunt on jumper ONSD. To disable VSD, remove the shunt.

### SDZ Step-Down Converter (VSDZ)

The SDZ step-down converter (VSDZ) is set to 2.5V. To enable VSDZ, install a shunt on jumper ONZ. To disable VSDZ, remove the shunt.

### CCDBST Step-Up Converter (VCCDBST)

The CCDBST step-up converter (VCCDBST) is set to 15V. To enable VCCDBST, install a shunt on jumper ONBST. To disable VCCDBST, remove the shunt.

### CCDINV Inverting Converter (VCCDINV)

The CCDINV inverting converter (VCCDINV) is set to -7.5V. To enable VCCDINV, install a shunt on jumper ONINV. To disable VCCDINV, remove the shunt.

### LED Boost Converter (VLEDBST)

The LEDBST step-up converter (VLEDBST) is capable of driving up to 4 white LEDs in series at up to 30mA. The EV kit comes with two surface-mounted white LEDs installed and is configured to drive the LEDs at a regulated 25mA. To protect against an open LED string, the overvoltage protection limits the maximum output voltage to 21.25V.

To enable VLEDBST, install a shunt on jumper ONLED. To disable VLEDBST, remove the shunt. To adjust the LED brightness or overvoltage protection, see the *Adjusting the Maximum LED Brightness and Overvoltage Protection Threshold* (*OVLED*) and *LED Converter PWM Dimming* sections.

## Customizing the MAX8857A Evaluation Kit

### Adjusting the SU Step-Up Converter (VSU)

The SU step-up converter (VSU) is adjustable from 3.3V to 5V using the following procedure:

1) Choose R2 to be 100kΩ or less.
2) Solve for R1 using:
   $R1 = R2 \times [(V_{SU}/1.01V) - 1]$
3) Install resistors R1 and R2.

**Table 1. Default EV Kit Output Voltages and Output Current**

| OUTPUT | VOLTAGE (V) | CURRENT (mA) |
|---|---|---|
| SU | 5 | 500 |
| MAIN | 3.3 | 300 |
| SD | 1.8 | 250 |
| SDZ | 2.5 | 200 |
| CCDBST | 15 | 30 |
| CCDINV | -7.5 | 80 |
| LEDBST | — | 25 |

**Table 2. Jumper Functions**

| LABEL (JUMPER) | OUTPUT | SHUNT ON | SHUNT OFF |
|---|---|---|---|
| ONSU | SU | On* | Off |
| ONM | MAIN | On* | Off |
| ONSD | SDZ | On* | Off |
| ONZ | SD | On* | Off |
| ONBST | CCDBST | On* | Off |
| ONINV | CCDINV | On* | Off |
| ONLED | LEDBST | On* | Off |

**Default position.*

### Adjusting the MAIN Step-Up Converter (VM)

The input to the MAIN step-up converter (VM) is connected to BATT. VM is adjustable from 3.3V to $V_{VSU}$ using the following procedure:

1) Choose R4 to be 10kΩ or less.
2) Solve for R3 using:

   $R3 = R4 \times [(V_M/1.01V) - 1]$
3) Install resistors R3 and R4.

### Configuring the SD Step-Down Converter (VSD)

The input to the SD step-down converter (VSD) is connected to BATT by default. To connect the PVSD input to VSU, cut the trace shorting JU4, and short circuit JU5.

VSD is adjustable from 1.01V to $V_{BATT}$ (or $V_{VSU}$) using the following procedure:

1) Choose R6 to be 100kΩ or less.
2) Solve for R5 using:

   $R5 = R6 \times [(V_{SD}/1.01V) - 1]$
3) Install resistors R5 and R6.

### Adjusting the SDZ Step-Down Converter (VSDZ)

The input to the SDZ step-down converter (VSDZ) is connected to VSU. VSDZ is adjustable from 1.01V to $V_{VSU}$ using the following procedure:

1) Choose R8 to be 100kΩ or less.
2) Solve for R7 using:

   $R7 = R8 \times [(V_{SDZ}/1.01V) - 1]$
3) Install resistors R7 and R8.

### Adjusting the CCDBST Step-Up Converter (VCCDBST)

The input to the CCDBST step-up converter (VCCDBST) is connected to BATT. The CCDBST converter cannot be powered from $V_{VSU}$. VCCDBST is adjustable from $V_{BATT}$ to 18V using the following procedure:

1) Choose R12 to be 100kΩ or less.
2) Solve for R11 using:

   $R11 = R12 \times [(V_{CCDBST}/1.02V) - 1]$
3) Install resistors R11 and R12.

### Configuring the CCDINV Inverting Converter (VCCDINV)

The input to the CCDINV inverting converter (VCCDINV) is connected to BATT by default. To connect the PVINV input to VSU, cut the trace shorting JU2, and short-circuit JU3.

To adjust the CCDINV output voltage, use the following procedure:

1) Choose R14 to be 100kΩ or less.
2) Solve for R13 using:

   $R13 = R14 \times (|V_{CCDINV}|/1.25V)$
3) Install resistors R13 and R14.

**Note:** for moderate to heavy loading on the CCDINV converter, adding a 100pF capacitor in parallel with R14 helps improve switching waveforms.

### Adjusting the Maximum LED Brightness and Overvoltage Protection Threshold (OVLED)

The overvoltage protection threshold (OVLED) for the LEDs is adjustable. To ensure that the LEDs are current regulated, VOVP must be set higher than the maximum forward-voltage drop of the LED string plus 0.25V ($V_{FBLED}$). Use the following procedure to set the overvoltage protection:

1) Choose R10 to be 100kΩ or less.
2) Solve for R9 using:

   $R9 = R10 \times [(V_{OVLED}/1.25V) - 1]$
3) Install resistors R9 and R10.

The MAX8857A uses an external sense resistor (R15) to program the maximum LED current. The MAX8857A regulates FBLED to 0.25V (typ) for full-scale output current. Calculate R15 (in ohms) using the following equation:

$$R15 = \frac{0.25V}{I_{LED(MAX)}}$$

where $I_{LED(MAX)}$ is the maximum LED current in amps. Maximum LED current is programmed to 25mA using a 10Ω resistor.

### LED Converter PWM Dimming

The ONLED input can also be driven by a logic-level PWM signal to control LED brightness. The minimum PWM frequency is 30kHz, where 0% duty cycle corresponds to zero current and 50% duty cycle corresponds to full current. With a PWM signal applied at ONLED, the FBLED voltage is regulated to 0.5V x D, where D is the duty cycle of the PWM signal. Drive ONLED low for more than 128μs to turn off the LEDBST converter.

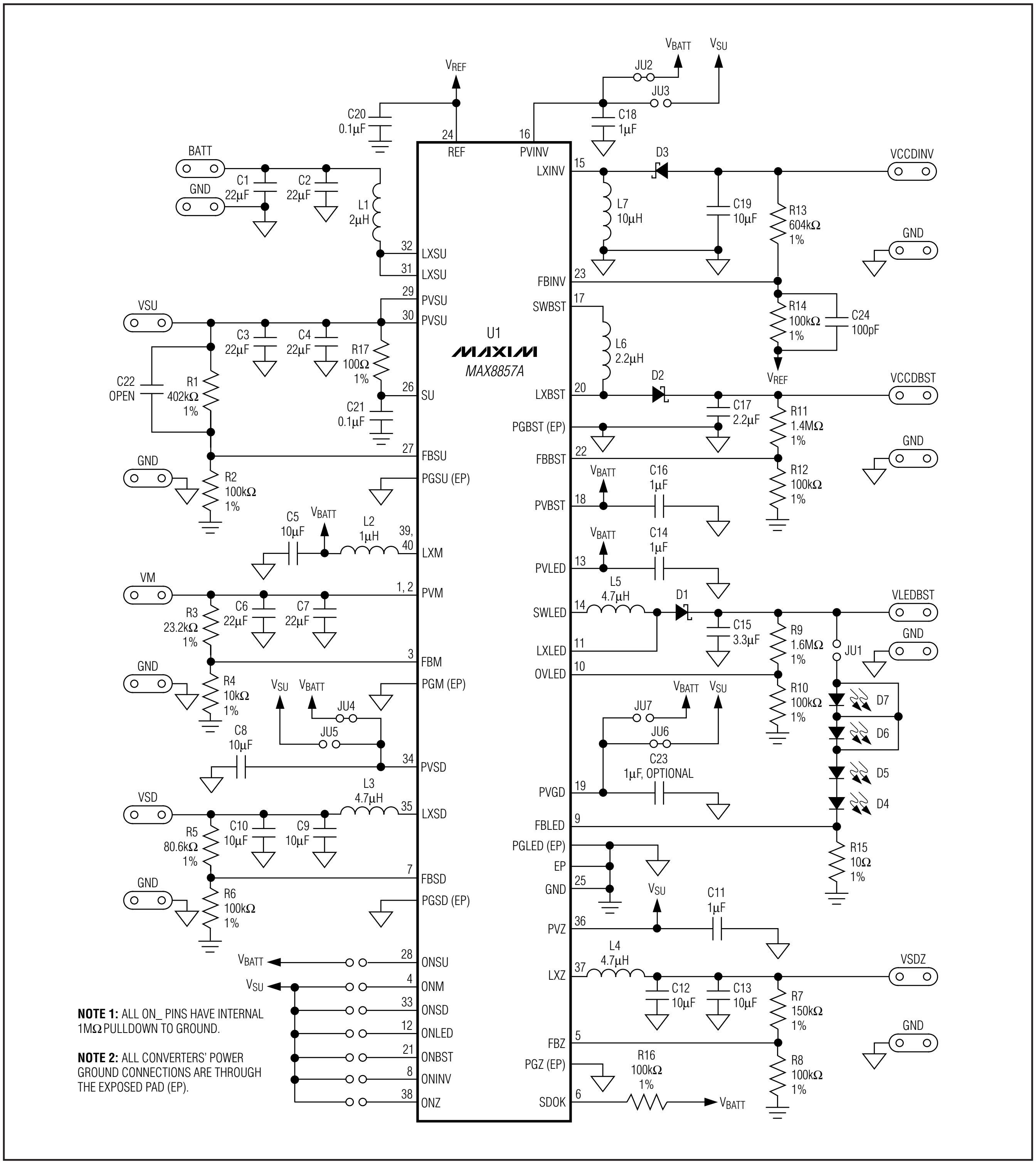


*Figure 1. MAX8857A EV Kit Schematic*

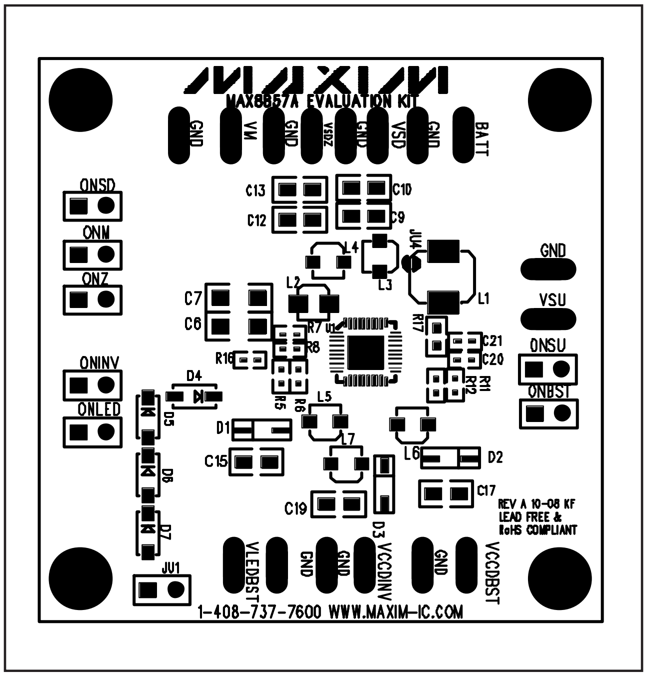


Figure 2. MAX8857A EV Kit Component Placement Guide—Top Layer

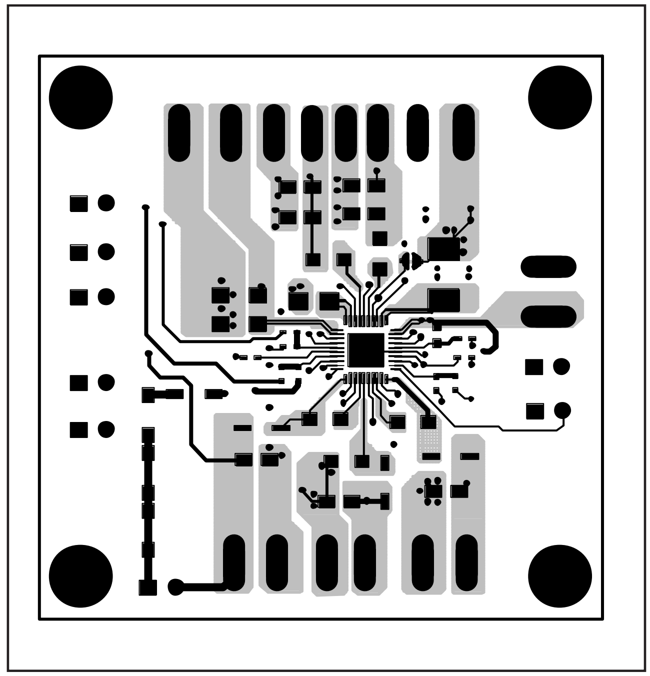

Figure 4. MAX8857A EV Kit PCB Layout—Top Layer

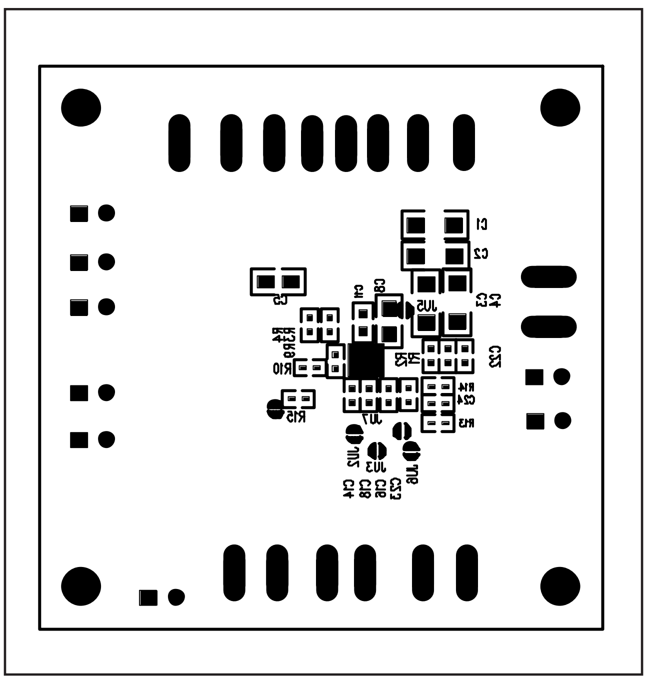

Figure 3. MAX8857A EV Kit Component Placement Guide—Bottom Layer

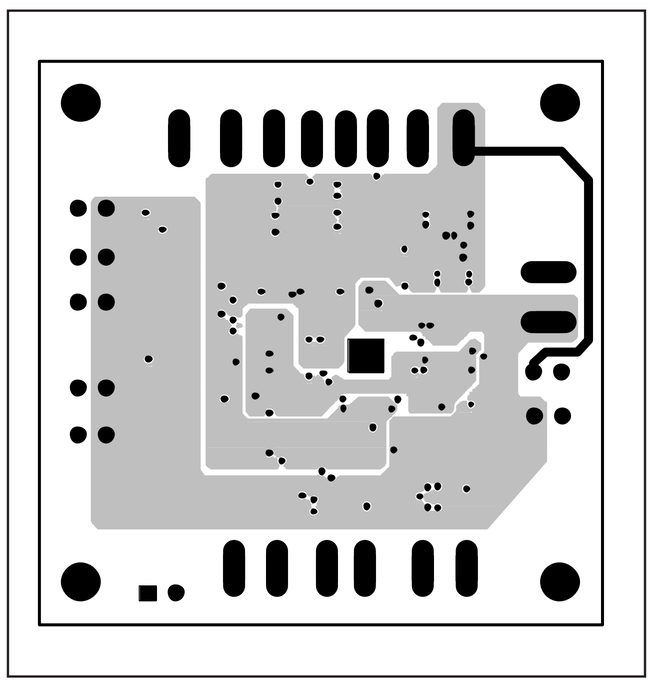

Figure 5. MAX8857A EV Kit PCB Layout—Inner Layer 2

# MAX8857A Evaluation Kit

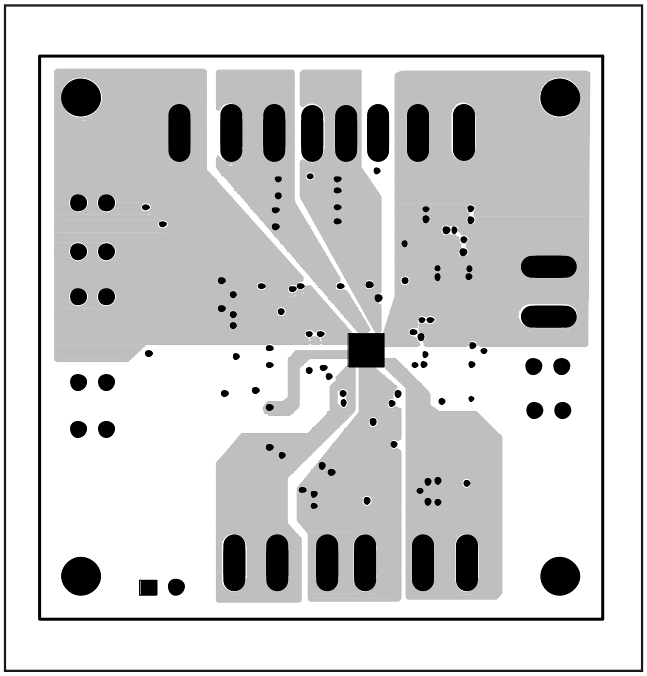

Figure 6. MAX8857A EV Kit PCB Layout—PGND Layer 3

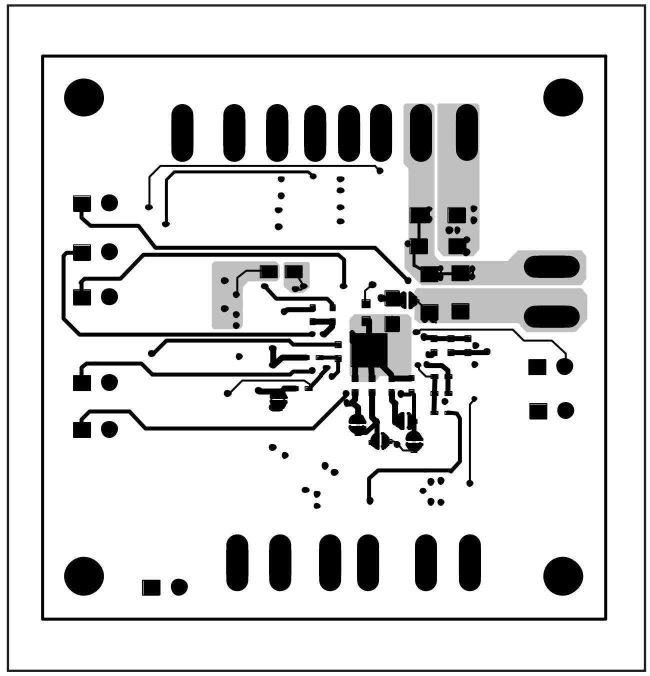

Figure 7. MAX8857A EV Kit PCB Layout—Bottom Layer