19-6219; Rev 0; 2/12

MAX8969 Evaluation Kit
Evaluates: MAX8969

General Description

The MAX8969 evaluation kit (EV kit) is a fully assembled and tested PCB for evaluating the MAX8969 IC. The IC is a simple 1A step-up converter in a small package that can be used in any single-cell Li-ion application. This IC provides protection features such as input undervoltage lockout, short circuit, and overtemperature shutdown.

The IC transitions to skip mode seamlessly under light-load conditions to improve efficiency. Under these conditions, switching occurs only as needed, reducing switching frequency and supply current to maintain high efficiency.

When the input voltage is sufficient to drive the load, the IC can be operated in track mode or automatic track mode (ATM). In track mode, the p-channel MOSFET acts as a current-limited load switch and quiescent current is as low as 30µA under a no-load condition. In ATM mode, the p-channel MOSFET acts as a current-limited load switch and quiescent current is as low as 60µA under a no-load condition. In ATM mode, the internal boost circuitry is enabled, allowing for fast transitions into boost mode.

Features

- **Compact Layout, Small External Components**
- **Up to 1A Output Current**
- **2.5V to 5.5V Input Voltage Range**
- **Over 90% Efficiency with Internal Synchronous Rectifier**
- **1A Current-Limited Track Mode**
- **Automatic Track Mode**
- **Proven PCB Layout**
- **Fully Assembled and Tested**

***Ordering Information* appears at end of data sheet.**

Component List

DESIGNATION	QTY	DESCRIPTION
C1	1	1µF ±10%, 6.3V X5R ceramic capacitor (0402) TDK C1005X5R0J105K Murata GRM155R60J105K
C2*	1	330µF ±20%, 10V X5R tantalum capacitor (R Case) Vishay Sprague 595D337X0010R2T
C3	1	22µF ±10%, 6.3V X5R ceramic capacitor (0603) Taiyo Yuden JMK107BBJ226MA Samsung CL10A226MQ8NRNE
C4	1	10µF ±20%, 6.3V X5R ceramic capacitor (0402) Taiyo Yuden JMK105CBJ106MV
C5	1	22µF ±10%, 6.3V X5R ceramic capacitor (0805) TDK C2012X5R0J226K
JU1, JU2	2	3-pin headers, 0.1in centers Digi-Key S1012E-36-ND
L1	1	1µH, 1.35A, 85mΩ inductor (2.5mm x 2.0mm x 1.2mm) TOKO MDT2520-CN1R0M
U1**	1	Step-up converter for handheld applications (9 WLP) Maxim MAX8969EWL37+T
—	1	PCB: MAX8969EVKIT#

**For the EV kit only. For actual input capacitor selection, refer to the MAX8969 IC data sheet.*

***Output voltage range is 3.3V to 5V. Contact the factory for other voltage options and availability. The EV kit comes with the 3.7V option only.*

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Digi-Key Corp.	800-344-4539	www.digikey.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
Taiyo Yuden	800-348-6100	www.t-yuden.com
TDK Corp.	847-803-6100	www.component.tdk.com
TOKO America, Inc.	847-297-0070	www.tokoam.com
Vishay	402-563-6325	www.vishay.com

Note: *Indicate that you are using the MAX8969 when contacting these component suppliers.*

Quick Start

Recommended Equipment

- MAX8969 EV kit
- 6V, 3A power supply (PS1)
- Two digital multimeters (DMM1, DMM2)
- 1A electronic load
- User-supplied cables

Procedure

The EV kit is a fully assembled and tested surface-mount board. Use the steps below to set up and verify the IC and board operation:

1) Verify that the jumpers on the EV kit are configured as shown in Table 1.
2) Set the electronic load to 1A and turn off.
3) Set the power supply (PS1) to 2.6V and turn off.
4) Connect the test fixture cable VIN to the positive terminal of PS1.
5) Connect the test fixture cable GND to the negative terminal of PS1.
6) Connect the positive terminal of DMM1 to the test fixture cable VIN.
7) Connect the negative terminal of DMM1 to the test fixture cable GND.
8) Connect the test fixture cable VOUT to the postive terminal of the electronic load.
9) Connect the test fixture cable GND1 to the negative terminal of the electronic load.
10) Connect the positive terminal of DMM2 to the test fixture cable VOUT.
11) Connect the negative terminal of DMM2 to the test fixture cable GND1.
12) Go to the *EV Kit Test Procedure* section and follow the procedure.

Table 1. Default Jumper Settings

JUMPER	DEFAULT SHUNT POSITION
JU1	1-2
JU2	1-2

EV Kit Test Procedure

1) Turn on the power supply (PS1).
2) Verify that the voltage read by DMM1 is approximately 2.6V.
3) Verify that the voltage read by DMM2 is approximately 3.7V.
4) Sweep PS1 down to 2.5V. Verify that the voltage read by DMM2 is approximately 3.7V.
5) Turn on the electronic load.
6) Verify that the voltage read by DMM2 is approximately 3.47V.
7) Sweep PS1 up to 3.2V. Verify that the voltage read by DMM2 is approximately 3.51V.
8) Turn off electronic load.
9) Switch jumpers JU1 and JU2 from pins 1-2 to 2-3 to shut down the part.
10) Switch JU2 from pins 2-3 to 1-2.
11) Set the power supply (PS1) to 3.6V and verify that the voltage read by DMM1 is approximately 3.6V.
12) Verify that the voltage read by DMM2 is approximately 3.6V.
13) Turn on the electronic load.
14) Verify that the voltage read by DMM2 is approximately 3.43V
15) Sweep PS1 up to 5.5V. Verify that the voltage read by DMM2 is approximately 5.36V.
16) After completion, switch JU1 and JU2 from pins 1-2 to 2-3.
17) Disconnect all test leads from the EV kit. Testing is complete.

Detailed Description of Hardware

The MAX8969 EV kit evaluates the MAX8969 step-up DC-DC switching converter that utilizes a fixed-frequency PWM architecture with True Shutdown™. With an advanced voltage-positioning control scheme and high 3MHz switching frequency, the IC is inexpensive to implement and compact using only a few small easily obtained external components. The IC is highly efficient with an internal switch and synchronous rectifier. Shutdown typically reduces the quiescent current to 1µA (typ). Low quiescent current and high efficiency make this device ideal for powering portable equipment.

The step-up converter typically generates a 3.7V output voltage from battery input voltage ranging from 2.5V to 3.5V. The input current limit is set to 2.6A to guarantee delivery of a 1A, 3.7V output from a 2.5V input supply.

Automatic Track Mode

Automatic track mode (ATM) is entered when an internal comparator signals that the input voltage has exceeded the ATM threshold. The ATM threshold is 95% of the output-voltage target. At this point, the IC enters automatic track mode, with the pMOS switch turned on, regardless of the status of the TREN. Note that EN must be high to enable ATM mode. This behavior is summarized in Table 2.

Fault Protection

In track, ATM, and boost modes, the IC has protection against overload and overheating.

- In track mode/ATM, current is limited to prevent excessive inrush current during soft-start and to protect against overload conditions. If the die temperature exceeds +165°C in track/ATM mode, the switch turns off until the die temperature has cooled to +145°C.
- In boost mode, if the inductor current exceeds 2.6A during each 3MHz switching cycle, the n-channel MOSFET is shut off and the p-channel MOSFET is switched on. The end result is that LX current is regulated to 2.6A or less. A 2.6A inductor current is a large enough current to guarantee a 1A output load current under all intended operating conditions. The IC can operate indefinitely while regulating the inductor current to 2.6A or less.

However, if a short circuit or extremely heavy load is applied to the output, the output voltage decreases since the inductor current is limited to 2.6A.

If the output voltage decreases to less than 72% of the regulation voltage target, a short circuit is assumed and the IC returns to the shutdown state.

The IC then attempts to start up if the output short is removed. Even if the output short persists indefinitely, the IC's thermal protection ensures that the die is not damaged.

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

Table 2. Modes of Operation

V_{IN} COMPARATOR	EN	TREN	MODE
X	0	0	True Shutdown
X	0	1	Track
0	1	0	Boost
0	1	1	Boost
1	1	X	Automatic track mode

X = Don't care.

True Shutdown

During operation in boost mode, the p-channel MOSFET prevents current from flowing from OUT_ to LX_. In all other modes of operation, it is desirable to block current flowing from LX_ to OUT_. True Shutdown prevents current from flowing from LX_ to OUT_ while the IC is shut down by reversing the internal body diode of the p-channel MOSFET. This feature is also active during track mode, allowing current limit to function as anticipated.

Upon leaving boost mode, the p-channel MOSFET continues to prevent current from flowing from OUT_ to LX_ until OUT_ and IN are approximately the same voltage. After this condition has been met, track mode and shutdown operate normally.

Thermal Considerations

In most applications, the IC does not dissipate much heat due to its high efficiency. But in applications where the IC runs at high ambient temperature with heavy loads, the heat dissipated might cause the temperature to exceed the maximum junction temperature of the part. If the junction temperature reaches approximately +165°C, the thermal overload protection is activated.

The IC's maximum power dissipation depends on the thermal resistance of the IC package and circuit board. The power dissipated (P_D) in the device is:

$$P_D = P_{OUT} \times (1/\eta - 1)$$

where η is the efficiency of the converter and P_{OUT} is the output power of the step-up converter.

The maximum allowed power dissipation is:

$$P_{MAX} = (T_{JMAX} - T_A)/\theta_{JA}$$

where $(T_{JMAX} - T_A)$ is the temperature difference between the IC's maximum rated junction temperature and the surrounding air, and θ_{JA} is the thermal resistance of the junction through the PCB, copper traces, and other materials to the surrounding air.

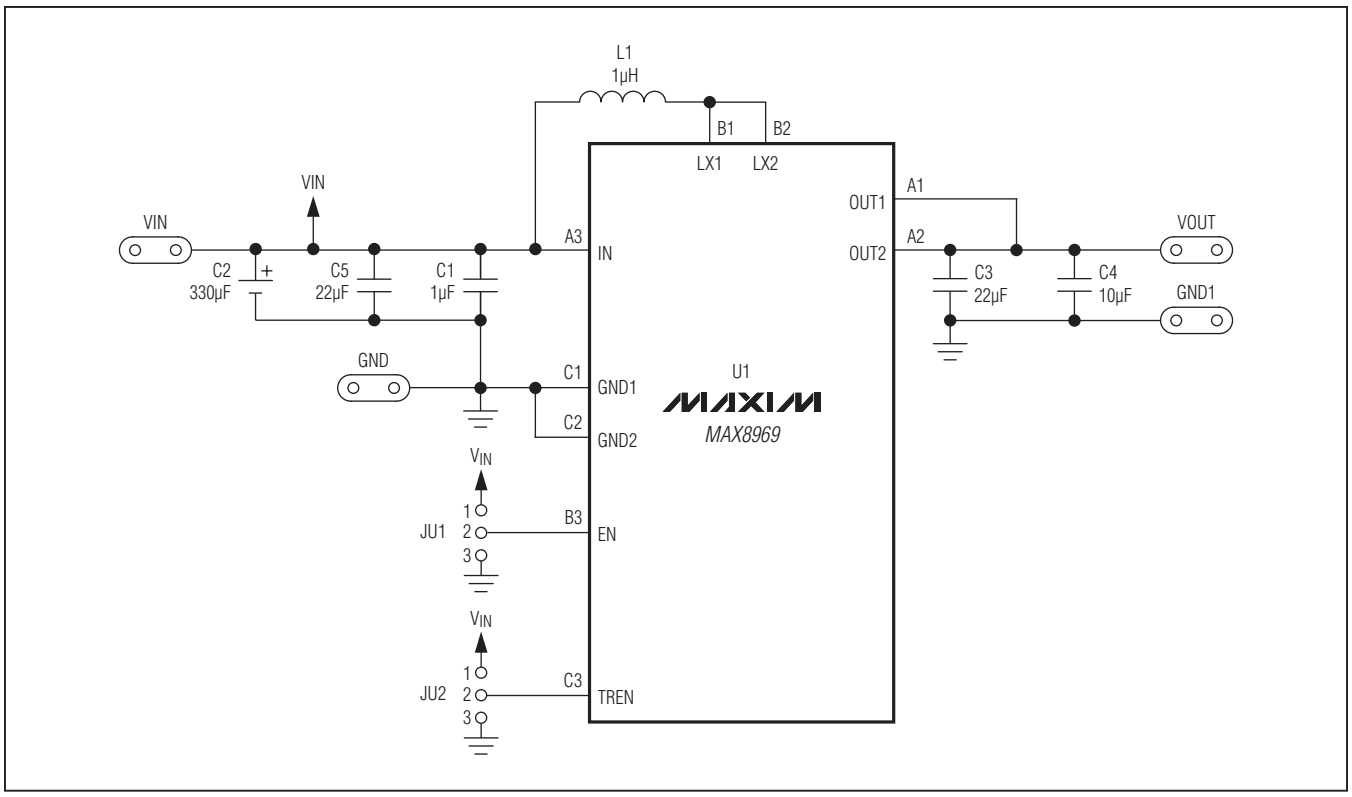

Figure 1. MAX8969 EV Kit Schematic

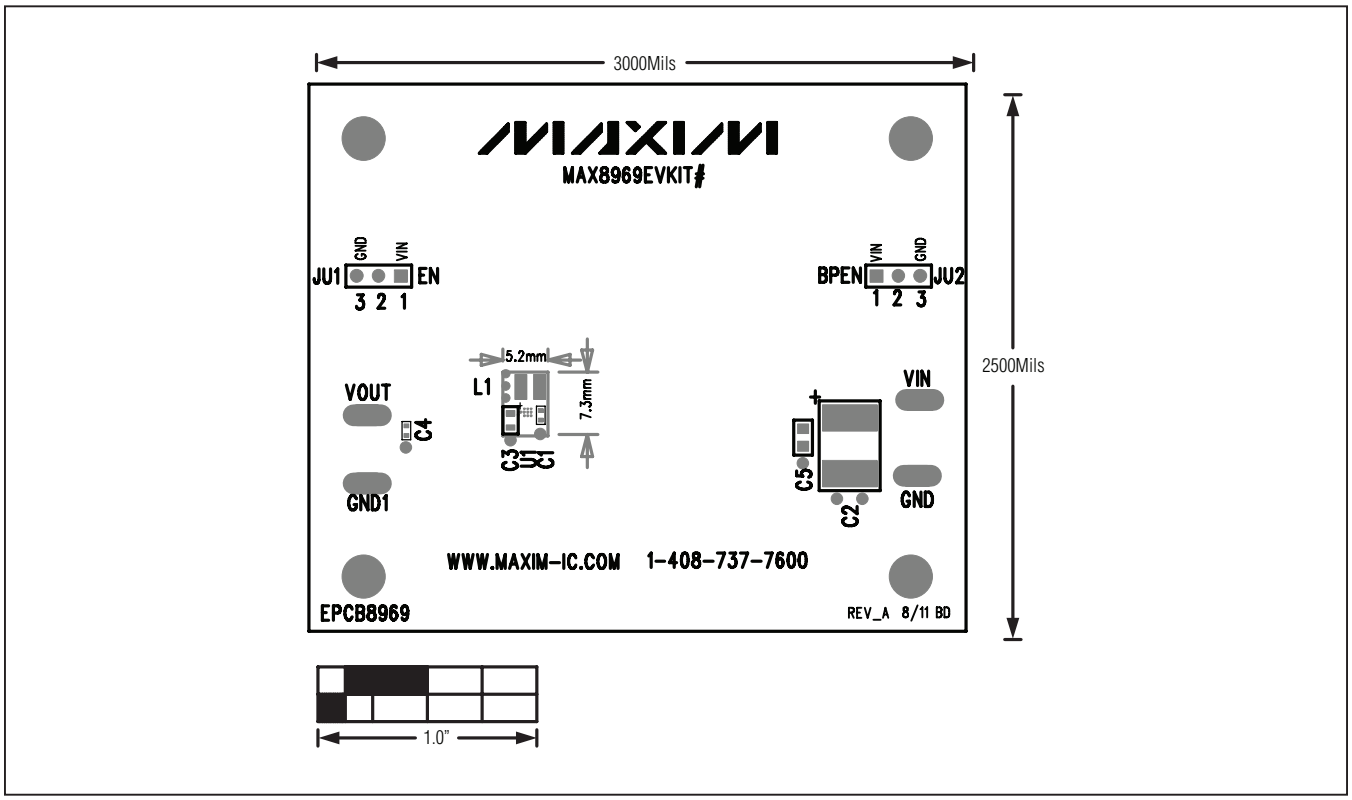

Figure 2. MAX8969 EV Kit Component Placement Guide—Component Side

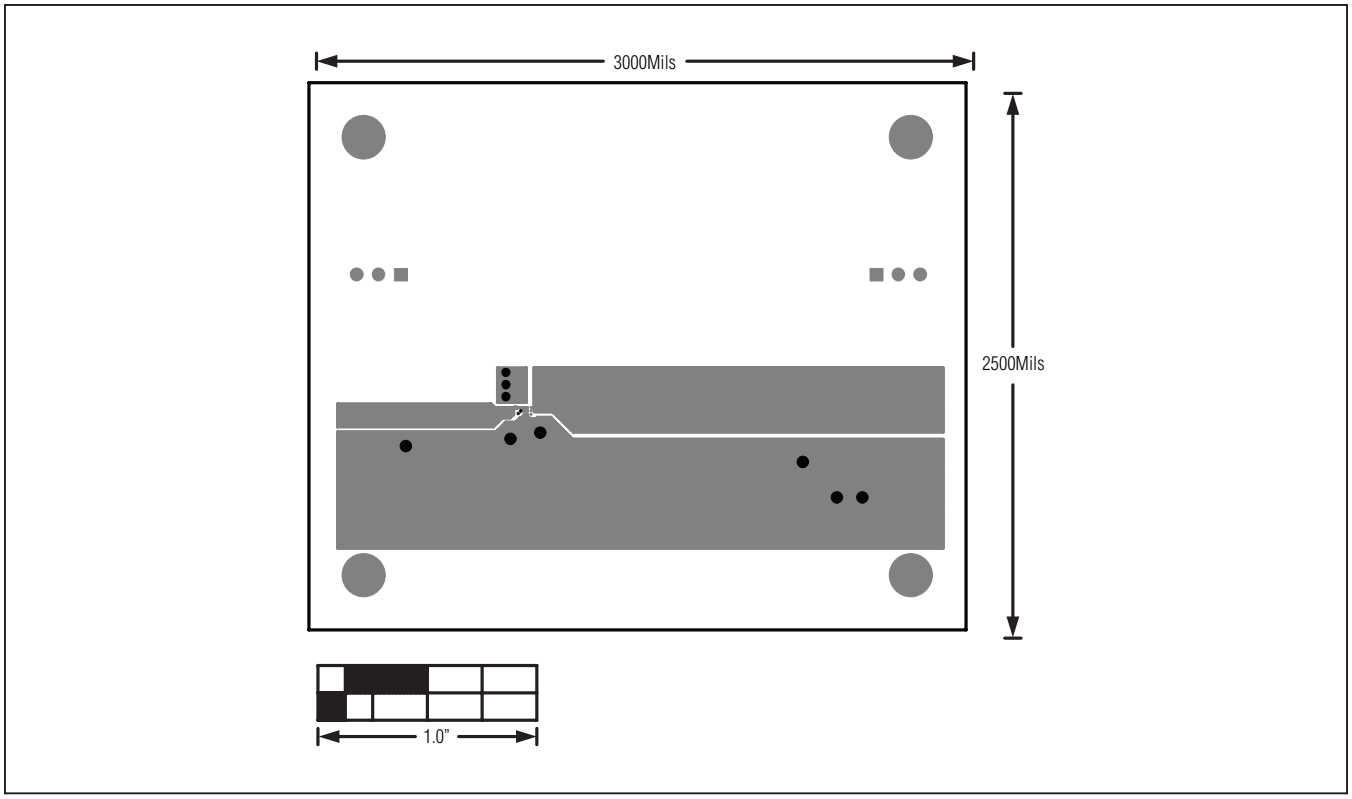

Figure 3. MAX8969 EV Kit PCB Layout—Component Side

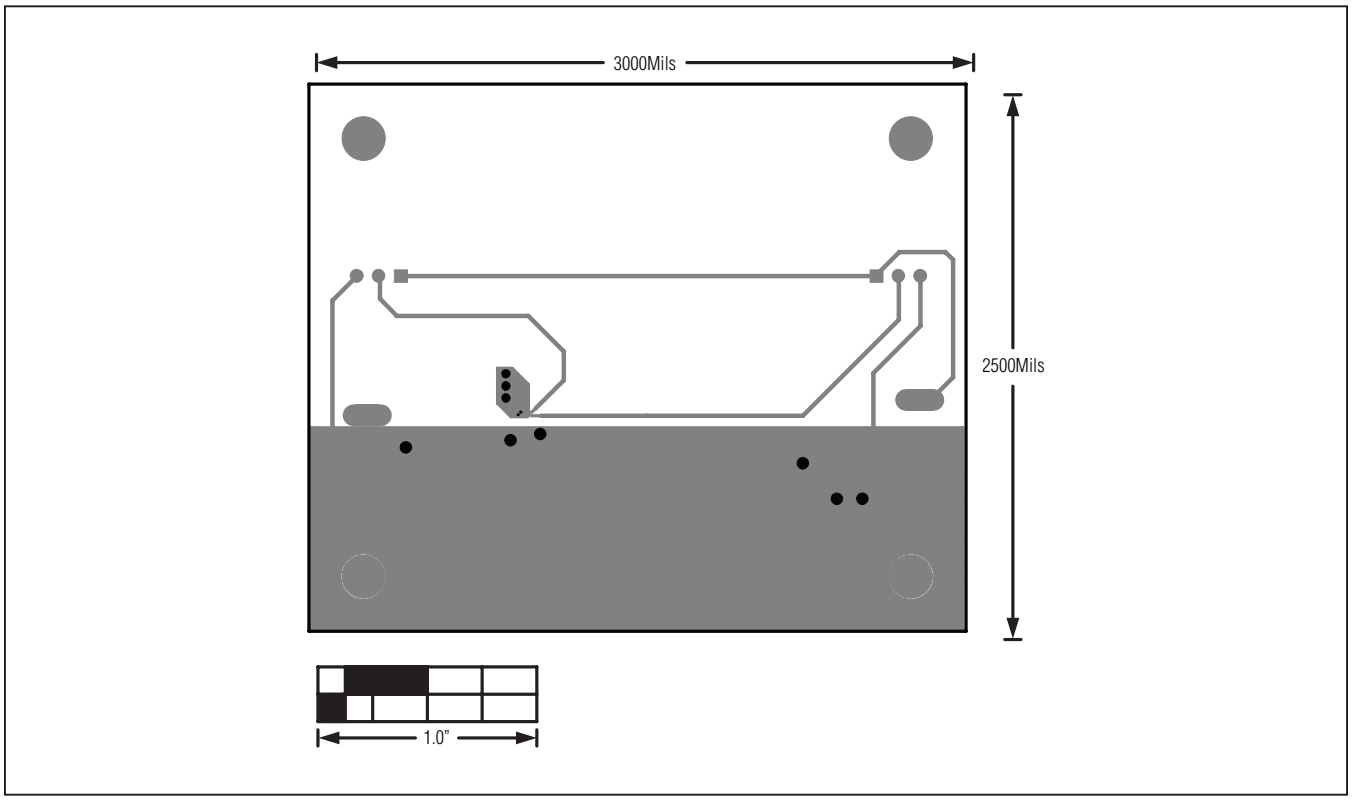

Figure 4. MAX8969 EV Kit PCB Layout—Solder Side

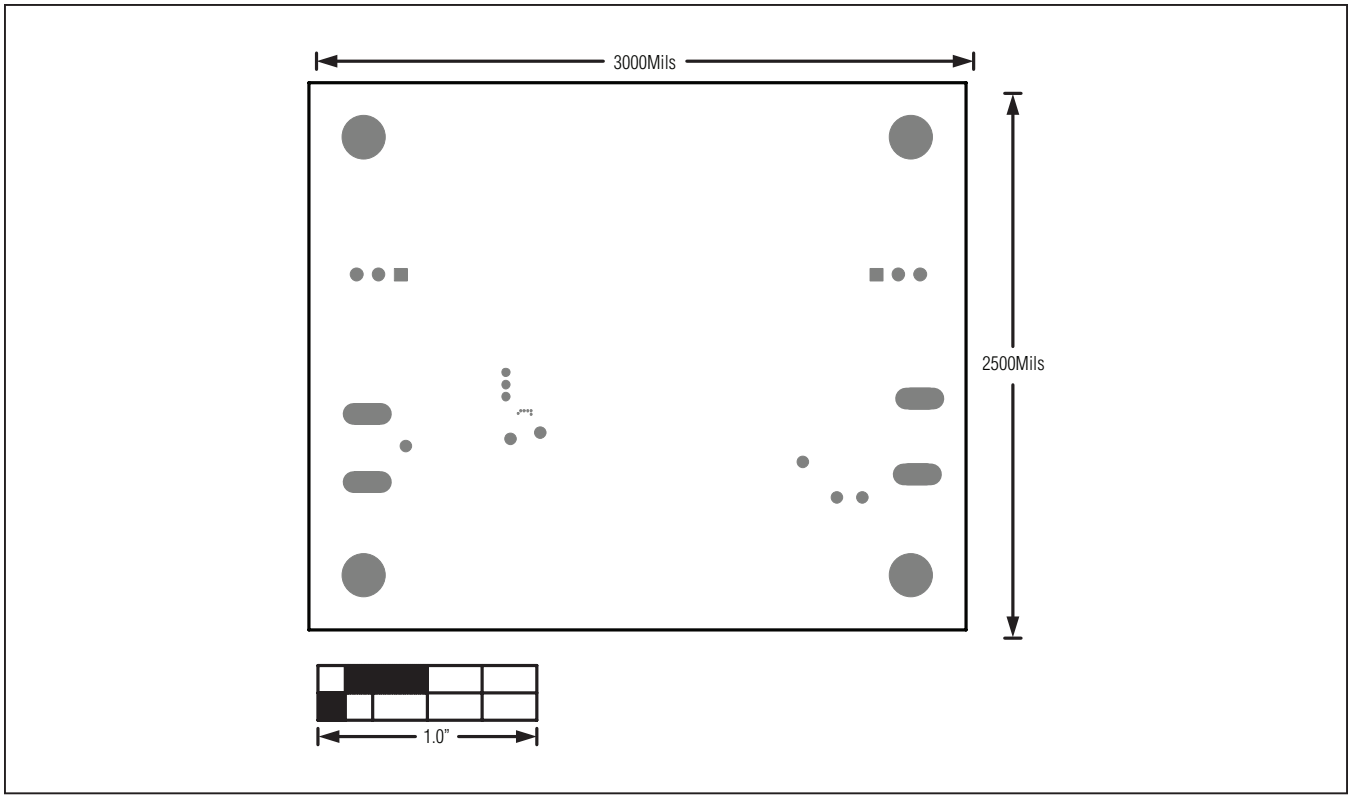

Figure 5. MAX8969 EV Kit Component Placement Guide—Solder Side

Ordering Information

PART	TYPE
MAX8969EVKIT#	EV Kit

#Denotes RoHS compliant.

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	2/12	Initial release	—