19-5149; Rev 0; 1/10

MAX15049 Evaluation Kit

Evaluates: MAX15048/MAX15049

General Description

The MAX15049 evaluation kit (EV kit) is a fully assembled and tested PCB that demonstrates the capabilities of the MAX15049. The MAX15049 is a high-performance, triple-output synchronous buck controller with sequencing capability. The EV kit requires a 5V to 16V (12V, typ) DC input-voltage range for normal operation.

The MAX15049 EV kit outputs are configured for 3.3V, 1.8V, and 1.2V. They provide a load current of 3A, 3A, and 6A, respectively. The EV kit's switching frequency is set to 500kHz, but can be programmed up to 1.2MHz by replacing a resistor. The EV kit comes configured for sequencing (MAX15049) and is capable of prebias startup. The EV kit can also be used to evaluate the MAX15048 for tracking applications by changing a few components. The PGOOD logic signal output pad is provided for circuit monitoring.

The MAX15049 EV kit comes with a MAX15049ETJ+ installed. To evaluate the MAX15048, contact the factory for samples of the pin-compatible MAX15048ETJ+.

Features

- **Triple-Output Power Supply**
  - **VOUT1 (3.3V, 3A)**
  - **VOUT2 (1.8V, 3A)**
  - **VOUT3 (1.2V, 6A)**
- **5.5V to 16V Input-Voltage Operation (Design Optimized for 12V Input)**
- **Optional 4.5V to 5.5V Input-Voltage Operation**
- **500kHz Switching Frequency per Converter**
- **Programmable Switching Frequency Up to 1.2MHz**
- **Sequencing Operation (Tracking Possible with Component Changes)**
- **PGOOD Power Monitoring**
- **Small 1.5in x 1in Circuit Footprint**
- **92.8% Peak Efficiency for OUT1**
- **Fully Assembled and Tested**

Ordering Information

PART	TYPE
MAX15049EVKIT+	EV Kit

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

Component List

DESIGNATION	QTY	DESCRIPTION
C1, C8, C9, C18, C19, C38	6	22µF ±20%, 16V X5R ceramic capacitors (1206) Murata GRM31CR61C226M
C2	1	1µF ±10%, 16V X5R ceramic capacitor (0603) Murata GRM188R61C105K
C5, C7, C15, C17, C25, C26, C35	7	0.1µF ±10%, 16V X5R ceramic capacitors (0402) Murata GRM155R61A104K
C6, C16	2	10µF ±10%, 16V X5R ceramic capacitors (0805) Murata GRM21BR61C106K
C10, C20	2	0.1µF ±10%, 16V X7R ceramic capacitors (0603) Murata GRM188R71C104K
C11, C22	2	330pF ±5% 50V C0G ceramic capacitors (0402) Murata GRM1555C1H331J
C12, C23, C30	3	22pF ±5%, 50V C0G ceramic capacitors (0402) Murata GRM1555C1H220J
C13, C21, C32	3	1500pF ±10%, 50V X7R ceramic capacitors (0402) Murata GRM155R71H152K
C14, C24	0	Not installed, ceramic capacitors (0402)
C27, C28	2	100µF ±20%, 6.3V X5R ceramic capacitors (1210) Murata GRM32ER60J107M
C29	1	220pF ±10%, 10V X7R ceramic capacitor (0402) Murata GRM155R61A103K
C31	1	680pF ±10%, 50V X7R ceramic capacitor (0402) Murata GRM155R71H681K

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.

MAX15049 Evaluation Kit

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
C33	1	1µF ±10%, 6.3V X5R ceramic capacitor (0402) Murata GRM155R60J105K
C34	1	2.2µF ±20%, 6.3V X5R ceramic capacitor (0402) Murata GRM155R60J225M
C36, C37, C39	3	1000pF ±10%, 50V X7R ceramic capacitors (0402) Murata GRM155R71H102K
EN1, EN2, EN3, PGOOD, REG, SGND	6	1-pin headers
JU1	0	Not installed, 2-pin header
L1, L2	2	3.3µH, 7A, 26mΩ inductors Vishay IHLP2525CZER3R3M07
L3	1	1µH, 14.1A, 7.1mΩ inductor TDK SPM6530T-1R0M120
N1, N2	2	30V dual n-channel PowerTrench MOSFETs (MLP) Fairchild FDMC8200
N3	1	9.1A/11A, 30V dual n-channel MOSFET (SO8) International Rectifier IRF7907PbF
R1, R7, R13	3	0Ω ±5% resistors (0402)
R2, R8, R19	0	Not installed, resistors (0402)
R3, R9, R16, R18	4	24.9kΩ ±1% resistors (0402)
R4, R10, R17	3	15kΩ ±1% resistors (0402)
R5, R11	2	1kΩ ±1% resistors (0402)
R6	1	5.49kΩ ±1% resistor (0402)
R12	1	12.4kΩ ±1% resistor (0402)
R14	1	20Ω ±5% resistor (0402)
R15	1	499Ω ±1% resistor (0402)
R20	1	2.2Ω ±5% resistor (0402)
R21	1	39.2kΩ ±1% resistor (0402)
R22	1	20kΩ ±5% resistor (0402)
R23, R24, R28	3	10kΩ ±1% resistors (0402)
R25	1	4.99kΩ ±1% resistor (0402)
R26	1	2.49kΩ ±1% resistor (0402)
R27	1	59kΩ ±1% resistor (0402)
R29	0	Not installed, resistor (0603)
U1	1	Triple-output buck controller (32 TQFN–EP*) Maxim MAX15049ETJ+
—	1	PCB: MAX15049 EVALUATION KIT+

**EP = Exposed pad.*

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Fairchild Semiconductor	888-522-5372	www.fairchildsemi.com
International Rectifier	310-322-3331	www.irf.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
TDK Corp.	847-803-6100	www.component.tdk.com
Vishay	402-563-6866	www.vishay.com

Note: *Indicate that you are using the MAX15049 when contacting these component suppliers.*

Quick Start

Required Equipment

- MAX15049 EV kit
- 12V, 10A power supply
- Four voltmeters

Procedure

The MAX15049 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.**

1) Verify that U1 is installed on the bottom side of the PCB.
2) Connect the positive terminal of voltmeter 1 (VM1) to the OUT1 pad. Connect the negative terminal of VM1 to the GND1 pad.
3) Connect the positive terminal of voltmeter 2 (VM2) to the OUT2 pad. Connect the negative terminal of VM2 to the GND2 pad.
4) Connect the positive terminal of voltmeter 3 (VM3) to the OUT3 pad. Connect the negative terminal of VM3 to the GND3 pad.
5) Connect the positive terminal of voltmeter 4 (VM4) to PGOOD (TP8) and the negative terminal to the PGND pad.
6) Set the power supply to 12V and disable the output.
7) Connect the positive terminal of the power supply to the VIN pad. Connect the negative terminal of the power supply to the PGND pad.
8) Turn on the power supply.
9) Verify that the VOUT1, VOUT2, and VOUT3 outputs measure 3.3V, 1.8V, and 1.2V, respectively.
10) Verify that PGOOD measures approximately 5V.
11) The EV kit is now ready for load testing. Use the respective OUT_ connector load points for high-current load testing.

Detailed Description of Hardware

The MAX15049 EV kit is a fully assembled and tested PCB that demonstrates the MAX15049, which integrates three high-performance PWM switching step-down DC-DC controllers. The EV kit circuit operates over the input-voltage range of 4.7V to 16V. The three outputs are configured for 3.3V, 1.8V, and 1.2V and can provide 3A, 3A, and 6A, respectively. The EV kit outputs operate in sequencing mode during startup and the three outputs operate 120 degrees out of phase. The EV kit outputs can start into prebiased loads. The EV kit switching frequency is set to 500kHz with resistor R21. The switching frequency can be programmed from 200kHz to 1.2MHz by replacing this resistor. The EV kit has a PGOOD output pad to indicate that all outputs have reached their steady-state values. The EV kit PCB is designed in four layers and 2oz copper for optimum performance.

Input Source

The MAX15049 EV kit is configured for normal operation with an input power source of 4.7V to 16V and design optimized for a 12V input voltage. The upper input-voltage limit can be raised to 23V by replacing capacitors C1, C2, C6, C16, and C38 with higher voltage-rated capacitors. The EV kit circuit requires a minimum 4.7V input voltage to start the power MOSFET switching.

MAX15049 Bias Input

The MAX15049 EV kit features an option to select the bias input for the MAX15049 when configuring the EV kit to operate with an input source less than 4.7V. Jumper JU1 shorts the input-voltage source for the MAX15049 to the controller REG pin. Without JU1 installed, the input-voltage range in this configuration is 4.7V to 16V.

When operating the MAX15049 EV kit with a supply between 4.5V to 5.5V, install jumper JU1.

Table 1. MAX15049 Bias Input Configuration (JU1)

SHUNT POSITION	MAX15049 IN PIN	MAX15049 EV KIT INPUT RANGE (V)
Installed	Connected to REG	4.5 to 5.5
Not installed	Connected to VIN	4.7 to 16

Triple Outputs

The MAX15049 EV kit's three outputs are configured to different voltages. The bottom side of the PCB contains the IC and the feedback and compensation components. The top side of the PCB contains the input/output capacitors, inductors, and FETs. OUT1 is configured to 3.3V with resistors R3 and R6 and can supply up to 3A. OUT2 is configured to 1.8V with resistors R9 and R12 and can supply up to 3A. OUT3 is configured to 1.2V with resistors R16 and R18 and can supply up to 6A. The output voltage for each output can be reconfigured between 0.6V and 3.3V by replacing the respective feedback resistors. Refer to the *Type III: Compensation When ƒCO < ƒZERO, ESR* section in the MAX15048/MAX15049 IC data sheet for instructions on selecting new resistor values for the respective outputs. Also, refer to the *Inductor Selection* and *Input-Capacitor Selection* sections in the IC data sheet to verify other component replacements for proper operation when changing the output voltage.

Current Limit

The MAX15049 EV kit uses the low-side MOSFET DC on resistance (R_{DSON}) for valley current sensing. The current-limit threshold is 69mV internally set inside the MAX15049. The MAX15049 compares the voltage across the low-side MOSFET (R_{DSON}) with the internal threshold to incorporate the current limit. OUT1 and OUT2 use the FDMC8200 FET with a low-side R_{DSON} of 9.5mΩ (typ) and 13.5mΩ (max). The current-limit threshold is 69mV (typ) and the output current limit calculated is approximately 6A. The IRF7907 FET has similar characteristics with a 9.1mΩ (typ) and 13.7mΩ (max) R_{DSON} and therefore, a similar current limit.

Switching Frequency

The MAX15049 PWM switching frequency is set to approximately 500kHz with resistor R21 (39.2kΩ). Replace resistor R21 with a new resistor value to progam the switching frequency between 200kHz and 1.2MHz. Use the following equation to choose the appropriate resistor value to reconfigure the switching frequency (f_{SW}):

$$f_{SW}(kHz) = 12.8 \times R21(k\Omega)$$

Evaluating the MAX15048 (Tracking)

The MAX15049 EV kit comes configured for sequencing. The EV kit can also evaluate the MAX15048 for tracking applications. The MAX15049 IC must be replaced with the MAX15048. It also requires modification at EN2 (pin 9) and EN3 (pin 24) for tracking operation with the MAX15048. Refer to the *MAX15048 Coincident/ Ratiometric Tracking (EN_)* section in the MAX15048/ MAX15049 IC data sheet to calculate the proper values for resistors R23–R26 and R29.

PGOOD Status Output

The MAX15049 EV kit provides a PGOOD logic output to indicate the regulation state of OUT1, OUT2, and OUT3. A logic-low at TP8 (PGOOD test point) indicates that one of the output voltages has dropped below 92% of its regulation voltage.

Individual EN_ Input

The MAX15049 EV kit provides an individual enable test point for each output. The EV kit comes configured for sequencing and connections so the enable test points are not needed. To disable sequencing and externally control each output, remove the sequencing components (R23–R28) and apply a voltage on the EN_ test point.

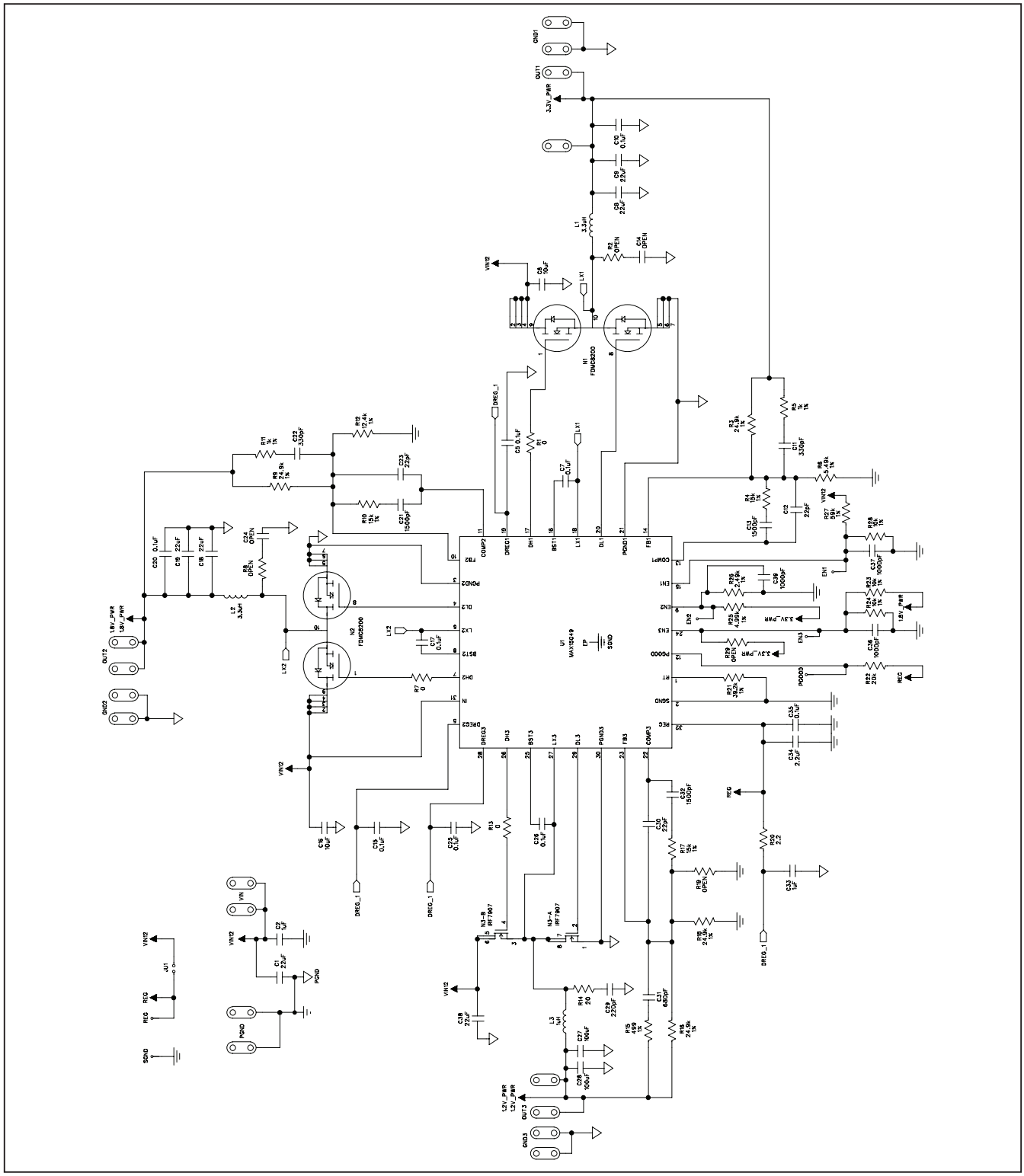

Figure 1. MAX15049 EV Kit Schematic

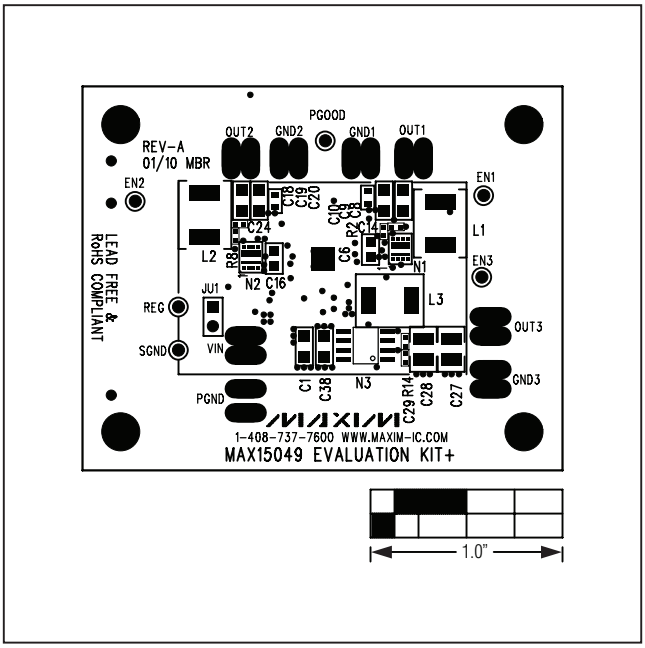

Figure 2. MAX15049 EV Kit Component Placement Guide—Component Side

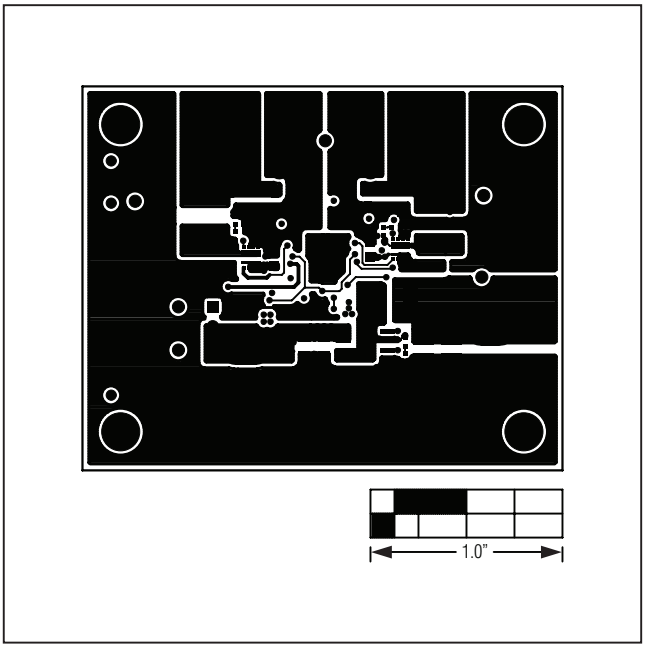

Figure 3. MAX15049 EV Kit PCB Layout—Component Side

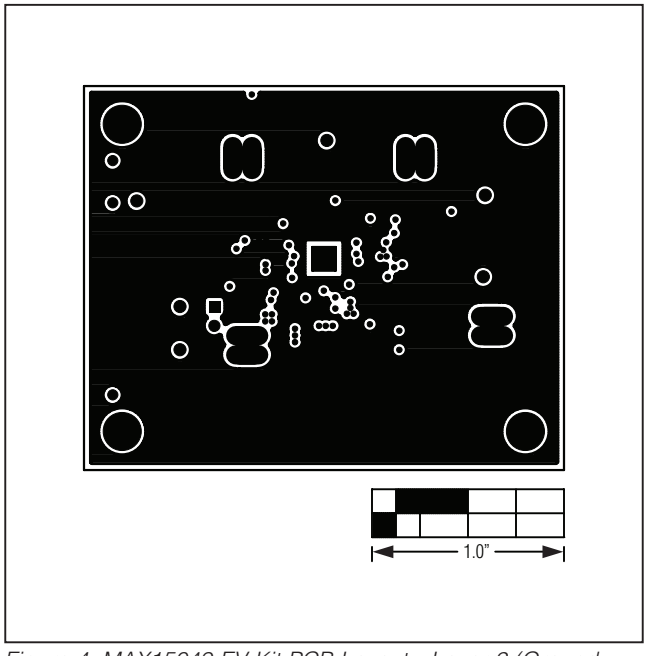

Figure 4. MAX15049 EV Kit PCB Layout—Layer 2 (Ground Layer)

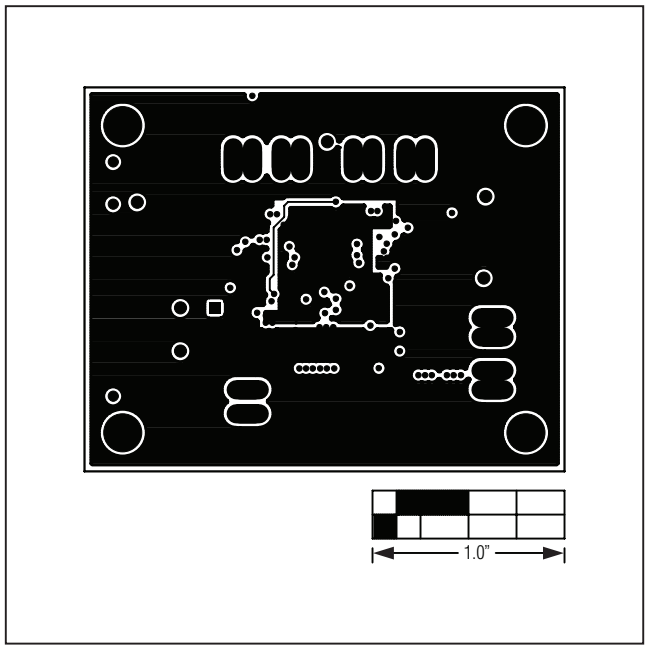

Figure 5. MAX15049 EV Kit PCB Layout—Layer 3 (Power Layer)

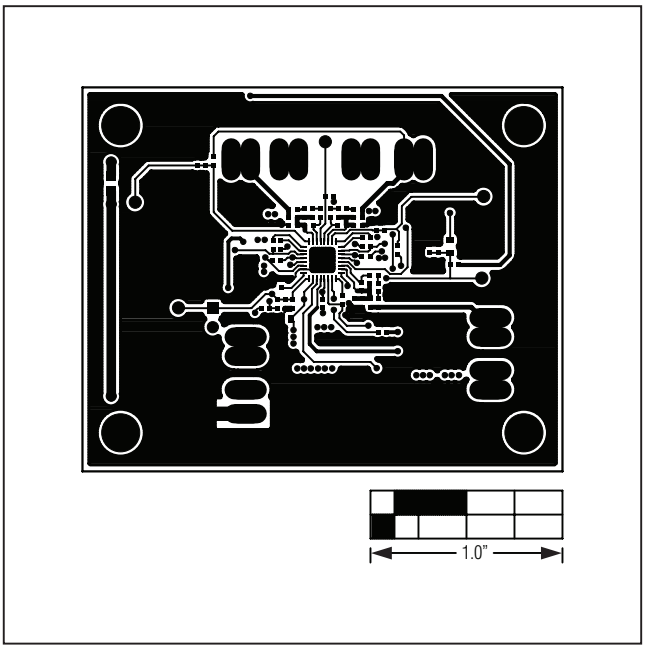

Figure 6. MAX15049 EV Kit PCB Layout—Solder Side

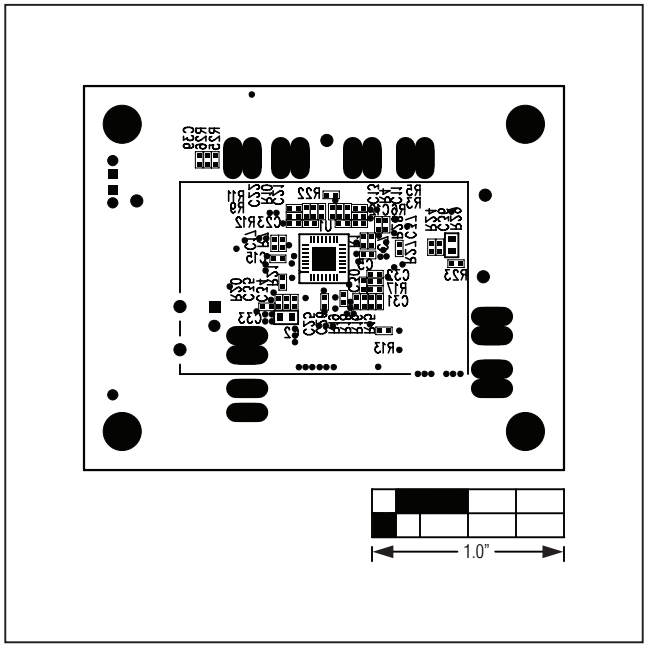

Figure 7. MAX15049 EV Kit Component Placement Guide—Solder Side

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