19-5319; Rev 0; 6/10

MAX15035 Evaluation Kit

Evaluates: MAX15035

General Description

The MAX15035 evaluation kit (EV kit) demonstrates the standard 15A application circuit of the MAX15035. This DC-DC converter steps down from the industry standard to generate low-voltage core or chipset/RAM bias supplies in computers.

The EV kit provides a dynamically adjustable 1.5V/1.05V output voltage from a 7V to 22V battery input range. It delivers up to 15A output current while achieving high efficiency. Programmed by a single resistor, the EV kit operates at 300kHz switching frequency and has superior line- and load-transient response.

The EV kit is a fully assembled and tested PCB. It also allows the evaluation of other dynamically adjustable output voltages by varying the external reference input, which can be realized by changing resistors R1, R2, and R3.

Features

- **7V to 22V Input Range**
- **Dynamically Selectable 1.5V/1.05V Output Voltage**
- **Dynamically Adjustable Output Voltage Range (0 to 0.9V_{IN})**
- **15A Output Current**
- **300kHz Switching Frequency**
- **Power-Good Output Indicator (PGOOD)**
- **Low-Profile Surface-Mount Components**
- **Fully Assembled and Tested**

Ordering Information

PART	TYPE
MAX15035EVKIT+	EV Kit

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

Component List

DESIGNATION	QTY	DESCRIPTION
C1, C2	2	1µF ±10%, 6.3V X5R ceramic capacitors (0402) TDK C1005X5R0J105K Taiyo Yuden LMK105BJ105KV
C3	1	1000pF ±10%, 50V ceramic capacitor (0402) TDK C1005X7R1H102K Murata GRM155R71H102K
C4, C5, C20, C21	4	10µF ±20%, 25V X5R ceramic capacitors (1210) TDK C3225X5R1E106M Taiyo Yuden TMK325BJ106MM
C6	0	Not installed, 1000µF, 50V aluminum electrolytic capacitor
C7	1	0.1µF ±10%, 25V X7R ceramic capacitor (0603) KEMET C0603C104K3RAC Murata GRM188R71E104K
C8, C9, C13	0	Not installed, capacitors (0603)
C10, C11	2	330µF, 2.5V, 9mΩ polymer capacitors (D case) SANYO 2R5TPE330M9 (1.8mm) Panasonic EEFSX0D331XR (6mΩ ESR, 1.9mm height) NEC TOKIN PSGD0E337M7 (7mΩ ESR, 2.8mm height)
C12, C15–C19	6	10µF ±20%, 6.3V X5R ceramic capacitors (0805) TDK C2012X5R0J106M Murata GRM21BR61A106K
C14	1	1µF ±10%, 25V X5R ceramic capacitor (0603) Murata GRM188R61E105K Taiyo Yuden GDK107BJ105KA
C22	1	680pF ±5%, 50V C0G ceramic capacitor (0603) TDK C1608C0G1H681J
D1	0	Not installed, 5.6V zener diode (SOT23)
D2	1	Green surface-mount LED (0805) Kingbright APHCM2012VGC/Z-F01
EN, FBSENSE, GATE, PGOOD, REFIN, $\overline{SKIP}$	6	Test points Keystone 5000
JU1	1	3-pin header Sullins PEC36SAAN Digi-Key S1012E-02-ND or equivalent

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Component List (continued)

DESIGNATION	QTY	DESCRIPTION
JU2	1	4-pin header Sullins PEC36SAAN Digi-Key S1012E-02-ND or equivalent
JU3	1	Single-row 2-pin header Sullins PEC36SAAN Digi-Key S1012E-02-ND or equivalent
L1	1	1µH, 3.7mΩ, 17.5A power inductor Vishay/Dale IHLP4040DZER1R0M01
N1	1	n-channel, logic-level MOSFET (SOT23)
N2	0	Not installed, n-channel MOSFET (DPAK)
Q1	0	Not installed, transistor (SOT23)
R1	1	49.9kΩ ±1% resistor (0603)
R2	1	54.9kΩ ±1% resistor (0603)
R3	1	97.6kΩ ±1% resistor (0603)
R4	1	1kΩ ±5% resistor (0603)
R5	1	200kΩ ±1% resistor (0603)
R6	1	4.7Ω ±5% resistor (0603)
R7, R9, R15–R18	0	Not installed, resistors (0603)
R8	1	0Ω ±5% resistor (0603)
R10	1	40.2kΩ ±1% resistor (0603)
R11	1	100kΩ ±1% resistor (0603)
R12	1	10kΩ ±1% NTC resistor (0603) Murata NCP18XH103F03RB
R13	1	100kΩ ±5% resistor (0603)
R14	0	Not installed, 1W resistor (2512)
R19	1	3.3Ω ±5% resistor (0805)
U1	1	15A step-down regulator (40 TQFN-EP*) Maxim MAX15035ETL+
—	2	Shunts
—	1	PCB: MAX15035 EVALUATION KIT+

**EP = Exposed pad.*

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Central Semiconductor Corp.	631-435-1110	www.centralsemi.com
Digi-Key Corp.	800-344-4539	www.digikey.com
KEMET Corp.	864-963-6300	www.kemet.com
Keystone Electronics Corp.	209-796-2032	www.keyelco.com
Kingbright Corporation	909-468-0500	www.kingbrightusa.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
NEC TOKIN America, Inc.	408-324-1790	www.nec-tokin.com/america
Panasonic Corp.	800-344-2112	www.panasonic.com
SANYO Electric Co., Ltd.	619-661-6835	www.sanyodevice.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
Vishay	402-563-6866	www.vishay.com

Note: *Indicate that you are using the MAX15035 when contacting these component suppliers.*

Quick Start

Recommended Equipment

- Adjustable 7V to 22V power supply, battery, AC adapter
- 5V at 100mA DC bias power supply
- Dummy load capable of sinking 15A
- Digital multimeter (DMM)
- 100MHz dual-trace oscilloscope

Procedure

The MAX15035 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 shunts are placed in their default positions, as shown in Table 1.
2) Connect the positive input of the adjustable 7V to 22V power supply to IN and the negative input of the power supply to PGND.
3) Connect the positive input of the 5V/100mA power supply to VDD and the negative input to PGND (or add Q1, R16, and R17 instead of the external power supply).
4) Connect the positive input of the electronic load to V_{OUT} and the negative input to PGND.
5) Connect the DMM to V_{OUT} and PGND.

EV Kit Test:

1) Turn on the 7V to 22V battery power prior to the 5V bias power; otherwise, the output undervoltage (UVP) FAULT latch is set, disabling the regulator until 5V power is cycled below the VCC POR (5V), or EN is toggled.
2) Observe the 1.5V ±0.3% at the V_{OUT} with the DMM and/or oscilloscope.
3) Turn on the load and increase the current slowly to 15A and observe that the V_{OUT} is 1.5V ±0.3% at all loads.

Table 1. Default Shunt Positions

JUMPER	SHUNT POSITION	FUNCTION
JU1	1-2	EN high
JU2	1-2	Forced PWM
JU3	One pin only	1.5V output

Detailed Description of Hardware

Jumper Settings

Several jumper settings in the following tables illustrate features of the MAX15035 EV kit.

Shutdown Control Input

The EV kit features a 3-pin jumper (JU1) that selects the shutdown control input. Table 2 lists the selectable jumper options.

Pulse-Skipping Control Input

The EV kit features a 4-pin jumper (JU2) for pulse-skipping control input. This four-level input determines the mode of operation under normal steady-state conditions and dynamic output-voltage transitions. The default configuration has a shunt installed at pins 1-2 for low-noise, forced-PWM mode. Table 3 lists the other selectable jumper options. Refer to the *Modes of Operation* section in the MAX15035 IC data sheet for a more detailed description.

External Gate

The EV kit features a 2-pin jumper (JU3) that controls the gate of the external MOSFET (N1). The external MOSFET can be controlled through the gate test point to dynamically adjust the REFIN voltage by forcing N1 to a low- or high-impedance state. The default configuration has a shunt installed on only one pin of JU3 to provide a 1.5V output. Table 4 lists the selectable jumper options.

Table 2. Jumper JU1 Functions

SHUNT POSITION	EN PIN	MAX15035 OUTPUT
1-2*	Connected to VDD	Enabled (V_{OUT} = 1.5V/1.05V)
2-3	Connected to GND	Shutdown mode (V_{OUT} = 0V)
Not installed	EN must be driven by an external signal connected to the EN test point	Operation depends on the external EN signal levels

**Default position.*

Table 3. Jumper JU2 Functions

SHUNT POSITION	$\overline{SKIP}$ PIN	OPERATIONAL MODE
1-2*	Connected to VDD	Low-noise mode, forced-PWM operation
1-3	Connected to REF	Pulse-skipping mode with forced-PWM during transitions
1-4	Connected to GND	Pulse-skipping mode without forced-PWM during transitions
Not installed	Open	Ultrasonic mode without forced-PWM during transitions

**Default position.*

Table 4. Jumper JU3 Functions

SHUNT POSITION	EXTERNAL GATE	MAX15035 OUTPUT
Installed	Connected to VDD	A logic-high on gate turns on the external MOSFET, effectively shorting R3 (V_{OUT} = 1.05V through resistor-dividers R1 and R2).
Not installed*	Pulled to GND by R13	A logic-low on gate turns off the external MOSFET (V_{OUT} = 1.5V through resistor-dividers R1 and R2 + R3).

**Default position.*

Evaluating Other Dynamic Output Voltages

The EV kit output is preset to 1.05V/1.5V. However, the output voltage can also be adjusted between 0 and 2V (V_{FB} = OUT) by selecting R1, R2, and R3 values. The device regulates FB to the voltage set at REFIN. By changing the voltage at REFIN, the device can be used in applications that require dynamic output-voltage changes between two set points. Using the external gate signal, a resistor can be switched in and out of the REFIN resistor-divider, changing the voltage at REFIN. A logic-high on gate turns on the external n-channel MOSFET (N1), forcing its drain to a low-impedance state. A logic-low on gate disables the n-channel MOSFET, so its drain is high impedance. The two output voltages (V_{FB} = OUT) are determined by the following equations:

$$V_{OUT(LOW)} = \left(\frac{R2}{R1+R2}\right)V_{REF}$$

$$V_{OUT(HIGH)} = \left(\frac{R2+R3}{R1+R2+R3}\right)V_{REF}$$

where V_{REF} = 2V.

Setting V_{OUT} with a Resistive Voltage-Divider at FB

Connecting FB to a resistive voltage-divider allows for output voltages above the reference voltage (0 to 0.9V_{IN} range). To get an output above 2V, install resistor R9 with a 10kΩ ±1% resistor and replace R8 with the following equation:

$$V_{OUT} = V_{FB}\left(1+\frac{R8}{R9}\right)$$

where V_{FB} = V_{REFIN}.

The switching frequency-setting input should then be adjusted by replacing the external resistor R5 (R_{TON}) according to the following equations:

$$t_{SW} = C_{TON}(R_{TON} + 6.5k\Omega)\left(\frac{V_{FB}}{V_{OUT}}\right)$$

$$t_{SW} = \frac{1}{f_{SW}}$$

where C_{TON} = 16.26pF, f_{SW} = 300kHz, and V_{FB} = V_{REFIN} under normal operating conditions. Refer to the MAX15035 IC data sheet for selection of output capacitor and inductor values for output voltages greater than 2V.

Transient Load Tester

The EV kit features an optional transient load tester consisting of power MOSFET N2, R14, and termination resistor R15. For a more detailed description, refer to Application Note 752: *Creating a Fast Load Transient* at **www.maxim-ic.com**.

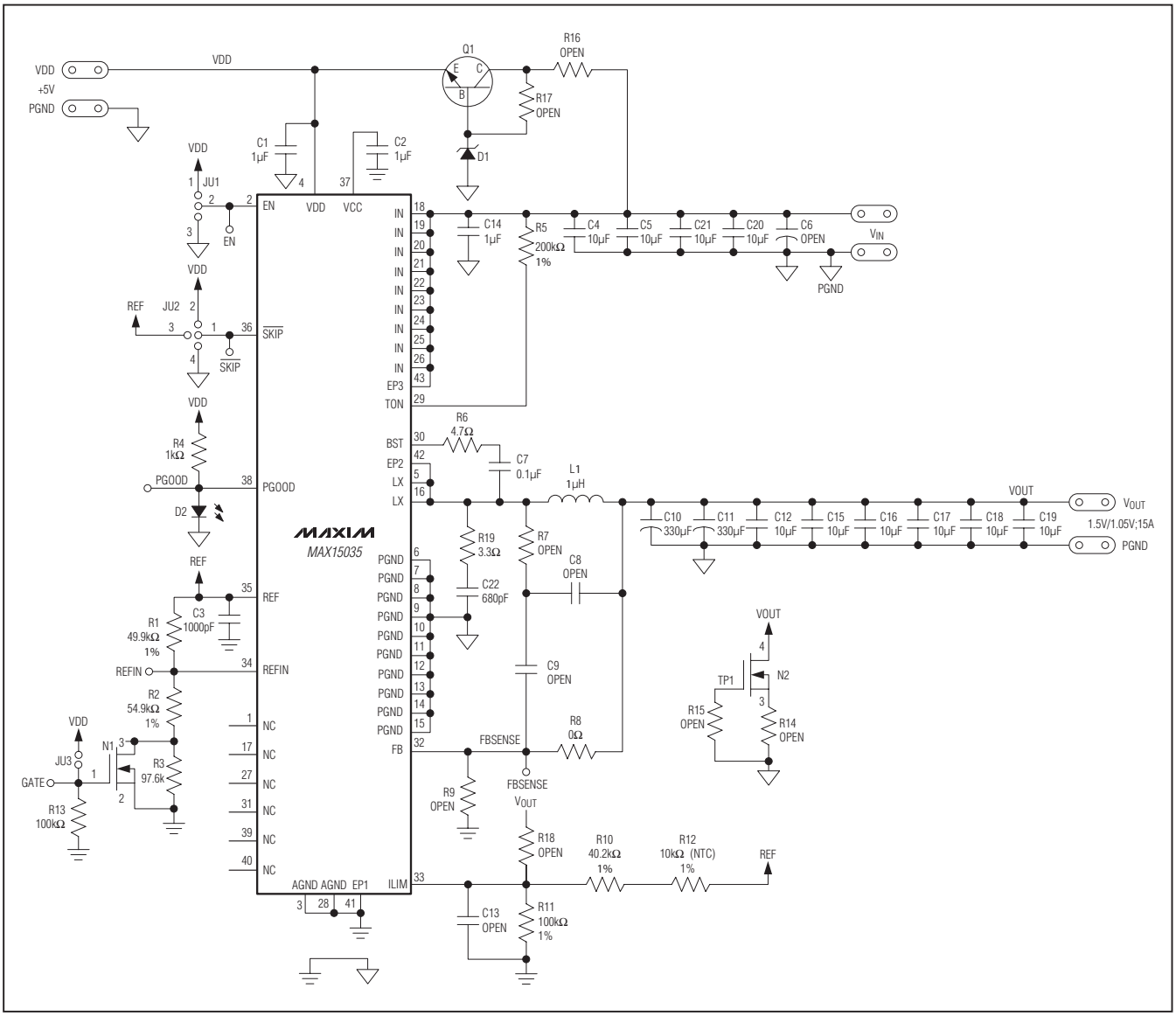

Figure 1. MAX15035 EV Kit Schematic

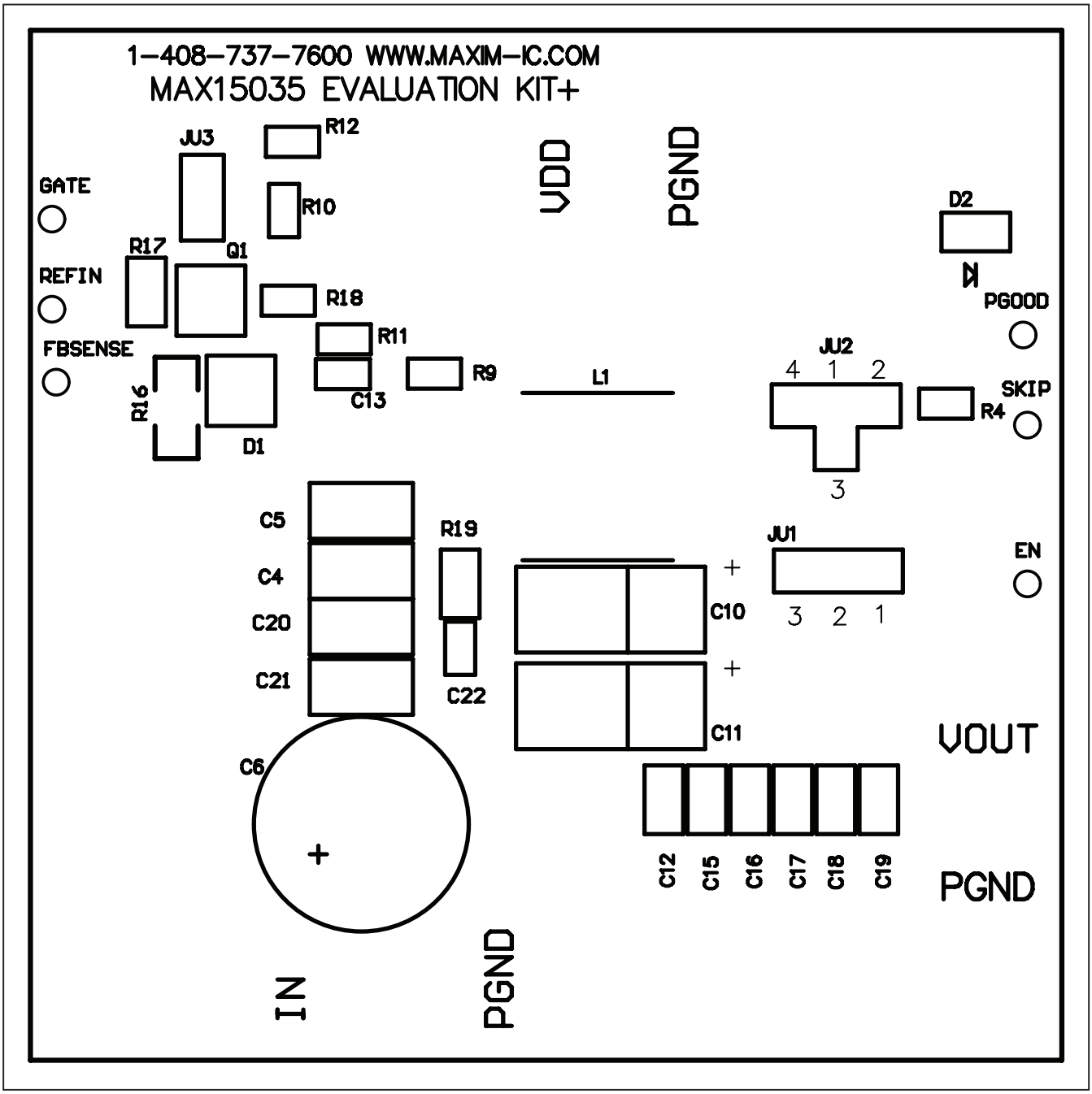

Figure 2. MAX15035 EV Kit Component Placement Guide—Component Side

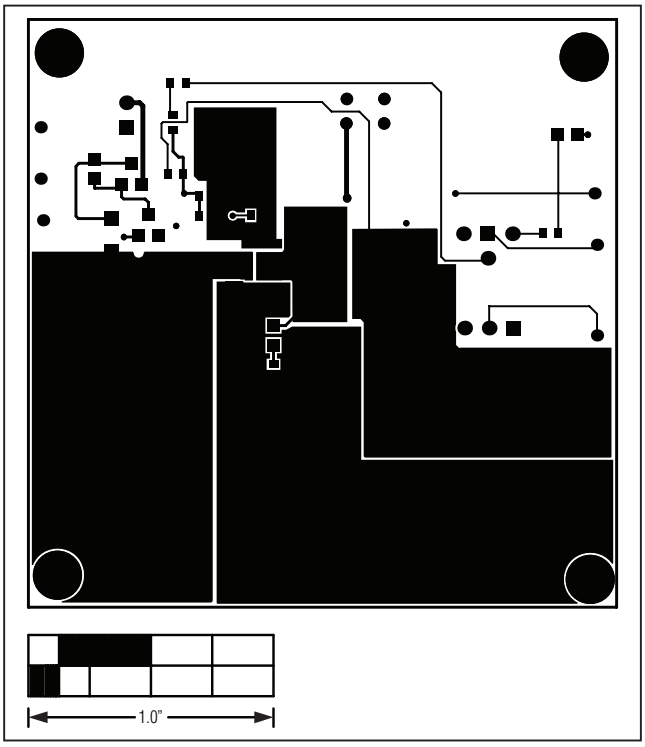

Figure 3. MAX15035 EV Kit PCB Layout—Component Side

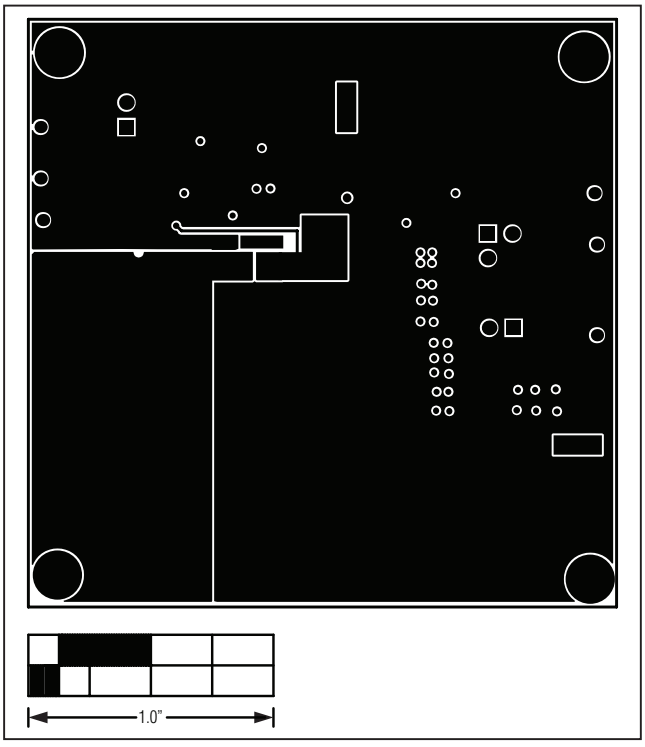

Figure 4. MAX15035 EV Kit PCB Layout—Internal layer 1

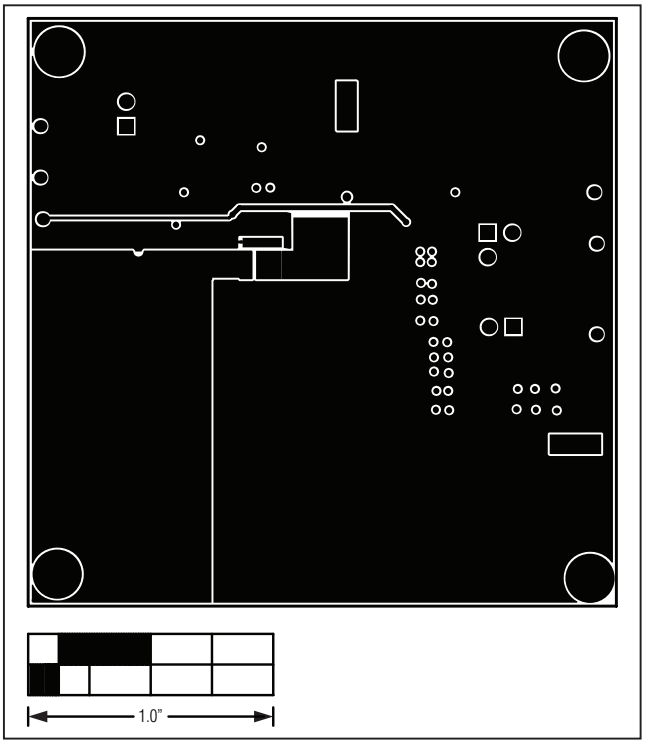

Figure 5. MAX15035 EV Kit PCB Layout—Internal Layer 2

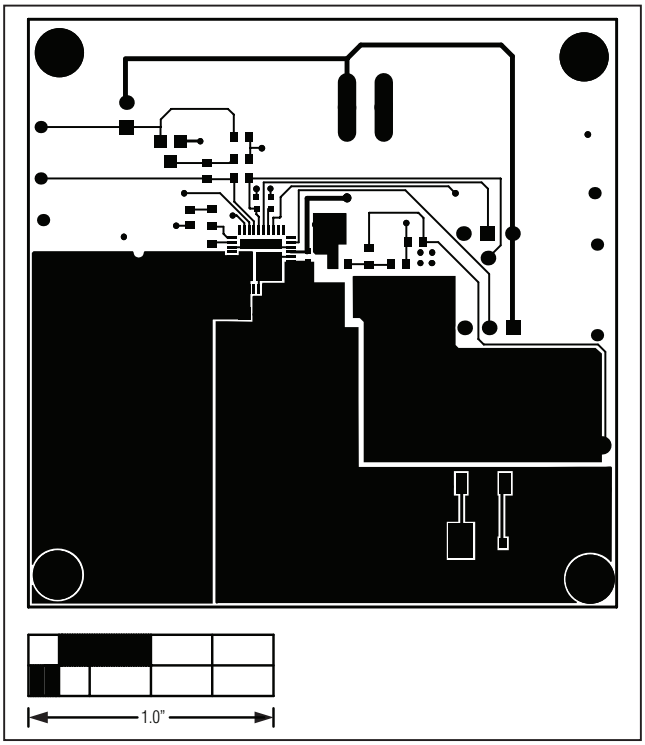

Figure 6. MAX15035 EV Kit PCB Layout—Solder Side

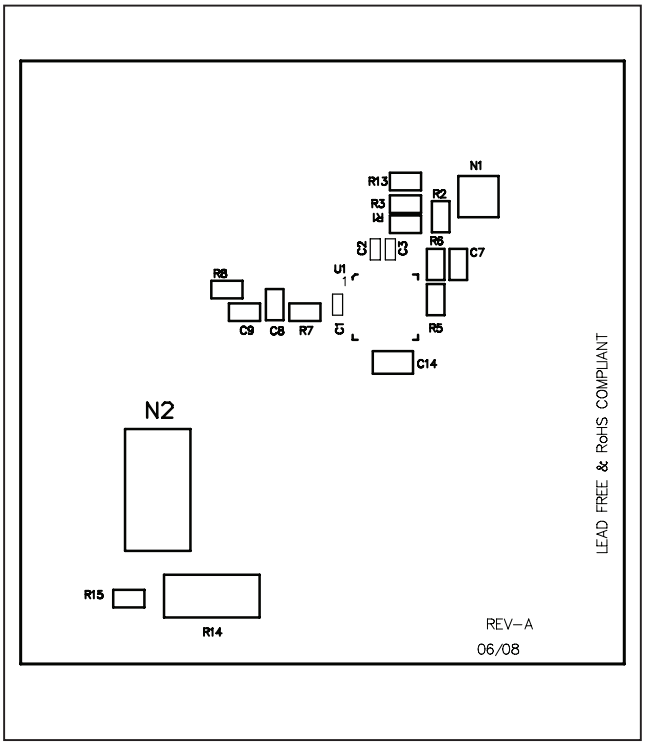

Figure 7. MAX15035 EV Kit Component Placement Guide—Solder Side

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	6/10	Initial release	—