19-0689; Rev 0; 12/06

MAX15015A Evaluation Kit

General Description

The MAX15015A evaluation kit (EV kit) is a fully assembled and tested PCB that evaluates the MAX15015A PWM/PFM step-down converter, which integrates a high-side switch and an LDO regulator. The MAX15015A EV kit operates over a wide input-voltage range of 4.5V to 40V and provides up to 1A at the 3.3V output. The LDO regulator provides up to 50mA at the preset 5V output. The MAX15015A features undervoltage lockout, overcurrent, and thermal-shutdown protection.

The MAX15015A normally operates as a PWM converter and automatically switches to PFM mode at light loads to improve efficiency. The MAX15015A switching frequency is preset to 500kHz and features a SYNC input to provide external frequency synchronization for sensitive applications. The EV kit provides PCB pads to evaluate the SYNC and ENABLE features of the MAX15015A. The EV kit board can also be used to evaluate the MAX15015B. The MAX15015A can operate over the automotive temperature range of -40°C to +125°C.

Features

- **3.3V, 1A, 500kHz Step-Down Converter**
- **5V, 50mA LDO Regulator**
- **LDO Voltage Adjustable Up to 11V**
- **Independent Turn On/Off Control for Step-Down Converter (EN_SW)**
- **Regulator Power-On Reset with Adjustable Timeout Period**
- **84% High Efficiency at V_{IN} = 12V and I_{OUT} = 1A**
- **Automatic PWM/PFM Mode**
- **Overcurrent and Thermal-Shutdown Protection**
- **Fully Assembled and Tested**

Ordering Information

PART	TEMP RANGE	IC PACKAGE
MAX15015AEVKIT+	0°C to +70°C*	36 TQFN-EP**

+Denotes a lead-free and ROHS-complaint EV kit.
**This limited temperature range is for the EV kit PCB only.*
***EP = Exposed paddle.*

Component List

DESIGNATION	QTY	DESCRIPTION
C1	1	10µF ±10%, 50V X5R ceramic capacitor (2220) Murata GRM55DR61H106K
C2, C4, C5, C6, C15	5	0.1µF ±10%, 50V X7R ceramic capacitors (0603) TDK CI608X7R1H104K
C3	1	0.22µF ±10%, 50V X7R ceramic capacitor (0805) Murata GRM21BR71H224K
C7	1	47µF ±20%, 6.3V X5R ceramic capacitor (1206) TDK C3216X5RUJ476M
C8, C13	2	0.033µF ±10%, 50V X7R ceramic capacitors (0603) Murata GRM188R71H333K
C9	1	0.47µF ±10%, 10V X7R ceramic capacitor (0603) TDK CI608X7R1A474K

DESIGNATION	QTY	DESCRIPTION
C10	1	1µF ±10%, 25V X7R ceramic capacitor (0805) TDK C2012X7R1E105K
C11	1	10µF ±10%, 16V X7R ceramic capacitor (1206) Murata GRM31CR61C106K
C12	1	220pF ±5%, 50V X7R ceramic capacitor (0603) TDK C1608X7R1H221J
C14	1	4700pF ±10%, 50V X7R ceramic capacitor (0603) Murata GRM188R71H472K
D1	1	150mA, 100V Schotky diode (SOD-123) Vishay BAT46W
D2	1	2A, 60V Schotky diode (SMB) Diode Inc. B260

Component List continued on next page.

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
JU1, JU2, JU3	3	2-pin headers
L1	1	27µH, 2.8A inductor Sumida CDRH124NP-270MC
R1, R2	2	332kΩ ±1% resistors (0603)
R3	0	Not installed, resistor (0603)
R4, R11	2	10kΩ ±5% resistors (0402)
R5	1	1Ω ±5% resistor (0603)
R6	1	2.26kΩ ±1% resistor (0603)
R7	1	4.53kΩ ±1% resistor (0603)
R8	1	133Ω ±1% resistor (0603)
R9	1	7.5kΩ ±1% resistor (0603)
R10	1	61.9kΩ ±1% resistor (0603)
R12	1	63.4kΩ ±1% resistor (0603)
TP1	1	PC mini red test point
U1	1	MAX15015AATX+ (36-pin, 6mm x 6mm x 0.8mm, TQFN)
—	3	Shunts (JU1, JU2, JU3)
—	1	MAX15015AEVKIT+ PCB

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Diodes Inc.	805-446-4800	www.diodes.com
Murata	770-436-1300	www.murata.com
Sumida	847-545-6700	www.sumida.com
TDK	847-803-6100	www.component.tdk.com
Vishay	203-268-6261	www.vishay.com

Note: *Indicate that you are using the MAX15015A when contacting these component suppliers.*

Quick Start

Recommended Equipment

- 40V adjustable, 2A power supply
- Electronic load capable of sinking up to 1A
- Three digital voltmeters

Procedure

The MAX15015A EV kit is fully assembled and tested. Follow these steps to verify board operation. **Do not turn on the power supply until all connections are completed.**

1) Connect the positive terminal of the electronic load to the VOUT PCB pad on the EV kit board. Connect the ground terminal of the electronic load to the PGND PC pad.
2) Connect digital voltmeters across the VIN and PGND pads, VOUT and PGND PC pads, and the LDO_OUT and GND pads.
3) Verify that shunts are installed on jumpers JU1 and JU2 (step-down converter and LDO outputs enabled).
4) Verify that a shunt is not installed at jumper JU3 (LDO_OUT set to 5V).
5) Connect the power supply's positive terminal to the VIN PCB pad on the EV kit. Connect the power-supply ground terminal to the PGND PC pad.
6) Turn on the power supply.
7) Set the power-supply voltage to 12V.
8) Enable the 1A electronic load.
9) Verify that the voltmeters at VOUT and LDO_OUT measure 3.3V and 5V, respectively.

Detailed Description

The MAX15015A EV kit evaluates the MAX15015A PWM/PFM step-down converter with an integrated high-side switch and LDO regulator. The MAX15015A EV kit operates over a wide input-voltage range of 4.5V to 40V and requires a 2A power supply.

The MAX15015A EV kit step-down converter is configured to 3.3V and provides up to 1A (typ). The MAX15015A step-down converter switching frequency is set to 500kHz, and can be synchronized to a SYNC input signal operating below 600kHz. The MAX15015A normally operates as a PWM converter and automatically switches to PFM mode at light loads to improve efficiency. The EV kit features PCB pads to evaluate the SYNC, EN_SW, and the EN_SYS features of the MAX15015A.

The LDO regulator has a default 5V output and can be configured for a 2.5V output after installing the shunt on jumper JU3. An open-drain $\overline{RESET}$ output changes from low to high whenever the LDO voltage rises to 92.5% of its regulated output. When LDO_OUT exceeds its rising threshold voltage, $\overline{RESET}$ remains low for the reset timeout period, and then goes high. The $\overline{RESET}$ signal can be monitored at test point TP1 on the EV kit and is pulled up to LDO_OUT by resistor R11. The reset timeout period is set by capacitor C8.

The MAX15015A features configurable soft-start, independent undervoltage lockout (UVLO) for the step-down converter and regulator, cycle-by-cycle current limit, hiccup-mode-output short-circuit protection, and thermal shutdown. The step-down converter UVLO is configurable by choosing the appropriate R2 and R3 resistor values.

Jumper Selection

Enabling VOUT and LDO_OUT

The MAX15015A features input pads EN_SW and EN_SYS that can be used to enable the VOUT and LDO_OUT outputs. The EV kit also provides jumpers JU1 and JU2 to configure the EN_SW and EN_SYS, respectively. See Table 1 for jumpers JU1 and JU2 configurations.

Table 1. EN_SYS and EN_SW Configuration

JU1 SHUNT POSITION	JU2 SHUNT POSITION	EV KIT FUNCTION	
		VOUT	LDO_OUT
Not installed	Not installed	Off	Off
Not installed	Installed	Off	Off
Installed	Not installed	Off	On
Installed	Installed	On	On

The MAX15015A EV kit shutdown current can be evaluated by removing jumper JU1.

LDO_OUT Selection

Jumper JU3 sets the linear regulator output voltage to 2.5V or 5V. See Table 2 for LDO jumper configuration. To configure LDO_OUT to other output voltages, refer to the *Setting the LDO Linear Regulator Output Voltage* section in the MAX15015A data sheet.

Table 2. LDO Configuration (JU3)

JU3 SHUNT POSITION	SET_LDO PIN CONNECTION	LDO_OUT OUTPUT VOLTAGE
Not installed	Connected to GND	5V
Installed	Connects to feedback resistors R10 and R12	2.5V

Configuring the Output Voltage (VOUT)

The MAX15015A EV kit step-down converter output voltage is configured to 3.3V by resistors R7 and R9. The EV kit's output voltage (VOUT) can be reconfigured in the range of 1.26V to 28V by replacing these resistors. To select a new value for resistor R7, refer to the *Setting the Output Voltage* section in the MAX15015A data sheet. Use the following equation to reconfigure the output voltage to the desired value:

$$R7 = \frac{R9}{\left[\frac{VOUT}{1.244} - 1\right]}$$

where VOUT is the desired output voltage in volts.

Reconfiguring the MAX15015A EV kit for a new output voltage may require replacing inductor L1 and capacitors C1 and/or C7. To select a new value for inductor L1 and capacitors C1 and C7, refer to the *Inductor Selection, Output Capacitor Selection,* and *Input Capacitor Selection* sections, respectively, in the MAX15015A data sheet.

Configuring the Undervoltage Lockout (UVLO)

The MAX15015A step-down converter and LDO regulator turns on when the input voltage (VIN) is above the MAX15015A minimum 4.1V threshold **(shunts on JU1 and JU2 must be installed)**. The converter turn-on threshold can be reconfigured to a desired value greater than 4.1V by selecting resistors R2 and R3. To reconfigure the converter's turn-on threshold, use the following equation:

$$R2 = R3 \times \left[\frac{V_{EN\_SW}}{1.5V} - 1\right]$$

where V_{EN_SW} is the desired turn-on threshold in volts.

Linear Regulator Operation

The MAX15015A linear regulator operates in either a preset voltage mode or an adjustable mode. In preset voltage mode, LDO_OUT is 5V. Select the preset voltage mode by removing the shunt at JU3. In adjustable mode, LDO_OUT is set to 2.5V by resistors R10 and R12 (shunt installed at JU3). To reconfigure LDO_OUT voltage to a different voltage (1.5V to 11V), replace resistors R10 and R12 with new values. Use the following equation to select a new resistor value:

$$R10 = \frac{R12}{\left[\frac{V_{LDO\_OUT}}{1.244} - 1\right]}$$

where V_{LDO_OUT} is the desired LDO_OUT voltage.

Synchronization Input (SYNC)

The EV kit's SYNC PCB pad can be used to synchronize the MAX15015A switching frequency with an external digital-clock signal in the range of 400kHz to 600kHz. When SYNC is driven with an external digital clock, the MAX15015A synchronizes to the rising edge of the external clock.

The square-wave clock source must provide the following signal qualities:

- Logic-low = 0 to 0.8V
- Logic-high = 2.2V to 5.5V
- Input frequency = 400kHz to 600kHz. Refer to the MAX15015A data sheet for more information on the SYNC pin.
- Duty cycle = 50%

To use external synchronization, connect the external square-wave clock to the SYNC and GND pads.

Compensation Network

The MAX15015A IC provides the flexibility of externally compensating its internal error amplifier to achieve stability for various applications. The MAX15015A is compensated by choosing values for resistors R6–R9, and capacitors C12, C13, and C14. To reconfigure the compensation network for specific requirements, refer to the *Compensation Design* section in the MAX15015A data sheet.

Evaluating the MAX15015B

The MAX15015A EV kit board can also evaluate the MAX15015B step-down converter. The MAX15015A IC must be removed and replaced with the MAX15015B. When using the MAX15015B, LDO_OUT has a 3.3V default output (JU3 not installed).

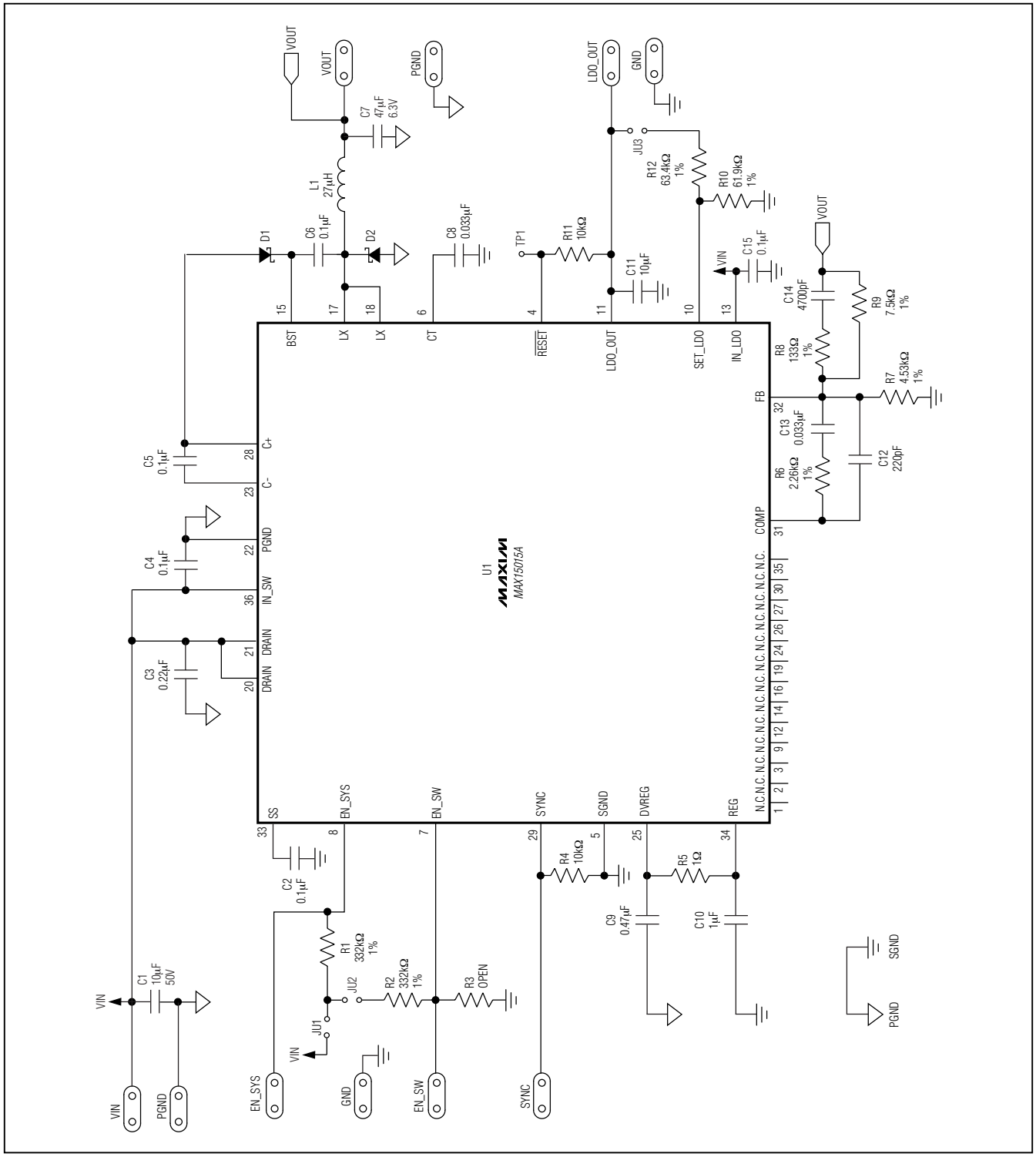

Figure 1. MAX15015A EV Kit Schematic

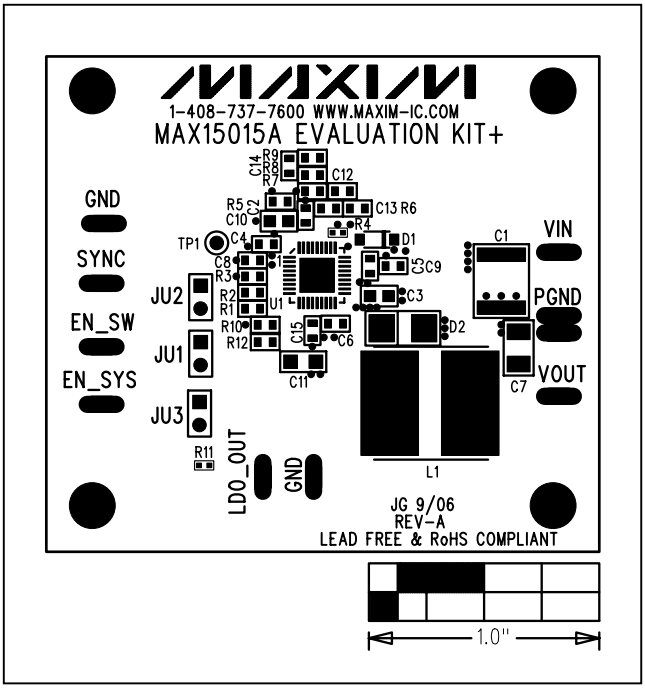

Figure 2. MAX15015A EV Kit Component Placement Guide—Component Side

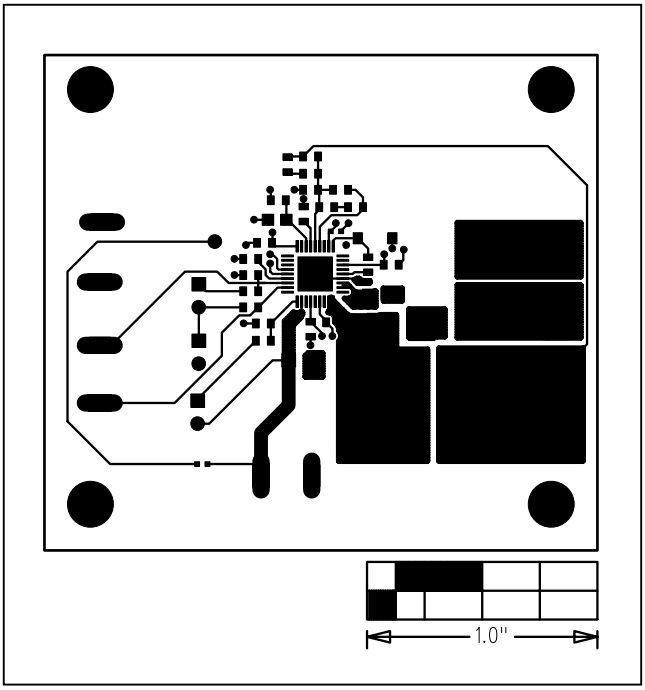

Figure 3. MAX15015A EV Kit PCB Layout—Component Side

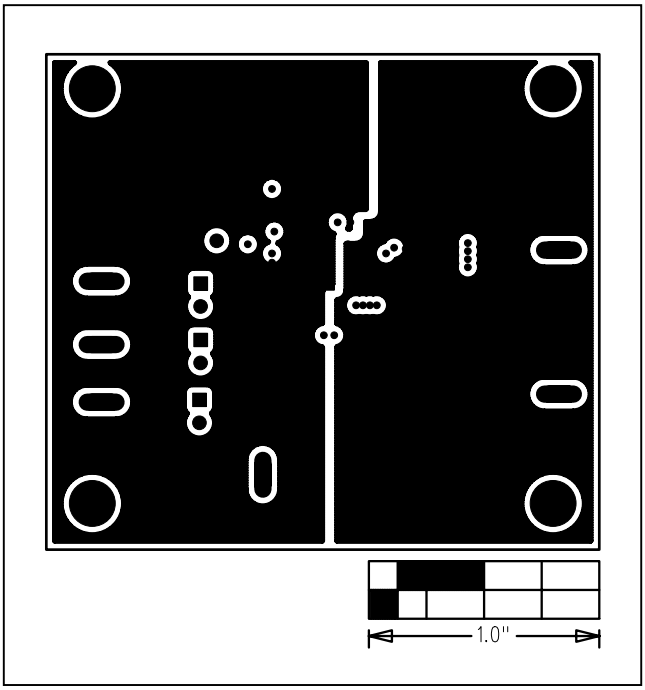

Figure 4. MAX15015A EV Kit PCB Layout—GND Layer 2

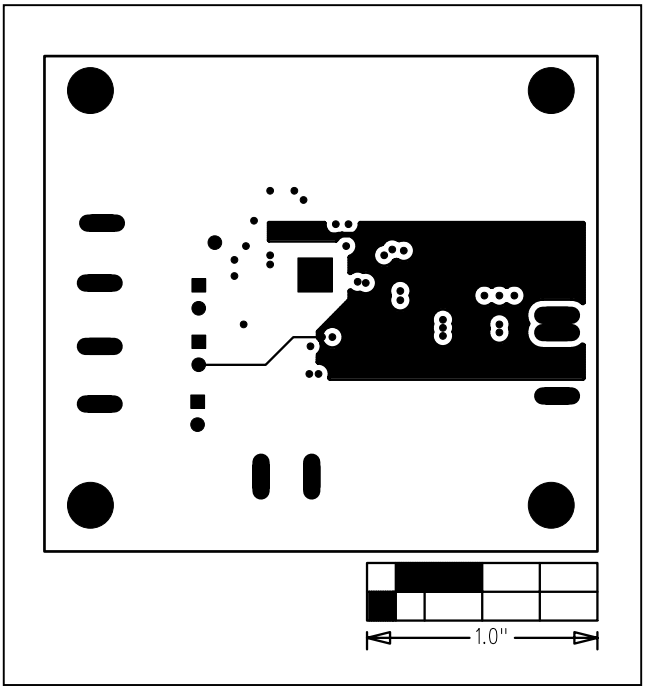

Figure 5. MAX15015A EV Kit PCB Layout—Power Layer 3

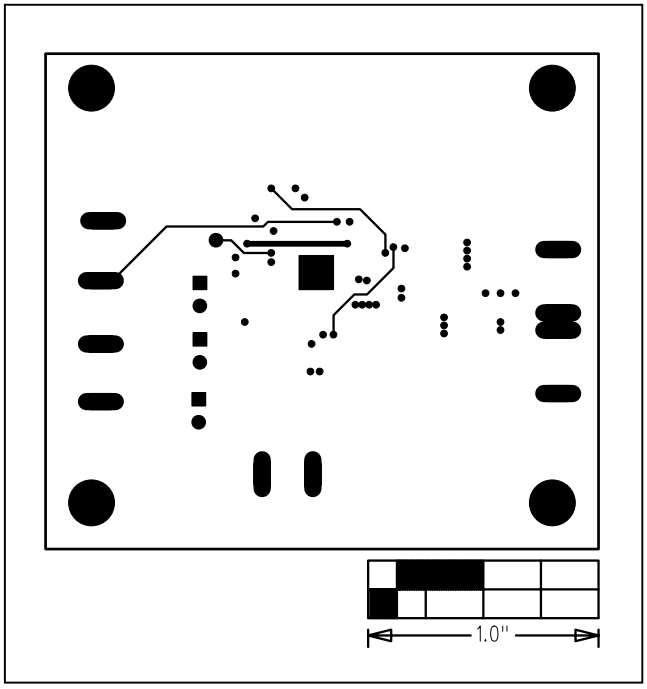

Figure 6. MAX15015A EV Kit PCB Layout—Solder Side