19-4885; Rev 0; 8/09

MAX15034B Evaluation Kit

Evaluates: MAX15034B/MAX5066

General Description

The MAX15034B evaluation kit (EV kit) is a two-phase, dual-output buck converter with a 5V to 16V input voltage range. The MAX15034B EV kit provides dual 1.2V output voltages (V_{OUT1} and V_{OUT2}). It delivers up to 20A output current for each output with 86.7% efficiency. The MAX15034B EV kit uses average current-mode control and operates at 300kHz switching frequency per phase where each phase is 180° out-of-phase with respect to the other.

The MAX15034B EV kit is a fully assembled and tested circuit board. Both outputs are adjustable between 0.61V and 5.5V by changing feedback resistors R4–R7. Additional features include thermal-shutdown and "hiccup-mode" short-circuit protection.

Component List

DESIGNATION	QTY	DESCRIPTION
AGND (x2), CLKIN, VREG	4	20G tinned copper bus wire formed into U-shaped loops (0.25in off the PCB)
C1	1	470µF, 35V electrolytic capacitor SANYO 35CE470KX Panasonic EEVFK1V471Q
C2, C25, C26, C27	4	22µF ±10%, 25V X5R ceramic capacitors (1210) Murata GRM32ER61E226K
C3	1	4.7µF ±10%, 10V X5R ceramic capacitor (0805) Murata GRM21BR61A475K TDK C2012X5R1A475K
C4, C5, C24	3	0.1µF ±10%, 25V X7R ceramic capacitors (0603) Murata GRM188R71E104K TDK C1608X7R1E104K

Features

- **5V to 16V Input-Voltage Range (Design Optimized for 12V Input)**
- **Output Voltages**
  - **1.2V at 20A (Adjustable from 0.61V to 5.5V)**
  - **1.2V at 20A (Adjustable from 0.61V to 5.5V)**
- **300kHz Switching Frequency**
- **Both Outputs Can be Paralleled for Higher Current Capability (Using Mode Function)**
- **Average Current-Mode Control Provides Accurate Current Limit**
- **Current-Sharing Accuracy within ±5% Between Parallel Channels**
- **180° Interleaved Operation Reduces Size of Input Filter Capacitors**
- **Overtemperature Shutdown**
- **Excellent Line- and Load-Transient Response**
- **Hiccup-Mode Overcurrent Protection**
- **Can be Synchronized to an External Clock**
- **Provision for Output DC Accuracy**
- **Low-Profile Components**
- **Fully Assembled and Tested**

Ordering Information

PART	TYPE
MAX15034BEVKIT+	EV Kit

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

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
C6, C7	2	0.47µF ±10%, 25V X5R ceramic capacitors (0603) Murata GRM188R61E474K TDK C1068X5R1E474K
C8, C13, C14	3	1µF ±10%, 16V X5R ceramic capacitors (0603) Murata GRM188R61C105K TDK C1608X7R1C105K
C9, C20	2	560µF, 4V, 9mΩ electrolytic capacitors (E12) SANYO 4SVPC560MX Nichicon PCJ0G561MCL9GS
C10, C11, C21, C22	4	100µF ±20%, 6.3V X5R ceramic capacitors (1206) Murata GRM31CR60J107ME39L
C16, C18	2	470pF ±10%, 50V X7R ceramic capacitors (0603) Murata GRM188R71H471K
C17, C19	2	0.033µF ±10%, 25V X7R ceramic capacitors (0603) Murata GRM188R71E333K
C28, C30	0	Not installed, ceramic capacitors (0603)
C29, C31	2	1200pF ±5%, 50V C0G ceramic capacitors (0603) Murata GRM1885C1H122J TDK C1608C0G1H122J
C32, C35	2	1µF ±10%,16V X5R ceramic capacitors (0603) Murata GRM188R61C105K
C33, C36	0	Not installed, ceramic capacitors (0603)
C34, C37	2	100pF ±5%, 50V C0G ceramic capacitors (0402) Murata GRM1555C1H101J TDK C1005C0G1H101J
C38, C39	0	Not installed, ceramic capacitors (0805)
C40, C43	2	10µF ±20%, 6.3V X5R ceramic capacitors (0603) Murata GRM188R60J106M
C41, C42	2	1µF ±10%, 6.3V X5R ceramic capacitors (0603) Murata GRM188R60J105K
C44, C45	0	Not installed, ceramic capacitors (0603)
D1, D2	2	100mA, 30V Schottky diodes (SOT23) Central Semi CMPSH-3 (Top Mark: D95)
JU1, JU2, JU3	3	3-pin headers, 0.1in centers Sullins PEC36SAAN
L1, L2	2	0.56µH, 1mΩ, 30A power inductors Cooper Bussmann (Coiltronics) HCF1305-R56-R
N1, N2	2	20V, 20A, 11.5mΩ n-channel MOSFETs (PowerPAK 8 SO) Vishay Siliconix SiR484DP
N3, N4	2	20V, 50A, 4mΩ n-channel MOSFETs (PowerPAK 8 SO) Vishay Siliconix SiR890DP
PGND (x3), VIN, VOUT1, VOUT2	6	Binding posts Johnson 111-2223-001
R1, R2	0	Not installed, sense resistors—short (PC trace) (2512)
R3	1	1Ω ±5% resistor (1206)
R4, R6	2	2.05kΩ ±1% resistors (0603)
R5, R7	2	2kΩ ±1% resistors (0603)
R8, R9	2	10kΩ ±1% resistors (0603)

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
R10, R11	2	4.7Ω resistors (0603)
R12	1	41.2kΩ ±1% resistor (0603)
R13, R14	2	5.1kΩ ±5% resistors (0603)
R15, R16	2	1kΩ ±1% resistors (0603)
R17, R19	0	Not installed, resistors (1206)
R18, R20	2	2.2Ω ±5% resistors (1206)
R21	1	33.2kΩ ±1% resistor (0603)
R22	1	10kΩ ±1% resistor (0603)
R23–R26	4	806Ω ±1% resistors (0603)
R27, R28	2	49.9Ω ±1% resistors (0402)
R29, R30	0	Not installed, resistors (0603)

DESIGNATION	QTY	DESCRIPTION
U1	1	Single-/dual-output synchronous buck controller (28 TSSOP-EP*) Maxim MAX15034BAUI+
TP1–TP8, TP1A–TP4A	12	Miniature test points Keystone 5000
—	3	Shunts (see Tables 1, 2, 3) Sullins STC02SYAN
—	1	PCB: MAX15034B EVALUATION KIT+

**EP = Exposed pad.*

Component Suppliers

SUPPLIER	PHONE	WEBSITE
Central Semiconductor Corp.	631-435-1110	www.centralsemi.com
Cooper Bussmann	916-941-1117	www.cooperet.com
Murata Electronics North America, Inc.	770-436-1300	www.murata-northamerica.com
Nichicon USA	858-824-1515	www.nichicon-us.com
Panasonic Corp.	800-344-2112	www.panasonic.com
SANYO Electric Co., Ltd.	619-661-6835	www.sanyodevice.com
TDK Corp.	847-803-6100	www.component.tdk.com
Vishay	402-563-6866	www.vishay.com

Note: *Indicate that you are using the MAX15034B when contacting these component suppliers.*

Quick Start

Recommended Equipment

- 5V to 16V power supply
- Digital multimeters (DMMs)
- 100MHz dual-trace oscilloscope

Procedure

The MAX15034B 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 the shunts are across:

   JU1 pins 1-2 (OUT1 enabled)

   JU2 pins 1-2 (OUT2 enabled)

   JU3 pins 2-3 (dual-output, out-of-phase operation)

2) Turn on the power supply and adjust the input voltage to 12V.

3) Verify that the output voltages are V_{OUT1} = 1.2V and V_{OUT2} = 1.2V.

Detailed Description of Hardware

Jumper Settings

Table 1. Jumper JU1 Functions (Output 1 Enable Control)

SHUNT POSITION	EN1 PIN	OUT1
1-2*	Connected to VREG	OUT1 is enabled, V_{OUT1} = 1.2V
2-3	Connected to GND	OUT1 is disabled, V_{OUT1} = 0V

**Default position.*

Table 2. Jumper JU2 Functions (Output 2 Enable Control)

SHUNT POSITION	EN2 PIN	OUT1
1-2*	Connected to VREG	OUT2 is enabled, V_{OUT2} = 1.2V
2-3	Connected to GND	OUT2 is disabled, V_{OUT2} = 0V

**Default position.*

Dual-Output/Dual-Phase Select (Mode Function)

The MAX15034B can operate as a dual-output, independently regulated buck converter, or as a dual-phase, single-output buck converter. The MODE input selects between the two operating modes. When MODE is grounded (logic-low), the MAX15034B operates as a dual-output DC-DC converter. When MODE is connected to REG (logic-high), the MAX15034B works as a dual-phase, single-output buck regulator with each phase 180° out-of-phase with respect to each other.

Operating the MAX15034B as a single-output, dual-phase DC-DC controller requires changes to the EV kit. Each DC-DC controller should have identical external components and the output of both DC-DC controllers should be connected to form a single output. Refer to the MAX15034 IC data sheet for selecting the appropriate components.

Evaluating Other Output Voltages

The MAX15034B provides programmed, dual 1.2V outputs (V_{OUT1} and V_{OUT2}). Both outputs can also be adjusted from 0.61V to 5.5V by using resistive voltage-dividers formed by R4/R5 and R6/R7.

The adjusted output voltages are:

V_{OUT1} = 0.61V (1 + R4/R5)

V_{OUT2} = 0.61V (1 + R6/R7)

Note: Refer to the MAX15034 IC data sheet for selection of output capacitors, inductor, and network compensation values for different output voltages.

RT/CLKIN Input

The MAX15034B EV kit is configured for a clock frequency of 300kHz. The EV kit can be evaluated at different clock frequencies by adjusting R12 or directly applying a clock signal (200kHz to 2MHz) to the CLKIN pad. Refer to the MAX15034 IC data sheet for proper selection of the clock-setting resistor, R12.

Table 3. Jumper JU3 Functions (Mode Function)

SHUNT POSITION	MODE PIN	OUT1
1-2	Connected to VREG	MAX15034B operates as a single-output, dual-phase buck regulator
2-3*	Connected to GND	MAX15034B operates as a dual-output, out-of-phase buck regulator

**Default position.*

High DC Output Accuracy

MAX15034 EV kit can be configured for either adaptive voltage positioning or for high DC output accuracy. For adaptive voltage positioning at the output, keep C44, C45, R29, and R30 open, and use resistors R8, R9, as suggested in the *Component List*. For high DC output accuracy at the output, see Table 4 for the necessary modifications (use capacitors at R8, R9).

With the above modifications for high DC output accuracy, the observed crossover frequency is 30.2kHz and phase margin is 54.5°.

Sense Resistor

As configured, the MAX15034B EV kit utilizes lossless inductor sensing to limit the maximum inductor current. The EV kit can also be evaluated with a current-sense resistor. To evaluate resistive sensing, reconfigure the EV kit as listed in Table 5.

Once the EV kit is reconfigured, make the following connections:

1) Connect TP1 to TP1A
2) Connect TP2 to TP2A
3) Connect TP3 to TP3A
4) Connect TP4 to TP4A

Alternate Components

As configured, the MAX15034B EV kit is fully functional and operational. However, the EV kit can be reconfigured with alternate components. Table 6 provides alternate MOSFETs (N1–N4) and inductors (L1, L2) for evaluation of the MAX15034B EV kit.

Evaluating the MAX5066

The MAX15034B EV kit can also be used to evaluate the MAX5066. To evaluate the EV kit with a MAX5066, order a MAX5066EUI+ with the MAX15034B EV kit. Additional EV kit modifications are needed, as listed in Table 7.

Table 4. Suggested Components for High DC Output Accuracy

DESIGNATION	QTY	DESCRIPTION
C44, C45	2	4700pF ±10%, 50V X7R ceramic capacitors (0603) Murata GRM188R71H472KA01D
R8, R9	2	100pF ±10%, 50V C0G ceramic capacitors (0603) Murata GRM188R71H472KA01D
R29, R30	2	12.1kΩ ±1% resistors (0603)

**Default position.*

Table 5. Sense Resistor Configuration

COMPONENT		DESCRIPTION
V_{OUT1}	V_{OUT2}	
C32, C33, C34	C35, C36, C37	Not installed
R1	R2	Install current-sense resistor*
R23, R24	R25, R26	Not installed, resistors
TP3, TP3A, TP4, TP4A	TP1, TP1A, TP2, TP2A	Miniature test points

**Refer to the Current Limit section in the MAX15034 IC data sheet.*

Table 6. Alternate Components List

DESIGNATION	DESCRIPTION
N1, N2 (high side)	Fairchild Semiconductor FDD8780
	Fairchild Semiconductor FDD8782
	Infineon IPD075N03LG
	ON Semiconductor NTD60N20R
	International Rectifier IRLR7821
N3, N4 (low side)	Infineon IPD031N03MG
	International Rectifier IRLR8743
	Fairchild Semiconductor FDD8870
L1, L2 (3 lead)	Sumida CEP125NP-0R6N-D
	NEC TOKIN C-PI-1250-0R6S
	Reisetech L510-R68MF
	Reisetech L816-R68MF
L1, L2 (2 lead)	Panasonic ETQP5LR50XFA
	Vishay (Dale) IHLP-5050EZ-ER-1R0-M-01

Table 7. MAX5066 Evaluation Configuration

DESIGNATION	DESCRIPTION
R21, R22	Not installed, resistors
C15 (installed in the R22 location)	0.22µF ±20%, 10V X7R ceramic capacitor (0603)

MAX15034B Evaluation Kit

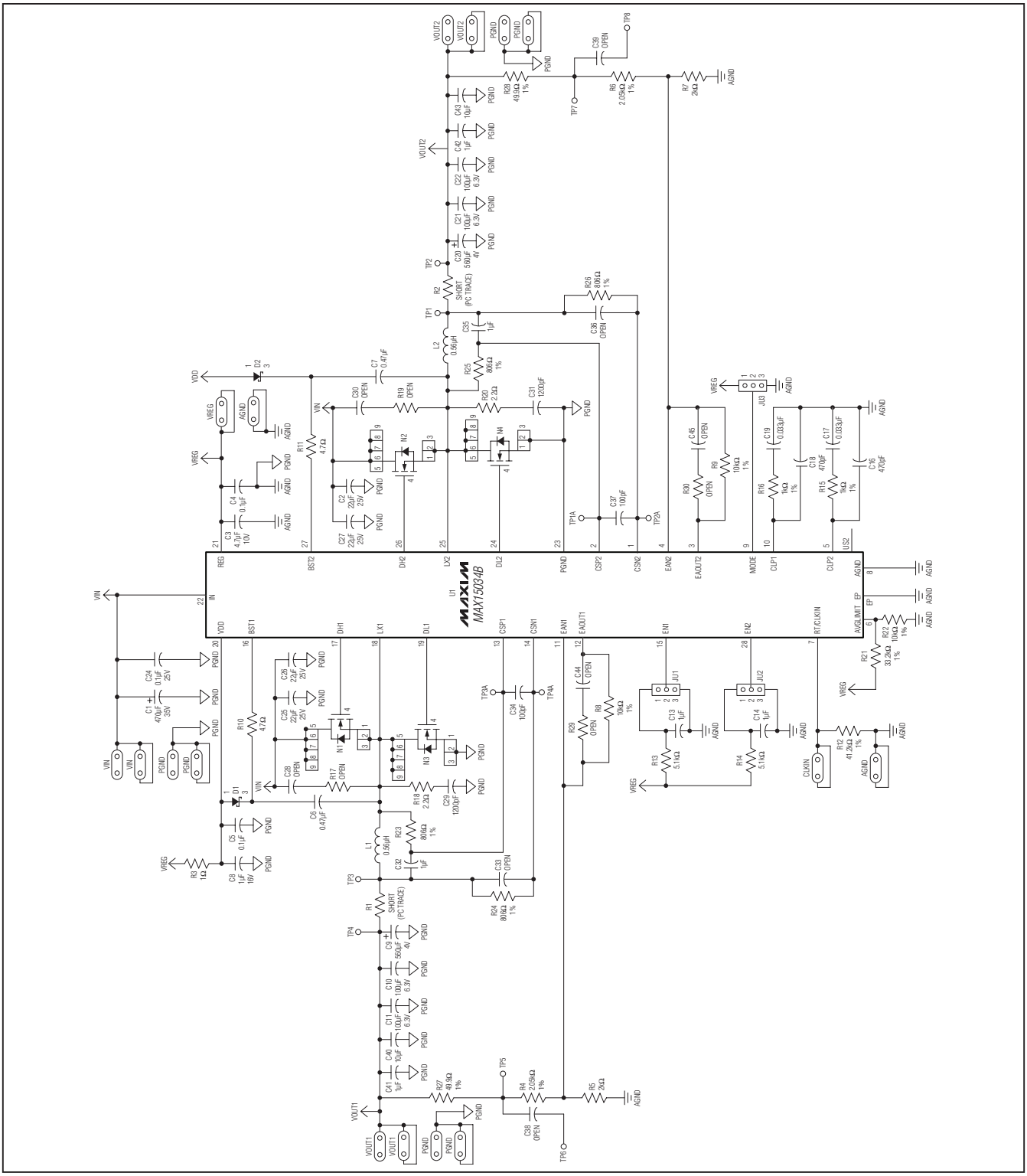

Figure 1. MAX15034B EV Kit Schematic

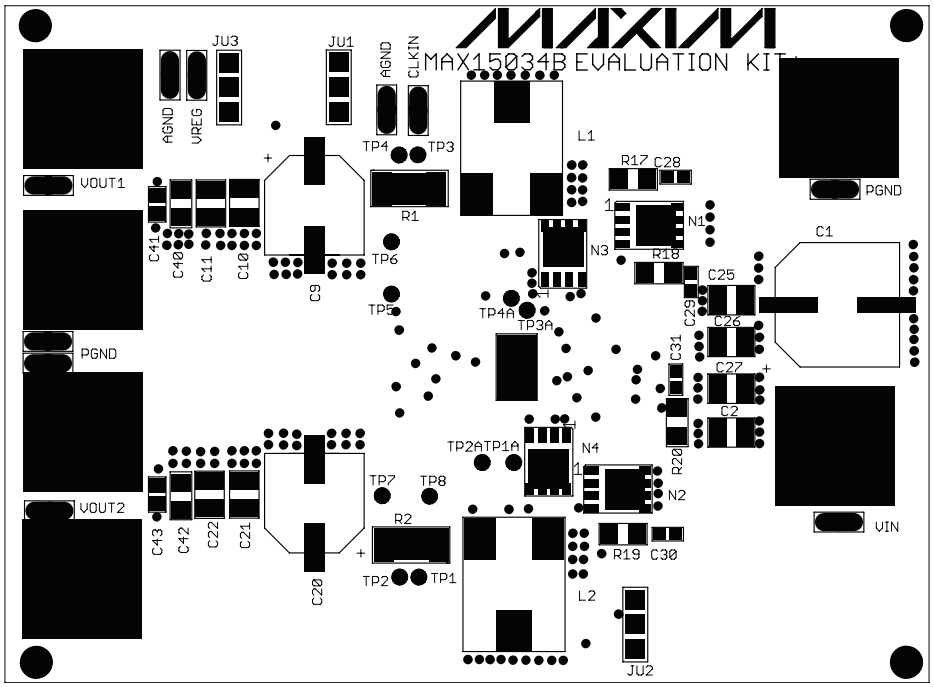

Figure 2. MAX15034B EV Kit Component Placement Guide—Component Side

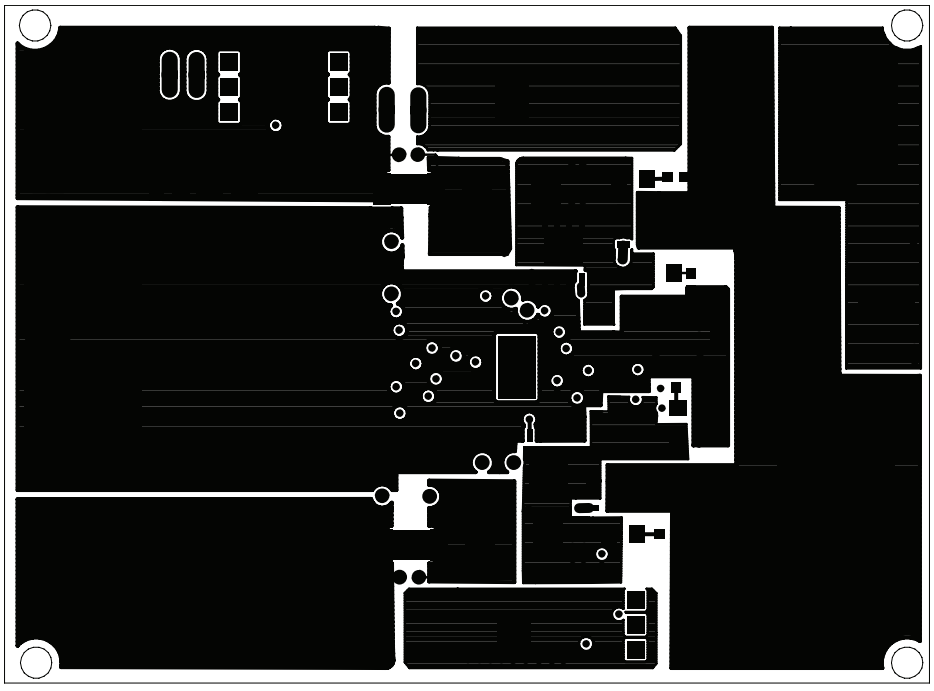

Figure 3. MAX15034B EV Kit PCB Layout—Component Side

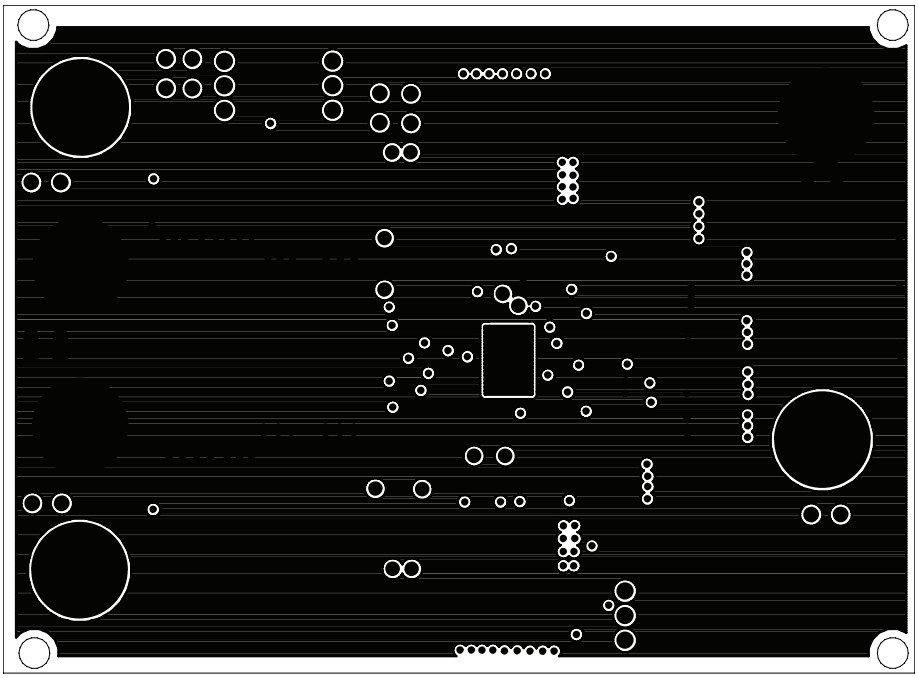

Figure 4. MAX15034B EV Kit PCB Layout—Internal Layer 2—PGND Plane

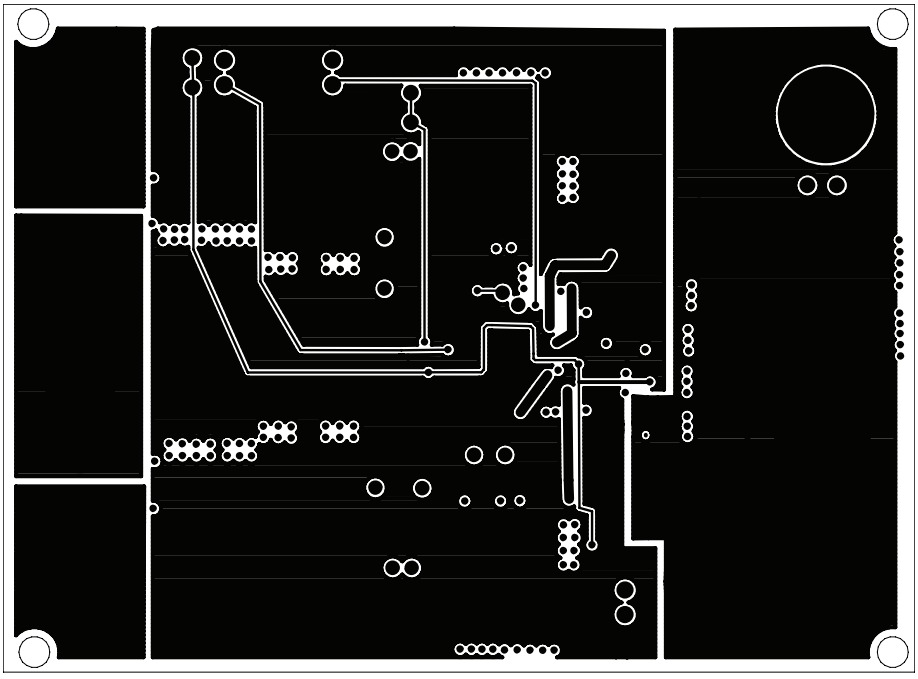

Figure 5. MAX15034B EV Kit PCB Layout—Internal Layer 3—AGND Layer

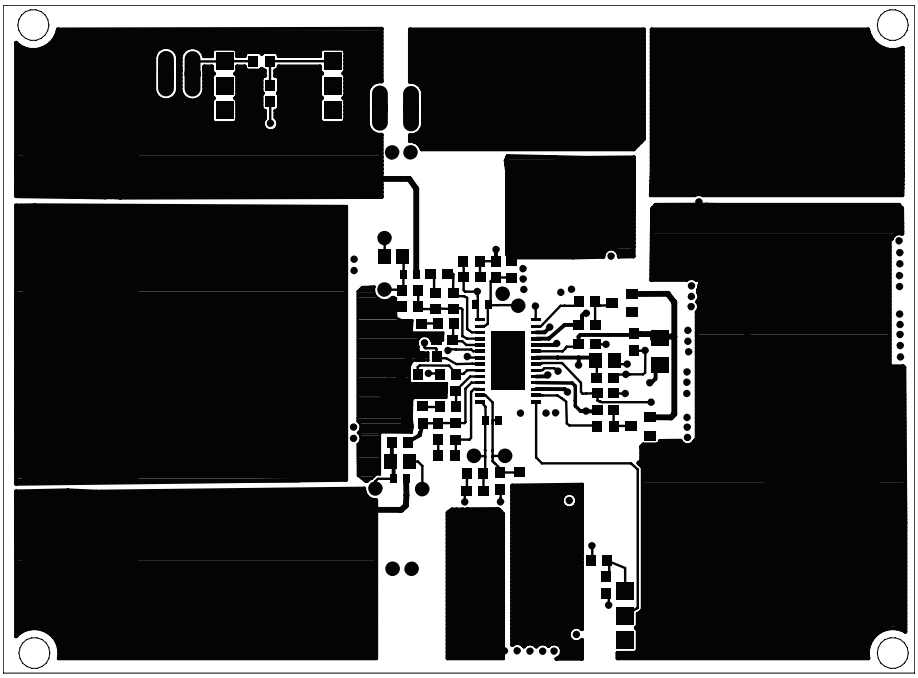

Figure 6. MAX15034B EV Kit PCB Layout—Solder Side

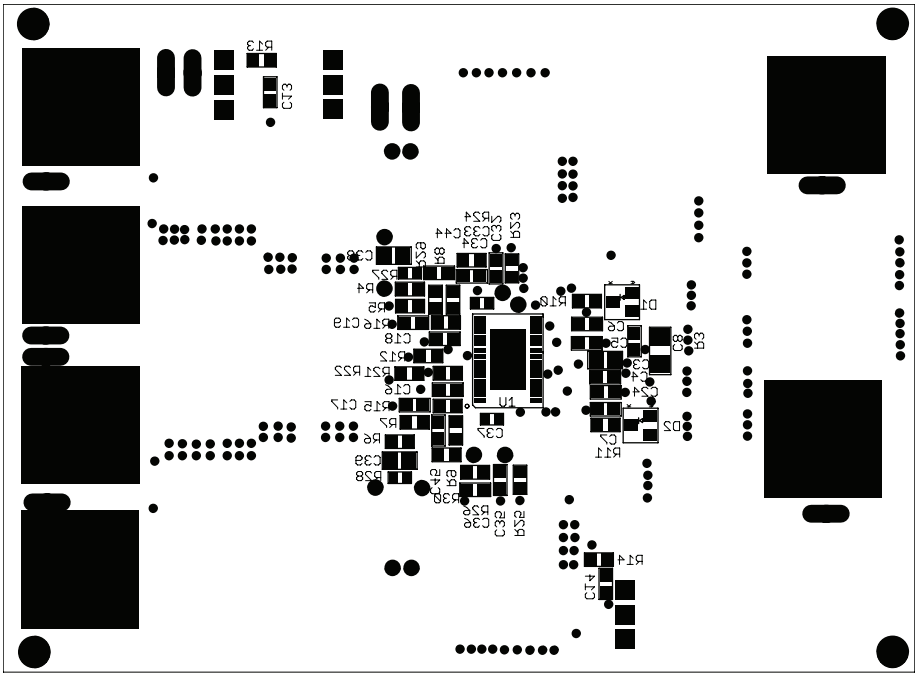

Figure 7. MAX15034B EV Kit Component Placement Guide—Solder Side