

# MAXIM

## MAX8544 Evaluation Kit

### General Description

The MAX8544 evaluation kit (EV kit) contains a fully assembled and tested circuit using the MAX8544 step-down controller. The MAX8544 circuit is designed to operate from a 10.8V to 13.2V input and provide a 2.5V output at up to 15A. The EV kit contains a second circuit (not populated) for evaluating the MAX8543. By changing the appropriate external components, both circuits can be configured to operate with input voltages from 3V to 13.2V and provide an output that is adjustable from 0.8V to  $(0.9 \times V_{IN})$ .

### Features

- ◆ Up to 15A Output Current Capability
- ◆ 10.8V to 13.2V Input Voltage Range
- ◆ Prebias Startup
- ◆ Lossless Inductor Current Sensing
- ◆ Enable Input
- ◆ Adjustable Soft-Start
- ◆ Overvoltage Protection
- ◆ Selectable Latch-Off or Automatic Recovery
- ◆ Fully Assembled and Tested

### Ordering Information

PART	TEMP RANGE	IC PACKAGE
MAX8544EVKIT	0°C to +70°C	20 QSOP

### Component List

#### MAX8544 Circuit

DESIGNATION	QTY	DESCRIPTION
C13	1	1 $\mu$ F $\pm$ 10%, 25V X7R ceramic capacitor (1206) Panasonic ECJ3YB1E105K Taiyo Yuden TMK316BJ105KL TDK C3216X7R1E105K
C14	1	0.1 $\mu$ F $\pm$ 10%, 50V X7R ceramic capacitor (0603) TDK C1608X7R1H104K Taiyo Yuden UMK107BJ104KA
C15, C16	2	180 $\mu$ F, 4V, 10m $\Omega$ aluminum polymer SPCAPs Panasonic EEFUE0G181XR
C17, C39	2	0.47 $\mu$ F $\pm$ 10%, 10V X7R ceramic capacitors (0603) TDK C1608X7R1A474K
C18, C19, C20	3	10 $\mu$ F $\pm$ 20%, 16V X5R ceramic capacitors (1206) Panasonic ECJ3YB1C106M TDK C3216X5R1C106M
C21	1	0.22 $\mu$ F $\pm$ 10%, 10V X7R ceramic capacitor (0603) Taiyo Yuden LMK107BJ224KA TDK C1608X7R1A224K

DESIGNATION	QTY	DESCRIPTION
C22	1	220pF $\pm$ 10%, 50V X7R ceramic capacitor (0603) TDK C1608X7R1H221K
C23	1	10pF $\pm$ 5%, 50V C0G ceramic capacitor (0603) TDK C1608C0G1H100J
C26	1	470 $\mu$ F $\pm$ 20%, 16V aluminum electrolytic (E) capacitor Rubycon 16MBZ470M
C27, C29, C37, C38	0	Not installed (0603)
C28	1	10 $\mu$ F $\pm$ 20%, 6.3V X5R ceramic capacitor (0805) Panasonic ECJ2FB0J106M Taiyo-Yuden JMK212BJ106MG TDK C2012X5R0J106M
C32	0	Not installed (1206)
C33	1	100pF $\pm$ 5%, 50V C0G ceramic capacitor (0603) TDK C1608C0G1H101J
D3	1	Schottky diode, 100mA, 30V (SOT323) Central CMSSH-3

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## Component List (continued)

### MAX8544 Circuit

DESIGNATION	QTY	DESCRIPTION
D4	1	Switching diode, 250mA, 100V (SOT23) Central CMPD914
JU4–JU7	4	3-pin headers
L2	1	0.82 $\mu$ H inductor Vishay IHLP-5050FD-01 .82 $\mu$ H
N5, N6	2	n-channel MOSFETs International Rectifier IRF7821
N7, N8	2	n-channel MOSFETs International Rectifier IRF7832
R10, R20	0	Not installed (0805)
R12	0	Not installed (2512) PC board short
R13	1	17.4k $\Omega$ $\pm$ 1% resistor (0603)

DESIGNATION	QTY	DESCRIPTION
R14	1	8.06k $\Omega$ $\pm$ 1% resistor (0603)
R15	1	90.9k $\Omega$ $\pm$ 1% resistor (0603)
R16	1	9.31k $\Omega$ $\pm$ 1% resistor (0603)
R17, R18	2	1.3k $\Omega$ $\pm$ 5% resistors (0603)
R19	1	42.2k $\Omega$ $\pm$ 1% resistor (0603)
R21, R24	2	100k $\Omega$ $\pm$ 5% resistors (0603)
R22	1	200k $\Omega$ $\pm$ 5% resistor (0603)
R23	1	220k $\Omega$ $\pm$ 5% resistor (0603)
R27, R30	0	Not installed (0603)
R31	0	Not installed (0603) PC board short
U2	1	MAX8544EEP
—	4	Shunts
—	1	MAX8544EVKIT PC board

## Component List

### Optional MAX8543 Circuit

DESIGNATION	QTY	DESCRIPTION
C1, C2	0	180 $\mu$ F, 4V, 10m $\Omega$ aluminum polymer SPCAPs Panasonic EEFUE0G181XR
C3, C40	0	0.47 $\mu$ F $\pm$ 10%, 10V X7R ceramic capacitors (0603) TDK C1608X7R1A474K
C4	0	0.1 $\mu$ F $\pm$ 10% 50V X7R ceramic capacitor (0603) TDK C1608X7R1H104K Taiyo Yuden UMK107BJ104KA
C5–C8	0	10 $\mu$ F $\pm$ 20% 16V X5R ceramic capacitors (1206) Panasonic ECJ3YB1C106M TDK C3216X5R1C106M
C9	0	1 $\mu$ F $\pm$ 10% 25V X7R ceramic capacitor (1206) Panasonic ECJ3YB1E105K Taiyo Yuden TMK316BJ105KL TDK C3216X7R1E105K
C10	0	0.22 $\mu$ F $\pm$ 10%, 10V X7R ceramic capacitor (0603) Taiyo Yuden LMK107BJ224KA TDK C1608X7R1A224K

DESIGNATION	QTY	DESCRIPTION
C11	0	12pF $\pm$ 5%, 50V C0G ceramic capacitor (0603) TDK C1608C0G1H120J
C12	0	220pF $\pm$ 10%, 50V X7R ceramic capacitor (0603) TDK C1608X7R1H221K
C24	0	470 $\mu$ F $\pm$ 20%, 6.3V POSCAP Sanyo 6TPB470M
C25, C31, C35, C36	0	Not installed (0603)
C30	0	10 $\mu$ F $\pm$ 20%, 6.3V X5R ceramic capacitor (0805) Panasonic ECJ2FB0J106M Taiyo-Yuden JMK212BJ106MG TDK C2012X5R0J106M
C34	0	100pF $\pm$ 5%, 50V C0G ceramic capacitor (0603) TDK C1608C0G1H101J
D1	0	Schottky diode, 100mA, 30V (SOT323) Central CMSSH-3
D2	0	Switching diode, 250mA, 100V (SOT23) Central CMPD914

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## Component List (continued)

### Optional MAX8543 Circuit

DESIGNATION	QTY	DESCRIPTION
JU1, JU2, JU3	0	3-pin headers
L1	0	0.33 $\mu$ H inductor Coilcraft DO3316P-331HC
N1, N2	0	n-channel MOSFETs Vishay Si4866DY
N3, N4	0	n-channel MOSFETs Vishay Si4866DY
R1	0	17.4k $\Omega$ $\pm$ 1% resistor (0603)
R2	0	8.06k $\Omega$ $\pm$ 1% resistor (0603)
R3	0	Not installed (2512) PC board short
R4, R5	0	680 $\Omega$ $\pm$ 5% resistors (0603)

DESIGNATION	QTY	DESCRIPTION
R6	0	53.6k $\Omega$ $\pm$ 1% resistor (0603)
R7	0	100k $\Omega$ $\pm$ 5% resistor (0603)
R8	0	200k $\Omega$ $\pm$ 5% resistor (0603)
R9, R25	0	Not installed (0805)
R11	0	150k $\Omega$ $\pm$ 5% resistor (0603)
R26	0	Not installed (0603)
R28, R29	0	Not installed (0603) PC board short
U1	0	MAX8543EEE
—	0	Shunts

## Quick Start

### Recommended Equipment

- Power supply capable of supplying 10.8V to 13.2V at 4A
- Load (up to 15A)
- Voltmeter

### Procedure

The MAX8544 EV kit is fully assembled and tested. Follow these steps to verify board operation:

- 1) Preset the power supply to between 10.8V and 13.2V. Turn off the power supply. **Do not turn on the power supply until all connections are completed.**
- 2) Connect the positive power-supply lead to the EV kit terminal labeled IN2.
- 3) Connect the negative power-supply lead to the EV kit terminal labeled PGND2.
- 4) Connect the load (up to 15A) and voltmeter between the OUT2 and PGND2 terminals of the EV kit.
- 5) Verify that jumper JU4 is shorted across pins 2-3 (enable).
- 6) Verify that jumpers JU5 and JU6 are shorted across pins 1-2 (sets the current limit to 50mV).
- 7) Turn on the power supply.
- 8) Verify that the voltmeter reads 2.5V  $\pm$ 2%.

## Detailed Description

### Enable/Shutdown

To enable the MAX8544 (MAX8543), short pins 2-3 of JU4 (JU1). To place the MAX8544 (MAX8543) in low-power shutdown mode, short pins 1-2 of JU4 (JU1) (see Table 1).

### Setting the Peak Current-Limit Threshold

The MAX8544 circuit is designed to operate with a 50mV peak current-limit threshold (JU5 and JU6 pins 1-2 shorted). JU5 and JU6 set the peak current-limit threshold as shown in Table 2. However, for proper operation, it is necessary to change some of the external components when changing the current limit. The MAX8543 circuit works similarly, but uses JU2 and JU3 for peak current-limit threshold programming. Refer to the MAX8543/MAX8544 data sheet for information on component selection.

### Selecting the Current-Limit Mode

Use JU7 to select the circuit behavior following an over-current condition (valley current limit exceeded). Short pins 1-2 of JU7 to automatically recover after the fault condition is removed, or short pins 2-3 to latch the part off as soon as the fault occurs (see Table 3). To restart the circuit after it latches off, either cycle the input supply off then on, or move JU4 to short pins 1-2, then back to pins 2-3. Refer to the MAX8543/MAX8544 data sheet for details of valley current limit and mode operation.

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**Table 1. JU1, JU4 Enable/Shutdown Selection**

JUMPER POSITION	FUNCTION
1-2	Shutdown
2-3	Enable

**Table 2. JU2, JU3, JU5, and JU6 Peak Current-Limit Threshold Select**

JU2/JU5 POSITION	JU3/JU6 POSITION	CURRENT-LIMIT THRESHOLD
1-2	1-2	50mV
1-2	2-3	100mV
2-3	1-2	150mV
2-3	2-3	200mV

**Table 3. JU7 Current-Limit Mode**

JU7 POSITION	CURRENT-LIMIT MODE
1-2	Autorecover
2-3	Latch-off

### Power-OK (POK)

POK is an open-drain output on the MAX8544 that monitors the output voltage. When the output is above 91% of its nominal regulation voltage, POK is high impedance. When the output drops below 91% of its nominal regulation voltage, POK is pulled low. POK is also pulled low when the MAX8544 is shut down. To allow POK to be used as a logic-level output, a 100kΩ pullup resistor from POK to V<sub>L</sub> is included in the EV kit.

### Synchronization

The MAX8544 (MAX8543) can be synchronized to an external clock by connecting the clock signal to the pad on the EV kit labeled SYNC\_IN2 (SYNC\_IN1). In addition, on the MAX8544 circuit, a synchronization output (SYNC\_OUT) provides a clock signal that is 180° out-of-phase with the MAX8544 switching. This clock signal can be used to synchronize a second MAX8543/MAX8544 controller 180° out-of-phase with the first. If an external clock is used, the clock duty cycle must be 50% for SYNC\_OUT to be 180° out-of-phase.

### Changing the Switching Frequency

The switching frequency is adjustable by changing R19 (R6). Note that the EV kit circuit is optimized for 600kHz (500kHz) operation. When changing the switching frequency, it is necessary to also change other components to obtain the best performance. Refer to the MAX8543/MAX8544 data sheet for information on calculating the value for R19 (R6) and selection of other components.

### Changing the Input Voltage Range

Although the MAX8544 EV kit is optimized for operation from a 10.8V to 13.2V input supply, it can be configured to operate with supplies from 3V to 13.2V by changing external components. Refer to the MAX8543/MAX8544 data sheet for information on component selection. When operating the EV kit from a supply of less than 5.5V, bypass the V<sub>L</sub> regulator by shorting the pads of R30.

### Setting the Output Voltage

The voltage-divider resistors R13 (R1) and R14 (R2) set the output voltage of the MAX8544 (MAX8543) circuit. Select a value for R14 (R2) between 8kΩ and 14kΩ, then solve for R13 (R1) from the following equation:

$$R13 = R14 \times \left( \frac{V_{OUT}}{V_{FB}} - 1 \right)$$

where V<sub>FB</sub> is 0.8V.

Refer to the MAX8543/MAX8544 data sheet for selecting output inductor, capacitor, and compensation components for optimized performance. If foldback current limit is used, the values of the current-limit threshold setting resistors must also be recalculated.

### Using a Current-Sense Resistor

To optimize efficiency, the MAX8544 EV kit is configured to use the inductor resistance for peak current sensing. For a more accurate current sense, use a current-sense resistor, R12 (R3), as the sensing element. When using the current-sense resistor, first cut the traces shorting R12 (R3) on the PC board and remove components R17 (R4), C17 (C3), C39 (C40), and R18 (R5). Refer to Figure 8 in the MAX8543/MAX8544 data sheet. Install the current-sense resistor (equivalent to R3 in Figure 8) into R12 (R3) on the EV kit. Install a resistor (equivalent to R4 in Figure 8) into C17 (C3) on the EV kit. Install a resistor and capacitor (equivalent to R5 and C10 in Figure 8) piggybacked into R27 (R26) on the EV kit. Finally, install a capacitor (equivalent to C9 in Figure 8) from the junction of C17 (C3) and R17 (R4) on the EV kit to the junction of the current-sense resistor and the output capacitors.

# MAX8544 Evaluation Kit

## Component Suppliers

SUPPLIER	PHONE	WEBSITE
Central Semiconductor	631-435-1110	www.centalsemi.com
Coilcraft	847-639-6400	www.coilcraft.com
International Rectifier	310-322-3331	www.irf.com
Kamaya	260-489-1533	www.kamaya.com
Murata	814-237-1431	www.murata.com
Panasonic	714-373-7939	www.panasonic.com
Rubycon	0265-72-7111	www.rubycon.co.jp
Sanyo	619-661-6835	www.sanyo.com
Taiyo Yuden	408-573-4150	www.t-yuden.com
TDK	847-803-6100	www.component.tdk.com
Vishay	402-564-3131	www.vishay.com

**Note:** Indicate that you are using the MAX8544 when contacting these component suppliers.

## Evaluating the MAX8543

An optional circuit layout is provided for evaluating the MAX8543. Typical components for this circuit are given in the *Component List* section. This circuit is designed for a 3V to 3.65V input and 2.5V output at up to 15A with a 500kHz switching frequency. To configure this circuit for different operating conditions, refer to the MAX8543/MAX8544 data sheet for component selection. If using this circuit with an input voltage greater than 5.5V, cut the trace shorting R29.

Evaluates: MAX8543/MAX8544

# MAX8544 Evaluation Kit

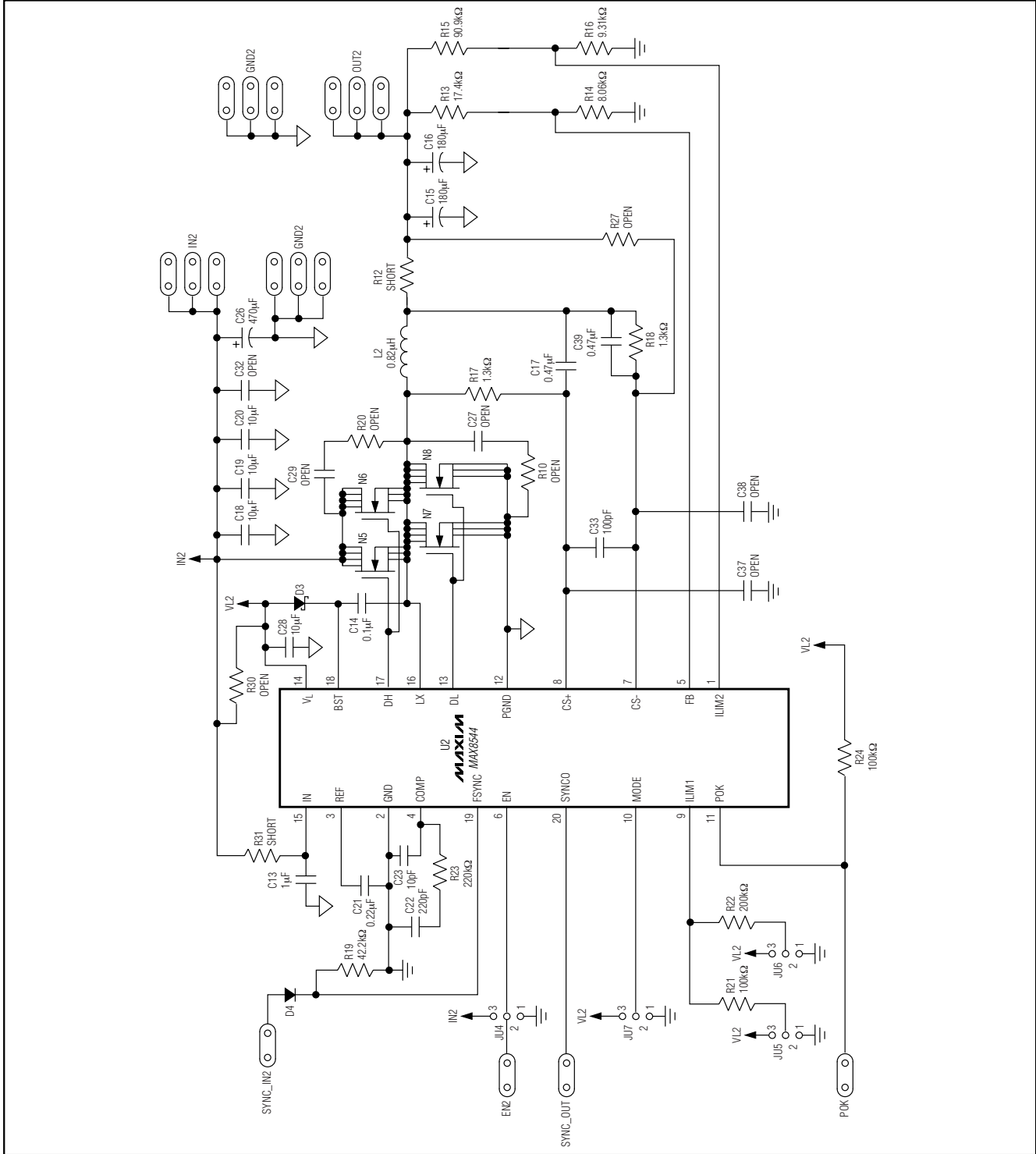


Figure 1. MAX8544 EV Kit MAX8544 Schematic

# MAX8544 Evaluation Kit

Evaluates: MAX8543/MAX8544

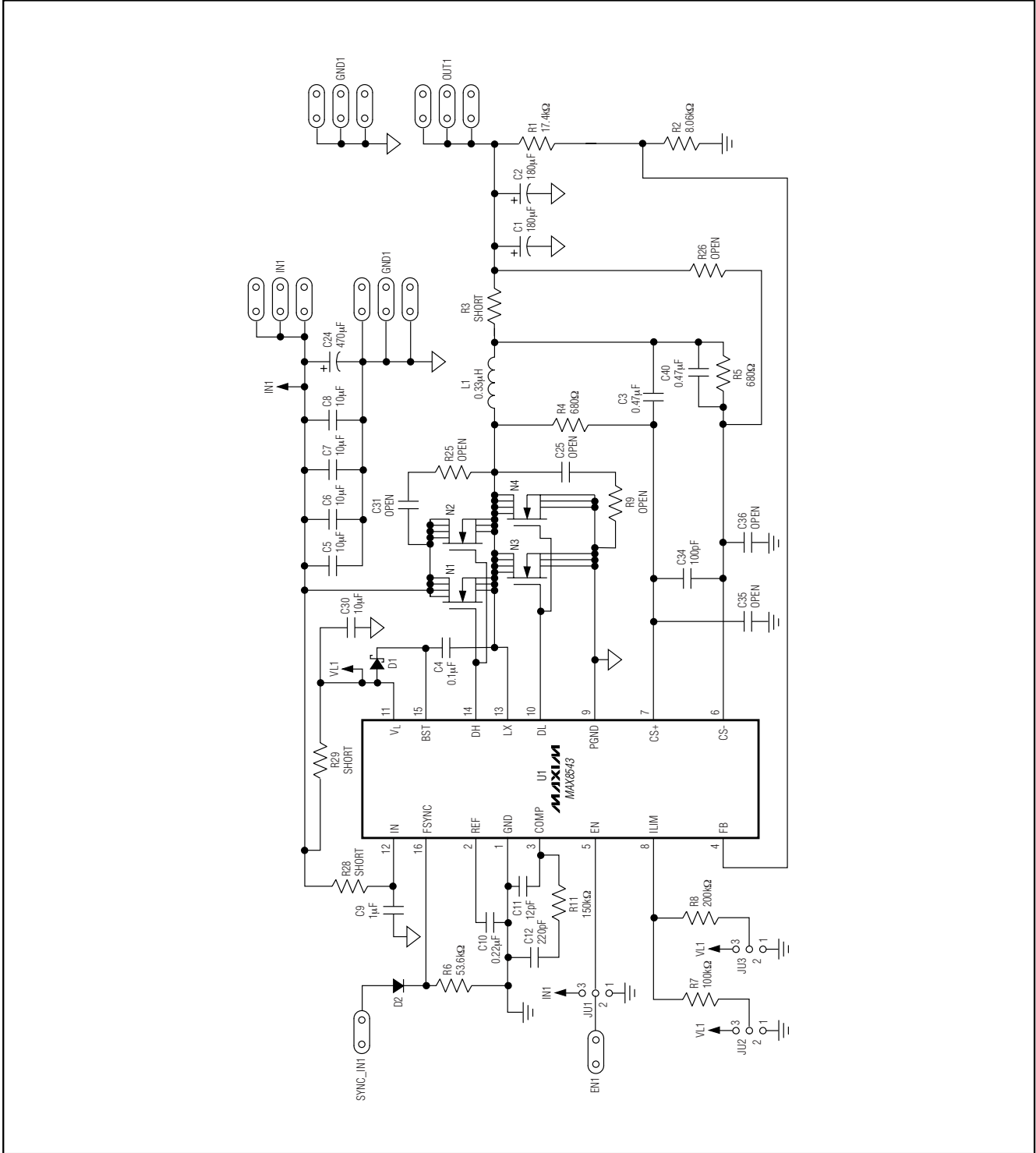


Figure 2. MAX8544 EV Kit Optional MAX8543 Schematic

# MAX8544 Evaluation Kit

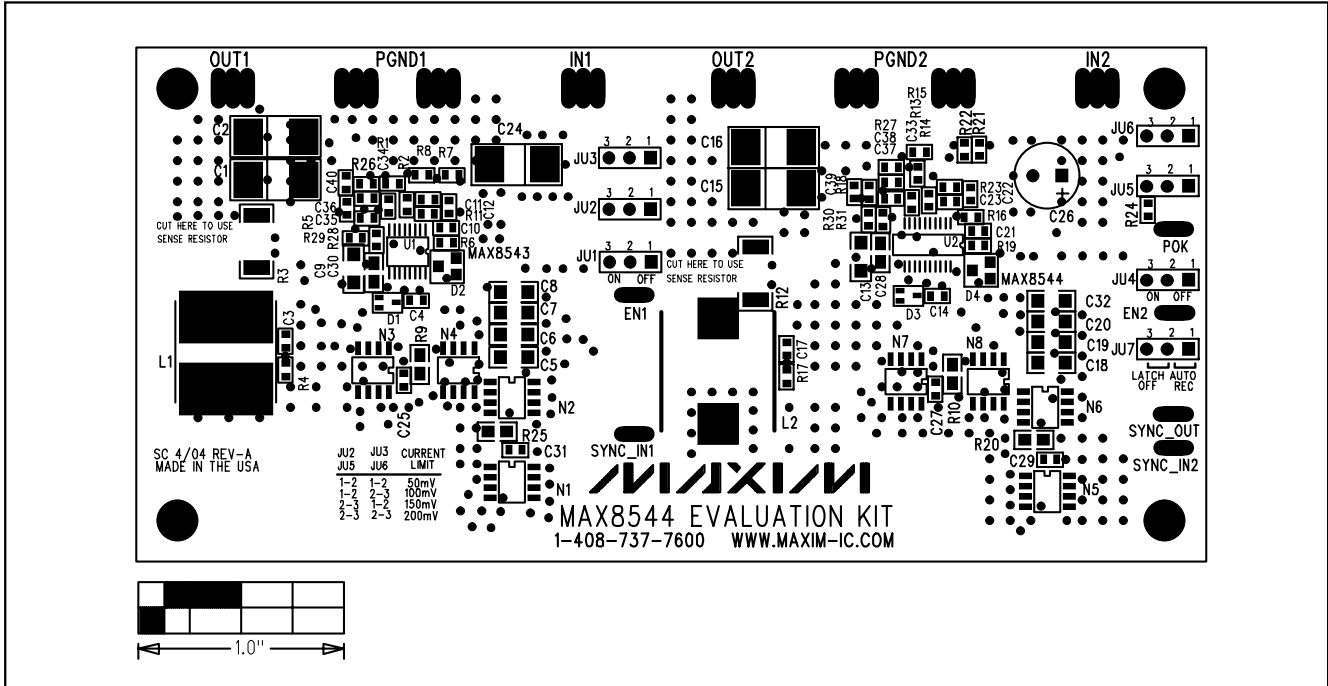


Figure 3. MAX8544 EV Kit Component Placement Guide—Component Side

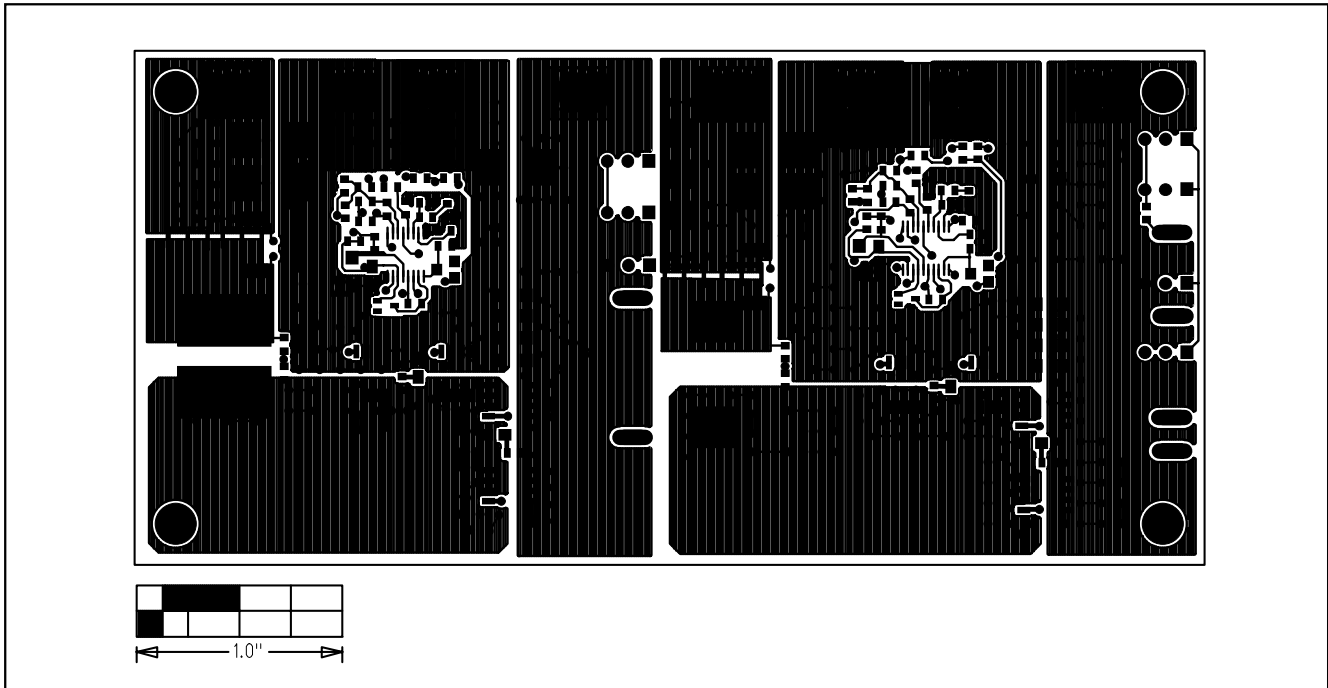


Figure 4. MAX8544 EV Kit PC Board Layout—Component Side



# MAX8544 Evaluation Kit

Evaluates: MAX8543/MAX8544



Figure 5. MAX8544 EV Kit PC Board Layout—Layer 2

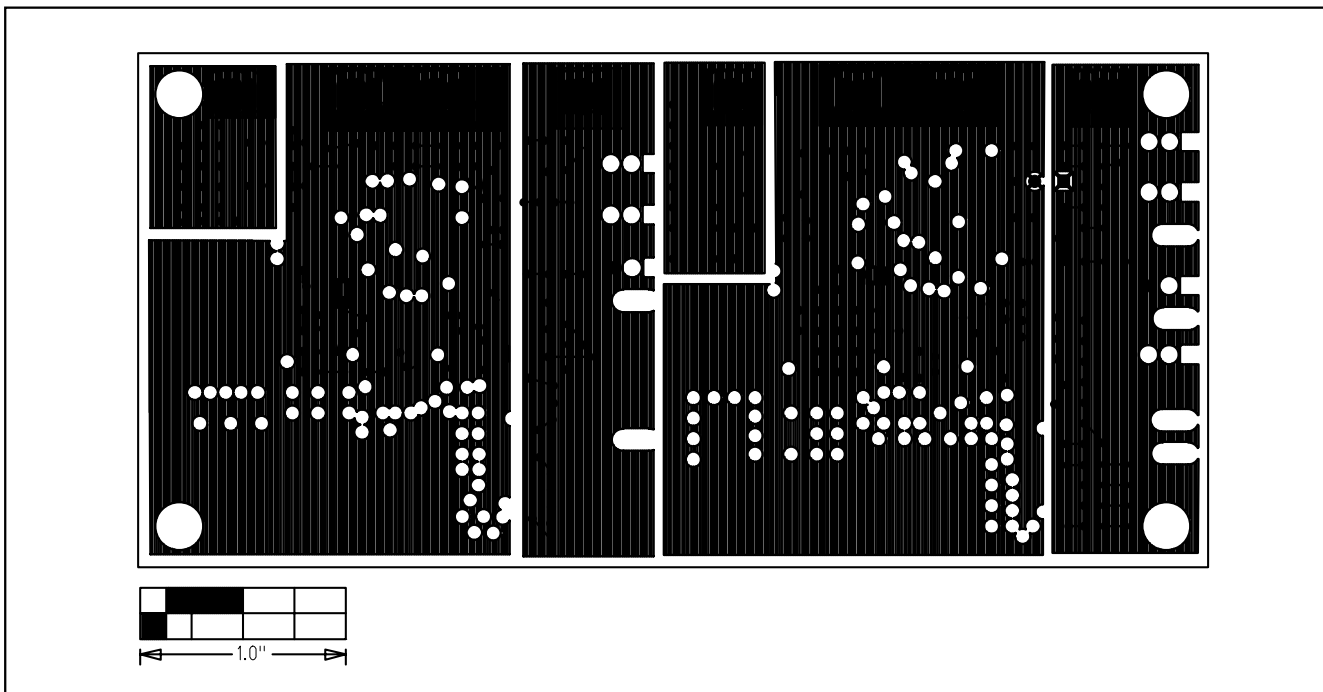


Figure 6. MAX8544 EV Kit PC Board Layout—Layer 3

# MAX8544 Evaluation Kit

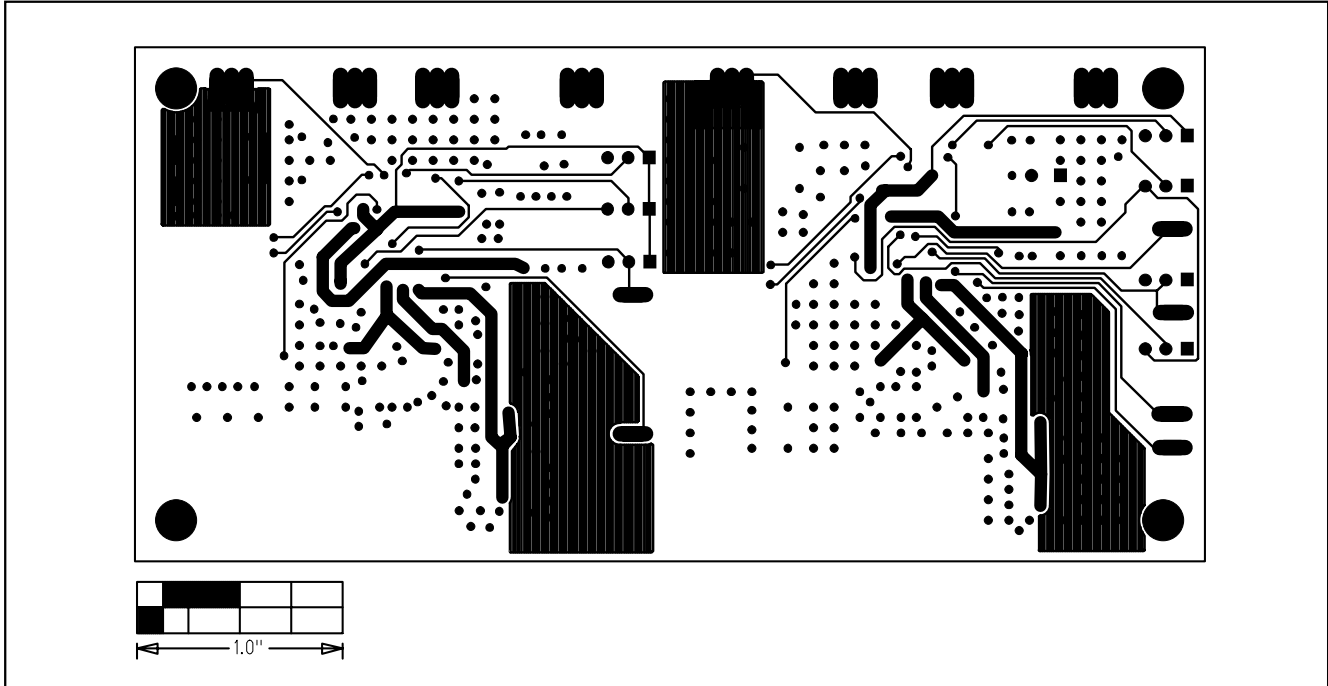


Figure 7. MAX8544 EV Kit PC Board Layout—Solder Side

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