19-2380; Rev 0; 4/02

MAX5040 Evaluation Kit

Evaluates: MAX5040

General Description

The MAX5040 evaluation kit (EV kit) is a complete, fully assembled and tested voltage-tracking controller circuit that demonstrates the capability of the MAX5040. The MAX5040 controls the output voltage of two power supplies, VI/O and VCORE, during power-up and power-down. The device ensures that the two supplies rise or fall at the same rate, limiting the voltage difference between them to under 200mV. The EV kit board comes with two step-down switching power supplies programmed to 3.3V and 1.8V output voltages that allow for an easy evaluation of the featured voltage-tracking controller. The EV kit board operates from a 5V supply capable of supplying up to 4A.

Features

- **On-Board Power Supplies Set at 3.3V and 1.8V**
- **Voltage Tracking of Dual Power Supplies During Power-Up and Power-Down**
- **Core Voltage Range Configurable from 0.8V to 4V**
- **I/O Voltage Range Configurable from VCORE to 4V**
- **Detects Short Circuit on VCORE and VI/O**
- **Disables Both Power Supplies During Short-Circuit Condition**
- **Output Undervoltage Monitoring and Power-OK (POK) Status**
- **Surface-Mount Construction**
- **Fully Assembled and Tested**

Ordering Information

PART	TEMP RANGE	IC PACKAGE
MAX5040EVKIT	0°C to +70°C	10 µMAX

Component List

DESIGNATION	QTY	DESCRIPTION
C1	1	1.0µF ±10%, 25V X7R ceramic capacitor (1206) TDK C3216X7R1E105KT or Taiyo Yuden TMK316BJ105KL
C2, C3, C6	3	0.1µF ±10%, 50V X7R ceramic capacitors (0805) TDK C2012X7R1H104KT or Taiyo Yuden UMK212BJ104KG
C4, C5	0	Not installed capacitor (HC)
C7	1	1500pF ±10%, 50V X7R ceramic capacitor (0603) Taiyo Yuden UMK107BJ152KZ
C8, C9	2	10µF ±20%, 10V X5R ceramic capacitors (1206) TDK C3216X5R1A106M
C10, C11	2	2.2µF ±10%, 10V X5R ceramic capacitors (0805) TDK C2012X5R1A225KT or Taiyo Yuden LMK212BJ225KG
C12	1	0.01µF ±10%, 50V X7R ceramic capacitor (0603) TDK C1608X7R1H103KT or Taiyo Yuden UMK107B103KZ
C13	1	0.022µF ±10%, 50V X7R ceramic capacitor (0603) TDK C1608X7R1H223KT
C14, C15	2	470pF ±10%, 50V, X7R ceramic capacitors (0603) TDK C1608X7R1H471KT
C16, C17	2	1.0µF ±10%, 10V X5R ceramic capacitors (0603) TDK C1608X5R1A105K
C18	0	Not installed capacitor (0603)
C19, C20	2	100µF, 6.3V low-ESR capacitors (C) Sanyo 6TPC100M (POSCAP)
C21, C22	0	Not installed capacitor (A)
D1	1	1A 30V Schottky diode (SOD123) Nihon EP10QY03 or Toshiba CRS02
JU1, JU2, JU3	3	2-pin headers
JU4, JU5	2	3-pin headers
L1, L2	2	2.2µH, 3.8A inductors Sumida CDRH6D28 4762-TO54

Component List (continued)

DESIGNATION	QTY	DESCRIPTION
N1	1	6A, 20V N-channel MOSFET (8-pin SO) Vishay Si9428DY
N2	0	Not installed N-channel MOSFET (DPAK)
N3	0	Not installed N-channel MOSFET (D^2PAK)
N4	1	1.8A, 30V N-channel MOSFET (3-pin SOT23) Fairchild FDN361AN
R1	1	261kΩ ±1% resistor (0805)
R2, R6	2	100kΩ ±1% resistors (0805)
R3, R4	2	10kΩ ±1% resistors (0805)
R5	1	143kΩ ±1% resistor (0805)
R7, R8	2	20kΩ ±5% resistors (0603)
R9, R10	0	Not installed resistor (0603)
R11, R12	2	10Ω ±5% resistors (0603)
R13	1	39.2kΩ ±1% resistor (0603)
R14	1	75kΩ ±1% resistor (0603)
R15	1	100kΩ ±1% resistor (0603)
R16	1	49.9kΩ ±1% resistor (0603)
R17, R18, R19	3	10kΩ ±5% resistors (0603)
R20	1	10kΩ ±5% resistor (0805)
R21	1	51Ω ±5% resistor (1206)
U1	1	MAX5040EUB (10-pin µMax)
U2, U3	2	MAX1842EEE (16-pin QSOP)
VI/O, VCORE, GND	3	Noninsulated banana jack connectors
None	5	Shunts (JU1–JU5)
None	1	MAX5040 PC board
None	1	MAX5040 data sheet
None	1	MAX5040 EV kit data sheet

Component Suppliers

SUPPLIER	PHONE	FAX	WEBSITE
Fairchild	888-522-5372	408-522-5372	www.fairchildsemi.com
Nihon	81-33343-3411	81-33342-5407	www.niec.co.jp
Sanyo	619-661-6322	619-661-1055	www.sanyo.com
Sumida	847-545-6700	847-545-6720	www.sumida.com
Taiyo Yuden	800-348-2496	847-925-0899	www.t-yuden.com
TDK	847-803-6100	847-390-4498	www.component.tdk.com
Toshiba	949-455-2000	949-859-3963	www.toshiba.com/taec/
Vishay	203-268-6261	203-452-5670	www.vishay.com

Note: *Please indicate that you are using the MAX5040 when contacting these component suppliers.*

Quick Start

The MAX5040 EV kit is a fully assembled and tested surface-mount board. Follow the steps below for simple board operation. **Do not turn on the power supply until all connections are completed.**

1) Verify that a shunt is connected across jumpers JU1, JU2, and JU3.
2) Verify that a shunt is connected across pins 1 and 2 of jumpers JU4 and JU5.
3) Connect the positive terminal of the 5V power supply to the VIN pad. Connect the ground terminal of the 5V power supply to the GND pad. Leave the VCC pad open circuit; it is connected to VIN through jumper JU3.
4) Connect voltmeters or an oscilloscope to pads $\overline{SDO}$ and POK to analyze the functionality of the MAX5040 voltage-tracking controller during power-up.
5) Connect an oscilloscope at V_{IN}, VI/O, and VCORE to observe voltage tracking during power-up and power-down. Set the oscilloscope to trigger on the rising edge of VIN.
6) Turn on the 5.0VDC power supply.
7) Verify that VI/O is 3.3V and VCORE is 1.8V.

Note: Connect the ground terminals of the voltmeters connected to $\overline{SDO}$ and POK to the AGND pad.

Detailed Description

The MAX5040 EV kit is a complete, fully assembled and tested circuit that demonstrates the capability of the MAX5040 voltage-tracking controller. The MAX5040 provides intelligent control to power systems where two supply voltages need to be tracked. The device limits the voltage difference between the two supply voltages during power-up and power-down. The controller generates logic signals that can be used to shut down the power sources or other devices when a fault is detected.

The EV kit board comes with two MAX1842 step-down switching power supplies preset to 3.3V (VI/O), 1.8V (VCORE), and operates from a 5V supply voltage capable of supplying up to 4A. The MAX5040 controller turns on the N-channel MOSFET (N1) when VI/O is below VCORE or when VCORE is below 1.6V. The undervoltage lockout threshold for the MAX5040 controller is set to 4.5V.

Input Voltage

The MAX5040 EV kit requires an input voltage of 4.5V to 5.5V for normal operation. The MAX5040 controller starts to function at an input voltage of 2.5V but it holds the VI/O and VCORE power supplies in shutdown mode until the 4.5V undervoltage lockout threshold has been exceeded. Once the input voltage exceeds this threshold, the controller enables the VI/O and VCORE supplies. The EV kit has a maximum input voltage limit of 5.5V. See the *Monitoring External Power Sources* section for instructions to disconnect the power supplies

On-Board Power Supplies

The MAX5040 EV kit includes two MAX1842 step-down switching power supplies that allow the user to evaluate the MAX5040 under conditions similar to a real system application. The first power supply (VI/O) is set to an output voltage of 3.3V and provides 2.5A of current. The VI/O supply is used to simulate a power source to an I/O bus in a system.

The second power supply (VCORE) is set to an output voltage of 1.8V and provides 2.5A of current. The VCORE supply is used to simulate a power source to the main core processor in a system. The VI/O and VCORE power supplies require a 3.3V to 5.5V input voltage at VIN. However, VI/O and VCORE do not start up until VIN reaches 4.5V. The MAX5040 controller's undervoltage lockout threshold is set to 4.5V and the controller holds VI/O and VCORE in shutdown mode until VIN is greater than 4.5V. VI/O and VCORE can be manually shut down by placing a shunt across pins 2 and 3 of jumpers JU4 and JU5. See Table 1 for jumper JU4 and JU5 configurations.

Note: A 33µF capacitor is recommended to stabilize the VI/O and VCORE inputs if a lab power supply is connected to the EV kit through long wires or if it has a poor transient response. For further information on the MAX1842 power supplies, refer to the MAX1742/MAX1842 EV kit or data sheets.

Output Voltage Delays

The VCORE and VI/O power supplies have an external RC signal delay of 2ms at their respective shutdown pins. If the delay is used in one of the power supplies, its start-up is delayed by 2ms with respect to the other power supply. VI/O and VCORE power supplies also have different soft-start capacitor values causing VCORE to rise slower than VI/O. The delay can be used to evaluate how the MAX5040 functions when one of the two tracking voltages lags behind the other during system startup. The delay can be bypassed by placing a shunt across pins 1 and 2 of jumpers JU4 and JU5. See Table 1 for jumper JU4, JU5 configurations and functions.

Table 1. Power Supplies Shutdown and Signal Delay (Shunt on JU2 Is Installed)

JUMPER	SHUNT POSITION	$\overline{\text{SHDN}}$ PIN	FUNCTION
JU4	1 and 2	Connected to $\overline{\text{SDO}}$	Bypasses the 2ms signal delay on the shutdown pin of VI/O
	2 and 3	Connected to ground	VI/O in shutdown mode
	None	Connected to $\overline{\text{SDO}}$ pin through the RC filter	VI/O shutdown pin has a 2ms delay
JU5	1 and 2	Connected to $\overline{\text{SDO}}$	Bypasses the 2ms signal delay on the shutdown pin of VCORE
	2 and 3	Connected to ground	VCORE in shutdown mode
	None	Connected to $\overline{\text{SDO}}$ pin through the RC filter	VCORE shutdown pin has a 2ms delay

Voltage Thresholds

The MAX5040 EV kit voltage-monitoring thresholds are programmed with external resistors as indicated in Table 2. Refer to the MAX5039/MAX5040 data sheet to select new resistor values.

Table 2. Threshold Settings

SOURCE	THRESHOLD (V)	EV KIT FUNCTIONS	FEEDBACK RESISTORS
VCC	4.5	Voltage below which $\overline{SDO}$ goes low	R1, R2
VCORE	1.6	VCORE threshold/ regulation voltage	R3, R4
VI/O (Sense)	3.0	Voltage below which POK goes low	R5, R6

Startup Mode

The MAX5040 EV kit starts to function when the system voltage V_{IN} reaches the minimum input voltage of 2.5V required by the voltage-tracking controller. The controller pulls the $\overline{SDO}$ pin low at an input voltage of 0.9V, which keeps the VI/O and VCORE supplies in shutdown. The $\overline{SDO}$ pin is connected to the active-low shutdown pin of VI/O and VCORE regulators through jumper JU2. When V_{IN} exceeds 4.5V, the $\overline{SDO}$ pin is pulled HIGH (to V_{IN}) to enable VI/O and VCORE. If the VI/O and VCORE output voltages are not above their thresholds within 15ms, the controller pulls $\overline{SDO}$ and POK low, shutting the voltage regulators and signaling a fault in the system. If VI/O and VCORE are above their thresholds within 15ms, the controller enters normal operation mode. See Table 3 for the complete startup sequence of the EV kit that also includes voltage conditions and EV kit outputs.

Note: SDO is the inverted signal of $\overline{SDO}$ that can be used for active-high shutdown pins. $\overline{SDO}$ and SDO high state is V_{IN}. POK high state is VI/O.

Normal Mode

In normal operation, the controller attempts to keep VCORE from falling below 1.6V. If V_{IN} falls below 4.5V, the controller shuts down the power supplies by pulling $\overline{SDO}$ low. If VCORE falls below 1.6V, the controller drives the NDRV pin high, which turns on the MOSFET connected across VCORE and VI/O, sourcing current from the VI/O rail to raise VCORE to 1.6V. The controller also drives the NDRV pin high if VI/O voltage falls below VCORE to source current in the opposite direction. POK is always pulled low when any fault is detected. See Table 4 for fault conditions.

Shutdown

The MAX5040 controller can be forced into shutdown mode by connecting an external device to the UV_CC pad and driving it low. When the controller is in shutdown mode, the controller pulls the $\overline{SDO}$ pin low, forcing VI/O and VCORE into shutdown.

Table 3. Startup Sequence

STEP	CONDITIONS			EV KIT OUTPUTS			EV KIT FUNCTIONS
	VCC	VI/O	VCORE	$\overline{SDO}$	SDO	POK	
1	<0.9V	X	X	X	X	X	Not operating
2	0.9V ≤ V_{CC} < 4.5V	0V	0V	L	H	L	Power supplies in shutdown mode
3	≥4.5V	S	S	H	L	L	Power supplies are turned ON
4	15ms later						
5	≥4.5V	VCORE < VI/O < 3.0V	≥1.6V	H	L	L	VI/O low forces POK low
		X	<1.6V	L	H	L	Startup fault
		<VCORE	≥1.6V				
		≥3.0V	≥1.6V	H	L	H	Normal operation

X = Don't care.

S = VI/O and VCORE power supplies in startup mode.

Table 4. Fault Conditions

CONDITIONS			EV KIT OUTPUTS			EV KIT FUNCTIONS
VCC	VI/O	VCORE	$\overline{SDO}$	SDO	POK	
<4.5V	≥3.0V	≥1.6V	L	H	L	Power supplies are turned OFF
≥4.5V	VCORE ≤ VI/O < 3.0V	≥1.6V	H	L	L	VI/O low forces POK low
≥4.5V	VI/O < VCORE	≥1.6V	H	L	L	NDRV pin is driven HIGH
	After 15ms		L	H	L	Power supplies are turned OFF
≥4.5V	X	<1.6V	H	L	L	NDRV pin is driven HIGH
	After 15ms		L	H	L	Power supplies are turned OFF

X = Don't care.

Monitoring External Power Sources

The MAX5040 voltage-tracking controller monitors two MAX1842 step-down switching power supplies that are set for 3.3V and 1.8V, and can deliver up to 2.5A. The input voltage range for the EV kit is 2.5V to 5.5V. The EV kit circuit can be modified to operate with external power sources set at different output voltages and/or current capabilities. The two on-board power supplies must be disabled from the controller circuit when using external supplies.

To monitor external power supplies:

1) Place a shunt across pins 2 and 3 of jumper JU4 and JU5 to disable the on-board power supplies.
2) Remove the shunt across jumper JU2.
3) Connect the external voltage source to the VI/O banana jack and the external core source to the VCORE banana jack. Connect the grounds from the external voltage sources to the GND banana jack.
4) Connect the shutdown pin of the external supplies to $\overline{SDO}$ (active-low shutdown) or SDO (active-high shutdown) pads.
5) Replace the feedback resistor pairs listed in Table 2 if the voltage thresholds or the output voltages are different from 3.3V and 1.8V.

For higher current capabilities, remove MOSFET N1 on the EV kit and install a DPAK N-channel MOSFET (N2) or a D^2PAK N-channel MOSFET (N3).

Jumper JU1

The MAX5040 EV kit circuit features D1 between the input power connection and the V_{CC} pin of the voltage-tracking controller. D1 and C1 can be used to hold the supply in the event of a rapid voltage drop by the power source. Install a 10µF capacitor at C1 to use this feature. This protection can be bypassed or implemented by reconfiguring jumper JU1. See Table 5 for jumper JU1 configuration.

Table 5. Jumper JU1 Functions

SHUNT LOCATION	EV KIT FUNCTIONS
None	EV kit operates normally when there is a momentary loss of input power (requires a 10µF capacitor at C1).
Installed	Full operation may be disrupted if there is a momentary loss of input power.

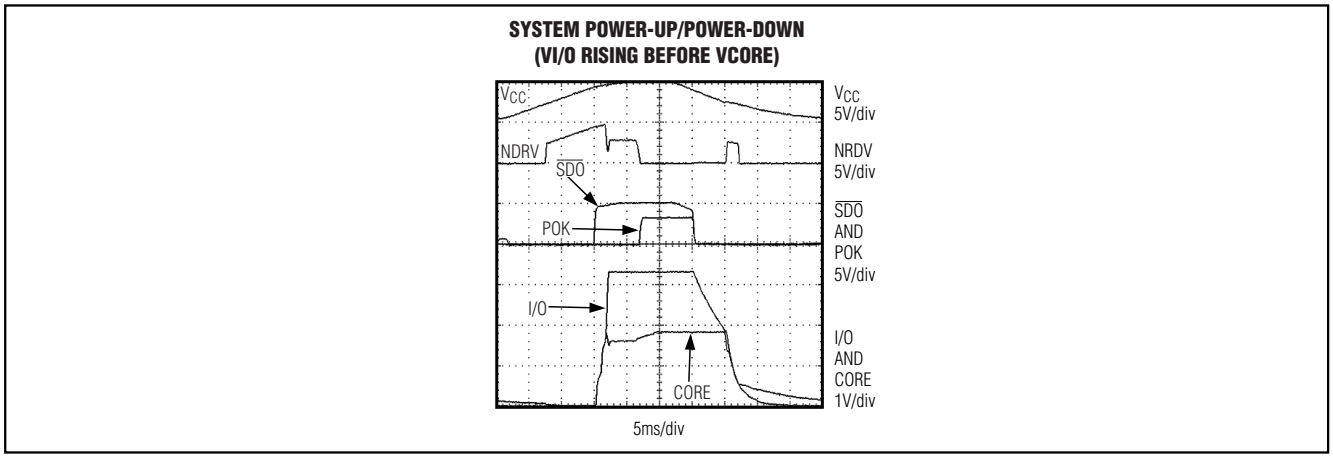

Figure 1. System Power-Up/Power-Down (VI/O Rising Before VCORE)

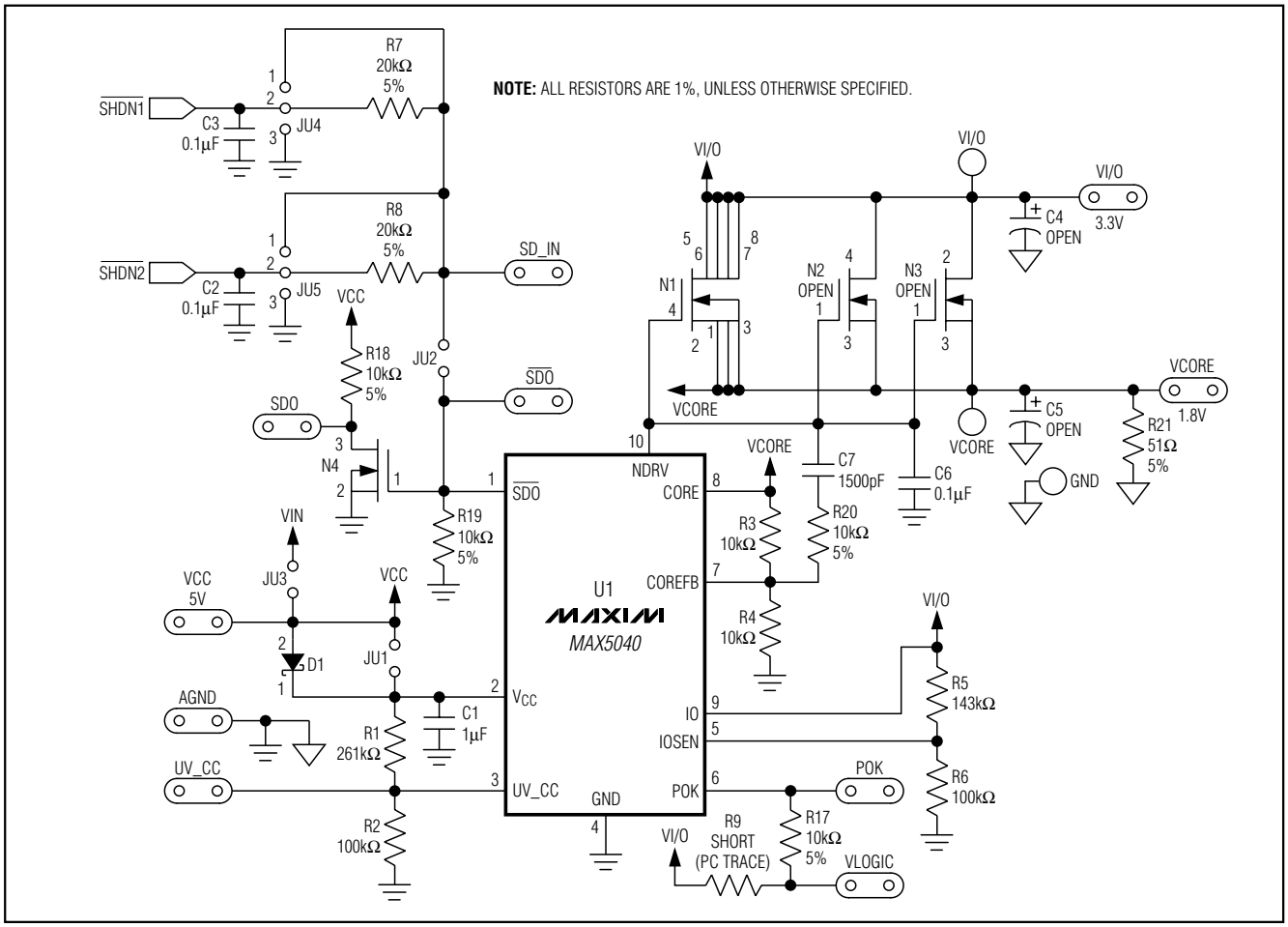

Figure 2. MAX5040 EV Kit Schematic—Voltage-Tracker Controller

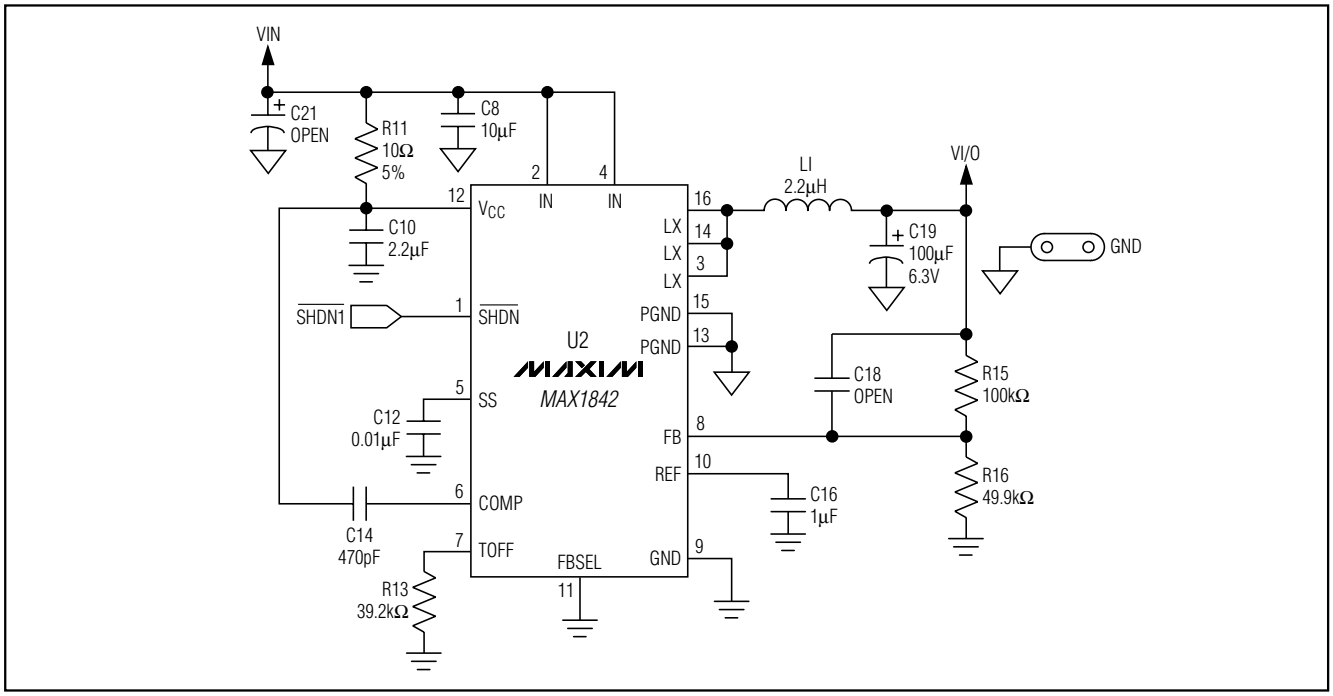

Figure 3. MAX5040 EV Kit Schematic—VI/O Step-Down Power Supply

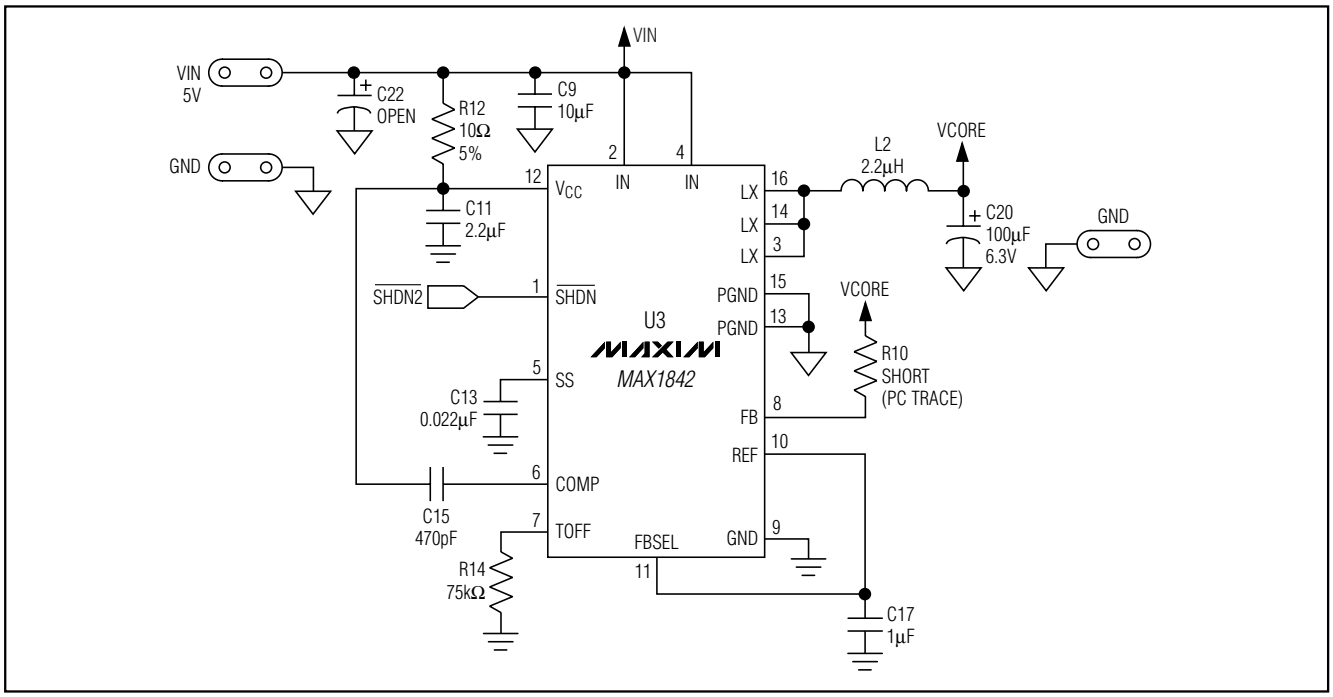

Figure 4. MAX5040 EV Kit Schematic—VCORE Step-Down Power Supply

MAX5040 Evaluation Kit

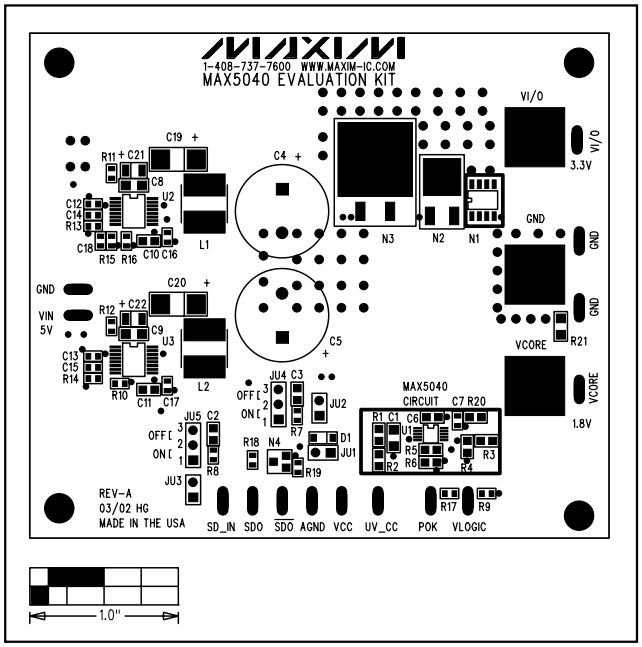

Figure 5. MAX5040 EV Kit Component Placement Guide—Component Side

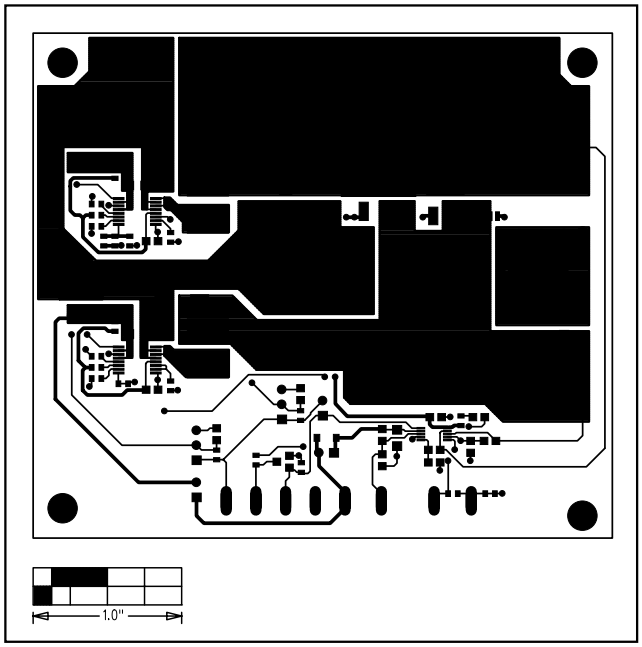

Figure 6. MAX5040 EV Kit PC Board Layout—Component Side

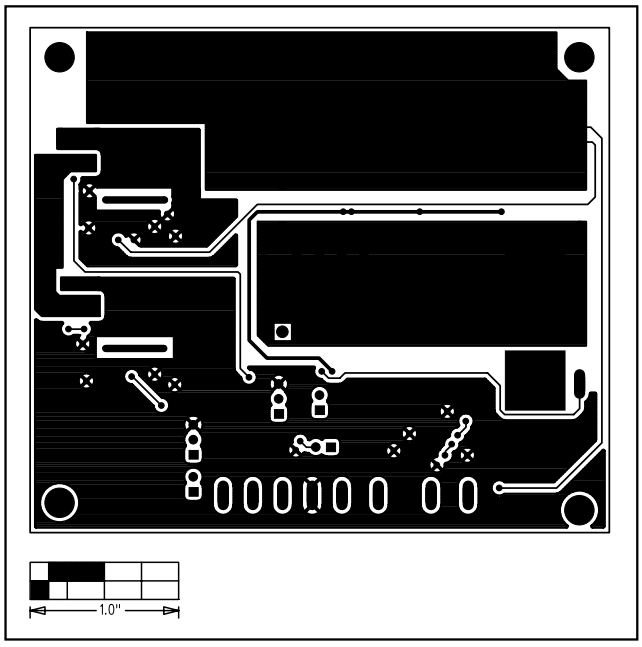

Figure 7. MAX5040 EV Kit PC Board Layout—Solder Side