MAX20097 Evaluation Kit

Evaluates: MAX20097

General Description

The MAX20097 evaluation kit (EV kit) provides a proven design to evaluate the MAX20097 dual-synchronous buck controller for high-power, high-brightness (HB) LED drivers. The EV kit is set up as a dual-buck LED driver and operates from a DC supply voltage from 4.5V to 65V. The EV kit is configured to deliver up to 2A of current through the LEDS for both the channels. The total voltage of each of the 2 LED strings can vary from 3V to 55V.

Features

- Input Voltage: 4.5V to 65V
- Drives 1 to 16 LEDs on Both Channels
- LED Current: 0A to 2A on Both Channels
- Demonstrates UVLO, Output Short Protection, Overload
- Demonstrates Current-Limit and Thermal-Shutdown Feature
- Proven PCB Layout and Thermal Design
- Fully Assembled and Tested

***Ordering Information* appears at end of data sheet.**

Quick Start

Required Equipment

- MAX20097 EV kit
- 5V to 65V, 5A DC power supply
- Four digital voltmeters
- Two series-connected LED strings rated to no less than 3A
- Two current probes to measure the HB LED current
- Small flat-blade screwdriver to turn the potentiometer
- Oscilloscope

Procedure

The MAX20097 EV kit is fully assembled and tested. Follow the steps below to verify board operation.

Caution: Do not turn on power supply until all connections are complete.

1) Verify that all jumper positions are as shown in Table 1.
2) Connect one of the LED string anode to the LED1+ PCB pad and the cathode to GND1. Connect the second LED string anode to LED2+ PCB pad and cathode to GND2 PCB pad.
3) Connect a voltmeter across the LED1+ and GND1 PCB pads and another voltmeter between LED2+ and GND2 PCB pads.
4) Connect a voltmeter across the REFI1, REF2, and AGND test points.
5) Connect the power supply terminals to the IN and the GND3 PCB pads.
6) Clip a current probe across the wire connecting to the LEDs in both of the LED strings.
7) Turn on the power supply and set to a voltage greater than the maximum LED string voltage, but less than the 65V maximum input voltage.
8) Use a screwdriver to turn the potentiometer R23 until voltmeter reads 1.2V. Do the same with potentiometer R5.
9) Measure the LED current using the current probe in both the LED strings and verify the current is 2A.
10) Use a voltmeter to verify the expected LED string voltage for both channels.

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Table 1. MAX20097 EV Kit Jumper Descriptions

JUMPER	SHUNT POSITION	DESCRIPTION
J1	Closed (Default)	Use the resistive divider to set the LED current on LED2+ string
	Open	Use the external power supply on REFI2 to set the LED2+ current.
J2	Closed (Default)	Single power supply input for both the buck controllers
	Open	Powers up the LED2+ controller separately through IN2 and GND4 PCB pads.
J3	Open	External PWM pulse generator to be applied on DIM2 test point.
	1-2 (Default)	DIM2 pulled up to V_{CC} for 100% PWM dimming.
	2-3	DIM2 input is GND and LED2+ string is disabled.
J4	1-2 (Default)	IN power supply connected to the IN pin of the device.
	2-3	IN pin of the device shorted to V_{CC} and external voltage between 4.5V to 5.5V can be forced on VCC test point.
J5	Open	External PWM pulse generator to be applied on DIM1 test point
	1-2 (Default)	DIM1 pulled up to V_{CC} for 100% PWM dimming.
	2-3	DIM1 input is GND and LED1+ string is disabled.
J6	Closed (Default)	Use the resistive divider to set the LED current on LED1+ string.
	Open	Use the external power supply on REFI1 to set the LED current.
J7	Closed (Default)	V_{CC} and V_{IO} shorted
J15	Closed (Default)	Pull FLTB to V_{CC} through 10kΩ resistor

Detailed Description

The MAX20097 is a dual-channel, high-voltage, synchronous N-channel high-current buck LED drivers. The device uses a proprietary average current mode control scheme to regulate the inductor current. This control method does not require any control loop compensation while maintaining nearly constant switching frequency. Inductor current sense is achieved by sensing the current in the bottom switching device. The MAX20097 integrates 2 fully synchronous buck controllers. The devices operate over a wide input range of 4.5V to 65V. The device is designed for high-frequency operation and can operate as high as 1MHz.

Analog Dimming Control (REFI1, REFI2)

The EV kit demonstrates the analog dimming feature of the device. R22 and R23 form a resistor-divider between V_{CC} and AGND and sets the voltage on REFI1 pin. R22 is a 10kΩ resistor and R23 is a 10kΩ potentiometer, with the wiper shorted to the high side of the potentiometer. Using a flat-blade screwdriver, turn the wiper-adjustment pin clockwise to increase the voltage on the REFI1 input. Turn the wiper-adjustment pin counterclockwise to decrease the voltage on the REFI input. The REFI1 input allows for analog dimming of the LED string connected between LED1+ and GND1. A REFI1 input voltage of 0.2V or less turns off the LED driver. A REFI1 input voltage between 0.2V and 1.2V provides linear dimming of the LED string. A REFI input voltage greater than 1.2V sets the LED string current to maximum current (based on the current-sense resistor). The analog dimming on channel 2 is controlled by the resistive-divider formed by R3 and R4 (potentiometer). Follow the same procedure as described for REFI1.

Alternatively, the analog dimming input can be set with an external power supply. Remove the shunt on J6 and connect an external power supply directly to the REFI1 test point to perform analog dimming on LED1+ string. Remove the shunt on J1 and connect an external power supply directly to the REFI2 test point to perform analog dimming on LED2+ string.

Pulse-Dimming Inputs (DIM1, DIM2)

The EV kit demonstrates the PWM dimming feature of the MAX20097. Remove the shunt on J5. Connect a PWM signal to the DIM1 test point. Vary the duty cycle to increase or decrease the intensity of the LED1+ string. The DIM1 and DIM2 inputs of the device have a 2V (max) rising threshold and a 0.8V (min) falling threshold and are compatible with 3.3V and 5V logic-level signals. Remove the shunt on J3 for PWM dimming on LED2+ string. Connect a PWM signal to the DIM2 test point. Vary the duty cycle to increase or decrease the intensity of the LED2+ string.

Fault Indicator

The EV kit demonstrates the fault-protection features of the device, which include short-LED, open-LED, and overtemperature protection. The FLTB output is an open-drain, active-low fault indicator.

Current Monitor Output

The EV kit also demonstrates the current monitor output feature of the device. The IOUTV1 and IOUTV2 test points output a voltage which is a measure of the LED current. Refer to the MAX20096/MAX20097 data sheet for the equation relating to the IOUTV1 and IOUTV2 voltage as well as the LED current.

External V_{CC} Input

The EV kit also demonstrates operation of the device with an external V_{CC} input. In this case, the internal LDO is not used. Move the shunt on J4 to pins 2-3. In this case, IN and V_{CC} pins of the device are shorted together. Apply an external power supply between 4.6V and 5.5V on the VCC test point to allow switching of the device.

Separate Power Supply Inputs

The second (LED2+) buck controller can be driven with a separate power supply, if needed. Removing the shunt on J2 enables to do this. Connect the second power supply between IN2 and GND4 PCB pads.

Ordering Information

PART	TYPE
MAX20097EVKIT#	EV Kit

#Denotes RoHS compliant.

MAX20097 EV Kit Bill of Materials

ITEM	QTY	REF DES	MAXINV	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION	COMMENTS
1	9	IN, IN2, AGND, GND1-GND4, LED1+, LED2+	01-9020BUSS20AWG-00	9020 BUSS	WEICO WIRE	MAXIMPAD	EVK KIT PARTS; MAXIM PAD; WIRE; NATURAL; SOLID; WEICO WIRE; SOFT DRAWN BUS TYPE-S; 20AWG	
2	2	C1, C28	20-0001U-CA96	CGA4J3X7R1H105M125AB	TDK	1UF	CAPACITOR; SMT (0805); CERAMIC CHIP; 1UF; 50V; TOL=20%; TG=-55 DEGC TO +125 DEGC; TC=X7R; AUTO	
3	6	C2, C6, C14, C16, C23, C27	20-000U1-DA52	CGA3E2X7R1H104K080AE	TDK	0.1UF	CAPACITOR; SMT (0603); CERAMIC CHIP; 0.1UF; 50V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R; AUTO; SOFT TERMINATION	
4	4	C3, C12, C18, C26	20-1000P-CA80	CGA3E2C0G2A102J080AA	TDK	1000PF	CAPACITOR; SMT (0603); CERAMIC CHIP; 1000PF; 100V; TOL=5%; TG=-55 DEGC TO +125 DEGC; TC=C0G; AUTO	
5	2	C4, C20	20-0001U-CA22	CGA3E1X7R1V105K	TDK	1UF	CAPACITOR; SMT (0603); CERAMIC CHIP; 1UF; 35V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R; AUTO	
6	4	C9, C11, C17, C21	20-004U7-CA59	CGA6M3X7S2A475K200AE	TDK	4.7UF	CAPACITOR; SMT (1210); CERAMIC CHIP; 4.7UF; 100V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7S; AUTO	
7	2	C10, C19	20-00U22-BA63	CGA3E3X7R1H224K080AB; GCM188R71H224KA49	TDK; MURATA	0.22UF	CAPACITOR; SMT (0603); CERAMIC CHIP; 0.22UF; 50V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R; AUTO	
8	1	C13	20-002U2-CA73	CGA3E1X7R0J225K080AC	TDK	2.2UF	CAPACITOR; SMT (0603); CERAMIC; 2.2UF; 6.3V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R; AUTO	
9	1	C15	20-000U1-CA82	CGA4J2X7R2A104K125AA	TDK	0.1UF	CAPACITOR; SMT (0805); CERAMIC CHIP; 0.1UF; 100V; TOL=10%; TG=-55 DEGC TO +125 DEGC; TC=X7R; AUTO	
10	2	D1, D4	30-1N4448WS7F-00	1N4448WS-7-F	DIODES INCORPORATED	1N4448WS-7-F	DIODE; SWT; SOD-323; PIV=75V; IF=0.5A	
11	4	D2, D3, D5, D6	30-B18013F-00	B180-13-F	DIODES INCORPORATED	B180-13-F	DIODE; SCH; SCHOTTKY BARRIER RECTIFIER; SMA; PIV=80V; IF=1A	
12	8	VCC, DIM1, DIM2, FLTB, REFI1, REFI2, IOUTV1, IOUTV2	02-TPCOMP5007-00	5007	KEYSTONE	N/A	TEST POINT; PIN DIA=0.125IN; TOTAL LENGTH=0.35IN; BOARD HOLE=0.063IN; WHITE; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH; RECOMMENDED FOR BOARD THICKNESS=0.062IN; NOT FOR COLD TEST	
13	5	J1, J2, J6, J7, J15	01-PCC02SAAN2P-21	PCC02SAAN	SULLINS	PCC02SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 2PINS; -65 DEGC TO +125 DEGC	
14	3	J3-J5	01-PCC03SAAN3P-21	PCC03SAAN	SULLINS	PCC03SAAN	CONNECTOR; MALE; THROUGH HOLE; BREAKAWAY; STRAIGHT THROUGH; 3PINS; -65 DEGC TO +125 DEGC	
15	2	L1, L2	50-0047U-S44A	MSS1278T-473ML	COILCRAFT	47UH	INDUCTOR; SMT; FERRITE BOBBIN CORE; 47UH; TOL=+/-20%; 5.4A	

MAX20097 EV Kit Bill of Materials (continued)

ITEM	QTY	REF DES	MAXINV	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION	COMMENTS
16	4	Q1-Q4	90-BUK9Y10780E-21	BUK9Y107-80E	NXP	BUK9Y107-80E	TRAN; N-CHANNEL 80V; 107MOHM LOGIC LEVEL MOSFET; NCH; LFPAK; PD-(37W); I-(11.8A); V-(80V)	
17	2	R1, R24	80-0453K-24	ERJ-3EKF4533V	PANASONIC	453K	RESISTOR; 0603; 453K OHM; 1%; 100PPM; 0.10W; THICK FILM	
18	4	R2, R3, R21, R25	80-024K9-24	CRCW060324K9FK	VISHAY DALE	24.9K	RESISTOR; 0603; 24.9K OHM; 1%; 100PPM; 0.10W; THICK FILM	
19	5	R4, R14, R22, R29, R30	80-0010K-24	CRCW060310K0FK; ERJ-3EKF1002	VISHAY DALE; PANASONIC	10K	RESISTOR; 0603; 10K; 1%; 100PPM; 0.10W; THICK FILM	
20	2	R5, R23	80-0010K-39A	3296W-1-103LF	BOURNS	10K	RESISTOR; THROUGH-HOLE-RADIAL LEAD; 3296 SERIES; 10K OHM; 10%; 100PPM; 0.5W; SQUARE TRIMMING POTENTIOMETER; 25 TURNS; MOLDER CERAMIC OVER METAL FILM	
21	2	R6, R20	80-000R1-CA25	RUW3216FR100	SAMSUNG ELECTRONICS	0.1	RESISTOR; 1206; 0.1 OHM; 1%; 150PPM; 1W; THICK FILM	
22	8	R7, R8, R10, R16, R18, R19, R31, R32	80-0000R-27	CRCW06030000ZS; MCR03EZPJ000; ERJ-3GEY0R00	VISHAY DALE/ROHM/ PANASONIC	0	RESISTOR; 0603; 0 OHM; 0%; JUMPER; 0.10W; THICK FILM	
23	4	R11-R13, R15	80-004R7-19	CRCW06034R70FN	VISHAY DALE	4.7	RESISTOR; 0603; 4.7 OHM; 1%; 100PPM; 0.10W; THICK FILM	
24	1	U1	00-SAMPLE-01	MAX20097AHI+	MAXIM	MAX20097AHI+	EVKIT PART-IC; DRV; DUAL CHANNEL HIGH VOLTAGE BUCK LED DRIVER WITH SPI INTERFACE; PACKAGE OUTLINE: 21-0066; PACKAGE CODE: U28-1; TSSOP28	
25	1	PCB	N/A	MAX20097EVK	MAXIM	PCB	PCB:MAX20097EVK	-
TOTAL	88							

MAX20097 EV Kit Schematic

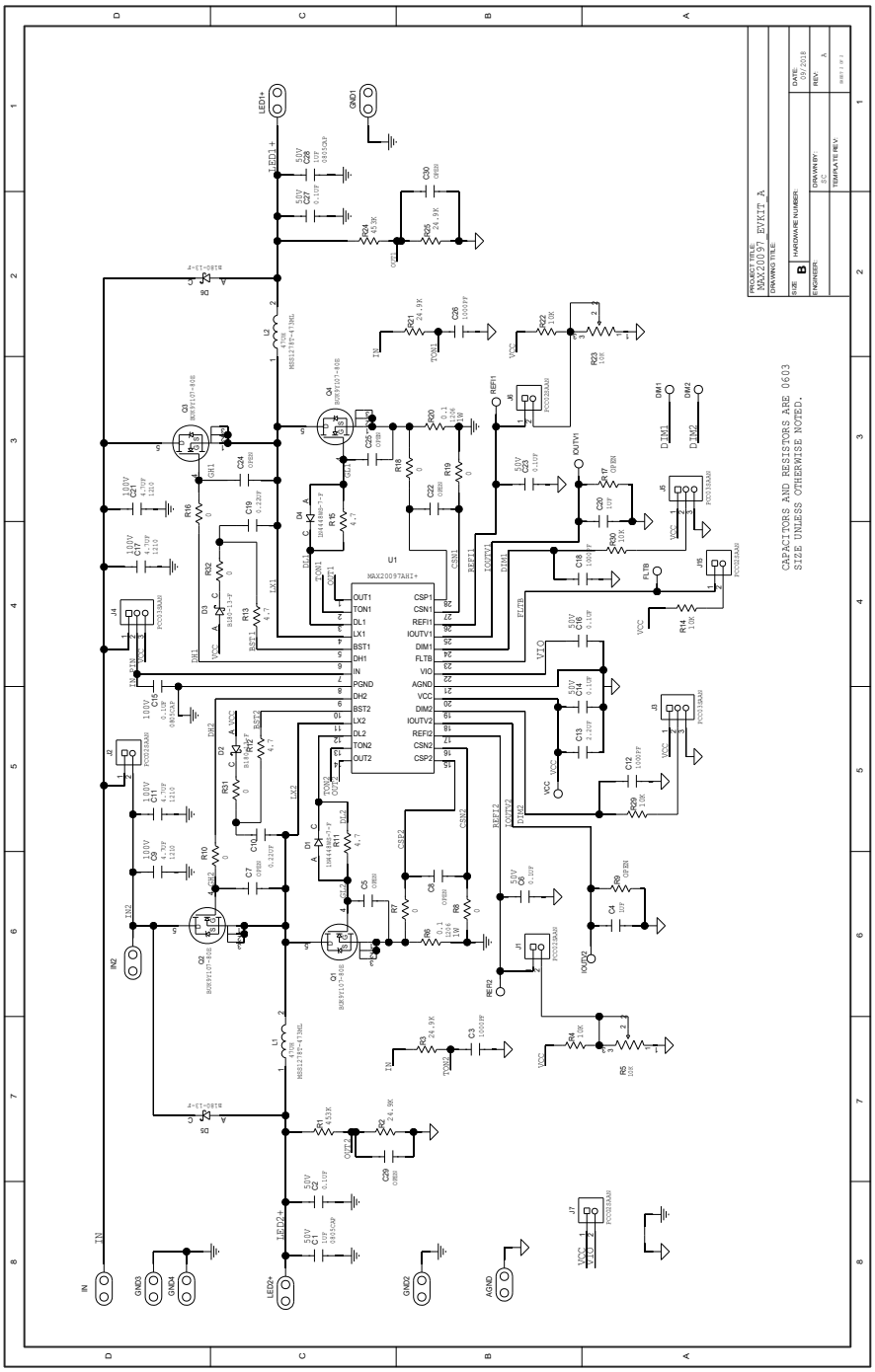

Figure 1. MAX20097 EV Kit Schematic

MAX20097 EV PCB Layouts

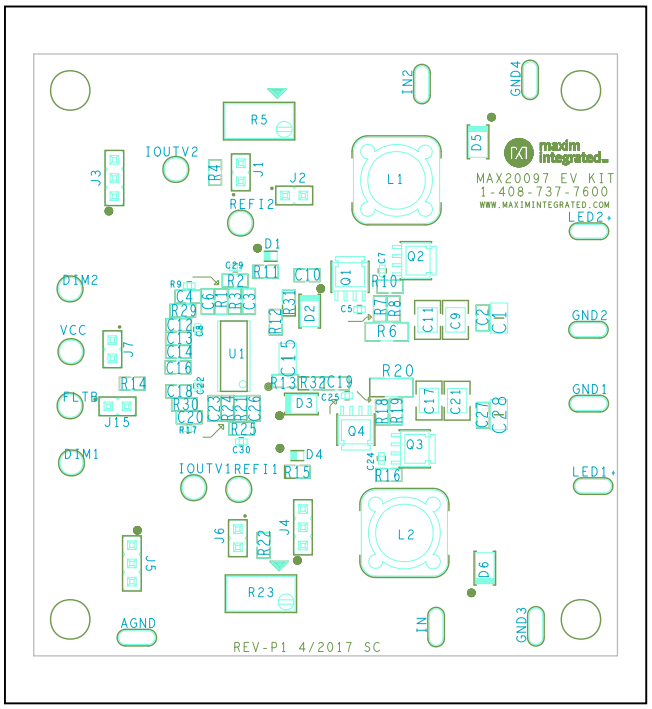

Figure 2. MAX20097 EV Kit Component Placement Guide—Component Side

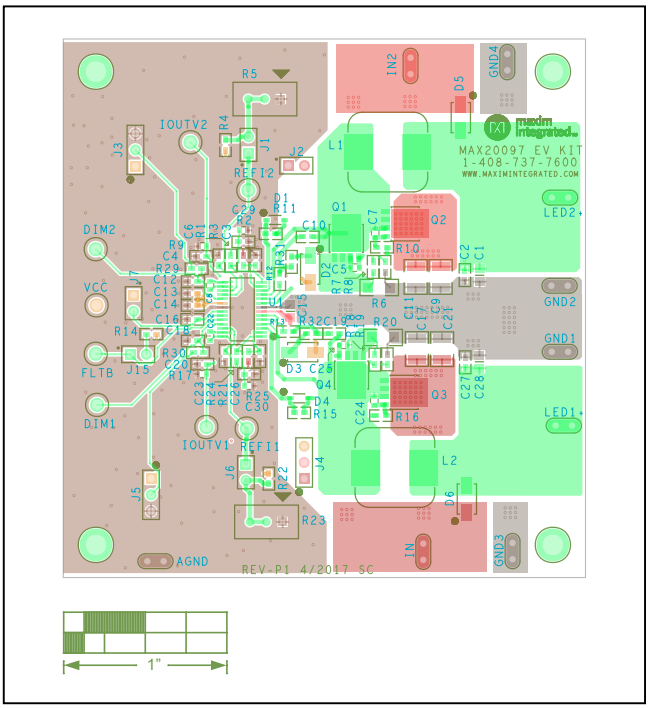

Figure 3. MAX20097 EV Kit PCB Layout—Top Layer

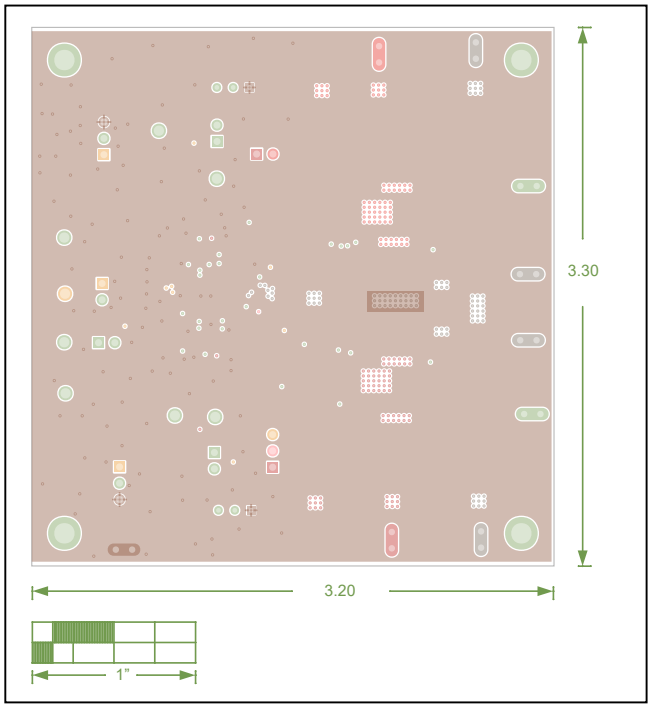

Figure 4. MAX20097 EV Kit PCB Layout—Inner Layer 1

MAX20097 EV PCB Layouts (continued)

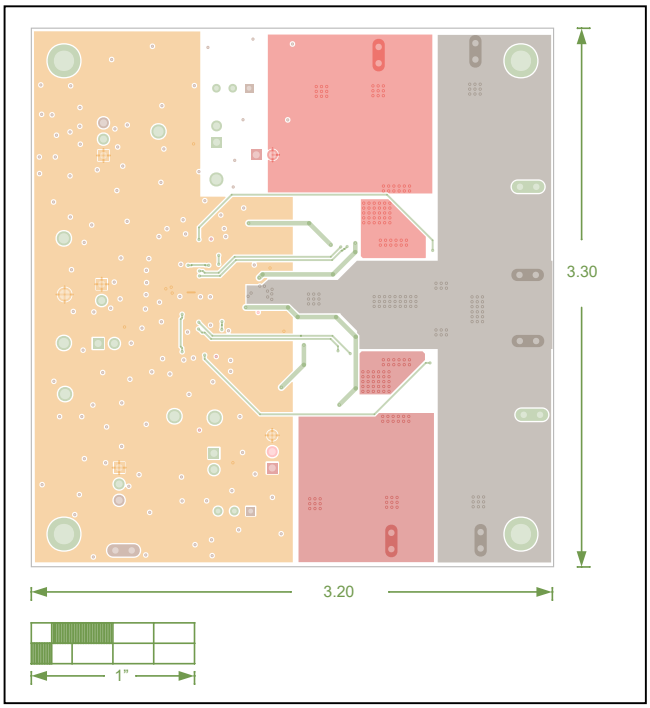

Figure 5. MAX20097 EV Kit PCB Layout—Inner Layer 2

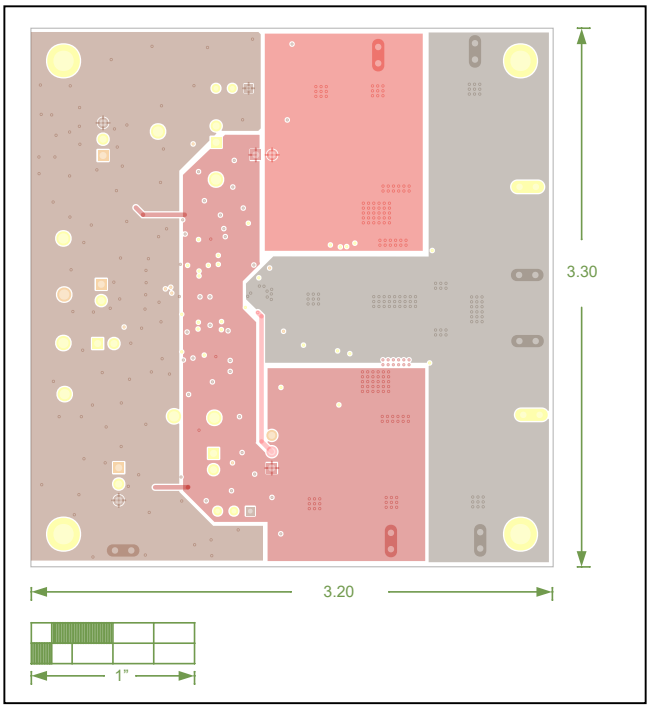

Figure 6. MAX20097 EV Kit PCB Layout—Bottom Layer

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	9/18	Initial release	—

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