General Description

The MAX20030 evaluation kit (EV kit) is a fully assembled and tested application circuit for the MAX20030 high-voltage, dual-synchronous step-down controller IC with preboost and an internal LDO. The EV kit is set up to provide 5V and 3.3V from an input voltage ranging from 3.5V to 36V. The preboost circuit maintains the 10V supply rail for input voltages below 10V. Each buck rail can deliver up to 5A load current. Various jumpers are provided to help evaluate features of the IC. The EV kit can also be used to evaluate the pin-compatible MAX20031 with IC replacement of U1.

Benefits and Features

- Dual-Synchronous Step-Down Controllers Operate at 180° Out-of-Phase to Reduce Switching Noise
- Preboost Controller Maintains Operation with Low Supply Voltage
- 3.5V to 36V Wide Input Supply Range
- Buck Output Voltage: 5V and 3.3V Fixed or Adjustable Between 1V and 10V
- 5V, 200mA LDO Output
- Current-Mode Controllers with Forced-PWM and Skip Modes
- Resistor-Programmable Frequency Between 1MHz and 2.2MHz
- Frequency Synchronization Input
- Independent Enable Inputs
- Voltage-Monitoring PGOOD_ Outputs
- Proven PCB Layout
- Fully Assembled and Tested

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

Quick Start

Required Equipment

- MAX20030 EV kit
- 3.5V to 36V, 15A power supply capable of providing 15A at 3V input
- Two voltmeters
- Two electronic loads capable of sinking 5A each

Procedure

The 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 all jumpers are in their default positions according to Table 1.
2) Connect the positive and negative terminals of the power supply to the VBATF and PGND test pads, respectively.
3) Connect the positive terminal of the first electronic load to the VOUT1 test pad. Connect the ground terminal of the electronic load to the corresponding PGND test pad.
4) Connect the positive terminal of the second electronic load to the VOUT2 test pad. Connect the ground terminal of the electronic load to the corresponding PGND test pad.
5) Set the power-supply voltage to 14V.
6) Turn on the power supply.
7) Enable the electronic loads.
8) Verify that VOUT1 is approximately 5V.
9) Verify that VOUT2 is approximately 3.3V.
10) Verify that the buck 1 and buck 2 switching frequency is approximately 2.0MHz.

Detailed Description

The MAX20030 EV kit, which evaluates the MAX20030 high-voltage, dual-synchronous step-down controller with a boost controller and a 200mA LDO, can supply up to four rails in a system. The EV kit includes two current-mode buck controllers that are fixed to 5V and 3.3V, or programmable from 1V to 10V with external resistor-dividers. The current capability is ~5A per rail. Both outputs are current limited and can be controlled independently through their respective enable inputs EN_. The EV kit includes an external boost controller that enables full output functionality during undervoltage events. The boost controller is designed to support full load on buck controllers down to 2V input. The EV kit also includes a 5V, 200mA linear regulator that is low I_Q and can be used to power always-on systems.

Switching Frequency/External Synchronization

The EV kit switching frequency can be adjusted from 220kHz to 2.2MHz by changing the FOSC resistor (R75). The EV kit can also be synchronized to an external clock by connecting the external clock signal to the FSYNC test point. Refer to the *Switching Frequency/External Synchronization* section in the MAX20030 IC data sheet for more information.

Buck Output Monitoring (PGOOD_)

The EV kit provides two power-good output test points (PGOOD1 and PGOOD2) to monitor the status of the two buck outputs (OUT1 and OUT2). Each PGOOD_ goes high impedance when the corresponding regulator output voltage is in regulation. Each PGOOD_ goes low when the corresponding regulator output voltage drops below 15% (typ) or rises above 10% (typ) of its nominal regulated voltage.

To obtain a logic signal, pull up PGOOD_ to V_{BIAS} by installing shunts on JU1 and JU2. See Table 1 for default jumper settings.

EXTVCC Switchover Comparator

The internal linear regulator can be bypassed by connecting an external supply (3V to 5.2V) or the output of one of the buck converters to EXTVCC. BIAS internally switches to EXTVCC and the internal linear regulator turns off. If V_{EXTVCC} drops below $V_{TH,EXTVCC}$ = 3V (min), the internal regulator enables and switches back to BIAS. See Table 2 for shunt positions.

Table 1. Default Jumper Settings

JUMPER	DEFAULT SHUNT POSITION	FUNCTIONS
JU1	1-2	Forced-PWM mode
JU2, JU6	Open, Installed	Boost disabled (active-high version IC used)
JU3	1-4	OUT1 connected to EXTVCC
JU4, JU5, JU7	1-2	Buck controllers and LDO enabled
JU8, JU9	Installed	PGOOD_ pulls up to V_{BIAS} when OUT_ is in regulation
JU10	Installed	Boost on-indicator enabled
JU11	2-3	Spread spectrum disabled

Table 2. EXTVCC (JU3)

SHUNT POSITION	EXTVCC PIN	BIAS
1-2	Connected to VOUT2	Switches to EXTVCC. Internal regulator disabled.
1-3	Connected to PGND	Internal regulator enabled to generate BIAS supply.
1-4*	Connected to VOUT1	Switches to EXTVCC. Internal regulator disabled.

**Default position.*

Mode of Operation

The EV kit features jumper JU1 to configure the mode switch-control input. Drive FSYNC high (pins 1-2 of JU1) to enable forced-PWM mode. Drive FSYNC low (pins 2-3 of JU1) to enable skip mode under light loads. See Table 3 for default jumper settings.

Enable Control

The EV kit features jumpers JU4, JU5, JU7 and JU2, JU6 to independently control the digital enable inputs of the buck 1 controller, the buck 2 controller, LDO, and the boost controller, respectively. Connect the active-high input EN_ to VIN (pins 1-2) to enable the corresponding controller. Connect the EN_ to ground (pins 2-3) to disable the corresponding controller. See Table 4 for default jumper settings..

Setting Output Voltage in Buck Converters

To externally adjust output voltage OUT1 between 1V and 10V, remove resistor R8. Connect a resistive divider from output OUT1 to FB1 to AGND. Place appropriate resistors in positions R5 and R6 according to the following equation:

$$R5 = R6\left[\left(\frac{V_{OUT1}}{V_{FB1}}\right) - 1\right]$$

where V_{FB1} = 1V (typ).

To externally adjust output voltage OUT2 between 1V and 10V, remove resistor R28. Connect a resistive divider from output OUT2 to FB2 to GND. Place appropriate resistors in positions R26 and R27, according to the following equation:

$$R26 = R27\left[\left(\frac{V_{OUT2}}{V_{FB2}}\right) - 1\right]$$

where V_{FB2} = 1V (typ).

Table 3. Mode of Operation (JU1)

SHUNT POSITION	FSYNC PIN	MODE
1-2*	Connected to BIAS	Forced-PWM mode
2-3	Connected to GND	Skip mode

**Default position.*

Table 4. Enable Control (JU2, JU4–JU7)

SHUNT POSITION	EN_ PIN	CONTROLLER_
JU2, JU6*	Open, Installed	EN3 active-low version boost enabled
JU2, JU6	Installed, Open	EN3 active-high version boost enabled
JU4, JU5, JU7*	1-2	Buck controllers and LDO enabled
JU4, JU5, JU7	2-3	Buck controllers and LDO disabled

**Default position.*

Boost Controller

The EV kit includes a synchronous current-mode boost controller with adjustable output. The boost controller output is called V_{IN} since it powers the input supply pin of the device. This boost controller can be used independently, but is ideally suited for applications that need to stay fully functional during input-voltage dropouts typical for automotive cold-crank or start-stop.

To externally adjust the boost output voltage (V_{IN}), place appropriate resistors in positions R18 and R19 according to the following equation:

$$R18 = R19\left[\left(\frac{V_{IN}}{V_{FB3}}\right) - 1\right]$$

where V_{FB3} = 1.005V (typ).

Evaluating with the MAX20030 EV Kit

The MAX20030 EV kit can be modified to operate at a 400kHz switching frequency, which would require a change in the following components:

1) Replace R30 (R_{FOSC}) with 80.6kΩ to achieve 400kHz switching frequency.
2) Replace the preboost inductor (L3) with a 2.2μH, 15A inductor.
3) Replace the buck inductors (L1, L2) with a 6.8μH, 7A inductor.

Contact Maxim Applications for any questions.

Ordering Information

PART	TYPE
MAX20030EVKIT#	EV Kit

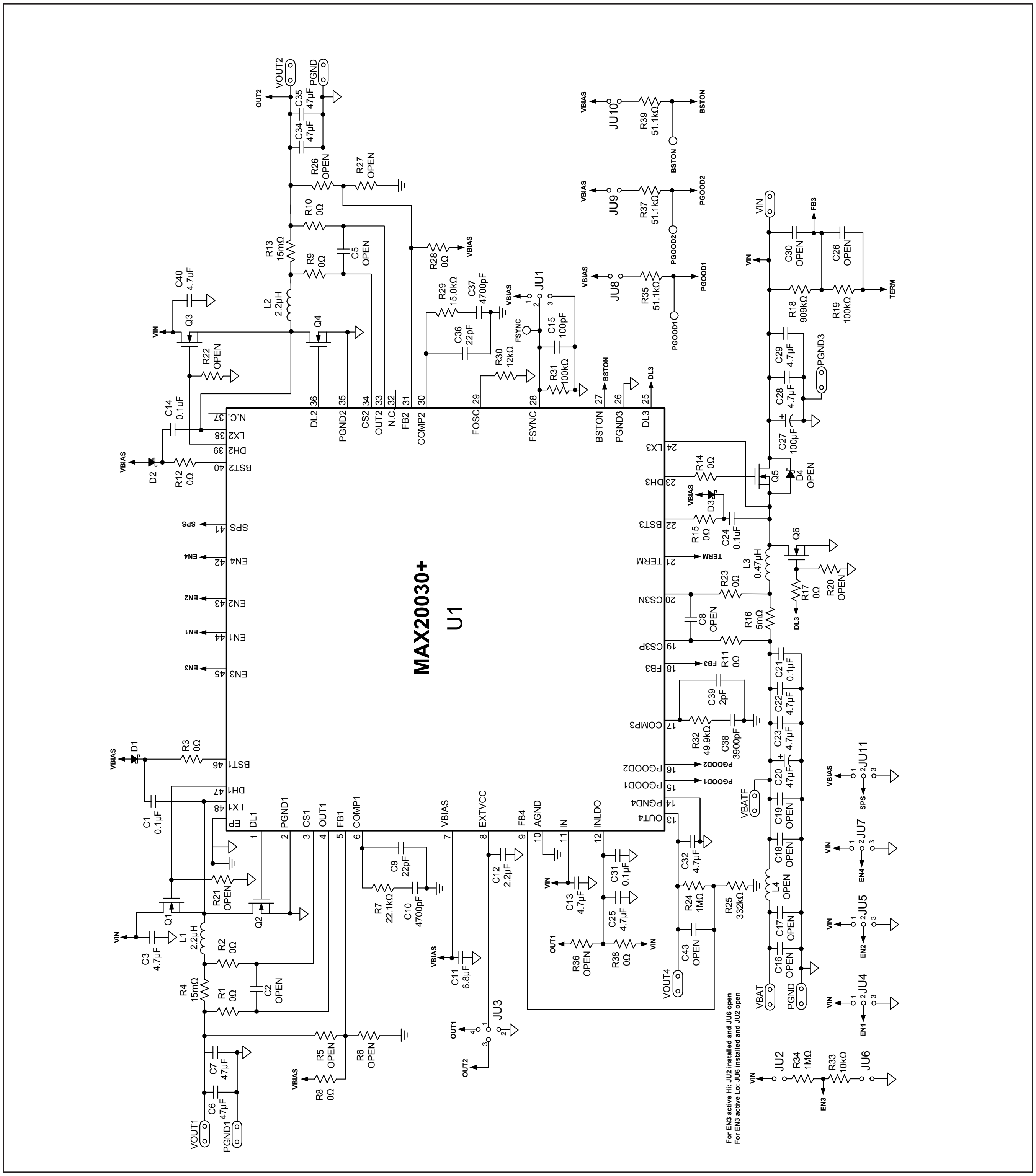
#Denotes RoHS compliant.

MAX20030 EV Kit BOM

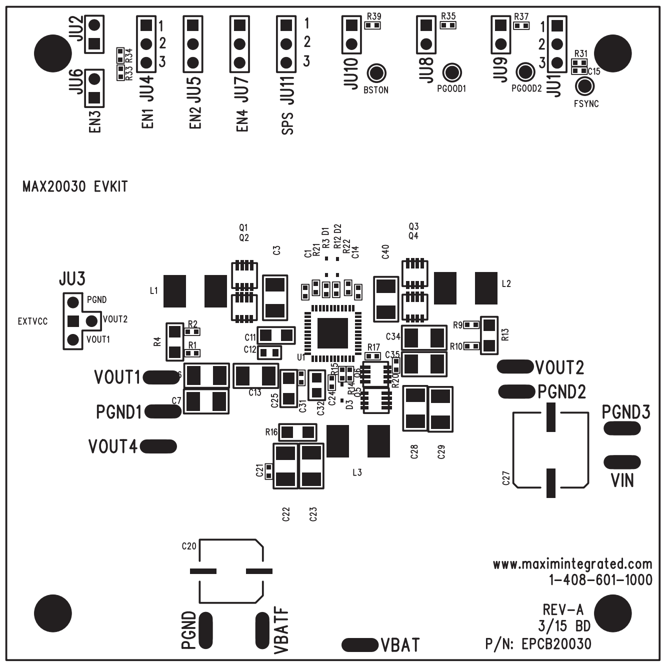
PART	QTY	DESCRIPTION	MANUFACTURER PART NUMBER
C1, C14, C21, C24, C31	5	0.1uF ±10%, 50V X7R ceramic capacitors (0402)	TDK CGA2B3X7R1H104K050BB
C2, C5, C8	—	Not installed, capacitor (0402)	
C3, C13, C22-C23, C25, C28, C29, C40	8	4.7uF ±10%, 50V X7R ceramic capacitor (1210)	Murata GCM32ER71H475KA55L
C6-C7, C34-C35	4	47uF ±10%, 10V X7R ceramic capacitor (1210)	Murata GRM32ER71A476K
C9, C36	2	22pF ±5% 16V C0G ceramic capacitor (0402)	Taiyo Yuden UMK105CG220JV-F
C10, C37	2	4700pF ±10% 50V X7R ceramic capacitor (0402)	Murata GRM155R71H472K
C11	1	6.8uF ±10%, 16V X7R ceramic capacitor (1206)	TDK C3216X7R1C685K
C12	1	2.2uF ±10%, 10V X7R ceramic capacitor (0603)	Murata GRM188R71A225K
C15	1	100pF ±10% 50V C0G ceramic capacitor (0402)	TDK CGA2BC0G1H101J050BA
C20	1	47uF, 50V aluminum electrolytic capacitor (6.2mm x 8mm)	Panasonic EEE-FK1H470P
C27	1	100uF, 50V aluminum electrolytic capacitor (10.0mm x 10.2mm)	Panasonic EEHZA1H101P
C32	1	4.7uF ±10%, 16V X7R ceramic capacitor (0805)	TDK CGA4J3X7R1C475K125AB
C38	1	3900pF ±10% 50V X7R ceramic capacitor (0402)	Murata GRM155R71H392KA01D
C39	1	2pF ±10% 50V C0G ceramic capacitor (0402)	TDK CGA2B2C0G1H020C050BA
D1-D3	3	200mA, 30V diodes (SOT-323)	Fairchild BAT54HT1G
JU1, JU4, JU5, JU7, JU11	5	3-pin header (CUT TO FIT)	SULLINS PEC36SAAN
JU2, JU6, JU8-JU10	4	2-pin header (CUT TO FIT)	SULLINS PEC36SAAN
JU3	1	4-pin header (CUT TO FIT)	SULLINS PEC36SAAN
L1, L2	2	2.2uH Power Inductor (R=13.2mOhms, I=7.2A, 5.2mm x 5.48mm)	Coilcraft XAL5030-222ME
L3	1	0.47uH Power Inductor (R=4mOhms, I=17.5A, 6.47mm x 6.86mm)	Vishay IHLP2525CZERR47M01
Q1-Q4	4	40V, 7.6A N-channel MOSFET (8-SOIC)	Fairchild FDMC8015L
Q5, Q6	2	60V, 40A N-channel MOSFET (PowerPAK 1212-8)	Vishay SIS862DN-T1-GE3
R1, R2, R9, R10, R11, R23	2	0Ω resistor (0402)	Any
R3, R8, R12, R14-R15, R17, R28, R38	8	0Ω resistor (0402)	Any
R4, R13	2	15mΩ, ½ W sense resistor (1206)	IRC LRF1206LF-01-R015-F
R7	1	22.1kΩ ±1% resistors (0402)	Any
R16	1	5mΩ, 1W sense resistor (1206)	TT Electronics LRMAM1206-R005FT5
R18	1	909kΩ ±1% resistors (0402)	Any
R19, R31	2	100kΩ ±1% resistors (0402)	Any
R24, R34	2	1.0MΩ ±1% resistors (0402)	Any
R25	1	332kΩ ±1% resistors (0402)	Any
R29	1	15.0kΩ ±1% resistors (0402)	Any
R30	1	12.0kΩ ±1% resistors (0402)	Any
R32	1	49.9kΩ ±1% resistors (0402)	Any
R33	1	10.0kΩ ±1% resistors (0402)	Any
R35, R37, R39	3	51.1kΩ ±1% resistors (0402)	Any
U1	1	Automotive Boost-Dual Buck with PreBoost (48 TQFN-EP)	Maxim MAX20030BATMA/V+
—	1	PCB: MAX20030EVKIT	

***= L4 can be populated with a 6A Ferrite Bead (1806) Murata BLM41PG600SN1L if EMI testing is needed. To be included with the EMI circuit is C16=C18=0.1μF±10%, 50V X7R (0603) and C17=C19=1,000pF±10%, 50V X7R (0603).*

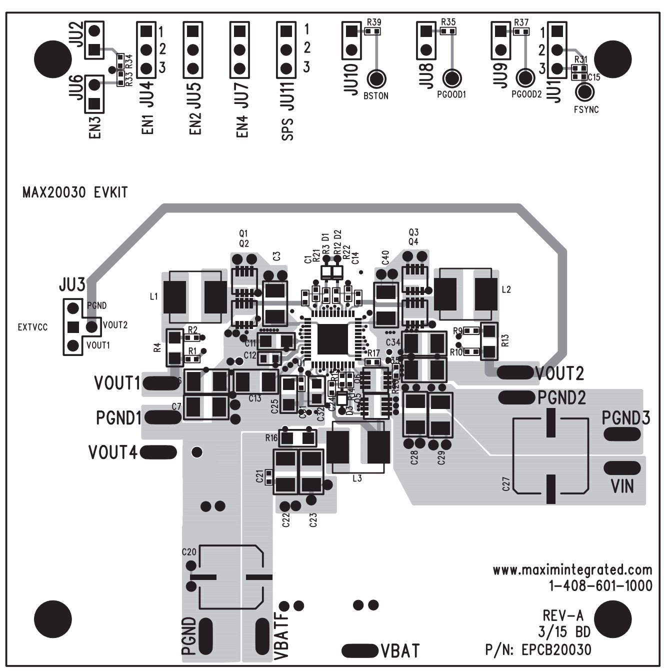
MAX20030 EV Kit Schematics



MAX20030 EV Kit PCB Layouts

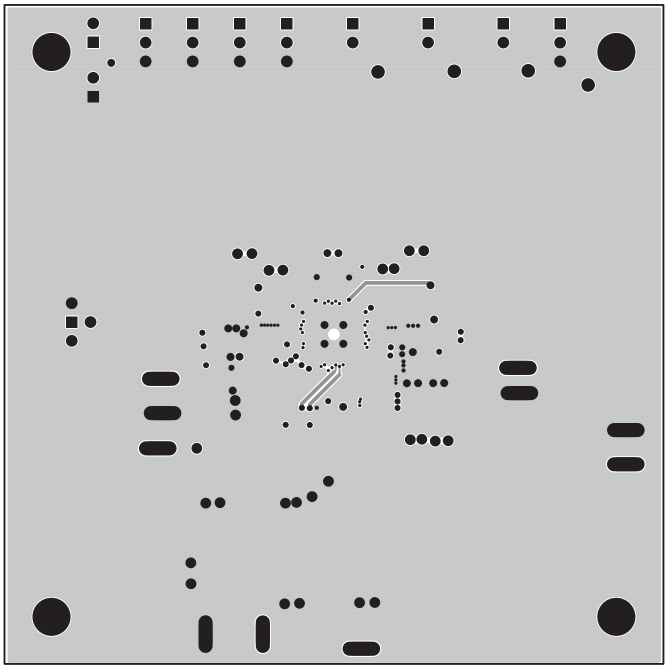


MAX20030 EV Kit—Top Assembly



MAX20030 EV Kit—Top Layer

MAX20030 EV Kit PCB Layouts (continued)



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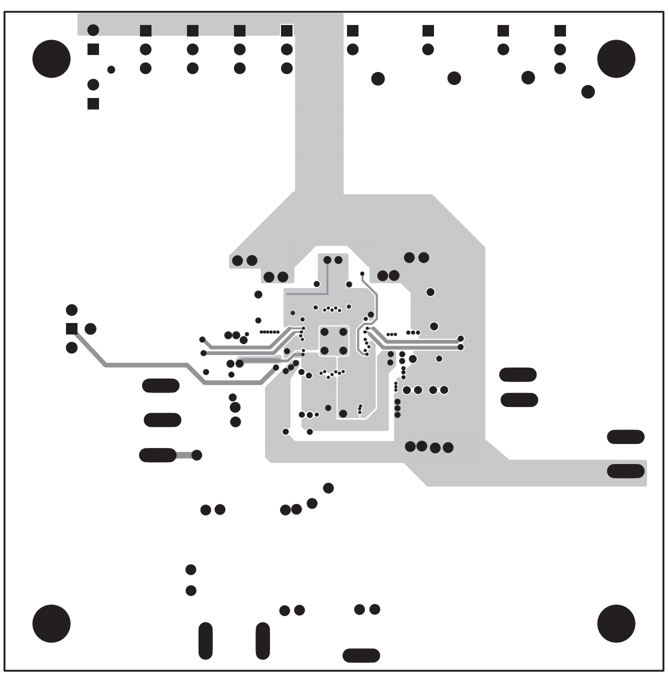
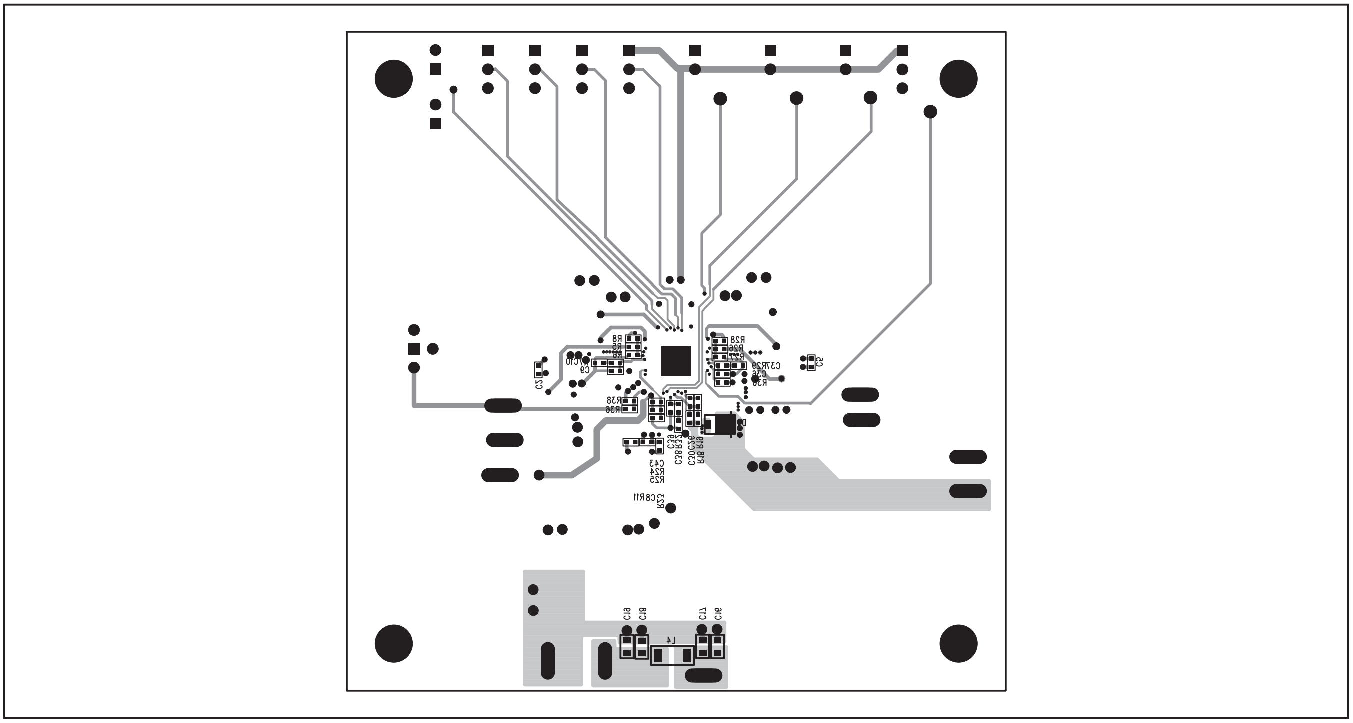
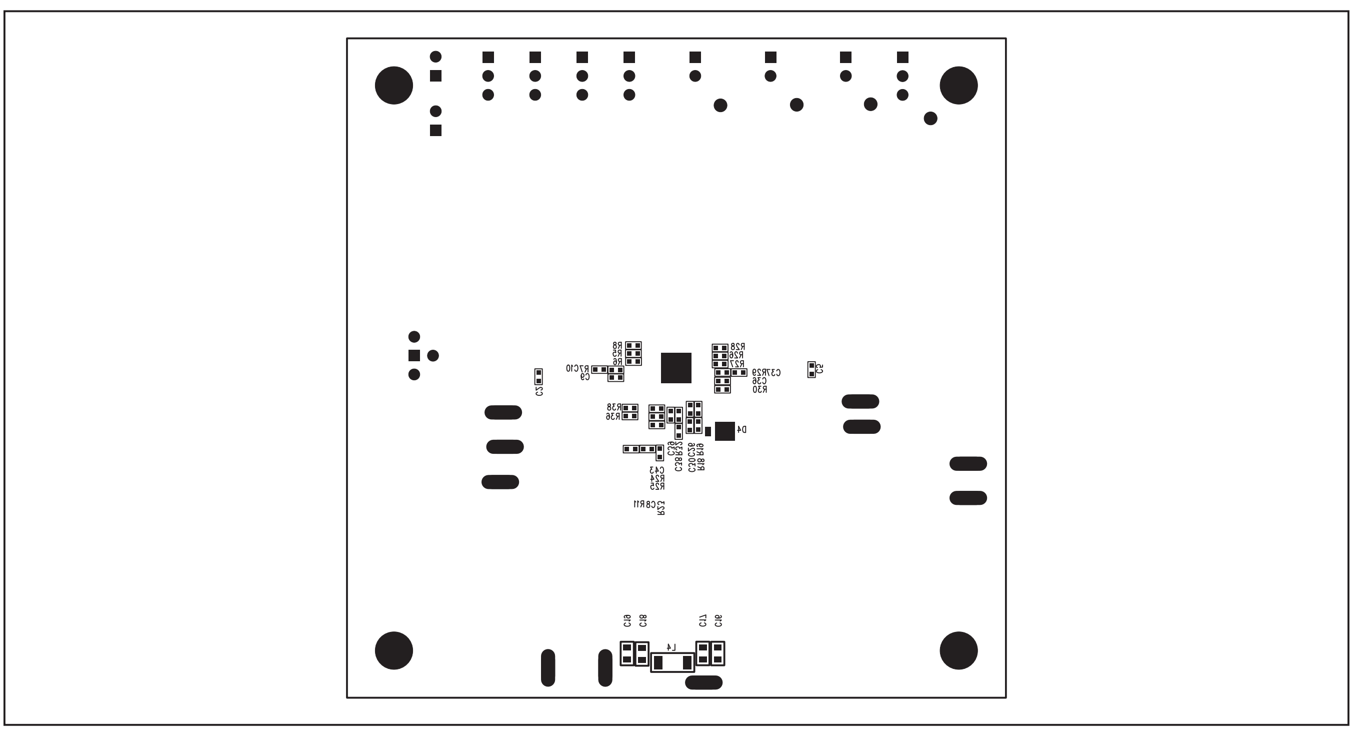


MAX20030 EV Kit—Inner Layer 3

MAX20030 EV Kit PCB Layouts (continued)



MAX20030 EV Kit—Bottom Layer



MAX20030 EV Kit—Bottom Assembly