MAX17557 5V Output Evaluation Kit

Evaluates: MAX17557 5V Output-Voltage Application

General Description

The MAX17557 5V-output evaluation kit (EV kit) provides a proven design to evaluate the MAX17557 high-voltage, high-efficiency, synchronous step-down DC-DC controller. The EV kit provides 5V/10A at the output from a 6.5V to 60V input supply. The switching frequency of the EV kit is preset to 350kHz for optimum efficiency and component size. The EV kit features Enable/UVLO Input, resistor-programmable UVLO threshold, adjustable soft-start time, open-drain PGOOD output, and overcurrent and overtemperature protection.

Features

- Operates from a 6.5V to 60V Input Supply
- 5V Output Voltage
- Up to 10A Output Current
- 350kHz Switching Frequency
- Enable/UVLO Input, Resistor-Programmable UVLO Threshold
- Adjustable Soft-Start Time
- Open-Drain PGOOD Output
- Overcurrent (OCP) and Overtemperature (OTP) Protection
- Proven PCB Layout
- Fully Assembled and Tested

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

Quick Start

Recommended Equipment

- MAX17557 5V-output EV kit
- 6.5V to 60V, 10A DC-input power supply
- Load capable of sinking 10A
- Digital voltmeter (DVM)

Procedure

The EV kit is fully assembled and tested. Follow the steps below to verify the board operation. **Caution: Do not turn on power supply until all connections are completed.**

1) Set the power supply at a voltage between 6.5V and 60V. Disable the power supply.
2) Connect the positive terminal of the power supply to the V_{IN} PCB pad and the negative terminal to the nearest PGND PCB pad. Connect the positive terminal of the 10A load to the V_{OUT} PCB pad and the negative terminal to the nearest PGND PCB pad.
3) Connect the DVM across the V_{OUT} PCB pad and the nearest PGND PCB pad.
4) Place the shunt on the jumpers JU1, JU3, and JU4 according to the intended operation (see Tables 1, 2, and 3 for details).
5) Turn on the DC power supply.
6) Enable the load.
7) Verify that the DVM displays 5V.

319-100068; Rev 0; 8/17

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Detailed Description of Hardware

The MAX17557 5V-output evaluation kit (EV kit) is a proven design to evaluate the MAX17557 high-voltage, high-efficiency, synchronous step-down DC-DC controller. The EV kit provides 5V/10A at the output from a 6.5V to 60V input supply. The switching frequency of the EV kit is preset to 350kHz for optimum efficiency and component size. The EV kit features current sensing using either an external current-sense resistor for accuracy or an inductor DCR for improved system efficiency. Current foldback limits MOSFET power dissipation under short-circuit conditions. The EV kit includes an EN/UVLO PCB pad and jumperJU4 to enable the output at a desired input voltage. A PGOOD PCB pad is available for monitoring when the converter output is in regulation.

Setting the Input Undervoltage Lockout Level

The EN pin can be open or pulled up to a voltage between 1.25V and 5.5V to turn on the controller. Figure 1 shows the possible configurations. The EN pin can be used as input undervoltage lockout detector with a typical hysteresis of 100mV. As shown in Figure 1, the input voltage at which the controller of the IC turns on, can be set with a resistor-divider connected to EN from IN to GND. Select R2 = 10kΩ and calculate R1 based on the following equation:

$$R1 = R2 \times \frac{(V_{IN\_UVLO} - 1.25)}{1.25}$$

where V_{INUVLO} is the input voltage at which the controller should be enabled.

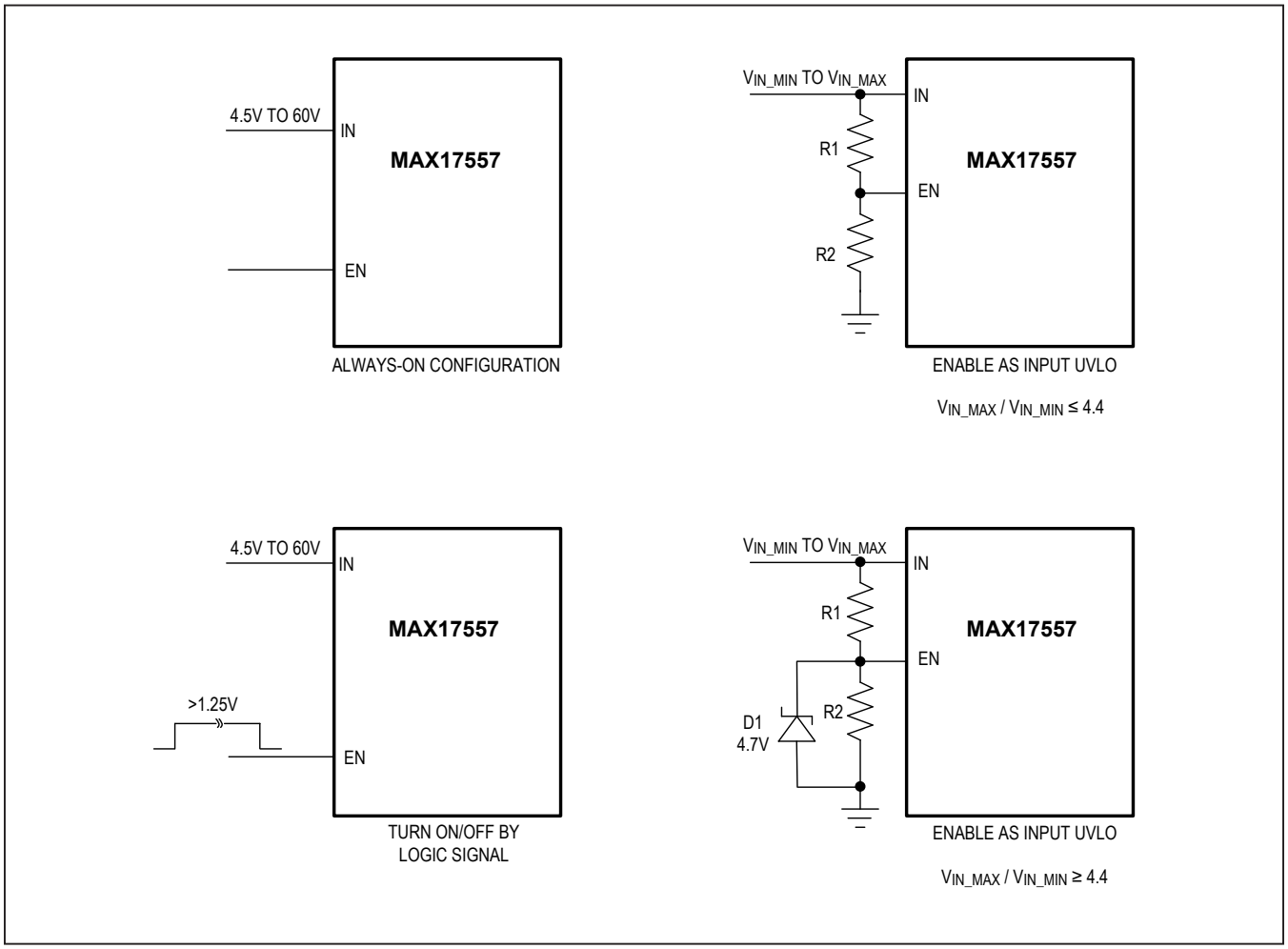


Figure 1. Setting the Input Under Voltage Lockout

Adjusting Output Voltage

The output voltage of the converter is set by connecting a resistor-divider to FB from the output to GND (Figure 2). Select R3 using the following equation, based on the offset introduced on the output voltage by the FB leakage. Let α be the offset introduced on the output voltage:

$$R3 \le \frac{\alpha}{I_{FB\_}}$$

where:

α = offset introduced on the output voltage

I_{FB} = FB leakage current (±100nA max)

For example, for V_{OUT} = 5V, α = 0.1% of V_{OUT} (= 5mV).

$$R3 \le 50k\Omega$$

Calculate R4 with the following equation:

$$R4 = \frac{R1}{\left(\frac{V_{OUT}}{0.8} - 1\right)}$$

Soft-Start Capacitor Selection

Soft-start time is programmed by connecting a capacitor from the SS pin to GND. An internal 5µA current source charges the capacitor at the SS pin providing a linear ramping voltage for output-voltage reference. The soft-start time is calculated based on the following equation:

$$t_{SS} = C_{SS} \times \frac{0.8V}{5\mu A}$$

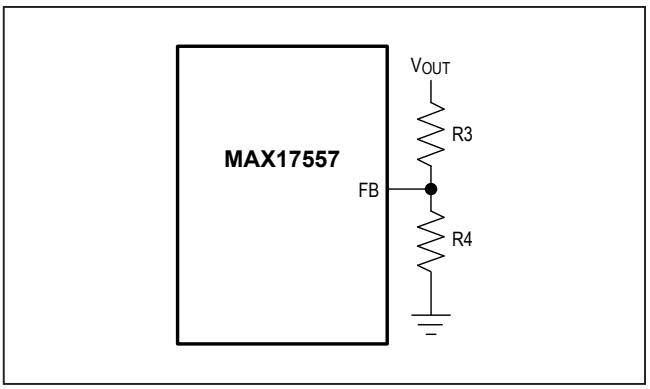


Figure 2: Adjusting Output Voltage

Frequency Selection (RT)

The selection of switching frequency is a tradeoff between efficiency and component size. Low-frequency operation increases efficiency by reducing MOSFET switching losses and gate-drive losses, but requires a larger inductor and/or capacitor to maintain low output-ripple voltage. The switching frequency of the device can be programmed between 100kHz and 2.2MHz using the RT pin. Connect a resistor from RT to GND to set the regulator's switching frequency. Leave RT open for the default 350kHz frequency. The following formula can be used to find the required resistor for a given switching frequency.

$$R_{RT} = \frac{19 \times 10^3}{f_{SW}} - 1.7$$

where R_{RT} is in kΩ and f_{SW} is in kHz. Leaving the RT pin open causes the device to operate at the default switching frequency of 350kHz.

Table 1. JU1: Switching Frequency Selection Jumper

JUMPER	SHUNT POSITION	R3	RT	MAX17557 SWITCHING FREQUENCY
JU1	Not Installed	Not installed	Unconnected	Default 350kHz
		R3 is used	Connected to GND through R3	f_{SW} = (19000) / (R_{RT} + 1.7)
	1-2	X	Connected to V_{CCINT}	Default 350kHz
	2-3	Controller does not start		

Table 2. JU3: Overcurrent Protection Mode Select

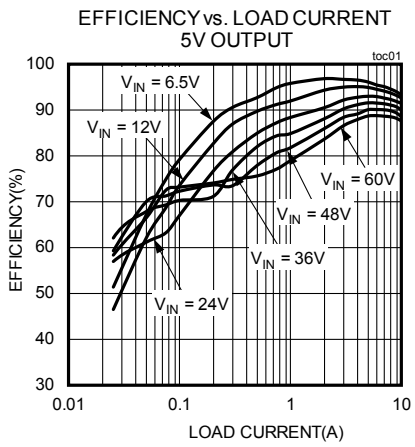
JUMPER	SHUNT POSITION	ILIMSEL	MODE
JU3	1-2	Connected to V_{CCINT}	Latch-off Mode
	2-3	Connected to GND	Foldback Mode

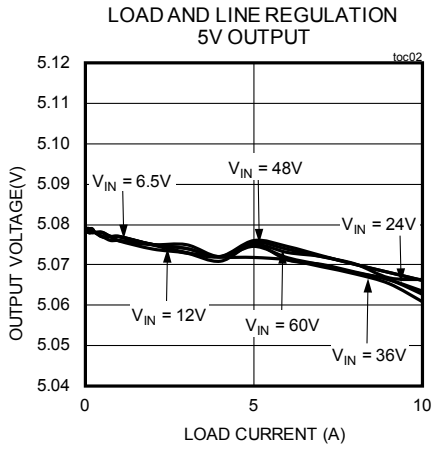
Table 3. JU4: Controller Enable (EN/UVLO) Description

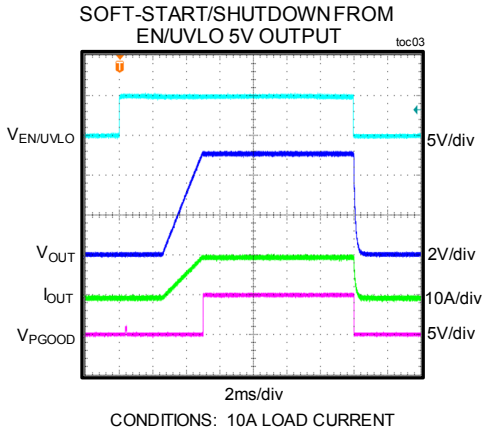
JUMPER	SHUNT POSITION	EN	MAX17557 OUTPUT
JU4	Not installed	Unconnected	Enabled
	1-2	Connected to the input UVLO divider midpoint.	Enabled, UVLO level is set by the resistor divider from V_{IN} to GND.
	2-3	Connected to GND	Disabled

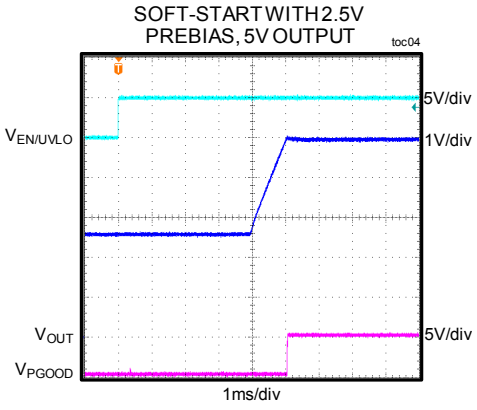
MAX17557 EV Kit Performance Report

V_{IN} = 24V, unless otherwise noted,





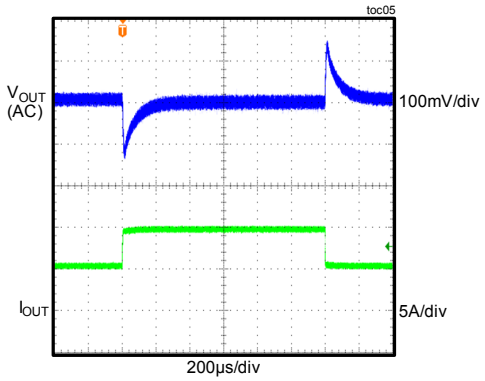




MAX17557 EV Kit Performance Report (continued)

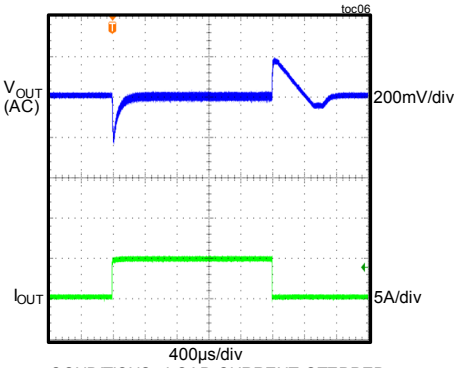
V_{IN} = 24V, unless otherwise noted,

LOAD TRANSIENT RESPONSE
5V OUTPUT



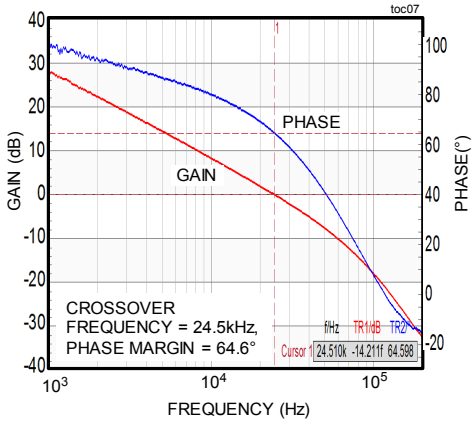
CONDITIONS: LOAD CURRENT STEPPED FROM 5A TO 10A

LOAD TRANSIENT RESPONSE
5V OUTPUT



CONDITIONS: LOAD CURRENT STEPPED FROM 0.1A TO 5A

5V OUTPUT BODE PLOT
CONDITIONS:10A LOAD CURRENT



Component List

SUPPLIER	WEBSITE
Coilcraft, Inc.	www.coilcraft.com
Murata Americas	www.murataamericas.com
Panasonic Corp.	www.panasonic.com
Renesas Electronics	www.renesas.com
Diode Inc.	www.diodes.com

Note: *Indicate that you are using the MAX17557 when contacting these component suppliers.*

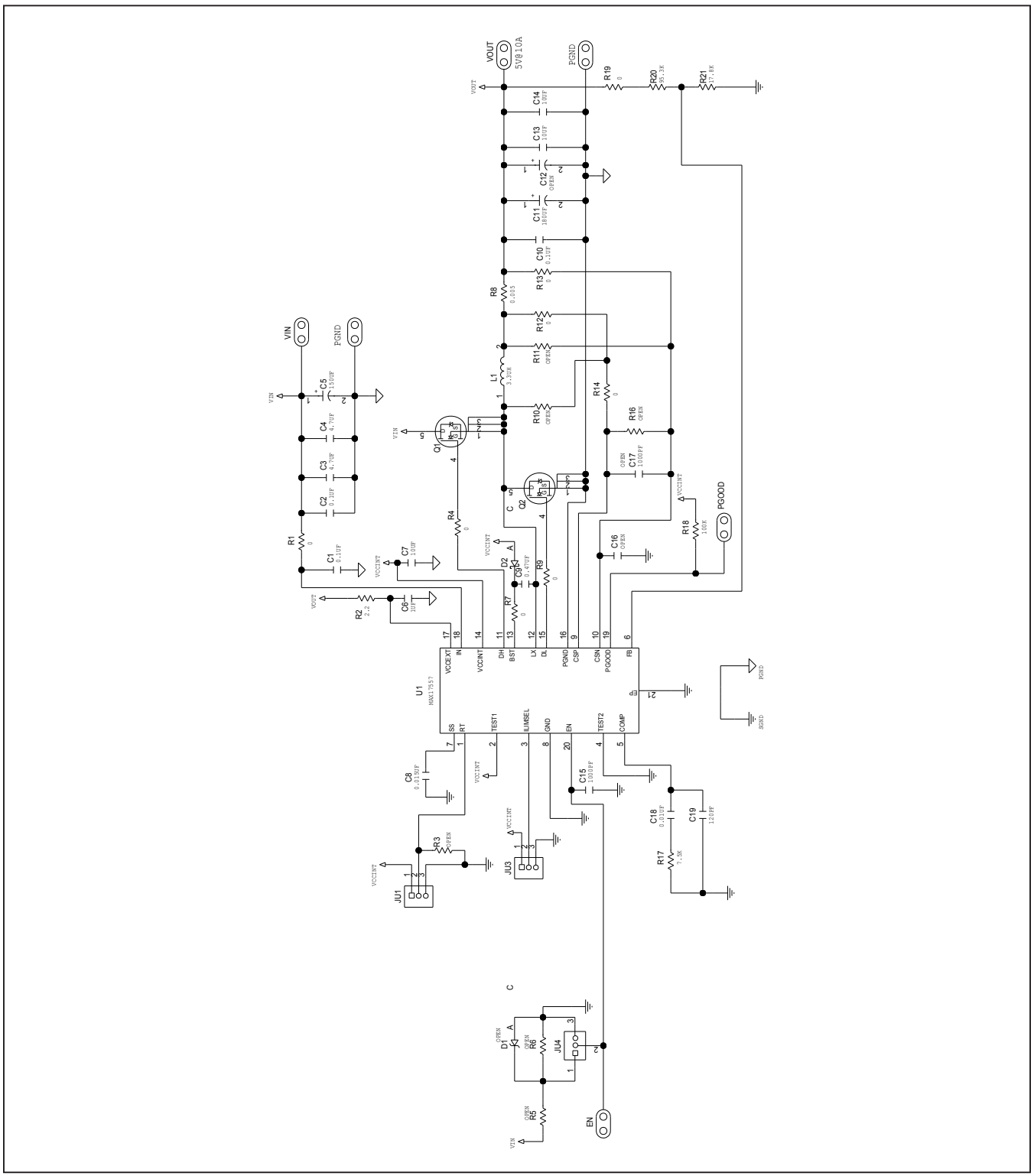
Ordering Information

PART	TYPE
MAX17557EVKIT#	EVKIT

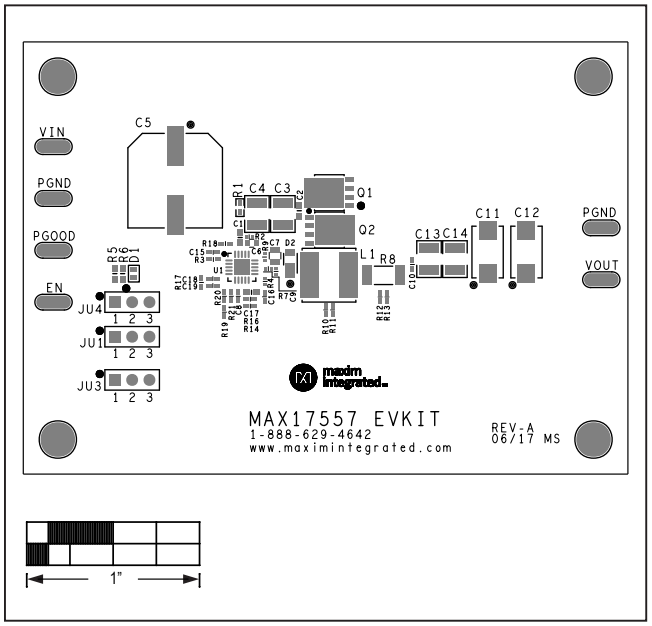
MAX17557 EV System Bill of Materials

No.	Description	Quantity	Designator	Part Number
1	0.1µF 10%, 100V ,X7R,Ceramic capacitor (0603)	2	C1,C2	MURATA GRM188R72A104KA35
2	4.7µF 20%, 80V ,X7R,Ceramic capacitor (1210)	2	C3,C4	MURATA GRM32ER71K475ME14
3	150µF,20%,80V,ELECT,13mm	1	C5	PANASONIC EEV-FK1K151Q
4	1µF 10%, 16V ,X7R,Ceramic capacitor (0603)	1	C6	MURATA GRM188R71C105KA12
5	10µF 10%, 10V ,X7R,Ceramic capacitor (0805)	1	C7	MURATA GGRM21BR71A106KE51
6	15000pF,10%,50V,X7R,0402,Ceramic capacitor(0402)	1	C8	MURATA GRM155R71H153KA12
7	0.47µF,10%,10V,X7R, Ceramic capacitor(0402)	1	C9	MURATA GRM155R61A474KE15
8	0.1µF,10%,50V,X7R, Ceramic capacitor(0402)	1	C10	MURATA GRM155R71H104KE14
9	180µF 20%, 6.3V ,X7R,Ceramic capacitor (1210)	1	C11	PANASONIC EEFSE0J181R
10	10µF 10%, 10V ,X7R,Ceramic capacitor (1210)	2	C13,C14	MURATA GRM32DR71A106KA01
11	1000pF,10%,100V,X7R,0402,Ceramic capacitor(0402)	1	C15	MURATA GRM155R72A102KA01
12	10nF,10%,50V,X7R,0402,Ceramic capacitor(0402)	1	C18	MURATA GRM155R71H103JA88
13	120pF,2%,50V,X7R,0402,Ceramic capacitor(0402)	1	C19	MURATA GRM1555C1H121GA01
14	Diode PIV=100V; IF=1A	1	D1	DIODES INCORPORATED DFLS1100-7
15	3-pin header (36-pin header 0.1” centers)	1	JU1,JU3,JU4	Sullins: PEC03SAAN
16	INDUCTOR, 3.3µH, 19.4A	1	L1	COILCRAFT XAL7070-332ME
17	N-CHANNEL POWER MOSFET(LFPAK) PD-(45W); I-(25A); V-(60V)	1	Q1	RENESAS RJK0651DPB-00#J5
18	N-CHANNEL POWER MOSFET(LFPAK) D-(65W); I-(45A); V-(60V)	1	Q2	RENESAS RJK0653DPB-00#J5
19	RES+,0Ω,1%,0402	8	R1, R4, R7, R9, R12-R14, R19	
20	RES+,2.2Ω,1%,0402	1	R2	
21	RES+,0.005Ω,1%,1.5W,2010	1	R8	
22	RES+,7.5KΩ OHM,1%,0402	1	R17	
23	RES+,100KΩ OHM,1%,0402	1	R18	
24	RES+,95.3KΩ OHM,1%,0402	1	R20	
25	RES+,17.8KΩ OHM,1%,0402	1	R21	
26	Buck Controller MAX17557ATP+	1	U1	MAX17557ATP+

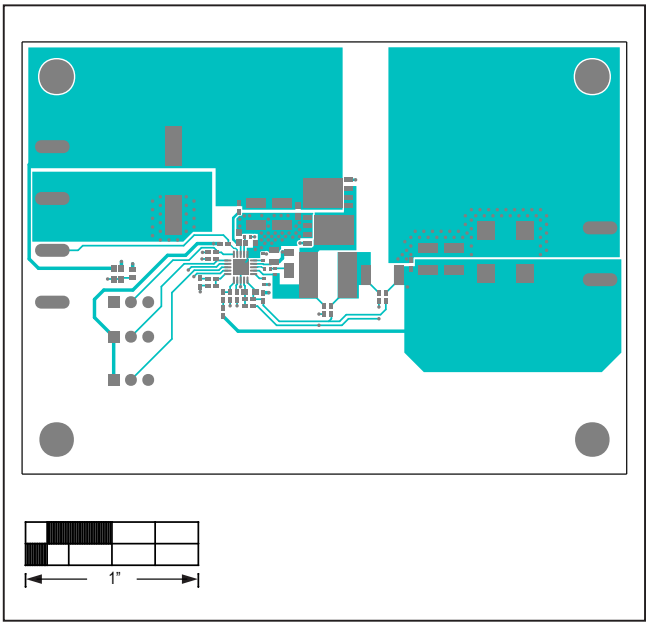
MAX17557 EV System Schematic



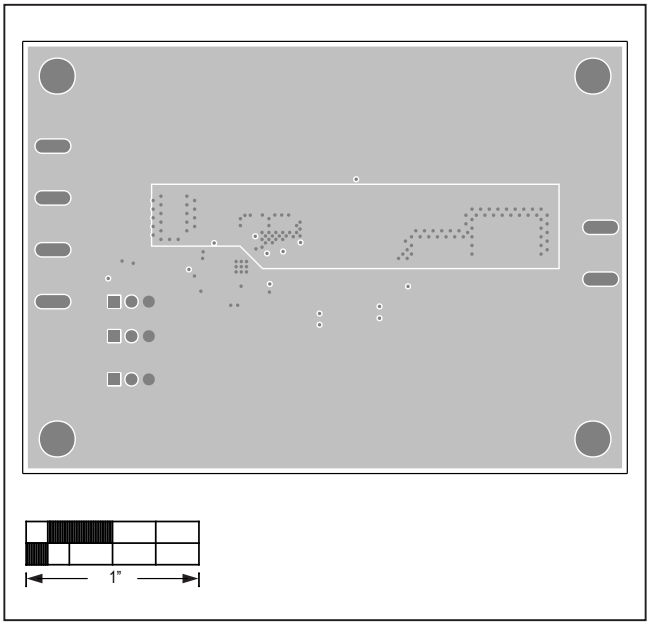
MAX17557 EV System PCB Layout



MAX17557 EV Kit Silk Top

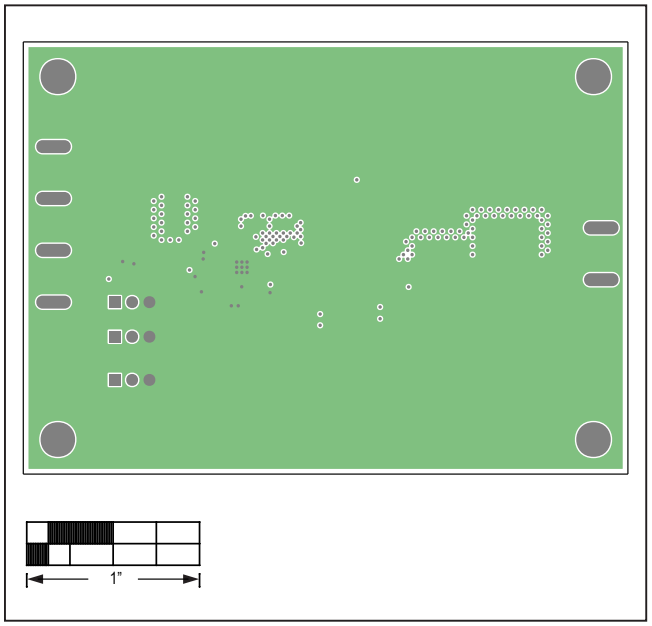


MAX17557 EV Kit Top

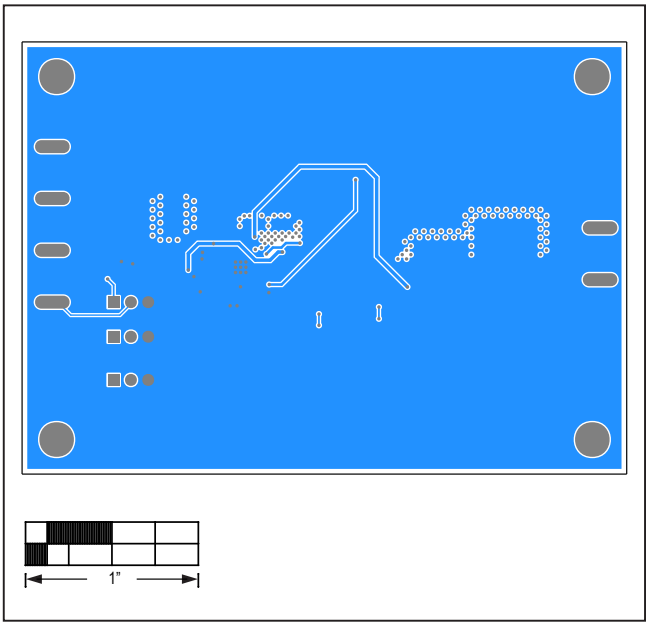


MAX17557 EV Kit L2-GND

MAX17557 EV System PCB Layout (continued)



MAX17557 EV Kit L3-GND



MAX17557 EV Kit Bottom

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	8/17	Initial release	—