Click here for production status of specific part numbers.

MAX17557EVKITE# Evaluation Kit

Evaluates: MAX17557 in 5V Output-Voltage Application

General Description

The MAX17557EVKITE# evaluation kit (EV kit) provides a proven design to evaluate the MAX17557 high-efficiency, high-voltage, Himalaya synchronous step-down DC-DC controller. The EV kit is preset to generate 5V output at load currents up to 10A from a 6.5V to 48V input supply. The EV kit features a 350kHz switching frequency for optimum efficiency and component size. The EV kit features PCB pads for enable/disable functionality, open-drain power-good (PGOOD) output, and external clock synchronization (MODE/SYNC). The EV kit also provides a good layout example, which is optimized for conducted, radiated EMI, and thermal performance. For more details about the device, refer to the MAX17557 IC data sheet's *Benefits and Features* section.

Features

- Operates from a 6.5V to 48V Input Supply
- 5V Output Voltage
- Up to 10A Output Current
- 350kHz Switching Frequency
- Enable/Disable Input, Resistor-Programmable UVLO Threshold
- MODE Selection Jumper to Select Between PWM and DCM Modes
- Capacitor Programmable Soft-Start Time
- External Clock Synchronization Input
- Jumper Programmable Soft-Stop Enable or Disable Functionality
- Open-Drain PGOOD Output
- Overcurrent Protection Mode Selection Jumper
- Overtemperature Protection
- Proven PCB Layout
- Fully Assembled and Tested
- Complies with CISPR32(EN55032) Class B Conducted and Radiated Emissions

Quick Start

Recommended Equipment

- MAX17557EVKITE#
- 60V, 10A DC input power supply
- Load capable of sinking 10A
- Two digital voltmeters (DVM)

Equipment Setup and Test Procedure

The EV kit is fully assembled and tested. Use the following steps to verify 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 48V. Disable the power supply.
2) Connect the positive terminal of the power supply to the VIN PCB pad and the negative terminal to the nearest PGND PCB pad. Connect the positive terminal of the 10A load to the VOUT PCB pad and the negative terminal to the nearest PGND PCB pad.
3) Connect one DVM across the VOUT PCB pad and the nearest PGND PCB pad, and other DVM across PGOOD PCB pad and SGND PCB pad.
4) Verify that shunts are installed across pins 1-2 on jumper JU3 (See Table 1 for details).
5) Select the shunt positions on the jumpers JU1, JU2 and JU4 according to the intended mode of operation. (See Table 2, Table 3, and Table 4 for details).

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

319-100655; Rev 0; 12/20

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6) Turn on the DC power supply.
7) Enable the load.
8) Ensure that the input voltage to be 6.5V or higher, with which the EN pin voltage is more than the EN rising threshold.
9) Verify that the DVM across the VOUT PCB pad and the nearest PGND PCB pad display 5V.
10) Verify that the DVM across the PGOOD PCB pad and the nearest SGND PCB pad display 5V.
11) Reduce the input voltage to 5V, which is below the EN falling threshold.
12) Verify that both the DVMs display 0V.
13) Disable the input power supply.

Detailed Description

The MAX17557EVKITE# provides a proven design to evaluate the MAX17557 high-efficiency, high-voltage, Himalaya synchronous step-down DC-DC controller. The EV kit generates 5V output at load currents up to 10A from a 6.5V to 48V input supply. The EV kit features a 350kHz switching frequency for optimum efficiency and component size. The EV kit enables using external current sense resistor, inductor DCR current sense methods. The MODE/SYNC PCB pad allows an external clock to synchronize the device. The EV kit features jumpers for selecting mode of operation (JU1), mode of overcurrent protection (JU2), enable/disable the converter output (JU3), and enable/disable the soft-stop functionality (JU4). A PGOOD PCB pad is available for monitoring the status of converter output voltage regulation.

Enable/Undervoltage Lockout (EN) Programming

The MAX17557 offers an adjustable enable and input undervoltage lockout feature. In this EV kit, for normal operation, install a shunt across pins 1-2 on EN jumper (JU3). When the shunt is installed, the MAX17557 is enabled when the input voltage rises above 6.45V. To disable the device, install shunt across pins 2–3 on the jumper JU3. The EV kit can handle input voltage up to 60V when the device is disabled. See Table 1 for jumper JU3 settings. The EN PCB pad on the EV kit supports external enable/disable control of the device. Leave the jumper open when external enable/disable control is desired. A potential divider formed by the resistors R5 and R6 at the EN pin sets the input voltage (V_{INU}) above which the converter is enabled when a shunt is installed across pins 1-2.

Select R5 to be 50kΩ and calculate R6 based on the following equation:

$$R6 = \frac{1.25 \times R5}{\left(V_{INU} - 1.25 + (2 \times 10^{-6} \times R5)\right)}$$

where R5 and R6 are in Ω. For more details, see the *Setting the Undervoltage Lockout Level* section in the MAX17557 IC data sheet.

Mode Selection (MODE/SYNC)

The EV kit provides a jumper (JU1) that allows the MAX17557 to operate in PWM and DCM modes. Refer to the *Modes of Operation* section in the MAX17557 IC data sheet for more details. Table 2 shows the mode selection jumper (JU2) settings that can be used to configure the desired mode of operation.

Table 1. Converter EN Jumper (JU3) Settings

JUMPER	SHUNT POSITION	EN PIN	MAX17557 OUTPUT
JU3	Not installed	Floating	Always ON
	1-2*	Connected to the center node of resistor-divider R5 and R6	Enabled, UVLO level set through the R5 and R6 resistors
	2-3	Connected to SGND	Disabled

**Default position.*

Table 2. Mode Selection Jumper (JU1) Settings

JUMPER	SHUNT POSITION	MODE/SYNC PIN	MAX17557 MODE OF OPERATION
JU1	1-2	Connected to VCCINT	DCM
	2-3*	Connected to SGND	PWM

**Default position.*

External Clock Synchronization (MODE/SYNC)

The EV kit provides a MODE/SYNC PCB pad to synchronize the MAX17557 to an optional external clock. Leave jumper JU1 open when external clock signals are applied. In the presence of a valid external clock for synchronization, the MAX17557 operates in PWM mode only. For more details, refer to the *External Clock Synchronization* section in the MAX17557 IC data sheet.

Overcurrent Protection (ILIMSEL) Selection

The EV kit provides a jumper JU2 to select the mode of overcurrent protection (See Table 3). For more details, refer to the *Overcurrent Protection* section in the MAX17557 IC data sheet.

Soft-Start Input (SS)

The EV kit offers an adjustable soft-start function to limit inrush current during startup. The soft-start time is adjusted by the value of external soft-start capacitor (C18) connected between SS and SGND. An internal 5µA current source charges the capacitor (C18) at the SS pin providing a linear ramping voltage for output-voltage reference.

The soft-start time (t_{SS}) is related to the capacitor (C_{SS}) connected at SS pin by the following equation:

$$t_{SS} = \frac{C_{SS}}{6.25 \times 10^{-6}}$$

For example, to program a 5.3ms soft-start time, a 33nF capacitor is connected from the SS pin to SGND.

Soft-Stop Enable (SSTPE):

The EV kit provides a jumper JU4 to enable or disable the soft-stop functionality during device's power down using the EN pin (See Table 4). Soft-stop time is equal to soft-start time. For more details, refer to the *Soft-Stop Enable* section in the MAX17557 IC data sheet.

Active-Low, Open-Drain Power Good Output (PGOOD)

The EV kit provides a PGOOD PCB pad to monitor the status of the converter. PGOOD goes high 20µs after VOUT rises above 92.5% (typ) of its nominal regulated output voltage and PGOOD goes low 10µs after VOUT falls below 90% (typ) of its nominal regulated voltage. Also, PGOOD goes low 20µs after VOUT rises above 110% (typ) of its nominal regulated output voltage and PGOOD goes high 10µs after VOUT falls below 107.5% (typ) of its nominal regulated voltage.

Table 3. Overcurrent Protection Jumper (JU2) Settings

JUMPER	SHUNT POSITION	MODE/SYNC PIN	MODE OF MAX17557 OVERCURRENT PROTECTION
JU2	1-2	Connected to VCCINT	Latch-off mode
	2-3*	Connected to SGND	Foldback mode

**Default position.*

Table 4. Soft-Stop Jumper (JU4) Settings

JUMPER	SHUNT POSITION	SSTPE PIN	MAX17557 SOFT-STOP FUNCTIONALITY
JU4	1-2	Connected to VCCINT	Enabled
	2-3*	Connected to SGND	Disabled

**Default position.*

Current-Sensing (CSP and CSN)

By default, the MAX17557EVKITE# enables current-sense by using an external sense resistor (R8 = 5mΩ) along with jumper resistors (R12, R13). The EV kit has also provisions to enable current-sense through inductor DCR by removing jumper resistors at R12, R13, and placing them at R10, R11; by placing proper values at R14, R16, and C26; by shorting R8 with a jumper resistor. It is recommended to select C26 in the range of 0.1µF to 0.47µF. Calculate R14 (if R16 is not used) based on following equation:

$$R14 = \frac{L}{DCR \times C26}$$

R16 is used in applications where DCR of inductor is greater than the desired current-sense resistance. In this case, calculate R14 and R16 using the following equations:

$$RP = \frac{L}{DCR \times C26}$$

$$R14 = \frac{DCR \times RP}{R_{SENSE}}$$

$$R16 = \frac{R14 \times RP}{R14 - RP}$$

where L is the selected inductance in H and R_{SENSE} is the desired current-sense resistance in Ω.

R_{SENSE} is chosen to be 5mΩ for the circuit in this EV kit. For more details, refer to the *Current Sensing* section in the MAX17557 IC data sheet.

Hot Plug-In and Long Input Cables

The MAX17557EVKITE# PCB layout provides an optional electrolytic capacitor (C11 = 150µF/80V). This capacitor limits the peak voltage at the input of the MAX17557 when the DC input source is hot-plugged into the EV kit input terminals with input cables. The equivalent series resistance (ESR) of the electrolytic capacitor dampens the oscillations caused by interaction of the inductance of the input cables, and the ceramic capacitors at the converters input.

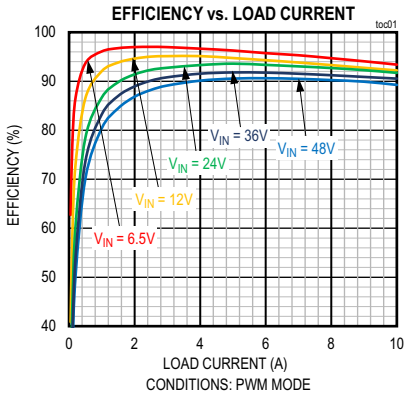
Electromagnetic Interference (EMI)

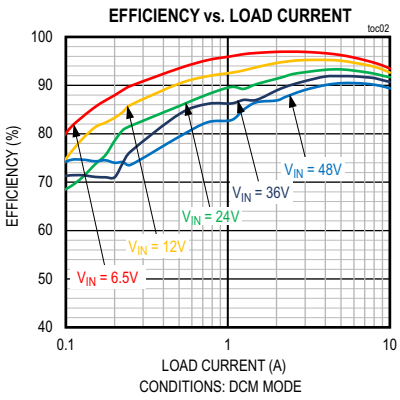
Compliance to conducted emissions (CE) standards requires an EMI filter at the input of a switching power converter. The EMI filter attenuates high-frequency currents drawn by the switching power converter and limits the noise injected back into the input power source.

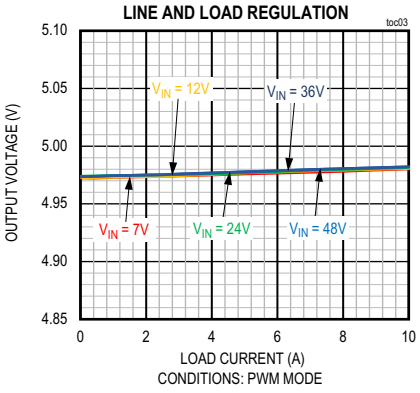
The MAX17557EVKITE# PCB has designated footprints on the EV kit for the placement of EMI filter components. Use of these filter components results in lower conducted emissions below CISPR32 Class B limits. Cut open the trace at L2 before installing conducted EMI filter components. The MAX17557EVKITE# PCB layout is also designed to limit radiated emissions from switching nodes of the power converter, resulting in radiated emissions below CISPR32 Class B limits.

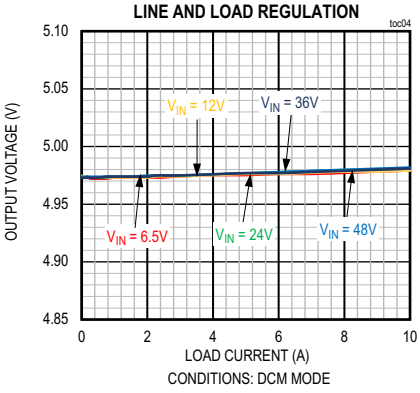
MAX17557EVKITE# Performance Report

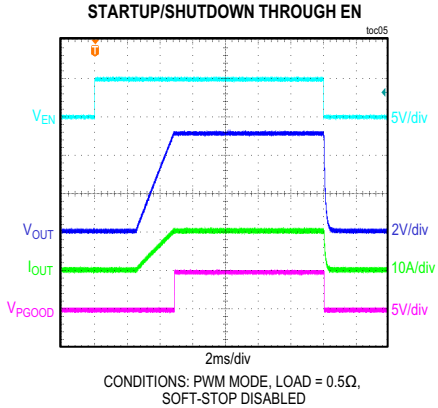
(V_{IN} = 24V, f_{SW} = 350kHz, T_A = +25°C, unless otherwise noted.)

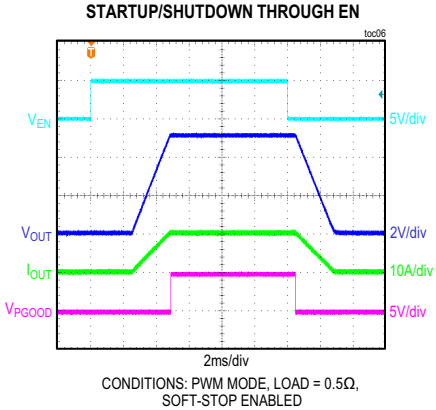








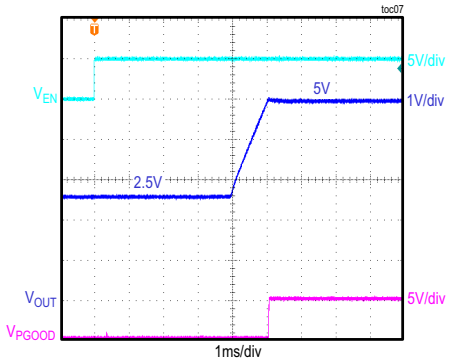




MAX17557EVKITE# Performance Report (continued)

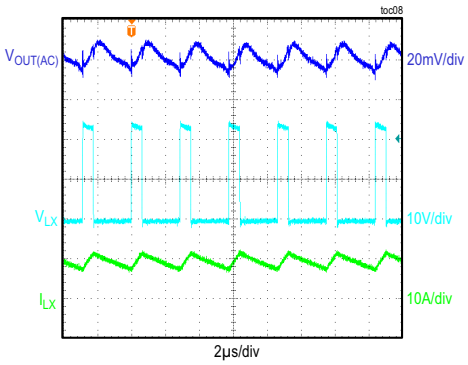
(V_{IN} = 24V, f_{SW} = 350kHz, T_A = +25°C, unless otherwise noted.)

STARTUP WITH 2.5V PREBIAS



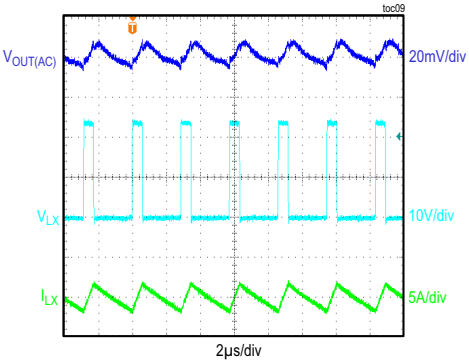
CONDITIONS: PWM MODE, LOAD = 50Ω

STEADY-STATE PERFORMANCE



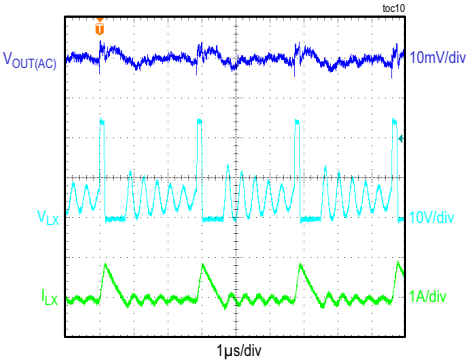
CONDITIONS: PWM MODE, LOAD = 0.5Ω

STEADY-STATE PERFORMANCE



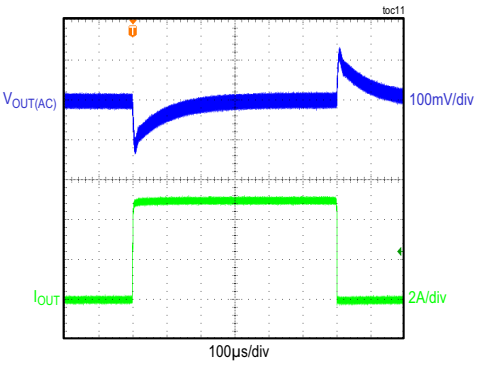
CONDITIONS: PWM MODE, NO LOAD

STEADY-STATE PERFORMANCE



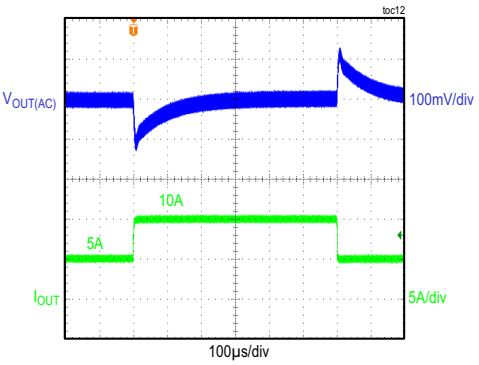
CONDITIONS: DCM MODE, LOAD = 50Ω

LOAD TRANSIENT BETWEEN 0A AND 5A



CONDITIONS: PWM MODE

LOAD TRANSIENT BETWEEN 5A AND 10A

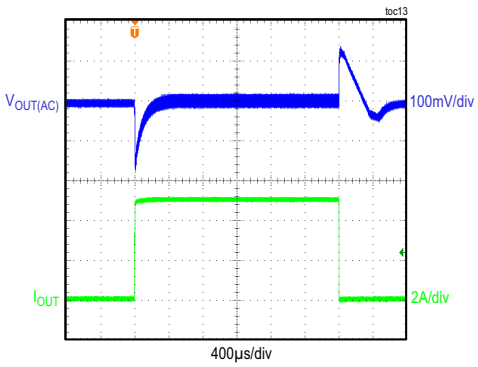


CONDITIONS: PWM MODE

MAX17557EVKITE# Performance Report (continued)

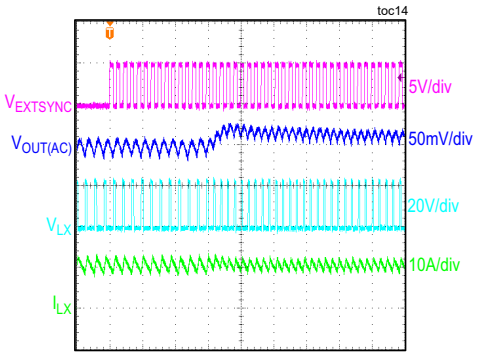
(V_{IN} = 24V, f_{SW} = 350kHz, T_A = +25°C, unless otherwise noted.)

LOAD TRANSIENT BETWEEN 100mA AND 5A



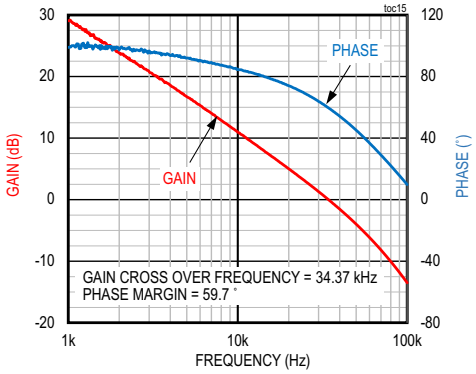
CONDITIONS: DCM MODE

EXTERNAL CLOCK SYNCHRONIZATION WITH 490kHz



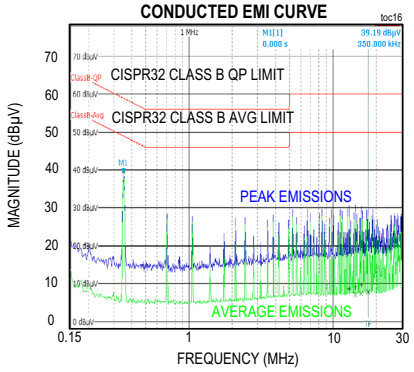
CONDITIONS: LOAD = 0.5Ω

BODE PLOT



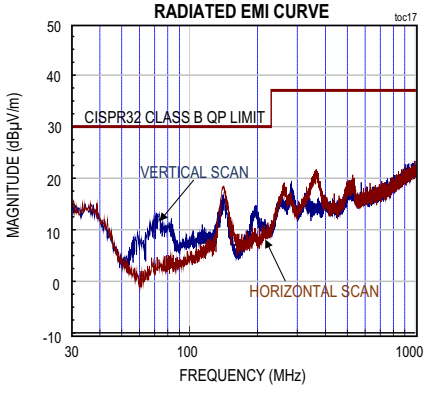
CONDITIONS: LOAD = 0.5Ω

5V OUTPUT,10A LOAD CURRENT, CONDUCTED EMI CURVE



CONDITIONS: L2 = 33µH, C5 = C6 = C9 = C10 = 4.7µF/100V/X7R/1206

5V OUTPUT, 10A LOAD CURRENT, RADIATED EMI CURVE



CONDITIONS: L2 = SHORT, C5 = C6 = C9 = C10 = OPEN

Component Suppliers

SUPPLIER	WEBSITE
Coilcraft, Inc.	www.coilcraft.com
Murata Americas	www.murataamericas.com
Panasonic Corp.	www.panasonic.com
Renesas Electronics	www.renesas.com
Diodes Inc.	www.diodes.com
Yageo Corp.	www.yageo.com
TDK	www.tdk.com
Taiyo Yuden	www.ty-top.com
Comchip	www.comchiptech.com
SullinsCorp	www.sullinscorp.com

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

Ordering Information

PART	TYPE
MAX17557EVKITE#	EV Kit

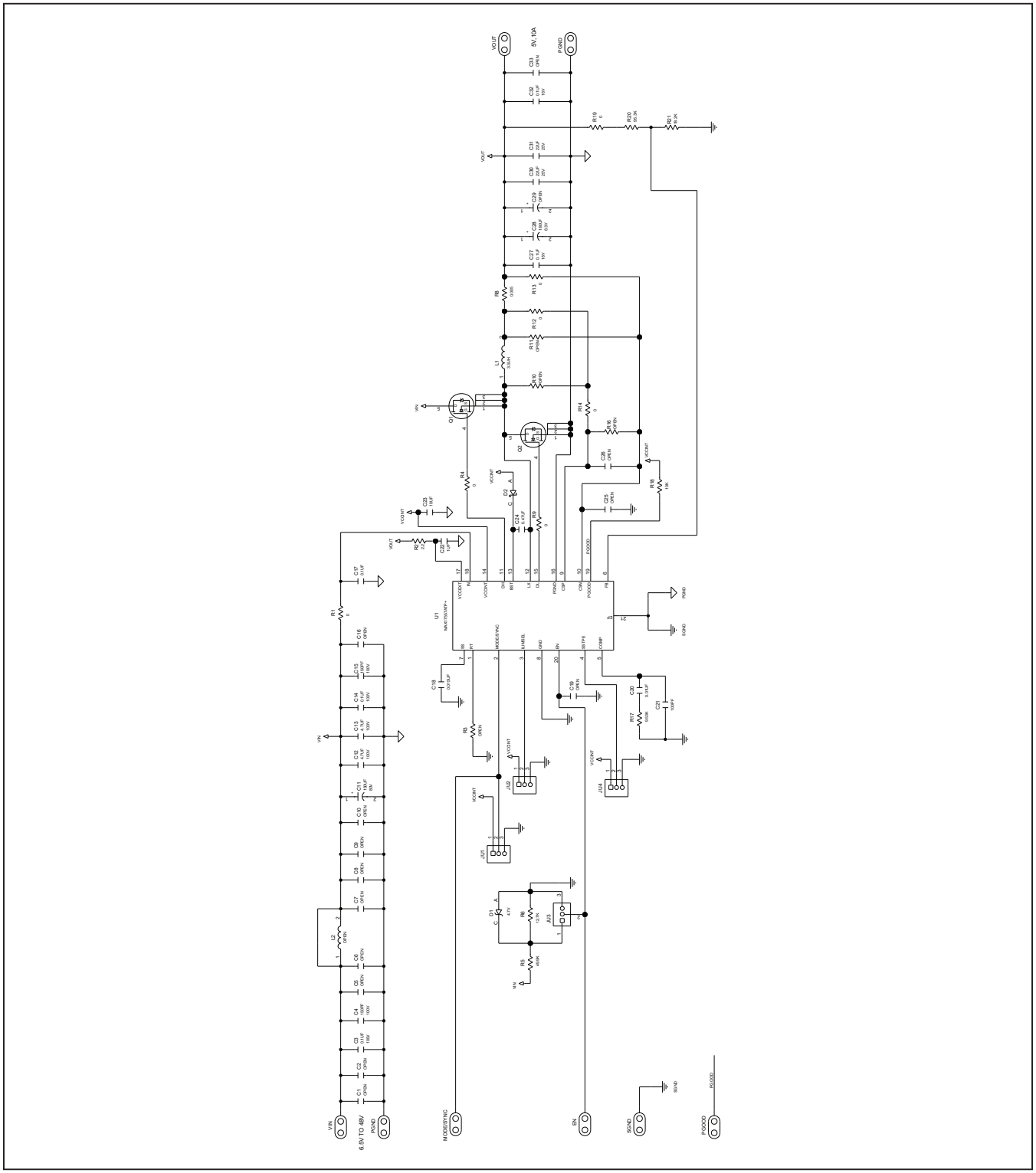
#Denotes RoHS compliance.

MAX17557EVKITE# Bill of Materials

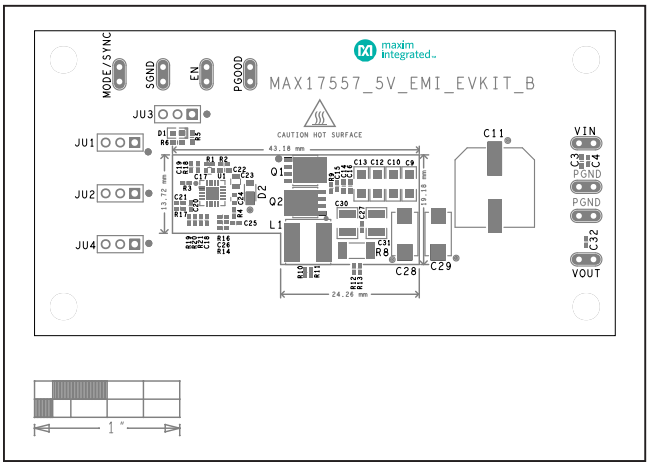
S. No	DESIGNATOR	DESCRIPTION	QUALITY	MANUFACTURER PART NUMBER
1	C3, C14, C17	0.1µF, 10%, 100V, X7R, Ceramic capacitor (0603)	3	MURATA GRM188R72A104KA35
2	C4, C15	150pF, 5%, 100V, COG, Ceramic capacitor (0402)	2	TDK C1005C0G2A151J050BA
3	C11	150uF, 20%, 80V, Electrolytic capacitor	1	PANASONIC EEV-FK1K151Q
4	C12, C13	4.7µF, 10%, 100V, X7R, Ceramic capacitor (1206)	2	MURATA GRM31CZ72A475KE11
5	C18	15000pF,10%,50V,X7R,0402,Ceramic capacitor(0402)	1	MURATA GRM155R71H153KA12
6	C20	0.01µF, 10%, 50V, X7R, Ceramic capacitor (0402)	1	MURATA GRM155R71H103KA88
7	C21	100pF, 5%, 50V, COG, Ceramic capacitor (0402)	1	MURATA GRM1555C1H101JA01
8	C22	1UF, 10%, 16V, X7R, Ceramic capacitor (0603)	1	MURATA GRM188R71C105KA12
9	C23	10UF, 10%, 10V, X7R, Ceramic capacitor (0805)	1	TAIYO YUDEN LMK212AB7106KG
10	C24	0.47UF, 10%, 16V, X7R, Ceramic capacitor (0603)	1	MURATA GRM188R71C474KA88
11	C27, C32	0.1UF, 10%, 16V, X7R, Ceramic capacitor (0402)	2	MURATA GCM155R71C104KA55
12	C28	180µF 20%, 6.3V ,X7R,Ceramic capacitor (1210)	1	PANASONIC EEF-SE0J181R
13	C30, C31	22UF, 20%, 25V, X7R, Ceramic capacitor (1210)	2	MURATA GRM32ER71E226ME15
14	D1	ZENER DIODE, VZ=4.7V, IZ=0.005A	1	COMCHIP CZRU52C4V7
15	D2	SCHOTTKY DIODE PIV=100V; IF=1A	1	DIODES INCORPORATED DFLS1100-7
16	L1	INDUCTOR, 3.3µH, 19.4A (7mm x 7mm)	1	COILCRAFT XAL7070-332ME
17	Q1	N-CHANNEL POWER MOSFET(LFPAK) PD-(45W); I-(25A); V-(60V)	1	RENESAS RJK0651DPB-00#J5
18	Q2	N-CHANNEL POWER MOSFET(LFPAK) PD-(65W); I-(45A); V-(60V)	1	RENESAS RJK0653DPB-00#J5
19	R1, R4, R9, R12-R14, R19	0Ω, 5%, 1/16W, Resistor (0402)	7	
20	R2	2.2Ω, 1%, 1/16W, Resistor (0402)	1	
21	R5	49.9kΩ, 1%, 1/10W, Resistor (0603)	1	
22	R6	13kΩ, 1%, 1/10W, Resistor (0603)	1	
23	R8	0.005Ω, 1%, 1W, Resistor (2010)	1	YAGEO PE2010FKE7W0R005L
24	R17	9.53KΩ, 1%, 1/16W, Resistor (0402)	1	
25	R18	10KΩ, 1%, 1/16W, Resistor (0402)	1	
26	R20	95.3KΩ, 1%, 1/16W, Resistor (0402)	1	
27	R21	18.2KΩ, 1%, 1/16W, Resistor (0402)	1	
28	U1	HIGH-EFFICIENCY SYNCHRONOUS STEP-DOWN DC-DC CONTROLLER	1	MAX17557ATP+
29	JU1-JU4	3-pin header (36-pin header 0.1” centers)	4	Sullins: PEC03SAAN
30	–	Shunts	4	
31	C5, C6, C9, C10	OPTIONAL: 4.7µF, 10%, 100V, X7R, Ceramic capacitor (1206)	4	MURATA GRM31CZ72A475KE11
32	L2	OPTIONAL: INDUCTOR, 33µH, 3.6A (6mm x 6mm)	1	COILCRAFT XAL6060-333ME
33	C1, C19, C25	OPEN: Capacitor (0402)	0	
34	C2, C16	OPEN: Capacitor (0603)	0	
35	C7, C8	OPEN: Capacitor (1206)	0	
36	C26	OPEN: Capacitor (0402)	0	
37	C29	OPEN: Electrolytic Capacitor	0	
38	C33	OPEN: Capacitor (0402)	0	
39	R3, R10, R11, R16	OPEN:Resistor (0402)	0	

DEFAULT JUMPER TABLE	
JUMPER	SHUNT POSITION
JU1, JU2, JU4	2-3
JU3	1-2

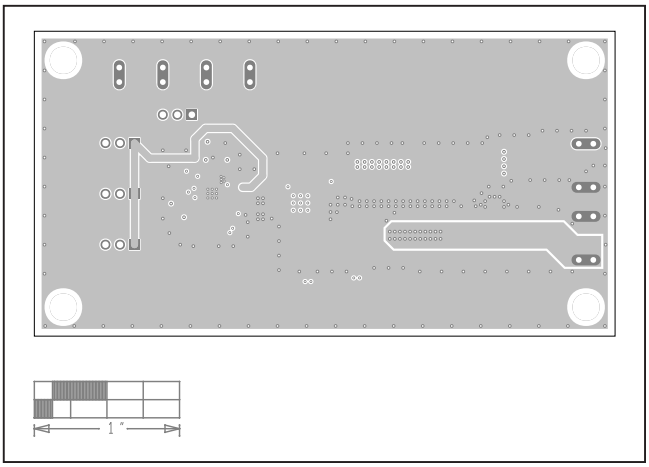
MAX17557EVKITE# Schematic



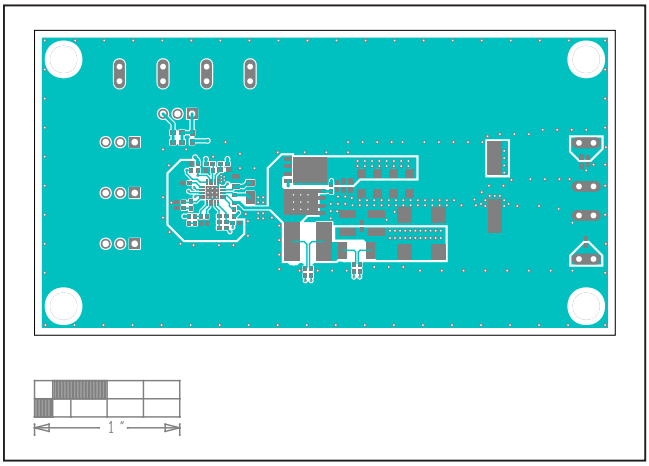
MAX17557EVKITE# PCB Layouts



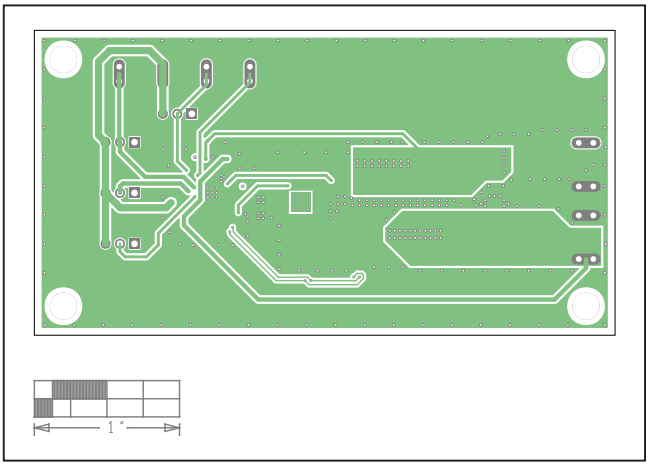
MAX17557EVKITE# Component Placement Guide—Top Silkscreen



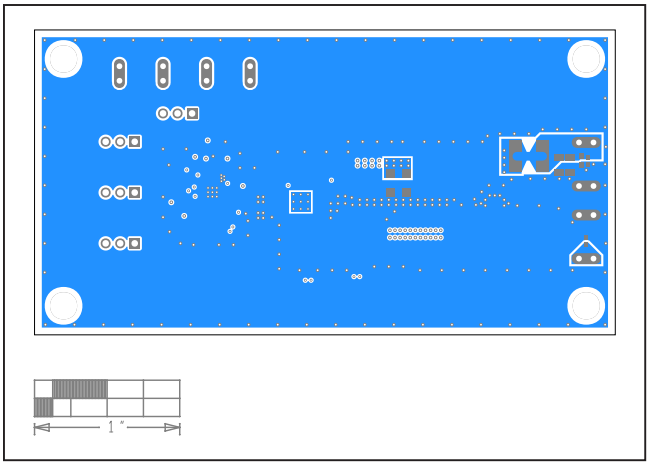
MAX17557EVKITE# PCB Layout—Layer 2



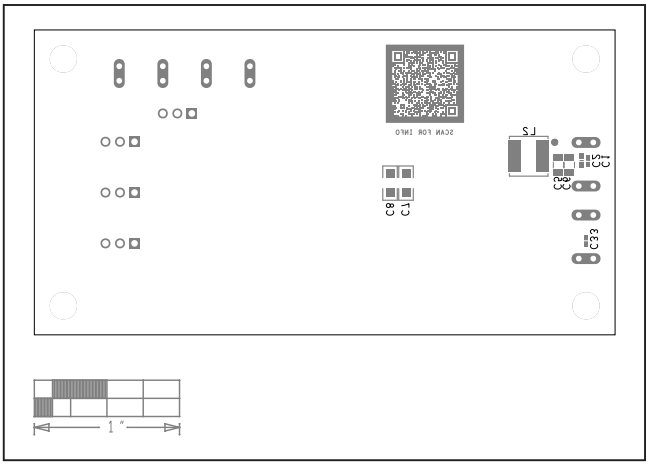
MAX17557EVKITE# PCB Layout—Top Layer



MAX17557EVKITE# PCB Layout—Layer 3



MAX17557EVKITE# PCB Layout—Bottom Layer



MAX17557EVKITE# Component Placement Guide—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	12/20	Initial release	—

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