Click here for production status of specific part numbers.

MAX17761EVKITBE# Evaluation Kit

Evaluates: MAX17761 in 5V Output-Voltage Application

General Description

The MAX17761EVKITBE# provides a proven design to evaluate the MAX17761 high-efficiency, high-voltage, synchronous step-down DC-DC converter in a TDFN package. The EV kit generates 5V at load currents up to 1A from a 7.5V to 76V input supply. The EV kit features a 400kHz switching frequency for optimum efficiency and component size. The EV kit features adjustable input undervoltage lockout, adjustable soft-start, adjustable switching frequency, adjustable current limit, open-drain $\overline{\text{RESET}}$ signal, and external clock synchronization. The EV kit also provides a good layout example, which is optimized for conducted, radiated EMI, and thermal performance. For more details about the IC benefits and features, refer to the MAX17761 IC data sheet.

Features

- Operates from a 7.5V to 76V Input Supply
- 5V Output Voltage
- Up to 1A Output Current
- 400kHz Switching Frequency
- Enable/UVLO Input, Resistor-Programmable UVLO Threshold
- Adjustable Soft-Start Time
- MODE/ILIM Pin to Select Among PWM or PFM Modes and 1.6A or 1.14A current limits
- Auxiliary Bootstrap LDO to improve efficiency
- Open-Drain $\overline{\text{RESET}}$ Output
- External Clock Synchronization
- Overcurrent and Overtemperature Protection
- Proven PCB Layout
- Fully Assembled and Tested
- Complies with CISPR22(EN55022) Class B Conducted and Radiated Emissions

Quick Start

Recommended Equipment

- MAX17761 5V output EV kit
- 7.5V to 76V, 2A DC input power supply
- Load capable of sinking 1A
- Digital voltmeter (DVM)

Equipment Setup and Test Procedure

The 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) Set the power supply at a voltage between 7.5V and 76V. 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 1A load to the VOUT PCB pad and the negative terminal to the nearest PGND PCB pad.
3) Connect the DVM across the VOUT PCB pad and the nearest PGND PCB pad.
4) Verify that shunts are installed across pins 1-2 on jumper JU1, JU2, and JU3 (see Table 1, Table 2, and Table 3 for details).
5) Turn on the DC power supply.
6) Enable the load.
7) Verify that the DVM displays 5V.

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

319-100430; Rev 0; 8/19

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Detailed Description

The MAX17761EVKITBE# provides a proven design to evaluate the MAX17761 high-efficiency, high-voltage, synchronous step-down DC-DC converter. The EV kit generates 5V at load currents up to 1A from a 7.5V to 76V input supply. The EV kit features a 400kHz switching frequency for optimum efficiency and component size. The EV kit includes an EN/UVLO PCB pad and JU1 to enable the output at a desired input voltage. The RT/SYNC PCB pad and JU3 allow an external frequency to synchronize the device. An additional $\overline{RESET}$ PCB pad is available for monitoring when the converter output is in regulation.

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 (C6) connected between SS and SGND. The selected output capacitance (C_{SEL}) and the output voltage (V_{OUT}) determine the minimum required soft-start capacitor as follows:

$$C_{SS} \geq 30 \times 10^{-6} \times C_{SEL} \times V_{OUT}$$

The soft-start time (t_{SS}) is related to the capacitor connected at SS (C_{SS}) 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 should be connected from the SS pin to SGND. The minimum possible soft-start time is 5ms.

Enable/Undervoltage-Lockout (EN/UVLO) Programming

The MAX17761 offers an Enable and an adjustable input undervoltage lockout feature. In this EV kit, for always on operation, leave the EN/UVLO jumper (JU1) open. To disable the MAX17761, install a shunt across pins 2–3 on JU1. See Table 1 for JU1 settings. The EN/UVLO PCB pad on the EV kit supports external enable/disable control of the device. Leave JU1 open when external enable/disable control is desired. A potential divider formed by R1 and R2 sets the input voltage (V_{INU}) above which the converter is enabled when a shunt is connected across pins 1-2 on JU1.

Choose R1 as follows:

$$R1 \leq (110000 \times V_{INU})$$

where, V_{INU} is the voltage at which the device is required to turn on, and R1 is in Ω.

Calculate the value of R2 as follows:

$$R2 = \frac{1.215 \times R1}{(V_{INU} - 1.215 + (2.5\mu A \times R1))}$$

Current Limit and Mode of Operation Selection (MODE/ILIM)

The EV Kit provides a jumper (JU2) and R9 resistor footprint that allows the MAX17761 to operate in PWM and PFM modes. Table 2 lists the values of the resistor R9 to program PWM or PFM modes of operation and 1.6A or 1.14A peak current limits. Refer to the MAX17761 data sheet for more details on the modes of operation.

The mode of operation cannot be changed on-the-fly after power-up.

Table 1. Converter EN/UVLO Jumper (JU1) Settings

JUMPER	SHUNT POSITION	EN/UVLO PIN	MAX17761 OUTPUT
JU1	1-2*	Connected to the center node of resistor-divider R1 and R2	Enabled, UVLO level set through the R1 and R2 resistors
	Not installed	Floating	Always On
	2-3	Connected to GND	Disabled

**Default position.*

Table 2. R_{ILIM} Resistor vs. Modes of Operation and Peak Current Limit

R9 (KΩ)	MODE OF OPERATION	PEAK CURRENT LIMIT (A)
OPEN*	PFM	1.6
422	PFM	1.14
243	PWM	1.6
121	PWM	1.14

**Default position.*

Switching Frequency Selection and External Clock Synchronization (RT/SYNC)

The EV kit provides RT/SYNC PCB pad, to synchronize the MAX17761 to an optional external clock. Short jumper (JU3) when external clock signals are applied. In the presence of a valid external clock for synchronization, the MAX17761 operates in PWM mode only. The resistor R5 sets the switching frequency of the part at any one of four discrete frequencies—200kHz, 300kHz, 400kHz, and 600kHz.

Table 3 provides the resistor values for different switching frequencies.

For more details about external clock synchronization and frequency selection, refer to the MAX17761 data sheet.

Active-Low, Open-Drain Reset Output ($\overline{RESET}$)

The EV kit provides a $\overline{RESET}$ PCB pad to monitor the status of the converter. $\overline{RESET}$ goes high when V_{OUT} rises above 95% (typ) of its nominal regulated voltage. $\overline{RESET}$ goes low when V_{OUT} falls below 92% (typ) of its nominal regulated voltage.

Table 3. Switching Frequency vs. RT Resistor

R5 (KΩ)	SWITCHING FREQUENCY (KHZ)
210	200
140	300
105	400*
69.8	600

**Default position.*

Hot Plug-In and Long Input Cables

The MAX17761EVKITBE# PCB layout provides an optional electrolytic capacitor (C1 = 22µF/100V). This capacitor limits the peak voltage at the input of the MAX17761 when the DC input source is “hot-plugged” to the EV kit input terminals with long input cables. The equivalent series resistance (ESR) of the electrolytic capacitor dampens the oscillations caused by interaction of the inductance of the long input cables, and the ceramic capacitors at the buck converter input.

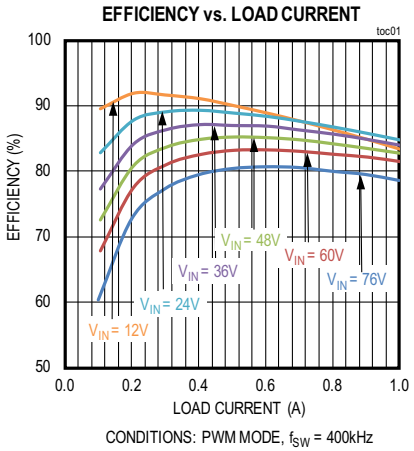
Electromagnetic Interference (EMI)

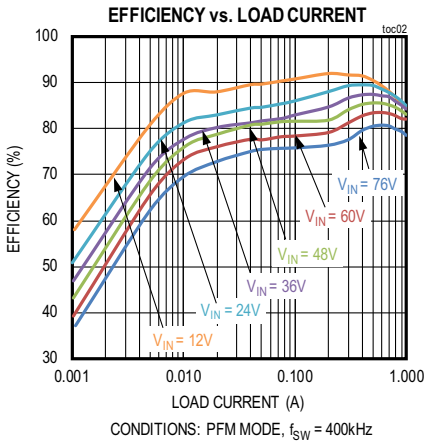
Compliance to conducted emissions (CE) standards requires an EMI filter at the input of a switching power converter. The EMI filter attenuates high-frequency currents drawn by the switching power converter and limits the noise injected back into the input power source.

The MAX17761EVKITBE# PCB has designated footprints on the EV kit for placement of EMI filter components. Use of these filter components results in lower conducted emissions below CISPR22 Class B limits. Cut open the trace at L2 before installing conducted EMI filter components. The MAX17761EVKITBE# PCB layout is also designed to limit radiated emissions from switching nodes of the power converter, resulting in radiated emissions below CISPR22 Class B limits.

MAX17761EVKITBE# Performance Report

(V_{IN} = 24V, V_{OUT} = 5V, I_{OUT} = 1A, f_{SW} = 400kHz, T_A = +25°C, unless otherwise noted.)

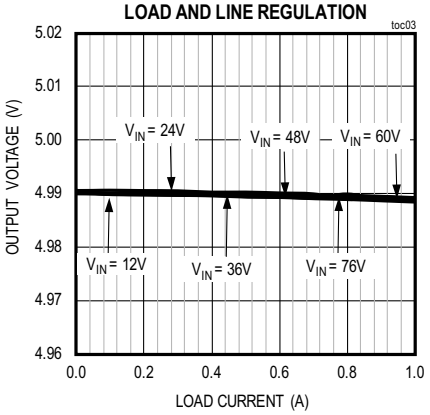




MAX17761EVKITBE# Performance Report (continued)

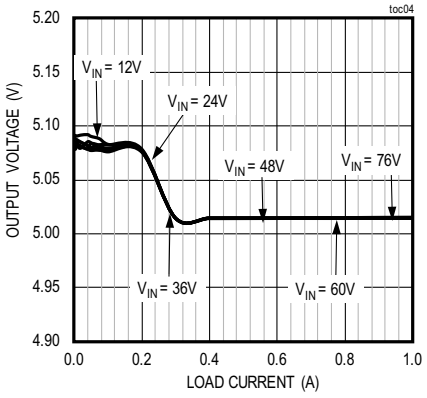
(V_{IN} = 24V, V_{OUT} = 5V, I_{OUT} = 1A, f_{SW} = 400kHz, T_A = +25°C, unless otherwise noted.)

LOAD AND LINE REGULATION



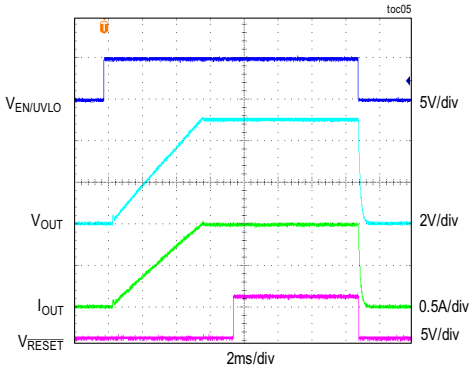
CONDITIONS: PWM MODE

LOAD AND LINE REGULATION



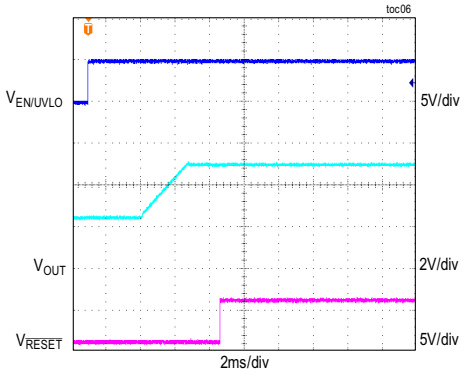
CONDITIONS: PFM MODE

SOFT-START/SHUTDOWN THROUGH EN/UVLO



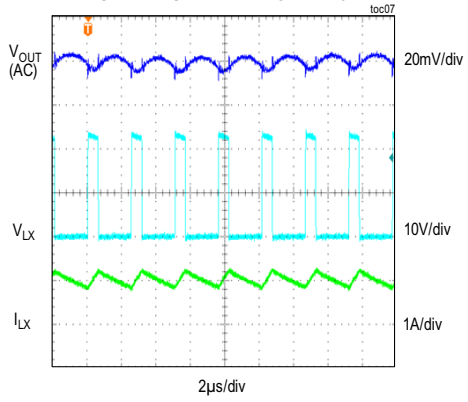
CONDITIONS: PWM MODE, 1A LOAD

SOFT-START WITH 2.5V PREBIAS VOLTAGE



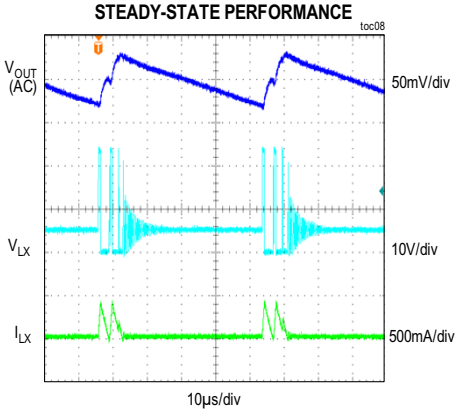
CONDITIONS: PWM MODE, 5mA LOAD

STEADY-STATE PERFORMANCE



CONDITIONS: 1A LOAD CURRENT

STEADY-STATE PERFORMANCE

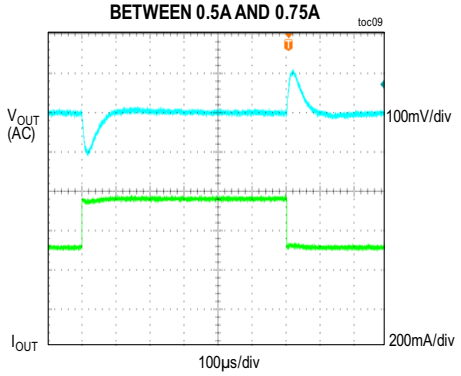


CONDITIONS: PFM MODE, 25mA LOAD

MAX17761EVKITBE# Performance Report (continued)

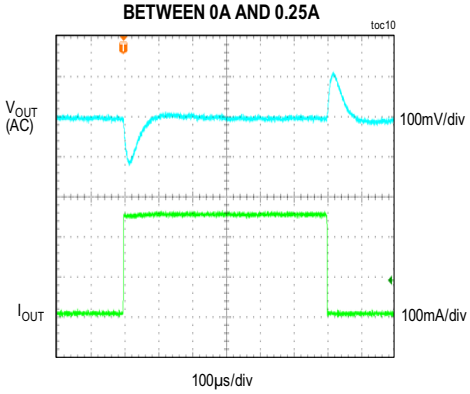
(V_{IN} = 24V, V_{OUT} = 5V, I_{OUT} = 1A, f_{SW} = 400kHz, T_A = +25°C, unless otherwise noted.)

LOAD TRANSIENT RESPONSE BETWEEN 0.5A AND 0.75A



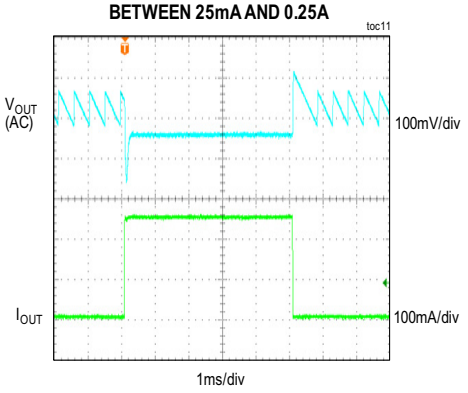
CONDITIONS: PWM MODE

LOAD TRANSIENT RESPONSE BETWEEN 0A AND 0.25A



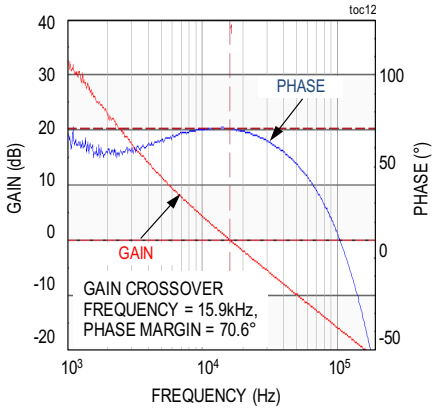
CONDITIONS: PWM MODE

LOAD TRANSIENT RESPONSE BETWEEN 25mA AND 0.25A



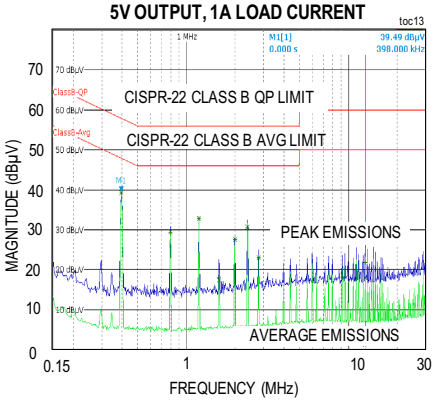
CONDITIONS: PFM MODE

BODE PLOT



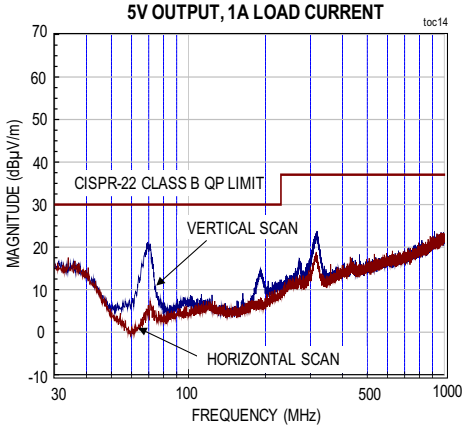
CONDITIONS: 1A LOAD, f_{SW} = 400kHz

CONDUCTED EMISSIONS PLOT 5V OUTPUT, 1A LOAD CURRENT



L2 = 10µH, C15 = C16 = 4.7µF/ 100V/X7R/1206

RADIATED EMISSIONS PLOT 5V OUTPUT, 1A LOAD CURRENT



L2 = SHORT, C15 = C16 = OPEN

Component Suppliers

SUPPLIER	WEBSITE
Murata Americas	www.murata.com
Panasonic Corp.	www.panasonic.com
TDK Corp.	www.tdk.com
SULLINS	www.sullinscorp.com
Wurth Electronics	www.we-online.com
Taiyo Yuden	www.ty-top.com

Note: *Indicate that you are using the MAX17761 when contacting these component suppliers.*

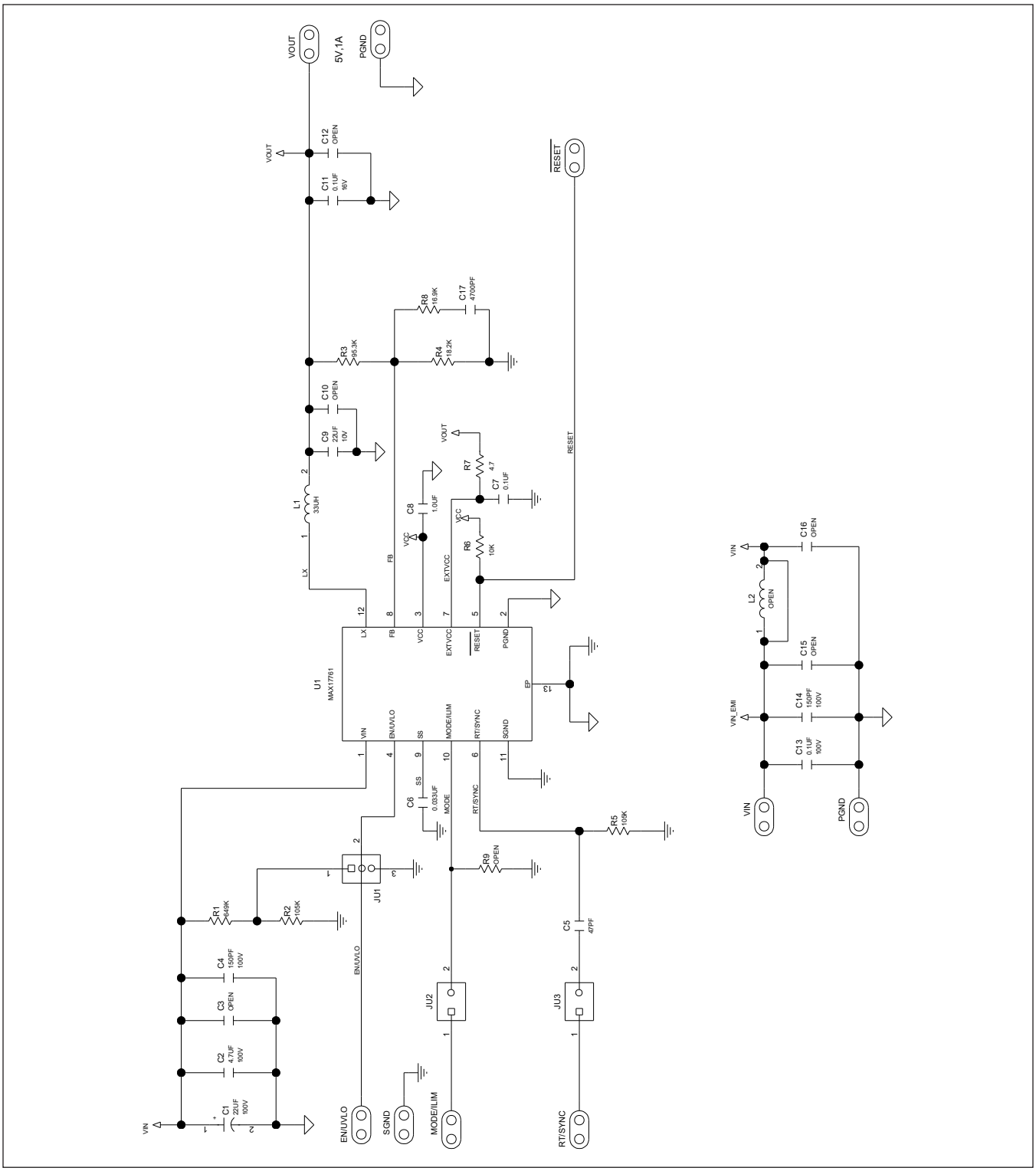
Ordering Information

PART	TYPE
MAX17761EVKITBE#	EV Kit

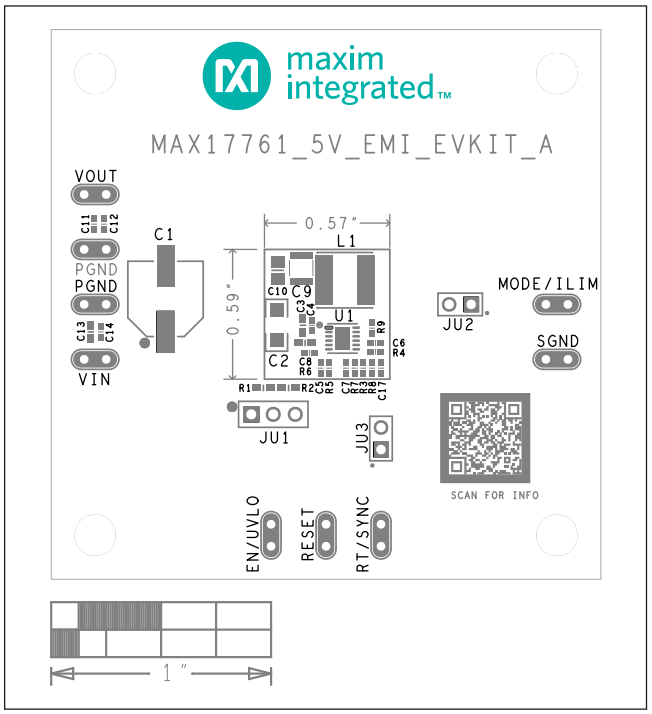
MAX17761EVKITBE# Bill of Materials

S. No.	Designator	Description	Quantity	Part Number
1	C1	22uF, 20%, 100V, Electrolytic capacitor	1	PANASONIC EEE-TG2A220UP
2	C2	4.7µF, 10%, 100V, X7R, Ceramic capacitor (1206)	1	MURATA GRM31CZ72A475KE11
3	C4, C14	150pF, 5%, 100V, C0G, Ceramic capacitor (0402)	2	TDK C1005C0G2A151J050BA
4	C5	47pF, 5%, 25V, C0G, Ceramic capacitor (0402)	1	MURATA GRM1555C1E470JA01
5	C6	33nF, 10%, 25V, X7R, Ceramic capacitor (0402)	1	MURATA GRM155R71E333KA88
6	C7	0.1uF, 10%, 50V, X7R, Ceramic capacitor (0402)	1	MURATA GRM155R71H104KE14
7	C8	1uF, 10%, 6.3V, X7R, Ceramic capacitor (0603)	1	MURATA GRM188R70J105KA01
8	C9	22uF, 10%, 10V, X7R, Ceramic capacitor (1210)	1	MURATA GRM32ER71A226K
9	C11	0.1uF, 10%, 16V, X7R, Ceramic capacitor (0402)	1	TAIYO YUDEN EMK105B7104KV-F
10	C13	0.1uF, 10%, 100V, X7R, Ceramic capacitor (0603)	1	TAIYO YUDEN HMK107B7104KA-T
11	C17	4700pF, 10%, 50V, X7R, Ceramic capacitor (0402)	1	MURATA GRM155R71H472KA01
12	JU1	3-pin header	1	SULLINS PEC03SAAN
13	JU2, JU3	2-pin header	2	SULLINS PEC02SAAN
14	L1	INDUCTOR, 33uH, 1.45A	1	WURTH 74404064330
15	R1	649kΩ ±1%, 1/10W, resistor (0603)	1	VISHAY DALE CRCW0603649KFK
16	R2	105kΩ ±1%, 1/10W, resistor (0603)	1	VISHAY DALE CRCW0603127KFK
17	R3	95.3kΩ ±1%, 1/16W, resistor (0402)	1	VISHAY DALE CRCW040295K3FK
18	R4	18.2kΩ ±1%, 1/16W, resistor (0402)	1	VISHAY DALE CRCW040218K2FK
19	R5	105kΩ, 1%, 1/16W, resistor (0402)	1	VISHAY DALE CRCW0402105KFK
20	R6	10kΩ ±1%, 1/10W, resistor (0402)	1	PANASONIC ERJ-2GEJ103
21	R7	4.7Ω, ±1%, 1/16W, resistor (0402)	1	VISHAY DALE CRCW04024R70FK
22	R8	16.9kΩ ±1%, 1/10W, resistor (0402)	1	VISHAY DALE CRCW040216K9FK
23		Shunts	3	SULLINS STC02SYAN
24	U1	Buck Converter, MAX17761 (TDFN12-EP 3X3)	1	MAXIM MAX17761ATC+
25	MH1-MH4	MACHINE FABRICATED; ROUND-THRU HOLE SPACER; NO THREAD; M3.5; 5/8IN; NYLON	4	KEYSTONE 9032
26	C15, C16	OPTIONAL: 4.7µF, 10%, 100V, X7R, Ceramic capacitor (1206)	1	MURATA GRM31CZ72A475KE11
27	L2	OPTIONAL: INDUCTOR, 10µH, 1A (2.8mm x 2.8mm)	1	WURTH ELECTRONICS 744025100
28	C3	OPEN: Capacitor (0603)	0	
29	C10	OPEN: Capacitor (0805)	0	
30	C12	OPEN: Capacitor (0402)	0	
31	R9	OPEN: Resistor (0402)	0	

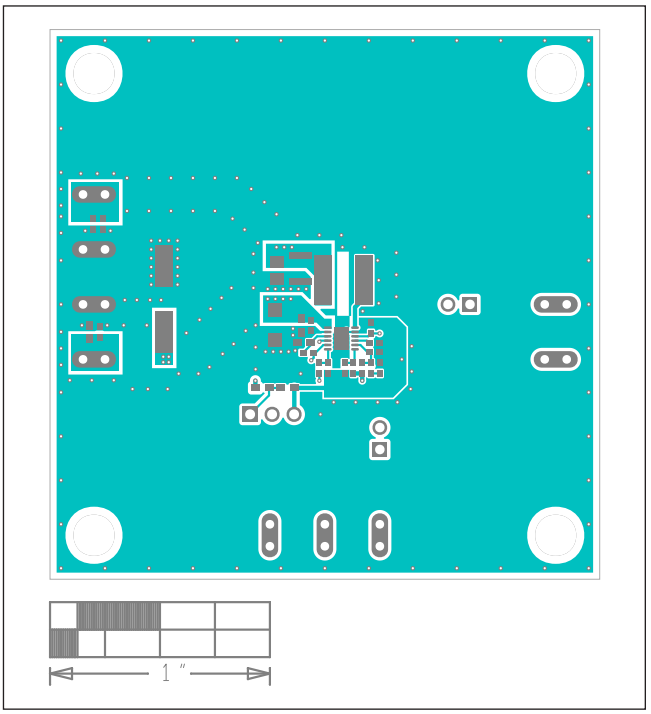
MAX17761EVKITBE# Schematic



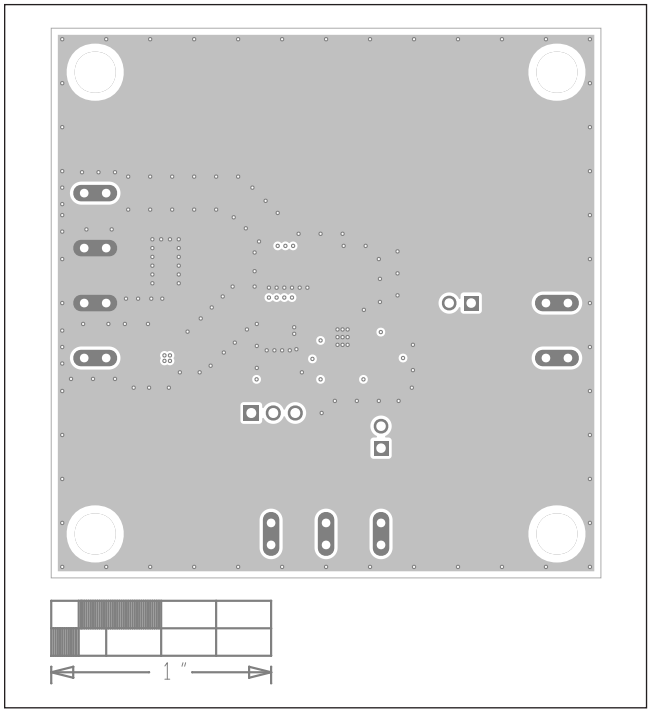
MAX17761EVKITBE# PCB Layout Diagrams



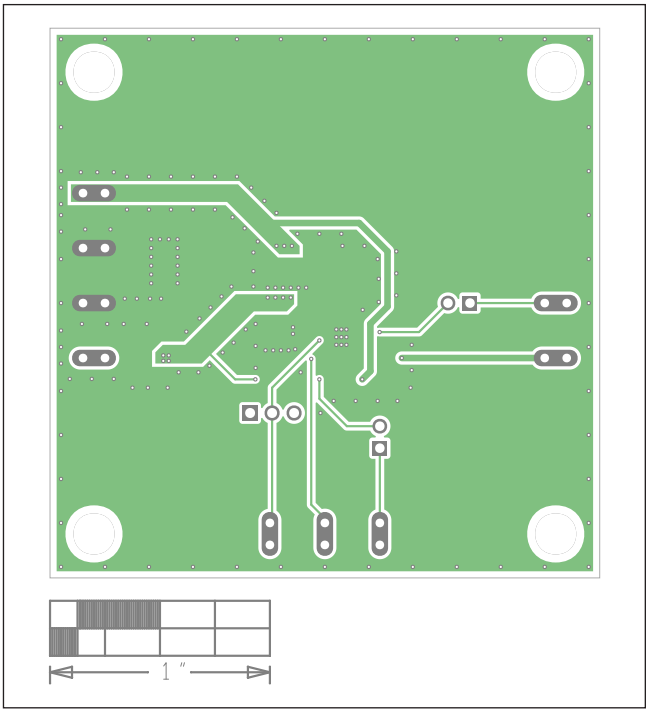
MAX17761EVKITBE# PCB Layout—Top Silkscreen



MAX17761EVKITBE# PCB Layout—Top Layer

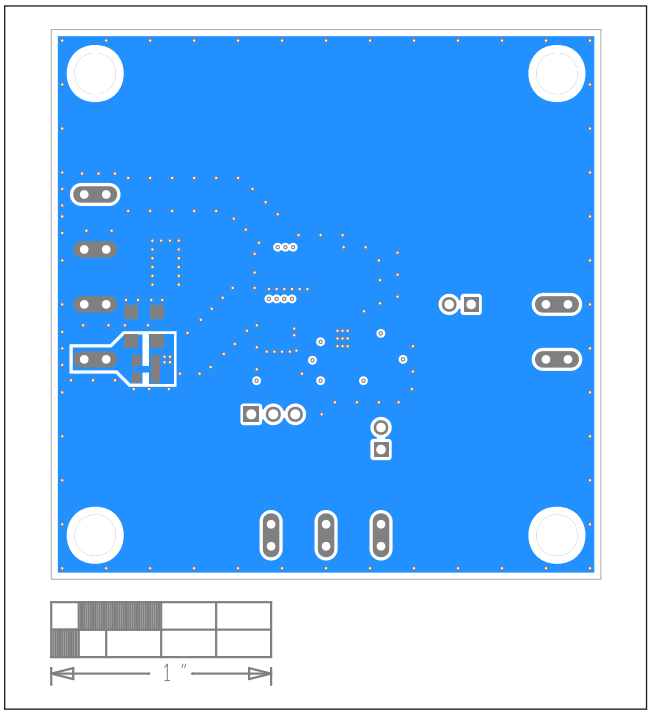


MAX17761EVKITBE# PCB Layout—Layer 2

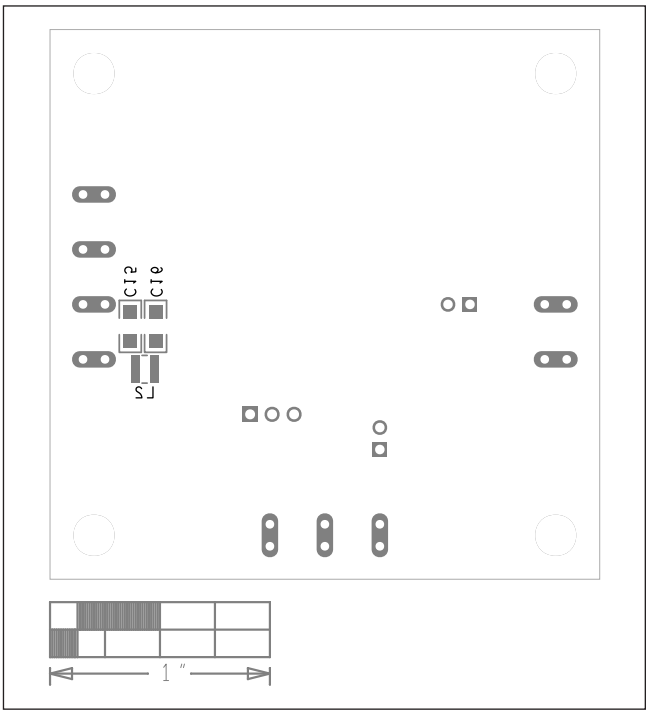


MAX17761EVKITBE# PCB Layout—Layer 3

MAX17761EVKITBE# PCB Layout Diagrams (continued)



MAX17761EVKITBE# PCB Layout—Bottom Layer



MAX17761EVKITBE# PCB Layout—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	8/19	Initial release	—