Click here for production status of specific part numbers.

MAX17576 5V Output Evaluation Kit

Evaluates: MAX17576 5V Output-Voltage Application

General Description

The MAX17576 5V output evaluation kit (EV kit) provides a proven design to evaluate the MAX17576 high-voltage, high-efficiency, synchronous step-down DC-DC converter. The EV kit is preset for 5V output at load currents up to 4A and features a 350kHz switching frequency for optimum efficiency and component size. The EV kit features adjustable input undervoltage lockout, adjustable soft-start, open-drain $\overline{\text{RESET}}$ signal, and external frequency synchronization. EV kit specifications, settings, features and benefits are highlighted. For more details about the IC benefits and features, refer to the MAX17576 data sheet.

Features

- Operates from a 6.5V to 60V Input Supply
- 5V Output Voltage
- Up to 4A Output Current
- 350kHz Switching Frequency
- Enable/UVLO Input, Resistor-Programmable UVLO Threshold
- Adjustable Soft-Start Time
- MODE/SYNC Pin to Select Either PWM, PFM, or DCM Mode
- Open-Drain $\overline{\text{RESET}}$ Output
- External Frequency Synchronization
- Overcurrent and Overtemperature Protection
- Proven PCB Layout
- Fully Assembled and Tested
- CISPR-22 Class B Compliant

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

Quick Start

Recommended Equipment

- MAX17576 5V output EV kit
- 6.5V to 60V, 5A DC input power supply
- Load capable of sinking 4A
- 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 VIN PCB pad and the negative terminal to the nearest PGND PCB pad. Connect the positive terminal of the 4A 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 (see Table 1 for details).
5) Select the shunt position on jumper JU2 according to the intended mode of operation (see Table 2 for details).
6) Turn on the DC power supply.
7) Enable the load.
8) Verify that the DVM displays 5V.

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Detailed Description

The MAX17576 5V output EV kit provides a proven design to evaluate the MAX17576 high-voltage, high-efficiency, synchronous step-down DC-DC converter. The EV kit is preset for 5V output from 6.5V to 60V input at load currents up to 4A and features a 350kHz switching frequency for optimum efficiency and component size.

The EV kit includes an EN/UVLO PCB pad and jumper JU1 to enable the output at a desired input voltage. The MODE/SYNC PCB pad allows an external clock to synchronize the device. Jumper JU2 allows the selection of a particular MODE/SYNC of operation based on light-load performance requirements. An additional $\overline{\text{RESET}}$ PCB pad is available for monitoring whether the converter output is in regulation or not.

Soft-Start Input (SS)

The device utilizes an adjustable soft-start function to limit inrush current during startup. The soft-start time is adjusted by the value of the external soft-start capacitor (C5) connected between SS and SGND. The selected output capacitance (C_{SEL}) and the output voltage (V_{OUT}) determine the minimum value of C5, as shown by the following equation:

$$C5 \geq 28 \times 10^{-6} \times C_{SEL} \times V_{OUT}$$

The soft-start time (t_{SS}) is related to C5 by the following equation:

$$t_{SS} = C5/(5.55 \times 10^{-6})$$

For example, to program a 1ms soft-start time, C5 should be 5.6nF.

Regulator Enable/Undervoltage-Lockout Level (EN/UVLO)

The device offers an adjustable input undervoltage-lockout level. For normal operation, a shunt should be installed across pins 1-2 on jumper JU1. To disable the output, install a shunt across pins 2-3 on JU1 and the EN/UVLO pin is pulled to SGND. See Table 1 for JU1 settings.

Set the voltage at which the device turns on with the resistive voltage-divider R1/R2 connected from V_{IN} to SGND. Connect the center node of the divider to EN/UVLO.

Choose R1 to be 3.32MΩ and then calculate R2 as follows:

$$R2 = \frac{R1 \times 1.215}{(V_{INU} - 1.215)}$$

where V_{INU} is the voltage at which the device is required to turn on.

MODE Selection (MODE/SYNC)

The device's MODE/SYNC pin can be used to select among PWM, PFM, or DCM modes of operation. The logic state of the MODE/SYNC pin is latched when V_{CC} and EN/UVLO voltages exceed the respective UVLO rising thresholds and all internal voltages are ready to allow LX switching. State changes on the MODE/SYNC pin are ignored during normal operation. Refer to the MAX17576 IC data sheet for more information on the PWM, PFM, and DCM modes of operation.

Table 2 shows EV kit jumper settings that can be used to configure the desired mode of operation.

External Clock Synchronization (MODE/SYNC)

The internal oscillator of the device can be synchronized to an external clock signal on the MODE/SYNC pin. The external synchronization clock frequency must be between 1.1 x f_{SW} and 1.4 x f_{SW}, where f_{SW} is the frequency of operation set by R3. The minimum external clock high pulse width should be greater than 50ns and the minimum external clock low pulse width should be greater than 160ns.

Table 1. Regulator Enable (EN/UVLO) Description (JU1)

SHUNT POSITION	EN/UVLO PIN	MAX17576_ OUTPUT
1-2	Connected to VIN	Enabled
Not installed*	Connected to the center node of resistor-divider R1 and R2	Enabled, UVLO level set through the R1 and R2 resistors
2-3	Connected to SGND	Disabled

**Default position.*

Table 2. MODE/SYNC Description (JU2)

SHUNT POSITION	MODE/SYNC PIN	MAX17576_ MODE
Not installed	Unconnected	PFM mode of operation
2-3*	Connected to SGND	PWM mode of operation
1-2	Connected to V_{CC}	DCM mode of operation

**Default position.*

Electro-Magnetic 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 MAX17576EVKITB# PCB has designated footprints for the placement of conducted EMI filter components as per the optional Bill of Material (BoM). Use of these filter components results in lower conducted EMI, below CISPR22 Class B limits. Cut open the trace at L1 before installing EMI filter components. The MAX17576EVKITB# 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.

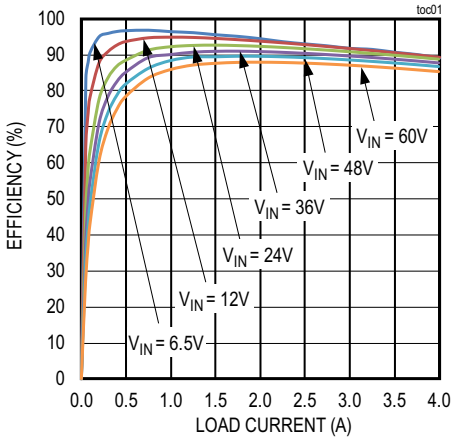
Hot Plug-In and Long Input Cables

The MAX17576EVKITB# PCB layout provides an optional electrolytic capacitor (CIN6, 68µF/100V). This capacitor limits the peak voltage at the input of the MAX17576 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.

EV Kit Test Report

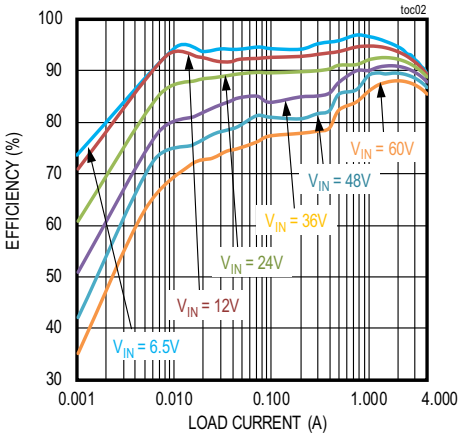
(V_{IN} = 24V, JU1 = not installed unless otherwise noted.)

EFFICIENCY vs. LOAD CURRENT



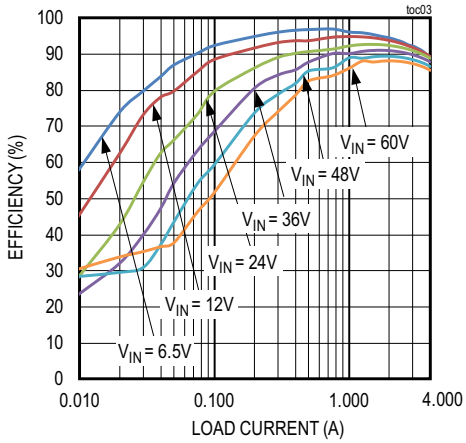
CONDITIONS: 5V OUTPUT, PWM MODE, f_{SW} = 350kHz

EFFICIENCY vs. LOAD CURRENT



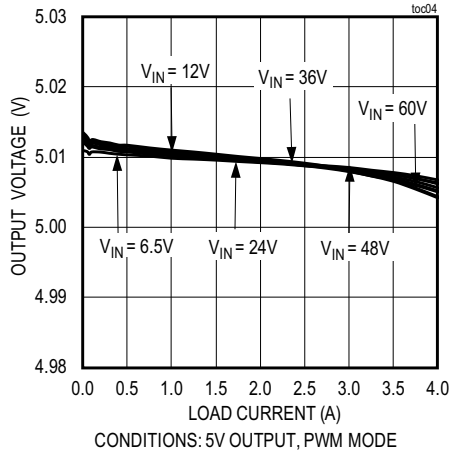
CONDITIONS: 5V OUTPUT, PFM MODE, f_{SW} = 350kHz, JU1: 1-2

EFFICIENCY vs. LOAD CURRENT



CONDITIONS: 5V OUTPUT, DCM MODE, f_{SW} = 350kHz

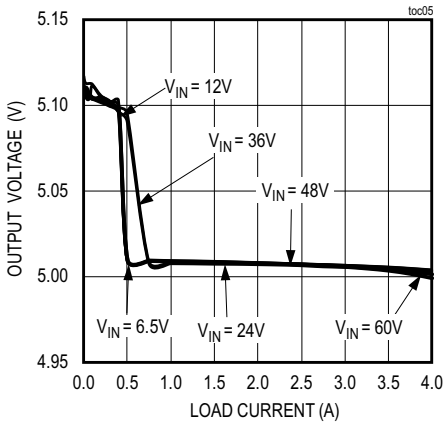
LOAD AND LINE REGULATION



CONDITIONS: 5V OUTPUT, PWM MODE

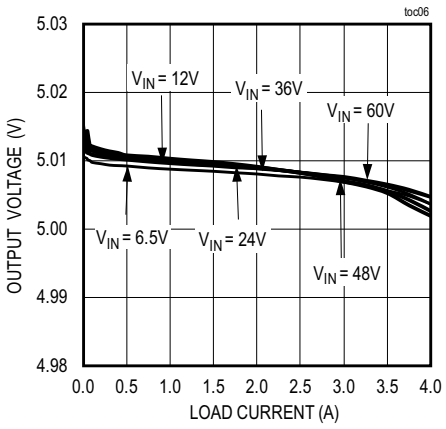
EV Kit Test Report (continued)

LOAD AND LINE REGULATION



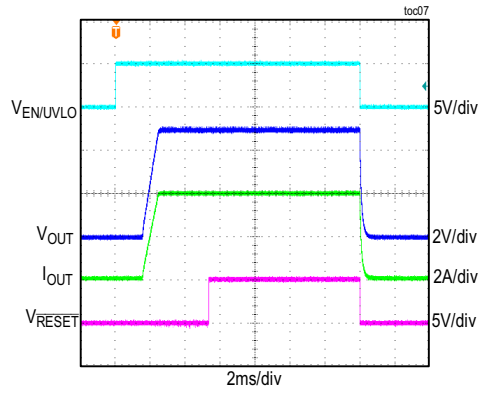
CONDITIONS: 5V OUTPUT, PFM MODE

LOAD AND LINE REGULATION



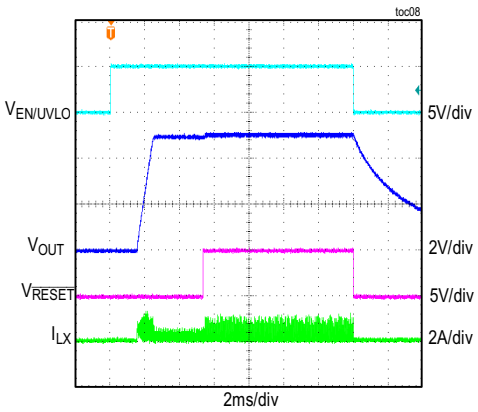
CONDITIONS: 5V OUTPUT, DCM MODE

SOFT-START/SHUTDOWN FROM EN/UVLO



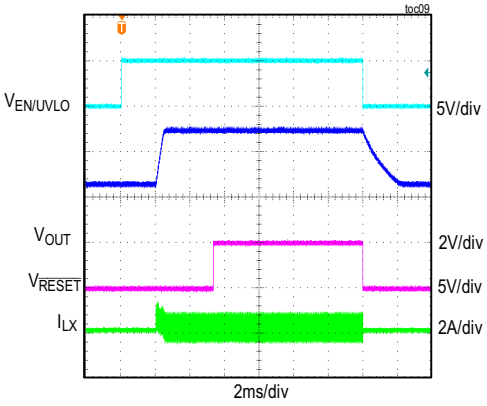
CONDITIONS: 5V OUTPUT, PWM MODE, 4A LOAD
$\overline{RESET}$ IS PULLED UP TO V_{CC} WITH A 10kΩ RESISTOR

SOFT-START/SHUTDOWN FROM EN/UVLO



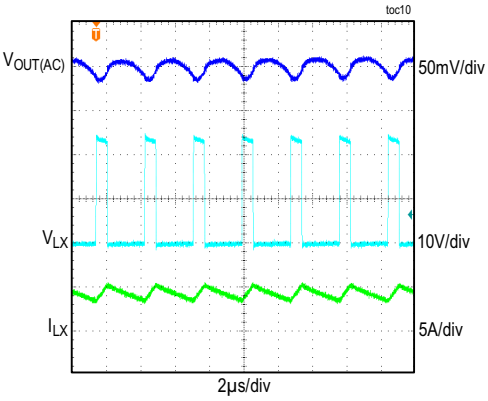
CONDITIONS: 5V OUTPUT, PFM MODE, 20mA LOAD
$\overline{RESET}$ IS PULLED UP TO V_{CC} WITH A 10kΩ RESISTOR

SOFT-START WITH PREBIAS VOLTAGE OF 2.5V



CONDITIONS: 5V OUTPUT, PWM MODE, 20mA LOAD
$\overline{RESET}$ IS PULLED UP TO V_{CC} WITH A 10kΩ RESISTOR

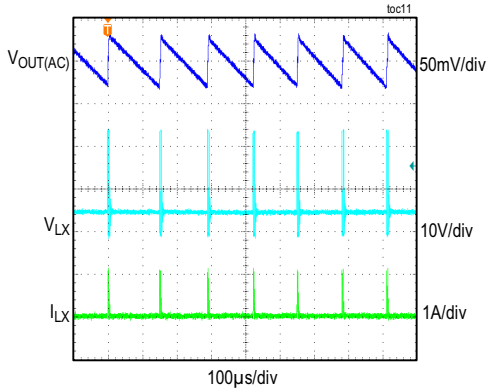
STEADY STATE PERFORMANCE



CONDITIONS: 5V OUTPUT, PWM MODE, 4A LOAD

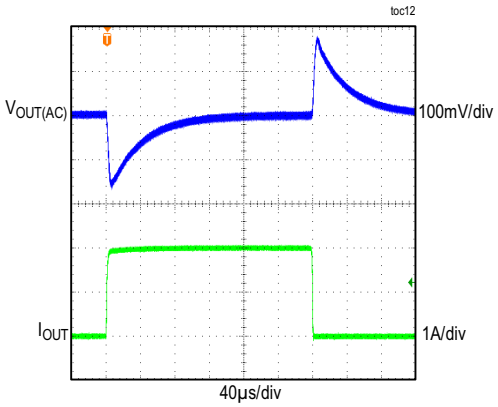
EV Kit Test Report (continued)

STEADY-STATE PERFORMANCE



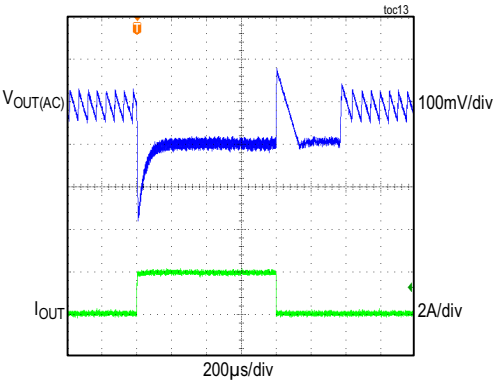
CONDITIONS: 5V OUTPUT, PFM MODE, 20mA LOAD

LOAD TRANSIENT BETWEEN 0A AND 2A



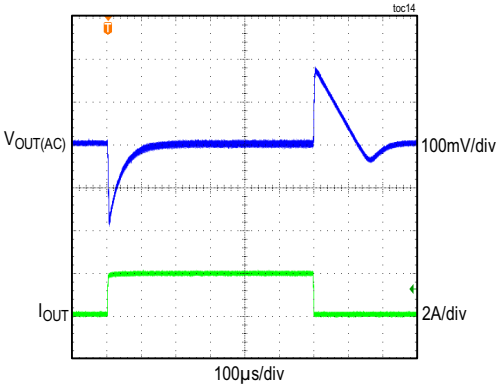
CONDITIONS: 5V OUTPUT, PWM MODE

LOAD TRANSIENT BETWEEN 50mA AND 2A



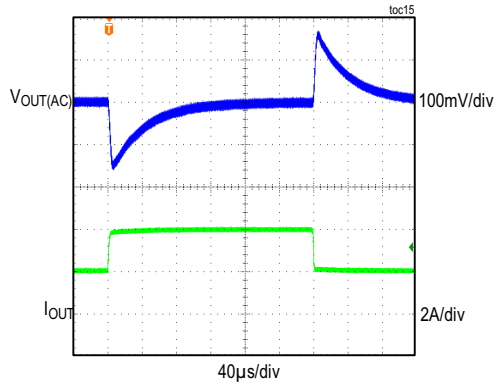
CONDITIONS: 5V OUTPUT, PFM MODE

LOAD TRANSIENT BETWEEN 80mA AND 2A



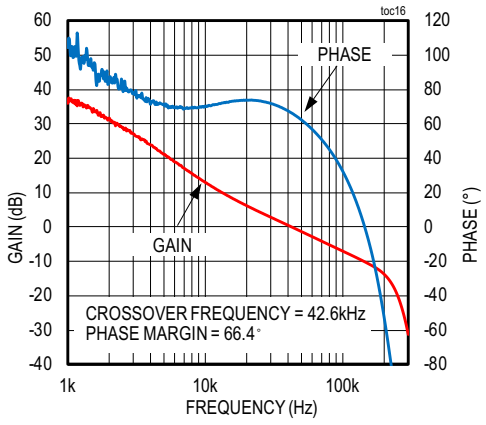
CONDITIONS: 5V OUTPUT, DCM MODE

LOAD TRANSIENT BETWEEN 2A AND 4A



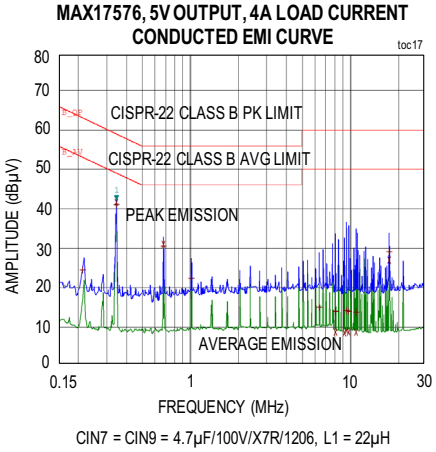
CONDITIONS: 5V OUTPUT, PWM MODE

CLOSED-LOOP BODE PLOT

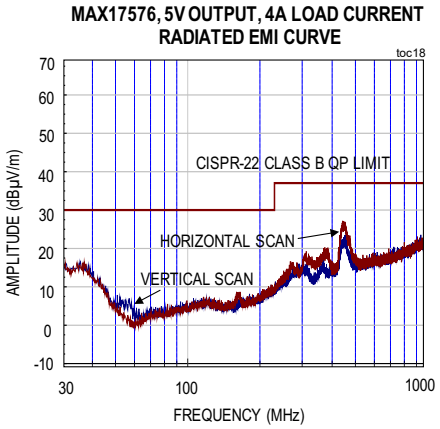


CONDITIONS: 5V OUTPUT, PWM MODE, 4A LOAD

EV Kit Test Report (continued)



CIN7 = CIN9 = 4.7µF/100V/X7R/1206, L1 = 22µH



CIN7 = CIN9 = OPEN, L1 = SHORT

Component Suppliers

SUPPLIER	WEBSITE
Coilcraft, Inc.	www.coilcraft.com
Murata Americas	www.murata.com
Panasonic Corp.	www.panasonic.com
TDK Corp.	www.tdk.com
Taiyo yuden Corp	www.ty-top.com
Vishay	www.vishay.com

Note: *Indicate that you are using the MAX17576 when contacting these component suppliers.*

Ordering Information

PART	TYPE
MAX17576EVKITB#	EV Kit

#Denotes RoHS compliant.

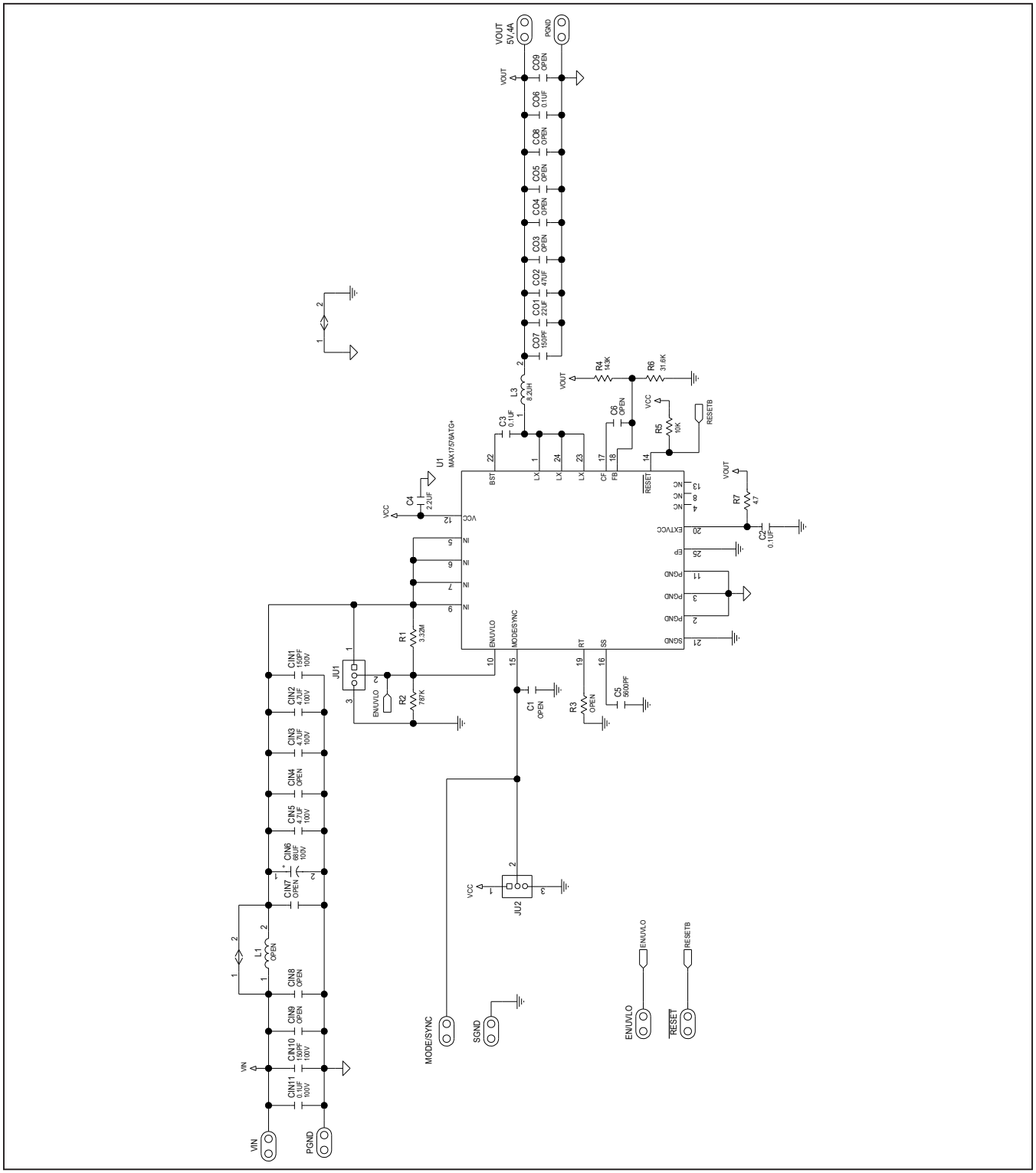
MAX17576 5V EV System Bill of Materials

ITEM	DESCRIPTION	DESIGNATOR	QUANTITY	PART NUMBER
1	0.1µF, 16V, X7R, ceramic capacitor; TOL = 10% (0402)	C2, C3	2	TAIYO YUDEN EMK105B7104KV
2	2.2µF,10V, X7R, ceramic capacitor; TOL = 10% (0603)	C4	1	MURATA GRM188R71A225KE15
3	5.6nF,50V, COG, ceramic capacitor, TOL = 2% (0402)	C5	1	MURATA GRM1555C1H562GE01
4	150pF, 100V, COG, ceramic capacitor; TOL = 10% (0402)	CIN1, CIN10, CO7	3	TDK C1005C0G2A151J050BA
5	4.7µF ±10%, 100V, X7R, ceramic capacitor (1206)	CIN2, CIN3, CIN5	3	MURATA GRM31CZ72A475KE11
6	68µF, 100V, ALUMINUM-ELECTROLYTC, TOL = 20%	CIN6	1	PANASONIC EEV-FK2A680Q
7	0.1µF, 100V, X7R, ceramic capacitor; TOL = 10% (0603)	CIN11	1	TAIYO YUDEN HMK107B7104KA
8	22µF ±10%, 25V X7R ceramic capacitor (1210)	CO1	1	MURATA GRM32ER71E226ME15
9	47µF ±10%, 10V X7R ceramic capacitor (1210)	CO2	1	MURATA GRM32ER71A476ME15
10	0.1µF, 50V, X7R, ceramic capacitor; TOL = 10% (0402)	CO6	1	TDK C1005X7R1H104K050BE
11	Test loops	EN/UVLO, MODE/SYNC, PGND, PGND2, RESET, SGND, VIN, VOUT	8	9020 BUSS WEICO WIRE
12	3-pin header (36-pin header 0.1” centers)	JU1, JU2	2	SULLINS PBC03SAAN
13	Inductor; SMT; Composite; 8.2µH; 20%; 8A	L3	1	COILCRAFT XAL6060-822ME
14	Resistor (0603); 3.32M?; 1%; 100PPM; 0.10W; thick film	R1	1	Any
15	Resistor (0603); 787K?; 1%; +/-100PPM/DEGC; 0.1W	R2	1	Any
16	Resistor (0402); 143K?; 1%; +/-100PPM/DEGC; 0.1W	R4	1	Any
17	Resistor (0402); 10K?; 1%; 100PPM; 0.0625W; thick film	R5	1	Any
18	Resistor (0402); 31.6K?; 1%; 100PPM; 0.10W; thick film	R6	1	Any
19	Resistor (0402); 4.7?, 1%, 100PPM, 0.0625W, thick film	R7	1	Any
20	Shunt	SU1, SU2	2	SULLINS STC02SYAN
21	Buck Converter, MAX17576	U1	1	MAX17576ATG+
CONDUCTED EMI FILTER COMPONENTS DETAILS (OPTIONAL)				
22	4.7µF ±10%, 100V, X7R, ceramic capacitor (1206)	CIN7, CIN9	2	MURATA GRM31CZ72A475KE11
23	Inductor; SMT; Composite; 22µH; 20%; 3.6A	L1	1	COILCRAFT XAL5050-223ME

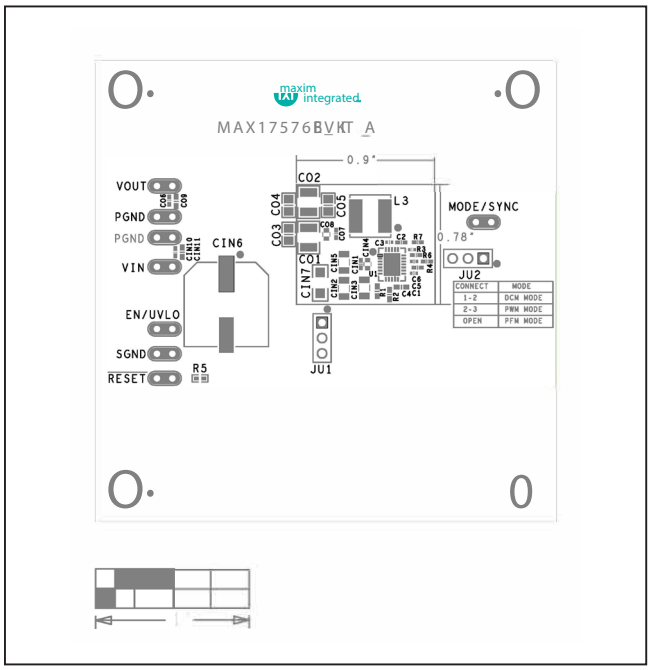
Jumper Table

JUMPER	SHUNT POSITION
JU1	Not installed
JU2	2-3

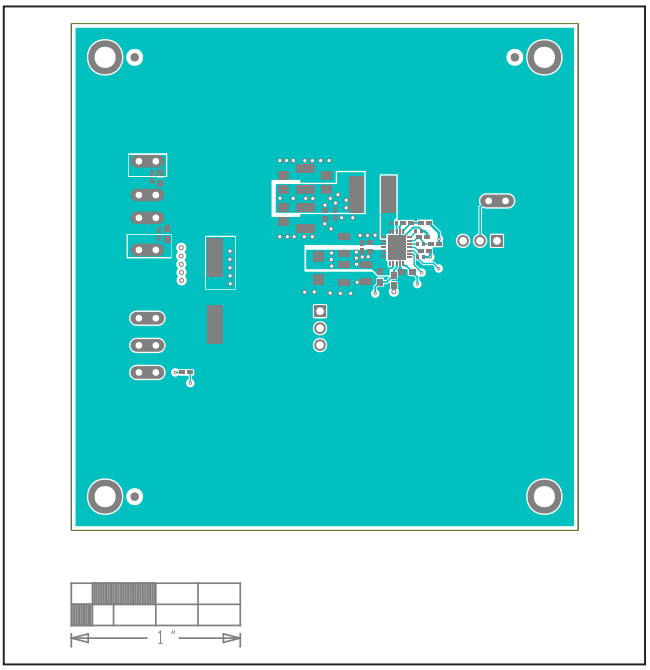
MAX17576 5V EV System Schematic



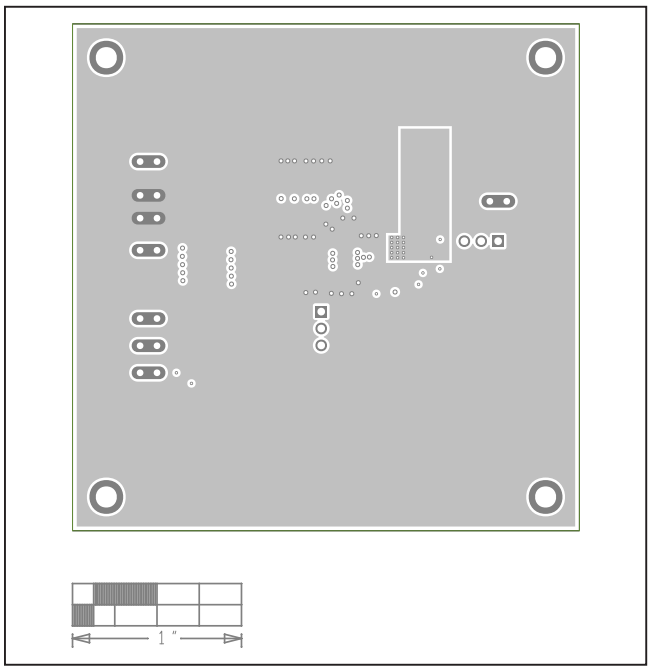
MAX17576 5V EV System PCB Layout



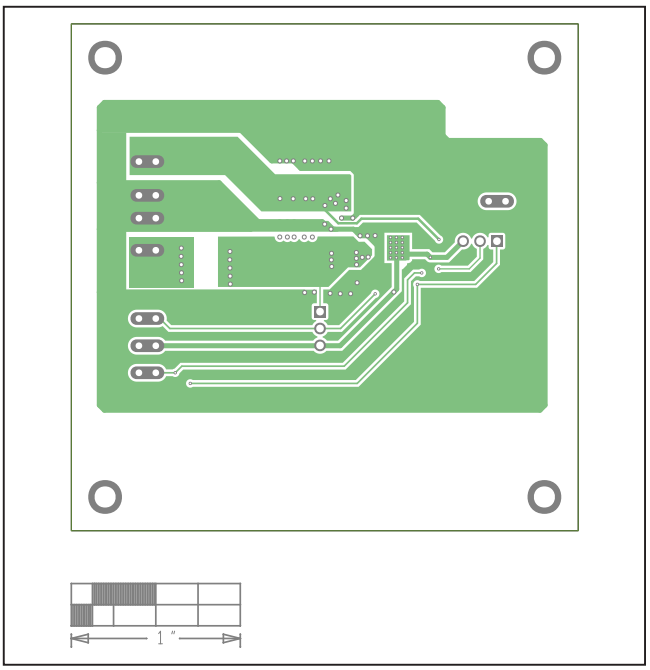
MAX17576 5V EV Kit—Top Silkscreen



MAX17576 5V EV Kit—Top

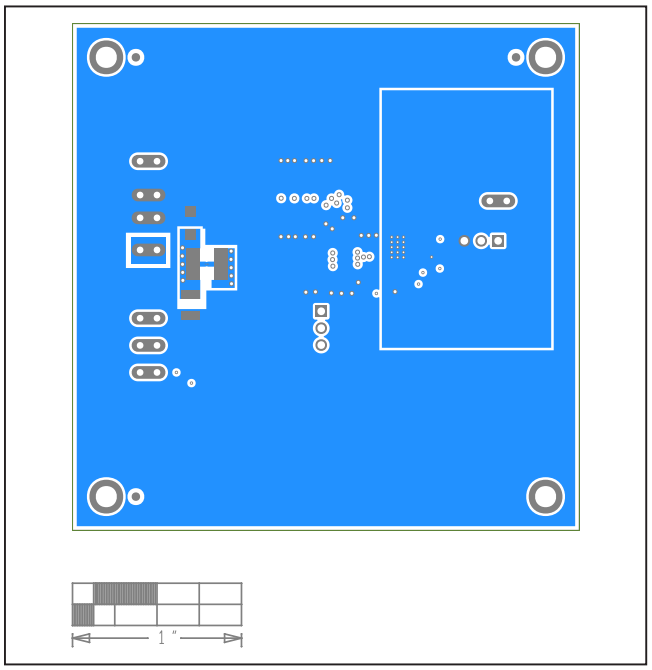


MAX17576 5V EV Kit—Layer 2 GND

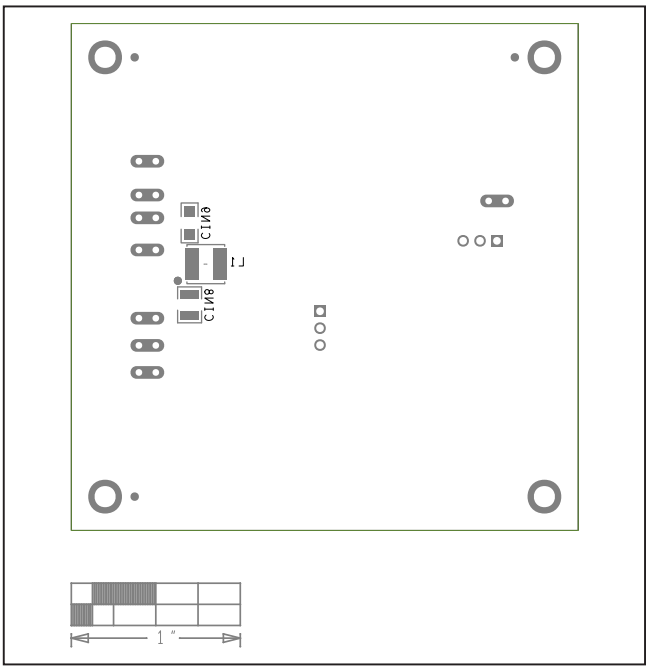


MAX17576 5V EV Kit—Layer 3 GND

MAX17576 EV System PCB Layout (continued)



MAX17576 5V EV Kit—Bottom



MAX17576 5V EV Kit—Silk Bottom

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	12/18	Initial release	—