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MAX17573 Evaluation Kit

Evaluates: MAX17573 in 5V and 3.3V Output-Voltage Applications

General Description

The MAX17573 evaluation kit (EV kit) provides proven 3.3V and 5V designs to evaluate the MAX17573 high-efficiency, wide input voltage Himalaya synchronous DC-DC converter. The 3.3V application circuit delivers load current up to 3.5A from a wide 4.5V to 60V input supply and operates at a 500kHz switching frequency. The 5V application circuit delivers load current up to 3.5A from a wide 6.5V to 60V input supply and operates at a 500kHz switching frequency.

Each application circuit on the EV kit features programmable enable and input Undervoltage Lockout (UVLO), soft-start, open-drain $\overline{\text{RESET}}$ signal, and external clock synchronization. The EV kit's layout is optimized for conducted and radiated EMI and thermal performance. For more details, refer to the *Product Highlights* section in the MAX17573 IC data sheet.

Features

- Operates over a Wide Input Range
  - MAX17573EVKITA#: V_{OUT1} = 3.3V, I_{OUT1} = 3.5A, V_{IN1} Range = 4.5V to 60V
  - MAX17573EVKITB#: V_{OUT2} = 5V, I_{OUT2} = 3.5A, V_{IN2} Range = 6.5V to 60V
- Enable/UVLO Input, Resistor-Programmable UVLO Threshold
- Selectable PWM, PFM, and DCM Modes of Operation
- Adjustable Soft-Start Time
- $\overline{\text{RESET}}$ Output with a Pullup Resistor to an External Supply
- External Clock Synchronization
- Overcurrent and Overtemperature Protection
- Proven PCB Layout
- Fully Assembled and Tested
- Complies with CISPR 32 (EN55032) Class B Conducted and Radiated Emissions

Ordering Information *appears at end of data sheet.*

Quick Start

Required Equipment

- MAX17573EVKITA#, MAX17573EVKITB#
- 60V, 3.5A DC input power supply
- Load capable of sinking 3.5A at 3.3V and 5V
- Two Digital Multimeters (DMM)

Equipment Setup and Test Procedure

The EV kit is fully assembled and tested. Use the following steps to verify and test individual device operation.

Caution: Do not turn on the power supply until all connections are completed.

1. Set the input power supply at 3.9V for MAX17573EVKITA# and at 5.9V for MAX17573EVKITB#. Disable the power supply.
2. Connect the positive terminal of the 60V power supply to the IN PCB pad and the negative terminal to the nearest PGND PCB pad.
3. Connect the positive terminal of the corresponding load to the respective VOUT PCB pad and the negative terminal to the nearest PGND PCB pad.
4. Connect one DMM across respective VOUT PCB pad and the nearest PGND PCB pad, and another DMM across the respective $\overline{\text{RESET}}$ PCB pad and the SGND PCB pad.
5. Verify that no shunts are installed on converter EN/UVLO jumpers (JU101, JU201). See Table 1 for details.
6. Select the shunt position on respective Mode selection jumpers (JU102, JU202) according to the intended mode of operation. See Table 2 for details.
7. Turn on the DC input power supply.
8. Enable the load.
9. Observe that both the DMMs display 0V.
10. Increase the input voltage to 4.5V or higher for MAX17573EVKITA# and to 6.5V or higher for MAX17573EVKITB#, which are above the EN/UVLO rising thresholds.
11. Verify the DMM across the output terminals displays 3.3V for MAX17573EVKITA# and 5V for MAX17573EVKITB#.
12. Verify the DMM across the $\overline{\text{RESET}}$ PCB pad and SGND PCB displays 5V.
13. Reduce the input voltage to 3.6V for MAX17573EVKITA# and to 5.3V for MAX17573EVKITB#, which are below the EN/UVLO falling thresholds.
14. Verify both the DMMs display 0V.
15. Disable the input power supply.

319-100914; Rev 0; 05/22

ANALOG DEVICES

Detailed Description of Hardware

The MAX17573EVKITA# and MAX17573EVKITB# EV kits are designed to demonstrate the salient features of the MAX17573 high-voltage, high-efficiency, synchronous step-down DC-DC converter in 5V and 3.3V applications. The EV kit consists of typical application circuits for 5V and 3.3V. These two circuits are electrically isolated from each other and hosted on the same PCB. Each of these circuits can be evaluated for its performance under different operating conditions by powering them from their respective input pins.

Soft-Start Input (SS)

The EV kit offers an adjustable soft-start function to limit inrush current during start-up. The soft-start time is adjusted by the value of the external soft-start capacitor connected between SS and SGND. The selected output capacitance (C_{SEL}) and the output voltage (V_{OUT}) determine the minimum required soft-start capacitor C_{SS}, as follows:

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

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

$$t_{SS} = \frac{C_{SS}}{5.55 \times 10^{-6}}$$

For example, to program a 1ms soft-start time, a 5600pF capacitor should be connected from the SS pin to SGND.

Enable/Undervoltage Lockout Level (EN/UVLO) Programming

The MAX17573 offers an enable and adjustable input undervoltage lockout feature. In these EV kits, for normal operation, leave the EN/UVLO jumpers (JU101, JU201) open. When jumpers are left open, the MAX17573EVKITA# EV kit is enabled when the input voltage rises above 4.3V and MAX17573EVKITB# EV kit is enabled when the input voltage rises above 6.2V. To disable the converters, install shunts across pin 2-3 on jumpers (JU101, JU201). See Table 1 for jumper (JU101, JU201) settings. The EN/UVLO PCB pad on the EV kits support external Enable/Disable control of the device. Leave the jumpers open when external Enable/Disable control is desired. A potential divider formed by the resistors R_{UVL_TOP} (R101, R201) and R_{UVL_BOT} (R102, R202) at the EN/UVLO pin sets the input voltage (V_{INU}), above which the converter is enabled when the jumpers are left open.

Choose R_{UVL_TOP} to be 3.32MΩ (max), and then calculate R_{UVL_BOT} as follows:

$$R_{ULV\_BOT} = \frac{R_{ULV\_TOP} \times 1.215}{(V_{INU} - 1.215)}$$

where, V_{INU} is the voltage at which the device is required to turn on. For more details about Setting the Input Undervoltage-Lockout Level, refer to the MAX17573 IC data sheet.

Table 1. Converter EN/UVLO Jumper (JU101, JU201) Settings

SHUNT POSITION	EN/UVLO PIN	OUTPUT
1-2	Connected to IN	Enabled
Not installed*	Connected to the center node of respective resistor-dividers (R101 and R102; R201 and R202)	Enabled, UVLO level is set by the resistor-divider between IN and SGND
2-3	Connected to SGND	Disabled

**Default position*

Mode Selection (MODE/SYNC)

The EV kits provide jumpers (JU102, JU202) that allow the converters to operate in PWM, PFM, and DCM modes. For more details on the modes of operation, refer to the MAX17573 data sheet. Table 2 shows the mode selection jumper (JU102, JU202) settings that can be used to configure the desired mode of operation for each converter.

Table 2. Mode Selection Jumper (JU102, JU202) Settings

SHUNT POSITION	EN/UVLO PIN	OUTPUT
1-2	Connected to VCC	DCM mode of operation
2-3*	Connected to SGND	PWM mode of operation
Not installed	Unconnected	PFM mode of operation

**Default position*

External Clock Synchronization (MODE/SYNC)

The EV kits provide MODE/SYNC PCB pads to synchronize the MAX17573 to an optional external clock. Leave jumpers (JU102, JU202) open when external clock signals are applied. In the presence of a valid external clock for synchronization, the MAX17573 operates in PWM mode only. For more details about *External Clock Synchronization*, refer to the MAX17573 IC data sheet.

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

The EV kits provide $\overline{\text{RESET}}$ PCB pads to monitor the status of the converters. $\overline{\text{RESET}}$ goes high when VOUT rises above 95% (typ) of its nominal regulated output voltage. $\overline{\text{RESET}}$ goes low when VOUT falls below 92% (typ) of its nominal regulated voltage.

Hot Plug-In and Long Input Cables

The MAX17573EVKITA# and MAX17573EVKITB# EV kit PCB layouts provide an optional electrolytic capacitor (CIN106, CIN206 = 68µF/100V). These capacitors limit the peak voltage at the input of the converters 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 converters input.

Electromagnetic Interference (EMI)

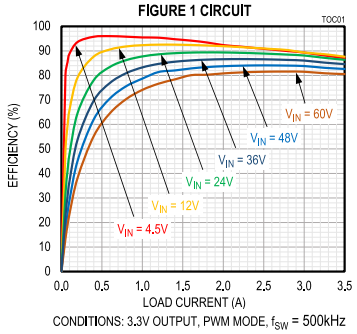
Compliance to Conducted Emissions (CE) standards requires an Electromagnetic Interference (EMI) filter at the input of a switching power converter. The EMI filter attenuates high-frequency currents drawn by the switching power converter, and limits the noise injected back into the input power source.

The MAX17573EVKITA# and MAX17573EVKITB# PCBs have designated footprints for the placement of conducted EMI filter components per the optional Bill of Material (BoM). Use of these filter components results in lower conducted EMI below CISPR32 Class B limits. Cut open the trace at L102 and L202 before installing conducted EMI filter components. The PCB layouts are also designed to limit radiated emissions from switching nodes of the power converter, resulting in radiated emissions below CISPR32 Class B limits.

MAX17573EVKITA# and MAX17573EVKITB# EV Kit Performance

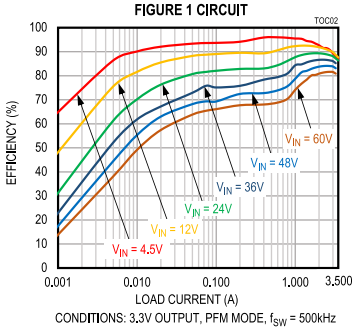
(V_{IN1} = V_{IN2} = 24V, V_{OUT1} = 3.3V, V_{OUT2} = 5V, I_{OUT1} = I_{OUT2} = 3.5A, f_{SW} = 500kHz, T_A = +25°C, unless otherwise noted)

EFFICIENCY vs. LOAD CURRENT
FIGURE 1 CIRCUIT



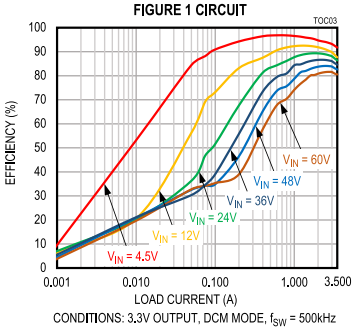
CONDITIONS: 3.3V OUTPUT, PWM MODE, f_{SW} = 500kHz

EFFICIENCY vs. LOAD CURRENT
FIGURE 1 CIRCUIT



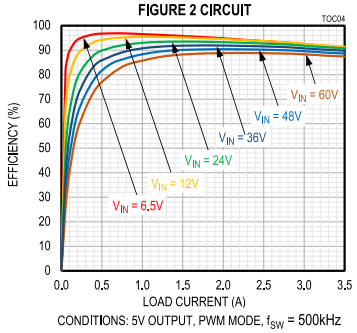
CONDITIONS: 3.3V OUTPUT, PFM MODE, f_{SW} = 500kHz

EFFICIENCY vs. LOAD CURRENT
FIGURE 1 CIRCUIT



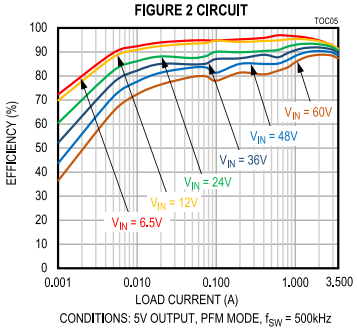
CONDITIONS: 3.3V OUTPUT, DCM MODE, f_{SW} = 500kHz

EFFICIENCY vs. LOAD CURRENT
FIGURE 2 CIRCUIT



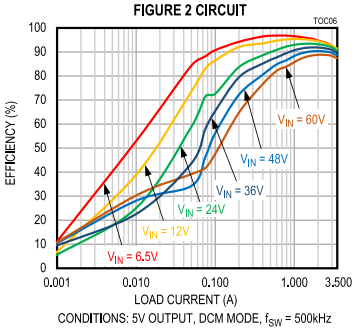
CONDITIONS: 5V OUTPUT, PWM MODE, f_{SW} = 500kHz

EFFICIENCY vs. LOAD CURRENT
FIGURE 2 CIRCUIT



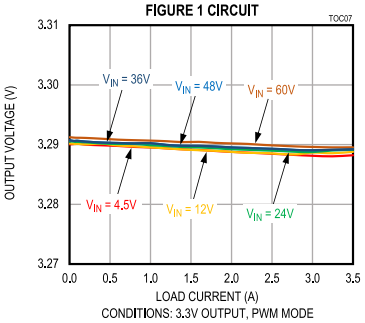
CONDITIONS: 5V OUTPUT, PFM MODE, f_{SW} = 500kHz

EFFICIENCY vs. LOAD CURRENT
FIGURE 2 CIRCUIT



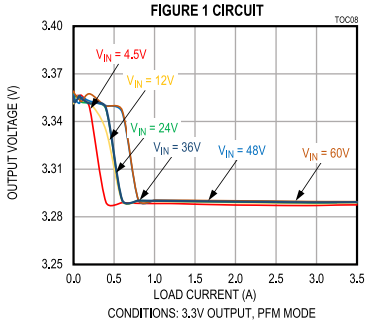
CONDITIONS: 5V OUTPUT, DCM MODE, f_{SW} = 500kHz

LINE AND LOAD REGULATION
FIGURE 1 CIRCUIT



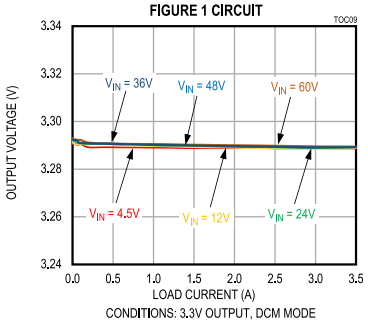
CONDITIONS: 3.3V OUTPUT, PWM MODE

LINE AND LOAD REGULATION
FIGURE 1 CIRCUIT



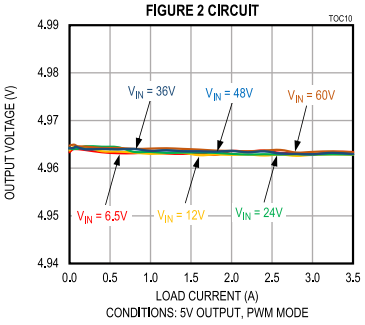
CONDITIONS: 3.3V OUTPUT, PFM MODE

LINE AND LOAD REGULATION
FIGURE 1 CIRCUIT



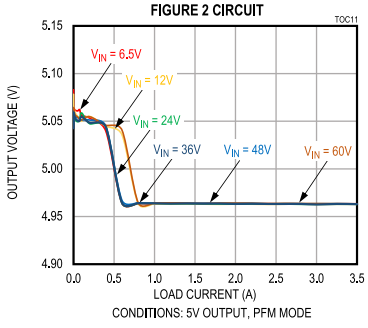
CONDITIONS: 3.3V OUTPUT, DCM MODE

LINE AND LOAD REGULATION
FIGURE 2 CIRCUIT



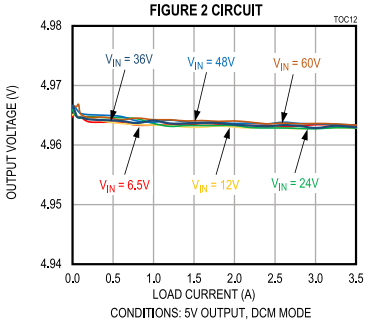
CONDITIONS: 5V OUTPUT, PWM MODE

LINE AND LOAD REGULATION
FIGURE 2 CIRCUIT



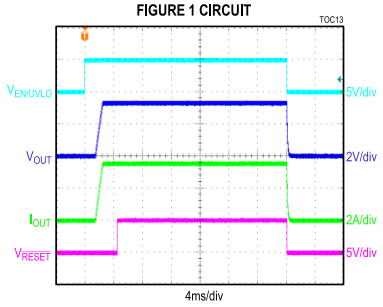
CONDITIONS: 5V OUTPUT, PFM MODE

LINE AND LOAD REGULATION
FIGURE 2 CIRCUIT



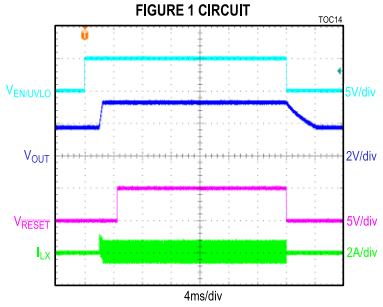
CONDITIONS: 5V OUTPUT, DCM MODE

SOFT-START/SHUTDOWN THROUGH EN/UVLO
FIGURE 1 CIRCUIT



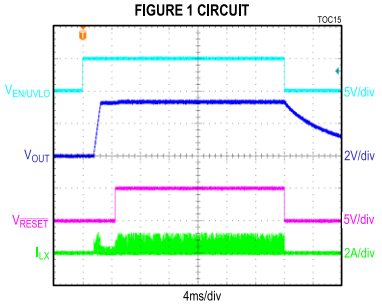
CONDITIONS: 3.3V OUTPUT, PWM MODE, 0.943Ω LOAD

SOFT-START WITH PREBIAS VOLTAGE OF 1.65V
FIGURE 1 CIRCUIT



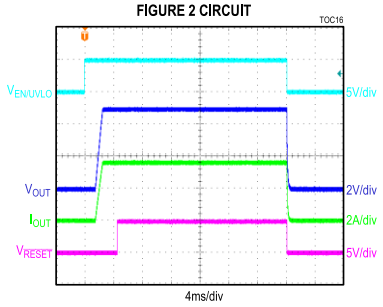
CONDITIONS: 3.3V OUTPUT, PWM MODE, 20mA LOAD

SOFT-START/SHUTDOWN THROUGH EN/UVLO
FIGURE 1 CIRCUIT



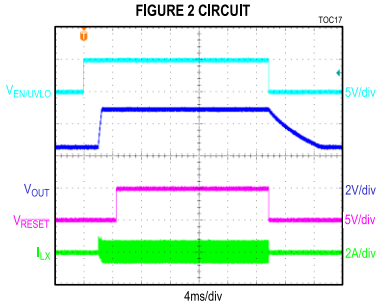
CONDITIONS: 3.3V OUTPUT, PFM MODE, 20mA LOAD

SOFT-START/SHUTDOWN THROUGH EN/UVLO
FIGURE 2 CIRCUIT



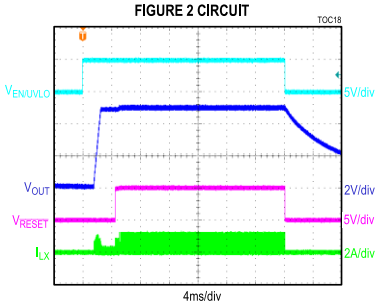
CONDITIONS: 5V OUTPUT, PWM MODE, 1.43Ω LOAD

SOFT-START WITH PREBIAS VOLTAGE OF 2.5V
FIGURE 2 CIRCUIT



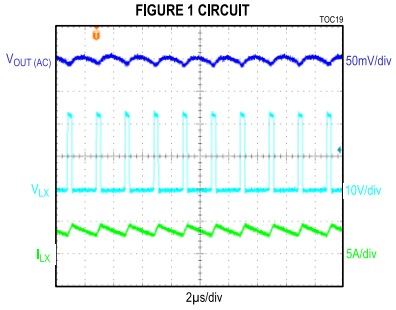
CONDITIONS: 5V OUTPUT, PWM MODE, 20mA LOAD

SOFT-START/SHUTDOWN THROUGH EN/UVLO
FIGURE 2 CIRCUIT



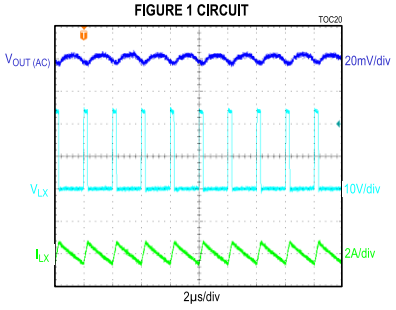
CONDITIONS: 5V OUTPUT, PFM MODE, 20mA LOAD

STEADY-STATE PERFORMANCE
FIGURE 1 CIRCUIT



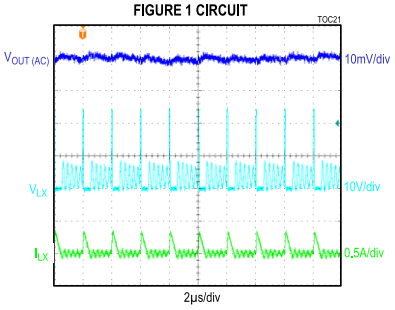
CONDITIONS: 3.3V OUTPUT, PWM MODE, 3.5A LOAD

STEADY-STATE PERFORMANCE
FIGURE 1 CIRCUIT



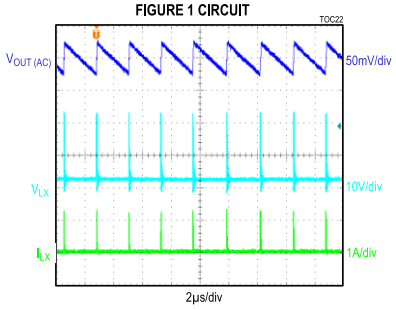
CONDITIONS: 3.3V OUTPUT, PWM MODE, NO LOAD

STEADY-STATE PERFORMANCE
FIGURE 1 CIRCUIT



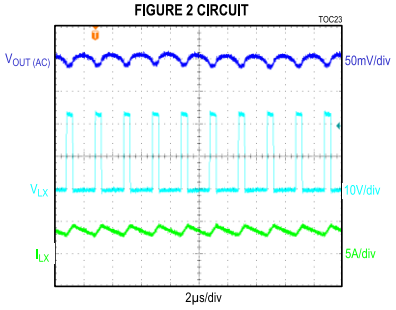
CONDITIONS: 3.3V OUTPUT, DCM MODE, 40mA LOAD

STEADY-STATE PERFORMANCE
FIGURE 1 CIRCUIT



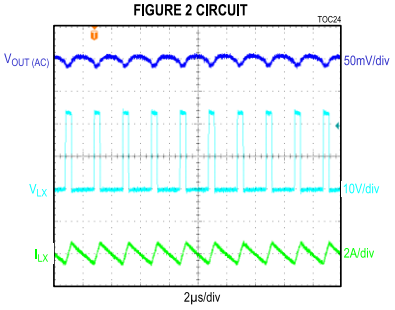
CONDITIONS: 3.3V OUTPUT, PFM MODE, 20mA LOAD

STEADY-STATE PERFORMANCE
FIGURE 2 CIRCUIT



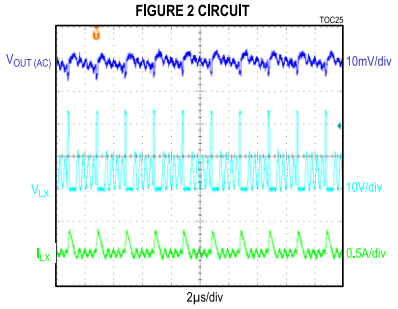
CONDITIONS: 5V OUTPUT, PWM MODE, 3.5A LOAD

STEADY-STATE PERFORMANCE
FIGURE 2 CIRCUIT



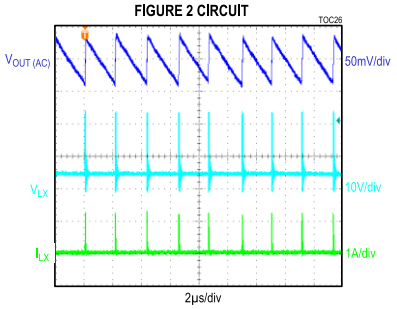
CONDITIONS: 5V OUTPUT, PWM MODE, NO LOAD

STEADY-STATE PERFORMANCE
FIGURE 2 CIRCUIT



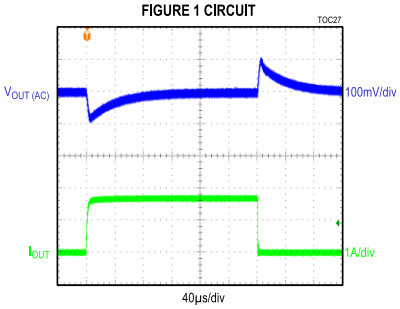
CONDITIONS: 5V OUTPUT, DCM MODE, 40mA LOAD

STEADY-STATE PERFORMANCE
FIGURE 2 CIRCUIT



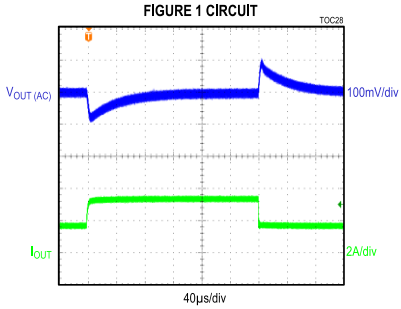
CONDITIONS: 5V OUTPUT, PFM MODE, 20mA LOAD

LOAD TRANSIENT BETWEEN 0A AND 1.75A
FIGURE 1 CIRCUIT



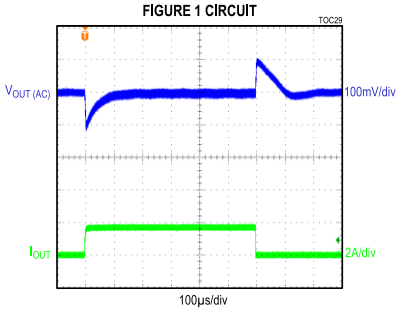
CONDITIONS: 3.3V OUTPUT, PWM MODE

LOAD TRANSIENT BETWEEN 1.75A AND 3.5A
FIGURE 1 CIRCUIT



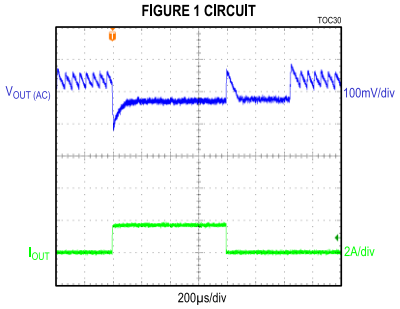
CONDITIONS: 3.3V OUTPUT, PWM MODE

LOAD TRANSIENT BETWEEN 50mA AND 1.75A
FIGURE 1 CIRCUIT



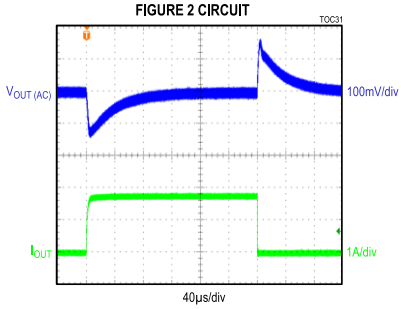
CONDITIONS: 3.3V OUTPUT, DCM MODE

LOAD TRANSIENT BETWEEN 50mA AND 1.75A
FIGURE 1 CIRCUIT



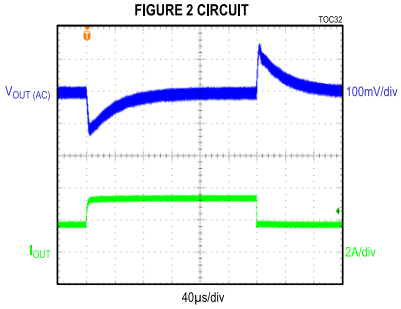
CONDITIONS: 3.3V OUTPUT, PFM MODE

LOAD TRANSIENT BETWEEN 0A AND 1.75A
FIGURE 2 CIRCUIT



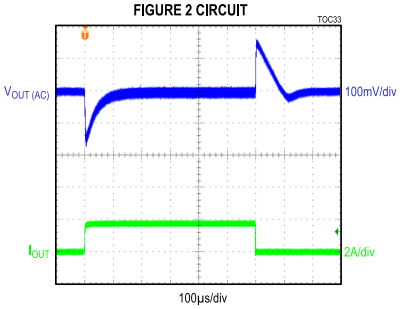
CONDITIONS: 5V OUTPUT, PWM MODE

LOAD TRANSIENT BETWEEN 1.75A AND 3.5A
FIGURE 2 CIRCUIT



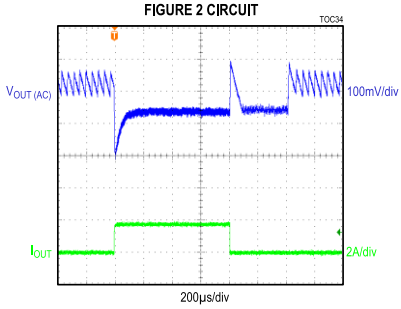
CONDITIONS: 5V OUTPUT, PWM MODE

LOAD TRANSIENT BETWEEN 50mA AND 1.75A
FIGURE 2 CIRCUIT



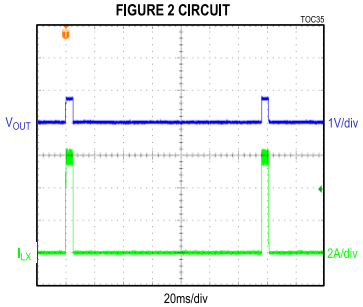
CONDITIONS: 5V OUTPUT, DCM MODE

LOAD TRANSIENT BETWEEN 50mA AND 1.75A
FIGURE 2 CIRCUIT



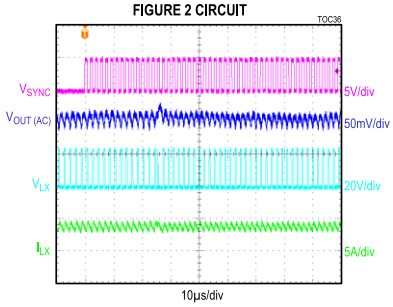
CONDITIONS: 5V OUTPUT, PFM MODE

OVERLOAD PROTECTION
FIGURE 2 CIRCUIT

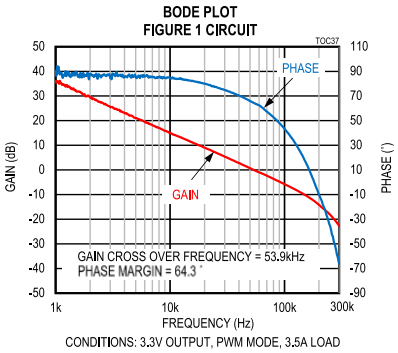


CONDITIONS: 5V OUTPUT, PWM MODE, 0.13Ω LOAD

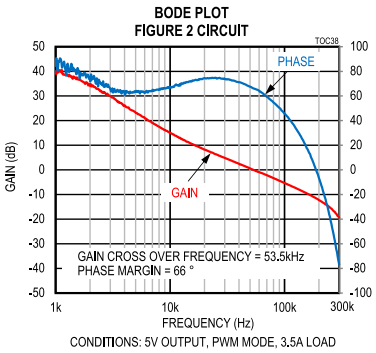
EXTERNAL CLOCK SYNCHRONIZATION
FIGURE 2 CIRCUIT



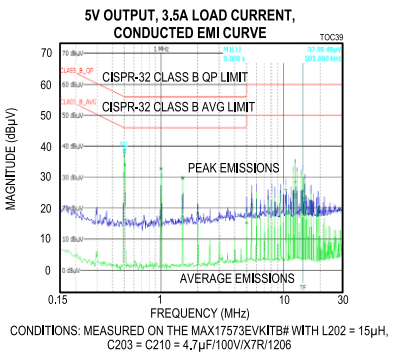
CONDITIONS: 5V OUTPUT, PWM MODE, 3.5A LOAD,
f_{SW} = 500kHz, EXTERNAL CLOCK FREQUENCY = 550kHz



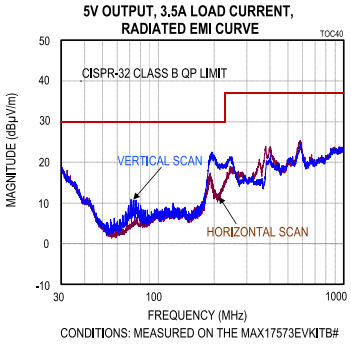
CONDITIONS: 3.3V OUTPUT, PWM MODE, 3.5A LOAD



CONDITIONS: 5V OUTPUT, PWM MODE, 3.5A LOAD



CONDITIONS: MEASURED ON THE MAX17573EVKITB# WITH L202 = 15µH, C203 = C210 = 4.7µF/100V/X7R/1206



CONDITIONS: MEASURED ON THE MAX17573EVKITB#

MAX17573EVKITA# and MAX17573EVKITB# EV Kit Bill of Materials

S.No	DESIGNATOR	DESCRIPTION	QUANTITY	MANUFACTURER PART NUMBER
1	C101, C108, C201, C208	0.1µF, ±10%, 100V, X7R, Ceramic capacitor (0603)	4	MURATA GRM188R72A104KA35
2	C102, C202	0.01µF, ±10%, 100V, X7R, Ceramic capacitor (0603)	2	MURATA GRM188R72A103KA01
3	C106, C206	ALUMINUM-ELECTROLYTIC; 68UF; 100V; TOL= ±20%; MODEL=EEV SERIES	2	PANASONIC EEV-FK2A680Q
4	C107, C109, C207, C209	4.7µF, ±10%, 100V, X7R, Ceramic capacitor (1206)	4	MURATA GRM31CZ72A475KE11
5	C111, C211	4700pF, ±10%, 100V, X7R, Ceramic capacitor (0402)	2	MURATA GRM155R72A472KA01
6	C113, C213	5600pF, ±2%, 50V, C0G, Ceramic capacitor (0402)	2	MURATA GRM1555C1H562GE01
7	C114, C214	2.2µF, ±10%, 10V, X7R, Ceramic capacitor (0603)	2	MURATA GRM188R71A225KE15
8	C115, C125, C215, C225, C228	0.1µF, ±10%, 16V, X7R, Ceramic capacitor (0402)	5	MURATA GRM155R71C104KA88
9	C118, C119, C219	47µF, ±20%, 10V, X7R, Ceramic capacitor (1210)	3	MURATA GRM32ER71A476ME15
10	C218	22µF, ±20%, 25V, X7R, Ceramic capacitor (1210)	1	MURATA GRM32ER71E226ME15
11	L101	INDUCTOR, 4.7µH, 13.5A (6.5mm x 6.7mm)	1	COILCRAFT XGL6060-472ME
12	L201	INDUCTOR, 6.8µH, 11.5A (6.5mm x 6.7mm)	1	COILCRAFT XGL6060-682ME
13	R101, R201	3.32MΩ, ±1%, 0.1W, Resistor (0603)	2	VISHAY DALE CRCW06033M32FK
14	R102	1.3MΩ, ±1%, 0.1W, Resistor (0603)	1	PANASONIC ERJ-3EKF1304
15	R103, R203	40.2kΩ, ±1%, 0.063W, Resistor (0402)	2	VISHAY DALE CRCW040240K2FK
16	R105, R205	10kΩ, ±1%, 0.1W, Resistor (0402)	2	PANASONIC ERJ-2RKF1002
17	R106	84.5kΩ, ±1%, 0.063W, Resistor (0402)	1	VISHAY DALE CRCW040284K5FK
18	R107	31.6kΩ, ±1%, 0.063W, Resistor (0402)	1	VISHAY DALE CRCW040231K6FK
19	R108	0Ω, Jumper, 0.1W, Resistor (0402)	1	PANASONIC ERJ-2GE0R00
20	R202	806kΩ, ±1%, 0.1W, Resistor (0603)	1	PANASONIC ERJ-3EKF8063
21	R204	4.7Ω, ±1%, 0.063W, Resistor (0402)	1	VISHAY DALE CRCW04024R70FK
22	R206	127kΩ, ±1%, 0.1W, Resistor (0402)	1	PANASONIC ERJ-2RKF1273
23	R207	28kΩ, ±1%, 0.063W, Resistor (0402)	1	VISHAY DALE CRCW040228K0FK
24	JU101, JU102, JU201, JU202	3-pin header (36-pin header 0.1” centers)	4	SULLINS PEC03SAAN
25	SU101, SU102, SU201, SU202	Shunts	4	SULLINS STC02SYAN
26	MH1-MH4	MACHINE FABRICATED; ROUND-THRU HOLE SPACER; NO THREAD; M3.5; 5/8IN; NYLON	4	KEYSTONE 9032
27	U101, U201	HIGH-EFFICIENCY SYNCHRONOUS STEP-DOWN DC-DC CONVERTER WITH INTERNAL COMPENSATION (24-PIN TQFN, 4mm x 5mm)	2	MAX17573ATG+
28	C203, C210	OPTIONAL: 4.7µF ±10%, 100V, X7R, Ceramic capacitor (1206)	2	MURATA GRM31CZ72A475KE11
29	L202	OPTIONAL: Inductor, 15µH, 3.6A (4mm x 4mm)	1	COILCRAFT XGL4040-153ME
30	L102	OPEN: Inductor (4mm x 4mm)	0	
31	R104	OPEN: Resistor (0402)	0	
32	C103, C110	OPEN: Capacitor (1206)	0	

33	C116, C117, C124, C216, C217, C224	OPEN: Capacitor (0402)	0	
34	C122, C222	OPEN: Capacitor (0805)	0	
35	C123, C223	OPEN: Capacitor (0603)	0	

Components Supplier

SUPPLIER	WEBSITE
Coilcraft	www.coilcraft.com
Murata Americas	www.murata.com
Panasonic Corp	www.panasonic.com
Vishay Dale	www.vishay.com
Sullins Corp	www.sullinscorp.com
Keystone Electronics Corp	www.keyelco.com

Note: *Indicate using the MAX17573 when contacting these component suppliers.*

Ordering Information

PART	TYPE
MAX17573EVKITA#	EV Kit
MAX17573EVKITB#	EV Kit

#Denotes RoHS-compliant.

MAX17573EVKITA# and MAX17573EVKITB# EV Kit Schematics

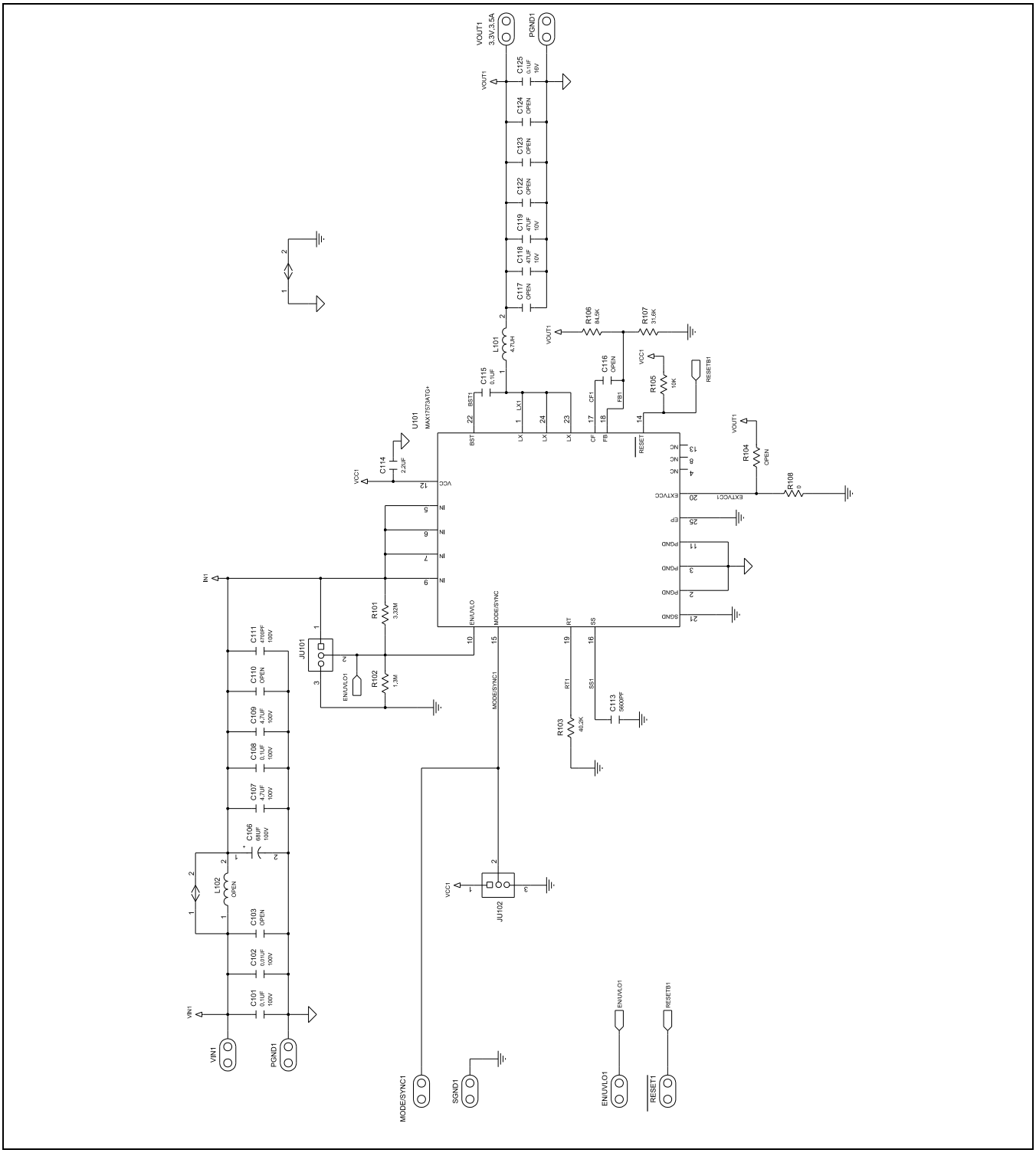


Figure 1. 3.3V Application Circuit Schematic Diagram

MAX17573EVKITA# and MAX17573EVKITB# EV Kit Schematics (continued)

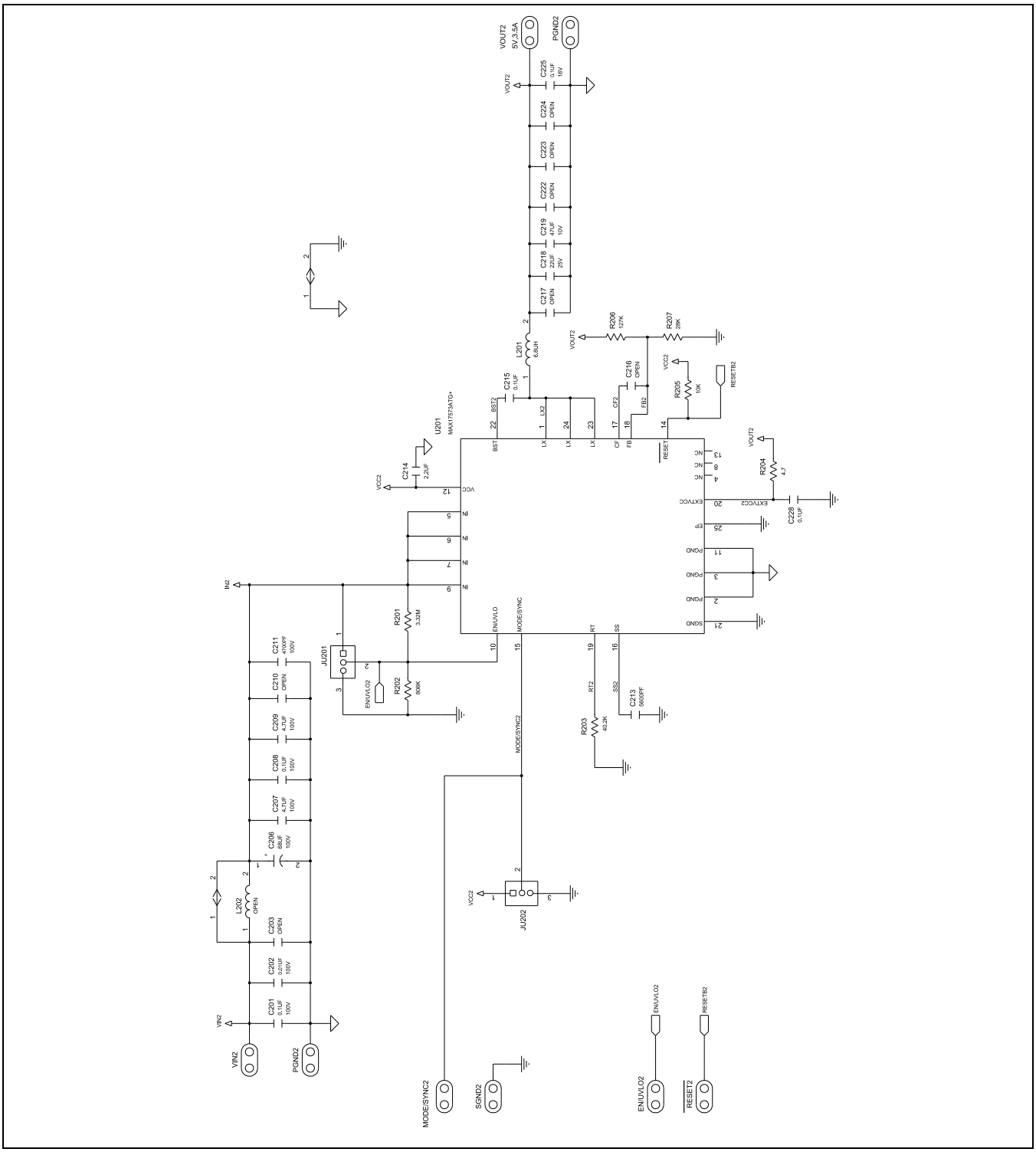
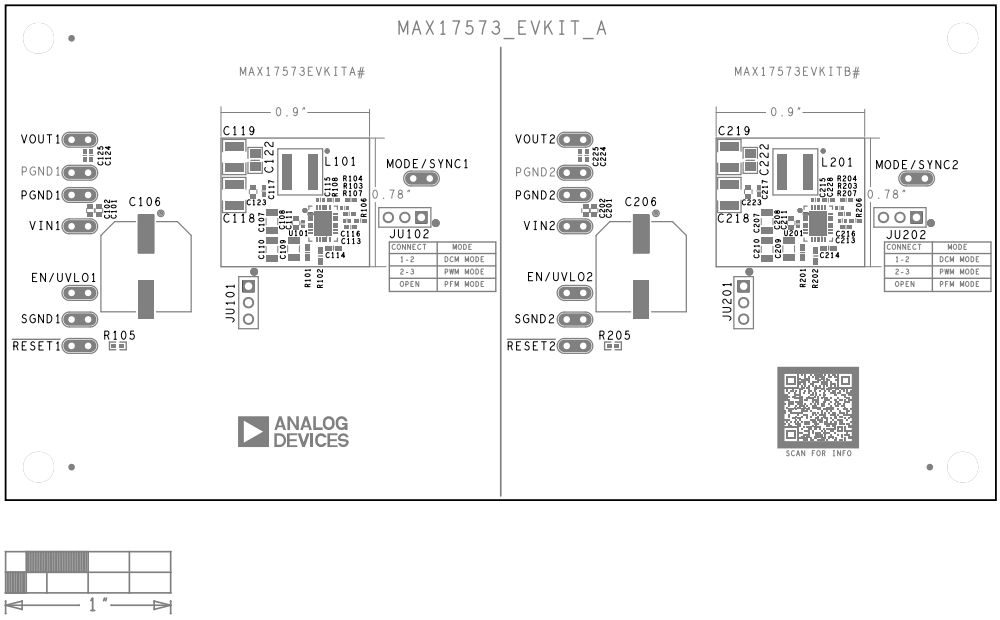
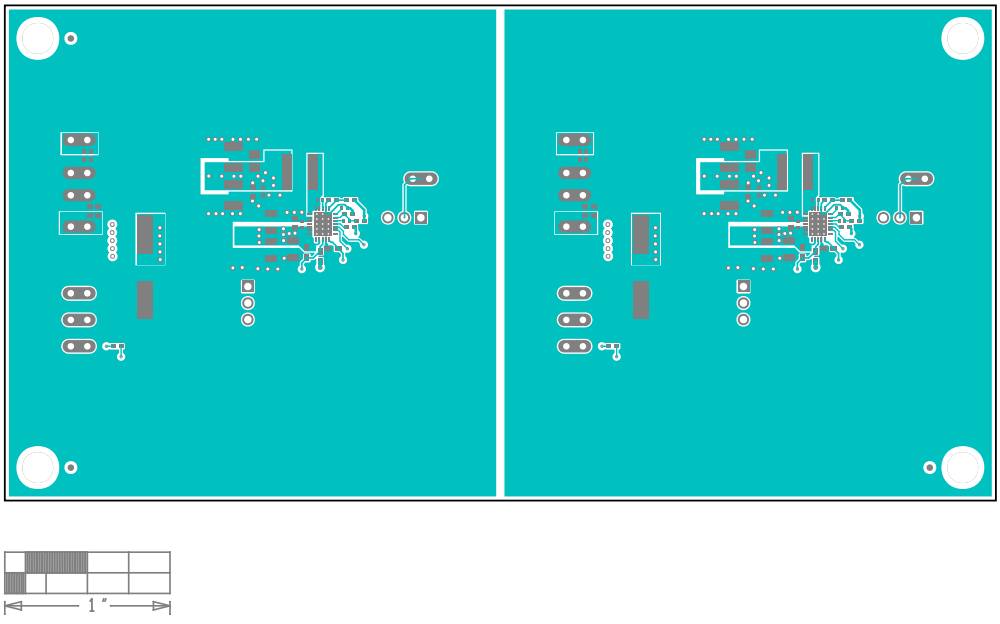


Figure 2. 5V Application Circuit Schematic Diagram

MAX17573 EV Kit PCB Layout

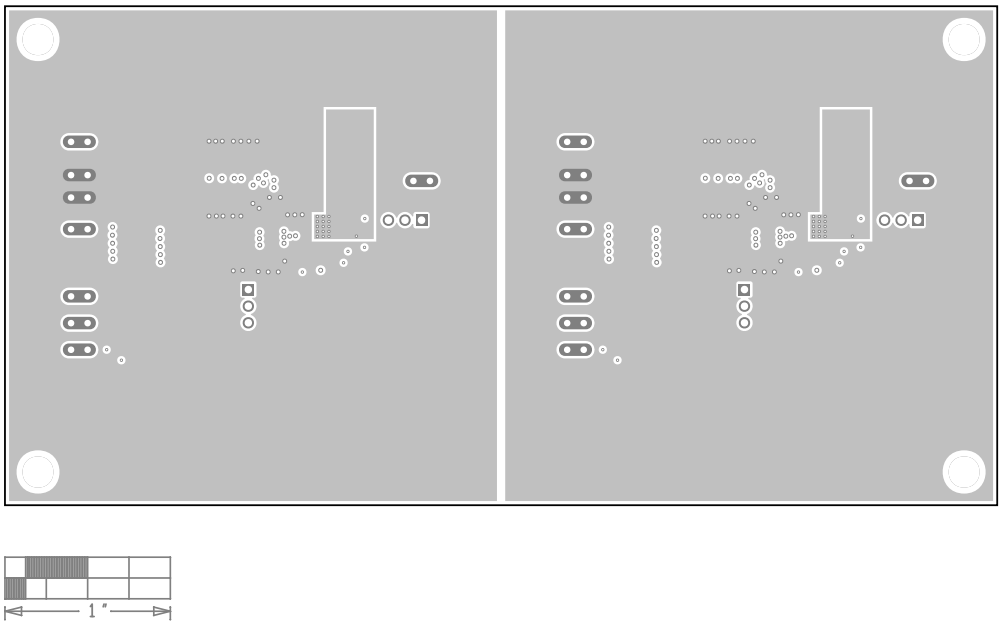


MAX17573 EV Kit Component Placement Guide—Top Silkscreen

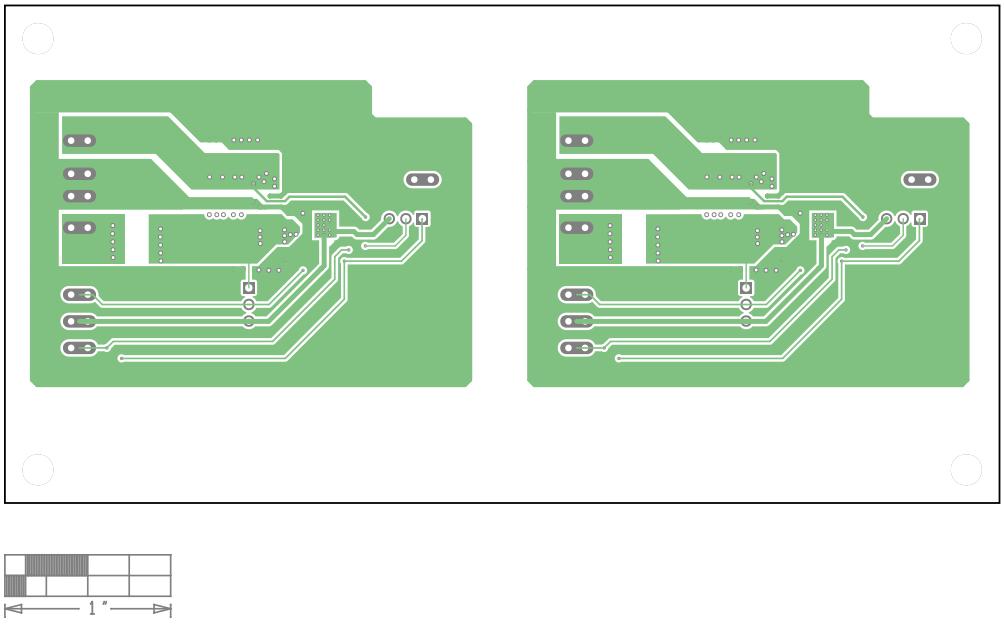


MAX17573 EV Kit PCB Layout—Top

MAX17573 EV Kit PCB Layout (continued)

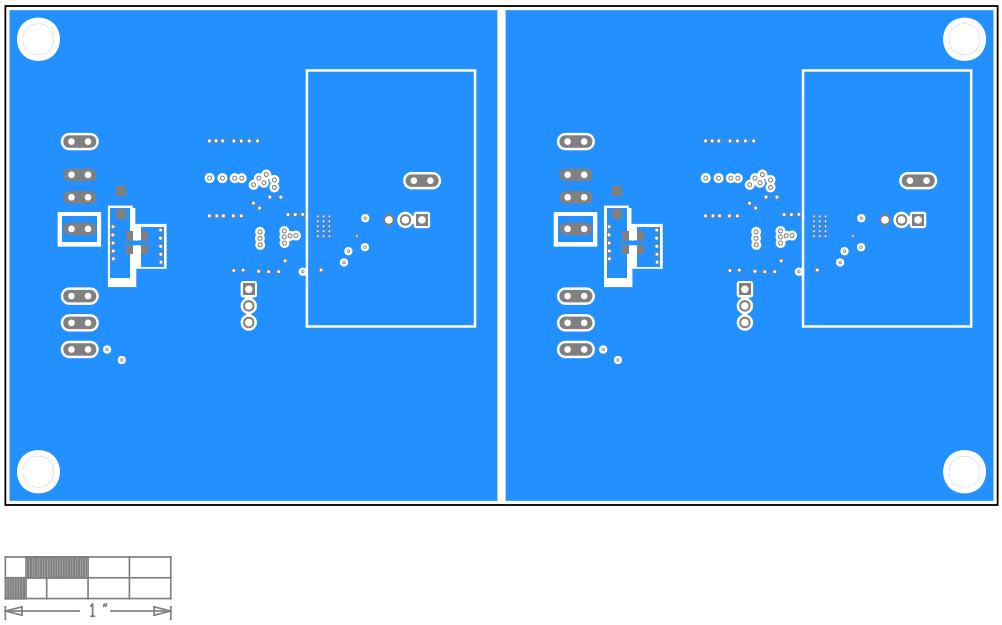


MAX17573 EV Kit PCB Layout—Layer 2

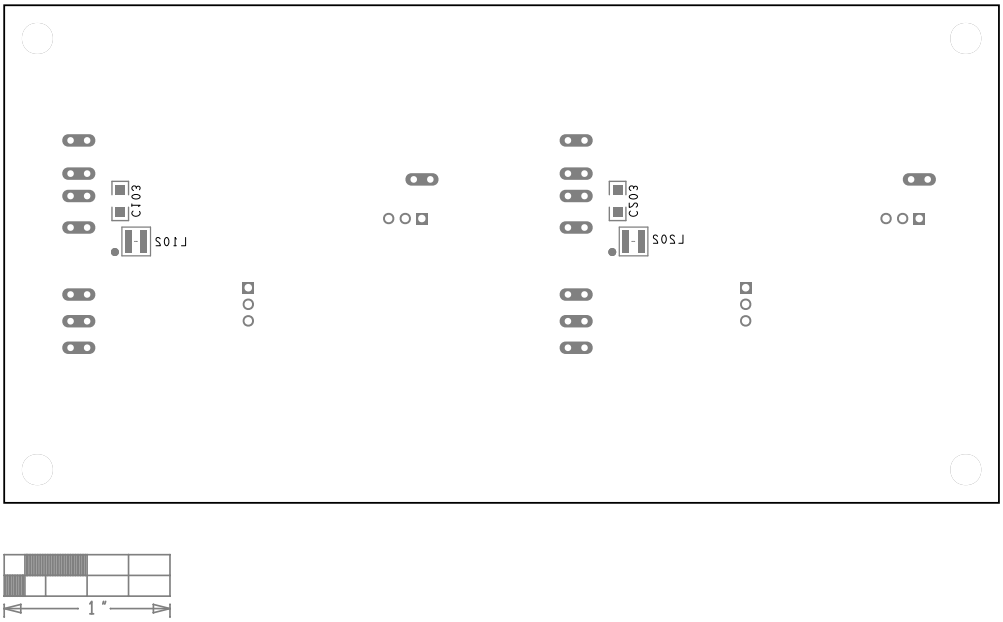


MAX17573 EV Kit PCB Layout—Layer 3

MAX17573 EV Kit PCB Layout (continued)



MAX17573 EV Kit PCB Layout—Bottom



MAX17573 EV Kit Component Placement Guide—Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	5/22	Initial release	—