MAX17632C Evaluation Kit

Evaluates: MAX17632
5V Output-Voltage Application

General Description

The MAX17632C 5V output evaluation kit (EV kit) provides a proven design to evaluate the MAX17632C high-efficiency, synchronous step-down DC-DC converter. The EV kit provides 5V/2A at the output from a 6.5V to 36V input supply. The switching frequency of the EV kit is preset to 400kHz 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.

Features

- Operates from a 6.5V to 36V Input Supply
- 5V Output Voltage
- Delivers Up to 2A Output Current
- 400kHz Switching Frequency
- Enable/UVLO Input, Resistor-Programmable UVLO Threshold
- Adjustable Soft-Start Time
- Open-Drain $\overline{\text{RESET}}$ Output
- Overcurrent and Overtemperature Protection
- Proven PCB Layout
- Fully Assembled and Tested

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

Quick Start

Recommended Equipment

- MAX17632C 5V output EV kit
- 6.5V to 36V, 2A DC-input power supply
- Load capable of sinking 2A
- 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 36V. Then, 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 2A 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) and pins 2-3 on jumper JU2 (see Table 2 for details)
5) Turn on the DC power supply.
6) Enable the load.
7) Verify that the DVM displays 5V.

319-100098; Rev 0; 11/17

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Detailed Description of Hardware

The EV kit is designed to deliver 5V at load current up to 2A at the output from a 6.5V to 36V input supply. The switching frequency of the EV kit is configured at 400 kHz by leaving RT resistor open.

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 and jumper JU2 allow an external clock to synchronize the device. Jumper JU2 allows the selection of the mode 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 the startup. The soft-start time is adjusted by the value of C3, the external capacitor from SS to SGND. The selected output capacitance (C_{SEL}) and the output voltage (V_{OUT}) determine the minimum value of C3, as shown by the following equation:

$$C3 \geq 28 \times 10^{-6} \times C_{SEL} \times V_{OUT}$$

The soft-start time (t_{SS}) is related to the soft-start capacitor C3 by the following equation:

$$t_{SS} = \frac{C3}{\left(5.55 \times 10^{-6}\right)}$$

For example, in order to program a 1ms soft-start time, C3 should be 5600pF.

Setting the Input Undervoltage Lockout Level (EN/UVLO)

The device offers an adjustable input undervoltage-lockout level, where output is enabled at the minimum desired input-voltage level. For always-enable operation, a shunt should be installed across pins 1-2 on jumper JU1, which pulls up the EN/UVLO to V_{IN}. In order to disable the output, install a shunt across pins 2-3 on JU1, which pulls down the EN/UVLO pin to V_{SGND}. See Table 1 for JU1 settings.

Set the input voltage level (input undervoltage-lockout level) at which the device turns on with the resistive voltage-divider R1 and R2 connected between VIN and SGND.

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 input voltage at that the device requires to turn on.

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

SHUNT POSITION	EN/UVLO PIN	MAX17632C OUTPUT
1-2*	Connected to VIN	Enabled
Not installed	Connected to the center node of resistor-divider R1 and R2	Enabled, UVLO level is set by the resistor-divider between VIN and SGND
2-3	Connected to SGND	Disabled

**Default position.*

Mode Selection (MODE/SYNC)

The device's MODE/SYNC pin can be used to select among forced PWM, DCM, or PFM modes of operation at light loads. 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 MAX17632 IC datasheet for more information on the PWM, DCM, and PFM modes of operation.

Table 2 shows the EV kit jumper (JU2) settings that can be used to configure the desired mode of operation at light loads.

Inductor Selection

Three key inductor parameters must be specified for operation with the device: inductance value (L), inductor saturation current (I_{SAT}) and DC resistance (R_{DCR}). The switching frequency and output voltage determine the inductor value as follows:

$$\text{For PWM/DCM mode, } L = \frac{V_{OUT}}{1.25 \times f_{SW}}$$

$$\text{For PFM mode, } L = \frac{V_{OUT}}{0.833 \times f_{SW}}$$

where V_{OUT} and f_{SW} are nominal values. For example, for 5V output and 400kHz, L = 10µH (part number: XAL5050-103ME) for PWM/DCM mode, and L = 15µH (part number: XAL6060-153ME) for PFM mode are used in this EV kit.

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 clock frequency must be between 1.1 × f_{SW} and 1.4 × f_{SW}, where f_{SW} is the frequency of operation set by R5. The minimum external clock high pulse width should be greater than 50ns and minimum external low pulse width should be greater than 160ns. Make sure that a shunt is not installed on jumper JU2 while connecting the external clock signal on the MODE/SYNC PCB pad.

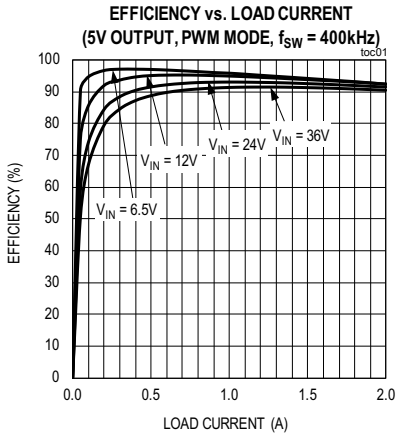
Table 2. MODE/SYNC Description (JU2)

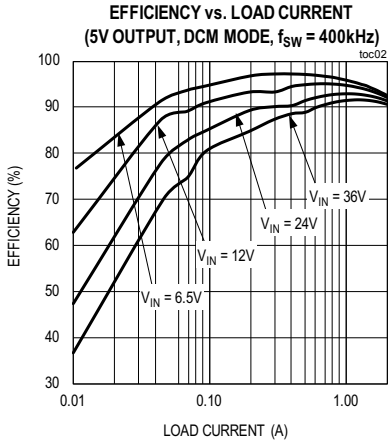
SHUNT POSITION	MODE/SYNC PIN	MAX17632C OUTPUT
1-2	Connected to V_{CC}	DCM mode of operation
2-3*	Connected to SGND	PWM mode of operation
Not installed	Unconnected	PFM mode of operation

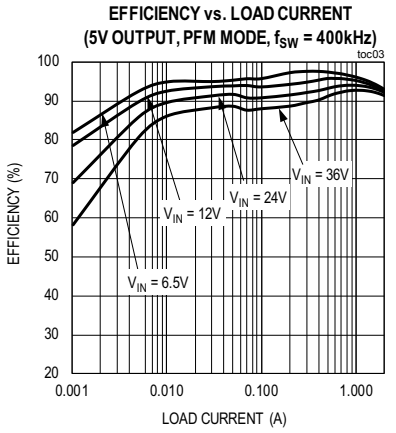
**Default position.*

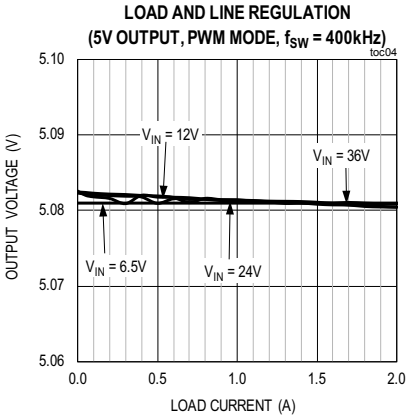
MAX17632C EV Kit Performance Report

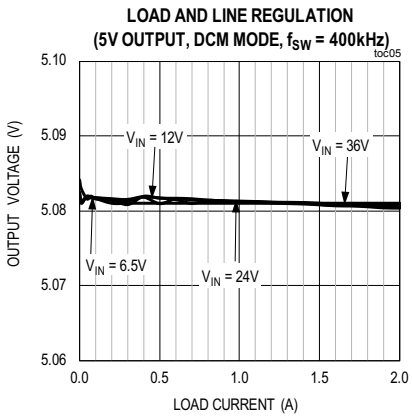
(V_{IN} = 24V, L = 10µH (XAL5050-103ME) for PWM/DCM mode, 15µH (XAL6060-153ME) for PFM mode, unless otherwise noted.)

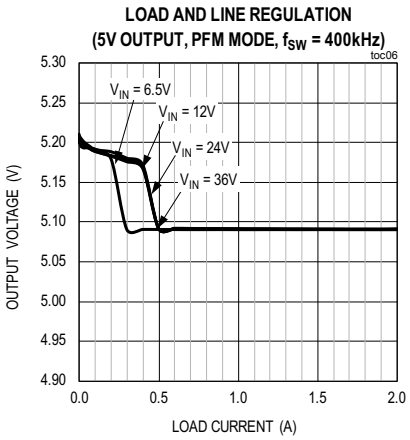


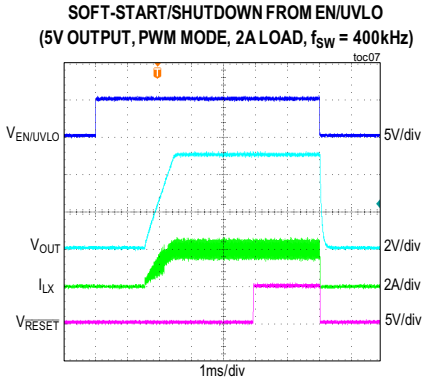


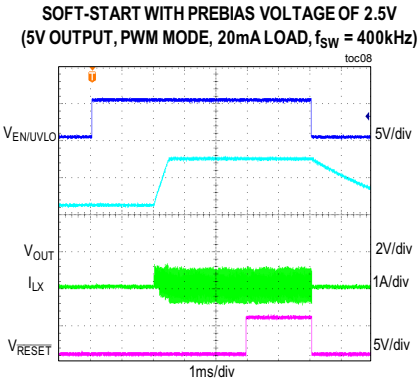


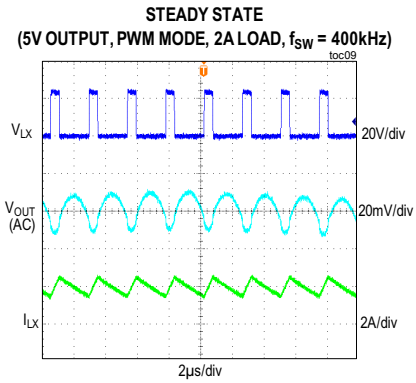








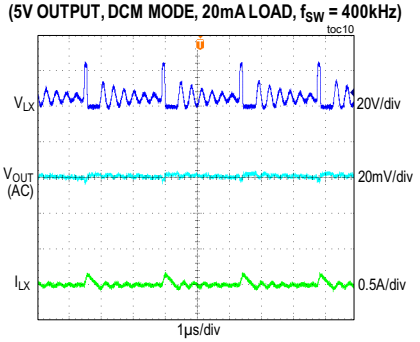




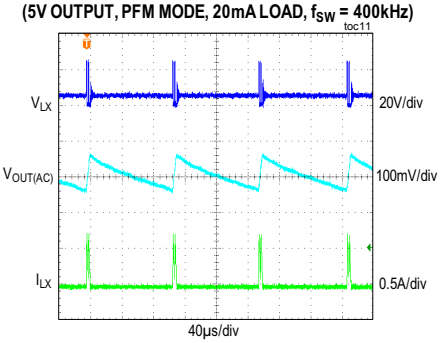
MAX17632C EV Kit Performance Report (continued)

(V_{IN} = 24V, L = 10µH (XAL5050-103ME) for PWM/DCM mode, 15µH (XAL6060-153ME) for PFM mode, unless otherwise noted.)

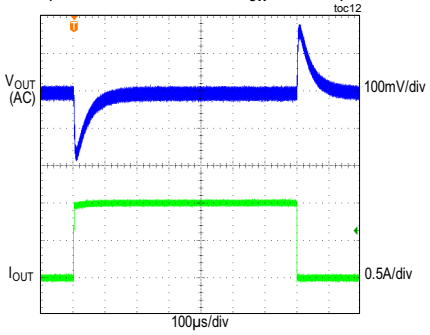
STEADY STATE
(5V OUTPUT, DCM MODE, 20mA LOAD, f_{SW} = 400kHz)



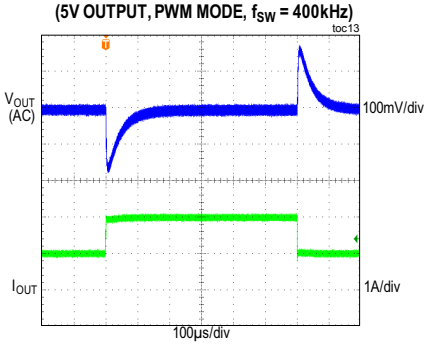
STEADY STATE
(5V OUTPUT, PFM MODE, 20mA LOAD, f_{SW} = 400kHz)



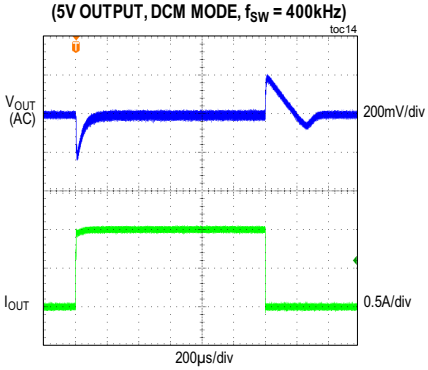
LOAD TRANSIENT BETWEEN 0A AND 1A
(5V OUTPUT, PWM MODE, f_{SW} = 400kHz)



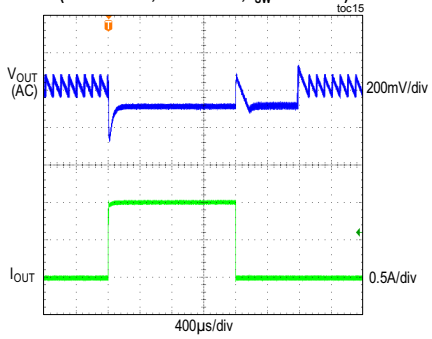
LOAD TRANSIENT BETWEEN 1A AND 2A
(5V OUTPUT, PWM MODE, f_{SW} = 400kHz)



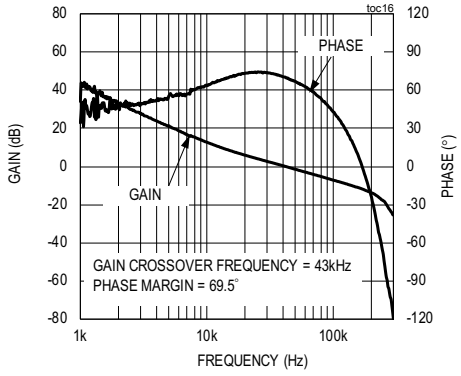
LOAD TRANSIENT BETWEEN 20mA AND 1A
(5V OUTPUT, DCM MODE, f_{SW} = 400kHz)



LOAD TRANSIENT BETWEEN 20mA AND 1A
(5V OUTPUT, PFM MODE, f_{SW} = 400kHz)



CLOSED-LOOP BODE PLOT
(5V OUTPUT, PWM MODE, 2A LOAD, f_{SW} = 400kHz)



Component Suppliers

SUPPLIER	WEBSITE
Coilcraft	www.coilcraft.com
Murata Americas	www.murata.com
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Vishay Dale	www.vishay.com
TDK Corp.	www.tdk.com
Venkel Ltd.	www.venkel.com
SullinsCorp	www.sullinscorp.com

Note: *Indicate that you are using the MAX17632C when contacting these component suppliers.*

Ordering Information

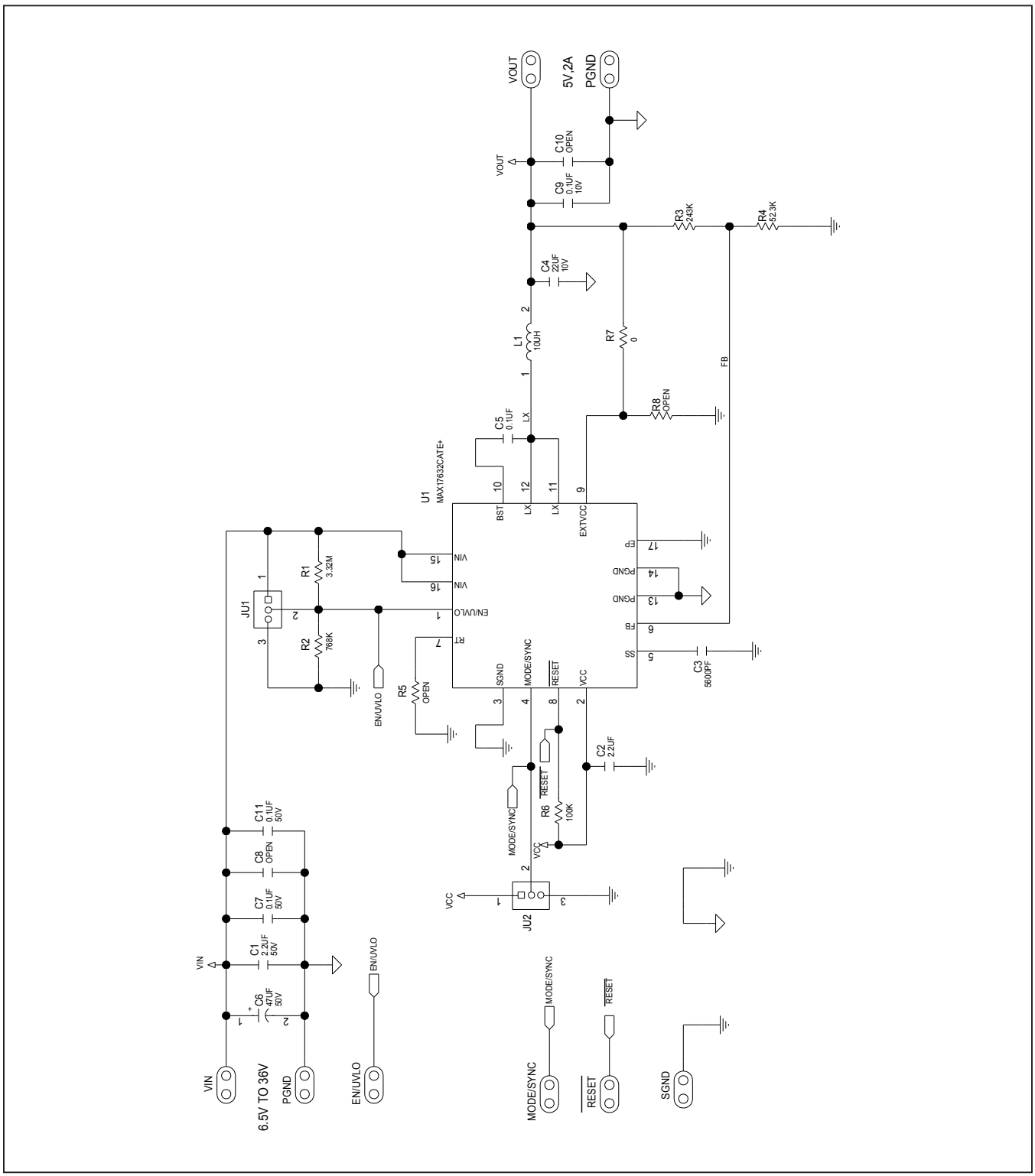
PART	TYPE
MAX17632C5EVKIT#	EVKIT

MAX17632C EV System Bill of Materials

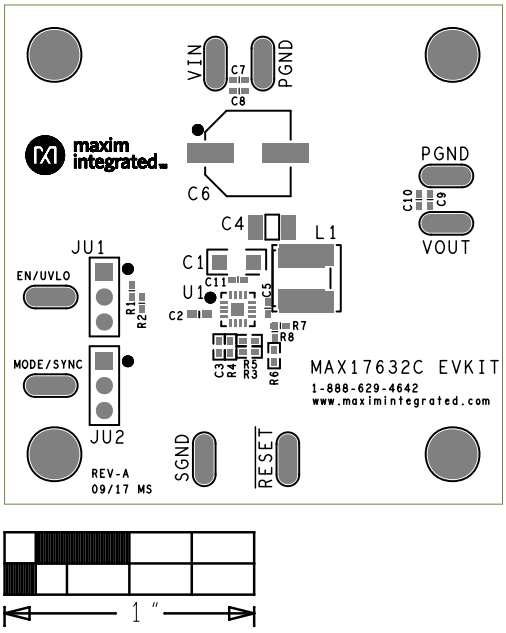
No.	Description	Quantity	Designator	Part Number
1	2.2µF, 10%, 50V, X7R,Ceramic capacitor (1206)	1	C1	MURATA GRM31CR71H225KA88
2	2.2µF, 10%, 6.3V, X7R, Ceramic capacitor (0603)	1	C2	TDK CGA3E1X7R0J225K080AC
3	5600pF, 10%, 25V, X7R, Ceramic capacitor (0402)	1	C3	MURATA GRM155R71E562KA01
4	22µF, 10%, 10V, X7R,Ceramic capacitor (1210)	1	C4	MURATA GRM32ER71A226K
5	0.1µF, 10%, 16V, X7R,Ceramic capacitor (0402)	1	C5	TDK CGA2B1X7R1C104K050BC
6	47uF, 20%, 50V, Electrolytic capacitor	1	C6	PANASONIC EEE-TG1H470UP
7	0.1µF, 10%, 50V, X7R,Ceramic capacitor (0402)	2	C7,C11	MURRATA GRM155R71H104KE14
8	0.1µF, 10%, 10V, X7R,Ceramic capacitor (0402)	1	C9	MURRATA GRM155R71A104KA01
9	3-pin header (36-pin header 0.1” centers)	2	JU1, JU2	SULLINS PEC03SAAN
10	INDUCTOR- 10µH, 4.9A for PWM/DCM modes 15uH, 6A for PFM mode	1	L1	COILCRAFT XAL5050-103ME for PWM/DCM modes, COILCRAFT XAL6060-153ME for PFM mode
11	3.32MΩ, ±1%, 1/16W, resistor (0402)	1	R1	Any
12	768kΩ, ±1%, 1/10W, resistor (0402)	1	R2	Any
13	243kΩ, ±1%, 1/16W, resistor (0402)	1	R3	Any
14	52.3kΩ, ±1%, 1/16W, resistor (0402)	1	R4	Any
15	100kΩ, ±1%, 1/16W, resistor (0402)	1	R6	Any
16	0Ω, ±1%, 1/10W, resistor (0402)	1	R7	Any
17	Buck Converter, MAX17632C	1	U1	MAXIM MAX17632CATE+
18	Shunts	2	-	SULLINS STC02SYAN

JUMPER TABLE	
JUMPER	**SHUNT POSITION**
JU1	1, 2 short
JU2	2, 3 short

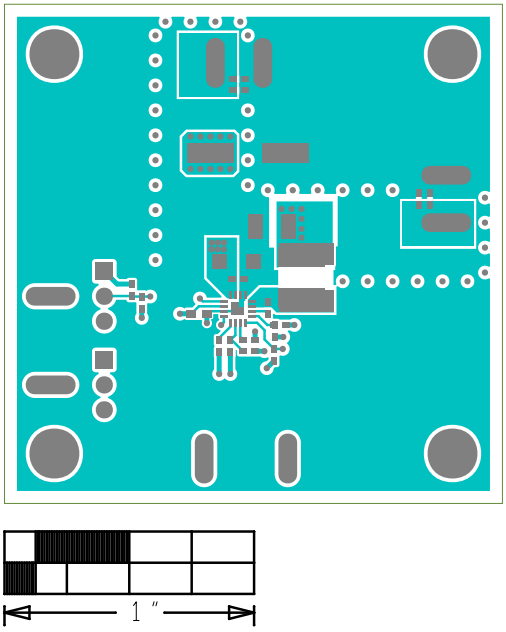
MAX17632C EV System Schematic



MAX17632C EV System PCB Layout

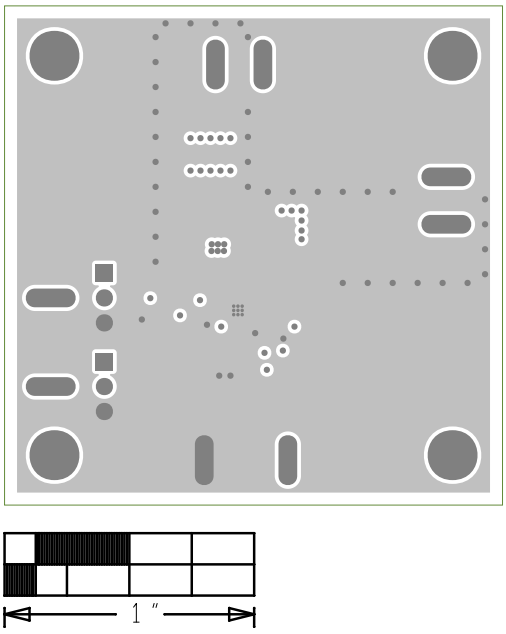


MAX17632C 5V EV Kit—Top Silkscreen

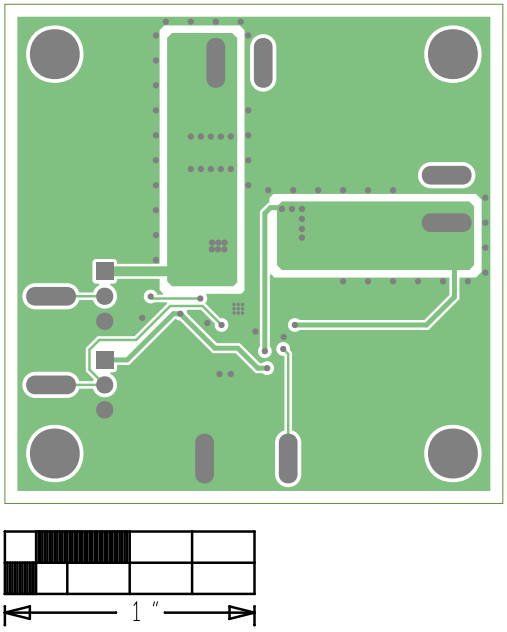


MAX17632C 5V EV Kit—Top Layer

MAX17632C EV System PCB Layout (continued)

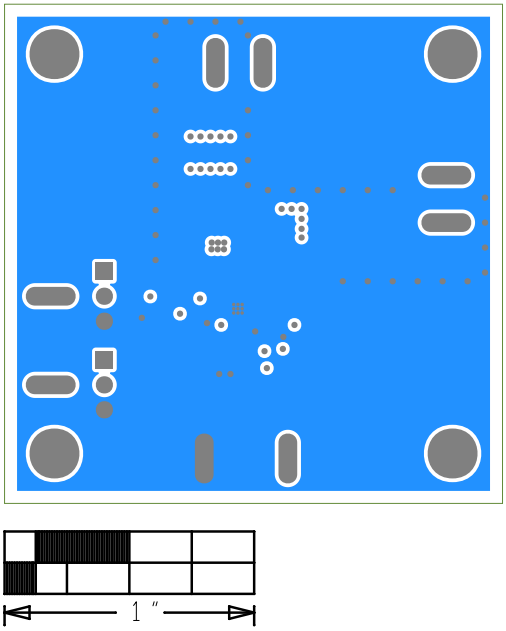


MAX17632C 5V EV Kit—Layer 2_GND



MAX17632C 5V EV Kit—Layer 3_GND

MAX17632C EV System PCB Layout (continued)



MAX17632C 5V EV Kit—Bottom Layer

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	11/17	Initial release	—
0.5		Corrected typos	2

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