Click here for production status of specific part numbers.

MAX17633AEVKIT# Evaluation Kit

Evaluates: MAX17633 3.3V Output-Voltage Application

General Description

The MAX17633AEVKIT# 3.3V output evaluation kit (EV kit) provides a proven design to evaluate the MAX17633A high-voltage, high-efficiency, synchronous step-down DC-DC converter. The EV kit is preset for 3.3V output at load currents of 3.5A and features a 500kHz switching frequency for optimum efficiency and component size. The EV kit features an adjustable input undervoltage lock-out, adjustable soft-start, open-drain $\overline{\text{RESET}}$ signal, and external frequency synchronization. EV kit specifications, settings, features and benefits are highlighted. For full MAX17633A IC features, benefits and parameters, refer to MAX17633 datasheet.

Features

- Wide 4.5V to 36V Input Range
- Programmed 3.3V Output, 3.5A Load Current
- 500kHz Switching Frequency
- EN/UVLO Input, Resistor-Programmable UVLO Threshold
- Programmed 1ms Soft-Start Time
- Selectable PWM, PFM, and DCM Modes
- Open-Drain $\overline{\text{RESET}}$ Output Pulled Up To 5V of INTVCC
- Provision for External Frequency Synchronization
- Overcurrent and Overtemperature Protection
- Proven PCB Layout
- Fully Assembled and Tested

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

Quick Start

Recommended Equipment

- One MAX17633AEVKIT# EV kit
- One 0V to 36V DC, 5A power supply
- Load capable of sinking 3.5A current
- 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 input power supply at a voltage between 4.5V and 36V. Disable the power supply.
2) Connect the positive terminal of the input power supply to the VIN PCB pad and the negative terminal to the nearest PGND pad. Connect the positive terminal of the 3.5A load to the VOUT pad and the negative terminal to the nearest PGND pad.
3) Connect a DVM across the VOUT pad and the nearest PGND pad.
4) Verify that shunts are not installed 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 input power supply.
7) Enable the load.
8) Verify that the DVM displays 3.3V.

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Detailed Description of Hardware

The MAX17633AEVKIT# is designed to demonstrate the salient features of the MAX17633A. The EV kit includes an EN/UVLO pad and jumper JU1 to enable the output at a desired input voltage. The MODE/SYNC pad allows an external clock interface to synchronize the device. Jumper JU2 allows selection of a particular mode of operation based on light-load performance requirements. An additional $\overline{\text{RESET}}$ pad is available for monitoring the status of the output voltage.

Setting the Switching Frequency

Switching frequency selection must consider input-voltage range, desired output voltage, $t_{ON(MIN)}$, and $t_{OFF(MIN)}$ of the MAX17633A and ambient temperature. To optimize converter size and efficiency of the EV kit, a switching frequency of 500kHz is chosen for 3.3V-programmed output. Resistor R5 connected between RT and SGND pins, programs the desired switching frequency. R5 resistor is kept open for a default 500kHz switching frequency. To program the switching frequency, the R5 resistor is calculated as follows:

$$R5 = \frac{21000}{f_{SW}} - 1.7$$

where R5 is in kΩ and f_{SW} is in kHz.

Soft-Start Programming

The EV kit offers an adjustable soft-start function to limit inrush current during startup. The soft-start time is adjusted by changing the value of C3, the external capacitor from the SS pin 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:

$$t_{SS} = \frac{C3}{5.55 \times 10^{-6}}$$

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

Enable/Undervoltage-Lockout (EN/UVLO) Programming

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 VIN. In order to disable the output, install a shunt across pins 2-3 on JU1, which pulls down the EN/UVLO pin to VSGND. See Table 1 for JU1 settings. Set the input voltage level (input undervoltage-lockout level) above 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:

$$R2 \geq \frac{4033.8}{(V_{INU} - 1.215)}$$

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	MAX17633A EV KIT 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*

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 the VCC 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 MAX17633 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.

Table 2. MODE/SYNC Description (JU2)

SHUNT POSITION	MODE/SYNC PIN	MAX17633A EV KIT OUTPUT
1-2	Connected to INTVCC	DCM mode of operation
2-3*	Connected to SGND	PWM mode of operation
Not Installed	Unconnected	PFM model of operation

**Default position*

External Clock Synchronization (MODE/SYNC)

The internal oscillator of the MAX17633A can be synchronized to an external clock signal through the MODE/ SYNC pin in DCM and PWM modes of operation. The synchronization to an external clock is not supported in PFM mode of operation. 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 as set by R5 resistor. The minimum external clock high pulse width should be greater than 50ns and minimum external low pulse width should be greater than 160ns. The source impedance of the external SYNC signal source should be below 25kΩ for reliable operation.

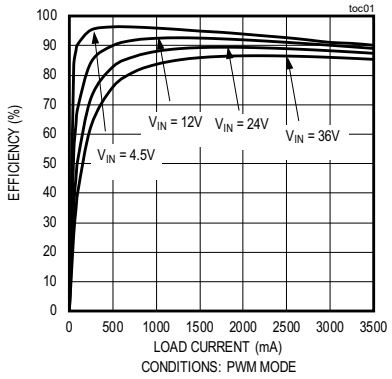
Hot Plug-In and Long Input Cables

The MAX17633AEVKIT# PCB layout provides an optional electrolytic capacitor (C6, 10µF/50V). This capacitor limits the peak voltage at the input of the MAX17633A 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 power module input.

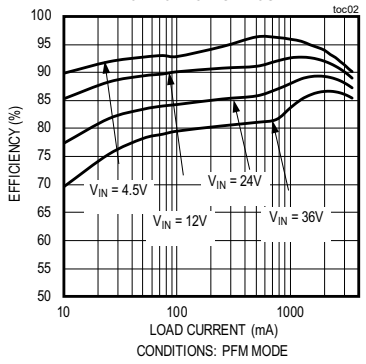
MAX17633A EV Kit Performance Report

(V_{IN} = 24V, L = 5.6µH (XAL5050-562ME), f_{SW} = 500kHz, unless otherwise noted.)

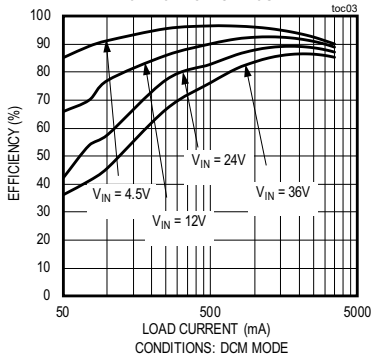
EFFICIENCY vs. LOAD CURRENT



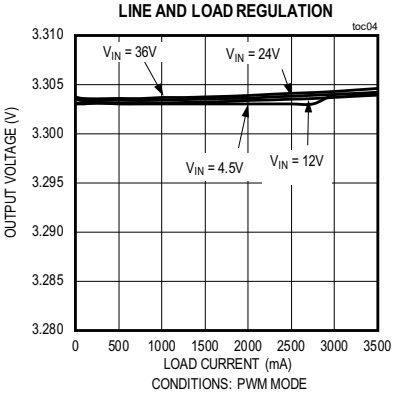
EFFICIENCY vs. LOAD CURRENT



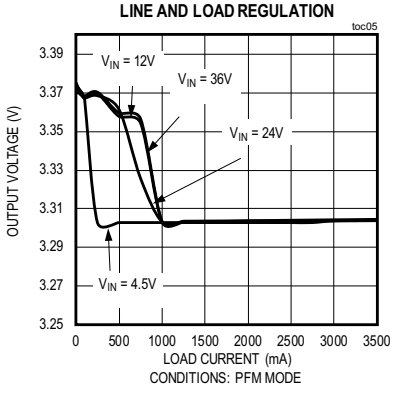
EFFICIENCY vs. LOAD CURRENT



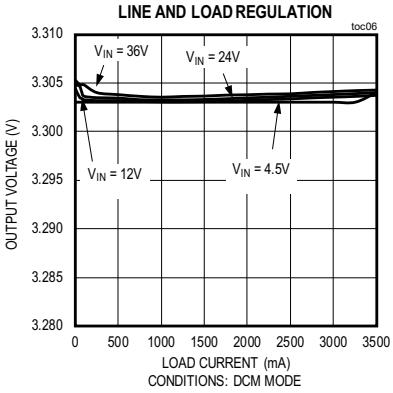
LINE AND LOAD REGULATION



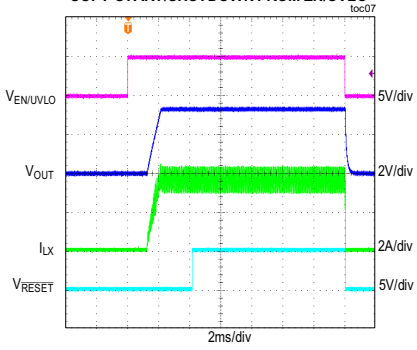
LINE AND LOAD REGULATION



LINE AND LOAD REGULATION

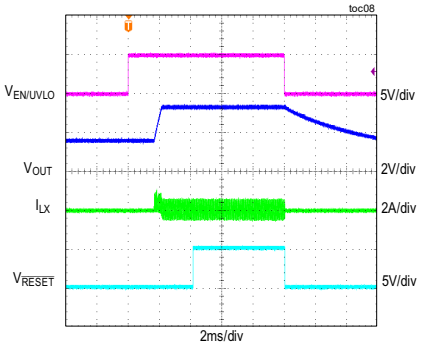


SOFT-START/SHUTDOWN FROM EN/UVLO



CONDITIONS: PWM MODE, 3.5A LOAD CURRENT

SOFT-START WITH PRE-BIAS OF VOLTAGE 1.65V

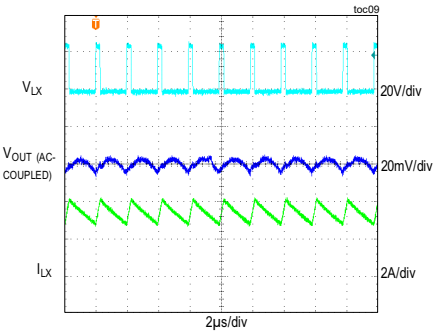


CONDITIONS: PWM MODE, 35mA LOAD CURRENT

MAX17633A EV Kit Performance Report (continued)

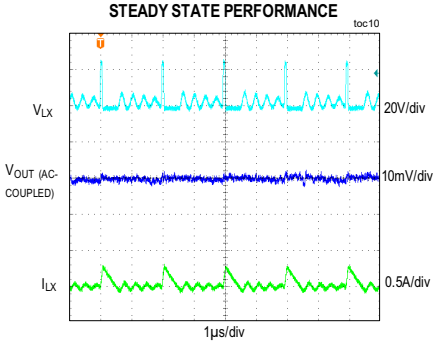
(V_{IN} = 24V, L = 5.6µH (XAL5050-562ME), f_{SW} = 500kHz, unless otherwise noted.)

STEADY STATE PERFORMANCE



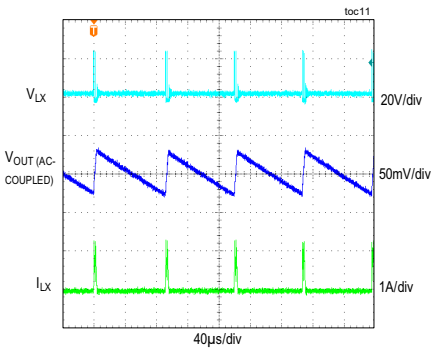
CONDITIONS: 3.5A LOAD CURRENT, PWM MODE

STEADY STATE PERFORMANCE



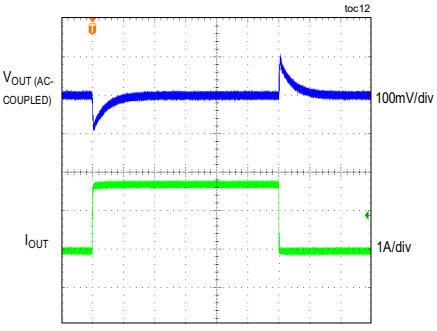
CONDITIONS: 35mA LOAD CURRENT, DCM MODE

STEADY STATE PERFORMANCE



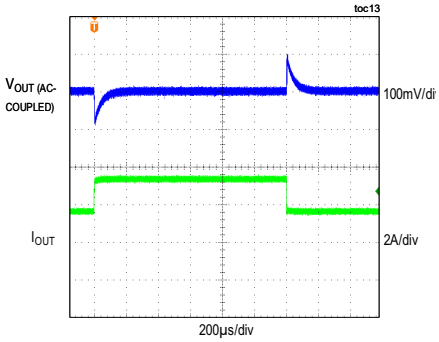
CONDITIONS: 35mA LOAD CURRENT, PFM MODE

LOAD TRANSIENT BETWEEN 0A AND 1.75A



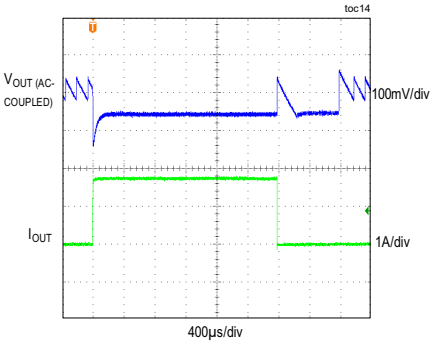
CONDITIONS: PWM MODE

LOAD TRANSIENT BETWEEN 1.75A AND 3.5A



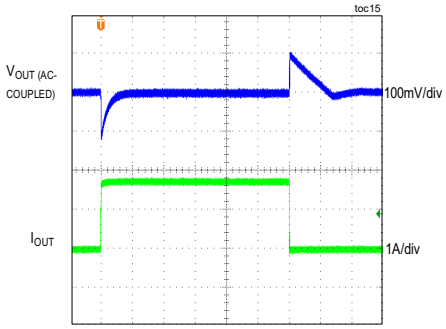
CONDITIONS: PWM MODE

LOAD TRANSIENT BETWEEN 0.035A AND 1.75A



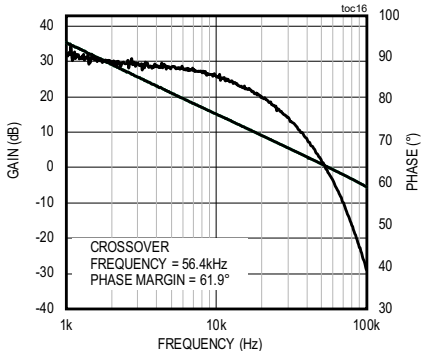
CONDITIONS: PFM MODE

LOAD TRANSIENT BETWEEN 0.035A AND 1.75A



CONDITIONS: DCM MODE

CLOSED LOOP BODE PLOT



CONDITIONS: 3.5A LOAD CURRENT, PWM MODE

Ordering Information

PART	TYPE
MAX17633AEVKIT#	EV Kit

#Denotes RoHS compliant.

Component Suppliers

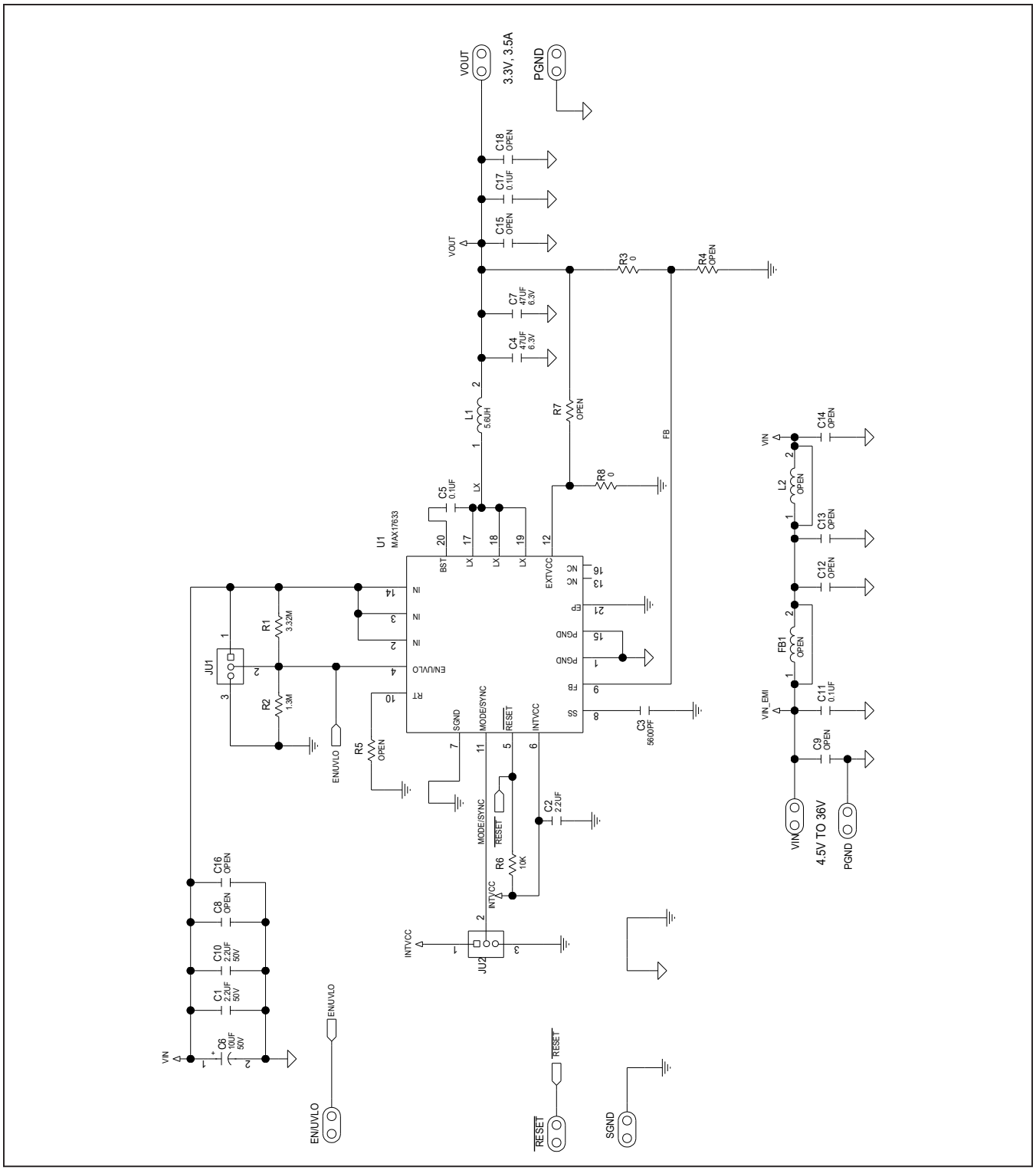
SUPPLIER	WEBSITE
Coilcraft, Inc.	www.coilcraft.com
Murata Americas	www.murata.com
Panasonic Corp.	www.panasonic.com
TDK Corp.	www.component.tdk.com
Venkel Ltd.	www.venkel.com
SullinsCorp	www.sullinscorp.com
Taiyo Yuden	www.t-yuden.com
Vishay Dale	www.vishay.com

Note: *Indicate that you are using the MAX17633A IC when contacting these component suppliers.*

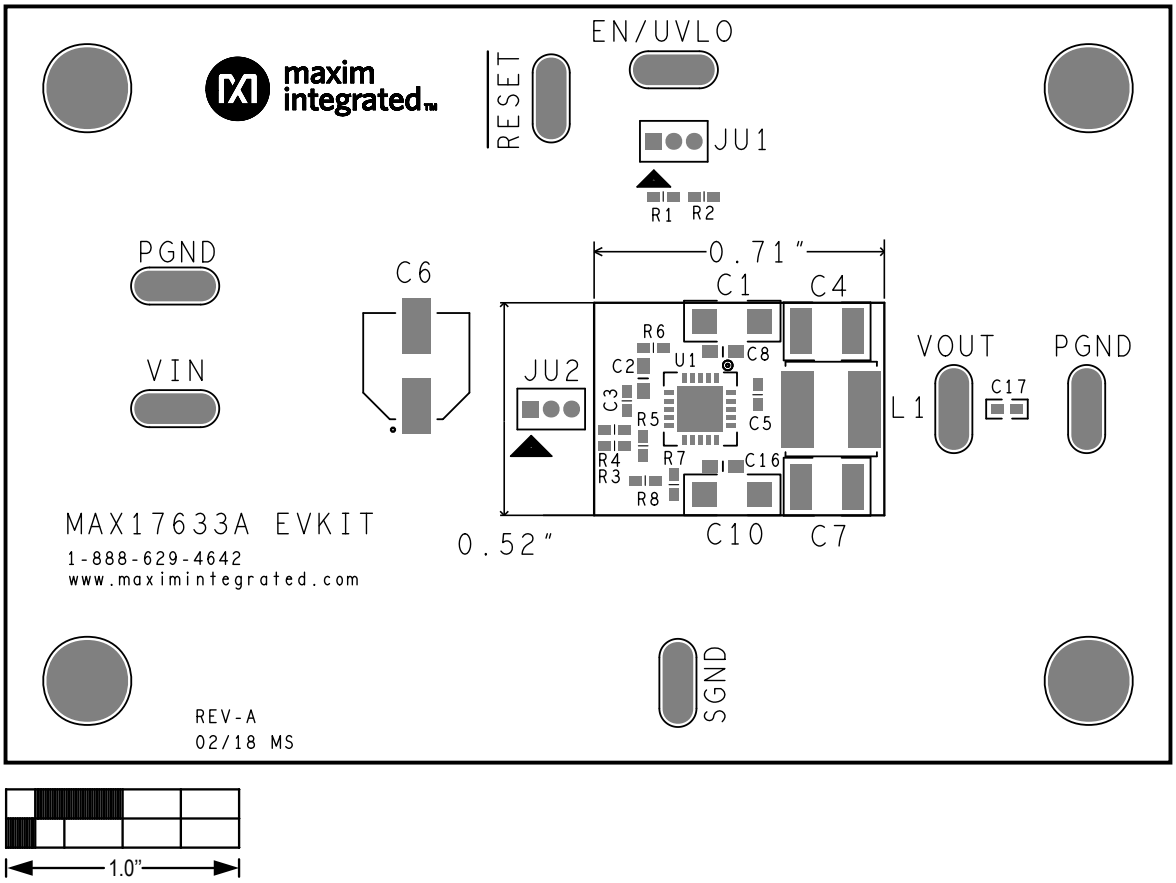
MAX17633A EV Kit Bill of Materials

S.NO	Ref Designator	Value	Description	Package	Manufacterer Part No.	Manufacterer	Qty
1	C1, C10	2.2UF	SMT Capacitor-X7R/50V	1206	GRM31CR71H225KA88	Murata	2
2	C2	2.2UF	SMT Capacitor-X7R/6.3V	0603	CGA3E1X7R0J225K080	TDK	1
3	C3	5600PF	SMT Capacitor-X7R/25V	0402	GRM155R71E562KA01	Murata	1
4	C4, C7	47UF	SMT Capacitor-X7R/6.3V	1210	GRM32ER70J476KE20	Murata	2
5	C5	0.1UF	SMT Capacitor-X7R/16V	0402	GCM155R71C104KA55	Murata	1
6	C6	10UF	SMT Aluminum-Electrolytic-X7R/50V	6.6mmx6.6mmx6.1mm	EEE-FK1H100P	Panasonic	1
7	C11	0.1UF	SMT Capacitor-X7R/100V	0603	CC0603KRX7R0BB104	Yageo	1
8	C17	0.1UF	SMT Capacitor-X7R/25V	0402	GRM155R71E104KE14	Murata	1
9	JU1,JU2	-	3-pin header	-	GRPB031VWVN-RC	SULLINS	2
10	L1	5.6UH	SMT Inductor	5.48mmx5.28mmx5.1mm	XAL5050-562ME	Coilcraft	1
11	R1	3.32M	SMT Resistor	0402	Generic	Generic	1
12	R2	1.3M	SMT Resistor	0402	Generic	Generic	1
13	R8,R3	0R	SMT Resistor	0402	Generic	Generic	2
14	R6	10K	SMT Resistor	0402	Generic	Generic	1
15	U1	4.5V-36V,3.5A	Buck Converter	20-Pin TQFN 4mmx4mm	MAX17633AATP+	MAXIM INTEGRATED	1

MAX17633A EV Kit Schematic

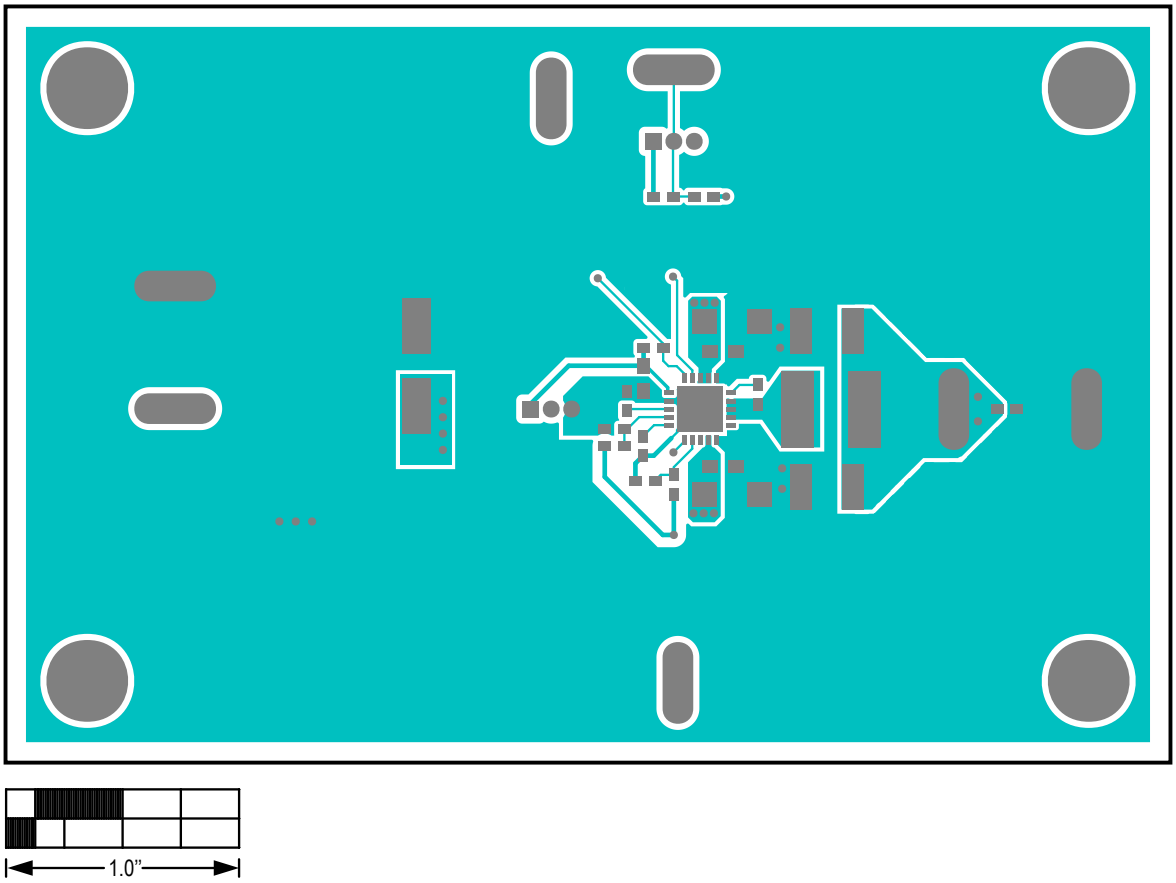


MAX17633A EV Kit PCB Layouts



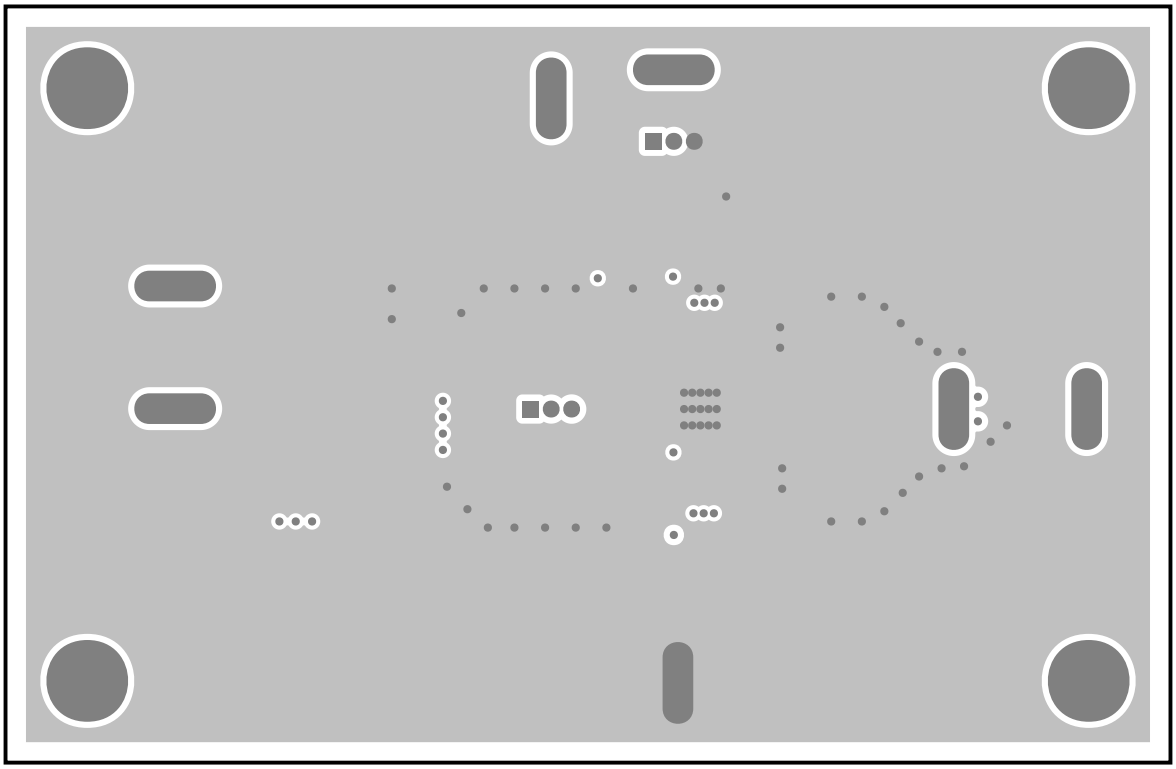
MAX17633A EV Kit — Top Silkscreen

MAX17633A EV Kit PCB Layouts (continued)



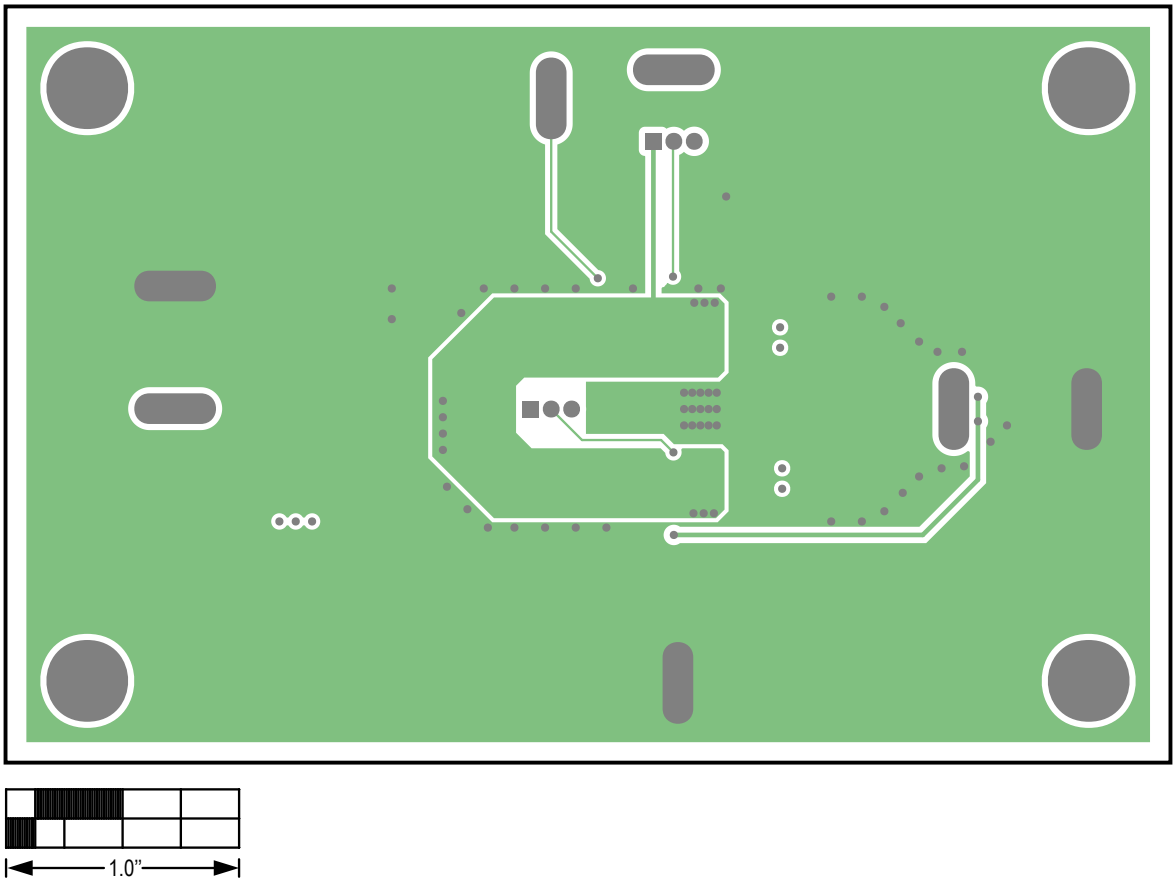
MAX17633A EV Kit — Top

MAX17633A EV Kit PCB Layouts (continued)



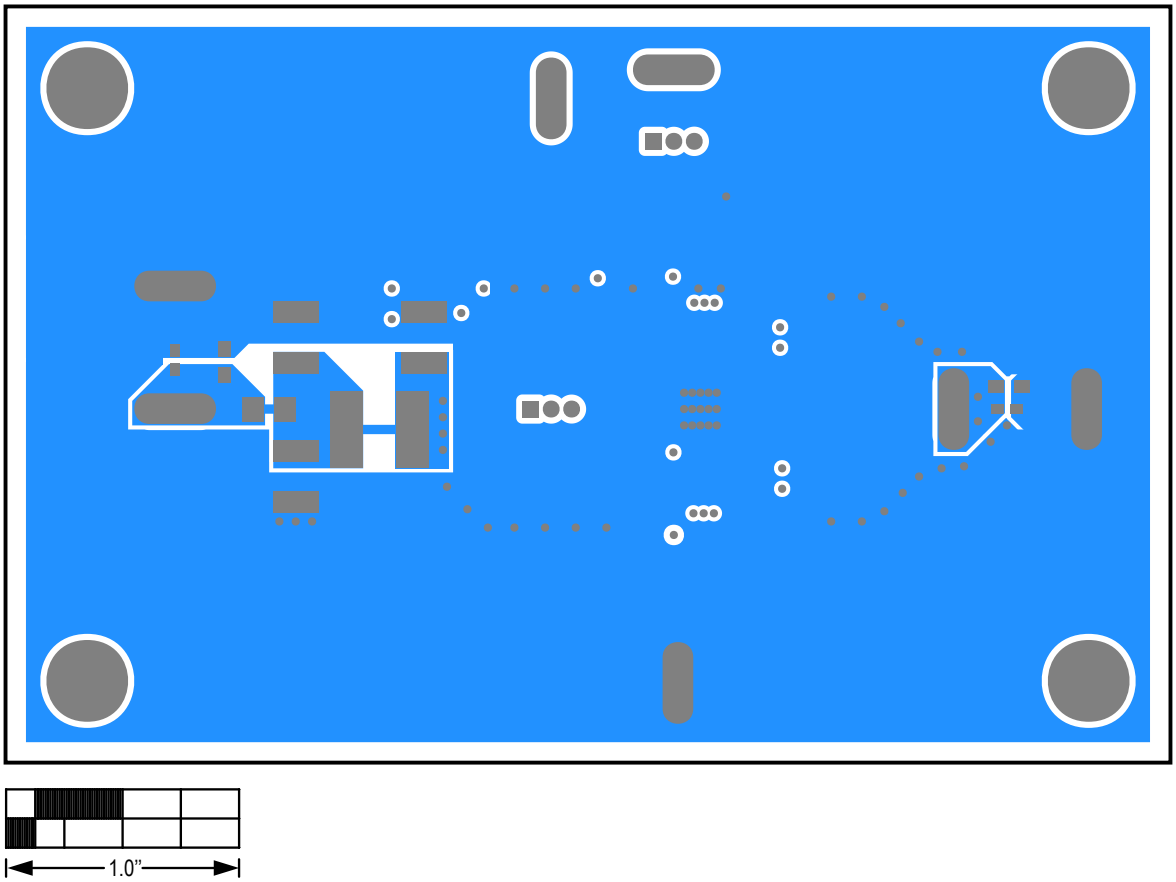
MAX17633A EV Kit — Layer2 GND

MAX17633A EV Kit PCB Layouts (continued)



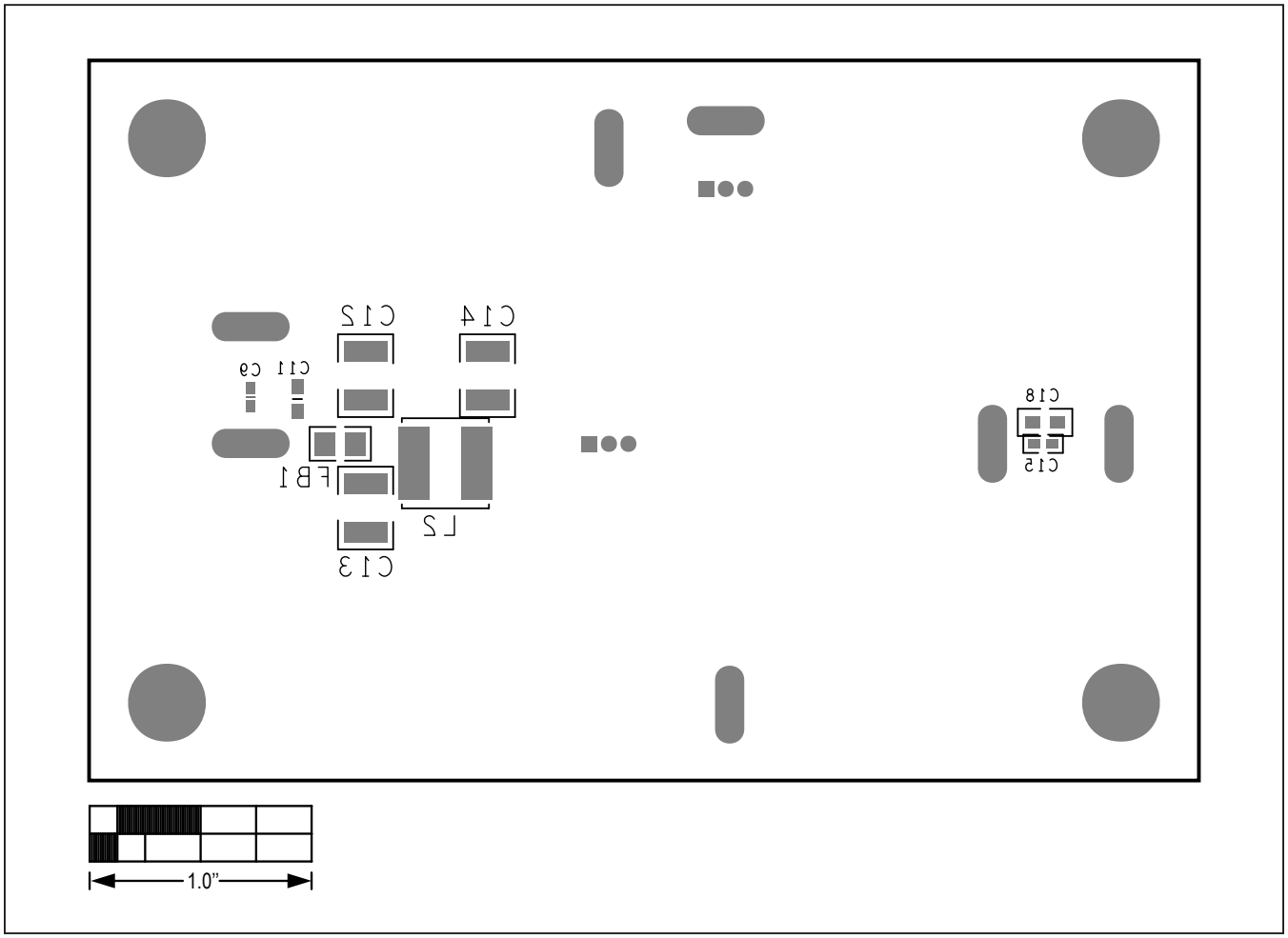
MAX17633A EV Kit — Layer3 GND

MAX17633A EV Kit PCB Layouts (continued)



MAX17633A EV Kit — Bottom

MAX17633A EV Kit PCB Layouts (continued)



MAX17633A EV Kit — Bottom Silkcreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	5/18	Initial release	—
1	8/18	Updated part number to MAX17633AEVKIT# and *Bill of Materials*.	1–14

For pricing, delivery, and ordering information, please visit Maxim Integrated's online storefront at **https://www.maximintegrated.com/en/storefront/storefront.html**.

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