Click here for production status of specific part numbers.

MAX17633CEVKIT# Evaluation Kit

Evaluates: MAX17633 5V Output-Voltage Application

General Description

The MAX17633CEVKIT# 5V output evaluation kit (EV kit) provides a proven design to evaluate the MAX17633C high-voltage, high-efficiency, synchronous step-down DC-DC converter. The EV kit is preset for 5V 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 lockout, adjustable soft-start, open-drain $\overline{\text{RESET}}$ signal, and external clock synchronization. EV kit specifications, settings, features and benefits are highlighted. 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 MAX17633 data sheet.

Features

- Wide 6.5V to 36V Input Range
- Programmed 5V 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
- Complies with CISPR22(EN55022) Class B Conducted and Radiated Emissions

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

Quick Start

Recommended Equipment

- One MAX17633CEVKIT# 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 6.5V 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 5V.

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Detailed Description of Hardware

The MAX17633CEVKIT# is designed to demonstrate the salient features of the MAX17633C. 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.

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 the value of external soft-start capacitor C3, connected between SS and 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 MAX17633 offers an Enable and adjustable input undervoltage lockout feature. In this EV kit, for normal operation, leave EN/UVLO jumper (JU1) open. When JU1 is left open, the MAX17633 is enabled when the input voltage rises above 6.4V. To disable MAX17633, install a jumper 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 JU1 is left open.

Choose R1 to be 3.32MΩ (max), and then calculate R2 as follows:

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

where, V_{INU} is the voltage at which the device is required to turn on, and R1 and R2 are in kΩ.

For more details about setting the undervoltage lockout level, refer to the MAX17633 data sheet.

Mode Selection (MODE)

The EV kit provides a jumper (JU2) that allows the MAX17633 to operate in PWM, PFM, and DCM modes. Table 2 shows the MODE SELECTION (JU2) settings that can be used to configure the desired mode of operation. Refer to the MAX17633 data sheet for more details on the modes of operation.

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

SHUNT POSITION	EN/UVLO PIN	MAX17633C 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*

Table 2. MODE Selection Jumper (JU2) Settings

SHUNT POSITION	MODE/SYNC PIN	MAX17633C 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 (SYNC)

The EV kit provides SYNC PCB pad to synchronize the MAX17633 to an optional external clock. Leave Jumper (JU3) open when external clock signals are applied. In the presence of a valid external clock for synchronization, the MAX17633 operates in PWM mode only. For more details about external clock synchronization, refer to the MAX17633 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 VOUT rises above 95% (typ) of its nominal regulated output voltage. $\overline{RESET}$ goes low when VOUT falls below 92% (typ) of its nominal regulated voltage.

Hot Plug-In and Long Input Cables

The MAX17633CEVKIT# PCB layout provides an optional electrolytic capacitor (C6, 10µF/50V). This capacitor limits the peak voltage at the input of the MAX17633C 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)

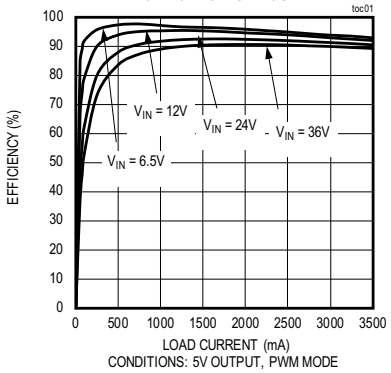
Compliance to conducted emissions (CE) standards requires an EMI filter at the input of a switching power converter. The EMI filter attenuates high-frequency currents drawn by the switching power converter, and limits the noise injected back into the input power source.

The MAX17633CEVKIT# 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 L2 before installing conducted EMI filter components. The MAX17633CEVKIT# 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.

MAX17633C EV Kit Performance Report

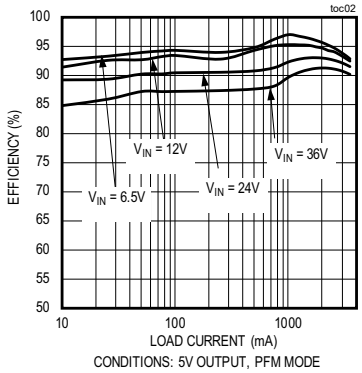
(V_{IN} = 24V, L = 6.8µH (XAL5050-682ME), f_{SW} = 500kHz, unless otherwise noted.)

EFFICIENCY vs. LOAD CURRENT



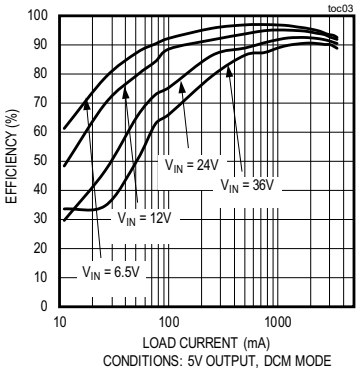
CONDITIONS: 5V OUTPUT, PWM MODE

EFFICIENCY vs. LOAD CURRENT



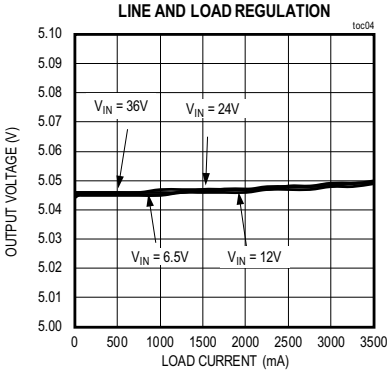
CONDITIONS: 5V OUTPUT, PFM MODE

EFFICIENCY vs. LOAD CURRENT



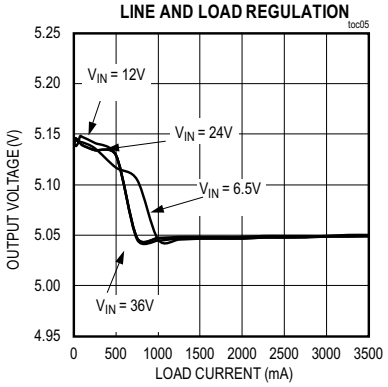
CONDITIONS: 5V OUTPUT, DCM MODE

LINE AND LOAD REGULATION



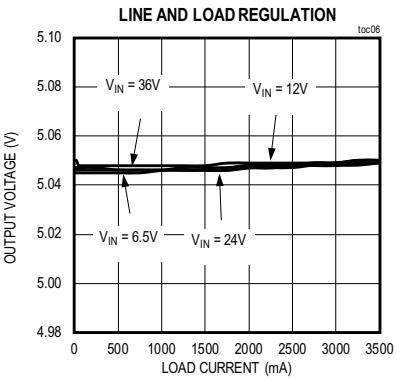
CONDITIONS: 5V OUTPUT, PWM MODE

LINE AND LOAD REGULATION



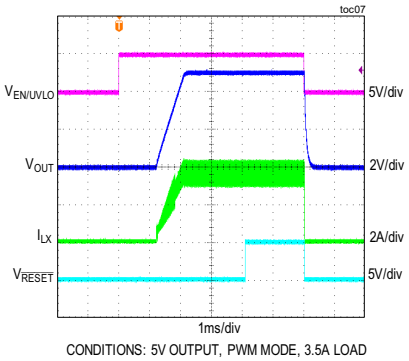
CONDITIONS: 5V OUTPUT, PWM MODE

LINE AND LOAD REGULATION



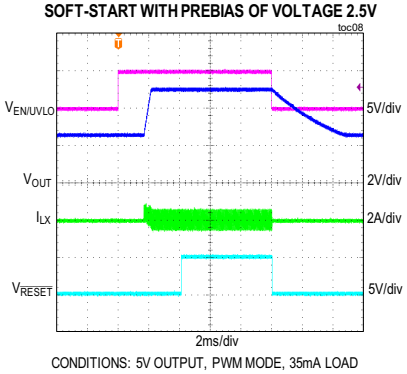
CONDITIONS: 5V OUTPUT, DCM MODE

SOFT-START/SHUTDOWN FROM EN/UVLO



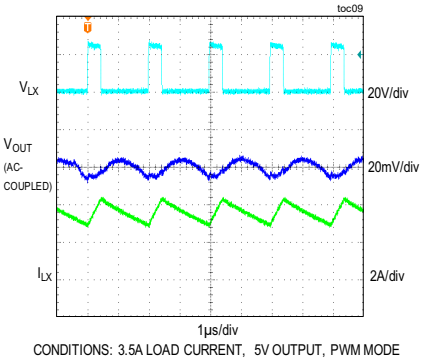
CONDITIONS: 5V OUTPUT, PWM MODE, 3.5A LOAD

SOFT-START WITH PREBIAS OF VOLTAGE 2.5V



CONDITIONS: 5V OUTPUT, PWM MODE, 35mA LOAD

STEADY-STATE PERFORMANCE

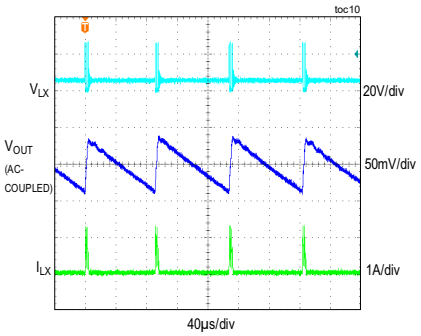


CONDITIONS: 3.5A LOAD CURRENT, 5V OUTPUT, PWM MODE

MAX17633C EV Kit Performance Report (continued)

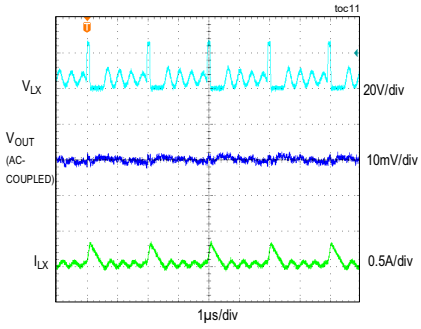
(V_{IN} = 24V, L = 6.8µH (XAL5050-682ME), f_{SW} = 500kHz, unless otherwise noted.)

STEADY-STATE PERFORMANCE



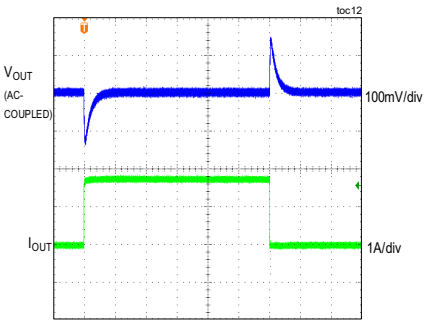
CONDITIONS: 35mA LOAD CURRENT, 5V OUTPUT, PFM MODE

STEADY-STATE PERFORMANCE



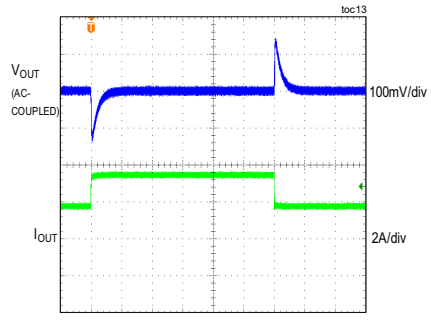
CONDITIONS: 35mA LOAD CURRENT, 5V OUTPUT, DCM MODE

LOAD TRANSIENT BETWEEN 0A AND 1.75A



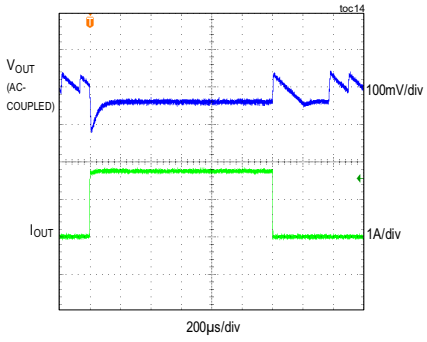
CONDITIONS: 5V OUTPUT, PWM MODE

LOAD TRANSIENT BETWEEN 1.75A AND 3.5A



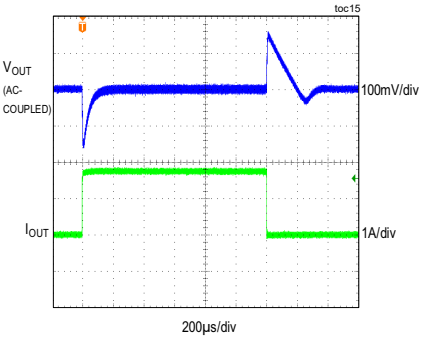
CONDITIONS: 5V OUTPUT, PWM MODE

LOAD TRANSIENT BETWEEN 0A AND 1.75A



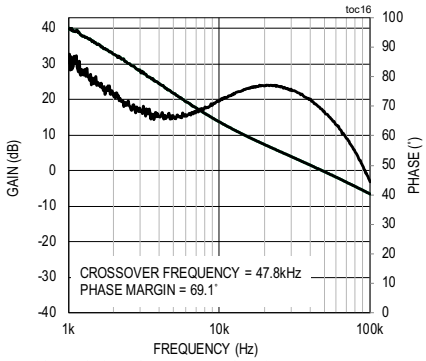
CONDITIONS: 5V OUTPUT, PFM MODE

LOAD TRANSIENT BETWEEN 0A AND 1.75A



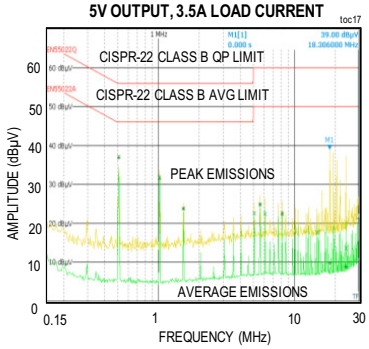
CONDITIONS: 5V OUTPUT, DCM MODE

CLOSED LOOP BODE PLOT



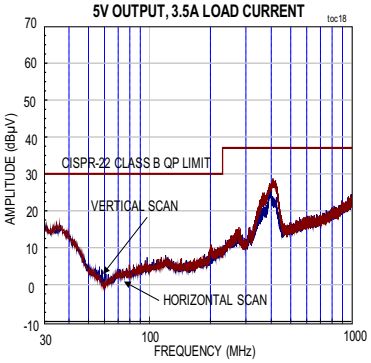
CONDITIONS: 5V OUTPUT, 3.5A LOAD CURRENT, PWM MODE

CONDUCTED EMI CURVE
5V OUTPUT, 3.5A LOAD CURRENT



L2 = 15µH, C12 = 1µF/1206/100V/X7R, C13 = 4.7µF/1206/50V/X7R, C14 = 10µF/50V/X7R/1210

RADIATED EMI CURVE
5V OUTPUT, 3.5A LOAD CURRENT



L2 = SHORT, C12 = C13 = C14 = OPEN

Ordering Information

PART	TYPE
MAX17633CEVKIT#	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

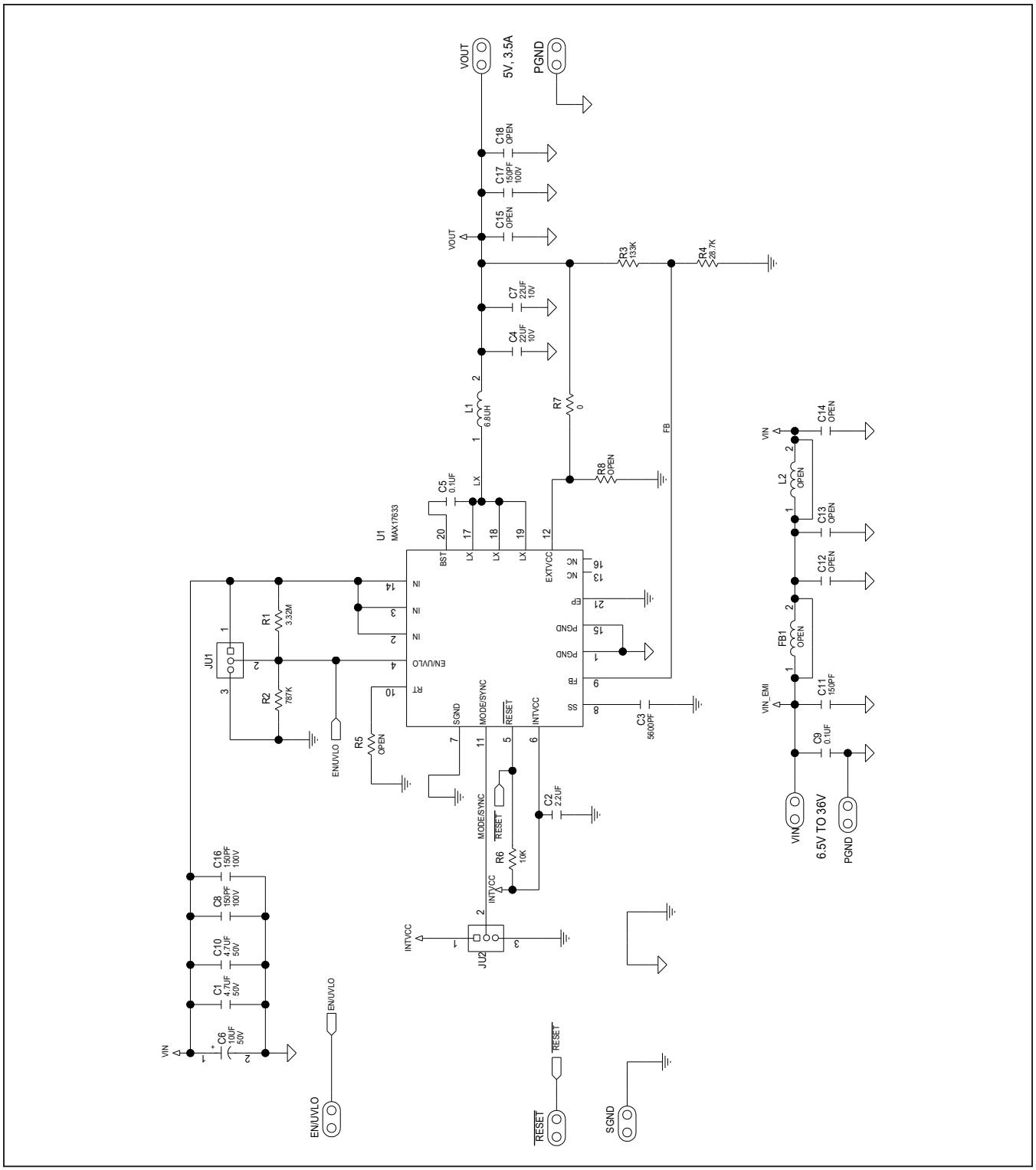
Note: *Indicate that you are using the MAX17633C IC when contacting these component suppliers.*

MAX17633C EV Kit Bill of Materials

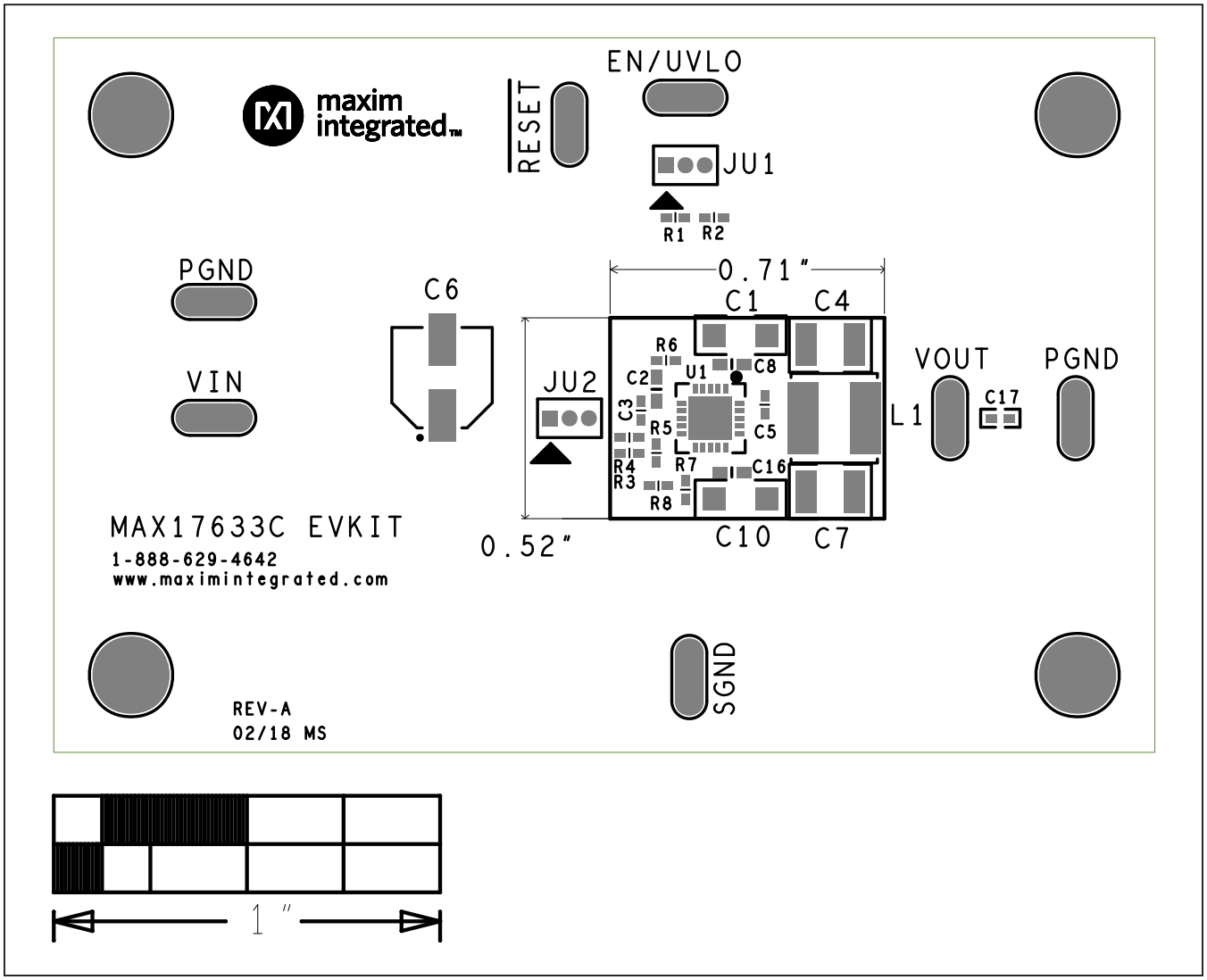
S.NO	Ref Designator	Value	Description	Package	Manufacturer Part No.	Manufacturer	Qty
1	C1, C10	4.7µF	SMT Capacitor-X7R/50V	1206	GRM31CR71H475KA12	Murata	2
2	C2	2.2µF	SMT Capacitor-X7R/6.3V	0603	CGA3E1X7R0J225K080	TDK	1
3	C3	5600PF	SMT Capacitor-X7R/25V	0402	GRM155R71E562KA01	Murata	1
4	C4, C7	22µF	SMT Capacitor-X7R/10V	1210	GRM32ER71A226K	Murata	2
5	C5	0.1µF	SMT Capacitor-X7R/16V	0402	EMK105B7104KV	Taiyo Yuden	1
6	C6	10µF	SMT Aluminum-Electrolytic-X7R/50V	6.6mmx6.6mmx6.1mm	EEE-FK1H100P	Panasonic	1
7	C8, C11, C16, C17	150pF	SMT Capacitor-X7R/50V	0402	C1005C0G2A151J050BA	TDK	4
8	C9	0.1µF	SMT Capacitor-X7R/50V	0402	C1005X7R1H104K050BE	TDK	1
9	JU1,JU2	-	3-pin header	-	GRPB031VWVN-RC	SULLINS	2
10	L1	6.8µH	SMT Inductor	5.48mmx5.28mmx5.1mm	XAL5050-682ME	Coilcraft	1
11	R1	3.32M	SMT Resistor	0402	Generic	Generic	1
12	R2	787K	SMT Resistor	0402	Generic	Generic	1
13	R3	133k	SMT Resistor	0402	Generic	Generic	1
14	R4	28.7k	SMT Resistor	0402	Generic	Generic	1
15	R6	10K	SMT Resistor	0402	Generic	Generic	1
16	R7	0R	SMT Resistor	0402	Generic	Generic	1
17	U1	4.5V-36V,3.5A	Buck Converter	20-Pin TQFN 4mmx4mm	MAX17633CATP+	MAXIM INTEGRATED	1

CONDUCTED EMI FILTER COMPONENT DETAILS (OPTIONAL)							
S.NO	Ref Designator	Value	Description	Package	Manufacturer Part No.	Manufacturer	Qty
1	L2	15µH	SMT Inductor	4mm x 4mm	XAL4040-153	Coilcraft	1
2	C12	1µF	SMT Capacitor-X7R/100V	1206	HMK316B7105KLHT	Taiyo Yuden	1
3	C13	4.7µF	SMT Capacitor-X7R/50V	1206	GRM31CR71H475KA12	Murata	1
4	C14	10µF	SMT Capacitor-X7R/50V	1210	GRM32ER71H106KA12	Murata	1

MAX17633C EV Kit Schematic

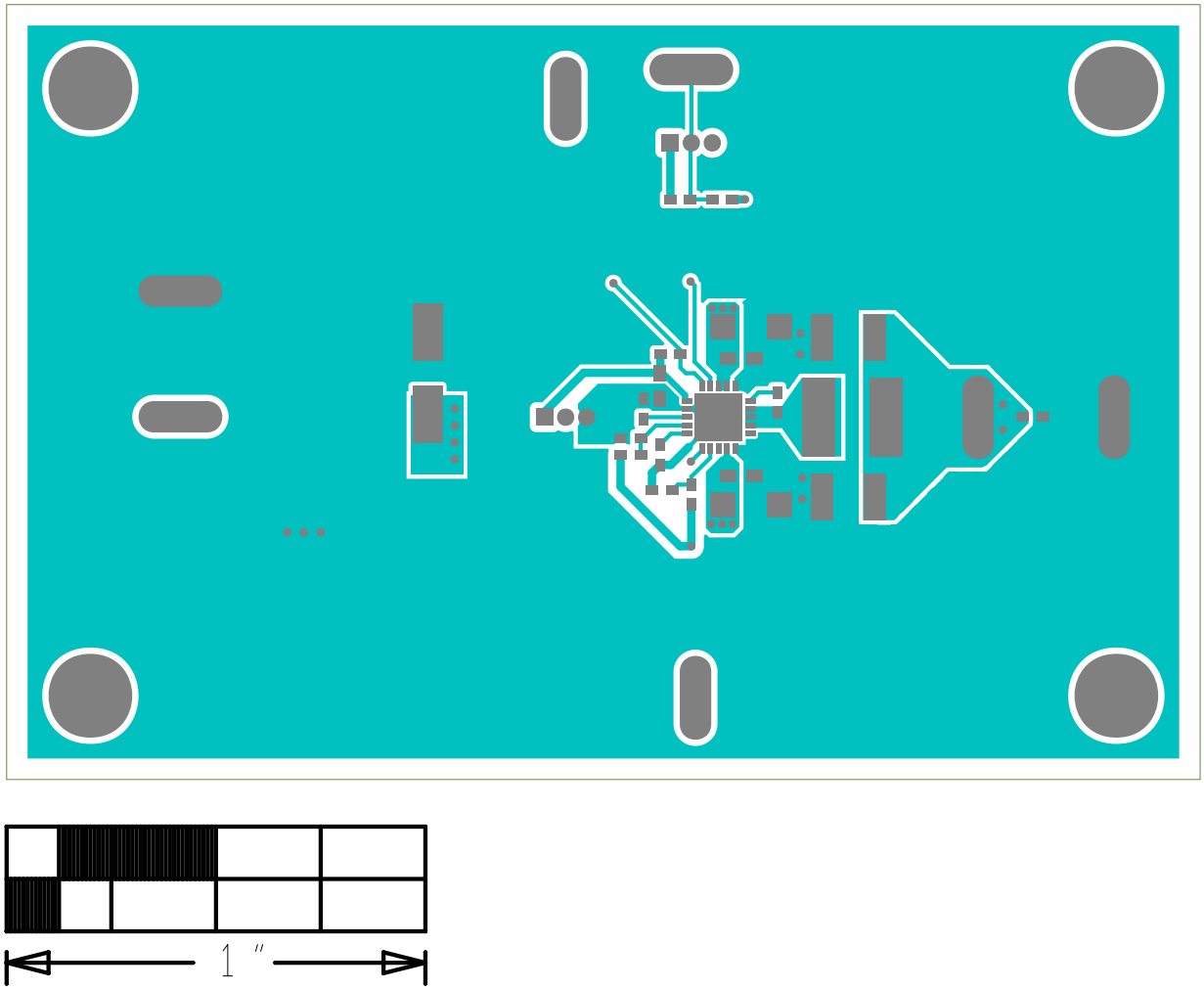


MAX17633C EV Kit PCB Layout



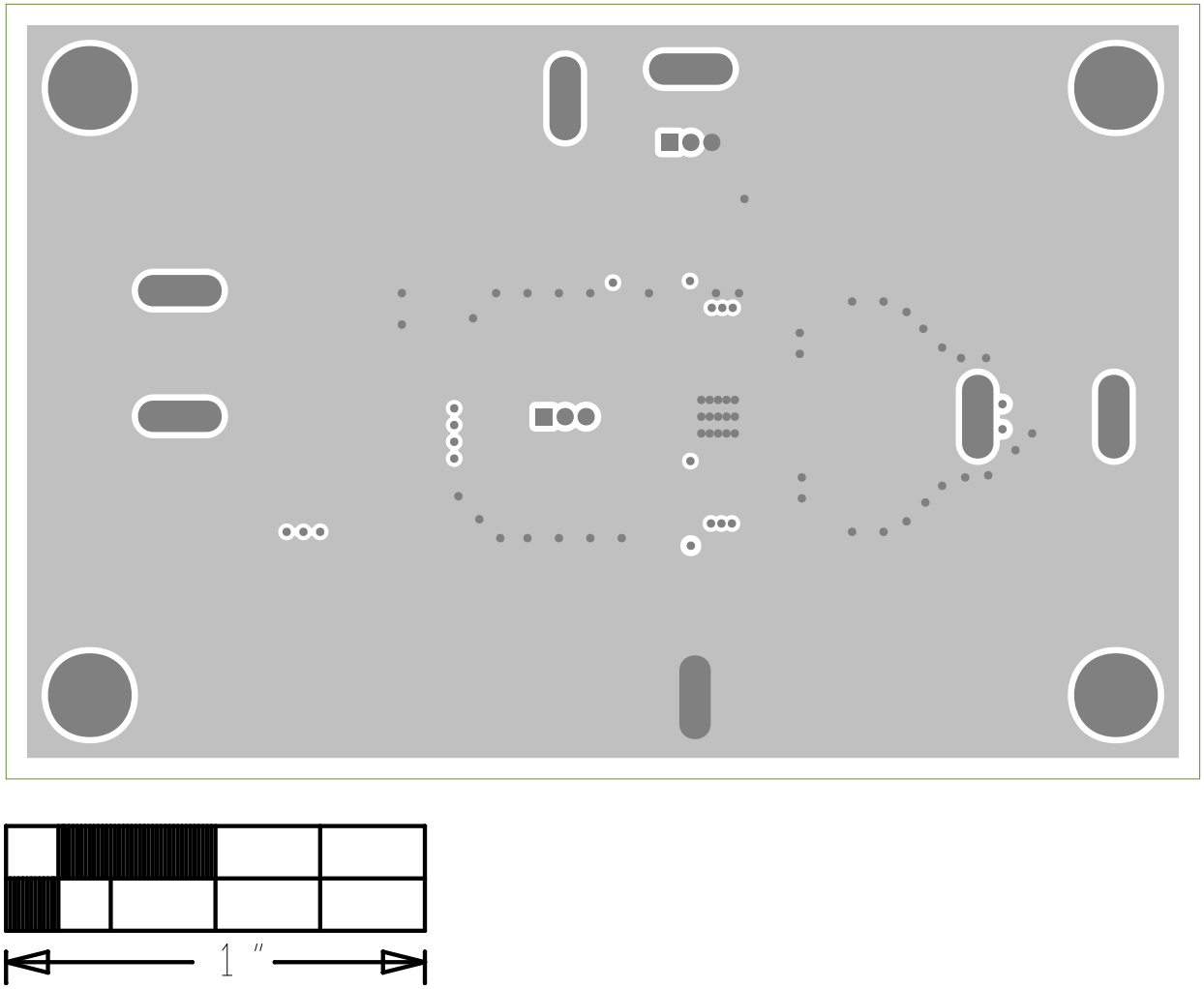
MAX17633C EV Kit — Top Silkscreen

MAX17633C EV Kit PCB Layout (continued)



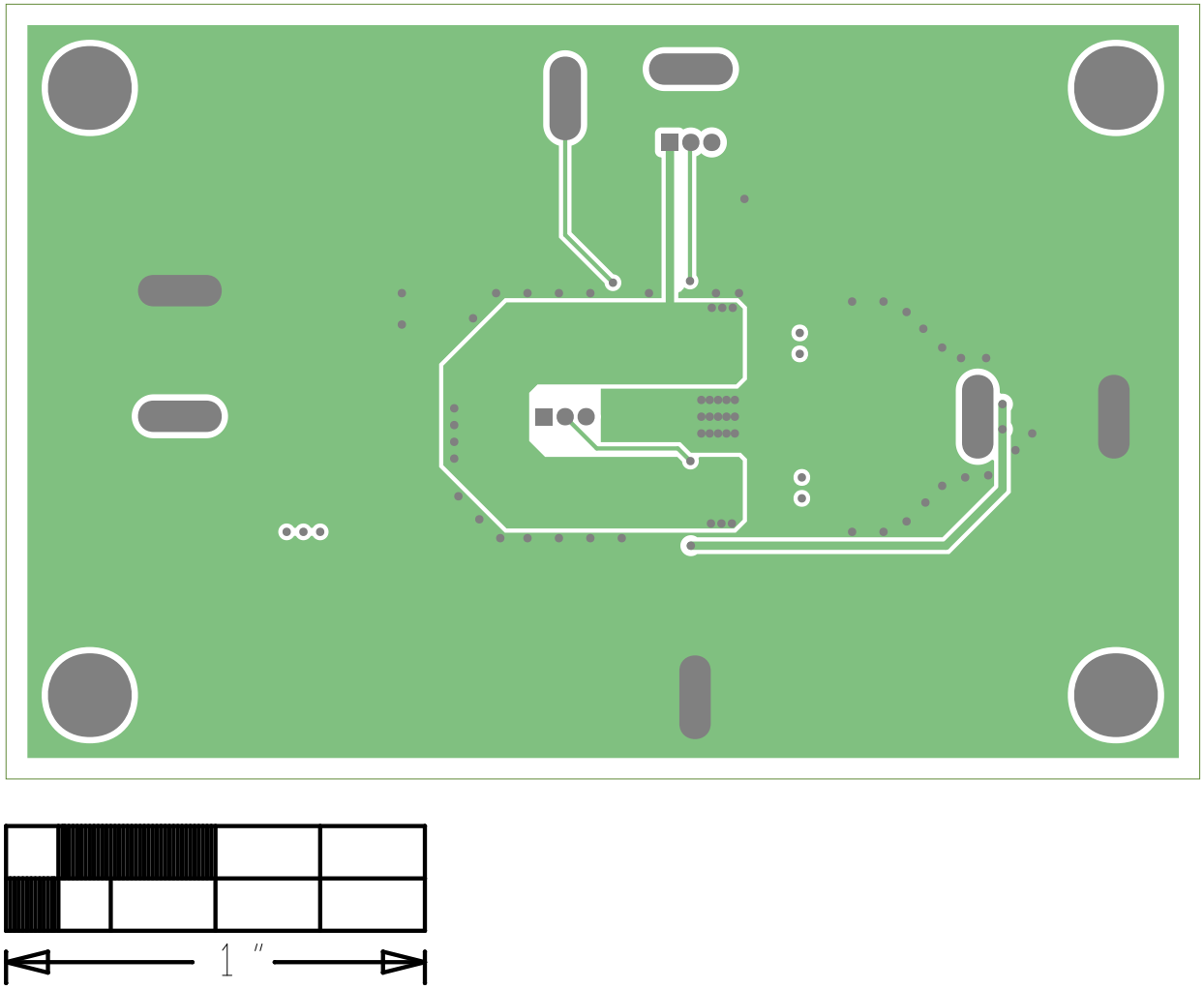
MAX17633C EV Kit — Top

MAX17633C EV Kit PCB Layout (continued)



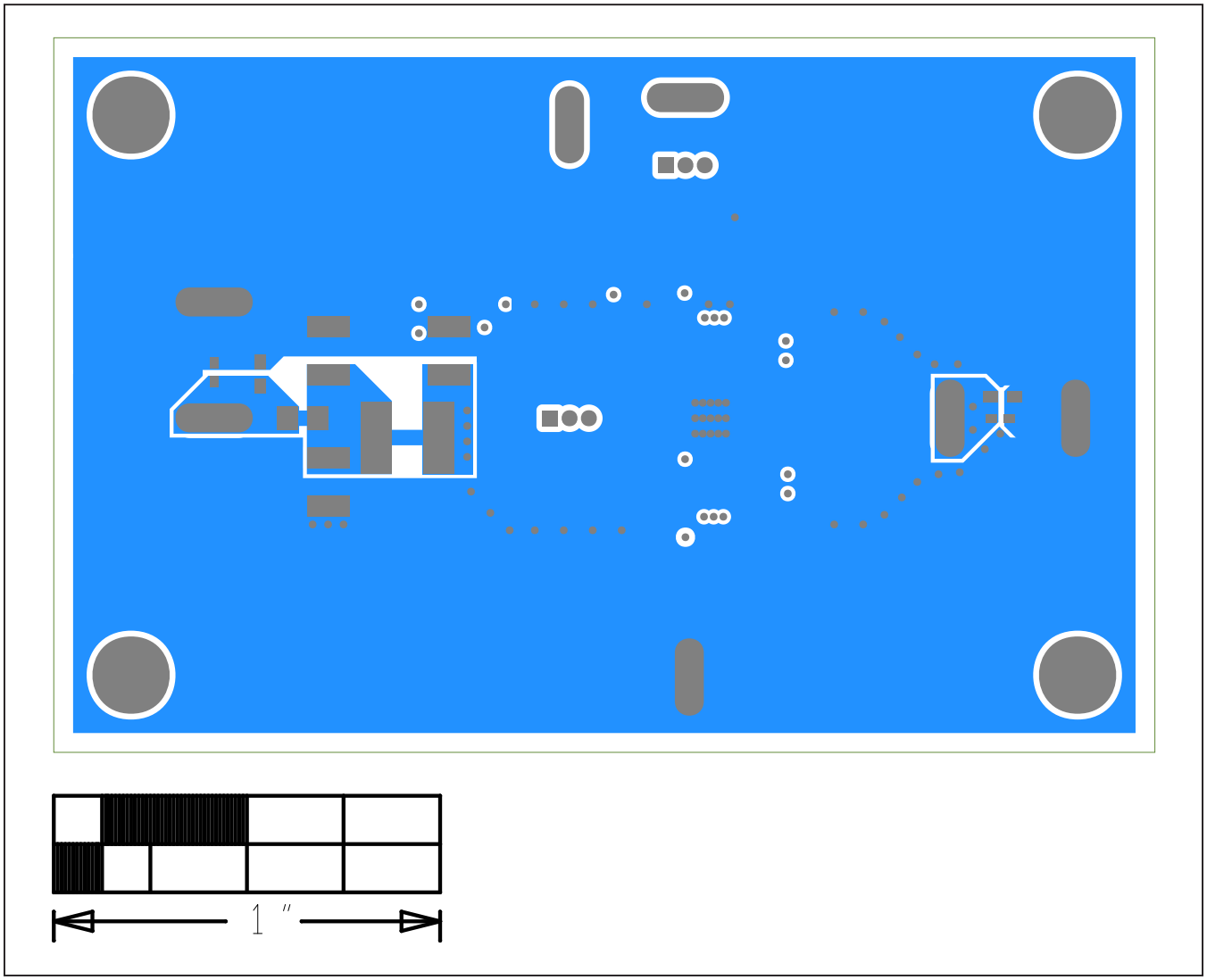
MAX17633C EV Kit — Layer2 GND

MAX17633C EV Kit PCB Layout (continued)



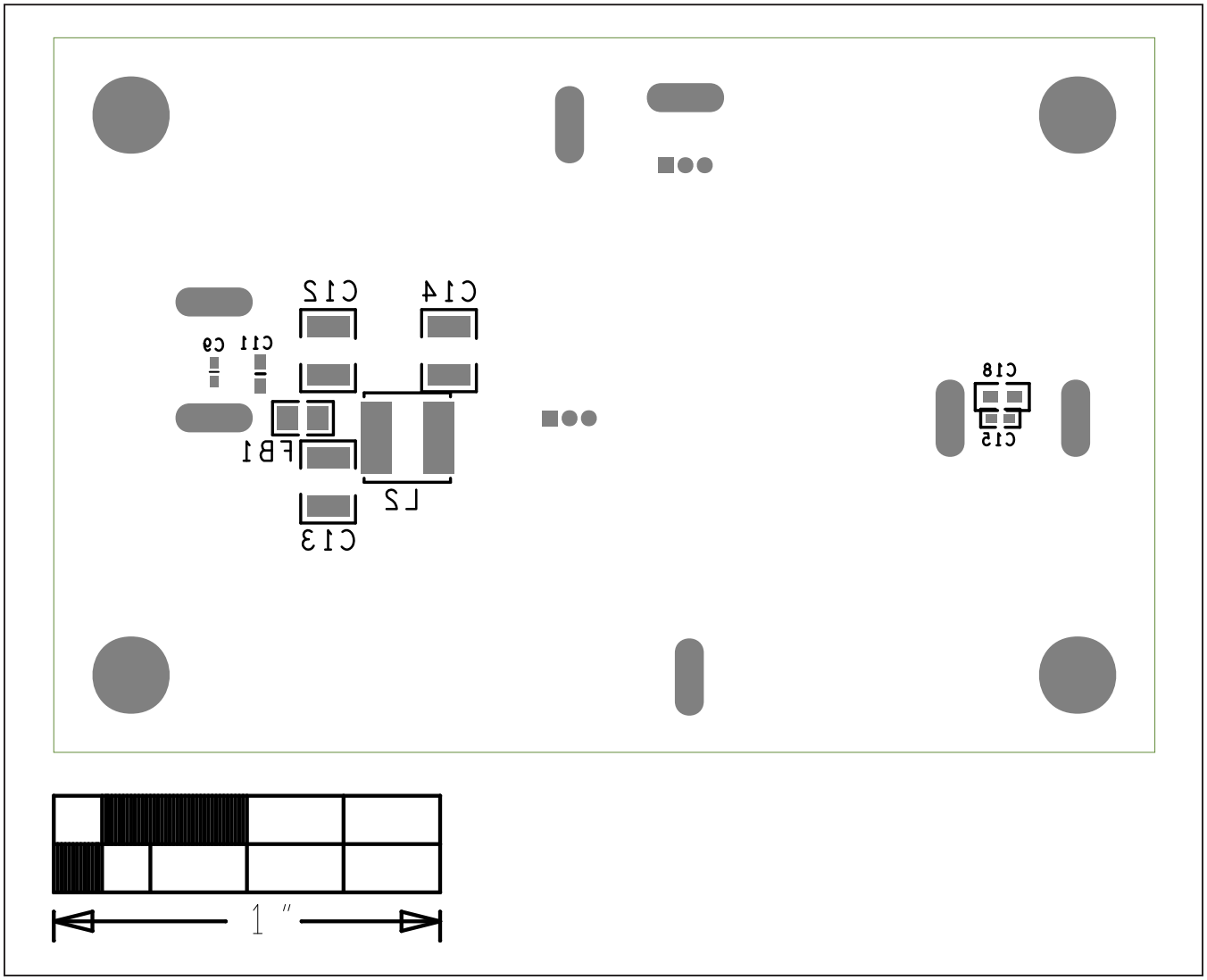
MAX17633C EV Kit — Layer3 GND

MAX17633C EV Kit PCB Layout (continued)



MAX17633C EV Kit — Bottom

MAX17633C EV Kit PCB Layout (continued)



MAX17633C EV Kit — Bottom Silkcreen