*Click here for production status of specific part numbers.*

# MAX17630C5EVKIT# Evaluation Kit

# Evaluates: MAX17630 5V Output-Voltage Application

## General Description

The MAX17630C5EVKIT# Evaluation Kit (EV kit) provides a proven design to evaluate the MAX17630C high-efficiency, synchronous step-down DC-DC converter. The EV kit provides 5V/1A 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 clock synchronization. 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 MAX17630 IC data sheet.

## Features

- Operates from a 6.5V to 36V Input Supply
- 5V Output Voltage
- Delivers Up to 1A 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
- Complies with CISPR22(EN55022) Class B Conducted and Radiated Emissions

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

## Quick Start

### Recommended Equipment

- MAX17630C5EVKIT# Evaluation Kit
- 6.5V to 36V, 1A DC-input power supply
- Load capable of sinking 1A
- Digital voltmeter (DVM)

### Equipment Setup and Test 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 1A 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.

*319-100374; Rev 0; 5/19*

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## Detailed Description of Hardware

The EV kit is designed to deliver 5V at load current up to 1A 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 EV kit offers an adjustable soft-start function to limit inrush current during the 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:

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

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

### Enable/Undervoltage-Lockout (EN/UVLO) Programming

The MAX17630 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 MAX17630 is enabled when the input voltage rises above 6.4V. To disable the MAX17630, 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:

$$R_2 = \frac{R_1 \times 1.215}{(V_{INU} - 1.215)}$$

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 MAX17630 data sheet.

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

| SHUNT POSITION | EN/UVLO PIN | MAX17630C 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 EV kit provides a jumper (JU2) that allows the MAX17630 to operate in PWM, PFM, and DCM modes. Refer to the MAX17630 data sheet for more details on the modes of operation. Table 2 shows the MODE SELECTION (JU2) settings that can be used to configure the desired mode of operation.

### External Clock Synchronization (MODE/SYNC)

The EV kit provides MODE/SYNC PCB pad, to synchronize the MAX17630 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 MAX17630 operates in PWM mode only. For more details about external clock synchronization, refer to the MAX17630 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 MAX17630C5EVKIT# PCB layout provides an optional electrolytic capacitor (C6 = 22µF/50V). This capacitor limits the peak voltage at the input of the MAX17630C 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 MAX17630C5EVKIT# 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 MAX17630C5EVKIT# 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.

## Table 2. Mode Selection Jumper (JU2) Settings

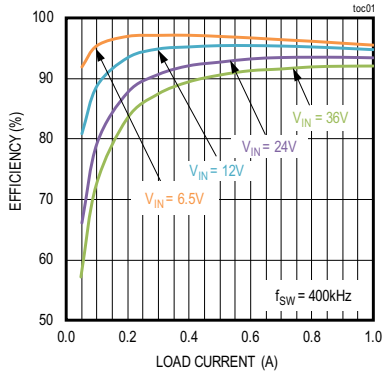
| SHUNT POSITION | MODE/SYNC PIN | MAX17630C OUTPUT |
|---|---|---|
| 1-2 | Connected to $V_{CC}$ | DCM mode of operation |
| 2-3* | Connected to SGND | PWM mode of operation |
| Not installed | OPEN | PFM mode of operation |

**Default position.*

## MAX17630C EV Kit Performance Report

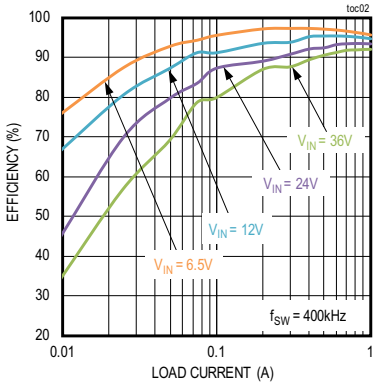
($V_{IN}$ = 24V, $V_{OUT}$ = 5V, $f_{SW}$ = 400kHz, unless otherwise noted.)

EFFICIENCY vs. LOAD CURRENT



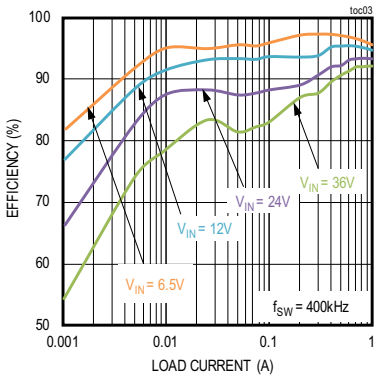

CONDITIONS: PWM MODE

EFFICIENCY vs. LOAD CURRENT



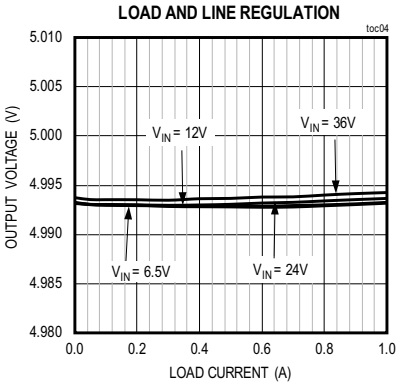

CONDITIONS: DCM MODE

EFFICIENCY vs. LOAD CURRENT



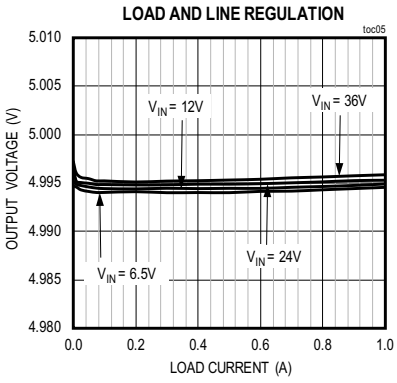

CONDITIONS: PFM MODE

LOAD AND LINE REGULATION



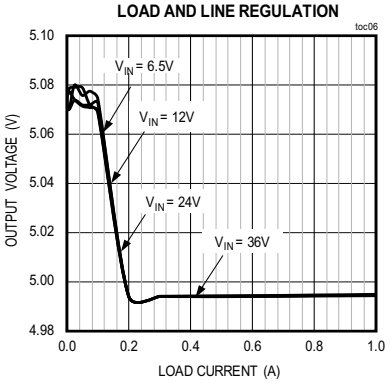

CONDITIONS: PWM MODE

LOAD AND LINE REGULATION



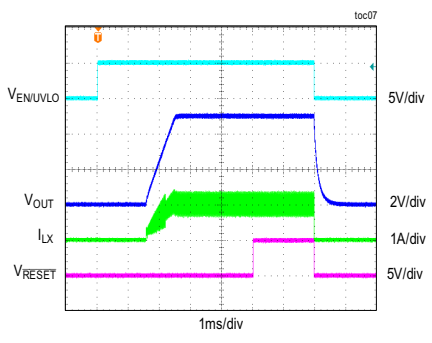

CONDITIONS: DCM MODE

LOAD AND LINE REGULATION



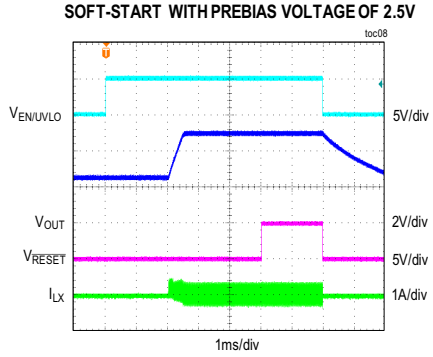

CONDITIONS: PFM MODE

SOFT-START/SHUTDOWN THROUGH EN/UVLO



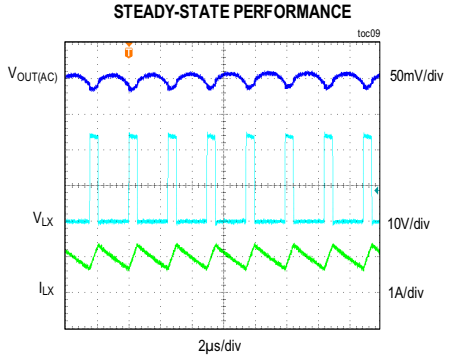

CONDITIONS: PWM MODE, 1A LOAD

SOFT-START WITH PREBIAS VOLTAGE OF 2.5V




CONDITIONS: PWM MODE, 20mA LOAD

STEADY-STATE PERFORMANCE

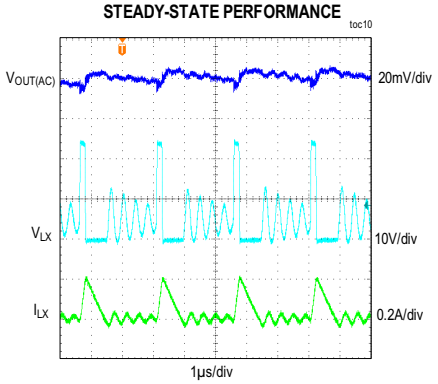



CONDITIONS: PWM MODE, 1A LOAD

## MAX17630C EV Kit Performance Report (continued)

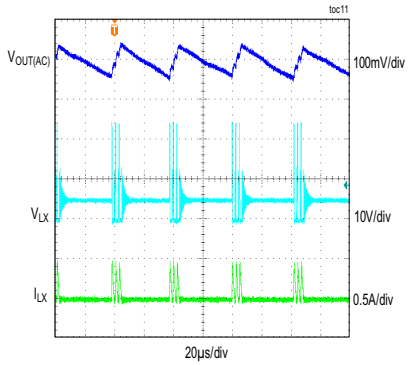
($V_{IN}$ = 24V, $V_{OUT}$ = 5V, $f_{SW}$ = 400kHz, unless otherwise noted.)

STEADY-STATE PERFORMANCE



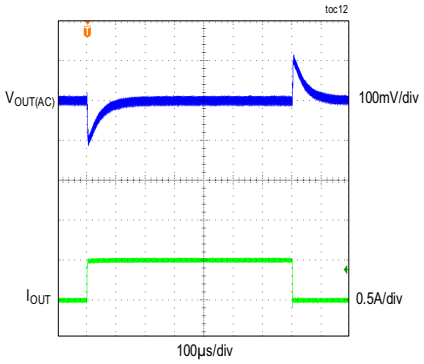

CONDITIONS: DCM MODE, 20mA LOAD

STEADY-STATE PERFORMANCE



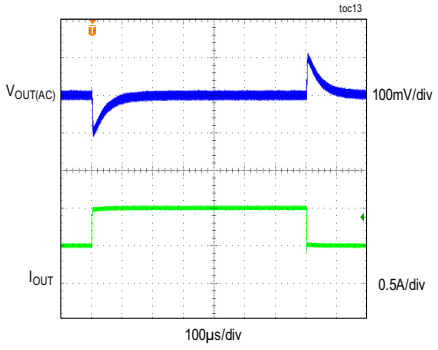

CONDITIONS: PFM MODE, 20mA LOAD

LOAD TRANSIENT RESPONSE
BETWEEN 0A AND 0.5A



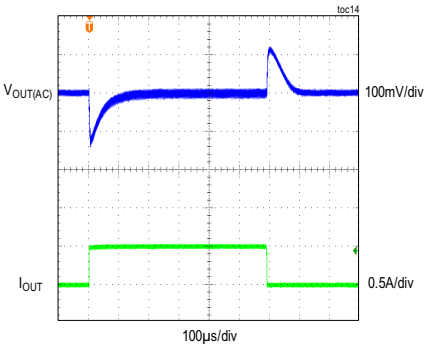

CONDITIONS: PWM MODE

LOAD TRANSIENT RESPONSE
BETWEEN 0.5A AND 1A



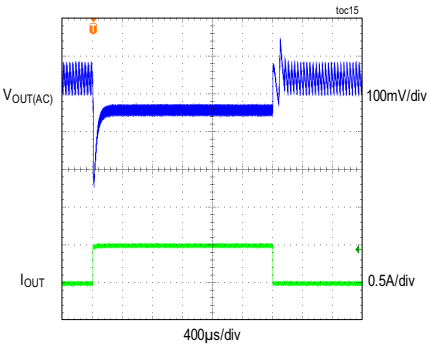

CONDITIONS: PWM MODE

LOAD TRANSIENT RESPONSE
BETWEEN 20mA AND 0.5A



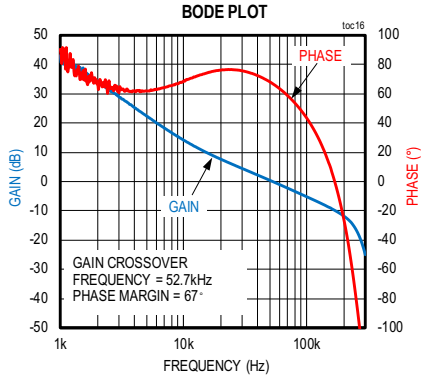

CONDITIONS: DCM MODE

LOAD TRANSIENT RESPONSE
BETWEEN 20mA AND 0.5A



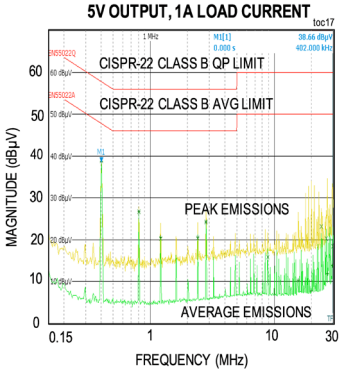

CONDITIONS: PFM MODE

BODE PLOT



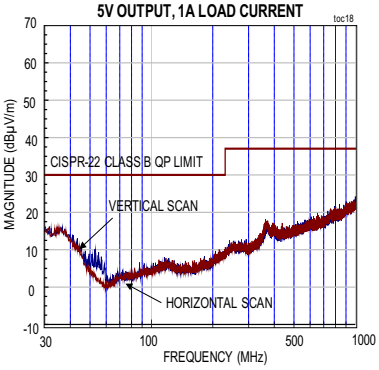

CONDITIONS: PWM MODE, 1A LOAD

CONDUCTED EMISSIONS PLOT
5V OUTPUT, 1A LOAD CURRENT




L2 = 10µH, C13 = C14 = 4.7µF/50V/X7R/1206

RADIATED EMISSIONS PLOT
5V OUTPUT, 1A LOAD CURRENT




L2 = SHORT, C13 = C14 = OPEN

## Component Suppliers

| SUPPLIER | WEBSITE |
|---|---|
| Coilcraft | www.coilcraft.com |
| Murata Americas | www.murata.com |
| Panasonic | www.panasonic.com |
| TDK Corp. | www.tdk.com |
| Taiyo Yuden | www.ty-top.com |
| SullinsCorp | www.sullinscorp.com |

***Note:*** *Indicate that you are using the MAX17630C when contacting these component suppliers.*

## Ordering Information

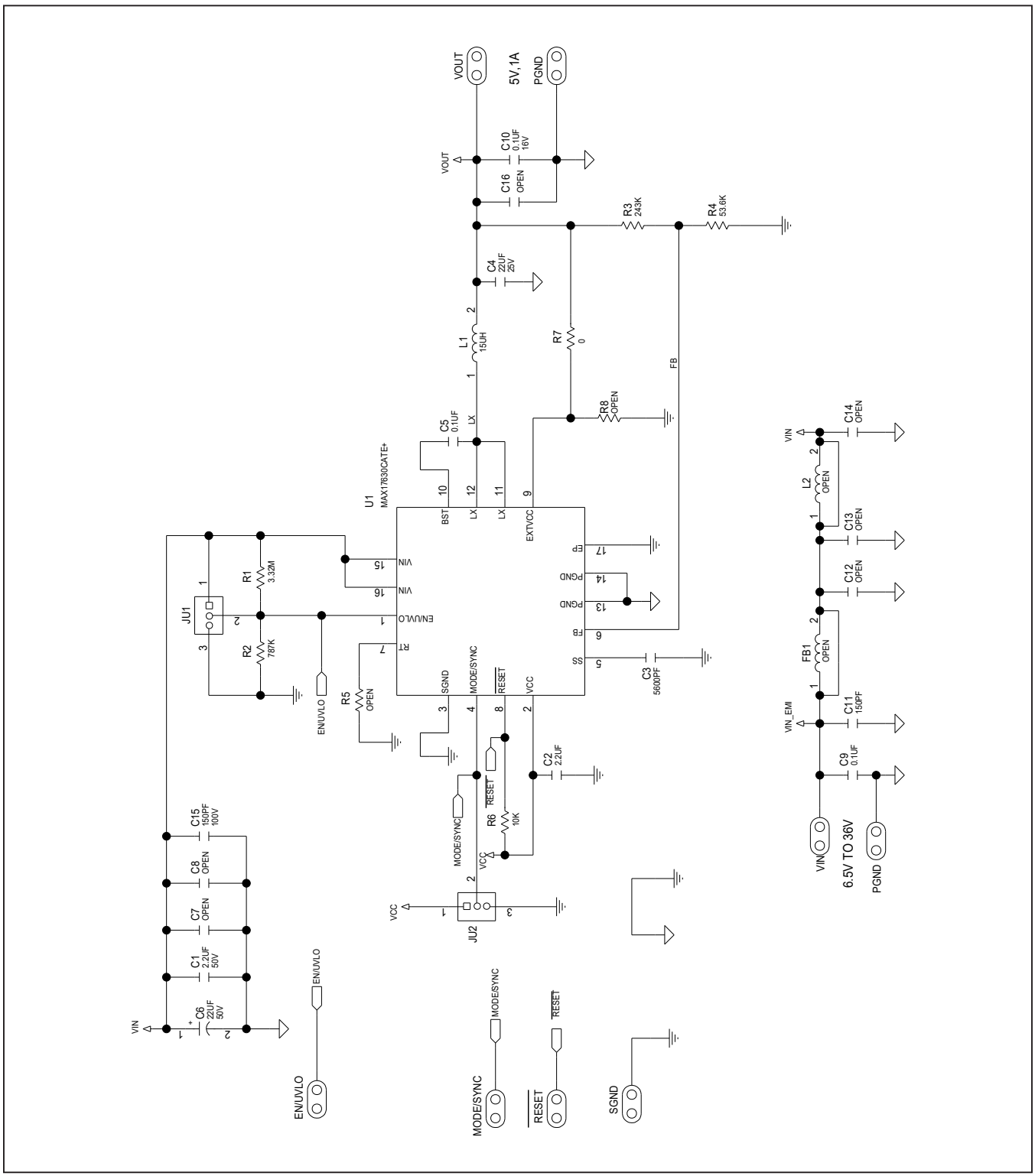
| PART | TYPE |
|---|---|
| MAX17630C5EVKIT# | EVKIT |

## MAX17630C5EVKIT# EV Kit Bill of Materials

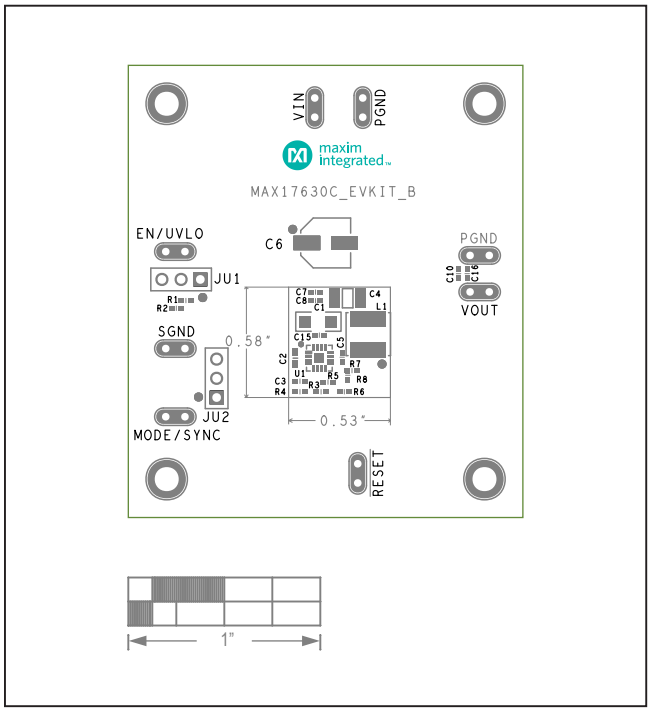
| S.No | Designator | Description | Quantity | Manufacturer Part Number |
|---|---|---|---|---|
| 1 | C1 | 2.2µF, 10%, 50V, X7R, Ceramic capacitor (1206) | 1 | TDK C3216X7R1H225K160AE |
| 2 | C2 | 2.2µF, 10%, 10V, X7R, Ceramic capacitor (0603) | 1 | MURATA GRM188R71A225KE15 |
| 3 | C3 | 5600pF, 2%, 25V, COG, Ceramic capacitor (0402) | 1 | MURATA GRM1555C1H562GE01 |
| 4 | C4 | 22µF, 20%, 25V, X7R, Ceramic capacitor (1210) | 1 | MURATA GRM32ER71E226ME15 |
| 5 | C5, C10 | 0.1µF, 10%, 16V, X7R, Ceramic capacitor (0402) | 2 | TAIYO YUDEN EMK105B7104KV |
| 6 | C11, C15 | 150pF, 10%, 100V, X7R, ceramic capacitor (0402) | 2 | TDK C1005C0G2A151J050BA |
| 7 | C9 | 0.1µF, 10%, 50V, X7R, Ceramic capacitor (0402) | 1 | TDK C1005X7R1H104K050BE |
| 8 | C6 | ALUMINUM-ELECTROLYTIC; 22UF; 50V; TOL = 20%; MODEL = FK SERIES | 1 | PANASONIC EEE-TG1H220P |
| 9 | L1 | INDUCTOR, 15µH; 20%; 3.9A (5mm x 5mm) | 1 | COILCRAFT XAL5050-153ME |
| 10 | R1 | RESISTOR, 3.32MΩ, 1% (0402) | 1 | VISHAY DALE CRCW04023M32FK |
| 11 | R2 | RESISTOR, 787kΩ, 1% (0402) | 1 | VISHAY DALE CRCW0402787KFK |
| 12 | R3 | RESISTOR, 243kΩ, 1% (0402) | 1 | PANASONIC ERJ-2RKF2433 |
| 13 | R4 | RESISTOR, 53.6kΩ, 1% (0402) | 1 | VISHAY DALE CRCW040253K6FK |
| 14 | R6 | RESISTOR, 10KΩ, 1% (0402) | 1 | VISHAY DALE CRCW040210K0FK |
| 15 | R7 | RESISTOR, 0Ω (0402) | 2 | PANASONIC ERJ-2GE0R00 |
| 16 | U1 | HIGH-EFFICIENCY; SYNCHRONOUS STEP-DOWN DC-DC CONVERTER (TQFN16-EP 3mm x 3mm) | 1 | MAX17630CATE+ |
| 17 | JU1, JU2 | 3-pin header (36-pin header 0.1” centers) | 2 | SULLINS PEC03SAAN |
| 18 | - | Shunts | 2 | SULLINS STC02SYAN |
| 19 | C13, C14 | OPTIONAL: 4.7µF, 10%, 50V, X7R, Ceramic capacitor (1210) | 2 | TAIYO YUDEN UMK325B7475KMHP |
| 20 | L2 | OPTIONAL: INDUCTOR, 10µH, 2.2A (4mm x 4mm) | 1 | COILCRAFT XAL4040-103ME |
| 21 | C7, C8, C12, C16 | OPEN: Capacitor (0402) | 0 | N/A |
| 22 | R5, R8 | OPEN: Resistor ( 0402) | 0 | N/A |
| 23 | FB1 | OPEN: Ferrite Bead (0805) | 0 | N/A |

| DEFAULT JUMPER TABLE | |
|---|---|
| **JUMPER** | **SHUNT POSITION** |
| JU1 | OPEN |
| JU2 | 2 - 3 SHORT |

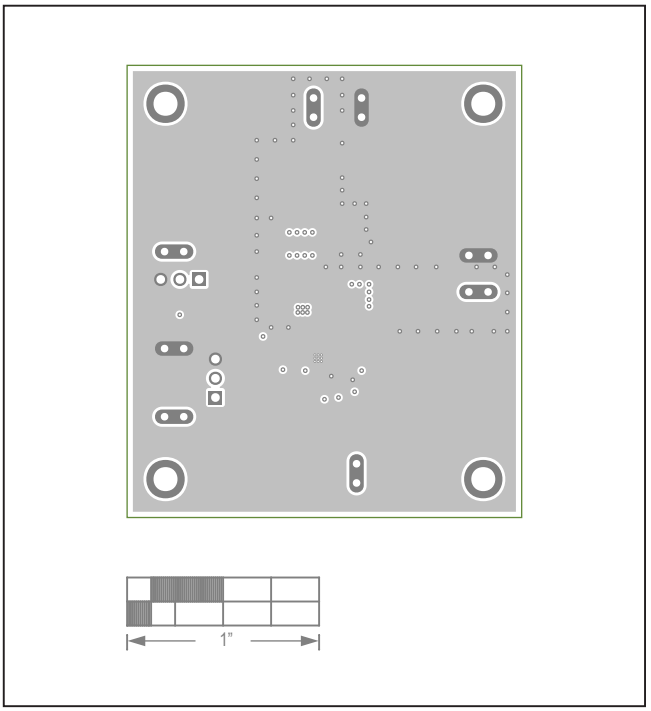
## MAX17630C5EVKIT# EV Kit Schematic



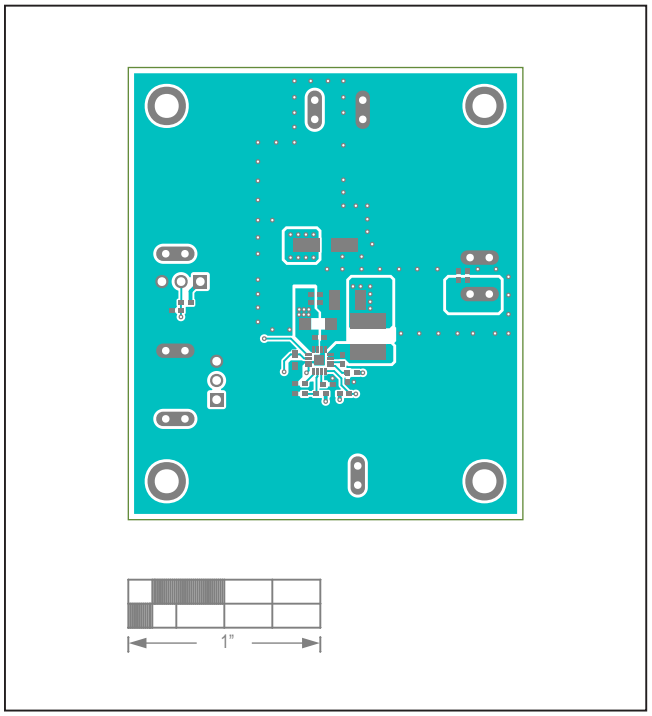
## MAX17630C5EVKIT# EV Kit PCB Layout



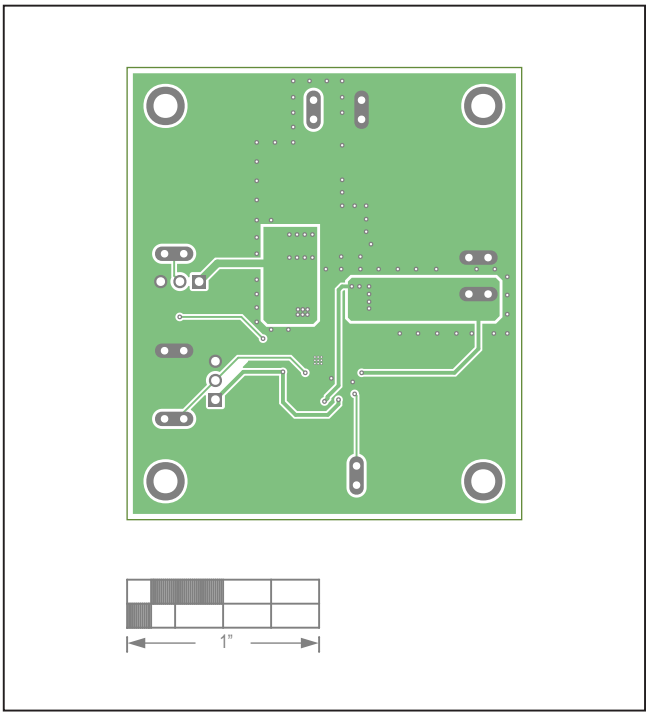

MAX17630C5EVKIT# EV Kit—Top Silkscreen




MAX17630C5EVKIT# EV Kit—Layer 2_GND

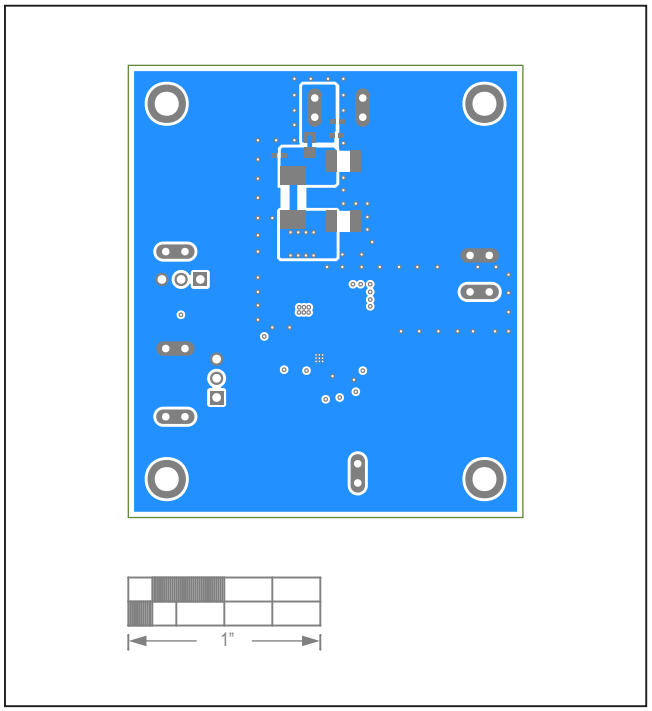



MAX17630C5EVKIT# EV Kit—Top Layer

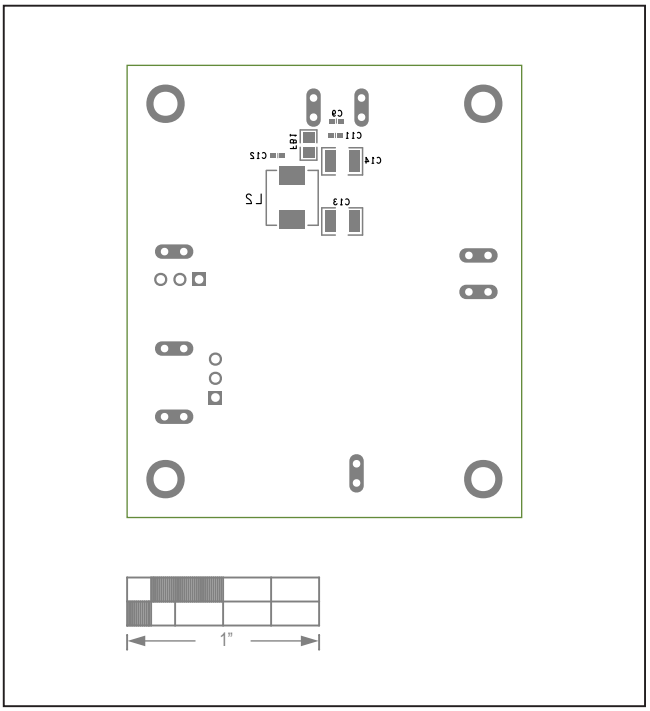



MAX17630C5EVKIT# EV Kit—Layer 3_GND

## MAX17630C5EVKIT# EV Kit PCB Layout (continued)




MAX17630C5EVKIT# EV Kit—Bottom Layer




MAX17630C5EVKIT# EV Kit—Bottom Silkscreen

## Revision History

| REVISION NUMBER | REVISION DATE | DESCRIPTION | PAGES CHANGED |
|---|---|---|---|
| 0 | 5/19 | Initial release | — |

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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