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MAXM15068 12V Output Evaluation Kit

Evaluates: MAXM15068 12V Output-Voltage Application

General Description

The MAXM15068 12V output evaluation kit (EV kit) provides a proven design to evaluate the MAXM15068 high-voltage, high-efficiency, synchronous step-down DC-DC module. The EV kit is programmed to deliver 12V output for loads up to 200mA. The EV kit features an adjustable input undervoltage lockout, selectable mode, and open-drain $\overline{RESET}$ signal. The MAXM15068 data sheet provides a complete description of the module that should be read in conjunction with this EV kit data sheet prior to modifying the demo circuit. For full module features, benefits and parameters, refer to the MAXM15068 data sheet.

Features

- Highly Integrated Solution
- Wide 15.5V to 60V Input Range
- Programmed 12V Output, Delivers Up To 200mA Output Current
- High 91.13% Efficiency (V_{IN} = 24V, V_{OUT} = 12V at 120mA)
- 550kHz Switching Frequency
- ENABLE/UVLO Input, Resistor-Programmable UVLO Threshold
- PFM Feature for Better Light-Load Efficiency
- Fixed Internal 3.75ms Soft-Start Time
- $\overline{RESET}$ Output, with Pullup Resistor to V_{CC}
- Overcurrent and Overtemperature Protection (OCP and OTP)
- Low-Profile, Surface-Mount Components
- Proven PCB Layout
- Fully Assembled and Tested
- Complies with CISPR22(EN55022) Class B Conducted and Radiated Emissions

Quick Start

Recommended Equipment

- One 15.5V to 60V DC, 200mA power supply
- 2.4W resistive load with 200mA sink capacity
- Four digital multimeters (DMM)
- MAXM15068EVKIT#

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 15.5V and 60V. 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 GND PCB pad. Connect the positive terminal of the 200mA load to the VOUT PCB pad and the negative terminal to the nearest GND PCB pad.
3) Connect the DMM in voltage-measurement mode across the VOUT PCB pad and the nearest GND PCB pad.
4) Verify that shunt is not installed on jumper J1 (see Table 1 for details).
5) Turn on the DC power supply.
6) Enable the load.
7) Verify that the DMM displays 12V.

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

319-100452; Rev 0; 10/19

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Detailed Description

The MAXM15068 EV kit is designed to demonstrate salient features of MAXM15068 power module. The EV kit includes an EN/UVLO PCB pad, and jumper J1, to enable the output at a desired input voltage. Jumper J2 allows selection of either PWM or PFM mode of operation based on light-load performance requirements. An additional $\overline{\text{RESET}}$ pad is available for monitoring if the converter output voltage is in regulation.

Output Capacitor Selection

X7R ceramic output capacitors are preferred due to their stability over temperature in industrial applications. The required output capacitor (C6) for 12V output is selected from *Table 1* of the *MAXM15068* data sheet as 4.7µF/25V.

Adjusting Output Voltage

The MAXM15068 supports an adjustable output-voltage range, from 5V to 12V, using a feedback resistive divider from V_{OUT} to FB. Output voltage can be programmed using the values given in *Table 1* of the *MAXM15068* data sheet. For 12V output, R3 is chosen as 931kΩ, and R4 is chosen as 75kΩ.

Enable/Undervoltage-Lockout (EN/UVLO) Programming

The MAXM15068 offers an adjustable input undervoltage-lockout feature. In this EV kit, for normal operation, leave jumper J1 open. When J1 is left open, the MAXM15068 is enabled when the input voltage rises above 15.5V. To disable MAXM15068, install a jumper across pins 2-3 on J1. See Table 1 for J1 settings. A potential divider formed by R1 and R2 sets the input voltage (V_{INU}) at which the module is enabled. The value of resistor R1 is chosen to be 2.2MΩ, and R2 is calculated using the following equation:

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

where R1 and R2 are in kΩ,

For MAXM15068 to turn on at 15.5V input, the Resistor R2 is calculated to be 191kΩ.

Input Capacitor Selection

The input capacitor serves to reduce the current peaks drawn from the input power supply and reduces switching frequency ripple at the input. The input capacitance must be greater than or equal to the value given in *Table 1* of *MAXM15068* data sheet. Input capacitor C3 is chosen to be 1µF/100V.

Electro-Magnetic 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.

Use of EMI filter components as shown in Figure 1 in conjunction with the schematic results in lower conducted emissions below CISPR22 Class B limits. The MAXM15068 EV kit 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. Further, capacitors (C1, C4, 0.1µF/100V) and (C7, 0.1µF/16V), help in attenuating high frequency noise.

Hot-Plug-In and Long Input Cables

The MAXM15068 EV kit PCB provides an optional electrolytic capacitor (C2, 4.7µF/100V) to dampen input voltage peaks and oscillations that can arise during hot-plug-in and/or due to long input cables. This capacitor limits the peak voltage at the input of the MAXM15068 power module, when the EV kit is powered directly from a precharged capacitive source or an industrial backplane PCB. Long input cables, between input power source and the EV kit circuit can cause input-voltage oscillations due

Table 1. UVLO Enable/Disable Configuration (J1)

POSITION	EN/UVLO PIN	MAXM15068_ OUTPUT
Not Installed*	Connected to the center node of resistor-divider R1 and R2.	Programmed to startup at desired input-voltage level.
1-2	Connected to V_{IN}	Enabled if V_{IN} is greater than $V_{IN(MIN)}$.
2-3	Connected to GND	Disabled

**Default position*

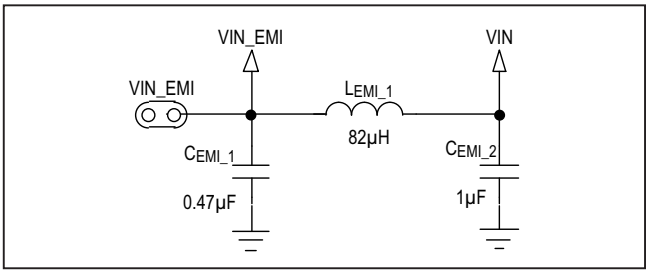


Figure 1. EMI Filter Components

to the inductance of the cables. The equivalent series resistance (ESR) of the electrolytic capacitor helps damp out the oscillations caused by long input cables.

Mode of Operation

The MAXM15068 features PFM mode of operation to increase the efficiency at light-load condition. If the MODE pin is left unconnected during powerup, the module operates in PFM mode at light loads. If the MODE pin is connected to GND during power-up, the part operates in constant-frequency PWM mode at all loads. See Table 2 for J2 settings.

Internal LDO

An internal regulator provides a 5V nominal supply to power the internal functions of the module. The output of the linear regulator (V_{CC}) should be bypassed with a 1µF capacitor C5 to GND.

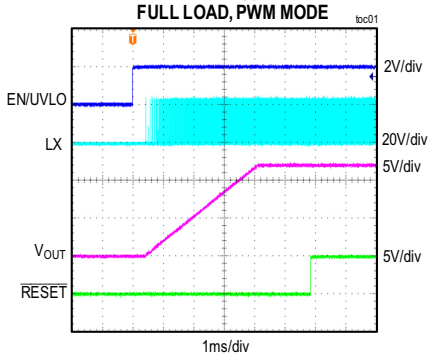
Table 2. Mode of Operation (J2)

POSITION	MODE PIN
1-2	Operates in PWM mode.
Not Installed*	Operates in PFM mode at light-load conditions.

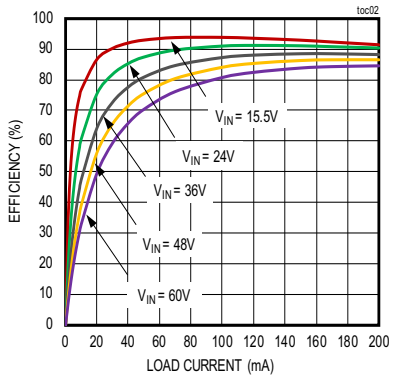
**Default position*

EV Kit Performance Report

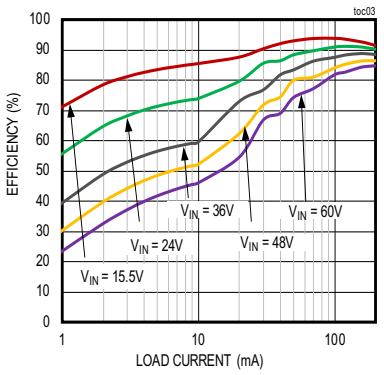
STARTUP THROUGH ENABLE
V_{IN} = 24V, V_{OUT} = 12V
FULL LOAD, PWM MODE



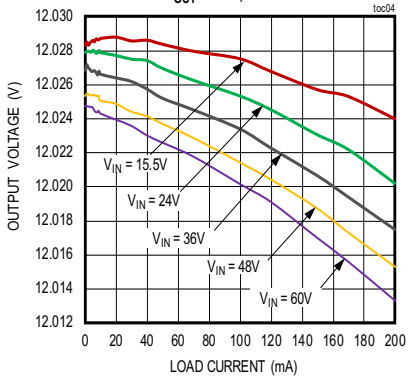
EFFICIENCY vs. LOAD CURRENT
V_{OUT} = 12V, PWM MODE



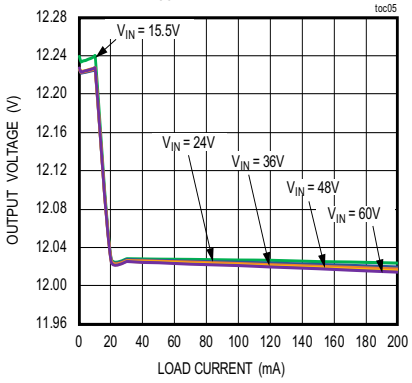
EFFICIENCY vs. LOAD CURRENT
V_{OUT} = 12V, PFM MODE



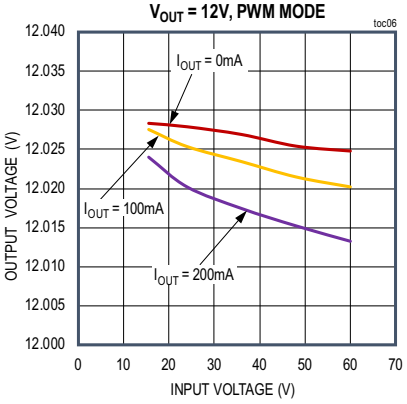
OUTPUT VOLTAGE vs. LOAD CURRENT
V_{OUT} = 12V, PWM MODE



OUTPUT VOLTAGE vs. LOAD CURRENT
V_{OUT} = 12V, PFM MODE

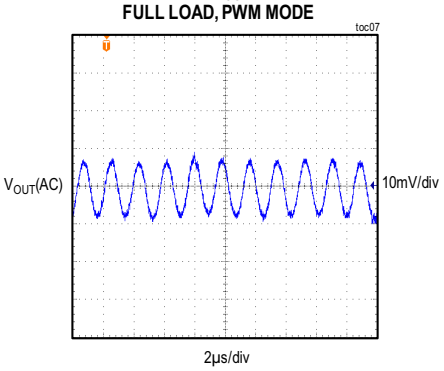


OUTPUT VOLTAGE vs. INPUT VOLTAGE
V_{OUT} = 12V, PWM MODE

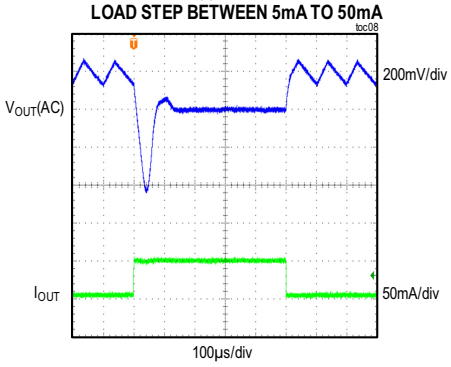


EV Kit Performance Report (continued)

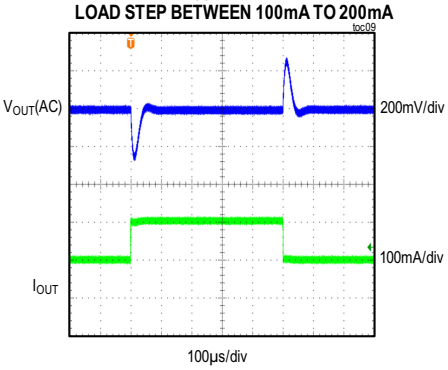
OUTPUT VOLTAGE RIPPLE
V_{IN} = 24V, V_{OUT} = 12V
FULL LOAD, PWM MODE



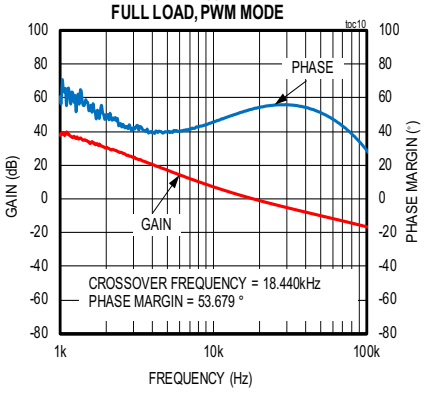
LOAD TRANSIENT RESPONSE
V_{IN} = 24V, V_{OUT} = 12V, PFM MODE
LOAD STEP BETWEEN 5mA TO 50mA



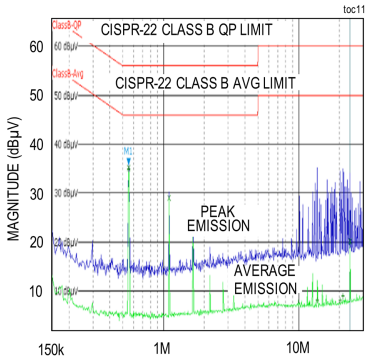
LOAD TRANSIENT RESPONSE
V_{IN} = 24V, V_{OUT} = 12V, PWM MODE
LOAD STEP BETWEEN 100mA TO 200mA



BODE PLOT
V_{IN} = 24V, V_{OUT} = 12V
FULL LOAD, PWM MODE

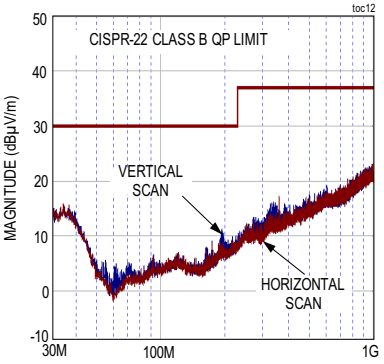


CONDUCTED EMISSION PLOT
WITH FILTER L_{EMI_1} = 82µH, C_{EMI_1} = 0.47µF, C_{EMI_2} = 1µF



CONDITIONS : V_{IN} = 24V, V_{OUT} = 12V, I_{OUT} = 0.2A

RADIATED EMISSION PLOT
L_{EMI_1} = SHORT, C_{EMI_1} = C_{EMI_2} = OPEN



CONDITIONS : V_{IN} = 24V, V_{OUT} = 12V, I_{OUT} = 0.2A

Ordering Information

PART	TYPE
MAXM15068EVKIT#	EV Kit

#Denotes RoHS compliant.

Component Suppliers

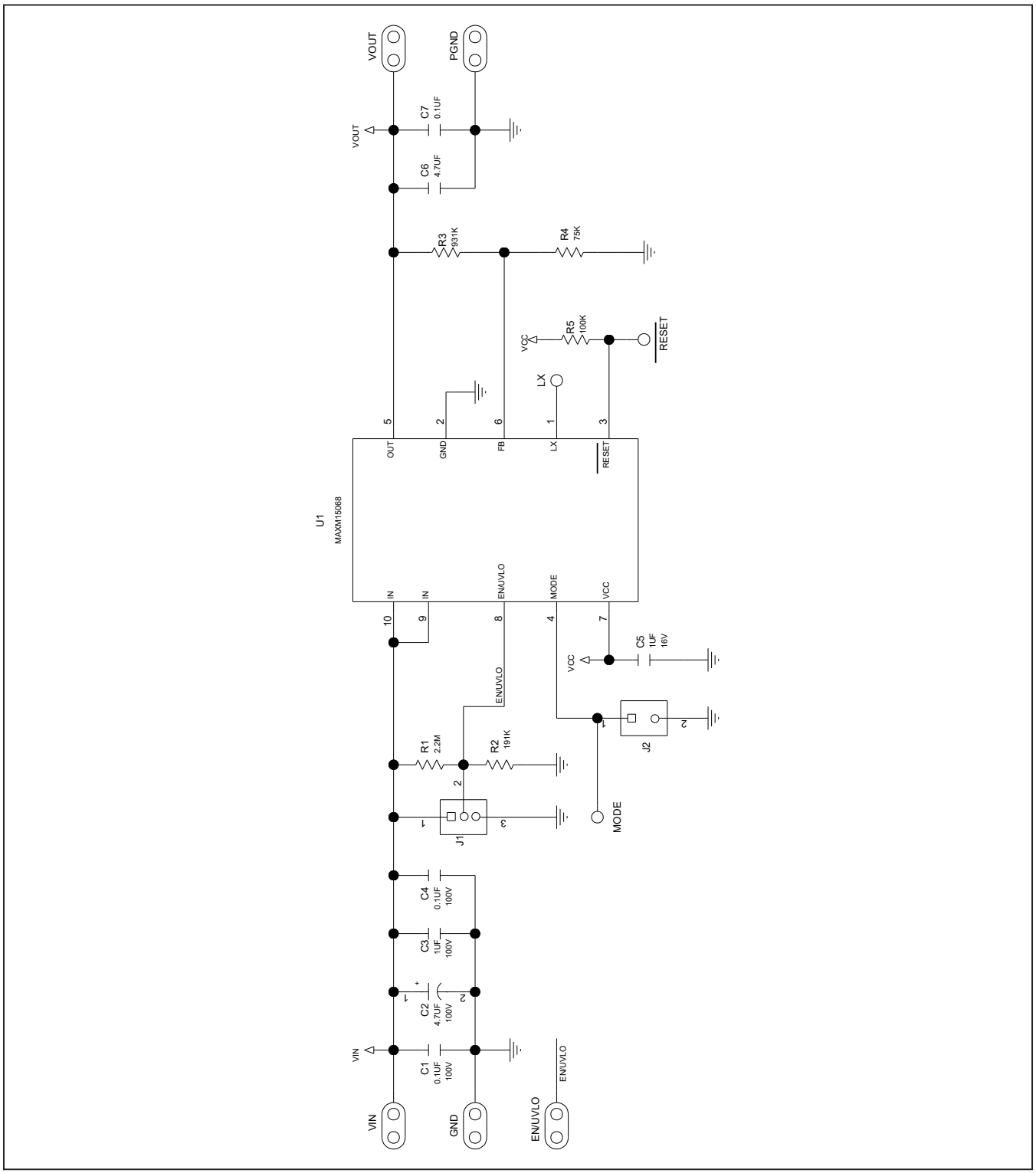
SUPPLIER	WEBSITE
Murata Americas	www.murata.com
Nichicon	www.nichicon.co.jp
Vishay Dale	www.vishay.com
Taiyo Yuden	www.yuden.co.jp

Note: *Indicate that you are using the MAXM15068 when contacting these component suppliers.*

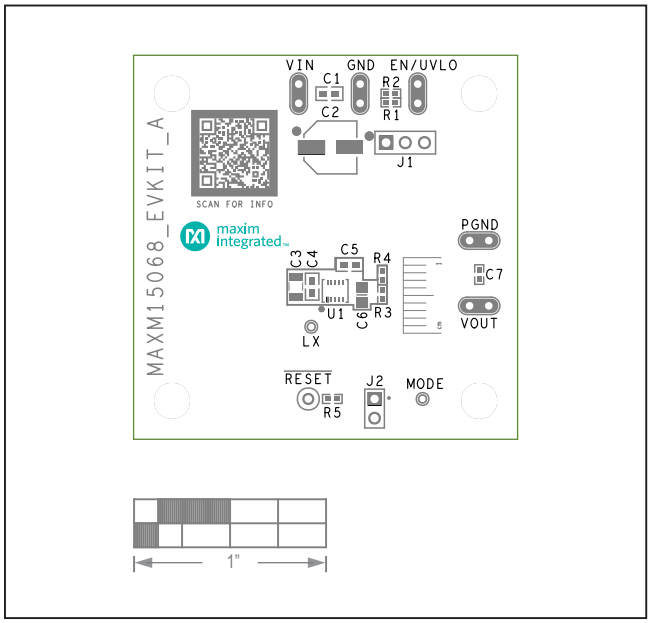
MAXM15068 12V EV Kit Bill of Materials

ITEM	QTY	DESIGNATION	DESCRIPTION	MANUFACTURER PART NUMBER
1	2	C1, C4	0.1µF±10%, 100V, X7R ceramic capacitor (0603)	TAIYO YUDEN HMK107B7104KA
2	1	C2	4.7µF±20%, 100V, Aluminum Electrolytic capacitor	NICHICON UUR2A4R7MCL6GS
3	1	C3	1µF±10%, 100V, X7R ceramic capacitor (1206)	TAIYO YUDEN HMK316B7105KLHT
4	1	C5	1µF±10%, 16V, X7R ceramic capacitor (0603)	TAIYO YUDEN EMK107B7105KA
5	1	C6	4.7µF±10%, 25V, X7R ceramic capacitor (0805)	MURATA GRM21BZ71E475KE15
6	1	C7	0.1µF±10%, 16V, X7R ceramic capacitor (0402)	TAIYO YUDEN EMK105B7104KV-F
7	1	R1	2.2MΩ±1% resistor (0402)	VISHAY DALE CRCW04022M20FK
8	1	R2	191kΩ±1% resistor (0402)	VISHAY DALE CRCW0402191KFK
9	1	R3	931kΩ±1% resistor (0402)	VISHAY DALE CRCW0402931KFK
10	2	R4	75kΩ±1% resistor (0402)	VISHAY DALE CRCW040275K0FK
11	1	R5	100kΩ±1% resistor (0402)	VISHAY DALE CRCW0402100KFK
12	1	U1	MAXM15068, 10-pin micro-SLIC Power Module	MAXIM MAXM15068AMB+T
13	1	L_{EMI_1}	OPTIONAL: 82µH±20%,150mA Shielded Wirewound Inductor (2016)	MURATA LQH2MPN820MGRL
14	1	C_{EMI_1}	OPTIONAL: 0.47µF±10%, 100V, X7R ceramic capacitor (1206)	MURATA GRM31MR72A474KA35L
15	1	C_{EMI_2}	OPTIONAL: 1µF±10%, 100V, X7R ceramic capacitor (1206)	TAIYO YUDEN HMK316B7105KLHT

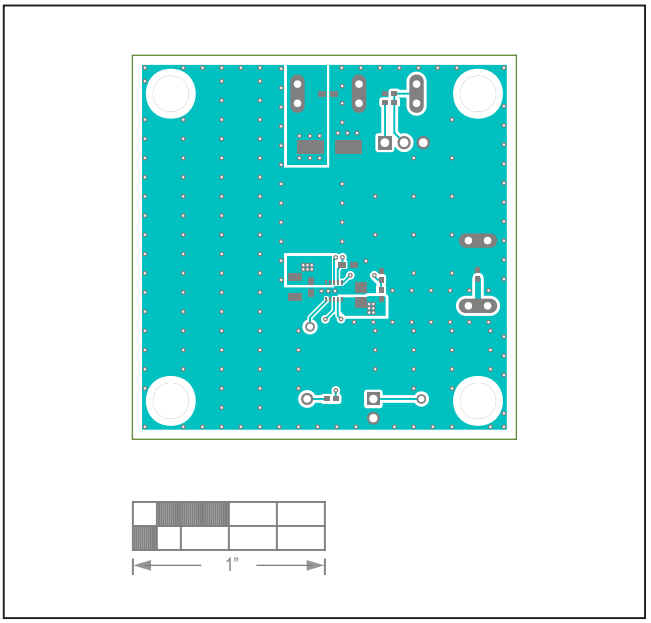
MAXM15068 12V EV Kit Schematic



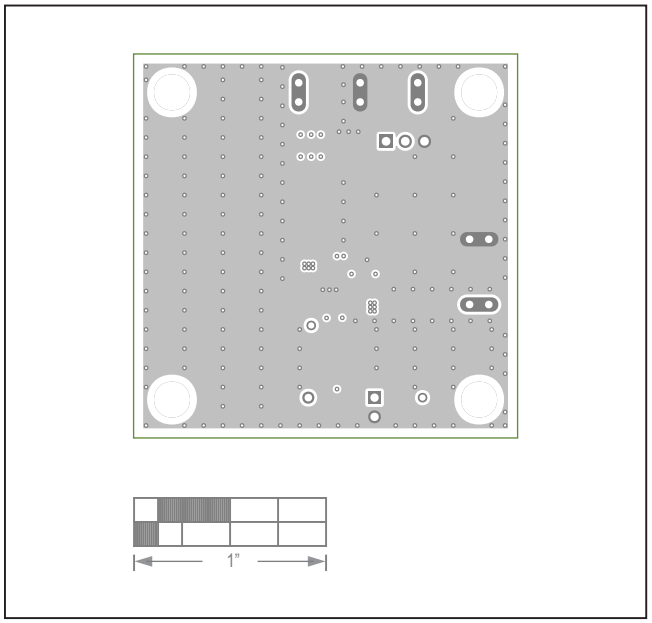
MAXM15068 12V EV Kit PCB Layout Diagrams



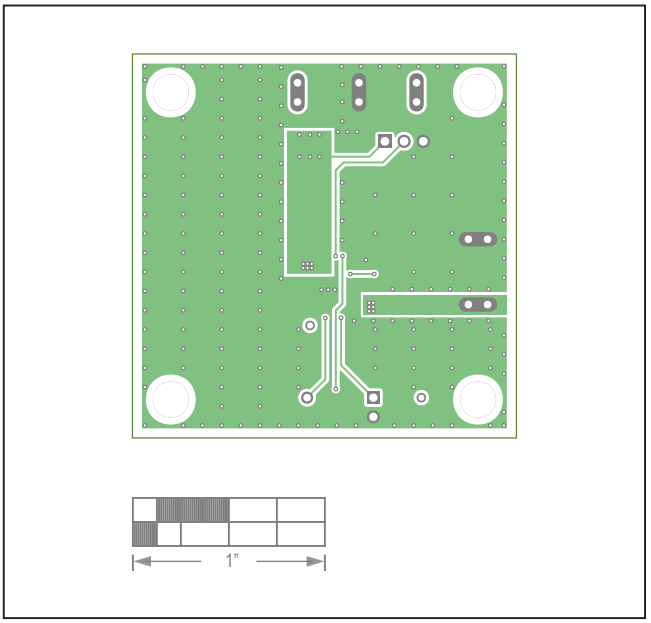
MAXM15068 EV Kit PCB Layout—Silk Top



MAXM15068 EV Kit PCB Layout—Top Layer

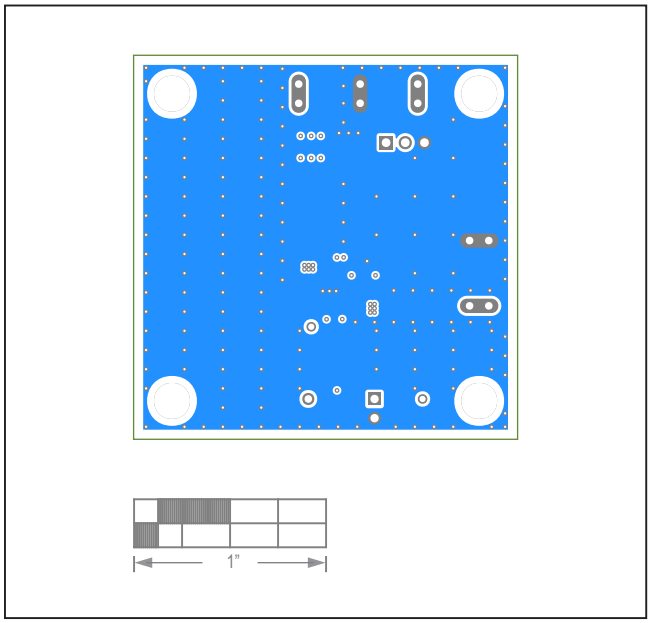


MAXM15068 EV Kit PCB Layout—Layer 2 Ground

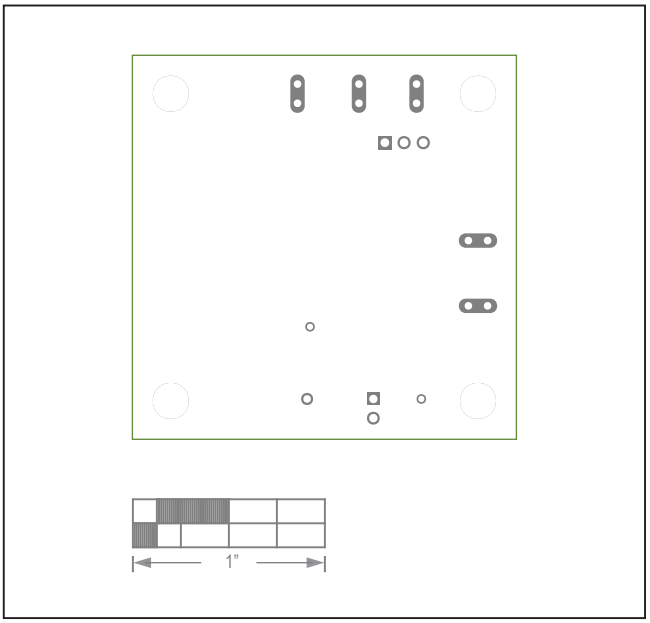


MAXM15068 EV Kit PCB Layout—Layer 3 Power

MAXM15068 12V EV Kit PCB Layout Diagrams (continued)



MAXM15068 EV Kit PCB Layout—Bottom Layer



MAXM15068 EV Kit PCB Layout—Silk Bottom

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	10/19	Initial release	—

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