MAXM17574 5V Output Evaluation Kit

Evaluates: MAXM17574 5V Output Application

General Description

The MAXM17574 5V-output evaluation kit (EV kit) provides a proven design to evaluate the MAXM17574 high-voltage, high-efficiency, synchronous step-down DC-DC converter. The EV kit is preset for 5V output at load currents up to 3A and features a 650kHz 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 frequency synchronization. The MAXM17574 module data sheet provides a complete description of the part that should be read in conjunction with this data sheet prior to operating the EV kit. For full module features, benefits and parameters for the IC, refer to the MAXM17574 data sheet.

Features

- Highly Integrated Solution with Built-In Shielded Inductor
- Wide 10V to 60V Input Range
- Programmed 5V Output, Up To 3A Output Current
- High 93% Efficiency (V_{IN} = 12V, V_{OUT} = 5V at 1.0A)
- 650kHz Switching Frequency
- EN/UVLO Input, Resistor-Programmable UVLO Threshold
- Programmed 4ms Soft-Start Time
- Selectable PWM And DCM Modes
- Open-Drain $\overline{\text{RESET}}$ Output Pulled Up To 5V V_{CC}
- Provision for External Frequency Synchronization
- Overcurrent and Overtemperature Protection
- Low-Profile, Surface-Mount Components
- Proven PCB Layout
- Fully Assembled and Tested
- CISPR-22 Class B Compliant

Quick Start

Recommended Equipment

- One 10V to 60V DC, 2A Power Supply
- One 15W resistive load with 3A sink capacity
- Four digital multimeters (DMM)
- One MAXM17574EVKITA# EV kit

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 10V and 60V. Disable the power supply.
2) Connect the positive terminal of the input power supply to the V_{IN_EMI} PCB pad and the negative terminal to the nearest PGND pad. Connect the positive terminal of the 3A load to the V_{OUT} pad and the negative terminal to the nearest PGND pad.
3) Connect a DVM (DMM in voltage measurement mode) across the V_{OUT} pad and the nearest PGND pad.
4) Verify that shunts are not installed on jumper J1 (see Table 1 for details).
5) Select the shunt position on jumper J2 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 across the output terminals.

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

319-100078; Rev 0; 9/17

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Detailed Description

The MAXM17574 EV kit is designed to demonstrate the salient features of the MAXM17574 power module. The EV kit includes an EN/UVLO pad and jumper J1 to enable the output at a desired input voltage. The MODE/SYNC pad allows an external clock interface to synchronize the device. Jumper J2 allows selection of a particular 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.

On the bottom layer of the EV kit, additional footprints for optional components are included to ease board modification for different input and output configurations. Placeholders are also available on the bottom layer for installation of EMI filter components. EMI component values are provided in the schematic.

Setting the Switching Frequency

Selection of switching frequency must consider input-voltage range, desired output voltage, $t_{ON(MIN)}$, and $t_{OFF(MIN)}$ of the MAXM17574. To optimize efficiency and component size, a switching frequency of 650kHz is chosen for 5V-programmed output. Resistor R2 connected between RT and SGND pins, programs the desired switching frequency. Using *Table 1. Selection of Components* in the MAXM17574 data sheet, choose R2 to be 30.1kΩ. *Table 1. Selection of Components* recommends optimized switching frequency for various output designs.

Input Capacitor Selection

The input capacitor serves to reduce the current peaks drawn from the input power supply and also reduce switching frequency voltage ripple at the input. *Table 1. Selection of Components* in the MAXM17574 data sheet summarizes the choice of input capacitor for various requirements. Using this table, the input capacitor (C2) for this EV kit is chosen to be 4.7µF/80V.

Output Capacitor Selection

X7R ceramic output capacitors are preferred due to their stability over temperature in industrial applications. *Table 1. Selection of Components* in the MAXM17574 data sheet summarizes the choice of output capacitor for various requirements. Using this table, the output capacitor (C8) for this EV kit is chosen to be 47µF/6.3V.

Adjusting Output Voltage

The MAXM17574 module supports an adjustable output voltage range, from 0.9V to 15V, using a feedback resistive divider from OUT to FB. To get different output voltages, refer to *Table 1. Selection of Components* in the MAXM17574 data sheet. R5 and R6 of the EV kit correspond to RU and RB in *Table 1. Selection of Components* of the MAXM17574 data sheet.

Soft-Start Programming

The MAXM17574 offers an adjustable soft-start function to limit inrush current during startup. The soft-start time is adjusted by changing the value of C4, the external capacitor from the SS pin to SGND. The capacitance required for a given soft-start time (t_{SS}) is given by the following equation:

$$C4 = 5.55 \times 10^{-6} \times t_{SS}$$

The capacitor required for a 4ms soft-start time is calculated to be 22nF.

Enable/Undervoltage-Lockout (EN/UVLO) Programming

The MAXM17574 module offers an adjustable input undervoltage-lockout feature. In this EV kit, for normal operation, leave jumper J1 open. To disable the output, install a jumper across pins 1-2 on J1. See Table 1 for J1 settings. Resistor R1 connected from EN/UVLO to SGND sets the input voltage (V_{INU}) at which the device turns on. The value of resistor R1 is calculated as follows:

$$R1 \geq \frac{4009.5}{(V_{INU} - 1.215)}$$

where R1 is in kΩ.

For the MAXM17574 to turn on at a 9.5V input, the R1 resistor is calculated to be 487kΩ.

MODE Selection (MODE/SYNC)

The MODE/SYNC pin can be used to select between PWM and DCM modes of operation. The logic state of the MODE/SYNC pin is latched when V_{CC} and EN/UVLO voltages exceed their respective 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 MAXM17574 module data sheet for more information on the PWM and DCM modes of operation. Table 2 shows EV kit jumper settings that can be used to configure the desired mode of operation.

External Clock Synchronization (MODE/SYNC)

The internal oscillator of the MAXM17574 can be synchronized to an external clock signal through the MODE/SYNC pin. 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 R2 resistor. The minimum external clock high-pulse width and amplitude should be greater than 50ns and 2.1V respectively. The maximum external clock low-pulse amplitude should be less than 0.8V. A 22pF/0402 capacitor should be placed at a C10 designator whenever the SYNC feature is utilized. Provision is made in the bottom side of EV kit to place the 22pF capacitor.

EXTVCC Linear Regulator

Powering V_{CC} from EXTVCC increases the efficiency of the power converter at higher input voltages. If the applied EXTVCC voltage is greater than 4.7V (typ), V_{CC} is powered from EXTVCC. If EXTVCC is lower than 4.7V (typ), V_{CC} is powered from V_{IN}. Refer to the MAXM17574 module data sheet for further information. Resistor R3 (0Ω) connects V_{OUT} to EXTVCC in this EV kit.

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.

The MAXM17574 EV kit PCB has designated footprints on the bottom side for placement of EMI filter components. Use of EMI filter components as shown in the schematic results in lower conducted emissions, below CISPR22 Class B limits. Cut open the trace at L1 before installing EMI filter components. The MAXM17574 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.

Hot Plug-In and Long Input Cables

The MAXM17574 EV kit PCB provides an optional electrolytic capacitor (C1, 10µF/100V). This capacitor limits the peak voltage at the input of the MAXM17574 power module, 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.

Table 1. UVLO Enable/Disable Configuration (J1)

POSITION	EN/UVLO PIN	MAXM17574 OPERATION
Not Installed*	Connected to the center node of resistor-divider 3.3MΩ (internal) and R1	Programmed to startup at desired input voltage level
1-2	Connected to SGND	Disabled

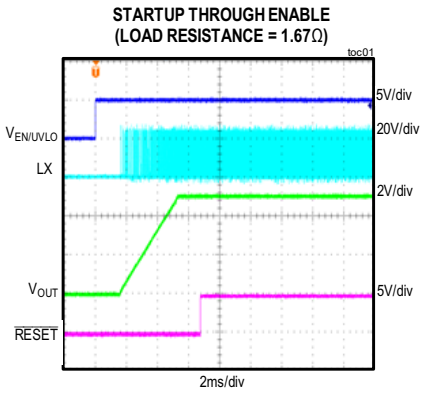
**Default position*

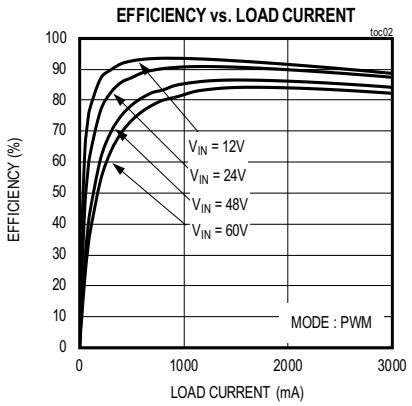
Table 2. MODE Configuration (J2)

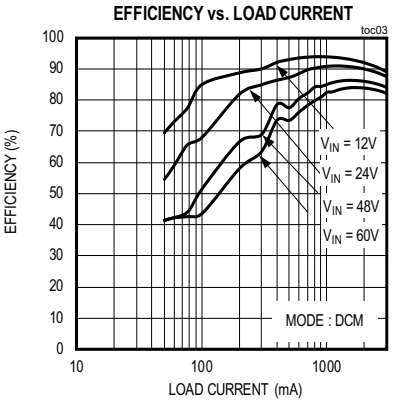
POSITION	MODE PIN	MAXM17574 OPERATION
1-2	Connected to V_{CC}	DCM mode
2-3*	Connected to GND	PWM mode

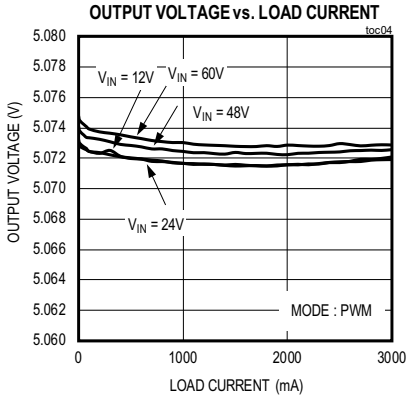
**Default position*

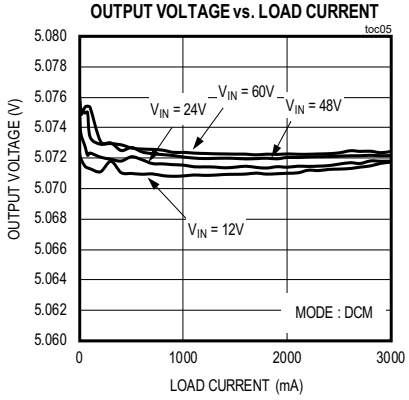
EV Kit Performance Report

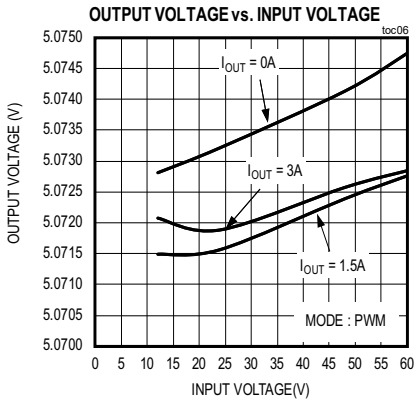


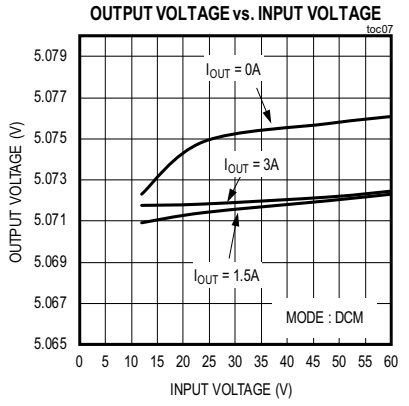






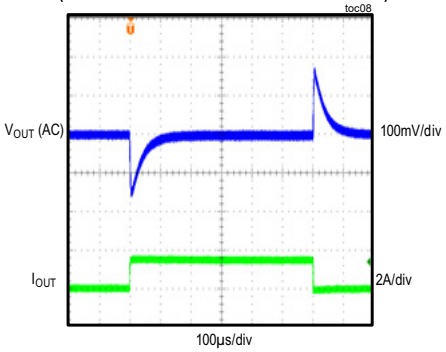




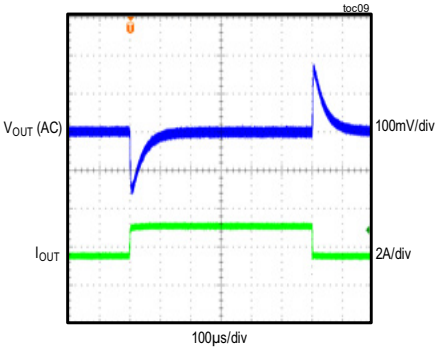


EV Kit Performance Report (continued

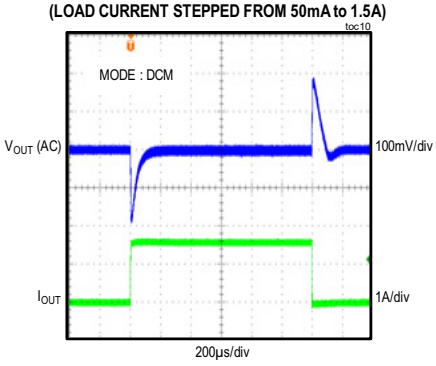
LOAD TRANSIENT RESPONSE
(LOAD CURRENT STEPPED FROM 0A to 1.5A)



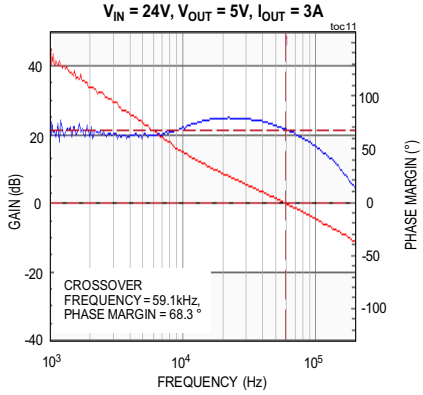
LOAD TRANSIENT RESPONSE
(LOAD CURRENT STEPPED FROM 1.5A to 3A)



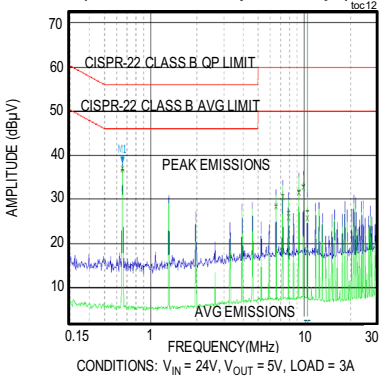
LOAD TRANSIENT RESPONSE
(LOAD CURRENT STEPPED FROM 50mA to 1.5A)



BODE PLOT
VIN = 24V, VOUT = 5V, IOUT = 3A

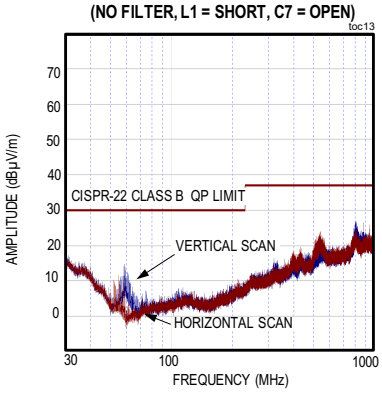


CONDUCTED EMISSION PLOT
(WITH FILTER, L1 = 10µH, C7 = 4.7µH)



CONDITIONS: VIN = 24V, VOUT = 5V, LOAD = 3A

RADIATED EMISSION PLOT
(NO FILTER, L1 = SHORT, C7 = OPEN)



CONDITIONS: VIN = 24V, VOUT = 5V, LOAD = 3A

MAXM17574 5V Kit Bill of Materials

S NO	DESIGNATION	QTY	DESCRIPTION	MANUFACTURER PARTNUMBER - 1	MANUFACTURER PARTNUMBER - 1
1	C1	1	10µF±20%,100V, Aluminimum Capacitor	PANASONIC EEE-TG2A100P	
2	C2	1	4.7µF±10%,80V, X7R ceramic capacitor (1210)	MURATA GRM32ER71K475KE14	
3	C3	1	OPEN(0603)	OPEN	
4	C4	1	0.022µF±10%,50V, X7R ceramic capacitor (0402)	MURATA GRM155R71H223KA12	
5	C5	1	0.1µF±10%,100V, X7R ceramic capacitor (0603)	MURATA GRM188R72A104KA35	TDK CC0603KRX7R0BB104
6	C6	1	OPEN(1210)	OPEN	
7	C7	1	OPEN(4.7µF±10%,80V, X7R ceramic capacitor (1210))	MURATA GRM32ER71K475KE14	
8	C8	1	47µF ±10%,6.3V, X7R ceramic capacitor (1210)	Murata GRM32ER70J476KE20L	
9	C9	1	OPEN (0402)	OPEN	
10	C10	1	OPEN (0402)	MURATE GRM1555C1H220JA01	TAIYO YUDEN UMK105CG220JV
11	C11	1	OPEN(1210)	OPEN	
12	C12	1	OPEN(1210)	OPEN	SAMSUNG ELECTRONICS CL32B106KBJNNN
13	R1	1	487kΩ ±1% resistor (0402)	VISHAY DALE CRCW0402487KFK	
14	R2	1	30.1kΩ ±1% resistor (0402)	VISHAY DALE CRCW040230K1FK	
15	R3	1	0R ±0% resistor (0402)	PANASONIC ERJ-2GE0R00X	
16	R4	1	10kΩ ±1% resistor (0402)	VISHAY DALE CRCW040210K0FK	YAGEO PHICOMP RC0402FR-0710K
17	R5	1	140kΩ ±1% resistor (0402)	PANASONIC ERJ-2RKF1403X	
18	R6	1	30.1kΩ ±1% resistor (0402)	VISHAY DALE CRCW04023012FK	
19	FB1	1	OPEN	OPEN	
20	L1	1	OPEN(10µH±20%,2A Inductor)	PULSE PA4332.103NLT	
21	U1	1	MAXM17574, 33-pin SIP Power Module	MAXM17574ALC#T	

Ordering Information

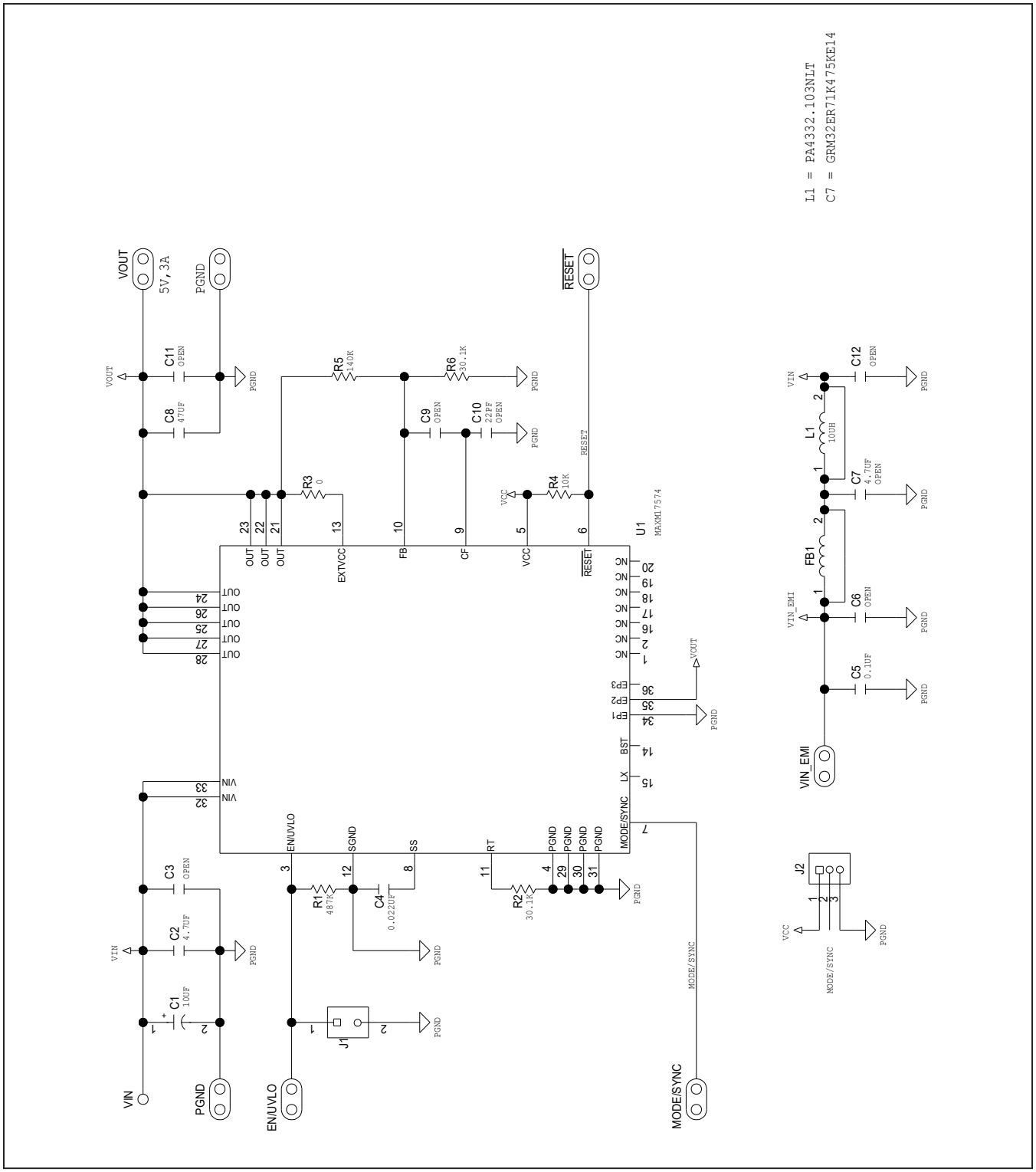
PART	TYPE
MAXM17574 EVKIT#	EV Kit

#Denotes RoHS compliant.

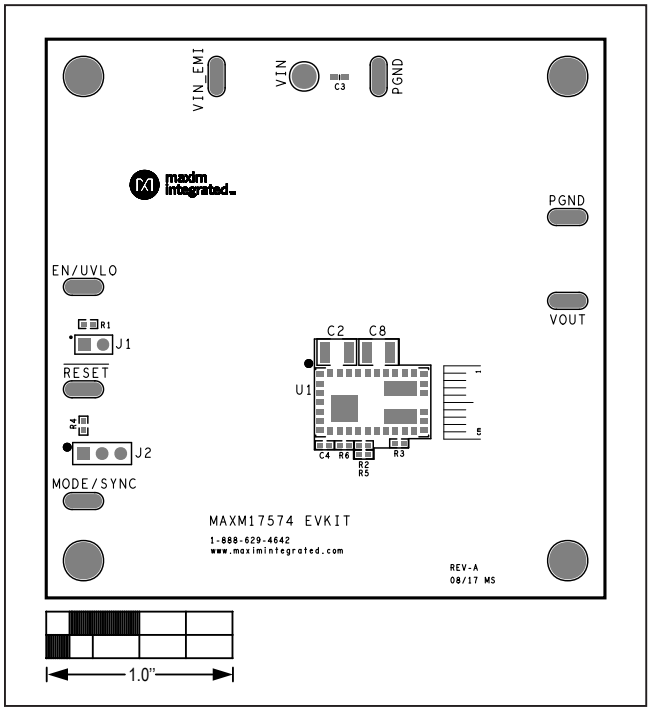
Component Suppliers

SUPPLIER	WEBSITE
Murata Americas	www.murata.com
NEC TOKIN America, Inc.	www.nec-tokinamerica.com
Panasonic Corp.	www.panasonic.com
SANYO Electric Co., Ltd.	www.sanyodevice.com
TDK Corp.	www.component.tdk.com
TOKO America, Inc.	www.tokoam.com

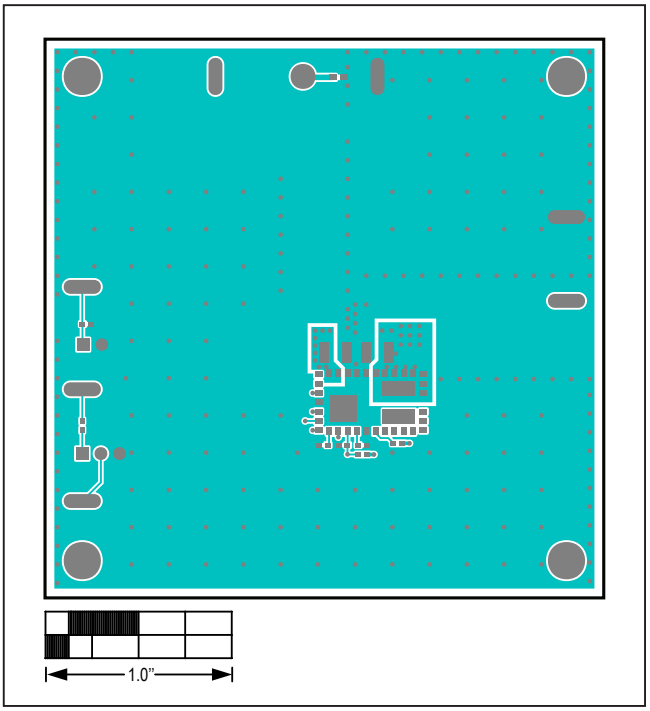
MAXM17574 5V Kit Schematic



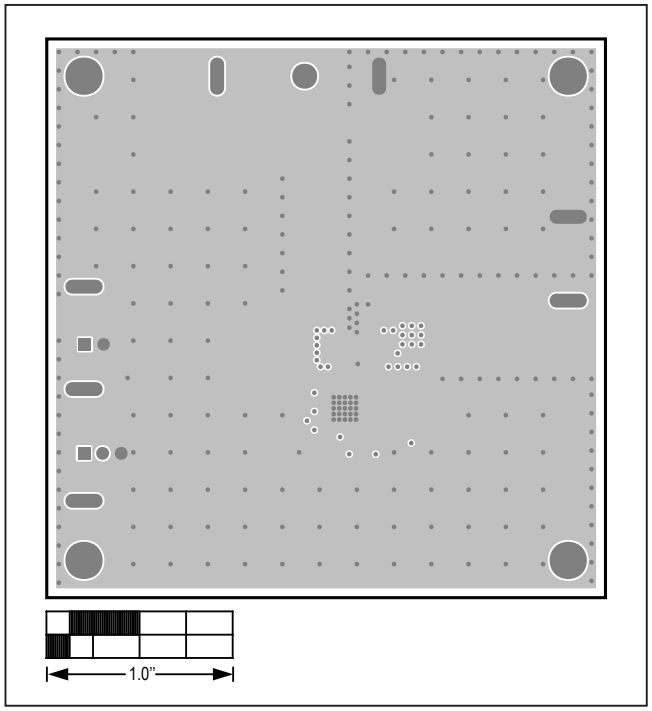
MAXM17574 PCB Layouts



MAXM17574 5V EV Kit Component Placement Guide—Component Side

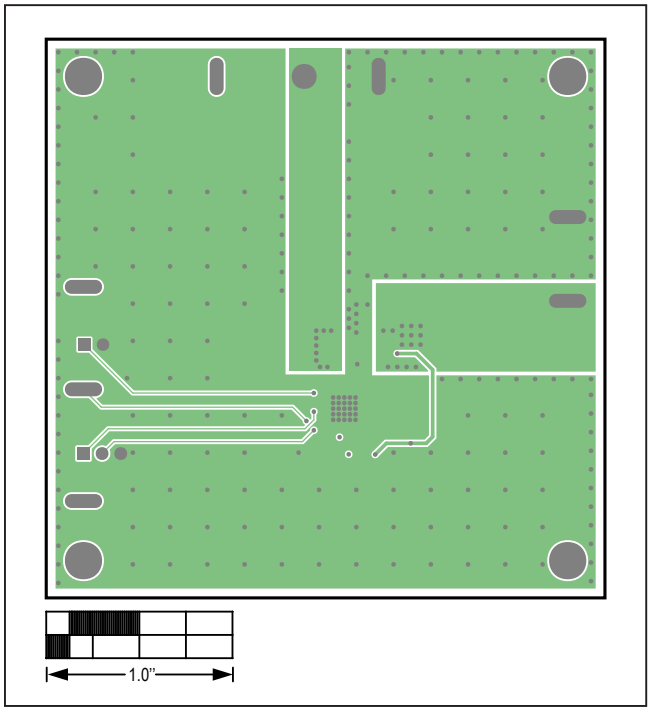


MAXM17574 5V EV Layout Top Layer

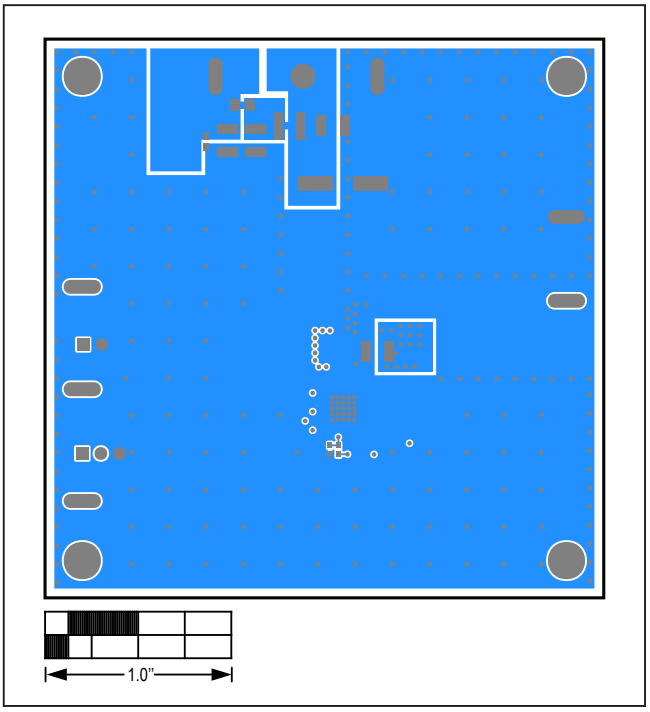


MAXM17574 5V EV Layout Layer 2

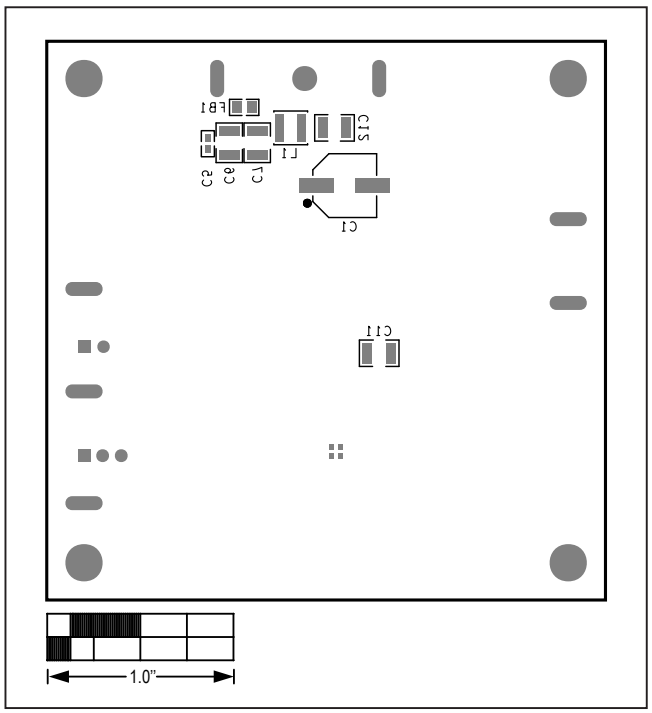
MAXM17574 EV Kit PCB Layouts (continued)



MAXM17574 5V EV Layout Layer 3



MAXM17574 5V EV Layout Bottom Layer



MAXM17574 5V EV Layout Bottom Silkscreen

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	9/17	Initial release	—