MAX77837 Evaluation Kit

Evaluates: MAX77837 in WLP Package

General Description

The MAX77837 evaluation kit (EV kit) is a fully assembled and tested printed circuit board (PCB) that demonstrating the MAX77837 nano power buck-boost converter. The EV kit has an input range of 1.8V to 5.5V, with a switch current limit of 1.05A.

The MAX77837 IC has two hardware control pins, SEL1 and SEL2. The resistor connected at SEL1 (R_{SEL1}) selects a predefined combination of two output voltages between 1.8V and 5.2V, OUT1 and OUT2. The resistor connected at SEL2 (R_{SEL2}) allows different configurations of switch current limit to optimize external components size, enable or disable DVS function, select either hiccup or latch-off mode, and IC startup voltage.

The EV kit is compatible with MAX77837 WLP IC (MAX77837EWA+T) and equipped with test points and jumpers to test most of the device's functionality. In addition, there are probing sockets on critical nodes (OUT-1, LX1, and LX2) for precise measurements.

Benefits and Features

- 1.8V to 5.5V Input Voltage
- Accessible Test points for INS and OUTS
- Output Voltage (OUT1 and OUT2) adjustable using R_{SEL1}.
- Switch current limit, DVS function, and Hiccup or Latch off mode operation.
- Sense sockets for high-accuracy measurements

Ordering Information ***appears at the end of datasheet***

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MAX77837 EV kit Specifications

Table 1. EV Kit Specifications

SPECIFICATION	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input Voltage		1.8		5.5	V
Output Voltage	Configured using R_{SEL1} and R_{SEL2}	1.8		5.2	V
Shutdown Supply Current	EN = LOW, T_J = +25°C		10	100	nA
Input Quiescent Current	EN = HIGH, T_J = +25°C, and No Switching		430	930	nA

Table 2. Default Jumper Positions

JUMPER	NODE OR FUNCTION	SHUNT POSITION	FEATURE
J1	EN	1-2*	Connects EN to HI
		2-3	Connects EN to GND
J2	SEL1	1-2*	Connects SEL1 to R2 (Potentiometer)
J3	SEL2	1-2*	Connects SEL2 to R4 (Potentiometer)

**Default position*

319-100974; Rev 0; 1/23

MAX77837 Evaluation Board Photo

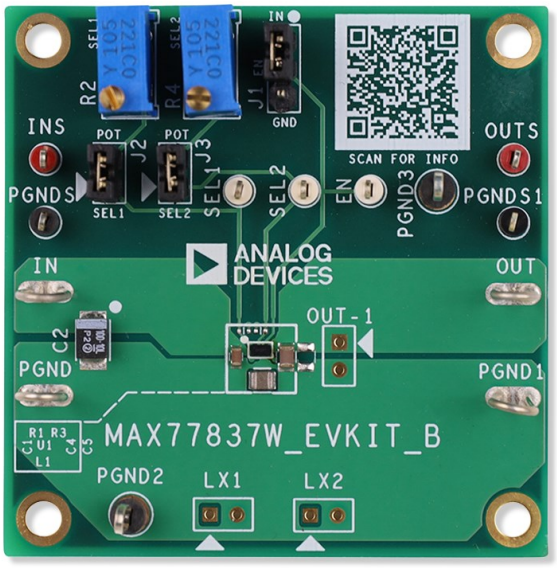


Figure 1. MAX77837 Evaluation Board

Quick Start

Required Equipment

- MAX77837 Evaluation Kit
- Adjustable DC Power Supply
- Digital Multi-meters (x4)
- Electronic Load

Setup Overview

See *Figure 2* for a Simplified EV kit circuit diagram and a typical bench setup for MAX77837 EV kit is shown in *Figure 3*.

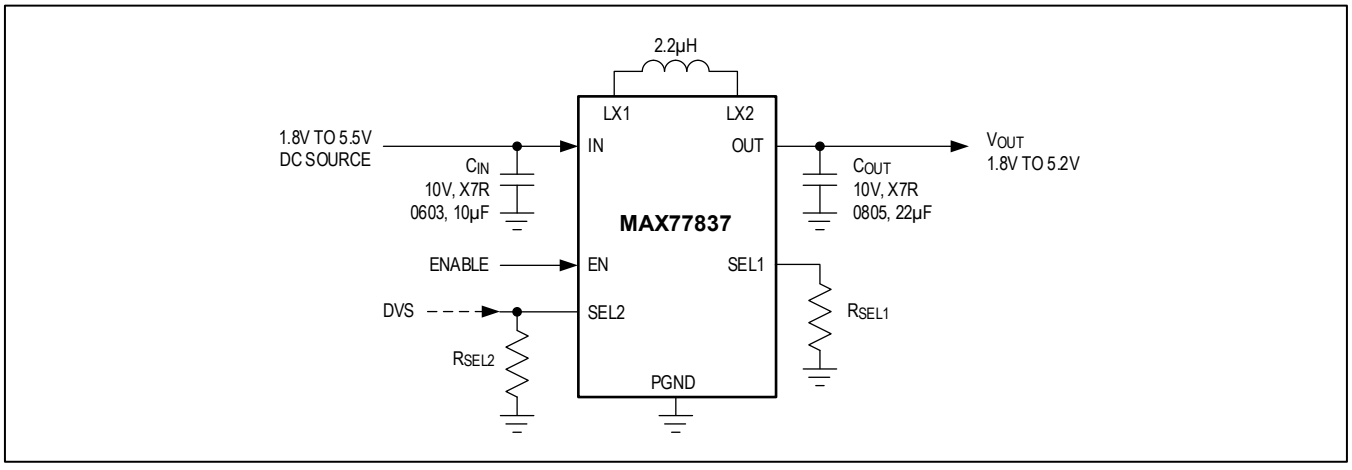


Figure 2. MAX77837 Typical Application Circuit

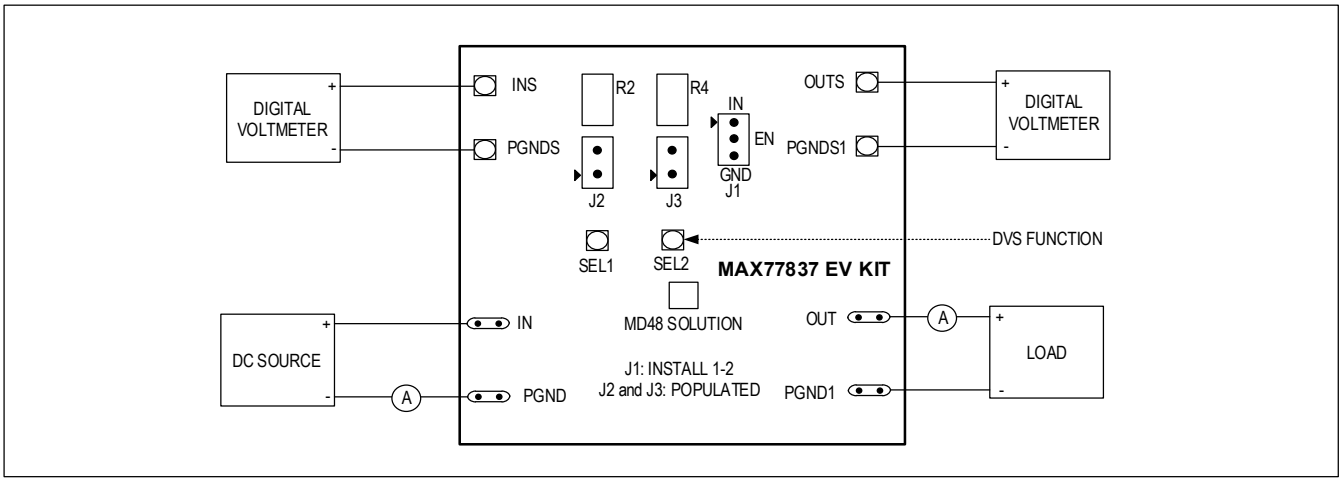


Figure 3. MAX77837 EV kit Simplified Block Diagram

Procedure

The MAX77837 EV kit is fully assembled and tested. Follow the steps to verify the board operation. Use twisted wires of appropriate gauges that are as short as possible to connect the load and power sources.

1. Identify the connections and test points shown in *Figure 3*. Ensure that the EV kit has the correct jumper settings, as shown in *Table 2*.
2. Connect a DVM to the INS and PGNDS pins to measure the input voltage.
3. Connect a DVM to the OUTS and PGNDS1 pins to measure the output voltage.
4. Set R_{SEL1} to 0Ω (OUT1 = 3.3V and OUT2 = 3.6V) and R_{SEL2} to 909 kΩ (DVS Enabled, Latch-off mode, Highest ILIM, Startup into OUT1). See *SEL Pin Configuration* Section for more information on how to select the R_{SEL1} and R_{SEL2} values.
5. Set the power supply to 5V (1A current limit) across IN and PGND terminals of the EV kit. Turn on the power supply.
6. Confirm the DVM connected to OUTS and PGNDS1 reads the default output voltage of the EV kit (about 3.36V). Confirm the ammeter reads the expected input supply current (less than 10µA).
7. Once the EV kit is confirmed working increase the current limit on the power supply connected across IN and PGND. Connect an electronic load across OUT and GND terminals to evaluate the performance of the MAX77837 buck-boost regulator.

The procedure's next phase is to evaluate MAX77837's Dynamic Voltage Scaling (DVS) functionality. Since R_{SEL2} is set to 909kΩ, the DVS function is enabled. See *Table 4* in *SEL Pin Configuration* Section for more information on how to select the R_{SEL2} values. If the evaluation of the DVS function is not required, the following steps can be skipped.

8. Turn off the power supply connected between IN and PGND.
9. Set the power supply to 5V (1A current limit) across IN and PGND of the EV kit. If you are using GPIO for DVS control, ensure that it is set to a High-Z state until VOUT settles to the target value after start-up. Then, turn on the on the power supply.
10. Confirm that the DVM connected to OUTS and PGNDS1 reads the default output voltage of the EV kit (about 3.36V).
11. Pull the SEL2 pin high after VOUT has settled to about 3.36V.
12. Confirm that the DVM connected to OUTS and PGNDS1 reads an output voltage of about 3.66V.

After the *Quick Start* procedure concludes, further evaluations can be carried out on the device for input, output voltages, and load conditions.

EV Kit Hardware

SEL Pin Configuration

MAX77837 has two hardware configuration pins (SEL1 and SEL2) to configure the part's features. A resistor between SEL1 and ground (R_{SEL1}) is used to select two output voltage levels (OUT1 and OUT2). A resistor between SEL2 and ground (R_{SEL2}) is used to select the startup output voltage, switch current limit, protection mode, and enable/disable the DVS function. See *Table 3* and *Table 4* for more details. If the OUT2 is required as the startup voltage, the part can only be operated with DVS disabled and in Auto-Restart Mode.

When R_{SEL2} enables DVS, the SEL2 pin will be configured as logic control input for the DVS function after soft-start. When SEL2 is pulled HIGH, the output voltage is will switch from OUT1 to OUT2; when SEL2 goes LOW, the output voltage is will switch from OUT2 to OUT1. The SEL2 pin should be in a High-Z state during and before the soft-start. The DVS function can only ramp up the output voltage level. There is no slew-down control when the DVS function transitions from a higher output voltage to a lower output voltage. The IC changes the reference voltage and waits until the load or leakage current brings the output voltage to a lower value and starts operating normally. Refer to the *Dynamic Voltage Setting* section in the MAX77837 IC datasheet for more information.

Table 3. R_{SEL1} Selection Guide

R_{SEL1} (kΩ)	OUT1 (V)	OUT2 (V)	R_{SEL1} (kΩ)	OUT1 (V)	OUT2 (V)
4.99	1.8	2.5	66.5	3.3	3.8
5.90	1.8	2.8	80.6	3.3	5.0
7.15	1.8	3.3	95.3	3.6	2.8
8.45	1.8	3.6	113	3.6	3.3
10.0	2.5	1.8	133	3.6	5.0
11.8	2.5	2.8	162	3.6	5.2
14.0	2.5	3.3	191	3.8	3.3
16.9	2.5	3.6	226	3.8	3.6
20.0	2.8	1.8	267	3.8	5.0
23.7	2.8	2.5	324	5.0	3.3
28.0	2.8	3.3	383	5.2	3.3
34.0	2.8	3.6	453	2.1	2.3
40.2	3.3	1.8	536	RESERVED	RESERVED
47.5	3.3	2.5	634	RESERVED	RESERVED
56.2	3.3	2.8	768	RESERVED	RESERVED
Short	3.3	3.6	909/OPEN	RESERVED	RESERVED

Table 4. R_{SEL2} Selection Guide

R_{SEL2} (kΩ)	DVS	PROTECTION	ILIM (mA)	STARTUP VOLTAGE
226	DISABLED	Hiccup/ Auto-Restart	1050	OUT2
267	DISABLED	Hiccup/ Auto-Restart	400	OUT2
324			1050	OUT1
383		Latch Off	400	OUT1
453			1050	OUT1
536	ENABLED	Hiccup/ Auto-Restart	400	OUT1
634			1050	OUT1
768		Latch Off	400	OUT1
909			1050	OUT1

Test Points and Critical Node Measurement (VOUT, LX1 & LX2)

The MAX77837 EV kit has holes on the board for measuring the critical nodes OUT-1, LX1, and LX2. Use these probing holes to eliminate as much noise as possible when measuring the critical nodes (See *Figure 4*). To ensure the best results, use a very short ground wire from the ground sleeve of the scope probe to the GND side of the probing hole, and use the bare tip of the probe directly to the signal side of the probing hole. These guidelines will give the most accurate results when measuring parameters including output voltage ripple, switching waveforms, and load transient response.

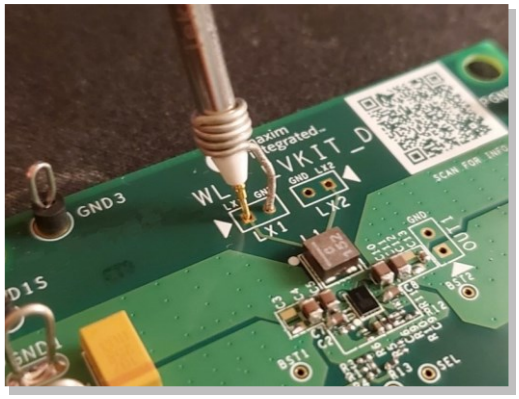


Figure 4. Probing Critical Nodes

Table 5. Usage of Critical Test Points

LOAD TRANSIENT, OUTPUT RIPPLE	LOAD REGULATION, LINE REGULATION, V_{OUT} ACCURACY	EFFICIENCY		SWITCHING NODE
		OUTPUT VOLTAGE	INPUT VOLTAGE	LX
OUT-1	OUTS and INS	OUTS	INS	LX1 and LX2

Layout Guidelines

Careful circuit board layout is critical to achieve low switching power loss and clean, stable operation.

When designing the PCB, follow these guidelines:

- Place the input capacitors (C_{IN}) and output capacitors (C_{OUT}) immediately next to the IN pin and OUT pin of the MAX77837 IC, respectively. Since the IC operates at a high switching frequency with a fast LX edges, this placement is critical for minimizing parasitic inductance within the input and output current loops, which can cause high voltage spikes and damage the internal switching MOSFETs.
- Place the inductor next to the LX bumps (as close as possible) and make the traces between the LX bumps and the inductor short and wide to minimize PCB trace impedance. Excessive PCB impedance reduces converter efficiency. When routing LX traces on a separate layer, make sure to include enough vias to minimize trace impedance. Routing LX traces on multiple layers is recommended to reduce trace impedance further. Furthermore, make LX traces take up a manageable amount of area. The voltage on this node switches quickly, and additional area creates more radiated emissions.
- Connect the inner GND bumps to the low-impedance ground plane on the PCB with vias placed next to the bumps. Do not create GND islands, as GND islands risk interrupting the hot loops.
- It is essential for high converter efficiency to keep the power traces and load connections short and wide.
- Do not neglect ceramic capacitor DC voltage derating. Choose capacitor values and case sizes carefully. Refer to the *Output Capacitor Selection* section and refer to *Tutorial 5527* for more information.

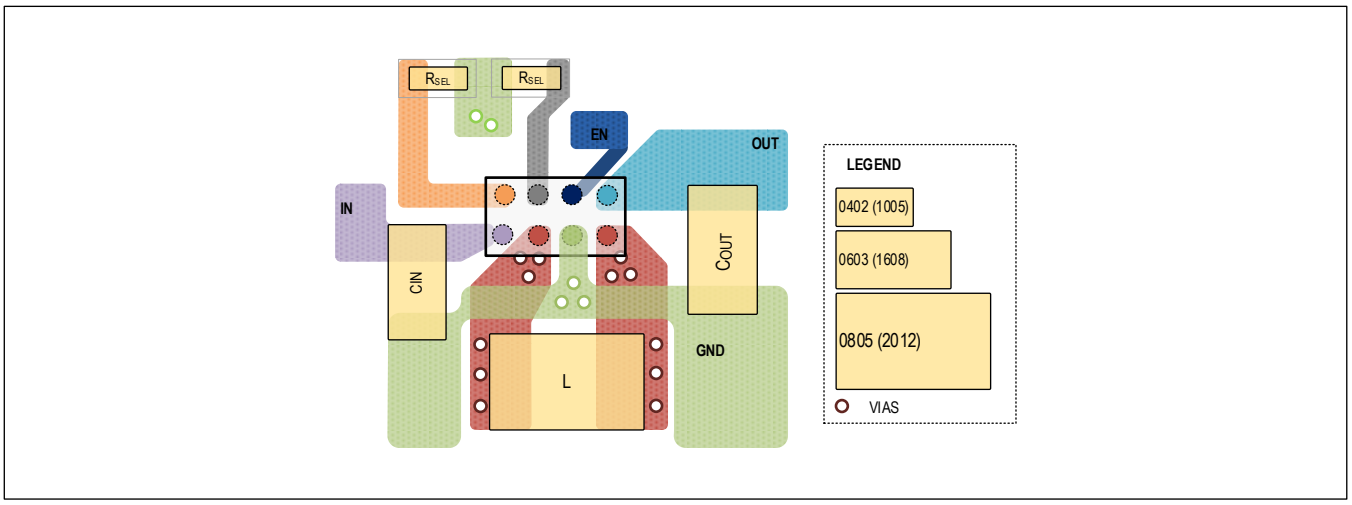


Figure 5. PCB Layout Guidelines

Ordering Information

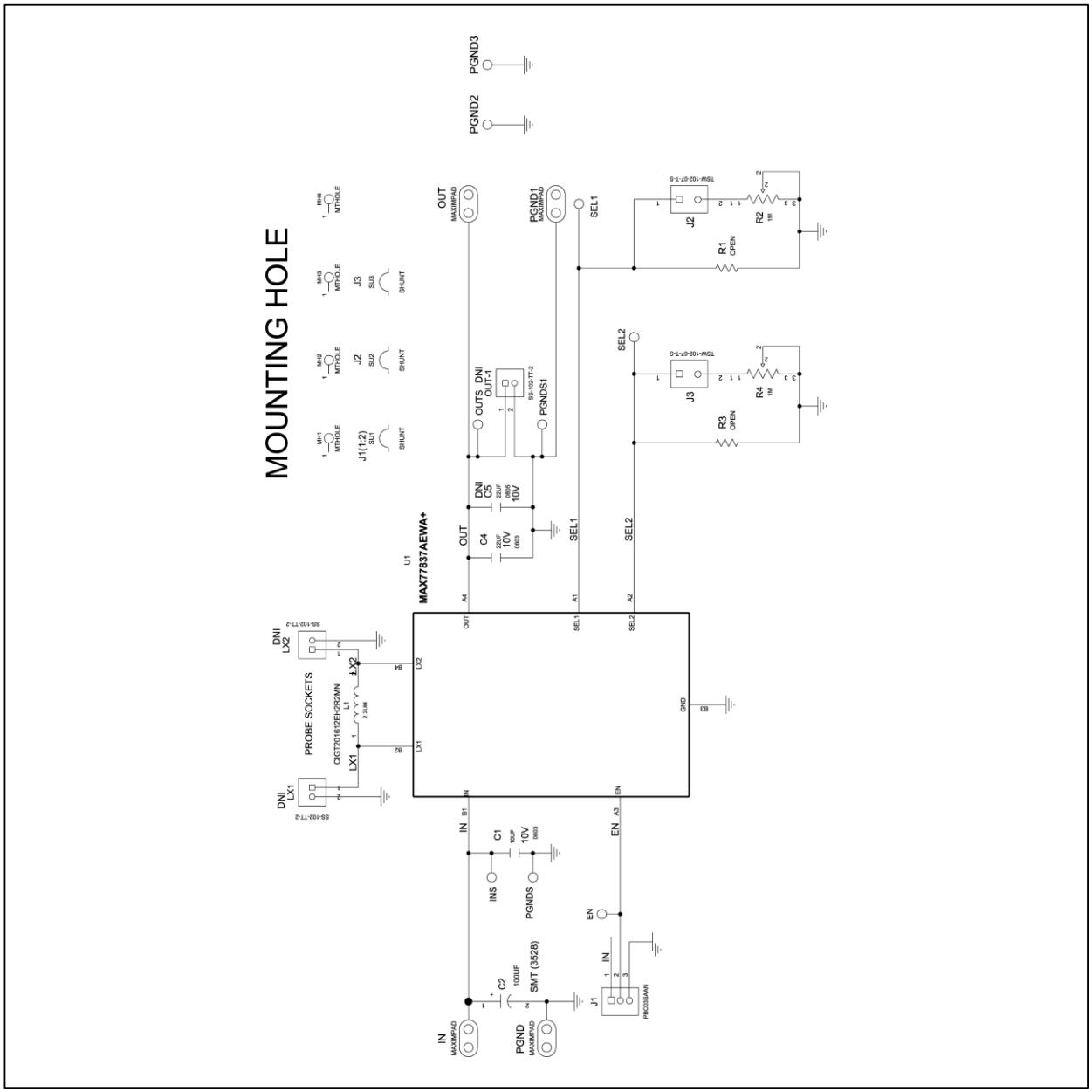
PART NUMBER	U1 IC	PIN PACKAGE
MAX77837WEVKIT#	MAX77837EWA+T	8 WLP

#Denotes RoHS-compliant.

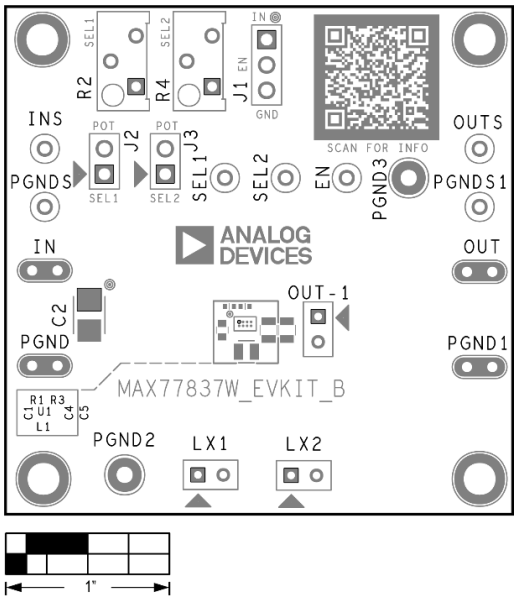
MAX77837 EV Kit Bill of Materials

PART	QTY	MFG PART #	MANUFACTURER	DESCRIPTION
C1	1	GRM188Z71A106KA73	MURATA	10µF ±10% 10V X7R CERAMIC CAPACITOR (0603)
C4	1	GRM21BD71A226ME44	MURATA	22µF ±10% 10V X7R CERAMIC CAPACITOR (0805)
L1	1	CIGT201610EH2R2MNE	SAMSUNG	2.2µH ±20% 2.4A THIN FILM INDUCTOR (0806)
R1, R3	0	N/A	N/A	RESISTOR OPEN (0402), PLACEHOLDER FOR R_{SEL1} AND R_{SEL2}
U1	1	MAX77837EWA+	MAXIM	1.05A NANO POWER BUCK-BOOST CONVERTER WLP8
Components below this line are outside of the immediate MAX77837 evaluation circuit and solution silkscreen.				
R2, R4	2	3296Y-1-105LF	BOURNS	1Meg ±10% ±100 PPM/DEGC RESISTOR (0402)
C2	1	TPSB107M010R0400	AVX	100µF ±20% 10V TANTALUM CAPACITOR (3528)
IN, OUT, PGND, PGND1	4	9020 BUSS	WEICO WIRE	MAXIM PAD WIRE WEICO WIRE SOFT DRAWN BUS TYPE-S 20AWG
EN, SEL1, SEL2	3	5002	KEYSTONE	TEST POINT BOARD HOLE=0.04IN; WHITE; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH
INS, PGNDS, PGNDS1	3	5001	KEYSTONE	TEST POINT BOARD HOLE=0.04IN; BLACK; PHOSPHOR BRONZE WIRE SILVER PLATE FINISH
PGND2, PGND3	2	5011	KEYSTONE	TEST POINT BOARD HOLE=0.063IN BLACK PHOSPHOR BRONZE WIRE SILVER PLATE FINISH
J1	1	PBC03SAAN	SULLINS	CONNECTOR; THROUGH HOLE; TSW SERIES; SINGLE ROW; STRAIGHT; 3PINS
J2, J3	2	TSW-102-07-T-S	SAMTEC	CONNECTOR; THROUGH HOLE; TSW SERIES; SINGLE ROW; STRAIGHT; 2PINS
PCB	1	MAX77837W	MAXIM	PCB:MAX77837W
SU1, SU2, SU3	3	S1100-B, SX1100-B, STC02SYAN	KYCON, KYCON, SULLINS ELECTRONICS CORP.	JUMPER STR TOTAL LENGTH=0.24IN BLACK PHOSPHOR BRONZE CONTACT=GOLD PLATED

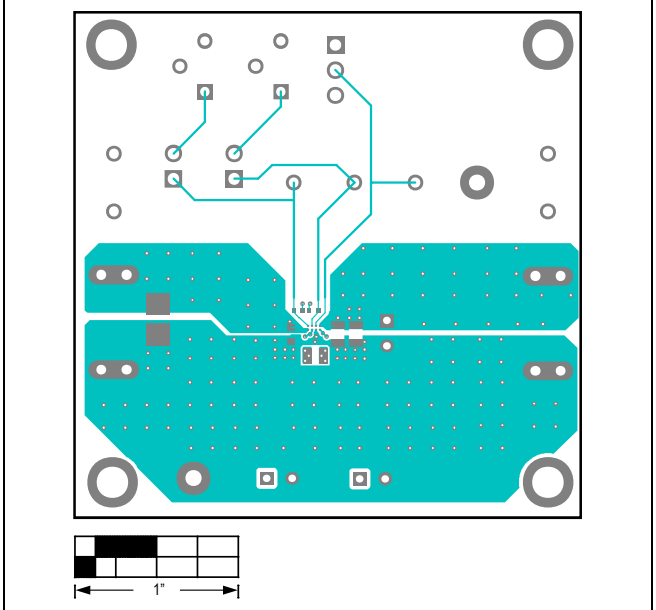
MAX77837 EV Kit Schematic Diagram



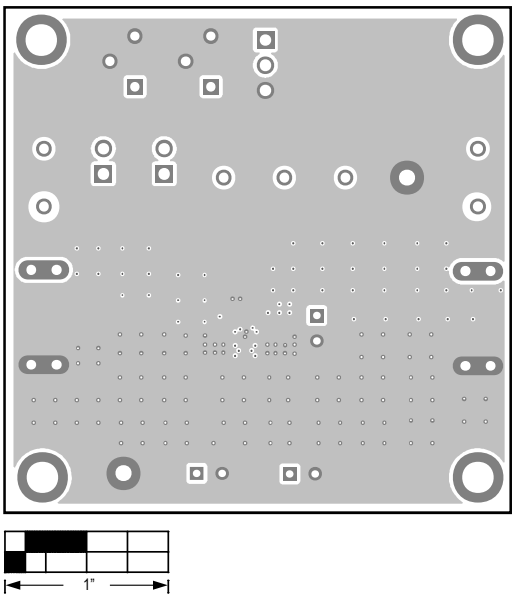
MAX77837 EV Kit PCB Layout Diagrams



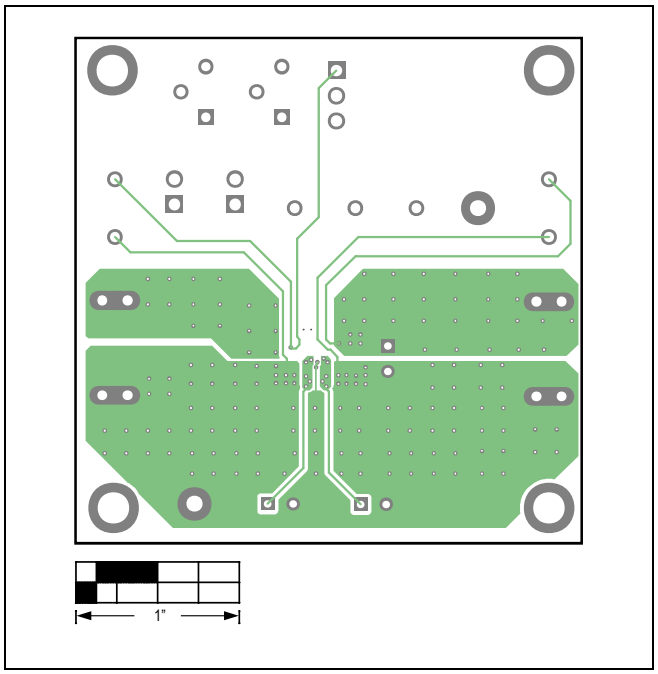
MAX77837 EV Kit Component Placement Guide—Top Silkscreen



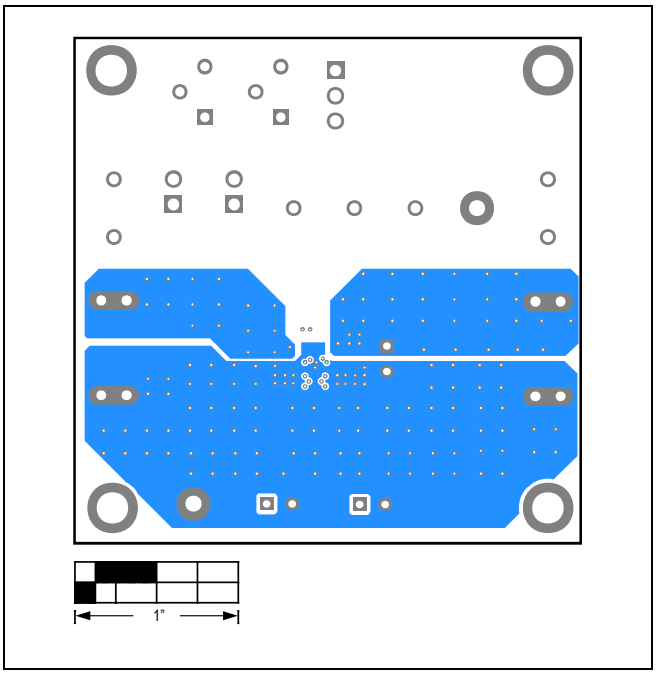
MAX77837 EV Kit PCB Layout—Top View



MAX77837 EV Kit PCB Layout—Layer 2



MAX77837 EV Kit PCB Layout—Layer 3



MAX77837 EV Kit PCB Layout—Bottom View

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	01/23	Initial release	—