Using the LMZ34002: Negative Output Voltage Simple Switcher® Power Module Evaluation Module

1 Introduction

The LMZ34002EVM-001 Evaluation Module is designed as an easy-to-use platform that facilitates an extensive evaluation of the features and performance of the Simple Switcher® power module. This guide provides information on the correct usage of the EVM and an explanation of the numerous test points on the board.

2 Description

The EVM features a LMZ34002 device configured for operation from a 4.5 V to 40 V input supply. The LMZ34002 is a non-synchronous, buck-boost (negative output) converter optimized for output voltages between -3 V and -17 V. The LMZ34002 operates at a fixed frequency of typically 800 kHz. The output voltage can be set to one of four popular values by using a simple configuration jumper. The EVM can supply up to 2 A of output current depending on the input and output voltage (See Figure 1). A minimal amount of input and output capacitance is used on the board. Component pads are provided for additional input and output capacitors if desired. Test points are provided that allow measurement of efficiency, power dissipation, input ripple, output ripple, line and load regulation, soft-start behavior, transient response, and UVLO behavior. The EVM uses a recommended PCB layout that maximizes thermal performance and minimizes output ripple and noise.

3 Getting Started

The host power supply is connected to the EVM at terminal block TB1. The VIN and GND terminals are clearly marked. The terminal block can accept up to number 16 AWG wire. For a complete evaluation, the host supply should be adjustable up to 40 V and be capable of delivering at least 3 A of current. The output of the EVM is presented to terminal block TB2. An electronic or resistive load can be connected to the block.

Input and output voltage test points are provided near the terminal blocks. These test points are intended to be used as voltage monitoring points where voltmeters can be connected to measure V_{IN} and V_{OUT}. Do not use these test points as the input supply or output load connection points. The PCB traces connecting to the test points are not designed to support high currents.

Before applying power, make certain that the V_{OUT} SELECT (J3) jumper is present and properly positioned for the intended output voltage. Always remove power before changing the jumper settings.

Once the jumper setting has been confirmed, set the host input supply to a voltage level between 4.5 V to 40 V, making sure that the sum of V_{IN} + $|V_{OUT}|$ does not exceed 50 V. See Table 1 for the maximum input voltages for the four preset V_{OUT} settings. Turn the host supply ON and then confirm that the selected output voltage is obtained.

Table 1. Output Voltage Settings and Maximum V_{IN}

V_{OUT} SELECT , J3 (V)	MAXIMUM V_{IN} (V)
-3.3	40
-5	40
-12	38
-15	35

4 Test Point Description

A number of wire loop test points have been provided as convenient connection points for DVMs or oscilloscope probes to aid in the evaluation of this device. A description of each test point is given in the following text.

V_{IN}	Input voltage monitoring point. Connect DVM to this point for efficiency measurements.
$-V_{OUT}$	Negative output voltage monitoring point. Connect DVM to this point for efficiency, line regulation, and load regulation measurements.
J1 (V_{IN})	Connect an oscilloscope probe with a short grounding tip to this pair of holes to measure input ripple voltage.
J2 ($-V_{OUT}$)	Connect an oscilloscope probe with a short grounding tip to this pair of holes to measure output ripple voltage and transient response.
SS	The voltage on the soft-start capacitor can be monitored here.
INH / UVLO	Ground this terminal to Inhibit power conversion via an on-board level-shifter. When open, the voltage on this pin is the voltage of the UVLO resistor divider network.
GND	Ground points for meters and oscilloscope probes.
PH	A via test point for monitoring the Phase pin (Switching Node) of the device with an oscilloscope. This test point can be used to measure the switching frequency of the regulator. Only a x10 oscilloscope probe should be used to monitor this point. The operation of the device can be affected by the stray capacitance of conventional cables or x1 probes.

5 Operation Notes

The UVLO threshold of the factory-stock EVM is approximately 4.5 V. The input voltage must be above the UVLO threshold before power conversion begins. The UVLO threshold is set by resistors R6 and R7. See the LMZ34002 datasheet for information on setting the UVLO voltage.

When the input voltage rises above the UVLO threshold, power conversion begins and the output voltage will ramp to its final value in approximately 10 ms. If desired, this soft-start interval can be increased by adding capacitance at location C4 on the bottom side of the EVM. This location is not populated on the factory-stock EVM.

The switching frequency of the factory-stock EVM is set to 800 kHz (typ) by populating resistor R8 with a 0-Ω resistor. The switching frequency can be changed to 500 kHz by changing R8 to 93.1 kΩ. See the LMZ34002 datasheet for switching frequency limits.

The CLK input pin (pin 31) has not been brought out to a test point on the factory-stock EVM.

The LMZ34002 is not designed to endure a sustained short circuit on its output. It survives momentary shorts (< 5 seconds), but sustained short circuits may cause permanent damage to the device.

The maximum output current is dependent on the input and output voltage. Figure 1 shows the output current limits for four common output voltages over the input voltage range.

6 Maximum Output Current

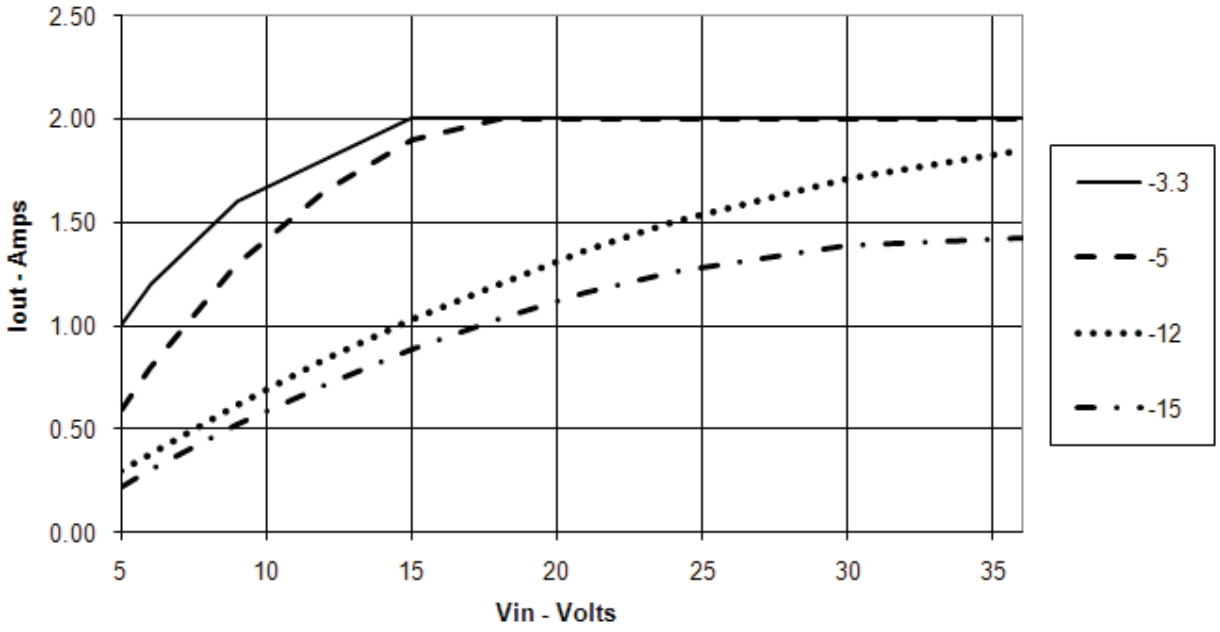

Figure 1. LMZ34002 Safe Output Current

7 Schematic

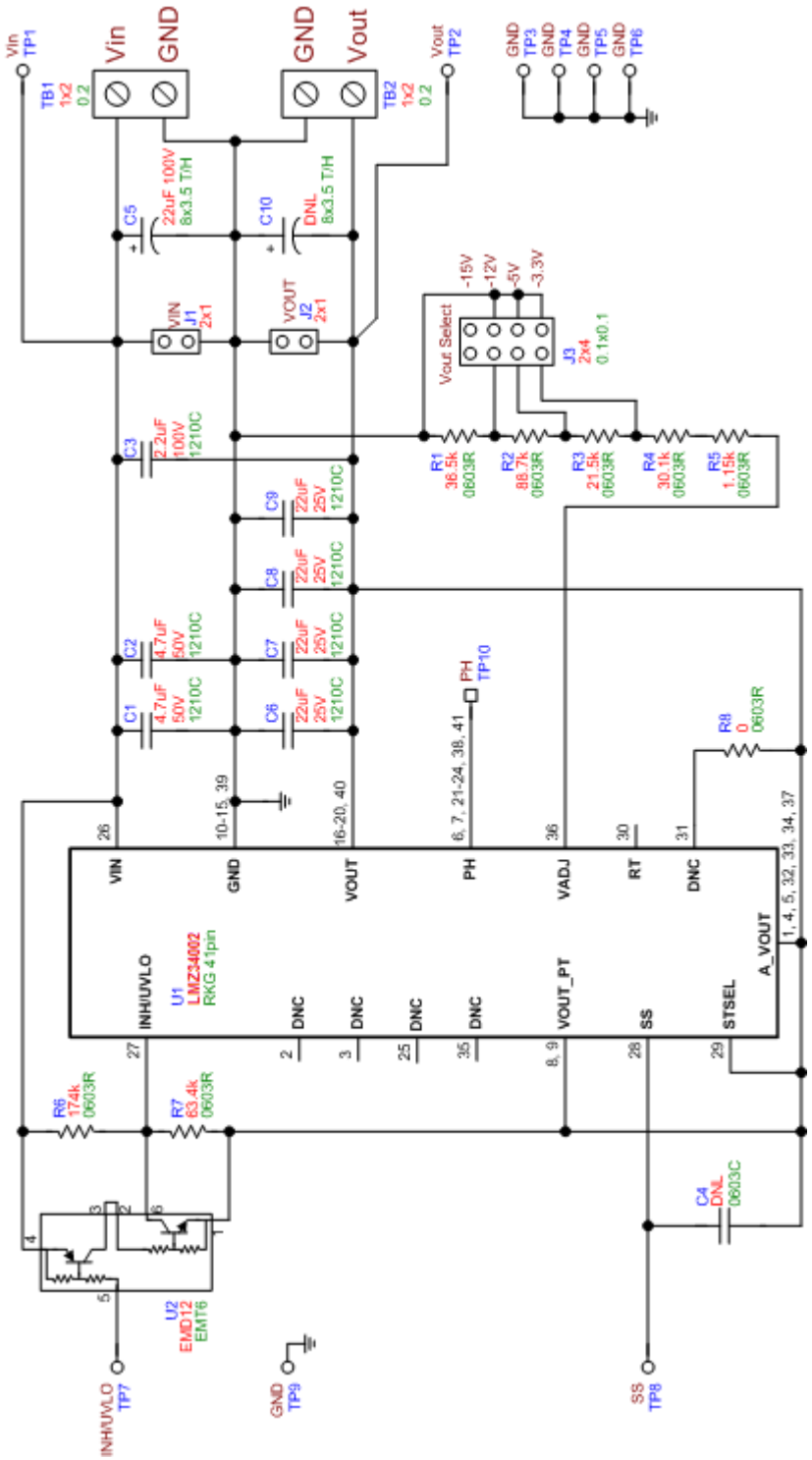

Figure 2. Schematic, LMZ34002 EVM

8 EVM Assembly Drawings and PCB Layout

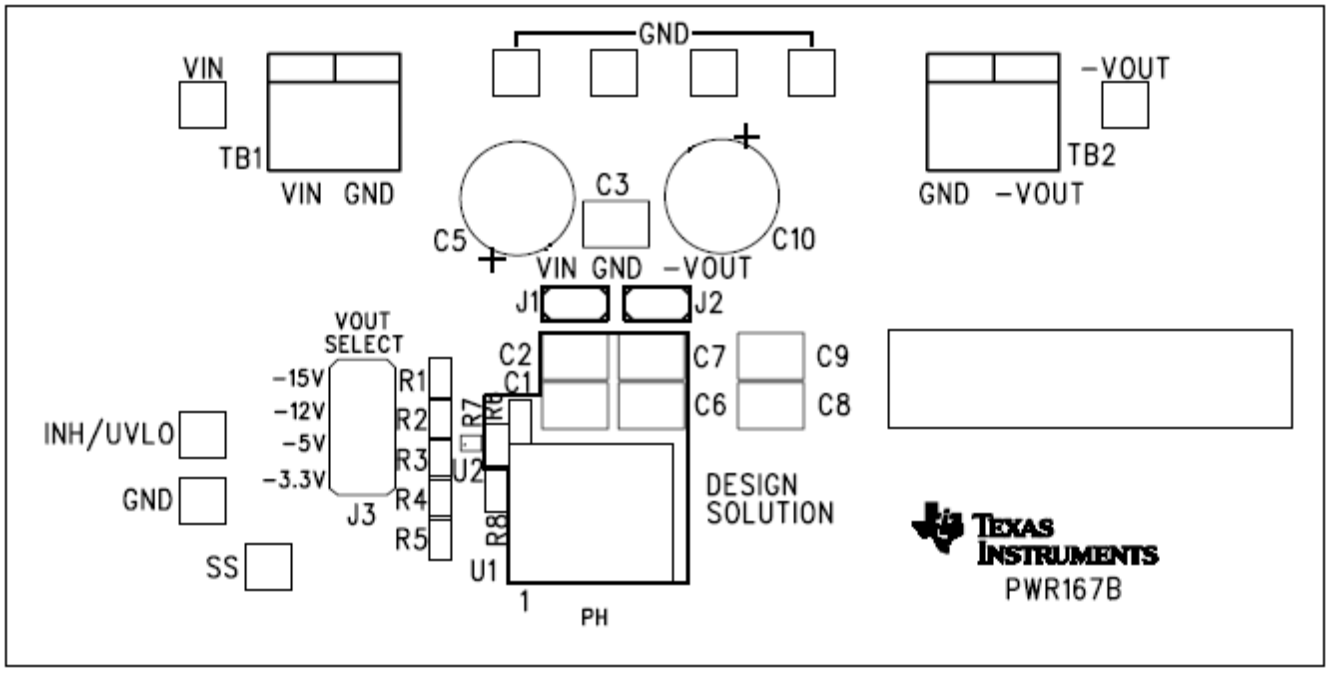

Figure 3. Top Side Components

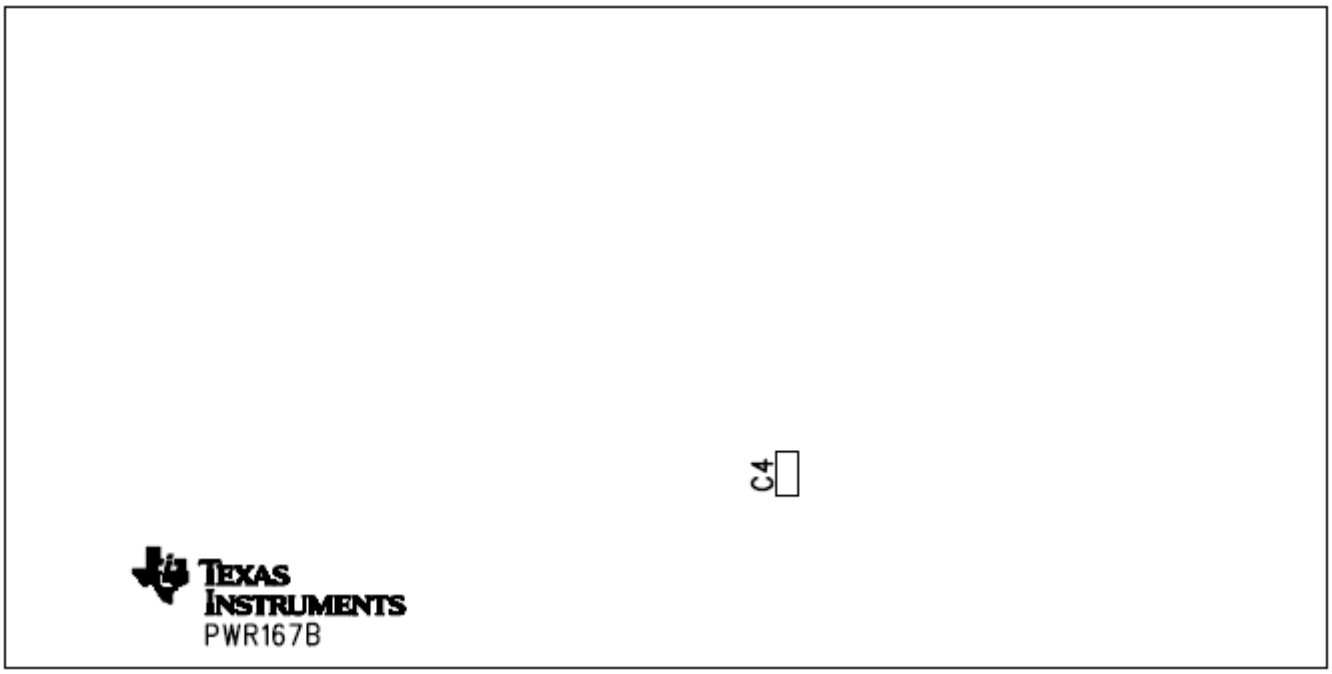

Figure 4. Bottom Side Components

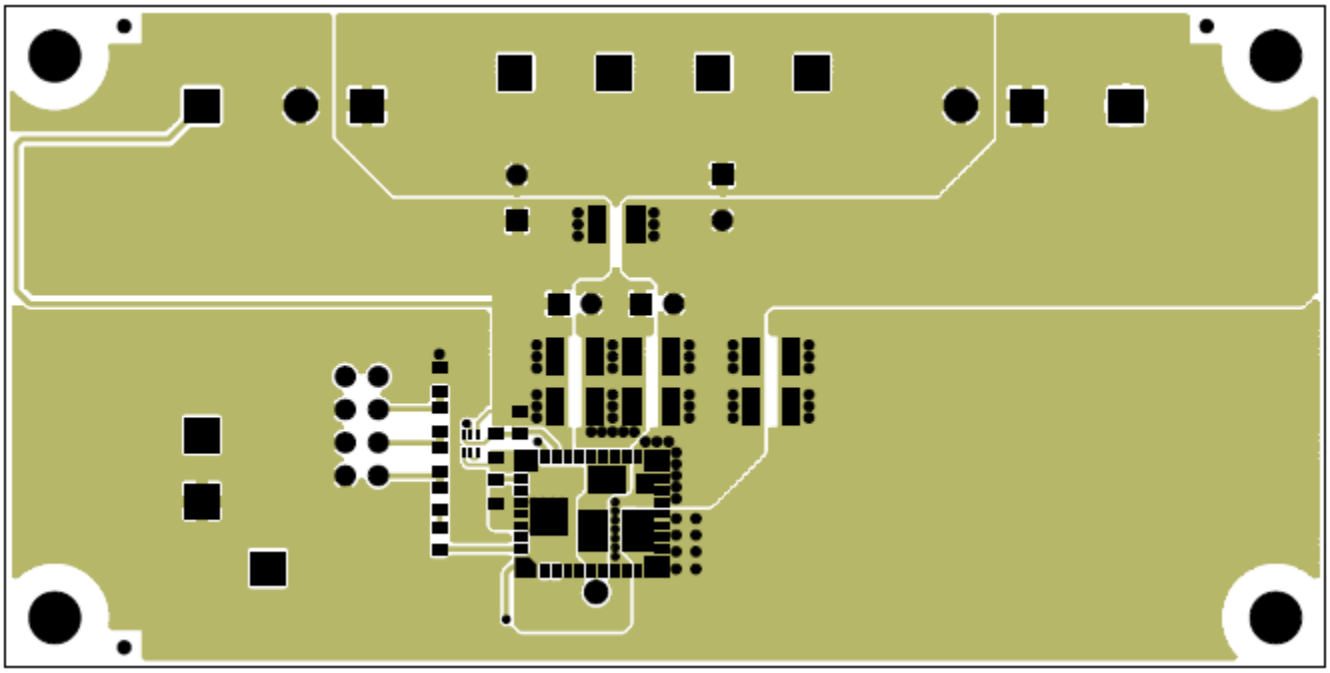

Figure 5. Layer 1

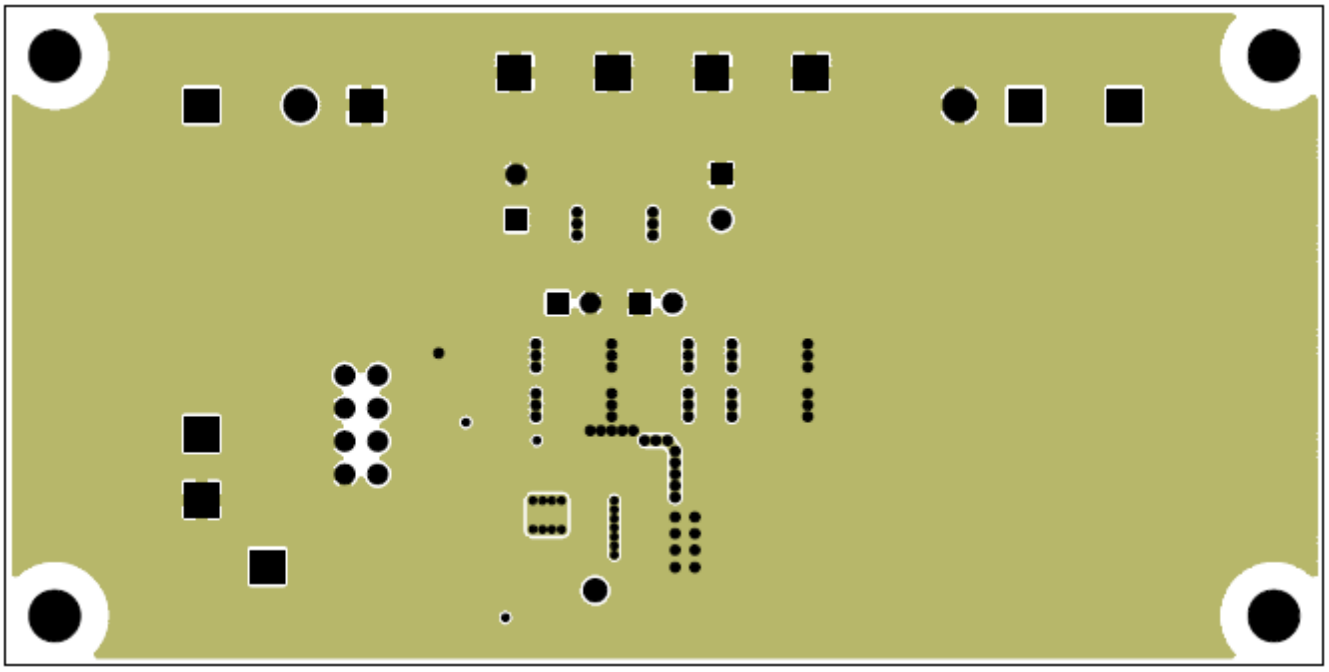

Figure 6. Layer 2

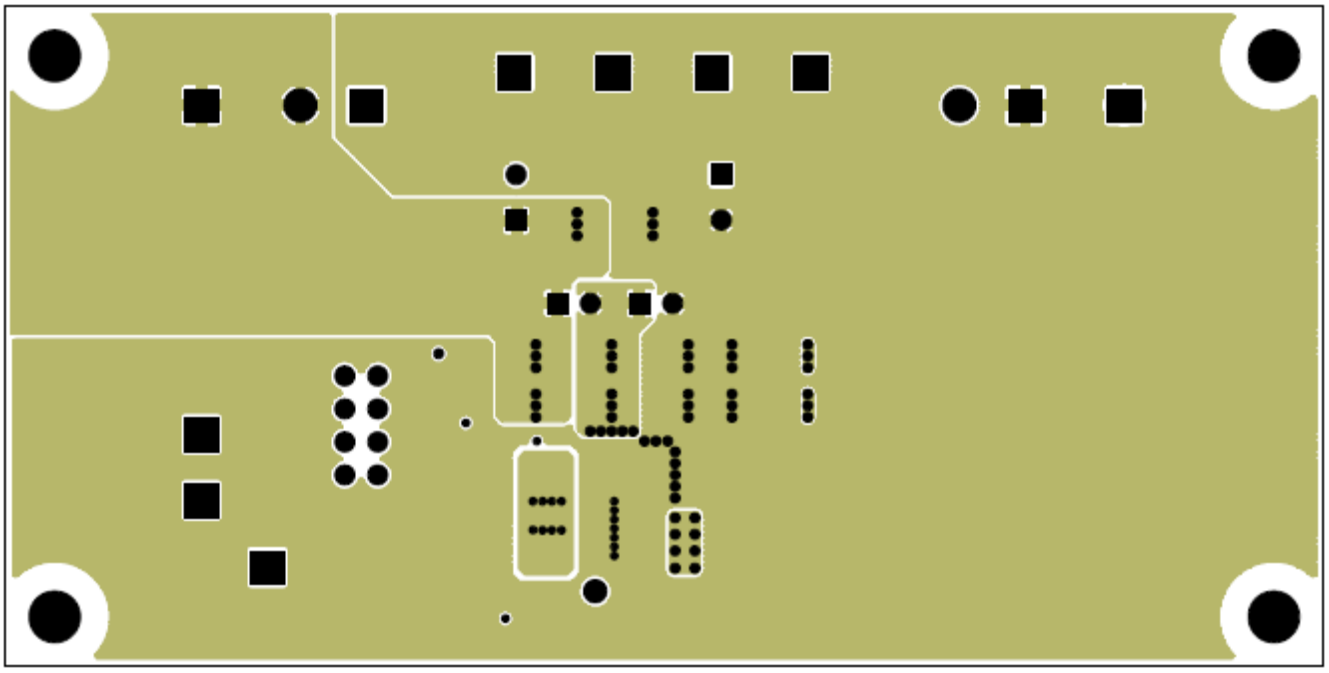

Figure 7. Layer 3

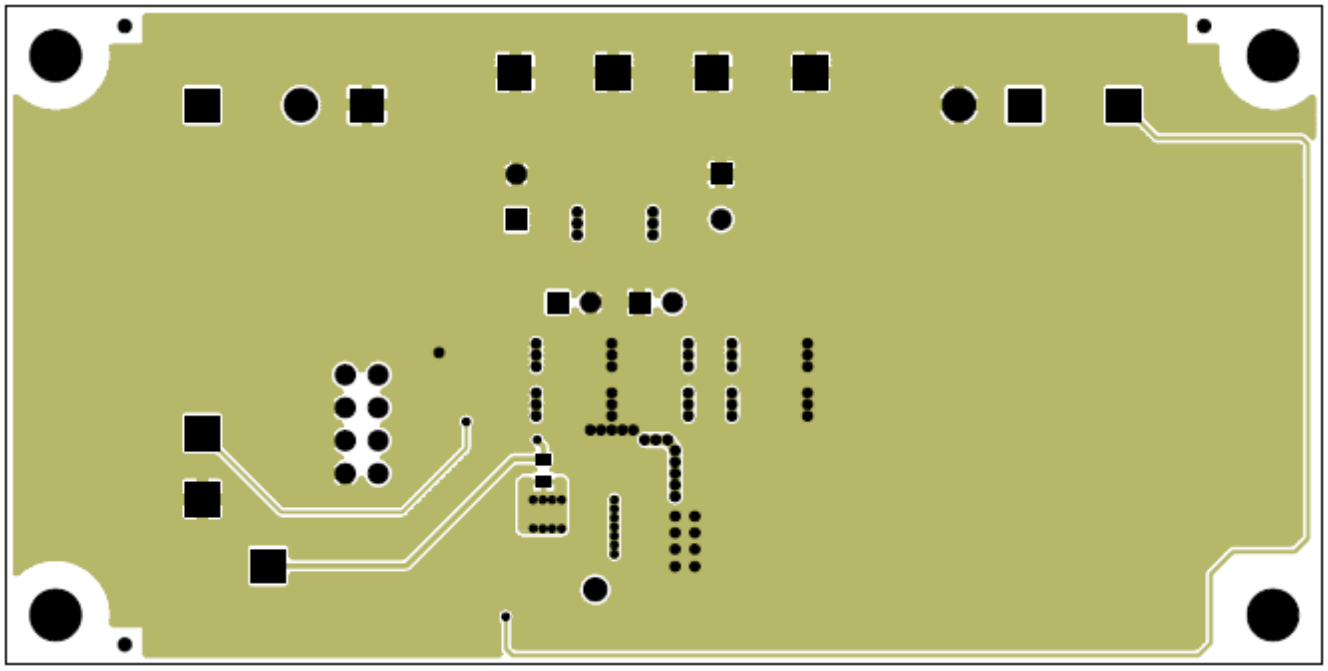

Figure 8. Layer 4

9 Bill of Material

Table 2. LMZ34002 EVM Bill of Material

Qty	RefDes	Value	Description	Size	Part Number	Mfr
2	C1, C2	4.7uF	Capacitor, Ceramic, 50V, X7R, 20%	1210	GRM32ER71H475K	Murata
1	C3	2.2uF	Capacitor, Ceramic, 100V, X7R, 10%	1210	GRF32ER72A225K	Murata
0	C4		Do Not Load	0603		
1	C5	22uF	Capacitor, Electrolytic, 100V	8 x 3.5 (mm)	EEU-FC2A220	Panasonic
4	C6, C7, C8, C9	22uF	Capacitor, Ceramic, 25V, X5R, 20%	1210	GRM32ER61E226K	Murata
0	C10		Do Not Load	8 x 3.5 (mm)		
0	J1, J2		Do Not Load			
1	J3	PEC04DAAN	Header, Male 2x4-pin, 100mil spacing	2 X 4 100mil	PEC04DAAN	Sullins
1	R1	36.5k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R2	88.7k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R3	21.5k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R4	30.1k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R5	1.15k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R6	174k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R7	63.4k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R8	0	Resistor, Chip, 1/16W, 1%	0603	Std	Std
2	TB1, TB2	ED120/2DS	Terminal Block, 2-pin, 15-A, 5.1mm	0.40 x 0.35 inch	ED120/2DS	OST
1	TP1	5010	Test Point, Red, Thru Hole	0.125 x 0.125 inch	5010	Keystone
1	TP2	5014	Test Point, Yellow, Thru Hole	0.125 x 0.125 inch	5014	Keystone
5	TP3-6,9	5011	Test Point, Black, Thru Hole	0.125 x 0.125 inch	5011	Keystone
2	TP7,8	5012	Test Point, White, Thru Hole	0.125 x 0.125 inch	5012	Keystone
0	TP10		Do Not Load			
1	U1**	LMZ34002RKG	IC, 5-36V Input, 2A, Buck-Boost, Power Module	QFN	LMZ34002RKG	TI
1	U2	DCX144EH-7	Trans, Prebias, NPN/PNP	SOT-563	DCX144EH-7	Diodes
1	--		PCB, LMZ34002 Sample Eval Bd	2 x 4 x 0.062 inch	074-01047	Any
1		929950-00	Shunt, Black	100-mil	929950-00	3M
1			EVM Plastic Base, 2 x 4 inch		076-00447	TI
4			4-40 x 1/4 Stainless Steel Panhead Screw	4-40 x 1/4 inch	Std	Std
4		SJ-5003	BUMPON HEMISPHERE .44X.20 BLACK		SJ-5003	3M

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- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

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Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

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Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

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http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

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3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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