TPS61089-PWR742 Evaluation Module

This user's guide describes the characteristics, operation, and the use of the TPS61089EVM-742 evaluation module (EVM). The EVM contains the TPS61089, which is a 7-A boost converter with 12.6-V maximum output voltage. This user's guide includes EVM specifications, recommended test setup, test results, a schematic diagram, bill of materials (BOM), and the board layout.

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1 Introduction

1.1 Performance Specification

Table 1 provides a summary of the TPS61089EVM performance specifications. All the specifications are given for an ambient temperature of 25°C.

Table 1. Performance Specification Summary

Specification	Test Conditions	MIN	TYP	MAX	Unit
Input voltage		3.0	3.6	5	V
Output voltage	TPS61089EVM, V_{IN} = 3.6 V, $I_O \le 2$ A	8.7	9	9.3	V

1.2 Modification

The printed-circuit board (PCB) for this EVM is designed to accommodate some user-modification. The external component can be changed according to the real application.

1.3 Input Capacitor

A 150-µF tantalum capacitor, C1, is added as the input capacitor in the EVM. The ESR of the tantalum capacitor is 0.1 Ω, to damp the ringing of the input voltage when the EVM is powered by a power supply with a long cable. The capacitor is not required for proper operation and can be removed in a real application.

2 Setup

This section describes how to properly connect, set up, and use the TPS61089EVM-742.

2.1 Input/Output Connector Descriptions

The input and output connector descriptions are described in this section:

J1-VIN Positive input connection from the input supply for the EVM

J2-GND Return connection from the input supply for the EVM

J3-VOUT Output voltage connection

JP1-Vin_control The VIN (internal control circuit's power supply) voltage select pin of the TPS61089. Put a jumper across it to let it directly connect to the power stage input voltage, or pull off the jumper to use a user-defined voltage.

JP2-EN EN pin input jumper. Place a jumper across EN and pin 1 to turn on the IC, place a jumper across EN and pin 3 to turn off the IC

3 Test Results

3.1 Startup Waveform

The startup waveform is shown in Figure 1.

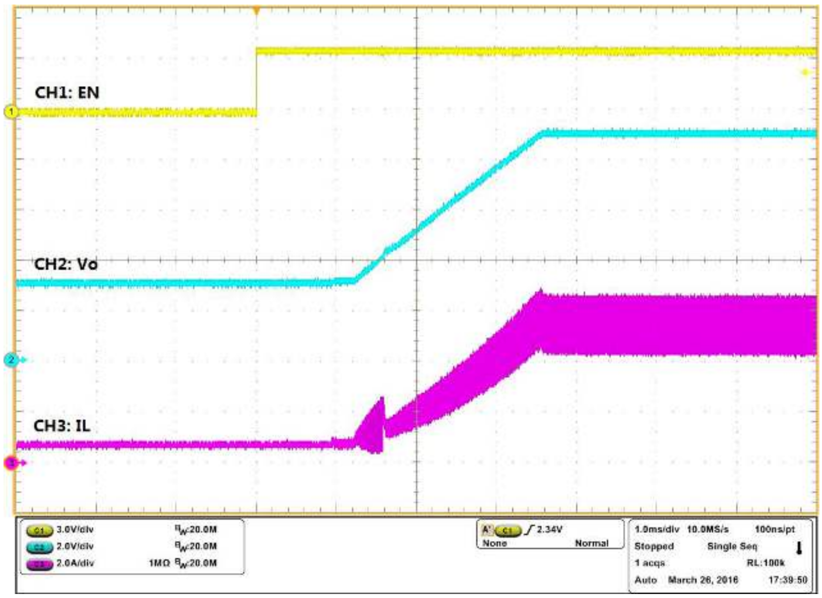

Figure 1. Startup Waveforms (V_{IN} = 3.6 V, V_O = 9 V / I_O = 2 A)

3.2 Efficiency

The conversion efficiency is shown in Figure 2.

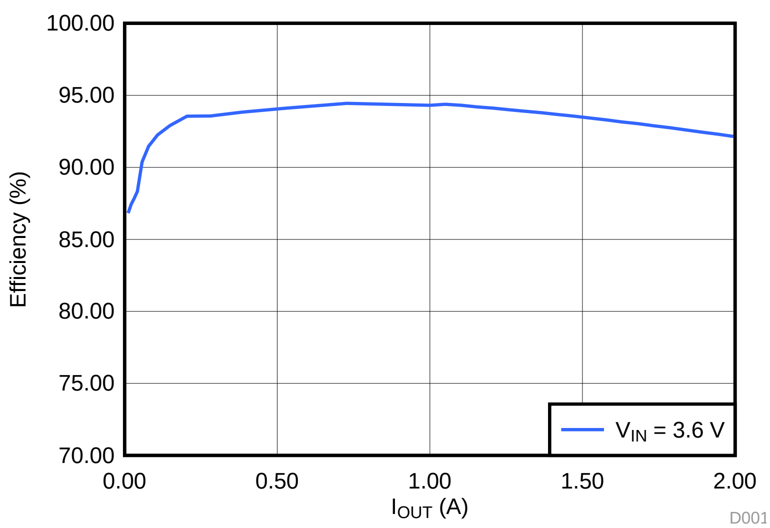

Figure 2. TPS61089EVM Efficiency (V_O = 9 V)

3.3 Load Transient

The load transient waveform is shown in Figure 3. Note that the effective output capacitance is about 34 µF under 9-V DC bias, although three 22-µF ceramic capacitors are used in the EVM. Larger effective capacitance helps improve the load transient.

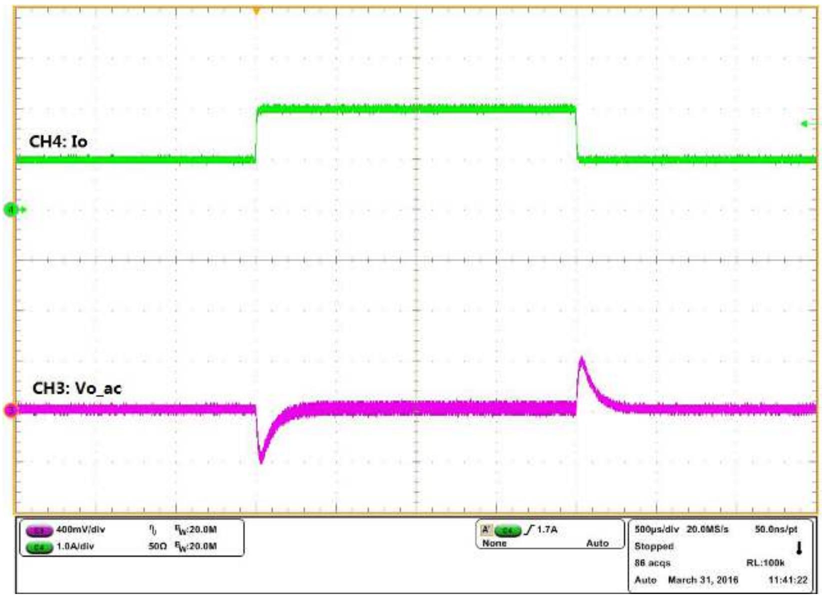

Figure 3. Load Transient (V_O = 9 V / I_O = 1 A to 2 A)

3.4 Loop Characteristics

The loop Bode plot is shown in Figure 4.

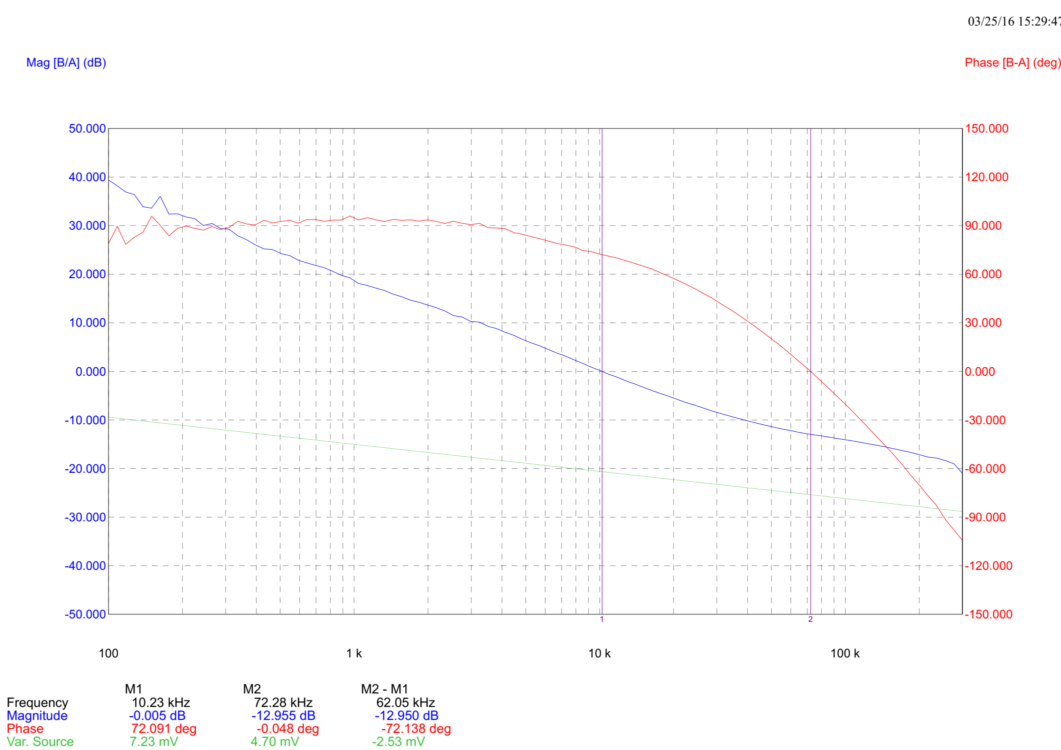

Figure 4. Loop Bode Plot (V_{IN} = 3.6 V, V_O = 9 V / I_O = 2 A)

3.5 Output Voltage Ripple

Figure 5 shows the output voltage ripple, switching waveforms, and the inductor current in CCM mode.

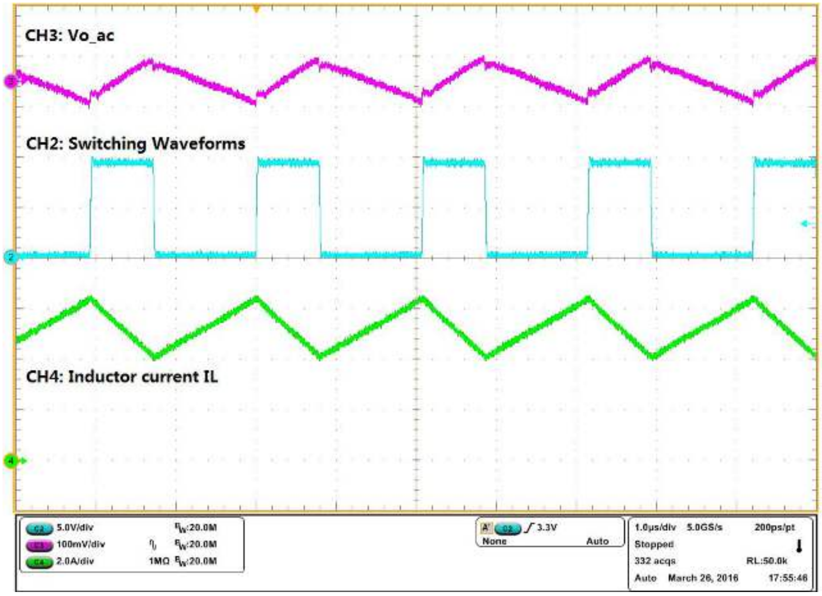

Figure 5. Output Ripple in CCM (V_{IN} = 3.6 V, V_O = 9 V / I_O = 2 A)

Figure 6 shows the output voltage ripple, switching waveforms, and the inductor current in DCM mode.

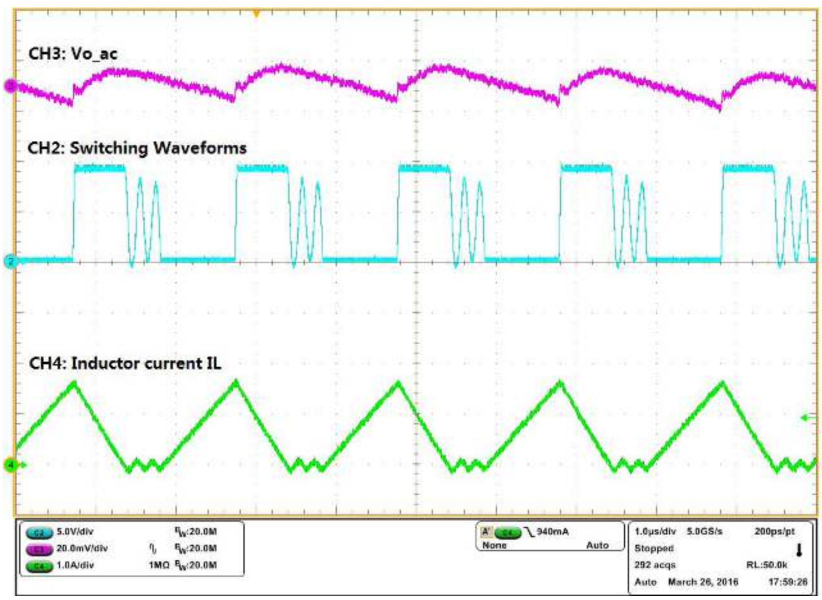

Figure 6. Output Ripple in DCM (V_{IN} = 3.6 V, V_O = 9 V / I_O = 0.25 A)

Figure 7 shows the output voltage ripple, switching waveforms, and the inductor current in PFM mode when the converter is operating at light load.

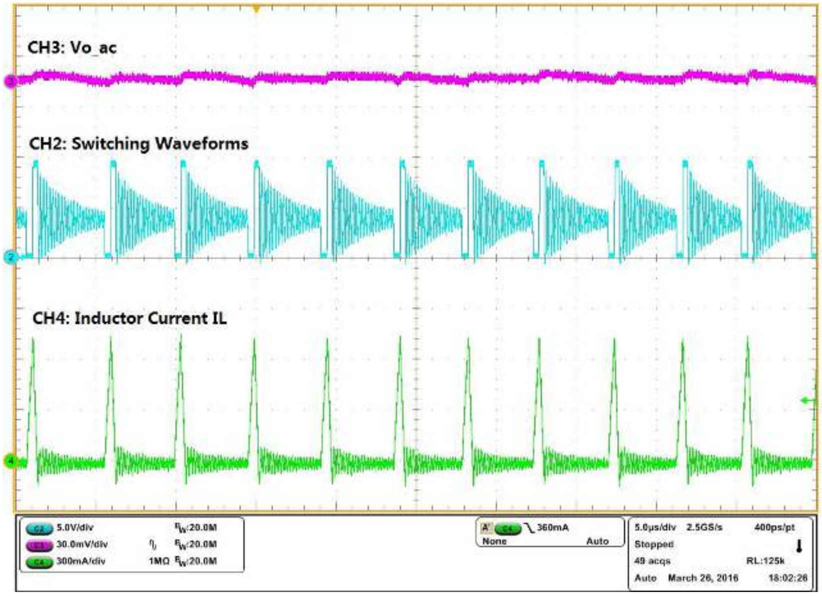

Figure 7. Output Ripple in PFM (V_{IN} = 3.6 V, V_O = 9 V / I_O = 20 mA)

4 Schematic and Bill of Materials

This section provides the TPS61089EVM-742 schematic, bill of materials (BOM), and board layout.

4.1 Schematic

Figure 8 illustrates the EVM schematic.

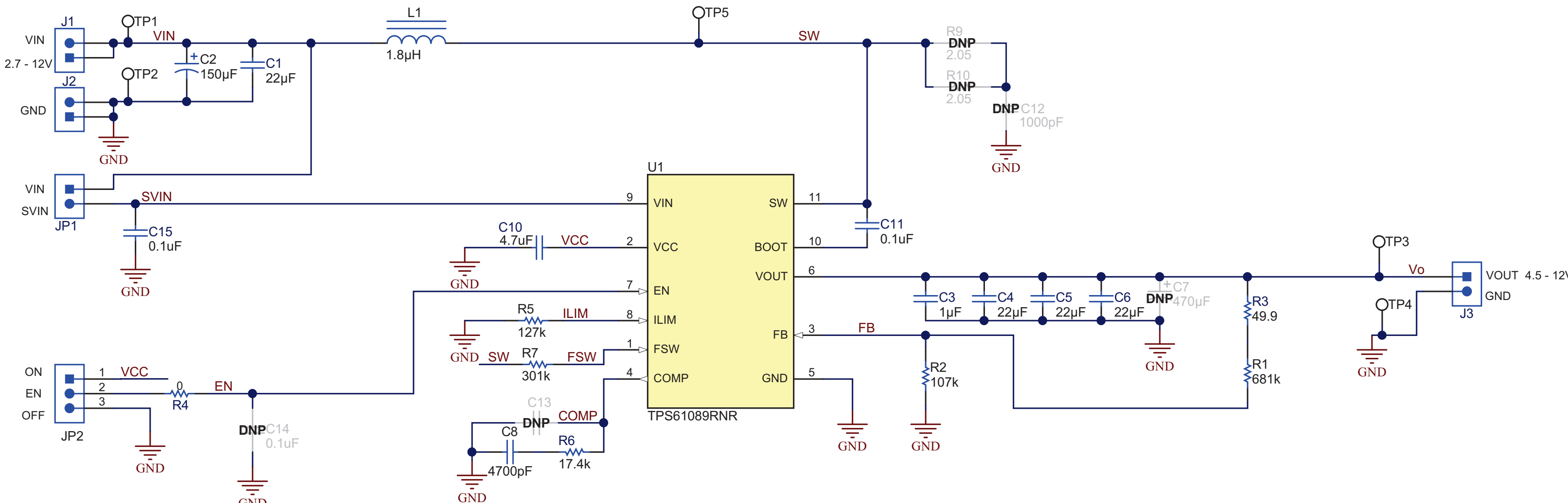

Figure 8. TPS61089EVM-742 Schematic

4.2 Bill of Materials

Table 2 displays the EVM bill of materials.

Table 2. TPS61089EVM-742 Bill of Materials

Designator	QTY	Value	Description	Package	Part Number	MFG
C1	1	22uF	CAP, CERM, 22 µF, 16 V, +/- 10%, X5R, 1206	1206	GRM31CR61C226KE15L	Murata
C2	1	150uF	CAP, TA, 150 µF, 10 V, +/- 10%, 0.1 ohm, SMD	7343-31	T495D157K010ATE100	Kemet
C3	1	1uF	CAP, CERM, 1 µF, 25 V, +/- 10%, X7R, 0603	0603	GRM188R71E105KA12D	Murata
C4, C5, C6	3	22uF	CAP, CERM, 22 µF, 25 V, +/- 10%, X7R, 1210	1210	GRM32ER71E226KE15L	Murata
C8	1	4700pF	CAP, CERM, 4700 pF, 50 V, +/- 10%, X5R, 0402	0402	GRM155R61H472KA01D	Murata
C10	1	4.7uF	CAP, CERM, 4.7uF, 10V, +/-10%, X5R, 0603	0603	0603ZD475KAT2A	AVX
C11, C15	2	0.1uF	CAP, CERM, 0.1uF, 16V, +/-10%, X5R, 0402	0402	GRM155R61C104KA88D	Murata
J1, J2, J3	3		Terminal Block, 6A, 3.5mm Pitch, 2-Pos, TH	7.0x8.2x6.5mm	ED555/2DS	On-Shore Technology
JP1	1		Header, 100mil, 2x1, Tin, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions
JP2	1		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions
L1	1	1.8uH	Inductor, Shielded Drum Core, Metal Composite, 1.8 µH, 9.3 A, 0.0126 ohm, SMD	9.5x8.7mm	CDMC8D28NP-1R8MC	Sumida
R1	1	681k	RES, 681 k, 1%, 0.063 W, 0402	0402	CRCW0402681KFKED	Vishay-Dale
R2	1	107k	RES, 107 k, 1%, 0.063 W, 0402	0402	CRCW0402107KFKED	Vishay-Dale
R3	1	49.9	RES, 49.9 ohm, 1%, 0.063W, 0402	0402	CRCW040249R9FKED	Vishay-Dale
R4	1	0	RES, 0 ohm, 5%, 0.063W, 0402	0402	RC0402JR-070RL	Yageo America
R5	1	127k	RES, 127 k, 1%, 0.063 W, 0402	0402	CRCW0402127KFKED	Vishay-Dale
R6	1	17.4k	RES, 17.4k ohm, 1%, 0.063W, 0402	0402	CRCW040217K4FKED	Vishay-Dale
R7	1	301k	RES, 301 k, 1%, 0.063 W, 0402	0402	CRCW0402301KFKED	Vishay-Dale
U1	1		12.6-V, 7-A FULLY INTEGRATED SYNCHRONOUS BOOST CONVERTER IN 2.0mm x 2.5mm QFN PACKAGE, RNR0011A	RNR0011A	TPS61089RNR	Texas Instruments
C7	0	470uF	CAP, AL, 470 µF, 25 V, +/- 20%, 0.053 ohm, TH	2-Pin Radial, Dia 10 mm, Height 12.5 mm, Pin Sapcing 5 mm	25ZLJ470M10X12.5	Rubycon
C12	0	1000pF	CAP, CERM, 1000 pF, 100 V, +/- 10%, X7R, 0603	0603	GRM188R72A102KA01D	Murata
C13	0	47pF	CAP, CERM, 47 pF, 50 V, +/- 1%, C0G, 0402	0402	GRM1555C1H470FA01D	Murata
C14	0	0.1uF	CAP, CERM, 0.1uF, 16V, +/-10%, X5R, 0402	0402	GRM155R61C104KA88D	Murata
R9, R10	0	2.05	RES, 2.05, 1%, 0.1 W, 0603	0603	CRCW06032R05FKEA	Vishay-Dale

5 Board Layout

Figure 9 through Figure 12 show the TPS61089EVM-742 PCB layout.

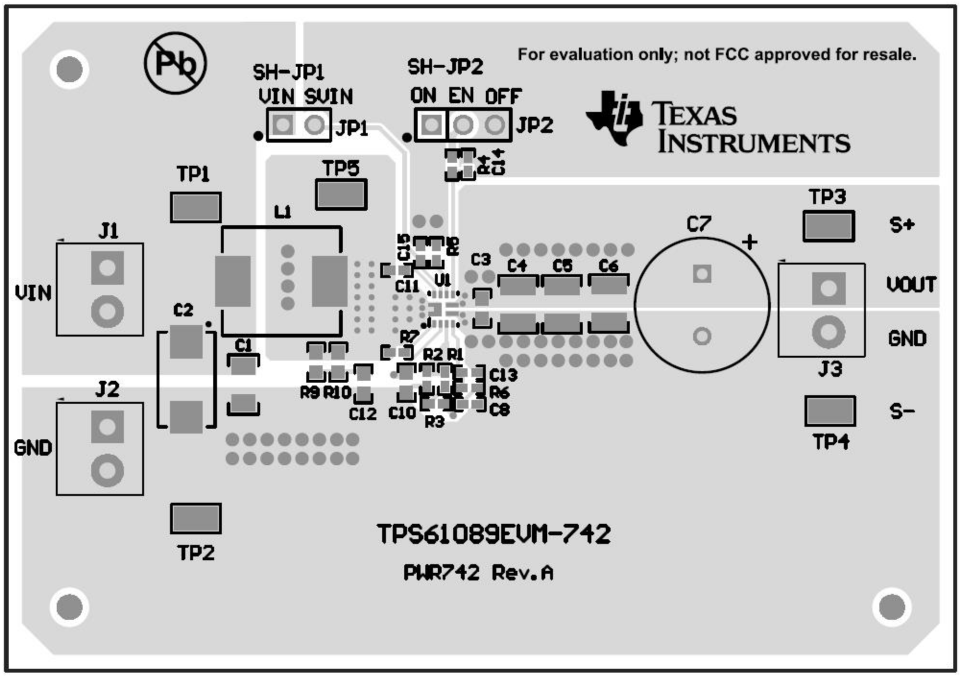

Figure 9. TPS61089EVM-742 Top-Side Layout

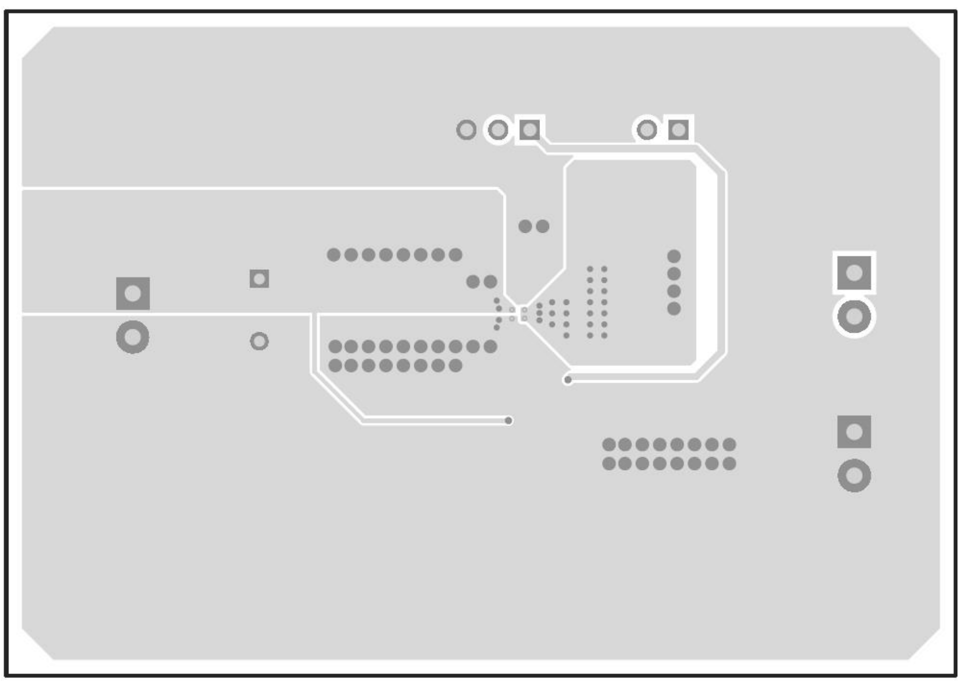

Figure 10. TPS61089EVM-742 Bottom-Side Layout

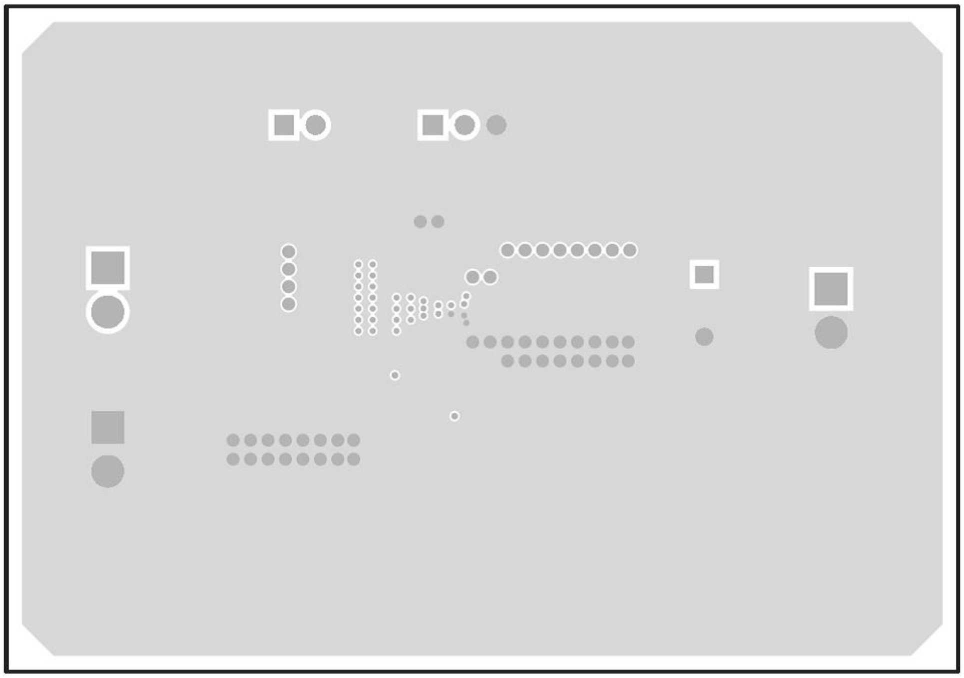

Figure 11. TPS61089EVM-742 Internal Layer 1

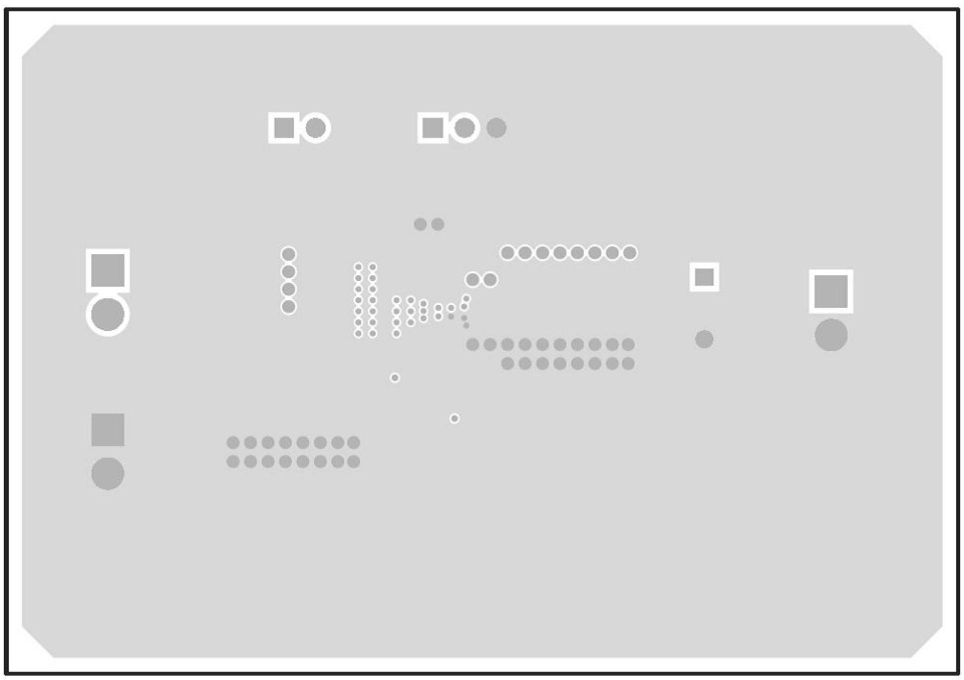

Figure 12. TPS61089EVM-742 Internal Layer 2

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   This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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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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3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210*

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Concernant les EVMs avec antennes détachables

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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2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
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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8. *Limitations on Damages and Liability:*

   8.1 *General Limitations*. IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS ANDCONDITIONS OR THE USE OF THE EVMS PROVIDED HEREUNDER, REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN ONE YEAR AFTER THE RELATED CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY WARRANTY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS AND CONDITIONS, OR ANY USE OF ANY TI EVM PROVIDED HEREUNDER, EXCEED THE TOTAL AMOUNT PAID TO TI FOR THE PARTICULAR UNITS SOLD UNDER THESE TERMS AND CONDITIONS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM AGAINST THE PARTICULAR UNITS SOLD TO USER UNDER THESE TERMS AND CONDITIONS SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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