TPS61087EVM

This user's guide describes the characteristics, operation, and use of the TPS61087EVM evaluation module (EVM). This EVM contains the Texas Instruments 650-kHz/1.2-MHz, 18.5-V step-up DC-DC converter TPS61087. The user's guide includes EVM specifications, recommended test setup, the schematic diagram, bill of materials, and the board layout.

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1 Introduction

This section contains background information for the TPS61087EVM evaluation module.

1.1 Background

This TPS61087EVM uses a TPS61087 boost converter to step up 2.5-V to 6-V input voltages to 15 V. The goal of the EVM is to facilitate evaluation of the TPS61087 power supply solution. The EVM uses the TPS61087 adjustable output boost converter and the appropriate feedback components to provide 15 V.

1.2 Performance Specification Summary

Table 1 provides a summary of the TPS61087EVM performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 1. Performance Specification Summary

SPECIFICATION	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{IN}		2.5		6	V
V_{OUT} (1)	TPS61087EVM, V_{IN} = 5 V +/- 2%, I_{OUT} < 500 mA, f_{SW} = 1.2 MHz	14.7	15	15.3	V

(1) Min and Max values include 1% resistor tolerance as well as IC reference tolerance.

2 Setup and Test Results

This section describes how to properly connect, set up, and use the TPS61087EVM.

2.1 Input/Output Connections

The connection points are described in the following paragraphs.

2.1.1 J1-VIN and GND

This header is the positive (pins 1 to 3) and return (pins 4 to 6) connections to the input power supply. The leads to the input supply should be twisted and kept as short as possible. The input voltage has to be between 2.5 V and 6 V.

2.1.2 J4-VOUT and GND

This header is the positive output (pins 1 to 3) and the return connection (pins 4 to 6) for the device.

2.1.3 J2-EN

Placing a jumper across pins 1 and 2 ties the EN pin to VIN, thereby enabling the device. Placing a jumper across pins 2 and 3 ties the EN pin to GND, which disables the device.

2.1.4 JP3-FREQ

The middle pin of this jumper connects to the FREQ pin of the IC. Placing this jumper across pins 1 and 2 ties the FREQ pin to V_{IN}, thereby implementing a 1.2-MHz switching frequency. Placing this jumper across pins 2 and 3 ties the FREQ pin to ground, thereby implementing a 650-kHz switching frequency.

2.2 EVM Operation

The user must connect an input power supply set between 2.5 V and 6 V at header J1 in order for the EVM to operate. The absolute maximum input voltage is 7 V. The user can connect a load resistance at J4. Connect a jumper between pins 1 and 2 of J2 to enable the device.

2.3 Compensation (R1, C6)

The regulator loop can be compensated by adjusting the external components connected to the COMP pin. The COMP pin is the output of the internal transconductance error amplifier. Standard values of R_{COMP} = 16 kΩ and C_{COMP} = 2.7 nF will work for the majority of the applications.

Refer to Table 2 for dedicated compensation networks giving an improved load transient response. The following equations can be used to calculate R_{COMP} and C_{COMP}:

$$R_{COMP} = \frac{110 \times V_{IN} \times V_S \times Cout}{L \times Iout\_max} \qquad C_{COMP} = \frac{V_S \times Cout}{7.5 \times Iout\_max \times R_{COMP}} \quad (1)$$

Table 2. Recommended Compensation Network Values at High/Low Frequency

FREQUENCY	L (µH)	V_S (V)	V_{IN} ± 20% (V)	R_{COMP} (kΩ)	C_{COMP}
High (1.2 MHz)	3.3	15	5	100	820 pF
			3.3	91	1.2 nF
		12	5	68	820 pF
			3.3	68	1.2 nF
		9	5	39	820 pF
			3.3	39	1.2 nF
Low (650 kHz)	6.8	15	5	51	1.5 nF
			3.3	47	2.7 nF
		12	5	33	1.5 nF
			3.3	33	2.7 nF
		9	5	18	1.5 nF
			3.3	18	2.7 nF

Table 2 gives conservatives Rcomp and Comp values for certain inductors, input and output voltages providing a very stable system. For a faster response time, a higher Rcomp value can be used to enlarge the bandwidth, as well as a slightly lower value of Ccomp to keep enough phase margin. These adjustments should be performed in parallel with the load transient response monitoring of TPS61087.

3 Schematic, Bill of Materials, and Board Layout

This section provides the TPS61087EVM bill of materials and schematics. Compensation is optimized for stability for different LC output filters. To optimize for fast transient response, see Section 2.3.

3.1 Schematic

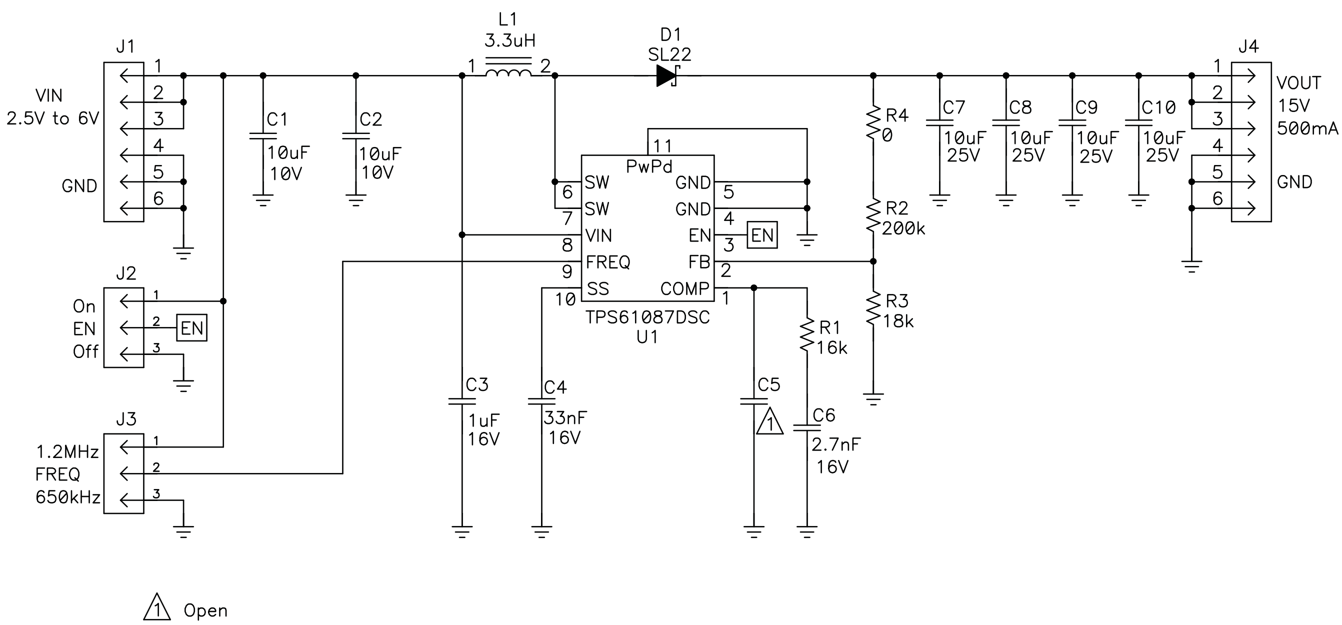

Figure 1. TPS61087EVM Schematic

3.2 Bill of Materials

Table 3. HPA317A Bill of Materials

RefDes	Value	Description	Size	Part Number	MFR
C1, C2	10 µF	Capacitor, Ceramic, 10V, X7R or X5R, 10%	0805	GRM21BR71A106KE51 or LMK212BJ106KG-T	Murata or Taiyo Yuden
C3	1 µF	Capacitor, Ceramic, 16V, X7R or X5R, 10%	0805	GRM21BR71C105KA01 or EMK212B7105KG-T	Murata or Taiyo Yuden
C4	33 nF	Capacitor, Ceramic, 16V, X7R, 10%	0805	Std	Std
C5	Open	Capacitor, Ceramic, 16V, X7R	0805	Std	Std
C6	2.7 nF	Capacitor, Ceramic, 16V, X7R, 10%	0805	Std	Std
C7, C8, C9, C10	10 µF	Capacitor, Ceramic, 25V, X7R or X5R, 10%	1206	GRM31CR61E106KA12 or TMK316BJ106KL-T	Murata or Taiyo Yuden
D1	SL22	Diode, Schottky Rectifier, 2A, 20 V	DO-214AA	SL22	Vishay
J1, J4		Header, Male 6-pin, 100mil spacing	0.100 inch x 6	Std	Std
J2, J3		Header, Male 3-pin, 100mil spacing	0.100 inch x 3	Std	Std
L1	3.3 µH	Inductor, SMT, 3.42A, 24 milliohm	0.288 x 0.288 inch	7447789003	Wurth Elektronik
R1	16k	Resistor, Chip, 1/10W, 1%	0805	Std	Std
R2	200k	Resistor, Chip, 1/10W, 1%	0805	Std	Std
R3	18k	Resistor, Chip, 1/10W, 1%	0805	Std	Std
R4	0	Resistor, Chip, 1/10W, 5%	0805	Std	Std
U1	TPS61087DSC	IC, 600kHz/1.2MHz Step-Up DC-DC Converter	SON-10	TPS6108DSC	TI
—		PCB	2.4 In x 1.65 In x 0.062 In	HPA317	Any
—		Shunt, 100-mil, Black	0.100	929950-00	3M

3.3 Board Layout

This section provides the TPS61087EVM board layout and illustrations.

3.3.1 Layout

Board layout is critical for all switch-mode power supplies. Figure 2, Figure 3, and Figure 4 show the board layout for the HPA317 PCB. The switching nodes with high-frequency noise are isolated from the noise-sensitive feedback circuitry, and careful attention has been given to the routing of high-frequency current loops. See the data sheet for further layout guidelines.

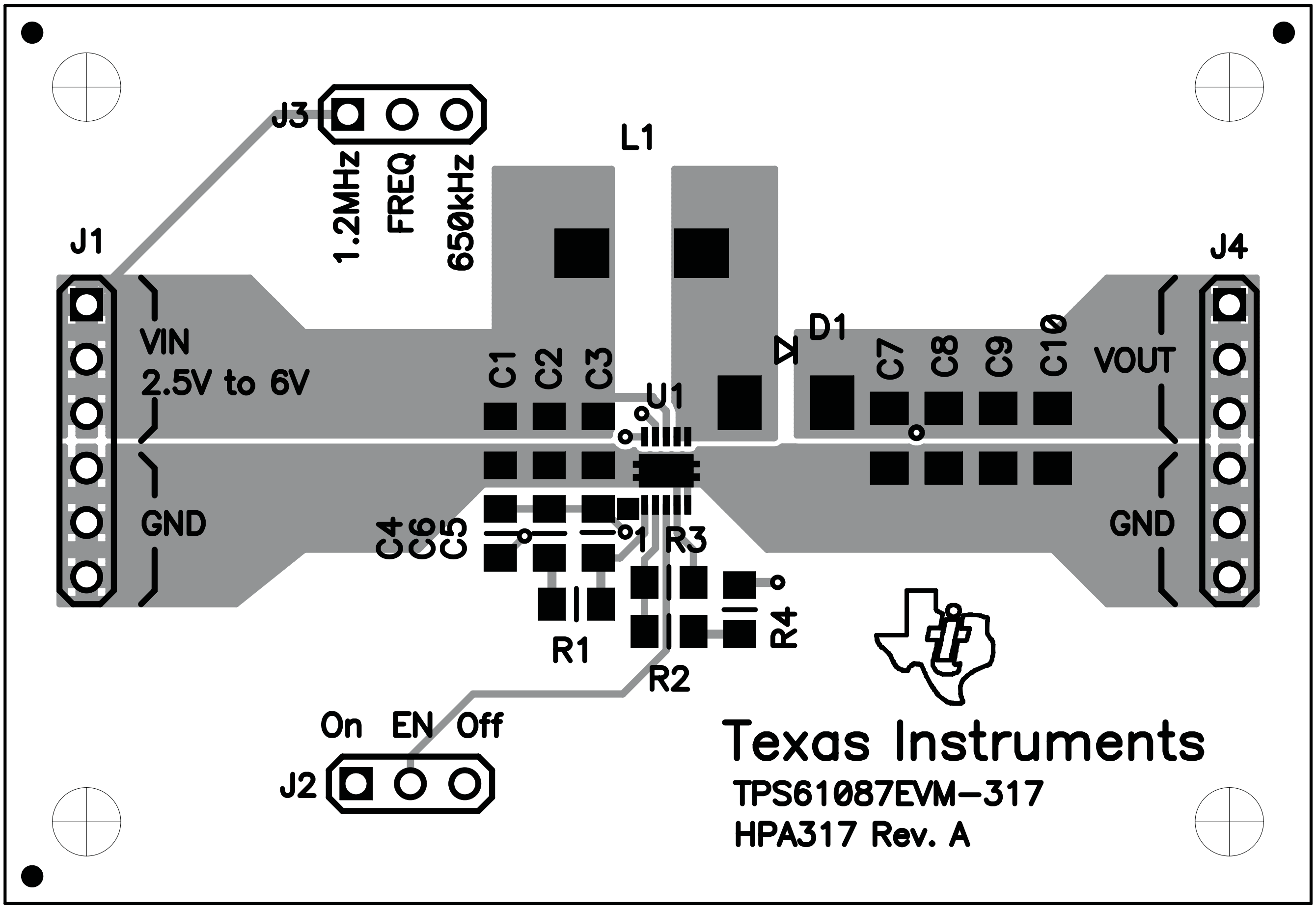

Figure 2. Top Assembly Layer

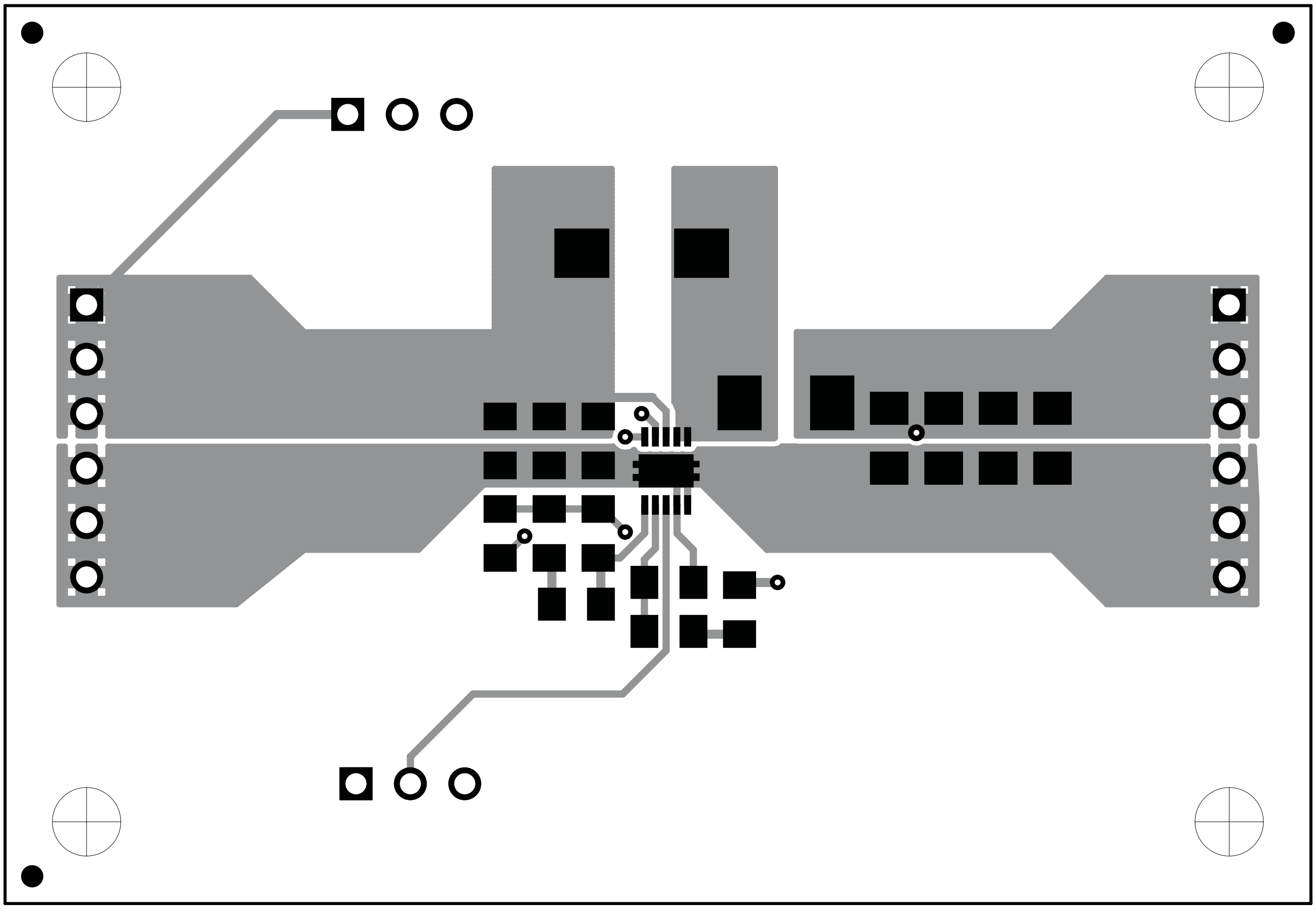

Figure 3. Top Layer Routing

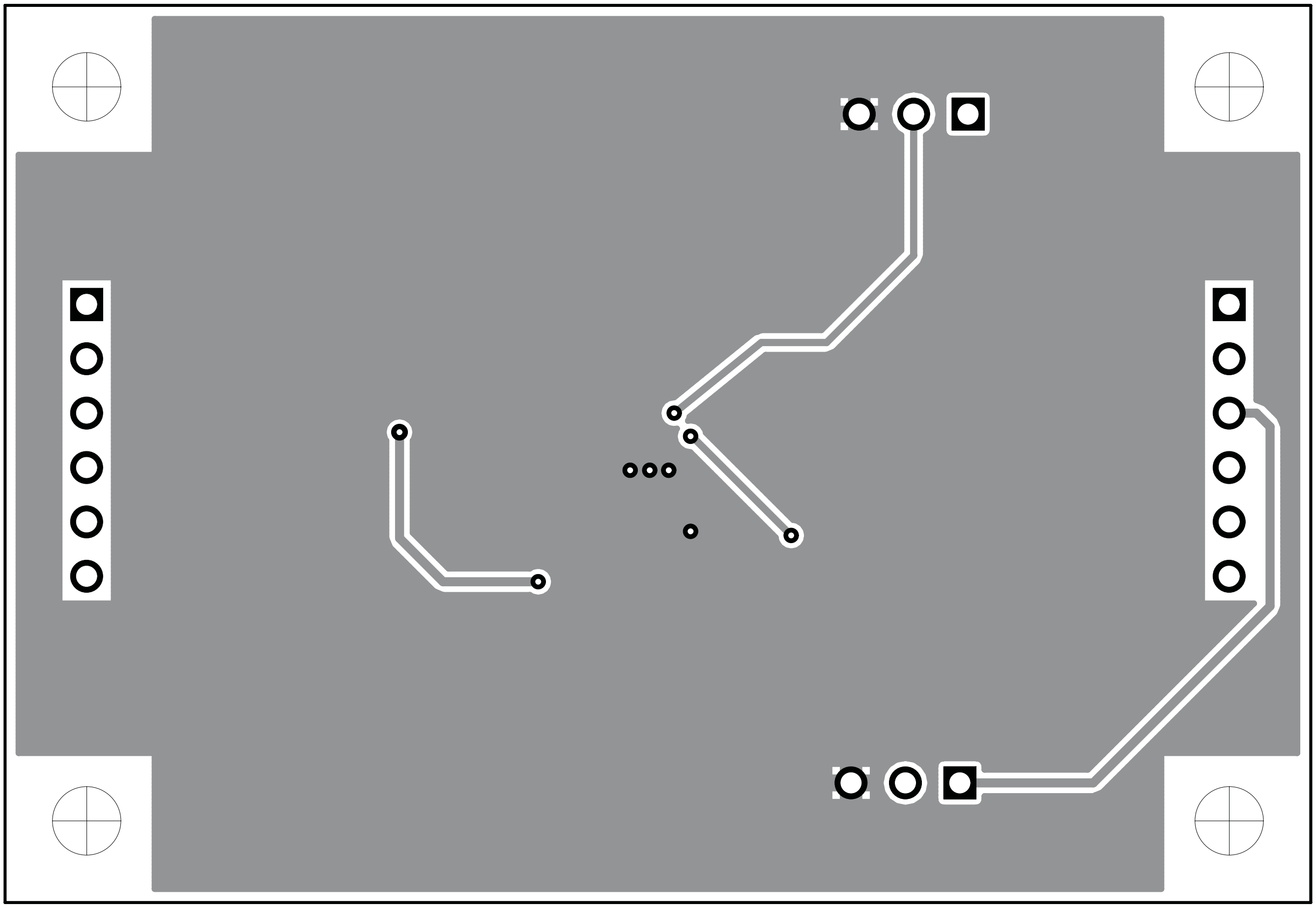

Figure 4. Bottom Layer Routing

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 2.5 V to 6 V and the output voltage range of up to 18.5 V, but 15 V as configured.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than 125° C. The EVM is designed to operate properly with certain components above 85° C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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