

## **TPS53127EVM-614**

The TPS53127EVM-614 Dual Output BUCK presents an easy to use reference design for a common dual output power supply using the TPS53127 controller in cost sensitive applications.

### **Contents**

1	Introduction .....	2
	1.1 Description .....	2
	1.2 Application .....	2
	1.3 Features .....	2
2	Electrical Performance Specifications .....	3
3	TPS53127EVM-614 Schematic .....	4
4	Connector and Test Point Descriptions .....	5
	4.1 Enable Switches (SW1 and SW2) .....	5
	4.2 Switching Frequency Select Switch (SW3) .....	5
	4.3 Test Point Descriptions .....	5
5	Test Setup .....	6
	5.1 Equipment .....	6
	5.2 Equipment Setup .....	7
	5.3 Start Up/Shut Down Procedure .....	9
	5.4 Output Ripple Voltage Measurement Procedure .....	9
	5.5 Equipment Shutdown .....	9
6	TPS53127EVM-614 Test Data .....	9
	6.1 Efficiency .....	10
	6.2 Line and Load Regulation .....	11
	6.3 Output Voltage Ripple and Switching Node waveforms .....	12
	6.4 Switch Node .....	13
7	TPS53127EVM-614 EVM Assembly Drawings and Layout .....	14
8	Bill of Materials .....	17

### **List of Figures**

1	TPS53127EVM-614 Schematic .....	4
2	Tip and Barrel Measurement for Output Voltage Ripple .....	6
3	TPS53127EVM-614 Recommended Test Setup .....	8
4	Efficiency vs Load ( $V_{IN} = 8\text{ V} - 22\text{ V}$ , $V_{OUT1} = 1.05\text{ V}$ , $I_{OUT1} = 0\text{ A} - 4\text{ A}$ ) .....	10
5	Efficiency vs Load ( $V_{IN} = 8\text{ V} - 22\text{ V}$ , $V_{OUT2} = 1.8\text{ V}$ , $I_{OUT2} = 0\text{ A} - 4\text{ A}$ ) .....	10
6	Output Voltage vs Load ( $V_{IN} = 8\text{ V} - 22\text{ V}$ , $V_{OUT1} = 1.05\text{ V}$ , $I_{OUT1} = 0\text{ A} - 4\text{ A}$ ) .....	11
7	Output Voltage vs Load ( $V_{IN} = 8\text{ V} - 22\text{ V}$ , $V_{OUT2} = 1.05\text{ V}$ , $I_{OUT2} = 0\text{ A} - 4\text{ A}$ ) .....	11
8	Output Voltage Ripple ( $V_{IN} = 12\text{ V}$ , $V_{OUT1} = 1.05\text{ V}$ , $I_{OUT1} = 4\text{ A}$ ) .....	12
9	Output Voltage Ripple ( $V_{IN} = 12\text{ V}$ , $V_{OUT2} = 1.8\text{ V}$ , $I_{OUT2} = 4\text{ A}$ ) .....	12
10	Switching Waveform ( $V_{IN} = 12\text{ V}$ , $V_{OUT1} = 1.05\text{ V}$ , $I_{OUT1} = 4\text{ A}$ ) .....	13
11	Switching Waveform ( $V_{IN} = 12\text{ V}$ , $V_{OUT2} = 1.8\text{ V}$ , $I_{OUT2} = 4\text{ A}$ ) .....	13
12	Top Assembly .....	14
13	Bottom Assembly .....	14
14	Top Layer .....	15
15	Bottom Layer .....	15

16	Internal Layer 1 .....	16
17	Internal Layer 2 .....	16

### List of Tables

1	TPS53127EVM-614 Electrical and Performance Specifications .....	3
2	TPS53127EVM-614 Test Points Description .....	5
3	TPS53127EVM-614 Bill of Materials .....	17

## 1 Introduction

### 1.1 Description

The TPS53127EVM-614 Dual Output BUCK evaluation board provides the user with a convenient way to evaluate the TPS53127 Dual D-CAP2 mode control BUCK controller in a realistic cost sensitive application. Providing both a low “core-type” 1.05V and “I/O type” 1.8V output at up to 4A from a loosely regulated 12V (8V-22V) source, the TPS53127EVM-614 includes switches and test-points to assist a user in evaluating the performance of the TPS53127 controller in their application.

### 1.2 Application

- Digital television
- Set-top box
- DSL and cable modems
- Cost-sensitive digital consumer products

### 1.3 Features

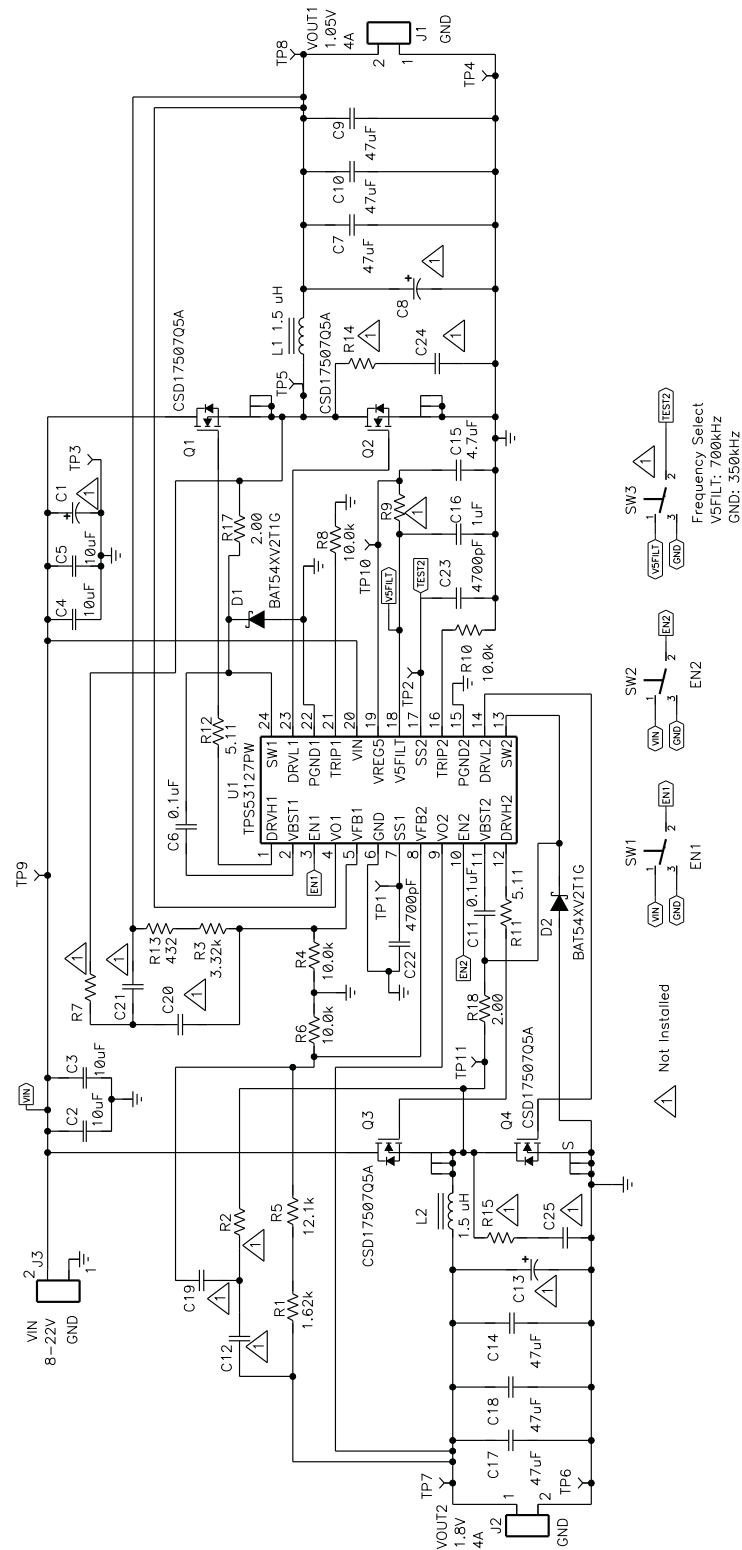
- 8-V to 22-V input
- 1.05-V and 1.8-V output
- Up to 4 A per channel output
- 700-kHz pseudo-fixed frequency D-CAP2 mode control
- Independent enable switches for power-on/power-off testing

## 2 Electrical Performance Specifications

**Table 1. TPS53127EVM-614 Electrical and Performance Specifications**

Parameter		Notes and Conditions	MIN	TYP	MAX	UNIT
<b>INPUT CHARACTERISTICS</b>						
$V_{IN}$	Input Voltage		8	12	22	V
$I_{IN}$	Input Current	$V_{IN} = 12\text{ V}$ , $I_{OUT1} = 4\text{ A}$ , $I_{OUT2} = 4\text{ A}$	–	1.2	1.5	A
	No Load Input Current	$V_{IN} = 12\text{ V}$ , $I_{OUT} = 0\text{ A}$	–	20	35	mA
$V_{IN\_UVLO}$	Input UVLO	$I_{OUT} = 4\text{ A}$	4.0	4.2	4.5	V
<b>OUTPUT CHARACTERISTICS</b>						
$V_{OUT1}$	Output Voltage 1	$V_{IN} = 12\text{ V}$ , $I_{OUT1} = 2\text{ A}$	1.03	1.05	1.07	V
	Line Regulation	$V_{IN} = 8\text{ V to }22\text{ V}$	–	–	1%	
	Load Regulation	$I_{OUT1} = 0\text{ A to }4\text{ A}$	–	–	1%	
$V_{OUT1\_rip}$	Output Voltage Ripple	$V_{IN} = 12\text{ V}$ , $I_{OUT2} = 4\text{ A}$	–	–	30	mVpp
$I_{OUT1}$	Output Current 1	$V_{IN} = 8\text{ V to }22\text{ V}$	0		4	A
$V_{OUT2}$	Output Voltage 2	$V_{IN} = 12\text{ V}$ , $I_{OUT2} = 2\text{ A}$	1.78	1.80	1.82	V
	Line Regulation	$V_{IN} = 8\text{ V to }22\text{ V}$	–	–	1%	
	Load Regulation	$I_{OUT2} = 0\text{ A to }4\text{ A}$	–	–	1%	
$V_{OUT2\_rip}$	Output Voltage Ripple	$V_{IN} = 12\text{ V}$ , $I_{OUT2} = 4\text{ A}$	–	–	30	mVpp
$I_{OUT2}$	Output Current 2	$V_{IN} = 8\text{ V to }22\text{ V}$	0		4	A
<b>SYSTEMS CHARACTERISTICS</b>						
$F_{SW}$	Switching Frequency		350	700	800	kHz
$\eta_{pk}$	Peak Efficiency	$V_{IN} = 12\text{ V}$	–	85%	–	
$\eta$	Full Load Efficiency	$V_{IN} = 12\text{ V}$ , $I_{OUT1} = 4\text{ A}$	–	83%	–	

### 3 TPS53127EVM-614 Schematic



NOTE: For Reference Only, See Table 3 for Specific Values.

Figure 1. TPS53127EVM-614 Schematic

## 4 Connector and Test Point Descriptions

### 4.1 Enable Switches (SW1 and SW2)

TPS53127EVM-614 includes independent enable switches for each of the two outputs. When the switch is in the DIS position, the channel is disabled and discharged per the TPS53127's internal discharge characteristics.

To Enable VOUT1, place SW1 in the EN position

To Enable VOUT2, place SW2 in the EN position

### 4.2 Switching Frequency Select Switch (SW3)

TPS53127EVM-614 does not populate SW3. When using TPS53127EVM-614 to evaluate the TPS53126 controller in the TSSOP package, SW3 can be populated to allow selection of the TPS53126 switching frequency between 350 kHz and 700 kHz.

### 4.3 Test Point Descriptions

Table 2 lists the test points, their labels, uses, and where additional information is located.

**Table 2. TPS53127EVM-614 Test Points Description**

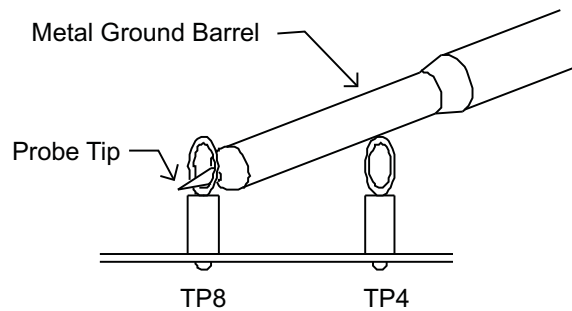
Test Point	Label	Use	Section
TP1	TEST1	Monitor Channel 1 Soft-Start Voltage	<a href="#">Section 4.3.4</a>
TP2	TEST2	Monitor Channel 2 Soft-Start Voltage	<a href="#">Section 4.3.4</a>
TP3	GND	Ground for Input Voltage	<a href="#">Section 4.3.1</a>
TP4	GND	Ground for Channel 1 Output Voltage	<a href="#">Section 4.3.2</a>
TP5	SW1	Monitor Switching Node for Channel 1	<a href="#">Section 4.3.5</a>
TP6	GND	Ground for Channel 2 Output Voltage	<a href="#">Section 4.3.3</a>
TP7	VO2	Monitor Output Voltage for Channel 2	<a href="#">Section 4.3.3</a>
TP8	VO1	Monitor Output Voltage for Channel 1	<a href="#">Section 4.3.2</a>
TP9	VIN	Monitor Input Voltage	<a href="#">Section 4.3.1</a>
TP10	VREG5	Monitor Output of VREG5 Regulator	<a href="#">Section 4.3.6</a>
TP11	SW2	Monitor Switching Node for Channel 2	<a href="#">Section 4.3.5</a>
CN1	VOUT1	Monitor Output Voltage for Channel 1	<a href="#">Section 4.3.2</a>
CN2	VOUT2	Monitor Output Voltage for Channel 2	<a href="#">Section 4.3.3</a>

#### 4.3.1 Input Voltage Monitoring (TP3 and TP9)

TPS53127EVM-614 provides two test points for measuring the voltage applied to the module. This allows the user to measure the actual module voltage without losses from input cables and connectors. All input voltage measurements should be made between TP9 and TP3. To use TP9 and TP3, connect a voltmeter positive terminal to TP9 and negative terminal to TP3.

#### 4.3.2 Channel 1 Output Voltage Monitoring (TP4 and TP8)

TPS53127EVM-614 provides two test points for measuring the voltage generated at the VO1 Output by the module. This allows the user to measure the actual output voltage without losses from output cables and connectors. All DC Output voltage measurements should be made between TP8 and TP4. To use TP8 and TP4, connect a voltmeter positive terminal to TP8 and negative terminal to TP4.



**Figure 2. Tip and Barrel Measurement for Output Voltage Ripple**

#### 4.3.3 Channel 2 Output Voltage Monitoring (TP6 and TP7)

TPS53127EVM-614 provides two test points for measuring the voltage generated at the VO1 Output by the module. This allows the user to measure the actual output voltage without losses from output cables and connectors. All DC Output voltage measurements should be made between TP7 and TP6. To use TP7 and TP6, connect a voltmeter positive terminal to TP7 and negative terminal to TP6.

#### 4.3.4 Soft-Start Voltage Monitoring (TP1, TP2 and TP3)

TPS53127EVM-614 provides two test points for measuring the soft-start ramp voltages. TP1 monitors the soft-start ramp of Channel 1. TP2 monitors the soft-start ramp of Channel 2. To use TP1 or TP2, connect an oscilloscope probe between TP1 or TP2 and TP3.

#### 4.3.5 Switching Node Monitoring (TP3, TP5 and TP11)

TPS53127EVM-614 provides two test points for measuring the switching node waveform voltages. TP5 monitors the switching node of Channel 1. TP2 monitors the switching node of Channel 2. To use TP5 or TP11, connect an oscilloscope probe between TP5 or TP11 and TP3.

#### 4.3.6 5-V Regulator Output Monitoring (TP3 and TP10)

TPS53127EVM-614 provides a test point for measuring the output of the internal 5V regulator. TP10 monitors the output voltage of the internal 5V regulator. To use TP10, connect a voltmeter positive terminal to TP10 and negative terminal to TP3.

## 5 Test Setup

### 5.1 Equipment

#### 5.1.1 Voltage Source

$V_{IN}$   
The input voltage source ( $V_{IN}$ ) shall be a 0-25V variable DC source capable of supplying 3.0 A minimum

#### 5.1.2 Meters

**A1:** 0-4A, Ammeter

**V1:**  $V_{IN}$ , 0-22V voltmeter

**V2:**  $V_{OUT1}$ , 0-2V voltmeter

**V3:**  $V_{OUT2}$ , 0-2V voltmeter

### 5.1.3 Loads

**LOAD1:** The Output Load shall be an Electronic Load set for Constant Current Mode capable of 0-4Adc at 1.05Vdc

**LOAD2:** The Output Load shall be an Electronic Load set for Constant Current Mode capable of 0-4Adc at 1.80Vdc

### 5.1.4 Oscilloscope

Oscilloscope

The Oscilloscope shall be an Analog or Digital Oscilloscope set for AC coupled measurement with 20MHz bandwidth Limiting. Use 20mV / division vertical resolution, 1.0µs / division horizontal resolution for Output Ripple Voltage Test. Set Cursors at +20mV and -20mV

Probe

One Oscilloscope probes shall be Tektronix P6138 or equivalent oscilloscope probe with exposed conductive ground barrels.

### 5.1.5 Recommended Wire Gauge

**V<sub>IN</sub> to J3** – The connection between the source voltage, VVIN and J1 of TPS53127EVM-614 can carry as much as 2.0Adc. The minimum recommended wire size is AWG #16 with the total length of wire less than 2 feet (1 foot input, 1 foot return).

**J1 to LOAD1 and J2 to LOAD2** – The connection between J1 and LOAD1 and J2 and LOAD2 of TPS53127EVM-614 can carry as much as 4Adc each. The minimum recommended wire size is AWG #14, with the total length of wire less than 2 feet (1 foot input, 1 foot return)

### 5.1.6 Other

**FAN** – The TPS53127EVM-614 Evaluation Module includes components that can get hot to the touch. Because this EVM is not enclosed to allow probing of circuit nodes, a small fan capable of 200-400 lfm is required to reduce component temperatures when operating

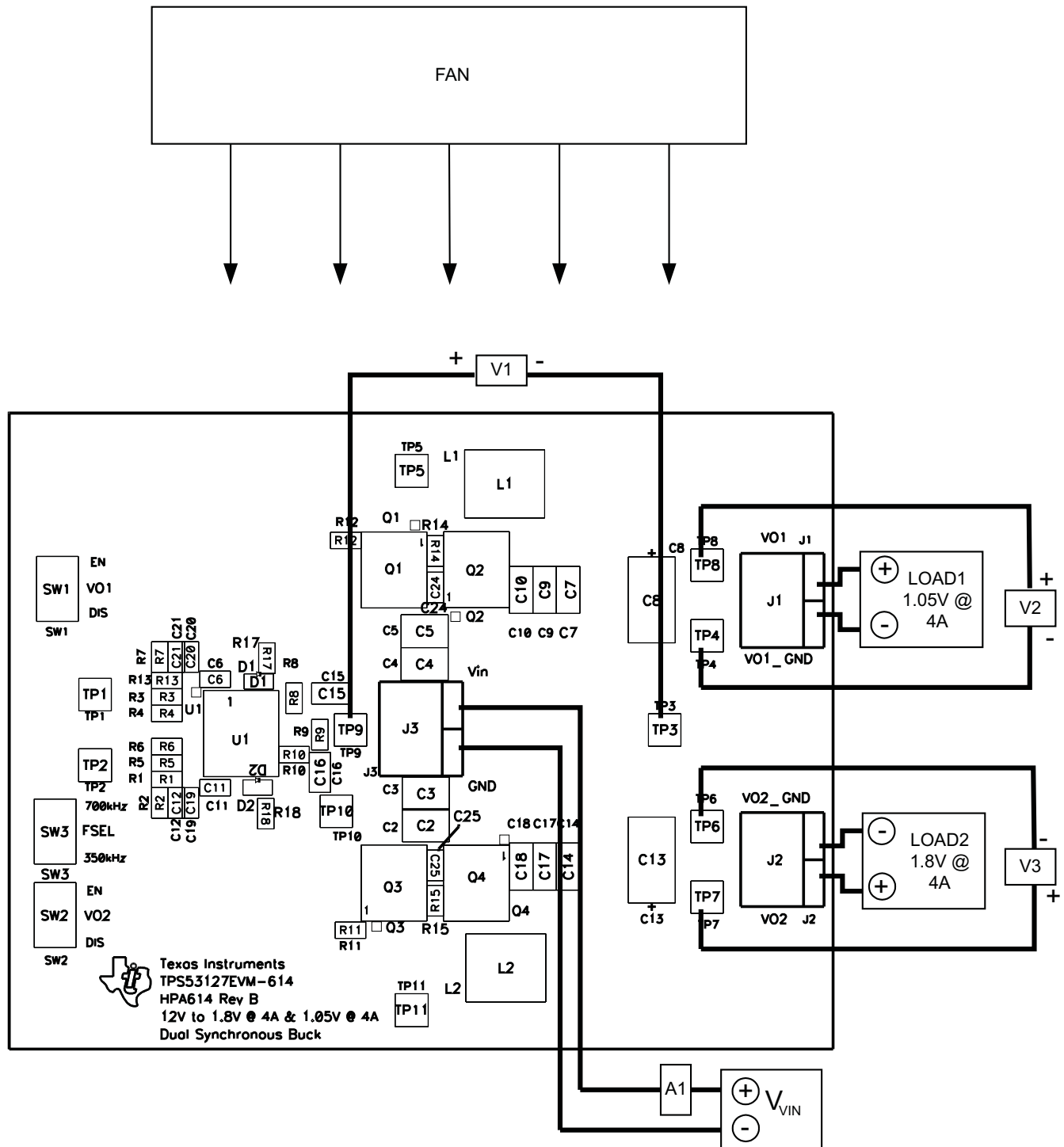
## 5.2 Equipment Setup

Shown in [Figure 3](#) is the basic test set up recommended to evaluate the TPS53127EVM-614. Note that although the return for J3 and J1 and JP2 are the same system ground, the connections should remain separate as shown in [Figure 3](#).

### 5.2.1 Procedure

1. Working at an ESD workstation, make sure that any wrist straps, bootstraps or mats are connected referencing the user to earth ground before power is applied to the EVM. Electrostatic smock and safety glasses should also be worn.
2. Prior to connecting the DC input source, V<sub>IN</sub>, it is advisable to limit the source current from V<sub>IN</sub> to 3.0A maximum. Make sure V<sub>IN</sub> is initially set to 0V and connected as shown in [Figure 3](#).
3. Verify SW1 and SW2 are in the desired position.
4. Place a fan as shown in [Figure 3](#) and turn on, making sure that air is flowing across the EVM.

### 5.2.2 Diagram



### Figure 3. TPS53127EVM-614 Recommended Test Setup



### 5.3 Start Up/Shut Down Procedure

Increase  $V_{IN}$  from 0V to 12Vdc

Vary LOAD1 from 0 – 4Adc

Vary LOAD2 from 0 – 4Adc

Vary  $V_{IN}$  from 8Vdc to 22Vdc

Decrease  $V_{IN}$  to 0Vdc

Decrease LOAD1 to 0A

Decrease LOAD2 to 0A

### 5.4 Output Ripple Voltage Measurement Procedure

Increase  $V_{IN}$  from 0V to 12Vdc

Adjust LOAD1 to desired load between 0Adc and 4Adc

Adjust LOAD2 to desired load between 0Adc and 4Adc

Adjust  $V_{IN}$  to desired load between 8Vdc and 22Vdc

Connect Oscilloscope Probe to CN1 or CN2 shown in [Figure 3](#)

Measure Output Ripple

Decrease  $V_{IN}$  to 0Vdc

Decrease LOAD1 to 0A

Decrease LOAD2 to 0A

### 5.5 Equipment Shutdown

Shut Down Oscilloscope

Shut down  $V_{IN}$

Shut down LOAD1

Shut down LOAD2

Shut down FAN

## 6 TPS53127EVM-614 Test Data

[Figure 4](#) through [Figure 11](#) present typical performance curves for the TPS53127EVM-614. Since actual performance data can be affected by measurement techniques and environmental variables, these curves are presented for reference and may differ from actual field measurements.

## 6.1 Efficiency

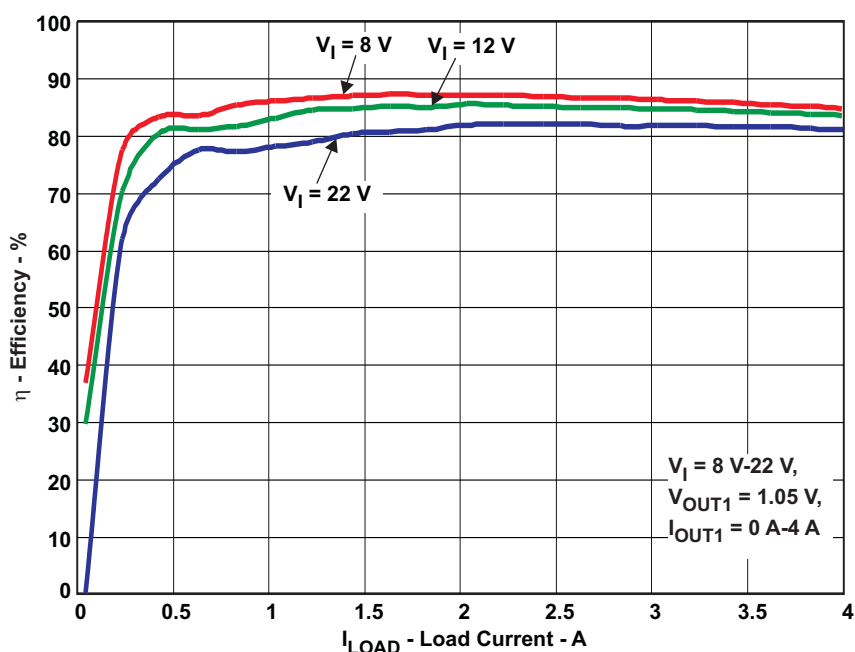


Figure 4. Efficiency vs Load ( $V_{IN} = 8\text{ V-}22\text{ V}$ ,  $V_{OUT1} = 1.05\text{ V}$ ,  $I_{OUT1} = 0\text{ A-}4\text{ A}$ )

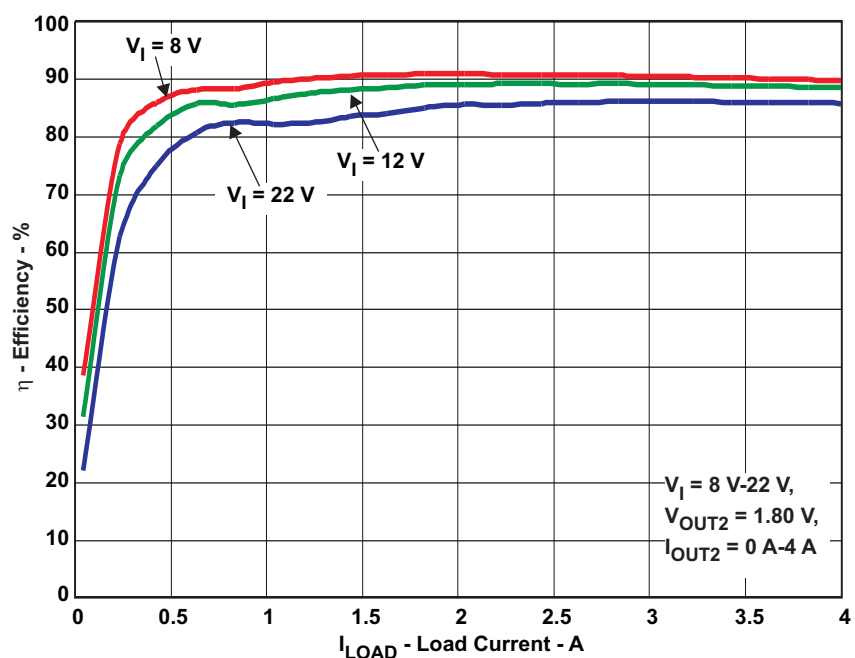


Figure 5. Efficiency vs Load ( $V_{IN} = 8\text{ V-}22\text{ V}$ ,  $V_{OUT2} = 1.8\text{ V}$ ,  $I_{OUT2} = 0\text{ A-}4\text{ A}$ )

## 6.2 Line and Load Regulation

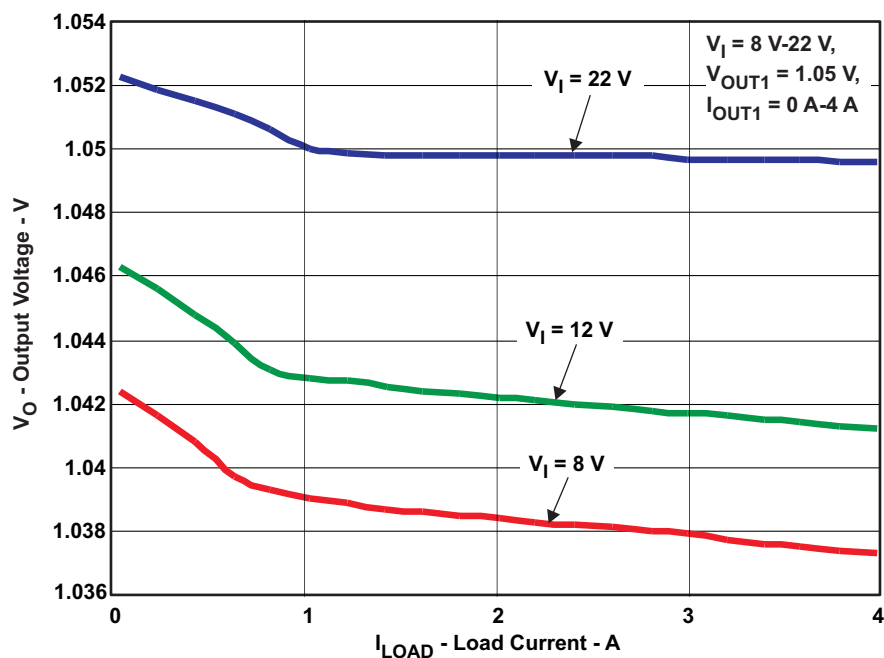


Figure 6. Output Voltage vs Load ( $V_{IN} = 8$  V–22 V,  $V_{OUT1} = 1.05$  V,  $I_{OUT1} = 0$  A–4 A)

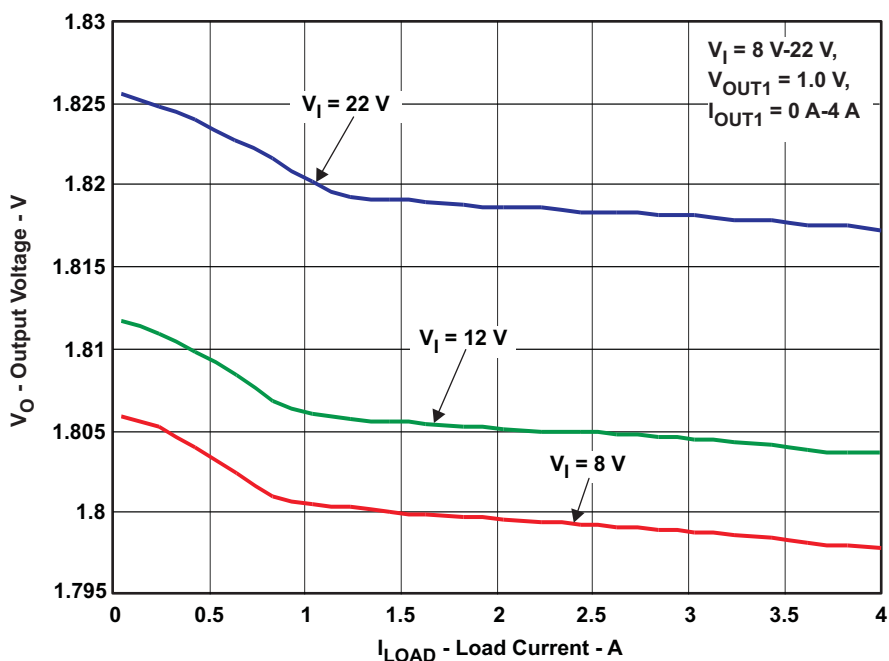
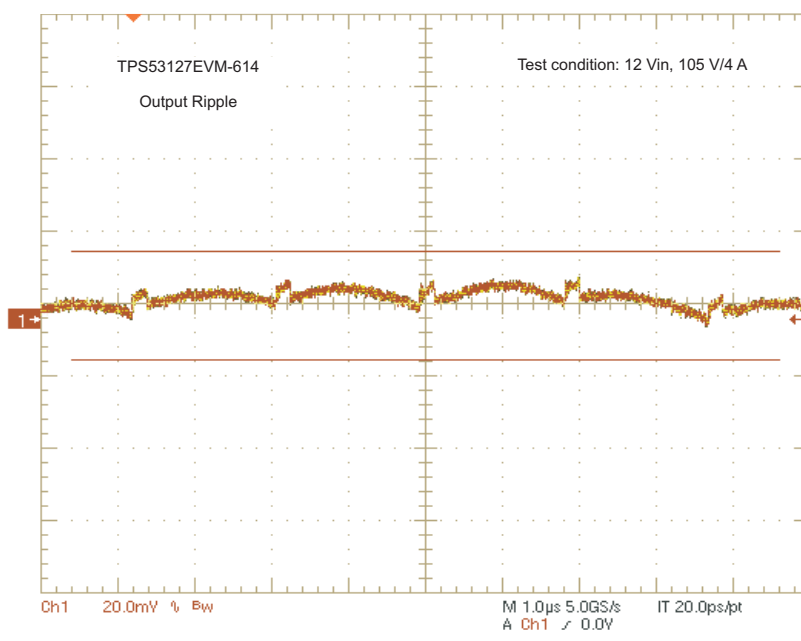
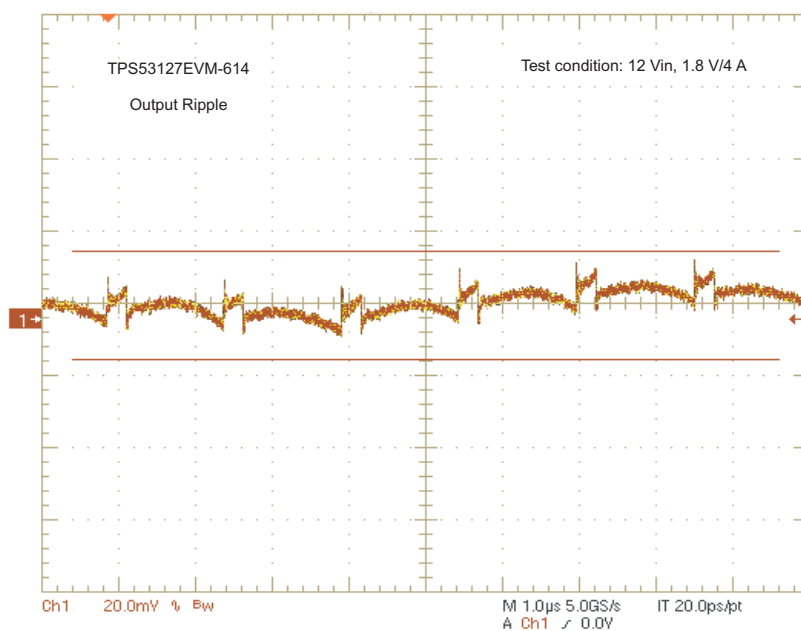


Figure 7. Output Voltage vs Load ( $V_{IN} = 8$  V–22 V,  $V_{OUT2} = 1.05$  V,  $I_{OUT2} = 0$  A–4 A)

### 6.3 Output Voltage Ripple and Switching Node waveforms

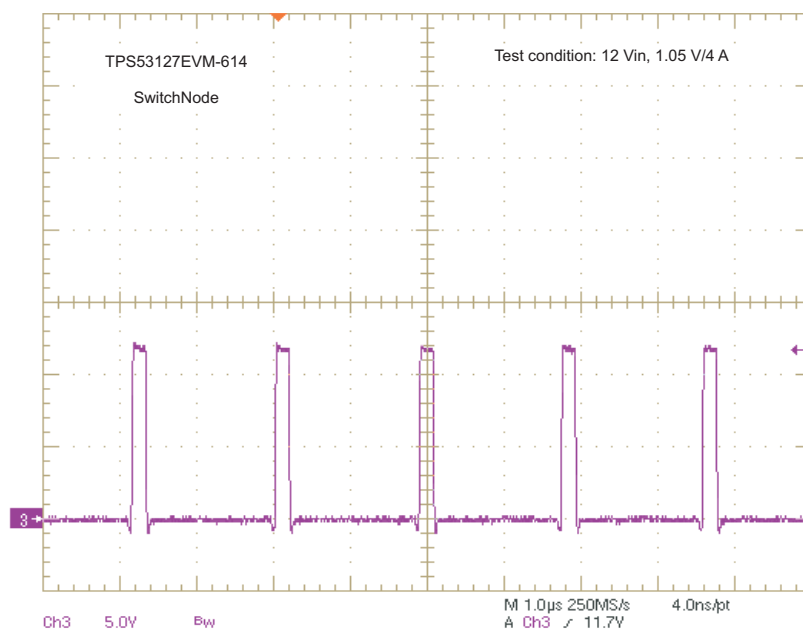


**Figure 8. Output Voltage Ripple ( $V_{IN} = 12\text{ V}$ ,  $V_{OUT1} = 1.05\text{ V}$ ,  $I_{OUT1} = 4\text{ A}$ )**

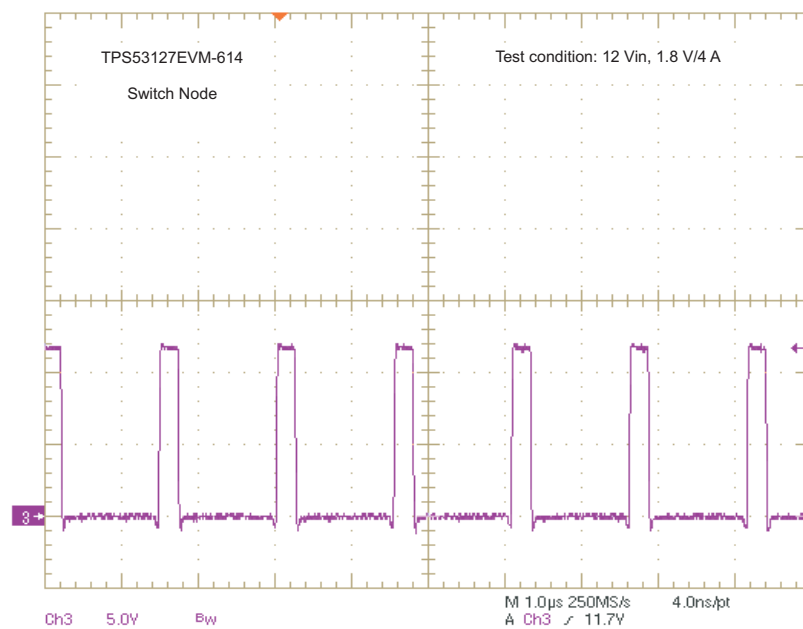


**Figure 9. Output Voltage Ripple ( $V_{IN} = 12\text{ V}$ ,  $V_{OUT2} = 1.8\text{ V}$ ,  $I_{OUT2} = 4\text{ A}$ )**

## 6.4 Switch Node



**Figure 10. Switching Waveform ( $V_{IN} = 12\text{ V}$ ,  $V_{OUT1} = 1.05\text{ V}$ ,  $I_{OUT1} = 4\text{ A}$ )**



**Figure 11. Switching Waveform ( $V_{IN} = 12\text{ V}$ ,  $V_{OUT2} = 1.8\text{ V}$ ,  $I_{OUT2} = 4\text{ A}$ )**

## 7 TPS53127EVM-614 EVM Assembly Drawings and Layout

The following figures (Figure 12 through Figure 16) show the design of the TPS53127EVM-614 printed circuit board. The EVM has been designed using a 4-Layer, 2oz copper-clad circuit board 3.5 in 2.7 to allow the user to easily view, probe and evaluate the TPS53127 control IC in a practical application. Moving components to both sides of the PCB or using additional internal layers can offer additional size reduction for space constrained systems.

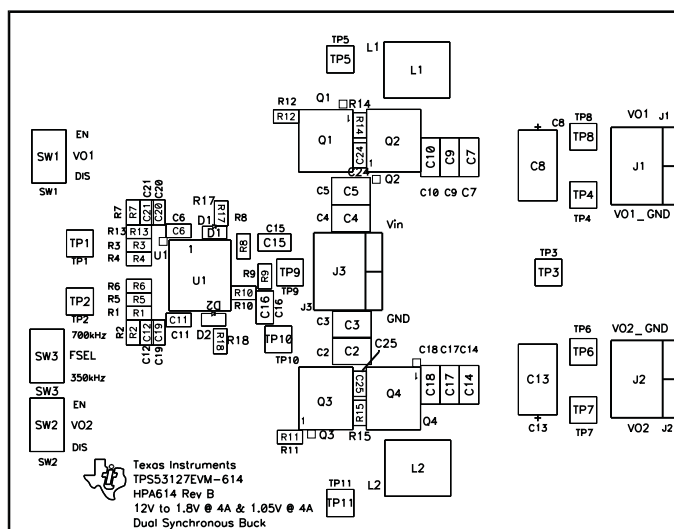


Figure 12. Top Assembly

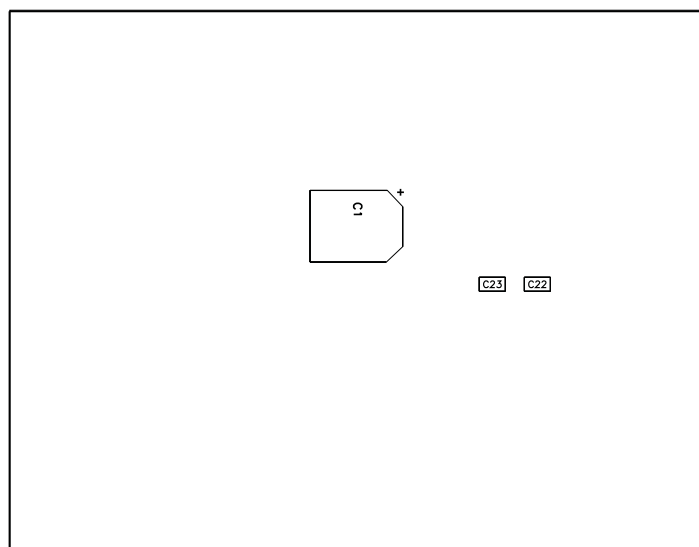
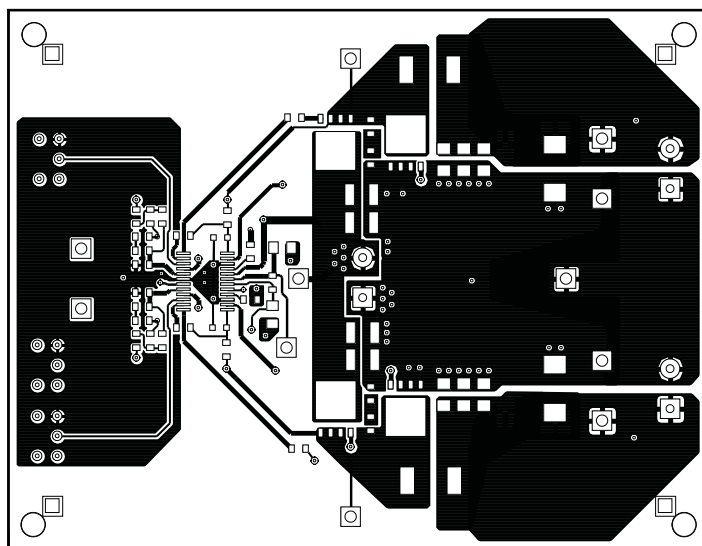
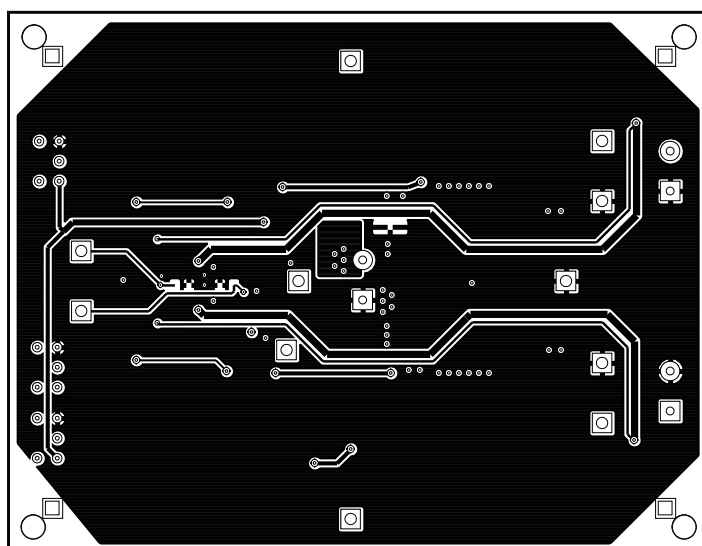


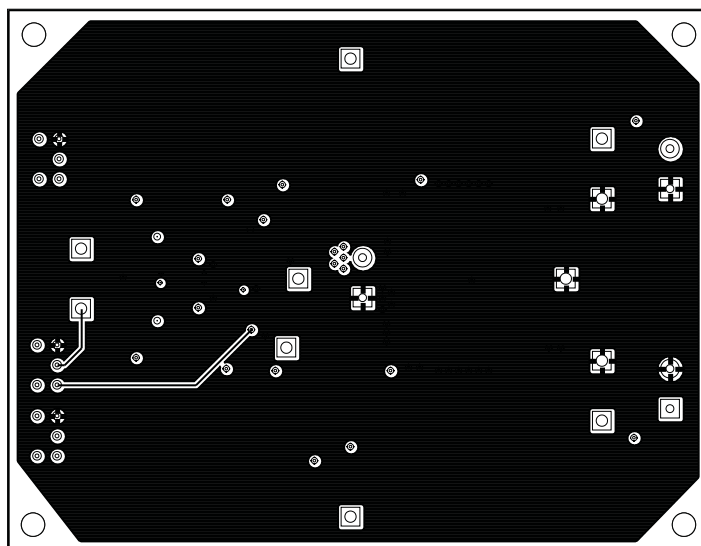
Figure 13. Bottom Assembly



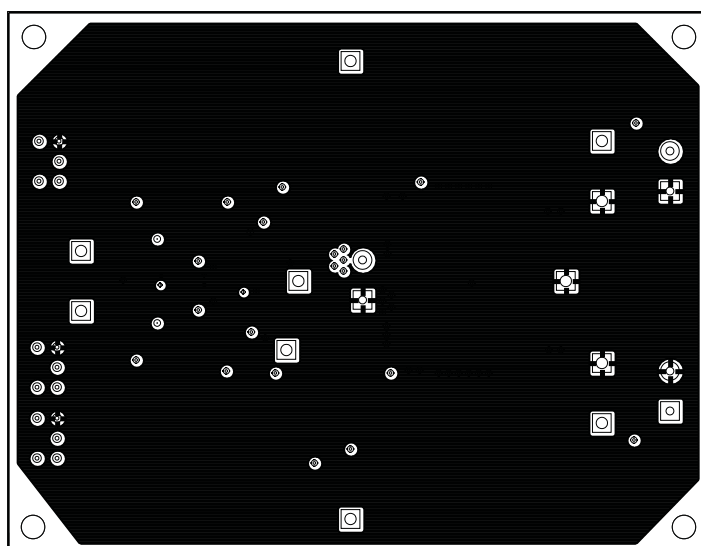
**Figure 14. Top Layer**



**Figure 15. Bottom Layer**



**Figure 16. Internal Layer 1**



**Figure 17. Internal Layer 2**



## 8 Bill of Materials

**Table 3** contains the Bill of Materials for TPS53127EVM-614. The reference designators reference the Schematic in [Figure 1](#) and Assembly locations in [Figure 12](#). Components with a Quantity 0 listed are not populated on the PCB but are provided for reference.

**Table 3. TPS53127EVM-614 Bill of Materials**

Count	RefDes	Value	Description	Size	Part Number	MFR
0	C1		Capacitor, Aluminum, 25V, 20%	0.328 x 0.390 inch	Std	Std
0	C12, C19, C20, C21		Capacitor, Ceramic	0603	Std	Std
1	C15	4.7 $\mu$ F	Capacitor, Ceramic, 10V, X5R, 20%	0805	Std	Std
1	C16	1 $\mu$ F	Capacitor, Ceramic, 16V, X5R, 20%	0805	Std	Std
4	C2, C3, C4, C5	10 $\mu$ F	Capacitor, Ceramic, 25V, X5R, 20%	1210	Std	Std
2	C22, C23	4700 pF	Capacitor, Ceramic, Low Inductance, 16V, X7R, 20%	0603	Std	Std
0	C24, C25		Capacitor, Ceramic, 25V, X7R, 20%	0603	Std	Std
2	C6, C11	0.1 $\mu$ F	Capacitor, Ceramic, 50V, X5R, 10%	0603	Std	Std
6	C7, C9, C10, C14, C17, C18	47 $\mu$ F	Capacitor, Ceramic, 6.3V, X5R, 20%	1206	Std	Std
0	C8, C13	330 $\mu$ F	Capacitor, PXE, 4.0V, 15 milliohm, 20%	7343 (D)	APXE4R0ARA331MF61G	NIPPON CHEMI-CON
2	D1, D2	BAT54XV2T1G	Diode, Schottky, 200 mA, 30 V	SOD523	BAT54XV2T1G	On Semi
3	J1, J2, J3	ED120/2DS	Terminal Block, 2-pin, 15-A, 5.1mm	0.40 x 0.35 inch	ED120/2DS	OST
2	L1, L2	1.5 $\mu$ H	Inductor, SMT, 11A, 9.7 milliohm	0.256 x 0.280 inch	SPM6530T-1R5M100	TDK
4	Q1, Q2, Q3, Q4	CSD17507Q5A	MOSFET, N-Chan, 30V, 65A, 11.8 milliohm	QFN-8 POWER	CSD17507Q5A	TI
1	R1	1.62k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
4	R10, R4, R6, R8	10.0k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
2	R11, R12	5.11	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R13	432	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	R14, R15		Resistor, Chip, 1/8W, 5%	0603	Std	Std
2	R17, R18	2.00	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	R2, R7, R9		Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R3	3.32k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R5	12.1k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
2	SW1, SW2	G12AP-RO	Switch, ON-ON Mini Toggle	0.28 x 0.18"	G12AP-RO	Nikkai
0	SW3	G12AP-RO	Switch, ON-ON Mini Toggle	0.28 x 0.18"	G12AP-RO	Nikkai
4	TP1, TP2, TP5, TP11	5012	Test Point, White, Thru Hole	0.125 x 0.125 inch	5012	Keystone
1	TP10	5013	Test Point, Orange, Thru Hole	0.125 x 0.125 inch	5013	Keystone
3	TP3, TP4, TP6	5011	Test Point, Black, Thru Hole	0.125 x 0.125 inch	5011	Keystone
2	TP7, TP8	5014	Test Point, Yellow, Thru Hole	0.125 x 0.125 inch	5014	Keystone
1	TP9	5010	Test Point, Red, Thru Hole	0.125 x 0.125 inch	5010	Keystone
1	U1	TPS53127PW	IC, Dual Synchronous Step-Down Controller For Low-Voltage Power Rails	TSSOP	TPS53127PW	TI
1	—		PCB, 2.70" x 3.50" x 0.063" FR-4	2.7" x 3.5"	HPA614	Any

- Notes: 1. These assemblies are ESD sensitive, ESD precautions shall be observed.
2. These assemblies must be clean and free from flux and all contaminants. Use of no clean flux is not acceptable.
3. These assemblies must comply with workmanship standards IPC-A-610 Class 2.
4. Ref designators marked with an asterisk (\*\*\*) cannot be substituted. All other components can be substituted with equivalent MFG's components.

## Evaluation Board/Kit Important Notice

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and therefore may not meet the technical requirements of these directives or other related directives.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. **THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.**

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

**EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.**

TI currently deals with a variety of customers for products, and therefore our arrangement with the user **is not exclusive**.

TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.**

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please contact the TI application engineer or visit [www.ti.com/esh](http://www.ti.com/esh).

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used.

## FCC Warning

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

## EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 8.0 V to 22V and the output voltage range of 1.03 V to 1.90 V . 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 40° C. The EVM is designed to operate properly with certain components above 40° 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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2011, Texas Instruments Incorporated

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

### Products

Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>

### Applications

Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
Transportation and Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
Wireless	<a href="http://www.ti.com/wireless-apps">www.ti.com/wireless-apps</a>

TI E2E Community Home Page

[e2e.ti.com](http://e2e.ti.com)

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2011, Texas Instruments Incorporated