

# TPS541620 2-Phase SWIFT™ Step-Down Converter Evaluation Module User's Guide



## ABSTRACT

The TPS541620SEVM-050 evaluation module (EVM) features the TPS541620, a highly integrated non-isolated Dual DC-DC converter that is capable of high frequency operation in a 3 mm x 5 mm package. The device can be configured as two single 6-A rails or combined to drive a single 12-A current load. Though the TPS541620 is highly configurable, the TPS541620SEVM-050 is configured for 2-phase operation only. The  $V_{out}$  is configured for 1.0 V and can deliver up to 12 A of load current. Input and output capacitors are included on the board. Monitoring test points are provided on the board as well.

**Table 1-1. Device Information**

Ordering Code	Configuration	Input Voltage	Output Voltage	Output Current
TPS541620SEVM-050	Single output $f_{SW} = 1$ MHz	$V_{IN} = 9$ V to 15 V	$V_{OUT1} = 1$ V; up to 12 A;	0 to 12 A

## Note

The EVM has jumpers and test points that allow easy evaluation of steady state measurements such as efficiency, line/load regulation, input/output voltage ripple. Other tests such as frequency response, load transient, start-up, and power down can be performed.

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## Trademarks

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## 1 Description

The TPS541620 is a configurable dual-output buck converter. The TPS541620SEVM uses a nominal 12-V bus to produce a regulated 1-V up to 12 A of load current. The TPS541620SEVM-050 only demonstrates the 2-Phase configuration.

### 1.1 Before You Begin

The following warnings and cautions are noted for the safety of anyone using or working close to the TPS541620SEVM. Observe all safety precautions.



**Warning**

The TPS541620SEVM-050 engineering verification board may become hot during operation due to power dissipation. Avoid contact with the board. Follow all applicable safety procedures applicable to your laboratory.



**Caution**

Do not leave the EVM powered when unattended.

**WARNING**

The circuit board has signal traces, components, and component leads on the bottom of the board. This may result in exposed voltages, hot surfaces or sharp edges. Do not reach under the board during operation.

**WARNING**

The circuit board surface area may be hot under some operating conditions. To avoid injury, use caution when touching the board during operation.

### 1.2 Typical Applications

- Wired and Wireless Infrastructure Equipment
- Ethernet Switches
- Router Network
- ASIC, SoC, FPGA, DSP I/O Voltage Rails
- Industrial Test and Measurement Equipment

### 1.3 Features

- Regulated 1-V output for TPS541620SEVM up to 12-A output current
- Convenient test points for probing

## 2 Electrical Performance Specifications

Table 2-1 lists the electrical performance specification (TPS541620SEVM-050) under room temperature 25°C.

**Table 2-1. TPS541620 Electrical Performance**

Parameter	Test Conditions	MIN	TYP	MAX	UNIT
<b>INPUT CHARACTERISTICS</b>					
Voltage range	$V_{IN}$	9	12	15	V
<b>OUTPUT CHARACTERISTICS</b>					
Output voltage, $V_{OUT1}$			1		V
Output load current, $I_{OUT1}$		0		12	A
<b>SYSTEMS CHARACTERISTICS</b>					
Switching frequency, $f_{SW}$	$V_{OUT1} = 1\text{ V}/12\text{ A}$		1		MHz

### 3 Getting Started

Figure 3-1 illustrates the TPS541620DEVM-050 EVM. The EVM is provided with input/output connectors and test points as shown in Table 4-1. A power supply capable of supplying 4 A or greater must be connected to J1 and/or J3 through a pair of wires 20AWG or lower. The Vout load must be connected to J2 and/or J4 through a pair of wires 20 AWG or lower. The maximum load current capability output is 12 A. Wire lengths should be minimized to reduce losses in the wires. The VIN input voltage can be monitored using TP3 with TP5 as the ground reference or using TP4 with TP6 as the ground reference. TP1 is used to monitor the output voltage VOUT with TP24 as the ground reference.

Make sure jumpers J9 and J10 are set in the ON position which enables both the DC/DC converters on the TPS541620. Jumper J9 enables DC/DC1 of the TPS541620. Setting the jumpers to the OFF position will disable the DC/DC converter. Apply the input voltage supply of 12 V to J1 and/or J3. Connect your oscilloscope or multimeter probes to the appropriate test points to observe.

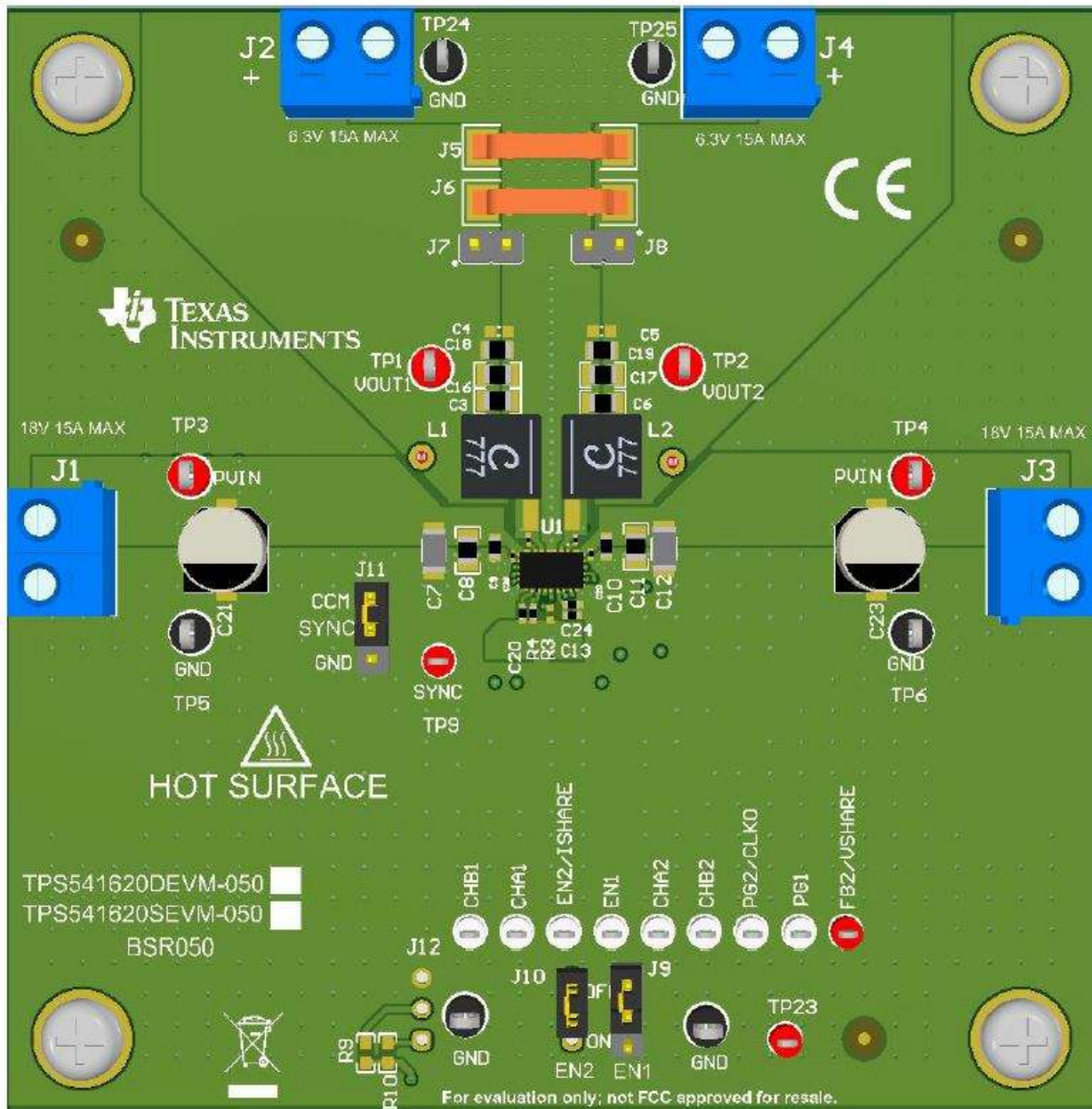


Figure 3-1. TPS541620SEVM-050 PCB Board



## 4 Test Setup

The EVM has jumpers and test points that allow easy evaluation of efficiency, frequency response, load transient, output ripple, startup, and power down.

### 4.1 List of Test Points, Jumpers, and Connectors

Table 4-1 lists the test point, jumpers, and connector functions.

**Table 4-1. Test Point Functions**

Reference Designator	Description
J1	VIN, Input Voltage Supply
J2	VOUT1, 1.0V up to 6A
J3	VIN, Input Voltage Supply
J4	VOUT1, 1.0V Channel 2
J9	Enable for Vout1, connects EN1 to BP5 or AGND
J10	Not Installed for TPS541620SEVM, Enable for Vout2, connects EN2 to BP5 or AGND for TPS541620DEVM
J11	Connect Sync to BP5 for Float for using external Sync
TP1, TP24	Vout1 sensing test points Channel 1
TP2, TP25	Vout1 sensing test points Channel 2
TP3, TP5, TP4, TP6	VIN sensing test points
TP23	BP5 sensing test point
SYNC	External Synchronization Input connection
CHA, CHB	Loop measurement test points
EN1	Enable for Vout1
EN2/ISHARE	ISHARE for TPS541620DEVM, Enable for Vout2 TPS541620DEVM
PG1	Power good for Vout1, connected to BP5 through 100kOhm
PG2/CLKO	Power good for Vout2, , connected to BP5 through 100kOhm
FB2/VSHARE	FB2 test point

## 5 EVM Assembly Drawing and PCB Layout

Figure 5-1 through Figure 5-8 show the design of the EVM printed circuit board.

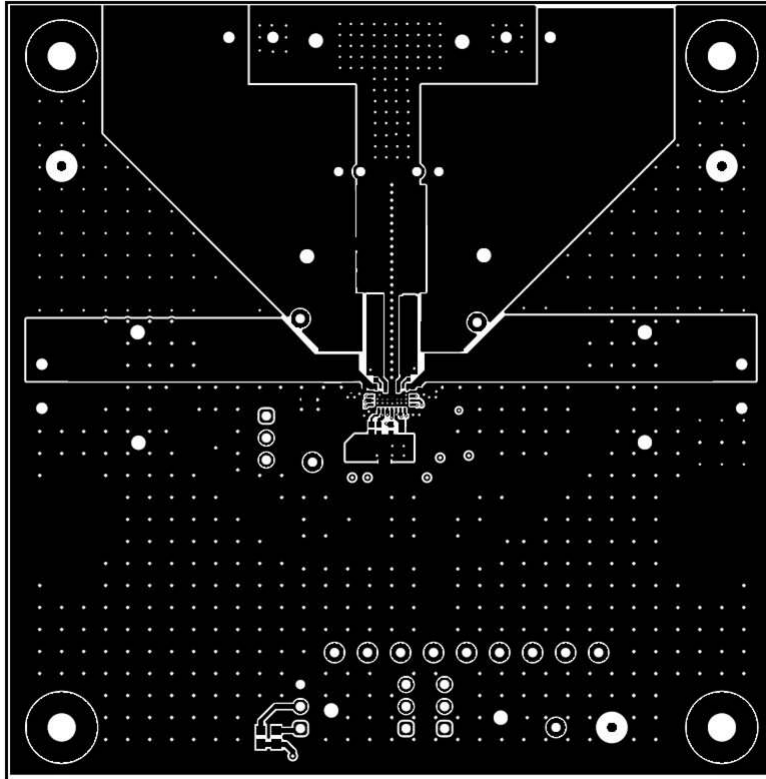


Figure 5-1. Top Layer PCB Drawing

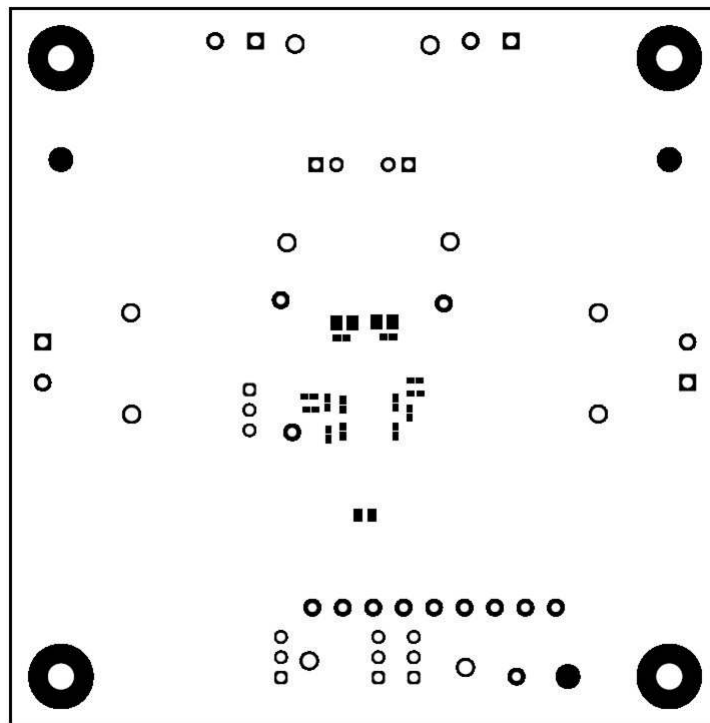


Figure 5-2. Top Layer Solder Layout

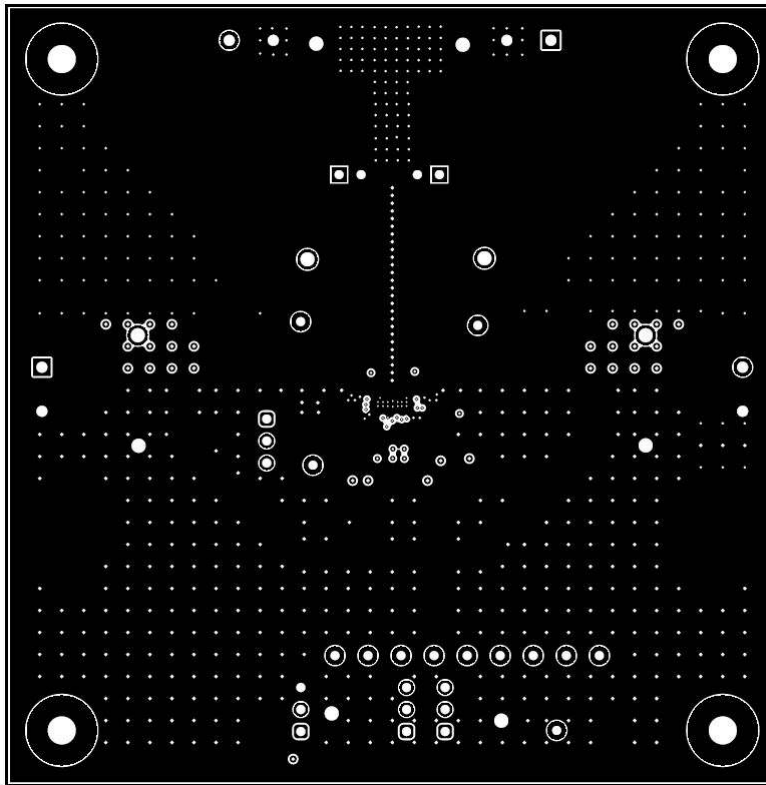


Figure 5-3. Signal Layer 1

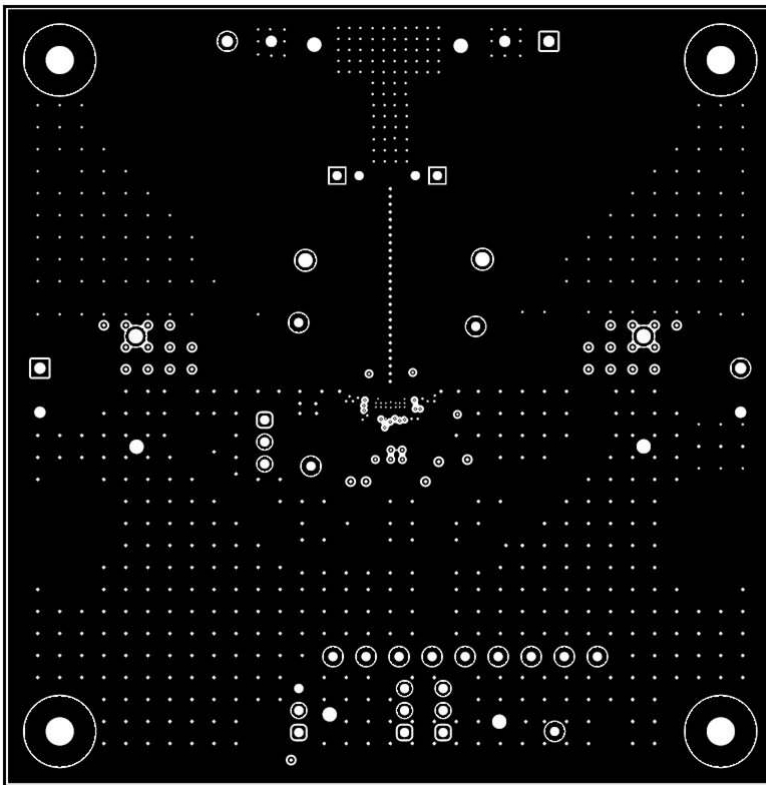


Figure 5-4. Signal Layer 2



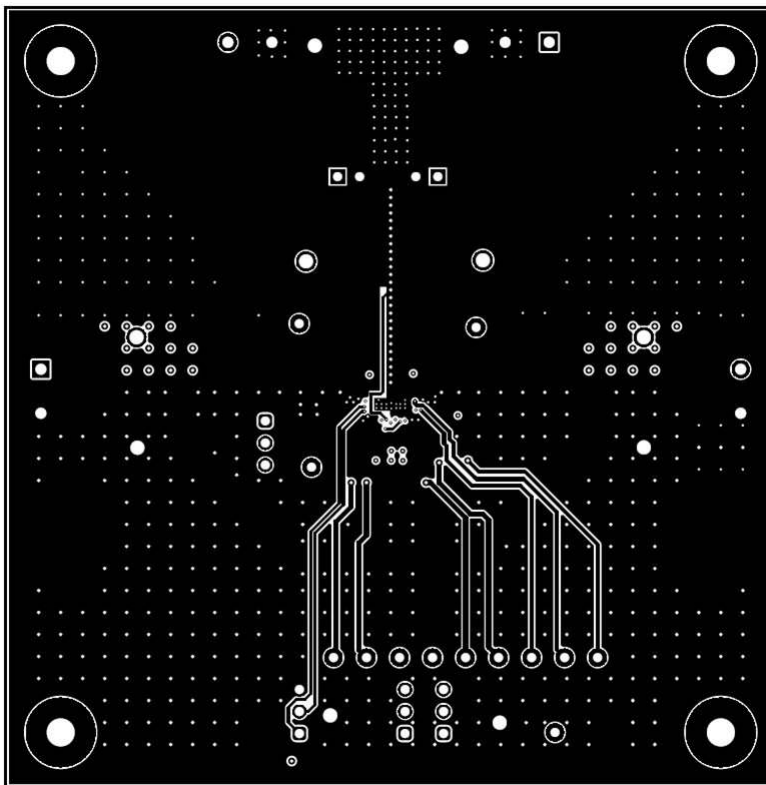


Figure 5-5. Signal Layer 3

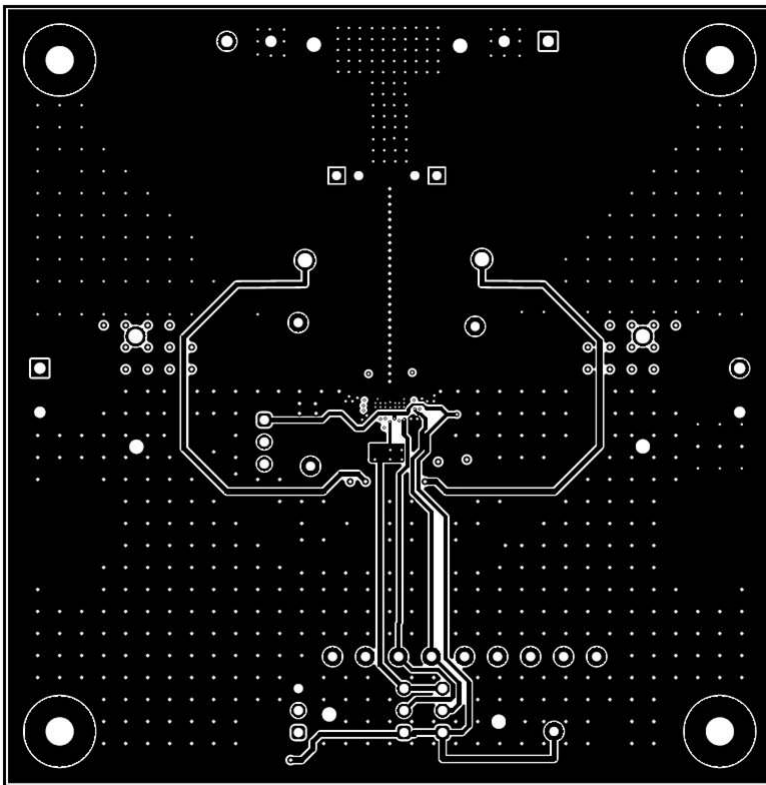


Figure 5-6. Signal Layer 4

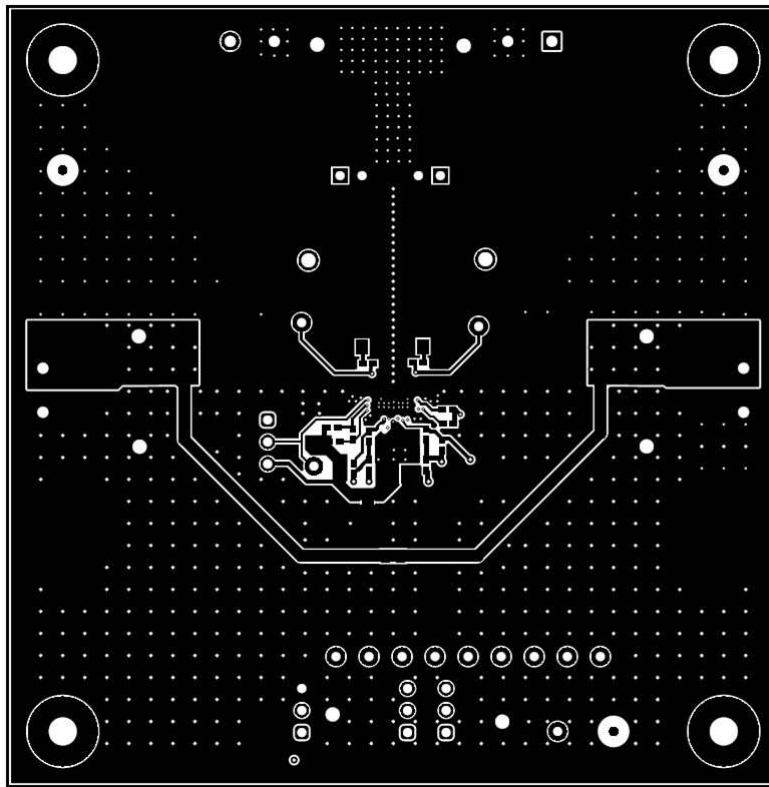


Figure 5-7. Bottom Layer PCB Layout

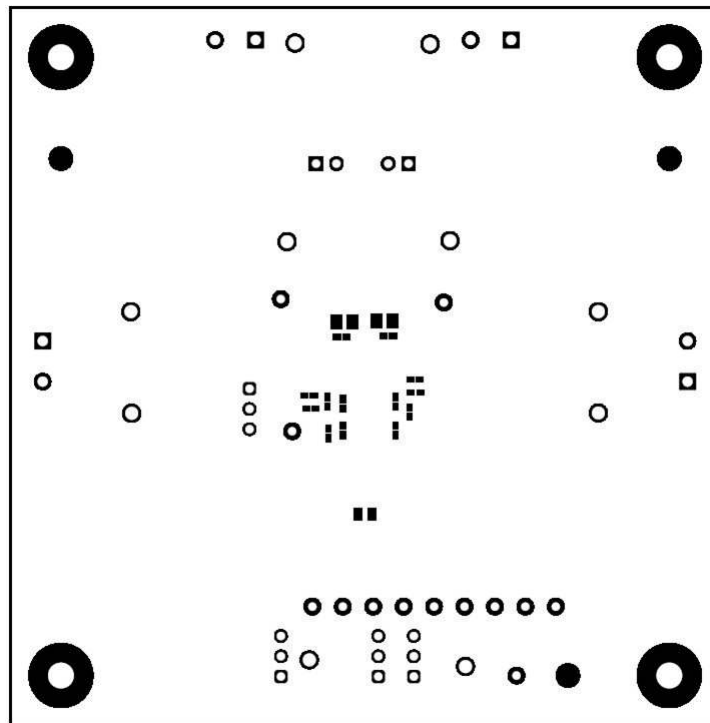


Figure 5-8. Bottom Solder

## 6 Bill of Materials

Table 6-1 lists the BOM for the (EVM).

**Table 6-1. BOM for TPS541620SEVM (Dual Output)**

QTY	DESIGNATOR	DESCRIPTION	PARTNUMBER	MANUFACTURER
2	C1, C2	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X5R, 0201	MuRata	GRM033C71C104KE14D
6	C3, C6, C16, C17, C18, C19	CAP, CERM, 100 uF, 6.3 V, +/- 20%, X5R, 0805	MuRata	GRM21BR60J107M
2	C7, C12	CAP, CERM, 47 uF, 25 V, +/- 20%, X5R, 1206_190	TDK	C3216X5R1E476M160AC
2	C8, C11	CAP, CERM, 22 uF, 25 V, +/- 20%, X5R, 0805	MuRata	GRM21BR61E226ME44L
2	C9, C10	CAP, CERM, 0.1 uF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	Kemet	C0603C104K5RACAUTO 2
1	C13	CAP, CERM, 2.2 uF, 6.3 V, +/- 20%, X5R, 0402	MuRata	GRM153R60J225ME95D 1
1	C20	CAP, CERM, 0.01 uF, 16 V, +/- 10%, X7R, 0402	Kemet	C0402C103K4RACTU
2	C21, C23	CAP, AL, 100 uF, 25 V, +/- 20%, 0.34 ohm, AEC-Q200 Grade 2, SMD	Panasonic	EEE-FK1E101XP
1	C24	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X7R, 0402	AVX	GRM033C81E104KE14D
2	C28, C29	CAP, CERM, 0.1 uF, 25 V, +/- 10%, X6S, 0201	MuRata	GRM033C81E104KE14D
4	H1, H2, H3, H4	Machine Screw, Round, #4-40 x 1/4, Nylon, Phillips panhea	B&F Fastener Supply	NY PMS 440 0025 PH
4	J1, J2, J3, J4	Terminal Block, 5.08 mm, 2x1, Brass, TH	On-Shore Technology	ED120/2DS
2	J7, J8	Header, 100mil, 2x1, Gold, TH	Sullins Connector Solutions	PBC02SAAN
2	J9, J11	Header, 2.54mm, 3x1, Gold, TH	Samtec	TSW-103-08-G-S
1	L1, L2	Inductor, Shielded, Composite, 560 nH, 22 A, 0.00331 ohm, AEC-Q200,SMD	Coilcraft	XAL6030-561MEB 1
3	R2, R4, R13	RES, 10.0 k, 1%, 0.1 W, 0603	Vishay-Dale	CRCW060310K0FKEA
1	R5	RES, 10.7 k, 1%, 0.1 W, 0603	Yageo	RC0603FR-0710K7L
1	R6	RES, 17.4 k, 1%, 0.1 W, 0603	Yageo	RC0603FR-0717K4L
1	R7	RES, 100 k, 1%, 0.1 W, 0603	Vishay-Dale	CRCW0603100KFKEA
1	R11	RES, 49.9, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW060349R9FKEA
1	R14	RES, 0, 1%, 0.5 W, 0805	Keystone	5106
2	SH-J1, SH-J2	Shunt, 100mil, Gold plated, Black	Samtec	SNT-100-BK-G
4	TP1, TP2, TP3, TP4	Test Point, Multipurpose, Red, TH	Keystone	5010
6	TP5, TP6, TP19, TP20, TP24, TP25	Test Point, Multipurpose, Black, TH	Keystone	5011
3	TP9, TP14, TP23	Test Point, Miniature, Red, TH	Keystone	5000
6	TP10, TP11, TP15, TP16, TP17, TP18	Test Point, Miniature, White, TH	Keystone	5002
2	TP21, TP22	PC Test Point, SMT	TE Connectivity	RCU-0C
1	U1	TPS541620RPBR, RPB0025A (VQFN-HR-25)	Texas Instruments	TPS541620RPBR

## 7 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision * (November 2020) to Revision A (May 2021)	Page
• Updated user's guide title.....	2

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