

TPS62840-1YBGEVM56 User's Guide

The TPS62840-1YBGEVM56 (BSR056-001) facilitates the evaluation of the TPS6284xYBG family of 750-mA, step-down converters with 60-nA I_Q in tiny 1.47-mm by 0.97-mm WCSP packages with 0.4-mm pitch. The EVM contains 2 separate circuits to create output voltages between 0.8 V and 3.3 V from higher input voltages between 1.8 V and 6.5 V. All circuits have a maximum height of 1 mm. Due to its extremely low I_Q , the TPS6284x provides a long battery lifetime for systems which have very low current consumption states such as wearables, Internet of Things- (IoT-) connected devices, and other portable end equipment.

Contents

1	Introduction	2
2	Setup	4
3	TPS62840-1YBGEVM56 Test Results	5
4	Board Layout	6
5	Schematic and Bill of Materials (BOM)	12

List of Figures

1	Loop Response Measurement Modification	3
2	TPS62840 Thermal Performance ($V_{IN} = 3.6\text{ V}$, $V_{OUT} = 1.8\text{ V}$, $I_{OUT} = 750\text{ mA}$)	5
3	Loop Response ($V_{IN} = 3.6\text{ V}$, $V_{OUT} = 1.8\text{ V}$, $I_{OUT} = 750\text{ mA}$)	5
4	Top Assembly	6
5	Top Layer	7
6	Internal Layer 1	8
7	Internal Layer 2	9
8	Bottom Layer	10
9	TPS62840-1YBGEVM56 Angled View	11
10	TPS62840-1YBGEVM56 Overhead View	11
11	TPS62840 Schematic	12
12	TPS62841 Schematic	12

List of Tables

1	BSR056 Circuit Options	2
2	Performance Specification Summary	2
3	TPS62840 Bill of Materials	13
4	TPS62841 Bill of Materials	13

Trademarks

All trademarks are the property of their respective owners.

1 Introduction

The TPS6284x is a family of synchronous, step-down converters in a 1.47-mm × 0.97-mm wafer chip-scale package (WCSP) with 0.4-mm pitch. The BSR056 EVM contains 2 completely independent circuits, each for a different IC version. See [Table 1](#) for a summary of the BSR056 EVMs.

The reference designator order is grouped together by sub-circuit. Reference designators beginning with '1' (for example, R1x, J1x, C1x) are part of one sub-circuit. The second digit of each reference designator is the same for the same component in different sub-circuits. R11 and R21, for example, refer to the same resistor in each sub-circuit.

Table 1. BSR056 Circuit Options

EVM Version	IC Installed	Output Voltage	Output Voltage Range	Output Current
TPS62840-1YBGEVM56 (BSR056-001)	TPS62840 (U11)	1.8 V	1.8 - 3.3 V (selectable)	750 mA
	TPS62841 (U21)	1.2 V	0.8 - 1.55 V (selectable)	750 mA

1.1 Performance Specification

[Table 2](#) provides a summary of the TPS62840-1YBGEVM56 performance specifications.

Table 2. Performance Specification Summary

SPECIFICATION	MIN	TYP	MAX	UNIT
Input voltage	1.8	3.6	6.5	V
Output voltage	See Table 1			V
Output current	0		See Table 1	mA

1.2 Modifications

The printed-circuit board (PCB) for this EVM uses the adjustable output voltage versions of this integrated circuit (IC). Additional input and output capacitors can also be added. Finally, the loop response of the IC can be measured.

1.2.1 Adjusting the Output Voltage

The output voltage is adjusted through the choice of Rx1 and Rx3 resistors. Since Rx1 and Rx3 are in parallel, only Rx1 or Rx3 should be installed at the same time. Rx1 is an 0201 size to represent a typical final solution. However, such a small size is difficult to manually replace. Therefore, Rx3 is provided in an 0603 size to easily change the output voltage. Simply remove Rx1 and install Rx3 in the desired value.

1.2.2 Input and Output Capacitors

Cx4 is provided for an additional input capacitor. This capacitor is not required for proper operation but can be used to reduce the input voltage ripple.

Cx5, Cx6, and Cx7 are provided for additional output capacitors. These capacitors are not required for proper operation but can be used to reduce the output voltage ripple and to improve the load transient response. The total output capacitance must remain within the recommended range in the data sheet for proper operation.

1.2.3 Loop Response Measurement

The loop response of the EVM can be measured with two simple changes to the circuitry. First, cut the trace between the VOS pin and the output capacitor on the top layer. This change is shown in [Figure 1](#). Second, install a 10-Ω resistor across the resistor pads on the back of the PCB at Rx2. The pads are spaced to allow installation of an 0603-sized resistor. With these changes, an ac signal (10-mV, peak-to-peak amplitude recommended) can be injected into the control loop across the added resistor. Details of measuring the control loop of DCS-Control devices are found in [How to Measure the Control Loop of DCS-Control™ Devices](#). The results of this test are shown in [Figure 3](#).

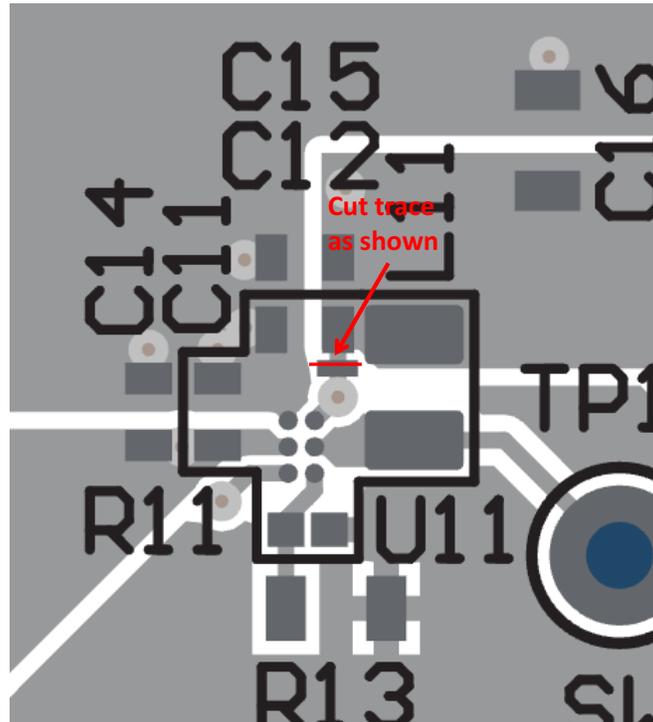


Figure 1. Loop Response Measurement Modification

2 Setup

This section describes how to properly use the TPS62840-1YBGEVM56.

2.1 Input/Output Connector Descriptions

Jx1, Pin 1 and 2 – VIN	Positive input connection from the input supply for the EVM.
Jx1, Pin 3 and 4 – S+/S-	Input voltage sense connections. Measure the input voltage at this point.
Jx1, Pin 5 and 6 – GND	Input return connection from the input supply for the EVM.
Jx2, Pin 1 and 2 – VOUT	Output voltage connection.
Jx2, Pin 3 and 4 – S+/S-	Output voltage sense connections. Measure the output voltage at this point.
Jx2, Pin 5 and 6 – GND	Output return connection.
JPx1 – EN	EN pin input jumper. Place the supplied jumper across ON and EN to turn on the IC. Place the jumper across OFF and EN to turn off the IC.

2.2 Setup

To operate the EVM, set jumper JPx1 to the desired position per [Section 2.1](#). Connect the input supply to Jx1 and connect the load to Jx2.

3 TPS62840-1YBGEVM56 Test Results

The TPS62840-1YBGEVM56 was used to take all the data in the [1.8V-6.5V, 750mA, 60nA I_Q Step-Down Converter](#) data sheet. See the device data sheet for the performance of this EVM. The only difference is the inductor used. This EVM was designed for the smallest solution size and uses a 0805-size inductor. The data sheet inductor achieves higher efficiency but is a 0806 size and taller.

Figure 2 shows the thermal performance of the EVM.

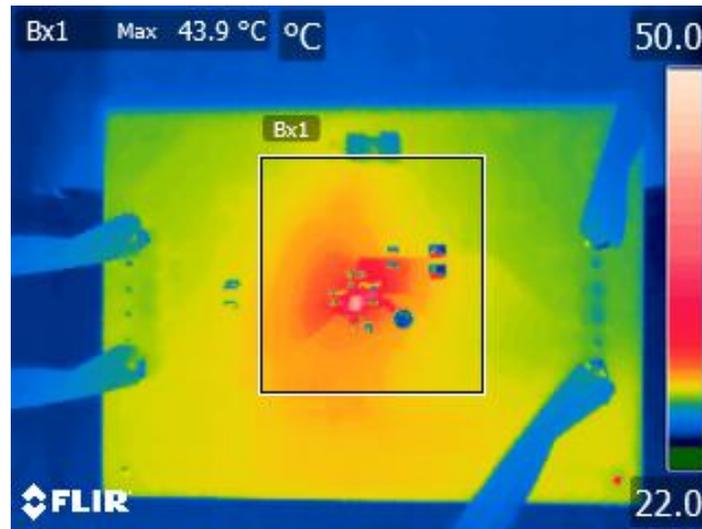


Figure 2. TPS62840 Thermal Performance ($V_{IN} = 3.6\text{ V}$, $V_{OUT} = 1.8\text{ V}$, $I_{OUT} = 750\text{ mA}$)

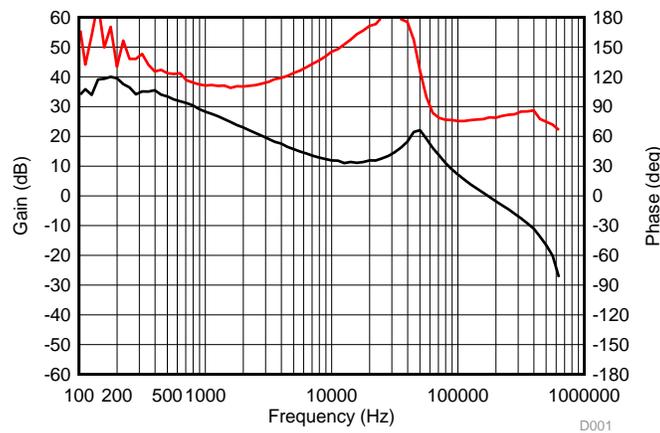


Figure 3. Loop Response ($V_{IN} = 3.6\text{ V}$, $V_{OUT} = 1.8\text{ V}$, $I_{OUT} = 750\text{ mA}$)

4 Board Layout

This section provides the TPS62840-1YBGEVM56 board layout and illustrations in [Figure 4](#) through [Figure 8](#). The Gerbers are available on the EVM product page: [TPS62840-1YBGEVM56](#).

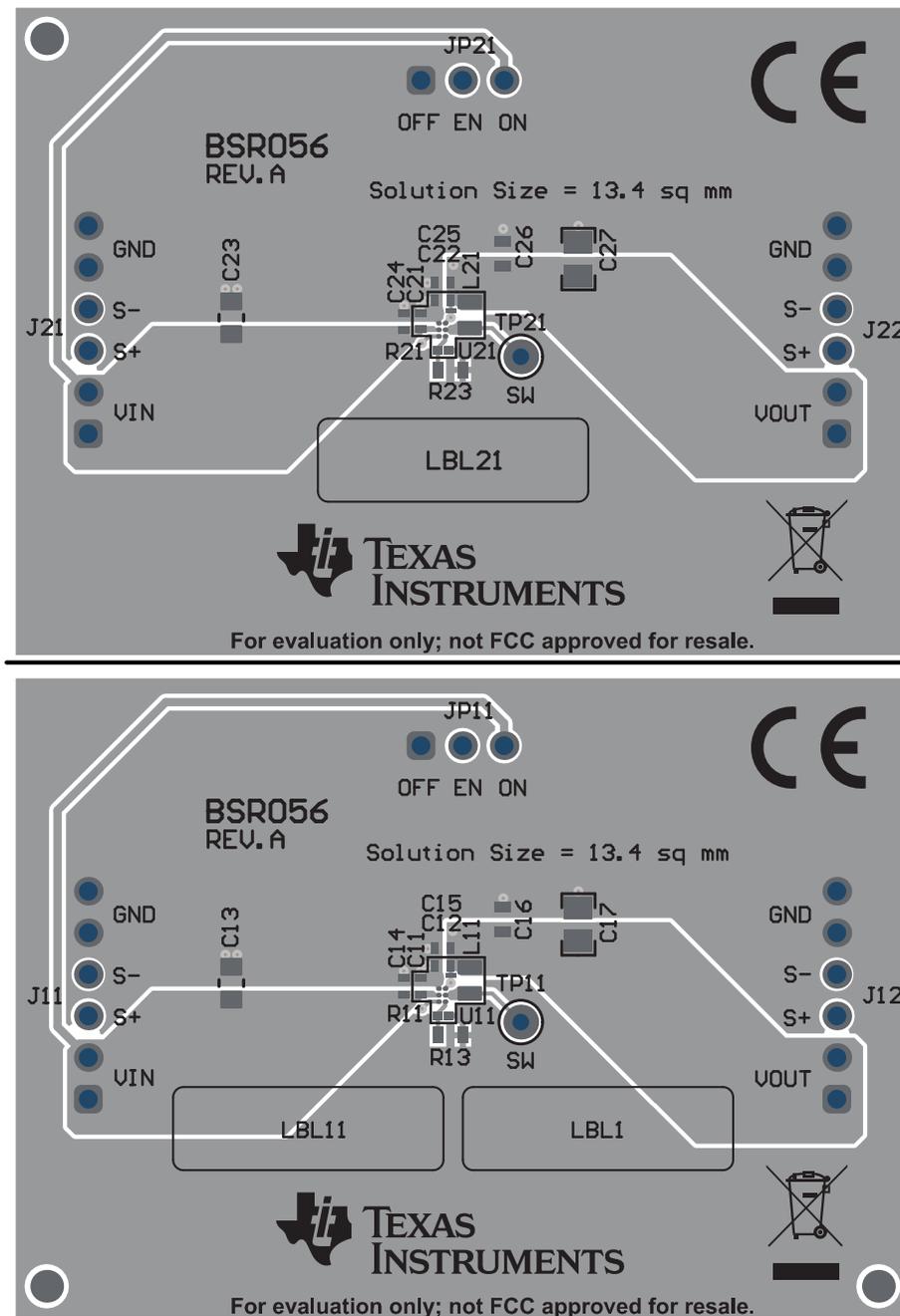


Figure 4. Top Assembly

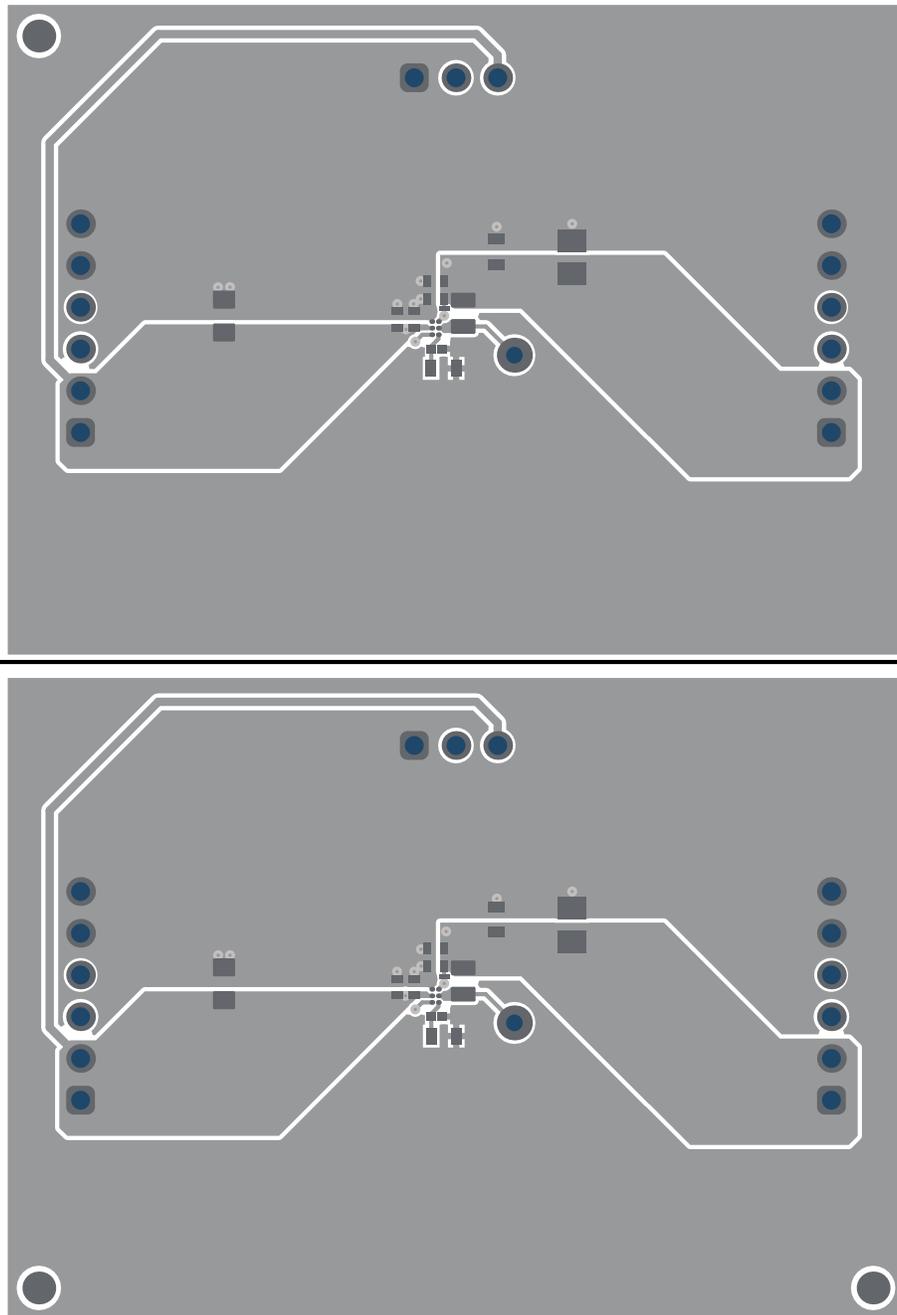


Figure 5. Top Layer

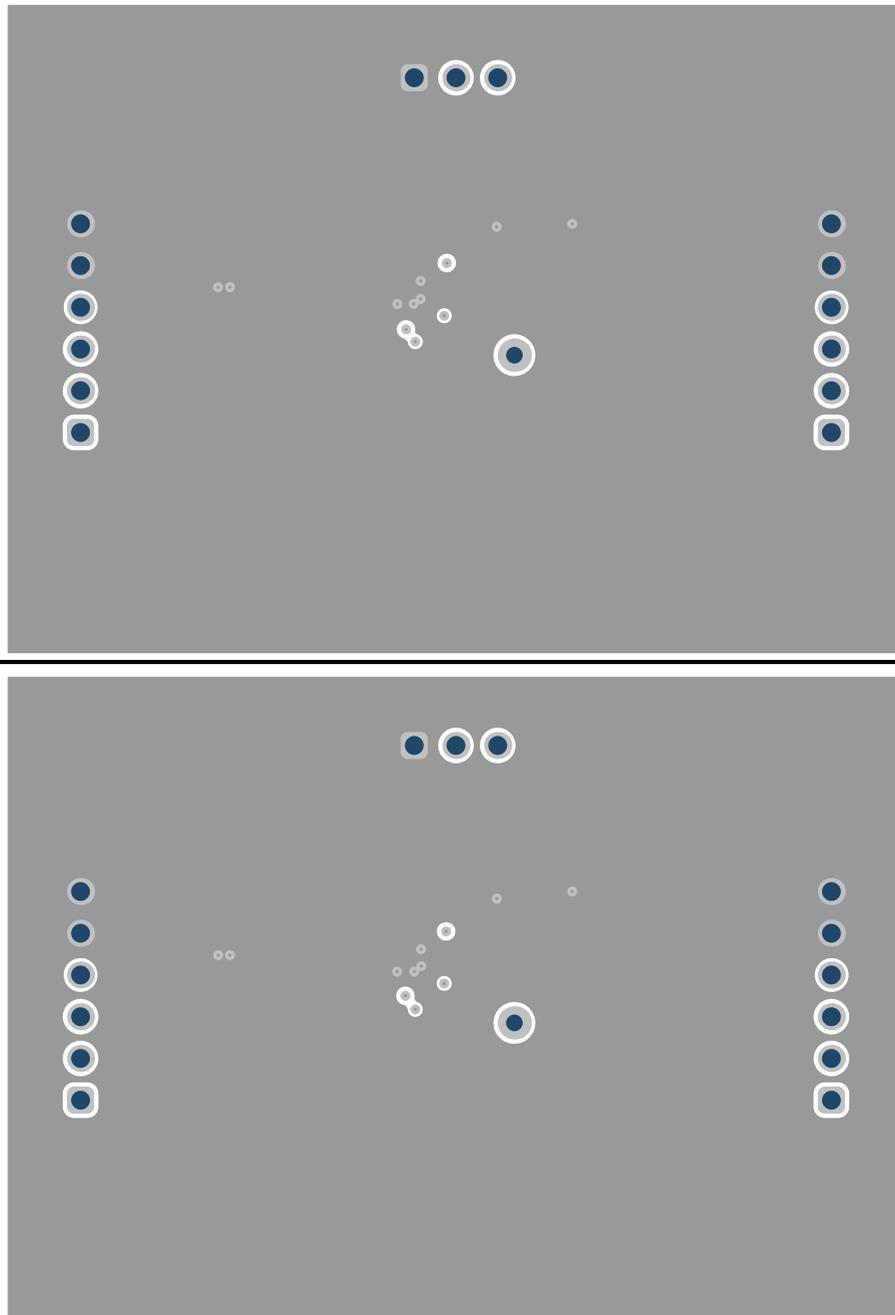


Figure 6. Internal Layer 1

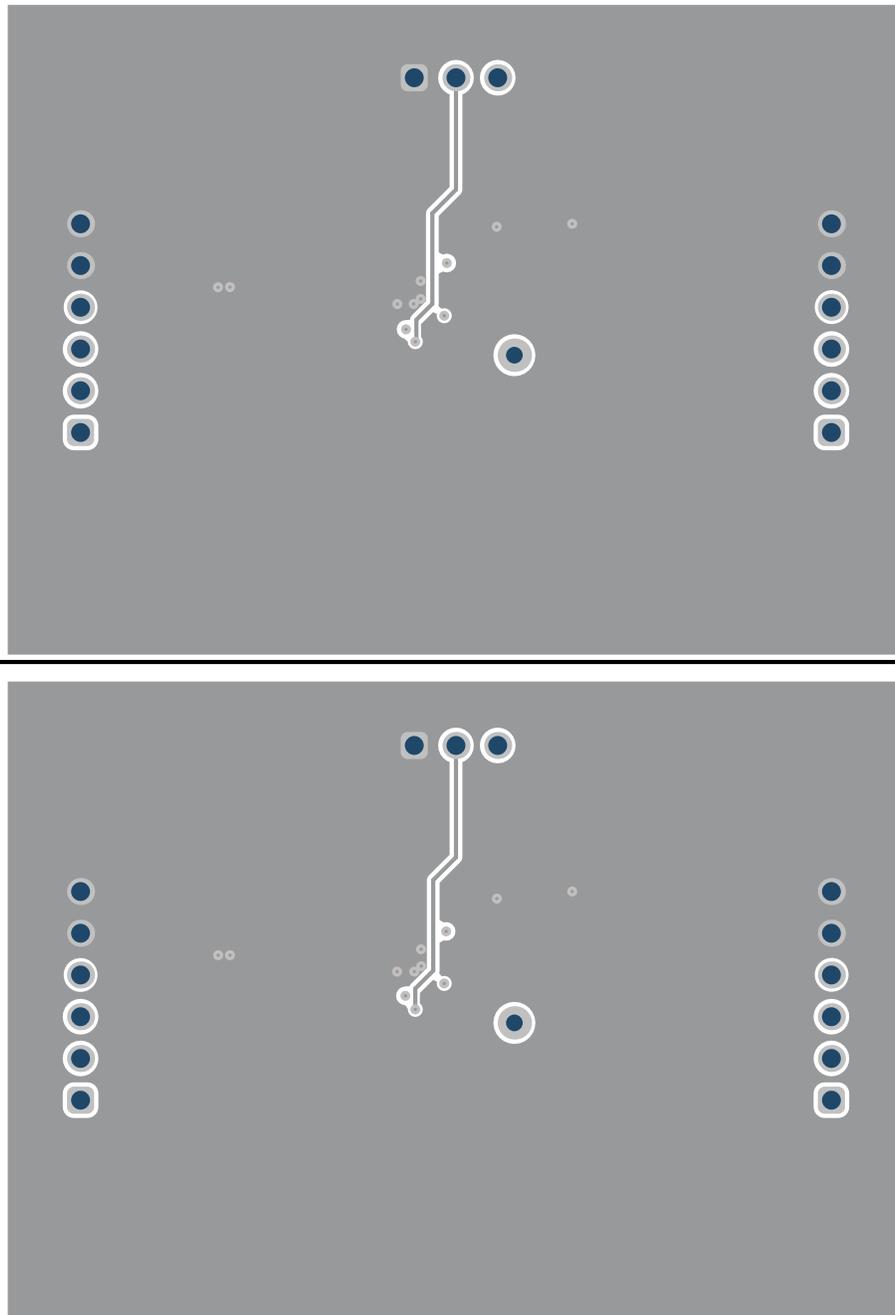


Figure 7. Internal Layer 2

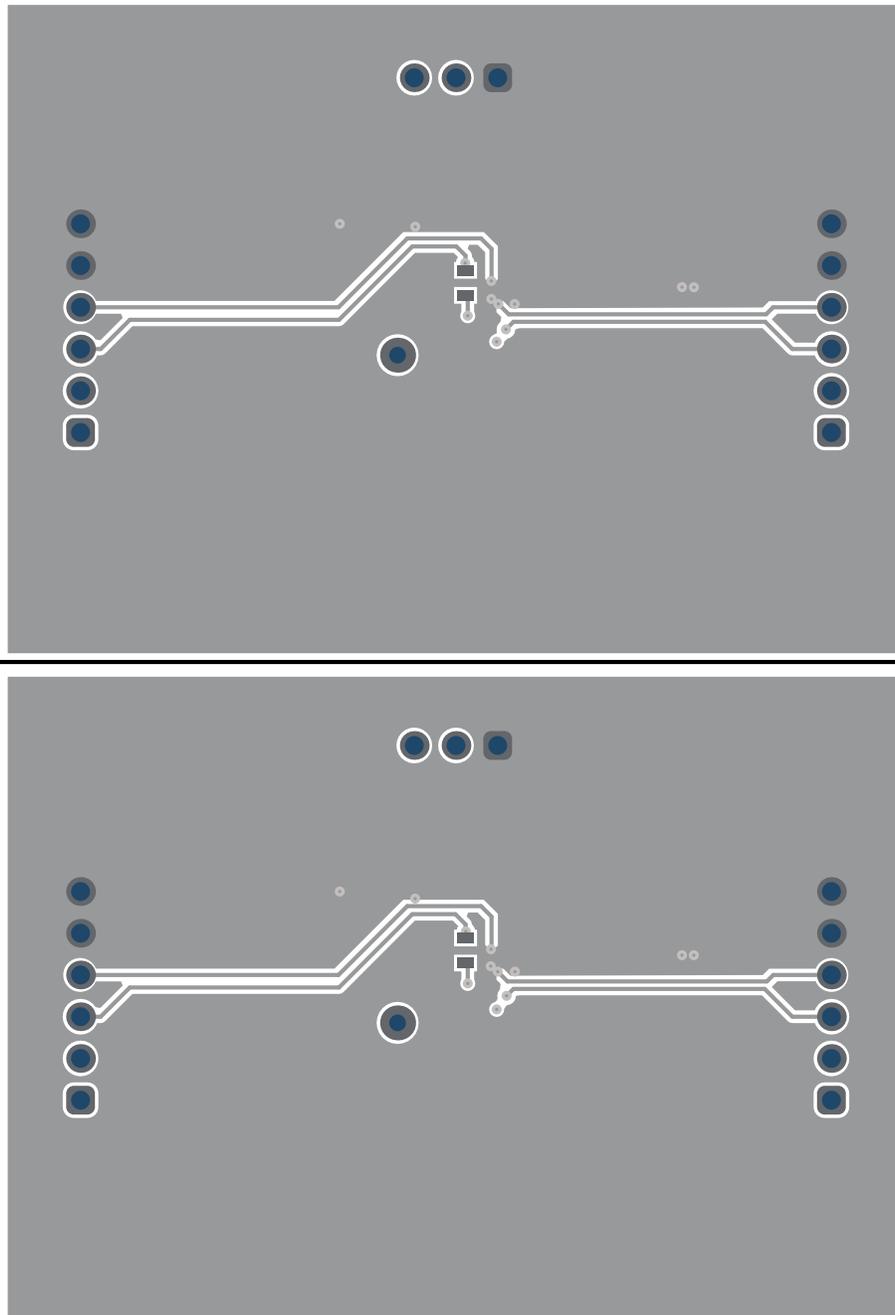


Figure 8. Bottom Layer

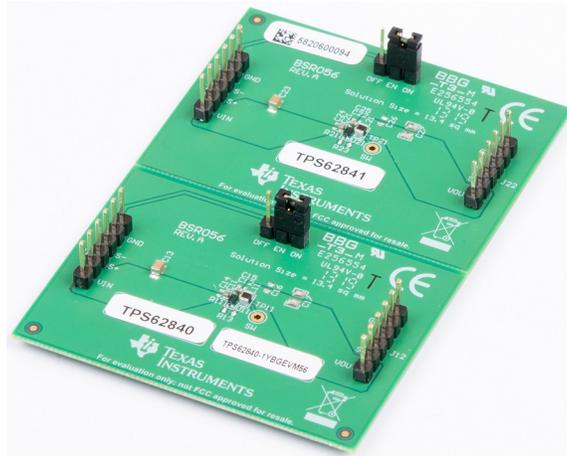


Figure 9. TPS62840-1YBGEVM56 Angled View

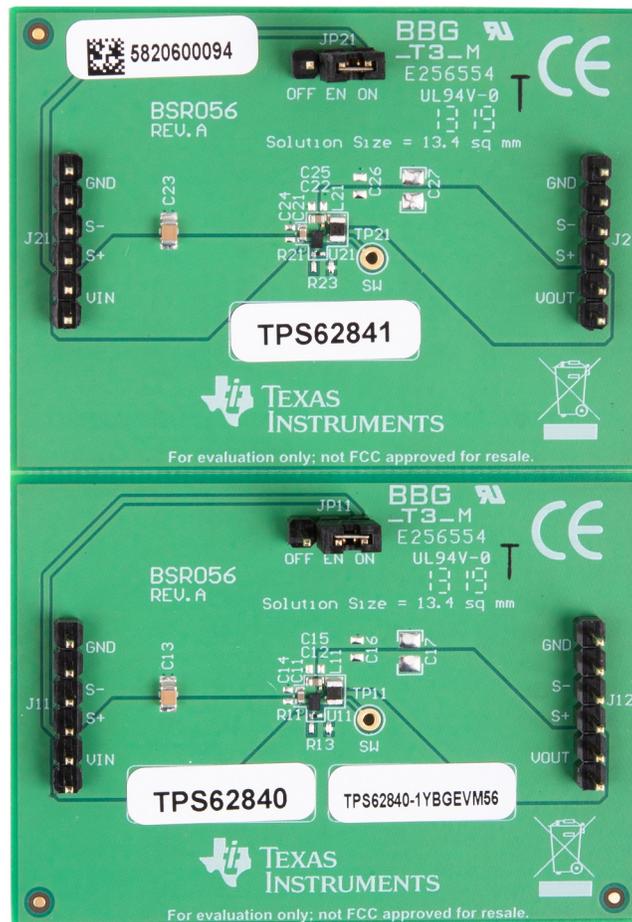


Figure 10. TPS62840-1YBGEVM56 Overhead View

5 Schematic and Bill of Materials (BOM)

This section provides the TPS62840-1YBGEVM56 schematic and bill of materials.

5.1 Schematic

Figure 11 illustrates the TPS62840 EVM schematic.

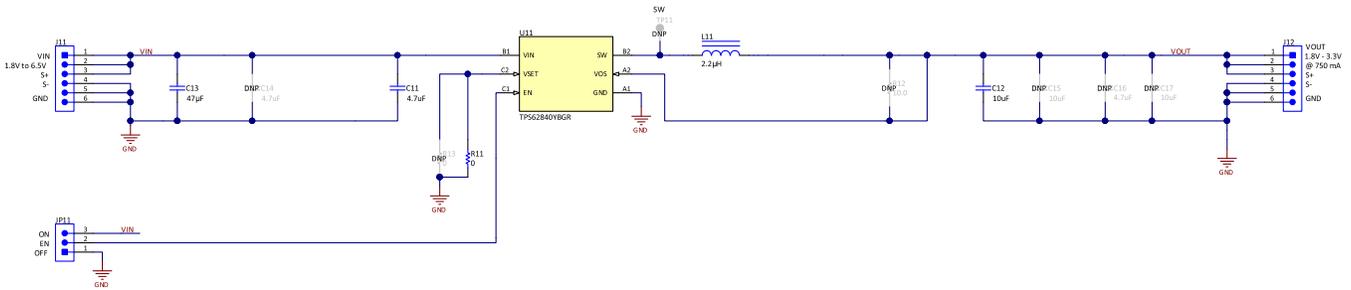


Figure 11. TPS62840 Schematic

Figure 12 illustrates the TPS62841 EVM schematic.

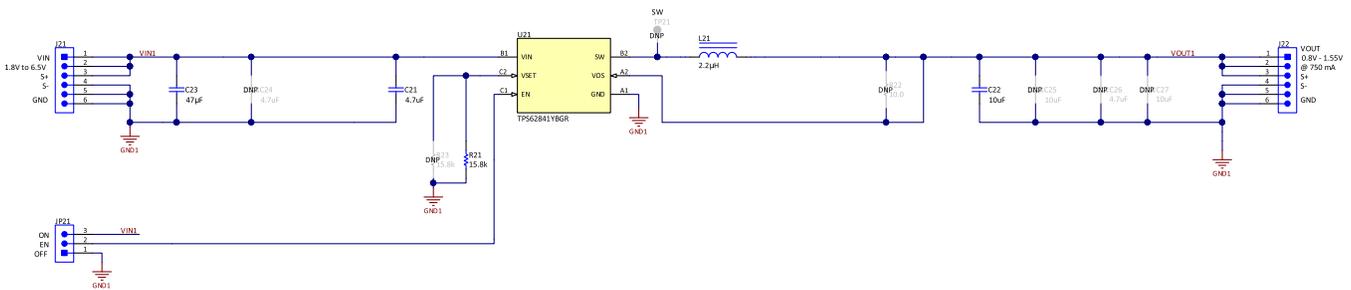


Figure 12. TPS62841 Schematic

5.2 Bill of Materials

Table 3 lists the TPS62840 EVM BOM.

Table 3. TPS62840 Bill of Materials

REF DES	QTY	DESCRIPTION	PART NUMBER	MANUFACTURER
C11	1	CAP, CERM, 4.7 μ F, 10 V, \pm 20%, X5R, 0402	GRM155R61A475MEAAD	Murata
C12	1	CAP, CERM, 10 μ F, 4 V, \pm 20%, X5R, 0402	GRM155R60G106ME44D	Murata
C13	1	CAP, CERM, 47 μ F, 10 V, \pm 20%, X5R, 0805	GRM21BR61A476ME15L	Murata
L11	1	Inductor, Shielded, Metal Composite, 2.2 μ H, 1.5 A, 127 m Ω , SMD	DFE201210S-2R2M=P2	Murata
R11	1	RES, 0 Ω , 1%, 0.05 W, 0201	Std	Std
U11	1	1.8V to 6.5V, 750mA, 60nA I _Q Step Down Converter in WCSP Package	TPS62840YBG	Texas Instruments

Table 4 lists the TPS62841 EVM BOM.

Table 4. TPS62841 Bill of Materials

REF DES	QTY	DESCRIPTION	PART NUMBER	MANUFACTURER
C21	1	CAP, CERM, 4.7 μ F, 10 V, \pm 20%, X5R, 0402	GRM155R61A475MEAAD	Murata
C22	1	CAP, CERM, 10 μ F, 4 V, \pm 20%, X5R, 0402	GRM155R60G106ME44D	Murata
C23	1	CAP, CERM, 47 μ F, 10 V, \pm 20%, X5R, 0805	GRM21BR61A476ME15L	Murata
L21	1	Inductor, Shielded, Metal Composite, 2.2 μ H, 1.5 A, 127 m Ω , SMD	DFE201210S-2R2M=P2	Murata
R21	1	RES, 15.8 k Ω , 1%, 0.05 W, 0201	Std	Std
U21	1	1.8V to 6.5V, 750mA, 60nA I _Q Step Down Converter in WCSP Package	TPS62841YBG	Texas Instruments

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2022, Texas Instruments Incorporated