TPS62125EVM-044 Evaluation Module

This user's guide describes the characteristics, operation, and use of the Texas Instruments TPS62125EVM-044 evaluation module (EVM). The EVM converts a 4-V to 17-V input voltage to a regulated 3.3-V output voltage that delivers 300 mA. The TPS62125 is a high efficiency and small solution for general purpose low power applications, such as those powered from multi-cell lithium, alkaline, or nickel batteries as well as energy harvesting.

NOTE: In July 2019, this EVM was updated in order to replace the TDK inductor which had been obsoleted. To accommodate a different inductor footprint, the printed circuit board (PCB) was updated to revision B. This entire user's guide was updated to reference the revision B PCB. The revision A schematic, bill of materials, and PCB layout are located at the end of this user's guide.

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Trademarks

All trademarks are the property of their respective owners.

1 Introduction

The TPS62125 is a 300-mA, synchronous, step-down converter in a 2x2-mm, 8-pin WSON package.

1.1 Background

The TPS62125EVM-044 (PWR044) uses the TPS62125 device and is set to a 3.3-V output. The EVM operates with full-rated performance with an input voltage between 4V and 17 V, assuming JP1 is connected between ON and EN.

The TPS62125 device contains an adjustable enable threshold and adjustable hysteresis feature. Thus, the input voltage at which the device enables and disables is fully programmable by the user. In the TPS62125EVM-044, the device is set to turn on at 6 V and turn off at 4 V. This feature can be bypassed by using jumper JP1, which overrides the programmed threshold voltages.

1.2 Performance Specification

Table 1 provides a summary of the TPS62125EVM-044 performance specifications.

Table 1. Performance Specification Summary

Specification	Test Conditions	Min	Typ	Max	Unit
Input voltage	JP1 connected between EN and ON	4		17	V
Output voltage setpoint			3.3		V
Output current		0		300	mA

1.3 Modifications

The PCB for this EVM accommodates additional input and output capacitors, as well as a feedforward capacitor. The loop response can be measured.

1.3.1 Input and Output Capacitors

C4 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.

C5, C6, and C7 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.

1.3.2 Feedforward Capacitor

C8 is provided for a feedforward capacitor. This capacitor is not required for proper operation but can be used to improve the transient response. Typically, using a 22-pF feedforward capacitor reduces or eliminates any output voltage overshoot that may occur at start-up. C8 is located on the back side of the PCB.

1.3.3 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 inductor 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 R7. 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*. Figure 2 shows the results of this test.

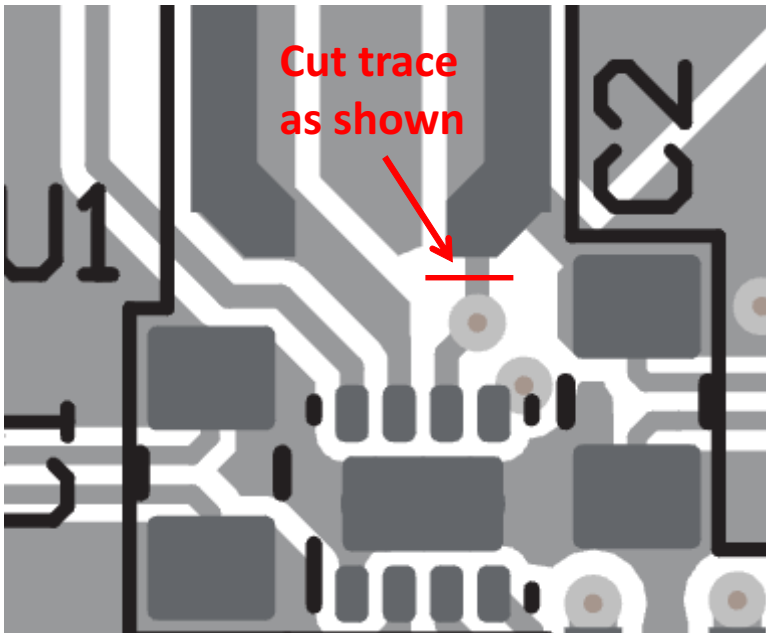


Figure 1. Loop Response Measurement Modification

2 Setup

This section describes how to properly use the TPS62125EVM-044.

2.1 Input/Output Connector Descriptions

J1, Pin 1 and 2 – VIN	Positive input connection from the input supply for the EVM.
J1, Pin 3 and 4 – S+/S-	Input voltage sense connections. Measure the input voltage at this point.
J1, Pin 5 and 6 – GND	Input return connection from the input supply for the EVM.
J2, Pin 1 and 2 – VOUT	Output voltage connection.
J2, Pin 3 and 4 – S+/S-	Output voltage sense connections. Measure the output voltage at this point.
J2, Pin 5 and 6 – GND	Output return connection.
J3 – PG/GND	The PG output appears on pin 1 of this header with a convenient ground on pin 2.
JP1 – 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. Do not install the supplied jumper to utilize the adjustable enable threshold voltage feature of the IC.
JP2 – PG Pullup Voltage	PG pin pullup voltage jumper. Place the supplied jumper on JP2 to connect the PG pin pullup resistor to Vout. Alternatively, the jumper can be removed and a different voltage can be supplied on pin 1 to pull up the PG pin to a different level. This externally applied voltage must remain below 12 V.

2.2 Setup

To operate the EVM, set jumpers JP1 and JP2 to the desired positions per Section 2.1. Connect the input supply to J1 and connect the load to J2.

3 TPS62125EVM-044 Test Results

This section provides test results of the TPS62125EVM-044. The TPS62125EVM-044 was used to take all the data in TPS62125 3-V to 17-V, 300-mA Step-Down Converter With Adjustable Enable Threshold and Hysteresis. See the device data sheet for the performance of this EVM.

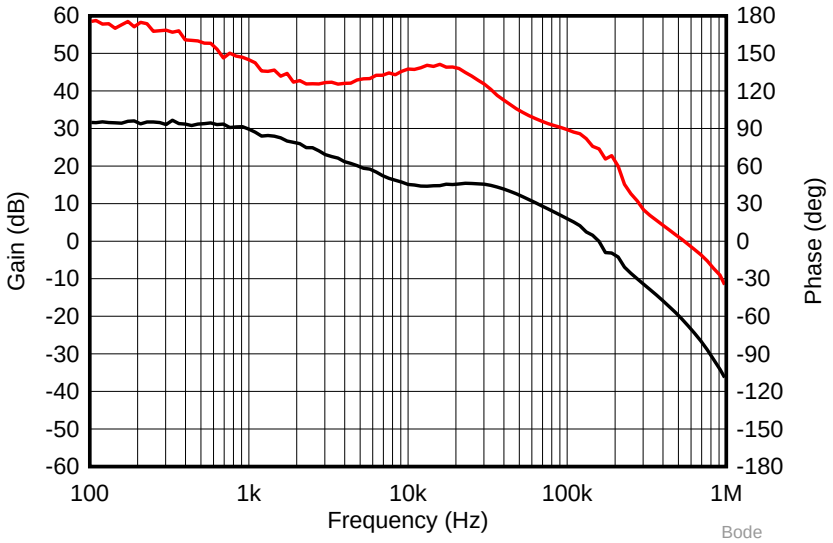


Figure 2. Loop Response With V_{IN} = 12 V and I_{OUT} = 300 mA

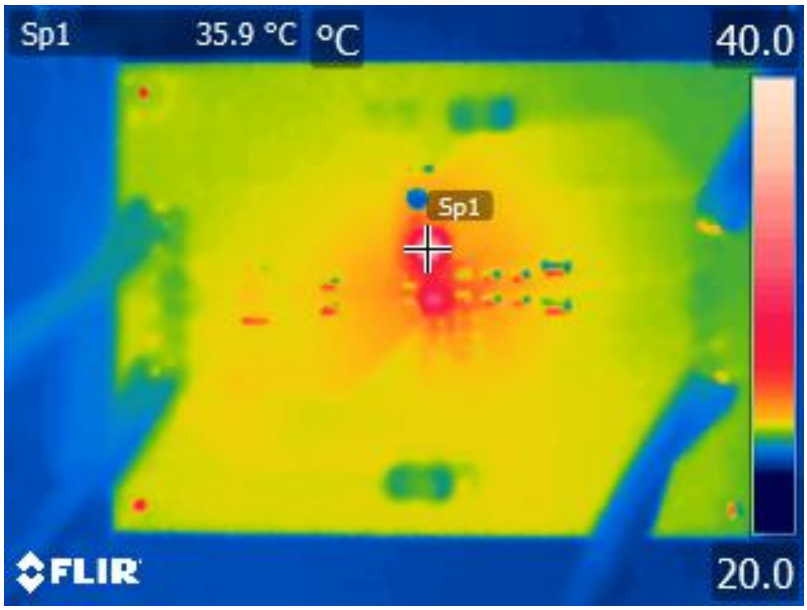


Figure 3. Thermal Performance With V_{IN} = 12 V and I_{OUT} = 300 mA

4 Board Layout

This section provides the TPS62125EVM-044 revision B board layout and illustrations.

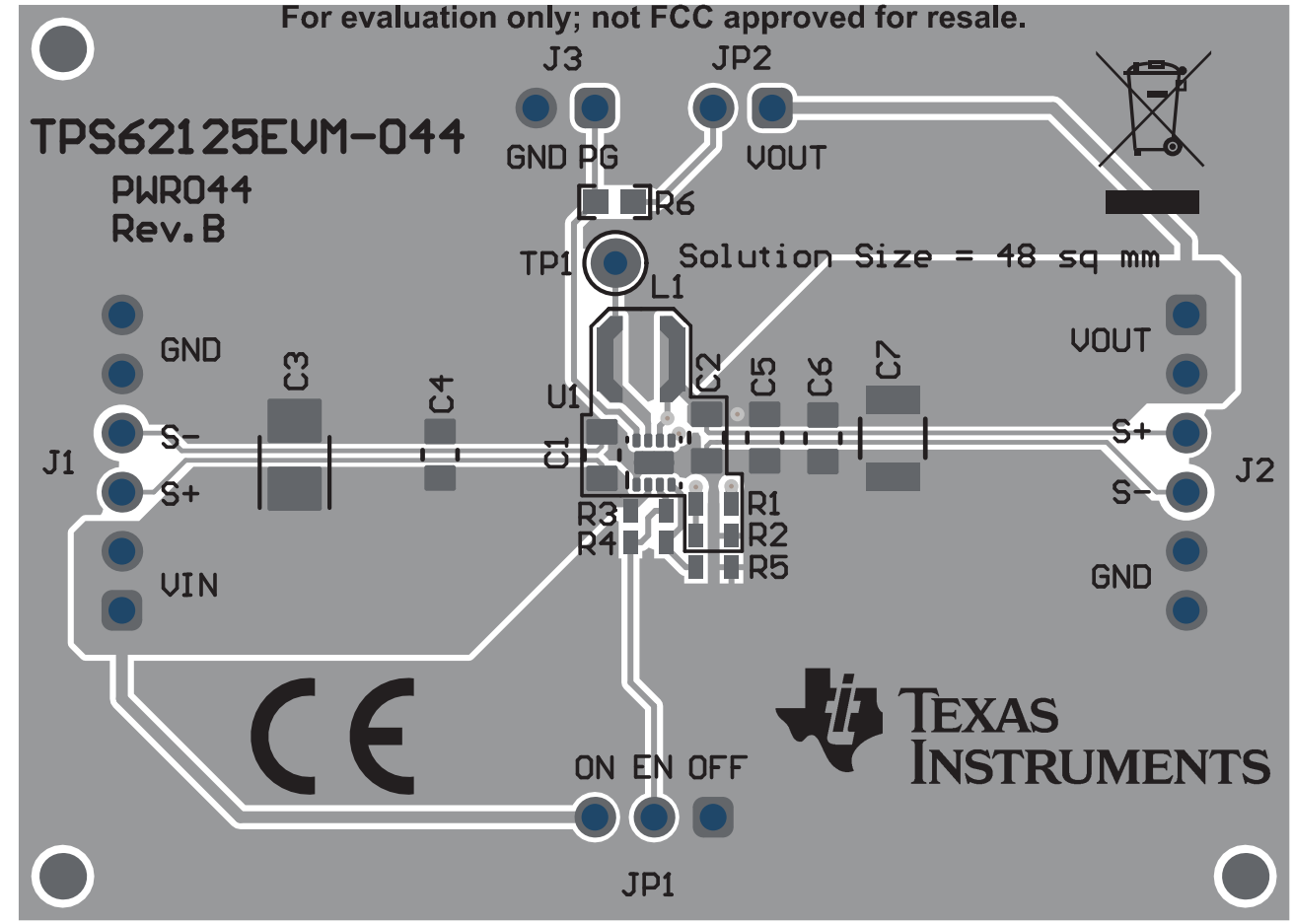


Figure 4. Revision B Top Assembly Layer

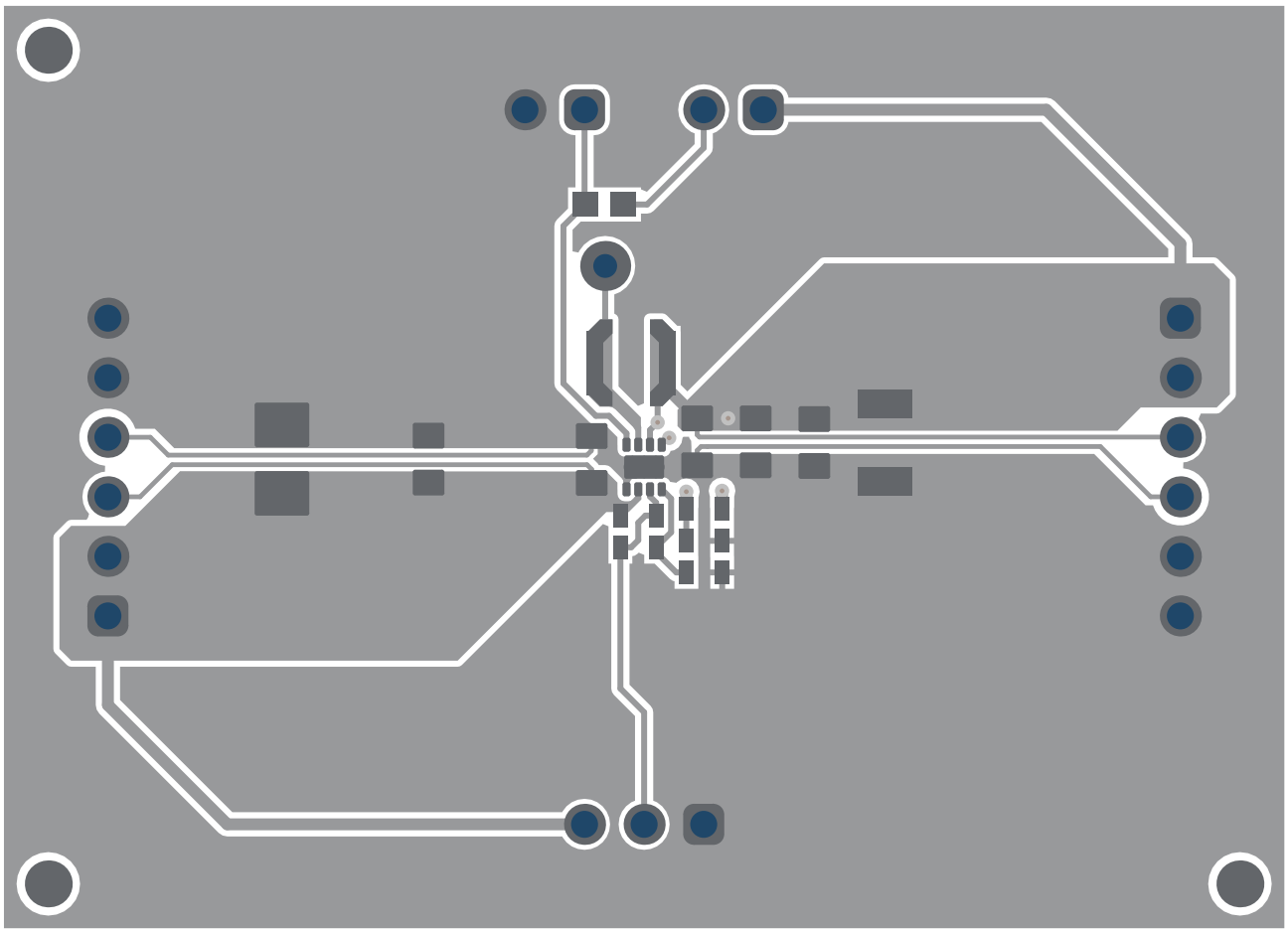


Figure 5. Revision B Top Layer

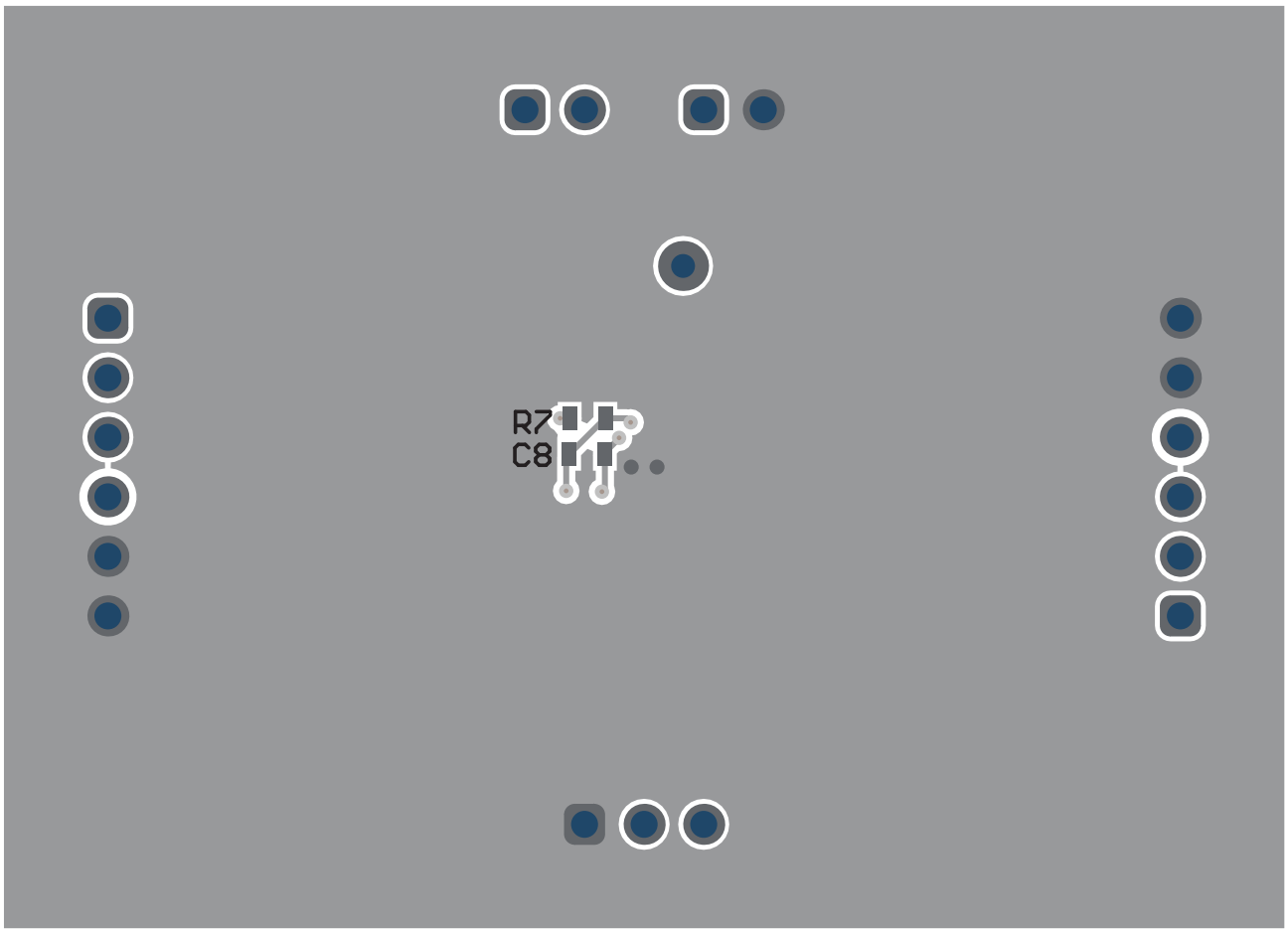
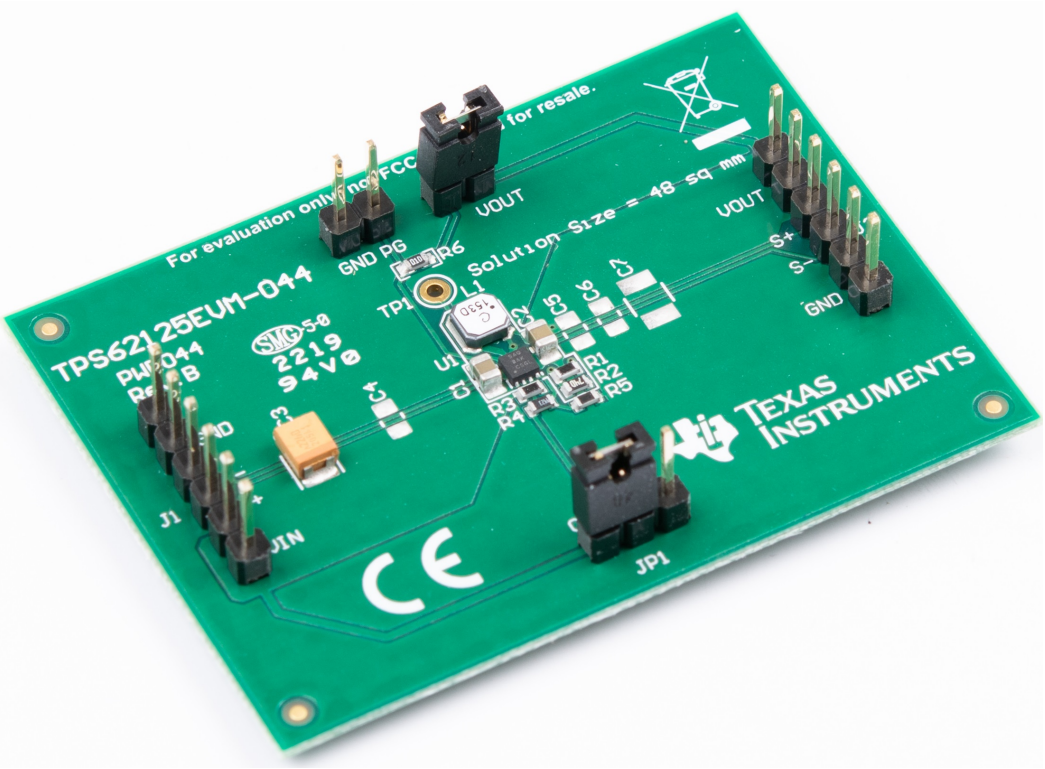


Figure 6. Revision B Bottom Layer

5 TPS62125EVM-044 Photos



6 Schematic and Bill of Materials

This section provides the TPS62125EVM-044 revision B schematic and bill of materials.

6.1 Schematic

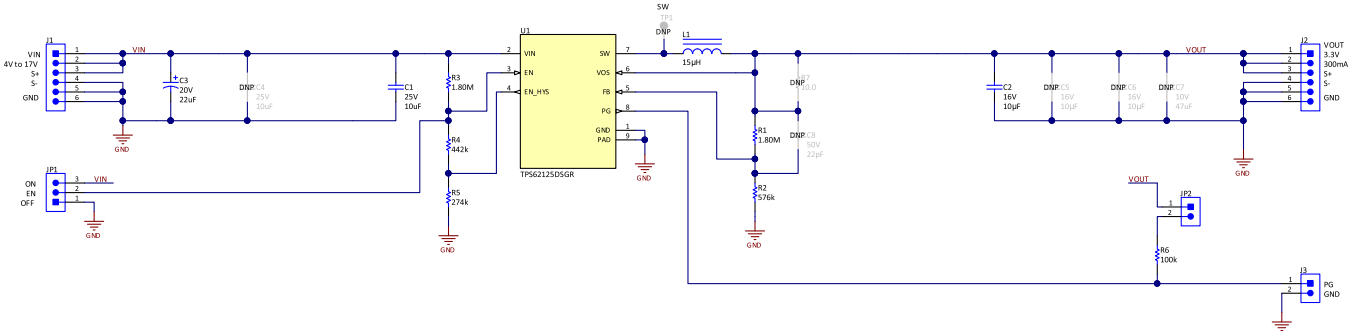


Figure 7. Revision B TPS62125EVM-044 Schematic

6.2 Bill of Materials

Table 2. Revision B TPS62125EVM-044 Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
1	C1	10 µF	Capacitor, Ceramic, 25V, X5R, ±20%	0805	GRM21BR61E106MA73L	Murata
1	C2	10 µF	Capacitor, Ceramic, 16V, X5R, ±20%	0805	GRM21BR61C106ME15L	Murata
1	C5	22 µF	Capacitor, Tantalum Polymer, 22 uF, 20 V, +/- 20%, 0.09 ohm	3528[B]	TCJB226M020R0090	AVX
1	L1	15 µH	Inductor, Shielded Drum Core, Ferrite, 0.59 A, 0.44 ohm	3.3 X 3.3 mm	LPS3314-153MRB	Coilcraft
2	R1, R4	1.8M	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R2	442k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R3	274k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R5	576k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R6	100k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	U1	TPS62125	IC, 3V-17V, 300mA Buck Converter with Adjustable Enable Threshold and Hysteresis	WSON-8	TPS62125DSG	TI

Revision A files

A.1 Board Layout

This section provides the TPS62125EVM-044 revision A board layout and illustrations.

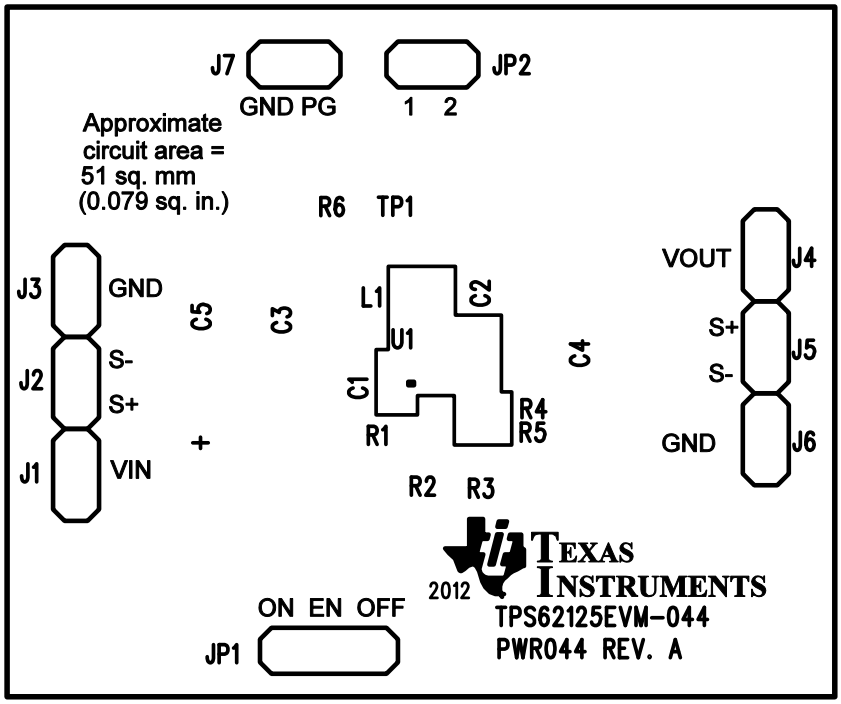


Figure 8. Revision A Top Silk Layer

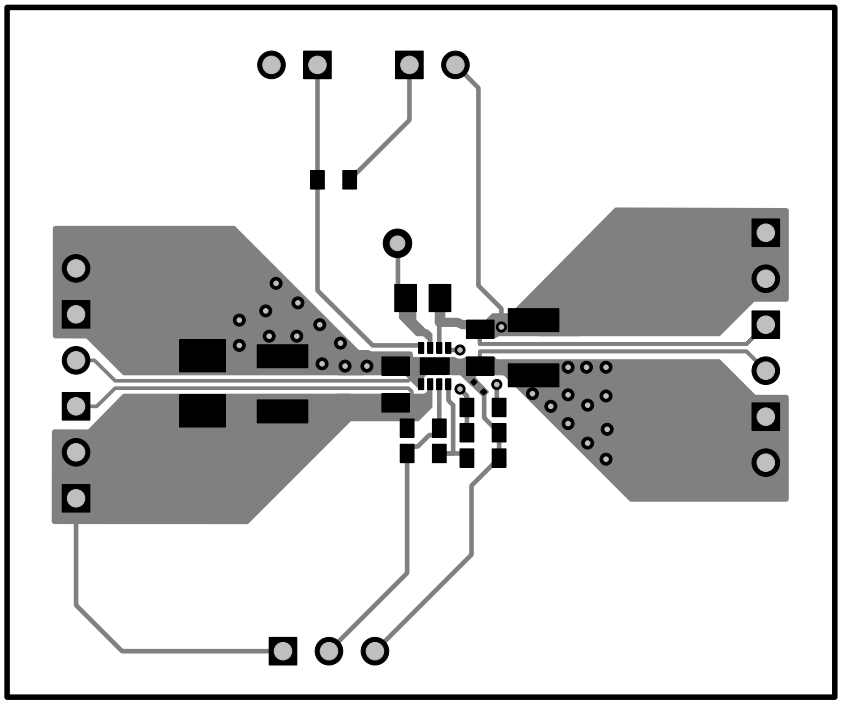


Figure 9. Revision A Top Layer

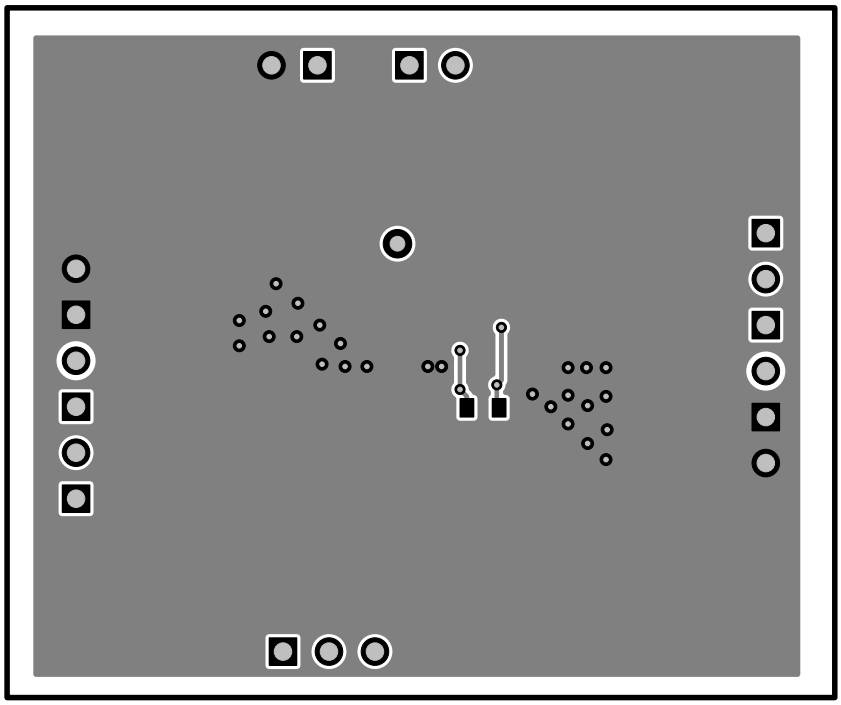


Figure 10. Revision A Bottom Layer

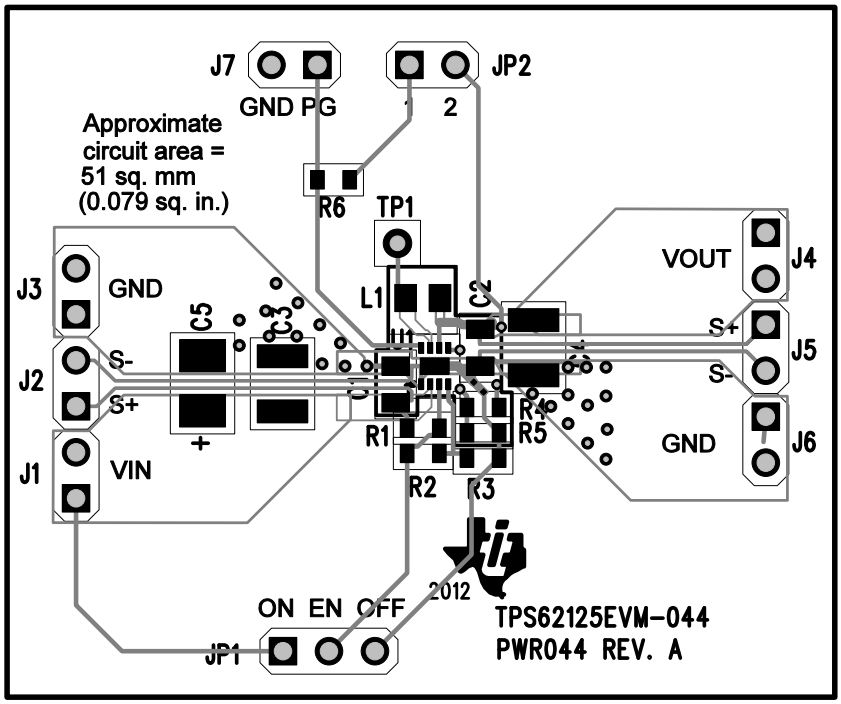


Figure 11. Revision A Top Assembly Layer

A.2 Schematic and Bill of Materials

This section provides the TPS62125EVM-044 revision A schematic and bill of materials.

A.2.1 Schematic

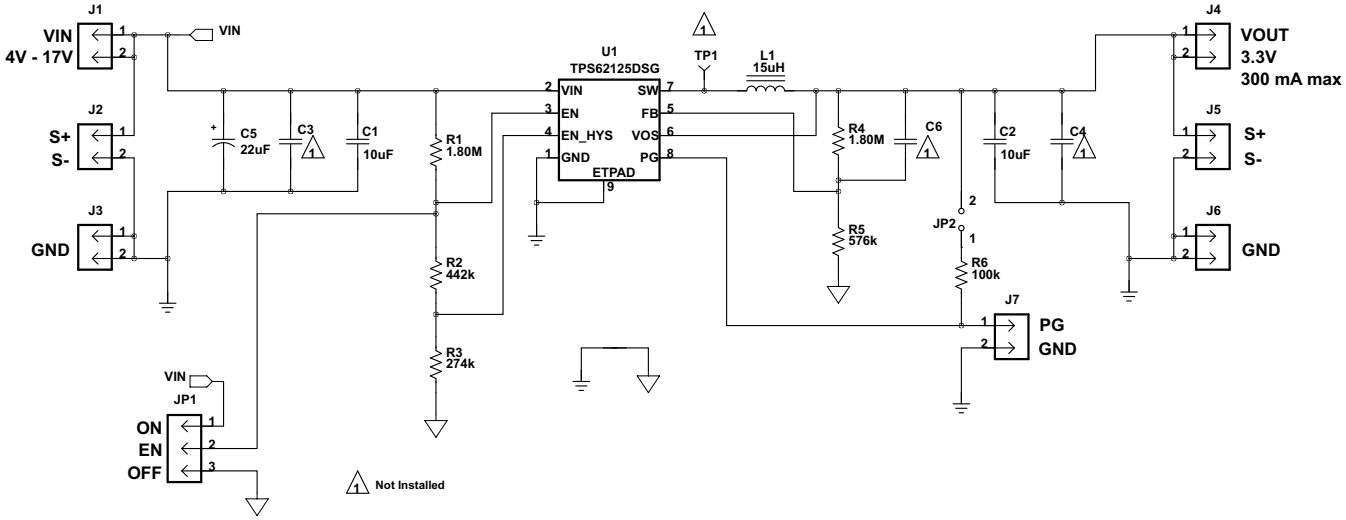


Figure 12. Revision A TPS62125EVM-044 Schematic

A.2.2 Bill of Materials

Table 3. Revision A TPS62125EVM-044 Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
1	C1	10 µF	Capacitor, Ceramic, 25V, X5R, ±20%	0805	GRM21BR61E106MA73L	Murata
1	C2	10 µF	Capacitor, Ceramic, 16V, X5R, ±20%	0805	GRM21BR61C106ME15L	Murata
1	C5	22 µF	Capacitor, POSCAP	3528[B]	20TQC22MYFB or 25TQC15MYFB	Panasonic
1	L1	15 µH	Inductor, Power, 0.56 A, 275-mΩ, ±20%	3 X 2.5 mm	VLF302515MT-150M or XFL3012-153ME	TDK or Coilcraft
2	R1, R4	1.8M	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R2	442k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R3	274k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R5	576k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R6	100k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	U1	TPS62125	IC, 3V-17V, 300mA Buck Converter with Adjustable Enable Threshold and Hysteresis	WSON-8	TPS62125DSG	TI

Revision History

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

Changes from A Revision (March 2012) to B Revision **Page**

- EVM PCB to include revision B. New PCB, Schematic, and BOM. 1
- References to EVM components updated throughout document 1
- Added NOTE: In July 2019, this EVM.... 1
- Changed the *TPS62125EVM-044 Test Results* section 4
- Add the TPS62125EVM-044 Photos 8
- Added Appendix A 10

Changes from Original (March 2012) to A Revision **Page**

- Changed "delivers 250 mA" To: "delivers 300 mA" in the first paragraph 1
- Changed "The TPS62125 is a 250-mA" To: "The TPS62125 is a 300-mA" in the Introduction 2
- Changed the Output current Max value From: 250 mA To: 300 mA in Table 1 2

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   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

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User shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 *Regulatory Notices:*

3.1 *United States*

3.1.1 *Notice applicable to EVMs not FCC-Approved:*

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

CAUTION

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.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *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.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

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

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
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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3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

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