EVM User's Guide: TPS563242EVM TPS563247EVM

TPS56324x Step-Down Converter Evaluation Module

Description

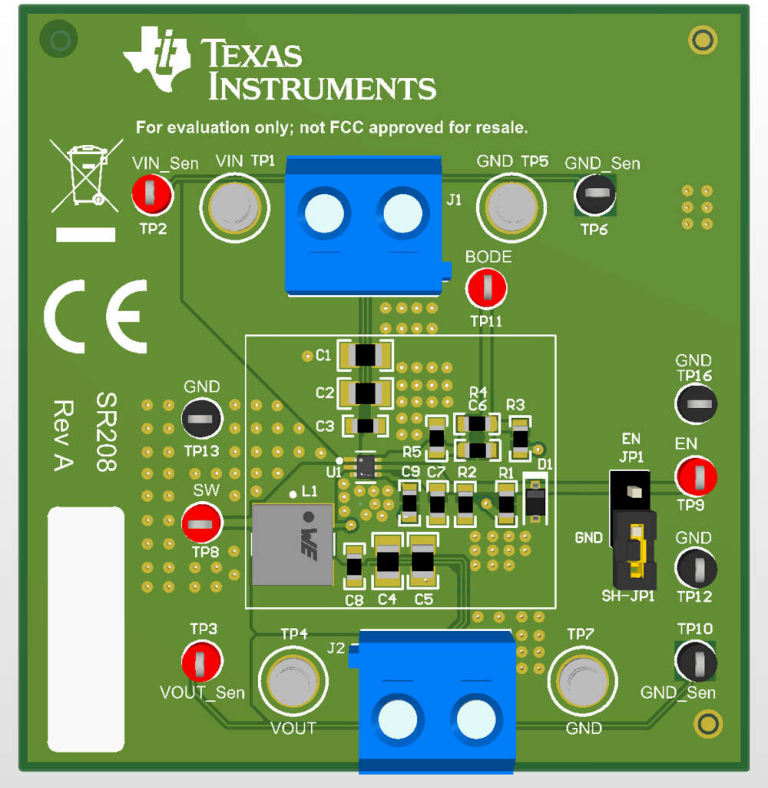
TPS56324x evaluation module (EVM) is a simple, easy-to-use, fully assembled and tested evaluation module for the TPS56324x 3A synchronous buck converter. The EVM operates from 3V to 17V input to deliver 1.05V output, with AC signal injection terminals for feedback loop measurements.

Features

- 3V to 17V input voltage range
- 0.6V to 10V output voltage range
- Up to 3A output current
- Eco-mode, FCCM mode
- Fast transient response

Applications

- WLAN/Wi-Fi access point, switch, router
- Pro-audio, surveillance, drone
- TV, STB and DVR, smart speaker



TPS56324xEVM Board (Top Side)

1 Evaluation Module Overview

1.1 Introduction

In light-load conditions, the TPS563242 operates in Eco-mode to enable higher efficiency by varying the switching frequency, and the TPS563247 operates in FCCM to maintain constant switching frequency. The main difference is at light loading, but the other behaviors are similar. This user's guide mainly introduces the TPS563242 and includes some TPS563247 features that are different from the TPS563242.

The TPS56324x is a single, adaptive on-time, D-CAP3™ control mode, synchronous buck converter that requires a very low external component count. The D-CAP3 control mode circuit is optimized for low-ESR output capacitors such as POSCAP, SP-CAP, or ceramic types and features fast transient response with no external compensation. The switching frequency is internally set at a nominal 1.2MHz. The high-side and low-side switching MOSFETs are incorporated inside the TPS56325x package along with the gate-drive circuitry. The low drain-to-source on resistance of the MOSFETs and fast switching slew rate allow the TPS56324x to achieve high efficiency and help keep the junction temperature low at high output currents. Power sequencing is possible by correctly configuring the enable and power-good indicator. The TPS56325x DC/DC synchronous converter is designed to support up to a 3A continuous current from an input voltage source of 3V to 17V. The output voltage range is from 0.6V to 10V. Table 1-1 gives the rated input voltage and output current ranges for the evaluation module.

Table 1-1. Input Voltage and Output Current Summary

EVM	INPUT VOLTAGE (V_{IN}) RANGE	OUTPUT CURRENT (I_{OUT}) RANGE
TPS563242EVM	V_{IN} = 3V to 17V	0A to 3A
TPS563247EVM		

The TPS563242EVM evaluation module (EVM) is a single, synchronous buck converter providing 1.05V at 3A from 3V to 17V input. This user’s guide describes the TPS563242EVM performance.

This user's guide introduces the TPS563242EVM and TPS563247EVM. These two devices differ in the light load behavior. The TPS563242 operates in Eco-mode and the TPS563247 operates in FCCM mode. This user's guide contains information for the TPS563242 and TPS563247 as well as support documentation for the TPS563242EVM and TPS563247EVM evaluation modules. This document also includes the following information for the TPS563242EVM and TPS563247EVM:

- Performance specifications
- Board layout
- Schematic
- List of materials

1.2 Kit Contents

- One TPS56324xEVM board
- EVM disclaimer Read Me

1.3 Specification

This EVM operates from 3V to 17V input, 12V nominal, and provides a 1.05V output at 3A. The EVM also includes AC signal injection terminals for feedback loop measurements. Specification, application information, and schematic are shown in Section 4.1 and Section 5.1.

1.4 Device Information

The synchronous buck converter TPS56324x is used in the EVM to achieve the high-efficiency power delivery and voltage conversion. The TPS563242 operates in Eco-mode, which maintains high efficiency during light loading. The TPS563247 operates in FCCM mode, which keeps the same frequency and lower output ripple during all load conditions.

Table 1-2. Device Information

PART NUMBER	MODE	PACKAGE
TPS563242	ECO	DRL (SOT-563, 6)
TPS563247	FCCM	

2 Performance Specification Summary

Table 2-1 provides a summary of the TPS563242EVM performance specifications. Specifications are given for an input voltage of V_{IN} = 12V and an output voltage of 1.05V, unless otherwise noted. The ambient temperature is 25°C for all measurement, unless otherwise noted.

Table 2-1. Performance Specifications Summary

SPECIFICATIONS	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input voltage range		3	12	17	V
Output voltage set point			1.05		V
Operating frequency	V_{IN} = 12V, I_O = 3A		1.2		MHz
Output current range		0		3	A
Over current limit	V_{IN} = 12V, L_O = 0.82µH		4.1		A
Output ripple voltage	V_{IN} = 12V, I_O = 3A		10		mV_{PP}

3 Output Voltage Setpoint

The output voltage of the EVM can be selected by changing the value of resistor R_4 (R_{UPPER}) and R_5 (R_{LOWER}). Use Equation 1 to calculate the value of R_4 for a specific output voltage. The output voltage is set with a resistor divider from the output node to the FB pin. TI recommends using 1% tolerance or better divider resistors. Start with a 10kΩ or 30kΩ for R4 (R_{FBB}) and use Equation 1 to calculate R5 (R_{FBT}) . To improve efficiency at light loads, consider using larger value resistors. If the values are too high, the regulator is more susceptible to noise and voltage errors from the FB input current are noticeable.

$$V_{OUT} = 0.6 \times \left(1 + \frac{R_4}{R_5}\right) \quad (1)$$

4 Hardware

4.1 Test Setup and Results

This section describes how to properly connect, set up, and use the TPS563242EVM. The section also includes test results typical for the evaluation modules and the following:

- Efficiency
- Output load regulation
- Output line regulation
- Load transient response
- Start-up
- Shutdown
- Output voltage ripple

4.1.1 Input, Output Connections

The TPS563242EVM is provided with input, output connectors, and test points as shown in Table 4-1. Figure 4-1 shows connectors and jumpers placement on TPS564252EVM board.

A power supply capable of supplying 3A must be connected to J1 through a pair of 20-AWG wires. The load must be connected to J2 through a pair of 20-AWG wires. The maximum load current capability is 3A. Wire lengths must be minimized to reduce losses in the wires. Test point TP2 provides a place to monitor the V_{IN} input voltages with TP6 providing a convenient ground reference. TP3 is used to monitor the output voltage with TP10 as the ground reference.

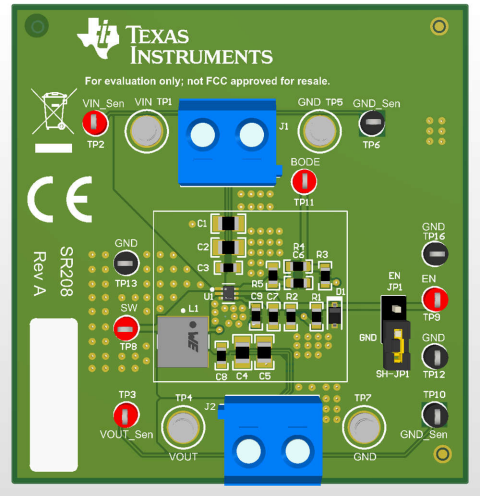


Figure 4-1. TPS563242EVM Connectors and Jumpers Placement

Table 4-1. Connection and Test Points

REFERENCE DESIGNATOR	FUNCTION
J1	V_{IN} (see Table 1-1 for V_{IN} range)
J2	V_{OUT}, 1.05V at 3A maximum
JP1	EN control. Shunt EN to GND to disable
TP1	V_{IN} positive power point
TP2	V_{IN} positive monitor point
TP3	V_{OUT} positive monitor point
TP4	V_{OUT} positive power point
TP5, TP7	GND power point
TP6, TP10, TP12, TP13, TP16	GND monitor point
TP8	Switch node test point
TP9	EN test point
TP11	Test point for loop response measurements

4.1.2 Start-Up Procedure

1. Verify that the jumper at JP1 (Enable control) pins 1 and 2 are covered to shunt EN to GND, disabling the output.
2. Apply appropriate input voltage to VIN (J1-2) and GND (J1-1).
3. Move the jumper at J1 (Enable control) pin 2 and 1 (EN and GND) to enable the output.

4.1.3 Efficiency

Figure 4-2 shows the efficiency for the TPS563242EVM at an ambient temperature of 25°C. Figure 4-3 shows the efficiency for the TPS563247EVM at an ambient temperature of 25°C.

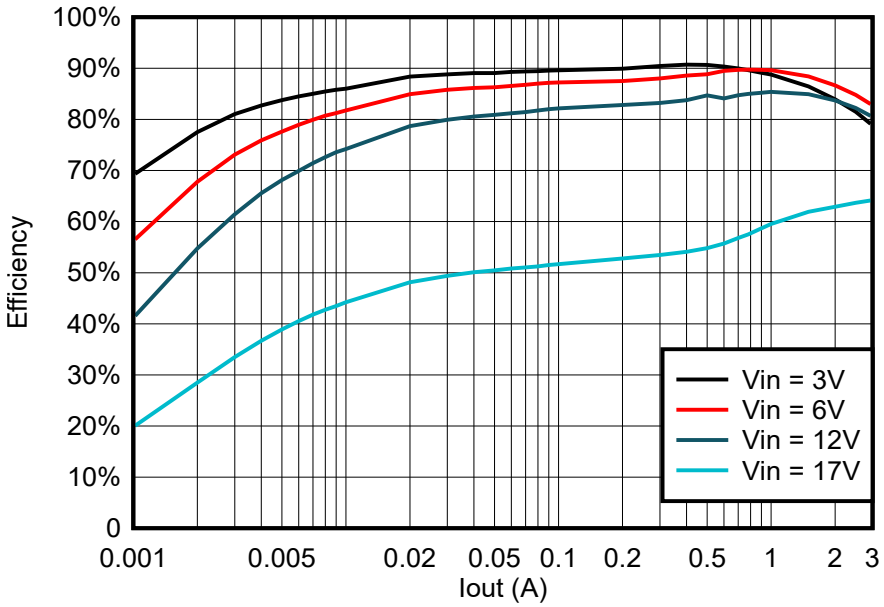


Figure 4-2. TPS563242EVM Efficiency

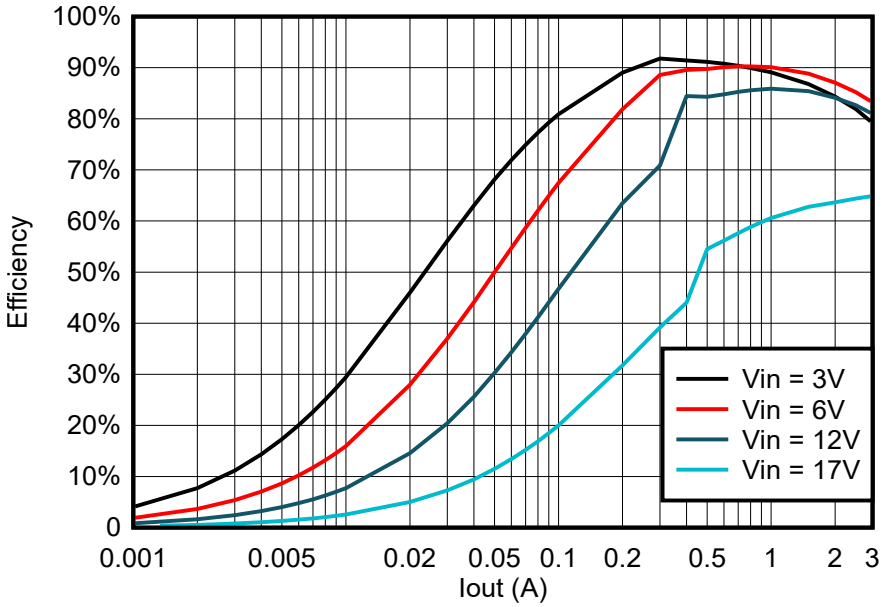


Figure 4-3. TPS563247EVM Efficiency

4.1.4 Load Regulation

Figure 4-4 shows load regulation for the TPS563242EVM. Figure 4-5 shows load regulation for the TPS563247EVM.

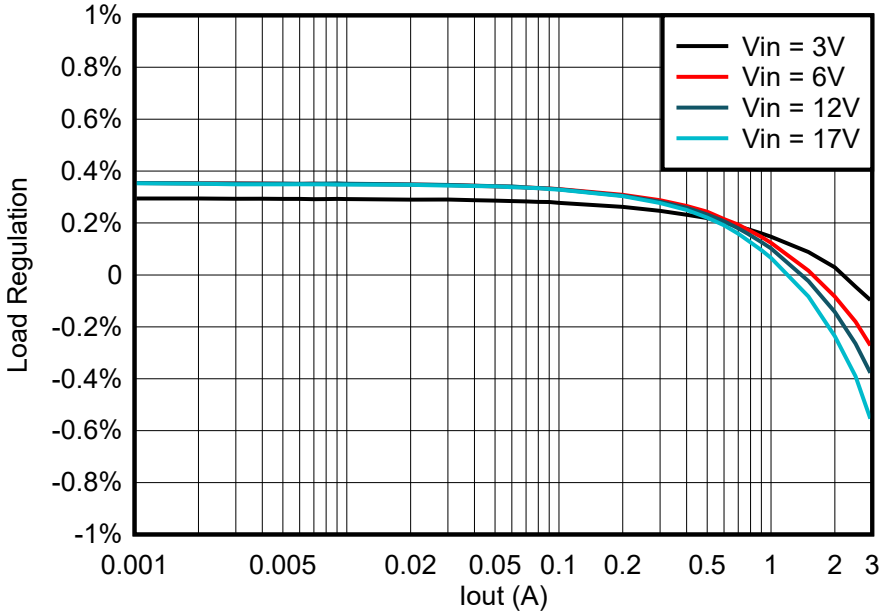


Figure 4-4. TPS563242EVM Load Regulation

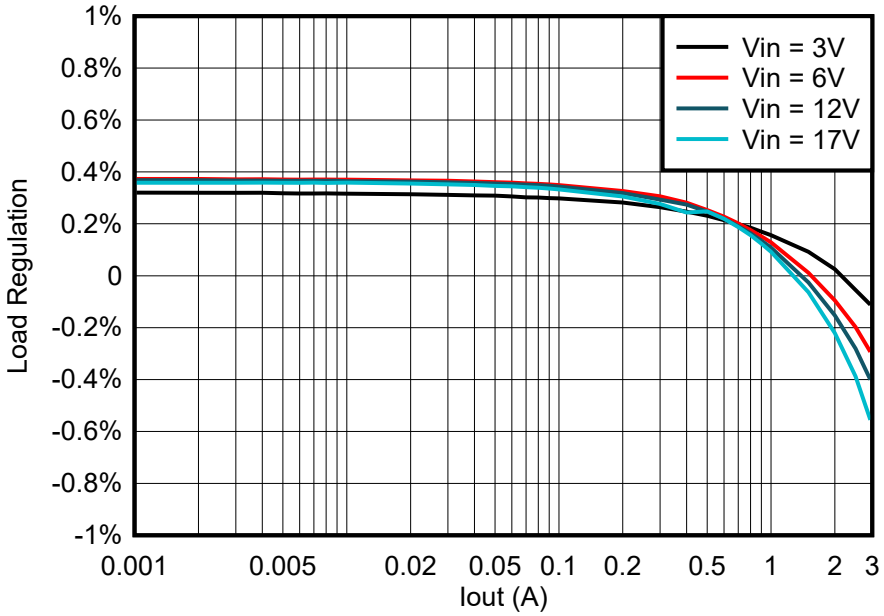


Figure 4-5. TPS563247EVM Load Regulation

4.1.5 Line Regulation

Figure 4-6 shows line regulation for the TPS563242EVM. Figure 4-7 shows line regulation for the TPS563247EVM.

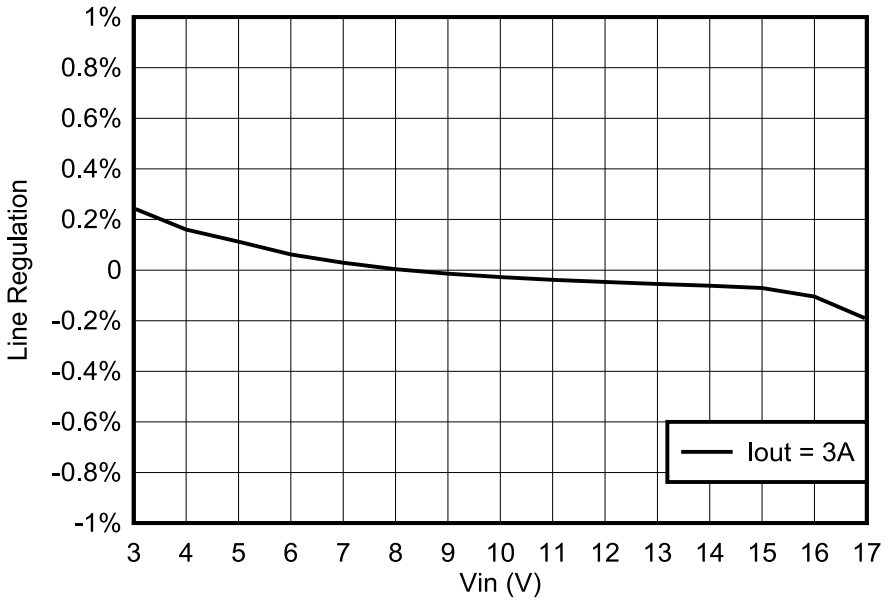


Figure 4-6. TPS563242EVM Line Regulation

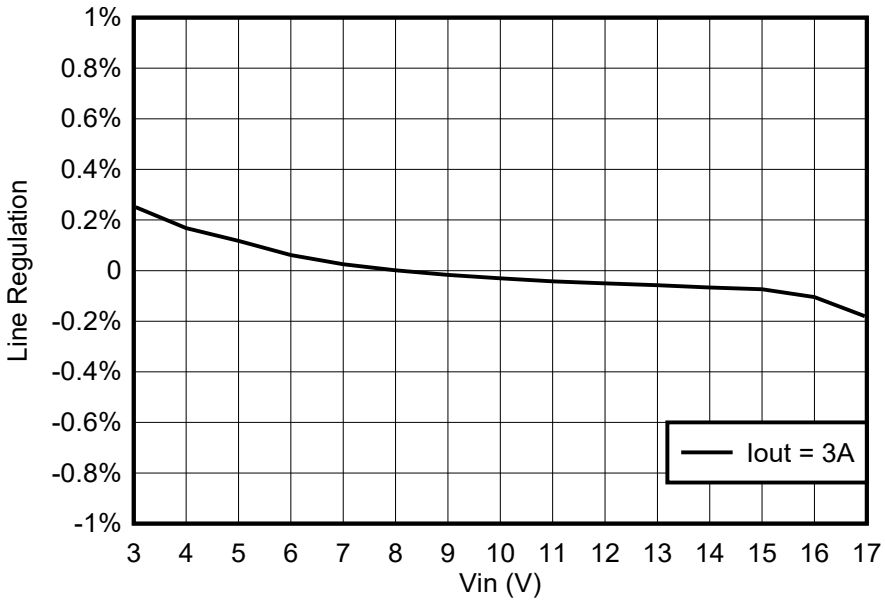


Figure 4-7. TPS563247EVM Line Regulation

4.1.6 Load Transient Response

Figure 4-8 shows the response to load transient for TPS563242EVM. Figure 4-9 shows the response to load transient for the TPS563247EVM. The current steps slew rate is set as 0.8A/µs.

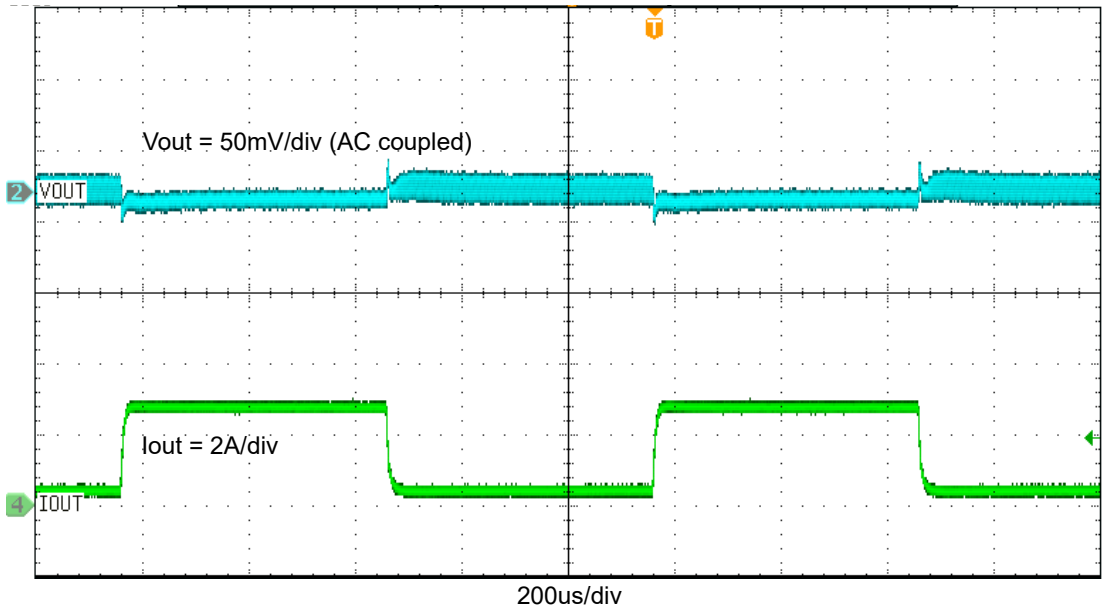


Figure 4-8. TPS563242EVM Load Transient Response, 10% to 90% (0.3A to 2.7A) Load Step

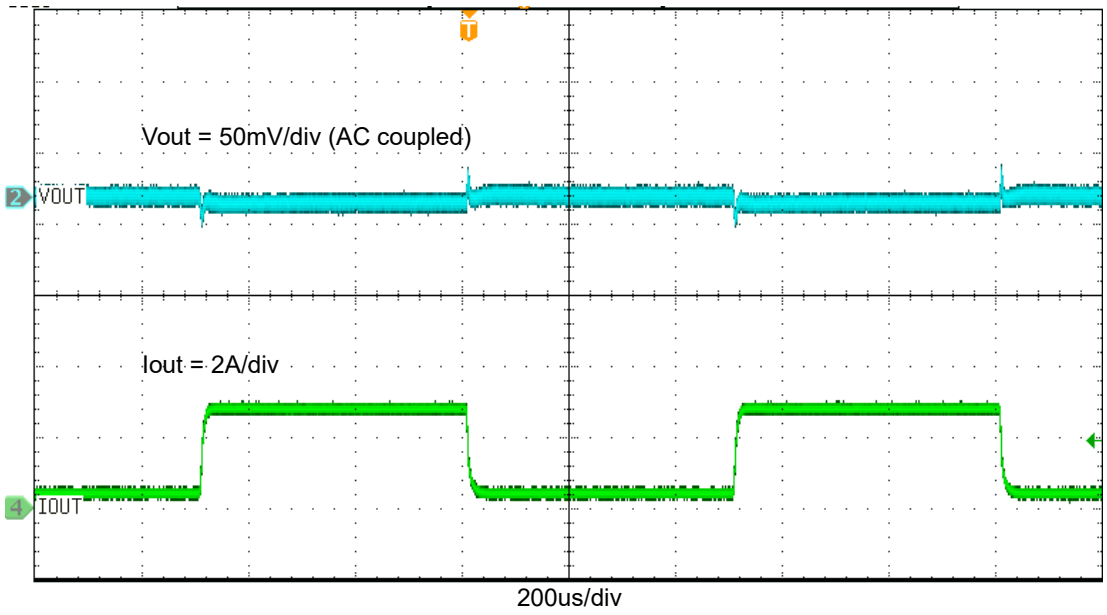


Figure 4-9. TPS563247EVM Load Transient Response, 10% to 90% (0.3A to 2.7A) Load Step

4.1.7 Start-Up

Figure 4-10 shows the TPS563242EVM start-up waveform relative to V_{IN}. The load is 3A.

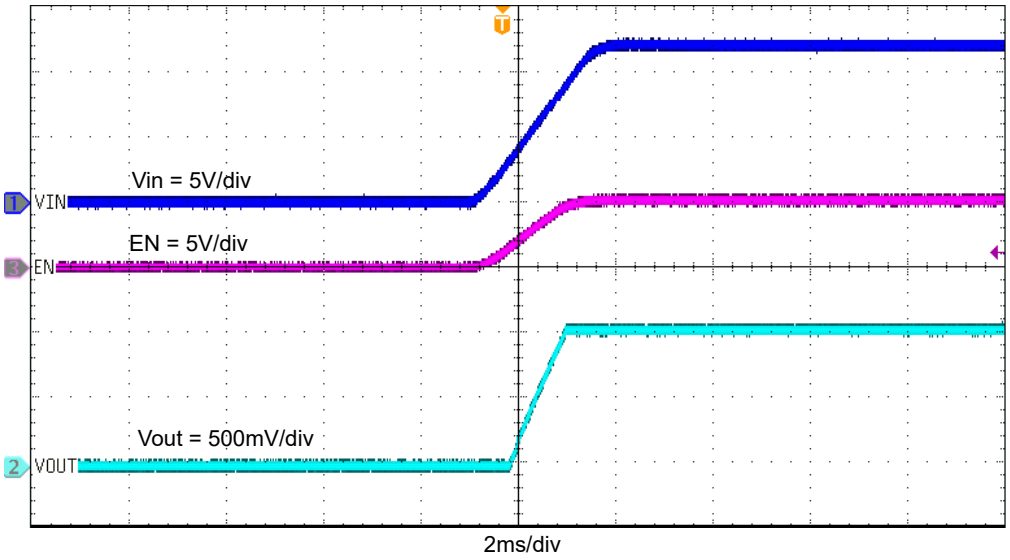


Figure 4-10. TPS563242EVM Start-Up Relative to V_{IN}

Figure 4-11 shows the TPS563242EVM start-up waveform relative to enable (EN). The load is 3A.

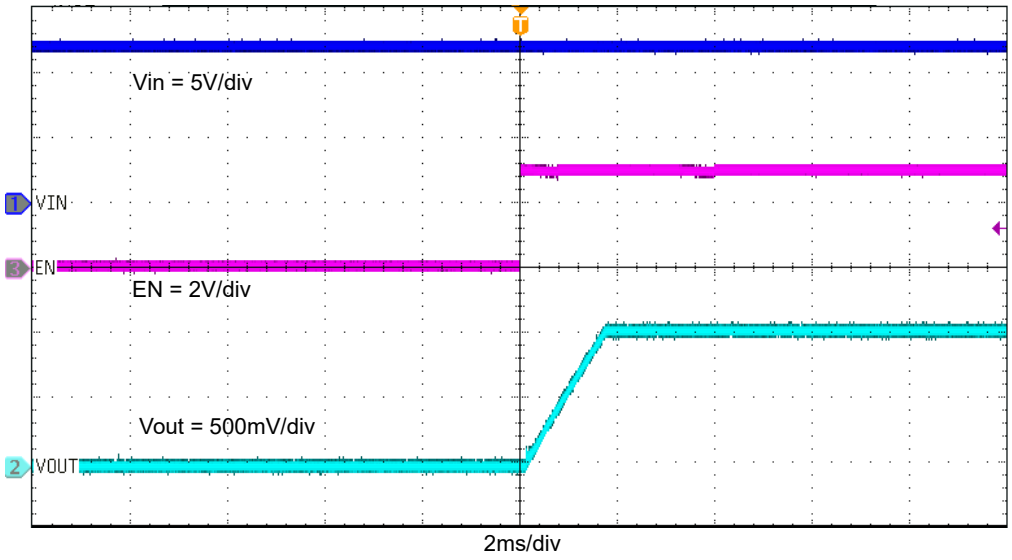


Figure 4-11. TPS563242EVM Start-Up Relative to EN

4.1.8 Shutdown

Figure 4-12 shows the TPS563242EVM shut-up waveform relative to V_{IN}. The load is 3A.

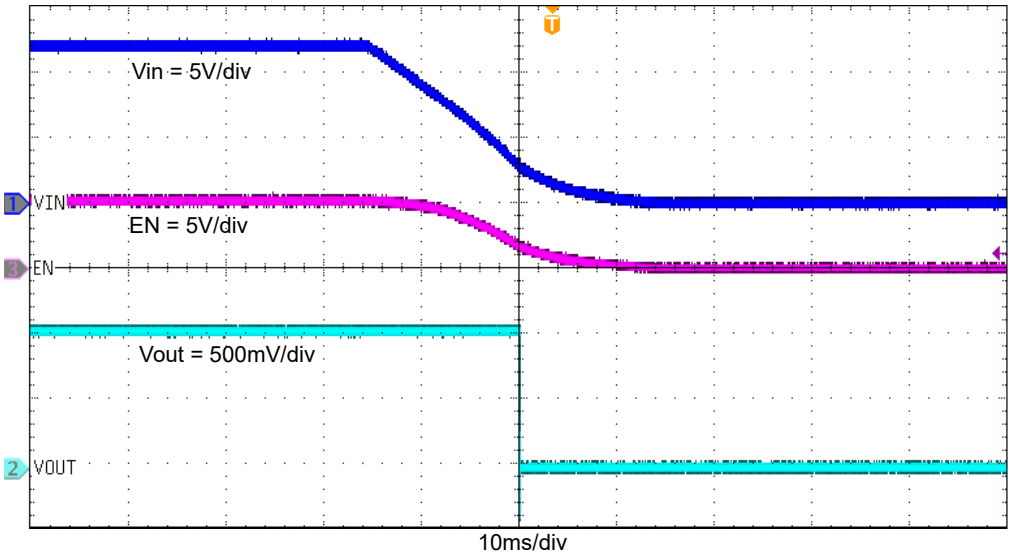


Figure 4-12. TPS563242EVM Shutdown Relative to V_{IN}

Figure 4-13 shows the TPS563242EVM shut-up waveform relative to enable (EN). The load is 3A.

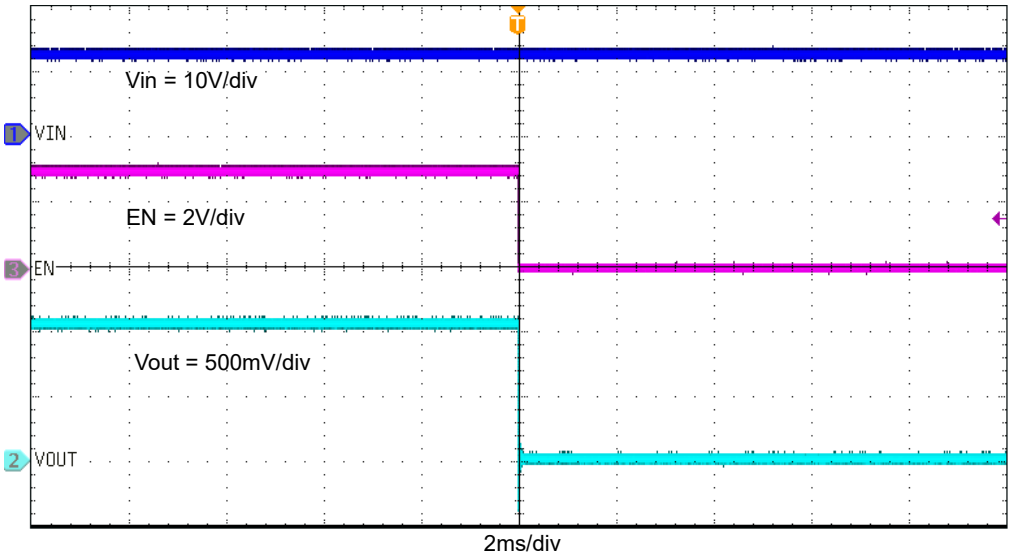


Figure 4-13. TPS563242EVM Shutdown Relative to EN

4.1.9 Output Voltage Ripple

Figure 4-14 and Figure 4-15 show the TPS563242EVM output voltage ripple. Figure 4-16 shows the TPS563247EVM output voltage ripple. The output currents are as indicated.

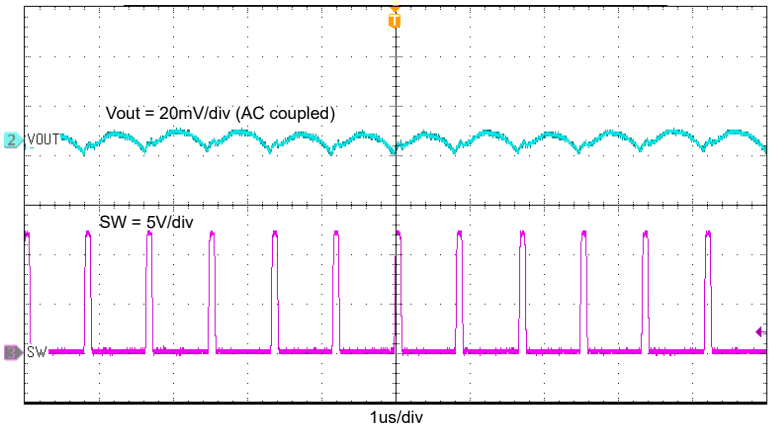


Figure 4-14. TPS563242EVM Output Voltage Ripple, I_{OUT} = 3A

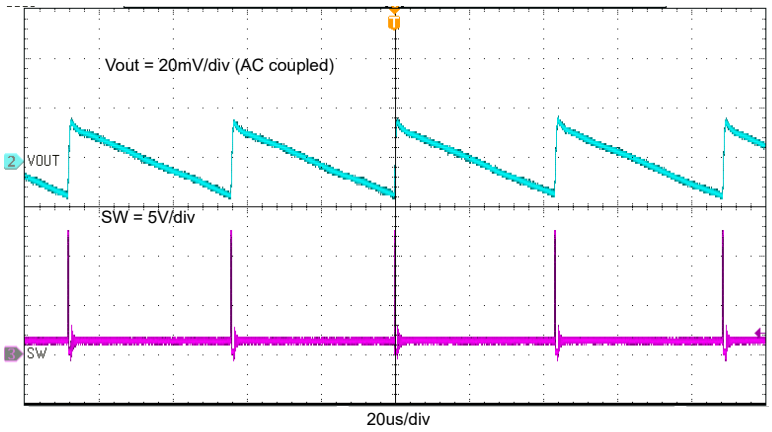


Figure 4-15. TPS563242EVM Output Voltage Ripple, I_{OUT} = 0.01A

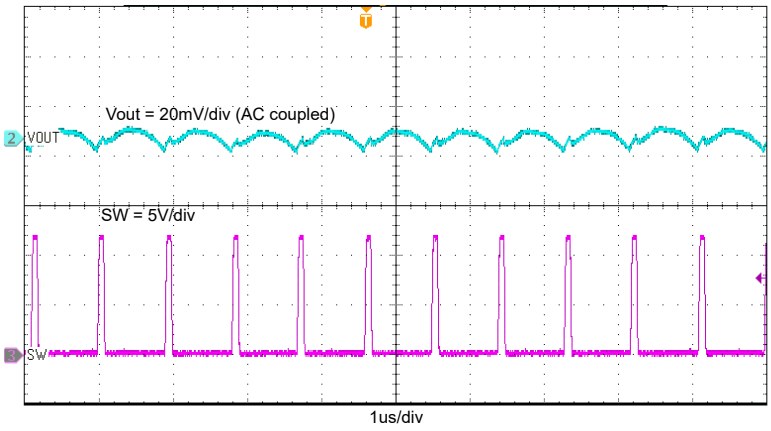


Figure 4-16. TPS563247EVM Output Voltage Ripple, I_{OUT} = 0.01A

5 Hardware Design Files

5.1 Schematic

Figure 5-1 is the schematic for the TPS563242EVM.

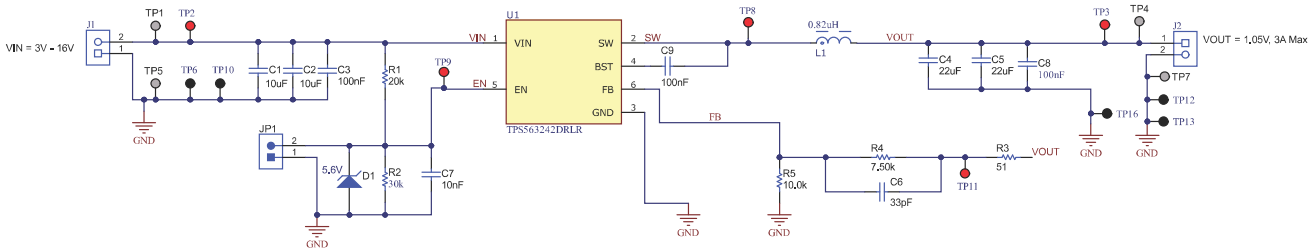


Figure 5-1. TPS563242EVM Schematic Diagram

5.2 `PCB Layout

This section provides a description of the TPS56324xEVM, board layout, and layer illustrations.

Figure 5-2, Figure 5-3, and Figure 5-4 show the board layout for the TPS563242EVM. The top layer contains the main power traces for VIN, VOUT, and ground. Connections for the pins of the TPS563242 and a large area filled with ground are also on the top layer. Most of the signal traces are also located on the top side. The input decoupling capacitors C1, C2, and C3 are located as close to the IC as possible. The input and output connectors, test points, and all of the components are located on the top side. The bottom layer is a ground plane along with the signal ground copper fill and the feedback trace from the point of regulation to the top of the resistor divider network. Both the top layer and bottom layer use 2oz copper thickness.

Figure 5-5 and Figure 5-6 are the TPS563242EVM board top view and bottom view, respectively.

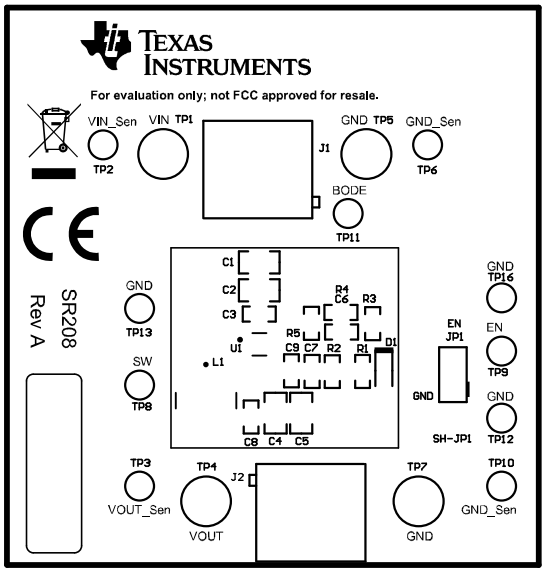


Figure 5-2. TPS563242EVM Top Assembly

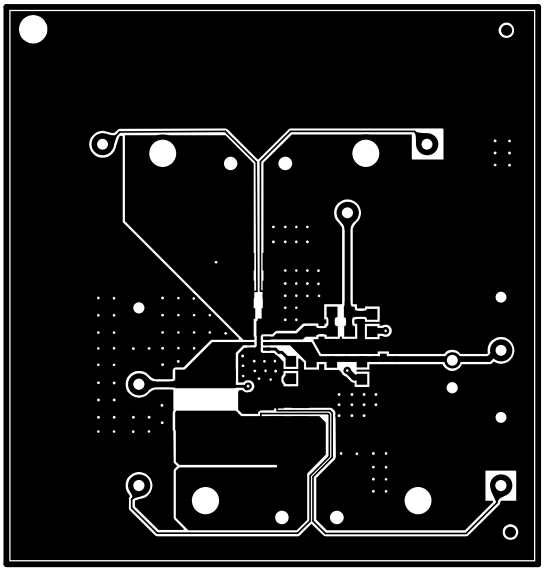


Figure 5-3. TPS563242EVM Top Layer

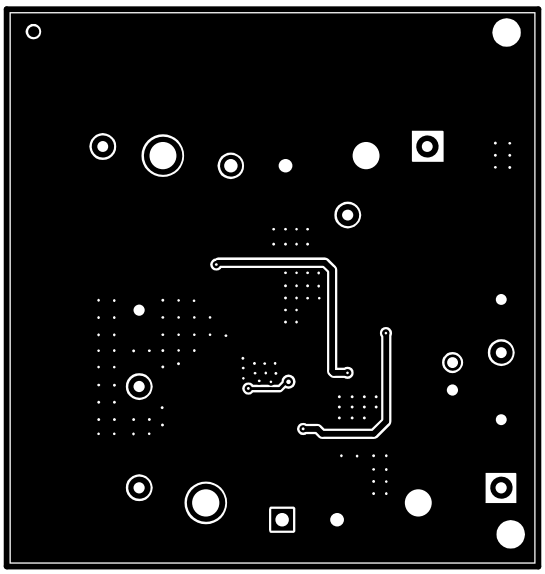


Figure 5-4. TPS563242EVM Bottom Layer

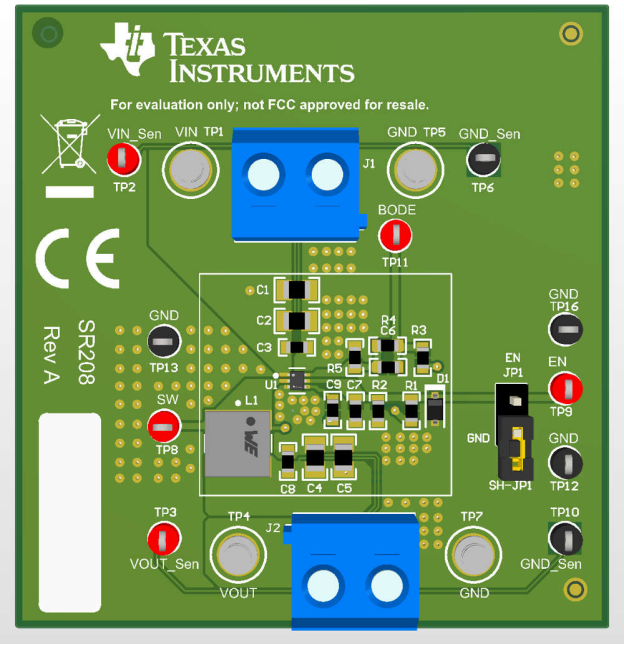


Figure 5-5. TPS563242EVM Board (Top View)

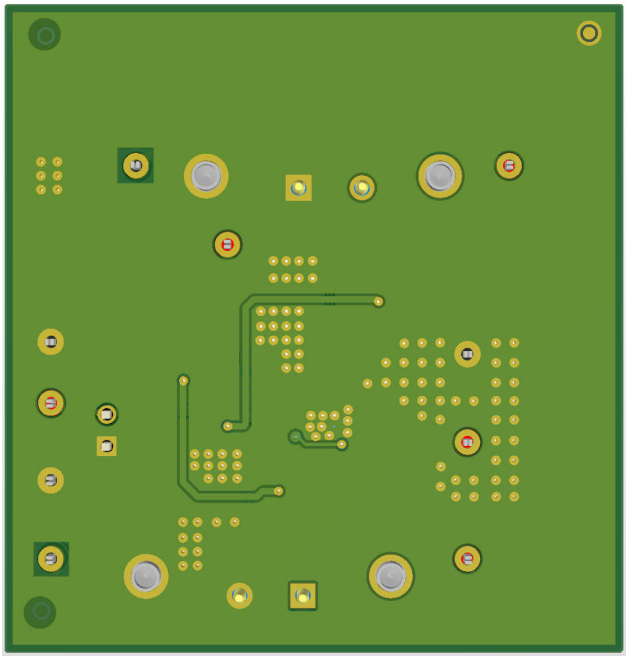


Figure 5-6. TPS563242EVM Board (Bottom View)

5.3 Bill of Materials

Table 5-1 lists the bill of materials.

Table 5-1. Bill of Materials

DES	QTY	DESCRIPTION	PART NUMBER	MANUFACTURER
!PCB1	1	Printed Circuit Board	SR208	Any
C1, C2	2	Capacitor, ceramic, 10µF, 25V, ±20%, X5R, 0805	GRM21BR61E106MA73L	MuRata
C3, C8,C9	3	Capacitor, ceramic, 0.1uF, 25V, ± 10%, X7R, 0603	C1608X7R1E104K080AA	TDK
C4, C5	2	Capacitor, ceramic, 22µF, 10V, ±20%, X5R, 0805	GRM21BR61A226ME44L	MuRata
C6	1	Capacitor, ceramic, 33pF, 100V, ±5%, C0G/NP0, 0603	GRM1885C2A330JA01D	MuRata
C7	1	Capacitor, ceramic, 0.01uF, 50V, ± 10%, X7R, 0603	C1608X7R1H103K080AA	TDK
J1, J2	2	Terminal block, 5.08mm, 2 × 1, Brass, TH	ED120/2DS	On-Shore Technology
JP1	1	Header, 100 mil, 2 × 1, Tin, TH	PEC02SAAN	Sullins Connector Solutions
L1	1	Shielded Inductor, 820nH, 8.8A, 0.0096Ω, SMD	744383660082	Wurth Elektronik
LBL1	1	Thermal transfer printable labels, 0.650" W × 0.200" H – 10,000 per roll	THT-14-423-10	Brady
R1	1	Resistor, 20kΩ, 5%, 0.1W, AEC-Q200 Grade 0, 0603	CRCW060320K0JNEA	Vishay-Dale
R2	1	Resistor, 30kΩ, 5%, 0.1W, AEC-Q200 Grade 0, 0603	CRCW060330K0JNEA	Vishay-Dale
R3	1	Resistor, 51Ω, 5%, 0.1W, AEC-Q200 Grade 0, 0603	CRCW060351R0JNEA	Vishay-Dale
R4	1	Resistor, 7.5kΩ, 1%, 0.1W, 0603	RC0603FR-077K5L	Yageo
R5	1	Resistor, 10.0kΩ, 1%, 0.1W, AEC-Q200 Grade 0, 0603	CRCW060310K0FKEA	Vishay-Dale
SH-JP1	1	Shunt, 100 mil, gold plated, black	SNT-100-BK-G	Samtec
TP1, TP4, TP5, TP7	4	Terminal, turret, TH, double	1502-2	Keystone
TP2, TP3, TP8, TP9, TP11	5	Test point, miniature, red, TH	5000	Keystone
TP6, TP10, TP12, TP13, TP16	5	Test point, miniature, black, TH	5001	Keystone
D1	1	Diode, Zener, 5.6V, 200 mW, SOD-323	MMSZ5232BS-7F	Diodes Inc.
U1	1	3V to 17V Input, 3A Synchronous Buck Converter, SOT-563	TPS563242DRLR	Texas Instruments

6 Additional Information

6.1 Trademarks

D-CAP3™ is a trademark of Texas Instruments.
All trademarks are the property of their respective owners.

7 Reference

Texas Instruments, *TPS56x24x 3V to 17V Input, 2A/3A, Synchronous Buck Converters in SOT-563 Package* datasheet

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   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.

WARNING

Evaluation Kits are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.

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。

https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

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.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。 技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
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東京都新宿区西新宿 6 丁目 2 4 番 1 号

西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

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:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user 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, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*

6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

   8.1 *General Limitations*. IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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