TPSM265R1EVM
3-V to 65-V Input Voltage 100-mA Output Current

User's Guide

Literature Number: SLVUBP6
August 2019

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Evaluating the TPSM265R1EVM

About This Manual

This guide provides information on the correct usage of the TPSM265R1EVM and explains the test points on the board. This evaluation module (EVM) is designed as an easy-to-use platform that facilitates an extensive evaluation of the features and performance of the TPSM265R1 power module.

Glossary

TI Glossary —This glossary lists and explains terms, acronyms, and definitions.

Related Documentation From Texas Instruments

For product information, visit the Texas Instruments website at http://www.ti.com.

SNVSBF6 —TPSM265R1, 100 mA Power Module Data Sheet

Community Resources

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TI Embedded Processors Wiki— ***Texas Instruments Embedded Processors Wiki.*** Established to help developers get started with Embedded Processors from Texas Instruments and to foster innovation and growth of general knowledge about the hardware and software surrounding these devices.

Board History

PCB Revision	History
Rev E1	Early evaluation EVM release
Rev A	Production EVM release

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Evaluation Module (EVM) Hardware

1 Introduction

The TPSM265R1EVM features the TPSM265R1 synchronous-buck power module configured for operation with typical 3-V to 65-V input bus applications. The output voltage is set to one of five popular values by using a configuration jumper. The EVM supplies the full output current rating of the device. Input and output capacitors are included to accommodate the entire range of input voltage and the selectable output voltages on the EVM. Monitoring test points are provided to allow measurement of the following:

- Efficiency
- Power dissipation
- Input ripple
- Output ripple
- Line and load regulation
- Transient response

Control test points, component footprints, and jumpers are provided for use of the following features of the TPSM265R1 device:

- Enable (EN)
- Undervoltage lockout (UVLO)
- Soft-start (SS)
- Power-good (PG)

The recommended PCB layout of the EVM showcases the minimal solution size, maximizes thermal performance, and minimizes output ripple and noise.

2 Getting Started

Figure 1 highlights the user interface items associated with the EVM. The *VIN Power* terminal block (J1) or test points TP1 and TP2 are used for connection to the host input supply. The *VOUT Power* terminal block (J2) or test points TP3 and TP4 are used for connection to the load. The terminal blocks accept up to 20-AWG wire.

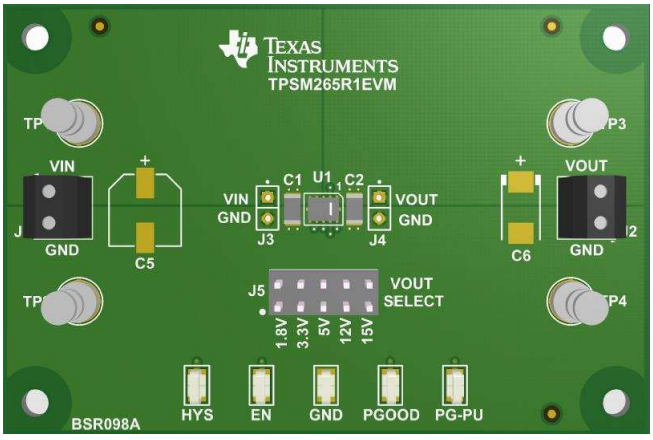


Figure 1. TPSM265R1EVM User Interface

Use the VIN and VOUT MONITOR test points (TP1, TP2, TP3, and TP4), located near the power terminal blocks, as voltage monitoring points where voltmeters can be connected to measure VIN and VOUT.

Use the VIN scope (J3) and VOUT scope (J4) sockets to monitor VIN and VOUT waveforms with an oscilloscope. These test points are intended to use un-hooded scope probes outfitted with a low-inductance ground lead (ground spring) mounted to the scope probe barrel. The two sockets of each test point are on 0.1 inch centers. Connect the scope probe tip to the socket labeled VIN or VOUT, and connect the scope ground lead to the socket labeled GND.

The control test points located near the bottom of the EVM test the features of the device. Refer to the *Test Points Descriptions* section of this guide for more information on the individual control test points.

The VOUT SELECT jumper (J5) is provided to select the desired output voltage. Before applying power to the EVM, make sure that the jumper is present and properly positioned for the intended output voltage. Always remove input power before changing the jumper settings. The output voltages that can be selected using J5 are 1.8 V, 3.3 V, 5 V, 12 V, and 15 V.

The Enable (EN) and Hysteresis (HYS) features can be monitored using the test points near the bottom of the EVM. The device can be disabled by connecting the EN test point to GND. Additionally, resistors R1, R2, and R3, on the back side of the EVM can be adjusted to set an external UVLO with adjustable hysteresis.

The Power Good feature can be monitored using the PGOOD test point. The PGOOD Pullup (PG-PU) test point is provided to make it easy to apply a pullup voltage for PGOOD. A 100-kΩ resistor is connected between PG-PU and PGOOD on the EVM.

A capacitor footprint, C7, is located on the back side of the EVM for adjusting the soft-start timing of the TPSM265R1. Consult the data sheet for recommended soft-start capacitor values.

When testing the EVM, it is recommended to use a resistive load on the output. Using an electronic load can cause undesired start-up behavior or even an overcurrent condition. However, if you are using an electronic load, set the load to constant resistive mode, but continue to monitor the load behavior.

3 Test Point Descriptions

Wire-loop test points and scope probe sockets are included for digital voltmeters (DVM) or oscilloscope probes to aid in the evaluation of the device. Table 1 shows a description of each test point.

Table 1. Test Point Descriptions(1)

VIN MONITOR (TP1)	Input voltage monitor. Connect the positive lead of a DVM to this point for measuring efficiency.
VOUT MONITOR (TP3)	Output voltage monitor. Connect the positive lead of a DVM to this point for measuring efficiency, line regulation, and load regulation.
GND (TP2 and TP4)	Ground test point. Connect the negative lead of a DVM to this point when measuring efficiency, line regulation, and load regulation.
VIN Scope (J3)	Input voltage scope monitor. Connect an oscilloscope to this set of points to measure input ripple voltage.
VOUT Scope (J4)	Output voltage scope monitor. Connect an oscilloscope to this set of points to measure output ripple voltage and transient response.
HYS	Hysteresis test point
EN	Enable test point. Connect this test point to GND to disable the device.
PGOOD	Power Good test point. Monitors the power good signal of the device. This is an open-drain signal. A 100-kΩ resistor is connected to this pin and the PG_PU pin on the EVM.
PG_PU	PGOOD pullup pin. Apply a voltage to this pin to use as a pullup voltage for the PGOOD signal. A 100-kΩ resistor is connected to this pin and the PGOOD pin. The recommended pullup voltage is ≤ 12 V.

(1) Refer to the TPSM265R1 data sheet for absolute maximum ratings associated with above features.

4 Performance Data

The following section demonstrates the TPSM265R1EVM performance.

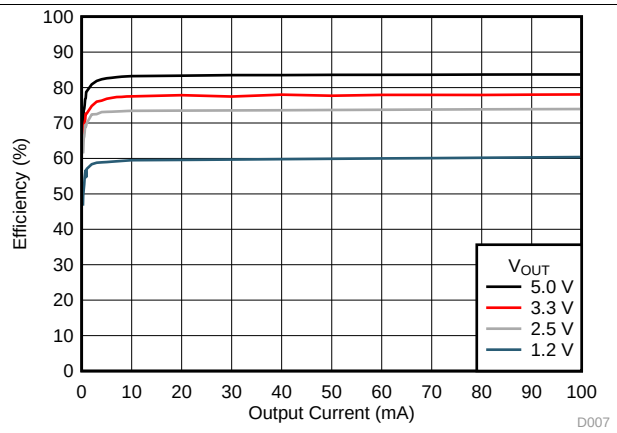


Figure 2. Efficiency for V_{IN} = 12 V

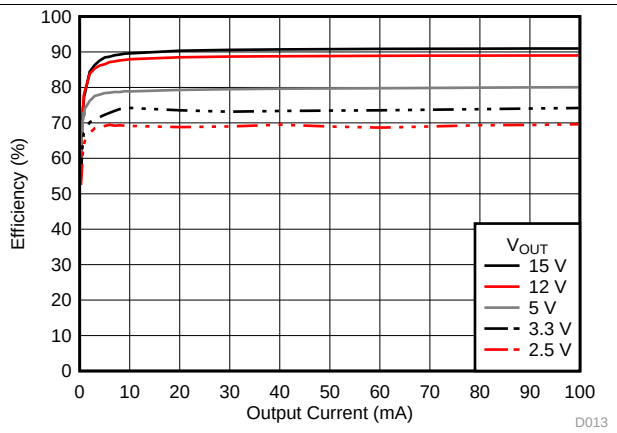


Figure 3. Efficiency for V_{IN} = 24 V

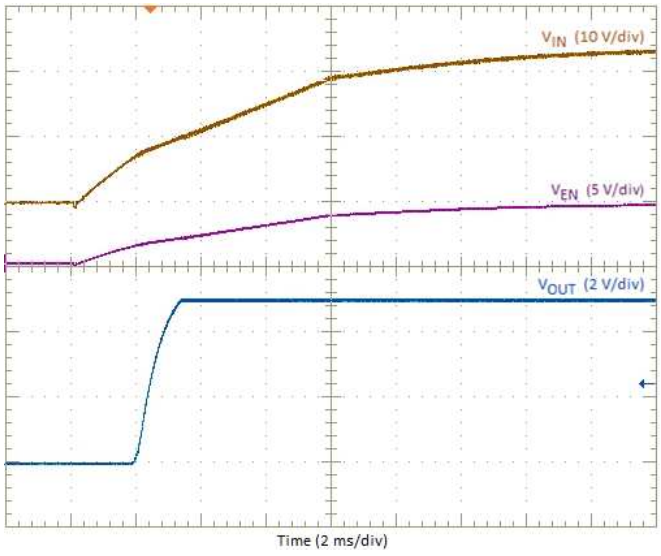
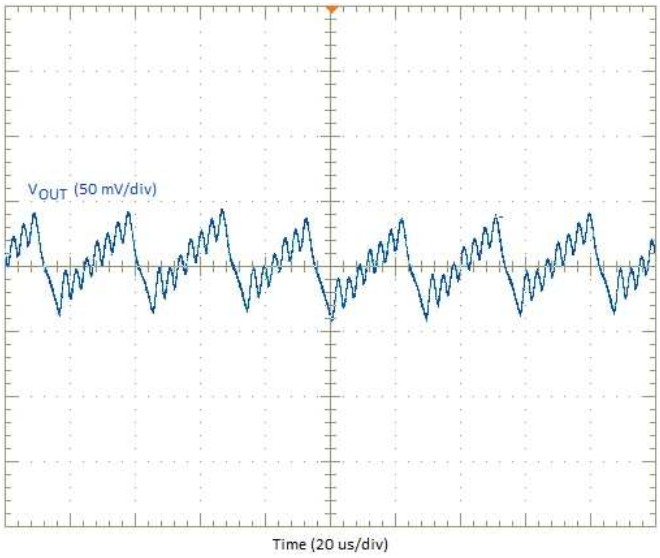


Figure 4. Start-up Waveform



V_{IN} = 24 V V_{OUT} = 5 V I_{OUT} = 100 mA 20 MHz BW

Figure 5. Output Ripple for V_{OUT} = 5 V

5 EVM Board Physical Specifications

This section includes the layout, schematic, and Bill of Materials (BOM) of the TPSM265R1EVM board.

5.1 Board Layout

The TPSM265R1EVM board dimensions are 50 mm × 75 mm. The EVM layers are provided in Figure 6 through Figure 11.

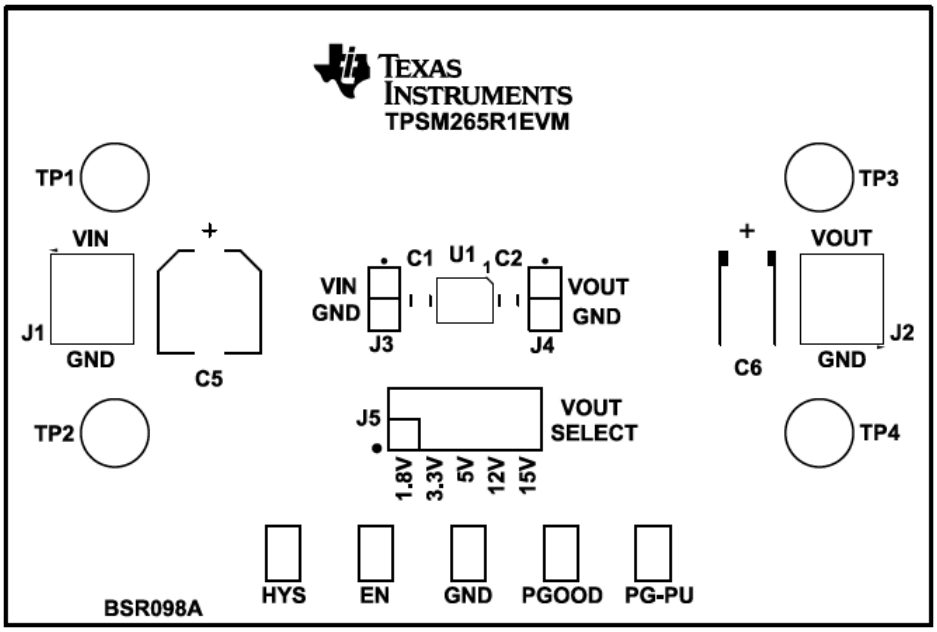


Figure 6. Top Silk Screen

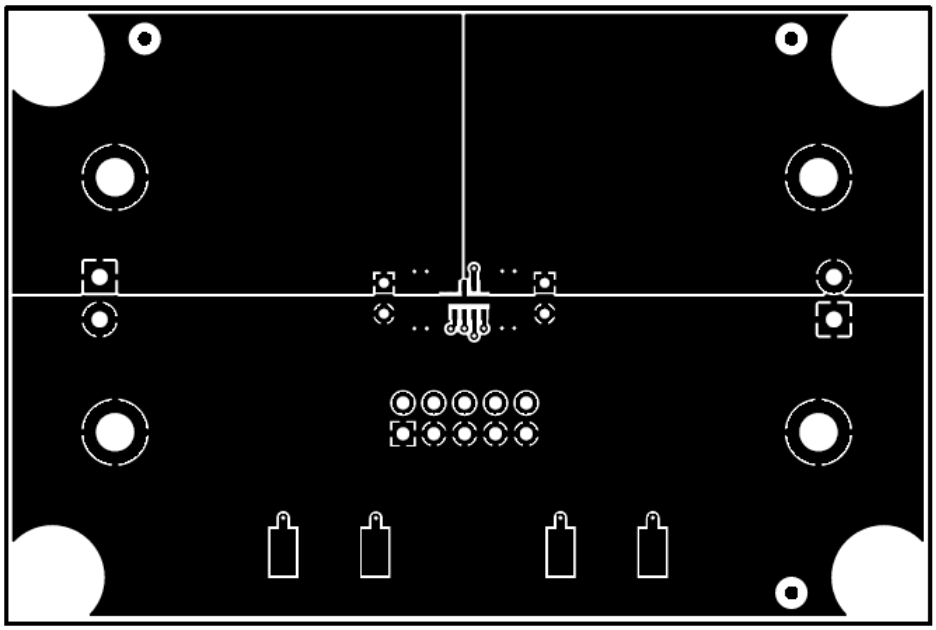


Figure 7. Top Copper Layer

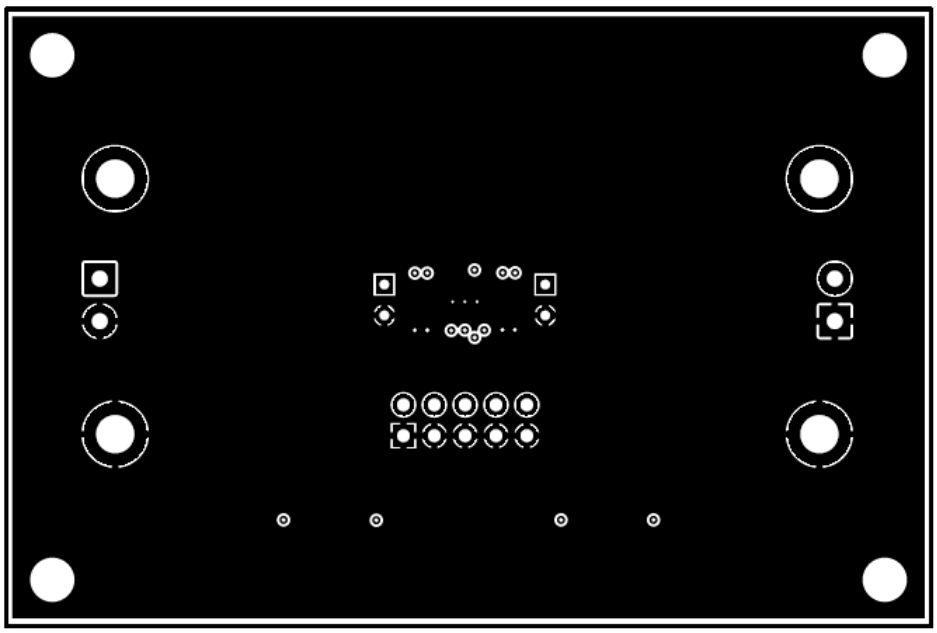


Figure 8. Layer 2 Copper

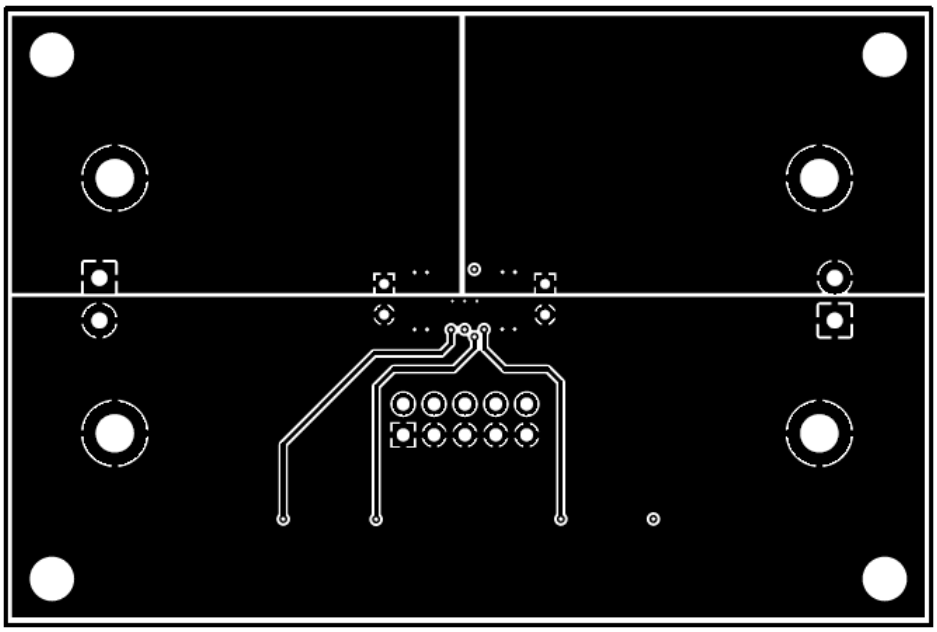


Figure 9. Layer 3 Copper

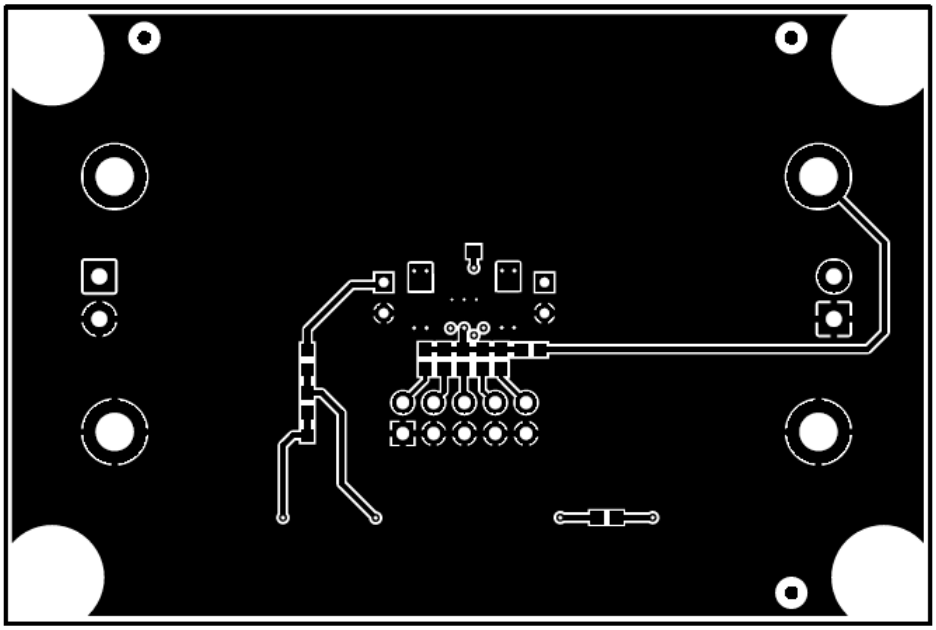


Figure 10. Bottom Copper Layer

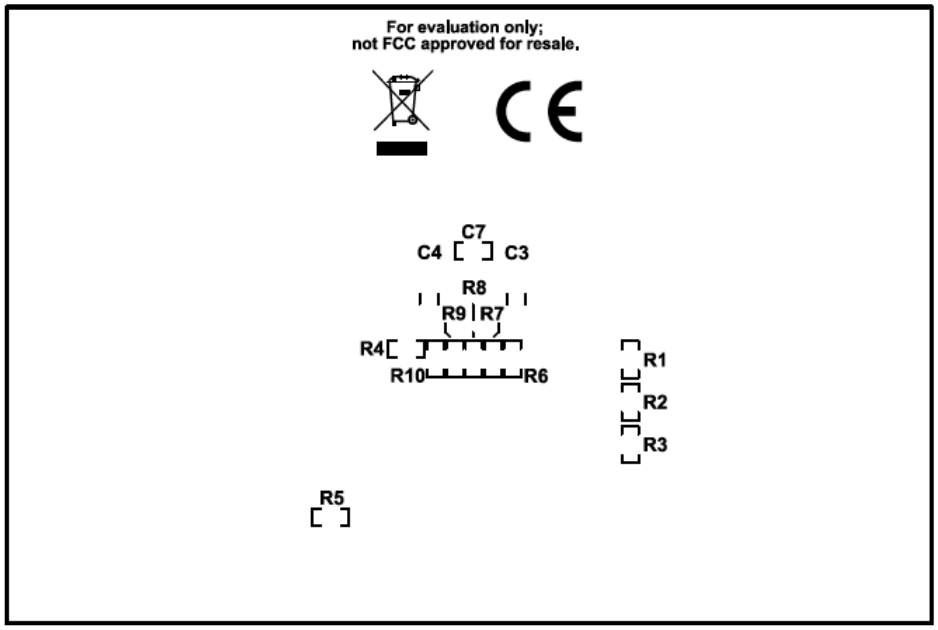


Figure 11. Bottom Layer Silk Screen (Bottom View)

5.2 EVM Schematic

Figure 12 shows the TPSM265R1EVM schematic.

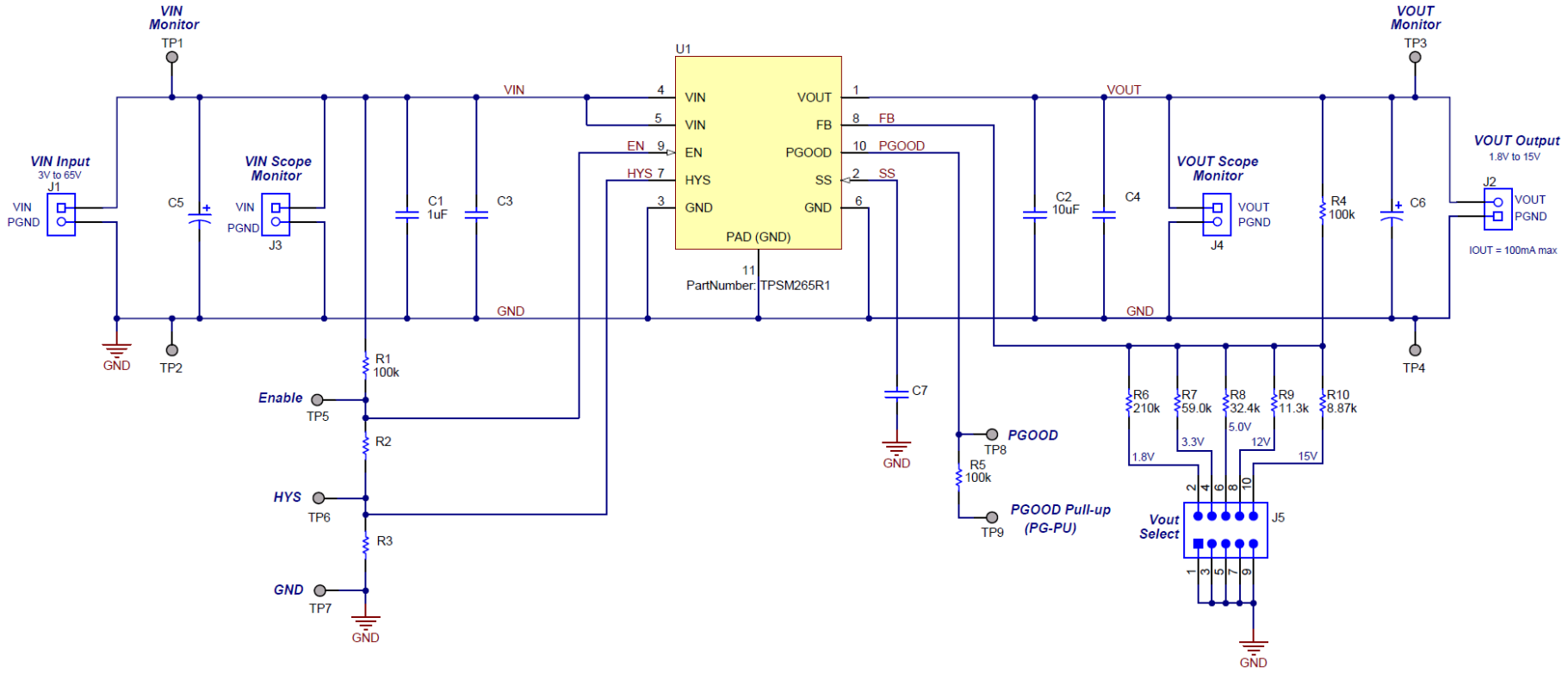


Figure 12. TPSM265R1EVM Schematic

5.3 Bill of Materials (BOM)

Table 2 shows the TPSM265R1EVM BOM.

Table 2. TPSM265R1EVM Bill of Materials

DESIGNATOR	QUANTITY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PART NUMBER
C1	1	1 µF	CAP, Ceramic, 1 µF, 100 V ±10%, X7R, 1206	1206	C3216X7R2A105K160AA

Table 2. TPSM265R1EVM Bill of Materials (continued)

DESIGNATOR	QUANTITY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PART NUMBER
C2	1	10 µF	'CAP, Ceramic, 10 µF, 25 V, ±10%, X7R, 1206	1206	GRM31CR71E106KA12L
J1, J2	2		Terminal Block, 3.5 mm Pitch, 2×1, TH	7.0 × 8.2 × 5 mm	ED555/2DS
J5	1		Header, 100 mil, 5×2, Tin, TH	Header, 5×2, 100 mil, Tin	PEC05DAAN
R1, R4, R5	3	100 k	RES, 100 k, 1%, 0.1 W, 0603	0603	CRCW0603100KFKEA
R6	1	210 k	RES 210 k, 1%, 0.1 W, 0603	0603	CRCW0603210KFKEA
R7	1	59.0 k	RES, 59.0 k, 1%, 0.1 W, 0603	0603	CRCW060359K0FKEA
R8	1	32.4 k	RES 32.4 k, 1%, 0.1 W, 0603	0603	CRCW060332K4FKEA
R9	1	11.3 k	RES, 11.3 k, 1%, 0.1 W, 0603	0603	CRCW060311K3FKEA
R10	1	8.87 k	RES, 8.87 k, 1%, 0.1 W, 0603	0603	CRCW06038K87FKEA
TP1, TP2, TP3, TP4	4		Terminal, Turret, TH, Double	Keystone 1503-2	1503-2
TP5, TP6, TP7, TP8, TP9	5		Test Point, Miniature, SMT	Test Point, Miniature, SMT	5019
U1	1		65 V Input, 100-mA Power Module	SIL0010C	TPSM265R1
Not Loaded					
C3, C4	0			1206	
C5	0			D8 × L12mm	
C6	0			7.3 × 4.3 mm	
C7	0			0603	
J3, J4	0			Socket Strip, 100 mil	
R2, R3	0			0603	

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NOTE:

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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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