

# TPSM82821EVM-080, TPSM82822EVM-080 and TPSM82823EVM-080 Evaluation Module



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## 1 TPSM82821EVM-080, TPSM82822EVM-080 and TPSM82823EVM-080 Evaluation Modules

These EVMs ship as the Revision B, the newer revision provides better thermal performance, smaller solution size and complies with CISPR 11 Class B. The TPSM8282xEVM-080 facilitates the evaluation of the TPSM82821, TPSM82822 and TPSM82823 1-A, 2-A and 3-A pin-to-pin compatible step-down module with DCS-Control in a 2-mm × 2.5-mm uSiL package. The EVMs have a 1.8-V output voltage with 1% accuracy for input voltages from 2.4 V to 5.5 V with a maximum solution height of 1.1 mm. The TPSM82821, TPSM82822 and TPSM82823 are highly efficient and small solutions for point-of-load (POL) modules in applications, such as optical modules, embedded camera systems and other space-limited applications.

## 2 Introduction

The TPSM82821, TPSM82822 and TPSM82823 are synchronous, step-down converter power modules in a small 2-mm × 2.5-mm uSiL package. The three different devices of this family support 1 A, 2 A or 3 A output current.

### 2.1 Performance Specification

Table 2-1 provides a summary of the TPSM8282xEVM-080 performance specifications.

**Table 2-1. Performance Specification Summary**

SPECIFICATION	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input voltage		2.4	5	5.5	V
Output voltage setpoint			1.8		V
Output current	TPSM82821EVM-080	0		1	A
	TPSM82822EVM-080	0		2	A
	TPSM82823EVM-080	0		3	A

### 2.2 Modifications

The printed-circuit board (PCB) for this EVM is designed to accommodate both the adjustable output voltage versions of this module. Additional input and output capacitors can also be added.

#### 2.2.1 Input and Output Capacitors

C5, shown in Figure 7-1, 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.

C6 and C7 are provided for additional output capacitors. These capacitors is 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.

## 3 Setup

This section describes how to properly use the TPSM8282xEVM-080 Rev.B.


### 3.1 Setup

To operate the EVM, set jumper JP1 between ON and EN to turn on the device as shown in [Section 3.2](#). Connect the input supply to J1 and connect the load to J2.

### 3.2 Input/Output Connector Descriptions

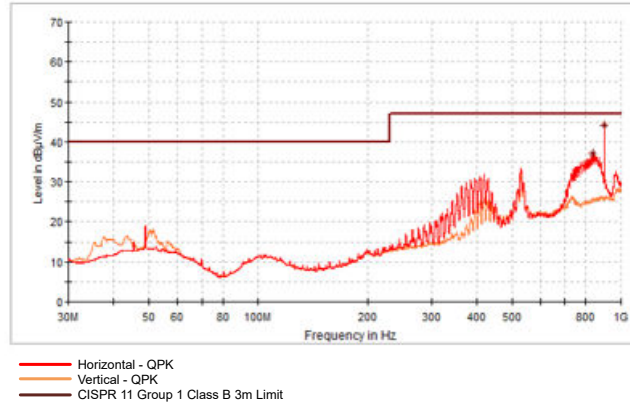
<b>J1, Pin 1 and 2 – VIN</b>	Positive input connection from the input supply for the EVM.
<b>J1, Pin 3 and 4 – S+/S–</b>	Input voltage sense connections. Measure the input voltage at this point.
<b>J1, Pin 5 and 6 – GND</b>	Input return connection from the input supply for the EVM.
<b>J2, Pin 1 and 2 – VOUT</b>	Output voltage connection
<b>J2, Pin 3 and 4 – S+/S–</b>	Output voltage sense connections. Measure the output voltage at this point.
<b>J2, Pin 5 and 6 – GND</b>	Output return connection
<b>J3 – PG/GND</b>	The PG output appears on pin 1 of this header with ground on pin 2.
<b>JP1 – EN</b>	EN pin input jumper. Place the supplied jumper across ON and EN to turn on the module. Place the jumper across OFF and EN to turn off the IC.

## 4 Safety Instructions

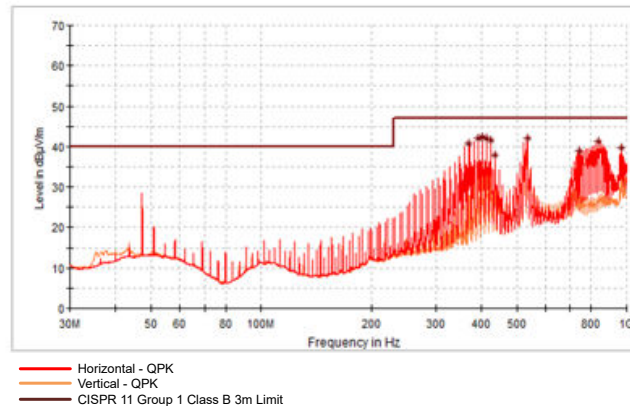
<b>WARNING</b>	
	
Hot surface. Contact may cause burns. Do not touch.	

## 5 TPSM8282xEVM-080 Test Results

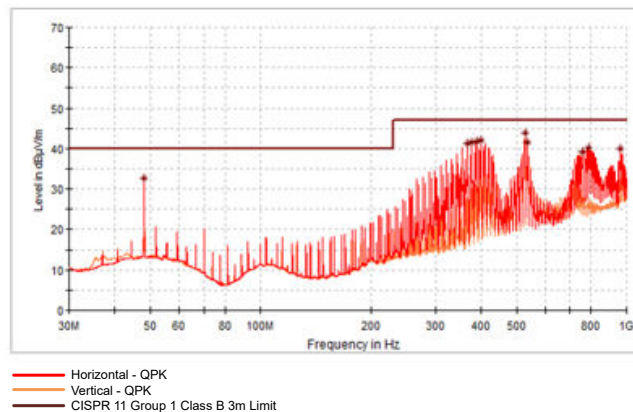
This section provides test results of the TPSM8282xEVM-080. The TPSM8282xEVM-080 was used to take all the data in [TPSM8282x 1-A, 2-A, and 3-A High Efficiency Step-Down Converter MicroSiP™ Power Module with Integrated Inductor](#). See the device data sheet for the performance of this EVM. The following EMI measurements were made for  $V_{IN} = 5.5\text{ V}$  and  $V_{OUT} = 1.8\text{ V}$ . The TPSM82821EVM-080 had a resistive load of 2.2 Ohms which results in an output current  $I_{OUT} = 0.82\text{ A}$ . The TPSM82822EVM-080 had a resistive load of 1 Ohms which results in an output current  $I_{OUT} = 1.8\text{ A}$ . The TPSM82823EVM-080 had a resistive load of 0.68 Ohms which results in an output current  $I_{OUT} = 2.65\text{ A}$ .



**Figure 5-1. TPSM82821EVM-080 Radiated EMI**



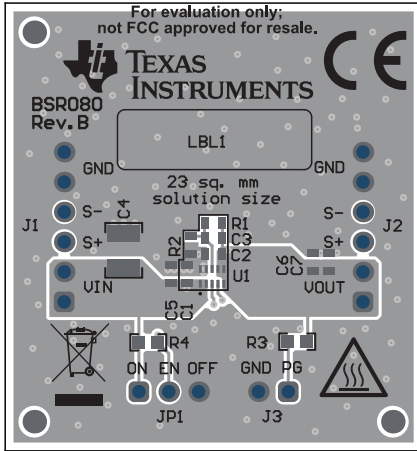
**Figure 5-2. TPSM82822EVM-080 Radiated EMI**



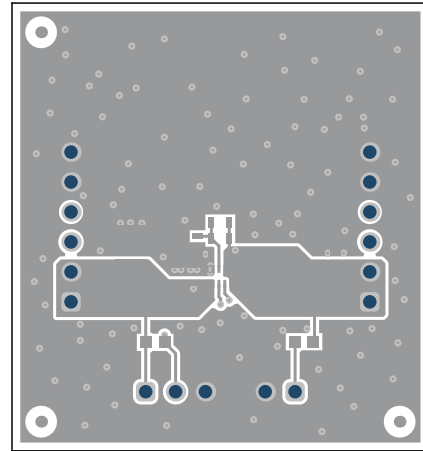
**Figure 5-3. TPSM82823EVM-080 Radiated EMI**

## 6 Board Layout

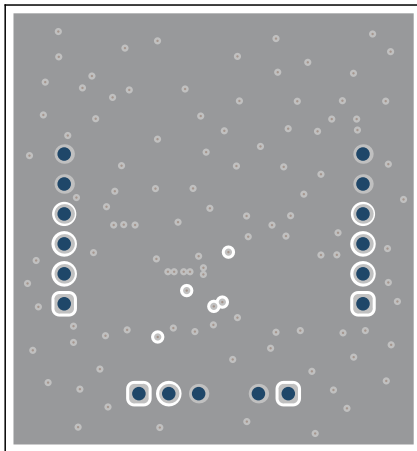
This section provides the TPSM8282xEVM-080 board layout and illustrations in [Figure 6-1](#) through [Figure 6-5](#). The Gerbers are available on the [TPSM82822EVM-080 product page](#).



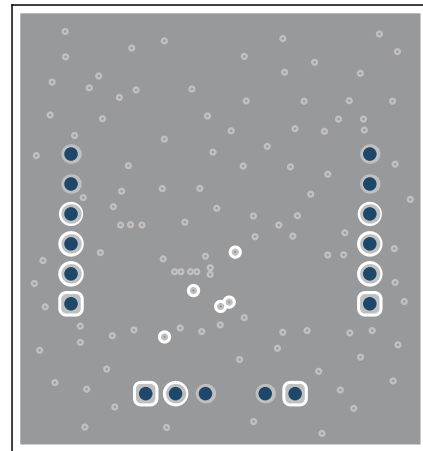
**Figure 6-1. Top Assembly**



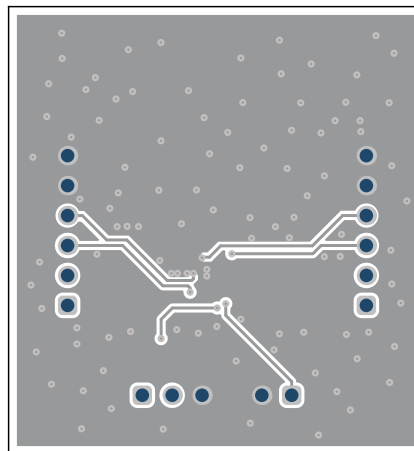
**Figure 6-2. Top Layer**



**Figure 6-3. Signal Layer 1**



**Figure 6-4. Signal Layer 2**



**Figure 6-5. Bottom Layer**

## 7 Schematic and Bill of Materials

This section provides the TPSM8282xEVM-080 schematic and bill of materials (BOM).

### 7.1 Schematic

Figure 7-1 illustrates the EVM schematic. The TPSM82821EVM-080 uses the TPSM82821 IC, the TPSM82822EVM-080 uses the TPSM82822 IC and the TPSM82823EVM-080 uses the TPSM82823 IC.

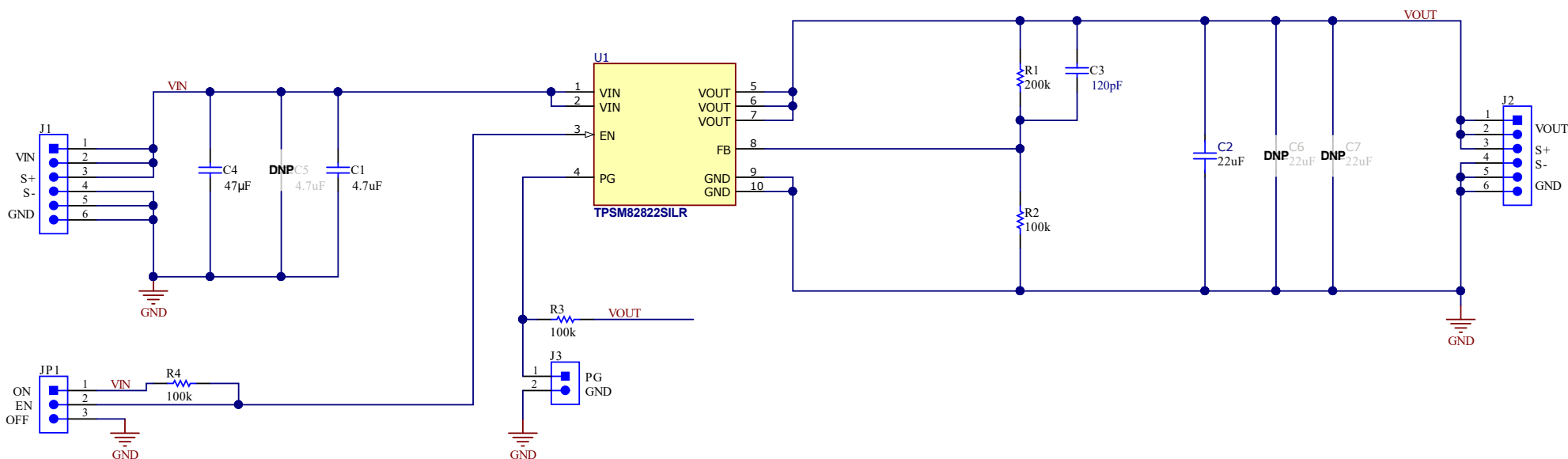


Figure 7-1. TPSM8282xEVM-080 Schematic

## 7.2 Bill of Materials

Section 7.2 lists the BOM for this EVM.

**Table 7-1. TPSM8282xEVM-080 Bill of Materials**

Count			Designator	Value	Description	Size	Part Number	Manufacturer
-001	-002	-003						
1	1	1	C1	4.7 $\mu$ F	CAP, CERM, 4.7 $\mu$ F, 6.3 V, $\pm$ 10%, X7R, 0603	0603	JMK107BB7475MA-T	Taiyo Yuden
1	1	1	C2	22 $\mu$ F	CAP, CERM, 22 $\mu$ F, 6.3V, $\pm$ 20%, X6S, 0603	0603	JMK107BC6226MA-T	Taiyo Yuden
1	1	1	C3	120 pF	CAP, CERM, 120 pF, 50 V, $\pm$ 5%, C0G/NP0, 0603	0603	06035A121JAT2A	AVX
1	1	1	C4	47 $\mu$ F	CAP, CERM, 47 $\mu$ F, 10 V, $\pm$ 20%, X7R, 1210	1210	LMK325B7476MM-PR	Taiyo Yuden
1	1	1	R1	200 k	RES, 200 k, 1%, 0.1 W, 0603	0603	RC0603FR-07200KL	Yageo
2	2	2	R2, R3, R4	100 k	RES, 100 k, 1%, 0.1 W, 0603	0603	RC0603FR-07100KL	Yageo
1	0	0	U1		1-A Step-Down Module with 1% Output Accuracy in 2-mm $\times$ 2.5-mm uSip	2 $\times$ 2.5 mm	TPSM82821SILR	Texas Instruments
0	1	0	U1		2-A Step-Down Module with 1% Output Accuracy in 2-mm $\times$ 2.5-mm uSip	2 $\times$ 2.5 mm	TPSM82822SILR	Texas Instruments
0	0	1	U1		3-A Step-Down Module with 1% Output Accuracy in 2-mm $\times$ 2.5-mm uSip	2 $\times$ 2.5 mm	TPSM82823SILR	Texas Instruments

## A Appendix - Rev.A EVM

### A.1 Rev.A - Input and Output Capacitors

This appendix contains the information about the original Revision A TPSM82821EVM-080 and TPSM82822EVM-080 EVMs which are now Revision B. The Revision A EVMs are no longer available for purchase.

C3, shown in [Figure A-6](#), 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.

C8 is provided for additional output capacitors. This capacitor is 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.



## A.2 Rev.A - Setup

This section describes how to properly use the TPSM8282xEVM-080 Rev.A.

### A.2.1 Rev.A - Setup

To operate the EVM, set jumper J3 between ON and EN to turn on the device as shown in [Appendix A.2.2](#). Connect the input supply to J1 and connect the load to J2.

### A.2.2 Rev.A - Input/Output Connector Descriptions

<b>J1, Pin 1 and 2 – VIN</b>	Positive input connection from the input supply for the EVM.
<b>J1, Pin 3 and 4 – S+/S–</b>	Input voltage sense connections. Measure the input voltage at this point.
<b>J1, Pin 5 and 6 – GND</b>	Input return connection from the input supply for the EVM.
<b>J2, Pin 1 and 2 – VOUT</b>	Output voltage connection
<b>J2, Pin 3 and 4 – S+/S–</b>	Output voltage sense connections. Measure the output voltage at this point.
<b>J2, Pin 5 and 6 – GND</b>	Output return connection
<b>J3 – EN</b>	EN pin input jumper. Place the supplied jumper across ON and EN to turn on the module. Place the jumper across OFF and EN to turn off the IC.
<b>J4 – PG/GND</b>	The PG output appears on pin 1 of this header with ground on pin 2.

## A.3 Rev.A - Board Layout

This section provides the TPSM8282xEVM-080 Revision A board layout and illustrations in [Figure A-1](#) through [Figure A-5](#).

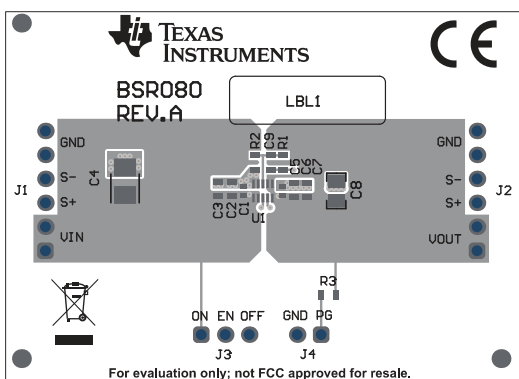


Figure A-1. Rev.A - Top Assembly

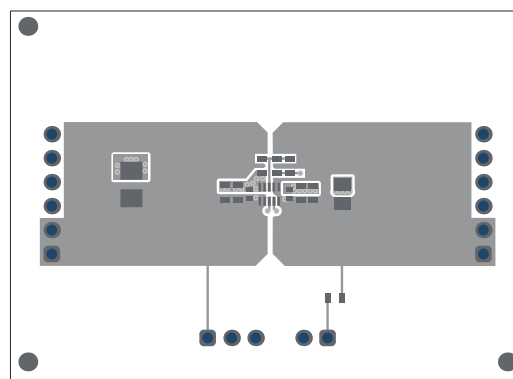


Figure A-2. Rev.A - Top Layer

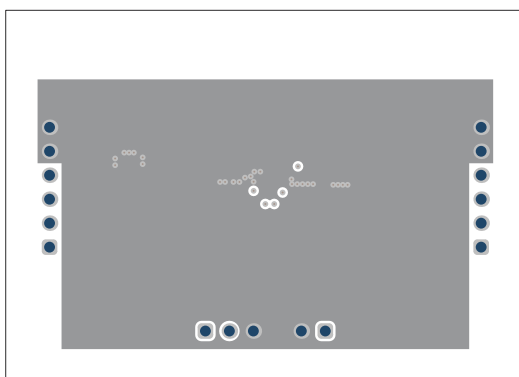


Figure A-3. Rev.A - Signal Layer 1

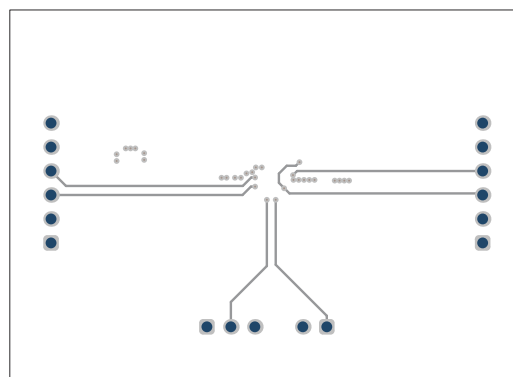
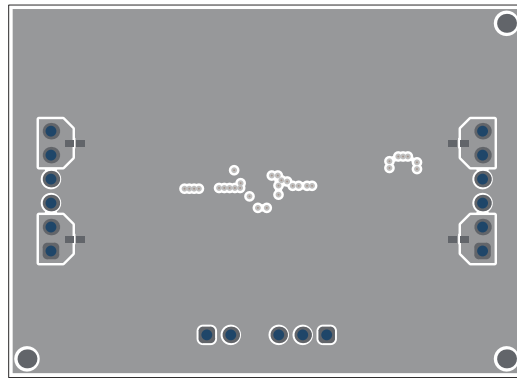


Figure A-4. Rev.A - Signal Layer 2



**Figure A-5. Rev.A - Bottom Layer**

## A.4 Rev.A - Schematic and Bill of Materials

This section provides the TPSM8282xEVM-080 schematic and bill of materials (BOM).

### A.4.1 Rev.A - Schematic

Figure A-6 illustrates the EVM schematic.

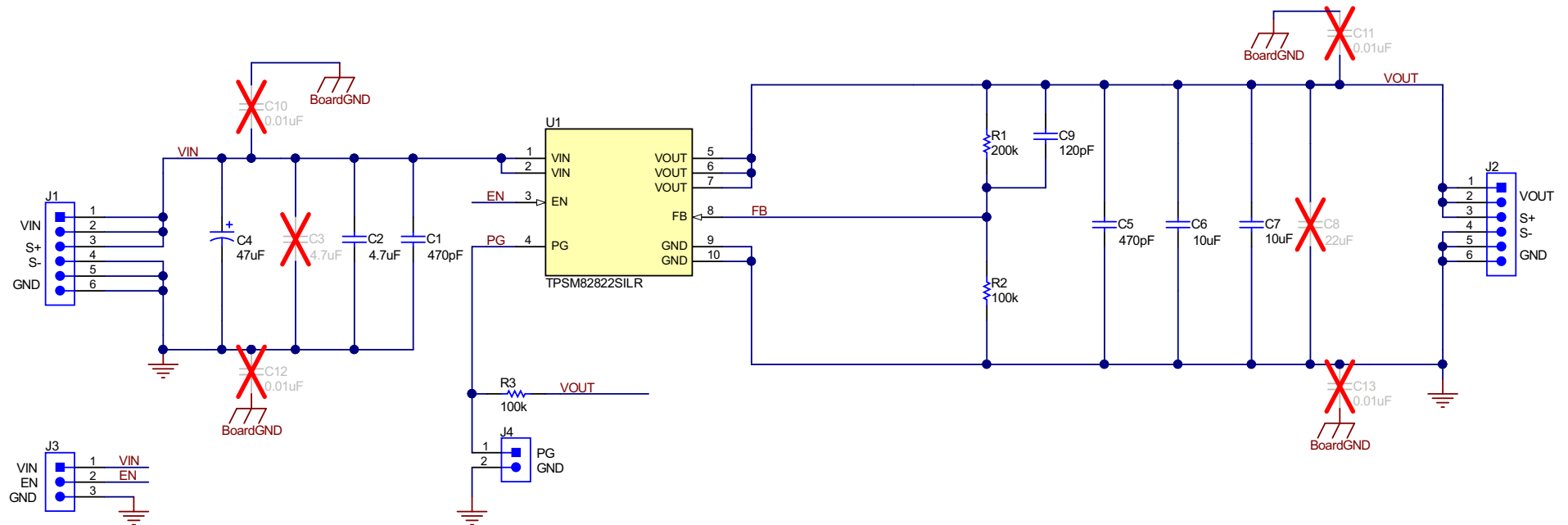


Figure A-6. TPSM8282xEVM-080 Revision A Schematic

## A.4.2 Rev.A - Bill of Materials

Table A-1 lists the BOM for this EVM.

**Table A-1. TPSM8282xEVM-080 Revision A Bill of Materials**

Count		Designat or	Value	Description	Size	Part Number	Manufacturer
-001	-002						
2	2	C1, C5	470 pF	CAP, CERM, 470 pF, 50 V, ±10%, X7R, 0402	0402	GCM155R71H471 KA37D	MuRata
2	2	C2	4.7 µF	CAP, CERM, 4.7 µF, 6.3 V, ±10%, X7R, 0603	0603	JMK107BB7475M A-T	Taiyo Yuden
1	1	C4	47 µF	CAP, TA, 47 µF, 10 V, ±10%, 0.25 Ω, SMD	3528-21	TPSB476K010R02 50	AVX
2	2	C6, C7	10 µF	CAP, CERM, 10 µF, 10 V, ±20%, X7R, 0603	0603	GRM188Z71A106 MA73D	Murata
1	1	C9	120 pF	CAP, CERM, 120 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C1H121 JA01D	Murata
1	1	R1	200 k	RES, 200 k, 1%, 0.1 W, 0603	0603	Std	Std
2	2	R2, R3	100 k	RES, 100 k, 1%, 0.1 W, 0603	0603	Std	Std
1	0	U1		1-A Step-Down Module with 1% Output Accuracy in 2-mm × 2.5-mm uSip	2×2.5 mm	TPSM82821SILR	Texas Instruments
0	1	U1		2-A Step-Down Module with 1% Output Accuracy in 2-mm × 2.5-mm uSip	2×2.5 mm	TPSM82822SILR	Texas Instruments

## B Revision History

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

<b>Changes from Revision B (December 2019) to Revision C (April 2021)</b>	<b>Page</b>
• Revised TPSM82821EVM-080 and TPSM82822EVM-080 from Rev.A to Rev.B.....	2
• Added TPSM82823EVM-080 Rev.B .....	2
• Added Radiated EMI Measurement Results of Rev.B EVM.....	4
• Moved Rev. A files to Appendix.....	8
<hr/>	
<b>Changes from Revision A (October 2019) to Revision B (December 2019)</b>	<b>Page</b>
• Edited Bill of Materials.....	7
• Edited Bill of Materials.....	12
<hr/>	
<b>Changes from Revision * (August 2019) to Revision A (October 2019)</b>	<b>Page</b>
• Edited Bill of Materials.....	7
• Edited Bill of Materials.....	12

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### **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 DEGRADATION 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/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/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/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/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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2. 実験局の免許を取得後ご使用いただく。
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3.3.3 *Notice for EVMs for Power Line Communication:* Please see [http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_02.page](http://www.tij.co.jp/lstds/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。  
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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.

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- 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.
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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.

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