User's Guide
SLVUAI6–January 2016

TPS62480EVM-671 Evaluation Module

This user's guide describes the characteristics, operation, and use of TI's TPS62480 evaluation module (EVM). This EVM is designed to help the user easily evaluate and test the operation and functionality of the TPS62480 6-A, 2-phase buck converter. The EVM converts a 2.4-V to 5.5-V input voltage to a regulated 1.8-V or 2.5-V output voltage that delivers up to 6 A. This user's guide includes setup instructions for the hardware, a printed-circuit board (PCB) layout, a schematic diagram, a bill of materials (BOM), and test results for the EVM.

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1 Introduction

The TPS62480 is a 6-A, dual-phase, synchronous, step-down converter in a 2.5 × 3-mm, 16-pin VSON package.

1.1 Performance Specification

Table 1 provides a summary of the TPS62480EVM-671 performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 1. Performance Specification Summary

Specification		Test Conditions	MIN	TYP	MAX	Unit
Input voltage			2.4		5.5	V
Output voltage setpoint	VSEL = High			2.5		V
	VSEL = Low			1.8		V
Output current			0		6	A
Soft-start time		Ramp time of V_{OUT}		370		µs

1.2 Modifications

The printed-circuit board (PCB) for this EVM is designed to accommodate additional input and output capacitors.

1.2.1 Input and Output Capacitors

C10 and C11 are provided for additional input capacitors. These capacitors are not required for proper operation but can be used to reduce the input voltage ripple.

C12, C13, C14, and C15 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 TPS62480 data sheet (SLVSCL9) for proper operation.

1.2.2 Configurable Tracking Voltage

R6 and R7 can be installed to set a user-selectable tracking voltage. See the equations in the data sheet for details of calculating the resistor values.

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2 Setup

This section describes how to properly use the TPS62480EVM-671.

2.1 Connector Descriptions

J1, Pin 1 and 2 – VIN	Positive input voltage connection from the input supply for the EVM. Use when the steady-state input current is less than 2 A. Otherwise, use J2.
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 – VIN/GND	Pin 2 is the positive input connection with pin 1, serving as the input return connection. Use this terminal block if the steady-state input current is greater than 2 A.
J3 – VOUT/GND	Pin 1 is the positive output connection with pin 2, serving as the output return connection. Use this terminal block if the steady-state output current is greater than 2 A.
J4, Pin 1 and 2 – VOUT	Positive output voltage connection. Use when the steady-state output current is less than 2 A; otherwise, use J3.
J4, Pin 3 and 4 – S+/S–	Output voltage sense connections. Measure the output voltage at this point.
J4, Pin 5 and 6 – GND	Output return connection.
J5 – SS/TR/GND	The SS/TR pin voltage appears on pin 1 of this header with a convenient ground on pin 3.
J5 – TRACK-IN	The TRACK-IN pin can be used to scale down a tracking-voltage.
J6 – PG/GND	The PG output appears on pin 1 of this header with a convenient ground on pin 2.
J7 – TG/GND	The TG output appears on pin 1 of this header with a convenient ground on pin 2.
JP1 – EN	EN pin 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.
JP2 – VSEL	VSEL pin jumper. Place the supplied jumper across LOW and VSEL for 1.8-V output. Place the jumper across HIGH and VSEL for 2.5-V output.
JP3 – MODE	Mode pin jumper. Place the supplied jumper across PWM and MODE to operate the converter in a forced PWM mode. Placed the jumper across MODE and PSM to operate the converter in power-saving (PSM) mode.
JP4 – PG Pullup Voltage	PG pin pullup voltage jumper. Place the supplied jumper on JP4 to connect the PG pin pullup resistor to the output voltage. 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 6 V.
JP5 – TG Pullup Voltage	TG pin pullup voltage jumper. Place the supplied jumper on JP5 to connect the PG pin pullup resistor to the output voltage. Alternatively, the jumper can be removed and a different voltage can be supplied on pin 1 to pull up the TG pin to a different level. This externally applied voltage must remain below 6 V.

2.2 Operation

To operate the EVM, set jumpers JP1, JP2, and JP3 to the desired positions per Section 2.1. Connect the input supply to J1 or J2 and connect the load to J3 or J4.

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3 TPS62480EVM-671 Test Results

The TPS62480EVM-671 was used to take the data in the TPS62480 data sheet (SLVSCL9). See the device data sheet for the performance of this EVM.

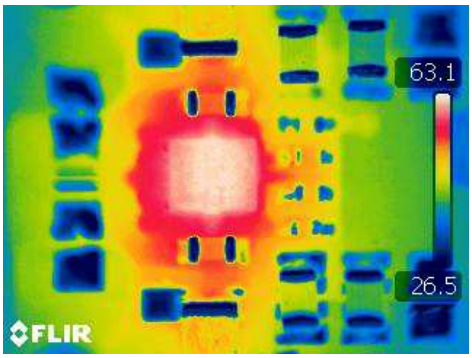


Figure 1. Thermal Performance (V_{IN} = 5 V, V_{OUT} = 1.8 V, Load = 6 A, Mode = PSM)

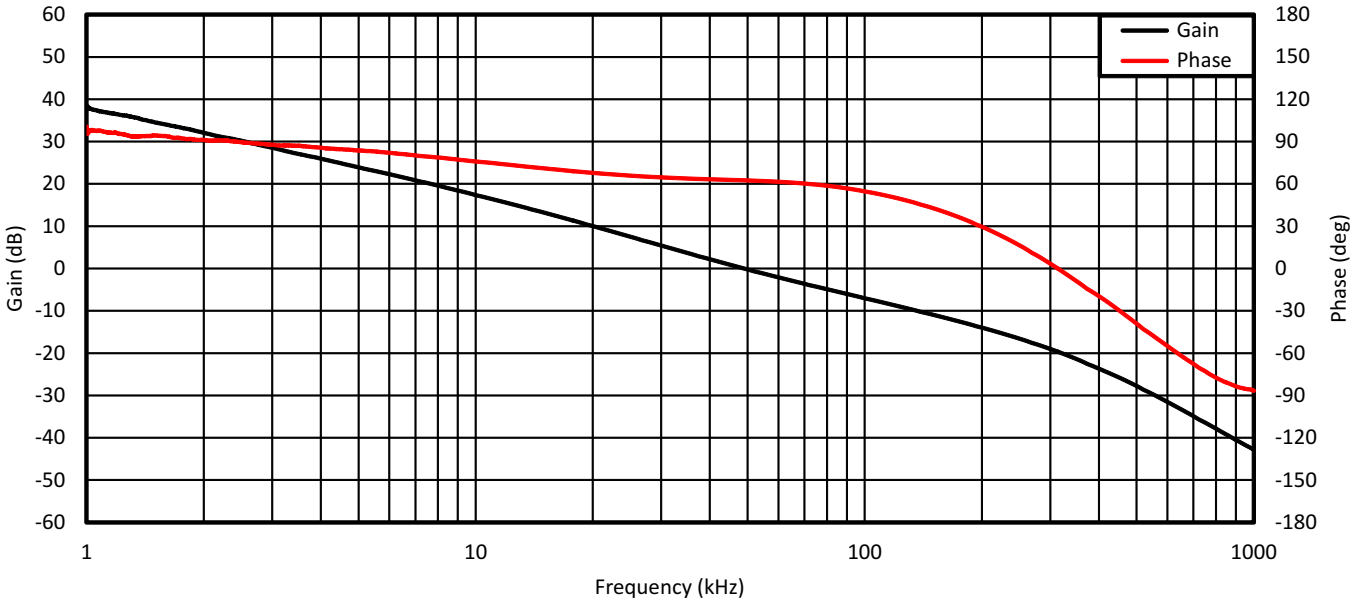


Figure 2. Loop Measurement (V_{IN} = 5 V, V_{OUT} = 1.8 V, Load = 6 A, Mode = PSM)

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4 Board Layout

This section provides the TPS62480EVM-671 board layout and illustrations. The Gerbers are available on the EVM product page: TPS62480EVM-671.

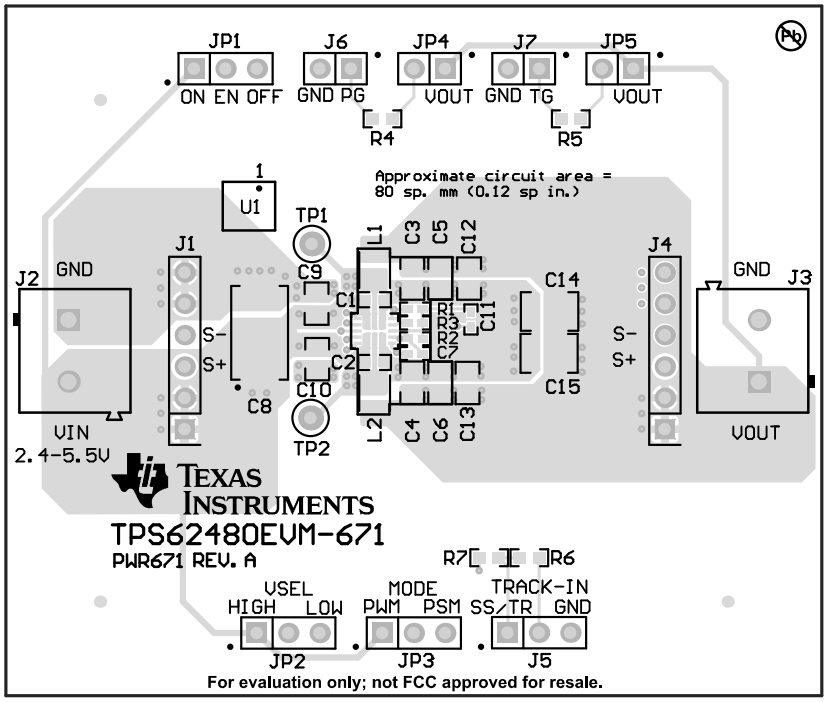


Figure 3. Assembly Layer

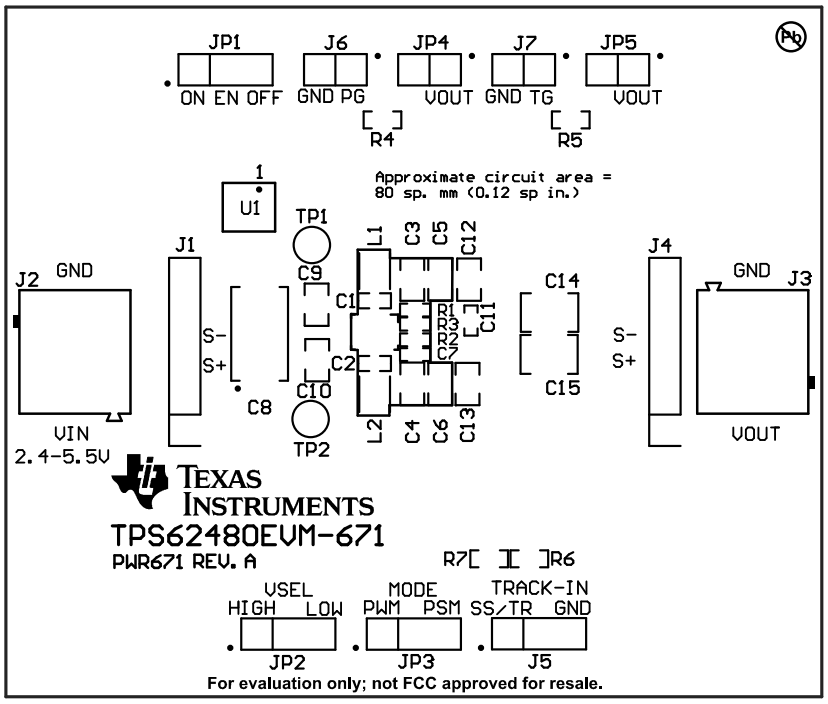


Figure 4. Top Overlay

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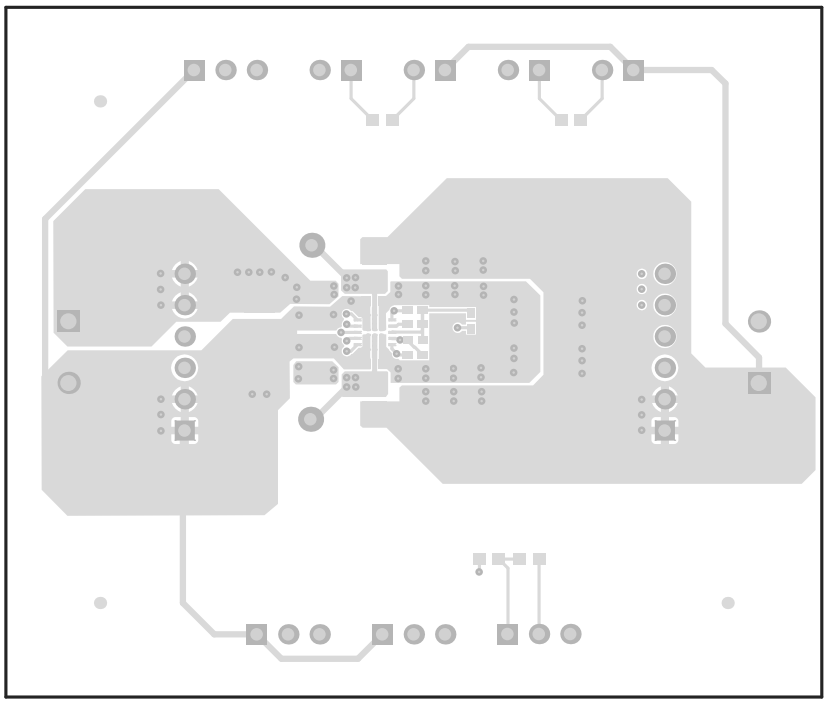


Figure 5. Top Layer

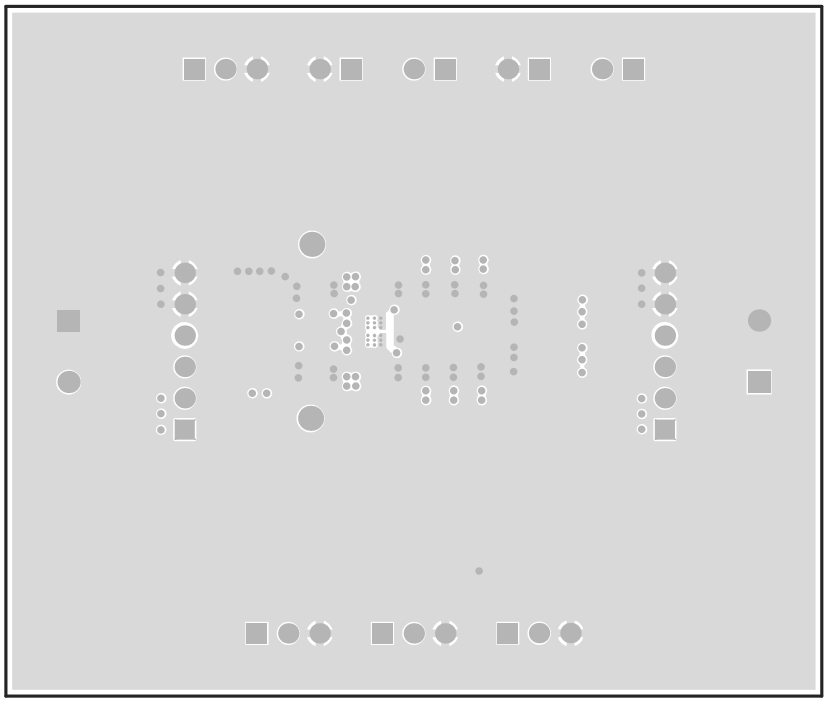


Figure 6. Internal Layer 1

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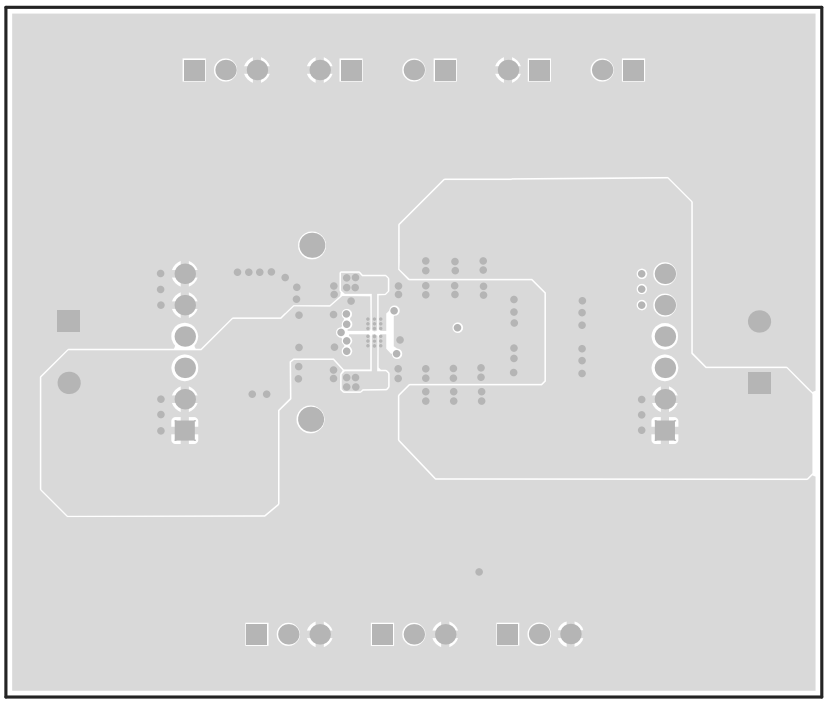


Figure 7. Internal Layer 2

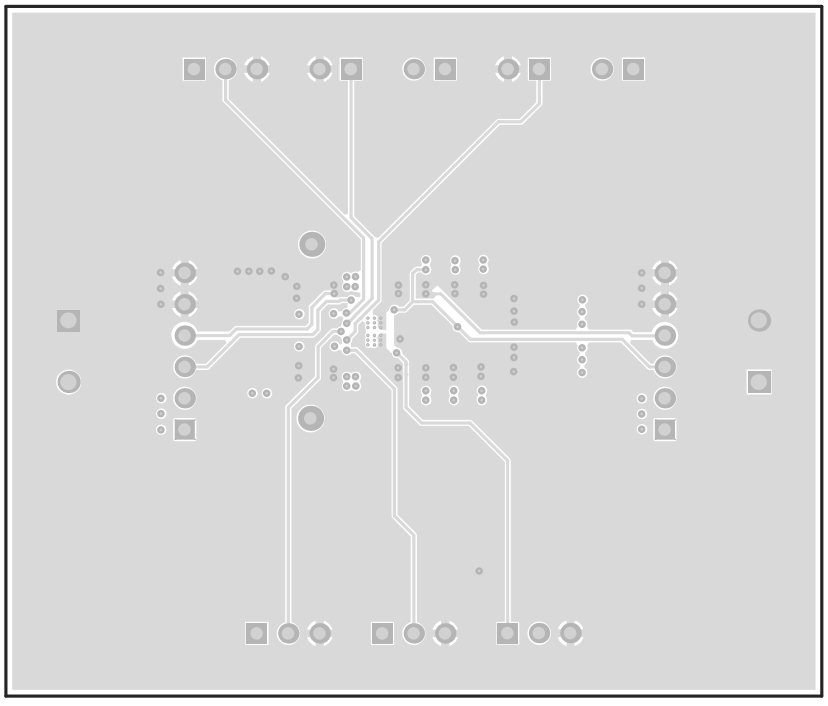


Figure 8. Bottom Layer

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5 Schematic and Bill of Materials

This section provides the TPS62480EVM-671 schematic and bill of materials.

5.1 Schematic

Figure 9 illustrates the TPS62480EVM-671 schematic.

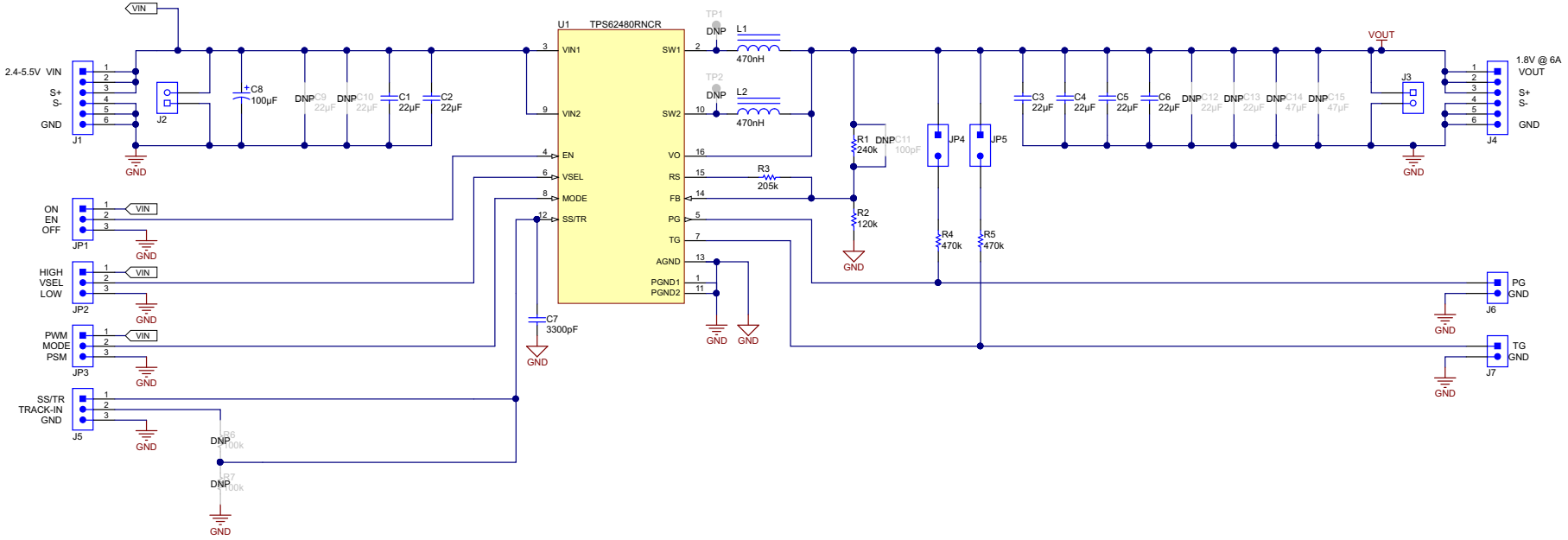


Figure 9. TPS62480EVM-671 Schematic

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5.2 Bill of Materials

Table 2 lists the TPS62480EVM-671 BOM.

Table 2. TPS62480EVM-671 Bill of Materials

Quantity	Ref Des	Value	Description	Size	Part Number	Manufacturer
2	C1, C2	22uF	CAP, CERM, 22uF, 10V, +/-20%, X5R, 0603	0603	GRM188R61A226ME15D	Murata
4	C3, C4, C5, C6	22uF	CAP, CERM, 22uF, 25V, +/-20%, X5R, 0805	0805	GRM21BR61E226ME44	Murata
1	C7	3300pF	CAP, CERM, 3300 pF, 50 V, +/- 10%, X7R, 0402	0402	GRM155R71H332KA01D	Murata
1	C8	100uF	CAP, TA, 100uF, 20V, +/-10%, 0.5 ohm, SMD	7343-43	293D107X9020E2TE3	Vishay-Sprague
2	L1, L2	0.47uH	Inductor, Shielded, 470 nH, 5.8 A, 0.017 ohm, SMD	2.5 x 2.0 x 1.2mm	DFE252012F-R47M	Toko
1	R1	240k	Resistor, Chip, 1/16W, 1%	0402	Std	Std
1	R2	120k	Resistor, Chip, 1/16W, 1%	0402	Std	Std
1	R3	205k	Resistor, Chip, 1/16W, 1%	0402	Std	Std
2	R4, R5	470k	Resistor, Chip, 0.1W, 1%	0603	Std	Std
1	U1	TPS62480	2.4 - 5.5V, 6A, 2-Phase Step-Down Converter	2.5 x 3.0 mm	TPS62480RNC	Texas Instruments

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      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*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). 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

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If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

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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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.

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