TPS62085EVM-169 Evaluation Module

This user's guide describes the characteristics, operation, and use of TI's TPS62085 evaluation module (EVM). This EVM is designed to easily evaluate and test the operation and functionality of the TPS62085. The EVM converts a 2.5-V to 6-V input voltage to a regulated 1.2-V output voltage that delivers 3 A. This user's guide includes setup instructions for the hardware, a printed-circuit board (PCB) layout for the EVM, a schematic diagram, a bill of materials, and test results for the EVM.

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1 Introduction

The TPS62085 is a 3-A, synchronous, step-down converter in a 2×2-mm, 7-pin QFN package. Both fixed and adjustable output voltage units are available.

1.1 Background

The TPS62085EVM-169 (PWR169-001) uses the TPS62085 adjustable version and is set to a 1.2-V output. The EVM operates with full-rated performance with an input voltage between 2.5 V and 6 V.

1.2 Performance Specification

Table 1 provides a summary of the TPS62085EVM-169 performance specifications. All specifications are given for an ambient temperature of 25°C and an input voltage of 3.6 V.

Table 1. Performance Specification Summary

Specification	Test Conditions	Min	Typ	Max	Unit
Input Voltage		2.5	3.6	6	V
Output Voltage	PWM mode	1.18	1.2	1.22	V
Output Current		0		3	A
Peak Efficiency	V_{IN} = 2.5V		91.8 %		
Soft-Start Time	Ramp Time of V_{OUT}		800		µs

1.3 Thermal Data

Table 2 shows the TPS62085EVM-169 thermal data after considering the PCB design of real applications. The big copper planes connecting to the pads of the IC on the PCB improve the thermal performance of the device.

Table 2. TPS62085EVM-169 Thermal Data

Thermal Metric[1]		TPS62085EVM-169	Units
θ_{JA_EVM}	Junction-to-ambient thermal resistance of EVM	69.8	°C/W
ψ_{JT}	Junction-to-top characterization parameter of EVM	1.4	
ψ_{JB}	Junction-to-board characterization parameter of EVM	33.8	

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, SPRA953.

1.4 Modifications

The PCB for this EVM is designed to accommodate both the fixed and adjustable voltage versions of this integrated circuit (IC). Additional output capacitors can also be added. Finally, the loop response of the IC can be measured.

1.4.1 Fixed Output Voltage Operation

U1 can be replaced with the fixed output voltage version of the IC for evaluation. For fixed output voltage version operation, replace R1 with a 0-Ω resistor and remove R2.

1.4.2 Output Capacitors

C3 and C4 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.

1.4.3 Feedforward Capacitor

C6 is provided for the installation of an optional feedforward capacitor. This capacitor is not required for proper operation.

1.4.4 Loop Response Measurement

The loop response of the TPS62085EVM-169 can be measured with two simple changes to the circuitry. First, install a 10-Ω resistor across the pads in the middle of the back of the PCB. The pads are spaced to allow installation of an 0603-sized resistor. Second, cut the short section of trace between the vias on the back of the PCB. This change is shown in Figure 1. With these changes, an ac signal (10-mV, peak-to-peak amplitude recommended) can be injected into the control loop across the added resistor. Details of measuring the control loop of DCS-Control devices are found in SLVA465. The results of this test are shown in Figure 3.

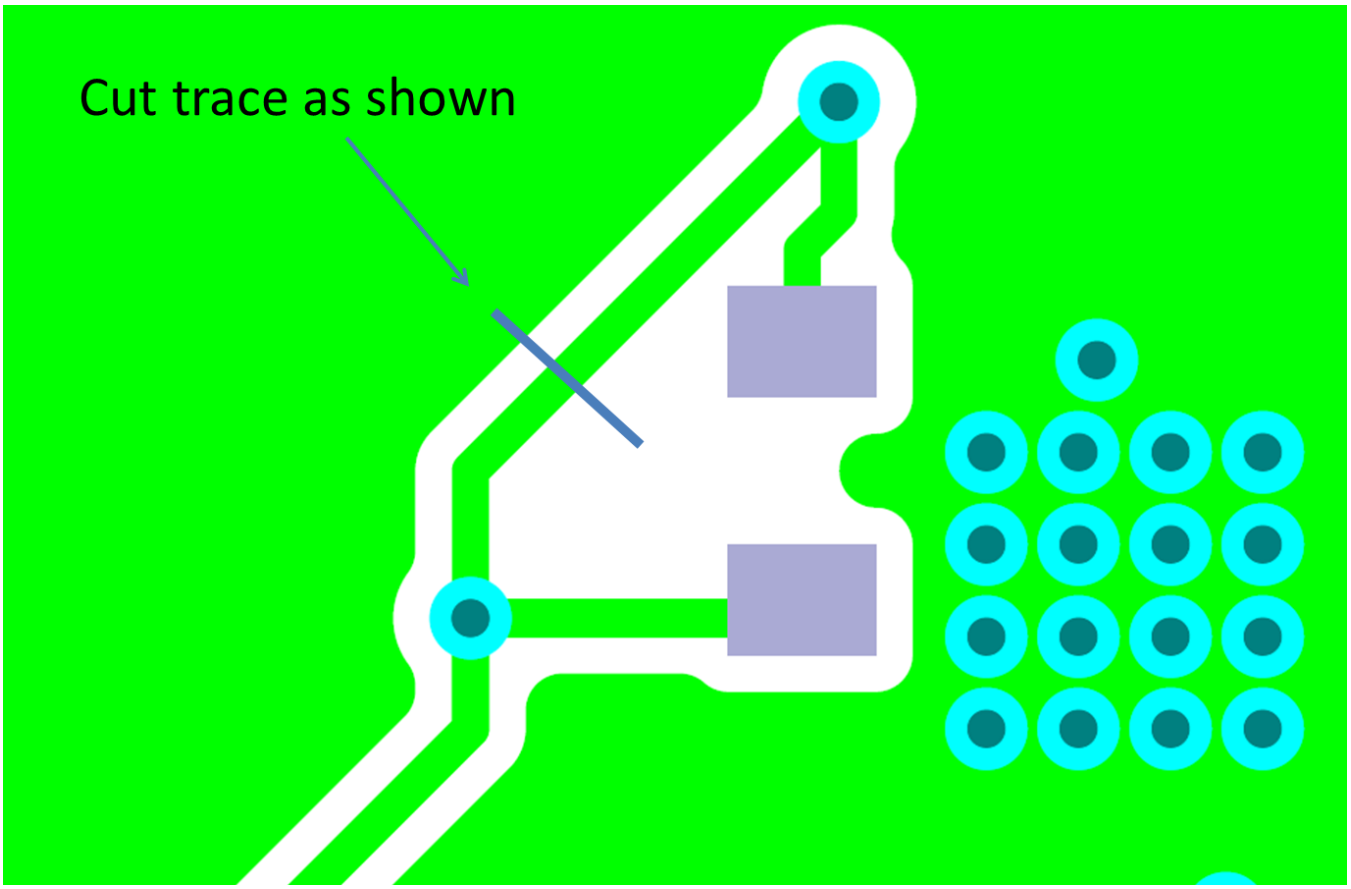

Figure 1. Loop Response Measurement Modification

2 Setup

This section describes how to properly use the TPS62085EVM-169.

2.1 Input/Output Connector Descriptions

J1 – VIN	Positive input connection from the input supply for the EVM.
J2 – S+/S-	Input voltage sense connections. Measure the input voltage at this point.
J3 – GND	Return connection from the input supply for the EVM.
J4 – VOUT	Output voltage connection.
J5 – S+/S-	Output voltage sense connections. Measure the output voltage at this point.
J6 – GND	Output return connection.
J7 – PG/GND	The PG output appears on pin 1 of this header with a convenient ground on pin 2.
JP1 – EN	EN pin input jumper. Place the supplied jumper across ON and EN to turn on the IC. Place the jumper across OFF and EN to turn off the IC.
JP2 – PG Pullup Voltage	PG pin pullup voltage jumper. Place the supplied jumper on JP2 to connect the PG pin pullup resistor to Vin. 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 should remain below 6 V.

2.2 Setup

To operate the EVM, set jumpers JP1 and JP2 to the desired positions per Section 2.1. Connect the input supply to J1 and J3 and connect the load to J4 and J6.

3 TPS62085EVM-169 Test Results

The TPS62085EVM-169 was used to take the data in the TPS62085 data sheet, SLVSB70. See the device data sheet for the performance of this EVM.

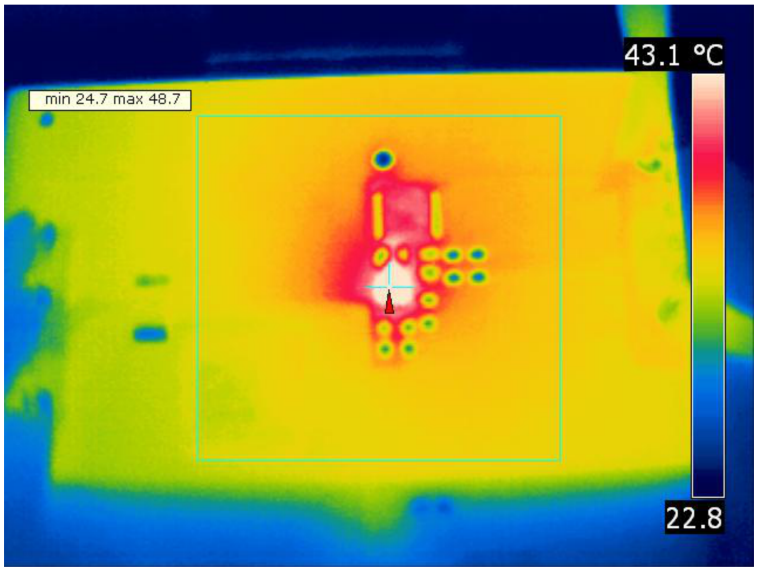

Figure 2. Thermal Performance (V_{IN} = 6 V, Load = 3 A)

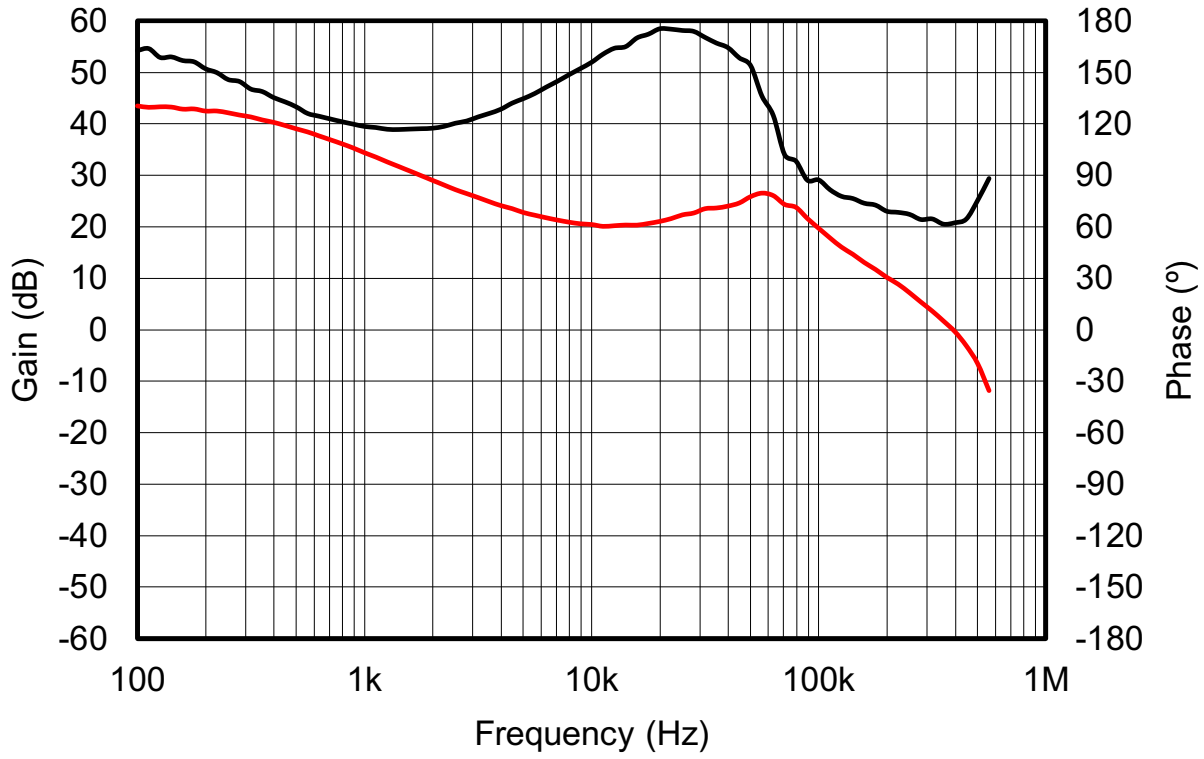

Figure 3. Loop Response Measurement (V_{IN} = 3.6 V, Load = 3 A)

4 Board Layout

This section provides the TPS62085EVM-169 board layout and illustrations. The gerbers are available on the EVM product page: TPS62085EVM-169

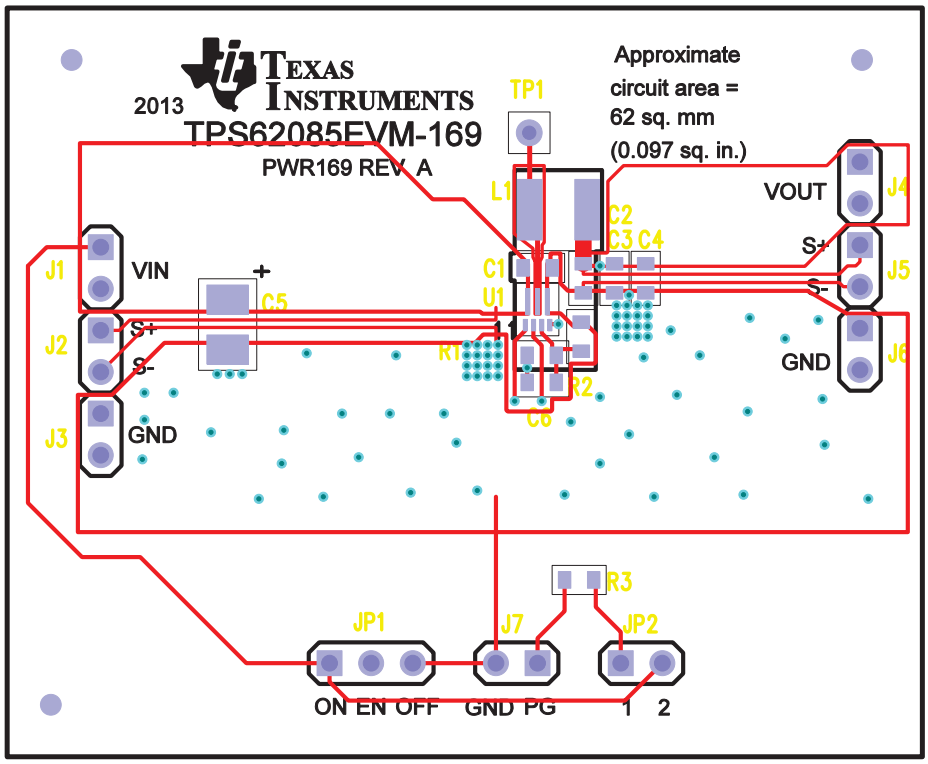

Figure 4. Assembly Layer

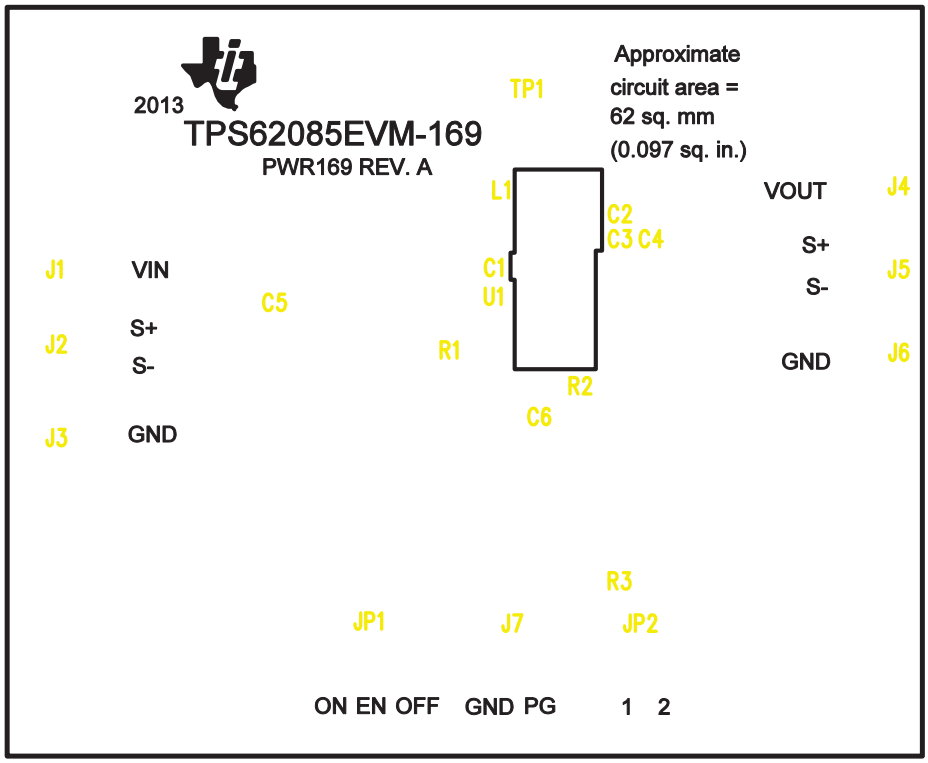

Figure 5. Top Silk Layer

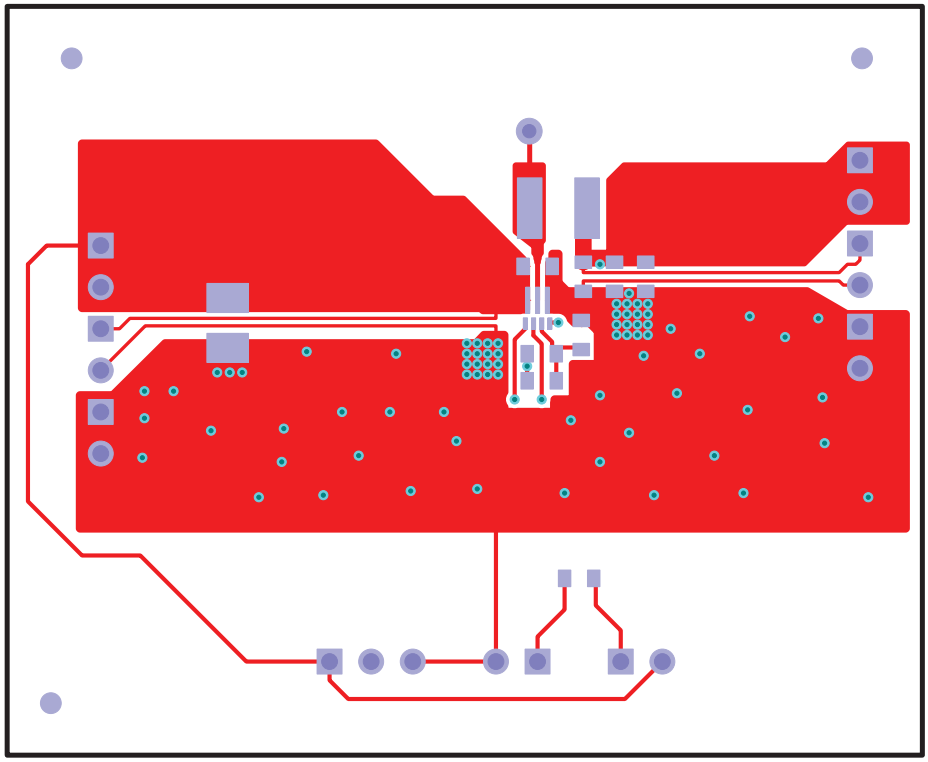

Figure 6. Top Layer

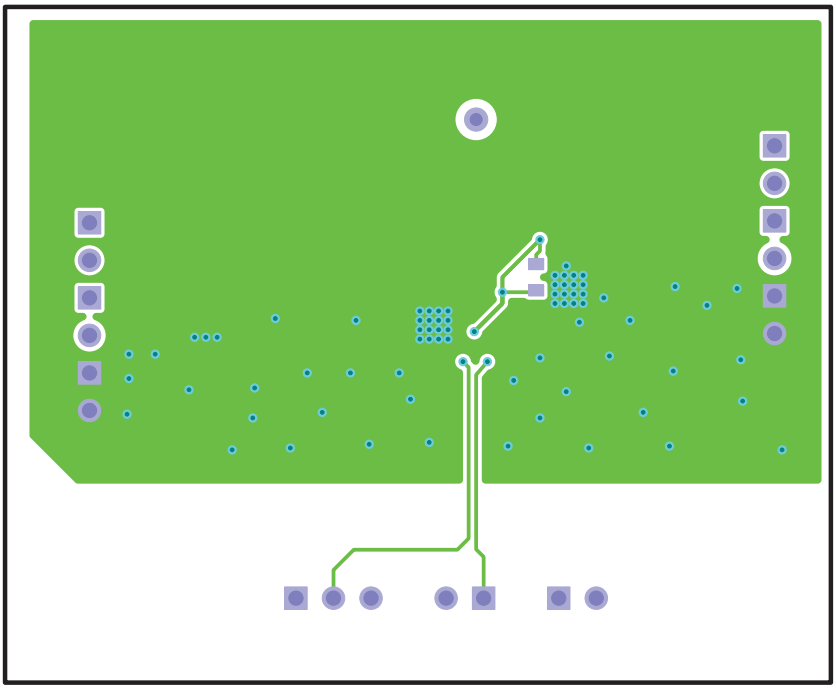

Figure 7. Bottom Layer

5 Schematic and Bill of Materials

This section provides the TPS62085EVM-169 schematic and bill of materials.

5.1 Schematic

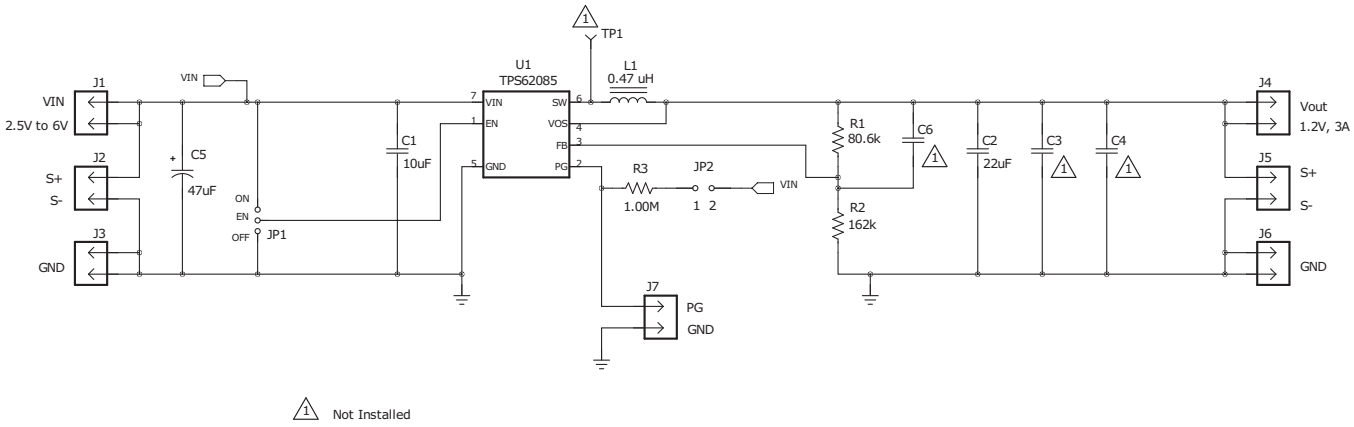

Figure 8. TPS62085EVM-169 Schematic

5.2 Bill of Materials

Table 3. TPS62085EVM-169 Bill of Materials

COUNT	RefDes	Value	Description	Size	Part Number	MFR
1	C1	10uF	Capacitor, Ceramic Chip, 10V, X7R, ±20%	0805	GRM21BR71A106ME51L	Murata
1	C2	22uF	Capacitor, Ceramic Chip, 6.3V, X5R, ±20%	0603	CL10A226MQ7NRNC	Samsung
1	C5	47uF	Capacitor, Tantalum, 8V, 35milliohm, 20%	3528(B)	T520B476M008ATE035	Kemet
1	L1	0.47 uH	Inductor, Shielded Power, 6.6A	4mm x 4mm	XFL4015-471ME	Coilcraft
1	R1	80.6k	Resistor, Chip, 1/16W, 1%	0603	RC0603FR-0780K6L	Yageo
1	R2	162k	Resistor, Chip, 1/16W, 1%	0603	RC0603FR-07162KL	Yageo
1	R3	1.00M	Resistor, Chip, 1/16W, 1%	0603	RC0603FR-071ML	Yageo
1	U1	TPS62085	IC, 3A High Efficiency Step Down Converter	2mm x 2mm	TPS62085RLT	TI

The TPS62085EVM-169 may be populated with TPS62085 (U1) devices that do not contain the correct top side markings on the top of the device itself. These devices are still fully tested TPS62085 devices and meet the specified electrical characteristics of the data sheet.

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For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

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

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

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.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

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

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-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.

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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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.

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.

【Important Notice for Users of EVMs for RF Products in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product 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 this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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3. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards (such as UL, CSA, VDE, CE, RoHS and WEEE) which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM’s electronic components and packing materials.

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Agreement to Defend, Indemnify and Hold Harmless. You agree to 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 use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

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