# TPSM82480EVM-002 Evaluation Module

The TPSM82480EVM-002 evaluation module (EVM) facilitates the evaluation of the TPSM82480 power module. The module converts a 2.4-V to 5.5-V input voltage to a regulated 1.8-V or 2.5-V output voltage at up to 6 A. This user 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 TPSM82480 is a 6-A, dual-phase, synchronous, step-down converter module in a 7.9-mm × 3.6-mm, 24-pin, open frame package. The inductors and IC are included in the module.

## 1.1 Performance Specification

Table 1 provides a summary of the TPSM82480EVM-002 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 set point | 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 Thermal Data

Table 2 shows the thermal data of the TPSM82480EVM-002 evaluation module.

**Table 2. TPSM82480EVM-002 EVM Thermal Data**

| Thermal Metric | | TPSM82480EVM-002 | Unit |
|---|---|---|---|
| $R_{\theta JA}$ | Junction-to-ambient thermal resistance | 31.4 | °C/W |
| $R_{\theta JC(top)}$ | Junction-to-case (top) thermal resistance | - | °C/W |
| $R_{\theta JB}$ | Junction-to-board thermal resistance | 10.9 | °C/W |
| $\psi_{JT}$ | Junction-to-top characterization parameter | 0.33 | °C/W |
| $\psi_{JB}$ | Junction-to-board characterization parameter | 10.9 | °C/W |
| $R_{\theta JC(bot)}$ | Junction-to-case (bottom) thermal resistance | - | °C/W |

## 1.3 Modifications

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

### 1.3.1 Input and Output Capacitors

C13 and C14 are provided for additional input capacitors. These capacitors are not required for proper operation but can be used to reduce the input voltage ripple.

C9, C10, C11, and C12 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 TPSM82480 data sheet (SLVSDT1) for proper operation.

### 1.3.2 Configurable Tracking Voltage

R11 and R12 can be installed to set a user-selectable tracking voltage. See the equations in the TPSM82480 data sheet (SLVSDT1) for details of calculating the resistor values.



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# 2 Setup

This section describes how to properly use the TPSM82480EVM-002 evaluation module.

## 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+ and 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 and 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 and 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 connections. Use when the steady-state output current is less than 2 A; otherwise, use J3. |
| **J4, Pin 3 and 4 – S+ and S-** | Output voltage sense connections. Measure the output voltage at this point. |
| **J4, Pin 5 and 6 – GND** | Output return connections. |
| **JP4, Pin 1 and 3 – SS/TR and GND** | The SS/TR pin voltage appears on pin 1 of this header with a convenient ground on pin 3. |
| **JP4, Pin 2 TR-IN** | The TR-IN pin can be used to scale down a tracking-voltage. |
| **J6 – PG and GND** | The PG output appears on pin 1 of this header with a convenient ground on pin 2. |
| **J5 – TG and GND** | The TG output appears on pin 1 of this header with a convenient ground on pin 2. |
| **JP1 – ON, EN, OFF** | 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 – HIGH, VSEL, LOW** | 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 – PWM, MODE, PSM** | 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. |
| **JP5 – PG Pullup Voltage** | PG 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 PG pin to a different level. This externally applied voltage must remain below 6 V. |
| **JP6 – TG Pullup Voltage** | TG pin pullup voltage jumper. Place the supplied jumper on JP6 to connect the TG 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. |


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### 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 J4 or J3.

## 3 TPSM82480EVM-002 Test Results

The TPSM82480EVM-002 evaluation module was used to take the data in the TPSM82480 data sheet. See the data sheet (SLVSDT1) for the performance of this EVM.



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## 4 Board Layout

This section provides the TPSM82480EVM-002 board layout and illustrations. The Gerber files are available on the EVM product page: TPSM82480EVM-002.

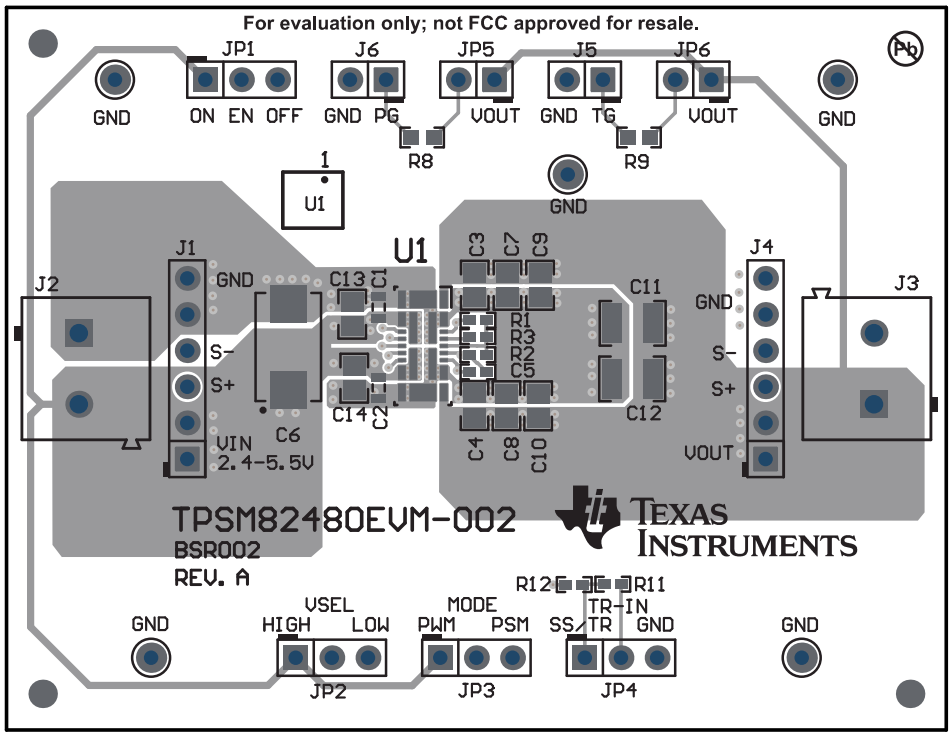



**Figure 1. Assembly Layer**

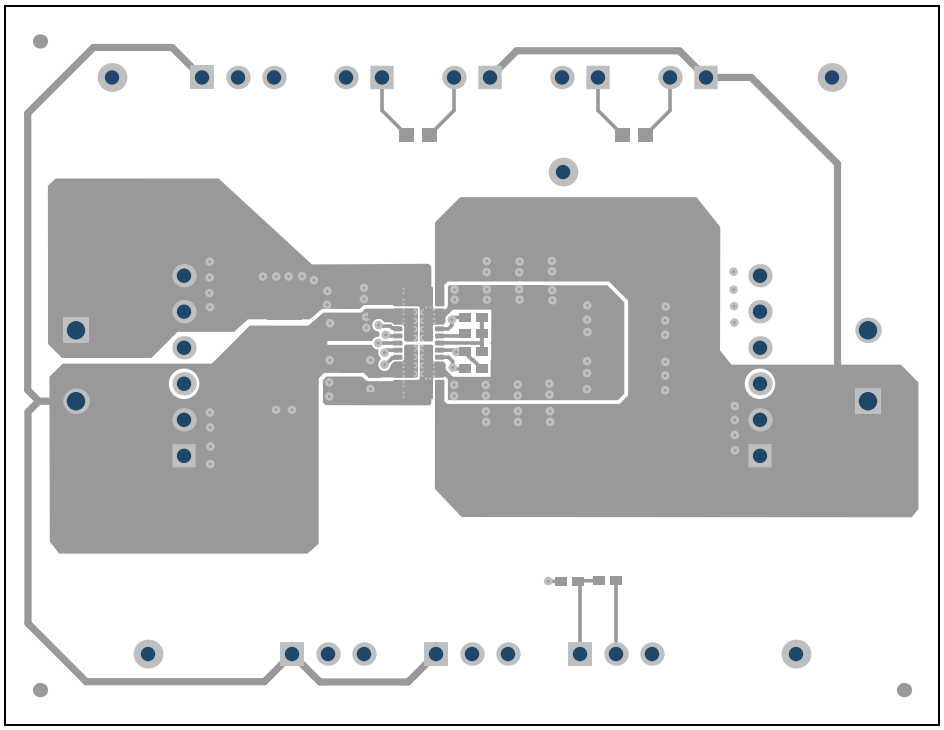


**Figure 2. Top Layer**


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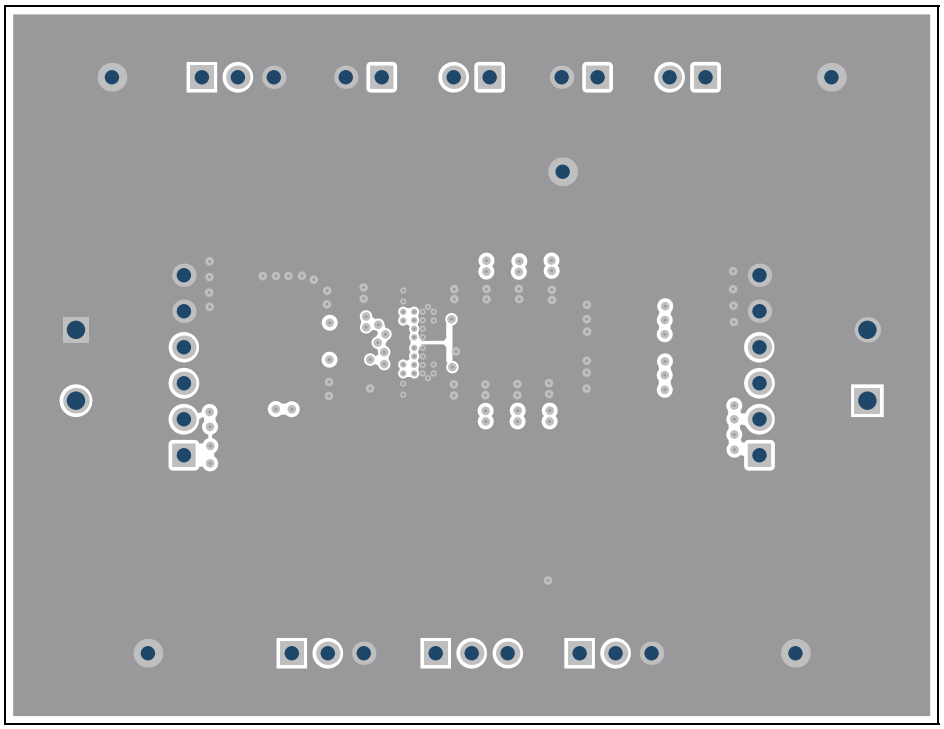


**Figure 3. Internal Layer 1**

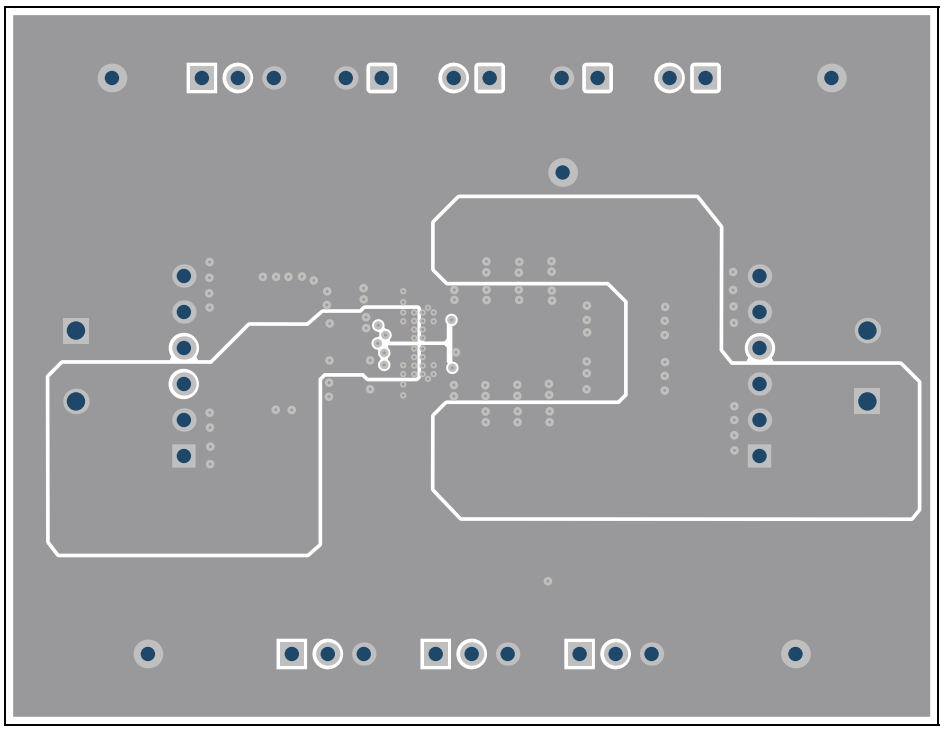


**Figure 4. Internal Layer 2**



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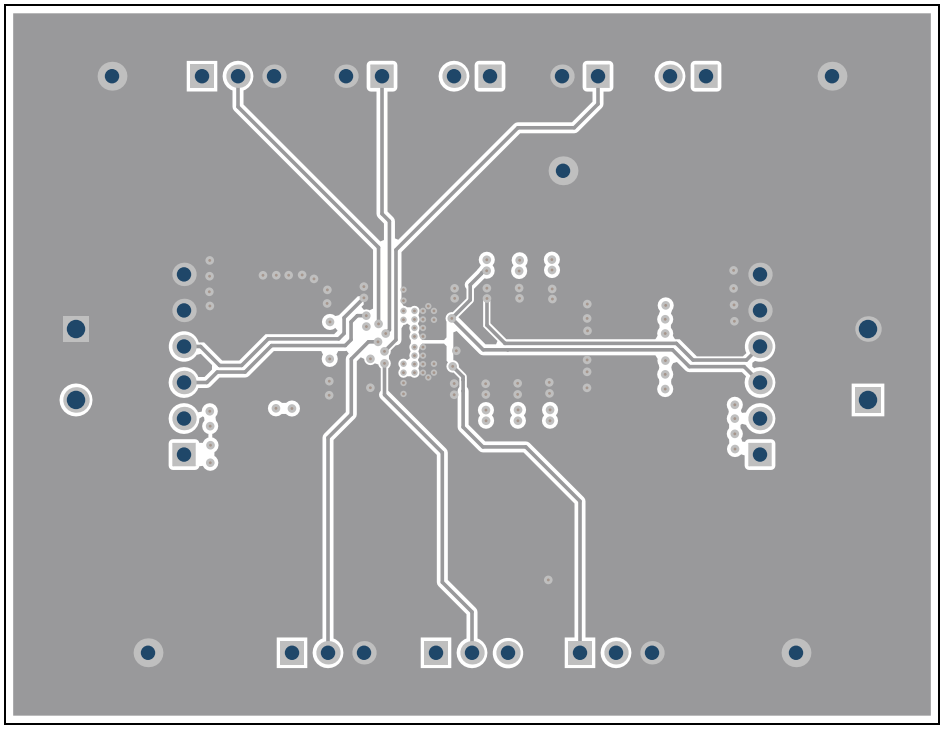


**Figure 5. Bottom Layer**


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# 5 Schematic and Bill of Materials

This section provides the TPSM82480EVM-002 schematic and bill of materials.

## 5.1 Schematic

Figure 6 illustrates the TPSM82480EVM-002 schematic.

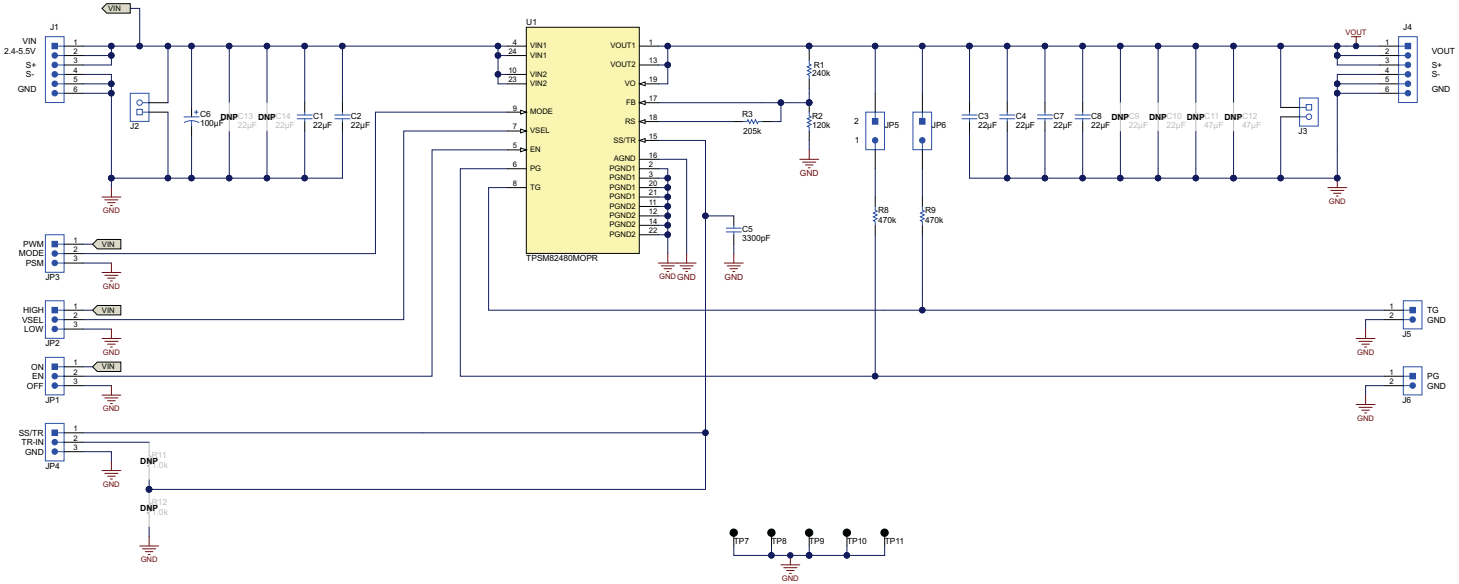



**Figure 6. TPSM82480EVM-002 Schematic**



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## 5.2 Bill of Materials

Table 3 lists the TPSM82480EVM-002 bill of materials.

**Table 3. TPSM82480EVM-002 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, C7, C8 | 22uF | CAP, CERM, 22uF, 25V, ±20%, X5R, 0805 | 0805 | GRM21BR61E226ME44 | Murata |
| 1 | C5 | 3300pF | CAP, CERM, 3300 pF, 50 V, ±10%, X7R, 0402 | 0402 | GRM155R71H332KA01D | Murata |
| 1 | C6 | 100uF | CAP, TA, 100uF, 20V, ±10%, 0.5 ohm, SMD | 7343-43 | 293D107X9020E2TE3 | Vishay-Sprague |
| 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 | R8, R9 | 470k | Resistor, Chip, 0.1W, 1% | 0603 | Std | Std |
| 1 | U1 | TPSM82480 | 2.4 - 5.5V, 6A, 2-Phase Step-Down Converter Module with Integrated Inductors | 7.9 mm x 3.6 mm | TPSM82480MOP | Texas Instruments |


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      **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.

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      **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.

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      **FCC Interference Statement for Class A EVM devices**

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- *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

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http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

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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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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.

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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.

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