TPS7A10EVM-004 Evaluation Module

User's Guide

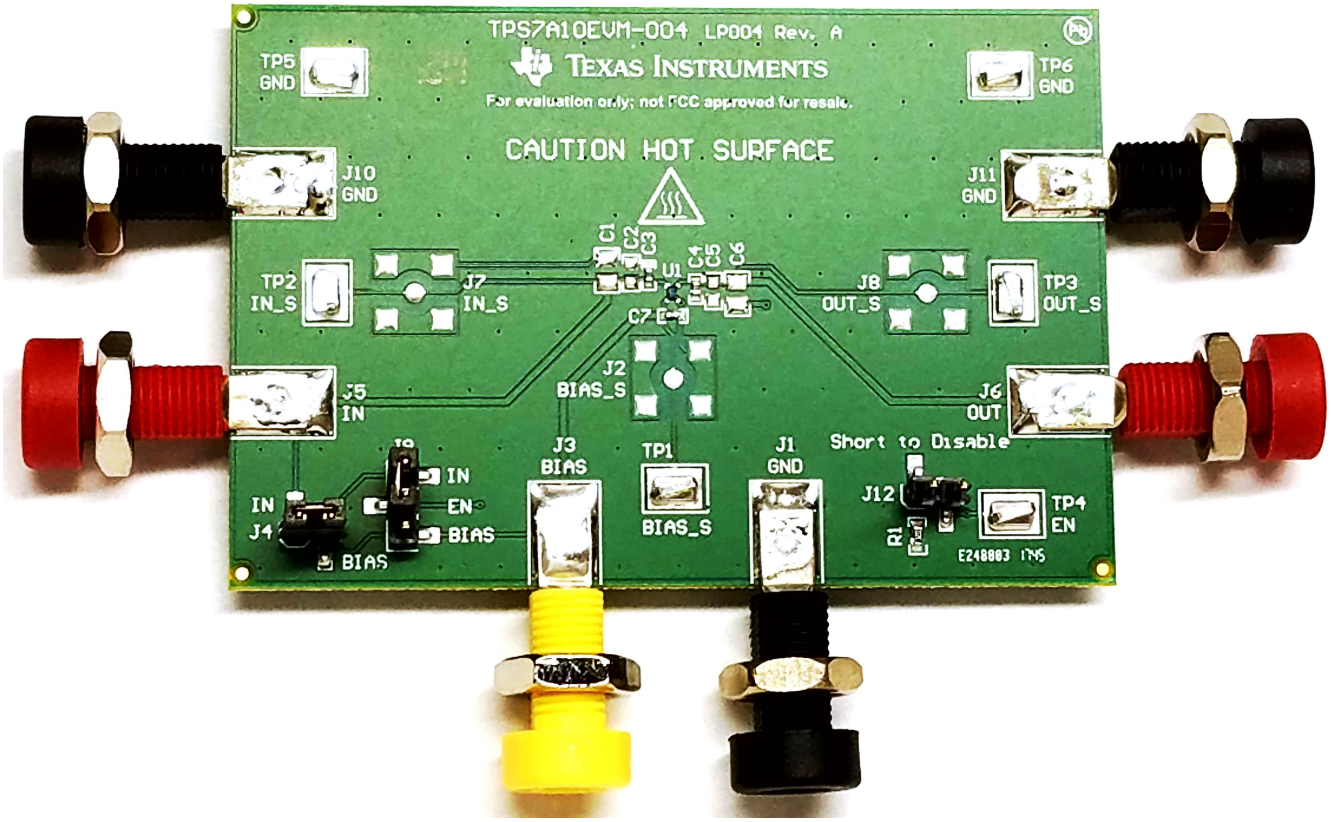
Literature Number: SBVU040
February 2018

TPS7A10EVM-004 Evaluation Module

This user's guide describes the operational use of the TPS7A10EVM-004 evaluation module (EVM) as a reference design for engineering demonstration and evaluation of the TPS7A10YKA low-dropout linear regulator (LDO). Setup and operating instructions, thermal and layout guidelines, a printed circuit board (PCB) layout, a schematic diagram, and a bill of materials (BOM) are included in this user's guide.

Throughout this document, the terms *demonstration kit*, *evaluation board*, and *evaluation module* are synonymous with the TPS7A10EVM-004.

The following related documents are available through the Texas Instruments website at www.ti.com.



Related Documentation

DEVICE	LITERATURE NUMBER
TPS7A10	SBVS314

1 Trademarks

All trademarks are the property of their respective owners.

2 Introduction

Texas Instruments' TPS7A10EVM-004 EVM helps design engineers evaluate the operation and performance of the TPS7A10 family of linear regulators for possible use in circuit applications. This particular EVM configuration contains a single linear regulator for handheld systems. The regulator is capable of delivering up to 300 mA to the load with ultra-low VIN to VOUT dropout voltage. For stability, use an output capacitor with a value between 2.2 µF and 47 µF.

2.1 Before You Begin

The following warnings and cautions are noted for the safety of anyone using or working close to the TPS7A10EVM-004. Observe all safety precautions.

Warning Warning Hot surface. Contact may cause burns. Do not touch.

CAUTION

The circuit module may be damaged by overtemperature. To avoid damage, monitor the temperature during evaluation and , as needed, for your system environment cool

CAUTION

Some power supplies can be damaged by application of external voltages. If using more than one power supply, check your equipment requirements and use blocking diodes or other isolation techniques, as needed, to prevent damage to your equipment.

CAUTION

The circuit module is not a finished product or electrical appliance. The module does not contain current or voltage thresholds for circuit protection. It must be used by qualified personnel with additional equipment for evaluation only.

3 EVM Setup

This section describes how to properly connect and set up the TPS7A10EVM-004, including the jumpers and connectors on the EVM board.

3.1 Input/Output Connectors and Jumper Descriptions

3.1.1 J1 – GND

Bias ground return connector.

3.1.2 J2 – BIAS_S

Bias sense pads for an SMA jack.

3.1.3 J3 – BIAS

Bias power-supply connector.

3.1.4 J4 – IN to BIAS short

Short this jumper to tie IN to BIAS.

3.1.5 J5 – IN

Input power-supply voltage connector. Twist together the positive input lead and ground return lead from the input power supply, and keep the leads as short as possible to minimize input inductance.

3.1.6 J6 – OUT

Regulated output voltage connector.

3.1.7 J7 – IN_S

Input sense pads for an SMA jack.

3.1.8 J8 – OUT_S

Output sense pads for an SMA jack.

3.1.9 J9 – EN

Output enable. To enable the output, connect a jumper to short VIN to EN or BIAS to EN.

3.1.10 J10 – GND

Input ground return connector.

3.1.11 J11 – GND

Output ground return connector.

3.1.12 J12 – Short to Disable

Short this jumper to disable the output. Depending on the current drive capability of the input or bias power supplies, removing a short on J9 may be required so that the power supplies do not over power the R1 pulldown resistor.

3.1.13 TP1 – BIAS_S

Bias sense test point.

3.1.14 TP2 – IN_S

Input sense test point.

3.1.15 TP3 – OUT_S

Output sense test point.

3.1.16 TP4 – EN

Enable test point.

3.1.17 TP5 – GND

Ground test point.

3.1.18 TP6 – GND

Ground test point.

3.2 Soldering Guidelines

To avoid damaging the integrated circuit (IC), use a hot-air system for any solder rework to modify the EVM for repair or other application reasons.

3.3 Equipment Connection

1. Set the input power supply to 3.3 V (maximum) and turn the power supply off.
2. Set the bias power supply to 5.5 V (maximum) and turn the power supply off.
3. Connect the positive voltage lead from the input power supply to IN at the J5 connector of the EVM.
4. Connect the ground lead from the input power supply to GND at the J10 connector of the EVM.
5. Connect the positive voltage lead from the bias power supply to BIAS at the J3 connector of the EVM.
6. Connect the ground lead from the bias power supply to GND at the J1 connector of the EVM.
7. Connect a 0-A to 300-mA load between OUT and GND.
8. Float J9 and short J12 to disable the output.

4 Operation

1. Turn on the power supplies.
2. Short J9 (the EN pin) to IN or BIAS and float J12 to enable the output.
3. Vary the respective load and input voltage for test purposes if necessary.

5 PCB Layout

Figure 1 to Figure 3 show the PCB layout for this EVM.

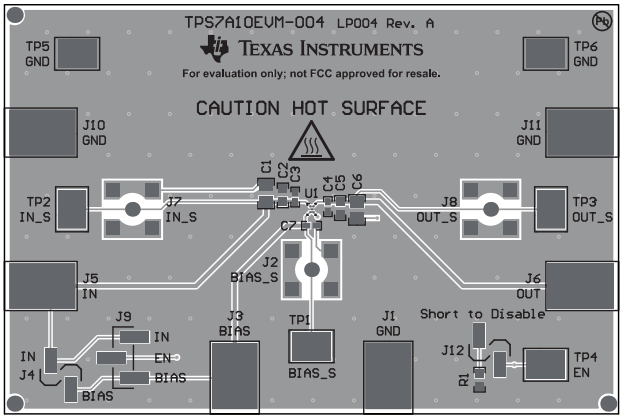


Figure 1. Assembly Layer

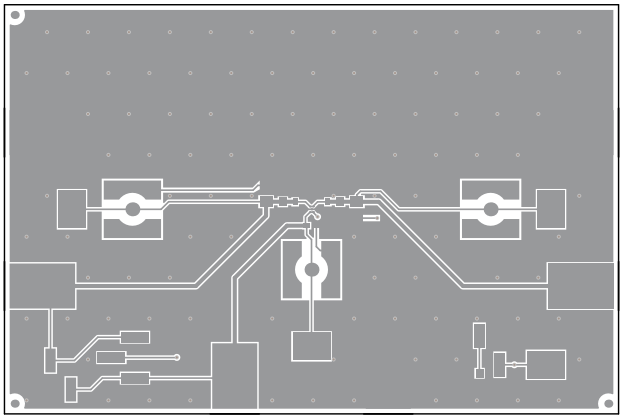


Figure 2. Top Layer Routing

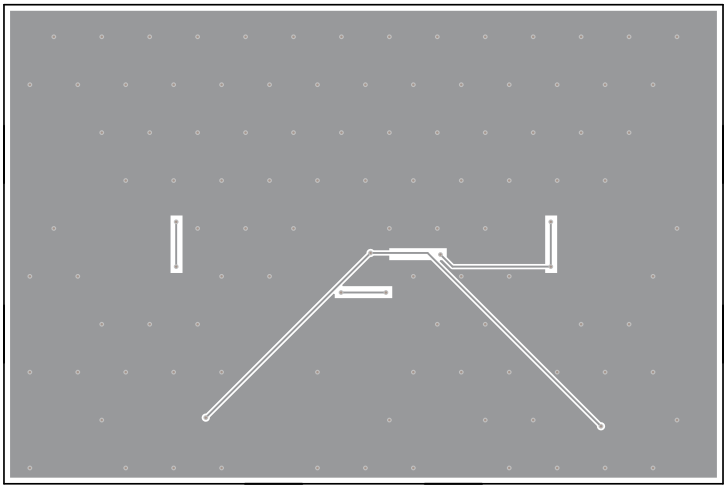


Figure 3. Bottom Layer Routing

6 Schematic

Figure 4 is the schematic for this EVM.

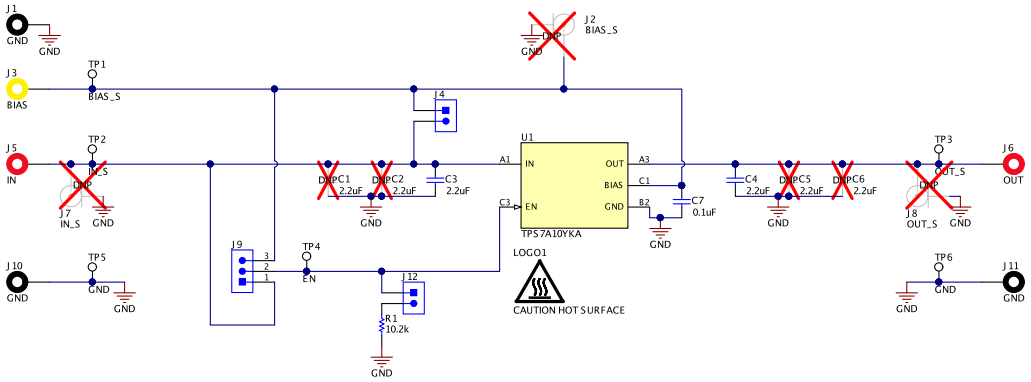


Figure 4. TPS7A10EVM-004 Schematic

7 Bill of Materials

Table 1 shows the BOM for this EVM.

Table 1. TPS7A10EVM-004 BOM(1)(2)(3)(4)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
!PCB1	1		Printed Circuit Board		LP004	Any		
C3, C4	2	2.2uF	CAP, CERM, 2.2 uF, 10 V, + /- 20%, X5R, 0402	0402	GRM155R61A225ME95	MuRata		
C7	1	0.1uF	CAP, CERM, 0.1 uF, 10 V, + /- 10%, X7R, 0402	0402	GRM155R71A104KA01D	MuRata		
J1, J10, J11	3		Standard Banana Jack, Insulated, Black	6092	6092	Keystone		
J3	1		BANANA JACK, 15A, Insulated, Nylon, Yellow	940x438x438 mil	108-0907-001	Cinch Connectivity		
J4, J12	2		Header, 2.54 mm, 2x1, Gold, R/A, SMT	Header, 2.54 mm, 2x1, R/A, SMT	878980204	Molex		
J5, J6	2		Standard Banana Jack, Insulated, Red	6091	6091	Keystone		
J9	1		Header, 100 mil, 3x1, Gold, SMT	Samtec_TSM-103-01-X-SV	TSM-103-01-L-SV	Samtec		
R1	1	10.2k	RES, 10.2 k, 1%, 0.1 W, 0603	0603	CRCW060310K2FKEA	Vishay-Dale		
SH-J1, SH-J2	2	1x2	Shunt, 100 mil, Gold plated, Black	Shunt	969102-0000-DA	3M	SNT-100-BK-G	Samtec
TP1, TP2, TP3, TP4, TP5, TP6	6		Test Point, Compact, SMT	Testpoint_Keystone_Compact	5016	Keystone		
U1	1		300 mA Low VIN, Low VOUT, Ultra-Low Dropout Regulator, YKA0005AFAF (-5)	YKA0005AFAF	TPS7A1011YKA	Texas Instruments		Texas Instruments
C1, C6	0	2.2uF	CAP, CERM, 2.2 uF, 10 V, + /- 20%, X7R, 0805	0805	GRM21BR71A225MA01 L	MuRata		
C2, C5	0	2.2uF	CAP, CERM, 2.2 uF, 10 V, + /- 10%, X7R, 0603	0603	GRM188R71A225KE15D	MuRata		
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A		
J2, J7, J8	0		Connector, SMA Jack, Vertical, Gold, SMD	SMA	142-0711-201	Cinch Connectivity		

(1) These assemblies are ESD sensitive; observe ESD precautions.
(2) These assemblies must be clean and free from flux and all contaminants. Do not use a no-clean flux.
(3) These assemblies must comply with workmanship standards according to IPC-A-610 Class 2.
(4) Unless otherwise noted in the Alternate Part Number or Alternate Manufacturer columns, all parts may be substituted with equivalents.

Evaluation Board/Kit Important Notice

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation board/kit 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. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and therefore may not meet the technical requirements of these directives or other related directives.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

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TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.**

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 1.1 V to 4.5 V and the output voltage range of 0.9 V to 3.6 V .

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 85° C. The EVM is designed to operate properly with certain components above 85° C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

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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2. 実験局の免許を取得後ご使用いただく。
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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:*

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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