

TPS25221 Evaluation Module

This user's guide describes the TPS25221 evaluation module (EVM). This guide contains the EVM schematic, bill of materials (BOM), assembly drawing, and top and bottom board layouts.

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Trademarks

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1 Introduction

The TPS25221 is an evaluation module (EVM) for Texas Instruments' family of power-distribution switches with adjustable current-limit. The EVM operates over a 2.5-V to 5.5-V range. An onboard jumper sets the output current-limit to either 1.3 A or 2.7 A. Test points provide convenient access to all critical node voltages.

The silkscreen outline on the PCB top-side encloses components found in a typical USB application.

The PCB top-side accepts a power-distribution switch in a SOT23-6 package; the PCB bottom side accepts a power-distribution switch in the smaller SON package with a thermal pad. These switches have an enable input, an overcurrent status output, and overtemperature shutdown.

1.1 Related Documentation from Texas Instruments

- [TPS25221 Precision Adjustable Current-Limited Power-Distribution Switches](#) datasheet

2 Electrical Specifications

The EVM meets the electrical specifications in [Table 1](#) over the recommended operating junction-temperature range of $-40^{\circ}\text{C} \leq T_j \leq 125^{\circ}\text{C}$ for the DBV (SOT23-6) and DRV (SON) package.

If the EVM current limit set to 2.7 A, the recommended max continuous current is 2 A according to TPS25221 specification. The user may also run 2.5-A continuous current on the EVM, but need make sure junction-temperature range $\leq 125^{\circ}\text{C}$ for long term reliability.

Table 1. EVM Electrical Specifications

Parameter	Condition	MIN	TYP	MAX	Unit
Input voltage, V_{IN}	J1	2.5	–	5.5	V
Short-circuit output current-limit, I_{LIMIT}	J3 shorting-jumper is absent, J2 is short circuited, TPS25221 is enabled		1.36		A
	J3 shorting-jumper is present, J2 is short circuited, TPS25221 is enabled		2.72		

2.1 Electrostatic Discharge

The EVM has been tested to IEC 61000-4-2. The level used was 8-kV contact discharge and 15-kV air discharge. Surges were applied to the EVM input and output. No damage to the TPS25221 was observed.

3 Schematic

3.1 EVM Options

Table 2. EVM Options

PSIL018	Device	Device Package	Enable
001	TPS25221DBV	SOT-23-6	Active High
002	TPS25221DRV	SON	Active High

3.2 Schematic

Figure 1 illustrates the EVM schematic.

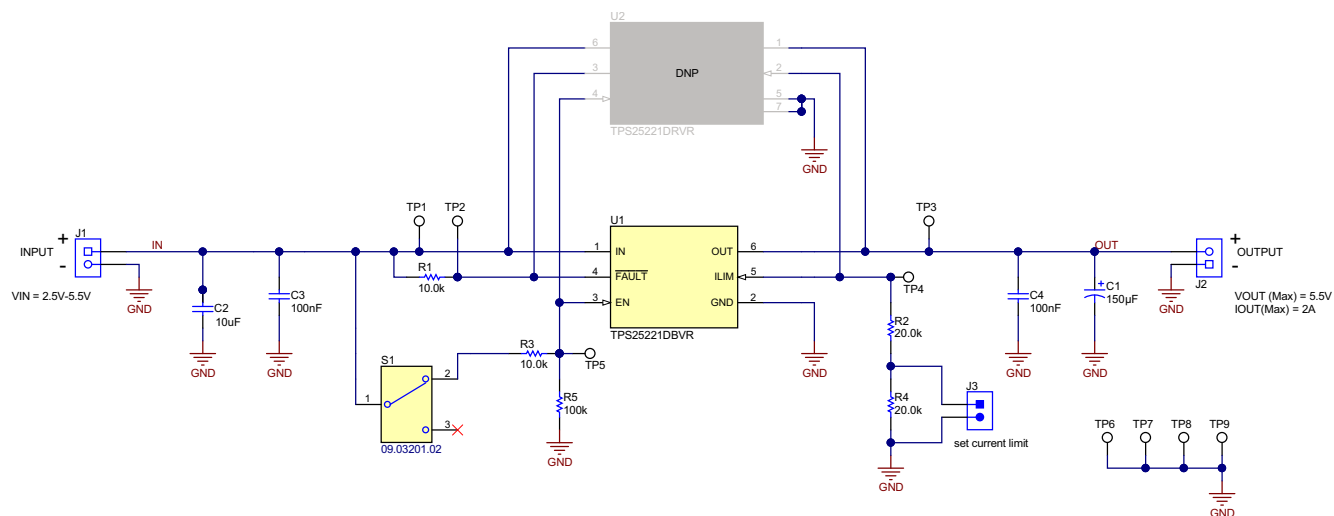


Figure 1. EVM Schematic

4 EVM Setup

4.1 Recommended Test Equipment

The following test equipment is recommended:

- Two-channel storage oscilloscope
- Current probe
- Voltage probe
- An adjustable power supply with a 2.5-V to 5.5-V output and a 10-A output current-limit
- Volt-ohm meter
- A passive or active load capable of handling 3 A

4.2 Measuring the Short-Circuit Output Current-Limit

TI recommends reading [TPS25221 Precision Adjustable Current-Limited Power-Distribution Switches](#) before using the EVM.

[Figure 2](#) shows the EVM test setup for measuring current-limit. Switch S1 enables the power-distribution switch into a short circuit for this measurement. For retry controllers, [Figure 3](#) shows the current waveform for the TPS25221DBVEVM with a shorting jumper populating header J3; [Figure 4](#) shows the current waveform with header J3 unpopulated.

[Figure 5](#) shows the current waveform for the TPS25221DRVEVM with a shorting jumper populating header J3; [Figure 6](#) shows the current waveform with header J3 unpopulated.

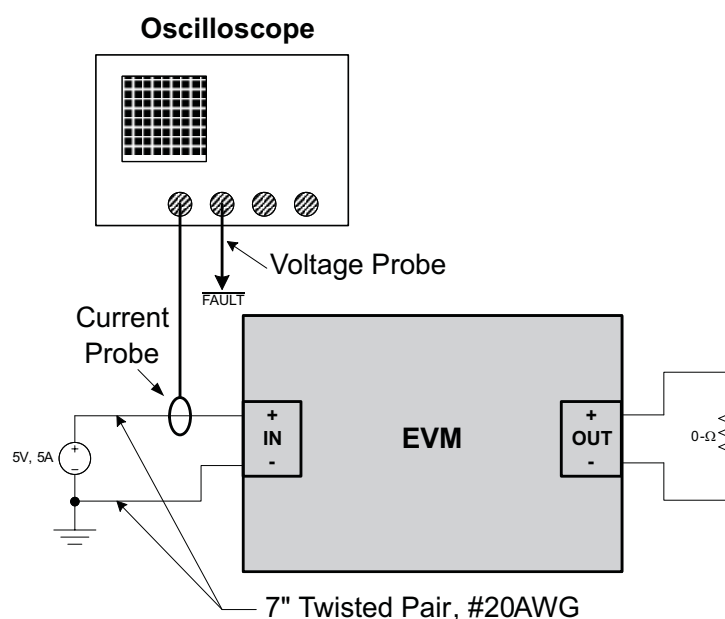


Figure 2. EVM Setup For Measuring Current-Limit

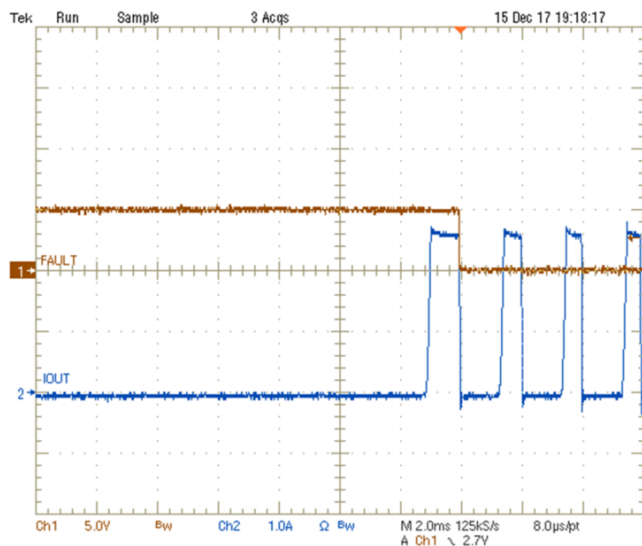


Figure 3. TPS25221DBVEVM Short-Circuit Output Current and FAULT Status With J3 Shorting Jumper Present

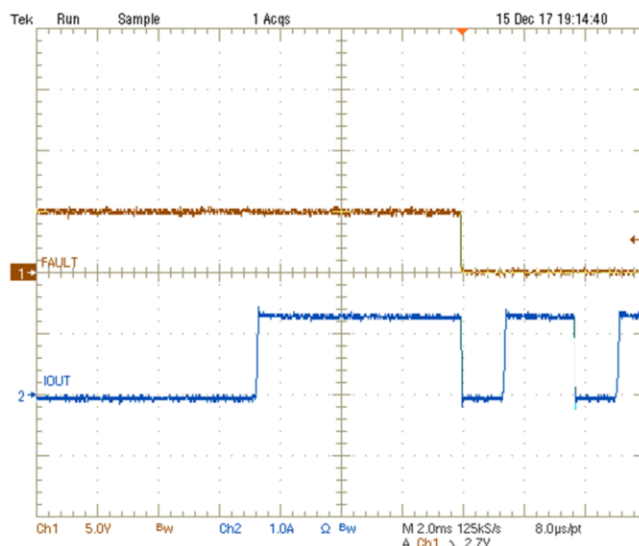


Figure 4. TPS25221DBVEVM Short-Circuit Output Current and FAULT Status With J3 Shorting Jumper Absent

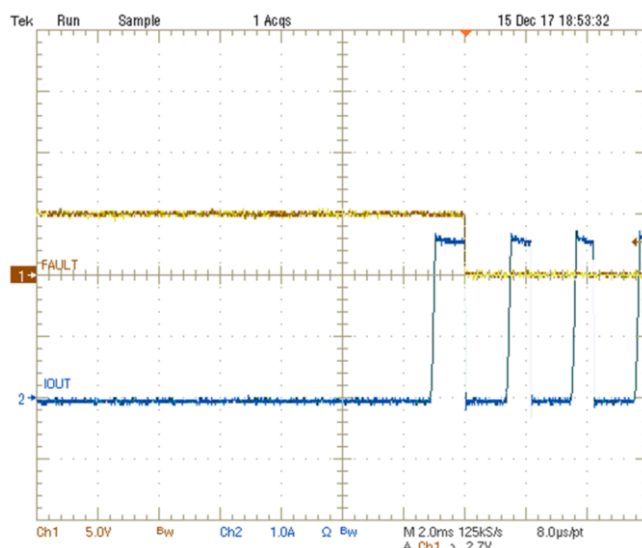


Figure 5. TPS25221DRVEVM Short-Circuit Output Current and FAULT Status With J3 Shorting Jumper Present

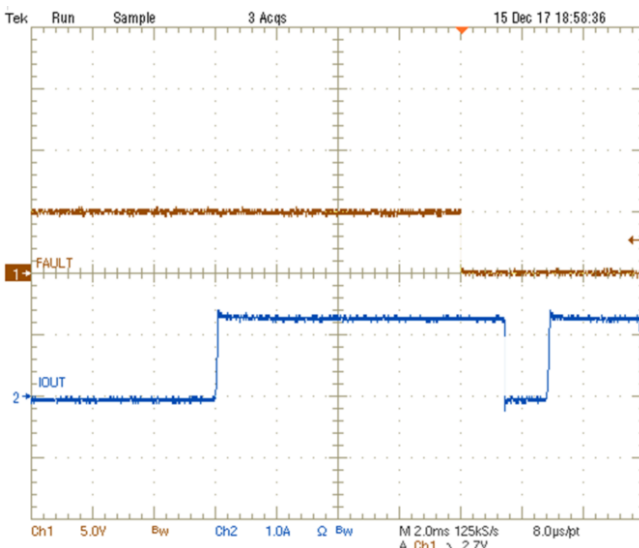


Figure 6. TPS25221DRVEVM Short-Circuit Output Current and FAULT Status With J3 Shorting Jumper Absent

4.3 Adjusting the Short-Circuit Output Current-Limit

The EVM provides two current-limit settings. If a different setting is required, populate header J3 with a shorting jumper and modify resistor R2 using the current limit resistor calculator, [TPS25221](#).

See [TPS25221 Precision Adjustable Current-Limited Power-Distribution Switches](#) datasheet for the worst-case current-limit variation.

5 Board Layout

Figure 7 through Figure 10 illustrate the PCB layout images.

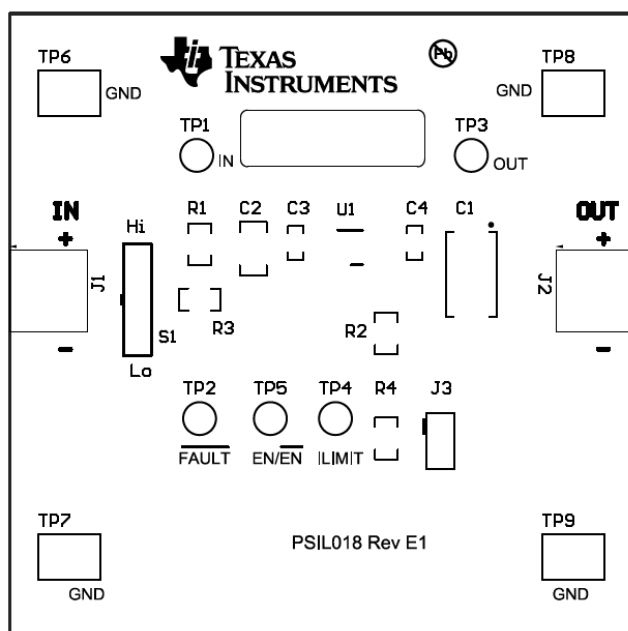


Figure 7. EVM Top Assembly

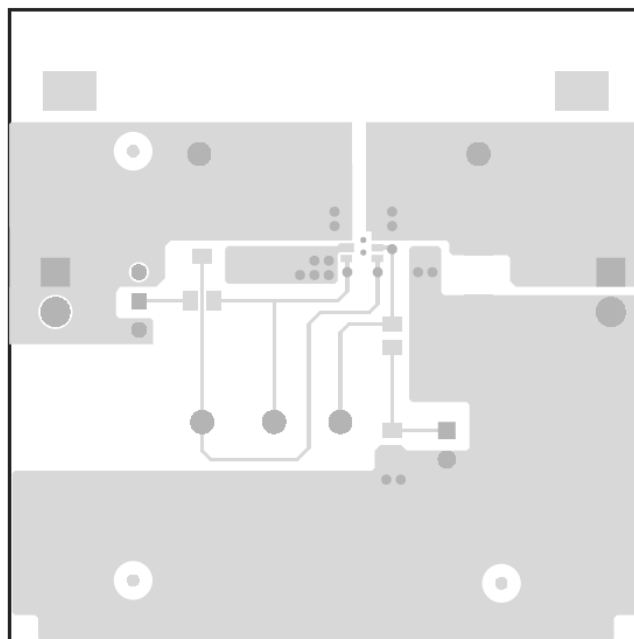


Figure 8. EVM Top-Side Layout

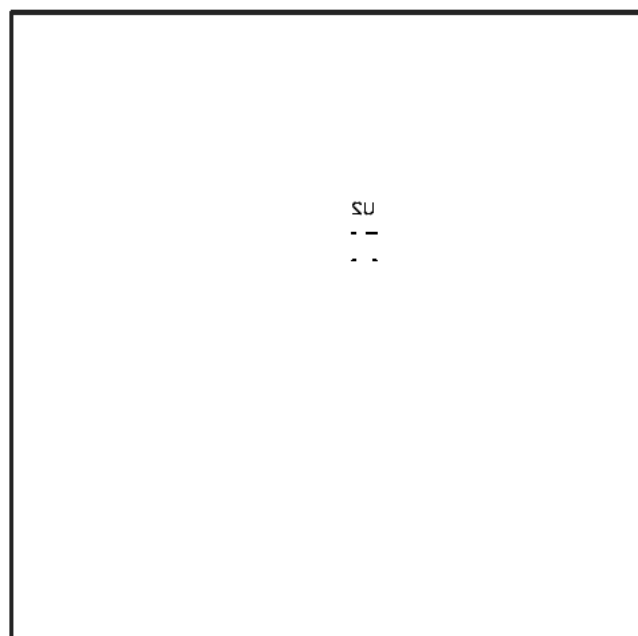


Figure 9. EVM Bottom Assembly

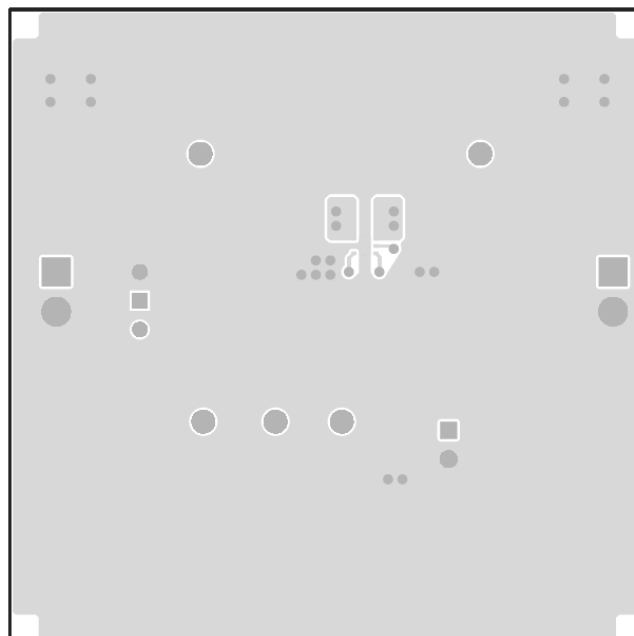


Figure 10. EVM Bottom-Side Layout

6 Bill of Materials

Table 3 lists the EVM BOM.

Table 3. EVM Bill of Materials ⁽¹⁾ ⁽²⁾ ⁽³⁾ ⁽⁴⁾ ⁽⁵⁾ ⁽⁶⁾

Quantity		Designator	Value	Description	Part Number	Manufacturer
001	002					
1	1	C1	150 uF	CAP, TA, 150 μ F, 10 V, \pm 10%, 0.1 ohm, SMD	T495D157K010ATE100	Kemet
1	1	C2	10 uF	CAP, CERM, 10 μ F, 16 V, \pm 10%, X7R, 1206	GRM31CR71C106KAC7L	MuRata
2	2	C3, C4	0.1 uF	CAP, CERM, 0.1 μ F, 16 V, \pm 10%, X7R, 0603	GRM188R71C104KA01D	MuRata
3	3	FID1, FID2, FID3		Fiducial mark. There is nothing to buy or mount.	N/A	N/A
2	2	J1, J2		Terminal Block, 3.5mm Pitch, 2x1, TH	ED555/2DS	On-Shore Technology
1	1	J3		Header, 100mil, 2x1, Tin, TH	PEC02SAAN	Sullins Connector Solutions
1	1	LBL1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	THT-14-423-10	Brady
2	2	R1, R3	10.0 k	RES, 10.0 k, 1%, 0.125 W, 0805	CRCW080510K0FKEA	Vishay-Dale
2	2	R2, R4	20.0 k	RES, 20.0 k, 1%, 0.125 W, 0805	CRCW080520K0FKEA	Vishay-Dale
1	1	R5	100 k	RES, 100 k, 1%, 0.1 W, 0603	CRCW0603100KFKEA	Vishay-Dale
1	1	S1		Switch, SPDT, Slide, On-On, 2 Pos, TH	09.03201.02	EAO Switch
5	5	TP1, TP2, TP3, TP4, TP5	White	Test Point, Miniature, White, TH	5002	Keystone
4	4	TP6, TP7, TP8, TP9	SMT	Test Point, Compact, SMT	5016	Keystone
1	0	U1		Precision Adjustable Current-Limited Power-Distribution Switch, DBV0006A (SOT-23-6)	TPS25221DBVR	Texas Instruments
0	1	U2		Precision Adjustable Current-Limited Power-Distribution Switch, DRV0006A (WSON-6)	TPS25221DRVR	Texas Instruments

- ⁽¹⁾ These assemblies are ESD sensitive, observe ESD precautions.
- ⁽²⁾ These assemblies must be clean and free from flux and all contaminants. Use of no clean flux is not acceptable.
- ⁽³⁾ These assemblies must comply with workmanship standards IPC-A-610 Class 2.
- ⁽⁴⁾ Ref designators marked with an asterisk ("**") cannot be substituted. All other components can be substituted with equivalent MFG's components.
- ⁽⁵⁾ Attach a rubber bumper to each corner of the PCB.
- ⁽⁶⁾ Insert shorting jumper on header J2.

Revision History

Changes from Original (January 2018) to A Revision	Page
• Updated <i>Electrical Specifications</i> section	2
• Updated Figure 1	3
• Updated <i>Bill of Materials</i> table	7

STANDARD TERMS FOR EVALUATION MODULES

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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:

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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/sds/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。

<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html>

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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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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4.2 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.

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