TPS7B63xx-Q1 Evaluation Module

This user's guide describes the characteristics, operation, and use of the TPS7B63xx-Q1 EVM evaluation module (EVM). Throughout this document, TPS7B63xx-Q1 refers to both the TPS7B6350-Q1 and TPS7B6333-Q1 devices. A complete schematic diagram, printed-circuit board layouts, and bill of materials are also included.

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1 Introduction

The Texas Instruments TPS7B63xx-Q1 evaluation module (EVM) helps designers evaluate the operation and performance of the TPS7B6333-Q1 and TPS7B6350-Q1, 300-mA watchdog LDO. For more information on the TPS7B63xx-Q1 device, see the data sheet (SLVSDU9).

The EVM contains one linear regulator (see Table 1).

Table 1. Device and Package Configurations

Designator	Devices	Package
U1	TPS7B6350QPWPRQ1 or TPS7B6333QPWPRQ1	16-pin HTSSOP

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2 Connector Descriptions, Setup, and Operation

This section describes the jumpers and connectors on the EVM as well as how to properly connect, setup, and use the TPS7B63xx-Q1 EVM.

2.1 Input and Output (I/O) Connector Descriptions

J1/VIN connector – This connector directly connects the regulator IN pin to the input power supply. Left open, this connector could protect the regulator from input reverse polarity connection.

J2/PGADJ connector – This connector sets the regulator PG (power good) threshold. Connect pin 3 and pin 4 to set the threshold to default. Connect pin 1 and pin 2 to set the threshold to 4 V (for TPS7B6350-Q1).

J3/EN/FSEL/WTS connector – This connector sets the regulator EN, FSEL, and WTS status.

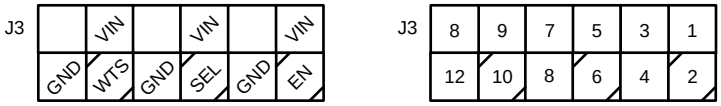


Figure 1. Connector J3

- **EN**: Connect pin 1 and pin 2 to enable the regulator. Connect pin 2 and pin 4 to disable the regulator.
- **FSEL**: Connect pin 5 and pin 6 to set FSEL to HIGH. Connect pin 6 and pin 8 to set FSEL to LOW.
- **WTS**: Connect pin 9 and pin 10 to select standard watchdog. Connect pin 10 and pin 12 to select window watchdog.

J4/$\overline{\text{WD_EN}}$ connector – This connector sets the watchdog function working status. Connect pin 1 and pin 2 to disable the watchdog function. Connect pin 2 and pin 3 to enable the watchdog function.

J5/PG connector – This connector connects the regulator PG pin to the OUT pin through a 10-kΩ resistor. Leave this connector open if the PG function is not used.

J6/WDO connector –This connector connects the watchdog WDO pin to the OUT pin through a 10-kΩ resistor. Leave this connector open if the watchdog function is not used.

J7/ROSC connector – This connector sets the duration of the watchdog window. Connect the corresponding pins to select the required watchdog period.

J8/DELAY connector – This connector sets the regulator power good delay time. Connect the corresponding pins to select the required delay time.

J9/WRS connector – This connector sets the open window and closed window ratio (window watchdog only). Connect pin 1 and pin 2 to set the open/closed window ratio to 8:1. Connect pin 2 and pin 3 to set the open/closed window ratio to 1:1.

J10/WDO-PG connector – This connector directly connects the watchdog WDO pin to the regulator RST pin.

J11/GND connector – This connector directly connects the regulator GND pin to the ground of the input power supply. Connecting an ammeter to pin 1 and pin 2 allows measurement of the regulator ground current.

TP1/VIN – This test point provides an input power supply to power the EVM.

TP2/OUT – This test point provides the output of the regulator to allow the user to attach a load to the EVM.

TP3/VIN – This test point allows measurement of the input voltage at the regulator IN pin.

TP4/OUT – This test point allows measurement of the output voltage at the regulator OUT pin.

TP5/EN - This test point allows measurement of the enable voltage at the regulator EN pin.

TP6/PGADJ – This test point allows measurement of the voltage at the regulator PGADJ pin.

TP7/$\overline{\text{WD_EN}}$ – This test point allows measurement of the watchdog enable voltage at the $\overline{\text{WD_EN}}$ pin.

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TP8/WDO – This test point allows measurement of the watchdog output signal at the WDO pin.

TP9/WD – This test point allows measurement of the watchdog service signal at the WD pin.

TP10/PG – This test point allows measurement of the power good voltage at the regulator PG pin.

TP11/WTS – This test point allows measurement of the signal at the WTS pin.

TP12/FSEL – This test point allows measurement of the signal at the FSEL pin.

TP13/ROSC – This test point allows measurement of the voltage at the ROSC pin.

TP14/WRS – This test point allows measurement of the signal at the WRS pin.

TP15/DELAY – This test point allows measurement of the voltage at the regulator DELAY pin.

TP16/TP17/TP18/TP19/TP20/TP21/GND – GND is the ground return for the regulator. The EVM provides TP16 and TP17, two GND test points to power up the EVM, to connect the load. The EVM also provides TP18 to TP21, four GND test points as the ground reference for the signal or voltage test point.

2.2 Bench Setup

The input voltage range for the watchdog LDO TPS7B63xx-Q1 is 4 V to 40 V. The EVM can support up to 300-mA load current. Use the following steps to set up the test bench for the EVM:

1. Set the power supply for input (VIN) to 12 V and set the current limit to 1 A.
2. Set the EVM board:
   (a) Regulator only. Connect EN to VIN (J3), and connect $\overline{\text{WD_EN}}$ to OUT (J4).
   (b) Watchdog enabled. Connect EN to VIN (J3), and connect $\overline{\text{WD_EN}}$ to GND (J4).
3. Connect the power supply positive lead to the VIN (TP1) and the negative lead to GND (TP16).
4. Apply the load between OUT (TP2) and GND (TP17).

2.3 Operation

The TPS7B63xx-Q1 powers up after the VIN voltage exceeds the UVLO rising threshold.

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3 Board Layout

Figure 2, Figure 3, and Figure 4 illustrate the PCB footprints for the TPS7B6350-Q1 device.

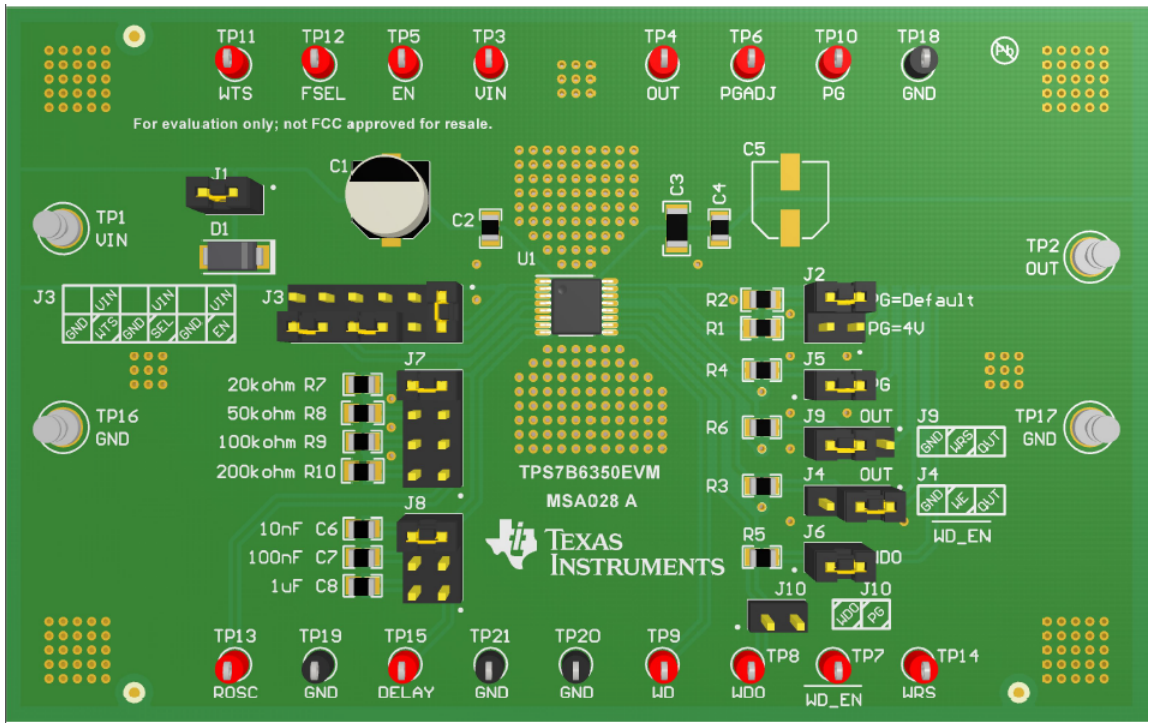


Figure 2. TPS7B6350EVM Component Placement (Assembly Top View)

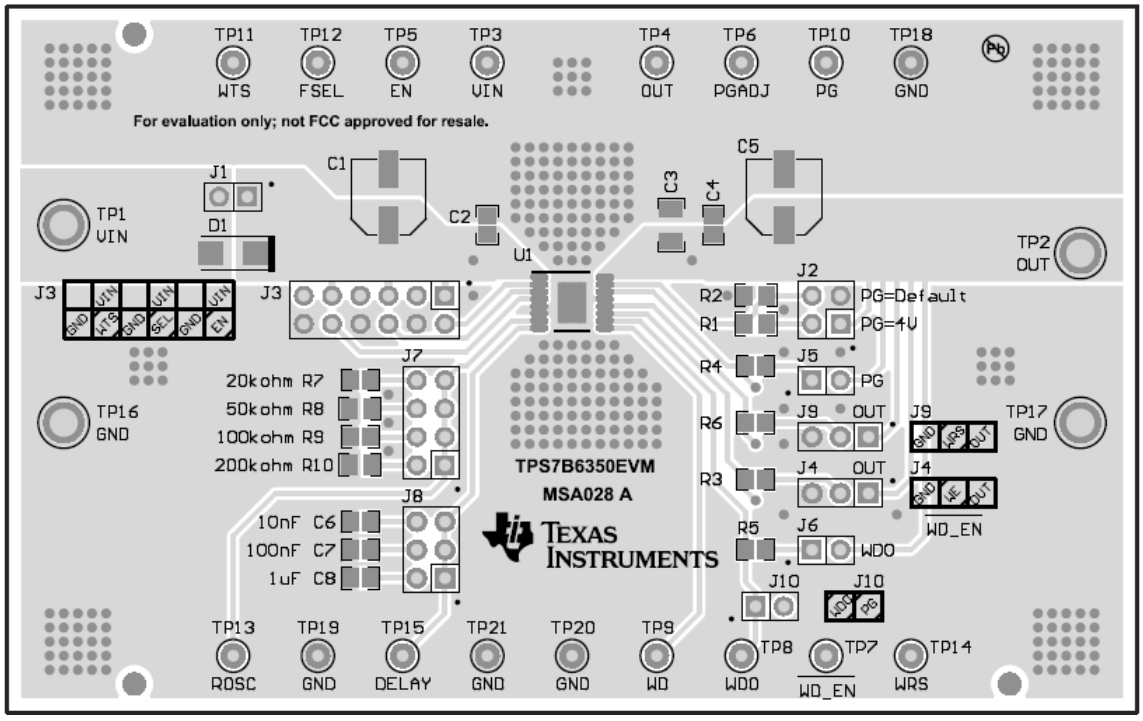


Figure 3. TPS7B6350EVM Top Layer Routing

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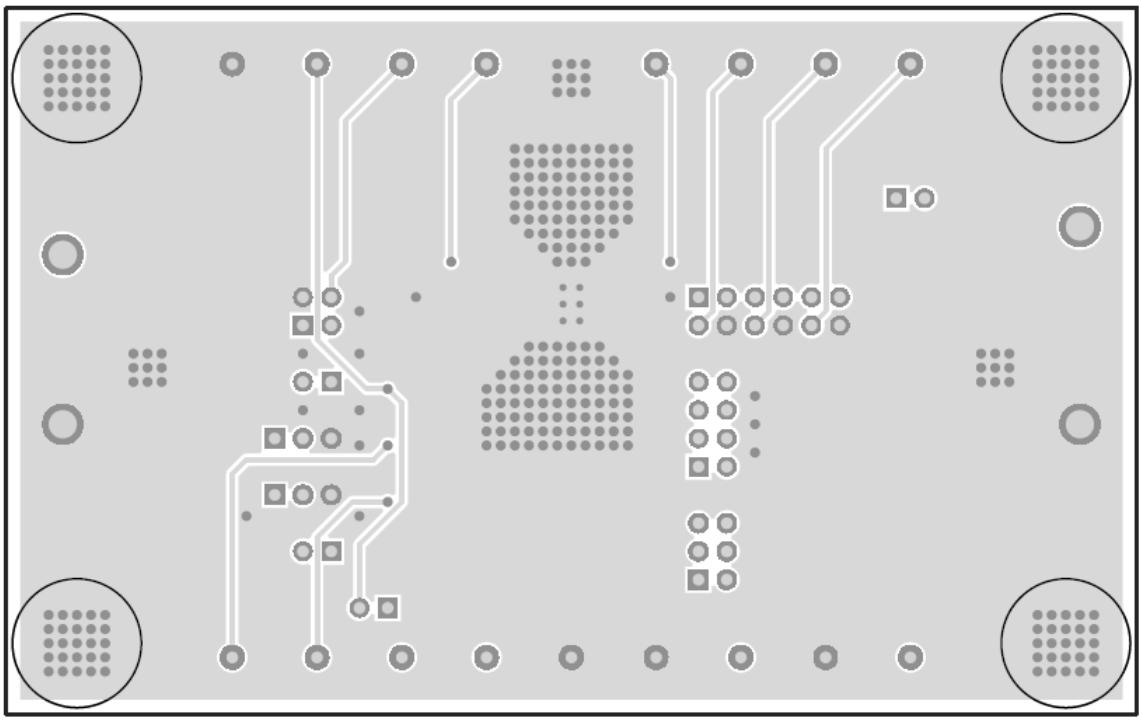
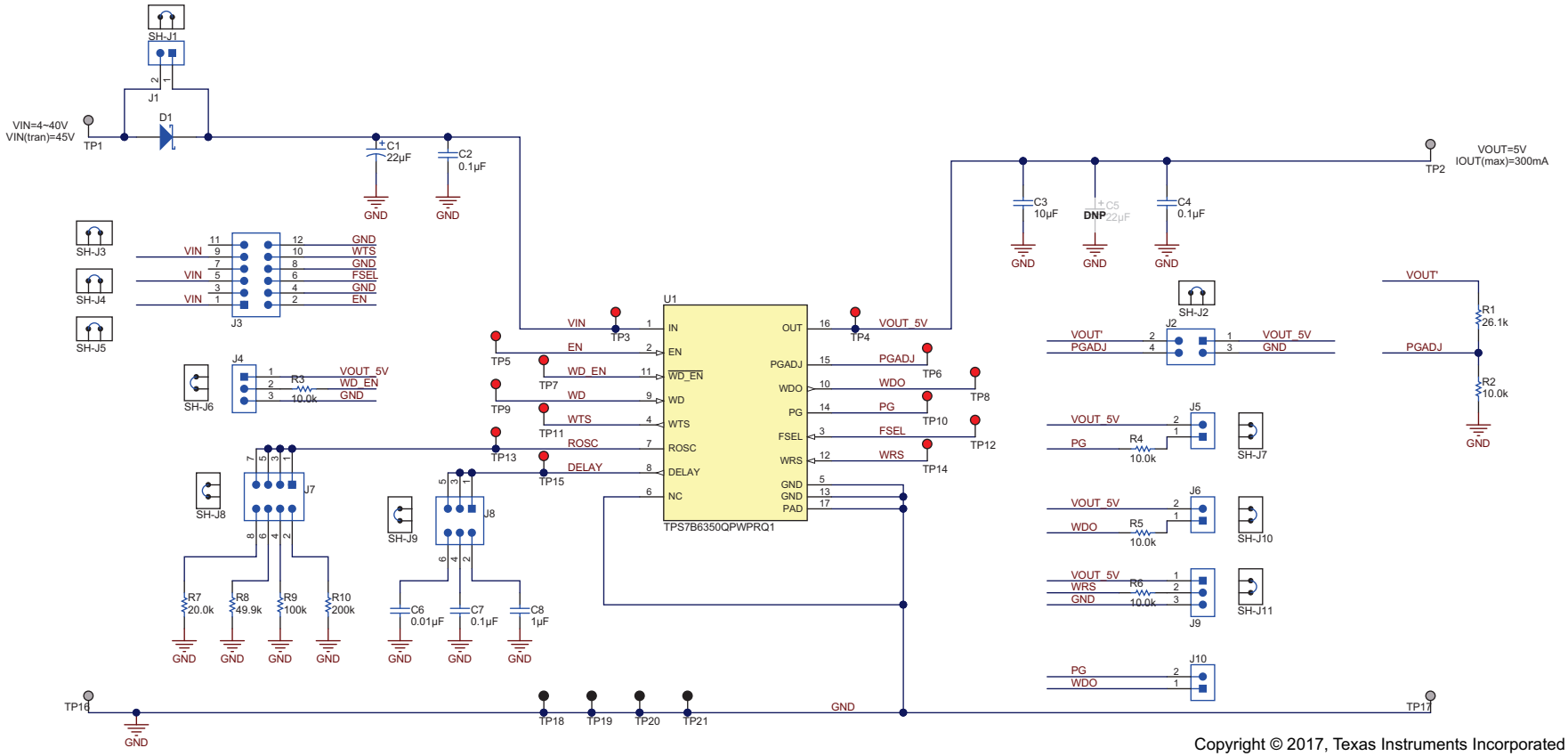


Figure 4. TPS7B6350EVM Bottom Layer Routing

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4 Schematic and Bill of Materials

Figure 5 illustrates the EVM schematic.



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Figure 5. TPS7B6350EVM Schematic

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Table 2 lists the EVM BOM.

Table 2. TPS7B6350EVM Bill of Materials

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
!PCB1	1		Printed Circuit Board		TPS7B6350EVM	Any
C1	1	22uF	CAP, AL, 22 µF, 50 V, +/- 20%, 0.88 ohm, SMD	SMT Radial D	EEE-FK1H220P	Panasonic
C2, C4	2	0.1uF	CAP, CERM, 0.1 µF, 50 V, +/- 10%, X7R, 0805	0805	GRM21BR71H104KA01L	Murata
C3	1	10uF	CAP, CERM, 10 µF, 25 V, +/- 10%, X7R, 1206	1206	GRM31CR71E106KA12L	Murata
C6	1	0.01uF	CAP, CERM, 0.01 µF, 50 V, +/- 10%, X7R, 0805	0805	GRM216R71H103KA01D	Murata
C7	1	0.1uF	CAP, CERM, 0.1 µF, 16 V, +/- 10%, X7R, 0805	0805	GRM219R71C104KA01D	Murata
C8	1	1uF	CAP, CERM, 1 µF, 16 V, +/- 10%, X7R, 0805	0805	GRM21BR71C105KA01L	Murata
D1	1	60V	Diode, Schottky, 60 V, 2 A, SMA	SMA	B260A-13-F	Diodes Inc.
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone
J1, J5, J6, J10, J11	5		Header, 100mil, 2x1, Gold, TH	2x1 Header	TSW-102-07-G-S	Samtec
J2	1		Header, 100mil, 2x2, Gold, TH	2x2 Header	TSW-102-07-G-D	Samtec
J3	1		Header, 100mil, 6x2, Gold, TH	6x2 Header	TSW-106-07-G-D	Samtec
J4, J9	2		Header, 100mil, 3x1, Gold, TH	3x1 Header	TSW-103-07-G-S	Samtec
J7	1		Header, 100mil, 4x2, Gold, TH	4x2 Header	TSW-104-07-G-D	Samtec
J8	1		Header, 100mil, 3x2, Gold, TH	3x2 Header	TSW-103-07-G-D	Samtec
R1	1	26.1k	RES, 26.1 k, 0.1%, 0.125 W, 0805	0805	RT0805BRD0726K1L	Yageo America
R2	1	10.0k	RES, 10.0 k, 0.1%, 0.125 W, 0805	0805	RT0805BRD0710KL	Yageo America
R3, R4, R5, R6	4	10.0k	RES, 10.0 k, 1%, 0.125 W, 0805	0805	CRCW080510K0FKEA	Vishay-Dale
R7	1	20.0k	RES, 20.0 k, 1%, 0.125 W, 0805	0805	CRCW080520K0FKEA	Vishay-Dale
R8	1	49.9k	RES, 49.9 k, 1%, 0.125 W, 0805	0805	CRCW080549K9FKEA	Vishay-Dale
R9	1	100k	RES, 100 k, 1%, 0.125 W, 0805	0805	CRCW0805100KFKEA	Vishay-Dale
R10	1	200k	RES, 200 k, 1%, 0.125 W, 0805	0805	CRCW0805200KFKEA	Vishay-Dale
TP1, TP2, TP16, TP17	4	Double	Terminal, Turret, TH, Double	Keystone1502-2	1502-2	Keystone
TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15	13	Red	Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone
TP18, TP19, TP20, TP21	4	Black	Test Point, Miniature, Black, TH	Black Miniature Testpoint	5001	Keystone
U1	1		300-mA 40-V High-Voltage Ultralow Quiescent-Current Watchdog LDO, PWP0016J	PWP0016J	TPS7B6350QPWPRQ1	Texas Instruments
C5	0	22uF	CAP, AL, 22 µF, 25 V, +/- 20%, 1 ohm, SMD	SMT Radial D	EEE-FC1E220P	Panasonic
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A

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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.

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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.

      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.

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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*

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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.

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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*

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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.

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.

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