TLV713xxPEVM-171 Evaluation Module

This user's guide describes the operational use of the TLV713xxPEVM-171 Evaluation Module (EVM) as a reference design for engineering demonstration and evaluation of the TLV713xxP, low-dropout linear regulator (LDO). Included in this user's guide are setup instructions, a schematic diagram, layout, thermal guidelines, a bill of materials, and test results.

1 Introduction

TI's TLV713xxPEVM-171 helps design engineers evaluate the operation and performance of the TLV713xxP family of linear regulators for possible use in their own circuit application. This particular EVM configuration contains a single linear regulator with low Iq, high power supply rejection ratio (PSRR) in a small 1-mm × 1-mm DQN package. The regulator is capable of delivering up to 150 mA to the load depending on the input-output power dissipation across the part which can be minimized because of the low dropout voltage. The output capacitor for the TLV713xxP must be 1 µF (effective minimum) for stability.

2 Setup

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

2.1 Input/Output Connectors and Jumper Descriptions

2.1.1 J1 – VIN

Input power supply voltage connector. Twist the positive input lead and ground return lead from the input power supply and keep them as short as possible to minimize EMI transmission. Add additional bulk capacitance between J1 and J2 if the supply leads are greater than six inches. For example, an additional 47-µF electrolytic capacitor connecting J1 to ground improves the transient response of the TLV713xxP while eliminating unwanted ringing on the input due to long wire connections.

2.1.2 J2 – GND

Return connector for the input power supply.

2.1.3 J3 – OUT

Regulated output voltage connector.

2.1.4 J4 – GND

Output ground return connector.

2.1.5 JP1 – EN

Output enable. To enable the output, connect a jumper to short the V_{IN} pin 1 to the EN center pin 2. To disable the output, connect a jumper to short EN pin 2 to GND pin 3. EN is pulled up to V_{IN} through resistor R1 when JP1 is not connected.

2.2 Soldering Guidelines

Any solder re-work to modify the EVM for the purpose of repair or other application reasons must be performed using a hot-air system to avoid damaging the integrated circuit (IC).

2.3 Equipment Interconnect

- Set the input power supply to 5.5 V(max). Turn the power supply off. Connect the positive voltage lead from input power supply to V_{IN}, at the J1 connector of the EVM. Connect the ground lead from the input power supply to GND at the J2 connector of the EVM.
- Connect a 0–150-mA load between the output, OUT, at connector J3, and ground, GND, at connector J4.
- Disable the output by jumping JP1, the EN pin to the OFF pin.

3 Operation

- Turn on the power supply.
- Enable the output by jumping JP1, the EN pin to the ON pin.
- Vary the respective load and input voltage as necessary for test purposes.

4 Test Results

This section provides typical performance waveforms for the EVM. Actual performance data can be affected by measurement techniques and environmental variables; therefore, these curves are presented for reference and may differ from actual results obtained by some users.

4.1 Turn-on Waveform

Figure 1 shows the turn-on characteristic where 3 V is applied to V_{IN}. The output drives a 12-Ω load (full load).

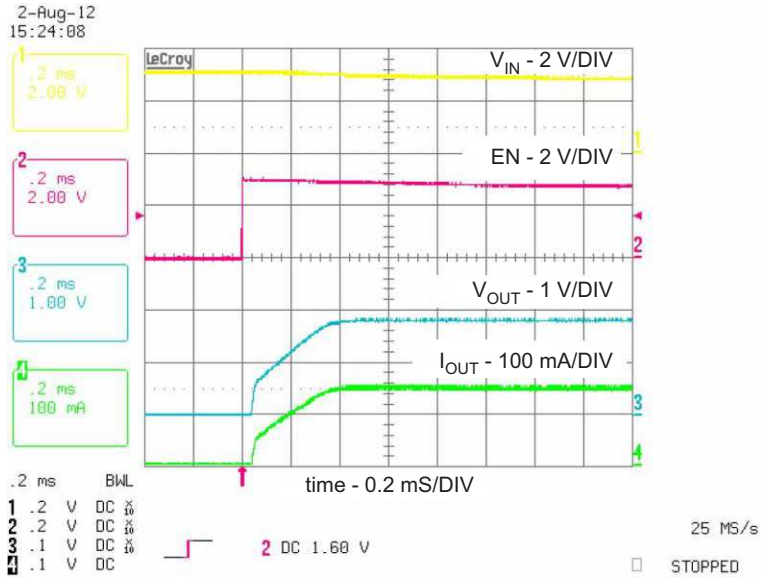


Figure 1. Turn-on Waveforms into Full Load (12 Ω) of the TLV71318PEVM-171

4.2 Turn-off Waveform

Figure 2 shows the turn-off characteristic where 3 V is applied to V_{IN}. The output drives a 12-Ω load.

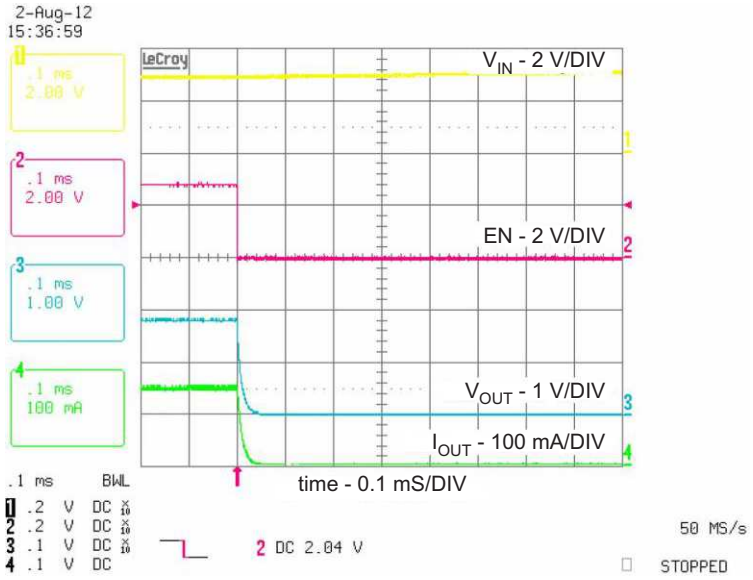


Figure 2. Turn-off Waveforms of the TLV71318PEVM-171

4.3 Load Transient

Figure 3 shows the load transient response for a load step transient from 10 mA to 150 mA where 3 V is applied to V_{IN}.

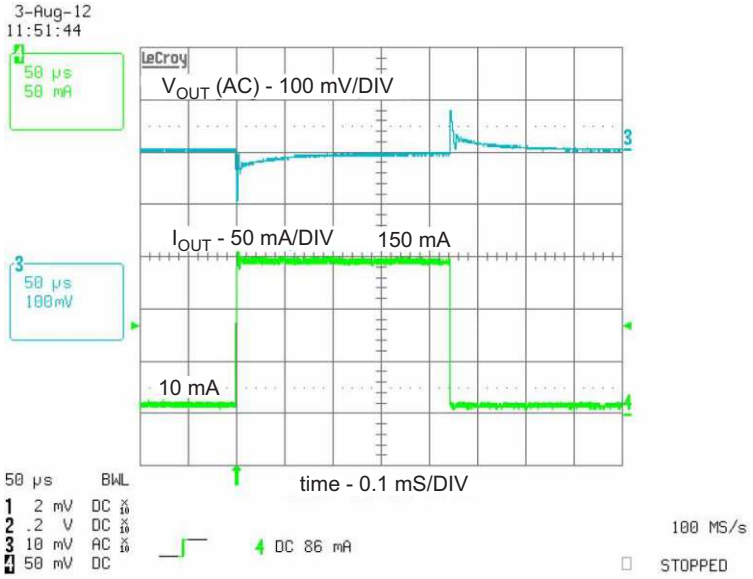


Figure 3. Load Step and Transient Response of the TLV71318PEVM-171

4.4 PSRR

Figure 4 shows the PSRR of the TLV71318EVM-171 at different load currents and Figure 5 shows the PSRR of the TLV71318PEVM-171 at different input voltages.

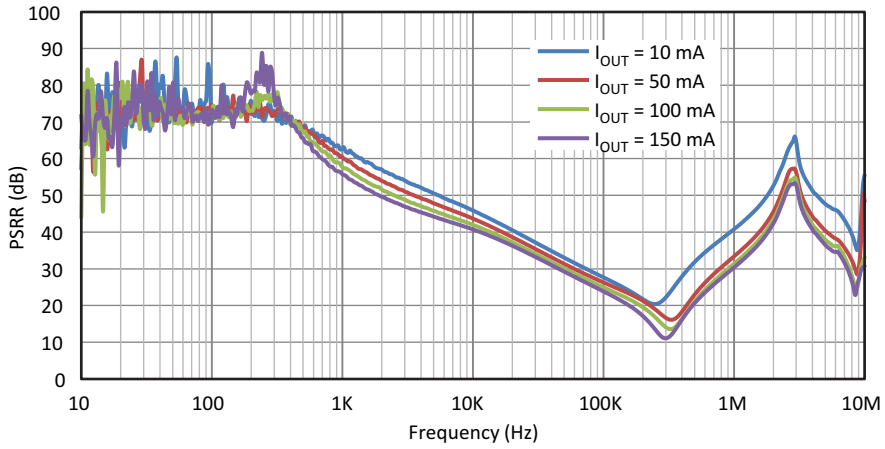


Figure 4. PSRR of the TLV71318PEVM-171 for Various Output Currents, V_{IN} = 3 V

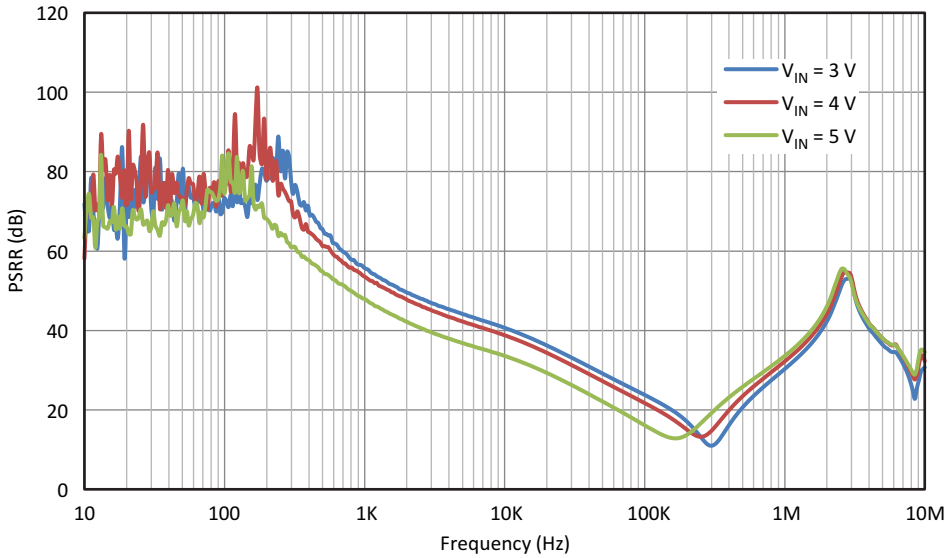


Figure 5. PSRR of the TLV71318PEVM-171 for Various Input Voltages, I_{OUT} = 150 mA

5 Thermal Guidelines and Layout Recommendations

Thermal management is a key component of the design of any power converter and is especially important when the power dissipation in the LDO is high. Use the following formula to approximate the maximum power dissipation for the particular ambient temperature:

$$T_J = T_A + P_D \times \theta_{JA}$$

Where T_J is the junction temperature, T_A is the ambient temperature, P_D is the power dissipation in the device (Watts), and θ_{JA} is the thermal resistance from junction to ambient. All temperatures are in degrees Celsius. The maximum operating junction temperature, T_J, must not be allowed to exceed 125°C. The layout design must be copper trace and plane areas smartly, as thermal sinks, in order not to allow T_J to exceed the absolute maximum rating under all temperature conditions and voltage conditions across the part.

Table 1 repeats information from the Dissipation Ratings Table of the TLV713xxP series data sheet for comparison with the thermal resistance, θ_{JA}, for High-K JEDEC standard boards. The maximum input voltage can be calculated for full loads at different ambient temperatures. The input voltage must be less than these values in order to maintain a safe junction temperature.

Table 1. Thermal Resistance, θ_{JA}, and Maximum Power Dissipation

IC	Board	Package	θ_{JA}	Max Vin at 150 mA (T_A = 25°C)	Max Vin at 150 mA (T_A = 70°C)
TLV71312	High-K	DQN	393.3°C/W	2.89 V	2.13 V
TLV71318	High-K	DQN	393.3°C/W	3.50 V	2.73 V
TLV71333	High-K	DQN	393.3°C/W	5.0 V	4.23 V

6 Board layout

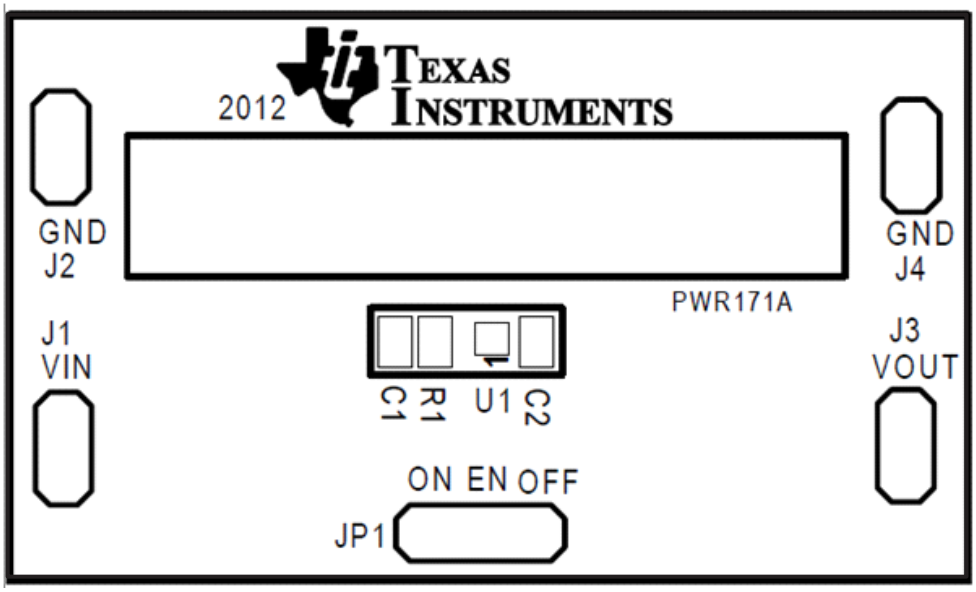


Figure 6. Assembly Layer

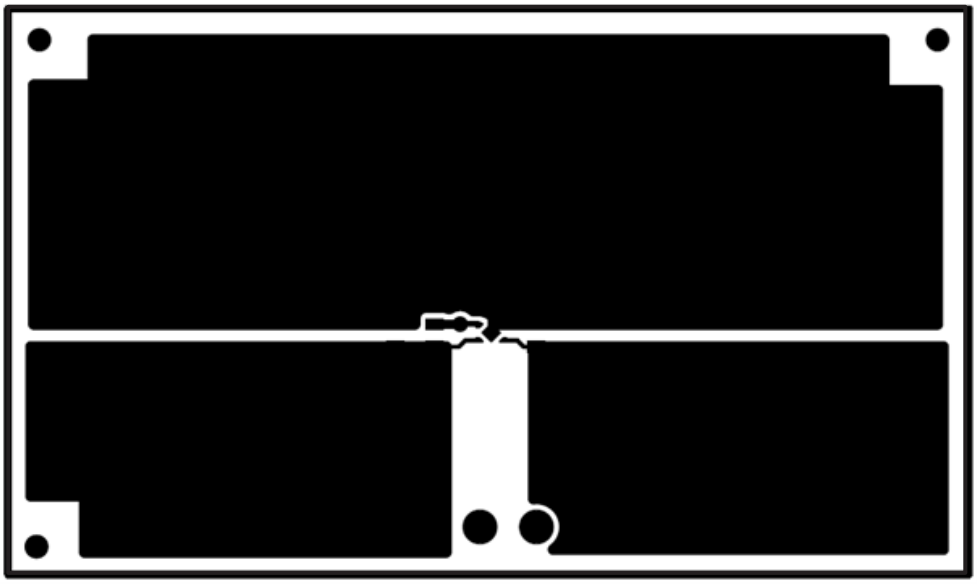


Figure 7. Top Layer Routing

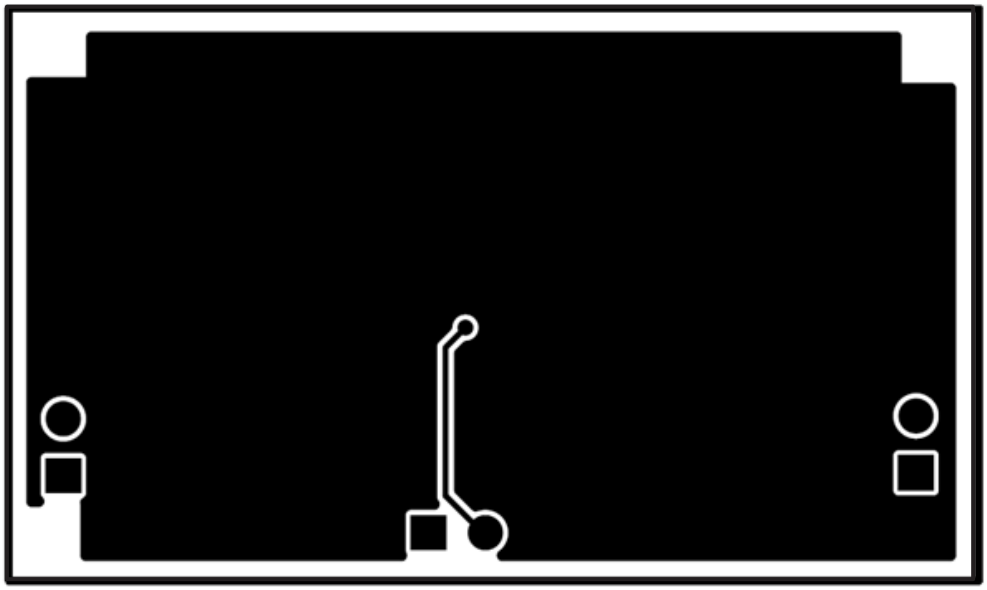
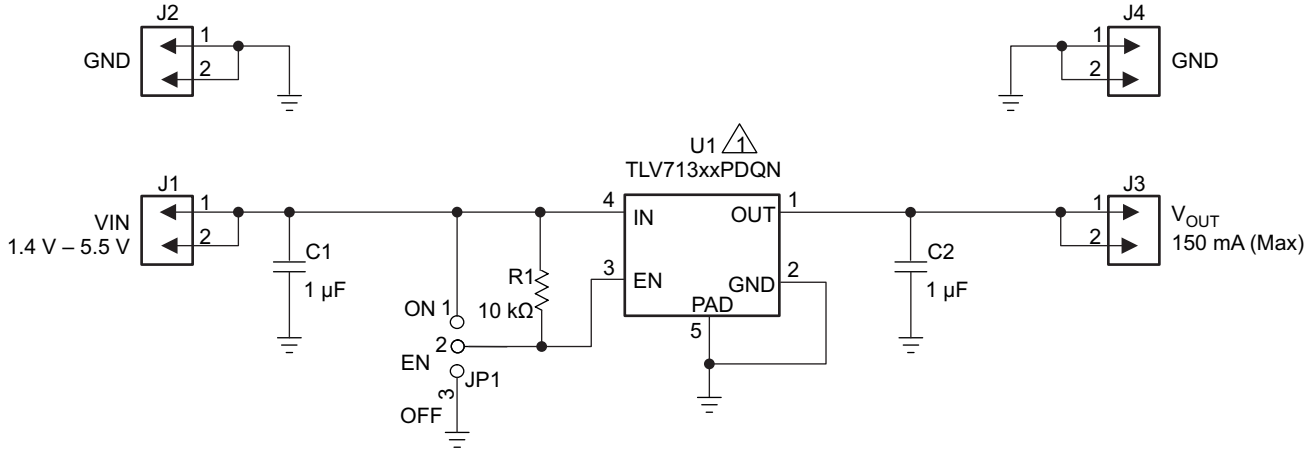


Figure 8. Bottom Layer Routing

7 Schematic



1 See BOM

ASSY	U1	VOUT
-001	TLV71312P	1.2 V
-002	TLV71318P	1.8 V
-003	TLV71333P	3.3 V

Figure 9. TLV713xxPEVM-171 Schematic

8 Bill of Material

Table 2. TLV713xxPEVM-171 Bill of Material

-001	-002	-003	RefDes	Value	Description	Size	Part Number	MFR
2	2	2	C1-2	1 µF	Capacitor, ceramic chip, 10 V, ±10%, X5R	0402	STD	STD
4	4	4	J1-4	PEC02SAAN	Header, male 2-pin, 100-mil spacing,	0.100 inch × 2	PEC02SAAN	Sullins
1	1	1	JP1	PEC03SAAN	Header, male 3-pin, 100-mil spacing,	0.100 inch × 3	PEC03SAAN	Sullins
1	1	1	R1	10 kΩ	Resistor, chip, 1/16W, 1%	0402	Std	Std
1	0	0	U1	TLV71312PDQN	IC, 150 mA, low IQ, ultra small LDO voltage reg.	QFN	TLV71312PDQN	TI
0	1	0	U1	TLV71318PDQN	IC, 150 mA, low IQ, ultra small LDO voltage reg.	QFN	TLV71318PDQN	TI
0	0	1	U1	TLV71333PDQN	IC, 150 mA, low IQ, ultra small LDO voltage reg.	QFN	TLV71333PDQN	TI
1	1	1	--		PCB, 1.7 in × 1 in × 0.062 in		PWR171A	Any
1	1	1	JP1		Shunt, black	100-mil	929950-00	3M
1	1	1	Label	1.25 × 0.25 inch	THT-13-457-10	Brady		

Notes: 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. Install label after wash. Text shall be 8 pt font. Text shall be per Table 1 below

Table 1

Assembly No.	Text
PWR171-001 PWR171-002 PWR171-003	TLV71312PEVM-171 TLV71333PEVM-171 TLV71333PEVM-171

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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.

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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.

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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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Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

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2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure 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.
3. 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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