

AN-2185 LMR14203/LMR14206 Demonstration Board

1 Introduction

The Texas Instruments LMR14203/06 is a PWM DC/DC buck (step-down) regulator. With a wide input range from 4.5V–42V, it is suitable for a variety of applications from automotive to power conditioning of unregulated sources. The LMR14203/LMR14006 demonstration board is designed to provide the design engineer with a fully functional power converter based on the buck topology to evaluate the LMR14203/06 series of buck regulators. The demonstration board comes populated with either the LMR14203XMK or LMR14206XMK, but can easily be modified to accommodate any of the LMR14203/06 regulator ICs.

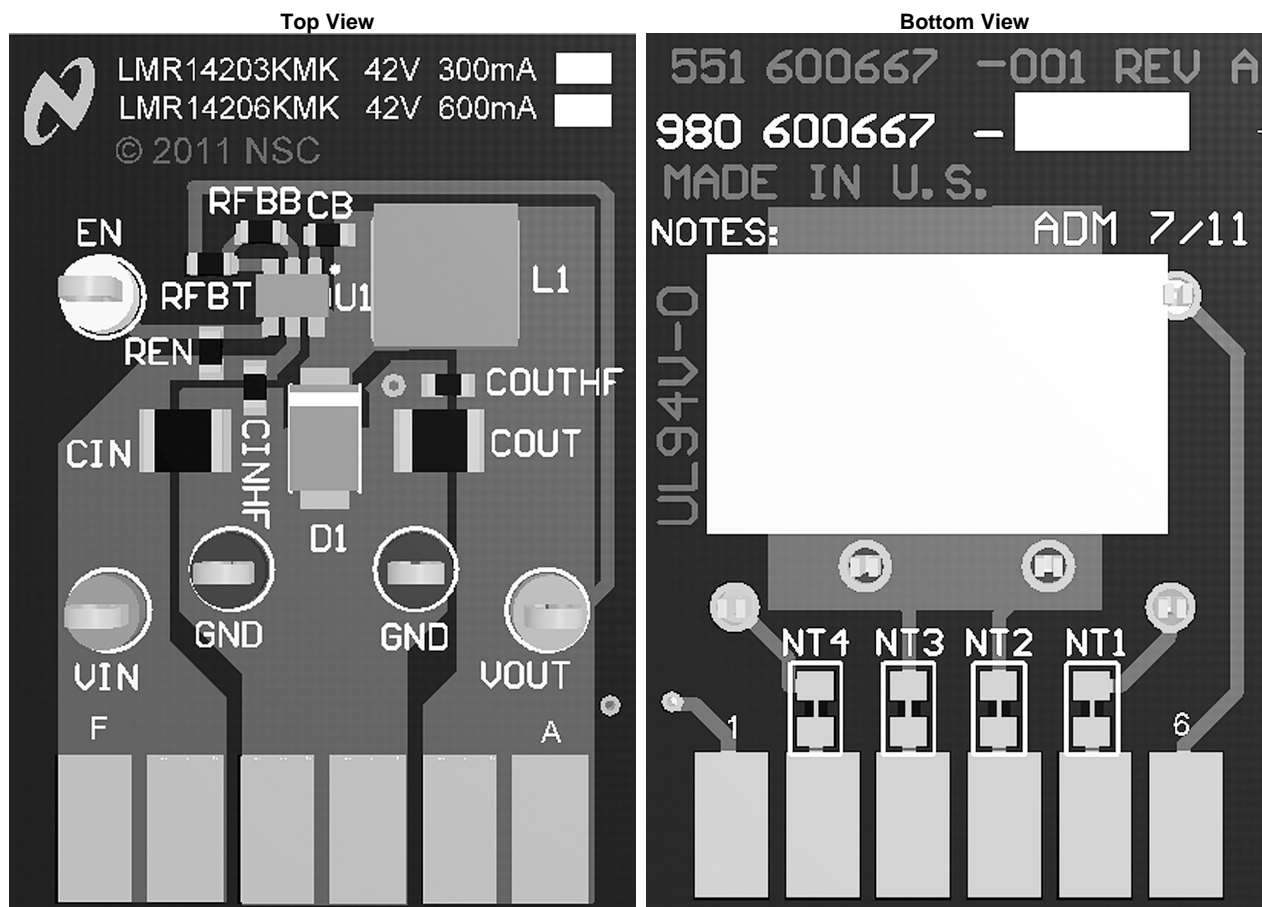


Figure 1. LMR14203/LMR14206 Demonstration Board

2 Features

- 4.5V to 42V Input Voltage Range
- 1.2V Output Voltage
- Up to 300/600 mA Output Current
- Switching Frequency of 1.25 MHz
- Internal Compensation

3 Shutdown Operation

The demonstration board includes a pull-up resistor to enable the device once V_{IN} has exceeded 1.0V (typ). Using the EN post to disable the device by pulling this node to GND. A logic signal may be applied, to the post, to test startup and shutdown of the device.

4 Adjusting the Output Voltage

The output voltage can be changed from 1.2V to another voltage by adjusting the feedback resistors using the following equation:

$$V_{OUT} = V_{FB}(1 + (R_{FBT}/R_{FBB})) \quad (1)$$

Where V_{FB} is 0.765V.

For more information on component selection and features, see:

- *LMR14203 SIMPLE SWITCHER 42Vin, 0.3A Step-Down Voltage Regulator in SOT-23* ([SNVS732](#))
- *LMR14206 SIMPLE SWITCHER 42Vin, 0.6A Step-Down Voltage Regulator in SOT-23* ([SNVS733](#))

5 LMR14203 Demonstration Board Schematic

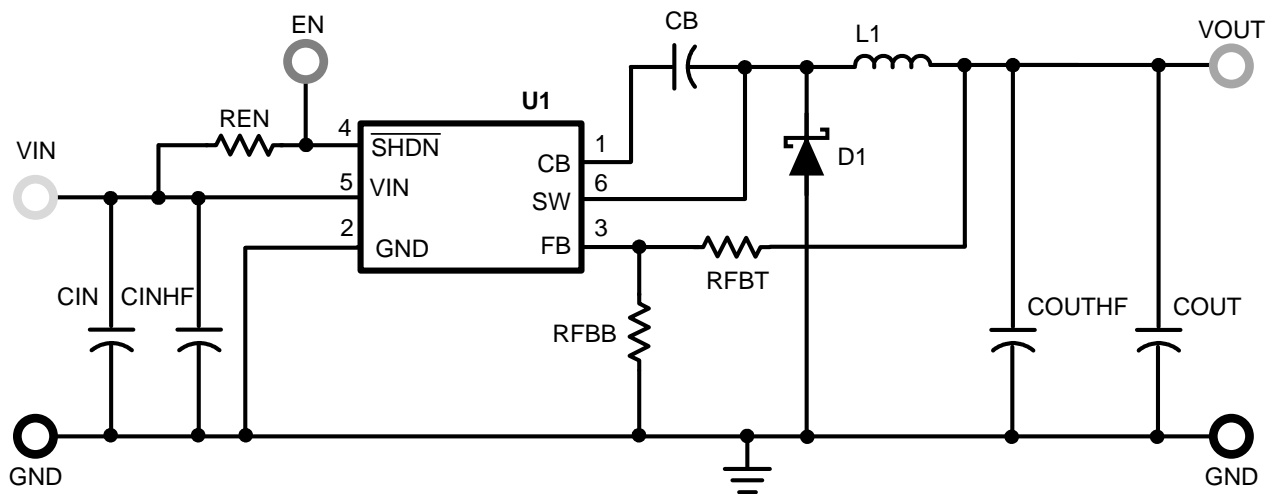


Figure 2. LMR14203 Demonstration Board Schematic

Table 1. Bill of Materials LMR14203

ID	Part Number	Type	Size	Parameters	Qty	Vendor
U1	LMR14203	Buck Regulator	SOT-6		1	Texas Instruments
L1	NR6045T150M	Inductor	NR6045	15 µH, 2.3A	1	Taiyo Yuden
D1	B260A-13-F	Diode	SMA	60V, 2 A	1	Diodes Inc
CIN	GRM32ER72A225KA35L	Capacitor	1210	2.2 µF, 100V	1	Murata
CINHF, COUTHF	C0603C223K3RACTU	Capacitor	0603	0.022 µF, 25V	2	Kemet
COUT	GRM32ER61A476KE20L	Capacitor	1210	47 µF, 10V	1	Murata
CB	C0603C224K4RACTU	Capacitor	0603	0.22 µF, 16V	1	Kemet
RFBT	CRCW06036K04FKEA	Resistor	0603	6.04 kΩ, 1%	1	Vishay
RFBB	CRCW060310K5FKEA	Resistor	0603	10.5 kΩ, 1%	1	Vishay
REN	CRCW06031M00JNEA	Resistor	0603	1.0 MΩ, 5%	1	Vishay
EN	5014	Test Point Loop		Yellow	1	Keystone
VIN	5010	Test Point Loop		Red	1	Keystone
VOUT	5013	Test Point Loop		Orange	1	Keystone
GND	5011	Test Point Loop		Black	2	Keystone

6 LMR14206 Demonstration Board Schematic

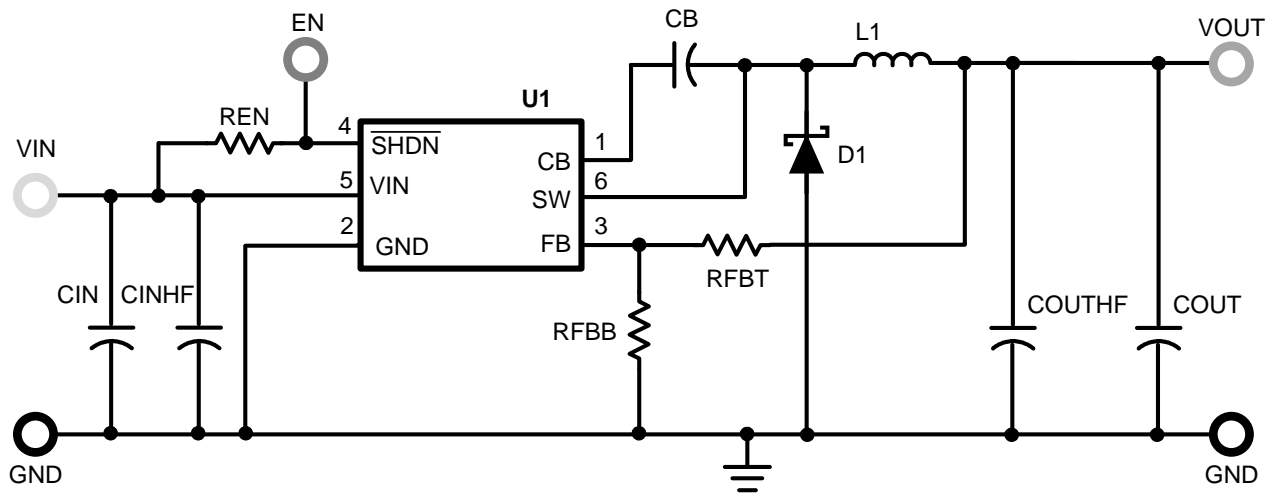


Figure 3. LMR14206 Demonstration Board Schematic

Table 2. Bill of Materials (BOM) LMR14206

ID	Part Number	Type	Size	Parameters	Qty	Vendor
U1	LMR14206	Buck Regulator	SOT-6		1	Texas Instruments
L1	NR6045T150M	Inductor	NR6045	15 μ H, 2.3A	1	Taiyo Yuden
D1	B260A-13-F	Diode	SMA	60V, 2 A	1	Diodes Inc
CIN	GRM32ER72A225KA35L	Capacitor	1210	2.2 μ F, 100V	1	Murata
CINHF, COUTHF	C0603C223K3RACTU	Capacitor	0603	0.022 μ F, 25V	2	Kemet
COUT	GRM32ER61A476KE20L	Capacitor	1210	47 μ F, 10V	1	Murata
CB	C0603C224K4RACTU	Capacitor	0603	0.22 μ F, 16V	1	Kemet
RFBT	CRCW06036K04FKEA	Resistor	0603	6.04 k Ω , 1%	1	Vishay
RFBB	CRCW060310K5FKEA	Resistor	0603	10.5 k Ω , 1%	1	Vishay
REN	CRCW06031M00JNEA	Resistor	0603	1.0 M Ω , 5%	1	Vishay
EN	5014	Test Point Loop		Yellow	1	Keystone
VIN	5010	Test Point Loop		Red	1	Keystone
VOUT	5013	Test Point Loop		Orange	1	Keystone
GND	5011	Test Point Loop		Black	2	Keystone

7 Quick Setup Procedures

Step 1: Connect a power supply to VIN terminals.

Step 2: Connect a load to VOUT terminals.

Step 3 EN should be left floating for normal operation. Short this to ground to shutdown the part.

Step 4: Set $V_{IN} = 24V$, with 0A load applied, check V_{OUT} with a voltmeter. Nominal 1.2V

Step 5: Apply a 300mA load and check V_{OUT} . Nominal 1.2V

8 Measurements

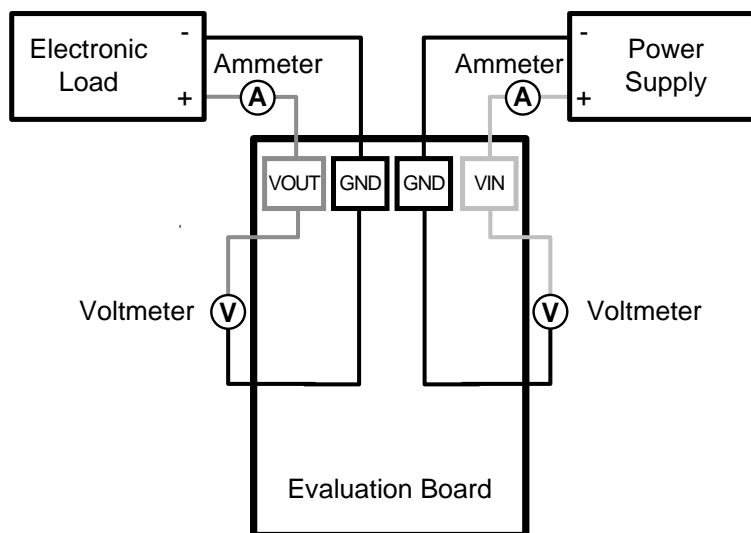


Figure 4. Efficiency Measurements

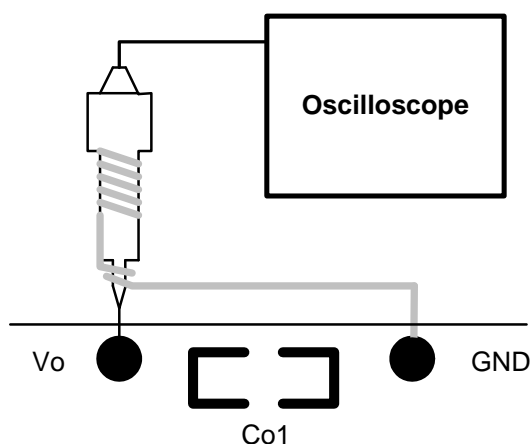


Figure 5. Voltage Ripple Measurements

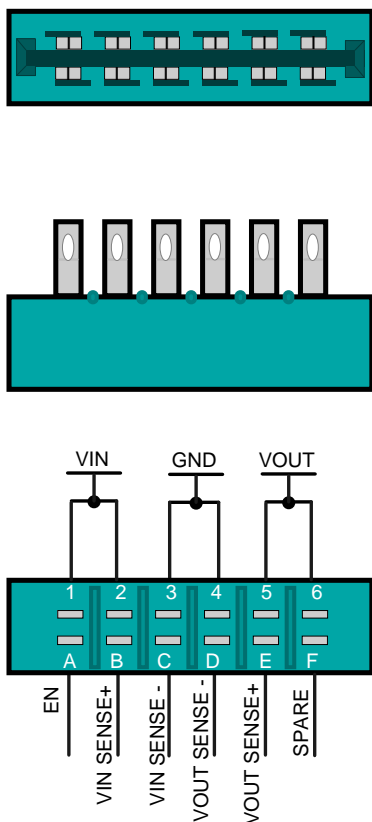
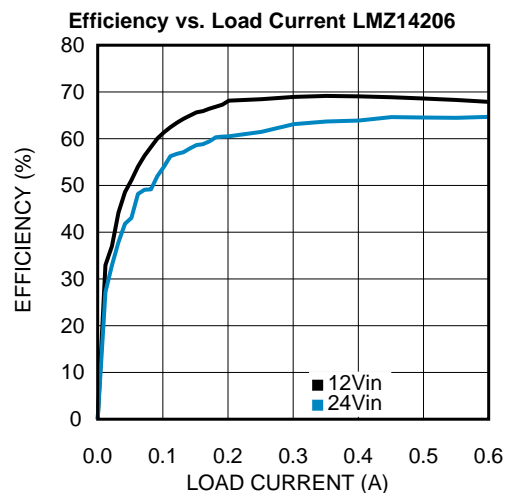
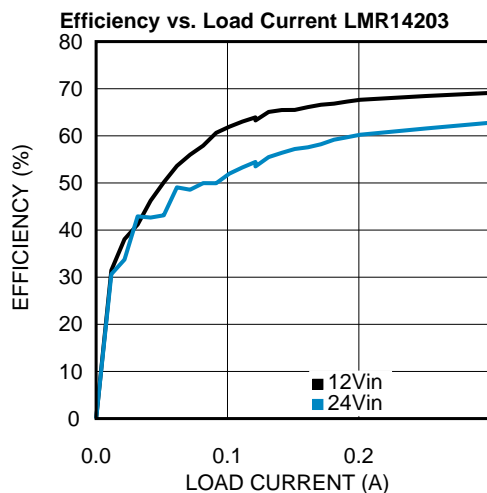
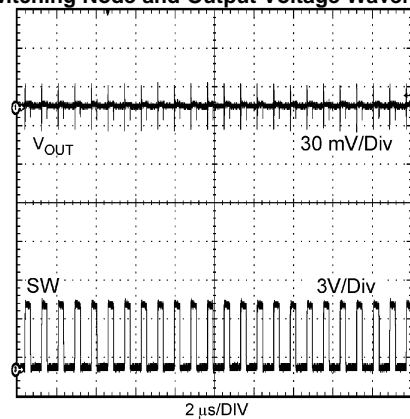


Figure 6. Edge Connector Schematic

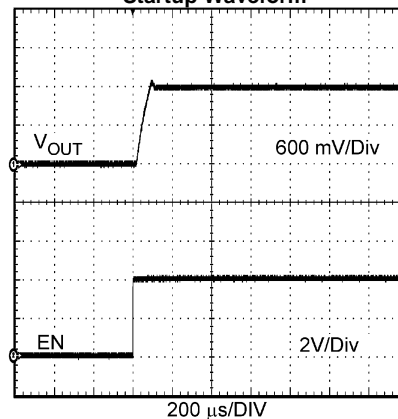
9 Typical Performance Characteristics



Switching Node and Output Voltage Waveforms



Startup Waveform



10 Layout

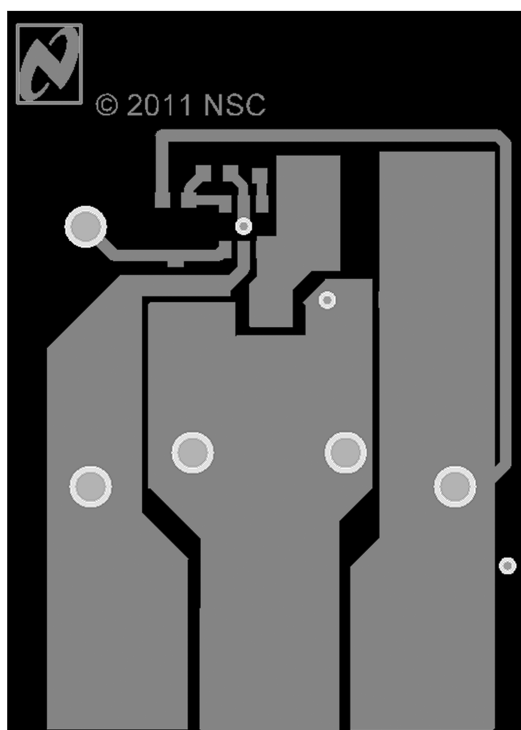


Figure 7. Top Layer

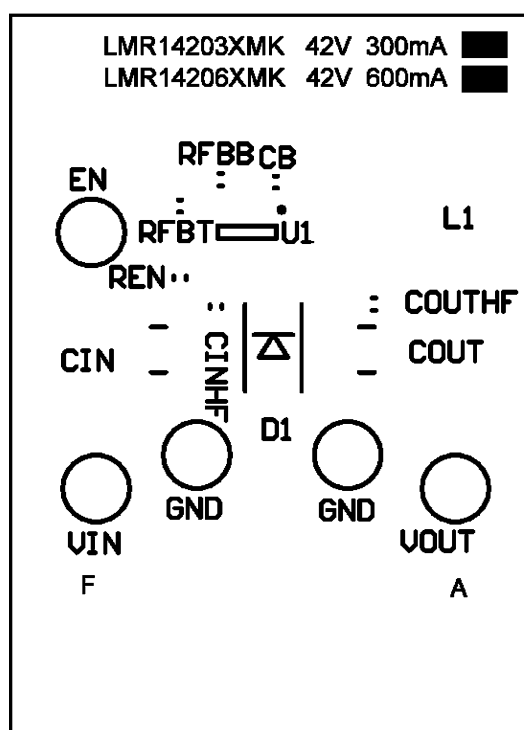


Figure 8. Top Overlay

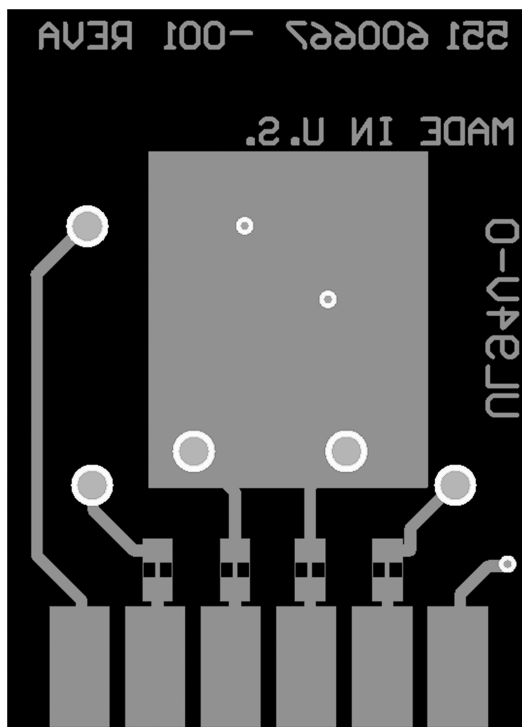


Figure 9. Bottom Layer

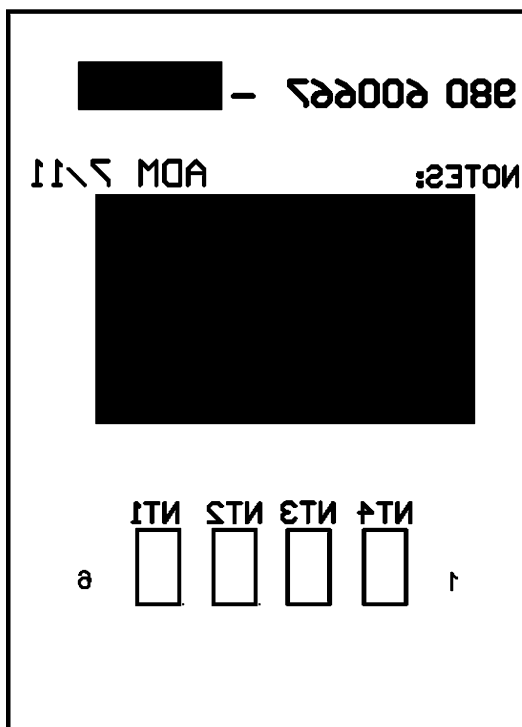


Figure 10. Bottom Overlay

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3 Regulatory Notices:

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3.1.1 Notice applicable to EVMs not FCC-Approved:

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

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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.

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