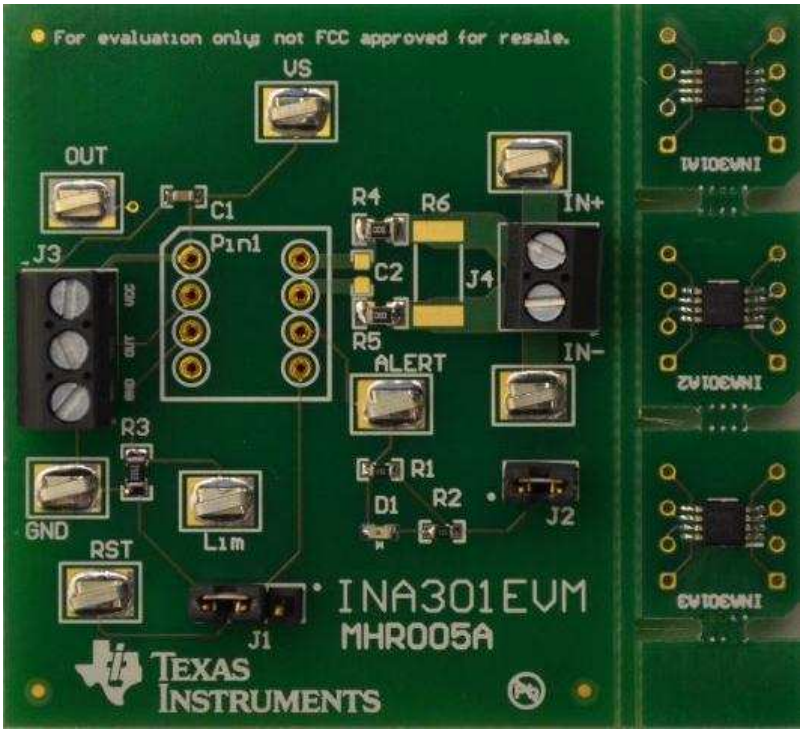
INA301EVM User's Guide



This user's guide describes the characteristics, operation, and use of the INA301EVM evaluation module. This guide discusses how to set up and configure the hardware. Throughout this document, the terms *evaluation board*, *evaluation module*, and *EVM* are synonymous with the *INA301EVM*. This document also includes an electrical schematic, printed circuit board (PCB) layout drawings, and a parts list for the EVM.

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1 Overview

The INA301 is a high- or low-side, current-shunt monitor with an analog output and an open-drain comparator. The integrated comparator features an adjustable threshold that is set using an external limit-setting resistor. The INA301EVM has four PCBs and a PDIP receptacle for accepting the INA301 device attached to coupon boards. All three gain versions are supplied within this EVM package. The EVM also consists of screw-terminals and test points for external hardware connections, placeholder pads to add components for filtering, surface-mount resistors for ease of adjusting the comparator threshold, a jumper to change comparator mode by connecting RESET pin to either VS or GND, and a jumper for enabling or disabling the LED light that is connected to the ALERT pin.

1.1 INA301EVM Kit Contents

Table 1 summarizes the contents of the INA301EVM kit. The included hardware is pictured on the front page. Contact the nearest Texas Instruments Product Information Center if any component is missing. Make sure to check the INA301 product folder on the TI web site at www.ti.com for any further information regarding this product.

Table 1. INA301EVM Kit Contents

Item	Quantity
INA301EVM test board	1
INA301A1 coupon board	1
INA301A2 coupon board	1
INA301A3 coupon board	1

1.2 Related Documentation from Texas Instruments

The following documents provide information regarding Texas Instruments' integrated circuits used in the assembly of the INA301EVM. This user's guide is available from the TI web site under literature number SBOU154. Any letter appended to the literature number corresponds to the document revision that is current at the time of the writing of this document. Newer revisions may be available from the TI web site (www.ti.com), or call the Texas Instruments' Literature Response Center at (800) 477-8924 or the Product Information Center at (972) 644-5580. When ordering, identify the document by both title and literature number.

Table 2. Related Documentation

Document	Literature Number
INA301 product data sheet	SBOS713

2 INA301EVM Hardware

The INA301EVM requires a 2.7-V to 5.5-V power supply. Connect the VIN+ and VIN– pins across an external shunt resistor in series with a 0-V to 36-V supply to determine the current flowing through that resistor. Use a voltmeter on the OUT pin to measure the voltage output and on the ALERT pin to determine the comparator output. The comparator threshold is set with a resistor. The open-drain comparator output is pulled up to VS and there is also a red LED light that serves as a visual indicator of a tripped comparator.

2.1 Theory of Operation for the INA301EVM

A block diagram of the INA301EVM test board hardware is shown in Figure 1. The INA301 test board contains eight test points, providing access to all eight pins of the INA301 for evaluation. Two terminal blocks also provide additional convenient connection to the DUT pins. Support circuitry is included on the PCB but can be removed or bypassed if needed.

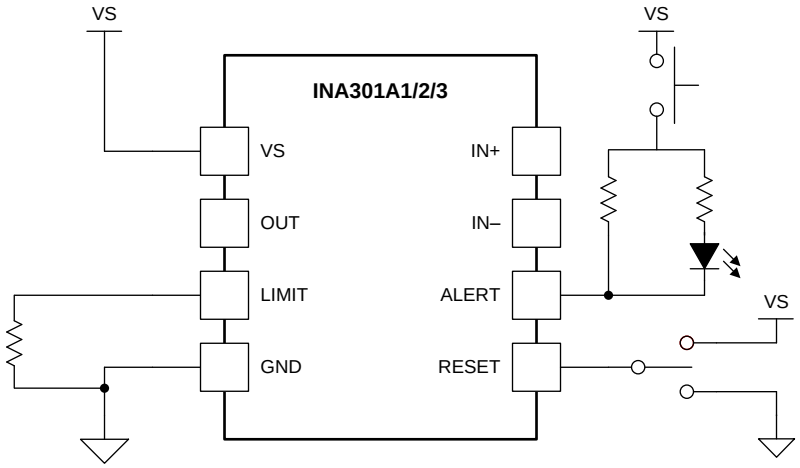

Figure 1. INA301EVM Test Board Block Diagram

2.2 INA301EVM Features

The INA301EVM provides basic functional evaluation of the INA301. The fixture layout is not intended to be a model for the target circuit, nor is it laid out for electromagnetic compatibility (EMC) testing.

The layout of the INA301EVM printed circuit board (PCB) is designed to provide the following features:

- Ease of access to all device pins
- Multiple input signal options
- Space for optional input filtering capacitors and resistors
- A threshold limit resistor for setting comparator input threshold
- A jumper reset for the comparator
- Visual LED indicator of the comparator output with the option to be enabled/disabled through a jumper.

The INA301EVM allows connection to both sides of a remote shunt resistor to measure current, or omit the shunt resistor and apply a differential voltage directly to the device inputs. This flexibility allows the testing of device operation in a simulated manner, as well as an actual application.

See the product data sheet for comprehensive information about the INA301 family of devices.

2.3 Quick-Start Setup and Use

Follow these procedures to set up and use the INA301EVM:

1. Connect an external dc supply voltage between 2.7 V and 5.5 V to the J3-1 terminal.
2. Connect the desired input to the J4 terminal. This input is either a remote shunt resistor or a differential voltage source with a common-mode voltage of 0 V to 36 V referenced to GND.

2.4 Voltage Inputs

The J4 terminal (VIN+ and VIN–) is used to connect to a remote shunt resistor or a differential voltage source. The voltage differential is multiplied by the 20-V/V device gain of the INA301A1. Other devices in this family are the INA301A2 with 50-V/V gain and the INA301A3 with 100-V/V gain. The full-scale sense input voltage (V_{SENSE}) is defined as VIN+ – VIN–, and has a maximum input of (V+ – 0.20) / gain in order to achieve linear output. The minimum voltage output is 10 mV.

2.5 Comparator Trip Point

The integrated comparator in the INA301 has a resistor programmable threshold. Connecting an appropriately sized resistor on the LIMIT pin sets up the comparator threshold. Adjust R3 (see Figure 2) to set the comparator trip point for the intended application. The EVM comes with R3 = 31.6 kΩ, which produces a comparator threshold of 80 µA × 31.6 kΩ = 2.528 V.

For example, if measuring current across a 10-mΩ shunt resistor (and the comparator must be tripped if an excess of 10 A is measured), then 10 A × 10 mΩ = 100 mV, and 100 mV × 20 V/V gain = 2 V. To achieve a comparator threshold of 2 V, select R3 so that R3 x 80 µA = 2 V. A simple calculation indicates R3 = 25 kΩ.

3 Schematic, PCB Layout, and Bill of Materials

3.1 Schematic

Figure 2 shows the complete schematic of the INA301 test board. R3 sets up the voltage threshold of the comparator. R1 is a pullup resistor for the open-drain comparator output pin. D1 is connected to the comparator output pin, and is a visual indicator of an alert condition. D1 can be disabled by disconnecting jumper J2. Use jumper J1 to configure the comparator mode. Install J1 at position 3-2 for transparent mode comparison output and at position 2-1 for latched mode comparison output. C1 is a bypass capacitor for VS. C2 along with R4 and R5 creates an optional filter for the VIN+ and VIN– inputs. R6 is an optional shunt resistor for the INA input.

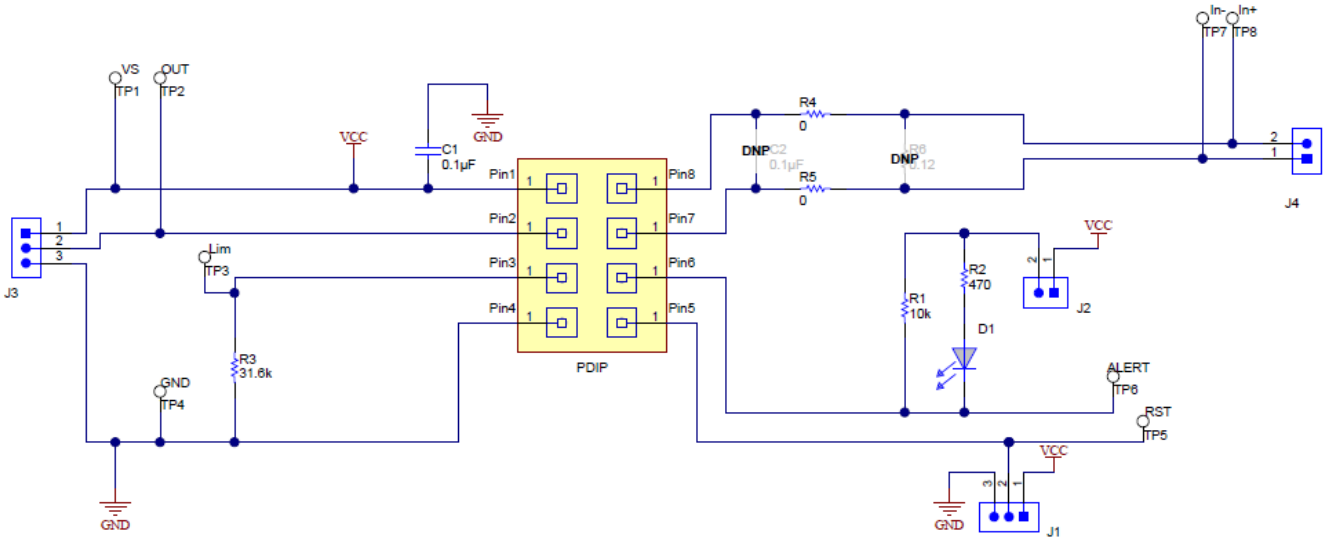

Figure 2. INA301EVM Test Board Schematic

3.2 PCB Layout

Figure 3 shows the component placement on the INA301EVM test board. There are no components on the bottom layer. Figure 4 and Figure 5 illustrate the top and bottom layers, respectively, of the test board.

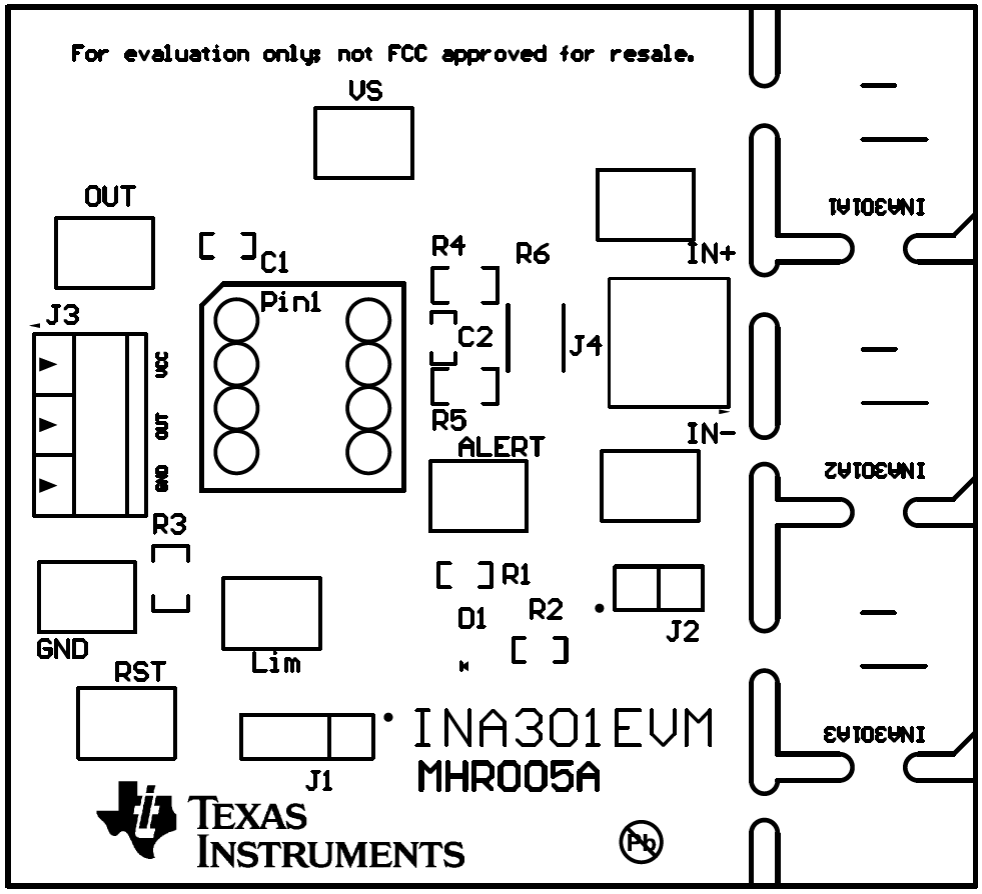

Figure 3. INA301EVM Component Placement

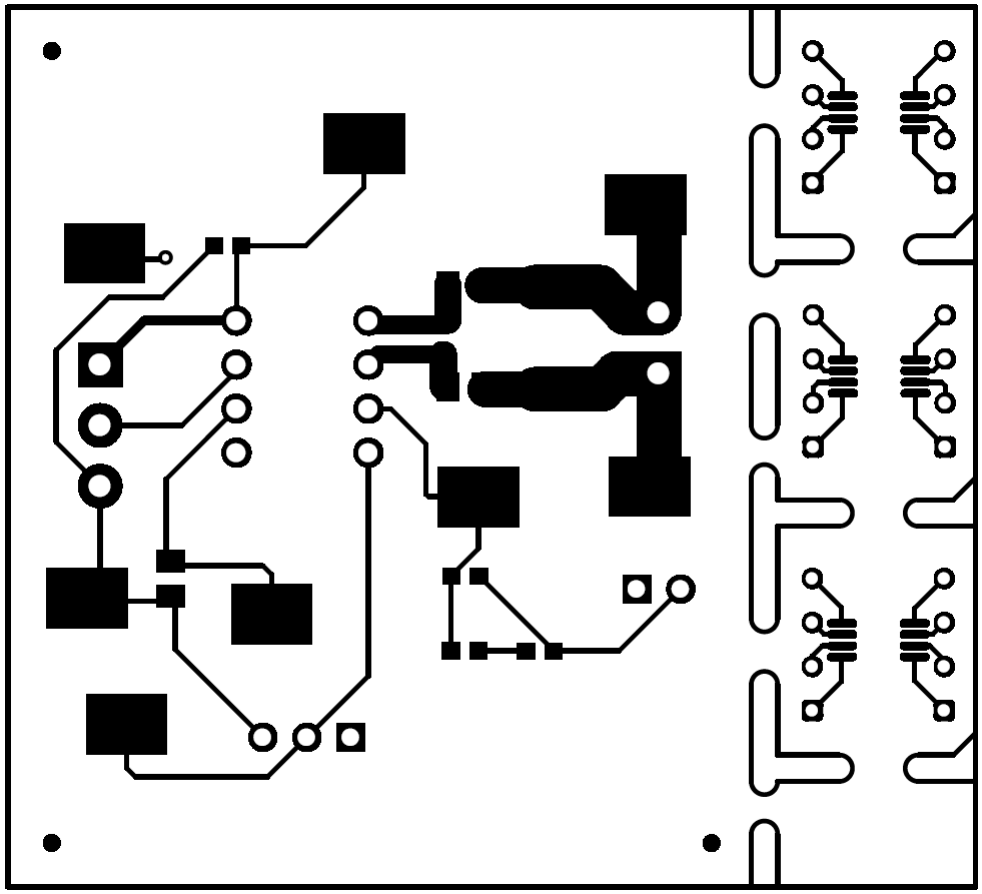

Figure 4. PCB Top Layer

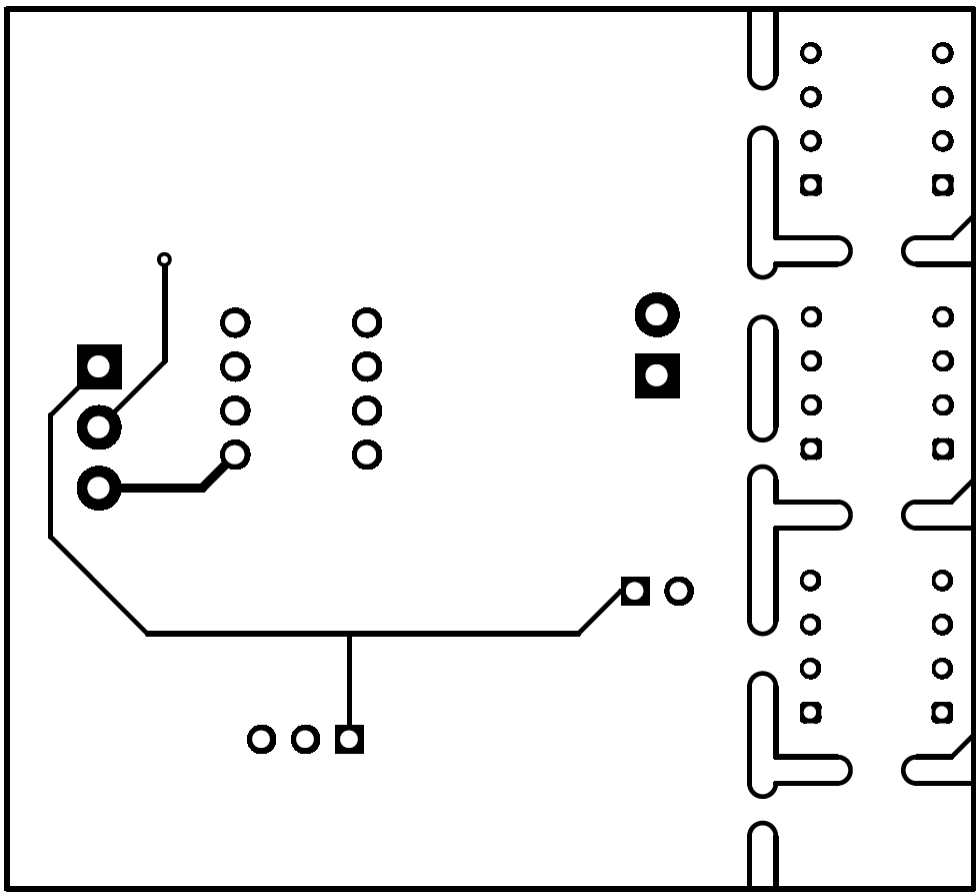

Figure 5. PCB Bottom Layer

3.3 Bill of Materials

Table 3 lists the bill of materials (BOM) for the INA301 test board.

Table 3. INA301 Test Board BOM

Qty	RefDes	Description	Part Number	MFR
8	RST, LIM, OUT, GND, V+, VIN+, VIN–, ALERT	Test Point, Compact, SMT	5016	Keystone
1	C1	CAP, CERM, 0.1 µF, 16 V, +/- 5%, X7R, 0603	0603YC104JAT2A	AVX Corp.
1	D1	Diode, LED, Red, 2.1-V, 20-mA, 6-mcd	LTST-C190CKT	Lite On
4	H9-H12	Bumpon, Hemisphere, 0.44 X 0.20, Clear	SJ-5303 (CLEAR)	3M
1	J1	Header, 100mil, 3x1, Gold, TH	TSW-103-07-G-S	Samtec
1	J2	Header, 100mil, 2x1, Gold, TH	TSW-102-07-G-S	Samtec
1	J3	Terminal Block, 6A, 3.5mm Pitch, 3-Pos, TH	ED555/3DS	On-Shore Technology
1	J4	Terminal Block, 6A, 3.5mm Pitch, 2-Pos, TH	ED555/2DS	On-Shore Technology
6	J5-J10	Header, 100mil, 4x1, Gold, TH	342-10-104-00-591000	Mill-Max
8	J11-J18	Socket, 1x1, Height 4.27mm, TH	50935	TE Connectivity
1	R1	RES, 10 k, 5%, 0.1 W, 0603	CRCW060310K0JNEA	Vishay-Dale
1	R2	RES, 470, 5%, 0.1 W, 0603	CRCW0603470RJNEA	Vishay-Dale
1	R3	RES, 31.6 k, 1%, 0.125 W, 0805	CRCW080531K6FKEA	Vishay-Dale
2	R4, R5	RES, 0, 5%, 0.125 W, 0805	ERJ-6GEY0R00V	ERJ-6GEY0R00V
1	U2	High- or Low-Side Current-Sense Amplifier with High-Speed Comparator, DGK0008A	INA301A1IDGKR	Texas Instruments
1	U3	High- or Low-Side Current-Sense Amplifier with High-Speed Comparator, DGK0008A	INA301A2IDGKR	Texas Instruments
1	U4	High- or Low-Side Current-Sense Amplifier with High-Speed Comparator, DGK0008A	INA301A3IDGKR	Texas Instruments

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      3.1.1 *Notice applicable to EVMs not FCC-Approved:*

      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.

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*

Concerning EVMs Including Radio Transmitters:

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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.

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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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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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