AN-2204 LM5017 Isolated Supply Evaluation Board

1 Introduction

An isolated bias supply is implemented in this evaluation board with LM5017 Constant-On-Time regulator. LM5017 regulator integrates both the high- and low-side power switches essential for creating isolated buck converter.

Board specifications are as follows:

- Input Range: 20 V to 100 V
- Primary Output Voltage: 10 V
- Secondary (Isolated) Output Voltage: 9.5 V
- Maximum Load Current (Primary + Secondary): 300 mA
- Maximum Power Output: 3 W
- Nominal Switching Frequency: 750 kHz
- Efficiency (FIN = 48 V, IOUT2 = 300 mA): 76 percent
- Board size: 2 inch x 2 inch

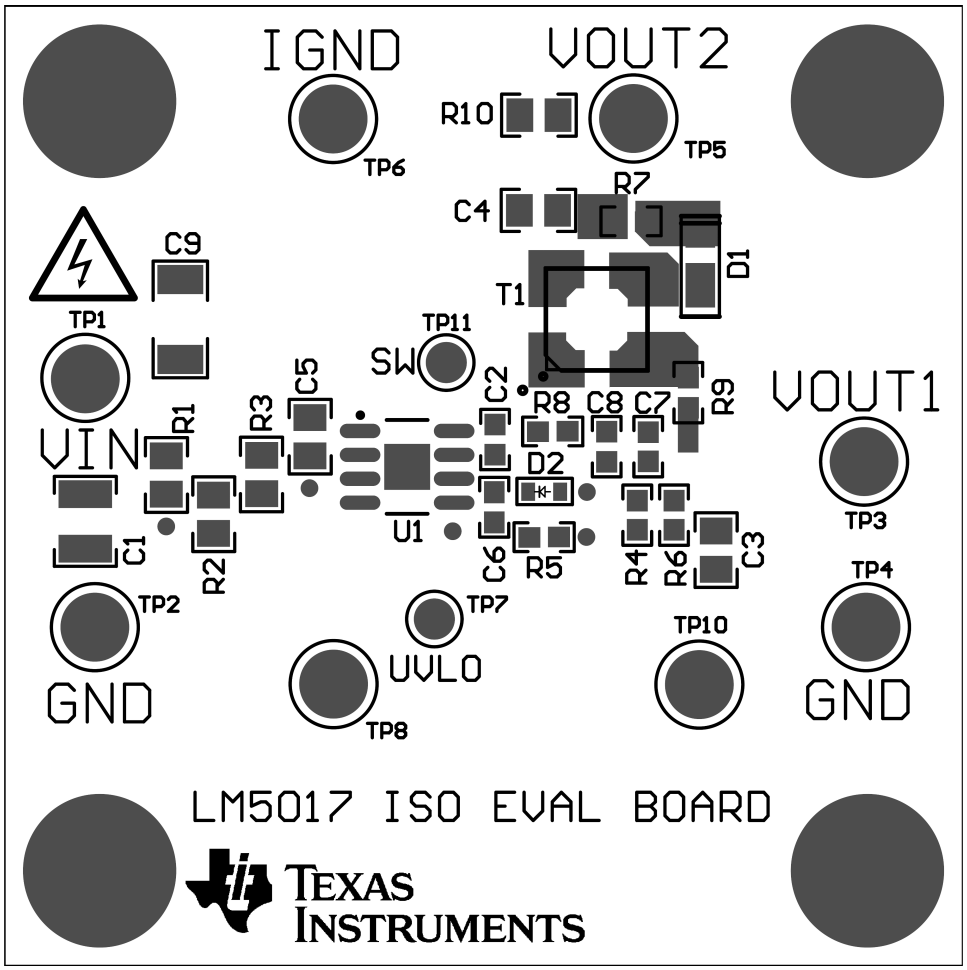

Figure 1. LM5017 Evaluation Board (Top View)

2 UVLO Threshold and Hysteresis

The UVLO resistors are selected using the following two equations:

$$V_{IN(HYS)} = I_{HYS} R_6 \quad (1)$$

and

$$V_{IN(UVLO,\,rising)} = 1.225V \times \left(\frac{R_6}{R_7} + 1 \right) \quad (2)$$

On this evaluation board R1 = 127 kΩ and R2 = 8.25 kΩ, resulting in UVLO rising threshold at VIN = 20.5 V and a hysteresis of 2.54 V.

2.1 Board Connection and Start-Up

The input connections are made using TP1 (VIN) and TP2 (GND) terminals. The primary output appears at TP3 (VOUT1) and TP4 (GND). The secondary (isolated) output is available across TP5 (VOUT2) and TP6 (IGND). The input voltage should be gradually increased above UVLO set point of 20.5 V. Both the outputs (VOUT1 and VOUT2) should be close to 10 V at this point. This board is designed to function with input voltage range of 20 V to 100 V. The minimum VIN threshold can be changed by changing the UVLO resistors R1, R2. VIN should not exceed 100 V.

The magnetics in this design is optimized for solution size, and therefore limits the output power. **The total load at the output should not exceed 300 mA otherwise the coupled inductor will saturate/overheat which can destroy both the coupled inductor and the regulator IC U1.** If a sustained over-current situation is to be tolerated, a coupled inductor with higher saturation and rms ratings should be used.

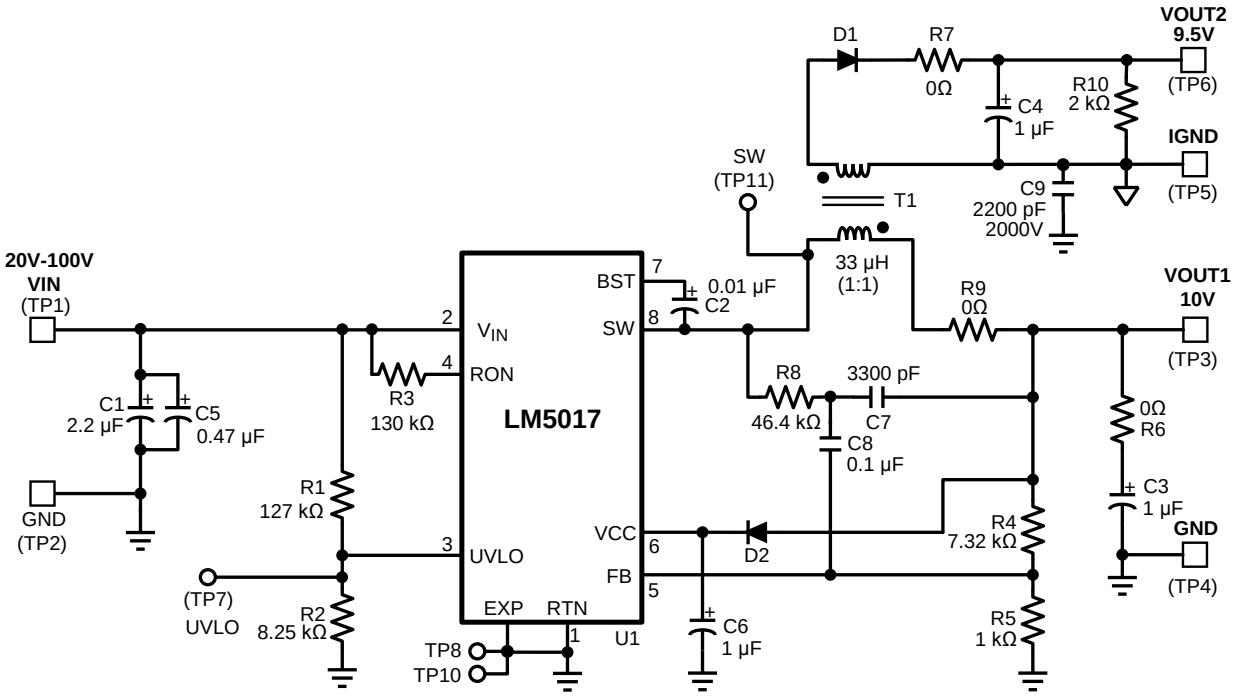

Figure 2. Complete Evaluation Board Schematic

Table 1. Bill of Materials

Item	Description	Mfg., Part Number	Package	Value
U1	Sync Switching Regulator	Texas Instruments, LM5017	SO PowerPAD-8	100V, 0.6A
T1	Coupled Inductor, 1500 VDC	Coilcraft, LPD5030V-333ME	5mm x 5mm	33uH, 0.47A
	Alternate Part	Wurth, 750312750	8.26mm x 6.60mm	22uH, 0.76A
D1	Schottky Diode	Diodes Inc., DFLS1100-7	Pwr–DI123	100V, 1A
D2	Schottky Diode	Diodes Inc., SDM10U45-7	SOD–523	40V, 100mA
C1	Ceramic Capacitor	TDK, C3225X7R2A225K	1210	2.2 µF, 100V, X7R
C2	Ceramic Capacitor	TDK, C1608X7R1C103K	0603	0.01 µF, 16V, X7R
C3, C4	Ceramic Capacitor	TDK, C2012X7R1E105K	0805	1 µF, 25V, X7R
C5	Ceramic Capacitor	Murata, GRM21BR72A474KA73L	0805	0.47 µF, 100V, X7R
C6	Ceramic Capacitor	TDK, C1608X7R1C105K	0603	1 µF, 16V, X7R
C7	Ceramic Capacitor	Murata, GRM188R72A332KA01D	0603	3300pF, 100V, ±5%
C8	Ceramic Capacitor	AVX, 0603YC104KAT2A	0603	0.1 µF, 16V, X7R
C9	Ceramic Capacitor	Johanson, 202R29W222KV4E	1808	2200pF, 2000V, X7R
R1	Resistor	Vishay/Dale, CRCW0805127KFKEA	0805	127k Ω, 1%
R2	Resistor	Vishay/Dale, CRCW08058K25FKEA	0805	8.25k Ω, 1%

Table 1. Bill of Materials (continued)

Item	Description	Mfg., Part Number	Package	Value
R3	Resistor	Vishay/Dale, CRCW0805130KFKEA	0805	130k Ω, 1%
R4	Resistor	Panasonic, ERJ-3EKF7321V	0603	7.32k Ω, 1%
R5	Resistor	Panasonic, ERJ-3EKF1001V	0603	1.0k Ω, 1%
R6	Resistor	Yageo, RC0603JR-070RL	0603	0 Ω
R7, R9	Resistor	Yageo, RC0603JR-070RL	0603	0 Ω
R8	Resistor	Panasonic, ERJ-3EKF4642V	0603	46.4k Ω, 1%
R10	Resistor	Panasonic, ERJ-6GEYJ202V	0805	2k Ω, 5%

3 Performance Curves

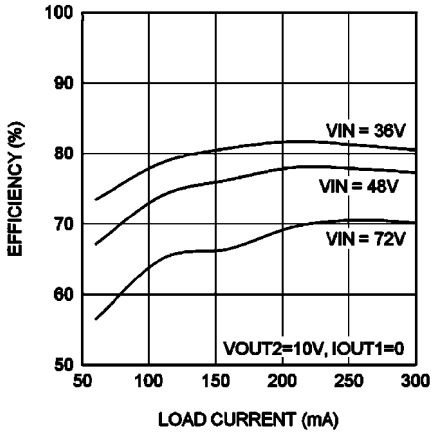

Figure 3. Efficiency at 750 kHz, VOUT1=10V

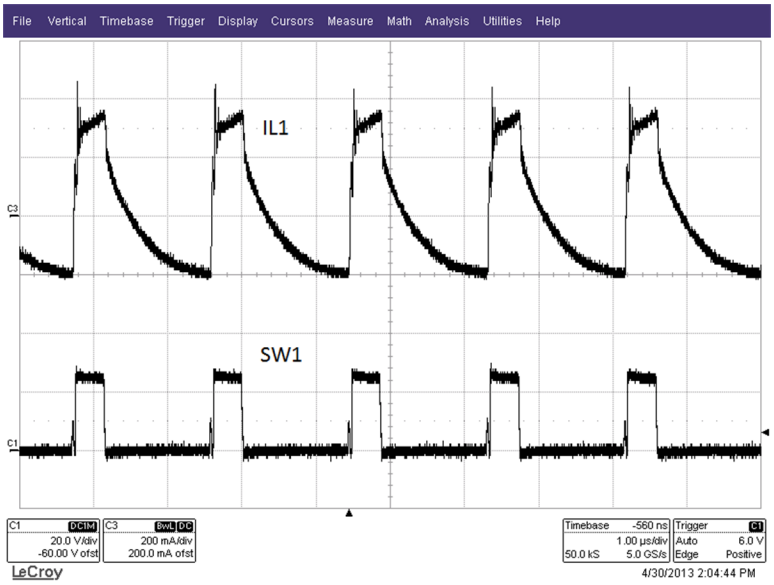

Figure 4. Steady State Waveform (VIN=48V, IOUT1= 100mA, IOUT2= 200mA)

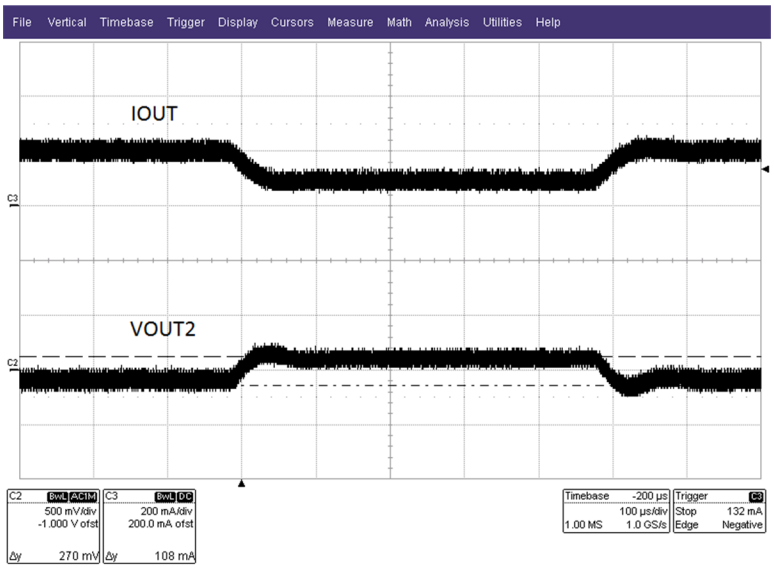

Figure 5. Step Load Response (VIN=48V, IOUT1=0, Step Load on IOUT2=100mA to 200mA)

4 PC Board Layout

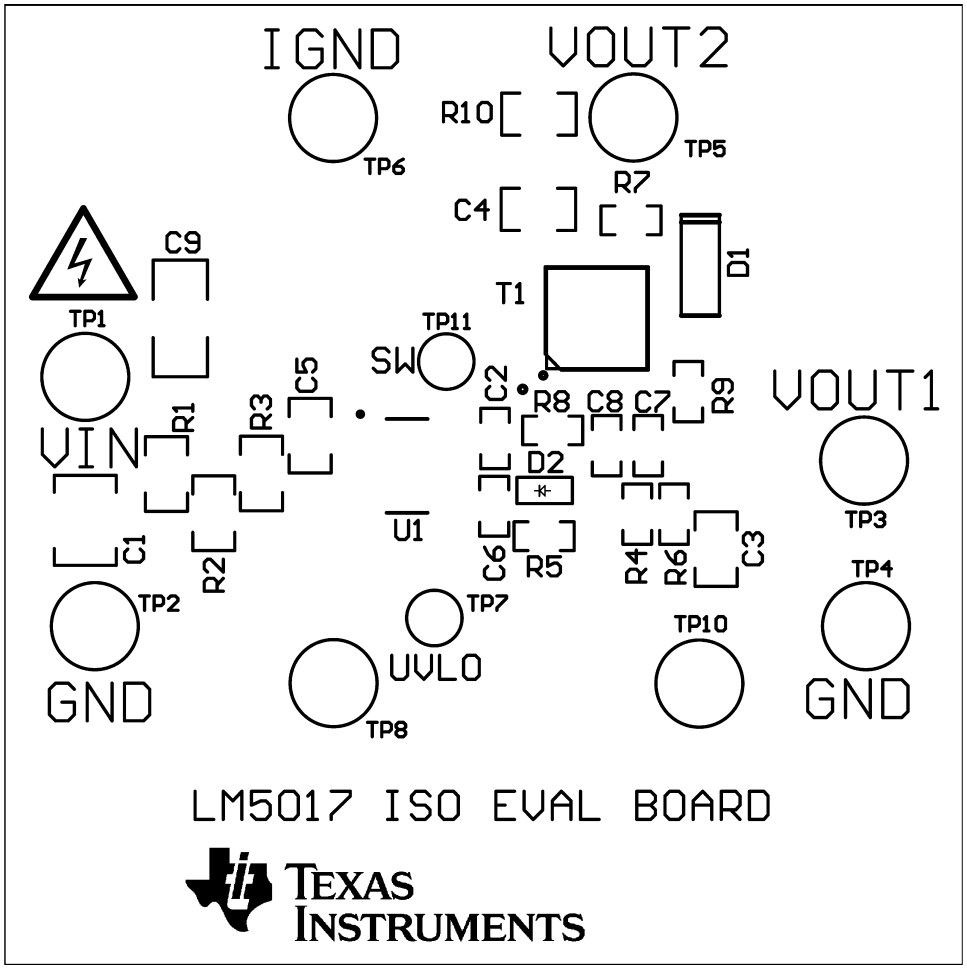

Figure 6. Board Silkscreen

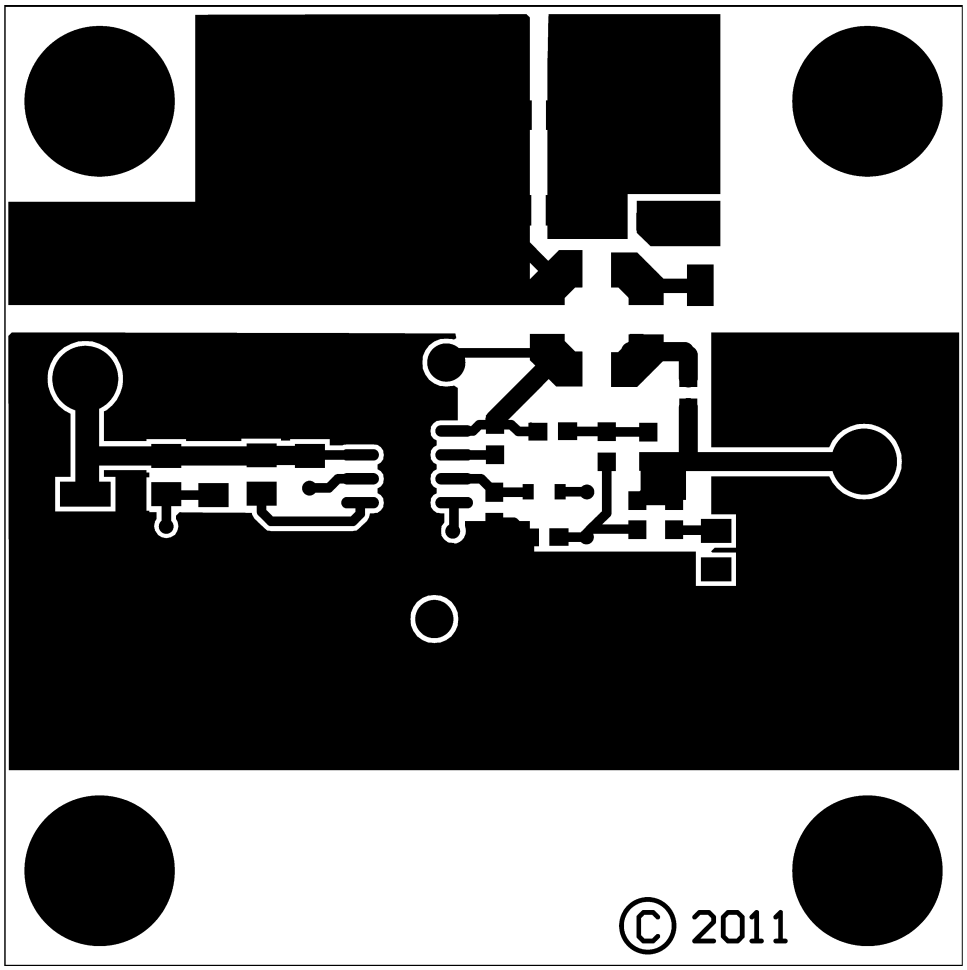

Figure 7. Board Top Layer

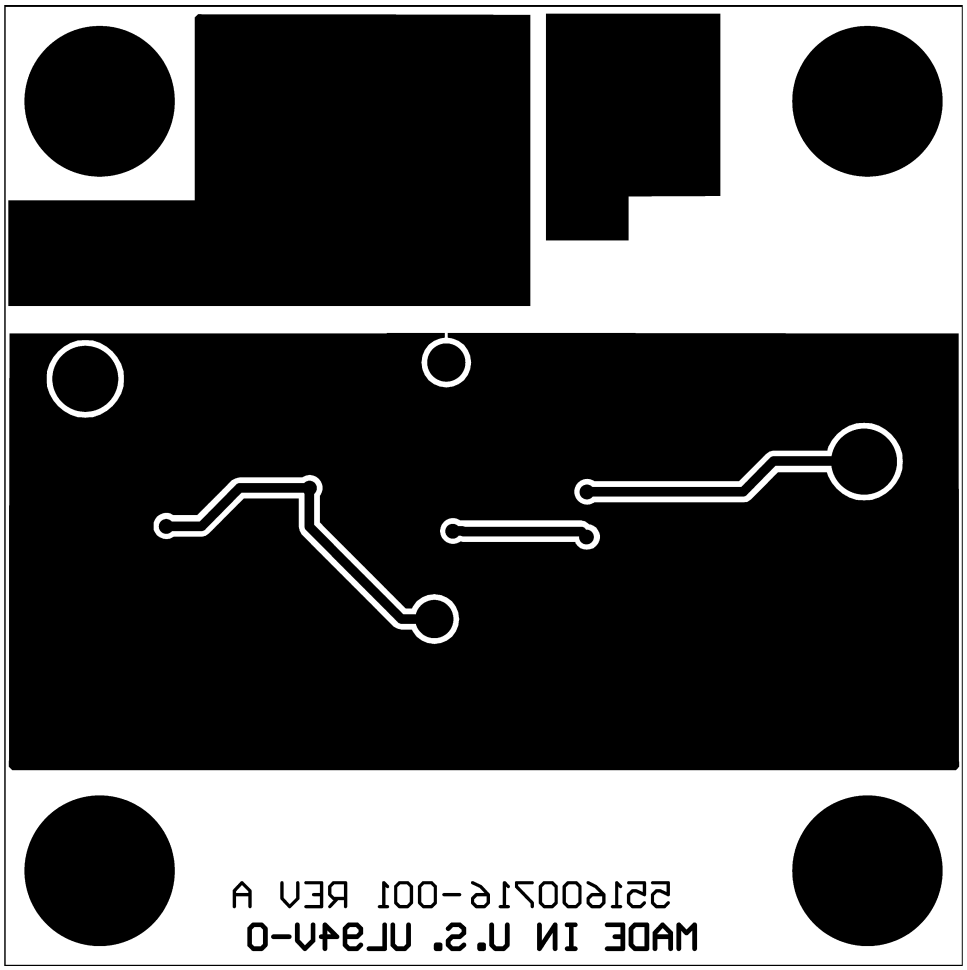

Figure 8. Board Bottom Layer

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Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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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.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

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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.

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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.

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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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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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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