User's Guide
SLVUB05–February 2017

TPS61178 Evaluation Board

This user's guide describes the characteristics, operation, and use of the TPS61178EVM board. This evaluation module (EVM) is optimized for 5.4-V to 12-V input voltage and 16-V output voltage applications. The feedback divider and compensation network can be modified for other application conditions, according to the data sheet

Contents

List of Figures

List of Tables

1 Introduction

The TPS61178 device is a 20-V, 10-A, fully integrated, synchronous boost converter that can be used in a wide variety of applications such as portable speakers, power banks, LCD displays, and more. This EVM is designed to evaluate electrical and thermal performance at 5.4-V to approximately 12-V input voltage and 16-V output voltage conditions. The operating conditions of the EVM can easily be changed by modifying the external components of the TPS61178 device.

1.1 Performance Specification

Table 1 provides the summary of the TPS61178EVM performance specifications. All the specifications are given for an ambient temperature of 25°C.

Table 1. Performance Specification

Specification	Test Condition	MIN	TYP	MAX	UNIT
Input voltage		5.4	7.6	12	V
Output voltage	V_{IN} = 7.6 V, I_{OUT} = 2 A	15.5	16	16.5	V
Output current	V_{IN} = 5.4 V			1.6	A
	V_{IN} = 7.6 V			2.2	A
Switching frequency	V_{IN} = 7.6 V, I_{OUT} = 1 A		500		KHz

1.2 Modification

The external components of the TPS61178 device can be modified to adjust the output voltage, input current limit, switching frequency, and response speed for real applications.

1.3 Input Capacitor C9

The 47-µF, 25-V, tantalum capacitor C9 is added as the input capacitor in the EVM. The ESR of the tantalum capacitor is 0.12 Ω, to damp the ringing of the input voltage when the EVM is powered by a power supply with a long cable. The capacitor is not required for proper operation and can be removed in a real application.

2 Test Setup

This section describes how to properly connect, set up, and use the TPS61178EVM-792.

J1– positive connection of the power supply

J2– negative connection of the power supply

J3– positive connection for the load

J4– negative connection for the load

J5– ground for waveform measurement

J6– EN pin input logic selection, to enable or disable the converter

J7– test point to accurately measure the input voltage

J8– test point to accurately measure the output voltage

TP1– SYNC pin signal input

3 Schematic and Bill of Materials

This section provides the TPS61178EVM-792 schematic and bill of materials (BOM).

3.1 Schematic

Figure 1 shows the schematic of the TPS61178EVM.

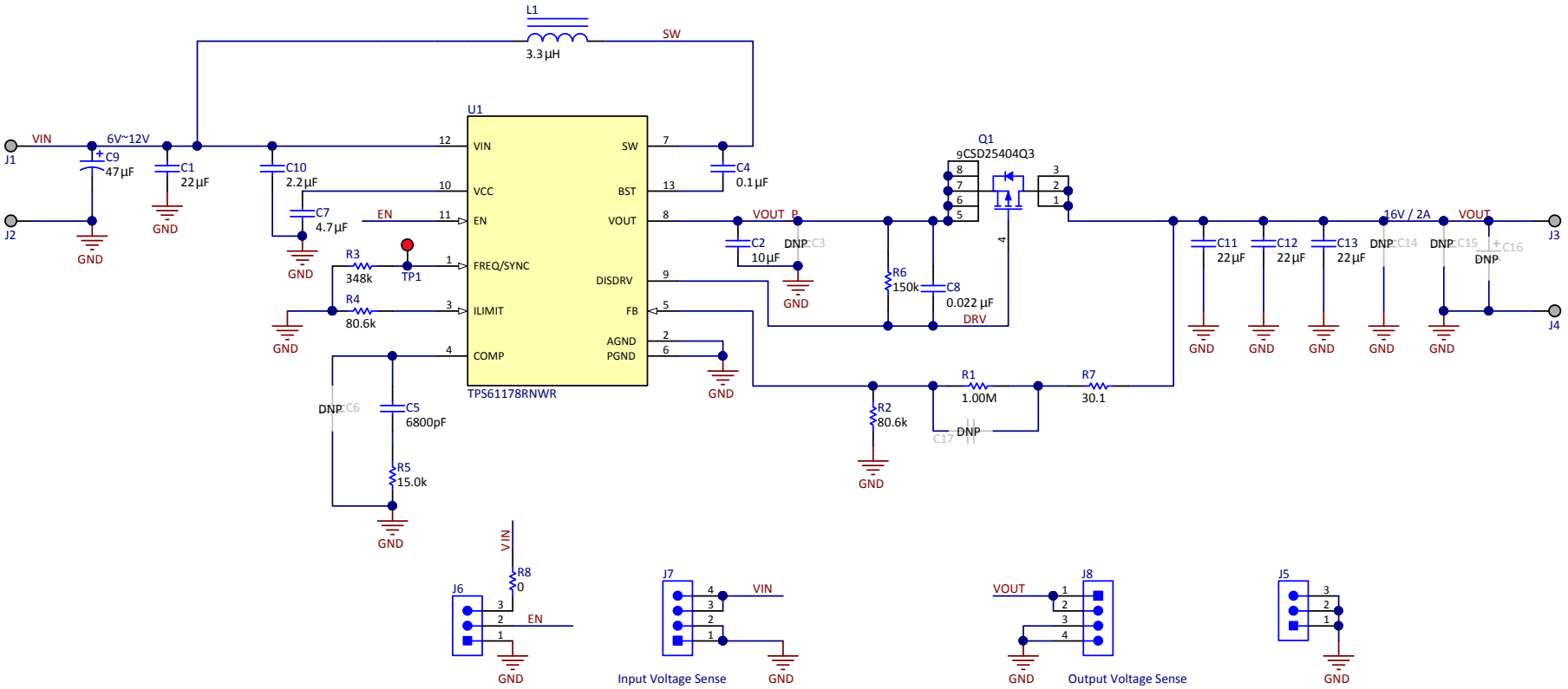

Figure 1. Schematic of the TPS61178EVM-792

3.2 Bill of Materials

Table 2 lists the BOM of the TPS61178EVM-792.

Table 2. Bill of Materials

Designator	Qty	Value	Description	Package	Part Number	Manufacturer
C1, C11, C12, C13	4	22 µF	CAP, CERM, 22 µF, 25 V, ±10%, X5R, 1210	1210	GRM32ER61E226KE15L	Murata
C2	1	10 µF	CAP, CERM, 10 µF, 25 V, ±20%, X5R, 0603	0603	GRM188R61E106MA73D	Murata
C4	1	0.1 µF	CAP, CERM, 0.1 µF, 16 V, ±10%, X5R, 0402	0402	GRM155R61C104KA88D	Murata
C5	1	6800 pF	CAP, CERM, 6800 pF, 25 V, ±10%, X7R, 0402	0402	GRM155R71E682KA01D	Murata
C7	1	4.7 µF	CAP, CERM, 4.7 µF, 10 V, ±20%, X5R, 0402	0402	GRM155R61A475MEAAD	Murata
C8	1	0.022 µF	CAP, CERM, 0.022 µF, 25 V, ±10%, X7R, 0402	0402	GRM155R71E223KA61D	Murata
C9	1	47 µF	CAP, TA, 47 µF, 25 V, ±20%, 0.12 Ω, SMD	7343-31	T495D476M025ATE120	Kemet
C10	1	2.2 µF	CAP, CERM, 2.2 µF, 25 V, ±10%, X5R, 0402	0402	GRM155R61E225KE11D	Murata
J1, J2, J3, J4	4	Double	Terminal, Turret, TH, Double	Keystone1502-2	1502-2	Keystone
J5, J6	2		Header, 100 mil, 3x1, Gold, TH	3 x 1 Header	TSW-103-07-G-S	Samtec
J7, J8	2		Header, 100 mil, 4x1, Gold, TH	4 x 1 Header	TSW-104-07-G-S	Samtec
L1	1	3.3 µH	Inductor, Shielded Drum Core, Powdered Iron, 3.3 µH, 8 A, 0.0108 Ω, SMD	10 x 3.8 x 10 mm	74437368033	Wurth Elektronik
Q1	1	-20 V	MOSFET, P-CH, -20 V, -60 A, DQG0008A	DQG0008A	CSD25404Q3	Texas Instruments
R1	1	1.00 Meg	RES, 1.00 M, 1%, 0.063 W, 0402	0402	CRCW04021M00FKED	Vishay-Dale
R2, R4	2	80.6 k	RES, 80.6 k, 1%, 0.063 W, 0402	0402	CRCW040280K6FKED	Vishay-Dale
R3	1	348 k	RES, 348 k, 1%, 0.063 W, 0402	0402	CRCW0402348KFKED	Vishay-Dale
R5	1	15.0 k	RES, 15.0 k, 1%, 0.063 W, 0402	0402	CRCW040215K0FKED	Vishay-Dale
R6	1	150 k	RES, 150 k, 1%, 0.063 W, 0402	0402	CRCW0402150KFKED	Vishay-Dale
R7	1	30.1	RES, 30.1, 1%, 0.063 W, 0402	0402	CRCW040230R1FKED	Vishay-Dale
R8	1	0	RES, 0, 5%, 0.1 W, 0603	0603	CRCW06030000Z0EA	Vishay-Dale
TP1	1	Red	Test Point, Multipurpose, Red, TH	Red Multipurpose Testpoint	5010	Keystone
U1	1		20-V_{out} Fully Integrated Synchronous Boost Converter with 8-A Switch Current, RNW0013A	RNW0013A	TPS61178RNWR	Texas Instruments
C3	0	10 µF	CAP, CERM, 10 µF, 25 V, ±20%, X5R, 0603	0603	GRM188R61E106MA73D	Murata
C6, C17	0	10 pF	CAP, CERM, 10 pF, 50 V, ±5%, C0G/NP0, 0402	0402	GRM1555C1H100JA01D	Murata
C14, C15	0	22 µF	CAP, CERM, 22 µF, 25 V, ±10%, X5R, 1210	1210	GRM32ER61E226KE15L	Murata
C16	0	220 µF	CAP, AL, 220 µF, 35 V, ±20%, TH	D8 x L11.5 mm	ECA-1VM221BJ	Panasonic

4 Board Layout

The TPS61178EVM board is a 4-layer, 2-oz copper thick PCB. All the components are placed on the top layer. Figure 2 and Figure 3 show the top view and bottom view, respectively

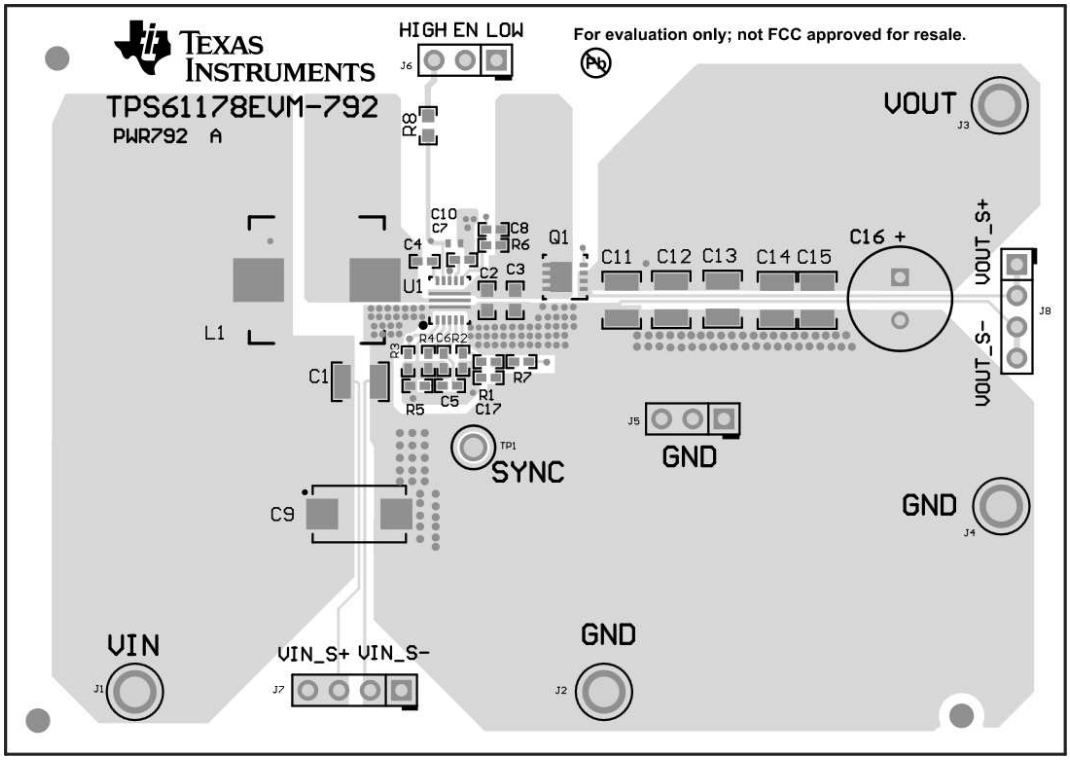

Figure 2. Top View of the TPS61178EVM-792

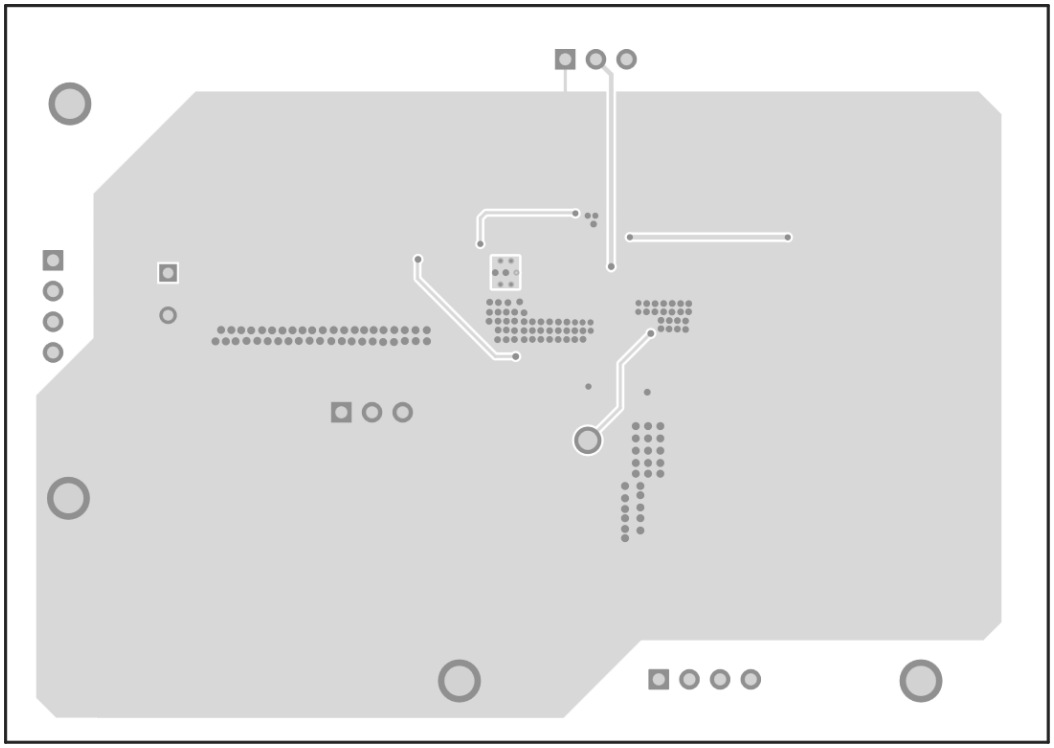

Figure 3. Bottom View of the TPS61178EVM-792

Internal layer 1 and layer 2 are ground panels that help to improve the thermal performance, as illustrated in Figure 4 and Figure 5.

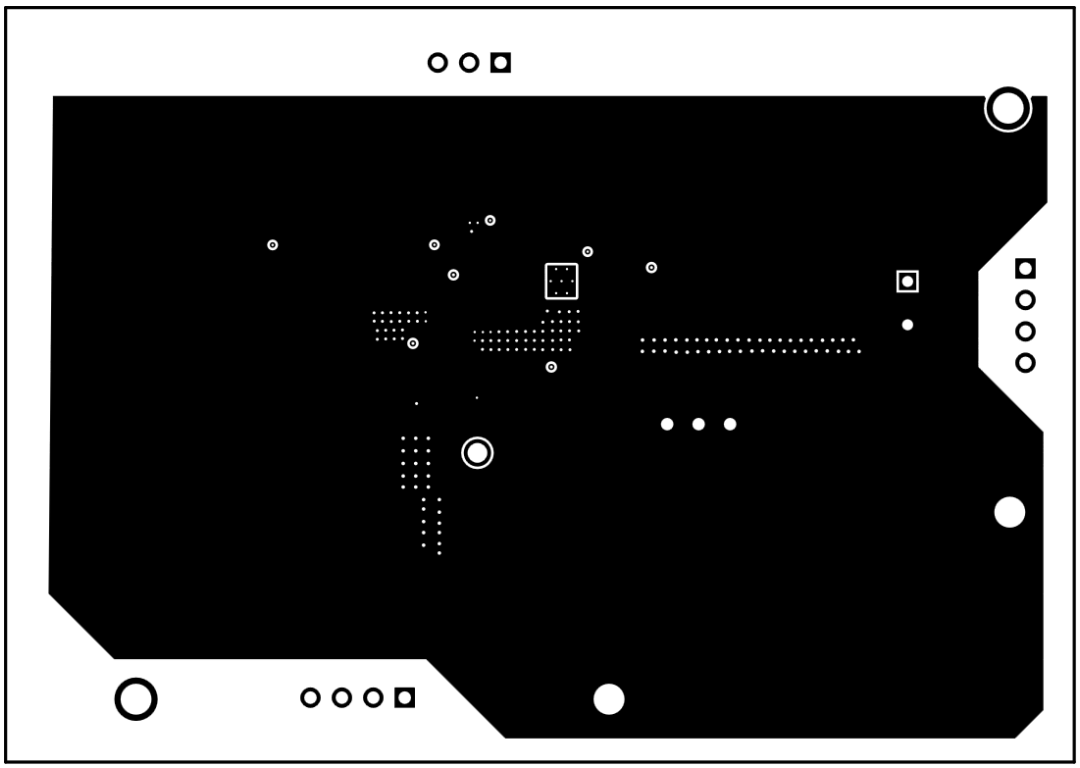

Figure 4. Internal Layer 1 of the TPS61178EVM-792

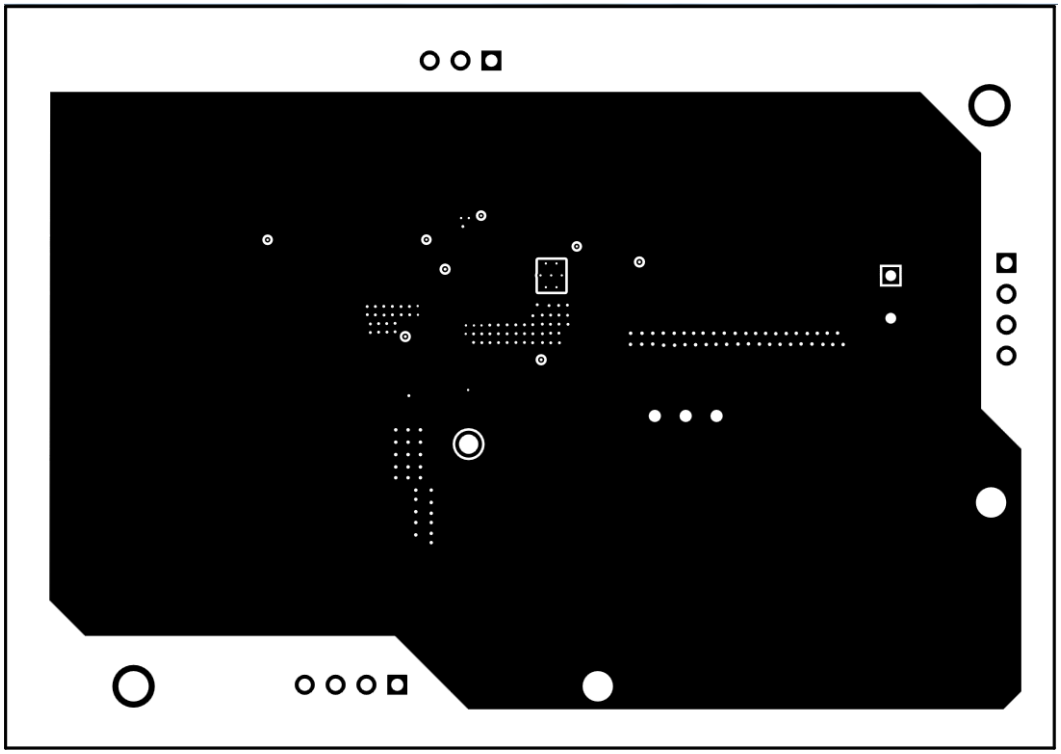

Figure 5. Internal Layer 2 of the TPS61178EVM-792

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      3.1.2 *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

      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.*

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(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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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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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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10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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