User's Guide
SLVU408–October 2010

TPS61252 Evaluation Module

This user's guide describes the characteristics, operation, and use of the TPS61252 evaluation module (EVM). This EVM contains the Texas Instruments 3.25 MHz, up to 6.5 V, step-up DC-DC converter TPS61252 with an adjustable input current limit. The user's guide includes EVM specifications, recommended test setup, the schematic diagram, bill of materials, the board layout, and test data.

CAUTION

Please be aware that the input current is limited to 500 mA on this EVM. For maximum output current operation remove R3 and connect ILIM to VIN.

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1 Introduction

The TPS61252 device provides a power supply solution for products powered by either a three-cell alkaline, NiCd or NiMH battery, or a one-cell Li-Ion or Li-polymer battery. The wide input voltage range is ideal to power portable applications like mobile phones or computer peripherals. The device has a resistor programmable (RILIM) input current limit and is suitable for a wide variety of applications.

1.1 Requirements

The TPS61252 EVM is designed to operate over the full input voltage range and produces an output voltage of 5.0 V. The output voltage can be adjusted by changing the feedback resistor divider network.

In order to operate this EVM, only a DC power supply capable of delivering between 2.3 V and 6.0 V at up to 500 mA is necessary.

1.2 Applications

- USB Host Supplies from a Single Li-Ion Battery
- Current Limited Applications
- Li-Ion Applications
- Audio Applications
- RF-PA Buffers

1.3 Features

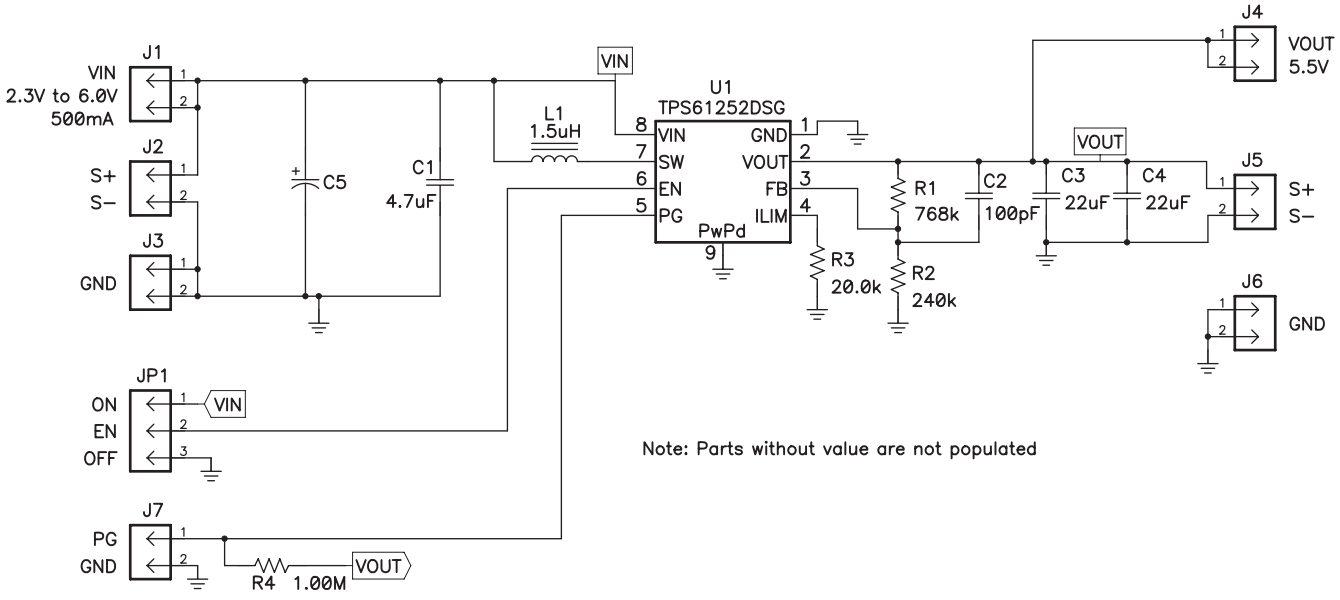
- Resistor Programmable Input Current Limit
  - ±20% Current Accuracy at 500 mA over Full Temperature Range
  - Programmable from 100 mA up to 1500 mA
- Up to 92% Efficiency
- V_{IN} Range from 2.3 V to 6.0 V
- Power Good Indicates the Appropriate Output Voltage Level
- Adjustable Output Voltage up to 6.5 V
- 100% Duty-Cycle Mode When $V_{IN} > V_{OUT}$
- Load Disconnect and Reverse Current Protection
- Double-sided, two-active-layer PCB with all components on top side
- Active converter area of approximately 60 mm^2

2 TPS61252 EVM Electrical Performance Specifications

Table 1. TPS61252 EVM Electrical and Performance Specifications

Parameter		Notes & Conditions	Min	Typ	Max	Unit
Input Characteristics						
V_{IN}	Input Voltage		2.3		6.0	V
I_{IN}	Average Input Current		400	500	600	mA
	No Load Input Current				1	mA
V_{IN_UVLO}	Input UVLO	Falling		2.0	2.1	V
Output Characteristics						
V_{OUT}	Output Voltage	V_{IN} = 3.6 V, I_{OUT} = 300 mA	4.9	4.99	5.1	V
	Line Regulation	V_{IN} = 2.3 V to 6.0 V		0.5%		
	Load Regulation	I_{OUT} = 0 mA to 300 mA		0.5%		
$V_{OUTripple}$	Output Voltage Ripple	V_{IN} = 3.6 V, I_{OUT} = 330 mA			50	mVpp
I_{OUT}	Output Current	V_{IN} = 3.6 V			330	mA
Systems Characteristics						
f	Switching Frequency			3.25		MHz
η_{pk}	Peak Efficiency	V_{IN} = 3.6 V		92%		
η	Full Load Efficiency	V_{IN} = 3.6 V, I_{OUT} = 330 mA		90%		

3 TPS61252 EVM Schematic



For Reference Only, See Table 2 for Specific Values

Figure 1. TPS61252 EVM Schematic

4 Connector and Test Point Descriptions

4.1 Input Connectors

4.1.1 J1 – VIN

This header is the positive connection to the input power supply. The power supply must be connected between these pins and J3 (GND). Twist the leads to the input supply and keep them as short as possible. The input voltage has to be between 2.3 V and 6.0 V.

4.1.2 J2 – Input Sense Connector

This header is intended to measure the input voltage directly on the input capacitor. Therefore, a 4-wire power and sense supply can be connected. Twist the leads to the sensing connector.

4.1.3 J3 –GND

This header is the return connection to the input power supply. Connect the power supply between these pins and J1 (VIN). Twist the leads to the input supply and keep them as short as possible. The input voltage must be between 2.3 V and 6.0 V.

4.2 Output Connectors

4.2.1 J4 – VOUT

This header is the positive connection of the output voltage. Connect the load between these pins and J6 (GND).

4.2.2 J5 – Output Sense Connector

This header is intended to measure the output voltage directly on the output capacitors.

4.2.3 J6 – GND

This header is the return connection of the output voltage. Connect the load between these pins and J4 (VOUT).

4.3 Other Connectors

4.3.1 J7 – Power Good Connector

The Power Good Output (PG) of the IC is an open-drain output and there is a 1 MΩ resistor connected between PG and VOUT. Pin 1 of this connector is connected to PG and Pin2 is connected to GND.

4.4 Jumpers

4.4.1 JP1 – Enable Jumper

Placing a jumper across pins EN and ON ties the EN pin to VIN, thereby enabling the device. Placing a jumper across pins EN and OFF ties the EN pin to GND, which disables the device.

5 TPS61252 EVM Test Data

Figure 5 through Figure 11 present typical performance curves for the TPS61252 EVM. Since actual performance data can be affected by measurement techniques and environmental variables, these curves are presented for reference and may differ from actual field measurements.

5.1 Efficiency

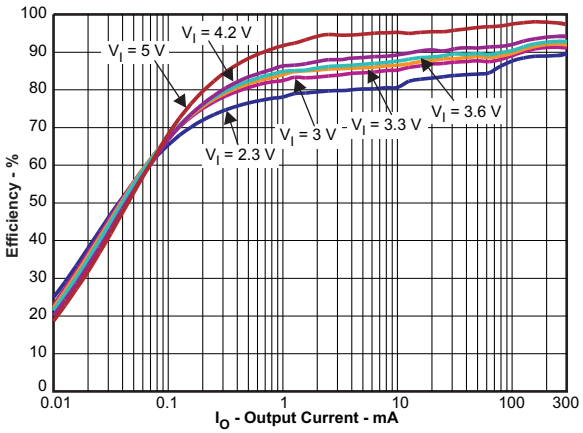


Figure 2. TPS61252 EVM Efficiency vs Load Current

5.2 Line and Load Regulation

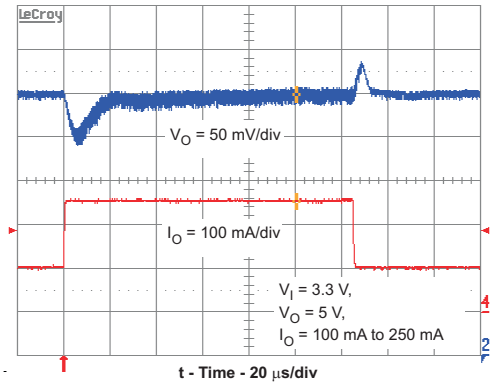


Figure 3. TPS61252 EVM Load Transient Response Continuous Conduction Mode

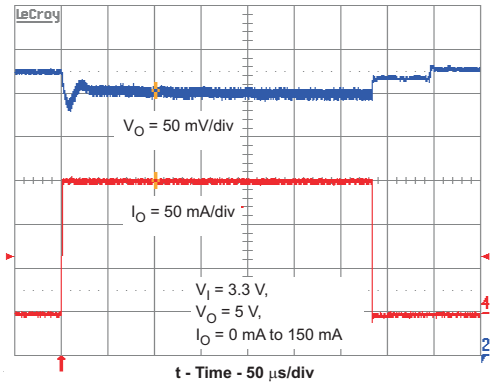


Figure 4. TPS61252 EVM Load Transient Response with Mode Change, Snooze Mode to Pulse Frequency Mode

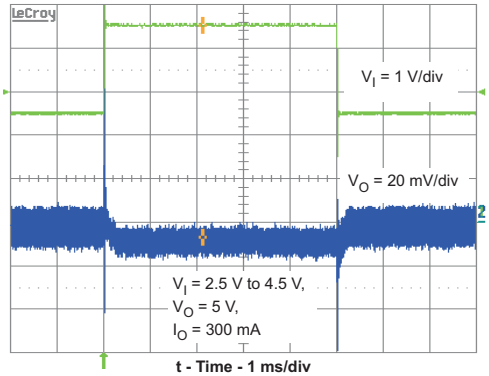


Figure 5. TPS61252 EVM Line Transient Response

5.3 Output Voltage Ripple

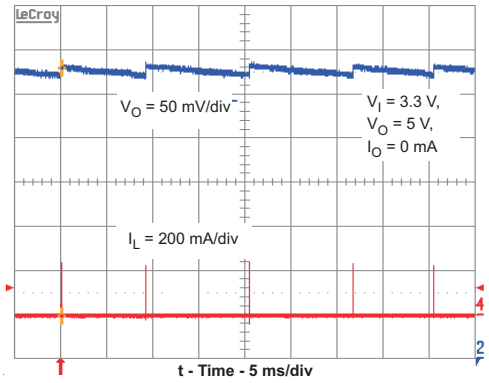


Figure 6. TPS61252 EVM Output Voltage Ripple at No Load

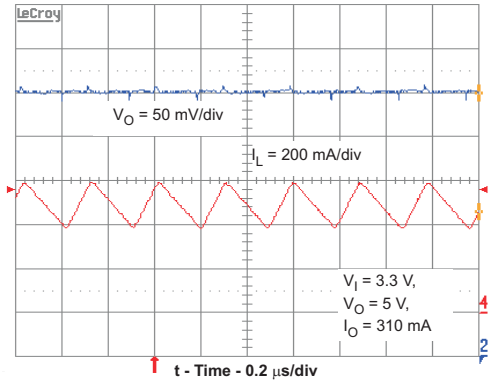


Figure 7. TPS61252 EVM Output Voltage Ripple at Load Limit

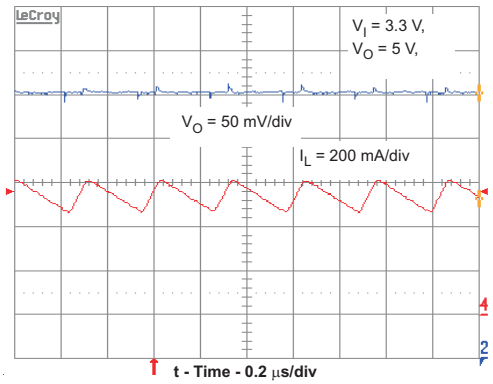


Figure 8. TPS61252 EVM Output Voltage Ripple at Overload

5.4 Control Loop Bode Diagram

The stability was measured with an input voltage of 3.3 V and an output current of 244 mA. The crossover frequency of 47 kHz and the phase margin of 42° correlate with the good load transient response of the part.

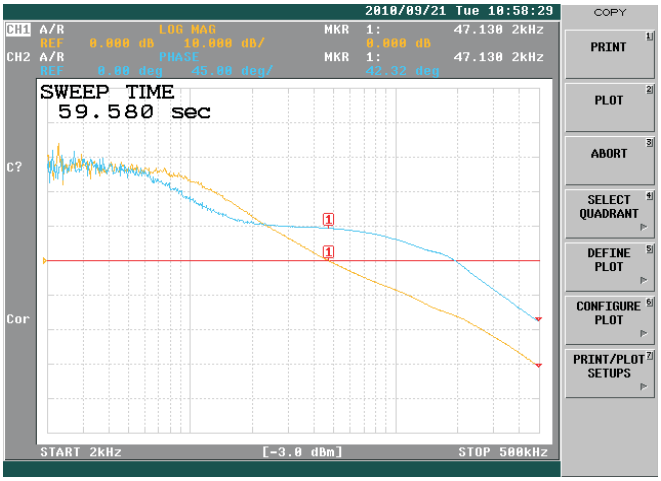


Figure 9. TPS61252 EVM Gain and Phase vs. Frequency

6 TPS61252 EVM Assembly Drawings and Layout

Figure 10 through Figure 12 show the design of the TPS61252 EVM printed circuit board. The EVM uses a 2-Layer, 1-oz copper-clad circuit board 61 mm x 51 mm with all components in a 7 mm x 11 mm active area on the top side. All active top and bottom layer traces allow easy viewing and probing for evaluating the TPS61252 control IC in a practical double-sided application. Moving components to both sides of the PCB, or using additional internal layers, can offer additional size reduction for space-constrained systems.

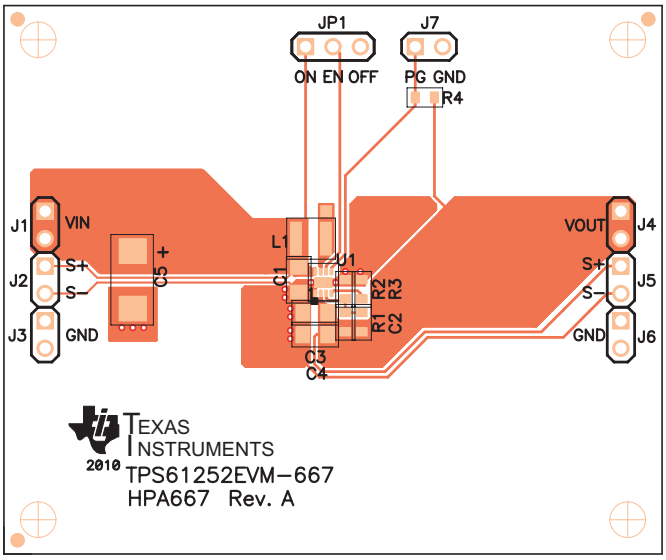


Figure 10. TPS61252 EVM Component Placement (Viewed from Top)

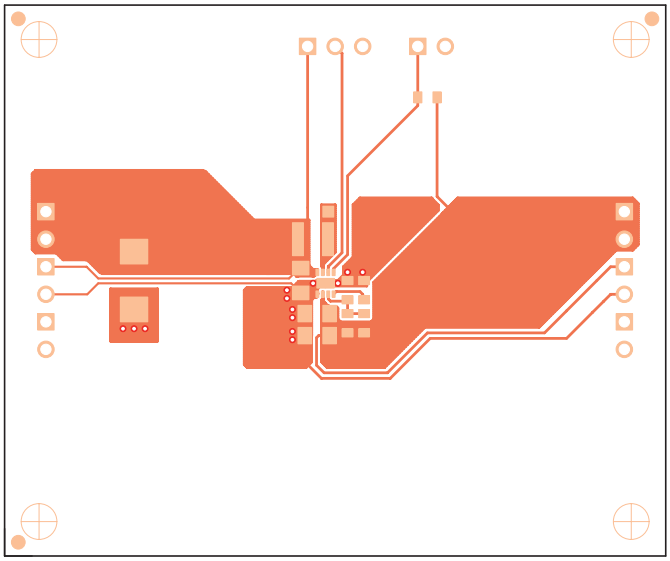


Figure 11. TPS61252 EVM Top Copper (Viewed from Top)

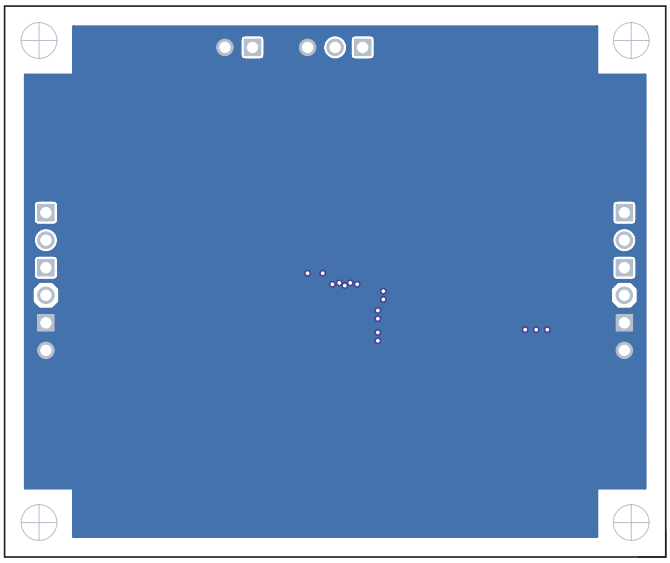


Figure 12. TPS61252 EVM Bottom Copper (Viewed from Bottom)

7 List of Materials

Table 2 lists the EVM components as configured according to the schematic shown in Figure 1.

Table 2. TPS61252 EVM Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
1	C1	4.7 µF	Capacitor, Ceramic, 10V, X7R, 10%	0805	GRM21BR71A475KA73	Murata
1	C2	100pF	Capacitor, Ceramic, 50V, X7R, 10%	0603	STD	STD
2	C3, C4	22 µF	Capacitor, Ceramic, 6.3V, X5R, 20%	0805	GRM21BR61A226ME51	Murata
0	C5	open	Capacitor, Aluminum	6032 (C)	STD	STD
1	L1	1.5 µH	Inductor, SMT, 2.2A, 72milliohm	0.118 X 0.118 inch	XFL3012-152ME	Coilcraft
1	R1	768k	Resistor, Chip, 1/16W, 1%	0603	STD	STD
1	R2	240k	Resistor, Chip, 1/16W, 1%	0603	STD	STD
1	R3	20.0k	Resistor, Chip, 1/16W, 1%	0603	STD	STD
1	R4	1.00M	Resistor, Chip, 1/16W, 1%	0603	STD	STD
1	U1	TPS61252DSG	IC, High Frequency Step-Up Converter, Variable Vout	QFN	TPS61252DSG	TI

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 2.3 V to 6 V and the output voltage range of 3.0 V to 6.5 V .

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than 60° C. The EVM is designed to operate properly with certain components above 60° C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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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.

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 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

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

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

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

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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3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

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.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

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.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

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Last updated 10/2025