EVM User's Guide: TPSM828510EVM TPSM828511EVM TPSM828512EVM

TPSM82851xEVM Evaluation Module

Description

TPSM82851xEVM evaluation module (EVM) is a simple, easy-to-use synchronous step-down DC/DC power modules with integrated inductors. The EVM is available for different output current versions such as TPSM828510EVM for 0.5A, TPSM828511EVM for 1A and TPSM828512EVM for 2A. The EVMs regulate the output voltage to 1.8 V with the input voltage from 2.7 V to 6 V.

Get Started

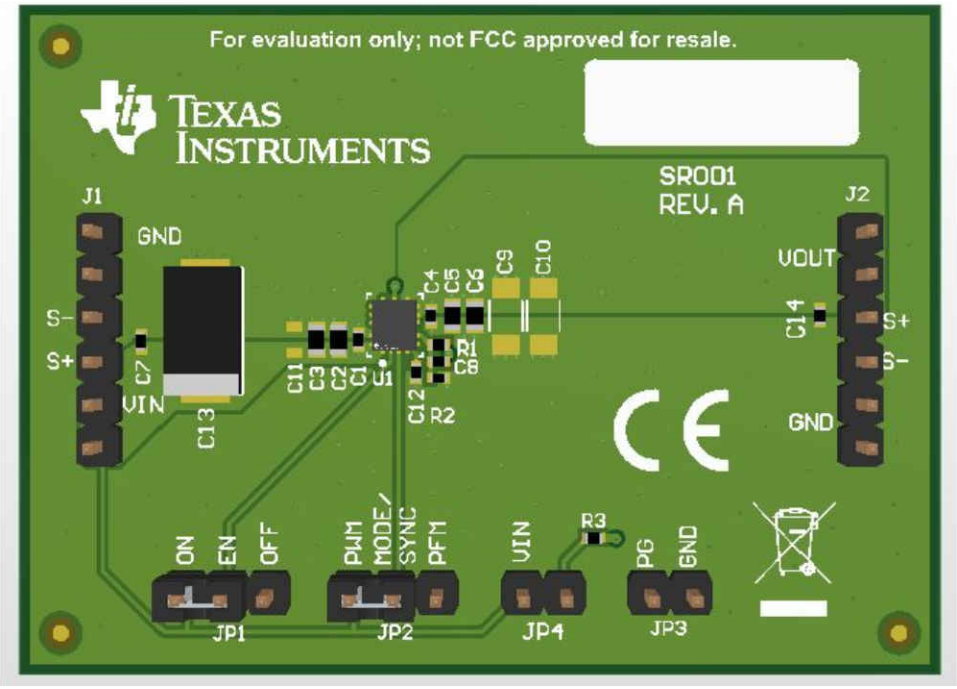
1. Order the EVM.
2. Download the data sheet.
3. Use data sheet or WEBENCH® to modify the soft-start time and output voltage.

Features

- Input voltage range: 2.7 V to 6 V
- Output voltage range: 0.6 V to 5.5 V
- 17-µA typical quiescent current
- Feedback voltage accuracy ±1% (PWM operation)
- Switching frequency of 2.25 MHz (PWM operation)
- External synchronization from 1.8 MHz to 4 MHz
- Selectable forced PWM or PFM/PWM operation
- Active output discharge
- Adjustable soft-start or tracking
- Power-good output with window comparator

Applications

- Factory automation and control
- Signal measurement, source generation, instrumentation
- Patient monitoring and diagnostics
- Wireless infrastructure
- Ruggedized Communication: sensors, imaging, and radar



TPSM82851xEVM Hardware Image (Top View)

1 Evaluation Module Overview

1.1 Introduction

The TPSM82851xEVM facilitates the evaluation of the TPSM82851x 0.5-A, 1-A and 2-A pin to pin compatible step-down converter power modules in a 2.7-mm × 3-mm × 2-mm overmolded QFN package. SR001-001 uses the 0.5-A TPSM828510 device, SR001-002 uses the 1-A TPSM828511 device and SR001-003 uses the 2-A TPSM828512 device. The EVMs regulate the output voltage to 1.8 V with the input voltage from 2.7 V to 6 V. This user's guide describes the characteristics, operation, and use of the TPSM82851xEVM Evaluation Module (EVM) with a complete schematic diagram, printed circuit board layouts, and bill of materials are included in this document.

The TPSM82851x device is a synchronous, step-down converter power module optimized for a small solution size and high efficiency. The devices focus on high-efficiency, step-down conversion over a different output current range. The internal compensation circuit allows a compact solution and small external components. The device is available in a 2.7-mm × 3-mm × 2-mm overmolded QFN package.

1.2 Kit Contents

Table 1-1. TPSM82851xEVM Kit Contents

Item	Description	Quantity
TPSM82851xEVM	PCB	1

1.3 Performance Specifications

Table 1-2. Performance Specifications Summary

SPECIFICATIONS		TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input voltage			2.7		6.0	V
Output voltage setpoint				1.8		V
Output current	TPSM828510EVM		0		0.5	A
	TPSM828511EVM		0		1.0	A
	TPSM828512EVM		0		2.0	A

1.4 Device Information

The EVM is for TPSM82851x device. TPSM82851x is a family of pin-to-pin compatible 0.5-A, 1-A and 2-A high efficiency and easy to use synchronous step-down DC/DC power modules with integrated inductors. The switching frequency is internally fixed at 2.25 MHz and can also be synchronized to an external clock in the range from 1.8 MHz to 4 MHz. In PFM/PWM mode, the TPSM82851x automatically enters Power Save Mode at light loads to maintain high efficiency across the whole load range.

2 Hardware

2.1 Setup

This section describes how to correctly use the TPSM82851xEVM.

2.1.1 Connector Descriptions

J1, Pin 1 and 2 – VIN	Positive input voltage connection from the input supply for the EVM.
J1, Pin 3 and 4 – S+/S–	Input voltage sense connections. Measure the input voltage at this point.
J1, Pin 5 and 6 – GND	Input return connection from the input supply for the EVM.
J2, Pin 1 and 2 – VOUT	Positive output voltage connection.
J2, Pin 3 and 4 – S+/S–	Output voltage sense connections. Measure the output voltage at this point.
J2, Pin 5 and 6 – GND	Output return connection.
JP1 – EN	EN pin jumper. Place the supplied jumper across ON and EN to turn on the IC. Place the jumper across OFF and EN to turn off the IC.
JP2 – MODE/SYNC	MODE/SYNC pin jumper. Place the supplied jumper across VIN and MODE/SYNC to force the device in fixed frequency PWM operation at all load currents. Place the jumper across MODE/SYNC and GND to enable power save mode. Connect a clock signal to MODE/SYNC referenced to GND to synchronize the switching frequency to the clock signal.
JP3 – PG	The PG output appears on pin 1 of this header with a convenient ground on pin 2.
JP4	PG pullup resistor jumper.

2.1.2 Hardware Setup

To operate the EVM, set jumpers JP1 and JP2 to the desired positions per Section 2.1.1. Connect the input supply to J1 between VIN and GND and connect the load to J2 between VOUT and GND.

2.2 Modifications

The printed-circuit board (PCB) for this EVM is designed to accommodate some modifications by the user. Additional input and output capacitors or a feedforward capacitor can be added and the soft-start time can be modified. Also, the MODE setting and output voltage setting configuration can be changed.

2.2.1 Input and Output Capacitors

Footprints for an additional input capacitor (C11) and output capacitors (C9 and C10) are provided. These capacitors are not required for proper operation but can be used to reduce the input and output voltage ripple and to improve the load transient response. For proper operation, the total output capacitance must remain within the recommended range described in the TPSM82851x 6-V input, 0.5-A / 1-A / 2-A Step-down Module with Integrated Inductor in a QFN Package.

2.2.2 Adjustable-Output IC U1 Operation

U1 is configured for evaluation of the adjustable-output version. This unit is set to 1.8 V. Resistors R1 and R2 can be used to set the output voltage between 0.6 V and 5.5 V. For recommended values, see the TPSM82851x 6-V input, 0.5-A / 1-A / 2-A Step-down Module with Integrated Inductor in a QFN Package.

2.2.3 Feedforward Capacitor

C8 is the feedforward capacitor. For recommended values, see the TPSM82851x 6-V input, 0.5-A / 1-A / 2-A Step-down Module with Integrated Inductor in a QFN Package.

2.2.4 Soft-Start Time

C16 controls the soft-start time of the converter and can be changed for a faster or slower ramp up of output voltage. For recommended values, see the TPSM82851x 6-V input, 0.5-A / 1-A / 2-A Step-down Module with Integrated Inductor in a QFN Package.

3 Implementation Results

3.1 TPSM82851xEVM Test Results

The TPSM82851xEVM was used to take the typical characteristics data in the TPSM82851x data sheet. See theTPSM82851x 6-V input, 0.5-A / 1-A / 2-A Step-down Module with Integrated Inductor in a QFN Package. for the performance of this EVM.

4 Hardware Design Files

4.1 Schematic

Figure 4-1 shows the EVM schematic.

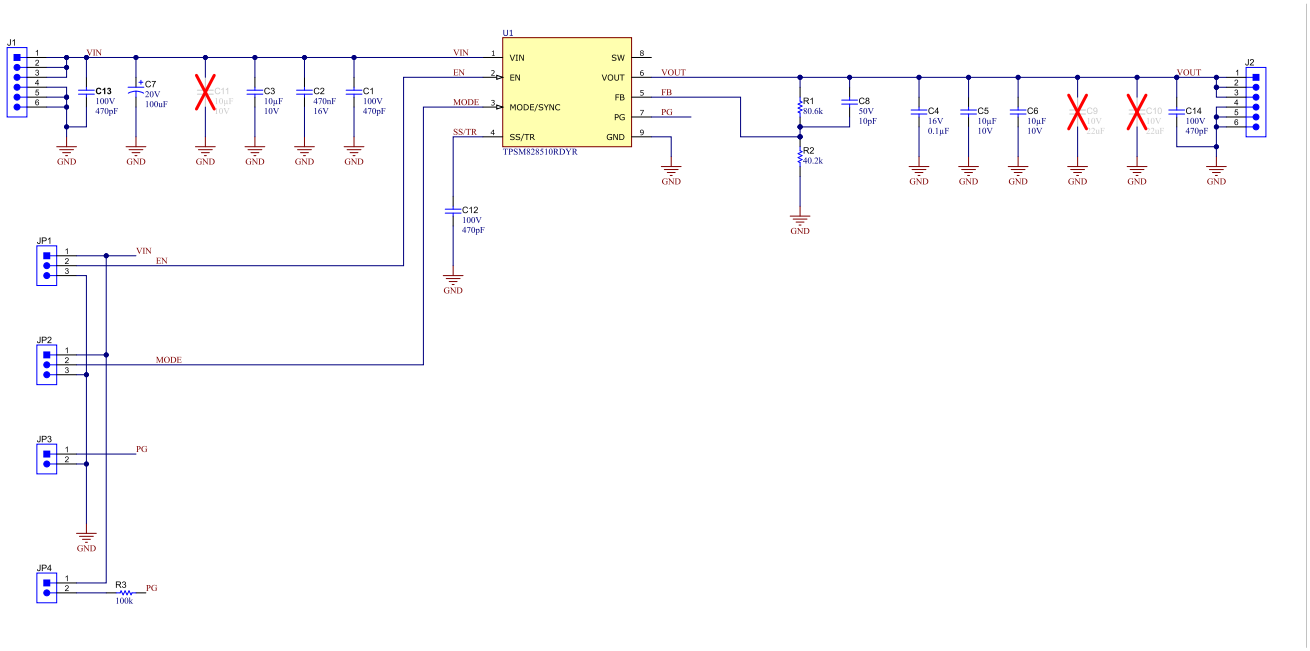


Figure 4-1. TPSM82851xEVM Schematic

4.2 PCB Layouts

This section provides the TPSM82851xEVM board layout. See the TPSM82851xEVM tool page for more details.

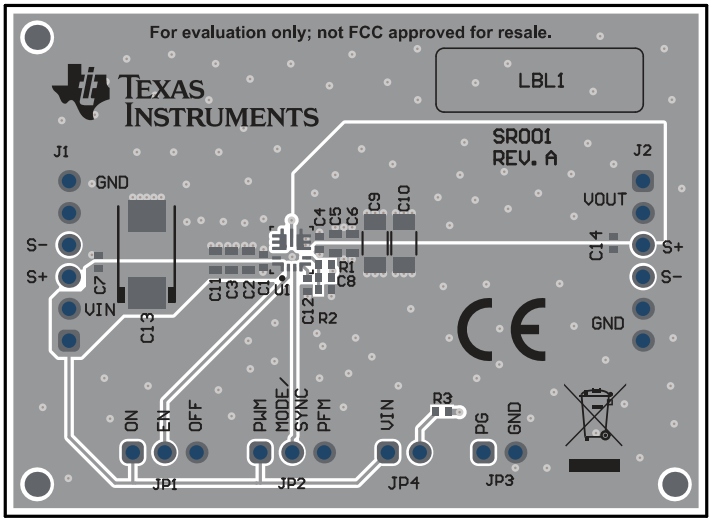


Figure 4-2. Top Silk

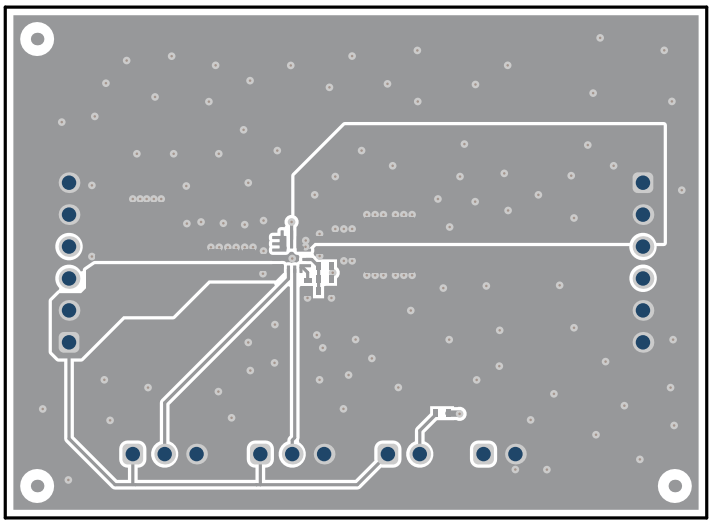


Figure 4-3. Top Layer

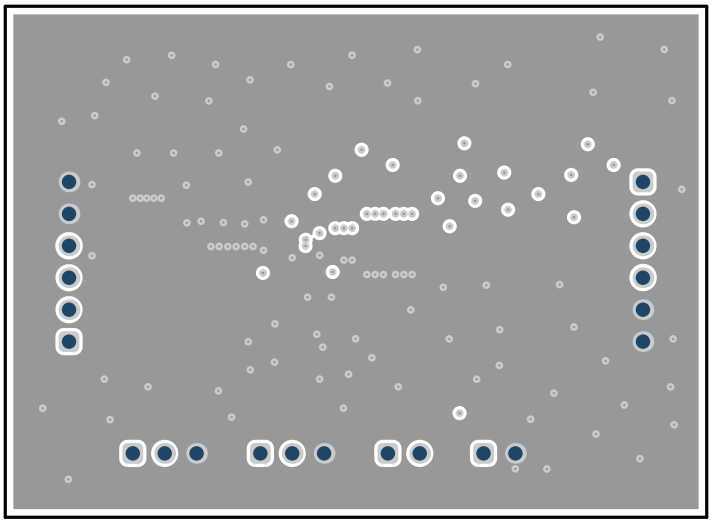


Figure 4-4. Layer 2

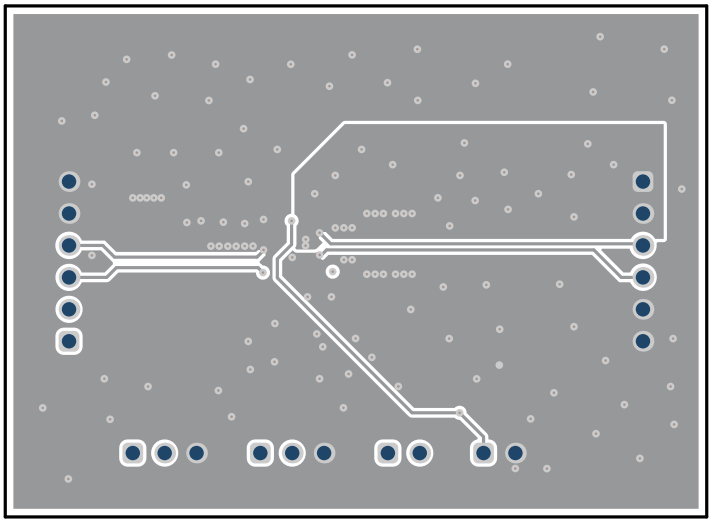


Figure 4-5. Layer 3

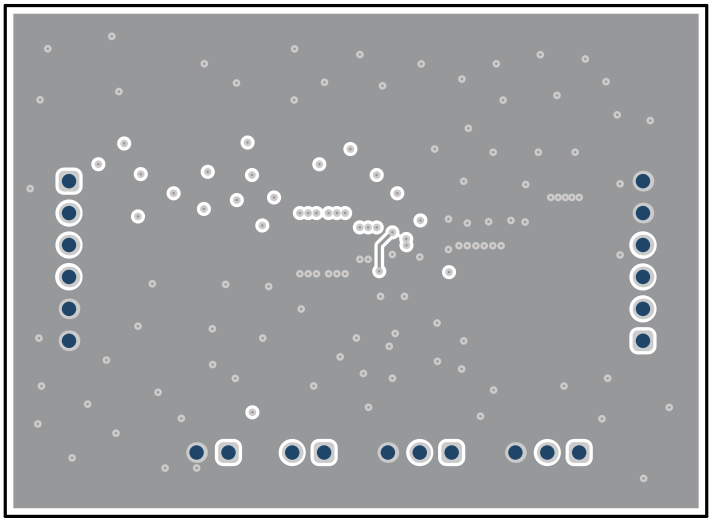


Figure 4-6. Bottom Layer

4.3 Bill of Materials

Table 4-1 lists the bill of materials for this EVM.

Table 4-1. TPSM82851xEVM Bill of Materials

QTY			REF DES	VALUE	DESCRIPTION	SIZE	PART NUMBER	MFR
-001	-002	-003						
1	1	1	C1, C12, C13,C14	470 pF	Ceramic Capacitor, 50 V, X7R	0402		any
1	1	1	C2	0.47 µF	Ceramic Capacitor, 16 V, X7R	0603	GRM188R71C474KA88D	MuRata
3	3	3	C3, C5, C6,C11	10 µF	Ceramic Capacitor, 10 V, X7R	0603	GRM188Z71A106MA73D	MuRata
1	1	1	C4	0.1 µF	Ceramic Capacitor, 16 V, X7R	0402		any
1	1	1	C7	100 µF	Polymer Capacitor, 20 V	7.3x4.3 mm	20TQC100MYF	Panasonic
1	1	1	C8	10 pF	Ceramic Capacitor, 50 V, COG/NPO	0402	GRM1555C1H100JA01D	MuRata
2	2	2	C9, C10	22 µF	Ceramic Capacitor, 10 V, X7R	1206	GRM31CR71A226KE15L	MuRata
1	1	1	R1	80.6 kΩ	Resistor 1%, 0.1 W	0402		any
1	1	1	R2	40.2 kΩ	Resistor 1%, 0.1 W	0402		any
1	1	1	R3	100 kΩ	Resistor 1%, 0.1 W	0402		any
0	0		U1		2.7-V to 6-V Adjustable-Frequency Step-Down Converter	QFN	TPSM828510RDYR	Texas Instruments
0	1	0	U1		2.7-V to 6-V Adjustable-Frequency Step-Down Converter	QFN	TPSM828511RDYR	Texas Instruments
1	0	0	U1		2.7-V to 6-V Adjustable-Frequency Step-Down Converter	QFN	TPSM828512RDYR	Texas Instruments

5 Additional Information

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   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

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Evaluation Kits 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 shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 *Regulatory Notices:*

3.1 *United States*

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

FCC NOTICE: 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.

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.

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