

TPSM852892EVM Buck-Boost Module Evaluation Module



Description

The TPSM852892EVM is designed to demonstrate the features and functionality of the TPSM852892 device, which is a high-performance, high-efficiency synchronous buck-boost module. The factory default settings of the TPSM852892EVM allow the operation with an input voltage range from 3V to 36V. All these features bring flexibility and design optimization for overall performance, as well as BOM optimization and design cost.

Get Started

1. Order the EVM at ti.com.
2. Read the user's guide carefully.
3. Prepare the bench setup per instructions. Take precautions to prevent damage by ESD when handling the EVM.
4. Power up the EVM by following the recommended steps.

5. Run tests and measurements. Take cautions of high voltage and hot temperature produced by the EVM during test.

Features

- Wide input and output voltage range
- User flexibilities in optimizing loop compensation
- Programmable PFM and FPWM mode at light load
- Optional programmable spread spectrum
- Adjustable output voltage compensation for voltage droop over the cable
- Rich protection features

Applications

- [Laser distance meter](#)
- [Powered surgical tools](#)
- [Parametric measurement unit \(PMU\)](#)

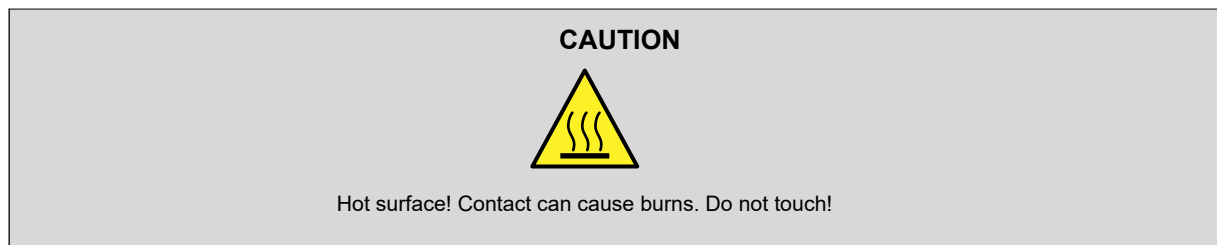


1 Evaluation Module Overview

1.1 Introduction

The TPSM852892 integrates four MOSFETs and one power inductor providing a compact design for a variety of applications and is optimized for converting battery voltage into power supply rails. The TPSM852892 has adjustable external loop compensation, programmable switching frequency, optional spread spectrum and rich protection features. The TPSM852892 also verifies safe operating with optional output current limit and hiccup-mode protection in sustained overload conditions.

This user's guide describes the characteristics and operation of the evaluation module TPSM852892EVM. This document provides instructions on how to use the evaluation module. Throughout this document, the terms of evaluation board, evaluation module, and EVM are synonymous with the TPSM852892EVM. This document also includes a schematic, reference printed circuit board (PCB) layout, and a complete bill of materials (BOM).



1.2 Kit Contents

Table 1-1 details the contents of the EVM kit.

Table 1-1. EVM Kit Contents

ITEM	QUANTITY
TPSM852892EVM	1

1.3 Specification

Table 1-2 provides a summary of the TPSM852892EVM performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 1-2. Performance Specification Summary

Parameter	Test Condition	Value	Unit
Input voltage		3.0–36	V
Output voltage		0.8–22	V
Maximum output current	$V_{IN} \geq 5V$, $V_{OUT} = 10V$	2	A
	$V_{IN} \geq 6V$, $V_{OUT} = 12V$		
	$V_{IN} \geq 12V$, $V_{OUT} = 20V$		
Default switching frequency		400	kHz

1.4 Device Information

The TPSM852892 is a buck-boost module which integrates four MOSFETs and power inductor, providing a compact device for a variety of applications. The device has up to 36V input voltage capability. The switching frequency is programmable from 400kHz to 1.0MHz by an external resistor and can be synchronized to an external clock. The spread spectrum function is optional to minimize peak EMI. The output over-voltage protection, average inductor current limit, cycle-by-cycle peak current limit, and output short circuit protection are provided. Refer to [TPSM852892 36V, 8A Buck-Boost Module Data Sheet](#) for more detailed information of the TPSM852892 fully integrated buck-boost module.

The factory default settings of the TPSM852892EVM allow the operation with an input voltage range from 3V to 36V. In addition, users can modify the EVM to adjust the switching frequency by changing resistor value at the FSW pin.

2 Hardware

This section describes how to properly connect, set up, and use the TPSM852892EVM.

2.1 Connector, Test Point, and Jumper Descriptions

This section describes how to properly connect, set up, and use the TPSM852892EVM.

2.1.1 Connector and Test Point Descriptions

This EVM includes I/O connectors and test points as shown in [Table 2-1](#). The power supply must be connected to input connectors, J1 and J2. The load must be connected to output connectors, J3 and J4.

Table 2-1. Connectors and Test Points

Reference Designator	Description
J1	Input voltage positive connection
J2	Input voltage return connection
J3	Output voltage connection
J4	Output voltage return connection

2.1.2 Jumper Configuration

2.1.2.1 JP1 (ENABLE)

The JP1 jumper enables the device. By default, this jumper is set to the OFF position. Put this jumper in the ON position to enable the device.

2.1.2.2 JP5 (SYNC)

The JP5 jumper is for frequency dithering selection. Placing a jumper across JP6 disables the frequency dithering function. Leave JP5 open when using the frequency dithering function.

2.1.2.3 JP4 (Internal or External VCC Selection)

The JP4 jumper is for the internal LDO or external VCC selection. By default, the jumper is set to the VCC position and the device selects an internal LDO as the VCC source.

To minimize the power dissipation of the internal LDO when both input voltage and output voltage are high, an external 5V power supply can be applied at the VCC pin to supply the TPSM852892. Place a jumper across EXTVC and AGND to set the device VCC source externally. The external 5V power supply must have at least 100mA output current capability and must be within the 4.75V to 5.5V regulation range.

2.2 Test Procedure

1. Set the power supply current limit to 10A. Set the power supply to approximately 12V. Turn off the power supply. Connect the positive output of the power supply to J1 and the negative output to J2.
2. Connect the load to J3 for the positive connection and connect the load J4 for the negative connection.
3. Turn on the power supply.
4. Set the JP1 jumper across EN and ON. The default output voltage is 12V.
5. Slowly increase the load while monitoring the output voltage between J3 and J4. The output voltage must remain in regulation when the load current is lower than 5A.
6. Slowly sweep the input voltage from 5V to 20V. The output voltage must remain in regulation when the load current is lower than the maximum load current specified in [Table 1-2](#).
7. Turn off the load and power supply. Then, turn on the load to discharge the output capacitors.

This section provides the TPSM852892 schematic, board layout and bill of materials (BOM).

3.1 Schematic

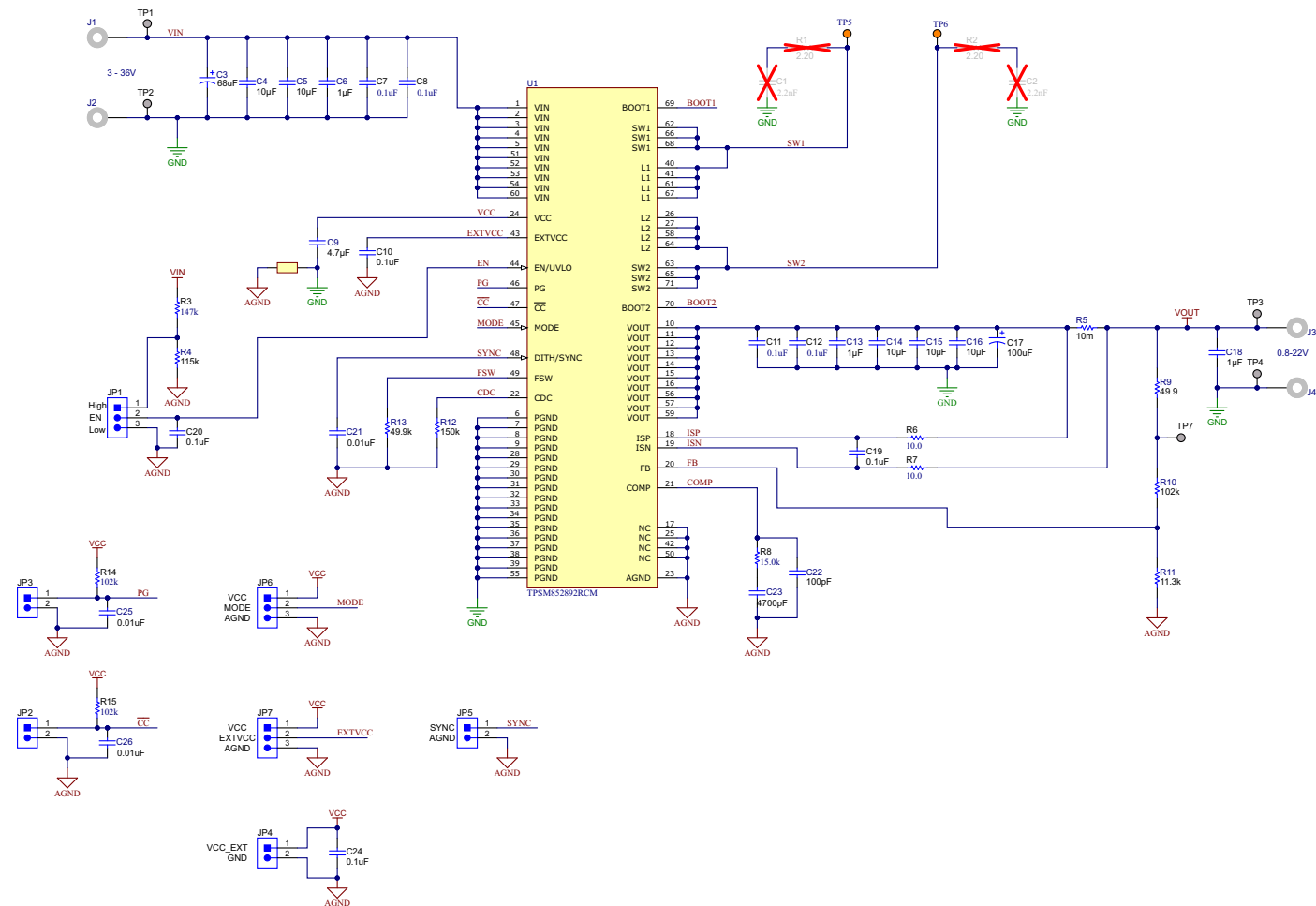


Figure 3-1. TPSM852892EVM Schematic

3.2 PCB Layouts

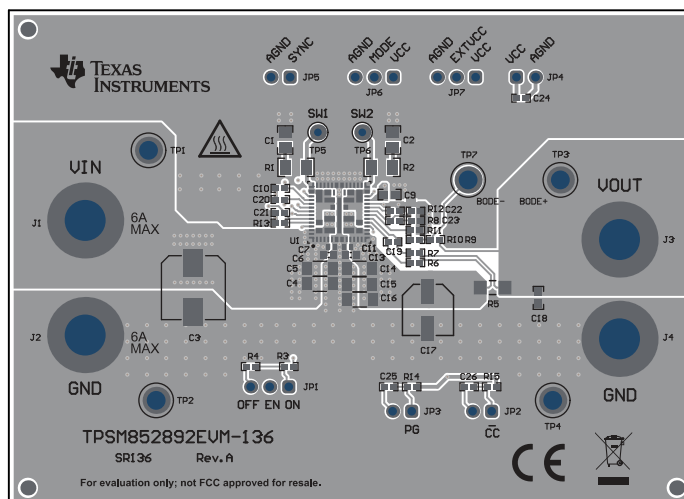


Figure 3-2. TPSM852892EVM Top-Side Layout

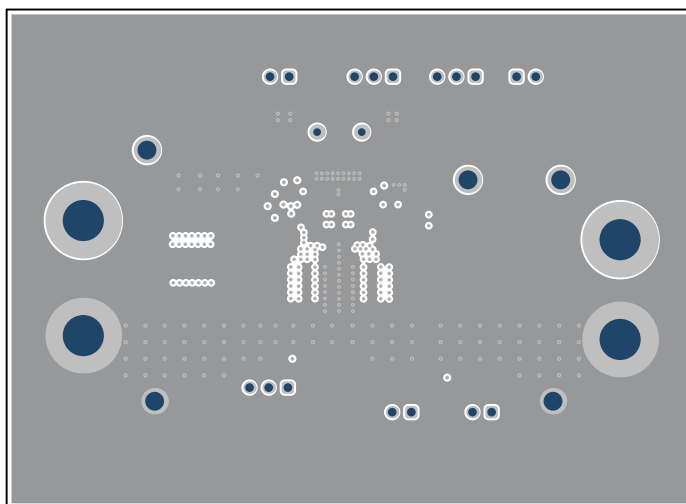


Figure 3-3. TPSM852892EVM Inner Layer1

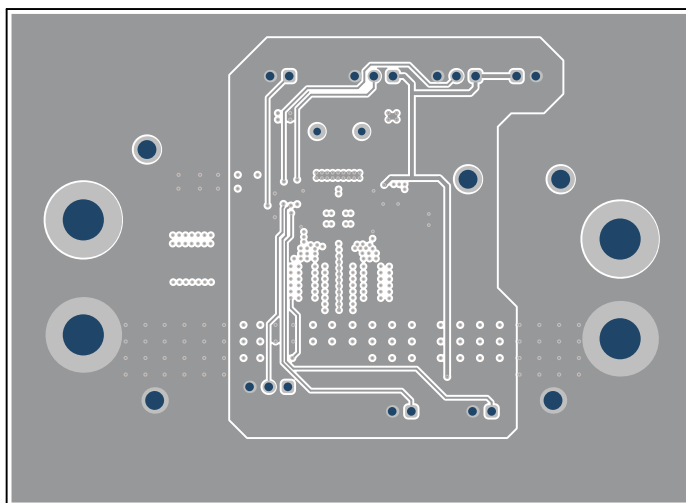


Figure 3-4. TPSM852892EVM Inner Layer2

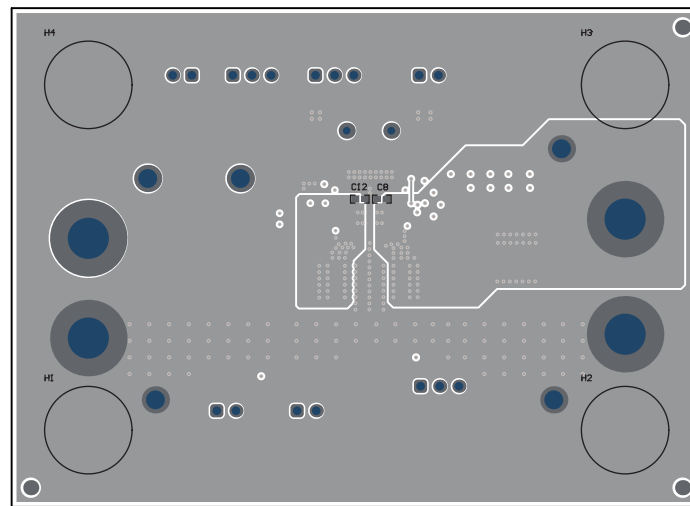


Figure 3-5. TPSM852892EVM Bottom-Side Layout

3.3 Bill of Materials

Table 3-1. Bill of Materials

Designator	Qty	Value	Description	Package	Part Number	Manufacturer
C3	1	68uF	CAP, Polymer Hybrid, 68uF, 50V, +/- 20%, 30ohm, 8x10 SMD	8x10	EEHZA1H680P	Panasonic
C4, C5, C14, C15, C16	5	10uF	CAP, CERM, 10uF, 50V, +/- 10%, X7R, AEC-Q200 Grade 1, 1206	1206	CGA5L1X7R1H106K160AC	TDK
C6, C13, C18	3	1uF	CAP, CERM, 1uF, 50V, +/- 20%, X5R, AEC-Q200 Grade 3, 0603	0603	GRT188R61H105ME13D	MuRata
C7, C8, C11, C12	4	0.1uF	CAP, CERM, 0.1uF, 50V, +/- 20%, X7R, 0402	0402	GRM155R71H104ME14D	MuRata
C9	1	4.7uF	CAP, CERM, 4.7uF, 16V, +/- 10%, X5R, AEC-Q200 Grade 3, 0603	0603	GRT188R61C475KE13D	MuRata
C10, C19, C20, C24	4	0.1uF	CAP, CERM, 0.1uF, 50V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	CGA2B3X7R1H104K050BB	TDK
C17	1	100uF	CAP, AL, 100uF, 35V, AEC-Q200 Grade 2, SMD	D6.3xL5.8mm	EEHZK1V101XP	Panasonic
C21, C25, C26	3	0.01uF	CAP, CERM, 0.01uF, 50V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	CGA2B3X7R1H103K050BB	TDK
C22	1	100pF	CAP, CERM, 100pF, 50V, +/- 5%, C0G/NP0, AEC-Q200 Grade 1, 0402	0402	CGA2B2C0G1H101J050BA	TDK
C23	1	4700pF	CAP, CERM, 4700pF, 50V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	CGA2B2X7R1H472K050BA	TDK
FID4, FID5, FID6	3		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
J1, J2, J3, J4	4		Standard Banana Jack, Uninsulated, 6.73mm	Standard Banana Jack, Uninsulated, 6.73mm	575-6	Keystone
JP1, JP6, JP7	3		Header, 2.54mm, 3x1, Gold, TH	Header, 2.54mm, 3x1, TH	61300311121	Würth Elektronik
JP2, JP3, JP4, JP5	4		Header, 2.54mm, 2x1, Gold, TH	Header, 2.54mm, 2x1, TH	61300211121	Würth Elektronik
R3	1	147k	RES, 147k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW0402147KFKE D	Vishay-Dale
R5	1		10 mOhms ±1% 1W Chip Resistor 1206 (3216 Metric) Automotive AEC-Q200, Current Sense, Moisture Resistant Metal Element	1206	CRF1206-FZ-R010ELF	Bourns
R4	1	115k	RES, 115k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW0402115KFKE D	Vishay-Dale
R9	1	49.9	RES, 49.9, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW040249R9FK ED	Vishay-Dale
R6, R7	2	10	RES, 10.0, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW040210R0FK ED	Vishay-Dale

Table 3-1. Bill of Materials (continued)

Designator	Qty	Value	Description	Package	Part Number	Manufacturer
R8	1	15.0k	RES, 15.0k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW040215K0FKE D	Vishay-Dale
R13	1	49.9k	RES, 49.9k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW040249K9FKE D	Vishay-Dale
R12	1	150k	RES, 150k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW0402150KFKE D	Vishay-Dale
R10, R14,R15	3	102k	RES, 102k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW0402102KFKE D	Vishay-Dale
R11	1	11.3k	RES, 11.3k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402	CRCW040211K3FKE D	Vishay-Dale
SH-JP1, SH-JP2, SH-JP3, SH-JP4	6		Shunt, 100mil, Gold plated, Black	Shunt 2 pos. 100 mil	881545-2	TE Connectivity
TP5, TP6	2		Test Point, Miniature, Orange, TH	Orange Miniature Testpoint	5003	Keystone Electronics
TP1, TP2, TP3, TP4, TP7	5		Terminal, Turret, TH, Double	Keystone1502-2	1502-2	Keystone
U1	1		36V, 6A Buck-boost Module	QFN-FCMOD71	TPSM852892RCM	Texas Instruments
C1, C2	0	2200pF	CAP, CERM, 2200pF, 250V, +/- 10%, X7R, 0805	0805	GRM21AR72E222K W01D	MuRata
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
R1, R2	0	2.2	RES, 2.20, 1%, 0.25W, AEC-Q200 Grade 0, 1206	1206	ERJ-8RQF2R2V	Panasonic

4 Additional Information

Trademarks

All trademarks are the property of their respective owners.

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.
 - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software
 - 1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.
2. *Limited Warranty and Related Remedies/Disclaimers:*
 - 2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
 - 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.

WARNING

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 DEGRADATION 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 instructions, 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/sds/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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2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/sds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html>

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.

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