EVM User's Guide: TMAG5233EVM

TMAG5233 Evaluation Model

Description

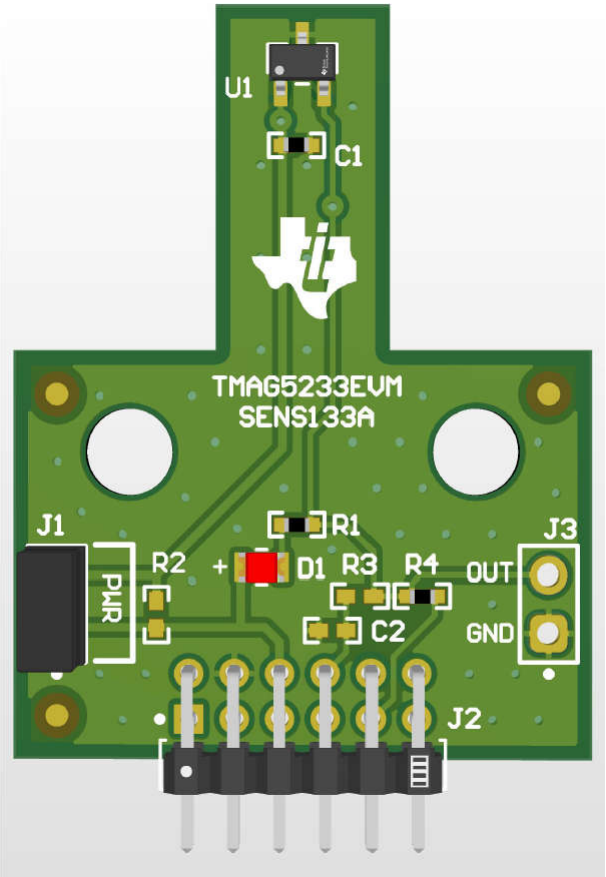
The TMAG5233EVM provides an easy-to-use platform to evaluate or prototype with the TMAG5233 Hall-effect switch. The evaluation module (EVM) includes one magnet in addition to the TMAG5233EVM.

Features

- Low power consumption
- Small form factor
- Push-pull output

Applications

- Door and Window Sensor
- Appliance Door Open/Close
- E-Meter Tamper Detection
- Electric Smart Lock
- Smoke Detector Push Button
- Food Processor Accessory Detection



TMAG5233EVM

1 Evaluation Module Overview

1.1 Introduction

This user's guide describes the characteristics, operation, and use of the TMAG5233 evaluation module (EVM). This EVM is designed to evaluate the performance of the TMAG5233. Throughout this document, the terms evaluation board, evaluation module, and EVM are synonymous with the TMAG5233EVM. This document includes a schematic, reference printed circuit board (PCB) layouts, and a complete bill of materials (BOM).

1.2 Kit Contents

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

Table 1-1. Kit Contents

ITEM	QUANTITY
TMAG5233EVM	1
Handheld magnet	1

1.3 Specifications

Table 1-2. TMAG5233 Specifications

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
I/O Characteristics					
V_{CC}, power supply voltage			3.3		V
V_{OH}, high-level output voltage	I_{OH} = 0.5mA	V_{CC} – 0.4		V_{CC}	V
V_{OL}, low-level output voltage	I_{OL} = 0.5mA	0		0.4	V
Magnetic Characteristics					
B_{OP}, magnetic operate point	T_A = 25°C		±3		mT
B_{RP}, magnetic release point	T_A = 25°C		±2.2		mT
B_{HYS}, magnetic hysteresis: $\lvert B_{OP} - B_{RP} \rvert$			0.8		mT

1.4 Device Information

The TMAG5233 is a low-power, in-plane, Hall-effect switch optimized for compact battery-powered industrial and consumer applications. The output is active-low push-pull, driving the output pin low when a magnetic field is present and returning high when no field is present. As an omnipolar switch, the output is sensitive to both the north and south magnetic poles. The TMAG5233 periodically samples the Hall sensor according to the sampling rate. After sampling, the device enters a low power sleep state to conserve power. For more information, see the TMAG5233 data sheet.

2 Hardware

The EVM is an easy-to-use platform for evaluating the main features and performance of the TMAG5233. The EVM provides LEDs tied to the outputs of the device for easy evaluation of the switch and a jumper in-line with the power supply to measure the device current or provide an external power supply. Users can also monitor the output through a test point on the right side of the board or through the header pins at the bottom of the board. All of these features allow the EVM to operate as a stand-alone board without the need of an MCU to process the digital output.

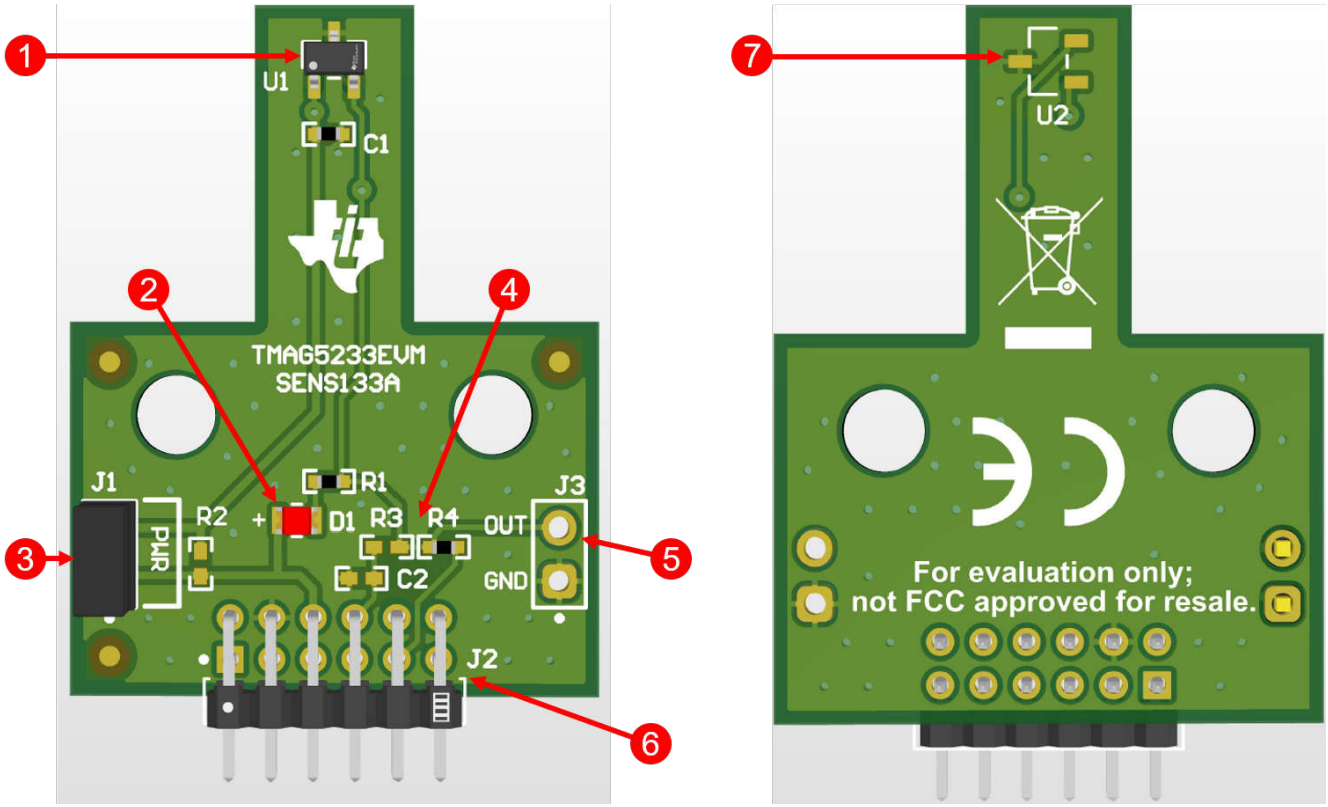


Figure 2-1. TMAG5233EVM With Callouts

Table 2-1. Board Description

CALLOUT NUMBER	DESCRIPTION
1	TMAG5233
2	LED connected to TMAG5233 OUT pin
3	Power header to measure current or provide external power
4	Resisters to connect/disconnect to J2
5	Connection points for OUT pins and GND
6	SCB connector
7	Alternate placement for TMAG5233 (rotated 90°)

Alternatively, the bottom headers are compatible with the TI-SCB, which can power the EVM and read the digital output using a GPIO pin. Figure 2-2 shows how to connect the EVM to the SCB.

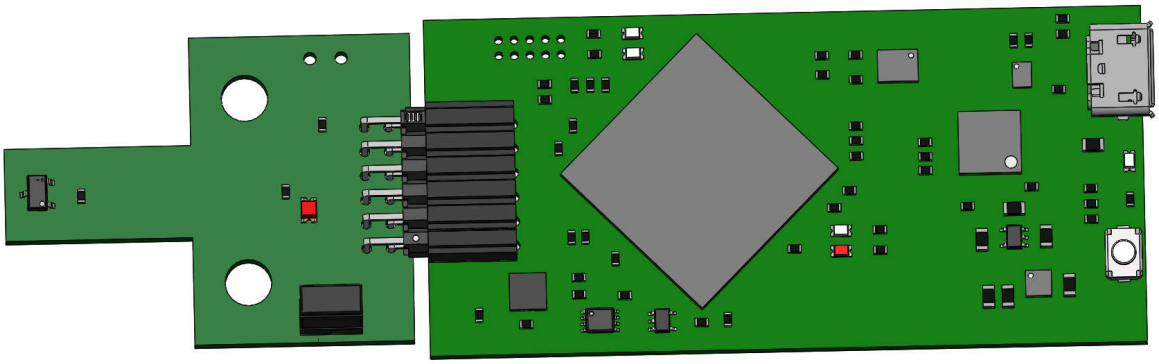


Figure 2-2. EVM Connected to SCB

The EVM is intended to provide basic functional evaluation of the device. The layout is not intended to be a model for the target circuit, nor is the EVM laid out for electromagnetic compatibility (EMC) testing.

3 EVM Operation

To use the EVM with the TI-SCB Controller, connect the EVM as shown in Figure 3-1, or connect the EVM using one of the ways described in Section 2. The TMAG5233 outputs trigger when a magnet is near the sensor. When the magnetic field at the sensor crosses the threshold of the device, the output turns the LEDs on. The user can also check the output through the connector on the board.

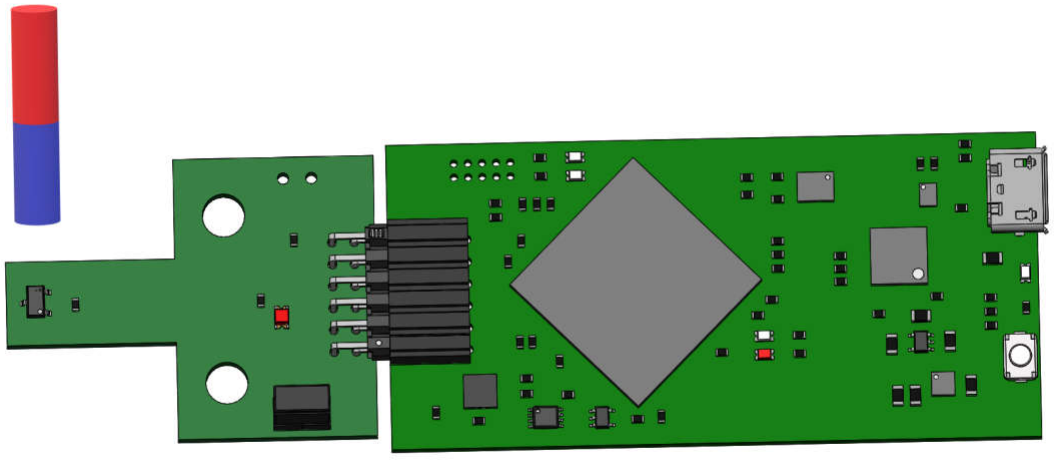


Figure 3-1. EVM With Magnet

4 Hardware Design Files

Note

Board layouts are not to scale. These figures are intended to show how the board is laid out. The figures are not intended to be used for manufacturing EVM PCBs.

4.1 Schematic

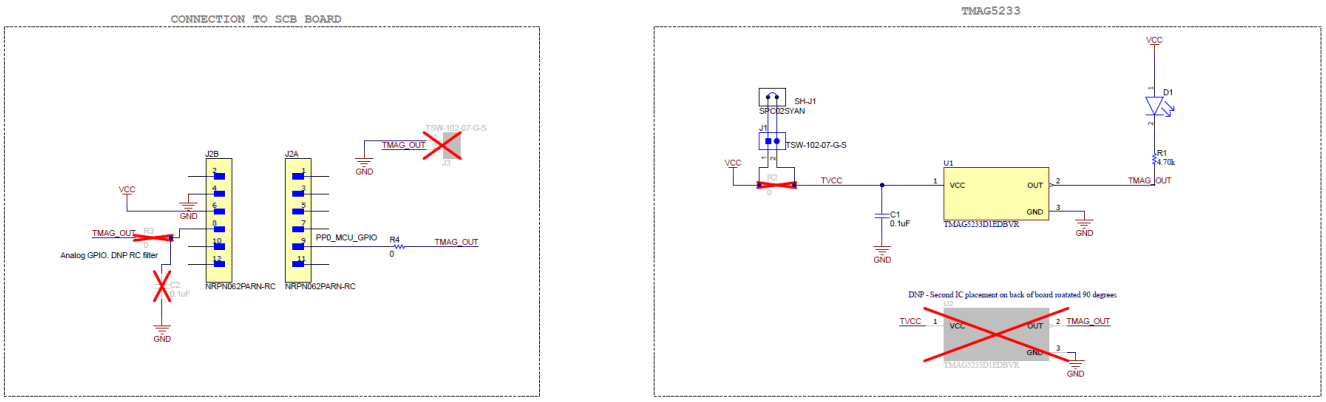


Figure 4-1. TMAG5233EVM Schematic

4.2 EVM Layout

The following figures show the TMAG5233EVM layout.

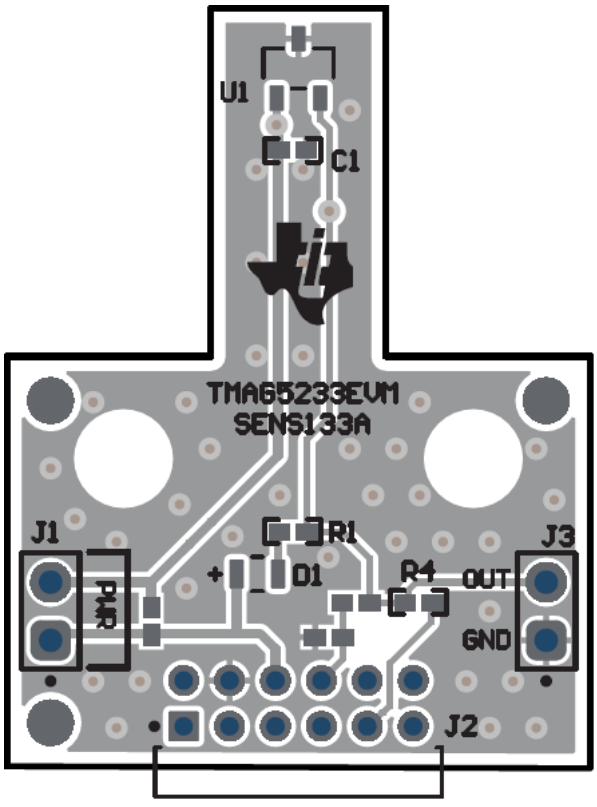


Figure 4-2. Top View

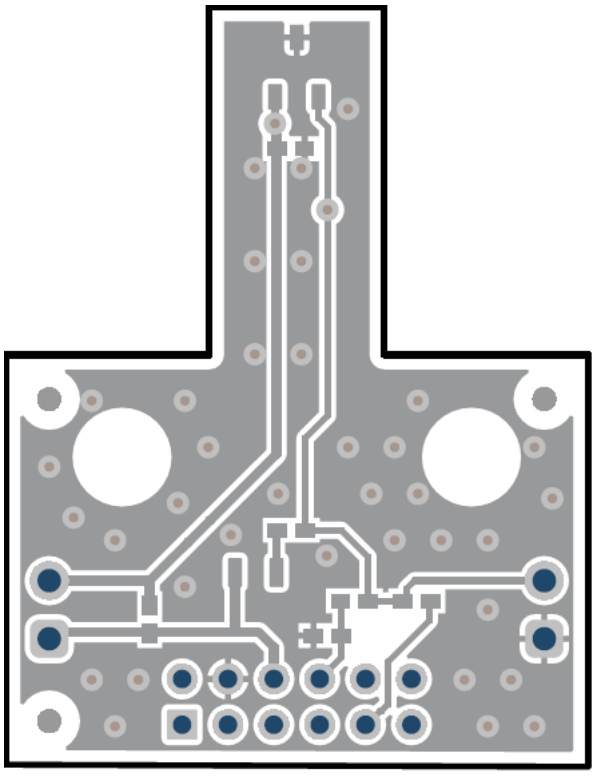


Figure 4-3. Top Layer

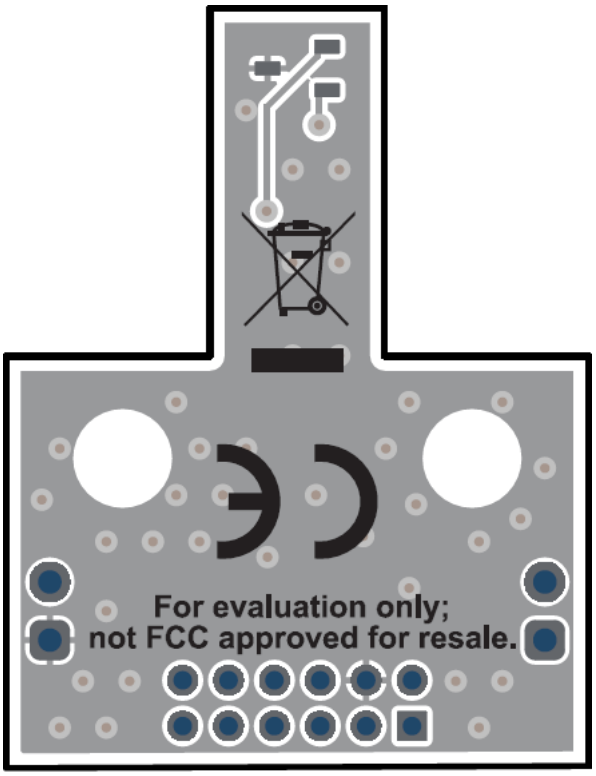


Figure 4-4. Bottom View

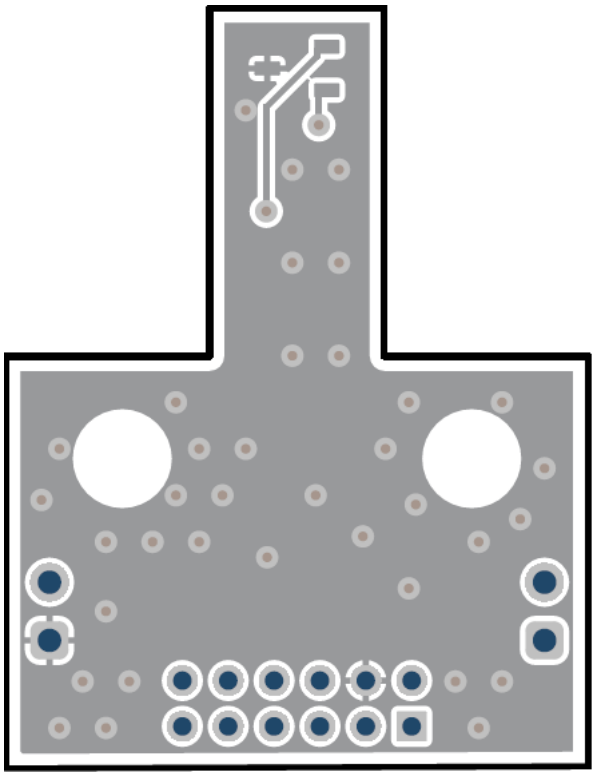


Figure 4-5. Bottom Layer

4.3 Bill of Materials (BOM)

Table 4-1. SENS133 REV A Bill of Materials (BOM)

ITEM #	DESIGNATOR	QUANTITY	VALUE	PART NUMBER	MANUFACTURER	DESCRIPTION	PACKAGE REFERENCE
1	!PCB1	1		SENS133	Any	Printed Circuit Board	
2	C1	1	0.1uF	GRM155R71H104 ME14D	MuRata	CAP, CERM, 0.1uF, 50V, +/-20%, X7R, 0402	0402
3	D1	1		SML-LX0805SRC-TR	Lumex	Red LED Indication - Discrete 1.7V 0805 (2012 Metric)	0805
4	J1	1		TSW-102-07-G-S	Samtec	Header, 100mil, 2x1, Gold, TH	2x1 Header
5	J2	1		NRPN062PARN-RC	Sullins Connector Solutions	CONN HEADER R/A 12POS 2MM	HDR12
6	R1	1	4.70k	RC0402FR-074K7L	Yageo America	RES, 4.70k, 1%, 0.0625W, 0402	0402
7	R4	1	0	RC0402JR-070RL	Yageo America	RES, 0, 5%, 0.063W, 0402	0402
8	SH-J1	1	1x2	SPC02SYAN	Sullins Connector Solutions	Shunt, 100mil, Flash Gold, Black	Closed Top 100mil Shunt
9	U1	1		TMAG5233D1EDB VR	Texas Instruments	Low Cost, In-Plane Hall-Effect Switch	SOT23
10	U2	0		TMAG5233D1EDB VR	Texas Instruments	Low Cost, In-Plane Hall-Effect Switch	SOT23
11	C2	0		GRM155R71H104 ME14D0.1uF	MuRata	CAP, CERM, 0.1uF, 50V, +/-20%, X7R, 0402	0402
12	FID1, FID2, FID3	0		N/A	N/A	Fiducial mark. There is nothing to buy or mount.	N/A
13	J3	0		TSW-102-07-G-S	Samtec	Header, 100mil, 2x1, Gold, TH	2x1 Header
14	R2, R3	0	0	RC0402JR-070RL	Yageo America	RES, 0, 5%, 0.063W, 0402	0402

5 Additional Information

5.1 Trademarks

All trademarks are the property of their respective owners.

6 Related Documentation

For related documentation, see the following:

- Texas Instruments, *TMAG5233 In-Plane Hall-Effect Switch for Cost-Optimized Designs* data sheet
- Texas Instruments, *TI Sensor Control Board* user's guide

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.

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   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.

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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.

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 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.

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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