User's Guide

TMAG5253EVM User's Guide

ABSTRACT

This user's guide describes the characteristics, operation, and use of the TMAG5253 evaluation module (EVM). This EVM is designed to evaluate the performance of the TMAG5253. Throughout this document, the terms evaluation board, evaluation module, and EVM are synonymous with the TMAG5253EVM. This document includes a schematic, reference printed circuit board (PCB) layouts, and a complete bill of materials (BOM).

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Trademarks

1 Overview

The TMAG5253 is a low-power, linear Hall effect sensor with an enable pin. This device is available in multiple unipolar or bipolar sensitivity range variants. The enable pin allows the user to activate a < 10-nA sleep mode, and the fast start-up feature of the device allows the user to duty cycle the enable pin to lower the average power consumption.

Table 1-1. TMAG5253 Device Summary

PRODUCT	SENSITIVITY RANGE
TMAG5253BA1IQDMRR	100 mV/mT, ±21-mT Range

1.1 Kit Contents

Table 1-2 lists the contents of the EVM kit. Contact the nearest Texas Instruments Product Information Center if any component is missing.

Table 1-2. Kit Contents

ITEM	QUANTITY
TMAG5253EVM	1
3D printed Trigger Assembly	1
Magnet	1

Figure 1-1 shows the 3D printed Trigger Assembly with a trigger top, trigger base, torsion spring, and an aluminum axle rod.

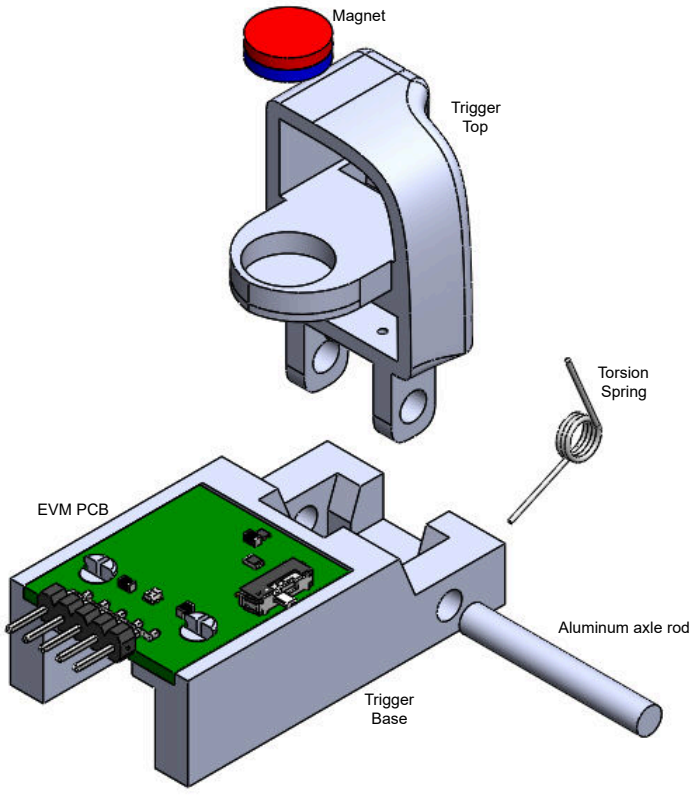

Figure 1-1. Trigger Assembly Exploded View

1.2 Related Documentation From Texas Instruments

This user's guide is available from the TI website under literature number SBAU400. Any letter appended to the literature number corresponds to the document revision that is current at the time of the writing of this document. Newer revisions are available from www.ti.com or the Texas Instruments' Literature Response Center at (800) 477-8924 or the Product Information Center at (972) 644-5580. When ordering, identify the document by both title and literature number. Table 1-3 lists the documentation related to the EVM. Click the links in Table 1-3 for further information. The device name links to the product web folder on www.ti.com. The literature number links to the document PDF.

Table 1-3. Related Documentation

DOCUMENT TITLE	DOCUMENT LITERATURE NUMBER
TMAG5253 data sheet	SBASAI5

2 Hardware

This EVM allows the user to evaluate the TMAG5253. The EVM includes a trigger attachment that controls the perceived brightness of an onboard RGB LED according to the analog output of the TMAG5253. The EVM is intended to provide basic functional evaluation of the devices. The layout is not intended to be a model for the target circuit, nor is it laid out for electromagnetic compatibility (EMC) testing.

2.1 Features

1. LED indicator for visual feedback corresponding to an analog output.
2. Receptacle for a CR-10-25 Coin Cell Battery to power the EVM.
3. 3D CAD files available for modifying and customizing trigger design.

3 Operation

3.1 Quick Start Setup

The following instructions describe how to set up and use the EVM.

1. Supply power to the device through one of these methods:
   - Apply a 3.3-V potential (see Figure 3-1)
   - Insert a CR1025 coin cell battery into the holder (see Figure 3-1)
2. Toggle the enable switch on.

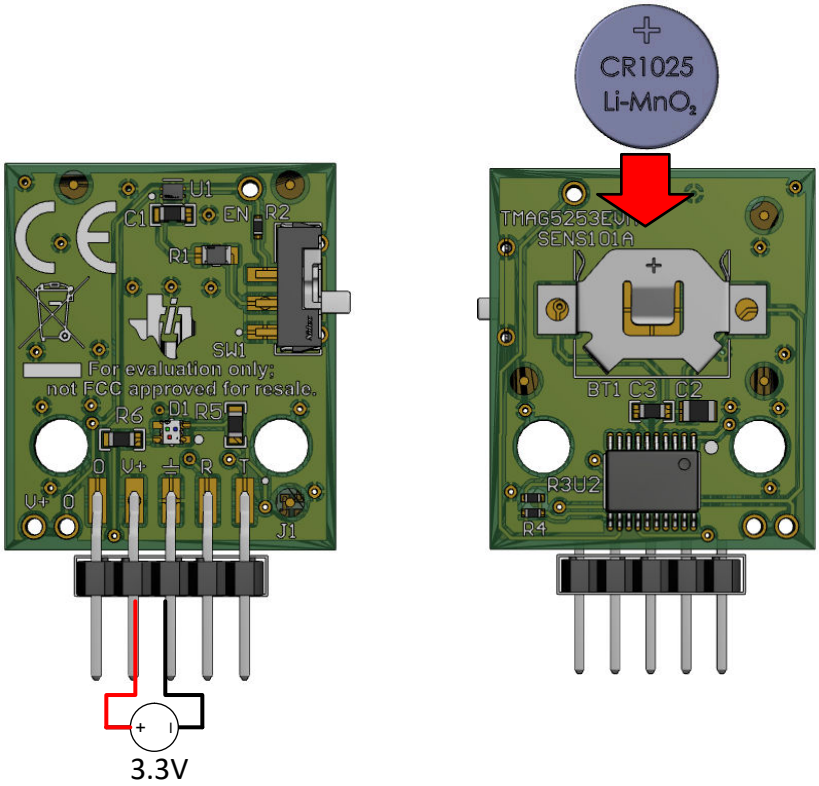

Figure 3-1. Powering On EVM

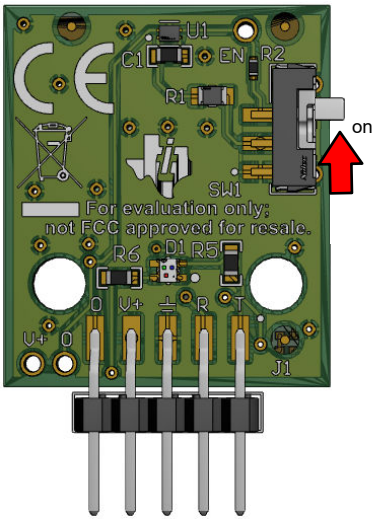

Figure 3-2. Enable TMAG5253

3.2 EVM Operation

While the TMAG5253 is available in either unipolar or bipolar configurations, the device featured in this EVM is a bipolar ratiometric device. The device output is an analog signal proportional to the field detected by the sensor. The output is routed to a header pin as well as a via which a test point or wire can be inserted into for inspection with an external voltmeter, oscilloscope, or microcontroller. The output is also routed to an onboard microcontroller that processes the analog potential and generates a PWM signal that can dim an RGB LED indicator to provide visual feedback to the user. If no LED light is on, the device is either disabled or there is little to no field measured. As in Figure 3-3, a bright red LED light indicates that the north pole is facing the top of the device sensing element, while a bright blue LED light, as in Figure 3-4, indicates that the south pole is facing the top of the device sensing element. When the board is inserted into the 3D attachment with the magnet installed, a little less than 50% of the analog output range will be observed over the trigger's range of motion according to the magnetic polarity facing the device.

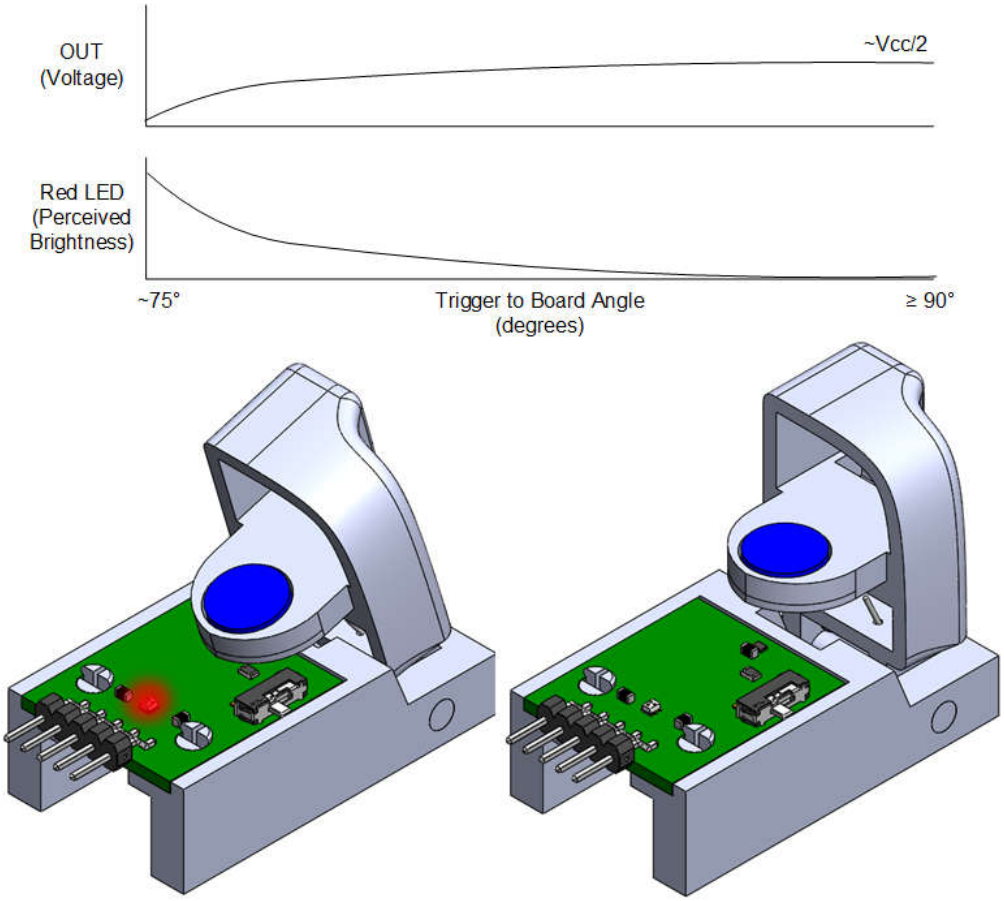

Figure 3-3. Red LED Operation

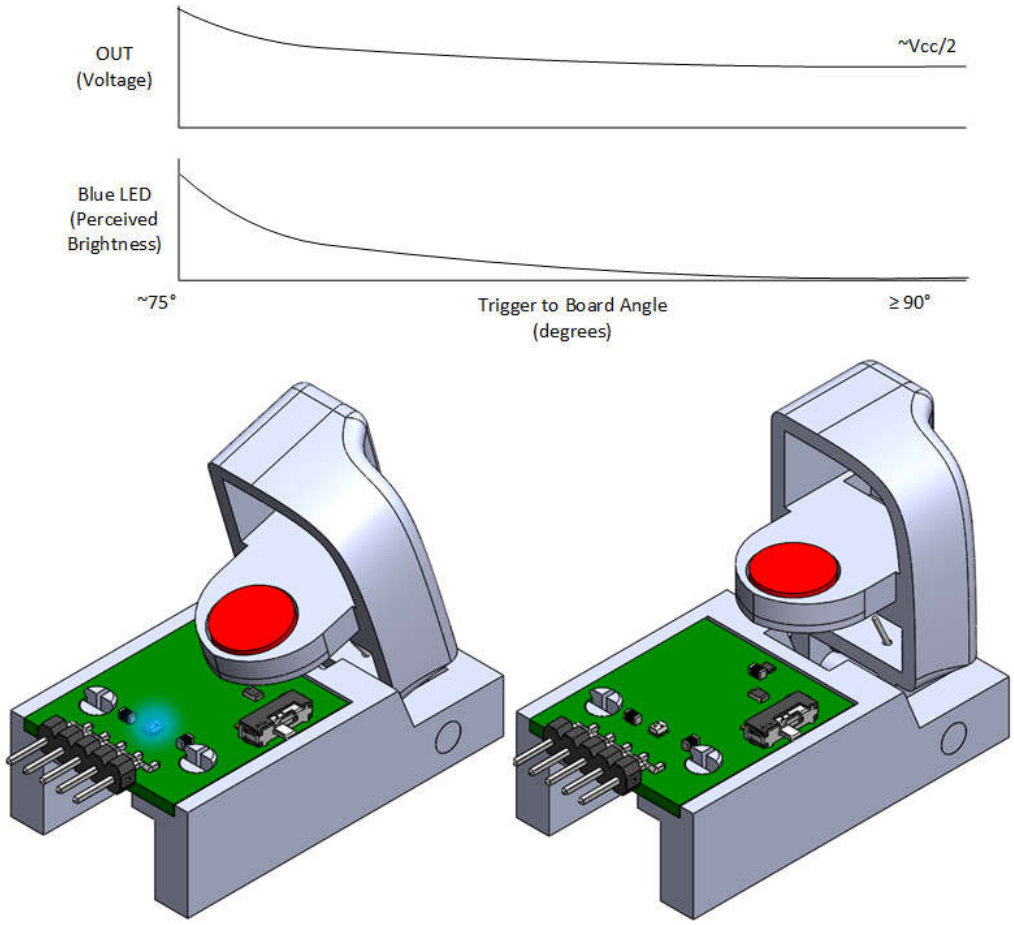

Figure 3-4. Blue LED Operation

4 Schematics, PCB Layout, and Bill of Materials

4.1 Schematic

Figure 4-1 shows the schematic of the EVM.

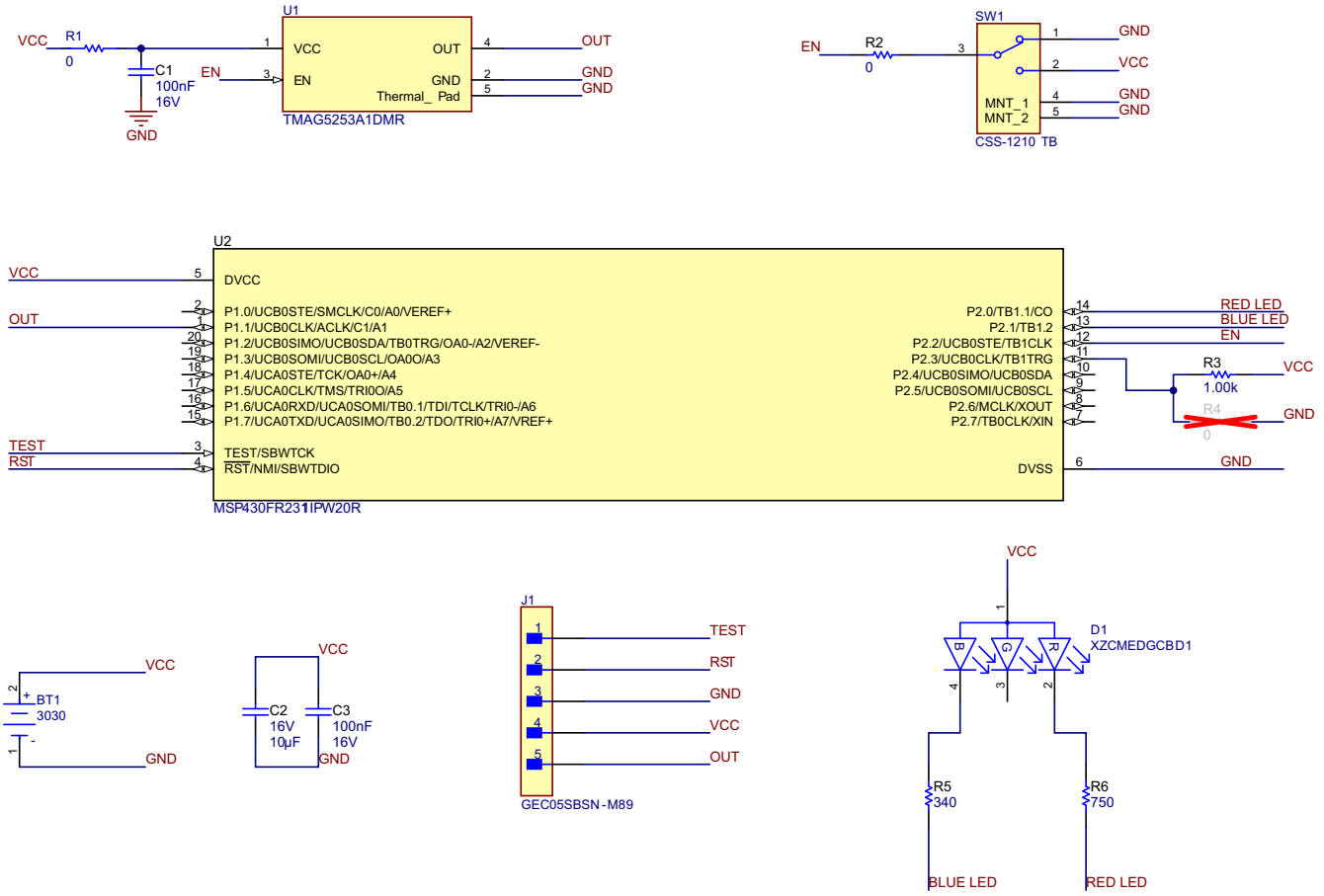

Figure 4-1. TMAG5253EVM Schematic

4.2 Component Functions

The descriptions of each circuit component found on the EVM are listed below:

- U1 is the TMAG5253 low-power, linear Hall effect sensor that this EVM is showcasing.
- U2 is the MSP430FR2311, which is included to modulate the LED light according to the TMAG5253 output potential.
- C1, C2, and C3 serve as decoupling capacitors that attenuate noise on the supply traces.
- D1 is the RGB LED that shines blue for south fields (flux pointing out of the TMAG5253 top) and red for north fields (flux pointing into the TMAG5253 top).
- R1 is the 0-Ω shunt that can be replaced by the user with an alternate shunt for current measurements.
- R2 is the 0-Ω shunt that can be removed so that a duty-cycled signal can be provided to the TMAG5253 externally or internally from the MSP430FR231.
- R4 is the 0-Ω shunt for the GPIO P2.3 to GND. R2 should be removed before adding this resistor and powering on the device. When GPIO is shorted to ground, the MSP430FR2311 duty cycles the TMAG5253 enable pin.

4.3 PCB Layout

Figure 4-2 through Figure 4-5 show the PCB layers of the EVM.

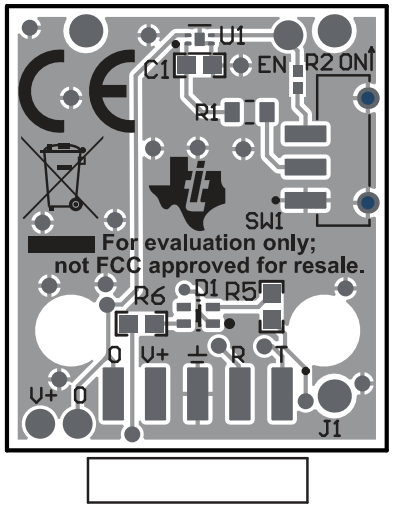

Figure 4-2. Top View

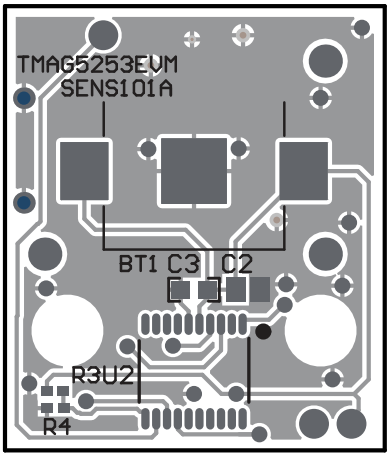

Figure 4-3. Bottom View

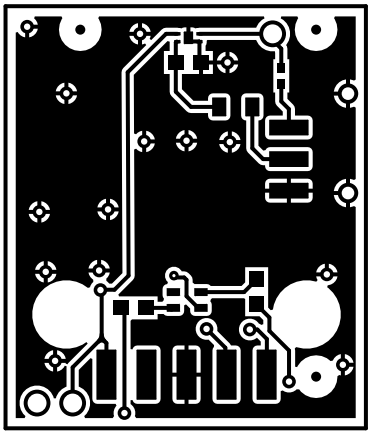

Figure 4-4. Top Layer

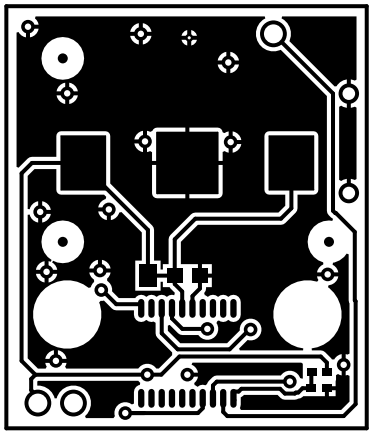

Figure 4-5. Bottom Layer

4.4 Bill of Materials

Table 4-1. TMAG5253EVM Bill of Materials

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
BT1	1		Battery Retainer Coin, 10.0mm 1 Cell SMD (SMT) Tab	SMT_BATT_RTNR	3030	Keystone
C1, C3	2	0.1uF	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X7R, 0603	0603	060330160104JXT	Knowles Syfer
C2	1	10uF	CAP, CERM, 10 µF, 16 V,+/- 10%, X7R, 0805	0805	CL21B106KOQNNNG	Samsung
D1	1		Red, Green, Blue (RGB) 621nm Red, 525nm Green, 465nm Blue LED Indication - Discrete 1.8V Red, 2.65V Green, 2.65V Blue 4-SMD, No Lead	SMT4	XZCMEDGCBD110W	SunLED
J1	1			HDR5	GEC05SBSN-M89	Sullins
R1	1	0	RES SMD 0 OHM JUMPER 1/8W 0805	0805	RC0805FR-070RL	Yageo
R2	1	0	RES, 0, 5%, 0.063 W, 0402	0402	MCR01MZPJ000	Rohm
R3	1	1.00k	RES, 1.00 k, 1%, 0.0625 W, 0402	0402	RC0402FR-071KL	Yageo America
R5	1	340	RES, 340, 1%, 0.1 W, 0603	0603	RC0603FR-07340RL	Yageo
R6	1	750	RES, 750, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW0603750RFKEA	Vishay-Dale
SW1	1		Switch Slide SPDT Side Slide 0.1A 12VDC Gull Wing SMD Embossed T/R	SMT_SW_8MM85_5MM00	CSS-1210TB	Nidec Copal Electronics
U1	1		Low power Ratiometric Linear Hall Effect Sensor	X2SON4	TMAG5253A1DMR	Texas Instruments
U2	1		16 MHz Ultra-Low-Power Microcontroller With 4 KB FRAM, 1 KB SRAM, 12 IO, 8 ch ADC10, OpAmps, TIA, PW0020A (TSSOP-20)	PW0020A	MSP430FR2311IPW20R	Texas Instruments
ROD	1		Multipurpose 6061 Aluminum Rod trimmed to 2.7cm		8974K19	McMaster Carr
SPRING	1		90 Degree Angle Torsion Spring, Right-Hand Wound, 0.204" OD		9271K143	McMaster Carr
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
R4	0	0	RES, 0, 5%, 0.063 W, 0402	0402	MCR01MZPJ000	Rohm

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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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   2.1 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 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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2. 実験局の免許を取得後ご使用いただく。
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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.

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.

6. *Disclaimers:*

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