

EVM User's Guide: TPSI88XXEVM

TPSI88XX 评估模块



说明

TPSI88XXEVM 是一款硬件评估模块，用于评估 TPSI88XX 系列中器件的性能。使用 TPSI88XXEVM 评估恒温器和 PLC 数字输出模块等应用要求。此 EVM 中集成了 TPSI8830ZB (DFP 封装)。

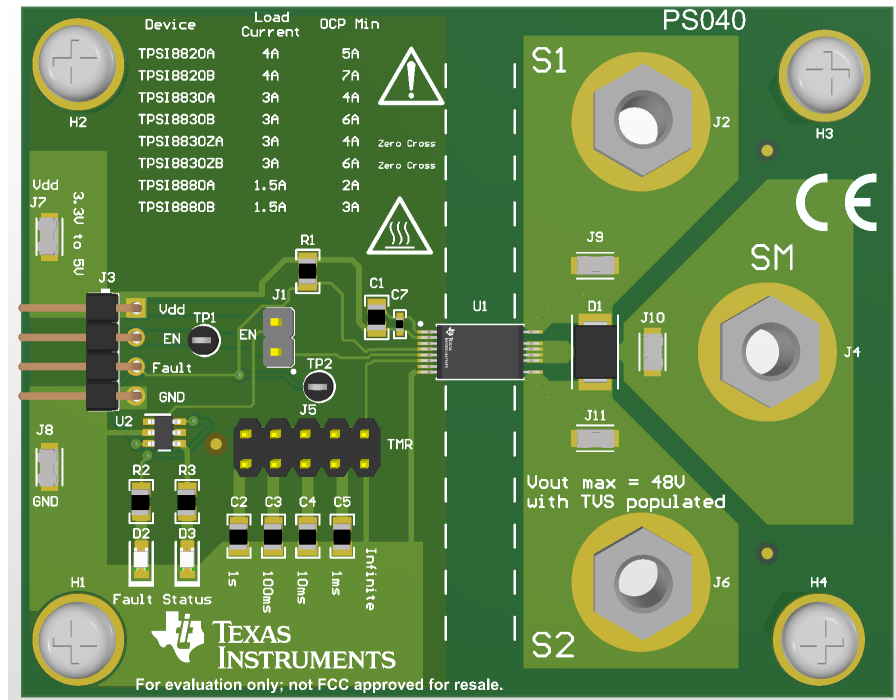
特性

- 具有 $\pm 80V$ 工作电压的集成式背对背 MOSFET
- 宽电源电压范围：3.0V 至 5.5V
- 可配置故障重试计时器 (TMR)

- 功能隔离
 - $200V_{RMS}$ 、 $250V_{DC}$ 工作电压
 - $570V_{RMS}$ 、 $800V_{DC}$ 瞬态电压 (60s)
- SSOP 14 引脚 (DFP) 封装器件，爬电距离和间隙为 8mm

应用

- [固态继电器](#)
- 温度调节装置
- PLC - 数字输出模块



TPSI88XXEVM

1 评估模块概述

1.1 简介

TPSI88XX 器件系列属于隔离式固态继电器，专为高压工业应用而设计。TI 具有高可靠性的电容隔离技术和背对背 MOSFET 整合在一起，形成了一款完全集成式解决方案，无需次级侧电源。

初级侧包含一个驱动器，为次级侧的每个内部 MOSFET 提供电力和使能逻辑信息。当使能引脚变为高电平，并且 VDD 电压高于 UVLO 阈值时，振荡器启动并且驱动器跨隔离栅输送电力和逻辑高电平。当使能引脚变为低电平，或者 VDD 电压降至 UVLO 阈值以下时，驱动器会被禁用。

1.2 套件内容

条目	数量
TPSI88XXEVM	1

1.3 规格

本节总结了默认配置下 TPSI88XXEVM 的性能规格。

		最小值	最大值	单位
V _{S1,S2}	开关输入电压	-80	80	V
V _{VDD}	初级侧电源电压	3.0	5.5	V
V _{FAULT}	FAULT 引脚电压	0	5.5	V
V _{TMR}	TMR 引脚电压	0	5.5	V
V _{EN}	启用电压	0	5.5	V
I _{S1,S2}	开关电流 S1/S2		4	A

1.4 器件信息

器件规格	值
初级侧电源电流	6.5mA 开启状态、30uA 关闭状态
瞬态隔离电压 (t = 60s)	AC = 500V _{RMS} , DC = 800V _{DC}
VDD 欠压阈值	上升 = 2.9V , 下降 = 2.8V
封装	DFP (SOIC 14) 5.4mm × 10.5mm

1.5 通用德州仪器 (TI) 高压评估模块 (TI HV EVM) 用户安全指南



务必遵循 TI 的安装和应用说明，包括在建议的电气额定电压和功率限制范围内使用所有接口元件。务必采取电气安全防护措施，这样有助于确保自身和周围人员的人身安全。有关更多信息，请联系 TI 的产品信息中心。

保存所有警告和说明以供将来参考。

警告

务必遵循警告和说明，否则可能引发电击和灼伤危险，进而造成财产损失或人员伤亡。

TI HV EVM 一词是指通常以开放式框架、敞开式印刷电路板装配形式提供的电子器件。该器件严格用于开发实验室环境，仅供了解开发和应用高压电路相关电气安全风险且接受过专门培训、具有专业知识背景的合格专业用户使用。德州仪器 (TI) 严禁将其用于任何其他用途或应用。如果不满足合格要求，应立即停止进一步使用 **HV EVM**。

1. 工作区安全：

- 保持工作区整洁有序。
- 每次电路通电时，都必须由具有资质的观察员在场监督。
- TI HV EVM** 及其接口电子元件通电区域必须设有有效的防护栏和标识，指示可能存在高压作业，以避免意外接触。
- 开发环境中使用的所有接口电路、电源、评估模块、仪器、仪表、示波器和其他相关装置如果超过 **50Vrms** 和 **75VDC**，则必须置于紧急断电 (EPO) 保护电源板内。
- 使用稳定且不导电的工作台。
- 使用充分绝缘的夹钳和导线来连接测量探针和仪器。尽量不要徒手进行测试。

2. 电气安全：

- 作为预防措施，假设整个 **EVM** 可能具有完全可接触和有效的高电压始终良好的工程实践。
- 在执行任何电气测量或其他诊断测量之前，需断开 **TI HV EVM** 及其全部输入、输出和电气负载。再次确认 **TI HV EVM** 已安全断电。
- 确认 **EVM** 断电后，根据所需的电路配置、接线、测量设备连接和其他应用需求执行进一步操作，同时仍假定 **EVM** 电路和测量仪器均带电。
- EVM** 准备就绪后，根据需要 **将 EVM 通电**。

警告

在运行期间以及甚至断电后的一段时间内，此评估模块上会存在直流高压。要评估此模块，参与人员必须具备电气工程实践中与高压相关的足够知识和技能。个人无法胜任可能造成严重伤害（包括死亡）。

具有隔离功能的直流电压源应满足 **IEC60950** 增强型绝缘标准，建议在对此 **EVM** 执行评估时必须满足此标准。

操作时应格外小心，尽量避免发生电击和热灼伤。有关安全问题和预防措施，请参阅 [通用德州仪器 \(TI\) 高压评估 \(TI HV EVM\) 用户安全指南](#)。

在开始任何物理评估之前，请仔细阅读并理解本用户指南。

a.

1. 人身安全：

- 穿戴个人防护装备（例如乳胶手套或具有侧护板的安全眼镜）或者用带有互锁机构的透明塑料箱装好 **EVM**，避免意外接触。

安全使用限制条件：

勿将 **EVM** 作为整体或部分生产单元使用。

2 硬件

2.1 建议测试设备

下方列表列出了推荐用于测试 TPSI88XXEVM 的设备

- 可调电源
- 示波器
- 数字万用表
- 可选：用于切换 TPSI8830ZB 使能 (EN) 引脚的函数发生器或微控制器

2.2 跳线信息

连接器	标签	说明
J1	EN	闭合时将 EN 引脚连接至 VDD 的跳线
J2	S1	用于 S1 连接的跳线
J3	Vdd、EN、Fault 和 GND	初级侧引脚的 GPIO 连接
J4	SM	用于 SM 连接的跳线
J5	TMR	用于配置重试时序的跳线
J6	S2	用于 S2 连接的跳线

2.3 测试点

测试点、跳线	标签	说明
TP1	EN	使能测试点
TP2	故障	故障引脚测试点
J7	Vdd	初级侧电源测试点
J8	GND	初级侧 GND 测试点
J9	S1	S1 引脚测试点
J10	SM	SM 引脚测试点
J11	S2	S2 引脚测试点

3 实现结果

3.1 设置

验证 TPSI88XXEVM 具有以下跳线设置：

1. TMR 1s — 将重试时间设置为 1s

以下示例参考的是由 TPSI8830ZB 驱动继电器的恒温器应用。

请按照下面列出的步骤操作：

1. 将 5V 电源连接到测试点 J7 并将负极引线连接到 J8 来为 TPSI8830ZB 供电
2. 在 J3 (引脚 2) EN 上连接一个函数发生器，以启用 TPSI8830ZB。
 - a. 将函数发生器设置为 5V 方波 (0.5Hz)
3. 在打开函数发生器通道之前，将变压器电源线连接到 TPSI8830ZB 的 S1
4. 将继电器连接到 TPSI8830ZB 的 S2
5. 连接继电器的 GND 和变压器的 GND
6. 打开函数发生器的输出
 - a. 继电器以函数发生器的频率切换

4 硬件设计文件

4.1 原理图

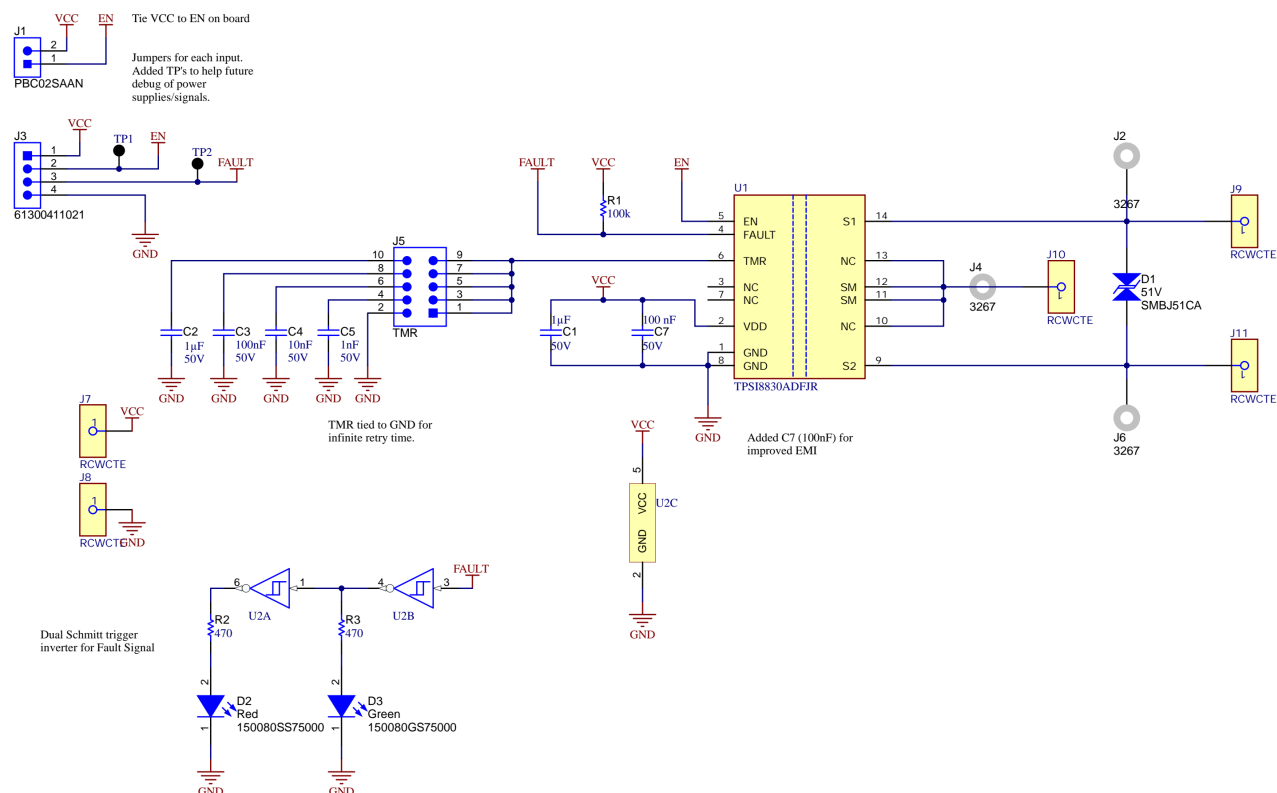


图 4-1. TPSI88XXEVM 原理图

4.2 PCB 布局

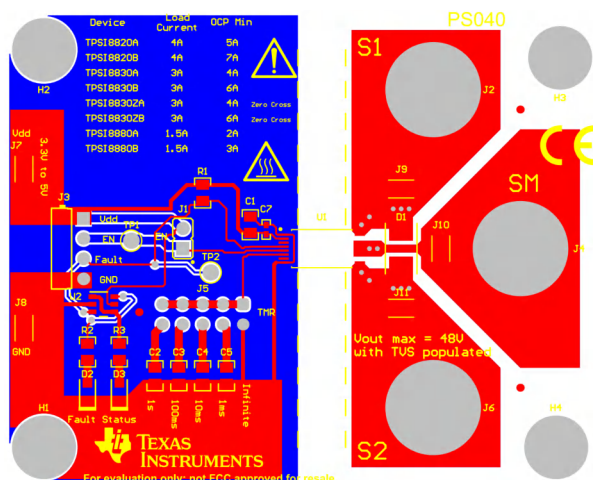


图 4-2. TPSI88XEVM 复合视图

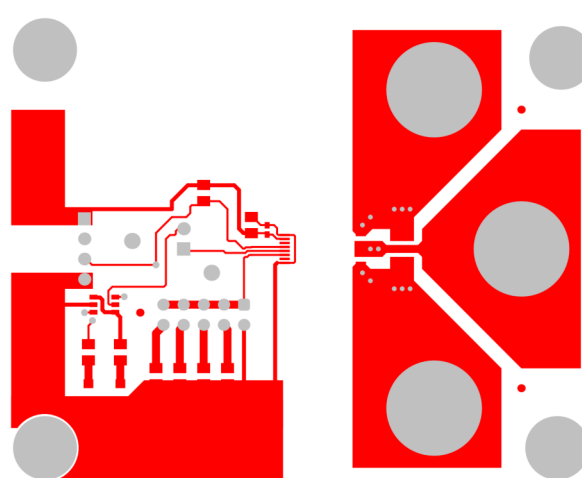


图 4-3. TPSI88XEVM 顶层

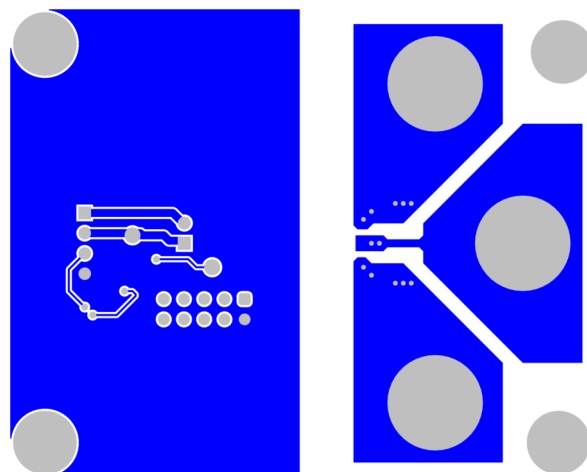


图 4-4. TPSI88XXEVM 底层

4.3 物料清单 (BOM)

位号	数量	值	说明
C1, C2	2	1uF	电容, 陶瓷, 1μF, 50V, ±20%, X7R, AEC-Q200 1 级, 0805
C3	1	0.1uF	电容, 陶瓷, 0.1uF, 50V, ±10%, X7R, 0805
C4	1	0.01uF	电容, 陶瓷, 0.01uF, 50V, ±10%, X7R, 0805
C5	1	1000pF	电容, 陶瓷, 1000pF, 50V, ±5%, X7R, 0805
C7	1	0.1uF	电容, 陶瓷, 0.1uF, 50V, ±10%, X7R, 0402
D1	1	51V	二极管, TVS, 双向, 51V, 82.4Vc, SMB
D2	1	红色	LED, 红色, SMD
D3	1	绿色	LED, 绿色, SMD
H1、H2、H3、H4	4		机械螺钉, 圆头, #4-40 x 1/4, 尼龙, 飞利浦盘形头
H5、H6、H7、H8	4		六角螺柱, 0.5"L #4-40, 尼龙
J1	1		接头, 100mil, 2x1, 金, TH
J2、J4、J6	3		标准的蕉形插头, 非绝缘
J3	1		接头, 2.54mm, 4x1, 金, R/A, TH
J5	1		接头, 2.54mm, 5x2, 金, TH
J7、J8、J9、J10、J11	5		PC 测试点镀层表面贴装安装类型
LBL1	1		热转印可打印标签, 0.650" (宽) × 0.200" (高) - 10,000/卷
R1	1	100k	电阻, 100k, 1%, 0.125W, 0805

位号	数量	值	说明
R2、R3	2	470	电阻，470，5%，0.125W，AEC-Q200 0 级，0805
TP1、TP2	2		测试点，微型，黑色，TH
U1	1		TPSI8830ADFJR
U2	1		双路施密特触发反相器，DBV0006A，SMALL T&R

5 其他信息

5.1 商标

所有商标均为其各自所有者的财产。

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.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
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。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・インスツルメンツ株式会社
東京都新宿区西新宿 6 丁目 2 4 番 1 号
西新宿三井ビル

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.

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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