



说明

德州仪器 (TI) 的 BP-IWRL6432WMOD 是面向 IWRL6432W 集成式 60GHz 毫米波传感器模块的基于 FR4 的易用型低成本评估板。该评估模块 (EVM) 包含评估和开始为雷达模块开发软件所需的一切资源。该 EVM 支持独立操作，以及使用德州仪器标准 BoosterPack 连接器的基于外部 MCU 的连接。该 EVM 还包括用于模块复位的板载按钮、用于电源和复位的 LED，以及用于存在检测的专用 LED。EVM 中有一个用于演示的 FTDI USB 和一个用于 uDFP 补丁更新的 XDS110 USB。

开始使用

请参阅快速入门指南以开始使用 [快速入门指南](#)

特性

- 57GHz 至 61.5GHz 毫米波雷达传感器模块评估板
- 附带预安装的 IWRL6432WMOD
- 用于模块和其他元件的板载电力传输网络

- 2-USB 端口：FTDI (用于演示) 、XDS110 (用于 uDFP 补丁更新)
- 板载 BoosterPack 连接器，用于通过德州仪器标准 LaunchPad 实现基于外部 MCU 的操作
- 用于存在检测的专用 LED

应用

- 空调
- 自动门
- 游戏
- 家庭影院和娱乐
- IP 网络摄像头
- 占位检测器
- PC/笔记本电脑
- 便携式电子产品
- 冰箱和冷冻柜
- 智能手表
- 平板电脑
- 电视
- 恒温器
- 可视门铃



1 评估模块概述

1.1 简介

BP-IWRL6432WMOD 是一款 BoosterPack EVM，适用于 TI 的首款 60GHz 毫米波传感器模块 IWRL6432WMOD。此 EVM 具有毫米波传感器模块的演示以及全部功能评估规定。

1.2 套件内容

该套件包含以下物品：

- BP-IWRL6432WMOD
- Micro-USB 电缆 (1m)
- 安装螺钉
- EVM 快速入门指南

1.3 规格

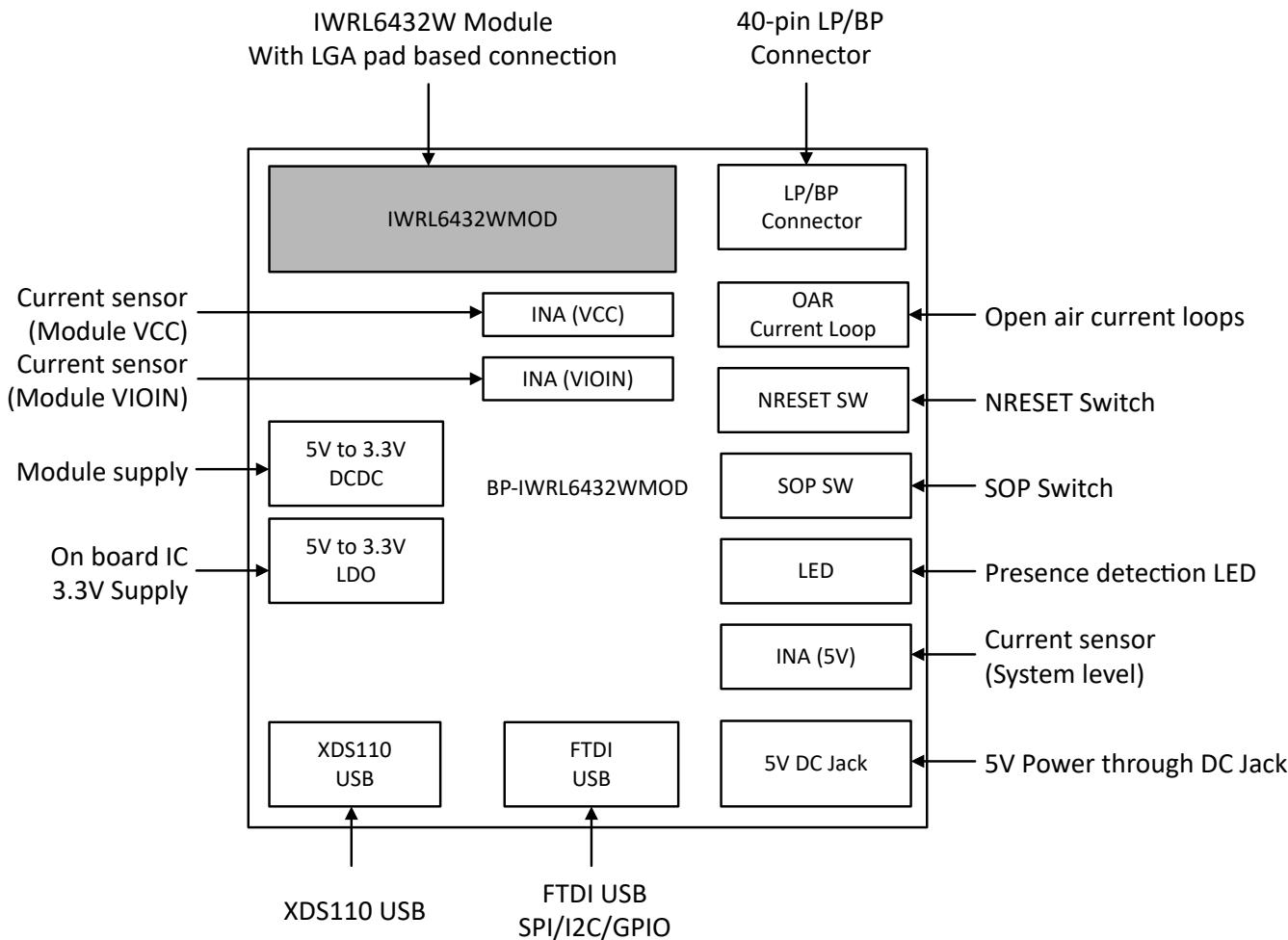


图 1-1. 功能方框图

图 1-1 代表 BP-IWRL6432WMOD 的功能方框图。

该 EVM 使用 30 引脚基板栅格阵列 (LGA) 焊盘同模块连接。模块的主要通信接口是 SPI，用于在 TI 演示中配置模块和输出数据。可通过 USB 端口与板载 FTDI 芯片来连接 SPI 接口。该 EVM 支持在 FTDI USB 的帮助下使用主机 PC 来独立地运行模块。使用 TI uDFFP SDK 软件包及其简单的用户界面，可根据检测灵敏度要求轻松配置模块。

EVM 还支持使用电路板上提供的 BoosterPack 连接器进行基于外部 MCU 的连接。这有助于与 TI 标准 LaunchPad 集成，以便与外部 MCU 进行通信，从而获取模块配置和检测数据。

BP-IWRL6432WMOD 具有可实现轻松模块复位的 NRESET 开关、专用的存在检测 LED 和带 XDS110 接口的额外 USB 端口，可支持 uDFP 补丁更新。

此外，EVM 还采用 INA 来测量模块级和系统级的功耗。对于手动测量，还存在露天标准电流环路，以支持基于霍尔效应传感器的电流测量。

1.4 器件信息

TI IWRL6432WMOD 是一款用 TI IWRL6432W 60GHz 毫米波传感器供电的完整系统解决方案/模块。该模块在 57-61.5GHz (4.5GHz 带宽) 的频带内工作，具有单个硬件设计和简单的 API 配置，能够满足需要存在和运动检测的应用的需求。

IWRL6432WMOD 是一款简单易用的可部署解决方案，适用于上述用例，具有以下特性：

1. 小尺寸 - 31mm (长) x 15mm (宽) x 1.6mm (高)
2. 易于安装基于 LGA 焊盘的模块安装 - 18 焊盘接口
3. 从外部 MCU 配置 (范围、灵敏度、更新率) 的简单 API (通过 SPI) 。
4. 通过 GPIO 进行存在和运动检测指示。
5. PCB 上蚀刻的 2D 天线，具有视场 (FoV) : $\pm 60^\circ$ (水平) ; $\pm 60^\circ$ (垂直)
6. 获得 FCC、RED 和 TELEC 的针对性模块化认证

2 硬件

2.1 EVM 标识

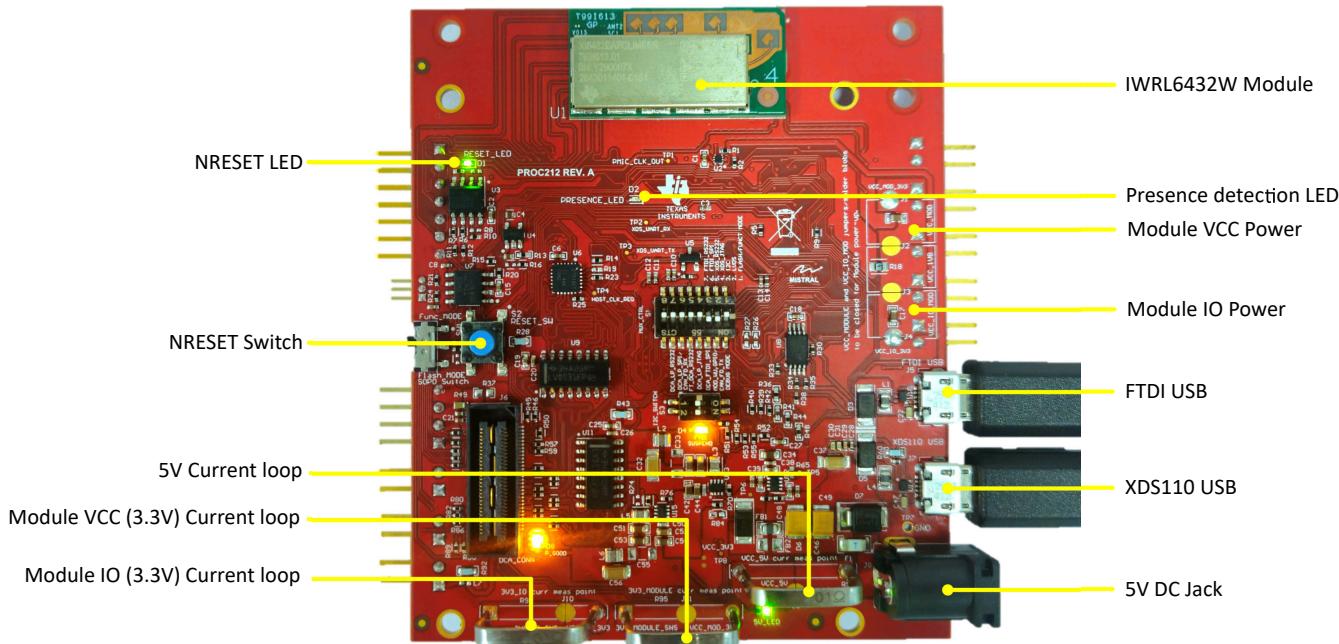


图 2-1. BP-IWRL6432WMOD - TOP

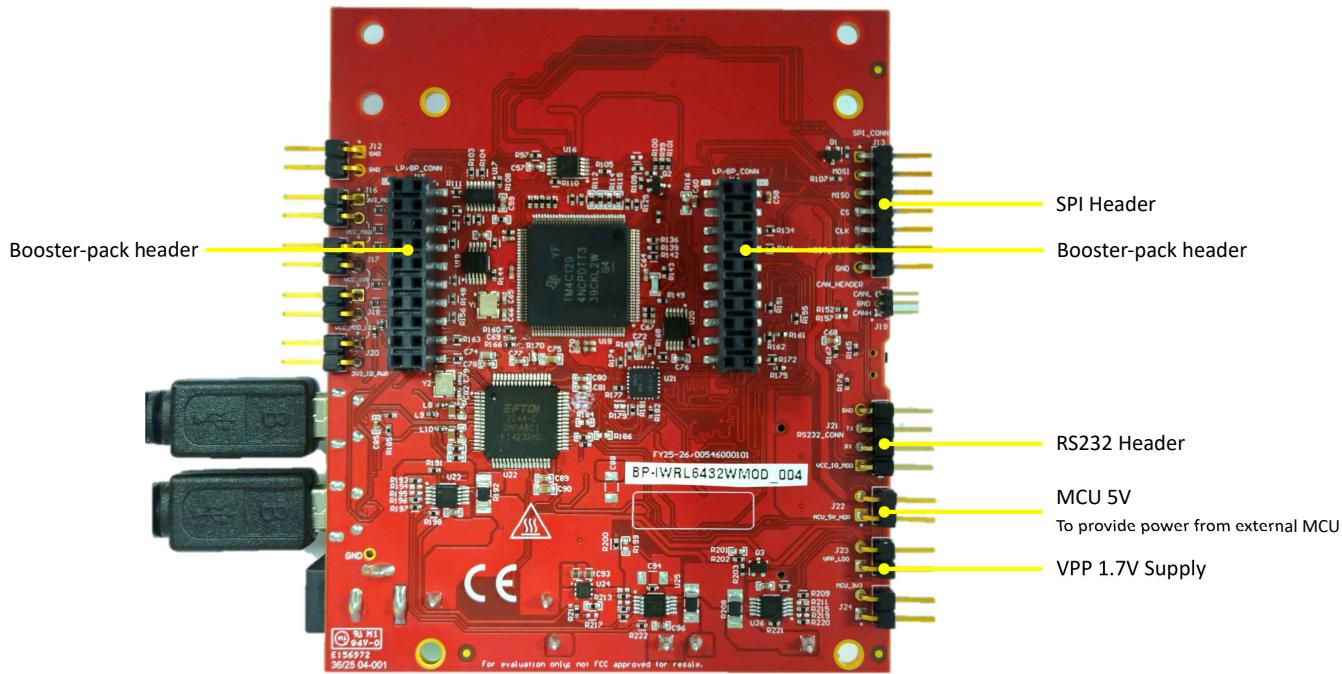


图 2-2. BP-IWRL6432WMOD - BOTTOM

2.2 电源要求

EVM 可以使用 5V 电源供电。可以通过不同的方式提供 5V :

1. **USB** : 通过主机 PC , 可通过两个 USB 端口中的任何一个为 EVM 供电。
2. **5V 直流插孔** : EVM 可以使用板载 5V DC 插孔通电。
3. **外部 MCU (LaunchPad)** : 可以使用外部 LaunchPad 上的 BoosterPack 连接器为 EVM 供电。为此 , J22 需要闭合。

备注

1. 5V 直流插孔优先于任何其他 5V 电源。这是为了确保在连接 5V 直流插孔的情况下断开 USB 电缆时模块电源不会中断。
2. 除了 USB 之外 , 如果只需要直流插孔或基于外部 LaunchPad 的 5V 电源 , 建议遵循以下顺序 :
 - a. 使用两根 USB 电缆中的任何一根为 EVM 供电
 - b. 使用在 BoosterPack 接头处连接的外部 LaunchPad 连接 5V 直流插孔或闭合 J22
 - c. 断开 USB 电源

2.3 设置

2.3.1 TI 演示设置

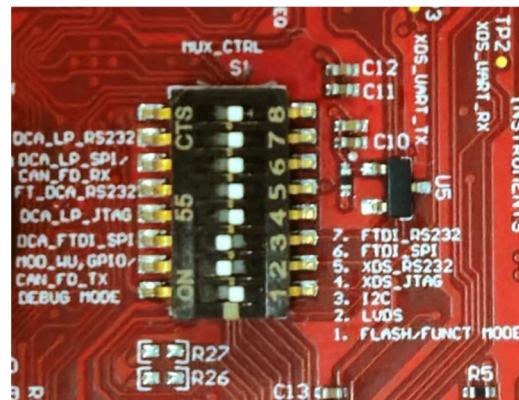


图 2-3. S1 - TI 演示的开关设置

要运行 TI 演示，请按照以下步骤操作：

1. 使用 micro-USB 电缆将 EVM FTDI USB 连接到主机 PC。
2. 确保采用图 2-3 中所示的开关设置
3. 使用 TI 毫米波 uDFP 可视化工具运行 TI 演示

有关更多信息，请参阅 uDFP 文档[毫米波 uDFP](#)

2.3.2 外部 MCU - 基于 LaunchPad 的设置

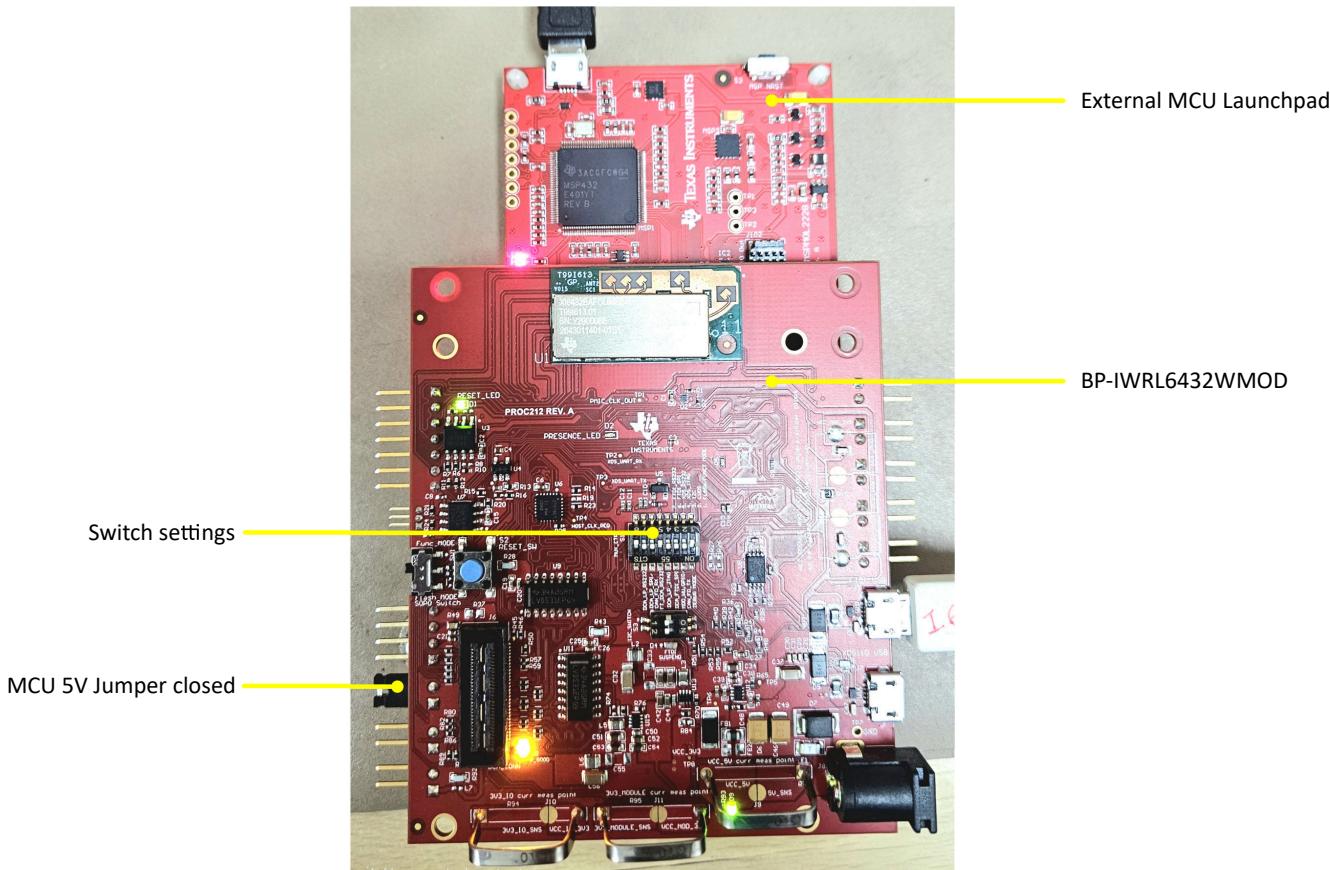


图 2-4. 外部 MCU - LaunchPad 连接

要连接外部 MCU - LaunchPad，请按照以下步骤操作：

1. 使用 PCB 底部的 BoosterPack 连接器与 LaunchPad 接头配合使用
2. 确保引脚映射正确无误。图 2-6 展示了连接器详细信息。

2.4 接头信息

2.4.1 SPI 接头

SPI 接头

J13 是 SPI 接头。若要使用 J13 访问板载 SPI S1 开关设置，开关设置需要为：

表 2-1. 在 J13 上使用外部 SPI 时的 S1 开关设置

开关	位置
S1.1	关闭
S1.2	导通
S1.3	导通
S1.4	关闭
S1.5	关闭
S1.6	导通
S1.7	关闭

2.4.2 BoosterPack 接头

BoosterPack 接头

要使用 BoosterPack 接头与外部启动盘连接，需要确保引脚映射。

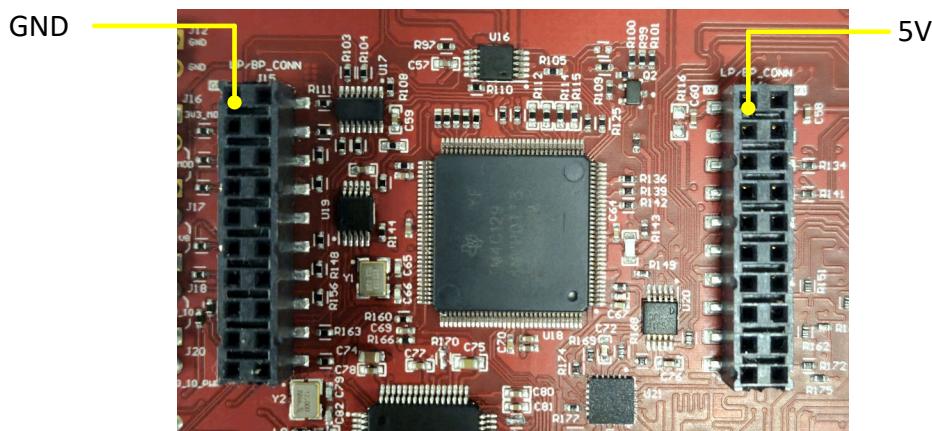


图 2-5. BoosterPack 连接器

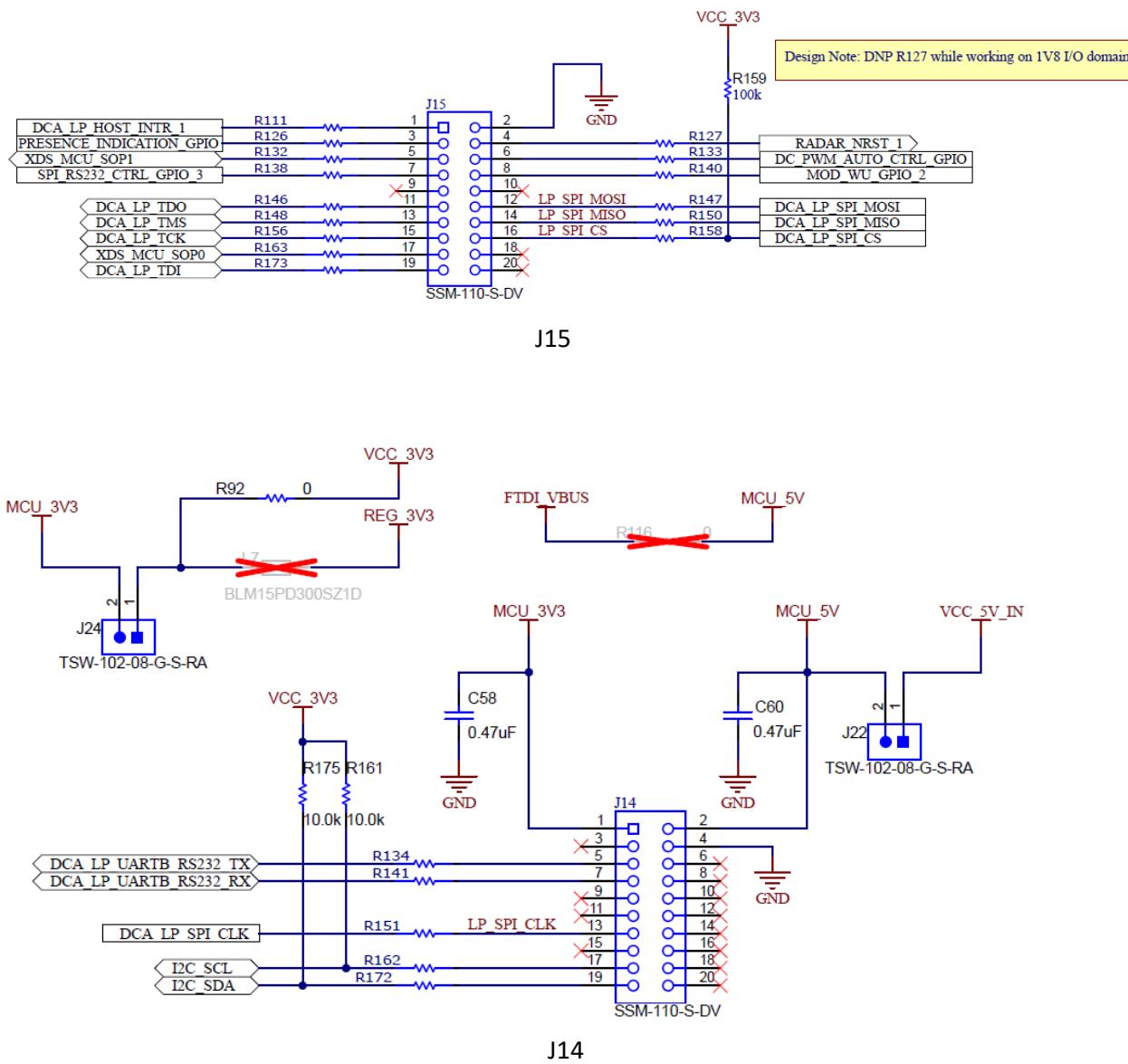


图 2-6. 引脚图 - 将在启动盘引脚分配时确保

2.5 跳线信息

VCC_MODULE 为了向模块提供核心 (VCC) 电源，需要闭合焊接跳线 J1 或接头跳线 J16 中的任何一个。

VCC_IO_MODULE 为了向模块提供 IO 电源，需要闭合任何焊接跳线 J4 或接头跳线 J20。

备注

在 EVM 中，默认情况下 J1 和 J4 处于闭合状态

2.6 按钮

复位开关 S2 是用于器件复位的按钮开关。

2.7 接口

演示：为了演示，EVM 在 J5 USB 处具有 SPI 接口

调试和开发：为了进行调试和开发，该 EVM 在 J7 上具有 XDS110 USB

外部 MCU - LaunchPad：J14 和 J15 是标准 LP/BP 连接器，用于连接 TI 标准的 LaunchPad 生态系统。

2.8 uDFP 补丁更新

对于 uDFP 补丁更新，EVM 在 J7 处具有 XDS110 USB (图 2-1)。有关更多信息，请参阅 uDFP 文档[毫米波 uDFP](#)

3 软件

3.1 软件说明

从 ti.com 下载并安装 TI 毫米波 uDFP 程序包毫米波 uDFP。请参阅以下位置的用户指南：[<安装文件夹>\mmWaveuDFP-0X_0X_0X\Tools\Module_Visualizer_User_Guide.pdf](http://ti.com/lit/ug/mmWaveuDFP-0X_0X_0X\Tools\Module_Visualizer_User_Guide.pdf)

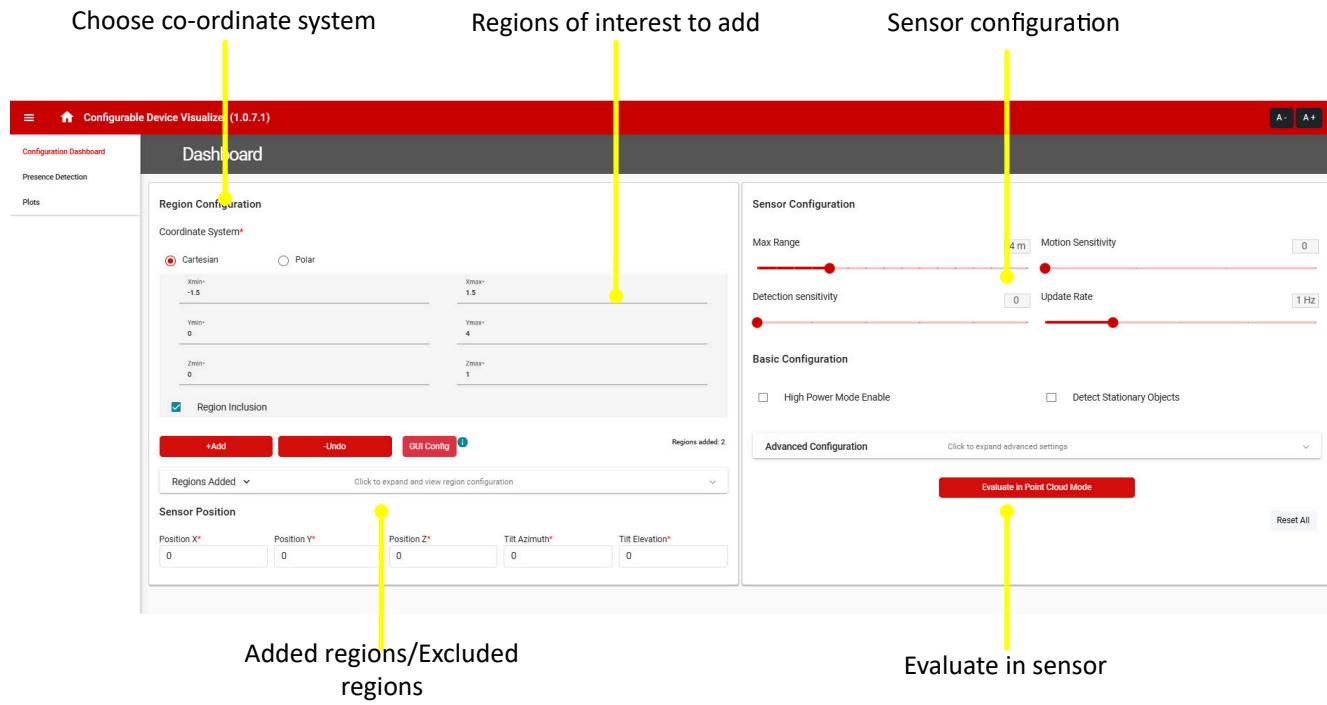


图 3-1. uDFP 可视化工具 UI

4 实现结果

4.1 评估设置

确保节 2.3.1 中提到的演示设置。

4.2 性能数据和结果

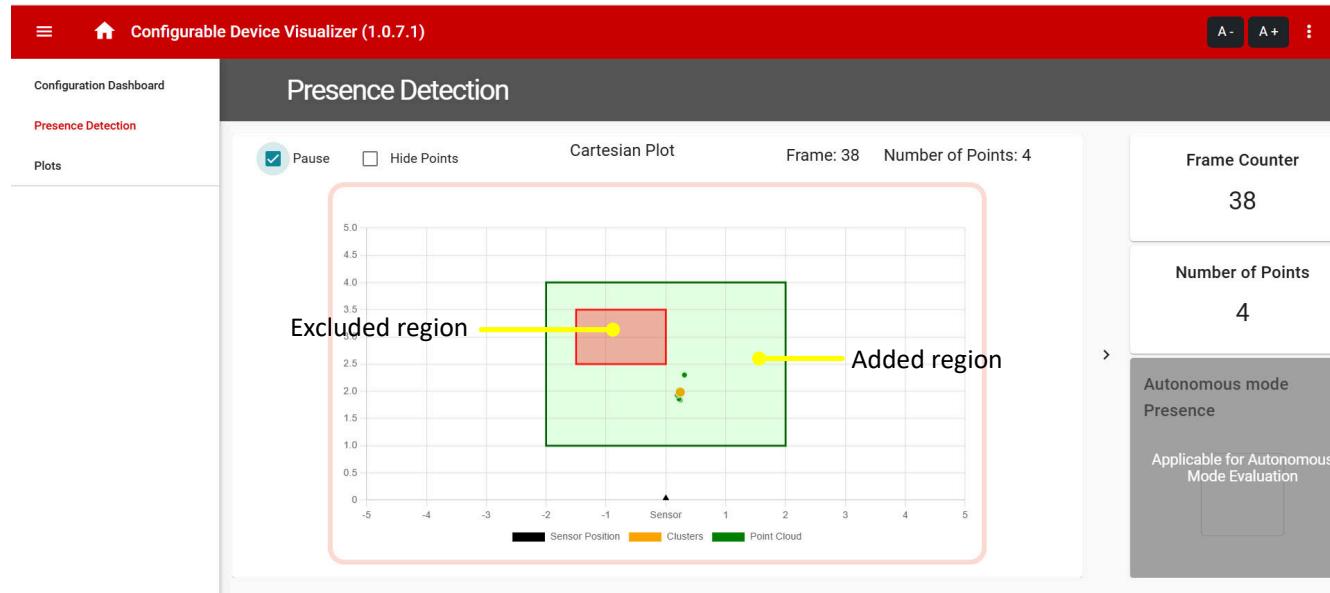


图 4-1. uDFP 可视化工具中源自点云数据的笛卡尔坐标图

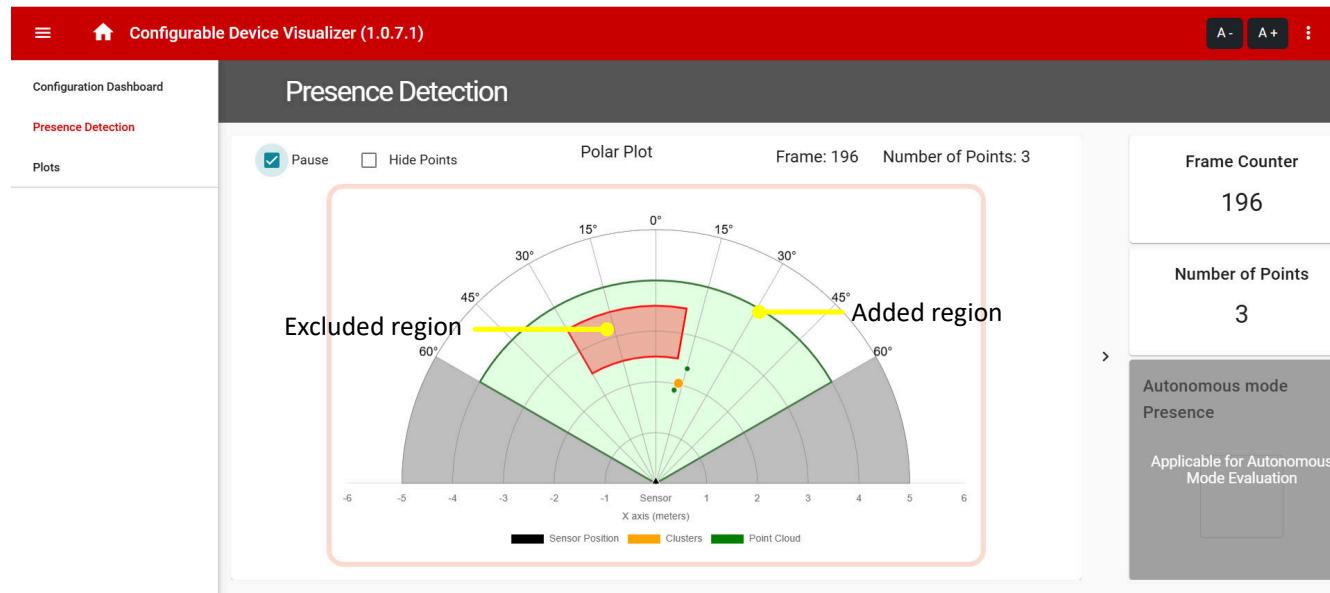


图 4-2. uDFP 可视化工具中源自点云数据的极坐标图

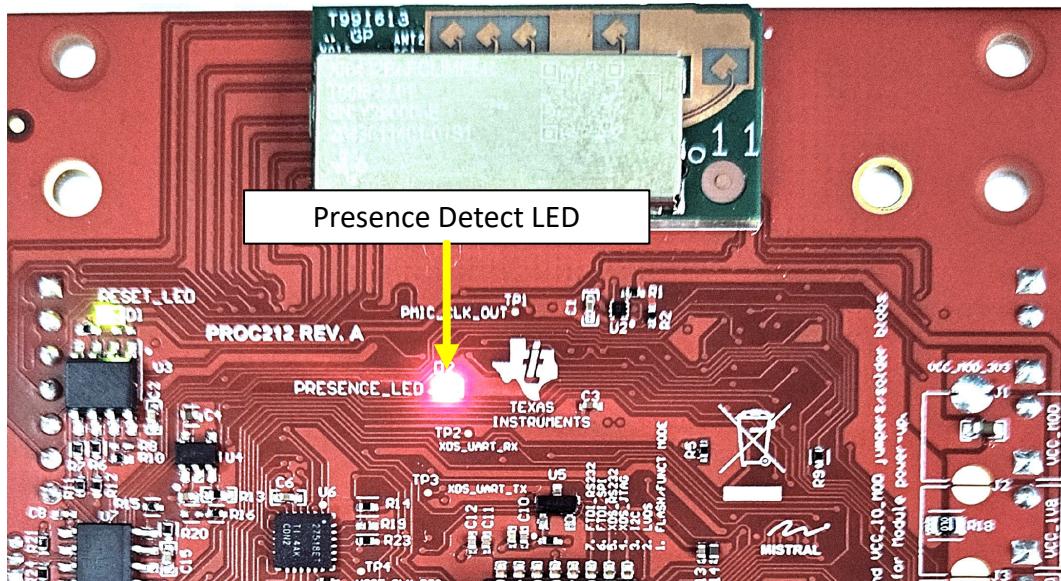


图 4-3. EVM 上的存在检测 LED 闪烁 - 检测到存在

5 硬件设计文件

5.1 原理图

[设计原理图](#)

5.2 PCB 布局

[设计布局](#)

5.3 物料清单 (BOM)

[设计物料清单 \(BOM\)](#)

6 相关文档

IWRL6432WMOD 数据表 - [IWRL6432WMOD](#)

IWRL6432W 数据表 - [IWRL6432W](#)

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 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 isotope 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/lsts/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24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/lsts/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:*

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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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最后更新日期：2025 年 10 月