

EVM User's Guide: INA151EVM

INA151 评估模块



说明

INA151EVM 评估模块 (EVM) 设计用于测试 INA151 的功能。该电路板通过香蕉连接器、SMA/SMB 连接器封装、测试点和多种连接参考电压的选项等方式，实现了灵活的输入和输出连接。

开始使用

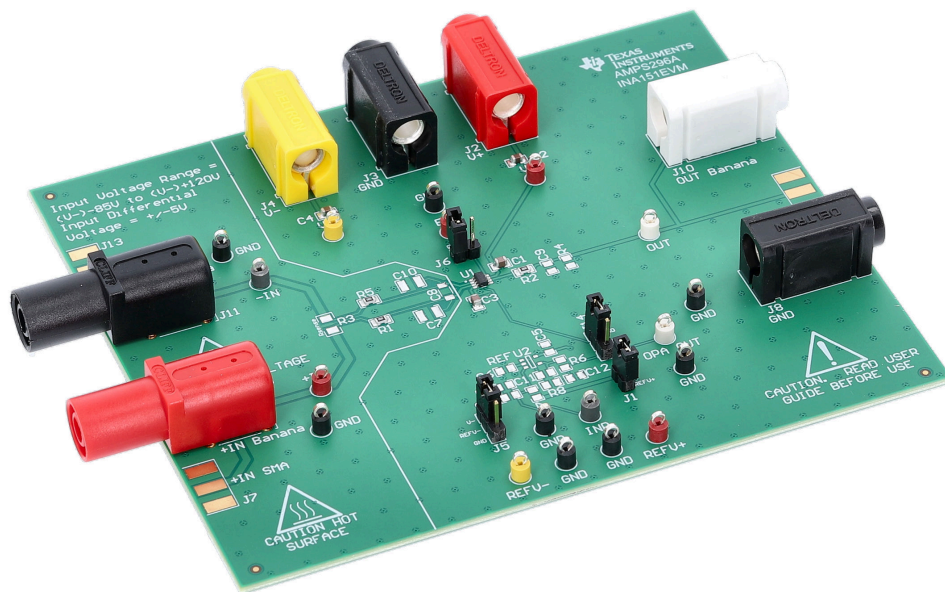
1. 从工具页面订购 [INA151EVM](#) 板。
2. 可选：如果不评估 INA151B，请订购替代 INA151 型号。
3. 有关详细的器件规格，请下载 [INA151 数据表](#)。
4. 下载 EVM 用户指南，了解相关说明。

特性

- 通过香蕉连接器、测试点和 SMB/SMA 封装实现灵活的输入和输出连接
- 通过测试点轻松连接设备引脚
- 封装可用于组装检测电阻器、输入滤波元件和外部基准缓冲器

应用

- [电芯化成和测试设备](#)
- [模拟输入模块](#)
- [混合模块 \(AI、AO、DI、DO \)](#)



1 评估模块概述

1.1 简介

本用户指南包含 INA151EVM 的支持文档。该 EVM 用于评估 INA151，并已装配 INA151BDDF 器件。可以通过取消组装板载 INA151 并替换为替代产品来测试 INA151 的替代增益型号。

本文档包括有关 EVM 使用方法、高压预防措施、套件内容、原理图、印刷电路板 (PCB) 布局和物料清单 (BOM) 的说明。本文档中的评估板、评估模块和 EVM 等术语指的是 INA151EVM。

1.2 套件内容

此 EVM 套件包括：

- INA151EVM 评估模块
- EVM 免责声明自述文件
- 高压自述文件

该套件不包括：

- 用作 R_{SENSE} 、输入滤波元件和输出负载的电容器和电阻器
- 外部基准电路的元件
- SMB/SMA 连接器

1.3 规格

INA151EVM 是一款评估模块，它提供了一种评估 INA151 的方法。该 EVM 装配有 INA151BDDF。印刷电路板 (PCB) 的尺寸为 4.20in × 5.05in。

EVM 提供以下功能：

- 高达 -80V 至 +120V 的高压输入端子。有关高压指南，请参阅 [节 通用德州仪器 \(TI\) 高压评估模块 \(TI HV EVM\) 用户安全指南](#)。
- 可选基准缓冲器封装 (采用 SOT-23 封装的单路运算放大器)
- 可选检测电阻器封装 (1206)
- 输入滤波电容器的封装 (1206 和 1210)
- 输出负载的封装 (0805)
- 适合 PCB 输入端和输出端的 SMA/SMB 连接器的封装
- 可将 EN 偏置到外部电压的选件

1.4 器件信息

INA151 是一款用于电压监测的精密差分放大器，其输入共模电压范围为 $(V^-) - 85V$ 至 $(V^-) + 120V$ 。INA151 可在高共模电压存在的情况下，精确测量最大 $\pm 5V$ 的差分电压，具有高共模抑制比、输入阻抗大于 $1.4M\Omega$ ，以及 $2\mu V/^\circ C$ 的偏移电压温漂。有关更多器件信息，请参阅 [INA151 具有使能/禁用功能的 120V、120dB CMRR 电压监测放大器 数据表](#)。

型号	增益 (V/V)
INA151A	1
INA151B	2/3
INA151C	1/2
INA151D	1/4

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 的设置和应用说明，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，确保自身和周围人员的人身安全。如需更多信息，请联系 TI 的产品信息中心 <http://ti.com/customer support>。

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) 严禁任何其他不合规的使用和/或应用。如果不满足资格，则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；指示可能存在高压操作，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/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：

- 作为一项预防措施，假定整个 EVM 可能存在用户可完全接触到的高电压是一种好的工程做法。
- 执行任何电气测量或其他诊断测量之前，需切断 TI HV EVM 及其全部输入、输出和电气负载的电源。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 will EVM 通电。

警告

EVM 通电后，请勿触摸 EVM 或电路，因为 EVM 或电路可能存在高压，会造成电击危险。

3. 人身安全

- 穿戴人员防护装备（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 电源要求

INA151 的工作电源电压范围为 $\pm 1.35\text{V}$ 至 $\pm 10\text{V}$ 双电源或 2.7V 至 20V 单电源。该 EVM 具有用于正电源 (+V)、负电源 (-V) 和接地 (GND) 的连接, 如图 2-1 所示。电路板上组装了旁路电容器 (C1、C2、C3、C4), 可作为器件电源。可以使用标准 4mm 香蕉插孔, 或通过使用电源测试点来完成电源连接, 然而在运行过程中不需要它们。如果在单电源中使用, 则将 (V-) 和 GND 都接地。

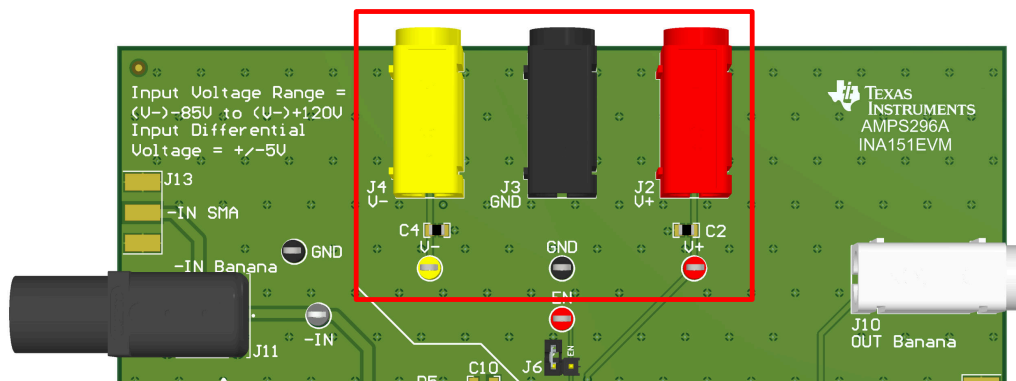


图 2-1. 电源连接器和测试点

图 2-2 显示电路板的高压部分由丝印和额定电压较高的香蕉插孔连接器 (J9、J11) 表示。丝印部分显示 PCB 布线如何针对高压电气间隙和设计规则进行优化, 以承受符合器件额定值的 -80V 至 $+120\text{V}$ 最大额定电压。所有其他香蕉插孔连接器的额定电压均低于 50V 。

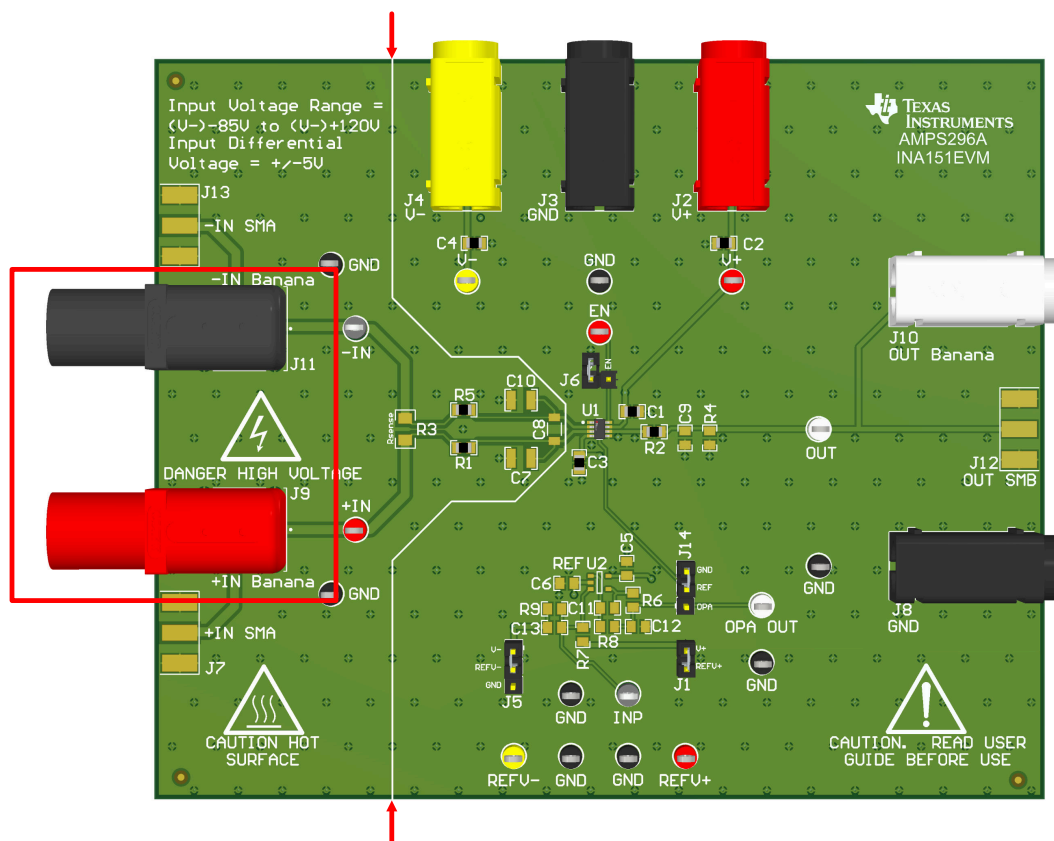


图 2-2. 评估板的高压部分

使用外部基准缓冲器时，基准缓冲器的电源电压（REFV+ 和 REFV-）可以通过 J1 和 J5 连接到电路板电源（V+ 和 V- 或 GND），也可以通过测试点 REFV- 和 REFV+ 在外部连接，然而在运行过程中不需要它们。测试点和接头的位置如图 2-3 所示。如果从外部驱动 REFV+ 和 REFV-，请从 J1 和 J5 上移除分流器。如果从外部驱动，请勿将电路板电源（V+ 和 V-）和 REF 电源（REFV+ 和 REFV-）连接在一起。有关更多信息，请参阅表 2-1。

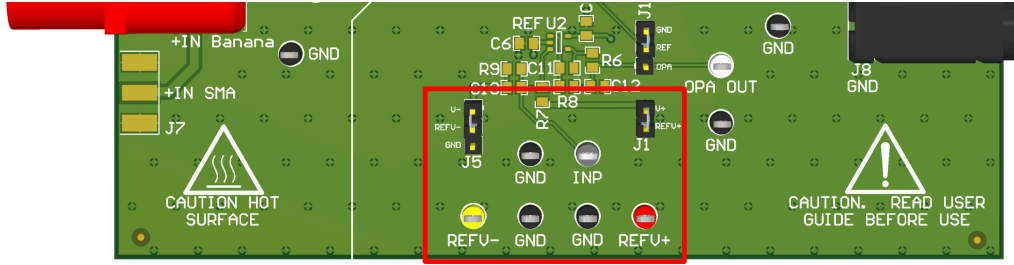


图 2-3. 基准电源引脚接头和测试点

表 2-1. 基准缓冲器电源接头

接头名称	功能	设置	说明
J1	REFV+	闭合	REFV+ 短接至 V+。请勿向 REFV+ 测试点施加外部电压。
		开路	REFV+ 悬空并且必须通过 REFV+ 测试点进行外部偏置。
J5	REFV-	闭合 (REFV- 至 V-)	REFV- 短接至 V-。请勿向 REFV- 测试点施加外部电压。
		闭合 (REFV- 至 GND)	REFV- 短接至 GND。请勿向 REFV- 测试点施加外部电压。
		开路	REFV- 悬空并且必须通过 REFV- 测试点进行外部偏置。

2.2 测试点

测试点位于整个电路板上，可在整条信号路径和多种电源中使用。测试点还可用于直接偏置输入电压、基准电压或电源电压上的电压。还包含了 GND 点以方便使用。有关所有测试点位置，请参阅 节 3.1。

2.3 设置

该 EVM 的默认配置无需进行任何修改即可测试 INA151，并且按照图 2-4 中所示的连接，使用标准实验室设备测试基本器件特性。节 2.3.1 至 节 2.3.5 显示了可对电路进行的修改。

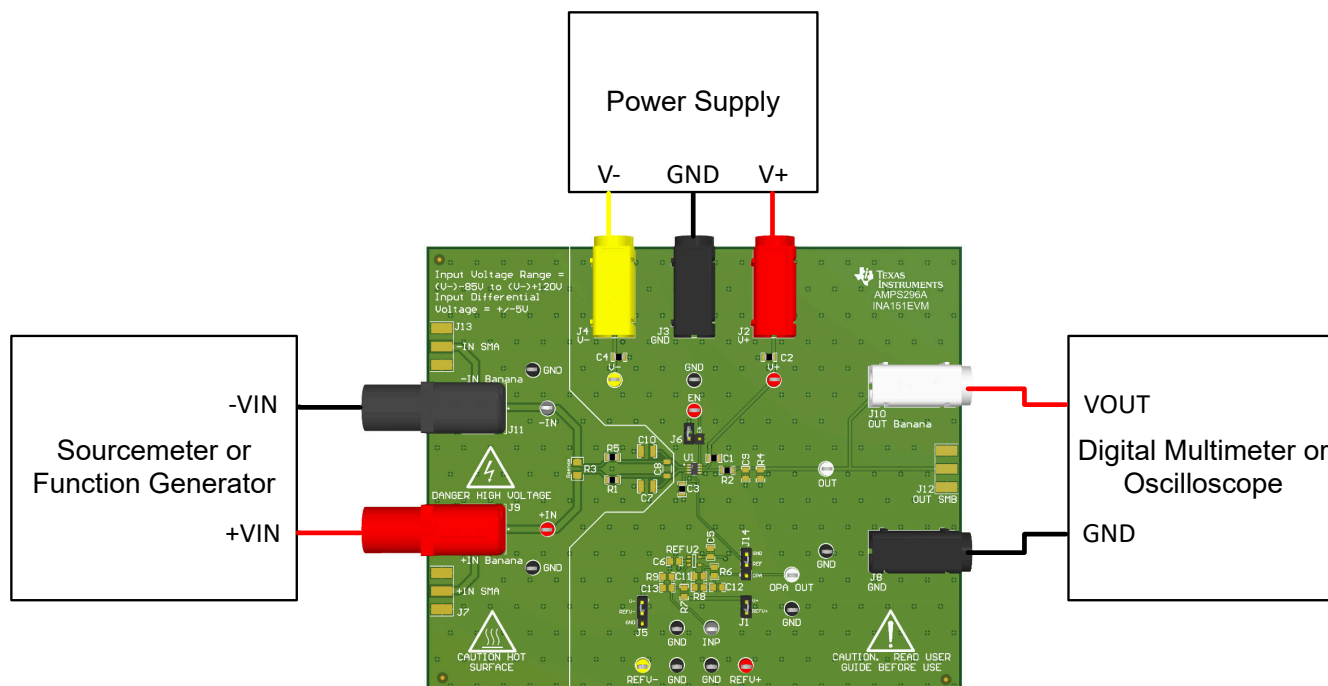


图 2-4. 使用默认设置的简化测试台配置

表 2-2. 默认接标头设置

接头名称	设置
J1	闭合
J5	闭合 (REFV- 至 V-)
J6	开路
J14	闭合 (REF 至 GND)

有关 INA151EVM 的详细原理图，请参阅节 3.1。

2.3.1 基准电压

EVM 提供了可选的基准缓冲器封装，使得基准引脚可以偏置到不同的电压电位。接头 J14 提供灵活性，可让基准电路将基准引脚 (REF) 连接到地或外部基准缓冲器电路。有关不同配置选项的信息，请参阅表 2-3。默认情况下，此电路未组装，并且可使用接头来设置器件 REF 引脚以接地。

表 2-3. REF 引脚的接头 J14 配置

设置	说明
REF 至 GND	REF 连接到 GND。
REF 至 OPA	REF 连接到基准缓冲器的输出端。

要从外部控制 REF 电压，请勿组装 REF 电路，将 J14 REF 设置为 OPA，并将外部电压连接到 OPA_OUT 测试点。

有关如何为基准缓冲电路供电的选项，请参阅节 2.1。

在原理图中选择 OPA191 作为基准缓冲器 (U2)。使用基准电路时，采用 SOT-23 (DDF) 封装的大多数单通道运算放大器都可以作为替代产品。

2.3.2 启用、禁用

EN 引脚控制 INA151 是处于启用模式还是禁用模式。接头 J6 可以配置为使能或禁用 INA151，如表 2-4 所示。当 J6 短接时，放大器输出被禁用。当 J6 断开时，EN 具有一个弱上拉电阻，允许在没有施加电压的情况下进行操作。

表 2-4. EN 引脚的接头 J6 配置

设置	说明
开路	启用 INA151 输出
闭合	禁用 INA151 输出

或者，如果 J6 处于导通状态，则可以将外部电压直接施加到 EN 测试点。EN 逻辑范围如表 2-5 中所示。DGND 连接至 EVM 上的 GND。

表 2-5. 使能电压逻辑高

EN 引脚逻辑状态	最小电压	最大电压
逻辑低电平	DGND	DGND + 0.9
逻辑高电平	DGND + 2	DGND + 5

2.3.3 电流检测

EVM 布局中设计了 R_{SENSE} 电阻器封装 (R3)，用于评估电流检测应用。如果使用 R_{SENSE} ，则该电阻器的额定值必须根据所选输入设置，且其尺寸范围必须为 0603 至 1206。布线宽度考虑到评估高达 5A 的负载电流。有关安全使用高压的所有预防措施，请参阅节 通用德州仪器 (TI) 高压评估模块 (TI HV EVM) 用户安全指南。

2.3.4 输入滤波

可以使用 C7、C8、C10 将共模和差分输入滤波应用于电路。默认情况下不组装这些元件。为电容器选择元件值时，建议 C8 大约比 C7 和 C10 大十倍。模拟工程师计算器工具可用于计算给定截止频率所需的电阻和电容值。请注意，所选的任何电容器和电阻器都必须根据施加的输入来设置其额定值。

2.3.5 输出负载

可使用 R4 和 C9 向电路施加输出负载，分别作为阻性负载和电容负载。R2 可与 C9 一起用作输出滤波器。默认情况下，R2 的电阻值为 0Ω ，而 R4 和 C9 未组装。

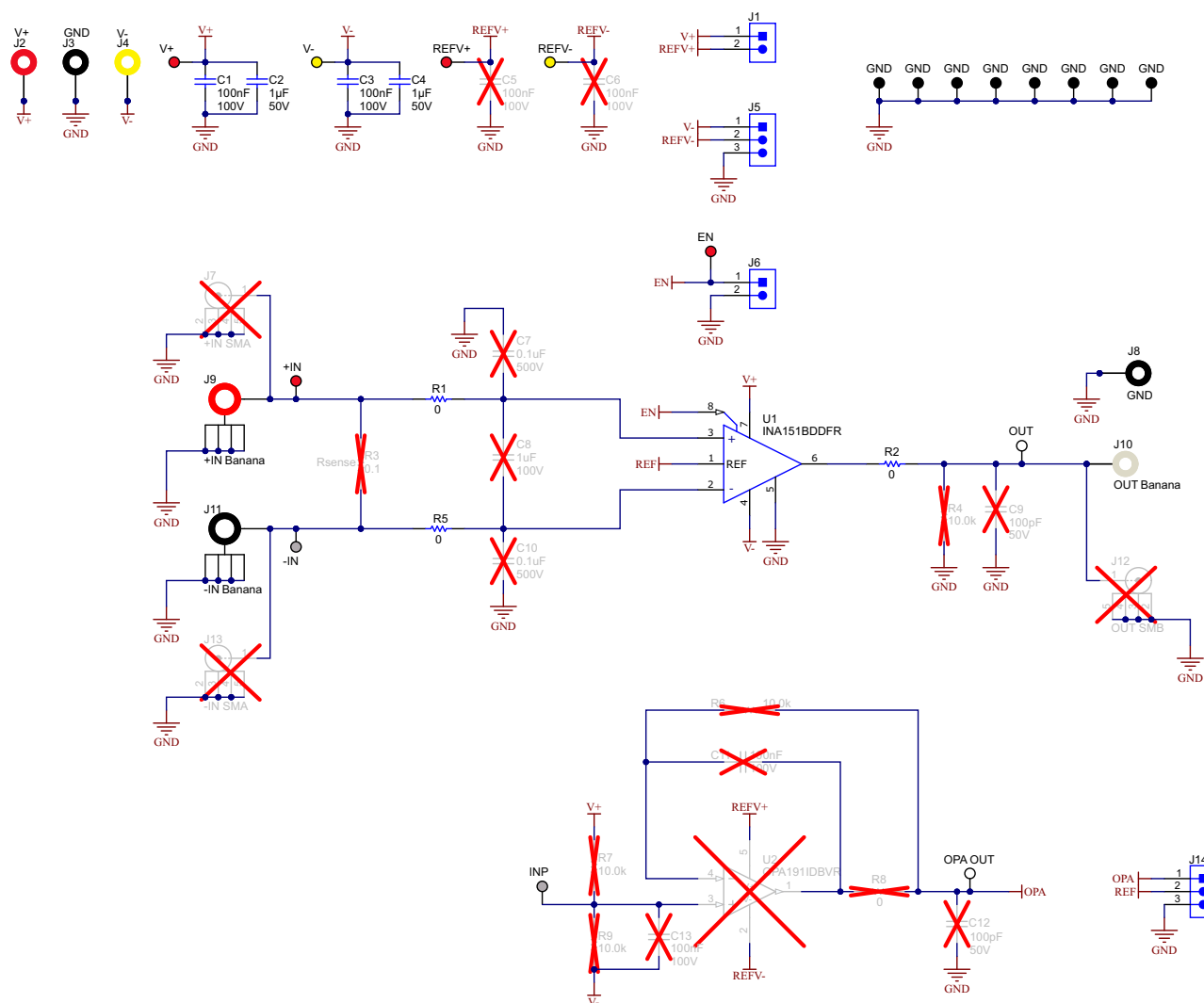
2.4 最佳实践

欲了解最佳实践：

- 参阅 [INA151 具有使能/禁用功能的 120V、120dB CMRR 电压监测放大器 数据表](#)。
- 查阅节 通用德州仪器 (TI) 高压评估模块 (TI HV EVM) 用户安全指南。
- 请注意，该 EVM 和板载所有元件仅用于评估。

3 硬件设计文件

3.1 原理图



English Document: SLVUDG8
Copyright © 2026 Texas Instruments Incorporated

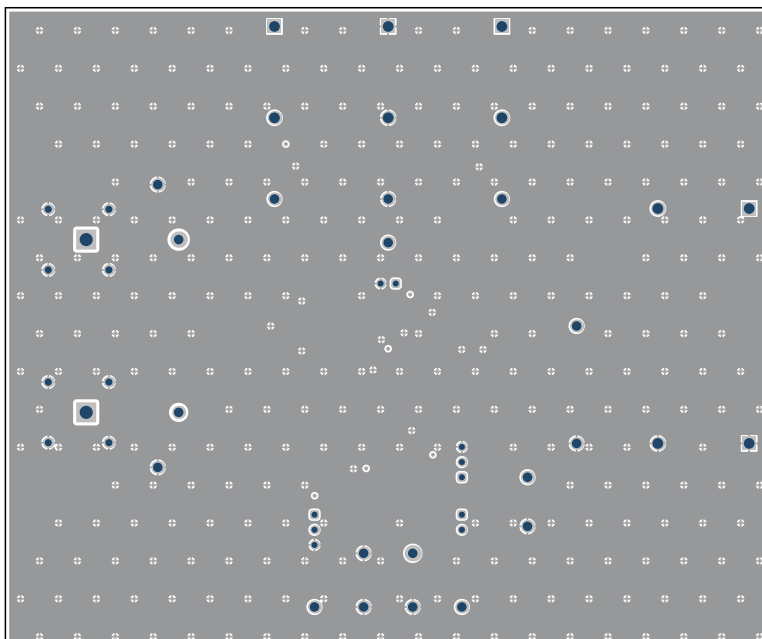


图 3-3. GND 层掩模

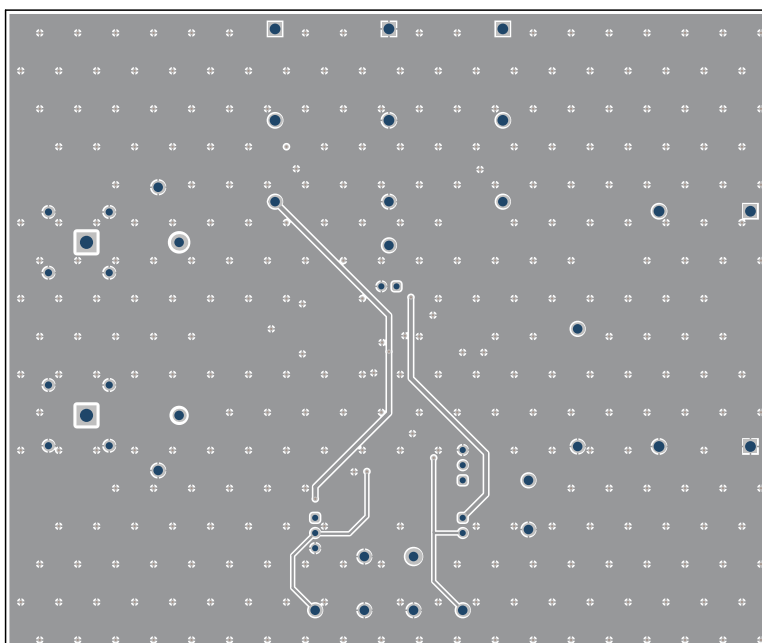


图 3-4. 电源层掩模

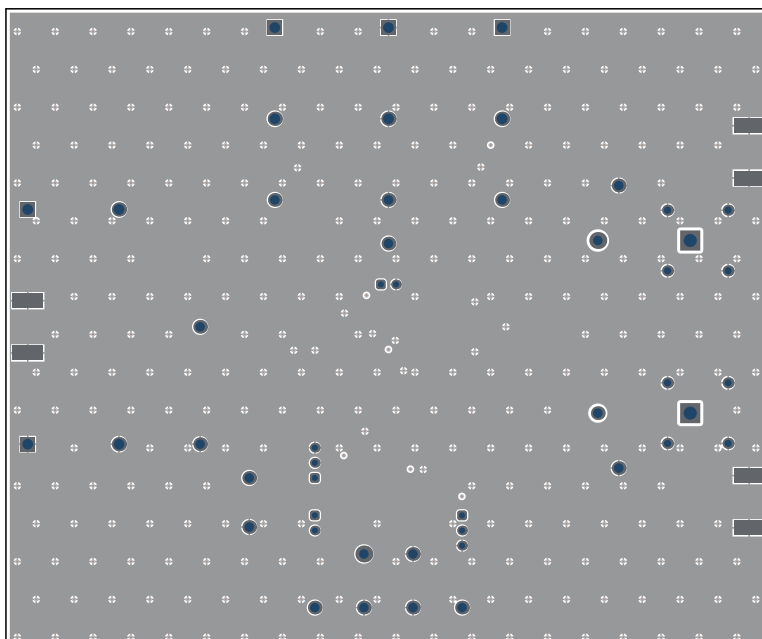


图 3-5. 底层掩模

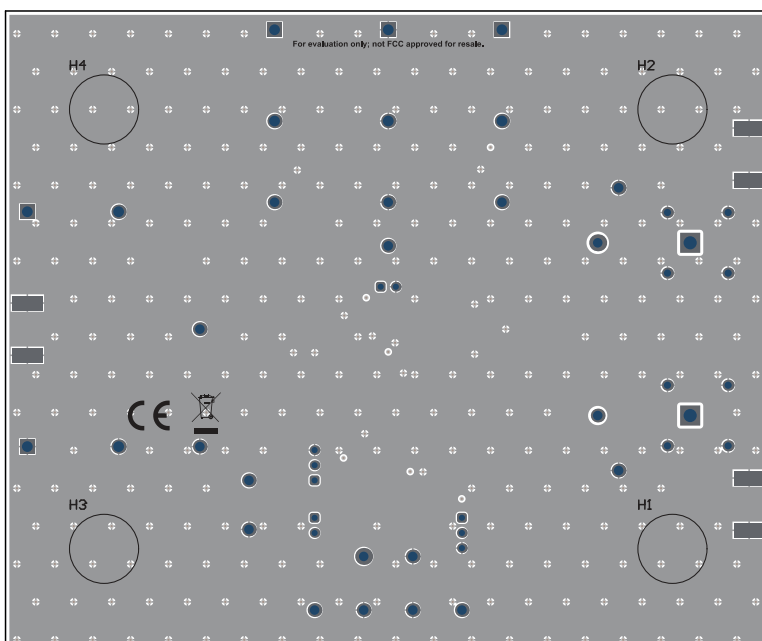


图 3-6. 底层丝印

3.3 物料清单 (BOM)

表 3-1. 物料清单

位号	数量	值	说明	封装参考	器件型号	制造商
!PCB1	1		印刷电路板		AMPS296	不限
C1, C3	2	0.1uF	电容, 陶瓷, 0.1μF, 100V, +/-10%, X7R, AEC-Q200 1 级, 0805	0805	GCM21BR72A104KA37L	MuRata
C2、C4	2	1μF	电容, 陶瓷, 1μF, 50V, +/-20%, X7R, AEC-Q200 1 级, 0805	0805	GCJ21BR71H105MA01L	MuRata
H1、H2、H3、H4	4		Bumpon, 半球形, 0.44 × 0.20, 透明	透明 Bumpon	SJ-5303 (CLEAR)	3M
J1、J6	2		接头, 2.54mm, 2x1, 锡, TH	接头, 2.54mm, 2x1, TH	TSW-102-23T-S	Samtec
J2	1		标准香蕉插孔, 绝缘, 10A, 红色	571-0500	571-0500	DEM Manufacturing
J3、J8	2		标准香蕉插孔, 绝缘, 10A, 黑色	571-0100	571-0100	DEM Manufacturing
J4	1		标准香蕉插孔, 绝缘, 10A, 黄色	571-0700	571-0700	DEM Manufacturing
J5、J14	2		接头, 2.54mm, 3x1, 金, TH	接头, 2.54mm, 3x1, TH	HMTSW-103-07G-S-240	Samtec
J9	1		香蕉插孔连接器, 标准香蕉焊片, 红色	CONN_BANANA_JACK	FCR7350R	CLIFF Electronic Components
J10	1		标准香蕉插孔, 绝缘, 10A, 白色	571-0600	571-0600	DEM Manufacturing
J11	1		香蕉插孔连接器, 标准香蕉焊片, 黑色	CONN_BANANA_JACK	FCR7350B	CLIFF Electronic Components
R1、R2、R5	3	0	电阻, 0, 5%, 0.125W, AEC-Q200 0 级, 0805	0805	ERJ-6GEY0R00V	Panasonic
SH-J1、SH-J2、SH-J3、SH-J4	4		分流器, 2.54mm, 金, 黑色	分流器, 2.54mm, 黑色	60900213421	Wurth Elektronik
TP1、TP3、TP13、TP14	4		测试点, 紧凑, 红色, TH	红色紧凑型测试点	5005	Keystone Electronics
TP2、TP4	2		测试点, 紧凑, 黄色, TH	黄色紧凑型测试点	5009	Keystone Electronics
TP5、TP6、TP7、TP8、TP9、TP10、TP11、TP12	8		测试点, 紧凑型, 黑色, TH	黑色紧凑型测试点	5006	Keystone Electronics
TP15、TP17	2		测试点, 紧凑型, 白色, TH	白色紧凑型测试点	5007	Keystone Electronics
TP16、TP18	2		测试点, 紧凑, 灰色, TH	测试点、灰色、220mil、TH	5123	Keystone Electronics
U1	1		INA151BDDFR	SOT-23	INA151BDDFR	德州仪器 (TI)
C5、C6、C11、C13	0	0.1uF	电容, 陶瓷, 0.1μF, 100V, +/-10%, X7R, AEC-Q200 1 级, 0805	0805	GCM21BR72A104KA37L	MuRata
C7、C10	0	0.1uF	电容, 陶瓷, 0.1μF, 500V, +/-10%, X7R		C1210X104KCRACTU	Kemet
C8	0	1μF	电容, 陶瓷, 1μF, 100V, +/-10%, X7R, 1206	1206	GRM31CR72A105KA01L	MuRata

表 3-1. 物料清单 (续)

位号	数量	值	说明	封装参考	器件型号	制造商
C9、C12	0	100pF	电容, 陶瓷, 100pF, 50V, +/-5%, C0G/NP0, 0805	0805	8.85012E+11	Wurth Elektronik
FID1、FID2、FID3	0		基准标记。没有需要购买或安装的元件。	不适用	不适用	不适用
J7、J12、J13	0		连接器, 末端发射 SMA, 50 Ω , SMT	SMA 末端发射	142-0701-851	Cinch Connectivity
R3	0	0.1	电阻, 0.1, 1%, 0.5W, AEC-Q200 1 级, 1206	1206	UR73V2BTTDR100F	KOA Speer
R4、R6、R7、R9	0	10.0k	电阻, 10.0k, 0.1%, 0.125W, 0805	0805	RT0805BRD0710KL	Yageo America
R8	0	0	电阻, 0, 5%, 0.125W, AEC-Q200 0 级, 0805	0805	ERJ-6GEY0R00V	Panasonic
U2	0		36V 低功耗, 精密, CMOS, 轨到轨输入/输出, 低失调电压, 低输入偏置电流精密运算放大器, DBV0005A (SOT-23-5)	DBV0005A	OPA191IDBVR	德州仪器 (TI)

4 其他信息

4.1 商标

所有商标均为其各自所有者的财产。

5 相关文档

5.1 补充内容

如要查看相关文件，请参阅以下内容：

- 德州仪器 (TI), [INA151 具有使能/禁用功能的 120V、120dB CMRR 电压监测放大器 数据表](#)
- 德州仪器 (TI), [ANALOG-ENGINEER-CALC](#)

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 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.

6. *Disclaimers:*

6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

8. *Limitations on Damages and Liability:*

8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS, REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMNITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM SHALL NOT ENLARGE OR EXTEND THIS LIMIT.

9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2023, Texas Instruments Incorporated

重要通知和免责声明

TI“按原样”提供技术和可靠性数据（包括数据表）、设计资源（包括参考设计）、应用或其他设计建议、网络工具、安全信息和其他资源，不保证没有瑕疵且不做任何明示或暗示的担保，包括但不限于对适销性、与某特定用途的适用性或不侵犯任何第三方知识产权的暗示担保。

这些资源可供使用 TI 产品进行设计的熟练开发人员使用。您将自行承担以下全部责任：(1) 针对您的应用选择合适的 TI 产品，(2) 设计、验证并测试您的应用，(3) 确保您的应用满足相应标准以及任何其他安全、安保法规或其他要求。

这些资源如有变更，恕不另行通知。TI 授权您仅可将这些资源用于研发本资源所述的 TI 产品的相关应用。严禁以其他方式对这些资源进行复制或展示。您无权使用任何其他 TI 知识产权或任何第三方知识产权。对于因您对这些资源的使用而对 TI 及其代表造成的任何索赔、损害、成本、损失和债务，您将全额赔偿，TI 对此概不负责。

TI 提供的产品受 [TI 销售条款](#)、[TI 通用质量指南](#) 或 [ti.com](#) 上其他适用条款或 TI 产品随附的其他适用条款的约束。TI 提供这些资源并不会扩展或以其他方式更改 TI 针对 TI 产品发布的适用的担保或担保免责声明。除非德州仪器 (TI) 明确将某产品指定为定制产品或客户特定产品，否则其产品均为按确定价格收入目录的标准通用器件。

TI 反对并拒绝您可能提出的任何其他或不同的条款。

版权所有 © 2026，德州仪器 (TI) 公司

最后更新日期：2025 年 10 月