EVM User's Guide: ADS9324EVM

ADS9324 BoosterPack™ 插件评估模块

说明

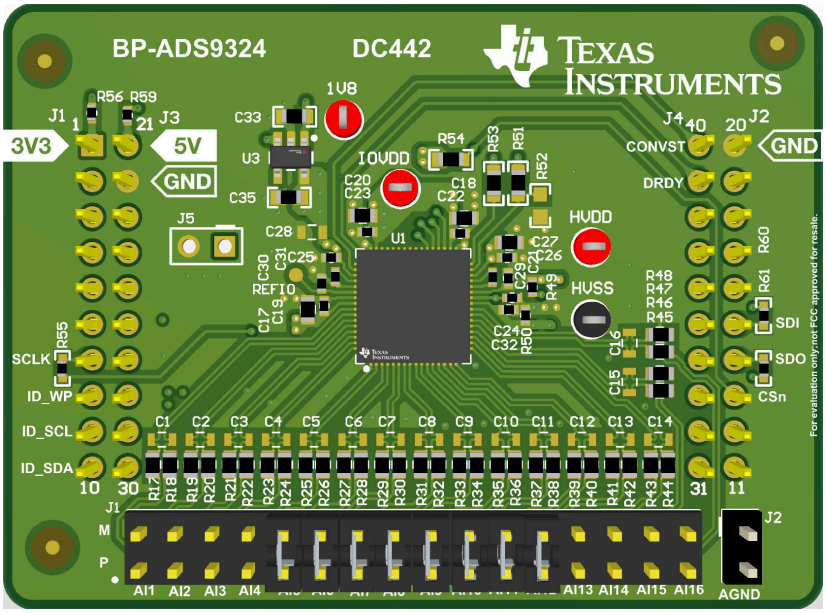
ADS9324 BoosterPack™ 插件模块 (BP-ADS9324) 为使用 ADS9324 开发应用提供了一个具有成本效益且易于使用的平台。此模块与 LAUNCHXL-F28P65X LaunchPad™ 评估套件兼容，包含用于支持与其他控制器配合使用的接头。提供了演示器件基本功能的示例代码，可作为应用开发的开放式起点。

开始使用

1. 订购 BP-ADS9324。
2. 下载 ADS9324 的软件示例 (ADS9324-BOOSTERPACK-C2000-CODE)。
   a. 要使用 LaunchPad 进行评估，请订购 LAUNCHXL-F28P65X。如需使用 LaunchPad 进行评估，请参阅硬件和软件部分。
   b. 要使用现有控制器进行评估，请参考 图 1-1 作为连接 BoosterPack 的指南；如适用，可将示例代码作为参考。

特性

- 具有集成模拟前端的 16 通道 16 位 ADC
- 通道独立的可编程输入：±12.5V、±10V、±6.25V、±5V、±2.5V
- 模拟带宽选项：25kHz 和 325kHz
- 兼容 LaunchPad 的接头引脚
- 灵活的控制器接口能力
- 兼容 ADS9324 系列其他器件、ADS9308V8I 系列器件，以及其他版本



1 评估模块概述

1.1 简介

ADS9324 BoosterPack 插件模块支持对德州仪器 (TI) ADS9324 的评估。该器件是一款 16 位、16 通道的 1MSPS ADC，输入范围最高可达 ±12.5V。该 BoosterPack 提供了一个硬件平台，支持使用 ADS9324 快速开始评估和应用开发。

本文档介绍了该模块的设计，并包含原理图、印刷电路板 (PCB) 布局以及物料清单 (BOM)

BP-ADS9324 BoosterPack 支持使用 LAUNCHXL-F28P65X LaunchPad 进行评估。C2000™ F28P65x LaunchPad 开发者套件用户指南提供了有关 LaunchPad 平台的更多详细信息。

ADS9324-BOOSTERPACK-C2000-CODE 演示了基本的 ADC 寄存器读取、寄存器写入以及转换数据读取操作，旨在作为完整应用开发的起点。

1.2 套件内容

ADS9324 BoosterPack 插件模块配备了两个与 LaunchPad 兼容的接头（J3 和 J4），便于与 TI LaunchPad 开发者套件集成，还配有一个可直接访问八个输入通道的附加接头。该配置支持与更广泛的控制器及用户自定义信号链进行灵活连接。

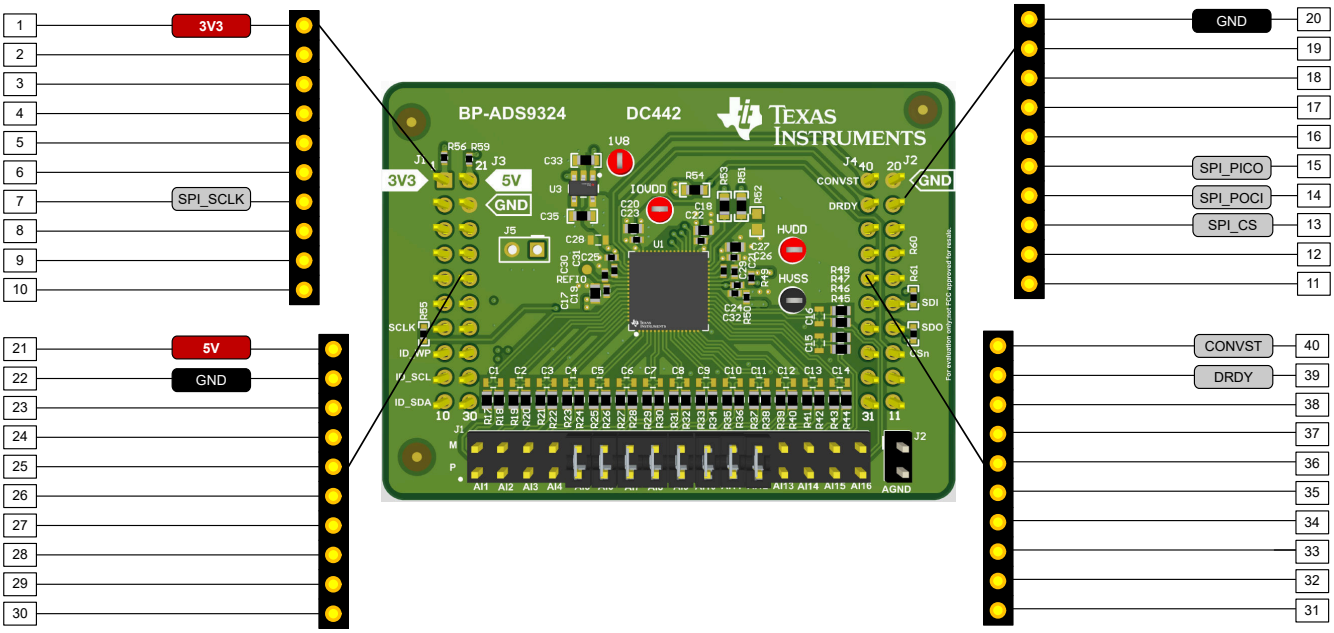


图 1-1. 接口引脚排列

表 1-1. 套件内容

条目	数量
BP-ADS9324 BoosterPack	1

表 1-2. 套件中不包含的元件

条目	数量
LAUNCHXL-F28P65X LaunchPad	1

从 www.ti.com 购买 LAUNCHXL-F28P65X LaunchPad。

1.3 规格

该模块为 ADS9324 器件提供直接的硬件访问，以支持用户自定义的信号调节、控制和系统集成。该电路板集成了 ADS9324，并配备相应的电源去耦电路，同时将信号引出至兼容 LaunchPad 的接头。板上未实现固定的信号调节电路，从而支持针对具体应用的前端设计。集成的测试点和可配置的元件封装布局便于在紧凑的板型尺寸内进行评估、修改和调试。

1.4 器件信息

ADS9324 是一款 16 位、16 通道的 1MSPS ADC，输入电压范围最高可达 ±12.5V。该器件为每个输入通道集成了模拟前端电路，包括集成式 PGA、低通滤波器和片上 4.096V 低温漂基准电压源。

2 硬件

2.1 电路板设置

BP-ADS9324 BoosterPack 为该器件的电源引脚提供电气连接。

输入配置：

- 根据需要安装 R1R16，以将 AINxM 短接至 GND。
- 根据需要将跳线放置在 J1 上，以将 AINxP 和 AINxM 短接在一起。

2.2 设置

- 将 BoosterPack 与 LaunchPad 的 J1、J2、J3 和 J4 接头对齐。将 BoosterPack 上的 3V3、5V 和 GND 丝印标识与 LaunchPad 对齐，如下所示。
- 连接 USB 电缆为 LaunchPad 上电。

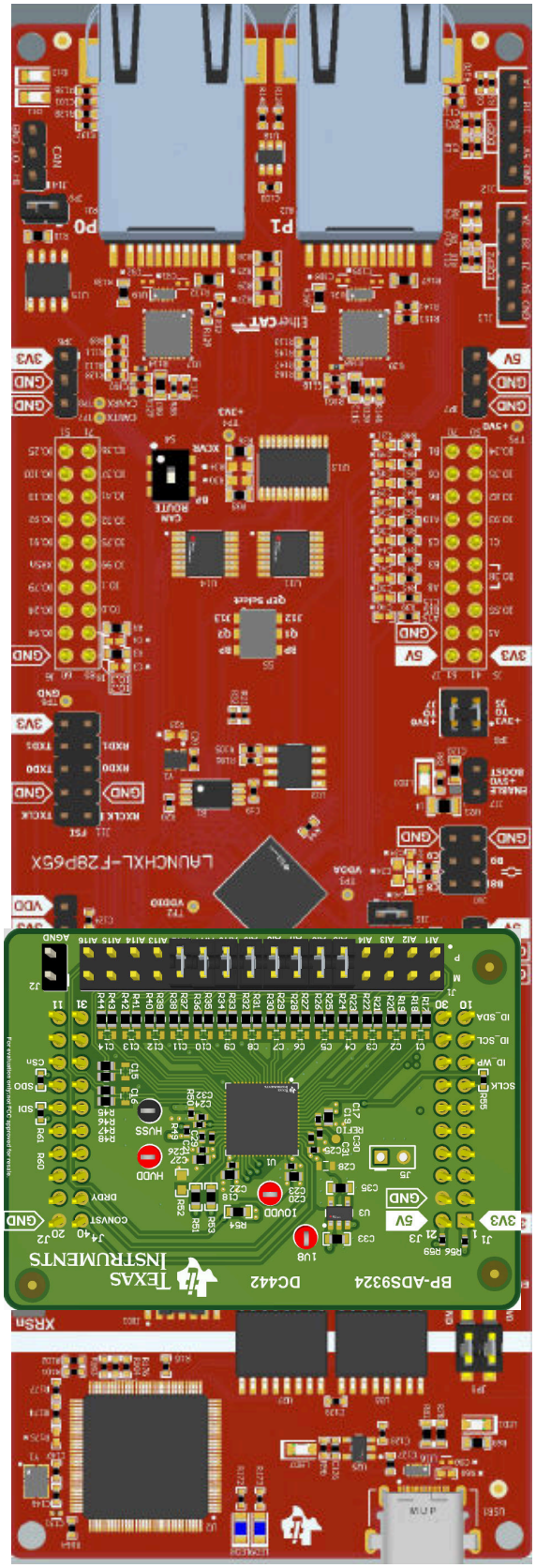


图 2-1. 硬件设置

3 软件

3.1 软件安装

- 使用 Code Composer Studio™ 集成开发环境，以 ADS9324-BOOSTERPACK-C2000-CODE 为起点对 LaunchPad 进行编程。

  有关更多信息，请查看包含的自述文件。

备注

如需了解如何使用 Code Composer Studio 或 LaunchPad，请查阅 C2000 软件开发者套件 (SDK) 中的相关资源，或访问 TI 云开发人员专区。C2000 Academy 的各种在线配套资料、培训，以及 TI E2E™ 支持论坛还可为 C2000 MCU 提供在线支持。

4 硬件设计文件

4.1 原理图

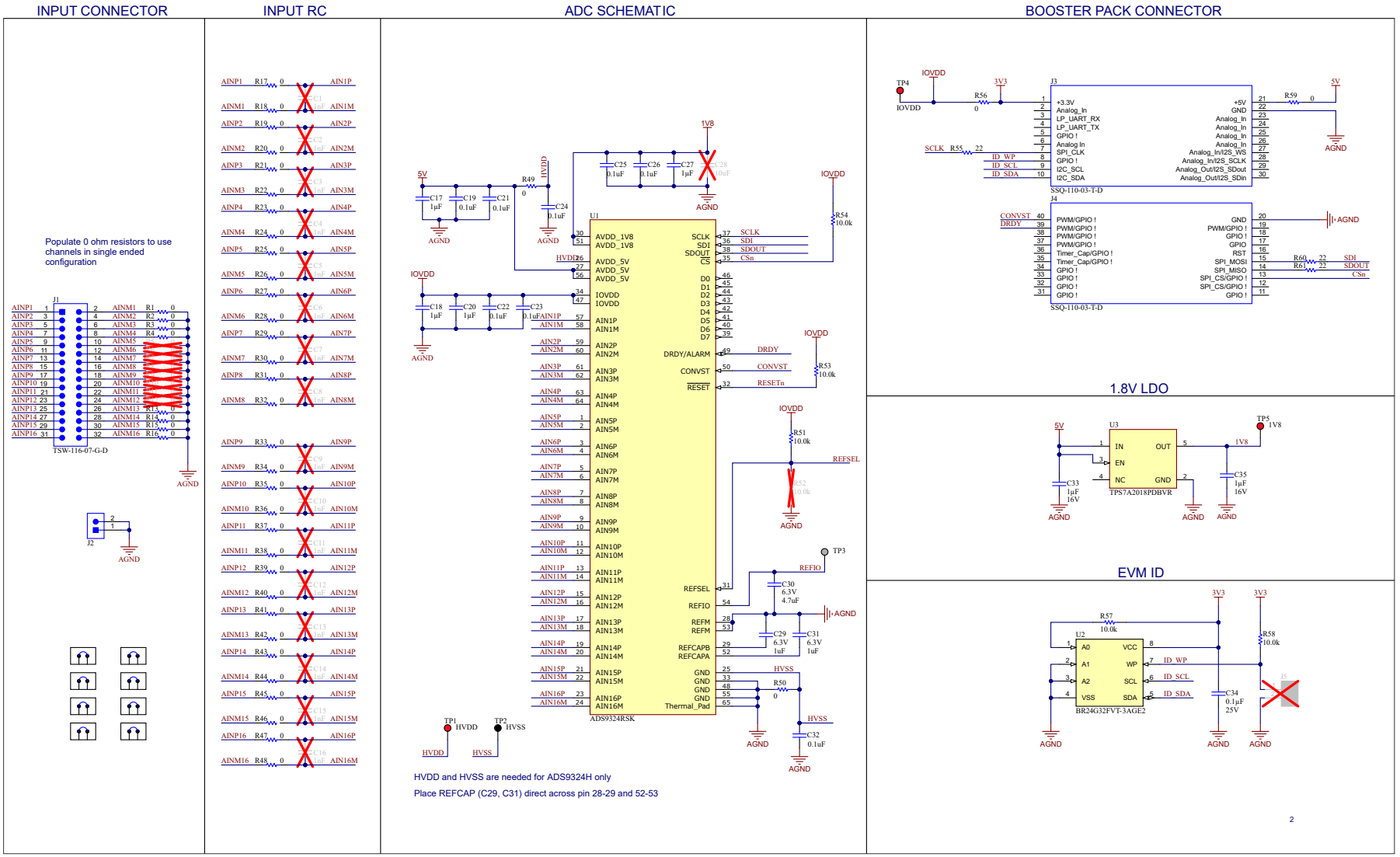


图 4-1. 原理图

4.2 PCB 布局

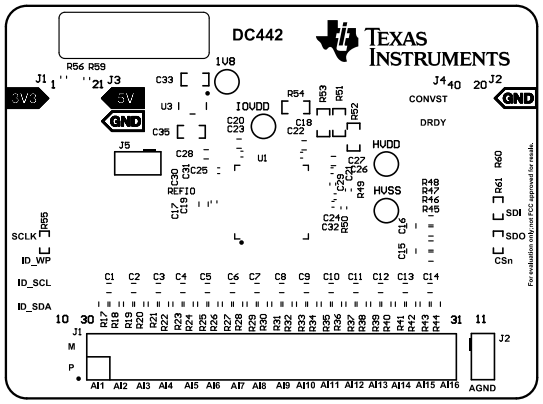


图 4-2. PCB 顶层丝印图

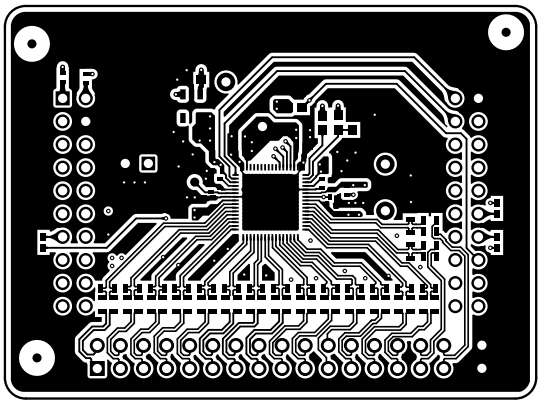


图 4-3. PCB 顶层

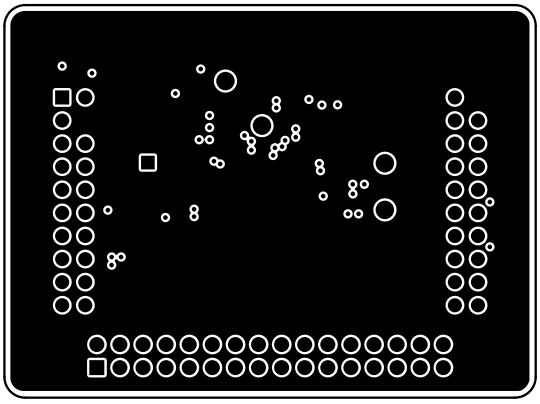


图 4-4. PCB 信号层 1

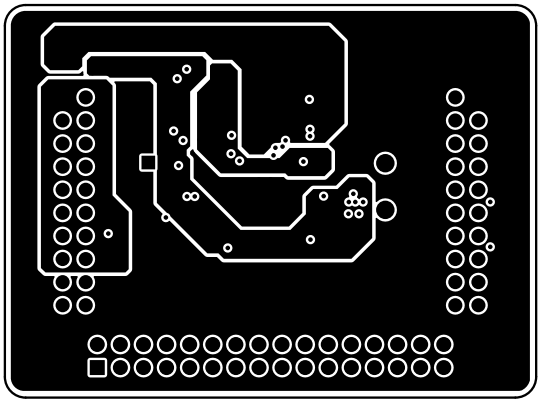


图 4-5. PCB 信号层 2

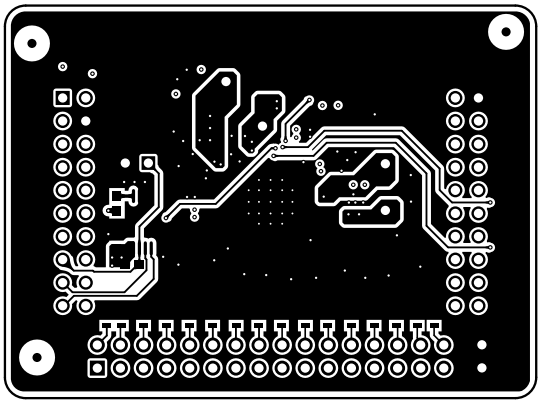


图 4-6. PCB 底层

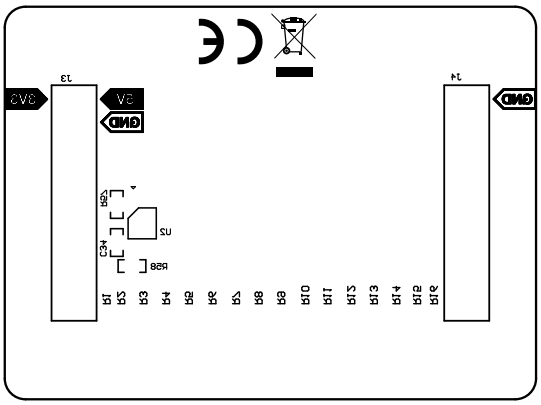


图 4-7. PCB 底层丝印图

4.3 物料清单 (BOM)

位号	器件型号	值	数量	说明	制造商	封装参考
C17、C18、C20、C27	CGA3E1X7R1E105K080AC	1uF	4	电容，陶瓷，1μF，25V，+/-10%，X7R，AEC-Q200 1 级，0603	TDK	0603
C19、C21、C22、C23、C24、C25、C26、C32	GRM155R61C104KA88D	0.1uF	8	电容，陶瓷，0.1uF，16V，+/-10%，X5R，0402	MuRata	0402
C29、C31	GRM155R70J105KA12D	1uF	2	电容，陶瓷，1uF，6.3V，+/-10%，X7R，0402	MuRata	0402
C30	GRM155R60J475ME87D	4.7uF	1	电容，陶瓷，4.7uF，6.3V，+/-20%，X5R，0402	MuRata	0402
C33、C35	C1608X7R1C105K080AC	1uF	2	电容，陶瓷，1uF，16V，+/-10%，X7R，0603	TDK	0603
C34	CL10A104KA8NNNC	0.1uF	1	电容，陶瓷，0.1μF，25V，+/-10%，X5R，0603	Samsung Electro-Mechanics	0603
J1	TSW-116-07G-D		1	接头，100mil，16x2，金，TH	Samtec	16x2 接头
J2	PEC02SAAN		1	接头，100mil，2x1，锡，TH	Sullins Connector Solutions	接头，2 引脚，100mil，锡
J3、J4	SSQ-110-03T-D		2	插座，2.54mm，10x2，锡，TH	Samtec	10x2 插座
R1、R2、R3、R4、R13、R14、R15、R16、R17、R18、R19、R20、R21、R22、R23、R24、R25、R26、R27、R28、R29、R30、R31、R32、R33、R34、R35、R36、R37、R38、R39、R40、R41、R42、R43、R44、R45、R46、R47、R48	ERJ-3GEY0R00V	0	40	电阻，0，5%，0.1W，AEC-Q200 0 级，0603	Panasonic	0603
R49、R50、R56、R59	CRCW04020000Z0ED	0	4	电阻，0，5%，0.063W，AEC-Q200 0 级，0402	Vishay-Dale	0402
R51、R53、R54、R57、R58	CRCW060310K0FKEA	10.0k	5	电阻，10.0k，1%，0.1W，AEC-Q200 0 级，0603	Vishay-Dale	0603

位号	器件型号	值	数量	说明	制造商	封装参考
R55、R60、R61	CRCW040222R0JNED	22	3	电阻，22，5%，0.063W，AEC-Q200 0 级，0402	Vishay-Dale	0402
TP1、TP4、TP5	5000		3	测试点，微型，红色，TH	Keystone Electronics	红色微型测试点
TP2	5001		1	测试点，微型，黑色，TH	Keystone Electronics	黑色微型测试点
U1	ADS9324RSK		1	具有集成模拟前端的 16 通道 16 位 1MSPS 同步采样 SAR ADC	德州仪器 (TI)	QFN64
U2	BR24G32FVT-3AGE2		1	I2C BUS EEPROM（2 线），TSSOP-B8	Rohm	TSSOP-8
U3	TPS7A2018PDBVR		1	线性稳压器 IC，固定正电压，1 输出，300mA，SOT-23-5	德州仪器 (TI)	SOT23-5
C1、C2、C3、C4、C5、C6、C7、C8、C9、C10、C11、C12、C13、C14、C15、C16	GRM188R72A102KA01D	1000pF	0	电容，陶瓷，1000pF，100V，+/-10%，X7R，0603	MuRata	0603
C28	GRM188R61E106MA73D	10uF	0	电容，陶瓷，10 µ F，25V，+/-20%，X5R，0603	MuRata	0603
J5	PEC02SAAN		0	接头，100mil，2x1，锡，TH	Sullins Connector Solutions	接头，2 引脚，100mil，锡
R5、R6、R7、R8、R9、R10、R11、R12	ERJ-3GEY0R00V	0	0	电阻，0，5%，0.1W，AEC-Q200 0 级，0603	Panasonic	0603
R52	CRCW060310K0FKEA	10.0k	0	电阻，10.0k，1%，0.1W，AEC-Q200 0 级，0603	Vishay-Dale	0603

5 其他信息

5.1 商标

BoosterPack™, LaunchPad™, Code Composer Studio™, and TI E2E™ are trademarks of Texas Instruments.
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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.

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Evaluation Kits are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.

User shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 *Regulatory Notices:*

3.1 *United States*

3.1.1 *Notice applicable to EVMs not FCC-Approved:*

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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3. 技術基準適合証明を取得後ご使用いただく。

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西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/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:*

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最后更新日期：2025 年 10 月