

# ADS9324 BoosterPack™ Plug-In Evaluation Module



## Description

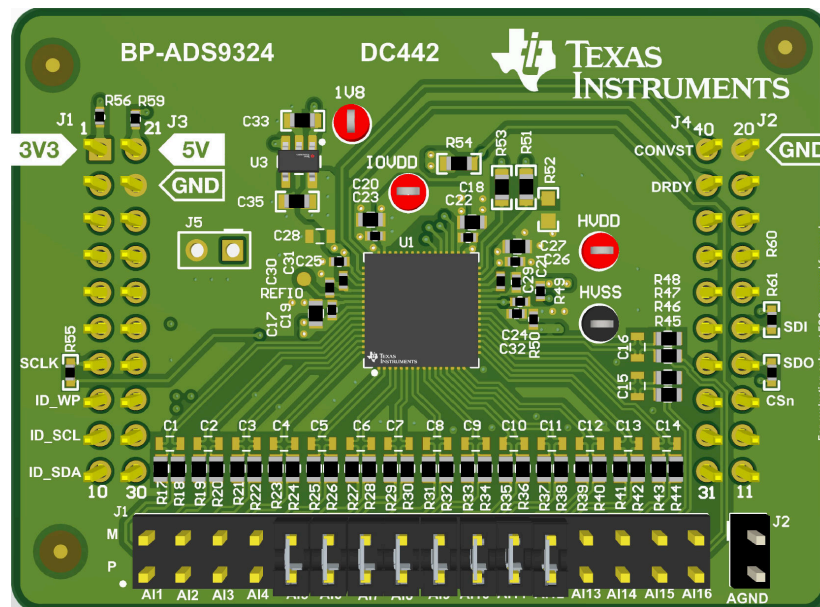
The ADS9324 BoosterPack™ Plug-in Module (BP-ADS9324) provides a cost effective and accessible platform for developing applications using the ADS9324. This module is compatible with the [LAUNCHXL-F28P65X](#) LaunchPad™ evaluation kit, and includes headers to support use with other controllers. Example code demonstrating basic device functionality is provided to serve as an open starting point for application development.

## Features

- 16-Channel, 16-bit ADC with integrated analog front-end
- Channel-independent programmable inputs:  $\pm 12.5V$ ,  $\pm 10V$ ,  $\pm 6.25V$ ,  $\pm 5V$ ,  $\pm 2.5V$
- Analog bandwidth options: 25kHz and 325kHz
- LaunchPad-compatible header pins
- Flexible controller interfacing capability
- Compatible with other ADS9324 family devices, ADS9308V8I, as well as other variants

## Get Started

1. Order the [BP-ADS9324](#).
2. Download the software example for ADS9324 ([ADS9324-BOOSTERPACK-C2000-CODE](#)).
  - a. For evaluation with LaunchPad, order the [LAUNCHXL-F28P65X](#). See [Hardware](#) and [Software](#) sections for evaluation with LaunchPad.
  - b. For evaluation with an existing controller, use [Figure 1-1](#) as a guide to connect to the BoosterPack and, if applicable, use the example code as reference.



# 1 Evaluation Module Overview

## 1.1 Introduction

The ADS9324 BoosterPack Plug-in Module enables the evaluation of Texas Instruments ADS9324, a 16-bit, 16-channel, 1MSPS ADC with up to  $\pm 12.5V$  input range. This BoosterPack provides a hardware platform to quickly begin evaluation and application development using the ADS9324.

This document describes the module design and includes the schematic, printed circuit board (PCB) layout, and bill of materials (BOM)

The [BP-ADS9324](#) BoosterPack can be evaluated with the [LAUNCHXL-F28P65X](#) LaunchPad. The [C2000™ F28P65x LaunchPad Development Kit User's Guide](#) provides additional details regarding the LaunchPad platform.

The [ADS9324-BOOSTERPACK-C2000-CODE](#) demonstrates basic ADC register read, register write, and conversion data read operations and is intended to serve as a starting point for full application development.

## 1.2 Kit Contents

The ADS9324 BoosterPack plug-in module is equipped with two LaunchPad-compatible headers (J3 and J4) for ease of integration with the TI Launchpad development kits, as well as an additional header that provides direct access to the eight input channels. This configuration enables flexible interfacing with a wider range of controllers and user-designed signal chains.

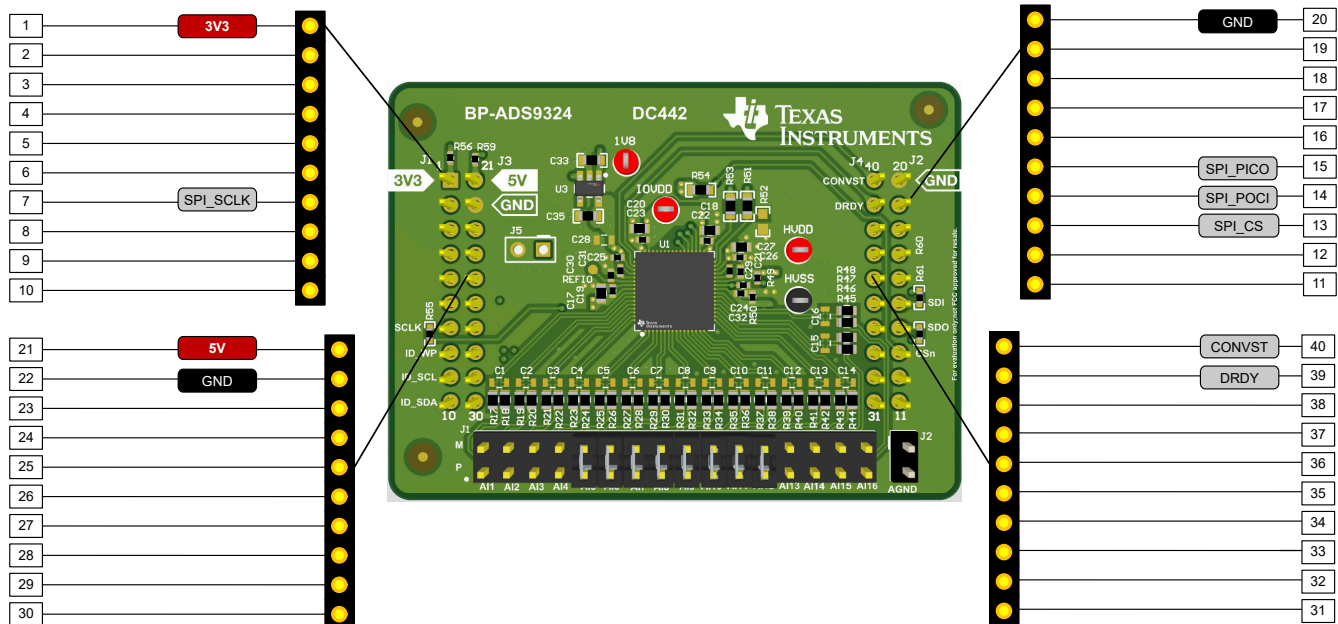


Figure 1-1. Interface Pinout

Table 1-1. Kit Contents

Item	Quantity
<a href="#">BP-ADS9324</a> BoosterPack	1

Table 1-2. Components Not Included With Kit

Item	Quantity
<a href="#">LAUNCHXL-F28P65X</a> LaunchPad	1

Purchase the [LAUNCHXL-F28P65X](#) LaunchPad from [www.ti.com](http://www.ti.com).

## 1.3 Specification

This module provides direct hardware access to the ADS9324 device to support user-defined signal conditioning, control, and system integration. The board includes the ADS9324 with supporting power-supply decoupling and routing to LaunchPad-compatible headers. No fixed signal-conditioning circuitry is implemented, enabling application-specific front-end design. Integrated test points and configurable component footprints facilitate evaluation, modification, and debugging within a compact form factor.

## 1.4 Device Information

The ADS9324 is a 16-bit, 16-channel, 1MSPS ADC with up to  $\pm 12.5V$  input voltage range. The device features integrated analog front-end circuitry for each input channel, including integrated PGA, low-pass filter and an on-chip 4.096V reference with low temperature drift.

## 2 Hardware

### 2.1 Board Settings

The [BP-ADS9324](#) BoosterPack provides electrical connections to the device supply pins.

Input Configuration:

- Populate R1R16 as needed to short AINxM to GND.
- Place jumpers on J1 as needed to short AINxP and AINxM together.

### 2.2 Setup

- Align the BoosterPack with the LaunchPad headers J1, J3 and J4, J2. Visually align the silkscreen for 3V3, 5V and GND on the BoosterPack with the LaunchPad as shown below.
- Power-up the LaunchPad by connecting a USB cable.

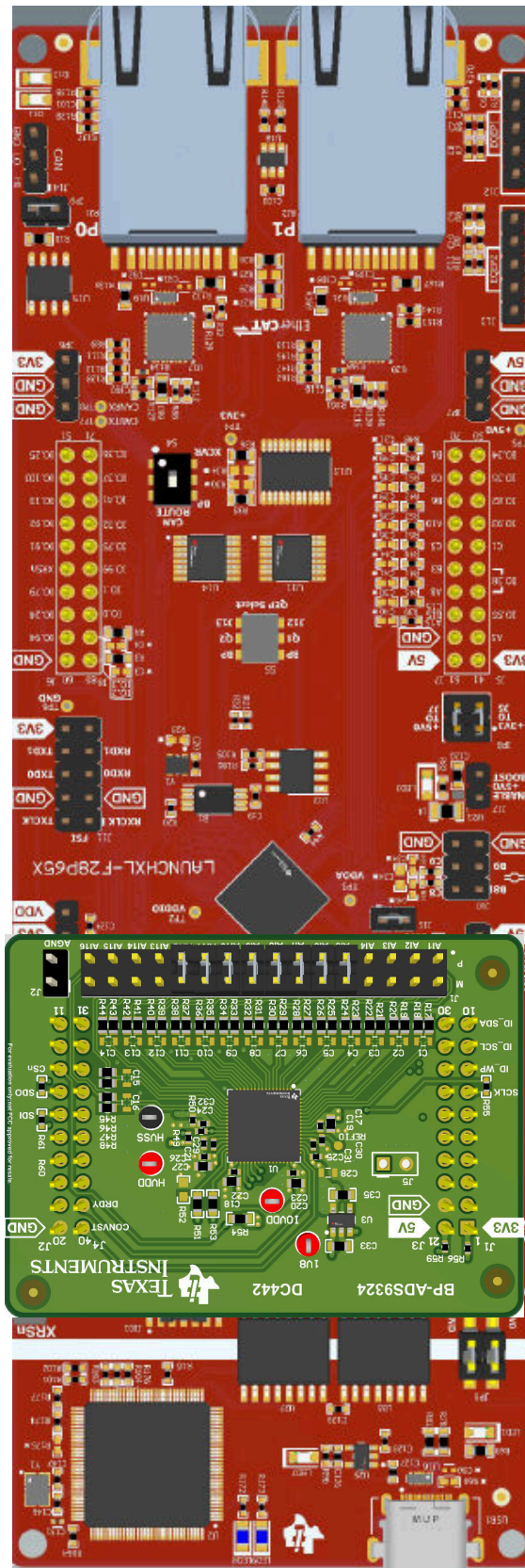


Figure 2-1. Hardware Setup

## 3 Software

### 3.1 Software Installation

- Program the LaunchPad with the [ADS9324-BOOSTERPACK-C2000-CODE](#) as a starting point, using the [Code Composer Studio™](#) integrated development environment.

Please view the README file included for more information.

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#### Note

For help using the Code Composer Studio or using the LaunchPad, find available resources in the C2000 software development kit (SDK), visit the [TI Cloud Developer Zone](#). C2000 MCUs are also supported by extensive online collateral, training with C2000 Academy, and online support through the [TI E2E™ support forums](#).

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## 4 Hardware Design Files

### 4.1 Schematics

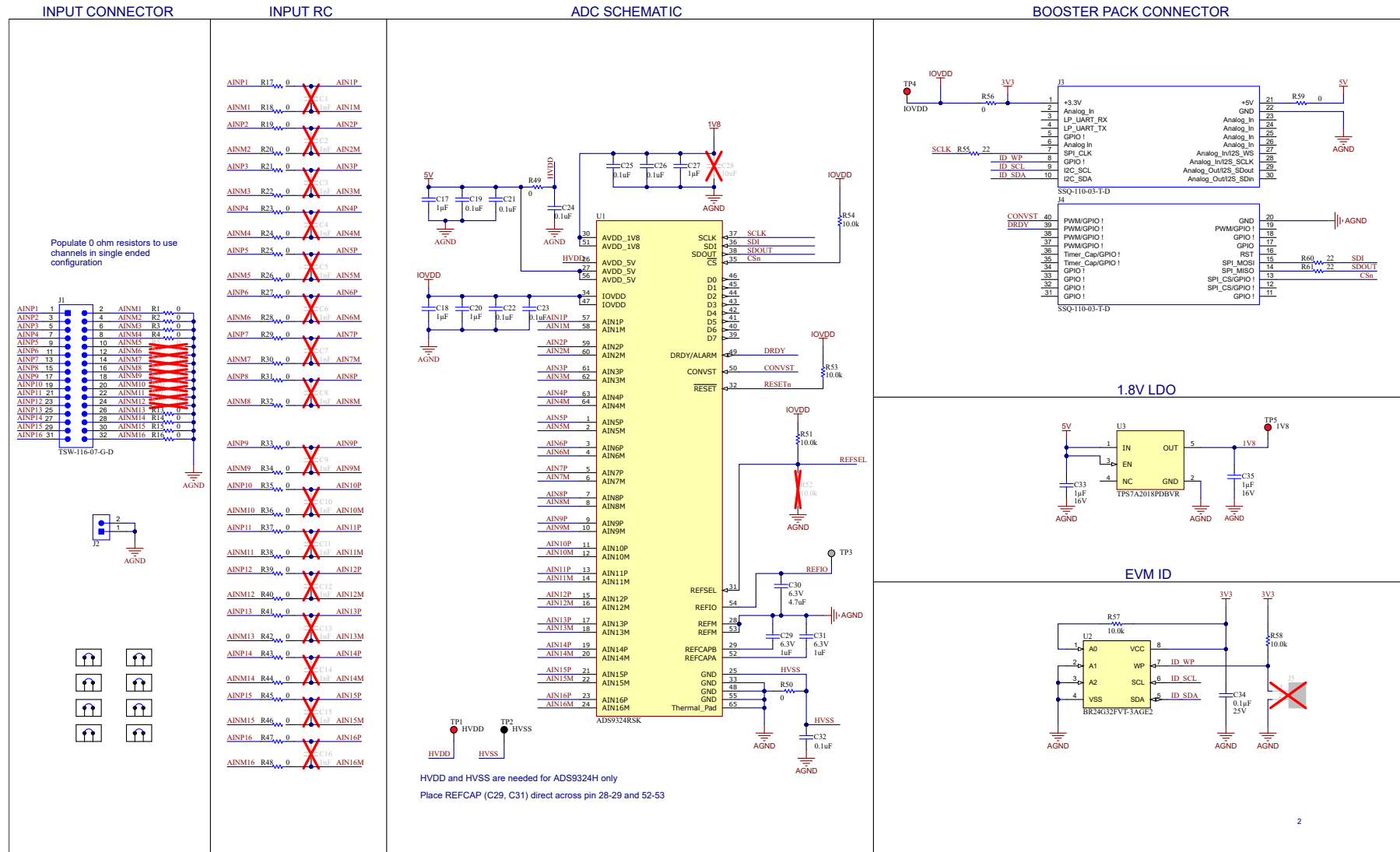


Figure 4-1. Schematic

## 4.2 PCB Layouts

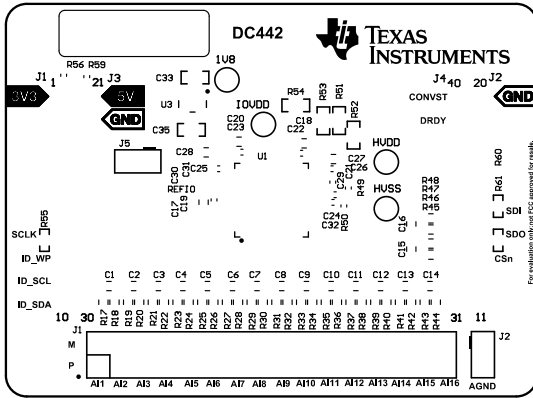


Figure 4-2. PCB Top Layer Overlay

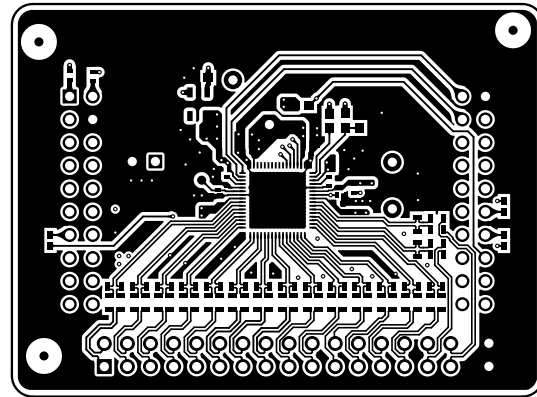


Figure 4-3. PCB Top Layer

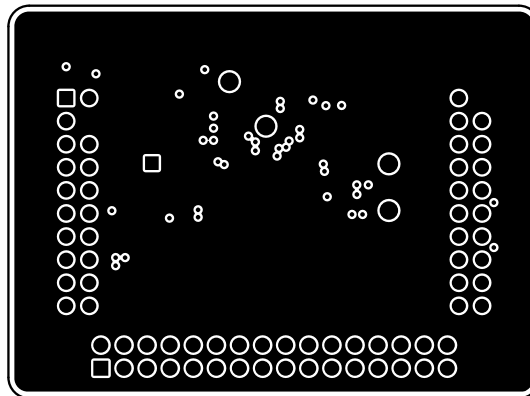


Figure 4-4. PCB Signal Layer 1

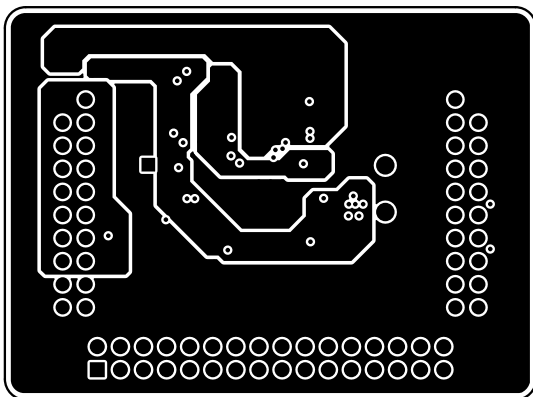


Figure 4-5. PCB Signal Layer 2

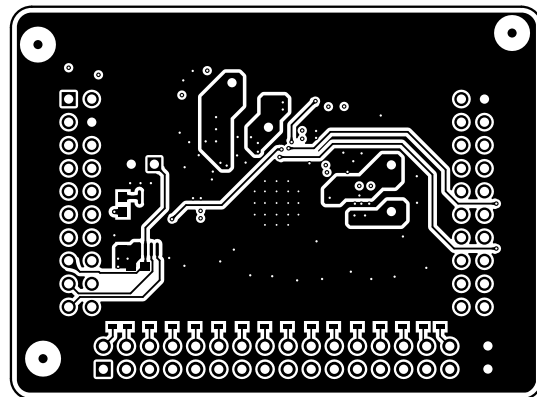


Figure 4-6. PCB Bottom Layer

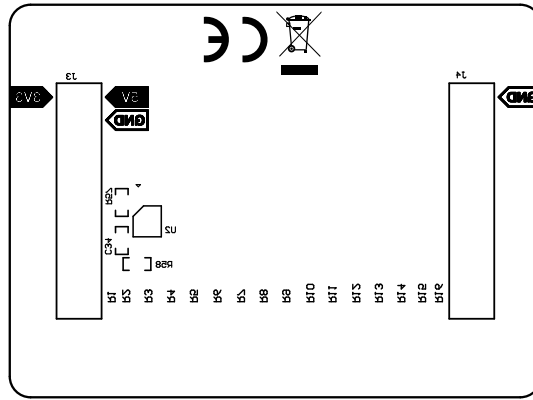


Figure 4-7. PCB Bottom Layer Overlay

### 4.3 Bill of Materials (BOM)

Designator	Part Number	Value	Quantity	Description	Manufacturer	Package Reference
C17, C18, C20, C27	CGA3E1X7R1E105K080AC	1uF	4	CAP, CERM, 1 $\mu$ F, 25V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	TDK	0603
C19, C21, C22, C23, C24, C25, C26, C32	GRM155R61C104KA88D	0.1uF	8	CAP, CERM, 0.1uF, 16V, +/- 10%, X5R, 0402	MuRata	0402
C29, C31	GRM155R70J105KA12D	1uF	2	CAP, CERM, 1uF, 6.3V,+/- 10%, X7R, 0402	MuRata	0402
C30	GRM155R60J475ME87D	4.7uF	1	CAP, CERM, 4.7uF, 6.3V, +/- 20%, X5R, 0402	MuRata	0402
C33, C35	C1608X7R1C105K080AC	1uF	2	CAP, CERM, 1uF, 16V, +/- 10%, X7R, 0603	TDK	0603
C34	CL10A104KA8NNNC	0.1uF	1	CAP, CERM, 0.1 $\mu$ F, 25V,+/- 10%, X5R, 0603	Samsung Electro-Mechanics	0603
J1	TSW-116-07G-D		1	Header, 100mil, 16x2, Gold, TH	Samtec	16x2 Header
J2	PEC02SAAN		1	Header, 100mil, 2x1, Tin, TH	Sullins Connector Solutions	Header, 2 PIN, 100mil, Tin
J3, J4	SSQ-110-03T-D		2	Receptacle, 2.54mm, 10x2, Tin, TH	Samtec	10x2 Receptacle
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	RES, 0, 5%, 0.1W, AEC-Q200 Grade 0, 0603	Panasonic	0603
R49, R50, R56, R59	CRCW04020000Z0ED	0	4	RES, 0, 5%, 0.063W, AEC-Q200 Grade 0, 0402	Vishay-Dale	0402
R51, R53, R54, R57, R58	CRCW060310K0FKEA	10.0k	5	RES, 10.0k, 1%, 0.1W, AEC-Q200 Grade 0, 0603	Vishay-Dale	0603
R55, R60, R61	CRCW040222R0JNED	22	3	RES, 22, 5%, 0.063W, AEC-Q200 Grade 0, 0402	Vishay-Dale	0402

Designator	Part Number	Value	Quantity	Description	Manufacturer	Package Reference
TP1, TP4, TP5	5000		3	Test Point, Miniature, Red, TH	Keystone Electronics	Red Miniature Testpoint
TP2	5001		1	Test Point, Miniature, Black, TH	Keystone Electronics	Black Miniature Testpoint
U1	ADS9324RSK		1	16-Channel, 16-Bit, 1MSPS, Simultaneous-Sampling SAR ADC With Integrated Analog Front-End	Texas Instruments	QFN64
U2	BR24G32FVT-3AGE2		1	I2C BUS EEPROM (2-Wire), TSSOP-B8	Rohm	TSSOP-8
U3	TPS7A2018PDBVR		1	Linear Voltage Regulator IC Positive Fixed 1 Output 300mA SOT-23-5	Texas Instruments	SOT23-5
C1, C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16	GRM188R72A102KA01D	1000pF	0	CAP, CERM, 1000pF, 100V, +/- 10%, X7R, 0603	MuRata	0603
C28	GRM188R61E106MA73D	10uF	0	CAP, CERM, 10uF, 25V, +/- 20%, X5R, 0603	MuRata	0603
J5	PEC02SAAN		0	Header, 100mil, 2x1, Tin, TH	Sullins Connector Solutions	Header, 2 PIN, 100mil, Tin
R5, R6, R7, R8, R9, R10, R11, R12	ERJ-3GEY0R00V	0	0	RES, 0, 5%, 0.1W, AEC-Q200 Grade 0, 0603	Panasonic	0603
R52	CRCW060310K0FKEA	10.0k	0	RES, 10.0k, 1%, 0.1W, AEC-Q200 Grade 0, 0603	Vishay-Dale	0603

## **5 Additional Information**

### **5.1 Trademarks**

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  - 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 semiconductor 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.
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  - 2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.
  - 2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.
  - 2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

### **WARNING**

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

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

**NOTE:**

**EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE 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/llds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/llds/ti_ja/general/eStore/notice_01.page) 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

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

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

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

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

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2. 実験局の免許を取得後ご使用いただく。
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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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