ADIS16501-2/PCBZ MEMS IMU Breakout Board

OVERVIEW

The ADIS16501-2/PCBZ breakout board offers a simple method for developing a prototype connection between the ADIS16501 inertial measurement unit (IMU) and any existing embedded processor platform that supports serial peripheral interface (SPI) communications. The ADIS16501-2/PCBZ comes pre-equipped with the ADIS16501 IMU and a 16-pin header that is designed to connect seamlessly with 2 mm ribbon cables. Generally, this board supports reliable communication over ribbon cables up to 20 cm in length. However, for optimal performance, especially when dealing with critical communication links, it is recommended to validate the signal integrity before entirely relying on this type of connection.

EVALUATION BOARD PHOTOGRAPH

Figure 1. ADIS16501-2/PCBZ IMU Top View

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REVISION HISTORY

6/2024—Revision 0: Initial Version

INTRODUCTION

The ADIS16501-2/PCBZ breakout board plays a crucial role as an interface between the ADIS16501 IMU and various embedded processor platforms, streamlining the prototype development process. This guide comprehensively covers all aspects of the breakout board, from initial setup and basic configurations to advanced customization and enhancement techniques. The ADIS16501-2/PCBZ is designed to support users from diverse technical backgrounds, ensuring they can successfully leverage its capabilities. Additionally, this guide emphasizes the compatibility of the ADIS16501-2/PCBZ across multiple versions and adaptability to meet specific system requirements, providing a flexible tool for various projects.

GUIDE OBJECTIVE AND SCOPE

The primary aim of this guide is to assist users in quickly and efficiently starting with the ADIS16501-2/PCBZ breakout board. This user guide covers a broad spectrum of essential topics:

- Setup procedures, step-by-step instructions to facilitate the initial setup
- Usage details, insights into effective utilization for prototype development
- Integration techniques, strategies to integrate the ADIS16501-2/PCBZ breakout board with various embedded processor platforms
- Advanced configurations, tips for advanced users exploring deeper customization and optimization

VERSIONS OF THE ADIS16501-2/PCBZ BREAKOUT BOARD

The ADIS16501-2/PCBZ breakout board is part of a family of products designed to facilitate the development of prototype connections between microelectric mechanical system (MEMS) IMUs and embedded processor platforms. This guide specifically covers the ADIS16501-2/PCBZ model, which includes:

- The ADIS16501 IMU, which is pre-equipped on the breakout board and is designed for seamless integration
- 16-pin header for connection with 2 mm ribbon cables, which support reliable communication over lengths up to 20 cm

While this guide focuses on the ADIS16501-2/PCBZ, the foundational principles and connection strategies can apply to other MEMS breakout board family models, provided that these breakout boards share a similar design and interface characteristics. Users can verify compatibility details for different models by consulting product-specific documentation.

COMPATIBLE SYSTEMS AND PROCESSOR PLATFORMS

The ADIS16501-2/PCBZ breakout board is designed with versatility, ensuring compatibility with a wide range of embedded processor platforms, including, but not limited to, systems that support the following:

- SPI communications because the board utilizes SPI for data transfer, making it compatible with any system that can communicate via a SPI
- A 3.3 V power supply because systems that can provide or support this power supply are compatible with the ADIS16501-2/PCBZ because this is the required voltage for this breakout board

EVALUATION SYSTEMS COMPATIBILITY

The ADIS16501-2/PCBZ breakout board is designed for seamless integration with the EVAL-ADIS-FX3, Analog Devices, Inc., recommended open-source evaluation platform. This modern evaluation system enhances the capabilities of the ADIS16501-2/PCBZ breakout board, facilitating rapid prototype development and testing.

For additional details on the EVAL-ADIS-FX3, FX3 *i*Sensor® evaluation system and its features and resources for supporting the development process of users, see the EVAL-ADIS-FX3 web page. This recommendation ensures that users have access to the most current and effective tools for their projects, leveraging the latest technology supported by Analog Devices.

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Figure 2. EVAL-ADIS-FX3 Board

HANDLING AND INSPECTING

Upon receiving the ADIS16501-2/PCBZ breakout board, ensure that the board has not been damaged during shipment and that the board is in optimal condition for use. Follow these instructions for unpacking and inspecting the ADIS16501-2/PCBZ breakout board:

- Before opening the shipping container, inspect it for any signs of damage, such as dents, holes, or water damage. If the container is damaged, take photos and note any potential issues because this may indicate that the ADIS16501-2/PCBZ inside may also be damaged.
- Prepare a clean, static-free workspace. Ensure that the surface where the ADIS16501-2/PCBZ will be unpacked is clean and free of static. Note that a static-free mat protects sensitive electronic components from electrostatic discharge (ESD).
- Use proper ESD safety measures. The user is recommended to wear an ESD wrist strap to ground yourself, preventing any static electricity present on your body from damaging the ADIS16501-2/PCBZ. If an ESD wrist strap is unavailable, the user must frequently touch a grounded metal object to dissipate static buildup.
- Open the shipping container carefully, avoiding sharp objects that could accidentally damage the contents inside.
- Gently remove any packing materials surrounding the ADIS16501-2/PCBZ breakout board. These materials may include foam, bubble wrap, or anti-static bags to protect the breakout board during shipping.
- Handle the ADIS16501-2/PCBZ carefully. Lift the breakout board from the packaging by its edges. Avoid touching any components, pins, or circuitry directly because skin oils can affect the conductivity and cause corrosion over time.

INSPECTING THE ADIS16501-2/PCBZ BREAKOUT BOARD

Take the following steps to inspect the ADIS16501-2/PCBZ breakout board and the contents of the shipping container:

- Begin by visually inspecting the breakout board. Look for any signs of damage, such as cracked components, bent pins, or scratches on the surface of the ADIS16501-2/PCBZ. If necessary, use a magnifying glass to inspect small components closely.
- Refer to the documentation or images of the ADIS16501-2/PCBZ to ensure all components are present and correctly soldered in place. Missing or loose components may indicate damage during shipping.
- Check the solder joints on the ADIS16501-2/PCBZ, especially those around the IMU and connector pins. Look for cold solder joints (which appear dull and not shiny) or solder bridges (accidental connections between adjacent pins) that may affect functionality.
- Verify connector integrity. Ensure that the 16-pin header and other connectors are straight and firmly attached to the ADIS16501-2/PCBZ. Misaligned or loose connectors may cause issues connecting the breakout board to other devices.
- Check for physical deformities. Ensure that the ADIS16501-2/PCBZ is flat and not warped. Warping can occur because of rough handling and may affect the ability of the breakout board to fit or function correctly in the user's setup.
- Compare the ADIS16501-2/PCBZ with the documentation provided, which includes verifying part numbers, layouts, and component placements to ensure that the correct breakout board version was received.

Note that handling the ADIS16501-2/PCBZ carefully and conducting a thorough inspection upon receipt of this board can prevent potential issues during development and ensure a smooth start to a project that uses the ADIS16501-2/PCBZ.

ADIS16501-2/PCBZ BREAKOUT BOARD COMPONENTS

The ADIS16501-2/PCBZ breakout board is specifically designed to facilitate simple access to the features of the ADIS16501 MEMS IMU for development, testing, and integration into embedded systems. Figure 3 shows the components on the ADIS16501-2/PCBZ.

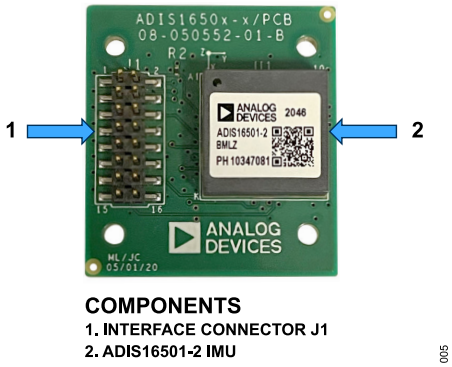

Figure 3. ADIS16501-2/PCBZ Components

The ADIS16501 IMU is central to the ADIS16501-2/PCBZ breakout board (see Figure 4). This high performance, multi-axis IMU provides accurate angular rate (gyroscope) and linear acceleration (accelerometer) measurements. The IMU captures and processes inertial data, offering six degrees of freedom (3-axis gyroscope and 3-axis accelerometer) motion tracking. The IMU includes built-in calibration and compensation algorithms to ensure data integrity.

Figure 4. ADIS16501 IMU

The 16-pin header (J1 connector) is a standard 16-pin connector that allows a simple interface with external systems via a 2 mm pitch ribbon cable. This header facilitates electrical connection and communication between the IMU and an embedded processor platform or evaluation system. Pin assignments include signals for power (VDD), ground (GND), SPI communication (SCLK, NCS, DOUT, and DIN), reset (NRESET), and additional functions, such as data ready (DR) and synchronization (SYNC). See Table 1 for additional details on the J1 connector interface.

Table 1. J1 Connector Interface Summary

Pin Number	Mnemonic	Description
1	NRESET	Reset, active low
2	SCLK	Serial clock (SPI)
3	NCS	Chip select (SPI), active low
4	DOUT	Data output (SPI)
5	DNC	Do not connect
6	DIN	Data input (SPI)
7	GND	Ground
8	GND	Ground
9	GND	Ground
10	VDD	Power supply, 3.3 V
11	VDD	Power supply, 3.3 V
12	VDD	Power supply, 3.3 V
13	DR	Data ready
14	SYNC	Synchronization input
15	DNC	Do not connect
16	DNC	Do not connect

RIBBON CABLE CONNECTION BETWEEN THE ADIS16501 AND EVAL-ADIS-FX3

ADIS16501-2/PCBZ AND EVAL-ADIS-FX3 CONNECTION

See Figure 5 and Table 2 for the general identification based on standard electronic components and board design.

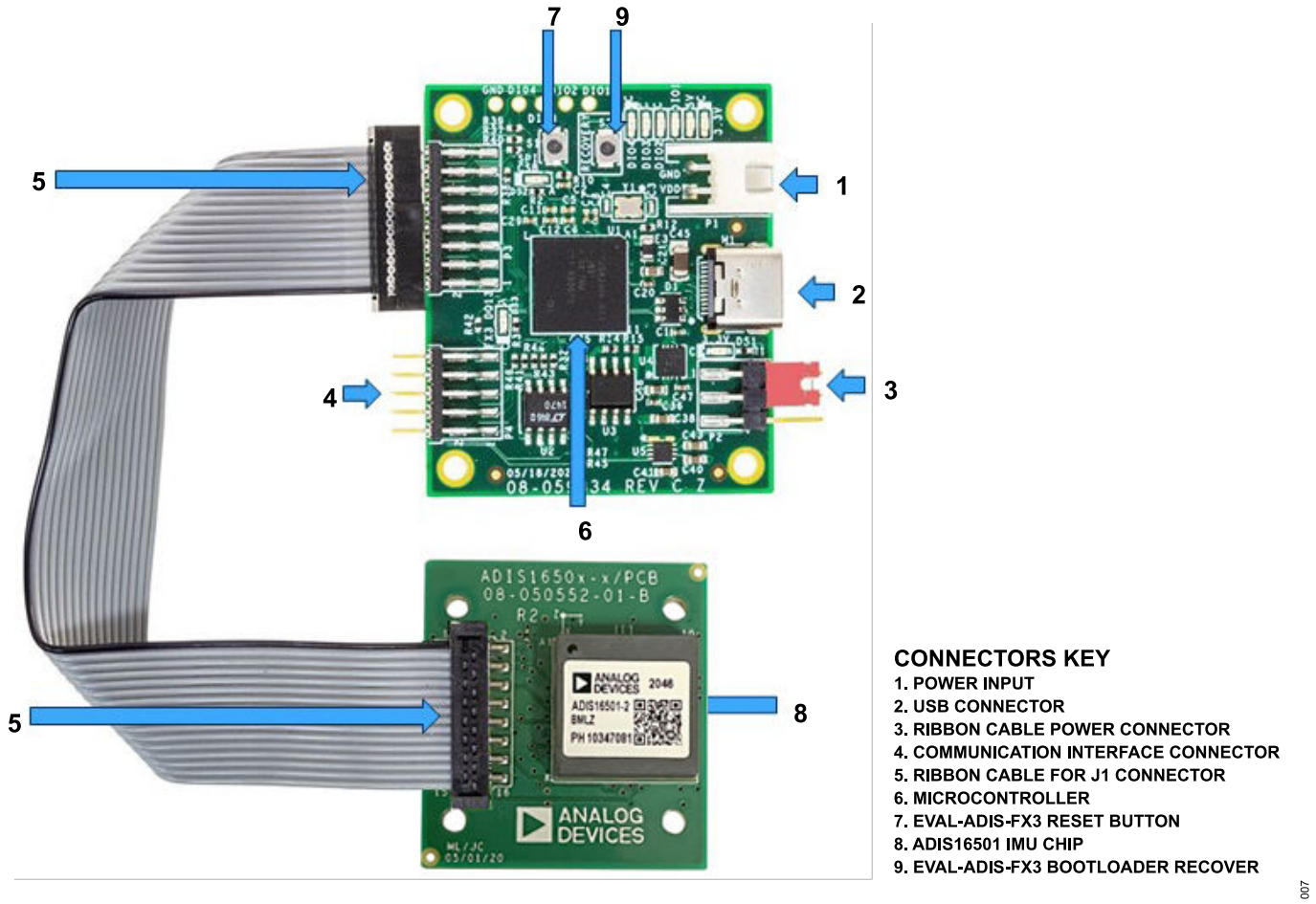

Figure 5. ADIS16501-2/PCBZ and EVAL-ADIS-FX3 Connections

Table 2. Standard Electronic Components and Usage

Component Description	Function	Usage Recommendations
Power Input	It serves as the primary power supply entry point for the ADIS16501-2/PCBZ breakout board.	Ensure that the power supply matches the ADIS16501-2/PCBZ specifications (typically 3.3 V). Incorrect voltage can damage the breakout board.
USB Connector	It provides a dual role for both programming the microcontroller and powering the ADIS16501-2/PCBZ when connected to a USB host device.	It can be used to upload firmware updates for debugging purposes through a direct connection to a PC.
Ribbon Cable Power Connector	Allows power distribution from the main board to additional connected boards via a ribbon cable.	Check the cable orientation and connection integrity to ensure stable power delivery and avoid connection errors.
Pin Header (Communication Interface Connector)	It facilitates the addition of peripheral devices or expansion boards, providing access to SPI, I^2C, or other communication protocols.	It helps integrate additional sensors or output devices that complement the functionality of the ADIS16501 IMU.
Ribbon Cable for J1 Connector	It transmits data and power signals between connected boards, maintaining signal integrity over short distances.	Handle with care to avoid bends or breaks that may disrupt signal continuity.

RIBBON CABLE CONNECTION BETWEEN THE ADIS16501 AND EVAL-ADIS-FX3

Table 2. Standard Electronic Components and Usage (Continued)

Component Description	Function	Usage Recommendations
Microcontroller (or Processing Unit)	It acts as the brain of the ADIS16501-2/PCBZ, processing all data from the IMU and managing communications with other connected devices.	It is programmed to customize its operation for specific applications under recommended conditions.
FX3 Reset Button.	It provides a manual method to reset the ADIS16501-2/PCBZ to its default operational state without needing to power cycle	Use the reset button to troubleshoot issues or to reset the ADIS16501-2/PCBZ configuration during development and testing.
ADIS16501 IMU Chip	The core sensor unit offers precise angular rates and acceleration measurements.	Optimal placement on the board to minimize noise and vibration.
FX3 Bootloader Recover	If the ADIS16501-2/PCBZ is not detected, reset the EVAL-ADIS-FX3 by unplugging the USB cable or pressing the **RESET** button. If this reset is unsuccessful, press and hold the **RECOVERY** button while plugging the EVAL-ADIS-FX3 into the PC to force recovery mode.	If required, use the bootloader recovery for device detection issues and firmware recovery during development and testing.

RIBBON CABLE CONNECTION BETWEEN THE ADIS16501 AND EVAL-ADIS-FX3

CABLING

The J1 connector supports connections with a 2.00 mm, insulation displacement connector (IDC), ribbon cable assembly.

It is recommended to use **2.00 mm IDC ribbon cable assembly** as search criteria to find the latest options on the market.

At the time of initial release for the ADIS16501-2/PCBZ breakout board, Analog Devices used the Samtec TCSD-10-S-01.00-01-N.

EVAL-ADIS-FX3 SYSTEM SETUP AND TROUBLESHOOTING

Comprehensive setup and troubleshooting instructions are available on the Analog Devices Wiki website for users intending to utilize the EVAL-ADIS-FX3 evaluation system with the ADIS16501. Detailed steps for hardware configuration, software installation, and standard troubleshooting procedures can be found in the EVAL-ADIS-FX3 evaluation system setup and troubleshooting guide (see the ADIS-FX3 Evaluation System Setup and Troubleshooting Guide). This guide covers essential topics such as the following:

- Initial hardware assembly and connections
- Software setup and configuration
- Diagnosing and resolving common error messages

If issues are encountered not covered in the ADIS-FX3 Evaluation System Setup and Troubleshooting Guide, contact Analog Devices Technical Support

In addition, to stay up to date, check for the latest version of the EVAL-ADIS-FX3 evaluation system and firmware updates to ensure compatibility.

ADIS16501-2/PCBZ DATA ACQUISITION

Data handling includes the following:

- Direct access to the ADIS16501 IMU via the J1 connector (see Figure 3).
- Data acquisition and transfer. The ADIS16501-2/PCBZ breakout board utilizes the microcontroller or processing unit (see Number 6 in Figure 5) to manage the flow of data from the ADIS16501 IMU chip (see Number 8 in Figure 5). The microcontroller processes the raw sensor data in real-time, filtering and converting the data into usable formats.
- Communication interfaces. Data from the ADIS16501 IMU can be sent to other systems or devices using different connectors. For direct data transfer to computers, use the USB connector (see Number 2 in Figure 5) with the ADIS16501-2/PCBZ and EVAL-ADIS-FX3 connections.

Performance enhancements include the following:

- Precision and accuracy. The microcontroller helps calibrate and compensate the data received from the ADIS16501 IMU, which can enhance the precision and accuracy of the measurements, which is crucial for applications such as navigation and motion analysis.
- Signal integrity. The layout and design of the ADIS16501-2/PCBZ breakout board are optimized to minimize noise and interference, ensuring high signal integrity and reliable data transmission, which is critical for maintaining the performance of the IMU.

ADIS16501-2/PCBZ INTEGRATION EXAMPLE

The ADIS16501 IMU offers a range of applications across various fields, paired seamlessly with the ADIS16501-2/PCBZ breakout board to enhance functionality and ease of integration, such as the following:

- Robotics
  - Used for stabilization, navigation, and motion control, providing essential data for precise movements and balance.
  - The ADIS16501-2/PCBZ processes the IMU data to determine orientation and movement, which is crucial for tasks such as balancing or navigating uneven terrain in robotic systems.
- Aerospace and defense
  - Essential for drones, guided munitions, and other aerospace systems that require accurate inertial measurements for navigation and control.
  - Integrates with control systems via the ADIS16501-2/PCBZ to deliver real-time, reliable inertial data that enhances the operational capabilities of aerospace applications.
- Wearable technology
  - Ideal for health monitoring and activity tracking due to the IMU's compact size, efficiency, and ability to enable long battery life.
  - The ADIS16501-2/PCBZ facilitates the integration of the IMU into wearable devices. The IMU accurately tracks human movement and activities that can be used for applications such as activity tracking and posture correction.
- Virtual reality (VR) and augmented reality (AR)
  - Enhances the immersion and interaction experience in VR and/or AR systems by providing accurate movement and orientation tracking.
  - By integrating the ADIS16501 IMU with VR and/or AR systems through the ADIS16501-2/PCBZ, developers can achieve more responsive and immersive user experiences.

These examples detail how the ADIS16501, in conjunction with the ADIS16501-2/PCBZ breakout board, supports a broad spectrum of applications by simplifying the integration process and enhancing the capabilities of the system. This integration ensures that users can maximize the utility of the IMU across diverse technological domains, leveraging its precision and efficiency to meet specific project requirements.

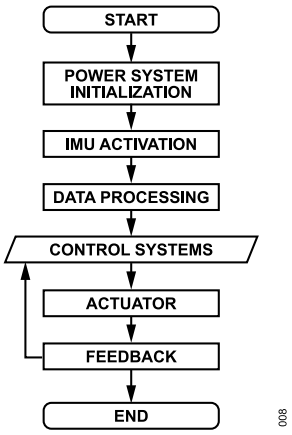

Figure 6. Integration Flowchart with Feedback Loop

DIMENSIONS AND MOUNTING HOLES

The ADIS16501-2/PCBZ breakout board has four mounting holes (one in each corner) that support attachment to another surface with M2 machine screws (see Figure 7).

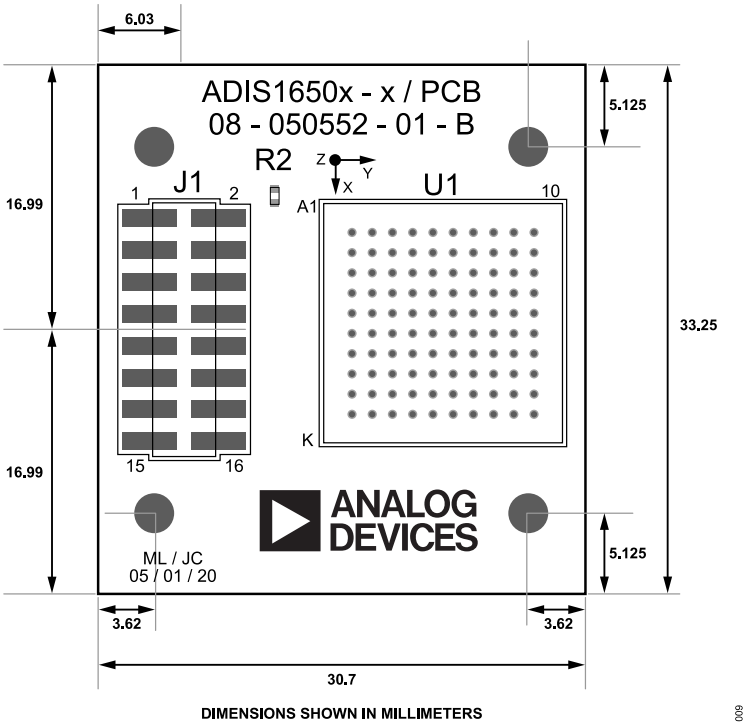

Figure 7. Dimensions and Mounting Holes

ELECTRICAL SCHEMATIC AND J1 CONNECTOR PIN CONFIGURATION

Figure 8 details the pin configuration for the J1 connector, and Figure 9 illustrates the electrical schematic for the ADIS16501-2/PCBZ.

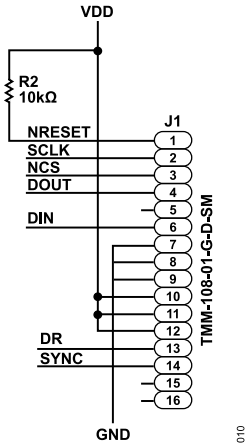

Figure 8. Pin Configuration for J1 Connector

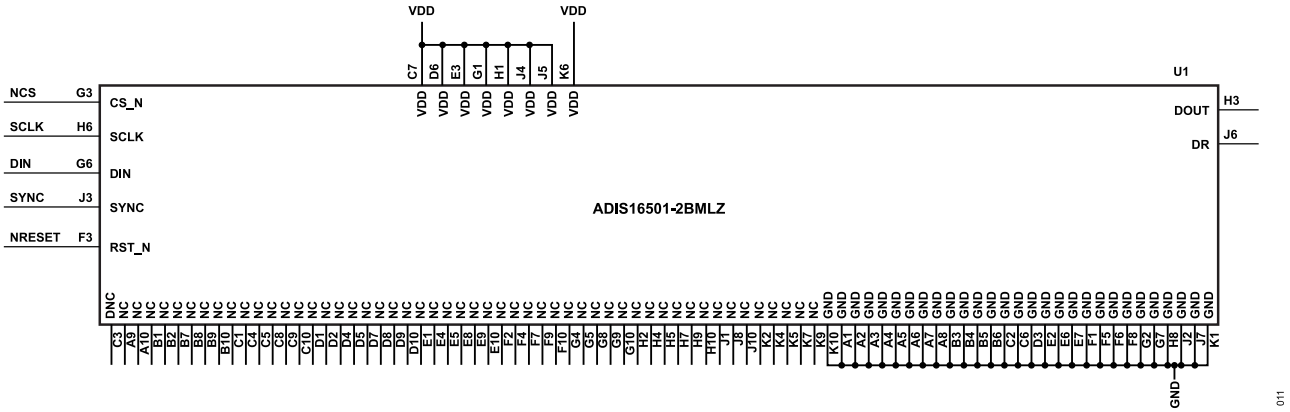

Figure 9. Electrical Schematic for the ADIS16501-2/PCBZ

REFERENCE DESIGNS FOR WORKING WITH THE ADIS16501-2/PCBZ

The following reference designs are provided for users ready to evaluate the ADIS16501. These designs include the following components:

- Physical connection
  - Details on the physical connection between the ADIS16501-2/PCBZ and a specific embedded processor platform and system, which includes schematics, wiring diagrams, and connection guidelines to ensure proper interfacing and communication.
- Embedded code
  - Embedded code that lists all of the user registers for the ADIS16501
  - Code for managing the SPI protocol requirements for the ADIS16501
  - Examples for accessing the registers for the ADIS16501
  - For detailed examples and further resources, refer to the ADI IMU Linux drivers and resources available at: ADI IMU Linux drivers/resources/eval/user-guides/inertial-mems/imu/adis1650x-pcb.txt

These reference designs provide basic support to facilitate the integration and evaluation of the ADIS16501 in user's applications.

PART NUMBER SUMMARY

See Table 3 for the available breakout board, along with its IMU model number that is the board.

Table 3. Available Breakout Board

Model		Measurement Range	
Breakout Board	**IMU**	**Gyroscope**	**Accelerometer**
ADIS16501-2/PCBZ	ADIS16501-2BMLZ	±500 DPS	±14 *g*

NOTES

ESD Caution
ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.