Ransanx ADS1115

Ransanx ADS1115 16-Bit 4-Channel I2C ADC PGA Converter User Manual

Model: ADS1115 | Brand: Ransanx

1. Introduction

This manual provides essential information for the proper use and operation of the Ransanx ADS1115 16-Bit 4-Channel I2C Analog-to-Digital Converter (ADC) with Programmable Gain Amplifier (PGA). The ADS1115 is designed for high-precision analog signal acquisition in various embedded systems, including those based on Raspberry Pi and Arduino platforms. Please read this manual thoroughly before installation and operation.

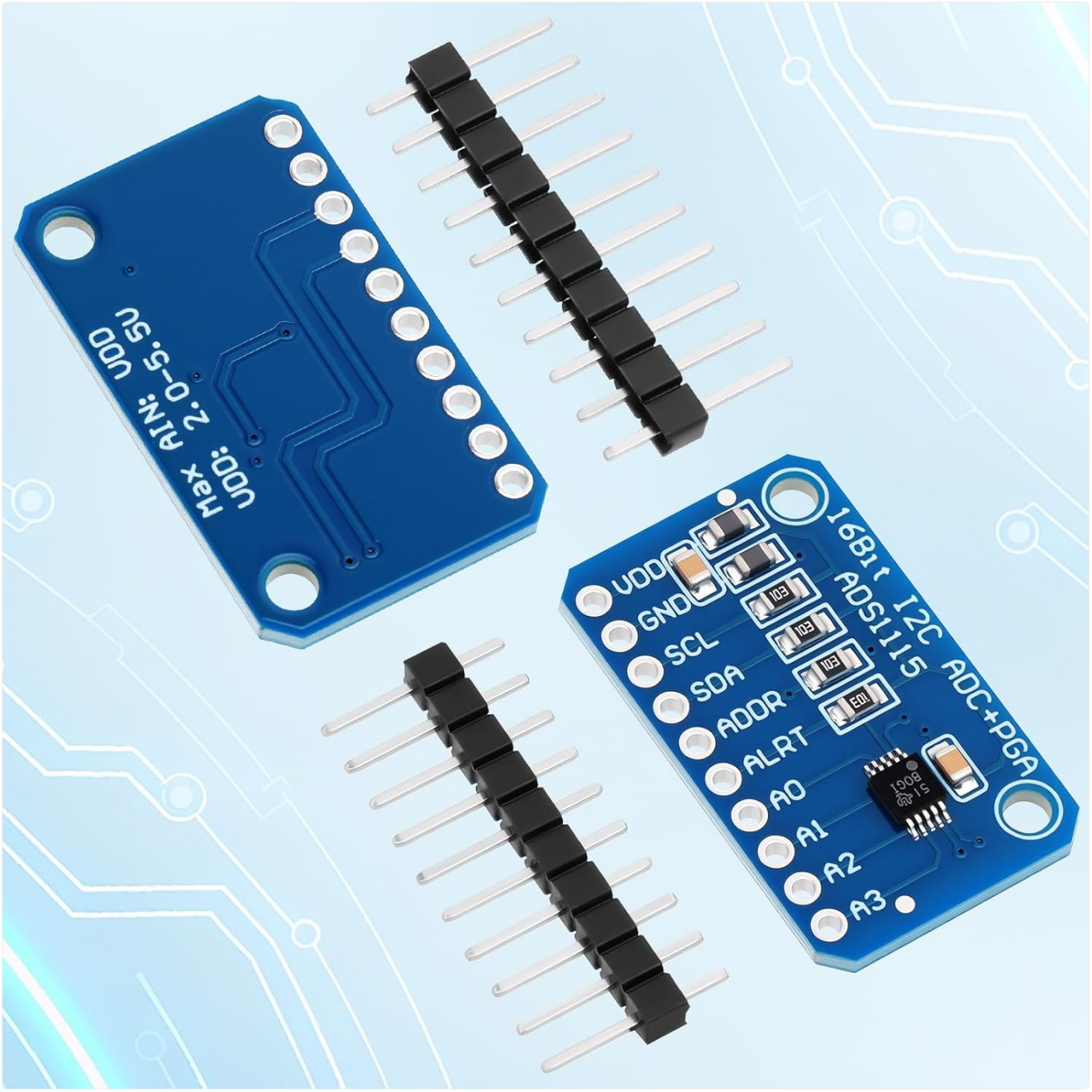

Image 1.1: Two Ransanx ADS1115 modules with accompanying pin headers. The modules are blue PCBs with various components and pin labels visible.

2. Key Features

The ADS1115 converter offers a range of features for versatile analog-to-digital conversion:

- **High Resolution:** 16-bit resolution for precise measurements.
- **Wide Operating Voltage:** Operates from 2.0V to 5.5V, suitable for various microcontrollers.
- **Integrated PGA:** Internal Programmable Gain Amplifier allows conversion rates up to 860 samples per second (SPS) and supports differential or single-ended inputs.
- **I2C Interface:** Utilizes an I2C-compatible serial interface for communication, with selectable slave addresses.
- **Flexible Input Multiplexer (MUX):** Provides two programmable comparator differential inputs or four single-ended inputs.
- **Low Power Consumption:** Features an automatic shutdown function in one-shot mode, significantly reducing idle current.
- **Compact Design:** Ultra-small, leadless technology for space-constrained applications.

Image 2.1: A visual representation highlighting the key features and specifications of the ADS1115 module, including its compact size and I2C interface.

3. Technical Specifications

Parameter	Value
Resolution	16-bit
Operating Voltage (VDD)	2.0V to 5.5V
Input Channels	4 single-ended or 2 differential
Interface	I2C (IIC)
Programmable Data Rate	8 SPS to 860 SPS
Internal PGA	Yes

Parameter	Value
Dimensions (Module)	Approx. 28mm x 17.2mm (1.1in x 0.68in)
Weight (Item)	0.705 ounces (approx. 20g)

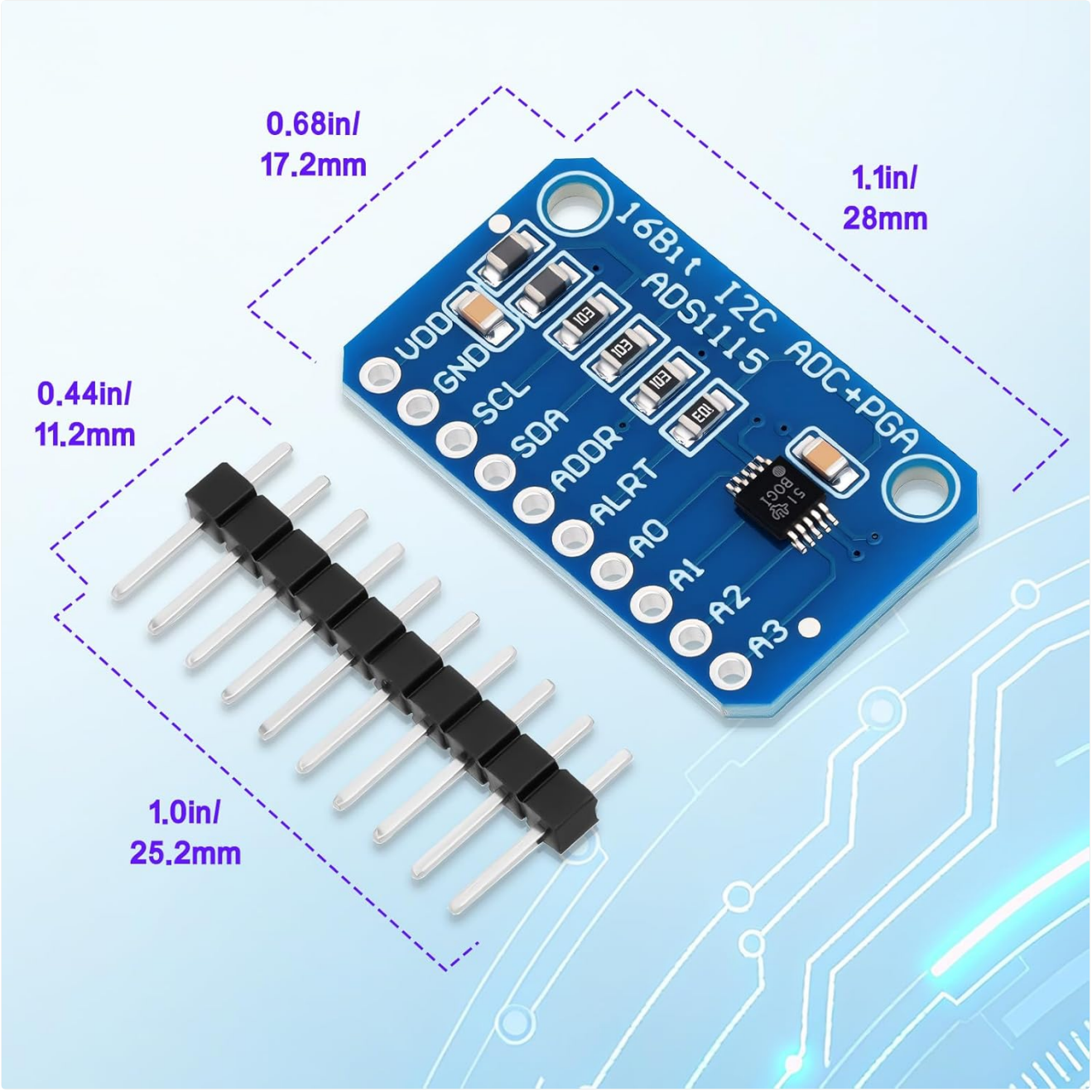

Image 3.1: Diagram illustrating the physical dimensions of the ADS1115 module and its accompanying pin headers in millimeters and inches.

4. Setup and Connection

The ADS1115 module communicates via the I2C protocol, requiring minimal connections to your microcontroller (e.g., Raspberry Pi, Arduino).

4.1 Pinout Description

- **VDD:** Power supply input (2.0V to 5.5V).
- **GND:** Ground connection.

- **SCL:** I2C Serial Clock line. Connect to your microcontroller's SCL pin.
- **SDA:** I2C Serial Data line. Connect to your microcontroller's SDA pin.
- **ADDR (AD0):** I2C address selection pin. Connect to VDD, GND, SDA, or SCL to select one of four possible I2C addresses.
- **ALRT:** Alert/Ready pin (optional). Can be configured as a conversion ready signal or a comparator output.
- **A0, A1, A2, A3:** Analog input channels. These can be configured as four single-ended inputs or two differential inputs.

4.2 Basic Connection Steps

1. Connect the **VDD** pin of the ADS1115 to the 3.3V or 5V power supply output of your microcontroller.
2. Connect the **GND** pin of the ADS1115 to the ground pin of your microcontroller.
3. Connect the **SCL** pin of the ADS1115 to the I2C SCL pin of your microcontroller.
4. Connect the **SDA** pin of the ADS1115 to the I2C SDA pin of your microcontroller.
5. Set the I2C address by connecting the **ADDR** pin as required. For example, connecting ADDR to GND typically sets the address to 0x48. Refer to the ADS1115 datasheet for other address options.
6. Connect your analog sensor outputs to the **A0, A1, A2, A3** pins as single-ended or differential inputs based on your application.

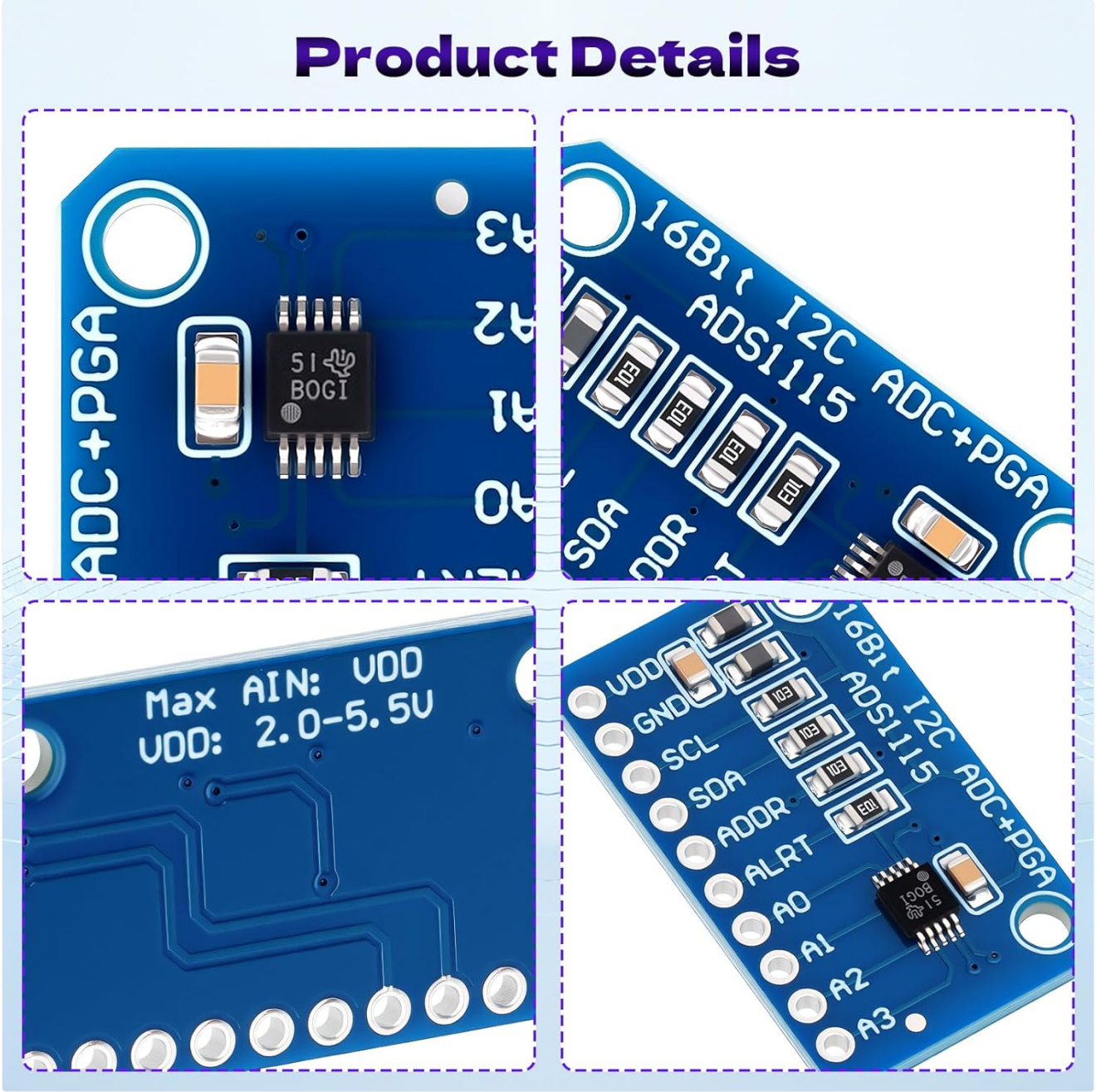

Image 4.1: A detailed view of the ADS1115 module, clearly showing the VDD, GND, SCL, SDA, ADDR, ALRT, A0, A1, A2, and A3 pins, crucial for proper wiring.

5. Operating Principles

The ADS1115 operates by converting analog voltage signals into digital data that can be read by a microcontroller. Its internal PGA allows for amplification of small signals, improving measurement precision.

5.1 I2C Communication

Communication with the ADS1115 is achieved through the I2C bus. Your microcontroller acts as the master, sending commands and receiving data from the ADS1115 slave device. Standard I2C libraries for Arduino or Python libraries for Raspberry Pi can be used to interact with the converter.

5.2 Configuration Registers

The ADS1115 features several internal registers that control its operation, including:

- **Conversion Register:** Stores the latest ADC conversion result.
- **Configuration Register:** Used to set parameters such as input multiplexer configuration (single-ended or differential), PGA gain, data rate (8 SPS to 860 SPS), operating mode (continuous or single-shot), and comparator settings.
- **Low Threshold Register** / **High Threshold Register:** Used for comparator functionality with the ALRT pin.

Detailed information on register settings and programming examples can be found in the ADS1115 datasheet and various online resources for Raspberry Pi and Arduino.

5.3 Operating Modes

- **Continuous Conversion Mode:** The ADC continuously performs conversions, updating the conversion register.
- **Single-Shot Conversion Mode:** The ADC performs a single conversion and then automatically powers down, conserving energy. This mode is ideal for portable instrumentation.

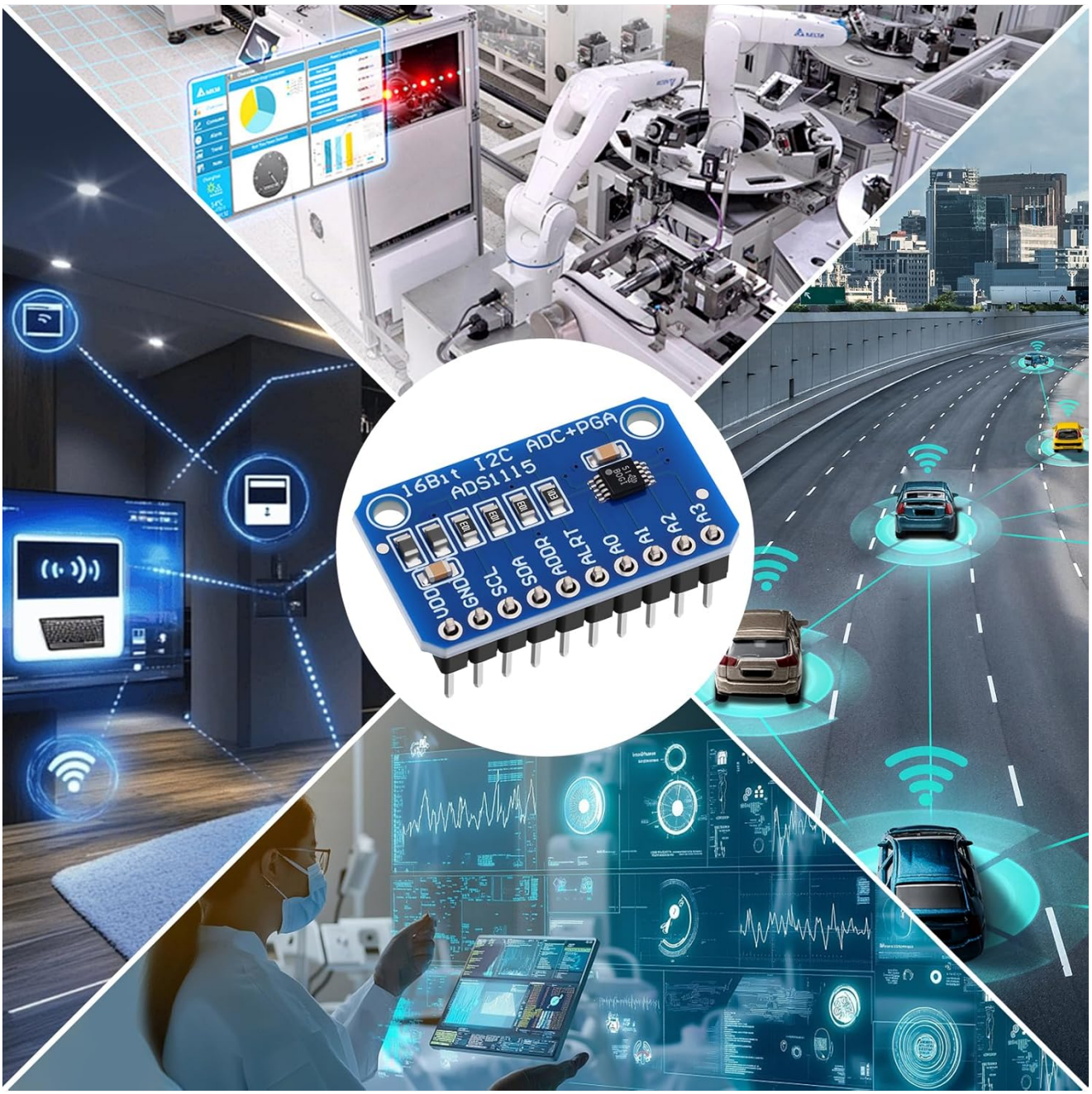

Image 5.1: A collage depicting diverse applications of the ADS1115, including industrial automation, smart home systems, automotive electronics, and data acquisition for research.

6. Maintenance

The Ransanx ADS1115 module is a robust electronic component designed for long-term operation with minimal maintenance. Follow these guidelines to ensure its longevity:

- **Handling:** Handle the module by its edges to avoid touching the electronic components, which can be sensitive to static discharge.
- **Cleaning:** If necessary, gently clean the module with a soft, dry, anti-static brush or cloth. Avoid using liquids or abrasive materials.
- **Storage:** Store the module in a dry, cool environment, away from direct sunlight and extreme temperatures. Keep it in its original anti-static packaging when not in use.
- **Power Supply:** Ensure the power supply voltage remains within the specified range (2.0V to 5.5V) to prevent damage.
- **Connections:** Periodically check all connections for secure contact and ensure no wires are frayed or short-circuiting.

7. Troubleshooting

If you encounter issues with your ADS1115 module, consider the following troubleshooting steps:

- **No I2C Communication:**
  - Verify all VDD, GND, SCL, and SDA connections are correct and secure.
  - Check the I2C address setting (ADDR pin). Ensure it matches the address used in your software.
  - Confirm that pull-up resistors are correctly installed on the SCL and SDA lines (typically 4.7kΩ to 10kΩ, often built into development boards).
  - Ensure your microcontroller's I2C bus is enabled and functioning.
- **Incorrect Readings / Noise:**
  - Check the analog input connections (A0-A3) for proper wiring and ensure they are not floating if unused.
  - Verify the PGA gain setting in your software. An incorrect gain can lead to saturation or insufficient resolution.
  - Ensure the input voltage to the analog pins does not exceed VDD or go below GND.
  - Consider adding decoupling capacitors near the ADS1115 VDD pin if power supply noise is suspected.
  - Reduce the data rate if noise is a significant issue, as lower rates can sometimes improve stability.
- **Module Not Powering On:**
  - Confirm that VDD and GND are correctly connected and receiving the expected voltage.
  - Check for any short circuits on the module or connections.

8. Package Contents

Each package typically includes:

- 4 x ADS1115 16-Bit 4-Channel I2C ADC PGA Converter Modules
- Pin Headers (unassembled, for soldering)

9. Warranty and Support

Ransanx products are designed for reliability and performance. For technical support, detailed datasheets, or warranty inquiries, please refer to the official Ransanx website or contact your retailer. Keep your purchase receipt for warranty claims.