Waveshare HMMD-mmWave-Sensor

Waveshare HMMD-mmWave-Sensor 24GHz Human Micro-Motion Detection Radar User Manual

Model: HMMD-mmWave-Sensor | Brand: Waveshare

1. Introduction

The Waveshare HMMD-mmWave-Sensor is a human micro-motion detection radar module. It utilizes Frequency Modulated Continuous Wave (FMCW) technology to accurately detect and identify human presence, including moving, standing, and subtle micro-motions. Designed for easy integration, this compact sensor is suitable for various AIoT applications such as smart homes, intelligent security systems, and smart lighting controls.

2. Key Features

- Based on AIoT mmWave Sensor SoC S3KM1110, featuring onboard high-performance 24GHz 1T1R antennas.
- Integrated MCU and built-in human micro-motion sensing algorithm for precise detection of moving, micro-motion, and standing human presence.
- Provides UART communication protocol, allowing configuration of sensing distance range, sensitivity, and absence report delay for flexible operation.
- Supports both UART port and GPIO header output for connectivity with host boards like Raspberry Pi, RP2040, Arduino, ESP32, and Jetson Nano.
- Offers wide-range human body sensing distance and supports both top-mounted and wall-mounted detection methods.
- Comes with online resources and comprehensive manual examples for various development platforms.

Image: Overview of the HMMD-mmWave-Sensor highlighting its core features and technical details.

3. Package Content

The package includes the following items:

- HMMD-mmWave-Sensor x1

Package Content

HMMD-mmWave-Sensor x1

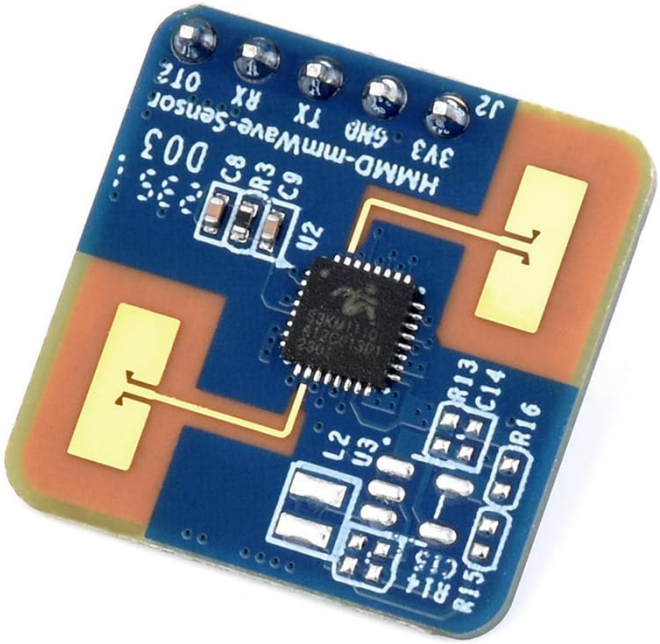

Image: The HMMD-mmWave-Sensor module as packaged.

4. Specifications

Hardware

Frequency band	24-24.25GHz
Bandwidth	0.25GHz
Modulation	FMCW
Power supply	3.3V
Output interface	UART & GPIO

UART baudrate	115200bps (default)
Environment temperature	-40~85°C
Dimension	20×20mm

System Performance

Detection range (wall-mounted)	Moving human target: 10m; Micro-motion human target: 6m
Detection range (top-mounted)	Moving human target: 5m; Micro-motion human target: 4m
Detection distance resolution	0.7m
Detection angle	±60°
Detection accuracy	0.15m (moving target within 10m radial distance from the radar)
Average operation current	50mA
Data refresh cycle	100ms

Features At A Glance

The **HMMD-mmWave-Sensor** is a human micro-motion sensor, adopts Frequency Modulated Continuous Wave (FMCW) technology to detect and identify moving, standing, and motionless human body. Combining radar signal processing with accurate human detection and ranging algorithms, supports configuring the sensibility for each range independently to improve anti-interference performance. Compact size, low power consumption, and easy integration, it can be widely used in AIoT scenarios such as Smart Home, Intelligent Security, Smart Business, and Intelligent Lights, etc.

- Based on AIoT mmWave Sensor SoC S3KM1110, onboard high performance 24GHz 1T1R antennas
- Onboard MCU and built-in human micro-motion sensing algorithm for accurate detecting of moving, micro-motion, and standing human
- Provides UART communication protocol, supports configuring sensing distance range, sensitivity, and absence report delay, easy to operate
- Supports UART port and GPIO header output, for connecting to host boards such as Raspberry Pi and Arduino
- Wide-range moving human body sensing distance, supports top-mounted and wall-mounted detection
- Comes with online resources and manual (examples for Raspberry Pi/RP2040/Arduino/ESP32/Jetson Nano)

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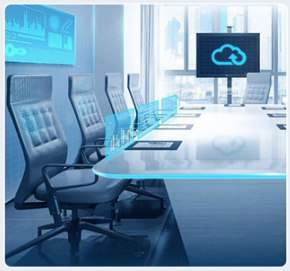
Image: Comprehensive specifications for the sensor module.

Application Scenarios

Smart Home

Presence Detection



Smart Office

Screen Sensing

Image: Outline dimensions of the HMMD-mmWave-Sensor.

5. Setup

5.1 Pinout Definition

The sensor provides a clear pinout for easy connection to various host boards.

GPIO OUT: General Purpose Input/Output pin.

RX: Receive pin for UART communication.

TX: Transmit pin for UART communication.

GND: Ground connection.

3.3V: Power supply input (3.3V).

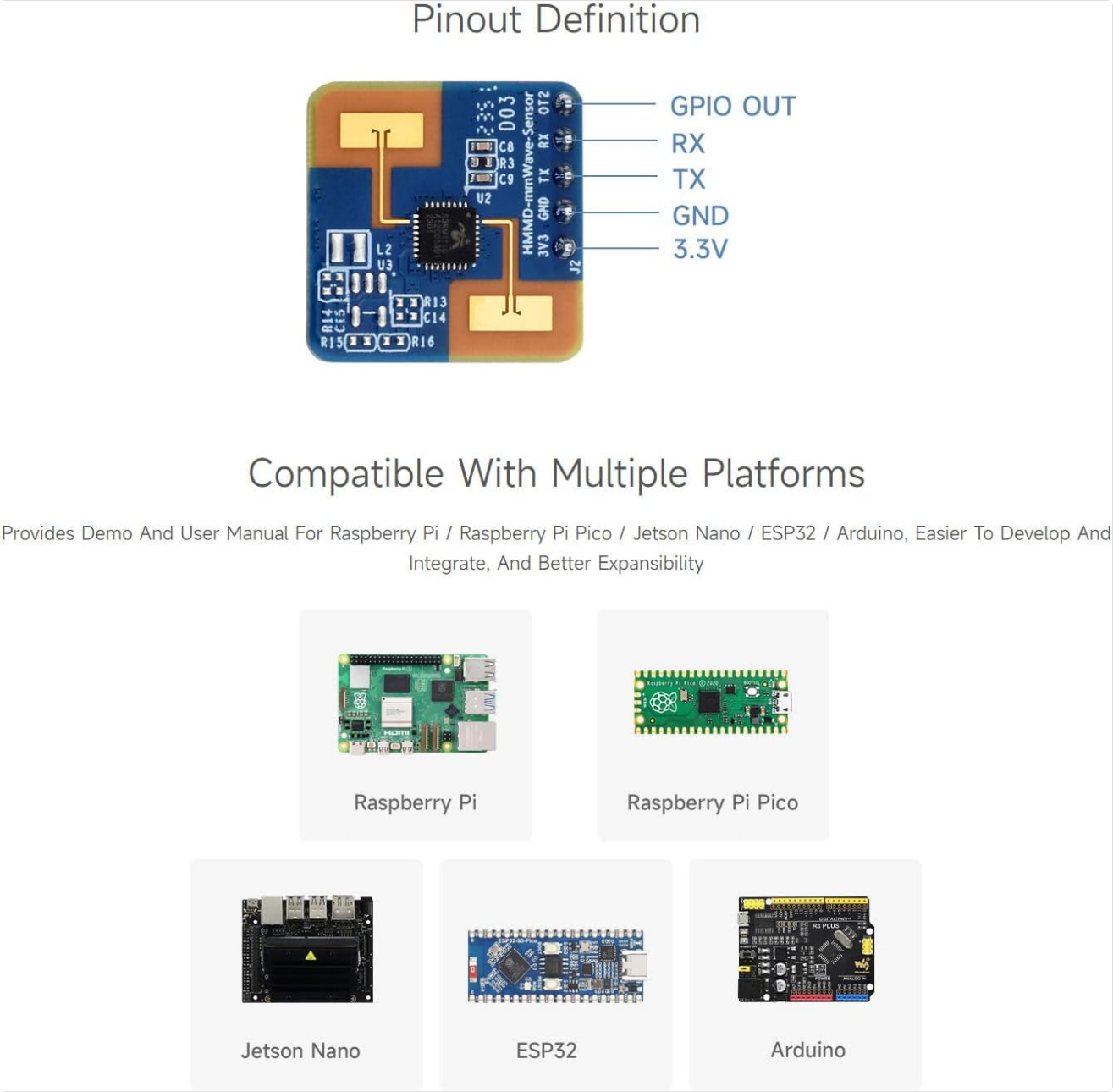


Image: Pinout diagram for connecting the sensor.

5.2 Compatible Platforms

The HMMD-mmWave-Sensor is designed for broad compatibility, offering demo and user manual examples for popular development platforms:

- Raspberry Pi
- Raspberry Pi Pico
- Jetson Nano
- ESP32
- Arduino

This ensures easier development, integration, and expandability for your projects.

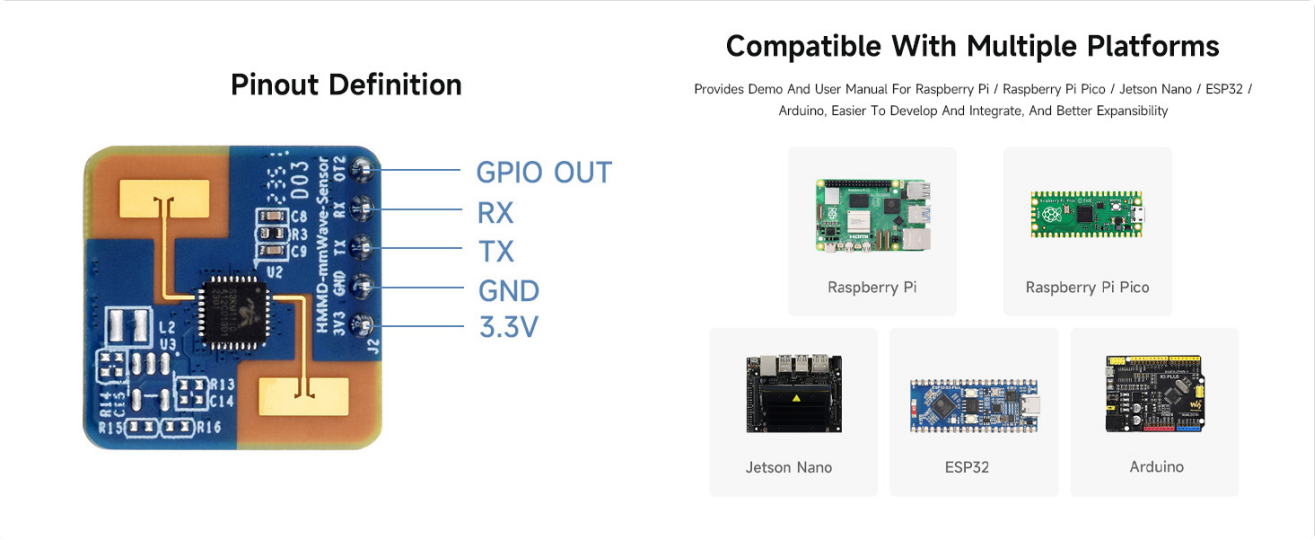


Image: Compatible development platforms.

5.3 Visual Host Support

For configuration and debugging, it is recommended to use a USB to UART module to easily connect the sensor to host software. This allows for visual monitoring and adjustment of sensor parameters.

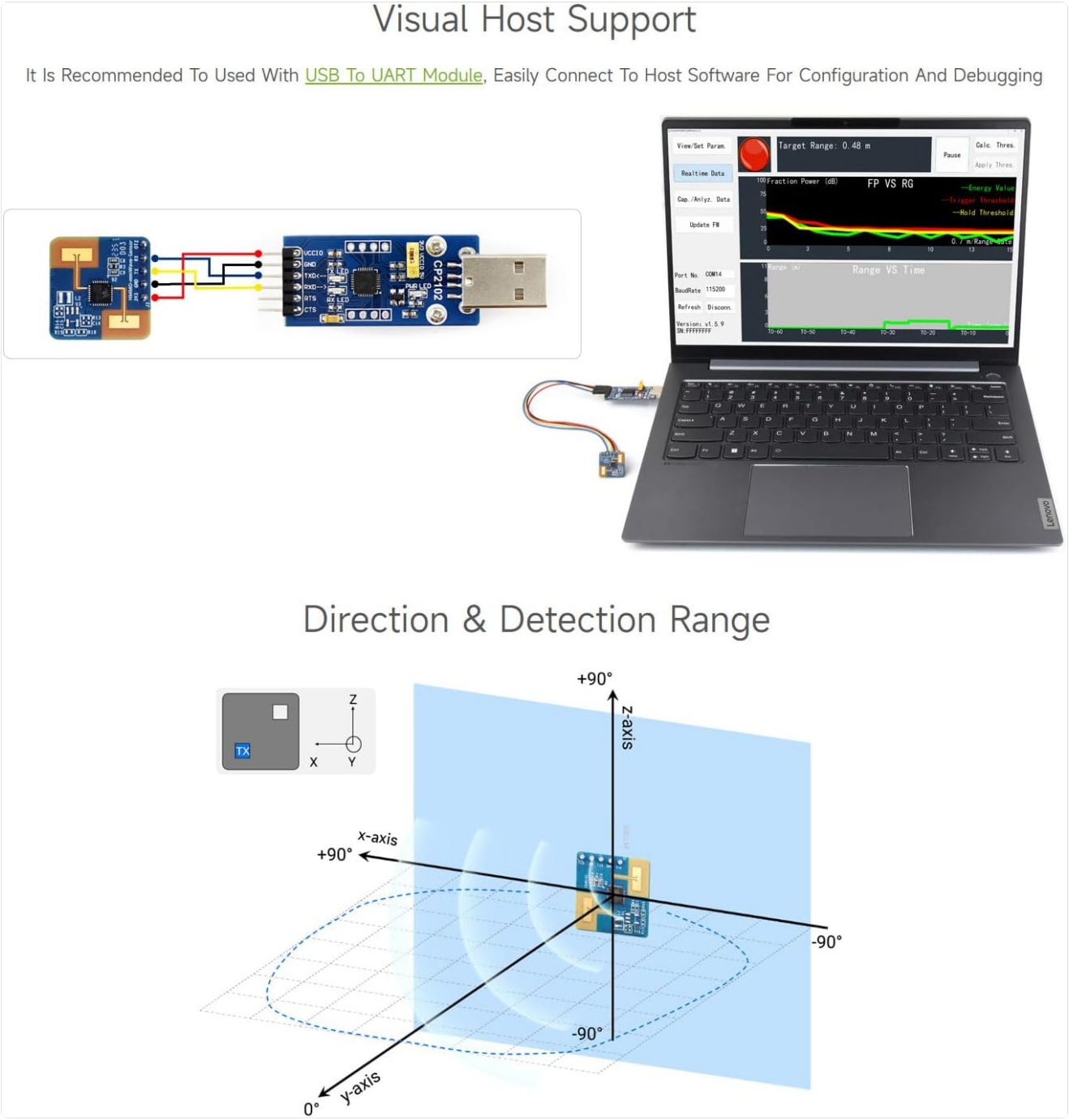


Image: Connecting the sensor via USB to UART for host software interaction.

5.4 Installation and Detection Range

The sensor supports both top-mounted and wall-mounted installations, each with specific detection characteristics. Understanding these is crucial for optimal performance.

Top-Mounted Installation:

When mounted on the ceiling, the sensor provides a conical detection area. The typical height for top-mounting is 2.7-3 meters, covering a floor area with a radius of approximately 5 meters for moving targets and 4 meters for micro-motion targets.

Wall-Mounted Installation:

For wall-mounted setups, the sensor should ideally be placed at a height of 1.5-2 meters. This configuration provides a wider, fan-shaped detection area, capable of detecting moving human targets up to 10 meters and micro-motion targets up to 6 meters.

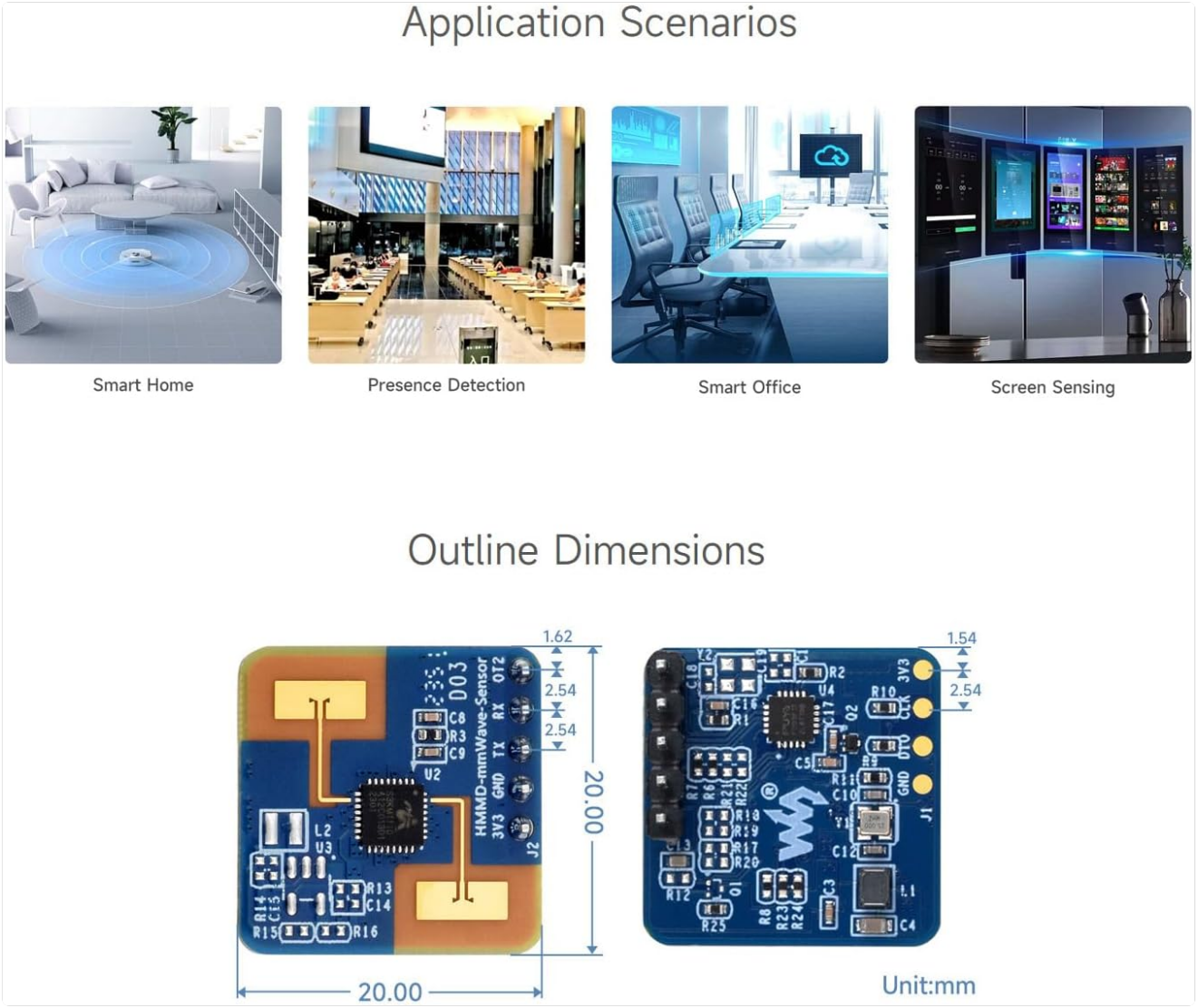


Image: Installation diagrams and corresponding detection ranges.

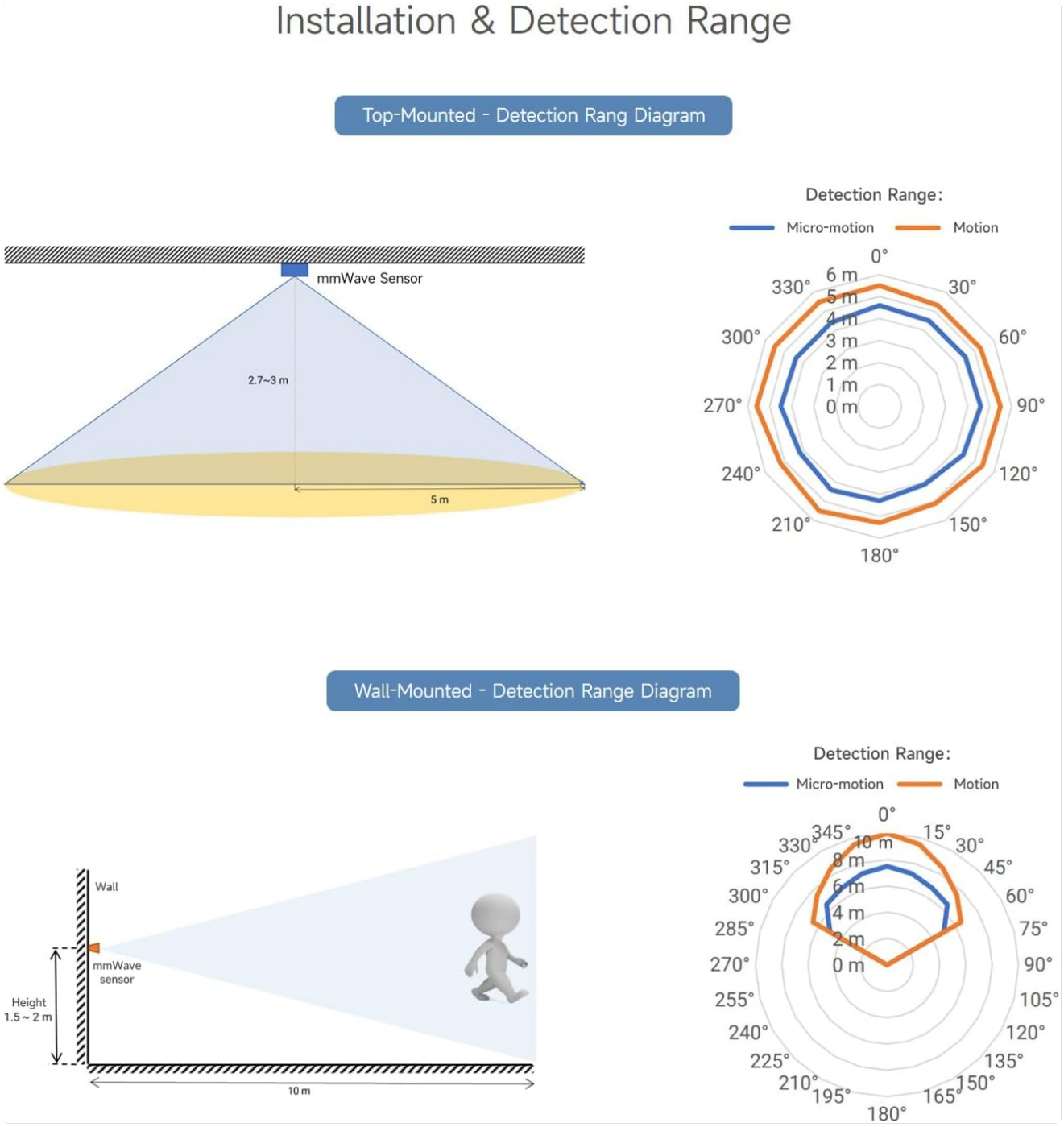


Image: Directional detection range of the sensor.

6. Operating Instructions

6.1 Configuring Sensor Parameters

The sensor's behavior can be customized via the UART communication protocol. Key parameters that can be configured include:

- **Sensing Distance Range:** Adjust the maximum distance for motion and micro-motion detection to suit the environment.
- **Sensitivity:** Fine-tune the sensor's responsiveness to different levels of human movement.
- **Absence Report Delay:** Set the time duration after which the sensor reports an absence if no motion is detected.

Refer to the online resources and manual examples for detailed commands and software interfaces for parameter configuration.

6.2 Application Scenarios

The HMMD-mmWave-Sensor is versatile and can be integrated into various intelligent systems:

- **Smart Home:** Automate lighting, HVAC, and security based on room occupancy.
- **Presence Detection:** Monitor occupancy in offices, meeting rooms, or public spaces for energy efficiency or security.
- **Smart Office:** Optimize workspace utilization and environmental controls.
- **Screen Sensing:** Automatically activate or deactivate displays based on user presence.

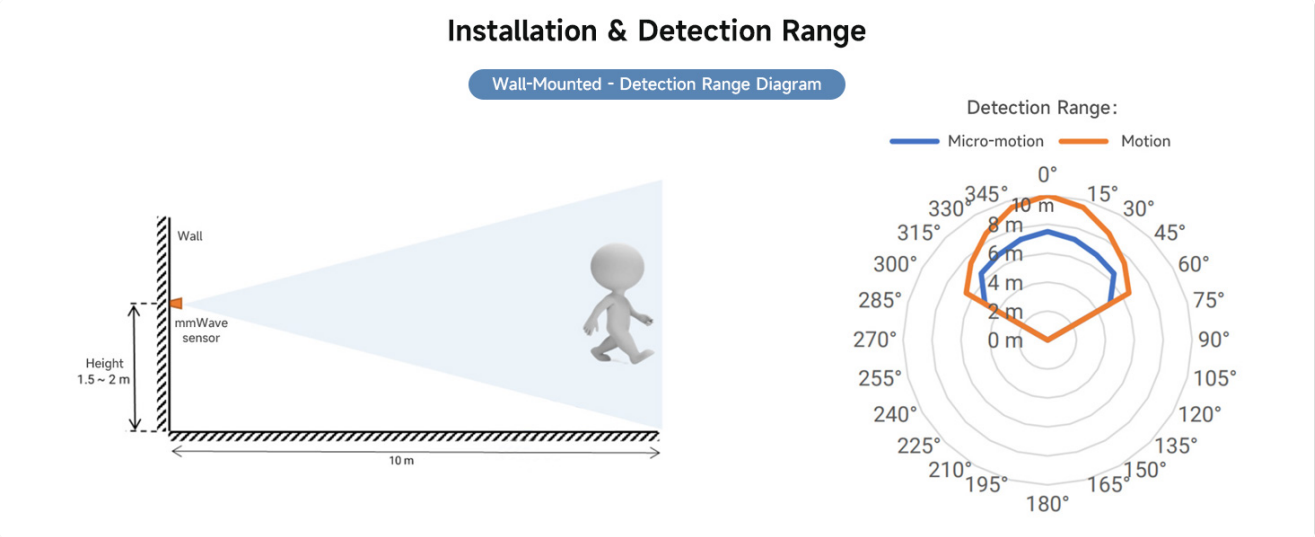


Image: Examples of sensor application scenarios.

7. Maintenance

The HMMD-mmWave-Sensor is designed for low maintenance. To ensure optimal performance:

- Keep the sensor module clean and free from dust or obstructions that could interfere with radar signals.
- Ensure the operating environment temperature remains within the specified -40~85°C range.
- Avoid placing the sensor near strong electromagnetic interference sources.

8. Troubleshooting

If you encounter issues with your HMMD-mmWave-Sensor, consider the following:

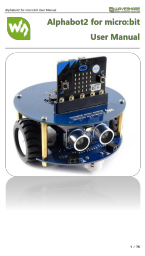
- **No Detection:**
  - Verify power supply (3.3V) is correctly connected.
  - Check physical obstructions in the detection area.
  - Ensure the sensor is installed within recommended height and orientation for the desired detection

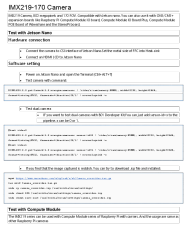
range.
    - Confirm sensor parameters (distance, sensitivity) are correctly configured via UART.
- **False Detections:**
    - Adjust sensitivity settings to a lower value.
    - Ensure the sensor is not facing moving objects like curtains, fans, or air vents, which can cause false triggers.
    - Recalibrate the detection range if necessary.
- **Communication Issues:**
    - Check UART wiring (RX to TX, TX to RX, GND to GND).
    - Confirm the baud rate (115200bps default) matches your host device.
    - Ensure the host board's UART port is correctly configured and enabled.

9. Support & Resources

For further technical support, detailed documentation, and example code, please refer to the official Waveshare online resources. These resources include comprehensive guides for integrating the HMMD-mmWave-Sensor with various development platforms like Raspberry Pi, RP2040, Arduino, ESP32, and Jetson Nano.
Visit the Waveshare Store for product updates and additional information.

Related Documents - HMMD-mmWave-Sensor

	Waveshare Alphabot2 for micro:bit User Manual - Robotics Programming Guide Explore the Waveshare Alphabot2 robot kit with this comprehensive user manual. Learn programming for BBC micro:bit, covering LEDs, sensors, motors, Bluetooth, and advanced robotics features for educational projects.
	VL53L1X Distance Sensor User Manual and Integration Guide A comprehensive user manual for the Waveshare VL53L1X Time-of-Flight (ToF) distance sensor. It details the sensor's specifications, features, pinouts, and provides step-by-step guides for integration with popular development platforms like Raspberry Pi, Arduino, and STM32, including demo code instructions.

	[WAVESHARE UART Fingerprint Sensor (F) Command Manual: Protocol and Command Reference] This manual details the serial communication protocol, command list, and data packet formats for the WAVESHARE UART Fingerprint Sensor (F) module. It serves as a comprehensive guide for developers integrating fingerprint recognition capabilities into their projects.
	[WaveShare X210II Rev1.0 Hardware Manual] Detailed hardware manual for the WaveShare X210II Rev1.0 development board, covering its features, core components, pin definitions, baseboard interfaces, and startup procedures.
	[PiRacer Pro AI Kit Assembly Manual] Assembly and usage guide for the PiRacer Pro AI Kit, including package contents, step-by-step assembly instructions, usage tips, and frequently asked questions.
	[IMX219-170 Camera User Guide for Jetson Nano and Compute Module] A guide to using the IMX219-170 camera with Jetson Nano and Raspberry Pi Compute Modules, including hardware connection, software setup, and troubleshooting.