

Batman BM101 mmWave EVM kit

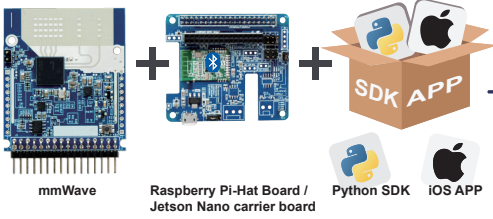
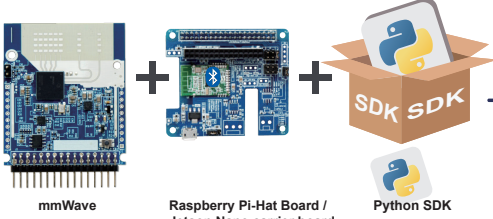
mmWAVE SENSOR EVALUATION SOLUTION

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Joybien Batman BM101 mmWave EVM kit is a compact, low power, high accuracy, and simple-to-use Millimeter-Wave (mmWave) Sensor Hardware & Software integrated evaluation kit suitable for various applications including: Education, Engineering, Science, Automotive, Industrial, Medical, and Business & Consumer applications.

Batman BM101 EVM Kit package includes

- A Small & Compact application dedicated mmWave Sensor Module based on Texas Instruments (TI) IWR1642 76GHz~81GHz mmWave ASIC , with pin-connection for UART communication.
- A Raspberry Pi-Hat Board with optional JBT24M Bluetooth Module; and that this Hat Board can also work independently for connecting the mmWave Sensor Module to other MCU based Hardware Board such as an Arduino Board, etc.
- An iOS mmWave Demo App available for download on Apple App Store.(Not including Short Range Radar)
- A Python SDK on GitHub available for developing software on Raspberry Pi and other computers, which is a perfect companion for AI + IoT Integration Implementation

| Batman BM101 EVM Kit includes | |
|------------------------------------|--|
| (VSD) Vital Signs Detection |  <p>mmWave + Raspberry Pi-Hat Board / Jetson Nano carrier board + SDK APP</p> <p>Python SDK iOS APP</p> <p>For VSD,PMB and HAM</p> |
| (HAM) High Accuracy Measurement | |
| (PMB) People Movement Behavior | |
| (SRR) Short Range Radar |  <p>mmWave + Raspberry Pi-Hat Board / Jetson Nano carrier board + SDK SDK</p> <p>Python SDK</p> <p>For SRR</p> |

Batman BM101 EVM Kit is for

- Technologically inclined engineering professors & students, scientists, electronics hardware & software engineers, automotive engineers and technologists, electronics hobbyists, etc.
- For a Novice, the user may follow the included sample Apps via Bluetooth wireless connectivity to iPhone/iPad to gain mmWave Radar's practical experience.
- For an Intermediate User, the user may apply Batman Kit for the Target Application by configuring Hardware I/O Port, and designing Software based on the included SDK
- For an Advanced User, the user may utilize Batman Kit as an IoT Sensor End Device for AI+IoT application with Deep Learning

Batman BM101 mmWave EVM kit

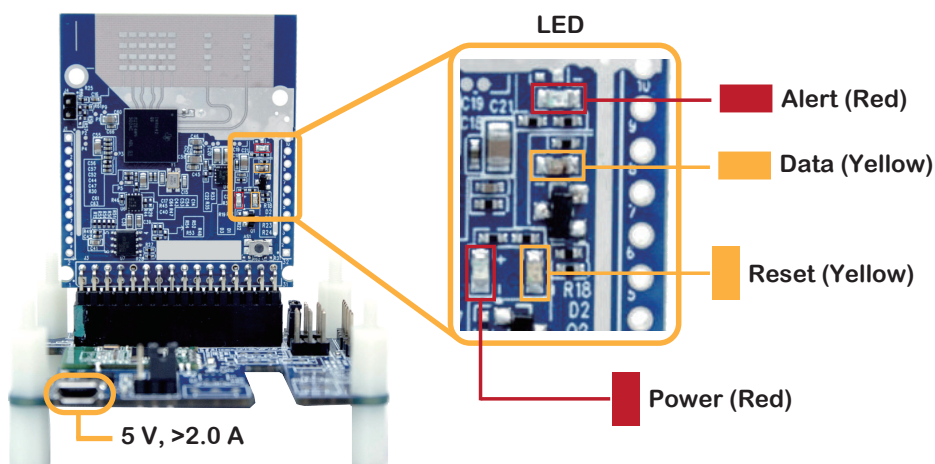
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Specification

| | |
|------------------------------------|--|
| (VSD) Vital Signs Detection | 30cm ~ 90cm (about 1~3 feet) Built-in with Vital Signs Detection (VSD) Firmware; for a contactless and wearableless 30cm ~ 90cm (about 1~3 feet) distance detection of Vital Signs (Heartbeat Rate & Respiration Rate) of a person, a pet, or an animal. |
| (HAM) High Accuracy Measurement | 30cm ~ 3meters (about 1~10 feet) Built-in with High Accuracy Measurement (HAM) Firmware; for measuring object distance from the mmWave Sensor Module with the range of 30cm ~ 3meters (about 1~10 feet) with millimeter resolution. |
| (PMB) People Movement Behavior | 4 x 4 meter or 16 meter square area (or about 172 square feet) Built-in with People Movement Behavior (PMB) Trigger Firmware; for detecting People movement in a 4 x 4 meter or 16 meter square area (or about 172 square feet), and with software that could set virtual geo-fence(s) to trigger alert or action when People are moving into the geo-fence(s). |
| (SRR) Short Range Radar | For Human:1 meters ~ 20meters (about 3 ~ 66 feet) For Vechile:1 meters ~ 50meters (about 3 ~ 164 feet) and with viewing angle of 120 degrees Built-in with Short Range Radar Firmware; for detecting objects' distance with the range of 1meters ~ 20meters (about 3 ~ 66 feet) and with viewing angle of 120 degrees, along with Doppler Data to distinguish for whether the objects are moving-towards or moving-away from the mmWave sensor. |

- Make sure you are using the correct power supply of 5 V, >2.0 A with a Micro USB

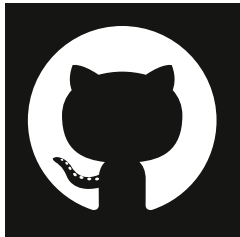



Batman BM101 mmWave EVM kit






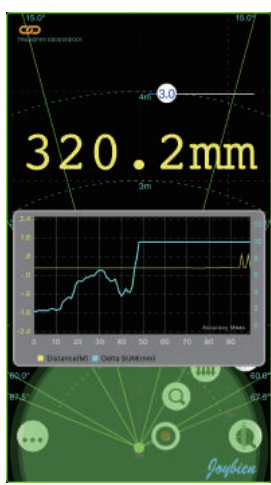

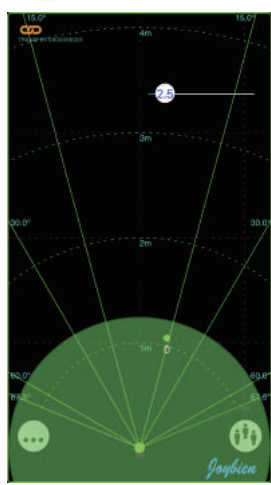
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Develop SDK: Python SDK

| | |
|------------------------------------|---|
| (VSD) Vital Signs Detection | <ul style="list-style-type: none"> Available on GitHub Note: Please refer to README.md file first for proper configuration   <p>GitHub</p> <p>https://github.com/bigheadG/mmWave</p> |
| (HAM) High Accuracy Measurement | |
| (PMB) People Movement Behavior | |
| (SRR) Short Range Radar | |

APP Demos: VSD, HAM and PMB

| | |
|---------------------|---|
| iOS mmWave Demo App | <ul style="list-style-type: none"> Available on Apple App Store for Vital Signs Detection, High Accuracy Measurement and People Movement Behavior. (Not including Short Range Radar)   |
| | <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Vital Signs Detection (VSD)</p>  </div> <div style="text-align: center;">  <p>High Accuracy Measurement (HAM)</p>  </div> <div style="text-align: center;">  <p>People Movement Behavior (PMB)</p>  </div> </div> |

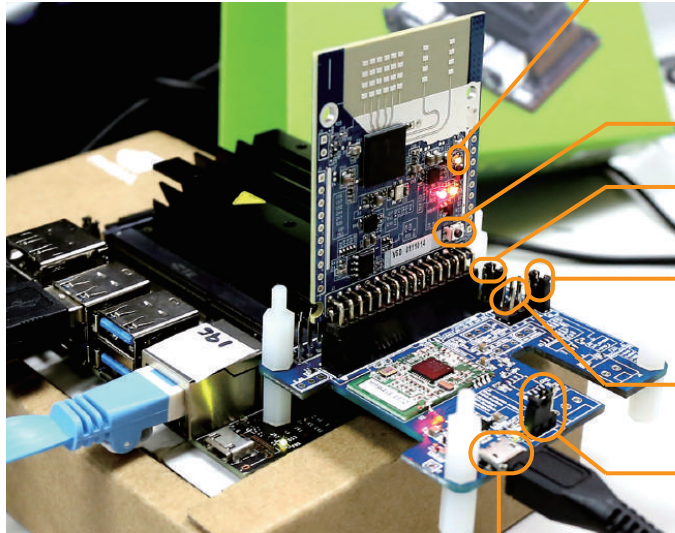
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Selection : Key Data Mode or Raw Data Mode Application

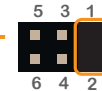
(A) Raw Data Mode



DATA LED (Yellow):

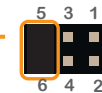
After Pressing the RESET Button, the Yellow LED will be flashing to indicate normal operation

RESET



JUMPER J1 at 1,2 position for Raspberry Pi / Jetson Nano selection

JUMPER J12 at 1,2 position for Raspberry Pi / Jetson Nano Interrupt Jumper



JUMPER J4 at 5,6 position for RX0

JUMPER J9 at 1,2 position for Raw Data Mode (921600/8/n/1)

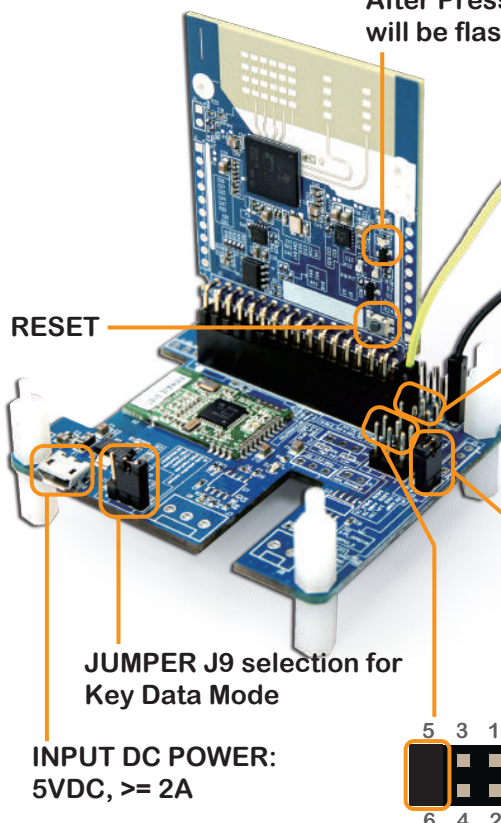
INPUT DC POWER: 5VDC, >= 2A

(B) Key Data Mode

This is for Bluetooth Data Transfer usage, NOT USED if using Raspberry Pi 4 / NVIDIA Jetson Nano / External Microprocessor

DATA LED (Yellow):

After Pressing the RESET Button, the Yellow LED will be flashing to indicate normal operation

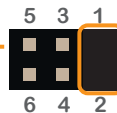


Wire connections for external microprocessor access on the HAT-Board, and where:

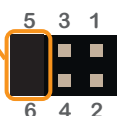
J1 PIN3 Yellow Wire location is for UART TX1 at 115200/8/n/1;

J3 PIN39 Black Wire location is for GND

Note: The UART Voltage Level is 3.3VDC (NOT 5VDC). Please handle with care.



JUMPER J1 at 1,2 position for Raspberry Pi / Jetson Nano selection



JUMPER J1 at 5,6 position for Bluetooth selection
Vital Signs Detection,
High Accuracy Measurement and
People Movement Behavior.
(Not including Short Range Radar)

JUMPER J9 selection for Key Data Mode

JUMPER J12 at 1,2 position for Raspberry Pi / Jetson Nano Interrupt Jumper

INPUT DC POWER: 5VDC, >= 2A



JUMPER J4 at 5,6 position for RX0

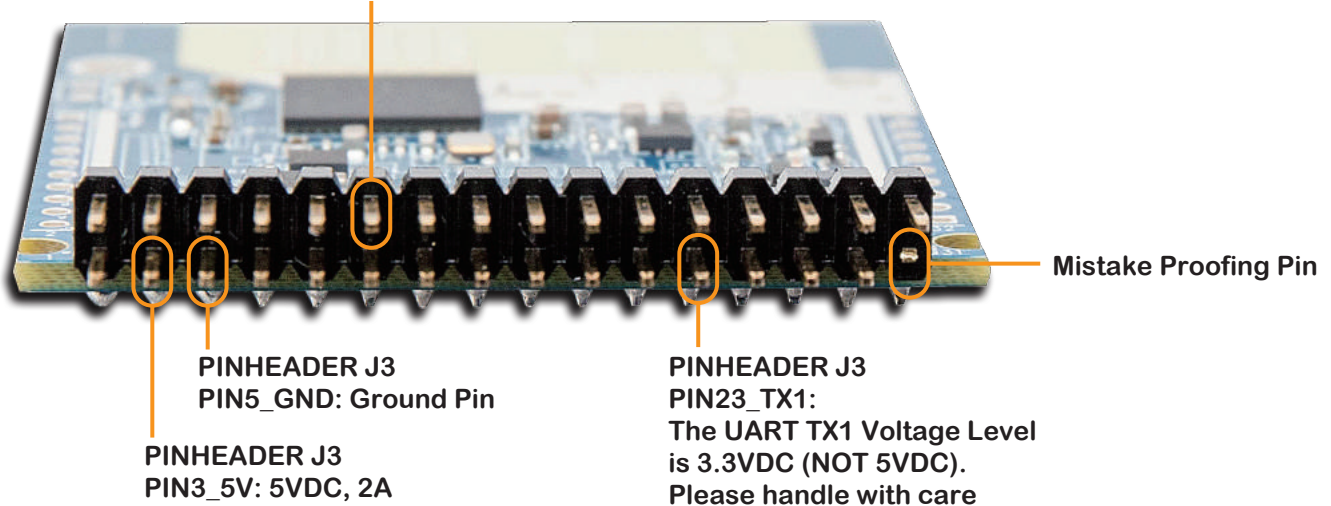
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Batman BM101 Module J3 Pin Assignment Note

PINHEADER J3 PIN12_GPIO_0 High: Raw Data Baud Rate 921600/8/n/1 selection for PIN23_TX1
 PINHEADER J3 PIN12_GPIO_0 Low : Key Data Baud Rate 115200/8/n/1 selection for PIN23_TX1



Alert : All GPIO Pins base on 3.3V System. Pin23_TX1 is DC 3.3V system.

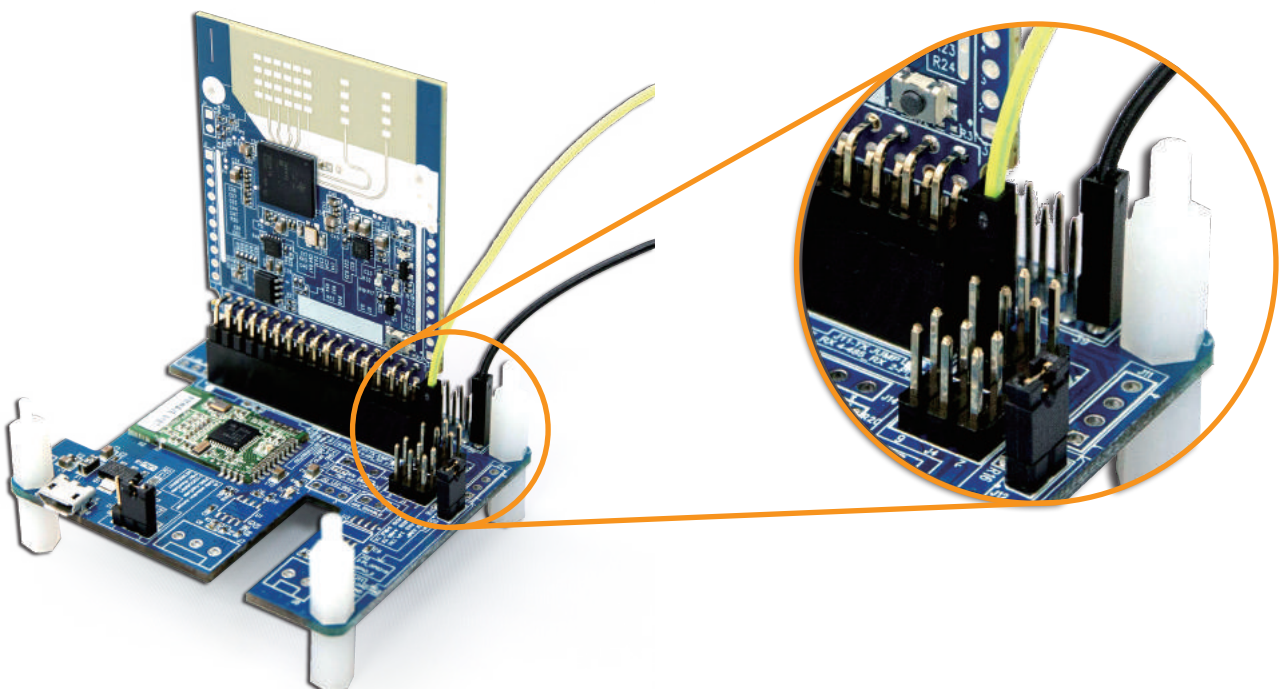
Batman BM101 EVM Kit + External Microprocessor

Wire connections for external microprocessor access on the HAT-Board, and where:

J1 PIN3 Yellow Wire location is for UART TX1 at 115200/8/n/1;

J3 PIN39 Black Wire location is for GND

Note: The UART Voltage Level is 3.3VDC (NOT 5VDC). Please handle with care.



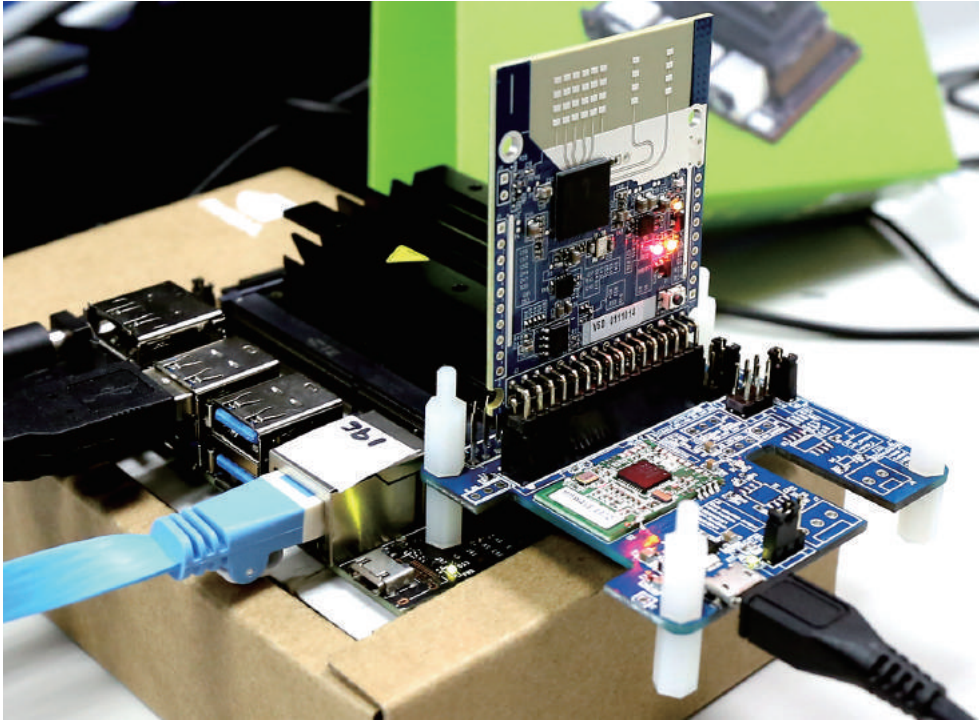
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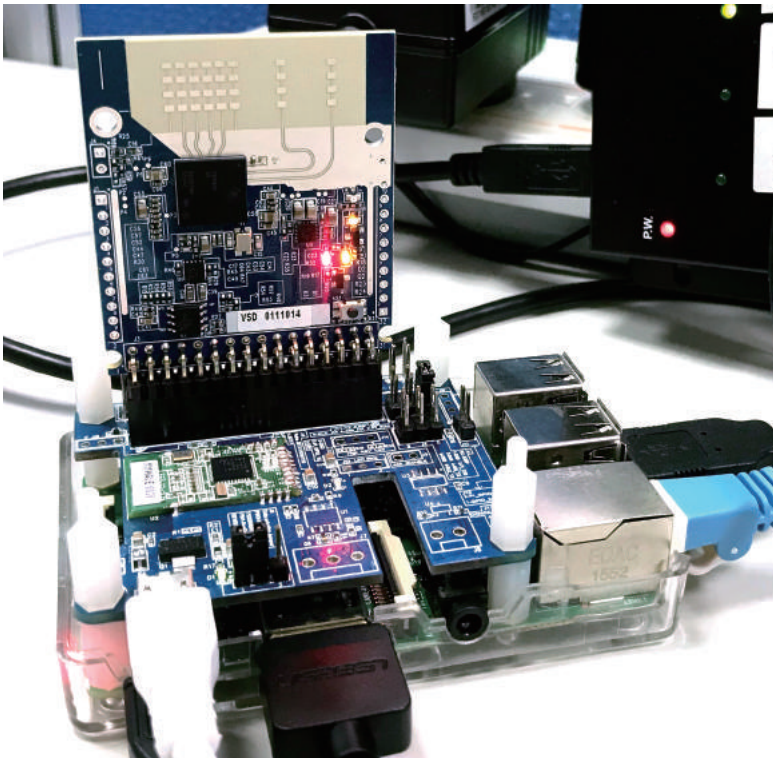
Batman BM101 EVM Kit + NVIDIA Jetson Nano

Please make sure that the JUMPER SETTING is for Raw Data Mode



Batman BM101 EVM Kit + Raspberry Pi

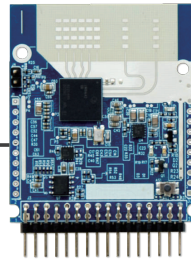
Please make sure that the JUMPER SETTING is for Raw Data Mode



Batman BM101 mmWave EVM kit

mmWAVE SENSOR EVALUATION SOLUTION

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Specifications

mmWave Sensor Evaluation Module

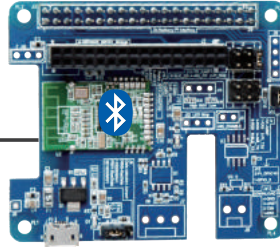
| | |
|---|---|
| FMCW Transceiver | <ul style="list-style-type: none"> ● Integrated PLL, Transmitter, Receiver, Baseband, and A2D ● 76- to 81-GHz Coverage With 4-GHz ● Continuous Bandwidth ● Four Receive Channels ● Two Transmit Channels ● Ultra-Accurate Chirp (Timing) Engine Based on Fractional-N PLL ● TX Power: 12.5 dBm ● RX Noise Figure: <ul style="list-style-type: none"> 14 dB (76 to 77 GHz) 15 dB (77 to 81 GHz) |
| Built-in Calibration and Self-Test (Monitoring) | <ul style="list-style-type: none"> ● ARM® Cortex® -R4F-Based Radio Control System ● Built-in Firmware (ROM) ● Self-calibrating System Across Frequency and Temperature |
| DSP | <ul style="list-style-type: none"> ● C674x DSP for FMCW Signal Processing |
| MCU | <ul style="list-style-type: none"> ● ARM Cortex-R4F Microcontroller for Application Control |
| I/O | <ul style="list-style-type: none"> ● SPI / CAN x 1 ● Up to 2 UARTs ● I2C x 1 ● GPIO: 0 ~ 2 |
| Antenna | <ul style="list-style-type: none"> ● Tx Antenna x 2 on Board ● Rx Antenna x 4 on Board |
| Pre-Programmed Firmware “Flavor” | <ul style="list-style-type: none"> ● Vital Signs Detection (VSD) Firmware; for 30cm ~ 90cm wireless & contactless detection of Heartbeat & Respiration Rate ● High Accuracy Measurement (HAM) Firmware; for 30cm ~ 300cm distance measurement with millimeter resolution ● People Movement Behavior (PMB) Firmware; for detecting People Movement in 4m x 4m or 16 meter-square region for setting geo-fence(s) trigger action ● Short Range Radar (SRR) Firmware; for detecting objects’ distance with the range of 20meters ~ 50meters (about 66 ~ 164 feet) and with viewing angle of 120 degrees, along with Doppler Data to distinguish for whether the objects are moving-towards or moving-away from the mmWave sensor. <p>Note: ONLY one of VSD, HAM, or PMB Firmware is pre-programmed within a single mmWave Module</p> |
| Operating Temperature Operating Humidity | <ul style="list-style-type: none"> ● 0° to 40° degree Celsius ● 10 ~ 85% Non-Condensing |
| Dimensions & Weight | <ul style="list-style-type: none"> ● 54.1mm x 45.7mm; 13.7 grams net |

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mmWave Raspberry Pi Hat



| | |
|---|--|
| Connector | <ul style="list-style-type: none"> ● Matching mmWave Module Female Connector ● Matching Raspberry Pi GPIO Female Connector ● Micro USB Power Connector ● Jumpers for Bluetooth Tx/Rx or Raspberry Pi Tx/Rx Selection ● Jumper for mmWave Raw Data or Key Data Selection |
| Bluetooth (optional) | <ul style="list-style-type: none"> ● Joybien JBT24M Bluetooth Low Energy Module |
| Micro USB Input Power | <ul style="list-style-type: none"> ● 5VDC, 2Amp. (Note: Power Adapter and Micro USB Cable NOT included) |
| Operating Temperature Operating Humidity | <ul style="list-style-type: none"> ● 0° to 40° degree Celsius ● 10 ~ 85% Non-Condensing |
| Dimensions & Weight | <ul style="list-style-type: none"> ● 65.3mm x 56.3mm ● 30 grams with JBT24M Bluetooth |

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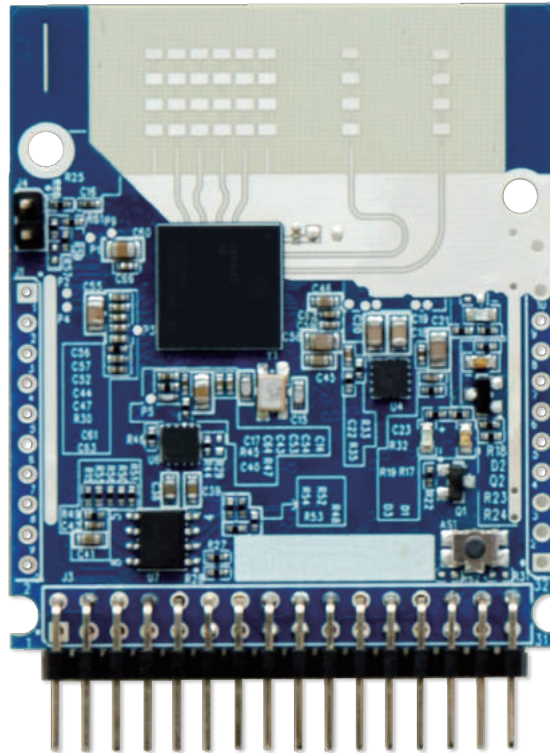
mmWAVE SENSOR EVALUATION SOLUTION

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mmWave Pin Assignment

J1 J1 Pin Assignment

| Pin# | Name |
|------|----------|
| 01 | GND |
| 03 | ANATEST1 |
| 05 | ANATEST2 |
| 07 | DP0 |
| 09 | DP1 |
| 11 | DP2 |
| 13 | DP3 |
| 15 | DP4 |
| 17 | DP5 |
| 19 | DP6 |

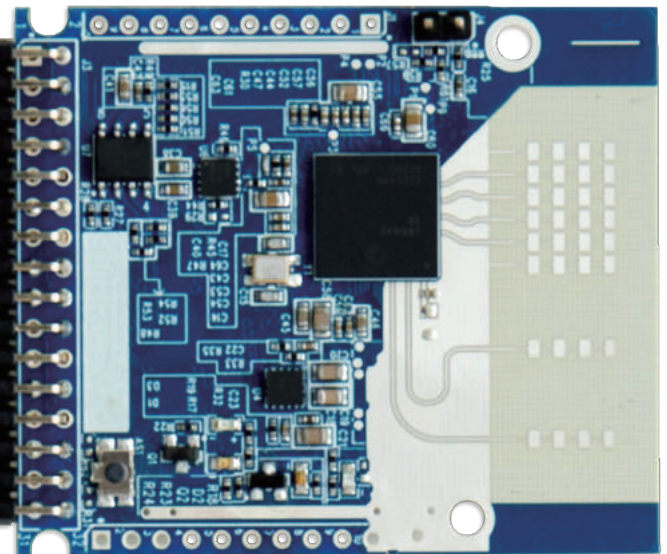


J2 J2 Pin Assignment

| Name | Pin# |
|------------|------|
| GND | 10 |
| ANAMUX | 09 |
| OSC CLKOUT | 08 |
| VSENSE | 07 |
| DP8 | 06 |
| DMM CLK | 05 |
| DMM SYNC | 04 |
| HOSTINTR1 | 03 |
| MCUCLKOUT | 02 |
| DP7 | 01 |

J3 J3 Pin Assignment

| Pin# | Name | Name | Pin# |
|------|------------------|---------------|------|
| 01 | USBD5V | 3V3 | 02 |
| 03 | USBD5V | PI SDA | 04 |
| 05 | GND | PI SCL | 06 |
| 07 | RS232 RX | SYNC IN JBRX1 | 08 |
| 09 | RS232 TX | GND | 10 |
| 11 | nRST | GPIO 0 | 12 |
| 13 | GND | GPIO 1 | 14 |
| 15 | JBCANRX DP13 | CS1 | 16 |
| 17 | JBCANTX DP12 | 3V3 | 18 |
| 19 | GND | MOSI 1 | 20 |
| 21 | BSS LOGGER | MISO 1 | 22 |
| 23 | MSS LOGGER JBTX1 | SPICLK 1 | 24 |
| 25 | PMIC CLKOUT SOP2 | GND | 26 |
| 27 | SYNC OUT SOP1 | nERRIN | 28 |
| 29 | GND | nERR OUT | 30 |
| 31 | WARMRST | GPIO 2 | 32 |



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mmWAVE SENSOR EVALUATION SOLUTION

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mmWave Pin Assignment

J1 Pin Assignment

| Pin No | Name | Pin Type | Function Description |
|--------|----------|----------|----------------------|
| 01 | GND | GROUND | Digital ground |
| 02 | ANATEST1 | O | ADC Channel 1 |
| 03 | ANATEST2 | O | ADC Channel 2 |
| 04 | DP0 | IO | General-purpose I/O |
| 05 | DP1 | IO | General-purpose I/O |
| 06 | DP2 | IO | General-purpose I/O |
| 07 | DP3 | IO | General-purpose I/O |
| 08 | DP4 | IO | General-purpose I/O |
| 09 | DP5 | IO | General-purpose I/O |
| 10 | DP6 | IO | General-purpose I/O |

J2 Pin Assignment

| Pin No | Name | Pin Type | Function Description |
|--------|------------|----------|---|
| 01 | DP7 | IO | General-purpose I/O |
| 02 | MCUCLKOUT | O | Programmable clock given out to external MCU or the processor |
| 03 | HOSTINTR1 | O | Out of Band Interrupt to an external host communicating over SPI |
| 04 | DMM SYNC | I | Debug Interface(Hardware In Loop) - Sync |
| 05 | DMM CLK | I | Debug Interface(Hardware In Loop) - Clock |
| 06 | DP8 | IO | General-purpose I/O |
| 07 | VSENSE | IO | ADC Channel 6 |
| 08 | OSC CLKOUT | O | Reference clock output from clocking sub system after cleanup PLL(1.8V output voltage swing). |
| 09 | ANAMUX | IO | ADC Channel 5 |
| 10 | GND | GROUND | Digital ground |

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mmWAVE SENSOR EVALUATION SOLUTION

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J3 Pin Assignment

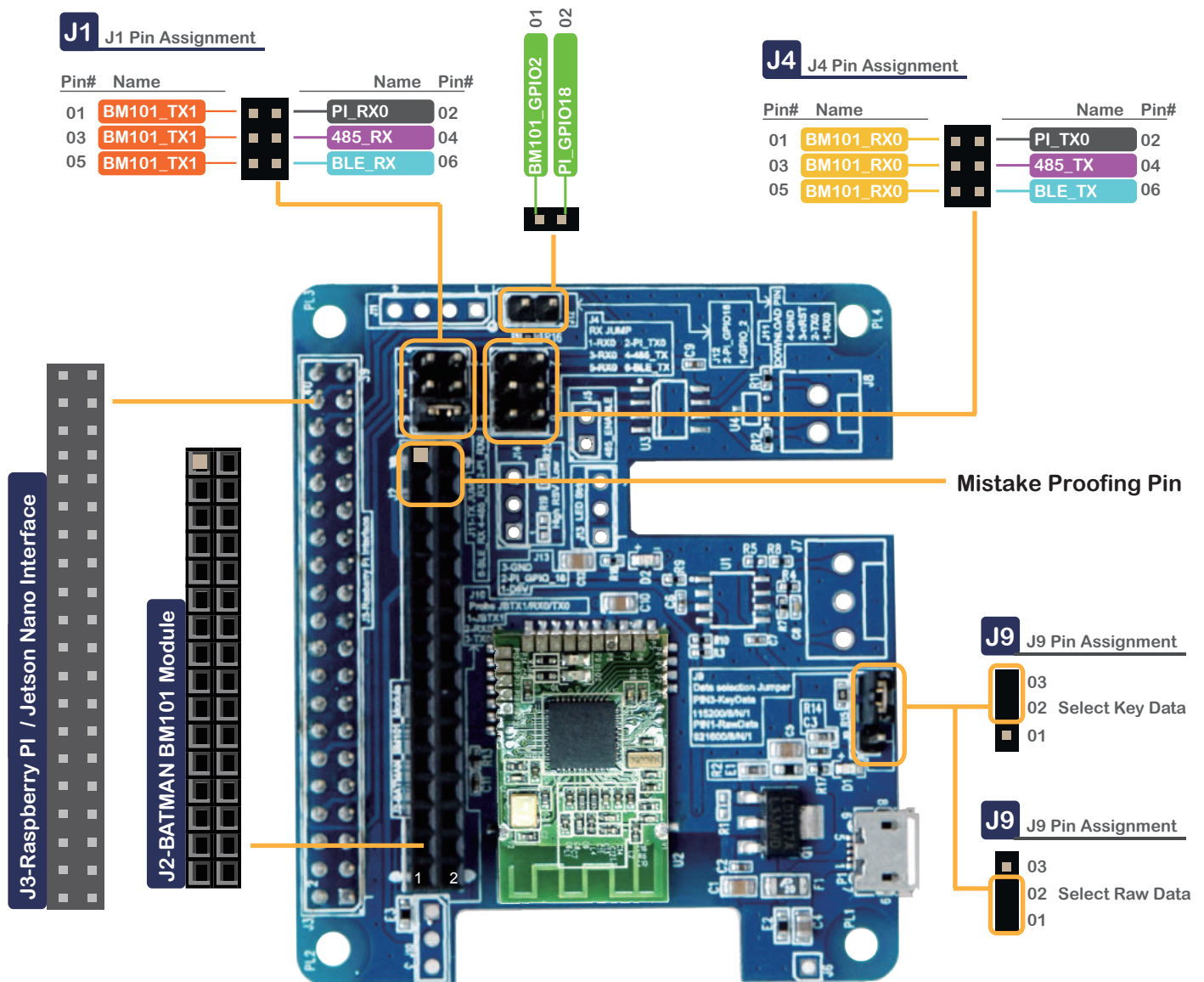
| Pin No | Name | Pin Type | Function Description |
|--------|------------------|----------|--|
| 01 | USBD5V | I | USB POWER DC 5V Input |
| 02 | 3V3 | O | For meaurement only |
| 03 | USBD5V | I | USB POWER DC 5V Input |
| 04 | SDA | IO | I2C Pin |
| 05 | GND | GROUND | Digital ground |
| 06 | SCL | IO | I2C Pin |
| 07 | RS232 RX0 | I | UART A Receive |
| 08 | SYNC IN JBRX1 | I | Low frequency Synchronization signal input, UART B Receive |
| 09 | RS232 TX0 | O | UART A Transmit |
| 10 | GND | GROUND | Digital ground |
| 11 | nRST | I | Power on reset for chip. Active low |
| 12 | GOIO 0 | IO | Select KeyData or RawData |
| 13 | GND | GROUND | Digital ground |
| 14 | GPIO 1 | I | Reserved |
| 15 | JBCANRX DP13 | I | CanRx |
| 16 | CS1 | IO | SPI Channel A - chip Select |
| 17 | JBCANTX DP12 | O | CanTx |
| 18 | 3V3 | O | For meaurement only |
| 19 | GND | GROUND | Digital ground |
| 20 | MOSI 1 | IO | SPI Channel A - Master Out Slave In |
| 21 | BSS LOGGER | IO | BSS LOGGER |
| 22 | MISO 1 | IO | SPI Channel A - Master In Slave Out |
| 23 | MSS LOGGER JBTX1 | O | UART B Transmit |
| 24 | SPICLK 1 | IO | SPI Channel A - Clock |
| 25 | SOP2 | I | SOP2 |
| 26 | GND | GROUND | Digital ground |
| 27 | SOP1 | I | SOP1 |
| 28 | nERRIN | I | Failsafe input to the device. Nerror output from any other device can be concentrated in the error signaling monitor module inside the device and appropriate action can be taken by Firmware. |
| 29 | GND | GROUND | Digital ground |
| 30 | nERR OUT | O | Open drain fail safe output signal. Connected to PMIC/ Processor/MCU to indicate that some severe criticatlity fault has happened. Recovery would be through reset. |
| 31 | WARMRST | IO | Mistake Proofing Pin |
| 32 | GPIO2 | O | LED Indicator |

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mmWave Raspberry Pi Hat Pin Assignment

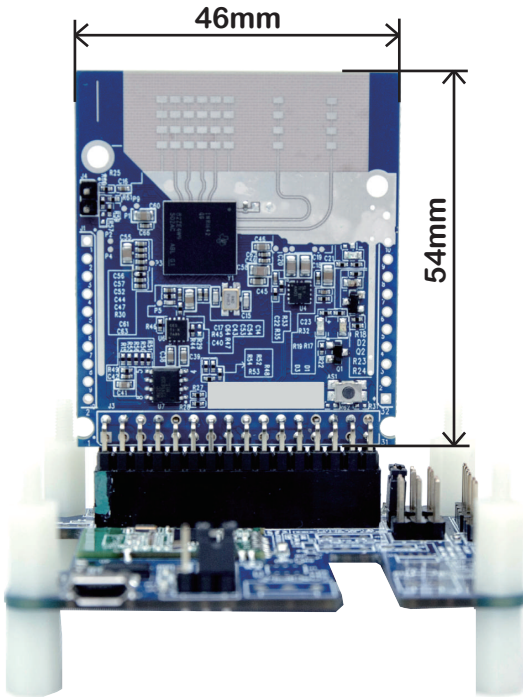


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mmWAVE SENSOR EVALUATION SOLUTION

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Product Dimensions



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"Python" is a registered trademark of the PSF.

This EVM Kit does not include Apple iPhone/iPad, Raspberry Pi computer, nor NVIDIA Jetson Nano computer.

mmWave Specification

| | |
|--|---|
|  <p>(VSD) Vital Signs Detection</p> | <p>30cm ~ 90cm (about 1~3 feet)</p> <p>Built-in with Vital Signs Detection (VSD) Firmware; for a contactless and wearableless 30cm ~ 90cm (about 1~3 feet) distance detection of Vital Signs (Heartbeat Rate & Respiration Rate) of a person, a pet, or an animal.</p> |
|  <p>(HAM) High Accuracy Measurement</p> | <p>30cm ~ 3meters (about 1~10 feet)</p> <p>Built-in with High Accuracy Measurement (HAM) Firmware; for measuring object distance from the mmWave Sensor Module with the range of 30cm ~ 3meters (about 1~10 feet) with millimeter resolution.</p> |
|  <p>(PMB) People Movement Behavior</p> | <p>4 x 4 meter or 16 meter square area (or about 172 square feet)</p> <p>Built-in with People Movement Behavior (PMB) Trigger Firmware; for detecting People movement in a 4 x 4 meter or 16 meter square area (or about 172 square feet), and with software that could set virtual geo-fence(s) to trigger alert or action when People are moving into the geo-fence(s).</p> |
|  <p>(SRR) Short Range Radar</p> | <p>For Human:1 meters ~ 20meters (about 3 ~ 66 feet)</p> <p>For Vechile:1 meters ~ 50meters (about 3 ~ 164 feet)</p> <p>and with viewing angle of 120 degrees</p> <p>Built-in with Short Range Radar Firmware; for detecting objects' distance with the range of 1meters ~ 20meters (about 3 ~ 66 feet) and with viewing angle of 120 degrees, along with Doppler Data to distinguish for whether the objects are moving-towards or moving-away from the mmWave sensor.</p> |
|  <p>(LPD) Long-Range People Detection</p> | <p>For Human:1 meters ~ 50meters (about 3 ~ 164 feet)</p> <p>The Kit's mmWave Module is built-in with Long-Range People Counting Firmware; for a contactless and wearableless real-time detection of people movement from 1 meter to 50 meter range for various applications that require people sensing or counting without privacy invasion.</p> |
|  <p>(FDS) Fall Detection Sensing</p> | <p>For Human: 3-dimensional movement from -3 meter ~ +3 meter on one direction, and -3 meter ~ + 3meter on the perpendicular/orthogonal direction, and +3 meter from ceiling to ground</p> <p>Built-in with Fall Detection Sensing Firmware; when positioned in the center of a room's ceiling, the mmWave Module is capable of detecting People's 3-dimensional movement from -3 meter ~ +3 meter on one direction, and -3 meter ~ + 3meter on the perpendicular/orthogonal direction, and +3 meter from ceiling to ground, all with the respect to the mmWave Sensor positioned in the center of the ceiling; and thus, the Sensor is capable to detect and track people movement along with standing, sitting, lying down positions.</p> |