

# Batman BM201-LPD mmWave EVM Kit

## mmWAVE SENSOR EVALUATION SOLUTION

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Joybien Batman BM201-LPD mmWave EVM Kit is a Texas Instruments (TI) IWR6843 ASIC based millimeter-wave (mmWave) Kit with Frequency-Modulated Continuous Wave (FMCW) radar technology capable of operation in the 60GHz to 64GHz band with up to 4 GHz continuous chirp, using 3 Transmission Antennas and 4 Receiving Antennas, for sensing target object's range, velocity, and angle parameters.

Batman BM201-LPD mmWave EVM Kit is with a small and compact mmWave Module (with low-power, self-monitored, ultra-accurate, and lighting condition independent versatilities), along with a Pi-Hat Board for simple and direct connectivity to a Raspberry Pi or NVIDIA Jetson Nano computer, suitable for various applications including: Education, Engineering, Science, Industrial, Medical, and Business & Consumer.

### Applications

- Education's Practical Radar Introduction
- Engineering & Science's Motion Detection, Displacement, etc.
- Industrial sensor for Displacement & Safe Guard, Factory Automation, Robotics, etc.
- Building Automation sensor for Occupancy Detection, Proximity & Position sensing, People Counting, Security and Surveillance
- Business' Traffic Monitoring, and Proximity Advertisement

### Long-Range People Detection (LPD)

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.

### Features

- Operating Frequency: 60GHz ~ 64GHz coverage  
with 4GHz continuous bandwidth
- Antenna: 3 Tx and 4 Rx Antennas on Module, with:  
TX Power: 10 dBm  
RX Noise Figure: 14 dB
- Processors: ARM R4F based MCU and C674x DSP  
for advanced signal processing
- On-Chip Memory: 1.75MB
- Internal Memories With ECC
- Integrated Peripherals
- Input Power: 3.3Vdc, 2.1A

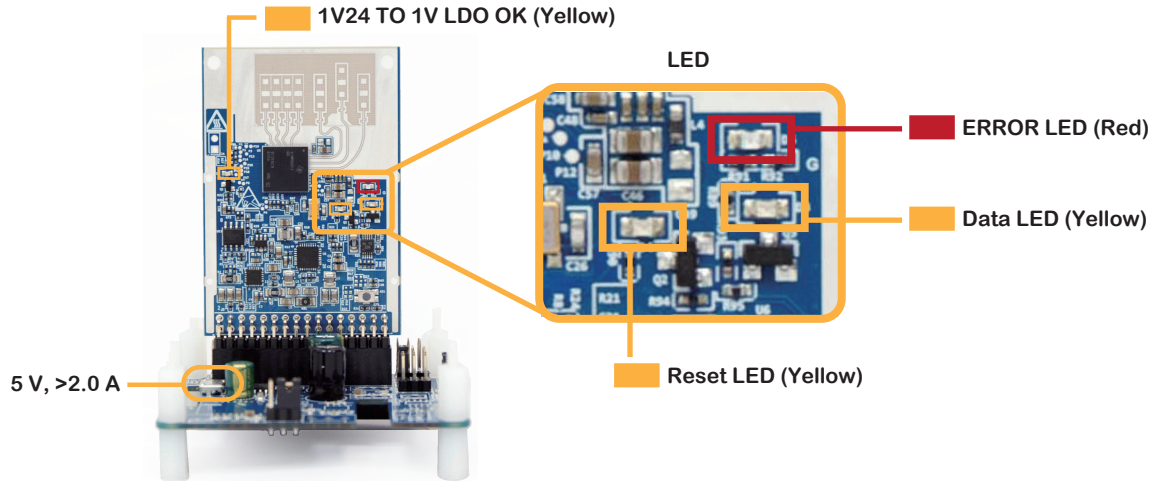
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### Packing List: mmWave Module, Raspberry Pi-Hat Board, Python SDK

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



### Batman BM201-LPD Kit includes

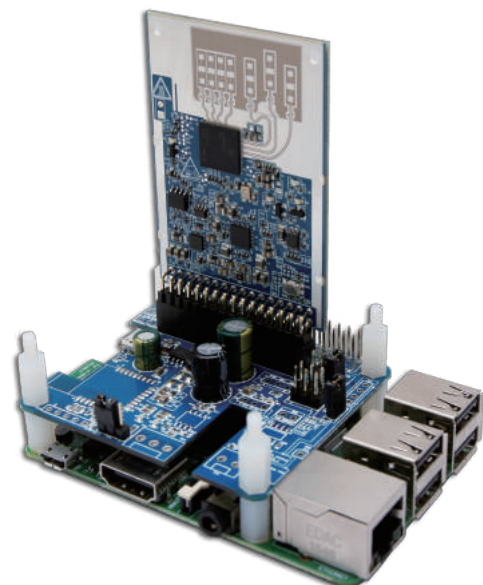
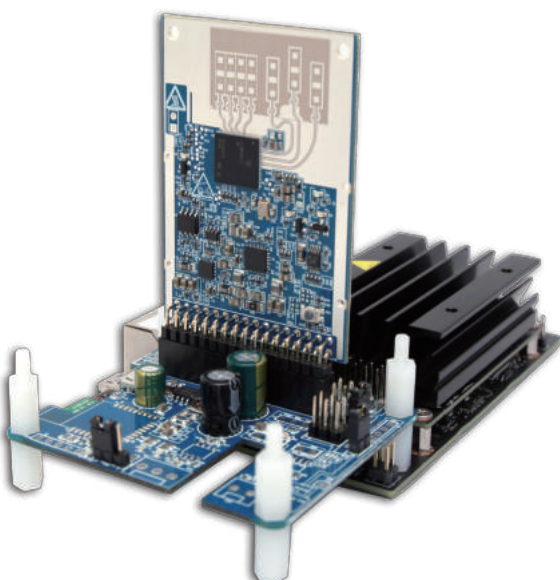
|                             |   |
|-----------------------------|---|
| Long-Range People Detection | <p>mmWave + Raspberry Pi-Hat Board / Jetson Nano carrier board + Python SDK</p> |
|-----------------------------|---|

### Batman Kit + NVIDIA Jetson Nano / Batman Kit + Raspberry Pi

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

Batman BM201-LPD EVM Kit + Jetson Nano

Batman BM201-LPD EVM Kit + Raspberry Pi



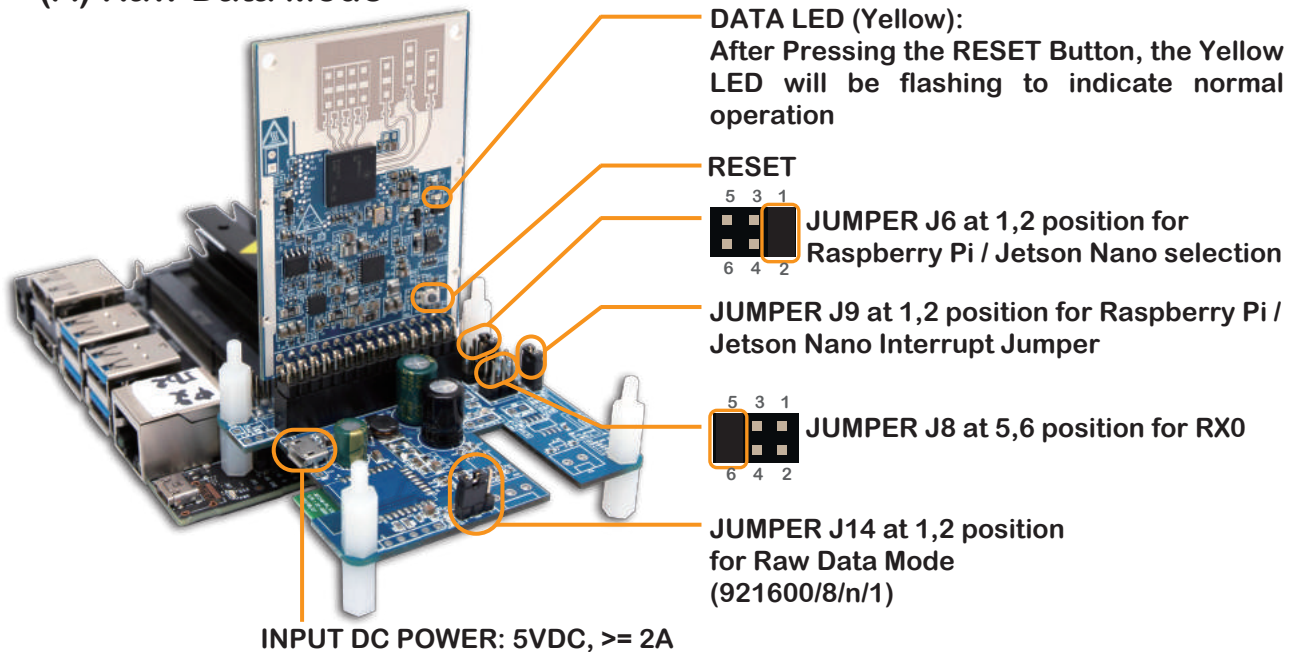
# Batman BM201-LPD mmWave EVM Kit

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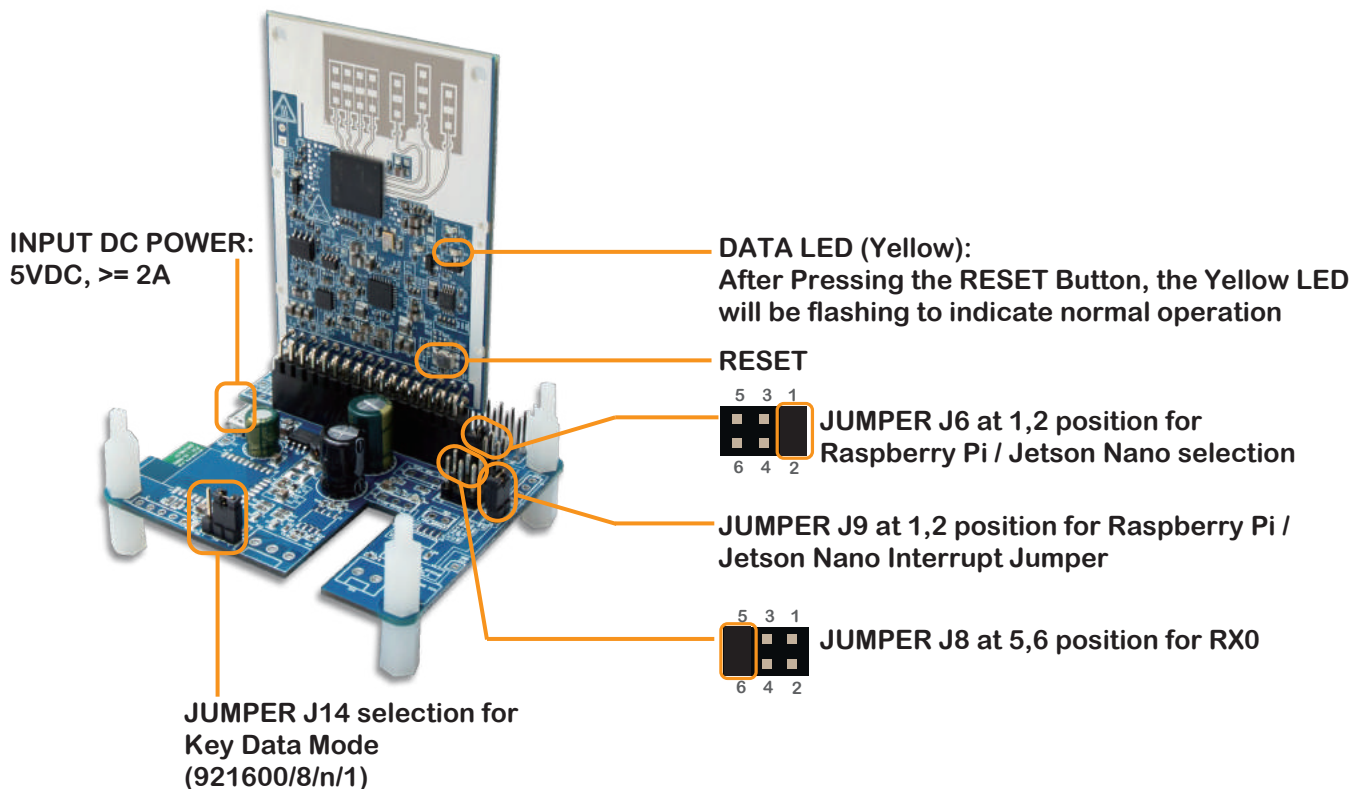
## mmWAVE SENSOR EVALUATION SOLUTION

### Selection : Key Data Mode or Raw Data Mode Application

#### (A) Raw Data Mode



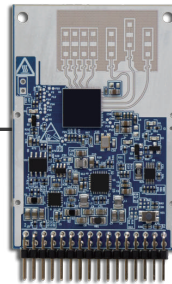
#### (B) Key Data Mode



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#### Specifications

#### mmWave Sensor Evaluation Module

|   |   |
|---|---|
| mmWave ASIC                                     | TI IWR6843 Single Chip mmWave Sensor  |
| FMCW Transceiver                                | <ul style="list-style-type: none"> <li>● Integrated PLL, Transmitter, Receiver, Baseband, and A2D</li> <li>● 60GHz to 64GHz Coverage With 4GHz Continuous Bandwidth</li> <li>● Four Receive Channels</li> <li>● Three Transmit Channels</li> <li>● Ultra-Accurate Chirp Engine Based on Fractional-N PLL</li> <li>● TX Power: 10 dBm</li> <li>● RX Noise Figure: 14 dB</li> <li>● Phase Noise at 1 MHz: -92 dBc/Hz</li> <li>● Antenna Type : ISK Antenna</li> </ul> |
| Built-in Calibration and Self-Test (Monitoring) | <ul style="list-style-type: none"> <li>● ARM® Cortex® -R4F-Based Radio Control System</li> <li>● Built-in Firmware (ROM)</li> <li>● Self-calibrating System Across Frequency and Temperature</li> </ul>   |
| DSP   | <ul style="list-style-type: none"> <li>● C674x DSP for Advanced Signal Processing</li> </ul>  |
| On-Chip Memory                                  | <ul style="list-style-type: none"> <li>● 1.75MB</li> </ul>  |
| MCU   | <ul style="list-style-type: none"> <li>● ARM R4F Microcontroller for Object Detection, and Interface Control</li> <li>● Joybien mmWave Protocol (Per configuration)</li> </ul>  |
| I/O   | <ul style="list-style-type: none"> <li>● Up to 6 ADC Channels (low sample rate monitoring)</li> <li>● Up to 2 SPI Ports</li> <li>● Up to 2 UARTs</li> <li>● I2C – GPIOs</li> </ul>  |
| Power Management                                | <ul style="list-style-type: none"> <li>● Built-in LDO Network for Enhanced PSRR</li> <li>● I/Os Support Dual Voltage 3.3 V/1.8 V</li> </ul>   |
| Clock Source                                    | 40MHz   |
| Antenna Orientation                             | 4 receive(RX) 3 transmit (TX) antenna with 108° azimuth field of view (FoV) and 44° elevation FoV   |
| Input Power                                     | 3.3VDC, 2.1A source   |
| Operating Temperature & Humidity                | 0°C ~ 40°C<br>10% ~ 85% Non-Condensing  |
| Dimensions & Weight                             | 67mm x 46mm x 2mm ; 15 grams net  |

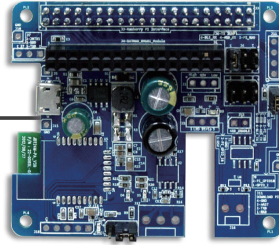


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## mmWAVE SENSOR EVALUATION SOLUTION

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Raspberry Pi-Hat Board /  
Jetson Nano carrier board



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

Python SDK



|            |  |
|------------|--|
| Python SDK | <ul style="list-style-type: none"> <li>● Available on GitHub</li> </ul> Note: Please refer to README.md file first for proper configuration <div>  <div> <h1>GitHub</h1> <p><a href="https://github.com/bigheadG/mmWave">https://github.com/bigheadG/mmWave</a></p> </div>  </div> |
|------------|--|

# Batman BM201-LPD mmWave EVM Kit

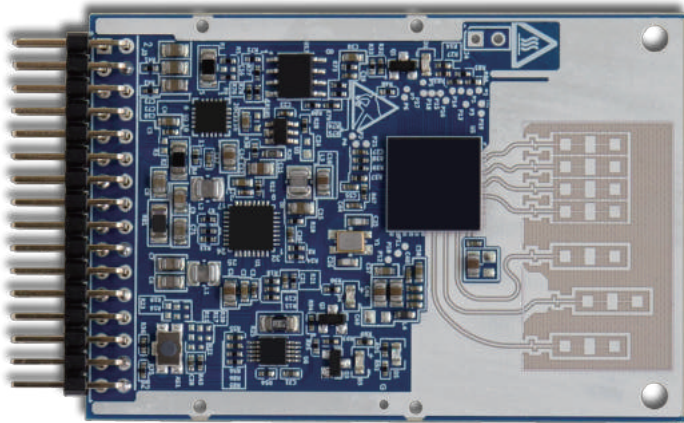
mmWAVE SENSOR EVALUATION SOLUTION

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## mmWave Pin Assignment

### J3 J3 Pin Assignment

| Pin# | Name             | Name          | Pin# |
|------|------------------|---------------|------|
| 01   | D3V3             | D3V3          | 02   |
| 03   | D3V3             | 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   | DP0              | CS1           | 16   |
| 17   | DP1              | 3V3_LS        | 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              | nERROUT       | 30   |
| 31   | WARMRST          | GPIO 2        | 32   |



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#### J3 Pin Assignment

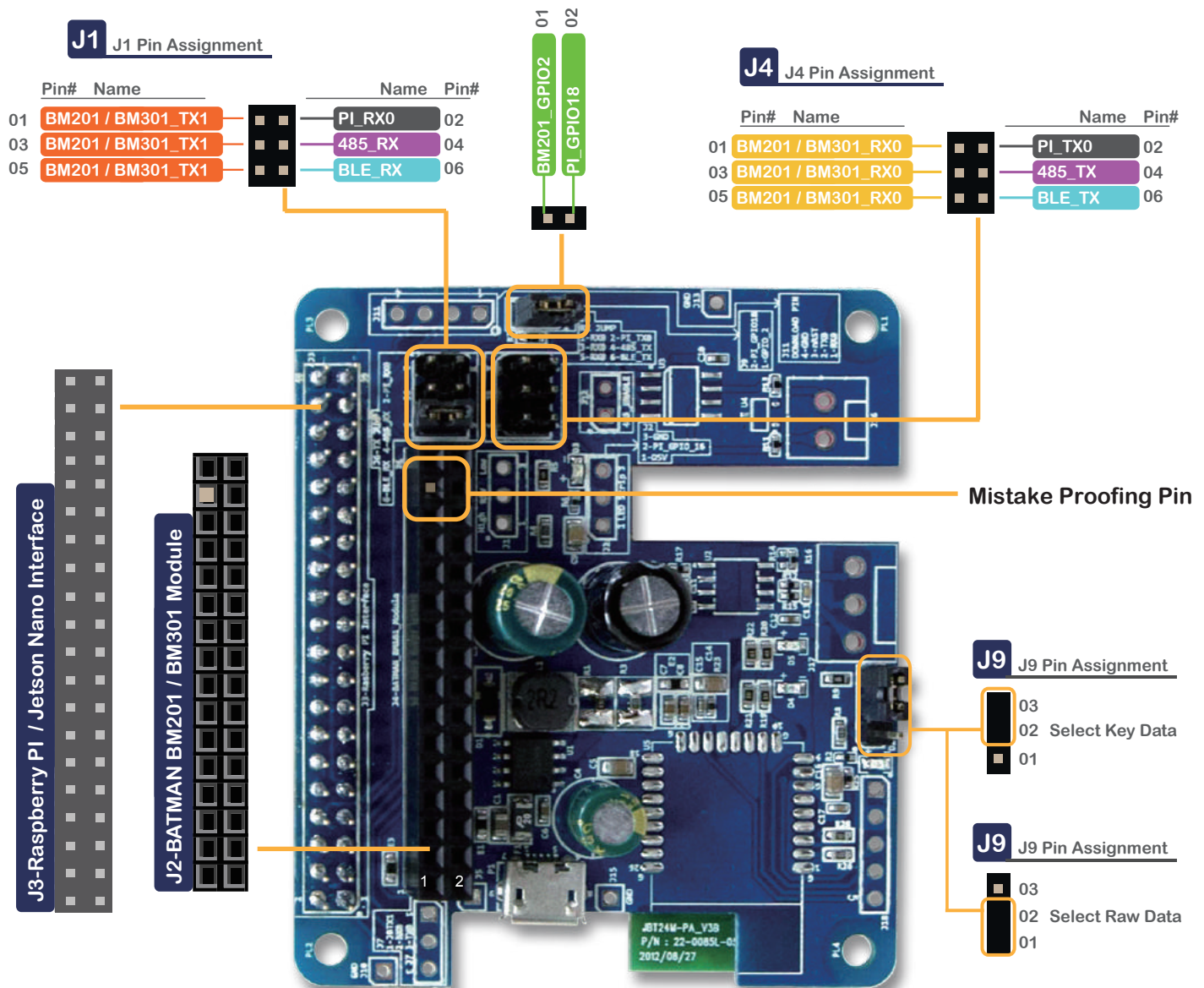
| Pin No | Name             | Pin Type | Function Description   |
|--------|------------------|----------|--|
| 01     | D3V3             | I        | POWER DC 3V3 Input   |
| 02     | D3V3             | I        | POWER DC 3V3 Input   |
| 03     | D3V3             | I        | POWER DC 3V3 Input   |
| 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           | I        | Select KeyData or RawData  |
| 13     | GND              | GROUND   | Digital ground   |
| 14     | GPIO 1           | I        | Reserved   |
| 15     | DP0              | IO       | GPIO Pin   |
| 16     | CS1              | IO       | SPI Channel A - chip Select  |
| 17     | DP1              | IO       | GPIO Pin   |
| 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   | Mistake Proofing Pin   |
| 30     | nERROUT          | 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       | Open drain fail safe warm reset signal. Can be driven from PMIC for diagnostic or can be used as status signal that the device is going through reset.   |
| 32     | GPIO2            | O        | LED Indicator  |

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## mmWave Raspberry Pi Hat Pin Assignment



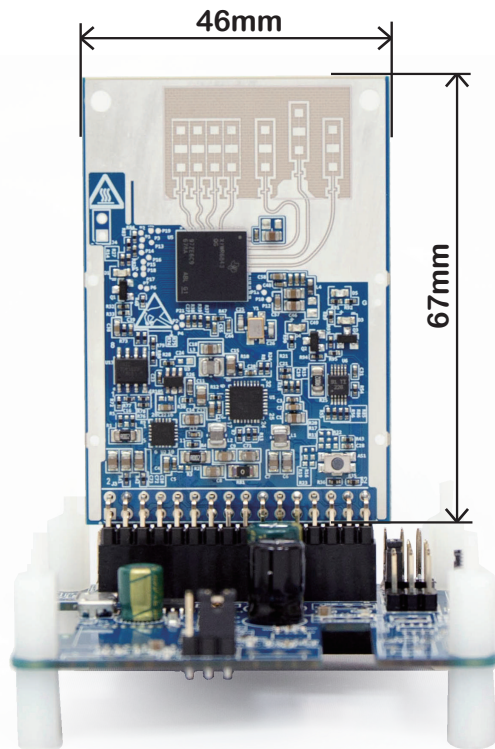


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### Product Dimensions



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This EVM Kit does not include Raspberry Pi computer, nor NVIDIA Jetson Nano computer.

Appendix: Joybien mmWave EVM Kit Application Solution Selection

|  |   |
|--|---|
|  <p>(VSD)<br/>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 &amp; Respiration Rate) of a person, a pet, or an animal.</p>  |
|  <p>(HAM)<br/>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)<br/>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)<br/>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)<br/>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)<br/>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> |