

# Batman BM201 mmWave EVM Kit

## mmWAVE SENSOR EVALUATION SOLUTION

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Joybien Batman BM201 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 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

### Specification

(BM201-LPD) Long-Range People Detection	For a contactless and wearableless Long-Range People Detection (LPD) of 1 meter ~ 50 meters (about 3 ~ 164 feet), for various applications that require people sensing or counting without privacy invasion.
(BM201-PC3) People Counting & Detection	For a wireless People Counting & Detection in 6 x 6 meter or 36 square meter area (or about 387.5 square feet), for various applications that require people sensing, people counting, or people occupancy density estimation without privacy invasion.
(BM201-TMD) Traffic Monitoring Detection	For detecting moving objects (such as vehicles) in 5m ~ 50m with FOV of approx. +/- 54 degrees with Position X&Y, Velocity X&Y info. And based on the detected data, a programmer may write a program to define virtual Zones, for mapping objects (vehicles) moving in and out of certain Zones for traffic monitoring applications.
(BM201-VSD) Vital Signs Detection	For a contactless and wearableless human Vital Signs Detection (VSD) with real-time Heartbeat Rate & Respiration Rate data, for range of 30cm ~ 90cm (about 1~3 feet); along with Status Indicator for sensing the presence of a person, as well as the measurement stability, and whether the person is present but without Vital Signs.
(BM201-HAM) High Accuracy Measurement	For a wireless High Accuracy Measurement (HAM) of an object distance with range of 30cm ~ 3 meters (about 1~10 feet), having millimeter measurement resolution.

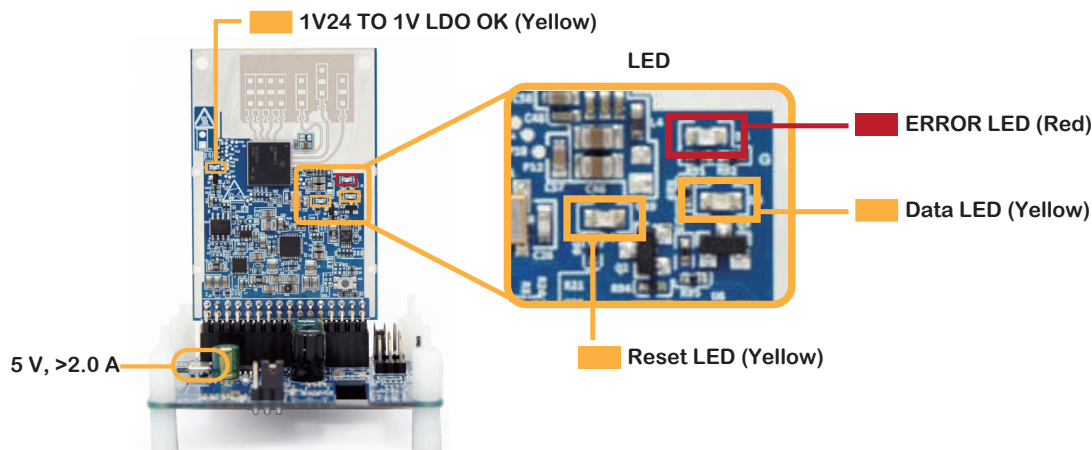
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### Packing List: mmWave Module, Raspberry Pi-Hat Board, Python SDK

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



Batman BM201 EVM Kit includes	
(VSD) Vital Signs Detection	mmWave + Raspberry Pi-Hat Board / Jetson Nano carrier board + SDK APP For VSD and HAM
(HAM) High Accuracy Measurement	mmWave + Raspberry Pi-Hat Board / Jetson Nano carrier board + Python SDK + iOS APP
(LPD) Long-Range People Detection	mmWave + Raspberry Pi-Hat Board / Jetson Nano carrier board + SDK SDK For LPD, PC3 and TMD
(PC3) People Counting & Detection	mmWave + Raspberry Pi-Hat Board / Jetson Nano carrier board + Python SDK
(TMD) Traffic Monitoring Detection	mmWave + Raspberry Pi-Hat Board / Jetson Nano carrier board + Python SDK

### 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

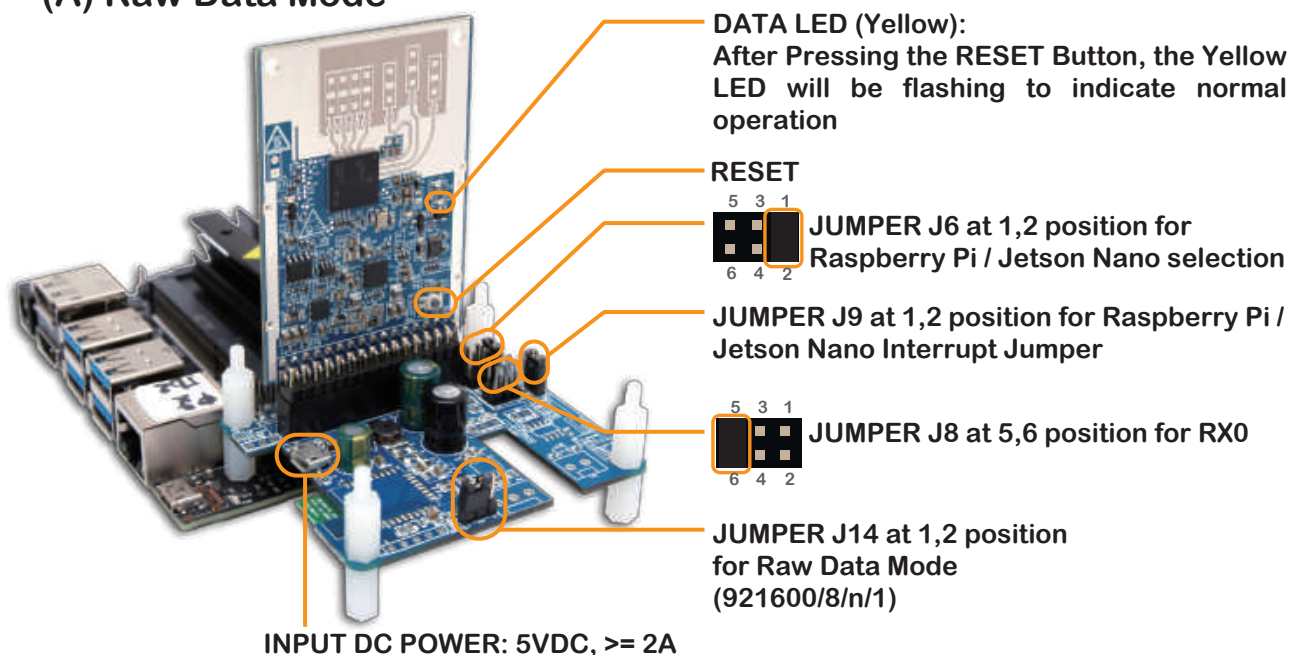
# Batman BM201 mmWave EVM Kit

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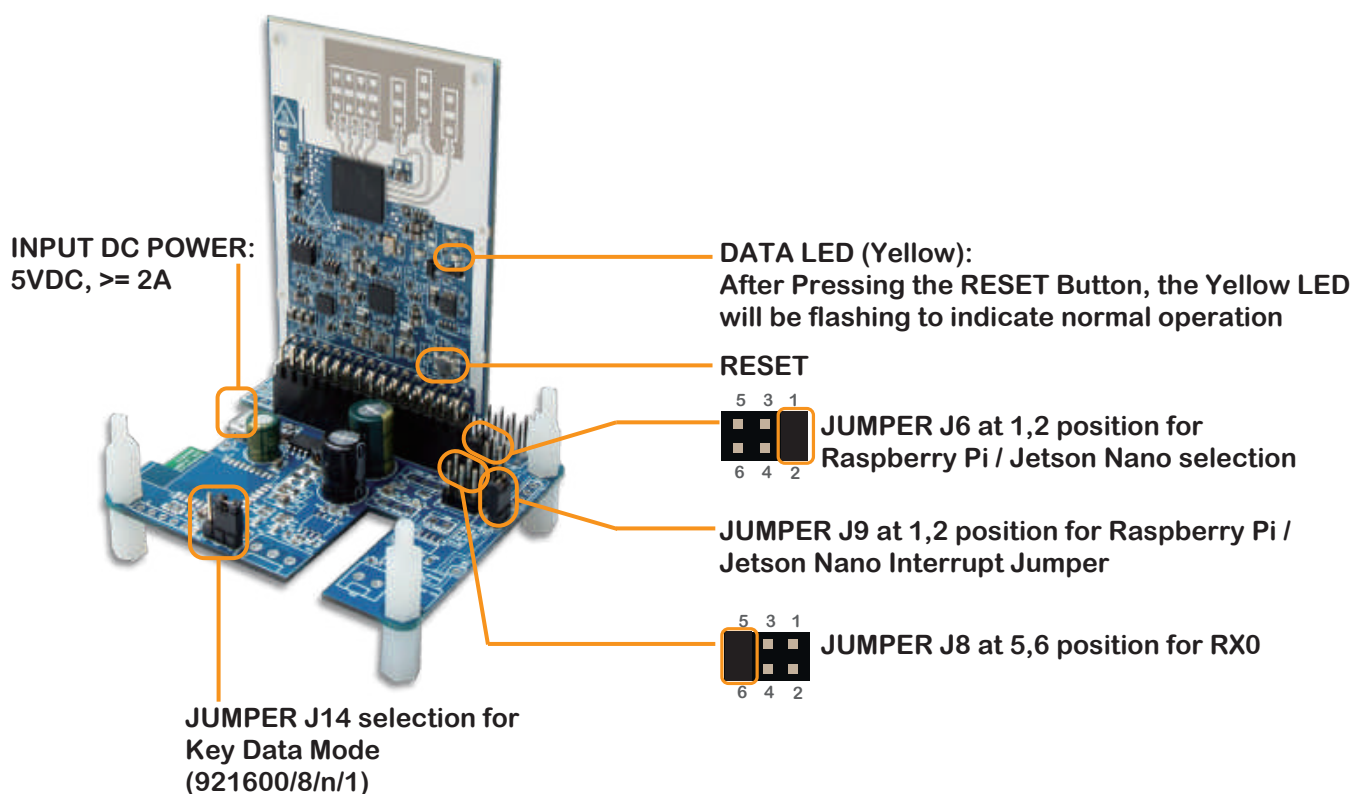
## mmWAVE SENSOR EVALUATION SOLUTION

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

#### (A) Raw Data Mode



#### (B) Key Data Mode



# Batman BM201 mmWave EVM Kit

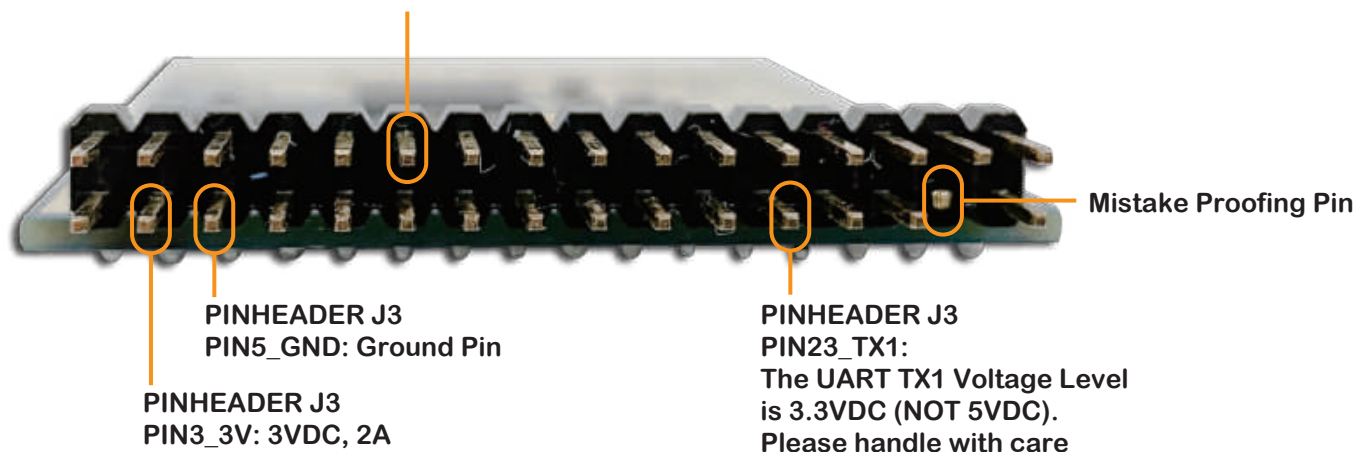
mmWAVE SENSOR EVALUATION SOLUTION

## mmWAVE SENSOR EVALUATION SOLUTION

### Batman BM201 Module J3 Pin Assignment Note

PINHEADER J3 PIN12\_GPIO\_0 High: Raw Data Baud Rate 921600/8/n/1 selection for PIN23\_TX1

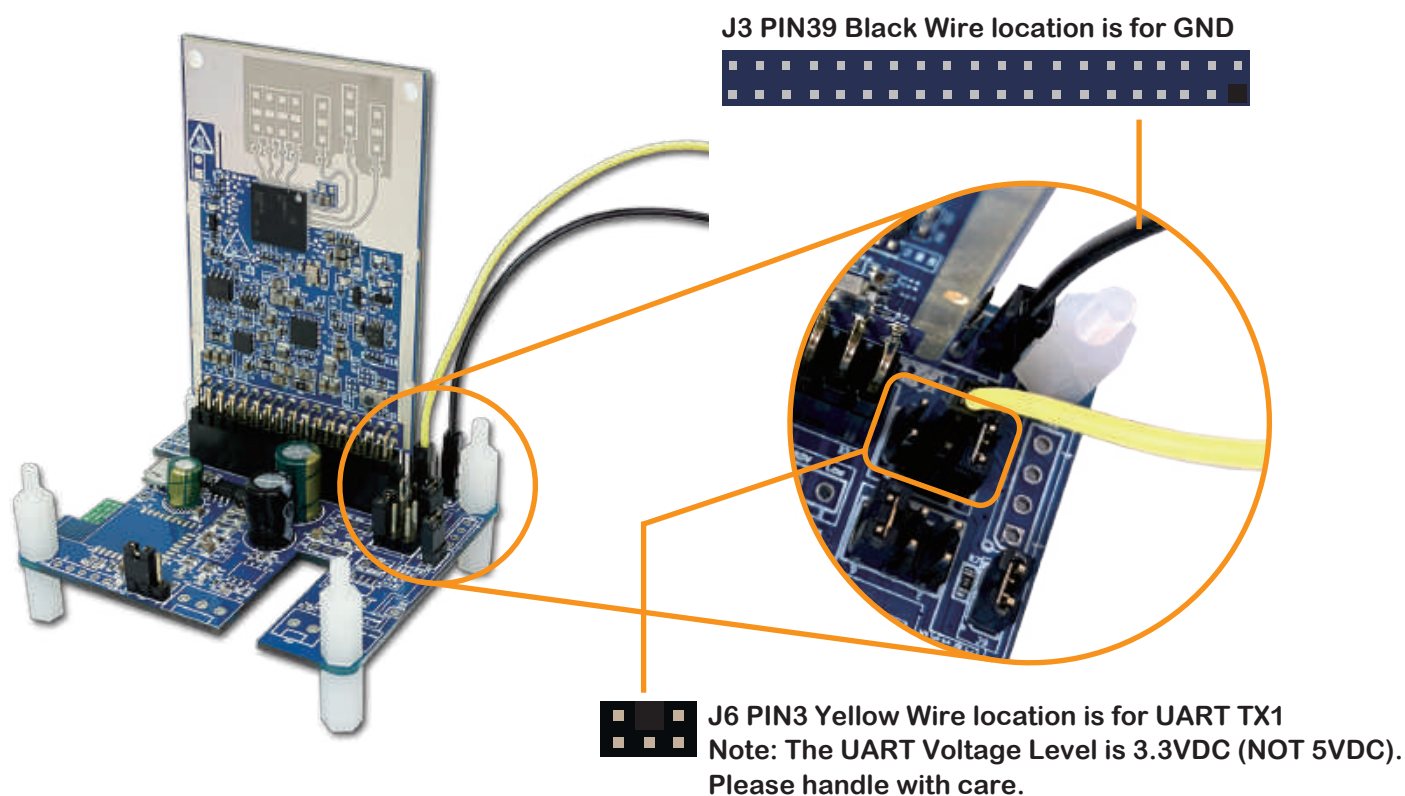
PINHEADER J3 PIN12\_GPIO\_0 Low : Key Data Baud Rate 115200/8/n/1 selection for PIN23\_TX1



Alert : All GPIO Pins base on 3.3V System. Pin23\_TX1 is DC 3.3V system.

### Batman BM201 EVM Kit + External Microprocessor

Wire connections for external microprocessor access on the HAT-Board





# Batman BM201 mmWave EVM Kit

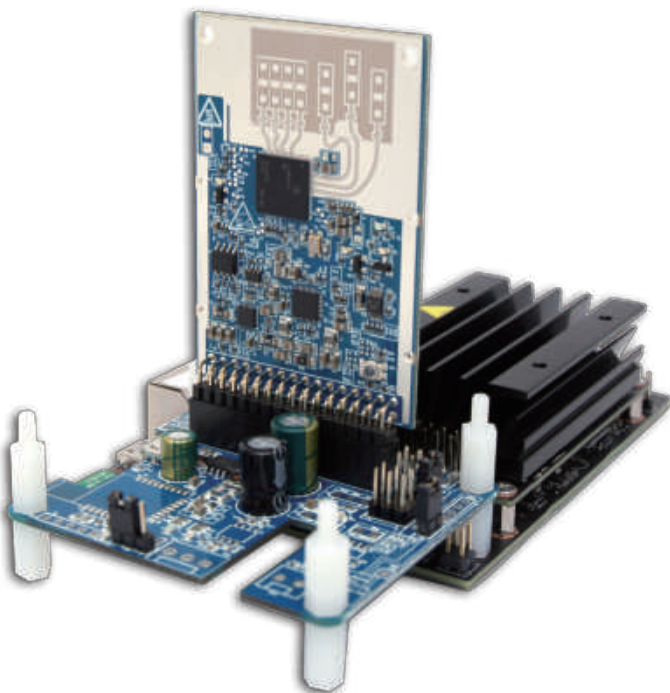
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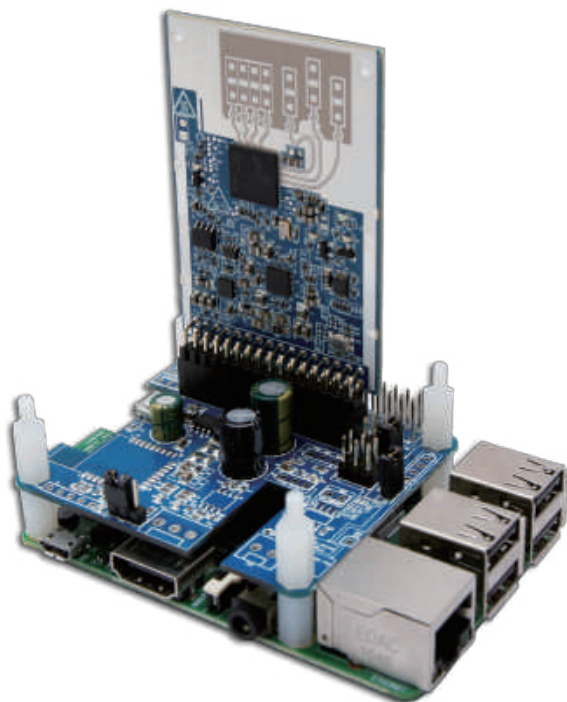
**Batman Kit + NVIDIA Jetson Nano / Batman Kit + Raspberry Pi**

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

### Batman BM201 EVM Kit + Jetson Nano



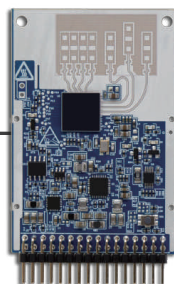
### Batman BM201 EVM Kit + Raspberry Pi



# Batman BM201 mmWave EVM Kit

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#### Specifications

#### mmWave Sensor Evaluation Module

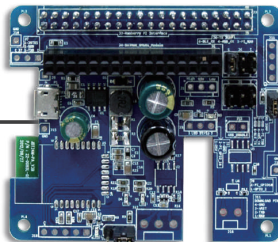
mmWave ASIC	TI IWR6843 Single Chip mmWave Sensor
FMCW Transceiver	<ul style="list-style-type: none"> <li>● Integrated PLL, Transmitter, Receiver, Baseband, and A2D</li> <li>● 60GHz to 64GHz Coverage With 4GHz Continuous Bandwidth</li> <li>● Four Receive Channels</li> <li>● Three Transmit Channels</li> <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 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> <p>(Note: Power Adapter and Micro USB Cable NOT included)</p>
Operating Temperature 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> <p>Note: Please refer to README.md file first for proper configuration</p> <div>  <div> <h1>GitHub</h1> <p><a href="https://github.com/bigheadG/mmWave">https://github.com/bigheadG/mmWave</a></p> </div>  </div>
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### iOS mmWave Demo App: VSD and HAM

**mmWaveApi**  
Free APP Download

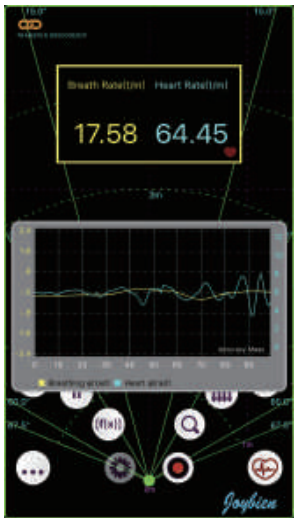
Download on the  
 **App Store**




- Available on Apple App Store for Vital Signs Detection and High Accuracy Measurement (Not including Long-Range People Detection, People Counting & Detection and Traffic Monitoring Detection)

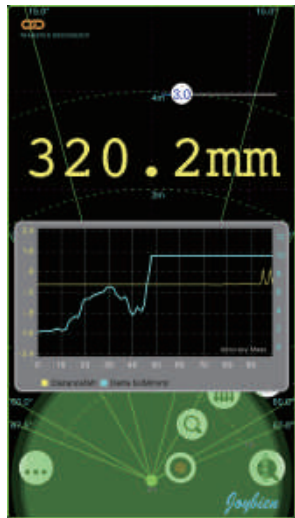


**BM201-VSD**  
Vital Signs Detection





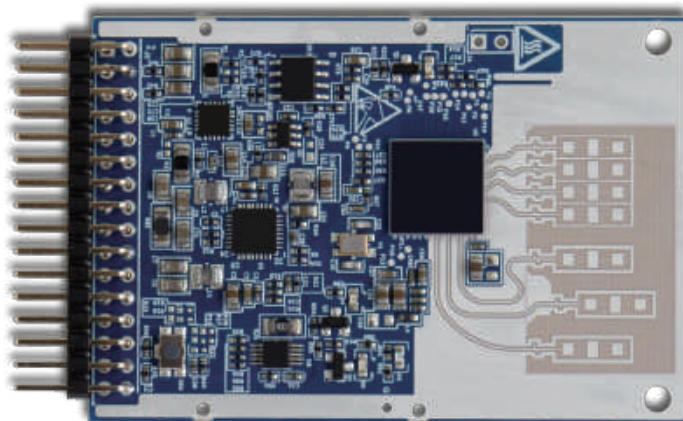
**BM201-HAM**  
High Accuracy Measurement



## 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(Mistake Proofing Pin)	nERROUT	30
31	WARMRST	GPIO 2	32





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#### J3 Pin Assignment

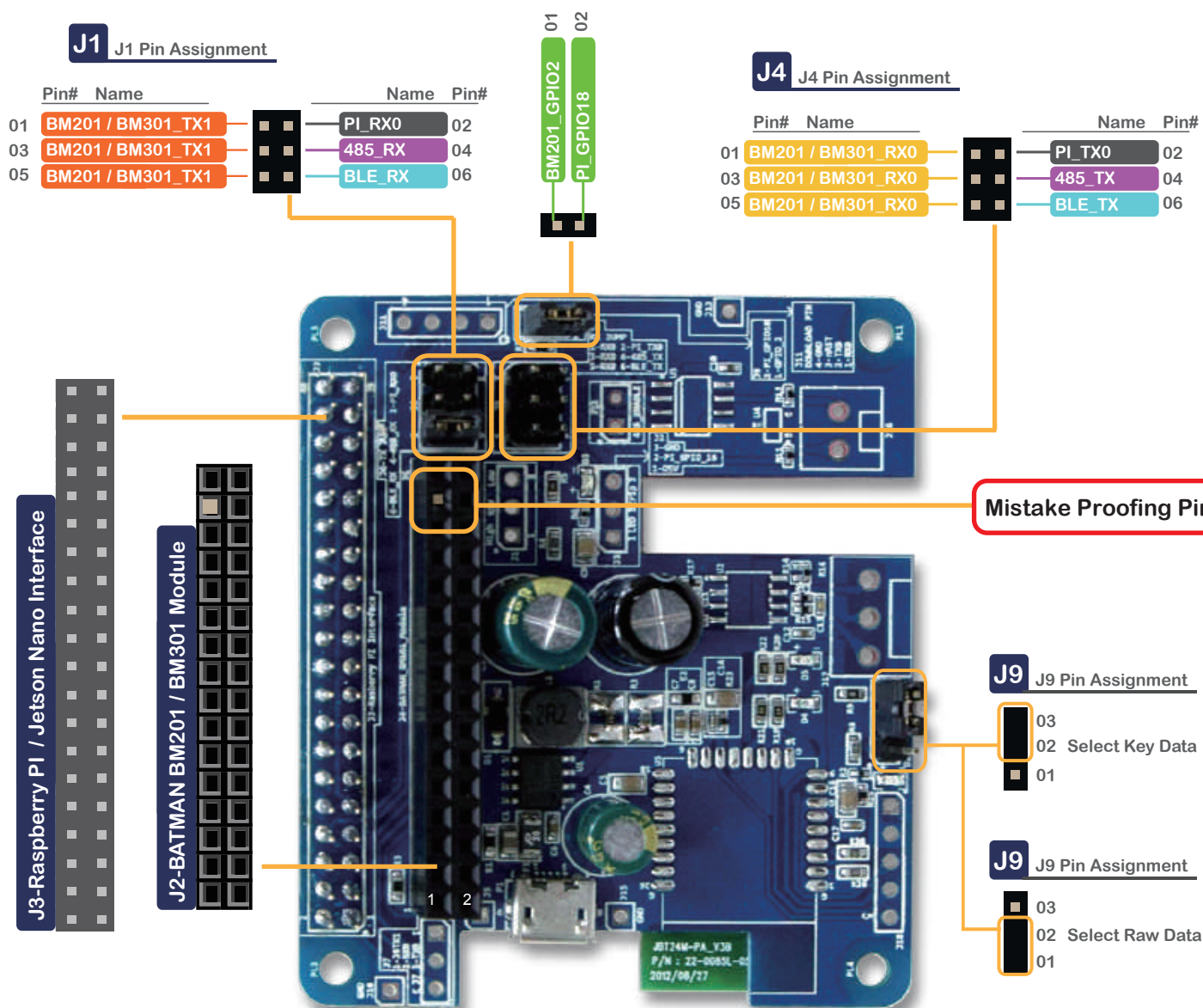
Pin No	Name	Pin Type	Function Description
01	D3V3	I	POWER DC 3V3 Input
02	D3V3	I	POWER DC 3V3 Input
03	D3V3	I	POWER DC 3V3 Input
04	SDA	IO	I2C Pin
05	GND	GROUND	Digital ground
06	SCL	IO	I2C Pin
07	RS232 RX0	I	UART A Receive
08	SYNC IN JBRX1	I	Low frequency Synchronization signal input, UART B Receive
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 critacatlly 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

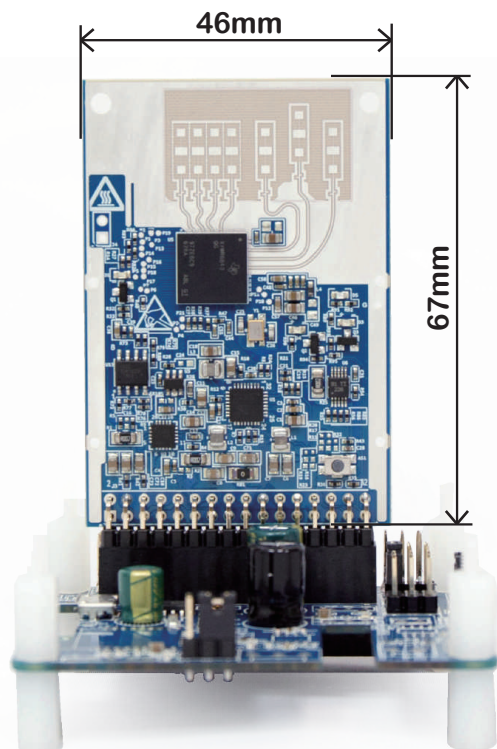


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### Product Dimensions



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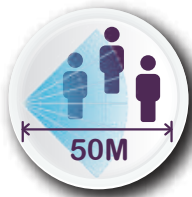
"Python" is a registered trademark of the PSF.

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

## Appendix : Joybien mmWave EVM Kit Application Solution Selection

 <p><b>(BM101-VSD)</b> Vital Signs Detection</p>	For a contactless and wearableless human Vital Signs Detection (VSD) with real-time Heartbeat Rate & Respiration Rate data, for range of 30cm ~ 90cm (about 1~3 feet); along with Status Indicator for sensing the presence of a person, as well as the measurement stability, and whether the person is present but without Vital Signs.
 <p><b>(BM101-HAM)</b> High Accuracy Measurement</p>	For a wireless High Accuracy Measurement (HAM) of an object distance with range of 30cm ~ 3 meters (about 1~10 feet), having millimeter measurement resolution.
 <p><b>(BM101-PMB)</b> People Movement Behavior</p>	For a wireless People Movement Behavior (PMB) detection in 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><b>(BM101-SRR)</b> Short Range Radar</p>	For Short Range Radar (SRR) detection of human in 1 meter ~ 20 meters (about 3 ~ 66 feet), or detection of vehicle in 1 meter ~ 50 meters (about 3 ~ 164 feet), along 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><b>(BM101-ZOD)</b> Zone Occupancy Detection</p>	For plotting a Range-Azimuth-Heatmap with a 64 x48 Grid Matrix covering: Range of 3meter/64row (approx. 0.047meter per row) x Azimuth of 120degree/48column (approx. 2.5degree/column). Subsequently a programmer may write a program to group the Grid(s) into Zone(s) for detecting whether the particular Zone(s) is occupied by Target(s).





**(BM201-LPD)**  
Long-Range People Detection

For a contactless and wearableless Long-Range People Detection (LPD) of 1 meter ~ 50 meters (about 3 ~ 164 feet), for various applications that require people sensing or counting without privacy invasion.



**(BM201-PC3)**  
People Counting & Detection

For a wireless People Counting & Detection in 6 x 6 meter or 36 square meter area (or about 387.5 square feet), for various applications that require people sensing, people counting, or people occupancy density estimation without privacy invasion.



**(BM201-TMD)**  
Traffic Monitoring Detection

For detecting moving objects (such as vehicles) in 5m ~ 50m with FOV of approx. +/- 54 degrees with Position X&Y, Velocity X&Y info. And based on the detected data, a programmer may write a program to define virtual Zones, for mapping objects (vehicles) moving in and out of certain Zones for traffic monitoring applications.



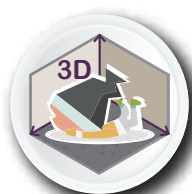
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Vital Signs Detection

For a contactless and wearableless human Vital Signs Detection (VSD) with real-time Heartbeat Rate & Respiration Rate data, for range of 30cm ~ 90cm (about 1~3 feet); along with Status Indicator for sensing the presence of a person, as well as the measurement stability, and whether the person is present but without Vital Signs.



**(BM201-HAM)**  
High Accuracy Measurement

For a wireless High Accuracy Measurement (HAM) of an object distance with range of 30cm ~ 3 meters (about 1~10 feet), having millimeter measurement resolution.



**(BM301-FDS)**  
Fall Detection Sensing

For the wireless detection of People in 3-Dimensional movement from -3 meter ~ +3 meter on one direction, and -3 meter ~ + 3 meter 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