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**

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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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-UPD) Ultra-Long-Range People Detection	For a contactless and wearables Ultra-Long-Range People Detection (UPD) of 1m ~ 100m (about 3 ~ 328 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-VOD) Vehicle Occupancy Detection	For plotting a Range-Azimuth-Heatmap with a 64 x 48 Grid Matrix covering: Range of 3 meter / 64 row (approx. 0.047 meter per row) x Azimuth of 108 degree / 48 column (approx. 2.3 degree /column). Subsequently a programmer may write code to group the Grid(s) into Zone(s) for detecting whether the particular Zone(s) is occupied by Target(s); suitable for vehicle occupancy detection or for occupancy detection for an area of around 3 meter x 3 meter.
(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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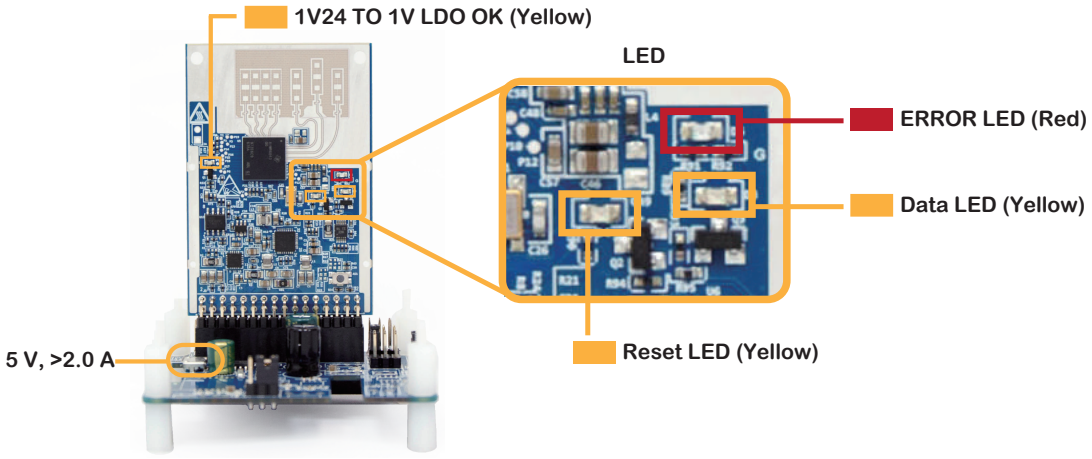
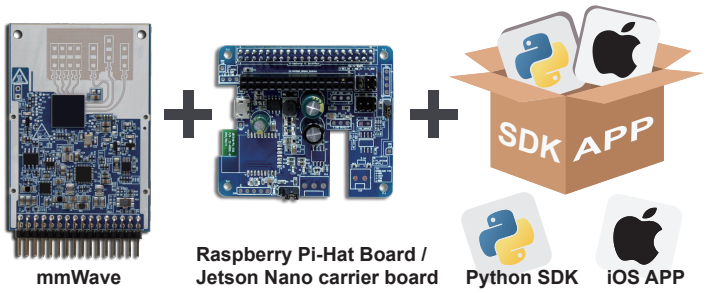
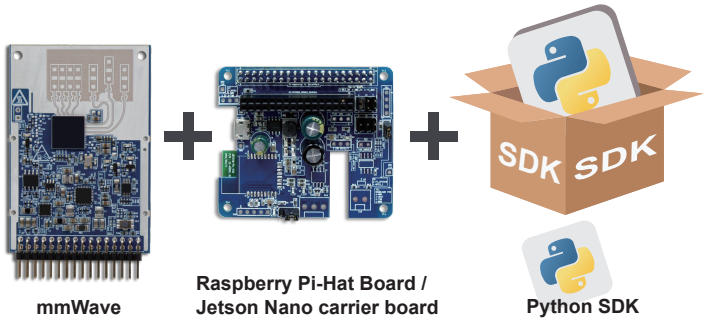
Packing List: mmWave Module, Raspberry Pi-Hat Board, Python SDK

- 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	
(BM201-VSD) Vital Signs Detection	For VSD and HAM 
(BM201-HAM) High Accuracy Measurement	
(BM201-LPD) Long-Range People Detection	For LPD,UPD,PC3,VOD and TMD 
(BM201-UPD) Ultra-Long-Range People Detection	
(BM201-PC3) People Counting & Detection	
(BM201-VOD) Vehicle Occupancy Detection	
(BM201-TMD) Traffic Monitoring Detection	

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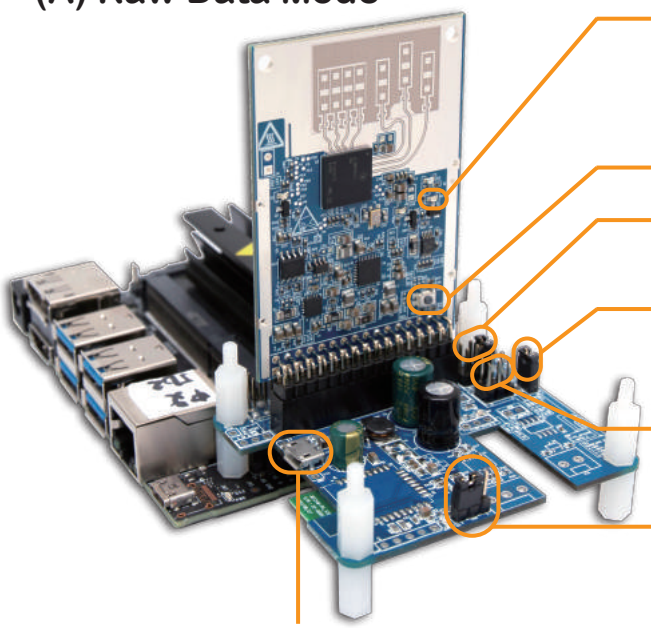
Selection：Key Data Mode or Raw Data Mode Application

(A) Raw Data Mode



DATA LED (Yellow):
After Pressing the RESET Button, the Yellow LED will be flashing to indicate normal operation

RESET

JUMPER J6 at 1,2 position for Raspberry Pi / Jetson Nano selection

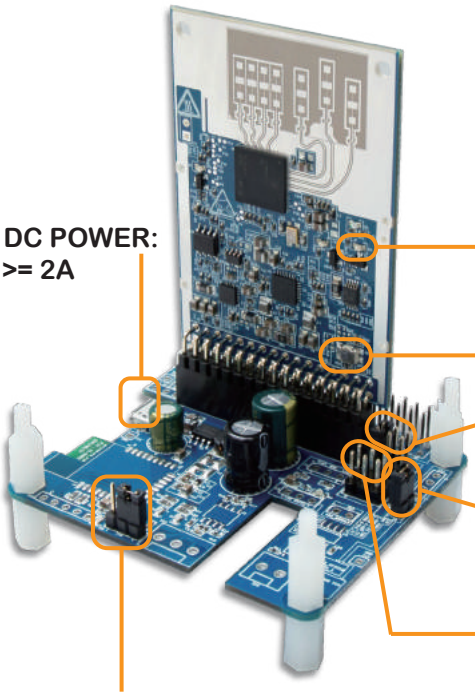
JUMPER J9 at 1,2 position for Raspberry Pi / Jetson Nano Interrupt Jumper

JUMPER J8 at 5,6 position for RX0

JUMPER J14 at 1,2 position for Raw Data Mode (921600/8/n/1)

INPUT DC POWER: 5VDC, >= 2A

(B) Key Data Mode



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5VDC, >= 2A

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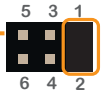
RESET



JUMPER J6 at 1,2 position for Raspberry Pi / Jetson Nano selection

JUMPER J9 at 1,2 position for Raspberry Pi / Jetson Nano Interrupt Jumper

JUMPER J8 at 5,6 position for RX0

JUMPER J14 selection for Key Data Mode (921600/8/n/1)

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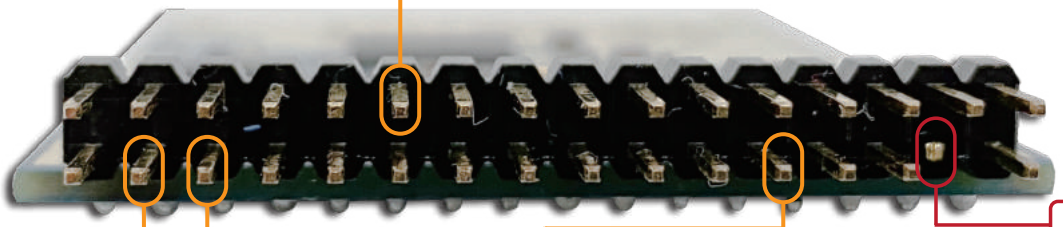
Batman BM201 Module J3 Pin Assignment Note

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



PINHEADER J3
PIN5_GND: Ground Pin

PINHEADER J3
PIN3_3V: 3VDC, 2A

PINHEADER J3
PIN23_TX1:
The UART TX1 Voltage Level is 3.3VDC (NOT 5VDC).
Please handle with care

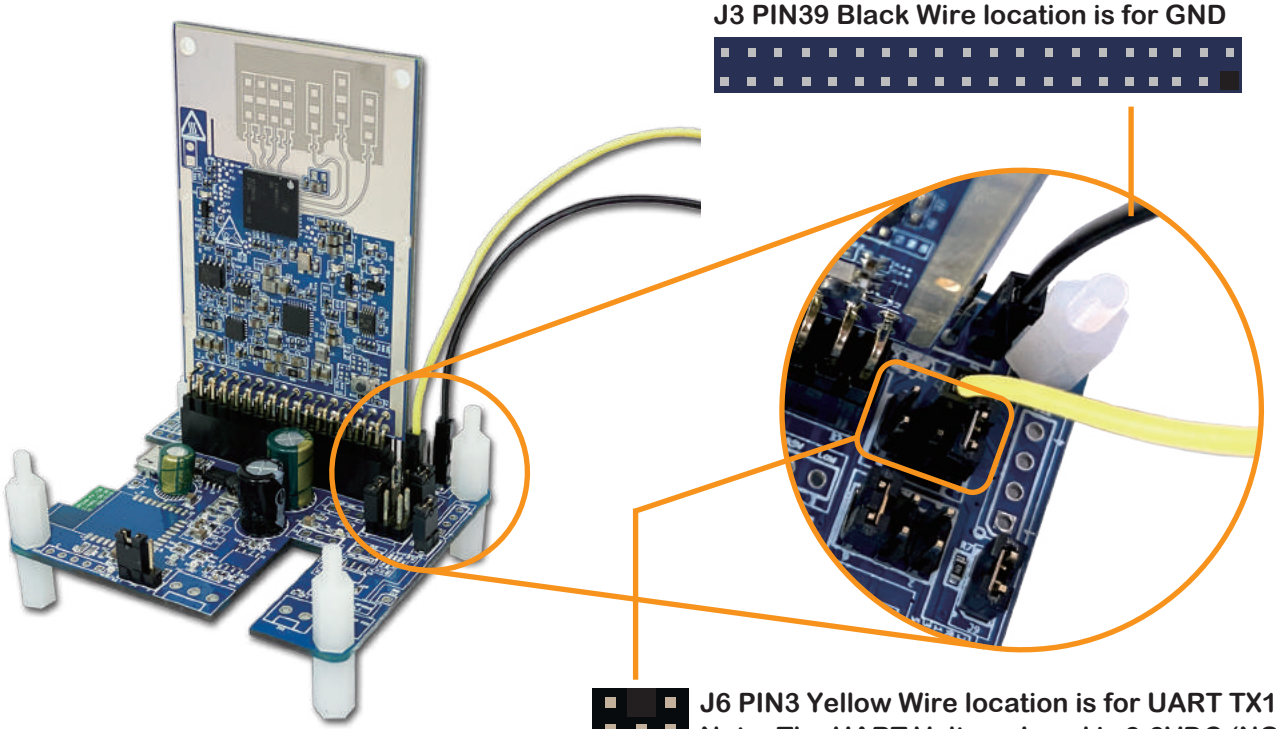
Mistake Proofing Pin

This is NOT a broken pin. It is a “Mistake Proofing Pin”, purposely cut-off; so to avoid a user to install the Module on top of the HAT-Board backward (also see the corresponding pin-hole location on the Female Connector on the HAT-Board with the pin-hole blocked).

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



J3 PIN39 Black Wire location is for GND

J6 PIN3 Yellow Wire location is for UART TX1
Note: The UART Voltage Level is 3.3VDC (NOT 5VDC).
Please handle with care.

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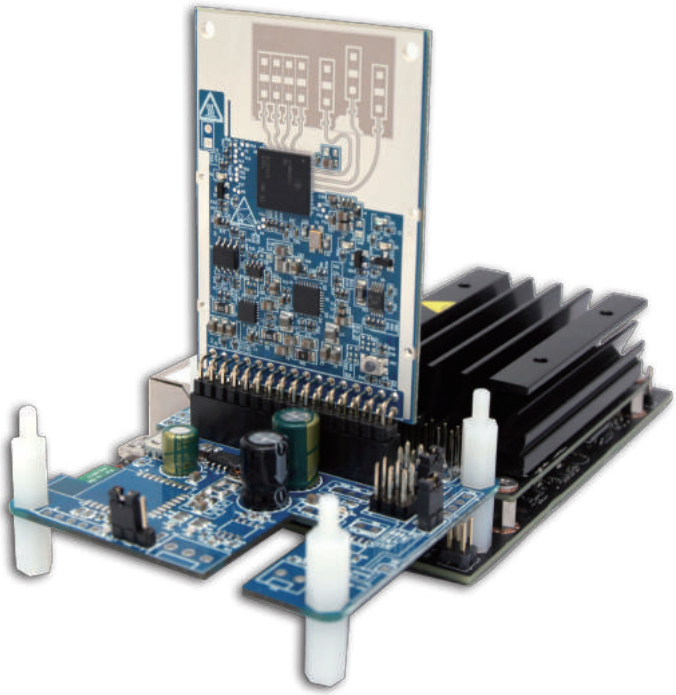
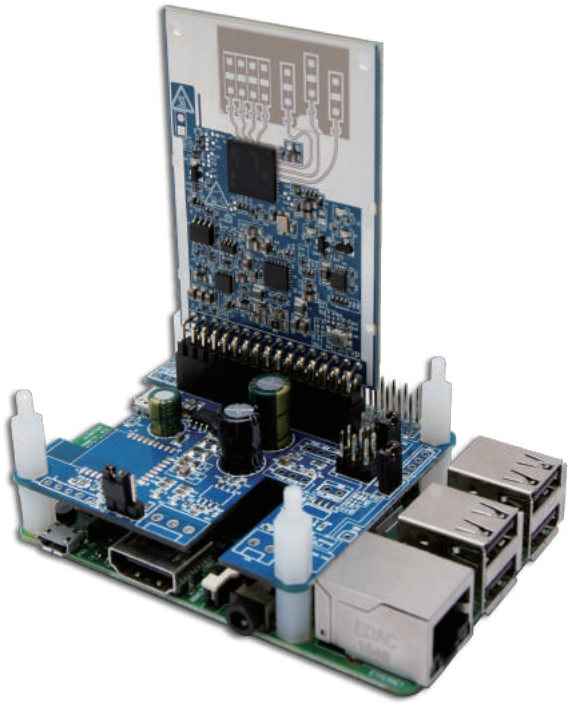
Batman Kit + NVIDIA Jetson Nano / Batman Kit + Raspberry Pi

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

Batman BM201 EVM Kit + Jetson Nano



Batman BM201 EVM Kit + Raspberry Pi



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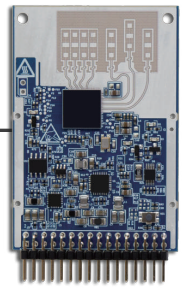
Specifications

mmWave Sensor Evaluation Module



mmWave ASIC	TI IWR6843 Single Chip mmWave Sensor
FMCW Transceiver	● Integrated PLL, Transmitter, Receiver, Baseband, and A2D ● 60GHz to 64GHz Coverage With 4GHz Continuous Bandwidth ● Four Receive Channels ● Three Transmit Channels ● Ultra-Accurate Chirp Engine Based on Fractional-N PLL ● TX Power: 10 dBm ● RX Noise Figure: 14 dB ● Phase Noise at 1 MHz: –92 dBc/Hz ● Antenna Type : ISK Antenna
Built-in Calibration and Self-Test (Monitoring)	● ARM® Cortex® -R4F-Based Radio Control System ● Built-in Firmware (ROM) ● Self-calibrating System Across Frequency and Temperature
DSP	● C674x DSP for Advanced Signal Processing
On-Chip Memory	● 1.75MB
MCU	● ARM R4F Microcontroller for Object Detection, and Interface Control ● Joybien mmWave Protocol (Per configuration)
I/O	● Up to 6 ADC Channels (low sample rate monitoring) ● Up to 2 SPI Ports ● Up to 2 UARTs ● I2C – GPIOs
Power Management	● Built-in LDO Network for Enhanced PSRR ● I/Os Support Dual Voltage 3.3 V/1.8 V
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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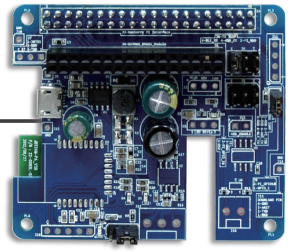
Raspberry Pi-Hat Board / Jetson Nano carrier board



Connector	● 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)	● Joybien JBT24M Bluetooth Low Energy Module
Micro USB Input Power	● 5VDC, 2Amp. (Note: Power Adapter and Micro USB Cable NOT included)
Operating Temperature Operating Humidity	● 0° to 40° degree Celsius ● 10 ~ 85% Non-Condensing
Dimensions & Weight	● 65.3mm x 56.3mm 30 grams with JBT24M Bluetooth

Python SDK

Python SDK	● Available on GitHub Note: Please refer to README.md file first for proper configuration GitHub https://github.com/bigheadG/mmWave

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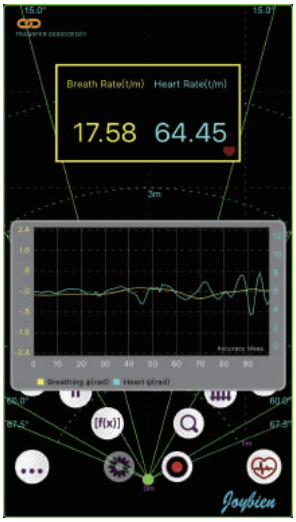
iOS mmWave Demo App: VSD and HAM

mmWaveApi
Free APP Download

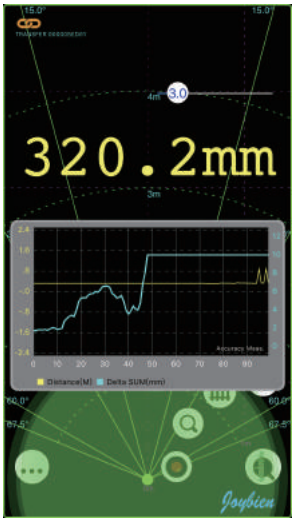
Download on the App Store

- 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



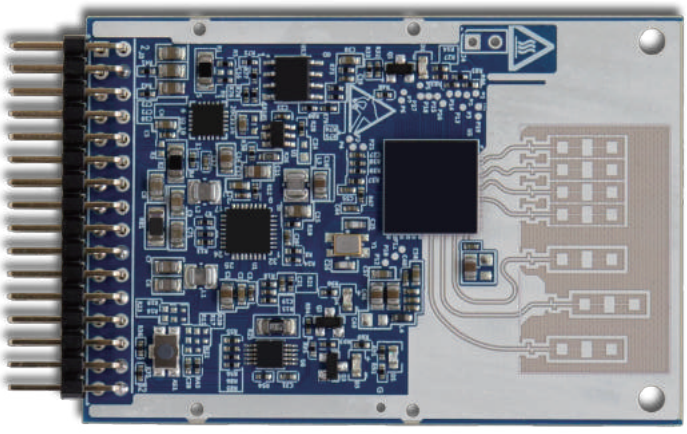
BM201-HAM
High Accuracy Measurement



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 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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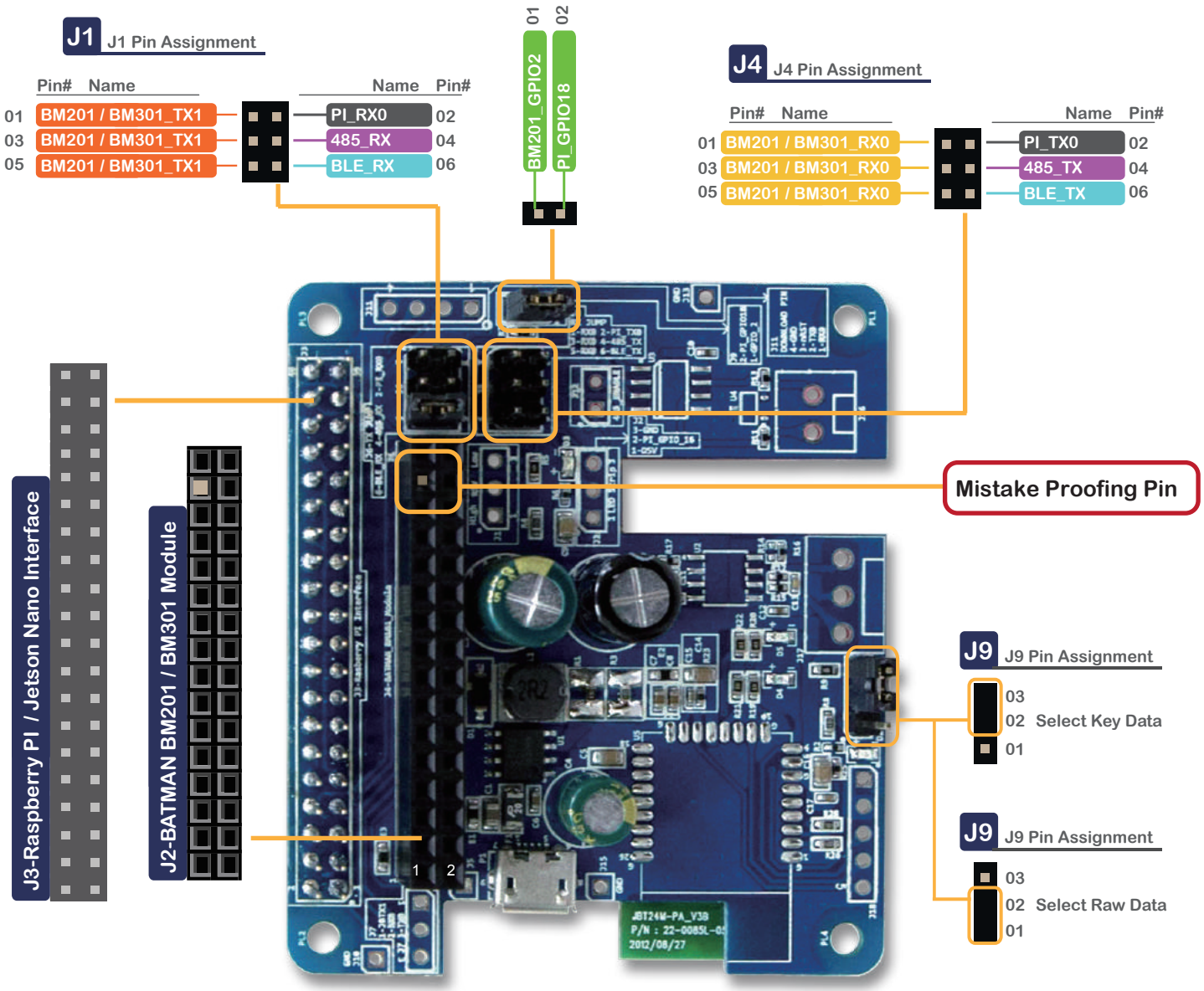
mmWave Raspberry Pi Hat Pin Assignment



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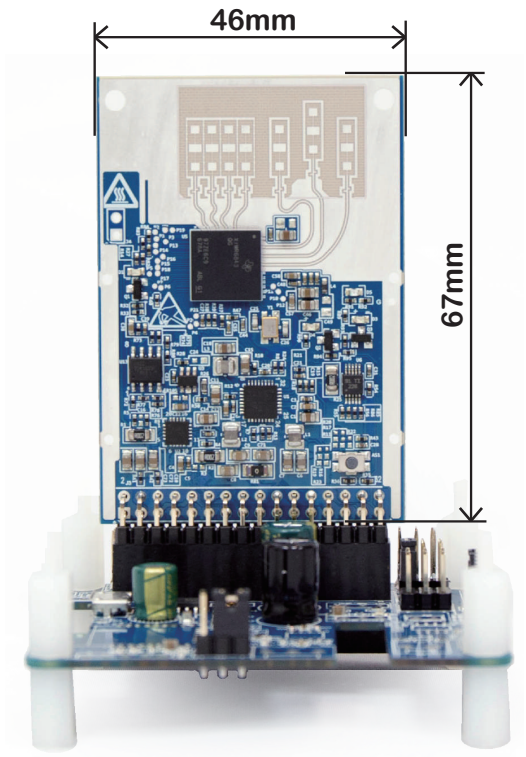
Product Dimensions



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"Python" is a registered trademark of the PSF.
This EVM Kit does not include Raspberry Pi computer, nor NVIDIA Jetson Nano computer.

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Appendix : Joybien mmWave EVM Kit Application Solution Selection

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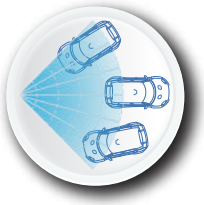 (BM201-TMD) Traffic Monitoring Detection	For detecting moving objects (such as vehicles) in 5m ~ 50m with FOV of approx. +/- 54 degrees with Position X&Y, Velocity X&Y info. And based on the detected data, a programmer may write a program to define virtual Zones, for mapping objects (vehicles) moving in and out of certain Zones for traffic monitoring applications.
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