Batman BM101 mmWave EVM kit

mmWAVE SENSOR EVALUATION SOLUTION

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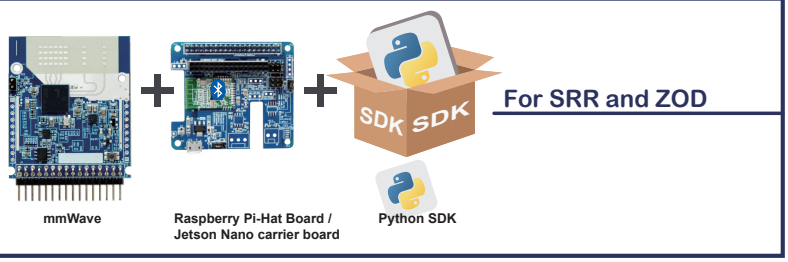
Joybien Batman BM101 mmWave EVM kit is a compact, low power, high accuracy, and simple-to-use Millimeter-Wave (mmWave) Sensor Hardware & Software integrated evaluation kit suitable for various applications including: Education, Engineering, Science, Automotive, Industrial, Medical, and Business & Consumer 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	
(HAM) High Accuracy Measurement	
(PMB) People Movement Behavior	
(SRR) Short Range Radar	
(ZOD) Zone Occupancy Detection	

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

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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.
(ZOD) Zone Occupancy Detection	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).

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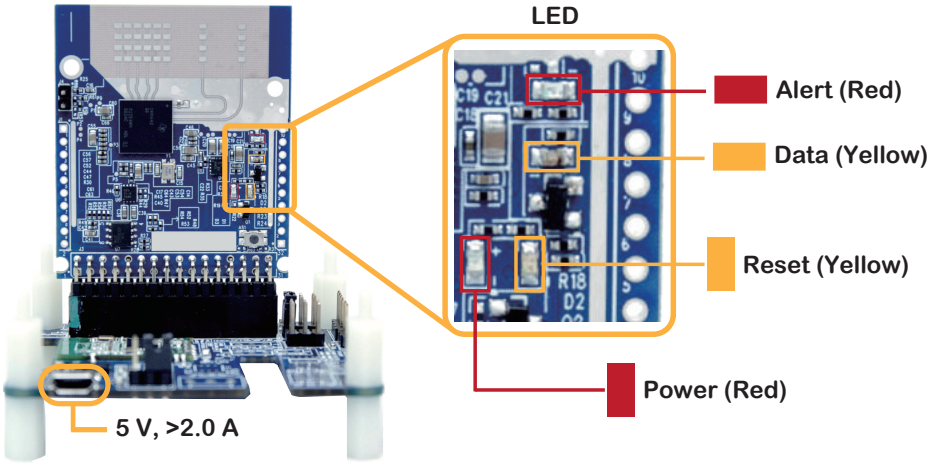
- Make sure you are using the correct power supply of 5 V, >2.0 A with a Micro USB



Develope SDK: Python SDK

(VSD) Vital Signs Detection
(HAM) High Accuracy Measurement
(PMB) People Movement Behavior
(SRR) Short Range Radar
(ZOD) Zone Occupancy Detection

- Available on GitHub

  Note: Please refer to README.md file first for proper configuration

GitHub

https://github.com/bigheadG/mmWave

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APP Demos: VSD, HAM and PMB

iOS mmWave Demo App

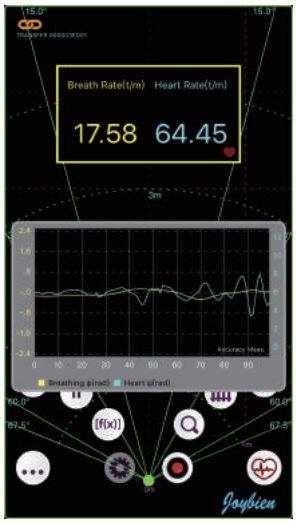
- Available on Apple App Store for Vital Signs Detection, High Accuracy Measurement and People Movement Behavior.
  (Not including Short Range Radar and Zone Occupancy Detection)

mmWaveApi

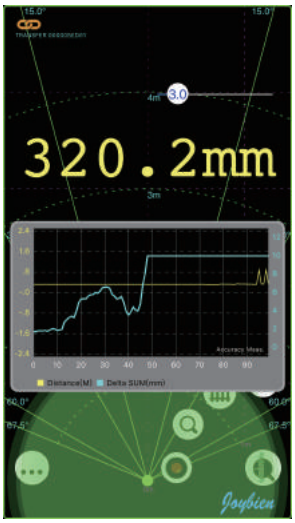
Free APP Download

Download on the App Store

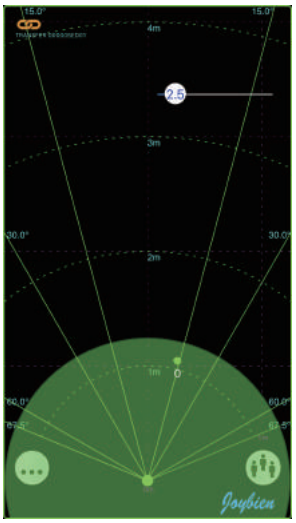
Vital Signs Detection (VSD)



High Accuracy Measurement (HAM)



People Movement Behavior (PMB)



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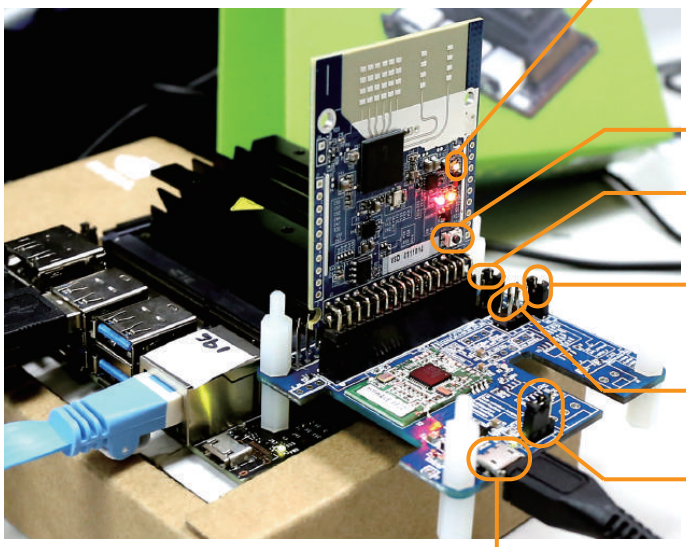
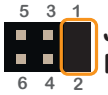
Selection：Key Data Mode or Raw Data Mode Application

(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

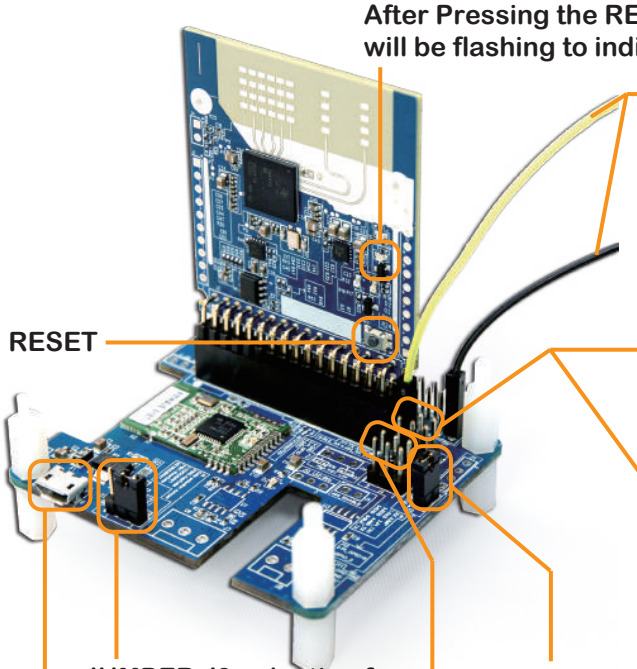
JUMPER J9 at 1,2 position for Raw Data Mode (921600/8/n/1)

INPUT DC POWER: 5VDC, >= 2A

(B) Key Data Mode

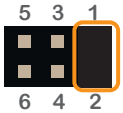
This is for Bluetooth Data Transfer usage, NOT USED if using Raspberry Pi 4 / NVIDIA Jetson Nano / External Microprocessor

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

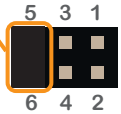


Wire connections for external microprocessor access on the HAT-Board, and where:
J1 PIN3 Yellow Wire location is for UART TX1 at 115200/8/n/1;
J3 PIN39 Black Wire location is for GND
Note: The UART Voltage Level is 3.3VDC (NOT 5VDC). Please handle with care.

RESET



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

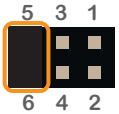


JUMPER J1 at 5,6 position for Bluetooth selection
Vital Signs Detection,
High Accuracy Measurement and
People Movement Behavior.
(Not including Short Range Radar)

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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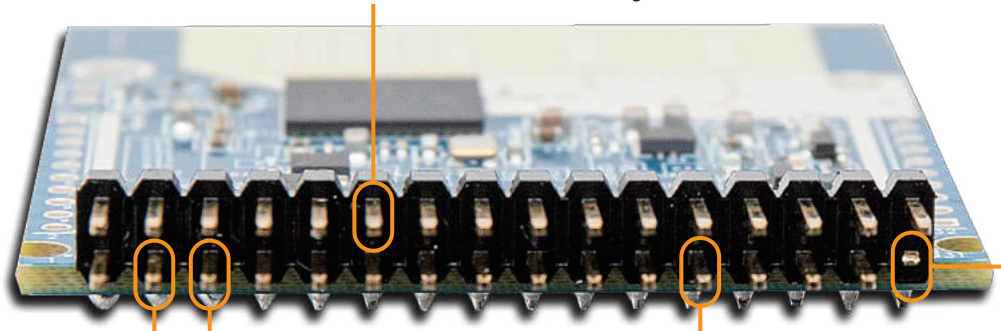
Batman BM101 Module J3 Pin Assignment Note

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



Mistake Proofing Pin

PINHEADER J3
PIN5_GND: Ground Pin

PINHEADER J3
PIN3_5V: 5VDC, 2A

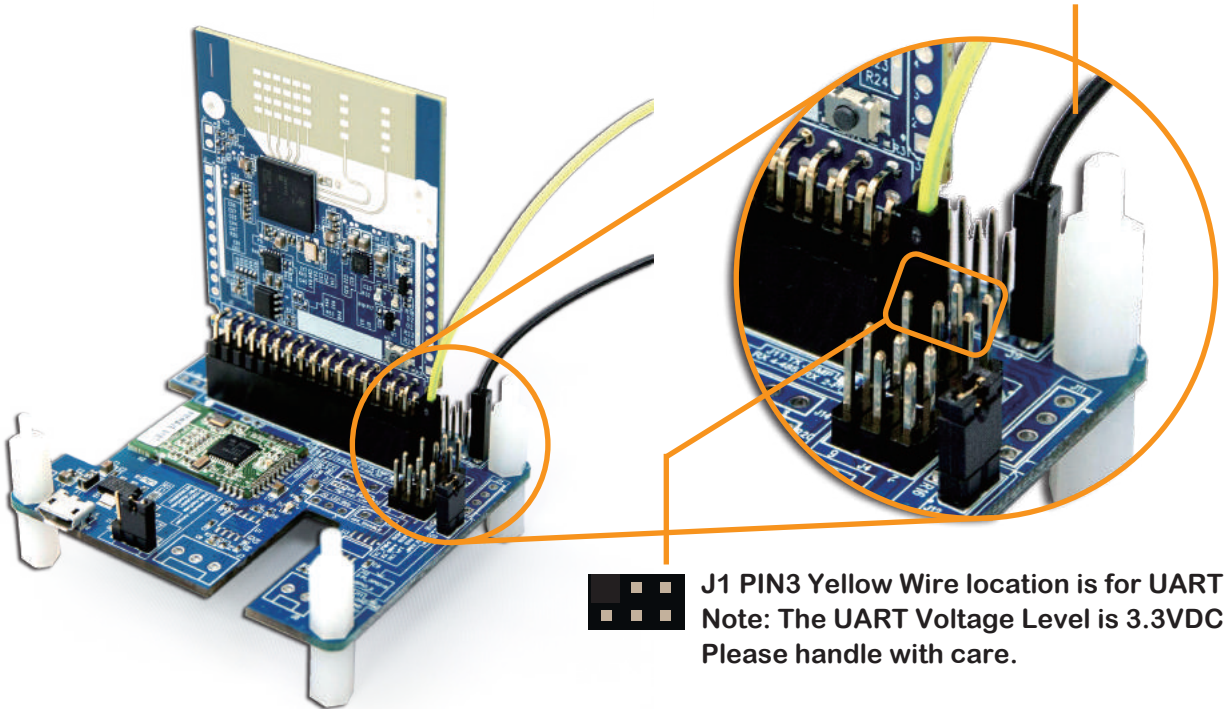
PINHEADER J3
PIN23_TX1:
The UART TX1 Voltage Level
is 3.3VDC (NOT 5VDC).
Please handle with care

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

J3 PIN39 Black Wire location is for GND



J1 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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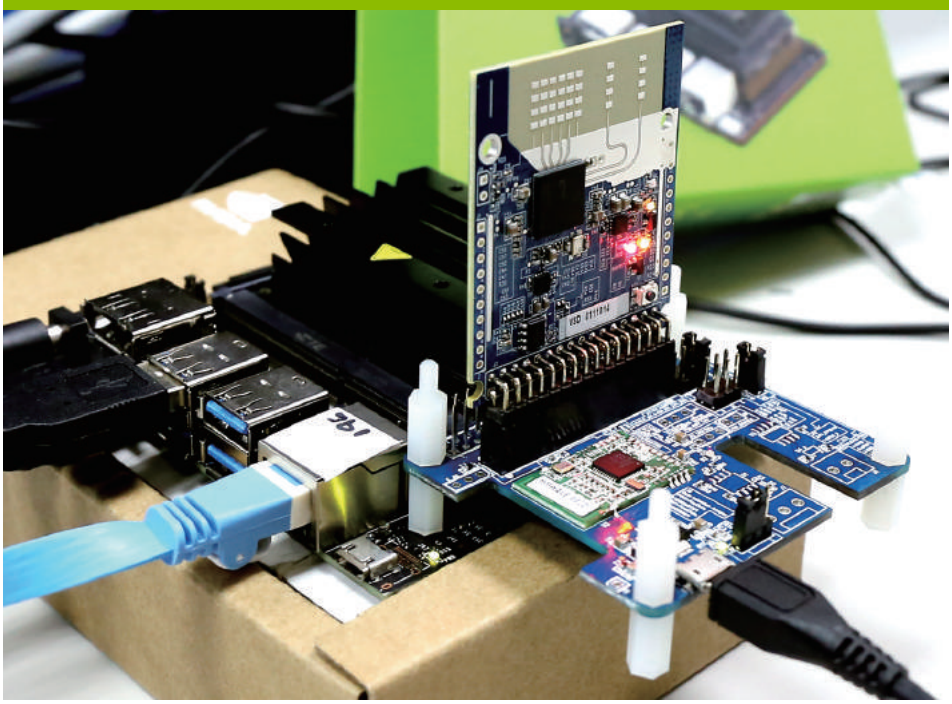
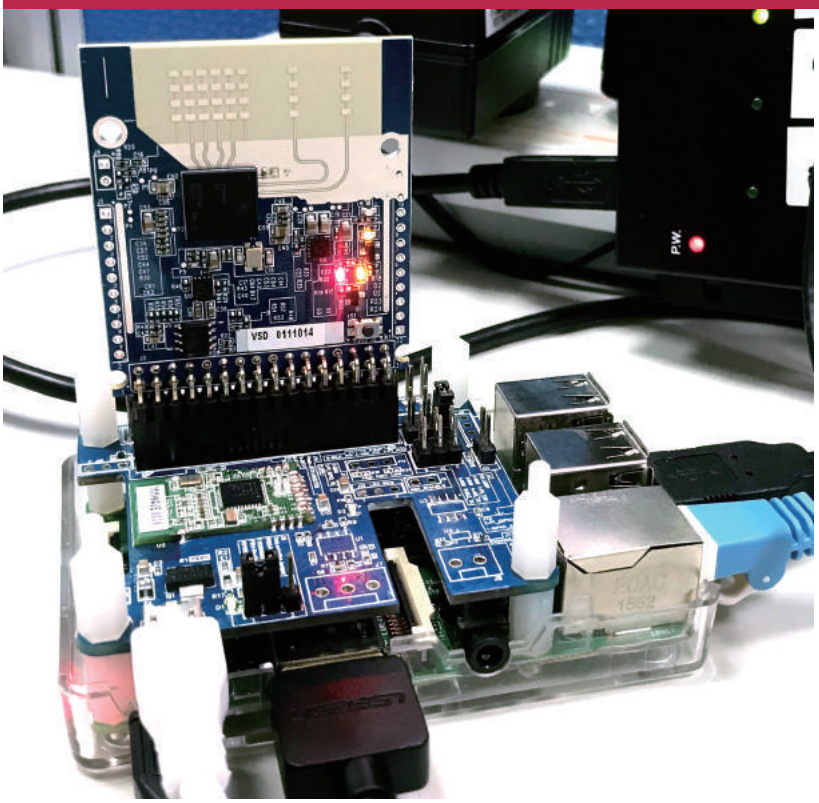
Batman Kit + NVIDIA Jetson Nano / Batman Kit + Raspberry Pi

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

Batman BM101 EVM Kit + NVIDIA Jetson Nano



Batman BM101 EVM Kit + Raspberry Pi



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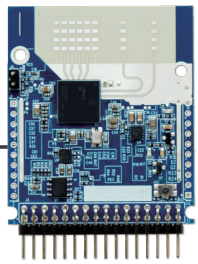

Specifications

mmWave Sensor Evaluation Module

FMCW Transceiver	● 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: 14 dB (76 to 77 GHz) 15 dB (77 to 81 GHz)
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 FMCW Signal Processing
MCU	● ARM Cortex-R4F Microcontroller for Application Control
I/O	● SPI / CAN x 1 ● Up to 2 UARTs ● I 2C x 1 ● GPIO: 0 ~ 2
Antenna	● Tx Antenna x 2 on Board ● Rx Antenna x 4 on Board
Pre-Programmed Firmware “Flavor”	● 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. ● Zone Occupancy Detection (ZOD) Firmware; 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). Note: ONLY one of VSD, HAM, or PMB Firmware is pre-programmed within a single mmWave Module

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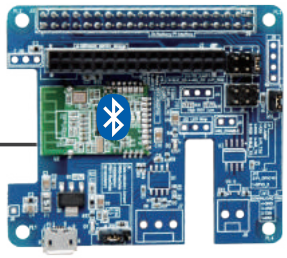
Operating Temperature Operating Humidity	● 0° to 40° degree Celsius ● 10 ~ 85% Non-Condensing
Dimensions & Weight	● 54.1mm x 45.7mm; 13.7 grams net

mmWave Raspberry Pi Hat



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

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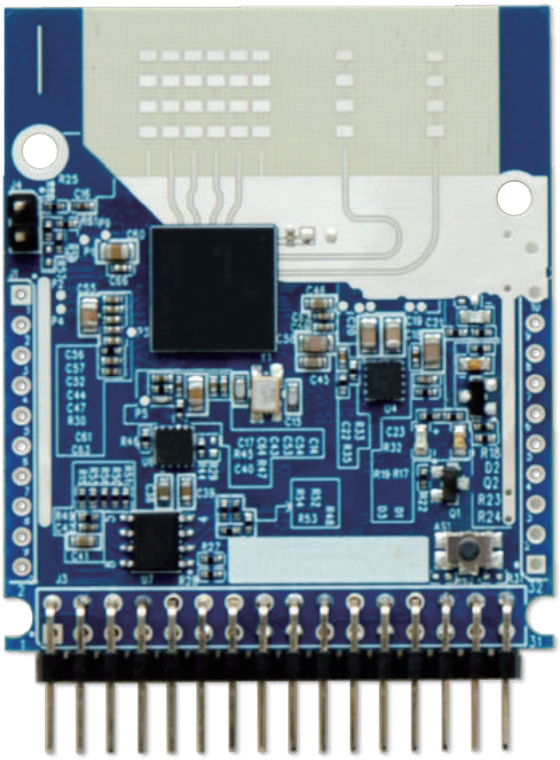
mmWave Pin Assignment

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

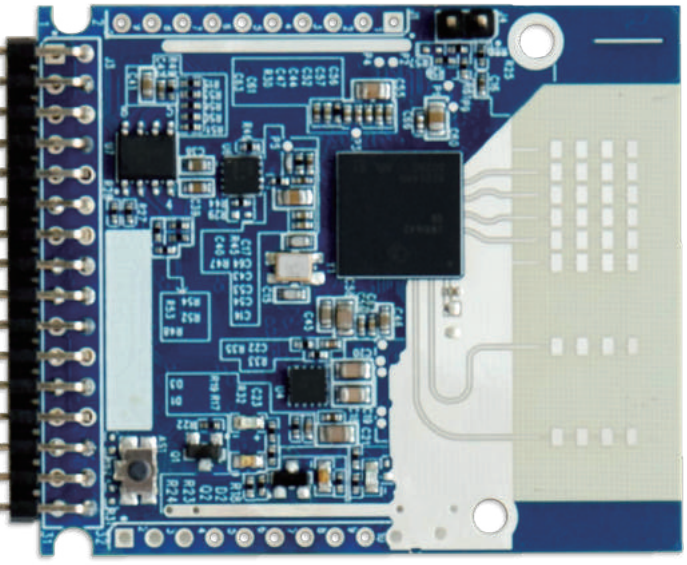


J2 J2 Pin Assignment

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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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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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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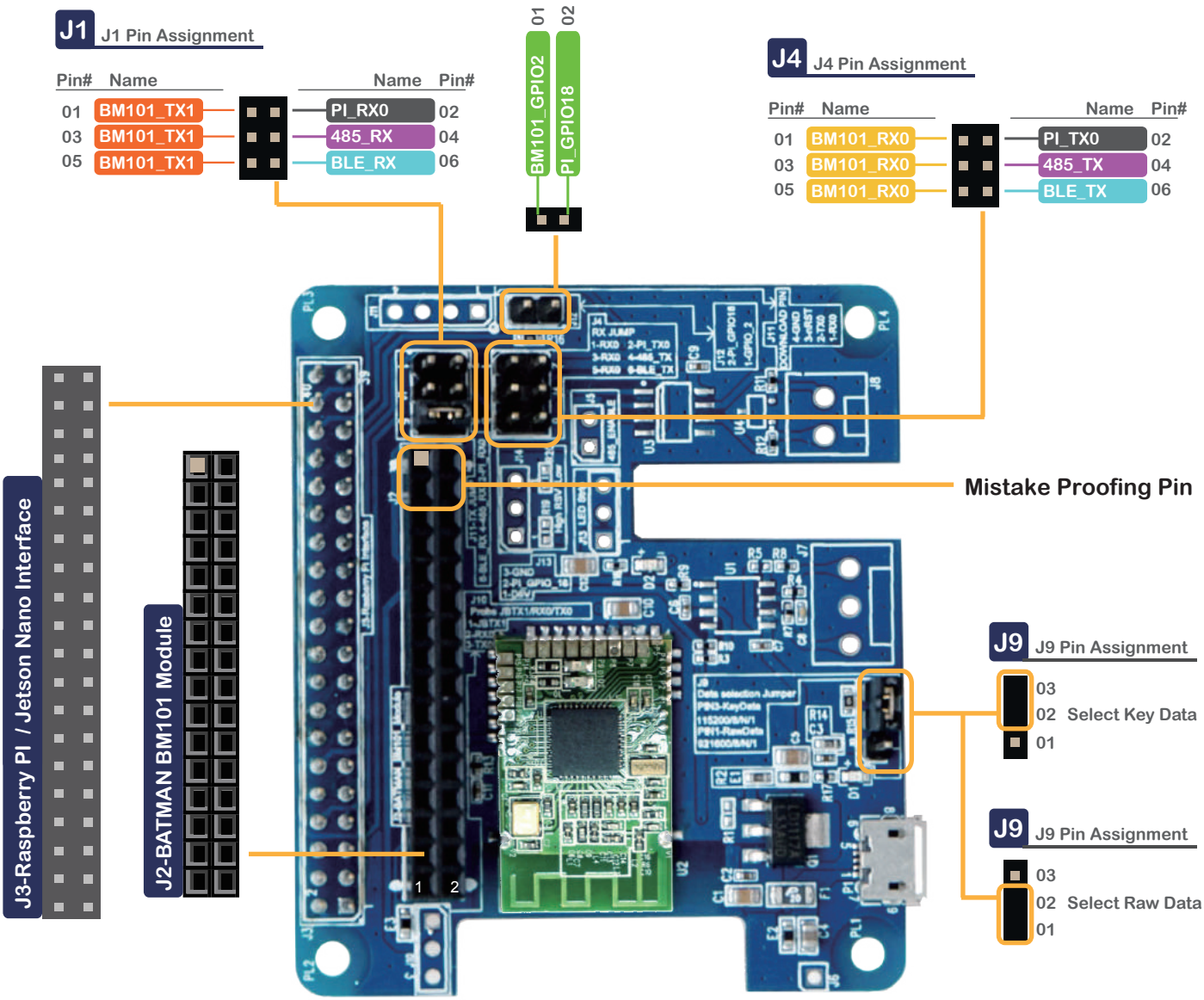
Batman BM101 mmWave EVM kit

mmWAVE SENSOR EVALUATION SOLUTION

mmWAVE SENSOR EVALUATION SOLUTION

mmWave Raspberry Pi Hat Pin Assignment



Batman BM101 mmWave EVM kit

mmWAVE SENSOR EVALUATION SOLUTION

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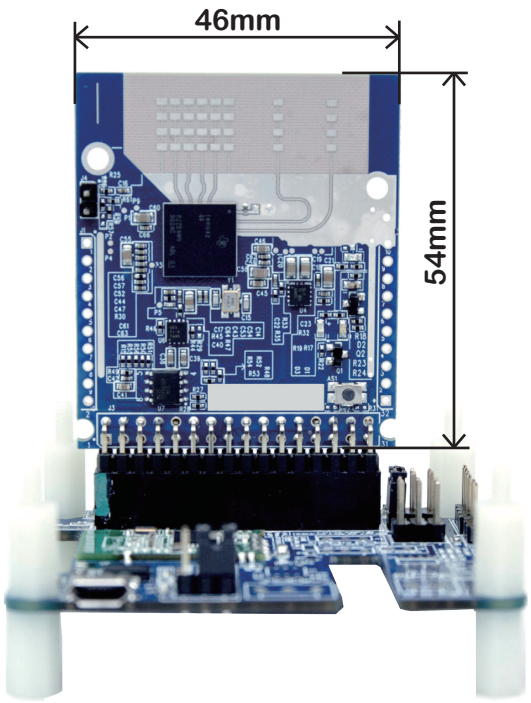
Product Dimensions



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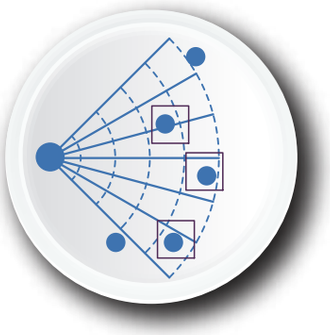
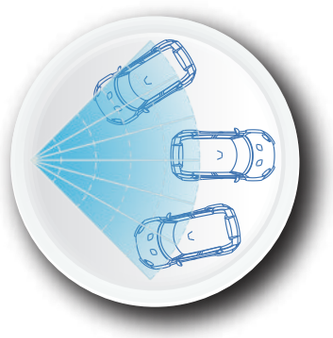
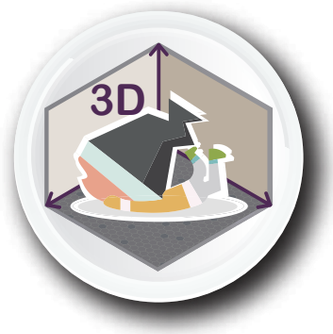
This EVM Kit does not include Apple iPhone/iPad, Raspberry Pi computer, nor NVIDIA Jetson Nano computer.

Appendix : Joybien mmWave EVM Kit Application Solution Selection

 (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.
 (ZOD) Zone Occupancy Detection	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).

 (LPD) Long-Range People Detection	For Human:1 meters ~ 50meters (about 3 ~ 164 feet) 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.
 (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.
 (FDS) Fall Detection Sensing	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 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.