

# Batman BM101 mmWave EVM kit

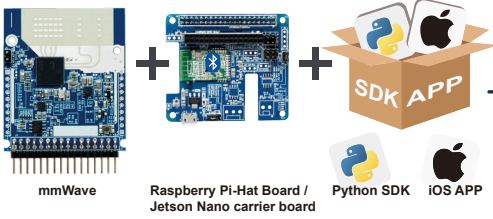
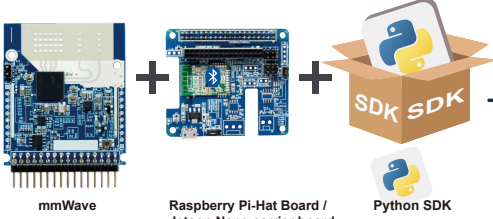
## mmWAVE SENSOR EVALUATION SOLUTION

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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 + 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

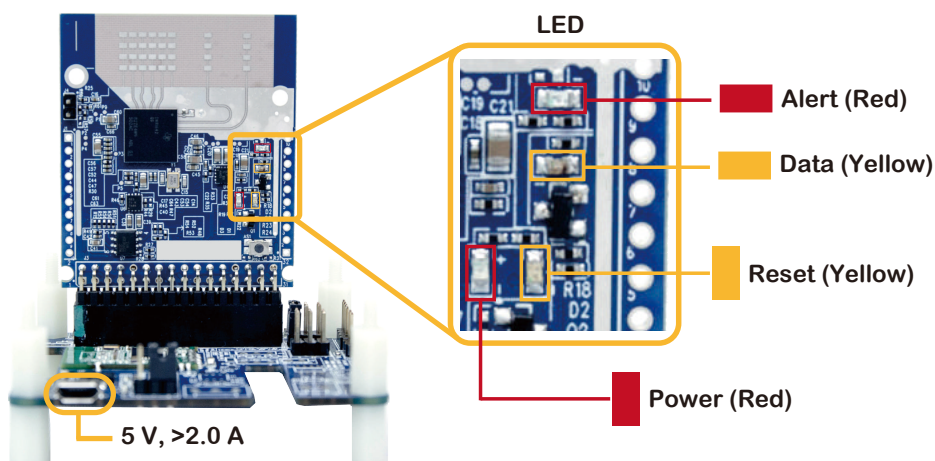
## mmWAVE SENSOR EVALUATION SOLUTION

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#### Specification

<p>(VSD) Vital Signs Detection</p>	<p>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 &amp; Respiration Rate) of a person, a pet, or an animal.</p>
<p>(HAM) High Accuracy Measurement</p>	<p>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.</p>
<p>(PMB) People Movement Behavior</p>	<p>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).</p>
<p>(SRR) Short Range Radar</p>	<p>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.</p>

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

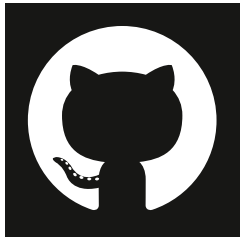



# Batman BM101 mmWave EVM kit






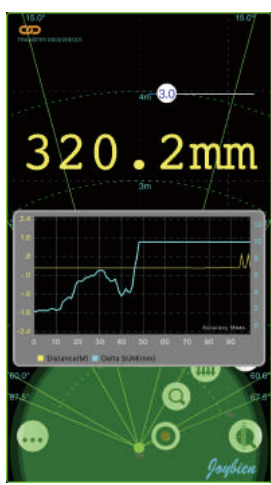

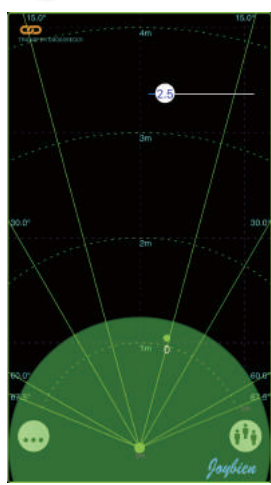
mmWAVE SENSOR EVALUATION SOLUTION

## mmWAVE SENSOR EVALUATION SOLUTION

### Develop SDK: Python SDK

(VSD) Vital Signs Detection	<ul style="list-style-type: none"> <li>Available on GitHub</li> <li><b>Note: Please refer to README.md file first for proper configuration</b></li> </ul>   <p><b>GitHub</b></p> <p><a href="https://github.com/bigheadG/mmWave">https://github.com/bigheadG/mmWave</a></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"> <li>Available on Apple App Store for Vital Signs Detection, High Accuracy Measurement and People Movement Behavior. (Not including Short Range Radar)</li> </ul>		
	<div style="display: flex; align-items: center; justify-content: center;"> <div style="text-align: center;">  <p><b>mmWaveApi</b> Free APP Download Download on the App Store</p> </div>  </div> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <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>		

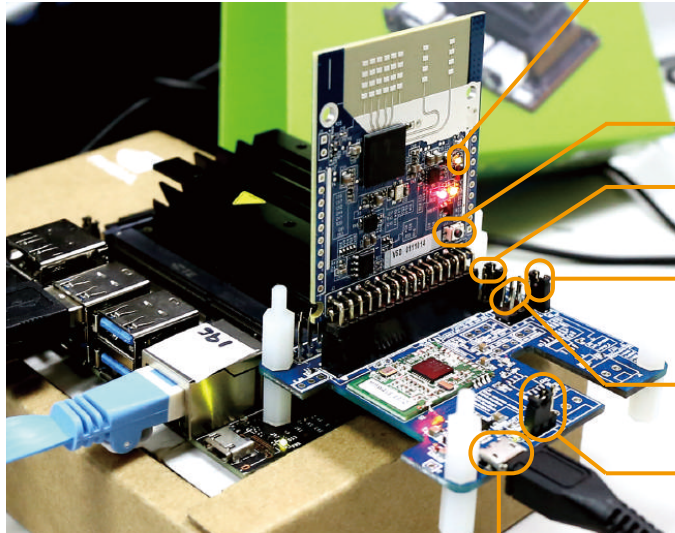
# Batman BM101 mmWave EVM kit

mmWAVE SENSOR EVALUATION SOLUTION

## mmWAVE SENSOR EVALUATION SOLUTION

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

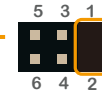
#### (A) Raw Data Mode



**DATA LED (Yellow):**

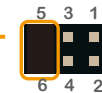
After Pressing the RESET Button, the Yellow LED will be flashing to indicate normal operation

**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)

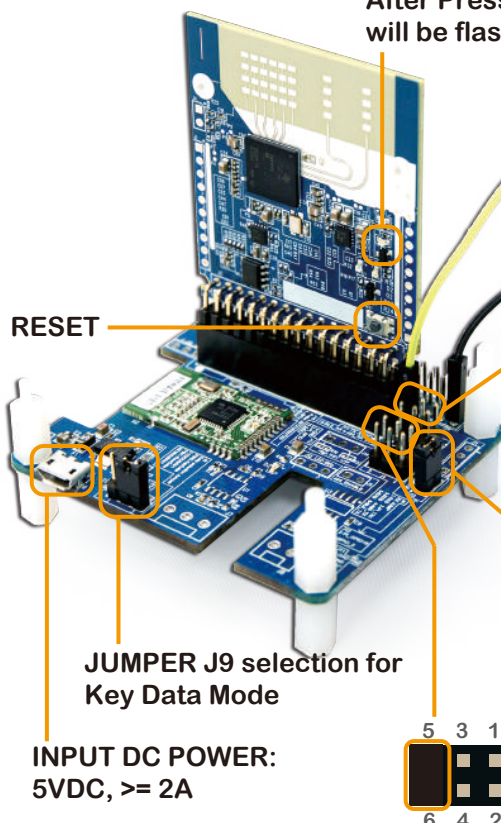
INPUT DC POWER: 5VDC, >= 2A

#### (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

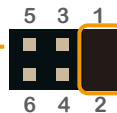


Wire connections for external microprocessor access on the HAT-Board, and where:

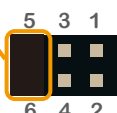
J1 PIN3 Yellow Wire location is for UART TX1 at 115200/8/n/1;

J3 PIN39 Black Wire location is for GND

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

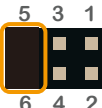


**JUMPER J1** at 1,2 position for Raspberry Pi / Jetson Nano selection



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



**JUMPER J4** at 5,6 position for RX0

INPUT DC POWER:  
5VDC, >= 2A



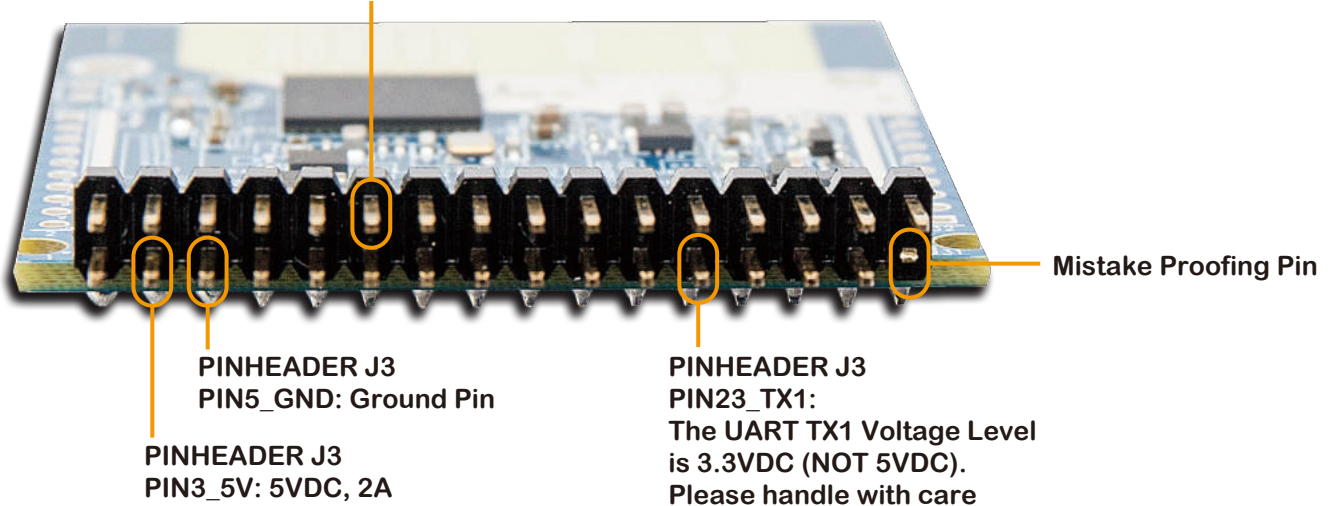
# Batman BM101 mmWave EVM kit

mmWAVE SENSOR EVALUATION SOLUTION

## mmWAVE SENSOR EVALUATION SOLUTION

### Batman BM101 Module J3 Pin Assignment Note

PINHEADER J3 PIN12\_GPIO\_0 High: Raw Data Baud Rate 921600/8/n/1 selection  
PINHEADER J3 PIN12\_GPIO\_0 Low : Key Data Baud Rate 115200/8/n/1 selection



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

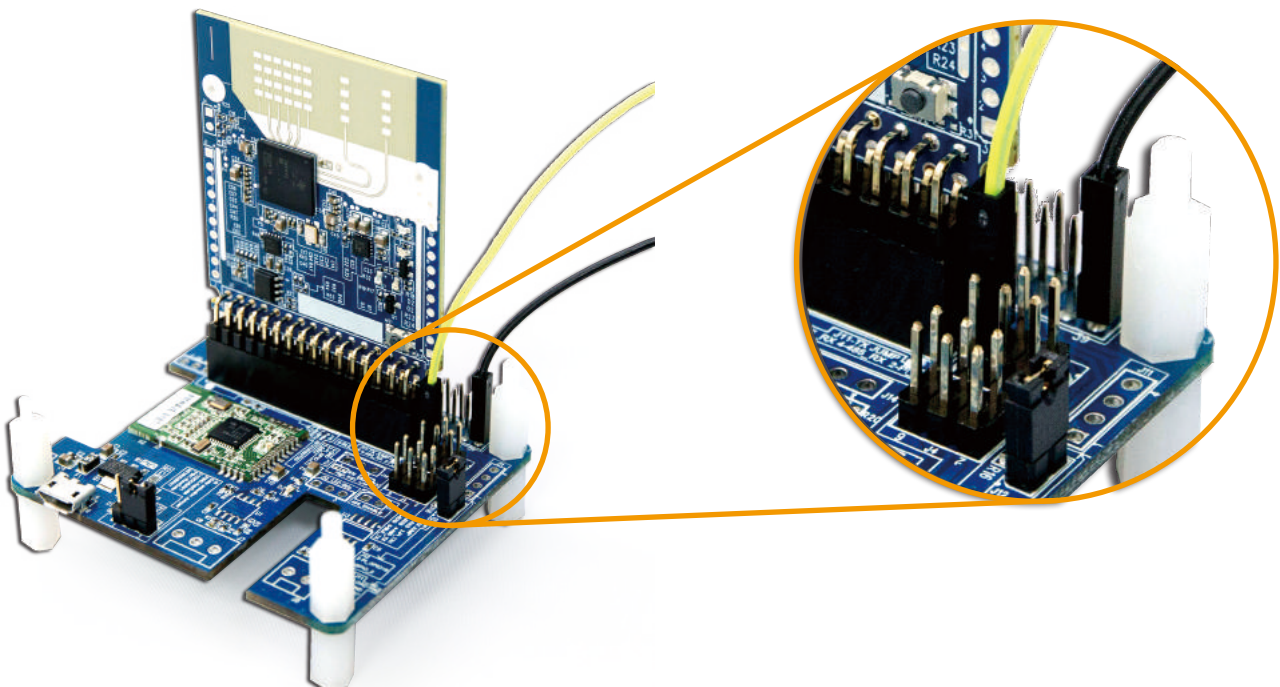
### Batman BM101 EVM Kit + External Microprocessor

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.



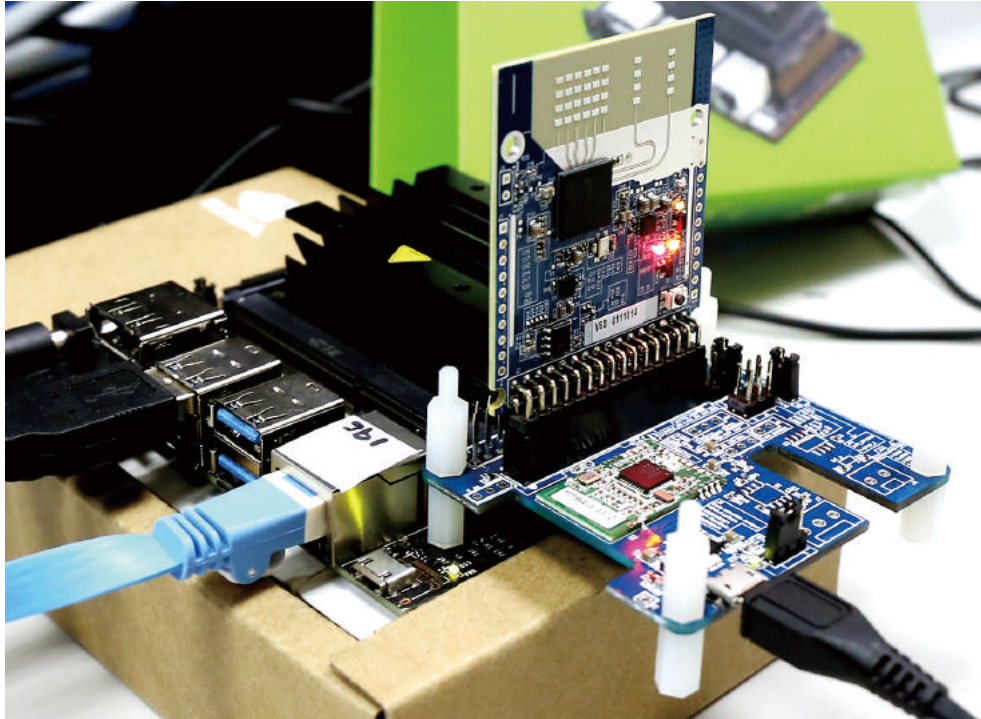
# Batman BM101 mmWave EVM kit

mmWAVE SENSOR EVALUATION SOLUTION

## mmWAVE SENSOR EVALUATION SOLUTION

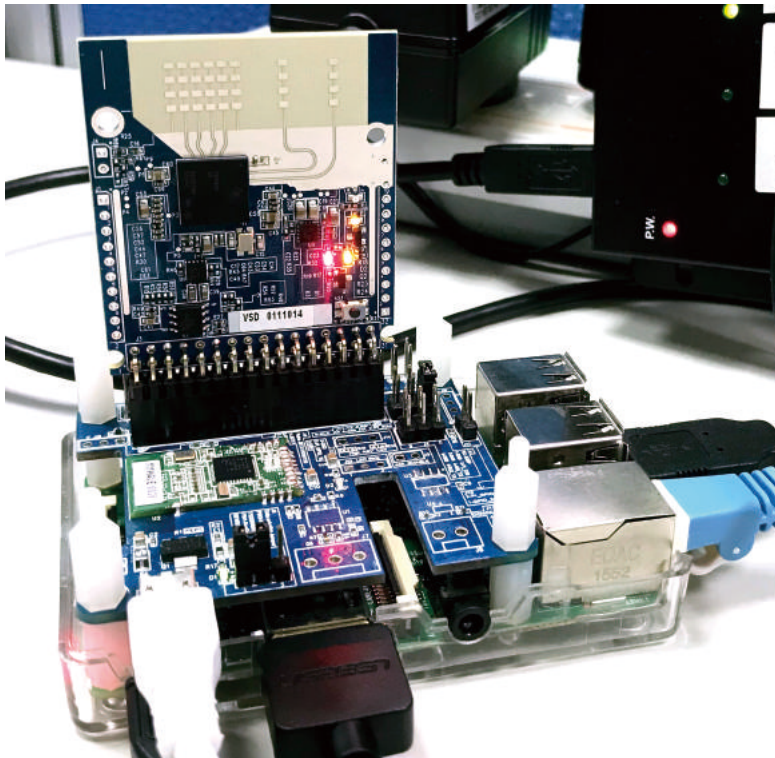
### Batman BM101 EVM Kit + NVIDIA Jetson Nano

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



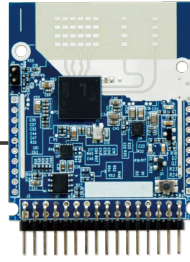
# Batman BM101 mmWave EVM kit

## mmWAVE SENSOR EVALUATION SOLUTION

### mmWAVE SENSOR EVALUATION SOLUTION

#### Specifications

#### mmWave Sensor Evaluation Module



FMCW Transceiver	<ul style="list-style-type: none"> <li>● Integrated PLL, Transmitter, Receiver, Baseband, and A2D</li> <li>● 76- to 81-GHz Coverage With 4-GHz</li> <li>● Continuous Bandwidth</li> <li>● Four Receive Channels</li> <li>● Two Transmit Channels</li> <li>● Ultra-Accurate Chirp (Timing) Engine Based on Fractional-N PLL</li> <li>● TX Power: 12.5 dBm</li> <li>● RX Noise Figure:               <ul style="list-style-type: none"> <li>14 dB (76 to 77 GHz)</li> <li>15 dB (77 to 81 GHz)</li> </ul> </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 FMCW Signal Processing</li> </ul>
MCU	<ul style="list-style-type: none"> <li>● ARM Cortex-R4F Microcontroller for Application Control</li> </ul>
I/O	<ul style="list-style-type: none"> <li>● SPI / CAN x 1</li> <li>● Up to 2 UARTs</li> <li>● I<sup>2</sup>C x 1</li> <li>● GPIO: 0 ~ 2</li> </ul>
Antenna	<ul style="list-style-type: none"> <li>● Tx Antenna x 2 on Board</li> <li>● Rx Antenna x 4 on Board</li> </ul>
Pre-Programmed Firmware “Flavor”	<ul style="list-style-type: none"> <li>● Vital Signs Detection (VSD) Firmware; for 30cm ~ 90cm wireless &amp; contactless detection of Heartbeat &amp; Respiration Rate</li> <li>● High Accuracy Measurement (HAM) Firmware; for 30cm ~ 300cm distance measurement with millimeter resolution</li> <li>● 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</li> <li>● 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.</li> </ul> <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"> <li>● 0° to 40° degree Celsius</li> <li>● 10 ~ 85% Non-Condensing</li> </ul>
Dimensions & Weight	<ul style="list-style-type: none"> <li>● 54.1mm x 45.7mm; 13.7 grams net</li> </ul>

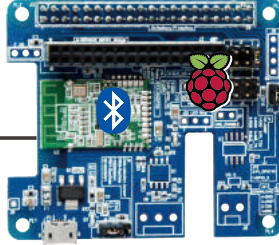


# Batman BM101 mmWave EVM kit

## mmWAVE SENSOR EVALUATION SOLUTION

### mmWAVE SENSOR EVALUATION SOLUTION

#### mmWave Raspberry Pi Hat



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 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>



# Batman BM101 mmWave EVM kit

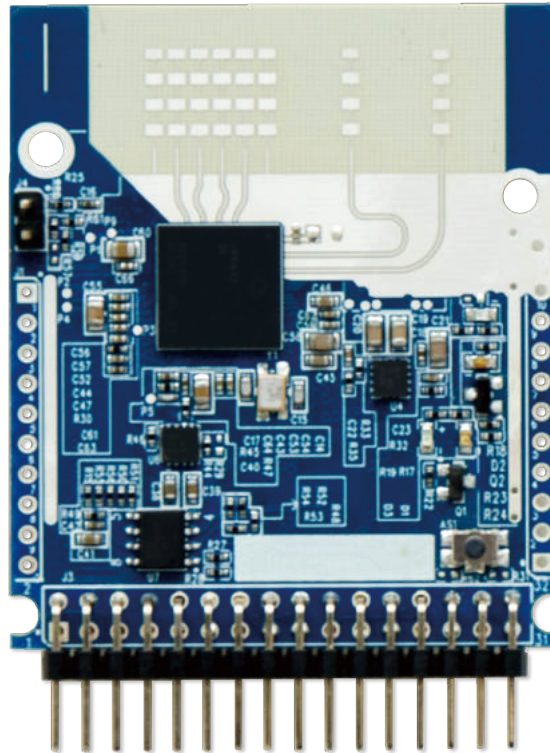
mmWAVE SENSOR EVALUATION SOLUTION

mmWAVE SENSOR EVALUATION SOLUTION

## 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

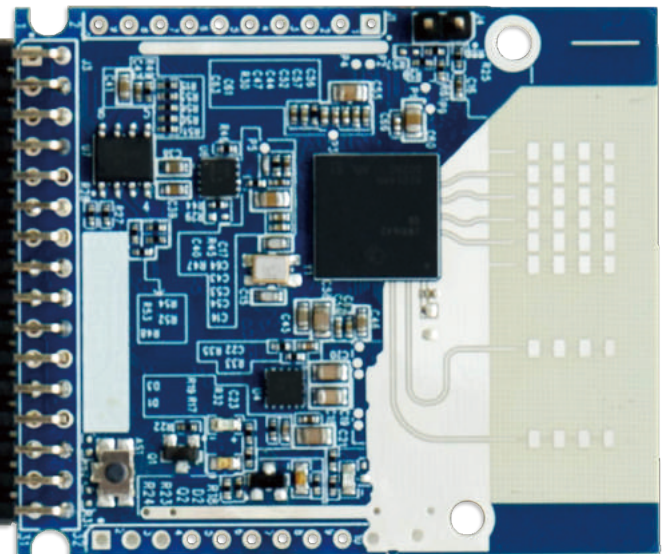


### J2 J2 Pin Assignment

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



# Batman BM101 mmWave EVM kit

## mmWAVE SENSOR EVALUATION SOLUTION

### mmWAVE SENSOR EVALUATION SOLUTION

## 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

# Batman BM101 mmWave EVM kit

## mmWAVE SENSOR EVALUATION SOLUTION

### mmWAVE SENSOR EVALUATION SOLUTION

#### J3 Pin Assignment

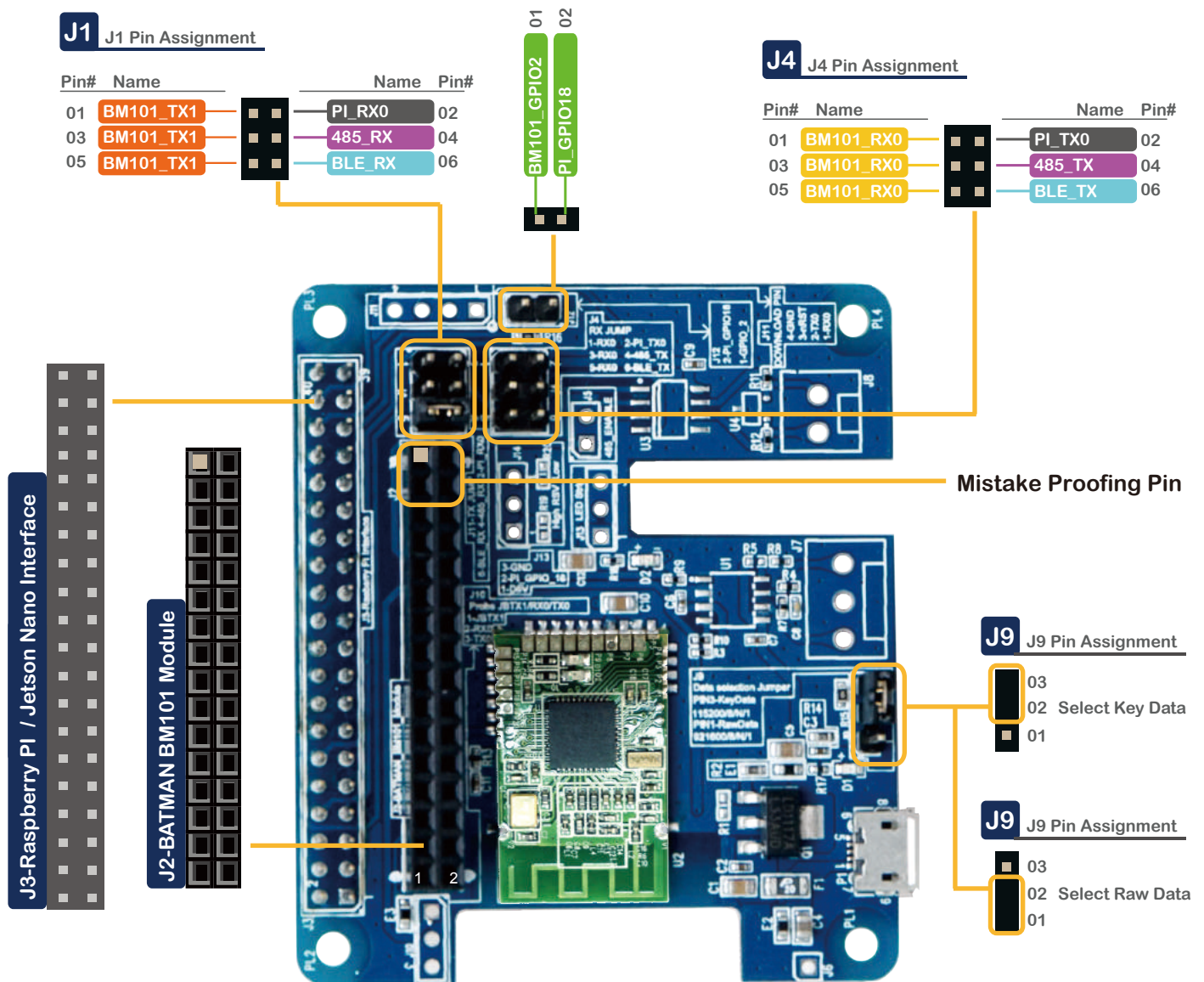
Pin No	Name	Pin Type	Function Description
01	USBD5V	I	USB POWER DC 5V Input
02	3V3	O	For meaurement only
03	USBD5V	I	USB POWER DC 5V Input
04	SDA	IO	I2C Pin
05	GND	GROUND	Digital ground
06	SCL	IO	I2C Pin
07	RS232 RX0	I	UART A Receive
08	SYNC IN JBRX1	I	Low frequency Synchronization signal input, UART 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 SENSOR EVALUATION SOLUTION

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## mmWave Raspberry Pi Hat Pin Assignment



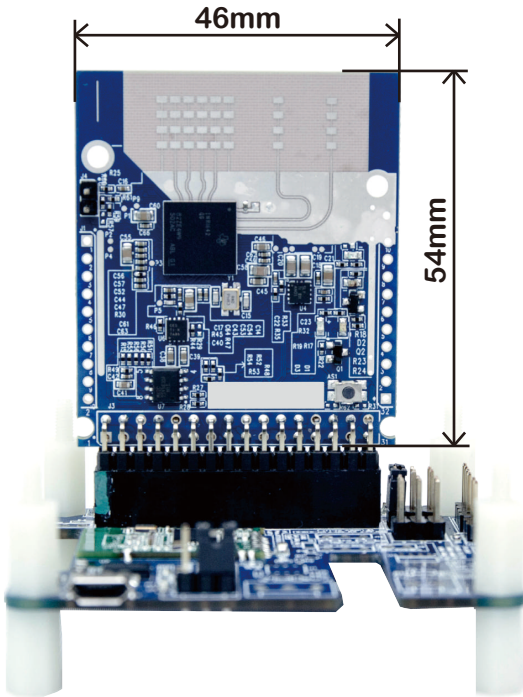


# Batman BM101 mmWave EVM kit

mmWAVE SENSOR EVALUATION SOLUTION

## mmWAVE SENSOR EVALUATION SOLUTION

### Product Dimensions



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