

# 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: 12 dBm  
RX Noise Figure: 12 dB  
(Phase noise at 1MHz:-93dBc/Hz)
- 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:5Vdc, 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-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.

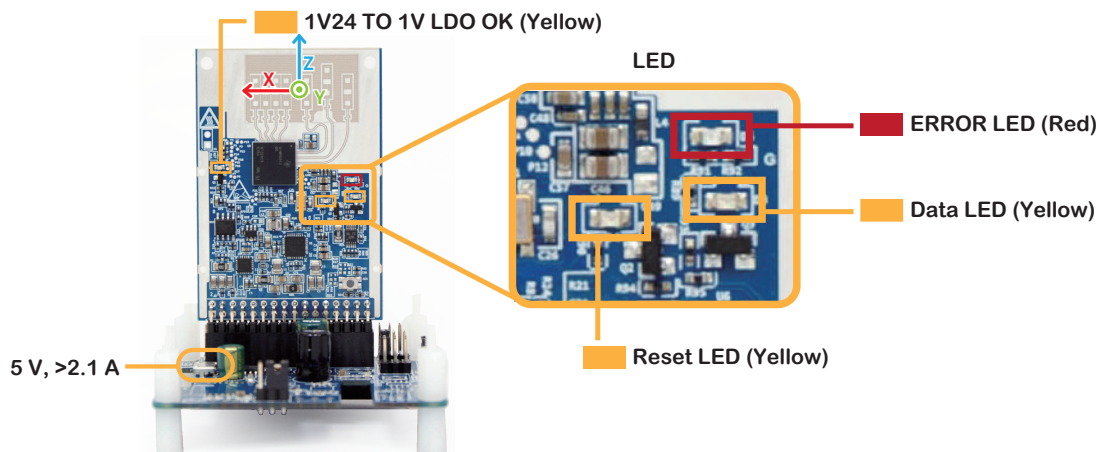
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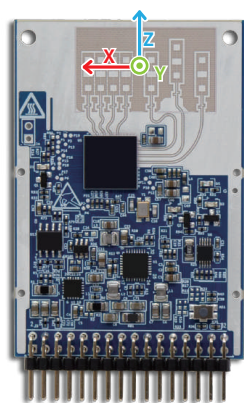
### Packing List: mmWave Module, Raspberry Pi-Hat Board, Python SDK

- Make sure you are using the correct power supply of 5 V, >2.1 A with a Micro USB connection

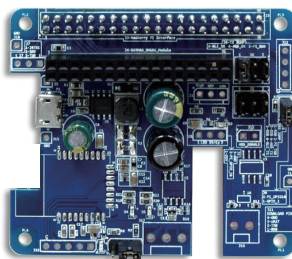


Note: Raspberry Pi, Jetson Nano, or Linux/Mac/Windows computer not included.

### Batman BM201 EVM Kit includes



mmWave



Raspberry Pi-Hat Board /  
Jetson Nano carrier board



Python SDK

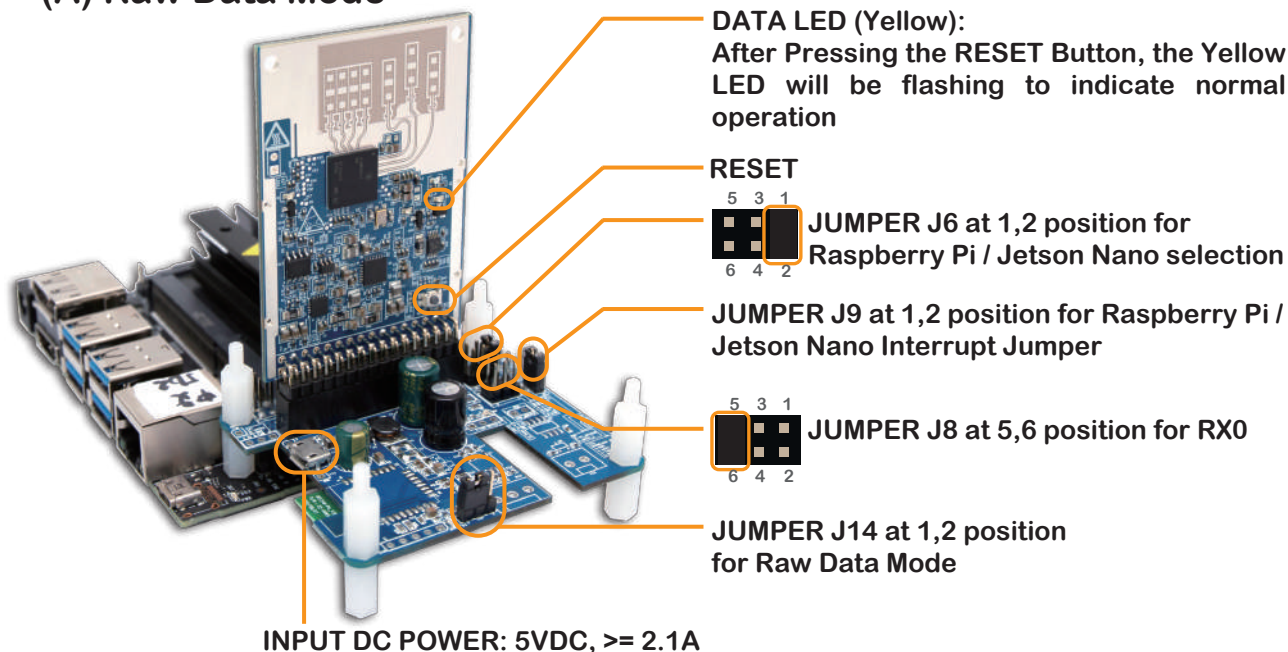
# Batman BM201 mmWave EVM Kit

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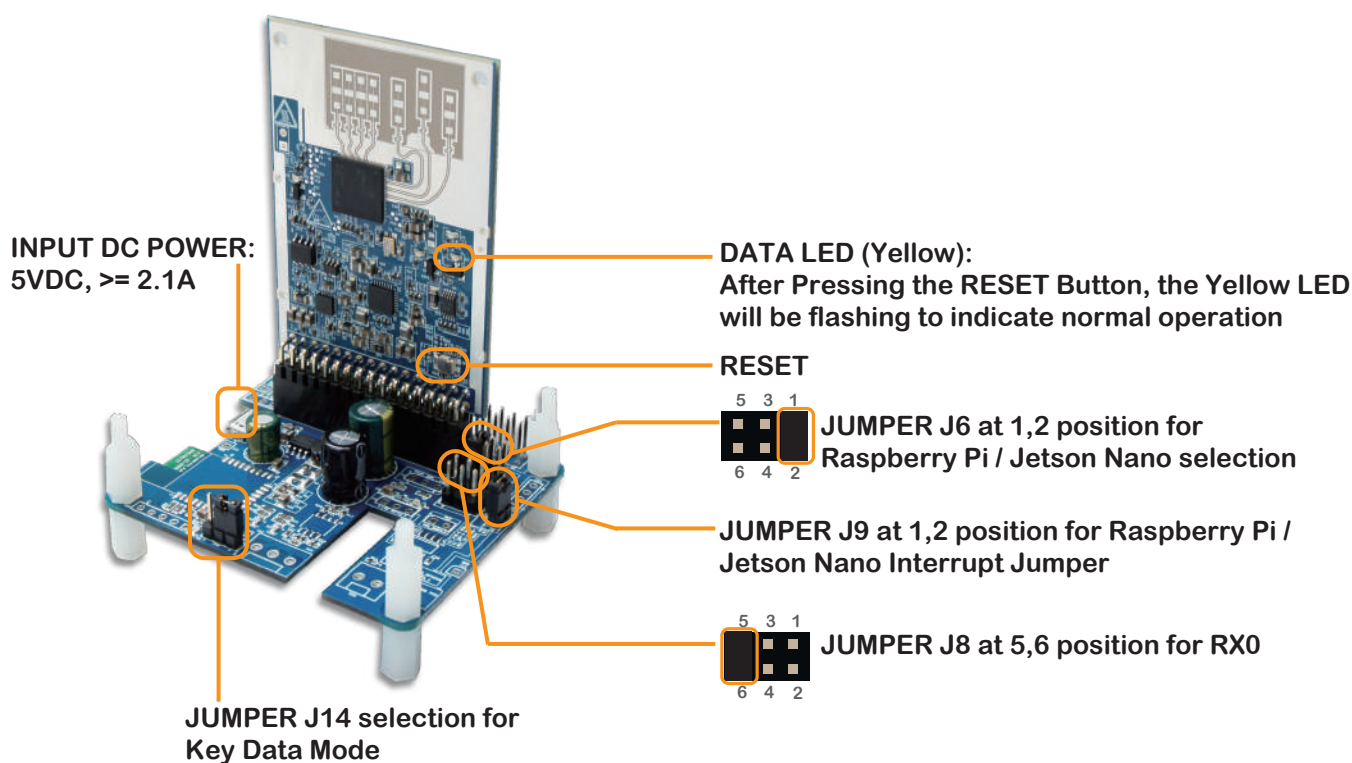
## mmWAVE SENSOR EVALUATION SOLUTION

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

#### (A) Raw Data Mode



#### (B) Key Data Mode





# Batman BM201 mmWave EVM Kit

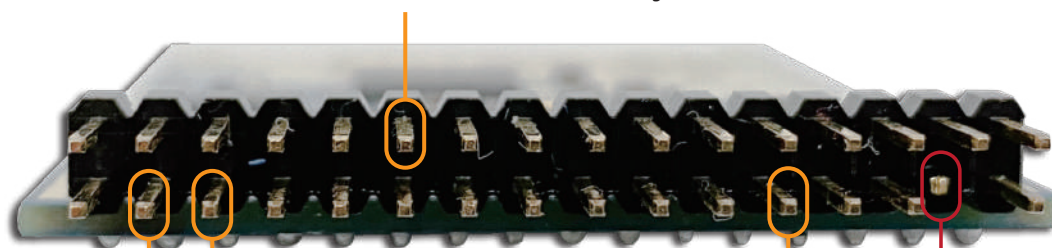
mmWAVE SENSOR EVALUATION SOLUTION

## 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



PINHEADER J3  
PIN5\_GND: Ground Pin  
  
PINHEADER J3  
PIN3\_3V: 3VDC, 2.1A

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.

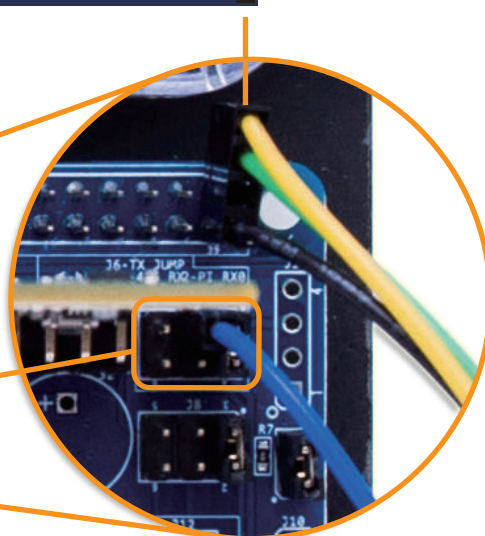
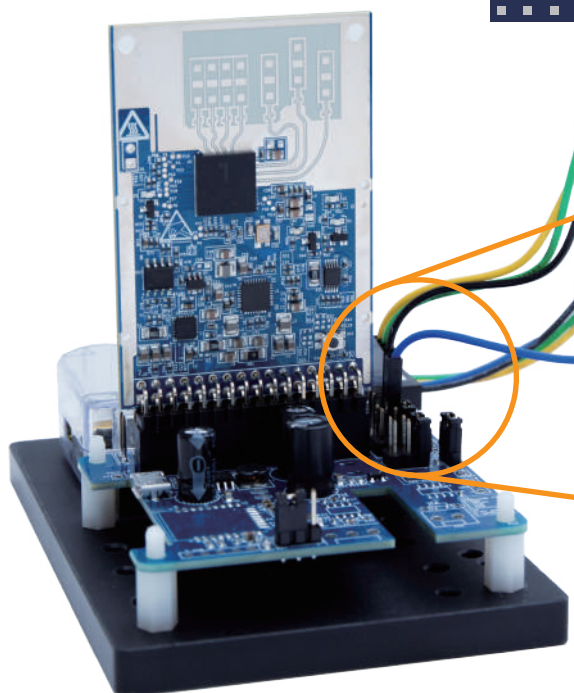
### Batman BM201 EVM Kit + External Microprocessor

Wire connections for external microprocessor access on the HAT-Board

**Note: EM110 Emulator not included within this EVM Kit.**

Please contact Joybien for purchasing info.

J3 PIN39 Black Wire location is for GND



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

# Batman BM201 mmWave EVM Kit

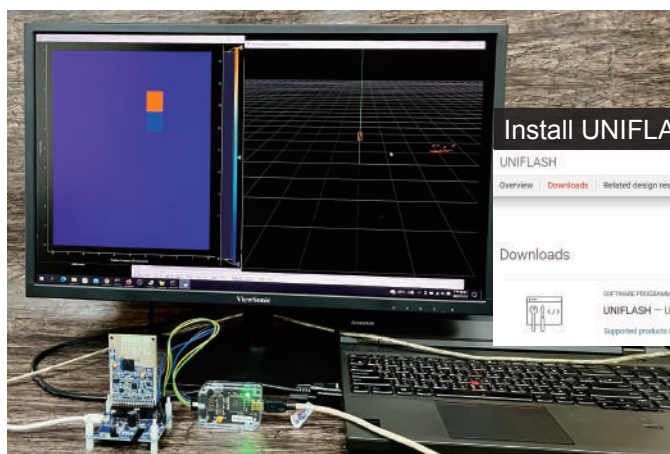
mmWAVE SENSOR EVALUATION SOLUTION

## mmWAVE SENSOR EVALUATION SOLUTION

### Batman Kit + EM110 Emulator for PC Computer Connection

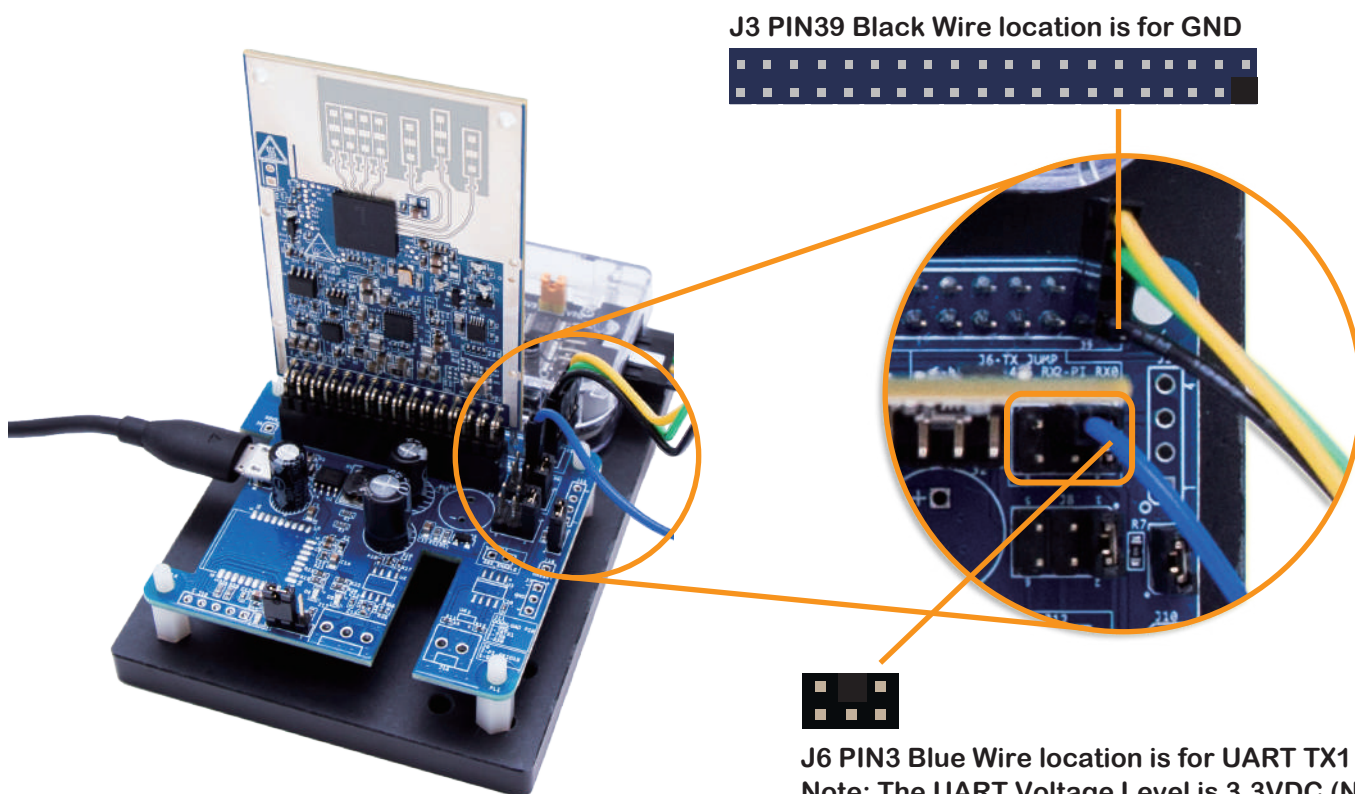
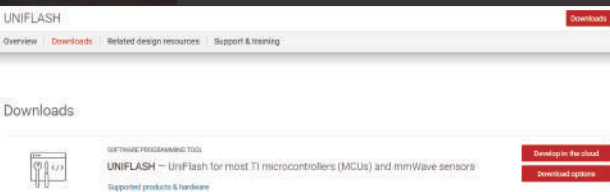
### Batman BM201 EVM Kit + EM110 Emulator+PC

Wire connections for external EM110 Emulator on the HAT-Board



Please visit TI website for UNIFLASH Driver download.

#### Install UNIFLASH Driver for EM110 Emulator



**Note: EM110 Emulator not included within this EVM Kit.**  
Please contact Joybien for purchasing info.

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

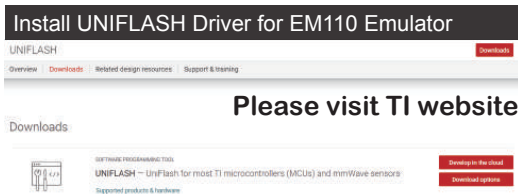
# Batman BM201 mmWave EVM Kit

## mmWAVE SENSOR EVALUATION SOLUTION

### mmWAVE SENSOR EVALUATION SOLUTION

#### BM201 EVM Kit Installation on Desktop Computer

On Software side, please download & install EM110 USB to UART Bridge Virtual COM Port (VCP) drivers for your Computer (Windows, Mac, or Linux) at:



Please visit TI website for UNIFLASH Driver download.

to enable the UART communication between BM201 EVM Kit and Computer.

Please make sure that you have installed Python on your Computer at:

<https://www.python.org/downloads/>

**Note:** You must enable “Add Python to PATH” upon installation.

You may download GEANY as your Python code editor at:

<https://www.geany.org/download/releases/>

At this point, you may download and execute the corresponding BM201 EVM Kit’s Python SDK examples at:

<https://github.com/bigheadG/mmWave>

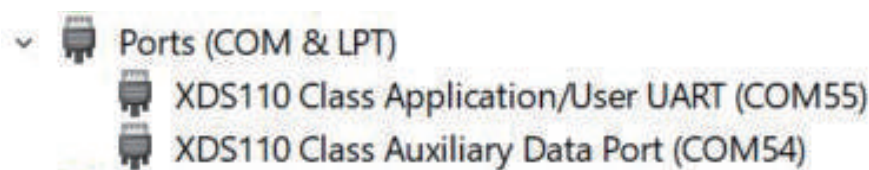
**Note:** Please follow the Python example to install relevant Libraries for proper execution.

To enable UART port on Computer, you will need to enable proper PORT setting within the Python Code. As an example, for Window PC having UART running at 921600 bps, please enable:

```
port = serial.Serial("COM#",baudrate = 921600, timeout = 0.5)
```

where the “#” of the COM# should correspond to the XDS110 Class Auxiliary Data Port dynamically assigned by Windows Device Manager’s Ports (COM & LPT) after the USB cable is properly connected on the both ends. As an example, in the picture below, the COM port used is the EM110’s XDS110 Class Auxiliary Data Port assigned, and in this case, it is COM54; so you will need to enable your Python Code to include:

```
port = serial.Serial("COM54",baudrate = 921600, timeout = 0.5)
```



Please follow similar process for Mac or Linux Computer for the UART communication port used.



# Batman BM201 mmWave EVM Kit

mmWAVE SENSOR EVALUATION SOLUTION

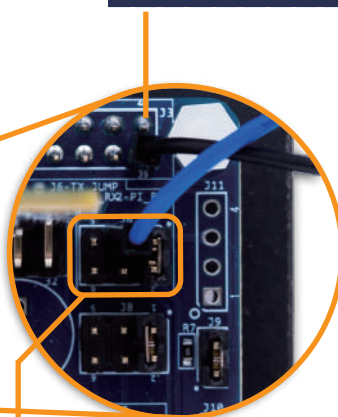
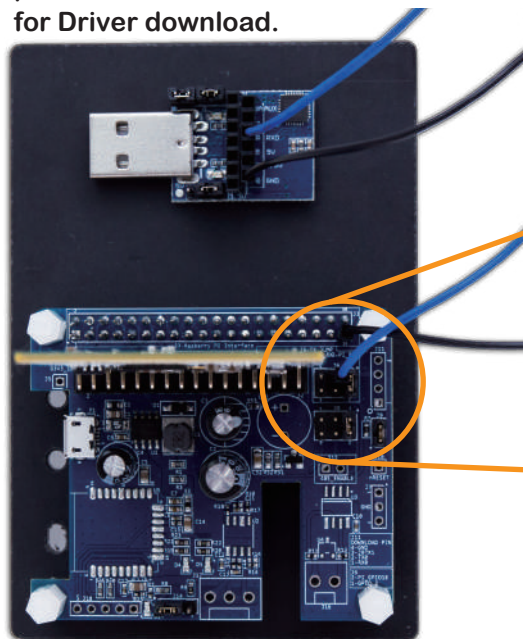
## mmWAVE SENSOR EVALUATION SOLUTION

### Batman BM201 EVM Kit + UART USB for PC Computer Connection

#### Batman BM201 EVM Kit + UART

For Silicon Labs CP210X UART-to-USB Dongle, please visit Silicon Labs website for Driver download.

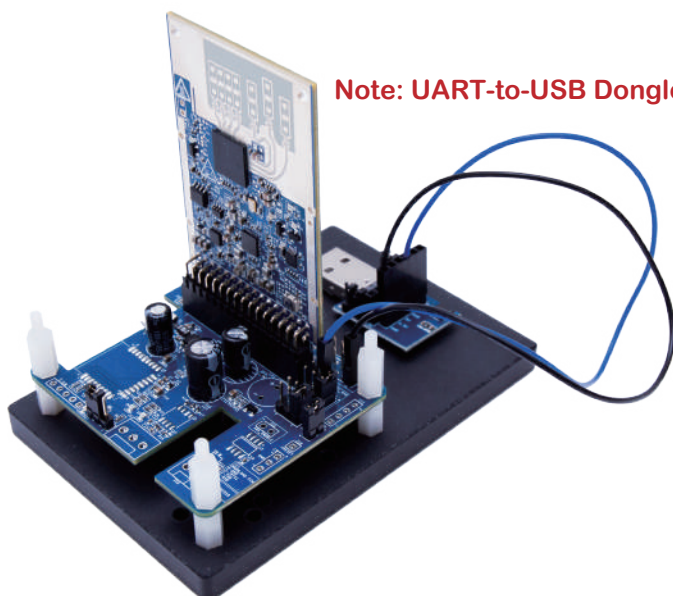
J3 PIN39 Black Wire location is for GND



J6 PIN3 Blue Wire location is for UART TX1

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

**Note: UART-to-USB Dongle not included within this EVM Kit.**





# Batman BM201 mmWave EVM Kit

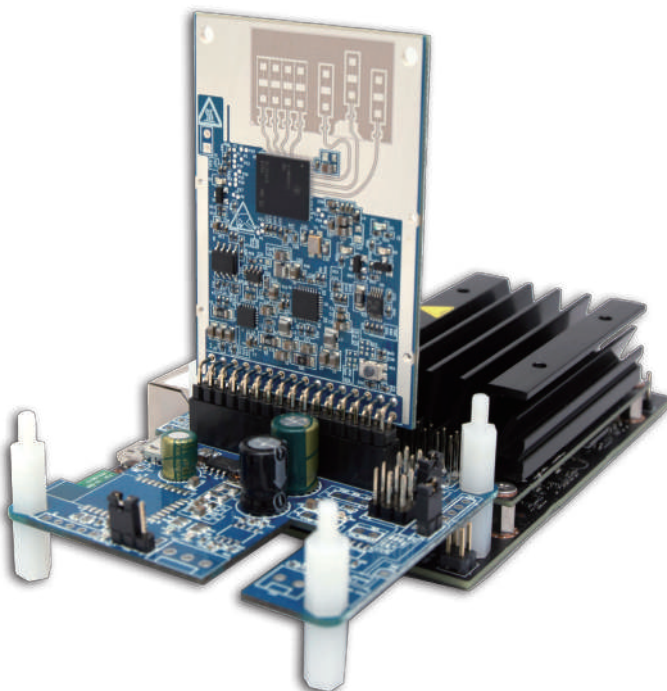
mmWAVE SENSOR EVALUATION SOLUTION

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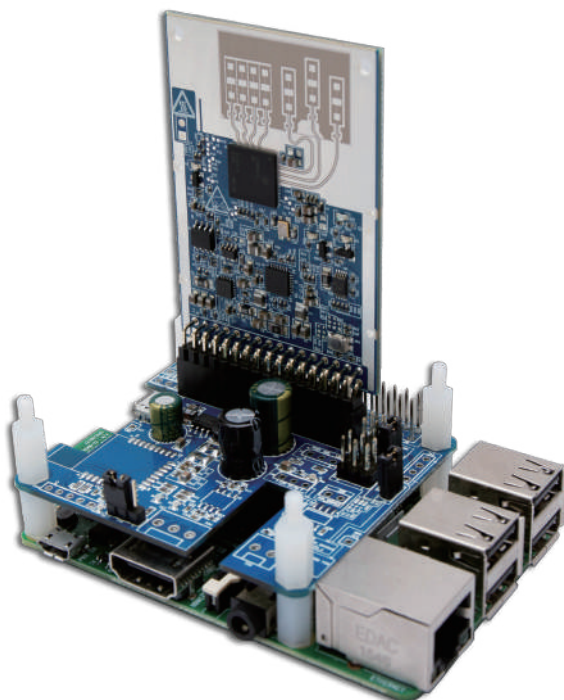
Batman Kit + NVIDIA Jetson Nano / Batman Kit + Raspberry Pi

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

### Batman BM201 EVM Kit + Jetson Nano



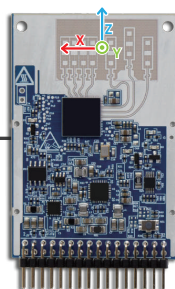
### Batman BM201 EVM Kit + Raspberry Pi



# Batman BM201 mmWave EVM Kit

mmWAVE SENSOR EVALUATION SOLUTION

## mmWAVE SENSOR EVALUATION SOLUTION



### Specifications

#### mmWave Sensor Evaluation Module

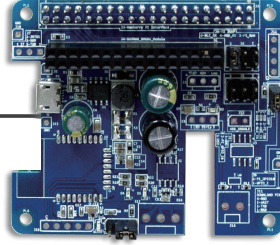
mmWave ASIC	TI IWR6843 Single Chip mmWave Sensor
FMCW Transceiver	<ul style="list-style-type: none"> <li>● Integrated PLL, Transmitter, Receiver, Baseband, and A2D</li> <li>● 60GHz to 64GHz Coverage With 4GHz Continuous Bandwidth</li> <li>● Four Receive Channels</li> <li>● Three Transmit Channels</li> <li>● Ultra-Accurate Chirp Engine Based on Fractional-N PLL</li> <li>● TX Power: 12 dBm</li> <li>● RX Noise Figure: 12 dB</li> <li>● Phase Noise at 1 MHz: -93 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

# Batman BM201 mmWave EVM Kit

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>23 grams</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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# Batman BM201 mmWave EVM Kit

mmWAVE SENSOR EVALUATION SOLUTION

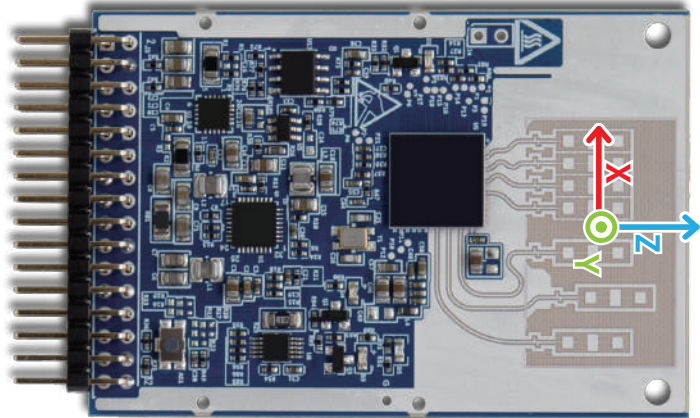
mmWAVE SENSOR EVALUATION SOLUTION

## 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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## mmWAVE SENSOR EVALUATION SOLUTION

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#### J3 Pin Assignment

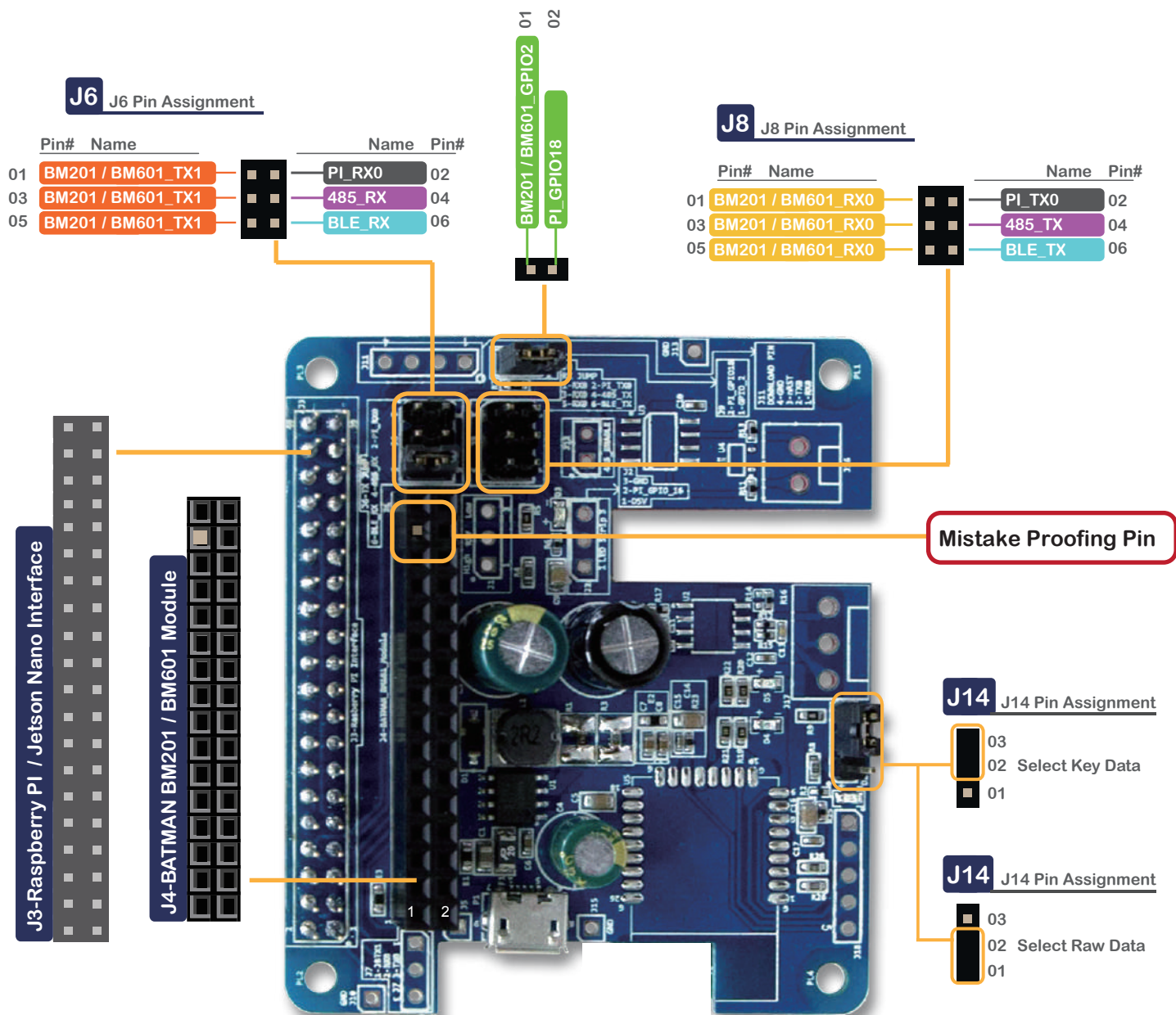
Pin No	Name	Pin Type	Function Description
01	D3V3	I	POWER DC 3V3 Input
02	D3V3	I	POWER DC 3V3 Input
03	D3V3	I	POWER DC 3V3 Input
04	SDA	IO	I2C Pin
05	GND	GROUND	Digital ground
06	SCL	IO	I2C Pin
07	RS232 RX0	I	UART A Receive
08	SYNC IN JBRX1	I	Low frequency Synchronization signal input, UART B Receive
09	RS232 TX0	O	UART A Transmit
10	GND	GROUND	Digital ground
11	nRST	I	Power on reset for chip. Active low
12	GPIO 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 SENSOR EVALUATION SOLUTION

mmWAVE SENSOR EVALUATION SOLUTION

## mmWave Raspberry Pi Hat Pin Assignment

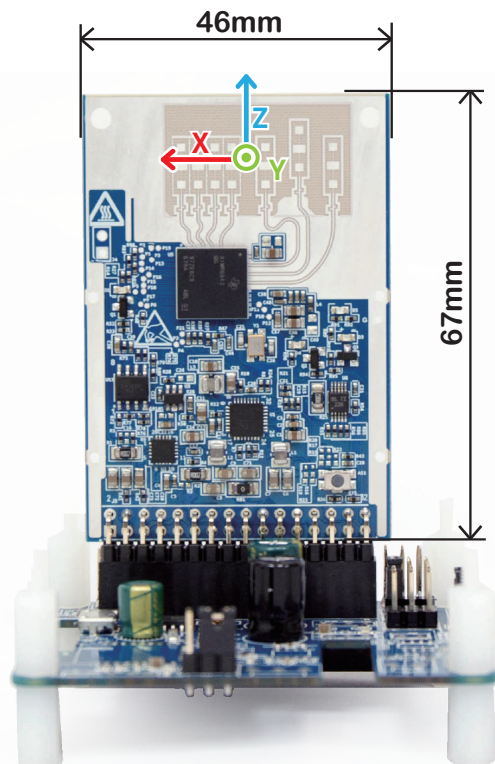


# Batman BM201 mmWave EVM Kit

mmWAVE SENSOR EVALUATION SOLUTION

## mmWAVE SENSOR EVALUATION SOLUTION

### 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.