

Batman BM501 mmWave EVM Kit

mmWAVE SENSOR EVALUATION SOLUTION

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Joybien Batman BM501 mmWave EVM Kit is a Texas Instruments (TI) IWR6843AOP 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 BM501 mmWave EVM Kit consists of an extremely light and compact mmWave Module (with approx. 1/3 of the size of the previous Batman series mmWave Module; along with low-power, self-monitored, ultra-accurate, and lighting condition independent versatilities), a Module Carrier Board that brings user experience and hardware integration flexibilities, and 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, People Density, Security and Surveillance,
- Healthcare's Vital Signs Detection, People Fall Detection, etc.
- Business' Traffic Monitoring, and Proximity Advertisement
- Consumer's Gesture Recognition, Obstacle Avoidance, etc.

Features

- Operating Frequency: 60GHz ~ 64GHz coverage
with 4GHz continuous bandwidth
- Antenna: 3 Tx and 4 Rx Antenna on Package (AOP), with:
TX Power: 15 dBm
RX Noise Figure: 9 dB
- Processors: ARM R4F based MCU, and C674x DSP
for FMCW signal processing
- On-Chip Memory: 1.75MB
- Internal Memories With ECC
- Integrated Peripherals
- Extremely light and compact Module design.
- Supplied Voltage: 5VDC & 1.5A

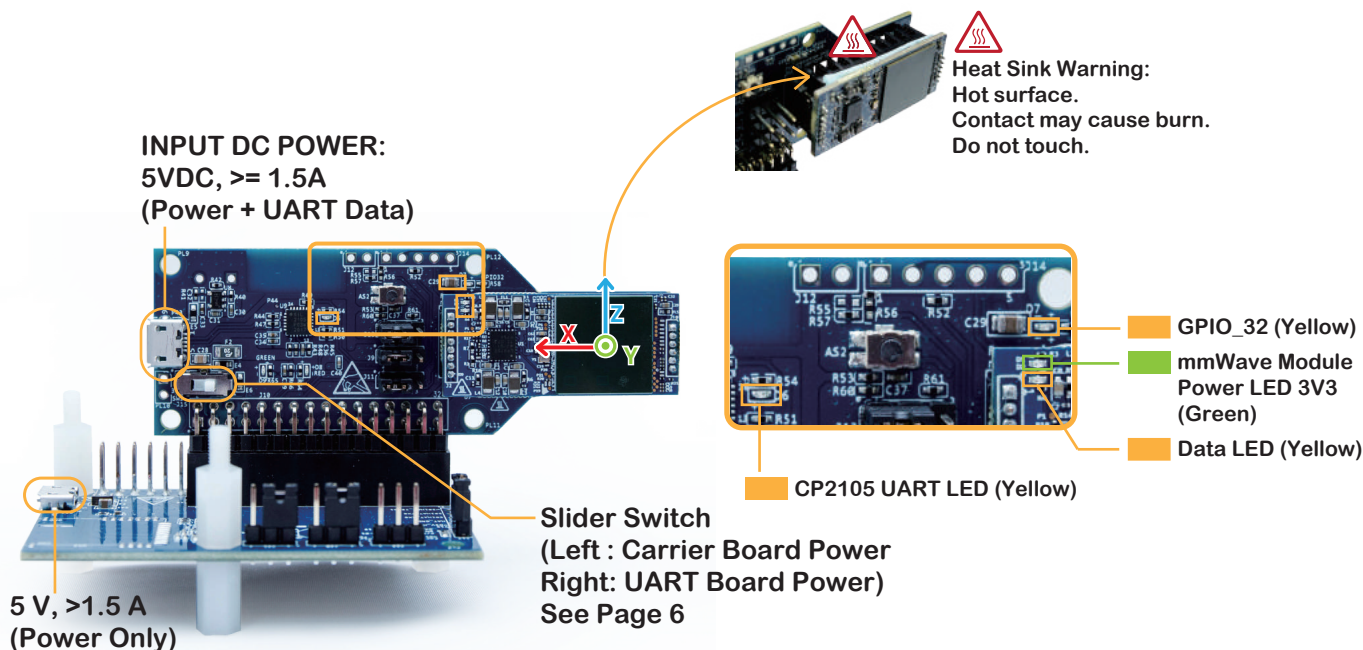
Batman BM501 mmWave EVM Kit

mmWAVE SENSOR EVALUATION SOLUTION

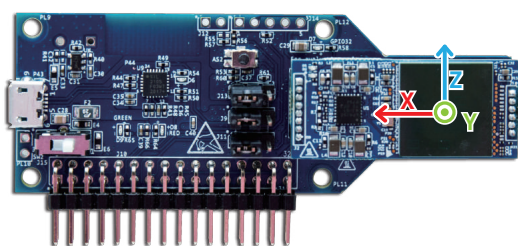
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Packing List: mmWave Module on Carrier Board, Raspberry Pi-Hat Board, Python SDK

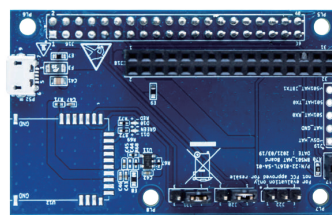
- Make sure you are using the correct power supply of 5 V, >1.5 A with a Micro USB connection



Batman BM501 EVM Kit includes



mmWave Module on Carrier Board



Raspberry Pi / Jetson Nano
Hat Board



Python SDK
(Python SDK upon request)

Python SDK



Python SDK upon purchasing BM501 EVM Kit via email or on Github at:

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

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Selection : Key Data Mode or Raw Data Mode Application

(A) Raw Data Mode(921600/8/n/1)

INPUT DC POWER:

5VDC, $\geq 1.5A$ (Power + UART Data)

RESET

DATA LED (Yellow):

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

JUMPER J13 at 1,2 position for Raw Data Mode (921600/8/n/1)

JUMPER J9,J11 at 1,2 position for HAT board pinheader

1 2 3

JUMPER J17 at 1,2 position for Raspberry Pi / Jetson Nano Interrupt Jumper

J21

J20

J22 GND

3 2 1

3 2 1

1 2 3

JUMPER J21,J20 at 1,2 position for Raspberry Pi / Jetson Nano selection

INPUT DC POWER:

5VDC, $\geq 1.5A$ (Power Only)

(B) Key Data Mode(921600/8/n/1)

INPUT DC POWER:

5VDC, $\geq 1.5A$
(Power + Data)

RESET

DATA LED (Yellow):

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

JUMPER J13 selection for Key Data Mode (921600/8/n/1)

JUMPER J9,J11 at 1,2 position for HAT board pinheader

1 2 3

JUMPER J17 at 1,2 position for Raspberry Pi / Jetson Nano Interrupt Jumper

J21

J20

J22 GND

3 2 1

3 2 1

3 2 1

JUMPER J21,J20 at 1,2 position for Raspberry Pi / Jetson Nano selection

INPUT DC POWER:

5VDC, $\geq 1.5A$ (Power Only)

Batman BM501 mmWave EVM Kit

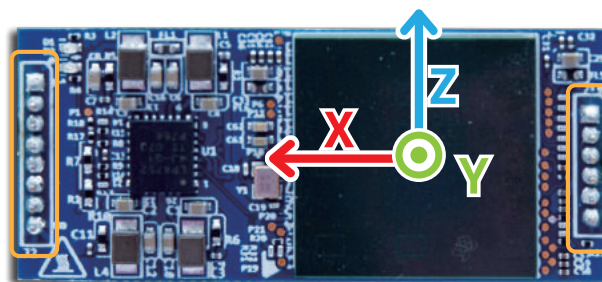
mmWAVE SENSOR EVALUATION SOLUTION

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Batman BM501 Module Pin Assignment Note

J2 Pin Assignment

| Pin# | Name |
|------|-------------------|
| J2.1 | 5VDC_IN |
| J2.2 | RS232_RX0 |
| J2.3 | RS232_TX0 |
| J2.4 | nRST |
| J2.5 | SOP2 |
| J2.6 | MSS_Logger_JB_TX1 |
| J2.7 | GPIO_0 |
| J2.8 | GND |



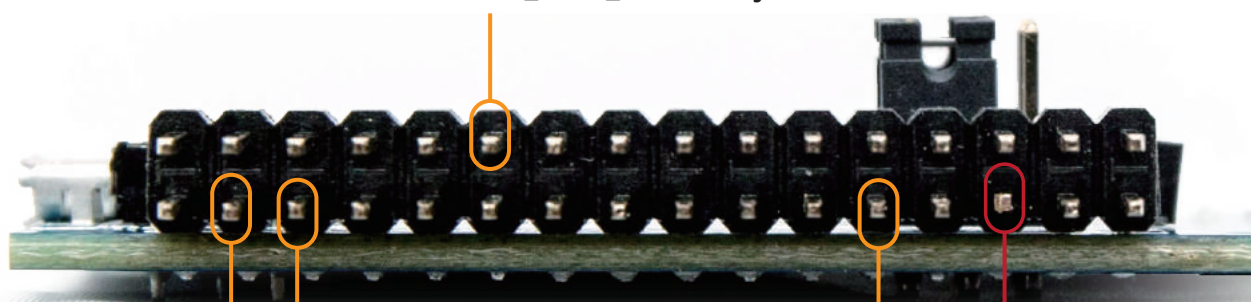
J1 Pin Assignment

| Name | Pin# |
|---------------|------|
| TBD,3V3DC_OUT | J1.1 |
| GPIO_31 | J1.2 |
| GPIO_32 | J1.3 |
| GPIO_2 | J1.4 |
| GPIO_1 | J1.5 |
| GND | J1.6 |

Batman BM501 Carry Board J10 Pin Assignment Note

PINHEADER J10 PIN12_GPIO_0 High: Raw Data Baud Rate 921600/8/n/1 selection for PIN23_TX1

PINHEADER J10 PIN12_GPIO_0 Low : Key Data Baud Rate 921600/8/n/1 selection for PIN23_TX1



PINHEADER J10
PIN5_GND: Ground Pin
PIN5V: 5VDC, 1.5A

PINHEADER J10
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).

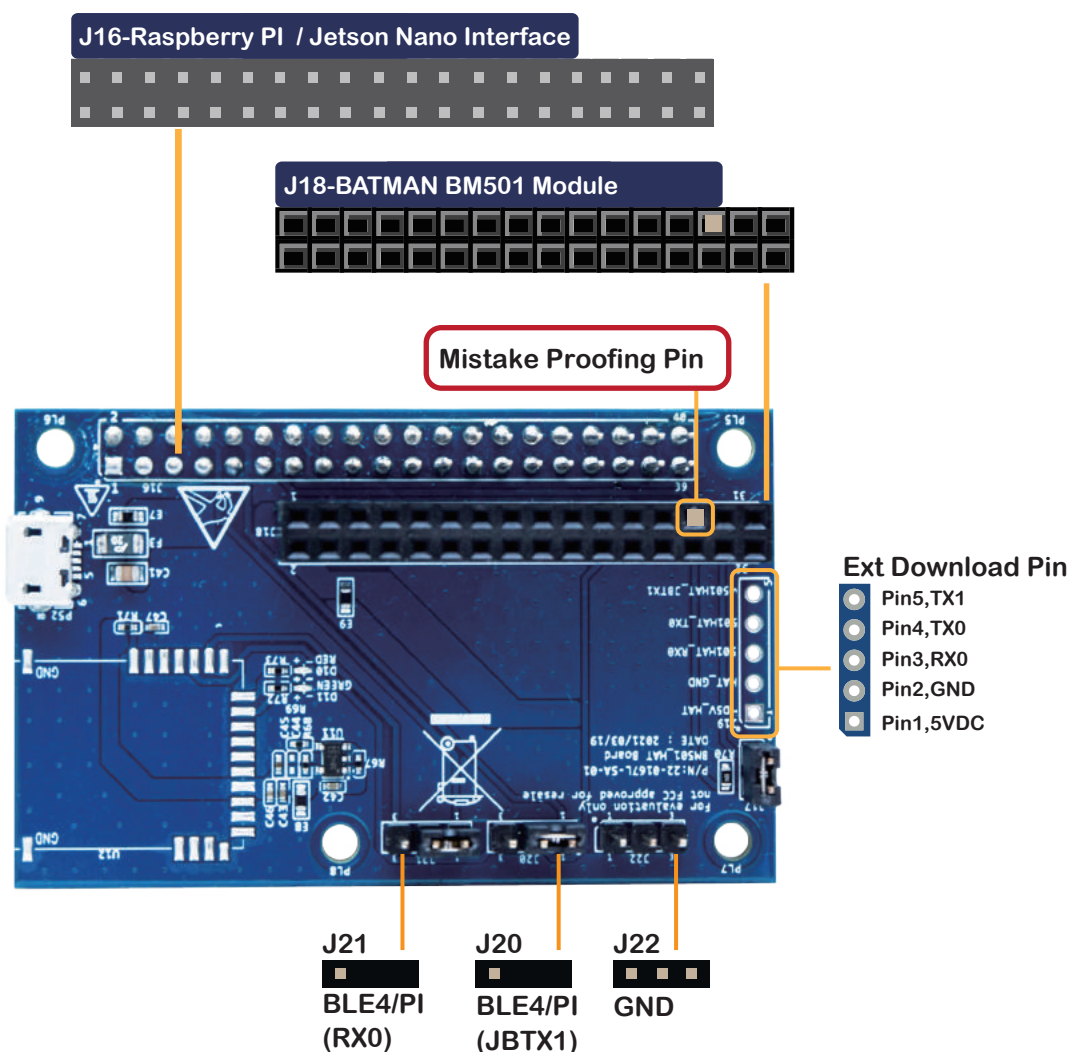
Alert : All GPIO Pins base on 5V System. Pin23_TX1 is DC 5V system.

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mmWave Raspberry Pi Hat Pin Assignment



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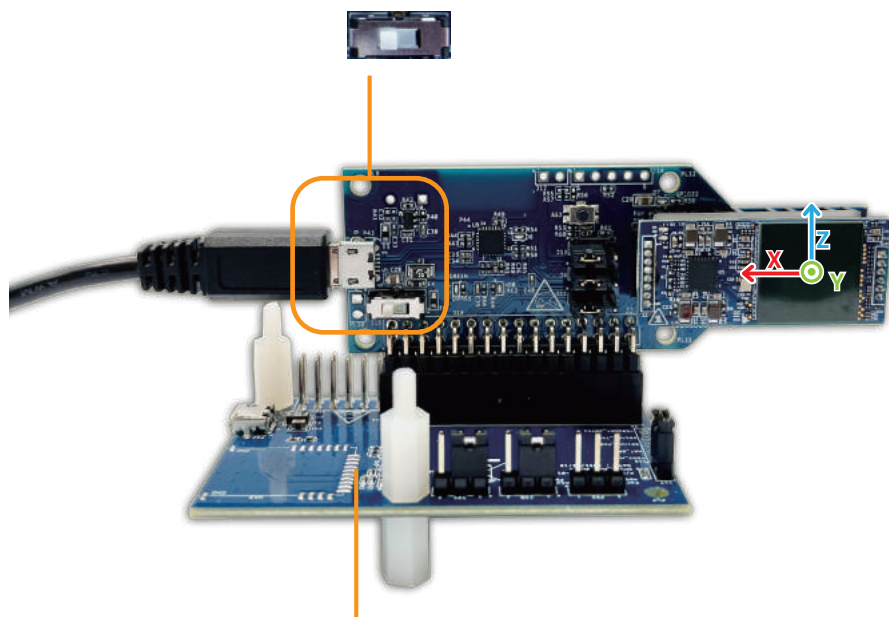
BM501 EVM Kit Installation on Desktop Computer

For hardware connection, please connect BM501 Module on Carrier Board and connect a USB Cable on the Carrier Board's Micro USB connector and move the slider switch to the LEFT side to enable Carrier Board's micro USB Power and Data Transfer capability (near the micro USB Connector), then connect the other side of the USB cable to a PC. Note that the HAT-Board is not used with this configuration electronic function-wise; nonetheless, the HAT-Board can be used as a "stand" for this mmWave set up.

Move the Slider Switch to the LEFT side

Note that the HAT-Board is not used with this configuration electronic function-wise; nonetheless, the HAT-Board can be used as a "stand" for this mmWave set up.

INPUT DC POWER: 5VDC, $\geq 1.5A$ (Power + UART Data)



HAT-Board as mmWave Module Stand only

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BM501 EVM Kit Installation on Desktop Computer

On Software side, please download & install Silicon Labs CP210x USB to UART Bridge Virtual COM Port (VCP) drivers for your Computer (Windows, Mac, or Linux) at:

<https://www.silabs.com/developers/usb-to-uart-bridge-vcp-drivers>

to enable the UART communication between BM501 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 BM501 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 Standard COM 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 Silicon Labs CP210x Standard COM Port assigned, and in this case, it is COM8; so you will need to enable your Python Code to include:

```
port = serial.Serial("COM8",baudrate = 921600, timeout = 0.5)
```

▼ Ports (COM & LPT)



Silicon Labs Dual CP2105 USB to UART Bridge: Enhanced COM Port (COM7)



Silicon Labs Dual CP2105 USB to UART Bridge: Standard COM Port (COM8)

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

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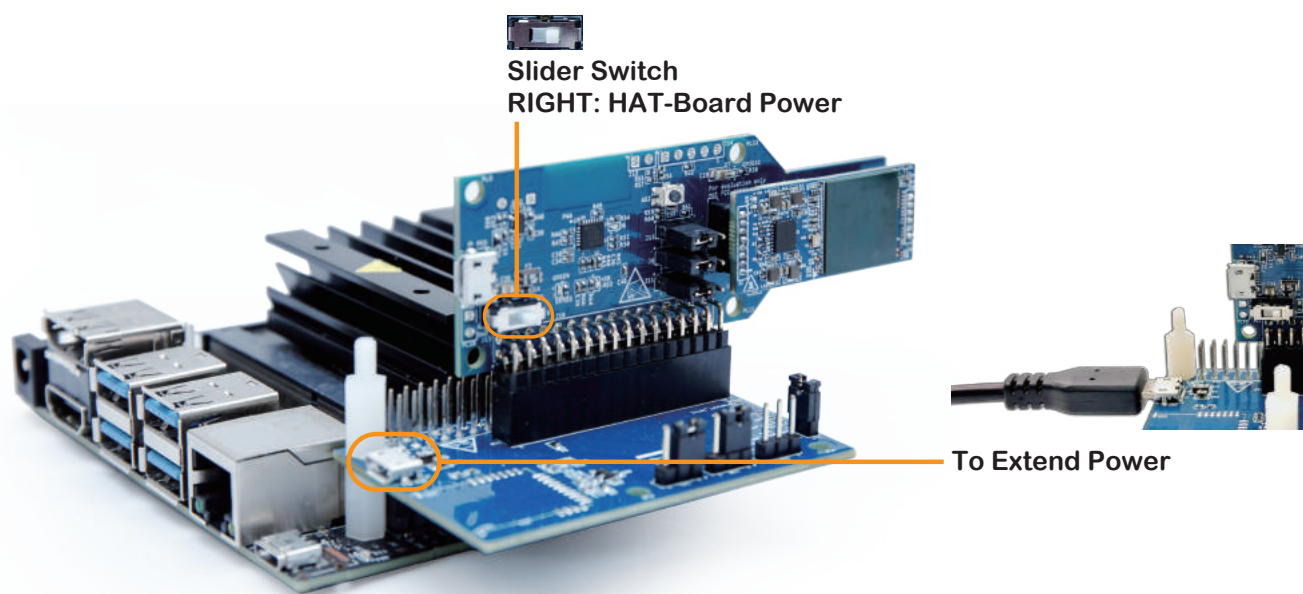
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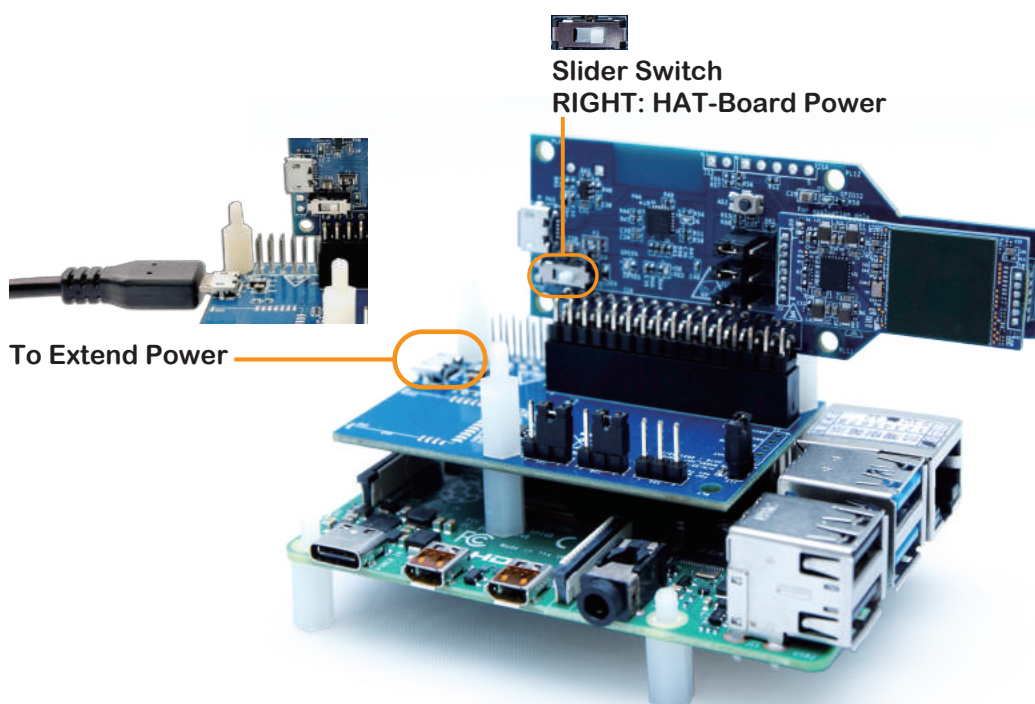
Batman Kit + NVIDIA Jetson Nano / Batman Kit + Raspberry Pi

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

Batman BM501 EVM Kit + Jetson Nano



Batman BM501 EVM Kit + Raspberry Pi



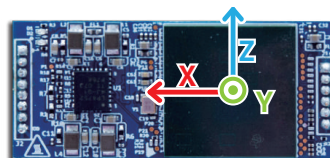
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Specifications

mmWave Sensor Evaluation Module



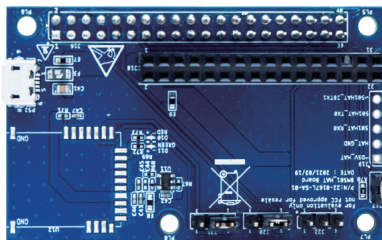
| | |
|---|--|
| mmWave ASIC | TI IWR6843AOP Single Chip mmWave Sensor |
| FMCW Transceiver | <ul style="list-style-type: none"> ● Integrated PLL, Transmitter, Receiver, Baseband, and A2D ● 60GHz to 64GHz Coverage With 4GHz Continuous Bandwidth ● Four Receive Channels ● Three Transmit Channels ● Ultra-Accurate Chirp Engine Based on Fractional-N PLL ● TX Power: 15 dBm ● RX Noise Figure: 9 dB ● Phase Noise at 1 MHz: -92 dBc/Hz ● Antenna Type : Antenna On Package(AOP) |
| Built-in Calibration and Self-Test (Monitoring) | <ul style="list-style-type: none"> ● ARM® Cortex® -R4F-Based Radio Control System ● Built-in Firmware (ROM) ● Self-calibrating System Across Frequency and Temperature |
| DSP | <ul style="list-style-type: none"> ● C674x DSP for Advanced Signal Processing |
| On-Chip Memory | <ul style="list-style-type: none"> ● 1.75MB |
| MCU | <ul style="list-style-type: none"> ● ARM R4F Microcontroller for Object Detection, and Interface Control ● Joybien mmWave Protocol (Per configuration) |
| I/O | <ul style="list-style-type: none"> ● UART x 2 ● GPIO x 2(GPIO_31,GPIO_32) |
| Power Management | <ul style="list-style-type: none"> ● Built-in LDO Network for Enhanced PSRR ● I/Os Support Dual Voltage 3.3 V |
| Clock Source | 40MHz |
| Antenna Orientation | 4 receive(RX) 3 transmit (TX) antenna with 120° azimuth field of view (FoV) and 120° elevation FoV |
| Input Power | 5VDC, 1.5A source |
| Operating Temperature & Humidity | 0°C ~ 40°C 10% ~ 85% Non-Condensing |
| Dimensions & Weight | 37mm x 16mm x 2.4mm ; 3 grams net |

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Raspberry Pi / Jetson Nano Hat Board



| | |
|---|---|
| Connector | <ul style="list-style-type: none"> ● Matching mmWave Module Female Connector ● Matching Raspberry Pi GPIO Female Connector ● Micro USB Power Connector (Power only) ● Jumpers for Bluetooth Tx/Rx or Raspberry Pi Tx/Rx Selection |
| Bluetooth (optional) | <ul style="list-style-type: none"> ● Joybien JBT24M Bluetooth Low Energy Module |
| Micro USB Input Power | <ul style="list-style-type: none"> ● 5VDC, 1.5Amp. <p>(Note: Power Adapter and Micro USB Cable NOT included)</p> |
| Operating Temperature Operating Humidity | <ul style="list-style-type: none"> ● 0° to 40° degree Celsius ● 10 ~ 85% Non-Condensing |
| Dimensions & Weight | <ul style="list-style-type: none"> ● 60mm x 39mm 21 grams |

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mmWave Carrier Board Pin Assignment

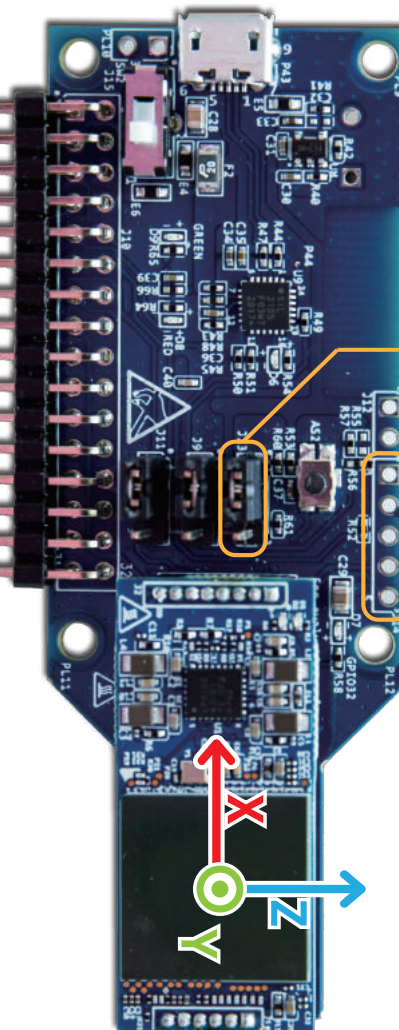
J10 J3 Pin Assignment

| Pin# | Name | Name | Pin# |
|------|----------------------|---------|------|
| 01 | 5VDC | 5VDC | 02 |
| 03 | 5VDC | X | 04 |
| 05 | GND | X | 06 |
| 07 | RS232 RX | X | 08 |
| 09 | RS232 TX | GND | 10 |
| 11 | nRST | GPIO 0 | 12 |
| 13 | GND | X | 14 |
| 15 | GPIO31 | X | 16 |
| 17 | GPIO32 | X | 18 |
| 19 | GND | X | 20 |
| 21 | X | X | 22 |
| 23 | MSS LOGGER JBTX1 | X | 24 |
| 25 | X | GND | 26 |
| 27 | Mistake Proofing Pin | X | 28 |
| 29 | GND | X | 30 |
| 31 | X | GPIO 32 | 32 |

J13 J13 Pin Assignment

13 Rawdata / Keydata

| Name | Pin# |
|-------|------|
| DC 5V | 01 |
| GND | 02 |
| RX0 | 03 |
| TX0 | 04 |
| TX1 | 05 |



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J10 Pin Assignment

“X” = Not applicable

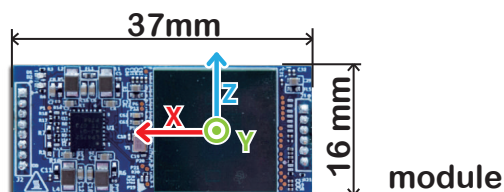
| Pin No | Name | Pin Type | Function Description |
|--------|------------------|----------|-------------------------------------|
| 01 | 5VDC | I | POWER 5VDC Input |
| 02 | 5VDC | I | POWER 5VDC Input |
| 03 | 5VDC | I | POWER 5VDC Input |
| 04 | X | X | X |
| 05 | GND | GROUND | Digital ground |
| 06 | X | X | X |
| 07 | RS232 RX0 | I | UART A Receive |
| 08 | X | X | X |
| 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 | X | X | X |
| 15 | GPIO 31 | IO | GPIO Pin |
| 16 | X | X | X |
| 17 | GPIO 32 | IO | GPIO Pin |
| 18 | X | X | X |
| 19 | GND | GROUND | Digital ground |
| 20 | X | X | X |
| 21 | X | X | X |
| 22 | X | X | X |
| 23 | MSS LOGGER JBTX1 | O | UART B Transmit |
| 24 | X | X | X |
| 25 | X | X | X |
| 26 | GND | GROUND | Digital ground |
| 27 | X | X | Mistake Proofing Pin |
| 28 | X | X | X |
| 29 | GND | GROUND | Digital ground |
| 30 | X | X | X |
| 31 | X | X | X |
| 32 | GPIO2 | O | LED Indicator |

Batman BM501 mmWave EVM Kit

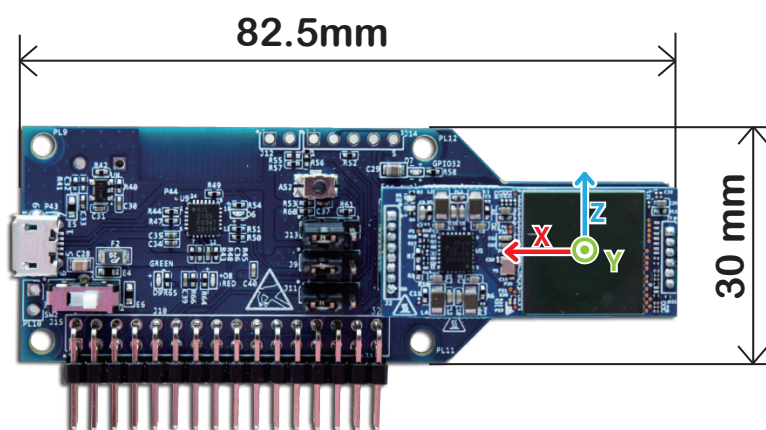
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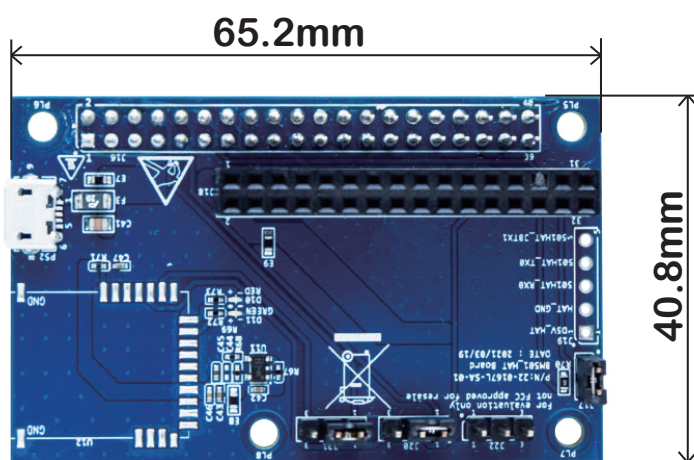
Product Dimensions



module



module + Carrier Board



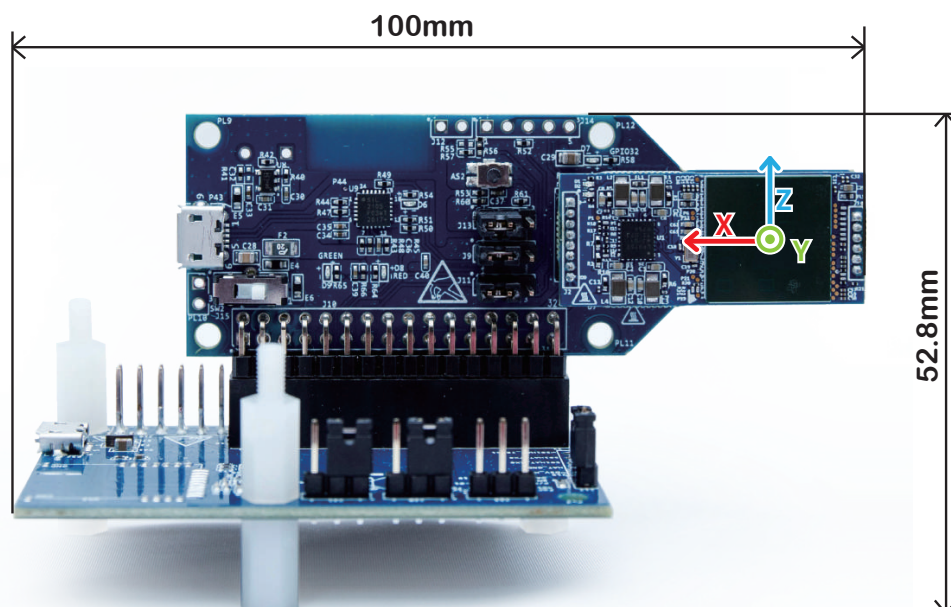
Hat board

Batman BM501 mmWave EVM Kit

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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.

Please contact us at Joybien in advance for BM501 commercial application for mass production.