Batman BM301-FDS mmWave EVM Kit

mmWAVE SENSOR EVALUATION SOLUTION

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Joybien Batman BM301-FDS 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 BM301-FDS 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 People Motion Detection**
- **Building Automation sensor for Occupancy Detection, Proximity & Position sensing, People Counting, Security and Surveillance**

Fall Detection Sensing (FDS)

The Kit's mmWave Module is 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.

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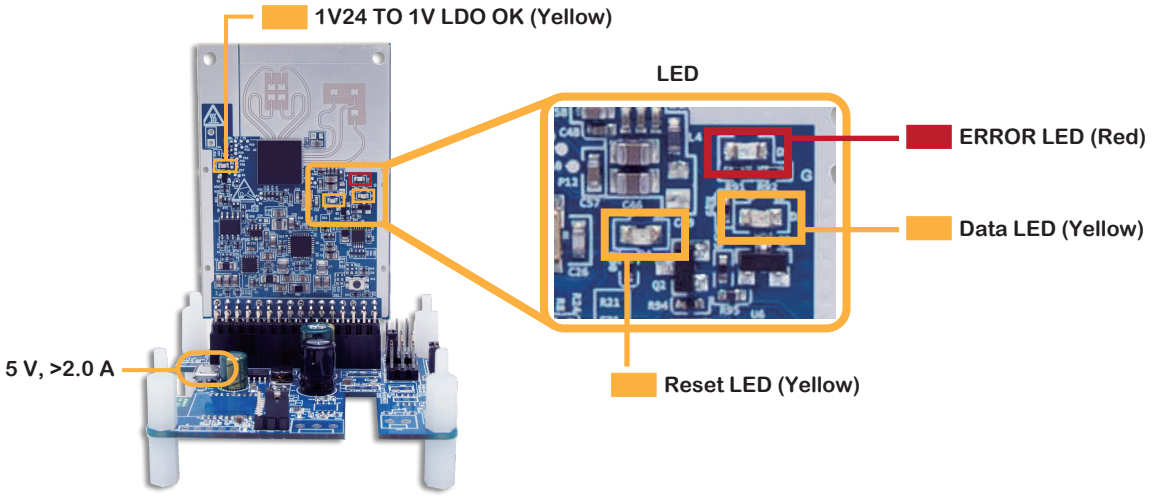
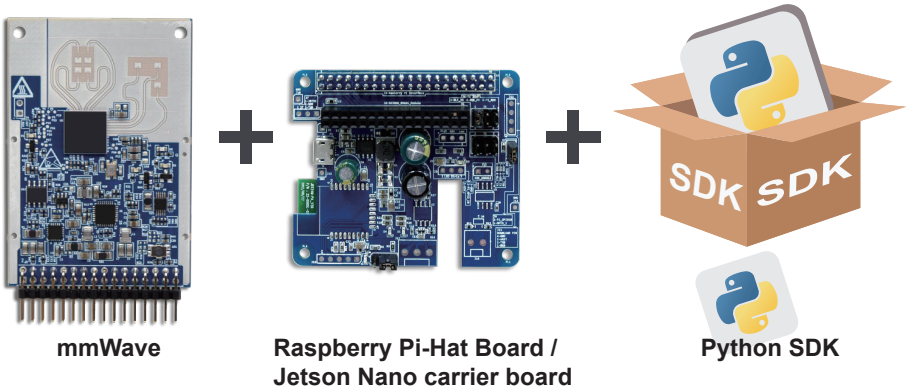
Packing List: mmWave Module, Raspberry Pi-Hat Board, Python SDK

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



Batman BM301-FDS Kit includes	
Fall Detection Sensing	 mmWave + Raspberry Pi-Hat Board / Jetson Nano carrier board + Python SDK

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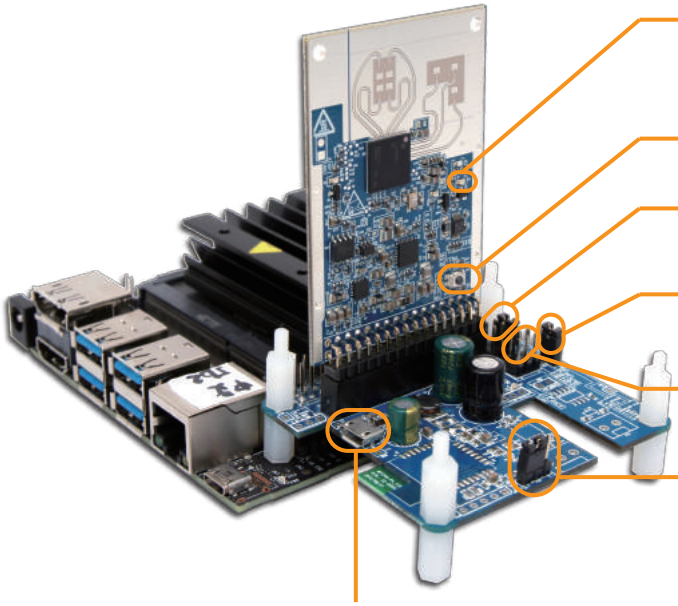
Selection：Key Data Mode or Raw Data Mode Application

(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

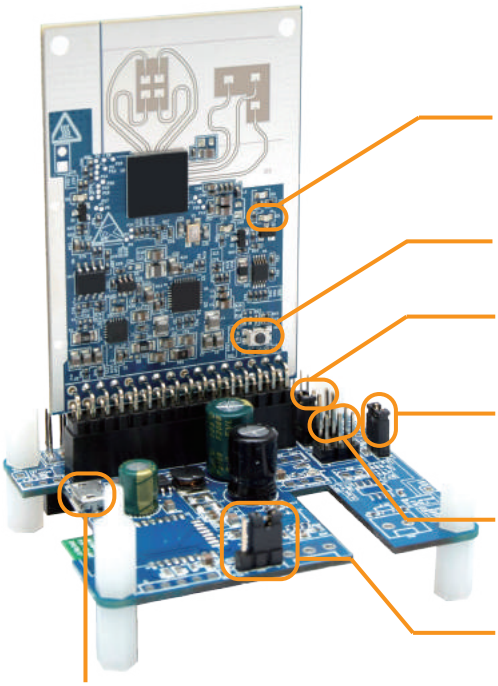
JUMPER J9 at 1,2 position for Raspberry Pi / Jetson Nano Interrupt Jumper

JUMPER J8 at 5,6 position for RX0

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

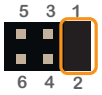
INPUT DC POWER: 5VDC, >= 2A

(B) Key Data Mode



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

INPUT DC POWER:
5VDC, >= 2A

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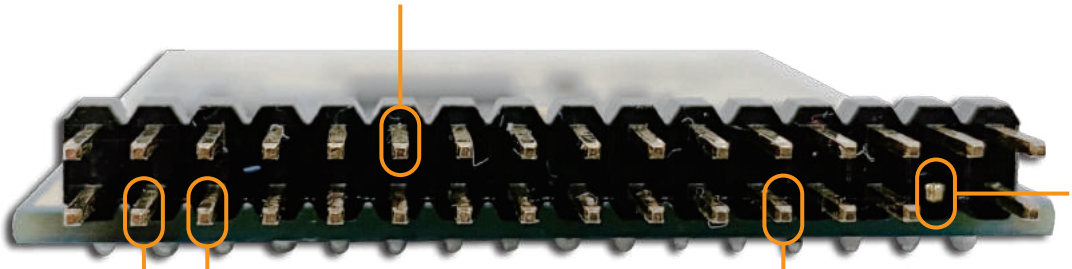
Batman BM301 Module J3 Pin Assignment Note

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_3V: 3VDC, 2A

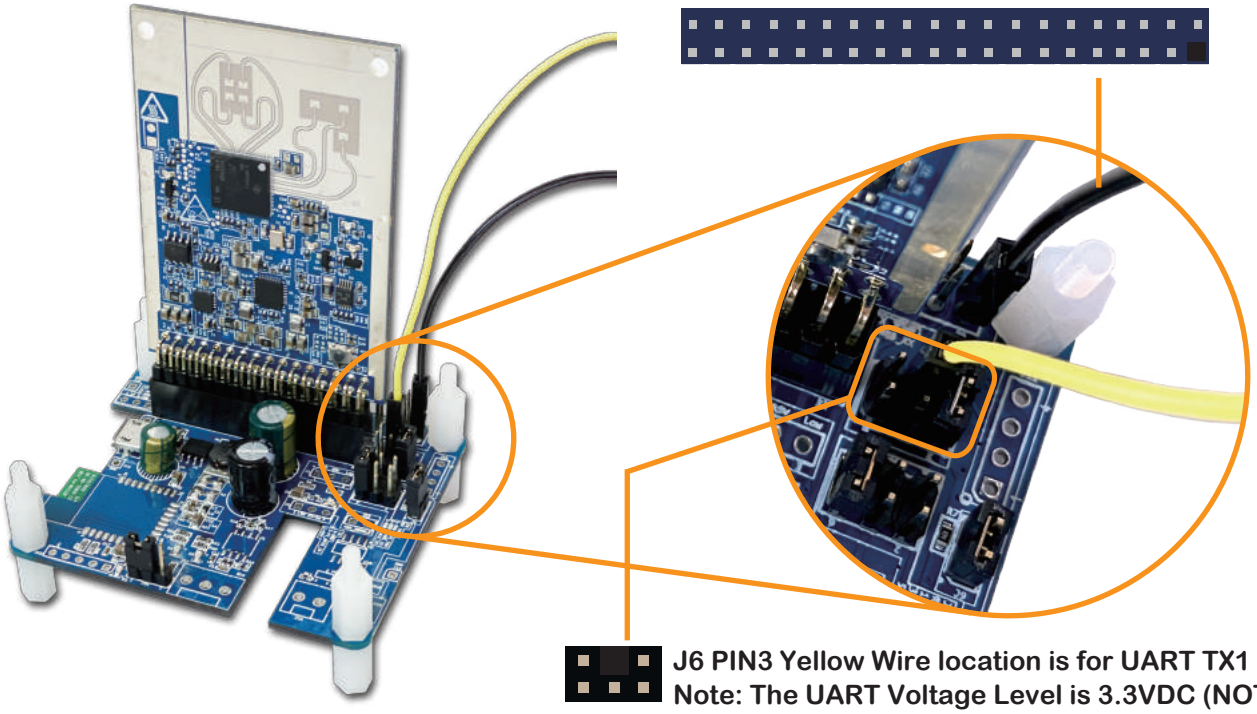
PINHEADER J3
PIN23_TX1:
The UART TX1 Voltage Level
is 3.3VDC (NOT 5VDC).
Please handle with care

Alert : All GPIO Pins base on 3.3V System. Pin23_TX1 is DC 3.3V system.

Batman BM301 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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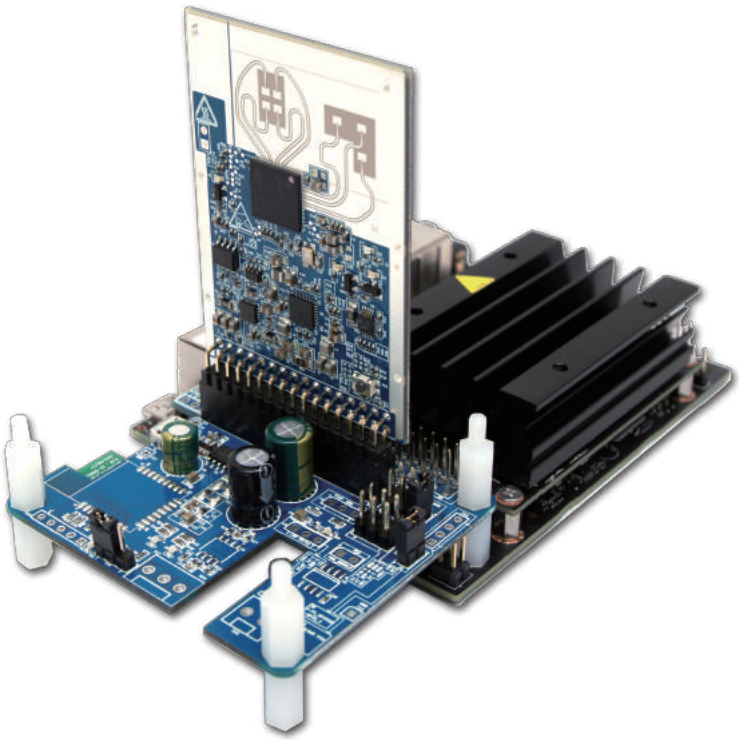
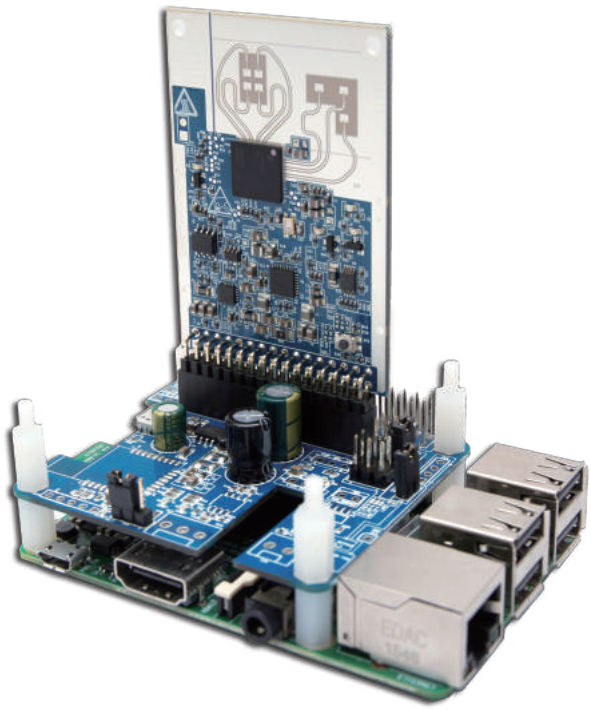
Batman Kit + NVIDIA Jetson Nano / Batman Kit + Raspberry Pi

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

Batman BM301 EVM Kit + Jetson Nano



Batman BM301 EVM Kit + Raspberry Pi



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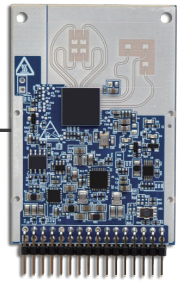
Specifications

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 : ODS 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 120° azimuth field of view (FoV) and 120° 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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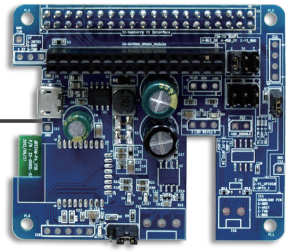
Raspberry Pi-Hat Board / Jetson Nano carrier board



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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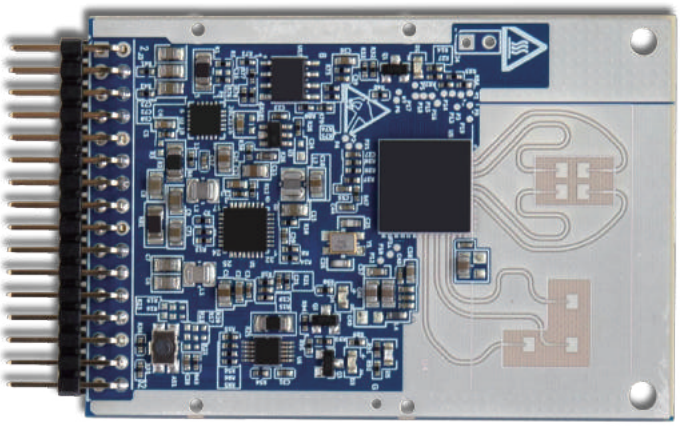
mmWave Pin Assignment

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	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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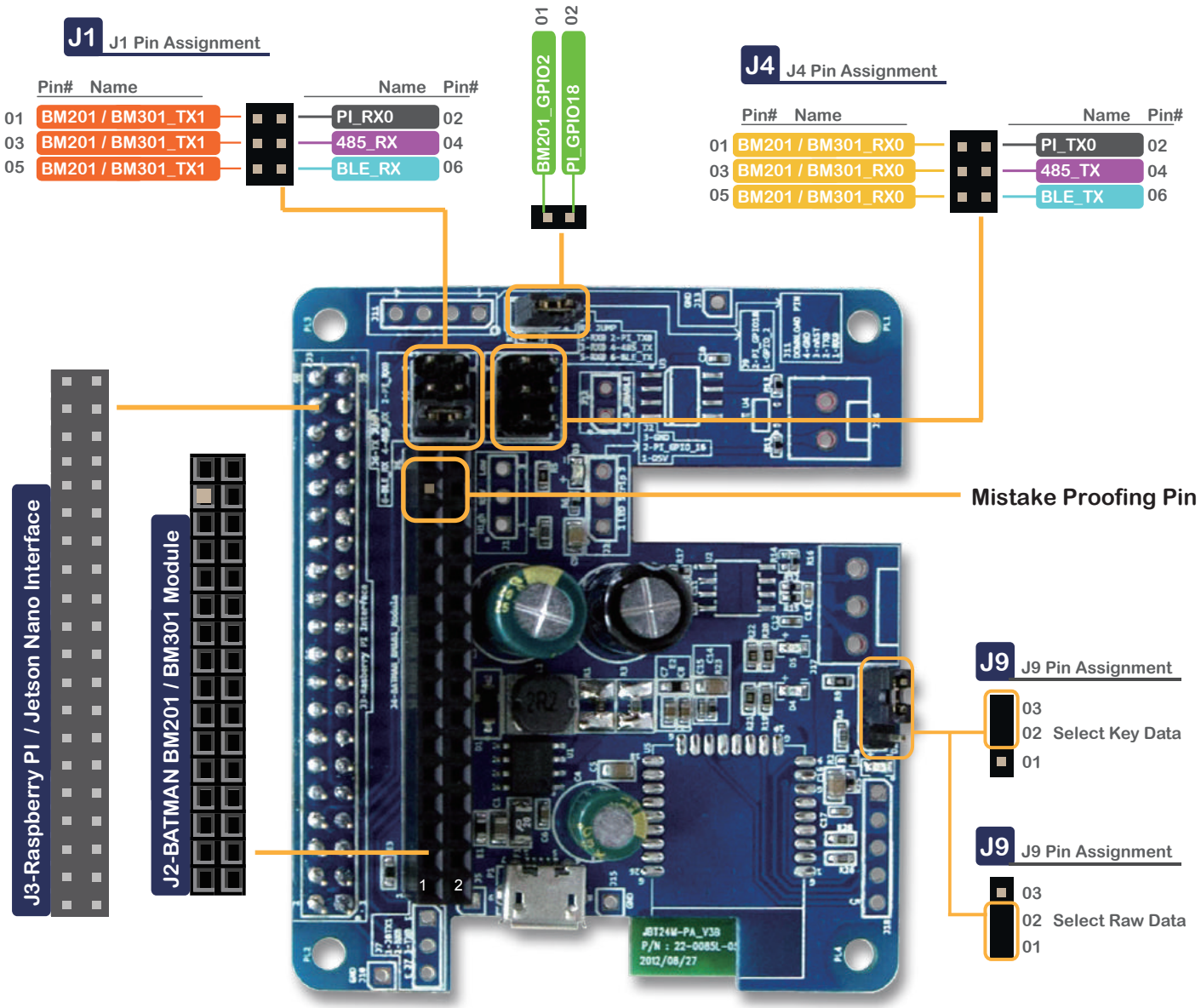
mmWave Raspberry Pi Hat Pin Assignment



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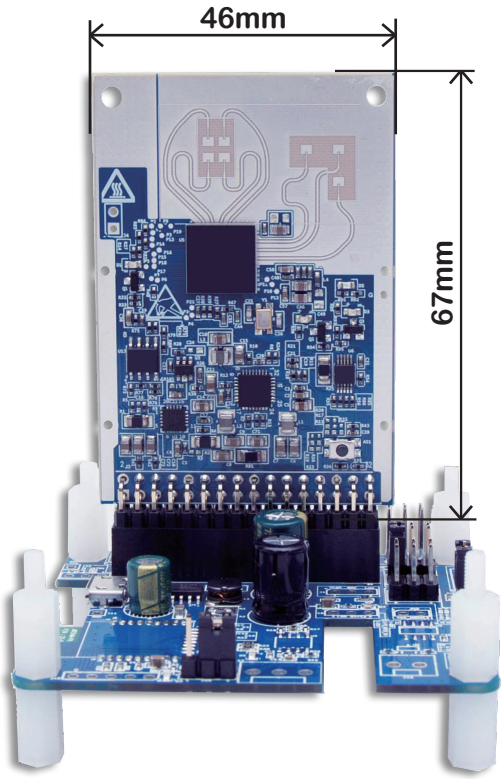
Product Dimensions



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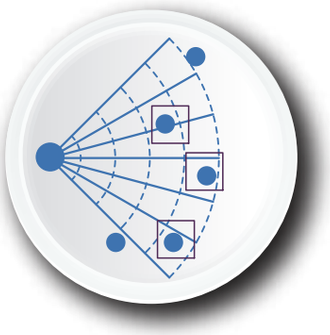
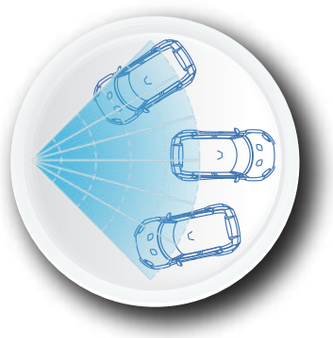
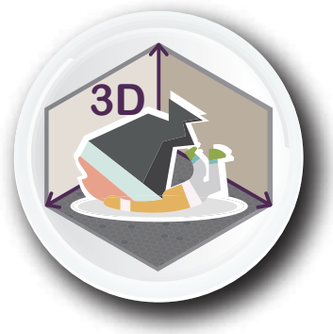
Raspberry Pi logo and Raspberry Pi 4 are trademarks and/or registered trademarks of Raspberry Pi Foundation.
"Python" is a registered trademark of the PSF.
This EVM Kit does not include Raspberry Pi computer, nor NVIDIA Jetson Nano computer.

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.