

# **Product Specification Of WM-BN-MT-52(ACK) Module**

## Introduction

The WM-BN-MT-52 is a small size module and provides an IPEX RF connector (w/o antenna) or onboard 2.4GHz antenna (w antenna) options.

The WN-BN-MT-52 module works with the Alexa Connect Kit, which means it has preloaded firmware that provides the ability to connect to Alexa.

The Alexa Connect Kit (ACK) is a way for device makers to connect devices to Alexa without worrying about managing cloud services, writing an Alexa skill, or developing complex networking and security firmware. ACK enables device makers to make any device an Alexa-connected smart device. With ACK, you pay for the hardware module and a low, upfront fee that covers your ongoing use of the ACK cloud service. ACK enables you to turn the ongoing and variable cost of managing your own cloud service into a fixed, one-time cost. While you build and manage devices more quickly and economically, your customers enjoy Alexa control, Wi-Fi simple setup, and (optionally) the Amazon Dash Replenishment Service.”

For the software and driver development, please contact Amazon.com.

## Features

### WM-BN-MT-52(ACK) Wireless Module

- Single band 2.4GHz IEEE 802.11b/g/n + BT4.2
- ARM 32-bit Cortex-M4 CPU
- Low power consumption and excellent power management performance which extends battery life
- Small size suitable for low volume system integration
- Three options for RF – LGA/IPEX SW23(w/o antenna) and onboard antenna(w antenna)
- Lead Free design which supporting Green design requirement, RoHS Compliance

### Device Package

**w/o antenna 16 x 16 x 1.92 mm**

**w antenna 16 x 23 x 1.87 mm**



## 802.11b/g/n + BT4.2 Alexa Connect Kit REV 1.2

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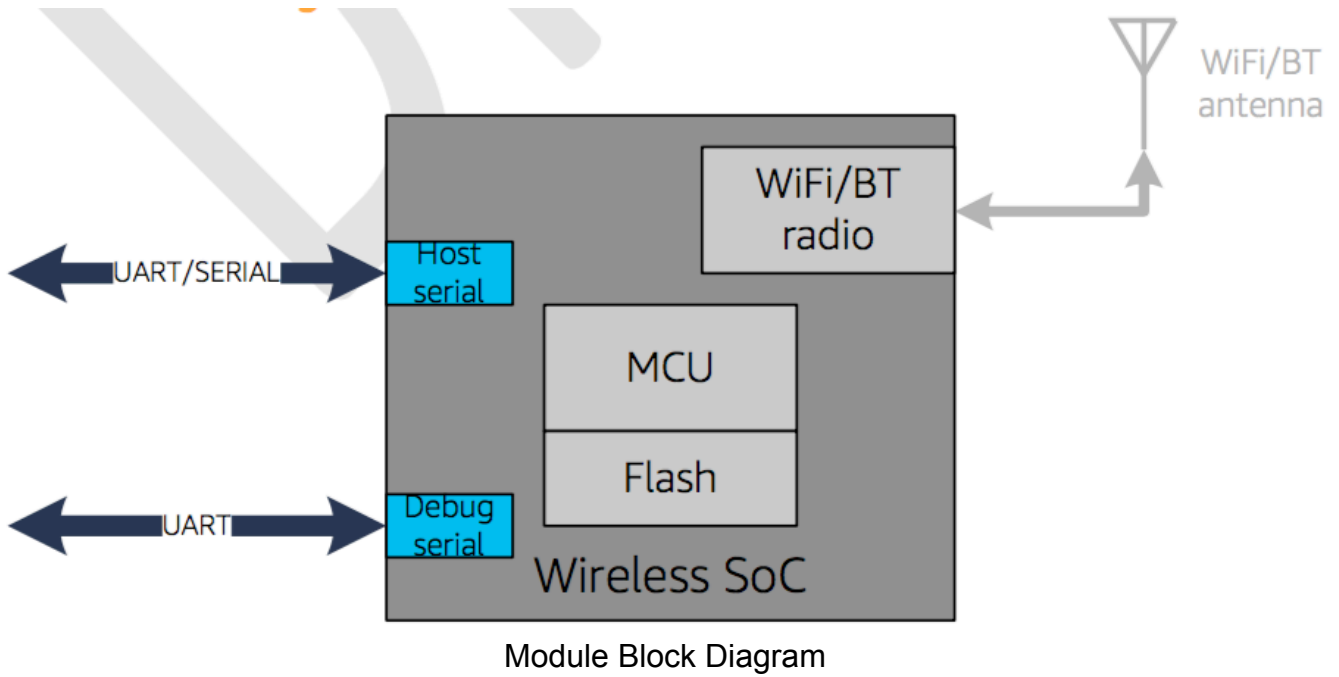
Change Lists					
Rev.	Date	Description of document change			Changed by
		Page	Par	Change(s)	
1.0	11/07/18	All	All	Initial Release	Chintang Lin
1.1	12/14/18	2		Wording optimization	Chintang Lin
1.2	09/16/19	2,19		Wording optimization and update reflow profile	Chintang Lin

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### 1. BLOCK DIAGRAM

The WM-BN-MT-52(ACK) module supports UART interface to connect the chipset to the host processor. A simplified block diagram of the WM-BN-MT-52(ACK) module is depicted in below Figure.



### 2. REFERENCE DOCUMENTS

C.I.S.P.R. Pub. 22	"Limits and methods of measurement of radio interference characteristics of information technology equipment." International Special Committee on Radio Interference (C.I.S.P.R.), Third Edition, 1997.
CB Bulletin No. 96A	"Adherence to IEC Standards: "Requirements for IEC 950, 2 <sup>nd</sup> Edition and Amendments 1 (1991), 2(1993), 3 (1995) and 4(1996). Product Categories: Meas, Med, Off, Tron." IEC System for Conformity Testing to Standards for Safety of Electrical Equipment (IECEE), April 2000.
CFR 47, Part 15-B	"Unintentional Radiators". Title 47 of the Code of Federal Regulations, Part 15, FCC Rules, Radio Frequency Devices, Subpart B.
CFR 47, Part 15-C	"Intentional Radiators". Title 47 of the Code of Federal Regulations, Part 15, FCC Rules, Subpart C. URL: <a href="http://www.access.gpo.gov/nara/cfr/waisidx_98/47cfr15_98.html">http://www.access.gpo.gov/nara/cfr/waisidx_98/47cfr15_98.html</a>
CSA C22.2 No. 950-95	"Safety of Information Technology Equipment including Electrical Business Equipment, Third Edition." Canadian Standards Association, 1995, including revised pages through July 1997.
EN 60 950	"Safety of Information Technology Equipment Including Electrical Business Equipment." European Committee for Electrotechnical Standardization (CENELEC), 1996, (IEC 950, Second Edition, including Amendment 1, 2, 3 and 4).
IEC 950	"Safety of Information Technology Equipment Including Electrical Business Equipment." European Committee for Electrotechnical Standardization, Intentional Electrotechnical Commission. 1991, Second Edition, including Amendments 1, 2, 3, and 4.
IEEE 802.11	"Wireless LAN Medium Access Control (MAC) And Physical Layer (PHY) Specifications." Institute of Electrical and Electronics Engineers. 1999.

## 3. TECHNICAL SPECIFICATIONS

### 3.1 ABSOLUTE MAXIMUM RATING

Supply Power	Max +3.5 Volt	
Non Operating Temperature	- 40° to 85° Celsius	
Voltage ripple	+/- 2%	Max. Values not exceeding Operating voltage

### 3.2 RECOMMEND OPERATION CONDITION

#### TEMPERATURE, HUMIDITY

The WM-BN-MT-52 module has to withstand the operational requirements as listed in the table below

Operating Temperature	-30° to 85° Celsius	
Specification Temperature	-20° to 70° Celsius	
Humidity range	Max 85%	Non condensing, relative humidity

All RF characteristics defined in the spec sheet are compliant in Specification Temperature Range. Functionality is guaranteed but performance may derate at extreme temperatures.

#### VOLTAGE

Power supply for the WM-BN-MT-52 module will be provided by the host via the power pins

Symbol	Parameter	Min.	Typ.	Max.	Unit
VCC	Power Supply for MCU	3.1	3.3	3.5	V

#### CURRENT CONSUMPTION

The WM-BN-MT-52 on TX mode Output current Consumption :

(Typical spec is defined @3.3V 25DegC ; MAX. spec is defined @3.1V 70DegC)

Current Consumption	TYP.* <sub>1</sub>	MAX.* <sub>1</sub>	MAX.* <sub>2</sub>
Tx output power @18 dBm on 11b 1M	260mA	320mA	340mA
Tx output power @ 18 dBm on 11b 11M	250mA	310mA	340mA
Tx output power @ 16 dBm on 11g 6M	230mA	290mA	300mA
Tx output power @ 15 dBm on 11g 54M	180mA	225mA	260mA
Tx output power @ 16dBm on 11n MCS0	240mA	280mA	300mA
Tx output power @ 15 dBm on 11n MCS7	180mA	225mA	260mA
Tx output power @ 5 dBm on BLE	65mA	125mA	125mA

\*1. WiFi packet Tx mode, the current consumption is measured at duty-on period.

\*2. WiFi continuous Tx mode, the current consumption is measured averagely.

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The WM-BN-MT-52 on RX mode current Consumption :

(Typical spec is defined @3.3V 25DegC ; MAX. spec is defined @3.1V 70DegC)

Current Consumption	TYP.	MAX.
Rx @ 11b 1M	80mA	105mA
Rx @ 11b 11M	80mA	105mA
Rx @ 11g 6M	80mA	105mA
Rx @ 11g 54M	80mA	105mA
Rx @ 11n MCS0	80mA	105mA
Rx @ 11n MCS7	80mA	105mA
Rx @ BT	45mA	105mA

### 3.3 WIRELESS STANDARDS

#### 3.3.1 WLAN

The WM-BN-MT-52 module complies with the following features and standards;

Features	Description
WLAN Standards	IEEE 802 11b/g/n
Antenna Port	Single Antenna
Frequency Band	2.400 GHz – 2.484 GHz
Number of Sub Channels	1~ 14 Channels
Modulation	DSSS, CCK, OFDM, BPSK, QPSK, 16QAM, 64QAM
Supported data rates	1, 2, 5.5, 11 (Mbps) 6, 9, 12, 18, 24, 36, 48, 54 (Mbps) HT20_MCS0(6.5Mbps) ~ HT20_MCS7(65Mbps)



## 802.11b/g/n + BT4.2 Alexa Connect Kit REV 1.2

### 3.3.2 BLUETOOTH

The Radio specification is compliant with the Bluetooth 4.2 specification

Features	Description
Frequency Band	2402 MHz ~ 2480 MHz
Number of Channels	Channel 0~39
Modulation	GFSK
Antenna Port	Single Antenna (LGA/IPEX/onboard antenna) for Wi-Fi and BT

### 3.4 RADIO SPECIFICATIONS

#### 3.4.1 WIFI'S OUTPUT POWER 、 EVM 、 SENSITIVITY

The WM-BN-MT-52 module WiFi output power is listed in the table below:

Characteristics		TYP.	Criteria	Unit
RF Average Output Power, 802.11b CCK Mode	1M	18	+/- 2	dBm
	11M	18	+/- 2	dBm
RF Average Output Power, 802.11g OFDM Mode	6M	16	+/- 2	dBm
	54M	15	+/- 2	dBm
RF Average Output Power, 802.11n OFDM Mode	MCS0	16	+/- 2	dBm
	MCS7	15	+/- 2	dBm

WiFi TX EVM follows the IEEE spec that is listed in the table below:

Characteristics		IEEE Spec	Unit
RF Average Output EVM (11b)	@1 Mbps	-10	dB
	@11 Mbps	-10	dB
RF Average Output EVM (11g)	@6 Mbps	-5	dB
	@54 Mbps	-25	dB
RF Average Output EVM (11n)	@ MCS0	-5	dB
	@ MCS7	-27	dB

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The WM-BN-MT-52 module WiFi Sensitivity is listed in the table below:

Receiver Characteristics	TYP.	MAX.	Unit
PER <8%, Rx Sensitivity @ 1 Mbps	-96	-92	dBm
PER <8%, Rx Sensitivity @ 11 Mbps	-88	-84	dBm
PER <10%, Rx Sensitivity @ 6 Mbps	-93	-89	dBm
PER <10%, Rx Sensitivity @ 54 Mbps	-75	-71	dBm
PER <10%, Rx Sensitivity @ MCS0	-92	-88	dBm
PER <10%, Rx Sensitivity @ MCS7	-73	-69	dBm

### 3.4.2 BLUETOOTH RADIO CHARACTERISTICS

Parameter	Conditions	Min.	Typ. <sup>*b</sup>	Max. <sup>*c</sup>	Unit
<b>BLE</b>					
BLE Output Power	Average Power	1	5	9	dBm
BLE Sensitivity (PER)	PER <30.8%	-	-95	-90	dBm
BLE Maximum Input Level	PER <30.8%	-	-	-10 <sup>*a</sup>	dBm

\* Note: a. Refer to Bluetooth specification.

b. Based on the test result at room temperature and typical voltage.

c. Based on the test result at the corner temperature and voltage operating.

\*\* Note: The WiFi/BT Performance will be updated after RF and reliability verifications

## 4. I/O PORT CHARACTERISTICS

Unless otherwise specified, the parameters are given as below *Table*.

Table4-1 I/O Static Characteristics on 3.3V VDD\_IO

Symbol	Parameter	Conditions	MIN	MAX	Unit
V <sub>IL</sub>	Input low Voltage	LVTTL	-0.28	0.8	V
V <sub>IH</sub>	Input High Voltage		2	3.63	V
V <sub>OL</sub>	Output Low Voltage	I <sub>OL</sub>   = 4~16 mA	-0.28	0.4	V
V <sub>OH</sub>	Output High Voltage	I <sub>OH</sub>   = 4~16 mA	2.4	VDD33+0.33	V
R <sub>PU</sub>	Input Pull-Up Resistance	PU=high,PD=low	40	190	KΩ
R <sub>PD</sub>	Input Pull-Down Resistance	PU=low, PD=high	40	190	KΩ

### 5. INTERFACES

ACK connectivity Module :

- Two UART interfaces, one to interface with the host MCU and one for debugging
- I2C port for host MCU (not enabled at this time)
- Interrupt pin for host interface (mandatory)
- Power enable and Reset pins for host interface (optional)

#### 5.1 UART

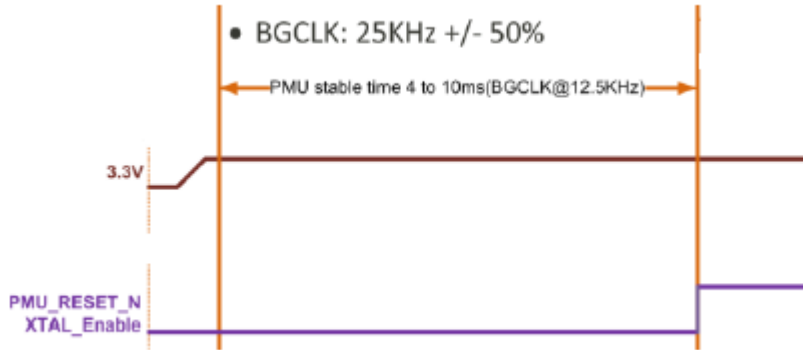
The host UART connects to a host at 115,200bps.

#### 5.2 I2C

Not enabled at this time.

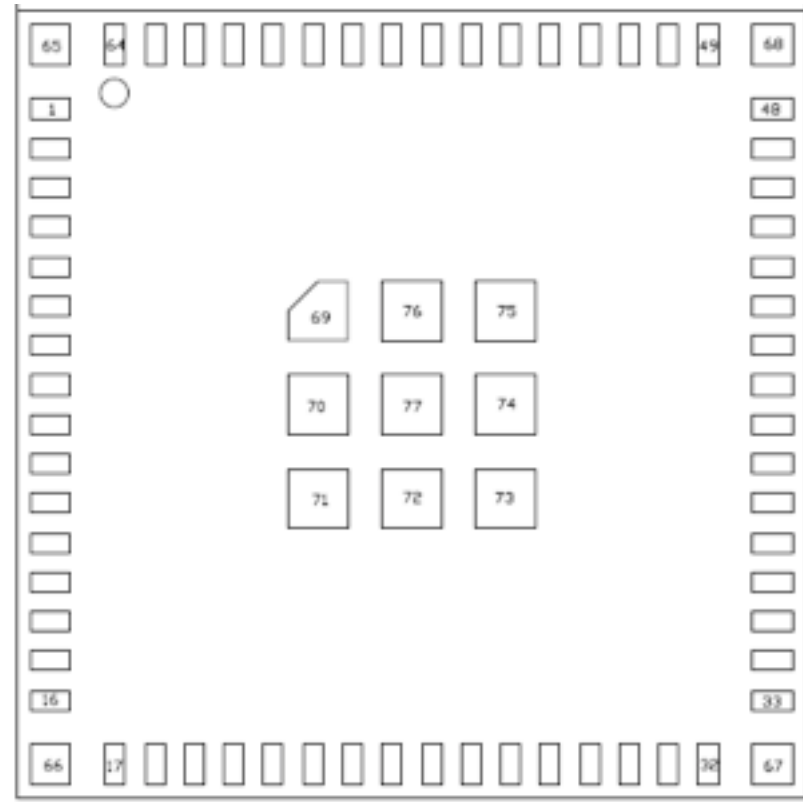
## 6. POWER ON SEQUENCE

The power-on control sequence diagram shows how the PMU\_RESET\_N is generated on the chip.



## 7. MODULE DIMENSIONS

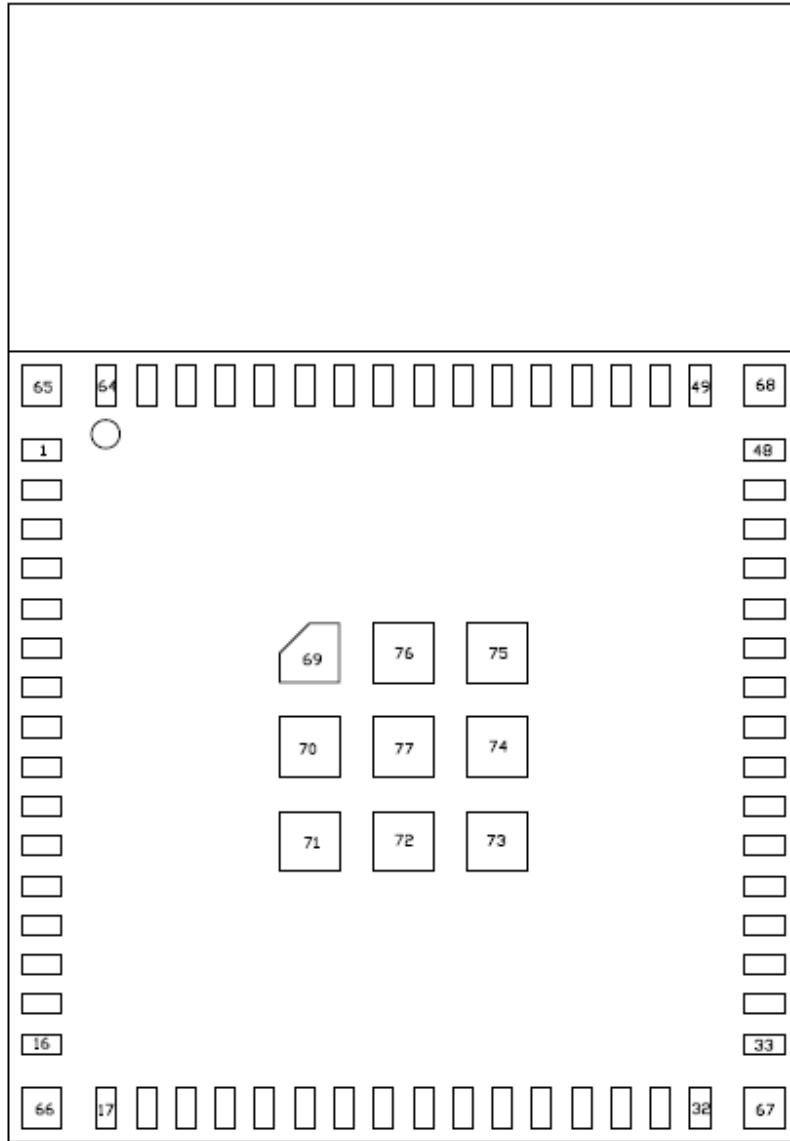
The WM-BN-MT-52(ACK) module size and thickness are w/o antenna “16 +/-0.1mm(W) x 16 +/-0.1mm (L) x 1.92 +0.28/-0.18mm (H)” and w antenna “16 +/-0.1mm(W) x 23 +/-0.1mm (L) x 1.87 +/-0.13mm (H) (Including metal shield)



w/o antenna (Top View)

# 802.11b/g/n + BT4.2 Alexa Connect Kit REV 1.2

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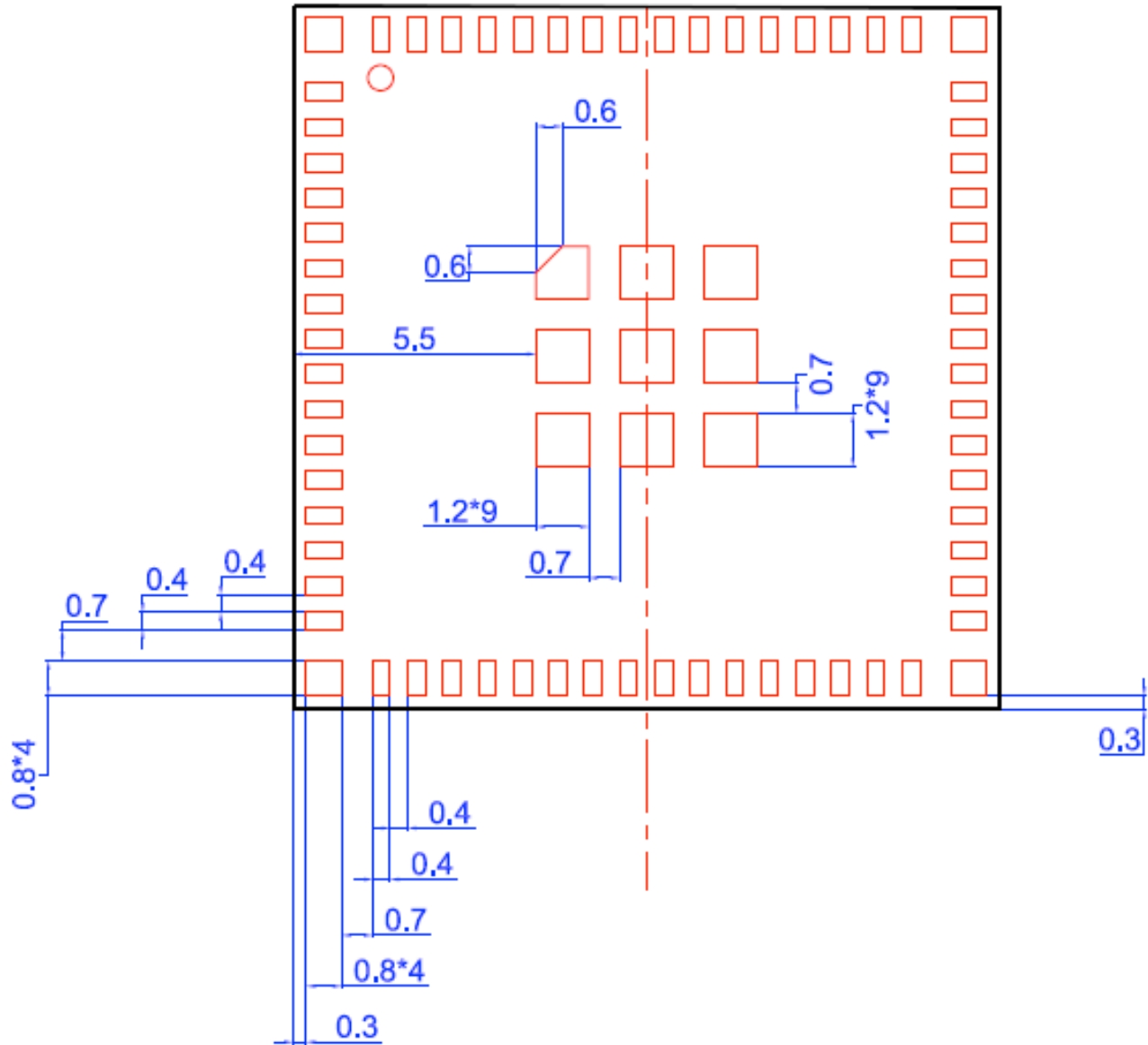


w antenna (Top View)

## 8. PIN DESCRIPTION

Pin-Number	Pin-Define	Type	Description	Notes
12, 20, 21, 23-32, 37, 42, 44, 50-77	GND	Power	Ground	
22, 43	VCC	Power	3.3V supply	
41	UART_TX	Output	UART transmit	Connect to host RX
45	UART_RX	Input	UART receive	Connect to host TX
47	HOST_INT_B	Output	Host interrupt	Connect to host GPIO
3	DBG_RX	Input	Debug receive	Needed for manufacturing/debug
4	DBG_TX	Output	Debug transmit	Needed for manufacturing/debug
19	PWR_EN	Input	Power enable	Optional
39	RESET_B	Input	Reset for module	Optional
15	I2C_CLK	Input	I2C Clock	Not implemented yet
17	I2C_DAT	Bi-directional	I2C Data	Not implemented yet
1, 2, 5-11, 13, 14, 16, 18, 33-36, 38, 40, 46, 48	NC	NA	Do not connect	
49	GND	Power	Ground	w antenna sku
	ANT	Output	WiFi/BT RF	w/o antenna sku

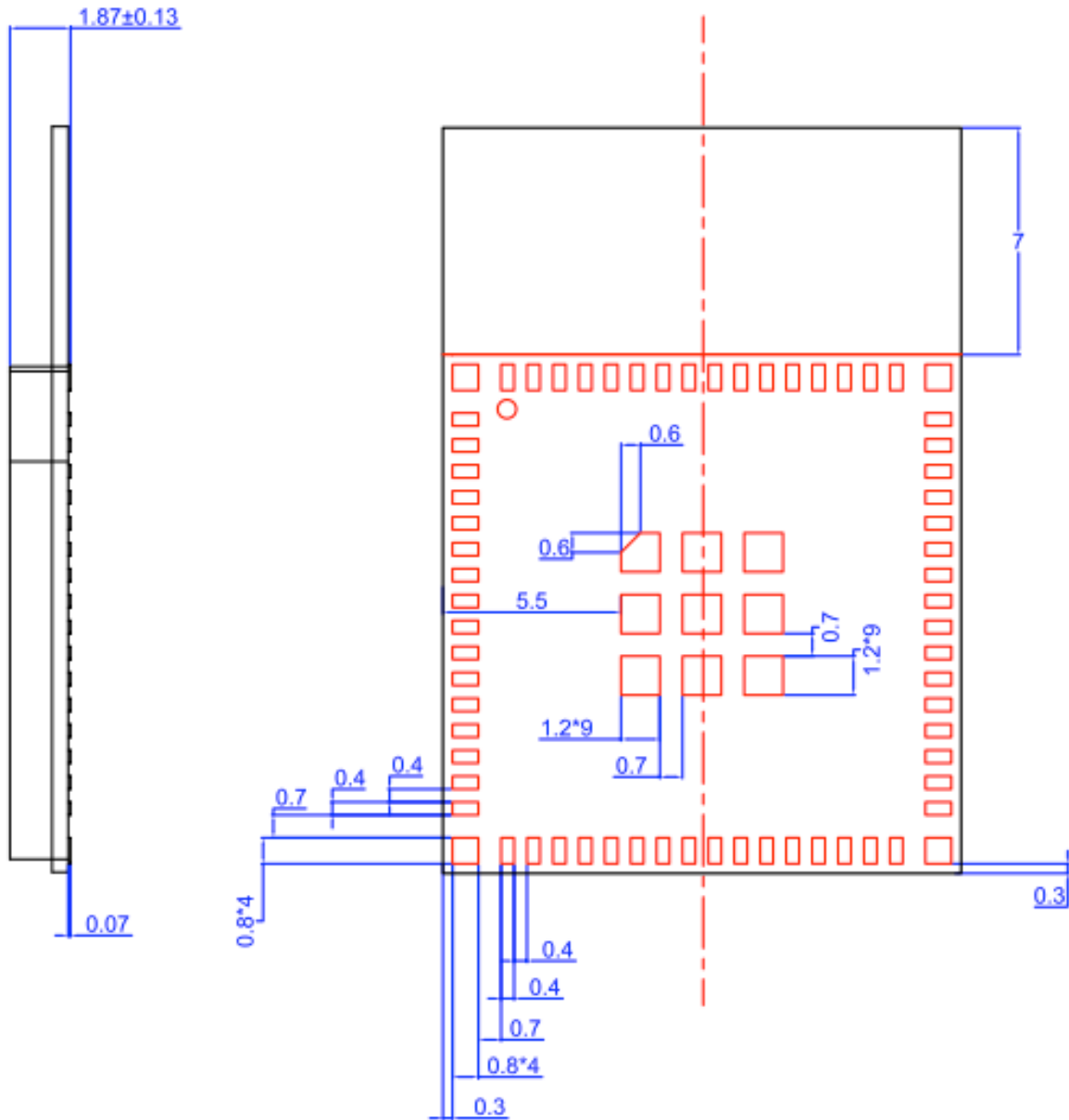
## 9. I/O PORT CHARACTERISTICS MODULE DIMENSIONS & RECOMMENDED LAYOUT



w/o antenna Top view / Unit:mm

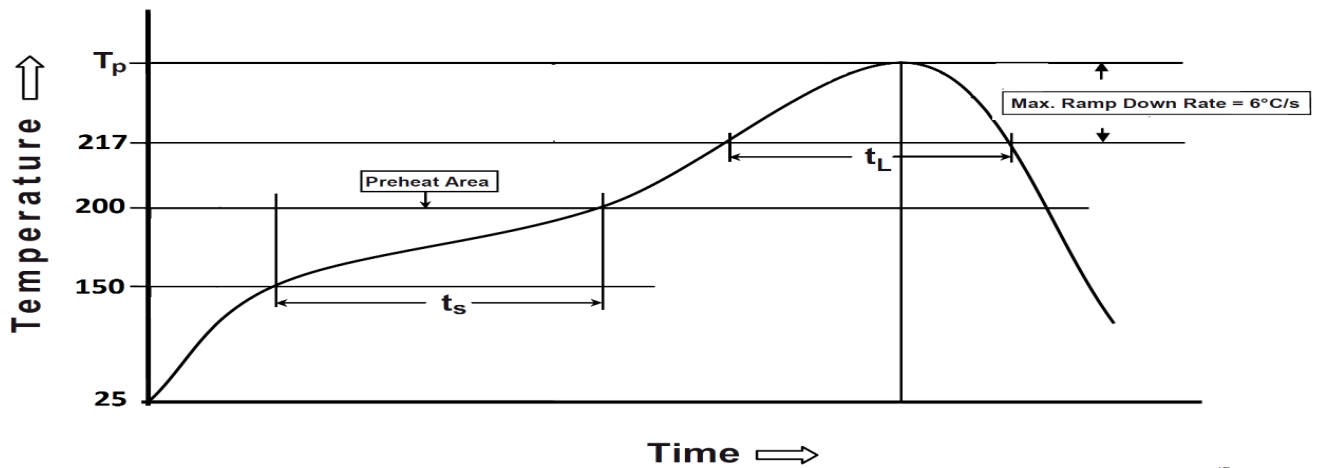


# TOP View



w antenna Top view / Unit : mm

## 10. RECOMMENDED REFLOW PROFILE



- (1) Solder paste alloy: SAC305(Sn96.5/Ag3.0/Cu0.5)
- (2) Pre-heat/ Soak time ( $t_s$ ) from 150°C to 200°C: 60~120s
- (3) Time ( $t_L$ ) above 217°C: 60~150s
- (4) Peak temp.( $T_p$ ):
  - (4.1) 235~250°C for solder joint (It should also take recommendation from specification of solder paste into consideration)
  - (4.2) <250°C for component body<sup>\*1</sup>
- (5) Ramp-down rate ( $T_p$  to 217°C): 6°C/s max
- (6) The oxygen concentration <2000ppm

\*1: The peak temperature for component body should take package size into account. Please refer table below to find proper peak temperature limitation (Reference: J-STD-020D)

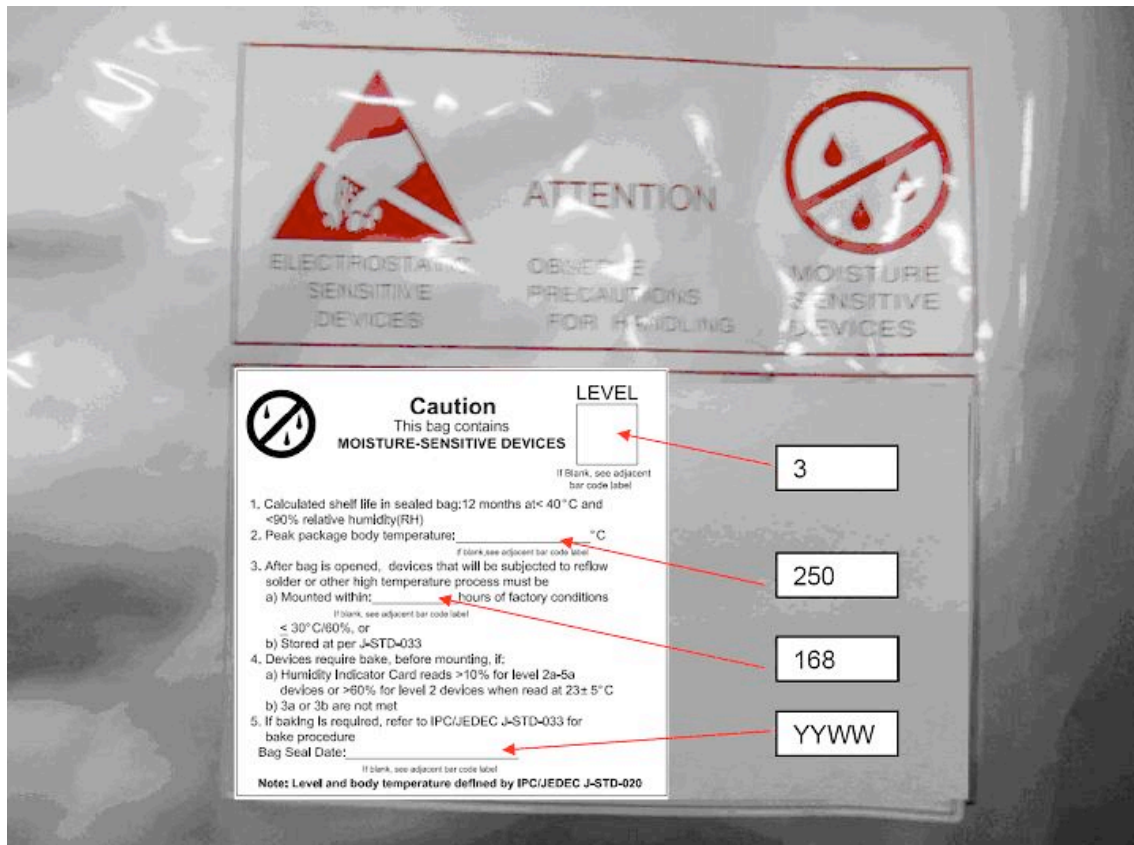
Package Thickness	Volume mm <sup>3</sup> <350	Volume mm <sup>3</sup> 350 - 2000	Volume mm <sup>3</sup> >2000
<1.6 mm	260 °C	260 °C	260 °C
1.6 mm - 2.5 mm	260 °C	250 °C	245 °C
>2.5 mm	250 °C	245 °C	245 °C

**Note:**

Need to inspect solder joint by X-ray post reflow.

## 11. PACKAGE AND STORAGE CONDITION

### ■ PACKAGE




### ■ EMC/ESD LEVEL

According to FCC and CE standard

- Surface Resistivity:  
Interior:  $10^9 \sim 10^{11} \Omega/\text{SQUARE}$   
EXTERIOR:  $10^8 \sim 10^{12} \Omega/\text{SQUARE}$
- Dimension: 475\*420mm
- Tolerance: +5,0mm
- Color:  
Background : Gray  
Text : Red

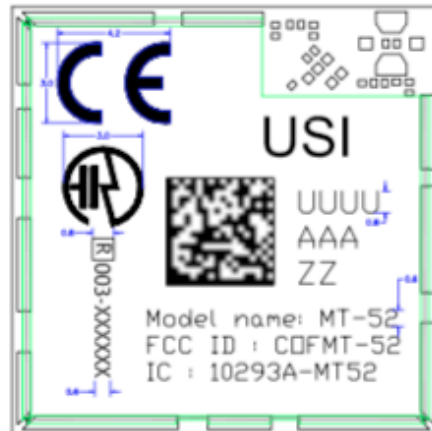
■ **MSL LEVEL/ STORAGE CONDITION (REFERENCE ONLY)**

	<b>Caution</b> This bag contains <b>MOISTURE-SENSITIVE DEVICES</b>	<b>LEVEL</b> <table border="1"><tr><td>3</td></tr></table>	3
	3		
<p>If Blank, see adjacent bar code label</p> <p>1. Calculated shelf life in sealed bag: 12 months at &lt; 40°C and &lt; 90% relative humidity (RH)</p> <p>2. Peak package body temperature: <u>250</u> °C <small>If blank, see adjacent bar code label</small></p> <p>3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must be</p> <p>a) Mounted within: <u>168</u> hours of factory conditions <small>If blank, see adjacent bar code label</small></p> <p><math>\leq 30^{\circ}\text{C}/60\%</math>, or</p> <p>b) Stored at per J-STD-033</p> <p>4. Devices require bake, before mounting, if:</p> <p>a) Humidity Indicator Card reads &gt;10% for level 2a-5a devices or &gt;60% for level 2 devices when read at <math>23 \pm 5^{\circ}\text{C}</math></p> <p>b) 3a or 3b are not met</p> <p>5. If baking is required, refer to IPC/JEDEC J-STD-033 for bake procedure</p> <p>Bag Seal Date: _____ <small>If blank, see adjacent bar code label</small></p> <p><b>Note: Level and body temperature defined by IPC/JEDEC J-STD-020</b></p>			

Half-Sine Shock  
Sustained for Mechanical Shock under 2000G

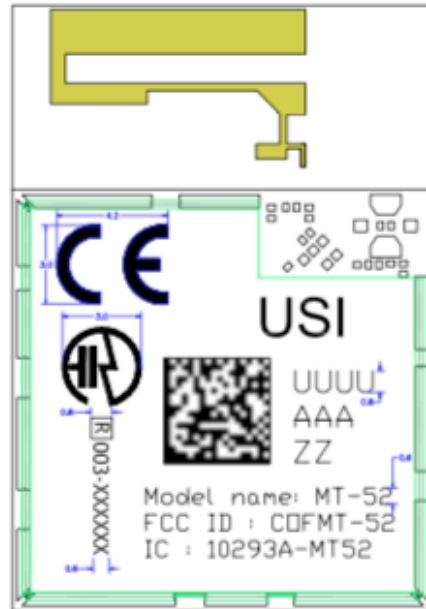
■ MARKING SPECIFICATION

W/O ANTENNA



Barcode Read: UUUUSSSAAAZZYMMDDNNNNNSSS  
UUUUSSSAAAZZ=USI PN with no "-"  
YYMMDD,date code,Ex: 2017.05.16 is 170516...  
NNNNNSSS=Serial, NNNNN=Panel Serial  
SSS=Module SN in the panel.  
Barcode type: Datamatrix, 4X4mm, ECC200  
Text: Arial ,0.7/0.8 mm or readable.

W ANTENNA



Barcode Read: UUUUSSSAAZZYYMMDDNNNNNSSS  
UUUUSSSAAZZ=USI PN with no "-"  
YYMMDD,date code,Ex: 2017.05.16 is 170516...  
NNNNNSSS=Serial, NNNNN=Panel Serial  
SSS=Module SN in the panel.  
Barcode type: Datamatrix, 4X4mm, ECC200  
Text: Arial ,0.7/0.8 mm or readable.

■ **ORDERING INFORMATION**

<b>USI Project Code</b>	<b>USI P/N</b>	<b>Description</b>
WM-BN-MT-52 (ACK)	8501-601600-02	ACK module ANT
	8501-601600-12	ACK module no ANT

Product Warranty: 1 year

USI reserves the right to make changes, without further notice, to any products or data to improve reliability, function, marking, and/or design. Any products, data or information furnished by USI is that USI believed to be accurate and reliable. However, USI shall not assume any liability arising from the application or use of such products, data and/or information.

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