

Zhejiang Sunseeker Industrial Co., Ltd.

## USER MANUAL

**PRODUCT NAME :** 2.4G Wi-Fi&Bluetooth module

**SPEC. NO. :** REV : 2.3

**DATE :** 10.08. 2018

PREPARED	REVIEW		APPROVED	DCC ISSUE
	PM	QA		

# AP6212/AP6212A

## HVIN:AP6212(HF)

WiFi + Bluetooth 4.1  
SIP Module Spec Sheet

# Revision History

Date	Revision Content	Revised By	Version
2017/04/28	Refer to the earlier release for detailed revision history.	Richard	1.9
2017/06/14	- Modify FM spec. - Add BT modulation 8DPSK	Richard	2.0
2017/09/07	- Modify Recommended Reflow Profile	Richard	2.1
2017/09/29	- Add Packing Dimension photo	Beth	2.2
2018/10/08	- Modify Operating Temperature.	Richard	2.3

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# 1. Introduction

Zhejiang Sunseeker Industrial Co., Ltd. would like to announce a low-cost and low-power consumption module which has all of the WiFi, Bluetooth functionalities. The highly integrated module makes the possibilities of web browsing, VoIP, Bluetooth headsets and other applications. With seamless roaming capabilities and advanced security, also could interact with different vendors' 802.11b/g/n Access Points in the wireless LAN.

The wireless module complies with IEEE 802.11 b/g/n standard and it can achieve up to a speed of 72.2Mbps with single stream in 802.11n draft, 54Mbps as specified in IEEE 802.11g, or 11Mbps for IEEE 802.11b to connect to the wireless LAN. The integrated module provides SDIO interface for WiFi, UART / I2S / PCM interface for Bluetooth.

This compact module is a total solution for a combination of WiFi + BT technologies. The module is specifically developed for Smart phones and Portable devices.

## 2. Features

- 802.11b/g/n single-band radio
- Bluetooth V4.1 with integrated Class 1.5 PA and Low Energy (BLE) support
- Concurrent Bluetooth and WLAN operation
- Simultaneous BT/WLAN receive with single antenna
- WLAN host interface options:
  - SDIO v2.0 — up to 50 MHz clock rate
- BT host digital interface:
  - UART (up to 4 Mbps)
- IEEE Co-existence technologies are integrated die solution
- ECI — enhanced coexistence support, ability to coordinate BT SCO transmissions around WLAN receives

## 3. Deliverables

### 3.1 Deliverables

The following products and software will be part of the product.

- Module with packaging
- Evaluation Kits
- Software utility for integration, performance test.
- Product Datasheet.
- Agency certified pre-tested report with the adapter board.

### 3.2 Regulatory certifications

The product delivery is a pre-tested module, without the module level certification. For module approval, the platform's antennas are required for the certification.

## 4. General Specification

### 4.1 General Specification

Model Name	AP6212/AP6212A
Product Description	Support WiFi/Bluetooth functionalities
Dimension	L x W x H: 12 x 12 x 1.5 (typical) mm
WiFi Interface	SDIOV 2.0
BT Interface	UART / PCM
Operating temperature <sup>a,b</sup>	-30°C to 85°C
Storage temperature	-40°C to 85°C
Humidity	Operating Humidity 10% to 95% Non-Condensing

- a. The operating temperature 65 to 85°C is feasible at conditional environment. Please examine the reliability on final product.
- b. Functionality is guaranteed across this range of temperature. Optimal RF performance as specified in the data sheet, however, is guaranteed only for -10°C to 55°C.

### 4.2 Voltages

#### 4.2.1 Absolute Maximum Ratings

Symbol	Description	Min.	Max.	Unit
VBAT	Input supply Voltage	-0.5	5.5	V
VDDIO	Digital/Bluetooth/SDIO/ I/O Voltage	-0.5	3.6	V

#### 4.2.2 Recommended Operating Rating

The module requires two power supplies: VBAT and VDDIO.

	Min.	Typ.	Max.	Unit
Operating Temperature	-30	25	85	deg.C
VBAT	3.0	3.3	3.8	V
VDDIO	1.7	3.3	3.6	V



# 5. WiFi RF Specification

## 5.1 2.4GHz RF Specification

Conditions : VBAT=3.3V ; VDDIO=3.3V ; Temp:25°C

Feature	Description
WLAN Standard	IEEE 802.11b/g/n, WiFi compliant
Frequency Range	2.4G Wi-Fi:2412~2462 MHz(802.11b/g/n20)
Modulation	802.11b : DQPSK, DBPSK, CCK 802.11 g/n : OFDM /64-QAM,16-QAM, QPSK, BPSK
Output Power	2.4G Wi-Fi: 802.11b: 18.672 dBm 802.11g: 24.210 dBm 802.11n20: 23.858 dBm
Receive Sensitivity (11n,20MHz) @10% PER	- MCS=0 PER @ -85 dBm, +/- 2dB
	- MCS=1 PER @ -84 dBm, +/- 2dB
	- MCS=2 PER @ -82 dBm, +/- 2dB
	- MCS=3 PER @ -80 dBm, +/- 2dB
	- MCS=4 PER @ -77 dBm, +/- 2dB
	- MCS=5 PER @ -73 dBm, +/- 2dB
	- MCS=6 PER @ -71 dBm, +/- 2dB
	- MCS=7 PER @ -68 dBm, +/- 2dB
Receive Sensitivity (11g) @10% PER	- 6Mbps PER @ -86 dBm, +/- 2dB
	- 9Mbps PER @ -85 dBm, +/- 2dB
	- 12Mbps PER @ -85 dBm, +/- 2dB
	- 18Mbps PER @ -83 dBm, +/- 2dB
	- 24Mbps PER @ -81 dBm, +/- 2dB
	- 36Mbps PER @ -78 dBm, +/- 2dB
	- 48Mbps PER @ -73 dBm, +/- 2dB
	- 54Mbps PER @ -71 dBm, +/- 2dB
Receive Sensitivity (11b) @8% PER	- 1Mbps PER @ -90 dBm, +/- 2dB
	- 2Mbps PER @ -88 dBm, +/- 2dB
	- 5.5Mbps PER @ -87 dBm, +/- 2dB
	- 11Mbps PER @ -84 dBm, +/- 2dB
Data Rate	802.11b : 1, 2, 5.5, 11Mbps
	802.11g : 6, 9, 12, 18, 24, 36, 48, 54Mbps

Data Rate (20MHz ,Long GI,800ns)	802.11n: 6.5, 13, 19.5, 26, 39, 52, 58.5, 65Mbps
Data Rate (20MHz ,short GI,400ns)	802.11n : 7.2, 14.4, 21.7, 28.9, 43.3, 57.8, 65,72.2Mbps
Maximum Input Level	802.11b : -10 dBm
	802.11g/n : -20 dBm
Maximum Antenna Gain:	2.37 dBi

# 6. Bluetooth Specification

## 6.1 Bluetooth Specification

Conditions : VBAT=3.3V ; VDDIO=3.3V ; Temp:25°C

Feature	Description		
<b>General Specification</b>			
Bluetooth Standard	Bluetooth V4.1 of 1, 2 and 3 Mbps.		
Host Interface	UART		
Maximum Antenna Gain:	2.37dBi		
Frequency Band	2402MHz ~ 2480MHz		
Number of Channels	79 channels		
Modulation	GFSK, $\pi/4$ -DQPSK, 8DPSK		
<b>RF Specification</b>			
	Min.	Typical.	Max.
BLE(1Mbps):		6.09 dBm	
Sensitivity @ BER=0.1% for GFSK (1Mbps)		-86 dBm	
Sensitivity @ BER=0.01% for $\pi/4$ -DQPSK (2Mbps)		-86 dBm	
Sensitivity @ BER=0.01% for 8DPSK (3Mbps)		-80 dBm	
Maximum power	GFSK (1Mbps):4.52 dBm		
	$\pi/4$ -DQPSK:6.83 dBm		
	8DPSK:7.16 dBm		

# 7. BLE Specification

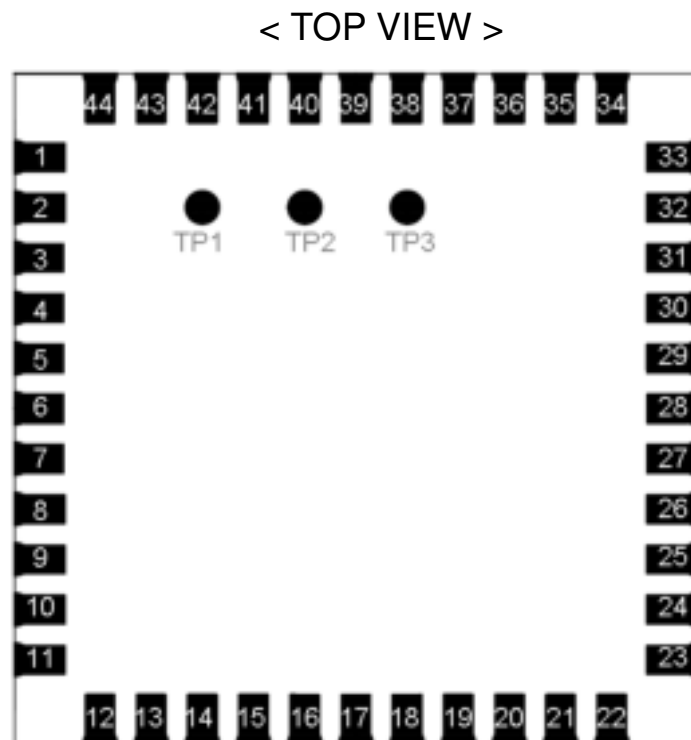
## 7.1 BLE Specification

Conditions : VBAT=3.3V ; VDDIO=3.3V ; Temp:25°C

Feature	Description
<b><i>General Specification</i></b>	
Frequency Band	2402MHz-2480MHz
Host Interface	UART
Frequency step	2MHz
Number of Channels	40CH

## 8. Pin Assignments

### 8.1 Pin Outline



### 8.2 Pin Definition

NO	Name	Type	Description
1	GND	—	Ground connections
2	WL_BT_ANT	I/O	RF I/O port
3	GND	—	Ground connections
4	FM_RX	I	FM radio RF input antenna port
5	NC	—	Floating (Don't connected to ground)
6	BT_WAKE	I	HOST wake-up Bluetooth device
7	BT_HOST_WAKE	O	Bluetooth device to wake-up HOST
8	NC	—	Floating (Don't connected to ground)
9	VBAT	P	Main power voltage source input
10	XTAL_IN	I	Crystal input
11	XTAL_OUT	O	Crystal output
12	WL_REG_ON	I	Internal regulators power enable/disable
13	WL_HOST_WAKE	O	WLAN to wake-up HOST

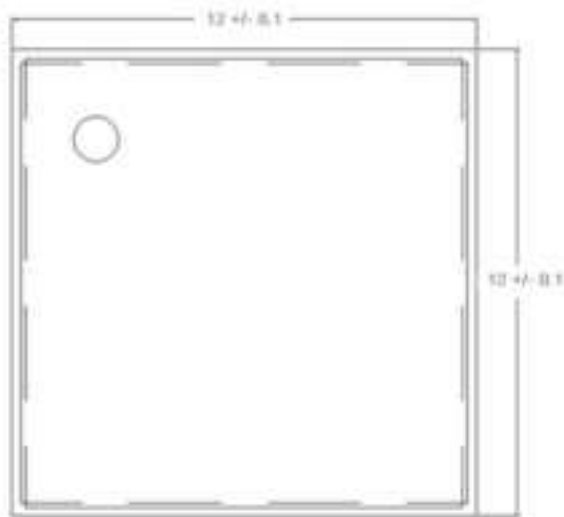
14	SDIO_DATA_2	I/O	SDIO data line 2
15	SDIO_DATA_3	I/O	SDIO data line 3
16	SDIO_DATA_CMD	I/O	SDIO command line
17	SDIO_DATA_CLK	I/O	SDIO clock line
18	SDIO_DATA_0	I/O	SDIO data line 0
19	SDIO_DATA_1	I/O	SDIO data line 1
20	GND	—	Ground connections
21	VIN_LDO_OUT	P	Internal Buck voltage generation pin
22	VDDIO	P	I/O Voltage supply input
23	VIN_LDO	P	Internal Buck voltage generation pin
24	LPO	I	External Low Power Clock input (32.768KHz)
25	PCM_OUT	O	PCM Data output
26	PCM_CLK	I/O	PCM clock
27	PCM_IN	I	PCM data input
28	PCM_SYNC	I/O	PCM sync signal
29	NC	—	Floating (Don't connected to ground)
30	NC	—	Floating (Don't connected to ground)
31	GND	—	Ground connections
32	NC	—	Floating (Don't connected to ground)
33	GND	—	Ground connections
34	BT_RST_N	I	Low asserting reset for Bluetooth core
35	NC	—	Floating (Don't connected to ground)
36	GND	—	Ground connections
37	NC	—	Floating (Don't connected to ground)
38	NC	—	Floating (Don't connected to ground)
39	GPIO2	I/O	WiFi Co-existence pin with LTE
40	GPIO1	I/O	WiFi Co-existence pin with LTE
41	UART_RTS_N	O	Bluetooth/FM UART interface
42	UART_TXD	O	Bluetooth/FM UART interface
43	UART_RXD	I	Bluetooth/FM UART interface
44	UART_CTS_N	I	Bluetooth/FM UART interface
45	TP1	O	FM Analog AUDIO left output
46	TP2	O	FM Analog AUDIO right output
47	TP3 (NC)	—	Floating (Don't connected to ground)

# 9. Dimensions

## 9.1 Physical Dimensions

(Unit: mm)

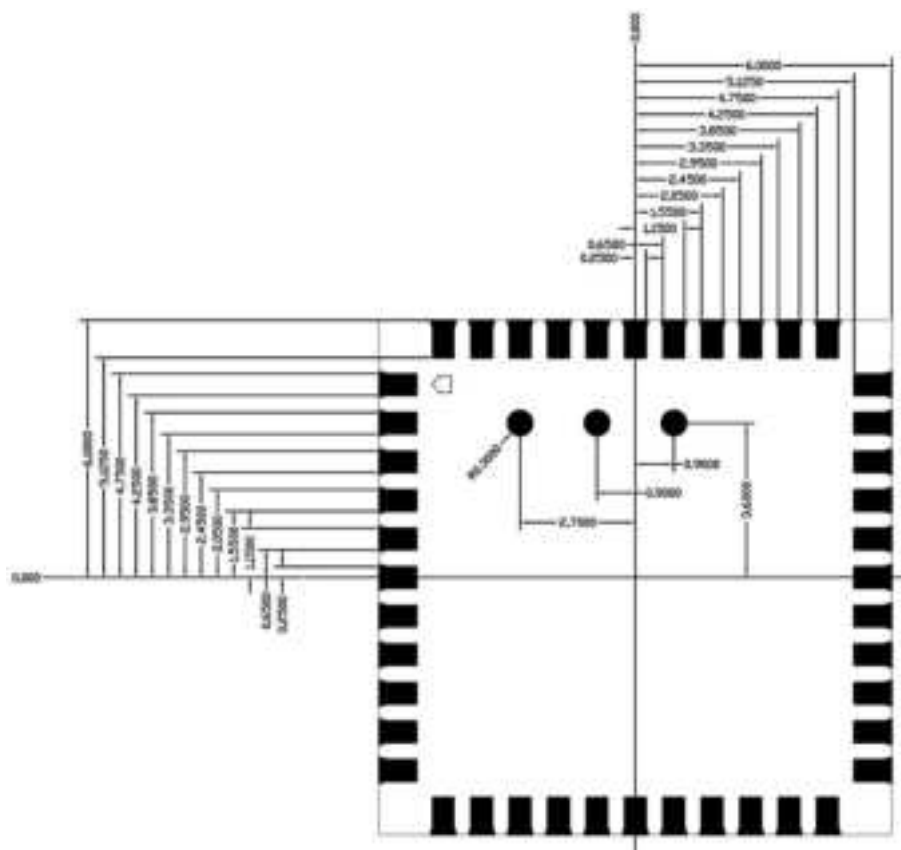
< TOP VIEW >



< Side View >



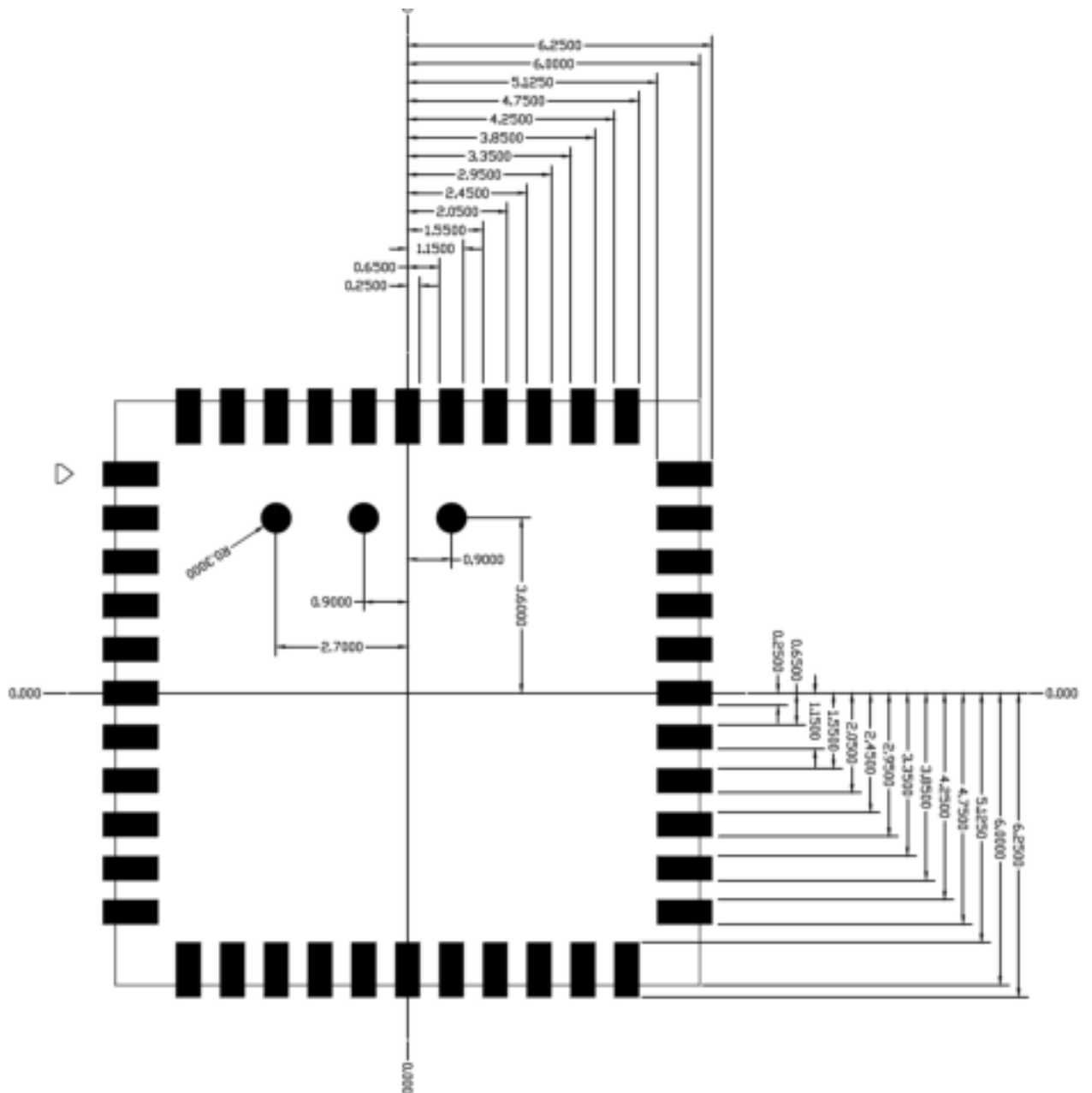
< TOP VIEW >



## 9.2 Layout Recommendation

(Unit: mm)

< TOP VIEW >





# 10. External clock reference

External LPO signal characteristics

Parameter	Specification	Units
Nominal input frequency	32.768	kHz
Frequency accuracy	± 30	ppm
Duty cycle	30 - 70	%
Module input Signal Level	400~3300	mV, p-p
Signal type	Square-wave	-
Input impedance	>100k <5	Ω pF
Clock jitter (integrated over 300Hz – 15KHz)	<1	Hz

External Ref\_CLK signal characteristics

No.	Item	Symb.	Electrical Specification				Remark
			Min.	Type	Max.	Units	
1	Nominal Frequency	F0	26.00000			MHz	
2	Mode of Vibration		Fundamental				
3	Frequency Tolerance	$\Delta F/F0$	-10	-	10	ppm	at 25°C±3°C
4	Operating Temperature Range	T <sub>OPR</sub>	-30	-	85	°C	
5	Frequency Stability	TC	-10	-	10	ppm	
6	Storage Temperature	T <sub>STG</sub>	-55	-	125	°C	
7	Load capacitance	CL	-	16		pF	
8	Equivalent Series Resistance	ESR	-	-	50	Ω	
9	Drive Level	DL	-	100	200	μW	
10	Insulation Resistance	IR	500	-	-	MΩ	At 100V <sub>DC</sub>
11	Shunt Capacitance	C0	-	-	3	pF	
12	Aging Per Year	Fa	-2	-	2	ppm	First Year

## 10.1 SDIO Pin Description

The module supports SDIO version 2.0 for 4-bit modes (100 Mbps), and high speed 4-bit (50 MHz clocks – 200 Mbps). It has the ability to stop the SDIO clock and map the interrupt signal into a GPIO pin. This ‘out-of-band’ interrupt signal notifies the host when the WLAN device wants to turn on the SDIO interface. The ability to force the control of the gated clocks from within the WLAN chip is also provided.

- ❖ Function 0 Standard SDIO function (Max BlockSize / ByteCount = 32B)

- ❖ Function 1 Backplane Function to access the internal System On Chip (SOC) address space (Max BlockSize / ByteCount = 64B)
- ❖ Function 2 WLAN Function for efficient WLAN packet transfer through DMA (Max BlockSize/ByteCount=512B)

#### SDIO Pin Description

SD 4-Bit Mode	
DATA0	Data Line 0
DATA1	Data Line 1 or Interrupt
DATA2	Data Line 2 or Read Wait
DATA3	Data Line 3
CLK	Clock
CMD	Command Line

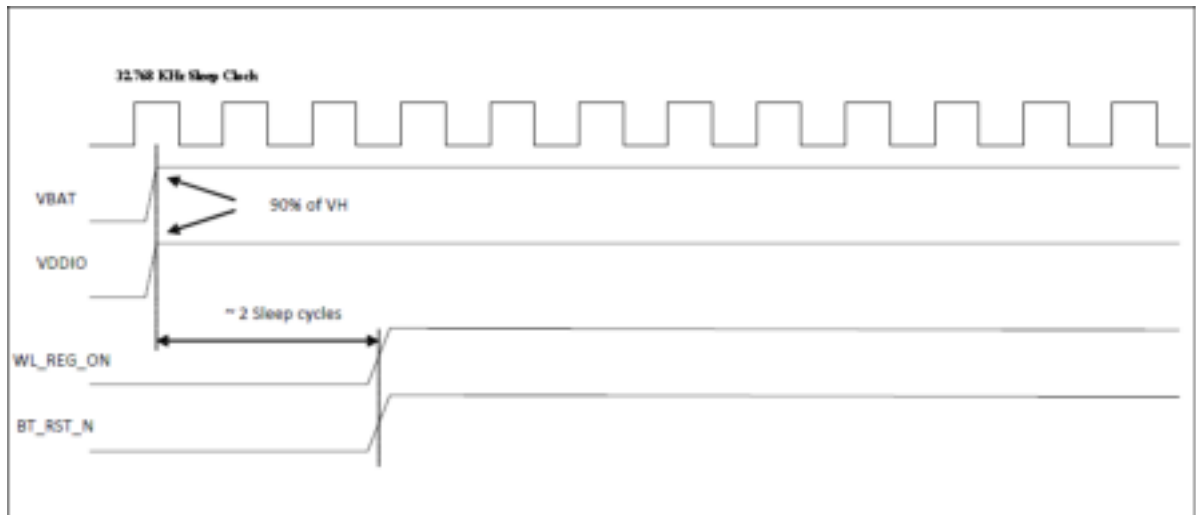
## 11. Host Interface Timing Diagram

### 11.1 Power-up Sequence Timing Diagram

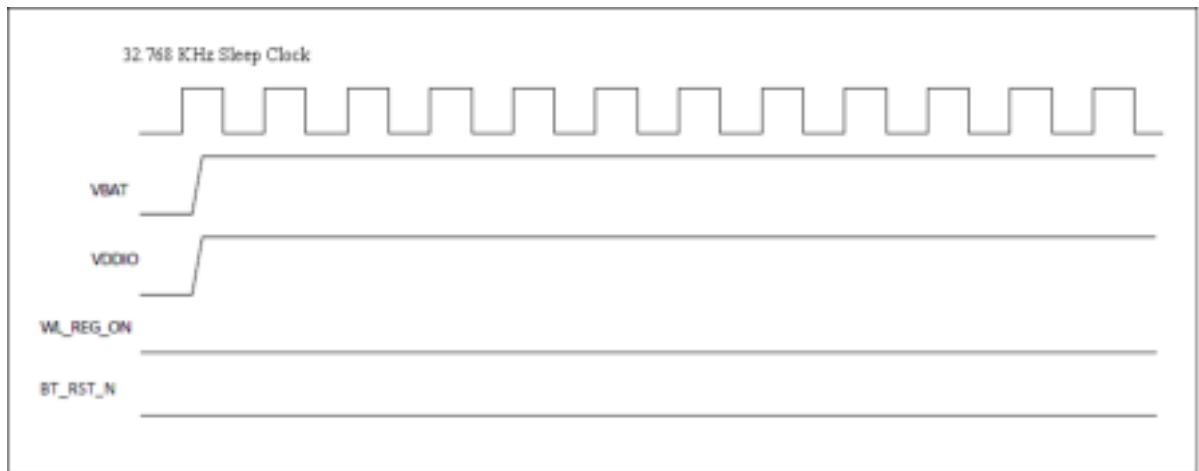
The module has signals that allow the host to control power consumption by enabling or disabling the Bluetooth, WLAN and internal regulator blocks. These signals are described below.

Additionally, diagrams are provided to indicate proper sequencing of the signals for various operating states. The timing value indicated are minimum required values: longer delays are also acceptable.

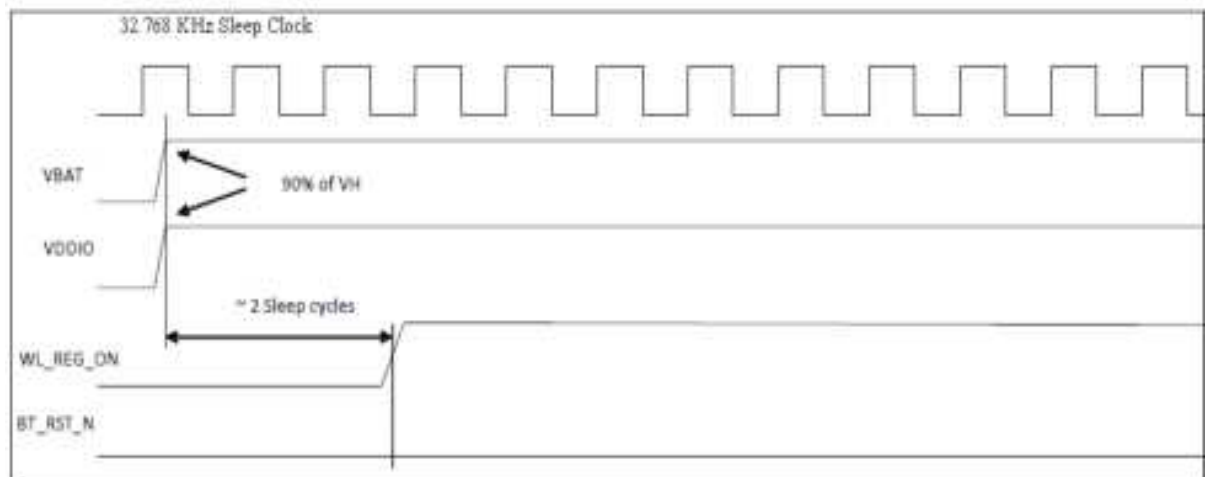
- ※ WL\_REG\_ON: Used by the PMU to power up the WLAN section. When this pin is high, the regulators are enabled and the WLAN section is out of reset. When this pin is low the WLAN section is in reset.
- ※ BT\_RST\_N: Low asserting reset for Bluetooth and FM only. This pin has no effect on WLAN and does not control any PMU functions. This pin must be driven high or low (not left floating).



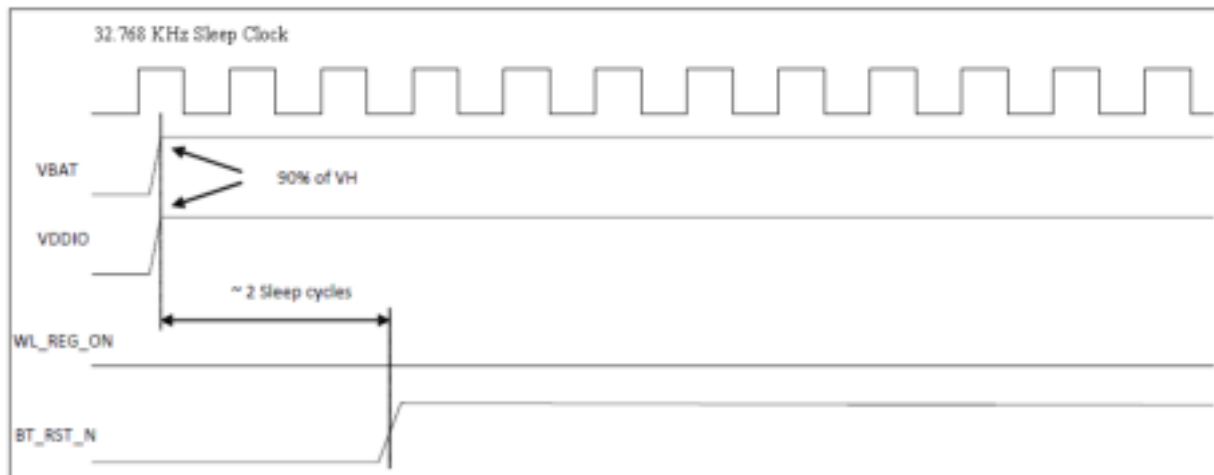
WLAN=ON, Bluetooth=ON



WLAN=OFF, Bluetooth=OFF

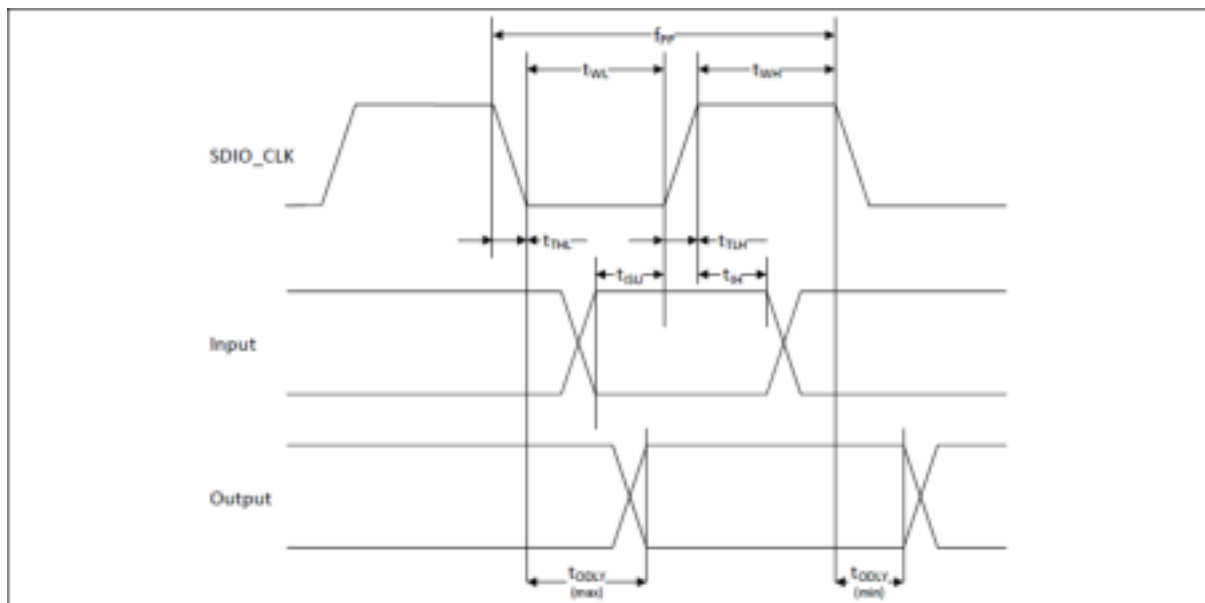


WLAN=ON, Bluetooth=OFF



WLAN=OFF, Bluetooth=ON

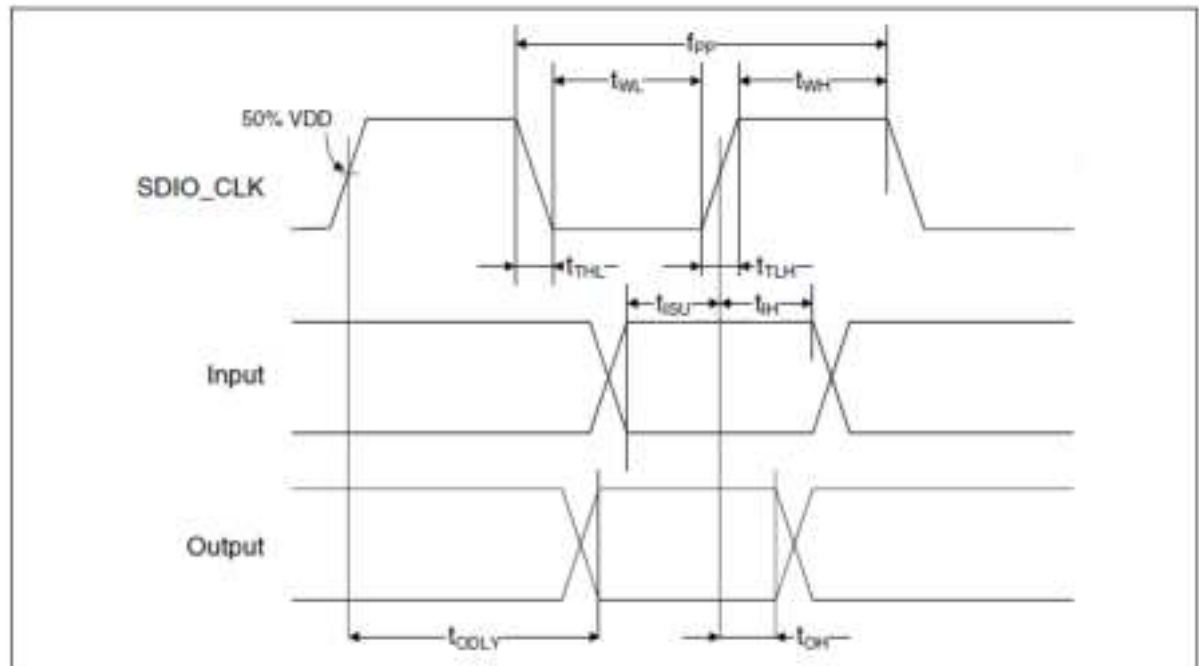
## 11.2 SDIO Default Mode Timing Diagram



Parameter	Symbol	Minimum	Typical	Maximum	Unit
<b>SDIO CLK (All values are referred to minimum VIH and maximum VIL<sup>a</sup>)</b>					
Frequency-Data Transfer mode	fPP	0	-	25	MHz
Frequency-Identification mode	fOD	0	-	400	kHz
Clock low time	tWL	10	-	-	ns
Clock high time	tWH	10	-	-	ns
Clock rise time	tTLH	-	-	10	ns
Clock low time	tTHL	-	-	10	ns
<b>Inputs: CMD, DAT (referenced to CLK)</b>					
Input setup time	tISU	5	-	-	ns
Input hold time	tIH	5	-	-	ns
<b>Outputs: CMD, DAT (referenced to CLK)</b>					
Output delay time – Data Transfer mode	tODLY	0	-	14	ns
Output delay time – Identification mode	tODLY	0	-	50	ns

a. Timing is based on CL ≤ 40pF load on CMD and Data.  
b. min(Vih) = 0.7 × VDDIO and max(Vil) = 0.2 × VDDIO.

### 11.3 SDIO High Speed Mode Timing Diagram



Parameter	Symbol	Minimum	Typical	Maximum	Unit
<b>SDIO CLK (All values are referred to minimum VIH and maximum VIL<sup>a</sup>)</b>					
Frequency-Data Transfer mode	fPP	0	-	50	MHz
Frequency-Identification mode	fOD	0	-	400	kHz
Clock low time	tWL	7	-	-	ns
Clock high time	tWH	7	-	-	ns
Clock rise time	tTLH	-	-	3	ns
Clock low time	tTHL	-	-	3	ns
<b>Inputs: CMD, DAT (referenced to CLK)</b>					
Input setup time	tISU	6	-	-	ns
Input hold time	tIH	2	-	-	ns
<b>Outputs: CMD, DAT (referenced to CLK)</b>					
Output delay time – Data Transfer mode	tODLY	-	-	14	ns
Output hold time	tOH	2.5	-	-	ns
Total system capacitance (each line)	CL	-	-	40	pF

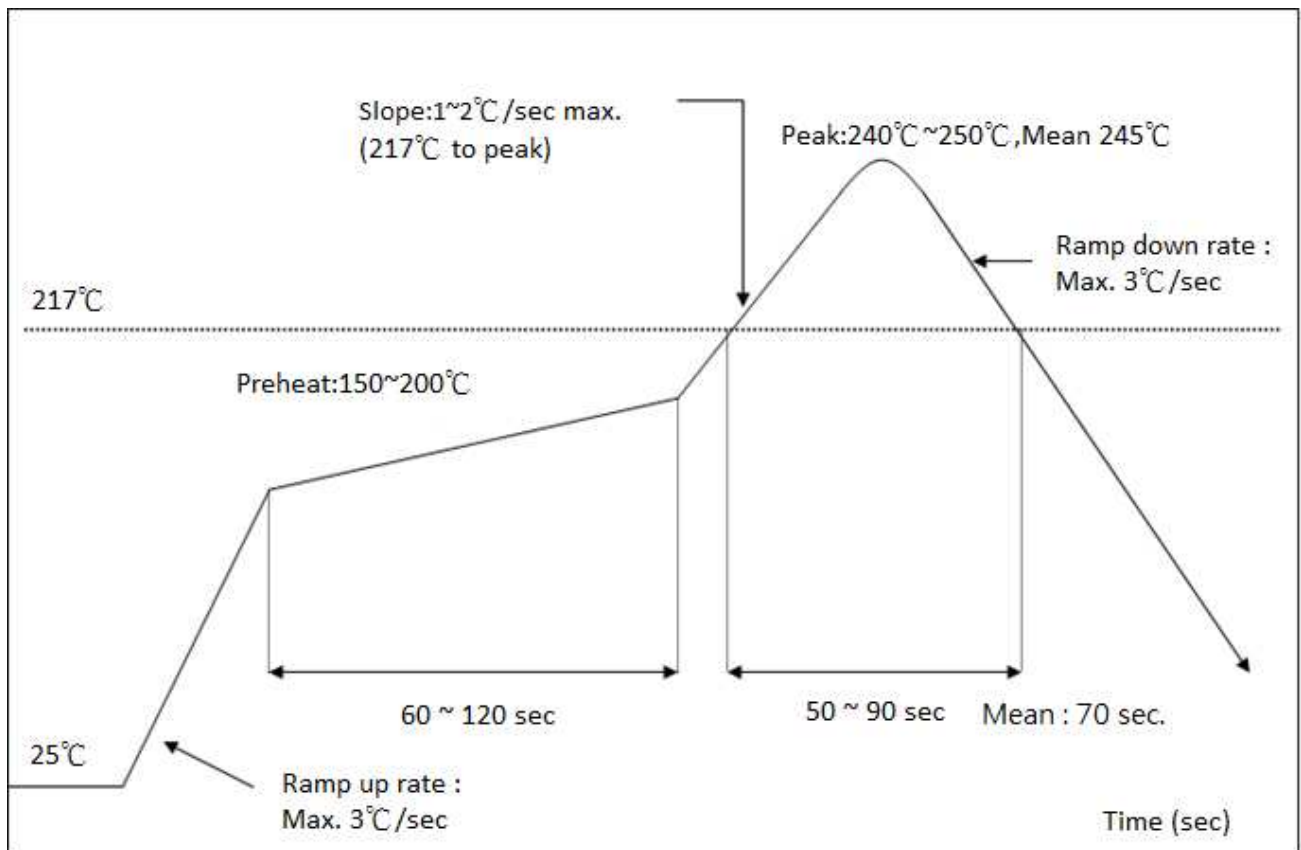
a. Timing is based on CL ≤ 40pF load on CMD and Data.  
b. min(Vih) = 0.7 × VDDIO and max(Vil) = 0.2 × VDDIO.

## 12. Recommended Reflow Profile

Referred to IPC/JEDEC standard.

Peak Temperature : <250°C

Number of Times : ≤2 times

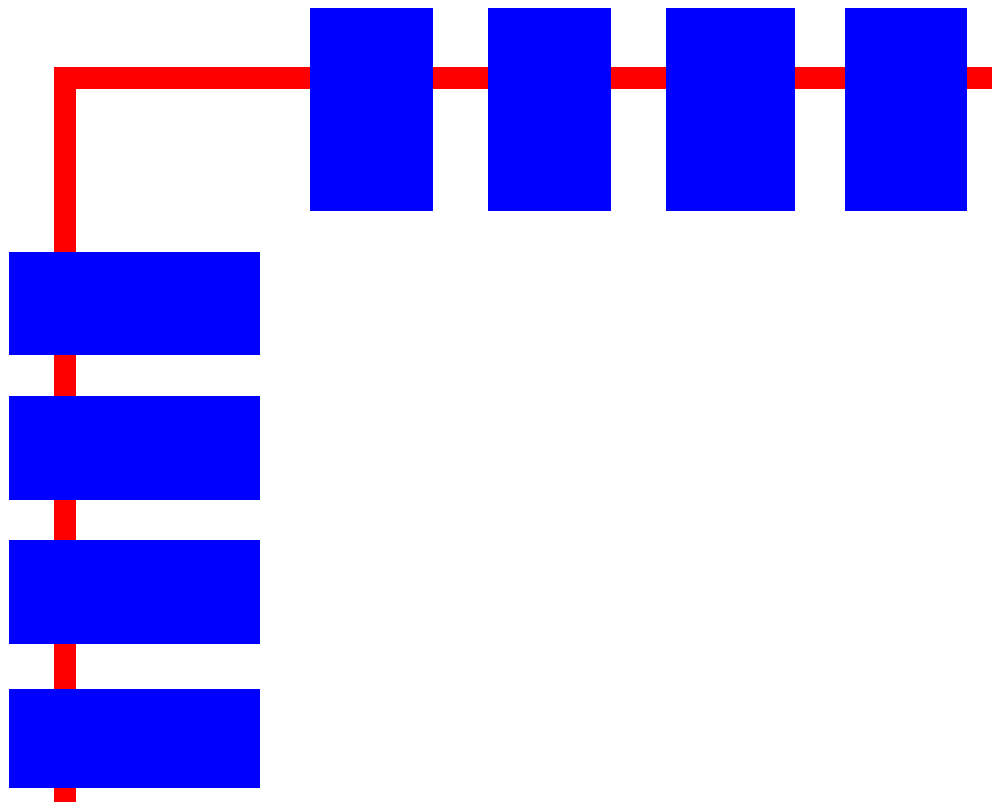


The notification of WiFi module before mounting:

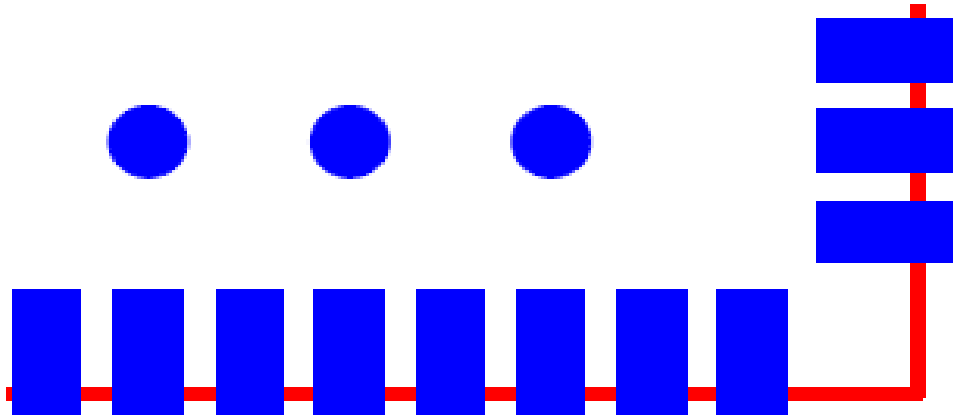
The aperture of stencil should be larger than foot print of module, and the stencil thickness should be not less than 0.12mm.

It must use N2 for reflow and suggest the concentration of oxygen less than 5000 ppm .

# Solder Paste definition



- Module Specifications : W:0.65mm \* L:0.95mm pitch 0.9 mm
- The proposed design W:0.65~0.75 mm \* L:1.33mm. Consider not place other parts in the peripheral area of 1 mm ~ 1.5 mm to facilitate additional amount of solder for PCB pad.
- We Suggest the thickness of Stencil between 0.12 mm ~0.15mm, the W between 0.6~0.65mm and the L between L1.5~1.6mm.
- If the thickness of the stencil is thinner, we suggest to adding more solder, to increase the wetting ability. Depends on different production situation, if the stencil thickness is 0.08~0.1mm, and the module nearby area is no more space for expending soldering area, we will suggest to increase the stencil thickness to increase the wetting ability.
- The major consideration parts of stencil design is to increase the solder paste wetting ability.



- Module Specifications L 0.7mm
- The design for PCB Pad : L:0.8mm
- We recommend the apertures for stencil L:0.5mm~0.6mm
- In order to avoid highness impact caused solder paste thickness, the stencil open size can be appropriately retracted



# 13. Package Information

## 13.1 Label

Label A→ Anti-static and humidity notice



Label B→ MSL caution / Storage Condition



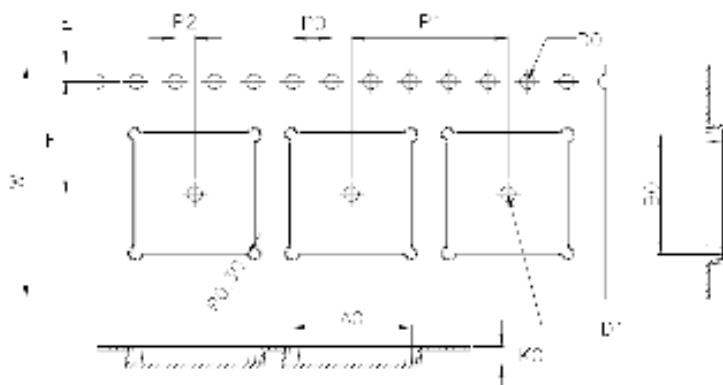
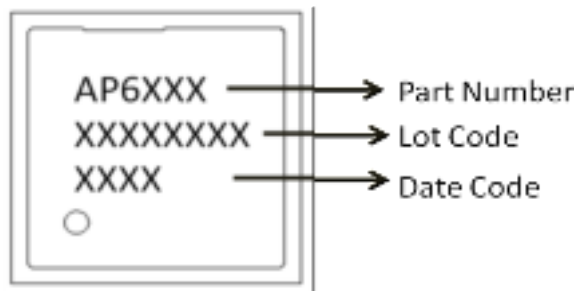
Label C→ Inner box label .



Label D→ Carton box label .

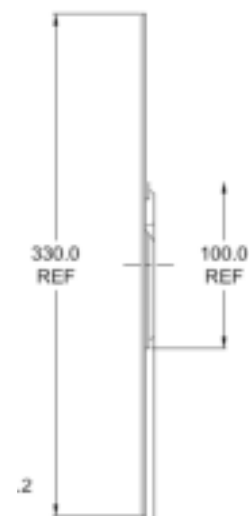
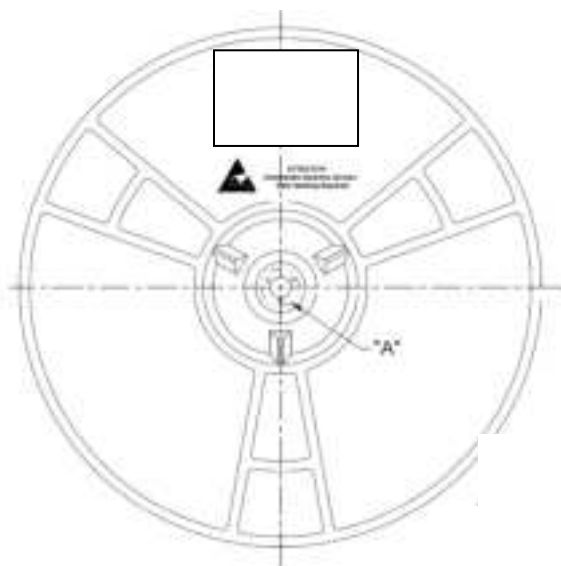


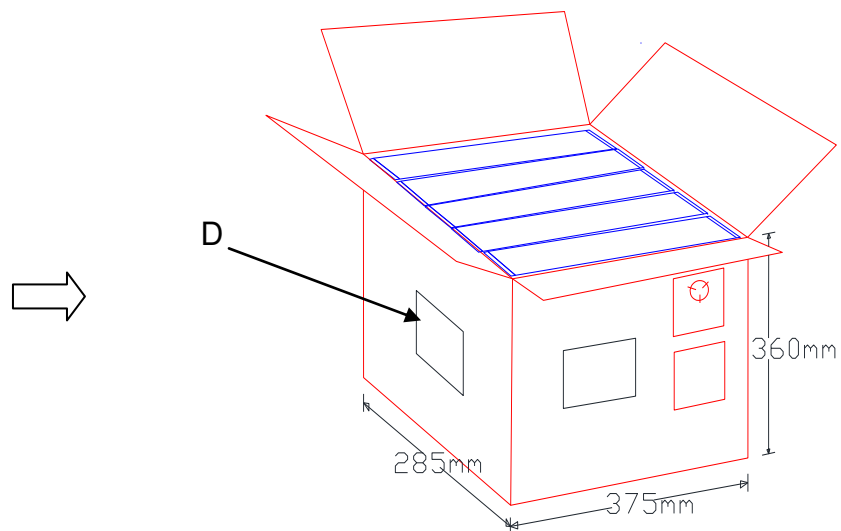
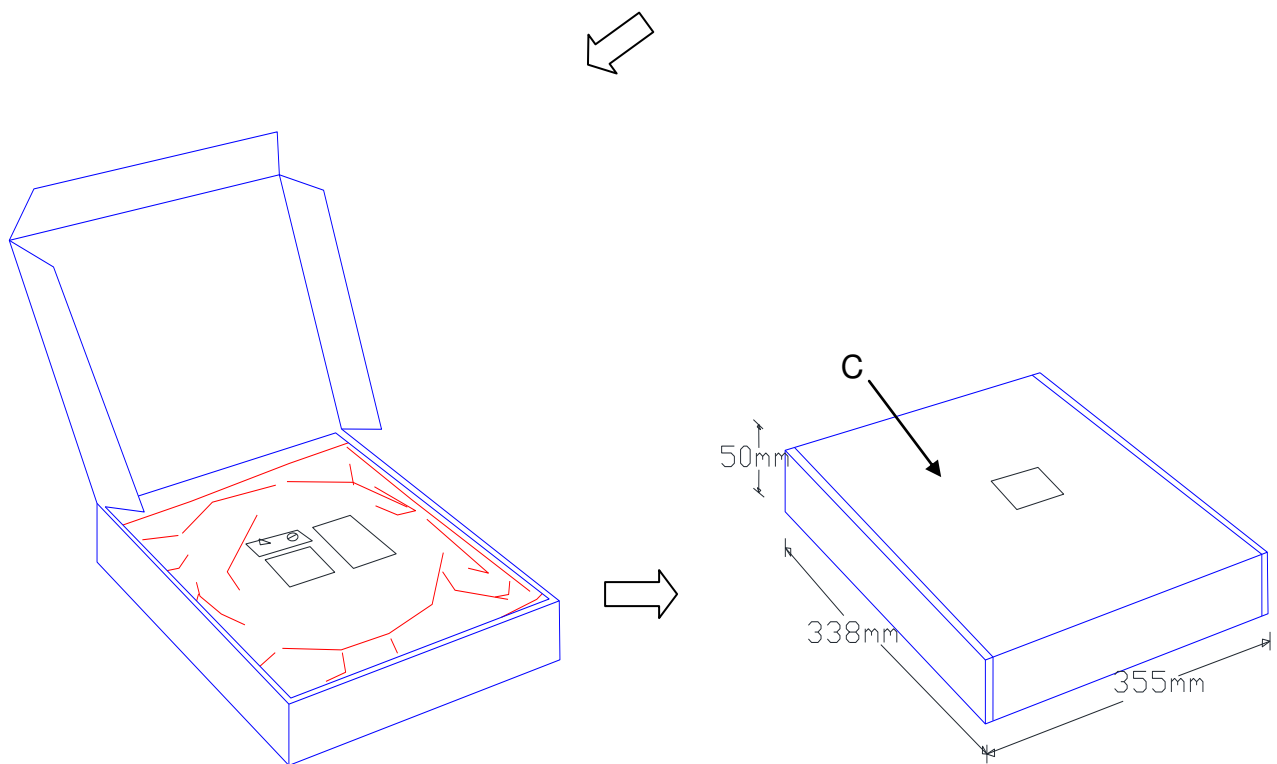
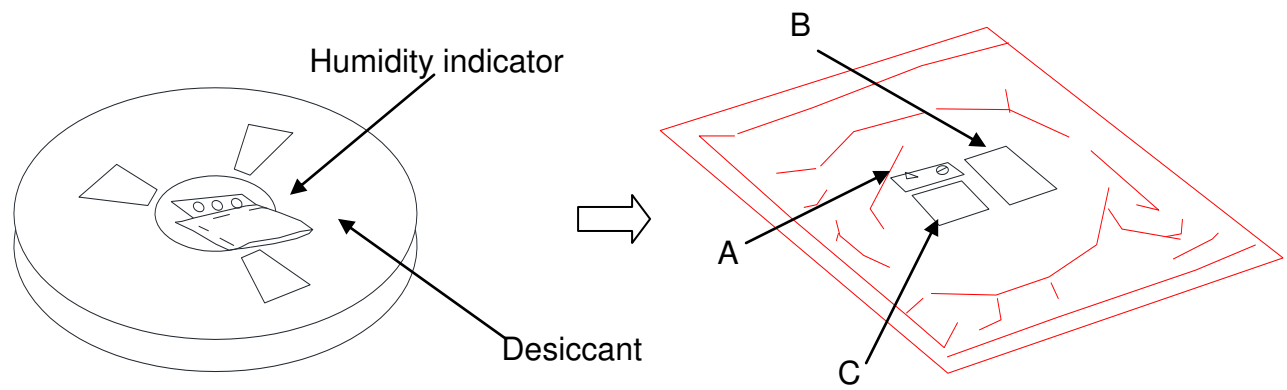
## 13.2 Dimension




w	24.00±0.30
A0	12.30±0.10
B0	12.30±0.10
K0	1.80±0.10
E	1.75±0.10
F	11.50±0.10
P0	4.00±0.10
T1	15.00±0.10
T2	2.00±0.10
T0	1.50±0.10
L	4.50±0.10

1. 10 sprocket hole pitch cumulative tolerance  $\pm 0.20$ .
2. Carrier camber is within 1 mm in 250 mm.
3. Material : Black Conductive Polystyrene Alloy.
4. All dimensions meet EIA-481-D requirements.
5. Thickness :  $0.30 \pm 0.05$  mm.
6. Packing length per 22" reel : 98.5 Meters. (1:3)
7. Component load per 13" reel : 1500 pcs.





### 13.3 MSL Level / Storage Condition

	<b>Caution</b> This bag contains <b>MOISTURE-SENSITIVE DEVICES</b>	<div style="border: 1px solid black; padding: 5px; display: inline-block;"><b>LEVEL</b> <b>4</b></div> <small>If blank, see adjacent bar code label</small>
<p>1. Calculated shelf life in sealed bag: 12 months at <math>&lt;40^{\circ}\text{C}</math> and <math>&lt;90\%</math> relative humidity (RH)</p> <p>2. Peak package body temperature: <u>250</u> <math>^{\circ}\text{C}</math> <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 style="margin-left: 20px;">a) Mounted within: <u>72</u> hours of factory conditions <small>If blank, see adjacent bar code label</small></p> <p style="margin-left: 40px;"><math>\leq 30^{\circ}\text{C} / 60\% \text{ RH}</math>, or</p> <p style="margin-left: 20px;">b) Stored per J-STD-033</p> <p>4. Devices require bake, before mounting, if:</p> <p style="margin-left: 20px;">a) Humidity Indicator Card reads <math>&gt;10\%</math> for level 2a-5a devices or <math>&gt;60\%</math> for level 2 devices when read at <math>23 \pm 5^{\circ}\text{C}</math></p> <p style="margin-left: 20px;">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 style="text-align: center; margin-top: 10px;"><small>Note: Level and body temperature defined by IPC/JEDEC J-STD-020</small></p>		

## **FCC Statement**

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

**Note :** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates,uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

## **FCC Radiation Exposure Statement:**

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment .This equipment should be installed and operated with minimum distance 20cm between the radiator& your body.

## **ISED statement**

This device complies with Innovation, Science and Economic Development Canada (ISED) licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. This equipment complies with ISED radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Cet appareil est conforme à la ou aux normes RSS exemptées de licence pour Innovation, Science et développement économique Canada. Le fonctionnement est soumis aux deux conditions suivantes: (1) ce dispositif ne peut pas causer d'interférence nocive, et (2) ce dispositif doit accepter toute interférence reçue, y compris les interférences pouvant causer un fonctionnement indésirable. Cet équipement respecte les limites d'exposition aux rayonnements ionisants fixées pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec une distance minimale de 20cm entre le radiateur et votre corps. Cet émetteur ne doit pas être localisé ou fonctionner en conjonction avec une autre antenne ou un autre émetteur.

## OEM instructions

(Reference KDB 996369 D03 OEM Manual v01, 996369 D04 Module Integration Guide v02)

1. Applicable FCC rules  
This device complies with part 15.247 of the FCC Rules.
2. The specific operational use conditions  
This module can be used in IoT devices. The input voltage to the module is nominally 3.0~3.8V<sub>DC</sub>. The operational ambient temperature of the module is -30 °C ~ +85 °C. The external antenna is NOT allowed.
3. Limited module procedures  
N/A
4. Trace antenna design  
N/A
5. RF exposure considerations  
The equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.
6. Antenna  
Antenna type: Dipole Antenna ; Peak antenna gain:2.37 dBi
7. Label and compliance information  
An exterior label on OEM's end product can use wording such as the following:  
"Contains FCC ID: 2BFD7-AP6212 "
8. Information on test modes and additional testing requirements
  - 1) The modular transmitter has been fully tested by the module grantee on the required number of channels, modulation types, and modes, it should not be necessary for the host installer to re-test all the available transmitter modes or settings. It is recommended that the host product manufacturer, installing the modular transmitter, perform some investigative measurements to confirm that the resulting composite system does not exceed the spurious emissions limits or band edge limits (e.g., where a different antenna may be causing additional emissions).
  - 2) The testing should check for emissions that may occur due to the intermixing of emissions with the other transmitters, digital circuitry, or due to physical properties of the host product (enclosure). This investigation is especially important when integrating multiple modular transmitters where the certification is based on testing each of them in a stand-alone configuration. It is important to note that host product manufacturers should not assume that because the modular transmitter is certified that they do not have any responsibility for final product compliance.

- 3) If the investigation indicates a compliance concern the host product manufacturer is obligated to mitigate the issue. Host products using a modular transmitter are subject to all the applicable individual technical rules as well as to the general conditions of operation in Sections 15.5, 15.15, and 15.29 to not cause interference. The operator of the host product will be obligated to stop operating the device until the interference have been corrected .

- 4) Additional testing, Part 15 Sub part B disclaimer:

The device is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. The final host / module combination need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device.

The host integrator installing this module into their product must ensure that the final composite product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation and should refer to guidance in KDB 996369. For host products with certified modular transmitter, the frequency range of investigation of the composite system is specified by rule in Sections 15.33(a)(1) through (a)(3), or the range applicable to the digital device, as shown in Section 15.33(b)(1), whichever is the higher frequency range of investigation When testing the host product, all the transmitters must be operating. The transmitters can be enabled by using publicly-available drivers and turned on, so the transmitters are active. When testing for emissions from the unintentional radiator, the transmitter shall be placed in the receive mode or idle mode, if possible. If receive mode only is not possible then, the radio shall be passive (preferred) and/or active scanning. In these cases, this would need to enable activity on the communication BUS (i.e., PCIe, SDIO, USB) to ensure the unintentional radiator circuitry is enabled. Testing laboratories may need to add attenuation or filters depending on the signal strength of any active beacons (if applicable) from the enabled radio(s). See ANSI C63.4, ANSI C63.10 for further general testing details. The product under test is set into a link/association with a partnering device, as per the normal intended use of the product. To ease testing, the product under test is set to transmit at a high duty cycle, such as by sending a file or streaming some media content.