AMPAK Technology Inc.

正基科技股份有限公司

SPECIFICATION

SPEC. NO.： _____ REV： 0.5

DATE： 09. 29 . 2017

PRODUCT NAME： AP6398S

Customer APPROVED	
Company	
Representative Signature	

PREPARED	REVIEW		APPROVED	DCC ISSUE
	PM	QA		

AMPAK

AP6398S

2x2 WiFi + Bluetooth 5.0
Module Spec Sheet

Revision History

Date	Revision Content	Revised By	Version
2017/06/03	- Preliminary	Richard	0.1
2017/06/07	- Modify RF Spec	Richard	0.2
2017/06/07	- Modify BT 4.2 to BT 5.0 - Modify Vbat operation range	Richard	0.3
2017/08/24	- Modify Recommended Reflow Profile	Richard	0.4
2017/09/29	- Modify Supply voltage range	Richard	0.5

Contents

1. Introduction

AMPAK Technology would like to announce a low-cost and low-power consumption module which has all of the WiFi and Bluetooth functionalities. The highly integrated module makes the possibilities of web browsing, VoIP, Bluetooth headsets applications. With seamless roaming capabilities and advanced security, also could interact with different vendors' 802.11a/b/g/n/ac 2x2 Access Points in the wireless LAN.

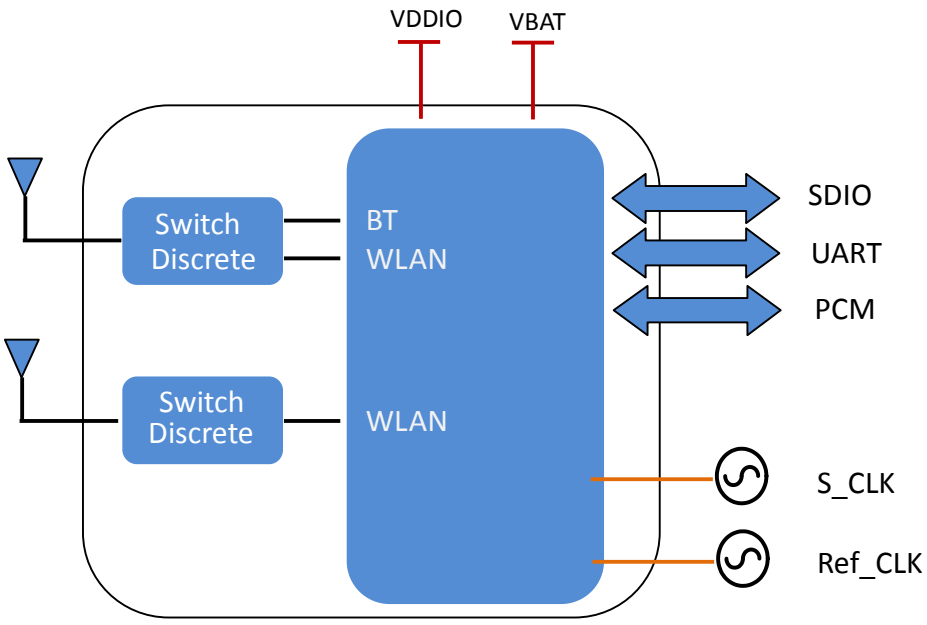
The wireless module complies with IEEE 802.11 a/b/g/n/ac 2x2 MIMO standard and it can achieve up to a speed of 867Mbps with dual stream in 802.11n to connect the wireless LAN. The integrated module provides SDIO interface for WiFi, UART / PCM interface for Bluetooth.

This compact module is a total solution for a combination of WiFi + BT technologies. The module is specifically developed for tablet, OTT box & portable devices.

2. Features

- Lead Free design which is compliant with ROHS requirements.
- TX and RX low-density parity check (LDPC) support for improved range and power efficiency.
- Dual-stream spatial multiplexing up to 867 Mbps data rate.
- 20, 40, 80 MHz channels with optional SGI (256 QAM modulation)
- IEEE 802.11 ac/n beam forming.
- Real simultaneous dual-band (RSDB)
- Supports 2 antennas with one for WLAN & Bluetooth shared port and one WLAN port. Also, shared Bluetooth and WLAN receive signal path eliminates the need for an external power splitter while maintaining excellent sensitivity for both Bluetooth and WLAN.
- Supports IEEE 802.15.2 external coexistence interface to optimize bandwidth utilization with other co-located wireless technologies such as LTE, GPS.
  - Supports standard SDIO v3.0, compatible with SDIO v2.0 HOST interfaces.
- BT host digital interface:
  - HCI UART (up to 4 Mbps)
  - PCM for audio data
- Complies with Bluetooth Core Specification Version 5.0 with provisions for supporting future specifications. With Bluetooth Class 1 or Class2 transmitter operation.
- Supports extended synchronous connections (eSCO), for enhanced voice quality by allowing for retransmission of dropped packets.
- Adaptive frequency hopping (AFH) for reducing radio frequency interference.

A simplified block diagram of the module is depicted in the figure below.



3. General Specification

3.1 General Specification

Model Name	AP6398S
Product Description	Support WiFi/Bluetooth functionalities
Dimension	L x W x H: 15 x 13 x 1.5 (typical) mm
WiFi Interface	Support SDIO V3.0/2.0
BT Interface	UART / PCM
Operating temperature	-30°C to 75°C
Storage temperature	-40°C to 85°C
Humidity	Operating Humidity 10% to 95% Non-Condensing

Optimal RF performance specified in the data sheet, however, is guaranteed only -10 °C to +55 °C and 3.2V< VBAT < 3.8V without derating performance.

3.2 Voltages

3.2.1 Absolute Maximum Ratings

Symbol	Description	Min.	Max.	Unit
VBAT	Input supply Voltage	-0.5	4.5	V
VDDIO	Digital/Bluetooth/SDIO/ I/O Voltage	-0.5	3.8	V

3.2.2 Recommended Operating Rating

The module requires two power supplies: VBAT and VDDIO.

	Min.	Typ.	Max.	Unit
Operating Temperature	-30	25	75	deg.C
VBAT	3.0	3.3	3.8	V
VDDIO	1.7	1.8, 3.3	3.6	V

VBAT current consumption 1200mA(Peak), when VBAT = 3.3V

4. WiFi RF Specification

4.1 2.4GHz RF Specification

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

Feature	Description
WLAN Standard	IEEE 802.11a/b/g/n/ac WiFi compliant
Frequency Range	2.400 GHz ~ 2.483 GHz (2.4 GHz ISM Band)
Number of Channels	2.4GHz：Ch1 ~ Ch13
Modulation	802.11b : DQPSK, DBPSK, CCK 802.11 g/n : OFDM /64-QAM,16-QAM, QPSK, BPSK
Output Power	802.11b /11Mbps : 17.5 dBm ± 1.5 dB @ EVM ≤ -9dB
	802.11g /54Mbps : 16.5 dBm ± 1.5 dB @ EVM ≤ -25dB
	802.11n /MCS7@20MHz : 15.5 dBm ± 1.5 dB @ EVM ≤ -27dB
SISO Receive Sensitivity (11b,20MHz) @8% PER	- 1Mbps PER @ -96 dBm, +/- 2dB
	- 2Mbps PER @ -93 dBm, +/- 2dB
	- 5.5Mbps PER @ -91 dBm, +/- 2dB
	- 11Mbps PER @ -88 dBm, +/- 2dB
SISO Receive Sensitivity (11g,20MHz) @10% PER	- 6Mbps PER @ -92 dBm, +/- 2dB
	- 9Mbps PER @ -91 dBm, +/- 2dB
	- 12Mbps PER @ -90 dBm, +/- 2dB
	- 18Mbps PER @ -87 dBm, +/- 2dB
	- 24Mbps PER @ -84 dBm, +/- 2dB
	- 36Mbps PER @ -81 dBm, +/- 2dB
	- 48Mbps PER @ -78 dBm, +/- 2dB
	- 54Mbps PER @ -76 dBm, +/- 2dB
MIMO Receive Sensitivity (11g,20MHz) @10% PER	- 6Mbps PER @ -95 dBm, +/- 2dB
	- 9Mbps PER @ -94 dBm, +/- 2dB
	- 12Mbps PER @ -93 dBm, +/- 2dB
	- 18Mbps PER @ -90 dBm, +/- 2dB
	- 24Mbps PER @ -87 dBm, +/- 2dB
	- 36Mbps PER @ -84 dBm, +/- 2dB
	- 48Mbps PER @ -81 dBm, +/- 2dB
	- 54Mbps PER @ -78 dBm, +/- 2dB
SISO Receive Sensitivity (11n,20MHz) @10% PER	- MCS=0 PER @ -91 dBm, +/- 2dB
	- MCS=1 PER @ -89 dBm, +/- 2dB
	- MCS=2 PER @ -87 dBm, +/- 2dB

	- MCS=3	PER @ -83 dBm, +/- 2dB
	- MCS=4	PER @ -80 dBm, +/- 2dB
	- MCS=5	PER @ -78 dBm, +/- 2dB
	- MCS=6	PER @ -76 dBm, +/- 2dB
	- MCS=7	PER @ -74 dBm, +/- 2dB
MIMO Receive Sensitivity (11n,20MHz) @10% PER	- MCS=0	PER @ -93 dBm, +/- 2dB
	- MCS=1	PER @ -92 dBm, +/- 2dB
	- MCS=2	PER @ -90 dBm, +/- 2dB
	- MCS=3	PER @ -87 dBm, +/- 2dB
	- MCS=4	PER @ -83 dBm, +/- 2dB
	- MCS=5	PER @ -80 dBm, +/- 2dB
	- MCS=6	PER @ -78 dBm, +/- 2dB
	- MCS=7	PER @ -76 dBm, +/- 2dB
	- MCS=8	PER @ -92 dBm, +/- 2dB
	- MCS=15	PER @ -73 dBm, +/- 2dB
Maximum Input Level	802.11b : -10 dBm	
	802.11g/n : -20 dBm	
Antenna Reference	Small antennas with 0~2 dBi peak gain	

4.2 5GHz RF Specification

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

Feature	Description
WLAN Standard	IEEE 802.11a/n 2x2, WiFi compliant
Frequency Range	5.15 GHz ~ 5.845 GHz (5.0 GHz ISM Band)
Number of Channels	5.0GHz：Please see the table[1]
Modulation	802.11a : OFDM /64-QAM,16-QAM, QPSK, BPSK 802.11n : OFDM /64-QAM,16-QAM, QPSK, BPSK 802.11ac : OFDM /256-QAM
Output Power	802.11a /54Mbps : 15 dBm ± 2 dB @ EVM ≤ -25dB
	802.11n /MCS7@20MHz : 14 dBm ± 2 dB @ EVM ≤ -27dB
	802.11n /MCS7@40MHz : 14 dBm ± 2 dB @ EVM ≤ -27dB
	802.11ac /MCS8@20MHz : 12 dBm ± 2 dB @ EVM ≤ -30dB
	802.11ac /MCS9@40MHz : 10 dBm ± 2 dB @ EVM ≤ -32dB
	802.11ac /MCS9@80MHz : 10 dBm ± 2 dB @ EVM ≤ -32dB
SISO Receive Sensitivity (11a,20MHz) @10% PER	- 6Mbps PER @ -91 dBm, +/- 2dB
	- 9Mbps PER @ -90 dBm, +/- 2dB
	- 12Mbps PER @ -88 dBm, +/- 2dB
	- 18Mbps PER @ -86 dBm, +/- 2dB
	- 24Mbps PER @ -83 dBm, +/- 2dB
	- 36Mbps PER @ -80 dBm, +/- 2dB
	- 48Mbps PER @ -76 dBm, +/- 2dB
	- 54Mbps PER @ -74 dBm, +/- 2dB
MIMO Receive Sensitivity (11a,20MHz) @10% PER	- 6Mbps PER @ -92 dBm, +/- 2dB
	- 9Mbps PER @ -92 dBm, +/- 2dB
	- 12Mbps PER @ -92 dBm, +/- 2dB
	- 18Mbps PER @ -89 dBm, +/- 2dB
	- 24Mbps PER @ -86 dBm, +/- 2dB
	- 36Mbps PER @ -83 dBm, +/- 2dB
	- 48Mbps PER @ -78 dBm, +/- 2dB
	- 54Mbps PER @ -77 dBm, +/- 2dB

SISO Receive Sensitivity (11n,20MHz) @10% PER	- MCS=0 PER @ -90 dBm, +/- 2dB
	- MCS=1 PER @ -88 dBm, +/- 2dB
	- MCS=2 PER @ -86 dBm, +/- 2dB
	- MCS=3 PER @ -83 dBm, +/- 2dB
	- MCS=4 PER @ -79 dBm, +/- 2dB
	- MCS=5 PER @ -76 dBm, +/- 2dB
	- MCS=6 PER @ -73 dBm, +/- 2dB
	- MCS=7 PER @ -72 dBm, +/- 2dB
MIMO Receive Sensitivity (11n,20MHz) @10% PER	- MCS=0 PER @ -92 dBm, +/- 2dB
	- MCS=1 PER @ -91 dBm, +/- 2dB
	- MCS=2 PER @ -89 dBm, +/- 2dB
	- MCS=3 PER @ -86 dBm, +/- 2dB
	- MCS=4 PER @ -82 dBm, +/- 2dB
	- MCS=5 PER @ -78 dBm, +/- 2dB
	- MCS=6 PER @ -76 dBm, +/- 2dB
	- MCS=7 PER @ -75 dBm, +/- 2dB
	- MCS=8 PER @ -89 dBm, +/- 2dB
	- MCS=15 PER @ -70 dBm, +/- 2dB
SISO Receive Sensitivity (11n,40MHz) @10% PER	- MCS=0 PER @ -88 dBm, +/- 2dB
	- MCS=1 PER @ -86 dBm, +/- 2dB
	- MCS=2 PER @ -83 dBm, +/- 2dB
	- MCS=3 PER @ -80 dBm, +/- 2dB
	- MCS=4 PER @ -77 dBm, +/- 2dB
	- MCS=5 PER @ -72 dBm, +/- 2dB
	- MCS=6 PER @ -70 dBm, +/- 2dB
	- MCS=7 PER @ -69 dBm, +/- 2dB
MIMO Receive Sensitivity (11n,40MHz) @10% PER	- MCS=0 PER @ -89 dBm, +/- 2dB
	- MCS=1 PER @ -88 dBm, +/- 2dB
	- MCS=2 PER @ -86 dBm, +/- 2dB
	- MCS=3 PER @ -83 dBm, +/- 2dB
	- MCS=4 PER @ -79 dBm, +/- 2dB
	- MCS=5 PER @ -75 dBm, +/- 2dB
	- MCS=6 PER @ -73 dBm, +/- 2dB
	- MCS=7 PER @ -72 dBm, +/- 2dB
	- MCS=8 PER @ -86 dBm, +/- 2dB
	- MCS=15 PER @ -67 dBm, +/- 2dB
SISO Receive Sensitivity	- MCS=0, NSS1 PER @ -90 dBm, +/- 2dB

(11ac,20MHz) @10% PER	- MCS=1, NSS1 PER @ -88 dBm, +/- 2dB
	- MCS=2, NSS1 PER @ -86 dBm, +/- 2dB
	- MCS=3, NSS1 PER @ -82 dBm, +/- 2dB
	- MCS=4, NSS1 PER @ -79 dBm, +/- 2dB
	- MCS=5, NSS1 PER @ -76 dBm, +/- 2dB
	- MCS=6, NSS1 PER @ -73 dBm, +/- 2dB
	- MCS=7, NSS1 PER @ -70 dBm, +/- 2dB
	- MCS=8, NSS1 PER @ -67 dBm, +/- 2dB
MIMO Receive Sensitivity (11ac,20MHz) @10% PER	- MCS=0, NSS1 PER @ -92 dBm, +/- 2dB
	- MCS=1, NSS1 PER @ -91 dBm, +/- 2dB
	- MCS=2, NSS1 PER @ -88 dBm, +/- 2dB
	- MCS=3, NSS1 PER @ -85 dBm, +/- 2dB
	- MCS=4, NSS1 PER @ -82 dBm, +/- 2dB
	- MCS=5, NSS1 PER @ -77 dBm, +/- 2dB
	- MCS=6, NSS1 PER @ -76 dBm, +/- 2dB
	- MCS=7, NSS1 PER @ -75 dBm, +/- 2dB
	- MCS=8, NSS1 PER @ -72 dBm, +/- 2dB
	- MCS=0, NSS2 PER @ -88 dBm, +/- 2dB
	- MCS=8, NSS2 PER @ -65 dBm, +/- 2dB
SISO Receive Sensitivity (11ac,40MHz) @10% PER	- MCS=0, NSS1 PER @ -88 dBm, +/- 2dB
	- MCS=1, NSS1 PER @ -86 dBm, +/- 2dB
	- MCS=2, NSS1 PER @ -83 dBm, +/- 2dB
	- MCS=3, NSS1 PER @ -80 dBm, +/- 2dB
	- MCS=4, NSS1 PER @ -76 dBm, +/- 2dB
	- MCS=5, NSS1 PER @ -72 dBm, +/- 2dB
	- MCS=6, NSS1 PER @ -70 dBm, +/- 2dB
	- MCS=7, NSS1 PER @ -69 dBm, +/- 2dB
	- MCS=8, NSS1 PER @ -65 dBm, +/- 2dB
	- MCS=9, NSS1 PER @ -63 dBm, +/- 2dB
MIMO Receive Sensitivity (11ac,40MHz) @10% PER	- MCS=0, NSS1 PER @ -90 dBm, +/- 2dB
	- MCS=1, NSS1 PER @ -88 dBm, +/- 2dB
	- MCS=2, NSS1 PER @ -86 dBm, +/- 2dB
	- MCS=3, NSS1 PER @ -82 dBm, +/- 2dB
	- MCS=4, NSS1 PER @ -79 dBm, +/- 2dB
	- MCS=5, NSS1 PER @ -77 dBm, +/- 2dB
	- MCS=6, NSS1 PER @ -73 dBm, +/- 2dB
	- MCS=7, NSS1 PER @ -72 dBm, +/- 2dB

	- MCS=8, NSS1 PER @ -68 dBm, +/- 2dB
	- MCS=9, NSS1 PER @ -66 dBm, +/- 2dB
	- MCS=0, NSS2 PER @ -86 dBm, +/- 2dB
	- MCS=9, NSS2 PER @ -60 dBm, +/- 2dB
SISO Receive Sensitivity (11ac,80MHz) @10% PER	- MCS=0, NSS1 PER @ -85 dBm, +/- 2dB
	- MCS=1, NSS1 PER @ -82 dBm, +/- 2dB
	- MCS=2, NSS1 PER @ -79 dBm, +/- 2dB
	- MCS=3, NSS1 PER @ -76 dBm, +/- 2dB
	- MCS=4, NSS1 PER @ -73 dBm, +/- 2dB
	- MCS=5, NSS1 PER @ -68 dBm, +/- 2dB
	- MCS=6, NSS1 PER @ -67 dBm, +/- 2dB
	- MCS=7, NSS1 PER @ -65 dBm, +/- 2dB
	- MCS=8, NSS1 PER @ -62 dBm, +/- 2dB
	- MCS=9, NSS1 PER @ -60 dBm, +/- 2dB
MIMO Receive Sensitivity (11ac,80MHz) @10% PER	- MCS=0, NSS1 PER @ -87 dBm, +/- 2dB
	- MCS=1, NSS1 PER @ -85 dBm, +/- 2dB
	- MCS=2, NSS1 PER @ -82 dBm, +/- 2dB
	- MCS=3, NSS1 PER @ -79 dBm, +/- 2dB
	- MCS=4, NSS1 PER @ -76 dBm, +/- 2dB
	- MCS=5, NSS1 PER @ -71 dBm, +/- 2dB
	- MCS=6, NSS1 PER @ -70 dBm, +/- 2dB
	- MCS=7, NSS1 PER @ -68 dBm, +/- 2dB
	- MCS=8, NSS1 PER @ -66 dBm, +/- 2dB
	- MCS=9, NSS1 PER @ -63 dBm, +/- 2dB
	- MCS=0, NSS2 PER @ -83 dBm, +/- 2dB
	- MCS=9, NSS2 PER @ -58 dBm, +/- 2dB
Maximum Input Level	802.11a/n : -30 dBm
Antenna Reference	Small antennas with 0~2 dBi peak gain

5GHz(20MHz) Channel table

Band (GHz)	Operating Channel Numbers	Channel center frequencies(MHz)
5.15GHz~5.25GHz	36	5180
	40	5200
	44	5220
	48	5240
5.25GHz~5.35GHz	52	5260
	56	5280
	60	5300

	64	5320
5.5GHz~5.7GHz	100	5500
	104	5520
	108	5540
	112	5560
	116	5580
	120	5600
	124	5620
	128	5640
	132	5660
	136	5680
	140	5700
5.725GHz~5.85GHz	149	5745
	153	5765
	157	5785
	161	5805
	165	5825

5. Bluetooth Specification

5.1 Bluetooth Specification

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

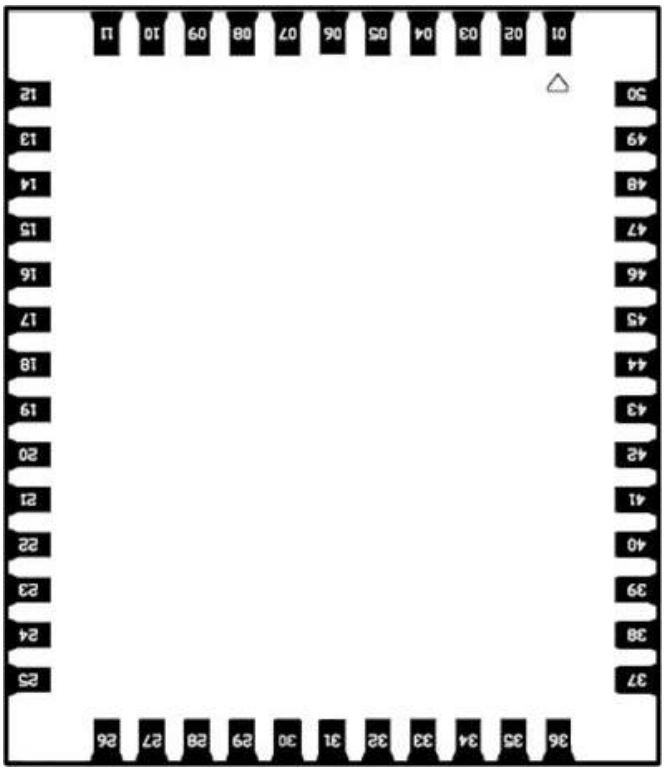
Feature	**Description**		
General Specification			
Bluetooth Standard	Bluetooth V5.0 of 1, 2 and 3 Mbps.		
Host Interface	UART		
Antenna Reference	Small antennas with 0~2 dBi peak gain		
Frequency Band	2402 MHz ~ 2480 MHz		
Number of Channels	79 channels		
Modulation	FHSS, GFSK, DPSK, DQPSK		
RF Specification			
	Min.	**Typical.**	**Max.**
Output Power[1]	0	-	10
Sensitivity @ BER=0.1% for GFSK (1Mbps)		-86 dBm	
Sensitivity @ BER=0.01% for π/4-DQPSK (2Mbps)		-88 dBm	
Sensitivity @ BER=0.01% for 8DPSK (3Mbps)		-84 dBm	
Maximum Input Level	GFSK (1Mbps):-20dBm		
	π/4-DQPSK (2Mbps) :-20dBm		
	8DPSK (3Mbps) :-20dBm		

NOTE[1]：Output power can be configured by HCD firmware.

6. Pin Assignments

6.1 Pin Outline

< TOP VIEW >



6.2 Pin Definition

NO	Name	Type	Description
1	GND	—	Ground connections
2	WL/BT_ANT0	I/O	RF I/O port0
3	GND	—	Ground connections
4	GND	—	Ground connections
5	GND	—	Ground connections
6	GND	—	Ground connections
7	GND	—	Ground connections
8	GND	—	Ground connections
9	WL_ANT1	I/O	RF I/O port1
10	GND	—	Ground connections
11	GND	—	Ground connections
12	NC	—	Floating (Don’t connected to ground)
13	XTAL_OUT	O	External Crystal out
14	XTAL_IN	I	External Crystal in/ Single clock source in

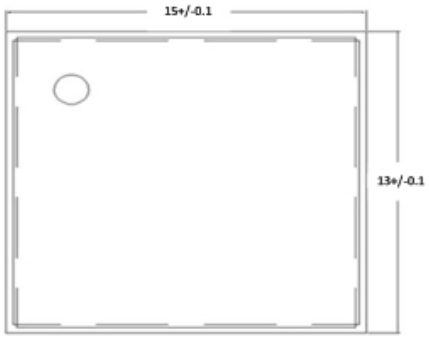
15	WL_REG_ON	I	Low asserting reset for WiFi core
16	WL_HOST_WAKE	O	WLAN to wake-up HOST
17	SDIO_DATA_CMD	I/O	SDIO command line
18	SDIO_DATA_CLK	I/O	SDIO clock line
19	SDIO_DATA_3	I/O	SDIO data line 3
20	SDIO_DATA_2	I/O	SDIO data line 2
21	SDIO_DATA_0	I/O	SDIO data line 0
22	SDIO_DATA_1	I/O	SDIO data line 1
23	GND	—	Ground connections
24	SDIO_VSEL	I	SDIO voltage select: 0: 3.3V 1:1.8V
25	VIN_LDO	P	Internal Buck voltage generation pin
26	VIN_LDO_OUT	P	Internal Buck voltage generation pin
27	PCM_SYNC	I/O	PCM sync signal
28	PCM_IN	I	PCM data input
29	PCM_OUT	O	PCM Data output
30	PCM_CLK	I/O	PCM clock
31	LPO	I	External Low Power Clock input (32.768KHz)
32	GND	—	Ground connections
33	NC	—	Floating (Don’t connected to ground)
34	VDDIO	P	I/O Voltage supply input
35	NC	—	Floating (Don’t connected to ground)
36	VBAT	P	Main power voltage source input
37	NC	—	Floating (Don’t connected to ground)
38	BT_REG_ON	I	Low asserting reset for Bluetooth core
39	GND	—	Ground connections
40	UART_TXD	O	Bluetooth UART interface
41	UART_RXD	I	Bluetooth UART interface
42	UART_RTS_N	O	Bluetooth UART interface
43	UART_CTS_N	I	Bluetooth UART interface
44	WL_UART_TX	O	WL_UART_TX
45	WL_UART_RX	I	WL_UART_RX
46	NC	—	Floating (Don’t connected to ground)
47	GND	—	Ground connections
48	NC	—	Floating (Don’t connected to ground)
49	BT_WAKE	I	HOST wake-up Bluetooth device
50	BT_HOST_WAKE	O	Bluetooth device to wake-up HOST

7. Dimensions

7.1 Physical Dimensions

(Unit: mm)

< TOP VIEW >



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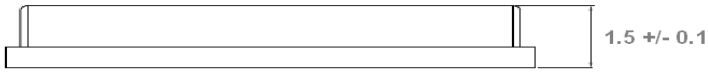

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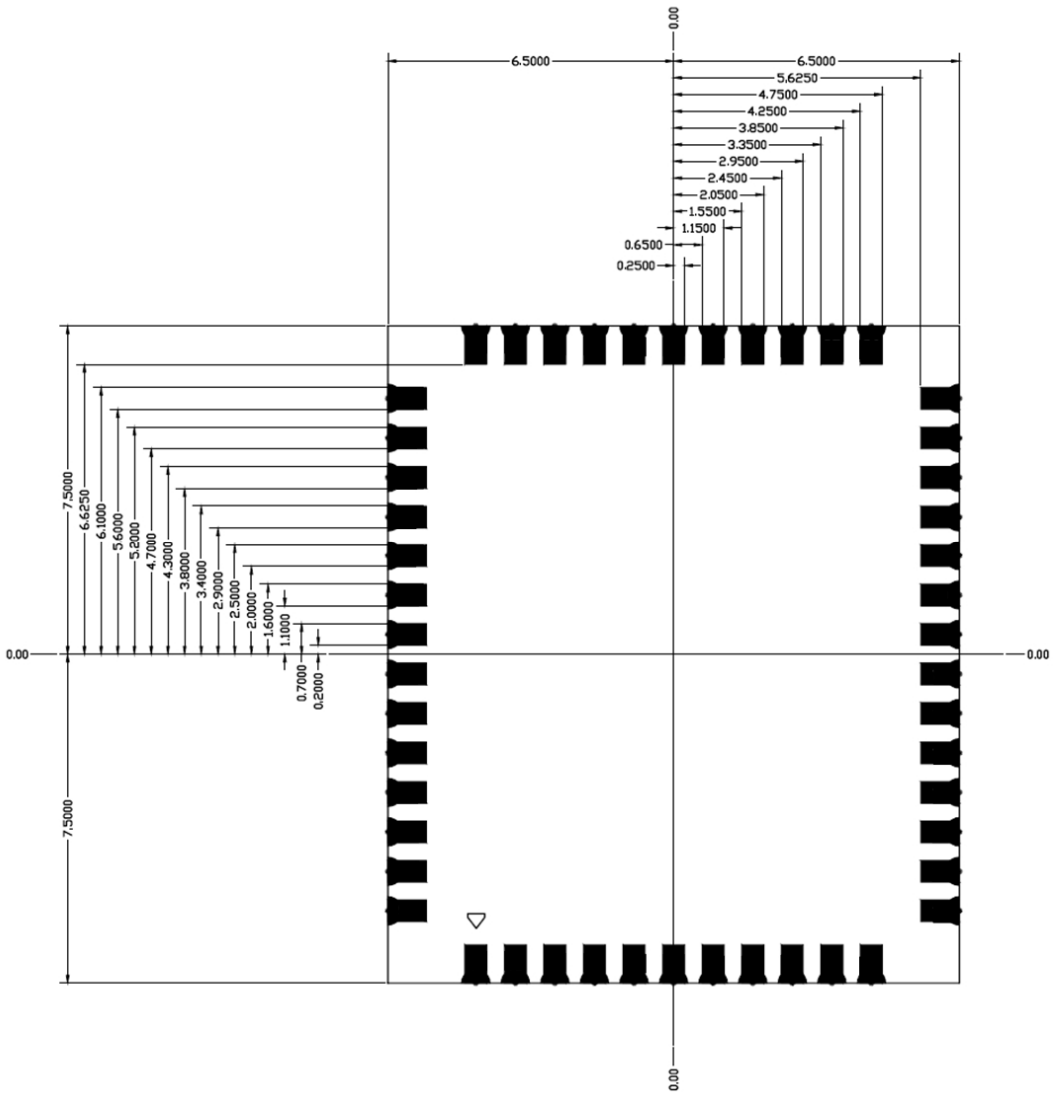

7.2 Layout Recommendation

(Unit: mm)

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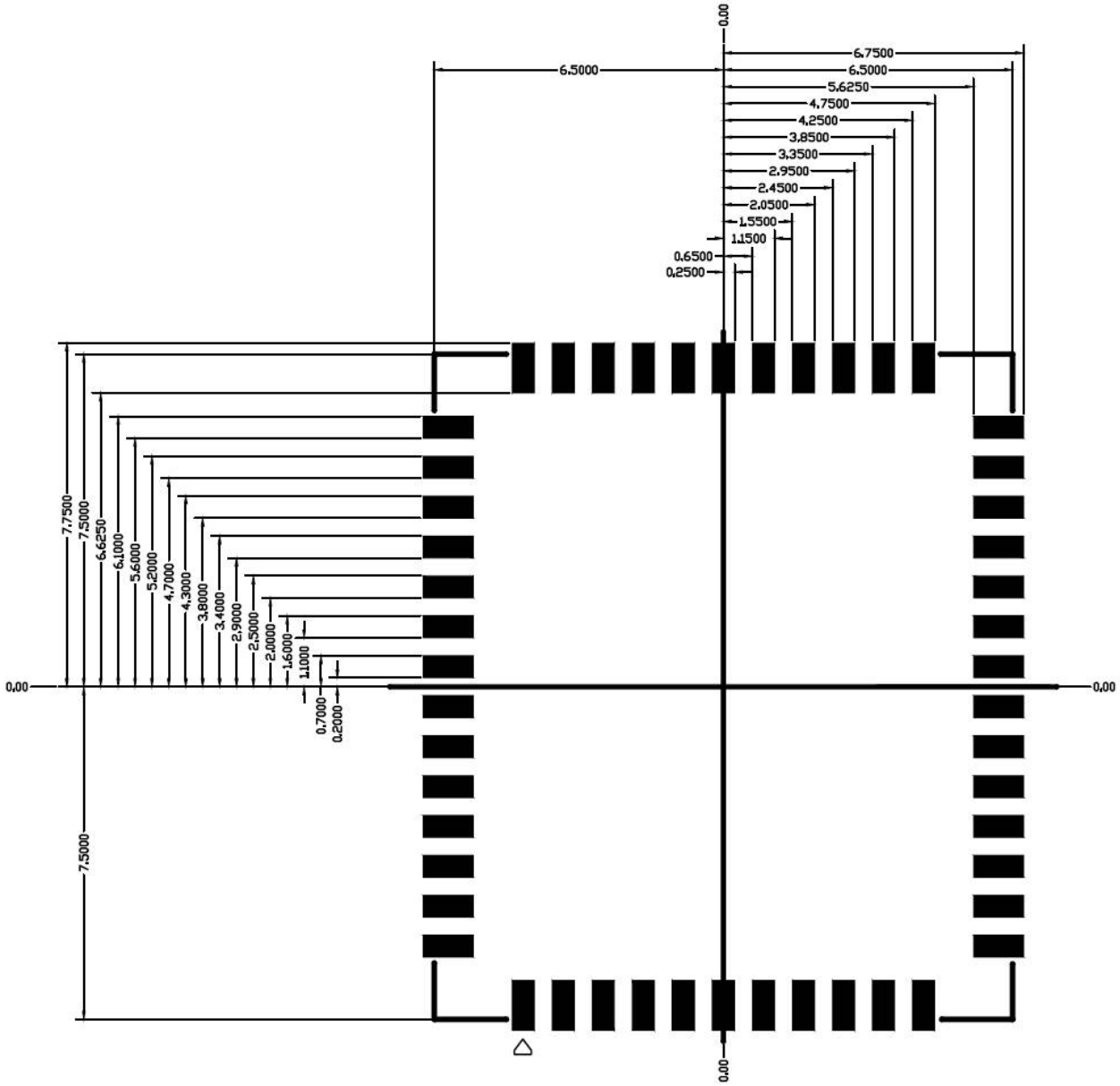


8. External clock reference

External LPO signal characteristics

Parameter	Specification	Units
Nominal input frequency	32.768	kHz
Frequency accuracy	±30	ppm
Duty cycle	30 - 70	%
Input signal amplitude	1600 to 3300	mV, p-p
Signal type	Square-wave or sine-wave	-
Input impedance	>100k <5	Ω pF
Clock jitter (integrated over 300Hz – 15KHz)	<1	Hz
Output high voltage	0.7Vio - Vio	V

8.1 SDIO Pin Description

The module supports SDIO version 3.0 for all 1.8V 4-bit UHSI speeds: SDR50(100 Mbps),SDR104(208MHz) and DDR50(50MHz, dual rates) in addition to the 3.3V default speed(25MHz) and high speed (50 MHz). 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

9. Host Interface Timing Diagram

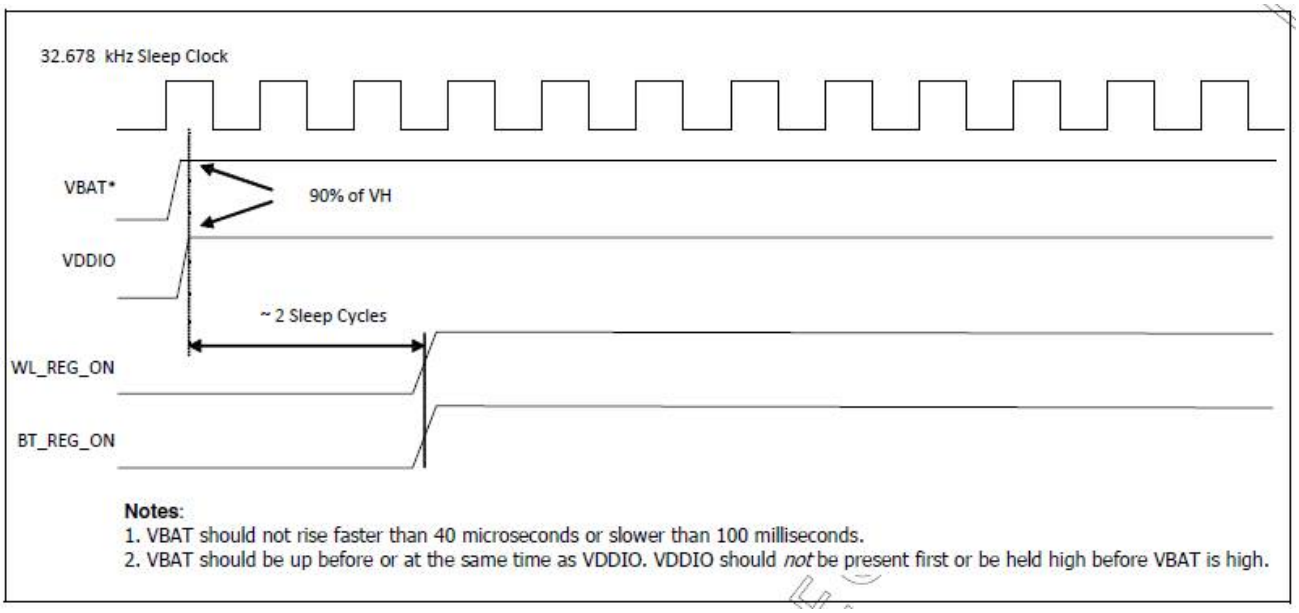
9.1 Power-up Sequence Timing Diagram

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.

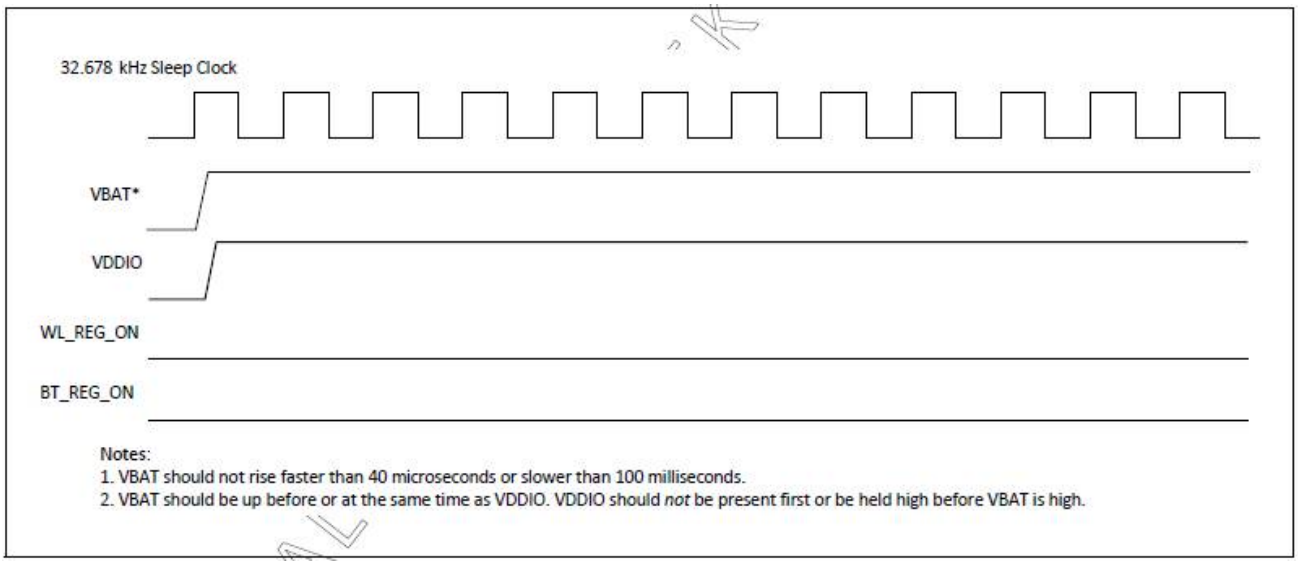
Additionally, diagrams are provided to indicate proper sequencing of the signals for carious operating states. The timing value indicated are minimum required values: longer delays are also acceptable.

※ WL_REG_ON: Used by the PMU to power up or power down the internal regulators used by 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.

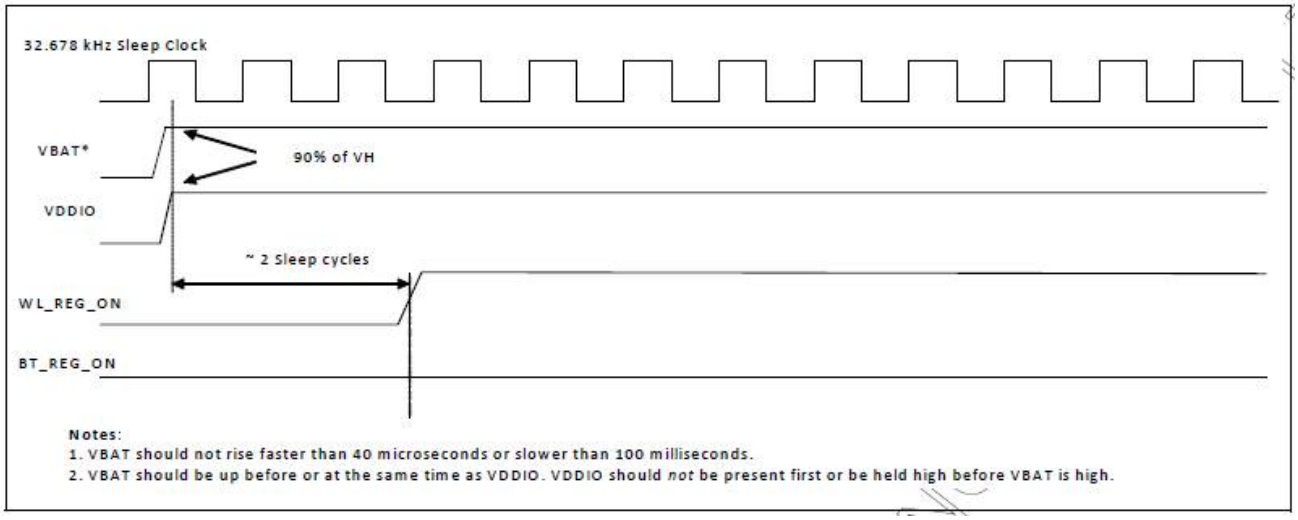
※ BT_REG_ON: Used by the PMU to power up or power down the internal regulators used by the BT section. Low asserting reset for Bluetooth. This pin has no effect on WLAN and does not control any PMU functions. This pin must be driven high or low (not left floating).



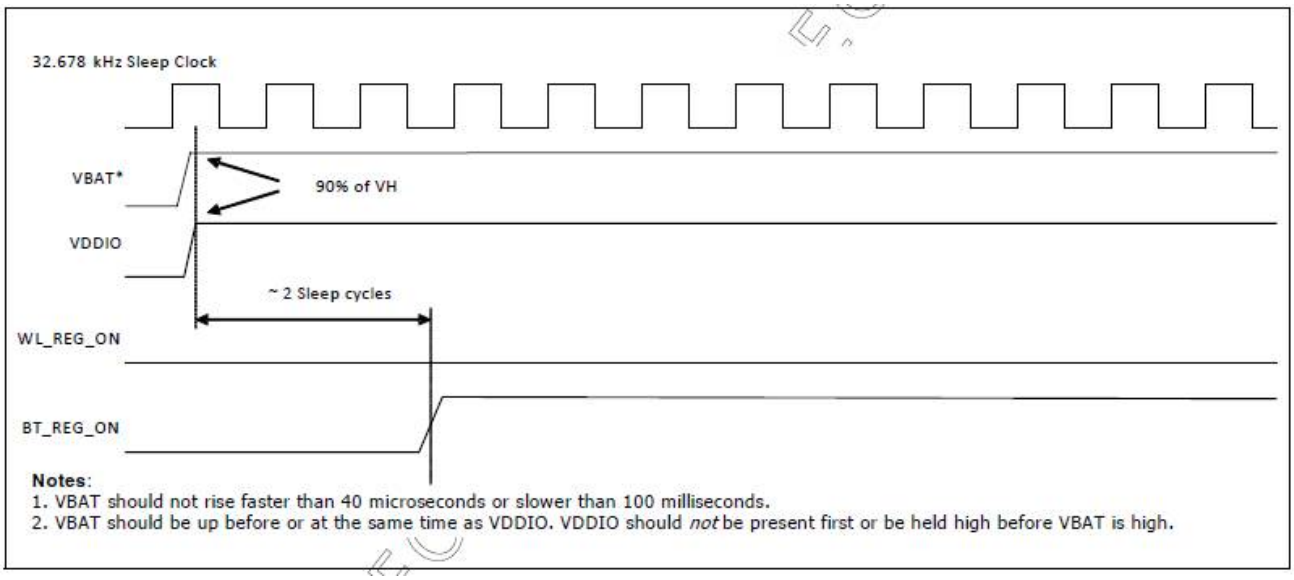
WLAN=ON, Bluetooth=ON



WLAN=OFF, Bluetooth=OFF

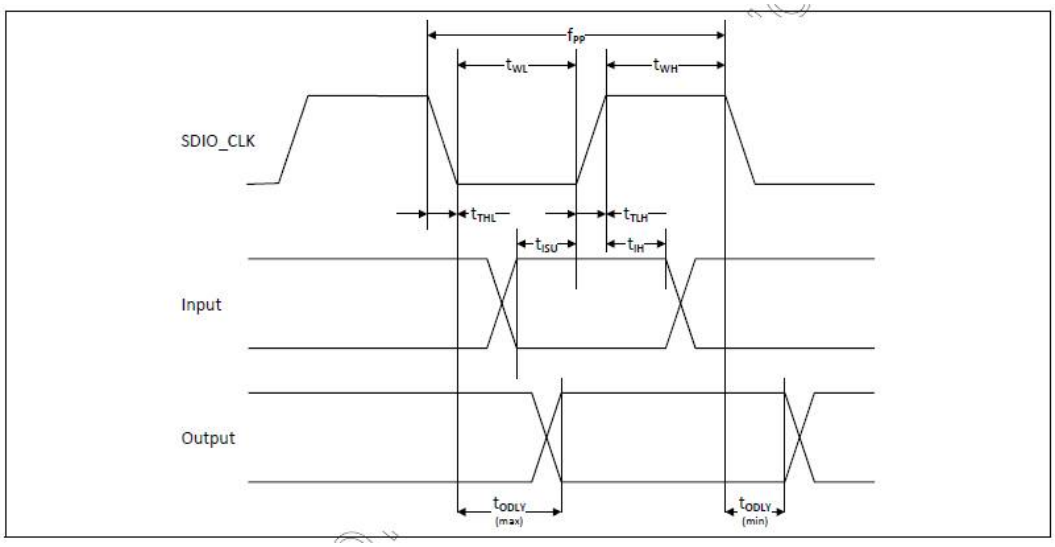


WLAN=ON, Bluetooth=OFF



WLAN=OFF, Bluetooth=ON

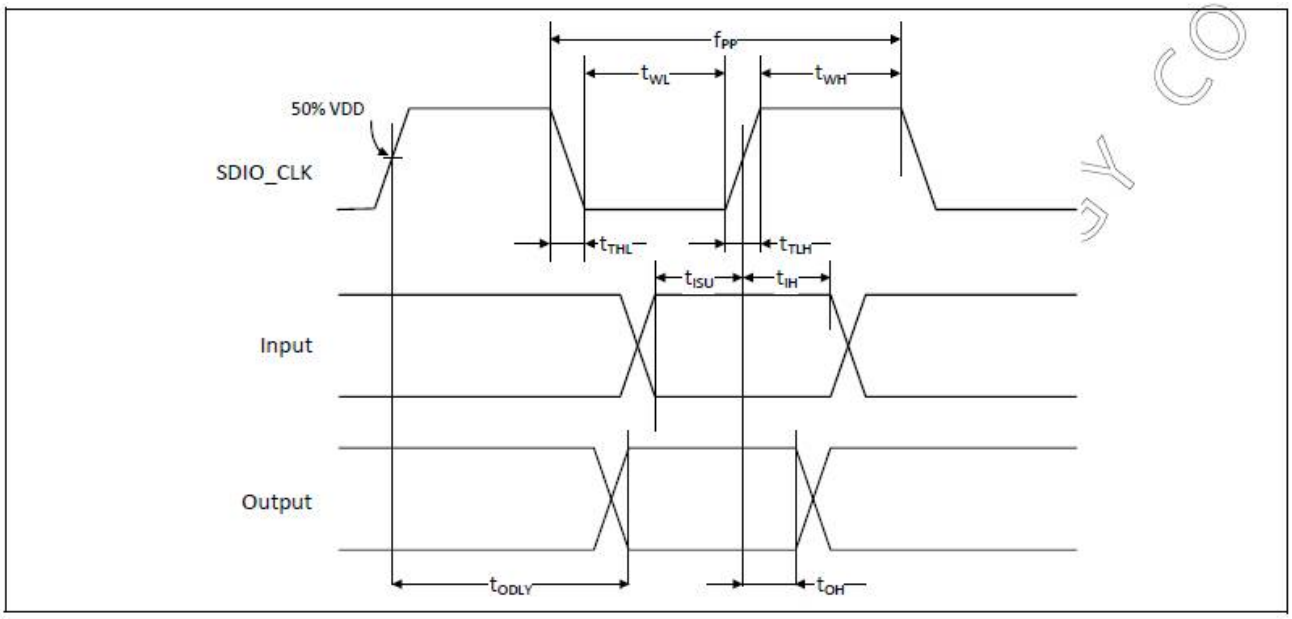
9.2 SDIO Default Mode Timing Diagram



Parameter	Symbol	Minimum	Typical	Maximum	Unit
SDIO CLK (All values are referred to minimum VIH and maximum VIL[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
Inputs: CMD, DAT (referenced to CLK)					
Input setup time	tISU	5	–	–	ns
Input hold time	tIH	5	–	–	ns
Outputs: CMD, DAT (referenced to CLK)					
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.

9.3 SDIO High Speed Mode Timing Diagram

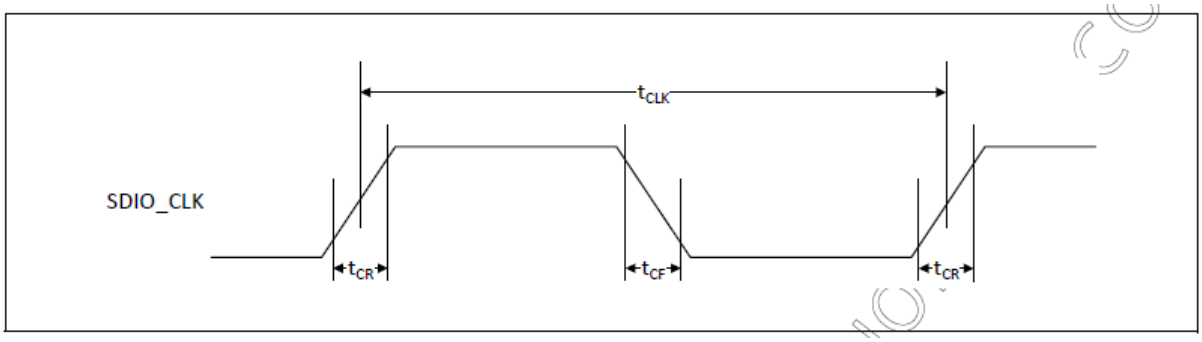


Parameter	*Symbol*	*Minimum*	*Typical*	*Maximum*	*Unit*
SDIO CLK (all values are referred to minimum VIH and maximum VIL[b])					
Frequency – Data Transfer Mode	fPP	0	–	50	MHz
Frequency – Identification Mode	fOD	0	–	400	kHz
Clock low time	tWL	7	–	–	ns
Clock high time	tWH	7	–	–	ns
Clock rise time	tTLH	–	–	3	ns
Clock low time	tTHL	–	–	3	ns
Inputs: CMD, DAT (referenced to CLK)					
Input setup Time	tISU	6	–	–	ns
Input hold Time	tIH	2	–	–	ns
Outputs: CMD, DAT (referenced to CLK)					
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 ≤ 40 pF load on CMD and Data.
b. min(Vih) = 0.7 × VDDIO and max(Vil) = 0.2 × VDDIO.

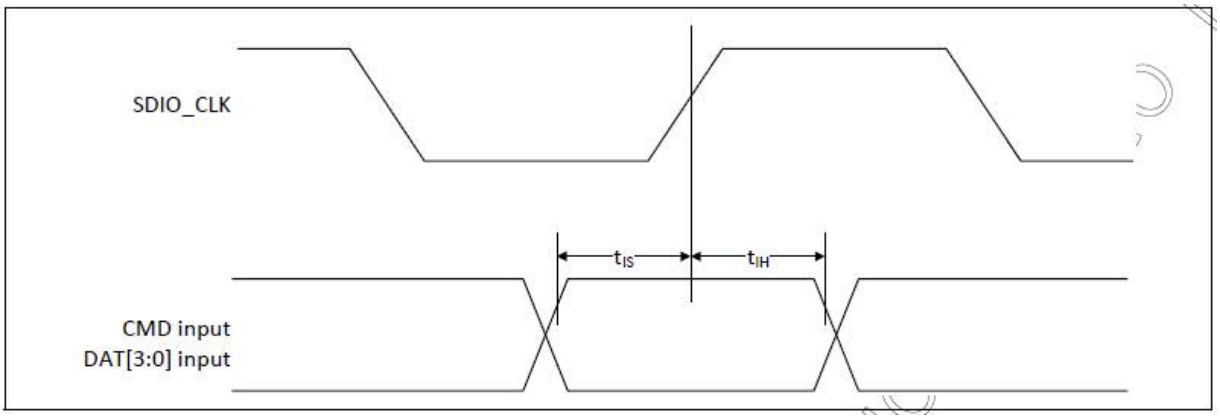
9.4 SDIO Bus Timing Specifications in SDR Modes

Clock timing(SDR Modes)



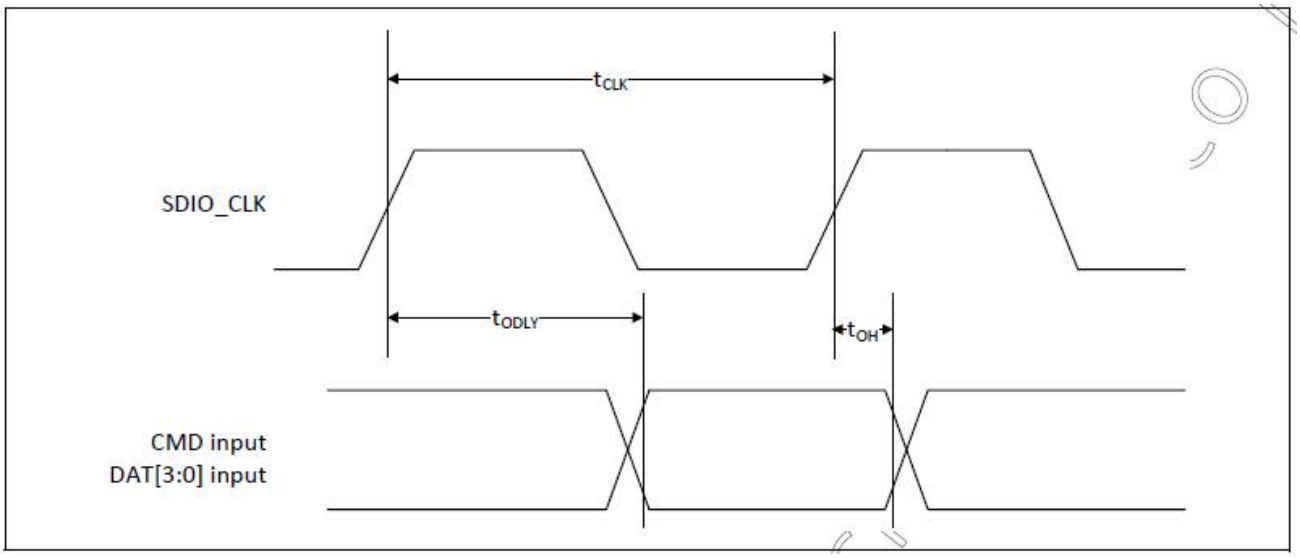
Parameter	Symbol	Minimum	Maximum	Unit	Comments
–	t_{CLK}	40	–	ns	SDR12 mode
		20	–	ns	SDR25 mode
		10	–	ns	SDR50 mode
		4.8	–	ns	SDR104 mode
–	t_{CR}, t_{CF}	–	0.2 × t_{CLK}	ns	t_{CR}, t_{CF} < 2.00 ns (max) @100 MHz, C_{CARD} = 10 pF t_{CR}, t_{CF} < 0.96 ns (max) @208 MHz, C_{CARD} = 10 pF
Clock duty	–	30	70	%	–

Card Input timing (SDR Modes)



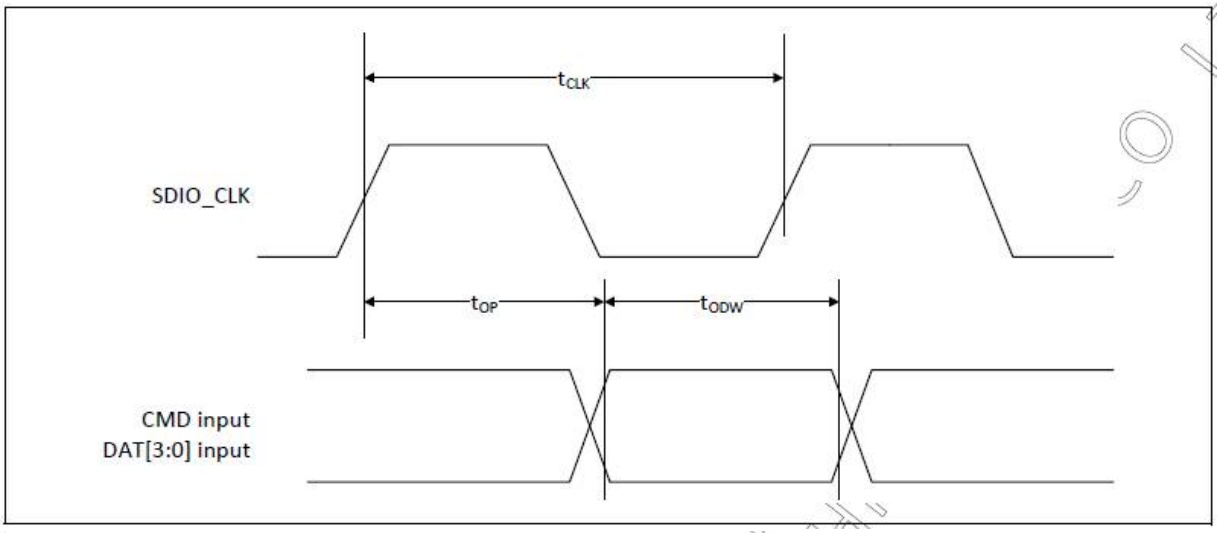
Symbol	Minimum	Maximum	Unit	Comments
SDR104 Mode				
t_{IS}	1.4	–	ns	C_{CARD} = 10 pF, VCT = 0.975V
t_{IH}	0.80	–	ns	C_{CARD} = 5 pF, VCT = 0.975V
SDR50 Mode				
t_{IS}	3.00	–	ns	C_{CARD} = 10 pF, VCT = 0.975V
t_{IH}	0.80	–	ns	C_{CARD} = 5 pF, VCT = 0.975V

Card output timing (SDR Modes up to 100MHz)



Symbol	Minimum	Maximum	Unit	Comments
t_{ODLY}	–	7.5	ns	t_{CLK} ≥ 10 ns C_L = 30 pF using driver type B for SDR50
t_{ODLY}	–	14.0	ns	t_{CLK} ≥ 20 ns C_L = 40 pF using for SDR12, SDR25
t_{OH}	1.5	–	ns	Hold time at the t_{ODLY} (min) C_L = 15 pF

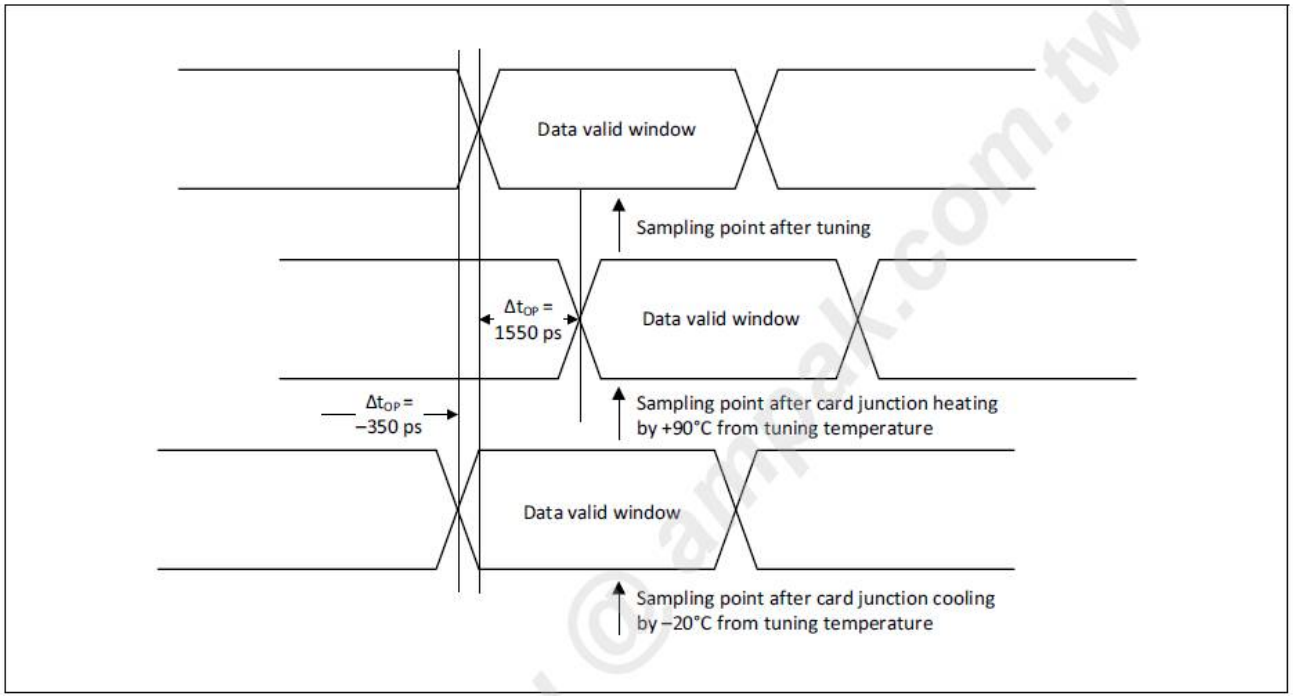
Card output timing (SDR Modes 100MHz to 208MHz)



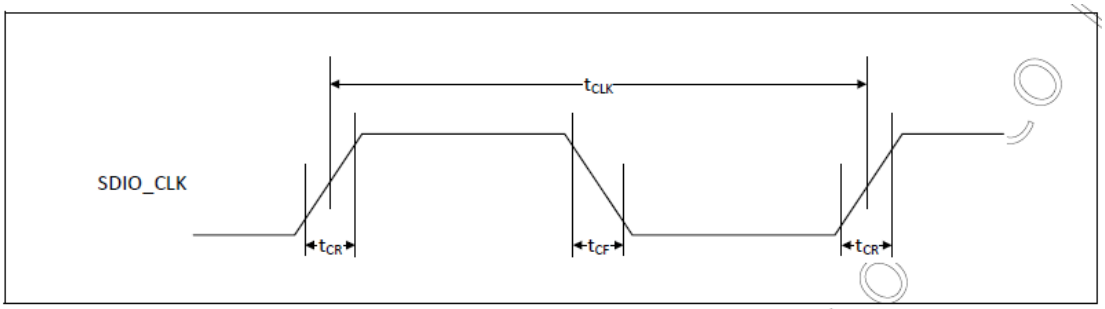
Symbol	Minimum	Maximum	Unit	Comments
t_{OP}	0	2	UI	Card output phase
Δt_{OP}	–350	+1550	ps	Delay variation due to temp change after tuning
t_{ODW}	0.60	–	UI	t_{ODW}=2.88 ns @208 MHz

- Δt_{OP} = +1550 ps for junction temperature of Δt_{OP} = 90 degrees during operation
- Δt_{OP} = –350 ps for junction temperature of Δt_{OP} = –20 degrees during operation
- Δt_{OP} = +2600 ps for junction temperature of Δt_{OP} = –20 to +125 degrees during operation

Δt_{OP} Consideration for Variable Data Window (SDR 104 Mode)

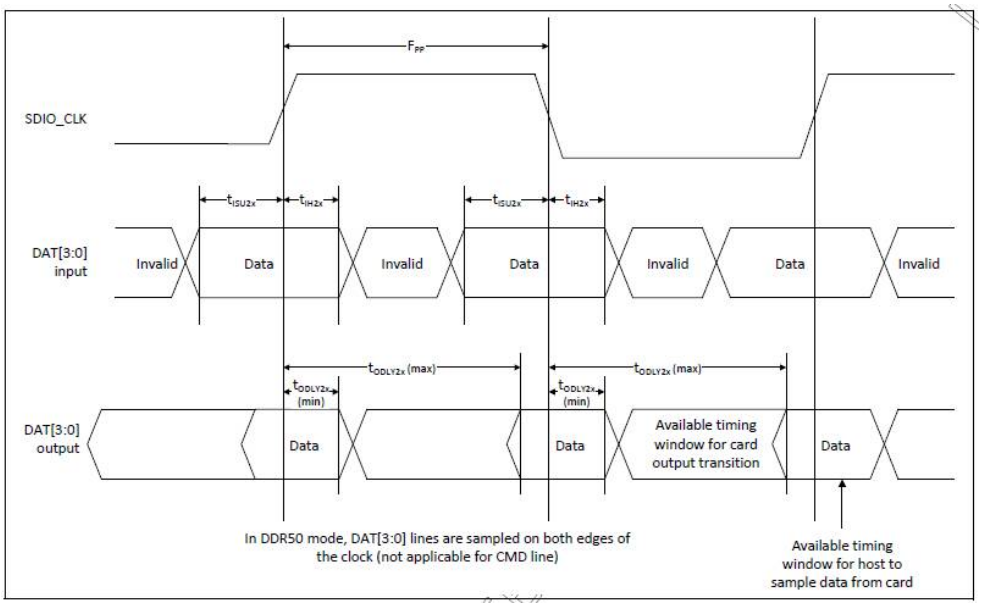


9.5 SDIO Bus Timing Specifications in DDR50 Mode



Parameter	Symbol	Minimum	Maximum	Unit	Comments
–	t_{CLK}	20	–	ns	DDR50 mode
–	t_{CR},t_{CF}	–	0.2 × tCLK	ns	t_{CR}, t_{CF} < 4.00 ns (max) @50 MHz, C_{CARD} = 10 pF
Clock duty	–	45	55	%	–

Data Timing



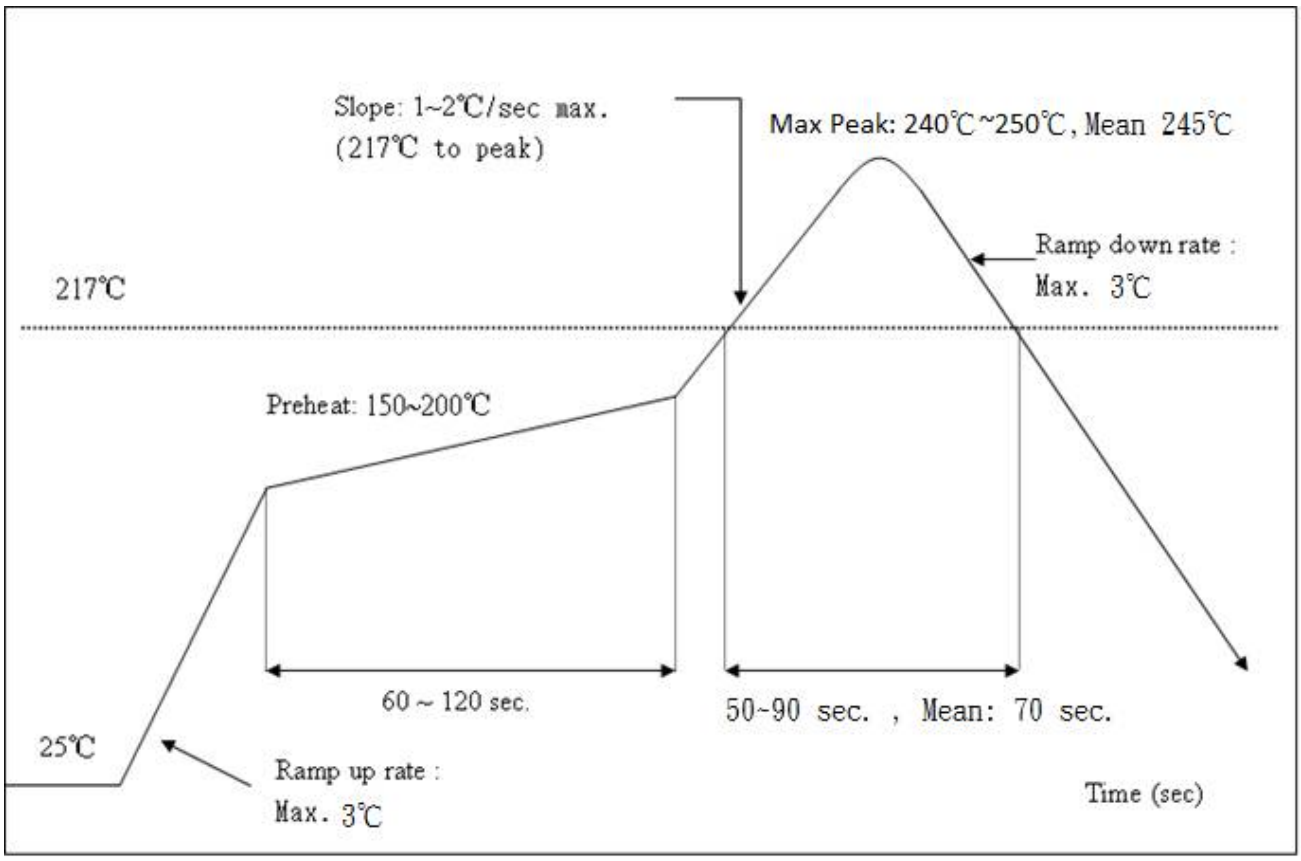
Parameter	Symbol	Minimum	Maximum	Unit	Comments
Input CMD					
Input setup time	t_{ISU}	6	–	ns	C_{CARD} < 10 pF (1 Card)
Input hold time	t_{IH}	0.8	–	ns	C_{CARD} < 10 pF (1 Card)
Output CMD					
Output delay time	t_{ODLY}	–	13.7	ns	C_{CARD} < 30 pF (1 Card)
Output hold time	t_{OH}	1.5	–	ns	C_{CARD} < 15 pF (1 Card)
Input DAT					
Input setup time	t_{ISU2x}	3	–	ns	C_{CARD} < 10 pF (1 Card)
Input hold time	t_{IH2x}	0.8	–	ns	C_{CARD} < 10 pF (1 Card)
Output DAT					
Output delay time	t_{ODLY2x}	–	7.5	ns	C_{CARD} < 25 pF (1 Card)
Output hold time	t_{ODLY2x}	1.5	–	ns	C_{CARD} < 15 pF (1 Card)

10. Recommended Reflow Profile

Referred to IPC/JEDEC standard.

Peak Temperature : <250°C

Number of Times : ≤2 times



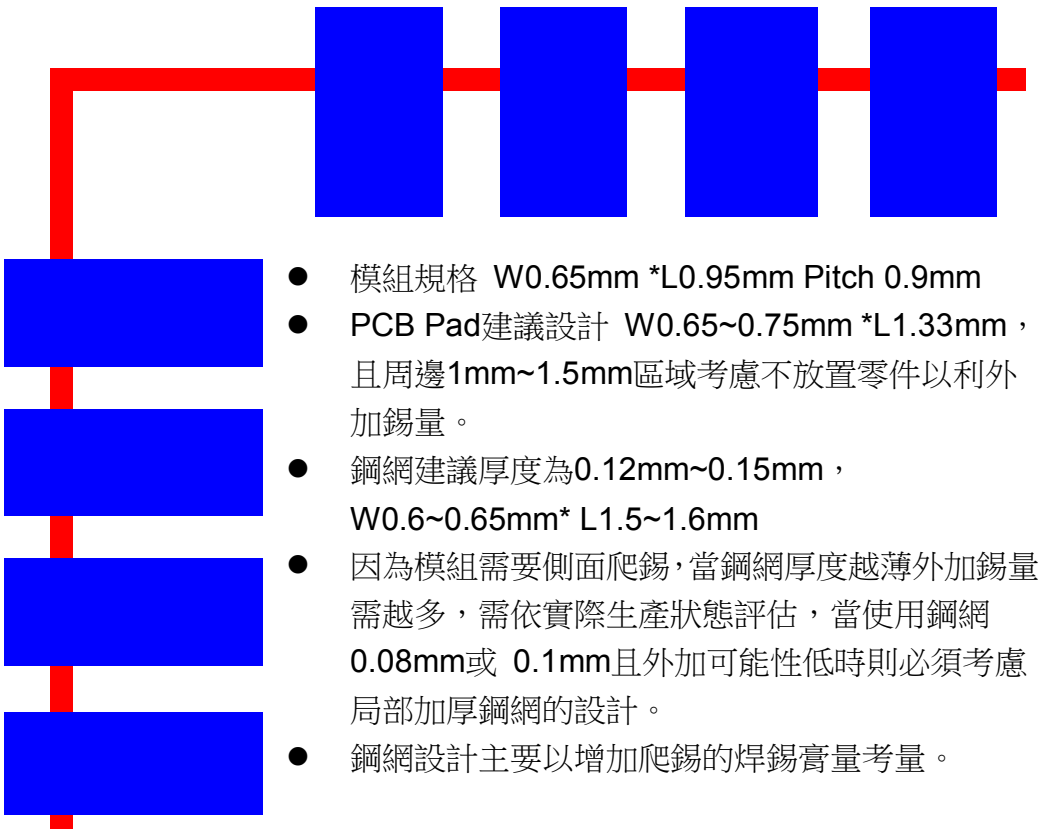
The notification of WiFi module before mounting:

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

Reflow 時需使用 N2, 含氧量建議 5000 ppm 以下,

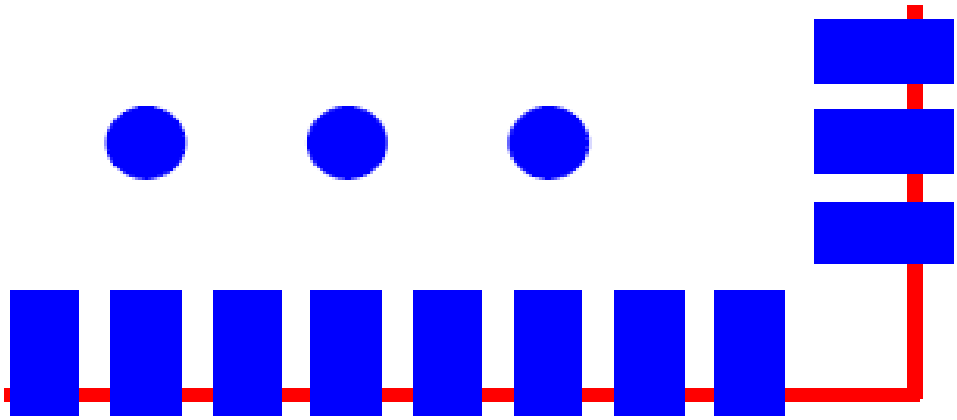
It must use N2 for reflow and suggest the concentration of oxygen less than 5000 ppm .

Solder Paste definition



- 模組規格 W0.65mm *L0.95mm Pitch 0.9mm
- PCB Pad建議設計 W0.65~0.75mm *L1.33mm，且周邊1mm~1.5mm區域考慮不放置零件以利外加錫量。
- 鋼網建議厚度為0.12mm~0.15mm，W0.6~0.65mm* L1.5~1.6mm
- 因為模組需要側面爬錫，當鋼網厚度越薄外加錫量需越多，需依實際生產狀態評估，當使用鋼網0.08mm或 0.1mm且外加可能性低時則必須考慮局部加厚鋼網的設計。
- 鋼網設計主要以增加爬錫的焊錫膏量考量。

- 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.



模組規格 L 0.7mm
PCB Pad 設計 L 0.8mm
鋼網開孔建議 L0.5mm~0.6mm
適當內縮可以避免撐高造成高度影響

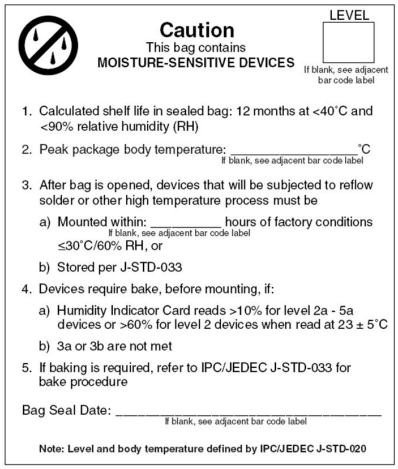
- Module Specifications L 0.7mm
- The design for PCB Pad : L:0.8mm
- We recommend the apertures for stencil L:0.5mm~0.6mm
- In order to avoid highness impact caused solder paste thickness, the stencil open size can be appropriately retracted

11. Package Information

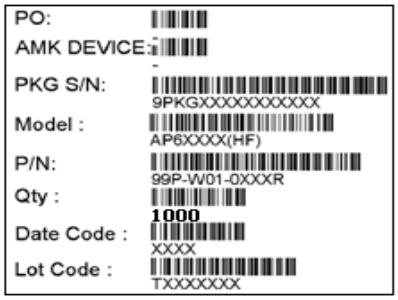
11.1 Label

Label A→ Anti-static and humidity notice

Label B→ MSL caution / Storage Condition

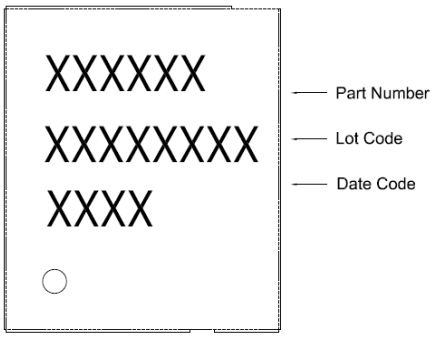


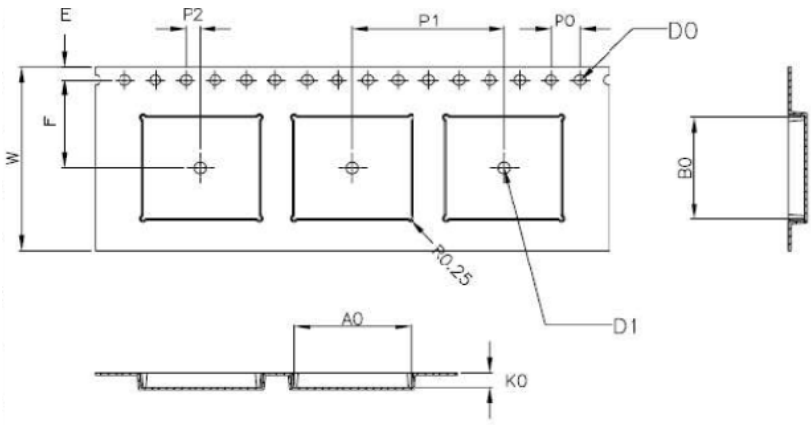
Label C→ Inner box label .



Label D→ Carton box label .

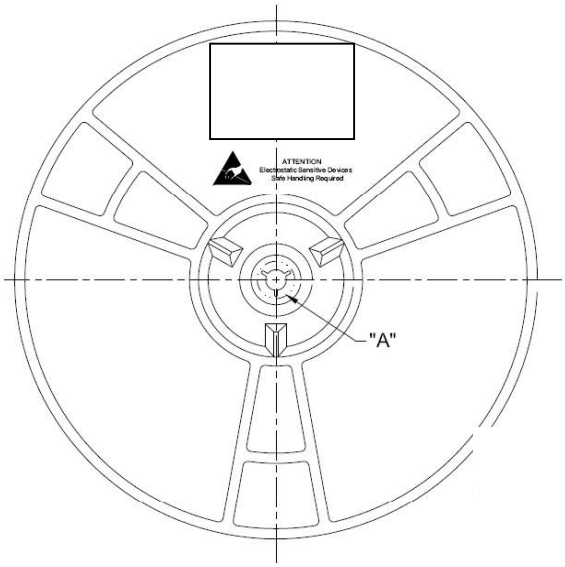
11.2 Dimension

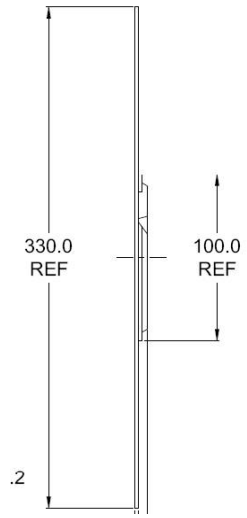


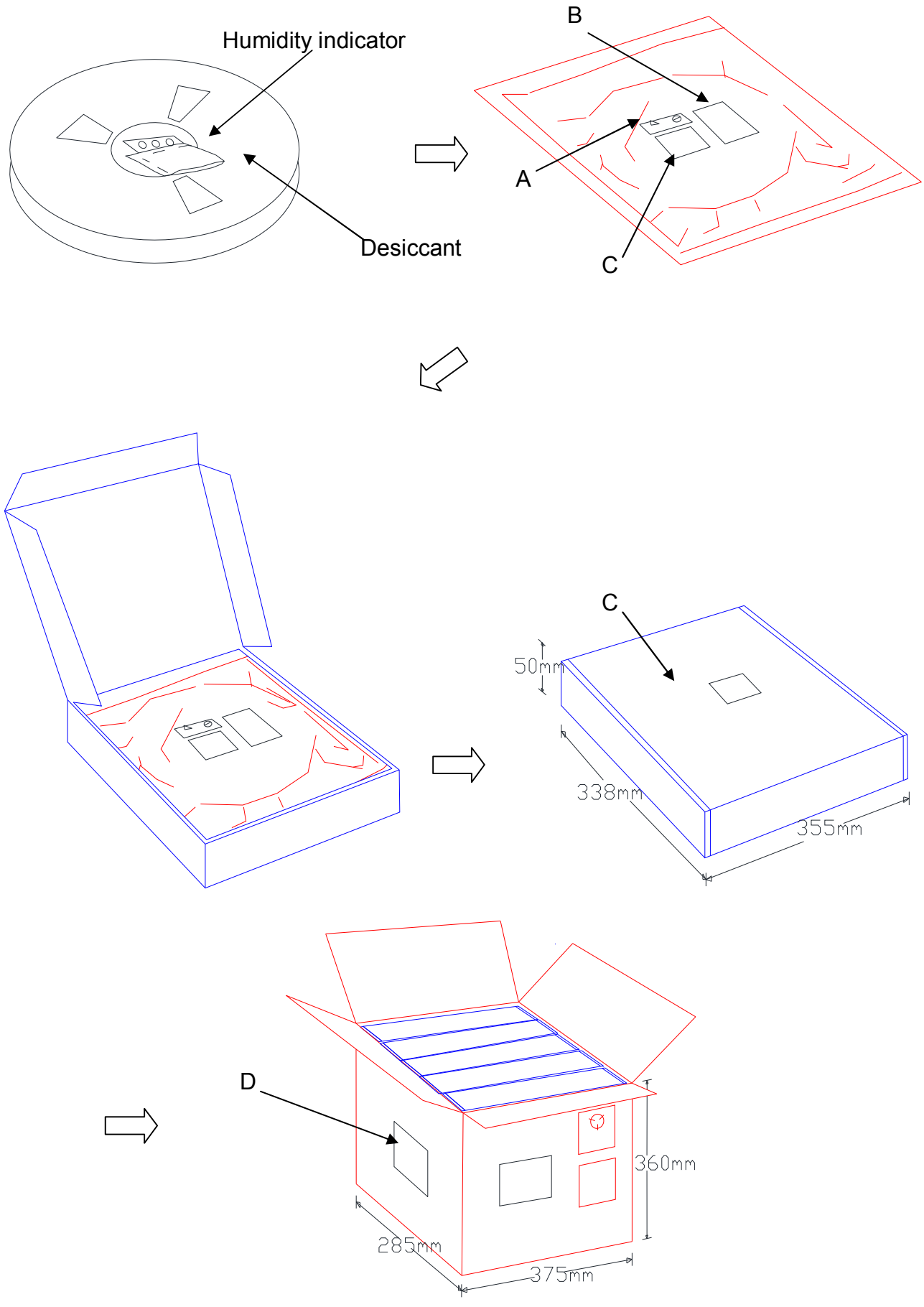


W	24.00±0.30
A0	15.30±0.10
B0	13.30±0.10
K0	2.00±0.10
E	1.75±0.10
F	11.50±0.10
P0	4.00±0.10
P1	20.00±0.10
P2	2.00±0.10
D0	1.50 $^{+0.10}_{-0.00}$
D1	ø1.5OMIN

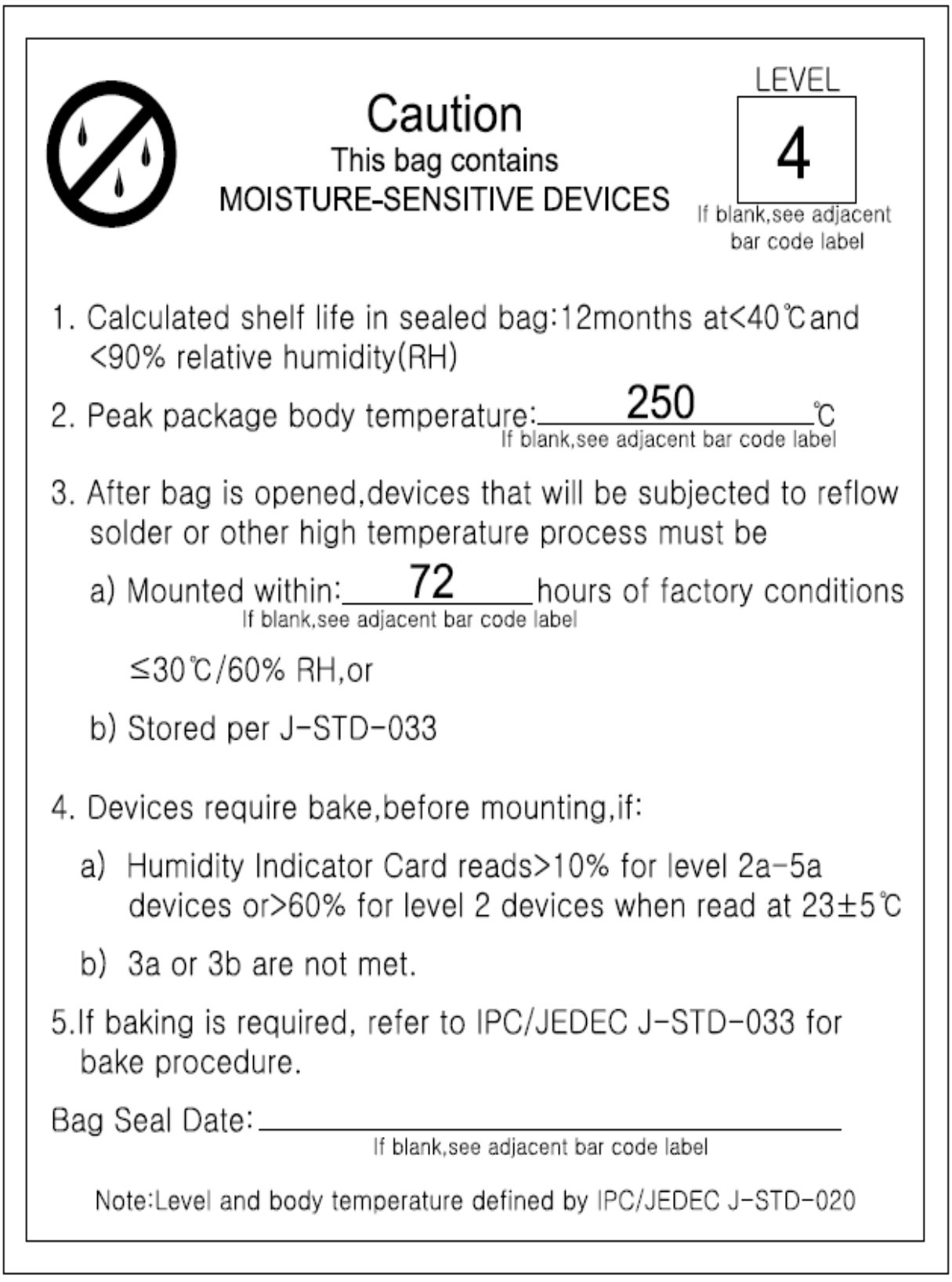
1. 10 sprocket hole pitch cumulative tolerance ±0.20.
2. Carrier camber is within 1 mm in 250 mm.
3. Material : Black Conductive Polystyrene Alloy.
4. All dimensions meet EIA-481-D requirements.
5. Thickness : 0.30±0.05mm.
6. Component load per 13”reel : 1000 pcs






Humidity indicator
Desiccant
B
A
C
C
50mm
338mm
355mm
D
360mm
285mm
375mm

11.3 MSL Level / Storage Condition



※NOTE : Accumulated baking time should not exceed 96hrs