



SPECIFICATION

SHENZHEN ELECTRON TECHNOLOGY CO., LTD.

PRODUCT NAME: AP6611S

REVISION: 1.5

DATE: Nov. 21th, 2023

Customer APPROVED	
Company	
Representative Signature	

PREPARED	REVIEW			APPROVED	DCC ISSUE
	PM	QA	ET		





AP6611S

Draft Data Sheet



Revision

Revision	Date	Description	Revised By
0.1	2023/02/14	-- Preliminary release	Ares
0.2	2023/04/15	-- Updated RF performance	Ares
0.3	2023/05/25	-- Updated RF Block diagram	Ares
0.4	2023/06/2	-- Updated Dimension	Ares
0.5	2023/07/27	-- Updated RF specifications	Ares
1.0	2023/10/06	-- Modify Introduction	Ali
1.1	2023/10/06	-- Modify RF specifications	Ali
1.2	2023/10/13	-- Modify RF specifications	Ali
1.3	2023/10/13	-- Modify Pin define	Ali
1.4	2023/10/24	-- Modify Model name	Ali
1.5	2023/11/21	-- Updated Dimension	Ali



Contents

1. Introduction	2
1.1 Overview	2
1.2 Product Features.....	3
2. General Specification	4
2.1 General Specification	4
2.2 DC Characteristics	4
2.2.1 Absolute Maximum Ratings.....	4
2.2.2 Operating Rating	5
3. Wi-Fi RF Specification	6
3.1 2.4GHz RF Specification	6
3.2 5 GHz RF Specification	8
3.3 6GHz RF Specification	14
4. Bluetooth Specification.....	17
4.1 Bluetooth Specification.....	17
5. Pin Definition	18
5.1 Pin Outline	18
5.2 Pin Assignment	19
6. Dimensions.....	21
6.1 Module Dimensions	21
6.2 Footprint	22
7. External clock reference.....	23
8. Host Interface Timing Diagram.....	24
8.1 Power-up Sequence Timing Diagram	24
8.2 SDIO Interface Description	26
8.4 UART Interface Description	39
9. Reflow Profile.....	41
10. Package Information.....	42
10.1 Label.....	42
10.2 Dimension	43
10.3 MSL Level / Storage Condition.....	45
11. Antenna Placement.....	49
12. Printed Circuit Board Layout Guidelines.....	50



1. Introduction

1.1 Overview

The AMPAK Technology® AP6611S is a fully Wi-Fi 6E and Bluetooth functionalities module with seamless roaming capabilities and advance security. It is capable of associating with variety of Wi-Fi 6E or legacy Access Points / Routers and run up to PHY rate of 500Mbps with single stream. Furthermore, AP6611S supports SDIO v3.0 / 2.0 interfaces by proper setting for Wi-Fi and UART/PCM interface for Bluetooth.

In addition, this compact module is a total solution for a combination of Wi-Fi + Bluetooth technologies. The module is specifically developed for tablet, OTT box and portable & mobile devices.



1.2 Product Features

IEEE 802.11 Key Features

- 802.11ax/ac/a/b/g/n compliant
- Radio band support for 2.4 / 5 / 6 GHz band including 6GHz UNII-5,6,7,8
- Support 802.11ax & legacy for 2.4 / 5 GHz band
- Support 802.11ax only for 6GHz band
- Lead-free & Halogen-free design which is compliant with ROHS requirements.
- TX and RX low-density parity check (LDPC) support for improved range and power efficiency.
- Single-stream spatial multiplexing up to 600 Mbps data rate.
- 20, 40, 80 MHz bandwidth channels with optional SGI (1024 QAM modulation) for 5 / 6 GHz bands
- 20MHz channels for 2.4 GHz band with optional SGI (1024 QAM modulation)
- Supports standard SDIO v3.0/v2.0.

Bluetooth Key Feature

- BT host digital interface:
 - HCI UART (up to 4 Mbps)
 - PCM for audio data
- Complies with Bluetooth Core Specification Version 5.3 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 above.
- BT Core Specification Version 5.3, including the following support:
 - Low energy(LE) isochronous channels
 - LE power control
 - LE enhanced connection update
 - LE channel classification
 - LE audio

2. General Specification

2.1 General Specification

Model Name	AP6611S
Product Description	1T1R 802.11 a/b/g/n/ac/ax Wi-Fi 6E + BT 5.3 Module
Dimension	L x W : 12 x 12 (typical) mm, H : 1.8 (Maximum) mm
Module type package	Stamp type with metal lid
Wi-Fi Interface	Support SDIO V3.0/ 2.0
BT Interface	UART / PCM
Operating temperature	-30°C to 85°C
Storage temperature	-40°C to 125°C
Humidity	Operating Humidity 10% to 95% Non-Condensing

Note:

The optimal RF performance specified in the data sheet, however, is guaranteed only -10 °C to +55 °C and $3.2V < V_{BAT} < 3.8V$ without derating performance.

2.2 DC Characteristics

2.2.1 Absolute Maximum Ratings

Symbol	Description	Min.	Max.	Unit
V _{BAT}	Input supply Voltage	3.0	4.8	V
V _{DDIO}	Digital/Bluetooth/SDIO/ I/O Voltage	1.62	1.98	V

Note : RF performance is optimal for $3.2V \leq V_{BAT} \leq 5.0V$. For $2.5V \leq V_{BAT} \leq 3.2V$, device radios will operate but RF performance will degrade.



2.2.2 Operating Rating

The module requires two power supplies: VBAT and VDDIO.

Voltage rails	Min.	Typ.	Max.	Unit
VBAT	3.2	3.3	4.8	V
VDDIO	1.62	1.8	1.98	V

VBAT current consumption 1000mA(Peak), when VBAT = 3.3V

The module requires two power supplies: other Digital I/O Pins.

For VDDIO=1.8V	Min.	Max.	Unit
Input high voltage	$0.65 \times \text{VDDIO}$	NA	V
Input low voltage	NA	$0.35 \times \text{VDDIO}$	V
Output high voltage @ 2mA	$\text{VDDIO} - 0.4$	NA	V
Output low voltage @ 2mA	NA	0.4	V



3. Wi-Fi RF Specification

3.1 2.4GHz RF Specification

Conditions : VBAT=3.3V ; VDDIO=1.8V ; Temp=25°C

Feature		Description			
WLAN Standard		IEEE 802.11 b/g/n/ax & Wi-Fi compliant			
Frequency Range		2400 MHz ~ 2483.5 MHz (2.4GHz ISM Band)			
Number of Channels		2400 MHz ~ 2483.5 MHz: Ch1 ~ Ch13			
Modulation		802.11b : DQPSK、DBPSK、CCK 802.11g/n : OFDM /64-QAM、16-QAM、QPSK、BPSK 802.11ax : OFDMA /256-QAM 、64-QAM、16-QAM、QPSK、BPSK			
Output Power , tolerance ± 1.5 dB					
The transmit EVM quality & spectrum mask are compliant with IEEE 802.11 standard					
802.11b	1Mbps	2Mbps	5.5Mbps	11Mbps	
	19	19	19	19	
802.11g	6、9Mbps	12、18Mbps	24Mbps	36Mbps	48Mbps
	19	19	18	18	17
	54Mbps				
	17				
802.11n 20MHz	MCS0~2	MCS3	MCS4	MCS5	MCS6
	18.5	18.5	18	17	16
	MCS7				
	16				
802.11ax 20MHz	HE0~2	HE3	HE4	HE5	HE6
	18.5	18.5	18	17	16
	HE7	HE8	HE9		
	16	15.5	15		

Note: The specifications of RF output power are subject to change to fulfill the safety regulation and requirements in end-user product.

Sensitivity, tolerance ± 2 dB CCK modulation PER $\leq 8\%$、OFDM modulation PER $\leq 10\%$				
802.11b	Data Rate	Spec.(dBm)		
	1Mbps	-96		
	2Mbps	-90		
	5.5Mbps	-88		
	11Mbps	-87		



802.11g	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	6Mbps	-91	24Mbps	-83
	9Mbps	-88	36Mbps	-80
	12Mbps	-87	48Mbps	-76
	18Mbps	-85	54Mbps	-73
802.11n_20MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	MCS0	-90	MCS4	-77
	MCS1	-87	MCS5	-75
	MCS2	-84	MCS6	-73
	MCS3	-80	MCS7	-72
802.11ax_20MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	HE0	-90	HE6	-72
	HE1	-87	HE7	-71
	HE2	-84	HE8	-69
	HE3	-80	HE9	-68
	HE4	-77		
	HE5	-75		
Maximum Input Level	802.11b : -10 dBm			
	802.11g/n/ax : -20 dBm			



3.2 5 GHz RF Specification

Conditions : VBAT=3.3V ; VDDIO=1.8V ; Temp=25°C

Feature		Description			
WLAN Standard		IEEE 802.11a/n/ac/ax & Wi-Fi compliant			
Frequency Range		5150~5350MHz、5470~5725MHz、5725~5850MHz （5GHz UNII Band）			
Number of Channels		5150~5350MHz： Ch36 ~ Ch64 5470~5725MHz： Ch100 ~ Ch144 5725~5850MHz： Ch149 ~ Ch165			
Modulation		802.11a：OFDM /64-QAM、16-QAM、QPSK、BPSK 802.11n：OFDM /64-QAM、16-QAM、QPSK、BPSK 802.11ac：OFDM /256-QAM、64-QAM、16-QAM、QPSK、BPSK 802.11ax：OFDMA /1024-QAM、256-QAM、64-QAM、16-QAM、QPSK、BPSK			
Output Power , tolerance ± 2 dB					
The transmit EVM quality & spectrum mask are compliant with IEEE 802.11 standard					
802.11a	Frequency (MHz)	6~9Mbps	12~18Mbps	24Mbps	36Mbps
	5150~5350	15.5	15.5	15.5	15.5
	5470~5725	15.5	15.5	15.5	15.5
	5725~5850	15.5	15.5	15.5	15.5
	Frequency (MHz)	48Mbps	54Mbps		
	5150~5350	15.5	15		
	5470~5725	15.5	15		
	5725~5850	15.5	15		
802.11n 20MHz	Frequency (MHz)	MCS0~2	MCS3	MCS4	MCS5
	5150~5350	15.5	15.5	15.5	15.5
	5470~5725	15.5	15.5	15.5	15.5
	5725~5850	15.5	1.5	15.5	15.5
	Frequency (MHz)	MCS6	MCS7		
	5150~5350	15	14		
	5470~5725	15	14		
	5725~5850	15	14		

802.11n 40MHz	Frequency (MHz)	MCS0~2	MCS3	MCS4	MCS5
	5150~5350	15	15	15	15
	5470~5725	15	15	15	15
	5725~5850	15	15	15	15
	Frequency (MHz)	MCS6	MCS7		
	5150~5350	15	14		
	5470~5725	15	14		
	5725~5850	15	14		
802.11ac 20MHz	Frequency (MHz)	MCS0~2	MCS3	MCS4	MCS5
	5150~5350	15.5	15.5	15.5	15.5
	5470~5725	15.5	15.5	15.5	15.5
	5725~5850	15.5	1.5	15.5	15.5
	Frequency (MHz)	MCS6	MCS7	MCS8	
	5150~5350	15	14.5	12.5	
	5470~5725	15	14.5	12.5	
	5725~5850	15	14.5	12.5	
802.11ac 40MHz	Frequency (MHz)	MCS0~2	MCS3	MCS4	MCS5
	5150~5350	15	15	15	15
	5470~5725	15	15	15	15
	5725~5850	15	15	15	15
	Frequency (MHz)	MCS6	MCS7	MCS8	MCS9
	5150~5350	15	14	12	11
	5470~5725	15	14	12	11
	5725~5850	15	14	12	11
802.11ac 80MHz	Frequency (MHz)	MCS0~2	MCS3	MCS4	MCS5
	5150~5350	15	15	15	15
	5470~5725	15	15	15	15
	5725~5850	15	15	15	15
	Frequency (MHz)	MCS6	MCS7	MCS8	MCS9
	5150~5350	15	13.5	12	11
	5470~5725	15	13.5	12	11
	5725~5850	15	13.5	12	11



802.11ax 20MHz	Frequency (MHz)	HE0~2	HE3	HE4	HE5
	5150~5350	15.5	15.5	15.5	15.5
	5470~5725	15.5	15.5	15.5	15.5
	5725~5850	15.5	1.5	15.5	15.5
	Frequency (MHz)	HE6	HE7	HE8	HE9
	5150~5350	15	14.5	12.5	12
	5470~5725	15	14.5	12.5	12
	5725~5850	15	14.5	12.5	12
	Frequency (MHz)	HE10	HE11		
	5150~5350	9.5	9.5		
	5470~5725	9.5	9.5		
	5725~5850	9.5	9.5		
802.11ax 40MHz	Frequency (MHz)	HE0~2	HE3	HE4	HE5
	5150~5350	15	15	15	15
	5470~5725	15	15	15	15
	5725~5850	15	15	15	15
	Frequency (MHz)	HE6	HE7	HE8	HE9
	5150~5350	15	14	12	11
	5470~5725	15	14	12	11
	5725~5850	15	14	12	11
	Frequency (MHz)	HE10	HE11		
	5150~5350	9	9		
	5470~5725	9	9		
	5725~5850	9	9		



802.11ax 80MHz	Frequency (MHz)	HE0~2	HE3	HE4	HE5
	5150~5350	15	15	15	15
	5470~5725	15	15	15	15
	5725~5850	15	15	15	15
	Frequency (MHz)	HE6	HE7	HE8	HE9
	5150~5350	15	13.5	12	11
	5470~5725	15	13.5	12	11
	5725~5850	15	13.5	12	11
	Frequency (MHz)	HE10	HE11		
	5150~5350	8	8		
	5470~5725	8	8		
	5725~5850	8	8		

Note: The specifications of RF output power are subject to change to fulfill the safety regulation and requirements in end-user product.

Sensitivity, tolerance ± 2 dB				
CCK modulation PER $\leq 8\%$ 、OFDM modulation PER $\leq 10\%$				
802.11a	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	6Mbps	-90	24Mbps	-83
	9Mbps	-90	36Mbps	-80
	12Mbps	-88	48Mbps	-75
	18Mbps	-86	54Mbps	-73
802.11n_20MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	MCS0	-90	MCS4	-79
	MCS1	-88	MCS5	-76
	MCS2	-86	MCS6	-73
	MCS3	-83	MCS7	-72
802.11n_40MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	MCS0	-88	MCS4	-77
	MCS1	-86	MCS5	-72
	MCS2	-83	MCS6	-70
	MCS3	-80	MCS7	-69
802.11ac_20MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	MCS0	-90	MCS5	-75
	MCS1	-88	MCS6	-73
	MCS2	-86	MCS7	-70
	MCS3	-83	MCS8	-68



	MCS4	-79		
802.11ac_40MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	MCS0	-88	MCS5	-72
	MCS1	-86	MCS6	-70
	MCS2	-83	MCS7	-69
	MCS3	-80	MCS8	-65
	MCS4	-76	MCS9	-64
802.11ac_80MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	MCS0	-85	MCS5	-68
	MCS1	-82	MCS6	-67
	MCS2	-79	MCS7	-65
	MCS3	-76	MCS8	-62
	MCS4	-73	MCS9	-61



802.11ax_20MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	HE0	-90	HE6	-73
	HE1	-88	HE7	-70
	HE2	-86	HE8	-68
	HE3	-83	HE9	-64
	HE4	-79	HE10	-59
	HE5	-75	HE11	-57
802.11ax_40MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	HE0	-88	HE6	-70
	HE1	-86	HE7	-69
	HE2	-83	HE8	-65
	HE3	-80	HE9	-64
	HE4	-76	HE10	-60
	HE5	-72	HE11	-55
802.11ax_80MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	HE0	-85	HE6	-67
	HE1	-82	HE7	-65
	HE2	-79	HE8	-62
	HE3	-76	HE9	-61
	HE4	-73	HE10	-57
	HE5	-68	HE11	-53
Maximum Input Level	802.11a/n/ac/ax : -30 dBm			



3.3 6GHz RF Specification

Conditions : VBAT=3.3V ; VDDIO=1.8V ; Temp=25°C # EIRP Power

Feature		Description			
WLAN Standard		IEEE 802.11ax & Wi-Fi compliant			
Frequency Range		5925~7125MHz (6GHz U-NII5, U-NII6, U-NII-7, U-NII-8 Band)			
Number of Channels		5925~6425MHz: 6G1 ~ 6G93 6425~6525MHz: 6G97 ~ 6G113 6525~6875MHz: 6G117~6G181 6875~7125MHz: 6G185~6G233			
Modulation		802.11ax : OFDMA /1024-QAM、256-QAM、64-QAM、16-QAM、QPSK、BPSK			
Output Power , tolerance ± 2.5 dB					
The transmit EVM quality & spectrum mask are compliant with IEEE 802.11 standard					
802.11ax 20MHz	Frequency (MHz)	HE0~2	HE3	HE4	HE5
	5925~6425	14.5	14	14	14
	6425~6525	14.5	14	14	14
	6525~6875	14	14	14	14
	6875~7125	13.5	13.5	13.5	13.5
	Frequency (MHz)	HE6	HE7	HE8	HE9
	5925~6425	14	13	11.5	10.5
	6425~6525	14	13	11.5	10.5
	6525~6875	14	13	11.5	10.5
	6875~7125	13	11	10.5	9.5
	Frequency (MHz)	HE10	HE11		
	5925~6425	9	9		
	6425~6525	9	9		
	6525~6875	9	9		
	6875~7125	8	8		
802.11ax 40MHz	Frequency (MHz)	HE0~2	HE3	HE4	HE5
	5925~6425	14.5	14	14	14
	6425~6525	14.5	14	14	14
	6525~6875	14	14	14	14
	6875~7125	14	13.5	13.5	13.5
	Frequency (MHz)	HE6	HE7	HE8	HE9
	5925~6425	13.5	12.5	10.5	9
	6425~6525	13.5	12.5	10.5	9.5
	6525~6875	13.5	12.5	10.5	9.5

	6875~7125	13	11.5	9.5	8.5
	Frequency (MHz)	HE10	HE11		
	5925~6425	8	8		
	6425~6525	8.5	8.5		
	6525~6875	8.5	8.5		
	6875~7125	7.5	7.5		
802.11ax 80MHz	Frequency (MHz)	HE0~2	HE3	HE4	HE5
	5925~6425	14.5	14	14	14
	6425~6525	14.5	14	14	14
	6525~6875	14	14	14	14
	6875~7125	14	13.5	13.5	13.5
	Frequency (MHz)	HE6	HE7	HE8	HE9
	5925~6425	13.5	12.5	10.5	9.5
	6425~6525	13.5	12.5	10.5	9.5
	6525~6875	13.5	12.5	10.5	9.5
	6875~7125	13	11.5	9.5	8.5
	Frequency (MHz)	HE10	HE11		
	5925~6425	8.5	8.5		
	6425~6525	8.5	8.5		
	6525~6875	8.5	8.5		
	6875~7125	7.5	7.5		

Note: The specifications of RF output power are subject to change to fulfill the safety regulation and requirements in end-user product.

Sensitivity, tolerance ± 2 dB, OFDM modulation PER $\leq 10\%$

802.11ax_20MHz SISO	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	HE0	-88	HE6	-71
	HE1	-86	HE7	-68
	HE2	-84	HE8	-66
	HE3	-83	HE9	-62
	HE4	-77	HE10	-57
	HE5	-73	HE11	-55
802.11ax_20MHz MIMO	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	HE0	-88	HE6	-71
	HE1	-86	HE7	-68
	HE2	-84	HE8	-66
	HE3	-81	HE9	-62
	HE4	-77	HE10	-57



	HE5	-73	HE11	-54
802.11ax_40MHz SISO	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	HE0	-86	HE6	-68
	HE1	-84	HE7	-67
	HE2	-81	HE8	-63
	HE3	-78	HE9	-62
	HE4	-74	HE10	-68
	HE5	-70	HE11	-53
802.11ax_40MHz MIMO	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	HE0	-85	HE6	-68
	HE1	-84	HE7	-67
	HE2	-81	HE8	-63
	HE3	-78	HE9	-62
	HE4	-74	HE10	-58
	HE5	-70	HE11	-53
802.11ax_80MHz SISO	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	HE0	-83	HE6	-65
	HE1	-80	HE7	-63
	HE2	-77	HE8	-60
	HE3	-74	HE9	-59
	HE4	-71	HE10	-55
	HE5	-66	HE11	-51
802.11ax_80MHz MIMO	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	HE0	-82	HE6	-65
	HE1	-80	HE7	-63
	HE2	-77	HE8	-60
	HE3	-74	HE9	-59
	HE4	-71	HE10	-55
	HE5	-66	HE11	-50
Maximum Input Level	802.11ax : -30dBm			



4. Bluetooth Specification

4.1 Bluetooth Specification

Conditions : VBAT=3.3V ; VDDIO=1.8V ; Temp=25°C

Feature	Description
General Specification	
Bluetooth Standard	BDR、EDR(1Mbps、2Mbps、3Mbps)、LE(1Mbps)、2LE(2Mbps)
Host Interface	UART
Frequency Band	2402 MHz ~ 2480 MHz
Number of Channels	79 channels for classic、40 channels for BLE
Modulation	GFSK, $\pi/4$ -DQPSK, 8DPSK
RF Specification	
Output Power , tolerance ± 2 dB	
	CL1 (dBm)
BDR Output Power	7
EDR Output Power	6
BLE Output Power	7
Sensitivity, tolerance ± 2 dB	
Sensitivity @ BER=0.1% for GFSK (1Mbps)	-87 dBm
Sensitivity @ BER=0.01% for $\pi/4$ -DQPSK (2Mbps)	-89 dBm
Sensitivity @ BER=0.01% for 8DPSK (3Mbps)	-84 dBm
Sensitivity @ PER=30.8% for LE (1Mbps)	-90 dBm
Sensitivity @ PER=30.8% for 2LE (2Mbps)	-90 dBm
Maximum Input Level	GFSK (1Mbps):-20dBm
	$\pi/4$ -DQPSK (2Mbps) :-20dBm
	8DPSK (3Mbps) :-20dBm

Note*: The Bluetooth BDR output power is able to be configured by firmware (hcd file).

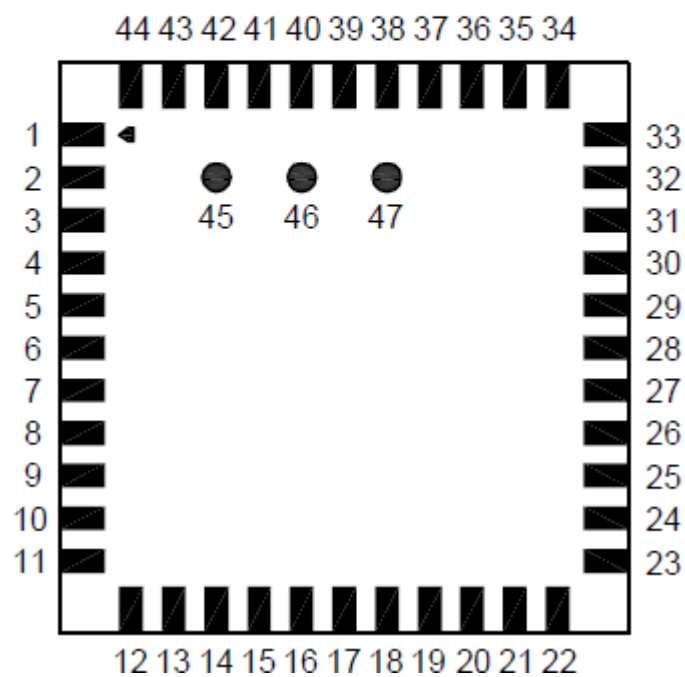


5. Pin Definition

5.1 Pin Outline

PIN OUTLINE

<TOP VIEW>



5.2 Pin Assignment

NO	Name	Type	Description
1	GND	—	Ground connections
2	WL_BT_ANT	I/O	RF I/O port
3	GND	—	Ground connections
4	NC	—	Floating (Don't connected to ground)
5	GND	—	Ground connections
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	Power up/down internal regulators used by WiFi section
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	ASR_VLX	O	Internal Analog Buck voltage generation pin
22	VDDIO	P	I/O Voltage supply input
23	ABUCK_1P12	I	Internal Analog 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_REG_ON	I	Power up/down internal regulators used by BT section

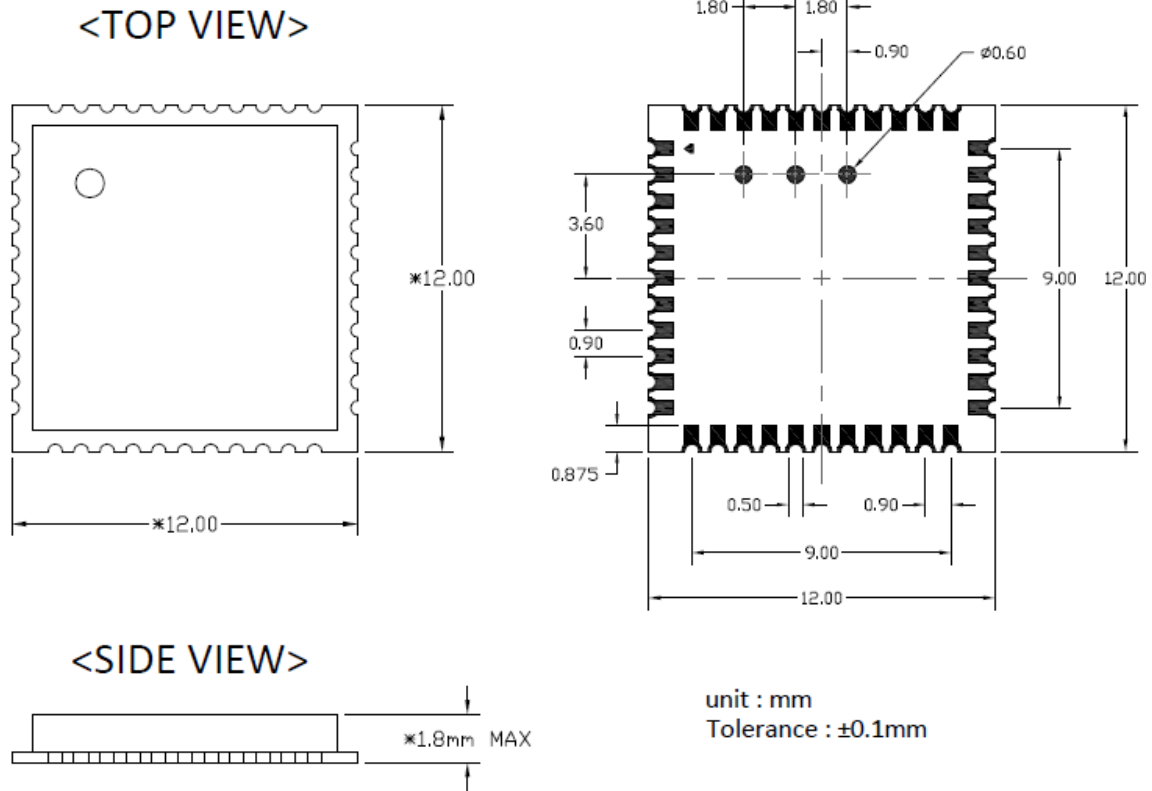


35	WL_GPIO_2	I/O	This pin can be programmed to be a GPIO2
36	GND	—	Ground connections
37	WL_GPIO_1	I/O	This pin can be programmed to be a GPIO1 (WL_DEV_WAKE)
38	WL_GPIO_3	I/O	This pin can be programmed to be a GPIO3
39	WL_GPIO_4	I/O	This pin can be programmed to be a GPIO4
40	WL_GPIO_5	I/O	This pin can be programmed to be a GPIO5
41	UART_RTS_N	O	Bluetooth UART interface
42	UART_TXD	O	Bluetooth UART interface
43	UART_RXD	I	Bluetooth UART interface
44	UART_CTS_N	I	Bluetooth UART interface
45	WL_GPIO_5	I/O	This pin can be programmed to be a GPIO, or the GCI external coexistence interface.
46	NC	—	Floating (Don't connected to ground)
47	NC	—	Floating (Don't connected to ground)



6. Dimensions

6.1 Module Dimensions



External clock reference

External LPO signal characteristics

Parameter	Specification	Units
Nominal input frequency	32.768	kHz
Frequency accuracy	+/-25	ppm
Duty cycle	30 - 70	%
Input signal amplitude	1.8±0.09	V
Signal type	Square-wave or sine-wave	-
Input impedance	>100k	Ω
	<5	pF
Clock jitter (integrated over 300Hz – 15KHz)	<1	Hz
Output high voltage	0.7Vio - Vio	V

External 37.4MHz Crystal characteristics

Parameter	Specification	Units
Nominal frequency - F0	37.4	MHz
Frequency Tolerance - $\Delta F / F_0$ (At 25°C +/- 3°C)	+/- 10	ppm
Operation Temperature Range - Topr	-30 ~ + 85	°C
Freq. Stability(over operating temperature) - TC Ref. to 25°C	+/- 10	ppm
Load capacitance - CL	18	pF
Equivalent Series Resistance – ESR	Max. 60	Ω
Drive Level - DL	Typ. 50, Max. 100	uW
Insulation resistance – IR At 100Vdc	Min. 500	M Ω



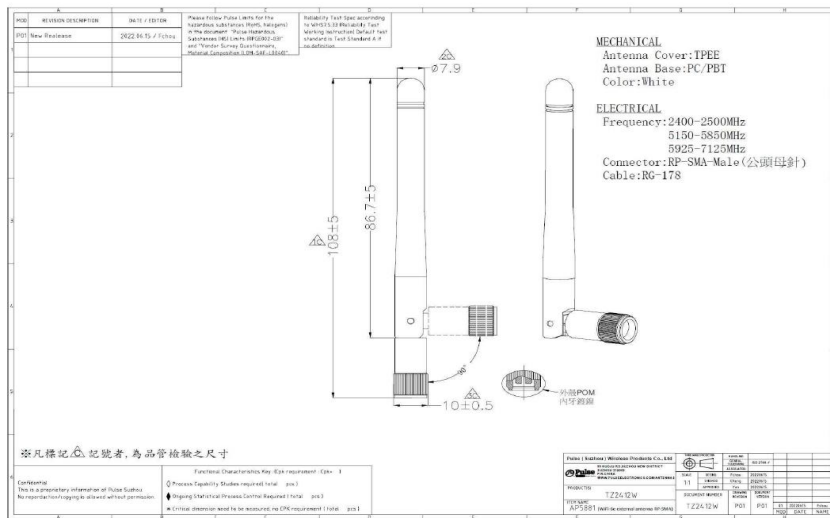
Brand: PULSE ELECTRONICS PTE LTD

Model Name: TZ2412W

Antenna Type: Dipole

Peak Gain: 2.4G=3.68dBi 、5G=4.65 dBi 、6GHz: 4.62

Connector: Reversed-SMA



Note: The above antenna gain doesn't include cable loss.

Cable Loss of Antenna:

Ant.	Cable Loss (dB)		
	2.4GHz	5GHz	6GHz
1	0.4	0.7	0.8

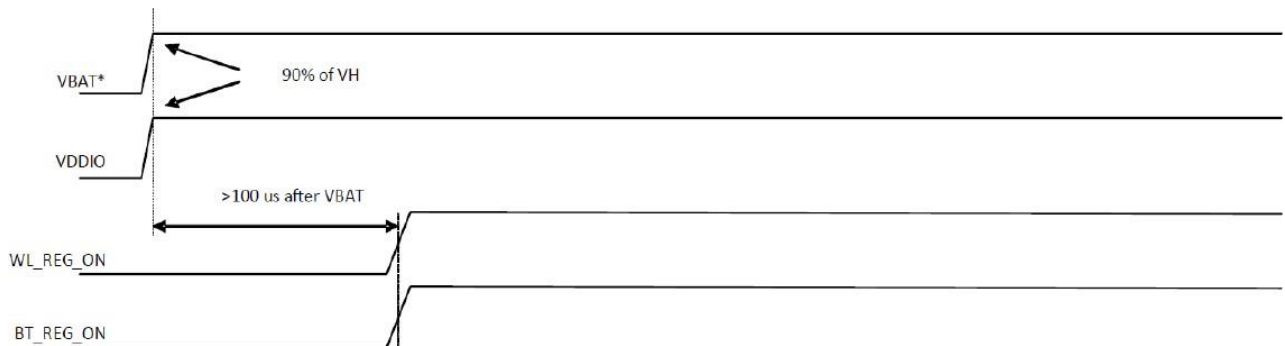
7. Host Interface Timing Diagram

8.1 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.

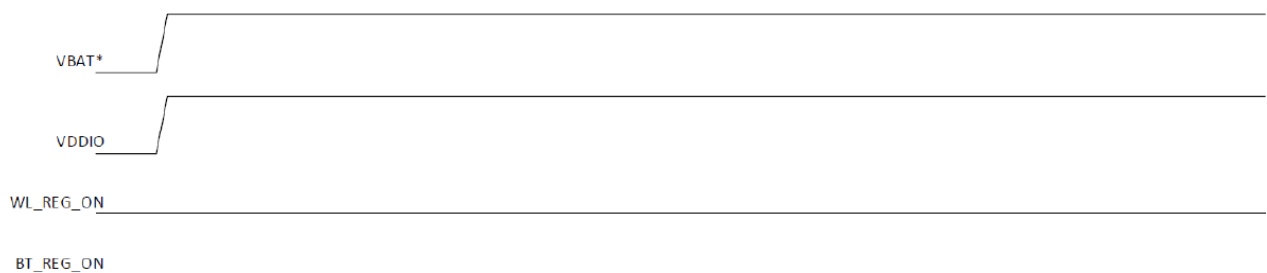
- **WL_REG_ON**: Used by the PMU to power up or power down the internal regulators used by the WLAN section. When this pin is high, the regulators are enabled and the WLAN section is out of reset. When this pin is low the WLAN section is in reset.
- **BT_REG_ON**: Used by the PMU to power up or power 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).



***Notes:**

1. The VBAT and VDDIO 10%–90% rise-time slopes must be greater than 50 microseconds/V.
2. VBAT should be up before or at the same time as VDDIO. VDDIO should NOT be present first or be held high before VBAT is high.

WLAN=ON, Bluetooth=ON

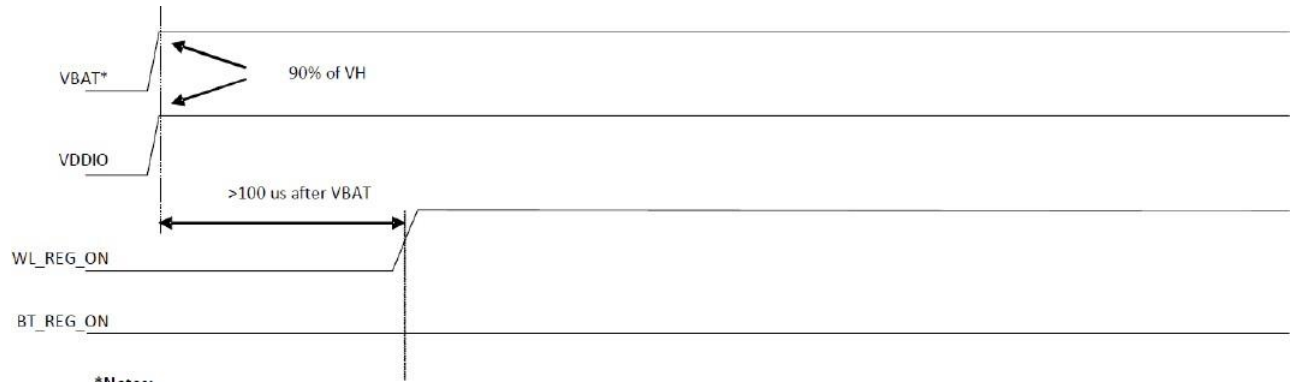


***Notes:**

1. The VBAT and VDDIO 10%–90% rise-time slopes must be greater than 50 microseconds/V.
2. VBAT should be up before or at the same time as VDDIO. VDDIO should NOT be present first or be held high before VBAT is high.

WLAN=OFF, Bluetooth=OFF

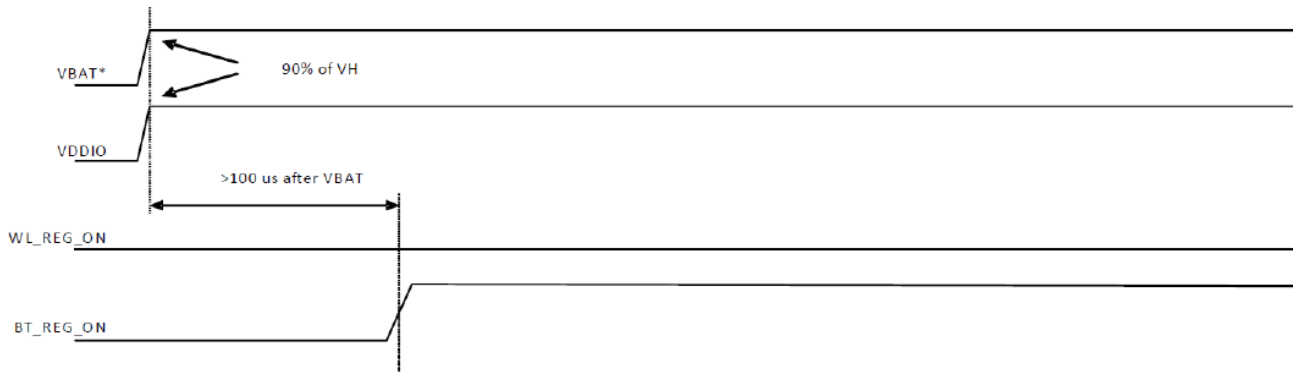




***Notes:**

1. The VBAT and VDDIO 10%–90% rise-time slopes must be greater than 50 microseconds/V.
2. VBAT should be up before or at the same time as VDDIO. VDDIO should NOT be present first or be held high before VBAT is high.

WLAN=ON, Bluetooth=OFF



WLAN=OFF, Bluetooth=ON

8.2 SDIO Interface 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). 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.

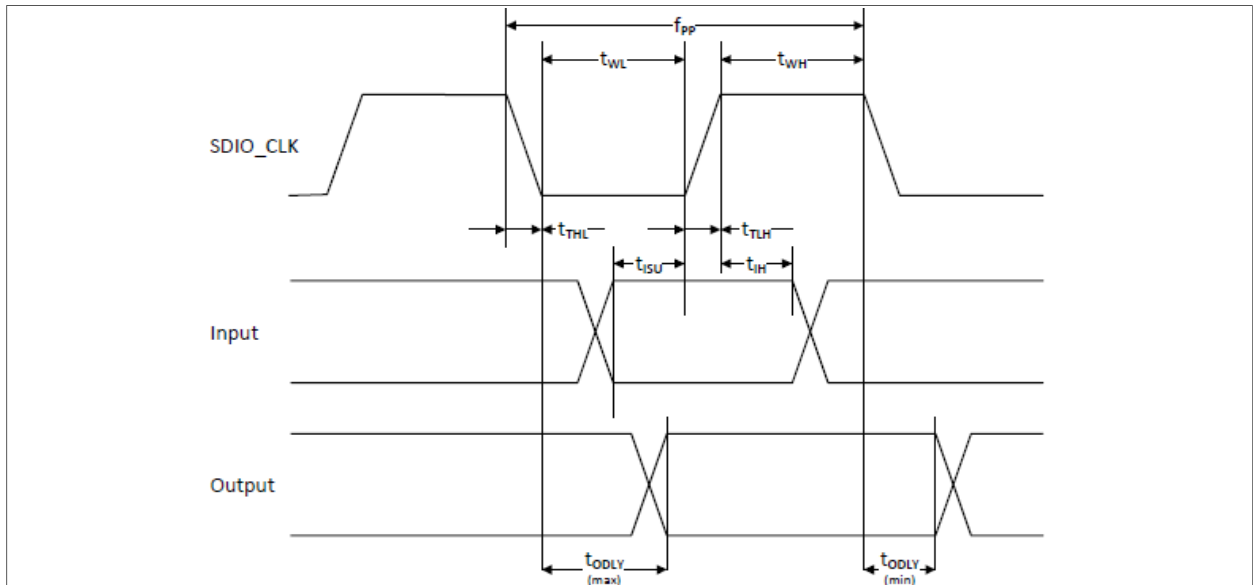
- Function 0 Standard SDIO function (Max BlockSize / ByteCount = 32B)
- Function 1 Backplane Function to access the internal System On Chip (SOC) address space (Max BlockSize / ByteCount = 64B)
- Function 2 WLAN Function for efficient WLAN packet transfer through DMA (Max BlockSize/ByteCount=512B)

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



SDIO Default Mode Timing Diagram

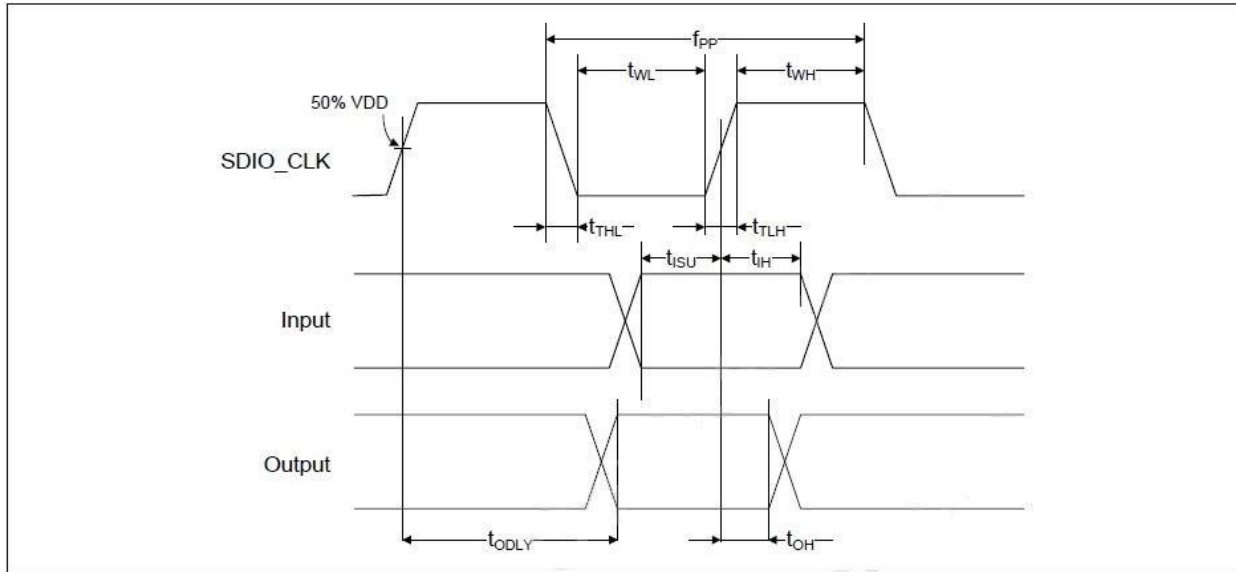


Parameter	Symbol	Minimum	Typical	Maximum	Unit
SDIO CLK (All values are referred to minimum V_{IH} and maximum V_{IL}^b)					
Frequency – Data Transfer mode	f_{PP}	0	–	25	MHz
Frequency – Identification mode	f_{OD}	0	–	400	kHz
Clock low time	t_{WL}	10	–	–	ns
Clock high time	t_{WH}	10	–	–	ns
Clock rise time	t_{TLH}	–	–	10	ns
Clock low time	t_{THL}	–	–	10	ns
Inputs: CMD, DAT (referenced to CLK)					
Input setup time	t_{ISU}	5	–	–	ns
Input hold time	t_{IH}	5	–	–	ns
Outputs: CMD, DAT (referenced to CLK)					
Output delay time – Data Transfer mode	t_{ODLY}	0	–	14	ns
Output delay time – Identification mode	t_{ODLY}	0	–	50	ns

a. Timing is based on $CL \leq 40pF$ load on CMD and Data.

b. $\min(V_{IH}) = 0.7 \times V_{DDIO}$ and $\max(V_{IL}) = 0.2 \times V_{DDIO}$.

SDIO High Speed Mode Timing Diagram



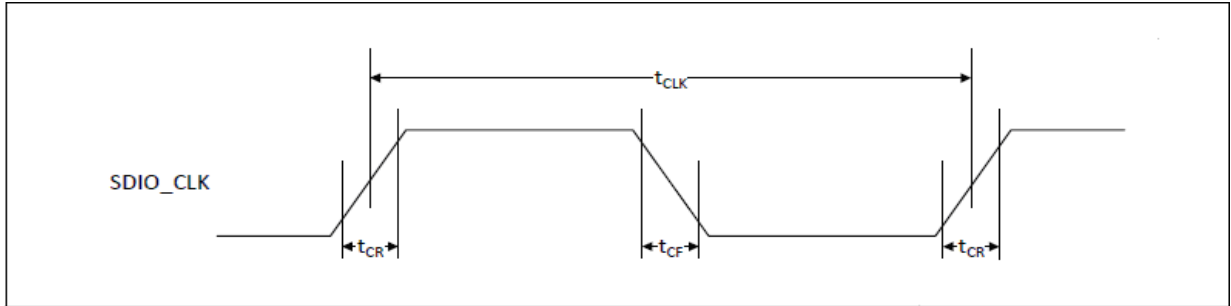
Parameter	Symbol	Minimum	Typical	Maximum	Unit
SDIO CLK (all values are referred to minimum VIH and maximum VIL^b)					
Frequency – Data Transfer Mode	f_{pp}	0	–	50	MHz
Frequency – Identification Mode	f_{OD}	0	–	400	kHz
Clock low time	t_{WL}	7	–	–	ns
Clock high time	t_{WH}	7	–	–	ns
Clock rise time	t_{TLH}	–	–	3	ns
Clock low time	t_{THL}	–	–	3	ns
Inputs: CMD, DAT (referenced to CLK)					
Input setup Time	t_{ISU}	6	–	–	ns
Input hold Time	t_{IH}	2	–	–	ns
Outputs: CMD, DAT (referenced to CLK)					
Output delay time – Data Transfer Mode	t_{ODLY}	–	–	14	ns
Output hold time	t_{OH}	2.5	–	–	ns
Total system capacitance (each line)	CL	–	–	40	pF

a. Timing is based on $CL \leq 40$ pF load on CMD and Data.

b. $\min(V_{IH}) = 0.7 \times V_{DDIO}$ and $\max(V_{IL}) = 0.2 \times V_{DDIO}$.

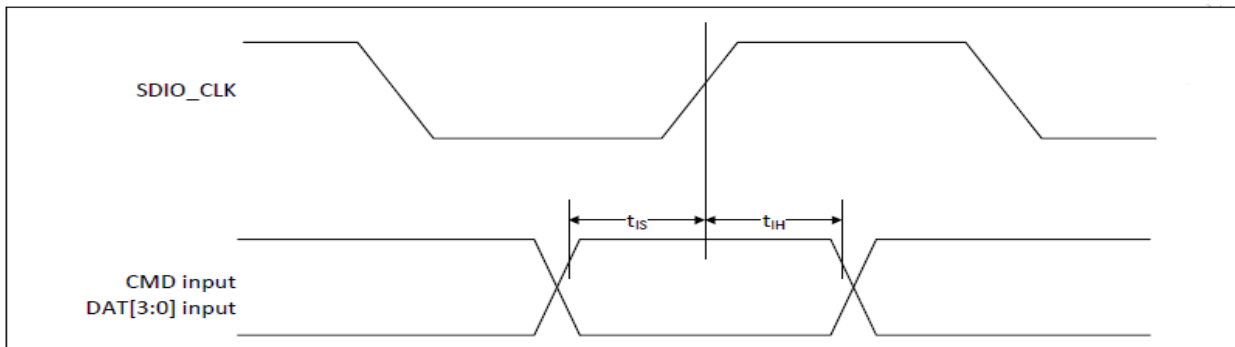
SDIO Bus Timing Specifications in SDR Modes

Clock timing (SDR Modes)



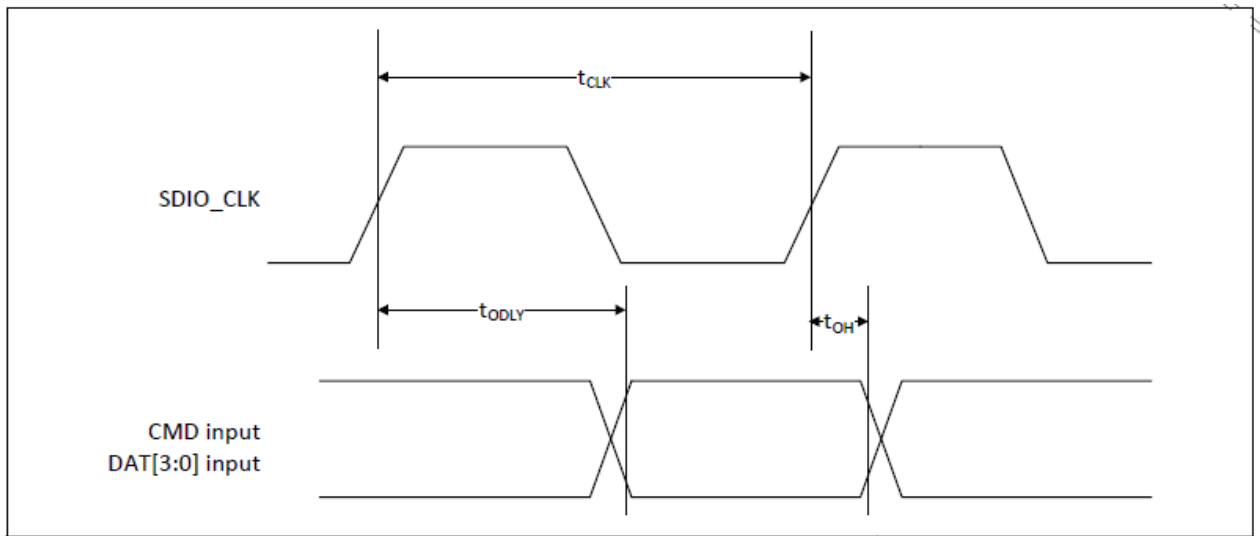
Parameter	Symbol	Minimum	Maximum	Unit	Comments
–	t_{CLK}	40	–	ns	SDR12 mode
		20	–	ns	SDR25 mode
		10	–	ns	SDR50 mode
		4.8	–	ns	SDR104 mode
–	t_{CR}, t_{CF}	–	$0.2 \times t_{CLK}$	ns	$t_{CR}, t_{CF} < 2.00$ ns (max) @100 MHz, $C_{CARD} = 10$ pF $t_{CR}, t_{CF} < 0.96$ ns (max) @208 MHz, $C_{CARD} =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

SDIO Bus Input timing (SDR Modes)



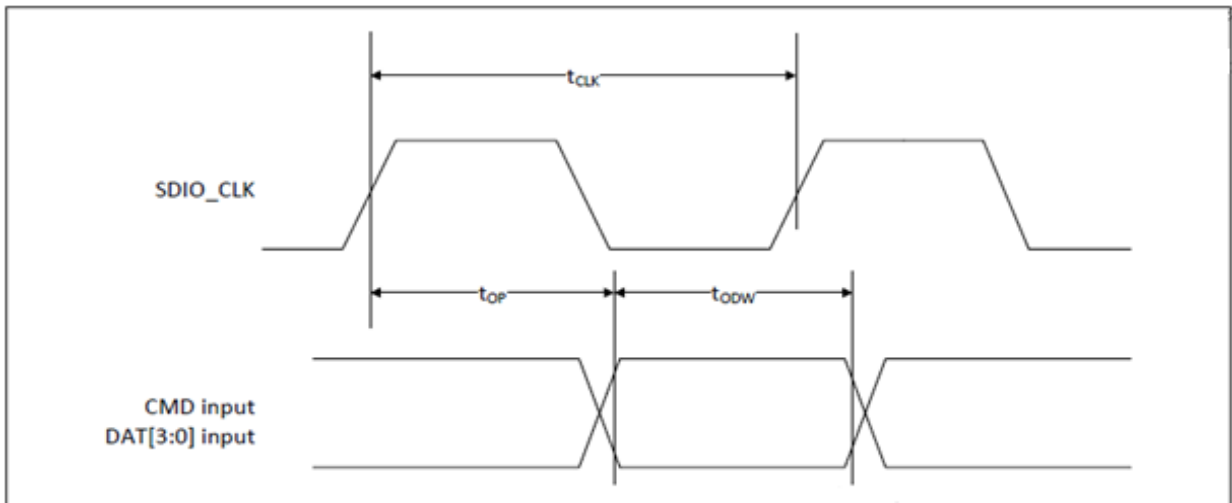
Symbol	Minimum	Maximum	Unit	Comments
SDR104 Mode				
t_{IS}	1.4	–	ns	$C_{CARD} = 10$ pF, VCT = 0.975V
t_{IH}	0.80	–	ns	$C_{CARD} = 5$ pF, VCT = 0.975V
SDR50 Mode				
t_{IS}	3.00	–	ns	$C_{CARD} = 10$ pF, VCT = 0.975V
t_{IH}	0.80	–	ns	$C_{CARD} = 5$ pF, VCT = 0.975V

SDIO Bus output timing (SDR Modes up to 100MHz)



Symbol	Minimum	Maximum	Unit	Comments
t_{ODLY}	–	7.5	ns	$t_{CLK} \geq 10$ ns $C_L = 30$ pF using driver type B for SDR50
t_{ODLY}	–	14.0	ns	$t_{CLK} \geq 20$ 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

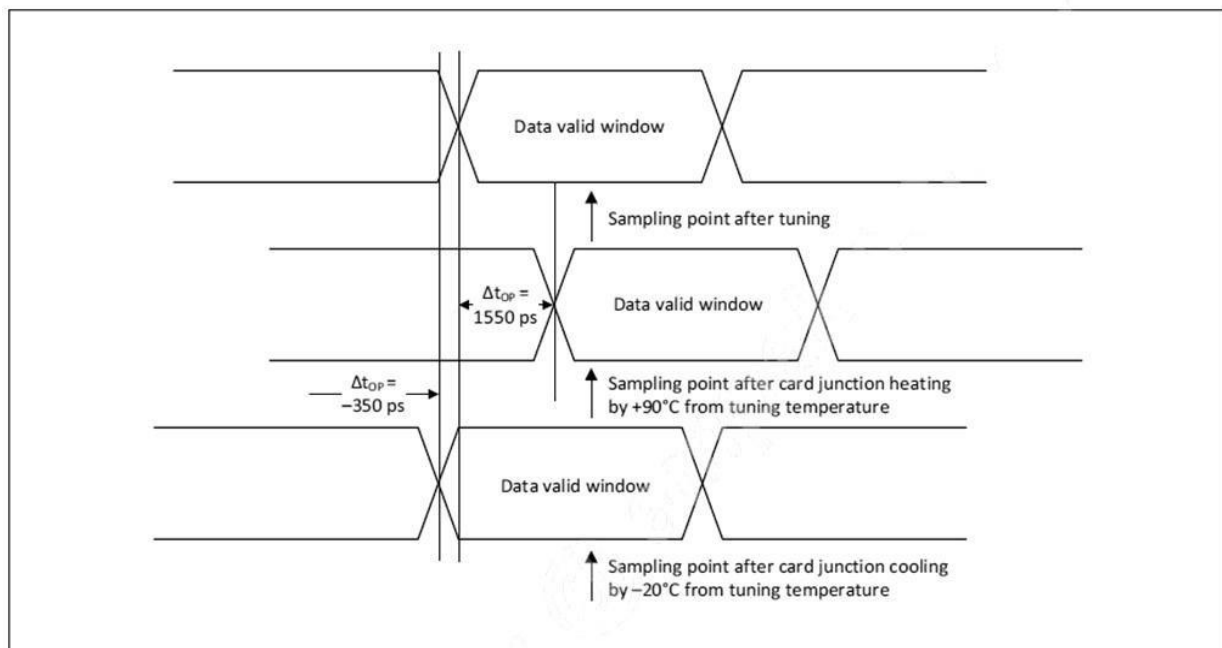
Card output timing (SDR Modes 100MHz to 208MHz)



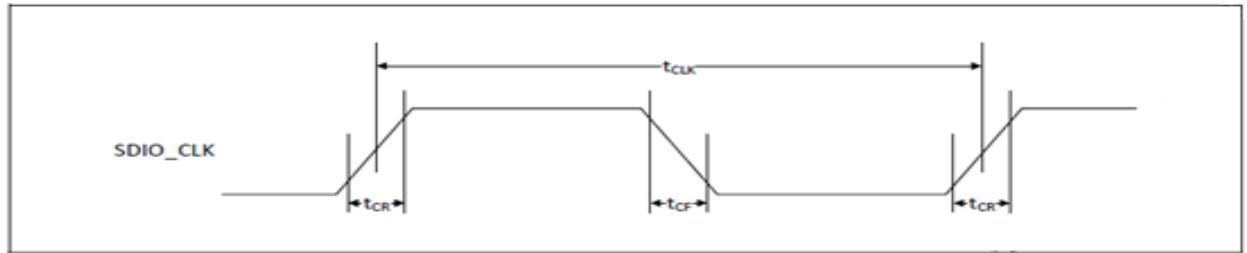
Symbol	Minimum	Maximum	Unit	Comments
t_{OP}	0	2	UI	Card output phase
Δt_{OP}	-350	+1550	ps	Delay variation due to temp change after tuning
t_{ODW}	0.60	—	UI	$t_{ODW}=2.88$ ns @208 MHz

- $\Delta t_{OP} = +1550$ ps for junction temperature of $\Delta t_{OP} = 90$ degrees during operation
- $\Delta t_{OP} = -350$ ps for junction temperature of $\Delta t_{OP} = -20$ degrees during operation
- $\Delta t_{OP} = +2600$ ps for junction temperature of $\Delta t_{OP} = -20$ to $+125$ degrees during operation

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

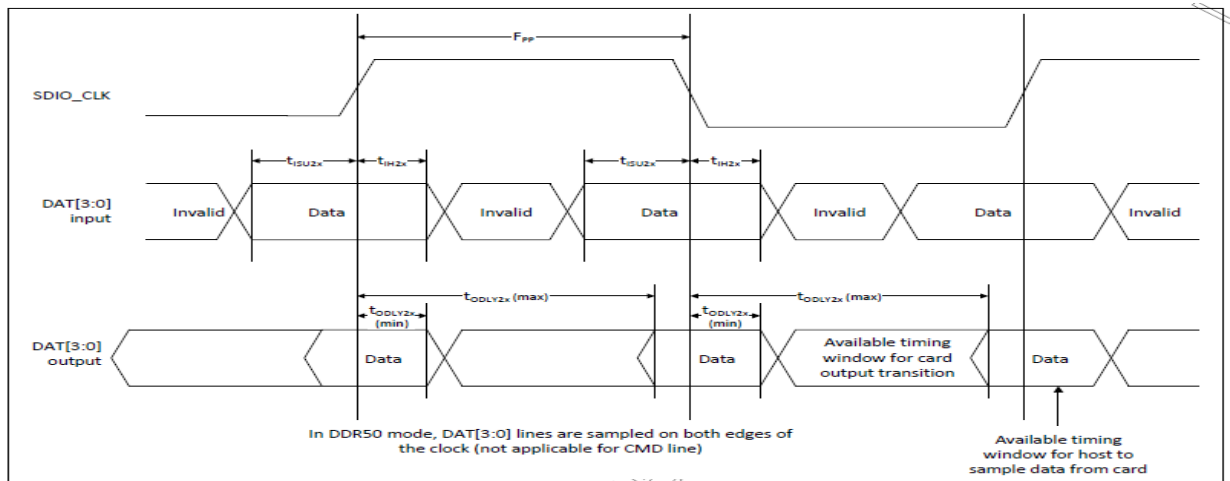


SDIO Bus Timing Specifications in DDR50 Mode



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

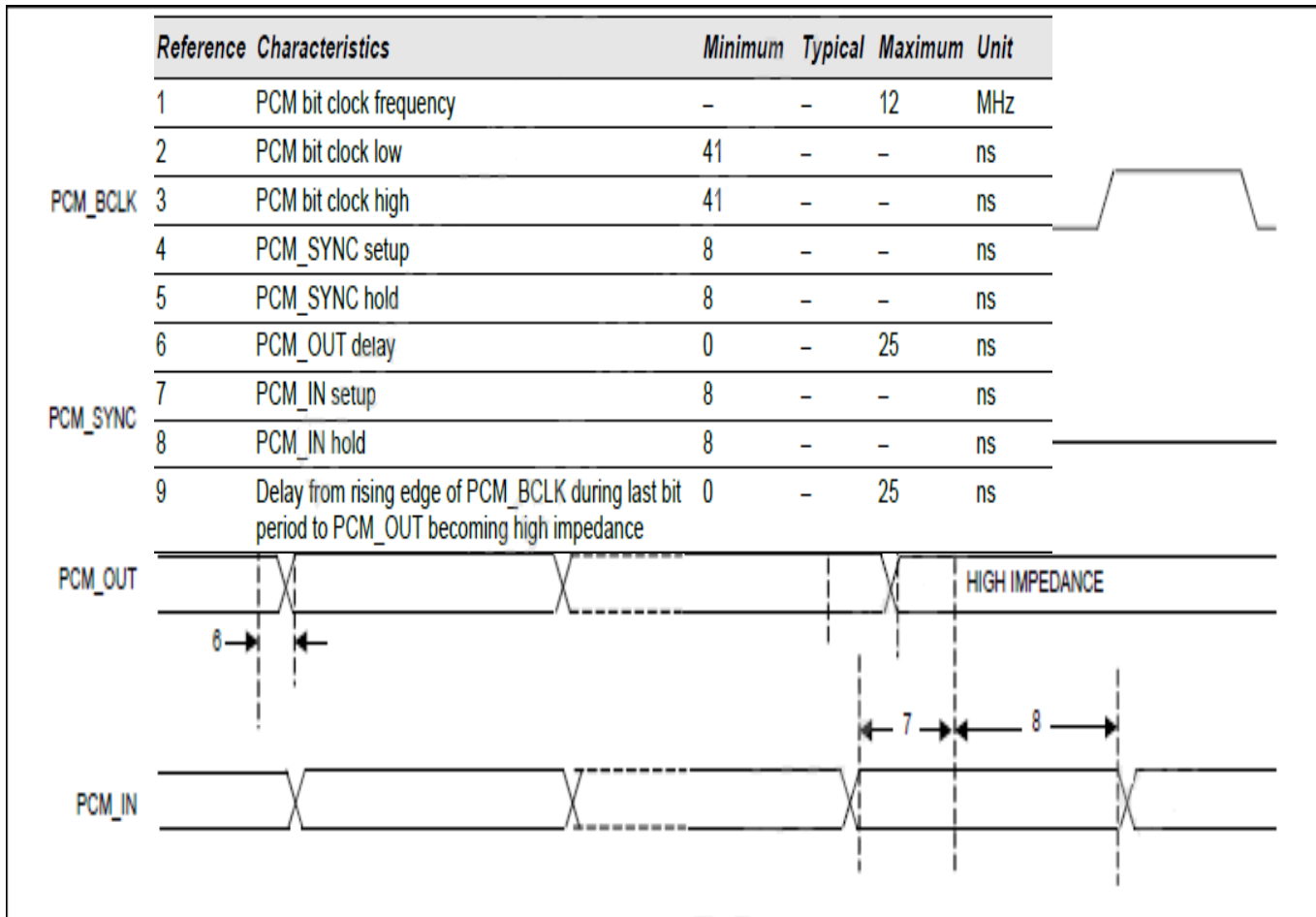
Data Timing



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)

Short Frame Sync, Slave Mode

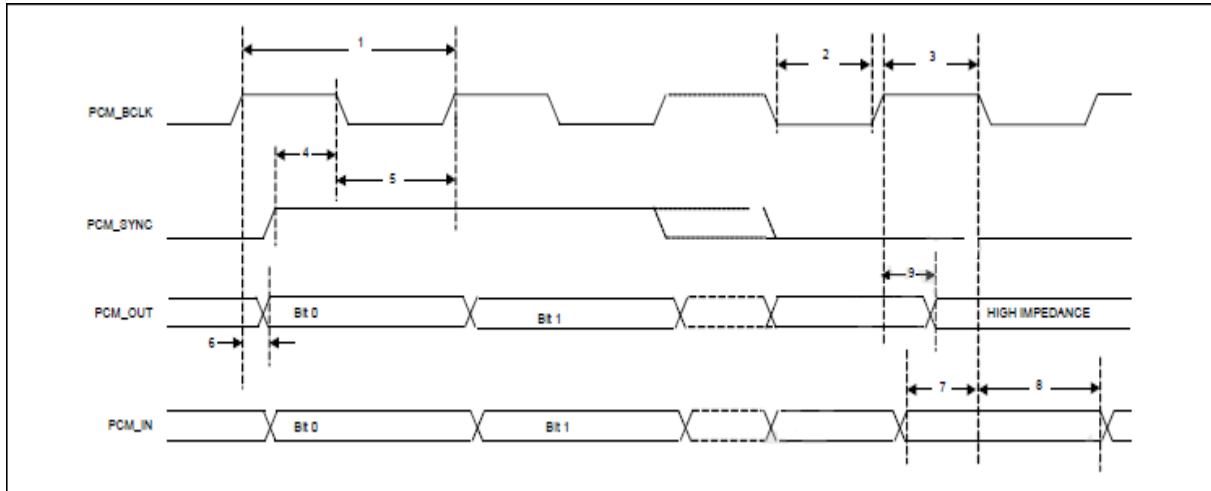
PCM Timing Diagram (Short Frame Sync, Slave Mode)



PCM Interface Timing Specifications (Short Frame Sync, Slave Mode)

Long Frame Sync, Slave Mode

PCM Timing Diagram (Long Frame Sync, Slave Mode)

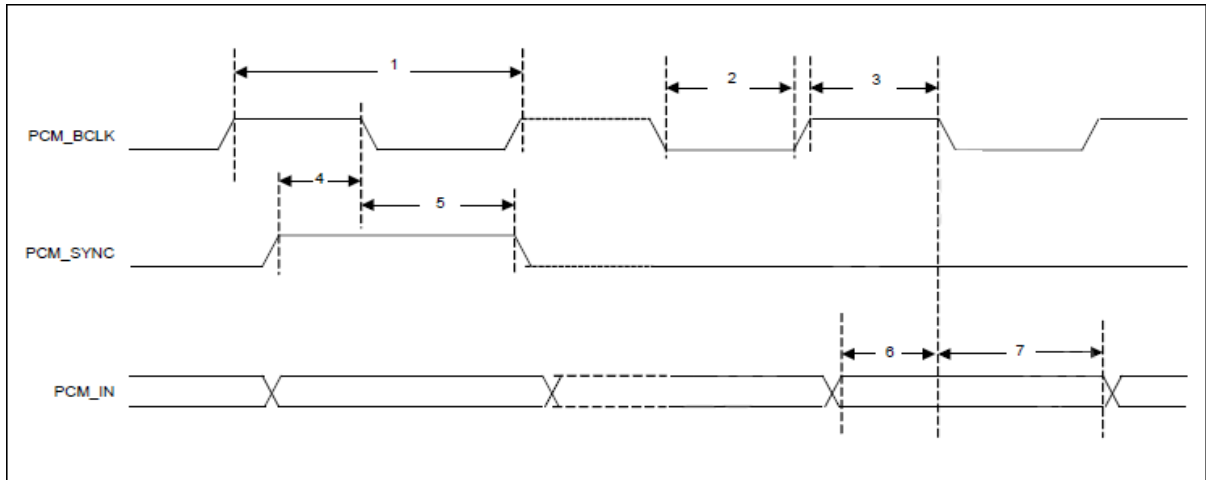


PCM Interface Timing Specifications (Long Frame Sync, Slave Mode)

Reference	Characteristics	Minimum	Typical	Maximum	Unit
1	PCM bit clock frequency	–	–	12	MHz
2	PCM bit clock low	41	–	–	ns
3	PCM bit clock high	41	–	–	ns
4	PCM_SYNC setup	8	–	–	ns
5	PCM_SYNC hold	8	–	–	ns
6	PCM_OUT delay	0	–	25	ns
7	PCM_IN setup	8	–	–	ns
8	PCM_IN hold	8	–	–	ns
9	Delay from rising edge of PCM_BCLK during last bit period to PCM_OUT becoming high impedance	0	–	25	ns

Short Frame Sync, Burst Mode

PCM Burst Mode Timing (Receive Only, Short Frame Sync)

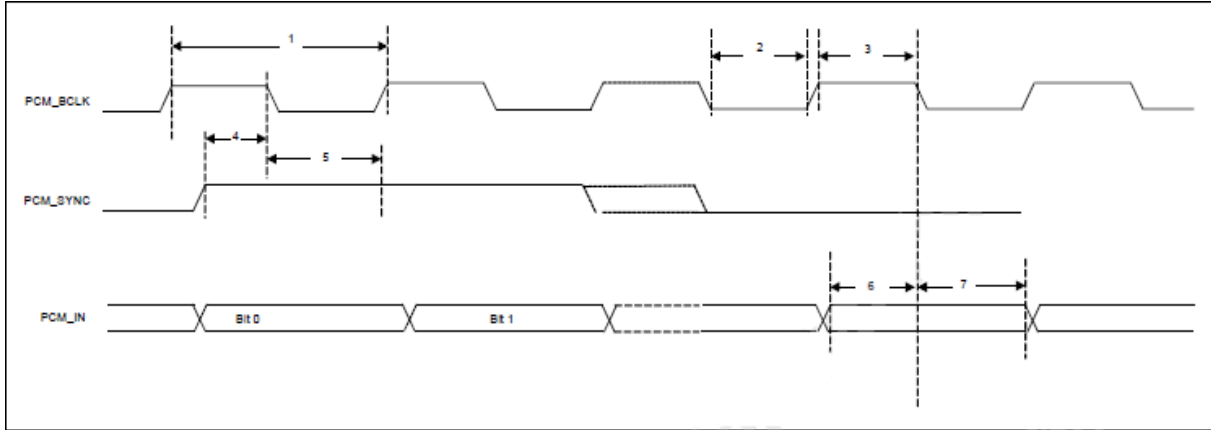


PCM Burst Mode (Receive Only, Short Frame Sync)

Reference	Characteristics	Minimum	Typical	Maximum	Unit
1	PCM bit clock frequency	–	–	24	MHz
2	PCM bit clock low	20.8	–	–	ns
3	PCM bit clock high	20.8	–	–	ns
4	PCM_SYNC setup	8	–	–	ns
5	PCM_SYNC hold	8	–	–	ns
6	PCM_IN setup	8	–	–	ns
7	PCM_IN hold	8	–	–	ns

Long Frame Sync, Burst Mode

PCM Burst Mode Timing (Receive Only, Long Frame Sync)



PCM Burst Mode (Receive Only, Long Frame Sync)

Reference	Characteristics	Minimum	Typical	Maximum	Unit
1	PCM bit clock frequency	–	–	24	MHz
2	PCM bit clock low	20.8	–	–	ns
3	PCM bit clock high	20.8	–	–	ns
4	PCM_SYNC setup	8	–	–	ns
5	PCM_SYNC hold	8	–	–	ns
6	PCM_IN setup	8	–	–	ns
7	PCM_IN hold	8	–	–	ns

8.3 UART Interface Description

The UART is a standard 4-wire interface (RX, TX, RTS, and CTS) with adjustable baud rates from 9600 bps to 4.0 Mbps. The interface features an automatic baud rate detection capability that returns a baud rate selection. Alternatively, the baud rate may be selected through a vendor-specific UART HCI command.

UART has a 1040-byte receive FIFO and a 1040-byte transmit FIFO to support EDR. Access to the FIFOs is conducted through the AHB interface through either DMA or the CPU. The UART supports the Bluetooth 5.0 UART HCI specification: H4, a custom Extended H4, and H5. The default baud rate is 115.2 Kbaud.

The UART supports the 3-wire H5 UART transport, as described in the Bluetooth specification (Three-wire UART Transport Layer). Compared to H4, the H5 UART transport reduces the number of signal lines required by eliminating the CTS and RTS signals.

The UART can perform XON/XOFF flow control and includes hardware support for the Serial Line Input Protocol (SLIP). It can also perform wake-on activity. For example, activity on the RX or CTS inputs can wake the chip from a sleep state.

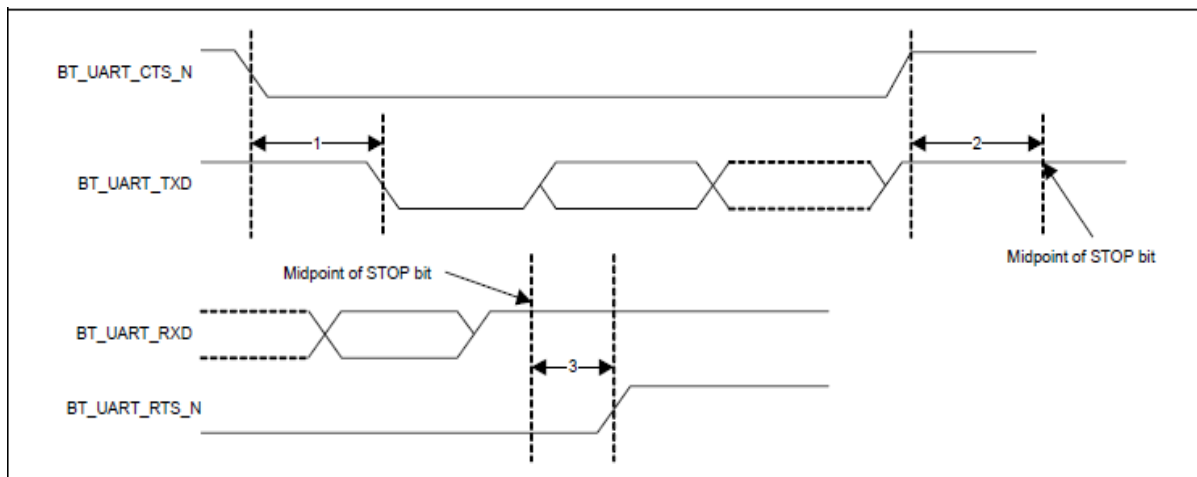
Normally, the UART baud rate is set by a configuration record downloaded after device reset, or by automatic baud rate detection, and the host does not need to adjust the baud rate. Support for changing the baud rate during normal HCI UART operation is included through a vendor-specific command that allows the host to adjust the contents of the baud rate registers. The UARTs operate correctly with the host UART as long as the combined baud rate error of the two devices is within $\pm 2\%$.

Example of Common Baud Rates



Desired Rate	Actual Rate	Error (%)
4000000	4000000	0.00
3692000	3692308	0.01
3000000	3000000	0.00
2000000	2000000	0.00
1500000	1500000	0.00
1444444	1454544	0.70
921600	923077	0.16
460800	461538	0.16
230400	230796	0.17
115200	115385	0.16
57600	57692	0.16
38400	38400	0.00
28800	28846	0.16
19200	19200	0.00
14400	14423	0.16
9600	9600	0.00

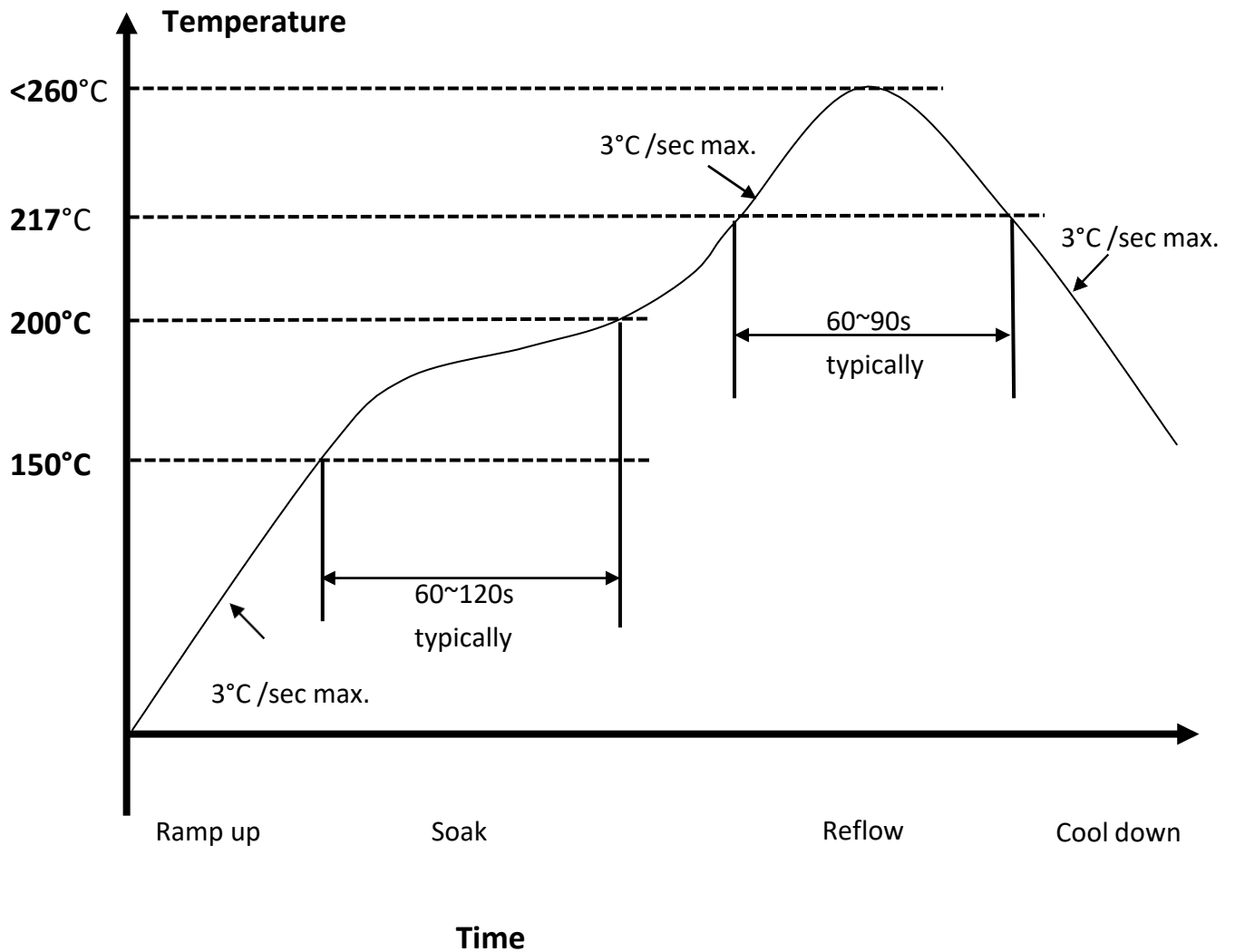
UART Timing



UART Timing Specifications

Ref	Characteristics	Min.	Typ.	Max.	Unit
1	Delay time, BT_UART_CTS_N low to BT_UART_TXD valid	–	–	1.5	Bit periods
2	Setup time, BT_UART_CTS_N high before midpoint of stop bit	–	–	0.5	Bit periods
3	Delay time, midpoint of stop bit to BT_UART_RTS_N high	–	–	0.5	Bit periods

8. Reflow Profile

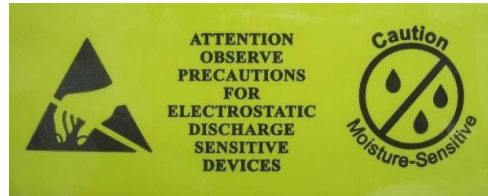


1. Referred to IPC/JEDEC standard
2. Peak Temperature : <260°C (Time within 5°C of actual Peak Temperature 20-40 seconds)
3. Cycle of Reflow : 2 times max.
4. Adding Nitrogen (N₂) to implement 2000ppm or less of oxygen concentration during reflow process.
5. If the shelf time is exceeded, be sure baking step to remove the moisture from the component

10. Package Information

10.1 Label

Label A → Anti-static and humidity notice



Label B → MSL caution / Storage Condition

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

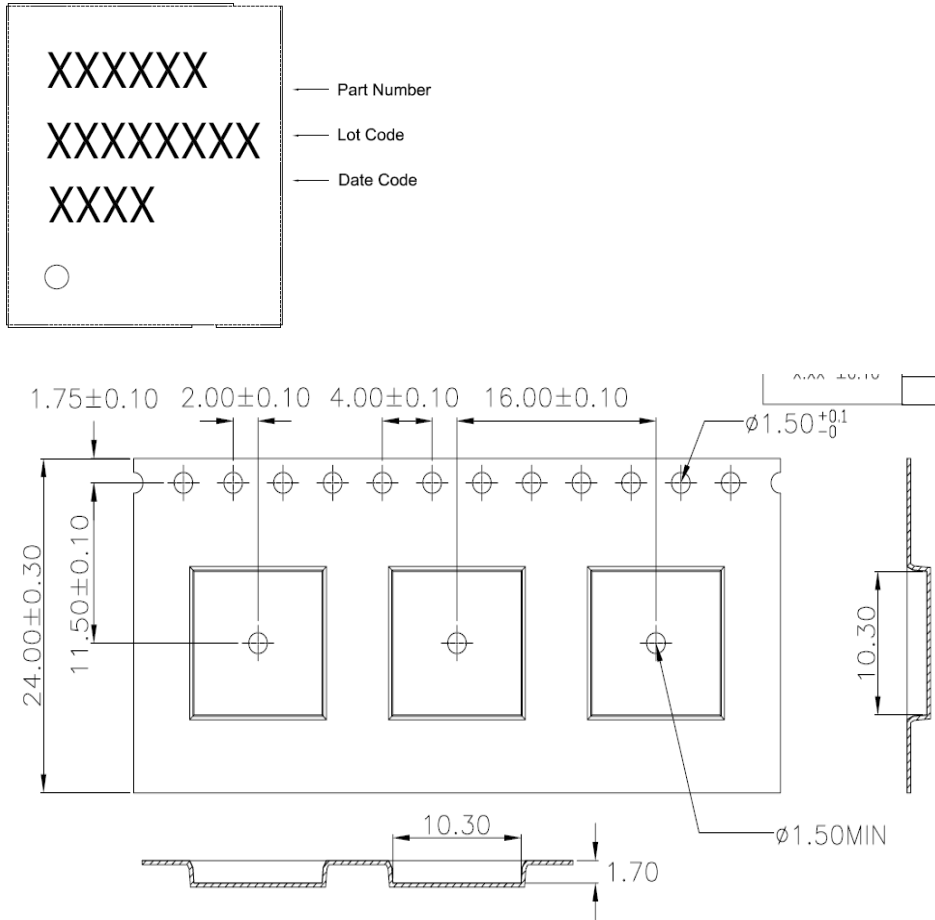
Label C → Inner box label .

PO:	
AMK DEVICE:	
PKG S/N:	
Model Name:	9PKGYYMDDNNNNN APXXXXXXXX (R3HF)
P/N:	
Quantity:	99X-XXX-XXXXR QQQQ
Date Code:	
Lot Code:	YYWW
	XXXXXXXX

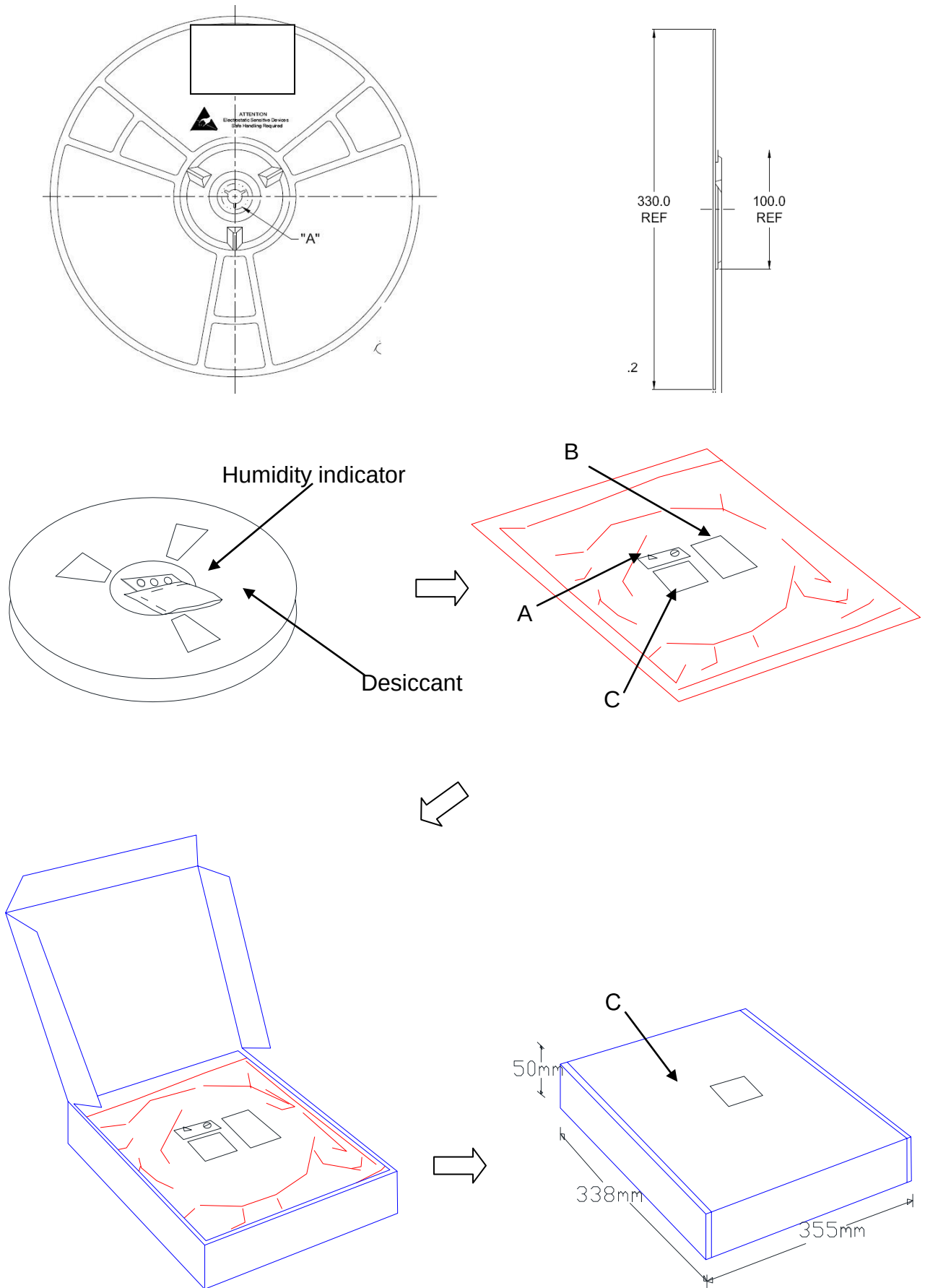
Label D → Carton box label .

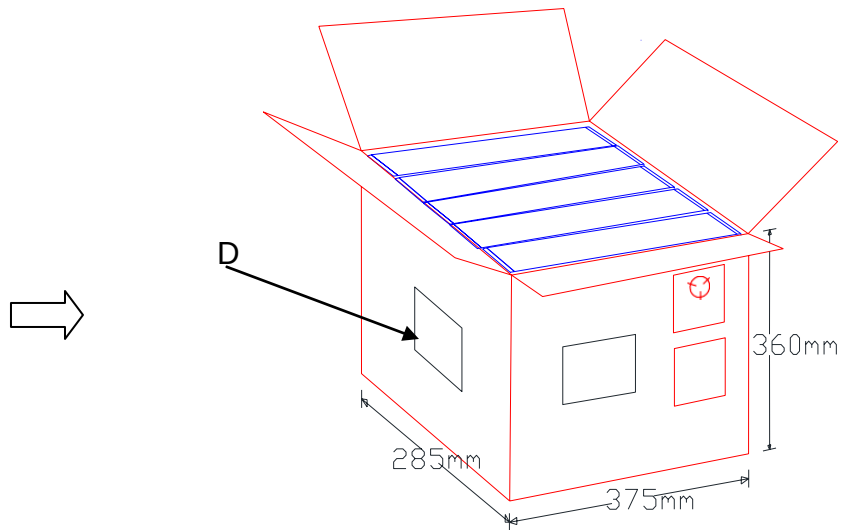
AMPAK Technology Inc.	
PO:	
AMK DEVICE:	
Model Name:	 APXXXXXXXX (R3HF)
Part No.:	 99X-XXX-XXXXR
Quantity:	 QQQQ
Lot D/C:	 XXXXXXXX YYWW QQQQ
Manufacture:	 YYYY/MM/DD

10.2 Dimension



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 ± 0.05 mm.
6. Component load per 13" reel : 1000 pcs





10.3 MSL Level / Storage Condition



11. Antenna Placement

Placement and Clearance for Antenna

The fundamental design concepts are as follows with regarding to placement of antenna parts:

- Make sure the RF PAD impedance is 50 ohm $\pm$ 10%.
- Place the antenna parts near the RF output port of wireless module as close as possible to avoid more insertion loss of RF transmission line on main board.
- Keep antenna parts away any metal materials. The clearance is 4cm or above in order to guarantee radiation performance.
- Metal housing or metal-plated housing can influence antenna performance seriously.
- Keep antenna parts away any noise sources, for instance, HDMI or high speed databuses, DDR, PMU, SSD...etc.
- Ensure the isolation between Wi-Fi and Bluetooth antenna, 25 dB or above, for ideal Wi-Fi / BT co-existence.

Footprint for IPEX RF Connector

It is strongly to follow reference footprint of RF connector in datasheet. Certain of design rules are shown on Figure 1 to benefit optimal RF performance and yield:

1. Put a NPTH hole underneath the RF signal pin of IPEX connector.
2. Put some ground holes near the ground pads properly.

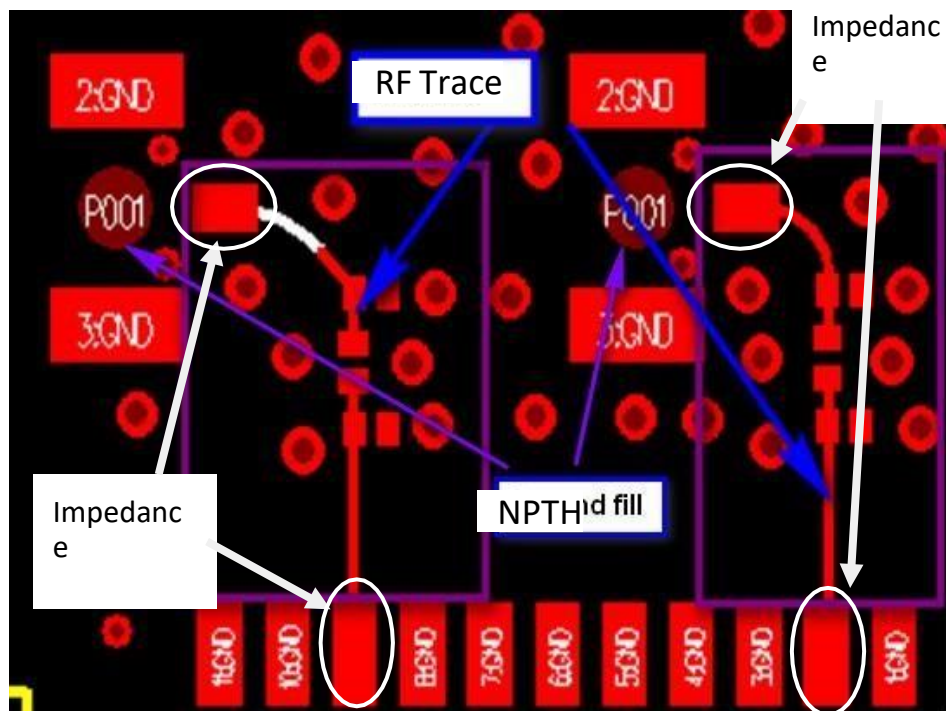


Figure 1



12. Printed Circuit Board Layout Guidelines

This chapter comes up with PCB layout guidelines for customer's board design in accordance with AMPA Evaluation board. Components placement, specifications and key points are involved.

Routing the RF Transmission Lines

The essential design rules of RF transmission lines are as follows:

- The characteristic impedance of RF transmission line is 50 Ohm +/- 10%.
- Keep the RF transmission lines on the same layer as module and RF connector mounted in order to guarantee 50 Ohm characteristic impedance and optimal matching.
- Put some ground through holes properly to guarantee the ideal grounding effects.
- The line width of RF transmission line is 8mil or above by well-designed microstrip line or CBCPW based on specific PCB stack-up and well-selected reference ground plane as Figure 2.

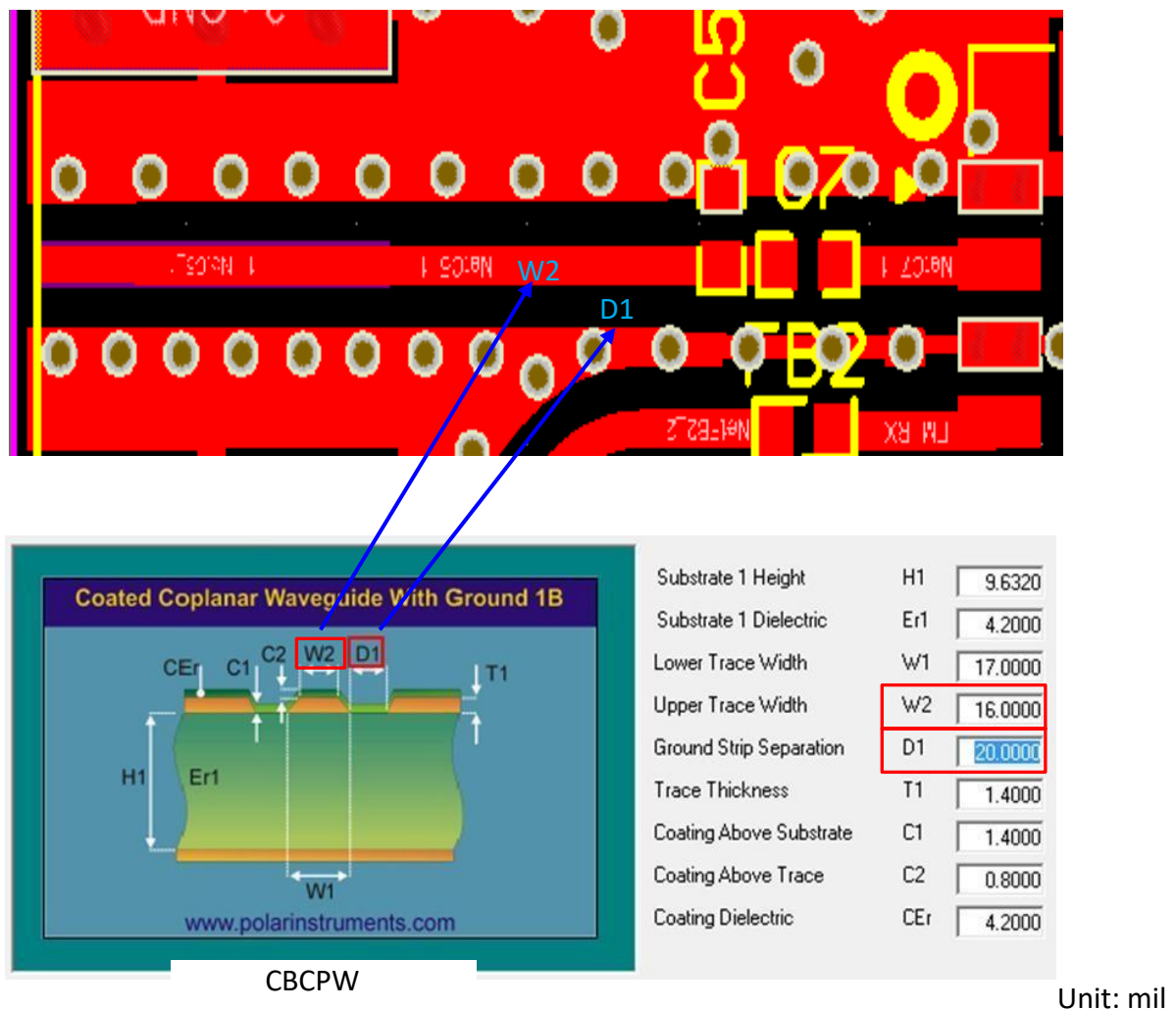


Figure 2

Routing the SDIO Bus

Please follow the design rule as below to guarantee function and performance of SDIO bus:

- The PCB area underneath module is keep-out area and do not route any power or signal lines
- Do not route SDIO traces directly cross any I/O traces or power rails to avoid any unexpected interference induced.
- Isolating each SDIO traces by grounding is strongly especially for 2 layer PCB stack-up as shown on Figure 3.
- Maintain the SDIO3.0 traces at 50 ohms for the line impedance.
- Traces should not have stubs.
- The length of a data trace could not be greater than a CLK trace. The length of the SDIO traces must match to within ± 50 mils.
- Keep the SDIO_CLK line away from the SDIO CMD and DATA lines as shown on Figure 4. Routing SDIO_CLK line closely parallel to the command and data lines can cause glitches on the trace that affect SDIO operation. For example, SDIO bus PCB layout and impedance calculation for 2 and 4 layer PCB design as below:

13. layer PCB Design

- PCB thickness : 1.6mm
- SDIO trace impedance and transmission line type : 50 Ohm, CBCPW

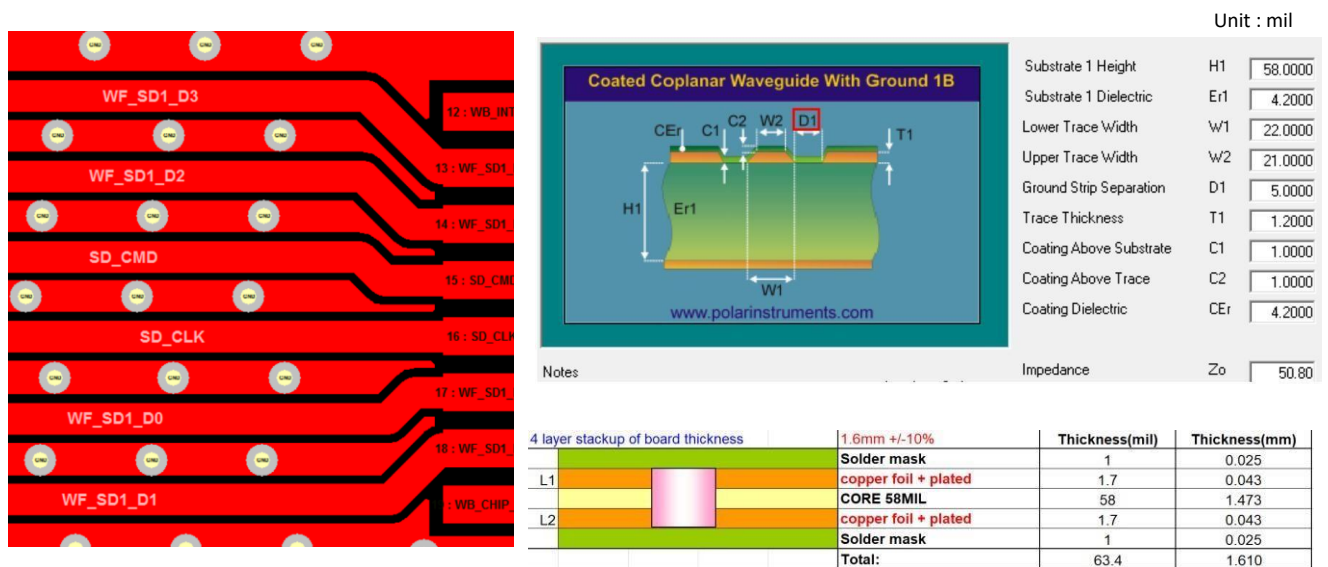


Figure 3 SDIO traces routing in 2 layer PCB and impedance calculation

layer PCB Design

- PCB thickness : 1.6mm
- SDIO trace impedance and transmission line type : 50 Ohm, micro-strip line

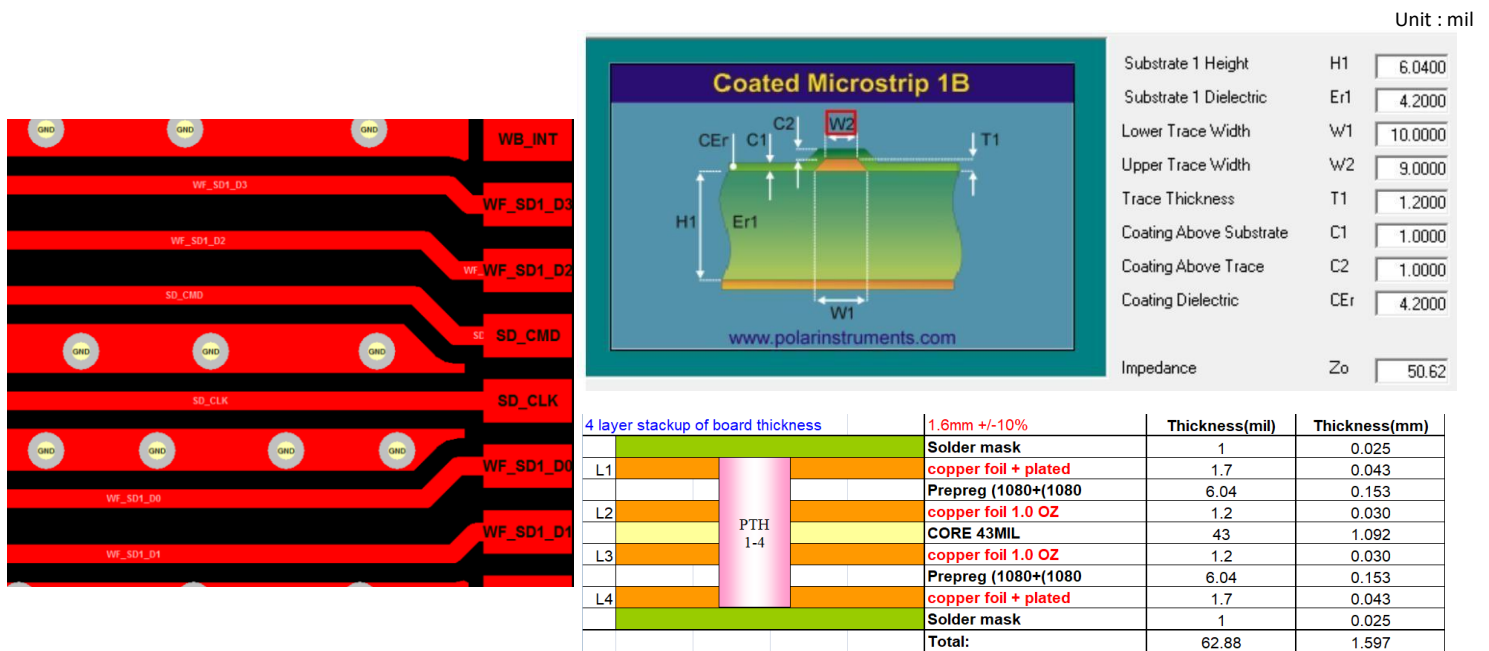


Figure 4 SDIO traces routing in 4 layer PCB and impedance calculation

FCC Compliance Statement:

Federal Communication Commission Interference Statement

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 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.

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.

Operation of transmitters in the 5.925-7.125 GHz band is prohibited for control of or Communications with unmanned aircraft systems.

Additional testing and certification is necessary when the lowest gain in WLAN operation 6GHz of antennas which may be used in the future that is less than the lowest gain of the original certified for Contention Based Protocol (CBP).

IMPORTANT NOTE:

This module is intended for OEM integrator. This module is only FCC authorized for the specific rule parts 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 product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Additional testing and certification may be necessary when multiple modules are used. OEM integrators that they must use the equivalent antennas or C2PC will be required.

This equipment complies with FCC mobile radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator & your body. If the module is installed in a portable host, a separate SAR evaluation is required to confirm compliance with relevant FCC portable RF exposure rules.

Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

The host manufacturer should reference KDB Publication 996369 D04 Module Integration Guide.

USERS MANUAL OF THE END PRODUCT:

In the users manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied.

The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

This device complies with Part 15 of 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.

Operation of transmitters in the 5.925-7.125 GHz band is prohibited for control of or Communications with unmanned aircraft systems.

LABEL OF THE END PRODUCT:

The final end product must be labeled in a visible area with the following " Contains TX FCC ID: ZQ6-AP6611S ".

This device complies with Part 15 of 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.



ISED:

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

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

Cet appareil contient des émetteurs / récepteurs exempts de licence qui sont conformes au (x) RSS (s) exemptés de licence d'Innovation, Sciences et Développement économique Canada. L'opération est soumise aux deux conditions suivantes:

- (1) Cet appareil ne doit pas provoquer d'interférences.*
- (2) Cet appareil doit accepter toute interférence, y compris les interférences susceptibles de provoquer un fonctionnement indésirable de l'appareil.*

This radio transmitter [11956A-AP6611S] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Le présent émetteur radio (11956A-AP6611S) a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal d'antenne. Les types d'antennes non inclus dans cette liste qui ont un gain supérieur au gain maximal indiqué pour tout type listé sont strictement interdits pour une utilisation avec cet appareil.

Ant:

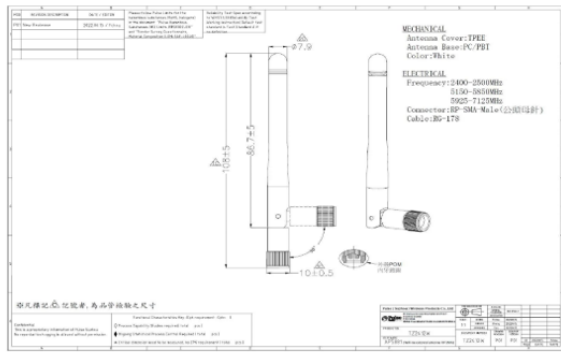
Brand: PULSE ELECTRONICS PTE LTD

Model Name: TZ2412W

Antenna Type: Dipole

Peak Gain: 2.4G=3.68dBi 、5G=4.65 dBi 、6GHz: 4.62

Connector: Reversed-SMA



Note: The above antenna gain doesn't include cable loss.

Cable Loss of Antenna:

Ant.	Cable Loss (dB)		
	2.4GHz	5GHz	6GHz
1	0.4	0.7	0.8

The device for operation in the band 5150–5250 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems.

les dispositifs fonctionnant dans la bande 5150-5250 MHz sont réservés uniquement pour une utilisation à l'intérieur afin de réduire les risques de brouillage préjudiciable aux systèmes de satellites mobiles utilisant les mêmes canaux.



The maximum antenna gain permitted for devices in the bands 5250-5350 MHz and 5470-5725 MHz shall be such that the equipment still complies with the e.i.r.p. limit.

le gain maximal d'antenne permis pour les dispositifs utilisant les bandes 5250-5350 MHz et 5470-5725 MHz doit se conformer à la limite de p.i.r.e.

The maximum antenna gain permitted for devices in the band 5725-5850 MHz shall be such that the equipment still complies with the e.i.r.p. limits specified for point-to-point and non-point-to-point operation as appropriate.

le gain maximal d'antenne permis (pour les dispositifs utilisant la bande 5725-5850 MHz)

doit se conformer à la limite de p.i.r.e. spécifiée pour l'exploitation point à point et non point à point, selon le cas.

For indoor use only.

Pour une utilisation en intérieur uniquement.

Devices shall not be used for control of or communications with unmanned aircraft systems.

Les appareils ne doivent pas être utilisés pour contrôler ou communiquer avec des systèmes d'aéronefs sans pilote.

IMPORTANT NOTE:

This module is intended for OEM integrator. The OEM integrator is responsible for the compliance to all the rules that apply to the product into which this certified RF module is integrated.

Additional testing and certification may be necessary when multiple modules are used.

OEM integrators that they must use the equivalent antennas or C2PC will be required.

20cm minimum distance has to be able to be maintained between the antenna and the users for the host this module is integrated into. Under such configuration, the IC RSS-102 radiation exposure limits set forth for an population/uncontrolled environment can be satisfied.

Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment.

USERS MANUAL OF THE END PRODUCT:

In the users manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the IC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied.

The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment. Operation is subject to the following two conditions: (1) this device may not cause harmful interference (2) this device must accept any interference received, including interference that may cause undesired operation.

Devices shall not be used for control of or communications with unmanned aircraft systems.

Les appareils ne doivent pas être utilisés pour contrôler ou communiquer avec des systèmes d'aéronefs sans pilote.

LABEL OF THE END PRODUCT:

The final end product must be labeled in a visible area with the following " Contains IC: 11956A-AP6611S ".

The Host Model Number (HMN) must be indicated at any location on the exterior of the end product or product packaging or product literature which shall be available with the end product or online.



	Caution This bag contains MOISTURE-SENSITIVE DEVICES	LEVEL 4 If blank, see adjacent bar code label
1. Calculated shelf life in sealed bag: 12 months at $<40^{\circ}\text{C}$ and $<90\%$ relative humidity (RH) 2. Peak package body temperature: <u>250</u> $^{\circ}\text{C}$ If blank, see adjacent bar code label 3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must be a) Mounted within: <u>72</u> hours of factory conditions If blank, see adjacent bar code label $\leq 30^{\circ}\text{C}/60\% \text{ RH}$, or b) Stored per J-STD-033 4. Devices require bake, before mounting, if: a) Humidity Indicator Card reads $>10\%$ for level 2a-5a devices or $>60\%$ for level 2 devices when read at $23 \pm 5^{\circ}\text{C}$ b) 3a or 3b are not met. 5. If baking is required, refer to IPC/JEDEC J-STD-033 for bake procedure. Bag Seal Date: _____ If blank, see adjacent bar code label Note: Level and body temperature defined by IPC/JEDEC J-STD-020		

