



正基科技股份有限公司

SPECIFICATION

PRODUCT NAME : AP5811SA

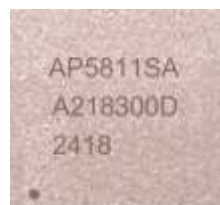
REVISION : 1.2

DATE : July. 10th , 2025

Customer APPROVED	
Company	
Representative Signature	

PREPARED	REVIEW			APPROVED	DCC ISSUE
	PM	QA	ET		

正基科技股份有限公司



AP5811SA Data Sheet

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Revision

Revision	Date	Description	Revised By
0.1	2023/12/05	-- Preliminary release	Ali
0.2	2024/01/15	-- Modify RF Specification	Ali
0.3	2024/03/11	-- Modify RF Specification	Gary
0.4	2024/03/28	-- Modify RF Specification	Gary
0.5	2024/03/29	-- Add Conformal Shielding on Dimension Page	Gary
0.6	2024/04/17	--Update Package Information	Gary
0.7	2024/12/12	-- Modify General Specification	Ali
0.8	2025/02/04	-- Modify Dimension Specification	Gary
0.9	2025/05/02	-- Modify 5G supported channel	Wade
1.0	2025/07/03	-- WL_GPIO_0 change to WL_HOST_WAKE	Gary
1.1	2025/07/04	-- Add Certificate Statement	Gary
1.2	2025/07/10	-- Modify Certificate Statement and add 2.4G AX HE10 and HE11	Gary

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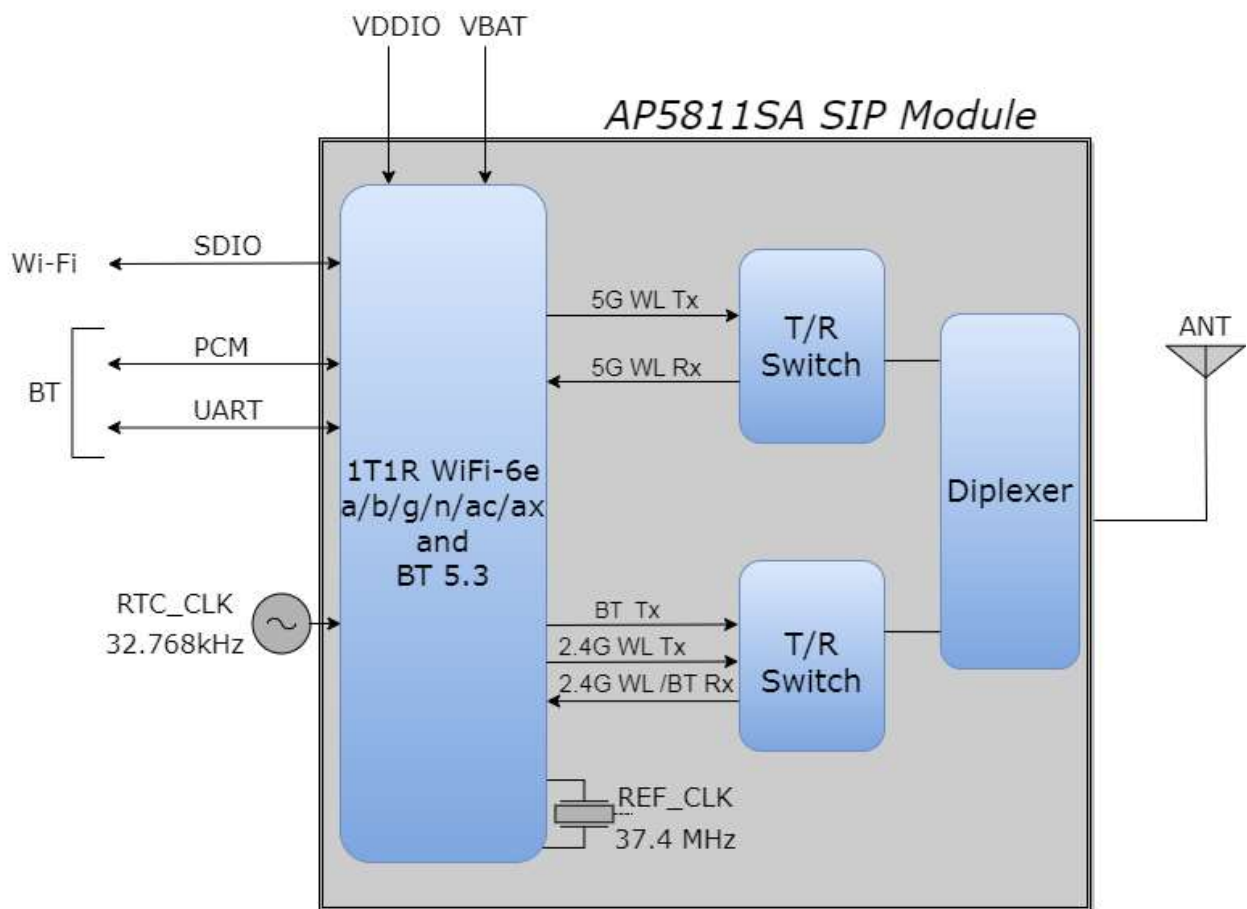
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1. Introduction

1.1 Overview

The AMPAK Technology® AP5811SA is a fully Wi-Fi 6E and Bluetooth functionalities module with seamless roaming capabilities and advance security. It is capable of associating with different vendors' Wi-Fi 6E or legacy Access Points / Routers and run up to PHY rate of 500Mbps with single stream. Furthermore, AP5811SA included 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 / 5GHz 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	AP5811SA
Product Description	1T1R 802.11 a/b/g/n/ac/ax Wi-Fi 6E + Bluetooth 5.3 Module
Dimension	L x W : 7.9 x 7.3 (typical) mm , H : 1.1 (Maximum) mm
Wi-Fi Interface	Support SDIO V3.0/ 2.0
BT Interface	UART / I2S
Operating temperature	-40°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 < VBAT < 3.8V without derating performance.

2.2 DC Characteristics

2.2.1 Absolute Maximum Ratings

Symbol	Description	Min.	Max.	Unit
VBAT	Input supply Voltage	3.0	5.25	V
VDDIO	Digital/Bluetooth/SDIO/ I/O Voltage	1.62	1.95	V

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

2.2.2 Recommended 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		2402 MHz ~ 2480MHz (2.4GHz ISM Band)			
Number of Channels		2412 MHz ~ 247 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	
	20	20	20	20	
802.11g	6、9Mbps	12、18Mbps	24Mbps	36Mbps	48Mbps
	18.5	18.5	18.5	18.5	16.5
	54Mbps				
	17				
802.11n 20MHz	MCS0~2	MCS3	MCS4	MCS5	MCS6
	18.5	18.5	18.5	17	17
	MCS7				
	15.5				
802.11ax 20MHz	HE0~2	HE3	HE4	HE5	HE6
	17.5	17.5	17.5	17	17
	HE7	HE8	HE9	HE10	HE11
	16	15	14	13	12

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	-98.5		
	2Mbps	-95		
	5.5Mbps	-93.5		
	11Mbps	-90		

802.11g	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	6Mbps	-94	24Mbps	-86
	9Mbps	-92.5	36Mbps	-82.5
	12Mbps	-92	48Mbps	-78.5
	18Mbps	-89	54Mbps	-77
802.11n_20MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	MCS0	-94	MCS4	-82.5
	MCS1	-91.5	MCS5	-78.5
	MCS2	-89	MCS6	-77
	MCS3	-86	MCS7	-75.5
802.11ax_20MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	HE0	-94	HE6	-78.5
	HE1	-93	HE7	-77.5
	HE2	-90.5	HE8	-73
	HE3	-88	HE9	-72
	HE4	-84	HE10	-67
	HE5	-80	HE11	-65
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 、 5745~5850MHz (5GHz UNII Band)			
Number of Channels		5150~5350MHz ： Ch36 ~ Ch64 5470~5725MHz ： Ch100 ~ Ch144 5745~5850MHz ： 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	16	16	16	16
	5470~5725	16	16	17	16
	5745~5850	16	16	16	16
	Frequency (MHz)	48Mbps	54Mbps		
	5150~5350	15	15		
	5470~5725	15	15		
	5745~5850	15	15		
802.11n 20MHz	Frequency (MHz)	MCS0~2	MCS3	MCS4	MCS5
	5150~5350	16	16	16	16
	5470~5725	17	17	16.5	17
	5745~5850	17	17	16.5	16.5
	Frequency (MHz)	MCS6	MCS7		
	5150~5350	16	15		
	5470~5725	16.5	15		
	5745~5850	16	15		

802.11n 40MHz	Frequency (MHz)	MCS0~2	MCS3	MCS4	MCS5
	5150~5350	16	16	16	16.5
	5470~5725	16	16	16.5	16.5
	5745~5850	16	16	16.5	16.5
	Frequency (MHz)	MCS6	MCS7		
	5150~5350	16	15		
	5470~5725	16	15		
	5745~5850	16	15		
802.11ac 20MHz	Frequency (MHz)	MCS0~2	MCS3	MCS4	MCS5
	5150~5350	16	16	16	16
	5470~5725	17	17	16	16.5
	5745~5850	17	16	17	16.5
	Frequency (MHz)	MCS6	MCS7	MCS8	
	5150~5350	16	15.5	15	
	5470~5725	16	15.5	15	
	5745~5850	16	15.5	15	
802.11ac 40MHz	Frequency (MHz)	MCS0~2	MCS3	MCS4	MCS5
	5150~5350	16.5	16.5	16	16
	5470~5725	16.5	16	16	16
	5745~5850	16.5	16.5	16	16.5
	Frequency (MHz)	MCS6	MCS7	MCS8	MCS9
	5150~5350	16.5	15	13.5	12.5
	5470~5725	16	15	14	13
	5745~5850	15.5	14.5	13	11.5
802.11ac 80MHz	Frequency (MHz)	MCS0~2	MCS3	MCS4	MCS5
	5150~5350	16.5	17	16.5	16
	5470~5725	17	18	17	17
	5745~5850	17	18	17	16
	Frequency (MHz)	MCS6	MCS7	MCS8	MCS9
	5150~5350	15	14	13	12
	5470~5725	15.5	15	13	10.5
	5745~5850	15.5	14.5	12.5	9.5

802.11ax 20MHz	Frequency (MHz)	HE0~2	HE3	HE4	HE5
	5150~5350	16	15.5	16	16
	5470~5725	16	16	16	16
	5745~5850	15.5	15.5	16	16
	Frequency (MHz)	HE6	HE7	HE8	HE9
	5150~5350	16	15.5	14.5	13
	5470~5725	16	15.5	15	14.5
	5745~5850	16	15.5	14.5	13
	Frequency (MHz)	HE10	HE11		
	5150~5350	10	10.5		
	5470~5725	13	13		
	5745~5850	9.5	9.5		
802.11ax 40MHz	Frequency (MHz)	HE0~2	HE3	HE4	HE5
	5150~5350	16.5	16.5	16.5	16.5
	5470~5725	16.5	16.5	16	16
	5745~5850	16.5	16.5	16.5	16.5
	Frequency (MHz)	HE6	HE7	HE8	HE9
	5150~5350	15.5	14.5	13	11
	5470~5725	15.5	14.5	14	13
	5745~5850	15.5	14	12.5	10.5
	Frequency (MHz)	HE10	HE11		
	5150~5350	9.5	9		
	5470~5725	11	10.5		
	5745~5850	8	8		

802.11ax 80MHz	Frequency (MHz)	HE0~2	HE3	HE4	HE5
	5150~5350	16.5	16.5	16.5	16
	5470~5725	17	17	17	16
	5745~5850	17	17	17	16
	Frequency (MHz)	HE6	HE7	HE8	HE9
	5150~5350	13	13	13	11.5
	5470~5725	14	15	14	13
	5745~5850	14	15	14	12
	Frequency (MHz)	HE10	HE11		
	5150~5350	9.5	9		
	5470~5725	10.5	10.5		
	5745~5850	11	10		

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	-92.5	24Mbps	-84.5
	9Mbps	-91	36Mbps	-81
	12Mbps	-90	48Mbps	-77
	18Mbps	-87.5	54Mbps	-75.5
802.11n_20MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	MCS0	-92	MCS4	-81
	MCS1	-89.5	MCS5	-76.5
	MCS2	-87	MCS6	-75
	MCS3	-84.5	MCS7	-73.5
802.11n_40MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	MCS0	-90	MCS4	-78
	MCS1	-87	MCS5	-74
	MCS2	-84.5	MCS6	-72.5
	MCS3	-81.5	MCS7	-71
802.11ac_20MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	MCS0	-92.5	MCS5	-76.5
	MCS1	-89.5	MCS6	-75
	MCS2	-87	MCS7	-73.5
	MCS3	-84.5	MCS8	-69.5

	MCS4	-81		
802.11ac_40MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	MCS0	-90	MCS5	-74.5
	MCS1	-87.5	MCS6	-73
	MCS2	-85	MCS7	-71
	MCS3	-82	MCS8	-67
	MCS4	-78.5	MCS9	-65
802.11ac_80MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	MCS0	-87	MCS5	-71
	MCS1	-84	MCS6	-69.5
	MCS2	-81.5	MCS7	-68
	MCS3	-78.5	MCS8	-64
	MCS4	-75	MCS9	-62
802.11ax_20MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	HE0	-92.5	HE6	-77
	HE1	-91	HE7	-75.5
	HE2	-88.5	HE8	-71.5
	HE3	-86	HE9	-70
	HE4	-82.5	HE10	-65
	HE5	-78.5	HE11	-63
802.11ax_40MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	HE0	-90.5	HE6	-74.5
	HE1	-89	HE7	-73.5
	HE2	-86	HE8	-69
	HE3	-84	HE9	-67.5
	HE4	-80	HE10	-64
	HE5	-76	HE11	-60
802.11ax_80MHz	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	HE0	-87.5	HE6	-72
	HE1	-86	HE7	-70
	HE2	-83	HE8	-66.5
	HE3	-80.5	HE9	-64.5
	HE4	-77.5	HE10	-60.5
	HE5	-73	HE11	-58
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

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	16	15.5	15.5	15.5
	6425~6525	15.5	14.5	14.5	14.5
	6525~6875	14	14	14	13
	6875~7125	11.5	11.5	10.5	10.5
	Frequency (MHz)	HE6	HE7	HE8	HE9
	5925~6425	15.5	15	15	13.5
	6425~6525	14.5	14.5	13.5	12
	6525~6875	11	11	10	8
	6875~7125	10.5	10.5	10	8.5
	Frequency (MHz)	HE10	HE11		
	5925~6425	12	12		
	6425~6525	11.5	11		
	6525~6875	8.5	8.5		
	6875~7125	8.5	8.5		
802.11ax 40MHz	Frequency (MHz)	HE0~2	HE3	HE4	HE5
	5925~6425	15.5	15.5	15.5	15.5
	6425~6525	14	14	14	14
	6525~6875	14	14	14	13.5
	6875~7125	13	13	13	12
	Frequency (MHz)	HE6	HE7	HE8	HE9
	5925~6425	14	14	13	11.5
	6425~6525	14	13	12	11
	6525~6875	14	12.5	10.5	9.5

	6875~7125	13	11.5	9.5	8.5
	Frequency (MHz)	HE10	HE11		
	5925~6425	10.5	10.5		
	6425~6525	9	9		
	6525~6875	8.5	7.5		
	6875~7125	8	8.5		
802.11ax 80MHz	Frequency (MHz)	HE0~2	HE3	HE4	HE5
	5925~6425	16	16	16	16
	6425~6525	15	15	15	15
	6525~6875	15	15	15	14.5
	6875~7125	14	13	13	13
	Frequency (MHz)	HE6	HE7	HE8	HE9
	5925~6425	15	14	11	11
	6425~6525	14	12.5	10.5	10
	6525~6875	13.5	12.5	11	10
	6875~7125	12	10.5	10	10
	Frequency (MHz)	HE10	HE11		
	5925~6425	8.5	8.5		
	6425~6525	8.5	8.5		
	6525~6875	9	8		
	6875~7125	6.5	6.5		

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	-92.5	HE6	-76.5
	HE1	-91	HE7	-75.5
	HE2	-88.5	HE8	-71
	HE3	-85.5	HE9	-69.5
	HE4	-82	HE10	-65
	HE5	-78	HE11	-63
802.11ax_40MHz SISO	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	HE0	-90.5	HE6	-74.5
	HE1	-89	HE7	-73
	HE2	-86	HE8	-69
	HE3	-83.5	HE9	-67.5
	HE4	-80	HE10	-64

	HE5	-76	HE11	-60
802.11ax_80MHz SISO	Data Rate	Spec.(dBm)	Data Rate	Spec.(dBm)
	HE0	-87.5	HE6	-71.5
	HE1	-86	HE7	-69.5
	HE2	-83	HE8	-66
	HE3	-80.5	HE9	-64.5
	HE4	-77	HE10	-60.5
	HE5	-72.5	HE11	-58
Maximum Input Level	802.11ax : -30dBm			

4. Bluetooth Specification

4.1 Bluetooth Specification

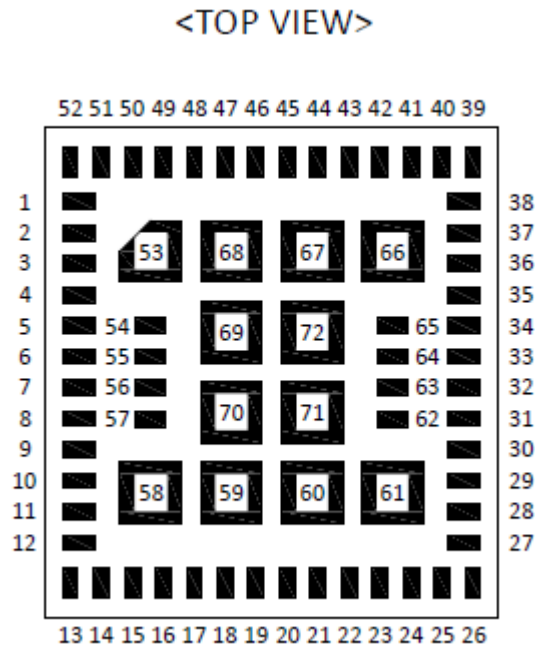
Conditions : VBAT=3.3V ; VDDIO=1.8V ; Temp:25°C

Feature	Description
General Specification	
Bluetooth Standard	BDR 、EDR(1Mbps & 2Mbps) 、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 ± 2.5 dB	
	CL1 (dBm)
BDR Output Power	7
EDR Output Power	6
BLE Output Power	6
Sensitivity, tolerance ± 2 dB	
Sensitivity @ BER=0.1% for GFSK (1Mbps)	-91 dBm
Sensitivity @ BER=0.01% for $\pi/4$ -DQPSK (2Mbps)	-94 dBm
Sensitivity @ BER=0.01% for 8DPSK (3Mbps)	-87.5 dBm
Sensitivity @ PER=30.8% for LE (1Mbps)	-93 dBm
Sensitivity @ PER=30.8% for 2LE (2Mbps)	-91.5 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



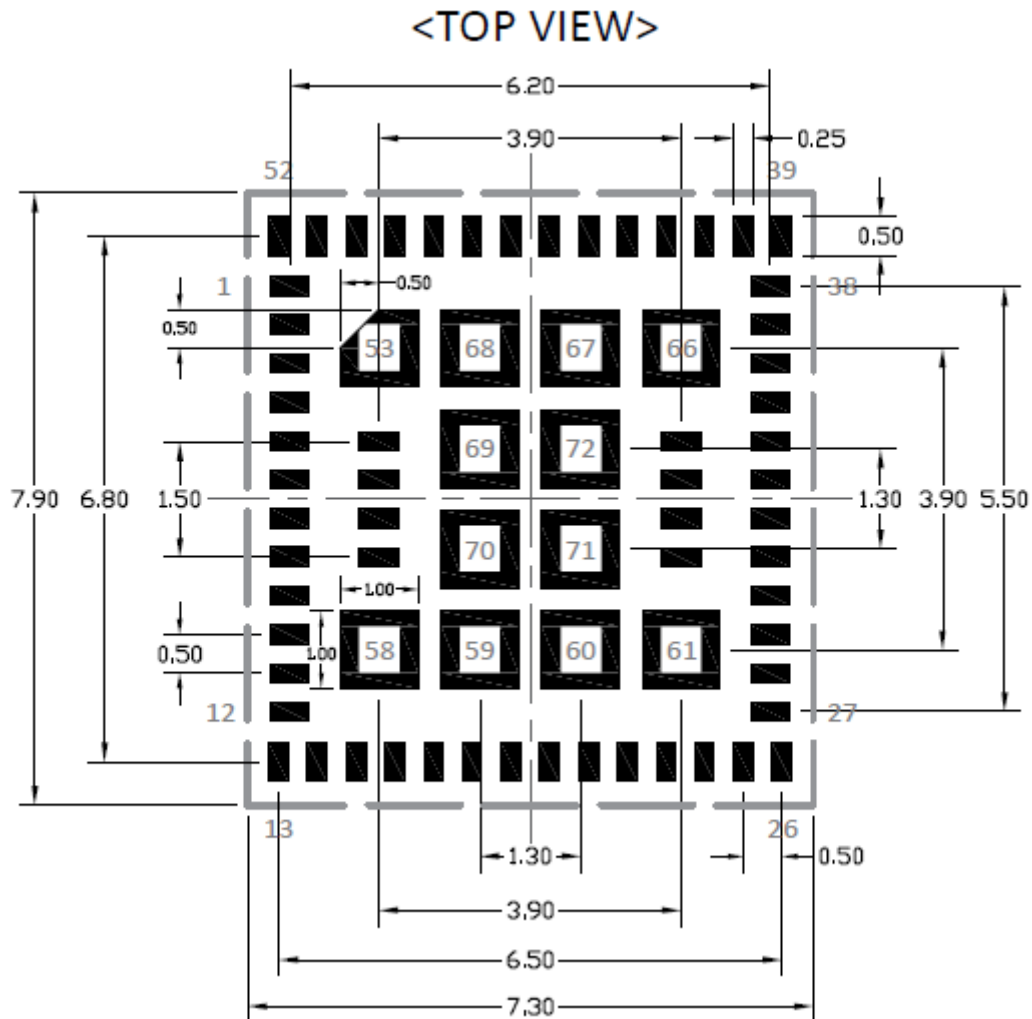
5.2 Pin Assignment

NO	Name	Type	Description
1	NC	—	Floating (Don't connected to ground)
2	NC	—	Floating (Don't connected to ground)
3	NC	—	Floating (Don't connected to ground)
4	GND	—	Ground connections
5	VIO	P	I/O Voltage supply input
6	GND	—	Ground connections
7	BT_REG_ON	I	Power up/down internal regulators used by BT section
8	WL_REG_ON	I	Power up/down internal regulators used by WIFI section
9	GND	—	Ground connections
10	NC	—	Floating (Don't connected to ground)
11	GND	—	Ground connections
12	NC	—	Floating (Don't connected to ground)
13	GND	—	Ground connections
14	VBAT	P	Main power voltage source input
15	VBAT	P	Main power voltage source input
16	SR_VLX	P	Internal CBUCK switching regulator output generation pin

17	GND	—	Ground connections
18	VDD_CBUCK_1P12	P	Internal CBUCK voltage input generation pin
19	GND	—	Ground connections
20	NC	—	Floating (Don't connected to ground)
21	NC	—	Floating (Don't connected to ground)
22	NC	—	Floating (Don't connected to ground)
23	NC	—	Floating (Don't connected to ground)
24	NC	—	Floating (Don't connected to ground)
25	GND	—	Ground connections
26	LPO	I	External Low Power Clock input (32.768KHz)
27	NC	—	Floating (Don't connected to ground)
28	SDIO_DATA_2	I/O	SDIO data line 2
29	SDIO_DATA_1	I/O	SDIO data line 1
30	SDIO_DATA_0	I/O	SDIO data line 0
31	SDIO_DATA_3	I/O	SDIO data line 3
32	SDIO_CMD	I/O	SDIO command line
33	SDIO_CLK	I/O	SDIO clock line
34	GND	—	Ground connections
35	BT_PCM_OUT	O	PCM Data output; BT_I2S_DO
36	BT_PCM_CLK	I/O	PCM clock; BT_I2S_CLK
37	BT_PCM_SYNC	I/O	PCM sync signal; BT_I2S_WS
38	BT_PCM_IN	I	PCM data input; BT_I2S_DI
39	GND	—	Ground connections
40	BT_UART_RXD	I	Bluetooth UART interface
41	BT_UART_TXD	O	Bluetooth UART interface
42	BT_UART_CTS_N	I	Bluetooth UART interface
43	BT_UART_RTS_N	O	Bluetooth UART interface
44	GND	—	Ground connections
45	GND	—	Ground connections
46	GND	—	Ground connections
47	GND	—	Ground connections
48	GND	—	Ground connections
49	GND	—	Ground connections
50	RF_PORT	I/O	RF I/O port
51	GND	—	Ground connections
52	GND	—	Ground connections
53	GND	—	Ground connections

54	WL_GPIO_3	I/O	This pin can be programmed to be a WIFI GPIO
55	WL_GPIO_2	I/O	This pin can be programmed to be a WIFI GPIO
56	WL_GPIO_1	I/O	This pin can be programmed to be a WIFI GPIO
57	WL_HOST_WAKE	O	WLAN to wake-up HOST
58	GND	—	Ground connections
59	GND	—	Ground connections
60	GND	—	Ground connections
61	GND	—	Ground connections
62	BT_WAKE	I	HOST wake-up Bluetooth device
63	BT_HOST_WAKE	O	Bluetooth device to wake-up HOST
64	NC	—	Floating (Don't connected to ground)
65	NC	—	Floating (Don't connected to ground)
66	GND	—	Ground connections
67	GND	—	Ground connections
68	GND	—	Ground connections
69	GND	—	Ground connections
70	GND	—	Ground connections
71	GND	—	Ground connections
72	GND	—	Ground connections

6.2 Recommended footprint



- Solder paste layer design is generally the same as recommended footprint.
(錫膏層設計通常建議和焊墊尺寸相同)
- If soldering quality with good wetting on upright side is essential for PQC, how to optimize the aperture design in the stencil to adjust the amount of solder paste would be crucial.
In addition, a kind of stencil design with stepped thickness in partial area would be considered if the thickness of stencil is about 0.1mm or thinner. Please optimize the stencil design by manufacture engineer or contact AMPAK FAE for assistance.
(如果模組吃錫品質考量側面爬錫，如何優化鋼網開孔設計以調整適當的錫膏量是非常重要的。尤其鋼網的厚度大約是 0.1mm 或更薄時，可考慮局部加厚鋼網的設計。請諮詢製程工程師以優化鋼網的設計,或是聯絡正基科技技術支持團隊).

7. 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	0.7V _{io} - V _{io}	V

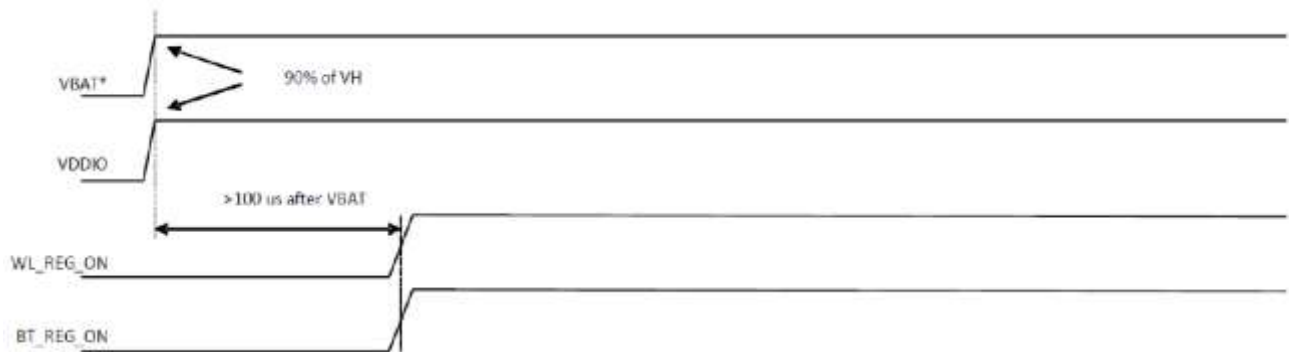
8. Host Interface Timing Diagram

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.

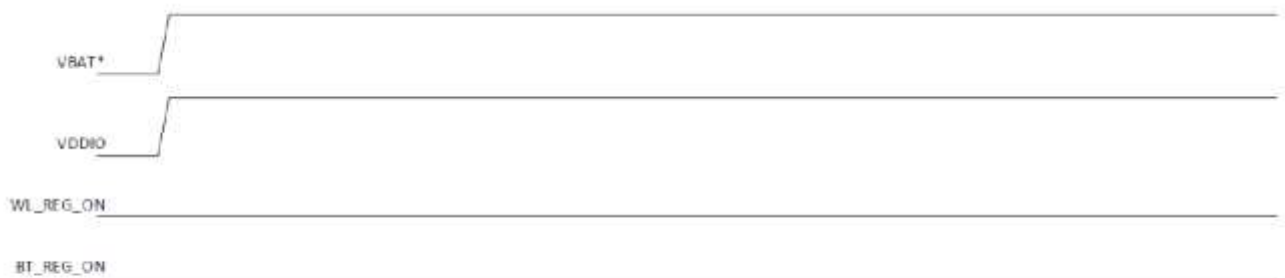
- WL_REG_ON: Used by the PMU to power up or power down the internal regulators used by the WLAN section. When this pin is high, the regulators are enabled and the WLAN section is out of reset. When this pin is low the WLAN section is in reset.
- BT_REG_ON: Used by the PMU to power up or power down the 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%-50% 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.

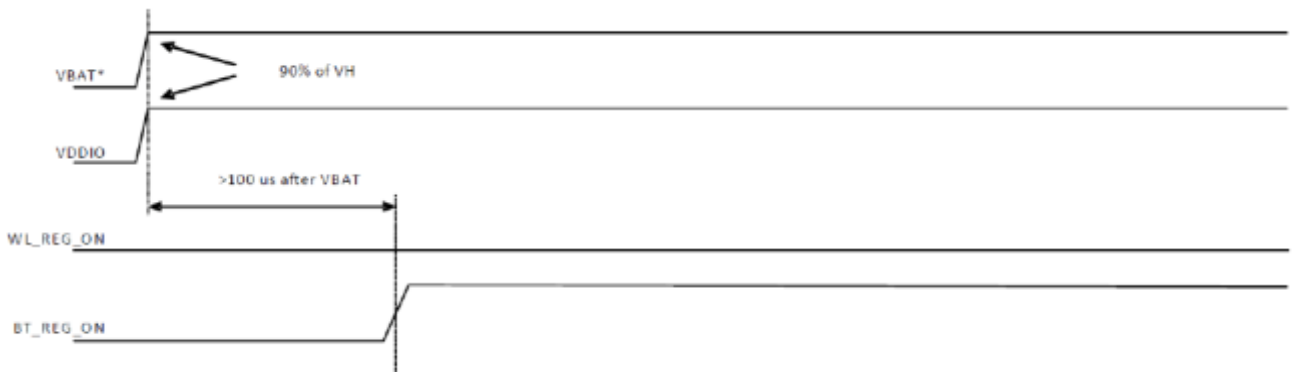
WLAN=OFF, Bluetooth=OFF



***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

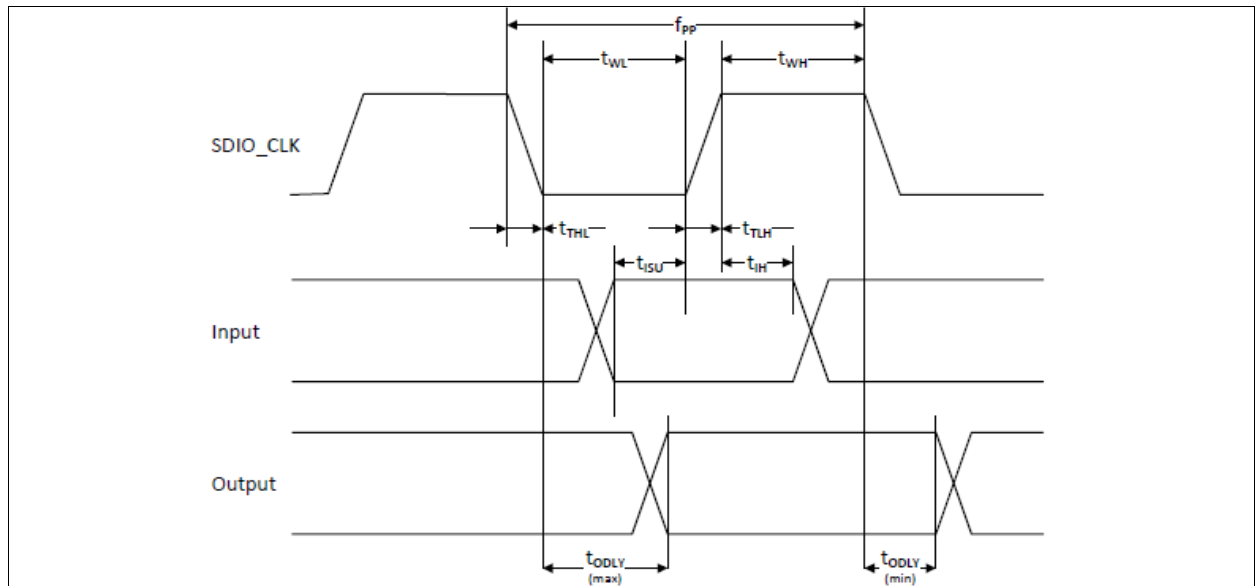
The module supports SDIO version 3.0 for all 1.8V 4-bit UHSI speeds: SDR50(100 Mbps),SDR104(208MHz) and DDR50(50MHz, dual rates). It has the ability to stop the SDIO clock and map the interrupt signal into a GPIO pin. This 'out-of-band' interrupt signal notifies the host when the WLAN device wants to 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

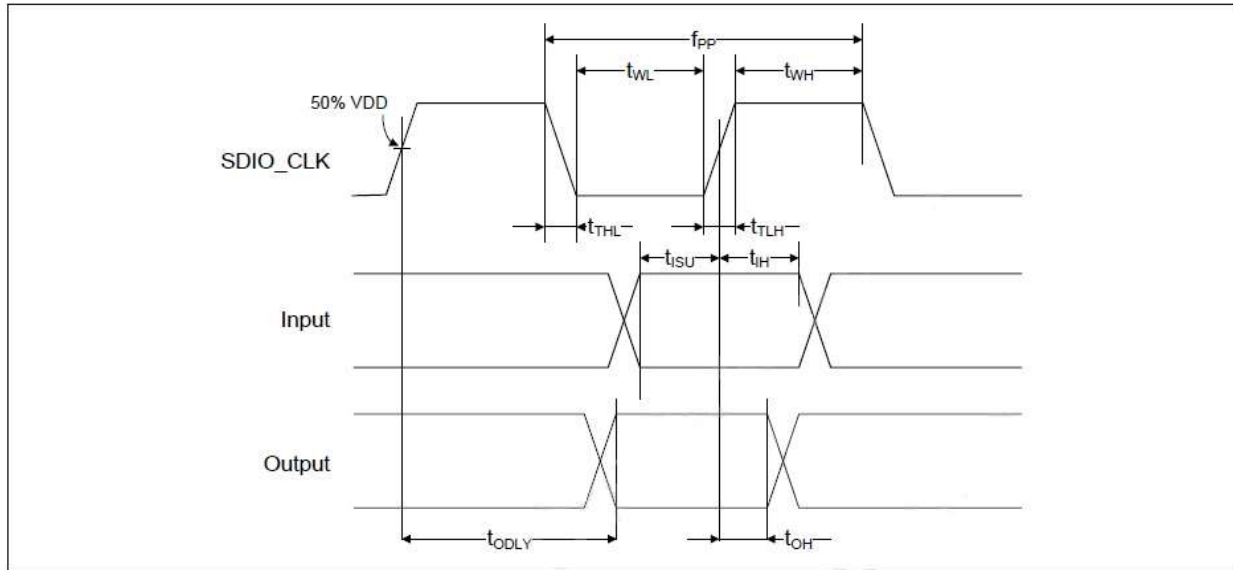
SDIO Default Mode Timing Diagram



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



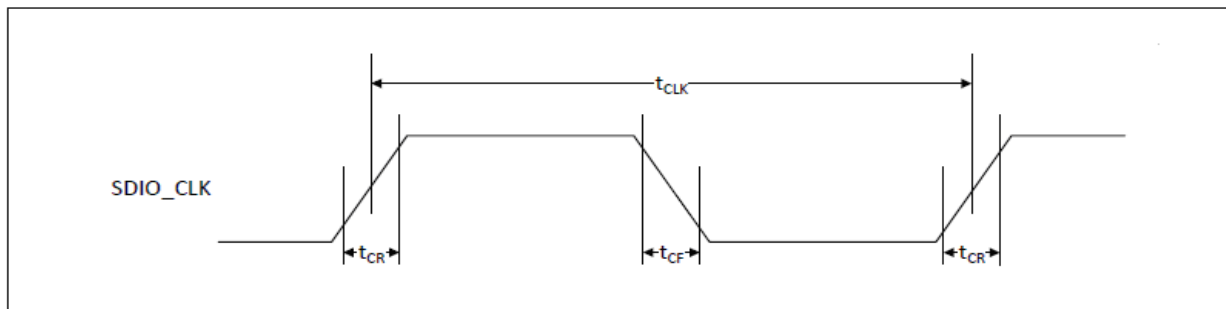
Parameter	Symbol	Minimum	Typical	Maximum	Unit
SDIO CLK (all values are referred to minimum VIH and maximum VIL^b)					
Frequency – Data Transfer Mode	f_{pp}	0	–	50	MHz
Frequency – Identification Mode	f_{OD}	0	–	400	kHz
Clock low time	t_{WL}	7	–	–	ns
Clock high time	t_{WH}	7	–	–	ns
Clock rise time	t_{TLH}	–	–	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 $\max(V_{IL}) = 0.2 \times V_{DDIO}$.

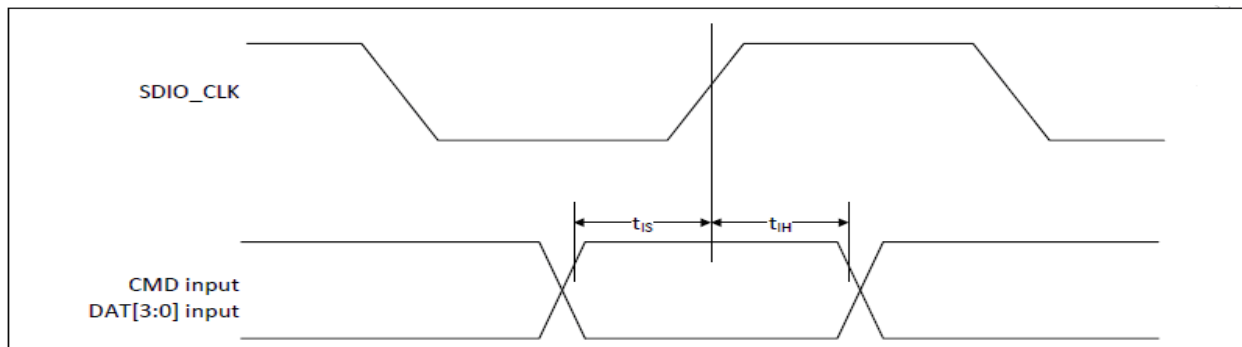
SDIO Bus Timing Specifications in SDR Modes

Clock timing (SDR Modes)



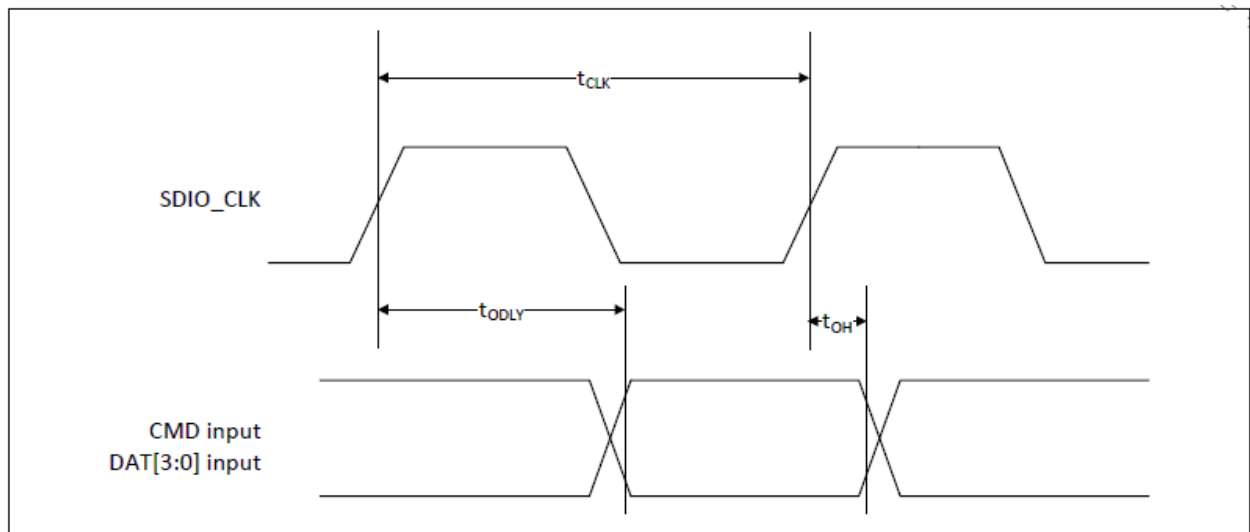
Parameter	Symbol	Minimum	Maximum	Unit	Comments
—	t_{CLK}	40	—	ns	SDR12 mode
		20	—	ns	SDR25 mode
		10	—	ns	SDR50 mode
		4.8	—	ns	SDR104 mode
—	t_{CR}, t_{CF}	—	$0.2 \times t_{CLK}$	ns	$t_{CR}, t_{CF} < 2.00$ ns (max) @100 MHz, $C_{CARD} = 10$ pF $t_{CR}, t_{CF} < 0.96$ ns (max) @208 MHz, $C_{CARD} =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

SDIO Bus Input timing (SDR Modes)



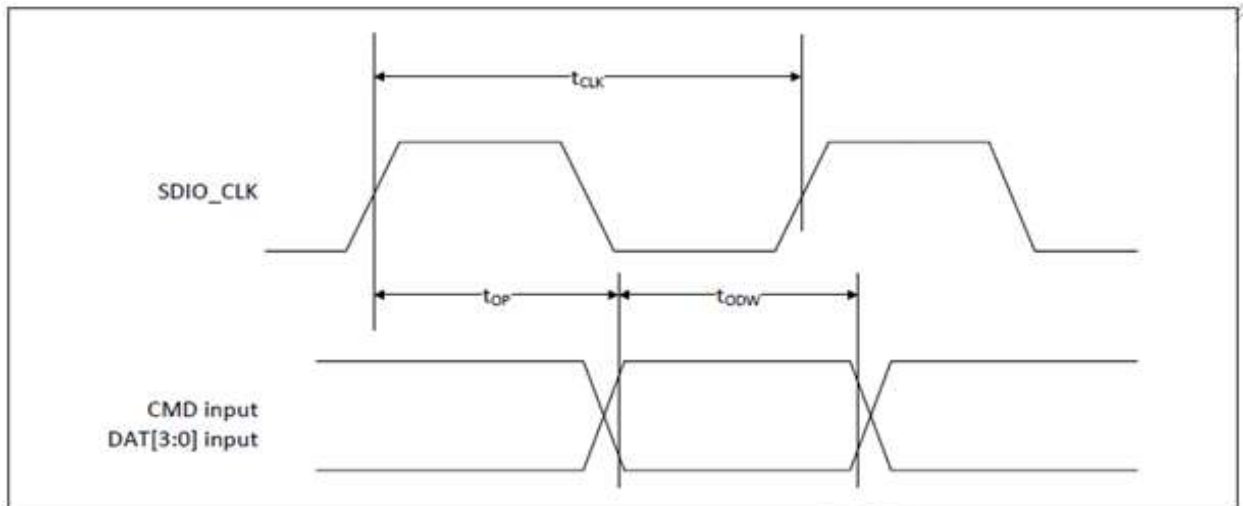
Symbol	Minimum	Maximum	Unit	Comments
SDR104 Mode				
t_{IS}	1.4	—	ns	$C_{CARD} = 10$ pF, VCT = 0.975V
t_{IH}	0.80	—	ns	$C_{CARD} = 5$ pF, VCT = 0.975V
SDR50 Mode				
t_{IS}	3.00	—	ns	$C_{CARD} = 10$ pF, VCT = 0.975V
t_{IH}	0.80	—	ns	$C_{CARD} = 5$ pF, VCT = 0.975V

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

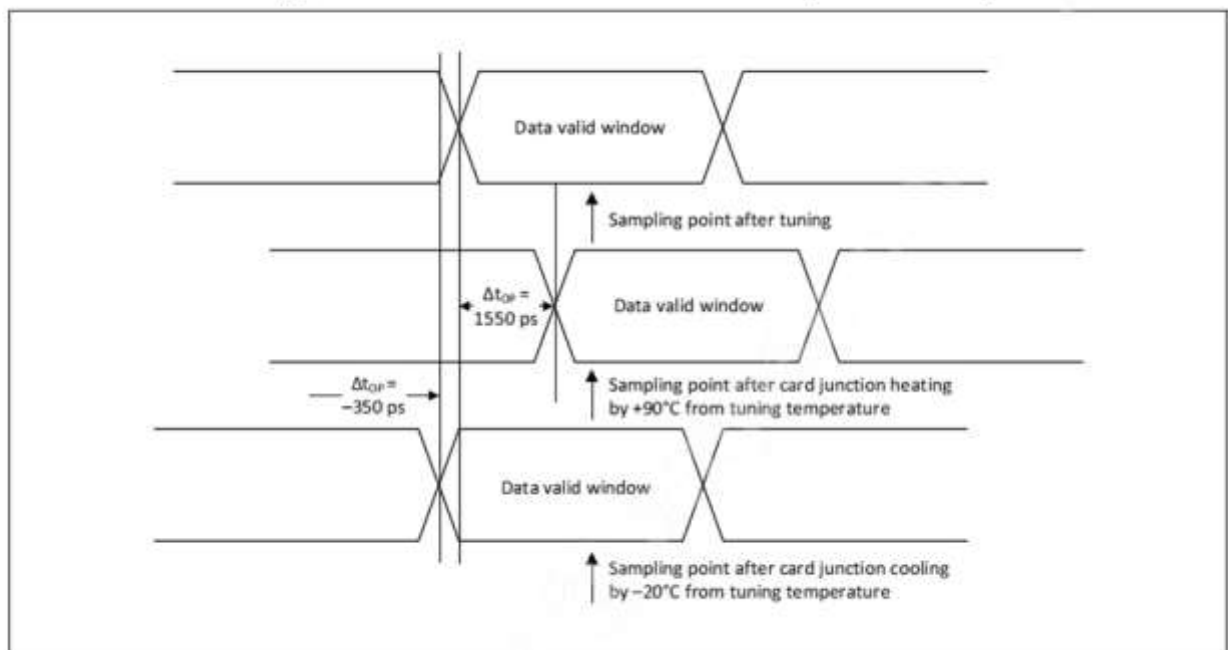
Card output timing (SDR Modes 100MHz to 208MHz)



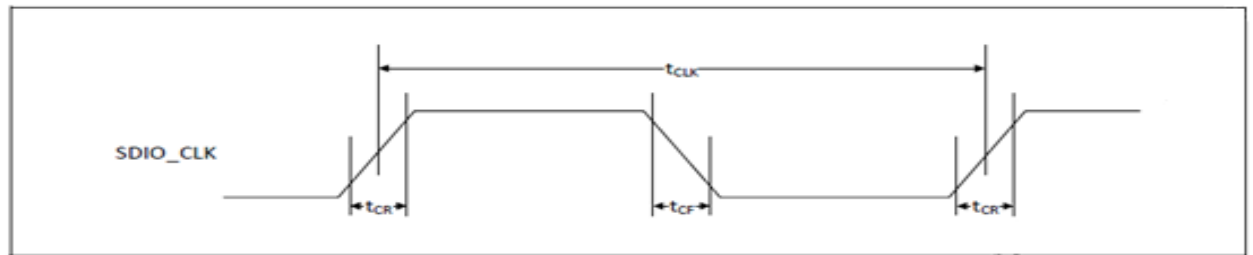
Symbol	Minimum	Maximum	Unit	Comments
t_{OP}	0	2	UI	Card output phase
Δt_{OP}	-350	+1550	ps	Delay variation due to temp change after tuning
t_{ODW}	0.60	—	UI	$t_{ODW}=2.88$ ns @208 MHz

- $\Delta t_{OP} = +1550$ 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)

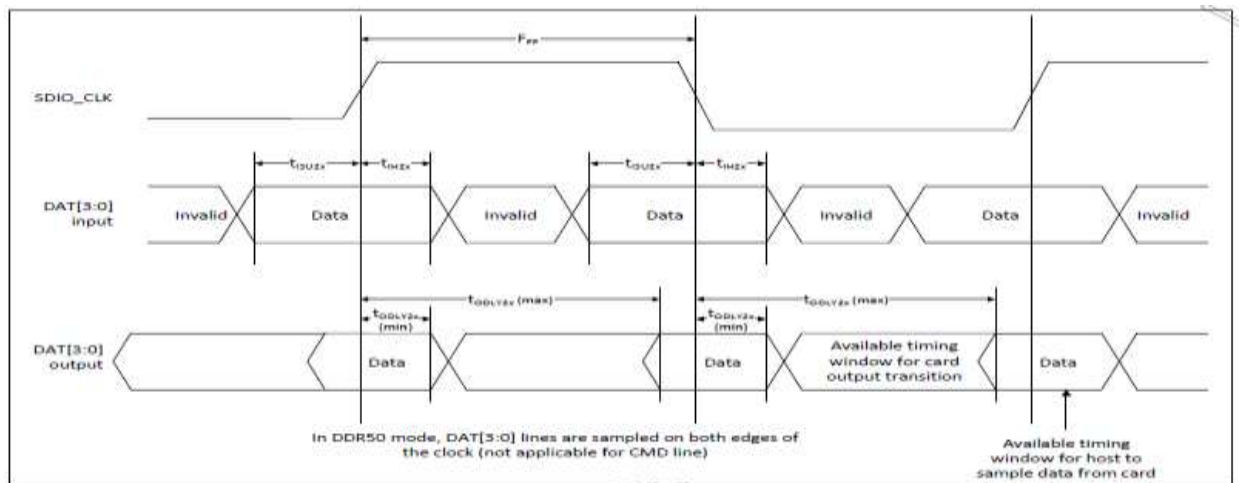


SDIO Bus Timing Specifications in DDR50 Mode



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



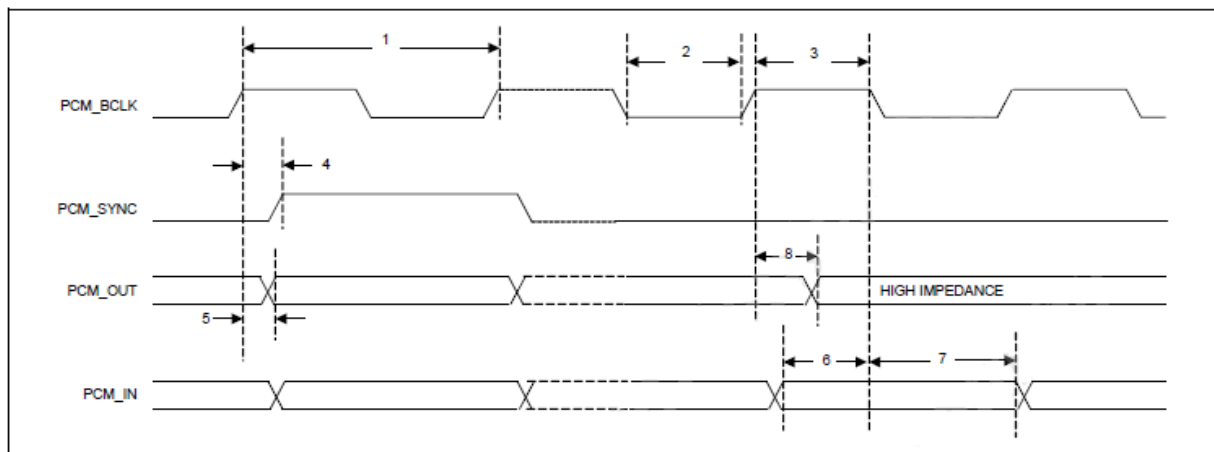
Parameter	Symbol	Minimum	Maximum	Unit	Comments
Input CMD					
Input setup time	t_{ISU}	6	—	ns	$C_{CARD} < 10$ pF (1 Card)
Input hold time	t_{IH}	0.8	—	ns	$C_{CARD} < 10$ pF (1 Card)
Output CMD					
Output delay time	t_{ODLY}	—	13.7	ns	$C_{CARD} < 30$ pF (1 Card)
Output hold time	t_{OH}	1.5	—	ns	$C_{CARD} < 15$ 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_{OH2x}	1.5	—	ns	$C_{CARD} < 15$ pF (1 Card)

8.3 PCM Interface Description

The PCM Interface on the AP5811SA can connect to linear PCM Codec devices in master or slave mode. In master mode, the AP5811SA generates the PCM_CLK and PCM_SYNC signals, and in slave mode, these signals are provided by another master on the PCM interface and are inputs to the AP5811SA. The configuration of the PCM interface may be adjusted by the host through the use of vendor-specific HCI commands.

Short Frame Sync, Master Modem

PCM Timing Diagram (Short Frame Sync, Master Mode)

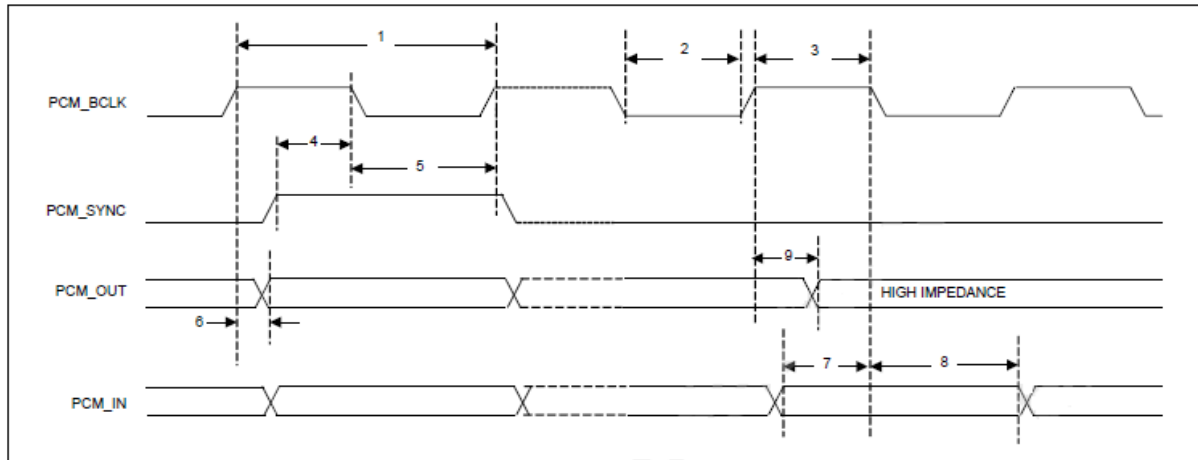


PCM Interface Timing Specifications (Short Frame Sync, Master Mode)

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 delay	0	–	25	ns
5	PCM_OUT delay	0	–	25	ns
6	PCM_IN setup	8	–	–	ns
7	PCM_IN hold	8	–	–	ns
8	Delay from rising edge of PCM_BCLK during last bit period to PCM_OUT becoming high impedance	0	–	25	ns

Short Frame Sync, Slave Mode

PCM Timing Diagram (Short Frame Sync, Slave Mode)

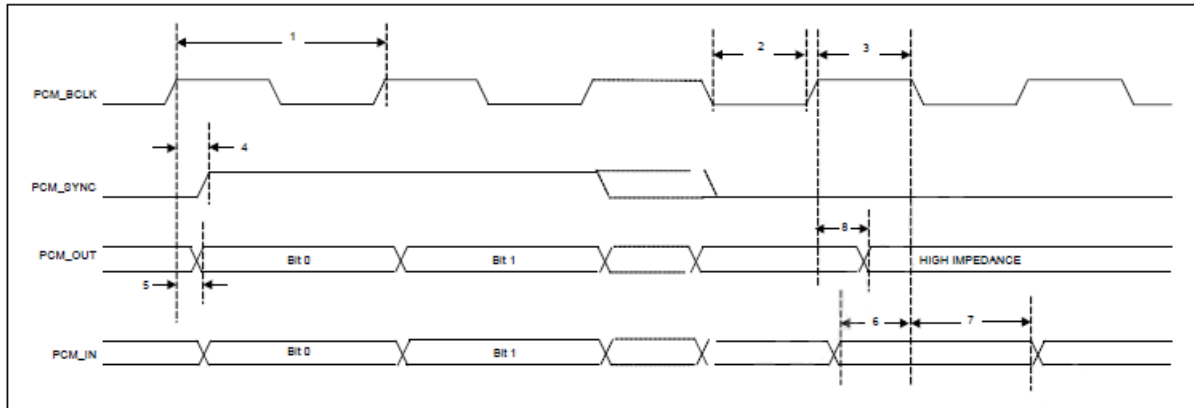


PCM Interface Timing Specifications (Short Frame Sync, Slave Mode)

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

Long Frame Sync, Master Mode

PCM Timing Diagram (Long Frame Sync, Master Mode)

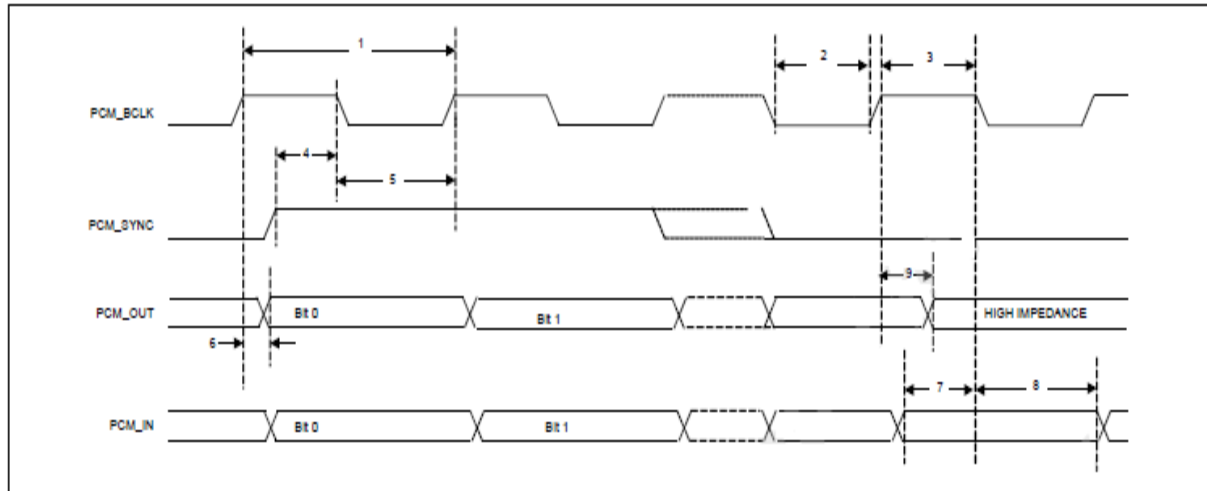


PCM Interface Timing Specifications (Long Frame Sync, Master Mode)

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 delay	0	–	25	ns
5	PCM_OUT delay	0	–	25	ns
6	PCM_IN setup	8	–	–	ns
7	PCM_IN hold	8	–	–	ns
8	Delay from rising edge of PCM_BCLK during last bit period to PCM_OUT becoming high impedance	0	–	25	ns

Long Frame Sync, Slave Mode

PCM Timing Diagram (Long Frame Sync, Slave Mode)

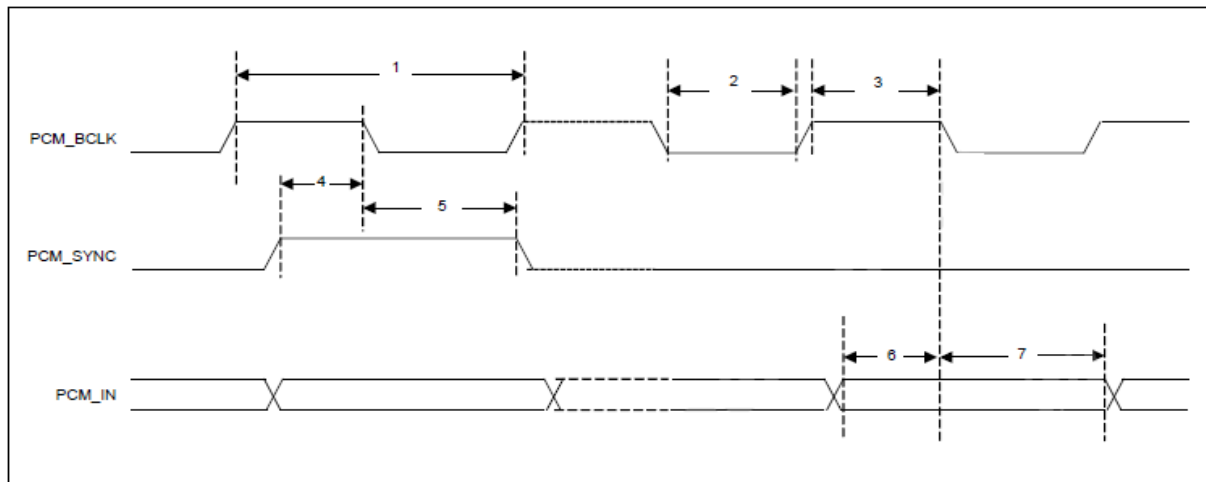


PCM Interface Timing Specifications (Long Frame Sync, Slave Mode)

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)

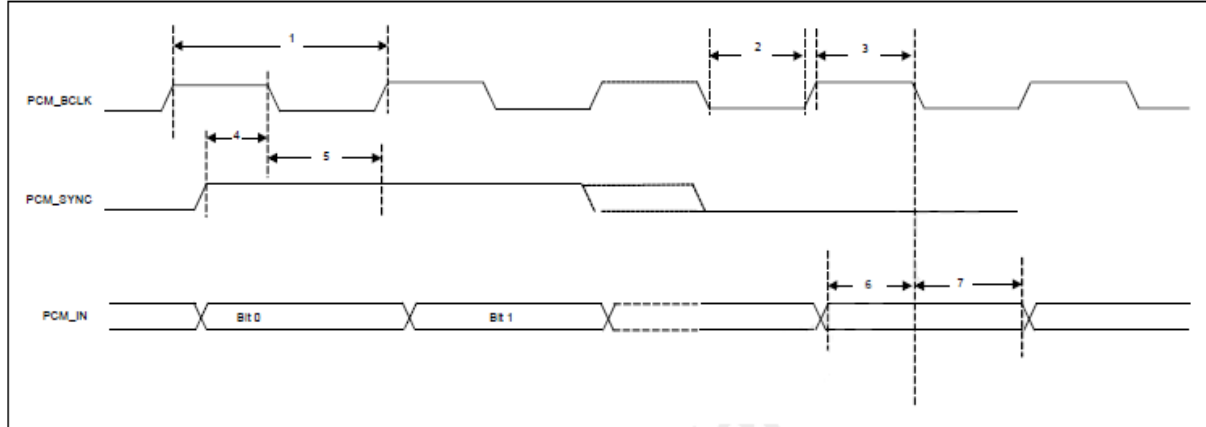


PCM Burst Mode (Receive Only, Short Frame Sync)

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

8.4 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.

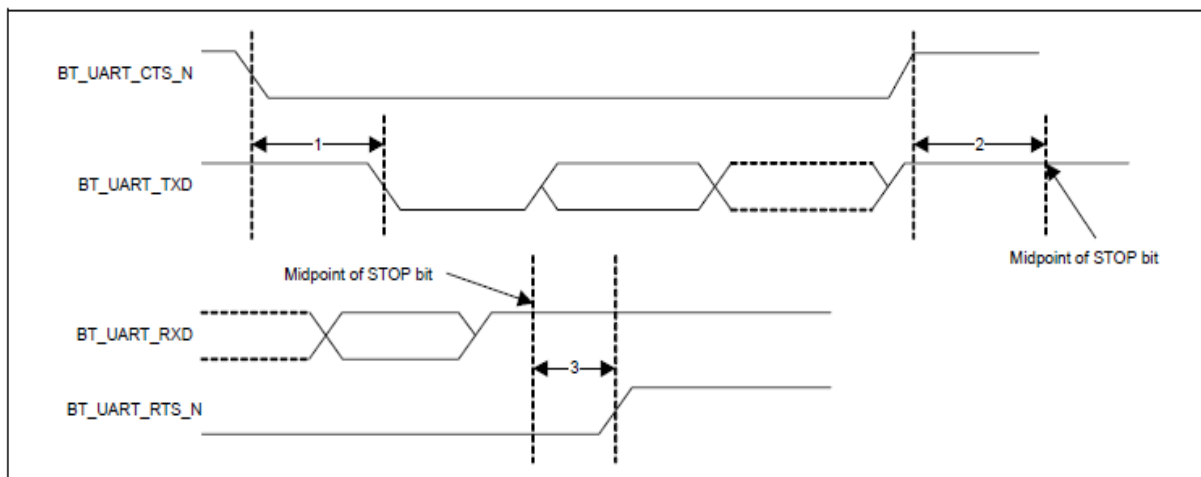
The UART can perform XON/XOFF flow control and includes hardware support for the Serial Line Input Protocol (SLIP). It can also perform wake-on activity. For example, activity on the RX or CTS inputs can wake the chip from a sleep state.

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

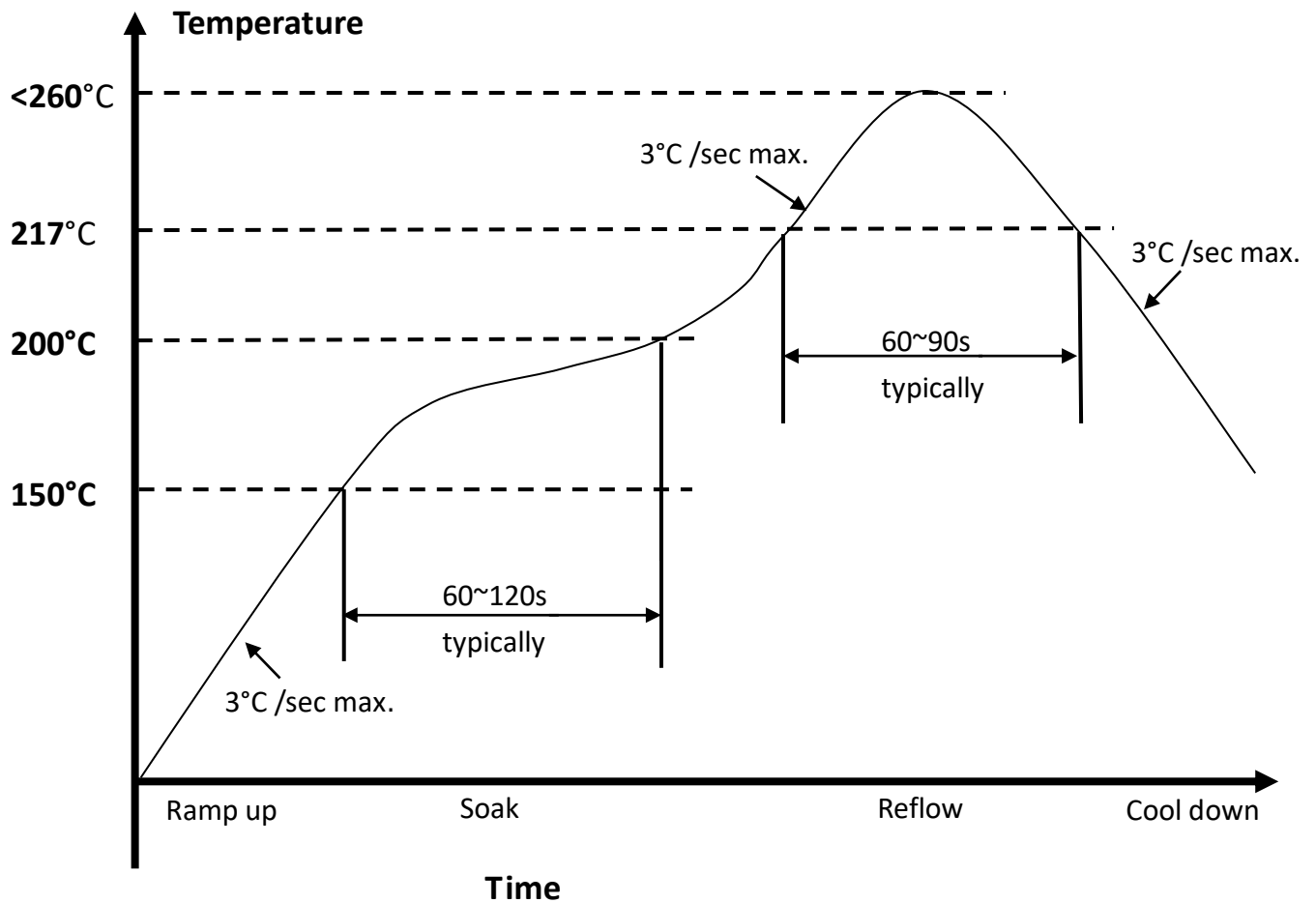
UART Timing



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

9. Recommended 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 is recommended.
5. If the shelf time is exceeded, be sure baking step to remove the moisture from the component

10. Package Information

10.1 Label

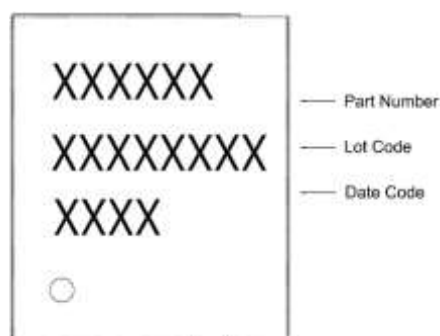
Inner box label A.

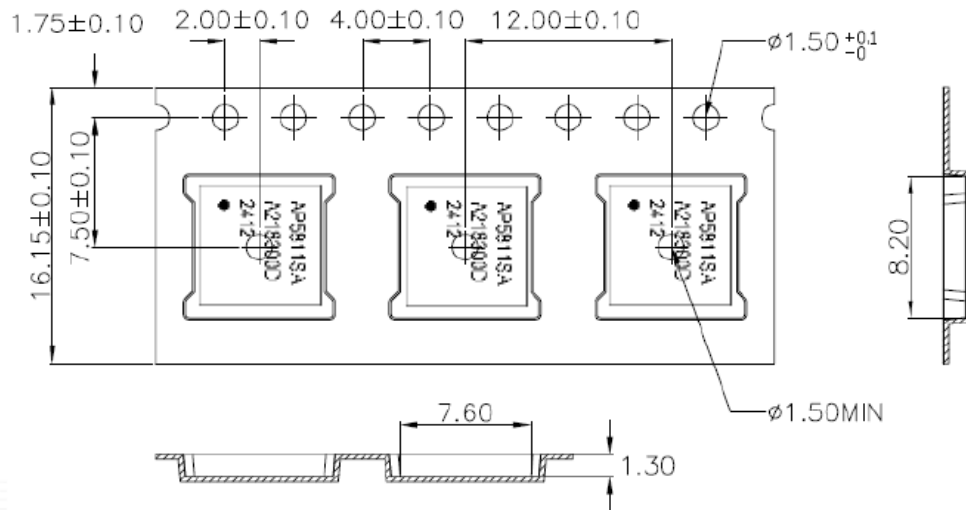


Carton box label B.

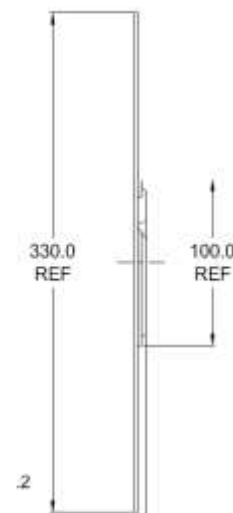
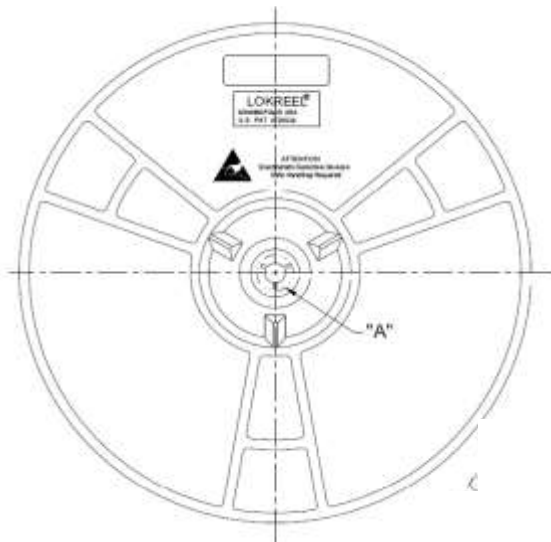


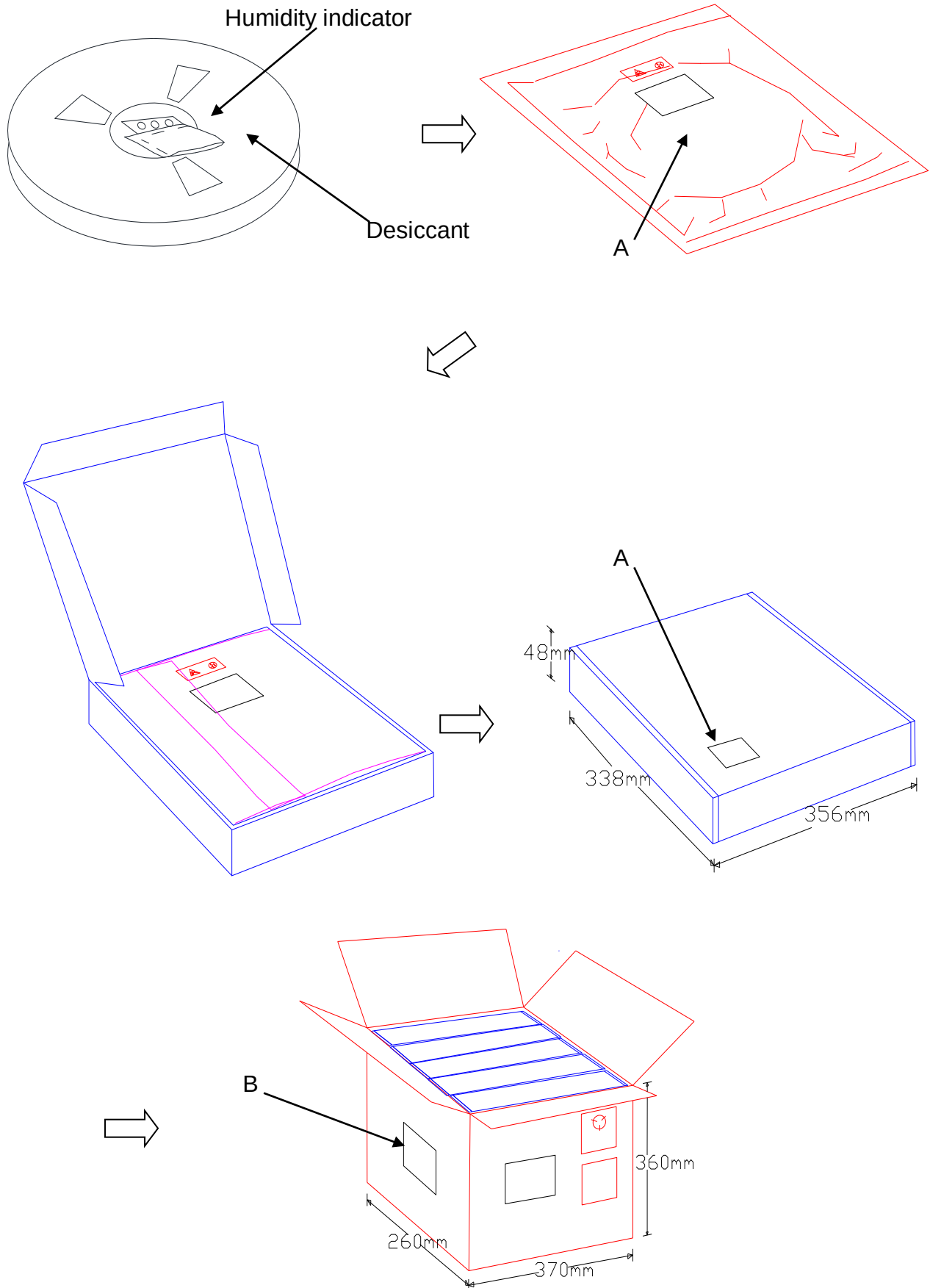
10.2 Packing





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 requirements.
5. Thickness: 0.30±0.05mm.
6. Component load per 13" reel : 3000 pcs





10.3 MSL Level / Storage Condition

	Caution	LEVEL
	This bag contains MOISTURE-SENSITIVE DEVICES	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		

11. Certificate Information

11.1 FCC Statement

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.

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

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

Important Note:

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 and your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. Country Code selection feature to be disabled for products marketed to the US/Canada.

This device is intended only for OEM integrators under the following conditions:

1. The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2. The transmitter module may not be co-located with any other transmitter or antenna,
3. For all products market in US, OEM has to limit the operation channels in CH1 to CH11 for 2.4G band by supplied firmware programming tool. OEM shall not supply any tool or info to the end-user regarding to Regulatory Domain change. (if modular only test Channel 1-11)

As long as the three conditions above are met, further transmitter testing will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Important Note:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for

re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labeling

The final end product must be labeled in a visible area with the following"

Contains **FCC ID: ZQ6-AP5811SA**

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01r01

2.2 List of applicable FCC rules

CFR 47 FCC PART 15 SUBPART C and CFR 47 FCC PART 15 SUBPART E has been investigated. It is applicable to the modular transmitter

2.3 Specific operational use conditions

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system. This radio transmitter ZQ6-AP5811SA have been approved by Federal Communications Commission 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. The concrete contents to check are the following three points.

- 1) Must use an antenna such as Dipole Antenna with a gain not exceeding 6.34 dBi for WIFI and 5.96dBi for BT;
- 2) Should be installed so that the end user cannot modify the antenna;
- 3) Feed line should be designed in 50ohm

Fine-tuning of return loss etc. can be performed using a matching network. The antenna shall not be accessible for modification or change by the end user. A modification to the antenna is required FCC/ISED Class II permissive change.

This device has been approved as mobile device in accordance with FCC and ISED Canada RF exposure requirements. This means that a restricted minimum separation distance of 20cm between the antenna and any person.

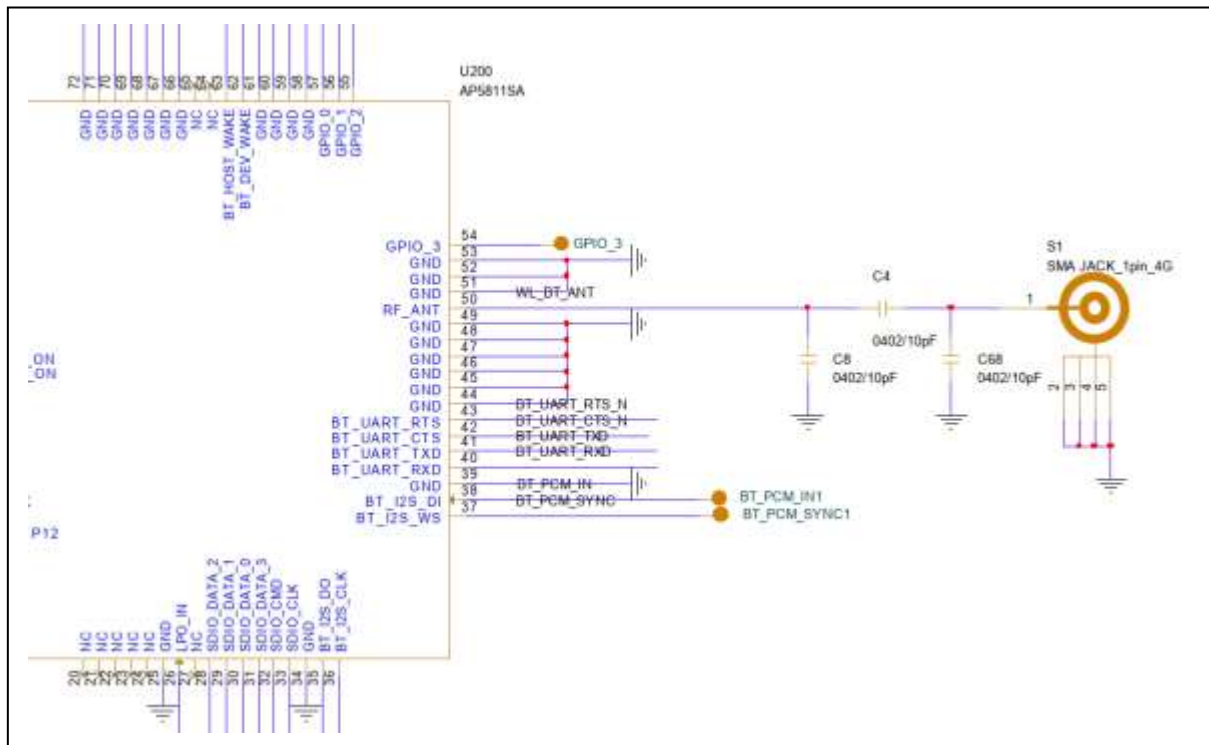
A change in use that involves a separation distance $\leq 20\text{cm}$ (Portable usage) between the Module's antenna and any persons is a change in the RF exposure of the module and, hence, is subject to a FCC Class 2 Permissive Change and a ISED Canada Class 4 Permissive Change policy in accordance with FCC KDB 996396 D01 and ISED Canada RSP-100.

2.4 Limited module procedures

Not applicable

2.5 Trace antenna designs

There is a circuit connection at the position from the antenna to the module



Type	Description	PartNumber
Capcitor	MLCC 10pF 16V 5% 0201 C0G Murata	C4
Capcitor	NC	C8,C68
SMA	SMA JACK	S1

2.6 RF exposure considerations

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.

2.7 Antennas

This radio transmitter **FCC ID: ZQ6-AP5811SA** has been approved by Federal Communications Commission 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.

Bluetooth&2.4G WIFI

Model No. of antenna:	Type of antenna:	Gain of the antenna (Max.)
		Antenna 1
AD-103AG	Dipole Antenna	2.02dBi
AD-301N	Dipole Antenna	4.4dBi
AD-302N	Dipole Antenna	3.14dBi
AD-303N	Dipole Antenna	3.14dBi
AD-305N	Dipole Antenna	5.0dBi
AD-501AX	Dipole Antenna	3.7dBi
AD-510AX	Dipole Antenna	2.27dBi
AD-512AX	Dipole Antenna	2.35dBi
AD-514AX	Dipole Antenna	3.07dBi
AD-515AX	Dipole Antenna	5.96dBi
Note: This module will use ten different antennas, and only the one with the larger antenna gain(Antenna1: 5.96dBi(AD-515AX))will be used for test.		

5G WIFI

Model No. of antenna:	Type of antenna:	Gain of the antenna (Max.)
		Antenna 1
AD-103AG	Dipole Antenna	2.03dBi
AD-301N	Dipole Antenna	5.8dBi
AD-302N	Dipole Antenna	2.87dBi
AD-303N	Dipole Antenna	3.45dBi
AD-305N	Dipole Antenna	5.53dBi
AD-501AX	Dipole Antenna	5.0dBi
AD-510AX	Dipole Antenna	3.52dBi
AD-512AX	Dipole Antenna	3.02dBi
AD-514AX	Dipole Antenna	4.17dBi
AD-515AX	Dipole Antenna	6.34dBi
Note: This module will use ten different antennas, and only the one with the larger antenna gain(Antenna1: 6.34dBi(AD-515AX)) will be used for test.		

6E

Model No. of antenna:	Type of antenna:	Gain of the antenna (Max.)	Gain of the antenna (Min.)
		Antenna 1	Antenna 1
AD-501AX	Dipole Antenna	5.00dBi	4.5 dBi
AD-510AX	Dipole Antenna	3.52dBi	2.29 dBi
AD-512AX	Dipole Antenna	3.02dBi	1.90 dBi
AD-514AX	Dipole Antenna	4.17dBi	2.99 dBi
AD-515AX	Dipole Antenna	6.34dBi	5.29 dBi
Note: This module will use five different WiFi antennas, and only the one with the larger antenna gain(Antenna1: 6.34dBi;(AD-515AX)) will be used for test.			

2.8 Label and compliance information

The final end product must be labeled in a visible area with the following" Contains

FCC ID: ZQ6-AP5811SA

2.9 Information on test modes and additional testing requirements

Host manufacturer which install this modular with single modular approval should perform the test of radiated emission and spurious emission according to FCC part 15C:15.247 and FCC Part 15 Subpart E 15.407 and 15.209 requirement, only if the test result comply with FCC part 15.247 and FCC Part 15 Subpart E 15.407 and 15.209 requirement, then the host can be sold legally.

2.10 Additional testing, Part 15 Subpart B disclaimer

Host manufacturer is responsible for compliance of the host system with module installed with all other applicable requirements for the system such as Part 15 B.

2.11 Note EMI Considerations

Host manufacture is recommended to use D04 Module Integration Guide recommending as "best practice" RF design engineering testing and evaluation in case non-linear interactions generate additional non-compliant limits due to module placement to host components or properties.

2.12 How to make changes

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system. According to the KDB 996369 D02 Q&A Q12, that a host manufacture only needs to do an evaluation (i.e., no C2PC required when no emission exceeds the limit of any individual device (including unintentional radiators) as a composite. The host manufacturer must fix any failure.

11.2 ISED Statement

- English: 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.

- French: Cet appareil contient des émetteurs/récepteurs exempts de licence qui sont conformes aux CNR exempts de licence d'Innovation, Sciences et Développement économique

Canada. Le fonctionnement est soumis aux deux conditions suivantes :

(1) Cet appareil ne doit pas causer d'interférences.

(2) Cet appareil doit accepter toute interférence, y compris les interférences susceptibles de provoquer un fonctionnement indésirable de l'appareil.

This device meets the exemption from the routine evaluation limits in section 6.3 of RSS 102 and

compliance with RSS 102 RF exposure, users can obtain Canadian information on RF exposure and compliance.

cet appareil est conforme à l'exemption des limites d'évaluation courante dans la section 6.3 du

cnr - 102 et conformité avec rss 102 de l'exposition aux rf, les utilisateurs peuvent obtenir des données canadiennes sur l'exposition aux champs rf et la conformité.

This equipment complies with Canada 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.

Cet équipement est conforme Canada limites d'exposition aux radiations dans un environnement non contrôlé.

Cet équipement doit être installé et utilisé avec une distance minimale de 20 cm entre le radiateur et votre corps.

The device for operation in the band 5150–5250 MHz is only for indoor use to

reduce the potential for harmful interference to cochannel mobile satellite systems.

L'appareil destiné à fonctionner dans la bande 5150-5250 MHz est uniquement destiné à une utilisation en intérieur afin de réduire le potentiel d'interférences nuisibles aux systèmes mobiles par satellite cocanaux.

11.3 RED2014/53/EU

Declaration of Conformity

Hereby, Ampak Technology Inc declares that this **AP5811SA** product is in compliance with essential requirements and other relevant provisions of Directive 2014/53/EU. A copy of the Declaration of conformity can be found at <https://www.ampak.com.tw/tw>

The **AP5811SA** used at 20cm from body.

When the device support wlan5G(5150-5250Mhz), Manufacture will list the following statement and country list (not EU country) on the user manual, and wlan5G only used to indoor

The 6E band 5.925 - 6.425GHz is for Low Power in-door (LPI)

	AT	BE	BG	HR	CY	CZ	DK
	EE	FI	FR	DE	EL	HU	IE
	IT	LV	LT	LU	MT	NL	PL
	PT	RO	SK	SI	ES	SE	UK

Bluetooth: 8.54dBm(EIRP)

2.4G WIFI: 17.66dBm(EIRP)

5G WIFI(Bnad1&2&3): 21.69dBm(EIRP)

5G WIFI(Bnad4): 13.91dBm(EIRP)

6E WIFI: 20.87dBm(EIRP)