

AW-AM281MA

**IEEE 802.11 1X1 a/b/g/n Wireless LAN
+ Bluetooth 5.0 Combo LGA Module
With M.2 2230 Adaptor Board**

Datasheet

Rev. C

DF

(For Standard)

1

FORM NO.: FR2-015_A

Responsible Department : WBU

Expiry Date: Forever

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Features

WLAN

- ◆ IEEE 802.11n compliant, 1x1 spatial stream with data rates up to MCS 7 (150 Mbps).
- ◆ PHY data rates up to 150 Mbps.
- ◆ Backward compatibility with legacy 802.11n/a/g/b technology.
- ◆ 20MHz bandwidth/ channel, 40MHz bandwidth/ channel, upper/ lower 20MHz packets in 40MHz channel, 20MHz duplicate legacy packets in 40MHz channel mode operation.
- ◆ Dynamic frequency selection (radar detection)
- ◆ Multiple power saving modes for low power consumption.
- ◆ 20/40 MHz coexistence.

Bluetooth

- ◆ Baseband and radio BDR and EDR packet types – 1Mbps (GFSK), 2Mbps ($\pi/4$ -DQPSK), and 3Mbps (8DPSK).
- ◆ Fully qualified Bluetooth BT4.2 (includes LE) and support Bluetooth 5.
- ◆ Enhanced Data Rate (EDR) compliant for both 2Mbps and 3Mbps supported.
- ◆ PCM/Inter-IC Sound(I2S) for Bluetooth.
- ◆ Standard Bluetooth power saving mechanisms.
- ◆ WLAN/Bluetooth Coexistence (BCA) protocol support.



Revision History

Document NO: R2-2281MA-DST-01

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1. Introduction

1.1 Product Overview

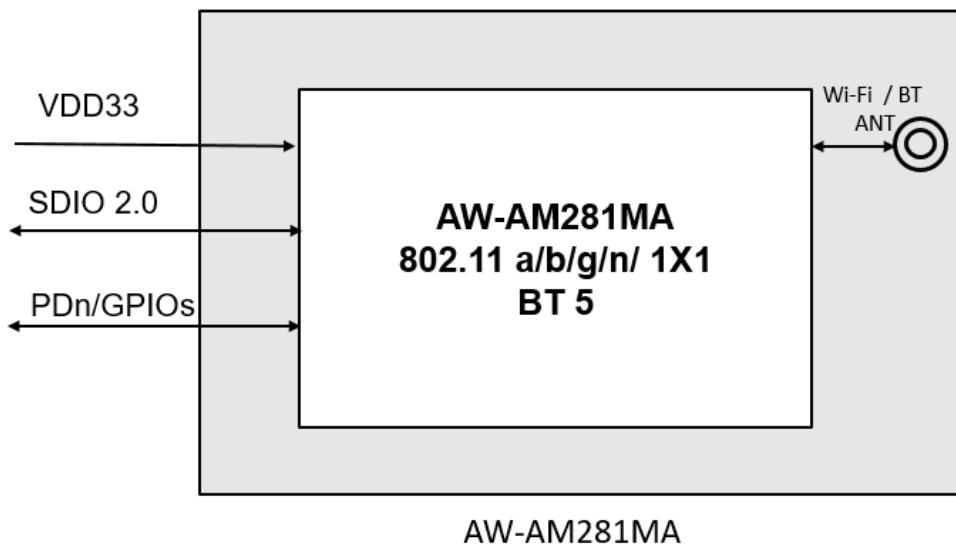
AzureWave Technologies, Inc. introduces the IEEE 802.11a/b/g/n WLAN, BT, combo LGA module with M.2 2230 adapter board – **AW-AM281MA**. With four advanced radio technologies integrated into a LGA module, AW-AM281MA provides the best and most convenient SMT process. The module is targeted to mobile devices including, Tablet PC, Portable Media Players (PMPs), Portable Navigation Devices (PNDs), Personal Digital Assistants (PDAs), Tracking Devices, Gaming Devices which need convenient SMT process, low power consumption.

By using AW-AM281MA, the customers can easily integrate the Wi-Fi, BT, by a M.2 2230 module with the benefits of **high design flexibility, short development cycle, and quick time-to-market**.

Compliance with the IEEE 802.11a/b/g/n standard, the AW-AM281MA uses **DSSS, OFDM, DBPSK, DQPSK, CCK and QAM** baseband modulation technologies. A high level of integration and full implementation of the power management functions specified in the IEEE 802.11 standard minimize the system power requirements by using AW-AM281MA.

The AW-AM281MA supports standard interface **SDIO (4-bit and 1-bit)** for WLAN/BT. AW-AM281MA is suitable for multiple mobile processors for different applications. With the combo functions and the good performance, the AW-AM281MA is the best solution for the consumer electronics and the tablet PC.

1.2 Block Diagram



1.3 Specifications Table

1.3.1 General

Features	Description
Product Description	IEEE 802.11 a/b/g/n Wi-Fi with Bluetooth 5.0 M.2 2230 Combo Module
Major Chipset	NXP 88W8977
Host Interface	WiFi + BT ● SDIO + SDIO (For Host configuration interface, please refer to section 2.3)
Dimension	22 mm X 30mm x 2.45 mm (Max) (Tolerance remarked in mechanical drawing)
Form factor	M.2 2230-S1-E
Antenna	I-PEX MHF4 Connector Receptacle (20449) ANT : WiFi/Bluetooth → TX/RX
Weight	TBD

1.3.2 WLAN

Features	Description
WLAN Standard	IEEE 802.11 a/b/g/n
Frequency Range	2.4 GHz ISM Bands 2.412-2.472 GHz 5.15-5.25 GHz (FCC UNII-low band) for US/Canada and Europe 5.25-5.35 GHz (FCC UNII-middle band) for US/Canada and Europe 5.47-5.725 GHz for Europe 5.725-5.825 GHz (FCC UNII-high band) for US/Canada
Modulation	DSSS, OFDM, DBPSK, DQPSK, CCK, 16-QAM, 64-QAM
Number of Channels	2.4GHz: ■ USA, NORTH AMERICA, Canada and Taiwan - 1 ~ 11 ■ China, Australia, Most European Countries - 1 ~ 13 ■ Japan, 1 ~ 13 5GHz: ■ USA, Canada, Most European Countries - 36,40,44,48,52,56,60,64,100,104,108,112,116,120,124,128,132,13 6,140,149,153,157,161,165 ■ Japan - 36,40,44,48,52,56,60,64,100,104,108,112,116,120,124,128,132,13 6,140

	■ China - 36,40,44,48,52,56,60,64, 149,153,157,161,165				
Output Power (Board Level Limit)*	2.4G				
	11b (11Mbps) @EVM<35%	Min 14	Typ 16	Max 18	Unit dBm
	11g (54Mbps) @EVM≤-27 dB	12	14	16	dBm
	11n (HT20 MCS7) @EVM≤-28 dB	11	13	15	dBm
	11n (HT40 MCS7) @EVM≤-28 dB	9	11	13	dBm
	5G				
	11a (54Mbps) @EVM≤-27 dB	11	13	15	dBm
	11n (HT20 MCS7) @EVM≤-28 dB	10	12	14	dBm
11n (HT40 MCS7) @EVM≤-28 dB	8	10	12	dBm	
Receiver Sensitivity	2.4G				
	11b (11Mbps)	Min -89	Typ -86	Max -86	Unit dBm
	11g (54Mbps)	-73	-70	-70	dBm
	11n (HT20 MCS7)	-71	-68	-68	dBm
	11n (HT40 MCS7)	-69	-66	-66	dBm
	5G				
	11a (54Mbps)	Min -73	Typ -70	Max -70	Unit dBm
	11n (HT20 MCS7)	-69	-66	-66	dBm
11n (HT40 MCS7)	-65	-62	-62	dBm	
Data Rate	WLAN: 802.11b : 1, 2, 5.5, 11Mbps 802.11a/g : 6, 9, 12, 18, 24, 36, 48, 54Mbps 802.11n : Maximum data rates up to 72 Mbps (20 MHz channel), 150 Mbps (40 MHz channel)				
Security	■ WAPI ■ WEP 64-bit and 128-bit encryption with H/W TKIP processing ■ WPA/WPA2 (Wi-Fi Protected Access) AES-CCMP hardware implementation as part of 802.11i security standard				

* If you have any certification questions about output power please contact FAE directly.

1.3.3 Bluetooth

Features	Description				
Bluetooth Standard	BT4.2+Enhanced Data Rate (EDR) Bluetooth 5 support				
Frequency Range	2402MHz~2480MHz				
Modulation	Header GFSK Payload 2M: π/4-DQPSK Payload 3M: 8DPSK				
Output Power		Min	Typ	Max	Unit
	BDR	0	2	4	dBm
	EDR	0	2	4	dBm
Receiver Sensitivity		Min	Typ	Max	Unit
	BLE	0	2	4	dBm
Receiver Sensitivity					
	BDR		-83		dBm

1.3.4 Operating Conditions

Features	Description
Operating Conditions	
Voltage	3.3V+-5%
Operating Temperature	-20 °C~ 85°C
Operating Humidity	less than 85% R.H.
Storage Temperature	-40 °C~ 85°C
Storage Humidity	less than 60% R.H.

2. Pin Definition

2.1 Pin Map

Pin	Signal	Signal	Pin
74	3.3 V	GND	75
72	3.3 V	NC	73
		NC	71
70	NC	GND	69
68	NC	NC	67
66	NC	NC	65
64	NC	GND	63
62	NC	NC	61
60	NC	NC	59
58	NC	GND	57
56	W_DISABLE1#	NC	55
54	W_DISABLE2#	NC	53
52	NC	GND	51
50	SUSCLK(32kHz)	NC	49
48	NC	NC	47
46	NC	GND	45
44	NC	NC	43
42	NC	NC	41
40	NC	GND	39
38	NC	NC	37
36	UART CTS	NC	35
34	UART RTS	GND	33
32	UART RXD	CONNECTOR KEY E	
	CONNECTOR Key E	CONNECTOR KEY E	
	CONNECTOR KEY E	CONNECTOR KEY E	
	CONNECTOR KEY E	CONNECTOR KEY E	
22	UART TXD	SDIO RESET#/TX_BLANKING	23
20	UART WAKE#	SDIO WAKE#	21
18	GND	SDIO DATA3	19
16	NC	SDIO DATA2	17
14	PCM_IN/I2S SD_IN	SDIO DATA1	15
12	PCM_OUT/I2S SD_OUT	SDIO DATA0	13
10	PCM_SYNC/I2S WS	SDIO CMD	11
8	PCM_CLK/I2S SCK	SDIO CLK/SYSCLK	9
6	NC	GND	7
4	3.3 V	NC	5
2	3.3 V	NC	3
		GND	1

2.2 Pin Table

Pin No	Definition	Basic Description	Voltage	Type
1	GND	Ground.	---	GND
2	3.3V_2	3.3V power pin	3.3V	Power
3	NC	Floating Pin, No connect to anything.	---	---
4	3.3V_4	3.3V power pin	3.3V	Power
5	NC	Floating Pin, No connect to anything.	---	---
6	NC	Floating Pin, No connect to anything.	---	---
7	GND	Ground.	---	GND
8	PCM_CLK	PCM Clock	1.8V/3.3V	I/O
9	SDIO_CLK	SDIO Clock Input	1.8V/3.3V	I
10	PCM_SYNC	PCM Synchronization control	1.8V/3.3V	O
11	SDIO_CMD	SDIO Command Input	1.8V/3.3V	I/O
12	PCM_OUT	PCM data out	1.8V/3.3V	O
13	SDIO_DATA0	SDIO Data Line 0	1.8V/3.3V	I/O
14	PCM_IN	PCM data Input	1.8V/3.3V	I
15	SDIO_DATA1	SDIO Data Line 1	1.8V/3.3V	I/O
16	NC	Floating Pin, No connect to anything.	---	---
17	SDIO_DATA2	SDIO Data Line 2	1.8V/3.3V	I/O
18	GND	Ground.	---	GND
19	SDIO_DATA3	SDIO Data Line 3	1.8V/3.3V	I/O
20	UART_WAKE	Connect to module's BT Host Wake Pin	1.8V/3.3V	O
21	SDIO_WAKE	WLAN to wake-up HOST	1.8V/3.3V	I/O
22	Reserve	Reserve Pin, Don't connect to anything.	---	---
23	SDIO Reset	WiFi reset pin	1.8V/3.3V	I
32	Reserve	Reserve Pin, Don't connect to anything.	---	---
33	GND	Ground.	---	GND
34	Reserve	Reserve Pin, Don't connect to anything.	---	---
35	NC	Floating Pin, No connect to anything.	---	---
36	Reserve	Reserve Pin, Don't connect to anything.	---	---
37	NC	Floating Pin, No connect to anything.	---	---
38	NC	Floating Pin, No connect to anything.	---	---
39	GND	Ground.	---	GND
40	NC	Floating Pin, No connect to anything.	---	---
41	NC	Floating Pin, No connect to anything.	---	---
42	NC	Floating Pin, No connect to anything.	---	---
43	NC	Floating Pin, No connect to anything.	---	---
44	NC	Floating Pin, No connect to anything.	---	---
45	GND	Ground.	---	GND
46	NC	Floating Pin, No connect to anything.	---	---
47	NC	Floating Pin, No connect to anything.	---	---
48	NC	Floating Pin, No connect to anything.	---	---

49	NC	Floating Pin, No connect to anything.	---	---
50	SUSCLK_IN	External Low Power Clock input (32.768KHz)	1.8V/3.3V	I
51	GND	Ground.	---	GND
52	NC	Floating Pin, No connect to anything.	---	---
53	NC	Floating Pin, No connect to anything.	---	---
54	W_Disable2	BT reset pin	1.8V/3.3V	I
55	NC	Floating Pin, No connect to anything.	---	---
56	W_Disable1	WiFi reset pin	1.8V/3.3V	I
57	GND	Ground.	---	GND
58	NC	Floating Pin, No connect to anything.	---	---
59	NC	Floating Pin, No connect to anything.	---	---
60	NC	Floating Pin, No connect to anything.	---	---
61	NC	Floating Pin, No connect to anything.	---	---
62	NC	Floating Pin, No connect to anything.	---	---
63	GND	Ground.	---	GND
64	NC	Floating Pin, No connect to anything.	---	---
65	NC	Floating Pin, No connect to anything.	---	---
66	NC	Floating Pin, No connect to anything.	---	---
67	NC	Floating Pin, No connect to anything.	---	---
68	NC	Floating Pin, No connect to anything.	---	---
69	GND	Ground.	---	GND
70	NC	Floating Pin, No connect to anything.	---	---
71	NC	Floating Pin, No connect to anything.	---	---
72	3.3V_72	3.3V power pin	3.3V	Power
73	NC	Floating Pin, No connect to anything.	---	---
74	3.3V_74	3.3V power pin	3.3V	Power
75	GND	Ground.	---	GND

3. Electrical Characteristics

3.1 Absolute Maximum Ratings

Symbol	Parameter	Minimum	Typical	Maximum	Unit
3.3V	DC supply for the 3.3V input	-	3.3	4.0	V
VIO	Host I/O power supply	-	3.3	4.0	V
			1.8	2.2	

3.2 Recommended Operating Conditions

Symbol	Parameter	Minimum	Typical	Maximum	Unit
3.3V	DC supply for the 3.3V input	2.97	3.3	3.63	V
VIO	1.8V/3.3V digital I/O power supply	2.97	3.3	3.63	V
		1.62	1.8	1.98	

3.3 Digital IO Pin DC Characteristics

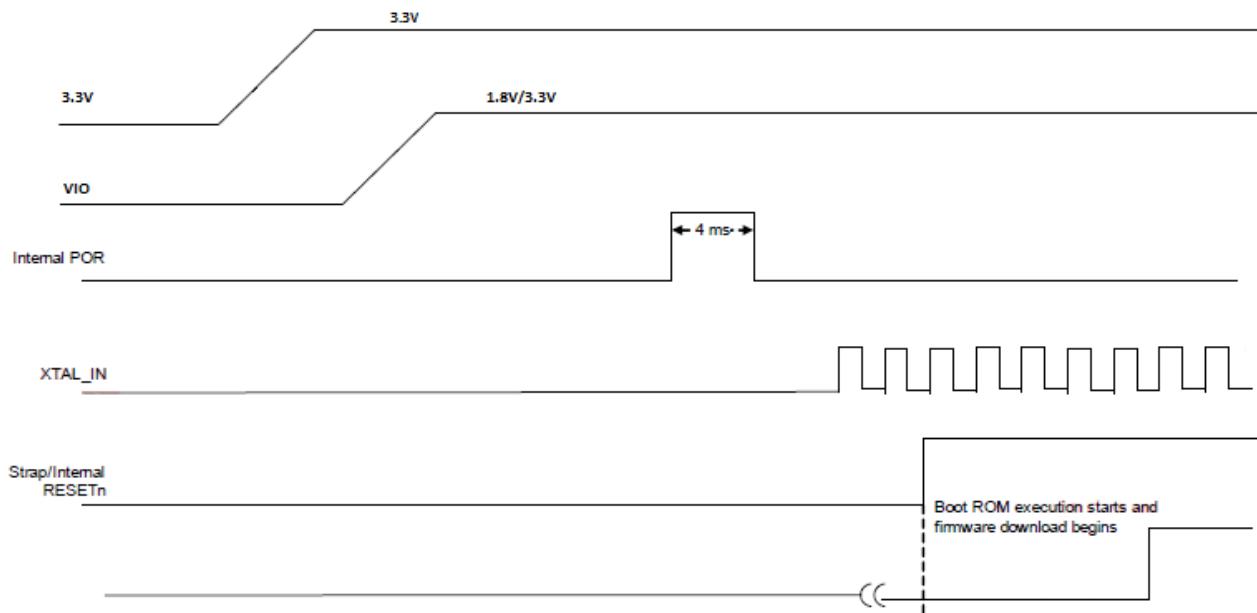
3.3.1 1.8V Operation (VIO)

Symbol	Parameter	Minimum	Typical	Maximum	Unit
V_{IH}	Input high voltage	$0.7*V_{18}$	-	$V_{18}+0.4$	V
V_{IL}	Input low voltage	-0.4	-	$0.3*V_{18}$	
V_{OH}	Output high voltage	$V_{18}-0.4$	-	-	
V_{OL}	Output low voltage	-	-	0.4	

3.3.2 3.3V Operation (VIO)

Symbol	Parameter	Minimum	Typical	Maximum	Unit
V_{IH}	Input high voltage	$0.7*V_{33}$	-	$V_{33}+0.4$	V
V_{IL}	Input low voltage	-0.4	-	$0.3*V_{33}$	V
V_{OH}	Output High Voltage	$V_{33}-0.4$	-	-	V
V_{OL}	Output Low Voltage	-	-	0.4	V

3.4 Power up Timing Sequence



3.5 Sleep Clock

An external crystal is used for generating all radio frequencies and normal operation clocking. As an alternative, an external frequency reference driven by a temperature-compensated crystal oscillator (TCXO) signal may be used. No software settings are required to differentiate between the two. In addition, a low-power oscillator (LPO) is provided for lower power mode timing.

External 32.768KHz Low-Power Oscillator

Symbol	Parameter	Min	Typ	Max	Units
CLK	Clock frequency range/ accuracy ■ CMOS input clock signal type ■ ± 250 ppm (initial, aging, temperature)	-	32.768	-	kHz
V_{IH}^*	Input levels, where $VIO=1.8, 3.3V$	0.7* VIO	-	$VIO+0.4$	V
V_{IL}^*		-0.4	-	0.3* VIO	V
PN	Phase noise requirement (@ 100KHz)	-	-125	-	dBc/Hz
Jc	Cycle jitter	-	1.5	-	ns (RMS)
SR	Slew rate limit (10-90%)	-	-	100	ns
DC	Duty cycle tolerance	20	-	80	%

*For V_{HL}, V_{IL} , see 3.3 Digital IO Pin DC Characteristics

4. Host Interface

4.1 SDIO Interface

The AW-AM281MA supports a SDIO device interface that conforms to the industry SDIO Full-Speed card specification and allows a host controller using the SDIO bus protocol to access the Wireless SoC device.

The AW-AM281MA acts as the device on the SDIO bus. The host unit can access registers of the SDIO interface directly and can access shared memory in the frvice through the use of BARs and a DMA engine.

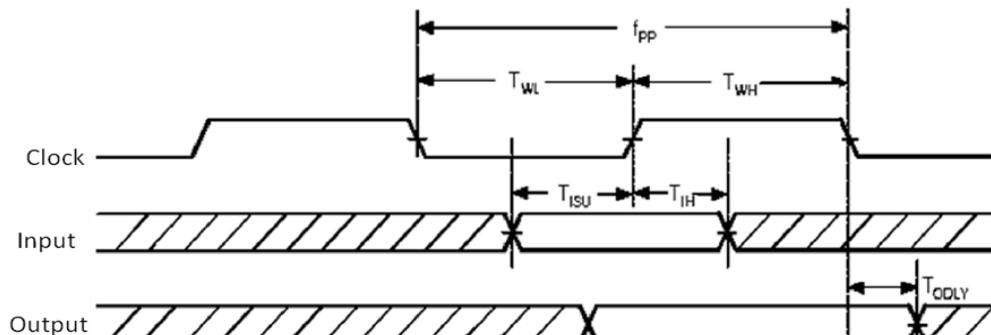
- ◆ Support SDIO 3.0 Standard.
- ◆ On-chip memory used for CIS.
- ◆ Supports 4-bit SDIO and 1-bit SDIO transfer modes.
- ◆ Special interrupt register for information exchange.
- ◆ Allows card to interrupt host.

SDIO Interface Signals

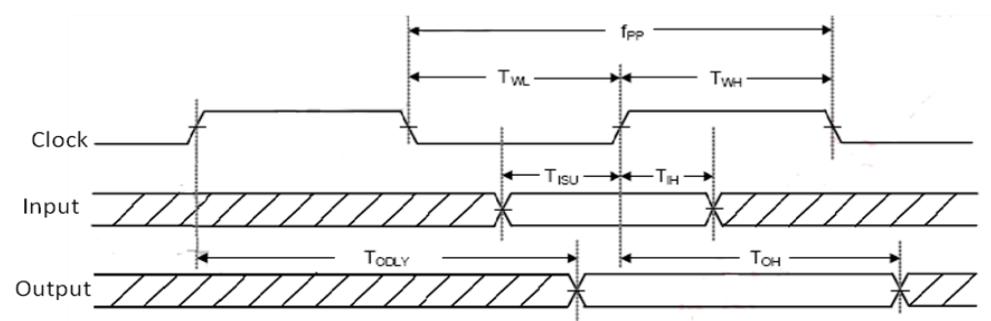
AW-AM281MA SDIO Pin Name	Type	Description
SDIO_DATA_CLK	I	SDIO 4-bit mode: Clock SDIO 1-bit mode: Clock
SDIO_DATA_CMD	I/O	SDIO 4-bit mode: Command line SDIO 1-bit mode: Command line
SDIO_DATA_3	I/O	SDIO 4-bit mode: Data line Bit[3] SDIO 1-bit mode: Not used
SDIO_DATA_2	I/O	SDIO 4-bit mode: Data line Bit[2] or Read Wait (optional) SDIO 1-bit mode: Read Wait (optional)
SDIO_DATA_1	I/O	SDIO 4-bit mode: Data line Bit[1] SDIO 1-bit mode: Interrupt
SDIO_DATA_0	I/O	SDIO 4-bit mode: Data line Bit[0] SDIO 1-bit mode: Data line

4.2 SDIO Protocol Timing

4.2.1 Default Speed, High-Speed Modes (3.3V)



SDIO protocol timing Diagram - Default mode. (3.3V)

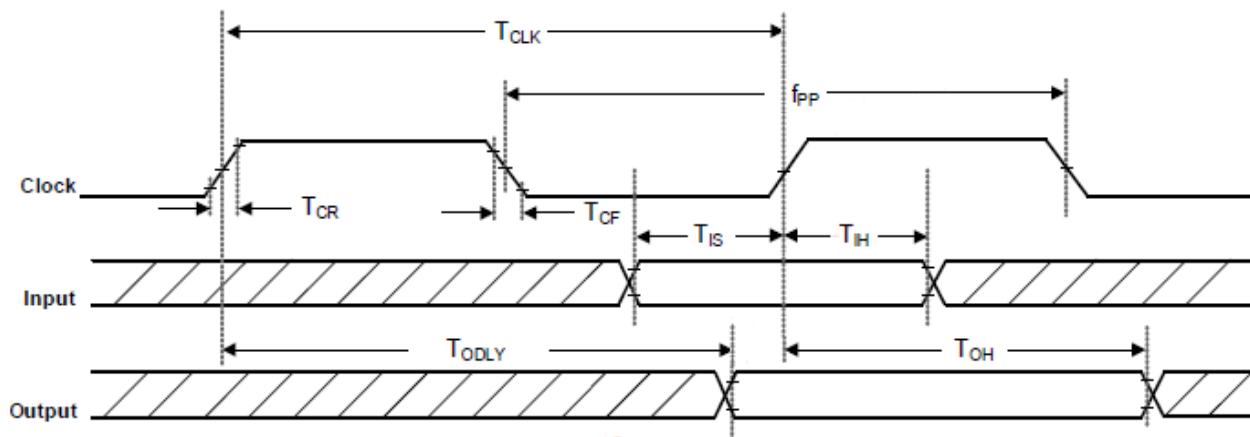


SDIO protocol timing Diagram - High Speed mode. (3.3V)

Symbol	Parameter	Condition	Min	Typ	Max	Units
f _{PP}	CLK Frequency	Normal	0	--	25	MHz
		High Speed	0	--	50	MHz
T _{WH}	CLK High Time	Normal	10	--	--	ns
		High Speed	7	--	--	ns
T _{WL}	CLK Low Time	Normal	10	--	--	ns
		High Speed	7	--	--	ns
T _{ISU}	Input Setup Time	Normal	5	--	--	ns
		High Speed	6	--	--	ns
T _{IH}	Input Hold Time	Normal	5	--	--	ns
		High Speed	2	--	--	ns
T _{ODLY}	Output Delay Time	Normal	--	--	14	ns
	CL ≤ 40pF (1 card)	High Speed	--	--	14	ns
T _{OH}	Output Hold Time	High Speed	2.5	--	--	ns

SDIO Timing Data – Default Speed / High-Speed modes. (3.3V)

4.2.2 SDR12, SDR25, SDR50 Modes (up to 100MHz) (1.8V)

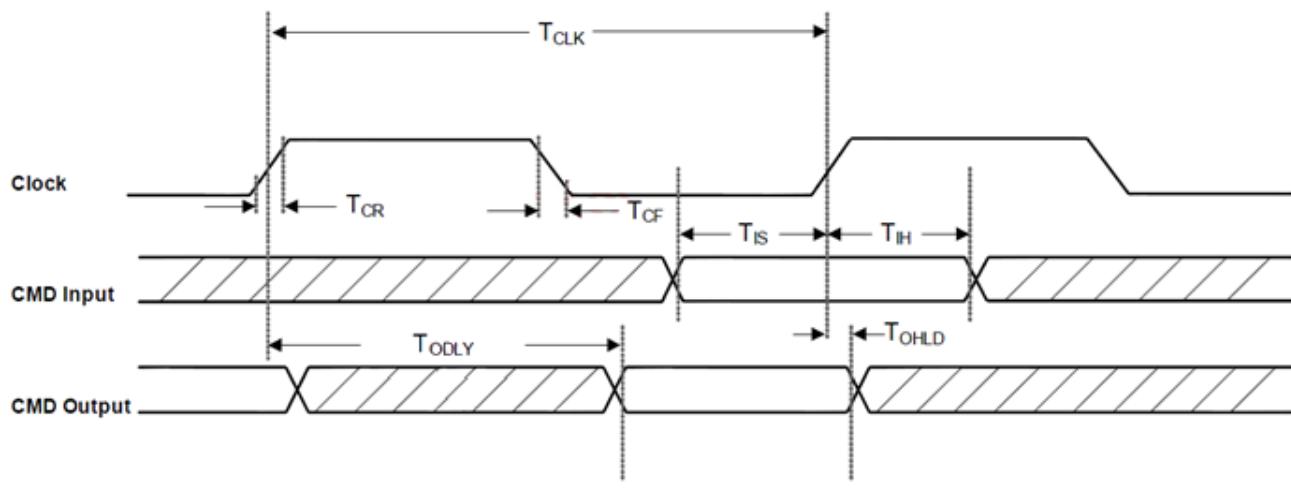


SDIO Protocol Timing Diagram - SDR12, SDR25, SDR50 Modes (up to 100 MHz)(1.8V)

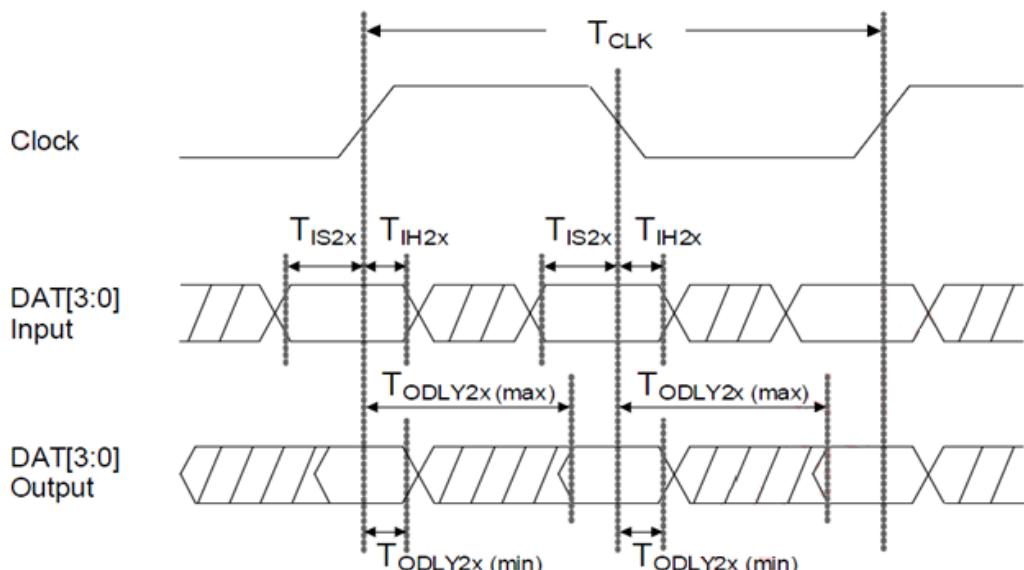
Symbol	Parameter	Condition	Min	Typ	Max	Units
F_{pp}	CLK Frequency	SDR12/25/50	25	-	100	MHz
T_{CLK}	Clock Time	SDR12/25/50	10	-	40	ns
T_{IS}	Input Setup Time	SDR12/25/50	3	-	-	ns
T_{IH}	Input Hold Time	SDR12/25/50	0.8	-	-	ns
T_{CR}, T_{CF}	Rise time, fall time TCR ,TCF <2ns(max) at 100MHz CCARD =10pF	SDR12/25/50	-	-	$0.2*T_{CLK}$	ns
T_{ODLY}	Output Delay Time $CL \leq 30pF$	SDR12/25/50	-	-	7.5	ns
T_{OH}	Output Hold Time $CL =15pF$	SDR12/25/50	1.5	-	-	ns

SDIO Timing Data - SDR12/25/50 modes. (1.8V)

4.2.3 DDR50 Mode (50MHz) (1.8V)



SDIO CMD Timing Diagram - DDR50 Mode (50 MHz)



SDIO DAT[3:0] Timing Diagram - DDR50 Mode¹ (50 MHz)

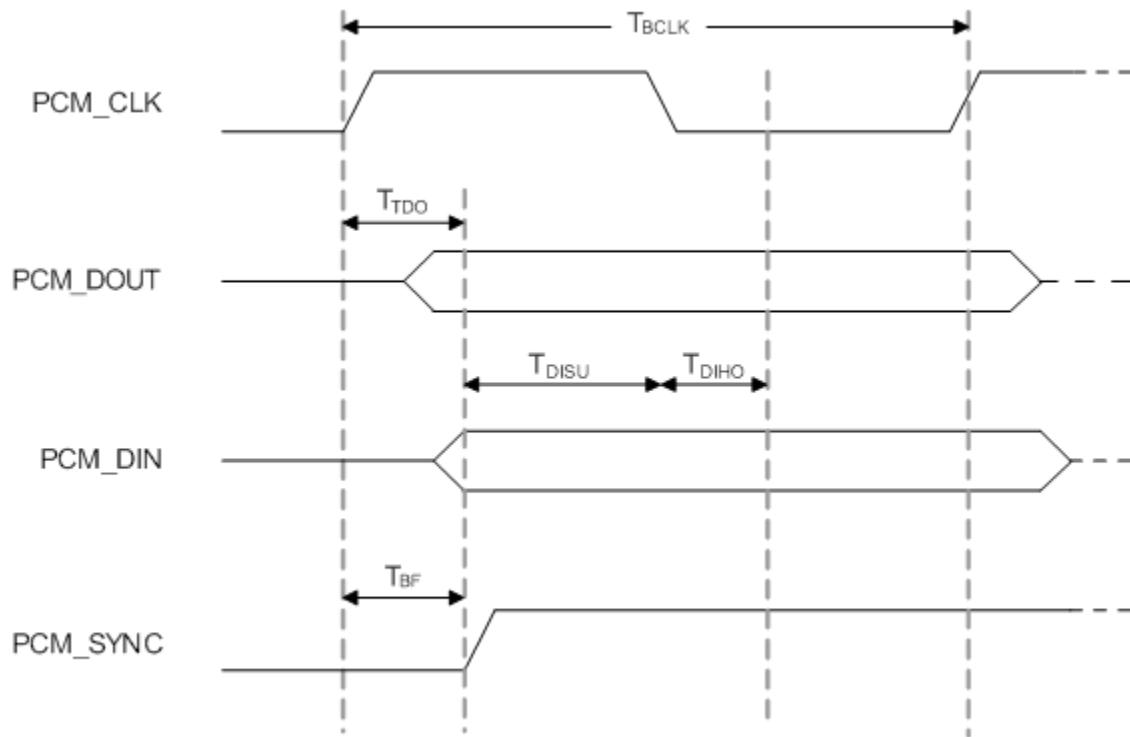
¹ In DDR50 mode, DAT[3:0] lines are sampled on both edges of the clock (not applicable for CMD line).

Symbol	Parameter	Condition	Min	Typ	Max	Units
Clock						
T _{CLK}	Clock time	DDR50	20	-	-	ns
T _{CR} , T _{CF}	Rise time, fall time	DDR50	-	-	0.2*T _{CLK}	Ns
Clock Duty		DDR50	45	-	55	%
CMD Input						
T _{IS}	Input setup time	DDR50	6	-	-	ns
T _{IH}	Input hold time	DDR50	0.8	-	-	ns
CMD Output						
T _{ODLY}	Output delay time during data transfer mode	DDR50	-	-	13.7	ns
T _{OHLD}	Output hold time	DDR50	1.5	-	-	ns
DAT [3:0] Input						
T _{IS2X}	Input hold time	DDR50	3	-	-	ns
T _{IH2X}	Input hold time	DDR50	0.8	-	-	ns
DAT [3:0] Output						
T _{ODLY2X(max)}	Output delay time during data transfer mode	DDR50	-	-	7	ns
T _{ODLY2X(min)}	Output hold time	DDR50	1.5	-	-	ns

SDIO Timing Data - DDR50 Mode (50MHz)

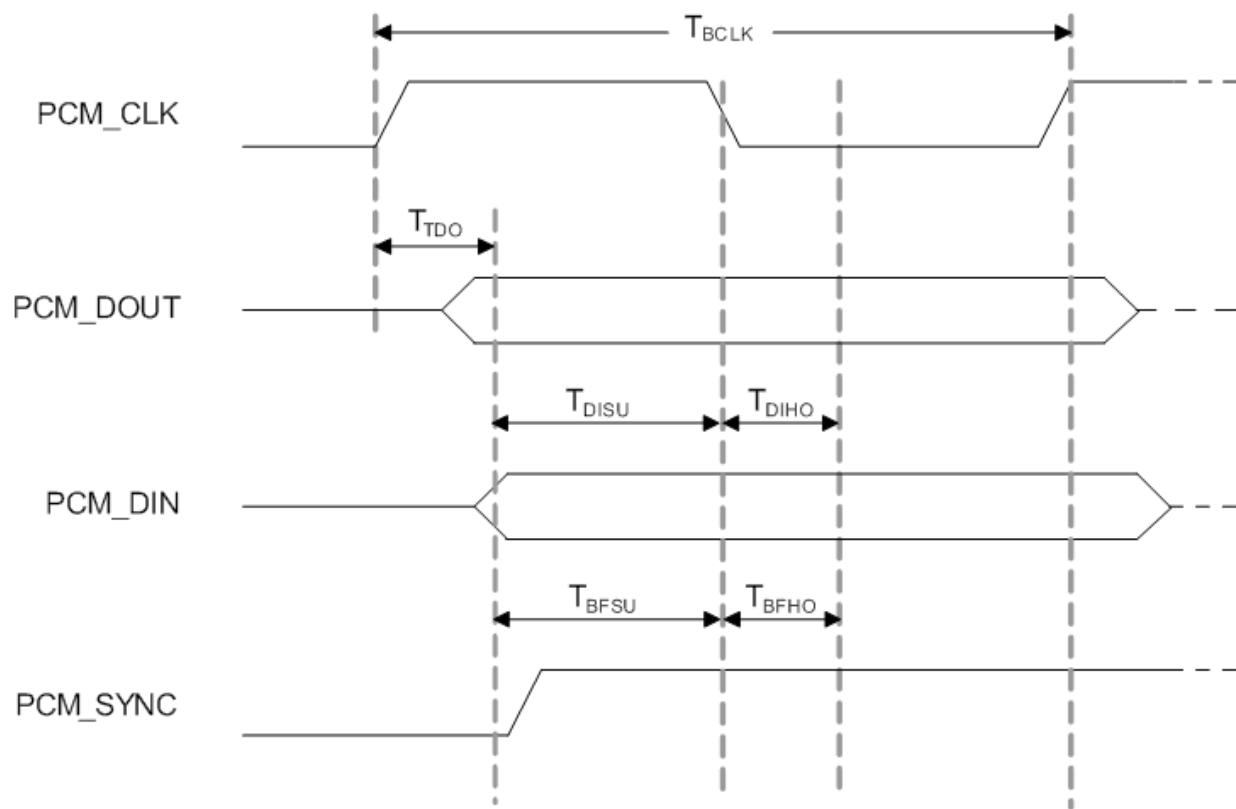
4.3 PCM Interface

4.3.1 PCM Timing Specification – Master Mode



Symbol	Parameter	Condition	Min	Typ	Max	Units
F_{BCLK}	--	--	--	2/2.048	--	MHz
Duty Cycle $BCLK$	--	--	0.4	0.5	0.6	--
T_{BCLK} rise/fall	--	--	--	3	--	ns
T_{DO}	--	--	--	--	15	ns
T_{DISU}	--	--	20	--	--	ns
T_{DIHO}	--	--	15	--	--	ns
T_{BF}	--	--	--	--	15	ns

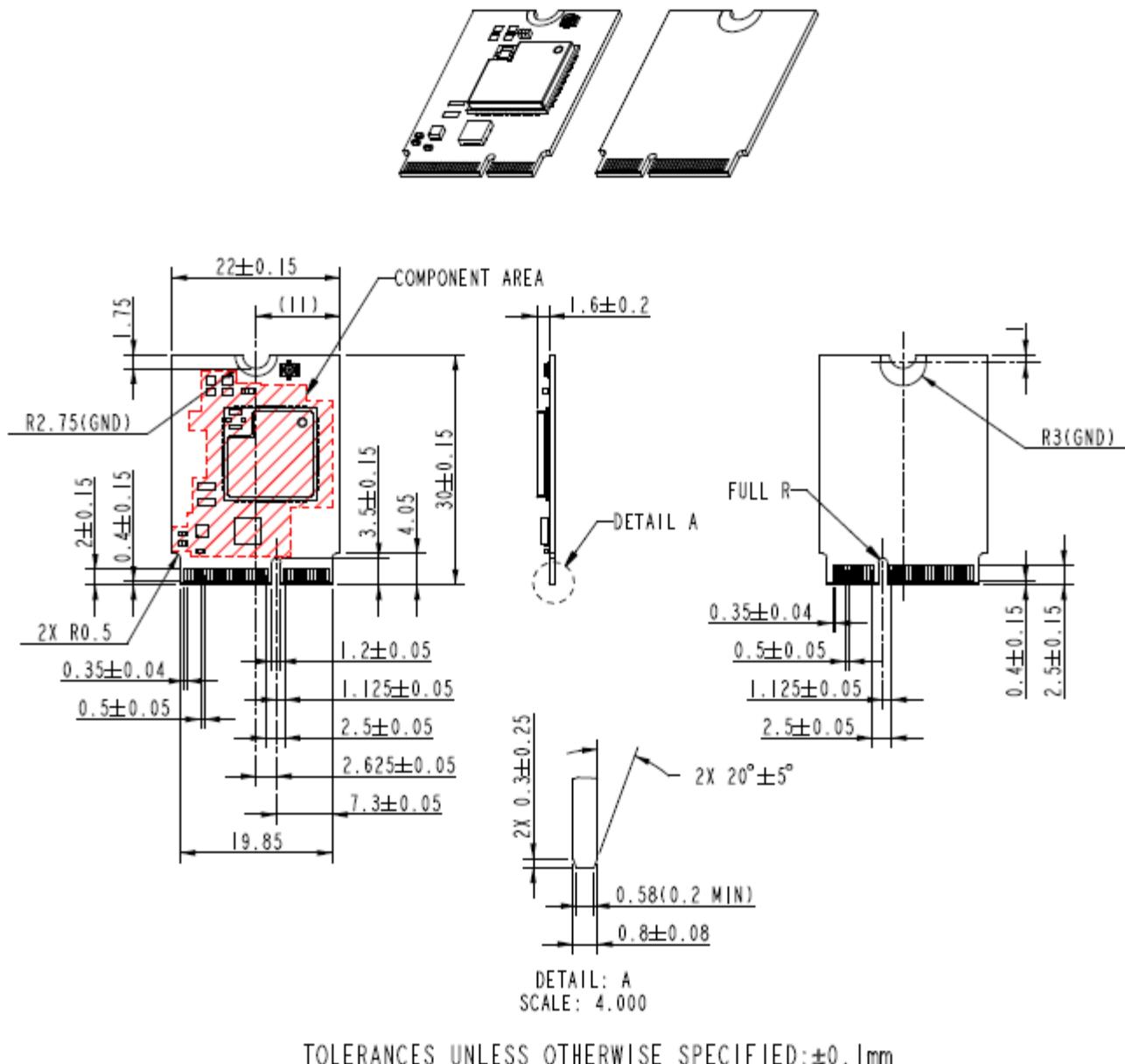
4.3.2 PCM Timing Specification – Slave Mode



Symbol	Parameter	Condition	Min	Typ	Max	Units
F_{BCLK}	--	--	--	2/2.048	--	MHz
Duty Cycle $BCLK$	--	--	0.4	0.5	0.6	--
T_{BCLK} rise/fall	--	--	--	3	--	ns
T_{DO}	--	--	--	--	30	ns
T_{DISU}	--	--	15	--	--	ns
T_{DIHO}	--	--	10	--	--	ns
T_{BFSU}	--	--	15	--	--	ns
T_{BFHO}	--	--	10	--	--	ns

5. Mechanical Information

5.1 Mechanical Drawing



6. Packaging Information

1. 160pcs M.2 2230 modules put in the one bottom tray



2. One cover tray put on bottom tray



3. 5pcs tray (cover + bottom) stacked together



4. Use P.P Strap to pack 5 trays



Remark : 160pcs/Tray , 5 Tray/inner box , 2 inner box/carton. 1,600pcs/carton

5. Put packed trays into inner box



6. Seal the inner box by AzureWave tape



7. One package label pasted in side of inner box



8. Two inner boxes put into one carton;

If only one inner box has modules, "Empty" label pasted on the other one inner box





Example:

空箱
Empty

9. Seal the carton by AzureWave tape



10. One carton label and box label pasted on the carton. If the carton is not full, one balance label pasted on the carton



Example of carton label	<table border="1" data-bbox="726 291 1362 834"><tr><td data-bbox="726 291 1362 390" style="text-align: center;"> AzureWave AzureWave Technologies Inc.</td></tr><tr><td>AzureWave P/N</td><td>By PO Request</td></tr><tr><td>Customer</td><td>由業務提供</td></tr><tr><td>Customer P/N</td><td>由業務提供</td></tr><tr><td>Customer PO</td><td>由業務提供</td></tr><tr><td>Description</td><td>AW-AM281MA</td></tr><tr><td>Q'ty</td><td>1600 pcs</td></tr><tr><td>C/N</td><td></td></tr><tr><td>N.W.</td><td>G.W.</td></tr></table> <p data-bbox="726 792 1036 865">RoHS </p> <p data-bbox="1134 834 1281 865">Made in China</p>	 AzureWave AzureWave Technologies Inc.	AzureWave P/N	By PO Request	Customer	由業務提供	Customer P/N	由業務提供	Customer PO	由業務提供	Description	AW-AM281MA	Q'ty	1600 pcs	C/N		N.W.	G.W.
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