AzureWave Technologies, Inc.

AW-AM457-D

IEEE 802.11 1X1 a/b/g/n Wireless LAN + Bluetooth 5.1 Combo LGA Module

Datasheet

Rev. C

DF

For Standard

Features

WLAN

- Support 802.11 a/b/g/n
- Dual bands: 2.4 GHz and 5 GHz
- Single stream 802.11n with 20 MHz and 40 MHz channels
- Up to MCS7 data rates (150 Mbps)
- Support 802.11mc for location
- Dynamic Rapid Channel Switching (DRCS) for simultaneous and power efficient operation in 2.4 GHz and 5 GHz bands
- Interface to coexist with 802.15.4, LTE, or other radios.
- Security: WPA3 and WPA.

Bluetooth

- Full Bluetooth 5.1 features
- Long range - 4x coverage
- 2 Mbps data rate - 2x faster
- Connection/connectionless AoA
- Connection/connectionless AoD
- Improved advertisement capacity- enables more IoT services
- Audio interface: I2S and PCM
- Security: AES

AzureWave Technologies, Inc.

Revision History

Document NO: R2-2457-DST-01

Version	Revision Date	DCN NO.	Description	Initials	Approved
A	2020/01/21	DCN016710	• Draft version	Renton Tao	N.C Chen
B	2020/12/10	DCN018928	• Modify model name • Add specification table and operating temperature • Add ESD information • Modify pin table(Pin 19) • Add power sequence • Add Power Consumption • Modify operating conditions	Roger Liu	N.C Chen
C	2021/02/18	DCN020661	• Modify datasheet form • Modify Host Interface • Modify Bluetooth specification • Update box label information	Roger Liu	N.C Chen

AzureWave Technologies, Inc.

Table of Contents

1. Introduction

1.1 Product Overview

AzureWave Technologies, Inc. introduces the IEEE 802.11a/b/g/n WLAN, BT, combo module – **AW-AM457-D.** With four advanced radio technologies integrated into a module, AW-AM457-D 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-AM457-D, the customers can easily integrate the Wi-Fi, BT, by a combo module with the benefits of **high design flexibility, high success rate on SMT process, short development cycle, and quick time-to-market.**

Compliance with the IEEE 802.11a/b/g/n standard, the AW-AM457-D 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-AM457-D.

The AW-AM457-D supports standard interface **SDIO3.0 for WLAN, UART for BT**. AW-AM457-D is suitable for multiple mobile processors for different applications. With the combo functions and the good performance, the AW-AM457-D is the best solution for the consumer electronics and the tablet PC.

1.2 Block Diagram

confidentiality

1.3 Specifications Table

1.3.1 General

Features	Description
Product Description	IEEE 802.11 a/b/g/n Wi-Fi with Bluetooth 5.1 Combo Module
Major Chipset	NXP IW416 (68-pin HVQFN)
Host Interface	WiFi + BT ● SDIO + UART
Dimension	15 mm X 15 mm x 2.5 mm(Max)
Form factor	LGA module, 76 pins
Antenna	For LGA, “1T1R, external ANT1：WiFi → TX/RX ANT2：Bluetooth → TX/RX
Weight	0.5 g

1.3.2 WLAN

Features	Description
WLAN Standard	IEEE 802.11 a/b/g/n 1T1R
WLAN VID/PID	NA
WLAN SVID/SPID	NA
Frequency Rage	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, 136,140,149,153,157,161,165

<table>
<tr><td></td><td>■ Japan - 36,40,44,48,52,56,60,64,100,104,108,112,116,120,124,128,132,136,140
China - 36,40,44,48,52,56,60,64, 149,153,157,161,165</td></tr>
<tr><td>Output Power
(Board Level Limit)*</td><td>2.4G
<table><tr><th></th><th>Min</th><th>Typ</th><th>Max</th><th>Unit</th></tr><tr><td>11b (11Mbps) @EVM<35%</td><td>15.5</td><td>17</td><td>18.5</td><td>dBm</td></tr><tr><td>11g (54Mbps) @EVM≦-30 dB</td><td>14.5</td><td>16</td><td>17.5</td><td>dBm</td></tr><tr><td>11n (HT20 MCS7) @EVM≦-30 dB</td><td>12.5</td><td>14</td><td>15.5</td><td>dBm</td></tr><tr><td>11n (HT40 MCS7) @EVM≦-30dB</td><td>12.5</td><td>14</td><td>15.5</td><td>dBm</td></tr></table>5G<table><tr><th></th><th>Min</th><th>Typ</th><th>Max</th><th>Unit</th></tr><tr><td>11a (54Mbps) @EVM≦-27 dB</td><td>14</td><td>16</td><td>18</td><td>dBm</td></tr><tr><td>11n (HT20 MCS7) @EVM≦-28 dB</td><td>13</td><td>15</td><td>17</td><td>dBm</td></tr><tr><td>11n (HT40 MCS7) @EVM≦-28 dB</td><td>12</td><td>14</td><td>16</td><td>dBm</td></tr></table></td></tr>
<tr><td>Receiver Sensitivity</td><td>2.4G
<table><tr><th></th><th>Min</th><th>Typ</th><th>Max</th><th>Unit</th></tr><tr><td>11b (11Mbps)</td><td>-</td><td>-86</td><td>-83</td><td>dBm</td></tr><tr><td>11g (54Mbps)</td><td>-</td><td>-73</td><td>-70</td><td>dBm</td></tr><tr><td>11n (HT20 MCS7)</td><td>-</td><td>-69</td><td>-66</td><td>dBm</td></tr><tr><td>11n (HT40 MCS7)</td><td>-</td><td>-69</td><td>-66</td><td>dBm</td></tr></table>5G<table><tr><th></th><th>Min</th><th>Typ</th><th>Max</th><th>Unit</th></tr><tr><td>11a (54Mbps)</td><td>-</td><td>-71</td><td>-68</td><td>dBm</td></tr><tr><td>11n (HT20 MCS7)</td><td>-</td><td>-68</td><td>-65</td><td>dBm</td></tr><tr><td>11n (HT40 MCS7)</td><td>-</td><td>-66</td><td>-63</td><td>dBm</td></tr></table></td></tr>
<tr><td>Data Rate</td><td>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)</td></tr>
<tr><td>Security</td><td>■ WiFi: WPA/WPA3
■ BT: AES</td></tr>
</table>

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

1.3.3 Bluetooth

<table>
<tr><th>Features</th><th>Description</th></tr>
<tr><td>Bluetooth Standard</td><td>Full Bluetooth 5.1 features</td></tr>
<tr><td>Bluetooth VID/PID</td><td>NA</td></tr>
<tr><td>Frequency Rage</td><td>2402MHz~2483MHz</td></tr>
<tr><td>Modulation</td><td>Header GFSK
Payload 2M: π/4-DQPSK
Payload 3M: 8DPSK</td></tr>
<tr><td>Output Power</td><td>
<table>
<tr><td></td><td>Min</td><td>Typ</td><td>Max</td><td>Unit</td></tr>
<tr><td>BDR</td><td>0</td><td>2</td><td>4</td><td>dBm</td></tr>
<tr><td>EDR</td><td>0</td><td>2</td><td>4</td><td>dBm</td></tr>
<tr><td>Low Energy</td><td>0</td><td>2</td><td>4</td><td>dBm</td></tr>
</table>
</td></tr>
<tr><td>Receiver Sensitivity</td><td>
<table>
<tr><td></td><td>Min</td><td>Typ</td><td>Max</td><td>Unit</td></tr>
<tr><td>BDR(DH1)</td><td>-</td><td>-83</td><td>-80</td><td>dBm</td></tr>
<tr><td>EDR(2DH5)</td><td>-</td><td>-88</td><td>-85</td><td>dBm</td></tr>
<tr><td>EDR(3DH5)</td><td>-</td><td>-83</td><td>-80</td><td>dBm</td></tr>
<tr><td>Low Energy</td><td>-</td><td>-96</td><td>TBD</td><td>dBm</td></tr>
</table>
BT Sensitivity (BER<0.1%)
</td></tr>
</table>

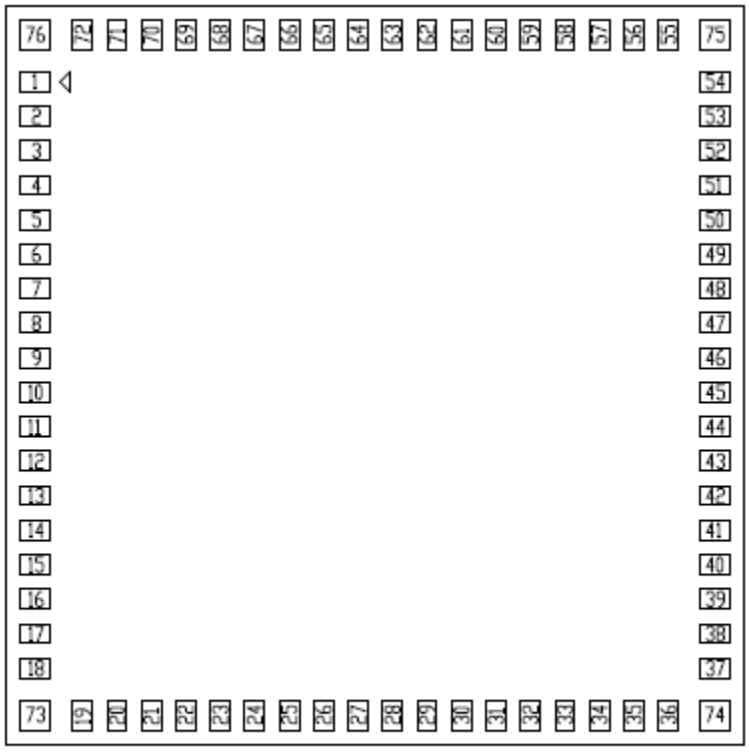
1.3.4 Operating Conditions

Features	Description
Operating Conditions	
Voltage	3.3V +-5%
Operating Temperature	0 °C to +70 °C
Operating Humidity	less than 85% R.H.
Storage Temperature	-40 °C to +125 °C
Storage Humidity	less than 60% R.H.
ESD Protection	
Human Body Model	+-2kV
Changed Device Model	+-500V

2. Pin Definition

2.1 Pin Map

AW-AM457-D pin out drawing (top view).



PIN DEFINED (TOP VIEW)

2.2 Pin Table

Pin No	Definition	Basic Description	Voltage	Type
1	NC	NC	---	Floating
2	NC	NC	---	Floating
3	WCI_SOUT	WCI interface serial output pin, for coexistence with LTE, 802.15.4 radio, or other external radios	1.8V	O
4	WCI_SIN	WCI interface serial input pin, for coexistence with LTE, 802.15.4 radio, or other external radios	1.8V	I
5	NC	NC	---	Floating
6	GND	Ground	---	---
7	SLP_CLK_IN	External Low Power Clock input (32.768KHz)	VDDIO	I
8	GND	Ground	---	---
9	GPIO[1]	GPIO Mode : GPIO[1].	VDDIO	I/O
10	GPIO[4]	GPIO Mode : GPIO[4].	VDDIO	I/O
11	GPIO[5]	GPIO Mode : GPIO[5].	VDDIO	I/O
12	GPIO[6]	GPIO Mode : GPIO[6].	VDDIO	I/O
13	GPIO[7]	GPIO Mode : GPIO[7].	VDDIO	I/O
14	GND	Ground	---	---
15	3V3	3.3V power voltage source input	3.3V	P
16	3V3	3.3V power voltage source input	3.3V	P
17	GND	Ground	---	---
18	Reserved	Reserved(Do not connect to anything)	---	Floating
19	NC	NC	---	Floating
20	NC	NC	---	Floating
21	1V8_IN	AVDD18 input	1.8V	P
22	VIO	1.8V/3.3V Digital I/O Power Supply	1.8V/3.3V	P
23	GND	Ground	---	---
24	GND	Ground	---	---
25	NC	NC	---	Floating
26	NC	NC	---	Floating
27	NC	NC	---	Floating
28	NC	NC	---	Floating
29	PDn	Full Power-down input pin (active low) 0 = full power-down mode 1 = normal mode	1.8V	I
30	SDIO_DATA_CMD	SDIO Command	VIO_SD	I/O
31	GND	Ground	---	---
32	SDIO_DATA_CLK	SDIO Clock input	VIO_SD	I
33	SDIO_DATA_0	SDIO Data line Bit[0]	VIO_SD	I/O
34	SDIO_DATA_1	SDIO Data line Bit[1]	VIO_SD	I/O
35	SDIO_DATA_2	SDIO Data line Bit[2]	VIO_SD	I/O
36	SDIO_DATA_3	SDIO Data line Bit[3]	VIO_SD	I/O
37	VIO_SD	1.8V/3.3V SDIO Power Supply	1.8V/3.3V	P
38	GND	Ground	---	---
39	USB_D+	USB 2.0 Serial Differential Data—Positive.	3.3V	I/O

40	USB_D-	USB 2.0 Serial Differential Data—Negative	3.3V	I/O
41	GND	Ground	---	---
42	UART_RX	UART SIN pin	VDDIO	I
43	UART_TX	UART SOUT.pin	VDDIO	O
44	UART_RTSn	UART Mode: UART_RTSn (output) (active low)	VDDIO	O
45	UART_CTSn	UART Mode: UART_CTSn input pin (active low)	VDDIO	I
46	GPIO[3]	GPIO Mode : GPIO[3].	VDDIO	I/O
47	GPIO[2]	GPIO Mode : GPIO[2].	VDDIO	I/O
48	GPIO[14]	GPIO Mode : GPIO[14].	VDDIO	I/O
49	GPIO[15]	GPIO Mode : GPIO[15].	VDDIO	I/O
50	GPIO[12]	GPIO Mode : GPIO[12].	VDDIO	I/O
51	GPIO[0]	GPIO Mode : GPIO[0].	VDDIO	I/O
52	GPIO[13]	GPIO Mode : GPIO[13].	VDDIO	I/O
53	CON[0]	Firmware Boot Options for Host interface. See below table*	VIO	I
54	CON[1]	Firmware Boot Options for Host interface. See below table*	VIO	I
55	GND	Ground	---	---
56	BT_ANT	BT RF pin	---	I/O
57	GND	Ground	---	---
58	GND	Ground	---	---
59	GND	Ground	---	---
60	GND	Ground	---	---
61	GND	Ground	---	---
62	GND	Ground	---	---
63	GND	Ground	---	---
64	GND	Ground	---	---
65	GND	Ground	---	---
66	GND	Ground	---	---
67	GND	Ground	---	---
68	GND	Ground	---	---
69	GND	Ground	---	---
70	GND	Ground	---	---
71	WL_ANT	WLAN RF pin	---	I/O
72	GND	Ground	---	---
73	GND	Ground	---	---
74	GND	Ground	---	---
75	GND	Ground	---	---
76	GND	Ground	---	---

*Firmware Boot options for Host Interface

Strap Value [1:0]	WLAN	Bluetooth/LE	Firmware Download	Firmware Download Mode	Number of SDIO Functions

00	USB2	USB2	USB2	Combined	-
01	USB2	USB2	USB2	Combined	-
10	SDIO	UART	SDIO+UART	Parallel	1(WLAN)
11	SDIO	SDIO	SDIO+SDIO	Parallel	2(WLAN, Bluetooth)

3. Electrical Characteristics

3.1 Absolute Maximum Ratings

Symbol	Parameter	Minimum	Typical	Maximum	Unit
3V3	DC supply for the 3.3V input	-	3.3	3.96	V
VIO	I/O power supply	-	3.3	4.0	V
		-	1.8	2.2	
VIO_SD	SDIO 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	3.14	3.3	3.46	V
VIO	1.8V/3.3V digital I/O power supply	2.97	3.3	3.47	V
		1.62	1.8	1.98	
VIO_SD	1.8V/3.3V SDIO power supply	2.97	3.3	3.47	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*VIO	-	VIO+0.4	V
V_{IL}	Input low voltage	-0.4	-	0.3*VIO	
V_{OH}	Output high voltage	VIO-0.4	-	-	
V_{OL}	Output low voltage	-	-	0.4	
V_{HYS}	Input Hysteresis	100			mV

3.3.2 3.3V Operation (VIO)

Symbol	Parameter	Minimum	Typical	Maximum	Unit
V_{IH}	Input high voltage	0.7*VIO	-	VIO+0.4	V
V_{IL}	Input low voltage	-0.4	-	0.3*VIO	
V_{OH}	Output High Voltage	VIO-0.4	-	-	
V_{OL}	Output Low Voltage	-	-	0.4	
V_{HYS}	Input Hysteresis	100			mV

3.3.3 1.8V Operation (VIO_SD)

Symbol	Parameter	Minimum	Typical	Maximum	Unit
V_{IH}	Input high voltage	0.7*VIO_SD	-	VIO_SD+0.4	V
V_{IL}	Input low voltage	-0.4	-	0.3*VIO_SD	
V_{OH}	Output High Voltage	VIO_SD-0.4	-	-	
V_{OL}	Output Low Voltage	-	-	0.4	
V_{HYS}	Input Hysteresis	100			mV

3.3.4 3.3V Operation (VIO_SD)

Symbol	Parameter	Minimum	Typical	Maximum	Unit
V_{IH}	Input high voltage	0.7*VIO_SD	-	VIO_SD+0.4	V
V_{IL}	Input low voltage	-0.4	-	0.3* VIO_SD	
V_{OH}	Output High Voltage	VIO_SD-0.4	-	-	
V_{OL}	Output Low Voltage	-	-	0.4	
V_{HYS}	Input Hysteresis	100			mV

3.4 Host Interface

3.4.1 SDIO Interface

The AW-AM457-D 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-AM457-D 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.

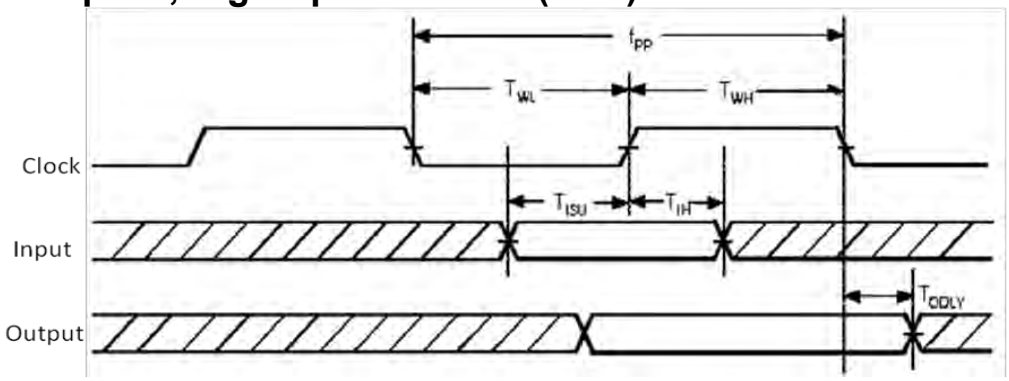
- Support SDIO 3.0 Standard.
- On-chip memory used for CIS.
- Supports 4-bit SDIO and 1-bit SDIO transfer modes.
- Special interrupt register for information exchange.
- Allows card to interrupt host.

SDIO Interface Signals

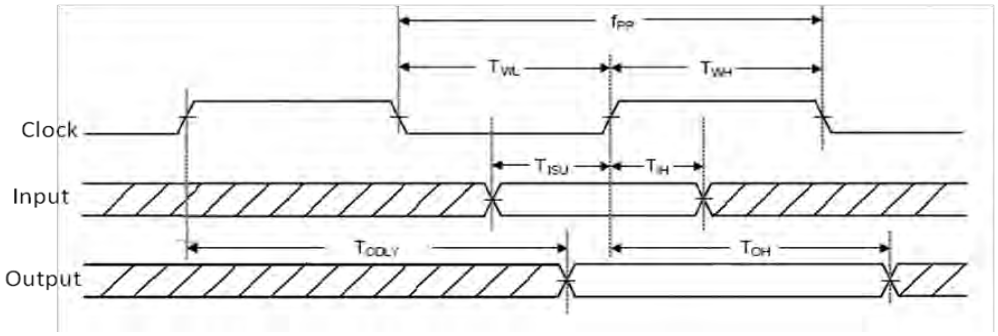
AW-AM457-D SDIO Pin Name	Type	Description
SDIO_DATA_CLK	I	SDIO 4-bit mode: Clock SDIO 1-bit mode: Clock
SDIO_DATA_CMD	I/O	SDIO 4-bit mode: Command line SDIO 1-bit mode: Command line
SDIO_DATA_3	I/O	SDIO 4-bit mode: Data line Bit[3] SDIO 1-bit mode: Not used
SDIO_DATA_2	I/O	SDIO 4-bit mode: Data line 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

3.4.2 SDIO Protocol Timing

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



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

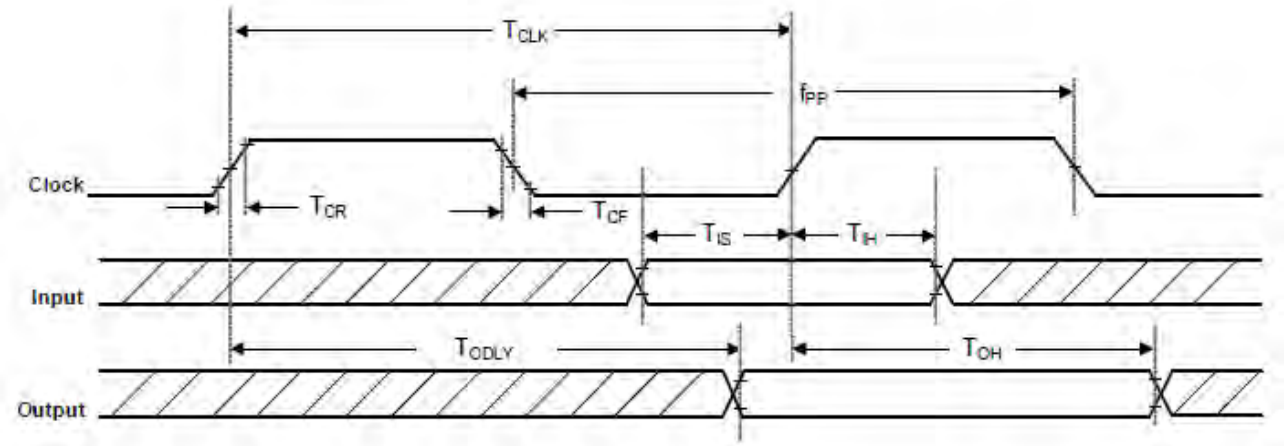


SDIO protocol timing Diagram - High Speed mode. (3.3V)

Symbol	Parameter	Condition	Min	Typ	Max	Units
fpp	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)

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

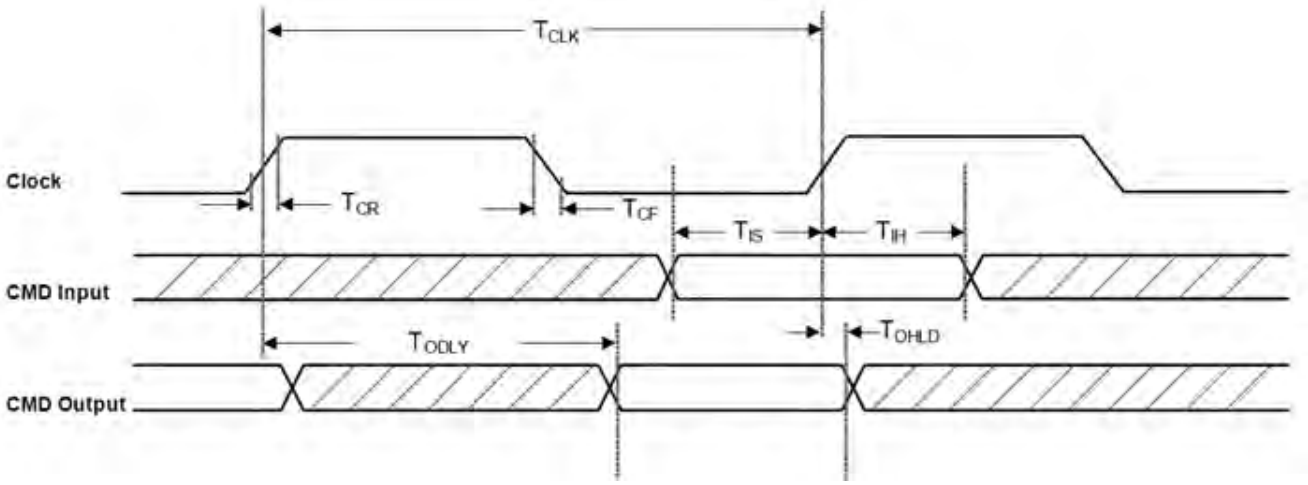


SDIO Protocol Timing Diagram - SDR12, SDR25, SDR50 Modes (up to 100 MHz)(1.8V)

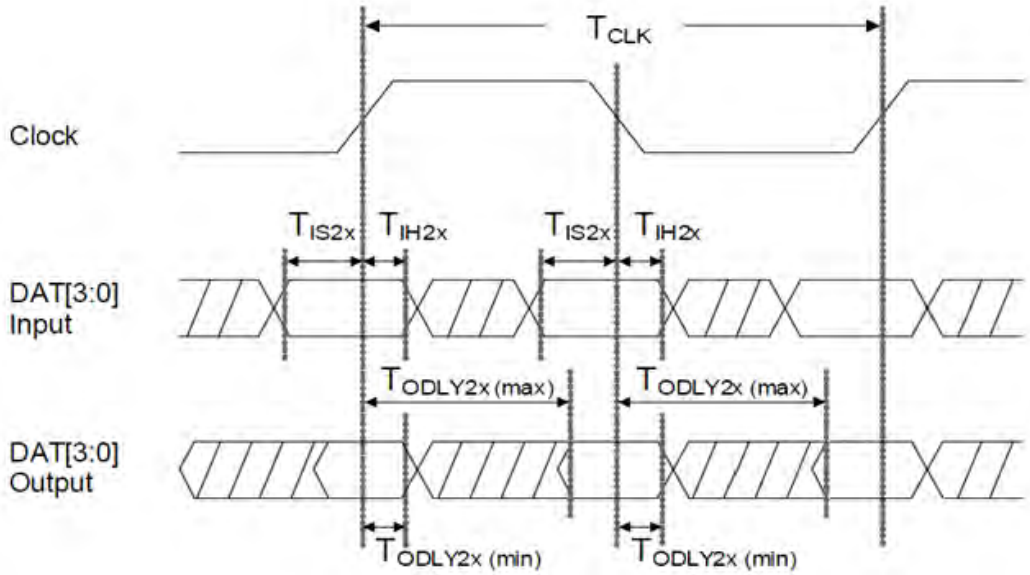
Symbol	Parameter	Condition	Min	Typ	Max	Units
F_{pp}	CLK Frequency	SDR12/25/50	25	-	100	MHz
T_{CLK}	Clock Time	SDR12/25/50	10	-	40	ns
T_{IS}	Input Setup Time	SDR12/25/50	3	-	-	ns
T_{IH}	Input Hold Time	SDR12/25/50	0.8	-	-	ns
T_{CR} ,T_{CF}	Rise time, fail time TCR ,TCF <2ns(max) at 100MHz CCARD =10pF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

3.4.2.3 DDR50 Mode (50MHz) (1.8V)



SDIO CMD Timing Diagram - DDR50 Mode (50 MHz)



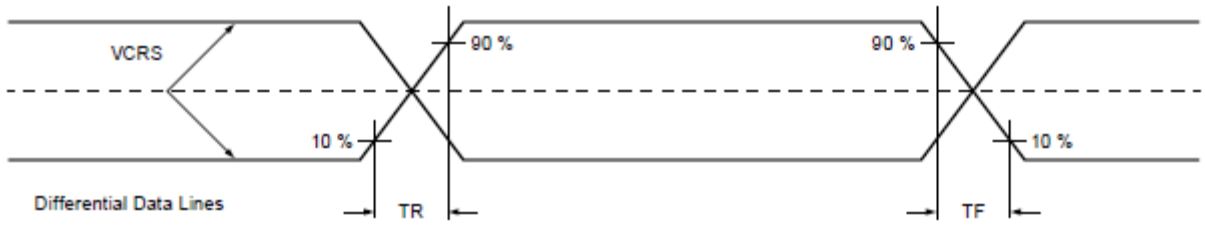
SDIO DAT[3:0] Timing Diagram - DDR50 Mode[1] (50 MHz)

[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 setup 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)

3.4.3 USB Interface



3.4.3.1 USB LS Driver and Receiver Parameters

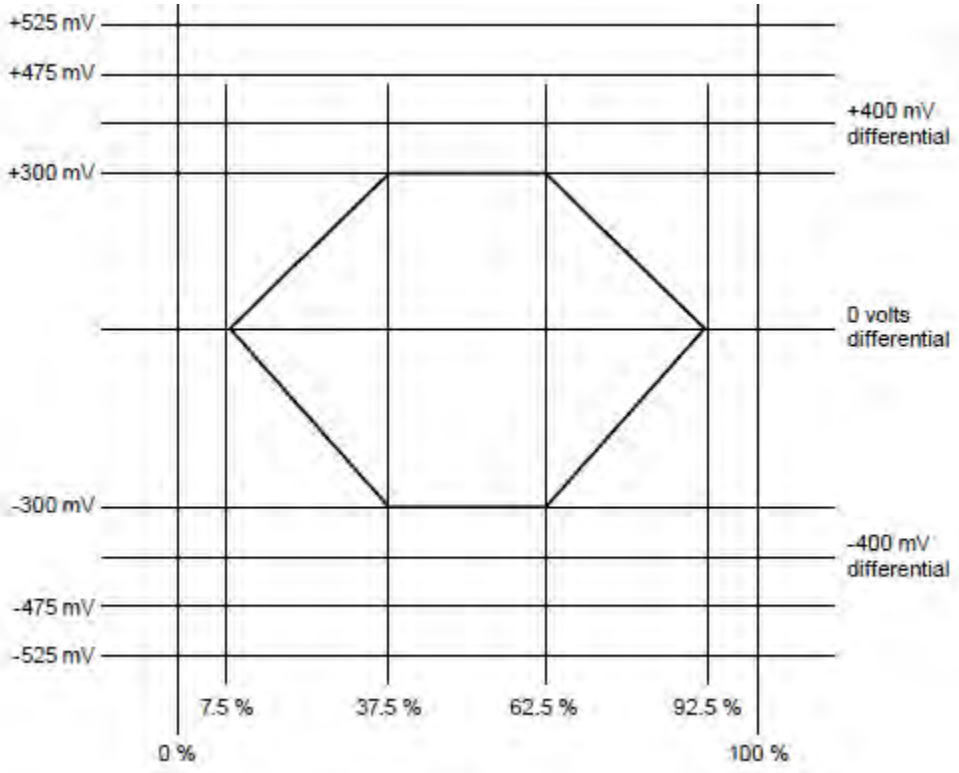
Symbol	Parameter	Min	Typ	Max	Units
BR	Baud rate	-	1.5	-	Mbps
BR_{ppm}	Baud rate tolerance	-15000	-	15000	ppm
Driver specifications					
V_{OH}	Output single ended high Defined with 1.425 kΩ pull-up resistor to 3.6V.	2.8	-	3.6	V
V_{OL}	Output single ended low Defined with 1.425 kΩ pull-down resistor to ground.	0	-	0.3	V
V_{CRS}	Output single crossover voltage	1.3	-	2.0	V
T_{LR}	Data rise time • Defined from 10% to 90% for rise time and 90% to 10% for fall time.	75	-	300	ns
T_{LF}	Data fall time • Defined from 10% to 90% for rise time and 90% to 10% for fall time.	75	-	300	ns
T_{LRFM}	Rise and fall time matching	80	-	125	%
T_{UDJ1}	Source jitter total: to next transition • Including frequency tolerance. Timing difference between the differential data signals. • Defined at crossover point of differential data signals.	-95	-	95	ns
T_{UDJ2}	Source jitter total: for paired transitions • Including frequency tolerance. Timing difference between the differential data signals. • Defined at crossover point of differential data signals.	-150	-	150	ns
Receiver specifications					
V_{IH}	Input single ended high	2.0	-	-	V
V_{IL}	Input single ended low	-	-	0.8	V
V_{DI}	Differential input sensitivity	0.2	-	-	V

3.4.3.2 USB FS Driver and Receiver Parameters

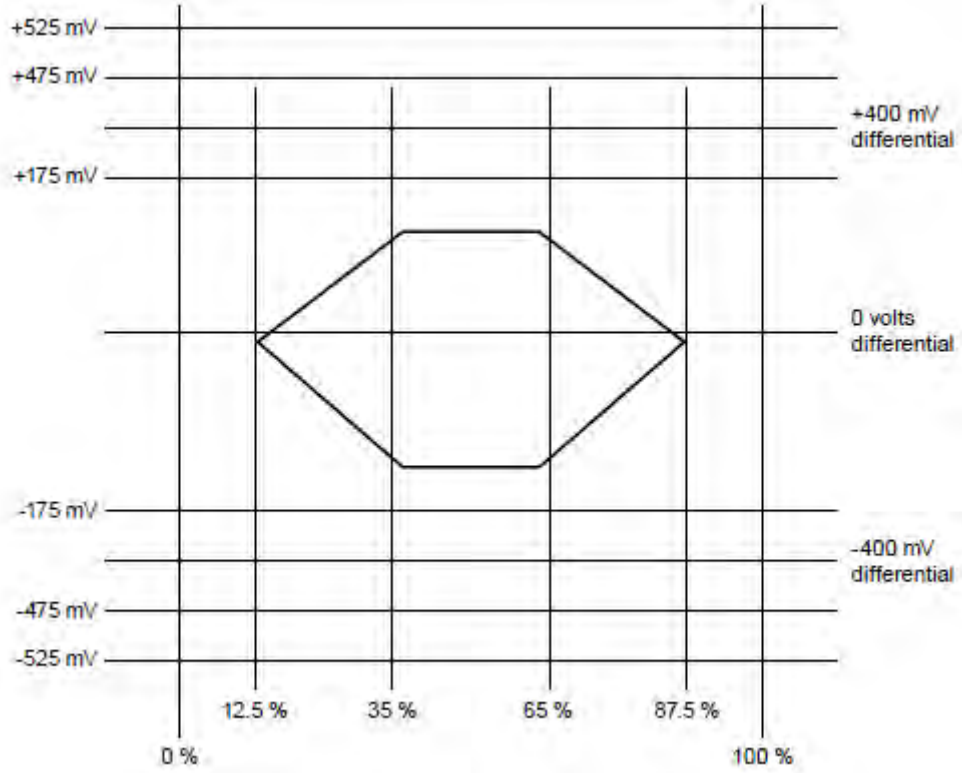
Symbol	Parameter	Min	Typ	Max	Units
BR	Baud rate	-	12	-	Mbps
BR_{ppm}	Baud rate tolerance	-2500	-	2500	ppm
Driver specifications					
V_{OH}	Output single ended high Defined with 1.425 kΩ pull-up resistor to 3.6V.	2.8	-	3.6	V
V_{OL}	Output single ended low Defined with 1.425 kΩ pull-down resistor to ground.	0	-	0.3	V
V_{CRS}	Output single crossover voltage	1.3	-	2.0	V
T_{FF}	Data fall time • Defined from 10% to 90% for rise time and 90% to 10% for fall time.	-4	-	20	ns
T_{FR}	Data rise time • Defined from 10% to 90% for rise time and 90% to 10% for fall time.	-4	-	20	ns
T_{DJ1}	Source jitter total: to next transition • Including frequency tolerance. Timing difference between the differential data signals. • Defined at crossover point of differential data signals.	-3.5	-	3.5	ns
T_{DJ2}	Source jitter total: for paired transitions • Including frequency tolerance. Timing difference between the differential data signals. • Defined at crossover point of differential data signals.	-4	-	4	ns
T_{FDEOP}	Source jitter for differential transition to SE0 transition Defined at crossover point of differential data signals.	-2		5	ns
Receiver specifications					
V_{IH}	Input single ended high	2.0	-	-	V
V_{IL}	Input single ended low	-	-	0.8	V
V_{DI}	Differential input sensitivity	0.2	-	-	V
T_{JR1}	Receiver jitter: to next transition Defined at crossover point of differential data signals.	-18.5	-	18.5	ns
T_{JR2}	Receiver jitter: for paired transitions Defined at crossover point of differential data signals.	-9	-	9	ns

3.4.3.3 USB HS Driver and Receiver Parameters

Symbol	Parameter	Min	Typ	Max	Units
BR	Baud rate	-	480	-	Mbps
BR_{ppm}	Baud rate tolerance	-500	-	500	ppm
Driver specifications					
V_{HSOH}	Data signaling high	360	-	440	mV
V_{HSOL}	Data signaling low	-10	-	10	mV
T_{HSR}	Data rise time • Defined from 10% to 90% for rise time and 90% to 10% for fall time.	500	-	-	ns
T_{HSF}	Data fall time • Defined from 10% to 90% for rise time and 90% to 10% for fall time.	-500	-	-	ns
--	Source jitter See below figure	-	-	-	-
Receiver specifications					
--	Differential input signaling levels See below figure	-	-	-	-
V_{HSCM}	Input single ended low	-50	-	500	mV
--	Receiver jitter tolerance See below figure	-	-	-	-



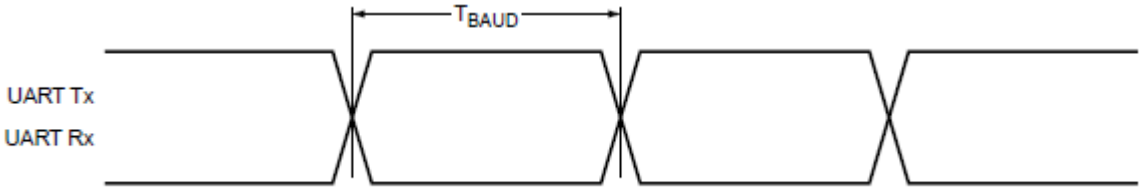
USB HS Tx Eye Diagram Pattern Template Diagram



USB HS Rx Eye Diagram Pattern Template Diagram

3.4.4.High-Speed UART Interface

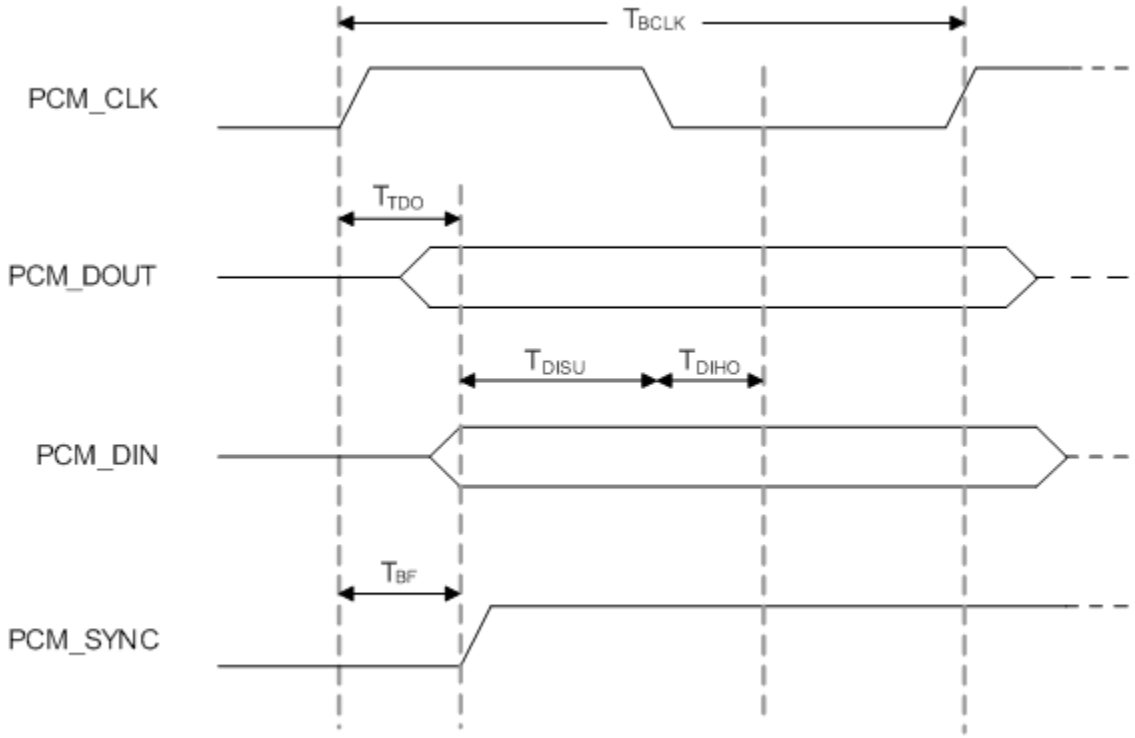
The AW-AM457-D supports a high-speed Universal Asynchronous Receiver/Transmitter (UART) interface, compliant to the industry standard 16550 specification. High-speed baud rates are supported to provide the physical transport between the device and the host for exchanging Bluetooth data.



Symbol	Parameter	Condition	Min	Typ	Max	Units
T_{BAUD}	Baud rate	26MHz input clock	250	-	-	ns

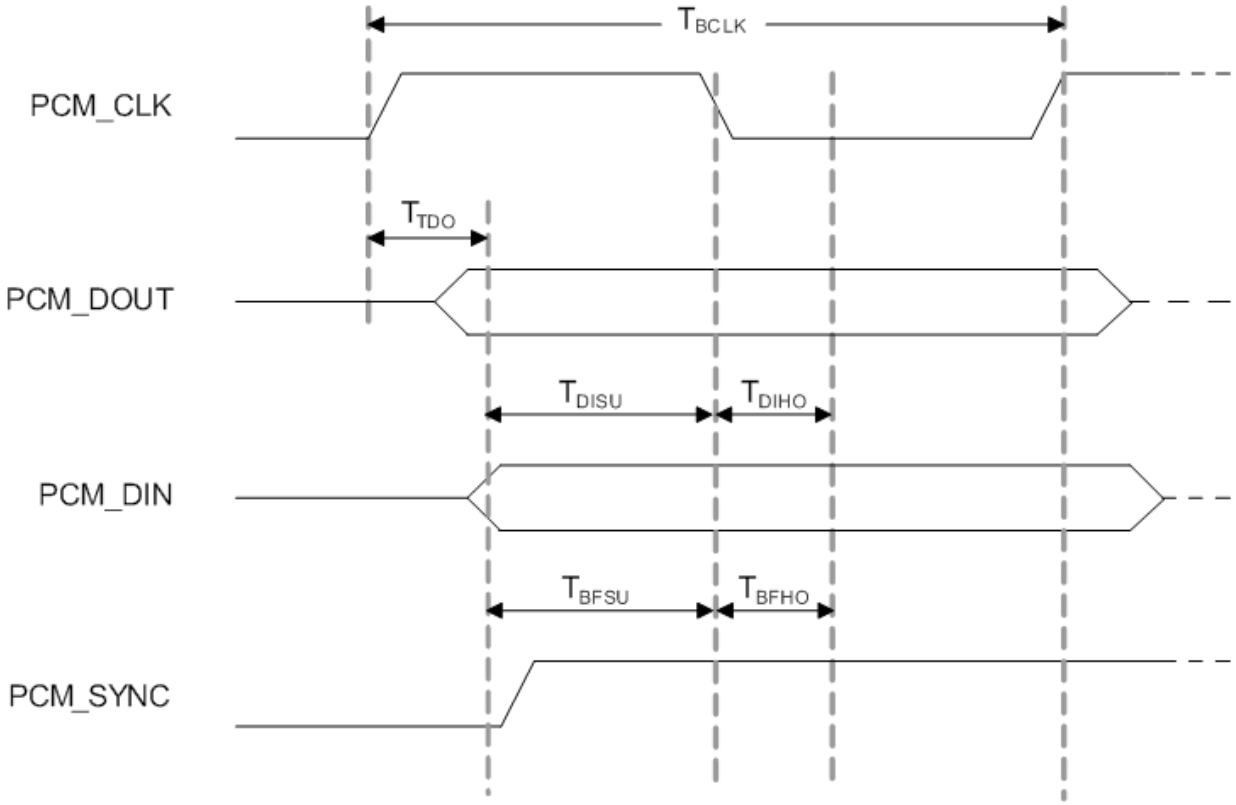
3.4.5 PCM Interface

3.4.5.1 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

3.4.5.2 PCM Timing Specification – Slave Mode

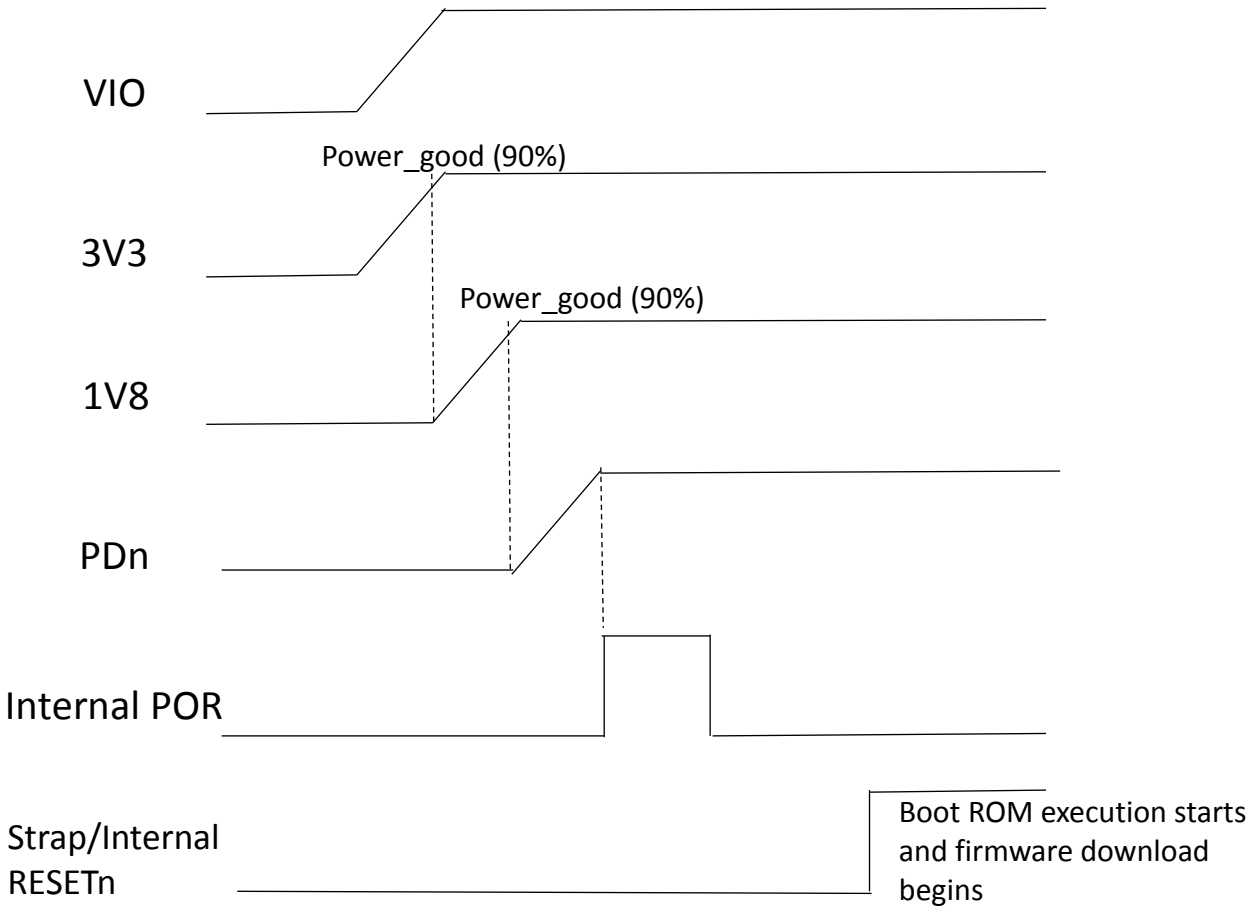


Symbol	Parameter	Condition	Min	Typ	Max	Units
F_{BCLK}	--	--	--	2/2.048	--	MHz
Duty $Cycle_{BCLK}$	--	--	0.4	0.5	0.6	--
$T_{BCLK\ rise/fall}$	--	--	--	3	--	ns
T_{DO}	--	--	--	--	30	ns
T_{DISU}	--	--	15	--	--	ns
T_{DIHO}	--	--	10	--	--	ns
T_{BFSU}	--	--	15	--	--	ns
T_{BFHO}			10		--	ns

3.5 Timing Sequence

AW-AM457-D power up timing sequence.

- VDD33 must be good (90%) before +1.8V starts ramping up.
- +1.8Vmust be good (90%) before PDn starts ramping up.



3.6 Power Consumption

3.6.1 WLAN

Test Condition

1. All results are with the **Bluetooth off** .(hciconfig hci0 down)
2. All results are run to **take 3 minutes** then record the test **average** and maximum value.

No.	Item	VDD=3.3 V	
		Max.	Avg.
1	WLAN OFF *(1)	TBD	TBD
2	Sleep *(3)	TBD	TBD
3	Power Save DTIM1 (2.4GHz) *(4) (6)	TBD	TBD
4	Power Save DTIM3 (2.4GHz) *(5) (6)	TBD	TBD
5	Power Save DTIM1 (5GHz) *(4) (6)	TBD	TBD
6	Power Save DTIM3 (5GHz) *(5) (6)	TBD	TBD

No.	Item			VDD=3.3 V		
				Max.	Avg.	
Band (GHz)	Mode	BW (MHz)	RF Power (dBm)	Transmit		
				Max.	Avg.	Duty (%)
2.4	11b@1Mbps	20	17	387.3mA	383.7mA	93 %
	11g@54Mbps	20	16	343.9mA	336.9mA	72 %
	11n@MCS7	20	14	311.8mA	305.4mA	70 %
	11n@MCS7	40	14	303.9mA	297.9mA	62 %
5	11a@54Mbps	20	16	454.2mA	447.0mA	75 %
	11n@MCS7	20	15	435.3mA	427.8mA	74 %
	11n@MCS7	40	14	403.4mA	395.8mA	74 %

Band (GHz)	Mode	BW(MHz)	Receive	
			Max.	Avg.
2.4	11b@1Mbps	20	80.0mA	74.1mA
	11n@MCS7	20	79.3mA	82.2mA
5	11a@54Mbps	20	120.4mA	101.5mA
	11n@MCS7	20	102.2mA	99.4mA
	11n@MCS7	40	119.0mA	116.2mA

No.	Item	VIO=3.3 V	
		Max.	Avg.
1	WLAN OFF *(1)	TBD	TBD
2	Sleep *(3)	TBD	TBD
3	Power Save DTIM1 (2.4GHz) *(4) (6)	TBD	TBD
4	Power Save DTIM3 (2.4GHz) *(5) (6)	TBD	TBD
5	Power Save DTIM1 (5GHz) *(4) (6)	TBD	TBD
6	Power Save DTIM3 (5GHz) *(5) (6)	TBD	TBD

No.	Item			VIO=3.3 V		
				Max.	Avg.	
Band (GHz)	Mode	BW (MHz)	RF Power (dBm)	Transmit		
				Max.	Avg.	Duty (%)
2.4	11b@1Mbps	20	17	2.80mA	2.78mA	52 %
	11g@54Mbps	20	16	2.79mA	2.78mA	52 %
	11n@MCS7	20	14	2.79mA	2.78mA	48 %
	11n@MCS7	40	14	2.80mA	2.78mA	48 %
5	11a@54Mbps	20	16	2.80mA	2.79mA	48 %
	11n@MCS7	20	15	2.80mA	2.78mA	47 %
	11n@MCS7	40	14	2.80mA	2.78mA	49 %

Band (GHz)	Mode	BW(MHz)	Receive	
			Max.	Avg.
2.4	11b@1Mbps	20	2.78mA	2.77mA
	11n@MCS7	20	2.79mA	2.78mA
5	11a@54Mbps	20	2.79mA	2.78mA
	11n@MCS7	20	2.79mA	2.78mA
	11n@MCS7	40	2.79mA	2.78mA

No.	Item	VDD=1.8 V	
		Max.	Avg.
1	WLAN OFF *(1)	TBD	TBD
2	Sleep *(3)	TBD	TBD
3	Power Save DTIM1 (2.4GHz) *(4)(6)	TBD	TBD

No.	Item			VDD=1.8 V		
				Max.	Avg.	
Band (GHz)	Mode	BW (MHz)	RF Power (dBm)	Transmit		
				Max.	Avg.	Duty (%)
2.4	11b@1Mbps	20	17	182.5 mA	177.4 mA	98%
	11g@54Mbps	20	16	181.4 mA	180.3 mA	80%
	11n@MCS7	20	14	178.6 mA	177.8 mA	79%
	11n@MCS7	40	14	179.8 mA	179.1 mA	70%
5	11a@54Mbps	20	16	210.7 mA	204.5 mA	83%
	11n@MCS7	20	15	212.4 mA	209.0 mA	80%
	11n@MCS7	40	14	213.0 mA	210.2 mA	73%

Band (GHz)	Mode	BW(MHz)	Receive	
			Max.	Avg.
2.4	11b@1Mbps	20	70.0 mA	69.7 mA
	11n@MCS7	20	76.2 mA	76.1 mA
5	11a@54Mbps	20	96.5 mA	96.4 mA
	11n@MCS7	20	95.5 mA	95.3 mA

	11n@MCS7	40	108.9 mA	108.7 mA

3.6.2 Bluetooth

Test Condition

1. The Bluetooth is in **test mode** run transmit or receive with a specified output power measure current consumption.
2. All results are run to **take 3 minutes** then record the test **average** and maximum value.

No.	Mode	Packet Type	RF Power (dBm)	VDD=3.3 V	
				Max.	Avg.
1	Transmit *(1)	DH5	12	177.4mA	152.3mA
2	Receive *(2)	3DH5	n/a	99.2mA	95.5mA
3	Transmit *(3)	LE	10	115.6mA	105.7mA
4	Receive *(4)	LE	n/a	104.0mA	97.1mA
No.	**Mode**	**Packet Type**	**RF Power (dBm)**	**VIO=3.3V**	
				Max.	**Avg.**
1	Transmit *(1)	DH5	12	2.79mA	2.77mA
2	Receive *(2)	3DH5	n/a	2.77mA	2.76mA
3	Transmit *(3)	LE	10	2.80mA	2.77mA
4	Receive *(4)	LE	n/a	2.77mA	2.76mA
No.	**Mode**	**Packet Type**	**RF Power (dBm)**	**VDD=1.8V**	
				Max.	**Avg.**
1	Transmit *(1)	DH5	12	131.2mA	129.5mA
2	Receive *(2)	3DH5	n/a	94.3mA	93.3mA
3	Transmit *(3)	LE	10	121.5mA	119.2mA
4	Receive *(4)	LE	n/a	95.7mA	94.7mA

3.7 Sleep Clock

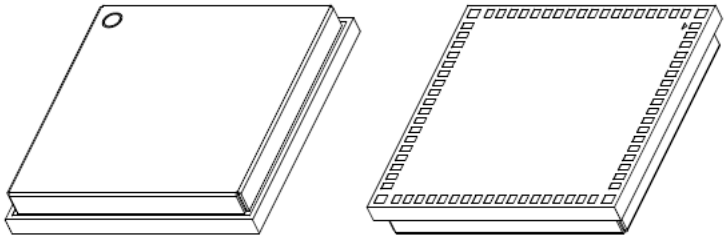
An external crystal is used for generating all radio frequencies and normal operation clocking. As an alternative, an external frequency reference driven by a temperature-compensated crystal oscillator (TCXO) signal may be used. No software settings are required to differentiate between the two. In addition,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

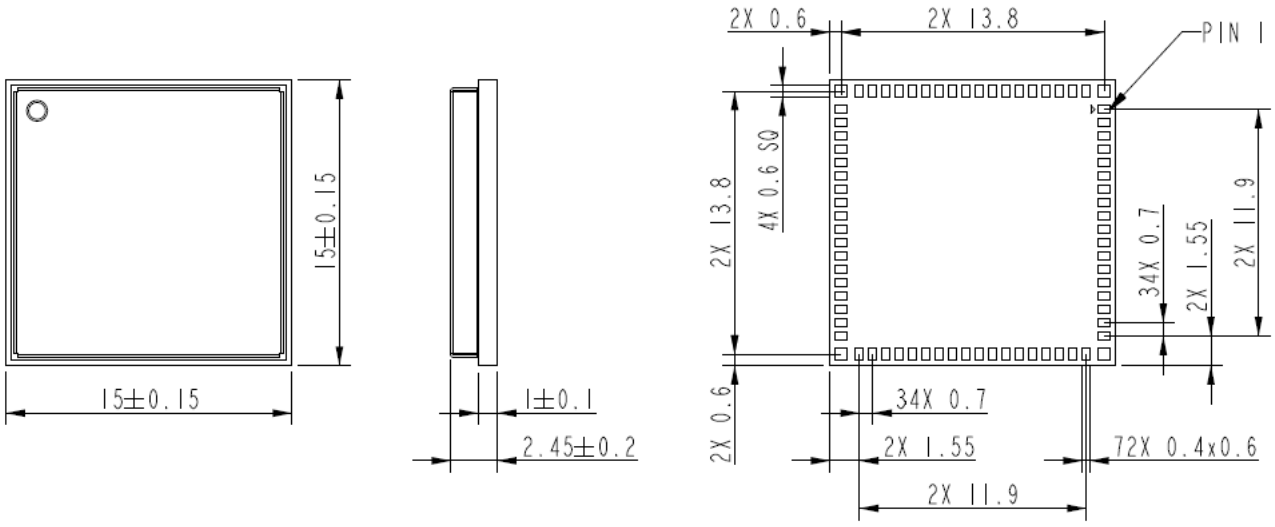
External 32.768KHz Low-Power Oscillator

Symbol	Parameter	Min	Typ	Max	Units
CLK	Clock frequency range/ accuracy ■ CMOS input clock signal type ■ ±250 ppm (initial, aging, temperature)	-	32.768	-	kHz
PN	Phase noise requirement (@ 100KHz)	-	-125	-	dBc/Hz
J_C	Cycle jitter	-	1.5	-	ns (RMS)
SR	Slew rate limit (10-90%)	-	-	100	ns
DC	Duty cycle tolerance	20	-	80	%

4. Mechanical Information

4.1 Mechanical Drawing

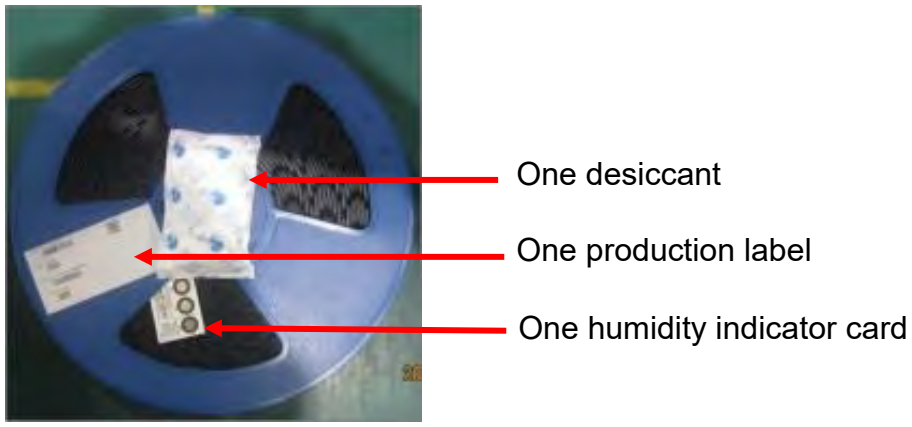




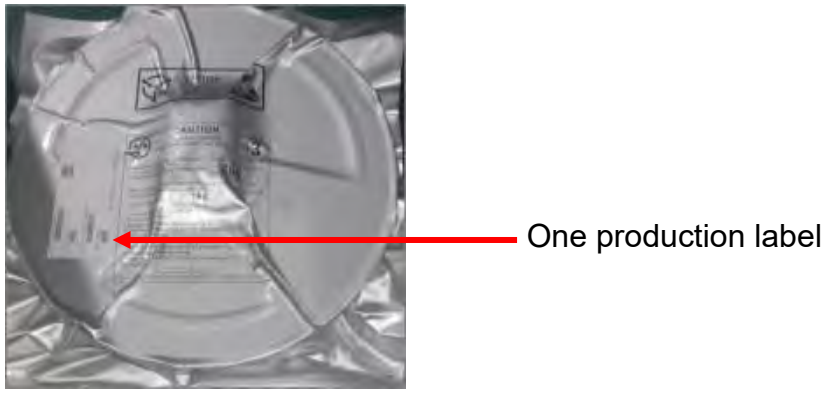
TOLERANCE UNLESS OTHERWISE SPECIFIED:±0.1mm

5. Packing Information

1. One reel can pack 750pcs modules
2. One production label is pasted on the reel, one desiccant and one humidity indicator card are put on the reel



3. One reel is put into the anti-static moisture barrier bag, and then one label is pasted on the bag



4. A bag is put into the anti-static pink bubble wrap

5. A bubble wrap is put into the inner box and then one label is pasted on the inner box

One production label

6. 4 inner boxes could be put into one carton

7. Sealing the carton by AzureWave tape

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

Example of carton label	AzureWave P/N Customer 由業務提供 Customer P/N 由業務提供 Customer PO 由業務提供 Description AW-XXXXXX QTY 1200 pcs C/N N.W. G.W. RoHS COMPLIANT
Example of box label	BOX0275346 2-XXXXX-XXX 数量: XXX
Example of production label	P/N: D/C: 1309 PCK NO.: PCKNO0069097 QTY: 294 BAG SEAL DATE: _____
Example of balance label	尾数 Balance

Note:

- **1 reel = 1 inner box = 750pcs**
- **1 carton = 4 inner boxes = 4 * 750pcs = 3,000pcs**

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.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This device is restricted for indoor use.

FCC Radiation Exposure Statement:

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

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.

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 FCC 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 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.

FCC regulations restrict the operation of this device to indoor use only.
The operation of this device is prohibited on oil platforms, cars, trains, boats, and aircraft, except that operation of this device is permitted in large aircraft while flying above 10,000 feet.

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: TLZ-AM457-D".

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.

Indoor Use only

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 device and its antenna(s) must not be co-located with any other transmitters except in accordance with IC multi-transmitter product procedures.
Referring to the multi-transmitter policy, multiple-transmitter(s) and module(s) can be operated simultaneously without reassessment permissive change.
Cet appareil et son antenne (s) ne doit pas être co-localisés ou fonctionnement en association avec une autre antenne ou transmetteur.

This radio transmitter [6100A-AM457D] 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 (6100A-AM457D) 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.

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.

IC Radiation Exposure Statement:

This equipment complies with IC RSS-102 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 aux limites d'exposition aux rayonnements IC établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

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.

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.

LABEL OF THE END PRODUCT:

The final end product must be labeled in a visible area with the following " Contains IC: 6100A-AM457D ".

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.

Ant list

Ant.	Port	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	1	Molex	1461531050	Dipole	I-PEX	Note 1
Ant.	**Port**	**Brand Holder**	**Model Name**	**Antenna Type**	**Connector**	**Gain (dBi)**
2	1	MAG. LAYERS SCIENTIFIC-TECHNICS CO., LTD	MSA-4008-25GC1-A2	PIFA	I-PEX	Note 1

Note1:

Ant.	Antenna Gain (dBi)		
	WLAN 2.4GHz	WLAN 5GHz	Bluetooth
1	3.2	4.25	3.2
2	2.98	5.16	2.98