AW-AM510

IEEE 802.11 1X1 a/b/g/n Wireless LAN + Bluetooth 5.1 Combo 12 x 12 LGA Module

Datasheet

Rev. A

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, WPA2, WPA2 and WPA mix mixed mode, WEP

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

Revision History

Document NO: R2-2510-DST-01

Version	Revision Date	DCN NO.	Description	Initials	Approved
A	2020/09/17	DCN018312	• Draft version	Renton Tao	N.C Chen

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-AM510.** With four advanced radio technologies integrated into a module, AW-AM510 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-AM510, 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-AM510 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-AM510.

The AW-AM510 supports standard interface **SDIO3.0 for WLAN**, **SDIO3.0 and UART, for BT**. AW-AM510 is suitable for multiple mobile processors for different applications. With the combo functions and the good performance, the AW-AM510 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 WLCSP
Host Interface	Wi-Fi: SDIO3.0, BT: SDIO3.0, UART
Dimension	12 mm X 12 mm x 2 mm(Max)
Package	LGA
Weight	TBD

1.3.2 WLAN

Features	Description
WLAN Standard	IEEE802.11 a/b/g/n
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 ■ 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

Output Power (Board Level Limit)*

2.4G

	Min	Typ	Max	Unit
11b (11Mbps) @EVM<35%		TBD		dBm
11g (54Mbps) @EVM≦-27 dB		TBD		dBm
11n (HT20 MCS7) @EVM≦-28 dB		TBD		dBm
11n (HT40 MCS7) @EVM≦-28 dB		TBD		dBm

5G

	Min	Typ	Max	Unit
11a (54Mbps) @EVM≦-27 dB		TBD		dBm
11n (HT20 MCS7) @EVM≦-28 dB		TBD		dBm
11n (HT40 MCS7) @EVM≦-28 dB		TBD		dBm

Receiver Sensitivity

2.4G

	Min	Typ	Max	Unit
11b (11Mbps)	-	TBD		dBm
11g (54Mbps)	-	TBD		dBm
11n (HT20 MCS7)	-	TBD		dBm
11n (HT40 MCS7)	-	TBD		dBm

5G

	Min	Typ	Max	Unit
11a (54Mbps)	-	TBD		dBm
11n (HT20 MCS7)	-	TBD		dBm
11n (HT40 MCS7)	-	TBD		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

- WiFi: WPA3, WPA2, WPA2 and WPA mixed mode, WEP
- BT: AES

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

1.3.3 Bluetooth

Features	Description
Bluetooth Standard	Full Bluetooth 5.1 features
Frequency Rage	2402MHz~2483MHz
Modulation	Header GFSK Payload 2M: π/4-DQPSK Payload 3M: 8DPSK
Output Power	
Receiver Sensitivity	BT Sensitivity (BER<0.1%)

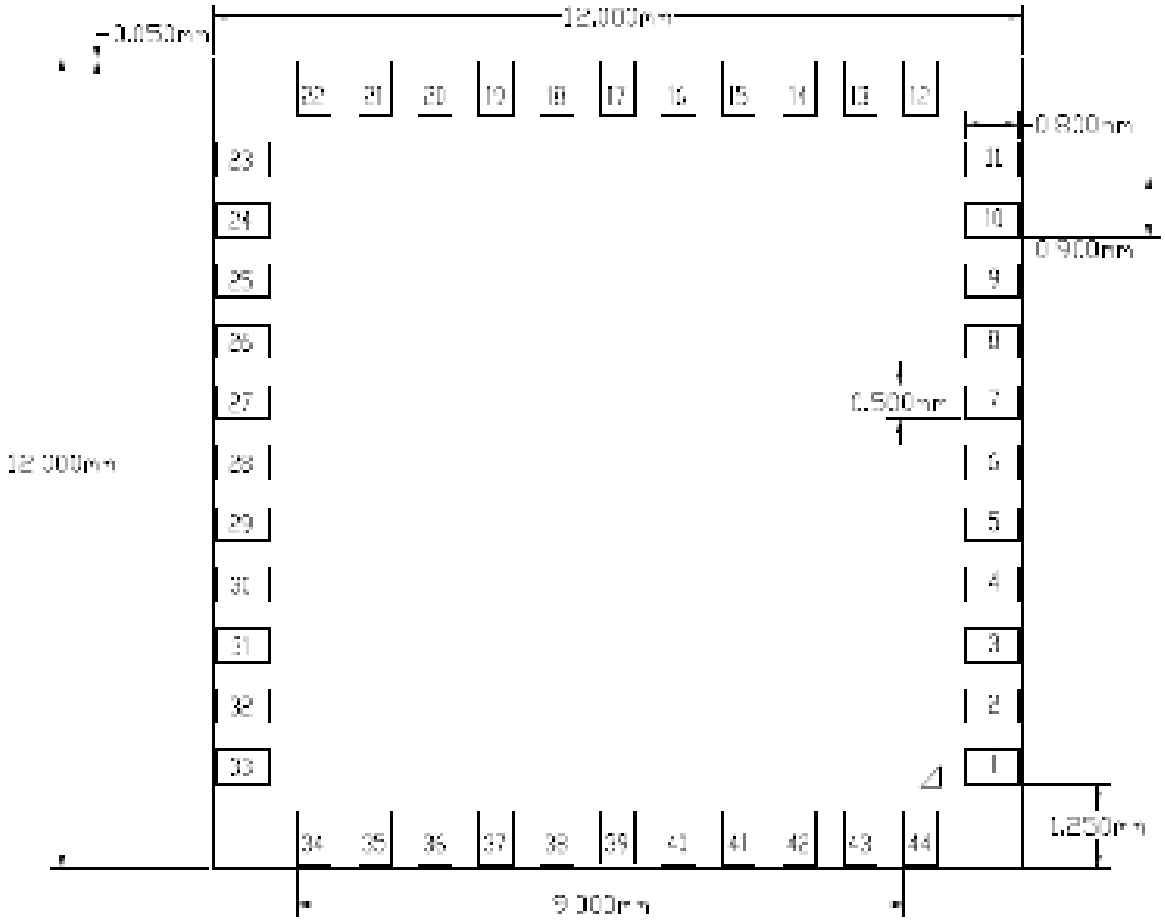
1.3.4 Operating Conditions

Features	Description
Operating Conditions	
Voltage	3.3V +-5%
Operating Temperature	0~70 °C
Operating Humidity	Less than 85% R.H.
Storage Temperature	-40 to +85 °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-AM510 pin out drawing (top view).



2.2 Pin Table

Pin No	Definition	Basic Description	Voltage	Type
1	GND1	Ground	---	---
2	WL_BT_ANT	Option for RF I/O pin out	1.8V	I/O
3	GND3	Ground	---	---
4	NC4	Floating Pin, No connect to anything.	---	Floating
5	NC5	Floating Pin, No connect to anything.	---	Floating
6	BT_HOST_WAKE_DEV	GPIO Mode : GPIO[12]. BT Device Wake	VDDIO	I
7	BT_DEV_WAKE_Host	GPIO Mode : GPIO[0]. BT Host Wake	VDDIO	O
8	NC8	Floating Pin, No connect to anything.	---	Floating
9	VDD33	3.3V power voltage source input	3.3V	P
10	NC10	Floating Pin, No connect to anything.	---	Floating
11	NC11	Floating Pin, No connect to anything.	---	Floating
12	WL_DIS#	Full Power-down (active low)	VDDIO	I
13	WL_DEV_WAKE_HOST	GPIO Mode : GPIO[1]. WL Host Wake	VDDIO	I/O
14	SDIO_DATA_2	SDIO Data line Bit[2]	VDDIO	I/O
15	SDIO_DATA_3	SDIO Data line Bit[3]	VDDIO	I/O
16	SDIO_DATA_CMD	SDIO Command	VDDIO	I/O
17	SDIO_DATA_CLK	SDIO Clock input	VDDIO	I
18	SDIO_DATA_0	SDIO Data line Bit[0]	VDDIO	I/O
19	SDIO_DATA_1	SDIO Data line Bit[1]	VDDIO	I/O
20	GND20	Ground	---	---
21	NC21	Floating Pin, No connect to anything.	---	Floating
22	VDDIO	1.8V/3.3V Digital I/O Power Supply	1.8V/3.3V	P
23	NC23	Floating Pin, No connect to anything.	---	Floating
24	SLP_CLK	External Low Power Clock input(32.768KHz) (optional)	VDDIO	I
25	PCM_OUT	PCM Data output	VDDIO	I/O
26	PCM_CLK	PCM Clock	VDDIO	I/O
27	PCM_IN	PCM data input	VDDIO	I/O
28	PCM_SYNC	PCM sync signal	VDDIO	I/O
29	NC29	Floating Pin, No connect to anything.	---	Floating
30	NC30	Floating Pin, No connect to anything.	---	Floating
31	GND31	Ground	---	---
32	NC32	Floating Pin, No connect to anything.	---	Floating
33	GND33	Ground	---	---
34	BT_DIS#	BT reset pin	VDDIO	I
35	NC35	Floating Pin, No connect to anything.	---	Floating
36	GND36	Ground	---	---
37	NC37	Floating Pin, No connect to anything.	---	Floating

38	GPIO13	GPIO Mode : GPIO[13]. Host-to-Wi-Fi reset recovery	VDDIO	I/O
39	GPIO14	GPIO Mode : GPIO[14]. Host-to-Chip wakeup	VDDIO	I/O
40	NC40	Floating Pin, No connect to anything.	---	Floating
41	UART_RTS	UART_RTSn (active low)	VDDIO	O
42	UART_TX	UART_SOUT	VDDIO	O
43	UART_RX	UART_SIN	VDDIO	I
44	UART_CTS	UART_CTSn(active low)	VDDIO	I

3. Electrical Characteristics

3.1 Absolute Maximum Ratings

Symbol	Parameter	Minimum	Typical	Maximum	Unit
VDD33	DC supply for the 3.3V input	-	3.3	3.96	V
VDDIO	I/O power supply	-	3.3	4.0	V
		-	1.8	2.2	

3.2 Recommended Operating Conditions

Symbol	Parameter	Minimum	Typical	Maximum	Unit
VDD33	DC supply for the 3.3V input	3.14	3.3	3.46	V
VDDIO	1.8V/3.3V digital I/O 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 (VDDIO)

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 (VDDIO)

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

3.4 Host Interface

3.4.1 SDIO Interface

The AW-AM510 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-AM510 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 device through the use of BARs and a DMA engine.

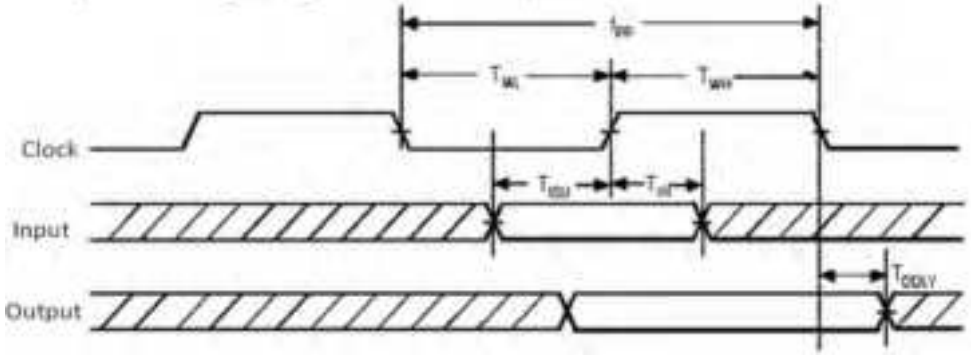
- Support SDIO 3.0 Standard.
- On-chip memory used for CIS.
- Supports 4-bit SDIO and 1-bit SDIO transfer modes.
- Special interrupt register for information exchange.
- Allows card to interrupt host.

SDIO Interface Signals

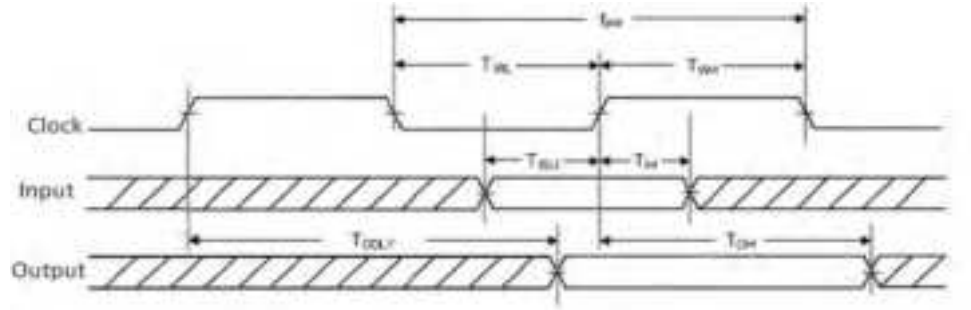
AW-AM510 SDIO Pin Name	Type	Description
SDIO_DATA_CLK	I	SDIO 4-bit mode: Clock SDIO 1-bit mode: Clock
SDIO_DATA_CMD	I/O	SDIO 4-bit mode: Command line SDIO 1-bit mode: Command line
SDIO_DATA_3	I/O	SDIO 4-bit mode: Data line Bit[3] SDIO 1-bit mode: Not used
SDIO_DATA_2	I/O	SDIO 4-bit mode: Data line Bit[2] 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)

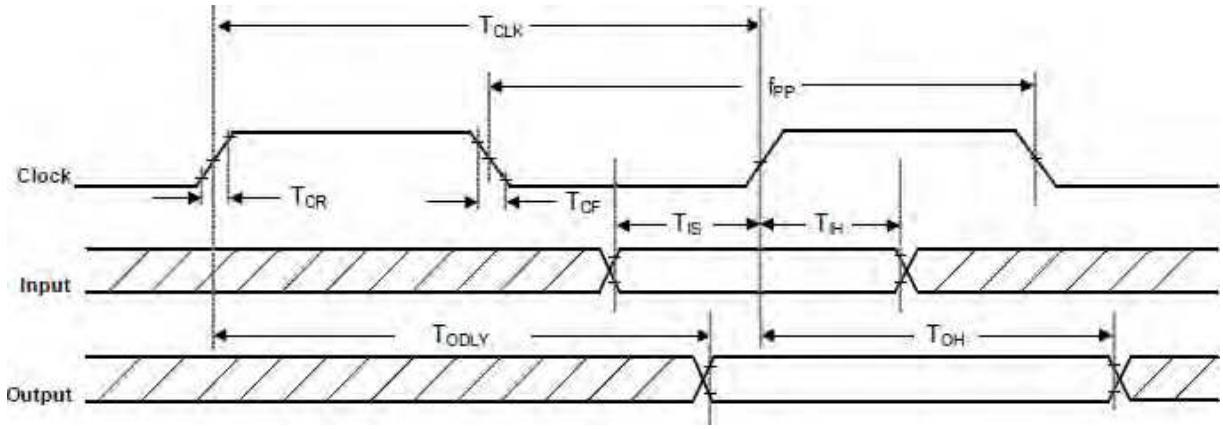


SDIO protocol timing Diagram - High Speed mode. (3.3V)

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)

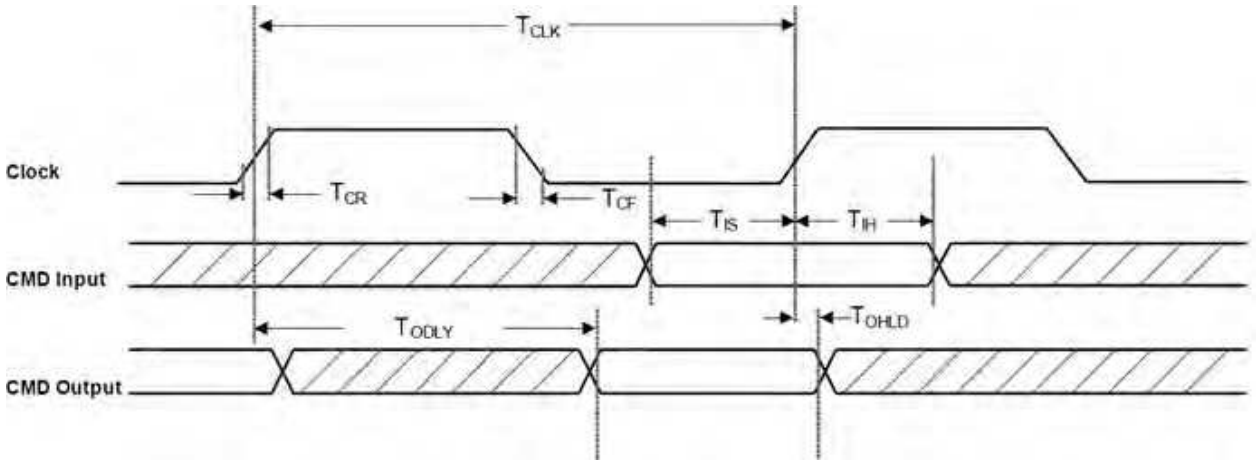


SDIO Protocol Timing Diagram - SDR12, SDR25, SDR50 Modes (up to 100 MHz)(1.8V)

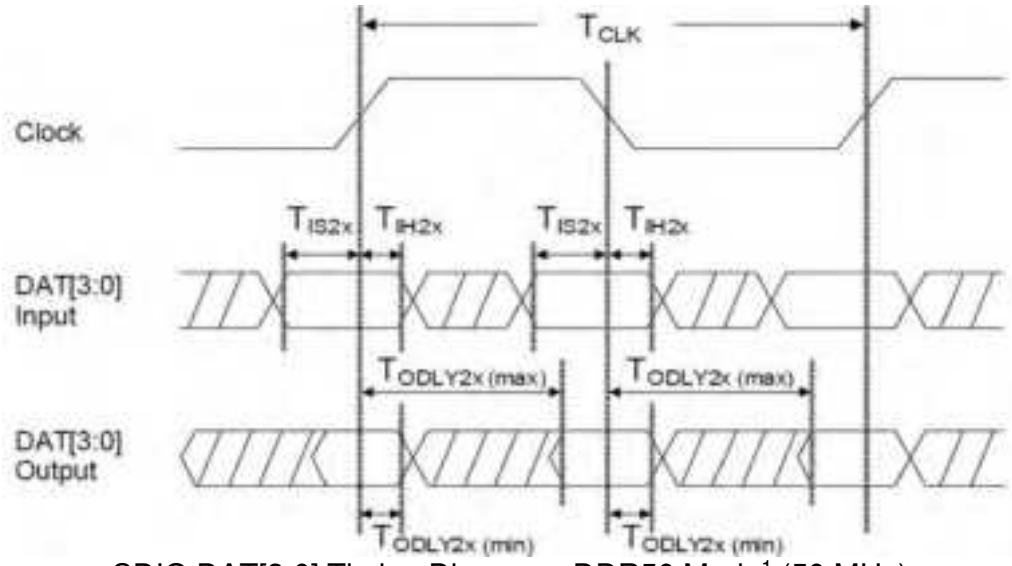
Symbol	Parameter	Condition	Min	Typ	Max	Units
F_{pp}	CLK Frequency	SDR12/25/50	25	-	100	MHz
T_{CLK}	Clock Time	SDR12/25/50	10	-	40	ns
T_{IS}	Input Setup Time	SDR12/25/50	3	-	-	ns
T_{IH}	Input Hold Time	SDR12/25/50	0.8	-	-	ns
T_{CR} ,T_{CF}	Rise time, fail time TCR ,TCF <2ns(max) at 100MHz CCARD =10pF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

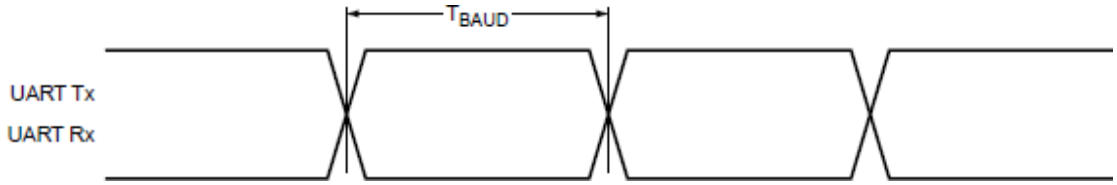
[1] In DDR50 mode, DAT[3:0] lines are sampled on both edges of the clock (not applicable for CMD line).

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.High-Speed UART Interface

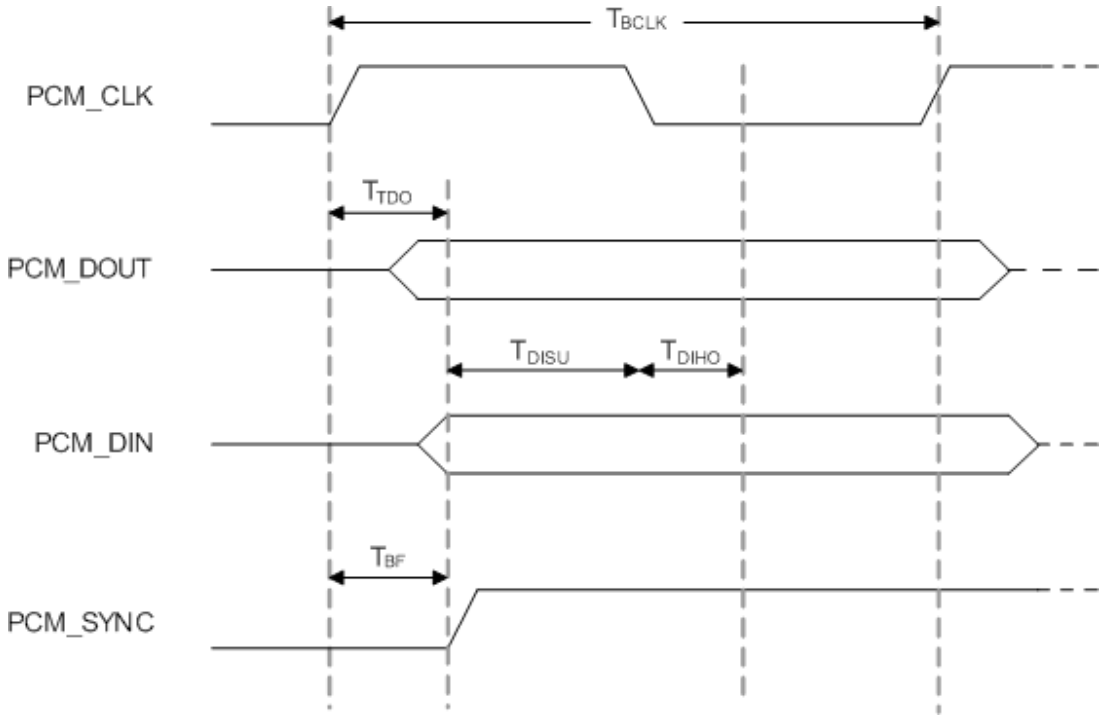
The AW-AM510 supports a high-speed Universal Asynchronous Receiver/Transmitter (UART) interface, compliant to the industry standard 16550 specification. High-speed baud rates are supported to provide the physical transport between the device and the host for exchanging Bluetooth data.



Symbol	Parameter	Condition	Min	Typ	Max	Units
T_{BAUD}	Baud rate	26MHz or 40MHz input clock	250	-	-	ns

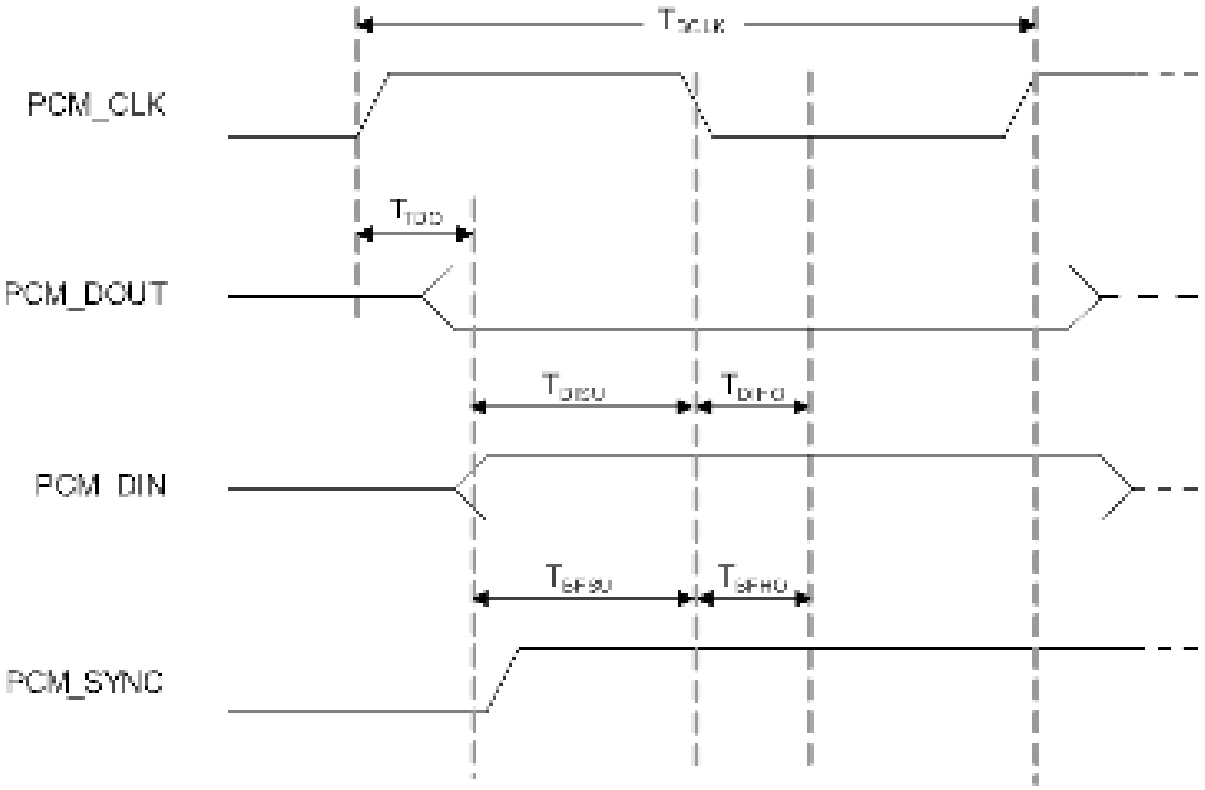
3.4.4 PCM Interface

3.4.4.1 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

3.4.4.2 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-AM510 power up timing sequence.

TBD

3.6 Power Consumption*

3.6.1 WLAN

TBD

3.6.2 Bluetooth

TBD

3.7 Sleep Clock(Optional)

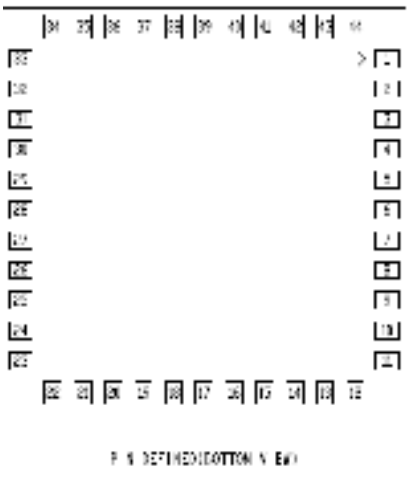
An external crystal is used for generating all radio frequencies and normal operation clocking. As an alternative, an external frequency reference driven by a temperature-compensated crystal oscillator (TCXO) signal may be used. No software settings are required to differentiate between the two. In addition,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

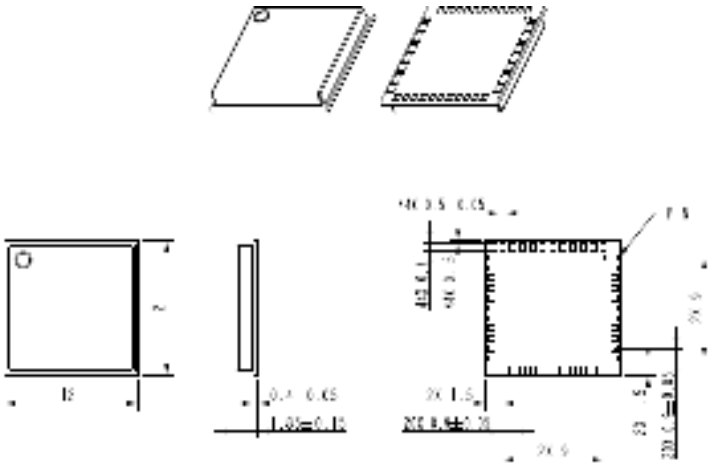
External 32.768KHz Low-Power Oscillator

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

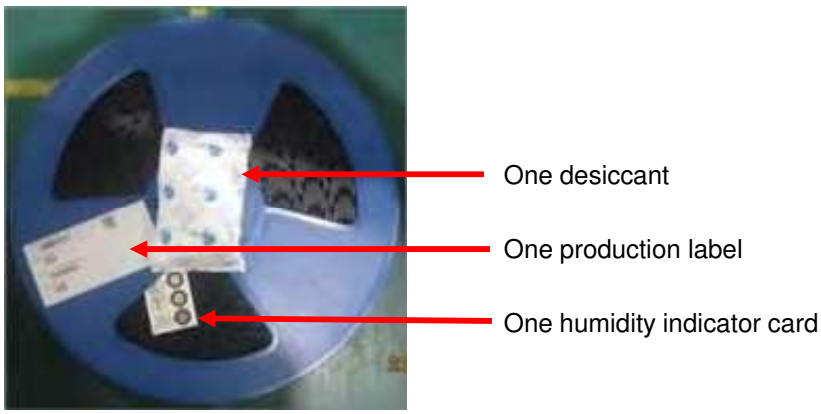




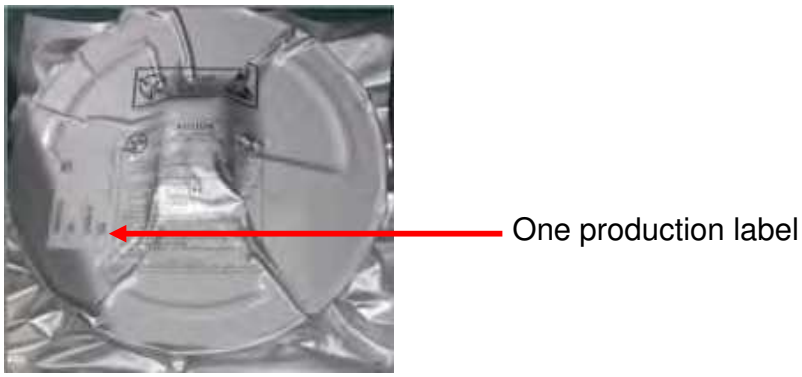
5. Packing Information

One reel can pack 1,500pcs 12x12 LGA modules

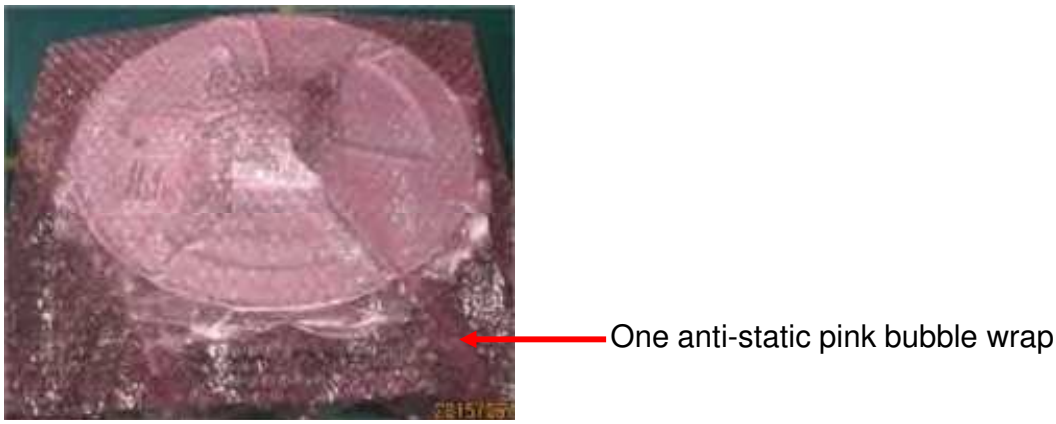
1. One production label is pasted on the reel, one desiccant and one humidity indicator card are put on the reel



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



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



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

One production label

5. 5 inner boxes could be put into one carton

6. Sealing the carton by AzureWave tape

7. 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

AW-AM510

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

12mm x 12mm LGA module

Layout Guide

Rev. B

(For Standard)

Revision History

Version	Revision Date	Description	Initials	Approved
A	2021/02/24	● Initial Version	Roger Liu	N.C. Chen
B	2021/05/24	● Add RF trace layout information	Roger Liu	N.C. Chen

INTRODUCTION

This document provides key guidelines and recommendations to be followed when creating AW-AM510 layout. It is strongly recommended that layouts be reviewed by the AzureWave engineering team before being released for fabrication.

The following is a summary of the major items that are covered in detail in this application note. Each of these areas of the layout should be carefully reviewed against the provided recommendations before the PCB goes to fabrication.

- GENERAL RF GUIDELINES
- Ground Layout
- Power Layout
- Digital Interface
- RF Trace
- Antenna
- Antenna Matching
- GENERAL LAYOUT GUIDELINES
- THE OTHER LAYOUT GUIDE INFORMATION

1. GENERAL RF GUIDELINES

Follow these steps for optimal WLAN performance.

1. Control WLAN 50 ohm RF traces by doing the following:

   • Route traces on the top layer as much as possible and use a continuous reference ground plane underneath them.

   • Verify trace distance from ground flooding. At a minimum, there should be a gap equal to the width of one trace between the trace and ground flooding. Also keep RF signal lines away from metal shields. This will ensure that the shield does not detune the signals or allow for spurious signals to be coupled in.

   • Keep all trace routing inside the ground plane area by at least the width of a trace.

   • Check for RF trace stubs, particularly when bypassing a circuit.

2. Keep RF traces properly isolated by doing the following:

   • Do not route any digital or analog signal traces between the RF traces and the reference ground.

   • Keep the balls and traces associated with RF inputs away from RF outputs. If two RF traces are close each other, then make sure there is enough room between them to provide isolation with ground fill.

   • Verify that there are plenty of ground vias in the shield attachment area. Also verify that there are no non-ground vias in the shield attachment area. Avoid traces crossing into the shield area on the shield layer.

3. Consider the following RF design practices:

   • Confirm antenna ground keep-outs.

   • Verify that the RF path is short, smooth, and neat. Use curved traces or microwave corners for all turns; never use 90-degree turns. Avoid width discontinuities over pads. If trace widths differ significantly from component pad widths, then the width change should be mitered. Verify there are no stubs.

   • Do not use thermals on RF traces because of their high loss.

   • The RF traces between AW-AM510 RF_ANT pin and antenna must be made using 50Ω controlled-impedance transmission line.

2. Ground Layout

Please follow general ground layout guidelines. Here are some general rules for customers' reference.

- The layer 2 of PCB should be a complete ground plane. The rule has to be obeyed strictly in the RF section while RF traces are on the top layer.
- Each ground pad of components on top layer should have via drilled to PCB layer 2 and via should be as close to pad as possible. A bulk decoupling capacitor needs two or more.
- Don't place ground plane and route signal trace below printed antenna or chip antenna to avoid destroying its electromagnetic field, and there is no organic coating on printed antenna. Check antenna chip vendor for the layout guideline and clearance.
- Move GND vias close to the pads.

3. Power Layout

Please follow general power layout guidelines. Here are some general rules for customers' reference.

- A 4.7uF capacitor is used to decouple high frequency noise at digital and RF power terminals. This capacitor should be placed as close to power terminals as possible.
- In order to reduce PCB's parasitic effects, placing more via on ground plane is better.

4. Digital Interface

Please follow power and ground layout guidelines. Here are some general rules for customers' reference.

- The digital interface to the module must be routed using good engineering practices to minimize coupling to power planes and other digital signals.
- The digital interface must be isolated from RF trace.

5. RF Trace

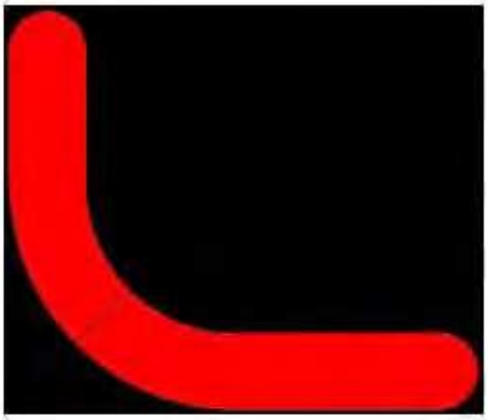
The RF trace is the critical to route. Here are some general rules for customers' reference.

- The RF trace impedance should be 50Ω between ANT port and antenna matching network.
- The length of the RF trace should be minimized.
- To reduce the signal loss, RF trace should laid on the top of PCB and avoid any via on it.

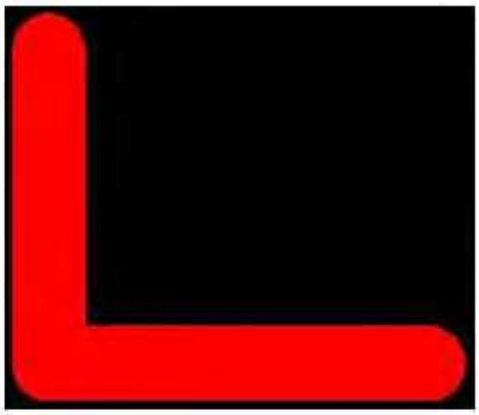
•The CPW (coplanar waveguide) design and the microstrip line are both recommended; the customers can choose either one depending on the PCB stack of their products.

•The RF trace must be isolated with aground beneath it. Other signal traces should be isolated from the RF trace either by ground plane or ground vias to avoid coupling.

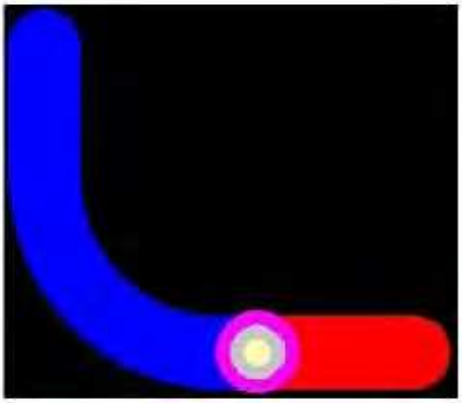
•To minimize the parasitic capacitance related to the corner of the RF trace, the right angle corner is not recommended.



Correct RF trace



Right-angled corner



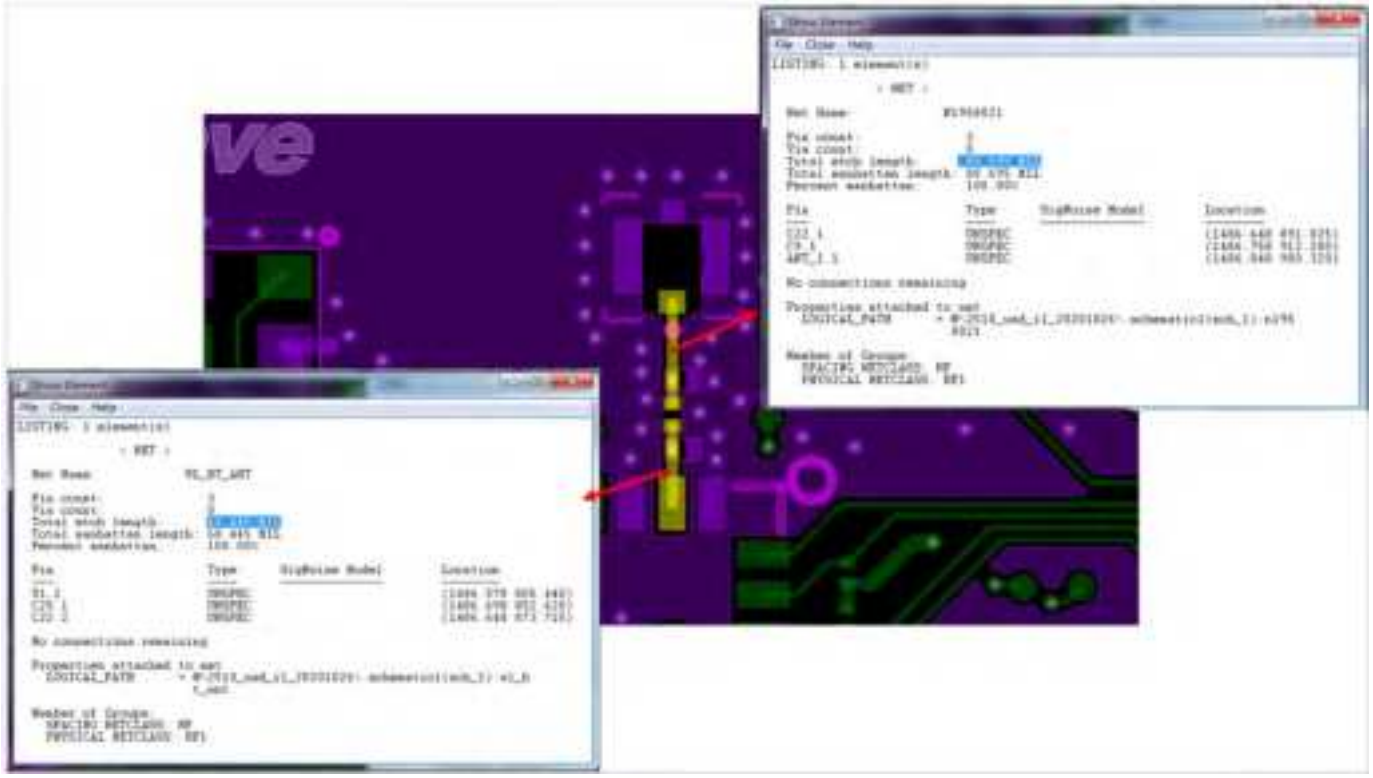
Via on RF trace

If the customers have any problem in calculation of trace impedance, please contact AzureWave.

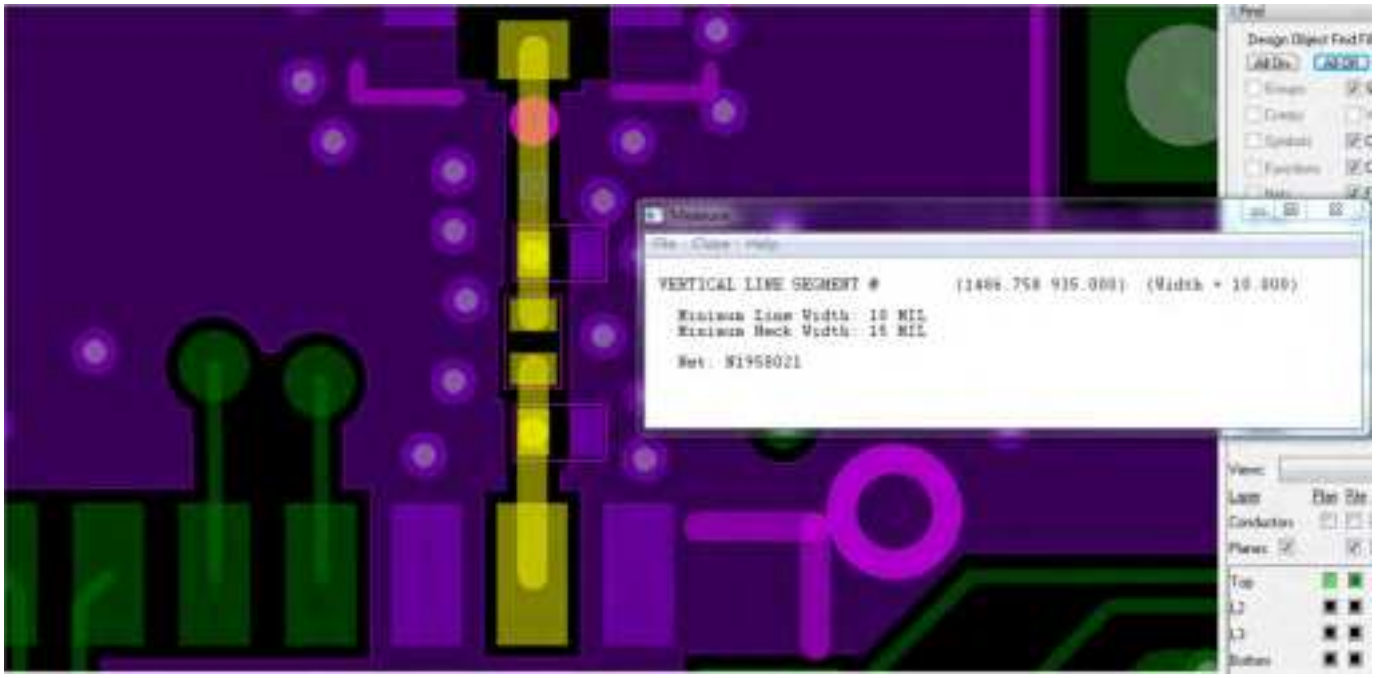
Incorrect RF trace

AW-AM510 RF trace should be follow the rules as below

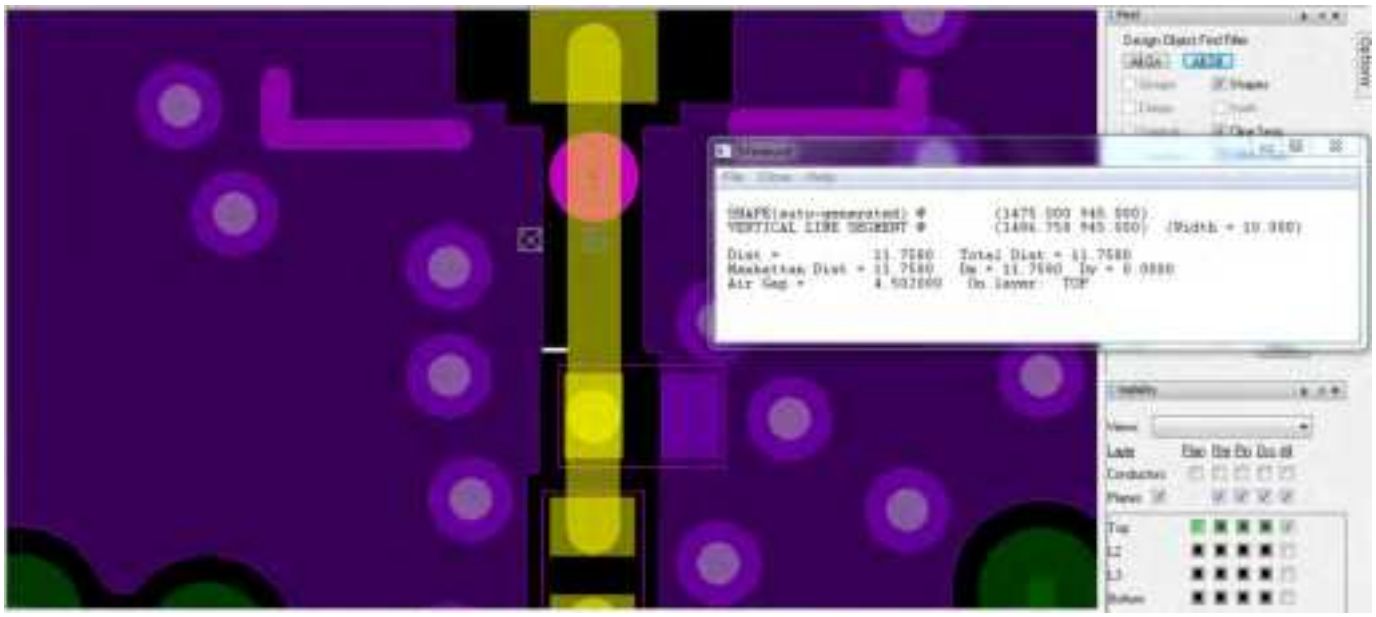
a. Line length of Antenna trace about 88.7mi and 68.5 mil



b. Line width of Antenna trace about 10 mil



c. Air gap between RF trace and ground about 4.5 mil

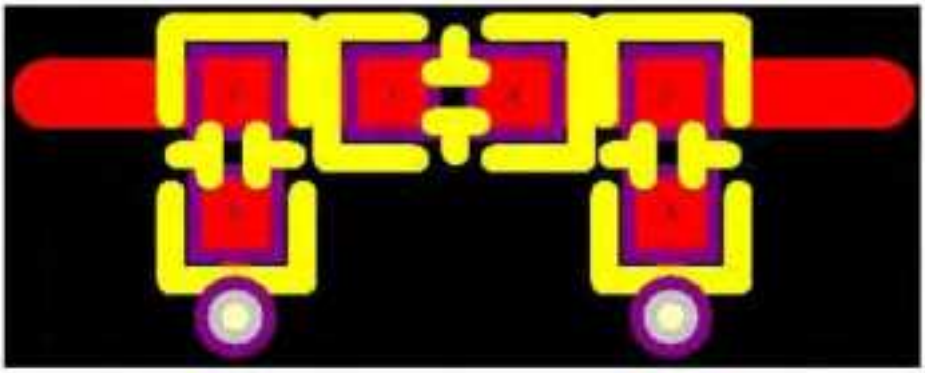


6. Antenna

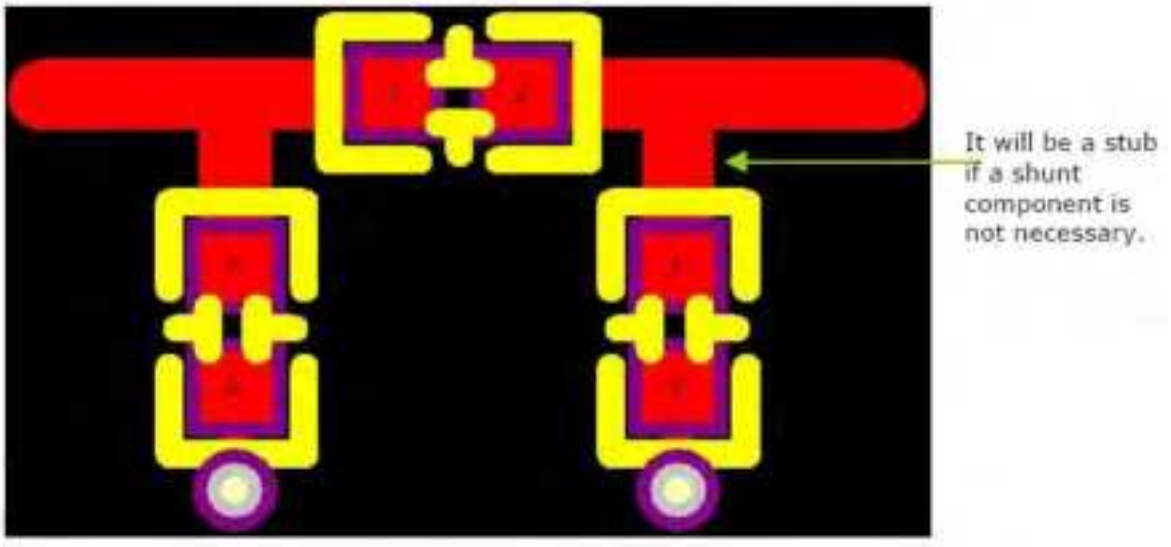
All the high-speed traces should be moved far away from the antenna. For the best radiation performance, check antenna chip vendor for the layout guideline and clearance.

7. Antenna Matching

PCB designer should reserve an antenna matching network for post tuning to ensure the antenna performance in different environments. Matching components should be close to each other. Stubs should also be avoided to reduce parasitic while no shunt component is necessary after tuning.



Correct layout for antenna matching



Incorrent layut for antenna matching

8. SHIELDING CASE

Magnetic shielding, ferrite drum shielding, or magnetic-resin coated shielding is highly recommended to prevent EMI issues.

9. GENERAL LAYOUT GUIDELINES

Follow these guidelines to obtain good signal integrity and avoid EMI:

1. Place components and route signals using the following design practices:
   - Keep analog and digital circuits in separate areas.
   - Identify all high-bandwidth signals and their return paths. Treat all critical signals as current loops. Check each critical loop area before the board is built. A small loop area is more important than short trace lengths.
   - Orient adjacent-layer traces so that they are perpendicular to one another to reduce crosstalk.
   - Keep critical traces on internal layers, where possible, to reduce emissions and improve immunity to external noise.

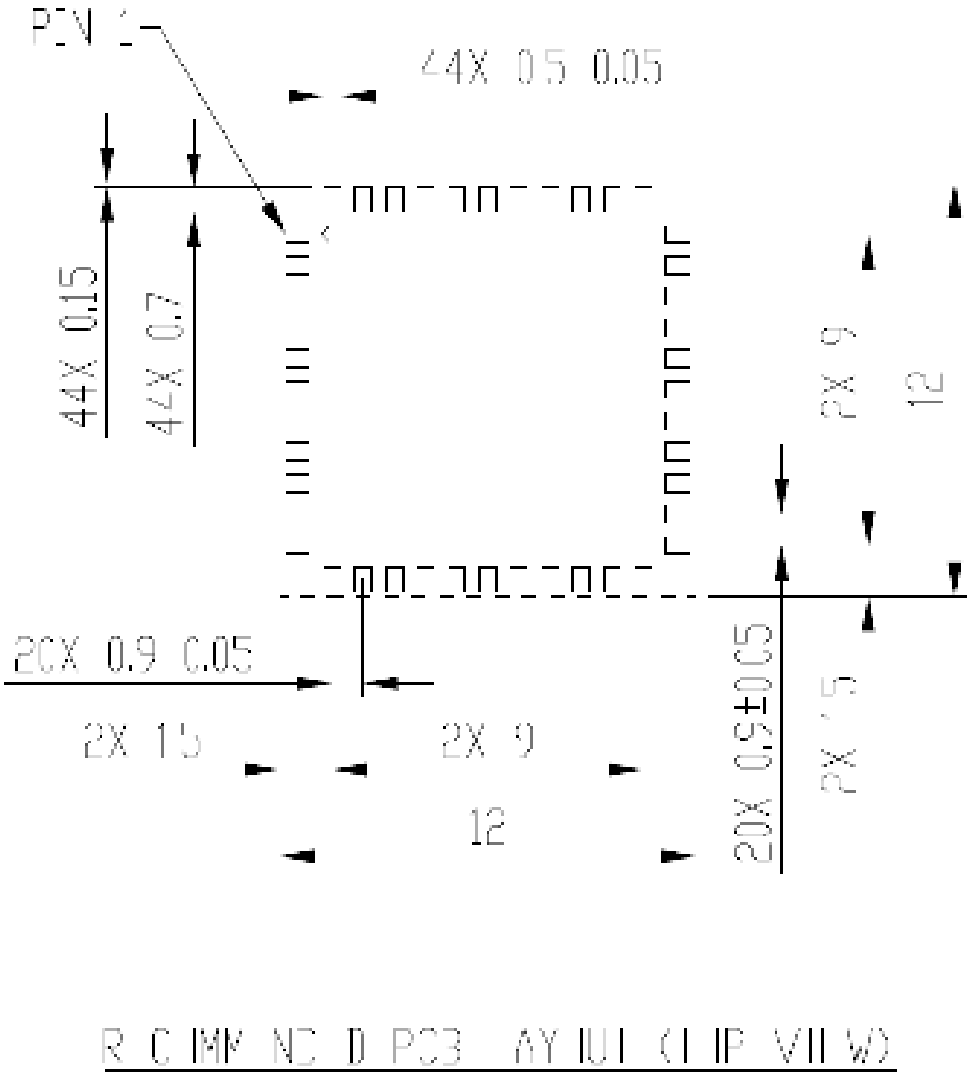
     However, RF traces should be routed on outside layers to avoid the use of vias on these traces.
   - Keep all trace lengths to a practical minimum. Keep traces, especially RF traces, straight wherever possible. Where turns are necessary, use curved traces or two 45-degree turns. Never use 90-degree turns.
2. Consider the following with respect to ground and power supply planes:
   - Route all supply voltages to minimize capacitive coupling to other supplies. Capacitive coupling can occur if supply traces on adjacent layers overlap. Supplies should be separated from each other in the stack-up by a ground plane, or they should be coplanar (routed on different areas of the same layer).
   - Provide an effective ground plane. Keep ground impedance as low as possible. Provide as much ground plane as possible and avoid discontinuities. Use as many ground vias as possible to connect all ground layers together.
   - Maximize the width of power traces. Verify that they are wide enough to support target currents, and that they can do so with margin. Verify that there are enough vias if the traces need to change layers.
3. Consider these power supply decoupling practices:
   - Place decoupling capacitors near target power pins. If possible, keep them on the same side as the IC they decouple to avoid vias that add inductance. If a filter component cannot be directly connected to a given power pin with a very short and fat etch, do not connect it by a copper trace. Instead, make the connection directly to the associated planes using vias.
   - Use appropriate capacitance values for the target circuit, and consider each capacitor's self-resonant frequency.

10. Stamp Module stencil and Pad opening Suggestion

- Stencil thickness：0.10~0.12mm
- Function Pad opening size suggestion: Max. 1:1

PS: This opening suggestion just for customer reference, please discuss with AzureWave's Engineer before you start SMT.

- Solder Printer Opening and Customer PCB Footprint suggestion.
- Example:



11. The other layout guide Information

• Make sure every power traces have good return path (ground path).

• Connect the input pins of unused internal regulators to ground.

• Leave the output pins of unused internal regulators floating.

• High speed interface (i.e. UART/SDIO/HSIC) shall have equal electrical length. Keep them away from noise sensitive blocks.

• Good power integrity of VDDIO will improve the signal integrity of digital interfaces.

• Good return path and well shielded signal can reduce crosstalk, EMI emission and improve signal integrity.

• RF IO is around 50 ohms, reserve Pi or T matching network to have better signal transition from port to port.

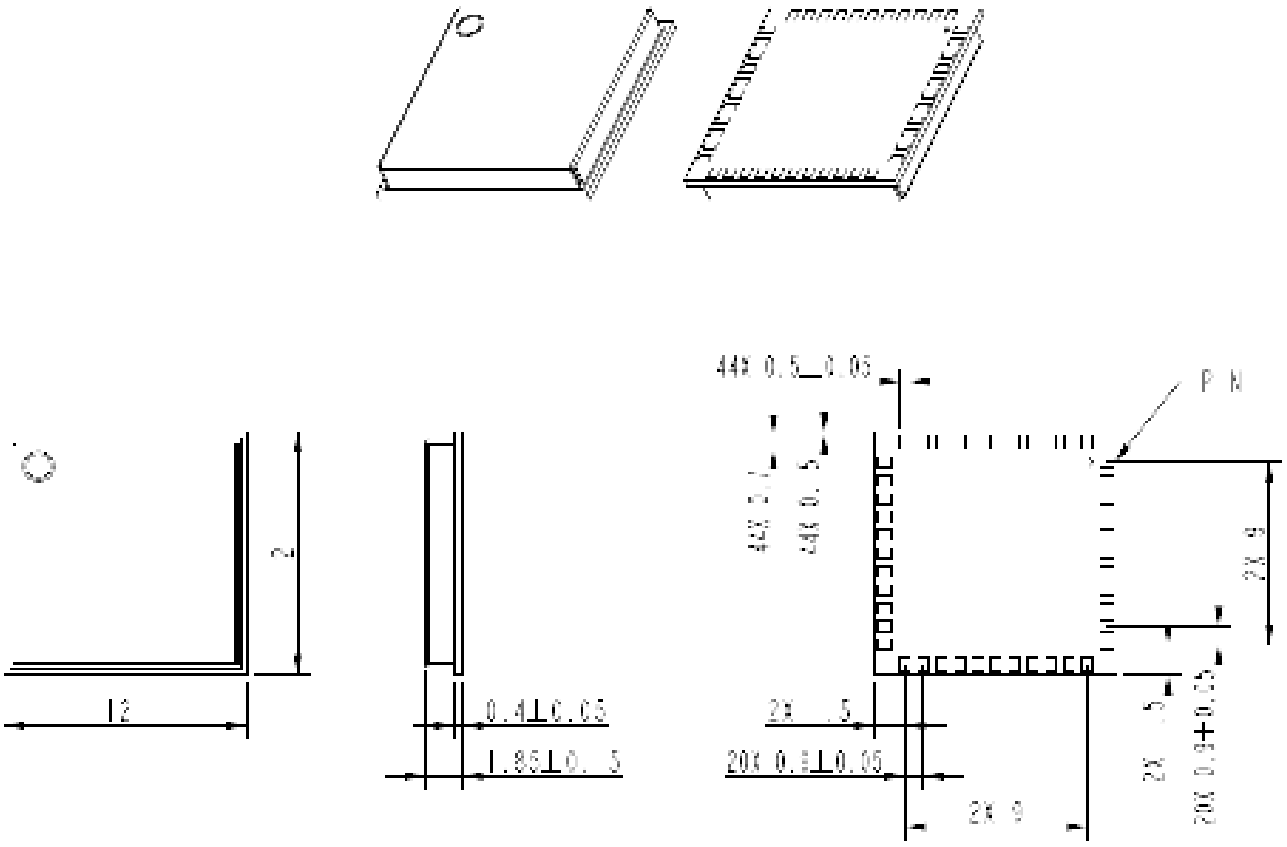
• Smooth RF trace help to reduce insertion loss. Do not use 90 degrees turn (use two 45 degrees turns or one miter bend instead).

• Well arranged ground plane near antenna and antenna itself will help to reduce near field coupling between other RF sources (e.g. GSM/CDMA … antennas).

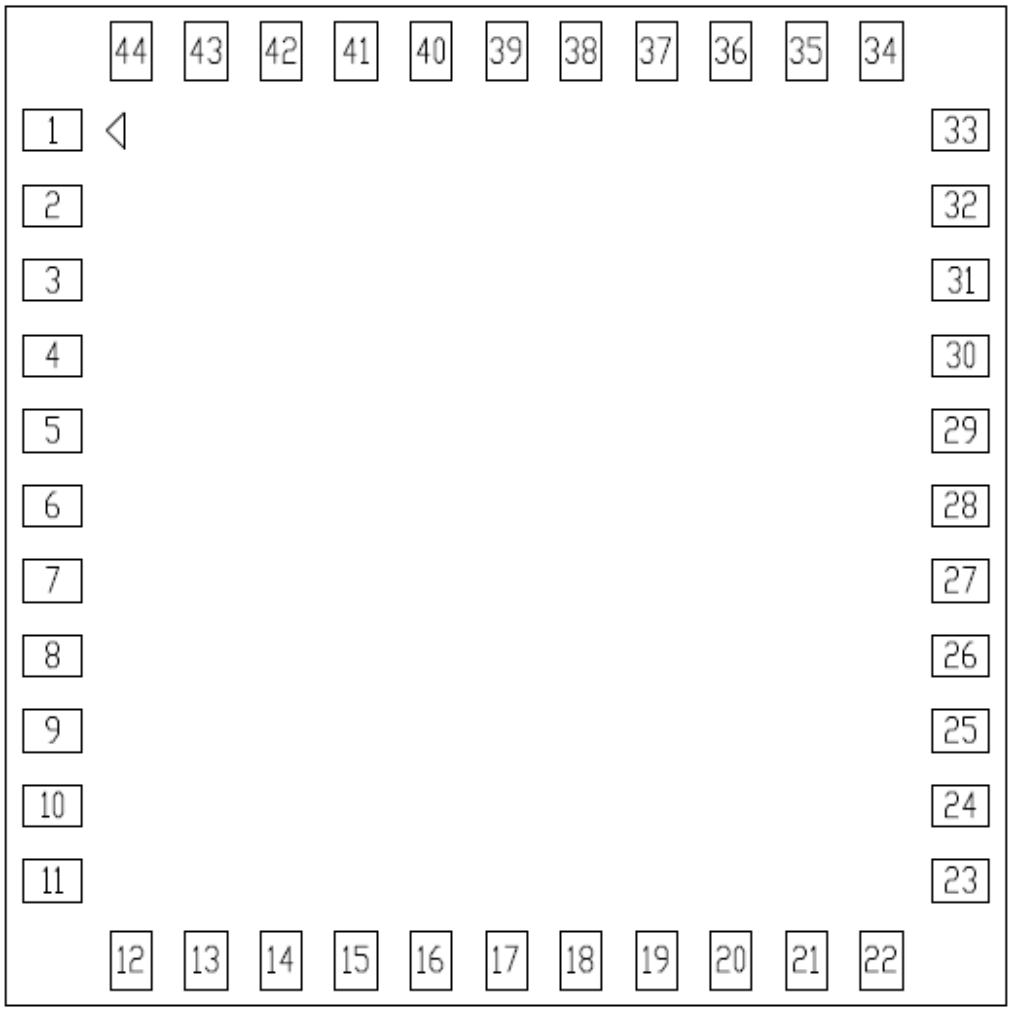
• Discuss with AzureWave Engineer after you finish schematic and layout job.

12. Mechanical Drawing

•Package Outline Drawing



·Bottom View of PCB Layout Foot Print



PIN DEFINED (TOP VIEW)

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.

IMPORTANT NOTE:

This module is intended for OEM integrator. This module is only FCC authorized for the specific rule parts listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed. Additional testing and certification may be necessary when multiple modules are

used.

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.

LABEL OF THE END PRODUCT:
The final end product must be labeled in a visible area with the following " Contains TX FCC ID: TLZ-AM510".

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.

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-AM510] 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-AM510) 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.

Ant.	Port	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	1	Molex	1461531050	Dipole	I-PEX	Note 1
2	1	MAG. LAYERS	MSA-4008-25GC1-A2	PIFA	I-PEX	Note 1
3	1	LYNwave	5-PP005421	PIFA	I-PEX	Note 1

Note1:

Ant.	Antenna Gain (dBi)		
	WLAN 2.4GHz	WLAN 5GHz	Bluetooth
1	3.20	4.25	3.20
2	2.98	5.16	2.98
3	2.90	4.30	2.90

IMPORTANT NOTE:

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.

IMPORTANT NOTE:

This module is intended for OEM integrator. The OEM integrator is responsible for the compliance to all the rules that apply to the product into which this certified RF module is integrated.
Additional testing and certification may be necessary when multiple modules are used.

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-AM510".
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
2	1	MAG. LAYERS	MSA-4008-25GC1-A2	PIFA	I-PEX	Note 1
3	1	LYNwave	5-PP005421	PIFA	I-PEX	Note 1

Note1:

Ant.	Antenna Gain (dBi)		
	WLAN 2.4GHz	**WLAN 5GHz**	**Bluetooth**
1	3.20	4.25	3.20
2	2.98	5.16	2.98
3	2.90	4.30	2.90

5GHz band (W52, W53): Indoor use only (except communicate to high power radio)