AzureWave Technologies, Inc.

AW-XM455

IEEE 802.11 2X2 WiFi 6 MIMO Wireless LAN + Bluetooth 5.3 Combo LGA Module

Datasheet

Rev. F

DF

For Standard

Features

WLAN

- Support 2x2 802.11 a/b/g/n/ac/ax
- Dual bands: 2.4 GHz and 5 GHz
- Support 20/40/80 MHz channel Bandwidths.
- 5GHz PHY data rates up to 1.2 Gbps
- 2.4 GHz PHY data rates up to 458 Mbps
- Uplink and downlink OFDMA and MU-MIMO
- Support DFS

Bluetooth

- Bluetooth 5.1
- Bluetooth class 2
- PCM interface for voice applications
- 2Mbit/s LE
- Long range
- LTE/MWS coexistence
- 2 x wide band speech (WBS) calls
- Security: AES

AzureWave Technologies, Inc.

Revision History

Document NO: R2-24550-DST-01

Version	Revision Date	DCN NO.	Description	Initials	Approved
A	2020/05/26	DCN017597	● Draft version	Renton Tao	N.C Chen
B	2021/02/08	DCN020611	● Update format ● Update features ● Update operating temperature ● Update pin map ● Update Host configuration table	Renton Tao	N.C Chen
C	2021/10/06	DCN023737	● Update block diagram ● Update output power ● Update receiver sensitivity ● Update pin table ● Update Mechanical drawing	Roger Chen	N.C Chen
D	2022/01/28	DCN025432	● Update Shielding Cover Temperature ● Update block diagram ● Update Power Consumption ● Update Power up Sequence	Roger Chen	N.C Chen
E	2022/10/24	DCN027754	● Update Block Diagram ● Update Power Consumption ● Update ESD Protection	Grace Yang	N.C Chen
F	2022/12/01	DCN028153	● Update Power Consumption	Grace Yang	N.C Chen

Table of Contents

1. Introduction

1.1 Product Overview

AzureWave Technologies, Inc. introduces the IEEE 802.11a/b/g/n/ac/ax Concurrent Dual WiFi(CDW) and BT, combo module – **AW-XM455.** With High Efficiency Wireless (HEW) and backward compatible with 802.11ac technologies integrated into a module, AW-XM455 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-XM455, 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/ac/ax standard, the AW-XM455 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-XM455.

The AW-XM455 supports standard interface **PCIe or USB2.0 for WLAN** interface connection, High-Speed **UART or USB2.0 for BT** interface connection. AW-XM455 is suitable for multiple mobile processors for different applications. With the combo functions and the good performance, the AW-XM455 is the best solution for the consumer electronics and the tablet PC.

1.2 Block Diagram

TBD.

1.3 Specifications Table

1.3.1 General

Features	Description
Product Description	IEEE 802.11 2X2 WiFi 6 MIMO Wireless LAN + Bluetooth 5.1 Combo LGA Module
Major Chipset	NXP IW620P
Host Interface	WiFi + BT ● PCIe + UART ● USB2.0 + USB2.0 (For Host configuration interface, please refer to section 2.3)
Dimension	20 mm X 18 mm x 2.82 mm(Max) (Tolerance remarked in mechanical drawing)
Form factor	LGA module, 98 pins
Antenna	2T2R for WiFi, standalone antenna for BT ANT1(Main)：WiFi_A → TX/RX ANT2(Aux)：WiFi_B→ TX/RX ANT3(BT): BT
Weight	1.9g

1.3.2 WLAN

Features	Description
WLAN Standard	IEEE 802.11 a/b/g/n/ac/ax 2T2R
WLAN VID/PID	
WLAN SVID/SPID	TBD
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, 256-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:

<table>
<tr><td></td><td>■ 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</td></tr>
<tr><td>Output Power</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>17</td><td>19</td><td>21</td><td>dBm</td></tr>
<tr><td>11g (54Mbps) @EVM≦-27 dB</td><td>15</td><td>17</td><td>19</td><td>dBm</td></tr>
<tr><td>11n (HT20 MCS7) @EVM≦-28 dB</td><td>14</td><td>16</td><td>18</td><td>dBm</td></tr>
<tr><td>11n (HT40 MCS7) @EVM≦-28 dB</td><td>14</td><td>16</td><td>18</td><td>dBm</td></tr>
<tr><td>11ax (HE20 MCS11) @EVM≦-35 dB</td><td>12</td><td>14</td><td>16</td><td>dBm</td></tr>
<tr><td>11ax (HE40 MCS11) @EVM≦-35 dB</td><td>12</td><td>14</td><td>16</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>
<tr><td>11ac(VHT20 MCS8) @EVM≦-31 dB</td><td>10</td><td>12</td><td>14</td><td>dBm</td></tr>
<tr><td>11ac(VHT40 MCS9) @EVM≦-32 dB</td><td>10</td><td>12</td><td>14</td><td>dBm</td></tr>
<tr><td>11ac(VHT80 MCS9) @EVM≦-32 dB</td><td>10</td><td>12</td><td>14</td><td>dBm</td></tr>
<tr><td>11ax(HE20 MCS11) @EVM≦-35 dB</td><td>6</td><td>8</td><td>10</td><td>dBm</td></tr>
<tr><td>11ax(HE40 MCS11) @EVM≦-35 dB</td><td>6</td><td>8</td><td>10</td><td>dBm</td></tr>
<tr><td>11ax(HE80 MCS11) @EVM≦-35 dB</td><td>6</td><td>8</td><td>10</td><td>dBm</td></tr>
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<table>
<tr><td>Receiver Sensitivity</td><td>
2.4G
<table>
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<tr><td>11b (11Mbps)</td><td>-</td><td>-87</td><td>-84</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>-70</td><td>-67</td><td>dBm</td></tr>
<tr><td>11n (HT40 MCS7)</td><td>-</td><td>-68</td><td>-65</td><td>dBm</td></tr>
<tr><td>11ax(HE20 MCS11)</td><td></td><td>-60</td><td>-57</td><td>dBm</td></tr>
<tr><td>11ax(HE40 MCS11)</td><td></td><td>-58</td><td>-55</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>-69</td><td>-66</td><td>dBm</td></tr>
<tr><td>11n (HT40 MCS7)</td><td>-</td><td>-67</td><td>-64</td><td>dBm</td></tr>
<tr><td>11ac(VHT20 MCS8)</td><td>-</td><td>-64</td><td>-61</td><td>dBm</td></tr>
<tr><td>11ac(VHT40 MCS9)</td><td></td><td>-61</td><td>-58</td><td>dBm</td></tr>
<tr><td>11ac(VHT80 MCS9)</td><td></td><td>-57</td><td>-54</td><td>dBm</td></tr>
<tr><td>11ax(HE20 MCS11)</td><td></td><td>-58</td><td>-55</td><td>dBm</td></tr>
<tr><td>11ax(HE40 MCS11)</td><td></td><td>-56</td><td>-53</td><td>dBm</td></tr>
<tr><td>11ax(HE80 MCS11)</td><td></td><td>-54</td><td>-51</td><td>dBm</td></tr>
</table>
</td></tr>
<tr><td>Data Rate</td><td>■ 802.11b: 1, 2, 5.5, 11Mbps
■ 802.11a/g: 6, 9, 12, 18, 24, 36, 48, 54Mbps
■ 802.11n: up to 150Mbps-single
■ 802.11n: up to 300Mbps-2x2 MIMO
■ 802.11ac:up to 192.6Mbps (20MHz channel)
■ 802.11ac:up to 400Mbps (40MHz channel)
■ 802.11ac:up to 866.7Mbps (80MHz channel)
■ 802.11ax:2.4GHz up to 458Mbps, 5GHz up to 1.2Gbps</td></tr>
<tr><td>Security</td><td>WiFi: WPA/WPA3</td></tr>
</table>

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

1.3.3 Bluetooth

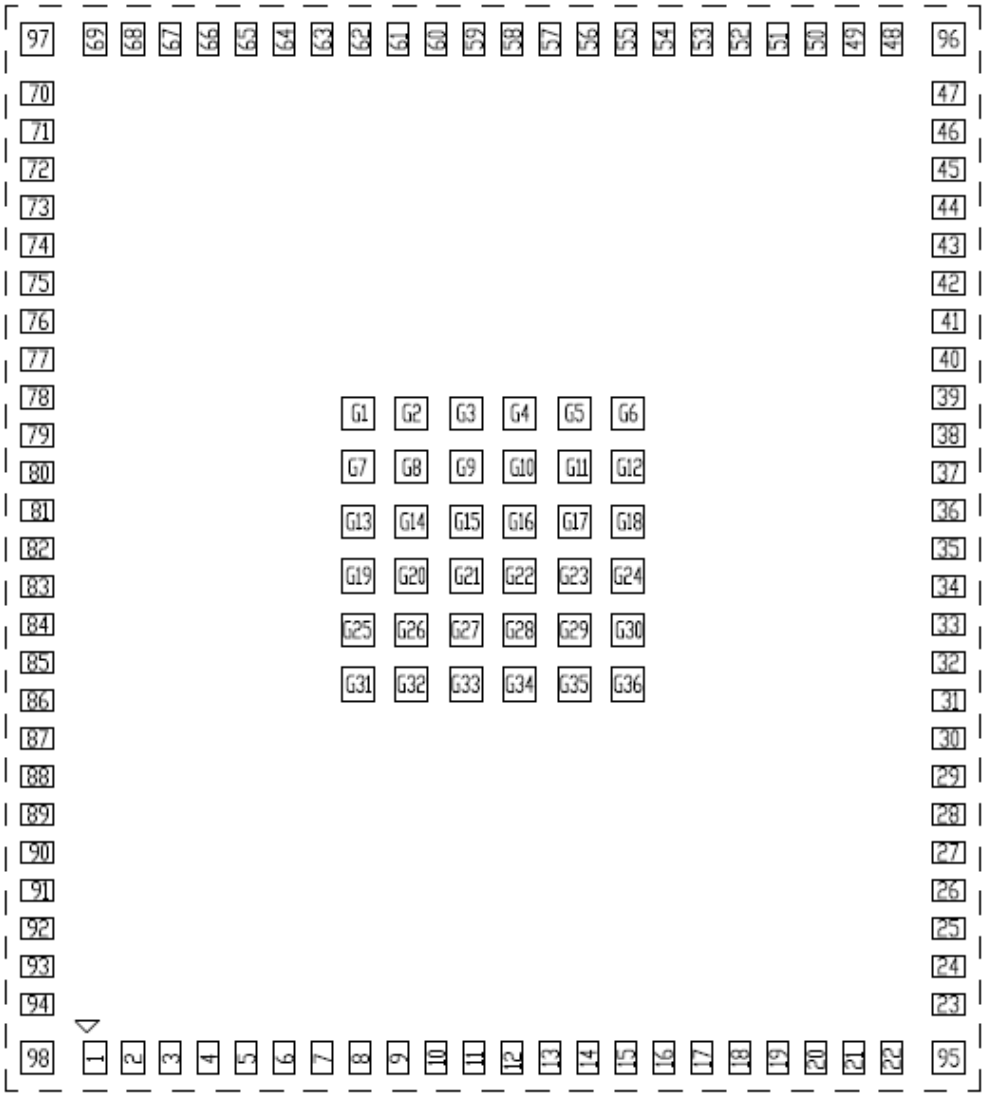
Features	Description
Bluetooth Standard	Bluetooth 5.1
Bluetooth VID/PID	N/A
Frequency Rage	2402MHz~2483MHz
Modulation	Header GFSK Payload 2M: π/4-DQPSK Payload 3M: 8DPSK

Output Power		Min	Typ	Max	Unit
	BDR	0	2	4	dBm
	EDR	0	2	4	dBm
	Low Energy (2MHz)	0	2	4	dBm
Receiver Sensitivity		Min	Typ	Max	Unit
	BDR		-85	-82	dBm
	EDR		-77	-74	dBm
	Low Energy (2MHz)		-82	-79	dBm

1.3.4 Operating Conditions

Features	Description
Operating Conditions	
Voltage	3.3V+-5%
Operating Temperature(T_A)	-10 ℃~ 85℃
Operating Humidity	less than 85% R.H.
Storage Temperature	-40 ℃~ 85℃
Storage Humidity	less than 60% R.H.
ESD Protection	
Human Body Model	±2kV
Changed Device Model	±500V

2.1 Pin Map



AW-XM455 Pin Map (Top View)

2.2 Pin Table

Pin No	Definition	Basic Description	Voltage	Type
1	GPIO[5]	GPIO Mode: GPIO[5]	VDDIO	I/O
2	GPIO[4]	GPIO Mode: GPIO[4]	VDDIO	I/O
3	GPIO[13]	GPIO Mode: GPIO[13]	VDDIO	I/O
4	GND	Ground	---	---
5	PCIE_RCLK_P	PCI Express Differential Clock Input—Positive	1.8V	I
6	PCIE_RCLK_N	PCI Express Differential Clock Input—Negative	1.8V	I
7	GND	Ground	---	---
8	PCIE_TX_P	PCI Express Transmit Data—Positive	1.8V	O
9	PCIE_TX_N	PCI Express Transmit Data—Negative	1.8V	O
10	GND	Ground	---	---
11	PCIE_RX_N	PCI Express Receive Data—Negative	1.8V	I
12	PCIE_RX_P	PCI Express Receive Data—Positive	1.8V	I
13	GND	Ground	---	---
14	USB_DM	USB Serial Differential Data Minus	3.3V	I/O
15	USB_DP	USB Serial Differential Data Plus	3.3V	I/O
16	GND	Ground	---	---
17	NC	NC	---	floating
18	NC	NC	---	floating
19	NC	NC	---	floating
20	NC	NC	---	floating
21	NC	NC	---	floating
22	NC	NC	---	floating
23	NC	NC	---	floating
24	GND	Ground	---	---
25	PCIE_PERSTn	PCIe host indication to reset the device (active low)	VIO	I
26	PCIE_CLKREQn	PCIe clock request (active low)	VIO	I/O
27	PCIE_WAKEn	PCIe wake signal (active low)	VIO	I/O
28	NC	NC	---	floating
29	GND	Ground	---	---
30	UART_RTSn	UART Mode: UART_RTSn (active low)	VDDIO	O
31	UART_CTSn	UART Mode: UART_CTSn (active low)	VDDIO	I
32	UART_RX	UART SIN pin	VDDIO	I
33	UART_TX	UART SOUT.pin	VDDIO	O
34	GPIO[12]	GPIO Mode: GPIO[12]	VDDIO	I/O
35	GPIO[15]	GPIO Mode: GPIO[15]	VDDIO	I/O
36	GPIO[19]	GPIO Mode: GPIO[19]	VDDIO	I/O
37	GPIO[20]	GPIO Mode: GPIO[20]	VDDIO	I/O
38	GPIO[21]	GPIO Mode: GPIO[21]	VDDIO	I/O
39	GPIO[18]	GPIO Mode: GPIO[18]	VDDIO	I/O
40	NC	NC	---	floating
41	NC	NC	---	floating

42	NC	NC	---	floating
43	NC	NC	---	floating
44	NC	NC	---	floating
45	NC	NC	---	floating
46	NC	NC	---	floating
47	NC	NC	---	floating
48	BT_ANT	RF I/O pad for BT	---	I/O
49	GND	Ground	---	---
50	GND	Ground	---	---
51	GND	Ground	---	---
52	WLAN_ANT_2	RF I/O pad for WLAN ANT 2	---	I/O
53	GND	Ground	---	---
54	GND	Ground	---	---
55	GND	Ground	---	---
56	GND	Ground	---	---
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	WLAN_ANT_1	RF I/O pad for WLAN ANT 1	---	I/O
70	3V3	3.3V DC power supply	3.3V	I
71	3V3	3.3V DC power supply	3.3V	I
72	GND	Ground	---	---
73	CON[0]	Firmware Boot Options. See below table*	VIO	I
74	CON[1]	Firmware Boot Options. See below table*	VIO	I
75	CON[2]	Firmware Boot Options. See below table*	VIO	I
76	NC	NC	---	floating
77	CON[7]	RF Control 4	1.8V	I
78	CONFIG_XTAL_SEL	RF Control 6	1.8V	I
79	GND	Ground	---	---
80	RF_CNTL7	RF Control 7 / Sleep Clock 32k	1.8V	I
81	GPIO[16]	GPIO Mode: GPIO[16]	VDDIO	I/O
82	GPIO[3]	GPIO Mode: GPIO[3]	VDDIO	I/O
83	GND	Ground	---	---
84	PDn	Full Power-down input pin (active low)	3.3V	I

		0 = full power-down mode 1 = normal mode		
85	CON[13]	RF Control 5	VDDIO	I/O
86	GPIO[0]	GPIO Mode: GPIO[0]	VDDIO	I/O
87	GPIO[2]	GPIO Mode: GPIO[2]	VDDIO	I/O
88	GPIO[14]	GPIO Mode: GPIO[14]	VDDIO	I/O
89	GPIO[7]	GPIO Mode: GPIO[7]	VDDIO	I/O
90	VIO	Digital I/O power supply	1.8 or 3.3V	I
91	GND	Ground	---	---
92	1V8	1.8V DC output (reserved only)	1.8V	O
93	1V8	1.8V DC output (reserved only)	1.8V	O
94	GPIO[6]	GPIO Mode: GPIO[6]	VDDIO	I/O
95	GND	Ground	---	---
96	GND	Ground	---	---
97	GND	Ground	---	---
98	GND	Ground	---	---
G1~36	GND	Ground	---	---

2.3 Host Configuration Interface Table

Strap Value	WLAN	Bluetooth/LE
011	PCIe	UART
110	USB	USB

*Firmware Boot options

3. Electrical Characteristics

3.1 Absolute Maximum Ratings

Symbol	Parameter	Minimum	Typical	Maximum	Unit
3V3	DC supply for the 3.3V input	-	3.3	3.63	V
VIO	I/O power supply	-	3.3	3.63	V
		-	1.8	1.98	

3.2 Recommended Operating Conditions

Symbol	Parameter	Minimum	Typical	Maximum	Unit
3V3	DC supply for the 3.3V input	3.14	3.3	3.46	V
VIO	I/O power supply	3.14	3.3	3.46	V
		1.71	1.8	1.89	

3.3 Digital IO Pin DC Characteristics

3.3.1 1.8/3.3V 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			

3.4 Host Interface

3.4.1 PCI Express Interface

3.4.1.1 Differential Tx Output Electricals

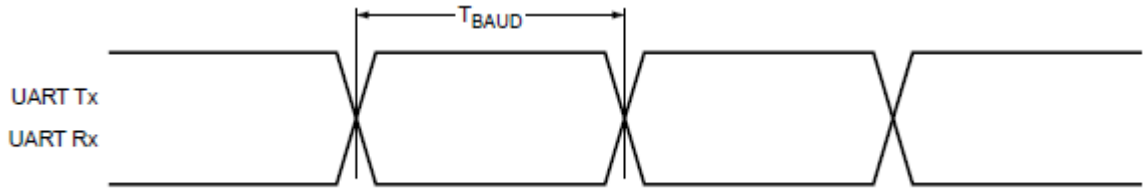
Symbol	Parameter	Min	Typ	Max	Units
UI	Unit interval Each UI is 400 ps ±300 PPM. UI does not account for SSC dictated variations.	399.98	400	400.12	ps
V_{Tx_DIFFpp}	Differential peak-to-peak output voltage $V_{Tx\_DIFFpp} = 2*\|V_{TX-D+} - V_{TX-D-}\|$	0.800	--	1.2	V
$V_{Tx\_DE\_RATIO}$	De-emphasized differential output voltage (ratio)	-3.0	-3.5	-4.0	db
T_{Rx_EYE}	Minimum Tx eye width	0.75	--	--	UI
$T_{Rx\_EYE\_MEDIAN\_MAX\_JIT}$	Maximum time between jitter median and maximum deviation from median	--	--	0.125	UI
T_{Tx_RISE}, T_{Tx_FALL}	D+/D- Tx output rise/fall time	0.125	--	--	UI
$V_{Tx\_CM\_DC\_ACTIVE\_IDLE\_DELTA}$	Absolute delta of DC common mode voltage during L0 and electrical idle	0-	-	100	mV
$V_{Tx\_CM\_DC\_LINE\_DELTA}$	Absolute delta of DC common mode voltage between D+ and D-	0-	-	25	mV
$V_{Tx\_IDLE\_DIFFp}$	Electrical idle differential peak output voltage	0	--	20	mV
$V_{Tx\_RCV\_DETECT}$	Voltage change allowed during receiver detection	--	--	600	mV
$V_{Tx\_DC\_CM}$	Tx DC common mode voltage	--	--	3.6	V
I_{Tx_SHORT}	Tx short circuit current limit	--	--	90	mA
$T_{Tx\_IDLE\_MIN}$	Minimum time spent in electrical idle	50	--	--	UI
$T_{Tx\_IDLE\_SET\_TO\_IDLE}$	Maximum time to transition to a valid electrical idle after sending an electrical idle ordered set	--	--	20	UI
$T_{Tx\_IDLE\_TO\_DIFF\_DATA}$	Maximum time to transition to valid Tx specifications after leaving an electrical idle condition	--	--	20	UI
RL_{Tx_DIFF}	Differential return loss	10	--	--	dB
RL_{Tx_CM}	Common mode return loss	6	--	--	dB
C_{Tx}	AC coupling capacitor	75	--	200	nF
$T_{Crosstalk}$	Crosstalk random timeout	0	--	1	ms

3.4.1.2 Differential Rx input Electricals

Symbol	Parameter	Min	Typ	Max	Units
UI	Unit interval Each UI is 400 ps ±300 ppm. UI does not account for SSC dictated variations.	399.98	400	400.12	ps
V_{Rx_DIFFpp}	Differential peak-to-peak voltage $V_{Rx\_DIFFpp} = 2*\|V_{RX-D+} - V_{RX-D-}\|$	0.175	--	1.2	V
T_{Rx_EYE}	Minimum receiver eye width	0.4	--	--	UI
$T_{Rx\_EYE\_MEDIAN\_MAX\_JIT}$	Maximum time between jitter median and maximum deviation from median	--	--	0.3	UI
$V_{Rx\_CM\_ACp}$	AC peak common mode input voltage	--	--	150	mV
RL_{Rx_DIFF}	Differential return loss	10	--	--	dB
RL_{Rx_CM}	Common mode return loss	6	--	--	dB
$Z_{Rx\_DIFF\_DC}$	DC differential input impedance	80	100	120	Ω
Z_{Rx_DC}	DC input impedance	40	50	60	Ω
$Z_{Rx\_HIGH\_IMP\_DC\_POS}$	Powered down DC input impedance positive	50	--	--	k
$Z_{Rx\_HIGH\_IMP\_DC\_NEG}$	Powered down DC input impedance negative	1	--	--	kΩ
$V_{Rx\_IDLE\_DET\_DIFFpp}$	Electrical idle detect threshold	65	--	175	mV
$T_{Rx\_IDLE\_DET\_DIFF\_ENTERTIME}$	Unexpected electrical idle enter detect threshold integration time	--	--	10	ms
L_{Rx_SKEW}	Total skew	---	-2	0	ns

3.4.2 High-Speed UART Interface

The AW-XM455 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.



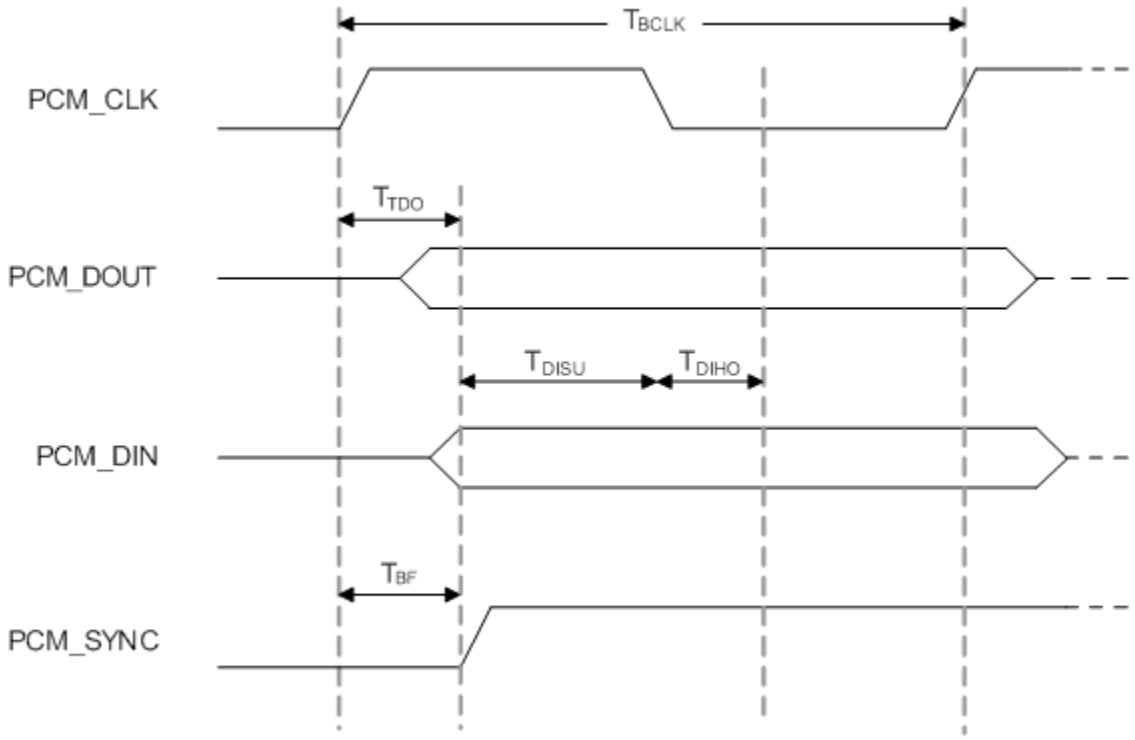
Symbol	Parameter	Condition	Min	Typ	Max	Units

.

T_{BAUD}	Baud rate	26MHz input clock	250	-	-	ns

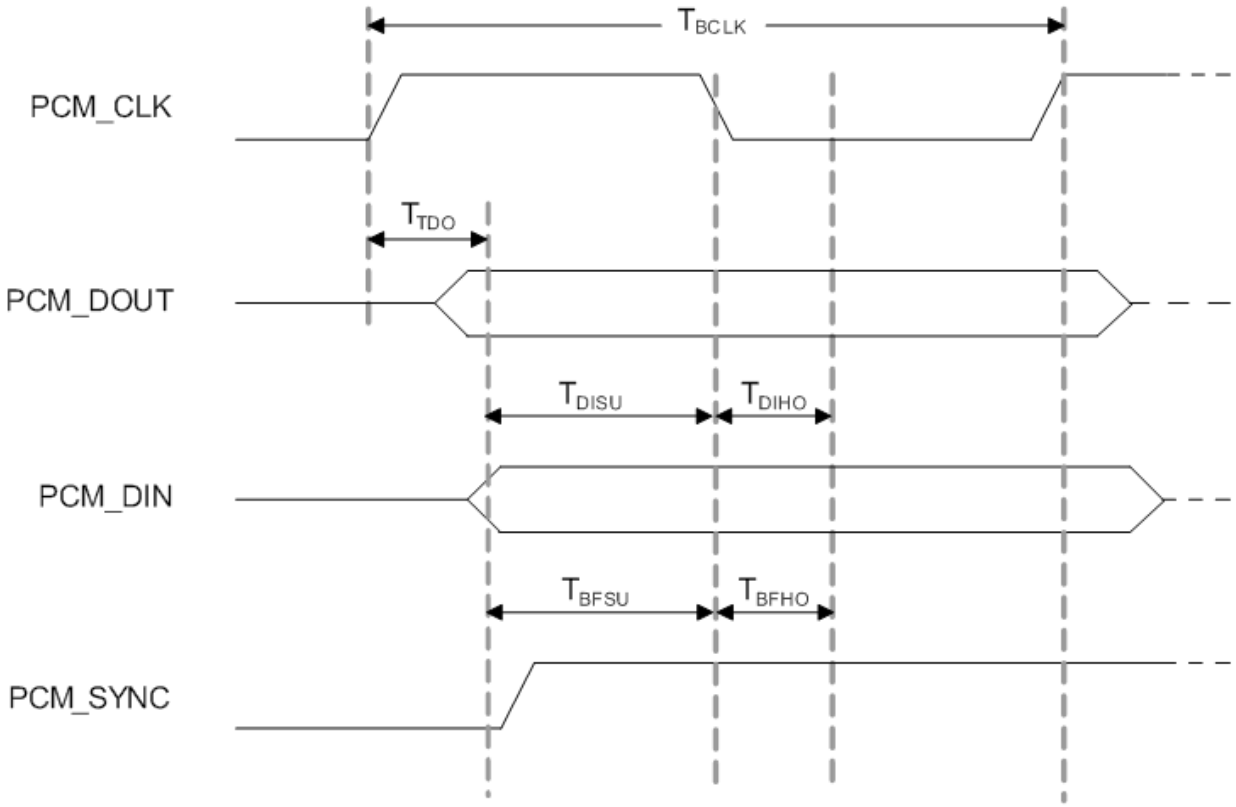
3.4.3 PCM Interface

3.4.3.1 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

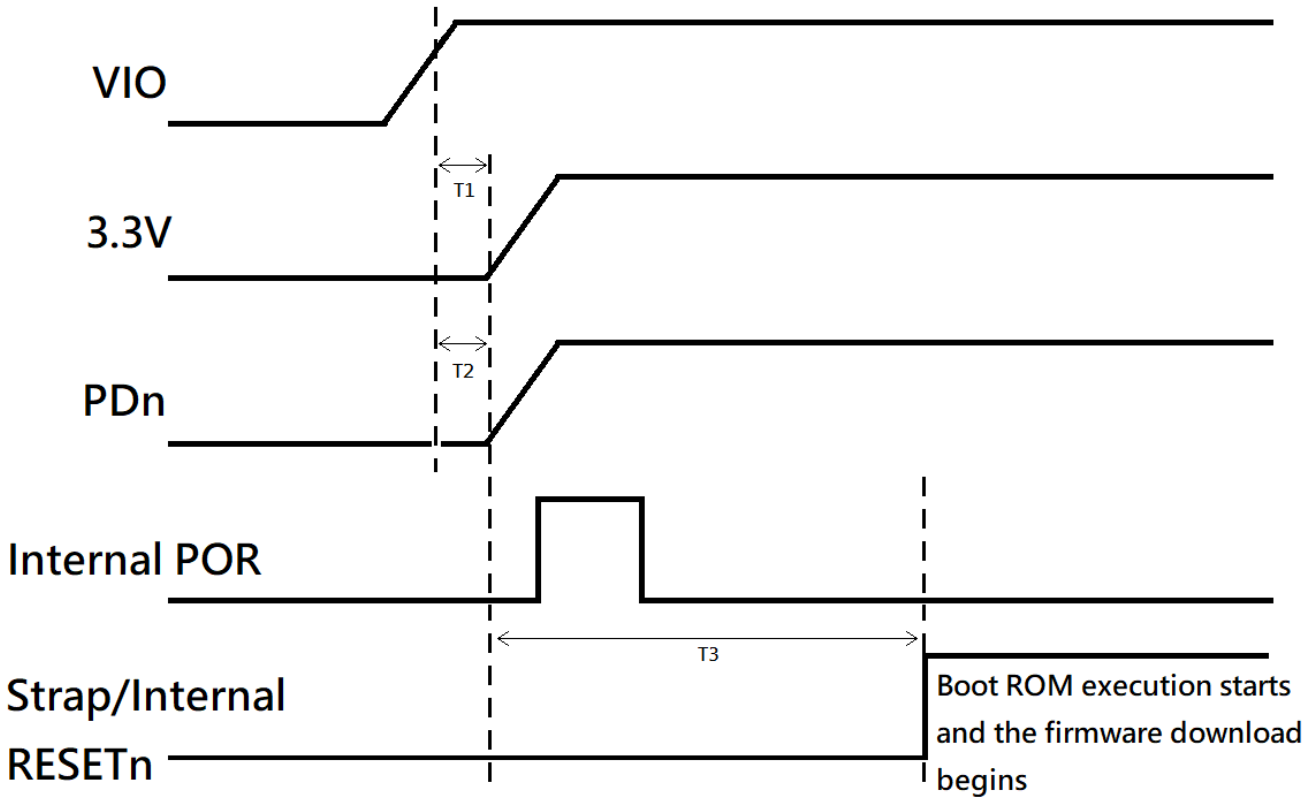
3.4.3.2 PCM Timing Specification – Slave Mode



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

3.5 Timing Sequence

AW-XM455 power up timing sequence.



Symbol	Description	Min	Typ	Max	Units
T1	Delay from VIO high (at least 90%) to start of 3.3V ramp-up	0	--	--	ms
T2	Delay from VIO high (at least 90%) to start of PDn ramp-up	0	--	--	ms
T3	Delay from PDn high (90%) to start of Boot ROM	--	10	--	ms

3.6 Power Consumption*

3.6.1 WLAN

No.	Item			VBAT_IN=3.3V(mA)		
				Max.		Avg.
1	Pdn			0.3		0.3
2	Deepsleep (usbsuspend)			0.7		0.7
3	Power Save 2.4GHz (DTIM-1)			136		26
4	Power Save 5GHz (DTIM-1)			181		25
Band (GHz)	Mode	BW (MHz)	RF Power (dBm)	Transmit(mA)		
				Max.	Avg.	Duty Mean (%)
2.4	11b@1Mbps	20	19	358	357	99
	11g@54Mbps	20	17	318	317	87
	11n@MCS8	40	16	546	544	93
	11n@MCS15	40	16	494	493	73
	11ax@MCS0	40	14	502	501	92
	11ax@MCS11	40	14	459	458	74
5	11a@6Mbps	20	16	400	399	98
	11n@MCS8	40	14	639	636	93
	11n@MCS15	40	14	577	576	73
	11ac@MSC0 NSS2	20	12	597	596	96
	11ac@MSC8 NSS2	20	12	549	548	78
	11ac@MSC0 NSS2	40	12	602	600	93
	11ac@MSC9 NSS2	40	12	545	544	72
	11ac@MSC0 NSS2	80	12	618	617	88
	11ac@MSC9 NSS2	80	12	555	554	67
	11ax@MSC0 NSS0	20	8	515	514	95
	11ax@MSC11 NSS2	20	8	480	479	76
	11ax@MSC0 NSS0	40	8	523	522	92
	11ax@MSC11 NSS2	40	8	481	480	74
	11ax@MSC0 NSS0	80	8	539	538	87
	11ax@MSC11 NSS2	80	8	501	500	71
Band (GHz)	Mode	BW(MHz)		Receive(mA)		
				Max.		Avg.
2.4	11b@11Mbps	20		134		128
	11n@MCS15	40		161		160
	11ax@MCS11 NSS2	40		159		155
5	11a@54Mbps	20		164		164
	11n@MCS15	40		183		182
	11ac@MCS9 NSS2	80		226		225
	11ax@MCS11 NSS2	80		220		219

No.	Item			VIO_1.8V(uA)	
				Max	Avg
1	Pdn			2.5	2.5
2	Deepsleep (usbsuspend)			25	25
3	Power Save 2.4GHz (DTIM-1)			65	65
4	Power Save 5GHz (DTIM-1)			65	65
Band (GHz)	Mode	BW (MHz)	RF Power (dBm)	Transmit(uA)	
				Max.	Avg.
2.4	11b@1Mbps	20	19	59	59
	11ax@MCS11 NSS2	40	14	59	59
5	11a@6Mbps	20	16	59	59
	11ax@MSC11 NSS2	80	8	59	59
Band (GHz)	Mode	BW(MHz)		Receive(uA)	
				Max.	Avg.
2.4	11b@11Mbps	20		59	59
	11ax@MCS11 NSS2	80		59	59

No.	Item			VIO_3.3V(uA)	
				Max.	Avg.
1	Pdn			7.8	7.8
2	Deepsleep (usbsuspend)			159	158
3	Power Save 2.4GHz (DTIM-1)			346	344
4	Power Save 5GHz (DTIM-1)			347	344
Band (GHz)	Mode	BW (MHz)	RF Power (dBm)	Transmit(uA)	
				Max.	Avg.
2.4	11b@1Mbps	20	19	348	346
	11ax@MCS11 NSS2	40	14	353	351
5	11a@6Mbps	20	16	349	348
	11ax@MSC11 NSS2	80	8	354	352
Band (GHz)	Mode	BW(MHz)		Receive(uA)	
				Max.	Avg.
2.4	11b@11Mbps	20		338	338
	11ax@MCS11 NSS2	80		342	341

3.6.2 Bluetooth

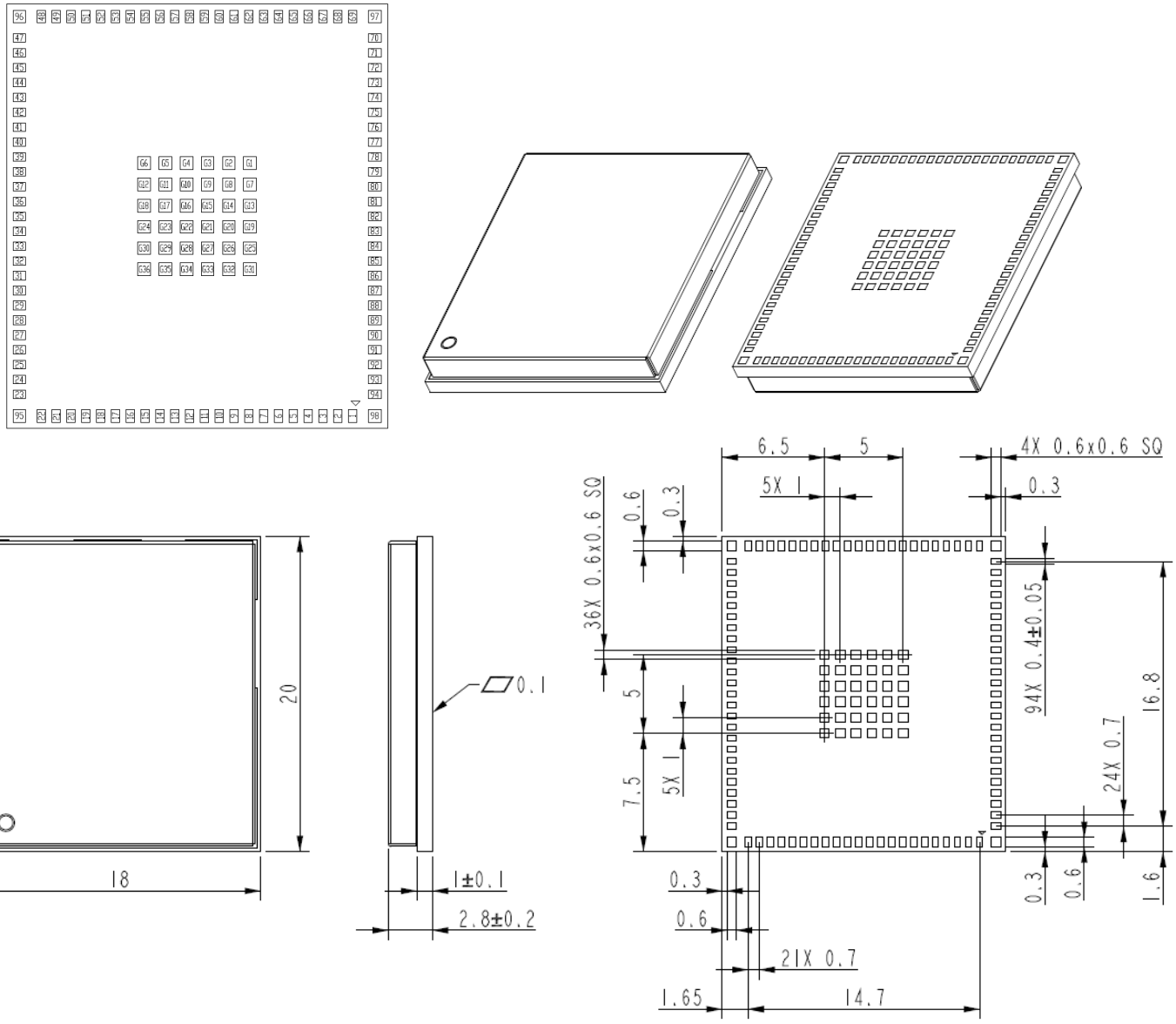
No.	Mode	Packet Type	RF Power (dBm)	VBAT_3.3V (mA)	
				Max.	Avg.
1	Deepsleep (usbsuspend)	N/A		0.7	0.6
2	Transmit	DH5	2	36	34
3	Receive	DH5	N/A	34	32

No.	Mode	Packet Type	RF Power (dBm)	VIO_3.3V (uA)	
				Max.	Avg.
1	Deepsleep (usbsuspend)	N/A		154	154
2	Transmit	DH5	2	328	328
3	Receive	DH5	N/A	328	328

No.	Mode	Packet Type	RF Power (dBm)	VIO_1.8V (uA)	
				Max.	Avg.
1	Deepsleep (usbsuspend)	N/A		25	25
2	Transmit	DH5	2	64	64
3	Receive	DH5	N/A	64	64

4. Mechanical Information

4.1 Mechanical Drawing

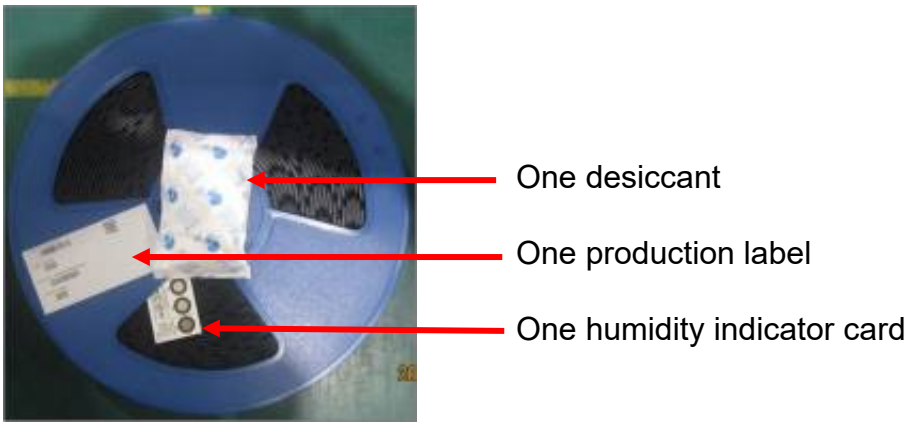


AW-XM455 (Bottom View)

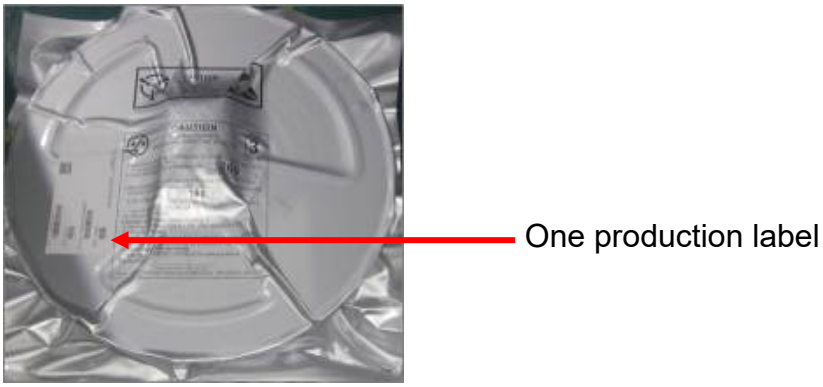
5. Packing Information

1. One reel can pack 650pcs AW-XM455 LGA 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 (出貨標籤的範例)	AzureWave AzureWave Technologies Inc. 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 (箱號標籤)	BOX0012018
Example of production label (生產標籤)	P/N: D/C: 1309 PCK NO.: PCKNO0069097 QTY: 294 BAG SEAL DATE: _____

.

FCC:

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.

IMPORTANT NOTE:

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.

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

USERS MANUAL OF THE END PRODUCT:

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

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

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

LABEL OF THE END PRODUCT:
The final end product must be labeled in a visible area with the following " Contains TX FCC ID: TLZ-XM455".

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.

IC:
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-XM455] 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-XM455) 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.

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.
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-XM455 ".

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.

JP:

W52/W53 屋内使用限定

Ant list

Ant.	Port			Brand	Model Name	Antenna Type	Connector	Gain (dBi)
	WLAN 2.4GHz	WLAN 5GHz	Bluetooth					
1	1/2	1/2	1	MAG. LAYERS	MSA-4008-25GC1-A2	PIFA	I-PEX	Note 1
2	1/2	1/2	1	SONY	IW611-IW620-D(100)	Dipole	I-PEX	
3	-	-	-	SONY	IW611-IW620-D(110)	Dipole	I-PEX	
4	-	-	-	SONY	IW611-IW620-D(120)	Dipole	I-PEX	
5	-	-	-	SONY	IW611-IW620-D(130)	Dipole	I-PEX	
6	-	-	-	SONY	IW611-IW620-D(140)	Dipole	I-PEX	
7	-	-	-	SONY	IW611-IW620-D(150)	Dipole	I-PEX	
8	-	-	-	SONY	IW611-IW620-D(160)	Dipole	I-PEX	
9	-	-	-	SONY	IW611-IW620-D(170)	Dipole	I-PEX	
10	-	-	-	SONY	IW611-IW620-D(180)	Dipole	I-PEX	
11	-	-	-	SONY	IW611-IW620-D(190)	Dipole	I-PEX	
12	-	-	-	SONY	IW611-IW620-D(200)	Dipole	I-PEX	
13	-	-	-	SONY	IW611-IW620-D(210)	Dipole	I-PEX	
14	-	-	-	SONY	IW611-IW620-D(220)	Dipole	I-PEX	
15	-	-	-	SONY	IW611-IW620-D(230)	Dipole	I-PEX	
16	-	-	-	SONY	IW611-IW620-D(240)	Dipole	I-PEX	
17	-	-	-	SONY	IW611-IW620-D(250)	Dipole	I-PEX	
18	-	-	-	SONY	IW611-IW620-D(260)	Dipole	I-PEX	
19	-	-	-	SONY	IW611-IW620-D(270)	Dipole	I-PEX	
20	-	-	-	SONY	IW611-IW620-D(280)	Dipole	I-PEX	
21	-	-	-	SONY	IW611-IW620-D(290)	Dipole	I-PEX	
22	-	-	-	SONY	IW611-IW620-D(300)	Dipole	I-PEX	
23	-	-	-	SONY	IW611-IW620-D(310)	Dipole	I-PEX	
24	-	-	-	SONY	IW611-IW620-D(320)	Dipole	I-PEX	

25	-	-	-	SONY	IW611-IW620-D(330)	Dipole	I-PEX	Note 1
26	-	-	-	SONY	IW611-IW620-D(340)	Dipole	I-PEX	
27	-	-	-	SONY	IW611-IW620-D(350)	Dipole	I-PEX	
28	-	-	-	SONY	IW611-IW620-D(360)	Dipole	I-PEX	
29	-	-	-	SONY	IW611-IW620-D(370)	Dipole	I-PEX	
30	-	-	-	SONY	IW611-IW620-D(380)	Dipole	I-PEX	
31	-	-	-	SONY	IW611-IW620-D(390)	Dipole	I-PEX	
32	-	-	-	SONY	IW611-IW620-D(400)	Dipole	I-PEX	
33	-	-	-	SONY	IW611-IW620-D(410)	Dipole	I-PEX	
34	-	-	-	SONY	IW611-IW620-D(420)	Dipole	I-PEX	
35	-	-	-	SONY	IW611-IW620-D(430)	Dipole	I-PEX	
36	-	-	-	SONY	IW611-IW620-D(440)	Dipole	I-PEX	
37	-	-	-	SONY	IW611-IW620-D(450)	Dipole	I-PEX	
38	-	-	-	SONY	IW611-IW620-D(460)	Dipole	I-PEX	
39	-	-	-	SONY	IW611-IW620-D(470)	Dipole	I-PEX	
40	-	-	-	SONY	IW611-IW620-D(480)	Dipole	I-PEX	
41	-	-	-	SONY	IW611-IW620-D(490)	Dipole	I-PEX	
42	-	-	-	SONY	IW611-IW620-D(500)	Dipole	I-PEX	
43	-	-	-	SONY	IW611-IW620-D(510)	Dipole	I-PEX	
44	-	-	-	SONY	IW611-IW620-D(520)	Dipole	I-PEX	
45	-	-	-	SONY	IW611-IW620-D(530)	Dipole	I-PEX	
46	-	-	-	SONY	IW611-IW620-D(540)	Dipole	I-PEX	
47	-	-	-	SONY	IW611-IW620-D(550)	Dipole	I-PEX	
48	-	-	-	SONY	IW611-IW620-D(560)	Dipole	I-PEX	
49	-	-	-	SONY	IW611-IW620-D(570)	Dipole	I-PEX	
50	-	-	-	SONY	IW611-IW620-D(580)	Dipole	I-PEX	
51	-	-	-	SONY	IW611-IW620-D(590)	Dipole	I-PEX	
52	-	-	-	SONY	IW611-IW620-D(600)	Dipole	I-PEX	
53	-	-	-	SONY	IW611-IW620-D(610)	Dipole	I-PEX	
54	-	-	-	SONY	IW611-IW620-D(620)	Dipole	I-PEX	
55	-	-	-	SONY	IW611-IW620-D(630)	Dipole	I-PEX	
56	-	-	-	SONY	IW611-IW620-D(640)	Dipole	I-PEX	
57	-	-	-	SONY	IW611-IW620-D(650)	Dipole	I-PEX	
58	-	-	-	SONY	IW611-IW620-D(660)	Dipole	I-PEX	
59	-	-	-	SONY	IW611-IW620-D(670)	Dipole	I-PEX	
60	-	-	-	SONY	IW611-IW620-D(680)	Dipole	I-PEX	
61	-	-	-	SONY	IW611-IW620-D(690)	Dipole	I-PEX	
62	-	-	-	SONY	IW611-IW620-D(700)	Dipole	I-PEX	
63	-	-	-	SONY	IW611-IW620-D(710)	Dipole	I-PEX	
64	-	-	-	SONY	IW611-IW620-D(720)	Dipole	I-PEX	
65	-	-	-	SONY	IW611-IW620-D(730)	Dipole	I-PEX	
66	-	-	-	SONY	IW611-IW620-D(740)	Dipole	I-PEX	
67	-	-	-	SONY	IW611-IW620-D(750)	Dipole	I-PEX	

68	-	-	-	SONY	IW611-IW620-D(760)	Dipole	I-PEX	
69	-	-	-	SONY	IW611-IW620-D(770)	Dipole	I-PEX	
70	-	-	-	SONY	IW611-IW620-D(780)	Dipole	I-PEX	
71	-	-	-	SONY	IW611-IW620-D(790)	Dipole	I-PEX	
72	-	-	-	SONY	IW611-IW620-D(800)	Dipole	I-PEX	
73	-	-	-	SONY	IW611-IW620-G(100)	Dipole	I-PEX	
74	-	-	-	SONY	IW611-IW620-G(110)	Dipole	I-PEX	
75	-	-	-	SONY	IW611-IW620-G(120)	Dipole	I-PEX	
76	-	-	-	SONY	IW611-IW620-G(130)	Dipole	I-PEX	
77	-	-	-	SONY	IW611-IW620-G(140)	Dipole	I-PEX	
78	-	-	-	SONY	IW611-IW620-G(150)	Dipole	I-PEX	
79	-	-	-	SONY	IW611-IW620-G(160)	Dipole	I-PEX	
80	-	-	-	SONY	IW611-IW620-G(170)	Dipole	I-PEX	
81	-	-	-	SONY	IW611-IW620-G(180)	Dipole	I-PEX	
82	-	-	-	SONY	IW611-IW620-G(190)	Dipole	I-PEX	
83	-	-	-	SONY	IW611-IW620-G(200)	Dipole	I-PEX	
84	-	-	-	SONY	IW611-IW620-G(210)	Dipole	I-PEX	
85	-	-	-	SONY	IW611-IW620-G(220)	Dipole	I-PEX	
86	-	-	-	SONY	IW611-IW620-G(230)	Dipole	I-PEX	
87	-	-	-	SONY	IW611-IW620-G(240)	Dipole	I-PEX	
88	-	-	-	SONY	IW611-IW620-G(250)	Dipole	I-PEX	Note 1
89	-	-	-	SONY	IW611-IW620-G(260)	Dipole	I-PEX	
90	-	-	-	SONY	IW611-IW620-G(270)	Dipole	I-PEX	
91	-	-	-	SONY	IW611-IW620-G(280)	Dipole	I-PEX	
92	-	-	-	SONY	IW611-IW620-G(290)	Dipole	I-PEX	
93	-	-	-	SONY	IW611-IW620-G(300)	Dipole	I-PEX	
94	-	-	-	SONY	IW611-IW620-G(310)	Dipole	I-PEX	
95	-	-	-	SONY	IW611-IW620-G(320)	Dipole	I-PEX	
96	-	-	-	SONY	IW611-IW620-G(330)	Dipole	I-PEX	
97	-	-	-	SONY	IW611-IW620-G(340)	Dipole	I-PEX	
98	-	-	-	SONY	IW611-IW620-G(350)	Dipole	I-PEX	
99	-	-	-	SONY	IW611-IW620-G(360)	Dipole	I-PEX	
100	-	-	-	SONY	IW611-IW620-G(370)	Dipole	I-PEX	
101	-	-	-	SONY	IW611-IW620-G(380)	Dipole	I-PEX	
102	-	-	-	SONY	IW611-IW620-G(390)	Dipole	I-PEX	
103	-	-	-	SONY	IW611-IW620-G(400)	Dipole	I-PEX	
104	-	-	-	SONY	IW611-IW620-G(410)	Dipole	I-PEX	
105	-	-	-	SONY	IW611-IW620-G(420)	Dipole	I-PEX	
106	-	-	-	SONY	IW611-IW620-G(430)	Dipole	I-PEX	
107	-	-	-	SONY	IW611-IW620-G(440)	Dipole	I-PEX	
108	-	-	-	SONY	IW611-IW620-G(450)	Dipole	I-PEX	
109	-	-	-	SONY	IW611-IW620-G(460)	Dipole	I-PEX	
110	-	-	-	SONY	IW611-IW620-G(470)	Dipole	I-PEX	

111	-	-	-	SONY	IW611-IW620-G(480)	Dipole	I-PEX	Note 1
112	-	-	-	SONY	IW611-IW620-G(490)	Dipole	I-PEX	
113	-	-	-	SONY	IW611-IW620-G(500)	Dipole	I-PEX	
114	-	-	-	SONY	IW611-IW620-G(510)	Dipole	I-PEX	
115	-	-	-	SONY	IW611-IW620-G(520)	Dipole	I-PEX	
116	-	-	-	SONY	IW611-IW620-G(530)	Dipole	I-PEX	
117	-	-	-	SONY	IW611-IW620-G(540)	Dipole	I-PEX	
118	-	-	-	SONY	IW611-IW620-G(550)	Dipole	I-PEX	
119	-	-	-	SONY	IW611-IW620-G(560)	Dipole	I-PEX	
120	-	-	-	SONY	IW611-IW620-G(570)	Dipole	I-PEX	
121	-	-	-	SONY	IW611-IW620-G(580)	Dipole	I-PEX	
122	-	-	-	SONY	IW611-IW620-G(590)	Dipole	I-PEX	
123	-	-	-	SONY	IW611-IW620-G(600)	Dipole	I-PEX	
124	-	-	-	SONY	IW611-IW620-G(610)	Dipole	I-PEX	
125	-	-	-	SONY	IW611-IW620-G(620)	Dipole	I-PEX	
126	-	-	-	SONY	IW611-IW620-G(630)	Dipole	I-PEX	
127	-	-	-	SONY	IW611-IW620-G(640)	Dipole	I-PEX	
128	-	-	-	SONY	IW611-IW620-G(650)	Dipole	I-PEX	
129	-	-	-	SONY	IW611-IW620-G(660)	Dipole	I-PEX	
130	-	-	-	SONY	IW611-IW620-G(670)	Dipole	I-PEX	
131	-	-	-	SONY	IW611-IW620-G(680)	Dipole	I-PEX	
132	-	-	-	SONY	IW611-IW620-G(690)	Dipole	I-PEX	
133	-	-	-	SONY	IW611-IW620-G(700)	Dipole	I-PEX	
134	-	-	-	SONY	IW611-IW620-G(710)	Dipole	I-PEX	
135	-	-	-	SONY	IW611-IW620-G(720)	Dipole	I-PEX	
136	-	-	-	SONY	IW611-IW620-G(730)	Dipole	I-PEX	
137	-	-	-	SONY	IW611-IW620-G(740)	Dipole	I-PEX	
138	-	-	-	SONY	IW611-IW620-G(750)	Dipole	I-PEX	
139	-	-	-	SONY	IW611-IW620-G(760)	Dipole	I-PEX	
140	-	-	-	SONY	IW611-IW620-G(770)	Dipole	I-PEX	
141	-	-	-	SONY	IW611-IW620-G(780)	Dipole	I-PEX	
142	-	-	-	SONY	IW611-IW620-G(790)	Dipole	I-PEX	
143	-	-	-	SONY	IW611-IW620-G(800)	Dipole	I-PEX	

Note 1:

Ant.	Gain (dBi)	
	WLAN 2.4GHz/Bluetooth	WLAN 5GHzz
1	2.98	5.16
2	0.38	1.68
3	0.35	1.63
4	0.32	1.59
5	0.28	1.54
6	0.25	1.49
7	0.22	1.45
8	0.19	1.4
9	0.16	1.36
10	0.13	1.31
11	0.09	1.26
12	0.06	1.22
13	0.03	1.17
14	0.00	1.12
15	-0.03	1.08
16	-0.06	1.03
17	-0.10	0.99
18	-0.13	0.94
19	-0.16	0.89
20	-0.19	0.85
21	-0.22	0.8
22	-0.25	0.75
23	-0.29	0.71
24	-0.32	0.66
25	-0.35	0.62
26	-0.38	0.57
27	-0.41	0.52
28	-0.44	0.48
29	-0.48	0.43
30	-0.51	0.38
31	-0.54	0.34
32	-0.57	0.29
33	-0.60	0.24
34	-0.63	0.2
35	-0.67	0.15
36	-0.70	0.11
37	-0.73	0.06
38	-0.76	0.01
39	-0.79	-0.03

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40	-0.82	-0.08
41	-0.86	-0.13
42	-0.89	-0.17
43	-0.92	-0.22
44	-0.95	-0.26
45	-0.98	-0.31
46	-1.01	-0.36
47	-1.05	-0.4
48	-1.08	-0.45
49	-1.11	-0.5
50	-1.14	-0.54
51	-1.17	-0.59
52	-1.21	-0.64
53	-1.24	-0.68
54	-1.27	-0.73
55	-1.30	-0.77
56	-1.33	-0.82
57	-1.36	-0.87
58	-1.40	-0.91
59	-1.43	-0.96
60	-1.46	-1.01
61	-1.49	-1.05
62	-1.52	-1.1
63	-1.55	-1.14
64	-1.59	-1.19
65	-1.62	-1.24
66	-1.65	-1.28
67	-1.68	-1.33
68	-1.71	-1.38
69	-1.74	-1.42
70	-1.78	-1.47
71	-1.81	-1.51
72	-1.84	-1.56
73	0.29	1.36
74	0.26	1.31
75	0.23	1.27
76	0.19	1.22
77	0.16	1.17
78	0.13	1.13
79	0.10	1.08
80	0.07	1.04
81	0.04	0.99
82	0.00	0.94

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83	-0.03	0.9
84	-0.06	0.85
85	-0.09	0.8
86	-0.12	0.76
87	-0.15	0.71
88	-0.19	0.67
89	-0.22	0.62
90	-0.25	0.57
91	-0.28	0.53
92	-0.31	0.48
93	-0.34	0.43
94	-0.38	0.39
95	-0.41	0.34
96	-0.44	0.3
97	-0.47	0.25
98	-0.50	0.2
99	-0.53	0.16
100	-0.57	0.11
101	-0.60	0.06
102	-0.63	0.02
103	-0.66	-0.03
104	-0.69	-0.08
105	-0.72	-0.12
106	-0.76	-0.17
107	-0.79	-0.21
108	-0.82	-0.26
109	-0.85	-0.31
110	-0.88	-0.35
111	-0.91	-0.4
112	-0.95	-0.45
113	-0.98	-0.49
114	-1.01	-0.54
115	-1.04	-0.58
116	-1.07	-0.63
117	-1.10	-0.68
118	-1.14	-0.72
119	-1.17	-0.77
120	-1.20	-0.82
121	-1.23	-0.86
122	-1.26	-0.91
123	-1.30	-0.96
124	-1.33	-1
125	-1.36	-1.05

126	-1.39	-1.09
127	-1.42	-1.14
128	-1.45	-1.19
129	-1.49	-1.23
130	-1.52	-1.28
131	-1.55	-1.33
132	-1.58	-1.37
133	-1.61	-1.42
134	-1.64	-1.46
135	-1.68	-1.51
136	-1.71	-1.56
137	-1.74	-1.6
138	-1.77	-1.65
139	-1.80	-1.7
140	-1.83	-1.74
141	-1.87	-1.79
142	-1.90	-1.83
143	-1.93	-1.88

AzureWave Technologies, Inc.

AW-XM455

IEEE 802.11 2X2 WiFi 6 MIMO Wireless LAN + Bluetooth 5.3 Combo LGA Module

Layout Guide

Rev. 01

(For PIFA antenna)

Revision History

Version	Revision Date	Description	Initials	Approved
For PIFA antenna	2021/09/30	● Initial Version	Roger Chen	N.C. Chen

INTRODUCTION

This document provides key guidelines and recommendations to be followed when creating AW-XM455 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 Pad and layout pattern
- 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-XM455 WLAN/BT_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

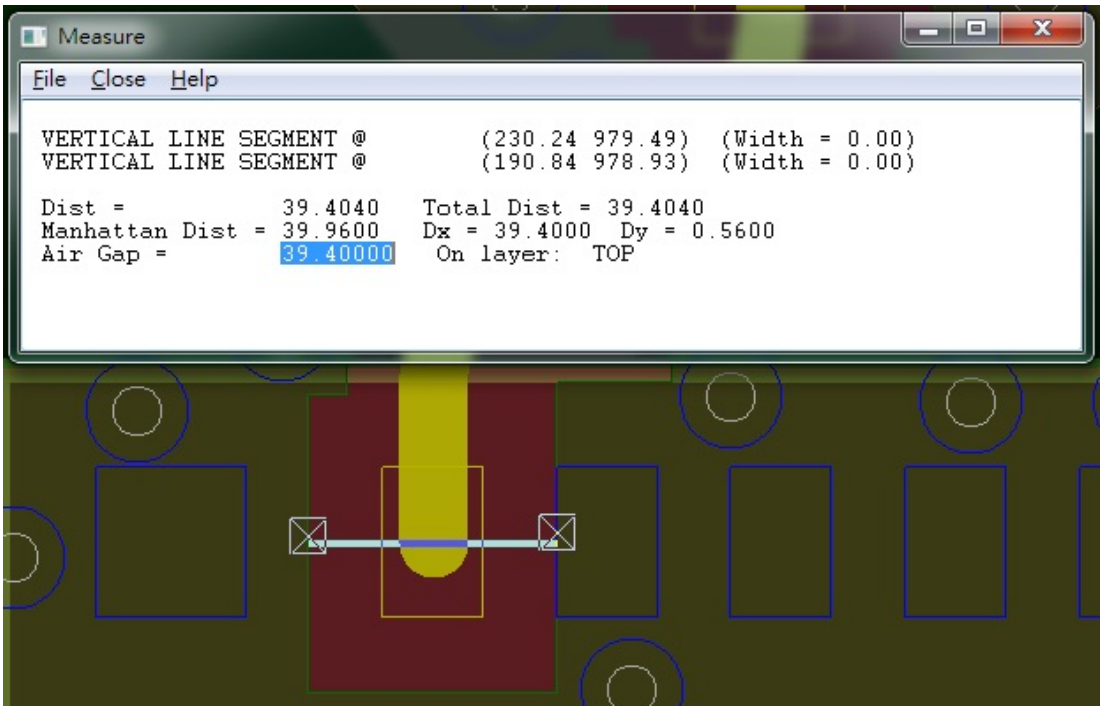
Please follow power and ground layout guidelines. Here are some general rules for customers' reference.

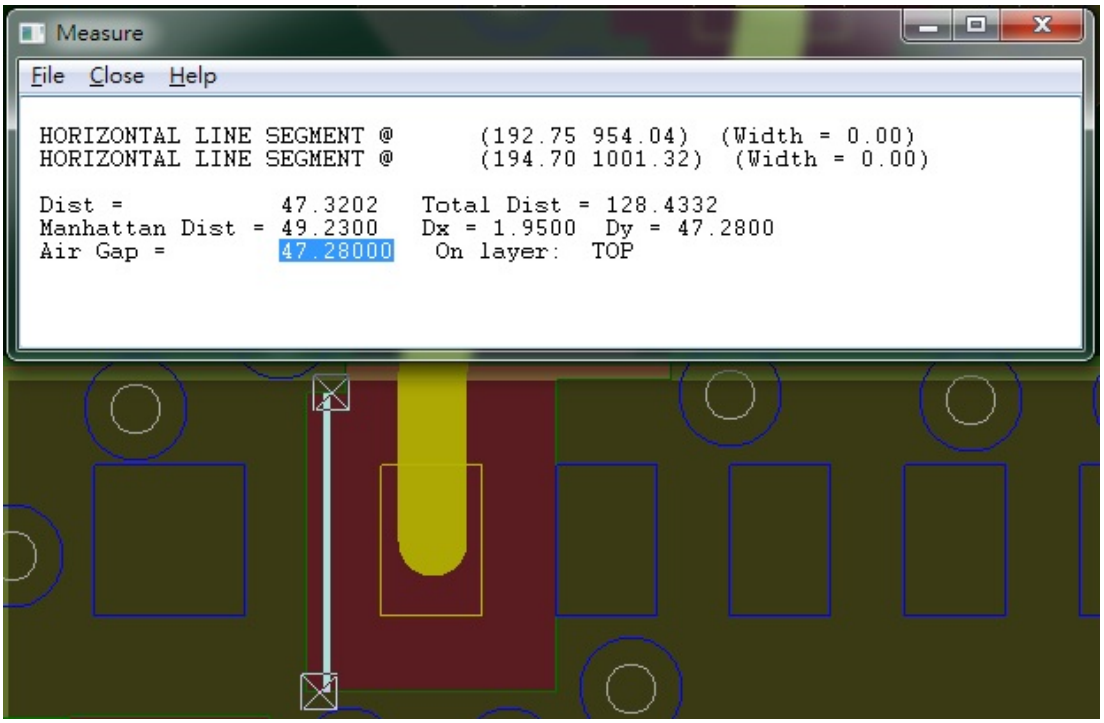
- The digital interface to the module must be routed using good engineering practices to minimize coupling to power planes and other digital signals.
- The digital interface must be isolated from RF trace.

5. RF pad and layout pattern

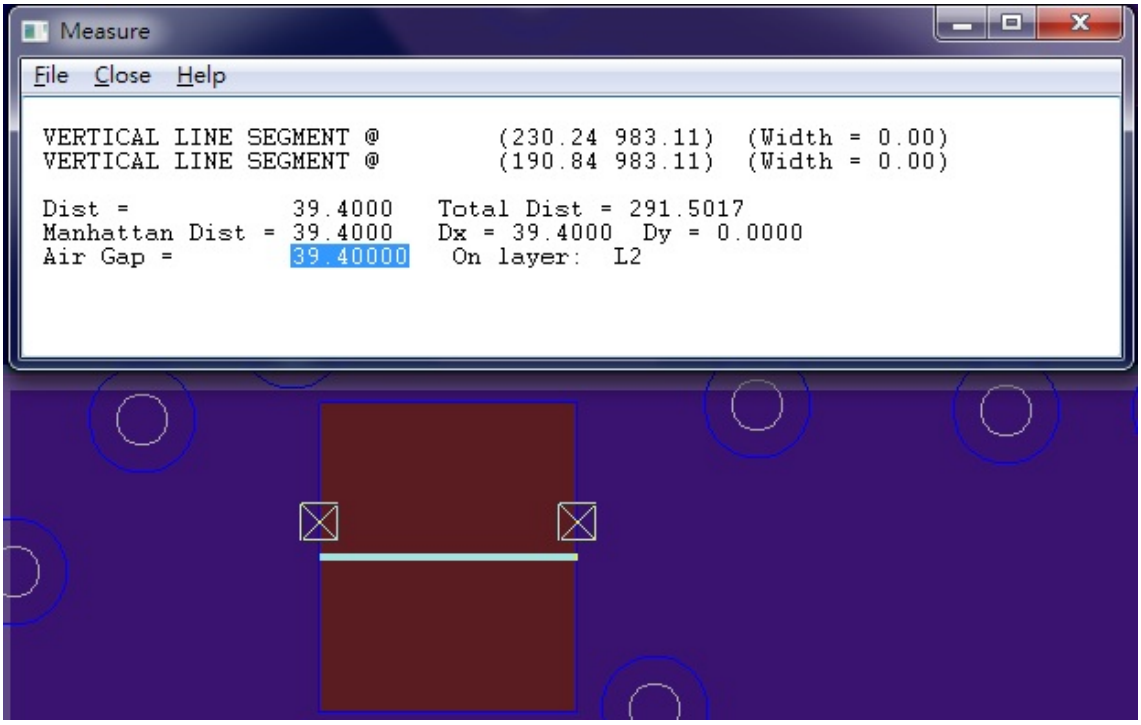
To ensure impedance to be 50Ω from AW-XM455 module RF pad to host PCBA RF pad, customer needs to follow below pattern design concept.

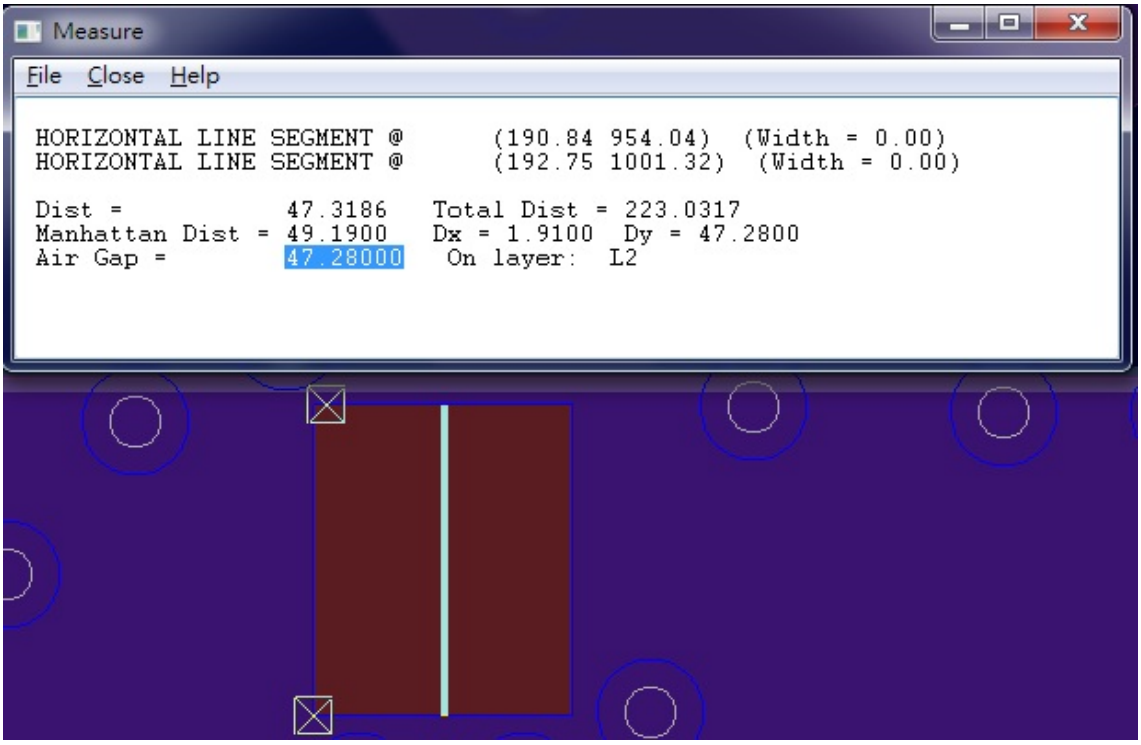
A. Top Layer design: The length and width of keepout at top layer is 39.4 and 47.28 mil.



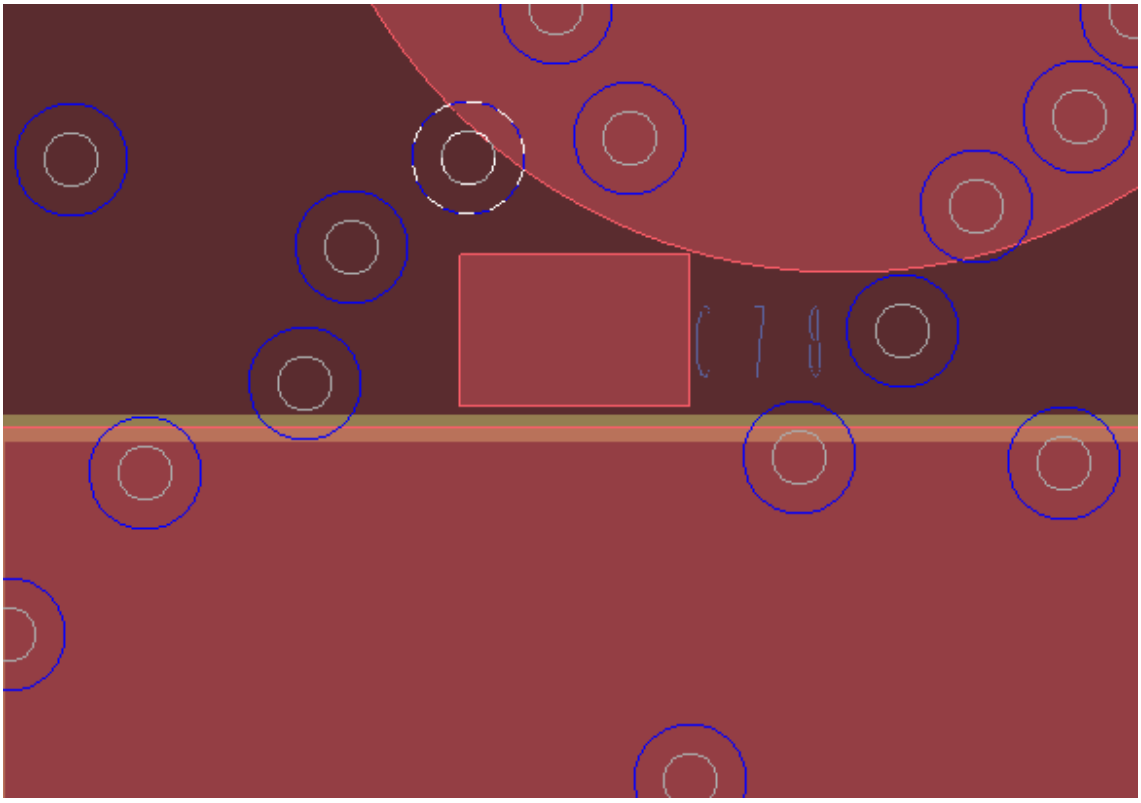


B. Inner layer(L2)design: The length and width of keepout at L2 is 39.4 and 47.28 mil.

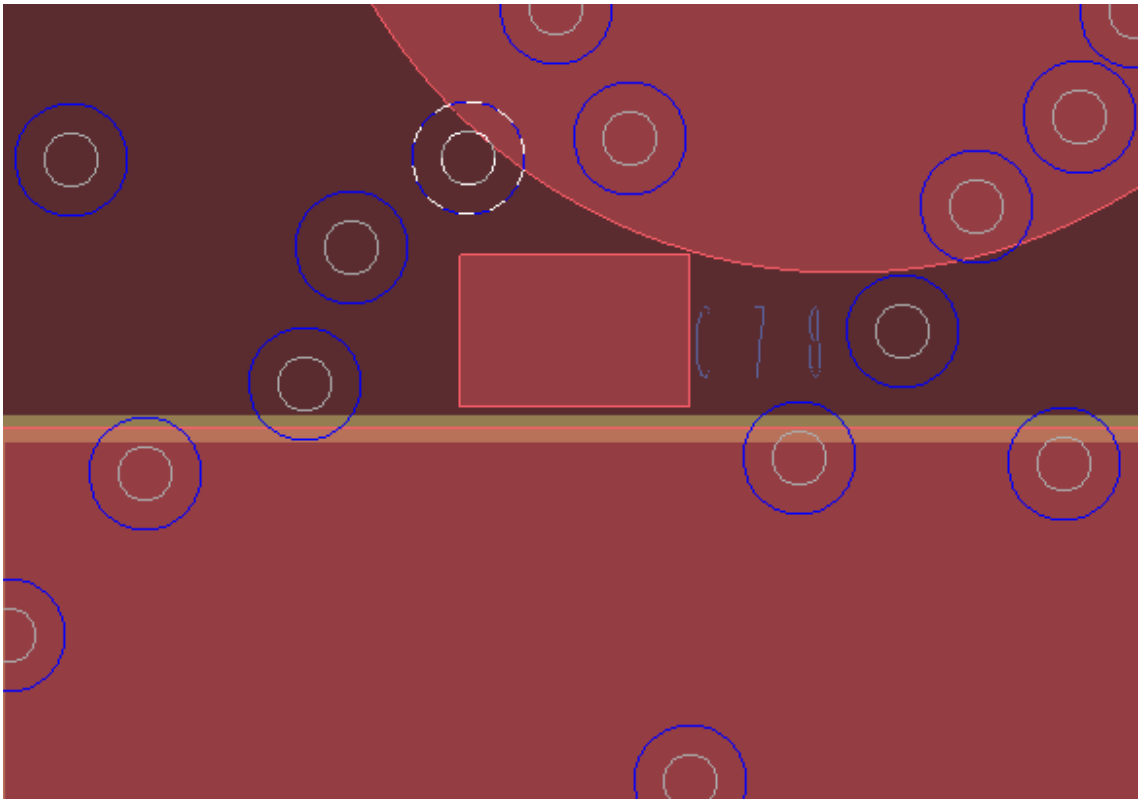




C. Inner layer(L3)design: Must be continuous reference ground plane



D. Bot layer design: Must be continuous reference ground plane

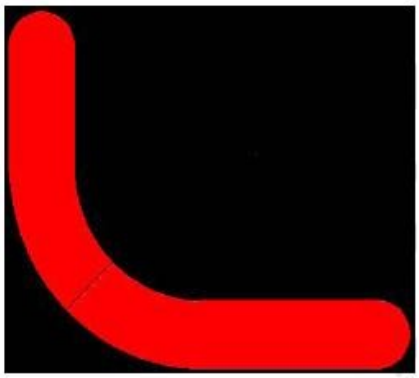


6. RF trace

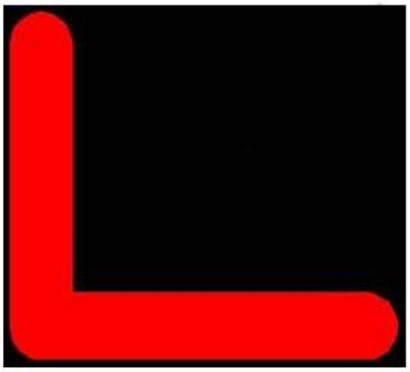
The RF trace is the critical to route. Here are some general rules for customers' reference.

- 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.

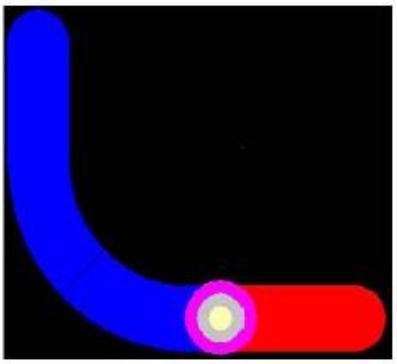
If the customers have any problem in calculation of trace impedance, please contact AzureWave.



Correct RF trace



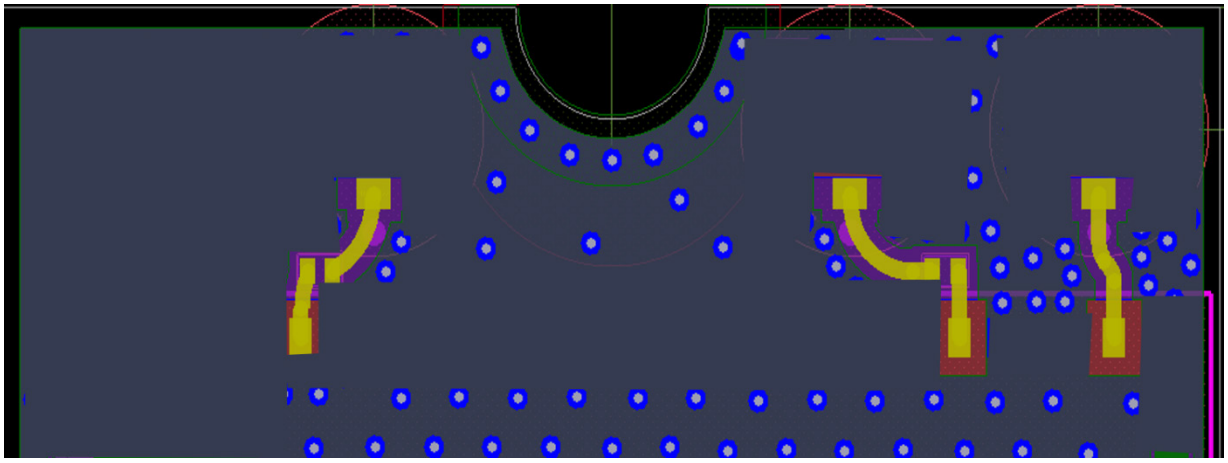
Right-angled corner



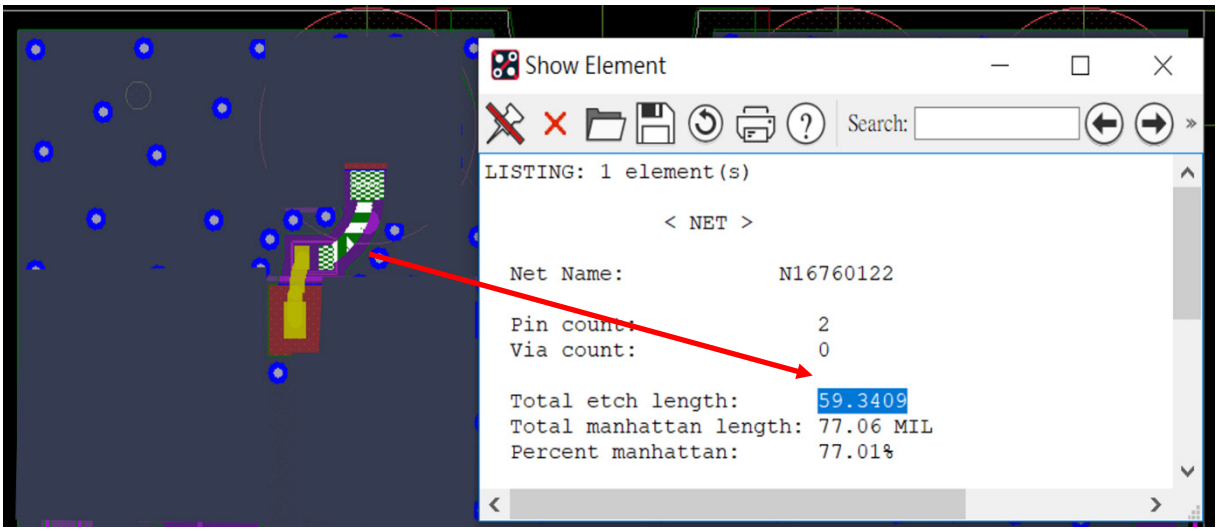
Via on RF trace

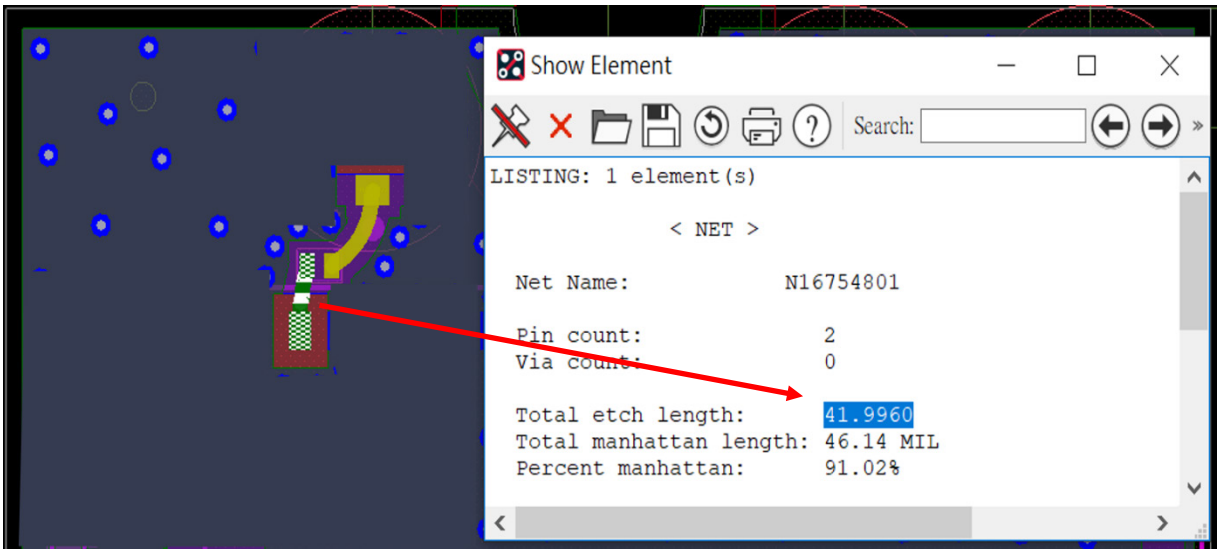
Incorrect RF trace

AW-XM455 RF trace should be follow the rules as below

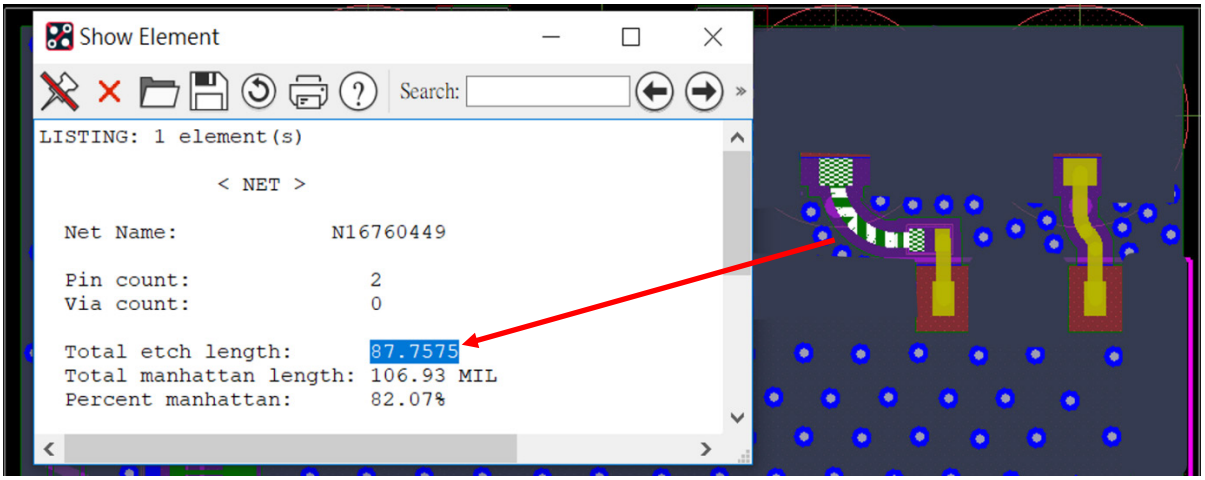


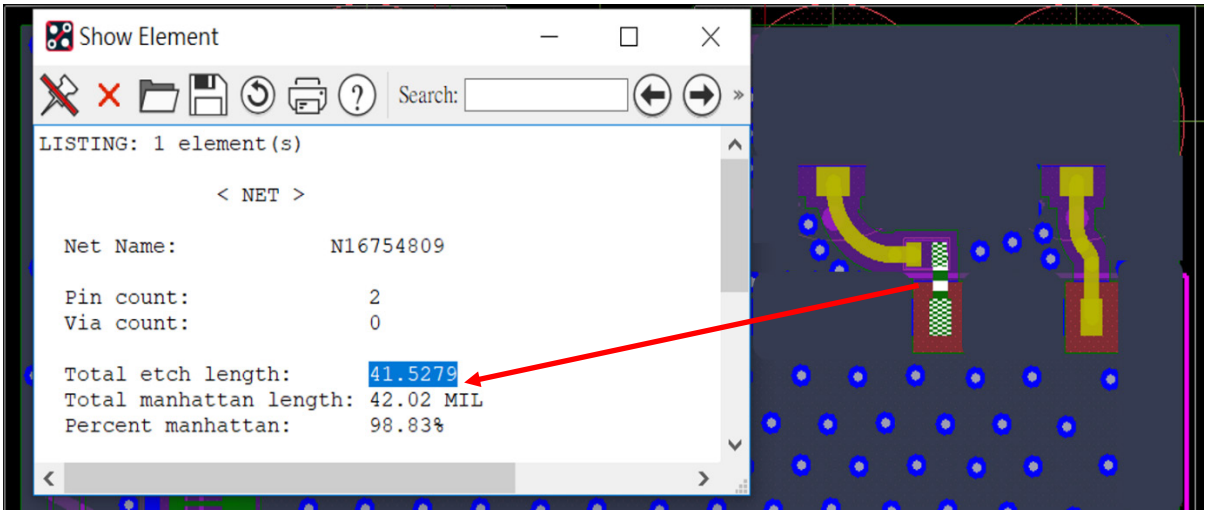
a. Trace length of ANT1 is about 59.34 mil and 41.99 mil.



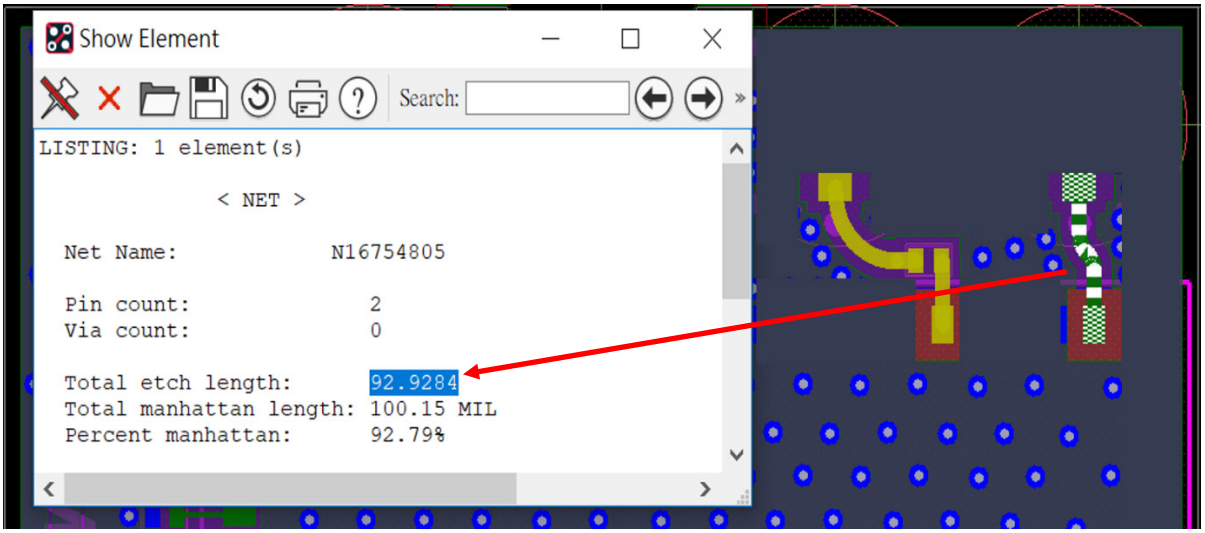


b. Trace length of ANT2 is about 87.75 mil and 41.52 mil.

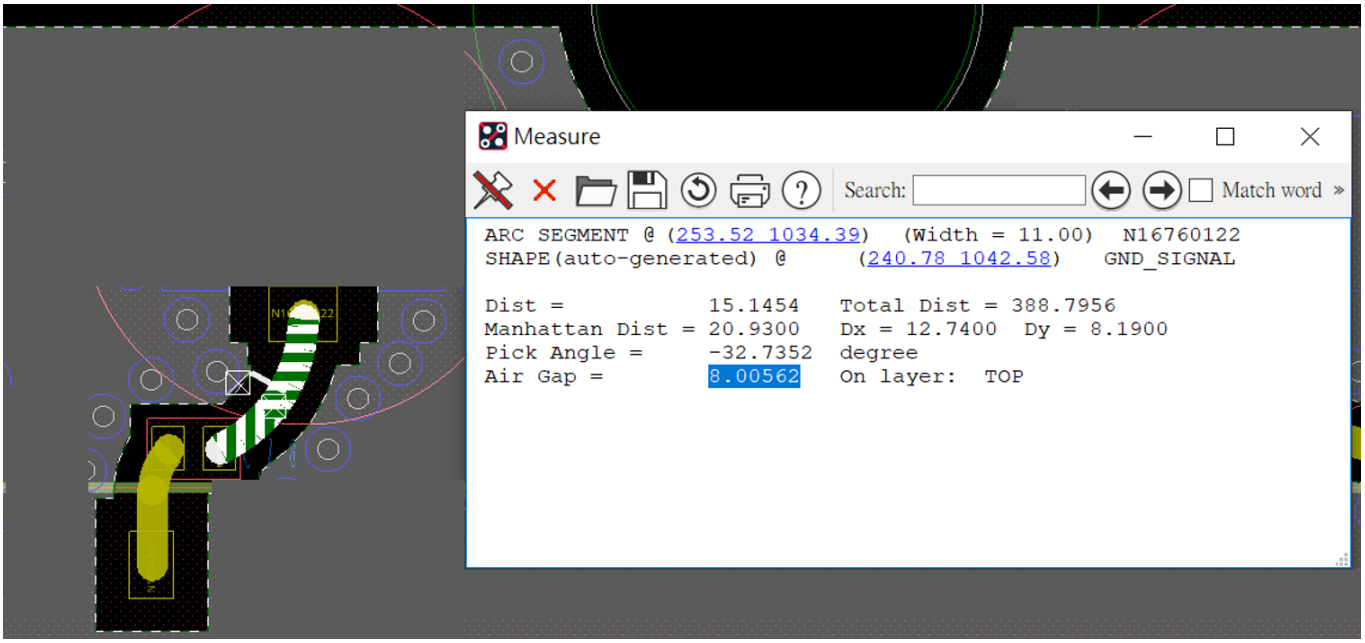




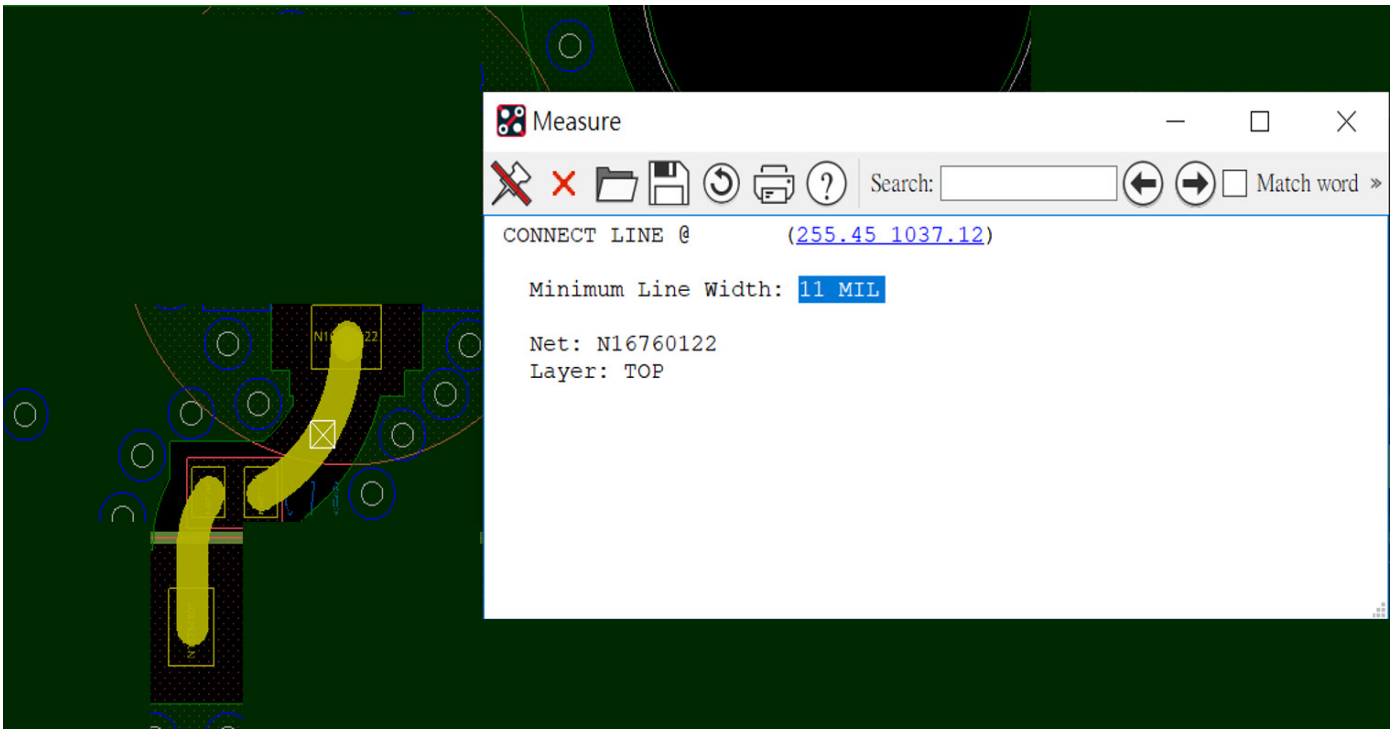
c. Trace length of ANT3 is about 92.92 mil.



d. Air gap between RF trace and ground is about 8 mil.



e. Trace width of all RF trace is all about 11 mil.

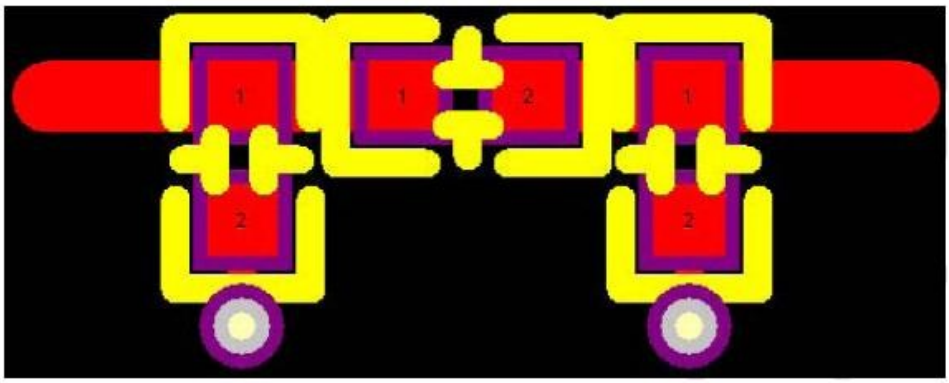


7. Antenna

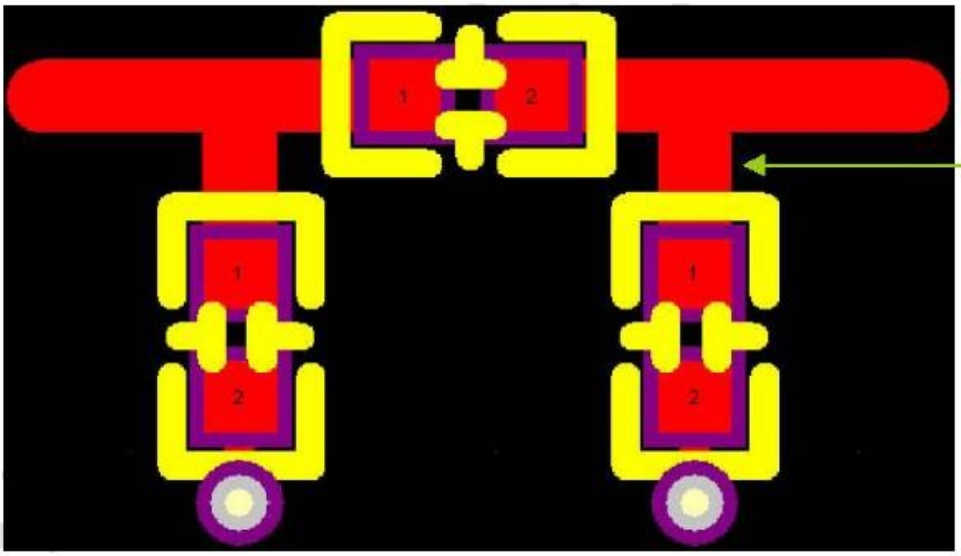
All the high-speed traces should be moved far away from the antenna. For the best radiation performance, check antenna chip vendor for the layout guideline and clearance.

8. 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

9. SHIELDING CASE

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

10. 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.

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.

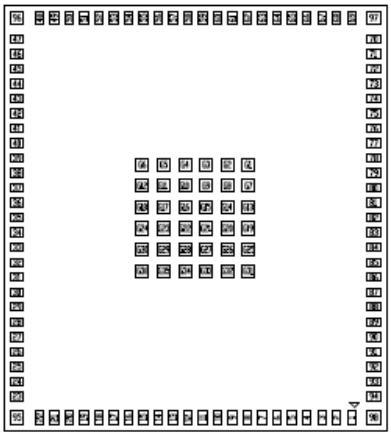
•Good power integrity of VDDIO will improve the signal integrity of digital interfaces.

- 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).

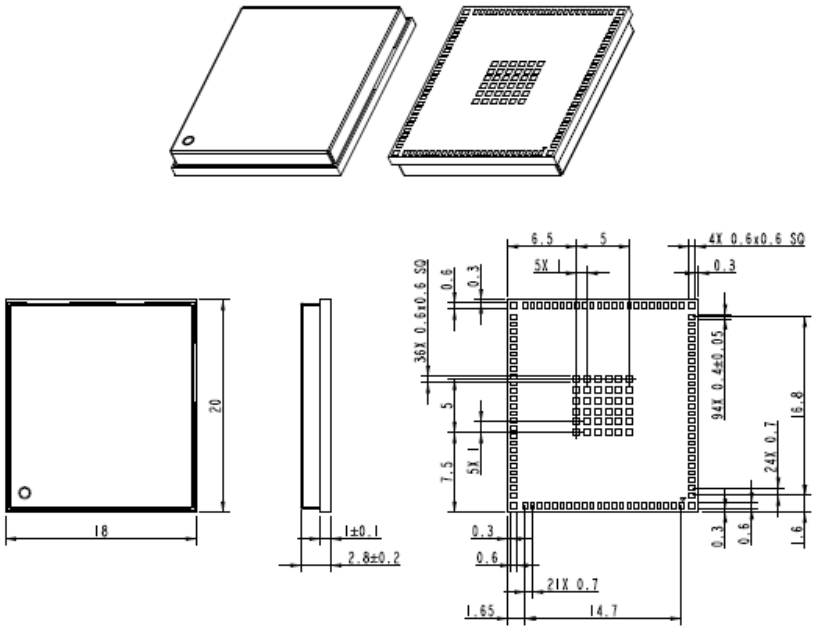
•Discuss with AzureWave Engineer after you finish schematic and layout job.

12. Mechanical Drawing

Package Outline Drawing



PIN DEFINED (BOTTOM VIEW)



TOLERANCE UNLESS OTHERWISE SPECIFIED:±0.1mm

Top View of PCB Layout Foot Print