AW-CM251NF

IEEE 802.11a/b/g/n/ac Wireless LAN and Bluetooth Combo Module (M.2 1216)

Datasheet

Version 1.0

B2

Revision History

Document release	Date	Modification	Initials	Approved
Version 0.1	2015/6/25	Initial Version	Terry	Amos
Version 0.2	2016/03/31	Specifications Table	Shihmeng Luo	Daniel Lee
Version 0.3	2016/4/13	Add power consumption	Yvonne Chen	Patrick Lin
Version 0.4	2016/09/05	Modify Pin Definition	Shihmeng Luo	Daniel Lee
Version 0.5	2016/10/14	1. Modify Specification Table 2. Add Power Sequence 3. Modify Table of Contents	Shihmeng Luo	Daniel Lee
Version 0.6	2016/12/26	1. Modify Block Diagram	Shihmeng Luo	Daniel Lee
Version 0.7	2017/01/09	1. Add PCB Layout Footprint	Shihmeng Luo	Daniel Lee
Version 0.8	2017/04/07	1. Modify Electrical Characteristics 2. Modify Pin Definition 3. Modify Schematic	Shihmeng Luo	Daniel Lee
Version 0.9	2019/08/28	Modify Specifications Table	N.C. Chen	Chihhao Liao
Version 1.0	2019/10/29	Updated the document to support for BT 5.0	N.C. Chen	Chihhao Liao

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Table of Contents

1. General Description

AzureWave Technologies, Inc. introduces the pioneer of the IEEE 802.11a/b/g/n/ac WIFI with Bluetooth 5.0 combo M.2 module ---**AW-CM251NF**. The AW-CM251NF IEEE 802.11 a/b/g/n/ac PCIE WIFI with Bluetooth 5.0 combo M.2 module is a highly integrated wireless local area network (WLAN) solution to let users enjoy the digital content through the latest wireless technology without using the extra cables and cords. It combines with Bluetooth 5.0 and provides a complete 2.4GHz Bluetooth system which is fully compliant to Bluetooth 5.0 and v2.1 that supports EDR of 2Mbps and 3Mbps for data and audio communications. It enables a **high performance, cost effective, low power, compact solution** that easily fits onto the PCI Express and USB M.2 module.

Compliant with the IEEE 802.11a/b/g/n/ac standard, AW-CM251NF uses Direct Sequence Spread Spectrum **(DSSS),** Orthogonal Frequency Division Multiplexing **(OFDM)**, **BPSK, QPSK, 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 system power requirements by using **AW-CM251NF**.

AW-CM251NF module adopts **QCA9377** single chip solution. The module design is based on the **QCA9377** solution.

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2. Key Features

1. **High speed wireless connection up to 433Mbps for Wi-Fi**
2. **2 antennas to support 1(Transmit) ×1(Receive) diversity technology and Bluetooth 5.0**
3. **Low power consumption and high performance**
4. **Enhanced wireless security**
5. **Fully qualified Bluetooth 5.0**
6. **Enhanced Data Rate(EDR) compliant for both 2Mbps and 3Mbps supported**

3. Block Diagram

A simplified block diagram of theAW-CM251NF module is depicted in the figure below.
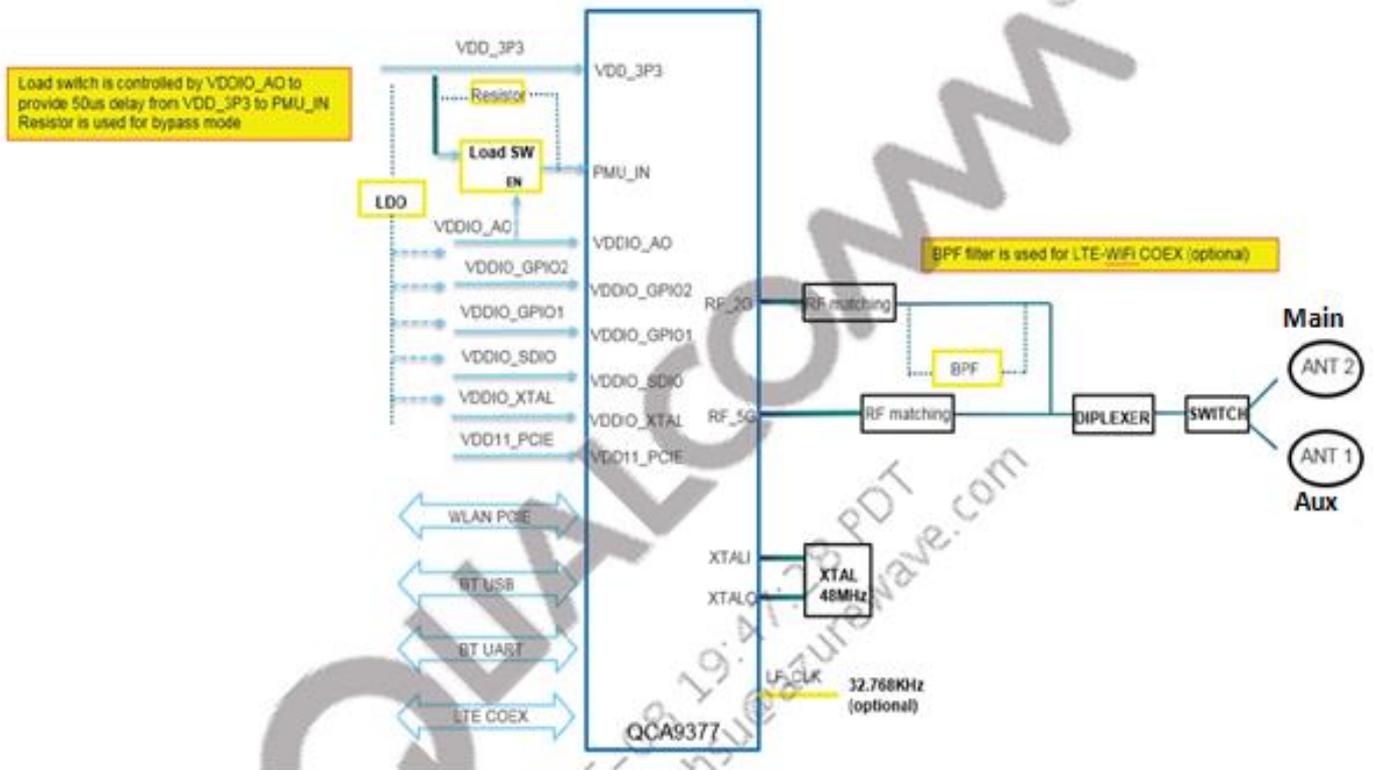
4. Specifications Table

Model Name	AW-CM251NF
Product Description	Wireless LAN &Bluetooth Combo M.2 Module
WLAN Standard	IEEE 802.11 a/b/g/n/ac
Bluetooth Standard	Bluetooth 2.1+Enhanced Data Rate (EDR)+ BT5.0
Major Chipset	QCA9377
Host Interface	Wi-Fi : PCI-E M.2, BT : USB
Antenna	Murata Connector Receptacle (20449) 1 (Main) :WiFi→ TX/RX ,BT→ TX/RX 2 (Aux): WiFi→ RX
Dimensions	12mm X 16mm x1.48mm
Wi-Fi VID/PID	168C / 0042
Wi-Fi SVID/SPID	1A3B / 2B51
BT VID/PID	13D3 / 3503
Weight	0.6g
Operating Conditions	
Voltage	power supply for host:3.3V
Temperature	0~70 ℃
Storage temperature	-40~105 ℃
Electrical Specifications	
Frequency Range	WLAN: 2.4 GHz ISM Bands 2.412-2.472 GHz 5G:4.9~5.925Ghz Bluetooth: 2402~2480MHz
Modulation	DSSS, OFDM, DBPSK, DQPSK, CCK, 16-QAM, 64-QAM,256-QAM for WLAN GFSK (1Mbps), П/4 DQPSK (2Mbps) and 8DPSK (3Mbps) for Bluetooth

Output Power	**WLAN:**
	   802.11b : 19 +-2dBm (11Mbps)
	   802.11g : 16 +-2dBm (54Mbps)
	   802.11n @2.4GHz : 16 +-2dBm (HT20 MCS7)
	   802.11n @2.4GHz : 15 +-2dBm (HT40 MCS7)
	   802.11a @5GHz : 13 +-2dBm (54Mbps)
	   802.11n @5GHz : 12 +-2dBm (HT20 MCS7)
	   802.11n @5GHz : 10 +-2dBm (HT40 MCS7)
	   802.11ac @5GHz : 8 +-2dBm (HT80 MCS9)
	
	BT: -4≤ Output Power ≤ 15 dBm (Conductive)

Receive Sensitivity	**For Main Ant**
	   802.11b: -76 dBm (11Mbps)
	   802.11g: -65 dBm (54Mbps)
	   802.11n @2.4GHz: -64 dBm (HT20 MCS7)
	   802.11n @2.4GHz: -61 dBm (HT40 MCS7)
	   802.11a @5GHz: -65 dBm (54Mbps)
	   802.11n @5GHz: -64 dBm (HT20 MCS7)
	    802.11n @5GHz: -61 dBm (HT40 MCS7)
	   802.11ac @5GHz: -51 dBm (VHT80 MCS9)
	
	For Aux Ant
	   802.11b: -76 dBm (11Mbps)
	   802.11g: -65 dBm (54Mbps)
	   802.11n @2.4GHz: -64 dBm (HT20 MCS7)
	   802.11n @2.4GHz: -61 dBm (HT40 MCS7)
	   802.11a @5GHz: -65 dBm (54Mbps)
	   802.11n @5GHz: -64 dBm (HT20 MCS7)
	    802.11n @5GHz: -61 dBm (HT40 MCS7)
	   802.11ac @5GHz: -51 dBm (VHT80 MCS9)
	
	BT: BER < 0.1% (Anritsu 8852B Tx -70 Bm)

Data Rates	**WLAN** **802.11b: 1, 2, 5.5, 11Mbps** **802.11a/g: 6, 9, 12, 18, 24, 36, 48, 54Mbps** **802.11n: up to 75Mbps-single** **802.11n: up to 150Mbps** **802.11ac:up to 96Mbps (20MHz channel)** **802.11ac:up to 200Mbps (40MHz channel)** **802.11ac:up to 433Mbps (80MHz channel)** **Bluetooth** **Bluetooth 2.1+EDR data rates of 1,2, and 3Mbps**
Security	◆ **WAPI** ◆ **WEP 64-bit and 128-bit encryption with H/W TKIP processing** ◆ **WPA/WPA2(Wi-Fi Protected Access)** ◆ **AES-CCMP hardware implementation as part of 802.11i security standard**

Operating System Compatibility	Refer to QCA/Atheros NFA425 regulatory list

5. Electrical Characteristics

5.1 Absolute Maximum Ratings

Symbol	Parameter	Maximum	Unit
V_{dd33}	Maximum I/O supply voltage	4.0	V
RF_{in}	Maximum RF input (reference to 50 Ω)	+10	dBm

5.2 PCI Express Bus Interface Characteristics

Signal Name	Mini PCI-E PIN	Type	Driver	PU/DP Resistance
PCIE_RST_L	52	IL	---	---
PCIE_CLKREQ_L	53	OD	---	---

IL : Input signals with weak internal pull-down, to prevent signals from floating when left open

OD: A digital output signal with open drain

PD: Pull down

5.3 GPIO Interface Characteristics for BT/WLAN

Signal Name(To chip GPIO PIN)	Mini PCI-E PIN	Type
WLAN_RF_KILL_L	56	Input
BT_ RF_KILL_L	54	Input
LED_ WLAN_L	6	Output
LED_BT_L	16	Output

PU: Pull Up

5.4 Recommended Operating Conditions

Symbol	Parameter	Rating	Unit
V_{dd33}	I/O voltage	3.135~3.465	V

5.5 GPIO DC Characteristics

Symbol	Parameter	Minimum	Typical	Maximum	Unit
V_{IH}	Input high voltage	2.31	--	3.6	V
V_{IL}	Input low voltage	-0.3	--	0.99	V
V_{OH}	Output high voltage	2.97	--	3.3	V
V_{OL}	Output low voltage	0	--	0.33	V

6 Power Sequence

Symbol	Parameter	Min	Typ	Max	Unit
VDD33_	3.3 V supply	3.135	3.3	3.465	V
VBUCK33_PM	1.1 V switcher supply from internal 1.1 V PMU	3.135	3.3	3.465	V
VDD11_PM	1.1 V voltage from internal 1.1 V PMU	1.045	1.1	1.155	V
VDDIO_	Voltage supply	1.71	1.8 or 3.3	3.46	V
VDD11_	1.1 V supply from internal 1.1 V PMU	1.045	1.1	1.155	V
VDD11D	1.1 V supply for digital from internal 1.1 V PMU	1.045	1.1	1.155	V
T_{OP}	For QCA9377-3 device variant	-40	–	85	°C
	For QCA9377-5 device variant	0	–	70	°C
	For QCA9377-7 device variant	-40	–	85	°C
T_{CASE}	Case temperature	0	–	115	°C
PsiJT	Junction to the top center of the package thermal resistance	–	–	TBD	°C/W

This figure shows the required powerup/down and reset sequences for the QCA9377 device using 3.3 V (external).
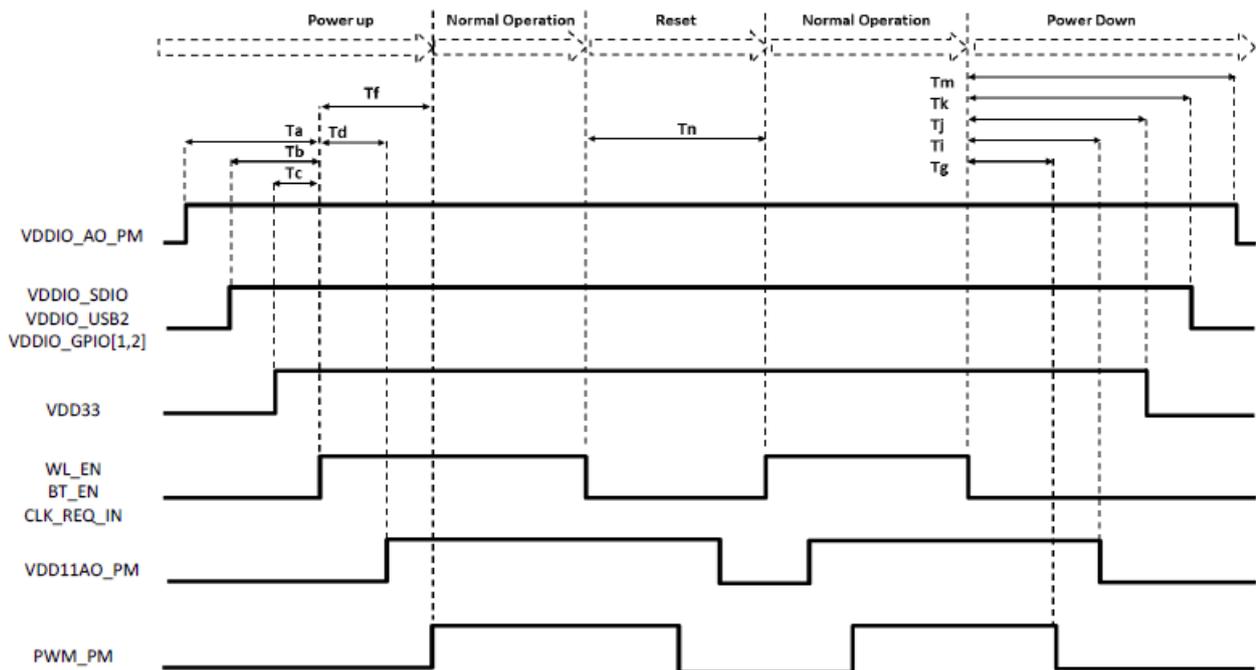
The QCA9377 device requires the following powerup sequence:

1. VDDIO_AO_PM and VDDIO_XTAL are tied to first I/O rail available

2. VDDIO_SDIO/GPIO1/GPIO2 (3.3 V)

3. All 3.3 V rails
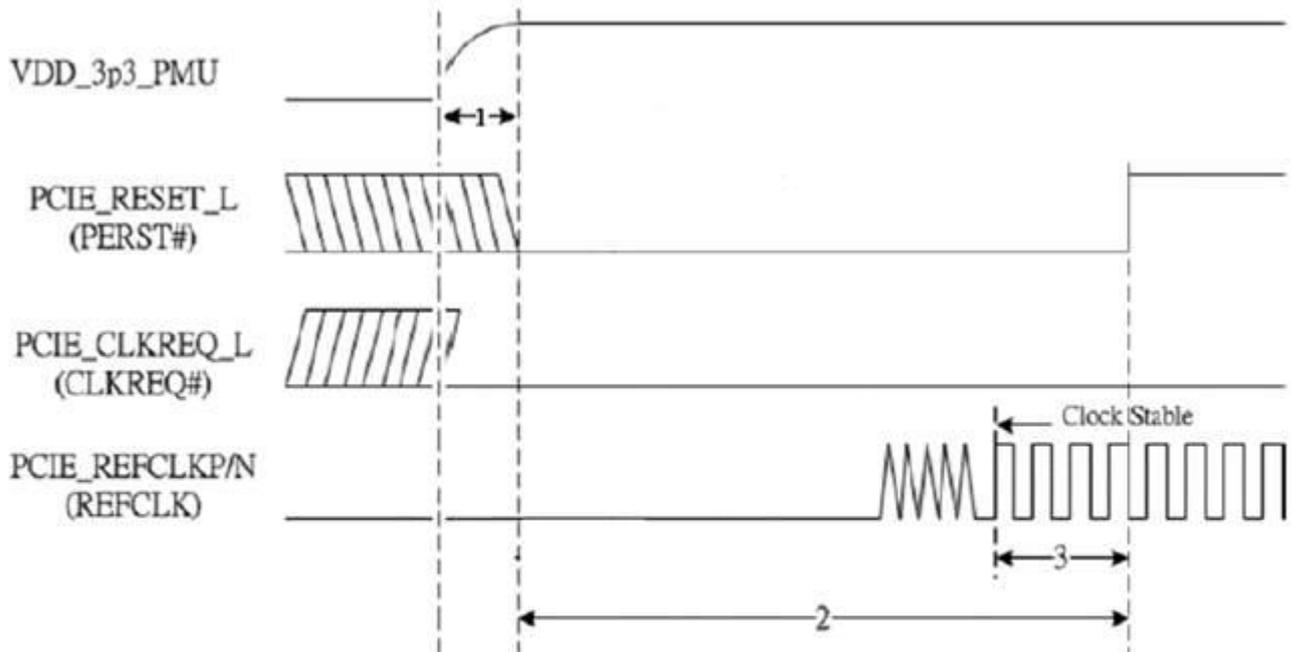
See 1. TPVRAMP 2. TPVPGL and 3. TPERST-CLK timing requirement

Symbol	Parameter	Min	Max	Units
TPVRAMP	Power Supply Ramp on 3.3V		100	mS
TPVPGL	Power(VDD_3p3_PMU) valid to PERST# Input inactive	10		mS
TPERST-CLK	REFCLK stable before PERST# inactive	100		μS

To power down the device, the following sequence is required:

1. All 3.3 V rails

2. VDDIO_SDIO/GPIO1/GPIO2 (3.3 V)

3. VDDIO_AO_PM and VDDIO_XTAL

NOTE: The following can be tied together:

  VDDIO_SDIO, VDDIO_GPIO1, and VDDIO_GPIO2

  VDDIO_AO_PM, VDDIO_XTAL, and VDDIO_SDIO, VDDIO_GPIO1, and

  VDDIO_GPIO2

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7 Power Consumption

WiFi

Static Test

Mode		Disable ASPM		L1 Mode	
		2.4G	**5G**	**2.4G**	**5G**
WLAN RF OFF		31.8		11.9	
No connection with wireless AP	**AVG**	36.6		16.4	
	MAX	103.4		79.9	
Connection AP	**AVG**	38.1	38.9	20.1	19.8
	MAX	101.2	111.6	78.0	89.1

Unit: mA

Note:

1. WLAN RF OFF is switch Airplane mode.

2. Connect AP mode is in 11n HT40 for 2.4g and 11ac VHT80 for 5g.

Dynamic Test

Band (GHz)	Mode	BW (MHz)	Link Speed	Transmit		Receive	
				Max.	**Avg.**	**Max.**	**Avg.**
2.4	802.11b	20	11M	244.0	239.7	101.2	99.6
	802.11g	20	54M	201.4	195.3	113.1	108.1
	802.11n	20	65M	192.5	181.9	89.3	85.7
		40	150M	223.2	206.5	260.3	133.9
5	802.11a	20	54M	268.2	255.1	146.6	144.5
	802.11ac	20	86.7M	373.4	345.9	156.7	127.5
		40	200M	325.6	247.2	148.0	142.5
		80	433.3M	293.1	232.2	173.5	166.0

Unit: mA

BT

No.	Mode	Voltage=VDD 3.3 V	
		Max.	**Avg.**
1	**Bluetooth RF Off**		1.6
2	**No Connection with any BT device**	14.6	2.7
3	**Connect BT Device**	24.3	12.1
4	**Transmit by BER 2.1**	36.2	35.0
5	**Receiver by BER 2.1**	26.1	25.7

Unit: mA

8 Pin Definition

Pin Description

Pin No.	Definition	Basic Description	Type
1	NC	Floating Pin, No connect to anything.	Floating
2	NC	Floating Pin, No connect to anything.	Floating
3	NC	Floating Pin, No connect to anything.	Floating
4	3.3V	3.3V power supply	P
5	3.3V	3.3V power supply	P
6	GND	GROUND	GND
7	RESERVED	Floating Pin, No connect to anything.	Floating
8	NC	Floating Pin, No connect to anything.	Floating
9	NC	Floating Pin, No connect to anything.	Floating
10	NC	Floating Pin, No connect to anything.	Floating
11	COEX1	LTE_UART_RXD	IN
12	COEX2	LTE_UART_TXD	OUT
13	COEX3	Floating Pin, No connect to anything.	Floating
14	NC	Floating Pin, No connect to anything.	Floating
15	NC	Floating Pin, No connect to anything.	Floating
16	RESERVED	Floating Pin, No connect to anything.	Floating
17	GND	GROUND	GND
18	RESERVED	Floating Pin, No connect to anything.	Floating
19	RESERVED	Floating Pin, No connect to anything.	Floating
20	GND	GROUND	GND
21	RESERVED	Floating Pin, No connect to anything.	Floating
22	RESERVED	Floating Pin, No connect to anything.	Floating

23	GND	GROUND	GND
24	RESERVED	Floating Pin, No connect to anything.	Floating
25	RESERVED	Floating Pin, No connect to anything.	Floating
26	GND	GROUND	GND
27	NC	Floating Pin, No connect to anything.	Floating
28	W_DISABLE1#	Turn off WLAN RF analog and front–end. Active low.	IN
29	PEWAKE#	Open Drain active Low signal. This signal is used to request that the system return from a sleep/suspended state to service a function initiated wake event.	OUT
30	CLKREQ#	Reference clock request	OUT
31	PERST#	PCI Express reset with weak pull–down	IN
32	GND	GROUND	GND
33	REFCLKn0	Differential reference clock.	IN
34	REFCLKp0	Differential reference clock.	IN
35	GND	GROUND	GND
36	PETn0	Differential transmit.	OUT
37	PETp0	Differential transmit.	OUT
38	GND	GROUND	GND
39	PERn0	Differential receive.	IN
40	PERp0	Differential receive.	IN
41	GND	GROUND	GND
42	VENDOR DEFINED	Floating Pin, No connect to anything.	Floating
43	VENDOR DEFINED	Floating Pin, No connect to anything.	Floating
44	VENDOR DEFINED	Floating Pin, No connect to anything.	Floating
45	NC	Floating Pin, No connect to anything.	Floating

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46	NC	Floating Pin, No connect to anything.	Floating
47	NC	Floating Pin, No connect to anything.	Floating
48	NC	Floating Pin, No connect to anything.	Floating
49	NC	Floating Pin, No connect to anything.	Floating
50	NC	Floating Pin, No connect to anything.	Floating
51	NC	Floating Pin, No connect to anything.	Floating
52	NC	Floating Pin, No connect to anything.	Floating
53	NC	Floating Pin, No connect to anything.	Floating
54	NC	Floating Pin, No connect to anything.	Floating
55	NC	Floating Pin, No connect to anything.	Floating
56	NC	Floating Pin, No connect to anything.	Floating
57	NC	Floating Pin, No connect to anything.	Floating
58	NC	Floating Pin, No connect to anything.	Floating
59	NC	Floating Pin, No connect to anything.	Floating
60	NC	Floating Pin, No connect to anything.	Floating
61	NC	Floating Pin, No connect to anything.	Floating
62	GND	GROUND	GND
63	W_DISABLE2#	Turn off BT RF analog and front–end. Active low.	IN
64	LED2#	BT led function	OUT
65	LED1#	WL led function	OUT
66	RESERVED	Floating Pin, No connect to anything.	Floating
67	RESERVED	Floating Pin, No connect to anything.	Floating
68	GND	GROUND	GND
69	USB_D-	DM_USB_BT	IN/OUT
70	USB_D+	DP_USB_BT	IN/OUT
71	GND	GROUND	GND

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72	3.3V	3.3V power supply	P
73	3.3V	3.3V power supply	P
74	GND	GROUND	GND
75	GND	GROUND	GND
76	GND	GROUND	GND
77	GND	GROUND	GND
78	GND	GROUND	GND
79	GND	GROUND	GND
80	GND	GROUND	GND
81	GND	GROUND	GND
82	GND	GROUND	GND
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85	GND	GROUND	GND
86	GND	GROUND	GND
87	GND	GROUND	GND
88	GND	GROUND	GND
89	GND	GROUND	GND
90	GND	GROUND	GND
91	GND	GROUND	GND
92	GND	GROUND	GND
93	GND	GROUND	GND
94	GND	GROUND	GND
95	GND	GROUND	GND
96	GND	GROUND	GND
G1	G1	GROUND	GND

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G2	G2	GROUND	GND
G3	G3	GROUND	GND
G4	G4	GROUND	GND
G5	G5	GROUND	GND
G6	G6	GROUND	GND
G7	G7	GROUND	GND
G8	G8	GROUND	GND
G9	G9	GROUND	GND
G10	G10	GROUND	GND
G11	G11	GROUND	GND
G12	G12	GROUND	GND

9 Schematics
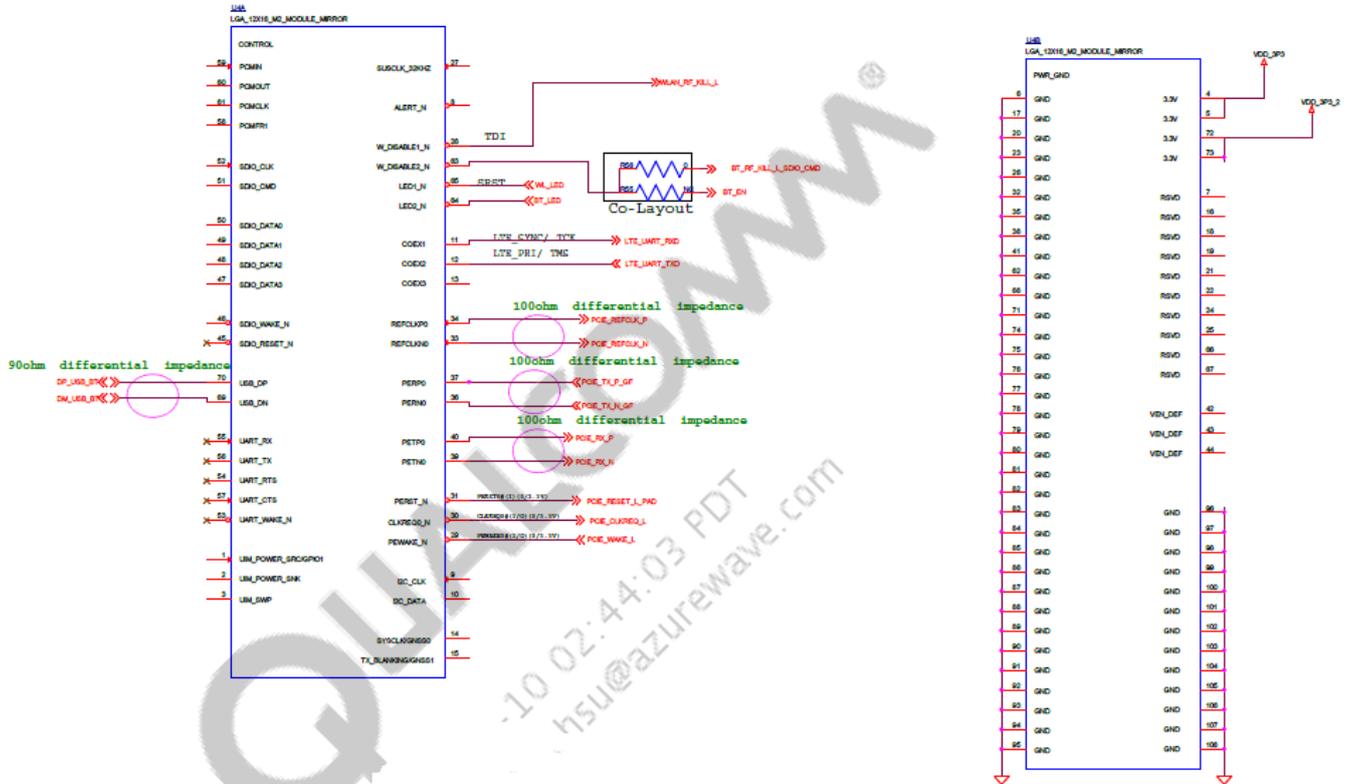
10 PCB Layout Footprint

AW-CM251NF Top View PCB Layout Footprint
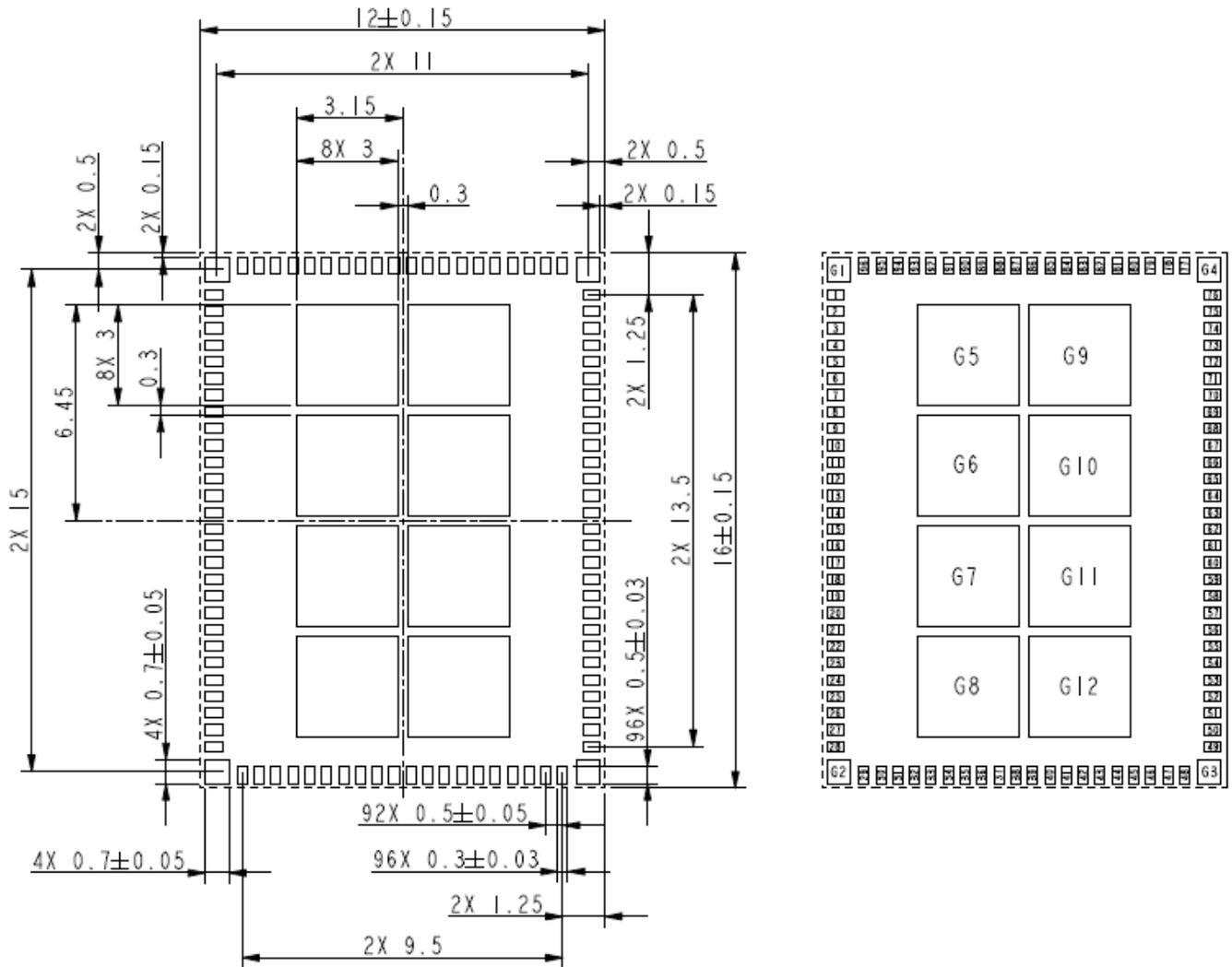
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11 Mechanical Information
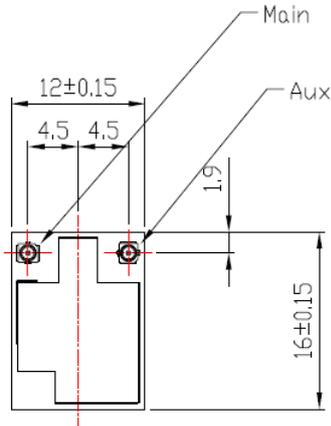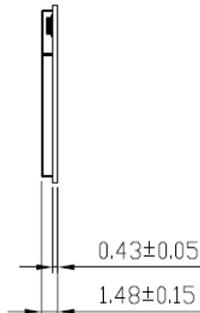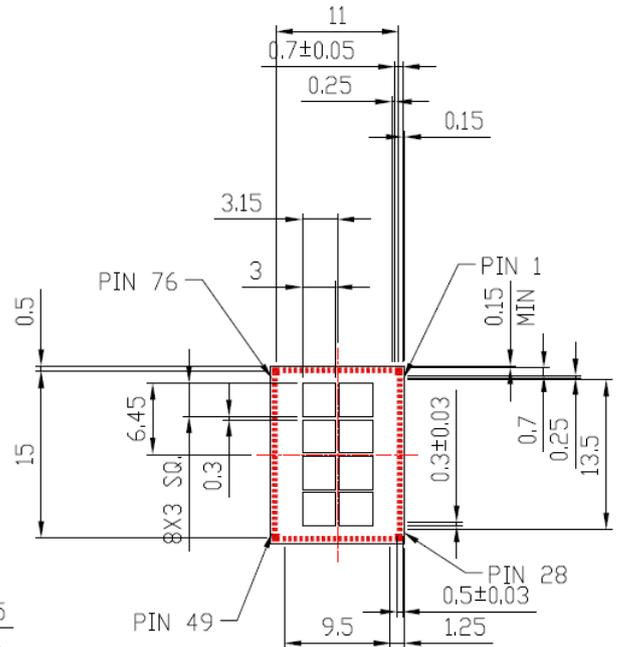
Top View   Right View   Back View

NOTES: UNLESS OTHERWISE SPECIFIED
1. DIMENSIONS SHALL BE INTERPRETED PER ASME Y14.5−2009.
2. HARMFUL MATERIAL CONTROL PLEASE FOLLOW DOC. NO. "EPI12".
3. PLEASE CONTACT FOXCONN SALES REPRESENTATIVE TO VERIFY PRODUCT DETAILS&AVAILABILITY.

REV.	ECN. No	APPD.
A	BC077063888	Yihsin Chen

SECTION A−A

FOXCONN P/N: KK1201*−**−**
MATING HEIGHT
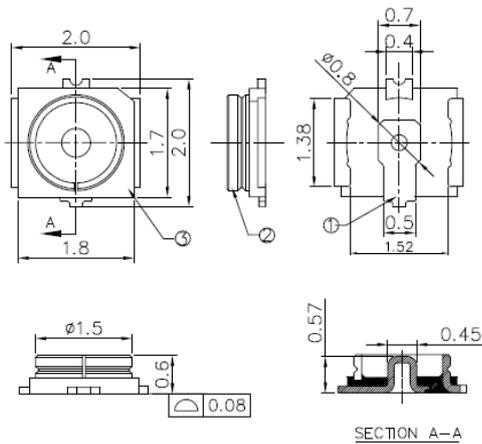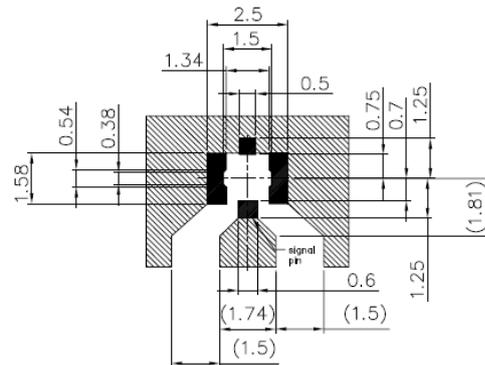
Electrode

P.C.B.A Layout
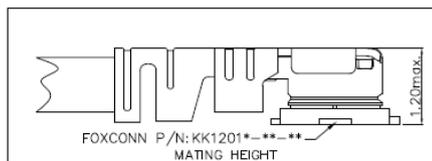
ITEMS		DECRIPTION
③	HOUSING	LCP
②	SHELL	SELECTIVITY PLATING
①	SIGNAL PIN	GOLD PLATING

X.±	X°±	UNITS mm	NAME(INTENDED USE)	FOXCONN
.x± 0.20	.x°±	MAT'L	RF HEADER	HON HAI PRECISION IND. CO.,LTD. TAIPEI, TAIWAN, R.O.C.
.xx± 0.10	.xx°±		PART NO.(INTENDED USE)	TITLE: CUSTOMER DRAWING
.xxx±	.xxx°±	FINISH	KK12 SERIES	SMT RF HEADER
		APPD: Yihsin Chen		DWG NO.:
		CHKD: Wolfe Liu	Q'TY	307-0000-1361
		DR: Fenghua Yu 8/'11		SCALE 1/1 SHEET 1/2 REV. AX5