AW-CM308NF

IEEE 802.11a/b/g/n/ac Wireless LAN 2T2R and Bluetooth 4.2 Combo Module (M.2 1216)

<u>Datasheet</u>

Version 0.8

Revision History

Document release	Date	Modification	Initials	Approved
Version 0.1	2017/1/5	Initial Version	Shihhua Huang	Daniel Lee
Version0.2	2017/2/13	Modify Pin Definition, Schematics and Mechanical information	Shihhua Huang	Daniel Lee
Version0.3	2017/2/14	Modify Specifications Table	Shihhua Huang	Daniel Lee
Version0.4	2017/3/13	Modify Specifications Table	Shihhua Huang	Daniel Lee
Version0.5	2017/4/5	Modify Block Diagram Modify Specifications Table Modify Electrical Characteristics -Add 1.8V IO Table Modify Pin Definition	Shihhua Huang	Daniel Lee
Version0.6	2017/4/11	Modify Specifications Table	Shihhua Huang	Daniel Lee
Version0.7	2017/04/18	Modify Specifications Table	Shihhua Huang	Daniel Lee
Version0.8	2017/06/30	Modify Specifications Table	Shihhua Huang	Daniel Lee

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Table of Contents

1. General Description

AzureWave Technologies, Inc. introduces the pioneer of the IEEE 802.11 a/b/g/n/ac WIFI with Bluetooth 4.2 combo M.2 module --- **AW-CM308NF**. The AW-CM308NF IEEE 802.11 a/b/g/n/ac PCIE WIFI with Bluetooth 4.2 combo M.2 module is a highly integrated single-chip MIMO (Multiple In, Multiple Out) 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 a WLAN MAC, a 2T2R capable WLAN baseband, and RF in s single chip. It enables a **high performance, cost effective, low power, compact solution** that easily fits onto the PCI Express and USB M.2 module.

The AW-CM308NF baseband implements Multi-user Multiple Input, Multiple Output (MU-MIMO) Orthogonal Frequency Division Multiplexing (OFDM) with two transmit and two receive paths (2T2R). Features include two spatial stream transmissions, short Guard Interval (GI) of 400ns, spatial spreading, and support for variant channel bandwidth. Moreover, AW-CM308NF provides one spatial stream space-time block code (STBC), Transmit Beamforming (TxBF) and Low Density Parity Check (LDPC) to extend the range of transmission. At the receiver, extended range and good minimum sensitivity is achieved by having receiver diversity up to 2 antennas. As the recipient, the AW-CM308NF also supports explicit sounding packet feedback that helps senders with beamforming capability.

For legacy compatibility, Direct Sequence Spread Spectrum (DSSS), Complementary Code Keying (CCK) and OFDM baseband processing are included to support all IEEE 802.11b, 802.11g and 802.11a data rates. Differential phase shift keying modulation schemes, DBPSK and DQPSK with data scrambling capability are available, and CCK provides support for legacy data rates, with long or short preamble. The high speed FFT/IFFT paths, combined with BPSK, QPSK, 16QAM, 64QAM and 256QAM modulation of the individual subcarriers, and rate compatible coding rate of 1/2, 2/3, 3/4, and 5/6, provide up to 866.7Mbps for IEEE 802.11ac MIMO OFDM.

The RTL8822BE-CG builds in an enhanced signal detector, an adaptive frequency domain equalizer, and a soft-decision Viterbi decoder to alleviate severe multi-path effects and mutual interference in the reception of multiple streams. For better detection quality, receive diversity with Maximal-Ratio-Combine (MRC) applying up to two receive paths is implemented. Robust interference detection and suppression are provided to protect against Bluetooth, cordless phone, and microwave oven interference.

Receive vector diversity for multi-stream application is implemented for efficient utilization of the MIMO channel. Efficient IQ-imbalance, DC offset, phase noise, frequency offset, and timing offset compensations are provided for the radio frequency front-end.

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2. **Key Features**

2-1. WLAN

- Support 802.11ac 2x2,Wave-2 compliant with MU-MIMO
- Complete 802.11n MIMO solution for 2.4GHz and 5Ghz band
- Maximum PHY data rate up to 173.3 Mbps using 20MHz bandwidth, 400Mbps using 40MHz bandwidth, and 866.7Mbps using 80MHz bandwidth.
- Backward compatible with 802.11a/b/g devices while operating at 802.11n data rates
- Backward compatible with 802.11a/n devices while operating at 802.11ac data rates.
- Complies with PCI Express Base Specification Revision 1.1
- PCIe LTR/L1.Off state supported
- IEEE 802.11a/b/g/n/ac compatible WLAN
- IEEE 802.11e QoS Enhancement (WMM)
- IEEE 802.11i (WPA, WPA2). Open, shared key, and pair-wise key authentication services
- IEEE 802.11h DFS, TPC, Spectrum Measurement
- WAPI (Wireless Authentication Privacy Infrastructure) certified.
- Cisco Compatible Extensions (CCX) for WLAN devices
- Frame aggregation for increased MAC efficiency (A-MSDU, A-MPDU)
- Low latency immediate Block Acknowledgement (BA)
- Multiple BSSID feature allows the RTL8822BE-CG to assume multiple MAC identities when used as a wireless bridge
- WiFi Direct supports wireless peer to peer applications.
- Supports Wake-On-WLAN via Magic Packet and Wake-up frame
- Transmit Beamforming
- Support S3/S4 AES/TKIP group key update
- Support Network List Offload
- CCA on secondary through RTS/CTS handshake.
- Support TCP/UDP/IP checksum offload
- Support LDPC
- Support STBC
- OFDM receive diversity with MRC using up to 2 receive paths. Switch diversity used for DSSS/CCK
- Fast receiver Automatic Gain Control (AGC)
- Maximum data rate 54Mbps in 802.11g, 300Mbps in 802.11n and 866.7bps in 802.11ac.
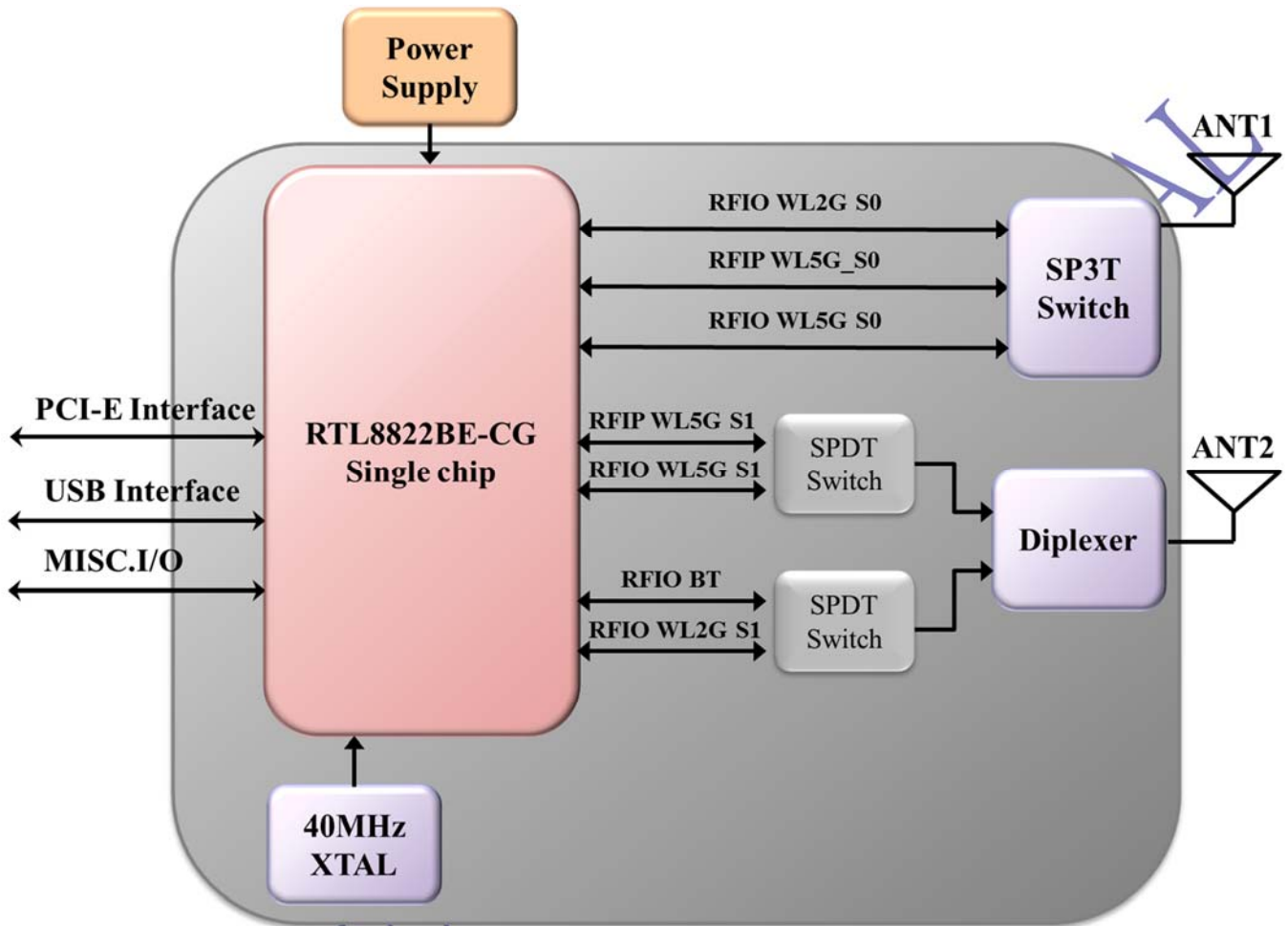
2-2. Bluetooth

● Compatible with Bluetooth v2.1 and v3.0+EDR

● Support Bluetooth 4.1 system

● Support Bluetooth 4.2 LE Secure Connection by upper layer software upgrade

● Integrated MCU to execute Bluetooth protocol stack

● Supports all packet types in basic rate and enhanced data rate

● Supports piconets in a scatterrnet

● Supports Secure Simple Pairing

● Supports Low Power Mode (Sniff/Sniff Sub-rating)

● Enhanced BT/WIFI Coexistence Control to improve transmission quality in different profiles

● Dual Mode support: Simultaneous LE and BR/EDR

● Supports multiple Low Energy states

● Fast AGC control to improve receiving dynamic range

● Supports AFH to dynamically detect channel quality to improve transmission quality

● ntegrated internal Class 1, Class 2, and Class 3 PA

● Supports Bluetooth Low Energy

● Integrated 32K oscillator for power management

3. Block Diagram

A simplified block diagram of the AW-CM308NF module is depicted in the figure below.

4. Specifications Table

Model Name	AW-CM308NF
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) + BT4.2
Major Chipset	RTL8822BE-CG
Host Interface	Wi-Fi : PCI-E , Bluetooth : USB
Antenna	I-PEX MHF4 Connector Receptacle (20449) ANT1 : WiFi → TX/RX ANT2 : WiFi/Bluetooth → Tx/Rx
Dimension	12mm x16mm x 1.7mm (Tolerance remarked in mechanical drawing)
Wi-Fi SVID/SSID	1A3B / 3081
BT VID/PID	13D3 / 3536
Weight	0.0006 kg
Operating Conditions	
Voltage	power supply for host:3.3V
Operating temperature	0~70 ℃
Storage temperature	-30~85 ℃
Electrical Specifications	
Frequency Range	WLAN: 2.4 GHz : 2.412 ~ 2.484 GHz 5 GHz: 4.915 ~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 : 16 +/-2dBm (11Mbps)
	  802.11g : 14 +/-2dBm (54Mbps)
	  802.11n @2.4GHz : 13 +/-2dBm (HT20 MCS7)
	  802.11n @2.4GHz : 13 +/-2dBm (HT40 MCS7)
	  802.11a @5GHz : 13 +/-2dBm (54Mbps)
	  802.11n @5GHz : 12 +/-2dBm (HT20 MCS7)
	  802.11n @5GHz : 12 +/-2dBm (HT40 MCS7)
	  802.11ac @5GHz : 10 +/-2dBm (HT80 MCS9)
	
	BT: 0 ~ 6 dBm

Receive Sensitivity	**WLAN :**
	  802.11b : -82dBm (11Mbps)
	  802.11g : -71dBm (54Mbps)
	  802.11n @2.4GHz : -68dBm (HT20 MCS7)
	  802.11n @2.4GHz : -66dBm (HT40 MCS7)
	  802.11a @5GHz : -69dBm (54Mbps)
	  802.11n @5GHz : -67dBm (HT20 MCS7)
	  802.11n @5GHz : -64dBm (HT40 MCS7)
	  802.11ac @5GHz : -54dBm (HT80 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 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)
	
	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 Realtek/ RTL8822BE-CG regulatory list**
ESD Specifications	
ESD rating	**HBM >1.5KV** **CDM > 400V**

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5. Electrical Characteristics

5.1 Recommended DC Operating Conditions

Symbol	Parameter	Minimum	Typical	Maximum	Unit
V_{dd33}	I/O voltage	3.0	3.3	3.6	V

5.2 Digital IO Pin DC Characteristics

Table 1. 3.3V IO DC Characteristics

Symbol	Parameter	Minimum	Typical	Maximum	Unit
V_{IH}	Input high voltage	2.0	3.3	3.6	V
V_{IL}	Input low voltage	--	0	0.9	V
V_{OH}	Output high voltage	2.97	--	3.3	V
V_{OL}	Output low voltage	0	--	0.33	V

Table 2. 1.8V IO DC Characteristics

Symbol	Parameter	Minimum	Typical	Maximum	Unit
VIH	Input high voltage	1.7	1.8	2.0	V
VIL	Input low voltage	-	0	0.8	V
VOH	Output high voltage	1.62	-	1.8	V
VOL	Output low voltage	0	-	0.18	V

5.3 LED mode behavior

State	Definition	Interpretation
OFF	The LED is emitting no light.	**Radio is incapable of transmitting.** This state is indicated when the card is not powered, the W_Disable# signal is asserted to disable the radio, or when the radio is disabled by software.
ON	The LED is emitting light.	**Radio is capable of transmitting.** The LED should remain ON even if the radio is bit actually transmitting. For example, the LED remains ON during temporary radio disablements performed by the Mini Card of its own volition to do scanning, switching radios/bands, power-management, etc. If the card is in a state wherein it is possible that radio can begin transmitting without the system user performing any action, this LED should remain ON.

5.4 PCIe Bus during power on sequence
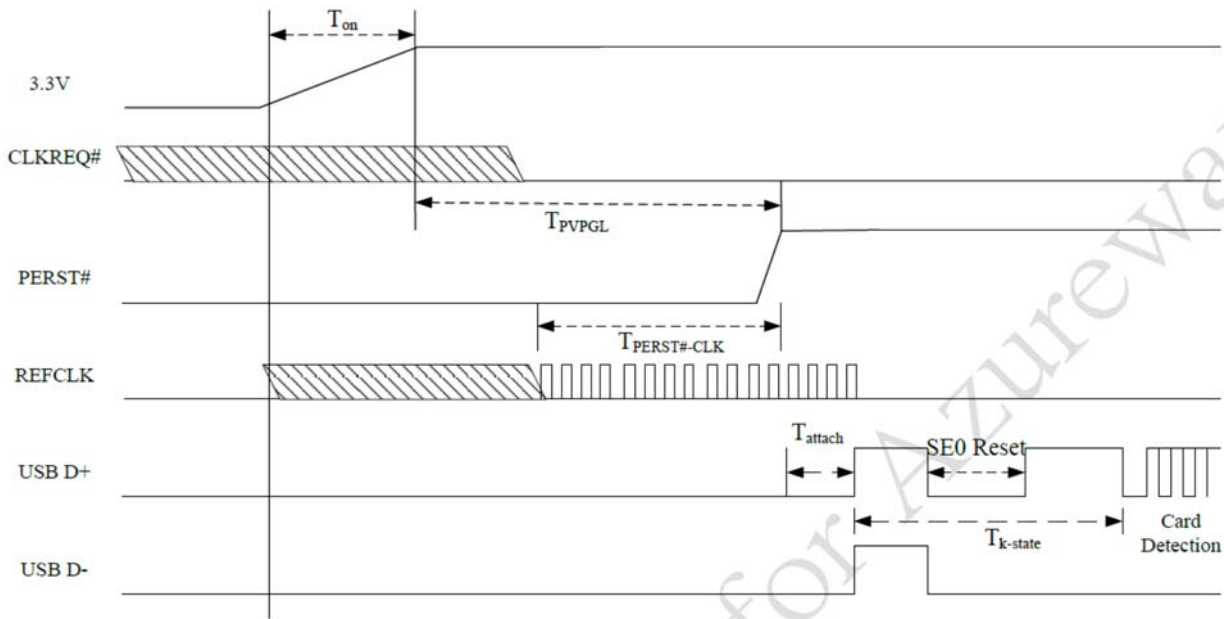
T_{on}: The main power ramp up duration

T_{PVPGL}: Power valid PERST# input inactive

$T_{PERST\#-CLK}$: Reference clock stable before PERST# inactive

T_{attach}: USB attach state

$T_{k-state}$: the duration from resister attached to USB host starting card detection procedure.

If use the 1.8V VIO, we suggest timing range 100us ~ 3ms after 3.3V power supply.

The typical timing range

Symbol	Unit	Min	Typical	Max
T_{on}	ms	1	1.5	5
T_{PVPGL}	ms			--
$T_{PERST\#-CLK}$	us	100		--
T_{attach}	ms	2	7	15
$T_{k-state}$	ms	50	250	--

6. Pin Definition

Pin Description (1216 NGFF)

| Pin No.	Definition	Basic Description	Type	Voltage
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	VCC	3.3V
5	3.3V	3.3V power supply	VCC	3.3V
6	GND	Ground.	GND	
7	RESERVED	Floating Pin, No connect to anything.	Floating	
8	RESERVED	Floating Pin, No connect to anything.	Floating	
9	RESERVED	Floating Pin, No connect to anything.	Floating	
10	RESERVED	Floating Pin, No connect to anything.	Floating	
11	RESERVED	Please don't connect to this pin.	N/A	
12	RESERVED	Please don't connect to this pin.	N/A	
13	RESERVED	Please don't connect to this pin.	N/A	
14	RESERVED	Floating Pin, No connect to anything.	Floating	
15	RESERVED	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	BT_WAKE	Host wake BT. No function, please don't connect to this pin.	N/A	
25	RESERVED	Floating Pin, No connect to anything.	Floating	
26	GND	Ground.	GND	
27	SUSCLK	Please don't connect to this pin.	Floating	
28	W_DISABLE1#	Turn off WLAN RF analog and front–end. Active low. This pin is controlled by system. (IC internal pull up)	IN	VIO
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	3.3V
30	CLKREQ#	Reference clock request.	I/O	3.3V

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31	PERST#	PCI Express reset with weak pull–down.	IN	3.3V
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	RESERVED	Floating Pin, No connect to anything.	Floating	
43	VIO (TEST_1V8)	VDDIO 1.8V/ 3.3V	VCC	VIO
44	TEST_3V3	For test pin.	N/A	
45	NC	Floating Pin, No connect to anything.	Floating	
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	USB_WAKE	BT wake host. No function, please don't connect to this pin.	N/A	
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	PCM_SYNC	PCM synchronous data output, connected to PCM_IN on the host.	Out	
59	PCM_IN	PCM Clock	I/O	
60	PCM_OUT	PCM synchronous data input, connected to PCM_OUT on the host.	IN	
61	PCM_CLK	PCM synchronous data SYNC	I/O	
62	GND	Ground.	GND	
63	BT_DISABLE	BT disable control. This pin is controlled by system. (IC internal pull up)	IN	VIO
64	LED2#	BT led function	OUT	
65	LED1#	WL led function	OUT	

66	RESERVED	Floating Pin, No connect to anything.	Floating	
67	BT_WAKE	Host wake BT. No function, please don't connect to this pin.	N/A	
68	GND	Ground.	GND	
69	USB_D-	DM_USB_BT	I/O	
70	USB_D+	DP_USB_BT	I/O	
71	GND	Ground.	GND	
72	3.3V	3.3V power supply	VCC	3.3V
73	3.3V	3.3V power supply	VCC	3.3V
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	
83	GND	Ground.	GND	
84	GND	Ground.	GND	
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	
G2	G2	Ground.	GND	
G3	G3	Ground.	GND	
G4	G4	Ground.	GND	
G5	G5	Ground.	GND	
G6	G6	Ground.	GND	

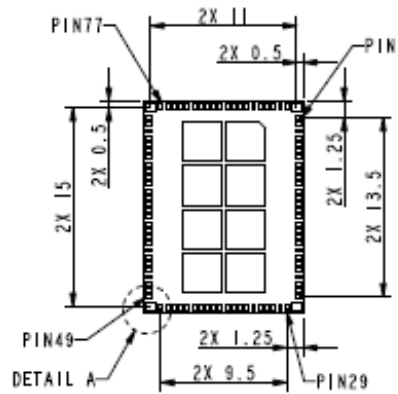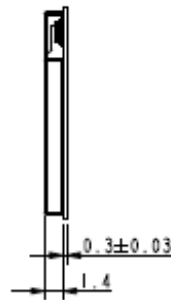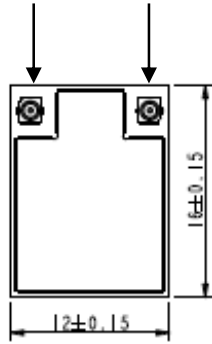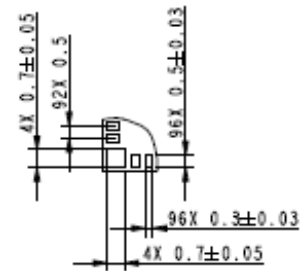| G7	G7	Ground.	GND	
G8	G8	Ground.	GND	
G9	G9	Ground.	GND	
G10	G10	Ground.	GND	
G11	G11	Ground.	GND	
G12	G12	Ground.	GND	

7 Schematics
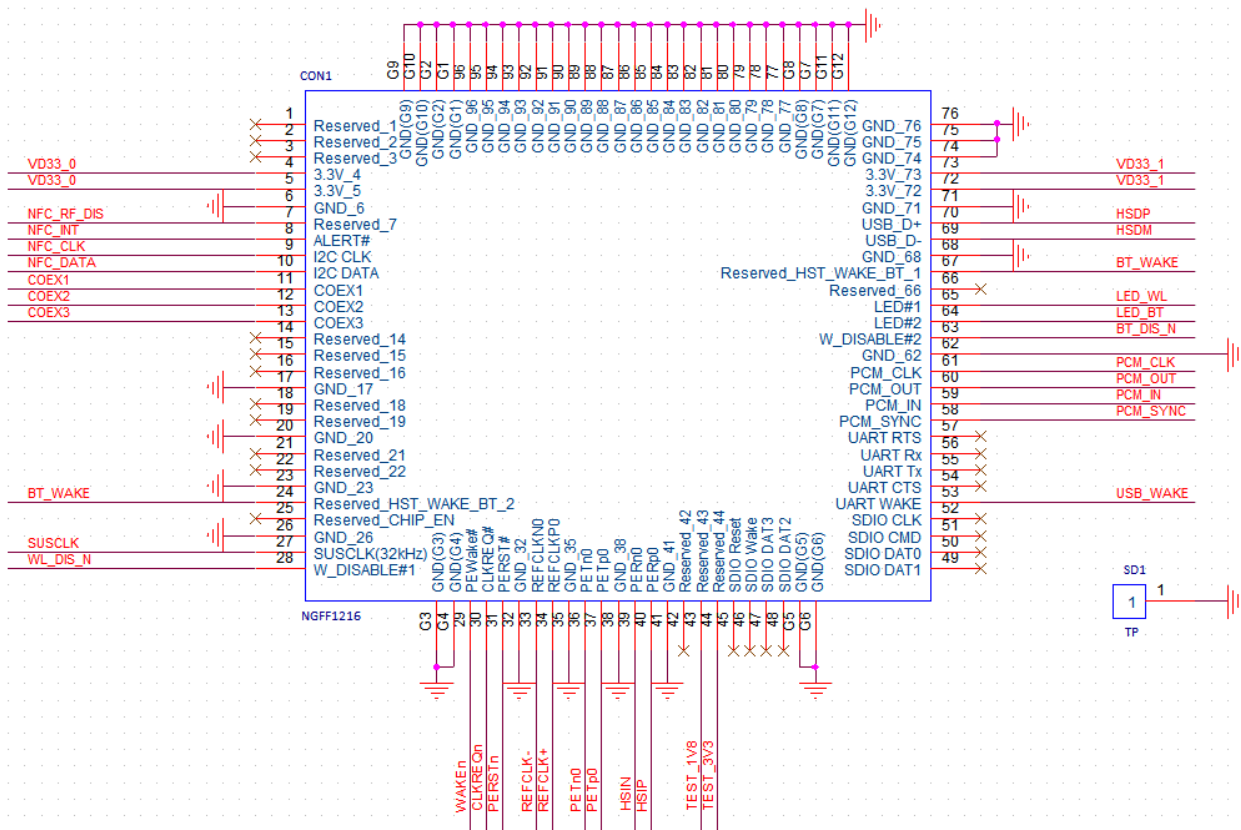
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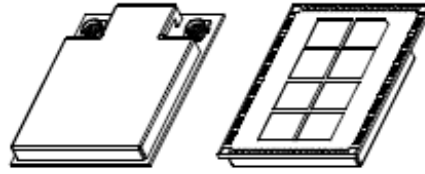
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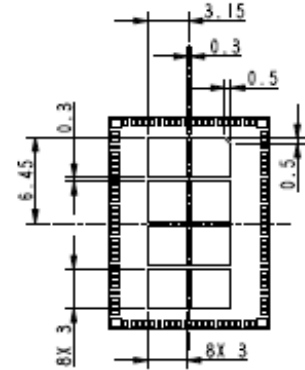
TOLERANCE UNLESS OTHERWISE SPECIFIED:±0.1mm
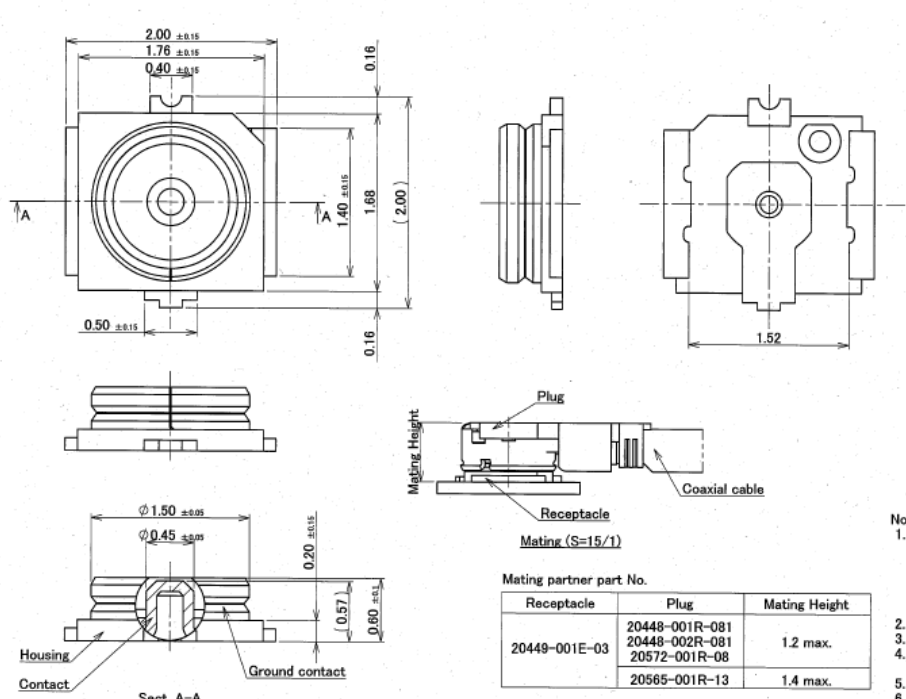
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SCALE:4.000

Antenna Connector Drawing
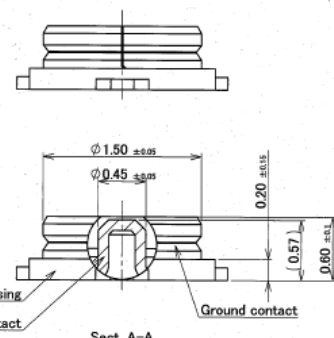

PART No. 20449-001E-03

Notes
1. Material
   (1) Housing : LCP black UL94-V-0
   (2) Contact : brass
       Au 0.01~0.05 μm over Pd-Ni 0.01~0.1 μm over Ni 1.27 μ mMIN.
   (3) Ground contact : phosphor bronze
       Au 0.01~0.05 μm over Pd-Ni 0.01~0.1 μm over Ni 1.27 μ mMIN.
2. Coplanarity : 0.1mm MAX
3. Packing : emboss tape
4. Mating partner part No.
   See table
5. This is "Pb-free" connector
6. RoHS compliant

Recommended footprint pattern (S=20/1)

Mating partner part No.

Receptacle	Plug	Mating Height
20449-001E-03	20448-001R-081 20448-002R-081 20572-001R-08	1.2 max.
	20565-001R-13	1.4 max.

GENERAL TOLERANCE

6 MAX.	±0.2
6 OVER MAX. 30	±0.3
30 OVER MAX. 120	±0.5
ANGLE	±2°

For Azurewave Technologies Inc.

DESIGNED BY J. Ohsawa May/01/2013
CHK'D BY

I-PEX DAI-ICHI SEIKO CO.,LTD.
I-PEX Business Company

TITLE
MHF4 Connector receptacle

REV	ECN	BY	DATE	APP
0	Z13177	J.O May/01/13		APP'D BY Weleanski May/01/13

REV.RECORD
SERIES No. R3

CUSTOMER COPY

PROJECTION

SCALE 10:1 UNIT mm DWG. No. 20449 SHEET 1/1 REV. 0

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: To assure continued compliance, any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. (Example - use only shielded interface cables when connecting to computer or peripheral devices).

End Product Labeling

This transmitter module is authorized only for use in devices where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in visible area with the following: "Contains FCC ID: TLZ-CM308NF"
 "

End Product Manual Information

The user manual for end users must include the following information in a prominent location "IMPORTANT NOTE: To comply with FCC RF exposure compliance requirements, the antenna used for this transmitter must be installed to provide a separation distance of at least 20cm from all persons and must not be colocated or operating in conjunction with any other antenna or transmitter."   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: In the event that these conditions can not be met (for example certain laptop configurations or colocation with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for reevaluating the end product (including the transmitter) and obtaining a separate FCC authorization.   This device is intended only for OEM integrators under the following conditions: The antenna must be installed such that 20 cm is maintained between the antenna and users. As long as a condition above is met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

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NCC警語

「依據低功率電波輻射性電機管理辦法」

第十二條經型式認證合格之低功率射頻電機，非經許可，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。

第十四條 低功率射頻電機之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。

前項合法通信，指依電信法規定作業之無線電通信。低功率射頻電機須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。」

*應避免影響附近雷達系統之操作。

*高增益指向性天線只得應用於固定式點對點系統。

本模組於取得認證後，將依規定於模組本體標示審驗合格標籤，並要求平台廠商於平台上標示「本產品內含射頻模組 XXXyyyLPDzzzz-x」

電磁波曝MPE標準值1mW/cm2，送測產品實_____mW/cm2。