FCC MPE Evaluation Report

Report No.	:	**SA170309C18**
Applicant	:	**AzureWave Technologies, Inc.**
Address	:	**8F., No. 94, Baozhong Rd., Xindian Dist., New Taipei City Taiwan**
Product	:	**IEEE 802.11 2X2 MIMO a/b/g/n/ac Wireless LAN + Bluetooth Module**
FCC ID	:	**TLZ-CM389NF**
Brand	:	**AzureWave**
Model No.	:	**AW-CM389NF**
Standards	:	**FCC Part 2 (Section 2.1091)** **KDB 447498 D01**
Sample Received Date	:	**Mar. 09, 2017**
Date of Evaluation	:	**Apr. 10, 2017**

CERTIFICATION: The above equipment have been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch – Lin Kou Laboratories**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's SAR characteristics under the conditions specified in this report. It should not be reproduced except in full, without the written approval of our laboratory. The client should not use it to claim product certification, approval, or endorsement by TAF or any government agencies.

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Table of Contents

Release Control Record

Report No.	Reason for Change	Date Issued
SA170309C18	Initial release	Apr. 12, 2017

1. Description of Equipment Under Test

EUT Type	IEEE 802.11 2X2 MIMO a/b/g/n/ac Wireless LAN + Bluetooth Module
FCC ID	TLZ-CM389NF
Brand Name	AzureWave
Model Name	AW-CM389NF
Tx Frequency Bands (Unit: MHz)	WLAN : 2412 ~ 2462, 5180 ~ 5240, 5260 ~ 5320, 5500 ~ 5700, 5745 ~ 5825 Bluetooth : 2402 ~ 2480
Uplink Modulations	802.11b : DSSS 802.11a/g/n/ac : OFDM Bluetooth : GFSK, π/4-DQPSK, 8-DPSK
Antenna Type	Refer to BV CPS Report No.: RF140407E07D
EUT Stage	Identical Prototype

Note:

1. The EUT is authorized for use in specific End-product. Please refer to below for more details.

Product	Brand	Model
Smart IOT	Compal	EIH3

2. The information of antenna which collocated in the End-product is listed as below.

Antenna Type	Manufacturer	Antenna Gain (dBi)				
		2.4GHz	U-NII-1	U-NII-2A	U-NII-2C	U-NII-3
Dipole	Speed	Main: 3.33 Aux.: 3.75	Main: 1.76 Aux.: 5.39	Main: 2.45 Aux.: 4.82	Main: 1.13 Aux.: 4.04	Main: 1.96 Aux.: 4.85

3. The above EUT information is declared by manufacturer and for more detailed features description please refers to the manufacturer's specifications or User's Manual.

List of Accessory of End-product:

AC Adapter	**Brand Name**	DVE
	Model Name	DSA-24PFM-12 FUS
	Power Rating	I/P: 100-240 Vac, 0.8 A O/P: 12 Vdc, 2 A
BT/WLAN Module	**Brand Name**	AzureWave
	Model Name	AW-CM389NF
Zigbee Module	**Brand Name**	MMBnetwork
	Model Name	Z357PA40-SMT
Z-Wave Module	**Brand Name**	Sigma Designs
	Model Name	ZM5202AU

2. MPE (Maximum Permissible Exposure) Assessment

2.1 Introduction

According to 47 CFR §2.1091, a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 cm is normally maintained between the transmitting antenna and the body of the user or nearby persons. In this context, the term "fixed location" means that the device is physically secured at one location and is not able to be easily moved to another location. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal computer, are considered to be mobile devices if they meet the 20 cm separation requirement. The limits to be used for MPE evaluation are specified in §1.1310. All unlicensed personal communications service (PCS) devices and unlicensed NII devices shall be subject to the limits for general population/uncontrolled exposure.

2.2 RF Radiation Exposure Limits

According to 47 CFR §1.1310, the criteria listed in below table shall be used to evaluate the environmental impact of human exposure to RF radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093.

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (min)
(A) Limits for Occupational / Controlled Exposures				
0.3 – 3.0	614	1.63	100	6
3.0 – 30	1842/f	4.89/f	$900/f^2$	6
30 – 300	61.4	0.163	1.0	6
300 – 1500	-	-	f/300	6
1500 – 100000	-	-	5	6
(B) Limits for General Population / Uncontrolled Exposures				
0.3 – 1.34	614	1.63	100	30
1.34 – 30	824/f	2.19/f	$180/f^2$	30
30 – 300	27.5	0.073	0.2	30
300 – 1500	-	-	f/1500	30
1500 – 100000	-	-	1.0	30

Limits for maximum permissible exposure (MPE)

Notes:

1. f = frequency in MHz
2. Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided they are made aware of the potential for exposure.
3. General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

2.3 MPE Assessment Method

Calculations can be made to predict RF field strength and power density levels around typical RF sources. For example, in the case of a single radiating antenna, a prediction for power density in the far-field of the antenna can be made by use of the general Equations below. This equation is generally accurate in the far-field of an antenna but will over-predict power density in the near field, where they could be used for making a "worst case" or conservative prediction.

$$\text{Power Density (S)} = \frac{PG}{4\pi R^2} = \frac{EIRP}{4\pi R^2}$$

Where

S = Power Density, unit in mW/cm^2

P = Power input to the antenna, unit in mW

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = Distance to the center of radiation of the antenna, unit in cm

EIRP = Effective isotropically radiated power

2.4 MPE Calculation for Standalone Operations

The manufacturer expects that the radiated component of this device will not close to the human body during normal usage and the warning statement was also stated in the user instruction. Since the transmitting antenna will be kept at least 20 cm away from the human body, the MPE level is calculated based on this condition and the result is listed in below table.

Band	Mode	Max. Time-averaged Power (dBm)	Peak Antenna Gain (dBi)	Max. Time-averaged EIRP (mW)	Max. Time-averaged ERP (W)	Calculated Power Density (mW/cm^2)	MPE Limit (mW/cm^2)	Result
WLAN 2.4G	Ant-0	16.5	3.75	105.93	0.06	0.02	1.00	PASS
	Ant-1	16.5	3.75	105.93	0.06	0.02	1.00	PASS
WLAN 5.2G	Ant-0	15.5	5.39	122.74	0.07	0.02	1.00	PASS
	Ant-1	16.0	5.39	137.72	0.08	0.03	1.00	PASS
WLAN 5.3G	Ant-0	15.5	4.82	107.65	0.07	0.02	1.00	PASS
	Ant-1	16.0	4.82	120.78	0.07	0.02	1.00	PASS
WLAN 5.6G	Ant-0	16.0	4.04	100.93	0.06	0.02	1.00	PASS
	Ant-1	16.0	4.04	100.93	0.06	0.02	1.00	PASS
WLAN 5.8G	Ant-0	15.5	4.85	108.39	0.07	0.02	1.00	PASS
	Ant-1	16.0	4.85	121.62	0.07	0.02	1.00	PASS
Bluetooth EDR	-	10.0	3.75	23.71	0.01	< 0.01	1.00	PASS
BLE	-	8.5	3.75	16.79	0.01	< 0.01	1.00	PASS

Summary:

Since the ERP (effective radiated power) operated at < 1.5 GHz is less than 1.5 watts and > 1.5 GHz is less than 3 watts, the routine environmental evaluation is not required, and the MPE result calculated for this device complies with the MPE limit as specified in 47 CFR §1.1310.

2.5 MPE Calculation for Simultaneous Transmission Operations

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is ≤ 1.0. The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency.

$$\sum_{i=1}^{\infty} \frac{MPE_i}{MPE_{Limit}} \leq 1.0$$

Where

MPE_i = the power density

MPE_{Limit} = the power density limit

Calculated Result:

Band	Mode	Power Density	Power Density Limit	P/L Ratio	Max. Ratio
WLAN 2.4G	Ant-0	0.02	1.00	0.02	0.02
	Ant-1	0.02	1.00	0.02	
Sum of the Ratio					0.04

Band	Mode	Power Density	Power Density Limit	P/L Ratio	Max. Ratio
WLAN 5.2G	Ant-0	0.02	1.00	0.02	0.03
	Ant-1	0.03	1.00	0.03	
Sum of the Ratio					0.05

Band	Mode	Power Density	Power Density Limit	P/L Ratio	Max. Ratio
WLAN 5.3G	Ant-0	0.02	1.00	0.02	0.02
	Ant-1	0.02	1.00	0.02	
Sum of the Ratio					0.04

Band	Mode	Power Density	Power Density Limit	P/L Ratio	Max. Ratio
WLAN 5.6G	Ant-0	0.02	1.00	0.02	0.02
	Ant-1	0.02	1.00	0.02	
Sum of the Ratio					0.04

Band	Mode	Power Density	Power Density Limit	P/L Ratio	Max. Ratio
WLAN 5.8G	Ant-0	0.02	1.00	0.02	0.02
	Ant-1	0.02	1.00	0.02	
Sum of the Ratio					0.04

The EUT is authorized for use in specific End-product. For the End-product, WLAN is possibly operated with Bluetooth, Zigbee, and Z-Wave at the same time, so the EUT was evaluated co-location as below. Refer to BV CPS report no.: SA170309C20 for MPE evaluation of Zigbee and Z-Wave.

WLAN 2.4G + Bluetooth + Zigbee + Z-wave

Band	Mode	Power Density	Power Density Limit	P/L Ratio	Max. Ratio
WLAN 2.4G	Ant-0	0.02	1.00	0.02	0.02
	Ant-1	0.02	1.00	0.02	
Bluetooth	-	< 0.01	1.00	0.01	0.01
Zigbee	-	0.02	1.00	0.02	0.02
Z-Wave	-	< 0.01	0.61	0.01	0.02
Sum of the Ratio					0.09

WLAN 5G + Bluetooth + Zigbee + Z-wave

Band	Mode	Power Density	Power Density Limit	P/L Ratio	Max. Ratio
WLAN 5.2G	Ant-0	0.02	1.00	0.02	0.03
	Ant-1	0.03	1.00	0.03	
Bluetooth	-	< 0.01	1.00	0.01	0.01
Zigbee	-	0.02	1.00	0.02	0.02
Z-Wave	-	< 0.01	0.61	0.015	0.02
Sum of the Ratio					0.10

Summary:

Since the summation of the ratio on worst condition comply the above formula; the simultaneous transmission operations also complies with the FCC restriction as specified in 47 CFR §1.1310.

3. Information on the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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The road map of all our labs can be found in our web site also.

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