

Radio Exposure Evaluation Report

FCC ID : TLZ-XB644NF

Equipment : IEEE 802.11 1X1 a/b/g/n/ac/ax Wireless LAN + Bluetooth 5.4
+ 802.15.4 Tri-radio M.2 2230 Module

Brand Name : AzureWave

Model Name : AW-XB644NF

Applicant : AzureWave Technologies, Inc.
8F., No.94, Baozhong Rd. , Xindian Dist., New Taipei City ,
Taiwan 231

Manufacturer : AzureWave Technologies, Inc.
8F., No.94, Baozhong Rd. , Xindian Dist., New Taipei City ,
Taiwan 231

Standard : 47 CFR FCC Part 2 Subpart J, section 2.1091

The product was received on Aug. 01, 2024, and testing was started from Aug. 18, 2024 and completed on Oct. 16, 2024. We, SPORTON INTERNATIONAL INC. Hsinhua Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in 47 CFR FCC Part 2 Subpart J, section 2.1091 and shown compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. Hsinhua Laboratory, the test report shall not be reproduced except in full.



Approved by: Jackson Tsai

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Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
2	-	Exposure evaluation	PASS	-

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

None

Reviewed by: Ben Tseng
Report Producer: Julie Tseng

1 General Description

1.1 Information

1.1.1 EUT General Information

RF General Information			
Evaluation Mode	Frequency Range (MHz)	Operating Frequency (MHz)	Modulation Type
2.4GHz WLAN	2400-2483.5	2412-2462	802.11b: DSSS (DBPSK, DQPSK, CCK) 802.11g/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) VHT: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM) 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)
5GHz WLAN	5150-5250 5250-5350 5470-5725 5725-5850 5850-5895	5180-5240 5260-5320 5500-5720 5745-5825 5845-5885	802.11a/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) 802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM) 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)
Bluetooth	2400-2483.5	2402-2480	BR / EDR: FHSS (GFSK / $\pi/4$ -DQPSK / 8DPSK) LE: DSSS (GFSK)
Thread	2400-2483.5	2405-2480	DSSS (O-QPSK)

1.1.2 Antenna Information

Ant.	Brand	Model Name	Antenna Type	Connector	Support
1	TE Connectivity	2195501-2	PCB	I-PEX	2.4G+5G+BT+Thread
2	TE Connectivity	2195505-2	PCB	I-PEX	2.4G+5G+BT+Thread
3	Inpaq	WA-P-LB-02-587	PCB	I-PEX	2.4G+5G+BT+Thread
4	Inpaq	WA-P-LB-03-129	PCB	I-PEX	2.4G+5G+BT+Thread
5	Inpaq	WA-P-LB-03-130	PCB	I-PEX	2.4G+5G+BT+Thread
6	Inpaq	WA-F-LB-03-110	PCB	I-PEX	2.4G+5G+BT+Thread
7	Inpaq	WA-F-LB-02-187	PCB	I-PEX	2.4G+5G+BT+Thread
8	Inpaq	WA-F-LA-01-015	PCB	I-PEX	2.4G+BT+Thread

Ant.	Gain (dBi)	
	2.4G	5G
1	0.47	1.88
2	0.77	0.96
3	4.43	7.52
4	6.51	3.2
5	4.91	5.84
6	-0.27	2.74
7	0.07	2.39
8	5.66	-

Note 1: The EUT has eight sets of antennas.

Note 2: EUT can match with above antennas for using. The highest gain in each set of antenna was used to perform the worst configuration and result of that was recorded as the final test result.

For 2.4GHz function:

For IEEE 802.11 b/g/n/VHT/ax mode (1TX/1RX)

Ant. 1 ~ Ant. 8 could transmit/receive.

For 5GHz function:

For IEEE 802.11 a/n/ac/ax mode (1TX/1RX)

Ant. 1 ~ Ant. 7 could transmit/receive.

For BT function:

For IEEE 802.15.1 Bluetooth mode (1TX/1RX)

Ant. 1 ~ Ant. 8 could transmit/receive.

For Thread function:

For IEEE 802.15.4 Thread mode (1TX/1RX)

Ant. 1 ~ Ant. 8 could transmit/receive.

1.2 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ 47 CFR FCC Part 2 Subpart J, section 2.1091
- ♦ KDB 447498 D04 Interim General RF Exposure Guidance v01

The following reference test guidance is not within the scope of accreditation of TAF.

- ♦ 47 CFR Part 1.1307
- ♦ 47 CFR Part 1.1310

1.3 Testing Location

Test Lab. : Sporton International Inc. Hsinhua Laboratory			
☒	Hsinhua (TAF: 3785)	ADD: No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333411, Taiwan (R.O.C.)	
		TEL: 886-3-327-3456	FAX: 886-3-327-0973
		Test site Designation No. TW3785 with FCC.	
☐	Wen 33rd.St. (TAF: 3785)	ADD: No.14-1, Ln. 19, Wen 33rd St., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.)	
		TEL: 886-3-318-0787	FAX: 886-3-318-0287
		Test site Designation No. TW0008 with FCC.	

2 Maximum Permissible Exposure

2.1 Limit of Maximum Permissible Exposure

(A) Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
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
1500-100,000	-	-	5	6

(B) Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm ²)	Averaging Time E ² , H ² or S (minutes)
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
1500-100,000	-	-	1.0	30

Note: f = frequency in MHz ; *Plane-wave equivalent power density

2.2 RF Exposure Exempt Measurement

Option	Refer Std.	Exemption Exposure Thresholds (TL)
A	§1.1307(b)(3)(i)(A)	Available maximum time-averaged power is no more than 1 mW
B	§1.1307(b)(3)(i)(B)	$P_{th}(mW) = \begin{cases} ERP_{20cm}(d / 20cm)^x \rightarrow d \leq 20cm \\ ERP_{20cm} \rightarrow 20cm < d \leq 40cm \end{cases}$ $x = -\log_{10} \left(\frac{60}{ERP_{20cm} \sqrt{f}} \right) \text{ and } f \text{ is in GHz}$ $\begin{cases} ERP_{20cm} : 0.3GHz \leq f < 1.5GHz \rightarrow 2040 f(mW) \\ ERP_{20cm} : 1.5GHz \leq f \leq 6GHz \rightarrow 3060(mW) \end{cases}$
C	§1.1307(b)(3)(i)(C)	$\begin{cases} 0.3 \sim 1.34MHz \rightarrow ERP(W) = 1920R^2 \\ 1.34 \sim 30MHz \rightarrow ERP(W) = 3450R^2 / f^2 \\ 30 \sim 300MHz \rightarrow ERP(W) = 3.83R^2 \\ 300 \sim 1500MHz \rightarrow ERP(W) = 0.0128R^2 f \\ 1500 \sim 100000MHz \rightarrow ERP(W) = 19.2R^2 \end{cases}$ f is in MHz; R is in m; $R > \lambda / 2\pi$

2.3 Multiple RF Sources Exposure

Refer Std.	Exemption Exposure Thresholds (TL)
§1.1307(b)(3)(ii)(A)	The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required)
§1.1307(b)(3)(ii)(B)	$\sum_{i=1}^a \frac{P_i}{P_{th,i}} + \sum_{j=1}^b \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^c \frac{Evaluated_k}{ExposureLimit_k} \leq 1$ a = number of fixed, mobile, or portable RF sources claiming exemption using paragraph §1.1307(b)(3)(i)(B) of this section for P , including existing exempt transmitters and those being added. b = number of fixed, mobile, or portable RF sources claiming exemption using paragraph §1.1307(b)(3)(i)(C) of this section for Threshold ERP, including existing exempt transmitters and those being added. c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance including existing evaluated transmitters. P_i = the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source i at a distance between 0.5 cm and 40 cm (inclusive). P_{th,i} = the exemption threshold power (P_{th}) according to paragraph §1.1307(b)(3)(i)(B) of this section for fixed, mobile, or portable RF source i. ERP_j = the ERP of fixed, mobile, or portable RF source j. ERP_{th,j} = exemption threshold ERP for fixed, mobile, or portable RF source j, at a distance of at least λ/2π according to the applicable formula of paragraph §1.1307(b)(3)(i)(C) of this section. Evaluated_k = the maximum reported SAR or MPE of fixed, mobile, or portable RF source k either in the device or at the transmitter site from an existing evaluation at the location of exposure. Evaluated Limit_k = either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable RF source k, as applicable from § 1.1310 of this chapter.

2.4 MPE Calculation Method

The MPE was calculated at 20 cm to show compliance with the power density limit.
The following formula was used to calculate the Power Density:

$$E \text{ (V/m)} = \frac{\sqrt{30 \times P \times G}}{d} \qquad \text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

E = Electric field (V/m)

P = RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 \times P \times G}{377 \times d^2}$$

2.5 Calculated Result and Limit

Exposure Environment: General Population / Uncontrolled Exposure

2.4G

Full RU

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
2.4G;G1D	6.51	19.13	23.49	0.50	250.611	20	B	3060.0	0.0819
2.4G;D1D	6.51	21.04	25.40	0.50	389.045	20	B	3060.0	0.1272

Partial RU

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
2.4G;D1D	6.51	10.74	15.10	0.50	36.308	20	B	3060.0	0.0119

5G

Full RU

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
5.2G;D1D	7.52	21.75	27.12	0.50	578.096	20	B	3060.0	0.1890
5.3G;D1D	7.52	21.83	27.20	0.50	588.844	20	B	3060.0	0.1925
5.6G;D1D	7.52	21.90	27.27	0.50	598.412	20	B	3060.0	0.1956
5.8G;D1D	7.52	21.76	27.13	0.50	579.429	20	B	3060.0	0.1894
5.81G;D1D	7.52	20.97	26.34	0.50	483.059	20	B	3060.0	0.1579

Partial RU

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
5.2G;D1D	7.52	14.29	19.66	0.50	103.753	20	B	3060.0	0.0339
5.3G;D1D	7.52	14.80	20.17	0.50	116.681	20	B	3060.0	0.0381
5.6G;D1D	7.52	15.46	20.83	0.50	135.831	20	B	3060.0	0.0444
5.8G;D1D	7.52	18.20	23.57	0.50	255.270	20	B	3060.0	0.0835
5.81G;D1D	7.52	17.74	23.11	0.50	229.615	20	B	3060.0	0.0751

**Bluetooth**

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
2.4G;BT-LE	6.51	13.27	17.63	0.50	65.013	20	B	3060.0	0.0213
2.4G;BT-BR	6.51	13.27	17.63	0.50	65.013	20	B	3060.0	0.0213
2.4G;BT-EDR	6.51	9.91	14.27	0.50	29.992	20	B	3060.0	0.0098

Thread

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
2.4G;D1D	6.51	3.27	7.63	0.50	6.501	20	B	3060.0	0.0021

————THE END————