Maximum Permissible Exposure Report

Product	:	11AX/AC/A/B/G/N (WIFI 6) 2T2R Dual Band Simultaneous full size MPCIE wireless card
Model Name	:	WM-1431
FCC ID	:	2AWKZ-WM1431
Test Regulation	:	47 CFR FCC Part 2.1091
Received Date	:	2023/2/15
Test Date	:	2023/3/20 ~ 2023/6/29
Issued Date	:	2023/7/26
Applicant	:	Enli Incorporation 4F., No. 42, Aly. 5, Ln. 12, Sec. 3, Bade Rd., Songshan Dist. Taipei 10559, Taiwan
Issued By	:	Underwriters Laboratories Taiwan Co., Ltd. Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Testing Laboratory
3398

REVISION HISTORY

Original Test Report No.: 4790738072-US-R3-V0

Rev.	Test report No.	Date	Page revised	Contents
Original	4790738072-US-R3-V0	2023/7/26	-	Initial issue

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1. Attestation of Test Results

APPLICANT:	Enli Incorporation 4F., No. 42, Aly. 5, Ln. 12, Sec. 3, Bade Rd., Songshan Dist. Taipei 10559, Taiwan
MANUFACTURER:	Edimax Technology Co., Ltd. Niu Shan Foreign Economic Industrial Park, Dong Cheng District, Dongguan, Guangdong, China
EUT DESCRIPTION:	11AX/AC/A/B/G/N (WIFI 6) 2T2R Dual Band Simultaneous full size MPCIE wireless card
BRAND:	Comtrend
MODEL:	WM-1431
SAMPLE STAGE:	Engineering Verification Test sample

APPLICABLE STANDARDS	
STANDARD	**Test Results**
47 CFR FCC Part 2.1091	PASS

Underwriters Laboratories Taiwan Co., Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Underwriters Laboratories Taiwan Co., Ltd. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Prepared By:

Cindy Hsin Date : 2023/7/26
Project Handler

Approved and Authorized By:

Eric Lee Date : 2023/7/26
Senior Laboratory Engineer

2. Test Methodology and Reference Procedures

The tests documented in this report were performed in accordance with KDB 447498 D04 Interim General RF Exposure Guidance v01.

3. Facilities and Accreditation

Test Location	Underwriters Laboratories Taiwan Co., Ltd.
Address	Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan
Accreditation Certificate	Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398.

4. Equipment Under Test

4.1. Description of EUT

Product Name	11AX/AC/A/B/G/N (WIFI 6) 2T2R Dual Band Simultaneous full size MPCIE wireless card
Brand Name	Comtrend
Model Name	WM-1431
Operating Frequency	**2.4GHz:** 2412MHz ~ 2462MHz **5GHz:** 5180MHz ~ 5240MHz 5260MHz ~ 5320MHz 5500MHz ~ 5720MHz 5745MHz ~ 5825MHz
Modulation	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM 1024QAM, 256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDMA

Number of Channel	2.4G WLAN 2412 ~ 2462 MHz	11 for 802.11b, 802.11g, 802.11n (HT20), 802.11ax (HE20) 7 for 802.11n (HT40), (HE20), 802.11ax (HE40)
	5G WLAN 5180 ~ 5240 MHz	4 for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20)
		2 for 802.11n (HT40), 802.11 ac (VHT40), 802.11ax (HE40)
		1 for 802.11ac (VHT80), 802.11ax (HE80)
	5G WLAN 5260 ~ 5320 MHz	4 for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20)
		2 for 802.11n (HT40), 802.11 ac (VHT40), 802.11ax (HE40)
		1 for 802.11ac (VHT80), 802.11ax (HE80)
		1 for 802.11ac (VHT160), 802.11ax (HE160)
	5G WLAN 5500 ~ 5720 MHz	12 for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20)
		6 for 802.11n (HT40), 802.11 ac (VHT40), 802.11ax (HE40)
		3 for 802.11ac (VHT80), 802.11ax (HE80)
		1 for 802.11ac (VHT160), 802.11ax (HE160)
	5G WLAN 5745 ~ 5825 MHz	5 for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20)
		2 for 802.11n (HT40), 802.11 ac (VHT40), 802.11ax (HE40)
		1 for 802.11ac (VHT80), 802.11ax (HE80)
Normal Voltage	3.3Vdc	
Sample ID	5790214	

Note:

1. The EUT incorporates a MIMO function. Physically, the EUT provides two completed transmitters and two receivers.

Modulation Mode	Tx,Rx Function
802.11a	2TX,2RX
802.11n (HT20)	2TX,2RX
802.11n (HT40)	2TX,2RX
802.11ac (VHT20)	2TX,2RX
802.11ac (VHT40)	2TX,2RX
802.11ac (VHT80)	2TX,2RX
802.11ac (VHT160)	2TX,2RX
802.11ax (HE20)	2TX,2RX
802.11ax (HE40)	2TX,2RX
802.11ax (HE80)	2TX,2RX
802.11ax (HE160)	2TX,2RX

2. The EUT contains following accessory devices:

Product	Brand	Model	Description
Antenna 1	LYNwave	ALX18P-222AA1-00	-
Antenna 2	LYNwave	ALX18P-222AA1-01	-
Antenna 3	KINSUN	6603303081	-
Antenna 4	WIESON	ARY121-0348-008-00	-
Antenna 5	ARISTOTLE	RFA-25-C2M2-M10-1	-
Antenna 6	ARISTOTLE	RFA-25-C2M2-U-M70	-
Antenna 7	WANSHIH	WSS038	-

3. For this report measurement uncertainty, statement of conformity, determining compliance, it is necessary to refer to the original measurement report of EUT.

4. The above EUT information is declared by manufacturer and for more detailed features description, please refer the manufacturer's or user's manual, the laboratory shall not be held responsible.

4.2. Description of Available Antennas

Ant. No.	Transmitter Circuit	Brand Name	Model Name	Ant. Type	Maximum Gain (dBi)	Remark
1	Chain (0)+(1)	LYNwave	ALX18P-222AA1-00	Panel	2.4GHz: 6.4 5GHz: 4.2	I-PEX
2	Chain (0)+(1)	LYNwave	ALX18P-222AA1-01	Panel	2.4GHz: 2.6 5GHz: 5.2	I-PEX
3	Chain (0)+(1)	KINSUN	6603303081	Dipole	2.4GHz: 2.18 5GHz: 3.58	RP-SMA
4	Chain (0)+(1)	WIESON	ARY121-0348-008-00	Dipole	2.4GHz: 1.75 5GHz: 1.9	RP-SMA
5	Chain (0)+(1)	ARISTOTLE	RFA-25-C2M2-M10-1	Dipole	2.4GHz: 2.56 5GHz: 1.81	RP-SMA
6	Chain (0)+(1)	ARISTOTLE	RFA-25-C2M2-U-M70	Dipole	2.4GHz: 2.56 5GHz: 1.81	RP-SMA
7	Chain (0)+(1)	WANSHIH	WSS038	Dipole	2.4GHz: 4.1 5GHz: 5.23	RP-SMA

Note: The above antenna information was provided from customer and for more detailed features description, please refer the manufacturer's specification or user's manual, the laboratory shall not be held responsible.

5. Requirement

Limits for General Population/Uncontrolled Exposure

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 1: f = frequency in MHz, * means Plane-wave equivalent power density				
Note 2: 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.				

Power Density (S) is calculated by the following formula:

$S=(P*G)/4\pi R^2$

where: S = power density (in appropriate units, e.g. mW/cm^2)
P = power input to the antenna (in appropriate units, e.g., 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 (appropriate units, e.g., cm)

6. General RF Exposure Test Exemption

The corresponding Exclusion Threshold condition, listed below:

1) Blanket Exempt: Following 47 CFR 1.1307(b)(3)(i)(A), the available maximum time-averaged power is no more than 1 mW.

2) SAR Exempt: Following 47 CFR 1.1307(b)(3)(i)(B), the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \text{cm})^{x} & d \le 20\ \text{cm} \\ ERP_{20\ cm} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20\ cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases}$$

d = the separation distance (cm);

3) MPE Exempt: Following 47 CFR 1.1307(b)(3)(i)(C), using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.

7. Radio Frequency Radiation Exposure Evaluation

(1) General RF Exposure Test Exemption

Option	Evaluation Method	Clause
☐	Blanket Exempt	47 CFR 1.1307(b)(3)(i)(A)
☐	SAR Exempt	47 CFR 1.1307(b)(3)(i)(B)
☒	MPE Exempt	47 CFR 1.1307(b)(3)(i)(C)

Note: Max. ERP (dBm) = Max. Average power (dBm) + Antenna Gain (dBi) - 2.15 (dB)

Non-Beamforming mode

WLAN 2.4GHz

Evaluation Frequency	λ/2π	R	Max. ERP	Max. ERP	Threshold ERP
(MHz)	(m)	(m)	(dBm)	(W)	(W)
2412 ~ 2462	0.0198	0.32	27.92	0.619	1.9661

Note:

1. λ(m) = $3*10^8$ (m/s) / frequency (Hz)
2. Max. ERP (dBm) = Max. Average power (dBm) + Antenna Gain (dBi) -2.15
3. Max. ERP (W) = $10^{(\text{Max. ERP (dBm)} / 10)}$ / 1000
4. Threshold ERP (W) (RF Source Frequency 1500 – 100000 MHz) = 19.2 R^2

WLAN 5GHz

Evaluation Frequency	λ/2π	R	Max. ERP	Max. ERP	Threshold ERP
(MHz)	(m)	(m)	(dBm)	(W)	(W)
5180 ~ 5240	0.0092	0.32	28.96	0.787	1.9661
5260 ~ 5320	0.0091	0.32	30.05	1.012	1.9661
5500 ~ 5720	0.0086	0.32	29.69	0.931	1.9661
5745 ~ 5825	0.0084	0.32	30.80	1.202	1.9661

Note:

1. λ(m) = $3*10^8$ (m/s) / frequency (Hz)
2. Max. ERP (dBm) = Max. Average power (dBm) + Antenna Gain (dBi) -2.15
3. Max. ERP (W) = $10^{(\text{Max. ERP (dBm)} / 10)}$ / 1000
4. Threshold ERP (W) (RF Source Frequency 1500 – 100000 MHz) = 19.2 R^2

Beamforming mode

WLAN 2.4GHz

Evaluation Frequency	λ/2π	R	Max. ERP	Max. ERP	Threshold ERP
(MHz)	(m)	(m)	(dBm)	(W)	(W)
2412 ~ 2462	0.0198	0.32	27.35	0.543	1.9661

Note:

1. λ(m) = $3*10^8$ (m/s) / frequency (Hz)
2. Max. ERP (dBm) = Max. Average power (dBm) + Antenna Gain (dBi) -2.15
3. Max. ERP (W) = $10^{(\text{Max. ERP (dBm)} / 10)}$ / 1000
4. Threshold ERP (W) (RF Source Frequency 1500 – 100000 MHz) = 19.2 R^2

WLAN 5GHz

Evaluation Frequency	λ/2π	R	Max. ERP	Max. ERP	Threshold ERP
(MHz)	(m)	(m)	(dBm)	(W)	(W)
5180 ~ 5240	0.0092	0.32	27.74	0.594	1.9661
5260 ~ 5320	0.0091	0.32	27.53	0.566	1.9661
5500 ~ 5720	0.0087	0.32	27.57	0.571	1.9661
5745 ~ 5825	0.0084	0.32	30.65	1.161	1.9661

Note:

1. λ(m) = $3*10^8$ (m/s) / frequency (Hz)
2. Max. ERP (dBm) = Max. Average power (dBm) + Antenna Gain (dBi) -2.15
3. Max. ERP (W) = $10^{(\text{Max. ERP (dBm)} / 10)}$ / 1000
4. Threshold ERP (W) (RF Source Frequency 1500 – 100000 MHz) = 19.2 R^2

(2) Simultaneously transmission condition:

Condition	Technology	
1	WLAN (2.4GHz)	WLAN (5GHz)

Condition 1	R (m)	Max. ERP (W)	Threshold ERP (W)	Transmit Simultaneously	Transmit Simultaneously Limit
802.11g	0.32	27.92	0.619	0.927	≦1
802.11ax(HE40)	0.32	30.80	1.202		

Therefore the maximum calculations of above situations are less than the “1” limit.

According to 47 CFR §2.1091, the RF exposure analysis concludes that the RF Exposure is FCC compliant.

END OF REPORT