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Project No: CB10410134

Maximum Permissible Exposure Report

Applicant's company	ZyXEL Communications Corporation
Applicant Address	No.2, Gongye E. 9th Road, Hsinchu Science Park, Hsinchu, Taiwan
FCC ID	I88C2100Z
Manufacturer's company (1)	MitraStar Technology Corporation
Manufacturer Address	No. 6, Innovation Rd II, Hsinchu Science Park, Hsinchu 30076, Taiwan
Manufacturer's company (2)	WuXi MitraStar Technology Co. Ltd
Manufacturer Address	60#-E, Minshan Road, Wuxi New district Jangsu, P.R.C.

Product Name	Dual-Band Wireless AC/N VDSL2 4-port Bonding Combo Wan IAD with HPNA3.1
Brand Name	ZyXEL
Model No.	C2100Z, VMG4825-B10A, VMG9823-B10A
Ref. Standard(s)	47 CFR FCC Part 2 Subpart J, section 2.1091
Received Date	Aug. 12, 2015
Final Test Date	Oct. 13, 2015
Submission Type	Original Equipment

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SPORTON INTERNATIONAL INC.



Testing Laboratory
1190



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History of This Test Report

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA581406	Rev. 01	Initial issue of report.	Dec. 08, 2015
FA581406	Rev. 02	Revising the FCC ID.	Dec. 28, 2015

1. GENERAL DESCRIPTION

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)
5GHz WLAN	5150-5250 5725-5850	5180-5240 5745-5825	802.11a/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) 802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM)

1.2. Table for Multiple Listing

The EUT has three model numbers which are identical to each other in all aspects except for the following table:

Model No.	Interface							
	WAN	LAN	DSL	FXS	HPNA	USB	Wi-Fi 2.4GHz 2×2	Wi-Fi 5GHz 4×4
C2100Z	×1	×4	×1	×2	×1	×1	V	V
VMG9823-B10A	×1	×4	×1	×2	-	×1	V	V
VMG4825-B10A	×1	×4	×1	-	-	×1	V	V

Only the most complex mode for Model No.: C2100Z was performed for all the tests and recorded in this report.

1.3. Testing Location

Testing Location		
<input type="checkbox"/>	HWA YA	ADD : No. 52, Hwa Ya 1st Rd., Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL : 886-3-327-3456 FAX : 886-3-327-0973
<input checked="" type="checkbox"/>	JHUBEI	ADD : No.8, Lane 724, Bo-ai St., Jhubei City, HsinChu County 302, Taiwan, R.O.C. TEL : 886-3-656-9065 FAX : 886-3-656-9085

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)*	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)*	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. MPE Calculation Method

The MPE was calculated at 21 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

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

E = Electric field (V/m)

P = Peak 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

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

2.3. Calculated Result and Limit

Exposure Environment: General Population / Uncontrolled Exposure

For 5GHz Band:

Antenna Type : PCB Antenna

Conducted Power for IEEE 802.11ac MCS0/Nss1 (VHT20): 26.20 dBm

Distance (cm)	Test Freq. (MHz)	Directional Gain (dBi)	Antenna Gain (numeric)	The maximum combined Average Output Power		Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
				(dBm)	(mW)			
21	5200	9.79	9.5266	26.2042	417.2725	0.717679	1	Complies

Note:
$$Directional\ Gain = 10 \log \left[\frac{\sum_{j=1}^{N_{SS}} \left(\sum_{K=1}^{N_{ANT}} g_{j,k} \right)^2}{N_{ANT}} \right]$$

For 2.4GHz Band:

Antenna Type : Metal Antenna

Conducted Power for 802.11n MCS8 (HT20): 27.42 dBm

Distance (cm)	Test Freq. (MHz)	Antenna Gain (dBi)	Antenna Gain (numeric)	The maximum combined Average Output Power		Power Density (S) (mW/cm ²)	Limit of Power Density (S) (mW/cm ²)	Test Result
				(dBm)	(mW)			
21	2437	3.70	2.3442	27.4169	551.6871	0.233488	1	Complies

Conclusion:

Both of the WLAN 2.4GHz Band and WLAN 5GHz Band can transmit simultaneously, the formula of calculated the MPE is:

$$CPD1 / LPD1 + CPD2 / LPD2 + \dots \text{etc.} < 1$$

CPD = Calculation power density

LPD = Limit of power density

Therefore, the worst-case situation is $0.233488 / 1 + 0.717679 / 1 = 0.951167$, which is less than "1". This confirmed that the device complies.