RF Exposure Evaluation Report

APPLICANT	:	Maestro Wireless Holdings Limited
EQUIPMENT	:	4G WIFI Router
BRAND NAME	:	Maestro
MODEL NAME	:	E228VZ
MARKETING NAME	:	E228 VZ
FCC ID	:	WN6-E228VZ
STANDARD	:	47 CFR Part 2.1091

We, SPORTON INTERNATIONAL (SHENZHEN) INC., would like to declare that the device has been evaluated in accordance with 47 CFR Part 2.1091, and pass the limit. Without written approval of SPORTON INTERNATIONAL (SHENZHEN) INC., the test report shall not be reproduced except in full.

Reviewed by: Eric Huang / Deputy Manager

Approved by: Jones Tsai / Manager

SPORTON INTERNATIONAL (SHENZHEN) INC.

1F & 2F, Building A, Morning Business Center, No. 4003 ShiGu Rd., Xili Town, Nanshan District, Shenzhen, Guangdong, P. R. China

Table of Contents

1. ADMINISTRATION DATA 4

1.1. Testing Laboratory 4

2. DESCRIPTION OF EQUIPMENT UNDER TEST (EUT) 5

3. MAXIMUM RF AVERAGE OUTPUT POWER AMONG PRODUCTION UNITS 6

4. RF EXPOSURE LIMIT INTRODUCTION 9

5. RADIO FREQUENCY RADIATION EXPOSURE EVALUATION 10

5.1. Standalone Power Density Calculation 10

5.2. Collocated Power Density Calculation 10

Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA581706	Rev. 01	Initial issue of report	Sep. 22, 2015

1. Administration Data

1.1. Testing Laboratory

Testing Laboratory	
Test Site	SPORTON INTERNATIONAL (SHENZHEN) INC.
Test Site Location	1F & 2F,Building A, Morning Business Center, No. 4003 ShiGu Rd., Xili Town, Nanshan District, Shenzhen, Guangdong, P. R. China TEL: +86-755-8637-9589 FAX: +86-755-8637-9595

Applicant	
Company Name	Maestro Wireless Holdings Limited
Address	FLAT A & B, 9/F, WING CHEONG FACTORY BUILDING, 121 KING LAM STREET, CHEUNG SHA WAN, HONG KONG

Manufacturer	
Company Name	Maestro Wireless Holdings Limited
Address	FLAT A & B, 9/F, WING CHEONG FACTORY BUILDING, 121 KING LAM STREET, CHEUNG SHA WAN, HONG KONG

2. Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT Type	4G WIFI Router
Brand Name	Maestro
Model Name	E228VZ
Marketing Name	E228 VZ
FCC ID	WN6-E228VZ
Wireless Technology and Frequency Range	LTE Band 4 : 1711.5 MHz ~ 1753.5 MHz LTE Band 13 : 779.5 MHz ~ 784.5 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz
Mode	• LTE: QPSK,16QAM • 802.11b/g/n HT20/HT40
Antenna Type	WWAN: Dipole Antenna WLAN: Dipole Antenna
HW Version	V05
SW Version	V1.0.0
EUT Stage	Pre-Production
Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.	

3. Maximum RF average output power among production units

LTE Band 13				
average power(dBm)				
Modulation	BW (MHz)	RB size	Target MPR	Target Power
QPSK	10	≤ 12	0	23.00
QPSK	10	> 12	0-1	22.50
16QAM	10	≤ 12	0-1	23.00
16QAM	10	> 12	0-2	22.50
QPSK	5	≤ 8	0	23.00
QPSK	5	> 8	0-1	22.50
16QAM	5	≤ 8	0-1	23.00
16QAM	5	> 8	0-2	22.50

LTE Band 4				
average power(dBm)				
Modulation	BW (MHz)	RB size	Target MPR	Target Power
QPSK	20	≤ 18	0	23.00
QPSK	20	> 18	0-1	23.00
16QAM	20	≤ 18	0-1	23.00
16QAM	20	> 18	0-2	23.00
QPSK	15	≤ 16	0	23.00
QPSK	15	> 16	0-1	23.00
16QAM	15	≤ 16	0-1	23.00
16QAM	15	> 16	0-2	23.00
QPSK	10	≤ 12	0	23.00
QPSK	10	> 12	0-1	23.00
16QAM	10	≤ 12	0-1	23.00
16QAM	10	> 12	0-2	23.00
QPSK	5	≤ 8	0	23.00
QPSK	5	> 8	0-1	23.00
16QAM	5	≤ 8	0-1	23.00
16QAM	5	> 8	0-2	23.00
QPSK	3	≤ 4	0	23.00
QPSK	3	> 4	0-1	23.00
16QAM	3	≤ 4	0-1	23.00
16QAM	3	> 4	0-2	23.00

Remark:

1. By design, maximum LTE RF power of smaller supported bandwidth does not exceed the RF power of largest supported bandwidth; the information is included in “tune-up procedure” exhibit
2. LTE MPR implementation is the same for normal mode and power reduction mode.

Mode			Maximum Average Power (dBm)
2.4GHz	802.11b	Ant. 1	16.50
		Ant. 2	13.00
	802.11g	Ant. 1	16.50
		Ant. 2	13.50
	802.11n-HT20	Ant. 1	15.50
		Ant. 2	13.00
		Ant. 1 + 2	17.50
	802.11n-HT40	Ant. 1	15.50
		Ant. 2	13.00
		Ant. 1 + 2	17.00

The table below summarized necessary items addressed in KDB 941225 D05 v02.

FCC ID	WN6-E228VZ
EUT	4G WIFI Router
Operating Frequency Range of each LTE transmission band	LTE Band 13: 779.5 MHz ~ 784.5 MHz LTE Band 4: 1711.5 MHz ~ 1753.5 MHz
Channel Bandwidth	LTE Band 13: 5MHz, 10MHz LTE Band 4: 3MHz, 5MHz, 10MHz, 15MHz, 20MHz

Transmission (H, M, L) channel numbers and frequencies in each LTE band

Band 13

	Bandwidth 5 MHz		Bandwidth 10 MHz	
	Channel #	Frequency (MHz)	Channel #	Frequency (MHz)
L	23205	779.5	23230	782
M	23230	782		
H	23255	784.5		

LTE Band 4

	Bandwidth 3 MHz		Bandwidth 5 MHz		Bandwidth 10 MHz		Bandwidth 15 MHz		Bandwidth 20 MHz	
	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)	Ch. #	Freq. (MHz)
L	19965	1711.5	19975	1712.5	20000	1715	20025	1717.5	20050	1720
M	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5	20175	1732.5
H	20385	1753.5	20375	1752.5	20350	1750	20325	1747.5	20300	1745

E category, uplink modulations used	Category 4, QPSK, and 16QAM
LTE transmitter and antenna implementation (standalone or sharing hardware components / antennas)	A primary antenna is used for LTE transmitting and receiving, standalone.
LTE Voice / Data requirements	Data only
LTE MPR permanently built-in by design	Yes, per 3GPP TS 36.101 v11.0.0
LTE A-MPR	In the base station simulator configuration, Network Setting value is set to NS_01 to disable A-MPR during SAR testing.
Base station simulator used for Testing	Anritsu MT8820C

Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3

Modulation	Channel bandwidth / Transmission bandwidth (RB)						MPR (dB)
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2

4. RF Exposure Limit Introduction

According to ANSI/IEEE C95.1-1992, the criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f2)	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				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f2)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

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:

$$S = \frac{PG}{4\pi R^2}$$

Where:
S = Power Density
P = Output Power at Antenna Terminals
G = Gain of Transmit Antenna (linear gain)
R = Distance from Transmitting Antenna

5. Radio Frequency Radiation Exposure Evaluation

5.1. Standalone Power Density Calculation

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum ERP/EIRP (W)	Maximum output power Limit (W)	Average EIRP (mW)	Power Density at 20cm (mW/cm2)	Limit (mW/cm2)	Power Density / Limit
LTE Band 13	779.5	2.16	23.00	25.16	0.33	328.10	0.07	0.52	0.13
LTE Band 4	1711.5	0.42	23.00	23.42	0.22	219.79	0.04	1.00	0.04
WLAN2.4GHz b Ant 1	2412.0	3.80	16.50	20.30	0.11	107.15	0.02	1.00	0.02
WLAN2.4GHz g Ant 1	2412.0	3.80	16.50	20.30	0.11	107.15	0.02	1.00	0.02
WLAN2.4GHz n-HT20 Ant 1+2	2412.0	3.80	17.50	21.30	0.13	134.90	0.03	1.00	0.03

Note: For conservativeness, the lowest uplink frequency of each band is used to determine the MPE limit of that band.

5.2. Collocated Power Density Calculation

Mode	Frequency	WLAN Power Density / Limit	LTE Band 13 Power Density / Limit	Σ(Power Density / Limit) of WWAN+WLAN
WLAN2.4GHz n-HT20	2412MHz ~ 2462MHz	0.03	0.13	0.16

Note:

1. For colocation analysis, LTE is chosen for summation due to the highest (power density/limit) among all WWAN wireless modes.
2. ∑(Power Density / Limit): This is a summation of [(power density for each transmitter/antenna included in the simultaneous transmission)/ (corresponding MPE limit)], for WWAN + WLAN.
3. Considering the WWAN collocation with the WLAN transmitter of the EIRP performance listed in the table above, the aggregated (power density /limit) is smaller than 1, and MPE of 2 collocated transmitters is compliant.

Conclusion:

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