



No. 1 Workshop, M-10, Middle section, Science & Technology Park, Nanshan
District, Shenzhen, Guangdong, China 518057
Telephone: +86 (0) 755 2601 2053
Fax: +86 (0) 755 2671 0594
Email: ee.shenzhen@sgs.com

Report No.: HKES150100009004
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RF Exposure Evaluation Report

Application No.: HKES1501000090IT
Applicant: Pismo Labs Technology Limited
Product Name: Multi-Cellular Mobile Router (trade name: Pepwave, Peplink, Pismo)
Item No.(EUT): MAX HD4
Add Item No.: MAX-HD4-MFA, MAX-HD2-MFA, MFA-200
FCC ID: U8G-P1803
Standards: 47 CFR Part 1.1307(2014)
47 CFR Part 1.1310(2014)
Date of Receipt: 2015-01-19
Date of Test: 2015-02-02 to 2015-02-09
Date of Issue: 2015-03-10

Test Result :	PASS*
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* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:



Jack Zhang
EMC Laboratory Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.

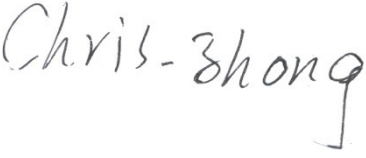
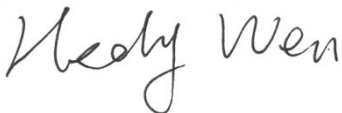

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government. All test results in this report can be traceable to National or International Standards.

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2 Version

Revision Record				
Version	Chapter	Date	Modifier	Remark
00		2015-03-10		Original

Authorized for issue by:			
Tested By		 _____ (Chris Zhong) /Project Engineer	2015-02-09
			Date
Prepared By		 _____ (Hedy Wen) /Clerk	2015-03-10
			Date
Checked By		 _____ (Emen Li) /Reviewer	2015-03-10
			Date

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4 General Information

4.1 Client Information

Applicant:	Pismo Labs Technology Limited
Address of Applicant:	FLAT/RM A5, 5/F HK SPINNERS IND BLDG PHASE 6, 481 CASTLE PEAK ROAD, CHEUNG SHA WAN, HONG KONG

4.2 General Description of EUT

Product Name:	Multi-Cellular Mobile Router (trade name: Pepwave, Peplink, Pismo)
Item No.:	MAX HD4
Quote :	EE 1412105R2
Sample Type:	Fixed production
Antenna Type:	Dual band Omni directional (Dipole)
Power Supply:	MODEL: ATS050-P121 INPUT: AC 100-240V 50/60Hz 1.2A MAX OUTPUT: DC 12V 4.2A
DC Output Line:	146cm (Unshielded with a ferrite core)
LTE module:	Model Number: MC7354 FCC ID: N7NMC7355
For 2.4GHz	
Operation Frequency:	IEEE 802.11b/g/n(HT20): 2412MHz to 2462MHz IEEE 802.11n(HT40): 2422MHz to 2452MHz
Channel Numbers:	IEEE 802.11b/g, IEEE 802.11n(HT20): 11 Channels IEEE 802.11n(HT40): 7 Channels
Channel Separation:	5MHz
Type of Modulation:	IEEE for 802.11b: DSSS(CCK,DQPSK,DBPSK) IEEE for 802.11g : OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE for 802.11n(HT20 and HT40) : OFDM (64QAM, 16QAM, QPSK, BPSK)
Antenna Gain:	3dBi
For 5GHz	
Operation Frequency:	IEEE 802.11a/ n(HT20/40): 5150MHz to 5250MHz IEEE 802.11a/ n(HT20/40): 5725MHz to 5850MHz
Type of Modulation:	IEEE for 802.11a: OFDM(BPSK/QPSK/16QAM/64QAM) IEEE for 802.11n : OFDM(BPSK/QPSK/16QAM/64QAM)
Antenna Gain:	5.5dBi
Number of transmitter chains	4

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Remark:

Item No.: MAX HD4, MAX-HD4-MFA, MAX-HD2-MFA, MFA-200

Only the item MAX HD4 was tested, since the electrical circuit design, layout, components used and internal wiring were identical for all above items. The difference is below,

MAX HD4 contains all the function.

MAX-HD4-MFA, MAX-HD2-MFA, MFA-200 are disable some functions base on MAX HD4.

4.3 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch E&E Lab

No. 1 Workshop, M-10, Middle section, Science & Technology Park, Shenzhen, Guangdong, China
518057

Telephone: +86 (0) 755 2601 2053 Fax: +86 (0) 755 2671 0594

No tests were sub-contracted.

4.4 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **CNAS (No. CNAS L2929)**

CNAS has accredited SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

- **VCCI**

The 10m Semi-anechoic chamber and Shielded Room (7.5m x 4.0m x 3.0m) of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-823, R-4188, T-1153 and C-2383 respectively.

- **FCC – Registration No.: 556682**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration No.: 556682.

- **Industry Canada (IC)**

Two 3m Semi-anechoic chambers of SGS-CSTC Standards Technical Services Co., Ltd. have been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 4620C-1 & 4620C-2.



4.5 Deviation from Standards

None.

4.6 Abnormalities from Standard Conditions

None.

4.7 Other Information Requested by the Customer

None.



5 RF Exposure Evaluation

5.1 RF Exposure Compliance Requirement

5.1.1 Limits

According to FCC Part1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in part1.1307(b)

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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/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				
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

F= Frequency in MHz

Friis Formula

Friis transmission formula: $P_d = (P_{out} * G) / (4 * \pi * R^2)$

Where

P_d = power density in mW/cm²

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

π = 3.1416

R = distance between observation point and center of the radiator in cm

P_d is the limit of MPE, 1 mW/cm². If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

5.1.2 Test Procedure

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.



5.1.3 EUT RF Exposure Evaluation

For 2.4GHz

Antenna Gain: 3dBi

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 2.00 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

Wi-Fi 1

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 40 cm (mW/cm ²)	Limit	Result
Lowest	2422	21.69	147.57	0.007	1.0	PASS

Wi-Fi 2

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 40 cm (mW/cm ²)	Limit	Result
Lowest	2422	21.29	134.59	0.007	1.0	PASS

Note: Refer to report No. HKES150100009002 for EUT test Max Conducted Peak Output Power value.

The distancer (4th column) calculated from the Fries transmission formula is far greater than 40 cm separation requirement.



For 5GHz

Antenna Gain: 5.5dBi

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 3.55 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

Wi-Fi 1

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 40 cm (mW/cm ²)	Limit	Result
151	5755	23.80	239.88	0.012	1.0	PASS

Wi-Fi 2

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 40 cm (mW/cm ²)	Limit	Result
151	5755	23.37	217.27	0.011	1.0	PASS

Note: Refer to report No. HKES150100009003 for EUT test Max Conducted Peak Output Power value.

The distancer (4th column) calculated from the Fries transmission formula is far greater than 40 cm separation requirement.

WWAN

Channel	Frequency (MHz)	Max Conducted Average Output Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 40 cm (mW/cm ²)	Limit	Result
23755	704	33	1995.262	0.099	0.469	PASS

Note: Refer to MPE evaluation report of LTE modular(FCC ID: N7NMC7355) and find Max average EIRP of WWAN is 1995.262.

Σ of ratios simultaneous transmitting= Wi-Fi 1(2.4G) + WiFi 2(2.4) + Wi-Fi 1(5G) + WiFi 2(5G)+4* WWAN

Ratio of Power Density of WiFi 1 (2.4G) at R = 40 cm	Ratio of Power Density of WiFi 2 (2.4G)at R = 40 cm	Ratio of Power Density of WiFi 1 (5G) at R = 40 cm	Ratio of Power Density of WiFi 2 (5G) at R = 40 cm	Ratio of Max. Power Density of WWAN at R = 40 cm	Total ratios simultaneous transmitting at R =40cm	Limit	Result
0.007/1	0.007/1	0.012/1	0.011/1	0.099*4/0.469	0.8814	1.0	PASS

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For 2.4GHz

Antenna Gain: 3dBi

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 2.00 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

Wi-Fi 1

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 65 cm (mW/cm ²)	Limit	Result
Lowest	2422	21.69	147.57	0.003	1.0	PASS

Wi-Fi 2

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 65 cm (mW/cm ²)	Limit	Result
Lowest	2422	21.29	134.59	0.003	1.0	PASS

For 5GHz

Antenna Gain: 5.5dBi

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 3.55 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

Wi-Fi 1

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 65 cm (mW/cm ²)	Limit	Result
151	5755	23.80	239.88	0.005	1.0	PASS

Wi-Fi 2

Channel	Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 65 cm (mW/cm ²)	Limit	Result
151	5755	23.37	217.27	0.004	1.0	PASS

Note: Refer to report No. HKES150100009003 for EUT test Max Conducted Peak Output Power value. The distancer (4th column) calculated from the Fries transmission formula is far greater than 40 cm separation requirement.

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WWAN

Channel	Frequency (MHz)	Max Conducted Average Output Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 65 cm (mW/cm ²)	Limit	Result
23755	704	33	1995.262	0.038	0.469	PASS

Note: Refer to MPE evaluation report of LTE modular(FCC ID: N7NMC7355) and find Max average EIRP of WWAN is 1995.262

3G dongle

Channel	Frequency (MHz)	Max Conducted Average Output Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 65 cm (mW/cm ²)	Limit	Result
128	824.0	36.3	4265.8	0.080	0.55	PASS

Note: The Max ERP power from user manual

Σ of ratios simultaneous transmitting= Wi-Fi 1(2.4G) + WiFi 2(2.4) + Wi-Fi 1(5G) + WiFi 2(5G)+4*

WWAN+3G Dongle

Ratio of Power Density of WiFi 1 (2.4G) at R = 65 cm	Ratio of Power Density of WiFi 2 (2.4G) at R = 65 cm	Ratio of Power Density of WiFi 1 (5G) at R = 65 cm	Ratio of Power Density of WiFi 2 (5G) at R = 65 cm	Ratio of Max. Power Density of WWAN at R = 65 cm	Ratio of Max. Power Density of 3G dongle at R = 65 cm	Total ratios simultaneous transmitting at R = 65 cm	Limit	Result
0.003/1	0.003/1	0.005/1	0.004/1	0.038*4/0.469	0.080/0.55	0.484	1.0	PASS

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