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Shenzhen Branch

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RF Exposure Evaluation Report

Application No.:	HKES1708002191IT
Applicant:	Pismo Labs Technology Limited
Address of Applicant:	Unit A5, HK Spinners Industrial Building, Phase 6, 481 Castle Peak Road, Cheung Sha Wan, Kowloon, Hong Kong
Manufacturer:	Pismo Labs Technology Limited
Address of Manufacturer:	Unit A5, HK Spinners Industrial Building, Phase 6, 481 Castle Peak Road, Cheung Sha Wan, Kowloon, Hong Kong
Equipment Under Test (EUT):	
Product Name:	Peplink / Pepwave / Pismo Labs Wireless Product
Model No.:	CX4, MAX CX4, MAX Transit Quad, MAX Transit Quad LTE, MAX Transit Quad LTEA, Pismo817, Pismo 817 ♣
♣	Please refer to section 4.1 of this report which indicates which model was actually tested and which were electrically identical.
FCC ID:	U8G-P1817
Standards:	47 CFR Part 1.1307 (2016)
	47 CFR Part 1.1310 (2016)
Date of Receipt:	2017-08-17
Date of Test:	2018-04-16 to 2018-06-21
Date of Issue:	2018-06-27
Test Result :	**PASS***

* In the configuration tested, the EUT complied with the standards specified above.

Keny Xu
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.

2 Version

Revision Record				
Version	**Chapter**	**Date**	**Modifier**	**Remark**
01		*2018-06-27*		*Original*

Authorized for issue by:				
				
		Harry Wu /Project Engineer		
				
		Eric Fu /Reviewer		

3 Contents

4 General Information

4.1 General Description of EUT

Power supply:	DC12.0V, 3A AC/DC adapter : Model: DSA-36PFH-12FUS 120300AN Input: AC100-240V, 50/60Hz, 1.0A Output: DC12.0V, 3.0A			
For 2.4G Wifi:				
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)			
Operating Frequency:	IEEE 802.11b/g/n(HT20): 2412MHz to 2462MHz IEEE 802.11n(HT40): 2422MHz to 2452MHz			
Channel Number:	IEEE 802.11b/g, IEEE 802.11n(HT20): 11 Channels IEEE 802.11n(HT40): 7 Channels			
Channels Step:	Channels with 5MHz step			
Antenna Type:	Dedicated Antenna			
Antenna Gain:	3dBi			
For 5G Wifi:				
Operation Frequency:	Band	Mode	Frequency Range(MHz)	Number of channels
	UNII Band I	IEEE 802.11a/n(HT20)/ac(VHT20)	5180-5240	4
		IEEE 802.11n(HT40)/ac(VHT40)	5190-5230	2
		IEEE 802.11ac(VHT80)	5210	1
	UNII Band III	IEEE 802.11a/n(HT20)/ac(VHT20)	5745-5825	5
		IEEE 802.11n(HT40)/ac(VHT40)	5755-5795	2
		IEEE 802.11ac(VHT80)	5775	1
Modulation Type:	IEEE 802.11a: OFDM(64QAM, 16QAM, QPSK, BPSK) IEEE 802.11n: OFDM (BPSK, QPSK, 16QAM, 64QAM) IEEE 802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM)			
Sample Type:	Mobile device			
Antenna Type:	Dedicated Antenna			
Antenna Gain:	Antenna 1: 4.5dBi, Antenna 2: 4.5dBi			

LTE module:	Model Number: MC7455
	FCC ID: N7NMC7455
Alternative LTE module:	Model Number: MC7354
	FCC ID: N7NMC7355
Antenna for LTE module:	Type: External Antenna Antenna Gain: 1.93dBi
Remark:	The device uses four LTE module, each module has two antennas (One main antenna and one DIV antenna)

Remark:

Model No.: CX4, MAX CX4, MAX Transit Quad, MAX Transit Quad LTE, MAX Transit Quad LTEA, Pismo817, Pismo 817

Only the model MAX Transit Quad was tested, since the electrical circuit design, layout, components used, internal wiring and functions were identical for the above models, with only difference as below:

- MAX Transit Quad, MAX Transit Quad LTE, MAX Transit Quad LTEA all include Wi-Fi Functions.

- CX4, MAX CX4 are variant models or PMN (Product Marketing Names) with the designation CX which represents carrier series, and optional Software Defined features. They are also built as quad cellular router with same 3G/4G telecommunication (UMTS/LTE technologies) as MAX Transit Quad and some RF systems on chip (SoC) components removed.

- Pismo 817 are the founding design name of basic model: MAX Transit Quad (with variants names of MAX Transit Quad LTE, MAX Transit Quad LTEA depending on the LTE / LTEA module type) or optionally marketed as designation: CX4 or MAX CX4.

4.2 Test Location

All tests were performed at:

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

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.

4.3 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.

• A2LA (Certificate No. 3816.01)

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

• VCCI

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

• FCC –Designation Number: CN1178

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1178. Test Firm Registration Number: 406779.

• Industry Canada (IC)

Two 3m Semi-anechoic chambers and the 10m Semi-anechoic chamber of SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab have been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 4620C-1, 4620C-2, 4620C-3.

4.4 Deviation from Standards

None.

4.5 Abnormalities from Standard Conditions

None.

4.6 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: Pd = (Pout*G)/(4* Pi * R 2)

Where

Pd = power density in mW/cm2

Pout = output power to antenna in mW

G = gain of antenna in linear scale

Pi = 3.1416

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

Pd id 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 2.4G WiFi

Antenna 1 Gain: 3dBi , Antenna 2 Gain: 3dBi

According to KDB 662911, the transmit signal is correlated,

So Directional gain = G_{ANT} + 10 log(N_{ANT}) dBi = 3 + 3 = 6

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 3.98 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

SISO mode (Worst case: 802.11g @ Ant. 1):

Channel	Frequency (MHz)	Conduct power (including Tune-up tolerance) (dBm)	E.I.R.P (mW)	Power Density at R = 40 cm (mW/cm2)	Limit	MPE Ratios	Result
Middle	2437	21.39	274.789	0.014	1	0.014	PASS

SISO mode (Worst case: 802.11n(HT20))

Channel	Frequency (MHz)	Conduct power (including Tune-up tolerance) (dBm)	E.I.R.P (mW)	Power Density at R = 40 cm (mW/cm2)	Limit	MPE Ratios	Result
Middle	2437	19.38	345.144	0.017	1	0.017	PASS

Note: Refer to report No. HKES170800219102 for EUT test EIRP value. The distancer (5th column) calculated from the Fries transmission formula is far greater than 40 cm separation requirement.

For 5G WiFi

Antenna1 Gain: 4.5dBi, Antenna2 Gain: 4.5dBi

According to KDB 662911, the transmit signal is correlated,

So Directional gain = G_{ANT} + 10 log(N_{ANT}) dBi =4.5 + 3 = 7.5

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 5.62 in linear scale.

Output Power Into Antenna & RF Exposure Evaluation Distance:

SISO mode (worst case: 802.11a @ Ant. 1):

Channel	Frequency (MHz)	Conduct power (including Tune-up tolerance) (dBm)	E.I.R.P (mW)	Power Density at R = 40 cm (mW/cm2)	Limit	MPE Ratios	Result
Middle	5220	12.12	45.92	0.002	1	0.002	PASS

MIMO mode (worst case: 802.11ac(HT20))

Channel	Frequency (MHz)	Conduct power (including Tune-up tolerance) (dBm)	E.I.R.P (mW)	Power Density at R = 40 cm (mW/cm2)	Limit	MPE Ratios	Result
Highest	5825	15.23	187.499	0.009	1	0.009	PASS

Note: Refer to report No. HKES170800219103 for EUT test EIRP value. The distancer (5th column) calculated from the Fries transmission formula is far greater than 40 cm separation requirement.

LTE for MC7455

Antenna Gain: 1.93dBi (One main antenna and a DIV antenna)

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 1.56 in linear scale.

Frequency (MHz)	Conduct power (including Tune-up tolerance) (dBm)	E.I.R.P (mW)	Power Density at R = 40 cm (mW/cm2)	Limit	MPE Ratios	Result
699	24.000	391.742	0.019	0.466	0.041	PASS

Note: Refer to MPE evaluation report of LTE modular(FCC ID:N7NMC7455) and find the maximum ratio of the measured power density with limit in channel 23010, so only choose the channel to do MPE evaluation.

LTE for MC7354

Antenna Gain: 1.93dBi (One main antenna and a DIV antenna)

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 1.56 in linear scale.

Frequency (MHz)	Max Conducted Peak Output Power (dBm)	Output Power to Antenna (mW)	Power Density at R = 40 cm (mW/cm2)	Limit	MPE Ratios	Result
704	24.000	391.742	0.019	0.467	0.041	PASS

Note: Refer to MPE evaluation report of LTE modular(FCC ID:N7NMC7454) and find the maximum ratio of the measured power density with limit in channel 23755, so only choose the channel to do MPE evaluation.

Exposure conditions for simultaneous transmission operations

∑of ratios simultaneous transmitting= Wi-Fi 2.4G + Wi-Fi 5G + LTE*8

Ratio of Power Density of Wi-Fi 2.4G at R = 40 cm	Ratio of Power Density of Wi-Fi 5G at R = 40 cm	Ratio of Max. Power Density of LTE at R = 40 cm	Total ratios simultaneous transmitting at R =40 cm	Limit	Result
0.014	0.002	0.041 * 8	0.344	1.0	PASS

Since the 2.4G Wifi and 5G Wifi use the same antennas, for MIMO mode, 2.4G Wifi and 5G Wifi can't tansmit simultaneously in mimo mode, hence the simultaneous transmission MPE is only evaluated under SISO mode.

- End of the Report -