A Test Lab Techno Corp.

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MPE Report

Test Report No.	:	1811FS16-01
Applicant	:	Pismo Labs Technology Limited
Product Type	:	Pepwave / Peplink / Pismo Labs Wireless Product
Trade Name	:	peplink, PEPWAVE, Pismo
Model Number	:	SpeedFusion Engine, SFE-CAM-AB-LTEA-W, SFE-CAM-VM-LTEA-W, SFE-CAM, Pismo827, Pismo 827
Date of Received	:	Sep. 11, 2018
Test Period	:	Nov. 05 ~ Nov. 06, 2018
Date of Issued	:	Dec. 21, 2018
Test Specification	:	ANSI / IEEE Std.C95.1-1992 / IEEE Std. 1528-2013
		47 CFR § 2.1091
		47 CFR § 1.1310
Location of Test Lab.	:	Chang-an Lab.

1. The test operations have to be performed with cautious behavior, the test results are as attached.
2. The test results are under chamber environment of A Test Lab Techno Corp. A Test Lab Techno Corp. does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples.
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Approved By : Edison Hu (Edison Hu)

Tested By : Kris Pan (Kris Pan)

Contents

1. Description of Equipment under Test (EUT)

Applicant	Pismo Labs Technology Limited A5, 5/F, HK Spinners Industrial Building, Phase 6, 481 Castle Peak Road, Cheung Sha Wan, Kowloon, Hong Kong	
Manufacturer	Pismo Labs Technology Limited Unit A5, 5/F, HK Spinners Industrial Building, Phase 6, 481 Castle Peak Road, Cheung Sha Wan, Kowloon, Hong Kong	
Product Type	Pepwave / Peplink / Pismo Labs Wireless Product	
Trade Name	peplink, PEPWAVE, Pismo	
Model Number	SpeedFusion Engine, SFE-CAM-AB-LTEA-W, SFE-CAM-VM-LTEA-W, SFE-CAM, Pismo827, Pismo 827	
Product Type / Trade Name / Models Different Description	Those model numbers differ from each other in selling region.	
IMEI No.	IMEI1: 359072061865230, IMEI2: 359072061860199	
FCC ID	U8G-P1827	
Frequency Range	Operate Band	Frequency Range (MHz)
	WCDMA Band II	1850 - 1910
	WCDMA Band IV	1710 - 1755
	WCDMA Band V	824 - 849
	LTE Band 2 (1.4 , 3, 5, 10, 15, 20 MHz)	1850 - 1910
	LTE Band 4 (1.4, 3, 5, 10, 15, 20 MHz)	1710 - 1755
	LTE Band 5 (1.4 , 3, 5, 10 MHz)	824 - 849
	LTE Band 7 (5, 10, 15, 20 MHz)	2500 - 2570
	LTE Band 12 (1.4, 3, 5, 10 MHz)	699 - 716
	LTE Band 13 (5, 10 MHz)	777 - 787
	LTE Band 25 (1.4 , 3, 5, 10, 15, 20 MHz)	1850 - 1915
	LTE Band 26 (1.4, 3, 5, 10, 15 MHz)	814 - 849
	LTE Band 30 (5, 10 MHz)	2305 - 2315
	LTE Band 41 (5, 10, 15, 20 MHz)	2496 - 2690
	IEEE 802.11b / 802.11g IEEE 802.11n 2.4 GHz 20 MHz	2412 - 2462
	IEEE 802.11n 2.4 GHz 40 MHz	2422 - 2452
	IEEE 802.11a U-NII Band I	5180 - 5240
	IEEE 802.11a U-NII Band III	5745 - 5825
	IEEE 802.11ac / 802.11n 5 GHz 20 MHz U-NII Band I	5180 - 5240
	IEEE 802.11ac / 802.11n 5 GHz 20 MHz U-NII Band III	5745 - 5825
	IEEE 802.11ac / 802.11n 5 GHz 40 MHz U-NII Band I	5190 - 5230
	IEEE 802.11ac / 802.11n 5 GHz 40 MHz U-NII Band III	5755 - 5795
	IEEE 802.11ac 80 MHz U-NII Band I	5210
	IEEE 802.11ac 80 MHz U-NII Band III	5775

	ANT	Model	Type	Max. Gain (dBi)	
Antenna Information	MAIN (White)	98PD8ZIPF000	PCB Antenna	WCDMA Band II	2.28
				WCDMA Band IV	2.65
				WCDMA Band V	0.38
				LTE Band 2	2.28
				LTE Band 4	2.65
				LTE Band 5	0.38
				LTE Band 7	2.61
				LTE Band 12	0.38
				LTE Band 13	0.38
				LTE Band 25	2.28
				LTE Band 26	0.38
				LTE Band 30	2.28
				LTE Band 41	2.61
	MAIN (Black)	98PD7ZIPF000	PCB Antenna	WCDMA Band II	1.89
				WCDMA Band IV	1.89
				WCDMA Band V	-1.67
				LTE Band 2	1.89
				LTE Band 4	1.89
				LTE Band 5	-1.67
				LTE Band 7	4.56
				LTE Band 12	-1.24
				LTE Band 13	-1.24
				LTE Band 25	1.89
				LTE Band 26	-1.24
				LTE Band 30	2.15
				LTE Band 41	2.55
	AUX (Blue)	98PD9ZIPF000	PCB Antenna	WCDMA Band II	3.47
				WCDMA Band IV	3.47
				WCDMA Band V	0.83
				LTE Band 2	3.47
				LTE Band 4	3.47
				LTE Band 5	0.83
				LTE Band 7	2.55
				LTE Band 12	0.83
				LTE Band 13	0.83
				LTE Band 25	3.47
				LTE Band 26	0.83
				LTE Band 30	3.72
				LTE Band 41	3.72

Antenna Information	ANT	Model	Type	Max. Gain (dBi)	
	AUX (Gary)	98PD7ZIPF000	PCB Antenna	WCDMA Band II	1.89
				WCDMA Band IV	1.89
				WCDMA Band V	-1.67
				LTE Band 2	1.89
				LTE Band 4	1.89
				LTE Band 5	-1.67
				LTE Band 7	4.56
				LTE Band 12	-1.24
				LTE Band 13	-1.24
				LTE Band 25	1.89
				LTE Band 26	-1.24
				LTE Band 30	2.15
				LTE Band 41	2.55
	WLAN ANT-0	98PD6PIPF000	PCB Antenna	WLAN 2.4 GHz	3.30
				U-NII Band I	5.25
				U-NII Band III	5.62
	WLAN ANT-1	98PD6PIPF000	PCB Antenna	WLAN 2.4 GHz	3.63
				U-NII Band I	5.38
				U-NII Band III	5.73
	G_{ANT}			WLAN 2.4 GHz	3.47
				U-NII Band I	5.32
				U-NII Band III	5.68
Antenna Delivery	IEEE 802.11b / IEEE 802.11g: 1TX IEEE 802.11n 2.4 GHz 20 MHz / 40 MHz: 2TX (CDD) IEEE 802.11a: 1TX IEEE 802.11ac 20 MHz / 40 MHz / 80 MHz: 2TX (CDD)				
RF Evaluation	0.438 mW/cm^2				
Temperature Range	-40 ~ +40°C				

The above equipment was tested by A Test Lab Techno Corp. For compliance with the requirements set forth in 47 CFR § 2.1091 / 47 CFR § 1.1310. The results of testing in this report apply only to the product/system, which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties

2. Human Exposure Assessment

Due to the design and installation of this product, it is not possible to conduct SAR evaluation. This is because client either manufactures or supplies the antenna(s) that will be used in the installation of this product. Therefore, this product will be evaluated as a mobile device per 47 CFR § 1.1310 titled “Radiofrequency radiation exposure limits”, generally referred to as MPE limits.

In 47 CFR § 2.1091, paragraph (b) defines a mobile device as “a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 cm is normally maintained between the transmitter’s radiating structure(s) and the body of the user or nearby persons. ” This product is intended to be installed into a vehicle such that the unit is physically secured at one location. In the installation guide supplied with the product,

Client has made the following statement: “IMPORTANT: To meet the FCC’s RF Exposure Guidelines, the antenna should be installed so there is at least 20 cm of separation between the body of the user and nearby persons and the antenna”. Based on the installation of the transceiver and the antenna, the transmitters radiating structure is more than 20 cm from the user. Thus, this product is a “mobile device” as defined in section § 2.1091 paragraph (b).

Exposure evaluation
$$S = \frac{PG}{4\pi R^2}$$ Where S: power density P: power input to the antenna 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.

3. RF Output Power

The conducted power turn-up tolerance reference manufacturer specification.

Band	Date Rate (Mbps)	Frequency (MHz)	Average Conducted power (dBm)		
			ANT-0	ANT-1	ANT-0+1
IEEE 802.11b	1	2412.0	19.72	---	---
		2437.0	**21.34**	---	---
		2462.0	18.21	---	---
	2	2437.0	21.24	---	---
	5.5	2437.0	21.22	---	---
	11	2437.0	21.18	---	---
IEEE 802.11g	6	2412.0	16.94	---	---
		2437.0	**22.41**	---	---
		2462.0	15.86	---	---
	9	2437.0	22.31	---	---
	12	2437.0	22.28	---	---
	18	2437.0	22.29	---	---
	24	2437.0	22.30	---	---
	36	2437.0	22.31	---	---
	48	2437.0	22.35	---	---
	54	2437.0	22.36	---	---
IEEE 802.11n 2.4 GHz 20 MHz	13	2412.0	13.40	8.98	14.74
		2437.0	21.76	17.53	**23.15**
		2462.0	10.48	9.41	12.99
	28.8	2437.0	21.68	17.38	23.05
	43.4	2437.0	21.65	17.40	23.04
	57.8	2437.0	21.69	17.43	23.07
	86.6	2437.0	21.65	17.44	23.05
	115.6	2437.0	21.61	17.43	23.01
	130	2437.0	21.64	17.45	23.04
	144.4	2437.0	21.67	17.44	23.06
IEEE 802.11n 2.4 GHz 40 MHz	27	2422.0	7.87	6.78	10.37
		2437.0	13.36	8.86	**14.68**
		2452.0	7.98	6.35	10.25
	60	2437.0	13.21	8.75	14.54
	90	2437.0	13.26	8.80	14.59
	120	2437.0	13.28	8.81	14.61
	180	2437.0	13.30	8.79	14.62
	240	2437.0	13.28	8.79	14.60
	270	2437.0	13.29	8.80	14.61
	300	2437.0	13.32	8.77	14.63

Note: The relevant measured result has the offset with cable loss already.

Band	Date Rate (Mbps)	Frequency (MHz)	Average Conducted power (dBm)		
			ANT-0	ANT-1	ANT-0+1
IEEE 802.11a	6	5180.0	15.51	---	---
		5200.0	23.25	---	---
		5220.0	**23.85**	---	---
		5240.0	19.89	---	---
		5745.0	**20.92**	---	---
		5765.0	20.81	---	---
		5785.0	20.58	---	---
		5805.0	20.07	---	---
		5825.0	19.80	---	---
	54	5180.0	15.41	---	---
		5200.0	23.17	---	---
		5220.0	23.76	---	---
		5240.0	19.80	---	---
		5745.0	20.82	---	---
		5765.0	20.70	---	---
		5785.0	20.50	---	---
		5805.0	19.96	---	---
		5825.0	19.72	---	---
IEEE 802.11ac 20 MHz	13	5180.0	18.75	17.59	21.22
		5200.0	23.19	22.75	25.99
		5220.0	23.71	23.68	**26.71**
		5240.0	19.80	19.27	22.55
		5745.0	22.54	21.92	**25.25**
		5765.0	22.41	21.98	25.21
		5785.0	21.45	21.39	24.43
		5805.0	21.86	21.41	24.65
		5825.0	21.57	21.26	24.43
	173.4	5180.0	18.70	17.47	21.14
		5200.0	23.07	22.68	25.89
		5220.0	23.65	23.62	26.65
		5240.0	19.75	19.19	22.49
		5745.0	22.49	21.86	25.20
		5765.0	22.35	21.88	25.13
		5785.0	22.38	21.30	24.88
		5805.0	21.80	21.36	24.60
		5825.0	21.50	21.17	24.35

Note: The relevant measured result has the offset with cable loss already.

Band	Date Rate (Mbps)	Frequency (MHz)	Average Conducted power (dBm)		
			ANT-0	ANT-1	ANT-0+1
IEEE 802.11ac 40 MHz	27	5190.0	15.59	14.53	18.10
		5230.0	20.81	18.58	**22.85**
		5755.0	22.45	22.21	**25.34**
		5795.0	21.81	21.59	24.71
	400	5190.0	15.51	14.47	18.03
		5230.0	20.75	18.50	22.78
		5755.0	22.38	22.14	25.27
		5795.0	21.73	21.51	24.63
IEEE 802.11ac 80 MHz	58.6	5210.0	11.98	11.85	**14.93**
		5775.0	19.45	19.31	**22.39**
	866.6	5210.0	11.83	11.77	14.81
		5775.0	19.38	19.24	22.32

Note: The relevant measured result has the offset with cable loss already.

4. Test Results

Band	Data Rate (Mbps)	Frequency (MHz)	Limit (mw)	Distance [R] (cm)	Max tune-up Power (upper limit) [P] (dBm)	ANT Gain (dBi)	Numeric Gain [G]	Duty Cycle	Power with Duty cycle [TP] (mW)	Power Density [S] (mw/cm^2)
IEEE 802.11b WLAN Ant-0	1	2412.0	1	20	21.50	3.30	2.14	1	302.28	0.060
		2437.0	1	20	21.50	3.30	2.14	1	302.28	0.060
		2462.0	1	20	21.50	3.30	2.14	1	302.28	0.060
IEEE 802.11g WLAN Ant-0	6	2412.0	1	20	23.00	3.30	2.14	1	426.99	0.085
		2437.0	1	20	23.00	3.30	2.14	1	426.99	0.085
		2462.0	1	20	23.00	3.30	2.14	1	426.99	0.085
IEEE 802.11a WLAN Ant-0	6	5180.0	1	20	24	5.25	3.35	1	841.48	0.167
		5200.0	1	20	24	5.25	3.35	1	841.48	0.167
		5220.0	1	20	24	5.25	3.35	1	841.48	0.167
		5240.0	1	20	24	5.25	3.35	1	841.48	0.167
		5745.0	1	20	21.5	5.62	3.65	1	515.58	0.103
		5765.0	1	20	21.5	5.62	3.65	1	515.58	0.103
		5785.0	1	20	21.5	5.62	3.65	1	515.58	0.103
		5805.0	1	20	21.5	5.62	3.65	1	515.58	0.103
		5825.0	1	20	21.5	5.62	3.65	1	515.58	0.103
IEEE 802.11n 2.4 GHz 20 MHz CDD	13	2412.0	1	20	23.50	3.47	2.22	1	497	0.099
		2437.0	1	20	23.50	3.47	2.22	1	497	0.099
		2462.0	1	20	23.50	3.47	2.22	1	497	0.099
IEEE 802.11n 2.4 GHz 40 MHz CDD	27	2422.0	1	20	15.00	3.47	2.22	1	70.2	0.014
		2437.0	1	20	15.00	3.47	2.22	1	70.2	0.014
		2452.0	1	20	15.00	3.47	2.22	1	70.2	0.014
IEEE 802.11ac 20 MHz CDD	13	5180.0	1	20	27	5.32	3.4	1	1704.04	0.339
		5200.0	1	20	27	5.32	3.4	1	1704.04	0.339
		5220.0	1	20	27	5.32	3.4	1	1704.04	0.339
		5240.0	1	20	27	5.32	3.4	1	1704.04	0.339
		5745.0	1	20	25.5	5.68	3.69	1	1309.26	0.260
		5765.0	1	20	25.5	5.68	3.69	1	1309.26	0.260
		5785.0	1	20	25.5	5.68	3.69	1	1309.26	0.260
		5805.0	1	20	25.5	5.68	3.69	1	1309.26	0.260
		5825.0	1	20	25.5	5.68	3.69	1	1309.26	0.260
IEEE 802.11ac 40 MHz CDD	27	5190.0	1	20	23	5.32	3.4	1	678.39	0.135
		5230.0	1	20	23	5.32	3.4	1	678.39	0.135
		5755.0	1	20	25.5	5.68	3.69	1	1309.26	0.260
		5795.0	1	20	25.5	5.68	3.69	1	1309.26	0.260
IEEE 802.11ac 80 MHz CDD	58.6	5210.0	1	20	15.5	5.32	3.4	1	120.64	0.024
		5775.0	1	20	22.5	5.68	3.69	1	656.19	0.131

Band	Data Rate (Mbps)	Frequency (MHz)	Limit (mw)	Distance [R] (cm)	Max tune-up Power (upper limit) [P] (dBm)	ANT Gain (dBi)	Numeric Gain [G]	Duty Cycle	Power with Duty cycle [TP] (mW)	Power Density [S] (mw/cm^2)
WCDMA Band II WWAN ANT	RMC-12.2K	1852.4	1	20	24.00	3.47	2.22	1	557.64	0.111
		1880.0	1	20	24.00	3.47	2.22	1	557.64	0.111
		1907.6	1	20	24.00	3.47	2.22	1	557.64	0.111
WCDMA Band IV WWAN ANT	RMC-12.2K	1712.4	1	20	24.00	3.47	2.22	1	557.64	0.111
		1732.6	1	20	24.00	3.47	2.22	1	557.64	0.111
		1752.6	1	20	24.00	3.47	2.22	1	557.64	0.111
WCDMA Band V WWAN ANT	RMC-12.2K	826.4	0.551	20	24.00	0.83	1.21	1	303.94	0.060
		836.4	0.558	20	24.00	0.83	1.21	1	303.94	0.060
		846.6	0.564	20	24.00	0.83	1.21	1	303.94	0.060
LTE Band 2 QPSK WWAN ANT	1RB	1860.0	1	20	24.00	3.47	2.22	1	557.64	0.111
		1880.0	1	20	24.00	3.47	2.22	1	557.64	0.111
		1900.0	1	20	24.00	3.47	2.22	1	557.64	0.111
LTE Band 4 QPSK WWAN ANT	1RB	1720.0	1	20	24.00	3.47	2.22	1	557.64	0.111
		1732.5	1	20	24.00	3.47	2.22	1	557.64	0.111
		1745.0	1	20	24.00	3.47	2.22	1	557.64	0.111
LTE Band 5 QPSK WWAN ANT	1RB	829.0	0.553	20	24.00	0.83	1.21	1	303.94	0.060
		836.5	0.558	20	24.00	0.83	1.21	1	303.94	0.060
		844.0	0.563	20	24.00	0.83	1.21	1	303.94	0.060
LTE Band 7 QPSK WWAN ANT	1RB	2510.0	1	20	23.00	4.56	2.86	1	570.65	0.114
		2535.0	1	20	23.00	4.56	2.86	1	570.65	0.114
		2560.0	1	20	23.00	4.56	2.86	1	570.65	0.114
LTE Band 12 QPSK WWAN ANT	1RB	704.0	0.469	20	24.00	0.83	1.21	1	303.94	0.060
		707.5	0.472	20	24.00	0.83	1.21	1	303.94	0.060
		711.0	0.474	20	24.00	0.83	1.21	1	303.94	0.060
LTE Band 13 QPSK WWAN ANT	1RB	782.0	0.521	20	24.00	0.83	1.21	1	303.94	0.060
LTE Band 25 QPSK WWAN ANT	1RB	1860.0	1	20	24.00	3.47	2.22	1	557.64	0.111
		1880.0	1	20	24.00	3.47	2.22	1	557.64	0.111
		1905.0	1	20	24.00	3.47	2.22	1	557.64	0.111
LTE Band 26 QPSK WWAN ANT	1RB	821.5	0.548	20	24.00	0.83	1.21	1	303.94	0.060
		831.5	0.554	20	24.00	0.83	1.21	1	303.94	0.060
		841.5	0.561	20	24.00	0.83	1.21	1	303.94	0.060
LTE Band 30 QPSK WWAN ANT	1RB	2310.0	1	20	23.00	3.72	2.36	1	470.88	0.094
LTE Band 41 QPSK WWAN ANT	1RB	2506.0	1	20	23.00	3.72	2.36	1	470.88	0.094
		2549.5	1	20	23.00	3.72	2.36	1	470.88	0.094
		2593.0	1	20	23.00	3.72	2.36	1	470.88	0.094
		2636.5	1	20	23.00	3.72	2.36	1	470.88	0.094
		2680.0	1	20	23.00	3.72	2.36	1	470.88	0.094

Note:

1. Mobile or fixed location transmitters, minimum separation distance is 20 cm, even if calculations indicate MPE distance is less.
2. The Numeric Gain calculated by 10^(ant. Gain(dBi) /10).
3. Each band max power which perform MPE of any configurations.
4. The MPE results are evaluated by lowest data rate for WLAN.
5. The device operating IEEE 802.11 a/b/g mode is 1TX (SISO).
6. The device operating IEEE 802.11 n/ac mode is 2TX (MIMO/CDD).
7. The WWAN MPE results are refer to Sierra MC7455 Module report.
8. The device support simultaneous transmission.

Simultaneous Transmitting:

Simultaneous MPE = 2.4 GHz MPE + 5 GHz MPE + WWAN MPE

= 0.099 + 0.339 + 0.114 = 0.552 mw/cm^2 < 10 mw/cm^2