

FCC Maximum Permissible RF Exposure (MPE) Estimation Report

**In accordance with the requirements of
FCC 47 CFR Part 2(2.1091), ANSI/IEEE C95.1-1992 and
KDB 447498 D01**

Product Name: PMA

Trademark: N/A

Model Name: PMA1.0

Family Model: N/A

Report No.: S18112901801003

FCC ID: 2ASEF -PMA10

Prepared for

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TEST RESULT CERTIFICATION

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Product description

Product name : PMA
Trademark : N/A
Model and/or type reference : PMA1.0
Family Model : N/A
Standards : FCC 47 CFR Part 1(1.1310)
FCC 47 CFR Part 2(2.1091)
ANSI/IEEE C95.1-1992
KDB 447498 D01

This device described above has been tested by Shenzhen NTEK. Testing has shown that this device is capable of compliance with MPE specified in FCC 47 CFR Part 2(2.1091) and ANSI/IEEE C95.1-1992. The test results in this report apply only to the tested sample of the stated device/equipment. Other similar device/equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

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Date of Test

Date (s) of performance of tests : 29 Nov. 2018 ~ 05 Jan. 2019

Date of Issue : 06 Jan. 2019

Test Result : **Pass**

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※ ※ Revision History ※ ※

REV.	DESCRIPTION	ISSUED DATE	REMARK
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1 General Information

1.1 RF Exposure Requirements

1.1.1 RF Exposure Limits

Table - 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 Exposure				
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
300-1,500			f/300	6
1,500-100,000			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
300-1,500			f/1500	30
1,500-100,000			1.0	30
f = frequency in MHz * = Plane-wave equivalent power density				

A rough estimation of the expected exposure in power flux density on a given point can be made with the following equation:

$$S = \frac{P_t * G_t}{4 * \pi * R^2}$$

Where:

S = Power density (mW/cm²)

P_t = Conducted output power

G_t = numeric gain of the antenna in the direction of interest relative to an isotropic radiator (dBi)

R = distance to the centre of radiation of the antenna (cm)

EIRP = P_t * G_t

The antenna of the product, under normal use condition is at least 20 cm away from the body of the user. Warning statement to the user for keeping at least 20cm separation distance and the prohibition of operating to a person has been printed on the user's manual. Therefore, the S of the device is calculated with R=20cm, and if it is below the limit S, then we can conclude the device complies with the rules.

1.1.2 Additional Description

An estimation of MPE in this application for product is used to ensure if it complies to the rules of the standard in the regulation list above.

Maximum permissible exposure (MPE) refers to the RF energy that is acceptable for human exposure. It is broken down into two categories, Occupational/controlled and General population/uncontrolled.

Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.

We analysis if it comply with the limits for General population/uncontrolled exposure. The FCC's MPE limits for field strength and power density are given in 47CFR 1.1310(Table below).These limits are generally based on recommended exposure guidelines published by the National Council on Radiation Protection and Measurements (NCRP), and also partly based on guidelines recommended by the American National Standards Institute (ANSI) in Section 4.1 of ANSI/IEEE C95.1.

1.2 EUT Description

Device Information	
Product Name	PMA
Trade Name	N/A
Model Name	PMA1.0
Family Model	N/A
FCC ID	2ASEF -PMA10
Device Phase	Identical Prototype
Exposure Category	General population / Uncontrolled environment
Antenna Type	See Note 1
Antenna Gain	See Note 1
Device Operating Configurations	
IEEE 802.11 WLAN Mode Supported	☒ 802.11b/g/a/AC(20MHz channel bandwidth) ☒ 802.11n/AC(20MHz channel bandwidth) ☒ 802.11n/AC(40MHz channel bandwidth) ☒ 802.11AC(80MHz channel bandwidth)
Modulation	OFDM with BPSK/QPSK/16QAM/64QAM/256QAM for 802.11a/n/ac;
Smart system	☒ SISO for 802.11a/ b/g ☒ MIMO for 802.11n/ac
Operating Frequency Range	☒ 2412-2462MHz for 802.11b/g/11n(HT20); ☒ 2422-2452 MHz for 802.11n(HT40) ☒ U-NII-1: 5150 MHz ~5250MHz ☒ U-NII-2A: 5250MHz~5350MHz ☒ U-NII-2C: 5470MHz~5725MHz ☒ U-NII-3: 5725 MHz ~5825 MHz

Note 1:

The EUT has two of antenna.

Antenna	Brand	Model Name (P/N)	Antenna Type	Connector	Antenna Gain(dBi)	
					2.4G	5.0G
A(main)	N/A	JT803	FPC	ECT Conn	4.34	4.76
B(aux)	N/A	JT803	FPC	ECT Conn	4.34	4.76

For MIMO mode , Directional gain=[$G_{ANT} + 10 \log(N_{ANT})$] dBi =7.35dbi in 2.4GHz

Directional gain=[$G_{ANT} + 10 \log(N_{ANT})$] dBi =7.77dbi in 5.0GHz

802.11n/ac has MIMO mode.

Note: G_A means antenna gain for ANT A in Num.

G_B means antenna gain for ANT B in Num.

1.3 Test specification(s)

FCC 47 CFR Part 1(1.1310)
FCC 47 CFR Part 2(2.1091)
ANSI/IEEE C95.1-1992
KDB 447498 D01 General RF Exposure Guidance

1.4 Ambient Condition

Ambient temperature	20°C – 24°C
Relative Humidity	30% – 70%

2 RF Output Power

2.1 Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
Agilent	Power Meter	DARE/ RPR3006W	15I00041SNO84	2018.08.05	2019.08.04

2.2 RF Output Power

2.2.1 WIFI Output Power

2.4G WIFI:

Test Channel	Frequency (MHz)	Power Setting	Duty Cycle Factor (dB)	Peak Output Power(dBm)		Total		LIMIT (dBm)	Verdict
				ANT A	ANT B	(dBm)			
802.11b									
1	2412	Default	0	14.80	13.90	-	-	26.21	PASS
6	2437	Default	0	14.80	14.40	-	-	26.21	PASS
11	2462	Default	0	14.80	14.40	-	-	26.21	PASS
802.11g									
1	2412	Default	0	12.40	11.50	-	-	26.21	PASS
6	2437	Default	0	12.40	11.90	-	-	26.21	PASS
11	2462	Default	0	12.50	11.90	-	-	26.21	PASS
802.11n HT20									
1	2412	Default	0	11.10	10.30	13.73		26.21	PASS
6	2437	Default	0	11.20	10.70	13.97		26.21	PASS
11	2462	Default	0	11.50	10.70	14.13		26.21	PASS
802.11n HT40									
3	2422	Default	0	11.70	10.80	14.28		26.21	PASS
6	2437	Default	0	11.70	11.00	14.37		26.21	PASS
9	2452	Default	0	11.80	11.40	14.61		26.21	PASS

TX (5.2G) Mode Frequency Band 1 (5150-5250MHz):

Test Channel	Frequency	Maximum output power. Antenna port		Total Power	LIMIT	Result
		(AV) (dBm)		(AV)		
	(MHz)	ANT A	ANT B	dBm	dBm	
TX 802.11a Mode						
CH36	5180	10.70	10.90	-	20.19	Pass
CH40	5200	10.60	10.90	-	20.19	Pass
CH48	5240	10.80	10.80	-	20.19	Pass
TX 802.11 n20M Mode						
CH36	5180	9.80	9.50	12.66	20.19	Pass
CH40	5200	9.90	9.60	12.76	20.19	Pass
CH48	5240	9.70	9.10	12.42	20.19	Pass
TX 802.11 n40M Mode						
CH38	5190	8.50	8.10	11.31	20.19	Pass
CH46	5230	8.40	8.00	11.21	20.19	Pass
TX 802.11 AC20M Mode						
CH36	5180	7.10	6.90	10.01	20.19	Pass
CH40	5200	7.10	6.50	9.82	20.19	Pass
CH48	5240	7.00	6.40	9.72	20.19	Pass
TX 802.11 AC40M Mode						
CH38	5190	6.20	5.90	9.06	20.19	Pass
CH46	5230	6.50	5.80	9.17	20.19	Pass
TX 802.11 AC80M Mode						
CH42	5210	5.10	4.80	7.96	20.19	Pass

TX (5.3G) Mode Frequency Band 2A (5250-5350MHz):

Test Channel	Frequency	Maximum output power. Antenna port		Total Power	LIMIT	Result
		(AV) (dBm)		(AV)		
	(MHz)	ANT A	ANT B	dBm	dBm	
TX 802.11a Mode						
CH52	5260	11.10	10.80	-	19.14	Pass
CH56	5280	11.00	10.90	-	19.12	Pass
CH64	5320	11.20	10.70	-	19.16	Pass
TX 802.11 n20M Mode						
CH52	5260	9.70	9.60	12.66	19.19	Pass
CH56	5280	9.80	9.50	12.66	19.18	Pass
CH64	5320	9.50	9.50	12.51	19.14	Pass
TX 802.11 n40M Mode						
CH54	5270	8.50	8.40	11.46	20.19	Pass
CH62	5310	8.60	8.50	11.56	20.19	Pass
TX 802.11 AC20M Mode						
CH52	5260	9.50	9.40	12.46	19.11	Pass
CH56	5280	9.60	9.50	12.56	19.12	Pass
CH64	5320	9.40	9.40	12.41	19.15	Pass
TX 802.11 AC40M Mode						
CH54	5270	6.60	6.30	9.46	20.19	Pass
CH62	5310	6.50	6.20	9.36	20.19	Pass
TX 802.11 AC80M Mode						
CH58	5290	5.50	5.00	8.27	20.19	Pass

TX (5.6G) Mode Frequency Band 2C (5470MHz~5725MHz):

Test Channel	Frequency	Maximum output power. Antenna port		Total Power	LIMIT	Result
		(AV) (dBm)		(AV)		
	(MHz)	ANT A	ANT B	dBm	dBm	
TX 802.11a Mode						
CH100	5500	10.90	10.80	-	19.10	Pass
CH120	5600	10.80	10.50	-	19.71	Pass
CH140	5700	10.80	10.60	-	19.12	Pass
TX 802.11 n20M Mode						
CH100	5500	10.30	10.10	13.21	19.19	Pass
CH120	5600	10.50	10.20	13.36	19.24	Pass
CH140	5700	9.60	9.50	12.56	19.38	Pass
TX 802.11 n40M Mode						
CH102	5510	9.00	8.20	11.63	20.19	Pass
CH118	5590	9.20	8.50	11.87	20.19	Pass
CH134	5670	9.50	8.60	12.08	20.19	Pass
TX 802.11 AC20M Mode						
CH100	5500	8.50	8.20	11.36	19.16	Pass
CH120	5600	8.60	8.30	11.46	19.15	Pass
CH140	5700	8.50	8.30	11.41	19.16	Pass
TX 802.11 AC40M Mode						
CH102	5510	6.50	6.50	9.51	20.19	Pass
CH118	5590	6.30	6.40	9.36	20.19	Pass
CH134	5670	6.80	6.70	9.76	20.19	Pass
TX 802.11 AC80M Mode						
CH 106	5530	5.40	5.50	8.46	20.19	Pass

TX (5.8G) Mode Frequency Band 3 (5725-5825MHz):

Test Channel	Frequency	Maximum output power. Antenna port		Total Power	LIMIT	Result
		(AV) (dBm)		(AV)		
	(MHz)	ANT A	ANT B	dBm	dBm	
TX 802.11a Mode						
CH149	5745	10.50	10.20	-	26.21	Pass
CH157	5785	10.30	10.10	-	26.21	Pass
CH165	5825	10.60	9.80	-	26.21	Pass
TX 802.11 n20M Mode						
CH149	5745	9.70	9.30	12.51	26.21	Pass
CH157	5785	9.50	9.40	12.46	26.21	Pass
CH165	5825	9.80	9.50	12.66	26.21	Pass
TX 802.11 n40M Mode						
CH151	5755	8.50	9.00	11.77	26.21	Pass
CH159	5795	8.60	8.90	11.76	26.21	Pass
TX 802.11 AC20M Mode						
CH149	5745	7.90	9.20	11.61	26.21	Pass
CH157	5785	8.20	9.30	11.80	26.21	Pass
CH165	5825	8.10	9.60	11.92	26.21	Pass
TX 802.11 AC40M Mode						
CH151	5755	6.00	5.80	8.91	26.21	Pass
CH159	5795	6.10	6.00	9.06	26.21	Pass
TX 802.11 AC80M Mode						
CH155	5775	5.00	5.00	8.01	26.21	Pass

3 RF Exposure Evaluation

3.1 Operation in WLAN 2.4G FOR SISO MODE

ANT A:

Max Tune-up (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
14.80	4.34	19.14	82.04	20	0.016	1.000	Pass

ANT B:

Max Tune-up (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
14.40	4.34	18.74	74.82	20	0.015	1.000	Pass

3.2 Operation in WLAN 5.2G FOR SISO MODE

ANT A:

Max Tune-up (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
10.80	4.76	15.56	35.97	20	0.007	1.000	Pass

ANT B:

Max Tune-up (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
10.90	4.76	15.66	36.81	20	0.007	1.000	Pass

3.3 Operation in WLAN 5.3G FOR SISO MODE

ANT A:

Max Tune-up (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
11.20	4.76	15.96	39.45	20	0.008	1.000	Pass

ANT B:

Max Tune-up (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
10.90	4.76	15.66	36.81	20	0.007	1.000	Pass

3.4 Operation in WLAN 5.6G FOR SISO MODE

ANT A:

Max Tune-up (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
10.90	4.76	15.66	36.81	20	0.007	1.000	Pass

ANT B:

Max Tune-up (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
10.80	4.76	15.56	35.97	20	0.007	1.000	Pass

3.5 Operation in WLAN 5.8G FOR SISO MODE

ANT A

Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
10.60	4.76	15.36	34.36	20	0.007	1.000	Pass

ANT B

Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
10.20	4.76	14.96	31.33	20	0.006	1.000	Pass

4 Exposure calculations for multiple sources

When a number of sources at different frequencies, and/or broadband sources, contribute to the total exposure, it becomes necessary to weigh each contribution relative to the MPE in accordance with the provisions of Table (A) and Table (B). To comply with the MPE, the fraction of the MPE in terms of E^2 , H^2 (or power density) incurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity.

In order to ensure compliance with the MPE for a controlled environment, the sum of the ratios of the power density to the corresponding MPE should not exceed unity. That is

$$\sum_{i=1}^n \frac{S_i}{MPE_i}$$

The product also has multiple transmitters The Simultaneous Transmission Possibilities are as below:

Simultaneous Tx Combination	Configuration
1	WLAN MIMO

4.1 Estimation for WLAN MIMO 2.4G

ANT	Max Tune-up (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	Total S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
A	11.80	4.34	16.14	41.11	20	0.008	0.015	1.000	Pass
B	11.40	4.34	15.74	37.50		0.007			

4.2 Estimation for WLAN MIMO 5.2G

ANT	Max Tune-up (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	Total S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
A	9.90	4.76	14.66	29.24	20	0.006	0.011	1.000	Pass
B	9.60	4.76	14.36	27.29		0.005			

4.3 Estimation for WLAN MIMO 5.3G

ANT	Max Tune-up (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	Total S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
A	9.80	4.76	14.56	28.58	20	0.006	0.011	1.000	Pass
B	9.50	4.76	14.26	26.67		0.005			

4.4 Estimation for WLAN MIMO 5.6G

ANT	Max Tune-up (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	Total S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
A	10.50	4.76	15.26	33.57	20	0.007	0.013	1.000	Pass
B	10.20	4.76	14.96	31.33		0.006			

4.5 Estimation for WLAN MIMO 5.8G

ANT	Max Tune-up (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	Total S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
A	9.80	4.76	14.56	28.58	20	0.006	0.011	1.000	Pass
B	9.50	4.76	14.26	26.67		0.005			

According to the Table above, we can conclude that the calculation results of all simultaneous transmission possibilities are less than 1, so it is into compliance.

Therefore the product also meets the requirements under multiple sources condition.

-----END-----