



Compliance Certification Services Inc.

Report No: C160317Z02-RP1-1 FCC ID: 2AGKH-PD-BYRD-0103 Date of Issue: March 31, 2016

MPE Report

Exposure category: General population/uncontrolled environment

EUT Type: Production Unit

Device Type: Mobile Device

Refer Standard:

ANSI C95.1-1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

FCC KDB publication 447498 D01 General 1 RF Exposure Guidance v05r01: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

FCC CFR 47 part1 1.1310: Radiofrequency radiation exposure limits.

FCC CFR 47 part2 2.1091: Radiofrequency radiation exposure evaluation: mobile devices.

1. Evaluation method

Systems operating under the provisions of FCC 47 CFR section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as mobile device whereby a distance of 0.2m normally can be maintained between the user and the device, and below RF Permissible Exposure limit shall comply with.

In accordance with KDB447498D01 for Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is ≤ 1.0 . The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency.

Either the maximum peak or spatially averaged results from measurements or numerical simulations may be used to determine the MPE ratios. Spatial averaging does not apply when MPE is estimated using simple calculations based on far-field plane-wave equivalent conditions. The antenna installation and operating requirements for the host device must meet the minimum test separation distances required by all antennas, in both standalone and simultaneous transmission operations, to satisfy compliance.

2. Limits for General Population/Uncontrolled Exposure

(B) Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	30
30-300	27.5	0.073	0.2	30
300-1500			F/1500	30
1500-100,000			1.0	30

Note: f = frequency in MHz ; *Plane-wave equivalent power density

3. Calculation Method

Predication of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S=power density

P=power input to antenna



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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

From the peak EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the maximum gain of the used antenna is 3dBi for GSM/UMTS/WLAN, the RF power density can be obtained.

4. Conducted Power Results

WIFI

Mode	Frequency(MHz)	AVG Conducted Output Power (dBm)
IEEE 802.11b	2412	11.64
	2437	15.39
	2462	14.92
IEEE 802.11g	2412	9.38
	2437	16.21
	2462	12.05
IEEE 802.11n HT20	2412	9.28
	2437	16.39
	2462	11.40
IEEE 802.11n HT40	2422	9.72
	2437	15.65
	2452	12.45

5G

Antenna	Frequency(MHz)	AVG Conducted Output Power (dBm)
Antenna 1	5845	20.92
	5777	20.00
	5810	19.31
Antenna 2	5845	20.33
	5777	19.76
	5810	18.80

5. Manufacturing tolerance

WIFI

IEEE 802.11b (AVG)			
Frequency (MHz)	2412	2437	2462
Target (dBm)	11.0	15.0	14.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11g (AVG)			
Frequency (MHz)	2412	2437	2462
Target (dBm)	9.0	16.0	12.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT20 (AVG)			
Frequency (MHz)	2412	2437	2462
Target (dBm)	9.0	16.0	11.0
Tolerance ±(dB)	1.0	1.0	1.0



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IEEE 802.11n HT40 (AVG)			
Frequency (MHz)	2422	2437	2452
Target (dBm)	9.0	15.0	12.0
Tolerance ±(dB)	1.0	1.0	1.0

5G

5.8GHz Wireless Modular @ Antenna 1 (Average)			
Frequency (MHz)	5745	5777	5810
Target (dBm)	20.0	20.0	19.0
Tolerance ±(dB)	1.0	1.0	1.0

5.8GHz Wireless Modular @ Antenna 2 (Average)			
Frequency (MHz)	5745	5777	5810
Target (dBm)	20.0	19.0	18.0
Tolerance ±(dB)	1.0	1.0	1.0

6. Measurement Results

6.1 Standalone MPE

2.4GHz WLAN

Mode	Average Output Power Including power tolerance		Antenna gain (dBi)	Antenna gain (numeric)	Duty Cycle	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)	Pass /Fail
	(dBm)	(mW)						
IEEE 802.11b	16.00	39.8107	2.00	1.5849	100%	0.0126	1.0000	Pass
IEEE 802.11g	17.00	50.1187	2.00	1.5849	100%	0.0158	1.0000	Pass
IEEE 802.11n HT20	17.00	50.1187	2.00	1.5849	100%	0.0158	1.0000	Pass
IEEE 802.11n HT40	16.00	39.8107	2.00	1.5849	100%	0.0126	1.0000	Pass

5.8G Wireless Modular

Antenna 1

Mode	Average Output Power Including power tolerance		Antenna gain (dBi)	Antenna gain (numeric)	Duty Cycle	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)	Pass /Fail
	(dBm)	(mW)						
5.8GHz Modular	21.00	125.8925	2.00	1.5849	100%	0.0397	1.0000	Pass

Antenna 2

Mode	Average Output Power Including power tolerance		Antenna gain (dBi)	Antenna gain (numeric)	Duty Cycle	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)	Pass /Fail
	(dBm)	(mW)						
5.8GHz Modular	21.00	125.8925	2.00	1.5849	100%	0.0397	1.0000	Pass



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6.2 Simultaneous Transmission

As 2.4GHz WLAN and 5.8GHz Wireless modular share difference antenna, we need consider transmit synchronization, more information as follows

Modular	Antenna	Standalone TX	Synchronization TX
2.4GHz WLAN	Antenna 0	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Antenna 0 and Antenna 1 <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
	Antenna 1	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> NO	Antenna 0 and Antenna 2 <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
5.8GHz Wireless	Antenna 2	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> NO	Antenna 1 and Antenna 2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
			Antenna 0 and Antenna 1 and Antenna 2 <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;

$$\Sigma \text{ of MPE ratios} \leq 1.0$$

$$\Sigma \text{ 2.4GHzWLAN/5.8GHz Wireless Modular MPE ratios} = \text{2.4GHzWLAN}_{\text{MPE ratios}} + \text{Maximum (5.8GHz Wireless Modular MPE ratios at antenna 1 and antenna 2)} = 0.1 < 1.0$$

Note: The estimation distance is 20cm

7. Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure of mobile device.