Report No: C160419Z02-RP1_MPE

FCC ID: 2AGPP-SK-WB8V2

Date of Issue: June 20, 2016

MPE Report

Exposure category: General population/uncontrolled environment

EUT Type: Production Unit Device Type: Mobile Device

Refer Standard: KDB 447498 D01 General RF Exposure Guidance v06

FCC Part 2 §2.1091

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 $ \mathbf{E} ^2$, $ \mathbf{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



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P=power input to 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

From the EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the maximum gain of the used antenna is 2dBi for 5GWLAN and 3.0dBi for 2.4GWLAN, the RF power density can be obtained.

4. Estimation Result

4.1 Conducted Power Results

2.4GHz WIFI

2.4GHZ WIF1								
Antenna	Mode	Frequency(MHz)	AVG Conducted Output					
7 xm cma	Wiode	r requency (Willz)	Power (dBm)					
		2412	17.29					
Antenna 0		2437	17.26					
	IEEE 002 111	2462	15.26					
	IEEE 802.11b	2412	15.28					
Antenna 1		2437	15.48					
		2462	15.09					
		2412	15.64					
Antenna 0		2437	13.51					
	IEEE 902 11 a	2462	13.26					
	IEEE 802.11g	2412	17.38					
Antenna 1		2437	13.25					
		2462	12.81					
		2412	12.25					
Antenna 0		2437	11.38					
	IEEE 902 11 - HT20	2462	14.72					
	IEEE 802.11n HT20	2412	12.27					
Antenna 1		2437	12.55					
		2462	14.43					
		2422	14.27					
Antenna 0		2437	9.86					
	TEEE 000 11 LITE40	2452	9.97					
	IEEE 802.11n HT40	2422	13.69					
Antenna 1		2437	11.53					
		2452	11.18					



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5GHz WIFI

SGHZ WIFI AVC Conducted O							
Antenna	Mode	Frequency(MHz)	AVG Conducted Output Power (dBm)				
		5180	16.34				
		5200	16.26				
		5240	16.12				
		5260	13.74				
		5300	16.29				
		5320	13.75				
Antenna 0		5500	17.68				
		5580	15.45				
		5700	15.52				
		5745	18.02				
		5785	18.08				
	HEEF 000 11	5825	14.67				
	IEEE 802.11a	5180	18.27				
		5200	18.17				
		5240	18.05				
		5260	17.84				
		5300	19.13				
		5320	15.95				
Antenna 1		5500	16.54				
		5580	16.57				
		5700	16.18				
		5745	16.98				
		5785	19.14				
		5825	16.22				
		5180	16.50				
		5200	16.16				
		5240	15.64				
		5260	15.62				
		5300	15.93				
•		5320	16.15				
Antenna 0	IEEE 802.11n HT20	5500	16.57				
		5580	15.97				
		5700	14.66				
		5745	15.44				
		5785	17.34				
		5825	14.28				
Antenna 1	7	5180	18.07				



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Antenna 0 Antenna 1 S200				
Antenna 0 Section			5200	17.93
Antenna 0 Sample			5240	17.97
Antenna 0 S320			5260	18.61
Antenna 1 5500 16.69 5580 17.31 5700 14.69 5745 14.91 5785 18.45 5825 15.15 5190 14.39 5230 16.18 5270 16.76 5310 16.38 5270 16.38 5550 18.89 5670 17.01 5755 17.70 5795 15.62 5190 15.10 5230 18.92 5270 15.41 5310 15.19 5510 15.24 5550 19.93 5670 16.85 5775 15.56 5795 15.50 5795 15.50 5795 15.50 5795 15.50 5795 15.50 5795 15.50 5795 15.50 5795 15.56 5795 15.56 5795 15.56 5795 15.56 5795 15.56 5795 15.56 5795 15.56 5795 15.56 5795 15.56 5795 15.56 5795 15.56 5795 15.50 5795 15.			5300	14.98
Antenna 1 5580 17.31 5700 14.69 5745 14.91 5785 18.45 5825 15.15 5190 14.39 5230 16.18 5270 16.76 5310 16.38 5550 18.89 5670 17.01 5755 17.70 5795 15.62 5190 15.10 5230 18.92 5270 15.41 5310 15.19 5310 15.19 5510 15.24 5550 19.93 5670 16.85 5755 15.56 5795 15.50 5795 15.			5320	18.95
Antenna 0 S700			5500	16.69
Antenna 0 Figure 802.11n HT40 Antenna 0 Antenna 0 Figure 802.11n HT40 Antenna 1 Figure 802.11n HT40 Figure 802.11n H			5580	17.31
Antenna 0 S785			5700	14.69
Antenna 0 S825			5745	14.91
Antenna 0 Antenna 0 IEEE 802.11n HT40 Antenna 0 Antenna 1 IEEE 802.11ac 80 Antenna 1 Antenna 1 Antenna 1 Antenna 1 IEEE 802.11ac 80 Antenna 1			5785	18.45
Antenna 0 Antenna 0 IEEE 802.11n HT40 Antenna 1 IEEE 802.11ac 80 Antenna 1 5230			5825	15.15
Antenna 0 Antenna 0 IEEE 802.11n HT40 Antenna 1 IEEE 802.11n HT40 Antenna 1 IEEE 802.11n HT40 Antenna 1 IEEE 802.11n HT40 IEEE 802.11n HT40 Antenna 1 IEEE 802.11n HT40 Antenna 1 Antenna 1 Antenna 1 IEEE 802.11ac 80 Antenna 1 Antenna 1 IEEE 802.11ac 80 Antenna 1			5190	14.39
Antenna 0 Antenna 0 IEEE 802.11n HT40 IEEE 802.11n HT40 Antenna 1 Antenna 1 Antenna 0 IEEE 802.11n HT40 IEEE 802.11n HT40 Antenna 1 Antenna 1 IEEE 802.11n HT40 IEEE 802.11n HT40 Antenna 1 Antenna 1 Antenna 0 IEEE 802.11n HT40 IEEE 802.11n HT40 Antenna 0 Antenna 1 Antenna 0 IEEE 802.11ac 80 Antenna 1 Antenn			5230	16.18
Antenna 0 S510			5270	16.76
Antenna 1 IEEE 802.11n HT40 IEEE 802.11n HT40 IEEE 802.11n HT40 Antenna 1 Antenna 1 IEEE 802.11n BT40 IEEE 802.11n BT40 IEEE 802.11n BT40 Antenna 1 IEEE 802.11n BT40 IEEE 802.11n BT40 Antenna 1 IEEE 802.11n BT40 IEEE 802.11n BT			5310	16.43
Antenna 1 IEEE 802.11n HT40 5670 5795 17.70 5795 15.62 5190 15.10 5230 18.92 5270 15.41 5310 15.19 5510 15.24 5550 19.93 5670 16.85 5755 15.56 5795 15.56 5795 15.56 5795 15.56 5795 15.10 5210 13.77 5290 14.10 5530 15.61 5775 15.10 5290 14.81 5530 15.41	Antenna 0		5510	16.38
Antenna 1 IEEE 802.11n HT40 5795 15.62 5190 15.10 5230 18.92 5270 15.41 5310 15.19 5510 15.24 5550 19.93 5670 16.85 5755 15.56 5795 15.56 5795 15.56 5795 15.56 5795 15.56 5795 15.10 5210 14.10 5530 15.61 5775 15.10 5290 14.81 5530 15.41			5550	18.89
Antenna 1 S795			5670	17.01
Antenna 1 S190			5755	17.70
Antenna 1 Antenna 1 Antenna 1 EEEE 802.11ac 80 5230 18.92 5270 15.41 5310 15.19 5510 15.24 5550 19.93 5670 16.85 5755 15.56 5795 15.56 5210 13.77 5290 14.10 5530 15.61 5775 15.10 5210 14.09 5290 14.81 5530 15.41			5795	15.62
Antenna 1 5270		IEEE 802.11n HT40	5190	15.10
Antenna 1 5310 15.19 5510 15.24 5550 19.93 5670 16.85 5755 15.56 5795 15.56 5795 15.56 5210 13.77 5290 14.10 5530 15.61 5775 15.10 5210 14.09 5290 14.81 5530 15.41			5230	18.92
Antenna 1 5510 15.24 5550 19.93 5670 16.85 5755 15.56 5795 15.56 5795 13.77 5290 14.10 5530 15.61 5775 15.10 Antenna 1 IEEE 802.11ac 80 5210 14.09 5290 14.81 5530 15.41			5270	15.41
Antenna 0 5550 19.93 5670 16.85 5755 15.56 5795 15.56 5210 13.77 5290 14.10 5530 15.61 5775 15.10 Antenna 1 5210 14.09 5290 14.81 5530 15.41			5310	15.19
Antenna 0 5670 16.85 5755 15.56 5795 15.56 5210 13.77 5290 14.10 5530 15.61 5775 15.10 Antenna 1 5290 14.81 5290 14.81 5530 15.41	Antenna 1		5510	15.24
Antenna 0 Antenna 0 IEEE 802.11ac 80 5755 5795 15.56 5210 13.77 5290 14.10 5530 15.61 5775 15.10 5210 14.09 5290 14.81 5530 15.41			5550	19.93
Antenna 0 Antenna 0 IEEE 802.11ac 80 5795 5210 13.77 5290 14.10 5530 15.61 5775 15.10 5210 14.09 5290 14.81 5530 15.41			5670	16.85
Antenna 0 IEEE 802.11ac 80 5210 13.77 5290 14.10 5530 15.61 5775 15.10 5210 14.09 5290 14.81 5530 15.41			5755	15.56
Antenna 0 IEEE 802.11ac 80 5290 14.10 5530 15.61 5775 15.10 5210 14.09 5290 14.81 5530 15.41			5795	15.56
Antenna 0 IEEE 802.11ac 80 5530 15.61 5775 15.10 5210 14.09 5290 14.81 5530 15.41			5210	
Antenna 0 IEEE 802.11ac 80 5530 15.61 5775 15.10 5210 14.09 5290 14.81 5530 15.41	Antenna 0		5290	14.10
Antenna 1 5775 15.10 5210 14.09 5290 14.81 5530 15.41			5530	
Antenna 1		WEED 002 11 00		
Antenna 1 5290 14.81 5530 15.41		TEEE 802.11ac 80	5210	
Antenna 1 5530 15.41				
	Antenna 1		5530	15.41
				16.31



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4.2 Manufacturing tolerance

2.4GHz WIFI

IEEE 802.11 b (AVG)										
Frequency	Antenna 0 Antenna 1									
(MHz)	2412	2437	2462	2412	2437	2462				
Target (dBm)	17.0	17.0	15.0	15.0	15.0	15.0				
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0				

IEEE 802.11 g (AVG)										
Frequency		Antenna 0 Antenna 1								
(MHz)	2412	2437	2462	2412	2437	2462				
Target (dBm)	15.0	13.0	13.0	17.0	13.0	12.0				
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0				

IEEE 802.11 n HT20 (AVG)										
Frequency	Antenna 0 Antenna 1									
(MHz)	2412	2437	2462	2412	2437	2462				
Target (dBm)	12.0	11.0	14.0	12.0	12.0	14.0				
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0				

	IEEE 802.11 n HT40 (AVG)										
Frequency		Antenna 0 Antenna 1									
(MHz)	2422	2437	2452	2422	2437	2452					
Target (dBm)	14.0	14.0 9.0 9.0 13.0 11.0 11.0									
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0					

5GHz WIFI

	IEEE 802.11 a (AVG)											
Frequency		Antenna 0		Antenna 1								
(MHz)	5180	5200	5240	5180	5200	5240						
Target (dBm)	16.0	16.0	16.0	18.0	18.0	18.0						
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0						
Frequency		Antenna 0 Antenna 1										
(MHz)	5260	5300	5320	5260	5300	5320						
Target (dBm)	13.0	16.0	13.0	17.0	19.0	15.0						
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0						
Frequency		Antenna 0			Antenna 1							
(MHz)	5500	5580	5700	5500	5580	5700						
Target (dBm)	17.0	15.0	15.0	16.0	16.0	16.0						
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0						



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Frequency		Antenna 0			Antenna 1	
(MHz)	5745	5785	5825	5745	5785	5825
Target (dBm)	18.0	18.0	14.0	16.0	19.0	16.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0

IEEE 802.11n HT20 (AVG)										
Frequency		Antenna 0		Antenna 1						
(MHz)	5180	5200	5240	5180	5200	5240				
Target (dBm)	15.5	15.5	15.5	17.5	17.5	17.5				
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0				
Frequency		Antenna 0			Antenna 1					
(MHz)	5260	5300	5320	5260	5300	5320				
Target (dBm)	16.0	16.0	16.0	19.0	15.0	19.0				
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0				
Frequency		Antenna 0			Antenna 1					
(MHz)	5500	5580	5700	5500	5580	5700				
Target (dBm)	18.0	16.0	15.0	20.0	17.0	15.0				
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0				
Frequency		Antenna 0			Antenna 1					
(MHz)	5745	5785	5825	5745	5785	5825				
Target (dBm)	15.0	17.0	14.0	14.0	18.0	15.0				
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0				

		IEEE 802.1	1n HT40 (A	VG)		
Frequency		Antenna 0			Antenna 1	
(MHz)	5190		5230	5190		5230
Target (dBm)	14.0		15.5	15.0		18.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0
Frequency		Antenna 0		Antenna 1		
(MHz)	5270		5310	5270		5310
Target (dBm)	16.0		16.0	15.0		15.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0
Frequency		Antenna 0			Antenna 1	
(MHz)	5510	5550	5670	5510	5550	5670
Target (dBm)	16.0	18.0	17.0	15.0	19.0	16.0



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Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0	
Frequency	Antenna 0			Antenna 1			
(MHz)	5755		5795	5755		5795	
Target (dBm)	17.0		15.0	15.0		15.0	
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0	

IEEE 802.11ac 80 (AVG)								
Frequency	Antenna 0			Antenna 1				
(MHz)	5210		5290	5210		5290		
Target (dBm)	13.0		14.0	14.0		14.0		
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0		
	IEEE 802.11ac 80 (AVG)							
Frequency		Antenna 0		Antenna 1				
(MHz)	5530		5775	5530		5775		
Target (dBm)	15.0		15.0	15.0		16.0		
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0		

4.3 Measurement Results

Antenna 1

2.4GWLAN

Mode	Output po		Antenna Gain	Antenna Duty Gain Cycle		MPE
	(dBm)	(mW)	(dBi)	(linear)	Cycle	(mW/cm^2)
IEEE 802.11 b	18.0	79.4328	3.0	1.9953	100%	0.0251
IEEE 802.11 g	16.0	39.8107	3.0	1.9953	100%	0.0158
IEEE 802.11 n HT20	15.0	31.6228	3.0	1.9953	100%	0.0126
IEEE 802.11 n HT40	15.0	31.6228	3.0	1.9953	100%	0.0126

5GWLAN

Mode	Output po (Including tune-u		Antenna Gain	Antenna Gain Duty Cycle		MPE
	(dBm)	(mW)	(dBi)	(linear) Cycle (mV	(mW/cm ²)	
IEEE 802.11 a	19.0	79.4328	2.0	1.5849	100%	0.0251
IEEE 802.11 n HT20	19.0	79.4328	2.0	1.5849	100%	0.0251
I IEEE 802.11 n HT40	18.0	63.0957	2.0	1.5849	100%	0.0199
IEEE 802.11 ac 80	16.0	39.8107	2.0	1.5849	100%	0.0126

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Antenna 2

2.4GWLAN

Mode	Output po		Antenna Gain	Antenna Gain Duty Cycle		MPE
	(dBm)	(mW)	(dBi)	(linear)	Cycle	(mW/cm ²)
IEEE 802.11 b	16.0	39.8107	3.0	1.9953	100%	0.0158
IEEE 802.11 g	18.0	79.4328	3.0	1.9953	100%	0.0251
IEEE 802.11 n HT20	15.0	31.6228	3.0	1.9953	100%	0.0126
IEEE 802.11 n HT40	14.0	25.1189	3.0	1.9953	100%	0.0100

5GWLAN

Mode	Output po		Antenna Gain	Antenna Gain Duty Cycle		MPE (mW/cm ²)
	(dBm)	(mW)	(dBi)	(linear)	Cycle	(III W/CIII)
IEEE 802.11 a	20.0	100.0000	2.0	1.5849	100%	0.0315
IEEE 802.11 n HT20	21.0	125.8925	2.0	1.5849	100%	0.0397
I IEEE 802.11 n HT40	19.0	79.4328	2.0	1.5849	100%	0.0251
IEEE 802.11 ac 80	17.0	50.1187	2.0	1.5849	100%	0.0158

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

 \sum of MPE ratios ≤ 1.0

Mode	MPE Antenna 1 (mW/cm ²)	MPE Antenna 2 (mW/cm ²)	∑ MPE ratios	Limit	Results
IEEE 802.11b	0.0251	0.0158	N/A	1.000	Pass
IEEE 802.11g	0.0158	0.0251	N/A	1.000	Pass
IEEE 802.11n HT20	0.0251	0.0397	0.0648	1.000	Pass
IEEE 802.11n HT40	0.0199	0.0251	0.0450	1.000	Pass
IEEE 802.11a	0.0251	0.0315	N/A	1.000	Pass
IEEE 802.11ac 80	0.0126	0.0158	0.0284	1.000	Pass

Note: The estimation distance is 20cm

Conclusion

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