RF Exposure Evaluation Result

1. Requirement

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.

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

2. 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

   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 5dBi, the RF power density can be obtained.

3. Estimation Result

3.1 Manufacturing tolerance

802.11b(peak)						
Channel	Antenna 0			Antenna 1		
	1	6	11	1	6	11
Target (dBm)	19.00	19.00	19.00	N/A	N/A	N/A
Tolerance ±(dB)	1.00	1.00	1.00	N/A	N/A	N/A

802.11g(peak)						
Channel	Antenna 0			Antenna 1		
	1	6	11	1	6	11
Target (dBm)	23.00	24.00	22.00	24.00	24.00	23.00
Tolerance ±(dB)	1.00	1.00	1.00	1.00	1.00	1.00

802.11nHT20(peak)						
Channel	Antenna 0			Antenna 1		
	1	6	11	1	6	11
Target (dBm)	17.00	20.00	16.00	16.00	20.00	17.00
Tolerance ±(dB)	1.00	1.00	1.00	1.00	1.00	1.00

802.11nHT40(peak)						
Channel	Antenna 0			Antenna 1		
	1	6	11	1	6	11
Target (dBm)	20.00	20.00	20.00	21.00	21.00	21.00
Tolerance ±(dB)	1.00	1.00	1.00	1.00	1.00	1.00

3.2 Measurement Results

As the product use three type antenna, we use maximum antenna gain to Evaluation,
also refer to Operation description for transmit at antenna port;

Mode	Antenna 0	Antenna 1	Antenna 0 and Antenna 1 simultaneous transmission	MPE Evaluation Antenna Gain
IEEE 802.11 b	Yes	No	No	☒ External 5dBi
IEEE 802.11 g	Yes	Yes	No	☐ External 3dBi
IEEE 802.11n HT20	Yes	Yes	Yes	☐ Internal 3dBi
IEEE 802.11n HT40	Yes	Yes	Yes	

Antenna 0

Mode	Frequency (MHz)	Output power (Including tune-up tolerance) (dBm)	Output power (mW)	Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)
11b	2412	20.00	100.00	5.0	3.16	0.0629
	2442	20.00	100.00	5.0	3.16	0.0629
	2462	20.00	100.00	5.0	3.16	0.0629
11g	2412	24.00	251.19	5.0	3.16	0.1581
	2442	25.00	316.23	5.0	3.16	0.1990
	2462	23.00	199.53	5.0	3.16	0.1256
11n HT 20	2412	18.00	63.10	5.0	3.16	0.0397
	2442	21.00	125.89	5.0	3.16	0.0792
	2462	17.00	50.12	5.0	3.16	0.0316
11n HT40	2422	21.00	125.89	5.0	3.16	0.0792
	2442	21.00	125.89	5.0	3.16	0.0792
	2452	21.00	125.89	5.0	3.16	0.0792

Antenna 1

Mode	Frequency (MHz)	Output power (Including tune-up tolerance) (dBm)	Output power (mW)	Antenna Gain (dBi)	Antenna Gain (linear)	MPE (mW/cm^2)
11b	2412	N/A	N/A	N/A	N/A	N/A
	2442	N/A	N/A	N/A	N/A	N/A
	2462	N/A	N/A	N/A	N/A	N/A
11g	2412	25.00	316.23	5.0	3.16	0.1990
	2442	25.00	316.23	5.0	3.16	0.1990
	2462	24.00	251.19	5.0	3.16	0.1581
11n HT 20	2412	17.00	50.12	5.0	3.16	0.0316
	2442	21.00	125.89	5.0	3.16	0.0792
	2462	18.00	63.10	5.0	3.16	0.0397
11n HT40	2422	22.00	158.49	5.0	3.16	0.0998
	2442	22.00	158.49	5.0	3.16	0.0998
	2452	22.00	158.49	5.0	3.16	0.0998

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

$\sum$ of MPE ratios ≤ 1.0

Mode	Frequency (MHz)	$\sum$ MPE ratios (mW/cm^2)	Limit	Results
Antenna 0 and Antenna 1				
11b	2412	N/A	1.000	Pass
	2442	N/A	1.000	Pass
	2462	N/A	1.000	Pass
11g	2412	N/A	1.000	Pass
	2442	N/A	1.000	Pass
	2462	N/A	1.000	Pass
11n HT 20	2412	0.0713	1.000	Pass
	2442	0.1584	1.000	Pass
	2462	0.0713	1.000	Pass
11n HT40	2422	0.1790	1.000	Pass
	2442	0.1790	1.000	Pass
	2452	0.1790	1.000	Pass

Note: The estimation distance is 20cm

Conclusion: PASS