RADIO FREQUENCY EXPOSURE

Limit

According to §1.1310 and §2.1091 RF exposure is calculated.

Table: Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Power Density (S) (mW/cm2)
0.3–1.34	*(100)
1.34–30	*($180/f^2$)
30–300	0.2
300–1500	f/1500
1500–100,000	1.0

F = frequency in MHz
* = Plane-wave equivalent power density

Maximum Permissible Exposure

The MPE was calculated at 20cm to show compliance with the power density limit.

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

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.

Note:

1. Manufacturer declared that the maximum antenna gain is 1.2dBi(Max.) for 2402-2480MHz, 2412~2462MHz and 5150.00~5250.00MHz/5745.00~5825.00MHz separately.

2. Manufacturer declared that the nearest distance between human and the EUT is 20cm.

3. Only record worst case data.

Conducted Power Results:

Bluetooth

Mode	Channel	Frequency (MHz)	Peak Conducted Output Power (dBm)
GFSK	00	2402	3.24
	40	2441	3.12
	78	2480	3.16
π /4-DQPSK	00	2402	1.49
	40	2441	2.15
	78	2480	2.01
8-DPSK	00	2402	2.10
	40	2441	2.36
	78	2480	2.15
BLE	0	2402	-0.554
	19	2440	0.238
	39	2480	-0.847

2.4GHz WLAN

2.4GHz WLAN IEEE 802.11b						
Frequency (MHz)	Antenna 0			Antenna 1		
	2412	2437	2462	2412	2437	2462
Peak Conducted Power (dBm)	15.28	15.44	15.39	15.02	15.21	15.43
2.4GHz WLAN IEEE 802.11g						
Frequency (MHz)	Antenna 0			Antenna 1		
	2412	2437	2462	2412	2437	2462
Peak Conducted Power (dBm)	14.07	14.11	14.20	14.41	14.27	14.15
2.4GHz WLAN IEEE 802.11n20						
Frequency (MHz)	Antenna 0			Antenna 1		
	2412	2437	2462	2412	2437	2462
Peak Conducted Power (dBm)	13.51	13.67	13.65	13.63	13.80	14.07
2.4GHz WLAN IEEE 802.11n40						
Frequency (MHz)	Antenna 0			Antenna 1		
	2422	2437	2452	2422	2437	2452
Peak Conducted Power (dBm)	12.45	12.61	12.69	13.02	13.10	13.25

5GHz WLAN

5.2GHz WLAN IEEE 802.11a						
Frequency (MHz)	Antenna 0			Antenna 1		
	5180	5220	5240	5180	5220	5240
Peak Conducted Power (dBm)	13.15	13.18	13.19	13.42	13.43	13.47
5GHz WLAN IEEE 802.11n HT20						
Frequency (MHz)	Antenna 0			Antenna 1		
	5180	5220	5240	5180	5220	5240
Peak Conducted Power (dBm)	12.33	12.45	12.33	12.74	12.72	12.78
5GHz WLAN IEEE 802.11n HT40						
Frequency (MHz)	Antenna 0			Antenna 1		
	5190	/	5230	5190	/	5230
Peak Conducted Power (dBm)	12.85	/	12.78	12.56	/	12.76

5.8GHz WLAN IEEE 802.11a						
Frequency (MHz)	Antenna 0			Antenna 1		
	5745	5785	5825	5745	5785	5825
Peak Conducted Power (dBm)	13.01	13.12	13.09	13.42	13.56	13.68
5GHz WLAN IEEE 802.11n HT20						
Frequency (MHz)	Antenna 0			Antenna 1		
	5745	5785	5825	5745	5785	5825
Peak Conducted Power (dBm)	12.57	12.41	12.45	12.82	12.58	12.80
5GHz WLAN IEEE 802.11n HT40						
Frequency (MHz)	Antenna 0			Antenna 1		
	5755	/	5795	5755	/	5795
Peak Conducted Power (dBm)	12.20	/	12.15	12.39	/	12.81

Manufacturing tolerance:

Manufacturing tolerance:

Bluetooth4.0(DSS)

Mode	Channel	Frequency (MHz)	Conducted Output Tune-up Tolerance(Peak) (dBm)
GFSK	00	2402	3.0 ± 1.0
	39	2441	3.0 ± 1.0
	78	2480	3.0 ± 1.0
π/4DQPSK	00	2402	2.0 ± 1.0
	39	2441	2.0 ± 1.0
	78	2480	2.0 ± 1.0
8-DPSK	00	2402	2.0 ± 1.0
	39	2441	2.0 ± 1.0
	78	2480	2.0 ± 1.0

Bluetooth4.0(DTS)

Mode	Channel	Frequency (MHz)	Conducted Output Tune-up Tolerance(Peak) (dBm)
GFSK	00	2402	0 ± 1.0
	39	2440	0 ± 1.0
	78	2480	0 ± 1.0

2.4GWLAN

Mode	Channel	Frequency (MHz)	Conducted Output Tune-up Tolerance(Peak) (dBm)
802.11b	01	2412	16.0 ± 2.0
	06	2437	16.0 ± 2.0
	11	2462	16.0 ± 2.0
802.11g	01	2412	15.0 ± 2.0
	06	2437	15.0 ± 2.0
	11	2462	15.0 ± 2.0
802.11n HT20	01	2412	14.0 ± 2.0
	06	2437	14.0 ± 2.0
	11	2462	14.0 ± 2.0
802.11n HT40	03	2422	14.0 ± 2.0
	06	2437	14.0 ± 2.0
	09	2452	14.0 ± 2.0

5.2GWLAN

Mode	Channel	Frequency (MHz)	Conducted Output Tune-up Tolerance(Peak) (dBm)
802.11a	36	5180	14.0 ± 2.0
	44	5220	14.0 ± 2.0
	48	5240	14.0 ± 2.0
802.11n HT20	36	5180	13.0 ± 2.0
	44	5220	13.0 ± 2.0
	48	5240	13.0 ± 2.0
802.11n HT40	38	5190	13.0 ± 2.0
	46	5230	13.0 ± 2.0

5.8GWLAN

Mode	Channel	Frequency (MHz)	Conducted Output Tune-up Tolerance(Peak) (dBm)
802.11a	149	5745	14.0 ± 2.0
	157	5785	14.0 ± 2.0
	165	5825	14.0 ± 2.0
802.11n HT20	149	5745	13.0 ± 2.0
	157	5785	13.0 ± 2.0
	165	5825	13.0 ± 2.0
802.11n HT40	151	5755	13.0 ± 2.0
	159	5795	13.0 ± 2.0

Evaluation Results

Standalone MPE

BT

Band/Mode	f (GHz)	ANT Max. Tune Up Power (dBm)	ANT Max. Tune Up Power (mW)	ANT MPE (mW/cm^2)	Limit (mW/cm^2)
GFSK	2.402	3.0 ± 1.0	2.5119	0.0007	1.0
	2.441	3.0 ± 1.0	2.5119	0.0007	1.0
	2.480	3.0 ± 1.0	2.5119	0.0007	1.0
π /4-DQPSK	2.402	2.0 ± 1.0	1.9953	0.0005	1.0
	2.441	2.0 ± 1.0	1.9953	0.0005	1.0
	2.480	2.0 ± 1.0	1.9953	0.0005	1.0
8-DPSK	2.402	2.0 ± 1.0	1.9953	0.0005	1.0
	2.441	2.0 ± 1.0	1.9953	0.0005	1.0
	2.480	2.0 ± 1.0	1.9953	0.0005	1.0
BLE	2.402	3.0 ± 1.0	2.5119	0.0007	1.0
	2.440	3.0 ± 1.0	2.5119	0.0007	1.0
	2.480	3.0 ± 1.0	2.5119	0.0007	1.0

2.4G WIFI:

Test	Mode	Channel	ANT Max. Tune Up Power (dBm)	ANT Max. Tune Up Power (mW)	ANT MPE (mW/cm^2)	Limit (mW/cm^2)
802.11b	Chain 0	1	16.0 ± 2.0	63.0957	0.0166	1.0
		6	16.0 ± 2.0	63.0957	0.0166	1.0
		11	16.0 ± 2.0	63.0957	0.0166	1.0
	Chain 1	1	16.0 ± 2.0	63.0957	0.0166	1.0
		6	16.0 ± 2.0	63.0957	0.0166	1.0
		11	16.0 ± 2.0	63.0957	0.0166	1.0

Test	Mode	Channel	ANT Max. Tune Up Power (dBm)	ANT Max. Tune Up Power (mW)	ANT MPE (mW/cm^2)	Limit (mW/cm^2)
802.11g	Chain 0	1	15.0 ± 2.0	50.1187	0.0132	1.0
		6	15.0 ± 2.0	50.1187	0.0132	1.0
		11	15.0 ± 2.0	50.1187	0.0132	1.0
	Chain 1	1	15.0 ± 2.0	50.1187	0.0132	1.0
		6	15.0 ± 2.0	50.1187	0.0132	1.0
		11	15.0 ± 2.0	50.1187	0.0132	1.0

Test	Mode	Channel	ANT Max. Tune Up Power (dBm)	ANT Max. Tune Up Power (mW)	ANT MPE (mW/cm^2)	Limit (mW/cm^2)
802.11n20	Chain 0	1	14.0 ± 2.0	39.8107	0.0104	1.0
		6	14.0 ± 2.0	39.8107	0.0104	1.0
		11	14.0 ± 2.0	39.8107	0.0104	1.0
	Chain 1	1	14.0 ± 2.0	39.8107	0.0104	1.0
		6	14.0 ± 2.0	39.8107	0.0104	1.0
		11	14.0 ± 2.0	39.8107	0.0104	1.0

Test	Mode	Channel	ANT Max. Tune Up Power (dBm)	ANT Max. Tune Up Power (mW)	ANT MPE (mW/cm^2)	Limit (mW/cm^2)
802.11n40	Chain 0	3	14.0 ± 2.0	39.8107	0.0104	1.0
		6	14.0 ± 2.0	39.8107	0.0104	1.0
		9	14.0 ± 2.0	39.8107	0.0104	1.0
	Chain 1	3	14.0 ± 2.0	39.8107	0.0104	1.0
		6	14.0 ± 2.0	39.8107	0.0104	1.0
		9	14.0 ± 2.0	39.8107	0.0104	1.0

5G WIFI

Test	Mode	Channel	ANT Max. Tune Up Power (dBm)	ANT Max. Tune Up Power (mW)	ANT MPE (mW/cm^2)	Limit (mW/cm^2)
802.11a	Chain 0	36	14.0 ± 2.0	39.8107	0.0104	1.0
		40	14.0 ± 2.0	39.8107	0.0104	1.0
		48	14.0 ± 2.0	39.8107	0.0104	1.0
		149	14.0 ± 2.0	39.8107	0.0104	1.0
		157	14.0 ± 2.0	39.8107	0.0104	1.0
		165	14.0 ± 2.0	39.8107	0.0104	1.0
	Chain 1	36	14.0 ± 2.0	39.8107	0.0104	1.0
		40	14.0 ± 2.0	39.8107	0.0104	1.0
		48	14.0 ± 2.0	39.8107	0.0104	1.0
		149	14.0 ± 2.0	39.8107	0.0104	1.0
		157	14.0 ± 2.0	39.8107	0.0104	1.0
		165	14.0 ± 2.0	39.8107	0.0104	1.0

Test	Mode	Channel	ANT Max. Tune Up Power (dBm)	ANT Max. Tune Up Power (mW)	ANT MPE (mW/cm^2)	Limit (mW/cm^2)
802.11n20	Chain 0	36	13.0 ± 2.0	31.6228	0.0083	1.0
		40	13.0 ± 2.0	31.6228	0.0083	1.0
		48	13.0 ± 2.0	31.6228	0.0083	1.0
		149	13.0 ± 2.0	31.6228	0.0083	1.0
		157	13.0 ± 2.0	31.6228	0.0083	1.0
		165	13.0 ± 2.0	31.6228	0.0083	1.0
	Chain 1	36	13.0 ± 2.0	31.6228	0.0083	1.0
		40	13.0 ± 2.0	31.6228	0.0083	1.0
		48	13.0 ± 2.0	31.6228	0.0083	1.0
		149	13.0 ± 2.0	31.6228	0.0083	1.0
		157	13.0 ± 2.0	31.6228	0.0083	1.0
		165	13.0 ± 2.0	31.6228	0.0083	1.0

Test	Mode	Channel	ANT Max. Tune Up Power (dBm)	ANT Max. Tune Up Power (mW)	ANT MPE (mW/cm^2)	Limit (mW/cm^2)
802.11n40	Chain 0	38	13.0 ± 2.0	31.6228	0.0083	1.0
		46	13.0 ± 2.0	31.6228	0.0083	1.0
		151	13.0 ± 2.0	31.6228	0.0083	1.0
		159	13.0 ± 2.0	31.6228	0.0083	1.0
	Chain 1	38	13.0 ± 2.0	31.6228	0.0083	1.0
		46	13.0 ± 2.0	31.6228	0.0083	1.0
		151	13.0 ± 2.0	31.6228	0.0083	1.0
		159	13.0 ± 2.0	31.6228	0.0083	1.0

Simultaneous transmission MPE

According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;
∑ of MPE ratios ≤ 1.0

2.4G WIFI**:**

Mode	Channel No.	Frequency (MHz)	∑ MPE ratios	Limit	Results
Chain 0+Chain 1+ Chain 2					
IEEE 802.11b	1	2412	N/A	1.000	Pass
	6	2442	N/A	1.000	Pass
	11	2462	N/A	1.000	Pass
IEEE 802.11g	1	2412	N/A	1.000	Pass
	6	2442	N/A	1.000	Pass
	11	2462	N/A	1.000	Pass
IEEE 802.11n HT20	1	2412	0.0208	1.000	Pass
	6	2442	0.0208	1.000	Pass
	11	2462	0.0208	1.000	Pass
IEEE 802.11n HT40	3	2422	0.0208	1.000	Pass
	6	2442	0.0208	1.000	Pass
	9	2452	0.0208	1.000	Pass

5G WIFI:

Mode	Channel No.	Frequency (MHz)	∑ MPE ratios	Limit	Results
Chain 0+Chain 1					
IEEE 802.11a	36	5180	N/A	1.000	Pass
	40	5200	N/A	1.000	Pass
	48	5240	N/A	1.000	Pass
	149	5745	N/A	1.000	Pass
	157	5785	N/A	1.000	Pass
	165	5825	N/A	1.000	Pass
IEEE 802.11n20	36	5180	0.0166	1.000	Pass
	40	5200	0.0166	1.000	Pass
	48	5240	0.0166	1.000	Pass
	149	5745	0.0166	1.000	Pass
	157	5785	0.0166	1.000	Pass
	165	5825	0.0166	1.000	Pass
IEEE 802.11n40	38	5190	0.0166	1.000	Pass
	46	5230	0.0166	1.000	Pass
	151	5755	0.0166	1.000	Pass
	159	5795	0.0166	1.000	Pass

Maximum Simultaneous transmission MPE Ratio for BT and 2.4GWIFI

Maximum MPE ratio BT	Maximum MPE ratio 2.4GWLAN	∑ MPE ratios	Limit	Results
0.0007	0.0208	0.0215	1.000	Pass

Maximum Simultaneous transmission MPE Ratio for BT and 5GWIFI

Maximum MPE ratio BT	Maximum MPE ratio 5GWLAN	∑ MPE ratios	Limit	Results
0.0007	0.0166	0.0173	1.000	Pass

Note: 1)The estimation distance is 20cm

2) 2.4GWIFI and 5GWIFI share the same antennas and can not transmit Simultaneously.

Conclusion

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

.....THE END OF REPORT.....