RF Exposure Evaluation

Limits

The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in 1.1307(b)

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 Exposures				
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
300–1500			f/300	6
1500–100,000			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
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz

Friis transmission formula: **$Pd = (Pout*G)/(4*pi*r^2)$**

Where

Pd = power density in mW/cm^2, **Pout** = output power to antenna in mW;

G = gain of antenna in linear scale, **Pi** = 3.1416;

R = distance between observation point and center of the radiator in cm

Pd id the limit of MPE, 1 mW/cm^2. If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

Test Procedure

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

Test Result of RF Exposure Evaluation

For BT BLE

Mode	Output power to antenna (dBm)	Tune UP tolerance (dBm)	Max Tune UP power (dBm)	Max Tune UP power (mW)	Power Density at R=20cm (mW/cm2)	Limit (mW/cm2)	Result
GFSK	2.586	2±1	3	2.00	0.000578	1.0	PASS

For BT EDR

Mode	Output power to antenna (dBm)	Tune UP tolerance (dBm)	Max Tune UP power (dBm)	Max Tune UP power (mW)	Power Density at R=20cm (mW/cm2)	Limit (mW/cm2)	Result
GFSK	3.424	3±1	4	2.51	0.000725	1.0	PASS
π/4-DQPSK	2.452	2±1	3	2.00	0.000578	1.0	PASS
8-DPSK	2.275	2±1	3	2.00	0.000578	1.0	PASS

Antenna1 gain for BT EDR/BLE: 1.65dBi

For 2.4G WIFI

Mode	Output power to antenna (dBm)	Tune UP tolerance (dBm)	Max Tune UP power (dBm)	Max Tune UP power (mW)	Power Density at R=20cm (mW/cm2)	Limit (mW/cm2)	Result
802.11b	10.584	10±1	11	12.59	0.003662	1.0	PASS
802.11g	13.571	13±1	14	25.12	0.007307	1.0	PASS
802.11n20	13.276	13±1	14	25.12	0.007307	1.0	PASS
802.11n40	13.663	13±1	14	25.12	0.007307	1.0	PASS
802.11ax20	13.972	13±1	14	25.12	0.007307	1.0	PASS
802.11ax40	14.037	14±1	15	31.62	0.009198	1.0	PASS

Antenna2 gain for: 2.4GWIFI: 1.65dBi

For 5.2G WIFI

Mode	Output power to antenna (dBm)	Tune UP tolerance (dBm)	Max Tune UP power (dBm)	Max Tune UP power (mW)	Power Density at R=20cm (mW/cm2)	Limit (mW/cm2)	Result
802.11a	7.02	7±1	8	6.31	0.002305	1.0	PASS
802.11n20	7.054	7±1	8	6.31	0.002305	1.0	PASS
802.11n40	7.112	7±1	8	6.31	0.002305	1.0	PASS
802.11ac20	7.102	7±1	8	6.31	0.002305	1.0	PASS
802.11ac40	7.069	7±1	8	6.31	0.002305	1.0	PASS
802.11ax20	6.805	7±1	8	6.31	0.002305	1.0	PASS
802.11ax40	6.732	7±1	8	6.31	0.002305	1.0	PASS

Antenna2 gain for: 5.2GWIFI: 2.64dBi

For 5.8G WIFI

Mode	Output power to antenna (dBm)	Tune UP tolerance (dBm)	Max Tune UP power (dBm)	Max Tune UP power (mW)	Power Density at R=20cm (mW/cm2)	Limit (mW/cm2)	Result
802.11a	8.171	8±1	9	7.94	0.002604	1.0	PASS
802.11n20	8.141	8±1	9	7.94	0.002604	1.0	PASS
802.11n40	7.795	7±1	8	6.31	0.002069	1.0	PASS
802.11ac20	8.184	8±1	9	7.94	0.002604	1.0	PASS
802.11ac40	7.876	7±1	8	6.31	0.002069	1.0	PASS
802.11ax20	8.013	8±1	9	7.94	0.002604	1.0	PASS
802.11ax40	7.605	7±1	8	6.31	0.002069	1.0	PASS

Antenna2 gain for: 5.8GWIFI: 2.17dBi

.

The same antenna cannot transmit at the same time, but ANT1 and ANT2 can transmit atthe same time, so the worst simultaneous transmntting corsideration:

The ratio = ANT1MPE(MAX) / limit + ANT2MPE(MAX) / limit

= 0.000725 / 1 + 0.009198 / 1

= 0.009923 < 1.0

So a SAR test is not required