8. RADIO FREQUENCY EXPOSURE

8.1. 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 4.0dBi (Max.)/ 2.51 (Numeric) when single antenna transmits.

Because signal is correlated, the maximum antenna gain when two antennas simultaneously transmit was 7.0dBi /5.01 (Numeric)by calculating.

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

3. Only record worst case data.

8.2 Test Results

5G WIFI

Test	Mode	Channel	ANT Power (dBm)	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	25.05	25.0±1.0	398.1072	0.199	1.0
		40	25.08	25.0±1.0	398.1072	0.199	1.0
		48	25.10	25.0±1.0	398.1072	0.199	1.0
		149	25.39	25.0±1.0	398.1072	0.199	1.0
		157	25.88	25.0±1.0	398.1072	0.199	1.0
		165	25.58	25.0±1.0	398.1072	0.199	1.0
	Chain 1	36	25.77	25.0±1.0	398.1072	0.199	1.0
		40	25.88	25.0±1.0	398.1072	0.199	1.0
		48	25.22	25.0±1.0	398.1072	0.199	1.0
		149	25.96	25.0±1.0	398.1072	0.199	1.0
		157	25.39	25.0±1.0	398.1072	0.199	1.0
		165	25.08	25.0±1.0	398.1072	0.199	1.0
	Chain 2	36	25.79	25.0±1.0	398.1072	0.199	1.0
		40	25.12	25.0±1.0	398.1072	0.199	1.0
		48	25.48	25.0±1.0	398.1072	0.199	1.0
		149	25.00	25.0±1.0	398.1072	0.199	1.0
		157	25.79	25.0±1.0	398.1072	0.199	1.0
		165	25.03	25.0±1.0	398.1072	0.199	1.0
	Chain 3	36	25.34	25.0±1.0	398.1072	0.199	1.0
		40	25.96	25.0±1.0	398.1072	0.199	1.0
		48	25.77	25.0±1.0	398.1072	0.199	1.0
		149	25.49	25.0±1.0	398.1072	0.199	1.0
		157	25.72	25.0±1.0	398.1072	0.199	1.0
		165	25.56	25.0±1.0	398.1072	0.199	1.0

Test	Mode	Channel	ANT Power (dBm)	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	25.40	25.0±1.0	398.1072	**0.199**	1.0
		40	25.55	25.0±1.0	398.1072	**0.199**	1.0
		48	25.61	25.0±1.0	398.1072	**0.199**	1.0
		149	25.27	25.0±1.0	398.1072	**0.199**	1.0
		157	25.15	25.0±1.0	398.1072	**0.199**	1.0
		165	25.40	25.0±1.0	398.1072	**0.199**	1.0
	Chain 1	36	25.80	25.0±1.0	398.1072	**0.199**	1.0
		40	25.77	25.0±1.0	398.1072	**0.199**	1.0
		48	25.18	25.0±1.0	398.1072	**0.199**	1.0
		149	25.58	25.0±1.0	398.1072	**0.199**	1.0
		157	25.13	25.0±1.0	398.1072	**0.199**	1.0
		165	25.87	25.0±1.0	398.1072	**0.199**	1.0
	Chain 0+Chain 1	36	**MPE(Chain0)+MPE(Chain1)**			**0.398**	1.0
		40				**0.398**	1.0
		48				**0.398**	1.0
		149				**0.398**	1.0
		157				**0.398**	1.0
		165				**0.398**	1.0
	Chain 2	36	25.28	25.0±1.0	398.1072	**0.199**	1.0
		40	25.84	25.0±1.0	398.1072	**0.199**	1.0
		48	25.56	25.0±1.0	398.1072	**0.199**	1.0
		149	25.30	25.0±1.0	398.1072	**0.199**	1.0
		157	25.21	25.0±1.0	398.1072	**0.199**	1.0
		165	25.99	25.0±1.0	398.1072	**0.199**	1.0
	Chain 3	36	25.53	25.0±1.0	398.1072	**0.199**	1.0
		40	25.03	25.0±1.0	398.1072	**0.199**	1.0
		48	25.55	25.0±1.0	398.1072	**0.199**	1.0
		149	25.86	25.0±1.0	398.1072	**0.199**	1.0
		157	25.34	25.0±1.0	398.1072	**0.199**	1.0
		165	25.45	25.0±1.0	398.1072	**0.199**	1.0
	Chain 2+Chain 3	36	**MPE(Chain2)+MPE(Chain3)**			**0.398**	1.0
		40				**0.398**	1.0
		48				**0.398**	1.0
		149				**0.398**	1.0
		157				**0.398**	1.0
		165				**0.398**	1.0

Test	Mode	Channel	ANT Power (dBm)	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	25.67	25.0±1.0	398.1072	**0.199**	1.0
		46	25.33	25.0±1.0	398.1072	**0.199**	1.0
		151	24.95	25.0±1.0	398.1072	**0.199**	1.0
		159	24.70	25.0±1.0	398.1072	**0.199**	1.0
	Chain 1	38	25.42	25.0±1.0	398.1072	**0.199**	1.0
		46	25.53	25.0±1.0	398.1072	**0.199**	1.0
		151	24.15	25.0±1.0	398.1072	**0.199**	1.0
		159	24.95	25.0±1.0	398.1072	**0.199**	1.0
	Chain 0+Chain 1	38	**MPE(Chain0)+MPE(Chain1)**			**0.398**	1.0
		46				**0.398**	1.0
		151				**0.398**	1.0
		159				**0.398**	1.0
	Chain 2	38	25.47	25.0±1.0	398.1072	**0.199**	1.0
		46	25.07	25.0±1.0	398.1072	**0.199**	1.0
		151	24.12	25.0±1.0	398.1072	**0.199**	1.0
		159	24.73	25.0±1.0	398.1072	**0.199**	1.0
	Chain 3	38	25.52	25.0±1.0	398.1072	**0.199**	1.0
		46	25.94	25.0±1.0	398.1072	**0.199**	1.0
		151	24.98	25.0±1.0	398.1072	**0.199**	1.0
		159	24.39	25.0±1.0	398.1072	**0.199**	1.0
	Chain 2+Chain 3	38	**MPE(Chain2)+MPE(Chain3)**			**0.398**	1.0
		46				**0.398**	1.0
		151				**0.398**	1.0
		159				**0.398**	1.0

2.4G wifi:

Test	Mode	Channel	ANT Power (dBm)	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	25.86	25.0±1.0	398.1072	0.199	1.0
		6	25.93	25.0±1.0	398.1072	0.199	1.0
		11	25.80	25.0±1.0	398.1072	0.199	1.0
	Chain 1	1	25.73	25.0±1.0	398.1072	0.199	1.0
		6	25.92	25.0±1.0	398.1072	0.199	1.0
		11	25.71	25.0±1.0	398.1072	0.199	1.0
	Chain 2	1	25.21	25.0±1.0	398.1072	0.199	1.0
		6	25.31	25.0±1.0	398.1072	0.199	1.0
		11	25.32	25.0±1.0	398.1072	0.199	1.0
	Chain 3	1	25.59	25.0±1.0	398.1072	0.199	1.0
		6	25.61	25.0±1.0	398.1072	0.199	1.0
		11	25.59	25.0±1.0	398.1072	0.199	1.0

Test	Mode	Channel	ANT Power (dBm)	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	25.20	25.0±1.0	398.1072	0.199	1.0
		6	25.43	25.0±1.0	398.1072	0.199	1.0
		11	25.14	25.0±1.0	398.1072	0.199	1.0
	Chain 1	1	25.40	25.0±1.0	398.1072	0.199	1.0
		6	25.21	25.0±1.0	398.1072	0.199	1.0
		11	25.39	25.0±1.0	398.1072	0.199	1.0
	Chain 2	1	25.33	25.0±1.0	398.1072	0.199	1.0
		6	25.33	25.0±1.0	398.1072	0.199	1.0
		11	25.18	25.0±1.0	398.1072	0.199	1.0
	Chain 3	1	25.16	25.0±1.0	398.1072	0.199	1.0
		6	25.08	25.0±1.0	398.1072	0.199	1.0
		11	25.21	25.0±1.0	398.1072	0.199	1.0

Test	Mode	Channel	ANT Power (dBm)	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	25.45	25.0±1.0	398.1072	**0.199**	1.0
		6	25.14	25.0±1.0	398.1072	**0.199**	1.0
		11	25.23	25.0±1.0	398.1072	**0.199**	1.0
	Chain 1	1	25.10	25.0±1.0	398.1072	**0.199**	1.0
		6	25.26	25.0±1.0	398.1072	**0.199**	1.0
		11	25.26	25.0±1.0	398.1072	**0.199**	1.0
	Chain 0+Chain 1	1	**MPE(Chain0)+MPE(Chain1)**			**0.398**	1.0
		6				**0.398**	1.0
		11				**0.398**	1.0
	Chain 2	1	25.27	25.0±1.0	398.1072	**0.199**	1.0
		6	25.03	25.0±1.0	398.1072	**0.199**	1.0
		11	25.15	25.0±1.0	398.1072	**0.199**	1.0
	Chain 3	1	25.05	25.0±1.0	398.1072	**0.199**	1.0
		6	25.24	25.0±1.0	398.1072	**0.199**	1.0
		11	25.11	25.0±1.0	398.1072	**0.199**	1.0
	Chain 2+Chain 3	1	**MPE(Chain2)+MPE(Chain3)**			**0.398**	1.0
		6				**0.398**	1.0
		11				**0.398**	1.0

Test	Mode	Channel	ANT Power (dBm)	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	24.68	25.0±1.0	398.1072	**0.199**	1.0
		6	24.76	25.0±1.0	398.1072	**0.199**	1.0
		9	24.60	25.0±1.0	398.1072	**0.199**	1.0
	Chain 1	3	24.21	25.0±1.0	398.1072	**0.199**	1.0
		6	24.41	25.0±1.0	398.1072	**0.199**	1.0
		9	24.88	25.0±1.0	398.1072	**0.199**	1.0
	Chain 0+Chain 1	3	**MPE(Chain0)+MPE(Chain1)**			**0.398**	1.0
		6				**0.398**	1.0
		9				**0.398**	1.0
	Chain 2	3	24.49	25.0±1.0	398.1072	**0.199**	1.0
		6	24.81	25.0±1.0	398.1072	**0.199**	1.0
		9	24.84	25.0±1.0	398.1072	**0.199**	1.0
	Chain 3	3	24.54	25.0±1.0	398.1072	**0.199**	1.0
		6	24.61	25.0±1.0	398.1072	**0.199**	1.0
		9	24.71	25.0±1.0	398.1072	**0.199**	1.0
	Chain 2+Chain 3	3	**MPE(Chain2)+MPE(Chain3)**			**0.398**	1.0
		6				**0.398**	1.0
		9				**0.398**	1.0

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

Note: The estimation distance is 20cm, π=3.14

Conclusion

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