

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 2.0dBi(Max.).
2. Manufacturer declared that the nearest distance between human and the EUT is 20cm.
3. Only record worst case data.

Bluetooth

Test Mode	Channel	Frequency (MHz)	ANT Power (dBm)	ANT Power Tune Up (dBm)
BLE	Low	2402	-2.08	-3.0 \pm 1.0
	Middle	2440	-2.27	-3.0 \pm 1.0
	High	2480	-2.08	-3.0 \pm 1.0
GFSK	Low	2402	5.48	5 \pm 1.0
	Middle	2441	5.57	5 \pm 1.0
	High	2480	5.94	5 \pm 1.0
π /4-DQPSK	Low	2402	4.56	4 \pm 1.0
	Middle	2441	4.74	4 \pm 1.0
	High	2480	4.86	4 \pm 1.0
8-DPSK	Low	2402	4.32	4 \pm 1.0
	Middle	2441	4.54	4 \pm 1.0
	High	2480	4.81	4 \pm 1.0

WIFI

Test Mode	Channel	Frequency (MHz)	ANT Power (dBm)	ANT Power Tune Up (dBm)
802.11b	Low	2412	14.17	14.0 \pm 1.0
	Middle	2437	14.34	14.0 \pm 1.0
	High	2462	14.22	14.0 \pm 1.0
802.11g	Low	2412	12.67	13.0 \pm 1.0
	Middle	2437	12.81	13.0 \pm 1.0
	High	2462	12.53	13.0 \pm 1.0
802.11n HT20	Low	2412	11.25	11.0 \pm 1.0
	Middle	2437	11.41	11.0 \pm 1.0
	High	2462	11.58	11.0 \pm 1.0

GSM

Mode	Channel	Frequency (MHz)	ANT Power (dBm)	ANT Power Tune Up (dBm)
GSM 850	Low	824.2	32.42	32.00 \pm 1.0
	Middle	836.6	32.71	32.00 \pm 1.0
	High	848.8	32.56	32.00 \pm 1.0
GPRS 850 (1 uplink), GMSK	Low	824.2	31.96	32.00 \pm 1.0
	Middle	836.6	31.90	32.00 \pm 1.0
	High	848.8	32.03	32.00 \pm 1.0
GPRS 850 (2 uplink), GMSK	Low	824.2	30.52	30.00 \pm 1.0
	Middle	836.6	30.59	30.00 \pm 1.0
	High	848.8	30.47	30.00 \pm 1.0
GPRS 850 (4 uplink), GMSK	Low	824.2	27.34	27.00 \pm 1.0
	Middle	836.6	27.40	27.00 \pm 1.0
	High	848.8	27.34	27.00 \pm 1.0

Mode	Channel	Frequency (MHz)	ANT Power (dBm)	ANT Power Tune Up (dBm)
PCS 1900	Low	1850.2	29.73	29.00 \pm 1.0
	Middle	1880.0	29.76	29.00 \pm 1.0
	High	1909.8	29.67	29.00 \pm 1.0
GPRS 1900 (1 uplink), GMSK	Low	1850.2	29.42	29.00 \pm 1.0
	Middle	1880.0	29.48	29.00 \pm 1.0
	High	1909.8	29.44	29.00 \pm 1.0
GPRS 1900 (2 uplink), GMSK	Low	1850.2	27.82	28.00 \pm 1.0
	Middle	1880.0	27.89	28.00 \pm 1.0
	High	1909.8	27.72	28.00 \pm 1.0
GPRS 1900 (4 uplink), GMSK	Low	1850.2	24.19	24.00 \pm 1.0
	Middle	1880.0	24.25	24.00 \pm 1.0
	High	1909.8	24.15	24.00 \pm 1.0

Mode	Channel	Frequency (MHz)	ANT Power (dBm)	ANT Power Tune Up (dBm)
WCDMA Band V RMC 12.2K	Low	826.4	22.64	22.00 \pm 1.0
	Middle	836.6	22.73	22.00 \pm 1.0
	High	846.6	22.34	22.00 \pm 1.0
HSDPA Subtest 1	Low	826.4	22.45	22.00 \pm 1.0
	Middle	836.6	22.51	22.00 \pm 1.0
	High	846.6	22.32	22.00 \pm 1.0
HSDPA Subtest 2	Low	826.4	21.66	21.00 \pm 1.0
	Middle	836.6	21.70	21.00 \pm 1.0
	High	846.6	21.65	21.00 \pm 1.0
HSDPA Subtest 3	Low	826.4	20.93	21.00 \pm 1.0
	Middle	836.6	21.25	21.00 \pm 1.0
	High	846.6	21.13	21.00 \pm 1.0
HSDPA Subtest 4	Low	826.4	20.63	20.00 \pm 1.0
	Middle	836.6	20.69	20.00 \pm 1.0
	High	846.6	20.65	20.00 \pm 1.0
HSUPA Subtest 1	Low	826.4	21.70	21.00 \pm 1.0
	Middle	836.6	21.50	21.00 \pm 1.0
	High	846.6	21.68	21.00 \pm 1.0
HSUPA Subtest 2	Low	826.4	21.40	21.00 \pm 1.0
	Middle	836.6	21.39	21.00 \pm 1.0
	High	846.6	21.39	21.00 \pm 1.0
HSUPA Subtest 3	Low	826.4	21.09	21.00 \pm 1.0
	Middle	836.6	21.21	21.00 \pm 1.0
	High	846.6	21.11	21.00 \pm 1.0
HSUPA Subtest 4	Low	826.4	20.93	21.00 \pm 1.0
	Middle	836.6	21.14	21.00 \pm 1.0
	High	846.6	21.05	21.00 \pm 1.0
HSUPA Subtest 5	Low	826.4	21.44	21.00 \pm 1.0
	Middle	836.6	21.59	21.00 \pm 1.0
	High	846.6	21.48	21.00 \pm 1.0

Mode	Channel	Frequency (MHz)	ANT Power (dBm)	ANT Power Tune Up (dBm)
WCDMA Band II RMC 12.2K	Low	1852.4	22.64	22.00 \pm 1.0
	Middle	1880.0	22.78	22.00 \pm 1.0
	High	1907.6	22.25	22.00 \pm 1.0
HSDPA Subtest 1	Low	1852.4	22.07	22.00 \pm 1.0
	Middle	1880.0	22.21	22.00 \pm 1.0
	High	1907.6	22.11	22.00 \pm 1.0
HSDPA Subtest 2	Low	1852.4	21.89	22.00 \pm 1.0
	Middle	1880.0	21.86	22.00 \pm 1.0
	High	1907.6	21.80	22.00 \pm 1.0
HSDPA Subtest 3	Low	1852.4	21.57	21.00 \pm 1.0
	Middle	1880.0	21.70	21.00 \pm 1.0
	High	1907.6	21.67	21.00 \pm 1.0
HSDPA Subtest 4	Low	1852.4	21.14	21.00 \pm 1.0
	Middle	1880.0	21.20	21.00 \pm 1.0
	High	1907.6	21.11	21.00 \pm 1.0
HSUPA Subtest 1	Low	1852.4	22.72	23.00 \pm 1.0
	Middle	1880.0	22.91	23.00 \pm 1.0
	High	1907.6	22.85	23.00 \pm 1.0
HSUPA Subtest 2	Low	1852.4	22.10	22.00 \pm 1.0
	Middle	1880.0	22.07	22.00 \pm 1.0
	High	1907.6	22.06	22.00 \pm 1.0
HSUPA Subtest 3	Low	1852.4	21.58	22.00 \pm 1.0
	Middle	1880.0	21.67	22.00 \pm 1.0
	High	1907.6	21.63	22.00 \pm 1.0
HSUPA Subtest 4	Low	1852.4	21.04	21.00 \pm 1.0
	Middle	1880.0	21.08	21.00 \pm 1.0
	High	1907.6	21.07	21.00 \pm 1.0
HSUPA Subtest 5	Low	1852.4	22.59	22.00 \pm 1.0
	Middle	1880.0	22.69	22.00 \pm 1.0
	High	1907.6	22.59	22.00 \pm 1.0

8.2 Test Results

Bluetooth

Test Mode	Channel	ANT Max. Tune Up Power (mW)	ANT MPE (mW/cm ²)	Limit (mW/cm ²)
BLE	Low	0.6310	0.000177	1.0
	Middle	0.6310	0.000177	1.0
	High	0.6310	0.000177	1.0
GFSK	Low	3.9811	0.001117	1.0
	Middle	3.9811	0.001117	1.0
	High	3.9811	0.001117	1.0
$\pi/4$ -DQPSK	Low	3.1623	0.000887	1.0
	Middle	3.1623	0.000887	1.0
	High	3.1623	0.000887	1.0
8-DPSK	Low	3.1623	0.000887	1.0
	Middle	3.1623	0.000887	1.0
	High	3.1623	0.000887	1.0

Antenna Gain (typical): 1.5dBi, 1.41(numeric)

Prediction distance: ≥ 20 cm

The power density level worst case at 20 cm is below the uncontrolled exposure limit.

WIFI

Test Mode	Channel	ANT Max. Tune Up Power (mW)	ANT MPE (mW/cm ²)	Limit (mW/cm ²)
802.11b	Low	31.6228	0.008870	1.0
	Middle	31.6228	0.008870	1.0
	High	31.6228	0.008870	1.0
802.11g	Low	25.1189	0.007046	1.0
	Middle	25.1189	0.007046	1.0
	High	25.1189	0.007046	1.0
802.11n HT20	Low	15.8489	0.004446	1.0
	Middle	15.8489	0.004446	1.0
	High	15.8489	0.004446	1.0

Antenna Gain (typical): 1.5dBi, 1.41(numeric)

Prediction distance: >=20cm

The power density level worst case at 20 cm is below the uncontrolled exposure limit.

Mode	Channel	ANT Max. Tune Up Power (mW)	ANT MPE (mW/cm ²)	Limit (mW/cm ²)
GSM 850	Low	1995.3	0.39695	1.0
	Middle	1995.3	0.39695	1.0
	High	1995.3	0.39695	1.0
GPRS 850 (1 uplink), GMSK	Low	1995.3	0.39695	1.0
	Middle	1995.3	0.39695	1.0
	High	1995.3	0.39695	1.0
GPRS 850 (2 uplink), GMSK	Low	1258.9	0.25045	1.0
	Middle	1258.9	0.25045	1.0
	High	1258.9	0.25045	1.0
GPRS 850 (4 uplink), GMSK	Low	631.0	0.12553	1.0
	Middle	631.0	0.12553	1.0
	High	631.0	0.12553	1.0

Mode	Channel	ANT Max. Tune Up Power (mW)	ANT MPE (mW/cm ²)	Limit (mW/cm ²)
PCS 1900	Low	1000	0.19894	1.0
	Middle	1000	0.19894	1.0
	High	1000	0.19894	1.0
GPRS 1900 (1 uplink), GMSK	Low	1000	0.19894	1.0
	Middle	1000	0.19894	1.0
	High	1000	0.19894	1.0
GPRS 1900 (2 uplink), GMSK	Low	794.3	0.15802	1.0
	Middle	794.3	0.15802	1.0
	High	794.3	0.15802	1.0
GPRS 1900 (4 uplink), GMSK	Low	316.2	0.06291	1.0
	Middle	316.2	0.06291	1.0
	High	316.2	0.06291	1.0

Antenna Gain (typical): 0dBi, 1.0(numeric)

Prediction distance: >=20cm

The power density level worst case at 20 cm is below the uncontrolled exposure limit.

Mode	Channel	ANT Max. Tune Up Power (mW)	ANT MPE (mW/cm ²)	Limit (mW/cm ²)
WCDMA Band V RMC 12.2K	Low	199.5	0.03135	1.0
	Middle	199.5	0.03135	1.0
	High	199.5	0.03135	1.0
HSDPA Subtest 1	Low	199.5	0.03135	1.0
	Middle	199.5	0.03135	1.0
	High	199.5	0.03135	1.0
HSDPA Subtest 2	Low	158.5	0.02491	1.0
	Middle	158.5	0.02491	1.0
	High	158.5	0.02491	1.0
HSDPA Subtest 3	Low	158.5	0.02491	1.0
	Middle	158.5	0.02491	1.0
	High	158.5	0.02491	1.0
HSDPA Subtest 4	Low	125.9	0.01979	1.0
	Middle	125.9	0.01979	1.0
	High	125.9	0.01979	1.0
HSUPA Subtest 1	Low	158.5	0.02491	1.0
	Middle	158.5	0.02491	1.0
	High	158.5	0.02491	1.0
HSUPA Subtest 2	Low	158.5	0.02491	1.0
	Middle	158.5	0.02491	1.0
	High	158.5	0.02491	1.0
HSUPA Subtest 3	Low	158.5	0.02491	1.0
	Middle	158.5	0.02491	1.0
	High	158.5	0.02491	1.0
HSUPA Subtest 4	Low	158.5	0.02491	1.0
	Middle	158.5	0.02491	1.0
	High	158.5	0.02491	1.0
HSUPA Subtest 5	Low	158.5	0.02491	1.0
	Middle	158.5	0.02491	1.0
	High	158.5	0.02491	1.0

Mode	Channel	ANT Max. Tune Up Power (mW)	ANT MPE (mW/cm ²)	Limit (mW/cm ²)
WCDMA Band II RMC 12.2K	Low	199.5	0.03135	1.0
	Middle	199.5	0.03135	1.0
	High	199.5	0.03135	1.0
HSDPA Subtest 1	Low	199.5	0.03135	1.0
	Middle	199.5	0.03135	1.0
	High	199.5	0.03135	1.0
HSDPA Subtest 2	Low	199.5	0.03135	1.0
	Middle	199.5	0.03135	1.0
	High	199.5	0.03135	1.0
HSDPA Subtest 3	Low	158.5	0.02491	1.0
	Middle	158.5	0.02491	1.0
	High	158.5	0.02491	1.0
HSDPA Subtest 4	Low	158.5	0.02491	1.0
	Middle	158.5	0.02491	1.0
	High	158.5	0.02491	1.0
HSUPA Subtest 1	Low	251.2	0.03948	1.0
	Middle	251.2	0.03948	1.0
	High	251.2	0.03948	1.0
HSUPA Subtest 2	Low	199.5	0.03135	1.0
	Middle	199.5	0.03135	1.0
	High	199.5	0.03135	1.0
HSUPA Subtest 3	Low	199.5	0.03135	1.0
	Middle	199.5	0.03135	1.0
	High	199.5	0.03135	1.0
HSUPA Subtest 4	Low	158.5	0.02491	1.0
	Middle	158.5	0.02491	1.0
	High	158.5	0.02491	1.0
HSUPA Subtest 5	Low	199.5	0.03135	1.0
	Middle	199.5	0.03135	1.0
	High	199.5	0.03135	1.0

Antenna Gain (typical): -1.0dBi, 0.79(numeric)

Prediction distance: >=20cm

The power density level worst case at 20 cm is below the uncontrolled exposure limit.