5.7. RF EXPOSURE REQUIRMENTS [§§ 15.247(i), 1.1310 & 2.1091]

5.7.1. Limits

§ **1.1310:** The criteria listed in the following table shall be used to evaluate the environmental 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
* = Plane-wave equivalent power density

Note 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

Note 2: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

5.7.2. Method of Measurements

Calculation Method of Power Density/RF Safety Distance:

$$S = \frac{PG}{4\pi \cdot r^2} = \frac{EIRP}{4\pi \cdot r^2}$$

Where, P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power.
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

5.7.3. RF Evaluation

Pursuant to KDB 447498 D01 General RF Exposure Guidance v06, Section 7.2:

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneously transmitting antennas incorporated in a host device is ≤ 1.0, according to calculated/estimated, numerically modeled, or measured field strengths or power density.

The maximum calculated MPE ratio of the EUT with 4.4 dBi antenna						
Frequency (MHz)	**EUT EIRP (dBm)**	**EUT EIRP (mW)**	**Evaluation Distance (cm)**	**Power Density (mW/cm^2)**	**FCC MPE Limit (mW/cm^2)**	**MPE Ratio**
2402	16.16	41.305	20	0.008	1.0	0.008

The maximum calculated MPE ratio for the EUT with 4.4 dBi antenna is 0.008, this configuration can be co-located with other antennas provided the sum of the MPE ratios for all the other simultaneous transmitting antennas incorporated in a host device is ≤ 1.0 - 0.008 ≤ 0. 0.992.

The following table addresses the co-location of the EUT with 4.4 dBi antenna and u-blox AG Cellular Module (FCC ID: XPY2AGQN4NNN, IC: 8595A-2AGQN4NNN)

EUT Co-located with u-blox AG Cellular Module (FCC ID: XPY2AGQN4NNN, IC: 8595A-2AGQN4NNN)										
Frequency Band (MHz)	**Frequency (MHz)**	**Conducted Output Power (mW)**	**[1]Conducted Output Power (dBm)**	**[2]Antenna Gain (dBi)**	**Max EUT EIRP (dBm)**	**Max EUT EIRP (mW)**	**Evaluation Distance (cm)**	**Power Density (mW/cm^2)**	**Power Density FCC Limit (mW/cm^2)**	**FCC Power Density MPE Ratio**
1850-1910	1850	316	25.00	7.12	32.12	1629.30	20	0.324	1.000	**0.324**
1710-1755	1710	316	25.00	6.74	31.74	1492.79	20	0.297	1.000	0.297
824-849	824	316	25.00	4.10	29.10	812.83	20	0.162	0.549	0.294
699-716	699	316	25.00	3.67	28.67	736.21	20	0.146	0.466	0.314
2402-2480 (EUT)	2402	15	11.76	4.4	16.16	41.30	20	0.008	1.000	**0.008**
Worst case sum of the MPE ratios for all simultaneously transmitting antennas:										**0.332**

[1] Conducted output power derived from u-blox AG Cellular Module (FCC ID: XPY2AGQN4NNN, IC: 8595A-2AGQN4NNN) filing.
[2] Maximum antenna gain permitted to be used with u-blox AG Cellular Module (FCC ID: XPY2AGQN4NNN, IC: 8595A-2AGQN4NNN) and EUT in this co-location evaluation.

The following table addresses the co-location of the EUT with 4.4 dBi antenna and General Cellular Module

EUT Co-located with General Cellular Module										
Frequency Band (MHz)	**Frequency (MHz)**	**Conducted Output Power (mW)**	**Conducted Output Power (dBm)**	**Antenna Gain (dBi)**	**Max EUT EIRP (dBm)**	**Max EUT EIRP (mW)**	**Evaluation Distance (cm)**	**Power Density (mW/cm^2)**	**Power Density FCC Limit (mW/cm^2)**	**FCC Power Density MPE Ratio**
1850-1915	1850	316	25.00	8	33.00	1995.26	20	0.397	1.000	0.397
1710-1755	1710	316	25.00	7	32.00	1584.89	20	0.315	1.000	0.315
814-849	814	316	25.00	5	30.00	1000.00	20	0.199	0.543	0.367
699-716	699	316	25.00	5	30.00	1000.00	20	0.199	0.466	0.427
777-787	777	316	25.00	5.5	30.50	1122.02	20	0.223	0.518	**0.431**
2402-2480 (EUT)	2402	15	11.76	4.4	16.16	41.30	20	0.008	1.000	**0.008**
Worst case sum of the MPE ratios for all simultaneously transmitting antennas:										**0.439**