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 FCC 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 EUT consisted of a BLE Module and a certified Telit Communications S.p.A. Data Terminal Module (FCC ID: RI7ME310G1WW, IC: 5131A-ME310G1WW). The Telit Data Terminal Module basic operation modes are GPRS/EGPRS, eMTC and NB-IoT, these modes cannot transmit simultaneous. The table below is a summary of the calculated MPE ratios for co-location at an evaluation distance of 25 cm.

Source	Maximum MPE Ratio
BLE module	0.002
Telit Communications S.p.A. data terminal module	0.641

The sum of the MPE ratios from all sources = 0.002 + 0.641 = 0.643 < 1. Thus, in compliant with general population/uncontrolled exposure MPE limit.

For detailed MPE ratio calculation for BLE Module and Telit Communications S.p.A. Data Terminal Module, refer to the following tables.

Calculated MPE Ratio for EUT with 4.0 dBi Antenna						
Frequency (MHz)	EUT EIRP (dBm)	EUT EIRP (mW)	Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)	MPE Ratio
2402	11.40	13.804	25	0.002	1.0	**0.002**

Calculated MPE Ratio for Telit Data Terminal Module Operating in NB-IoT and eMTC Modes										
Operating Mode	**Band**	**[1]Measured Power (dBm)**	**[1]Max. Power incl. tune-up (dBm)**	**[2]Antenna Gain (dBi)**	**Max. E.I.R.P. (dBm)**	**Max. E.I.R.P. (mW)**	**Evaluation Distance (cm)**	**Power Density (mW/cm^2)**	**[1]MPE Limit (mW/cm^2)**	**MPE Ratio**
NB-IoT	2	24.5	25	8.0	33.0	1995.26	25	0.254	1.0	0.254
	4	24.6	25	5.0	30.0	1000.00	25	0.127	1.0	0.127
	5	24.8	25	9.4	34.4	2754.23	25	0.351	0.549	0.639
	12	24.9	25	8.7	33.7	2344.23	25	0.298	0.466	**0.641**
	13	25.0	25	9.1	34.1	2570.40	25	0.327	0.518	0.632
	25	24.4	25	8.0	33.0	1995.26	25	0.254	1.0	0.254
	26	25.0	25	9.3	34.3	2691.53	25	0.343	0.543	0.631
	66	24.7	25	5.0	30.0	1000.00	25	0.127	1.0	0.127
	71	20.7	22	11.4	33.4	2187.76	25	0.279	0.442	0.630
	85	24.9	25	8.6	33.6	2290.87	25	0.292	1.0	0.292
eMTC	2	23.5	24	8.0	32	1584.89	25	0.202	1.0	0.202
	4	23.5	24	5.0	29	794.33	25	0.101	1.0	0.101
	5	23	24	9.5	33.5	2238.72	25	0.285	0.549	**0.519**
	12	23	24	8.7	32.7	1862.09	25	0.237	0.466	0.509
	13	23.6	24	9.1	33.1	2041.74	25	0.260	0.518	0.502
	25	24	24	8.0	32	1584.89	25	0.202	1.0	0.202
	26	23.2	24	9.3	33.3	2137.96	25	0.272	0.543	0.501
	66	23.5	24	5.0	29	794.33	25	0.101	1.0	0.101
	85	23.2	24	8.6	32.6	1819.70	25	0.232	0.465	0.498

[1] Data derived from Telit Communications S.p.A. Data Terminal Module RF exposure evaluation test report, Test Report No. 60356613 004 (FCC ID: RI7ME310G1WW, IC: 5131A-ME310G1WW).

[2] Maximum permitted antenna gain.

Calculated MPE Ratio for Telit Data Terminal Module Operating in Private Network in NB-IoT Configuration									
Operating Mode	**Band**	**Frequency (MHz)**	**Max Conducted EUT Power (dBm)**	**Maximum Antenna Gain (dBi)**	**Averaged Max EUT EIRP (mW)**	**Evaluation Distance (cm)**	**Power Density (mW/cm^2)**	**Power Density FCC Limit (mW/cm2)**	**FCC Power Density MPE Ratio**
NB-IoT	8_39D 897.5-900.5 MHz	897.5	25	8.9	2454.709	25	0.313	0.598	**0.523**

Calculated MPE ratio for Telit Data Terminal Module Operating in GPRS and EGPRS Modes											
Operating Mode	**Band**	**[2] Measured Power (dBm)**	**[2] Max. Power incl. tune- up (dBm)**	**[1] Division factor (dB)**	**[3] Antenna Gain (dBi)**	**Max. E.I.R.P. (dBm)**	**Max. E.I.R.P. (mW)**	**Evaluation Distance (cm)**	**Power Density (mW/cm^2)**	**[2] MPE Limit (mW/cm^2)**	**MPE Ratio**
GPRS	850(1slot)	32.3	33.5	-9.03	6.9	31.37	1370.88	25	0.175	0.549	0.318
	850(2slots)	31.7	33.5	-6.02	6.9	34.38	2741.57	25	0.349	0.549	**0.636**
	850(3slots)	28.8	30	-4.26	6.9	32.64	1836.54	25	0.234	0.549	0.426
	850(4slots)	26.8	28	-3.01	6.9	31.89	1545.25	25	0.197	0.549	0.358
	1900(1slot)	30.2	30.5	-9.03	2.5	23.97	249.46	25	0.032	1.0	0.032
	1900(2slots)	28.9	30.5	-6.02	2.5	26.98	498.88	25	0.064	1.0	0.064
	1900(3slots)	28.1	30	-4.26	2.5	28.24	666.81	25	0.085	1.0	0.085
	1900(4slots)	27.2	29	-3.01	2.5	28.49	706.32	25	0.090	1.0	0.090
EGPRS	850(1slot)	26.8	28	-9.03	6.9	25.87	386.37	25	0.049	0.549	0.090
	850(2slots)	26.4	28	-6.02	6.9	28.88	772.68	25	0.098	0.549	0.179
	850(3slots)	26.3	28	-4.26	6.9	30.64	1158.78	25	0.148	0.549	0.269
	850(4slots)	26.1	27	-3.01	6.9	30.89	1227.44	25	0.156	0.549	**0.285**
	1900(1slot)	26.1	27	-9.03	2.5	20.47	111.43	25	0.014	1.0	0.014
	1900(2slots)	26	27	-6.02	2.5	23.48	222.84	25	0.028	1.0	0.028
	1900(3slots)	25.8	27	-4.26	2.5	25.24	334.20	25	0.043	1.0	0.043
	1900(4slots)	25.1	27	-3.01	2.5	26.49	445.66	25	0.057	1.0	0.057

[1] Division factors, 1Tx slot = 1 transmit time slot out of 8 time slots= -9.03dB; 2Tx slots= 2 transmit time slots out of 8 time slots= - 6.02dB; 3Tx slots= 3 transmit time slots out of 8 time slots= -4.26dB; 4Tx slots= 4 transmit time slots out of 8 time slots= -3.01dB

[2] Data derived from Telit Communications S.p.A. Data Terminal Module RF exposure evaluation test report, Test Report No. 60356613 004 (FCC ID: RI7ME310G1WW, IC: 5131A-ME310G1WW).

[3] Maximum permitted antenna gain.