

**5.10. RF EXPOSURE REQUIRMENTS [§§ 15.247(i), 1.1310 & 2.1091] RSS Gen 3.4, RSS 102**

§ 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 <sup>2</sup> )	Averaging time (minutes)
<b>(A) Limits for Occupational/Controlled Exposures</b>				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
<b>(B) Limits for General Population/Uncontrolled Exposure</b>				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	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.

**(RF) radiation as specified in RSS-102**

**Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)**

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m <sup>2</sup> )	Reference Period (minutes)
300-6000	3.142 $f^{0.3417}$	0.008335 $f^{0.3417}$	0.02619 $f^{0.6834}$	6
<b>Note:</b> f is frequency in MHz.				

### 5.10.1. 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<sup>2</sup>  
G: numeric gain of antenna relative to isotropic radiator  
r: distance to centre of radiation in cm

### 5.10.2. RF Evaluation

#### 5.10.2.1. Standalone

##### FCC

Frequency (MHz)	EIRP (dBm)	EIRP (mW)	Evaluation Distance, r (cm)	Power Density, S (mW/cm <sup>2</sup> )	FCC MPE Limit (mW/cm <sup>2</sup> )	Margin (mW/cm <sup>2</sup> )
902.4	36	3981.072	38	0.219	0.602	-0.382

##### ISED

Frequency (MHz)	EIRP (dBm)	EIRP (mW)	Evaluation Distance, r (cm)	Power Density, S (mW/cm <sup>2</sup> )	ISED MPE Limit (mW/cm <sup>2</sup> )	Margin (mW/cm <sup>2</sup> )
902.4	36	3981.072	38	0.219	0.274	-0.055

#### 5.10.2.2. Co-location

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.*

##### FCC

Co-location will only applies to EUT with 3 dBi dipole antenna, used in co-location at the minimum **38 cm** evaluation separation distance required by the operating configurations and exposure conditions of the host device. EIRP is approximately 33 dBm with this antenna.

The maximum calculated MPE ratio of the EUT with 3 dBi dipole antenna (rubber ducky antenna)

Frequency (MHz)	EUT EIRP (dBm)	EUT EIRP (mW)	Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	FCC MPE Limit (mW/cm <sup>2</sup> )	MPE Ratio
902.4	33	1995.262	38	0.11	0.602	0.183

The maximum calculated MPE ratio (FCC) for the EUT with 3 dBi dipole antenna is 0.183, 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 - 0.183 ≤ 0.817.

The following table addresses the co-location of the EUT with 3 dBi antenna with the specified radio modules.

**EUT with 3 dBi dipole antenna co-location with radio module identified in this table**

*Radio Module	Frequency (MHz)	EIRP (dBm)	EIRP (mW)	Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	FCC MPE Limit (mW/cm <sup>2</sup> )	MPE Ratio	MPE Ratio of EUT with 3 dBi antenna	Sum of MPE Ratio	Verdict
LTE-A Cat 12 M.2 Module (FCC ID XMR201901EM12G, IC 10224A-201901EM12G)	814.7	30.50	1122.018	38.00	0.062	0.543	0.114	0.183	0.297	Compliant
LTE Module (FCC ID XMR201903EG25G , IC 10224A-201903EG25G)	824.2	34.41	2766.942	38.00	0.152	0.549	0.278	0.183	0.461	Compliant
SARA-R410M LTE Cat-M1 Module (FCC ID: XPY2AGQN4NNN, IC: 8595A-2AGQN4NNN)	1850.0	32.12	1629.296	38.00	0.090	1	0.090	0.183	0.273	Compliant
L850 LTE Module (FCC ID: ZMOL850GL, IC: 21374-L850GL)	826.4	--	501.19	38.00	0.028	0.551	0.050	0.183	0.233	Compliant

\* The test data of the radio modules represented in this table is the worst-case configuration (maximum MPE ratio) derived from the original radio modules MPE reports. Refer to these reports for detail.

**ISED**

Co-location will only applies to EUT with 3 dBi dipole antenna, used in co-location at the minimum **38 cm** evaluation separation distance required by the operating configurations and exposure conditions of the host device. EIRP is approximately 33 dBm with this antenna.

**The maximum calculated MPE ratio of the EUT with 3 dBi dipole antenna (rubber ducky antenna)**

Frequency (MHz)	EUT EIRP* (dBm)	EUT EIRP (mW)	Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	ISED MPE Limit (mW/cm <sup>2</sup> )	MPE Ratio
902.4	33	1995.262	38	0.11	0.274	0.401

The maximum calculated MPE ratio for the EUT with 3 dBi dipole antenna is 0.401, 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  $\leq 1.0 - 0.401 \leq 0.599$ .

The following table addresses the co-location of the EUT with 3 dBi antenna with the specified radio modules.

**EUT with 3 dBi dipole antenna co-location with radio module identified in this table**

*Radio Module	Frequency (MHz)	EIRP (dBm)	EIRP (mW)	Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	ISED MPE Limit (mW/cm <sup>2</sup> )	MPE Ratio	MPE Ratio of EUT with 3 dBi antenna	Sum of MPE Ratio	Verdict
LTE-A Cat 12 M.2 Module (FCC ID XMR201901EM12G, IC 10224A-201901EM12G)	814.7	30.50	1122.018	38.00	0.062	0.256	0.242	0.401	0.643	Compliant
LTE Module (FCC ID XMR201903EG25G , IC 10224A-201903EG25G)	826.4	34.42	2766.942	38.00	0.152	0.258	0.591	0.401	0.992	Compliant
SARA-R410M LTE Cat-M1 Module (FCC ID: XPY2AGQN4NNN, IC: 8595A-2AGQN4NNN)	1850.0	32.12	1629.296	38.00	0.090	0.448	0.200	0.401	0.602	Compliant
L850 LTE Module (FCC ID: ZMOL850GL, IC: 21374-L850GL)	826.4	--	501.19	38.00	0.028	0.258	0.107	0.401	0.508	Compliant

\* The test data of the radio modules represented in this table is the worst-case configuration (maximum MPE ratio) derived from the original radio modules MPE reports. Refer to these reports for details.