

The Device is a carrier grade gateway designed for IoT applications. The device is intended to be installed in controlled area like tower or roof top building with restricted access to general public. The installation and maintenance must be performed by professional trained RF technician.

The device has 3 antenna ports, which must be used with antenna respecting the requirement specified in the technical documentation.

Kona Mega gateway is evaluated for RF radiation exposure according to the provisions of FCC §2.1091, MPE guidelines identified in FCC §1.1310 and FCC KDB 447498:2015.

Limits for General Population/Uncontrolled Exposure: 47 CFR 1.1310 Table 1 (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)
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
300-1,500			f/1500	30
1,500-100,000			1.0	30
Where <i>f</i> is in MHz		*Plane-wave equivalent power density		

The worst-case scenario for **LoRa Radio at 923 MHz** is

S = 0.615 mW/cm², for General Population/Uncontrolled Exposure

S = 3.615 mW/cm², for Occupational/Controlled Exposure

The worst-case scenario for **LTE pre-certifies Module (EM7455) LTE Band 12 at 699 MHz** is

S = 0.466 mW/cm², for General Population/Uncontrolled Exposure

S = 2.33 mW/cm², for Occupational/Controlled Exposure

The Avg EIRP calculations for the EM7355 are shown in the table below for each mode of operation. The worst case value is highlighted below.

Operating Band	Tx Freq. Range (MHz)		Max. Time-Avg Cond. Power (dBm)	Max Antenna Gain (dBi)	Max. Time-Avg EIRP (dBm)	Max. Time-Avg EIRP (mW)
WCDMA Band II LTE Band 2	1850	1910	24	6	30	1000
WCDMA Band IV LTE Band 4	1710	1755	24	6	30	1000
WCDMA Band V LTE Band 5	824	849	24	6	30	1000
LTE Band 7	2500	2570	23	9	32	1584.9
LTE Band 12	699	716	24	6	30	1000
LTE Band 13	777	787	24	6	30	1000
LTE Band 25	1850	1915	24	6	30	1000
LTE Band 26	814	849	24	6	30	1000
LTE Band 30	2305	2315	23	1	24	251.19
LTE Band 41	2496	2690	23	9	32	1584.9

LoRa RF conducted power measurement and antenna gain as per ETC test reports t29e22a277-DTS_FCC section 2.3.5 are reported below. The maximum duty cycle of the radio in real life operation is 33%. The worst-case value is in bold below

TX	Frequency (MHz)	Max Avg Conducted RF Output 100% Duty Cycle (dBm)	¹ Cable Loss BTW ANT Port & ANT (dB)	Max. antenna gain (dBi)	EIRP 100% Duty Cycle (mW)
LoRa 500 KHz DTS Single Carrier	923.3	27.55	0.5	8	3451.4
	925.5	27.95	0.5	8	3507.5
	927.5	27.88	0.5	8	3451.4
LoRa 500 KHz DTS Dual Carrier	924.5+925.1	27.58	2	8	2280.3
	926.3+926.9	27.82	2	8	2410.0
	926.9+927.5	27.91	2	8	2460.
Worse Case Tx Power		30	2	8	3981.1

¹ As per manufacturer used manual cable loss between TX antenna and EUT antenna ports is 2 dB for dual carrier and 0.5dB for single carrier.

Conclusion

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$$\begin{aligned}
 \text{Total Worse Case EIRP from Two Radios} &= \text{Worse LTE EIRP (mW)} + \text{Worse LoRA EIRP (mW)} \\
 &= 1585 \text{ mW} + 3981 \text{ mW} \\
 \text{EIRP} &= 5566 \text{ mW}
 \end{aligned}$$

To determine the minimum safe distance, the sum of all transmitted power is used

$$S = \text{EIRP} / (4\pi R^2)$$

Where: S, power density in 'mW/cm²'

EIRP, Effective Isotropic Radiated Power in 'mW'

R, distance to the center of the radiation of the antenna in 'cm'

And then re-arrange to determine the minimum safe distance for General Population/Uncontrolled Exposure.

$$\begin{aligned}
 R &= \sqrt{[\text{EIRP} / (4\pi S)]} \\
 R &= \sqrt{[5566 / (4\pi \times 0.466)]} \\
 R &= 30.8300132 \text{ cm} \\
 R &= \text{rounded up to 31.0 cm distance Uncontrolled Exposure}
 \end{aligned}$$

Power Density using calculated distance

$$\begin{aligned}
 S &= \text{EIRP} / (4\pi R^2) \\
 S &= 5566 / [4\pi (31)^2] \\
 S &= 0.461 < 0.466 \text{ mW/cm}^2
 \end{aligned}$$

To determine the minimum safe distance for Occupational/Controlled Exposure.

$$\begin{aligned}
 R &= \sqrt{[\text{EIRP} / (4\pi S)]} \\
 R &= \sqrt{[5566 / (4\pi \times 2.33)]} \\
 R &= 13.78760105 \text{ cm} \\
 R &= \text{rounded up to 14.0 cm}
 \end{aligned}$$

Power Density using calculated distance

$$\begin{aligned}
 S &= \text{EIRP} / (4\pi R^2) \\
 S &= 5566 / [4\pi (14)^2] \\
 S &= 2.26 < 2.33 \text{ mW/cm}^2
 \end{aligned}$$

R = 31 cm, for uncontrolled exposure (rounded up to the first decimal)

R = 14 cm, for controlled exposure (rounded up to the first decimal)

The device is intended to be installed in a fix controlled area location like tower or roof top building with restricted access to general public. The installation and maintenance must be performed by professional trained RF technician. The device has 3 antenna ports, which must be used with approved antenna respecting the requirement specified in the technical documentation. The manufacturer manual specified a minimum safe distance of 80 cm.