

RF Exposure Report

1 Overview of RF Exposure Compliance Requirements

The limit for the Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is allowed. The gain of the antennas used in the product is extracted from the antenna data sheet provided and also the maximum total power input into the antenna is measured. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of the MPE is reached.

Although the Friis Transmission formula is far field assumption, the calculated result of that is an over-prediction for near field power density, it is taken as worst case to specify the safety range.

Exemption limit for Routine evaluation is applied according to RSS-102 issue 6, section 5

2 RF Exposure Limits:

2.1 For FCC

1. According to the FCC Part 1 Subpart I 1.1310: The criteria listed in the following table shall be used to evaluate the environmental impact of the human exposure to radio-frequency (RF) radiation is specified in 1.1307 (b) showed Table 1.

Table 1: Limits for Maximum Permissible Exposure (MPE) as per FCC			
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)
Limits for Occupational / controlled Exposures			
300 - 1500	--	--	F/300
1500 - 100000	--	--	5.0
Limits for General population / Uncontrolled Exposure			
300 - 1500	--	--	F/1500
1500 - 100000	--	--	1.0

F = frequency in MHz

Friss Formula

Friss Transmission Formula: $P_d = (P_{out} * Gain) / (4 * \pi * r^2)$

Where

P_d = Power Spectral Density

P_{out} = output power to antenna in mW

G = gain of the antenna in linear scale

π = 3.1416

R = Distance between the observation point and the centre of radiator in cm

If the maximum antenna gain and the total output power delivered to the antenna are known, the MPE value at a distance of 20 cm can be calculated.

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Test Results:

Note:

- 1.The Mentioned Maximum Transmitter Conducted Power taken from test report: 91800100101001 (Model: Zeus R2)
2. Antenna gain: -0.06 dBi
3. Manufactured has declared the tune-up value as ± 0.5 is considered in MPE calculation.
- 4.Calculation is performed for 20cm separation distance.

Protocol	Frequency (MHz)	Maximum measured RF output power at antenna terminal (dBm)	Tune-up tolerance (dB)	Max power including tune-up value (mW)	Min Separation distance (cm)	Power Density (mW/cm ²)	Limit (mW/cm ²)
LoRa	914.9	19.66	± 0.5	103.75	20	0.0203	0.6099

2.2 For IC

According to IC RSS 102: The criteria is listed following table shall be used to evaluate the environmental impact of the human exposure to radio-frequency (RF) radiation is specified in section 5 showed in table 7.

Frequency range (MHz)	Electric field (V _{RMS} /m)	Magnetic field (A _{RMS} /m)	Power density (W/m ²)	Reference period (minutes)
10-20	27.46	0.0728	2	6
20-48	$58.07 / f^{0.25}$	$0.1540 / f^{0.25}$	$8.944 / f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	$3.142 f^{0.3417}$	$0.008335 f^{0.3417}$	$0.02619 f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	$616000 / f^{1.2}$
150000-300000	$0.158 f^{0.5}$	$4.21 \times 10^{-4} f^{0.5}$	$6.67 \times 10^{-5} f$	$616000 / f^{1.2}$

Note: f is frequency in MHz.

Protocol	Frequency (MHz)	Maximum measured RF output power at antenna terminal (dBm)	Tune-up tolerance (dB)	Max power including tune-up value (mW)	Min Separatio distance (CM)	Power Density (mW/cm ²)	Limit (mW/cm ²)
LoRa	914.9	19.66	±0.5	103.75	20	0.0203	0.2766

Conclusion:

This evaluation has been performed in accordance with FCC KDB 447498 D01 General RF Exposure Guidance v06 and demonstrates that the device does not require SAR testing under the defined exemption criteria.