

1 RF Exposure Report

1.1 RF Exposure Measurement

The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310. The gain of the antennas used in the product is extracted from the Antenna data sheets provided and also the maximum total power input to 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 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.

1.2 RF Exposure Limit

According to FCC 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 as specified in 1.1307 (b) showed in 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 or f = Frequency in MHz

1.2.1 Friis Formula

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

Where

P_d = power density in mW/cm²

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

π = 3.1416

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

If we know the maximum gain of the antenna and the total output power to the antenna, through calculation, we will know MPE value at distance 20cm.

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1.3 Compliance criteria

The Radio frequency Human Exposure Evaluation specification, method and procedures for LoRaWAN® Concentrator miniPCle - USB / SPI is in accordance with the following standard FCC 1.1310

1.4 Test Results

Protocol: LoRa

Data Rate: 21.9Kbps

Antenna types	Antenna gain
Omnidirectional antenna	3+/-0.5dBi

MPE calculations : For FCC 1.1307 (b)

Channel Frequency (MHz)	Maximum output power (dBm)	Output Power to Antenna (mW)	Tune up Value in (dB)	Antenna Gain (dBi)	Antenna gain (dBd)	Antenna gain in linear scale	Power Density (Pd) (mW/cm²)	FCC Limit (mW/cm²)
927	27.29	535.79	1	3.0	0.85	1.9952	0.2677	0.618

Note:

1. MPE evaluation is performed for 20 cm separation distance
2. MPE evaluation is performed for highest antenna gain of 3.0 dBi

1.5 Conclusion:

The Power density of the EUT is less than defined limit as shown above, hence EUT is exempted from routine SAR evaluation, this evaluation is only applicable to RFID transmission