FCC §15.247 (i) &§1.1307 (b) (3) - RF EXPOSURE EVALUATION

Applicable Standard

According to subpart 15.247 (i) and §1.1307(b) (3), systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

According to KDB 447498 D04 Interim General RF Exposure Guidance

SAR-Based Exemption:

SAR-based thresholds are derived based on frequency, power, and separation distance of the RF source. The formula defines the thresholds in general for either available maximum timeaveraged power or maximum time-averaged ERP, whichever is greater.

Per § 1.1307(b)(3)(i)(B), for single RF sources (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2) of this section): A single RF source is exempt if:

the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \text{cm})^{x} & d \le 20\ \text{cm} \\ ERP_{20\ cm} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20\ cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases}$$

d = the separation distance (cm);

According to § 1.1307(b)(3)(ii)(B) ,in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^{a}\frac{P_i}{P_{th,i}} + \sum_{j=1}^{b}\frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^{c}\frac{Evaluated_k}{Exposure\ Limit_k} \le 1$$

Result

Mode	Frequency (MHz)	P_{th}		Maximum tune-up conducted power		Exemption
		(mW)	(dBm)	(dBm)	(mW)	
Lora	915	1867	32.71	11.5	14.1	Compliant
Bluetooth	2402-2480	3060	34.86	3.5	2.2	Compliant
Wi-Fi	2412-2462	3060	34.86	18.0	63.1	Compliant

Note: 1. The tune up conducted power was declared by the applicant.
2. For Lora, the antenna gain is 2dBi(-0.15dBd), for BT and Wi-Fi, the antenna gain is 0.37dBi(-1.78dBd),so the conducted power was used for evaluation
3. The Lora can transmit at the same time with BT or Wi-Fi, the BT cannot transmit at the same time with Wi-Fi.

Simultaneous transmitting consideration (worst case):

The ratio=$P_{Lora}/P_{th\_Lora} + P_{Wi\text{-}Fi}/P_{th\_Wi\text{-}Fi}$=14.1/1867+63.1/3060=0.028＜1.0,

so simultaneous exposure is compliant.

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliant.