FCC§1.1307 (b) (3) &§2.1091 – RF EXPOSURE

Applicable Standard

According to FCC §2.1091 and §1.1307(b) (3), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

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);

For multiple RF sources: Multiple RF sources are exempt if:

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

For worst case:

Mode	Frequency (MHz)	Tune up conducted power		Antenna Gain		ERP		Evaluation Distance (m)	Pth (mW)
		(dBm)	(mW)	(dBi)	(dBd)	(dBm)	(mW)		
2.4G Wi-Fi	2412-2462	24.0	251.19	6.51	4.36	28.36	685.49	0.2	3060
5G Wi-Fi	5180-5240	25.0	316.23	8.37	6.22	31.22	1324.34	0.2	3060
	5260-5280	19.0	79.43	8.37	6.22	25.22	332.66	0.2	3060
	5500-5700	19.0	79.43	8.37	6.22	25.22	332.66	0.2	3060
	5745-5825	25.5	354.81	8.37	6.22	31.72	1485.94	0.2	3060

Note 1: The tune-up power and antenna gain was declared by the applicant.
Note 2: 0dBd=2.15dBi.
Note 3: the 2.4G Wi-Fi and 5G Wi-Fi can transmit at same time
Note 4. The device employ beamforming for 802.11n/ac/ax mode.
Direction Gain = G_{ANT} + 10*log(N_{ANT}/N_{SS})
For EUT, N_{ANT}=2, for the worst case, N_{SS}=1
For 5G Wi-Fi, G_{ANT1}=4.79dBi, G_{ANT2}=5.37dBi, use the higher gain 5.37dBi for the calculate
So, the direction Gain=5.37dBi+10*log(2/1)=8.37dBi
For 2.4G Wi-Fi, *GANT1=3.3dBi, GANT2=3.51dBi, use the higher gain 3.51dBi for the calculate*
*So, the direction Gain=3.51dBi+10*log(2/1)=6.51dBi*

Simultaneous transmitting consideration (worst case):

The ratio=$P_{2.4G}$/Pth+P_{5G}/Pth=685.49/3060+1485.94/3060=0.71＜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.