RADIO FREQUENCY EXPOSURE

Limit

According to section B.4 of 447498 D04 Interim General RF Exposure Guidance v01

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 time-averaged power or maximum time-averaged ERP, whichever is greater.

If the ERP of a device is not easily determined, such as for a portable device with a small form factor, the applicant may use the available maximum time-averaged power exclusively if the device antenna or radiating structure does not exceed an electrical length of λ/4.

As for devices with antennas of length greater than λ/4 where the gain is not well defined, but always less than that of a half-wave dipole (length λ/2), the available maximum time-averaged power generated by the device may be used in place of the maximum time-averaged ERP, where that value is not known.

The separation distance is the smallest distance from any part of the antenna or radiating structure for all persons, during operation at the applicable ERP. In the case of mobile or portable devices, the separation distance is from the outer housing of the device where it is closest to the antenna.

The SAR-based exemption formula of § 1.1307(b)(3)(i)(B), repeated here as Formula (B.2), applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power or effective radiated power (ERP), whichever is greater, of less than or equal to the threshold Pth (mW).

This method shall only be used at separation distances from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive). Pth is given by Formula (B.2).

$$P_{\text{th}}\ (\text{mW}) = \begin{cases} ERP_{20\ \text{cm}}(d/20\ \text{cm})^{x} & d \le 20\ \text{cm} \\ ERP_{20\ \text{cm}} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases} \qquad (\text{B.2})$$

Where

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

and f is in GHz, d is the separation distance (cm), and ERP_{20cm} is per Formula (B.1).

Results

BLE:

RF Exposure at Separation distance (cm): 20									
Mode	Antenna	Frequency [MHz]	Conducted Power [dBm]	Manufacturing tolerance		Antenna Gain [dBi]	Max of ERP and Conducted Power including Tune Up		SAR-based exemption threshold Pth [mW]
				Target Power [dBm]	Tolerance ±[dB]		[dBm]	[mW]	
BLE_1M	Ant1	2402	1.04	0.5	1	5.13	4.48	2.81	3060.00
BLE_1M	Ant1	2440	1.96	1.5	1	5.13	5.48	3.53	3060.00
BLE_1M	Ant1	2480	1.61	1	1	5.13	4.98	3.15	3060.00
BLE_2M	Ant1	2402	0.98	0.5	1	5.13	4.48	2.81	3060.00
BLE_2M	Ant1	2440	1.91	1.5	1	5.13	5.48	3.53	3060.00
BLE_2M	Ant1	2480	1.63	1	1	5.13	4.98	3.15	3060.00

EDR:

RF Exposure at Separation distance (cm): 20									
Mode	Antenna	Frequency [MHz]	Conducted Power [dBm]	Manufacturing tolerance		Antenna Gain [dBi]	Max of ERP and Conducted Power including Tune Up		SAR-based exemption threshold Pth [mW]
				Target Power [dBm]	Tolerance ±[dB]		[dBm]	[mW]	
DH5	Ant1	2402	1.09	0.5	1	5.13	4.48	2.81	3060.00
DH5	Ant1	2441	1.93	1.5	1	5.13	5.48	3.53	3060.00
DH5	Ant1	2480	1.67	1	1	5.13	4.98	3.15	3060.00
2DH5	Ant1	2402	0.41	0	1	5.13	3.98	2.50	3060.00
2DH5	Ant1	2441	1.19	0.5	1	5.13	4.48	2.81	3060.00
2DH5	Ant1	2480	0.93	0.5	1	5.13	4.48	2.81	3060.00
3DH5	Ant1	2402	0.68	0	1	5.13	3.98	2.50	3060.00
3DH5	Ant1	2441	1.54	1	1	5.13	4.98	3.15	3060.00
3DH5	Ant1	2480	1.25	1	1	5.13	4.98	3.15	3060.00

2.4G:

RF Exposure at Separation distance (cm): 20									
Mode	Antenna	Frequency [MHz]	Conducted Power [dBm]	Manufacturing tolerance		Antenna Gain [dBi]	Max of ERP and Conducted Power including Tune Up		SAR-based exemption threshold Pth [mW]
				Target Power [dBm]	Tolerance ±[dB]		[dBm]	[mW]	
11B	Ant1	2412	12.94	12.5	1	5.13	16.48	44.46	3060.00
11B	Ant1	2437	12.14	11.5	1	5.13	15.48	35.32	3060.00
11B	Ant1	2462	10.94	10.5	1	5.13	14.48	28.05	3060.00
11G	Ant1	2412	15.23	14.5	1	5.13	18.48	70.47	3060.00
11G	Ant1	2437	16.35	16	1	5.13	19.98	99.54	3060.00
11G	Ant1	2462	14.45	14	1	5.13	17.98	62.81	3060.00
11N20SISO	Ant1	2412	15.75	15.5	1	5.13	19.48	88.72	3060.00
11N20SISO	Ant1	2437	17.32	17	1	5.13	20.98	125.31	3060.00
11N20SISO	Ant1	2462	15.66	15	1	5.13	18.98	79.07	3060.00
11N40SISO	Ant1	2422	16.25	16	1	5.13	19.98	99.54	3060.00
11N40SISO	Ant1	2437	17.15	16.5	1	5.13	20.48	111.69	3060.00
11N40SISO	Ant1	2452	16.45	16	1	5.13	19.98	99.54	3060.00
11AX20SISO	Ant1	2412	16.48	16	1	5.13	19.98	99.54	3060.00
11AX20SISO	Ant1	2437	17.8	17.5	1	5.13	21.48	140.60	3060.00
11AX20SISO	Ant1	2462	16.16	15.5	1	5.13	19.48	88.72	3060.00
11AX40SISO	Ant1	2422	16.73	16	1	5.13	19.98	99.54	3060.00
11AX40SISO	Ant1	2437	17.45	17	1	5.13	20.98	125.31	3060.00
11AX40SISO	Ant1	2452	16.62	16	1	5.13	19.98	99.54	3060.00

5.8G:

RF Exposure at Separation distance (cm): 20									
Mode	Antenna	Frequency [MHz]	Conducted Power [dBm]	Manufacturing tolerance		Antenna Gain [dBi]	Max of ERP and Conducted Power including Tune Up		SAR-based exemption threshold Pth [mW]
				Target Power [dBm]	Tolerance ±[dB]		[dBm]	[mW]	
11A	Ant1	5745	8.2	7.5	1	5.16	11.51	14.16	3060.00
11A	Ant1	5785	8.81	8.5	1	5.16	12.51	17.82	3060.00
11A	Ant1	5825	7.74	7	1	5.16	11.01	12.62	3060.00
11N20SISO	Ant1	5745	8.46	8	1	5.16	12.01	15.89	3060.00
11N20SISO	Ant1	5785	8.11	7.5	1	5.16	11.51	14.16	3060.00
11N20SISO	Ant1	5825	8.53	8	1	5.16	12.01	15.89	3060.00
11N40SISO	Ant1	5755	8.43	8	1	5.16	12.01	15.89	3060.00
11N40SISO	Ant1	5795	8.03	7.5	1	5.16	11.51	14.16	3060.00
11AC20SISO	Ant1	5745	8.27	8	1	5.16	12.01	15.89	3060.00
11AC20SISO	Ant1	5785	8.17	7.5	1	5.16	11.51	14.16	3060.00
11AC20SISO	Ant1	5825	7.96	7.5	1	5.16	11.51	14.16	3060.00
11AC40SISO	Ant1	5755	8.42	8	1	5.16	12.01	15.89	3060.00
11AC40SISO	Ant1	5795	7.91	7.5	1	5.16	11.51	14.16	3060.00
11AX20SISO	Ant1	5745	8.33	8	1	5.16	12.01	15.89	3060.00
11AX20SISO	Ant1	5785	8.23	7.5	1	5.16	11.51	14.16	3060.00
11AX20SISO	Ant1	5825	8.65	8	1	5.16	12.01	15.89	3060.00
11AX40SISO	Ant1	5755	6.41	6	1	5.16	10.01	10.02	3060.00
11AX40SISO	Ant1	5795	5.44	5	1	5.16	9.01	7.96	3060.00

Max of ERP and Conducted Power including Tune Up (dBm) = Max Conducted Tune Up Power(dBm) and Max Conducted Tune Up Power(dBm) + Antenna Gain(dBi)-2.15), whichever is greater.

The Maximum Erp is used for Routine Evaluation Exemption according to B.4 of 447498 D04 Interim General RF Exposure Guidance v01.

So, the SAR evaluation is not required.