

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 $\lambda/4$.

As for devices with antennas of length greater than $\lambda/4$ where the gain is not well defined, but always less than that of a half-wave dipole (length $\lambda/2$), 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 P_{th} (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). P_{th} is given by Formula (B.2).

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

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 $ERP_{20 \text{ cm}}$ is per Formula (B.1).

Results**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 $\pm$ [dB]		[dBm]	[mW]	
DH5	Ant1	2402	2.62	2	1	4.83	5.68	3.70	3060.00
DH5	Ant1	2441	2.79	2.5	1	4.83	6.18	4.15	3060.00
DH5	Ant1	2480	2.68	2	1	4.83	5.68	3.70	3060.00
2DH5	Ant1	2402	1.18	0.5	1	4.83	4.18	2.62	3060.00
2DH5	Ant1	2441	1.4	1	1	4.83	4.68	2.94	3060.00
2DH5	Ant1	2480	1.33	1	1	4.83	4.68	2.94	3060.00
3DH5	Ant1	2402	1.73	1	1	4.83	4.68	2.94	3060.00
3DH5	Ant1	2441	1.97	1.5	1	4.83	5.18	3.30	3060.00
3DH5	Ant1	2480	1.78	1.5	1	4.83	5.18	3.30	3060.00

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 $\pm$ [dB]		[dBm]	[mW]	
BLE_1M	Ant1	2402	5.22	4.5	1	4.83	8.18	6.58	3060.00
BLE_1M	Ant1	2440	5.7	5	1	4.83	8.68	7.38	3060.00
BLE_1M	Ant1	2480	5.44	5	1	4.83	8.68	7.38	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 $\pm$ [dB]		[dBm]	[mW]	
11B	Ant1	2412	8.36	8	1	4.83	11.68	14.72	3060.00
11B	Ant2	2412	12.59	12	1	2.35	13.2	20.89	3060.00
11B	Ant1	2437	9.48	9	1	4.83	12.68	18.54	3060.00
11B	Ant2	2437	13.26	13	1	2.35	14.2	26.30	3060.00
11B	Ant1	2462	7.95	7.5	1	4.83	11.18	13.12	3060.00
11B	Ant2	2462	12.58	12	1	2.35	13.2	20.89	3060.00
11G	Ant1	2412	9.25	9	1	4.83	12.68	18.54	3060.00
11G	Ant2	2412	12.82	12.5	1	2.35	13.7	23.44	3060.00
11G	Ant1	2437	10.32	10	1	4.83	13.68	23.33	3060.00
11G	Ant2	2437	13.42	13	1	2.35	14.2	26.30	3060.00
11G	Ant1	2462	8.94	8.5	1	4.83	12.18	16.52	3060.00
11G	Ant2	2462	12.16	11.5	1	2.35	12.7	18.62	3060.00
11N20MIMO	Ant1	2412	5.19	4.5	1	4.83	8.18	6.58	3060.00
11N20MIMO	Ant2	2412	8.4	8	1	2.35	9.2	8.32	3060.00
11N20MIMO	total	2412	10.1	9.5	1	4.83	13.18	20.80	3060.00
11N20MIMO	Ant1	2437	7.04	6.5	1	4.83	10.18	10.42	3060.00
11N20MIMO	Ant2	2437	9.5	9	1	2.35	10.2	10.47	3060.00
11N20MIMO	total	2437	11.45	11	1	4.83	14.68	29.38	3060.00
11N20MIMO	Ant1	2462	5.05	4.5	1	4.83	8.18	6.58	3060.00
11N20MIMO	Ant2	2462	8.25	8	1	2.35	9.2	8.32	3060.00
11N20MIMO	total	2462	9.95	9.5	1	4.83	13.18	20.80	3060.00
11N40MIMO	Ant1	2422	6.44	6	1	4.83	9.68	9.29	3060.00
11N40MIMO	Ant2	2422	9.39	9	1	2.35	10.2	10.47	3060.00
11N40MIMO	total	2422	11.17	10.5	1	4.83	14.18	26.18	3060.00
11N40MIMO	Ant1	2437	6.65	6	1	4.83	9.68	9.29	3060.00
11N40MIMO	Ant2	2437	9.7	9	1	2.35	10.2	10.47	3060.00
11N40MIMO	total	2437	11.45	11	1	4.83	14.68	29.38	3060.00
11N40MIMO	Ant1	2452	5.6	5	1	4.83	8.68	7.38	3060.00
11N40MIMO	Ant2	2452	8.69	8	1	2.35	9.2	8.32	3060.00
11N40MIMO	total	2452	10.42	10	1	4.83	13.68	23.33	3060.00

5.2G:

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 $\pm$ [dB]		[dBm]	[mW]	
11A	Ant1	5180	6.58	6	1	4.07	8.92	7.80	3060.00
11A	Ant2	5180	8.66	8	1	4.56	11.41	13.84	3060.00
11A	Ant1	5200	6.47	6	1	4.07	8.92	7.80	3060.00
11A	Ant2	5200	9.52	9	1	4.56	12.41	17.42	3060.00
11A	Ant1	5240	6.12	5.5	1	4.07	8.42	6.95	3060.00
11A	Ant2	5240	10.13	9.5	1	4.56	12.91	19.54	3060.00
11N20MIMO	Ant1	5180	5.75	5.5	1	4.07	8.42	6.95	3060.00
11N20MIMO	Ant2	5180	8.28	8	1	4.56	11.41	13.84	3060.00
11N20MIMO	total	5180	10.21	9.5	1	4.56	12.91	19.54	3060.00
11N20MIMO	Ant1	5200	6.15	5.5	1	4.07	8.42	6.95	3060.00
11N20MIMO	Ant2	5200	8.9	8.5	1	4.56	11.91	15.52	3060.00
11N20MIMO	total	5200	10.75	10.5	1	4.56	13.91	24.60	3060.00
11N20MIMO	Ant1	5240	5.74	5	1	4.07	7.92	6.19	3060.00
11N20MIMO	Ant2	5240	9.07	8.5	1	4.56	11.91	15.52	3060.00
11N20MIMO	total	5240	10.73	10	1	4.56	13.41	21.93	3060.00
11N40MIMO	Ant1	5190	5.95	5.5	1	4.07	8.42	6.95	3060.00
11N40MIMO	Ant2	5190	9.05	8.5	1	4.56	11.91	15.52	3060.00
11N40MIMO	total	5190	10.78	10.5	1	4.56	13.91	24.60	3060.00
11N40MIMO	Ant1	5230	4.8	4.5	1	4.07	7.42	5.52	3060.00
11N40MIMO	Ant2	5230	9.47	9	1	4.56	12.41	17.42	3060.00
11N40MIMO	total	5230	10.74	10	1	4.56	13.41	21.93	3060.00
11AC20MIMO	Ant1	5180	5.14	4.5	1	4.07	7.42	5.52	3060.00
11AC20MIMO	Ant2	5180	7.57	7	1	4.56	10.41	10.99	3060.00
11AC20MIMO	total	5180	9.53	9	1	4.56	12.41	17.42	3060.00
11AC20MIMO	Ant1	5200	5.4	5	1	4.07	7.92	6.19	3060.00
11AC20MIMO	Ant2	5200	8.72	8	1	4.56	11.41	13.84	3060.00
11AC20MIMO	total	5200	10.38	10	1	4.56	13.41	21.93	3060.00
11AC20MIMO	Ant1	5240	5.53	5	1	4.07	7.92	6.19	3060.00
11AC20MIMO	Ant2	5240	9.35	9	1	4.56	12.41	17.42	3060.00
11AC20MIMO	total	5240	10.86	10.5	1	4.56	13.91	24.60	3060.00

11AC40MIMO	Ant1	5190	5.52	5	1	4.07	7.92	6.19	3060.00
11AC40MIMO	Ant2	5190	8.76	8.5	1	4.56	11.91	15.52	3060.00
11AC40MIMO	total	5190	10.45	10	1	4.56	13.41	21.93	3060.00
11AC40MIMO	Ant1	5230	5.29	5	1	4.07	7.92	6.19	3060.00
11AC40MIMO	Ant2	5230	9.22	8.5	1	4.56	11.91	15.52	3060.00
11AC40MIMO	total	5230	10.7	10	1	4.56	13.41	21.93	3060.00
11AC80MIMO	Ant1	5210	5.76	5.5	1	4.07	8.42	6.95	3060.00
11AC80MIMO	Ant2	5210	9	8.5	1	4.56	11.91	15.52	3060.00
11AC80MIMO	total	5210	10.69	10	1	4.56	13.41	21.93	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 $\pm$ [dB]		[dBm]	[mW]	
11A	Ant1	5745	8.52	8	1	2.63	9.48	8.87	3060.00
11A	Ant2	5745	10.96	10.5	1	5.8	15.15	32.73	3060.00
11A	Ant1	5785	8.65	8	1	2.63	9.48	8.87	3060.00
11A	Ant2	5785	11.32	11	1	5.8	15.65	36.73	3060.00
11A	Ant1	5825	8.36	8	1	2.63	9.48	8.87	3060.00
11A	Ant2	5825	10.84	10.5	1	5.8	15.15	32.73	3060.00
11N20MIMO	Ant1	5745	5.94	5.5	1	2.63	6.98	4.99	3060.00
11N20MIMO	Ant2	5745	7.81	7.5	1	5.8	12.15	16.41	3060.00
11N20MIMO	total	5745	9.99	9.5	1	5.8	14.15	26.00	3060.00
11N20MIMO	Ant1	5785	6.03	5.5	1	2.63	6.98	4.99	3060.00
11N20MIMO	Ant2	5785	8.17	7.5	1	5.8	12.15	16.41	3060.00
11N20MIMO	total	5785	10.24	9.5	1	5.8	14.15	26.00	3060.00
11N20MIMO	Ant1	5825	6.09	5.5	1	2.63	6.98	4.99	3060.00
11N20MIMO	Ant2	5825	7.59	7	1	5.8	11.65	14.62	3060.00
11N20MIMO	total	5825	9.91	9.5	1	5.8	14.15	26.00	3060.00
11N40MIMO	Ant1	5755	5.52	5	1	2.63	6.48	4.45	3060.00
11N40MIMO	Ant2	5755	7.92	7.5	1	5.8	12.15	16.41	3060.00
11N40MIMO	total	5755	9.89	9.5	1	5.8	14.15	26.00	3060.00
11N40MIMO	Ant1	5795	6.04	5.5	1	2.63	6.98	4.99	3060.00
11N40MIMO	Ant2	5795	8.26	8	1	5.8	12.65	18.41	3060.00

11N40MIMO	total	5795	10.3	10	1	5.8	14.65	29.17	3060.00
11AC20MIMO	Ant1	5745	5.28	5	1	2.63	6.48	4.45	3060.00
11AC20MIMO	Ant2	5745	7.08	6.5	1	5.8	11.15	13.03	3060.00
11AC20MIMO	total	5745	9.28	9	1	5.8	13.65	23.17	3060.00
11AC20MIMO	Ant1	5785	6.07	5.5	1	2.63	6.98	4.99	3060.00
11AC20MIMO	Ant2	5785	8.01	7.5	1	5.8	12.15	16.41	3060.00
11AC20MIMO	total	5785	10.16	9.5	1	5.8	14.15	26.00	3060.00
11AC20MIMO	Ant1	5825	5.92	5.5	1	2.63	6.98	4.99	3060.00
11AC20MIMO	Ant2	5825	7.67	7	1	5.8	11.65	14.62	3060.00
11AC20MIMO	total	5825	9.89	9.5	1	5.8	14.15	26.00	3060.00
11AC40MIMO	Ant1	5755	5.21	4.5	1	2.63	5.98	3.96	3060.00
11AC40MIMO	Ant2	5755	7.81	7.5	1	5.8	12.15	16.41	3060.00
11AC40MIMO	total	5755	9.71	9	1	5.8	13.65	23.17	3060.00
11AC40MIMO	Ant1	5795	6.06	5.5	1	2.63	6.98	4.99	3060.00
11AC40MIMO	Ant2	5795	7.92	7.5	1	5.8	12.15	16.41	3060.00
11AC40MIMO	total	5795	10.1	9.5	1	5.8	14.15	26.00	3060.00
11AC80MIMO	Ant1	5775	6.01	5.5	1	2.63	6.98	4.99	3060.00
11AC80MIMO	Ant2	5775	8.55	8	1	5.8	12.65	18.41	3060.00
11AC80MIMO	total	5775	10.47	10	1	5.8	14.65	29.17	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.