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).

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

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:

				Manufacturing tolerance			Max of ERP and Conducted Power including Tune Up		SAR-based exemption threshold Pth [mW]
Mode	Antenna	Frequency [MHz]	Conducted Power [dBm]	Target Power [dBm]	Tolerance ±[dB]	Antenna Gain [dBi]	[dBm]	[mW]	
BLE_1M	Ant1	2402	0.87	0.5	1	3	2.35	1.72	2.79
BLE_1M	Ant1	2440	2.19	1.5	1	3	3.35	2.16	2.75
BLE_1M	Ant1	2480	2.17	1.5	1	3	3.35	2.16	2.72

(Table title row: RF Exposure at Separation distance (cm): 0.5)

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.

NFC:

Test Mode	Max Field strength at 3m distance (dBμV/m)	Max of ERP (dBm)	Max of ERP (mW)	Exemption Limit(mW)
Transmitting	64.59	-32.76	0.00053	1

When necessary, Field strength measurements shall be converted to ERP or EIRP for comparison to the applicable regulatory limits.

EIRP (dBm) = E (dBuV/m) + 20log(D) - 104.8, where D is the measurement distance

ERP = EIRP - 2.15 dB

So, the SAR evaluation is not required.