

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).

The example values shown in Table B.2 are for illustration only.

Frequency (MHz)	Distance (mm)										
		5	10	15	20	25	30	35	40	45	50
	300	39	65	88	110	129	148	166	184	201	217
	450	22	44	67	89	112	135	158	180	203	226
	835	9	25	44	66	90	116	145	175	207	240
	1900	3	12	26	44	66	92	122	157	195	236
	2450	3	10	22	38	59	83	111	143	179	219
	3600	2	8	18	32	49	71	96	125	158	195
	5800	1	6	14	25	40	58	80	106	136	169

Conducted Power Results

TestMode	Antenna	Frequency[MHz]	Result[dBm]
BLE_1M	Ant1	2402	-1.94
BLE_1M	Ant1	2440	-1.63
BLE_1M	Ant1	2480	-2.42
BLE_2M	Ant1	2402	-1.90
BLE_2M	Ant1	2440	-1.49
BLE_2M	Ant1	2480	-2.34

Test Mode	Antenna	Frequency[MHz]	Result [dBm]
11B	Ant1	2412	8.18
11B	Ant1	2437	6.00
11B	Ant1	2462	9.17
11G	Ant1	2412	9.24
11G	Ant1	2437	7.61
11G	Ant1	2462	7.86
11N20SISO	Ant1	2412	10.80
11N20SISO	Ant1	2437	8.69
11N20SISO	Ant1	2462	8.95

Manufacturing tolerance**Bluetooth(BLE)**

GFSK(1Mbps) (Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	-2.5	-2	-3
Tolerance $\pm$ (dB)	1	1	1
GFSK(2Mbps) (Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	-2.5	-2	-3
Tolerance $\pm$ (dB)	1	1	1

WiFi 2.4GHz Band

IEEE 802.11b(Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	1.5	0.5	1.5
Tolerance $\pm$ (dB)	1	1	1
IEEE 802.11g(Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	2	1.5	1.5
Tolerance $\pm$ (dB)	1	1	1
IEEE 802.11n HT20(Average)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	2	1	1.5
Tolerance $\pm$ (dB)	1	1	1

Results

Bluetooth(BLE)

Test Mode	Max Conducted Tune Up Power(dBm)	Max of ERP and Conducted Power including Tune Up (dBm)	Max of ERP and Conducted Power including Tune Up (mW)	Exemption Limit(mW)
GFSK(1Mbps)	-1.0	-1.0	0.79	3
GFSK(2Mbps)	-1.0	-1.0	0.79	3

WiFi 2.4GHz Band

Test Mode	Max Conducted Tune Up Power(dBm)	Max of ERP and Conducted Power including Tune Up (dBm)	Max of ERP and Conducted Power including Tune Up (mW)	Exemption Limit(mW)
IEEE 802.11b	2.5	2.5	1.78	3
IEEE 802.11g	3.0	3.0	2.00	3
IEEE 802.11n HT20	3.0	3.0	2.00	3

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 antenna gain of the EUT for BT is 2dBi (Max). the Maximum Eirp 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.