

RF Exposure evaluation

1. Limits

According 1.1310 (d)

For operations within the frequency range of 300 kHz and 6 GHz (inclusive), the limits for maximum permissible exposure (MPE), derived from whole-body SAR limits and listed in Table 1 in paragraph (e)(1) of this section, may be used instead of whole-body SAR limits as set forth in paragraphs (a) through (c) of this section to evaluate the environmental impact of human exposure to RF radiation as specified in § 1.1307(b) of this part, except for portable devices as defined in § 2.1093 of this chapter as these evaluations shall be performed according to the SAR provisions in § 2.1093.

Table 1 to § 1.1310(e)(1)—Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(i) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*(100)	≤6
3.0-30	1842/f	4.89/f	*(900/f ²)	≤6
30-300	61.4	0.163	1.0	≤6
300-1,500			f/300	≤6
1,500-100,000			5	≤6
(ii) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	<30
1.34-30	824/f	2.19/f	*(180/f ²)	<30
30-300	27.5	0.073	0.2	<30
300-1,500			f/1500	<30
1,500-100,000			1.0	<30
f = frequency in MHz. * = Plane-wave equivalent power density.				

According to 447498 D04 Interim General RF Exposure Guidance v01

1-mW Test Exemption

A single RF source is exempt RF device (from the requirement to show data demonstrating compliance to RF exposure limits, as previously mentioned) if the available maximum time-averaged power is no more than 1 mW, regardless of separation distance.

This exemption applies to all operating configurations and exposure conditions, for the frequency range 100 kHz to 100 GHz, regardless of fixed, mobile, or portable device exposure conditions. This is a standalone exemption, and it cannot be applied in conjunction with any other test exemption.

1-mW Test Exemption for Multiple Sources

The 1-mW exemption intended for single transmitters may be also applied to simultaneous transmission conditions, within the same host device, according one of the following criteria:

a) When maximum available power each individual transmitting antenna within the same time averaging period is ≤ 1 mW, and the nearest parts of the antenna structures of the simultaneously operating transmitters are separated by at least 2 cm.

b) When the aggregate maximum available power of all transmitting antennas is ≤ 1 mW in the same time-averaging period.

This exemption may not be combined with any other exemption.

According to 447498 D01 General RF Exposure Guidance v06

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

$f(\text{GHz})$ is the RF channel transmit frequency in GHz

Power and distance are rounded to the nearest mW and mm before calculation

The result is rounded to one decimal place for comparison

Worse case is as below: [2402MHz: -1.888 dBm (0.647 mW) output power]
 $(0.647\text{mW}/5\text{mm}) \cdot [\sqrt{2.402 (\text{GHz})}] = 0.2005 < 3.0$ for 1-g SAR

Mode	Frequency (MHz)	Fundamental Emission (dBμV/m)	Electric field strength (V/m)	Limi (V/m)	SAR Test Exclusion
NFC	13.56	47.17	0.000228	60.77	Yes

Maximum Simultaneous transmission MPE Ratios for BLE+NFC:

Max MPE ratio BLE/Limit	Max MPE ratio NFC/Limit	ΣMPE ratios	Limit	Result
0.2005	0.000228	0.200728	1	PASS

Then SAR evaluation is not required