

* RF Exposure

1. Regulation

Regulation

This document is prepared to show compliance with the RF Exposure requirements as required in §1.1310 of the FCC rules and Regulations.

The limit for Maximum Permissible Exposure (MPE), specified in FCC §1.1310, is listed in Table 1-1. According to FCC §1.1310: the criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b).

Table 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 [minute]
(A) 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 ~ 15 000	/	/	5	6
(B) 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/1 500	30
1 500 ~ 15 000	/	/	1.0	30

f=frequency in MHz, * = plane-wave equivalent power density

Per the guidance of KDB 680106, the E-field and H-field limits shown in the table above are extended down to 100 kHz

2. Result

MPE (Maximum Permissible Exposure) Prediction

Predication of MPE limit at a given distance: Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2 \quad (\Rightarrow R = \sqrt{PG/4\pi S})$$

S = power density [mW/cm^2]

P = Power input to antenna [mW]

G = Power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna [cm]

RF Exposure Compliance Issue

The information should be included in the user's manual:

This appliance and its antenna must not be co-located or operation is conjunction with any other antenna or transmitter. A minimum separation distance of 20 cm must be maintained between the antenna and the person for this appliance to satisfy the RF exposure requirements.

Note.

1. The power density P_d (5th column) at a distance of 20 cm calculated from the friis transmission Formula is far below the limit of 1 mW/cm^2 .

2. Unequal antenna gains, with equal transmit powers. For antenna gains given by G_1, G_2, \dots, G_N dBi (i) If transmit signals are correlated, then

Directional gain = $10 \log[(10^{G_1/10} + 10^{G_2/10} + \dots + 10^{G_N/10})/N]$ dB i [Note the "20"s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

Antenna gain

Antenna	Band	BT	BLE	2.4 GHz	5 GHz (UNII-3)
ANT			1.88		3.60

Calculation Result of RF Exposure

Maximum tune-up tolerance (Worst Case)

Mode	Frequency [MHz]	Max Tune-up Power [dBm]	Max Tune-up Power [mW]	Ant Gain [dBi]	Power density at 20 cm [mW/cm ²]	Limit [mW/cm ²]
BDR	2 480	0.00	1.00	1.88	0.000 31	1.00
1 Mbps	2 480	6.00	3.98	1.88	0.001 22	1.00
11b	2 412	5.00	3.16	1.88	0.000 97	1.00
11g	2 412	4.00	2.51	1.88	0.000 77	1.00
11n_HT20	2 412	4.00	2.51	1.88	0.000 77	1.00
11n_HT40	2 422	4.00	2.51	1.88	0.000 77	1.00
11a	5 745	8.50	7.08	3.60	0.003 23	1.00
11ac_VHT20	5 785	8.50	7.08	3.60	0.003 23	1.00
11ac_VHT40	5 755	9.00	7.94	3.60	0.003 62	1.00