



## APPENDIX L

### : RF EXPOSURE EVALUATION



# 1. RF Exposure Evaluation

## Radiofrequency radiation exposure limits.

Specific absorption rate (SAR) shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in § 1.1307(b) of this part within the frequency range of 100 kHz to 6 GHz (inclusive).

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	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 <sup>2</sup> )	<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 <sup>2</sup> )	<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.

## Friis Formula

Friis transmission formula:  $Pd = (Pout * G) / (4 * \pi * r^2)$

where

Pd = power density in mW/cm<sup>2</sup>

Pout = output power to antenna in mW

G = gain of antenna in linear scale

Pi = 3.1416

R = distance between observation point and center of the radiator in cm

If we know the maximum Gain of the antenna and the total power input to the antenna, through the calculation, we will know the MPE value at distance r.



**Antenna #1 Gain: 0.22 dBi**

Frequency (MHz)	Average Conducted Output Power (dBm)	Average Conducted Output Power (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
2 402	4.6	2.884	0.000 126	1.0
2 440	4.1	2.570	0.000 112	1.0
2 480	-10.7	0.085	0.000 004	1.0

**Antenna #2 Gain: 2.9 dBi**

Frequency (MHz)	Average Conducted Output Power (dBm)	Average Conducted Output Power (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
2 402	4.6	2.884	0.001 664	1.0
2 440	4.1	2.570	0.001 483	1.0
2 480	-10.7	0.085	0.000 049	1.0

**Antenna #3 Gain: 4.9 dBi**

Frequency (MHz)	Average Conducted Output Power (dBm)	Average Conducted Output Power (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
2 402	4.6	2.884	0.002 811	1.0
2 440	4.1	2.570	0.002 505	1.0
2 480	-10.7	0.085	0.000 083	1.0

**Antenna #4 Gain: 5.21 dBi**

Frequency (MHz)	Average Conducted Output Power (dBm)	Average Conducted Output Power (mW)	Power Density (mW/cm <sup>2</sup> )	Limit of Power Density (mW/cm <sup>2</sup> )
2 402	4.6	2.884	0.002 989	1.0
2 440	4.1	2.570	0.002 664	1.0
2 480	-10.7	0.085	0.000 088	1.0