

RF EXPOSURE EVALUATION

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency(RF) Radiation as specified in §1.1307(b)

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)
(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
1,500-100,000			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/1500	30
1,500-100,000			1.0	30

f = frequency in MHz * = Plane-wave equivalent power density

MPE Calculation Method

$$E \text{ (V/m)} = \frac{\sqrt{30 * P * G}}{d}$$

$$\text{Power Density: } Pd \text{ (W/m}^2\text{)} = \frac{E^2}{377}$$

E = Electric field (V/m)

P = Average RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

$$Pd = \frac{30 * P * G}{377 * D^2}$$

From the EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained.

Measurement Result

Operation Frequency: NFC: 13.56MHz WPT: 111kHz~205kHz

Power density limited: 1mW/ cm²

Antenna Type: Induction coil

Antenna gain: 0dBi,

R=20cm

Transmit power

NFC

Frequency (MHz)	Max Output power (dBuV/m)	EIRP power (dBm)
13.56	78	-17.26

$$\text{EIRP} = E - 104.8 + 20\log(D)$$

Mode	Channel Freq. (MHz)	EIRP power (dBm)	EIRP power (mW)	Tune-up power (dBm)	Max tune-up power (dBm)	Evaluation result (mW/cm ²)	Power density Limits (mW/cm ²)
NFC	13.56	-17.26	0.019	-17±1	-16	0.0000050	0.0090

WPT

Test Position	H-Field Strength Measure Result		Limits (A/m)	
	Mode 2			
	A/m			
A	0.38		1.63	
B	0.61		1.63	
C	0.17		1.63	
D	0.39		1.63	
E	0.68		1.63	
F	0.39		1.63	

E-Field Strength at 15 cm from the edges surrounding the EUT (V/m)

Test Position	E-Field Strength Measure Result		Limits (V/m)	
	Mode 3			
	V/m			
A	1.01		614	
B	1.06		614	
C	0.61		614	
D	0.65		614	
E	1.79		614	
F	0.69		614	

SIMULTANEOUS TRANSMISSIONS

When a number of sources at different frequencies, and/or broadband sources, contribute to the total exposure, it becomes necessary to weigh each contribution relative to the MPE. To comply with the MPE, the fraction of the MPE in terms of E^2 , H^2 (or power density) incurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity. In order to ensure compliance with the MPE for a controlled environment, the sum of the ratios of the power density to the corresponding MPE should not exceed unity. That is

$$\sum_{i=1}^n \frac{S_i}{MPE_i} \leq 1$$

Max. SIMULTANEOUS TRANSMISSIONS for NFC + WPT

Mode	Channel Freq. (MHz)	Evaluation result	Limits	Calculation result
NFC	13.56	0.0000050 (mW/cm ²)	0.0090 (mW/cm ²)	
WPT	0.128	0.68 (A/m)	1.63 (A/m)	0.4177

Conclusion:

For the max result : $0.4177 \leq 1.0$ for Max Power Density, compliance RF exposure..



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