

RF Exposure Evaluation

Reference: CFR 47 FCC Part 1.1310
RSS-102. Issue 5

Description: All 3 transmitters in the device have the possibility of transmitting simultaneously. The worst-case exposure for each transmitter was used to calculate the percentage of the allowable limit that each transmitter contributed. All of the percentages were then added together to verify that at the specified operating distance, they were below the allowable limit.

All measurements were peak or RMS power readings taken from test reports from accredited test labs. Antenna gains were taken from the manufacturer’s specifications.

Limits: Maximum exposure limits from CFR 47, FCC Part 1.1310:

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 (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

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Occupational/Controlled	0
General Population/uncontrolled	1

Transmitter	Frequency	Antenna Gain	Power (conducted)	Power (conducted) +10% for tolerance	Power Density	Limit at specified distance	% of limit	Highest	Total
	MHz	numerical	mW	mW	mW/cm ²	mW/cm ²			
1	2402	1	58.34	64.17	0.01277	1.00	1.28%	1	1.28%
1	2440	1	57.54	63.29	0.01260	1.00	1.26%		
1	2480	1	49.66	54.63	0.01087	1.00	1.09%		
2	2412	1	2.64	2.90	0.00058	1.00	0.06%	1	0.06%
2	2437	1	1.95	2.15	0.00043	1.00	0.04%		
2	2462	1	1.61	1.77	0.00035	1.00	0.04%		
								TOTAL	1.34%

Distance	20	cm
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PASS?	YES
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Table 2 - Calculations according to CFR 47, Part 1.1310, Table 1(B)

When measurements were performed as EIRP, the antenna gain is listed as 1. In cases where the antenna gain is not listed as 1, the power measurement was performed as conducted and the antenna gain from the manufacturer's datasheet was used.

The power density is calculated as shown below:

$$S = (P \times G)/(4 \times \pi \times d^2) - \text{used to calculate exposure at 20 cm}$$

$$d = \sqrt{(S/(P \times G) \times 4 \times \pi)} - \text{used to calculate minimum distance to meet limits}$$

$$1 \text{ mW/cm}^2 = 10 \text{ W/m}^2$$

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Using RSS-102, Issue 5, Section 2.5.2

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{(0.6834)}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance). In these cases, the information contained in the RF exposure

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Occupational/Controlled	0
General Population/uncontrolled	1

Transmitter	Frequency	Antenna Gain	Power	Power* Density	Limit	% of limit	Highest	Total	Type
	MHz	numerical	mW	W/m ²	W/m ²	Percent of limit			
1	2402	1	58.34	0.12773	0.2676	0.48	1	47.73%	AV/Conducted
1	2440	1	57.54	0.12598	0.2705	0.47			AV/Conducted
1	2480	1	49.66	0.10873	0.2736	0.40			AV/Conducted
2	2412	1	2.64	0.00578	0.2684	0.02	1	2.15%	PK/conducted
2	2437	1	1.95	0.00427	0.2703	0.02			PK/conducted
2	2462	1	1.61	0.00353	0.2722	0.01			PK/conducted
							TOTAL	49.88%	

Distance	20	cm
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PASS?	YES
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*10% was added to account for power tolerance