The Nebraska Center for Excellence in Electronics
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FCC

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

The power density is calculated as shown below:

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

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

S= power density
P = transmitter conducted power (in mW)
G = antenna numeric gain
D = distance to radiation center (20 cm)

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Table 2 – Power Density Calculations

Occupational/Controlled	
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	905.6	1.637	8.02	8.822	0.00261	0.60	0.43	1	0.43
1	915	1.637	7.57	8.327	0.00247	0.61	0.40		
1	924.4	1.637	6.15	6.765	0.00200	0.62	0.32		
								TOTAL	0.43%

Distance	20	cm

PASS?	YES

Note: This equipment is not intended to be operated by hand, and instead is operated by a separate handheld remote. It is expected that a 20cm separation will be maintained at all times.

Output power = $10^{(-3.98 \text{ dBm}/10)}$ = 0.40 mW

-3.98dBm was measured in NCEE Labs report R20170113-20A

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IC / ISED

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 MHz6 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/ƒ0.5 W (adjusted for tune-up tolerance), where ƒ 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 x 10-2 ƒ^(0.6834) W (adjusted for tune-up tolerance), where ƒ 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	
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	905.6	1.637	8.02	8.822	0.00261	0.191	4.35	1	0.191%
1	915	1.637	7.57	8.327	0.00247	0.179	4.05		
1	924.4	1.637	6.15	6.765	0.00200	0.140	3.23		
								TOTAL	0.191%

Distance	20	cm

PASS?	YES

The limit was converted from W/cm^2 to mW/m^2 by dividing by 10
 (W→mW = .001) × (/cm^2→/m^2 = 100) = 0.1 = /10
The power density is calculated as shown below:

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

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

1 mW/cm^2 = 10 W/m^2

S= power density
P = transmitter conducted power (in mW)
G = antenna numeric gain
D = distance to radiation center