



RF Exposure rev4

Applicant: Appareo Systems, LLC
 Device: Gateway

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

Description: All 4 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

RF Exposure rev4

Applicant: Appareo Systems, LLC
 Device: Gateway

Table 2 - From Table 4 of RSS-102 Issue 5

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²¹	83	90	-	Instantaneous*
0.1-10	-	0.73/ <i>f</i>	-	6**
1.1-10	87/ <i>f</i> ^{0.5}	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ <i>f</i> ^{0.25}	0.1540/ <i>f</i> ^{0.25}	8.944/ <i>f</i> ^{0.5}	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 <i>f</i> ^{0.3417}	0.008335 <i>f</i> ^{0.3417}	0.02619 <i>f</i> ^{0.6834}	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ <i>f</i> ^{1.2}
150000-300000	0.158 <i>f</i> ^{0.5}	4.21 x 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 x 10 ⁻⁵ <i>f</i>	616000/ <i>f</i> ^{1.2}
<p>Note: <i>f</i> is frequency in MHz. *Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).</p>				

RF Exposure rev4

Applicant: Appareo Systems, LLC
 Device: Gateway

Calculations:

Table 3 - Calculations according to CFR 47, Part 1.1310, Table 1(B)

Occupational/Controlled	0
General Population/uncontrolled	1

Transmitter	Frequency	Antenna Gain	Power (conducted)	Power Density	Limit at specified distance	% of limit	Highest	Total
	MHz	numerical	mW	mW/cm ²	mW/cm ²			
1	433	2	1.70	0.00	0.29	0.06%	1	0.06%
2	2442	6.5	46.00	0.01	1.00	1.49%		
2	2442	6.5	44.50	0.01	1.00	1.44%		
2	2442	6.5	47.00	0.02	1.00	1.52%		
2	2405	6.5	20.30	0.01	1.00	0.66%		
2	2402	6.5	51.30	0.02	1.00	1.66%	1	1.66%
2	2442	6.5	41.00	0.01	1.00	1.33%		
3	824	2.47	2400.00	0.29	0.55	53.73%	1	53.73%
3	1850	5.5	1120.00	0.31	1.00	30.65%		
4	1616	3.5	1967.90	0.34	1.00	34.27%	1	34.27%
4	1621	3.5	1909.90	0.33	1.00	33.26%		
4	1626	3.4	1909.90	0.32	1.00	32.31%		
							TOTAL	89.72%

Distance	40	cm
----------	----	----

PASS?	YES
-------	-----

Transmitter 1: 433 MHz communication link See NCEE Labs report R20141212-20-01
 Transmitter 2: Bluetooth/Wi-Fi; FCC ID XF6-RS9113SB, IC: 8407A-RS9113S8
 Transmitter 3: 4G Cellular data link; FCC ID: QIPXSA, IC: 7830A-PXS8
 Transmitter 4: Satellite Communication link, see NCEE Labs report R20141212-20-02

RF Exposure rev4

Applicant: Appareo Systems, LLC
 Device: Gateway

Table 4 - Calculation according to Industry Canada RSS-102, Table 6

Occupational/Controlled	0
General Population/uncontrolled	1

Transmitter	Frequency	Antenna Gain	Power (conducted)	Power Density	Limit at specified distance	% of limit	Highest	Total
	MHz	numerical	mW	W/m ²	W/m ²			
1	433	2	1.70	0.00075	1.66	0.05%	1	0.05%
2	2442	6.5	46.00	0.06613	5.41	1.22%		
2	2442	6.5	44.50	0.06397	5.41	1.18%		
2	2442	6.5	47.00	0.06756	5.41	1.25%		
2	2405	6.5	20.30	0.02918	5.36	0.54%		
2	2402	6.5	51.30	0.07375	5.35	1.38%	1	1.38%
2	2442	6.5	41.00	0.05894	5.41	1.09%		
3	824	2.47	2400.00	1.31104	2.58	50.90%	1	50.90%
3	1850	5.5	1120.00	1.36235	4.48	30.43%		
4	1616	3.5	1967.90	1.52328	4.08	37.32%	1	37.32%
4	1621	3.5	1909.90	1.47838	4.09	36.15%		
4	1626	3.4	1909.90	1.43614	4.10	36.15%		
							TOTAL	89.65%

Distance	60	cm
----------	----	----

2.91 W/m² (MAX TOTAL)

PASS?	YES
-------	-----

Transmitter 1: 433 MHz communication link See NCEE Labs report R20141212-20-01B

Transmitter 2: Bluetooth/Wi-Fi; FCC ID XF6-RS9113SB, IC: 8407A-RS9113S8

Transmitter 3: 4G Cellular data link; FCC ID: QIPXSA, IC: 7830A-PXS8

RF Exposure rev4

Applicant: Appareo Systems, LLC
Device: Gateway

Transmitter 4: Satellite Communication link, see NCEE Labs report R20141212-20-02C

The limit was converted from W/cm² to mW/m² by dividing by 10
(W→mW = .001) × (/cm²→/m² = 100) = 0.1 = /10

The power density is calculated as shown below:

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

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

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

S= power density

P = transmitter conducted power (in mW)

G = antenna numeric gain

D = distance to radiation center

See the antenna datasheets and specifications for antenna gain

Notes: The minimum separation distance was defined as the closest point from the transmitting antenna to any part of the body or extremity of a user or bystander.

The minimum separation distance is listed as 40cm the FCC and IC.