

## RF Exposure

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 <sup>2</sup> ) | Averaging time (minutes) |
|--|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| <b>(A) Limits for Occupational/Controlled Exposure</b>         |                               |                               |                                     |                          |
| 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                        |
| <b>(B) Limits for General Population/Uncontrolled Exposure</b> |                               |                               |                                     |                          |
| 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                       |

**RF Exposure**

|          |    |    |
|----------|----|----|
| Distance | 20 | cm |
|----------|----|----|

| TX | Low Frequency | High Frequency | Antenna Gain | Power  | Power Density | Limit   | % of limit | Highest      | Total         |
|----|---------------|----------------|--------------|--------|---------------|---------|------------|--------------|---------------|
|    | MHz           | MHz            | numerical    | W      | mW/cm^2       | mW/cm^2 |            |              |               |
| 1  | 2402          | 2480           | 1            | 0.0005 | 0.0000995     | 1.0000  | 0.01%      | 1            | 0.01%         |
| 2  | 699           | 716            | 4.3          | 0.21   | 0.1780255     | 0.4660  | 38.20%     | 0            | 38.20%        |
|    | 777           | 787            | 4.3          | 0.21   | 0.1814490     | 0.5180  | 35.03%     | 0            | 0.00%         |
|    | 788           | 798            | 4.3          | 0.23   | 0.1934315     | 0.5253  | 36.82%     | 1            | 0.00%         |
|    | 814           | 849            | 4.3          | 0.22   | 0.1848726     | 0.5427  | 34.07%     | 0            | 0.00%         |
|    | 823           | 824.7          | 4.3          | 0.21   | 0.1771696     | 0.5487  | 32.29%     | 0            | 0.00%         |
|    | 1710          | 1780           | 4.3          | 0.22   | 0.1865844     | 1.0000  | 18.66%     | 0            | 0.00%         |
|    | 1850          | 1915           | 4.3          | 0.25   | 0.2096935     | 1.0000  | 20.97%     | 0            | 0.00%         |
|    |               |                |              |        |               |         |            | <b>TOTAL</b> | <b>38.21%</b> |

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

Notes:

1. EIRP was used for 2402 – 2480 MHz band, so antenna gain is set to 1 numeric
2. The highest values from each radio as percentages of the limit were summed together for the total MPE.
3. Peak gain for TX is 6.3 dBi = 4.3 numeric

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The limit was converted from W/cm<sup>2</sup> to mW/m<sup>2</sup> by dividing by 10  
(W→mW = .001) × ( /cm<sup>2</sup>→/m<sup>2</sup> = 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.