

5. RF EXPOSURE EVALUATION

5.1 Applicable Standard

According to subpart 15.247(i) and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

| (B) Limits for General Population/Uncontrolled Exposure | | | | |
|---|-------------------------------|-------------------------------|-------------------------------------|--------------------------|
| Frequency Range (MHz) | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (mW/cm ²) | Averaging Time (minutes) |
| 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 |
| 300–1500 | / | / | f/1500 | 30 |
| 1500–100,000 | / | / | 1.0 | 30 |

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

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculation formula:

Prediction of power density at the distance of the applicable MPE limit

$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm²);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

5.2 Measurement Result

| Mode | Frequency (MHz) | Antenna Gain | | Conducted output power including Tune-up Tolerance | | Evaluation Distance (cm) | Power Density (mW/cm ²) | MPE Limit (mW/cm ²) |
|-----------------------------|-----------------|--------------|-----------|--|--------|--------------------------|-------------------------------------|---------------------------------|
| | | (dBi) | (numeric) | (dBm) | (mW) | | | |
| BLE | 2402-2480 | 1.67 | 1.47 | 7.0 | 5.01 | 20 | 0.0015 | 1 |
| GSM850 (worst case 3slots) | 824-849 | -0.56 | 0.88 | 26.74 | 472.06 | 20 | 0.083 | 0.55 |
| PCS1900 (worst case 2slots) | 1850-1910 | 0.48 | 1.12 | 24 | 251.19 | 20 | 0.056 | 1 |
| LTE B2 | 1850-1910 | 0.48 | 1.12 | 25 | 316.23 | 20 | 0.070 | 1 |
| LTE B4 | 1710-1755 | 0.1 | 1.02 | 25 | 316.23 | 20 | 0.064 | 1 |
| LTE B5 | 824-849 | -0.56 | 0.88 | 25 | 316.23 | 20 | 0.055 | 0.55 |
| LTE B7 | 2500-2570 | 1.04 | 1.27 | 25 | 316.23 | 20 | 0.080 | 1 |
| LTE B12 | 699-716 | -2.98 | 0.50 | 25 | 316.23 | 20 | 0.031 | 0.47 |
| LTE B13 | 777-787 | -2.16 | 0.61 | 25 | 316.23 | 20 | 0.038 | 0.52 |
| LTE B17 | 704-716 | -2.98 | 0.50 | 25 | 316.23 | 20 | 0.031 | 0.47 |
| LTE B25 | 1850-1915 | 0.48 | 1.12 | 25 | 316.23 | 20 | 0.070 | 1 |
| LTE B26 | 814-849 | -0.56 | 0.88 | 25 | 316.23 | 20 | 0.055 | 0.54 |
| LTE B38 | 2570-2620 | -0.12 | 0.97 | 25 | 316.23 | 20 | 0.061 | 1 |
| LTE B41 | 2496-2690 | 1.04 | 1.27 | 25 | 316.23 | 20 | 0.080 | 1 |
| LTE B66 | 1710-1780 | 0.1 | 1.02 | 25 | 316.23 | 20 | 0.064 | 1 |

Note:

1. The device contains a certified WWAN Module, FCC ID: 2ASWY23EG912UGL.
2. The WWAN Conducted output power comes from module report.
3. The antenna gain was provided by applicant.
4. For GSM, the duty cycle is 1/8 for 1 TX slots, 1/4 for 2 TX slots, 1/2.66 for 3 TX slots, 1/2 for 4 TX slots,

The BLE and WWAN can transmit simultaneously:

$$\sum_i \frac{S_i}{S_{Limit,i}}$$

$$=S_{BLE}/S_{limit-WLAN} + S_{WWAN}/S_{limit-WWAN}$$

$$=0.0015/1+0.083/0.55$$

$$=0.152$$

$$< 1.0$$

Result: The device meets FCC MPE at **20 cm** distance