

RF Exposure evaluation

FCC ID: **2A2FCBT4101**

1. Applicable Standard

According to §1.1307(b)(1), 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.

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

KDB447498 v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

2. Limit

FCC:

Systems operating under the provisions of FCC 47 CFR 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.

In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as mobile device whereby a distance of 0.2m normally can be maintained between the user and the device, and below RF Permissible Exposure limit shall comply with.

In accordance with KDB447498D01 for Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is ≤ 1.0 . The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency. Either the maximum peak or spatially averaged results from measurements or numerical simulations may be used to determine the MPE ratios. Spatial averaging does not apply when MPE is estimated using simple calculations based on far-field plane-wave equivalent conditions. The antenna installation and operating requirements for the host device must meet the minimum test separation distances required by all antennas, in both standalone and simultaneous transmission operations, to satisfy compliance.

Limits for Maximum Permissible Exposure (MPE)/Controlled Exposure

| Frequency Range(MHz) | Electric Field Strength(V/m) | Magnetic Field Strength(A/m) | Power Density (mW/cm ²) | Averaging Time (minute) |
|---|------------------------------|------------------------------|-------------------------------------|-------------------------|
| 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 – 1500 | / | / | f/300 | 6 |
| 1500 – 100,000 | / | / | 5 | 6 |

Limits for Maximum Permissible Exposure (MPE)/Uncontrolled Exposure

| Frequency Range(MHz) | Electric Field Strength(V/m) | Magnetic Field Strength(A/m) | Power Density (mW/cm ²) | Averaging Time (minute) |
|---|------------------------------|------------------------------|-------------------------------------|-------------------------|
| Limits for Occupational/Controlled Exposure | | | | |
| 0.3 – 3.0 | 614 | 1.63 | (100) * | 30 |
| 3.0 – 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

3. MPE Calculation Method

FCC:

Predication of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S=power density

P=power input to antenna

G=power gain of the antenna in the direction of interest relative to an isotropic radiator

R=distance to the center of radiation of the antenna

4. Result

| Mode | Minimum Separation Distance | Output Power (Turn-up Procedure) | | Antenna Gain (Numeric) | Power Density At 20 cm (mW/cm ²) | Power Density Limit (mW/cm ²) | MPE Ratios | Test Results |
|------------------|-----------------------------|----------------------------------|--------|------------------------|--|---|------------|--------------|
| | (cm) | dBm | mW | | | | | |
| LTE Band 2-M1 | 20.00 | 24.0 | 251.19 | 1.26 | 0.06294 | 1.0 | 0.06294 | PASS |
| LTE Band 4-M1 | 20.00 | 22.0 | 158.49 | 1.26 | 0.03971 | 1.0 | 0.03971 | PASS |
| LTE Band 5-M1 | 20.00 | 21.0 | 125.89 | 1.26 | 0.03155 | 0.549 | 0.05747 | PASS |
| LTE Band 12-M1 | 20.00 | 21.0 | 125.89 | 1.26 | 0.03155 | 0.466 | 0.06770 | PASS |
| LTE Band 13-M1 | 20.00 | 20.0 | 100.00 | 1.26 | 0.02506 | 0.518 | 0.04838 | PASS |
| LTE Band 18-M1 | 20.00 | 22.0 | 158.49 | 1.26 | 0.03971 | 0.543 | 0.07313 | PASS |
| LTE Band 19-M1 | 20.00 | 22.0 | 158.49 | 1.26 | 0.03971 | 0.553 | 0.07181 | PASS |
| LTE Band 25-M1 | 20.00 | 22.0 | 158.49 | 1.26 | 0.03971 | 1.0 | 0.03971 | PASS |
| LTE Band 26-M1 | 20.00 | 21.0 | 125.89 | 1.26 | 0.03155 | 0.543 | 0.05810 | PASS |
| LTE Band 66-M1 | 20.00 | 22.0 | 158.49 | 1.26 | 0.03971 | 1.0 | 0.03971 | PASS |
| LTE Band 85-M1 | 20.00 | 20.0 | 100.00 | 1.26 | 0.02506 | 0.519 | 0.04829 | PASS |
| LTE Band 2-NB2 | 20.00 | 23.0 | 199.53 | 1.26 | 0.05000 | 1.0 | 0.05000 | PASS |
| LTE Band 4- NB2 | 20.00 | 21.0 | 125.89 | 1.26 | 0.03155 | 1.0 | 0.03155 | PASS |
| LTE Band 5- NB2 | 20.00 | 21.0 | 125.89 | 1.26 | 0.03155 | 0.549 | 0.05747 | PASS |
| LTE Band 12- NB2 | 20.00 | 21.0 | 125.89 | 1.26 | 0.03155 | 0.466 | 0.06770 | PASS |
| LTE Band 13- NB2 | 20.00 | 22.0 | 158.49 | 1.26 | 0.03971 | 0.518 | 0.07666 | PASS |
| LTE Band 18- NB2 | 20.00 | 23.0 | 199.53 | 1.26 | 0.05000 | 0.543 | 0.09208 | PASS |
| LTE Band 19- NB2 | 20.00 | 23.0 | 199.53 | 1.26 | 0.05000 | 0.553 | 0.09042 | PASS |
| LTE Band 25- NB2 | 20.00 | 22.0 | 158.49 | 1.26 | 0.03971 | 1.0 | 0.03971 | PASS |
| LTE Band 66- NB2 | 20.00 | 22.0 | 158.49 | 1.26 | 0.03971 | 1.0 | 0.03971 | PASS |
| LTE Band 85- NB2 | 20.00 | 22.0 | 158.49 | 1.26 | 0.03971 | 0.465 | 0.08540 | PASS |
| BT | 20.00 | -2.08 | 0.62 | 1.78 | 0.00022 | 1.0 | 0.00022 | PASS |

Note: $F/1500$ (F =frequency in MHz)

Band 5: Power Density Limit (mW/cm²)= $824/1500=0.549$ mW/cm²

Band 12: Power Density Limit (mW/cm²)= $699/1500=0.466$ mW/cm²

Band 13: Power Density Limit (mW/cm²)= $777/1500=0.518$ mW/cm²

Band 18: Power Density Limit (mW/cm²)= $814/1500=0.543$ mW/cm²

Band 19: Power Density Limit (mW/cm²)= $830/1500=0.553$ mW/cm²

Band 26: Power Density Limit (mW/cm²)= $814/1500=0.543$ mW/cm²

Band 85: Power Density Limit (mW/cm²)= $778.8/1500=0.519$ mW/cm²

Band 85-NB2: Power Density Limit (mW/cm²)= $698/1500=0.465$ mW/cm²

5. Simultaneous transmission MPE Considerations

According to KDB447498 :For mobile exposure host platform to qualify for simultaneous transmission MPE test exclusion, all transmitters and antennas in the host must be either evaluated for MPE compliance, by measurement or computational modeling, or qualify for the standalone MPE test exclusion in section 7.1.

Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is ≤ 1.0 .

This means that:

$$\sum \text{ of MPE ratios} \leq 1.0$$

BT and LTE Simultaneous evaluation
0.00022+0.05000/0.543=0.0923 <1

6. Conclusion

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.