

# RF Exposure Evaluation Result

**FCC ID: ZO4-M2**

**Exposure category: General population/uncontrolled environment**

**EUT Type: Production Unit**

**Device Type: Mobile Device**

**Refer Standard: KDB 447498 D01 General RF Exposure Guidance v05r02 & FCC Part 2 §2.1091**

## 1. FCC Requirement

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 according with KDB447498 Sections 7.2. Transmitters used in mobile exposure conditions for simultaneous transmission operations:

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  $\leq 1.0$ . 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.

## 2. Limits

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 <sup>2</sup> ) | 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 <sup>2</sup> )*              | 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 <sup>2</sup> ) | 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 <sup>2</sup> )*              | 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. Calculation Method

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

From the peak EUT RF output power, the minimum mobile separation distance, d=0.2m, as well as the gain of the used antenna, the RF power density can be obtained.

### 4. Manufacturing tolerance

| 802.11b( Average) |      |      |      |
|-------------------|------|------|------|
| Channel           | 1    | 6    | 11   |
| Target (dBm)      | 15.0 | 15.0 | 15.0 |
| Tolerance ±(dB)   | 1.0  | 1.0  | 1.0  |

| 802.11g( Average) |      |      |      |
|-------------------|------|------|------|
| Channel           | 1    | 6    | 11   |
| Target (dBm)      | 10.0 | 10.0 | 10.0 |
| Tolerance ±(dB)   | 1.0  | 1.0  | 1.0  |

| 2.4G Transmitter (Peak) |      |      |      |
|-------------------------|------|------|------|
| Frequency               | 2402 | 2442 | 2480 |
| Target (dBm)            | 1.0  | 4.0  | 4.0  |
| Tolerance ±(dB)         | 1.0  | 1.0  | 1.0  |

## 5. Estimation Result

### 5.1 Standalone MPE

| Mode             | Frequency (MHz) | Average Output power (including tolerance) |       | Antenna Gain (dBi) | Antenna Gain (linear) | MPE (mW/cm <sup>2</sup> ) | MPE Ratio |
|------------------|-----------------|--|-------|--------------------|-----------------------|---------------------------|-----------|
|                  |                 | dBm  | mW    |                    |                       |                           |           |
| 11b              | 2412            | 16.0                                       | 39.81 | 0                  | 1.00                  | 0.0079                    | 0.0079    |
|                  | 2437            | 16.0                                       | 39.81 | 0                  | 1.00                  | 0.0079                    | 0.0079    |
|                  | 2462            | 16.0                                       | 39.81 | 0                  | 1.00                  | 0.0079                    | 0.0079    |
| 11g              | 2412            | 11.0                                       | 12.59 | 0                  | 1.00                  | 0.0025                    | 0.0025    |
|                  | 2437            | 11.0                                       | 12.59 | 0                  | 1.00                  | 0.0025                    | 0.0025    |
|                  | 2462            | 11.0                                       | 12.59 | 0                  | 1.00                  | 0.0025                    | 0.0025    |
| 2.4G Transmitter | 2402            | 2.0  | 1.58  | 0                  | 1.00                  | 0.0003                    | 0.0003    |
|                  | 2442            | 5.0  | 3.16  | 0                  | 1.00                  | 0.0006                    | 0.0006    |
|                  | 2480            | 5.0  | 3.16  | 0                  | 1.00                  | 0.0006                    | 0.0006    |

## 5.2 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  $\leq 1.0$ .

This means that:

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

For DUT can support WLAN and 2.4G transmitter modular, WLAN and 2.4G transmitter share difference transmit modular and difference antenna, WLAN and 2.4G transmitter can transmit signal simultaneously. Thus simultaneous transmission MPE of DUT should also need meet simultaneous transmission MPE limit.

| Maximum MPE ratios of WLAN | Maximum MPE ratios of 2.4G Transmitter | $\sum \text{MPE}_{\text{WLAN, BT}}$ ratios | Limit of $\sum$ of MPE ratios | Test Results |
|----------------------------|--|--|-------------------------------|--------------|
| 0.0079                     | 0.0006                                 | 0.0085                                     | 1.0                           | PASS         |

## 6. Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure.

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