



## MPE Report

Exposure category: General population/uncontrolled environment

EUT Type: Production Unit

Device Type: Mobile Device

Refer Standard: KDB 447498 D01 General RF Exposure Guidance v06

FCC Part 2 §2.1091

### 1. Evaluation method

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 HWB1BLE40AWH 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  $\leq 1.0$ . 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 for General Population/Uncontrolled Exposure

(B) Limits for General Population / Uncontrolled Exposure

| Frequency Range (MHz) | Electric Field Strength (E) (V/m) | Magnetic Field Strength (H) (A/m) | Power Density (S) (mW/cm <sup>2</sup> ) | Averaging Time  E  <sup>2</sup> ,  H  <sup>2</sup> or S (minutes) |
|-----------------------|-----------------------------------|-----------------------------------|---|---|
| 0.3-1.34              | 614                               | 1.63                              | (100)*                                  | 30  |
| 1.34-30               | 824/f                             | 2.19/f                            | (180/f)*                                | 30  |
| 30-300                | 27.5                              | 0.073                             | 0.2                                     | 30  |
| 300-1500              |                                   |                                   | F/1500                                  | 30  |
| 1500-100,000          |                                   |                                   | 1.0                                     | 30  |

Note: 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



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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 EUT RF output power, the minimum mobile separation distance,  $d=0.2\text{m}$ , as well as the maximum gain of the used 0dBi for Bluetooth, the RF power density can be obtained.

| Frequency Band | Antenna type and antenna number | Maximum antenna gain |
|----------------|---------------------------------|----------------------|
| BT             | BT Antenna                      | 2dBi                 |
| 2.4G           | WLAN Antenna                    | 0.44dBi              |

### 4. Estimation Result

#### 4.1 Conducted Power Results

##### *Bluetooth*

| Mode          | Channel | Frequency(MHz) | Peak Conducted Output Power (dBm) |
|---------------|---------|----------------|-----------------------------------|
| GFSK-BLE      | 00      | 2402           | 0.64                              |
|               | 19      | 2440           | 2.27                              |
|               | 39      | 2480           | 2.13                              |
| GFSK          | 00      | 2402           | 2.89                              |
|               | 39      | 2441           | 4.28                              |
|               | 78      | 2480           | 3.67                              |
| $\pi/4$ DQPSK | 00      | 2402           | 0.04                              |
|               | 39      | 2441           | 1.89                              |
|               | 78      | 2480           | 1.08                              |
| 8DPSK         | 00      | 2402           | 0.51                              |
|               | 39      | 2441           | 2.35                              |
|               | 78      | 2480           | 1.69                              |

##### *2.4GHz WIFI*

| Mode              | Frequency(MHz) | Peak Conducted Output Power (dBm) |
|-------------------|----------------|-----------------------------------|
| IEEE 802.11b      | 2412           | 12.77                             |
|                   | 2437           | 12.67                             |
|                   | 2462           | 12.67                             |
| IEEE 802.11g      | 2412           | 16.96                             |
|                   | 2437           | 17.21                             |
|                   | 2462           | 17.83                             |
| IEEE 802.11n HT20 | 2412           | 16.78                             |
|                   | 2437           | 17.21                             |
|                   | 2462           | 17.66                             |



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|                   |      |       |
|-------------------|------|-------|
| IEEE 802.11n HT40 | 2412 | 15.58 |
|                   | 2437 | 15.40 |
|                   | 2462 | 15.36 |

### 4.2 Manufacturing tolerance

#### *Bluetooth*

| GFSK-BLE                   |            |            |            |
|----------------------------|------------|------------|------------|
| Channel                    | Channel 00 | Channel 19 | Channel 39 |
| Maximum Output Power (dBm) | 0.64       | 2.27       | 2.13       |

| GFSK                       |            |            |            |
|----------------------------|------------|------------|------------|
| Channel                    | Channel 00 | Channel 39 | Channel 78 |
| Maximum Output Power (dBm) | 2.89       | 4.28       | 3.67       |

| $\pi/4$ DQPSK              |            |            |            |
|----------------------------|------------|------------|------------|
| Channel                    | Channel 00 | Channel 39 | Channel 78 |
| Maximum Output Power (dBm) | 0.04       | 1.89       | 1.08       |

| 8DPSK                      |            |            |            |
|----------------------------|------------|------------|------------|
| Channel                    | Channel 00 | Channel 39 | Channel 78 |
| Maximum Output Power (dBm) | 0.51       | 2.35       | 1.69       |

#### *2.4GHz WIFI*

| IEEE 802.11b               |       |       |       |
|----------------------------|-------|-------|-------|
| Frequency(MHz)             | 2412  | 2437  | 2462  |
| Maximum Output Power (dBm) | 12.77 | 12.67 | 12.67 |

| IEEE 802.11 g              |       |       |       |
|----------------------------|-------|-------|-------|
| Frequency(MHz)             | 2412  | 2437  | 2462  |
| Maximum Output Power (dBm) | 16.96 | 17.21 | 17.83 |

| IEEE 802.11n HT20          |       |       |       |
|----------------------------|-------|-------|-------|
| Frequency(MHz)             | 2412  | 2437  | 2462  |
| Maximum Output Power (dBm) | 16.78 | 17.21 | 17.66 |

| IEEE 802.11n HT40          |       |       |       |
|----------------------------|-------|-------|-------|
| Frequency(MHz)             | 2412  | 2437  | 2462  |
| Maximum Output Power (dBm) | 15.58 | 15.40 | 15.36 |



### 4.3 Measurement Results

#### 4.3.1 Standalone MPE

##### *Bluetooth*

| Mode           | Output power<br>(Including tune-up tolerance) |        | Antenna Gain<br>(dBi) | Antenna Gain<br>(linear) | Duty Cycle | MPE<br>(mW/cm <sup>2</sup> ) | MPE Limits<br>(mW/cm <sup>2</sup> ) |
|----------------|---|--------|-----------------------|--------------------------|------------|------------------------------|-------------------------------------|
|                | (dBm)   | (mW)   |                       |                          |            |                              |                                     |
| GFSK-LE        | 2.27  | 1.6866 | 2                     | 1.5849                   | 100%       | 0.00053                      | 1.0000                              |
| GFSK           | 4.28  | 2.6792 | 2                     | 1.5849                   | 100%       | 0.00085                      | 1.0000                              |
| 8DPSK          | 1.89  | 1.5453 | 2                     | 1.5849                   | 100%       | 0.00049                      | 1.0000                              |
| $\pi/4$ -DQPSK | 2.35  | 1.7179 | 2                     | 1.5849                   | 100%       | 0.00054                      | 1.0000                              |

##### *2.4GWLAN*

| Mode               | Output power |         | Antenna Gain<br>(dBi) | Antenna Gain<br>(linear) | Duty Cycle | MPE<br>(mW/cm <sup>2</sup> ) | MPE Limits<br>(mW/cm <sup>2</sup> ) |
|--------------------|--------------|---------|-----------------------|--------------------------|------------|------------------------------|-------------------------------------|
|                    | (dBm)        | (mW)    |                       |                          |            |                              |                                     |
| IEEE 802.11 b      | 12.77        | 18.9234 | 0.44                  | 1.1066                   | 100%       | 0.00417                      | 1.0000                              |
| IEEE 802.11 g      | 17.83        | 60.6736 | 0.44                  | 1.1066                   | 100%       | 0.01336                      | 1.0000                              |
| IEEE 802.11 n HT20 | 17.66        | 58.3445 | 0.44                  | 1.1066                   | 100%       | 0.01285                      | 1.0000                              |
| IEEE 802.11 n HT40 | 15.58        | 36.1410 | 0.44                  | 1.1066                   | 100%       | 0.00796                      | 1.0000                              |

##### *Maximum MPE Ratios for BT and 2.4GHz WLAN simultaneous transmission*

| Maximum MPE Ratio <sub>2.4GHzBT</sub> | Maximum MPE Ratio <sub>2.4GHzWLAN</sub> | $\Sigma$ MPEratios | Limit | Results |
|---------------------------------------|---|--------------------|-------|---------|
| 0.00085                               | 0.01336                                 | 0.01421            | 1.000 | Pass    |

##### *Remark:*

1. Maximum average power including tune-up tolerance;
2. MPE use distance is 20cm from manufacturer declaration of user manual.
3. We choose 2402 MHz for Bluetooth and 2412MHz (lowest frequency operate at 2.4GHz)to calculate MPE limit as higher frequency will have higher MPE limits

According to KDB447498 for Transmitters used in mobile exposure conditions for simultaneous transmission operations;

##### **Conclusion**

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

----- END OF REPORT-----