

## RF EXPOSURE EVALUATION

### Limits

According KDB 447498 D01 General RF Exposure Guidance v06.

The RF exposure evaluation requirements of §2.1091 for mobile device exposure conditions subject to MPE limits: Requirements of this section are a consequence of Commission responsibilities under the National Environmental Policy Act to evaluate the environmental significance of its actions. See subpart I of part 1 of this chapter, in particular § 1.1307(b).

For purposes of this section, the definitions in § 1.1307(b)(2) of this chapter shall apply. A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the RF source's radiating structure(s) and the body of the user or nearby persons. In this context, the term “fixed location” means that the device is physically secured at one location and is not able to be easily moved to another location while transmitting. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal desktop computer, are considered to be mobile devices if they meet the 20-centimeter separation requirement.

The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in 1.1307(b).

Limits for Maximum Permissible Exposure (MPE)

| Frequency range<br>(MHz)                                | Electric field<br>strength<br>(V/m) | Magnetic field strength<br>(A/m) | Power density<br>(mW/cm <sup>2</sup> ) | Averaging time<br>(minutes) |
|---------------------------------------------------------|-------------------------------------|----------------------------------|----------------------------------------|-----------------------------|
| (A) Limits for Occupational/Controlled Exposures        |                                     |                                  |                                        |                             |
| 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                           |
| (B) Limits for General Population/Uncontrolled Exposure |                                     |                                  |                                        |                             |
| 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                          |
| 300–1500                                                |                                     |                                  | f/1500                                 | 30                          |
| 1500–100,000                                            |                                     |                                  | 1.0                                    | 30                          |

f = frequency in MHz

Friis transmission formula:  $Pd = (P_{out} * G) / (4 * \pi * r^2)$

Where

**Pd** = power density in mW/cm<sup>2</sup>, **Pout** = output power to antenna in mW;

**G** = gain of antenna in linear scale, **Pi** = 3.1416;

**R** = distance between observation point and center of the radiator in cm

Pd is the limit of MPE, 1 mW/cm<sup>2</sup>. If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

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### Test Procedure

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

### Test Result of RF Exposure Evaluation

WIFI2.4G:

| Mode      | Output power to antenna (dBm) | Tune UP tolerance (dBm) | Max Tune UP power (dBm) | Max Tune UP power (mW) | Power Density at R=20cm (mW/cm2) | Limit (mW/cm2) | Result |
|-----------|-------------------------------|-------------------------|-------------------------|------------------------|----------------------------------|----------------|--------|
| 802.11b   | 17.92                         | 17±1                    | 18                      | 63.10                  | 0.02181                          | 1.0            | PASS   |
| 802.11g   | 15.59                         | 15±1                    | 16                      | 39.81                  | 0.01376                          | 1.0            | PASS   |
| 802.11n20 | 13.59                         | 13±1                    | 14                      | 25.12                  | 0.00868                          | 1.0            | PASS   |
| 802.11n40 | 12.31                         | 12±1                    | 13                      | 19.95                  | 0.00690                          | 1.0            | PASS   |

Antenna gain: 2.40dBi

WIFI5.1G:

| Mode       | Output power to antenna (dBm) | Tune UP tolerance (dBm) | Max Tune UP power (dBm) | Max Tune UP power (mW) | Power Density at R=20cm (mW/cm2) | Limit (mW/cm2) | Result |
|------------|-------------------------------|-------------------------|-------------------------|------------------------|----------------------------------|----------------|--------|
| 802.11a    | 13.34                         | 13±1                    | 14                      | 25.12                  | 0.00716                          | 1.0            | PASS   |
| 802.11n20  | 12.20                         | 12±1                    | 13                      | 19.95                  | 0.00569                          | 1.0            | PASS   |
| 802.11n40  | 12.64                         | 12±1                    | 13                      | 19.95                  | 0.00569                          | 1.0            | PASS   |
| 802.11ac20 | 11.48                         | 11±1                    | 12                      | 15.85                  | 0.00452                          | 1.0            | PASS   |
| 802.11ac40 | 10.96                         | 10±1                    | 11                      | 12.59                  | 0.00359                          | 1.0            | PASS   |
| 802.11ac80 | 9.41                          | 9±1                     | 10                      | 10.00                  | 0.00285                          | 1.0            | PASS   |

Antenna gain: 1.56dBi

Remark: The same antenna cannot transmit at the same time.