

## FCC RF Exposure

Exposure category: General population/uncontrolled environment

EUT Type: Production Unit

Device Type: Portable Device

Refer Standard: KDB 447498 D01 General RF Exposure Guidance v06

FCC Part 2 §2.1093

### Evaluation method

According to KDB447498 D01 General RF Exposure Guidance v06 Section 4.3.1 Standalone SAR test exclusion considerations: "Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Test Exclusion Threshold condition, listed below, is satisfied. These test exclusion conditions are based on source-based time-averaged maximum conducted output power of the RF channel requiring evaluation, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions.<sup>22</sup> The minimum test separation distance is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander (see 5) of section 4.1). To qualify for SAR test exclusion, the test separation distances applied must be fully explained and justified by the operating configurations and exposure conditions of the transmitter and applicable host platform requirements, typically in the SAR measurement or SAR analysis report, according to the required published RF exposure KDB procedures. When no other RF exposure testing or reporting is required, a statement of justification and compliance must be included in the equipment approval, in lieu of the SAR report, to qualify for the SAR test exclusion. When required, the device specific conditions described in the other published RF exposure KDB procedures must be satisfied before applying these SAR test exclusion provisions; for example, handheld PTT two-way radios, handsets, laptops & tablets etc.<sup>23</sup> "  
$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [f (\text{GHz})] \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR, where:}$$

- $f$  (GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

The test exclusions are applicable only when the minimum test separation distance is  $\leq 50$  mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is  $< 5$  mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

**Conducted Power Results:**

| <i>2.4GHz WLAN IEEE 802.11b</i>   |           |      |      |           |      |      |
|-----------------------------------|-----------|------|------|-----------|------|------|
| Frequency<br>(MHz)                | Antenna 0 |      |      | Antenna 1 |      |      |
|                                   | 2412      | 2437 | 2462 | 2412      | 2437 | 2462 |
| Peak Conducted Power<br>(dBm)     | 8.48      | 8.10 | 8.24 | 8.31      | 8.06 | 8.12 |
| <i>2.4GHz WLAN IEEE 802.11g</i>   |           |      |      |           |      |      |
| Frequency<br>(MHz)                | Antenna 0 |      |      | Antenna 1 |      |      |
|                                   | 2412      | 2437 | 2462 | 2412      | 2437 | 2462 |
| Peak Conducted Power<br>(dBm)     | 7.56      | 7.42 | 7.81 | 7.58      | 7.39 | 7.19 |
| <i>2.4GHz WLAN IEEE 802.11n20</i> |           |      |      |           |      |      |
| Frequency<br>(MHz)                | Antenna 0 |      |      | Antenna 1 |      |      |
|                                   | 2412      | 2437 | 2462 | 2412      | 2437 | 2462 |
| Peak Conducted Power<br>(dBm)     | 5.42      | 5.39 | 5.31 | 5.38      | 5.41 | 5.29 |
| <i>2.4GHz WLAN IEEE 802.11n40</i> |           |      |      |           |      |      |
| Frequency<br>(MHz)                | Antenna 0 |      |      | Antenna 1 |      |      |
|                                   | 2422      | 2437 | 2452 | 2422      | 2437 | 2452 |
| Peak Conducted Power<br>(dBm)     | 5.37      | 5.34 | 5.36 | 5.33      | 5.24 | 5.40 |

| <i>5GHz WLAN IEEE 802.11a</i>      |           |      |      |           |      |      |
|------------------------------------|-----------|------|------|-----------|------|------|
| Frequency<br>(MHz)                 | Antenna 0 |      |      | Antenna 1 |      |      |
|                                    | 5745      | 5785 | 5825 | 5745      | 5785 | 5825 |
| Peak Conducted Power<br>(dBm)      | 3.46      | 3.39 | 3.41 | 3.42      | 3.40 | 3.38 |
| <i>5GHz WLAN IEEE 802.11n HT20</i> |           |      |      |           |      |      |
| Frequency<br>(MHz)                 | Antenna 0 |      |      | Antenna 1 |      |      |
|                                    | 5745      | 5785 | 5825 | 5745      | 5785 | 5825 |
| Peak Conducted Power<br>(dBm)      | 3.02      | 3.05 | 3.12 | 3.11      | 3.02 | 3.06 |
| <i>5GHz WLAN IEEE 802.11n HT40</i> |           |      |      |           |      |      |
| Frequency<br>(MHz)                 | Antenna 0 |      |      | Antenna 1 |      |      |
|                                    | 5755      | /    | 5795 | 5755      | /    | 5795 |
| Peak Conducted Power<br>(dBm)      | 3.07      | /    | 3.01 | 3.02      | /    | 3.04 |

**Manufacturing tolerance:**

| 2.4GHz WLAN IEEE 802.11b   |           |      |      |           |      |      |
|----------------------------|-----------|------|------|-----------|------|------|
| Frequency<br>(MHz)         | Antenna 0 |      |      | Antenna 1 |      |      |
|                            | 2412      | 2437 | 2462 | 2412      | 2437 | 2462 |
| Target (dBm)               | 8.0       | 8.0  | 8.0  | 8.0       | 8.0  | 8.0  |
| Tolerance $\pm$ (dB)       | 1.0       | 1.0  | 1.0  | 1.0       | 1.0  | 1.0  |
| 2.4GHz WLAN IEEE 802.11g   |           |      |      |           |      |      |
| Frequency<br>(MHz)         | Antenna 0 |      |      | Antenna 1 |      |      |
|                            | 2412      | 2437 | 2462 | 2412      | 2437 | 2462 |
| Target (dBm)               | 7.0       | 7.0  | 7.0  | 7.0       | 7.0  | 7.0  |
| Tolerance $\pm$ (dB)       | 1.0       | 1.0  | 1.0  | 1.0       | 1.0  | 1.0  |
| 2.4GHz WLAN IEEE 802.11n20 |           |      |      |           |      |      |
| Frequency<br>(MHz)         | Antenna 0 |      |      | Antenna 1 |      |      |
|                            | 2412      | 2437 | 2462 | 2412      | 2437 | 2462 |
| Target (dBm)               | 5.5       | 5.5  | 5.5  | 5.5       | 5.5  | 5.5  |
| Tolerance $\pm$ (dB)       | 1.0       | 1.0  | 1.0  | 1.0       | 1.0  | 1.0  |
| 2.4GHz WLAN IEEE 802.11n40 |           |      |      |           |      |      |
| Frequency<br>(MHz)         | Antenna 0 |      |      | Antenna 1 |      |      |
|                            | 2422      | 2437 | 2452 | 2422      | 2437 | 2452 |
| Target (dBm)               | 5.5       | 5.5  | 5.5  | 5.5       | 5.5  | 5.5  |
| Tolerance $\pm$ (dB)       | 1.0       | 1.0  | 1.0  | 1.0       | 1.0  | 1.0  |

| 5GHz WLAN IEEE 802.11a      |           |      |      |           |      |      |
|-----------------------------|-----------|------|------|-----------|------|------|
| Frequency<br>(MHz)          | Antenna 0 |      |      | Antenna 1 |      |      |
|                             | 5745      | 5785 | 5825 | 5745      | 5785 | 5825 |
| Target (dBm)                | 3.5       | 3.5  | 3.5  | 3.5       | 3.5  | 3.5  |
| Tolerance $\pm$ (dB)        | 1.0       | 1.0  | 1.0  | 1.0       | 1.0  | 1.0  |
| 5GHz WLAN IEEE 802.11n HT20 |           |      |      |           |      |      |
| Frequency<br>(MHz)          | Antenna 0 |      |      | Antenna 1 |      |      |
|                             | 5745      | 5785 | 5825 | 5745      | 5785 | 5825 |
| Target (dBm)                | 3.0       | 3.0  | 3.0  | 3.0       | 3.0  | 3.0  |
| Tolerance $\pm$ (dB)        | 1.0       | 1.0  | 1.0  | 1.0       | 1.0  | 1.0  |
| 5GHz WLAN IEEE 802.11n HT40 |           |      |      |           |      |      |
| Frequency<br>(MHz)          | Antenna 0 |      |      | Antenna 1 |      |      |
|                             | 5755      | /    | 5795 | 5755      | /    | 5795 |
| Target (dBm)                | 3.0       | /    | 3.0  | 3.0       | /    | 3.0  |
| Tolerance $\pm$ (dB)        | 1.0       | /    | 1.0  | 1.0       | /    | 1.0  |

## Evaluation Results

### Standalone MPE:

#### 2.4GHz WLAN

##### Antenna 0

| Band/Mode     | f (MHz) | Antenna Distance (mm) | RF output power (including tune-up tolerance) |        | SAR Test Exclusion Threshold | SAR Test Exclusion |
|---------------|---------|-----------------------|-----------------------------------------------|--------|------------------------------|--------------------|
|               |         |                       | dBm                                           | mW     |                              |                    |
| 802.11b       | 2412    | 5                     | 9                                             | 7.9433 | 2.4673<3.0                   | Yes                |
|               | 2437    | 5                     | 9                                             | 7.9433 | 2.4800<3.0                   | Yes                |
|               | 2462    | 5                     | 9                                             | 7.9433 | 2.4927<3.0                   | Yes                |
| 802.11g       | 2412    | 5                     | 8                                             | 6.3096 | 1.9599<3.0                   | Yes                |
|               | 2437    | 5                     | 8                                             | 6.3096 | 1.9700 <3.0                  | Yes                |
|               | 2462    | 5                     | 8                                             | 6.3096 | 1.9800 <3.0                  | Yes                |
| 802.11n(HT20) | 2412    | 5                     | 6.5                                           | 5.0119 | 1.5568 <3.0                  | Yes                |
|               | 2437    | 5                     | 6.5                                           | 5.0119 | 1.5648 <3.0                  | Yes                |
|               | 2462    | 5                     | 6.5                                           | 5.0119 | 1.5728 <3.0                  | Yes                |
| 802.11n(HT40) | 2422    | 5                     | 6.5                                           | 5.0119 | 1.5600 <3.0                  | Yes                |
|               | 2437    | 5                     | 6.5                                           | 5.0119 | 1.5648 <3.0                  | Yes                |
|               | 2452    | 5                     | 6.5                                           | 5.0119 | 1.5696 <3.0                  | Yes                |

##### Antenna 1

| Band/Mode     | f (MHz) | Antenna Distance (mm) | RF output power (including tune-up tolerance) |        | SAR Test Exclusion Threshold | SAR Test Exclusion |
|---------------|---------|-----------------------|-----------------------------------------------|--------|------------------------------|--------------------|
|               |         |                       | dBm                                           | mW     |                              |                    |
| 802.11b       | 2412    | 5                     | 9                                             | 7.9433 | 2.4673<3.0                   | Yes                |
|               | 2437    | 5                     | 9                                             | 7.9433 | 2.4800<3.0                   | Yes                |
|               | 2462    | 5                     | 9                                             | 7.9433 | 2.4927<3.0                   | Yes                |
| 802.11g       | 2412    | 5                     | 8                                             | 6.3096 | 1.9599<3.0                   | Yes                |
|               | 2437    | 5                     | 8                                             | 6.3096 | 1.9700 <3.0                  | Yes                |
|               | 2462    | 5                     | 8                                             | 6.3096 | 1.9800 <3.0                  | Yes                |
| 802.11n(HT20) | 2412    | 5                     | 6.5                                           | 5.0119 | 1.5568 <3.0                  | Yes                |
|               | 2437    | 5                     | 6.5                                           | 5.0119 | 1.5648 <3.0                  | Yes                |
|               | 2462    | 5                     | 6.5                                           | 5.0119 | 1.5728 <3.0                  | Yes                |
| 802.11n(HT40) | 2422    | 5                     | 6.5                                           | 5.0119 | 1.5600 <3.0                  | Yes                |
|               | 2437    | 5                     | 6.5                                           | 5.0119 | 1.5648 <3.0                  | Yes                |
|               | 2452    | 5                     | 6.5                                           | 5.0119 | 1.5696 <3.0                  | Yes                |

## 5GHz WLAN

## Antenna 0

| Band/Mode     | f (MHz) | Antenna Distance (mm) | RF output power (including tune-up tolerance) |        | SAR Test Exclusion Threshold | SAR Test Exclusion |
|---------------|---------|-----------------------|-----------------------------------------------|--------|------------------------------|--------------------|
|               |         |                       | dBm                                           | mW     |                              |                    |
| 802.11a       | 5745    | 5                     | 4.5                                           | 2.8184 | 1.3511<3.0                   | Yes                |
|               | 5785    | 5                     | 4.5                                           | 2.8184 | 1.3558<3.0                   | Yes                |
|               | 5825    | 5                     | 4.5                                           | 2.8184 | 1.3604<3.0                   | Yes                |
| 802.11n(HT20) | 5745    | 5                     | 4.0                                           | 2.5119 | 1.2041<3.0                   | Yes                |
|               | 5785    | 5                     | 4.0                                           | 2.5119 | 1.2083 <3.0                  | Yes                |
|               | 5825    | 5                     | 4.0                                           | 2.5119 | 1.2125 <3.0                  | Yes                |
| 802.11n(HT40) | 5755    | 5                     | 4.0                                           | 2.5119 | 1.2052 <3.0                  | Yes                |
|               | /       | /                     | /                                             | /      | /                            | /                  |
|               | 5795    | 5                     | 4.0                                           | 2.5119 | 1.2094 <3.0                  | Yes                |

## Antenna 1

| Band/Mode     | f (MHz) | Antenna Distance (mm) | RF output power (including tune-up tolerance) |        | SAR Test Exclusion Threshold | SAR Test Exclusion |
|---------------|---------|-----------------------|-----------------------------------------------|--------|------------------------------|--------------------|
|               |         |                       | dBm                                           | mW     |                              |                    |
| 802.11a       | 5745    | 5                     | 4.5                                           | 2.8184 | 1.3511<3.0                   | Yes                |
|               | 5785    | 5                     | 4.5                                           | 2.8184 | 1.3558<3.0                   | Yes                |
|               | 5825    | 5                     | 4.5                                           | 2.8184 | 1.3604<3.0                   | Yes                |
| 802.11n(HT20) | 5745    | 5                     | 4.0                                           | 2.5119 | 1.2041<3.0                   | Yes                |
|               | 5785    | 5                     | 4.0                                           | 2.5119 | 1.2083 <3.0                  | Yes                |
|               | 5825    | 5                     | 4.0                                           | 2.5119 | 1.2125 <3.0                  | Yes                |
| 802.11n(HT40) | 5755    | 5                     | 4.0                                           | 2.5119 | 1.2052 <3.0                  | Yes                |
|               | /       | /                     | /                                             | /      | /                            | /                  |
|               | 5795    | 5                     | 4.0                                           | 2.5119 | 1.2094 <3.0                  | Yes                |

## Simultaneous Transmission MPE:

Summary simultaneous transmission information:

| Modulation Type   | Work Frequency Band | Transmit Antenna |           | Antenna 0<br>Antenna 1<br>Synchronization transmit | Antenna 0<br>Antenna 1<br>Synchronization transmit |
|-------------------|---------------------|------------------|-----------|----------------------------------------------------|----------------------------------------------------|
|                   |                     | Antenna 0        | Antenna 1 |                                                    |                                                    |
| IEEE 802.11a      | 5.8GHz              | Yes              | Yes       | No                                                 | Yes                                                |
| IEEE 802.11b      | 2.4GHz              | Yes              | Yes       | No                                                 |                                                    |
| IEEE 802.11g      | 2.4GHz              | Yes              | Yes       | No                                                 |                                                    |
| IEEE 802.11n HT20 | 2.4GHz              | Yes              | Yes       | Yes                                                |                                                    |
| IEEE 802.11n HT20 | 5.8GHz              | Yes              | Yes       | Yes                                                |                                                    |
| IEEE 802.11n HT40 | 2.4GHz              | Yes              | Yes       | Yes                                                |                                                    |
| IEEE 802.11n HT40 | 5.8GHz              | Yes              | Yes       | Yes                                                |                                                    |

Summary simultaneous transmission results:

*Antenna 0, Antenna 1 for 2.4GWLAN*

| Band/Mode     | f (MHz) | Antenna Distance (mm) | RF output power<br>(including tune-up tolerance) |                 |          | SAR Test Exclusion Threshold | SAR Test Exclusion |
|---------------|---------|-----------------------|--------------------------------------------------|-----------------|----------|------------------------------|--------------------|
|               |         |                       | Antenna 0 (dBm)                                  | Antenna 0 (dBm) | Sum (mW) |                              |                    |
| 802.11b       | 2412    | 5                     | 9                                                | 9               | /        | /                            | /                  |
|               | 2437    | 5                     | 9                                                | 9               | /        | /                            | /                  |
|               | 2462    | 5                     | 9                                                | 9               | /        | /                            | /                  |
| 802.11g       | 2412    | 5                     | 8                                                | 8               | /        | /                            | /                  |
|               | 2437    | 5                     | 8                                                | 8               | /        | /                            | /                  |
|               | 2462    | 5                     | 8                                                | 8               | /        | /                            | /                  |
| 802.11n(HT20) | 2412    | 5                     | 6.5                                              | 6.5             | 8.9337   | 2.7749 <3.0                  | Yes                |
|               | 2437    | 5                     | 6.5                                              | 6.5             | 8.9337   | 2.7893 <3.0                  | Yes                |
|               | 2462    | 5                     | 6.5                                              | 6.5             | 8.9337   | 2.8035 <3.0                  | Yes                |
| 802.11n(HT40) | 2422    | 5                     | 6.5                                              | 6.5             | 8.9337   | 2.7807 <3.0                  | Yes                |
|               | 2437    | 5                     | 6.5                                              | 6.5             | 8.9337   | 2.7893 <3.0                  | Yes                |
|               | 2452    | 5                     | 6.5                                              | 6.5             | 8.9337   | 2.7978 <3.0                  | Yes                |

*Antenna 0 and Antenna 1 for 5GWLAN*

| Band/Mode     | f (MHz) | Antenna Distance (mm) | RF output power<br>(including tune-up tolerance) |                 |          | SAR Test Exclusion Threshold | SAR Test Exclusion |
|---------------|---------|-----------------------|--------------------------------------------------|-----------------|----------|------------------------------|--------------------|
|               |         |                       | Antenna 0 (dBm)                                  | Antenna 0 (dBm) | Sum (mW) |                              |                    |
| 802.11a       | 5745    | 5                     | 4.5                                              | 4.5             | /        | /                            | /                  |
|               | 5785    | 5                     | 4.5                                              | 4.5             | /        | /                            | /                  |
|               | 5825    | 5                     | 4.5                                              | 4.5             | /        | /                            | /                  |
| 802.11n(HT20) | 5745    | 5                     | 4.0                                              | 4.0             | 5.0238   | 2.4083 <3.0                  | Yes                |
|               | 5785    | 5                     | 4.0                                              | 4.0             | 5.0238   | 2.4167 <3.0                  | Yes                |
|               | 5825    | 5                     | 4.0                                              | 4.0             | 5.0238   | 2.4250 <3.0                  | Yes                |
| 802.11n(HT40) | 5755    | 5                     | 4.0                                              | 4.0             | 5.0238   | 2.4104 <3.0                  | Yes                |
|               | /       | /                     | /                                                | /               | /        | /                            | /                  |
|               | 5795    | 5                     | 4.0                                              | 4.0             | 5.0238   | 2.4187 <3.0                  | Yes                |

Note: 2.4GHz WLAN and 5GHz WLAN can not transmit simultaneously they share the same antennas.

**Conclusion**

The measurement results comply with the FCC Limit per 47 CFR 2.1093 for the uncontrolled RF Exposure and SAR Exclusion Threshold per KDB 447498 v06.

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