

## RF Exposure Evaluation

According to KDB 447498 D01 General RF Exposure Guidance v06 and part 2.1091, 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(s), listed below, is (are) satisfied.

## Limits

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 (MHz)                                   | Electric field strength (V/m) | Magnetic field strength (A/m) | Power density (mW/cm <sup>2</sup> ) | Averaging time (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.

## 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

|     | Modulation | Rate  | Frequency MHz | Output power to antenna (dBm) | Target power W/tolerance (dBm) | Max Output power to antenna (dBm) | Antenna Gain | Max Output power to antenna (mW) | Power Density at R=20cm (mW/cm <sup>2</sup> ) | Limit (mW/cm <sup>2</sup> ) | Result |
|-----|------------|-------|---------------|-------------------------------|--------------------------------|-----------------------------------|--------------|----------------------------------|-----------------------------------------------|-----------------------------|--------|
| BLE | GFSK       | 1Mbps | 2402          | -1.71                         | -1.5±1                         | -0.5                              | 3.59         | 0.891251                         | 0.000405                                      | 1.0                         | PASS   |
|     |            |       | 2440          | -1.26                         | -1±1                           | 0                                 | 3.59         | 1.000000                         | 0.000455                                      | 1.0                         | PASS   |
|     |            |       | 2480          | -1.59                         | -1.5±1                         | -0.5                              | 3.59         | 0.891251                         | 0.000405                                      | 1.0                         | PASS   |
|     |            | 2Mbps | 2402          | -1.78                         | -1.5±1                         | -0.5                              | 3.59         | 0.891251                         | 0.000405                                      | 1.0                         | PASS   |
|     |            |       | 2440          | -1.35                         | -1±1                           | 0                                 | 3.59         | 1.000000                         | 0.000455                                      | 1.0                         | PASS   |
|     |            |       | 2480          | -1.76                         | -1.5±1                         | -0.5                              | 3.59         | 0.891251                         | 0.000405                                      | 1.0                         | PASS   |

|           | Modulation      | Frequency MHz | Output power to antenna (dBm) | Target power W/tolerance (dBm) | Max Output power to antenna (dBm) | Antenna Gain | Max Output power to antenna (mW) | Power Density at R=20cm (mW/cm <sup>2</sup> ) | Limit (mW/cm <sup>2</sup> ) | Result |
|-----------|-----------------|---------------|-------------------------------|--------------------------------|-----------------------------------|--------------|----------------------------------|-----------------------------------------------|-----------------------------|--------|
| WIFI 2.4G | 802.11b         | 2412          | 16.09                         | 16±1                           | 17                                | 3.59         | 50.118723                        | 0.022789                                      | 1.0                         | PASS   |
|           |                 | 2437          | 15.37                         | 15±1                           | 16                                | 3.59         | 39.810717                        | 0.018102                                      | 1.0                         | PASS   |
|           |                 | 2462          | 14.14                         | 14±1                           | 15                                | 3.59         | 31.622777                        | 0.014379                                      | 1.0                         | PASS   |
|           | 802.11g         | 2412          | 20.93                         | 21±1                           | 22                                | 3.59         | 158.489319                       | 0.072066                                      | 1.0                         | PASS   |
|           |                 | 2437          | 18.03                         | 18±1                           | 19                                | 3.59         | 79.432823                        | 0.036119                                      | 1.0                         | PASS   |
|           |                 | 2462          | 17.25                         | 17±1                           | 18                                | 3.59         | 63.095734                        | 0.028690                                      | 1.0                         | PASS   |
|           | 802.11n (HT20)  | 2412          | 18.75                         | 19±1                           | 20                                | 3.59         | 100.000000                       | 0.045471                                      | 1.0                         | PASS   |
|           |                 | 2437          | 18.12                         | 18±1                           | 19                                | 3.59         | 79.432823                        | 0.036119                                      | 1.0                         | PASS   |
|           |                 | 2462          | 17.25                         | 17±1                           | 18                                | 3.59         | 63.095734                        | 0.028690                                      | 1.0                         | PASS   |
|           | 802.11ax (HE20) | 2412          | 20.38                         | 20±1                           | 21                                | 3.59         | 125.892541                       | 0.057244                                      | 1.0                         | PASS   |
|           |                 | 2437          | 19.74                         | 20±1                           | 21                                | 3.59         | 125.892541                       | 0.057244                                      | 1.0                         | PASS   |
|           |                 | 2462          | 18.90                         | 19±1                           | 20                                | 3.59         | 100.000000                       | 0.045471                                      | 1.0                         | PASS   |
|           | 802.11n (HT40)  | 2422          | 19.05                         | 19±1                           | 20                                | 3.59         | 100.000000                       | 0.045471                                      | 1.0                         | PASS   |
|           |                 | 2437          | 18.63                         | 19±1                           | 20                                | 3.59         | 100.000000                       | 0.045471                                      | 1.0                         | PASS   |
|           |                 | 2462          | 18.15                         | 18±1                           | 19                                | 3.59         | 79.432823                        | 0.036119                                      | 1.0                         | PASS   |
|           | 802.11ax (HE40) | 2422          | 20.16                         | 20±1                           | 21                                | 3.59         | 125.892541                       | 0.057244                                      | 1.0                         | PASS   |
|           |                 | 2437          | 19.77                         | 20±1                           | 21                                | 3.59         | 125.892541                       | 0.057244                                      | 1.0                         | PASS   |
|           |                 | 2452          | 19.40                         | 19±1                           | 20                                | 3.59         | 100.000000                       | 0.045471                                      | 1.0                         | PASS   |

|           | Modulation   | Frequency<br>MHz | Output<br>power to<br>antenna<br>(dBm) | Target<br>power<br>W/tolerance<br>(dBm) | Max<br>Output<br>power to<br>antenna<br>(dBm) | Max<br>Output<br>power to<br>antenna<br>(mW) | Power<br>Density at<br>R=20cm<br>(mW/cm <sup>2</sup> ) | Limit<br>(mW/cm <sup>2</sup> ) | Result |
|-----------|--------------|------------------|----------------------------------------|-----------------------------------------|-----------------------------------------------|----------------------------------------------|--------------------------------------------------------|--------------------------------|--------|
| Wifi 5.2g | 802.11a      | 5180             | 14.44                                  | 14±1                                    | 15                                            | 31.622777                                    | 0.013700                                               | 1.0                            | PASS   |
|           |              | 5200             | 13.91                                  | 14±1                                    | 15                                            | 31.622777                                    | 0.013700                                               | 1.0                            | PASS   |
|           |              | 5240             | 14.75                                  | 15±1                                    | 16                                            | 39.810717                                    | 0.017248                                               | 1.0                            | PASS   |
|           | 802.11n(20)  | 5180             | 13.74                                  | 14±1                                    | 15                                            | 31.622777                                    | 0.013700                                               | 1.0                            | PASS   |
|           |              | 5200             | 14.6                                   | 15±1                                    | 16                                            | 39.810717                                    | 0.017248                                               | 1.0                            | PASS   |
|           |              | 5240             | 15.32                                  | 15±1                                    | 16                                            | 39.810717                                    | 0.017248                                               | 1.0                            | PASS   |
|           | 802.11n(40)  | 5190             | 12.44                                  | 12±1                                    | 13                                            | 19.952623                                    | 0.008644                                               | 1.0                            | PASS   |
|           |              | 5230             | 12.97                                  | 13±1                                    | 14                                            | 25.118864                                    | 0.010883                                               | 1.0                            | PASS   |
|           | 802.11ac(20) | 5180             | 12.91                                  | 13±1                                    | 14                                            | 25.118864                                    | 0.010883                                               | 1.0                            | PASS   |
|           |              | 5200             | 13.96                                  | 14±1                                    | 15                                            | 31.622777                                    | 0.013700                                               | 1.0                            | PASS   |
|           |              | 5240             | 13.89                                  | 14±1                                    | 15                                            | 31.622777                                    | 0.013700                                               | 1.0                            | PASS   |
|           | 802.11ac(40) | 5190             | 12.51                                  | 13±1                                    | 14                                            | 25.118864                                    | 0.010883                                               | 1.0                            | PASS   |
|           |              | 5230             | 12.93                                  | 13±1                                    | 14                                            | 25.118864                                    | 0.010883                                               | 1.0                            | PASS   |
|           | 802.11ax(20) | 5180             | 13.48                                  | 13±1                                    | 14                                            | 25.118864                                    | 0.010883                                               | 1.0                            | PASS   |
|           |              | 5200             | 13.72                                  | 14±1                                    | 15                                            | 31.622777                                    | 0.013700                                               | 1.0                            | PASS   |
|           |              | 5240             | 13.76                                  | 14±1                                    | 15                                            | 31.622777                                    | 0.013700                                               | 1.0                            | PASS   |
|           | 802.11ax(40) | 5190             | 11.99                                  | 12±1                                    | 13                                            | 19.952623                                    | 0.008644                                               | 1.0                            | PASS   |
|           |              | 5230             | 12.67                                  | 13±1                                    | 14                                            | 25.118864                                    | 0.010883                                               | 1.0                            | PASS   |

|           | Modulation   | Frequency<br>MHz | Output<br>power to<br>antenna<br>(dBm) | Target<br>power<br>W/tolerance<br>(dBm) | Max<br>Output<br>power to<br>antenna<br>(dBm) | Max<br>Output<br>power to<br>antenna<br>(mW) | Power<br>Density at<br>R=20cm<br>(mW/cm <sup>2</sup> ) | Limit<br>(mW/cm <sup>2</sup> ) | Result |
|-----------|--------------|------------------|----------------------------------------|-----------------------------------------|-----------------------------------------------|----------------------------------------------|--------------------------------------------------------|--------------------------------|--------|
| Wifi 5.8g | 802.11a      | 5745             | 14.52                                  | 15±1                                    | 16                                            | 39.810717                                    | 0.019087                                               | 1.0                            | PASS   |
|           |              | 5785             | 15.07                                  | 15±1                                    | 16                                            | 39.810717                                    | 0.019087                                               | 1.0                            | PASS   |
|           |              | 5825             | 13.63                                  | 14±1                                    | 15                                            | 31.622777                                    | 0.015161                                               | 1.0                            | PASS   |
|           | 802.11n(20)  | 5745             | 15.19                                  | 15±1                                    | 16                                            | 39.810717                                    | 0.019087                                               | 1.0                            | PASS   |
|           |              | 5785             | 14.26                                  | 14±1                                    | 15                                            | 31.622777                                    | 0.015161                                               | 1.0                            | PASS   |
|           |              | 5825             | 15.1                                   | 15±1                                    | 16                                            | 39.810717                                    | 0.019087                                               | 1.0                            | PASS   |
|           | 802.11n(40)  | 5755             | 15.81                                  | 16±1                                    | 17                                            | 50.118723                                    | 0.024029                                               | 1.0                            | PASS   |
|           |              | 5795             | 15.45                                  | 15±1                                    | 16                                            | 39.810717                                    | 0.019087                                               | 1.0                            | PASS   |
|           | 802.11ac(20) | 5745             | 16.05                                  | 16±1                                    | 17                                            | 50.118723                                    | 0.024029                                               | 1.0                            | PASS   |
|           |              | 5785             | 14.79                                  | 15±1                                    | 16                                            | 39.810717                                    | 0.019087                                               | 1.0                            | PASS   |
|           |              | 5825             | 14.36                                  | 14±1                                    | 15                                            | 31.622777                                    | 0.015161                                               | 1.0                            | PASS   |

|  |              |      |       |            |    |           |          |     |      |
|--|--------------|------|-------|------------|----|-----------|----------|-----|------|
|  | 802.11ac(40) | 5755 | 15.28 | $15 \pm 1$ | 16 | 39.810717 | 0.019087 | 1.0 | PASS |
|  |              | 5795 | 14.77 | $15 \pm 1$ | 16 | 39.810717 | 0.019087 | 1.0 | PASS |
|  | 802.11ax(20) | 5745 | 15.42 | $15 \pm 1$ | 16 | 39.810717 | 0.019087 | 1.0 | PASS |
|  |              | 5785 | 14.69 | $15 \pm 1$ | 16 | 39.810717 | 0.019087 | 1.0 | PASS |
|  |              | 5825 | 14.62 | $15 \pm 1$ | 16 | 39.810717 | 0.019087 | 1.0 | PASS |
|  | 802.11ax(40) | 5755 | 14.77 | $15 \pm 1$ | 16 | 39.810717 | 0.019087 | 1.0 | PASS |
|  |              | 5795 | 14.51 | $15 \pm 1$ | 16 | 39.810717 | 0.019087 | 1.0 | PASS |

Remark: 1. BT& wifi 2.4g Antenna gain is 3.59dBi

wifi 5.2g Antenna gain is 3.38dBi, wifi 5.8g Antenna gain is 3.82dBi

1. BLE and wifi can transmit at the same time

2. In the case of simultaneous launches for wifi and BT:

The Max Calc. Thresholds : BLE: 0.000455, Wifi 2.4G: 0.072066 Wifi 5.8G: 0.024029

BT and Wifi:  $0.000455 + 0.072066 + 0.024029 = 0.09655 \leq 1$

So a SAR test is not required