

## RF Exposure evaluation

### FCC ID: **2AKBS-GE0003**

According to 447498 D01 General RF Exposure Guidance v06

#### 4.3. General SAR test exclusion guidance

##### 4.3.1. Standalone SAR test exclusion considerations

- a) For 100 MHz to 6 GHz and test separation distances  $\leq 50$  mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:  $[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$  for 1-g SAR, and  $\leq 7.5$  for 10-g extremity SAR,<sup>30</sup> where

- $f(\text{GHz})$  is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation<sup>31</sup>
- The result is rounded to one decimal place for comparison
- The values 3.0 and 7.5 are referred to as numeric thresholds in step b) 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 4.1 f) is applied to determine SAR test exclusion.

<sup>30</sup> This is equivalent to the formula written as:  $[(\text{max. power of channel, including tune-up tolerance, mW}) / (60 / \sqrt{f(\text{GHz})} \text{ mW})] \cdot [20 \text{ mm} / (\text{min. test separation distance, mm})] \leq 1.0$  for 1-g SAR; also see Appendix A for approximate exclusion threshold numerical values at selected frequencies and distances.

$$\text{eirp} = \text{pt} \times \text{gt} = (\text{EXd})^2 / 30$$

where:

pt = transmitter output power in watts,

gt = numeric gain of the transmitting antenna (unitless),

E = electric field strength in V/m, ---  $10((\text{dBuV/m})/20)/10^6$

d = measurement distance in meters (m)---3m

So  $\text{pt} = (\text{EXd})^2 / 30 \times \text{gt}$

**RF Exposure evaluation**

Copied from the FCC test report: clause 9.4 Maximum Peak Output Power

**Test Result:**

For BLE:

| Test Mode | Frequency<br>MHz | Reading<br>dBm | Output Power<br>mW | Limit<br>mW |
|-----------|------------------|----------------|--------------------|-------------|
| GFSK(BLE) | 2402             | 0.93           | 1.24               | 1000        |
|           | 2442             | 1.65           | 1.46               | 1000        |
|           | 2480             | 1.12           | 1.29               | 1000        |

*Note: the antenna gain of 0.5dB less than 6dBi maximum permission antenna gain value based on 1 watt peak output power limit.*

Then we choose Normal mode channel as the worst case of Maximum Peak Output Power:

| Test Mode | Frequency<br>MHz | Reading<br>dBm | Output Power<br>mW | Limit<br>mW |
|-----------|------------------|----------------|--------------------|-------------|
| GFSK(BLE) | 2402             | 0.93           | 1.24               | 1000        |
|           | 2442             | 1.65           | 1.46               | 1000        |
|           | 2480             | 1.12           | 1.29               | 1000        |

$EIRP/ \text{dBm} = \text{Conducted Max Output Power/ dBm} + \text{Antenna gain /dBi}.$

Since the distance from the internal BT-antenna to the outer is more than 10mm, we choose the min. test separation distance = 5mm

General RF Exposure:

$(1.43\text{mW})/5.0\text{mm} \times \sqrt{2.402 \text{ GHz}} = 0.431$

$(2.15\text{mW})/5.0\text{mm} \times \sqrt{2.442 \text{ GHz}} = 0.513$

$(1.62\text{mW})/5.0\text{mm} \times \sqrt{2.480 \text{ GHz}} = 0.457$

SAR requirement:  $S=3.0$

General RF Exposure < 3

Then SAR evaluation is not required

For BLE:

*Note: the antenna gain of 1dB less than 6dBi maximum permission antenna gain value based on 1 watt peak output power limit.*

| Test Mode         | Frequency<br>MHz | Reading<br>dBm | Output Power<br>mW | Limit<br>mW |
|-------------------|------------------|----------------|--------------------|-------------|
| 802.11b _ 11Mbps  | 2412             | 7.25           | 5.31               | 1000        |
|                   | 2437             | 7.02           | 5.04               | 1000        |
|                   | 2462             | 6.88           | 4.88               | 1000        |
| 802.11g_54Mbps    | 2412             | 7.54           | 5.68               | 1000        |
|                   | 2437             | 7.30           | 5.37               | 1000        |
|                   | 2462             | 6.64           | 4.61               | 1000        |
| 802.11n HT20_MCS7 | 2412             | 6.91           | 4.91               | 1000        |
|                   | 2437             | 6.25           | 4.22               | 1000        |
|                   | 2462             | 6.88           | 4.88               | 1000        |
| 802.11n HT40_MCS7 | 2422             | 7.12           | 5.15               | 1000        |
|                   | 2437             | 7.66           | 5.83               | 1000        |
|                   | 2452             | 7.00           | 5.01               | 1000        |

Then we choose Normal mode channel as the worst case of Maximum Peak Output Power:

| Test Mode         | Frequency<br>MHz | Reading<br>dBm | Output Power<br>mW | Limit<br>mW |
|-------------------|------------------|----------------|--------------------|-------------|
| 802.11b _ 11Mbps  | 2412             | 7.25           | 5.31               | 1000        |
| 802.11g_54Mbps    | 2412             | 7.54           | 5.68               | 1000        |
| 802.11n HT20_MCS7 | 2412             | 6.91           | 4.91               | 1000        |
| 802.11n HT40_MCS7 | 2437             | 7.66           | 5.83               | 1000        |

$EIRP/ \text{dBm} = \text{Conducted Max Output Power/ dBm} + \text{Antenna gain /dBi}$ .

Since the distance from the internal BT-antenna to the outer is more than 10mm, we choose the min. test separation distance = 5mm

General RF Exposure:

$(8.25\text{mW})/(5.0\text{mm}) \times \sqrt{2.412 \text{ GHz}} = 2.076$

$(8.54\text{mW})/(5.0\text{mm}) \times \sqrt{2.412 \text{ GHz}} = 2.219$

$(7.91\text{mW})/(5.0\text{mm}) \times \sqrt{2.412 \text{ GHz}} = 1.920$

$(8.66\text{mW})/(5.0\text{mm}) \times \sqrt{2.437 \text{ GHz}} = 2.293$

SAR requirement:  $S=3.0$

General RF Exposure  $< 3$

Then SAR evaluation is not required