

* RF Exposure

1. Regulation

1-1. FCC

According to the KDB 447498 D01 V06, the following RF exposure evaluation shall demonstrate RF exposure compliance.

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. 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. The minimum test separation distance defined in 4.1 f) 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. To qualify for SAR test exclusion, the test separation distances applied must be fully explained and justified, typically in the SAR measurement or SAR analysis report, by the operating configurations and exposure conditions of the transmitter and applicable host platform requirements, according to the required published RF exposure KDB procedures. When no other RF exposure testing or reporting are required, a statement of justification and compliance must be included in the equipment approval, in lieu of the SAR report, to qualify for 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 and tablets, etc.

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,30 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
- 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.

b) For 100 MHz to 6 GHz and test separation distances $>$ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following (also illustrated in Appendix B):

- 1) {[Power allowed at numeric threshold for 50 mm in step a)] + [(test separation distance – 50 mm) \cdot (f(MHz)/150)]} mW, for 100 MHz to 1500 MHz
- 2) {[Power allowed at numeric threshold for 50 mm in step a)] + [(test separation distance – 50 mm) \cdot 10]} mW, for $>$ 1500 MHz and \leq 6 GHz

c) For frequencies below 100 MHz, the following may be considered for SAR test exclusion (also illustrated in Appendix C):

- 1) For test separation distances > 50 mm and < 200 mm, the power threshold at the corresponding test separation distance at 100 MHz in step b) is multiplied by $[1 + \log(100/f(\text{MHz}))]$
- 2) For test separation distances ≤ 50 mm, the power threshold determined by the equation in c) 1) for 50 mm and 100 MHz is multiplied by $\frac{1}{2}$
- 3) SAR measurement procedures are not established below 100 MHz.

When SAR test exclusion cannot be applied, a KDB inquiry is required to determine SAR evaluation requirements for any SAR test results below 100 MHz to be acceptable.

1-2. IC

According to RSS-102 Issue 5

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in Table 1.

Output power level shall be the higher of the maximum conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power. For test separation distance less than 5mm, the exemption limits for a separation distance of 5 mm can be applied to determine if a routine evaluation is required.

Table 1: SAR evaluation – Exemption limits for routine evaluation based on frequency and separation distance

| Frequency (MHz) | Exemption Limits (mW) | | | | |
|-----------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| | At separation distance of ≤5 mm | At separation distance of 10 mm | At separation distance of 15 mm | At separation distance of 20 mm | At separation distance of 25 mm |
| ≤300 | 71 mW | 101 mW | 132 mW | 162 mW | 193 mW |
| 450 | 52 mW | 70 mW | 88 mW | 106 mW | 123 mW |
| 835 | 17 mW | 30 mW | 42 mW | 55 mW | 67 mW |
| 1 900 | 7 mW | 10 mW | 18 mW | 34 mW | 60 mW |
| 2 450 | 4 mW | 7 mW | 15 mW | 30 mW | 52 mW |
| 3 500 | 2 mW | 6 mW | 16 mW | 32 mW | 55 mW |
| 5 800 | 1 mW | 6 mW | 15 mW | 27 mW | 41 mW |

| Frequency (MHz) | Exemption Limits (mW) | | | | |
|-----------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|----------------------------------|
| | At separation distance of 30 mm | At separation distance of 35 mm | At separation distance of 40 mm | At separation distance of 45 mm | At separation distance of ≥50 mm |
| ≤300 | 223 mW | 254 mW | 284 mW | 315 mW | 345 mW |
| 450 | 141 mW | 159 mW | 177 mW | 195 mW | 213 mW |
| 835 | 80 mW | 92 mW | 105 mW | 117 mW | 130 mW |
| 1 900 | 99 mW | 153 mW | 225 mW | 316 mW | 431 mW |
| 2 450 | 83 mW | 123 mW | 173 mW | 235 mW | 309 mW |
| 3 500 | 86 mW | 124 mW | 170 mW | 225 mW | 290 mW |
| 5 800 | 56 mW | 71 mW | 85 mW | 97 mW | 106 mW |

2. Result

2-1. Calculation Result of RF Exposure (FCC)

| Mode | Test frequency [MHz] | Max. tune-up Power [dBm] | Conducted output power [mW] | Min. test separation distance [mm] | SAR test exclusion thresholds ≤ 3.0 for 1-g SAR |
|--------------|-------------------------|--------------------------------|-----------------------------------|---|---|
| Bluetooth LE | 2 402 | -7.00 | 0.20 | 5.00 | 0.06 |

Note:

1. SAR test exclusion thresholds

= [(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [$\sqrt{f(\text{GHz})}$]

Bluetooth LE = [(0.20)/(5.00)] · [$\sqrt{2.402}$] = 0.08

2-2. Calculation Result of RF Exposure (IC)

| Mode | Frequency [MHz] | Max tune up power [dBm] | Ant Gain [dBi] | E.I.R.P [dBm] | E.I.R.P [mW] | Min. test separation distance [mm] | Limit [mW] |
|-----------------|--------------------|-------------------------------|-------------------|------------------|-----------------|---|---------------|
| Bluetooth LE | 2 402 | -7.00 | 3.10 | -3.90 | 0.41 | 5.00 | 4.00 |

Note:

1. e.i.r.p. (dBm) = Conducted output power(dBm) + Antenna gain(dBi)

3. Target power and tolerance, Max tuneup power

| Mode | Target power [dBm] | Tolerance [dB] | Max tuneup power [dBm] | Average Power [dBm] |
|----------------------------|-----------------------|-------------------|---------------------------|------------------------|
| Bluetooth LE _2 402 MHz | -9.00 | ±2.00 | -7.00 | -7.64 |
| Bluetooth LE _2 440 MHz | -9.00 | ±2.00 | -7.00 | -8.57 |
| Bluetooth LE _2 480 MHz | -10.00 | ±2.00 | -8.00 | -9.31 |

4. RF Exposure Compliance Issue

Therefore, EUT is not required the SAR Evaluation.