

# RF EXPOSURE EVALUATION

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Evaluation of compliance with the exposure limits in § 1.1310 of this chapter and KDB 447498 D01 General RF Exposure Guidance v06:

- 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.

- 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):<sup>32</sup>

- 1)  $\{[\text{Power allowed at numeric threshold for 50 mm in step a)}] + [(\text{test separation distance} - 50 \text{ mm}) \cdot (f_{\text{(MHz)}}/150)]\}$  mW, for 100 MHz to 1500 MHz
- 2)  $\{[\text{Power allowed at numeric threshold for 50 mm in step a)}] + [(\text{test separation distance} - 50 \text{ mm}) \cdot 10]\}$  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):<sup>33</sup>

- 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*  $\leq 50$  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.<sup>34</sup>

Routine SAR evaluation refers to that specifically required by §2.1093, using measurements or computer simulation. When routine SAR evaluation is not required, portable transmitters with output power greater than the applicable low threshold require SAR evaluation to qualify for TCB approval.

**Step 1: Evaluate BLE module**

Mode	Channel (MHz)	Maximum output power (dBm)	Target Power (dBm)	Tune up tolerance (dBm)	Max Tune Up Power (dBm)	Distance (mm)	Calculation results	Limit
BLE	2402	-2.71	-2	$\pm 1$	-1	5	0.246	3
	2440	-3.28	-3	$\pm 1$	-2	5	0.197	3
	2480	-2.93	-2	$\pm 1$	-2	5	0.250	3

**Step 2: Evaluate 4G module:**

a) We can see the following photos, the minimum distance between 4G box antenna and human body is more than 110mm, we use 110mm to calculate the results.



b) Calculate the Min. SAR Test Exclusion Threshold (mW) at a distance of 110mm.

Band	Frequency (MHz)	Distance (mm)	Min. SAR Test Exclusion Threshold (mW)
LTE Band 2	1850.7~1909.3	110	709
LTE Band 4	1710.7~1754.3	110	713
LTE Band 5	824.7~848.3	110	495
LTE Band 7	2502.5~2567.5	110	694
LTE Band 12	699.7~715.3	110	459
LTE Band 13	779.5~784.5	110	482
LTE Band 25	1850.7~1914.3	110	708
LTE Band 26 for Part 22	814.7~848.3	110	492
LTE Band 26 for Part 90	814.7~848.3	110	492
LTE Band 38	2572.5~2617.5	110	693
LTE Band 41	2498.5~2687.5	110	691
LTE Band 66	1710.7~1779.3	110	712
LTE Band 71	665.5~695.5	110	450

c) Compared the the Max. Tune Up Power with Min. SAR Test Exclusion Threshold at a distance of 110mm.

Band	Maximum Power (dBm)	Tune up tolerance (dBm)	Max Tune Up Power (dBm)	Max Tune Up Power (mW)	Distance (mm)	Min. SAR Test Exclusion Threshold (mW)	Verdict
LTE Band 2	25.5	±1	26.5	446.68	110	709	Pass
LTE Band 4	24.5	±1	25.5	354.81	110	713	Pass
LTE Band 5	24.5	±1	25.5	354.81	110	495	Pass
LTE Band 7	25.5	±1	26.5	446.68	110	694	Pass
LTE Band 12	25	±1	26.0	398.11	110	459	Pass
LTE Band 13	24.5	±1	25.5	354.81	110	482	Pass
LTE Band 25	25.5	±1	26.5	446.68	110	708	Pass
LTE Band 26 for Part 22	24	±1	25.0	316.23	110	492	Pass
LTE Band 26 for Part 90	24	±1	25.0	316.23	110	492	Pass
LTE Band 38	24.5	±1	25.5	354.81	110	693	Pass
LTE Band 41	23.5	±1	24.5	281.84	110	691	Pass
LTE Band 66	24.5	±1	25.5	354.81	110	712	Pass
LTE Band 71	25	±1	26.0	398.11	110	450	Pass

**Step 3: Evaluate the condition of 4G module and BLE module work simultaneously**

In addition, for this product with multiple transmitter and antenna (4G and BLE), the requirement of Simultaneous Transmission evaluation has also been considered and has complied with the following conditions of the worse case:

$$\text{MPE1/Limit1} + \text{MPE2/Limit2} \leq 1$$

Thus,

$$\begin{array}{ccccccc} 0.250/3 & + & 398.11/450 & = & 0.9684 & \leq & 1 \\ \text{BLE} & & \text{4G (Max.)} & & & & \end{array}$$

It is concluded that no Simultaneous Transmission evaluation is required.