

RF Exposure Evaluation

REQUIREMENT

KDB447498 D01 General RF Exposure Guidance v06, Clause 4.3.1(a)

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, 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) $\{[\text{Power allowed at numeric threshold for 50 mm in step a}] + [(\text{test separation distance} - 50 \text{ mm}) \cdot (f(\text{MHz})/150)]\}$ 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):

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.

For simultaneous transmission SAR test exclusion considerations:

KDB447498 D01 General RF Exposure Guidance v06, Clause 4.3.2(b)

- b) When an antenna qualifies for the standalone SAR test exclusion of 4.3.1 and also transmits simultaneously with other antennas, the standalone SAR value must be estimated according to the following to determine the simultaneous transmission SAR test exclusion criteria:³⁶
 - 1) $[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f_{(\text{GHz})}/x}] \text{ W/kg, for test separation distances} \leq 50 \text{ mm};$
where $x = 7.5$ for 1-g SAR and $x = 18.75$ for 10-g SAR.
 - 2) 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distance is $>$ 50 mm.³⁷

KDB447498 D01 General RF Exposure Guidance v06, Clause 4.3.2(c):

When the sum of SAR is larger than the limit, SAR test exclusion is determined by the SAR to peak location

separation ratio. The simultaneously transmitting antennas in each operating mode and exposure condition combination must be considered one pair at a time to determine the SAR to peak location separation ratio to qualify for test exclusion. The ratio is determined by $(\text{SAR1} + \text{SAR2})^{1.5}/\text{R}_i$, rounded to two decimal digits, and must be ≤ 0.04 for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion. When 10-g SAR applies, the ratio must be ≤ 0.10 . SAR1 and SAR2 are the highest reported or estimated SAR values for each antenna in the pair, and R_i is the separation distance in mm between the peak SAR locations for the antenna pair.

TEST RESULT

Passed **Not Applicable**

Radio Type	Frequency range (MHz)	Conducted Power (dBm)	Maximum Tune-up (dBm)	Calculating data	Limit	Result
Bluetooth	2402-2480	0.17	0.32	0.3268	3.00	Pass

Note:

- 1) The maximum antenna gain is 0.2dBi
- 2) The exposure evaluation safety distance is 5mm.

Test Frequency	H-field strength (dBuV/m)	H-field strength (dBm)	H-field strength (mW)	Limit (mW)	Result
433.92MHz	81.16	-14.04	0.04	3.0	Pass

Note:

- 1) The 433.92MHz maximum antenna gain is -9.8dBi
- 2) The exposure evaluation safety distance is 5mm.
- 3) $(\text{dBm}) = E(\text{dBuV}/m) + 20\log(d) - 104.77 = E(\text{dBuV}/m) - 95.2$

Test Frequency	H-field strength (dBuV/m)	H-field strength (dBm)	H-field strength (mW)	Limit (mW)	Result
13.56MHz	59.86	-35.34	0.000292	443	Pass

Note:

- 1) The exposure evaluation safety distance is 5mm
- 2) $(\text{dBm}) = E(\text{dBuV}/m) + 20\log(d) - 104.77 = E(\text{dBuV}/m) - 95.2$

For the device transmitting simultaneously conditions, according to KDB447498 D01 General RF Exposure Guidance v06 section 4.3.2 (b),

Radio Type	Frequency range (MHz)	Conducted Power (dBm)	Maximum Tune-up (dBm)	Calculating data (W/kg)	Limit(W/kg)	Result
Bluetooth	2402-2480	0.17	0.32	0.0452	0.4	Pass

Note:

- 1) The maximum antenna gain is 0.2dBi
- 2) The exposure evaluation safety distance is 5mm.

Test Frequency	H-field strength (dBuV/m)	H-field strength (dBm)	Calculating data (W/kg)	Limit (W/kg)	Result
433.92MHz	81.16	-14.04	0.0007	0.4	Pass

Note:

- 1) The 433.92MHz maximum antenna gain is -9.8dBi
- 2) The exposure evaluation safety distance is 5mm.
- 3) $(dBm)=E(dBuV/m)+20\log(d)-104.77=E(dBuV/m)-95.2$

Test Frequency	H-field strength (dBuV/m)	H-field strength (dBm)	Calculating data (W/kg)	Limit (W/kg)	Result
13.56MHz	59.86	-35.34	0.0001	0.4	Pass

Note:

- 1) The exposure evaluation safety distance is 5mm
- 2) $(dBm)=E(dBuV/m)+20\log(d)-104.77=E(dBuV/m)-95.2$

So, Bluetooth + 433.92MHz + 13.56MHz=0.0452+0.0007+0.0001=0.046≤0.4 W/kg, it can be exempted the SAR testing