

RF Exposure

Standard Applicable:

According to §1.1307(b)(1), systems operating under the provisions of this section shall be operated in the manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

This is a Portable device with its physical nature to be used nearby, the distance between radiating structure and human is less than 20cm.

As per KDB 447498 D01 §4.3.1.1, The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm, and ≤ 5 m (not to exceed) are determined by:

$$\left[\frac{\text{(max. power of channel, including tune-up tolerance, mW)}}{\text{(min. test separation distance, mm)}} \right] \cdot \sqrt{f(\text{GHz})} \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR, where}$$

f (GHz) is the RF channel transmit frequency in GHz

Power and distance are rounded to the nearest mW and mm before calculation

After the confirmation through KDB inquiry to FCC, the operational distance for this given application is 10mm in need to be carried out 1 gram SAR on body, and 0mm in expectation to be performed 10 gram SAR on extremity.

Problem Statement:

To develop the SAR exemption from stand-alone, and co-location for body and extremity condition of this given host

Step 1: ($\leq 5\text{mm}$)

This is a portable device and the Max output power is (10.0mW) lower than the threshold given and derived as formula given above, where

Test with 1gram SAR with 10mm separation

Limit of threshold:

Limit on 10 gram	Limit on 1 gram
7.5	3.0

Wifi 802.11b/g/n_20MHz:

Mode	Frequency	Power (avg in dBm)*1	Power (avg mw)	Distance (mm)	Threshold ($<10\text{mm}$)
802.11b	2437	12.5	18	10	2.809960854
802.11g	2437	12.5	18	10	2.809960854
802.11n	2437	12.5	18	10	2.809960854

Bluetooth:

Mode	Frequency	Power (avg in dBm) *1 *2	Power (avg mw)	Distance (mm)	Threshold ($<10\text{mm}$)
GFSK	2441	3.32	2	10	0.312473999
$\pi/4$ DQPSK	2441	3.32	2	10	0.312473999
8DPSK	2441	3.32	2	10	0.312473999

Test with 10gram SAR with 0mm separation, taken 5mm as the most conservative test distance

Wifi 802.11b/g/n_20MHz:

Mode	Frequency	Power (avg in dBm) *1	Power (avg mw)	Distance (mm)	Threshold ($<5\text{mm}$)
802.11b	2437	12.5	18	5	5.619921708
802.11g	2437	12.5	18	5	5.619921708
802.11n	2437	12.5	18	5	5.619921708

Bluetooth:

Mode	Frequency	Power (avg in dBm) *1 *2	Power (avg mw)	Distance (mm)	Threshold (<5mm)
GFSK	2441	3.32	2	5	0.624947998
π /4DQPSK	2441	3.32	2	5	0.624947998
8DPSK	2441	3.32	2	5	0.624947998

Note1: The power is given as the maximum rating as given in the operation description with the inclusion of manufacturing tolerance.

Note2: The power is given as the maximum rating as given in the operation description with the inclusion of manufacturing tolerance.

Conclusion:

As the result of calculation result indicates, the RF exposure generating from given transmitter (transmitter employed digital modulation) can be excluded from SAR measurement, (<0.3), and therefore is deemed compliant with RF exposure as per KDB 447498 D01, FCC.

Simultaneous SAR evaluation:

Problem Statement: To evaluate whether or not how RF exposure as cause by simultaneous transmission from two radio transmitting part can be excluded.

$(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm}) \cdot [\sqrt{f(\text{GHz})/X}] \text{ W/kg for test separation distances } \leq 50 \text{ mm}$

Where X = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR

Estimated SAR on IEEE 802.11b/g/n

1-g value gaining from previous table	10-g value gaining from previous table	1-g SAR	10-g SAR	Estimated SAR on 1-g	Estimated SAR on 10-g
2.81	5.62	7.5	18.75	0.37	0.30
2.81	5.62	7.5	18.75	0.37	0.30
2.81	5.62	7.5	18.75	0.37	0.30

Estimated SAR on Bluetooth

1-g value gaining from previous table	10-g value gaining from previous table	1-g SAR	10-g SAR	Estimated SAR on 1-g	Estimated SAR on 10g
0.31	0.62	7.5	18.75	0.04	0.03
0.31	0.62	7.5	18.75	0.04	0.03
0.31	0.62	7.5	18.75	0.04	0.03

Summation of SAR1 + SAR 2 / Ri to qualify the exclusion of simultaneous transmission:

	Estimated SAR on 1- g	Estimated SAR on 10- g	The Summation of SAR	R *1	Estimated SAR on 1- g	Limit
Wifi	0.37	0.3	0.67	24.55	0.03	0.04
Bluetooth	0.04	0.03	0.07	24.55	0.003	0.1

Note: R = 24.5mm at which the distance is shown in the operational description

Conclusion:

As the result of calculation result indicates, the RF exposure generating from given 2 transmitters (transmitter employed digital modulation) which is capable of transmitting simultaneously can be excluded from collocation SAR requirement, (<0.04 for 1gram, <0.10 for 10gram), and therefore is deemed compliant with RF exposure for both individual, and collocation as per KDB 447498 D01.