

FCC RF Exposure Evaluation

Exposure category: General population/uncontrolled environment

EUT Type: Production Unit

Device Type: Portable device

Refer Standard: KDB 447498 D01 General RF Exposure Guidance v06

FCC Part 2 §2.1093

Evaluation method

According to KDB447498 D01 General RF Exposure Guidance v06 Section 4.3.1 Standalone SAR test exclusion considerations: "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, listed below, is 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.²² The minimum test separation distance 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 (see 5) of section 4.1). To qualify for SAR test exclusion, the test separation distances applied must be fully explained and justified by the operating configurations and exposure conditions of the transmitter and applicable host platform requirements, typically in the SAR measurement or SAR analysis report, according to the required published RF exposure KDB procedures. When no other RF exposure testing or reporting is required, a statement of justification and compliance must be included in the equipment approval, in lieu of the SAR report, to qualify for the 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 & tablets etc.²³ "

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

- f (GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

The test exclusions are applicable only when the minimum test separation distance is ≤ 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 5) in section 4.1 is applied to determine SAR test exclusion.

Estimated standalone SAR

When the standalone SAR test exclusion of section 4.3.1 is applied to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to the following to determine simultaneous transmission SAR test exclusion:

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

W/kg for test separation distances ≤ 50 mm;

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

Simultaneous transmission

When one of the following test exclusion conditions is satisfied for all combinations of simultaneous When one of the following test exclusion conditions is satisfied for all combinations of simultaneous

The $[\sum \text{ of (the highest measured or estimated SAR for each standalone antenna configuration, adjusted for maximum tune-up tolerance) } / 1.6 \text{ W/kg}] + [\sum \text{ of MPE ratios}] \leq 1.0$.

Conducted Power Results**BT V3.0**

Mode	Channel	Frequency (MHz)	Conducted Peak Output Power (dBm)
GFSK	0	2402	2.78
	39	2441	4.47
	78	2480	5.25
$\pi/4$ DQPSK	0	2402	0.87
	39	2441	2.53
	78	2480	3.40
8-DPSK	0	2402	1.30
	39	2441	3.00
	78	2480	3.64

2.4GHz Transmitter

Mode	Channel	Frequency (MHz)	Conducted Peak Output Power (dBm)
GFSK	1	2405	-13.26
	7	2442	-14.39
	12	2474	-13.07

Manufacturing tolerance**Bluetooth****GFSK (Peak)**

Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	2.0	4.0	5.0
Tolerance \pm (dB)	1.0	1.0	1.0

 $\pi/4$ DQPSK (Peak)

Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	0.0	2.0	3.0
Tolerance \pm (dB)	1.0	1.0	1.0

8DPSK (Peak)

Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	1.0	3.0	3.0
Tolerance \pm (dB)	1.0	1.0	1.0

2.4GHz Transmitter**GFSK (Peak)**

Channel	Channel 1	Channel 7	Channel 12
Target (dBm)	-13.0	-14.0	-13.0
Tolerance \pm (dB)	1.0	1.0	1.0

Evaluation Results**Standalone****Bluetooth**

Band/Mode	f (GHz)	Antenna Distance (mm)	RF output power		SAR Test Exclusion Threshold	SAR Test Exclusion
			dBm	mW		
GFSK	2.450	5	6.00	3.9811	1.2<3.0	Yes
$\pi/4$ DQPSK	2.450	5	4.00	2.5119	0.8 < 3.0	Yes
8-DPSK	2.450	5	4.00	2.5119	0.8 < 3.0	Yes

2.4GHz Transmitter

Band/Mode	f (GHz)	Antenna Distance (mm)	RF output power		SAR Test Exclusion Threshold	SAR Test Exclusion
			dBm	mW		
GFSK	2.450	5	-12.00	0.0631	0.1<3.0	Yes

Estimated standalone SAR

Band/Mode	f (GHz)	Antenna Distance (mm)	RF output power (including tune-up tolerance)		Estimated Position	Estimated Standalone SAR (W/Kg)
			dBm	mW		
2.4GHz Transmitter	2.45	5	-12.00	0.0631	Body	0.0026
BT	2.45	5	6.00	3.9811	Body	0.1656

Remark:

1. Output power including tune up tolerance;
2. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 5) in section 4.1 is applied to determine SAR test exclusion.

Simultaneous transmission

As BT and 2.4GHz transmitter modular share difference antennas, so BT and 2.4GHz transmitter modular can transmit simultaneous.

$$\sum (2.4\text{GHz Transmitter}_{\text{estimated SAR}} + \text{BT}_{\text{estimated SAR}}) / 1.60 = (0.0026 + 0.1656) / 1.6 = 0.1 < 1.0.$$

Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1093 for the uncontrolled RF Exposure and SAR Exclusion Threshold per KDB 447498 v06.

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