

FCC RF Exposure

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 "

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

- f (GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- 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.

Conducted Power Results

Mode	Channel	Frequency(MHz)	Peak Conducted Output Power (dBm)	
			Antenna 0	Antenna 1
GFSK	00	2402	-2.56	-/-
	19	2440	-2.65	-/-
	39	2480	-2.71	-/-
802.11b	01	2412	8.85	7.99
	06	2437	8.56	7.73
	11	2462	8.35	7.17
802.11g	01	2412	8.10	8.01
	06	2437	8.35	8.33
	11	2462	8.13	7.93
802.11n(HT20)	01	2412	5.56	5.42
	06	2437	5.34	5.38
	11	2462	5.25	5.19
802.11n(HT40)	03	2422	5.16	5.11
	06	2437	5.06	4.98
	09	2452	4.98	4.87

Mode	Channel	Frequency(MHz)	Average Conducted Output Power (dBm)	
			Antenna 0	Antenna 1
802.11a	36	2412	3.93	3.88
	40	2437	4.07	3.87
	48	2462	4.03	3.87
802.11n(HT20)	36	2412	3.51	3.55
	40	2437	3.53	3.51
	48	2462	3.55	3.57
802.11n(HT40)	38	2422	3.49	3.56
	46	2437	3.43	3.63

Manufacturing tolerance

Antenna 0			
BLE-GFSK			
Channel	Channel 00	Channel 19	Channel 39
Target (dBm)	-3.0	-3.0	-3.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11b (Peak)			
Channel	Channel 01	Channel 06	Channel 11
Target (dBm)	8.0	8.0	8.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11g (Peak)			
Channel	Channel 01	Channel 06	Channel 11
Target (dBm)	8.0	8.0	8.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11n HT20 (Peak)			
Channel	Channel 01	Channel 06	Channel 11
Target (dBm)	5.0	5.0	5.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11n HT40 (Peak)			
Channel	Channel 03	Channel 06	Channel 09
Target (dBm)	5.0	5.0	5.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11a (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	3.5	3.5	3.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11n20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	3.0	3.0	3.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11n40 (Average)			
Channel	Channel 38	Channel 46	
Target (dBm)	3.0	3.0	
Tolerance $\pm$ (dB)	1.0	1.0	

Antenna 1			
802.11b (Peak)			
Channel	Channel 01	Channel 06	Channel 11
Target (dBm)	8.0	8.0	8.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11g (Peak)			
Channel	Channel 01	Channel 06	Channel 11
Target (dBm)	8.0	8.0	8.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11n HT20 (Peak)			
Channel	Channel 01	Channel 06	Channel 11
Target (dBm)	5.0	5.0	5.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11n HT40 (Peak)			
Channel	Channel 03	Channel 06	Channel 09
Target (dBm)	5.0	5.0	5.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11a (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	3.5	3.5	3.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11n20 (Average)			
Channel	Channel 36	Channel 40	Channel 48
Target (dBm)	3.0	3.0	3.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
802.11n40 (Average)			
Channel	Channel 38	Channel 46	
Target (dBm)	3.0	3.0	
Tolerance $\pm$ (dB)	1.0	1.0	

Standalone Evaluation Results

Band/Mode	f (GHz)	Antenna Distance (mm)	RF output power (including tune-up tolerance)				SAR Test Exclusion Threshold		SAR Test Exclusion
			Antenna 0		Antenna 1		Antenna 0	Antenna 1	
			dBm	mW	dBm	mW			
BLE-GFSK	2402	5	-2.00	0.6310	-/-	-/-	0.20<3.00	-/-	Yes
	2440	5	-2.00	0.6310	-/-	-/-	0.20<3.0	-/-	Yes
	2480	5	-2.00	0.6310	-/-	-/-	0.20<3.0	-/-	Yes
802.11b	2412	5	9.00	7.9433	9.00	7.9433	2.47<3.0	2.47<3.0	Yes
	2437	5	9.00	7.9433	9.00	7.9433	2.48<3.0	2.48<3.0	Yes
	2462	5	9.00	7.9433	9.00	7.9433	2.49<3.0	2.49<3.0	Yes
802.11g	2412	5	9.00	7.9433	9.00	7.9433	2.47<3.0	2.47<3.0	Yes
	2437	5	9.00	7.9433	9.00	7.9433	2.48<3.0	2.48<3.0	Yes
	2462	5	9.00	7.9433	9.00	7.9433	2.49<3.0	2.49<3.0	Yes
802.11n HT20	2412	5	6.00	3.9811	6.00	3.9811	1.24<3.0	1.24<3.0	Yes
	2437	5	6.00	3.9811	6.00	3.9811	1.24<3.0	1.24<3.0	Yes
	2462	5	6.00	3.9811	6.00	3.9811	1.25<3.0	1.25<3.0	Yes
802.11n HT40	2422	5	6.00	3.9811	6.00	3.9811	1.24<3.0	1.24<3.0	Yes
	2437	5	6.00	3.9811	6.00	3.9811	1.24<3.0	1.24<3.0	Yes
	2452	5	6.00	3.9811	6.00	3.9811	1.25<3.0	1.25<3.0	Yes
802.11a	5180	5	4.50	2.8184	4.50	2.8184	1.28<3.0	1.28<3.0	Yes
	5200	5	4.50	2.8184	4.50	2.8184	1.29<3.0	1.29<3.0	Yes
	5240	5	4.50	2.8184	4.50	2.8184	1.29<3.0	1.29<3.0	Yes
802.11n HT20	5180	5	4.00	2.5119	4.00	2.5119	1.14<3.0	1.14<3.0	Yes
	5200	5	4.00	2.5119	4.00	2.5119	1.15<3.0	1.15<3.0	Yes
	5240	5	4.00	2.5119	4.00	2.5119	1.15<3.0	1.15<3.0	Yes
802.11n HT40	5190	5	4.00	2.5119	4.00	2.5119	1.14<3.0	1.14<3.0	Yes
	5230	5	4.00	2.5119	4.00	2.5119	1.15<3.0	1.15<3.0	Yes

Simultaneous Transmission for SAR Exclusion

The sample supports 2 antennas for 2.4GHz WLAN, the 2 antenna can transmit simultaneous, need consider simultaneous transmission;

Summary simultaneous transmission information:

Modulation Type	Work Frequency Band	Transmit Antenna		Antenna 0 and Antenna 1 Synchronization transmit
		Antenna 0	Antenna 1	
BLE-GFSK	2.4GHz	Yes	No	No
IEEE 802.11b	2.4GHz	Yes	Yes	No
IEEE 802.11g	2.4GHz	Yes	Yes	No
IEEE 802.11n HT20	2.4GHz	Yes	Yes	Yes
IEEE 802.11n HT40	2.4GHz	Yes	Yes	Yes
IEEE 802.11a	5.2GHz	Yes	Yes	No
IEEE 802.11n HT20	5.2GHz	Yes	Yes	Yes
IEEE 802.11n HT40	5.2GHz	Yes	Yes	Yes

NOTE:

- 1) Per KDB 447498 D01 v06, simultaneous transmission SAR is compliant if,
 - a) **Scalar SAR summation < 1.6W/kg.**
 - b) $SPLSR = (SAR1 + SAR2)^{1.5} / (\text{min. separation distance, mm})$, and the peak separation distance is determined from the square root of $\sqrt{(x1-x2)^2 + (y1-y2)^2 + (z1-z2)^2}$, where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan
 - c) If $SPLSR \leq 0.04$, simultaneously transmission SAR measurement is not necessary
 - d) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg
- 2) For simultaneous transmission analysis, standalone SAR for each antenna is estimated per KDB 447498 D01v06 based on the formula below.
 - a) **(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] . $\sqrt{f(\text{GHz}) / x}$ W/kg for test separation distances ≤ 50 mm; where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.**
 - b) When the minimum separation distance is < 5mm, the distance is used 5mm to determine SAR test exclusion.
 - c) 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is > 50 mm.

Summary simultaneous transmission results:

Modulation Type	Max. estimated SAR _{1g} at Antenna 0 (W/kg)	Max. estimated SAR _{1g} at Antenna 1 (W/kg)	MAX. Σ SAR _{1g} (W/kg)	Limit (W/kg)
IEEE 802.11n HT20(2.4G)	0.2561	0.2561	0.5122	1.6
IEEE 802.11n HT40(2.4G)	0.2561	0.2561	0.5122	1.6
IEEE 802.11n HT20(5.2G)	0.3510	0.3510	0.7020	1.6
IEEE 802.11n HT40(5.2G)	0.3510	0.3510	0.7020	1.6

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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