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 "

[(max. power of channel, including tune-up tolerance, mW)/ (min. test separation distance, mm)] · [√f (GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 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)
GFSK	0	2402	6.819
	39	2441	7.806
	78	2480	8.101
π/4DQPSK	0	2402	6.795
	39	2441	7.790
	78	2480	8.091
8DPSK	0	2402	6.798
	39	2441	7.778
	78	2480	8.071
GFSK(BLE)	0	2402	2.858
	19	2440	2.850
	39	2480	2.597
IEEE 802.11b	1	2412	7.45
	6	2437	7.24
	11	2462	6.02
IEEE 802.11g	1	2412	8.09
	6	2437	7.85
	11	2462	7.01
IEEE 802.11n HT20	1	2412	8.48
	6	2437	8.54
	11	2462	7.22
IEEE 802.11n HT40	3	2422	7.61
	6	2437	7.99
	9	2452	6.73

Mode	Channel	Frequency(MHz)	Average Conducted Output Power (dBm)
IEEE 802.11a (5.2G)	36	5180	6.24
	44	5220	6.39
	48	5240	6.90
IEEE 802.11n(HT20) (5.2G)	36	5180	6.20
	44	5220	6.29
	48	5240	6.97
IEEE 802.11n(HT40) (5.2G)	38	5190	6.09
	46	5230	6.71
IEEE 802.11a (5.8G)	149	5745	6.08
	157	5785	6.42
	165	5825	6.24
IEEE 802.11n(HT20) (5.8G)	149	5745	5.77
	157	5785	6.41
	165	5825	6.23
IEEE 802.11n(HT40) (5.8G)	151	5755	6.30
	159	5795	6.50

Manufacturing tolerance

GFSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	6.0	7.0	8.0
Tolerance ±(dB)	1.0	1.0	1.0
π/4DQPSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	6.0	7.0	8.0
Tolerance ±(dB)	5.0	5.0	5.0
8DPSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	6.0	7.0	8.0
Tolerance ±(dB)	1.0	1.0	1.0
GFSK (BLE) (Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	2.0	2.0	2.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11b(Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	7.0	7.0	6.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11g(Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	8.0	7.0	7.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT20(Peak)			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	8.0	8.0	7.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n HT40(Peak)			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	7.0	7.0	6.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11a(5.2G) (Average)			
Channel	Channel 36	Channel 44	Channel 48
Target (dBm)	6.0	6.0	6.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n(HT20)(5.2G) (Average)			
Channel	Channel 36	Channel 44	Channel 48
Target (dBm)	6.0	6.0	6.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n(HT40)(5.2G) (Average)			
Channel	Channel 38	Channel 46	
Target (dBm)	6.0	6.0	
Tolerance ±(dB)	1.0	1.0	
IEEE 802.11a(5.8G) (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	6.0	6.0	6.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n(HT20)(5.8G) (Average)			
Channel	Channel 149	Channel 157	Channel 165
Target (dBm)	5.0	6.0	6.0
Tolerance ±(dB)	1.0	1.0	1.0
IEEE 802.11n(HT40)(5.8G) (Average)			
Channel	Channel 151	Channel 159	
Target (dBm)	6.0	6.0	
Tolerance ±(dB)	1.0	1.0	

Evaluation Results

Band/Mode		f (GHz)	Antenna Distance (mm)	RF output Peak power (including tune-up tolerance)		SAR Test Exclusion Threshold	SAR Test Exclusion
				dBm	mW		
BT 4.1 DSS	GFSK	2.402	5.0	7.0	5.012	1.5536<3.0	Yes
		2.441	5.0	8.0	6.310	1.9717<3.0	Yes
		2.480	5.0	9.0	7.943	2.5017<3.0	Yes
	π/4DQPSK	2.402	5.0	7.0	5.012	1.5536<3.0	Yes
		2.441	5.0	8.0	6.310	1.9717<3.0	Yes
		2.480	5.0	9.0	7.943	2.5017<3.0	Yes
	8DPSK	2.402	5.0	7.0	5.012	1.5536<3.0	Yes
		2.441	5.0	8.0	6.310	1.9717<3.0	Yes
		2.480	5.0	9.0	7.943	2.5017<3.0	Yes
BT 4.1 DTS	GFSK(BLE)	2.402	5.0	3.0	1.995	0.6184<3.0	Yes
		2.440	5.0	3.0	1.995	0.6233<3.0	Yes
		2.480	5.0	3.0	1.995	0.6283<3.0	Yes
2.4G WLAN	802.11b	2.412	5.0	8.0	6.310	1.9600<3.0	Yes
		2.437	5.0	8.0	6.310	1.9701<3.0	Yes
		2.462	5.0	7.0	5.012	1.5728<3.0	Yes
	802.11g	2.412	5.0	9.0	7.943	2.4672<3.0	Yes
		2.437	5.0	8.0	6.310	1.9701<3.0	Yes
		2.462	5.0	8.0	6.310	1.9802<3.0	Yes
	802.11n(HT20)	2.412	5.0	9.0	7.943	2.4672<3.0	Yes
		2.437	5.0	9.0	7.943	2.4799<3.0	Yes
		2.462	5.0	8.0	6.310	1.9802<3.0	Yes
	802.11n(HT40)	2.422	5.0	8.0	6.310	1.9640<3.0	Yes
		2.437	5.0	8.0	6.310	1.9701<3.0	Yes
		2.452	5.0	7.0	5.012	1.5696<3.0	Yes

Band/Mode		f (GHz)	Antenna Distance (mm)	RF output AVG power (including tune-up tolerance)		SAR Test Exclusion Threshold	SAR Test Exclusion
				dBm	mW		
5.2G WLAN	802.11a	5.180	5.0	7.0	5.012	2.2814<3.0	Yes
		5.220	5.0	7.0	5.012	2.2902<3.0	Yes
		5.240	5.0	7.0	5.012	2.2946<3.0	Yes
	802.11n(HT20)	5.180	5.0	7.0	5.012	2.2814<3.0	Yes
		5.220	5.0	7.0	5.012	2.2902<3.0	Yes
		5.240	5.0	7.0	5.012	2.2946<3.0	Yes
	802.11n(HT40)	5.190	5.0	7.0	5.012	2.2836<3.0	Yes
		5.230	5.0	7.0	5.012	2.2924<3.0	Yes
5.8G WLAN	802.11a	5.745	5.0	7.0	5.012	2.4026<3.0	Yes
		5.785	5.0	7.0	5.012	2.4110<3.0	Yes
		5.825	5.0	7.0	5.012	2.4193<3.0	Yes
	802.11n(HT20)	5.745	5.0	6.0	3.981	1.9084<3.0	Yes
		5.785	5.0	7.0	5.012	2.4110<3.0	Yes
		5.825	5.0	7.0	5.012	2.4193<3.0	Yes
	802.11n(HT40)	5.755	5.0	7.0	5.012	2.4047<3.0	Yes
		5.795	5.0	7.0	5.012	2.4131<3.0	Yes

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 of KDB447498 is applied to determine SAR test exclusion.
3, The sample only support one WIFI&BT modular and one antenna, no need consider simultaneous transmission;

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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