

RF Exposure evaluation

FCC ID: RBWESY15I1D

1.1. Applicable Standard

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

According to §1.1310 and §2.1093 RF exposure requirement

KDB447498 v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies

1.2. Requirement

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.

Manufacturing tolerance
Bluetooth Antenna 1

GFSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	1.0	1.0	1.0
Tolerance ±(dB)	1.0	1.0	1.0
π/4DQPSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	2.0	2.0	2.0
Tolerance ±(dB)	1.0	1.0	1.0
8DPSK (Peak)			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	3.0	3.0	3.0
Tolerance ±(dB)	1.0	1.0	1.0
GFSK BT LE 1M (Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	-1.0	-1.0	-1.0
Tolerance ±(dB)	1.0	1.0	1.0
GFSK BT LE 2M(Peak)			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	-1.0	-1.0	-1.0
Tolerance ±(dB)	1.0	1.0	1.0

2.4GHz WLAN

IEEE 802.11b (PEAK)						
Frequency (MHz)	Antenna 1			Antenna 2		
	2412	2442	2462	2412	2442	2462
Target (dBm)	1.0	1.0	1.0	1.0	1.0	1.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11g (PEAK)						
Frequency (MHz)	Antenna 1			Antenna 2		
	2412	2442	2462	2412	2442	2462
Target (dBm)	1.0	1.0	1.0	1.0	1.0	1.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT20 (PEAK)						
Frequency (MHz)	Antenna 1			Antenna 2		
	2412	2442	2462	2412	2442	2462
Target (dBm)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT40 (PEAK)						
Frequency (MHz)	Antenna 1			Antenna 2		
	2422	2442	2462	2422	2442	2462
Target (dBm)	-2.0	-2.0	-2.0	-2.0	-2.0	-2.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0

5GHz WLAN Band 1

IEEE 802.11a (Average)						
Frequency (MHz)	Antenna 1			Antenna 2		
	5180	5200	5240	5180	5200	5240
Target (dBm)	2.0	2.0	2.0	2.0	2.0	2.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11n HT20 (Average)						
Frequency (MHz)	Antenna 1			Antenna 2		
	5180	5200	5240	5180	5200	5240
Target (dBm)	1.0	1.0	1.0	1.0	1.0	1.0
Tolerance ± (dB)	1.0	1.0	1.0	1.0	1.0	1.0
IEEE 802.11ac VHT20 (Average)						
Frequency	Antenna 1			Antenna 2		

(MHz)	5180	5200	5240	5180	5200	5240
Target (dBm)	1.0	1.0	1.0	1.0	1.0	1.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<i>IEEE 802.11n HT40 (Average)</i>						
Frequency (MHz)	Antenna 1			Antenna 2		
	5190		5230	5190		5230
Target (dBm)	0		0	0		0
Tolerance $\pm$ (dB)	1.0		1.0	1.0		1.0
<i>IEEE 802.11ac VHT40 (Average)</i>						
Frequency (MHz)	Antenna 1			Antenna 2		
	5190		5230	5190		5230
Target (dBm)	0		0	0		0
Tolerance $\pm$ (dB)	1.0		1.0	1.0		1.0
<i>IEEE 802.11ac VHT80 (Average)</i>						
Frequency (MHz)	Antenna 1			Antenna 2		
	5210			5210		
Target (dBm)	-2.0			-2.0		
Tolerance $\pm$ (dB)	1.0			1.0		

5GHz WLAN Band 3

<i>IEEE 802.11a (Average)</i>						
Frequency (MHz)	Antenna 1			Antenna 2		
	5745	5785	5825	5745	5785	5825
Target (dBm)	0	0	0	0	0	0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<i>IEEE 802.11n HT20 (Average)</i>						
Frequency (MHz)	Antenna 1			Antenna 2		
	5745	5785	5825	5745	5785	5825
Target (dBm)	0	0	0	0	0	0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<i>IEEE 802.11ac VHT20 (Average)</i>						
Frequency (MHz)	Antenna 1			Antenna 2		
	5745	5785	5825	5745	5785	5825
Target (dBm)	0	0	0	0	0	0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<i>IEEE 802.11n HT40 (Average)</i>						
Frequency (MHz)	Antenna 1			Antenna 2		
	5755		5795	5755		5795
Target (dBm)	-2.0		-2.0	-2.0		-2.0
Tolerance $\pm$ (dB)	1.0		1.0	1.0		1.0
<i>IEEE 802.11ac VHT40 (Average)</i>						
Frequency (MHz)	Antenna 1			Antenna 2		
	5755		5795	5755		5795
Target (dBm)	-2.0		-2.0	-2.0		-2.0
Tolerance $\pm$ (dB)	1.0		1.0	1.0		1.0
<i>IEEE 802.11ac VHT80 (Average)</i>						
Frequency (MHz)	Antenna 1			Antenna 2		
	5775			5775		
Target (dBm)	-3.0			-3.0		
Tolerance $\pm$ (dB)	1.0			1.0		

2. Evaluation Result

Standalone

Antenna 1

Band/Mode	f (GHz)	Antenna Distance (mm)	RF output power including tune up		SAR Test Exclusion Threshold	SAR Test Exclusion	Estimated SAR
			dBm	mW			
BT Classic	2.5	5	4.0	2.5119	$0.8 < 3.0$	Yes	0.106
BT LE	2.5	5	0	1.000	$0.32 < 3.0$	Yes	0.042
2.4G WIFI	2.5	5	2.0	1.5849	$0.5 < 3.0$	Yes	0.067
5.2G WIFI	5.25	5	3.0	1.9953	$0.92 < 3.0$	Yes	0.122
5.8G WIFI	5.85	5	1.0	1.2589	$0.61 < 3.0$	Yes	0.081

Antenna 2

Band/Mode	f (GHz)	Antenna Distance (mm)	RF output power including tune up		SAR Test Exclusion Threshold	SAR Test Exclusion	Estimated SAR
			dBm	mW			
2.4G WIFI	2.5	5	2.0	1.5849	$0.5 < 3.0$	Yes	0.067
5.2G WIFI	5.25	5	3.0	1.9953	$0.92 < 3.0$	Yes	0.122
5.8G WIFI	5.85	5	1.0	1.2589	$0.61 < 3.0$	Yes	0.081

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 f) in section 4.1 is applied to determine SAR test exclusion.*

Simultaneous Transmission for SAR Exclusion

The sample support Two separate antennas, need consider simultaneous transmission;
 $\sum$ of (the highest measured or estimated $SAR_{ant1} + SAR_{ant2}$)/1.6 = $(0.122 + 0.122)/1.6 = 0.153 < 1.0$;

3. 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, No SAR is required.

.....**End**.....