

FCC ID: SMC-H70

RF EXPOSURE EVALUATION

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency(RF) Radiation as specified in §1.1307(b)

Limits for Maximum Permissible Exposure (MPE)

Frequency Range(MHz)	Electric Field Strength(V/m)	Magnetic Field Strength(A/m)	Power Density(mW/cm ²)	Average Time
(A) Limits for Occupational/Control Exposures				
300-1500	--	--	F/300	6
1500-100000	--	--	5	6
(B) Limits for General Population/Uncontrol Exposures				
300-1500	--	--	F/1500	6
1500-100000	--	--	1	30

11.1 Friis transmission formula: $P_d = \frac{P_{out} * G}{4 * \pi * R^2}$

Where

P_d = Power density in mW/cm²

P_{out} = output power to antenna in mW

G = Numeric gain of the antenna relative to isotropic antenna

π = 3.1416

R = distance between observation point and center of the radiator in cm(20cm)

P_d the limit of MPE, 1mW/cm². If we know the maximum gain of the antenna and total power input to the antenna, through the calculation, we will know the distance where the MPE limit is reached.

$mW = 10^{(dBm/10)}$

11.2 Measurement Result

Operation Frequency: WIFI 802.11b/g/n HT20: 2412-2462MHz,

802.11n HT40: 2422-2452MHz,

Power density limited: $1\text{mW}/\text{cm}^2$

Antenna A Type: FPCB Antenna

Antenna B Type: FPCB Antenna

Antenna A gain: 3dBi

Antenna B gain: 3dBi

R=20cm

$\text{mW}=10^{(\text{dBm}/10)}$

802.11b/g/n

Mode	Frequency (MHz)	Peak Output Power(dBm)		Total		Tune-up		Max Tune-up	
		ANT A	ANT B	(dBm)		(dBm)		(dBm)	
B	2412	15.4	15.4	-	-	15±1	15±1	16	16
	2437	17.0	17.0	-	-	17±1	17±1	18	18
	2462	16.4	16.5	-	-	16±1	16±1	17	17
G	2412	12.1	12.4	-	-	12±1	12±1	13	13
	2437	14.2	14.2	-	-	14±1	14±1	15	15
	2462	13.4	13.5	-	-	13±1	13±1	14	14
N20	2412	11.6	11.7	14.66		11±1	11±1	12	12
	2437	13.5	13.5	16.51		13±1	13±1	14	14
	2462	12.8	12.9	15.86		13±1	13±1	14	14
N40	2422	11.1	11.2	14.16		11±1	11±1	12	12
	2437	12.6	12.8	15.71		12±1	12±1	13	13
	2452	11.9	11.9	14.91		12±1	12±1	13	13

Operation Frequency: 5180-5240MHz for 802.11a/n(HT20)/ac20;
 5190-5230MHz for 802.11n(HT40)/ac40;
 5210MHz for 802.11 ac80;
 5745-5825 MHz for 802.11a/n(HT20)/ac20;
 5755-5795 MHz for 802.11a/n(HT40)/ac40;
 5775MHz for 802.11 ac80;

Power density limited: 1mW/ cm²

Antenna A Type: FPCB Antenna

Antenna B Type: FPCB Antenna

Antenna A gain: 3dBi

Antenna B gain: 3dBi

R=20cm

mW=10^(dBm/10)

802.11a/n/ac

5150-5250MHz

Test Channel	Frequency	Maximum output power. Antenna port		Total Power	Tune-up		Max Tune-up	
		(AV) (dBm)		(AV)				
	(MHz)	ANT A	ANT B	dBm	dBm	dBm		
TX 802.11a Mode								
CH36	5180	8.2	8.2	-	8±1	8±1	9	9
CH40	5200	8.3	8.3	-	8±1	8±1	9	9
CH48	5240	7.2	7.1	-	7±1	7±1	8	8
TX 802.11 n20M Mode								
CH36	5180	7.3	7.4	10.36	7±1	7±1	8	8
CH40	5200	7.0	7.0	10.01	7±1	7±1	8	8
CH48	5240	6.2	6.1	9.16	6±1	6±1	7	7
TX 802.11 n40M Mode								
CH38	5190	7.0	7.1	10.06	7±1	7±1	8	8
CH46	5230	6.2	6.1	9.16	6±1	6±1	7	7
TX 802.11 ac20M Mode								
CH36	5180	7.3	7.3	10.31	7±1	7±1	8	8
CH40	5200	7.3	7.3	10.31	7±1	7±1	8	8
CH48	5240	6.5	6.6	9.56	6±1	6±1	7	7
TX 802.11 ac40M Mode								
CH38	5190	6.5	6.5	9.51	6±1	6±1	7	7
CH46	5230	5.8	5.8	8.81	6±1	6±1	7	7
TX 802.11 ac80M Mode								
CH42	5210	6.1	6.1	9.11	6±1	6±1	7	7

802.11a/n/ac
5725-5825MHz

Test Channel	Frequency	Maximum output power. Antenna port		Total Power	Tune-up		Max Tune-up	
		(AV) (dBm)		(AV)				
	(MHz)	ANT A	ANT B	dBm	dBm	dBm	dBm	
TX 802.11a Mode								
CH 149	5745	8.2	8.2	-	8±1	8±1	9	9
CH 157	5785	8.0	8.1	-	8±1	8±1	9	9
CH 165	5825	7.0	7.1	-	7±1	7±1	8	8
TX 802.11 n20M Mode								
CH 149	5745	7.7	7.8	10.76	7±1	7±1	8	8
CH 157	5785	7.8	7.7	10.76	7±1	7±1	8	8
CH 165	5825	6.0	6.1	9.06	6±1	6±1	7	7
TX 802.11 n40M Mode								
CH 151	5755	7.4	7.5	10.46	7±1	7±1	8	8
CH 159	5795	7.3	7.4	10.36	7±1	7±1	8	8
TX 802.11 ac20M Mode								
CH 149	5745	7.8	7.8	10.81	7±1	7±1	8	8
CH 157	5785	7.4	7.3	10.36	7±1	7±1	8	8
CH 165	5825	5.8	5.9	8.86	6±1	6±1	7	7
TX 802.11 ac40M Mode								
CH 151	5755	7.1	7.0	10.06	7±1	7±1	8	8
CH 159	5795	7.3	7.4	10.36	7±1	7±1	8	8
TX 802.11 ac80M Mode								
CH 155	5775	6.7	6.6	9.66	6±1	6±1	7	7

Operation Frequency: 2402MHz~2480MHz

Power density limited: $1\text{mW}/\text{cm}^2$

Antenna Type: FPCB Antenna

Antenna gain: 3.0dBi,

R=20cm

$\text{mW}=10^{(\text{dBm}/10)}$

Bluetooth Moduel 1 EDR:

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)
2402	GFSK	1.56	1 ± 1	2
2441		1.71	1 ± 1	2
2480		0.96	1 ± 1	2
2402	$\pi/4$ -DQPSK	2.76	2 ± 1	3
2441		2.93	2 ± 1	3
2480		2.15	2 ± 1	3
2402	8DPSK	2.94	2.5 ± 1	3.5
2441		3.18	2.5 ± 1	3.5
2480		2.45	2.5 ± 1	3.5

Operation Frequency: 2402MHz~2480MHz

Power density limited: $1\text{mW}/\text{cm}^2$

Antenna Type: FPCB Antenna

Antenna gain: 3.0dBi,

R=20cm

$\text{mW}=10^{(\text{dBm}/10)}$

Bluetooth Moduel 2 EDR:

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)
2402	GFSK	1.58	1 ± 1	2
2441		1.67	1 ± 1	2
2480		0.97	1 ± 1	2
2402	$\pi/4$ -DQPSK	2.85	2 ± 1	3
2441		2.91	2 ± 1	3
2480		2.21	2 ± 1	3
2402	8DPSK	2.96	2.5 ± 1	3.5
2441		3.16	2.5 ± 1	3.5
2480		2.39	2.5 ± 1	3.5

Operation Frequency: 2402MHz~2480MHz
 Power density limited: $1\text{mW}/\text{cm}^2$
 Antenna Type: FPCB Antenna
 Antenna gain: 3.0dBi,
 R=20cm
 $\text{mW}=10^{(\text{dBm}/10)}$

Bluetooth Moduel 1 BLE:

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)
2402	GFSK	3.38	3 ± 1	4
2440		3.45	3 ± 1	4
2480		2.72	3 ± 1	4

Operation Frequency: 2402MHz~2480MHz
 Power density limited: $1\text{mW}/\text{cm}^2$
 Antenna Type: FPCB Antenna
 Antenna gain: 3.0dBi,
 R=20cm
 $\text{mW}=10^{(\text{dBm}/10)}$

Bluetooth Moduel 2 BLE:

Channel Freq. (MHz)	modulation	conducted power (dBm)	Tune-up power (dBm)	Max tune-up power (dBm)
2402	GFSK	3.34	3 ± 1	4
2440		3.48	3 ± 1	4
2480		2.71	3 ± 1	4

RF Exposure Evaluation**Operation in WLAN 2.4G FOR SISO MODE**

ANT A:

Max conducted power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
17.0	3.0	20	100.00	20	0.0199	1	Pass

ANT B:

Max conducted power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
17.0	3.0	20	100.00	20	0.0199	1	Pass

Estimation for WLAN MIMO 2.4G

ANT	Max conducted power (m)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	Total S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
A	13.5	3.0	16.5	44.67	20	0.0089	0.0178	1.000	Pass
B	13.5	3.0	16.5	44.67		0.0089			

Operation in WLAN 5.2G FOR SISO MODE

ANT A:

Max conducted power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
8.3	3.0	11.3	13.49	20	0.0027	1.000	Pass

ANT B:

Max conducted power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
8.3	3.0	11.3	13.49	20	0.0027	1.000	Pass

Operation in WLAN 5.8G FOR SISO MODE

ANT A:

Max conducted power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
8.2	3.0	11.2	13.18	20	0.0026	1.000	Pass

ANT B:

Max conducted power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
8.2	3.0	11.2	13.18	20	0.0026	1.000	Pass

Estimation for WLAN MIMO 5.2G

ANT	Max conducted power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	Total S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
A	7.3	3.0	10.3	10.72	20	0.0021	0.0043	1.000	Pass
B	7.4	3.0	10.4	10.96		0.0022			

Estimation for WLAN MIMO 5.8G

ANT	Max conducted power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	Total S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
A	7.8	3.0	10.8	12.02	20	0.0024	0.0050	0.0048	Pass
B	7.8	3.0	10.8	12.02		0.0024			

Bluetooth Moduel 1 EDR:

Max conducted power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
3.18	3.0	6.18	4.15	20	0.0008	1.000	Pass

Bluetooth Moduel 2 EDR:

Max conducted power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
3.16	3.0	6.16	4.13	20	0.0008	1.000	Pass

Bluetooth Moduel 1 BLE:

Max conducted power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
3.45	3.0	6.45	4.42	20	0.0009	1.000	Pass

Bluetooth Moduel 2 BLE:

Max conducted power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm ²)	MPE Limit (mW/cm ²)	Conclusion
3.48	3.0	6.48	4.45	20	0.0009	1.000	Pass

Conclusion:

For the max result : $0.0199 \leq 1.0$, compliance with FCC's RF Exposure.

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Signature:

Date: 2018-6-29

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