

## RF EXPOSURE EVALUATION

### EUT Specification

<b>EUT</b>	WIFI+BT Module
<b>Frequency band (Operating)</b>	<input checked="" type="checkbox"/> WLAN: 2.412GHz ~ 2.462GHz <input checked="" type="checkbox"/> WLAN: 5.150GHz ~ 5.250GHz <input checked="" type="checkbox"/> WLAN: 5.725GHz ~ 5850GHz <input checked="" type="checkbox"/> Others(Bluetooth: 2.402GHz ~ 2.480GHz)
<b>Device category</b>	<input type="checkbox"/> Portable (<20cm separation) <input checked="" type="checkbox"/> Mobile (>20cm separation) <input type="checkbox"/> Others ____
<b>Antenna diversity</b>	<input checked="" type="checkbox"/> Single antenna <input type="checkbox"/> Multiple antennas <input type="checkbox"/> Tx diversity <input type="checkbox"/> Rx diversity <input type="checkbox"/> Tx/Rx diversity
<b>Max. output power</b>	6.53dBm(4.50mW) for Bluetooth -BDR+EDR -0.82dBm(0.83mW) for Bluetooth -BLE 21.87dBm(153.82mW) for 2.4G WLAN 19.80dBm (95.50mW) for 5G WLAN Band 5150-5250 19.40dBm (87.10mW) for 5G WLAN Band 5725-5850
<b>Antenna gain</b>	0.38dBi for 2.4G 2.95dBi for 5G
<b>Evaluation applied</b>	<input checked="" type="checkbox"/> MPE Evaluation <input type="checkbox"/> SAR Evaluation

Limits for Maximum Permissible Exposure (MPE)

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

## Friis transmission formula: $Pd=(Pout \cdot G) / (4 \cdot \pi \cdot R^2)$

Where

$Pd$ = Power density in  $mW/cm^2$

$Pout$ =output power to antenna in Mw

$G$ = gain of antenna in linear scale

$\pi$ =3.1416

$R$ = distance between observation point and center of the radiator in cm

$Pd$  the limit of MPE,  $1mW/cm^2$ . 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.

## Measurement Result

Channel	Channel Frequency (MHz)	Max Output power (dBm)	Tolerance	Max Tune-UP power (mW)	Power density at 20cm ( $mW/cm^2$ )	Power density Limits ( $mW/cm^2$ )
<b>Test Mode: 802.11b</b>						
Low	2412	17.05	$\pm 0.5$	56.89	0.012353	1
Middle	2437	16.91	$\pm 0.5$	55.08	0.011960	1
High	2462	16.38	$\pm 0.5$	48.75	0.010585	1
<b>Test Mode: 802.11g</b>						
Low	2412	20.55	$\pm 0.5$	127.35	0.027652	1
Middle	2437	20.61	$\pm 0.5$	129.12	0.028036	1
High	2462	20.06	$\pm 0.5$	113.76	0.024701	1
<b>Test Mode: 802.11n(HT20)</b>						
Low	2412	21.87	$\pm 0.5$	172.58	0.037473	1
Middle	2437	21.46	$\pm 0.5$	157.04	0.034099	1
High	2462	20.99	$\pm 0.5$	140.93	0.030601	1
<b>Test Mode: 802.11n(HT40)</b>						
Low	2422	20.50	$\pm 0.5$	125.89	0.027335	1
Middle	2437	20.33	$\pm 0.5$	121.06	0.026286	1
High	2452	20.03	$\pm 0.5$	112.98	0.024532	1

Channel	Channel Frequency (MHz)	Max Output power (dBm)	Tolerance	Max Tune-UP power (mW)	Power density at 20cm (mW/cm <sup>2</sup> )	Power density Limits (mW/cm <sup>2</sup> )
<b>Test Mode: BLE</b>						
Low	2402	-0.82	±0.5	0.93	0.000202	1
Middle	2440	-0.83	±0.5	0.93	0.000202	1
High	2480	-1.17	±0.5	0.86	0.000187	1
<b>Test Mode: GFSK</b>						
Low	2402	5.36	±0.5	3.85	0.000836	1
Middle	2441	5.57	±0.5	4.05	0.000879	1
High	2480	5.05	±0.5	3.59	0.000780	1
<b>Test Mode: π4/-DQPSK</b>						
Low	2402	6.29	±0.5	4.78	0.001038	1
Middle	2441	6.53	±0.5	5.05	0.001097	1
High	2480	6.12	±0.5	4.59	0.000997	1
<b>Test Mode: 8DPSK</b>						
Low	2402	5.55	±0.5	4.03	0.000875	1
Middle	2441	5.78	±0.5	4.25	0.000923	1
High	2480	5.30	±0.5	3.80	0.000825	1

Note: For the device consider simultaneous transmission of 2.4G WIFI and BT, the worst MPE evaluation =  $0.037473 + 0.001097 = 0.03857 < 1.0$

Channel	Channel Frequency (MHz)	Max Output power (dBm)	Tolerance	Max Tune-UP power (mW)	Power density at 20cm (mW/cm <sup>2</sup> )	Power density Limits (mW/cm <sup>2</sup> )
<b>Test Mode: 802.11a</b>						
Low	5180	17.56	±0.5	63.97	0.025102	1
Middle	5200	17.39	±0.5	61.52	0.024140	1
High	5240	19.80	±0.5	107.15	0.042046	1
<b>Test Mode: 802.11n(HT20)</b>						
Low	5180	15.25	±0.5	37.58	0.014746	1
Middle	5200	15.16	±0.5	36.81	0.014444	1
High	5240	17.47	±0.5	62.66	0.024588	1
<b>Test Mode: 802.11n(HT40)</b>						
Low	5190	15.23	±0.5	37.41	0.014680	1
Middle	5230	17.34	±0.5	60.81	0.023862	1
<b>Test Mode: 802.11ac(VHT20)</b>						
Low	5180	15.41	±0.5	38.99	0.015300	1
Middle	5200	15.46	±0.5	39.45	0.015480	1
High	5240	17.31	±0.5	60.40	0.023701	1
<b>Test Mode: 802.11ac(VHT40)</b>						
Low	5190	15.19	±0.5	37.07	0.014546	1
High	5230	17.23	±0.5	59.29	0.023265	1
<b>Test Mode: 802.11ac(VHT80)</b>						
Nominal	5210	18.19	±0.5	73.96	0.029022	1

Channel	Channel Frequency (MHz)	Max Output power (dBm)	Tolerance	Max Tune-UP power (mW)	Power density at 20cm (mW/cm <sup>2</sup> )	Power density Limits (mW/cm <sup>2</sup> )
<b>Test Mode: 802.11a</b>						
Low	5745	17.56	±0.5	63.97	0.025102	1
Middle	5785	16.45	±0.5	49.55	0.019443	1
High	5825	16.89	±0.5	54.83	0.021515	1
<b>Test Mode: 802.11n(HT20)</b>						
Low	5745	19.40	±0.5	97.72	0.038345	1
Middle	5785	18.45	±0.5	78.52	0.030811	1
High	5825	18.91	±0.5	87.30	0.034257	1
<b>Test Mode: 802.11n(HT40)</b>						
Low	5755	17.51	±0.5	63.24	0.024815	1
Middle	5795	16.81	±0.5	53.83	0.021123	1
<b>Test Mode: 802.11ac(VHT20)</b>						
Low	5745	17.48	±0.5	62.81	0.024647	1
Middle	5785	16.30	±0.5	47.86	0.01878	1
High	5825	16.90	±0.5	54.95	0.021562	1
<b>Test Mode: 802.11ac(VHT40)</b>						
Low	5755	17.45	±0.5	62.37	0.024474	1
High	5795	16.48	±0.5	49.89	0.019577	1
<b>Test Mode: 802.11ac(VHT80)</b>						
Nominal	5775	18.22	±0.5	74.47	0.029222	1