





**MPE Calculations**

**1. Antenna Gain:**

Antenna	2.4G/5G Antenna Gain(dBi)
ANT. 1	2.4GHz 3.40dBi FPC Antenna 5180MHz~5240MHz 2.47dBi FPC Antenna 5260MHz~5320MHz 2.61dBi FPC Antenna 5500MHz~5700MHz 3.70dBi FPC Antenna 5745MHz~5825MHz 2.50 dBi FPC Antenna
ANT. 2	2.4GHz 4.18dBi FPC Antenna 5180MHz~5240MHz 3.28dBi FPC Antenna 5260MHz~5320MHz 3.47dBi FPC Antenna 5500MHz~5700MHz 4.31dBi FPC Antenna 5745MHz~5825MHz 3.08dBi FPC Antenna

**2. EUT Operation Condition:**

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

**3. Exposure Evaluation:**

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = (PG) / 4\pi R^2$$

Where

**S:** power density

**P:** power input to the antenna

**G:** power gain of the antenna in the direction of interest relative to an isotropic radiator.

**R:** distance to the center of radiation of the antenna

**4. Simultaneous transmission MPE Considerations**

According to KDB447498 :All transmitters and antennas in the host must be either evaluated for MPE compliance, by measurement or computational modeling, or qualify for the standalone MPE test exclusion in section 7.1. Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modeled or measured field strengths or power density, is  $\leq 1.0$ .

This means that:

$$\sum \text{ of MPE ratios } \leq 1.0$$



**5. Standalone MPE Evaluation:**

Mode	Antenna	Channel	Conducted power[dBm]	Turn-up Power Tolerance(dBm)
11A-CDD	Ant1	5180	10.45	10±1
	Ant2	5180	9.98	9±1
	Ant1	5200	10.42	10±1
	Ant2	5200	9.51	9±1
	Ant1	5240	10.45	10±1
	Ant2	5240	9.28	9±1
	Ant1	5260	10.62	10±1
	Ant2	5260	9.38	9±1
	Ant1	5280	10.35	10±1
	Ant2	5280	9.09	9±1
	Ant1	5320	9.79	9±1
	Ant2	5320	8.94	8±1
	Ant1	5500	9.30	9±1
	Ant2	5500	9.90	9±1
	Ant1	5580	11.12	11±1
	Ant2	5580	10.79	10±1
	Ant1	5700	8.21	8±1
	Ant2	5700	9.49	9±1
	Ant1	5745	8.43	8±1
	Ant2	5745	9.08	9±1
Ant1	5785	9.08	9±1	
Ant2	5785	9.21	9±1	
Ant1	5825	9.26	9±1	
Ant2	5825	9.25	9±1	
11N20MIMO	Ant1	5180	7.88	7±1
	Ant2	5180	7.08	7±1
	Ant1	5200	7.70	7±1
	Ant2	5200	6.69	6±1
	Ant1	5240	7.82	7±1
	Ant2	5240	6.46	6±1
	Ant1	5260	11.45	11±1
	Ant2	5260	9.99	9±1
	Ant1	5280	11.12	11±1
	Ant2	5280	9.71	9±1
	Ant1	5320	10.68	10±1
	Ant2	5320	9.68	9±1
	Ant1	5500	8.01	8±1
	Ant2	5500	8.77	8±1
	Ant1	5580	9.89	9±1
	Ant2	5580	9.64	9±1
	Ant1	5700	12.8	12±1
	Ant2	5700	6.83	6±1
	Ant1	5745	8.10	8±1
	Ant2	5745	8.53	8±1
Ant1	5785	9.10	9±1	
Ant2	5785	9.14	9±1	
Ant1	5825	9.30	9±1	
Ant2	5825	9.34	9±1	
11N40MIMO	Ant1	5190	7.74	7±1
	Ant2	5190	6.92	6±1
	Ant1	5230	7.74	7±1
	Ant2	5230	6.30	6±1
	Ant1	5270	9.00	9±1
	Ant2	5270	7.50	7±1
	Ant1	5310	8.20	8±1
	Ant2	5310	6.99	6±1
Ant1	5510	7.67	7±1	



	Ant2	5510	8.59	8±1
	Ant1	5550	8.71	8±1
	Ant2	5550	9.01	9±1
	Ant1	5670	7.47	7±1
	Ant2	5670	8.14	8±1
	Ant1	5755	8.96	8±1
	Ant2	5755	9.71	9±1
	Ant1	5795	9.40	9±1
	Ant2	5795	9.93	9±1
11AC20MIMO	Ant1	5180	8.45	8±1
	Ant2	5180	7.51	7±1
	Ant1	5200	8.17	8±1
	Ant2	5200	7.09	7±1
	Ant1	5240	8.06	8±1
	Ant2	5240	6.77	6±1
	Ant1	5260	9.84	9±1
	Ant2	5260	8.25	8±1
	Ant1	5280	9.65	9±1
	Ant2	5280	8.00	8±1
	Ant1	5320	9.31	9±1
	Ant2	5320	7.88	7±1
	Ant1	5500	7.09	7±1
	Ant2	5500	7.66	7±1
	Ant1	5580	8.87	8±1
	Ant2	5580	8.37	8±1
	Ant1	5700	7.48	7±1
	Ant2	5700	8.82	8±1
	Ant1	5745	7.64	7±1
	Ant2	5745	7.99	7±1
	Ant1	5785	8.33	8±1
	Ant2	5785	8.22	8±1
	Ant1	5825	8.29	8±1
	Ant2	5825	8.35	8±1
11AC40MIMO	Ant1	5190	7.94	7±1
	Ant2	5190	6.94	6±1
	Ant1	5230	7.79	7±1
	Ant2	5230	6.43	6±1
	Ant1	5270	9.15	9±1
	Ant2	5270	7.56	7±1
	Ant1	5310	8.36	8±1
	Ant2	5310	7.07	7±1
	Ant1	5510	7.79	7±1
	Ant2	5510	8.59	8±1
	Ant1	5550	8.80	8±1
	Ant2	5550	9.14	9±1
	Ant1	5670	7.53	7±1
	Ant2	5670	8.35	8±1
	Ant1	5755	8.01	8±1
	Ant2	5755	8.78	8±1
	Ant1	5795	8.44	8±1
	Ant2	5795	8.99	8±1
11AC80MIMO	Ant1	5210	7.48	7±1
	Ant2	5210	6.27	6±1
	Ant1	5290	8.14	8±1
	Ant2	5290	7.26	7±1
	Ant1	5530	7.60	7±1
	Ant2	5530	7.60	7±1
	Ant1	5610	8.21	8±1
	Ant2	5610	8.17	8±1
	Ant1	5775	7.40	7±1
	Ant2	5775	7.93	7±1

## [2.4GHz WLAN]

Mode	Channel	Frequency	Peak Conducted Output Power (dBm)		Turn-up Power Tolerance(dBm)	
			Ant.1	Ant.2	Ant.1	Ant.2
IEEE 802.11b	1	2412	17.72	16.87	17±1	16±1
	6	2437	17.65	16.55	17±1	16±1
	11	2462	17.78	16.30	17±1	16±1
IEEE 802.11g	1	2412	16.97	17.66	16±1	17±1
	6	2437	16.89	17.24	16±1	17±1
	11	2462	12.89	16.93	12±1	16±1
IEEE 802.11n HT20	1	2412	16.82	17.52	16±1	17±1
	6	2437	16.84	17.22	16±1	17±1
	11	2462	16.89	16.99	16±1	16±1

## [Bluetooth]

Mode	Channel	Frequency	Peak Conducted Output Power (dBm)		Turn-up Power Tolerance(dBm)	
			Ant.1	Ant.2	Ant.1	Ant.2
Bluetooth GFSK	00	2402	1.46		1±1	
	39	2441	3.35		3±1	
	78	2480	6.78		6±1	
Bluetooth $\pi$ /4-DQPSK	00	2402	6.35		6±1	
	39	2441	7.65		7±1	
	78	2480	8.6		8±1	
Bluetooth 8-DPSK	00	2402	7.08		7±1	
	39	2441	7.68		7±1	
	78	2480	8.74		8±1	

## [Bluetooth LE]

Mode	Channel	Frequency	Peak Conducted Output Power (dBm)		Turn-up Power Tolerance(dBm)	
			Ant.1	Ant.2	Ant.1	Ant.2
Bluetooth LE 1Mbps	00	2402	1.71		1±1	
	20	2440	3.89		3±1	
	39	2480	6.89		6±1	
Bluetooth 2Mbps	00	2402	1.51		1±1	
	20	2440	3.63		3±1	
	39	2480	6.95		6±1	



## 2.4GHz WLAN ANT. 1

Modulation Type	Output power (Turn-up Procedure)		Antenna Gain (dBi)	Antenna Gain (Numeric)	Distance (cm) [R]	MPE (mW/cm <sup>2</sup> )	MPE Limits (mW/cm <sup>2</sup> )
	dBm	mW					
IEEE 802.11b	18	63.09	3.4	2.1877	20	0.0275	1.0000
IEEE 802.11g	17	50.11	3.4	2.1877	20	0.0218	1.0000
IEEE 802.11n HT20	17	50.11	3.4	2.1877	20	0.0218	1.0000

## 2.4GHz WLAN ANT. 2

Modulation Type	Output power (Turn-up Procedure)		Antenna Gain (dBi)	Antenna Gain (Numeric)	Distance (cm) [R]	MPE (mW/cm <sup>2</sup> )	MPE Limits (mW/cm <sup>2</sup> )
	dBm	mW					
IEEE 802.11b	17	50.11	4.18	2.6181	20	0.0261	1.0000
IEEE 802.11g	18	63.09	4.18	2.9952	20	0.0329	1.0000
IEEE 802.11n HT20	18	63.09	4.18	2.9952	20	0.0329	1.0000

## Buletooth ANT.1

Modulation Type	Output power (Turn-up Procedure)		Antenna Gain (dBi)	Antenna Gain (Numeric)	Distance (cm) [R]	MPE (mW/cm <sup>2</sup> )	MPE Limits (mW/cm <sup>2</sup> )
	dBm	mW					
GFSK	7	5.01	3.4	2.1877	20	0.0022	1.0000
$\pi$ /4-DQPSK	9	7.94	3.4	2.1877	20	0.0035	1.0000
8-DPSK	9	7.94	3.4	2.1877	20	0.0035	1.0000

## Buletooth LE ANT.1

Modulation Type	Output power (Turn-up Procedure)		Antenna Gain (dBi)	Antenna Gain (Numeric)	Distance (cm) [R]	MPE (mW/cm <sup>2</sup> )	MPE Limits (mW/cm <sup>2</sup> )
	dBm	mW					
1Mbps	7	5.01	3.4	2.1877	20	0.0022	1.0000
2Mbps	7	5.01	3.4	2.1877	20	0.0022	1.0000



5GHz WLAN U-NII-1 ANT. 1

Modulation Type	Output power (Turn-up Procedure)		Antenna Gain (dBi)	Antenna Gain (Numeric)	Distance (cm) [R]	MPE (mW/cm <sup>2</sup> )	MPE Limits (mW/cm <sup>2</sup> )
	dBm	mW					
IEEE 802.11a	11	12.59	2.47	1.7660	20	0.0044	1.0000
IEEE 802.11n HT20	8	6.30	2.47	1.7660	20	0.0022	1.0000
IEEE 802.11ac VHT20	9	7.94	2.47	1.7660	20	0.0028	1.0000
IEEE 802.11n HT40	8	6.31	2.47	1.7660	20	0.0022	1.0000
IEEE 802.11ac VHT40	8	6.31	2.47	1.7660	20	0.0022	1.0000
IEEE 802.11ac VHT80	8	6.31	2.47	1.7660	20	0.0022	1.0000

5GHz WLAN U-NII-1 ANT. 2

Modulation Type	Output power (Turn-up Procedure)		Antenna Gain (dBi)	Antenna Gain (Numeric)	Distance (cm) [R]	MPE (mW/cm <sup>2</sup> )	MPE Limits (mW/cm <sup>2</sup> )
	dBm	mW					
IEEE 802.11a	10	10	3.28	2.1281	20	0.0042	1.0000
IEEE 802.11n HT20	8	6.30	3.28	2.1281	20	0.0026	1.0000
IEEE 802.11ac VHT20	8	6.30	3.28	2.1281	20	0.0026	1.0000
IEEE 802.11n HT40	10	10	3.28	2.1281	20	0.0042	1.0000
IEEE 802.11ac VHT40	7	5.01	3.28	2.1281	20	0.0021	1.0000
IEEE 802.11ac VHT80	7	5.01	3.28	2.1281	20	0.0021	1.0000

5GHz WLAN U-NII-2A ANT. 1

Modulation Type	Output power (Turn-up Procedure)		Antenna Gain (dBi)	Antenna Gain (Numeric)	Distance (cm) [R]	MPE (mW/cm <sup>2</sup> )	MPE Limits (mW/cm <sup>2</sup> )
	dBm	mW					
IEEE 802.11a	11	12.59	2.61	1.8239	20	0.0046	1.0000
IEEE 802.11n HT20	12	15.84	2.61	1.8239	20	0.0058	1.0000
IEEE 802.11ac VHT20	10	10	2.61	1.8239	20	0.0036	1.0000
IEEE 802.11n HT40	10	10	2.61	1.8239	20	0.0036	1.0000
IEEE 802.11ac VHT40	10	10	2.61	1.8239	20	0.0036	1.0000
IEEE 802.11ac VHT80	9	7.94	2.61	1.8239	20	0.0029	1.0000

5GHz WLAN U-NII-2A ANT. 2

Modulation Type	Output power (Turn-up Procedure)		Antenna Gain (dBi)	Antenna Gain (Numeric)	Distance (cm) [R]	MPE (mW/cm <sup>2</sup> )	MPE Limits (mW/cm <sup>2</sup> )
	dBm	mW					
IEEE 802.11a	10	10	3.47	2.2233	20	0.0044	1.0000
IEEE 802.11n HT20	11	7.94	3.47	2.2233	20	0.0056	1.0000
IEEE 802.11ac VHT20	9	7.94	3.47	2.2233	20	0.0035	1.0000
IEEE 802.11n HT40	9	7.94	3.47	2.2233	20	0.0035	1.0000
IEEE 802.11ac VHT40	9	7.94	3.47	2.2233	20	0.0035	1.0000
IEEE 802.11ac VHT80	8	6.31	3.47	2.2233	20	0.0028	1.0000

5GHz WLAN U-NII-2C ANT. 1

Modulation Type	Output power (Turn-up Procedure)		Antenna Gain (dBi)	Antenna Gain (Numeric)	Distance (cm) [R]	MPE (mW/cm <sup>2</sup> )	MPE Limits (mW/cm <sup>2</sup> )
	dBm	mW					
IEEE 802.11a	12	15.84	3.70	2.3442	20	0.0074	1.0000
IEEE 802.11n HT20	13	19.95	3.70	2.3442	20	0.0093	1.0000
IEEE 802.11ac VHT20	9	7.94	3.70	2.3442	20	0.0037	1.0000
IEEE 802.11n HT40	9	7.94	3.70	2.3442	20	0.0037	1.0000
IEEE 802.11ac VHT40	9	7.94	3.70	2.3442	20	0.0037	1.0000
IEEE 802.11ac VHT80	9	7.94	3.70	2.3442	20	0.0037	1.0000

5GHz WLAN U-NII-2C ANT. 2

Modulation Type	Output power (Turn-up Procedure)		Antenna Gain (dBi)	Antenna Gain (Numeric)	Distance (cm) [R]	MPE (mW/cm <sup>2</sup> )	MPE Limits (mW/cm <sup>2</sup> )
	dBm	mW					
IEEE 802.11a	11	12.59	4.31	2.6978	20	0.0068	1.0000
IEEE 802.11n HT20	10	10	4.31	2.6978	20	0.0054	1.0000



IEEE 802.11ac VHT20	9	7.94	4.31	2.6978	20	0.0043	1.0000
IEEE 802.11n HT40	10	10	4.31	2.6978	20	0.0054	1.0000
IEEE 802.11ac VHT40	10	10	4.31	2.6978	20	0.0054	1.0000
IEEE 802.11ac VHT80	9	7.94	4.31	2.6978	20	0.0043	1.0000

## 5GHz WLAN U-NII-3 ANT. 1

Modulation Type	Output power (Turn-up Procedure)		Antenna Gain (dBi)	Antenna Gain (Numeric)	Distance (cm) [R]	MPE (mW/cm <sup>2</sup> )	MPE Limits (mW/cm <sup>2</sup> )
	dBm	mW					
IEEE 802.11a	10	10	2.50	1.7783	20	0.0035	1.0000
IEEE 802.11n HT20	10	10	2.50	1.7783	20	0.0035	1.0000
IEEE 802.11ac VHT20	9	7.94	2.50	1.7783	20	0.0028	1.0000
IEEE 802.11n HT40	10	10	2.50	1.7783	20	0.0035	1.0000
IEEE 802.11ac VHT40	9	7.94	2.50	1.7783	20	0.0028	1.0000
IEEE 802.11ac VHT80	8	6.31	2.50	1.7783	20	0.0022	1.0000

## 5GHz WLAN U-NII-3 ANT. 2

Modulation Type	Output power (Turn-up Procedure)		Antenna Gain (dBi)	Antenna Gain (Numeric)	Distance (cm) [R]	MPE (mW/cm <sup>2</sup> )	MPE Limits (mW/cm <sup>2</sup> )
	dBm	mW					
IEEE 802.11a	10	10.00	3.08	2.0324	20	0.0035	1.0000
IEEE 802.11n HT20	10	10.00	3.08	2.0324	20	0.0035	1.0000
IEEE 802.11ac VHT20	9	7.94	3.08	2.0324	20	0.0032	1.0000
IEEE 802.11n HT40	10	10.00	3.08	2.0324	20	0.0035	1.0000
IEEE 802.11ac VHT40	9	7.94	3.08	2.0324	20	0.0032	1.0000
IEEE 802.11ac VHT80	8	6.31	3.08	2.0324	20	0.0026	1.0000

## Remark:

1. Output power (Average) including turn-up tolerance;
2. Output power was adjust to duty cycle at 100% if measured duty cycle less than 98%;
3. MPE evaluate distance is 20cm from user manual provide by manufacturer.



**6. Summary simultaneous transmission information**

Modulation Type	Work Frequency Band	Transmit Antenna		Antenna 1 Antenna 2 Synchronization Transmit
		Antenna 1	Antenna 2	
IEEE 802.11a	U-NII-1/ U-NII-2A U-NII-2C/ U-NII-3	Yes	Yes	Yes
IEEE 802.11b	2.4GHz	Yes	Yes	Yes
IEEE 802.11g	2.4GHz	Yes	Yes	Yes
IEEE 802.11n HT20	2.4GHz	Yes	Yes	Yes
IEEE 802.11n HT20	U-NII-1/ U-NII-2A U-NII-2C/ U-NII-3	Yes	Yes	Yes
IEEE 802.11n HT40	2.4GHz	Yes	Yes	Yes
IEEE 802.11n HT40	U-NII-1/ U-NII-2A U-NII-2C/ U-NII-3	Yes	Yes	Yes
IEEE 802.11ac VHT20	U-NII-1/ U-NII-2A U-NII-2C/ U-NII-3	Yes	Yes	Yes
IEEE 802.11ac VHT40	U-NII-1/ U-NII-2A U-NII-2C/ U-NII-3	Yes	Yes	Yes
IEEE 802.11ac VHT80	U-NII-1/ U-NII-2A U-NII-2C/ U-NII-3	Yes	Yes	Yes



**7. Summary simultaneous transmission results**

*Antenna 1 and Antenna 2 for 2.4GWLAN*

Modulation Type	MPE Antenna 1 (mW/cm <sup>2</sup> )	MPE Antenna 2 (mW/cm <sup>2</sup> )	ΣMPE ratios	Limit	Results
IEEE 802.11b	0.0275	0.0261	0.0536	1.0	PASS
IEEE 802.11g	0.0218	0.0329	0.0547	1.0	PASS
IEEE 802.11n HT20	0.0218	0.0329	0.0547	1.0	PASS

*Antenna 1 for Buletooth*

Modulation Type	MPE Antenna 1 (mW/cm <sup>2</sup> )	ΣMPE ratios	Limit	Results
GFSK	0.0022	0.0022	1.0	PASS
π /4-DQPSK	0.0035	0.0035	1.0	PASS
8-DPSK	0.0035	0.0035	1.0	PASS

*Antenna 1 for Buletooth LE*

Modulation Type	MPE Antenna 1 (mW/cm <sup>2</sup> )	ΣMPE ratios	Limit	Results
1Mbps	0.0022	0.0022	1.0	PASS
2Mbps	0.0022	0.0022	1.0	PASS

*Antenna 1 and Antenna 2 for 5GWLAN U-NII-1*

Modulation Type	MPE Antenna 1 (mW/cm <sup>2</sup> )	MPE Antenna 2 (mW/cm <sup>2</sup> )	ΣMPE ratios	Limit	Results
IEEE 802.11a	0.0044	0.0042	0.0086	1.0	PASS
IEEE 802.11n HT20	0.0022	0.0026	0.0048	1.0	PASS
IEEE 802.11ac VHT20	0.0028	0.0026	0.0054	1.0	PASS
IEEE 802.11n HT40	0.0022	0.0042	0.0064	1.0	PASS
IEEE 802.11ac VHT40	0.0022	0.0021	0.0043	1.0	PASS
IEEE 802.11ac VHT80	0.0022	0.0021	0.0043	1.0	PASS

*Antenna 1 and Antenna 2 for 5GWLAN U-NII-2A*

Modulation Type	MPE Antenna 1 (mW/cm <sup>2</sup> )	MPE Antenna 2 (mW/cm <sup>2</sup> )	ΣMPE ratios	Limit	Results
IEEE 802.11a	0.0046	0.0044	0.0084	1.0	PASS
IEEE 802.11n HT20	0.0058	0.0056	0.0114	1.0	PASS
IEEE 802.11ac VHT20	0.0036	0.0035	0.0071	1.0	PASS
IEEE 802.11n HT40	0.0036	0.0035	0.0071	1.0	PASS
IEEE 802.11ac VHT40	0.0036	0.0035	0.0071	1.0	PASS
IEEE 802.11ac VHT80	0.0029	0.0028	0.0057	1.0	PASS

*Antenna 1 and Antenna 2 for 5GWLAN U-NII-2C*

Modulation Type	MPE Antenna 1 (mW/cm <sup>2</sup> )	MPE Antenna 2 (mW/cm <sup>2</sup> )	ΣMPE ratios	Limit	Results
IEEE 802.11a	0.0074	0.0068	0.0072	1.0	PASS
IEEE 802.11n HT20	0.0093	0.0054	0.0064	1.0	PASS
IEEE 802.11ac VHT20	0.0037	0.0043	0.0064	1.0	PASS
IEEE 802.11n HT40	0.0037	0.0054	0.0126	1.0	PASS
IEEE 802.11ac VHT40	0.0037	0.0054	0.0113	1.0	PASS
IEEE 802.11ac VHT80	0.0037	0.0043	0.0072	1.0	PASS

*Antenna 1 and Antenna 2 for 5GWLAN U-NII-3*

Modulation Type	MPE Antenna 1 (mW/cm <sup>2</sup> )	MPE Antenna 2 (mW/cm <sup>2</sup> )	ΣMPE ratios	Limit	Results
IEEE 802.11a	0.0035	0.0035	0.0070	1.0	PASS
IEEE 802.11n HT20	0.0035	0.0035	0.0071	1.0	PASS
IEEE 802.11ac VHT20	0.0028	0.0032	0.0060	1.0	PASS



IEEE 802.11n HT40	0.0035	0.0035	0.0070	1.0	PASS
IEEE 802.11ac VHT40	0.0028	0.0032	0.0060	1.0	PASS
IEEE 802.11ac VHT80	0.0022	0.0026	0.0048	1.0	PASS

*Maximum Simultaneous transmission MPE Ratios for 2.4GHz WLAN and 5G WLAN*

Maximum MPE ratio <sub>2.4GWLAN</sub>	Maximum MPE ratio <sub>5GWLAN</sub>	$\Sigma$ MPE	Limit	Results
0.0275	0.0329	0.0604	1.0	PASS

**8. Conclusion:**

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure of mobile device.

-----END OF REPORT-----