



RF EXPOSURE REPORT

REPORT NO.: SA990622C09

MODEL NO.: MRLBB-1003

FCC ID: RTP-MRLBB1003

ACCORDING: FCC Guidelines for Human Exposure
IEEE C95.1

APPLICANT: Wistron NeWeb Corp.

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ISSUED BY: Bureau Veritas Consumer Products Services
(H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory

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RF Exposure Measurement

1. Introduction

In this document, we try to prove the safety of radiation harmfulness to the human body for our product. The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. The Gain of the antenna used in this product is measured in a Fully Anechoic Chamber (FAC) calibrated for antenna measurement in our lab, and also the maximum total power input to the antenna is measured. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis transmission formula is a far field assumption, the calculated result of that is an over-prediction for near field power density. We will take that as the worst case to specify the safety range.

2. RF Exposure Limit

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environmental 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 (minutes)
(A)Limits For Occupational / Control Exposures				
300-1500	F/300	6
1500-100,000	5	6
(B)Limits For General Population / Uncontrolled Exposure				
300-1500	F/1500	30
1500-100,000	1.0	30

F = Frequency in MHz

3. Friis Formula

Friis transmission formula : $P_d = (P_{out} \cdot G) / (4 \cdot \pi \cdot r^2)$

where

P_d = power density in mW/cm^2

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

π = 3.1416

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

P_d is the limit of MPE, 1 mW/cm^2 . If we know the maximum Gain of the antenna and the total power input to the antenna, through the calculation, we will know the MPE value at distance 70cm.

Ref. : David K. Cheng, *Field and Wave Electromagnetics*, Second Edition,
Page 640, Eq. (11-133).

4. EUT Operating condition

The software provided by Manufacturer enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

5. Classification

The antenna of this product, under normal use condition, is at least 70cm away from the body of the user. So, this device is classified as **Mobile Device**.



6. TEST RESULTS

6.1 Antenna Gain

There are five antennas provided to this EUT, please refer to the following table:

No.	Brand name	Model name	Antenna Gain (dBi) (include cable loss)		Antenna Type	Connector	Point to point
			For 2.4GHz	For 5GHz			
1	WNC	5184-6684	5.41	7.02	PIFA	U.FL	-
2	Laird	J9169A	8.00	10.70	Directional	Reverse SMA	Yes
3	Laird	J9170A	10.90	13.50	Directional	Reverse SMA	Yes
4	Laird	J9171A	3.00	4.00	Omni	Reverse SMA	Yes
5	Laird	J9659	2.00	2.00	Omni	Reverse SMA	Yes

Note: 1. From the above antennas, **Antenna 1, 3 and 4** were selected as representative antennas for the test and their data were recorded in this report.
2. Antenna 3 only use in 2.4GHz and 5GHz(band 2-4)



6.2 Output Power Into Antenna & RF Exposure value at distance 20cm:

For 15.247(2.4GHz) - PIFA Antenna:

802.11b:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	75.5	0.013	1.0
6	2437	96.4	0.016	1.0
11	2462	75.0	0.013	1.0

802.11g:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	307.7	0.052	1.0
6	2437	375.1	0.064	1.0
11	2462	273.8	0.046	1.0

802.11n (20MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	309.1	0.017	1.0
6	2437	533.3	0.030	1.0
11	2462	246.3	0.014	1.0

802.11n (40MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2422	178.2	0.010	1.0
4	2437	370.4	0.021	1.0
7	2452	118.2	0.007	1.0



For 15.247(2.4GHz) - Directional Antenna:

802.11b:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	75.5	0.045	1.0
6	2437	96.4	0.058	1.0
11	2462	75.0	0.045	1.0

802.11g:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	307.7	0.184	1.0
6	2437	375.1	0.225	1.0
11	2462	273.8	0.164	1.0

802.11n (20MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	309.1	0.062	1.0
6	2437	533.3	0.107	1.0
11	2462	246.3	0.049	1.0

802.11n (40MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2422	178.2	0.036	1.0
4	2437	370.4	0.074	1.0
7	2452	118.2	0.024	1.0



For 15.247(2.4GHz) - Omni Antenna:

802.11b:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	75.5	0.007	1.0
6	2437	96.4	0.009	1.0
11	2462	75.0	0.007	1.0

802.11g:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	307.7	0.030	1.0
6	2437	375.1	0.036	1.0
11	2462	273.8	0.027	1.0

802.11n (20MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	309.1	0.010	1.0
6	2437	533.3	0.017	1.0
11	2462	246.3	0.008	1.0

802.11n (40MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2422	178.2	0.006	1.0
4	2437	370.4	0.012	1.0
7	2452	118.2	0.004	1.0



For 15.247(5GHz) - PIFA Antenna:

802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
149	5745	257.6	0.063	1.0
157	5785	244.4	0.060	1.0
165	5825	213.3	0.052	1.0

802.11n (20MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
149	5745	255.7	0.021	1.0
157	5785	177.3	0.014	1.0
165	5825	222.0	0.018	1.0

802.11n (40MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
151	5755	257.4	0.021	1.0
159	5795	204.6	0.017	1.0



For 15.247(5GHz) - Directional Antenna:

802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
149	5745	257.6	0.281	1.0
157	5785	244.4	0.267	1.0
165	5825	213.3	0.233	1.0

802.11n (20MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
149	5745	255.7	0.093	1.0
157	5785	177.3	0.064	1.0
165	5825	222.0	0.081	1.0

802.11n (40MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
151	5755	257.4	0.094	1.0
159	5795	204.6	0.074	1.0



For 15.247(5GHz) - Omni Antenna:

802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
149	5745	257.6	0.032	1.0
157	5785	244.4	0.030	1.0
165	5825	213.3	0.026	1.0

802.11n (20MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
149	5745	255.7	0.010	1.0
157	5785	177.3	0.007	1.0
165	5825	222.0	0.009	1.0

802.11n (40MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
151	5755	257.4	0.011	1.0
159	5795	204.6	0.008	1.0

For 15.407(5GHz) - PIFA Antenna:

802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
36	5180	6.8	0.002	1.0
40	5200	7.0	0.002	1.0
48	5240	7.0	0.002	1.0
52	5260	7.8	0.002	1.0
60	5300	7.8	0.002	1.0
64	5320	7.6	0.002	1.0
100	5500	7.9	0.002	1.0
116	5580	7.8	0.002	1.0
132	5660	7.5	0.002	1.0
140	5700	8.5	0.002	1.0

802.11n (20MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
36	5180	20.9	0.002	1.0
40	5200	22.1	0.002	1.0
48	5240	20.9	0.002	1.0
52	5260	23.8	0.002	1.0
60	5300	23.9	0.002	1.0
64	5320	23.1	0.002	1.0
100	5500	22.6	0.002	1.0
116	5580	24.0	0.002	1.0
132	5660	25.8	0.002	1.0
140	5700	17.2	0.001	1.0

802.11n (40MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
38	5190	35.3	0.003	1.0
46	5230	34.7	0.003	1.0
54	5270	43.4	0.004	1.0
62	5310	25.9	0.002	1.0
102	5510	10.7	0.001	1.0
110	5550	43.0	0.004	1.0
134	5670	18.7	0.002	1.0



For 15.407(5GHz) - Directional Antenna:

802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
52	5260	7.8	0.009	1.0
60	5300	7.8	0.009	1.0
64	5320	7.6	0.008	1.0
100	5500	7.9	0.009	1.0
116	5580	7.8	0.009	1.0
132	5660	7.5	0.008	1.0
140	5700	8.5	0.009	1.0

802.11n (20MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
52	5260	23.8	0.009	1.0
60	5300	23.9	0.009	1.0
64	5320	23.1	0.008	1.0
100	5500	22.6	0.008	1.0
116	5580	24.0	0.009	1.0
132	5660	25.8	0.009	1.0
140	5700	17.2	0.006	1.0

802.11n (40MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
54	5270	43.4	0.016	1.0
62	5310	25.9	0.009	1.0
102	5510	10.7	0.004	1.0
110	5550	43.0	0.016	1.0
134	5670	18.7	0.007	1.0



For 15.407(5GHz) - Omni Antenna:

802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
36	5180	6.8	0.001	1.0
40	5200	7.0	0.001	1.0
48	5240	7.0	0.001	1.0
52	5260	7.8	0.001	1.0
60	5300	7.8	0.001	1.0
64	5320	7.6	0.001	1.0
100	5500	7.9	0.001	1.0
116	5580	7.8	0.001	1.0
132	5660	7.5	0.001	1.0
140	5700	8.5	0.001	1.0

802.11n (20MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
36	5180	20.9	0.001	1.0
40	5200	22.1	0.001	1.0
48	5240	20.9	0.001	1.0
52	5260	23.8	0.001	1.0
60	5300	23.9	0.001	1.0
64	5320	23.1	0.001	1.0
100	5500	22.6	0.001	1.0
116	5580	24.0	0.001	1.0
132	5660	25.8	0.001	1.0
140	5700	17.2	0.001	1.0

802.11n (40MHz):

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46	5230	34.7	0.001	1.0
54	5270	43.4	0.002	1.0
62	5310	25.9	0.001	1.0
102	5510	10.7	0.000	1.0
110	5550	43.0	0.002	1.0
134	5670	18.7	0.001	1.0



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CONCLUSION:

Both of the 2.4GHz and 5GHz can transmit simultaneously, the formula of calculated the MPE is:

$$CPD_1 / LPD_1 + CPD_2 / LPD_2 + \dots \text{etc.} < 1$$

CPD = Calculation power density

LPD = Limit of power density

Therefore, the worst-case situation is $0.225 / 1 + 0.281 / 1 = 0.506$, which is less than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.

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