



RF EXPOSURE REPORT

REPORT NO.: SA980406H01A

MODEL NO.: AP-7131N

ACCORDING: FCC Guidelines for Human Exposure
IEEE C95.1

APPLICANT: Motorola Inc.

ADDRESS: One Symbol Plaza Holtsville, NY11742 USA

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

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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 : $P_d = (P_{out} * G) / (4 * \pi * r^2)$

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 28cm.

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 28cm away from the body of the user. Warning statement to the user for keeping at least 28cm or more separation distance with the antenna should be included in users manual. So, this device is classified as **Mobile Device**



6. Test Results

6.1 Antenna Gain

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

No	Brand	Model	Antenna Type	Connector Type (External only)	Frequency range (MHz)	Indoor or Outdoor
1	Symbol	ML-2499-BYGA2-01R	YAGI	Type N-Female	2400~2500	Indoor
2	Symbol	ML-2499-11PNA2-01R	Panel	RP-BNC-Female	2400~2500	Indoor
3	Symbol	ML-2452-APA2-01	Dipole	RP-SMA MALE	2400-2500, 5150-5850	Indoor
4	Motolora	ML-2452-PTA2M3X3-1	Embedded	RP-SMA-Male	2400-2500, 4900-5990	Indoor
5	Symbol	ML-5299-WPNA1-01R	Panel	RP-SMA-Female	5150-5875	Indoor
6	Symbol	ML-2499-HPA3-01R	Dipole	RP-BNC FEMALE	2400-2500	Indoor
7	Symbol	ML-5299-HPA1-01R	Dipole	RP-SMA FEMALE	5150-5875	Indoor
8	Motolora	ML-2452-PTA3M3-036	Patch	RP-SMA-Male	2400-2500, 4900-5990	Indoor
9	WHA YU	ML-2452-APA6J-01	Dipole	SMA Plug Reverse	2400-2500, 4900-5990	Indoor
10	Motolora	ML-2452-PNL9M3-036	Panel	Reverse SMA	2400-2500, 5150-5875	Indoor
11	Motolora	ML-5299-BYGA15-012	YAGI	Type N Female connector	4900-5800	Indoor
12	WHA YU	M25.90002.S01	Dipole	I-PEX	2400-2500, 5150-5850	Indoor
No	Brand	Model	Gain (dBi)	Cable Loss(dB) (External only, if any)	Net Gain (dB)	Cable Length (External only, if any)
1	Symbol	ML-2499-BYGA2-01R	14.2	0.3	13.9	12 inch
2	Symbol	ML-2499-11PNA2-01R	11.2	2.7	8.5	96 inch
3	Symbol	ML-2452-APA2-01	3 / 4	N/A	3 / 4	N/A
4	Motolora	ML-2452-PTA2M3X3-1	1 / 2	N/A	1 / 2	N/A
5	Symbol	ML-5299-WPNA1-01R	14.2	1.2	13	36 inch
6	Symbol	ML-2499-HPA3-01R	4.6	1.3	3.3	48 inch
7	Symbol	ML-5299-HPA1-01R	5.9	0.84	5.06	36 inch
8	Motolora	ML-2452-PTA3M3-036	6/7	0.92 / 1.97	5.08 / 5.03	36 inch
9	WHA YU	ML-2452-APA6J-01	-6 / -6	N/A	2.4GHz Peak gain : -5.76dBi 5GHz Peak gain : band 1: -3.77dBi band 2: -3.38dBi band 3: -2.84dBi band 4: -2.94dBi	N/A
10	Motolora	ML-2452-PNL9M3-036	8 / 10.7	N/A	8 / 10.7	36 inch
11	Motolora	ML-5299-BYGA15-012	14.5	N/A	14.5	3 ft



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12	WHA YU	M25.90002.S01	3.03 / 4.06	N/A	3.03 / 4.06	63mm
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Note :

1. For Radio card 1: The antennas 1~4, 6 & 8-10 will be use, therefore antenna 1, 2, 4, 6, 8, were chosen for final test.
2. For Radio card 2: The antennas 3~5 & 7-11 will be use, therefore antenna 4, 5, 7, 8, 11, were chosen for final test.
3. For Radio card 3: The antenna 12 will be use only, therefore antenna 12 was chosen for final test.

6.2 Output Power Into Antenna & RF Exposure value at distance 28cm:

For 15.247(2.4GHz) – Antenna 1<Radio 1>:

For Part 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	106.53	0.265	1.0
6	2437	108.86	0.271	1.0
11	2462	90.19	0.225	1.0

For Part 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	127.463	0.318	1.0
6	2437	139.609	0.348	1.0
11	2462	107.291	0.267	1.0

DRAFT 802.11n (20MHz) OFDM

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	104.609	0.261	1.0
6	2437	149.939	0.374	1.0
11	2462	87.900	0.219	1.0

DRAFT 802.11n (40MHz) OFDM

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2422	62.895	0.157	1.0
4	2437	126.103	0.314	1.0
7	2452	58.534	0.146	1.0



For 15.247(2.4GHz) – Antenna 2<Radio 1>:

For Part 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	194.175	0.140	1.0
6	2437	308.169	0.221	1.0
11	2462	211.995	0.152	1.0

For Part 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	288.683	0.207	1.0
6	2437	324.163	0.233	1.0
11	2462	304.367	0.219	1.0

DRAFT 802.11n (20MHz) OFDM

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	246.900	0.177	1.0
6	2437	289.148	0.208	1.0
11	2462	196.362	0.141	1.0

DRAFT 802.11n (40MHz) OFDM

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2422	213.705	0.154	1.0
4	2437	233.642	0.168	1.0
7	2452	133.471	0.096	1.0



For 15.247(2.4GHz) – Antenna 4<Radio 1>:

For Part 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	538.069	0.069	1.0
6	2437	344.990	0.044	1.0
11	2462	231.925	0.030	1.0

For Part 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	987.513	0.126	1.0
6	2437	766.574	0.098	1.0
11	2462	996.802	0.127	1.0

DRAFT 802.11n (20MHz) OFDM

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	986.682	0.126	1.0
6	2437	834.655	0.107	1.0
11	2462	963.743	0.123	1.0

DRAFT 802.11n (40MHz) OFDM

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2422	957.167	0.122	1.0
4	2437	999.385	0.128	1.0
7	2452	992.868	0.127	1.0



For 15.247(2.4GHz) – Antenna 6<Radio 1>:

For Part 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	306.536	0.067	1.0
6	2437	956.375	0.208	1.0
11	2462	366.338	0.079	1.0

For Part 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	801.872	0.174	1.0
6	2437	903.749	0.196	1.0
11	2462	588.130	0.128	1.0

DRAFT 802.11n (20MHz) OFDM

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	691.446	0.150	1.0
6	2437	943.888	0.205	1.0
11	2462	447.237	0.097	1.0

DRAFT 802.11n (40MHz) OFDM

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2422	384.409	0.083	1.0
4	2437	646.982	0.140	1.0
7	2452	382.799	0.083	1.0

For 15.247(2.4GHz) – Antenna 8<Radio 1>:
For Part 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	221.788	0.073	1.0
6	2437	509.155	0.166	1.0
11	2462	315.230	0.103	1.0

For Part 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	739.218	0.242	1.0
6	2437	801.957	0.262	1.0
11	2462	434.111	0.142	1.0

DRAFT 802.11n (20MHz) OFDM

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	371.063	0.121	1.0
6	2437	718.918	0.235	1.0
11	2462	332.442	0.109	1.0

DRAFT 802.11n (40MHz) OFDM

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2422	300.871	0.098	1.0
4	2437	519.772	0.170	1.0
7	2452	340.301	0.111	1.0



For 15.247(2.4GHz) – Antenna 12<Radio 3>:

For Part 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	276.058	0.056	1.0
6	2437	283.792	0.058	1.0
11	2462	282.488	0.058	1.0

For 15.247(5GHz) – Antenna 4<Radio 2>:

For Part 802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5745	940.387	0.151	1.0
3	5785	904.190	0.145	1.0
4	5805	890.768	0.143	1.0

For DRAFT 802.11n (20MHz) OFDM:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5745	921.281	0.148	1.0
3	5785	894.687	0.144	1.0
4	5805	882.593	0.142	1.0

DRAFT 802.11n (40MHz) OFDM

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5755	898.173	0.144	1.0
2	5795	894.447	0.144	1.0

For 15.247(5GHz) – Antenna 5<Radio 2>:

For Part 802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5745	177.84	0.360	1.0
3	5785	183.43	0.371	1.0
4	5805	189.62	0.384	1.0

For DRAFT 802.11n (20MHz) OFDM:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5745	173.924	0.352	1.0
3	5785	183.244	0.371	1.0
4	5805	181.696	0.368	1.0

DRAFT 802.11n (40MHz) OFDM

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5755	175.731	0.356	1.0
2	5795	178.048	0.361	1.0

For 15.247(5GHz) – Antenna 7<Radio 2>:

For Part 802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5745	940.387	0.306	1.0
3	5785	904.190	0.294	1.0
4	5805	890.768	0.290	1.0

For DRAFT 802.11n (20MHz) OFDM:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5745	921.281	0.300	1.0
3	5785	894.687	0.291	1.0
4	5805	882.593	0.287	1.0

DRAFT 802.11n (40MHz) OFDM

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5755	898.173	0.292	1.0
2	5795	894.447	0.291	1.0

For 15.247(5GHz) – Antenna 8<Radio 2>:

For Part 802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5745	940.387	0.304	1.0
3	5785	904.190	0.292	1.0
4	5805	890.768	0.288	1.0

For DRAFT 802.11n (20MHz) OFDM:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5745	921.281	0.298	1.0
3	5785	894.687	0.289	1.0
4	5805	882.593	0.285	1.0

DRAFT 802.11n (40MHz) OFDM

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5755	898.173	0.290	1.0
2	5795	894.447	0.289	1.0

For 15.247(5GHz) – Antenna 11<Radio 2>:

For Part 802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5745	136.405	0.390	1.0
3	5785	133.130	0.381	1.0
4	5805	134.014	0.383	1.0

For DRAFT 802.11n (20MHz) OFDM:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5745	135.623	0.388	1.0
3	5785	125.013	0.358	1.0
4	5805	131.667	0.377	1.0

DRAFT 802.11n (40MHz) OFDM

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5755	133.889	0.383	1.0
2	5795	123.506	0.353	1.0



For 15.247(5GHz) – Antenna 12<Radio 3>:

For Part 802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5745	310.456	0.080	1.0
3	5785	303.389	0.078	1.0
4	5805	299.916	0.078	1.0

For 15.407(5GHz) – Antenna 4<Radio 2>:

For Part 802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5180	30.990	0.005	1.0
2	5200	29.592	0.005	1.0
4	5240	30.786	0.005	1.0

For DRAFT 802.11n (20MHz) OFDM:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5180	30.606	0.005	1.0
2	5200	28.858	0.005	1.0
4	5240	28.263	0.005	1.0

For DRAFT 802.11n (40MHz) OFDM:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5190	30.374	0.005	1.0
2	5230	46.138	0.007	1.0

For 15.407(5GHz) – Antenna 5<Radio 2>:

For Part 802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5180	5.747	0.012	1.0
2	5200	6.131	0.012	1.0
4	5240	6.148	0.012	1.0

For DRAFT 802.11n (20MHz) OFDM:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5180	6.993	0.014	1.0
2	5200	5.930	0.012	1.0
4	5240	5.739	0.012	1.0

For DRAFT 802.11n (40MHz) OFDM:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5190	9.149	0.019	1.0
2	5230	9.274	0.019	1.0

For 15.407(5GHz) – Antenna 7<Radio 2>:

For Part 802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5180	30.990	0.010	1.0
2	5200	29.592	0.010	1.0
4	5240	30.786	0.010	1.0

For DRAFT 802.11n (20MHz) OFDM:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5180	30.606	0.010	1.0
2	5200	28.858	0.009	1.0
4	5240	28.263	0.009	1.0

For DRAFT 802.11n (40MHz) OFDM:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5190	43.932	0.014	1.0
2	5230	46.138	0.015	1.0

For 15.407(5GHz) – Antenna 8 <Radio 2>:

For Part 802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5180	30.990	0.010	1.0
2	5200	29.592	0.010	1.0
4	5240	30.786	0.010	1.0

For DRAFT 802.11n (20MHz) OFDM:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5180	30.606	0.010	1.0
2	5200	28.858	0.009	1.0
4	5240	28.263	0.009	1.0

For DRAFT 802.11n (40MHz) OFDM:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5190	43.932	0.014	1.0
2	5230	46.138	0.015	1.0

For 15.407(5GHz) – Antenna 11<Radio 2>:

For Part 802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5180	3.750	0.011	1.0
2	5200	4.600	0.013	1.0
4	5240	4.096	0.012	1.0

For DRAFT 802.11n (20MHz) OFDM:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5180	4.559	0.013	1.0
2	5200	4.208	0.012	1.0
4	5240	4.366	0.012	1.0

For DRAFT 802.11n (40MHz) OFDM:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5190	6.458	0.018	1.0
2	5230	6.660	0.019	1.0

For 15.407(5GHz) – Antenna 12<Radio 3>:

For Part 802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5180	9.016	0.002	1.0
2	5200	9.311	0.002	1.0
4	5240	9.705	0.003	1.0

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 calculation of this situation is $0.374 / 1 + 0.390 / 1 + 0.058 / 1 = 0.822$, which is less than the “1” limit.