RF EXPOSURE REPORT

REPORT NO.: SA980406H01B
MODEL NO.: AP-7131N

ACCORDING: FCC Guidelines for Human Exposure
IEEE C95.1

APPLICANT: Motorola Inc.

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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 : $Pd = (Pout*G) / (4*pi*r^2)$

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 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	Connecter 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	4.75 / 5.5 (with Cable)	N/A	4.75 / 5.5	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

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

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 15.407(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)
5	5260	44.535	0.007	1.0
7	5300	45.447	0.007	1.0
8	5320	44.137	0.007	1.0
9	5500	43.087	0.007	1.0
14	5600	43.097	0.007	1.0
19	5700	39.661	0.006	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)
5	5260	44.902	0.007	1.0
7	5300	44.563	0.007	1.0
8	5320	42.867	0.007	1.0
9	5500	43.755	0.007	1.0
14	5600	42.425	0.007	1.0
19	5700	42.847	0.007	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)
3	5270	41.392	0.007	1.0
4	5310	41.744	0.007	1.0
5	5510	24.836	0.004	1.0
7	5590	41.251	0.007	1.0
9	5670	43.707	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)
5	5260	27.655	0.056	1.0
7	5300	26.529	0.054	1.0
8	5320	26.928	0.055	1.0
9	5500	27.611	0.056	1.0
14	5600	28.839	0.058	1.0
19	5700	21.389	0.043	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)
5	5260	30.594	0.062	1.0
7	5300	26.016	0.053	1.0
8	5320	28.435	0.058	1.0
9	5500	26.963	0.055	1.0
14	5600	31.141	0.063	1.0
19	5700	19.991	0.040	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)
3	5270	41.392	0.084	1.0
4	5310	29.192	0.059	1.0
5	5510	8.781	0.018	1.0
7	5590	41.251	0.084	1.0
9	5670	43.707	0.089	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)
5	5260	44.535	0.014	1.0
7	5300	45.447	0.015	1.0
8	5320	44.137	0.014	1.0
9	5500	43.087	0.014	1.0
14	5600	43.097	0.014	1.0
19	5700	39.661	0.013	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)
5	5260	44.902	0.015	1.0
7	5300	44.563	0.015	1.0
8	5320	42.867	0.014	1.0
9	5500	43.755	0.014	1.0
14	5600	42.425	0.014	1.0
19	5700	42.847	0.014	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)
3	5270	41.392	0.013	1.0
4	5310	41.744	0.014	1.0
5	5510	20.197	0.007	1.0
7	5590	41.251	0.013	1.0
9	5670	43.707	0.014	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)
5	5260	44.535	0.014	1.0
7	5300	45.447	0.015	1.0
8	5320	44.137	0.014	1.0
9	5500	43.087	0.014	1.0
14	5600	43.097	0.014	1.0
19	5700	39.661	0.013	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)
5	5260	44.902	0.015	1.0
7	5300	44.563	0.014	1.0
8	5320	42.867	0.014	1.0
9	5500	43.755	0.014	1.0
14	5600	42.425	0.014	1.0
19	5700	42.847	0.014	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)
3	5270	41.392	0.013	1.0
4	5310	41.744	0.013	1.0
5	5510	24.836	0.008	1.0
7	5590	41.251	0.013	1.0
9	5670	43.707	0.014	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)
5	5260	23.218	0.066	1.0
7	5300	19.736	0.056	1.0
8	5320	18.986	0.054	1.0
9	5500	18.956	0.054	1.0
14	5600	21.047	0.060	1.0
19	5700	22.165	0.063	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)
5	5260	22.298	0.064	1.0
7	5300	21.144	0.060	1.0
8	5320	21.760	0.062	1.0
9	5500	21.263	0.061	1.0
14	5600	22.979	0.066	1.0
19	5700	20.936	0.060	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)
3	5270	30.090	0.086	1.0
4	5310	30.723	0.088	1.0
5	5510	10.654	0.030	1.0
7	5590	33.519	0.096	1.0
9	5670	33.206	0.095	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)
5	5260	43.954	0.011	1.0
7	5300	40.832	0.011	1.0
8	5320	43.152	0.011	1.0
9	5500	43.853	0.011	1.0
14	5600	40.272	0.010	1.0
19	5700	39.902	0.010	1.0

CONCULSION:

Both of the 11g and 11a can transmit simultaneously, the formula of calculated the MPE is:

$CPD_1 / LPD_1 + CPD_2 / LPD_2 + ……etc. < 1$

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.

※ The “CPD” please refer original report RF980406H01A.