RF EXPOSURE REPORT

REPORT NO.: SA940816H02H-1

MODEL NO.: AP-5131

PART NO.: AP-5131-44000-WW

ACCORDING: FCC Guidelines for Human Exposure

IEEE C95.1

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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 20cm.

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 20cm away from the body of the user. Warning statement to the user for keeping at least 20cm 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 six antennas provided to this EUT, please refer to the following table:

No.	Symbol P/N	Gain (dBi)	Cable Loss (dB)	Net Gain (dB)	Antenna Type	Connector	Remark
For 2.4GHz							
1	*ML-2452-APA2-01	3.0	0	3.0	Dipole	RP SMA	Omni
2	ML-2499-11PNA2-01	11.2	2.7	8.5	Panel	Reverse BNC	Directional
3	ML-2499-HPA3-01	4.6	1.3	3.3	Dipole	Reverse BNC	Omni
4	**ML-2499-BYGA2-01	14.2	0.3	13.9	Yagi	RP SMA	Directional
For 5GHz							
No.	Symbol P/N	Gain (dBi)	Cable Loss (dB)	Net Gain (dB)	Antenna Type	Connector	Remark
1	*ML-2452-APA2-01	4.0	0	4.0	Dipole	RP SMA	Omni
2	ML-5299-WPNA1-01	14.2	1.2	13.0	Patch	RP SMA	Directional
3	ML-5299-HPA1-01	5.9	0.84	5.0	Omni	RP SMA	Omni

Note:

1. All of the above antennas are Indoor Antenna except the Symbol P/N: ML-2499-BYGA2-01.
2. "*" is a Dual Band antenna can be used in both 2.4GHz and 5GHz.
3. "**" is an Outdoor Antenna it can only be used in point-to-point applications.
4. For 2.4GHz Antenna No. 2 and 3 have Extend cable (0.5 dB loss).
5. For 2.4GHz Antenna No. 4 has Extend cable (0.5 dB loss) and Arrestor (1.0 dB loss).

From the above modes, **Antenna 2** was chosen for final test.

※According to client's declaration letter which declares diplexer characteristic is same as the original application, there is worst case antenna has to be performed. And all data was verified to meet the requirements.

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

For 15.247(2.4GHz):

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	16.2	0.020	1.0
6	2437	144.5	0.181	1.0
11	2462	11.5	0.014	1.0

For 15.247(5GHz):
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	72.4	0.287	1.0
157	5785	74.1	0.294	1.0
165	5825	74.1	0.294	1.0

For 15.407(5GHz):
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	7.2	0.029	1.0
40	5200	7.8	0.031	1.0
48	5240	7.8	0.031	1.0

CONCULSION:

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

$CPD_1 / LPD_1 + CPD_2 / LPD_2 + \ldots\ldots$etc. < 1

CPD = Calculation power density

LPD = Limit of power density

Therefore, the calculation of this situation is 0.181 / 1 + 0.294 / 1 = 0.475, which is less than the "1" limit.