RF Exposure Measurement

1. Introduction

The maximum Gain measured in Fully Anechoic Chamber is 2.0 dBi or 1.62 (numeric).

Because this deivce is transmitting the high power signal, it is regarded specially as a dangerous band for its heating harmfulness to the human body. The manufacturer whose product is working in this frequency band is obligatory to prove the harmfulness of his product.

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), and 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,

2. Classification

MODE: iDen (QAM)

The antenna of the product, under normal use condition, is at least 20cm away from the body of the user. Warning statement for keeping 20cm separation distance and the prohibition of operating next to a person has been printed on the user's manual. So, this product is classified as the Mobile Device.

3. 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) - **Class A**

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm^2)	Average Time (minutes)
0.3 - 3.0	614	1.63	*(100)	6
3.0 - 30	1842/f	4.89/f	*($900/f^2$)	6
30 - 300	61.4	0.163	1.0	6
300 - 1500			F/300	6
1500 - 100,000			5	6

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE) - **Class B**

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength(A/m)	Power Density (mW/cm^2)	Average Time (minutes)
0.3 - 1.34	614	1.63	*(100)	30
1.34 - 30	824/f	2.19/f	*($180/f^2$)	30
30 - 300	27.5	0.073	0.2	30
300 - 1500	-	-	F/1500	30
1500 - 100,000	-	-	1.0	30

F = Frequency in MHz * = Plane-wave equivalent power density

4. Friis Formula

Friis transmission formula : $P_d = (Pout*G) / (4*\pi*r2)$

The maximum Gain measured in Fully Anechoic Chamber is 2.0 dBi or 1.62 (numeric).

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

Pi = 3.1416

MODE: CCK, OFDM

Pd is the limit of MPE, 1mW/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 distance r where the MPE limit is reached.

The software provided by Manufacturer enabled the EUT to transmit with max power at lowest, middle and highest channel individually.

5. PRODUCT INFORMATION

5.1 Equipment Description

Frequency Range	For 802.11ac - VHT20 : 5 180 ~ 5 240 MHz, 5 745 ~ 5 825 MHz For 802.11ac - VHT40 : 5 190 ~ 5 230 MHz, 5 755 ~ 5 795 MHz For 802.11ac - VHT80 : 5 210 MHz, 5 775 MHz
Type of Modulation	802.11 ac : OFDM
Maximum Average Output Power with ANT #1	802.11ac - VHT20 : 11.47 dBm(Band 1), 11.91 dBm(Band 3) 802.11ac - VHT40 : 10.55 dBm(Band 1), 13.12 dBm(Band 3) 802.11ac - VHT80 : 10.03 dBm(Band 1), 13.07 dBm(Band 3)
Maximum Average Output Power with ANT #2	802.11ac - VHT20 : 11.64 dBm(Band 1), 12.01 dBm(Band 3) 802.11ac - VHT40 : 9.08 dBm(Band 1), 13.84 dBm(Band 3) 802.11ac - VHT80 : 7.85 dBm(Band 1), 12.88 dBm(Band 3)
Maximum Average Output Power with ANT #3	802.11ac - VHT20 : 10.90 dBm(Band 1), 12.15 dBm(Band 3) 802.11ac - VHT40 : 9.54 dBm(Band 1), 13.79 dBm(Band 3) 802.11ac - VHT80 : 8.34 dBm(Band 1), 12.54 dBm(Band 3)
Maximum Average Output Power with ANT #4	802.11ac - VHT20 : 11.07 dBm(Band 1), 10.20 dBm(Band 3) 802.11ac - VHT40 : 7.93 dBm(Band 1), 12.80 dBm(Band 3) 802.11ac - VHT80 : 8.01 dBm(Band 1), 13.30 dBm(Band 3)
Antenna	Band 1 Max Gain : 1.902 dBi Band 3 Max Gain : 1.950 dBi Beamforming Gain : 3 dBi Type : MIMO 4X4
Transmitted as the output of all ports, the output of individual ports are not supported.	

6. Test Results

The maximum Gain measured in Fully Anechoic Chamber is 2.0 dBi or 1.62 (numeric).

6.1 Output Power into Antenna & RF Exposure value at distance 20 cm :

MODE: OFDM

TEST MODE	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm2)	Limit of Power Density (mW/cm2)
802.11ac VHT20	5180 - 5240	52.72	0.0166	1.00
802.11ac VHT20	5745 - 5825	58.04	0.0183	1.00
802.11ac VHT40	5190 - 5230	34.64	0.0109	1.00
802.11ac VHT40	5755 - 5795	87.71	0.0276	1.00
802.11ac VHT80	5210	29.31	0.0092	1.00
802.11ac VHT80	5775	79.01	0.0248	1.00

The minimum allowable distance is very close to the enclosure of the antenna and is very far away from the human beign under normal use condition.