

RF Exposure Measurement

1. Introduction

The maximum Gain measured in Fully Anechoic Chamber

Because this device 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, where the limit of MPE is reached.

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

3. Friis Formula

$$R = \sqrt{\frac{PG}{4\pi S}}$$

The maximum Gain measured in Fully Anechoic Chamber

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

Pi = 3.1416

5. Test Results

5.1 The maximum Gain measured in Fully Anechoic Chamber

Band	antenna gain (dBi)	nemeric
Uplink : 817 ~ 824 MHz	8.5 dBi	7.08 (numeric)
Downlink : 862~ 869 MHz	8.5 dBi	7.08 (numeric)
Downlink : 758 ~ 775 MHz	7.5 dBi	5.62 (numeric)
Downlink : 851 ~ 862 MHz	8.5 dBi	7.08 (numeric)
Uplink : 788 ~ 805 MHz	7.5 dBi	5.62 (numeric)
Uplink : 806 ~ 817 MHz	8.5 dBi	7.08 (numeric)

5.2 Output Power into Antenna & Power Density (0.5mW/cm2) :

MODE: Uplink

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm2)
Uplink : 817 ~ 824 MHz	802.5 MHz	501.19	22.98
Uplink : 788 ~ 805 MHz	796.5 MHz	501.19	20.55
Uplink : 806 ~ 817 MHz	815.3 MHz	501.19	22.80

MODE: Downlink

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm2)
Downlink : 862~ 869 MHz	766.50	2511.88	52.64
Downlink : 758 ~ 775 MHz	865.50	2511.88	44.14
Downlink : 851 ~ 862 MHz	860.28	2511.88	49.69

The Maximum antenna gain is 8.5 dBi and the shortest distance from the human specific is 52.64 cm, the device is compliant with the requirement MPE limit for uncontrolled exposure.