

# RF Exposure Report

## RF Exposure Measurement

The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. The gain of the antennas used in the product is extracted from the Antenna data sheets provided 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 far field assumption, the calculated result of that is an over-prediction for near field power density. It is taken as worst case to specify the safety range.

## RF Exposure Limit

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environmental impact of the human exposure to radio-frequency (RF) radiation as specified in 1.1307 (b)

Limits for Maximum Permissible Exposure (MPE)

Table: Limits For Maximum Permissible Exposure (MPE)

(A) Limits for Occupational/controlled Exposure				
Frequency Range(MHz)	Electric Field Strength(E)(V/m)	Magnetic Field Strength(H)(A/m)	Power Density (S)(mW/cm <sup>2</sup> )	Averaging Time (minute) E  <sup>2</sup> , H  <sup>2</sup> or S
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f <sup>2</sup> )*	6
30-300	61.4	0.163	1.0	6
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6
(B) Limits for General Population/uncontrolled Exposure				
Frequency Range(MHz)	Electric Field Strength(E)(V/m)	Magnetic Field Strength(H)(A/m)	Power Density (S)(mW/cm <sup>2</sup> )	Averaging Time (minute) E  <sup>2</sup> , H  <sup>2</sup> or S
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f)*	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	

Friss Formula

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

Where  
Pd = power density in mW/cm²  
Pout = output power to antenna in mW  
G = gain of antenna in linear scale  
Pi = 3.1416  
R = Distance between observation point and the center of radiator in cm

If we know the maximum gain of the antenna and the total output power to the antenna, through calculation, we will know MPE value at distance 20cm.

EUT Operation condition

EUT was enabled to transmit and receive at lowest, middle and highest channels.

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 from the antenna should be included in the User manual. So, this device is classified as Mobile device.

Mode	WIFI
IEEE 802.11b	8±1dBm
IEEE 802.11g	8±1dBm
IEEE 802.11n HT20	8±1dBm
IEEE 802.11n HT40	5±1dBm
Mode	GSM
GSM 850	27±1dBm
GSM 1900	27±1dBm
Mode	WCDMA
WCDMA 850	23±1dBm
WCDMA 1900	23±1dBm
WCDMA 1700	23±1dBm
Mode	LTE
LTE Band 2	24±1dBm
LTE Band 4	24±1dBm
LTE Band 5	24±1dBm
LTE Band 17	24±1dBm

Test Results

Gain (G): 3 dBi

Protocol	Channel Frequency (MHz)	Power (dBm)	Antenna Gain (dBi)	Max Output Power (mW)	Power Density (mW/cm²)	Limit (mW/cm²)
802.11 b	N/A	9.3	3	16.982	0.003378	1.000
802.11 g		9	3	15.849	0.003153	1.000
802.11 n20		9	3	15.849	0.003153	1.000
802.11 n40		6	3	7.943	0.00158	1.000

Antenna Gain (G): 2.15dBi

Protocol	Channel Frequency (MHz)	Power (dB)	Antenna Gain (dBi)	Max Output Power (mW)	Power Density (mW/cm²)	Limit (mW/cm²)
GSM 850	848.8	27.42	2.15	552.0774393	0.236168999	0.5495
GSM 1900	1880.0	27.34	2.15	542.0008904	0.231858429	1
WCDMA 850	836.4	23.24	2.15	210.862815	0.090203396	0.549
WCDMA 1900	1880.0	23.25	2.15	211.348904	0.090411336	1
WCDMA 1700	1732.6	23.30	2.15	213.796209	0.09145825	1
LTE Band 2	1850.7	23.59	2.15	228.5598803	0.097773889	1
LTE Band 4	1710.7	24.66	2.15	292.4152378	0.125090085	1
LTE Band 5	844.0	23.31	2.15	214.2890601	0.091669083	0.549
LTE Band 17	706.5	25.18	2.15	329.6097122	0.141001226	0.469