



RF EXPOSURE REPORT

REPORT NO.: SA960830H04A

MODEL NO.: SMCWBR14-3GN, MR3306A, DIR-615

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 ADT, 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	6
1500-100,000	1.0	30

F = Frequency in MHz

3. Friis Formula

Friis transmission formula : $P_d = (P_{out} \cdot G) / (4 \cdot \pi \cdot r^2)$

where

P_d = power density in mW/cm^2

P_{out} = 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

P_d 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 three antennas provided to this EUT, please refer to the following table:

Transmitter Circuit	Antenna Type	Gain (dBi)	Antenna Connector
Chain(0)	monopole	1.7	MHF 20351-1X1R-37
Chain(1)	monopole	1.7	MHF 20351-1X1R-37
Chain(2)	monopole	1.7	MHF 20351-1X1R-37

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

For Part 802.11b:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	119.124	0.035	1.0
6	2437	122.462	0.036	1.0
11	2462	125.603	0.037	1.0

For Part 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	264.850	0.078	1.0
6	2437	268.534	0.079	1.0
11	2462	256.448	0.075	1.0

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)
1	2412	321.607	0.095	1.0
6	2437	384.288	0.113	1.0
11	2462	353.522	0.104	1.0

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)
1	2422	411.822	0.121	1.0
4	2437	409.603	0.121	1.0
7	2452	338.217	0.100	1.0

With 3G Card: E220 (Gain: 2.2dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW) (EIRP)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
661	1880	805.378	0.160	1.0

With 3G Card: MD300 (Gain: -0.3dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW) (EIRP)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
512	1850.2	758.578	0.151	1.0

With 3G Card: C100S (Gain: -1.69dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW) (EIRP)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
251	848.8	1180.321	0.235	0.5659

NOTE: Limit of power density = 848.8 (MHz) / 1500 = 0.5659

CONCLUSION:

Both of the WLAN and GSM can transmit simultaneously, the formula of calculated the MPE is:

$$CPD_1 / LPD_1 + CPD_2 / LPD_2 + \dots \text{etc.} < 1$$

CPD = Calculation power density

LPD = Limit of power density

Therefore, the worst-case situation is $0.235 / 0.5659 + 0.121 / 1 = 0.53627$, which is less than "1". This confirmed that the device comply with FCC 1.1310 MPE limit.