

RF EXPOSURE REVIEW

REVIEW NO.: RFI/REGE2/RP48271JD07A

SUPERSEDES REVIEW NO.: RFI/REGE1/RP48271JD07A

MODEL NO.: WISM (Wireless LAN Module)

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. The maximum EIRP level was measured in an open area test site using calibrated equipments; in-conjunction with the module's permanent attached antenna (2dBi) and (3dBi gain) Antenna attachable antenna.

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

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3. Friis Formula

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

Where

P_d = power density in mW/cm

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

π = 3.1416

R = distance between observation point and center of the radiator in cm

P_d is the limit of MPE, 1 mW/cm².

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

This is a Mobile Modular Transmitter powered via a regulated power supply. So under normal use condition, it is easy to be relocated in the place where at least 20 cm far 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.

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6. Test Results

6.1 Internal Antenna Gain

The maximum Gain measured in Fully Anechoic Chamber are 2dBi or 1.58489(numeric)

6.2 Output Power into Antenna & RF Exposure value at distance

20cm:

Calculations (802.11b):

Friis transmission formula: $P_d = (P_{out} * G) / (4 * \pi * r^2)$
 $P_d = (46.8 * 1.58489) / (4 * 3.1416 * 20^2)$
 $P_d = 0.01475622 \text{ mW/cm}^2$

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) |
|---------|-------------------------|------------------------------|-------------------------------------|--|
| 11 | 2462 | 46.8 | 0.015 | 1.0 |

Calculations (802.11g):

Friis transmission formula: $P_d = (P_{out} * G) / (4 * \pi * r^2)$
 $P_d = (85.1 * 1.58489) / (4 * 3.1416 * 20^2)$
 $P_d = 0.026832357 \text{ mW/cm}^2$

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 | 85.1 | 0.027 | 1.0 |

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6.3 External Antenna Gain

The maximum Gain measured in Fully Anechoic Chamber are 3dBi or 1.99526(numeric)

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

Calculations (802.11b):

Friis transmission formula: $Pd = (Pout \cdot G) / (4 \cdot \pi \cdot r^2)$
 $Pd = (46.8 \cdot 1.99526) / (4 \cdot 3.1416 \cdot 20^2)$
 $Pd = 0.018576996 \text{ mW/cm}^2$

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) |
|---------|-------------------------|------------------------------|-------------------------------------|--|
| 11 | 2462 | 46.8 | 0.019 | 1.0 |

Calculations (802.11g):

Friis transmission formula: $Pd = (Pout \cdot G) / (4 \cdot \pi \cdot r^2)$
 $Pd = (85.1 \cdot 1.99526) / (4 \cdot 3.1416 \cdot 20^2)$
 $Pd = 0.033779965 \text{ mW/cm}^2$

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 | 85.1 | 0.034 | 1.0 |

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