RF EXPOSURE REPORT

REPORT NO.: SA970821H05
MODEL NO.: WMP-ND02, WMP-N08, WMP-N10

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 : $Pd = (Pout*G) / (4*pi*r^2)$

where
Pd = power density in mW/cm^2
Pout = 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

Pd 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 five set antennas provided to this EUT, please refer to the following table:

Set No.	Transmitter Circuit	Antenna Gain	For 2.4GHz Gain (dBi)	For 5.15~ 5.25GHz Gain (dBi)	For 5.725~ 5.850GHz Gain (dBi)	Cable Length (cm)
Set. 1	Chain(0), Chain(1), Chain(2)	Gain (dBi)	2.31	2.26	3.91	18
		Cable Loss (dB)	1.48	1.45	1.53	
		Net Gain (dB)	0.83	0.81	2.38	
Set 2	Chain(0)	Gain (dBi)	2.31	2.26	3.91	40
		Cable Loss (dB)	1.51	2.16	2.29	
		Net Gain (dB)	0.8	0.1	1.62	
	Chain(1)	Gain (dBi)	2.31	2.26	3.91	18
		Cable Loss (dB)	1.48	1.45	1.53	
		Net Gain (dB)	0.83	0.81	2.38	
	Chain(2)	Gain (dBi)	2.31	2.26	3.91	27
		Cable Loss (dB)	1.16	1.17	1.87	
		Net Gain (dB)	1.15	1.09	2.04	
Set 3	Chain(0), Chain(1)	Gain (dBi)	3.72	3.55	2.76	25.5
		Cable Loss (dB)	0.52	0.82	1.00	
		Net Gain (dB)	3.2	2.73	1.76	
	Chain(2)	Gain (dBi)	3.72	3.55	2.76	12
		Cable Loss (dB)	0.51	0.75	0.90	
		Net Gain (dB)	3.21	2.8	1.86	
Set 4	Chain(0)	Gain (dBi) involve cable loss	2.65	NA	NA	11
	Chain(1), Chain(2)	Gain (dBi) involve cable loss	2.49	NA	NA	10
Set 5	Chain(0), Chain(1), Chain(2)	Gain (dBi) involve cable loss	2.43	NA	NA	6

Set No.	Transmitter Circuit	Antenna Type	Manufacture	Model No.	Antenna Connector
Set 1	Chain(0)	Dipole	WANSHIH ELECTRONIC CO., LTD.	WSS001	RP-SMA(M)
	Chain(1)				
	Chain(2)				
Set 2	Chain(0)	Dipole	WANSHIH ELECTRONIC CO., LTD.	WSS001	RP-SMA(M)
	Chain(1)				
	Chain(2)				
Set 3	Chain(0)	Dipole	WHA YU INDUSTRIAL CO., LTD.	C056-510399-A	SMA Plug Reverse
	Chain(1)				
	Chain(2)				
Set 4	Chain(0)	PCB	WHA YU GROUP	C037-510934-A (SSR-83320)	I-PEX
	Chain(1)			C037-510935-A (SSR-83347)	
	Chain(2)			C037-510935-A (SSR-83347)	
Set 5	Chain(0)	PCB	WHA YU GROUP	C037-510953-A (SSR-84244)	MHF Plug
	Chain(1)				
	Chain(2)				

From the above antennas, the worst case was found in set no. 1 for 5GHz (5.725~ 5.850), no. 3 for 2.4GHz / 5GHz (5.15~ 5.25) & no. 4 for 2.4GHz. Therefore only the test data of the mode was recorded in this report individually.

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

For 15.247(2.4GHz) :

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	134.276	0.0558	1.0
6	2437	104.713	0.0435	1.0
11	2462	75.858	0.0315	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	266.686	0.1108	1.0
6	2437	302.691	0.1258	1.0
11	2462	272.270	0.1132	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	423.398	0.1760	1.0
6	2437	549.592	0.2284	1.0
11	2462	435.616	0.1811	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	422.715	0.1757	1.0
4	2437	408.348	0.1697	1.0
7	2452	289.165	0.1202	1.0

For 15.247(5GHz) :

For Part 802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	5745	174.181	0.0599	1.0
3	5785	196.336	0.0676	1.0
5	5825	206.538	0.0711	1.0

For 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	5745	227.457	0.0783	1.0
3	5785	235.890	0.0812	1.0
5	5825	238.593	0.0821	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	5755	231.828	0.0798	1.0
2	5795	235.215	0.0809	1.0

For 15.407(5GHz) :

For Part 802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	5180	17.989	0.0067	1.0
2	5200	17.783	0.0066	1.0
4	5240	18.836	0.0070	1.0

For 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	5180	28.727	0.0107	1.0
2	5200	29.251	0.0109	1.0
4	5240	29.014	0.0108	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	5190	27.233	0.0102	1.0
2	5230	28.533	0.0106	1.0