

RF EXPOSURE REPORT

REPORT NO. : SA960822A05

MODEL NO. : MTG

MODEL NAME: XPS A2010, XPS A2010n

ACCORDING : FCC Guidelines for Human Exposure
IEEE C95.1

APPLICANT : ASUSTeK COMPUTER INC.

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ISSUED BY : Advance Data Technology Corporation

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RF Exposure Measurement (Mobile Device)

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

π = 3.1416

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

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 r .

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 the product, under normal use condition, is at least 20cm away from the body of the user. Warning statement for keeping 20cm separation distance and the prohibition of operating next to a person has been printed on the user's manual. So, this product is classified as the Mobile Device.

6. Test Results

6.1 Antenna Gain

2.4GHz:

The maximum Gain measured in Fully Anechoic Chamber is -0.62dBi ($= 0.87$ numeric).

Bluetooth:

The maximum Gain measured in Fully Anechoic Chamber is 2dBi ($= 1.58$ numeric).

GFSK 2.4GHz:

The maximum Gain measured in Fully Anechoic Chamber is -3.50dBi ($= 0.45$ numeric).

5.0GHz:

The maximum Gain measured in Fully Anechoic Chamber is 4.26dBi ($= 2.67$ numeric).

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

**FOR 2.400~2483.5GHz BAND:
802.11b DSSS MODULATION:**

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (mW)	PEAK POWER OUTPUT (dBm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	46.559	16.68	0.0080	1
6	2437	45.604	16.59	0.0079	1
11	2462	43.053	16.34	0.0074	1

802.11g OFDM MODULATION:

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (mW)	PEAK POWER OUTPUT (dBm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	2412	40.832	16.11	0.0070	1
6	2437	37.325	15.72	0.0064	1
11	2462	39.084	15.92	0.0067	1

DRAFT 802.11n (20MHz) OFDM MODULATION:

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (mW)		PEAK POWER OUTPUT (dBm)		TOTAL PEAK POWER (mW)	TOTAL PEAK POWER (dBm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
		CHAIN 0	CHAIN 1	CHAIN 0	CHAIN 1				
1	2412	17.593	16.106	12.44	12.07	33.645	15.27	0.0058	1
6	2437	17.298	15.031	12.38	11.77	32.330	15.10	0.0056	1
11	2462	16.558	15.524	12.19	11.91	32.082	15.06	0.0055	1

DRAFT 802.11n (40MHz) OFDM MODULATION:

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (mW)		PEAK POWER OUTPUT (dBm)		TOTAL PEAK POWER (mW)	TOTAL PEAK POWER (dBm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
		CHAIN 0	CHAIN 1	CHAIN 0	CHAIN 1				
1	2422	21.380	20.941	13.30	13.21	42.321	16.27	0.0073	1
4	2437	24.155	18.793	13.83	12.74	42.948	16.33	0.0074	1
7	2452	21.184	18.923	13.26	12.77	40.107	16.03	0.0069	1

BLUETOOTH GFSK MODULATION:

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (mW)	PEAK POWER OUTPUT (dBm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
0	2402	0.975	-0.11	0.0003	1
39	2441	1.074	0.31	0.0003	1
78	2480	1.130	0.53	0.0004	1

BLUETOOTH 8DPSK MODULATION:

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (mW)	PEAK POWER OUTPUT (dBm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
0	2402	1.746	2.42	0.0006	1
39	2441	1.941	2.88	0.0006	1
78	2480	1.982	2.97	0.0006	1

2.4GHz GFSK MODULATION:

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (mW)	PEAK POWER OUTPUT (dBm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
0	2402	1.845	2.66	0.0002	1
38	2440	1.694	2.29	0.0002	1
77	2479	1.429	1.55	0.0001	1

FOR 5.725~5.850GHz BAND:

802.11a OFDM MODULATION:

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (mW)	PEAK POWER OUTPUT (dBm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5745	56.494	17.52	0.0208	1
3	5785	51.880	17.15	0.0191	1
5	5825	48.529	16.86	0.0179	1

DRAFT 802.11n (20MHz) OFDM MODULATION:

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (mW)		PEAK POWER OUTPUT (dBm)		TOTAL PEAK POWER (mW)	TOTAL PEAK POWER (dBm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
		CHAIN 0	CHAIN 1	CHAIN 0	CHAIN 1				
1	5745	29.174	28.184	14.65	14.50	57.358	17.59	0.0211	1
3	5785	26.915	29.174	14.30	14.65	56.090	17.49	0.0206	1
5	5825	25.119	26.669	14.00	14.26	51.787	17.14	0.0190	1

DRAFT 802.11n (40MHz) OFDM MODULATION:

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (mW)		PEAK POWER OUTPUT (dBm)		TOTAL PEAK POWER (mW)	TOTAL PEAK POWER (dBm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
		CHAIN 0	CHAIN 1	CHAIN 0	CHAIN 1				
1	5755	30.339	29.717	14.82	14.73	60.056	17.79	0.0221	1
2	5795	30.832	30.690	14.89	14.87	61.522	17.89	0.0226	1

FOR 5.150~5.350GHz BAND:

802.11a OFDM MODULATION:

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (mW)	PEAK POWER OUTPUT (dBm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
1	5180	31.261	14.95	0.0166	1
4	5240	26.122	14.17	0.0139	1
5	5260	24.378	13.87	0.0129	1
8	5320	27.040	14.32	0.0143	1

DRAFT 802.11n (20MHz) OFDM MODULATION:

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (mW)		PEAK POWER OUTPUT (dBm)		TOTAL PEAK POWER (mW)	TOTAL PEAK POWER (dBm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
		CHAIN 0	CHAIN 1	CHAIN 0	CHAIN 1				
1	5180	15.668	15.241	11.95	11.83	30.908	14.90	0.0164	1
4	5240	13.932	12.972	11.44	11.13	26.903	14.30	0.0143	1
5	5260	12.218	11.508	10.87	10.61	23.726	13.75	0.0126	1
8	5320	12.794	12.503	11.07	10.97	25.296	14.03	0.0134	1

DRAFT 802.11n (40MHz) OFDM MODULATION:

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (mW)		PEAK POWER OUTPUT (dBm)		TOTAL PEAK POWER (mW)	TOTAL PEAK POWER (dBm)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm ²)
		CHAIN 0	CHAIN 1	CHAIN 0	CHAIN 1				
1	5190	19.907	18.836	12.99	12.75	38.743	15.88	0.0205	1
2	5230	16.482	16.255	12.17	12.11	32.737	15.15	0.0174	1
3	5270	15.311	14.588	11.85	11.64	29.899	14.76	0.0159	1
4	5310	15.740	15.740	11.97	11.97	31.480	14.98	0.0167	1

CONCLUSION:

The WLAN, Bluetooth and the 2.4GHz GFSK module 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 calculation of this situation is $0.0226/1 + 0.0006/1 + 0.0002/1 = 0.0234$ which is less than the "1" limit.