RF EXPOSURE REPORT

REPORT NO.: 921107R01
MODEL NO.: AP-AG-AT-01,AP-AG-AT-03, RT-AG-AT-01

ACCORDING: FCC Guidelines for Human Exposure
IEEE C95.1

APPLICANT: UNIVERSAL SCIENTIFIC INDUSTRIAL CO., LTD.
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ISSUED BY: Advance Data Technology Corporation

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Lab Code: 200376-0

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

This device is not fixed inside the host equipment, it is connected with host through wire. So it is easy to be re-located 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**.

6. Test Results

6.1 Antenna Gain

Antenna 1: The maximum Gain of the antenna is 2.5dBi.
Antenna 2: The maximum Gain of the antenna is 2.0dBi.
Antenna 3: The maximum Gain of the antenna is 3.0dBi.
Antenna 4: The maximum Gain of the antenna is 10.0dBi.
Antenna 5: The maximum Gain of the antenna is 14.0dBi.
Antenna 6: The maximum Gain of the antenna is 14.0dBi.
Antenna 7: The maximum Gain of the antenna is 24.0dBi.

FOR DSSS:

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

Antenna 1

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	107.1519	0.03791	1.0
6	2437	136.1445	0.04816	1.0
11	2462	141.2537	0.04997	1.0

Antenna 2

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	141.9057	0.04474	1.0
6	2437	156.3148	0.49287	1.0
11	2462	138.6756	0.43725	1.0

Antenna 3

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	107.1519	0.04253	1.0
6	2437	136.1445	0.05404	1.0
11	2462	141.2537	0.05607	1.0

Output Power Into Antenna & RF Exposure value at distance 100cm:

Antenna 4

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	66.52732	0.00529	1.0
6	2437	123.02688	0.00979	1.0
11	2462	79.43282	0.00632	1.0

Antenna 5

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	7.26106	0.00145	1.0
6	2437	23.01442	0.00460	1.0
11	2462	23.17395	0.00463	1.0

Antenna 6

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	17.78279	0.00355	1.0
6	2437	60.53409	0.01210	1.0
11	2462	37.49730	0.00750	1.0

Antenna 7

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
3	2422	7.26106	0.01451	1.0
6	2437	8.91251	0.01782	1.0
9	2452	7.14496	0.01428	1.0

FOR OFDM:

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

Antenna 1

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	128.5287	0.04547	1.0
6	2437	161.8080	0.05724	1.0
11	2462	137.0882	0.04850	1.0

Antenna 2

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	120.7814	0.03808	1.0
6	2437	212.8139	0.06710	1.0
11	2462	138.9953	0.04383	1.0

Antenna 3

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	128.5287	0.05102	1.0
6	2437	161.8080	0.64223	1.0
11	2462	137.0882	0.05442	1.0

Output Power Into Antenna & RF Exposure value at distance 100cm:

Antenna 4

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	33.11311	0.00264	1.0
6	2437	125.89254	0.01002	1.0
11	2462	42.95364	0.00342	1.0

Antenna 5

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	10.28016	0.00205	1.0
6	2437	63.82635	0.01276	1.0
11	2462	15.52387	0.00310	1.0

Antenna 6

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	15.84893	0.00317	1.0
6	2437	63.24119	0.01264	1.0
11	2462	29.64831	0.00593	1.0

Antenna 7

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
3	2422	15.34617	0.03068	1.0
6	2437	14.35489	0.02869	1.0
9	2452	15.88547	0.03175	1.0

For 802.11a (5GHz Band):

Antenna Gain

Antenna 1: The maximum Gain of the antenna is 3.5dBi.
Antenna 2: The maximum Gain of the antenna is 3.0dBi.
Antenna 3: The maximum Gain of the antenna is 4.0dBi.
Antenna 4: The maximum Gain of the antenna is 13.0dBi.
Antenna 5: The maximum Gain of the antenna is 17.0dBi.
Antenna 6: The maximum Gain of the antenna is 28.2dBi.
Antenna 7: The maximum Gain of the antenna is 33.4dBi.
Antenna 8: The maximum Gain of the antenna is 13.0dBi.

Normal Mode:

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

Antenna 1

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
5	5260	217.771	0.096990	1.0
8	5320	104.713	0.046637	1.0
9	5745	196.336	0.087444	1.0
11	5785	194.536	0.086642	1.0
13	5825	187.068	0.083316	1.0

Antenna 2

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	5180	42.658	0.016933	1.0
4	5240	42.364	0.016816	1.0
5	5260	187.932	0.074598	1.0
8	5320	208.449	0.082743	1.0
9	5745	212.814	0.084475	1.0
11	5785	207.014	0.082173	1.0
13	5825	172.584	0.068506	1.0

Antenna 3

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	5180	45.920	0.022947	1.0
4	5240	43.752	0.021864	1.0
5	5260	142.561	0.071241	1.0
8	5320	151.356	0.075636	1.0
9	5745	207.970	0.103927	1.0
11	5785	209.894	0.104889	1.0
13	5825	190.546	0.095220	1.0

Output Power Into Antenna & RF Exposure value at distance 100cm:

Antenna 4

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
5	5260	34.27678	0.00544	1.0
8	5320	39.26449	0.00623	1.0

Antenna 5

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
5	5260	18.07174	0.00721	1.0
8	5320	17.94734	0.00716	1.0
9	5745	112.71975	0.00180	1.0
11	5785	114.81536	0.00183	1.0
13	5825	109.14403	0.00174	1.0

Antenna 6 +10dB Pad

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
5	5260	2.96483	0.00621	1.0
8	5320	2.21309	0.00463	1.0

Antenna 6 +4dB Pad

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
9	5745	117.48976	0.24592	1.0
11	5785	118.85022	0.24876	1.0
13	5825	179.06059	0.37479	1.0

Antenna 7 +10dB Pad

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
5	5260	2.74789	0.00478	1.0
8	5320	2.14289	0.00373	1.0

Antenna 7 +4dB Pad

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
9	5745	105.92537	0.73416	1.0
11	5785	102.56519	0.71087	1.0
13	5825	64.56542	0.44750	1.0

Antenna 8

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
9	5745	127.05741	0.50435	1.0
11	5785	123.59474	0.49060	1.0
13	5825	120.50359	0.47833	1.0

Turbo Mode:

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

Antenna 1

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
3	5290	201.372	0.089687	1.0
4	5760	168.655	0.075115	1.0
5	5800	171.791	0.076512	1.0

Antenna 2

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	5210	43.551	0.017287	1.0
2	5250	42.462	0.016855	1.0
3	5290	193.642	0.076865	1.0
4	5760	208.930	0.082933	1.0
5	5800	173.780	0.068981	1.0

Antenna 3

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	5210	46.345	0.023159	1.0
2	5250	44.875	0.022425	1.0
3	5290	144.212	0.072066	1.0
4	5760	203.704	0.101796	1.0
5	5800	208.930	0.104407	1.0

Output Power Into Antenna & RF Exposure value at distance 100cm:

Antenna 4

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
3	5290	201.37242	0.03197	1.0

Antenna 5

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
3	5290	15.59553	0.00622	1.0
4	5760	103.03861	0.00164	1.0
5	5800	100.00000	0.00160	1.0

Antenna 6 +4dB Pad

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
3	5290	2.54097	0.00532	1.0

Antenna 6 +4dB Pad

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
4	5760	176.60378	0.36965	1.0
5	5800	171.00153	0.35792	1.0

Antenna 7 +4dB Pad

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
3	5290	2.54683	0.00443	1.0

Antenna 7 +4dB Pad

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
4	5760	13.18257	0.09137	1.0
5	5800	19.86095	0.13765	1.0

Antenna 8

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
4	5760	127.05741	0.50435	1.0
5	5800	117.48976	0.46637	1.0