RF EXPOSURE REPORT

REPORT NO.: RF921107R02
MODEL NO.: AP-AG-AT-02, AP-AG-AT-04, RT-AG-AT-02

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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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	167.1091	0.05912	1.0
6	2437	139.9587	0.04951	1.0
11	2462	137.7209	0.04872	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	215.2782	0.06788	1.0
6	2437	139.9587	0.04413	1.0
11	2462	137.7209	0.04342	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	182.8100	0.07257	1.0
6	2437	171.3957	0.06803	1.0
11	2462	164.8162	0.06542	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	52.8445	0.00420	1.0
6	2437	125.8925	0.01002	1.0
11	2462	70.7946	0.00563	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	5.1523	0.00103	1.0
6	2437	19.3197	0.00386	1.0
11	2462	7.2778	0.00146	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	8.0353	0.00161	1.0
6	2437	61.9441	0.01238	1.0
11	2462	44.6684	0.00893	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	5.2602	0.01052	1.0
6	2437	8.3946	0.01678	1.0
9	2452	7.3282	0.01465	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	85.1138	0.03011	1.0
6	2437	201.3724	0.07124	1.0
11	2462	105.6818	0.03739	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	130.0170	0.04099	1.0
6	2437	270.3958	0.08526	1.0
11	2462	124.7384	0.03933	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	169.8244	0.06741	1.0
6	2437	207.4914	0.08236	1.0
11	2462	151.3561	0.06008	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	50.2343	0.00400	1.0
6	2437	121.3389	0.00966	1.0
11	2462	52.8445	0.00420	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	12.6183	0.00252	1.0
6	2437	15.9221	0.00318	1.0
11	2462	15.5955	0.00312	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	22.3872	0.00448	1.0
6	2437	59.4292	0.01188	1.0
11	2462	37.3250	0.00746	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	12.7350	0.02546	1.0
6	2437	16.0694	0.03212	1.0
9	2452	16.2181	0.03242	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	194.089	0.086443	1.0
8	5320	65.917	0.029358	1.0
9	5745	184.077	0.081984	1.0
11	5785	172.982	0.077042	1.0
13	5825	83.176	0.037045	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	42.954	0.017050	1.0
4	5240	41.495	0.016471	1.0
5	5260	148.252	0.058848	1.0
8	5320	115.345	0.045786	1.0
9	5745	245.471	0.097438	1.0
11	5785	237.684	0.094347	1.0
13	5825	112.202	0.044538	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	45.186	0.022580	1.0
4	5240	43.652	0.021814	1.0
5	5260	206.063	0.102974	1.0
8	5320	217.270	0.108575	1.0
9	5745	177.011	0.088456	1.0
11	5785	177.828	0.088865	1.0
13	5825	142.889	0.071405	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	45.0817	0.00716	1.0
8	5320	43.8531	0.00696	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	17.2584	0.00688	1.0
8	5320	17.8649	0.00712	1.0
9	5745	77.4462	0.03089	1.0
11	5785	50.6991	0.02022	1.0
13	5825	32.3594	0.01290	1.0

Antenna 6 + 2dB Pad

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
5	5260	2.2284	0.00739	1.0
8	5320	2.0045	0.00665	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)
9	5745	53.4564	0.2811	1.0
11	5785	53.7032	0.2824	1.0
13	5825	51.7601	0.2721	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)
5	5260	2.0512	0.00712	1.0
8	5320	1.4588	0.00507	1.0
9	5745	77.0903	0.53430	1.0
11	5785	51.4044	0.35628	1.0
13	5825	50.1187	0.34737	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	106.6596	0.01694	1.0
11	5785	79.4328	0.01261	1.0
13	5825	52.4807	0.00833	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	104.713	0.046637	1.0
4	5760	170.216	0.075810	1.0
5	5800	169.044	0.075289	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	42.462	0.016855	1.0
2	5250	42.462	0.016855	1.0
3	5290	104.713	0.041565	1.0
4	5760	170.216	0.067566	1.0
5	5800	169.044	0.067101	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	44.463	0.022219	1.0
2	5250	43.351	0.021664	1.0
3	5290	199.986	0.099938	1.0
4	5760	212.814	0.106348	1.0
5	5800	184.077	0.091988	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	37.6704	0.00598	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	16.3682	0.00653	1.0
4	5760	63.6796	0.02540	1.0
5	5800	50.5825	0.02017	1.0

Antenna 6 + 2dB Pad

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
3	5290	1.6672	0.00553	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)
4	5760	108.1434	0.5686	1.0
5	5800	122.1800	0.6424	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	1.5922	0.00553	1.0
4	5760	118.5769	0.82184	1.0
5	5800	105.9254	0.73416	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	126.1828	0.02004	1.0
5	5800	135.5189	0.02152	1.0