RF EXPOSURE REPORT

REPORT NO.: SA940816H02
MODEL NO.: AP-5131
PART NO.: AP-5131-44000-WW

ACCORDING: FCC Guidelines for Human Exposure
IEEE C95.1

APPLICANT: Symbol Technologies Inc.

ADDRESS: One Symbol Plaza, Holtsville, NY 11742- 1300 U.S.A.

ISSUED BY: Advance Data Technology Corporation

LAB LOCATION: No. 81-1, Lu Liao Keng, 9 Ling, Wu Lung Tsuen, Chiung Lin Hsiang, Hsin Chu Hsien, Taiwan, R.O.C.

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 is a stand alone radio device. So under normal use condition, 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

For 2.4GHz

Antenna 1: The maximum Gain of the antenna is 3.0dBi.
Antenna 2: The maximum Gain of the antenna with cable and extend cable loss is 11.0dBi.
Antenna 3: The maximum Gain of the antenna with cable and extend cable loss is 2.8dBi.
Antenna 4: The maximum Gain of the antenna with cable, extend cable and Arrestor loss is 12.4dBi.

For 5GHz

Antenna 1: The maximum Gain of the antenna is 4.0dBi.
Antenna 2: The maximum Gain of the antenna with cable loss is 13.0dBi.
Antenna 3: The maximum Gain of the antenna with cable loss is 5.0dBi.

For 2.4GHz							
No.	Symbol P/N	Gain (dBi)	Cable Loss (dB)	Net Gain (dB)	Antenna Type	Connector	Remark
1	*ML-2452-APA2-01	3.0	0	3.0	Dipole	RP SMA	Omni
2	ML-2499-11PNA2-01	11.2	2.7	8.5	Panel	Reverse BNC	Directional
3	ML-2499-HPA3-01	4.6	1.3	3.3	Dipole	Reverse BNC	Omni
4	**ML-2499-BYGA2-01	14.2	0.3	13.9	Yagi	RP SMA	Directional
For 5GHz							
No.	Symbol P/N	Gain (dBi)	Cable Loss (dB)	Net Gain (dB)	Antenna Type	Connector	Remark
1	*ML-2452-APA2-01	4.0	0	4.0	Dipole	RP SMA	Omni
2	ML-5299-WPNA1-01	14.2	1.2	13.0	Patch	RP SMA	Directional
3	ML-5299-HPA1-01	5.9	0.84	5.0	Omni	RP SMA	Omni

Note:

1. All of the above antennas are Indoor Antenna except the Symbol P/N: ML-2499-BYGA2-01.
2. "*" is a Dual Band antenna can be used in both 2.4GHz and 5GHz.
3. "**" is an Outdoor Antenna it can only be used in point-to-point applications.
4. For 2.4GHz Antenna No. 2 and 3 were tested with Extend cable (0.5 dB loss).
5. For 2.4GHz Antenna No. 4 was tested with Extend cable (0.5 dB loss) and Arrestor (1.0 dB loss).

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

For 2.4GHz

802.11b:

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	41.11497211	0.016320337	1.0
6	2437	83.94599865	0.033321852	1.0
11	2462	39.62780343	0.015730015	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	15.41700453	0.019352146	1.0
6	2437	83.94599865	0.105372948	1.0
11	2462	11.80320636	0.014815937	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	41.11497211	0.015585801	1.0
6	2437	83.94599865	0.031822121	1.0
11	2462	39.62780343	0.015022047	1.0

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	15.41700453	0.053300236	1.0
6	2437	83.94599865	0.290221197	1.0
11	2462	11.80320636	0.04080648	1.0

802.11g:

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	55.97576015	0.022219236	1.0
6	2437	154.1700453	0.061196859	1.0
11	2462	41.11497211	0.016320337	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	16.82674061	0.021121713	1.0
6	2437	154.1700453	0.193521459	1.0
11	2462	11.85768748	0.014884324	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	55.97576015	0.021219206	1.0
6	2437	154.1700453	0.058442546	1.0
11	2462	41.11497211	0.015585801	1.0

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	16.82674061	0.058174027	1.0
6	2437	154.1700453	0.533002356	1.0
11	2462	9.682778563	0.033475659	1.0

For 5GHz

Operated in 5150 ~ 5250MHz, 5250MHz ~ 5350MHz, 5725MHz ~ 5825MHz band: (15.407)

Antenna 1

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	5180	40.17908108	0.020078401	1.0
4	5240	42.95364268	0.021464913	1.0
5	5260	200.9092813	0.10039894	1.0
8	5320	144.2115352	0.072065786	1.0
9	5745	73.79042301	0.036874754	1.0
12	5805	75.6832895	0.037820662	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	7.870457897	0.031241302	1.0
4	5240	8.090958992	0.032116568	1.0
5	5260	44.05548635	0.174875564	1.0
8	5320	14.42115352	0.057243889	1.0
9	5745	58.21032178	0.23106232	1.0
12	5805	59.15616342	0.23481678	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	40.17908108	0.02527721	1.0
4	5240	42.95364268	0.027022724	1.0
5	5260	200.9092813	0.126394777	1.0
8	5320	116.6809617	0.073405589	1.0
9	5745	73.79042301	0.046422565	1.0
12	5805	75.6832895	0.047613393	1.0

Operated in 5725 ~ 5850MHz band: (15.247)

Antenna 1

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	5745	77.62471166	0.038790835	1.0
3	5785	78.16278046	0.03905972	1.0
5	5825	66.68067692	0.033321852	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	5745	77.62471166	0.308126556	1.0
3	5785	78.16278046	0.310262387	1.0
5	5825	66.68067692	0.264684878	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	5745	77.62471166	0.048834768	1.0
3	5785	78.16278046	0.049173274	1.0
5	5825	66.68067692	0.041949726	1.0