RF EXPOSURE REPORT

REPORT NO.: SA951026H01
MODEL NO.: AP-5181

ACCORDING: FCC Guidelines for Human Exposure
IEEE C95.1

APPLICANT: Symbol Technologies Inc.

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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 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				
No.	Model No.	Gain (dBi)	Antenna Type	Connector
1	ML-2499-FHPA5-01R	7.7	Omni	Type-N(m)
2	ML-2499-FHPA9-01R	9	Omni	Type-N(m)
3	* ML-2452-PNA7-01R	7.8	Panel	Type-N(m)
4	* ML-2452-PNA5-01R	4.5	Panel	Type-N(m)
For 5GHz				
No.	Model No.	Gain (dBi)	Antenna Type	Connector
A	* ML-2452-PNA7-01R	4.9-5.25: 7.0 5.25-5.9: 10.7	Panel	Type-N(m)
B	* ML-2452-PNA5-01R	4.9-5.25: 5 5.25-5.9: 7.5	Panel	Type-N(m)
C	ML-5299-FHPA10-01R	10	Omni	Type-N(m)
D	ML-5299-FHPA6-01R	8	Omni	Type-N(m)

Note:

1. "*" is a Dual Band antenna can be used in both 2.4GHz and 5GHz.

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

For 2.4GHz

802.11b:

Antenna 1 (Gain : 7.7 dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	23.442	0.027	1.0
6	2437	53.703	0.063	1.0
11	2462	20.893	0.024	1.0

Antenna 2 (Gain : 9 dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	11.220	0.018	1.0
6	2437	42.658	0.067	1.0
11	2462	11.220	0.018	1.0

Antenna 3 (Gain : 7.8 dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	12.882	0.015	1.0
6	2437	43.652	0.052	1.0
11	2462	12.589	0.015	1.0

Antenna 4 (Gain : 4.5 dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	10.000	0.006	1.0
6	2437	33.113	0.019	1.0
11	2462	9.333	0.005	1.0

802.11g:

Antenna 1 (Gain : 7.7 dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	46.774	0.055	1.0
6	2437	95.499	0.112	1.0
11	2462	35.481	0.042	1.0

Antenna 2 (Gain : 9 dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	23.442	0.037	1.0
6	2437	60.256	0.095	1.0
11	2462	17.783	0.028	1.0

Antenna 3 (Gain : 7.8 dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	31.623	0.038	1.0
6	2437	66.069	0.079	1.0
11	2462	17.783	0.021	1.0

Antenna 4 (Gain : 4.5 dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	21.380	0.012	1.0
6	2437	67.608	0.038	1.0
11	2462	15.136	0.008	1.0

For 5GHz

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

Antenna A (4.9GHz~5.25GHz) Gain : 7.0 dBi
Antenna A (5.25GHz~5.9GHz) Gain : 10.7 dBi

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	5180	37.757	0.038	1.0
4	5240	37.931	0.038	1.0
5	5745	29.174	0.069	1.0
7	5785	99.541	0.233	1.0
8	5805	23.823	0.056	1.0

Antenna B (4.9GHz~5.25GHz)Gain : 5 dBi
Antenna B (5.25GHz~5.9GHz)Gain : 7.5 dBi

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	5180	47.643	0.030	1.0
4	5240	47.315	0.030	1.0
5	5745	29.174	0.033	1.0
7	5785	99.541	0.111	1.0
8	5805	29.0401	0.032	1.0

Antenna C (Gain : 10 dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	5180	17.906	0.035	1.0
4	5240	18.578	0.037	1.0
5	5745	24.044	0.048	1.0
7	5785	99.541	0.198	1.0
8	5805	36.898	0.073	1.0

Antenna D (Gain : 8 dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	5180	29.581	0.037	1.0
4	5240	27.102	0.034	1.0
5	5745	16.444	0.021	1.0
7	5785	99.541	0.125	1.0
8	5805	15.560	0.020	1.0

Operated in 5725 ~ 5850MHz band: (15.247)

Antenna A (Gain : 10.7 dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	5745	79.433	0.186	1.0
3	5785	69.183	0.162	1.0
5	5825	54.954	0.128	1.0

Antenna B (Gain : 7.5 dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	5745	79.433	0.089	1.0
3	5785	69.183	0.077	1.0
5	5825	54.954	0.061	1.0

Antenna C (Gain : 10 dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	5745	79.433	0.158	1.0
3	5785	69.183	0.138	1.0
5	5825	54.954	0.109	1.0

Antenna D (Gain : 8 dBi)

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	5745	79.433	0.100	1.0
3	5785	69.183	0.087	1.0
5	5825	54.954	0.069	1.0

CONCULSION:

Both of the 11g and 11a can transmit simultaneously, the formula of calculated the MPE is:

$CPD_1 / LPD_1 + CPD_2 / LPD_2 + ……etc. < 1$
CPD = Calculation power density
LPD = Limit of power density

Therefore, the calculation of this situation is 0.112 / 1 + 0.233 / 1 = 0.345, which is less than the “1” limit.