RF EXPOSURE REPORT

REPORT NO.: SA981015H02
MODEL NO.: MC3090Z

ACCORDING: FCC Guidelines for Human Exposure
IEEE C95.1

APPLICANT: Motorola Inc.

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ISSUED BY: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch

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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 our lab, 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	30
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

The antenna of this product, under normal use condition, is at least 20cm 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

There are four antennas provided to this EUT, please refer to the following table:

For WLAN (RX has diversity function)					
No.	**Model**	**Antenna Type**	**Gain (dBi)**	**Connecter Type**	**Frequency range (MHz)**
1	OZONE WLAN 1	PCB(TX,RX)	2.96 (2.4G) 4.16 (5G)	N/A	2400~2850 4920~5850
2	OZONE WLAN 2	PIFA(RX only)	3.45 (2.4G) 3.32 (5G)	N/A	2400~2850 4920~5850

For Bluetooth					
No.	**Model**	**Antenna Type**	**Gain (dBi)**	**Connecter Type**	**Frequency range (MHz)**
1	Mica 2.4GHz	SMD	-0.45	N/A	2400~2500

For RFID					
No.	**Model**	**Antenna Type**	**Gain (dBi)**	**Connecter Type**	**Frequency range (MHz)**
1	OZONE RFID	Hor- dipole, outside antenna, Ver- slot, inside antenna	1.7483(Max)	N/A	902~928

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

For WLAN:

For 15.247(2.4GHz):

802.11b:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	77.6	0.034	1.0
6	2437	83.2	0.037	1.0
11	2462	83.2	0.037	1.0

802.11g:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	93.3	0.041	1.0
6	2437	89.1	0.039	1.0
11	2462	83.2	0.037	1.0

For 15.247(5GHz):

802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
149	5745	75.9	0.039	1.0
157	5785	77.6	0.040	1.0
165	5825	77.6	0.040	1.0

For 15.407(5GHz):

802.11a:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
36	5180	25.1	0.013	1.0
40	5200	25.1	0.013	1.0
48	5240	28.2	0.015	1.0
52	5260	38.9	0.020	1.0
60	5300	39.4	0.020	1.0
64	5320	40.7	0.021	1.0
100	5500	33.9	0.018	1.0
120	5600	34.7	0.018	1.0
140	5700	25.7	0.013	1.0

For Bluetooth:

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
0	2402	1.3	0.0002	1.0
39	2441	1.3	0.0002	1.0
78	2480	1.2	0.0002	1.0

For RFID:

For PR-ASK(DRM):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
0	902.75	631.0	0.188	0.601
24	914.75	660.7	0.197	0.601
49	927.25	602.6	0.179	0.601

For DSB-ASK(MRM):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
0	902.75	977.2	0.291	0.601
24	914.75	955.0	0.284	0.601
49	927.25	933.3	0.278	0.601

For PR-ASK(XRM):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
0	902.75	977.2	0.291	0.601
24	914.75	977.2	0.291	0.601
49	927.25	912.0	0.271	0.601

CONCLUSION:

The WLAN, Bluetooth and RFID 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 worst-case situation is 0.041 / 1 + 0.0002 / 1 + 0.291 / 0.6018 = 0.524, which is less than “1”. This confirmed that the device comply with FCC 1.1310 MPE limit.