RF EXPOSURE REPORT

REPORT NO.: SA990819E02

MODEL NO.: RT3593

FCC ID: VQF-RT3593

ACCORDING: FCC Guidelines for Human Exposure
IEEE C95.1

APPLICANT: Ralink Technology Corporation

ADDRESS: 5F, No. 36, Taiyuan street, Jhu-Bei City, Hsin-Chu County 302, Taiwan, R.O.C

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

LAB ADDRESS: No. 81-1, Lu Liao Keng, 9th Ling,Wu Lung Tsuen, Chiung Lin Hsiang, Hsin Chu Hsien 307, Taiwan

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. So, this device is classified as **Mobile Device**.

6. TEST RESULTS

6.1 Antenna Gain

There are two sets of antennas provided to this EUT, please refer to the following table:

Set 1						
Chain	Brand name	Model name	Antenna Gain (dBi)	Antenna Cable Length(mm)	Antenna Type	Connector
Chain (0)	JOYMAX	TWX-614XRSXX-999	3 (For 2.4GHz) 5 (For 5GHz)	320	Dipole	Reverse SMA
Chain (1)	JOYMAX	TWX-614XRSXX-999	3 (For 2.4GHz) 5 (For 5GHz)	320	Dipole	Reverse SMA
Chain (2)	JOYMAX	TWX-614XRSXX-999	3 (For 2.4GHz) 5 (For 5GHz)	320	Dipole	Reverse SMA
Set 2						
Chain	Brand name	Model name	Antenna Gain (dBi)	Antenna Cable Length(mm)	Antenna Type	Connector
Chain (0)	ACON	APP6P-700119	3.25 (For 2.4GHz) 5.01 (For 5GHz)	225	PIFA	IPEX
Chain (1)	ACON	APP6P-700119	3.25 (For 2.4GHz) 5.01 (For 5GHz)	225	PIFA	IPEX
Chain (2)	ACON	APP6P-700119	3.25 (For 2.4GHz) 5.01 (For 5GHz)	225	PIFA	IPEX

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

For 15.247(2.4GHz) - Dipole Antenna:

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	134.9	0.054	1.0
6	2437	162.2	0.064	1.0
11	2462	107.2	0.043	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	245.5	0.097	1.0
6	2437	281.8	0.112	1.0
11	2462	218.8	0.087	1.0

802.11n (20MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	513.8	0.204	1.0
6	2437	616.7	0.245	1.0
11	2462	420.8	0.167	1.0

802.11n (40MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2422	518.3	0.206	1.0
4	2437	572.9	0.227	1.0
7	2452	297.7	0.118	1.0

For 15.247(2.4GHz) - PIFA Antenna:

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	134.9	0.057	1.0
6	2437	162.2	0.068	1.0
11	2462	107.2	0.045	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	245.5	0.103	1.0
6	2437	281.8	0.118	1.0
11	2462	218.8	0.092	1.0

802.11n (20MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2412	513.8	0.216	1.0
6	2437	616.7	0.259	1.0
11	2462	420.8	0.177	1.0

802.11n (40MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
1	2422	518.3	0.218	1.0
4	2437	572.9	0.241	1.0
7	2452	297.7	0.125	1.0

For 15.247(5GHz) - Dipole Antenna:

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	239.9	0.151	1.0
157	5785	208.9	0.131	1.0
165	5825	186.2	0.117	1.0

802.11n (20MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
149	5745	405.2	0.255	1.0
157	5785	358.8	0.226	1.0
165	5825	317.7	0.200	1.0

802.11n (40MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
151	5755	437.9	0.275	1.0
159	5795	390.6	0.246	1.0

For 15.247(5GHz) - PIFA Antenna:

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	239.9	0.151	1.0
157	5785	208.9	0.132	1.0
165	5825	186.2	0.117	1.0

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Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
149	5745	405.2	0.256	1.0
157	5785	358.8	0.226	1.0
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For 15.407(5GHz) - Dipole Antenna:

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	29.5	0.019	1.0
40	5200	27.5	0.017	1.0
48	5240	26.3	0.017	1.0
52	5260	85.1	0.054	1.0
60	5300	87.1	0.055	1.0
64	5320	58.9	0.037	1.0
100	5500	52.5	0.033	1.0
120	5600	83.2	0.052	1.0
140	5700	51.3	0.032	1.0

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36	5180	25.2	0.016	1.0
40	5200	25.6	0.016	1.0
48	5240	27.2	0.017	1.0
52	5260	153.9	0.097	1.0
60	5300	69.7	0.044	1.0
64	5320	47.1	0.030	1.0
100	5500	53.5	0.034	1.0
120	5600	141.7	0.089	1.0
140	5700	45.2	0.028	1.0

802.11n (40MHz):

Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
38	5190	46.5	0.029	1.0
46	5230	46.1	0.029	1.0
54	5270	151.6	0.095	1.0
62	5310	73.3	0.046	1.0
102	5510	37.5	0.024	1.0
118	5590	139.5	0.088	1.0
134	5670	94.9	0.060	1.0

For 15.407(5GHz) - PIFA Antenna:

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	29.5	0.019	1.0
40	5200	27.5	0.017	1.0
48	5240	26.3	0.017	1.0
52	5260	85.1	0.054	1.0
60	5300	87.1	0.055	1.0
64	5320	58.9	0.037	1.0
100	5500	52.5	0.033	1.0
120	5600	83.2	0.052	1.0
140	5700	51.3	0.032	1.0

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102	5510	37.5	0.024	1.0
118	5590	139.5	0.088	1.0
134	5670	94.9	0.060	1.0

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