RF EXPOSURE REPORT

REPORT NO.: SA971001H06
MODEL NO.: RTL8192E

ACCORDING: FCC Guidelines for Human Exposure
IEEE C95.1

PREPARED BY: Realtek Semiconductor Corp

ADDRESS: No. 2, Innovation Road II, Hsinchu Science Park, Hsinchu 300, Taiwan

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

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 fifty-four antennas provided to this EUT, please refer to the following table:

No.	Brand	Model	Antenna type	Gain (dBi) with & w/o cable loss	Cable loss (dB)	Connector type	Difference
1	wistron	DQ661500301(Main) DQ661500301(Aux)	PIFA	3.95 3.90	N.A.	IPEX	Antenna length
2	Wistron	DQ661500115(Main) DQ661500115 (Aux)	PIFA	1.10 0.64	1.89 2.55	IPEX	Antenna length
3	Wgt	AR830WIPI01A (L) AR830WIPI02A (R)	PIFA	2.17 2.39	-1.60 -2.03	IPEX	Antenna length
4	Wgt	AR320WIPI01B (L) AR320WIPI02B (R)	PIFA	0.86 2.11	-1.43 -1.78	IPEX	Antenna length
5	Wgt	ARW62WIPI01G (L) ARW62WIP102G (R)	PIFA	2.48 1.32	-2.39 -1.76	IPEX	Antenna length
6	Wgt	ARUMPWIPI02+C (L) ARUMPWIPI01+D (R)	PIFA	2.41 2.07	N.A.	IPEX	Antenna length
7	Foxconn	WDAN-GQMA6001-DF (Main) WDAN-GQMA6001-DF (Aux)	PIFA	2.32 1.10	-1.262 -1.813	IPEX	Antenna length
8	Foxconn	WDAN-GQMA6002-DF (Main) WDAN-GQMA6002-DF (Aux)	PIFA	0.74 0.78	-1.446 -2.009	IPEX	Antenna length
9	Galtronics	021020168NC3587 (Main) 021020168NC3587-1 (Aux)	PIFA	-0.25 3.64	1.75 2	U.FL	Antenna length
10	Galtronics	021020168NC3586 (Main) 021020168NC3586-1 (Aux)	PIFA	-0.04 3.25	1.9 1.85	U.FL	Antenna length
11	HIGH-TEK	AAFQ5050001LK0 (Main) AAFQ5050001RK0 (Aux)	PIFA	2.86 1.52	2.4 1.7	IPEX	Antenna length
12	Hitachi	HFT40-IV17 (Main) HMG03-IV17 (Aux)	PIFA	0.48 0.64	N.A.	IPEX	Antenna length
13	WNC	81.EE215.016 (Main) 81.EE215.016 (Aux)	PIFA	0.34 0.79	2.52 3.17	IPEX	Antenna length
14	WNC	ASAW 001(L) ASAW 001 (R)	PIFA	1.34 1.25	N.A.	IPEX	Antenna length
15	Wgt	B1425050G00003 (Main) B1425050G00002 (Aux)	PIFA	0.03 0.63	-2.01 -2.05	IPEX	Antenna length
16	TYCO	ASAT 001 (Main) ASAT 001 (Aux)	PIFA	0.61 0.16	N.A.	IPEX	Antenna length
17	ACON	ASAA 001 (L) ASAA 001 (R)	PIFA	1.56 1.36	N.A.	IPEX	Antenna length
18	Hitachi	HFT40 (Main) HFP40 (Aux)	PIFA	0.58 1.12	1.42 2.12	IPEX	Antenna length
19	Hitachi	HFT60 (Main) HFT60 (Aux)	PIFA	-1.65 -0.92	1.48 2.18	IPEX	Antenna length

No.	Brand	Model	Antenna type	Gain (dBi) with & w/o cable loss	Cable loss (dB)	Connector type	Difference
20	Hitachi	HTL008 (Main) HTL008 (Aux)	PIFA	2.24 1.84	1.72 2.20	IPEX	Antenna length
21	Hitachi	HTL017 (Main) HTL017 (Aux)	PIFA	2.82 2.94	1.94 2.39	IPEX	Antenna length
22	WNC	WNC001 (Main) WNC001 (Aux)	PIFA	-1.10 1.76	1.17 1.17	IPEX	P/N No.
23	WNC	WNC002 (Main) WNC002 (Aux)	PIFA	1.18 1.75	2.28 2.12	IPEX	Antenna length
24	TYCO	TIAN01 (Main) TIAN01 (Aux)	PIFA	0.57 0.87	-1.463 -1.865	IPEX	Antenna length
25	TYCO	TBN001 (Main) TBN001 (Aux)	PIFA	3.45 2.41	1.45 2.13	IPEX	Antenna length
26	TYCO	TBN003 (Main) TBN003 (Aux)	PIFA	-1.11 -1.11	1.84 2.16	IPEX	Antenna length
27	Wgt	U40 (L) U40 (R)	PIFA	-0.65 -1.32	N.A.	IPEX	Antenna length
28	Wgt	U50 (L) U50 (R)	PIFA	0.56 0.94	N.A.	IPEX	Antenna length
29	JEM	U40 (L) U40 (R)	PFIA	2.99 1.90	N.A.	IPEX	Antenna length
30	JEM	U50 (L) U50 (R)	PFIA	2.53 0.34	N.A.	IPEX	Antenna length
31	FVC	22G600810-10 (L) 22G600530-00 (R)	PIFA	0.21 -0.80	N.A.	IPEX	Antenna length
32	FVC	22G600810-10 (L)	PIFA	0.21	N.A.	IPEX	NA
33	FVC	22G600820-00 (L) 22G600575-00 (R)	PIFA	0.37 1.15	N.A.	IPEX	Antenna length
34	wgt	22G600820-30 (L) 22G600575-10 (R)	PIFA	2.28 2.81	N.A.	IPEX	Antenna length
35	FVC	22G600820-00 (L) 22G600630-10 (R)	PIFA	-1.46 2.14	N.A.	IPEX	Antenna length
36	wgt	22G600750-30 (L)	PIFA	1.68	N.A.	IPEX	NA
37	FOXCONN	WDAN-TQ BD3001-DF (TX1) WDAN-TQ BD3001-DF (TX2) WDAN-TQ BD3001-DF (TX3)	PIFA	-0.87 -2.86 -1.27	2.5 2.5 2.5	IPEX	Antenna length
38	FOXCONN	WDAN-TQ BD3002-DF (TX1) WDAN-TQ BD3002-DF (TX2)	PIFA	-0.87 -2.86	2.5 2.5	IPEX	Antenna length
39	FOXCONN	WDAN-TQ BL5001-DF (TX1) WDAN-TQ BL5001-DF (TX2) WDAN-TQ BL5001-DF (TX3)	PIFA	-2.24 -2.41 -0.65	2.5 2.5 2.5	IPEX	Antenna length
40	FOXCONN	WDAN-TQ BL5002-DF (TX1) WDAN-TQ BL5002-DF (TX2)	PIFA	-2.24 -2.41	2.5 2.5	IPEX	Antenna length

No.	Brand	Model	Antenna type	Gain (dBi) with & w/o cable loss	Cable loss (dB)	Connector type	Difference
41	FOXCONN	WDAN-TQ BU2001-DF (TX1) WDAN-TQ BU2001-DF (TX2) WDAN-TQ BU2001-DF (TX3)	PIFA	-0.42 -0.37 -0.9	2.5 2.5 2.5	IPEX	Antenna length
42	FOXCONN	WDAN-TQ BU2002-DF (TX1) WDAN-TQ BU2002-DF (TX2)	PIFA	-0.42 -0.37	2.5 2.5	IPEX	Antenna length
43	FOXCONN	WDAN-TQ TE1001-DF (TX1) WDAN-TQ TE1001-DF (TX2) WDAN-TQ TE1001-DF (TX3)	PIFA	-0.43 -0.70 -0.25	2.5 2.5 2.5	IPEX	Antenna length
44	FOXCONN	WDAN-TQ TE1002-DF (TX1) WDAN-TQ TE1002-DF (TX2)	PIFA	-0.43 -0.70	2.5 2.5	IPEX	Antenna length
45	Tyco	2023935-1 (Main) 2023936-1 (Aux) 2023936-1 (MIMO)	PIFA	2.95 1.90 -0.28	1.88 2.03 2.01	U.FL	Antenna length
46	Tyco	2023937-1 (Main) 2023937-1 (Aux) 2023934-1 (MIMO)	PIFA	1.60 0.05 -0.28	1.85 2.00 2.01	U.FL	Antenna length
47	Tyco	2023938-1 (Main) 2023938-1 (Aux) 2023939-1 (MIMO)	PIFA	1.41 1.24 0.04	2.17 2.40 2.35	U.FL	Antenna length
48	Tyco	2023954-1 (Main) 2023954-1 (Aux) 2023955-1 (MIMO)	PIFA	1.68 0.92 1.98	2.14 3.02 1.44	U.FL	Antenna length
49	Hitachi	HBY07 (TX1) HBY07 (TX2)	PIFA	2.19 -0.33	0.95 0.95	I-PEX	Antenna color
50	Hitachi	HBY051 (TX1) HBY051 (TX2)	PIFA	2.91 2.82	0.95 0.95	I-PEX	Antenna color
51	Hitachi	HBY052 (TX1) HBY052 (TX2)	PIFA	0.27 0.02	0.95 0.95	I-PEX	Antenna color
52	Hitachi	HBY061 (TX1) HBY061 (TX2)	PIFA	1.30 2.42	0.95 0.95	I-PEX	Antenna color
53	Hitachi	HBY062 (TX1) HBY062 (TX2)	PIFA	-1.04 -1.19	0.95 0.95	I-PEX	Antenna color
54	Hitachi	HFT65 (TX1) HFT65 (TX2)	PIFA	-1.74 1.16	0.95 0.95	I-PEX	Antenna color

From the above antennas, the worst case was found in **No. 1**

The maximum Gain measured in Fully Anechoic Chamber is 3.95dBi or 2.48313 (numeric)

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

For Part 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	109.648	0.054	1.0
6	2437	102.329	0.051	1.0
11	2462	100.000	0.049	1.0

For Part 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	208.930	0.103	1.0
6	2437	275.423	0.136	1.0
11	2462	301.995	0.149	1.0

DRAFT 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	194.984	0.096	1.0
6	2437	288.403	0.142	1.0
11	2462	309.030	0.153	1.0

DRAFT 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	165.959	0.082	1.0
4	2437	257.040	0.127	1.0
7	2452	245.471	0.121	1.0