

RF EXPOSURE REPORT

REPORT NO.: SA970212H01 MODEL NO.: RTL8192E

ACCORDING: FCC Guidelines for Human Exposure

IEEE C95.1

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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	Electric Field	Magnetic Field	Power Density	Average Time			
Range	Strength (V/m)	Strength (A/m)	(mW/cm ²)	(minutes)			
(MHz)							
(A)Limits For Occupational / Control Exposures							
300-1500			F/300	6			
1500-100,000	•••	•••	5	6			
(B)L	(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/cm²

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/cm². 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 Gain (dBi) with & wo cable loss (dB) Cable loss (dB) Connector type Difference Difference type	11010	are mity i	our antennas provide	u to tilis L	· · · · · · · · · · · · · · · · · · ·	CICI to till	5 TOHOWING	tabic.
Wistron DQ661500315(Main) PIFA 3.90 N.A. IPEX Antenna length	No.	Brand	Model					Difference
Wistron DQ6615001301(Aux) PIFA 3.90 N.A. IPEX length			DQ661500301(Main)	5:54			1551	Antenna
DO661500115 (Aux)	1	wistron		PIFA		N.A.	IPEX	
2 WISHORD DQ661500115 (Aux) PIFA 0.64 2.55 IPEX Length AR830WIPI01A (L) PIFA 2.39 -2.03 IPEX Antenna Length AR830WIPI01B (L) AR830WIPI02B (R) PIFA 2.39 -2.03 IPEX Antenna Length AR320WIPI02B (R) PIFA 2.11 -1.78 IPEX Antenna Length AR320WIPI02B (R) PIFA 2.48 -2.39 IPEX Antenna Length ARW62WIPI02G (R) PIFA 2.48 -2.39 IPEX Antenna Length ARW62WIPI01G (L) PIFA 2.41 -1.76 Length Antenna Length ARW62WIPI01CB (R) PIFA 2.07 N.A. IPEX Antenna Length WDAN-GQMA6001-DF WDAN-GQMA6001-DF WDAN-GQMA6001-DF WDAN-GQMA6001-DF WDAN-GQMA6001-DF WDAN-GQMA6001-DF MISHORD WDAN-GQMA6001-DF MISHORD WDAN-GQMA6002-DF WDAN-GQMA6002-DF MISHORD WDAN-GQMA6002-DF MISHORD WDAN-GQMA6002-DF MISHORD WDAN-GQMA6002-DF MISHORD WDAN-GQMA6002-DF WDAN-GQMA6002-DF MISHORD WDAN-GQMA6002-DF MISHORD WDAN-GQMA6002-DF MISHORD WDAN-GQMA6002-DF WDAN-GQMA6002-DF MISHORD MIS						1.89		
3 Wgt AR830WIPI01A (L) PIFA 2.37 -1.60 IPEX Antenna length	2	Wistron		PIFA			IPEX	
AR830WIPI02A (R)								
A	3	Wgt		PIFA			IPEX	
Wygt								_
S	4	Wgt		PIFA			IPEX	
S								
6 Wgt ARUMPWIPI02+C (L) ARUMPWIPI01+D (R) PIFA 2.41 2.07 N.A. IPEX Antenna length 7 Foxconn WDAN-GQMA6001-DF (Main) PIFA 2.32 1.262 1.813 IPEX Antenna length 8 Foxconn WDAN-GQMA6002-DF (Aux) 1.10 -1.813 IPEX Antenna length 9 Foxconn WDAN-GQMA6002-DF (Main) WDAN-GQMA6002-DF (Aux) PIFA 0.74 -1.446 -2.009 IPEX Antenna length 9 Galtronics 021020168NC3587 (Main) 021020168NC3587-1(Au x) PIFA -0.25	5	Wgt		PIFA			IPEX	
Toconn						-1.70		
Toxicon	6	Wgt		PIFA		N.A.	IPEX	
Toxconn	-				2.07			iengin
Poxicolin WDAN-GQMA6001-DF (Aux) PIFA 1.10 -1.813 PEX length			-		0.00	4 000		A t
WDAN-GQMA6002-DF	7	Foxconn		PIFA			IPEX	
Section WDAN-GQMA6002-DF (Main) WDAN-GQMA6002-DF (Aux) WDAN-GQM					1.10	-1.813		length
8			(/					
Pick Poccom WDAN-GQMA6002-DF (Aux) PIFA 0.78 -2.009 Pick length					a - .			
WDAN-GQMADU2-DF (Aux) 1.78 -2.009 1ength 1.009 1.000 1.0	8	Foxconn		PIFA			IPFX	
9 Galtronics		. 6,1661			0.78	-2.009	, .	length
9 Galtronics (Main) 021020168NC3587-1(Au x) PIFA 3.64 2 U.FL Antenna length 10 Galtronics (Main) 021020168NC3586 (Main) 021020168NC3586-1 (Aux)								
Galtronics								_
10 Galtronics	9	Galtronics		PIFA			UFI	
10 Galtronics		Gaiti GriioG		/ .	3.64	2	O., L	length
10 Galtronics (Main) 021020168NC3586-1 (Aux)			,					
10 Galtronics 021020168NC3586-1 (Aux) PIFA 3.25 1.85 U.FL length								
11 HIGH-TEK	10	Galtronics		PIFA			U FI	
HIGH-TEK		Gara Graige		/ .	3.25	1.85	O., L	length
11 HIGH-TEK								
11 HIGH-TEK AAFQ5050001RK0 (Aux) PIFA 1.52 1.7 IPEX length 12 Hitachi HFT40-IV17 (Main) HMG03-IV17 (Aux) PIFA 0.48 N.A. IPEX Antenna length 13 WNC 81.EE215.016 (Main) 81.EE215.016 (Aux) PIFA 0.34 2.52 IPEX Antenna length 14 WNC ASAW 001(L) ASAW 001(L) ASAW 001 (R) PIFA 1.34 N.A. IPEX Antenna length 15 Wgt B1425050G00003 (Main) B1425050G00002 (Aux) PIFA 0.63 -2.05 IPEX Antenna length 16 TYCO ASAT 001 (Main) ASAT 001 (Aux) PIFA 0.61 N.A. IPEX Antenna length 17 ACON ASAA 001 (L) ASAA 001 (R) PIFA 1.56 N.A. IPEX Antenna length 18 Hitachi HFT40 (Main) HFT40 (Main) HFT40 (Main) HFT40 (Main) HFT40 (Main) HIFA 1.12 2.12 IPEX Antenna length 19 Hitachi HFT60 (Main) HFT60 (Main) DIFA -1.65 1.48 IPEX Antenna length 10 Hitachi HFT60 (Main) DIFA -1.65 1.48 IPEX Antenna length 10 Hitachi HFT60 (Main) DIFA -1.65 1.48 IPEX Antenna length 10 Hitachi HFT60 (Main) DIFA -1.65 1.48 IPEX Antenna length 11 ANTENNA IPEX Antenna length 12 Antenna IPEX Antenna IPEX Antenna IPEX Antenna IPEX Antenna IPEX Antenna IPEX IPEX Antenna IPEX Antenna IPEX Antenna IPEX IPEX IPEX Antenna IPEX IPEX IPEX Antenna IPEX IPEX								_
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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 0.317 IPEX Antenna length 14 WNC ASAW 001(L) ASAW 001 (R) PIFA 1.34 N.A. IPEX Antenna length 15 Wgt B1425050G00003 (Main) B1425050G00002 (Aux) PIFA 0.03 0.03 0.63 -2.01 0.63 IPEX Antenna length 16 TYCO ASAT 001 (Main) ASAT 001 (Main) ASAT 001 (Aux) PIFA 0.61 0.16 N.A. N.A. IPEX Antenna length 17 ACON ASAA 001 (L) ASAA 001 (R) PIFA 1.56 N.A. N.A. IPEX Antenna length 18 Hitachi HFT40 (Main) HFP40 (Aux) PIFA 0.58 0.58 0.58 0.58 0.58 0.58 0.58 0.58	1	· · · · · · · · · · · · ·		/ .	1.52	1.7	2/	length
12								
13 WNC	12	Hitachi		PIFA		N.A.	IPFX	
13	<u> </u>		` ,					
14 WNC ASAW 001(L) ASAW 001(R) PIFA 1.34 IPEX N.A. IPEX Antenna length 15 Wgt B1425050G00003 (Main) B1425050G00002 (Aux) PIFA 0.03 O.63 -2.01 O.63 IPEX Antenna length 16 TYCO ASAT 001 (Main) ASAT 001 (Aux) PIFA 0.61 O.16 N.A. IPEX Antenna length 17 ACON ASAA 001 (L) ASAA 001 (R) PIFA 1.56 O.58 O.58 N.A. IPEX Antenna length 18 Hitachi HFT40 (Main) HFP40 (Aux) PIFA 0.58 O.58 O.58 O.58 1.42 O.58 O.58 O.58 O.58 O.58 O.58 O.58 O.58	13	WNC		PIFA			IPFX	
15 Wgt B1425050G00003	<u> </u>			, .,		3.17		
15 Wgt B1425050G00003	14	WNC		PIFA		N.A.	IPEX	
15 Wgt (Main) B1425050G00002 (Aux) PIFA 0.03 0.63 -2.05 -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 1.42 1.22 1.2 IPEX Antenna length 10 Hitachi HFT60 (Main) PIFA -1.65 1.48 IPEX Antenna					1.25			length
15 Wgt	1 ,_			5.	0.03	-2.01	IDE:	Antenna
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 1.42 1.12 2.12 IPEX Antenna length 10 Hitachi HFT60 (Main) HFT60 (Main) PIFA -1.65 1.48 IPEX Antenna	15	Wgt		PIFA			IPEX	
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17 ACON ASAA 001 (L) ASAA 001 (R) PIFA 1.56 N.A. IPEX Antenna length	16	TYCO		PIFA		N.A	IPFX	
18				, , ,			/\	
ASAA 001 (R)	17	ACON		PIFΔ		ΝΔ	IPFX	
18 Hitachi HFP40 (Aux) PIFA 1.12 2.12 IPEX length	L''	7.0014		1 11 / 1				
HFP40 (Aux) 1.12 2.12 length HFT60 (Main) DIEA -1.65 1.48 IDEY Antenna	12	Hitachi	, ,	PIFΔ			IPFY	
	10	TITACIII		1117			II LA	
1 1 HFT60 (Aux)	10	Hitachi		DIEV			IDEY	
	13	Tittaciii	HFT60 (Aux)	1117	-0.92	2.18	II LA	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	tyco	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	N.A.
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	N.A.
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	Antenn a 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



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/cm²)
1	2412	76.736	0.038	1.0
6	2437	77.446	0.038	1.0
11	2462	75.858	0.037	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/cm²)		
1	2412	97.724	0.048	1.0		
6	2437	96.828	0.048	1.0		
11	2462	94.842	0.047	1.0		

DRAFT 802.11n (20MHz):

210 11 100211111 (2011112) 1						
Channel	Channel Frequency (MHz)	Output Power to Antenna (mW)	Power Density (mW/cm ²)	Limit of Power Density (mW/cm²)		
1	2412	98.401	0.049	1.0		
6	2437	95.060	0.047	1.0		
11	2462	79.068	0.039	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	99.312	0.049	1.0
4	2437	72.778	0.036	1.0
7	2452	33.884	0.017	1.0