

Partial FCC/IC RF Test Report

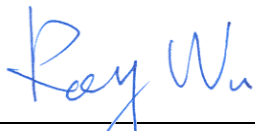
APPLICANT : Ralink Technology Corporation
EQUIPMENT : 802.11 b/g/n RT3090BC4 Combo Card
(Tested inside of HP Notebook PC, HSTNN-I77C)
BRAND NAME : Hewlett-Packard
MODEL NAME : HSTNN-I77C
FCC ID : VQF-RT3090BC4
IC : 7542A-RT3090BC4
STANDARD : FCC Part 15 Subpart C §15.247
IC RSS-210 Issue 7
CLASSIFICATION : Digital Spread Spectrum (DSS)

This is a partial report which is only valid combined with the Bluetooth Module (Brand name: Ralink / Model name: RT3090BC4, FCC ID: VQF-RT3090BC4, IC: 7542A-RT3090BC4) Report. The product was installed into HP Notebook Computer (Brand Name: HP, Model Name: HSTNN-I77C, FCC ID: VQF-RT3090BC4, IC: 7542A-RT3090BC4) during test.

The product was received on May 21, 2010 and completely tested on May 26, 2010. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.4-2003 and shown the compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by:



Roy Wu / Manager



SPORTON INTERNATIONAL INC.

No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.



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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR052502B	Rev. 01	Initial issue of report	Jun. 21, 2010

SUMMARY OF TEST RESULT

Report Section	FCC Rule	IC Rule	Description	Limit	Result	Remark
3.1	15.207	Gen 7.2.2	AC Conducted Emission	15.207(a)	Pass	Under limit 13.9 dB at 1.902 MHz
3.2	15.247(d)	A8.5	Transmitter Radiated Emission	15.209(a) & 15.247(d)	Pass	Under limit 3.63 dB at 40.53 MHz
3.3	15.203 & 15.247(b)	A8.4	Antenna Requirement	N/A	Pass	-



1 General Description

1.1 Applicant

Ralink Technology Corporation

5F., No. 36, Taiyuan St., Jhubei City, Hsinchu County 302, Taiwan, R.O.C.

1.2 Manufacturer

Ralink Technology Corporation

5F., No. 36, Taiyuan St., Jhubei City, Hsinchu County 302, Taiwan, R.O.C.

1.3 Feature of Equipment Under Test

Product Feature & Specification	
Equipment	802.11 b/g/n RT3090BC4 Combo Card (Tested inside of HP Notebook PC, HSTNN-I77C)
Brand Name	Hewlett-Packard
Model Name	HSTNN-I77C
FCC ID	VQF-RT3090BC4
IC	7542A-RT3090BC4
Host (Notebook Computer)	Brand Name : HP Model Name : HSTNN-I77C Antenna Type : Antenna 1 (WNC): Main Antenna : PIFA Antenna with -0.65 dBi Aux. Antenna : PIFA Antenna with 1.14 dBi Antenna 2 (YAGEO): Main Antenna : PIFA Antenna with -0.56 dBi Aux. Antenna : PIFA Antenna with -0.68 dBi HW Version : MB-AX1 SW Version : Image: 602588-001_Rev2 Bios: B09 Note: Only the highest gain antenna (Antenna 1) was used for the testing.
Tx/Rx Frequency Range	2400 MHz ~ 2483.5 MHz
Number of Channels	79
Carrier Frequency of Each Channel	2402+n*1 MHz; n=0~78
Channel Spacing	1 MHz
HW Version	V22ST
SW Version	V1.5.6.4
Type of Modulation	Bluetooth (1Mbps) : GFSK Bluetooth EDR (2Mbps) : $\pi/4$ -DQPSK Bluetooth EDR (3Mbps) : 8-DPSK
EUT Stage	Identical Prototype

Remark:

1. This test report recorded only product characteristics and test results of Digital Spread Spectrum (DSS).
2. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.4 Testing Site

Test Site	SPORTON INTERNATIONAL INC.		
Test Site Location	No. 52, Hwa Ya 1 st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL: +886-3-3273456 / FAX: +886-3-3284978		
Test Site No.	Sporton Site No.		FCC/IC Registration No.
	CO05-HY	03CH05-HY	TW1022/4086B-1

1.5 Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ FCC Part 15 Subpart C §15.247
- ♦ FCC Public Notice DA 00-705
- ♦ ANSI C63.4-2003
- ♦ IC RSS-210 Issue 7

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B (DoC), recorded in a separate test report.

1.6 Ancillary Equipment List

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Notebook	DELL	Vostro 1510	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
2.	LCD TV	Dell	U2410	FCC DoC	Shielded, 1.6 m	Unshielded, 1.8 m
3.	iPod	Apple	A1285	FCC DoC	Shielded, 1.0 m	N/A
4.	iPod Earphone	Apple	N/A	FCC DoC	Unshielded, 1.2 m	N/A

2 Test Configuration of Equipment Under Test

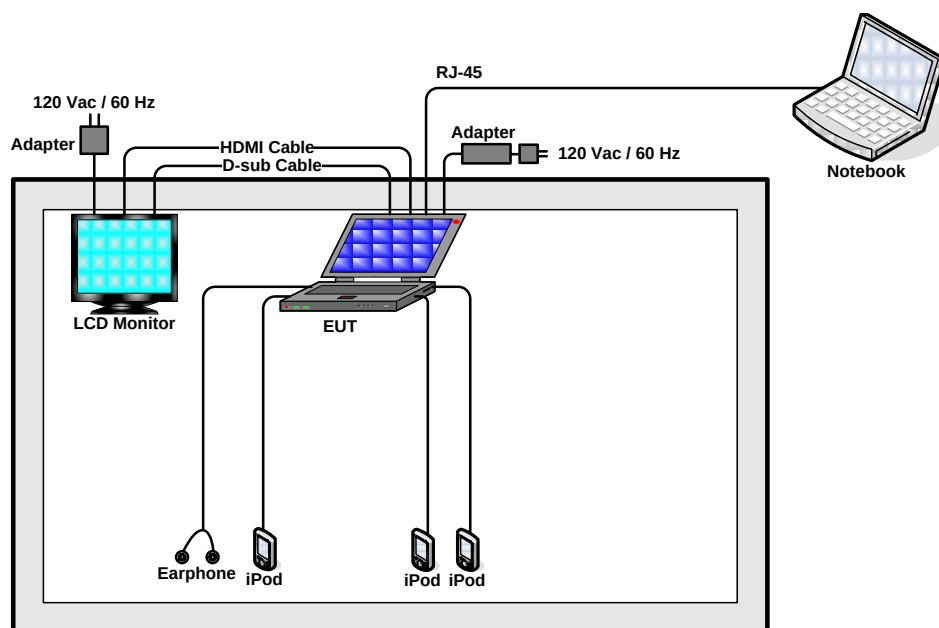
2.1 Test Mode

The EUT has been associated with peripherals pursuant to ANSI C63.4-2003 and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction (150 kHz to 30 MHz), radiation (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).

The following tables are showing the test modes as the worst cases and recorded in this report.

Test Cases	
Test Item	Data Rate / Modulation
	Bluetooth EDR 3Mbps 8-DPSK
Radiated TCs	Mode 1 : CH39_2441 MHz
AC Conducted Emission	Mode 1 : Bluetooth Link + TC + Adapter
Remark:	
1. TC stands for Test Configuration, and consists of iPod, monitor, earphone, and RJ-45.	
2. Only the radiated emission and conducted emission was performed in this report, and the conducted test cases can be referred to Ralink module report (FCC ID: VQF-RT3090BC4 / IC: 7542A-RT3090BC4).	
3. Base on the worst case of module report, only Bluetooth CH39 of radiated emission was tested.	

2.2 Connection Diagram of Test System



2.3 RF Utility

For Bluetooth function, the RF utility, "BlueTest" was installed in EUT which was programmed in order to make the EUT into the engineering modes to contact with Bluetooth base station for transmitting and receiving signals continuously.

3 Test Result

3.1 AC Conducted Emission Measurement

3.1.1 Limit of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

Frequency of emission (MHz)	Conducted limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

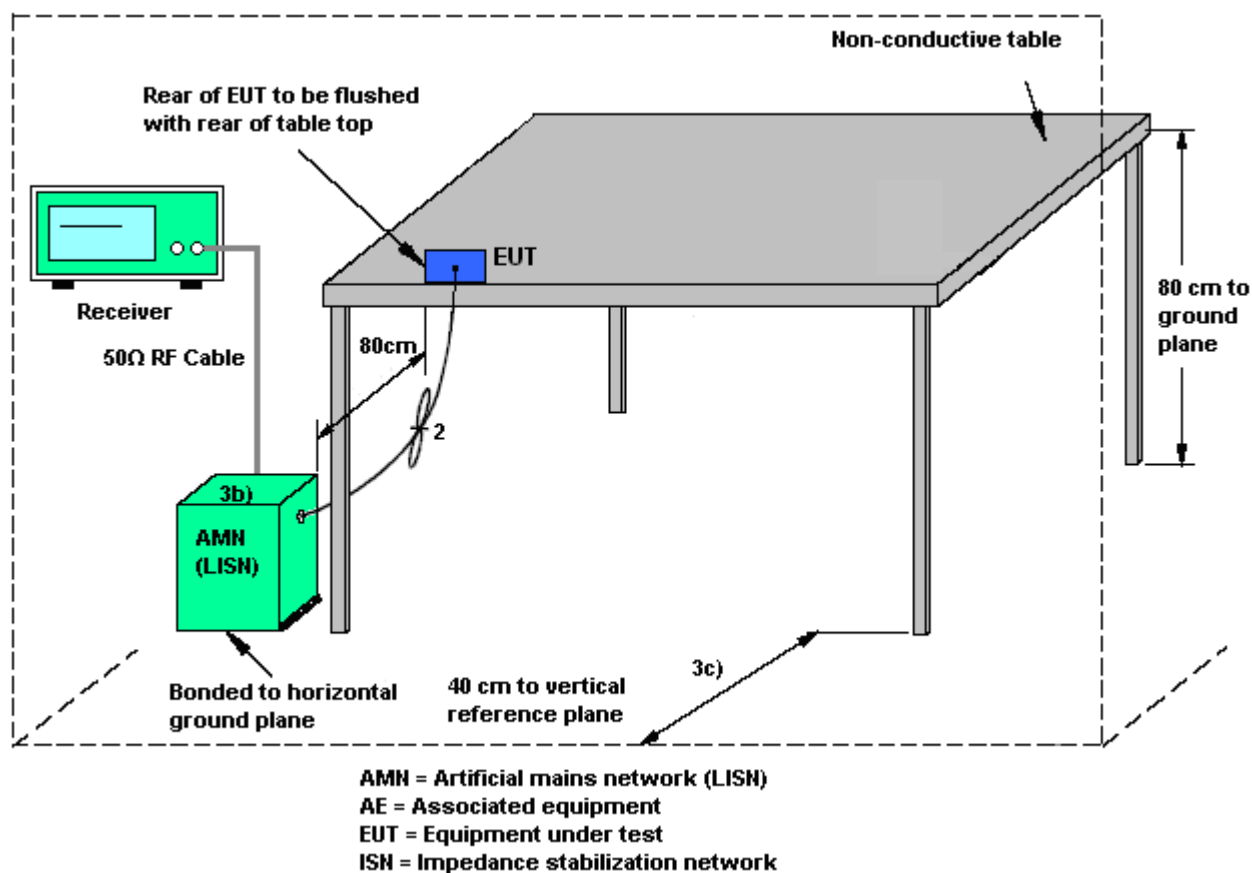
3.1.2 Measuring Instruments

See list of measuring instruments of this test report.

3.1.3 Test Procedures

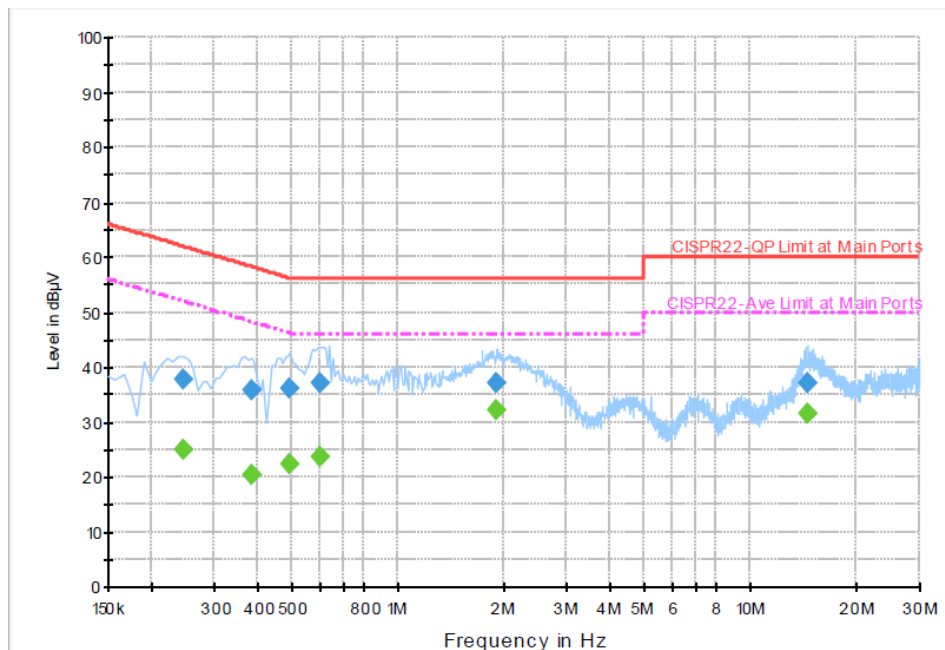
1. Please follow the guidelines in ANSI C63.4-2003.
2. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
1. Connect EUT to the power mains through a line impedance stabilization network (LISN).
2. All the support units are connecting to the other LISN.
3. The LISN provides 50 ohm coupling impedance for the measuring instrument.
4. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
5. Both sides of AC line were checked for maximum conducted interference.
6. The frequency range from 150 kHz to 30 MHz was searched.
7. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.

3.1.4 Test Setup



3.1.5 Test Result of AC Conducted Emission

Test Mode :	Mode 1	Temperature :	20~22°C
Test Engineer :	Novic Jiang	Relative Humidity :	50~52%
Test Voltage :	120Vac / 60Hz	Phase :	Line
Function Type :	Bluetooth Link + TC + Adapter		
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



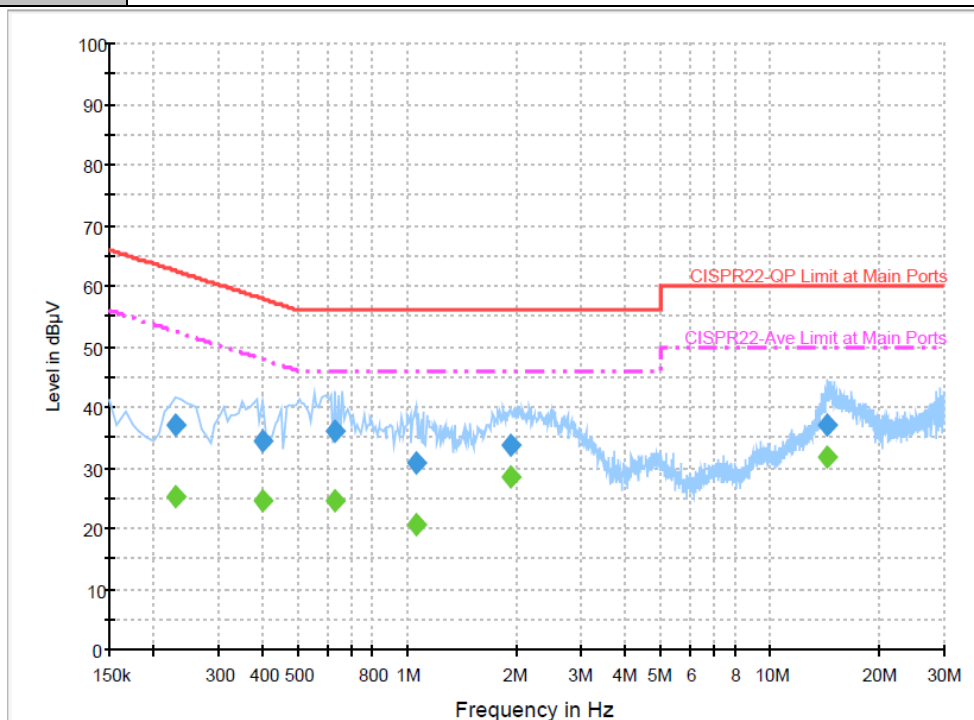
Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.246000	37.6	Off	L1	19.5	24.3	61.9
0.382000	35.8	Off	L1	19.5	22.4	58.2
0.494000	35.9	Off	L1	19.4	20.2	56.1
0.598000	37.1	Off	L1	19.5	18.9	56.0
1.902000	37.2	Off	L1	19.5	18.8	56.0
14.438000	37.0	Off	L1	19.7	23.0	60.0

Final Result 2

Frequency (MHz)	Average (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.246000	24.9	Off	L1	19.5	27.0	51.9
0.382000	20.3	Off	L1	19.5	27.9	48.2
0.494000	22.3	Off	L1	19.4	23.8	46.1
0.598000	23.5	Off	L1	19.5	22.5	46.0
1.902000	32.1	Off	L1	19.5	13.9	46.0
14.438000	31.6	Off	L1	19.7	18.4	50.0

Test Mode :	Mode 1	Temperature :	20~22°C
Test Engineer :	Novic Jiang	Relative Humidity :	50~52%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Function Type :	Bluetooth Link + TC + Adapter		
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		


Final Result 1

Frequency (MHz)	QuasiPeak (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.230000	37.1	Off	N	19.5	25.3	62.4
0.398000	34.4	Off	N	19.4	23.5	57.9
0.630000	36.1	Off	N	19.5	19.9	56.0
1.054000	31.0	Off	N	19.4	25.0	56.0
1.910000	33.8	Off	N	19.5	22.2	56.0
14.254000	37.0	Off	N	19.7	23.0	60.0

Final Result 2

Frequency (MHz)	Average (dBµV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.230000	25.1	Off	N	19.5	27.3	52.4
0.398000	24.6	Off	N	19.4	23.3	47.9
0.630000	24.5	Off	N	19.5	21.5	46.0
1.054000	20.8	Off	N	19.4	25.2	46.0
1.910000	28.4	Off	N	19.5	17.6	46.0
14.254000	31.9	Off	N	19.7	18.1	50.0

3.2 Radiated Emission Measurement

3.2.1 Limit of Radiated Emission

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

3.2.2 Measuring Instruments

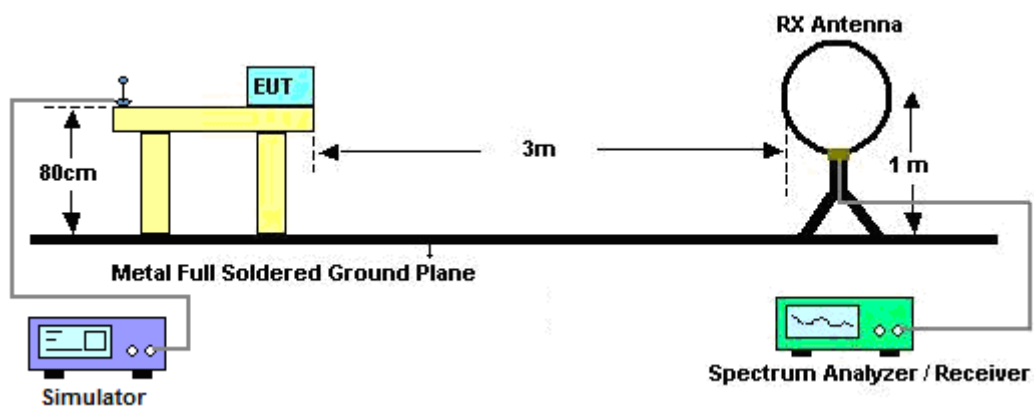
See list of measuring instruments of this test report.

3.2.3 Test Procedures

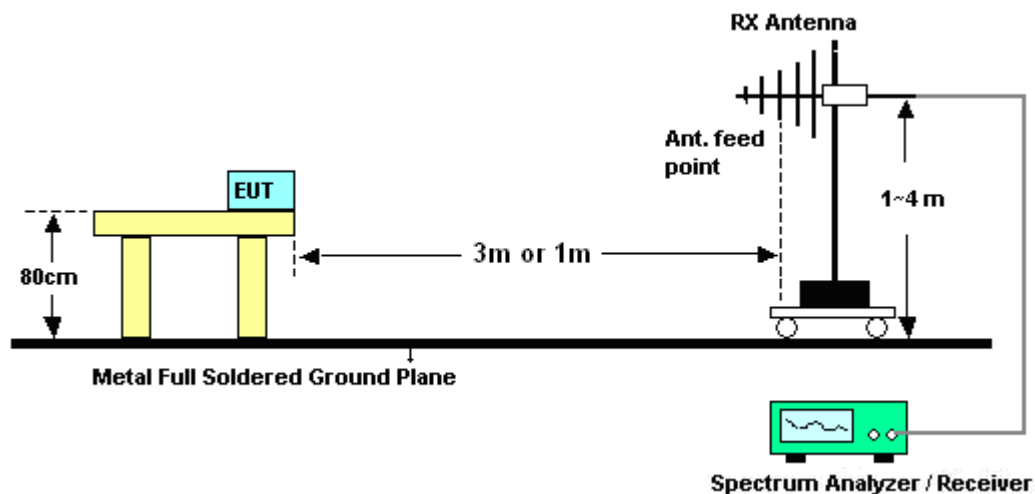
- The testing follows the guidelines in FCC Public Notice DA 00-705 Measurement Guidelines.
- Use the following spectrum analyzer settings:
 - Span = wide enough to fully capture the emission being measured; RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz; VBW $\geq$ RBW; Sweep = auto; Detector function = peak; Trace = max hold.
 - Above 18 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade from 3m to 1m.
Distance extrapolation factor = $20 \log (\text{specific distance [3m]} / \text{test distance [1m]})$ (dB)
- Follow the guidelines in ANSI C63.4-2003 with respect to maximizing the emission by rotating the EUT, measuring the emission for three EUT orthogonal planes, and adjusting the measurement antenna height and polarization. A pre-amp and a high pass filter are used for this test in order to get the good signal level.

3.2.4 Test Setup

For radiated emissions below 30MHz



For radiated emissions above 30MHz



3.2.5 Test Results of Radiated Emissions (9 kHz ~ 30 MHz)

Test Engineer :	Cona Huang	Temperature :	24~25°C	
		Relative Humidity :	48~51%	

Frequency (MHz)	Level (dBuV)	Over Limit (dB)	Limit Line (dBuV)	Remark
-	-	-	-	See Note

Note:

The amplitude of spurious emissions that are attenuated by more than 20dB below the permissible value has no need to be reported.

Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

3.2.6 Test Result of Radiated Emission (30 MHz ~ 10th Harmonic)

Test Mode :	Mode 1	Temperature :	24~25°C
Test Channel :	39	Relative Humidity :	48~51%
Test Engineer :	Cona Huang	Polarization :	Horizontal
Remark :	2441 MHz is Fundamental Signals which can be ignored.		

Frequency (MHz)	Level (dBuV/m)	Over Limit (dB)	Limit Line (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
42.69	35.17	-4.83	40	54.56	11.34	31.54	0.81	100	155	Peak
166.62	36.56	-6.94	43.5	56.69	9.84	31.53	1.56	-	-	Peak
242.49	39.63	-6.37	46	57.39	11.88	31.52	1.88	-	-	Peak
414.1	38.46	-7.54	46	50.16	17.04	31.17	2.43	-	-	Peak
578.6	40.41	-5.59	46	49.12	19.3	30.9	2.89	-	-	Peak
623.4	36.72	-9.28	46	45.06	19.46	30.82	3.02	-	-	Peak
2374	43.90	-30.10	74	43.45	31.83	36.07	4.69	133	226	Peak
2374	33.77	-20.23	54	33.32	31.83	36.07	4.69	133	226	Average
2441	101.7	-	-	101.08	31.93	36.09	4.78	133	226	Peak
2441	87.09	-	-	86.47	31.93	36.09	4.78	133	226	Average
2484	44.09	-29.91	74	43.37	31.98	36.1	4.84	133	226	Peak
2484	32.12	-21.88	54	31.4	31.98	36.1	4.84	133	226	Average
4882	51.23	-22.77	74	46.77	33.9	36.1	6.66	100	226	Peak
4882	44.56	-9.44	54	40.1	33.9	36.1	6.66	100	226	Average
8322	51.34	-22.66	74	43.5	35.73	36.67	8.78	100	168	Peak
8322	40.33	-13.67	54	32.49	35.73	36.67	8.78	100	168	Average

Test Mode :	Mode 1	Temperature :	24~25°C
Test Channel :	39	Relative Humidity :	48~51%
Test Engineer :	Cona Huang	Polarization :	Vertical
Remark :	2441 MHz is Fundamental Signals which can be ignored.		

Frequency (MHz)	Level (dBuV/m)	Over Limit (dB)	Limit Line (dBuV/m)	Read Level (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Remark
40.53	36.37	-3.63	40	54.92	12.17	31.52	0.8	100	256	Peak
115.05	36.17	-7.33	43.5	53.87	12.51	31.52	1.31	-	-	Peak
207.93	37.37	-6.13	43.5	57.66	9.44	31.46	1.73	-	-	Peak
349.7	39.83	-6.17	46	53.89	14.99	31.31	2.26	-	-	Peak
414.1	39.25	-6.75	46	50.95	17.04	31.17	2.43	-	-	Peak
761.3	39.66	-6.34	46	46.17	20.73	30.54	3.3	-	-	Peak
2364	43.52	-30.48	74	43.09	31.81	36.07	4.69	102	314	Peak
2364	32.11	-21.89	54	31.68	31.81	36.07	4.69	102	314	Average
2441	85.62	-	-	85	31.93	36.09	4.78	102	314	Average
2441	99.97	-	-	99.35	31.93	36.09	4.78	102	314	Peak
2492	42.21	-31.79	74	41.47	32	36.1	4.84	102	314	Peak
2492	31.05	-22.95	54	30.31	32	36.1	4.84	102	314	Average
4882	50.80	-23.20	74	46.34	33.9	36.1	6.66	104	175	Peak
4882	45.60	-8.40	54	41.14	33.9	36.1	6.66	104	175	Average
8382	51.76	-22.24	74	43.89	35.72	36.68	8.83	110	122	Peak
8382	40.46	-13.54	54	32.59	35.72	36.68	8.83	110	122	Average



3.3 Antenna Requirements

3.3.1 Standard Applicable

If directional gain of transmitting antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the FCC rule.

3.3.2 Antenna Connected Construction

The antennas type used in this product is PIFA Antenna without connector and it is considered to meet antenna requirement.

3.3.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Due Date	Remark
EMI Test Receive	R&S	ESCS 30	100356	9KHz – 2.75GHz	Aug. 05, 2009	Aug. 04, 2010	Conduction (CO05-HY)
Two-LISN	R&S	ENV216	11-100081	9kHz~30MHz	Nov. 30, 2009	Nov. 29, 2010	Conduction (CO05-HY)
Two-LISN	R&S	ENV216	11-100080	9kHz~30MHz	Nov. 23, 2009	Nov. 22, 2010	Conduction (CO05-HY)
AC Power Source	APC	APC-1000W	N/A	N/A	N/A	N/A	Conduction (CO05-HY)
Spectrum Analyzer	R&S	FSP40	100057	9KHz-40GHz	Oct. 20, 2009	Oct. 19, 2010	Radiation (03CH05-HY)
COM-POWER	COM-POWER	PA-103	161075	1KHz - 1GHz	May 22, 2009	May 21, 2010	Radiation (03CH05-HY)
Bilog Antenna	SCHAFFNER	CBL6111C	2727C	30 MHz - 1 GHz	Aug. 12, 2009	Aug. 11, 2010	Radiation (03CH05-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170251	15GHz- 40GHz	Oct. 14, 2009	Oct. 13, 2010	Radiation (03CH05-HY)
Pre Amplifier	Agilent	8449B	3008A01917	1GHz- 26.5GHz	Nov. 11, 2009	Nov. 10, 2010	Radiation (03CH05-HY)
Turn Table	HD	Deis HD 2000	420/611	0 - 360 degree	N/A	N/A	Radiation (03CH05-HY)
Antenna Mast	HD	MA 240	240/666	1 m - 4 m	N/A	N/A	Radiation (03CH05-HY)
Horn Antenna	ESCO	3117	00066584	1GHz ~ 18GHz	Aug. 05, 2009	Aug. 04, 2010	Radiation (03CH05-HY)
Horn Antenna	Training Research	AH-0801	95119	8GHz~18GHz	Nov. 02, 2009	Nov. 01, 2010	Radiation (03CH05-HY)
Loop Antenna	R&S	HFH2-Z2	860004/001	9 kHz~30 MHz	Jul. 28, 2008	Jul. 28, 2010	Radiation (03CH05-HY)

5 Uncertainty of Evaluation

Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Contribution	Uncertainty of X_i		$u(X_i)$
	dB	Probability Distribution	
Receiver Reading	0.10	Normal (k=2)	0.05
Cable Loss	0.10	Normal (k=2)	0.05
AMN Insertion Loss	2.50	Rectangular	0.63
Receiver Specification	1.50	Rectangular	0.43
Site Imperfection	1.39	Rectangular	0.80
Mismatch	+0.34 / -0.35	U-Shape	0.24
Combined Standard Uncertainty $U_c(y)$	1.13		
Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_c(y)$)	2.26		

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Contribution	Uncertainty of X_i		$u(X_i)$
	dB	Probability Distribution	
Receiver Reading	0.41	Normal (k=2)	0.21
Antenna Factor Calibration	0.83	Normal (k=2)	0.42
Cable Loss Calibration	0.25	Normal (k=2)	0.13
Pre-Amplifier Gain Calibration	0.27	Normal (k=2)	0.14
RCV/SPA Specification	2.50	Rectangular	0.72
Antenna Factor Interpolation for Frequency	1.00	Rectangular	0.29
Site Imperfection	1.43	Rectangular	0.83
Mismatch	+0.39 / -0.41	U-Shape	0.28
Combined Standard Uncertainty $U_c(y)$	1.27		
Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_c(y)$)	2.54		

Uncertainty of Radiated Emission Measurement (1 GHz ~ 40 GHz)

Contribution	Uncertainty of X_i		$u(X_i)$	C_i	$C_i * u(X_i)$
	dB	Probability Distribution			
Receiver Reading	± 0.10	Normal (k=2)	0.10	1	0.10
Antenna Factor Calibration	± 1.70	Normal (k=2)	0.85	1	0.85
Cable Loss Calibration	± 0.50	Normal (k=2)	0.25	1	0.25
Receiver Correction	± 2.00	Rectangular	1.15	1	1.15
Antenna Factor Directional	± 1.50	Rectangular	0.87	1	0.87
Site Imperfection	± 2.80	Triangular	1.14	1	1.14
Mismatch Receiver VSWR $\Gamma_1 = 0.197$ Antenna VSWR $\Gamma_2 = 0.194$ Uncertainty = $20\text{Log}(1-\Gamma_1*\Gamma_2)$	+0.34 / -0.35	U-Shape	0.244	1	0.244
Combined Standard Uncertainty $U_c(y)$	2.36				
Measuring Uncertainty for a Level of Confidence of 95% ($U = 2U_c(y)$)	4.72				