

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 Transmission System (DTS)

This is a partial report which is only valid combined with the WLAN 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
FR052502A	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 12.7 dB at 1.91 MHz
3.2	15.247(d)	A8.5	Transmitter Radiated Emission	15.209(a) & 15.247(d)	Pass	Under limit 4.20 dB at 32.97 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	11
Carrier Frequency of Each Channel	2412+(n-1)*5 MHz; n=1~11
Channel Spacing	5 MHz
HW Version	V22ST
SW Version	V1.5.6.4
Type of Modulation	802.11b : DSSS (BPSK / QPSK / CCK) 802.11g/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)
EUT Stage	Identical Prototype

Remark:

1. This test report recorded only product characteristics and test results of Digital Transmission System (DTS).
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 KDB Publication No. 558074 (Measurement Guidelines of DTS)
- ♦ 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

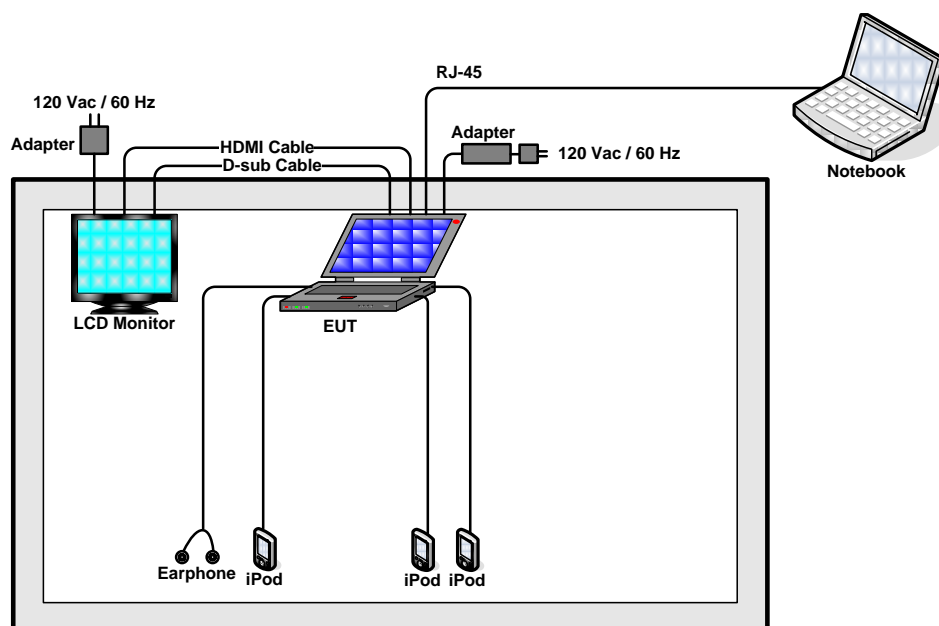
2.1 Test Mode

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: conducted emission (150 kHz to 30 MHz), radiated emission (30 MHz 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	802.11b
Radiated TCs	Mode 1 : 802.11b CH06_2437 MHz for Ant. 1
AC Conducted Emission	Mode 1 : WLAN Link + TC + Adapter
Remark: <ol style="list-style-type: none">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 802.11b CH06 of radiated emission was tested.	

2.2 Connection Diagram of Test System



2.3 RF Utility

The programmed RF utility, "QA" is installed in EUT to provide channel selection, power level, data rate and the application type. RF Utility can send transmitting signal for all testing. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

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.

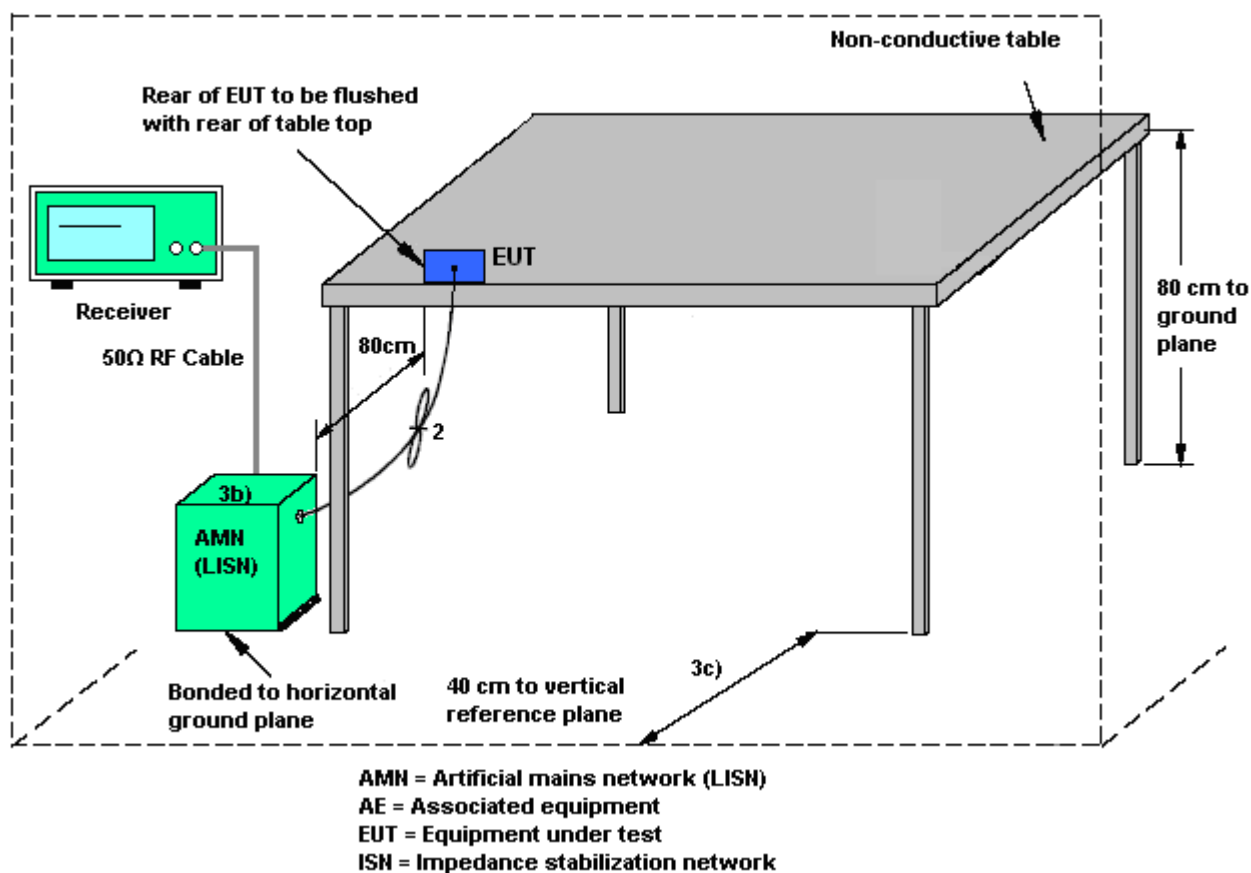
3.1.2 Measuring Instruments

See list of measuring instruments of this test report.

3.1.3 Test Procedures

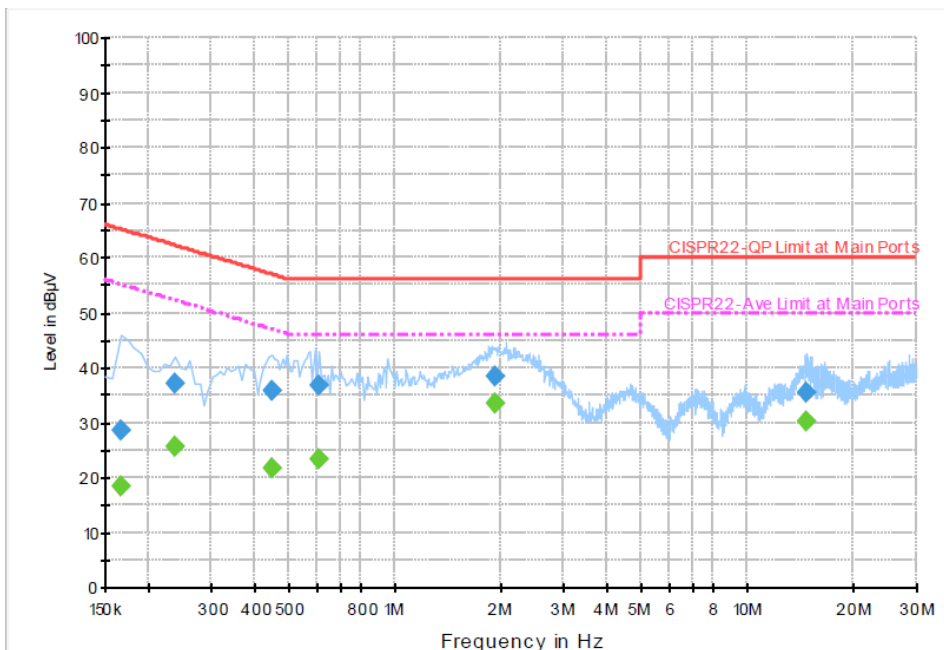
1. The testing follows the guidelines in ANSI C63.4-2003.
2. The EUT was placed 0.4 meter from the conducting wall of the shielding room, and it was kept at least 80 centimeters from any other grounded conducting surface.
3. Connect EUT to the power mains through a line impedance stabilization network (LISN).
4. All the support units are connecting to the other LISN.
5. The LISN provides 50 ohm coupling impedance for the measuring instrument.
6. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
7. Both sides of AC line were checked for maximum conducted interference.
8. The frequency range from 150 kHz to 30 MHz was searched.
9. 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 :	WLAN Link + TC + Adapter		
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



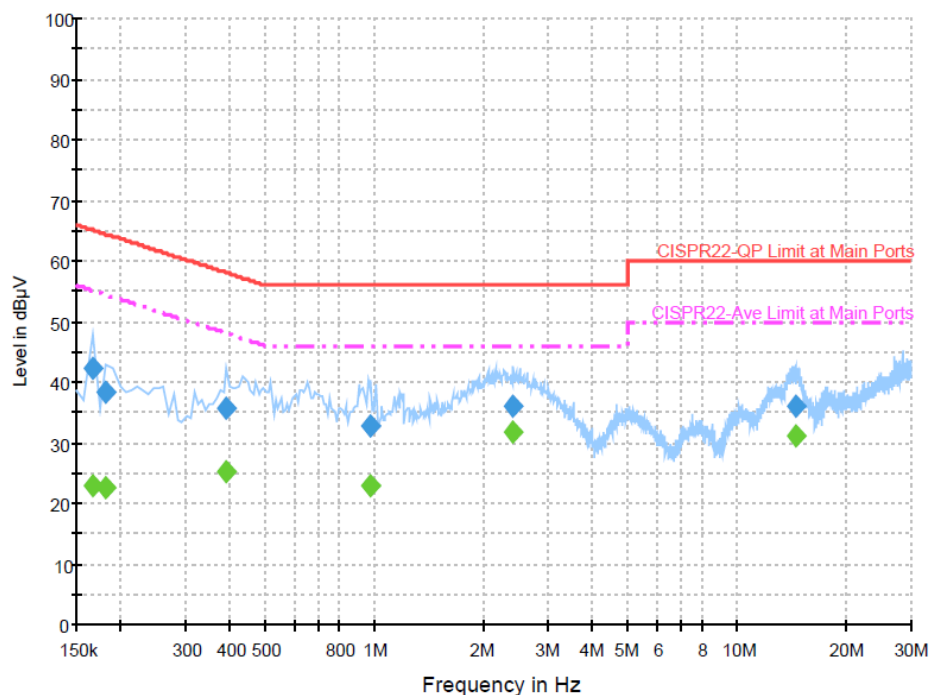
Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.166000	28.7	Off	L1	19.5	36.5	65.2
0.238000	37.1	Off	L1	19.5	25.1	62.2
0.446000	35.7	Off	L1	19.4	21.2	56.9
0.606000	36.8	Off	L1	19.5	19.2	56.0
1.910000	38.2	Off	L1	19.5	17.8	56.0
14.734000	35.5	Off	L1	19.7	24.5	60.0

Final Result 2

Frequency (MHz)	Average (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.166000	18.5	Off	L1	19.5	36.7	55.2
0.238000	25.5	Off	L1	19.5	26.7	52.2
0.446000	21.7	Off	L1	19.4	25.2	46.9
0.606000	23.2	Off	L1	19.5	22.8	46.0
1.910000	33.3	Off	L1	19.5	12.7	46.0
14.734000	30.2	Off	L1	19.7	19.8	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 :	WLAN 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)
0.166000	42.4	Off	N	19.5	22.8	65.2
0.182000	38.4	Off	N	19.5	26.0	64.4
0.390000	35.9	Off	N	19.4	22.2	58.1
0.974000	32.7	Off	N	19.4	23.3	56.0
2.406000	36.2	Off	N	19.5	19.8	56.0
14.446000	36.1	Off	N	19.7	23.9	60.0

Final Result 2

Frequency (MHz)	Average (dBμV)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.166000	22.9	Off	N	19.5	32.3	55.2
0.182000	22.6	Off	N	19.5	31.8	54.4
0.390000	25.2	Off	N	19.4	22.9	48.1
0.974000	22.9	Off	N	19.4	23.1	46.0
2.406000	31.7	Off	N	19.5	14.3	46.0
14.446000	31.1	Off	N	19.7	18.9	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. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. 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.

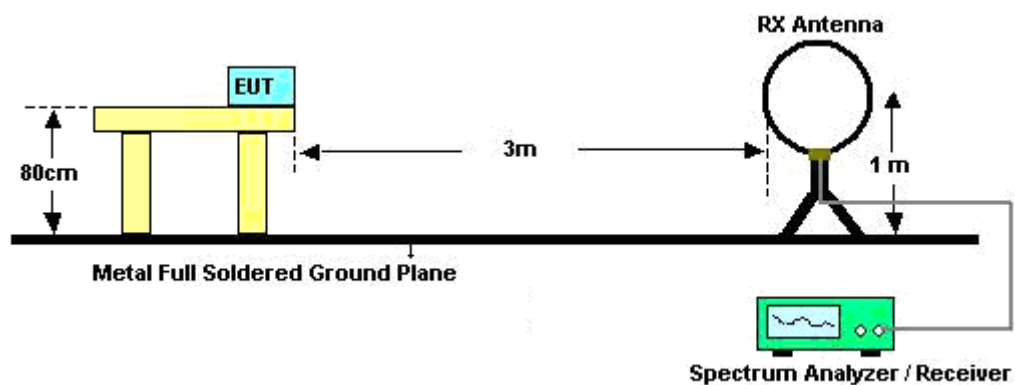
3.2.3 Test Procedures

1. The testing follows the guidelines in FCC KDB Publication No. 558074 (Measurement Guidelines of DTS).
2. Use the following spectrum analyzer settings:
 - (1) 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.
 - (2) 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)
3. 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

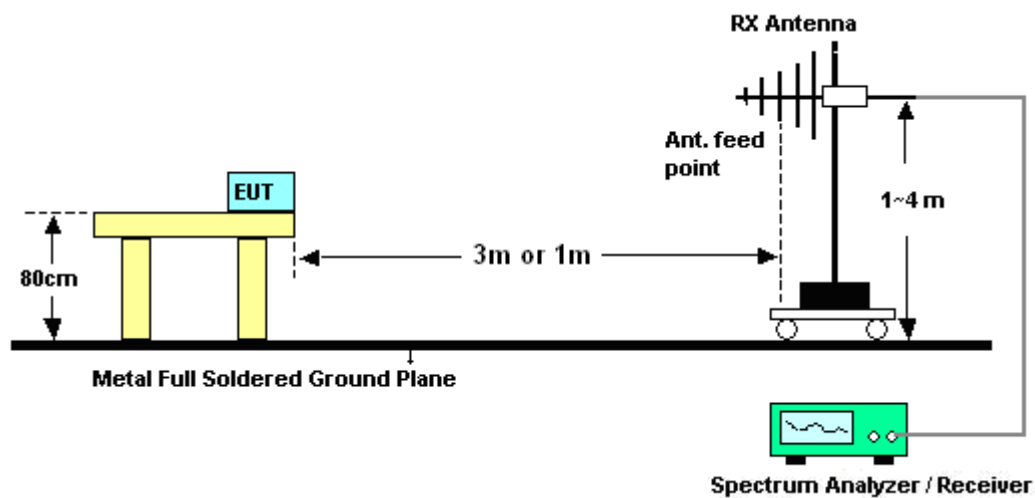
this test in order to get the good signal level.

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℃	
		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 :	06	Relative Humidity :	48~51%
Test Engineer :	Cona Huang	Polarization :	Horizontal
Remark :	2437 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
92.37	27.06	-16.44	43.5	47.58	9.84	31.54	1.18	-	-	Peak
165.81	36.61	-6.89	43.5	56.71	9.87	31.53	1.56	-	-	Peak
242.49	39.27	-6.73	46	57.03	11.88	31.52	1.88	100	142	Peak
405	38.42	-7.58	46	50.5	16.68	31.18	2.42	-	-	Peak
696.9	37.04	-8.96	46	44.61	19.94	30.72	3.21	-	-	Peak
761.3	37.42	-8.58	46	43.93	20.73	30.54	3.3	-	-	Peak
2388	56.29	-17.71	74	52.16	31.86	32.45	4.72	134	136	Peak
2388	44.92	-9.08	54	40.79	31.86	32.45	4.72	134	136	Average
2437	108.01	-	-	103.74	31.93	32.44	4.78	134	136	Average
2437	111.56	-	-	107.32	31.9	32.44	4.78	134	136	Peak
2500	57.17	-16.83	74	52.77	32	32.44	4.84	134	136	Peak
2500	46.03	-7.97	54	41.63	32	32.44	4.84	134	136	Average
8274	52.46	-21.54	74	41.08	35.74	33.11	8.75	100	159	Peak
8274	42.13	-11.87	54	30.75	35.74	33.11	8.75	100	159	Average



Test Mode :	Mode 1	Temperature :	24~25℃
Test Channel :	06	Relative Humidity :	48~51%
Test Engineer :	Cona Huang	Polarization :	Vertical
Remark :	2437 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
32.97	35.8	-4.20	40	49.91	16.71	31.54	0.72	100	161	Peak
42.69	35.17	-4.83	40	54.56	11.34	31.54	0.81	-	-	Peak
207.93	38.26	-5.24	43.5	58.55	9.44	31.46	1.73	-	-	Peak
349.7	39.93	-6.07	46	53.99	14.99	31.31	2.26	-	-	Peak
414.1	38.82	-7.18	46	50.52	17.04	31.17	2.43	-	-	Peak
587.7	40.96	-5.04	46	49.61	19.3	30.89	2.94	-	-	Peak
2382	52.64	-21.36	74	48.54	31.83	32.45	4.72	100	334	Peak
2382	41.26	-12.74	54	37.16	31.83	32.45	4.72	100	334	Average
2437	104.21	-	-	99.94	31.93	32.44	4.78	100	334	Average
2437	107.8	-	-	103.53	31.93	32.44	4.78	100	334	Peak
2484	53.82	-20.18	74	49.44	31.98	32.44	4.84	100	334	Peak
2484	40.8	-13.20	54	36.42	31.98	32.44	4.84	100	334	Average
8223	51.4	-22.60	74	40	35.76	33.08	8.72	100	241	Peak
8223	41.22	-12.78	54	29.82	35.76	33.08	8.72	100	241	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. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. 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 = $20\log(1-\Gamma_1*\Gamma_2)$	+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				