

FCC EMI TEST REPORT

REPORT NO. : FC473142
MODEL NO. : BCM94356Z
PART NO. : BCM94356Z, BCM94356ZAE
RECEIVED DATE : Jul. 31, 2014
FINAL TESTED DATE : Aug. 08, 2014
ISSUED DATE : Sep. 23, 2014
TEST STANDARD : 47 CFR FCC Rules and Regulations Part 15
Subpart B, Class B Digital Device
Filing Type : Certification
FCC ID : QDS-BRCM1085
APPLICANT : Broadcom Corporation
ADDRESS : 190 Mathilda Place Sunnyvale CA 94086 U.S.A.
Manufacturer : Broadcom Corporation
ADDRESS : 190 Mathilda Place Sunnyvale CA 94086 U.S.A.
ISSUED BY : SPORTON International Inc.
LAB ADDRESS : No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park,
Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.

- The test result refers exclusively to the test presented test model / sample.
- Without written approval of SPORTON International Inc., the test report shall not be reproduced except in full.
- This test report is only applicable to U.S.A..



Table of Contents

CERTIFICATE OF COMPLIANCE.....	1
1. Summary of Test Results	2
2. General Description of Equipment under Test.....	3
3. Test Configuration of Equipment under Test	4
4. General Information of Test.....	9
5. Test of Conducted Emission	10
6. Test of Radiated Emission.....	14
7. List of Measuring Equipment Used	22
8. Uncertainty of Test Site	23
Appendix A. TEST PHOTOS	A1 ~ A7

History of This Test Report

REPORT NO.	VERSION	ISSUED DATE	Description
FC473142	Rev. 01	Sep. 23, 2014	Initial issue of report

CERTIFICATE OF COMPLIANCE

**EQUIPMENT NAME : Broadcom 802.11a/b/g/n/ac WLAN + Bluetooth
PCI-E NGFF 2230 Card**

BRAND NAME : Broadcom

MODEL NO. : BCM94356Z

PART NO. : BCM94356Z, BCM94356ZAE

APPLICANT : Broadcom Corporation

ADDRESS : 190 Mathilda Place Sunnyvale CA 94086 U.S.A.

FINAL TESTED DATE : Aug. 08, 2014

**TEST STANDARD : 47 CFR FCC Rules and Regulations Part 15
Subpart B, Class B Digital Device**

I HEREBY CERTIFY THAT:

The measurements shown in this test report were made in accordance with the procedures given in **ANSI C63.4 – 2009**.

The above equipment has been tested by **SPORTON International Inc. LAB.**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMI characteristics under the conditions specified in this report.



Ray Yeh
SPORTON INTERNATIONAL INC.

1. Summary of Test Results

After estimating all the combination of every test mode, the result shown as below is the worst case.

The EUT has been tested according to the following specifications.

EMISSION			
Test Standard	Test Type	Result	Remarks
47 CFR FCC Rules and Regulations Part 15 Subpart B, Class B Digital Device	AC Power Port Conducted emission test 150 kHz – 30 MHz	PASS	Meet minimum passing margin is -12.54dB at 0.15080MHz.
	Radiated emission test 30 MHz – 1,000 MHz @ 3 m 1,000 MHz – 18,000 MHz @ 3 m 18,000 MHz – 30,000 MHz @ 1 m	PASS	Meet minimum passing margin is -3.42dB at 272.50MHz.

2. General Description of Equipment under Test

Product Detail	
Equipment Name	Broadcom 802.11a/b/g/n/ac WLAN + Bluetooth PCI-E NGFF 2230 Card
Model No.	BCM94356Z
Part No.	BCM94356Z, BCM94356ZAE
Brand Name	Broadcom
Power Supply	From host system
Accessories	N/A

2.1. Feature of Equipment under Test

1. The EUT has two part numbers which are identical to each other in all aspects except for the following table:

Model No.	Part No.	Description
BCM94356Z	BCM94356Z	The base pin between these two models is different.
	BCM94356ZAE	

From the above models, part number: BCM94356Z was selected as representative model for the test and its data was recorded in this report.

2. For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.

2.2. Modification of EUT

Please refer to the Photographs of EUT.

3. Test Configuration of Equipment under Test

3.1. Test Mode

Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Conducted Emissions	
Test Mode	Normal Link
1	2.4GHz WLAN function + Bluetooth function
2	5GHz WLAN function + Bluetooth function
Mode 1 generated the worst test result, so it was recorded in this report.	

Radiated Emissions	
Test Mode	Normal Link
1	2.4GHz WLAN function + Bluetooth function
2	5GHz WLAN function + Bluetooth function
For Radiated Emission test below 1GHz: Mode 1 generated the worst test result, so it was recorded in this report. For Radiated Emission test above 1GHz: Mode 1 generated the worst test result for Radiated emission below 1GHz test, thus the measurement for Radiated emission above 1 GHz test will follow this same test configuration.	

3.2. Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

For AC Power Port Conducted emission test:

Support Unit	Brand	Model	FCC ID
Wireless AP	Planex	GW-AP54SGX	KA220030603014-1
Test fixture	Broadcom	BCM9NGFF2EC_1	N/A
Broadcom 802.11a/b/g/n/ac WLAN + Bluetooth PCI-E NGFF 2230 Card (Device)	Broadcom	BCM94356Z	QDS-BRCM1085
NB	DELL	E4300	DoC
Mouse	Logitech	M-U0026	DoC
Earphone	SHYARO CHI	MIC-04	N/A
NB	DELL	E4300	DoC
Test fixture	Broadcom	BCM9NGFF2EC_1	N/A

For Radiated emission test:

Support Unit	Brand	Model	FCC ID
Wireless AP	Netgear	R6300V2	PY313200227
Test fixture	Broadcom	BCM9NGFF2EC_1	N/A
Broadcom 802.11a/b/g/n/ac WLAN + Bluetooth PCI-E NGFF 2230 Card (Device)	Broadcom	BCM94356Z	QDS-BRCM1085
NB	DELL	M1340	E2K4965AGNM
Mouse	Logitech	M-U0026	DoC
Earphone	E-BOOKI	E-EPC040	N/A
NB	DELL	E4300	RSE-TG233
Test fixture	Broadcom	BCM9NGFF2EC_1	N/A

3.3. EUT Operation Condition

An executive program, EMCTEST.EXE under WIN 7, which generates a complete line of continuously repeating " H " pattern was used as the test software.

The program was executed as follows :

- a. Turn on the power of all equipment.
- b. The NB sends " H " messages to the panel, and the panel displays " H " patterns on the screen.
- c. Repeat the step b.

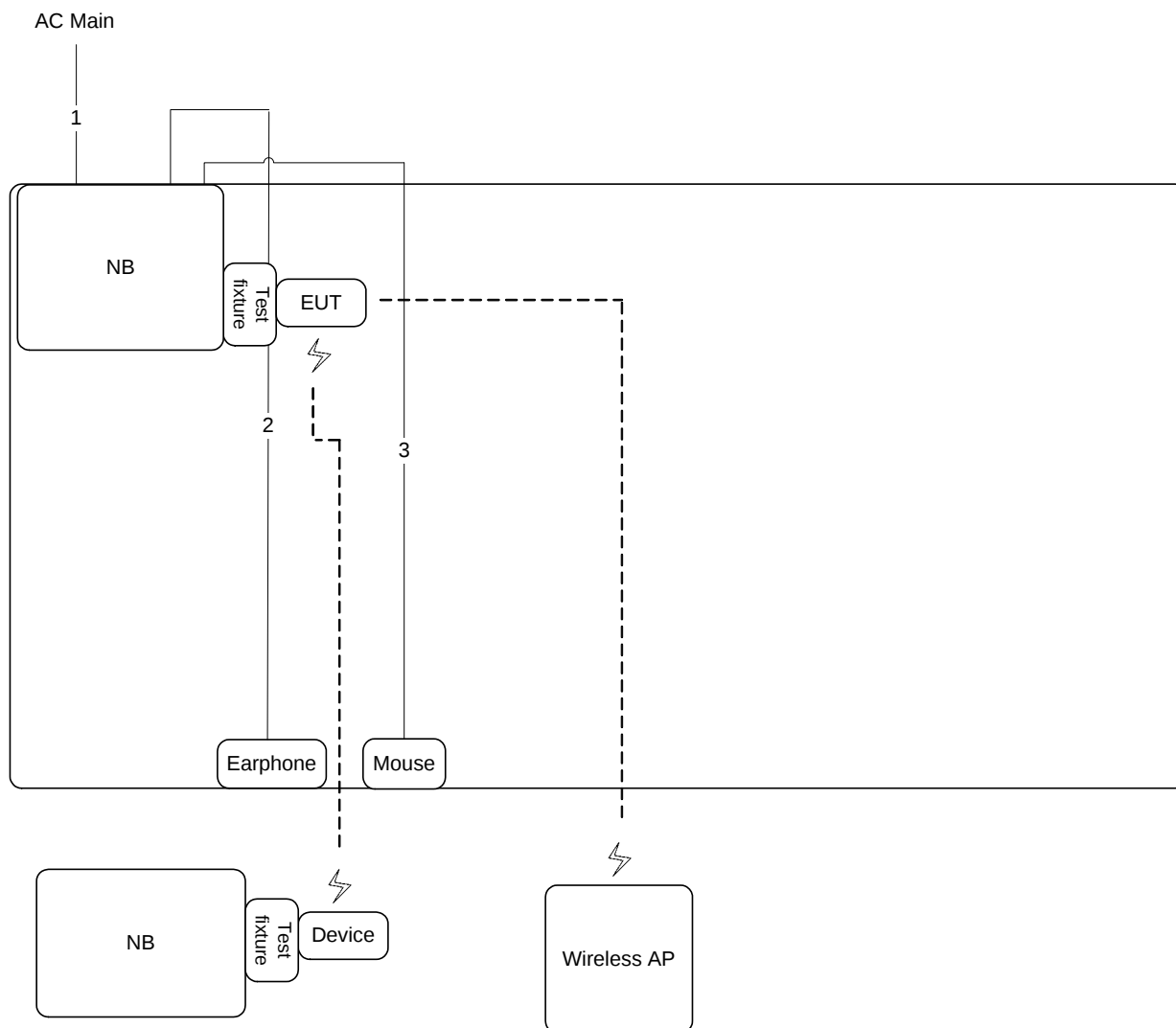
At the same time, the following programs under WIN 7 were executed:

The remote notebook executed "ping.exe" to link with the EUT to maintain the connection by WLAN.

The remote notebook executed "Bluetool" to link with the EUT to receive and transmit signal by Bluetooth.

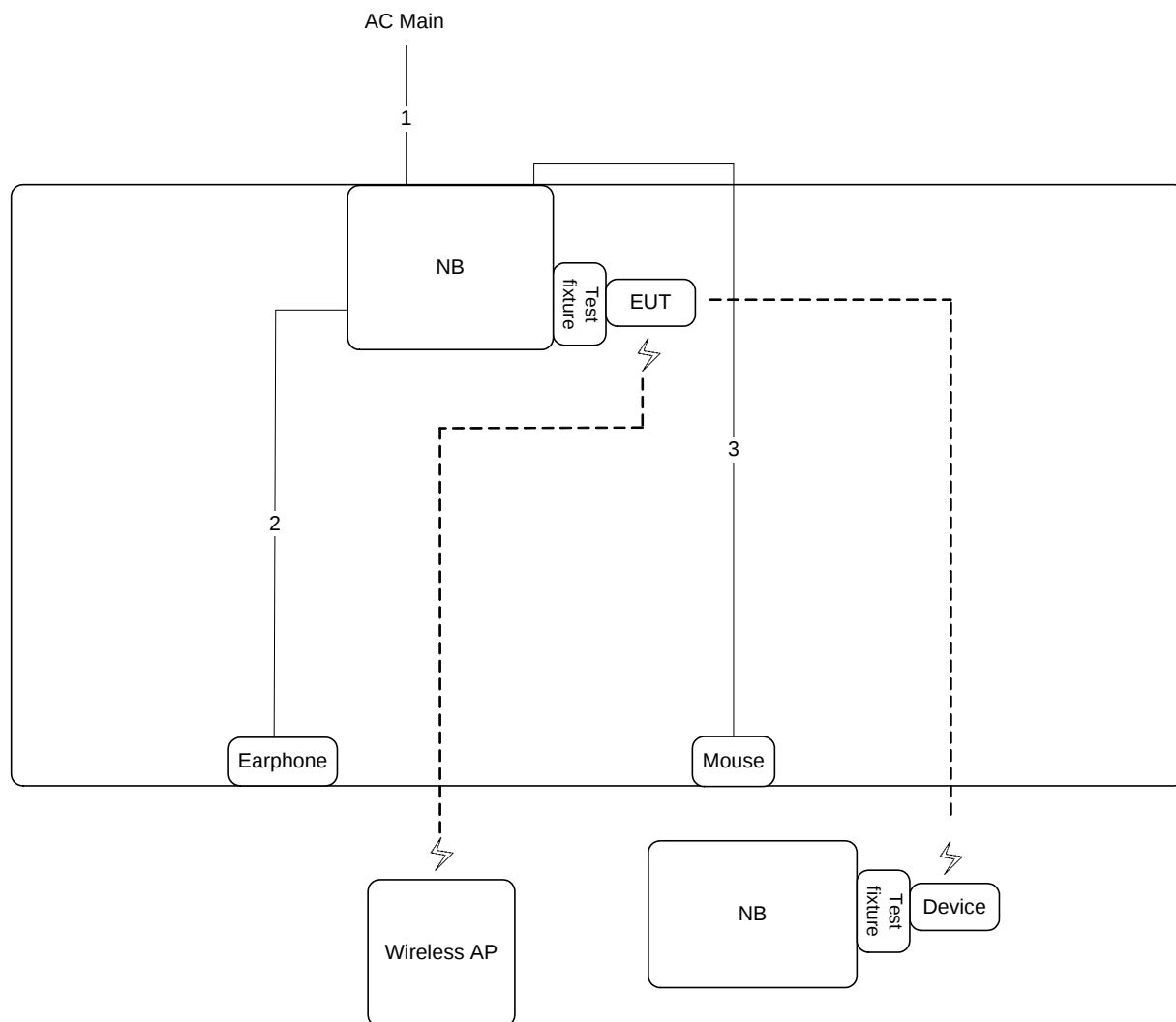
3.4. Connection Diagram of Test System

3.4.1. AC Power Line Conduction Emissions Test Configuration



Item	Connection	Shielded	Length
1	Power cable	No	2.6m
2	Audio cable	No	1.5m
3	USB cable	Yes	1.8m

3.4.2. Radiation Emissions Test Configuration



Item	Connection	Shielded	Length
1	Power cable	No	2.6m
2	Audio cable	No	1.1m
3	USB cable	Yes	1.8m

4. General Information of Test

4.1. Test Facility

Test Site Location : No.8, Lane 724, Bo-ai St., Jhubei City,
Hsinchu County 302, Taiwan, R.O.C.
TEL : 886-3-656-9065
FAX : 886-3-656-9085
Test Site No. : Conduction: CO01-CB
Radiation: 03CH01-CB

4.2. Test Voltage

Power Type	Test Voltage
AC Power Supply	120 V / 60 Hz

4.3. Standard for Methods of Measurement

ANSI C63.4-2009

4.4. Frequency Range Investigated

Test Items	Frequency Range
Conducted emission test	150 kHz to 30 MHz
Radiated emission test	30 MHz to 30,000 MHz

4.5. Test Distance

Test Items	Test Distance
Radiated emission test below 1 GHz (30 MHz to 1,000 MHz)	3 m
Radiated emission test above 1 GHz (1,000 MHz to 18,000 MHz)	3 m
Radiated emission test above 1 GHz (18,000 MHz to 30,000 MHz)	1 m

5. Test of Conducted Emission

5.1. Limit

Frequency (MHz)	QP Limit (dBuV)	AV Limit (dBuV)
0.15~0.5	66~56	56~46
0.5~5	56	46
5~30	60	50

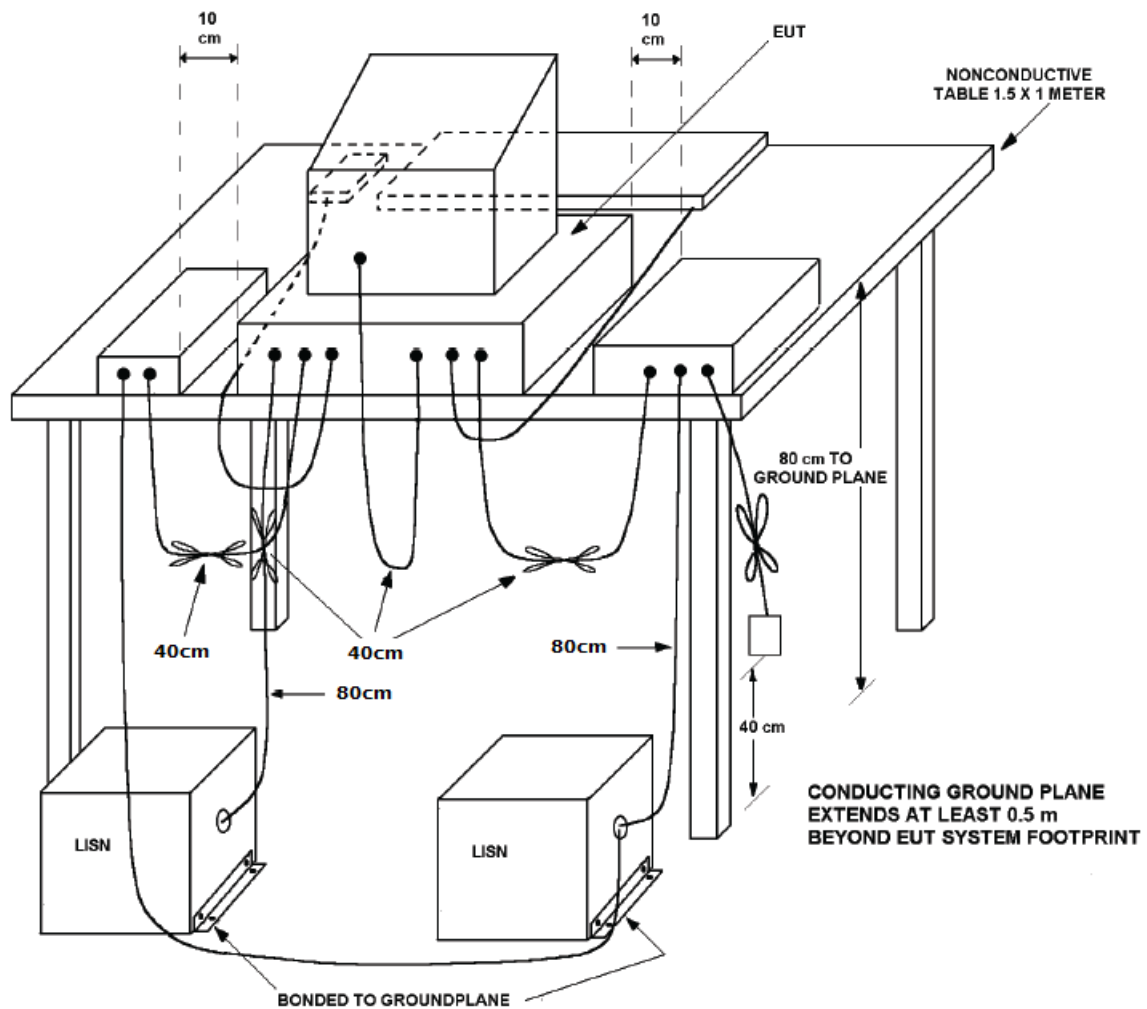
5.2. Description of Major Test Instruments

Test Receiver	R&S ESCS 30
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

5.3. Test Procedures

- 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.
- Connect EUT to the power mains through a line impedance stabilization network (LISN).
- All the support units are connect to the other LISN.
- The LISN provides 50 Ω coupling impedance for the measuring instrument.
- The FCC states that a 50 Ω , 50 μ H LISN should be used.
- Both sides of AC line were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched.
- Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

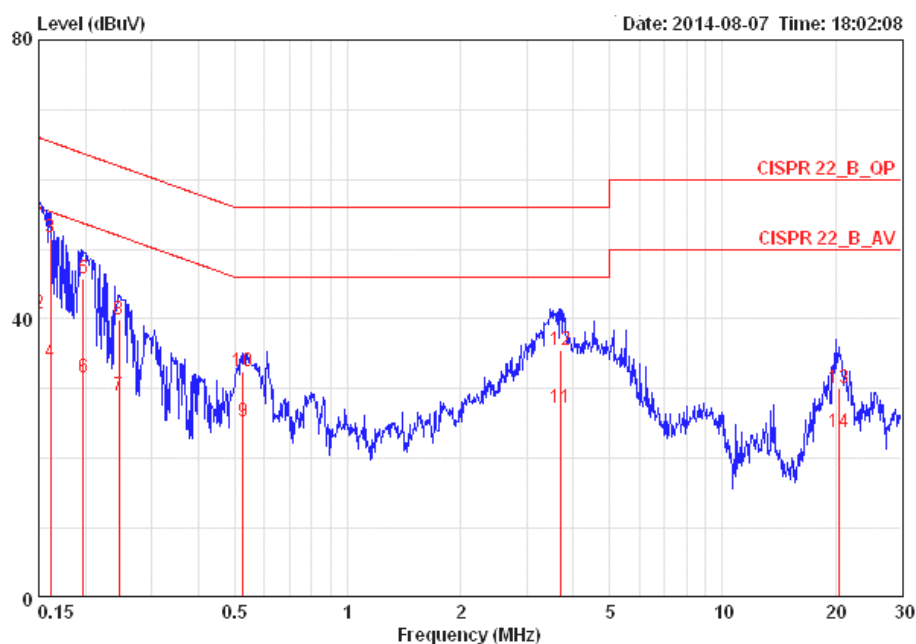
5.4. Typical Test Setup Layout of Conducted Emission



5.5. Test Result of AC Power Ports

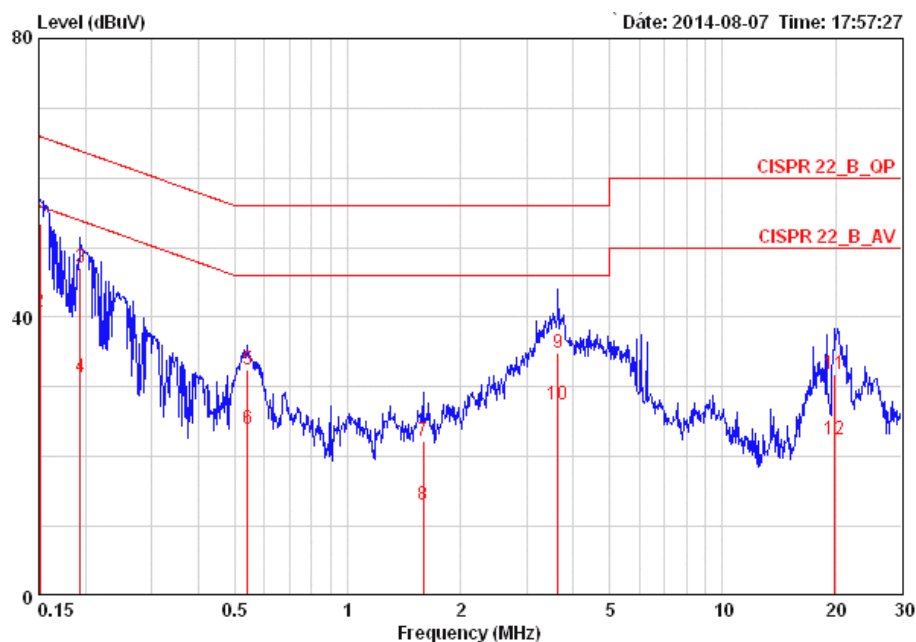
Temperature	25°C	Humidity	52%
Test Engineer	Parody Lin	Frequency Range	0.15 MHz to 30 MHz
Test Mode	Mode 1		
▪ Corrected Reading (dBuV) = LISN Factor + Cable Loss + Read Level = Level ▪ All emissions not reported here are more than 10 dB below the prescribed limit. ▪ The test was passed at the minimum margin that marked by a frame in the following table			

Line



	Freq	Level	Over	Limit	LISN	Read	Cable		Remark
	MHz	dBuV	Limit	Line	Factor	Level	Loss	Pol/Phase	
			dB	dBuV	dB	dBuV	dB		
1	0.15000	53.37	-12.63	66.00	0.10	53.11	0.16	LINE	QP
2	0.15000	40.67	-15.33	56.00	0.10	40.41	0.16	LINE	AVERAGE
3	0.16155	51.63	-13.75	65.38	0.10	51.37	0.16	LINE	QP
4	0.16155	33.77	-21.61	55.38	0.10	33.51	0.16	LINE	AVERAGE
5	0.19758	45.86	-17.85	63.71	0.10	45.60	0.16	LINE	QP
6	0.19758	31.55	-22.16	53.71	0.10	31.29	0.16	LINE	AVERAGE
7	0.24552	28.97	-22.94	51.91	0.10	28.70	0.17	LINE	AVERAGE
8	0.24552	39.91	-22.00	61.91	0.10	39.64	0.17	LINE	QP
9	0.52655	25.28	-20.72	46.00	0.11	24.98	0.19	LINE	AVERAGE
10	0.52655	32.56	-23.44	56.00	0.11	32.26	0.19	LINE	QP
11	3.700	27.30	-18.70	46.00	0.20	26.80	0.29	LINE	AVERAGE
12	3.700	35.62	-20.38	56.00	0.20	35.12	0.29	LINE	QP
13	20.377	30.19	-29.81	60.00	0.48	29.19	0.52	LINE	QP
14	20.377	23.83	-26.17	50.00	0.48	22.83	0.52	LINE	AVERAGE

Neutral



	Freq	Level	Over Limit	Limit Line	LISN Factor	Read Level	Cable Loss	Pol/Phase	Remark
	MHz	dBuV	dB	dBuV	dB	dBuV	dB		
1	0.15080	53.42	-12.54	65.96	0.09	53.17	0.16	NEUTRAL	QP
2	0.15080	40.74	-15.22	55.96	0.09	40.49	0.16	NEUTRAL	AVERAGE
3	0.19344	47.04	-16.84	63.89	0.09	46.79	0.16	NEUTRAL	QP
4	0.19344	31.48	-22.40	53.89	0.09	31.23	0.16	NEUTRAL	AVERAGE
5	0.54068	32.46	-23.54	56.00	0.10	32.17	0.19	NEUTRAL	QP
6	0.54068	23.97	-22.03	46.00	0.10	23.68	0.19	NEUTRAL	AVERAGE
7	1.593	22.20	-33.80	56.00	0.13	21.83	0.23	NEUTRAL	QP
8	1.593	12.98	-33.02	46.00	0.13	12.61	0.23	NEUTRAL	AVERAGE
9	3.642	34.87	-21.13	56.00	0.18	34.39	0.29	NEUTRAL	QP
10	3.642	27.37	-18.63	46.00	0.18	26.89	0.29	NEUTRAL	AVERAGE
11	19.950	31.75	-28.25	60.00	0.44	30.80	0.51	NEUTRAL	QP
12	19.950	22.55	-27.45	50.00	0.44	21.60	0.51	NEUTRAL	AVERAGE

6. Test of Radiated Emission

6.1. Limit

Radiated Emission below 1 GHz test at 3 m:

Frequency (MHz)	QP (dBuV/m)
30~88	40
88~216	43.5
216~960	46
Above 960	54

Radiated Emission 1~18 GHz test at 3 m:

Frequency (MHz)	PK (dBuV/m)	AV (dBuV/m)
1,000 to 18,000	74	54

Radiated Emission 18~30 GHz test at 1 m:

Frequency (MHz)	PK (dBuV/m)	AV (dBuV/m)
18,000 to 30,000	83.54	63.54

6.2. Description of Major Test Instruments

6.2.1. 30 MHz ~ 1,000 MHz

Receiver Parameter	Setting
Start ~ Stop Frequency	30MHz~1000MHz / RBW 120kHz for QP

6.2.2. Above 1 GHz

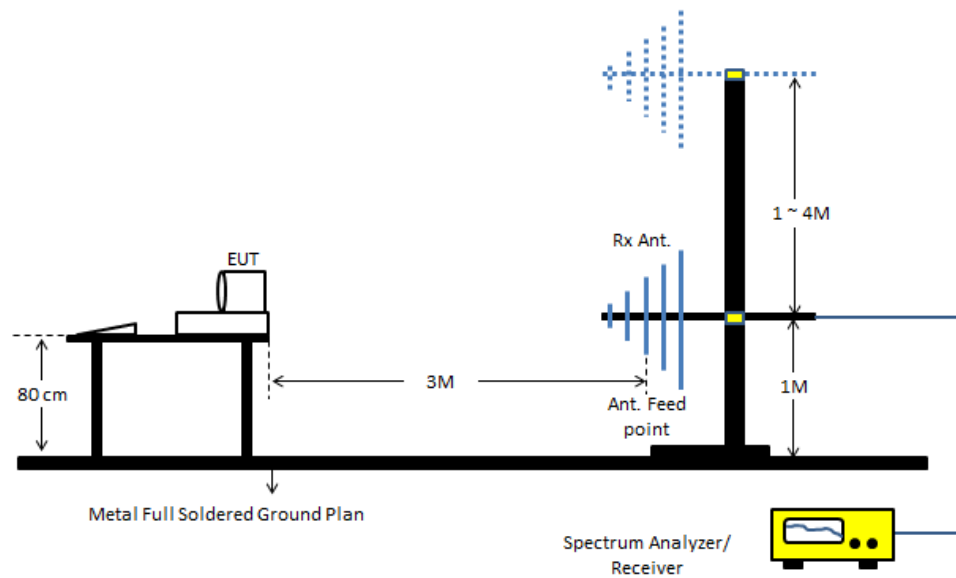
Spectrum Parameter	Setting
Start Frequency	1000 MHz
Stop Frequency	5th harmonic of highest frequency
RBW / VBW	1 MHz / 3MHz for Peak ; 1 MHz / 10Hz for Average

6.3. Test Procedures

- a. The EUT was placed on a rotatable table top 0.8 meter above ground.
- b. The EUT was set 3m meters from the interference receiving antenna which was mounted on the top of a variable height antenna tower.
- c. The table was rotated 360 degrees to determine the position of the highest radiation.
- d. The antenna is a half wave dipole and its height is varied between one meter and four meters above ground to find the maximum value of the field strength both horizontal polarization and vertical polarization of the antenna are set to make the measurement.
- e. For each suspected emission the EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turn table (from 0 degree to 360 degrees) to find the maximum reading.
- f. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method and reported.
- h. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.

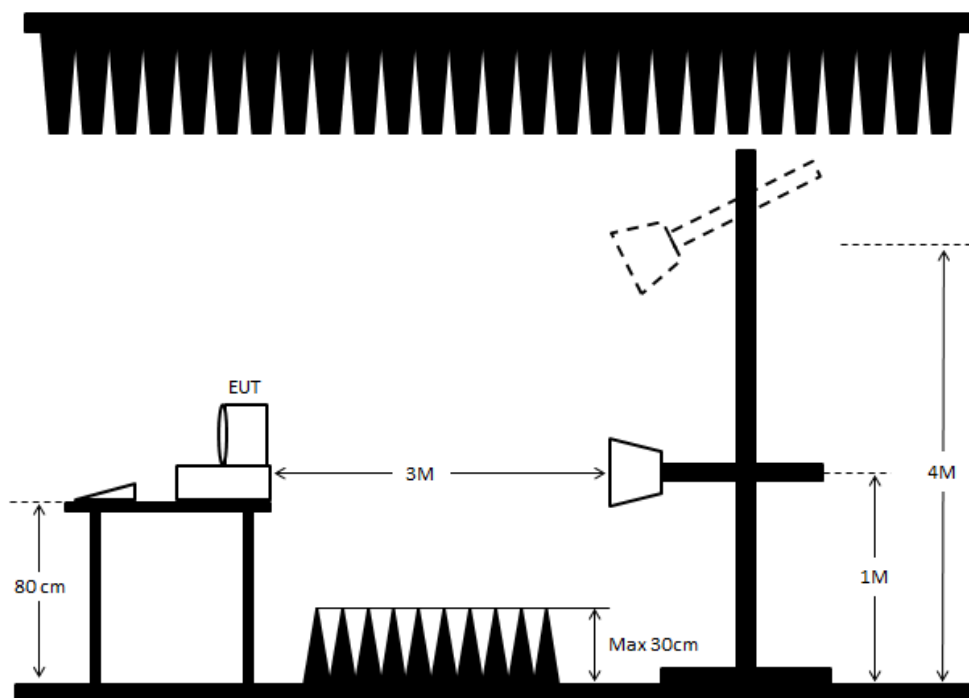
6.4. Typical Test Setup Layout of Radiated Emission

<Below 1 GHz>:

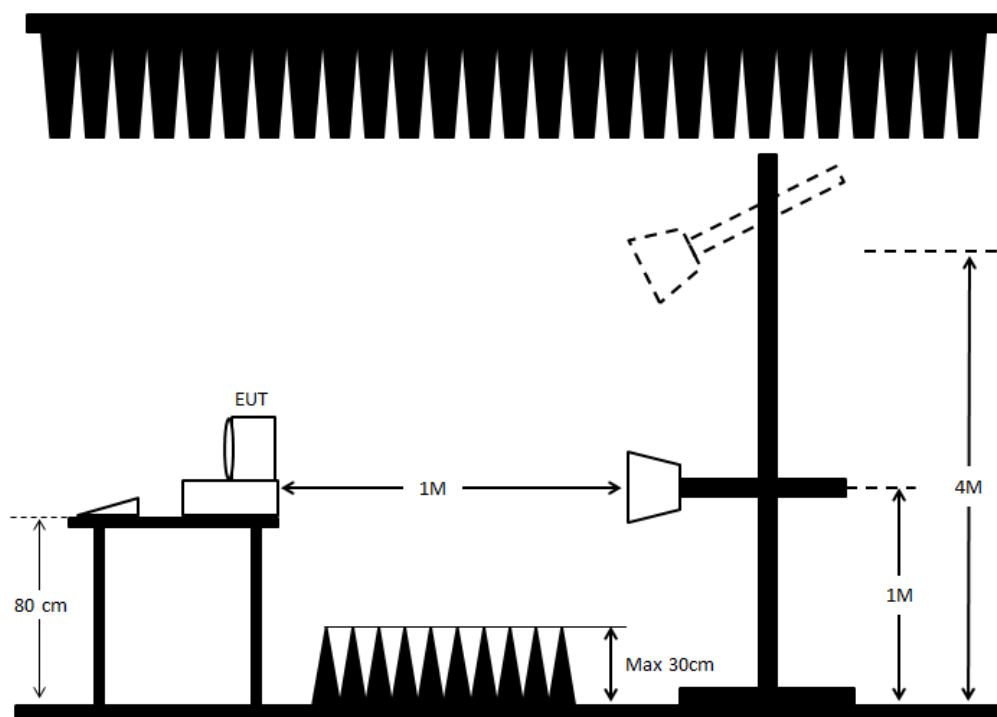


<Above 1 GHz>:

1,000~18,000 MHz



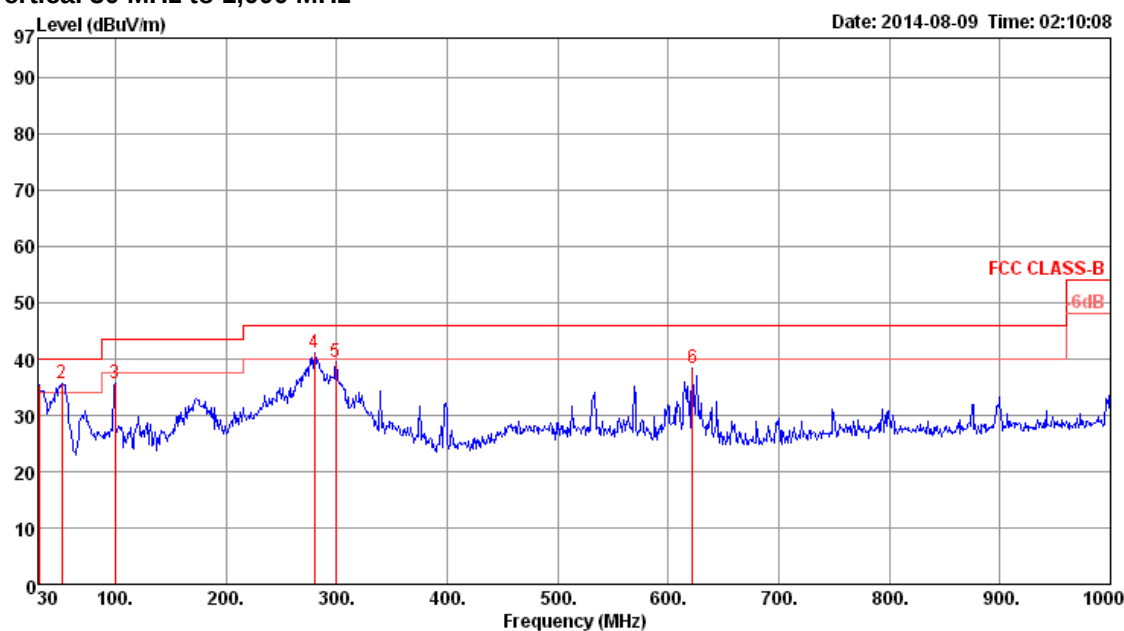
18,000~30,000 MHz



6.5. Test Result of Radiated Emission below 1 GHz

Temperature	23°C	Humidity	61%
Test Engineer	YC Chen	Frequency Range	30 MHz to 1,000 MHz
Test Mode	Mode 1		
▪ Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level ▪ The test was passed at the minimum margin that marked by the frame in the following test record			

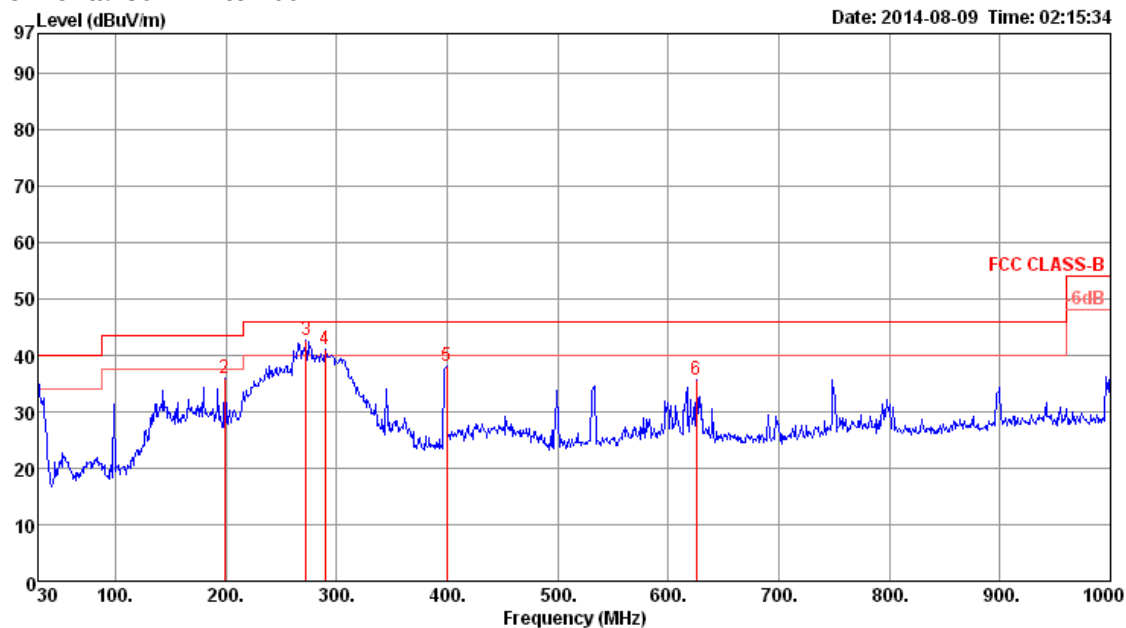
Vertical 30 MHz to 1,000 MHz



	Freq	Level	Limit	Over	Read	Cable	Antenna	Preamp		A/Pos	T/Pos	
	MHz	dBuV/m	dBuV/m	dB	dBuV	Loss	Factor	Factor	Remark	cm	deg	Pol/Phase
1	30.97	35.48	40.00	-4.52	44.43	0.63	18.22	27.80	Peak	400	0	VERTICAL
2	51.34	35.71	40.00	-4.29	54.29	0.86	8.35	27.79	Peak	400	0	VERTICAL
3	99.84	35.64	43.50	-7.86	51.08	1.17	10.99	27.60	Peak	400	0	VERTICAL
4	280.26	41.16	46.00	-4.84	53.04	1.93	13.13	26.94	Peak	400	0	VERTICAL
5	299.66	39.58	46.00	-6.42	51.09	2.03	13.36	26.90	Peak	400	0	VERTICAL
6	621.70	38.34	46.00	-7.66	44.69	2.89	18.84	28.08	Peak	400	0	VERTICAL

Horizontal 30 MHz to 200 MHz

Date: 2014-08-09 Time: 02:15:34

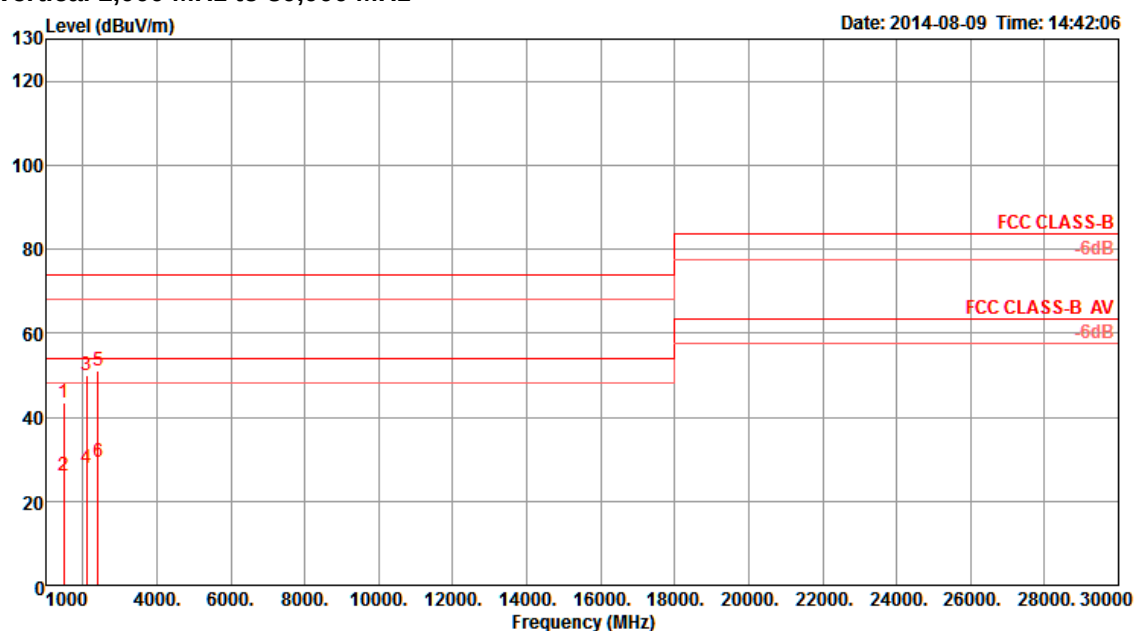


	Freq	Level	Limit	Over	Read	CableAntenna	Preamp		A/Pos	T/Pos	
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg	Pol/Phase
1	30.00	35.96	40.00	-4.04	44.39	0.61	18.76	27.80	100	0	HORIZONTAL
2	198.78	35.82	43.50	-7.68	52.02	1.66	9.25	27.11	100	0	HORIZONTAL
3	272.50	42.58	46.00	-3.42	54.61	1.89	13.04	26.96	100	0	HORIZONTAL
4	289.96	41.18	46.00	-4.82	52.88	1.98	13.24	26.92	100	0	HORIZONTAL
5	399.57	37.97	46.00	-8.03	47.21	2.30	16.06	27.60	100	0	HORIZONTAL
6	625.58	35.62	46.00	-10.38	41.94	2.90	18.85	28.07	100	0	HORIZONTAL

6.6. Test Result of Radiated Emission above 1 GHz

Temperature	23°C	Humidity	61%
Test Engineer	YC Chen	Frequency Range	1,000 MHz to 30,000 MHz
Test Mode	Mode 1		
▪ Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level ▪ The test was passed at the minimum margin that marked by the frame in the following test record			

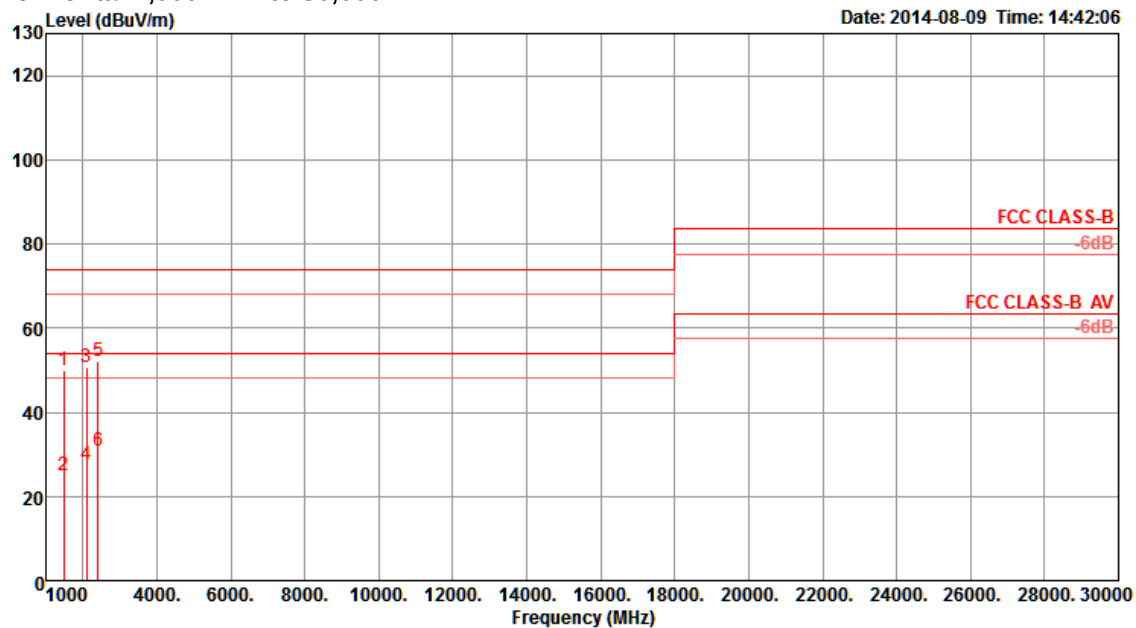
Vertical 1,000 MHz to 30,000 MHz



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Pol/Phase	A/Pos	T/Pos	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	1491.04	43.42	74.00	-30.58	50.64	2.25	25.50	34.97	VERTICAL	100	0	Peak
2	1491.04	25.96	54.00	-28.04	33.18	2.25	25.50	34.97	VERTICAL	100	0	Average
3	2104.84	49.83	74.00	-24.17	53.44	2.73	28.28	34.62	VERTICAL	100	0	Peak
4	2104.84	27.93	54.00	-26.07	31.54	2.73	28.28	34.62	VERTICAL	100	0	Average
5	2411.74	51.15	74.00	-22.85	54.97	2.92	27.90	34.64	VERTICAL	100	0	Peak
6	2411.74	29.43	54.00	-24.57	33.25	2.92	27.90	34.64	VERTICAL	100	0	Average

Horizontal 1,000 MHz to 30,000 MHz

Date: 2014-08-09 Time: 14:42:06



	Freq	Level	Limit	Over	Read	CableAntenna	Preamp		A/Pos	T/Pos	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	Loss	Factor	Factor	Pol/Phase	cm	deg
1	1491.04	50.12	74.00	-23.88	57.34	2.25	25.50	34.97	HORIZONTAL	100	0 Peak
2	1491.04	24.92	54.00	-29.08	32.14	2.25	25.50	34.97	HORIZONTAL	100	0 Average
3	2104.84	50.63	74.00	-23.37	54.24	2.73	28.28	34.62	HORIZONTAL	100	0 Peak
4	2104.84	27.43	54.00	-26.57	31.04	2.73	28.28	34.62	HORIZONTAL	100	0 Average
5	2411.74	52.29	74.00	-21.71	56.11	2.92	27.90	34.64	HORIZONTAL	100	0 Peak
6	2411.74	30.93	54.00	-23.07	34.75	2.92	27.90	34.64	HORIZONTAL	100	0 Average

7. List of Measuring Equipment Used

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
EMI Test Receiver	R&S	ESCS 30	100355	9 kHz ~ 2.75 GHz	Apr. 23, 2014	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-50-16-2	04083	150 kHz ~ 100 MHz	Nov. 23, 2013	Conduction (CO01-CB)
LISN	Schwarzbeck	NSLK 8127	8127478	9kHz ~ 30MHz	Nov. 11, 2013	Conduction (CO01-CB)
COND Cable	Woken	Cable	01	150 kHz ~ 30 MHz	Dec. 04, 2013	Conduction (CO01-CB)
Software	Audix	E3	5.410e	-	N.C.R.	Conduction (CO01-CB)
BILOG ANTENNA	Schaffner	CBL6112D	22021	20MHz ~ 2GHz	May 26, 2014	Radiation (03CH01-CB)
Horn Antenna	EMCO	3115	00075790	750MHz~18GHz	Nov. 01, 2013	Radiation (03CH01-CB)
Horn Antenna	SCHWARZBEAK	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Dec. 17, 2013	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8447D	2944A10991	0.1MHz ~ 1.3GHz	Nov. 12, 2013	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8449B	3008A02310	1GHz ~ 26.5GHz	Dec. 16, 2013	Radiation (03CH01-CB)
Pre-Amplifier	WM	TF-130N-R1	923365	26GHz ~ 40GHz	Oct. 23, 2013	Radiation (03CH01-CB)
Spectrum analyzer	R&S	FSP40	100019	9kHz~40GHz	Dec. 02, 2013	Radiation (03CH01-CB)
EMI Test Receiver	Agilent	N9038A	MY52260123	9kHz ~ 8GHz	Dec. 12, 2013	Radiation (03CH01-CB)
Turn Table	INN CO	CO 2000	N/A	0 ~ 360 degree	N.C.R.	Radiation (03CH01-CB)
Antenna Mast	INN CO	CO2000	N/A	1 m - 4 m	N.C.R.	Radiation (03CH01-CB)
RF Cable-low	Woken	Low Cable-1	N/A	30 MHz - 1 GHz	Nov. 17, 2013	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-1	N/A	1 GHz - 26.5 GHz	Nov. 17, 2013	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-2	N/A	1 GHz - 26.5 GHz	Nov. 17, 2013	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-3	N/A	1 GHz - 40 GHz	Nov. 17, 2013	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-4	N/A	1 GHz - 40 GHz	Nov. 17, 2013	Radiation (03CH01-CB)

※ Calibration Interval of instruments listed above is one year.

※ N.C.R. means Non-Calibration required.

8. Uncertainty of Test Site

Test Items	Uncertainty	Remark
Conducted Emissions	2.4 dB	Confidence levels of 95%
Radiated Emissions below 1GHz	3.6 dB	Confidence levels of 95%
Radiated Emissions 1GHz ~ 18GHz	3.7 dB	Confidence levels of 95%
Radiated Emissions 18GHz ~ 40GHz	3.5 dB	Confidence levels of 95%