

FCC EMI TEST REPORT

REPORT NO. : FC473142-05
MODEL NO. : BCM94356Z
PART NO. : BCM94356Z, BCM94356ZAE
RECEIVED DATE : Jul. 31, 2014
FINAL TESTED DATE : May 14, 2015
ISSUED DATE : Jun. 04, 2015

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.

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History of This Test Report

REPORT NO.	VERSION	ISSUED DATE	Description
FC473142-05	Rev. 01	Jun. 04, 2015	Initial issue of report

VERIFICATION 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 : May 14, 2015

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

I **HEREBY** DECLARE 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	Section	Test Type	Result	Remarks
47 CFR FCC Rules and Regulations Part 15 Subpart B, Class B Digital Device	15.109 (a)	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 -3.00dB at 88.20MHz.

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

2.1. Feature of Equipment under Test

1. Accessories

N/A

2. Table for Multiple Listing

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.

3. Table for Class II Change

This product is an extension of original one reported under Sporton project number: FC473142

Below is the table for the change of the product with respect to the original one

Modifications	Performance Checking
Adding a dipole antenna	Radiated Emission

4. 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.

Radiated Emissions	
According to original test report, the Radiated Emissions test was performed at its 3-axis (X-axis, Y-axis and Z-axis) and the worst-case was found at X-axis. Thus, measurements for Radiated Emissions test will follow this test mode.	
Test Mode	Description
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 1GHz 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.

Support Unit	Brand	Model	FCC ID
Notebook*2	DELL	E4300	DoC
Wireless ac AP	Netgear	R6300V2	PY313200227
Mouse	Logitech	M-U0026	DoC
Earphone	SHYARO CHI	MIC-04	N/A
Test fixture*2	Broadcom	BCM9MC2EC_1	N/A
Broadcom 802.11a/b/g/n/ac WLAN + Bluetooth PCI-E NGFF 2230 Card (Device)	Broadcom	BCM94356Z	QDS-BRCM1085

3.3. EUT Operation Condition

An executive program, EMCTEST.EXE under WIN XP, 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.

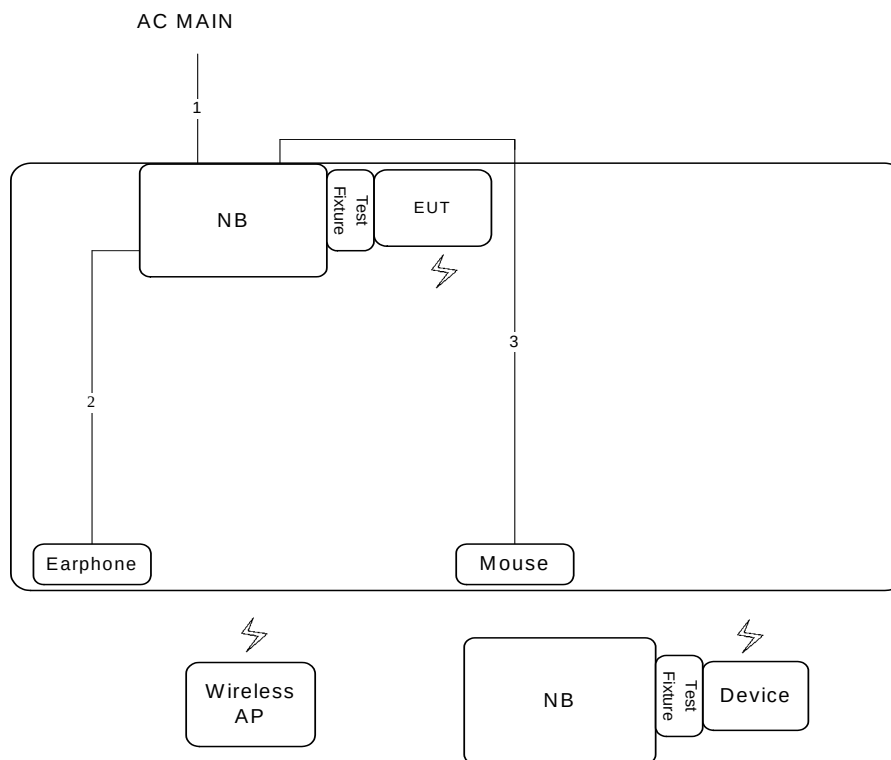
At the same time, the following programs were executed:

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

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

3.4. Connection Diagram of Test System

3.4.1. 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. : Radiation: 03CH01-CB

4.2. Standard for Methods of Measurement

ANSI C63.4-2009

4.3. Frequency Range Investigated

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

4.4. 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 Radiated Emission

5.1. 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

5.2. Description of Major Test Instruments

5.2.1. 30 MHz ~ 1,000 MHz

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

5.2.2. Above 1 GHz

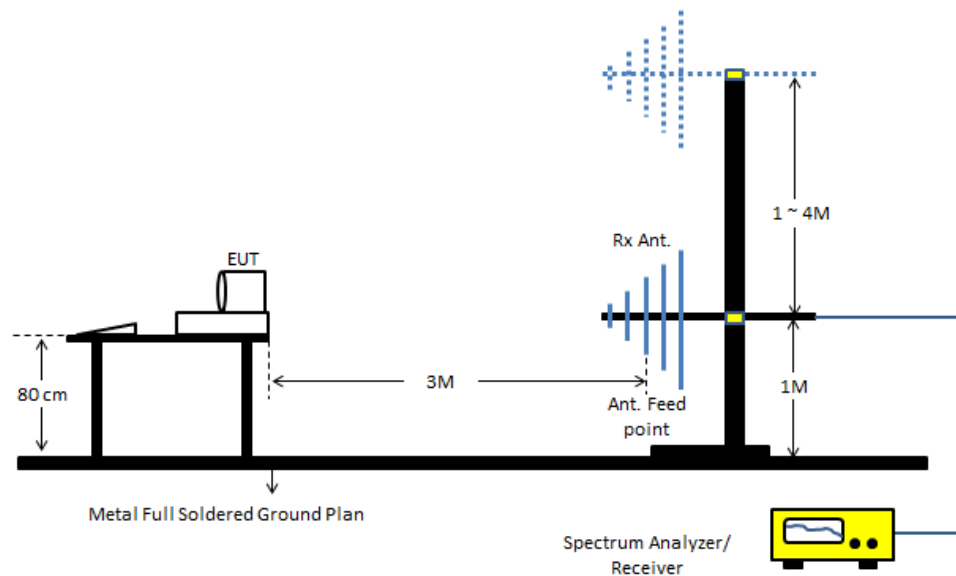
Spectrum Parameter	Setting
Start Frequency	1000 MHz
Stop Frequency	5th harmonic of highest frequency
RBW / VBW	1 MHz / 3MHz for Peak ; 1 MHz / 10Hz for Average

5.3. 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.

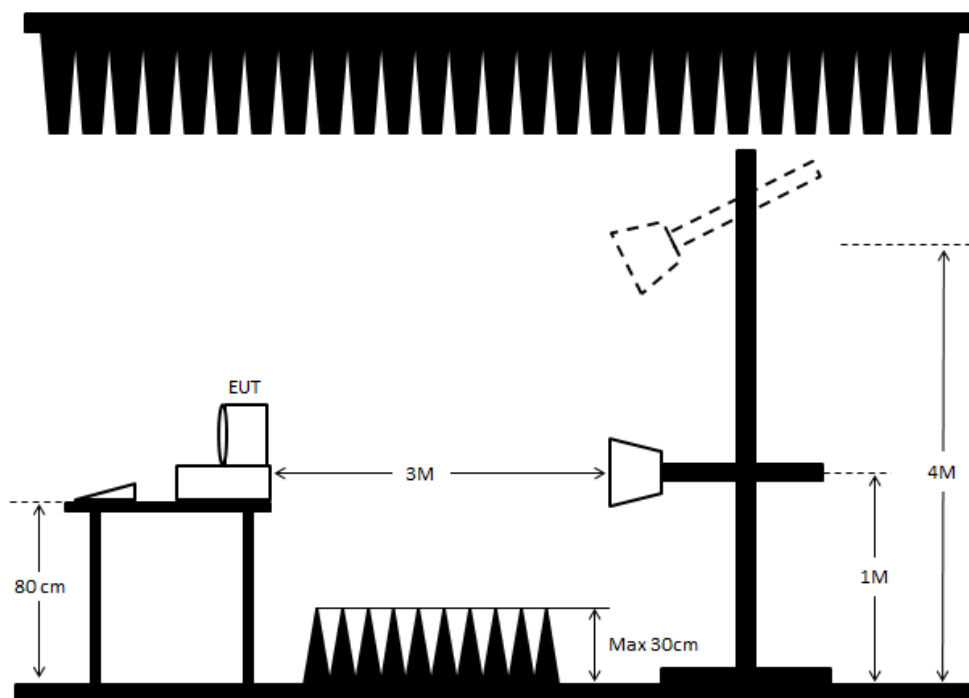
5.4. Typical Test Setup Layout of Radiated Emission

<Below 1 GHz>:

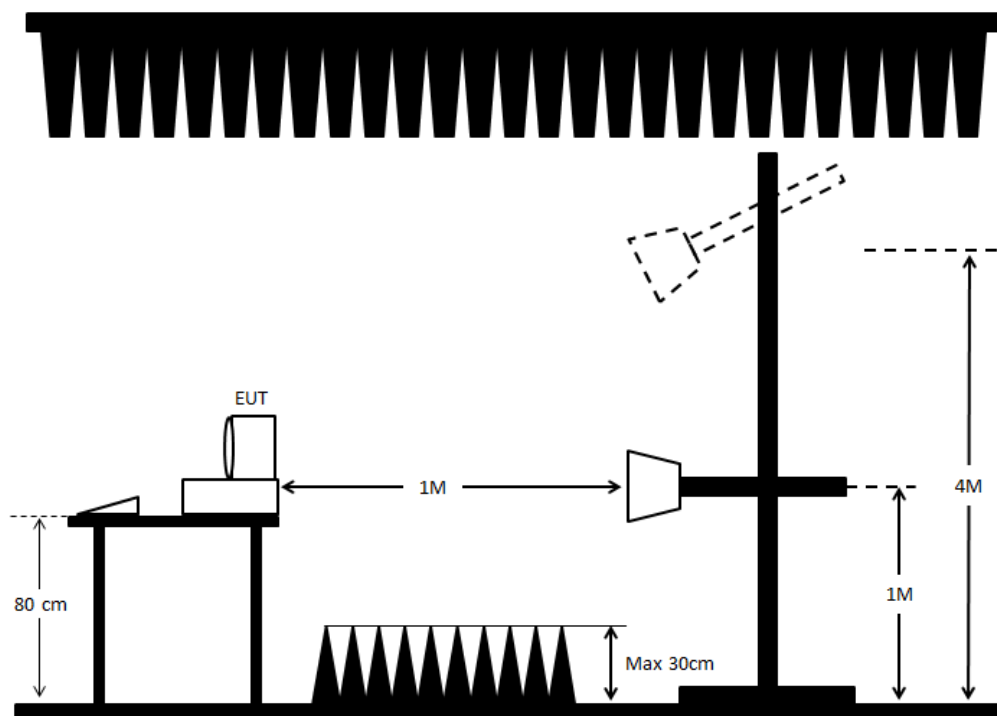


<Above 1 GHz>:

1,000~18,000 MHz



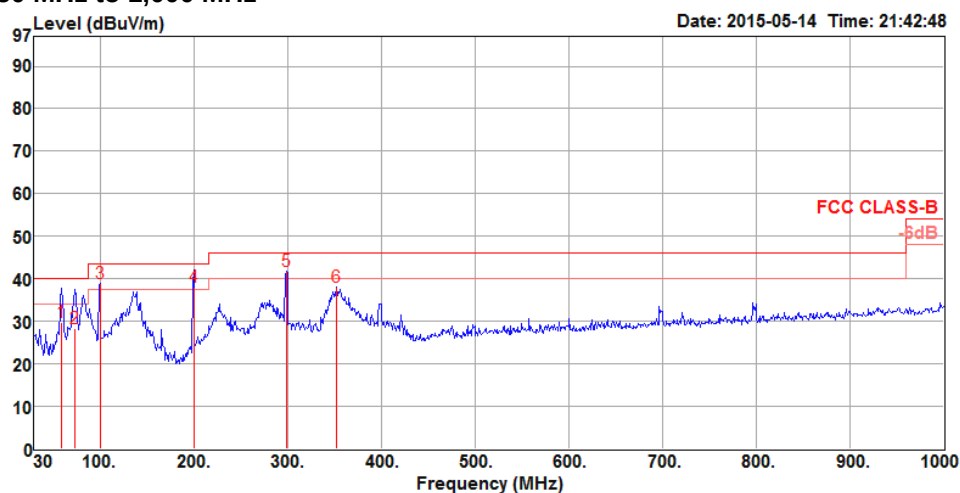
18,000~30,000 MHz



5.5. Test Result of Radiated Emission below 1 GHz

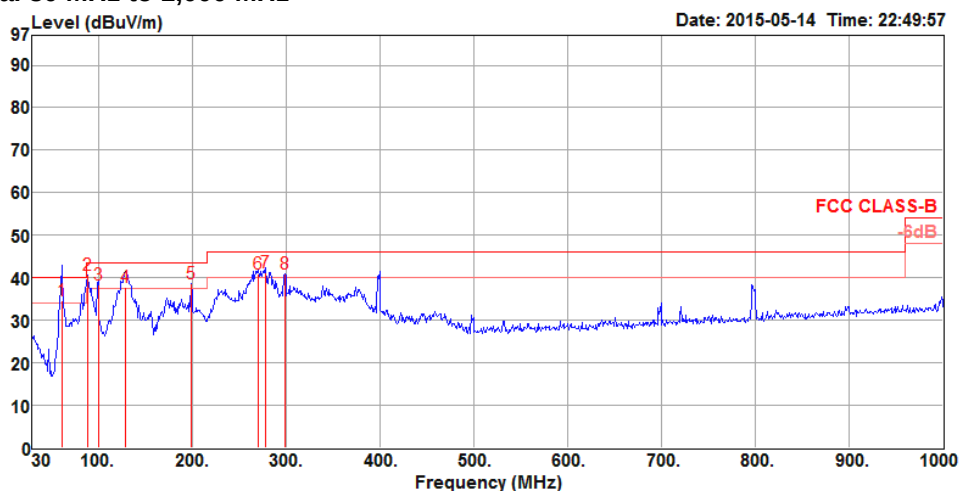
Temperature	26°C	Humidity	51%
Test Engineer	Mars Lin	Frequency Range	30 MHz to 1,000 MHz
Test Mode	Mode 1		
▪ Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level ▪ Margin = - Limit + (Read Level + Antenna Factor + Cable Loss - Preamp Factor) ▪ The test was passed at the 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	Preamp	Antenna		T/Pos	A/Pos	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB/m	Pol/Phase	deg	cm	
1	59.10	29.91	40.00	-10.09	54.61	0.78	32.50	7.02	VERTICAL	124	400	QP
2	73.65	28.40	40.00	-11.60	52.85	0.87	32.41	7.09	VERTICAL	116	100	QP
3	99.84	38.80	43.50	-4.70	59.19	0.98	32.47	11.10	VERTICAL	92	300	Peak
4	199.75	38.05	43.50	-5.45	58.65	1.39	32.29	10.30	VERTICAL	69	200	Peak
5	298.69	41.88	46.00	-4.12	58.59	1.71	32.30	13.88	VERTICAL	192	150	Peak
6	352.04	38.06	46.00	-7.94	53.20	1.87	32.36	15.35	VERTICAL	4	200	Peak

Horizontal 30 MHz to 1,000 MHz

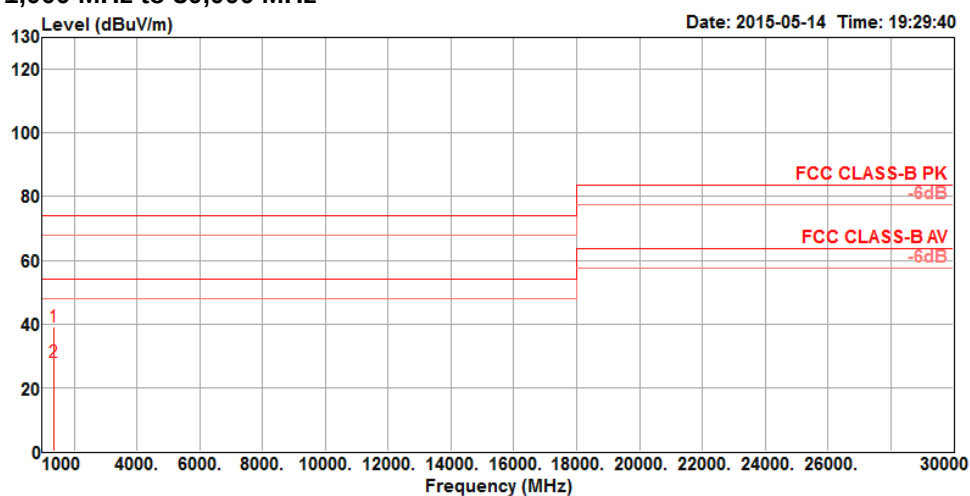


	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Preamp Factor	Antenna Factor	Pol/Phase	T/Pos	A/Pos	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB/m		deg	cm	
1	61.04	34.69	40.00	-5.31	59.60	0.79	32.50	6.80	HORIZONTAL	46	300	QP
2	88.20	40.50	43.50	-3.00	63.06	0.94	32.43	8.93	HORIZONTAL	195	400	Peak
3	99.84	38.31	43.50	-5.19	58.73	0.98	32.47	11.07	HORIZONTAL	202	400	Peak
4	128.94	37.67	43.50	-5.83	56.34	1.15	32.43	12.61	HORIZONTAL	237	150	QP
5	198.78	38.50	43.50	-5.00	59.20	1.39	32.29	10.20	HORIZONTAL	178	150	Peak
6	270.56	40.80	46.00	-5.20	57.92	1.63	32.44	13.69	HORIZONTAL	137	125	Peak
7	278.32	41.22	46.00	-4.78	58.44	1.65	32.40	13.53	HORIZONTAL	276	125	Peak
8	298.69	40.97	46.00	-5.03	57.69	1.71	32.30	13.87	HORIZONTAL	336	125	Peak

5.6. Test Result of Radiated Emission above 1 GHz

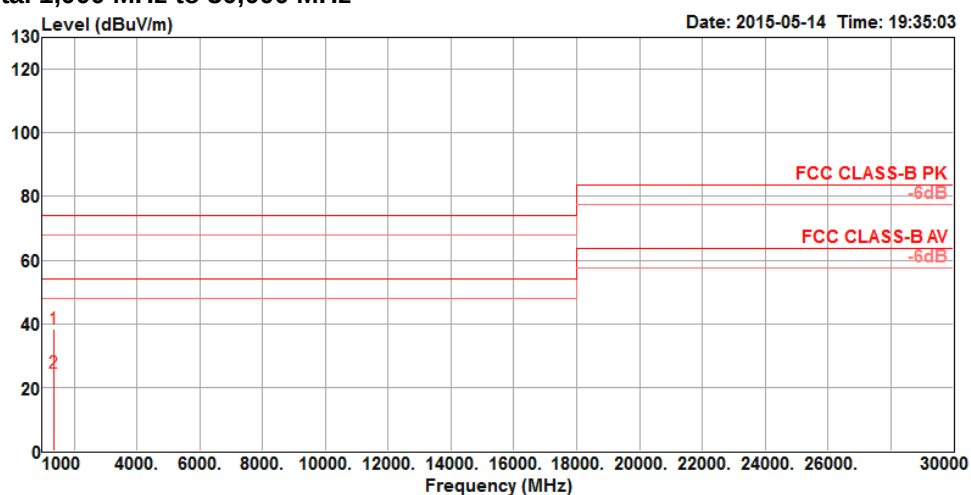
Temperature	26°C	Humidity	51%
Test Engineer	Mars Lin	Frequency Range	1,000 MHz to 30,000 MHz
Test Mode	Mode 1		
▪ Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level ▪ Margin = - Limit + (Read Level + Antenna Factor + Cable Loss - Preamp Factor) ▪ The test was passed at 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	Preamp Factor	Antenna Factor	Pol/Phase	T/Pos	A/Pos	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB/m		deg	cm	
1	1349.68	38.97	74.00	-35.03	46.85	3.65	36.57	25.04	VERTICAL	7	102	Peak
2	1349.93	27.92	54.00	-26.08	35.80	3.65	36.57	25.04	VERTICAL	7	102	Average

Horizontal 1,000 MHz to 30,000 MHz



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Preamp Factor	Antenna Factor	Pol/Phase	T/Pos	A/Pos	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB	dB/m		deg	cm	
1	1355.50	38.36	74.00	-35.64	46.20	3.66	36.55	25.05	HORIZONTAL	30	100	Peak
2	1355.54	24.58	54.00	-29.42	32.42	3.66	36.55	25.05	HORIZONTAL	30	100	Average

6. List of Measuring Equipment Used

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
BILOG ANTENNA	Schaffner	CBL6112D	22021	20MHz ~ 2GHz	May 26, 2014	Radiation (03CH01-CB)
Horn Antenna	EMCO	3115	00075790	750MHz ~ 18GHz	Oct. 28, 2014	Radiation (03CH01-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Aug. 22, 2014	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8447D	2944A10991	0.1MHz ~ 1.3GHz	Feb. 24, 2015	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8449B	3008A02310	1GHz ~ 26.5GHz	Jan. 12, 2015	Radiation (03CH01-CB)
Pre-Amplifier	WM	TF-130N-R1	923365	26GHz ~ 40GHz	Nov. 25, 2014	Radiation (03CH01-CB)
Spectrum Analyzer	R&S	FSP40	100056	9kHz ~ 40GHz	Nov. 06, 2014	Radiation (03CH01-CB)
EMI Test Receiver	Agilent	N9038A	MY52260123	9kHz ~ 8GHz	Jan. 21, 2015	Radiation (03CH01-CB)
Turn Table	INN CO	CO 2000	N/A	0 ~ 360 degree	N.C.R.	Radiation (03CH01-CB)
Antenna Mast	INN CO	CO 2000	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. 15, 2014	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-40G-1	N/A	1 GHz ~ 40 GHz	Nov. 15, 2014	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-40G-2	N/A	1 GHz ~ 40 GHz	Nov. 15, 2014	Radiation (03CH01-CB)

※ Calibration Interval of instruments listed above is one year.

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

7. Uncertainty of Test Site

Test Items	Uncertainty	Remark
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%