SPORTON International Inc.
No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.
Ph: 886-3-327-3456 / FAX: 886-3-327-0973 / www.sporton.com.tw

FCC RADIO TEST REPORT

Applicant's company	**Broadcom Corporation**
Applicant Address	190 Mathilda Place Sunnyvale CA 94086 U.S.A.
FCC ID	**QDS-BRCM1084**
Manufacturer's company	**Broadcom Corporation**
Manufacturer Address	190 Mathilda Place Sunnyvale CA 94086 U.S.A.

Product Name	Broadcom 802.11a/b/g/n WLAN+ Bluetooth PCI-E NGFF2230 card
Brand Name	Broadcom
Model Name	BCM943228Z
Test Rule	47 CFR FCC Part 15 Subpart C § 15.247
Test Freq. Range	2402 ~ 2480MHz
Received Date	Apr. 01, 2014
Final Test Date	Jul. 17, 2015
Submission Type	Class II Change

Statement

Test result included is only for the Bluetooth LE of the product.

The test result in this report refers exclusively to the presented test model / sample.

Without written approval of SPORTON International Inc., the test report shall not be reproduced except in full.

The measurements and test results shown in this test report were made in accordance with the procedures and found in compliance with the limit given in **ANSI C63.10-2013**, **47 CFR FCC Part 15 Subpart C** and **KDB558074 D01 v03r03**.

The test equipment used to perform the test is calibrated and traceable to NML/ROC.

TAF
Testing Laboratory
1190

Table of Contents

History of This Test Report

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR440181-03AD	Rev. 01	Initial issue of report	Jul. 29, 2015

1. VERIFICATION OF COMPLIANCE

Product Name	:	Broadcom 802.11a/b/g/n WLAN+ Bluetooth PCI-E NGFF2230 card
Brand Name	:	Broadcom
Model No.	:	BCM943228Z
Applicant	:	Broadcom Corporation
Test Rule Part(s)	:	47 CFR FCC Part 15 Subpart C § 15.247

Sporton International as requested by the applicant to evaluate the EMC performance of the product sample received on Apr. 01, 2014 would like to declare that the tested sample has been evaluated and found to be in compliance with the tested rule parts. The data recorded as well as the test configuration specified is true and accurate for showing the sample's EMC nature.

Sam Chen
SPORTON INTERNATIONAL INC.

2. SUMMARY OF THE TEST RESULT

Applied Standard: 47 CFR FCC Part 15 Subpart C				
Part	**Rule Section**	**Description of Test**	**Result**	**Under Limit**
4.1	15.207	AC Power Line Conducted Emissions	Complies	14.38 dB
4.2	15.247(d)	Radiated Emissions	Complies	3.67 dB
4.3	15.247(d)	Band Edge Emissions	Complies	7.07 dB
4.4	15.203	Antenna Requirements	Complies	-

3. GENERAL INFORMATION

3.1. Product Details

Items	Description
Power Type	From host system
Modulation	DSSS
Data Rate (Mbps)	GFSK: 1
Frequency Range	2402 ~ 2480MHz
Channel Number	40 (37 hopping + 3 advertising channel)
Channel Band Width (99%)	1.092 MHz
Maximum Conducted Output Power	-2.86 dBm
Carrier Frequencies	Please refer to section 3.4
Antenna	Please refer to section 3.3

3.2. Accessories

N/A

3.3. Table for Filed Antenna

Set	Ant.	Brand	Model Name (Part Number)	Antenna Type	Connector	Gain (dBi)				
						2.4G	5G B1	5G B2	5G B3	5G B4
1	1	WNC	81XCAA15.G03 (497317-003)	Dipole antenna	Reversed-SMA	1.26	1.58	1.58	1.01	1.09
	2	WNC	81XCAA15.G03 (497317-003)	Dipole antenna	Reversed-SMA	1.26	1.58	1.58	1.01	1.09
2	1	ACON	DM(External) SMA Dipole	Dipole antenna	Reversed-SMA	-1.04	-2.45	-3.28	-4.13	-4.17
	2	ACON	DM(External) SMA Dipole	Dipole antenna	Reversed-SMA	-1.04	-2.45	-3.28	-4.13	-4.17

Note1: The each set has two antennas.

Note2: Set 1~2 are the same type antenna. Only the highest gain antenna was selected to test and record in this report.

For 2.4GHz:

For IEEE 802.11b mode (1TX/1RX)

Only Chain 1 can be used as transmitting/receiving antenna.

For IEEE 802.11g/n mode (2TX/2RX)

Chain 1 and Chain 2 can be used as transmitting/receiving antenna.

Chain 1 and Chain 2 could transmit/receive simultaneously.

For 5GHz:

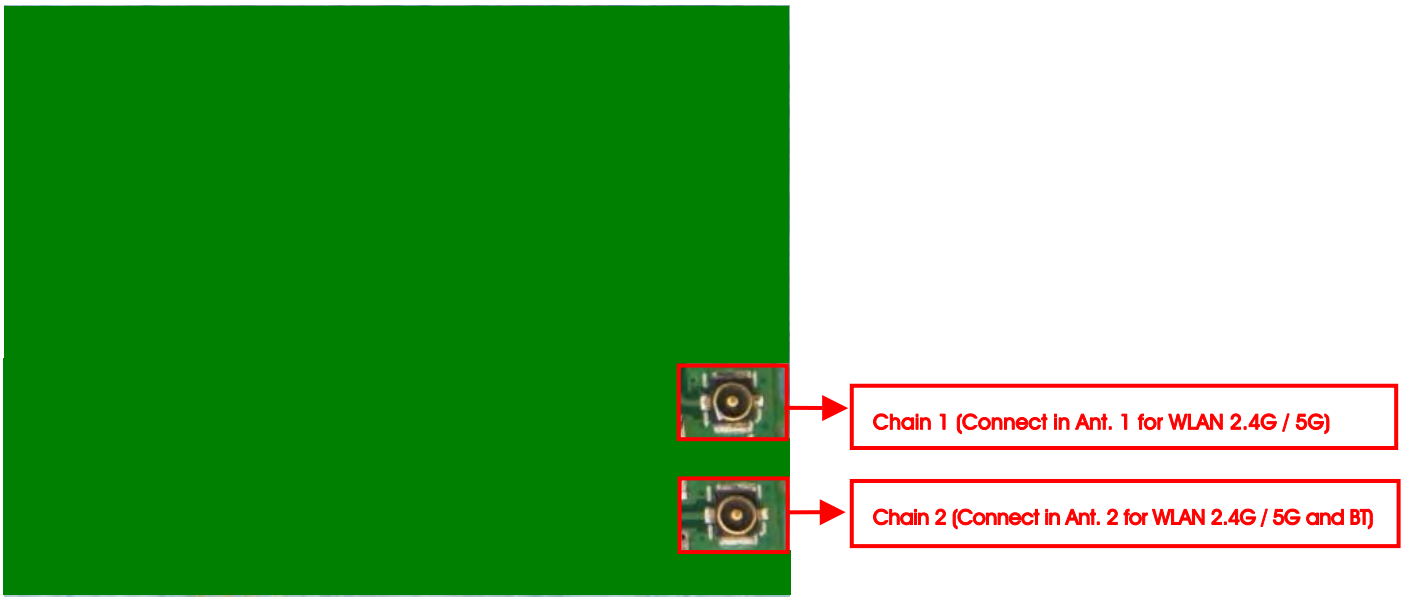
For IEEE 802.11a/n mode (2TX/2RX)

Chain 1 and Chain 2 can be used as transmitting/receiving antenna.

Chain 1 and Chain 2 could transmit/receive simultaneously.

For Bluetooth mode (1TX/1RX)

Only Chain 2 can be used as transmitting/receiving antenna.



3.4. Table for Carrier Frequencies

Frequency Band	Channel No.	Frequency	Channel No.	Frequency
2400~2483.5MHz	0	2402 MHz	20	2442 MHz
	1	2404 MHz	:	:
	2	2406 MHz	37	2476 MHz
	:	:	38	2478 MHz
	18	2438 MHz	39	2480 MHz
	19	2440 MHz	-	-

3.5. Table for Test Modes

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. 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.

Test Items	Mode	Data Rate	Channel	Chain
AC Power Line Conducted Emissions	Normal Link	-	-	-
Radiated Emissions 9kHz~1GHz	Normal Link	-	-	-
Radiated Emissions 1GHz~10th Harmonic	GFSK	1 Mbps	0/20/39	2
Band Edge Emissions	GFSK	1 Mbps	0/20/39	2

The following test modes were performed for all tests:

For Conducted Emission test:

Mode 1. 2.4GHz WLAN Function + Bluetooth Function

Mode 2. 5GHz WLAN Function + Bluetooth Function

Mode 1 is the worst case, so it was selected to record in this test report.

For Radiated Emission Below 1GHz test:

Mode 1. 2.4GHz WLAN Function + Bluetooth Function

Mode 2. 5GHz WLAN Function + Bluetooth Function

Mode 1 is the worst case, so it was selected to record in this test report.

For Radiated Emission Above 1GHz test:

Mode 1. CTX-EUT

For Co-location test:

Mode 1. 2.4GHz WLAN function + Bluetooth function

Mode 2. 5GHz WLAN function + Bluetooth function

3.6. Table for Testing Locations

Test Site Location				
Address:	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.	**Site Category**	**Location**	**FCC Reg. No.**	**IC File No.**
03CH01-CB	SAC	Hsin Chu	262045	IC 4086D
CO01-CB	Conduction	Hsin Chu	262045	IC 4086D

Open Area Test Site (OATS); Semi Anechoic Chamber (SAC).

3.7. Table for Class II Change

This product is an extension of original one reported under Sporton project number: FR440181AD
Below is the table for the change of the product with respect to the original one.

Modifications	Performance Checking
Adding two set dipole antennas for the device.	1. AC Power Conducted Emissions 2. Radiated Emissions 3. Band Edge Emissions 4. Radiated Emission Co-Location

Note1: The above test items will be based on original output power to re-test.

Note2: There is no change in hardware or in existing RF relevant portion.

3.8. Table for Supporting Units

For Test Site No: CO01-CB

Support Unit	Brand	Model	FCC ID
NB	DELL	E6220	DoC
AP Router	Planex	GW-AP54SGX	KA220030603014-1
Broadcom 802.11a/b/g/n WLAN+ Bluetooth PCI-E NGFF2230 card (Device)	Broadcom	BCM943228Z	QDS-BRCM1084
NB	DELL	E6430	DoC
Mouse	HP	FM100	DoC
Earphone	SHYARO CHI	MIC-04	N/A
Test Fixture*2	Broadcom	BCM9NGFF2EC_1	N/A

For Test Site No: 03CH01-CB (For Below 1GHz)

Support Unit	Brand	Model	FCC ID
NB	DELL	E4300	DoC
Wireless ac AP	Netgear	R6300V2	PY313200227
Broadcom 802.11a/b/g/n WLAN+ Bluetooth PCI-E NGFF2230 card (Device)	Broadcom	BCM943228Z	QDS-BRCM1084
NB	DELL	E4300	DoC
Mouse	Logitech	M-U0026	DoC
Earphone	e-Power	S90W	N/A
Test Fixture*2	Broadcom	BCM9NGFF2EC_1	N/A

For Test Site No: 03CH01-CB (For Above 1GHz)

Support Unit	Brand	Model	FCC ID
NB	DELL	E4300	DoC
Test Fixture	Broadcom	BCM9NGFF2EC_1	N/A

3.9. Table for Parameters of Test Software Setting

During testing, Channel and Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. 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.

Power Parameters:

Test Software Version	Broadcom BlueTool V1.8.4.8		
Frequency	2402 MHz	2442 MHz	2480 MHz
Power Parameters	Default	Default	Default

3.10. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

3.11. Duty Cycle

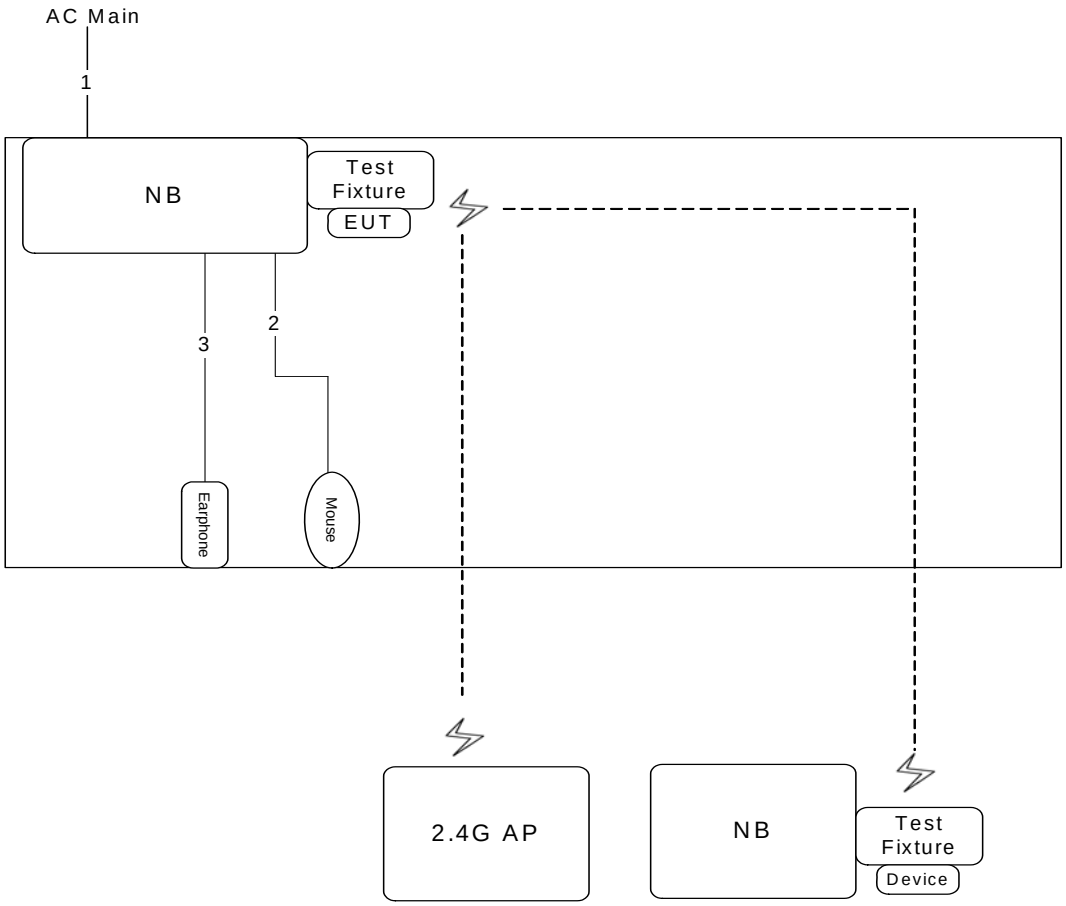
Mode	TX-on (ms)	TX-on+TX-off (ms)	TX-on/(TX-on+TX-off)x 100= Duty cycle (%)	Duty Factor (dB)
GFSK	0.155	0.625	24.80	6.06

3.12. Maximum Conducted Output Power for original report

Channel	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
0	2402 MHz	-3.28	30.00	Complies
20	2442 MHz	-2.86	30.00	Complies
39	2480 MHz	-3.12	30.00	Complies

3.13. Test Configurations

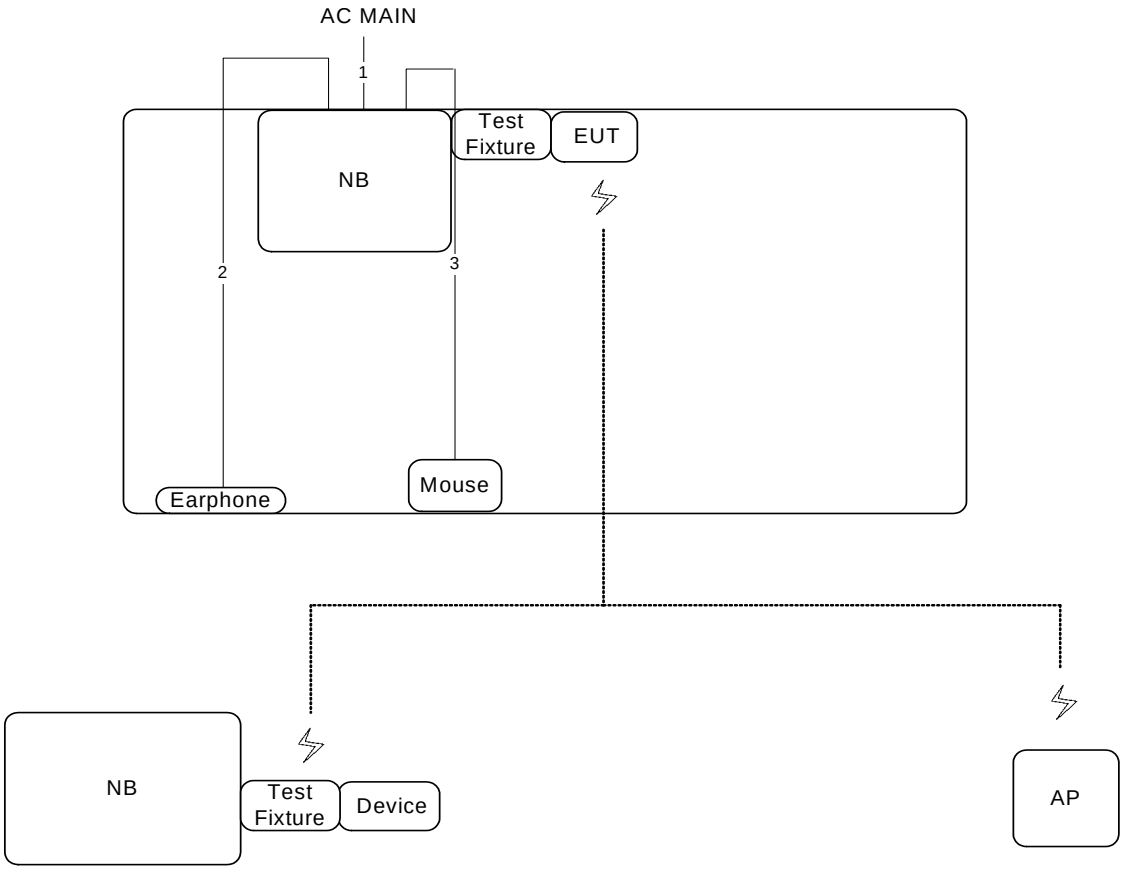
3.13.1. AC Power Line Conduction Emissions Test Configuration



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

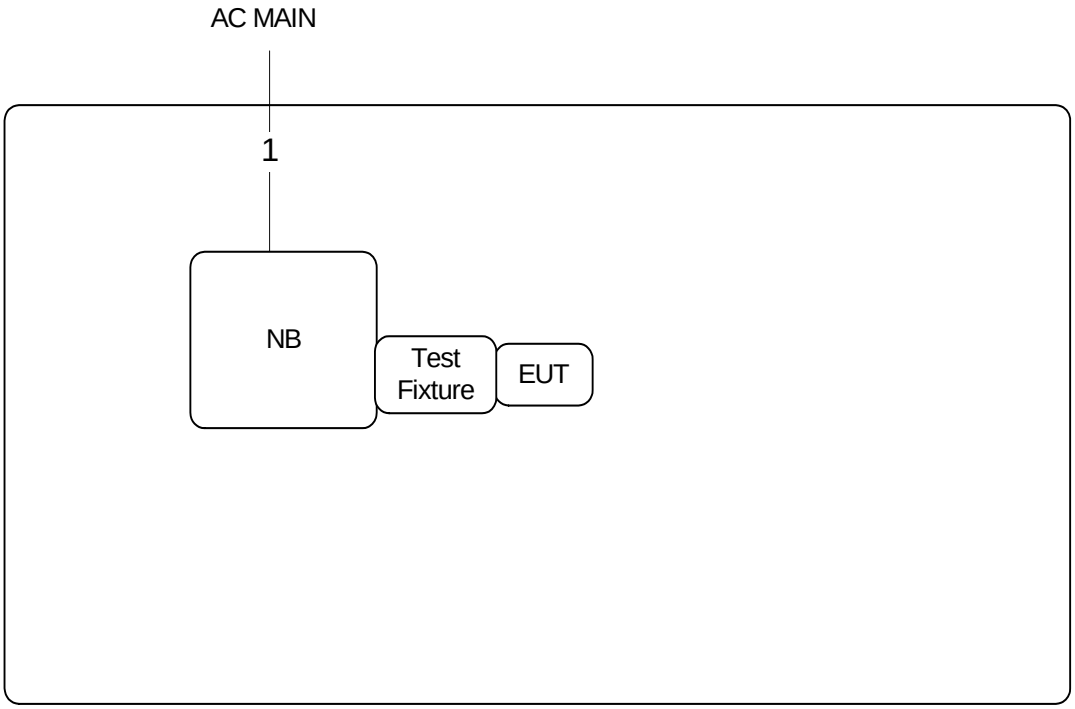
3.13.2. Radiation Emissions Test Configuration

Test Configuration: 30MHz~1GHz



Item	Connection	Shielded	Length(m)
1	Power cable	No	2.6
2	Audio cable	No	1.4
3	USB cable	Yes	1.8

Test Configuration: above 1GHz



Item	Connection	Shielded	Length(m)
1	Power cable	No	2.6

4. TEST RESULT

4.1. AC Power Line Conducted Emissions Measurement

4.1.1. Limit

For this product which is designed to be connected to the 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 below limits table.

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

4.1.2. Measuring Instruments and Setting

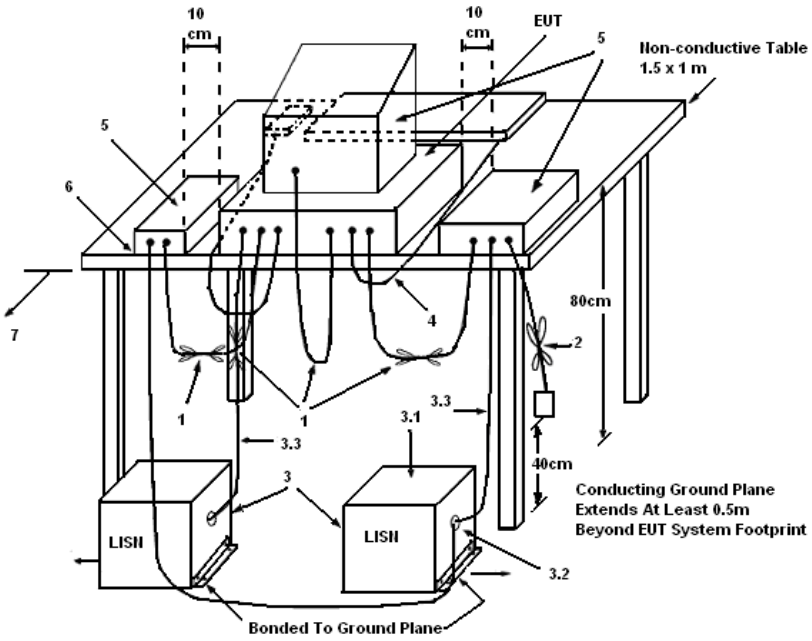
Please refer to section 5 of equipments list in this report. The following table is the setting of the receiver.

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

4.1.3. Test Procedures

1. Configure the EUT according to ANSI C63.10. The EUT or host of EUT has to be placed 0.4 meter far from the conducting wall of the shielding room and at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT or host of EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connected to the other LISNs. The LISN should provide 50uH/50ohms coupling impedance.
4. The frequency range from 150 kHz to 30 MHz was searched.
5. Set the test-receiver system to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. The measurement has to be done between each power line and ground at the power terminal.

4.1.4. Test Setup Layout



LEGEND:

(1) Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.

(2) I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.

(3) EUT connected to one LISN. Unused LISN measuring port connectors shall be terminated in 50 Ω. LISN can be placed on top of, or immediately beneath, reference ground plane.

(3.1) All other equipment powered from additional LISN(s).

(3.2) Multiple outlet strip can be used for multiple power cords of non-EUT equipment.

(3.3) LISN at least 80 cm from nearest part of EUT chassis.

(4) Cables of hand-operated devices, such as keyboards, mice, etc., shall be placed as for normal use.

(5) Non-EUT components of EUT system being tested.

(6) Rear of EUT, including peripherals, shall all be aligned and flush with rear of tabletop.

(7) Rear of tabletop shall be 40 cm removed from a vertical conducting plane that is bonded to the ground plane.

4.1.5. Test Deviation

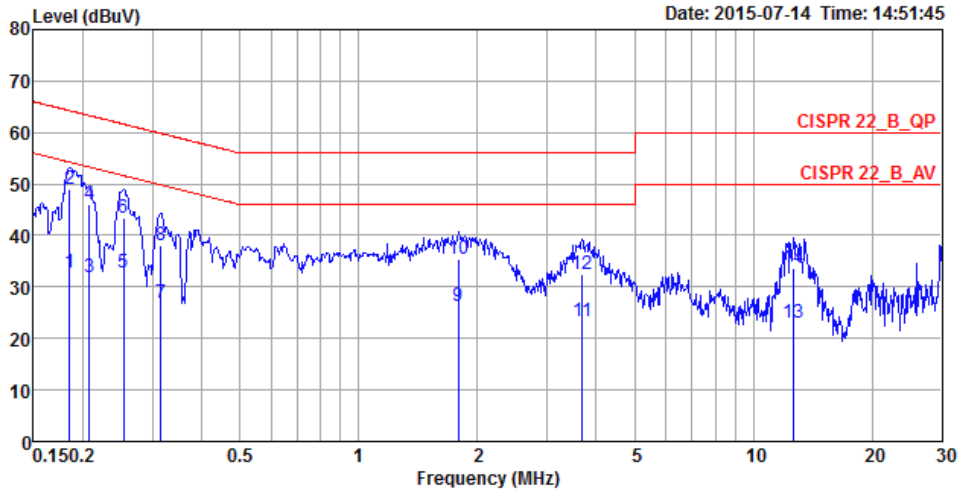
There is no deviation with the original standard.

4.1.6. EUT Operation during Test

The EUT was placed on the test table and programmed in normal function.

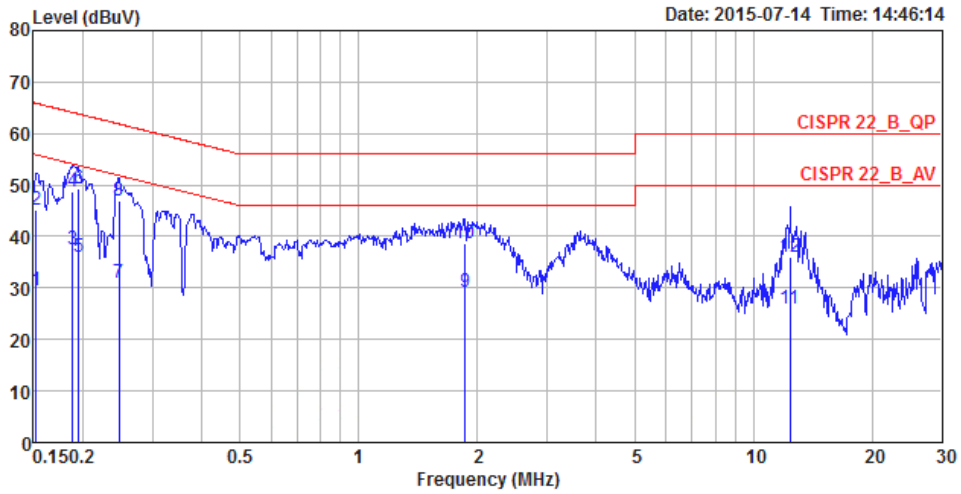
4.1.7. Results of AC Power Line Conducted Emissions Measurement

Temperature	22°C	Humidity	58%
Test Engineer	Ryo Fan	Phase	Line
Configuration	Normal Link	Test Mode	Mode 1



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Pol/Phase	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.1854	32.82	-21.42	54.24	22.62	10.01	0.19	LINE	Average
2	0.1854	48.90	-15.34	64.24	38.70	10.01	0.19	LINE	QP
3	0.2072	31.85	-21.47	53.32	21.65	10.01	0.19	LINE	Average
4	0.2072	46.05	-17.27	63.32	35.85	10.01	0.19	LINE	QP
5	0.2535	32.71	-18.93	51.64	22.51	10.01	0.19	LINE	Average
6	0.2535	43.52	-18.12	61.64	33.32	10.01	0.19	LINE	QP
7	0.3149	26.93	-22.91	49.84	16.72	10.01	0.20	LINE	Average
8	0.3149	38.01	-21.83	59.84	27.80	10.01	0.20	LINE	QP
9	1.7905	26.25	-19.75	46.00	15.95	10.05	0.25	LINE	Average
10	1.7905	35.54	-20.46	56.00	25.24	10.05	0.25	LINE	QP
11	3.6806	23.43	-22.57	46.00	13.05	10.08	0.30	LINE	Average
12	3.6806	32.60	-23.40	56.00	22.22	10.08	0.30	LINE	QP
13	12.5821	22.96	-27.04	50.00	12.27	10.28	0.41	LINE	Average
14	12.5821	33.67	-26.33	60.00	22.98	10.28	0.41	LINE	QP

Temperature	22°C	Humidity	58%
Test Engineer	Ryo Fan	Phase	Neutral
Configuration	Normal Link	Test Mode	Mode 1



	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Pol/Phase	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB		
1	0.1524	29.49	-26.38	55.87	19.32	10.00	0.17	NEUTRAL	Average
2	0.1524	45.02	-20.85	65.87	34.85	10.00	0.17	NEUTRAL	QP
3	0.1884	37.43	-16.68	54.11	27.23	10.01	0.19	NEUTRAL	Average
4	0.1884	48.81	-15.30	64.11	38.61	10.01	0.19	NEUTRAL	QP
5	0.1955	35.97	-17.83	53.80	25.77	10.01	0.19	NEUTRAL	Average
6	0.1955	49.42	-14.38	63.80	39.22	10.01	0.19	NEUTRAL	QP
7	0.2468	30.90	-20.96	51.86	20.70	10.01	0.19	NEUTRAL	Average
8	0.2468	46.82	-15.04	61.86	36.62	10.01	0.19	NEUTRAL	QP
9	1.8581	29.22	-16.78	46.00	18.92	10.04	0.26	NEUTRAL	Average
10	1.8581	38.74	-17.26	56.00	28.44	10.04	0.26	NEUTRAL	QP
11	12.3837	25.97	-24.03	50.00	15.30	10.27	0.40	NEUTRAL	Average
12	12.3837	36.10	-23.90	60.00	25.43	10.27	0.40	NEUTRAL	QP

Note:

Level = Read Level + LISN Factor + Cable Loss

4.2. Radiated Emissions Measurement

4.2.1. Limit

30dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micorvolts/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

4.2.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RBW / VBW (Emission in restricted band)	1MHz / 3MHz for Peak, 1MHz / 1/T for Average
RBW / VBW (Emission in non-restricted band)	100kHz / 300kHz for peak

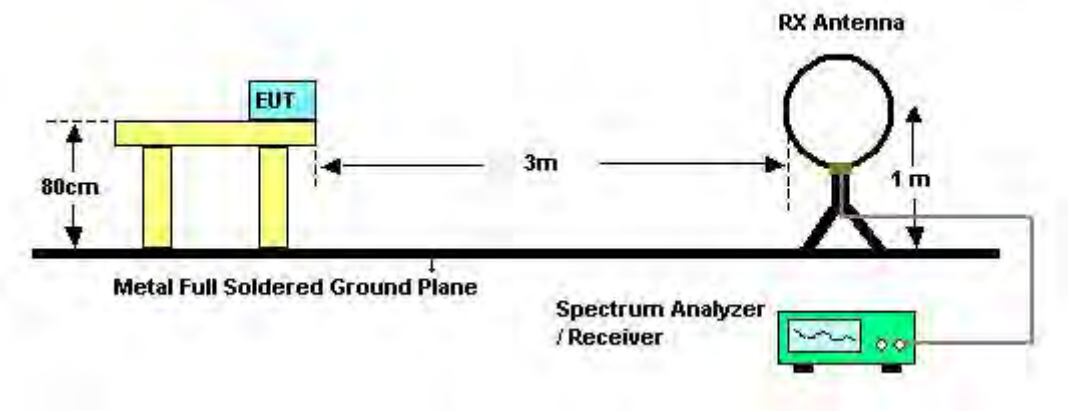
Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RBW 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RBW 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RBW 120kHz for QP

4.2.3. Test Procedures

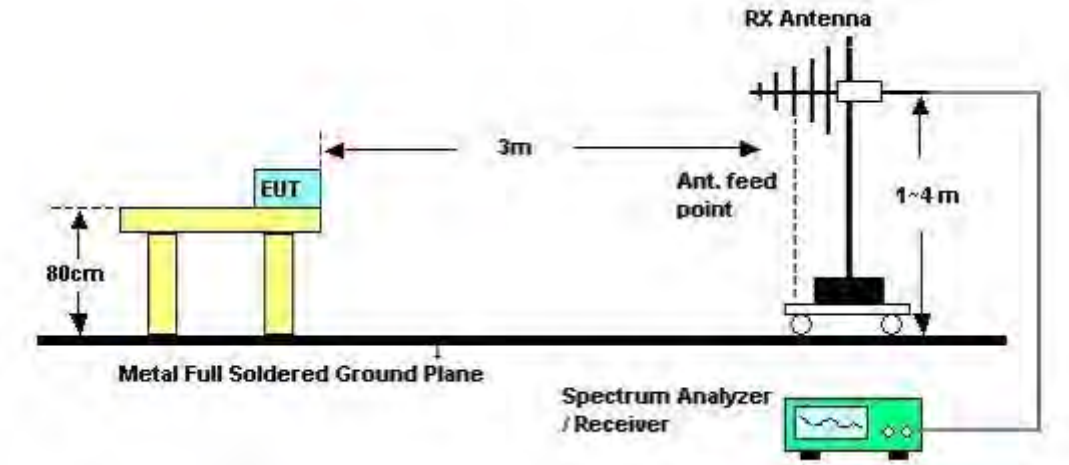
1. Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 1m & 3m far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz VBW and 3MHz RBW for peak reading. Then 1MHz RBW and 1/T VBW for average reading in spectrum analyzer.
7. If the emissions level of the EUT in peak mode was 3 dB lower than the average 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 for below 1GHz.
8. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions 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.
9. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High – Low scan is not required in this case.

4.2.4. Test Setup Layout

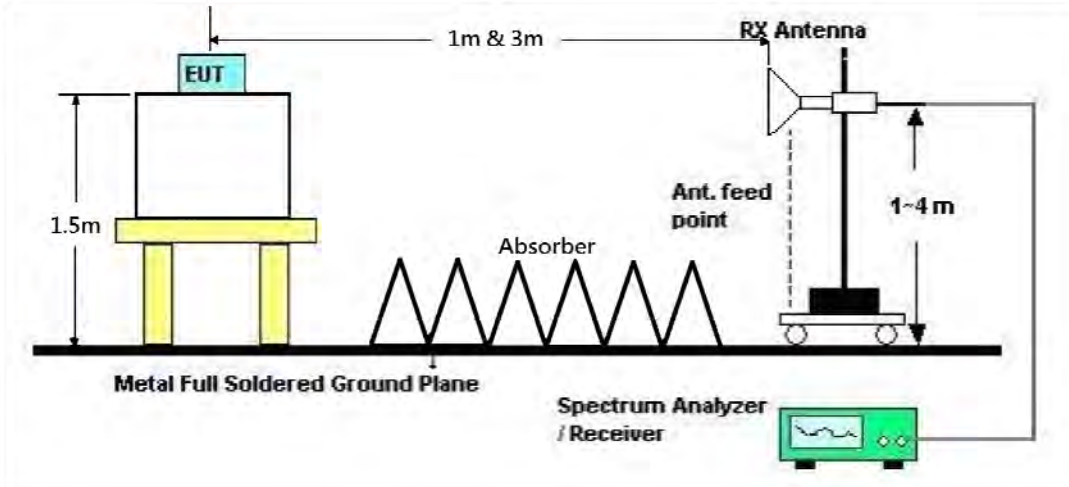
For Radiated Emissions: 9kHz ~30MHz



For Radiated Emissions: 30MHz~1GHz



For Radiated Emissions: Above 1GHz



4.2.5. Test Deviation

There is no deviation with the original standard.

4.2.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.2.7. Results of Radiated Emissions (9kHz~30MHz)

Temperature	22°C	Humidity	64%
Test Engineer	Magic Lai	Configurations	Normal Link
Test Date	Jul. 16, 2015	Test Mode	Mode 1

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

Note:

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

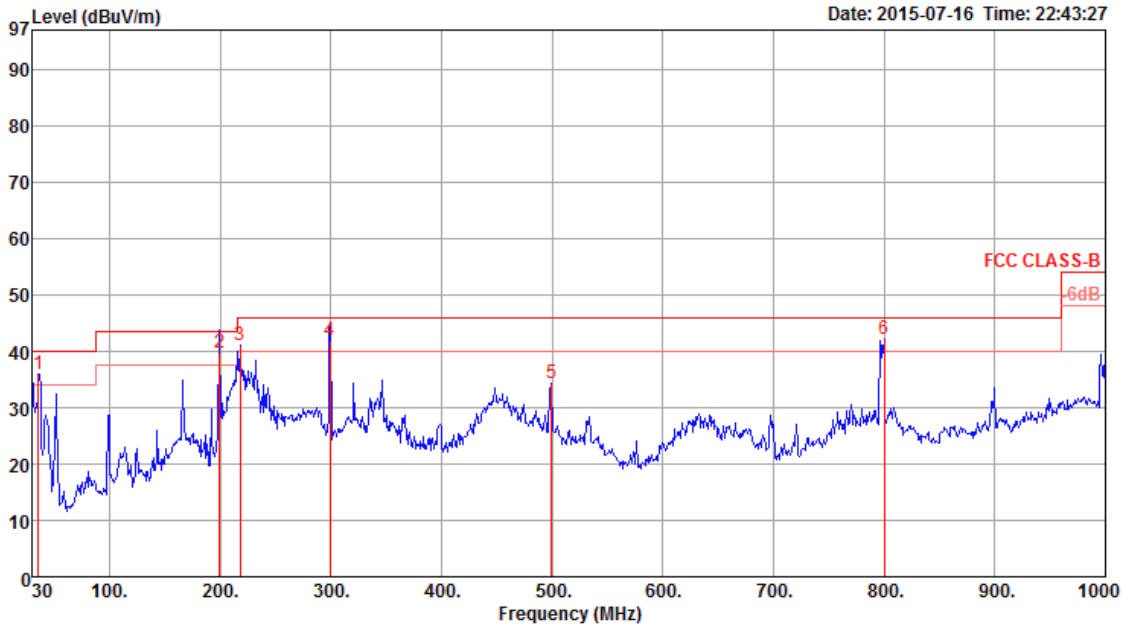
Distance extrapolation factor = 40 log (specific distance / test distance) (dB);

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

4.2.8. Results of Radiated Emissions (30MHz~1GHz)

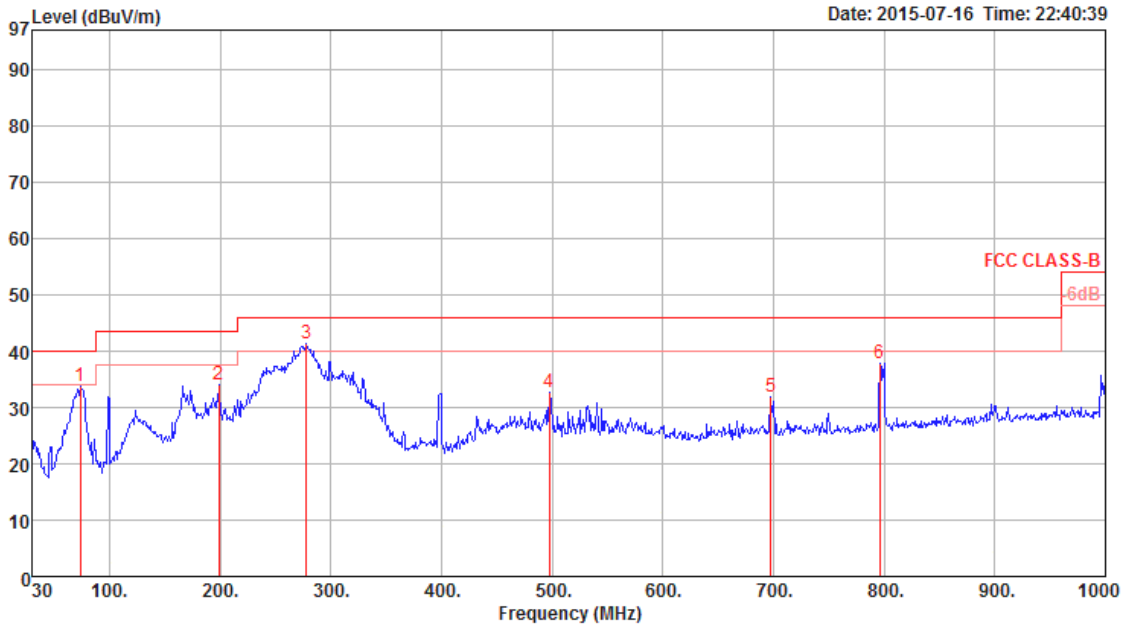
Temperature	22℃	Humidity	64%
Test Engineer	Magic Lai	Configurations	Normal Link
Test Mode	Mode 1		

Horizontal



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	35.82	36.01	40.00	-3.99	46.13	0.69	16.62	27.43	Peak	100	0	HORIZONTAL
2	199.75	39.83	43.50	-3.67	55.69	1.66	10.20	27.72	QP	121	51	HORIZONTAL
3	218.18	41.12	46.00	-4.88	56.46	1.70	10.64	27.68	Peak	100	0	HORIZONTAL
4	299.66	41.85	46.00	-4.15	53.40	2.03	13.90	27.48	QP	147	122	HORIZONTAL
5	499.48	34.32	46.00	-11.68	42.53	2.67	17.79	28.67	Peak	100	0	HORIZONTAL
6	800.18	42.23	46.00	-3.77	46.54	3.22	20.80	28.33	Peak	100	0	HORIZONTAL

Vertical



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	73.65	33.83	40.00	-6.17	54.19	0.94	7.09	28.39	Peak	400	0	VERTICAL
2	198.78	33.93	43.50	-9.57	49.87	1.66	10.13	27.73	Peak	400	0	VERTICAL
3	278.32	41.24	46.00	-4.76	53.25	1.92	13.60	27.53	Peak	400	0	VERTICAL
4	497.54	32.70	46.00	-13.30	40.95	2.66	17.76	28.67	Peak	400	0	VERTICAL
5	697.36	31.93	46.00	-14.07	37.75	3.09	19.69	28.60	Peak	400	0	VERTICAL
6	796.30	37.84	46.00	-8.16	42.22	3.22	20.75	28.35	Peak	400	0	VERTICAL

Note:

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

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

4.2.9. Results for Radiated Emissions (1GHz~10th Harmonic)

Temperature	22°C	Humidity	64%
Test Engineer	Magic Lai	Configurations	Channel 0
Test Date	Jul. 17, 2015		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4878.52	47.69	74.00	-26.31	43.25	5.92	33.53	35.01	Peak	152	181	HORIZONTAL
2	4891.28	35.32	54.00	-18.68	30.83	5.93	33.57	35.01	Average	152	181	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4800.16	48.14	74.00	-25.86	43.92	5.85	33.38	35.01	Peak	160	158	VERTICAL
2	4805.76	35.09	54.00	-18.91	30.87	5.85	33.38	35.01	Average	160	158	VERTICAL

Temperature	22℃	Humidity	64%
Test Engineer	Magic Lai	Configurations	Channel 20
Test Date	Jul. 17, 2015		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4878.52	47.69	74.00	-26.31	43.25	5.92	33.53	35.01	Peak	152	181	HORIZONTAL
2	4891.28	35.32	54.00	-18.68	30.83	5.93	33.57	35.01	Average	152	181	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4885.48	48.42	74.00	-25.58	43.93	5.93	33.57	35.01	Peak	147	209	VERTICAL
2	4888.76	35.30	54.00	-18.70	30.81	5.93	33.57	35.01	Average	147	209	VERTICAL

Temperature	22℃	Humidity	64%
Test Engineer	Magic Lai	Configurations	Channel 39
Test Date	Jul. 17, 2015		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4950.92	48.97	74.00	-25.03	44.31	5.98	33.69	35.01	Peak	152	325	HORIZONTAL
2	4959.44	35.67	54.00	-18.33	30.96	6.00	33.72	35.01	Average	152	325	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	4959.68	36.54	54.00	-17.46	31.83	6.00	33.72	35.01	Average	156	337	VERTICAL
2	4968.24	48.89	74.00	-25.11	44.18	6.00	33.72	35.01	Peak	156	337	VERTICAL

Note:

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

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

4.3. Emissions Measurement

4.3.1. Limit

30dBc in any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micorvolts/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

4.3.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	100 MHz
RBW / VBW (Emission in restricted band)	1MHz / 3MHz for Peak, 1MHz / 1/T for Average
RBW / VBW (30dBc in any 100 kHz bandwidth emission)	100 kHz / 300 kHz for Peak

4.3.3. Test Procedures

For Radiated band edges Measurement:

1. The test procedure is the same as section 4.2.3.

For Radiated Out of Band Emission Measurement:

1. Test was performed in accordance with KDB558074 D01 v03r03 for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 10.1 Unwanted Emissions into Non-Restricted Frequency Bands Measurement Procedure.

4.3.4. Test Setup Layout

For Radiated band edges Measurement:

This test setup layout is the same as that shown in section 4.2.4.

For Radiated Out of Band Emission Measurement:

This test setup layout is the same as that shown in section 4.2.4.

4.3.5. Test Deviation

There is no deviation with the original standard.

4.3.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.3.7. Test Result of Band Edge and Fundamental Emissions

Temperature	22°C	Humidity	64%
Test Engineer	Magic Lai	Configurations	Channel 0, 20, 39
Test Date	Jul. 17, 2015		

Channel 0

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	2388.40	58.49	74.00	-15.51	26.19	4.09	28.21	0.00	Peak	216	62	VERTICAL
2	2389.80	46.70	54.00	-7.30	14.40	4.09	28.21	0.00	Average	216	62	VERTICAL
3	2402.00	88.31			56.01	4.09	28.21	0.00	Average	216	62	VERTICAL
4	2402.40	96.20			63.90	4.09	28.21	0.00	Peak	216	62	VERTICAL

Item 3, 4 are the fundamental frequency at 2402 MHz.

Channel 20

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	2388.80	56.54	74.00	-17.46	24.24	4.09	28.21	0.00	Peak	192	289	VERTICAL
2	2390.00	46.66	54.00	-7.34	14.36	4.09	28.21	0.00	Average	192	289	VERTICAL
3	2442.00	89.96			57.52	4.13	28.31	0.00	Average	192	289	VERTICAL
4	2442.00	97.98			65.54	4.13	28.31	0.00	Peak	192	289	VERTICAL
5	2483.50	46.93	54.00	-7.07	14.40	4.16	28.37	0.00	Average	192	289	VERTICAL
6	2488.30	58.28	74.00	-15.72	25.71	4.17	28.40	0.00	Peak	192	289	VERTICAL

Item 3, 4 are the fundamental frequency at 2442 MHz.

Channel 39

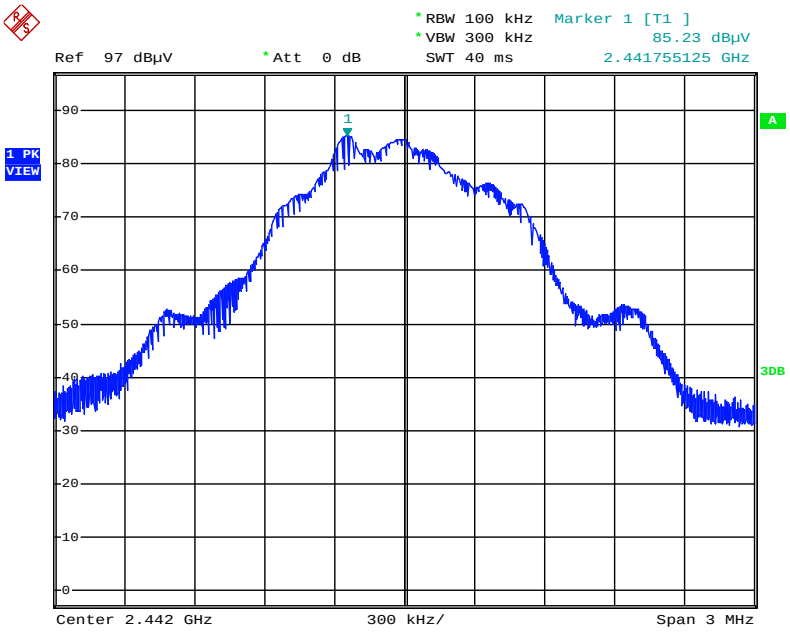
	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	Remark	A/Pos	T/Pos	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB		cm	deg	
1	2479.80	93.80			61.27	4.16	28.37	0.00	Peak	167	22	VERTICAL
2	2480.00	85.94			53.41	4.16	28.37	0.00	Average	167	22	VERTICAL
3	2483.90	46.88	54.00	-7.12	14.35	4.16	28.37	0.00	Average	167	22	VERTICAL
4	2485.70	57.23	74.00	-16.77	24.70	4.16	28.37	0.00	Peak	167	22	VERTICAL

Item 1, 2 are the fundamental frequency at 2480 MHz.

Note: Both antenna polarizations have been tested and only the worst case was recorded in test report.

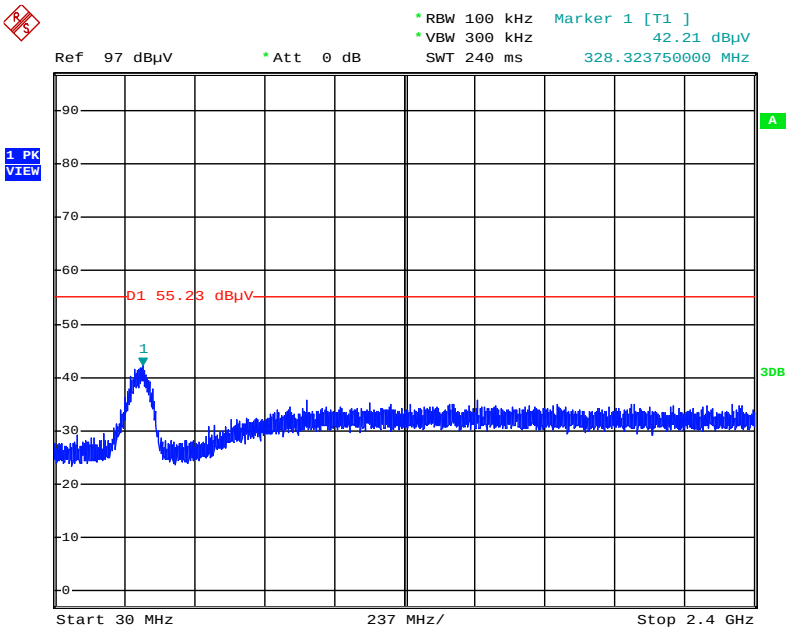
For Emission not in Restricted Band

Plot on Configuration / Reference Level (Vertical)



Date: 17.JUL.2015 23:45:24

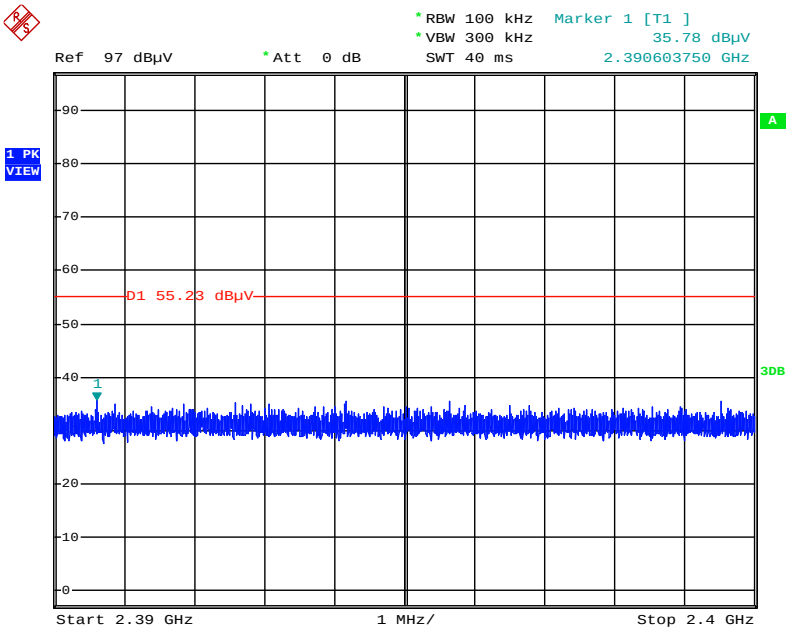
Plot on Configuration For Bluetooth 4.0 / Channel 0 / 30MHz~2400MHz (down 30dBc) (Vertical)



Date: 17.JUL.2015 23:46:57

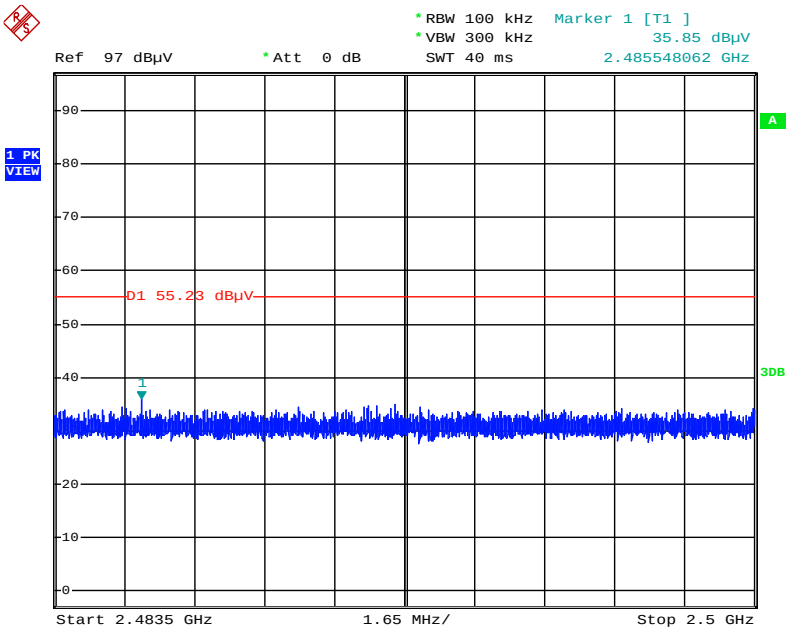
Note: Only the worse polarization (Vertical) is tested and recorded in test report.

Plot on Configuration For Bluetooth 4.0 / Channel 0 / 2390MHz~2400MHz (down 30dBc) (Vertical)



Date: 17.JUL.2015 23:47:53

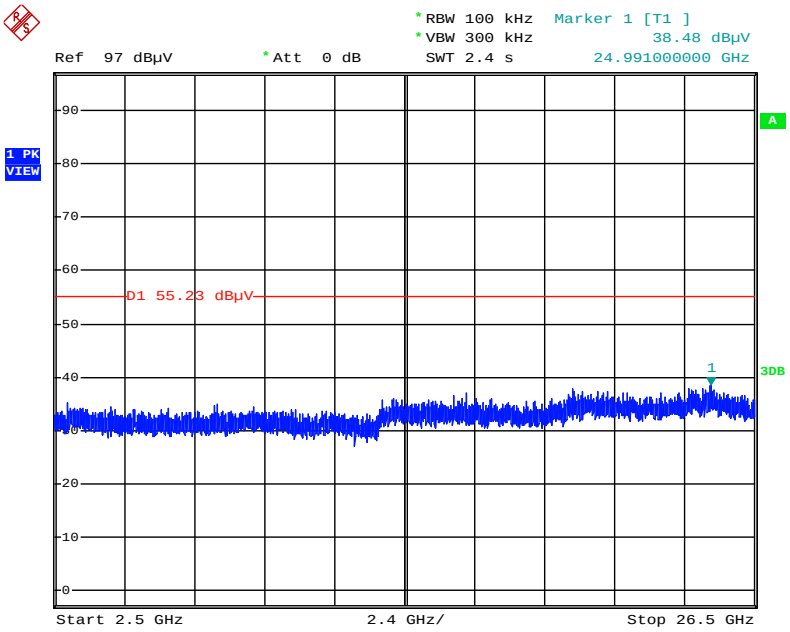
Plot on Configuration For Bluetooth 4.0 / Channel 0 / 2483.5MHz~2500MHz (down 30dBc) (Vertical)



Date: 17.JUL.2015 23:48:16

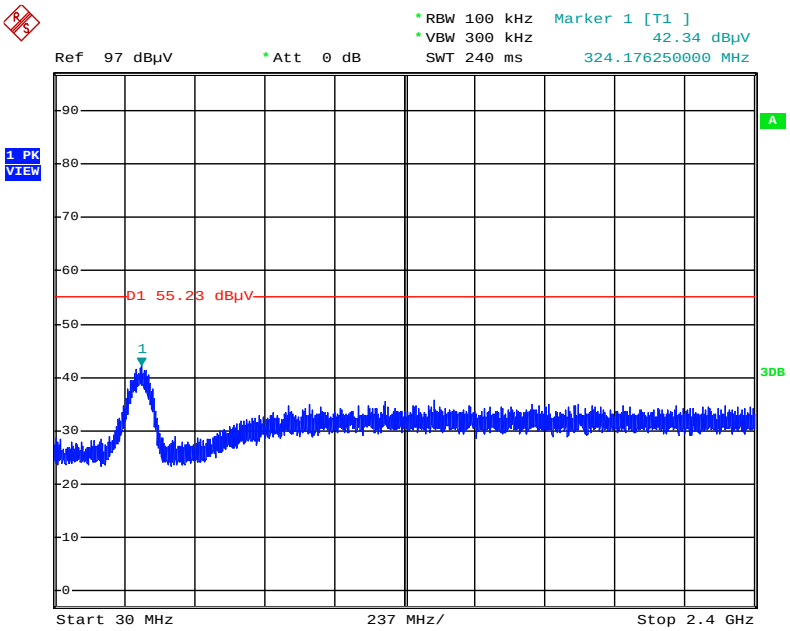
Note: Only the worse polarization (Vertical) is tested and recorded in test report.

Plot on Configuration For Bluetooth 4.0 / Channel 0 / 2500MHz~26500MHz (down 30dBc) (Vertical)



Date: 17.JUL.2015 23:47:28

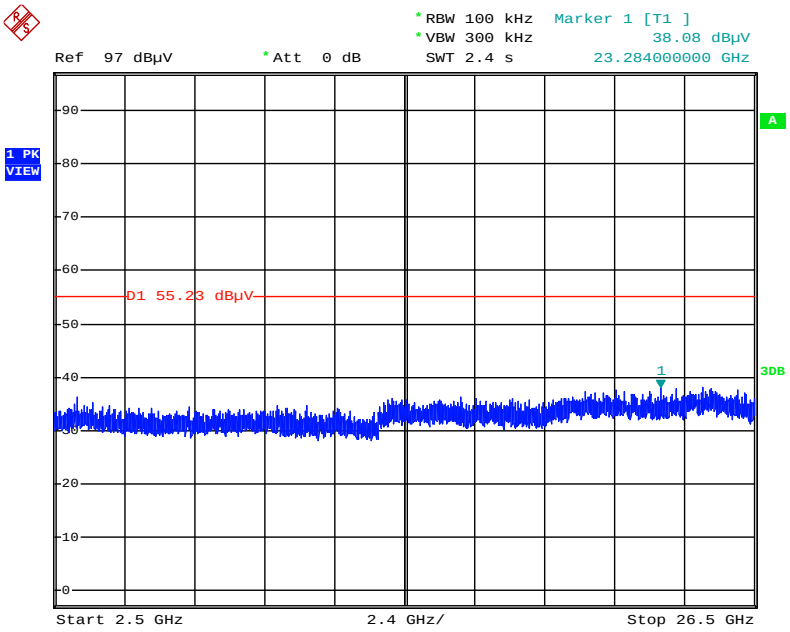
Plot on Configuration For Bluetooth 4.0 / Channel 39 / 30MHz~2400MHz (down 30dBc) (Vertical)



Date: 17.JUL.2015 23:49:10

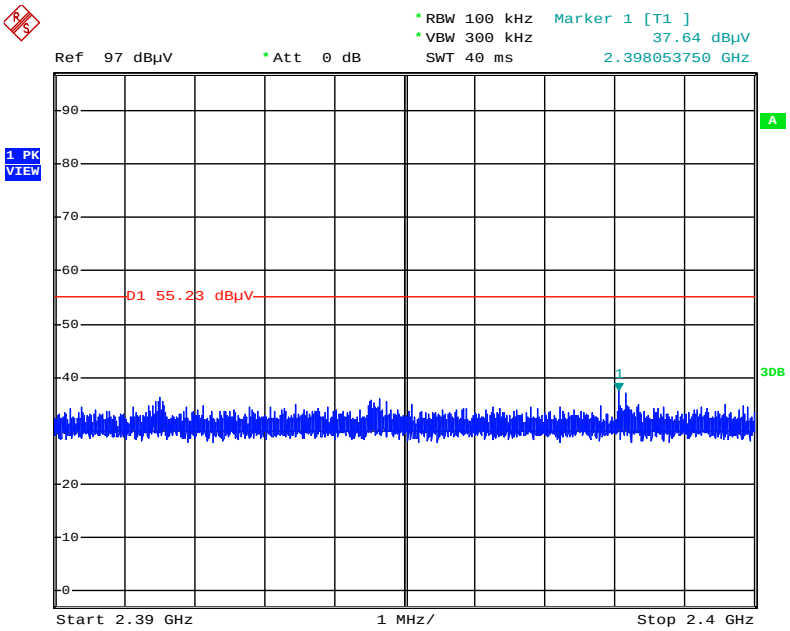
Note: Only the worse polarization (Vertical) is tested and recorded in test report.

Plot on Configuration For Bluetooth 4.0 / Channel 39 / 2390MHz~2400MHz (down 30dBc) (Vertical)



Date: 17.JUL.2015 23:49:46

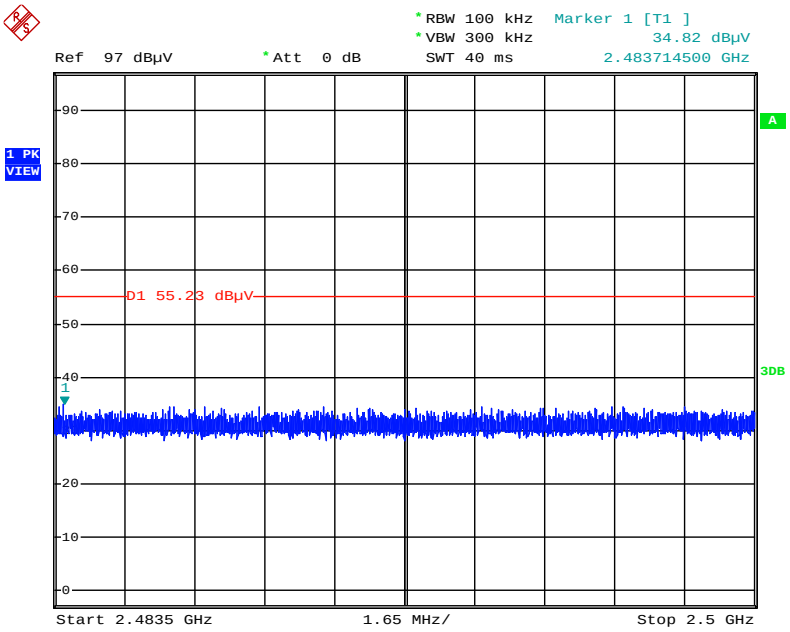
Plot on Configuration For Bluetooth 4.0 / Channel 39 / 2483.5MHz~2500MHz (down 30dBc) (Vertical)



Date: 17.JUL.2015 23:50:06

Note: Only the worse polarization (Vertical) is tested and recorded in test report.

Plot on Configuration For Bluetooth 4.0 / Channel 39 / 2500MHz~26500MHz (down 30dBc) (Vertical)



Date: 17.JUL.2015 23:50:32

Note: Only the worse polarization (Vertical) is tested and recorded in test report.

4.4. Antenna Requirements

4.4.1. Limit

Except for special regulations, the Low-power Radio-frequency Devices must not be equipped with any jacket for installing an antenna with extension cable. An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. 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 provisions of this Section. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

4.4.2. Antenna Connector Construction

Please refer to section 3.3 in this test report; antenna connector complied with the requirements.

5. LIST OF MEASURING EQUIPMENTS

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
EMI Test Receiver	R&S	ESCS 30	100355	9kHz ~ 2.75GHz	Apr. 22, 2015	Conduction (CO01-CB)
LISN	F.C.C.	FCC-LISN-50-16-2	04083	150kHz ~ 100MHz	Dec. 02, 2014	Conduction (CO01-CB)
LISN	Schwarzbeck	NSLK 8127	8127647	9kHz ~ 30MHz	Dec. 02, 2014	Conduction (CO01-CB)
COND Cable	Woken	Cable	01	150kHz ~ 30MHz	Dec. 03, 2014	Conduction (CO01-CB)
Software	Audix	E3	5.410e	-	N.C.R.	Conduction (CO01-CB)
BILOG ANTENNA	Schaffner	CBL6112D	22021	20MHz ~ 2GHz	May 06, 2015	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)
Spectrum Analyzer	R&S	FSP40	100056	9kHz ~ 40GHz	Nov. 06, 2014	Radiation (03CH01-CB)
EMI Receiver	Agilent	N9038A	MY52260123	9kHz ~ 8.4GHz	Jan. 21, 2015	Radiation (03CH01-CB)
Loop Antenna	Teseq	HLA 6120	24155	9kHz - 30 MHz	Mar. 12, 2015	Radiation (10CH01-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)

Note: Calibration Interval of instruments listed above is one year.

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

6. MEASUREMENT UNCERTAINTY

Test Items	Uncertainty	Remark
Conducted Emission (150kHz ~ 30MHz)	2.4 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	3.6 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	3.7 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	3.5 dB	Confidence levels of 95%