ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LOW-POWER, NON-LICENSED TRANSMITTER

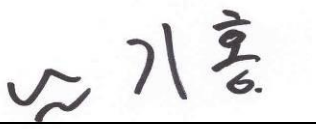
Test Report No.	**: W152R-D004**
AGR No.	**: A151A-184**
Applicant	**: ROBOTIS**
Address	**: #1505, 1506, Ace High End Tower No.3, 371-50 Gasandong Geumcheongu, Seoul, Korea**
Manufacturer	**: ROBOTIS**
Address	**: #1505, 1506, Ace High End Tower No.3, 371-50 Gasandong Geumcheongu, Seoul, Korea**
Type of Equipment	**: Bluetooth**
FCC ID.	**: SOD-BT-410**
Model Name	**: BT-410**
Serial number	**: N/A**
Total page of Report	**: 39 pages (including this page)**
Date of Incoming	**: January 29, 2015**
Date of issue	**: February 10, 2015**

SUMMARY

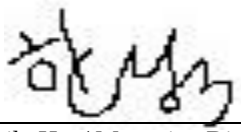
The equipment complies with the regulation; ***FCC PART 15 SUBPART C Section 15.247***

This test report only contains the result of a single test of the sample supplied for the examination.

It is not a generally valid assessment of the features of the respective products of the mass-production.

Reviewed by: 

Ki-Hong, Nam / Senior Engineer
ONETECH Corp.

Approved by: 

Sung-ik, Han/ Managing Director
ONETECH Corp.

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Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
W152R-D004	February 10, 2015	Initial Issue	All

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1. VERIFICATION OF COMPLIANCE

Applicant : ROBOTIS
Address : #1505, 1506, Ace High End Tower No.3, 371-50 Gasandong Geumcheongu, Seoul, Korea
Contact Person : Eunsung, Lee / Senior Engineer
Telephone No. : +82-70-8671-2600
FCC ID : SOD-BT-410
Model Name : BT-410
Serial Number : N/A
Date : February 10, 2015

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	Bluetooth
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2009
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247
Modifications on the Equipment to Achieve Compliance	None
Final Test was Conducted On	3 m, Semi Anechoic Chamber

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

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2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.247 (a) (2)	Minimum 6 dB Bandwidth	Met the Limit / PASS
15.247 (b) (3)	Maximum Peak Conducted Output Power	Met the Limit / PASS
15.247 (d)	100 kHz Bandwidth Outside the Frequency Band	Met the Limit / PASS
15.247 (d)	Radiated Emission which fall in the Restricted Band	Met the Limit / PASS
15.247 (e)	Peak Power Spectral Density	Met the Limit / PASS
15.209	Radiated Emission Limits	Met the Limit / PASS
15.207	Conducted Limits	Met the Limit / PASS
15.203	Antenna Requirement	Met requirement / PASS

2.2 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

2.3 Related Submittal(s) / Grant(s)

Original submittal only

2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in FCC PART 15 SUBPART C Section 15.247.

2.5 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2009. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

2.6 Test Facility

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025.

The Electromagnetic compatibility measurement facilities are located at #505 SK APT. Factory 223-28, Sangdaewon 1 Dong, Jungwon-Gu, Seongnam-City, Gyunggi-Do, 462-121, Korea

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-4112/ C-4617/ G-666/ T-1842 IC (Industry Canada) – Registration No. Site# 3736-3

-. Site Accreditation:

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation No. 85

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

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3. GENERAL INFORMATION

3.1 Product Description

The ROBOTIS, Model BT-410 (referred to as the EUT in this report) is a Bluetooth. The product specification described herein was obtained from product data sheet or user's manual.

Device Type	Bluetooth
Temperature Range	-10 ℃ ~ +50 ℃
Operating Frequency	2 402 MHz ~ 2 480 MHz
RF Output Power	-4.47 dBm
Number of Channel	40 Channel
Modulation Type	GFSK
Antenna Type	Chip Antenna
USED RF CHIP	Marker: PLATEL Corporation Model Name: ABM6020B2
Antenna Gain	-0.70 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	16 MHz

3.2 Alternative type(s)/model(s); also covered by this test report.

-. None

4. EUT MODIFICATIONS

-. None

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5. SYSTEM TEST CONFIGURATION

5.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	ROBOTIS	BIC16_A01_E001	N/A

5.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested:

Model	Manufacturer	Description	Connected to
BT-410	ROBOTIS	Bluetooth (EUT)	Notebook PC
Pavilion g6	HP	Notebook PC	EUT

5.3 Mode of operation during the test

For the testing, software used to control the EUT for staying in continuous transmitting is programmed.

For final testing, the EUT was set at 2 402 MHz, 2 440 MHz, and 2 480 MHz to get a maximum emission levels from the EUT. The EUT was moved throughout the XY, XZ, and YZ planes and the worst case is “XZ” axis, but the worst data was recorded in this report.

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5.4 Configuration of Test System

Line Conducted Test: The jig board of the EUT was connected to LISN. All supporting equipments were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2009 to determine the worse operating conditions.

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2009 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 meter Semi Anechoic Chamber.

The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

5.5 Antenna Requirement

For intentional device, according to section 15.203, 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.

Antenna Construction:

The antenna of the EUT is a Chip antenna on the main board in the EUT, so no consideration of replacement by the user.

6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

During Preliminary Tests, the following operating mode was investigated

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

6.2 General Radiated Emissions Tests

During Preliminary Tests, the following operating modes were investigated

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

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7. MIMIMUM 6 dB BANDWIDTH

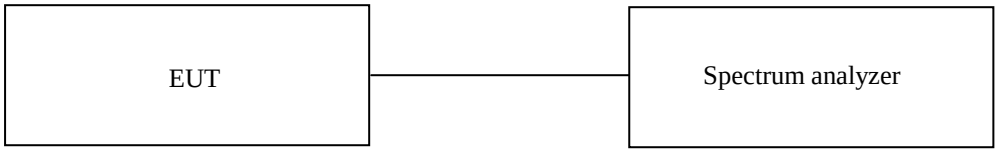
7.1 Operating environment

Temperature : 21.6 ℃

Relative humidity : 43.0 % R.H.

7.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz, and peak detection was used. The 6 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 6 dB.



7.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)

All test equipment used is calibrated on a regular basis.

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7.4 Test data

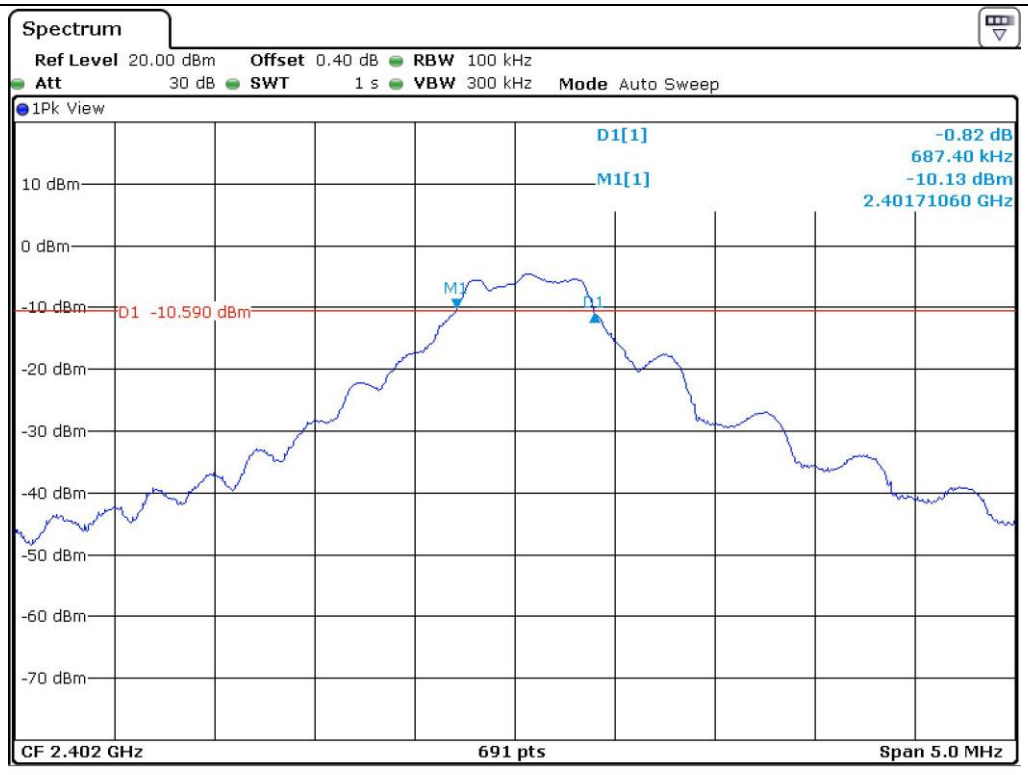
-. Test Date : January 30, 2015

-. Test Result : Pass

CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (kHz)	LIMIT (kHz)	MARGIN (kHz)
Low	2 402	687.40	500	187.40
Middle	2 440	701.90	500	201.90
High	2 480	701.90	500	201.90

Remark. Margin = Measured Value - Limit

Tested by: hyung-kwon, Oh / Engineer



Low Channel

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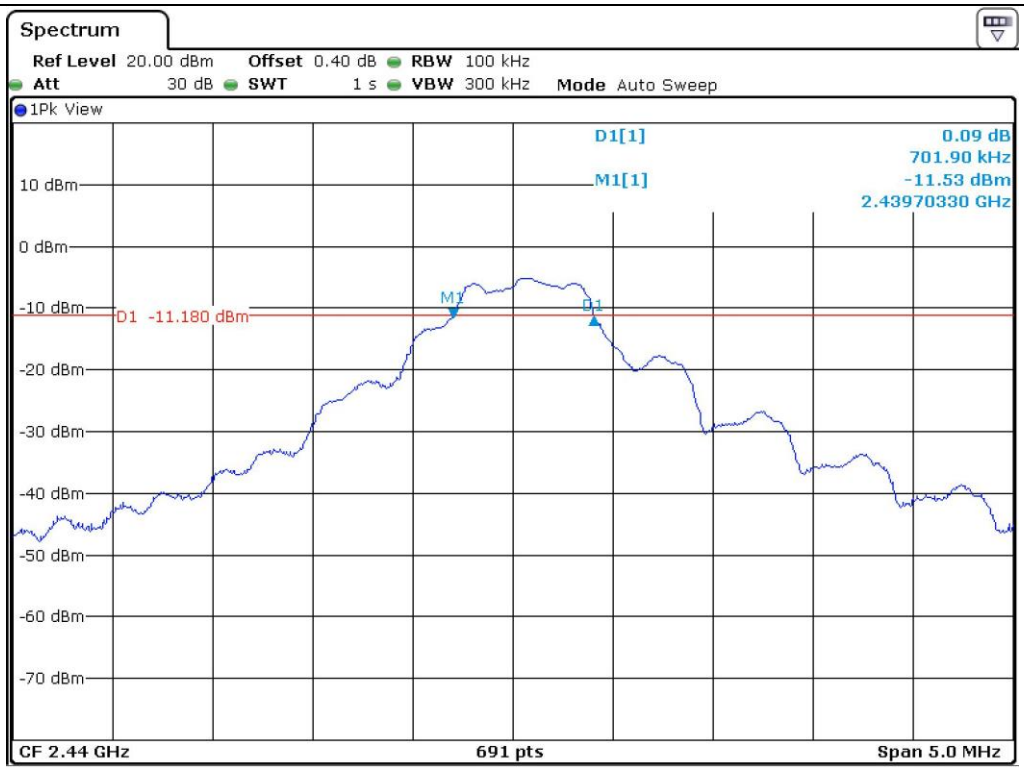
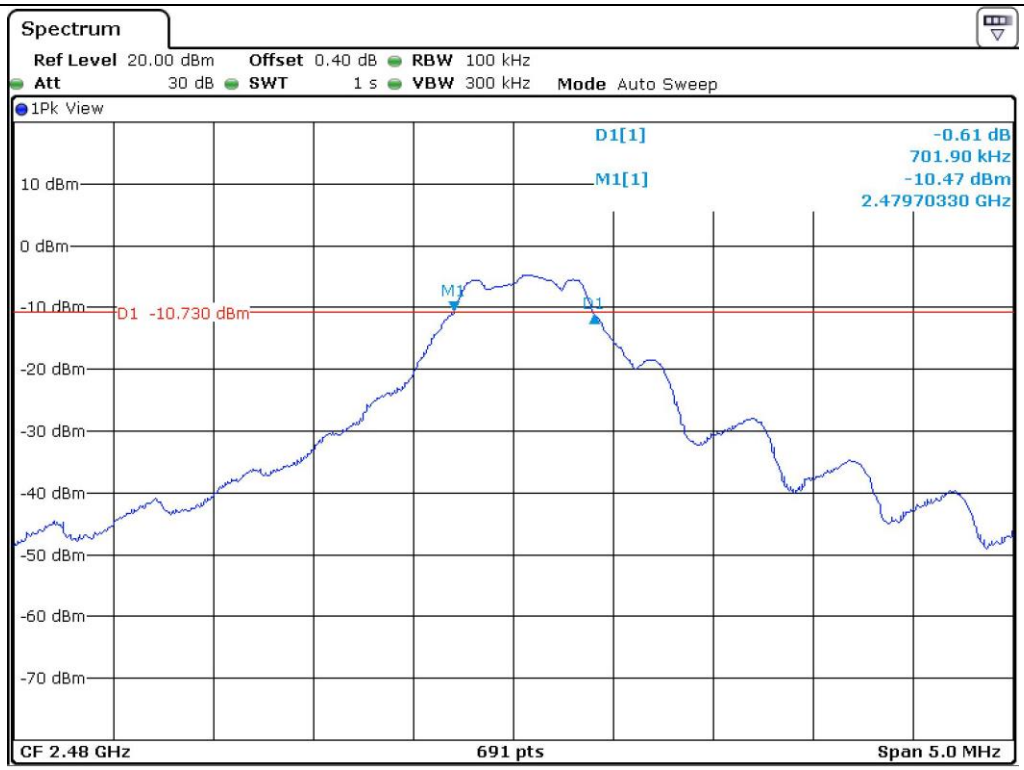


Middle Channel



High Channel

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8. MAXIMUM PEAK OUTPUT POWER

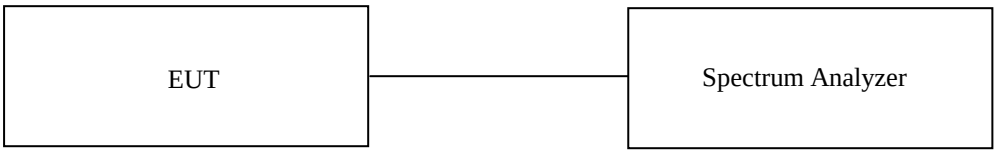
8.1 Operating environment

Temperature : 21.6 ℃

Relative humidity : 43.0 % R.H.

8.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz, the video bandwidth is set to 3 times the resolution bandwidth.



8.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)

All test equipment used is calibrated on a regular basis.

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8.4 Test data

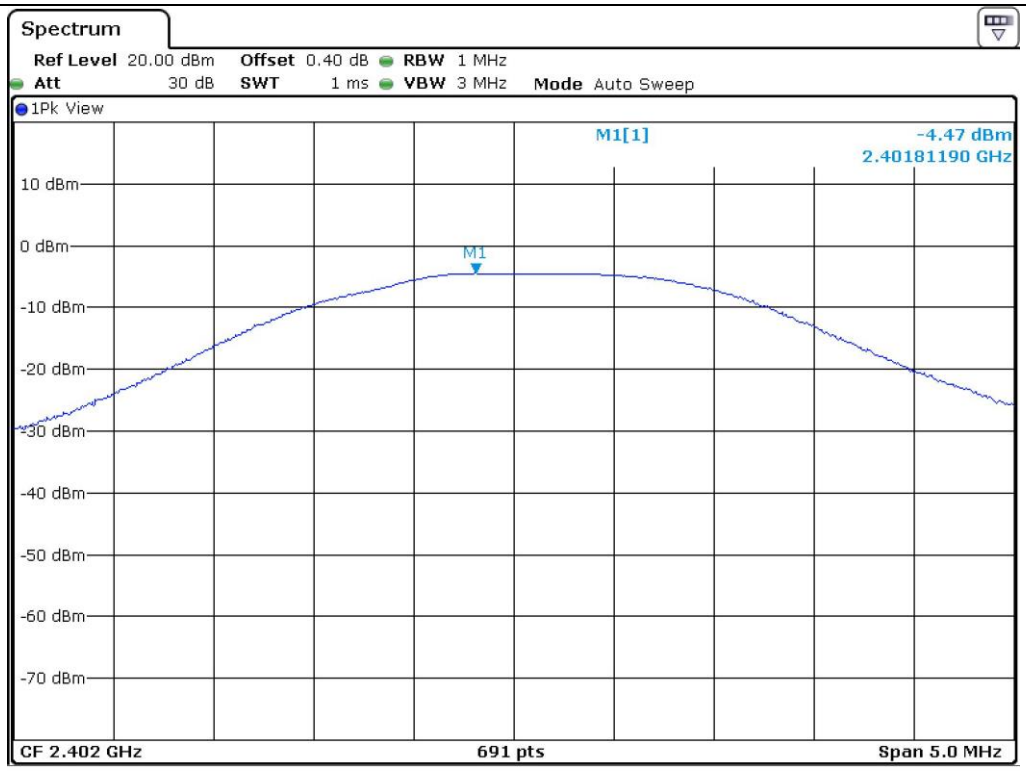
-. Test Date : February 02, 2015

-. Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 402	-4.47	30	34.47
MIDDLE	2 440	-4.87	30	34.87
HIGH	2 480	-4.56	30	34.56

Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)

Tested by: hyung-kwon, Oh / Engineer



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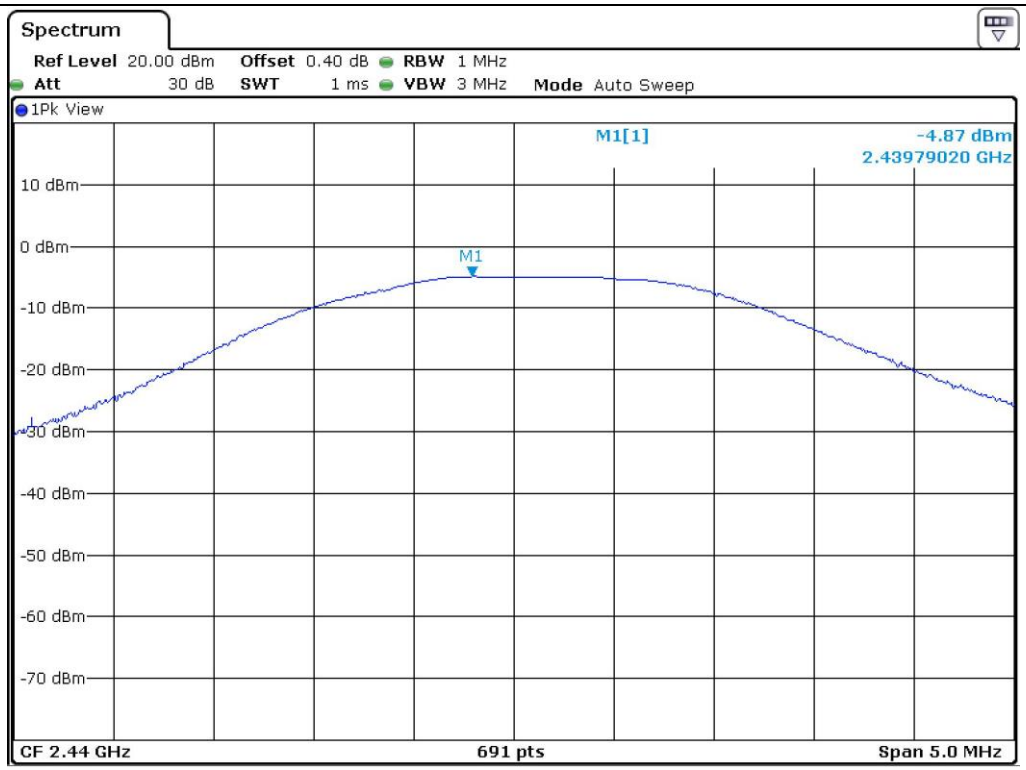
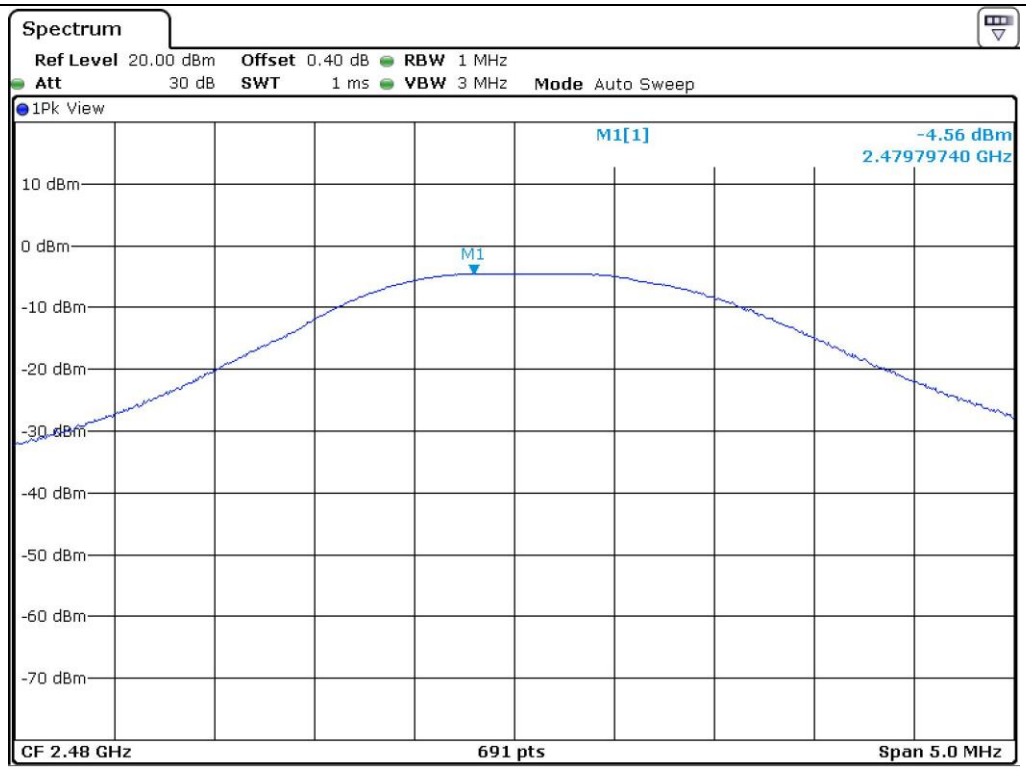


Middle Channel



High Channel

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9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

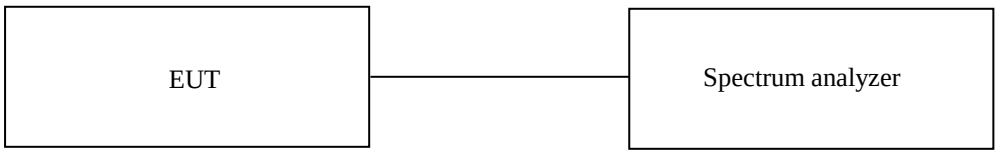
9.1 Operating environment

Temperature : 21.6 ℃

Relative humidity : 43.0 % R.H.

9.2 Test set-up for conducted measurement

The antenna output of the EUT was connected to the spectrum analyzer. The resolution and video bandwidth is set to 100 kHz, and peak detection was used.



9.3 Test set-up for radiated measurement

The radiated emissions measurements were performed on the 3 m, open-field test site. The EUT was placed on a non-conductive turntable approximately 0.8 m above the ground plane.

The frequency spectrum from 30 MHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

9.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
☐ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Nov. 03, 2014(1Y)
■ -	ESU	Rohde & Schwarz	EMI Test Receiver	100261	Apr. 29, 2014(1Y)
☐ -	8564E	HP	Spectrum Analyzer	3650A00756	Apr. 28, 2014(1Y)
☐ -	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Oct. 08, 2014(1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Apr. 28, 2014(1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)
■ -	SCU-18	Rohde & Schwarz	PRE-AMPLIFIER	10041	Nov. 25, 2014(1Y)
■ -	MA240	HD GmbH	Antenna Master	N/A	N/A
■ -	HD100	HD GmbH	Position Controller	N/A	N/A
■ -	DS420S	HD GmbH	Turn Table	N/A	N/A
■ -	HFH2-Z2	Rohde & Schwarz	Loop Antenna	879 285/26	Dec. 09, 2014(2Y)
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-255	May 02, 2014(2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Sep. 05, 2013(2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Sep. 05, 2013(2Y)
■ -	83051A	Agilent	Microwave System Preamplifer	3950M00201	Apr. 30, 2014(1Y)

All test equipment used is calibrated on a regular basis.

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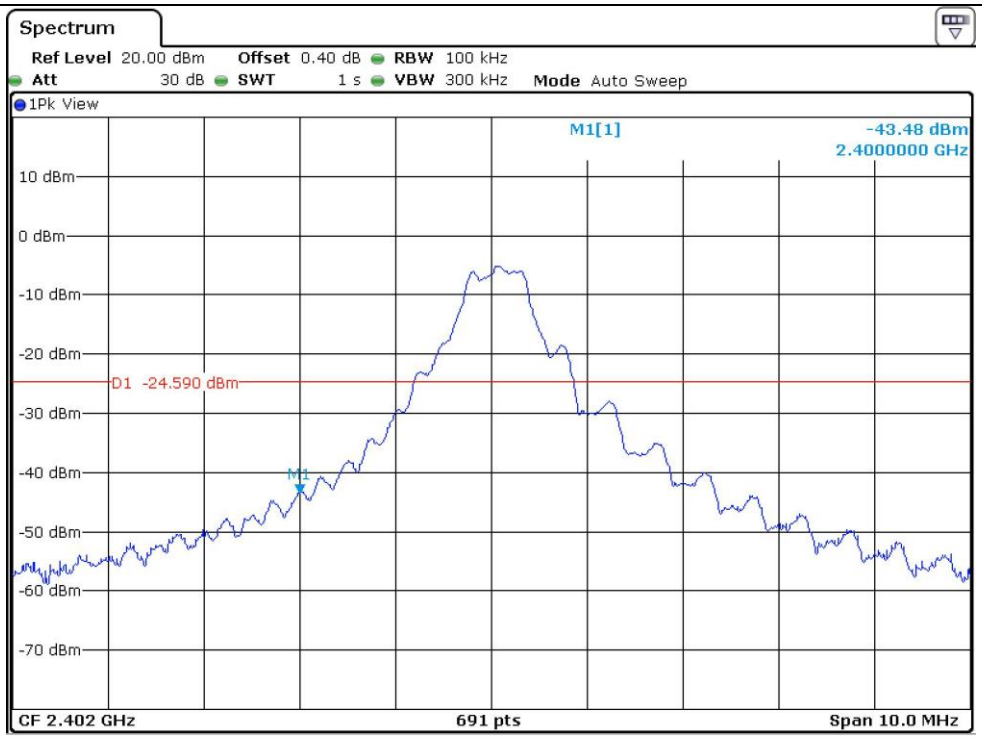
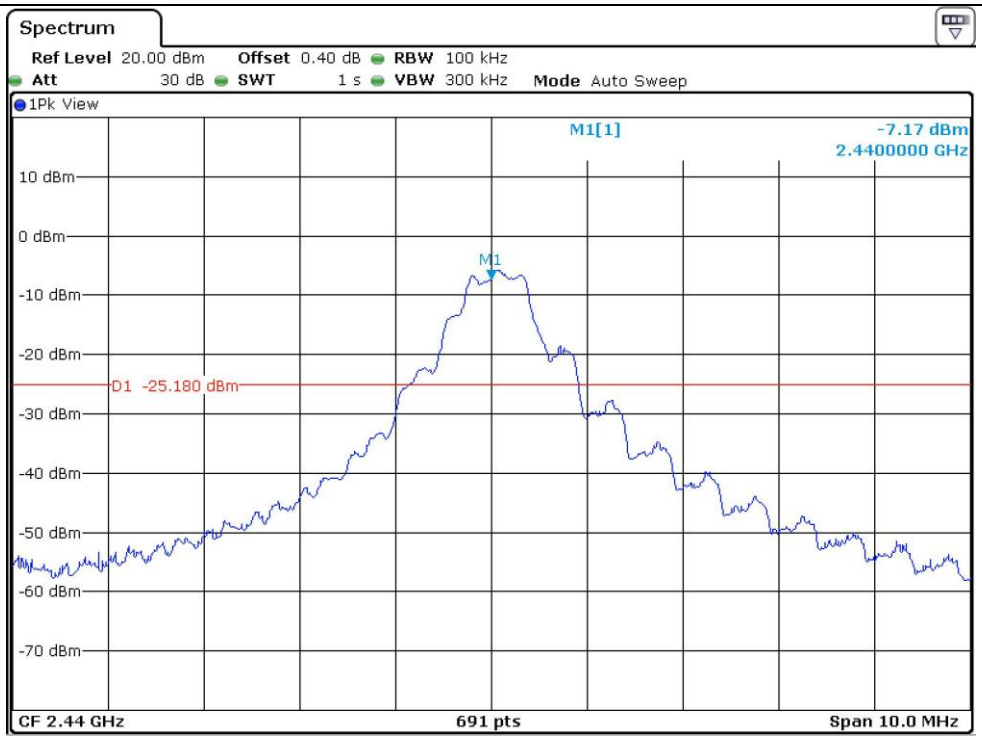
9.5 Test data for conducted emission



Low Channel



Middle Channel

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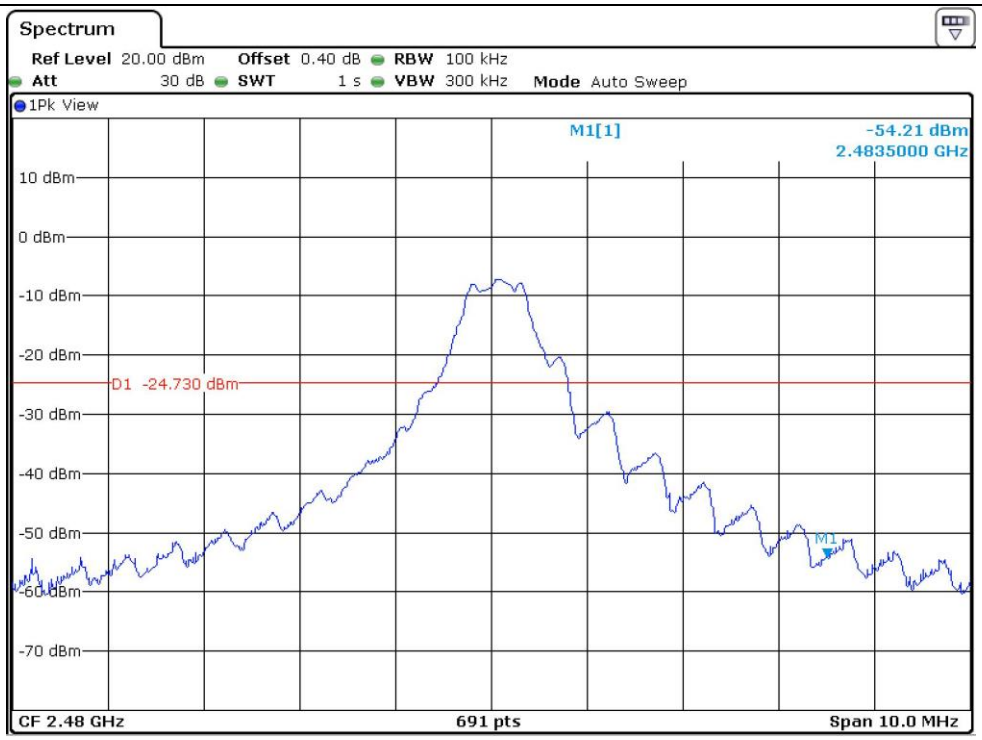

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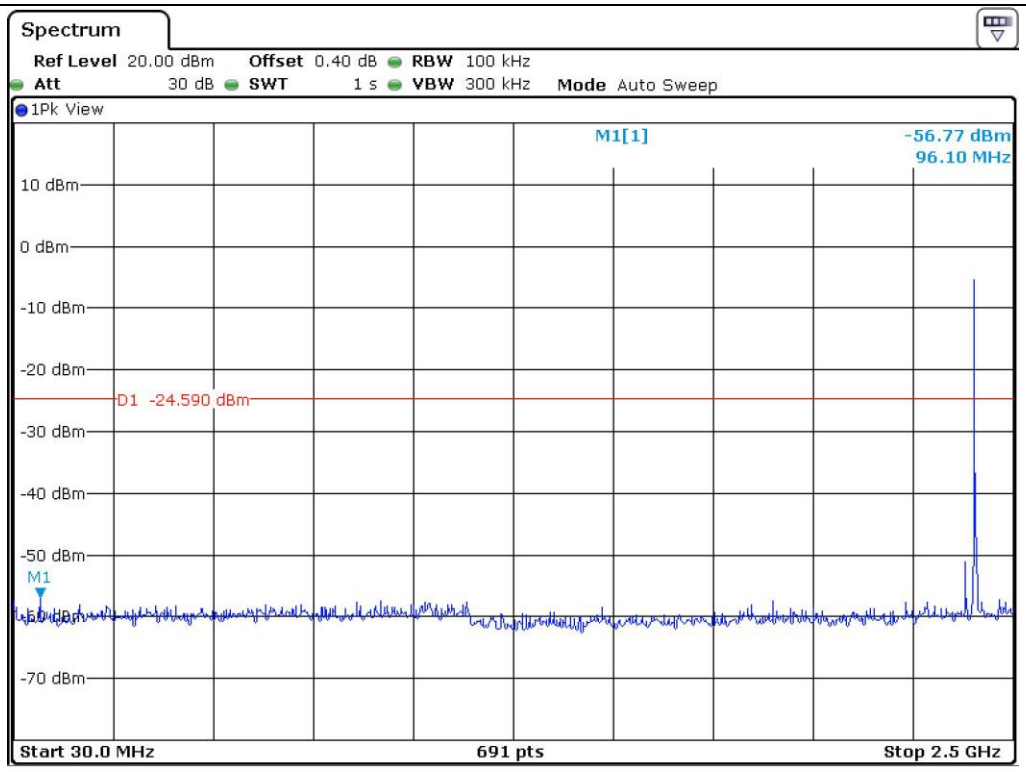
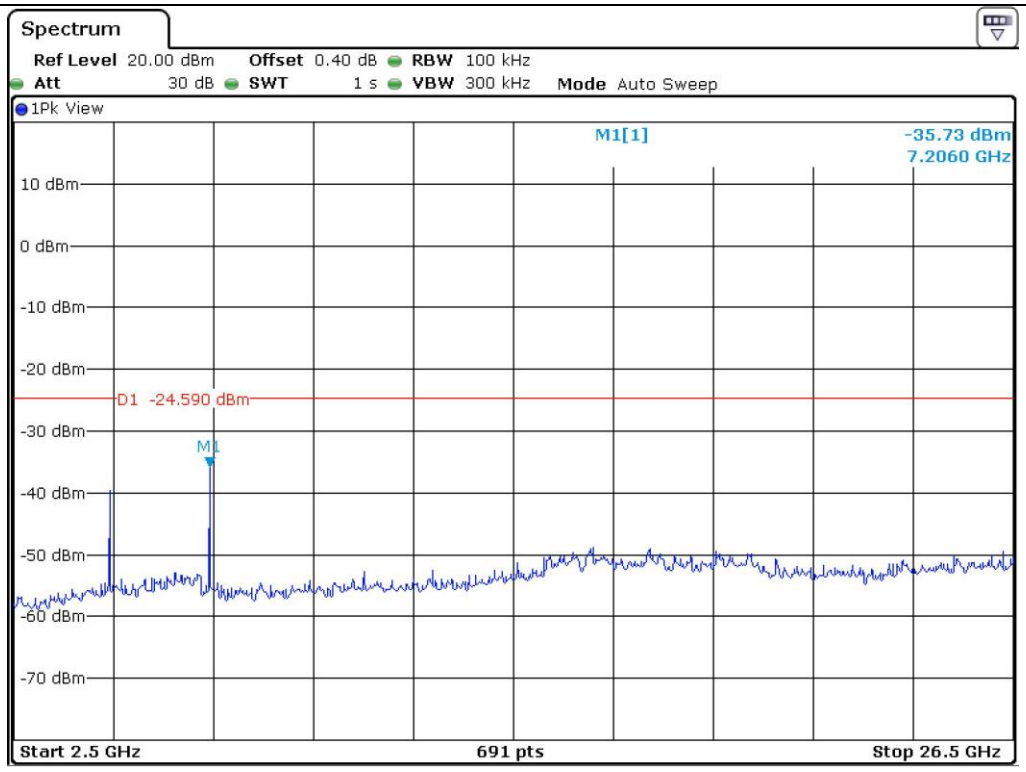


Low Channel



Low Channel

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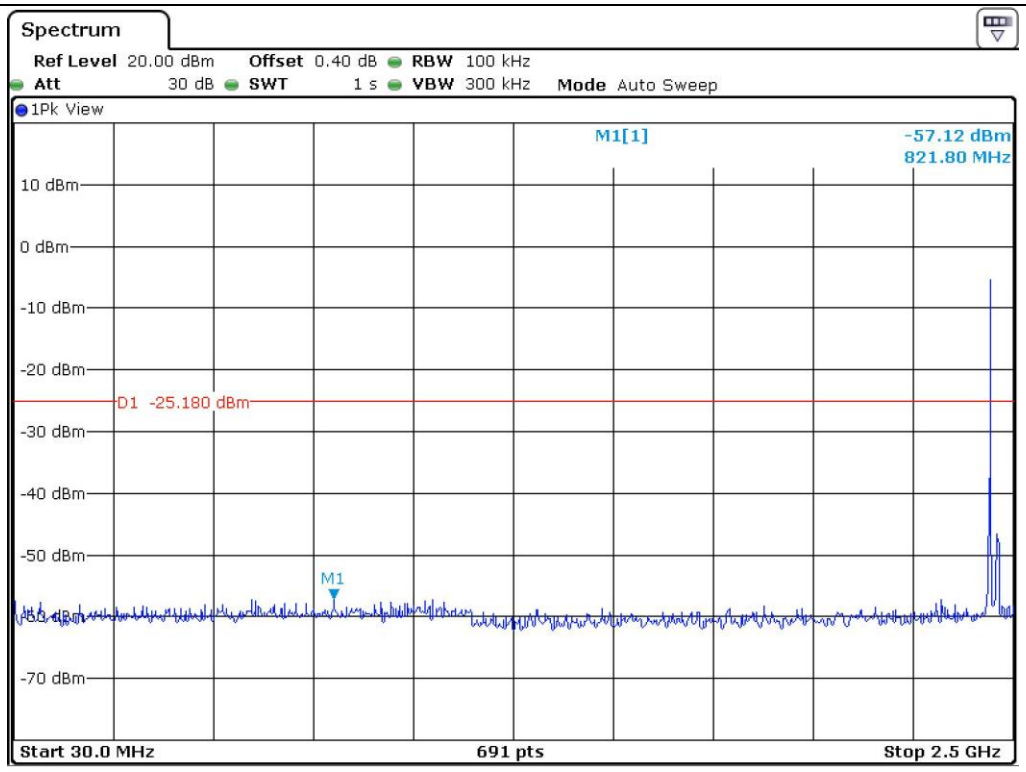
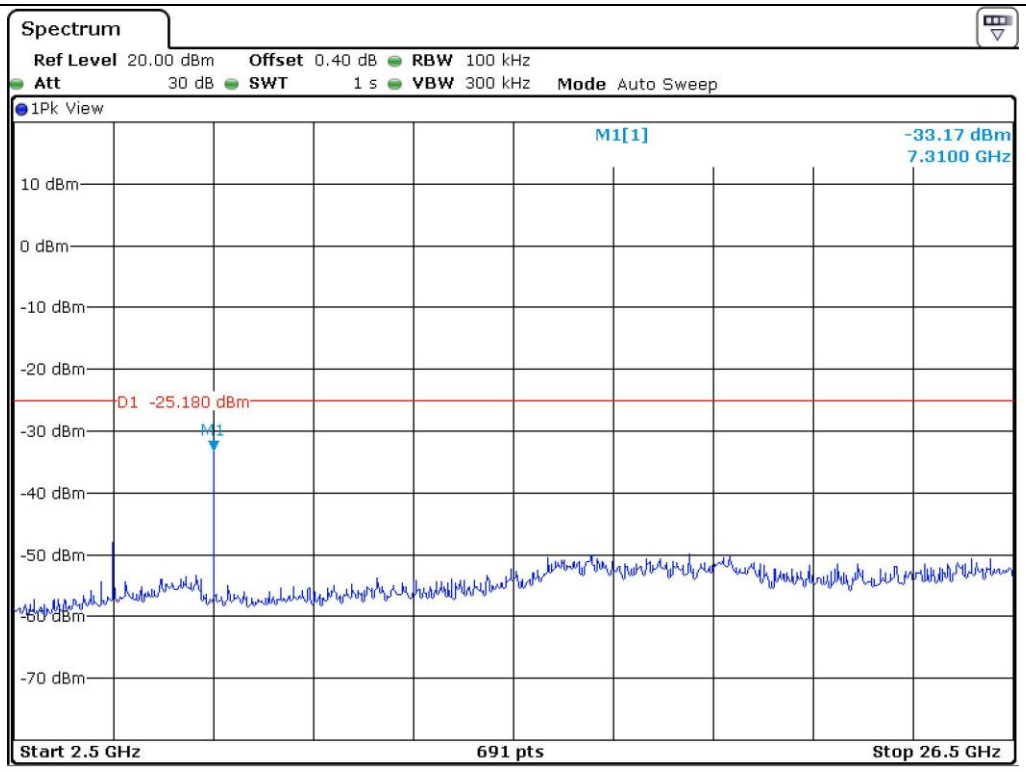


Middle Channel



Middle Channel

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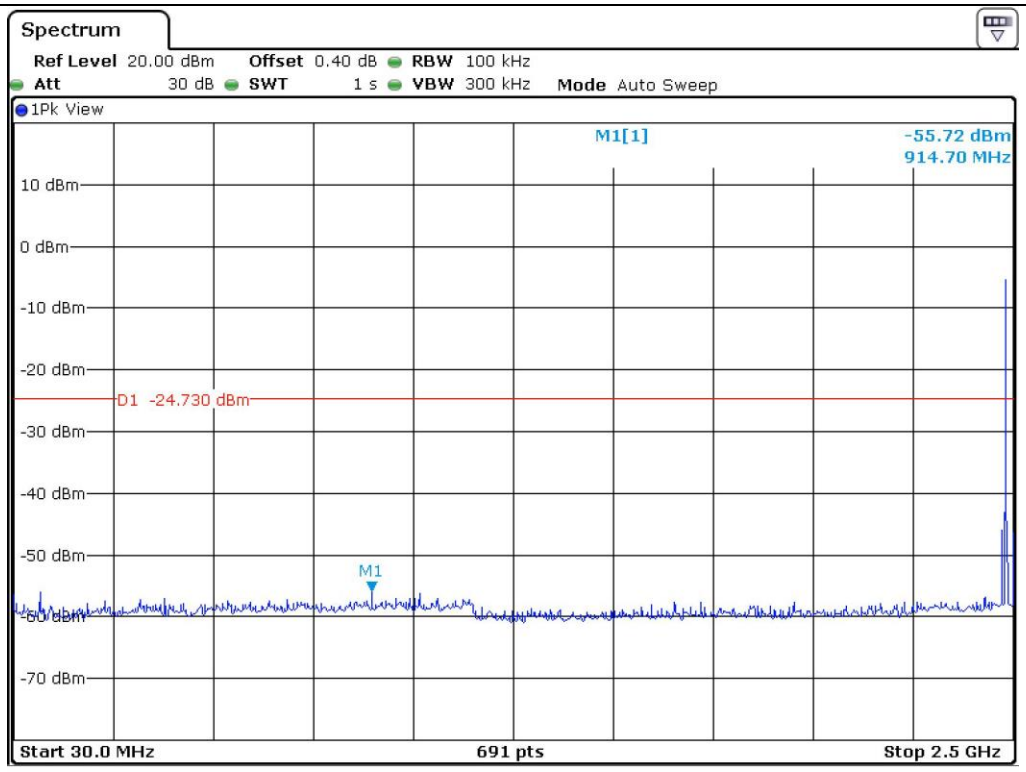
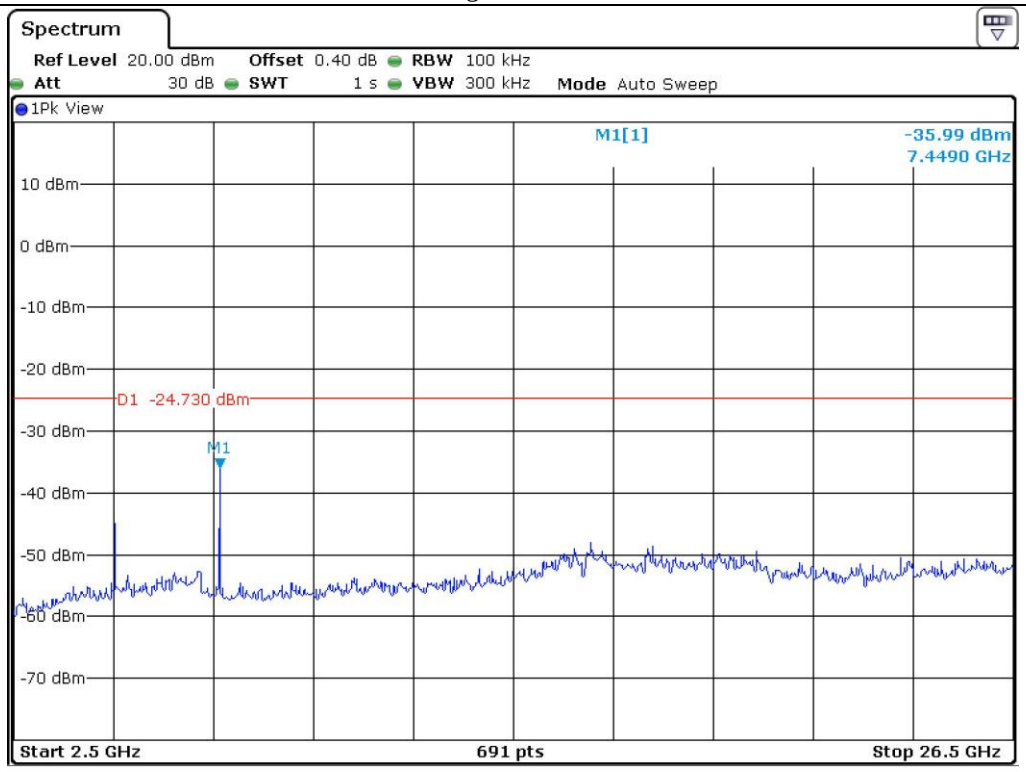


High Channel



High Channel

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9.6 Test data for radiated emission

9.6.1 Radiated Emission which fall in the Restricted Band

-. Test Date : February 03, 2015

-. Resolution bandwidth : 1 MHz for Peak and Average Mode

-. Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode

-. Measurement distance : 3 m

-. Result : PASSED

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Test Data for Low Channel									
2 389.00	54.67	Peak	H	27.10	7.50	43.00	39.85	74.00	34.15
	39.18	Average	H				26.75	54.00	27.25
2 389.57	54.29	Peak	V				39.67	74.00	34.33
	38.96	Average	V				26.79	54.00	27.21
Test Data for High Channel									
2 483.58	56.15	Peak	H	27.10	7.50	43.00	39.55	74.00	34.45
	40.26	Average	H				26.13	54.00	27.87
2 484.70	56.61	Peak	V				39.63	74.00	34.37
	39.93	Average	V				26.49	54.00	27.51

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical

Margin (dB) = Limits (dBµV/m) - Total Level (dBµV/m)

Total Level = Reading + Antenna Factor + Cable Loss – Pre-Amplifier Gain

Tested by: hyung-kwon, Oh / Engineer

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9.6.2 Spurious & Harmonic Radiated Emission

-. Test Date : February 03, 2015

-. Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,
100 kHz for Peak Mode for the emissions outside restricted band

-. Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Result : PASSED

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 402.00	91.88	Peak	H	27.00	7.50	42.80	83.58	-	-
	87.34	Peak	V				79.04	-	-
4 804.00	44.60	Peak	H	30.60	11.10	42.50	43.80	74.00	30.20
	23.27	Average	H				22.47	54.00	31.53
	43.05	Peak	V				42.25	74.00	31.75
	21.82	Average	V				21.02	54.00	32.98
Test Data for Middle Channel									
2 440.00	88.14	Peak	H	27.20	7.60	42.80	80.14	-	-
	84.21	Peak	V				76.21	-	-
4 880.00	41.95	Peak	H	30.70	11.20	42.50	41.35	74.00	32.65
	21.71	Average	H				21.11	54.00	32.89
	42.67	Peak	V				42.07	74.00	31.93
	22.06	Average	V				21.46	54.00	32.54

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Test Data for High Channel									
2 480.00	84.02	Peak	H	27.40	7.70	42.90	76.22	-	-
	81.10	Peak	V				73.30	-	-
4 960.00	38.69	Peak	H	30.80	11.30	42.50	38.29	74.00	35.71
	16.65	Average	H				16.25	54.00	37.75
	38.78	Peak	V				38.38	74.00	35.62
	16.01	Average	V				15.61	54.00	38.39

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical

Margin (dB) = Limits (dBμV/m) - Total Level (dBμV/m)

Total Level = Reading + Antenna Factor + Cable Loss – Pre-Amplifier Gain

Tested by: hyung-kwon, Oh / Engineer

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10. PEAK POWER SPECTRAL DENSITY

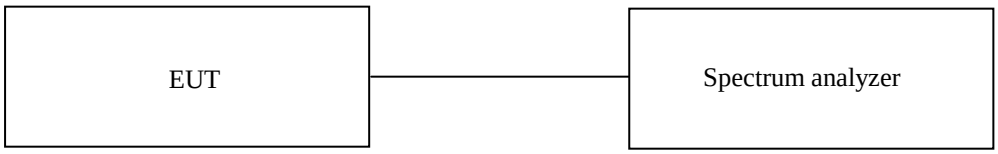
10.1 Operating environment

Temperature : 21.6 ℃

Relative humidity : 43.0 % R.H.

10.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 3 kHz, the video bandwidth is set to 3 times the resolution bandwidth.



10.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)

All test equipment used is calibrated on a regular basis.

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10.4 Test data

-. Test Date : January 30, 2015

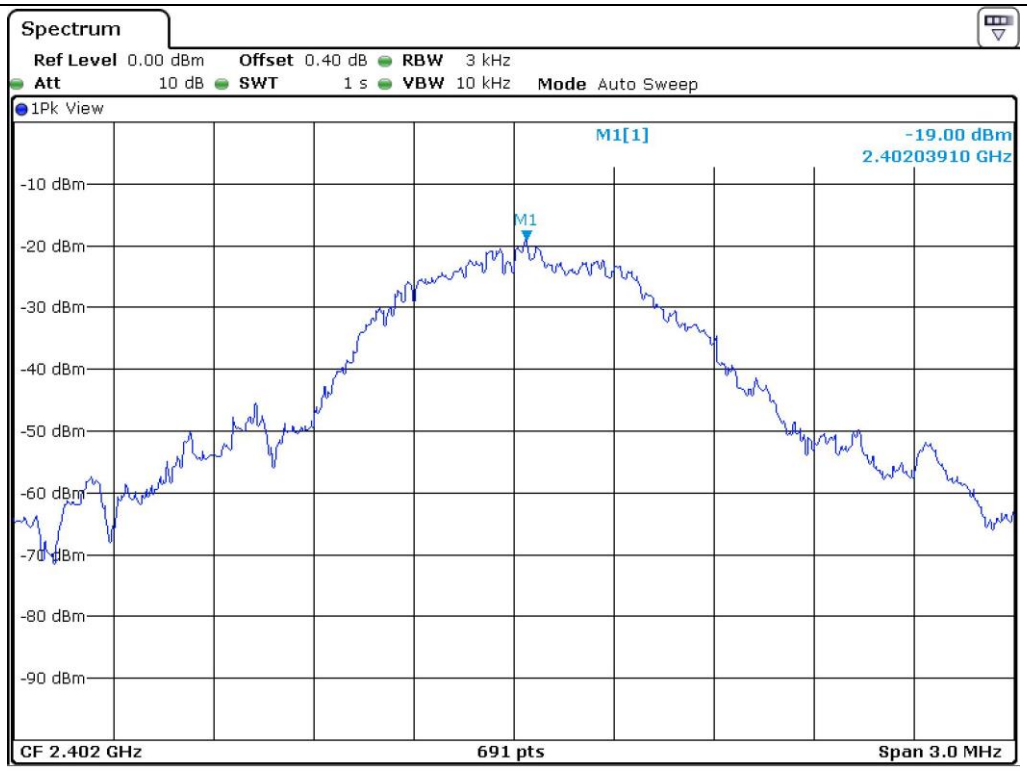
-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 402	-19.00	8.00	27.00
Middle	2 440	-19.00	8.00	27.00
High	2 480	-19.32	8.00	27.32

Remark. Margin = Limit – Measured value

Tested by: hyung-kwon, Oh / Engineer



Low Channel

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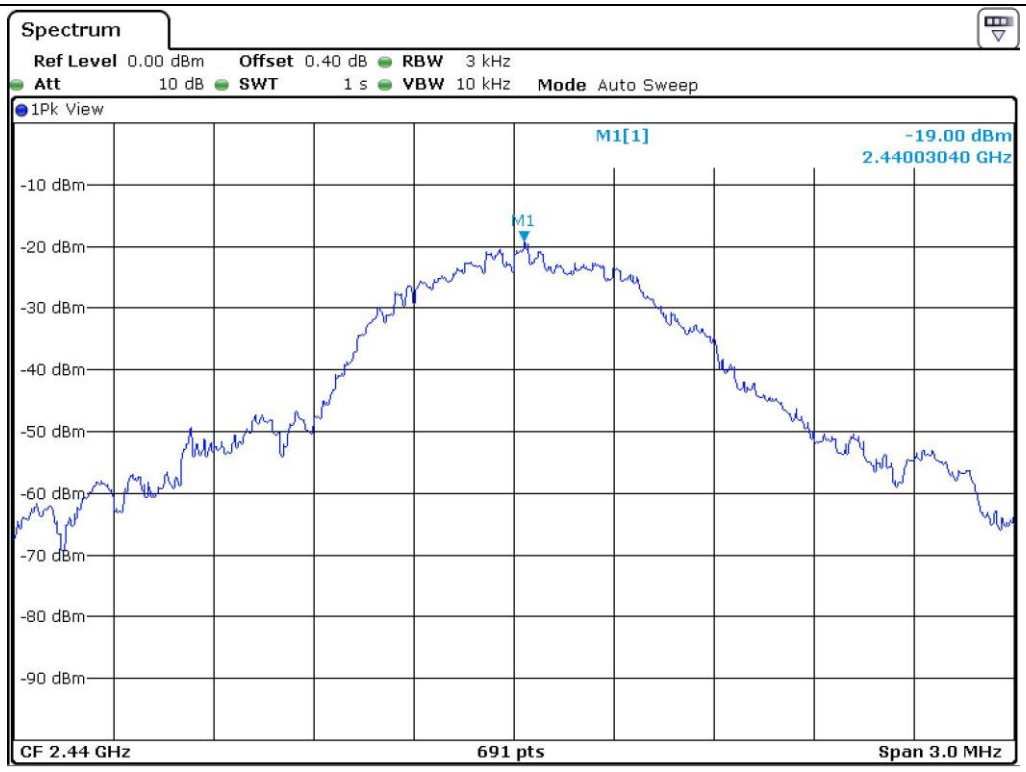
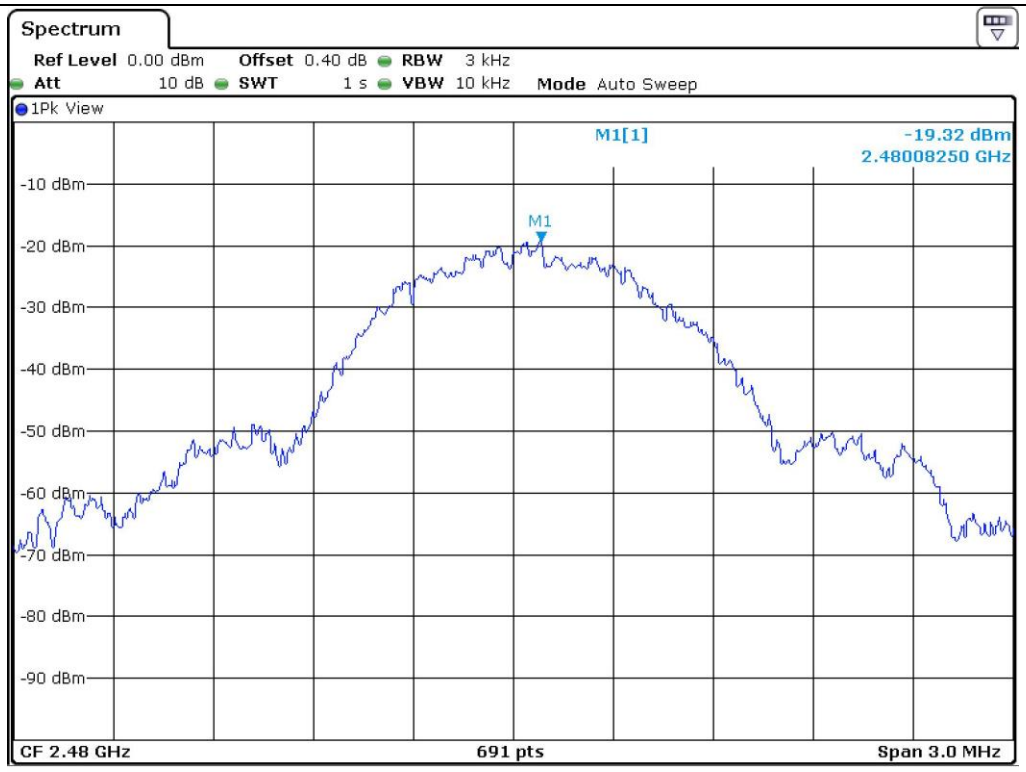


Middle Channel



High Channel

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11. RADIATED EMISSION TEST

11.1 Operating environment

Temperature : 21.6 ℃

Relative humidity : 43.0 % R.H.

11.2 Test set-up

The radiated emissions measurements were on the 3 m, open-field test site. The EUT and other support equipment were placed on a non-conductive turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30 MHz to 26.5 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

11.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
☐ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Nov. 03, 2014(1Y)
■ -	ESU	Rohde & Schwarz	EMI Test Receiver	100261	Apr. 29, 2014(1Y)
☐ -	8564E	HP	Spectrum Analyzer	3650A00756	Apr. 28, 2014(1Y)
☐ -	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Oct. 08, 2014(1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Apr. 28, 2014(1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2014(1Y)
■ -	SCU-18	Rohde & Schwarz	PRE-AMPLIFIER	10041	Nov. 25, 2014(1Y)
■ -	MA240	HD GmbH	Antenna Master	N/A	N/A
■ -	HD100	HD GmbH	Position Controller	N/A	N/A
■ -	DS420S	HD GmbH	Turn Table	N/A	N/A
■ -	HFH2-Z2	Rohde & Schwarz	Loop Antenna	879 285/26	Dec. 09, 2014(2Y)
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-255	May 02, 2014(2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Sep. 05, 2013(2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Sep. 05, 2013(2Y)
■ -	83051A	Agilent	Microwave System Preamplifer	3950M00201	Apr. 30, 2014(1Y)

All test equipment used is calibrated on a regular basis.

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11.4 Test data for Transmitting Mode

11.4.1 Test data for 30 MHz ~ 1 GHz

Humidity Level : 43.0 % R.H. Temperature: 21.6 ℃

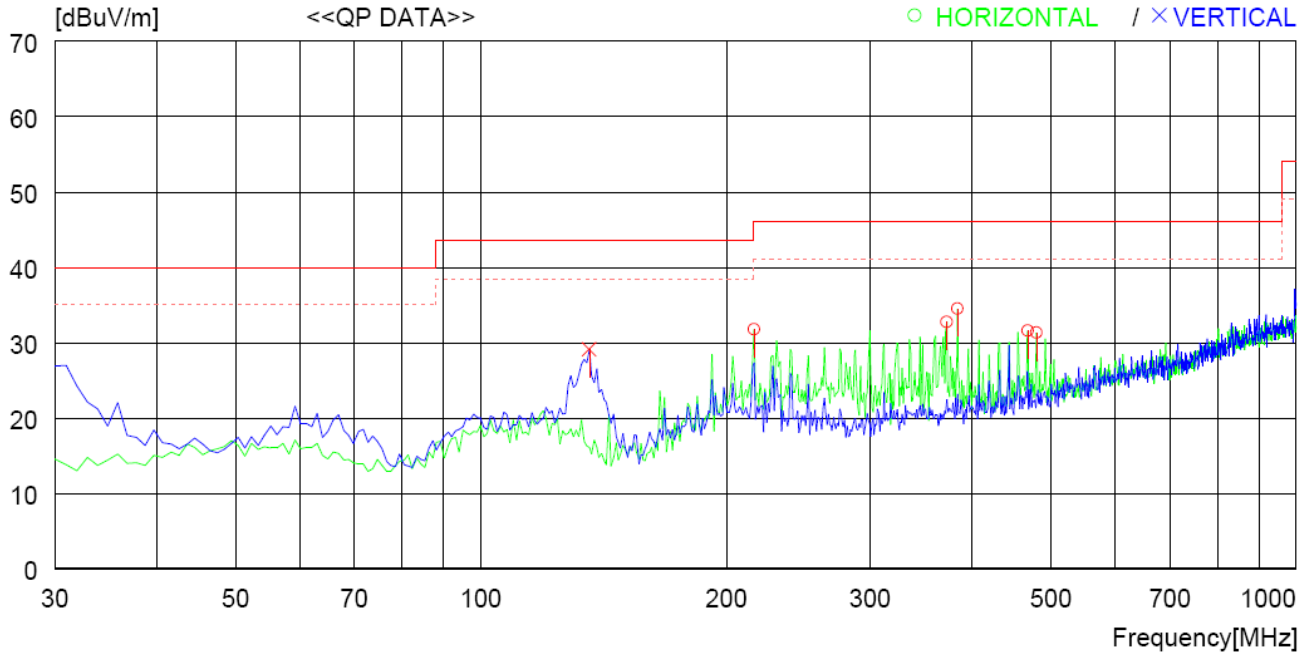
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : Bluetooth Date: February 03, 2015

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)

Operating condition : Low Channel



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	216.240	43.5	11.3	9.8	32.9	31.7	46.0	14.3	100	0
2	372.410	39.3	15.3	11.1	33.0	32.7	46.0	13.3	100	0
3	384.050	40.8	15.5	11.2	33.0	34.5	46.0	11.5	100	0
4	468.441	35.7	16.9	12.1	33.1	31.6	46.0	14.4	200	0
5	480.081	35.4	17.0	12.1	33.2	31.3	46.0	14.7	100	0
----- Vertical -----										
6	135.730	44.7	8.6	8.8	33.0	29.1	43.5	14.4	100	0

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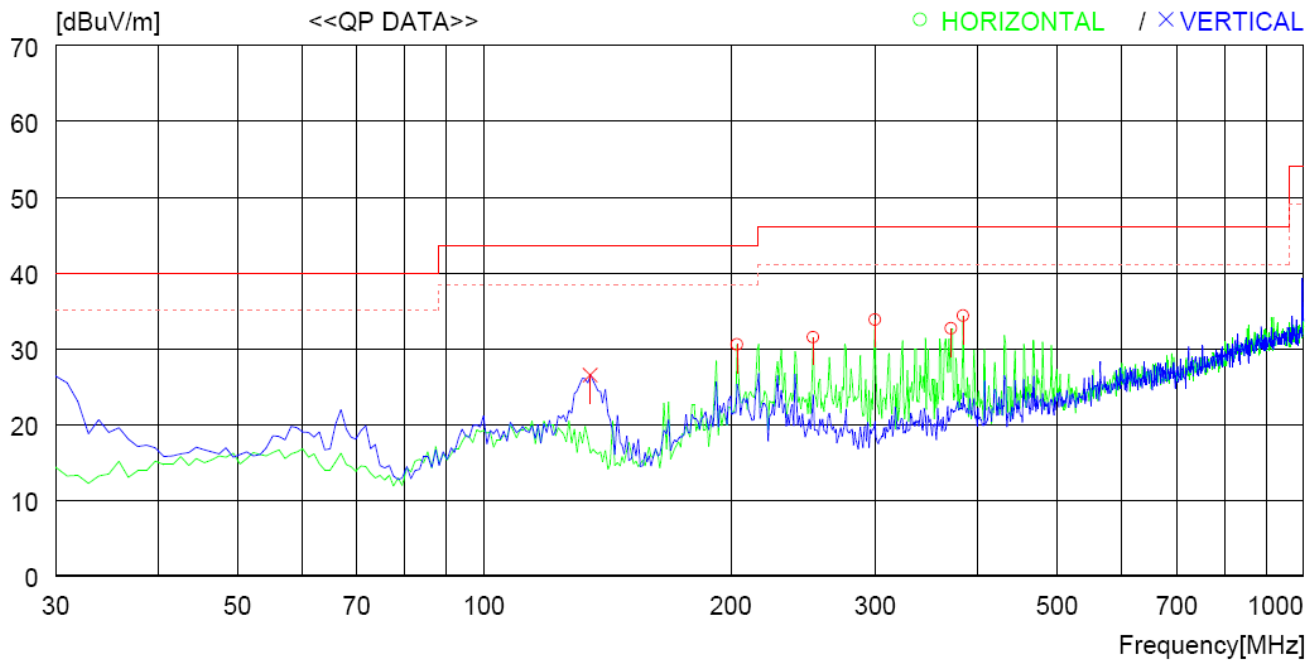
Operating condition : Middle Channel



No.	FREQ	READING QP	ANT FACTOR	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	[dBuV]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal ------										
1	203.630	42.9	10.9	9.6	32.9	30.5	43.5	13.0	100	0
2	252.130	41.8	12.5	10.1	32.9	31.5	46.0	14.5	100	0
3	299.660	42.6	13.6	10.5	32.9	33.8	46.0	12.2	100	0
4	371.440	39.3	15.2	11.1	33.0	32.6	46.0	13.4	100	0
5	384.050	40.6	15.5	11.2	33.0	34.3	46.0	11.7	100	0
----- Vertical ------										
6	134.760	42.1	8.7	8.7	33.0	26.5	43.5	17.0	100	0

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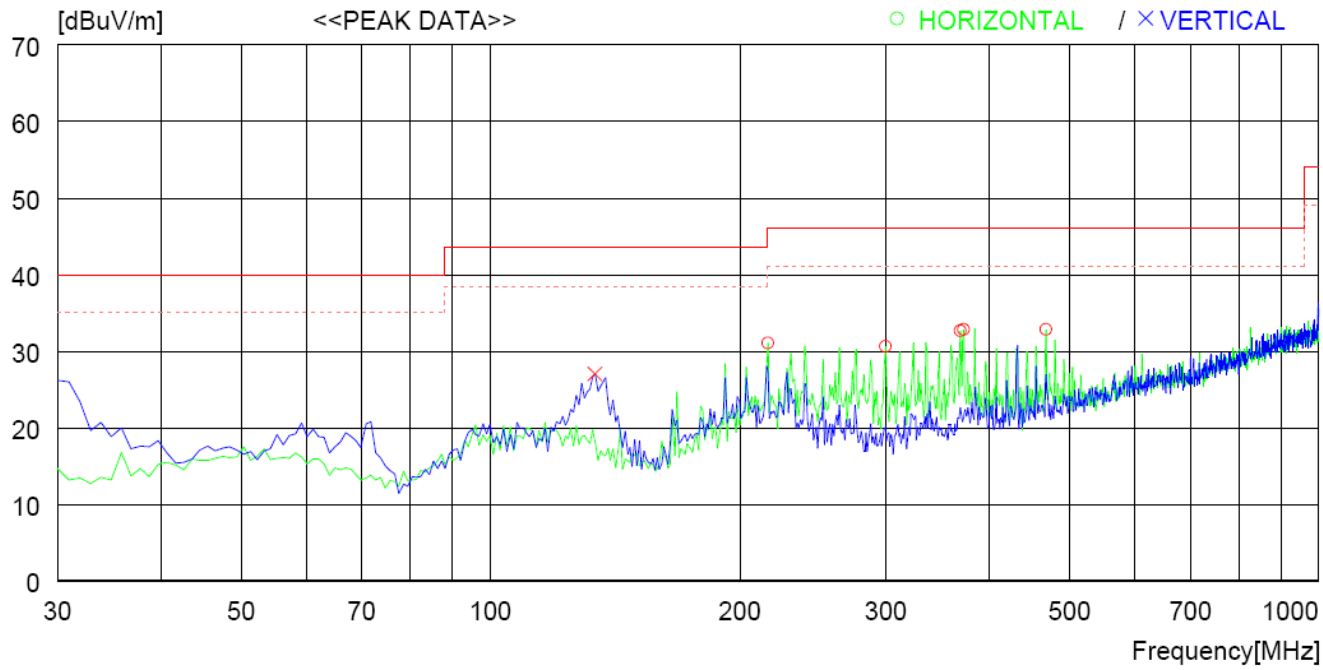
Operating condition : High Channel



No.	FREQ [MHz]	READING PEAK [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal ------										
1	216.240	42.8	11.3	9.8	32.9	31.0	46.0	15	200	0
2	299.660	39.4	13.6	10.5	32.9	30.6	46.0	15.4	100	0
3	369.500	39.3	15.2	11.1	33.0	32.6	46.0	13.4	100	0
4	372.410	39.4	15.3	11.1	33.0	32.8	46.0	13.2	100	0
5	468.441	36.9	16.9	12.1	33.1	32.8	46.0	13.2	200	0
----- Vertical ------										
6	133.790	42.5	8.8	8.7	33.0	27.0	43.5	16.5	100	0

Tested by: hyung-kwon, Oh / Engineer

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11.4.2 Test data for Below 30 MHz

-. Test Date : February 03, 2015

-. Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)

-. Frequency range : 9 kHz ~ 30 MHz

-. Measurement distance : 3 m

-.Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBµV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBµV/m)	Limits (dBµV/m)	Margin (dB)
It was not observed any emissions from the EUT.									

11.4.3 Test data for above 1 GHz

-. Test Date : February 03, 2015

-. Resolution bandwidth : 1 MHz for Peak and Average Mode

-. Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-.Operating mode : Transmitting mode

Frequency (MHz)	Reading (dBµV)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dBµV/m)	Limits (dBµV/m)	Margin (dB)
It was not observed any emissions from the EUT.									

Tested by: hyung-kwon, Oh / Engineer

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12. CONDUCTED EMISSION TEST

12.1 Operating environment

Temperature : 21.6 ℃

Relative humidity : 43.0 % R.H.

12.2 Test set-up

The EUT was placed on a wooden table, 0.8 m height above the floor. Power was fed to the EUT through a 50 Ω / 50 μH + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

12.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	ESPI	Rohde & Schwarz	EMI Test Receiver	101278	Nov. 03, 2014 (1Y)
☐ -	ESHS10	Rohde & Schwarz	EMI Test Receiver	834467/007	Jul. 15, 2014 (1Y)
☐	NSLK8128	Schwarzbeck	AMN	8128-216	Apr. 11, 2014 (1Y)
■ -	NSLK8126	Schwarzbeck	AMN	8126-404	Jul. 11, 2014 (1Y)
☐ -	3825/2	EMCO	AMN	9109-1869	Apr. 29, 2014 (1Y)
■ --	3825/2	EMCO	AMN	9109-1867	Apr. 29, 2014 (1Y)

All test equipment used is calibrated on a regular basis.

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12.4 Test data for Transmitting Mode

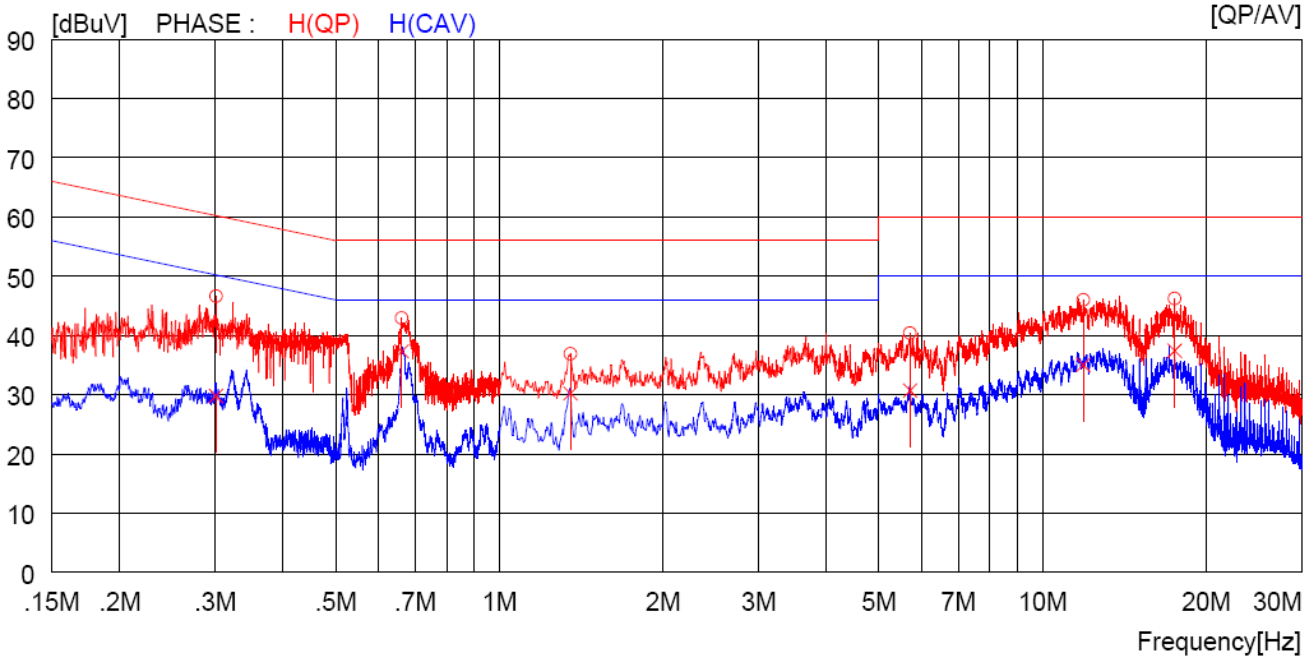
12.4.1 Test data for Low Channel

-. Test Date : February 03, 2015

-. Resolution bandwidth : 9 kHz

-. Frequency range : 0.15 MHz ~ 30 MHz

-. Tested Line : HOT LINE



NO	FREQ [MHz]	READING QP [dBuV]	READING AV [dBuV]	C.FACTOR [dB]	RESULT QP [dBuV]	RESULT AV [dBuV]	LIMIT QP [dBuV]	LIMIT AV [dBuV]	MARGIN QP [dBuV]	MARGIN AV [dBuV]	PHASE
1	0.30100	36.6	----	10.0	46.6	----	60.2	----	13.6	----	H(QP)
2	0.66100	32.9	----	10.0	42.9	----	56.0	----	13.1	----	H(QP)
3	1.35200	26.9	----	10.0	36.9	----	56.0	----	19.1	----	H(QP)
4	5.70500	30.3	----	10.1	40.4	----	60.0	----	19.6	----	H(QP)
5	11.89000	35.8	----	10.2	46.0	----	60.0	----	14.0	----	H(QP)
6	17.52000	36.0	----	10.2	46.2	----	60.0	----	13.8	----	H(QP)
7	0.30100	----	19.8	10.0	----	29.8	----	50.2	----	20.4	H(CAV)
8	0.66100	----	27.3	10.0	----	37.3	----	46.0	----	8.7	H(CAV)
9	1.35200	----	20.2	10.0	----	30.2	----	46.0	----	15.8	H(CAV)
10	5.70500	----	20.6	10.1	----	30.7	----	50.0	----	19.3	H(CAV)
11	11.89000	----	24.8	10.2	----	35.0	----	50.0	----	15.0	H(CAV)
12	17.52000	----	27.2	10.2	----	37.4	----	50.0	----	12.6	H(CAV)

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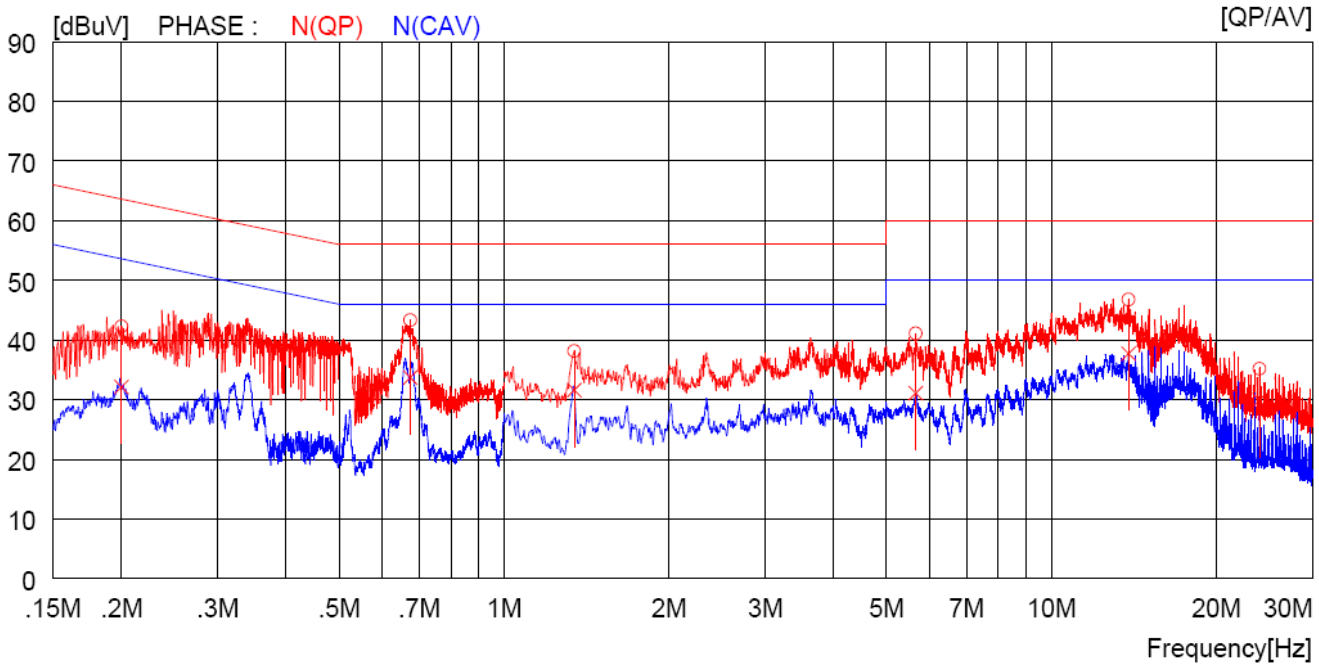
-. Tested Line : NEUTRAL LINE



NO	FREQ [MHz]	READING QP [dBuV]	READING AV [dBuV]	C.FACTOR [dB]	RESULT QP [dBuV]	RESULT AV [dBuV]	LIMIT QP [dBuV]	LIMIT AV [dBuV]	MARGIN QP [dBuV]	MARGIN AV [dBuV]	PHASE
1	0.20000	32.3	----	10.0	42.3	----	63.6	----	21.3	----	N(QP)
2	0.67400	33.3	----	10.0	43.3	----	56.0	----	12.7	----	N(QP)
3	1.34400	28.1	----	10.0	38.1	----	56.0	----	17.9	----	N(QP)
4	5.65500	31.0	----	10.1	41.1	----	60.0	----	18.9	----	N(QP)
5	13.84000	36.6	----	10.2	46.8	----	60.0	----	13.2	----	N(QP)
6	24.00000	25.0	----	10.2	35.2	----	60.0	----	24.8	----	N(QP)
7	0.20000	----	22.1	10.0	----	32.1	----	53.6	----	21.5	N(CAV)
8	0.67400	----	23.7	10.0	----	33.7	----	46.0	----	12.3	N(CAV)
9	1.34400	----	21.6	10.0	----	31.6	----	46.0	----	14.4	N(CAV)
10	5.65500	----	21.0	10.1	----	31.1	----	50.0	----	18.9	N(CAV)
11	13.84000	----	27.5	10.2	----	37.7	----	50.0	----	12.3	N(CAV)
12	24.00000	----	19.7	10.2	----	29.9	----	50.0	----	20.1	N(CAV)

Remark: Margin (dB) = Limit – Level (Result)

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.

Tested by: hyung-kwon, Oh / Engineer

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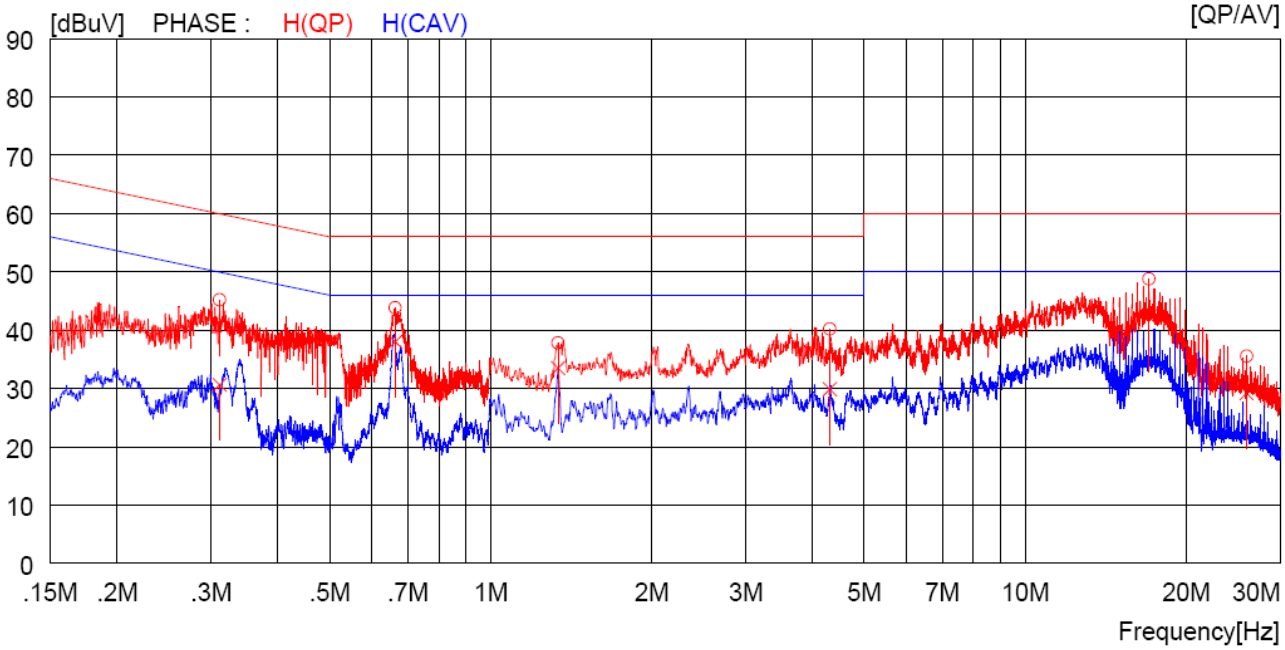
12.4.2 Test data for Middle Channel

-. Test Date : February 03, 2015

-. Resolution bandwidth : 9 kHz

-. Frequency range : 0.15 MHz ~ 30 MHz

-. Tested Line : HOT LINE



NO	FREQ	READING QP [dBuV]	READING AV [dBuV]	C.FACTOR [dB]	RESULT QP [dBuV]	RESULT AV [dBuV]	LIMIT QP [dBuV]	LIMIT AV [dBuV]	MARGIN QP [dBuV]	MARGIN AV [dBuV]	PHASE
	[MHz]										
1	0.31100	35.2	----	10.0	45.2	----	59.9	----	14.7	----	H(QP)
2	0.66300	33.8	----	10.0	43.8	----	56.0	----	12.2	----	H(QP)
3	1.33600	27.8	----	10.0	37.8	----	56.0	----	18.2	----	H(QP)
4	4.30800	30.1	----	10.1	40.2	----	56.0	----	15.8	----	H(QP)
5	17.04000	38.6	----	10.2	48.8	----	60.0	----	11.2	----	H(QP)
6	25.96000	25.3	----	10.2	35.5	----	60.0	----	24.5	----	H(QP)
7	0.31100	----	20.6	10.0	----	30.6	----	49.9	----	19.3	H(CAV)
8	0.66300	----	28.0	10.0	----	38.0	----	46.0	----	8.0	H(CAV)
9	1.33600	----	23.5	10.0	----	33.5	----	46.0	----	12.5	H(CAV)
10	4.30800	----	19.8	10.1	----	29.9	----	46.0	----	16.1	H(CAV)
11	17.04000	----	32.1	10.2	----	42.3	----	50.0	----	7.7	H(CAV)
12	25.96000	----	19.0	10.2	----	29.2	----	50.0	----	20.8	H(CAV)

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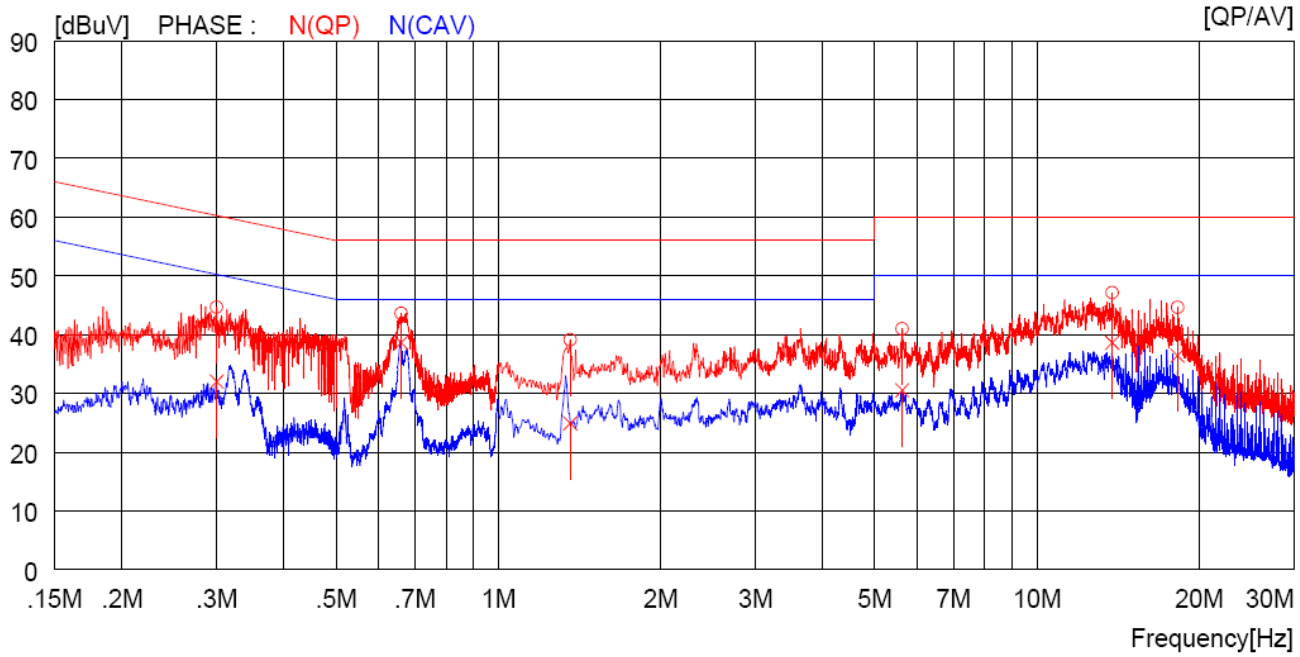
-. Tested Line : NEUTRAL LINE



NO	FREQ [MHz]	READING QP [dBuV]	READING AV [dBuV]	C.FACTOR [dB]	RESULT QP [dBuV]	RESULT AV [dBuV]	LIMIT QP [dBuV]	LIMIT AV [dBuV]	MARGIN QP [dBuV]	MARGIN AV [dBuV]	PHASE
1	0.30000	34.7	----	10.0	44.7	----	60.2	----	15.5	----	N(QP)
2	0.66000	33.6	----	10.0	43.6	----	56.0	----	12.4	----	N(QP)
3	1.36000	29.1	----	10.0	39.1	----	56.0	----	16.9	----	N(QP)
4	5.62500	30.9	----	10.1	41.0	----	60.0	----	19.0	----	N(QP)
5	13.79000	36.9	----	10.2	47.1	----	60.0	----	12.9	----	N(QP)
6	18.25000	34.4	----	10.2	44.6	----	60.0	----	15.4	----	N(QP)
7	0.30000	----	22.0	10.0	----	32.0	----	50.2	----	18.2	N(CAV)
8	0.66000	----	28.6	10.0	----	38.6	----	46.0	----	7.4	N(CAV)
9	1.36000	----	14.9	10.0	----	24.9	----	46.0	----	21.1	N(CAV)
10	5.62500	----	20.4	10.1	----	30.5	----	50.0	----	19.5	N(CAV)
11	13.79000	----	28.4	10.2	----	38.6	----	50.0	----	11.4	N(CAV)
12	18.25000	----	26.2	10.2	----	36.4	----	50.0	----	13.6	N(CAV)

Remark: Margin (dB) = Limit – Level (Result)

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.

Tested by: hyung-kwon, Oh / Engineer

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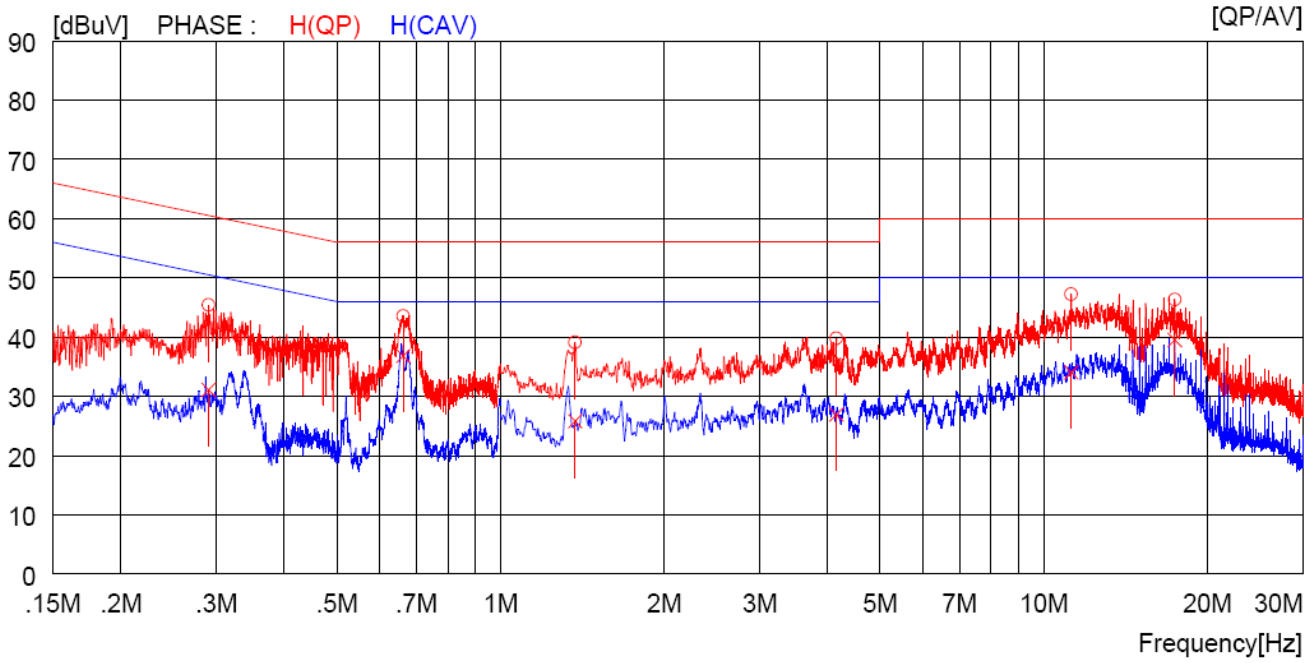
12.4.3 Test data for High Channel

-. Test Date : February 03, 2015

-. Resolution bandwidth : 9 kHz

-. Frequency range : 0.15 MHz ~ 30 MHz

-. Tested Line : HOT LINE



NO	FREQ [MHz]	READING QP [dBuV]	READING AV [dBuV]	C.FACTOR [dB]	RESULT QP [dBuV]	RESULT AV [dBuV]	LIMIT QP [dBuV]	LIMIT AV [dBuV]	MARGIN QP [dBuV]	MARGIN AV [dBuV]	PHASE
1	0.29000	35.4	----	10.0	45.4	----	60.5	----	15.1	----	H(QP)
2	0.66200	33.5	----	10.0	43.5	----	56.0	----	12.5	----	H(QP)
3	1.37200	29.1	----	10.0	39.1	----	56.0	----	16.9	----	H(QP)
4	4.15200	29.7	----	10.1	39.8	----	56.0	----	16.2	----	H(QP)
5	11.24000	37.0	----	10.2	47.2	----	60.0	----	12.8	----	H(QP)
6	17.43000	36.1	----	10.2	46.3	----	60.0	----	13.7	----	H(QP)
7	0.29000	----	21.1	10.0	----	31.1	----	50.5	----	19.4	H(CAV)
8	0.66200	----	26.8	10.0	----	36.8	----	46.0	----	9.2	H(CAV)
9	1.37200	----	15.8	10.0	----	25.8	----	46.0	----	20.2	H(CAV)
10	4.15200	----	16.8	10.1	----	26.9	----	46.0	----	19.1	H(CAV)
11	11.24000	----	23.8	10.2	----	34.0	----	50.0	----	16.0	H(CAV)
12	17.43000	----	29.3	10.2	----	39.5	----	50.0	----	10.5	H(CAV)

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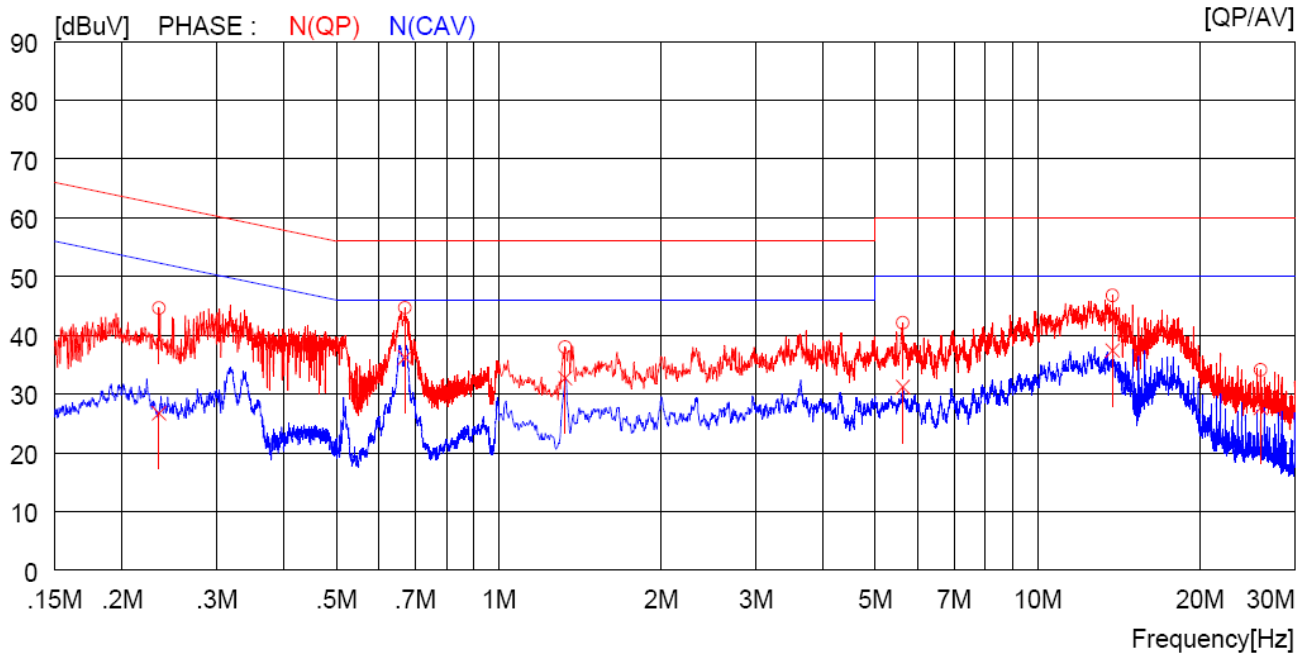
-. Tested Line : NEUTRAL LINE



NO	FREQ [MHz]	READING QP [dBuV]	READING AV [dBuV]	C.FACTOR [dB]	RESULT QP [dBuV]	RESULT AV [dBuV]	LIMIT QP [dBuV]	LIMIT AV [dBuV]	MARGIN QP [dBuV]	MARGIN AV [dBuV]	PHASE
1	0.23400	34.6	----	10.0	44.6	----	62.3	----	17.7	----	N(QP)
2	0.67000	34.7	----	10.0	44.7	----	56.0	----	11.3	----	N(QP)
3	1.32800	28.0	----	10.0	38.0	----	56.0	----	18.0	----	N(QP)
4	5.62500	32.0	----	10.1	42.1	----	60.0	----	17.9	----	N(QP)
5	13.78000	36.6	----	10.2	46.8	----	60.0	----	13.2	----	N(QP)
6	25.93000	23.9	----	10.2	34.1	----	60.0	----	25.9	----	N(QP)
7	0.23400	----	16.7	10.0	----	26.7	----	52.3	----	25.6	N(CAV)
8	0.67000	----	26.2	10.0	----	36.2	----	46.0	----	9.8	N(CAV)
9	1.32800	----	22.7	10.0	----	32.7	----	46.0	----	13.3	N(CAV)
10	5.62500	----	21.1	10.1	----	31.2	----	50.0	----	18.8	N(CAV)
11	13.78000	----	27.2	10.2	----	37.4	----	50.0	----	12.6	N(CAV)
12	25.93000	----	17.4	10.2	----	27.6	----	50.0	----	22.4	N(CAV)

Remark: Margin (dB) = Limit – Level (Result)

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.

Tested by: hyung-kwon, Oh / Engineer

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