

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

Test Report No. : W15DR-D024

AGR No. : A15NA-010

Applicant : LG Electronics USA

Address : 1000 Sylvan Avenue, Englewood Cliffs, New Jersey, 07632, United States

Manufacturer : LG Electronics Inc.

Address : 222 LG-ro, Jinwi-Myeon, Pyeongtaek -Si, Gyeonggi-Do, 451-713, Korea

Type of Equipment : Zigbee Module

FCC ID. : BEJ-WZB1NP6

IC Certification No. : 2703K-WZB1NP6

Model Name : WZB1NP6

Serial number : N/A

Total page of Report : 39 pages (including this page)

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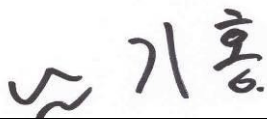
SUMMARY

The equipment complies with the regulation; *FCC PART 15 SUBPART C Section 15.247 and IC RSS-Gen Issue 4 Nov 2014 and RSS-247 Issue 1 May 2015*

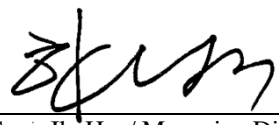
This test report only contains the result of a single test of the sample supplied for the examination.

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

Reviewed by:


Ki-Hong, Nam / Asst, Chief 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
W15DR-D024	December 29, 2015	Initial Issue	All

1. VERIFICATION OF COMPLIANCE

Applicant : LG Electronics USA
 Address : 1000 Sylvan Avenue, Englewood Cliffs, New Jersey, 07632, United States
 Contact Person : Yongduk Kwon / Research Engineer
 Telephone No. : +82-31-610-9606
 FCC ID : BEJ-WZB1NP6
 IC CERTIFICATION NO. : 2703K-WZB1NP6
 Model Name : WZB1NP6
 Serial Number : N/A
 Date : December 29, 2015

EQUIPMENT CLASS	FCC: DTS – DIGITAL TRNSMISSION SYSTEM IC: Low Power License-Exempt Radio-communication Device
E.U.T. DESCRIPTION	Zigbee Module
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
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 and RSS-Gen Issue 4 Nov 2014, RSS-247 Issue 1 May 2015
Modifications on the Equipment to Achieve Compliance	None
Final Test was Conducted On	10 m, Semi Anechoic Chamber

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC& IC 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.

2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.247 (a) (2)	RSS-247, 5.2(1) Minimum 6 dB Bandwidth & 99 % Occupied Bandwidth	Met the Limit / PASS
15.247 (b) (3)	RSS-247, 5.4(4) Maximum Peak Conducted Output Power	Met the Limit / PASS
15.247 (d)	RSS-247, 5.5 100 kHz Bandwidth Outside the Frequency Band	Met the Limit / PASS
15.247 (d)	RSS-247, 5.5 Radiated Emission which fall in the Restricted Band	Met the Limit / PASS
15.247 (e)	RSS-247, 5.2(2) Peak Power Spectral Density	Met the Limit / PASS
15.209	RSS-247, 5.5 Radiated Emission Limits	Met the Limit / PASS
15.207	RSS-Gen, Section 7.2.4 Conducted Limits	Met the Limit / PASS
15.203	RSS-Gen, Section 7.1.2 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 and IC RSS-Gen Issue 4 Nov 2014 and RSS-247 Issue 1 May 2015

2.5 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013. 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 301-14, Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do, 464-862 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. KT085

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

3. GENERAL INFORMATION

3.1 Product Description

The LG Electronics USA , Model WZB1NP6 (referred to as the EUT in this report) is a Zigbee Module. The product specification described herein was obtained from product data sheet or user's manual.

Device Type	Zigbee Module
Temperature Range	0 °C ~ + 60 °C
Operating Frequency	2 405 MHz ~ 2 480 MHz
RF Output Power	18.59 dBm
Number of Channel	16 Channel
Modulation Type	O-QPSK
Antenna Type	PCB Antenna
USED RF CHIP	Marker: Silicon Labs Model Name: EM3588
Antenna Gain	1.33 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	24 MHz

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

-. None

4. EUT MODIFICATIONS

-. None

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	LG Electronics Inc.	N/A	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
WZB1NP6	LG Electronics Inc.	Zigbee Module (EUT)	-
LGR501	LG	Notebook PC	-

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 2 405 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.

5.4 Configuration of Test System

Line Conducted Test: The EUT was connected to USB and the power of USB was connected to Notebook PC. All supporting equipments were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions.

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 meter open area test site.

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 and RSS-Gen Issue 4 November 2014 Section 8.3, 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 PCB 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)
It is not need to test this requirement, because the EUT shall be operated by DC power supply.	

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

7. MINIMUM 6 dB BANDWIDTH & 99 % OCCUPIED BANDWIDTH

7.1 Operating environment

Temperature : 22.1 °C
Relative humidity : 48.2 % 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. 29, 2015(1Y)

All test equipment used is calibrated on a regular basis.

7.4 Test data

-. Test Date : October 07, 2015

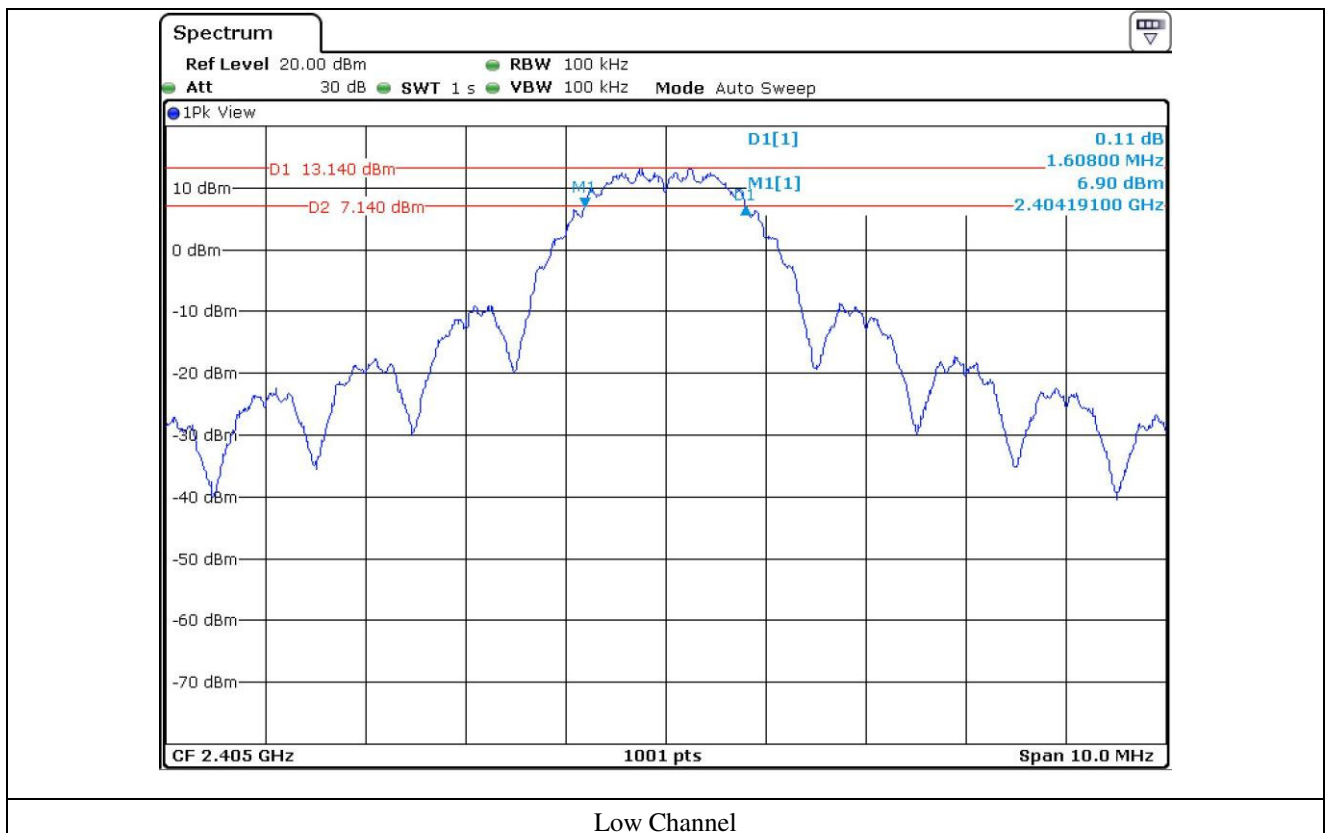
-. Test Result : Pass

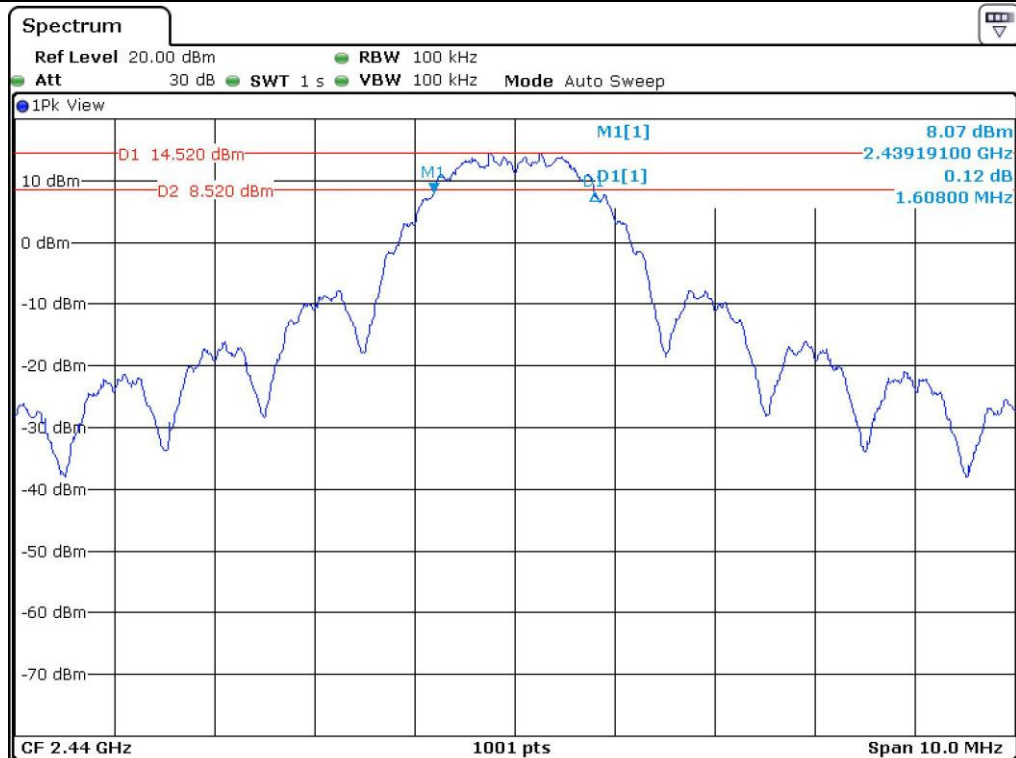
CHANNEL	FREQUENCY (MHz)	Occupied Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	Limit (MHz)	Margin (MHz)
Low	2 405	1.61	2.42	0.5	1.11
Middle	2 440	1.61	2.42	0.5	1.11
High	2 480	1.61	2.43	0.5	1.11

Remark. Margin = Measured Value - Limit

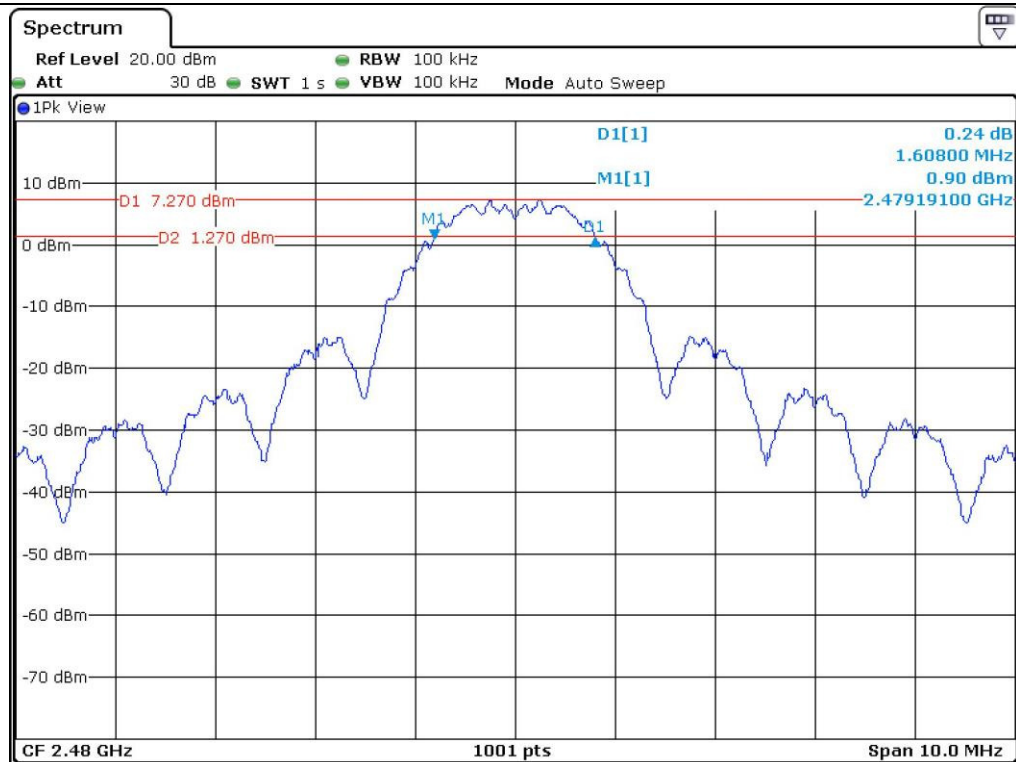


Tested by: Tae-Ho, Kim / Project Engineer





Middle Channel



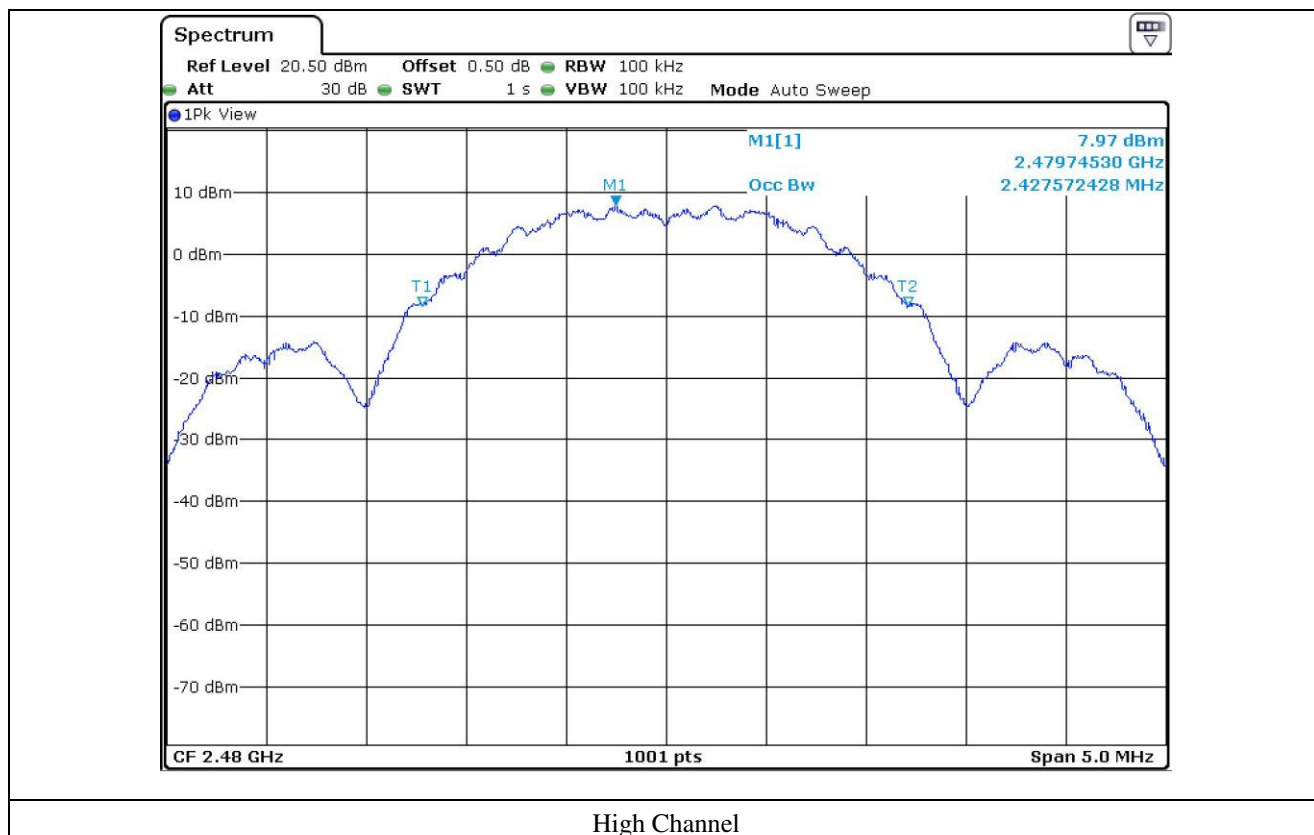
High Channel



Low Channel



Middle Channel



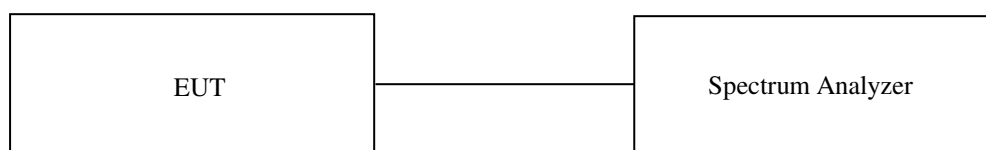
8. MAXIMUM PEAK OUTPUT POWER

8.1 Operating environment

Temperature : 22.1 °C
Relative humidity : 48.2 % 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. 29, 2015(1Y)

All test equipment used is calibrated on a regular basis.

8.4 Test data

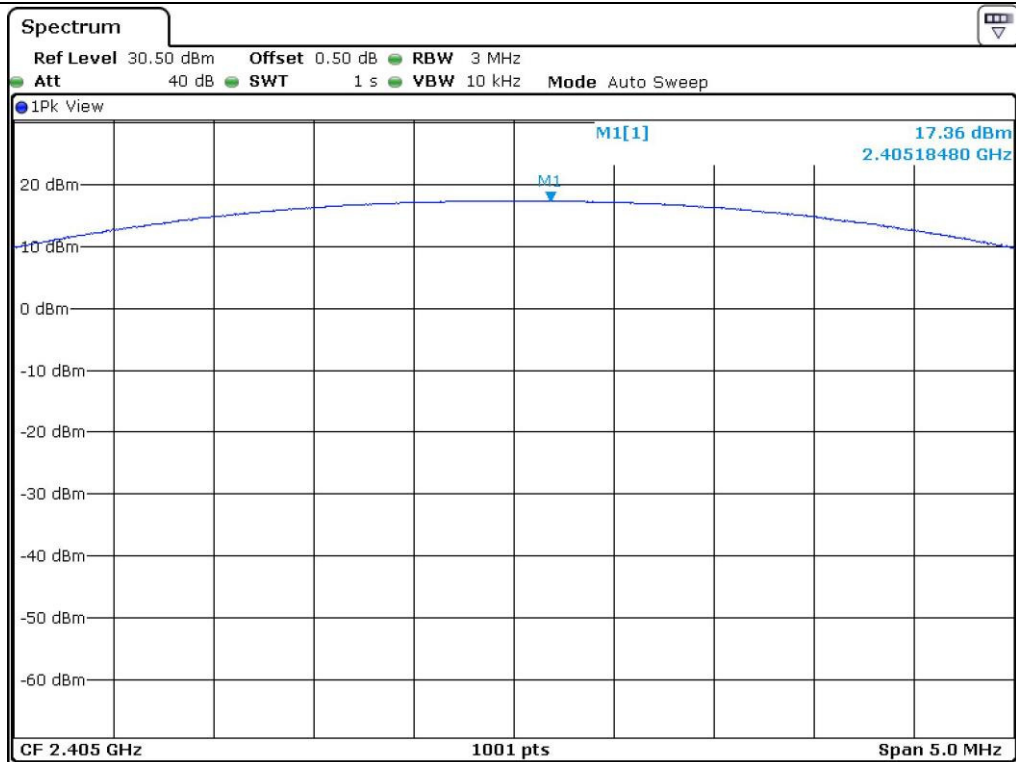
-. Test Date : October 07, 2015
 -. Test Result : Pass

- FCC Test data

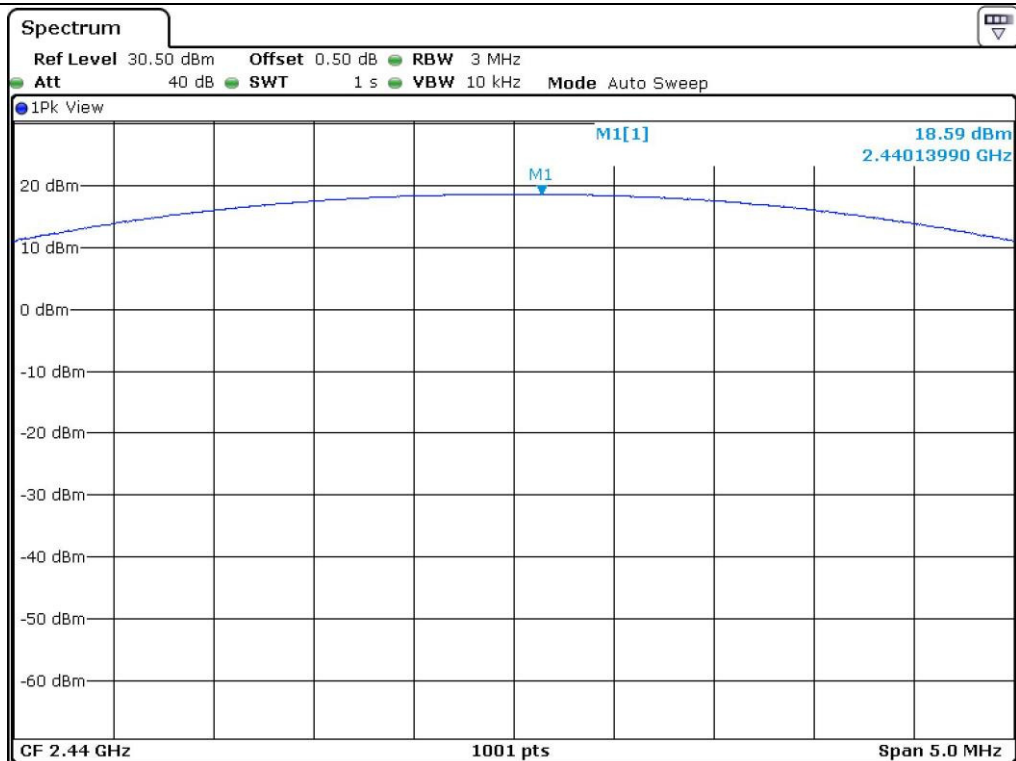
CHANNEL	FREQUENCY (MHz)	DTS (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 405	1.61	17.36	30	12.64
MIDDLE	2 440	1.61	18.59	30	11.41
HIGH	2 480	1.61	11.23	30	18.77

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

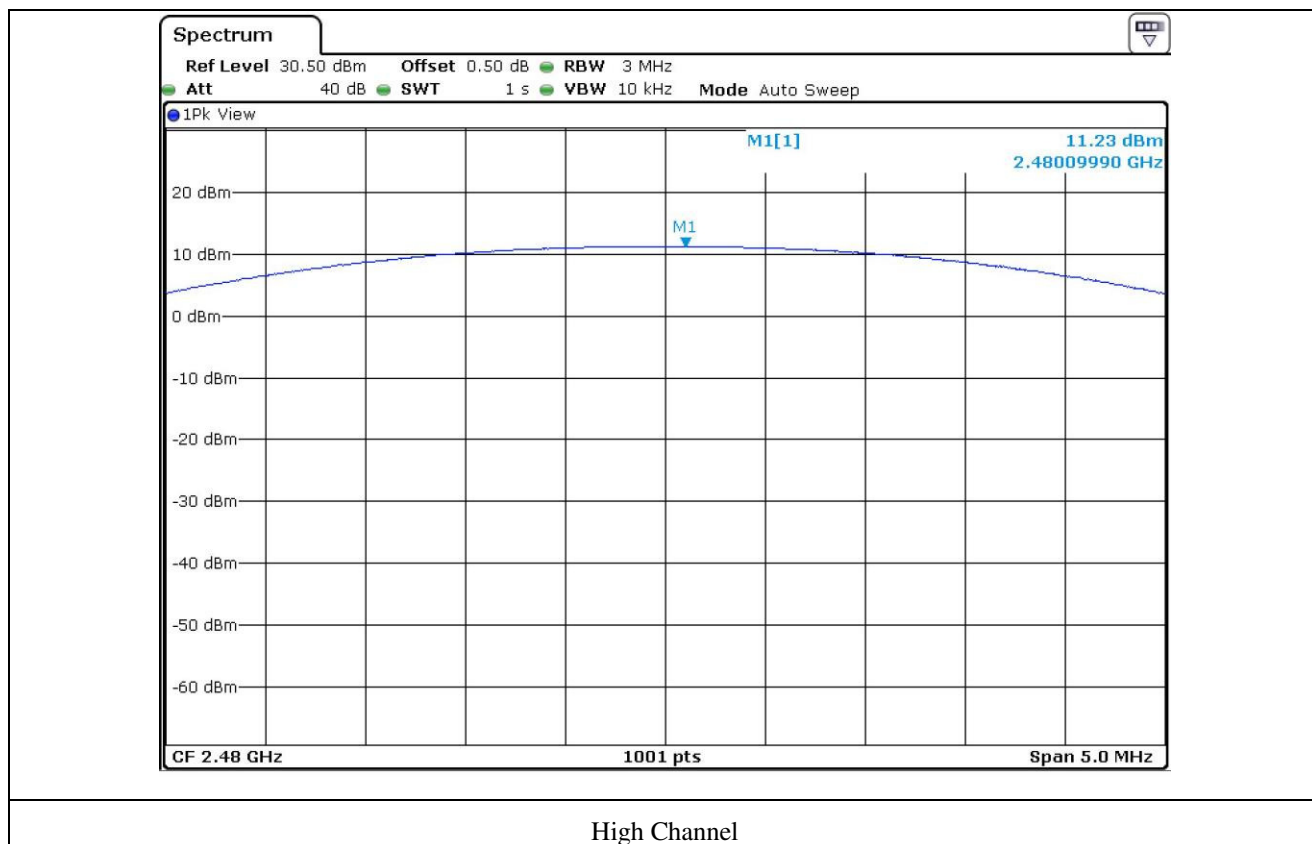
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Low Channel



Middle Channel



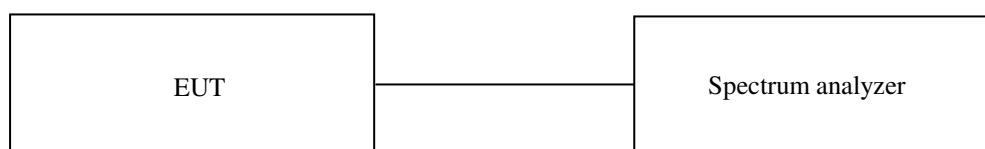
9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

9.1 Operating environment

Temperature : 22.2 °C
Relative humidity : 45 % 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 on the 3 m semi anechoic chamber. 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 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. 02, 2015(1Y)
■ -	ESU	Rohde & Schwarz	EMI Test Receiver	100261	Apr. 29, 2015(1Y)
□ -	8564E	HP	Spectrum Analyzer	3650A00756	Apr. 28, 2015(1Y)
□ -	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Oct. 07, 2015(1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Apr. 29, 2015(1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2015(1Y)
■ -	SCU-18	Rohde & Schwarz	PRE-AMPLIFIER	10041	Nov. 02, 2015(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	879285/26	Dec. 09, 2014(2Y)
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-255	May 02, 2014(2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Apr. 31, 2015(2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Apr. 31, 2015(2Y)
■ -	83051A	Agilent	Microwave System Preamplifier	3950M00201	Apr. 30, 2015(1Y)

All test equipment used is calibrated on a regular basis.

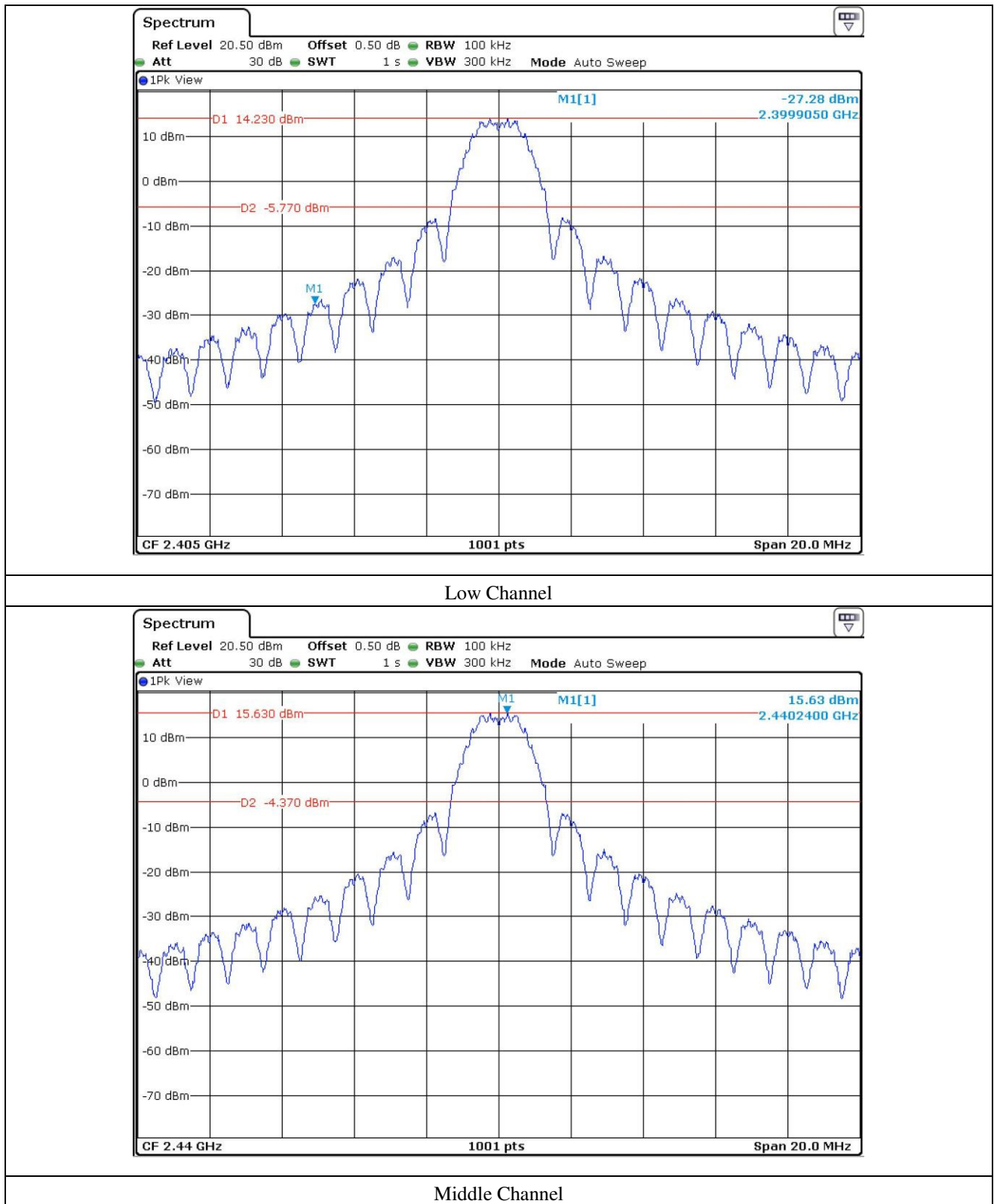
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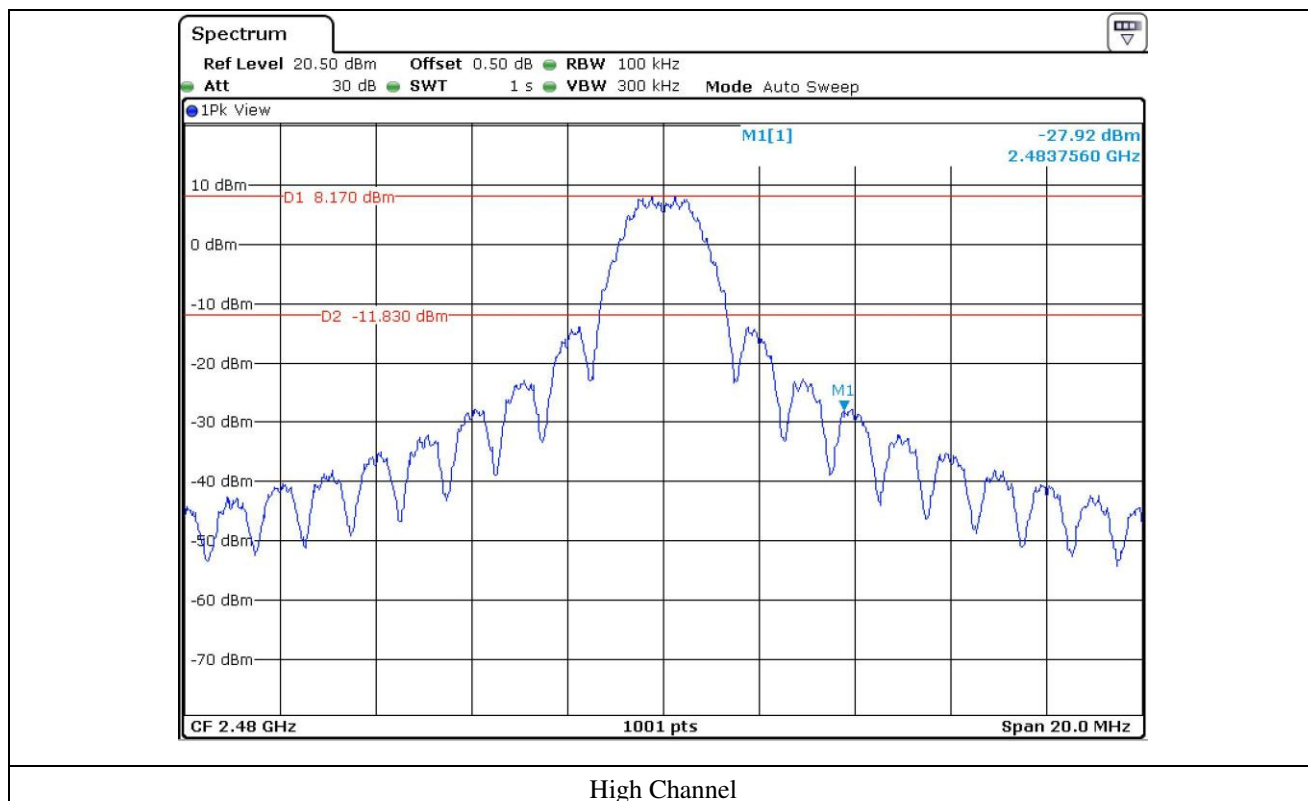
EMC-003 (Rev.2)

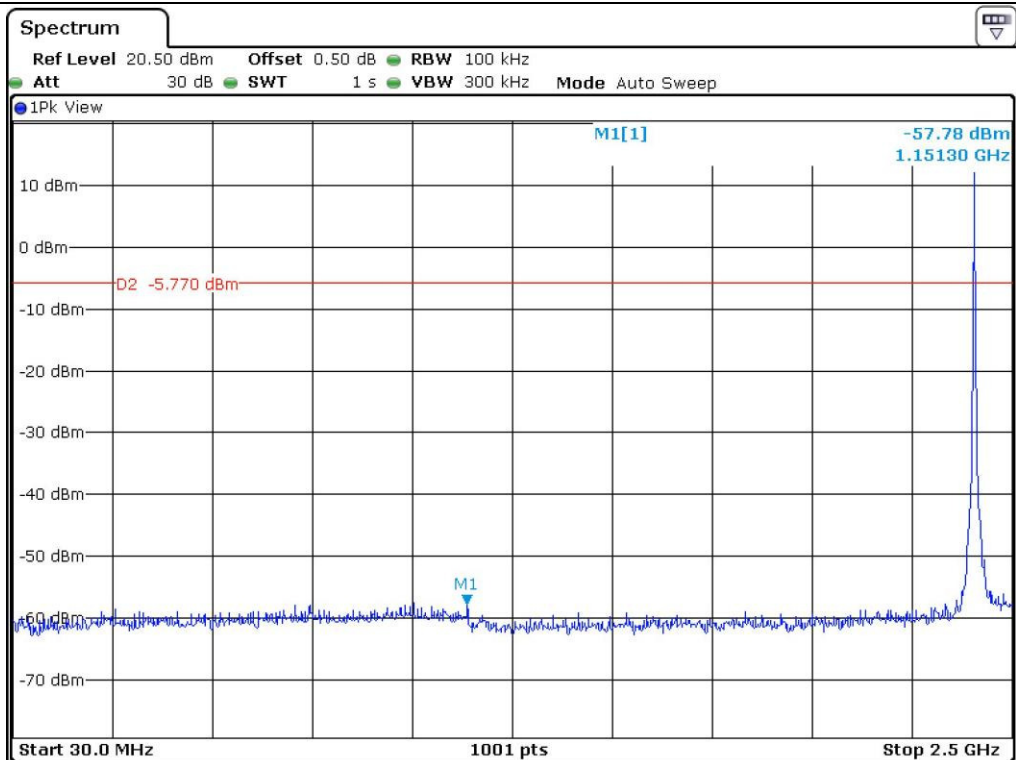
HEAD OFFICE : 301-14 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

EMC Testing Div. : 307-51 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-765-8289, FAX: 82-31-766-2904)

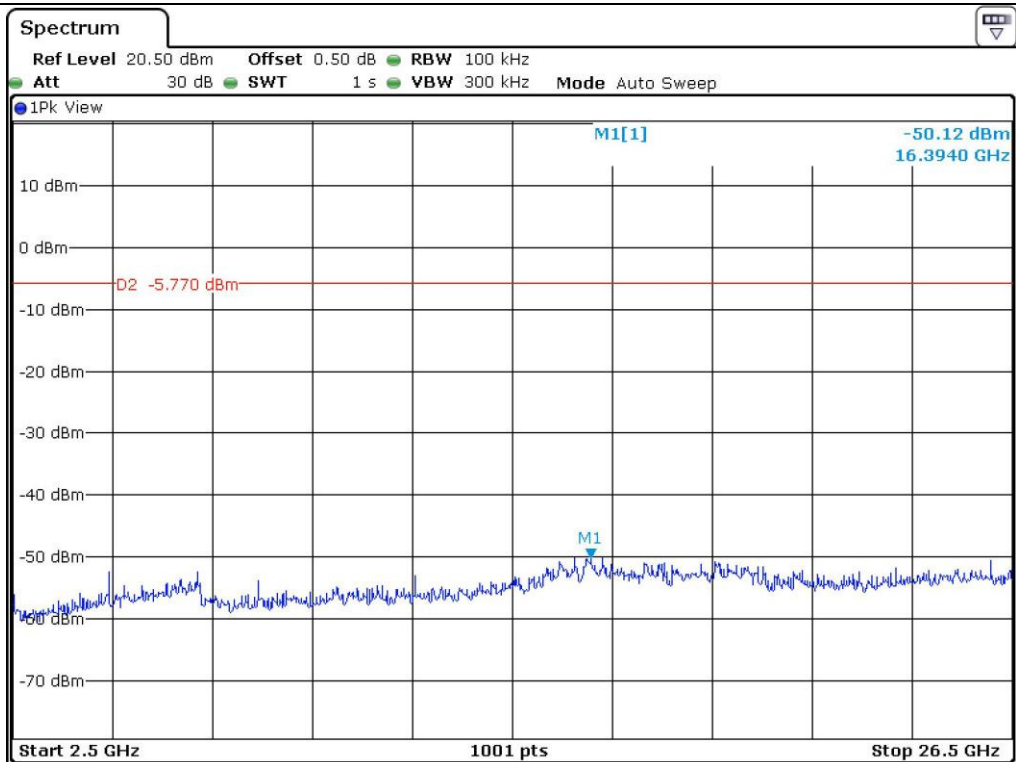
9.5 Test data for conducted emission



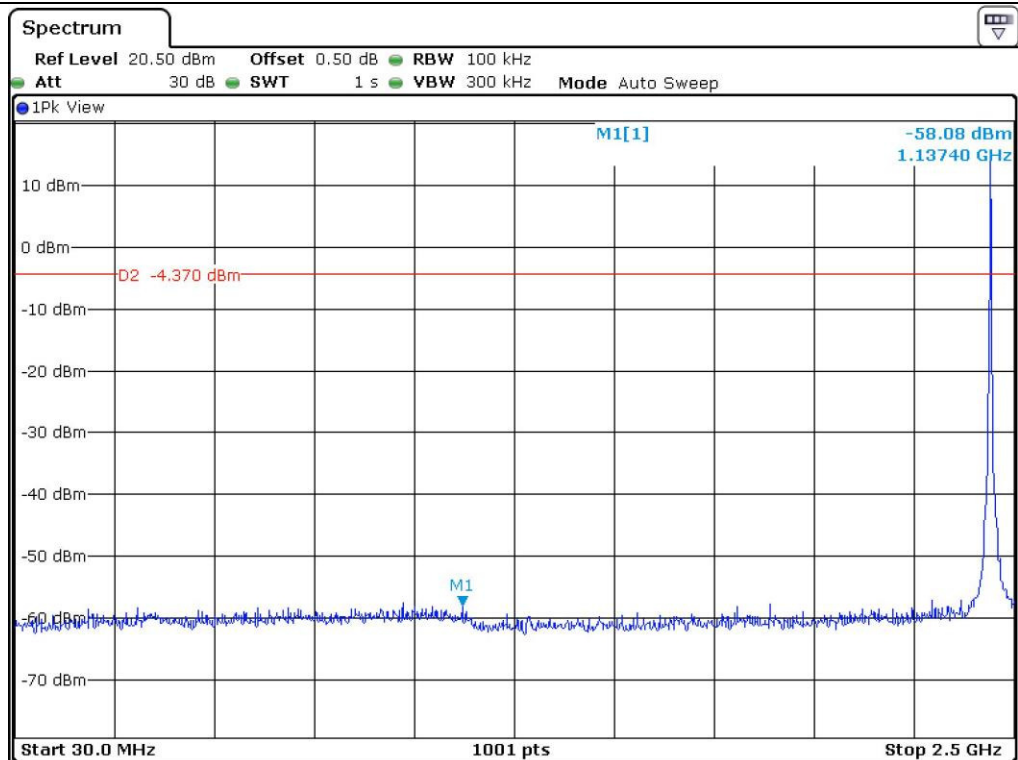




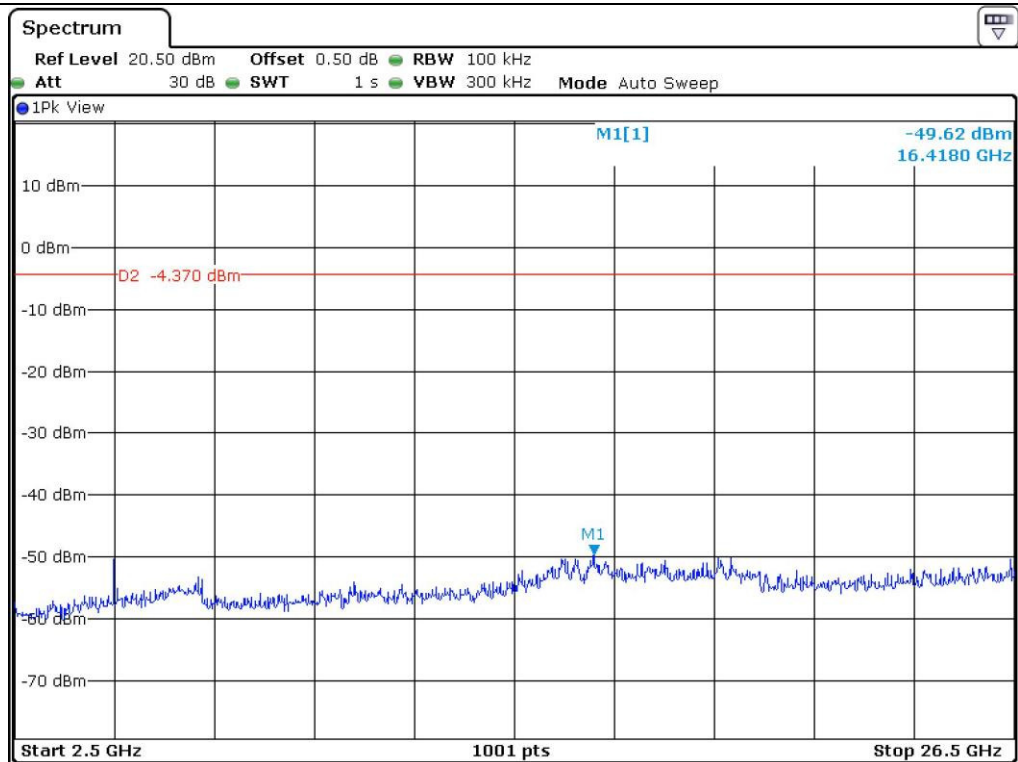
Low Channel



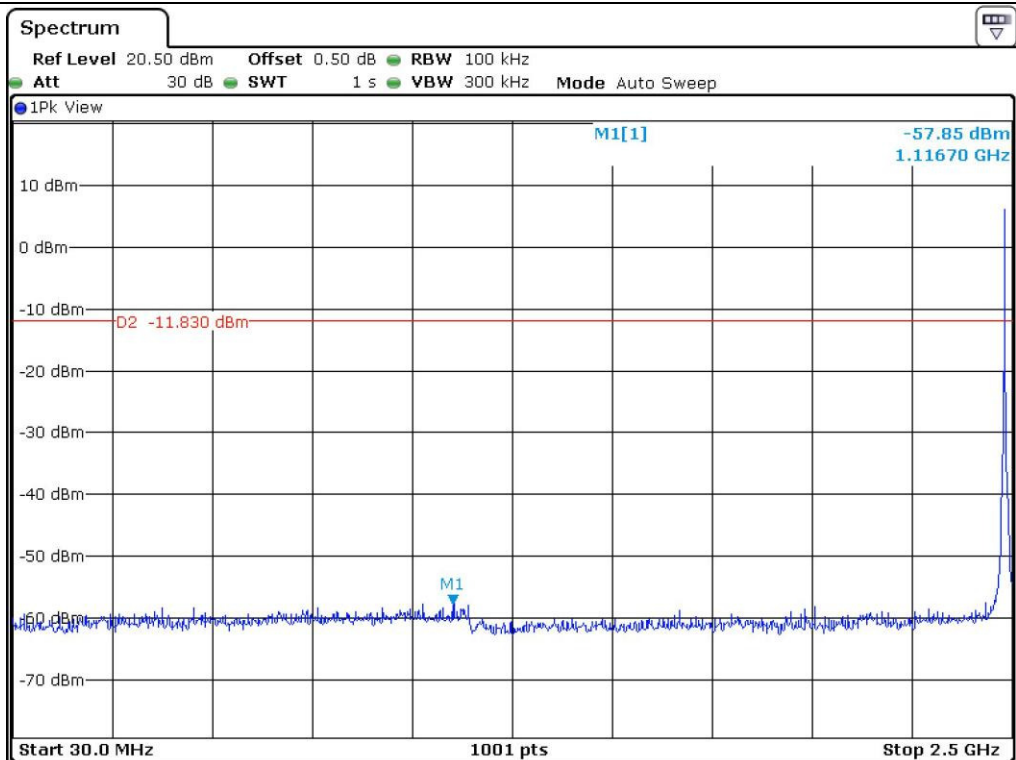
Low Channel



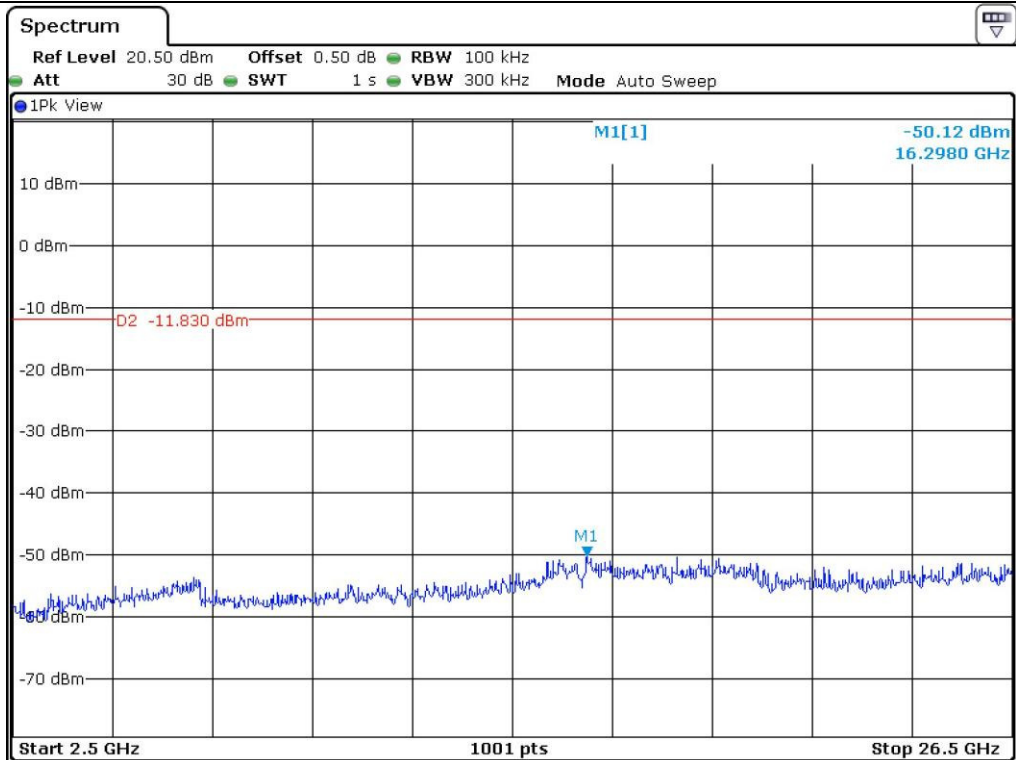
Middle Channel



Middle Channel



High Channel



High Channel

9.6 Test data for radiated emission

9.6.1 Radiated Emission which fall in the Restricted Band

- Test Date : October 07, 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
- 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									
2.390 000	45.24	Peak	H	27.20	7.10	43.10	36.44	74.00	37.56
	38.70	Average	H				29.90	54.00	24.10
	42.71	Peak	V				33.91	74.00	40.09
	35.25	Average	V				26.45	54.00	27.55
Test Data for Middle Channel									
2.400 000	64.33	Peak	H	27.20	7.10	43.10	55.53	74.00	18.47
	58.69	Average	H				49.89	54.00	4.11
	60.61	Peak	V				51.81	74.00	22.19
	54.23	Average	V				45.43	54.00	8.57
Test Data for High Channel									
2.483 580	65.75	Peak	H	27.40	7.10	43.10	57.15	74.00	16.85
	58.12	Average	H				49.52	54.00	4.48
	55.70	Peak	V				47.10	74.00	26.90
	41.20	Average	V				32.60	54.00	21.40

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: Tae-Ho, Kim / Project Engineer

9.6.2 Spurious & Harmonic Radiated Emission

- Test Date : October 07, 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									
4 810.00	48.12	Peak	H	31.10	9.60	42.40	46.42	73.98	27.56
	37.95	Average	H				36.25	53.98	17.73
	49.25	Peak	V				47.55	73.98	26.43
	37.51	Average	V				35.81	53.98	18.17
Test Data for Middle Channel									
4 880.00	48.51	Peak	H	31.30	9.80	42.40	47.21	73.98	26.77
	38.21	Average	H				36.91	53.98	17.07
	50.22	Peak	V				48.92	73.98	25.06
	49.89	Average	V				48.59	53.98	5.39
Test Data for High Channel									
4 960.00	46.84	Peak	H	31.30	9.90	42.30	45.74	73.98	28.24
	36.51	Average	H				35.41	53.98	18.57
	47.88	Peak	V				46.78	73.98	27.20
	37.26	Average	V				36.16	53.98	17.82

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: Tae-Ho, Kim / Project Engineer

10. PEAK POWER SPECTRUL DENSITY

10.1 Operating environment

Temperature : 22.1 °C
Relative humidity : 48.2 % 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. 29, 2015(1Y)

All test equipment used is calibrated on a regular basis.

10.4 Test data

-. Test Date : October 07, 2015

-. Test Result : Pass

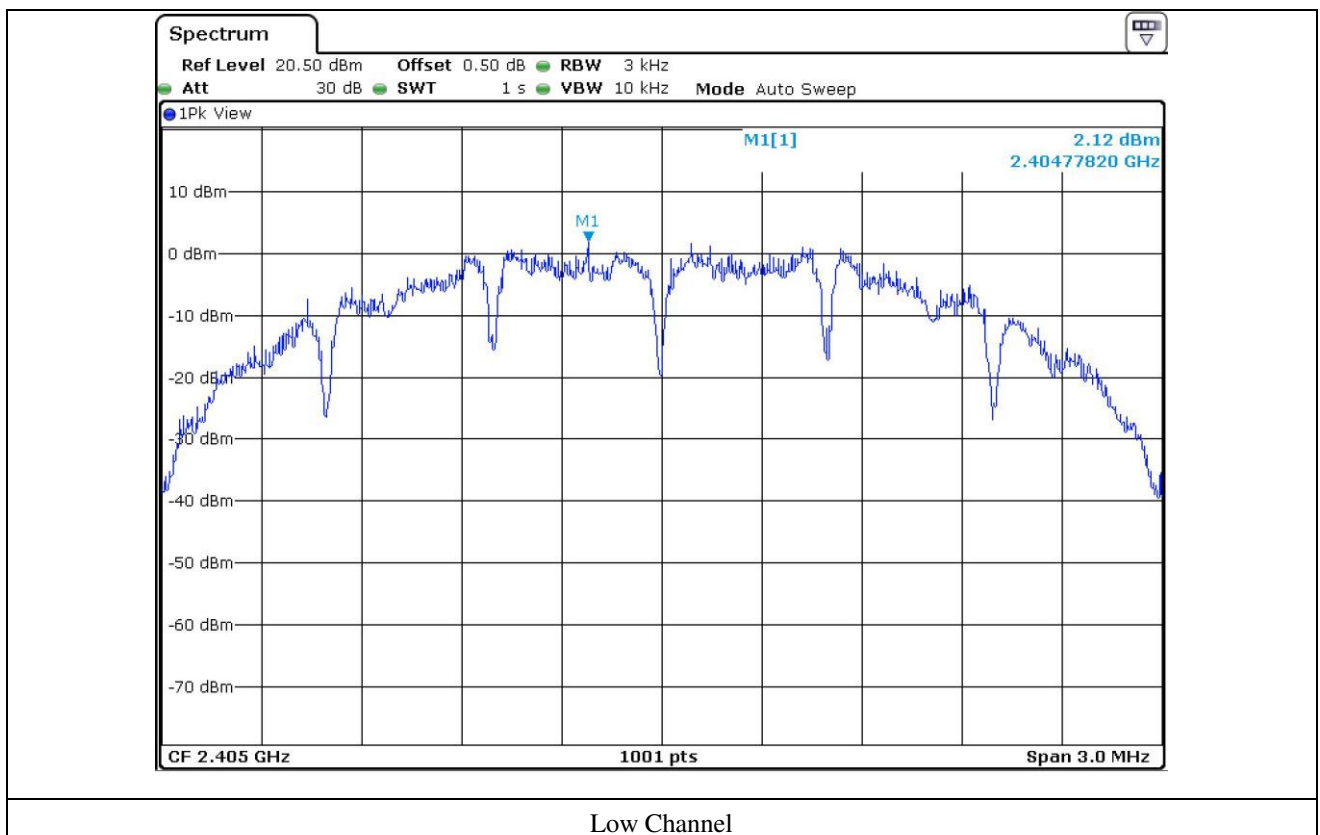
-. Operating Condition : Continuous transmitting mode

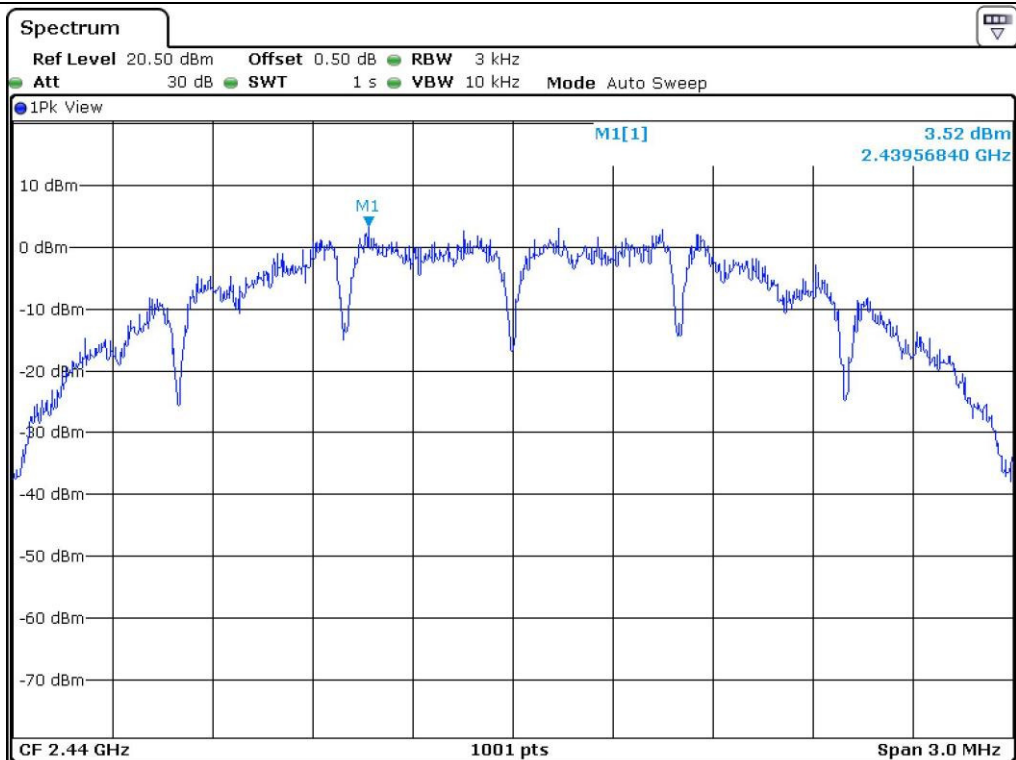
CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 405	2.12	8.00	-6.88
Middle	2 440	3.52	8.00	-4.48
High	2 480	-3.85	8.00	-11.85

Remark. Margin = Limit – Measured value

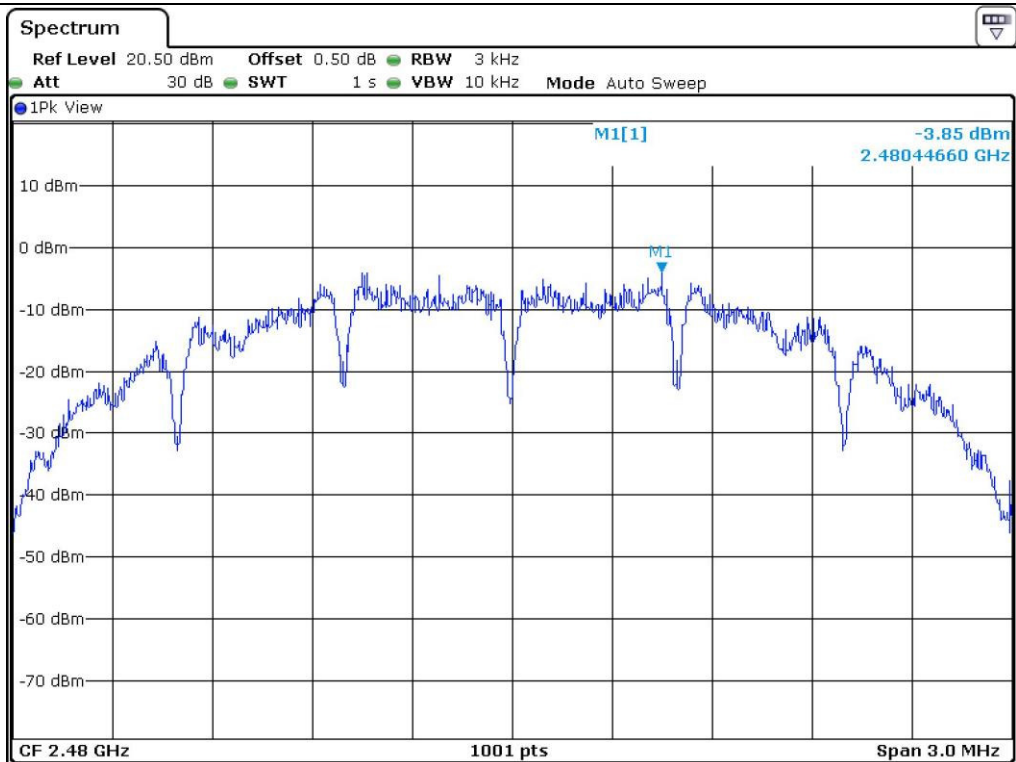


Tested by: Tae-Ho, Kim / Project Engineer





Middle Channel



High Channel

11. RADIATED EMISSION TEST

11.1 Operating environment

Temperature : 22.1 °C
Relative humidity : 48.2 % R.H.

11.2 Test set-up

The radiated emissions measurements were on the 3 m, 3 m semi anechoic chamber. 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. 02, 2015(1Y)
■ -	ESU	Rohde & Schwarz	EMI Test Receiver	100261	Apr. 29, 2015(1Y)
□ -	8564E	HP	Spectrum Analyzer	3650A00756	Apr. 28, 2015(1Y)
□ -	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Oct. 07, 2015(1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Apr. 29, 2015(1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2015(1Y)
■ -	SCU-18	Rohde & Schwarz	PRE-AMPLIFIER	10041	Nov. 02, 2015(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	879285/26	Dec. 09, 2014(2Y)
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-255	May 02, 2014(2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Apr. 31, 2015(2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Apr. 31, 2015(2Y)
■ -	83051A	Agilent	Microwave System Preamplifier	3950M00201	Apr. 30, 2015(1Y)

All test equipment used is calibrated on a regular basis.

11.4 Test data

11.4.1 Test data for 30 MHz ~ 1 000 MHz

Humidity Level : 48.2 % R.H.

Temperature: 22.1 °C

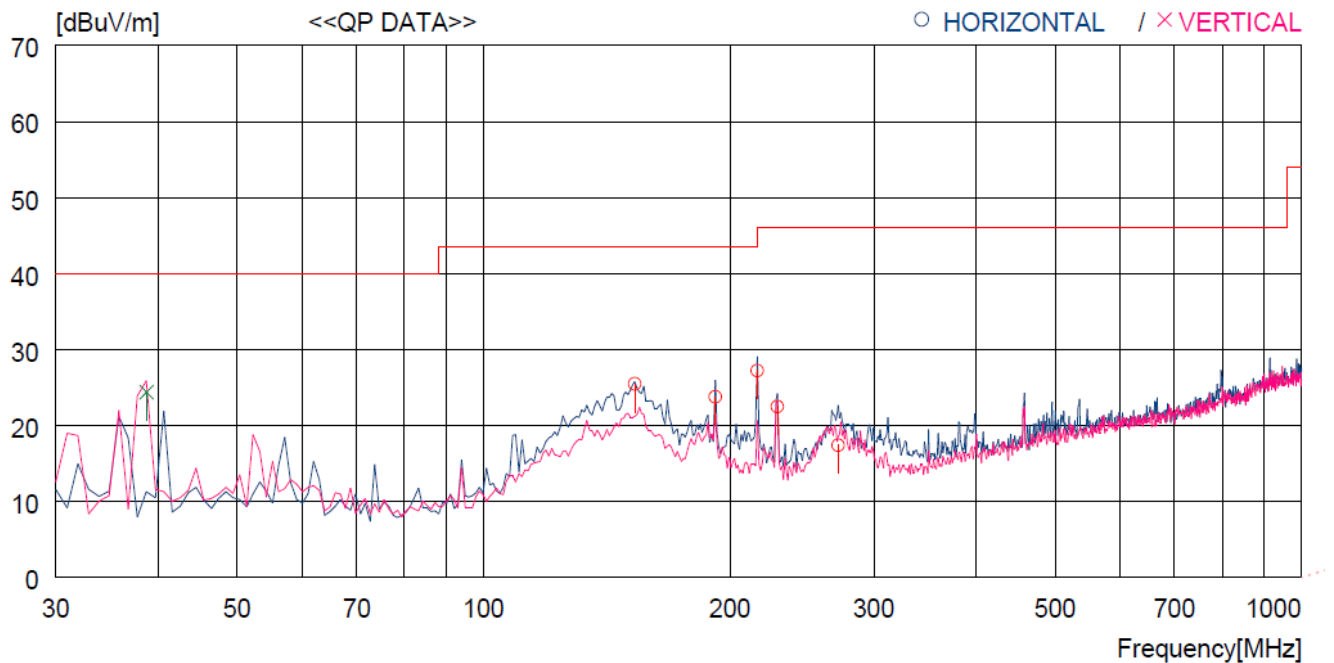
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : Zigbee Module

Date: October 07, 2015

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



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	[dBuV]	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal -----										
1	153.190	46.8	8.4	3.3	33.0	25.5	43.5	18.0	200	239
2	191.990	42.6	10.3	3.7	32.8	23.8	43.5	19.7	200	54
3	216.240	44.8	11.3	3.9	32.8	27.2	46.0	18.8	200	282
4	228.850	39.6	11.7	4.0	32.8	22.5	46.0	23.5	200	47
5	271.530	32.9	12.9	4.4	32.8	17.4	46.0	28.6	400	126
----- Vertical -----										
6	38.730	42.5	13.0	1.8	32.9	24.4	40.0	15.6	400	359

Tested by: Tae-Ho, Kim / Project Engineer

11.4.2 Test data for Below 30 MHz

- . Test Date : October 07, 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 (dB μ V)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
It was not observed any emissions from the EUT.									

11.4.3 Test data for above 1 GHz

- . Test Date : October 07, 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 (dB μ V)	Ant. Pol. (H/V)	Ant. Height (m)	Angle (°)	Ant. Factor (dB/m)	Cable Loss	Emission Level(dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
It was not observed any emissions from the EUT.									



Tested by: Tae-Ho, Kim / Project Engineer

12. SPURIOUS EMISSION - RECEIVER

12.1 Operating environment

Temperature : 22.1 °C
Relative humidity : 48.2 % R.H.

12.2 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.



12.3 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 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.

12.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
□ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Nov. 02, 2015(1Y)
■ -	ESU	Rohde & Schwarz	EMI Test Receiver	100261	Apr. 29, 2015(1Y)
□ -	8564E	HP	Spectrum Analyzer	3650A00756	Apr. 28, 2015(1Y)
□ -	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Oct. 07, 2015(1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Apr. 29, 2015(1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101372	Apr. 28, 2015(1Y)
■ -	SCU-18	Rohde & Schwarz	PRE-AMPLIFIER	10041	Nov. 02, 2015(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	879285/26	Dec. 09, 2014(2Y)
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-255	May 02, 2014(2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Apr. 31, 2015(2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Apr. 31, 2015(2Y)
■ -	83051A	Agilent	Microwave System Preamplifier	3950M00201	Apr. 30, 2015(1Y)

All test equipment used is calibrated on a regular basis.

12.5 Test data

12.5.1 Test data for 30 MHz ~ 1 000 MHz

Humidity Level : 48.2 % R.H.

Temperature: 22.1 °C

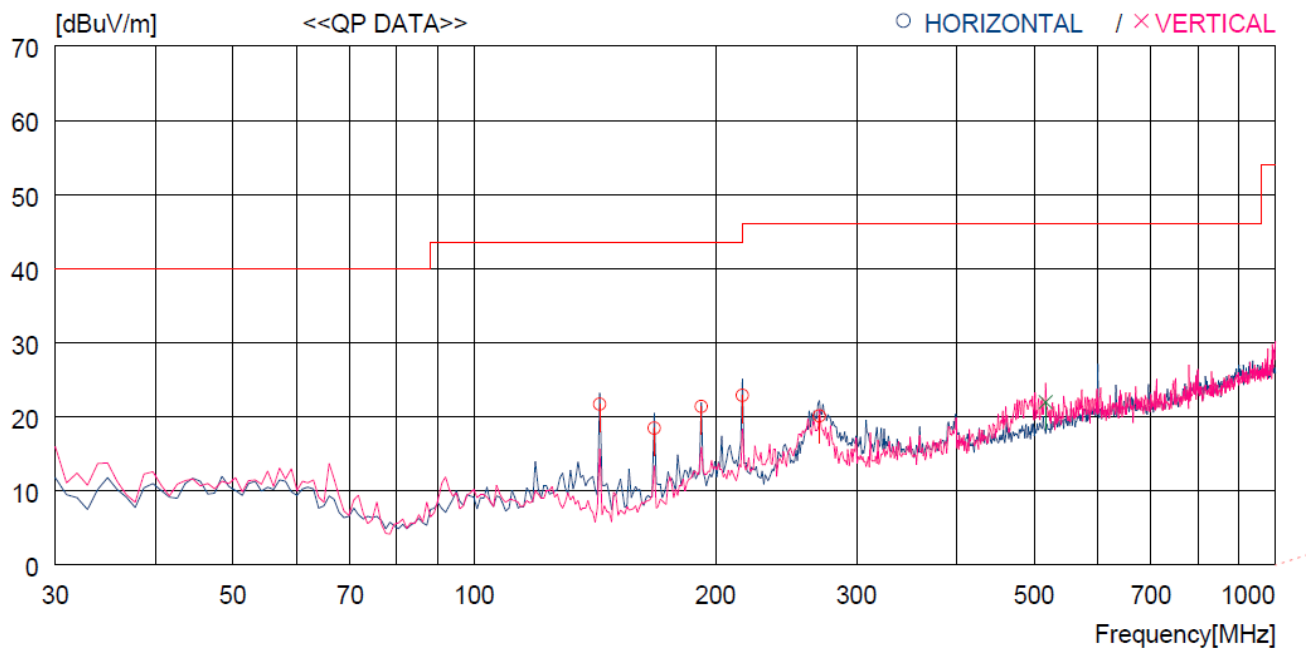
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : Zigbee Module

Date: October 07, 2015

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



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	QP	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal -----										
1	143.490	43.3	8.2	3.2	33.0	21.7	43.5	21.8	200	358
2	167.740	38.9	9.0	3.5	32.9	18.5	43.5	25.0	300	197
3	191.990	40.2	10.3	3.7	32.8	21.4	43.5	22.1	200	358
4	216.240	40.5	11.3	3.9	32.8	22.9	46.0	23.1	200	326
5	269.590	35.6	12.9	4.4	32.8	20.1	46.0	25.9	400	0
----- Vertical -----										
6	516.940	31.2	17.6	6.1	32.9	22.0	46.0	24.0	100	34

Tested by: Tae-Ho, Kim / Project Engineer

12.5.2 Test data for Below 30 MHz

- . Test Date : October 07, 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

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.									

12.5.3 Test data for above 1 GHz

- . Test Date : October 07, 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

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: Tae-Ho, Kim / Project Engineer

13. CONDUCTED EMISSION TEST

13.1 Operating environment

Temperature : 22.1 °C
Relative humidity : 48.2 % R.H.

13.2 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 μ H + 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.

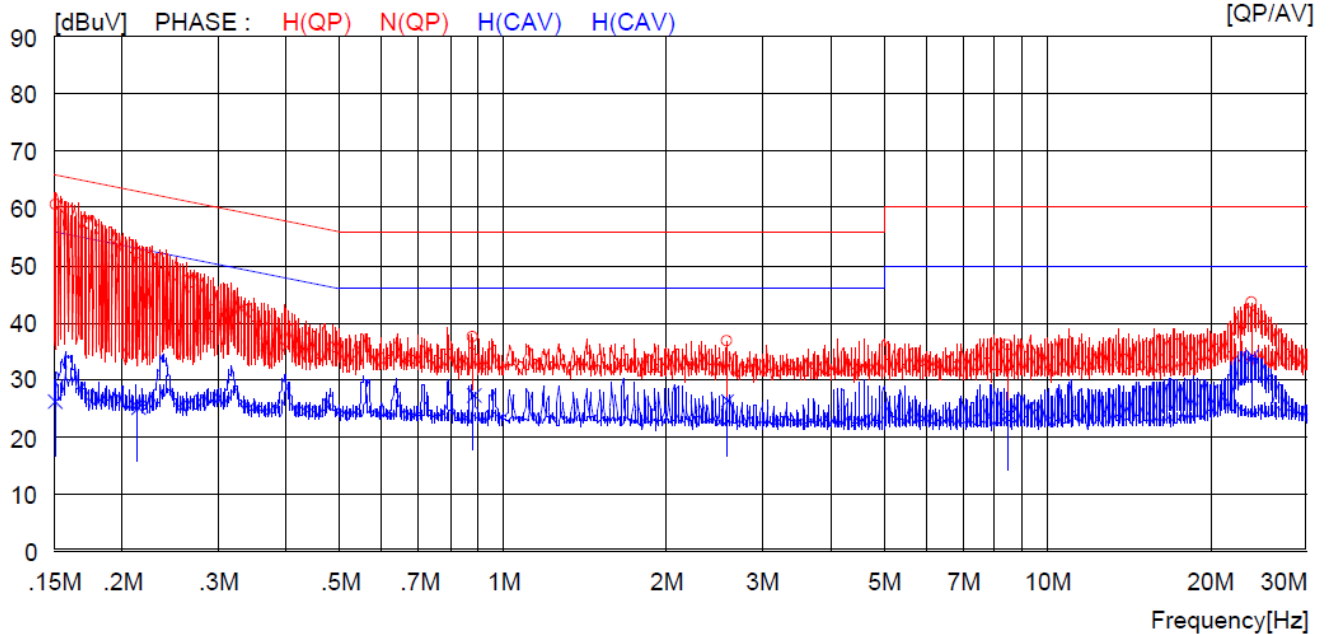
13.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	ESPI	Rohde & Schwarz	Test Receiver	101012	Nov. 03, 2014 (1Y)
□ -	ESHS10	Rohde & Schwarz	Test Receiver	834467/007	Apr. 29, 2015 (1Y)
□ -	NSLK8128	Schwarzbeck	AMN	8128-216	Apr. 06, 2015 (1Y)
■ -	NSLK8126	Schwarzbeck	AMN	8126-404	Apr. 29, 2015 (1Y)
□ -	3825/2	EMCO	AMN	9109-1869	Apr. 29, 2015 (1Y)
■ -	3825/2	EMCO	AMN	9109-1867	Apr. 29, 2015 (1Y)

All test equipment used is calibrated on a regular basis.

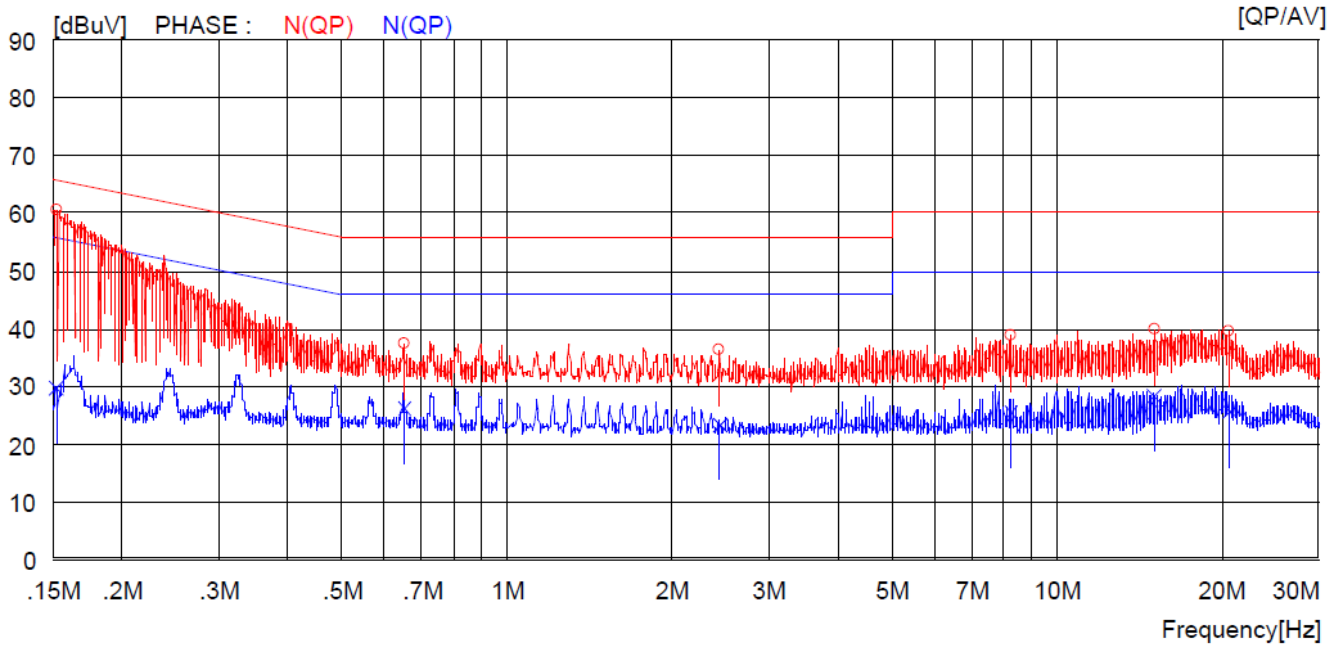
13.4 Test data

- Test Date : October 07, 2015
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Tested Line : HOT LINE



NO	FREQ		READING		C.FACTOR		RESULT		LIMIT		MARGIN	PHASE
	QP	AV	QP	AV	QP	AV	QP	AV	QP	AV		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]		
1	0.15100	40.2	---	---	20.2	---	60.4	---	65.9	---	5.5	H(QP)
2	0.21400	31.8	---	---	20.2	---	52.0	---	63.0	---	11.0	H(QP)
3	0.88400	17.3	---	---	20.2	---	37.5	---	56.0	---	18.5	H(QP)
4	2.58400	16.5	---	---	20.2	---	36.7	---	56.0	---	19.3	H(QP)
5	8.50000	15.7	---	---	20.3	---	36.0	---	60.0	---	24.0	H(QP)
6	23.80000	23.1	---	---	20.4	---	43.5	---	60.0	---	16.5	H(QP)
7	0.15100	---	---	6.0	20.2	---	26.2	---	55.9	---	29.7	H(CAV)
8	0.21400	---	---	5.0	20.2	---	25.2	---	53.0	---	27.8	H(CAV)
9	0.88400	---	---	7.2	20.2	---	27.4	---	46.0	---	18.6	H(CAV)
10	2.58400	---	---	6.2	20.2	---	26.4	---	46.0	---	19.6	H(CAV)
11	8.50000	---	---	3.6	20.3	---	23.9	---	50.0	---	26.1	H(CAV)
12	23.80000	---	---	13.7	20.4	---	34.1	---	50.0	---	15.9	H(CAV)

-. Tested Line : NEUTRAL LINE



NO	FREQ		READING		C.FACTOR		RESULT		LIMIT		MARGIN		PHASE
	QP	AV	QP	AV	QP	AV	QP	AV	QP	AV	QP	AV	
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	
1	0.15200	40.4	----	20.2	60.6	----	65.9	----	5.3	----	N(QP)		
2	0.65300	17.2	----	20.2	37.4	----	56.0	----	18.6	----	N(QP)		
3	2.44400	16.0	----	20.2	36.2	----	56.0	----	19.8	----	N(QP)		
4	8.24500	18.5	----	20.3	38.8	----	60.0	----	21.2	----	N(QP)		
5	15.05000	19.6	----	20.3	39.9	----	60.0	----	20.1	----	N(QP)		
6	20.63000	19.3	----	20.3	39.6	----	60.0	----	20.4	----	N(QP)		
7	0.15200	----	9.6	20.2	----	29.8	----	55.9	----	26.1	N(CAV)		
8	0.65300	----	6.1	20.2	----	26.3	----	46.0	----	19.7	N(CAV)		
9	2.44400	----	3.2	20.2	----	23.4	----	46.0	----	22.6	N(CAV)		
10	8.24500	----	5.2	20.3	----	25.5	----	50.0	----	24.5	N(CAV)		
11	15.05000	----	8.1	20.3	----	28.4	----	50.0	----	21.6	N(CAV)		
12	20.63000	----	5.4	20.3	----	25.7	----	50.0	----	24.3	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: Tae-Ho, Kim / Project Engineer