

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

Test Report No. : E142R-046

AGR No. : A141A-198

Applicant : HUMAX Co.,Ltd.
Address : HUMAX Village, 11-4, Sunae-dong, Bundang-gu, Seongnam city, Gyeonggi-do, 463-825, Korea

Manufacturer : HUMAX Co.,Ltd.
Address : HUMAX Village, 216, Hwangsaeul-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, 463-875, Korea

Type of Equipment : IP Client STB

FCC ID. : O6ZTCI-100

Model Name : TCI-100

Serial number : N/A

Total page of Report : 61 pages (including this page)

Date of Incoming : February 05, 2014

Date of issue : February 18, 2014

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.

Prepared by: 

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 ONETECH Corp.

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 ONETECH Corp.

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Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
E142R-046	February 18, 2014	Initial Issue	All

1. VERIFICATION OF COMPLIANCE

Applicant : HUMAX Co.,Ltd.
 Address : HUMAX Village, 11-4, Sunae-dong, Bundang-gu, Seongnam city, Gyeonggi-do,
 463-825, Korea
 Contact Person : Mr. Nak Yool Sung / Engineer
 Telephone No. : +82-31-776-6748
 FCC ID : O6ZTCI-100
 Model Name : TCI-100
 Serial Number : N/A
 Date : February 18, 2014

Equipment Class	<i>DTS – DIGITAL TRNSMISSION SYSTEM</i>
Kind of Equipment	IP Client STB
This Report Concerns	Original Grant
Measurement Procedures	ANSI C63.10: 2009 FCC KDB 558074 D01 DTS Meas Guidance v03r01
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.

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
15.247 (i)	Radio Frequency Exposure Level	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 section 2.1.

2.5 Test Methodology

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

2.6 Test Facility

The open area test site is located at 307-51 Daessangryung-ri, Chowol-eup, Gwangju-si, Gyeonggi-do and 10 m Semi Anechoic Chamber (SAC) and conducted measurement facilities are located at 301-14, Daessangryung-ri, Chowol-eup, Gwangju-si, Gyeonggi-do, 464-862, Korea. The Onetech Corp. has been accredited as a Conformity Assessment Body (CAB) with designation number KR0013 under APEC TEL MAR between the RRA and the FCC

3. GENERAL INFORMATION

3.1 Product Description

The HUMAX Co.,Ltd., Model TCI-100 (referred to as the EUT in this report) is a IP Client STB which has a function of Zigbee, TV Interface, and PC Peripheral device, but this report concerns for Zigbee function and test report for other functions shall be issued with another test report number. The product specification described herein was obtained from product data sheet or user’s manual.

Device Type	IP Client STB	
Temperature Range	-10 °C ~ +50 °C	
Operating Frequency	2 425 MHz ~ 2 475 MHz	
RF Output Power	ANTENNA 0	1.83 dBm
	ANTENNA 1	0.20 dBm
Number of Channel	3 Channels	
Data Rate	250 kbps	
Modulation Type	O-QPSK	
Antenna Connector Type	PCB Antenna	
Antenna Gain	ANTENNA 0	3.60 dBi
	ANTENNA 1	1.80 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	CPU 50MHz, RF4CE 16MHz, MoCA 50MHz, DDR 800MHz	
External Connector	LAN, Cable in, cable out, HDMI out, USB,	

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	HUMAX Co.,Ltd.	TCI-100 CPU B/D REV.:0.3	N/A

5.2 Peripheral equipment

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

Model	Manufacturer	FCC ID	Description	Connected to
TCI-100	HUMAX Co.,Ltd.	O6ZTCI-100	IP Client STB (EUT)	PC & AC/DC Adapter
PP11L	DELL	N/A	PC	EUT
ADP-15AR AB	DELTA ELECTRONICS,INC	N/A	AC/DC Adapter	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 Low Channel (2 425 MHz), Middle Channel (2 450 MHz), and High Channel (2 475 MHz) to get a maximum emission levels from the EUT.

The EUT has 2 TX/RX antennas, so each antenna was tested and corrected the results in this report.

5.4 Configuration of Test System

Line Conducted Test: 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 m 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 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)
TX 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)
TX mode	X

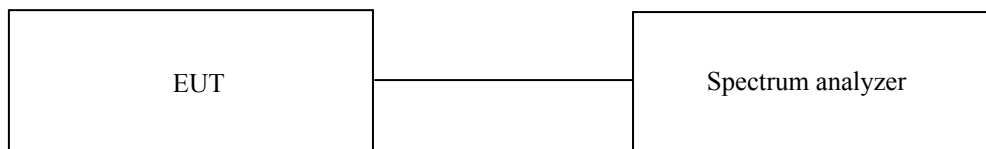
7. MIMIMUM 6 dB BANDWIDTH

7.1 Operating environment

Temperature : 24 °C
Relative humidity : 44 % 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.
■ - FSW	R/S	Spectrum Analyzer	13128000K67	Dec 11, 2013 (1Y)

All test equipment used is calibrated on a regular basis.

7.4 Test data

7.4.1 Test date for Antenna 0

- Test Date : February 10, 2014

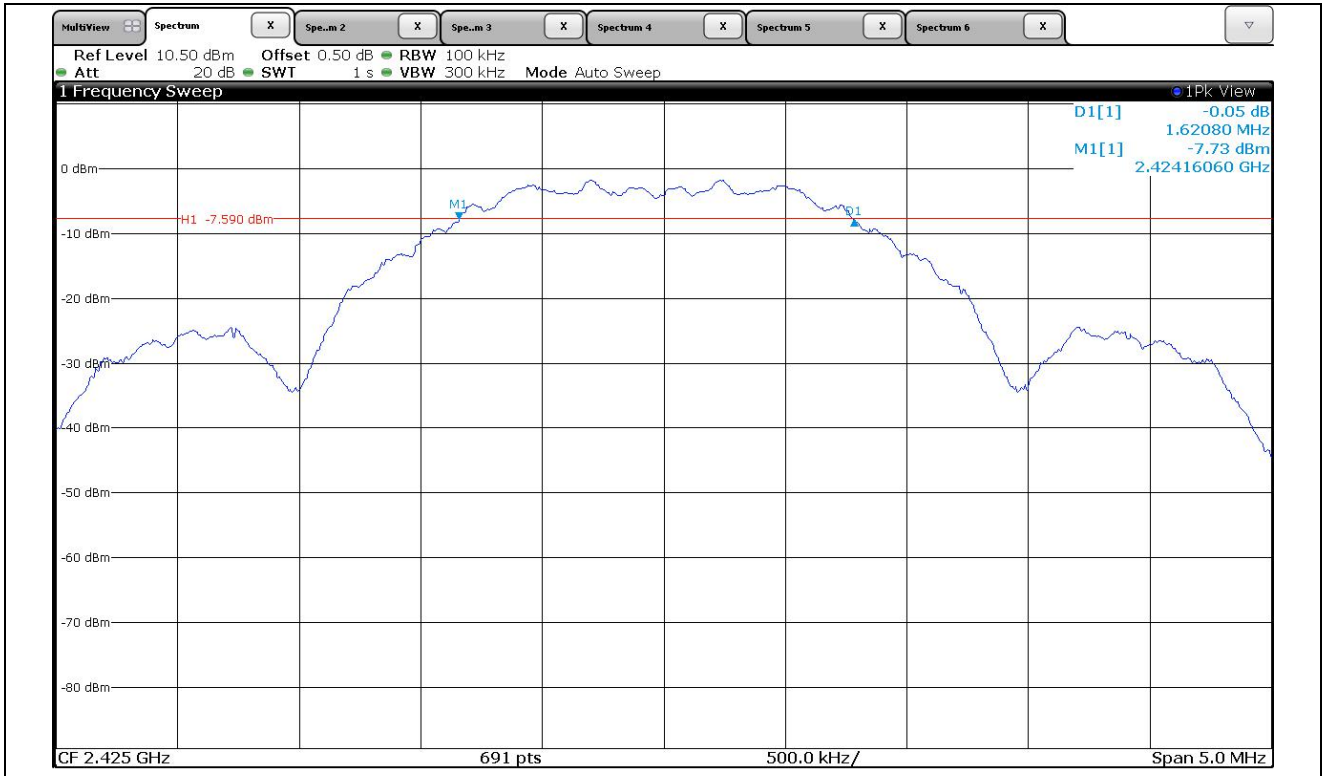
- Test Result : Pass

CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (kHz)	LIMIT (kHz)	MARGIN (kHz)
Low	2 425	1 620.80	500	1 120.80
Middle	2 450	1 606.40	500	1 106.40
High	2 475	1 570.20	500	1 070.20

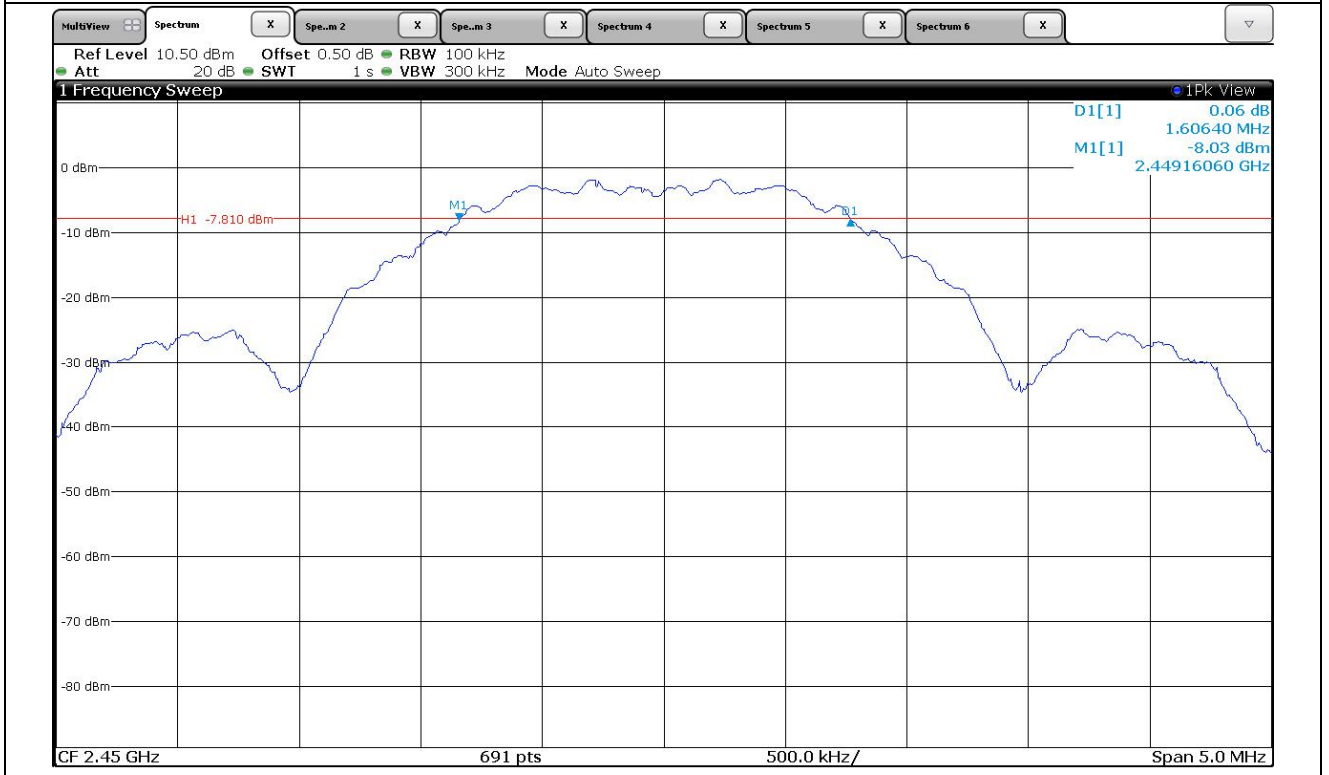
Remark: See next page for an overview sweep performed with peak detector.



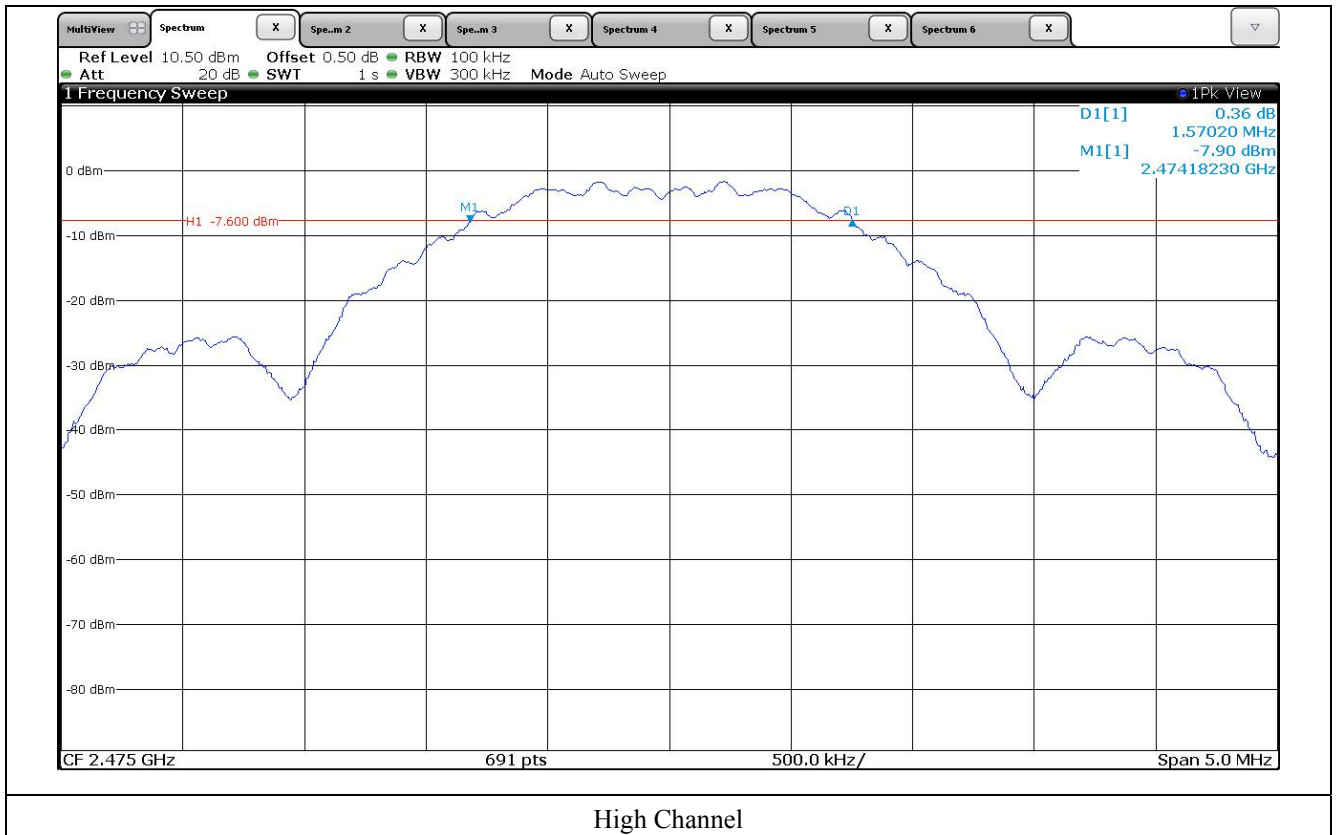
Tested by: Hong-Kyu, Lee/ Engineer



Low Channel



Middle Channel



7.4.2 Test date for Antenna 1

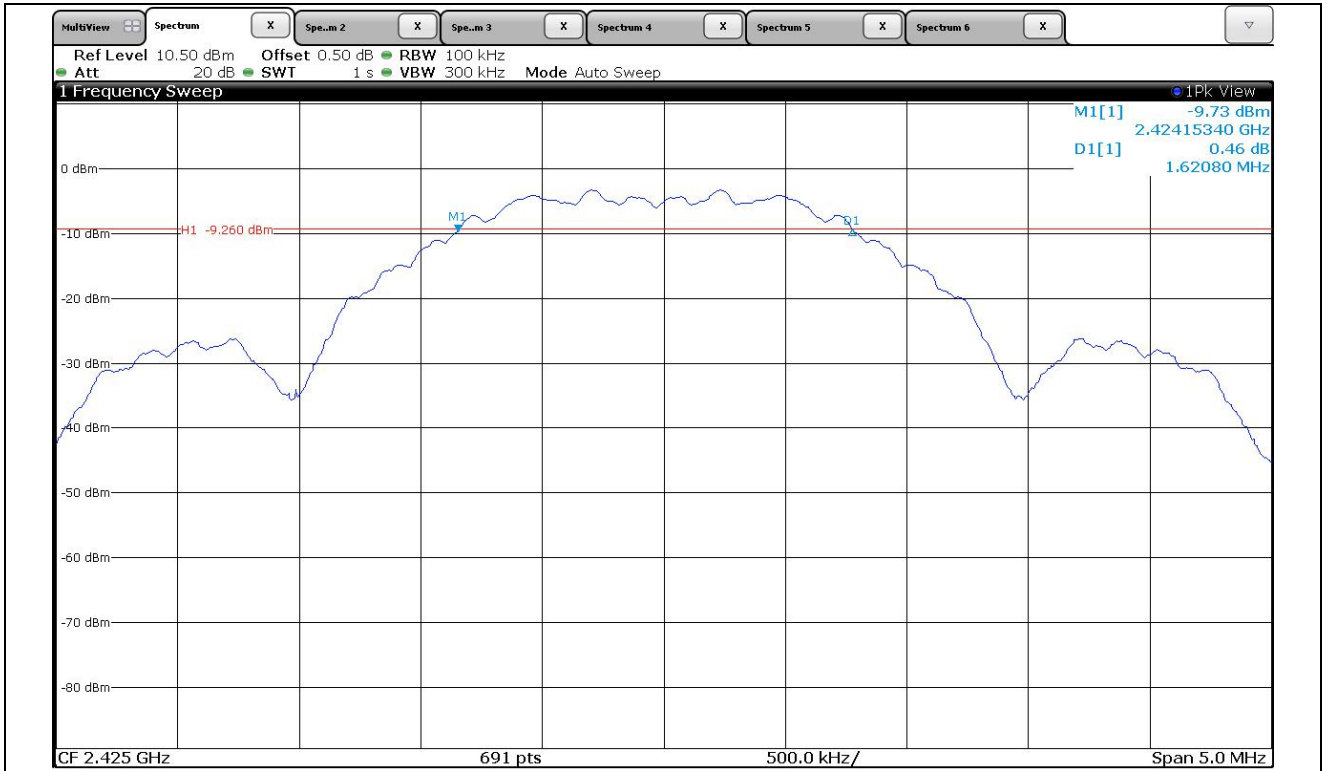
- Test Date : February 10, 2014
- Test Result : Pass

CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (kHz)	LIMIT (kHz)	MARGIN (kHz)
Low	2 425	1 620.80	500	1 120.80
Middle	2 450	1 606.40	500	1 106.40
High	2 475	1 591.90	500	1 091.90

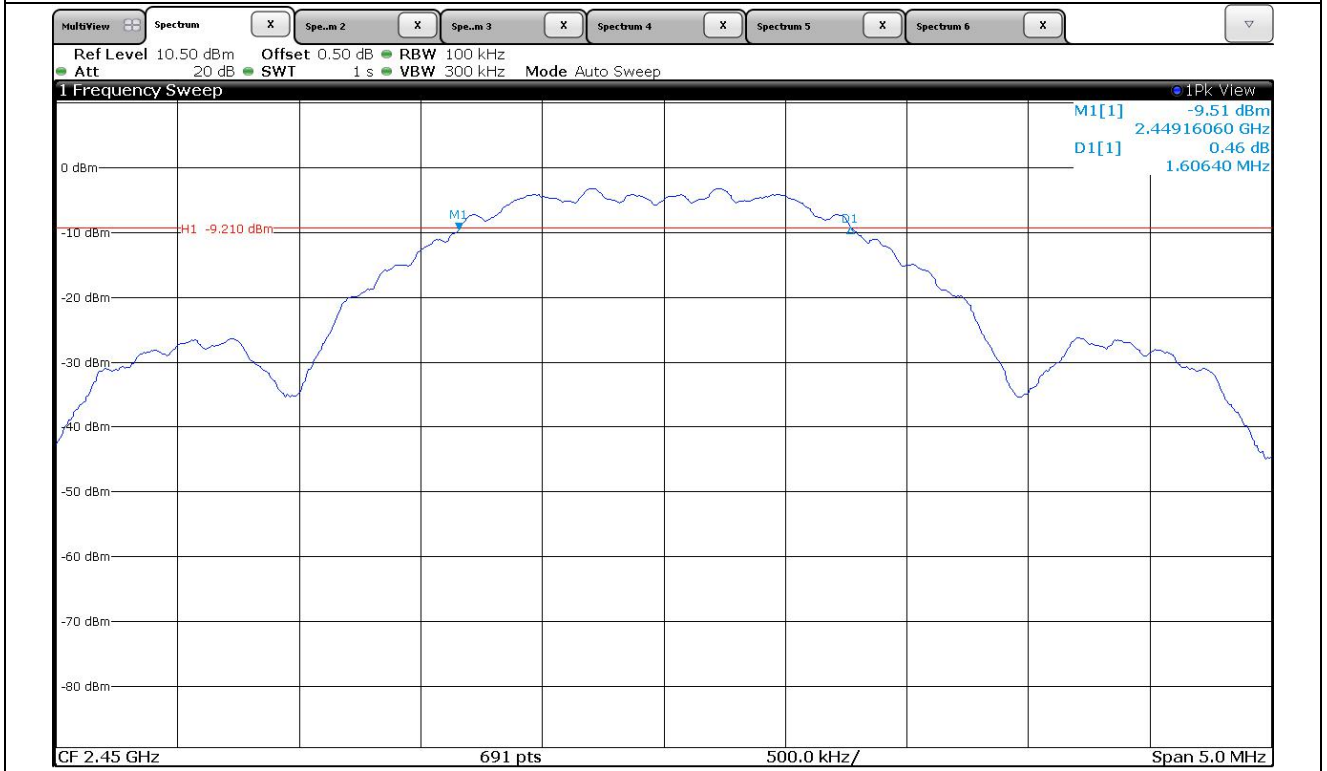
Remark: See next page for an overview sweep performed with peak detector.



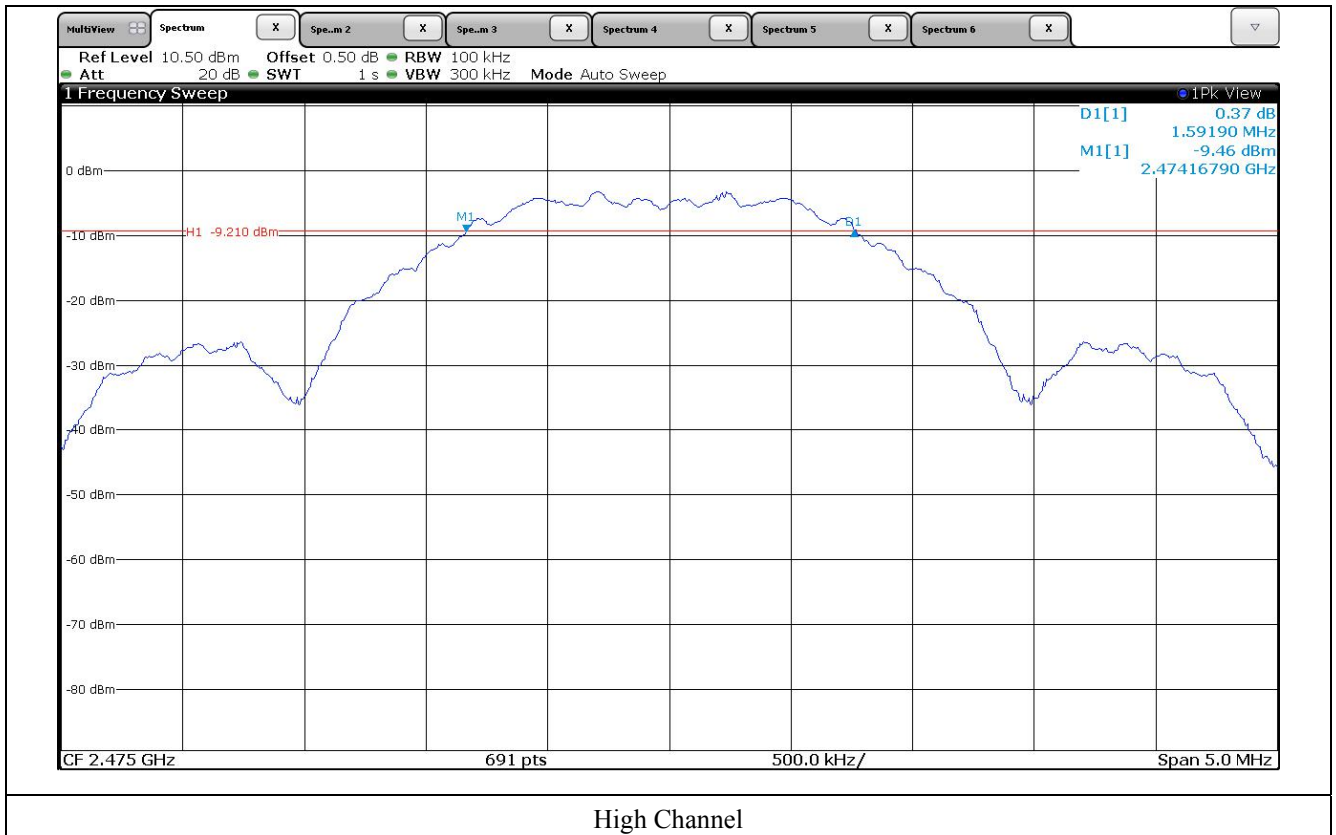
Tested by: Hong-Kyu, Lee/ Engineer



Low Channel



Middle Channel



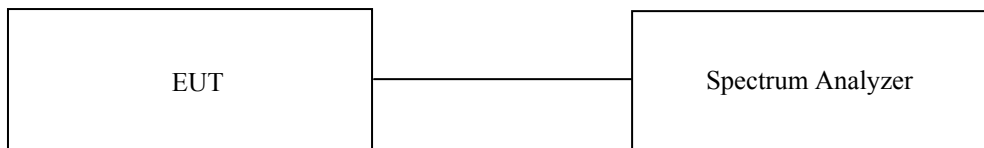
8. MAXIMUM PEAK OUTPUT POWER

8.1 Operating environment

Temperature : 24 °C
Relative humidity : 44 % R.H.

8.2 Test set-up

The maximum peak output power was measured with the spectrum analyzer connected to the antenna output of the EUT. The EUT was operating in transmit mode at the appropriate center frequency.



8.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101372	May 20, 2013(1Y)

All test equipment used is calibrated on a regular basis.

8.4 Test data

8.4.1 Test date for Antenna 0

- Test Date : February 10, 2014

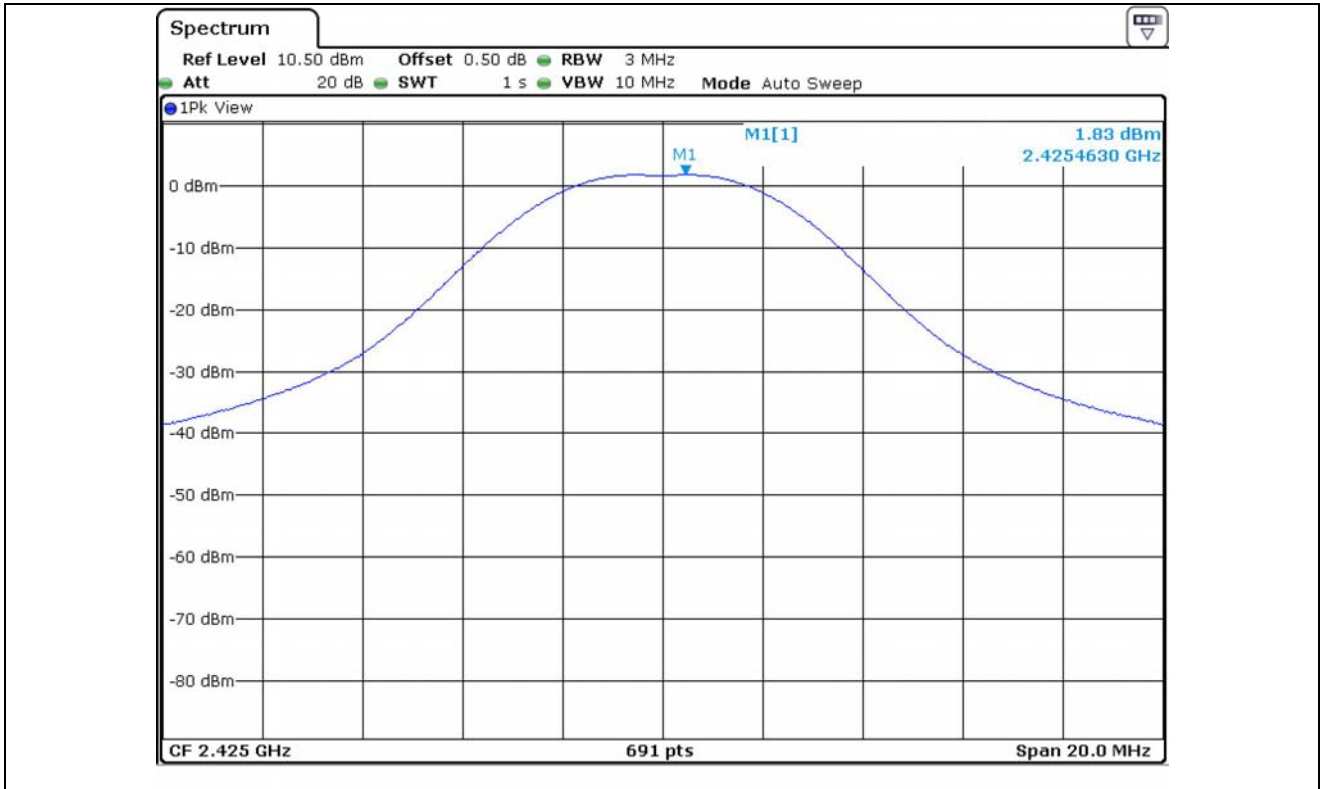
- Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 425	1.83	30	28.17
Middle	2 450	1.69	30	28.31
High	2 475	1.27	30	28.73

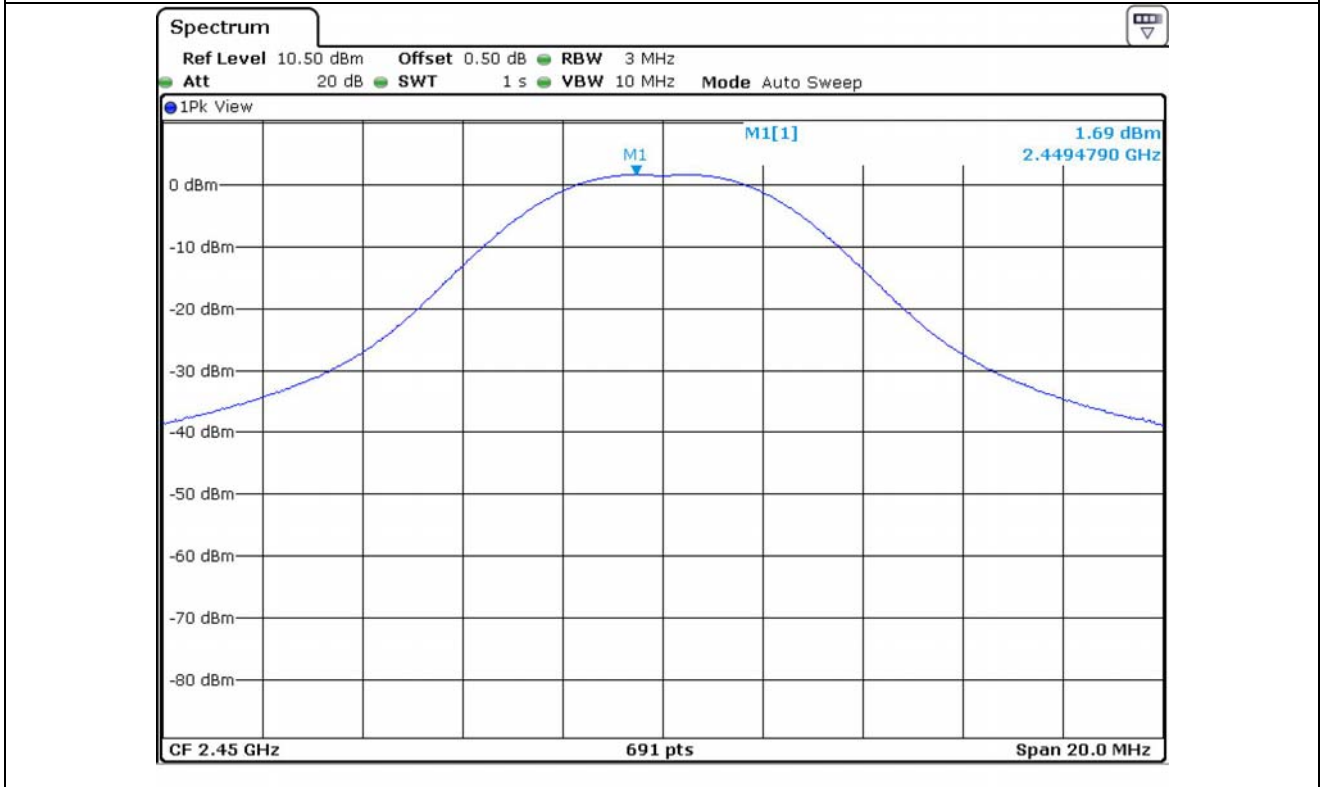
Remark: See next page for an overview sweep performed with peak detector.



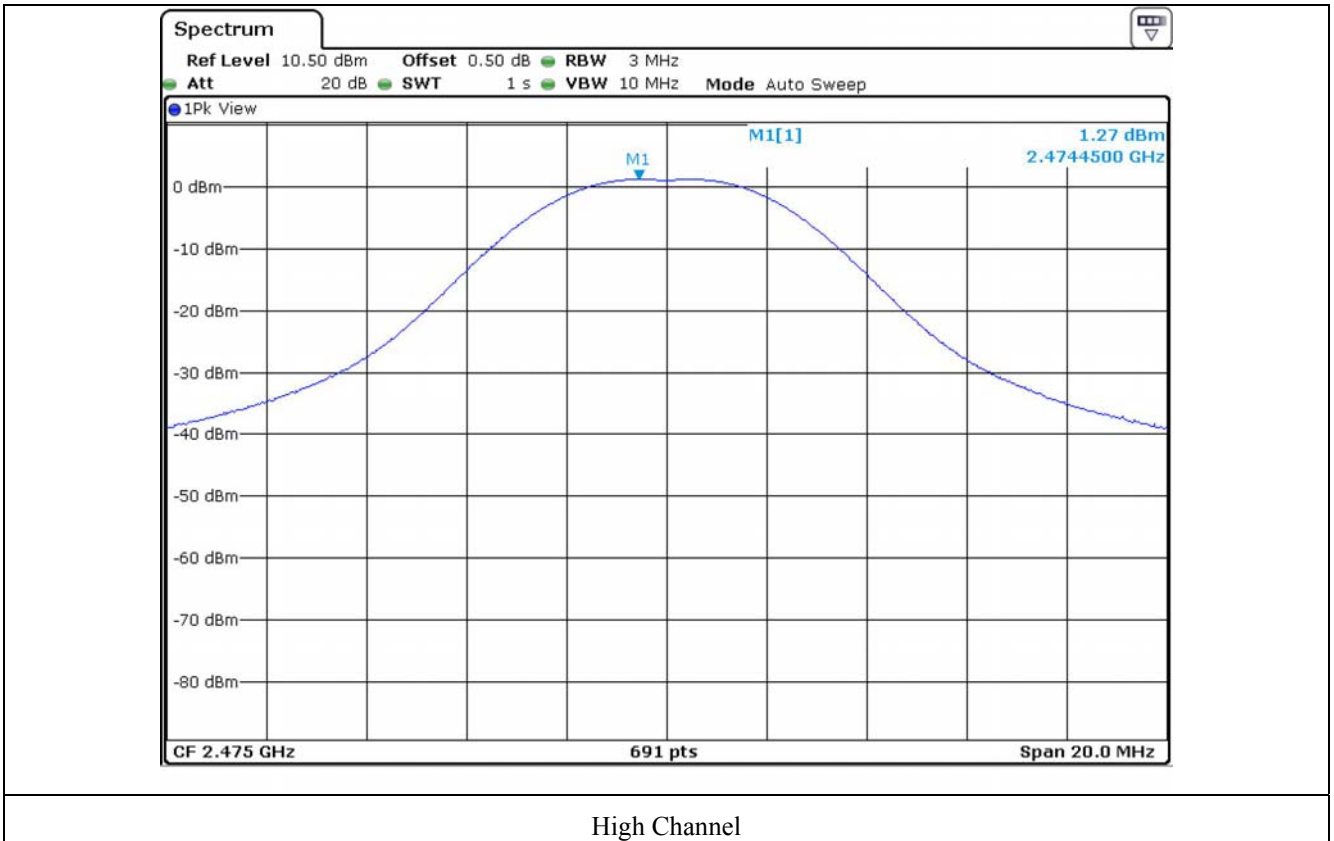
Tested by: Hong-Kyu, Lee/ Engineer



Low Channel



Middle Channel



High Channel

8.4.2 Test date for Antenna 1

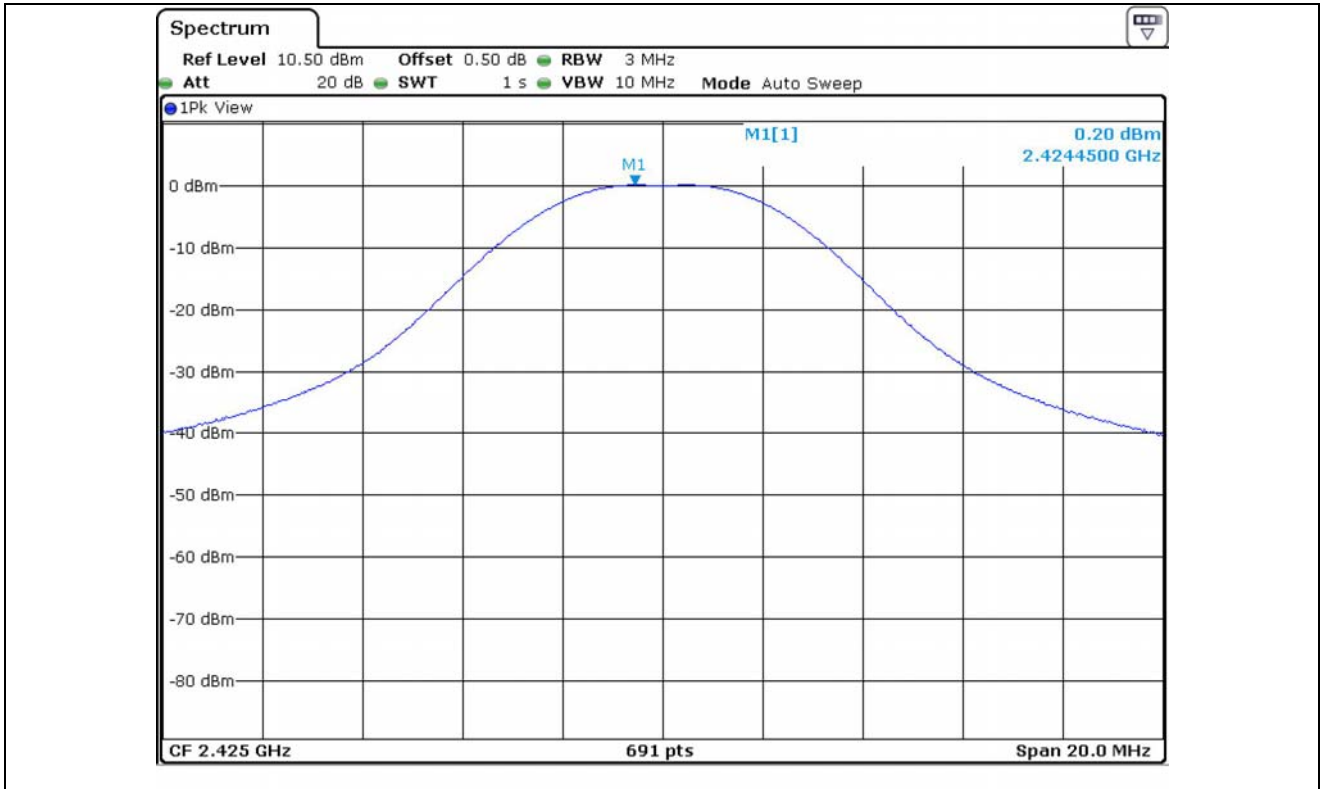
- Test Date : February 10, 2014
- Test Result : Pass

CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 425	0.20	30	29.80
Middle	2 450	-0.24	30	30.24
High	2 475	-0.38	30	30.38

Remark: See next page for an overview sweep performed with peak detector.

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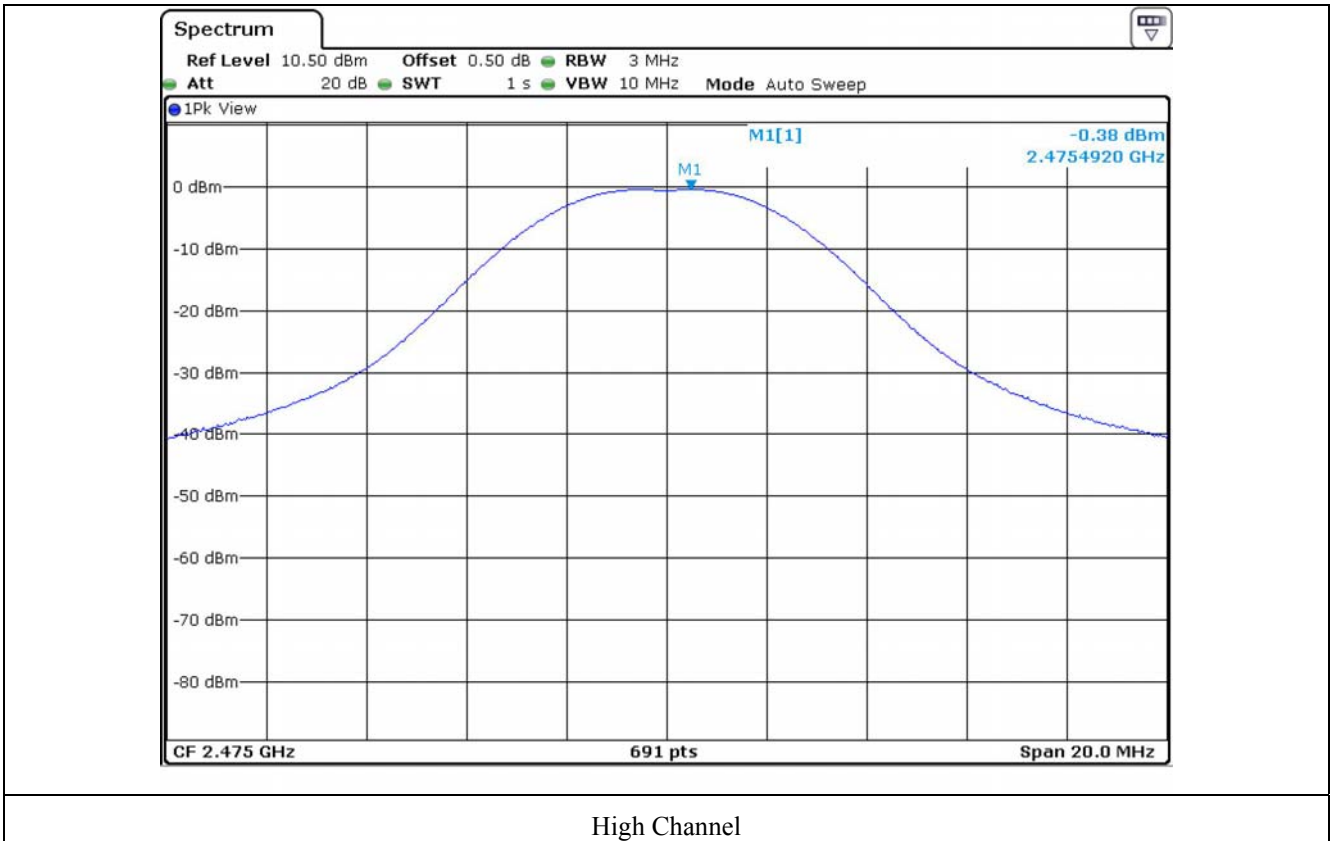
Tested by: Hong-Kyu, Lee/ Engineer



Low Channel



Middle Channel



High Channel

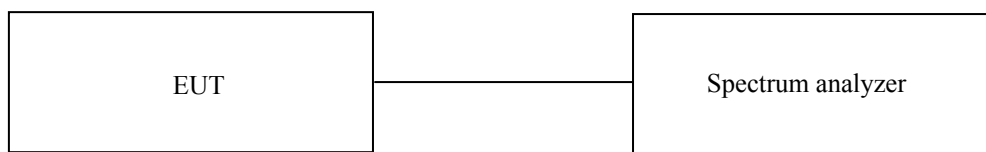
9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

9.1 Operating environment

Temperature : 28 °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 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.

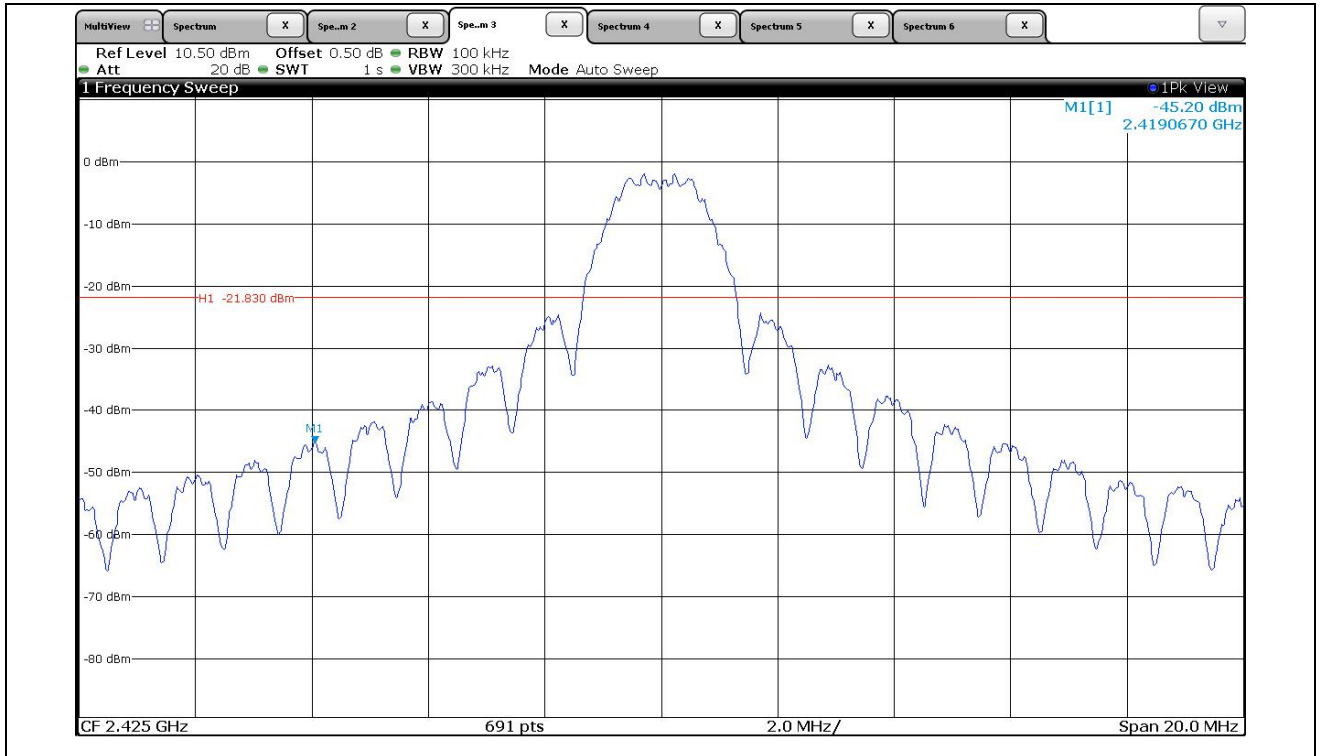
9.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
□ -	8564E	HP	Spectrum Analyzer	3650A00756	May 03, 2013(1Y)
■ -	ESU	Rohde & Schwarz	EMI Test Receiver	100261	May 27, 2013(1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	May 21, 2013(1Y)
■ -	FSW	R/S	Spectrum Analyzer	13128000K67	Dec 11, 2013 (1Y)
■ -	SCU-18	Rohde & Schwarz	PRE-AMPLIFIER	10041	Jan. 25, 2013(1Y)
■ -	MA220	HD	Turn Table	N/A	N/A
■ -	HD240	HD	Antenna Mast	N/A	N/A
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	VULB9163-255	Apr. 24, 2012(2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D294	Jun. 17, 2013 (2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Jun. 17, 2013 (2Y)
■ -	83051A	Agilent	Microwave System Preamplifier	3950M00201	May 22, 2013(1Y)

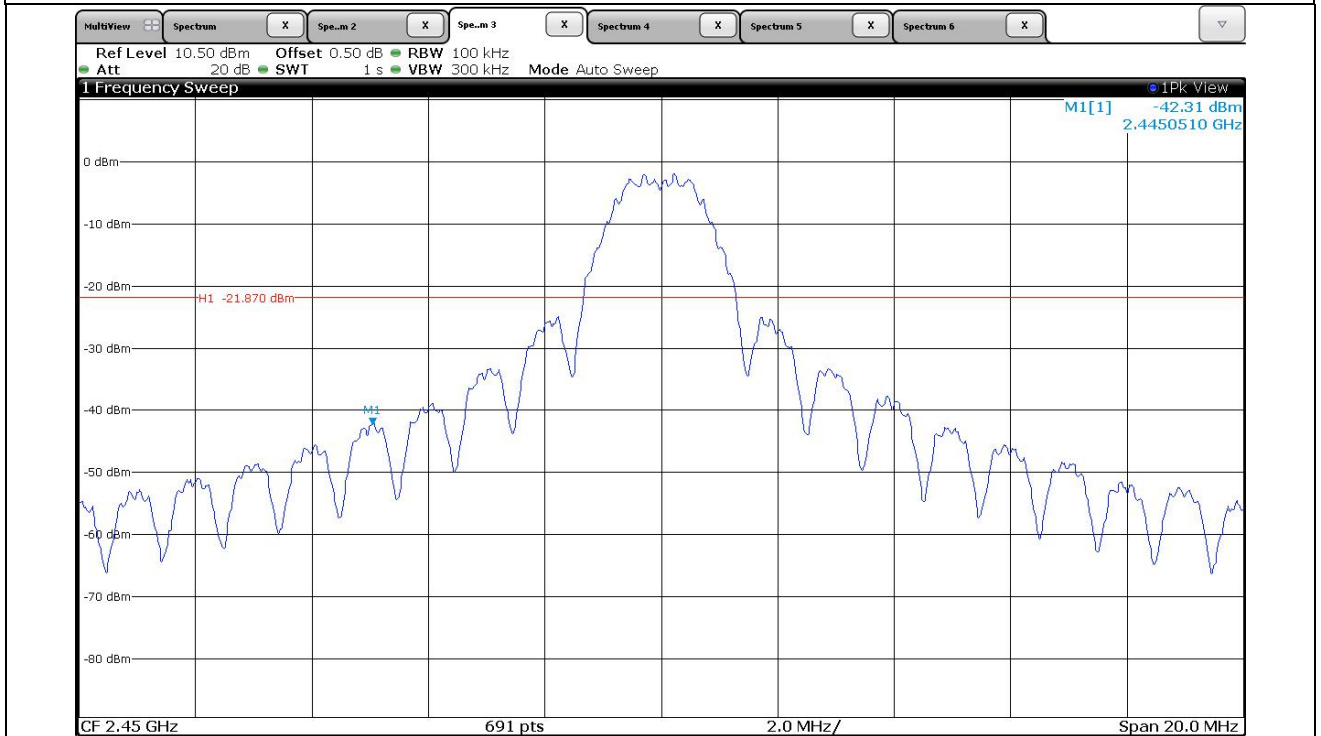
All test equipment used is calibrated on a regular basis.

9.5 Test data for conducted emission

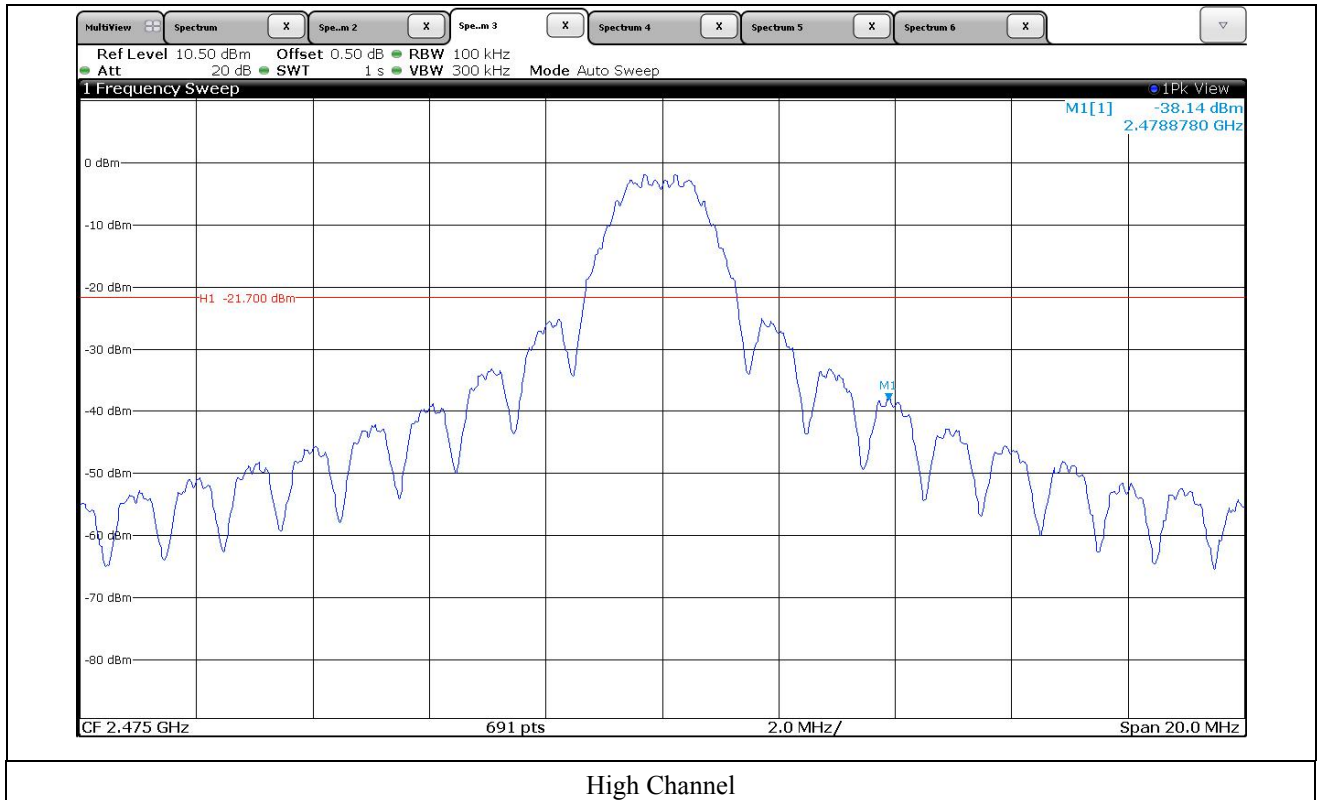
9.5.1 Test date for Antenna 0



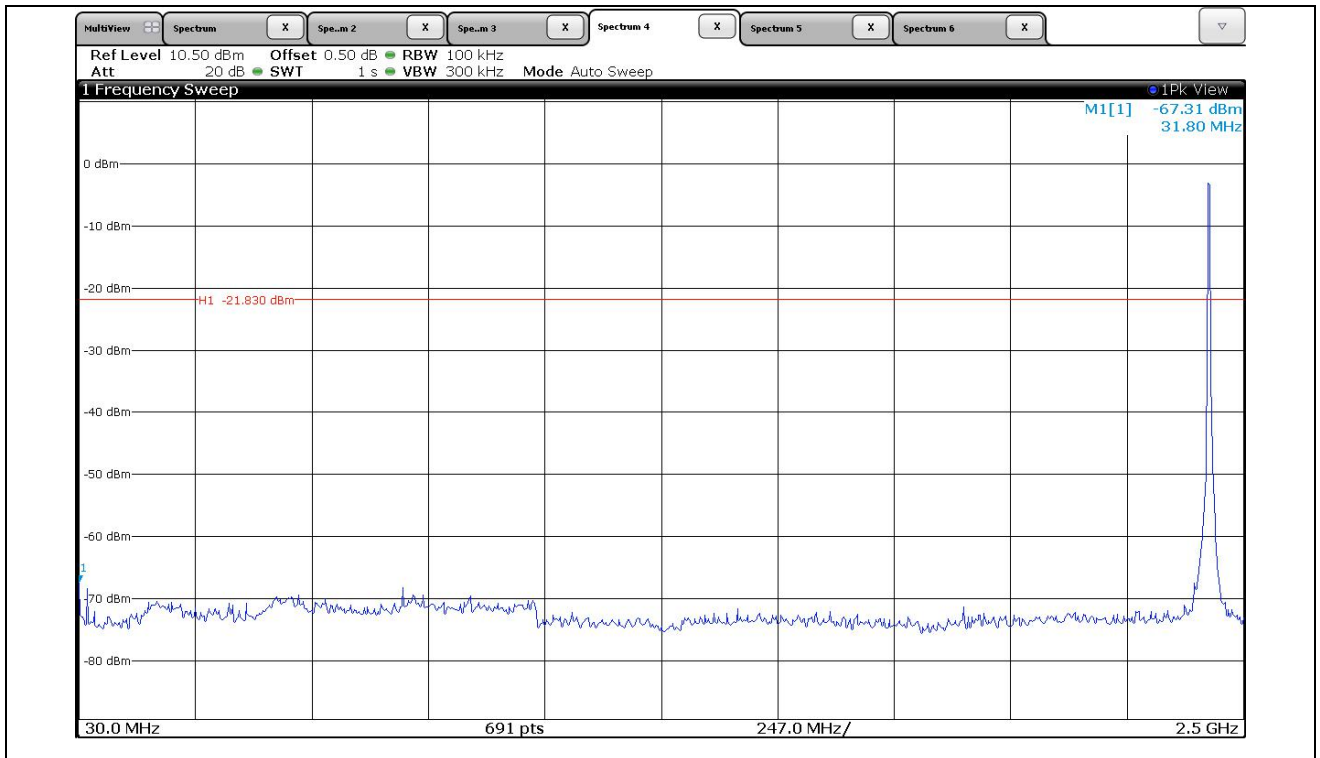
Low Channel



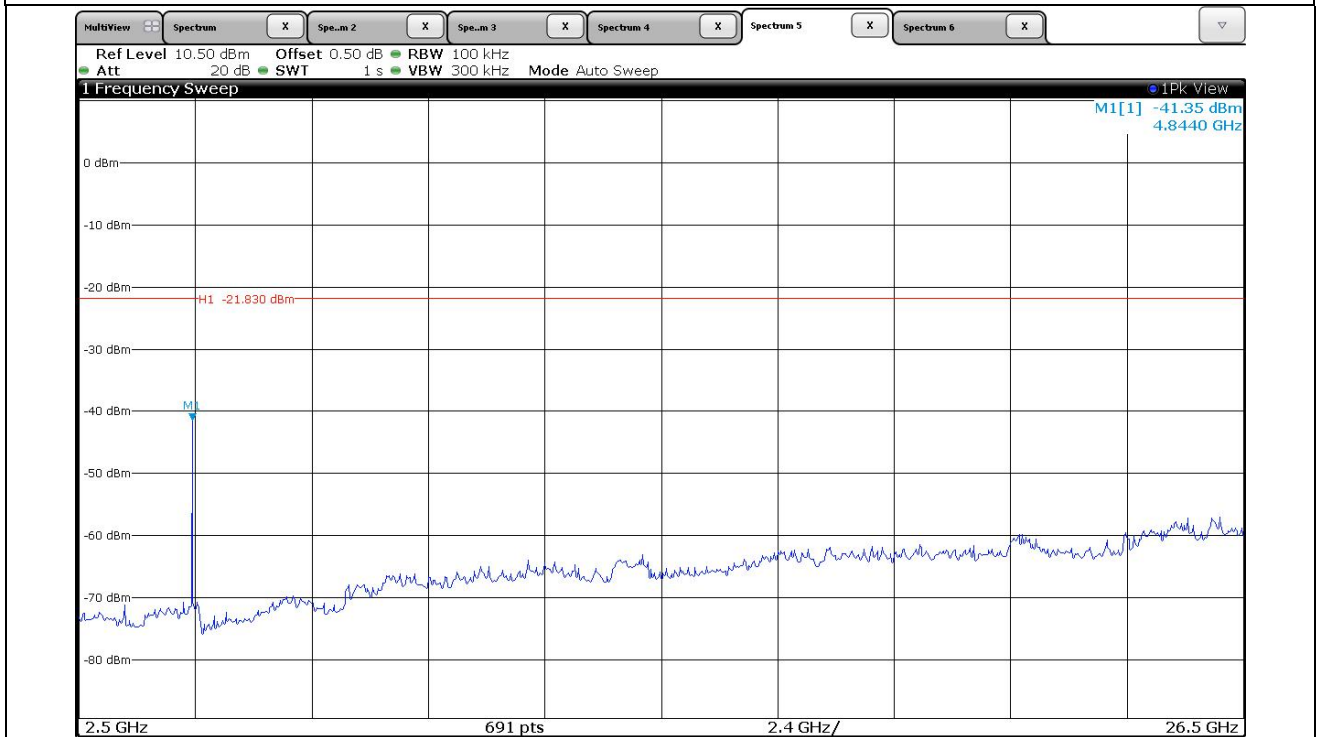
Middle Channel



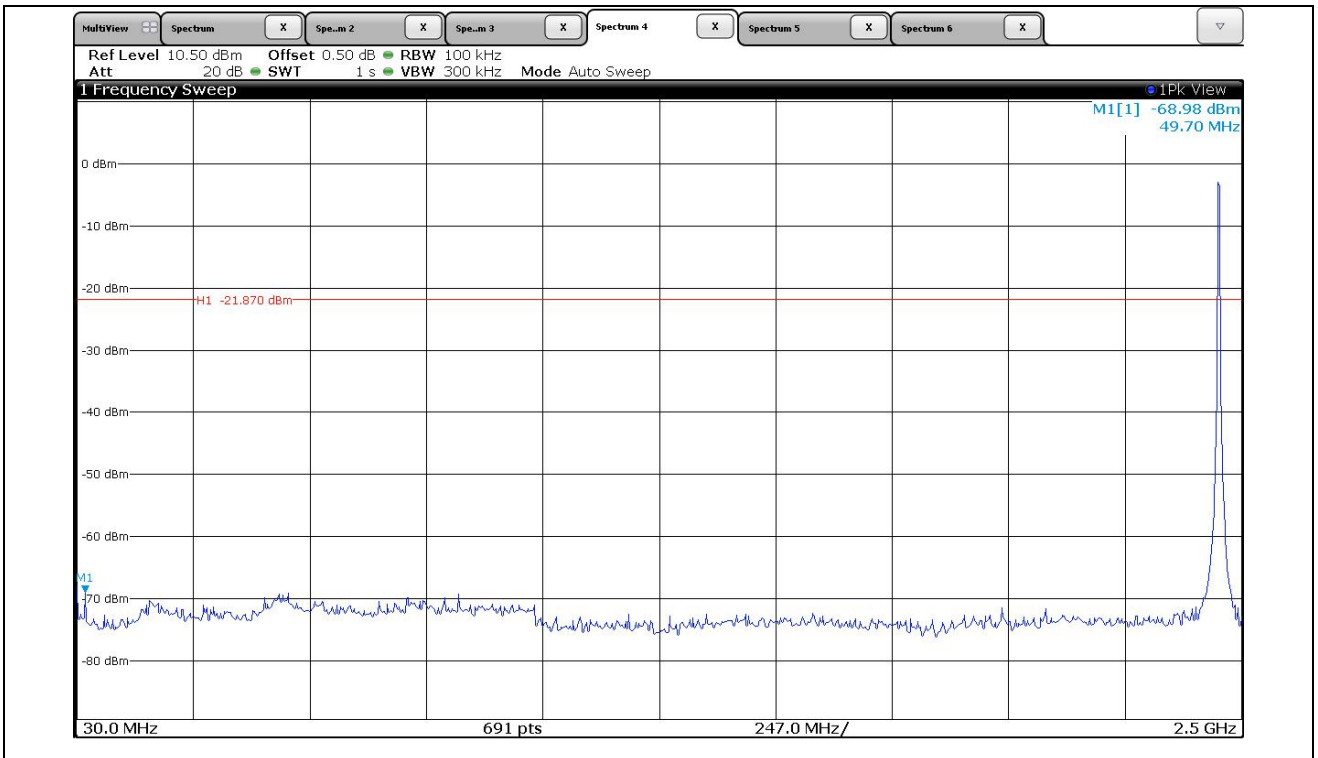
High Channel



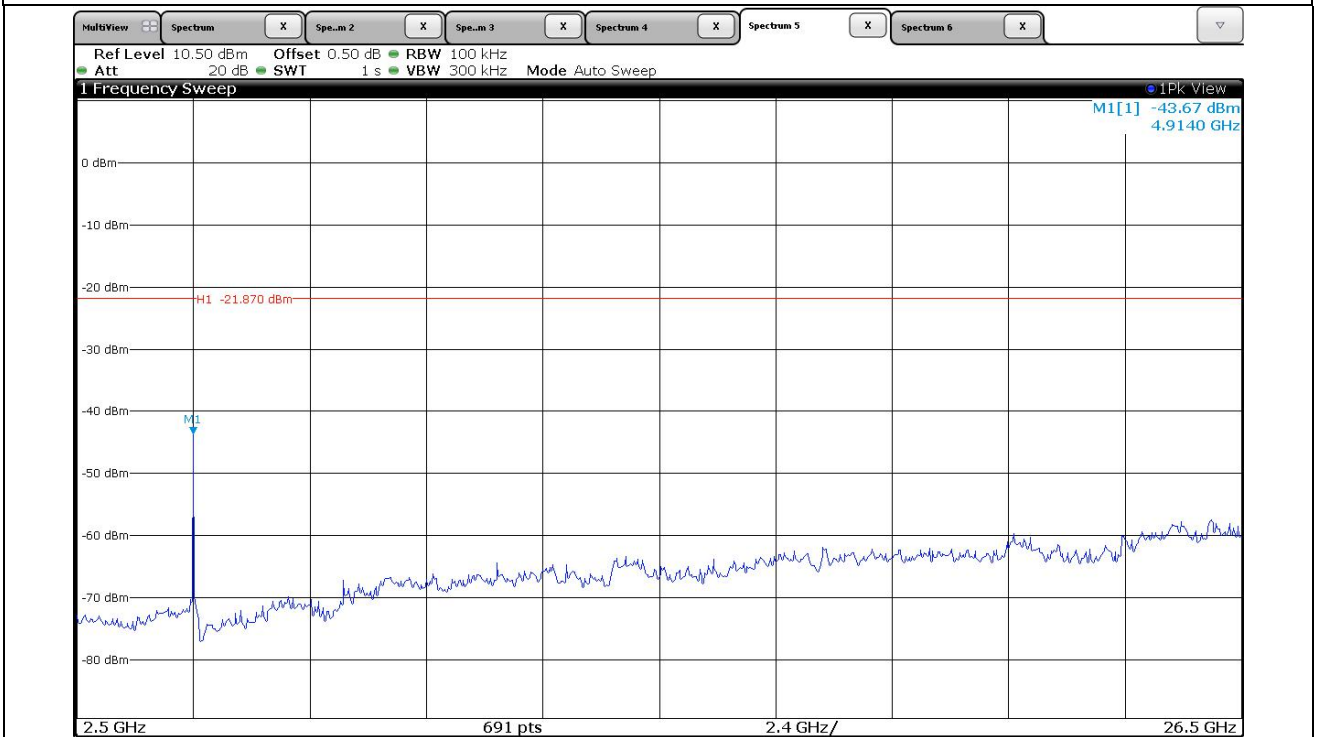
Low Channel



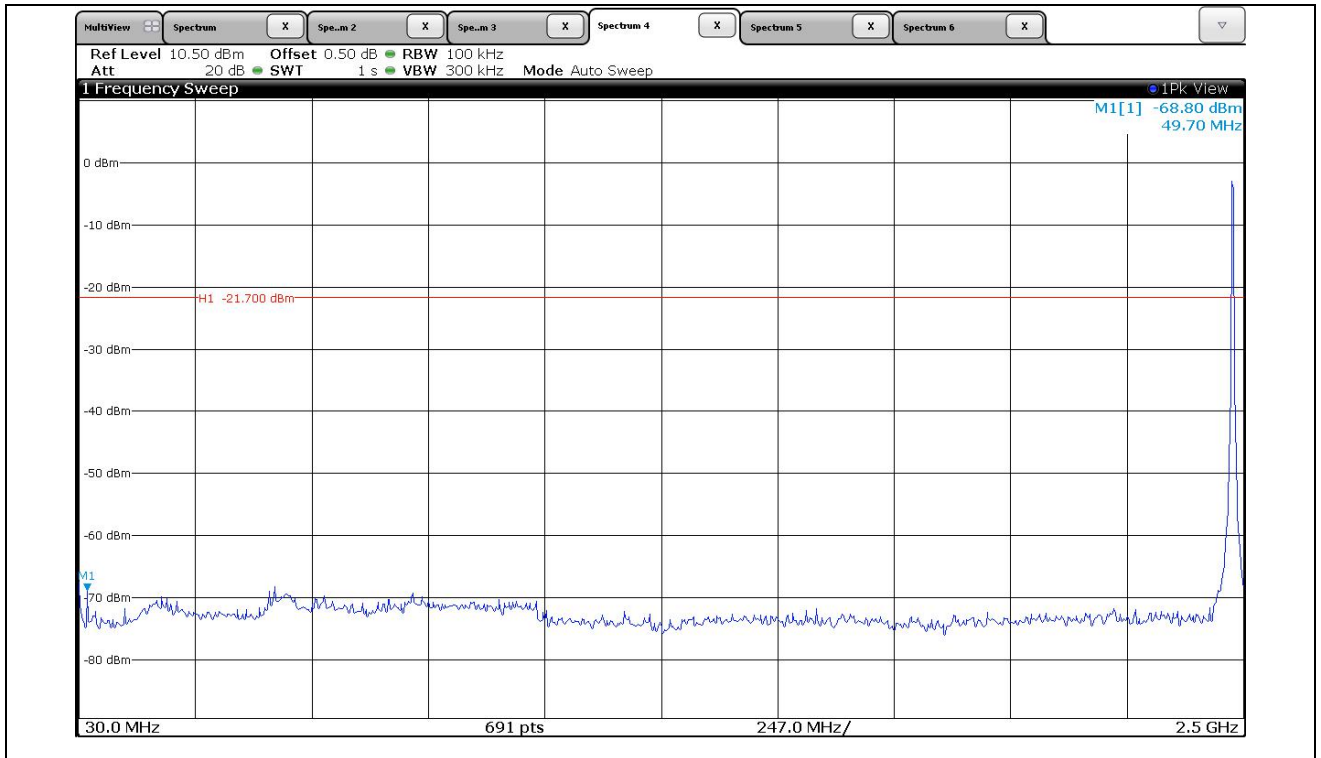
Low Channel



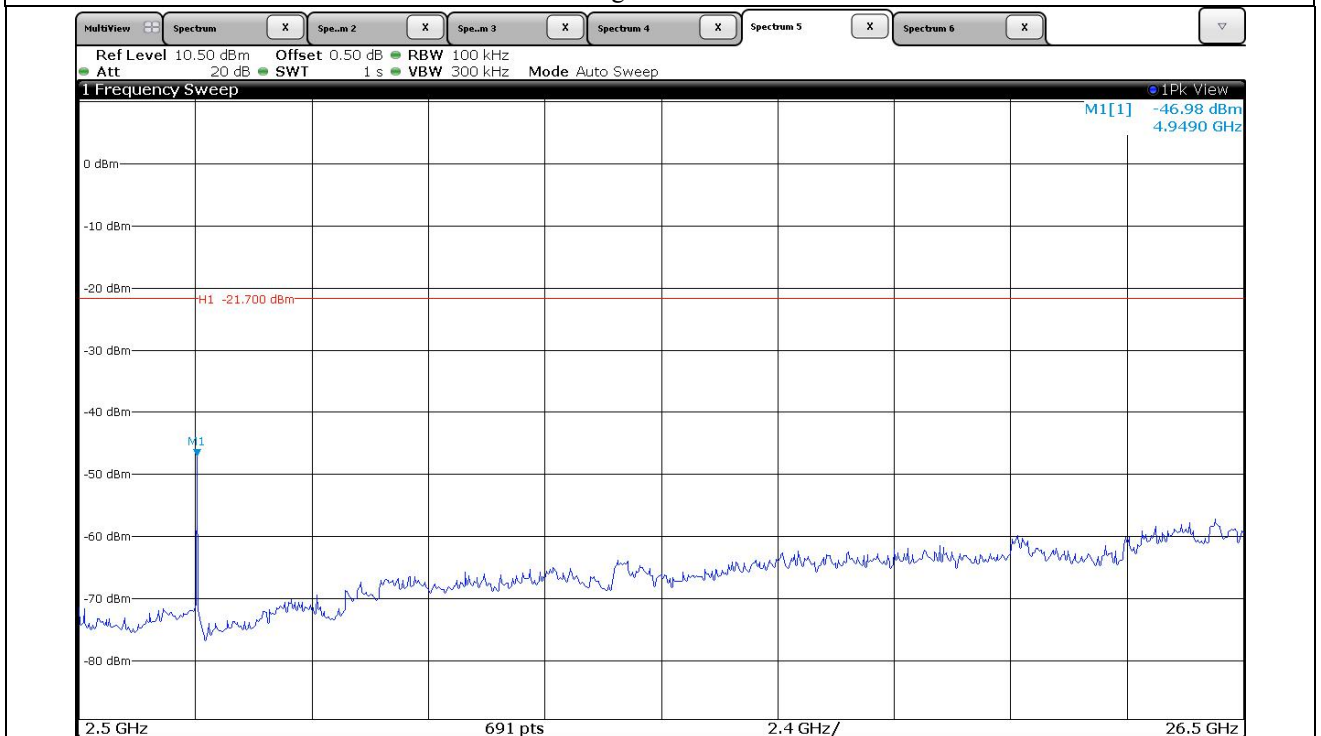
Middle Channel



Middle Channel

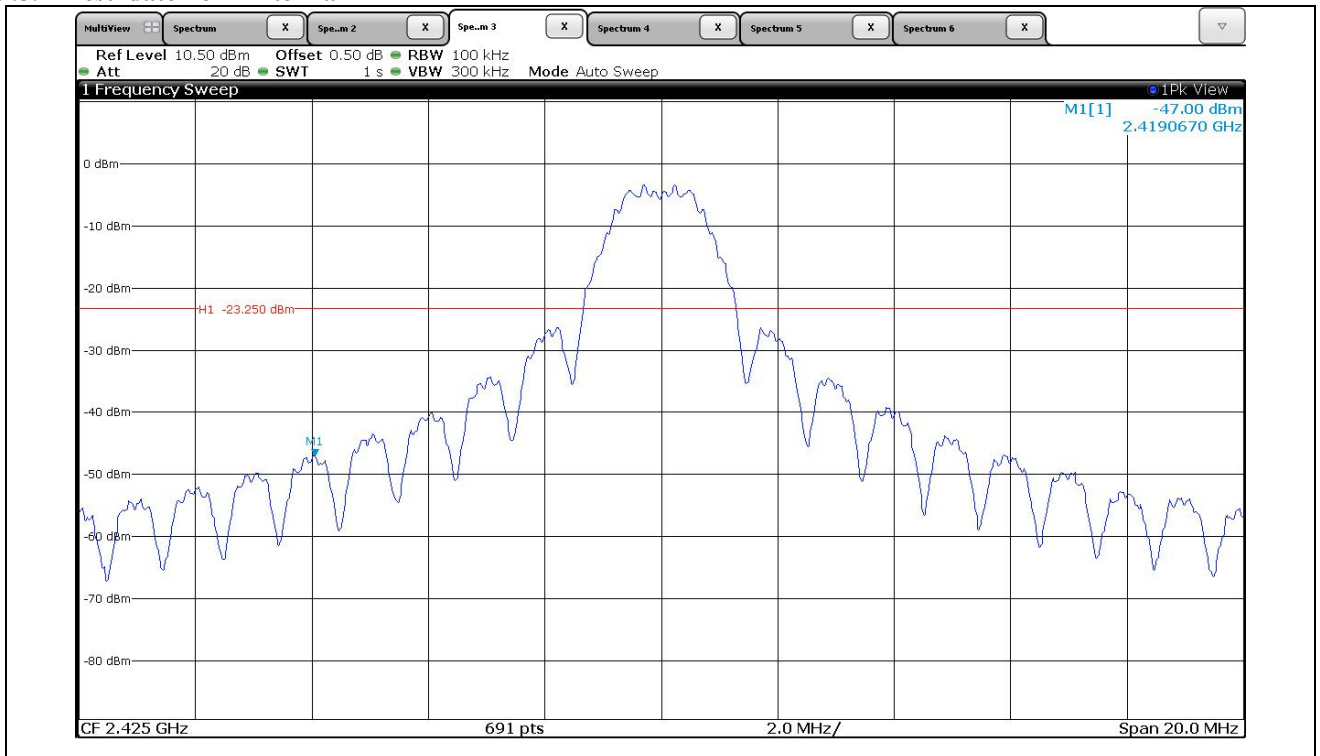


High Channel

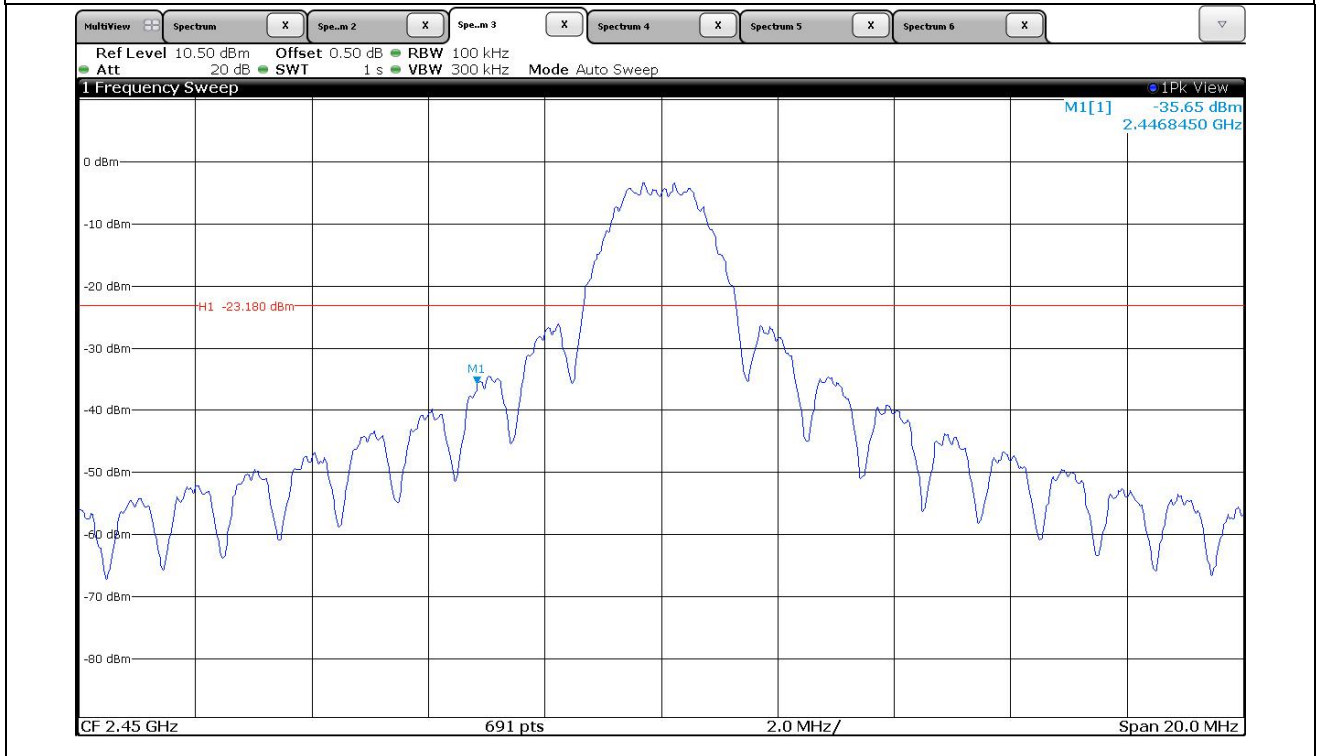


High Channel

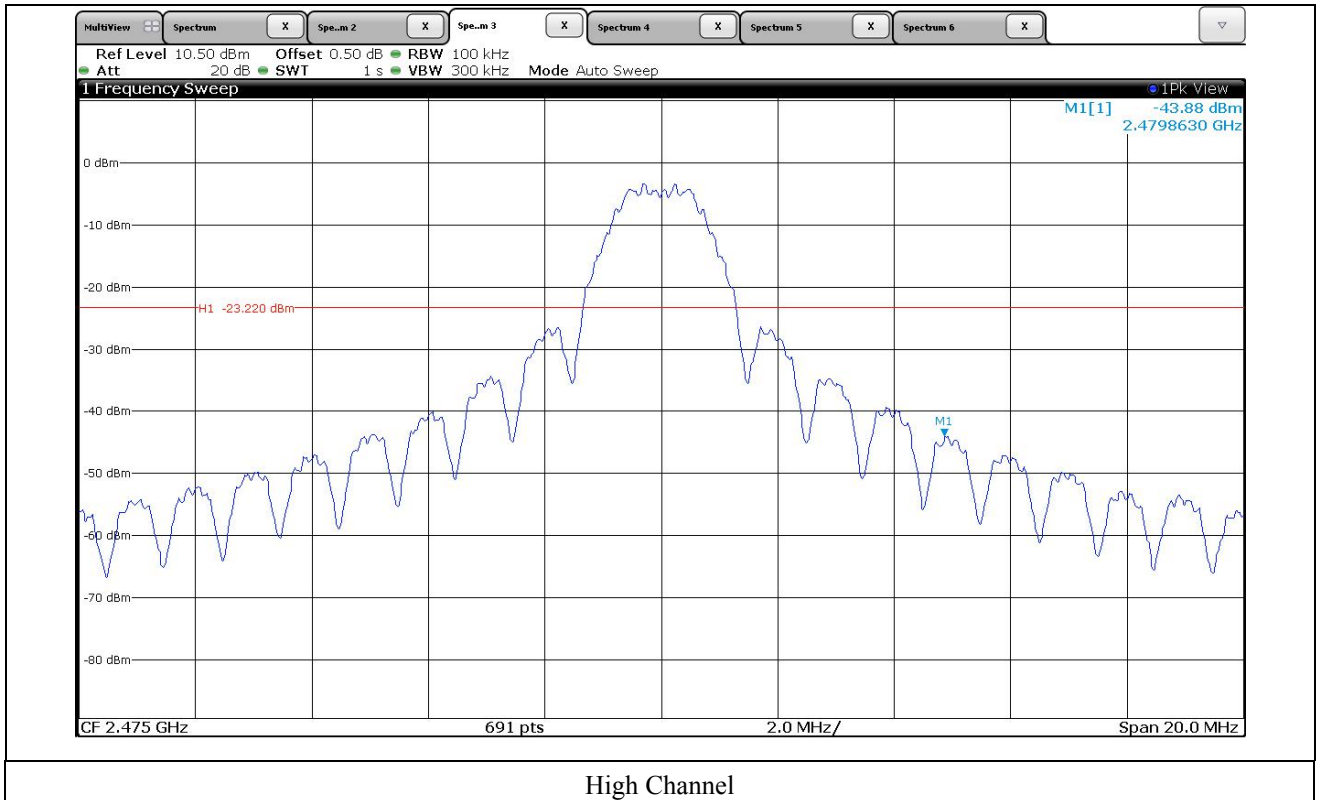
9.5.2 Test date for Antenna 1

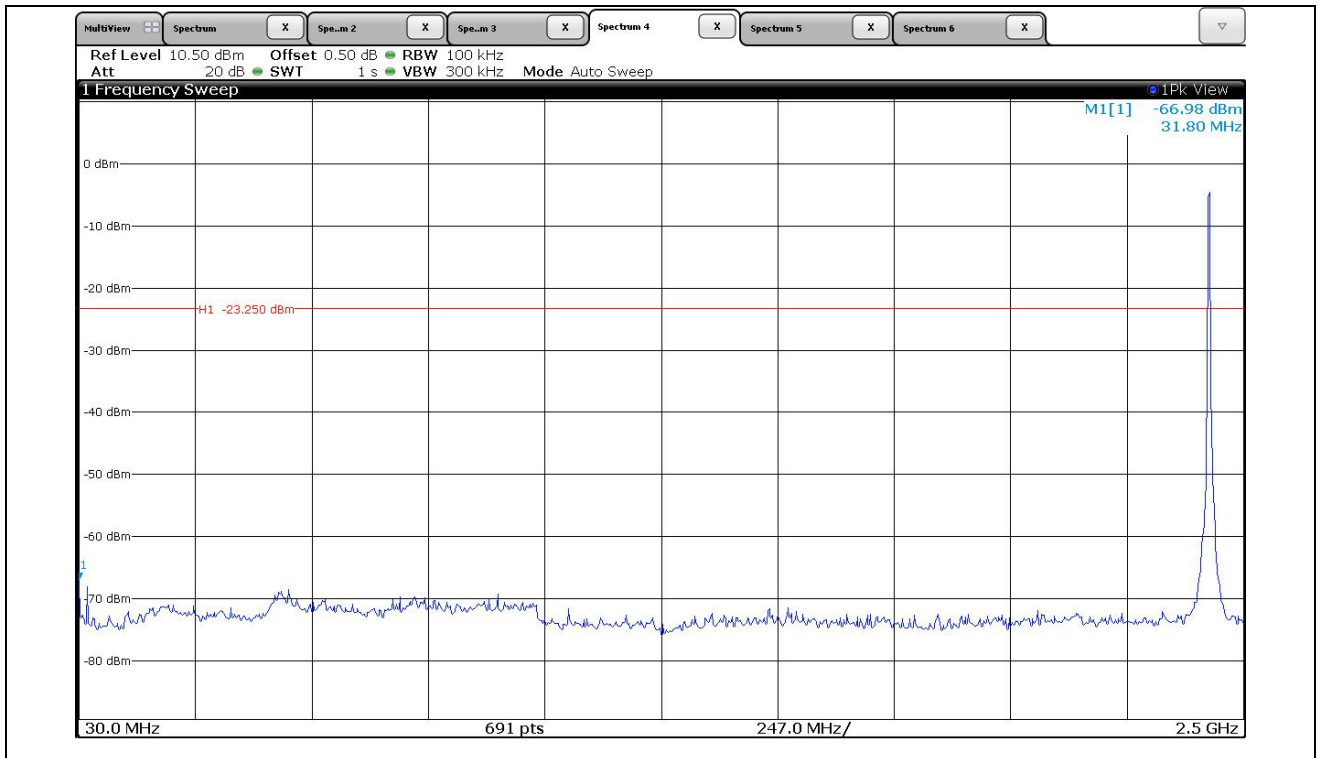


Low Channel

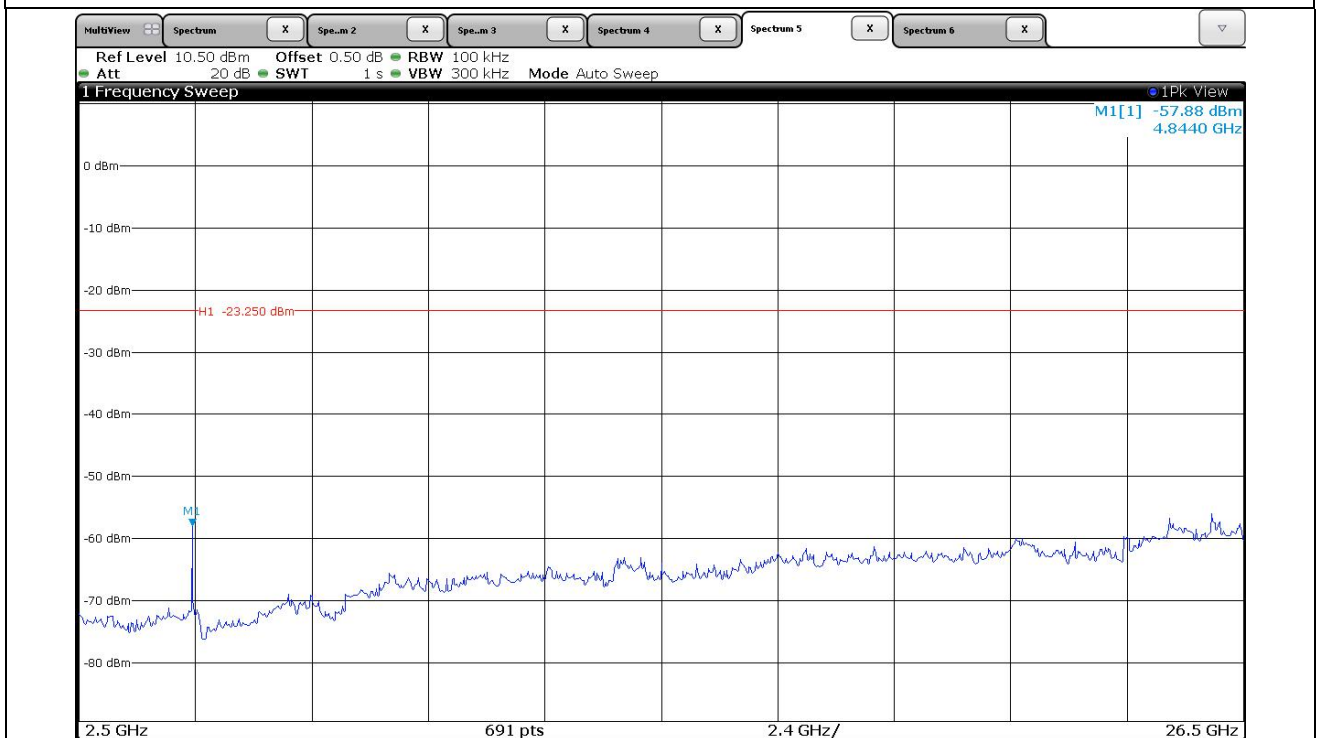


Middle Channel

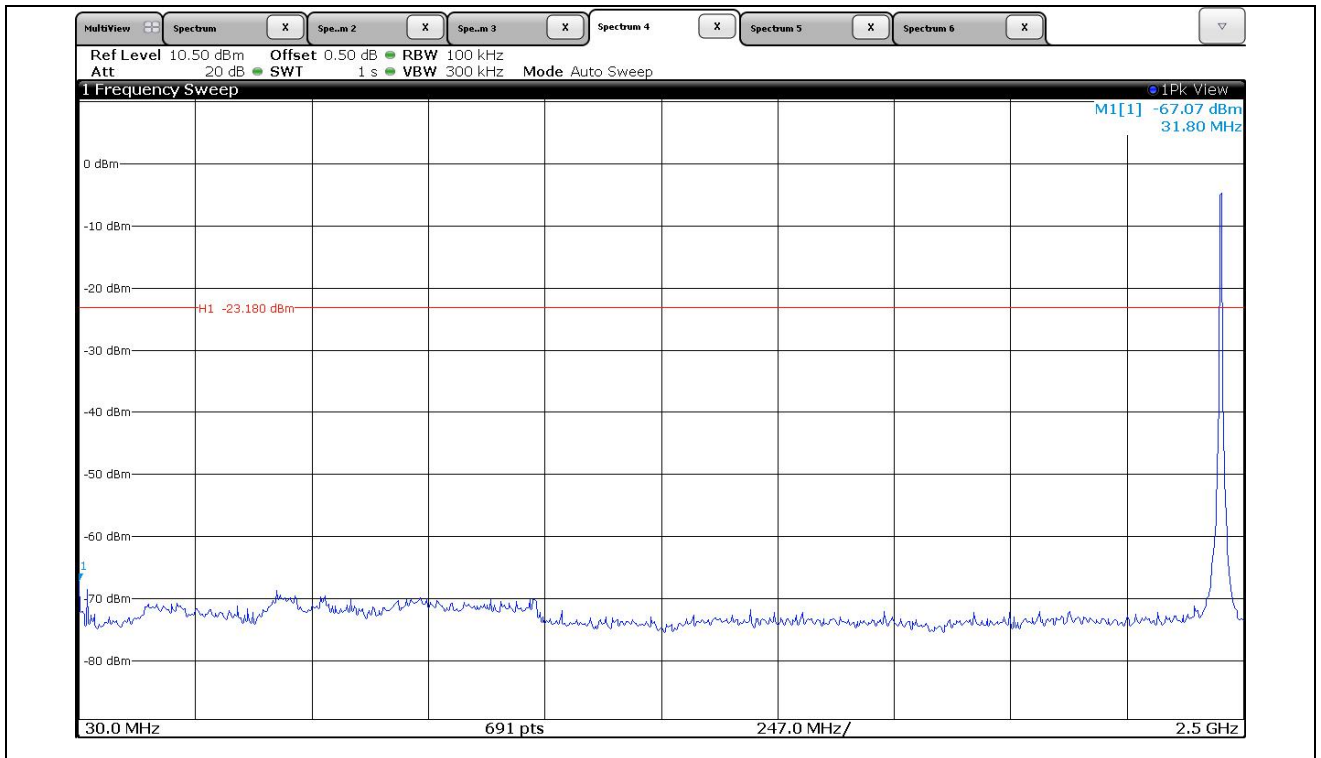




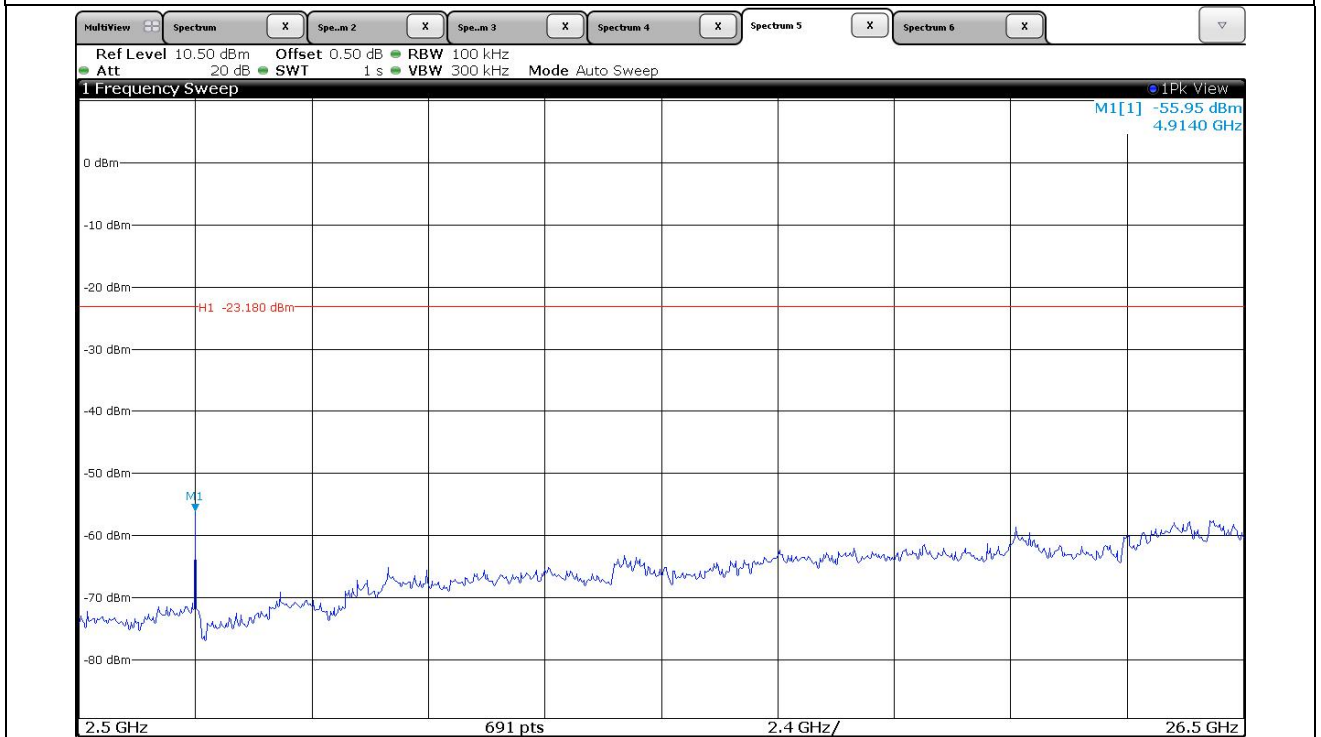
Low Channel



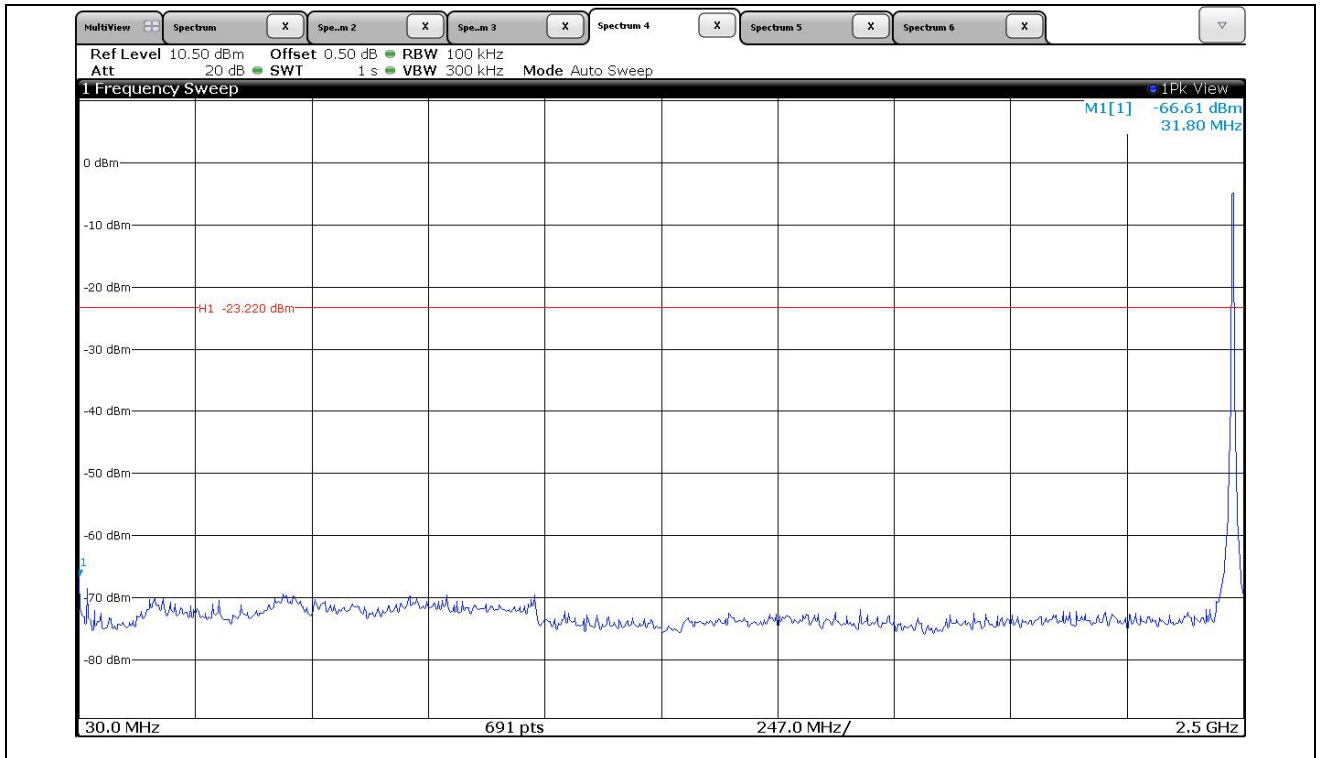
Low Channel



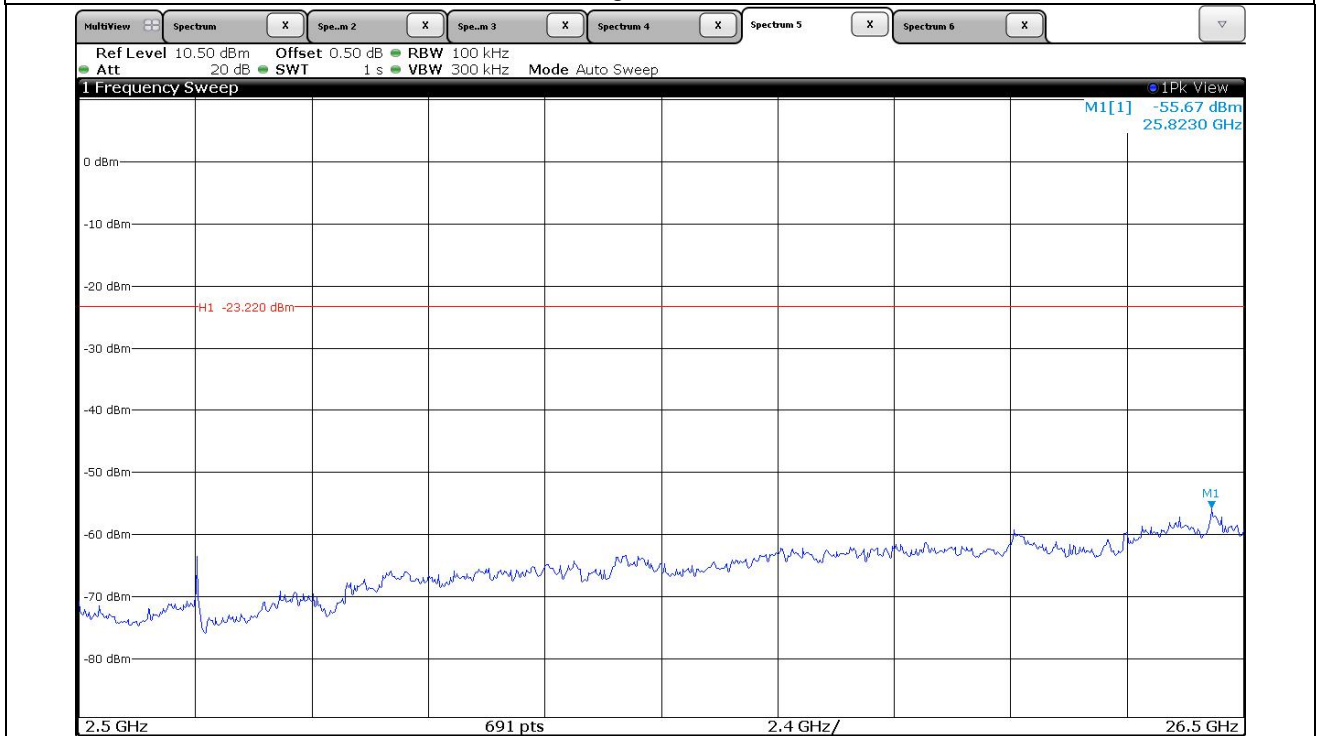
Middle Channel



Middle Channel



High Channel



High Channel

9.6 Test data for radiated emission

9.6.1 Radiated Emission which fall in the Restricted Band

9.6.1.1 Test data for Antenna 0

- Test Date : February 12, 2014
- Resolution bandwidth : 1 GHz below 100 kHz for Peak and Average Mode
1 GHz above 1MHz for Peak and Average Mode
- Video bandwidth : 1 GHz below 100 kHz for Peak and Average Mode
1 GHz above 1MHz for Peak and 10 Hz for Average Mode
- Frequency range : 30 MHz ~ 26.5 GHz
- 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									
2 390.00	45.07	Peak	H	27.00	7.80	43.00	36.87	74.00	37.13
	30.13	Average	H				21.93	54.00	32.07
	47.63	Peak	V				39.43	74.00	34.57
	32.59	Average	V				24.39	54.00	29.61
Test Data for High Channel									
2 483.50	44.43	Peak	H	27.40	8.00	43.00	36.83	74.00	37.17
	30.68	Average	H				23.08	54.00	30.92
	46.78	Peak	V				39.18	74.00	34.82
	31.95	Average	V				24.35	54.00	29.65

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Pre-Amplifier Gain}$$



Tested by: Hong-Kyu, Lee/ Engineer

9.6.1.2 Test data for Antenna 1

- Test Date : February 12, 2014
- Resolution bandwidth : 1 GHz below 100 kHz for Peak and Average Mode
1 GHz above 1MHz for Peak and Average Mode
- Video bandwidth : 1 GHz below 100 kHz for Peak and Average Mode
1 GHz above 1MHz for Peak and 10 Hz for Average Mode
- Frequency range : 30 MHz ~ 26.5 GHz
- 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									
2 390.00	47.98	Peak	H	27.00	7.80	43.00	39.78	74.00	34.22
	31.39	Average	H				23.19	54.00	30.81
	49.36	Peak	V				41.16	74.00	32.84
	33.46	Average	V				25.26	54.00	28.74
Test Data for High Channel									
2 483.50	44.09	Peak	H	27.40	8.00	43.00	36.49	74.00	37.51
	30.53	Average	H				22.93	54.00	31.07
	46.84	Peak	V				39.24	74.00	34.76
	32.23	Average	V				24.63	54.00	29.37

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Pre-Amplifier Gain}$$



Tested by: Hong-Kyu, Lee/ Engineer

9.6.2 Spurious & Harmonic Radiated Emission

9.6.2.1 Test data for Antenna 0

- Test Date : February 12, 2014
- Resolution bandwidth : 1 GHz below 100 kHz for Peak and Average Mode
1 GHz above 1MHz for Peak and Average Mode
- Video bandwidth : 1 GHz below 100 kHz for Peak and Average Mode
1 GHz above 1MHz for Peak and 10 Hz for Average Mode
- Frequency range : 30 MHz ~ 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									
2 425.00	69.56	Peak	H	27.10	7.90	43.00	61.56	113.98	52.42
	66.18	Average	H				58.18	93.98	35.80
	67.96	Peak	V				59.96	113.98	54.02
	62.71	Average	V				54.71	93.98	39.27
4 850.00	39.53	Peak	H	30.70	12.00	42.40	39.83	73.98	34.15
	26.81	Average	H				27.11	53.98	26.87
	39.32	Peak	V				39.62	73.98	34.36
	26.74	Average	V				27.04	53.98	26.94
Test Data for Middle Channel									
2 450.00	70.54	Peak	H	27.20	7.90	43.00	62.64	113.98	51.34
	66.22	Average	H				58.32	93.98	35.66
	66.27	Peak	V				58.37	113.98	55.61
	63.11	Average	V				55.21	93.98	38.77
4 900.00	39.14	Peak	H	30.80	12.00	42.40	39.54	73.98	34.44
	26.25	Average	H				26.65	53.98	27.33
	39.18	Peak	V				39.58	73.98	34.40
	26.38	Average	V				26.78	53.98	27.20

Test Data for High Channel									
2 475.00	69.79	Peak	H	27.30	8.00	43.00	62.09	113.98	51.89
	66.08	Average	H				58.38	93.98	35.60
	66.11	Peak	V				58.41	113.98	55.57
	62.26	Average	V				54.56	93.98	39.42
4 950.00	39.36	Peak	H	30.80	12.10	42.30	39.96	73.98	34.02
	26.77	Average	H				27.37	53.98	26.61
	39.11	Peak	V				39.71	73.98	34.27
	26.54	Average	V				27.14	53.98	26.84

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Pre-Amplifier Gain}$$



Tested by: Hong-Kyu, Lee/ Engineer

9.6.2.1 Test data for Antenna 1

- Test Date : February 12, 2014
- Resolution bandwidth : 1 GHz below 100 kHz for Peak and Average Mode
1 GHz above 1MHz for Peak and Average Mode
- Video bandwidth : 1 GHz below 100 kHz for Peak and Average Mode
1 GHz above 1MHz for Peak and 10 Hz for Average Mode
- Frequency range : 30 MHz ~ 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									
2 425.00	64.08	Peak	H	27.10	7.90	43.00	56.08	113.98	57.90
	58.97	Average	H				50.97	93.98	43.01
	64.86	Peak	V				56.86	113.98	57.12
	61.05	Average	V				53.05	93.98	40.93
4 850.00	39.42	Peak	H	30.70	12.00	42.40	39.72	73.98	34.26
	26.25	Average	H				26.55	53.98	27.43
	39.11	Peak	V				39.41	73.98	34.57
	26.84	Average	V				27.14	53.98	26.84
Test Data for Middle Channel									
2 450.00	65.28	Peak	H	27.20	7.90	43.00	57.38	113.98	56.60
	59.35	Average	H				51.45	93.98	42.53
	65.94	Peak	V				58.04	113.98	55.94
	59.88	Average	V				51.98	93.98	42.00
4 900.00	39.08	Peak	H	30.70	12.00	42.40	39.38	73.98	34.60
	26.93	Average	H				27.23	53.98	26.75
	39.74	Peak	V				40.04	73.98	33.94
	26.33	Average	V				26.63	53.98	27.35

Test Data for High Channel									
2 475.00	62.44	Peak	H	27.30	8.00	43.00	54.74	113.98	59.24
	57.82	Average	H				50.12	93.98	43.86
	64.52	Peak	V				56.82	113.98	57.16
	59.04	Average	V				51.34	93.98	42.64
4 950.00	39.33	Peak	H	30.80	12.10	42.30	39.93	73.98	34.05
	26.25	Average	H				26.85	53.98	27.13
	39.14	Peak	V				39.74	73.98	34.24
	26.74	Average	V				27.34	53.98	26.64

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

$$\text{Margin (dB)} = \text{Limits (dB}\mu\text{V/m)} - \text{Total Level (dB}\mu\text{V/m)}$$

$$\text{Total Level} = \text{Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Pre-Amplifier Gain}$$

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Tested by: Hong-Kyu, Lee/ Engineer

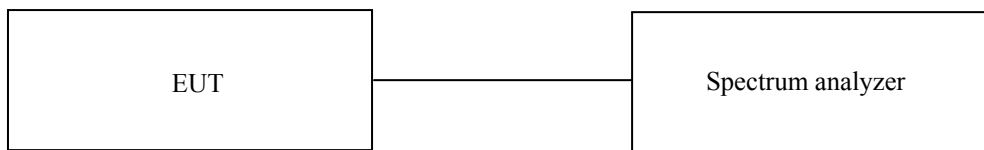
10. PEAK POWER SPECTRUL DENSITY

10.1 Operating environment

Temperature : 24 °C
Relative humidity : 44 % 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. The maximum level form the EUT in 3 kHz bandwidth was measured with above condition.



10.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSW	R/S	Spectrum Analyzer	13128000K67	Dec 11, 2013

All test equipment used is calibrated on a regular basis.

10.4 Test data

10.4.1 Test data for Antenna 0

- Test Date : February 10, 2014

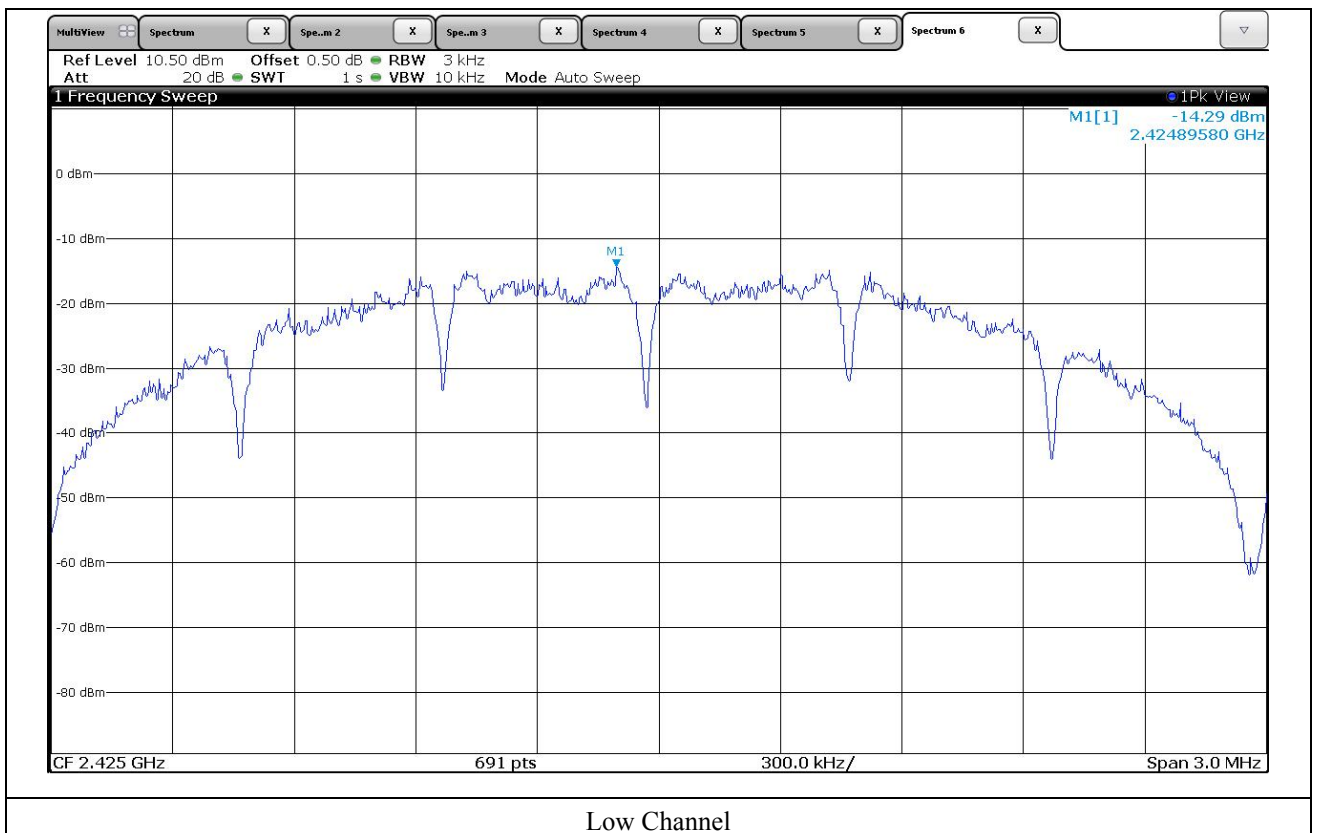
- Test Result : Pass

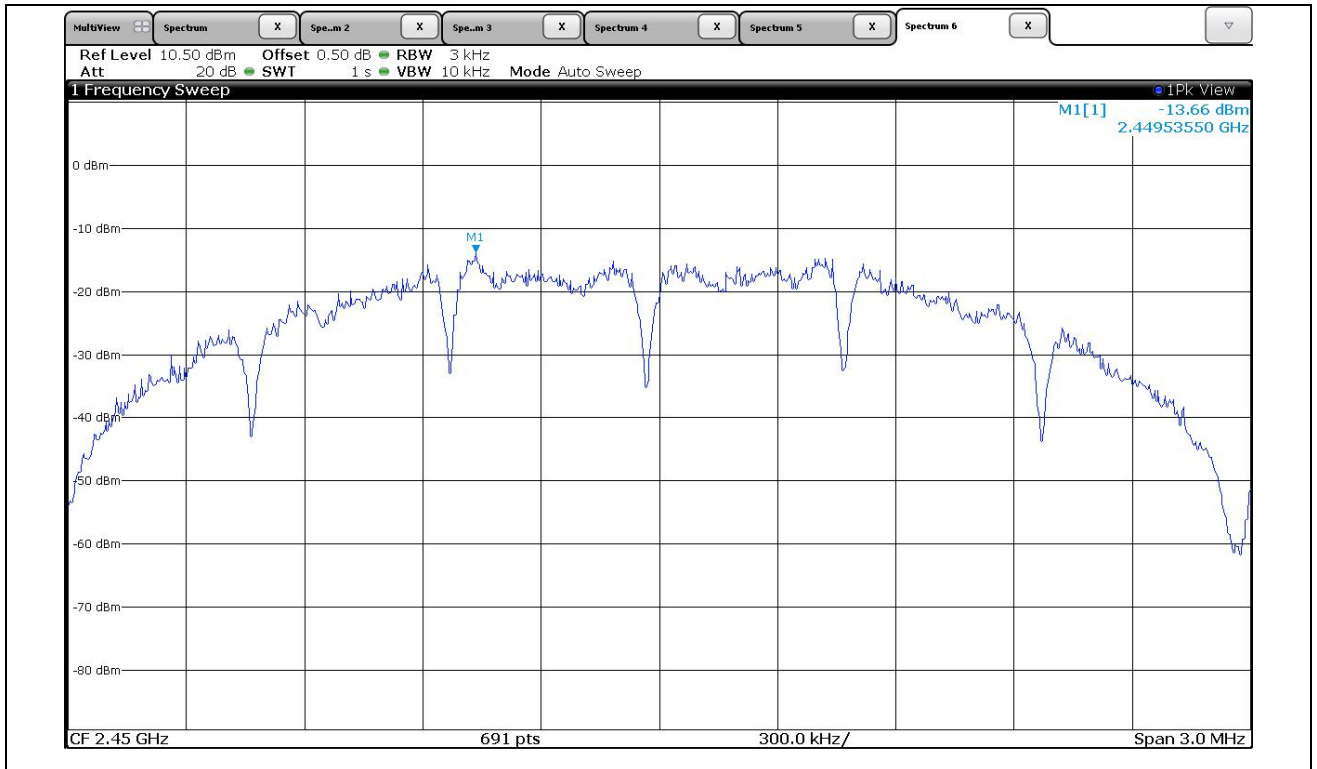
CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 425	-14.29	8.00	22.29
Middle	2 450	-13.66	8.00	21.66
High	2 475	-14.64	8.00	22.64

Remark. Margin = Limit – Measured value

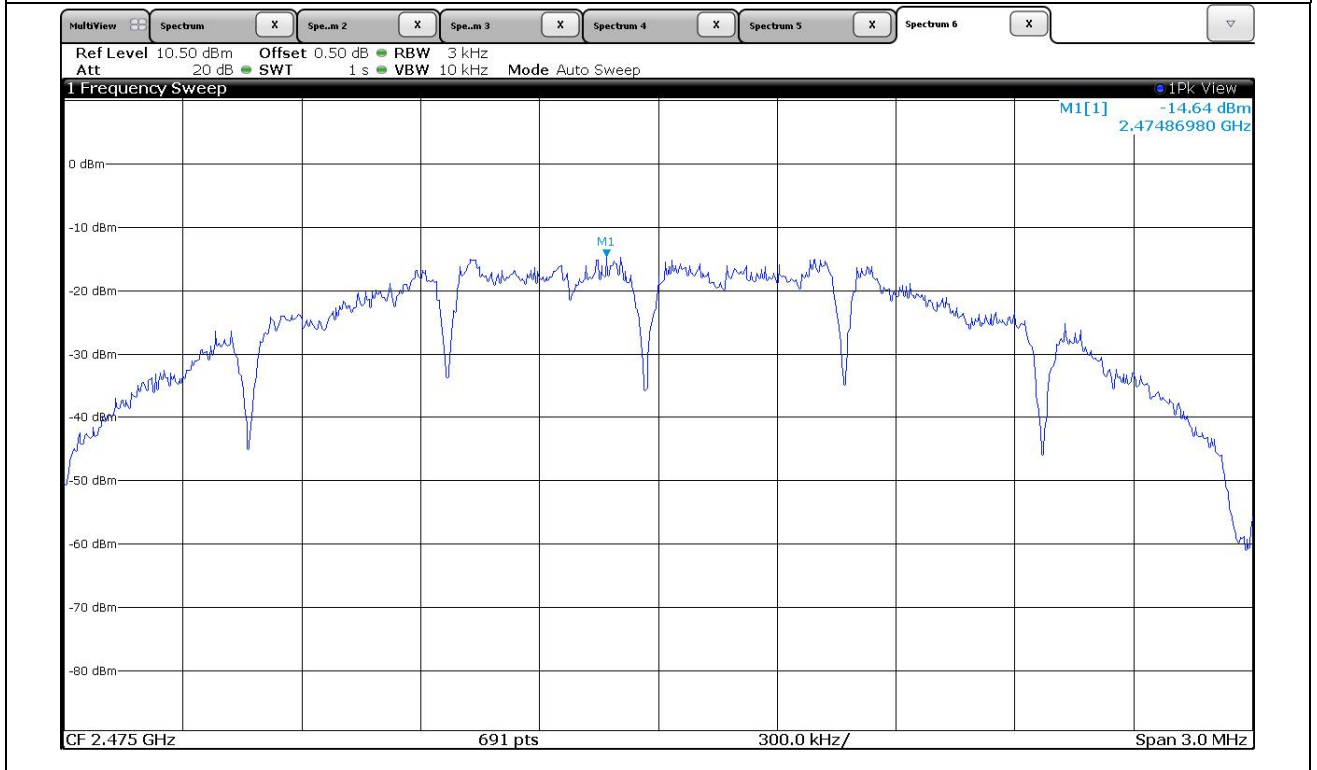
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Tested by: Hong-Kyu, Lee/ Engineer





Middle Channel



High Channel

10.4.2 Test data for Antenna 1

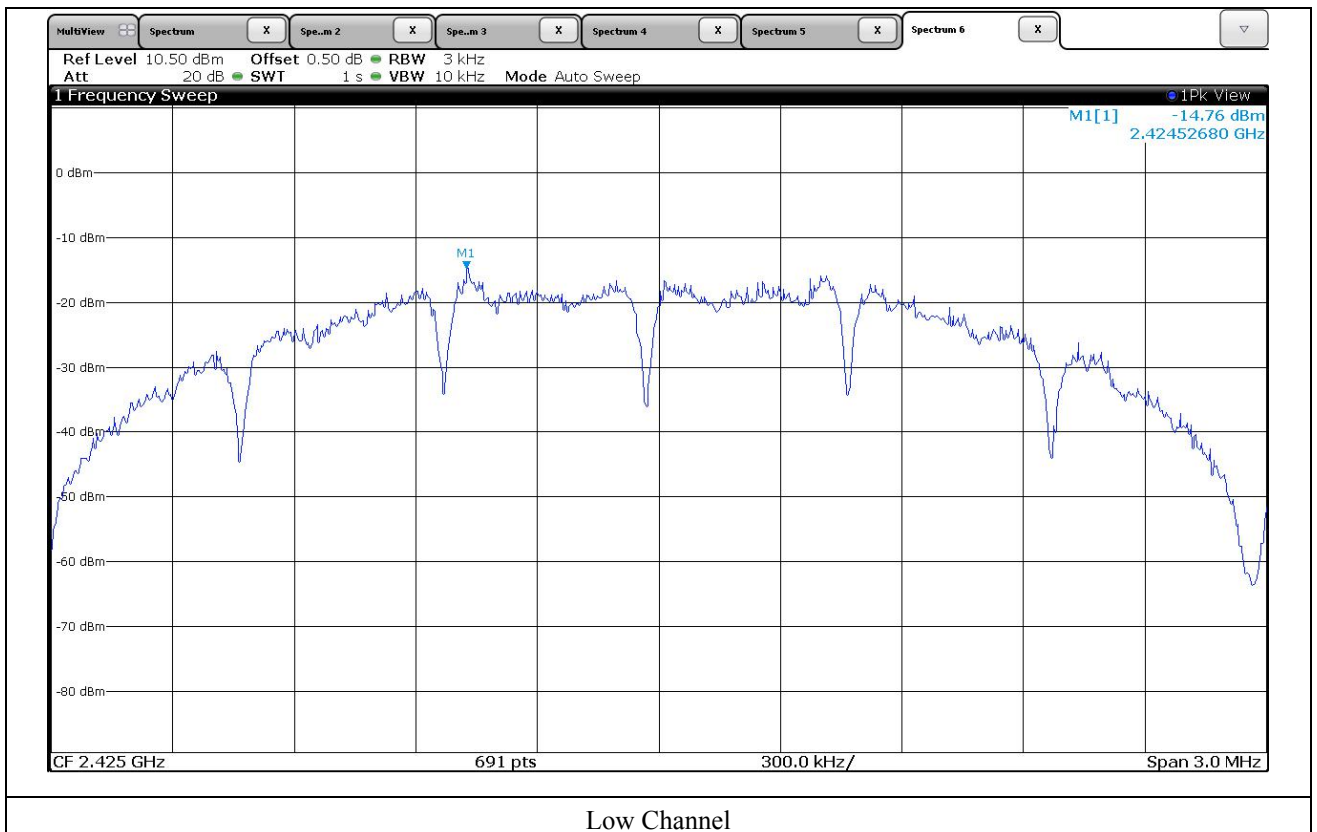
- Test Date : February 10, 2014
- Test Result : Pass

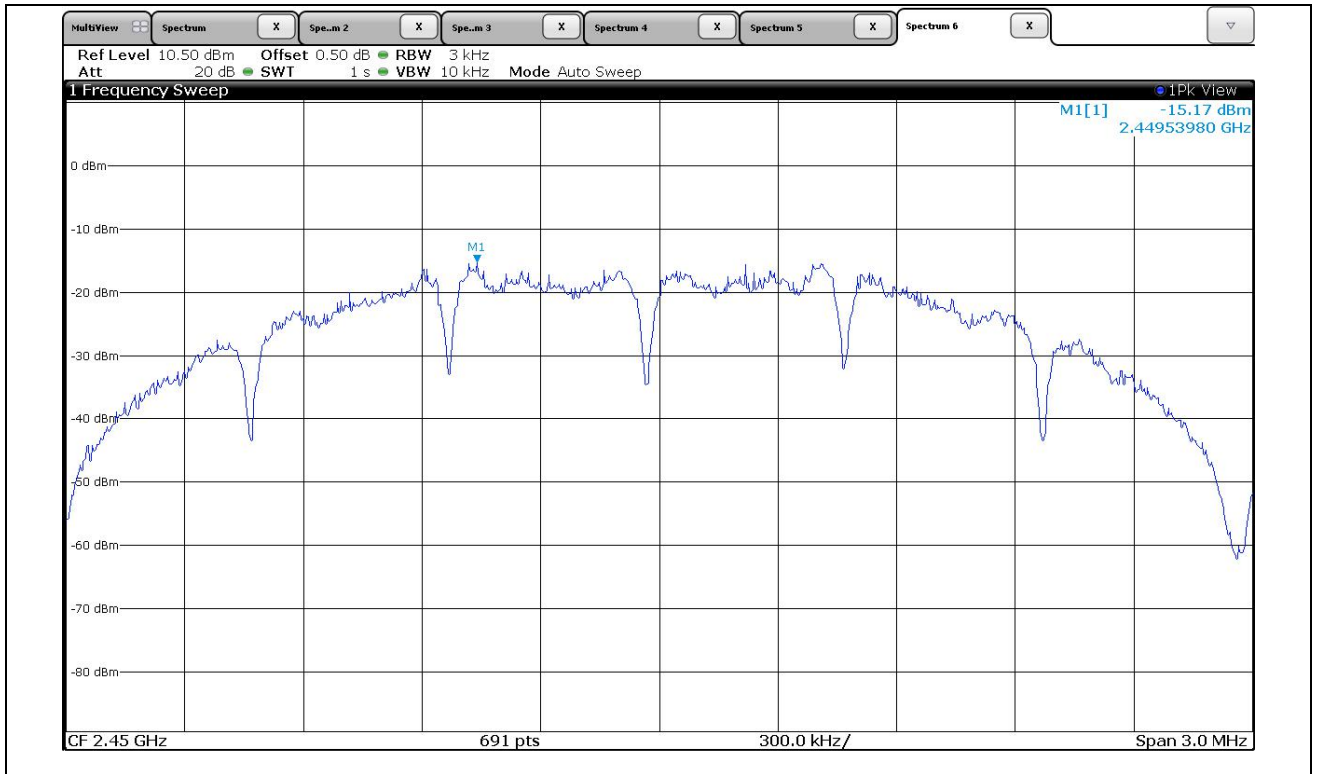
CHANNEL	FREQUENCY(MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 425	-14.76	8.00	22.76
Middle	2 450	-15.17	8.00	23.17
High	2 475	-15.10	8.00	23.10

Remark. Margin = Limit – Measured value

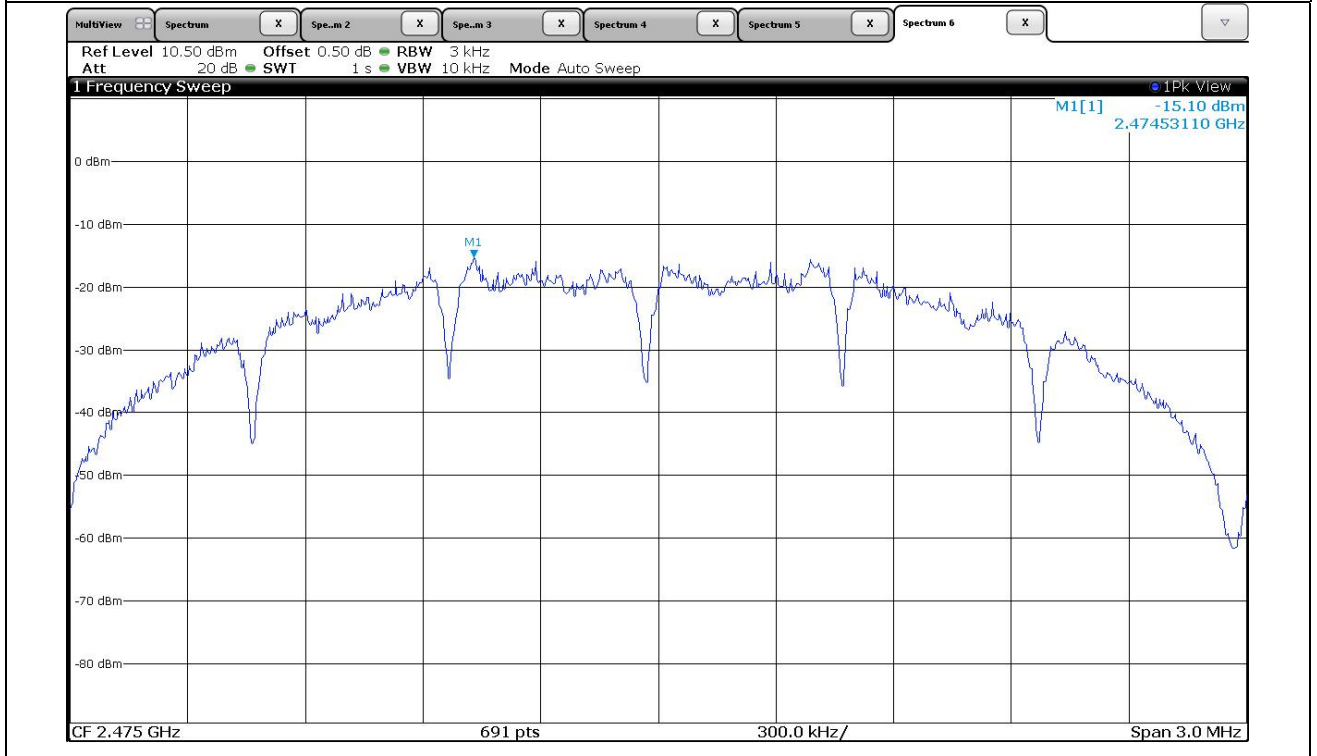
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Tested by: Hong-Kyu, Lee/ Engineer





Middle Channel



High Channel

11. RADIATED EMISSION TEST

11.1 Operating environment

Temperature : 24 °C
Relative humidity : 44 % 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 1 000 MHz 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. 18, 2013(1Y)
■ - ESU	Rohde & Schwarz	EMI Test Receiver	100261	May 27, 2013(1Y)
□ - 8564E	HP	Spectrum Analyzer	3650A00756	May 03, 2013(1Y)
□ - FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Nov. 05, 2013(1Y)
■ - 310N	Sonoma Instrument	AMPLIFIER	312544	May 21, 2013(1Y)
■ - FSW	R/S	Spectrum Analyzer	13128000K67	Dec 11, 2013 (1Y)
□ - - FSV30	Rohde & Schwarz	Signal Analyzer	101372	May 20, 2013(1Y)
■ - SCU-18	Rohde & Schwarz	PRE-AMPLIFIER	10041	Jan. 20, 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. 11, 2012(2Y)
■ - VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-255	Apr. 24, 2012(2Y)
■ - BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Sep. 05, 2013(2Y)
■ - BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Jun. 17, 2013(2Y)
■ - 83051A	Agilent	Microwave System Preamplifier	3950M00201	May 22, 2013(1Y)

All test equipment used is calibrated on a regular basis.

11.4 Test data

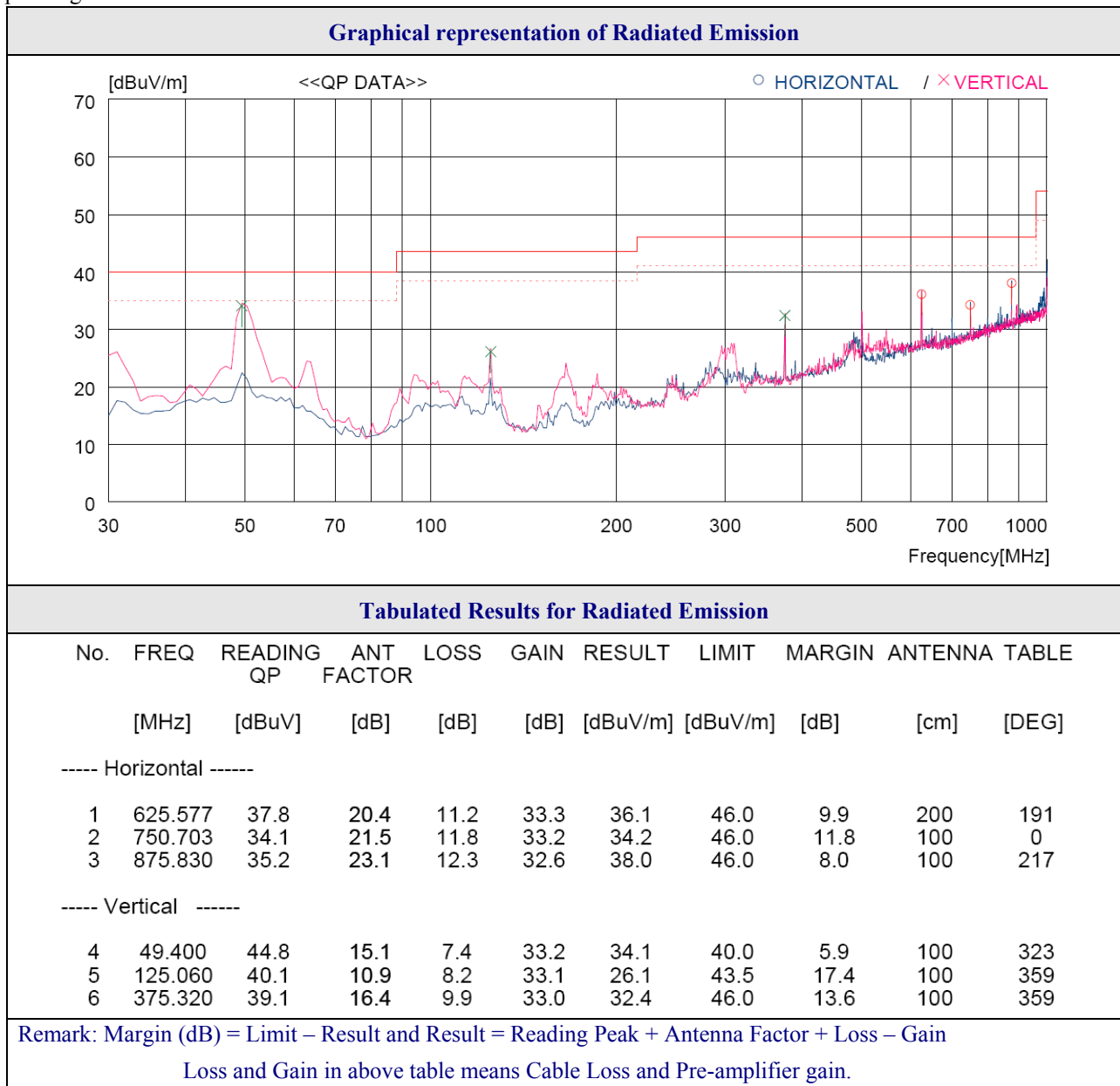
11.4.1 Test data for Antenna 0

11.4.1.1 Test data for 30 MHz ~ 1 000 MHz

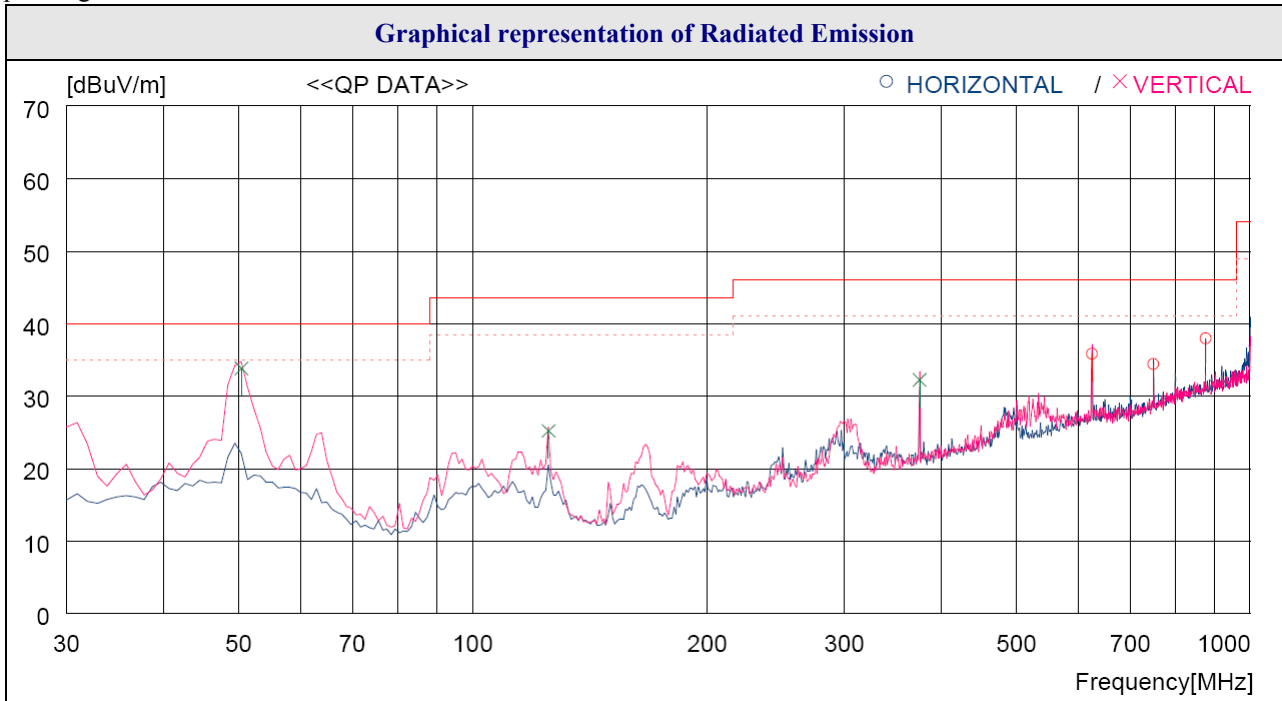
Humidity Level : (43 ~ 44) % R.H. Temperature: (21 ~ 22) °C
 Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247
 Result : PASSED

EUT : IP Client STB Date: February 12, 2014
 Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)

Operating condition : Low Channel



Operating condition : Middle Channel

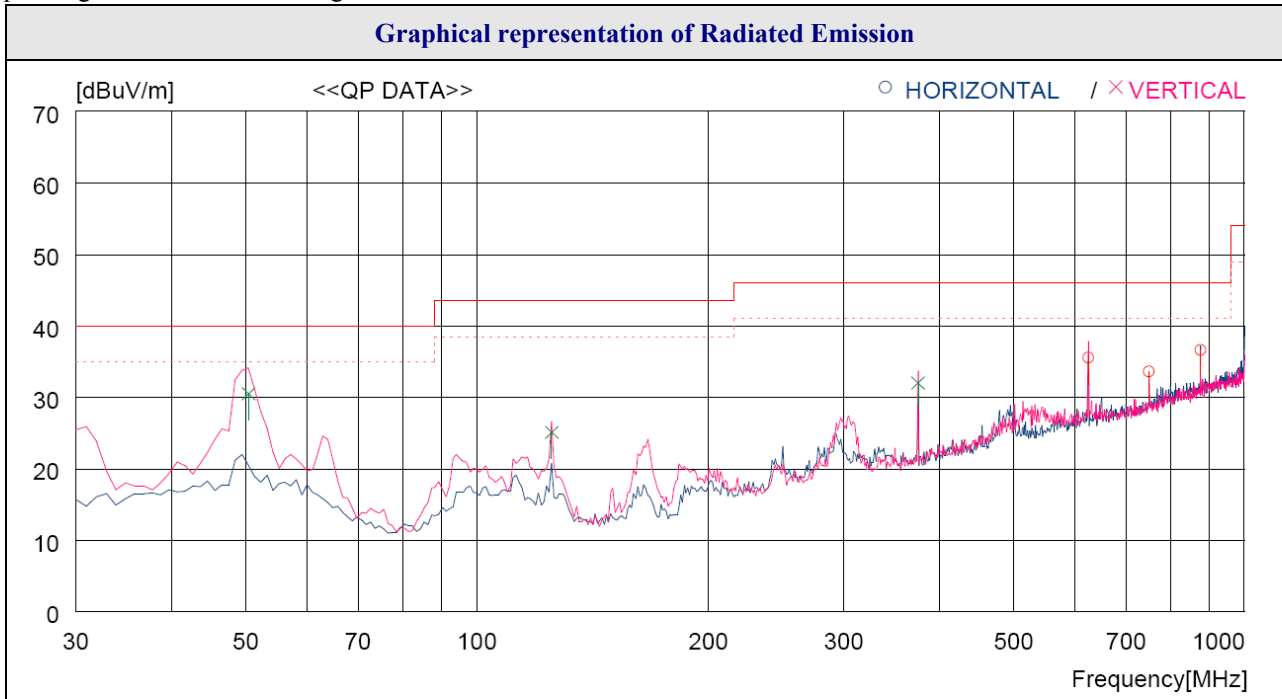


Tabulated Results for Radiated Emission

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	625.577	37.5	20.4	11.2	33.3	35.8	46.0	10.2	200	198
2	750.703	34.3	21.5	11.8	33.2	34.4	46.0	11.6	100	0
3	875.830	35.1	23.1	12.3	32.6	37.9	46.0	8.1	100	232
----- Vertical -----										
4	50.370	44.5	15.1	7.4	33.2	33.8	40.0	6.2	100	359
5	125.060	39.2	10.9	8.2	33.1	25.2	43.5	18.3	100	359
6	375.320	38.9	16.4	9.9	33.0	32.2	46.0	13.8	200	0

Remark: Margin (dB) = Limit – Result and Result = Reading Peak + Antenna Factor + Loss – Gain
Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

Operating condition : High Channel



Tabulated Results for Radiated Emission

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	625.577	37.2	20.4	11.2	33.3	35.5	46.0	10.5	200	0
2	750.703	33.5	21.5	11.8	33.2	33.6	46.0	12.4	100	25
3	875.830	33.8	23.1	12.3	32.6	36.6	46.0	9.4	100	359
----- Vertical -----										
4	50.370	41.2	15.1	7.4	33.2	30.5	40.0	9.5	100	0
5	125.060	39.1	10.9	8.2	33.1	25.1	43.5	18.4	100	0
6	375.320	38.7	16.4	9.9	33.0	32.0	46.0	14.0	200	359

Remark: Margin (dB) = Limit – Result and Result = Reading Peak + Antenna Factor + Loss – Gain
Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

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Tested by: Hong-Kyu, Lee/ Engineer

11.4.1.2 Test data for Below 30 MHz

- Test Date : February 12, 2014
- 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 (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.									

11.4.1.3 Test data for above 1 GHz

- Test Date : February 12, 2014
- 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 (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.									

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Tested by: Hong-Kyu, Lee/ Engineer

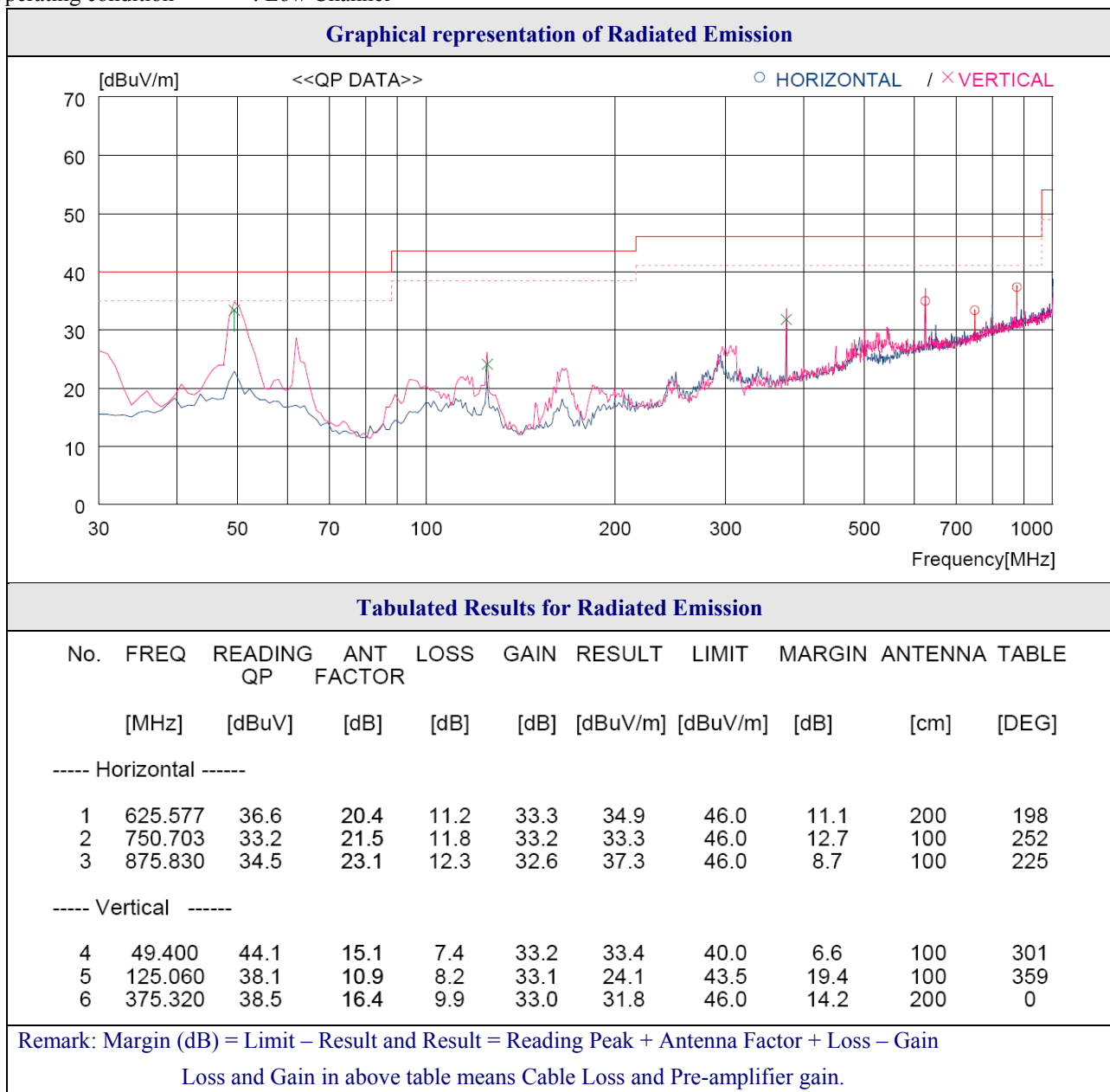
11.4.2 Test data for Antenna 1

11.4.2.1 Test data for 30 MHz ~ 1 000 MHz

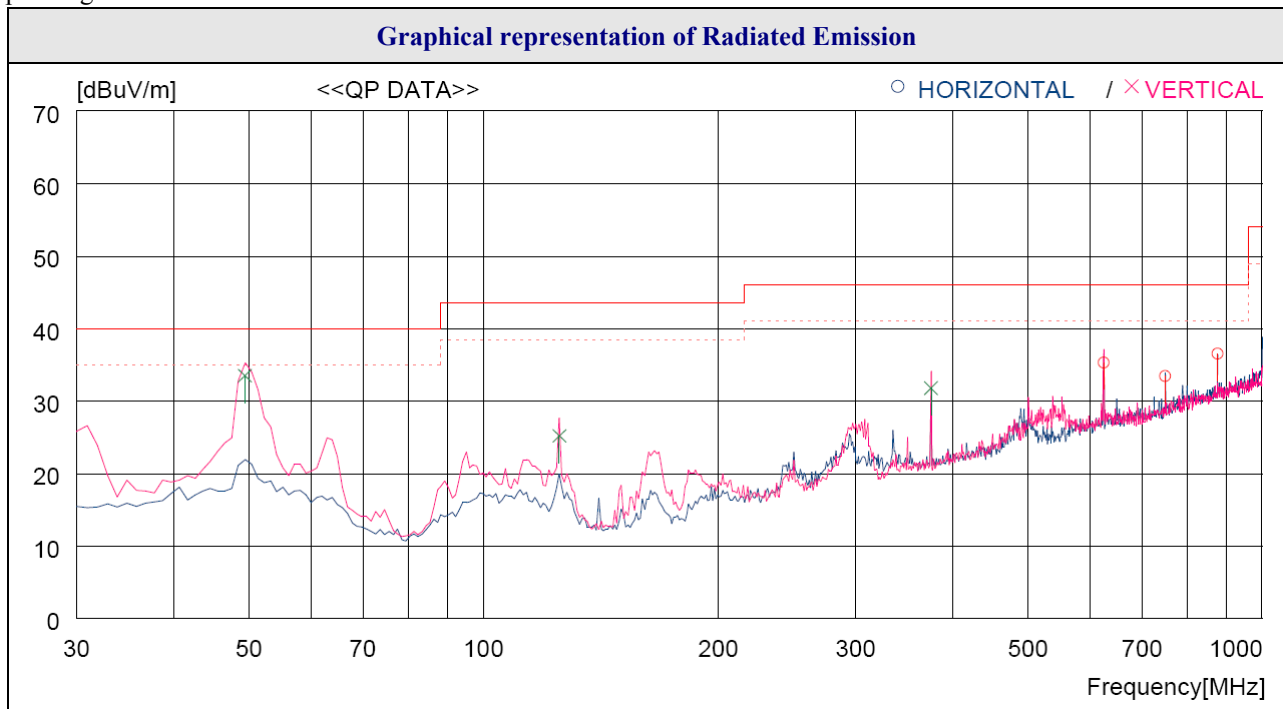
Humidity Level : (43 ~ 44) % R.H. Temperature: (21 ~ 22) °C
 Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247
 Result : PASSED

EUT : IP Client STB Date: February 12, 2014
 Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)

Operating condition : Low Channel



Operating condition : Middle Channel

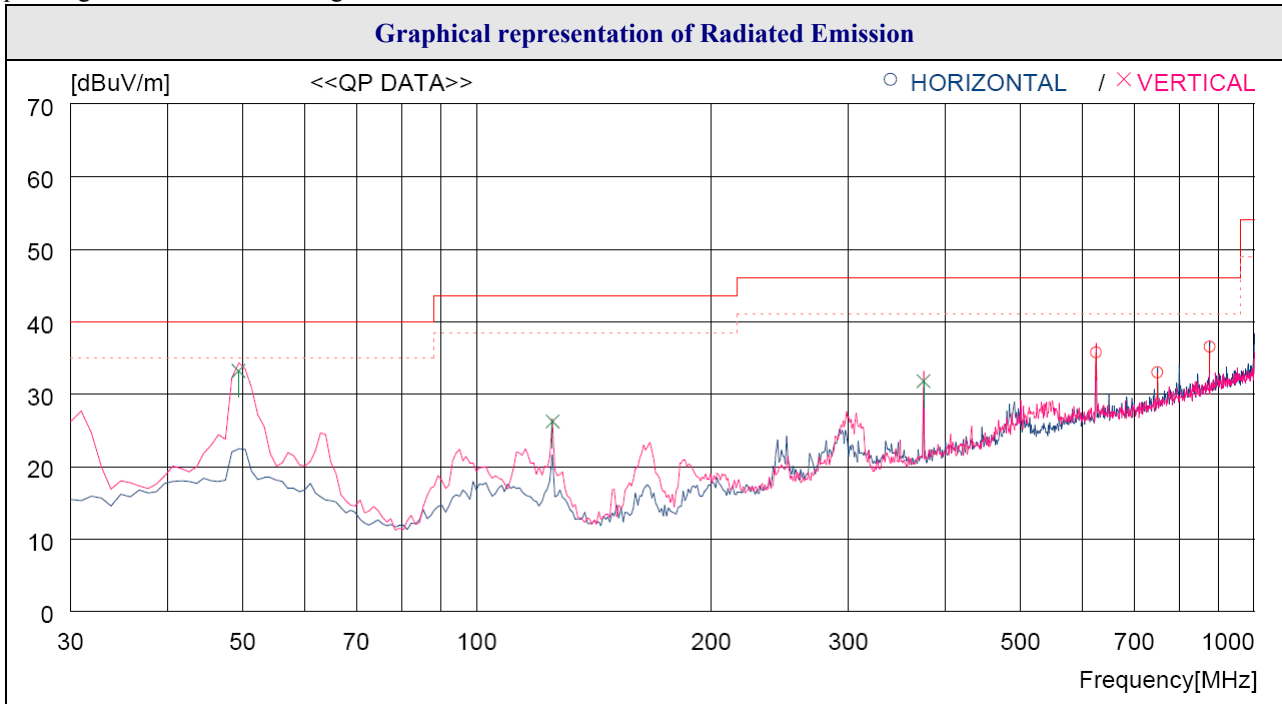


Tabulated Results for Radiated Emission

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	625.577	37.0	20.4	11.2	33.3	35.3	46.0	10.7	200	205
2	750.703	33.3	21.5	11.8	33.2	33.4	46.0	12.6	200	359
3	875.830	33.7	23.1	12.3	32.6	36.5	46.0	9.5	100	0
----- Vertical -----										
4	49.400	44.2	15.1	7.4	33.2	33.5	40.0	6.5	100	359
5	125.060	39.2	10.9	8.2	33.1	25.2	43.5	18.3	100	359
6	375.320	38.5	16.4	9.9	33.0	31.8	46.0	14.2	200	0

Remark: Margin (dB) = Limit – Result and Result = Reading Peak + Antenna Factor + Loss – Gain
Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

Operating condition : High Channel



Tabulated Results for Radiated Emission

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	625.577	37.4	20.4	11.2	33.3	35.7	46.0	10.3	200	359
2	750.703	32.9	21.5	11.8	33.2	33.0	46.0	13.0	100	0
3	875.830	33.7	23.1	12.3	32.6	36.5	46.0	9.5	100	218
----- Vertical -----										
4	49.400	43.9	15.1	7.4	33.2	33.2	40.0	6.8	100	359
5	125.060	40.2	10.9	8.2	33.1	26.2	43.5	17.3	100	80
6	375.320	38.5	16.4	9.9	33.0	31.8	46.0	14.2	200	0

Remark: Margin (dB) = Limit – Result and Result = Reading Peak + Antenna Factor + Loss – Gain
Loss and Gain in above table means Cable Loss and Pre-amplifier gain.

이 홍규

Tested by: Hong-Kyu, Lee/ Engineer

11.4.2.2 Test data for Below 30 MHz

- Test Date : February 12, 2014
- 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 (dB μ V)	Ant. Pol. (H/V)	Ant. Height (m)	Angle ($^{\circ}$)	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.									

11.4.2.3 Test data for above 1 GHz

- Test Date : February 12, 2014
- 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 (dB μ V)	Ant. Pol. (H/V)	Ant. Height (m)	Angle ($^{\circ}$)	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.									

이 홍규

Tested by: Hong-Kyu, Lee/ Engineer

12. CONDUCTED EMISSION TEST

12.1 Operating environment

Temperature : 23 °C
Relative humidity : 43 % 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.
■ - ESCI	Rohde & Schwarz	Test Receiver	101012	Nov. 18, 2013
■ - LT 32C	AFJ INSTRUMENTS	AMN	32031306157	May. 29, 2013
■- 3825/2	EMCO	AMN	9109-1869	May 20, 2013

All test equipment used is calibrated on a regular basis.

12.4 Test data

12.4.1 Test data for Antenna 0

- Test Date : February 11, 2014
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz

Frequency (MHz)	Line	Quasi-Peak (dBµV)		Margin (dB)
		Emission level	Q.P Limits	
0.16	H	54.10	65.30	11.20
0.17	N	53.40	64.80	11.40
0.20	H	51.90	63.50	11.60
0.22	N	47.70	62.90	15.20
0.27	H	45.00	61.00	16.00
0.43	N	45.90	57.30	11.40
Frequency (MHz)	Line	Average (dBµV)		Margin (dB)
		Emission level	Limits	
0.20	H	31.00	53.50	22.50
0.27	H	26.60	51.00	24.40
0.43	N	31.00	47.30	16.30
0.64	N	24.70	46.00	21.30

Line Conducted Emissions Tabulated Data

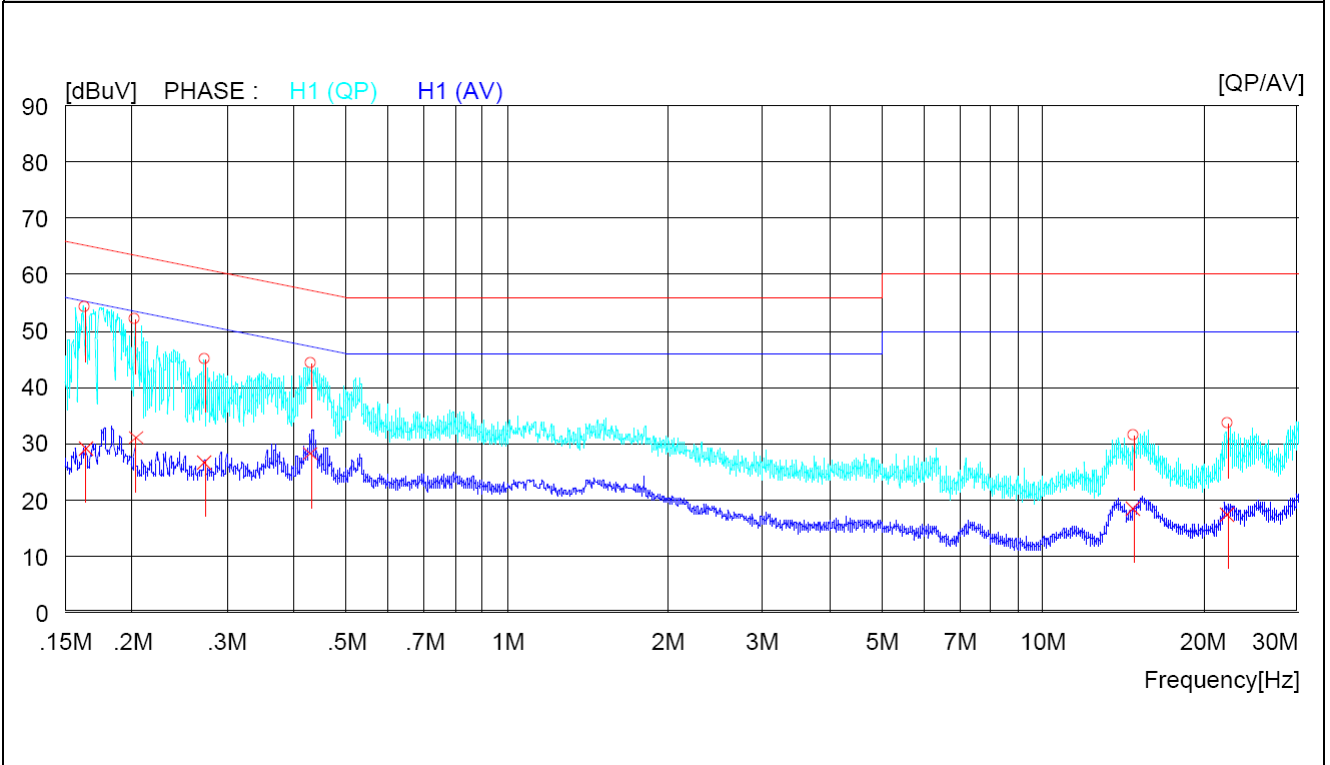
Remark : "H": Hot Line, "N": Neutral Line

See next page for an overview sweep performed with quasi-peak and average detector modes.

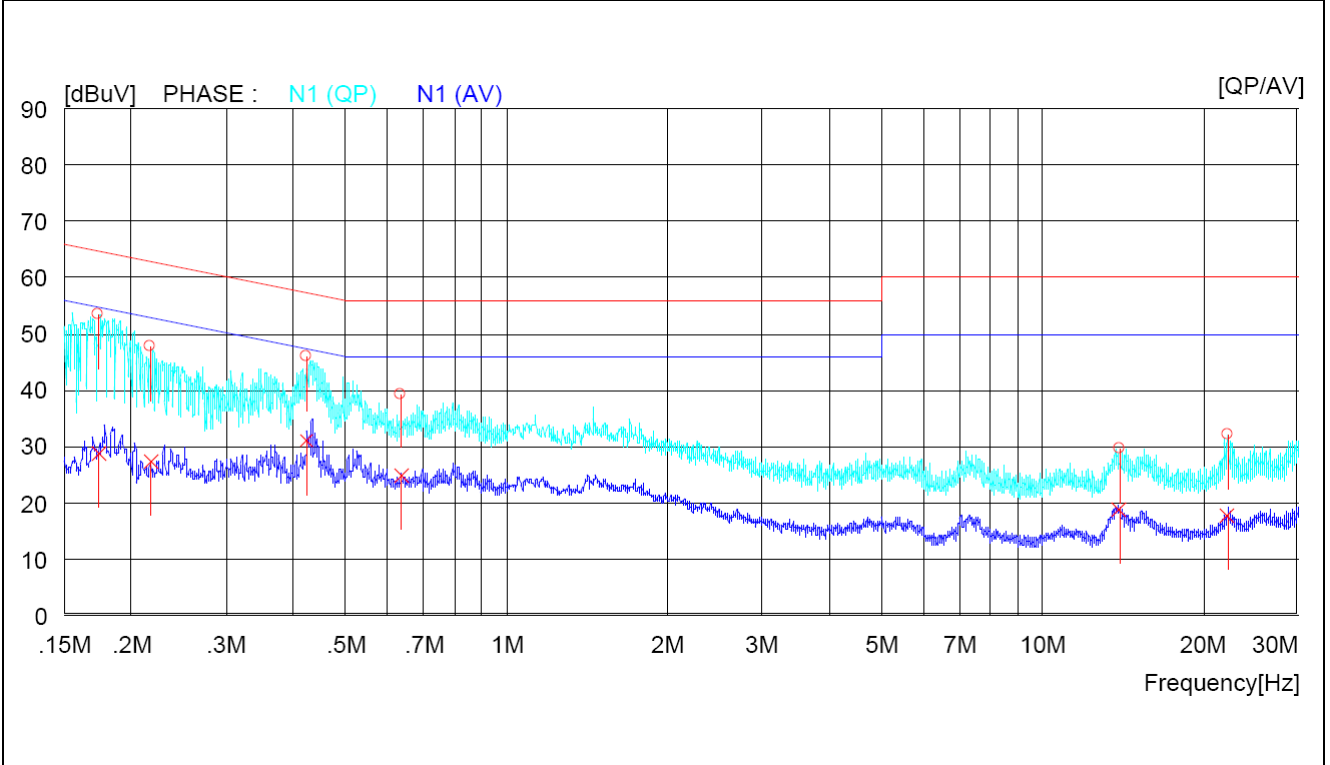


Tested by: Hong-Kyu, Lee/ Engineer

Graphical representation of Conducted Emission



HOT LINE



NEUTRAL LINE

12.4.2 Test data for Antenna 1

- Test Date : February 11, 2014
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz

Frequency (MHz)	Line	Quasi-Peak (dB μ V)		Margin (dB)
		Emission level	Q.P Limits	
0.16	N	53.40	65.50	12.10
0.17	H	53.70	65.20	11.50
0.18	N	52.30	64.30	12.00
0.33	H	42.10	59.40	17.30
0.43	N	45.90	57.20	11.30
0.52	H	42.60	56.00	13.40
Frequency (MHz)	Line	Average (dB μ V)		Margin (dB)
		Emission level	Limits	
0.18	N	31.70	54.30	22.60
0.33	H	26.70	49.40	22.70
0.43	N	34.60	47.20	12.60
0.52	H	28.60	46.00	17.40

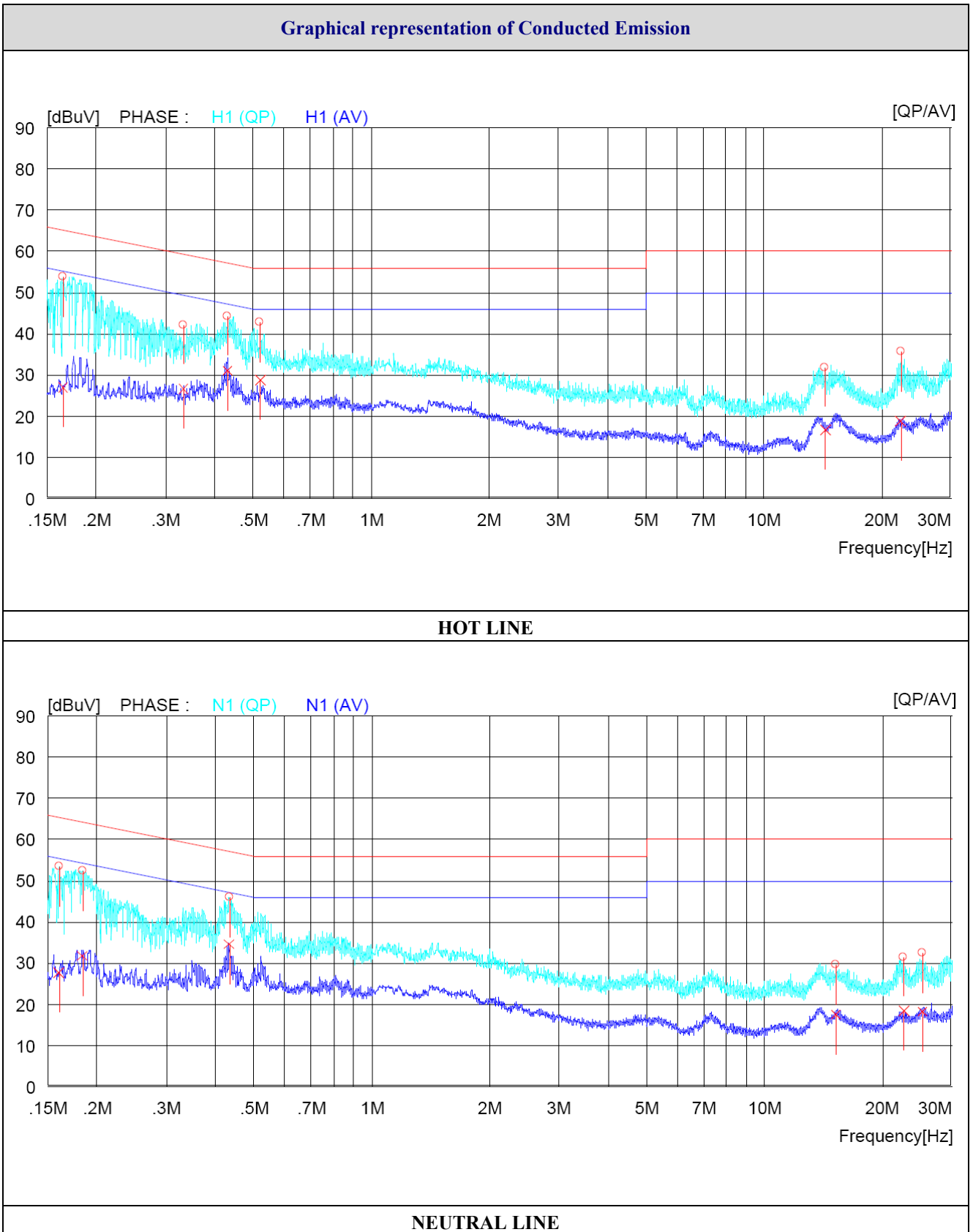
Line Conducted Emissions Tabulated Data

Remark : "H": Hot Line, "N": Neutral Line

See next page for an overview sweep performed with quasi-peak and average detector modes.



Tested by: Hong-Kyu, Lee/ Engineer



13. RADIO FREQUENCY EXPOSURE

13.1 RF Exposure Limit

According to the FCC rule §1.1310, the limit for General Population/Uncontrolled exposure is 1 mW/cm² for the device operating 1 500 ~ 100 000 MHz.

13.2 EUT Description

Kind of EUT	IP Client STB
Operating Frequency Band	<input type="checkbox"/> Wireless Microphone: 494.000 MHz ~ 501.000 MHz and 498.200 MHz ~ 505.200 MHz <input type="checkbox"/> WLAN: 2 412 MHz ~ 2 462 MHz <input type="checkbox"/> WLAN: 5 180 MHz ~ 5 320 MHz / 5 500 MHz ~ 5 700 MHz <input type="checkbox"/> WLAN: 5 745 MHz ~ 5 825 MHz <input type="checkbox"/> Bluetooth: 2 402 MHz ~ 2 480 MHz <input checked="" type="checkbox"/> Zigbee: 2 425 MHz ~ 2 475 MHz
Device Category	<input type="checkbox"/> Portable (< 20 cm separation) <input type="checkbox"/> Mobile (> 20 cm separation) <input checked="" type="checkbox"/> Others
Max. Output Power	Antenna0: 1.83 dBm (1.52 mW) Antenna1: 0.20 dBm (1.05 mW)
Used Antenna	PCB Antenna
Used Antenna Gain	Antenna0: 3.60 dBi Antenna1: 1.80 dBi
Exposure Evaluation Applied	<input checked="" type="checkbox"/> MPE <input type="checkbox"/> SAR <input type="checkbox"/> N/A

13.3 Test Result

According to the procedure, KDB 447498 D01, the standalone SAR test exclusion threshold is

$$\begin{aligned} & [(\text{Max. Power of channel, including tune-up tolerance, mW}) / (\text{Mim. test separation distance, mm})] X [\sqrt{ f(\text{GHz}) }] < 3 \\ & = [1.52 / 5] X \sqrt{ 2.475 } = 0.5 \end{aligned}$$

Conclusion: The SAR test exclusion threshold is less than 3, so the device meets the RF Exposure Requirement and excluded SAR Test.