

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

Test Report No. : E12NR-032

AGR No. : A12OA-228

Applicant : HUMAX. Co.,Ltd.

Address : Humax B/D, 212-1, yuband-Dong, Yongin-City, Gyunggi-Do, Korea

Manufacturer : HUMAX Co.,Ltd.

Address : Humax B/D, 212-1, yuband-Dong, Yongin-City, Gyunggi-Do, Korea

Type of Equipment : IP Client STB

FCC ID. : O6ZXI3-H

Model Name : XI3-H

Serial number : N/A

Total page of Report : 50 pages (including this page)

Date of Incoming : November 12, 2012

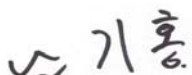
Date of issue : November 16, 2012

## 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.

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## CONTENTS

### PAGE

|                                                                          |           |
|--------------------------------------------------------------------------|-----------|
| <b>1. VERIFICATION OF COMPLIANCE .....</b>                               | <b>6</b>  |
| <b>2. TEST SUMMARY.....</b>                                              | <b>7</b>  |
| 2.1 TEST ITEMS AND RESULTS.....                                          | 7         |
| 2.2 ADDITIONS, DEVIATIONS, EXCLUSIONS FROM STANDARDS .....               | 7         |
| 2.3 RELATED SUBMITTAL(S) / GRANT(S) .....                                | 7         |
| 2.4 PURPOSE OF THE TEST .....                                            | 7         |
| 2.5 TEST METHODOLOGY .....                                               | 7         |
| 2.6 TEST FACILITY .....                                                  | 7         |
| <b>3. GENERAL INFORMATION.....</b>                                       | <b>8</b>  |
| 3.1 PRODUCT DESCRIPTION.....                                             | 8         |
| 3.2 ALTERNATIVE TYPE(S)/MODEL(S); ALSO COVERED BY THIS TEST REPORT. .... | 8         |
| <b>4. EUT MODIFICATIONS .....</b>                                        | <b>8</b>  |
| <b>5. SYSTEM TEST CONFIGURATION.....</b>                                 | <b>9</b>  |
| 5.1 JUSTIFICATION .....                                                  | 9         |
| 5.2 PERIPHERAL EQUIPMENT.....                                            | 9         |
| 5.3 MODE OF OPERATION DURING THE TEST.....                               | 9         |
| 5.4 CONFIGURATION OF TEST SYSTEM .....                                   | 10        |
| 5.5 ANTENNA REQUIREMENT .....                                            | 10        |
| <b>6. PRELIMINARY TEST .....</b>                                         | <b>10</b> |
| 6.1 AC POWER LINE CONDUCTED EMISSIONS TESTS.....                         | 10        |
| 6.2 GENERAL RADIATED EMISSIONS TESTS.....                                | 10        |
| <b>9. TEST DATA.....</b>                                                 | <b>11</b> |
| <b>9.1 MINIMUM 6 DB BANDWIDTH .....</b>                                  | <b>11</b> |
| 9.1.1 OPERATING ENVIRONMENT .....                                        | 11        |
| 9.1.2 TEST SET-UP .....                                                  | 11        |
| 9.1.3 TEST EQUIPMENT USED .....                                          | 11        |
| 9.1.4 TEST DATA.....                                                     | 12        |
| 9.1.4.1 Test date for Antenna 1 .....                                    | 12        |
| 9.1.4.2 Test date for Antenna 2 .....                                    | 15        |
| <b>9.2 MAXIMUM PEAK OUTPUT POWER.....</b>                                | <b>18</b> |

|                                                                                 |    |
|---------------------------------------------------------------------------------|----|
| 9.2.1 OPERATING ENVIRONMENT .....                                               | 18 |
| 9.2.2 TEST SET-UP .....                                                         | 18 |
| 9.2.3 TEST EQUIPMENT USED .....                                                 | 18 |
| 9.2.4 Test data .....                                                           | 19 |
| 9.2.4.1 Test data for Antenna 1 .....                                           | 19 |
| 9.2.4.2 Test data for Antenna 2 .....                                           | 22 |
| 9.3 100 KHZ BANDWIDTH OUTSIDE THE FREQUENCY BAND .....                          | 25 |
| 9.3.1 OPERATING ENVIRONMENT .....                                               | 25 |
| 9.3.2 TEST SET-UP FOR CONDUCTED MEASUREMENT .....                               | 25 |
| 9.3.3 TEST SET-UP FOR RADIATED MEASUREMENT .....                                | 25 |
| 9.3.4 TEST EQUIPMENT USED .....                                                 | 25 |
| 9.3.5. TEST DATA FOR CONDUCTED EMISSION .....                                   | 26 |
| 9.3.5.1 Test data for Antenna 1 .....                                           | 26 |
| 9.3.5.2 Test data for Antenna 2 .....                                           | 30 |
| 9.3.6. TEST DATA FOR RADIATED EMISSION .....                                    | 34 |
| 9.3.6.1 Radiated Emission which fall in the Restricted Band for Antenna 1 ..... | 34 |
| 9.3.6.2 Spurious & Harmonic Radiated Emission for Antenna1 .....                | 35 |
| 9.3.6.3 Radiated Emission which fall in the Restricted Band for Antenna 2 ..... | 36 |
| 9.3.6.4 Spurious & Harmonic Radiated Emission for Antenna 2 .....               | 37 |
| 9.4 PEAK POWER SPECTRUL DENSITY .....                                           | 38 |
| 9.4.1 OPERATING ENVIRONMENT .....                                               | 38 |
| 9.4.2 TEST SET-UP .....                                                         | 38 |
| 9.4.3 TEST EQUIPMENT USED .....                                                 | 38 |
| 9.4.4 TEST DATA .....                                                           | 39 |
| 9.4.4.1 Test data for Antenna 1 .....                                           | 39 |
| 9.4.4.2 Test data for Antenna 2 .....                                           | 41 |
| 11. RADIATED EMISSION TEST .....                                                | 43 |
| 11.1 OPERATING ENVIRONMENT .....                                                | 43 |
| 11.2 TEST SET-UP .....                                                          | 43 |
| 11.3 TEST EQUIPMENT USED .....                                                  | 43 |
| 11.4 TEST DATA .....                                                            | 44 |
| 12. CONDUCTED EMISSION TEST .....                                               | 47 |
| 12.1 OPERATING ENVIRONMENT .....                                                | 47 |
| 12.2 TEST SET-UP .....                                                          | 47 |

|                                           |           |
|-------------------------------------------|-----------|
| <b>12.3 TEST EQUIPMENT USED .....</b>     | <b>47</b> |
| <b>12.4 TEST DATA .....</b>               | <b>48</b> |
| <b>13. RADIO FREQUENCY EXPOSURE .....</b> | <b>50</b> |
| <b>13.1 RF EXPOSURE LIMIT .....</b>       | <b>50</b> |
| <b>13.2 EUT DESCRIPTION .....</b>         | <b>50</b> |
| <b>13.3 TEST RESULT .....</b>             | <b>50</b> |

### Revision History

| Issued Report No. | Issued Date       | Revisions     | Effect Section |
|-------------------|-------------------|---------------|----------------|
| E12NR-032         | November 16, 2012 | Initial Issue | All            |
|                   |                   |               |                |
|                   |                   |               |                |

## 1. VERIFICATION OF COMPLIANCE

Applicant : HUMAX. Co.,Ltd.  
Address : Humax B/D, 212-1, yuband-Dong, Yongin-City, Gyunggi-Do, Korea  
Contact Person : Mr. Nak Yool Sung / Engineer  
Telephone No. : +82-31-776-6748  
FCC ID : O6ZXI3-H  
Model Name : XI3-H  
Serial Number : N/A  
Date : November 16, 2012

|                                                         |                                                |
|---------------------------------------------------------|------------------------------------------------|
| Equipment Class                                         | <b><i>DTS – DIGITAL TRNSMISSION SYSTEM</i></b> |
| Kind of Equipment                                       | IP Client STB                                  |
| This Report Concerns                                    | Original Grant                                 |
| Measurement Procedures                                  | ANSI C63.4: 2009                               |
| Type of Equipment Tested                                | Pre-Production                                 |
| Kind of Equipment Authorization Requested               | Certification                                  |
| Equipment will be Operated Under<br>FCC Rules Part(s)   | FCC PART 15 SUBPART C Section 15.247           |
| Modifications on the Equipment to Achieve<br>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

Both conducted and radiated testing was performed according to the procedures in ANSI C63.4: 2009. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

### 2.6 Test Facility

The open area test site and conducted measurement facilities are located on 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.

### 3. GENERAL INFORMATION

#### 3.1 Product Description

The HUMAX. Co.,Ltd., Model XI3-H (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                                    | 1.60 dBm                                                                                                                              |
| Number of Channel                                  | 3 Channels                                                                                                                            |
| Data Rate                                          | 250 kbps                                                                                                                              |
| Modulation Type                                    | O-QPSK                                                                                                                                |
| Antenna                                            | ANTENNA 1 - Manufacturer: DONGNAM CO.,LTD., Model No.: TP103ANT<br>ANTENNA 2 - Manufacturer: DONGNAM CO.,LTD., Model No.: TP104ANT    |
| Antenna Connector Type                             | Inverted F Antenna                                                                                                                    |
| Antenna Gain                                       | TP103ANT : 3.397 dBi / TP104ANT : 2.520 dBi                                                                                           |
| List of each Osc. or crystal Freq.(Freq. >= 1 MHz) | CPU 50MHz, RF4CE 16MHz, MoCA 50MHz, DDR 800MHz                                                                                        |
| External Connector                                 | Rear : Cable in(MoCA), TV out, Digital audio out (SPDIF), HDMI input, HDMI output, Ethernet, USB, and DC jack (5V)<br>Front : SD Card |

#### 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. | XI3-H CPU B/D REV. 0.2A | N/A    |
| USB Board   | HUMAX Co.,Ltd. | XI3-H USB B/D REV. 0.2A | 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 |
|--------------|----------------|----------|---------------------|--------------|
| XI3-H        | HUMAX Co.,Ltd. | O6ZXI3-H | IP Client STB (EUT) | PC           |
| PP11L        | DELL           | N/A      | PC                  | EUT          |
| 3453CM056UOA | DELL           | N/A      | Mouse               | 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 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 C63.4: 2009 7.2.3 to determine the worse operating conditions.

**Radiated Emission Test:** Preliminary radiated emissions test were conducted using the procedure in ANSI C63.4: 2009 8.3.1.1 and 13.1.4.1 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, 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 transmitter antenna of the EUT is installed inside of 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                                                     |

## 9. TEST DATA

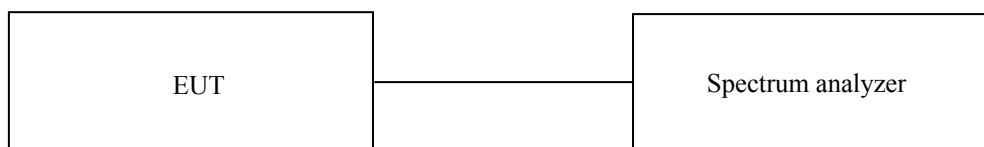
### 9.1 MINIMUM 6 dB BANDWIDTH

#### 9.1.1 Operating environment

Temperature : 25 °C  
Relative humidity : 55 % R.H.

#### 9.1.2 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.



#### 9.1.3 Test equipment used

|     | Model Number | Manufacturer | Description       | Serial Number | Last Cal.      |
|-----|--------------|--------------|-------------------|---------------|----------------|
| ■ - | 8564E        | HP           | Spectrum Analyzer | 3650A00756    | April 04, 2012 |

All test equipment used is calibrated on a regular basis.

## 9.1.4 Test data

### 9.1.4.1 Test date for Antenna 1

-. Test Date : November 14, 2012

-. Test Result : Pass

| CHANNEL | FREQUENCY(MHz) | MEASURED VLAUE (kHz) | LIMIT (kHz) | MARGIN (kHz) |
|---------|----------------|----------------------|-------------|--------------|
| Low     | 2 425          | 1 575                | 500         | -1 075       |
| Middle  | 2 450          | 1 583                | 500         | -1 583       |
| High    | 2 475          | 1 583                | 500         | -1 583       |

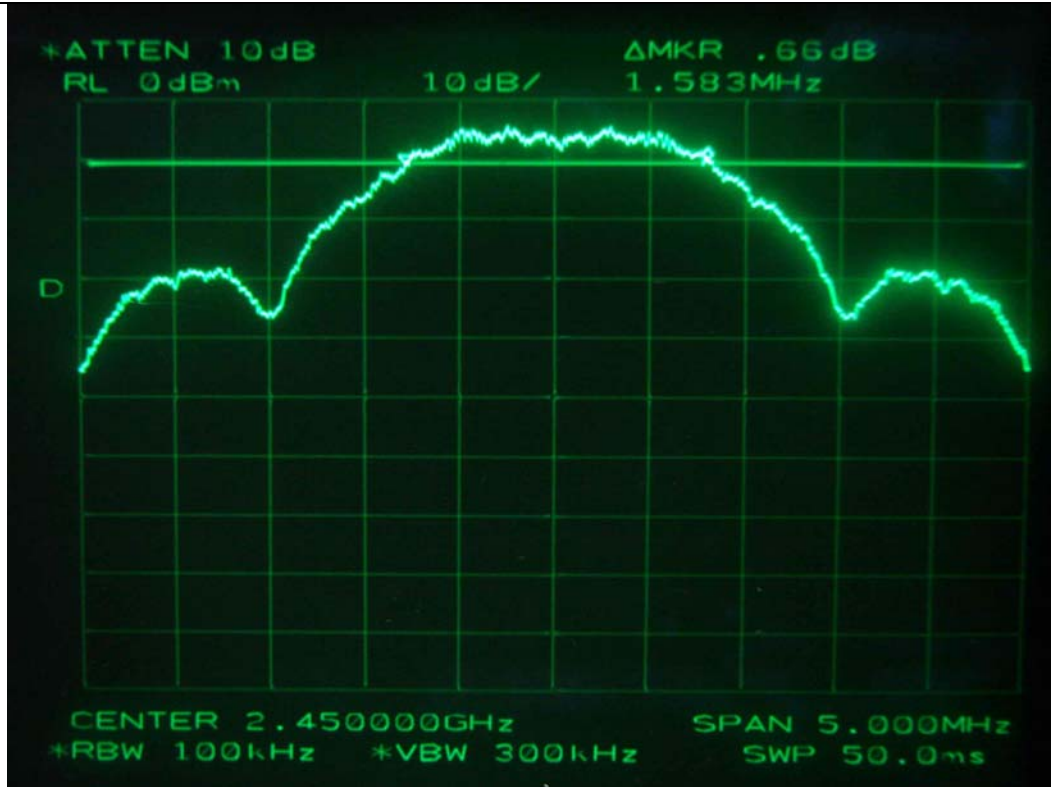
Remark: See next page for an overview sweep performed with peak detector.



**Tested by: Ki-Hong, Nam / Senior Engineer**



Low Channel



Middle Channel



High Channel

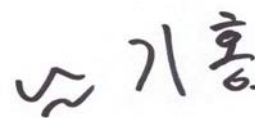
#### 9.1.4.2 Test date for Antenna 2

- Test Date : November 14, 2012

- Test Result : Pass

| CHANNEL | FREQUENCY(MHz) | MEASURED VLAUE (kHz) | LIMIT (kHz) | MARGIN (kHz) |
|---------|----------------|----------------------|-------------|--------------|
| Low     | 2 425          | 1 575                | 500         | -1 075       |
| Middle  | 2 450          | 1 575                | 500         | -1 575       |
| High    | 2 475          | 1 575                | 500         | -1 575       |

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



Tested by: Ki-Hong, Nam / Senior Engineer





Low Channel



Middle Channel





High Channel

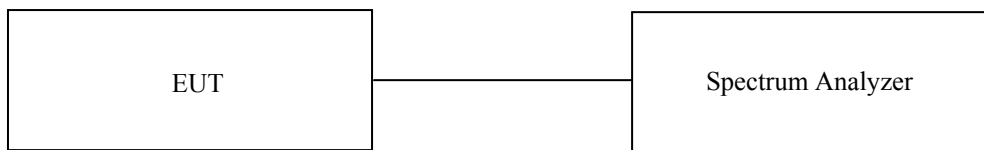
## 9.2 MAXIMUM PEAK OUTPUT POWER

### 9.2.1 Operating environment

Temperature : 25 °C  
Relative humidity : 55 % R.H.

### 9.2.2 Test set-up

The maximum peak output power was measured with the spectrum analyzer connected to the antenna output of the EUT. The spectrum analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99 % bandwidth. The EUT was operating in transmit mode at the appropriate center frequency.



### 9.2.3 Test equipment used

|     | Model Number | Manufacturer | Description       | Serial Number | Last Cal.      |
|-----|--------------|--------------|-------------------|---------------|----------------|
| ■ - | 8564E        | HP           | Spectrum Analyzer | 3650A00756    | April 04, 2012 |

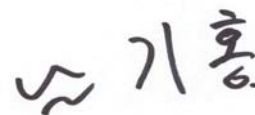
All test equipment used is calibrated on a regular basis.

**9.2.4 Test data****9.2.4.1 Test date for Antenna 1**

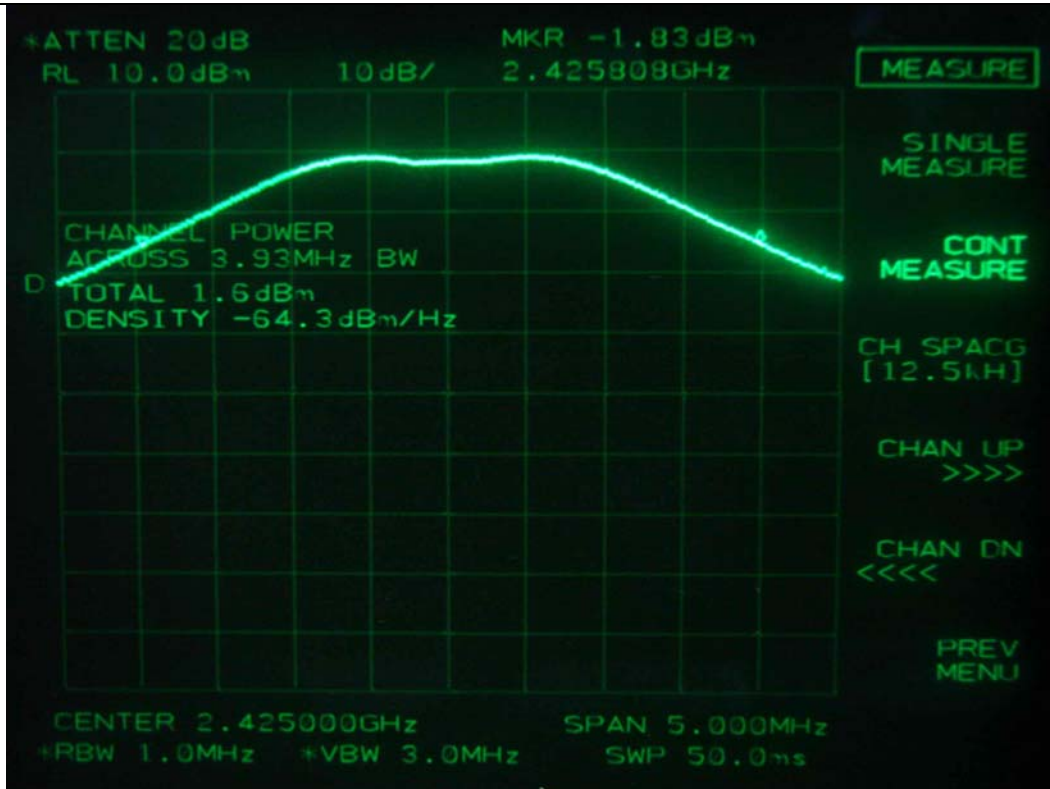
- Test Date : November 14, 2012  
- Test Result : Pass

| CHANNEL | FREQUENCY<br>(MHz) | 99 % Occupied<br>Bandwidth (MHz) | MEASURED<br>VLAUE (dBm) | LIMIT<br>(dBm) | MARGIN<br>(dB) |
|---------|--------------------|----------------------------------|-------------------------|----------------|----------------|
| Low     | 2 425              | 3.933                            | 1.60                    | 30.00          | -28.40         |
| Middle  | 2 450              | 3.958                            | 1.30                    | 30.00          | -28.70         |
| High    | 2 475              | 3.933                            | 0.70                    | 30.00          | -29.30         |

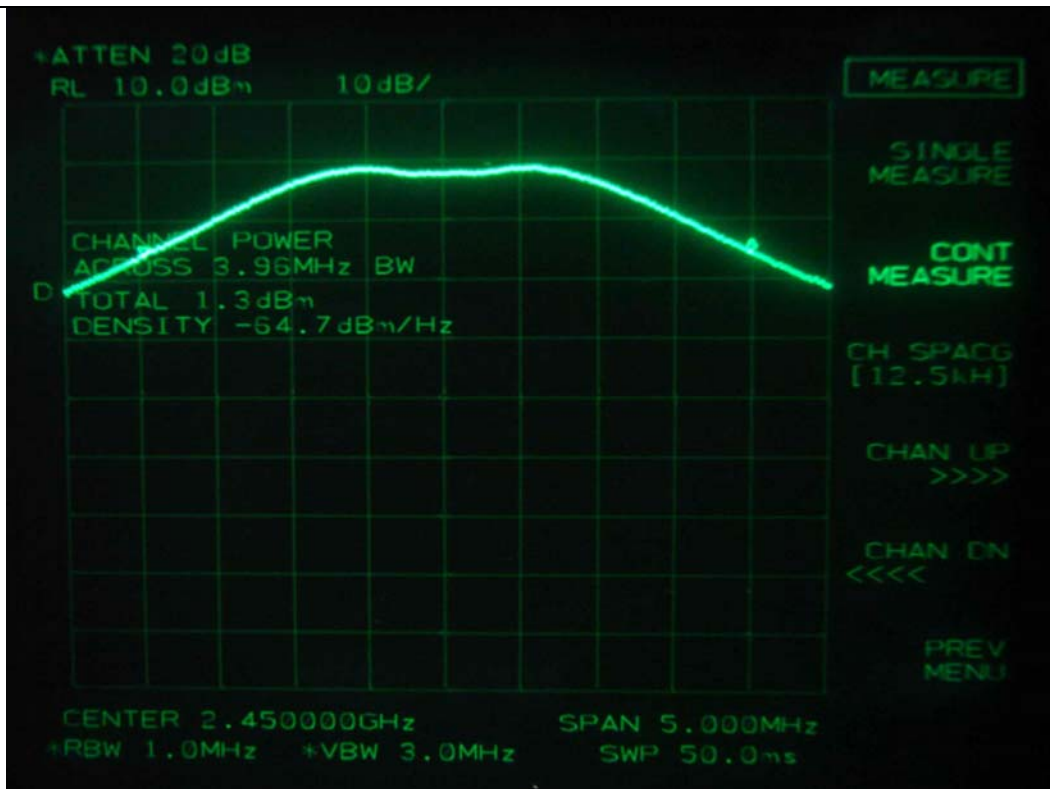
Remark: See next page for an overview sweep performed with peak detector.



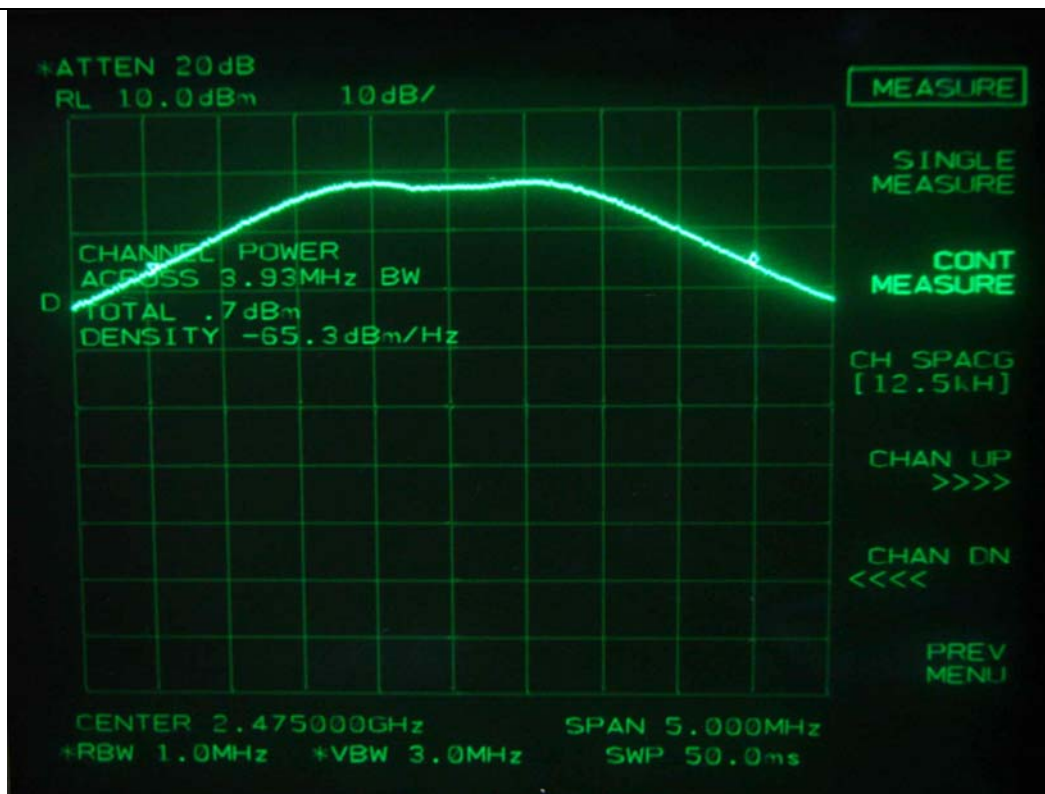
**Tested by: Ki-Hong, Nam / Senior Engineer**



Low Channel



Middle Channel



High Channel

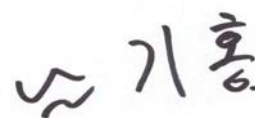
#### 9.2.4.2 Test date for Antenna 2

-. Test Date : November 14, 2012

-. Test Result : Pass

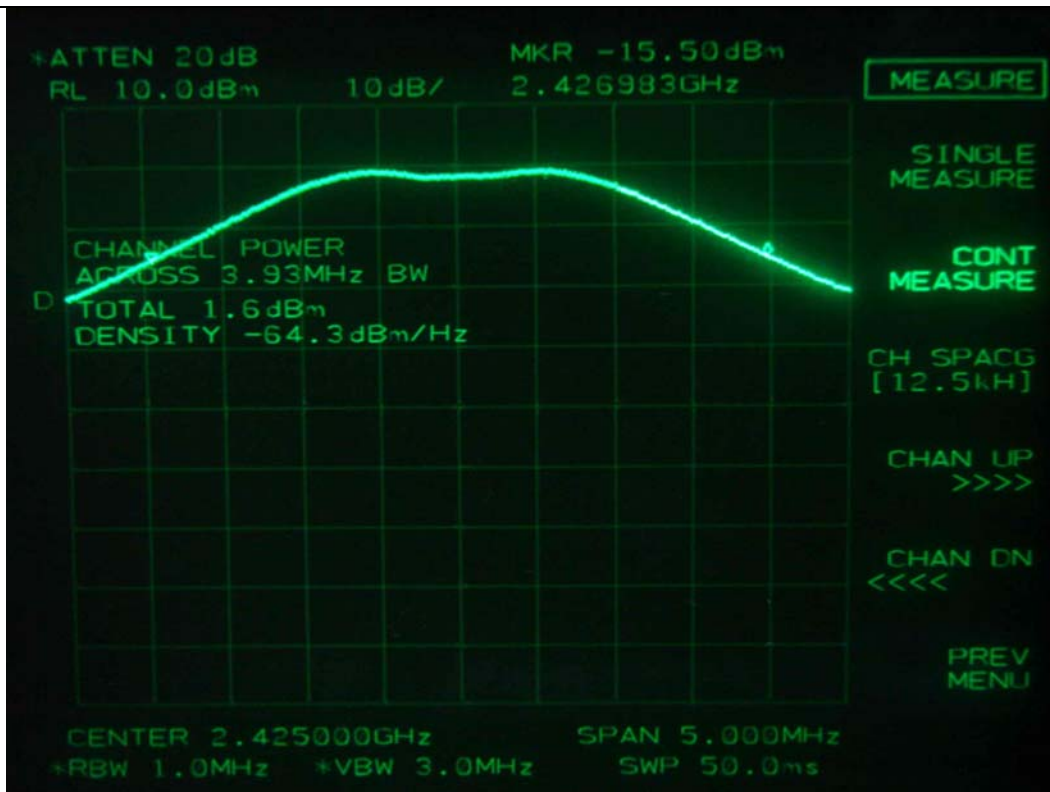
| CHANNEL | FREQUENCY<br>(MHz) | 99 % Occupied<br>Bandwidth (MHz) | MEASURED<br>VLAUE (dBm) | LIMIT<br>(dBm) | MARGIN<br>(dB) |
|---------|--------------------|----------------------------------|-------------------------|----------------|----------------|
| Low     | 2 425              | 3.925                            | 1.60                    | 30.00          | -28.40         |
| Middle  | 2 450              | 3.958                            | 1.20                    | 30.00          | -28.80         |
| High    | 2 475              | 3.925                            | 0.50                    | 30.00          | -29.50         |

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

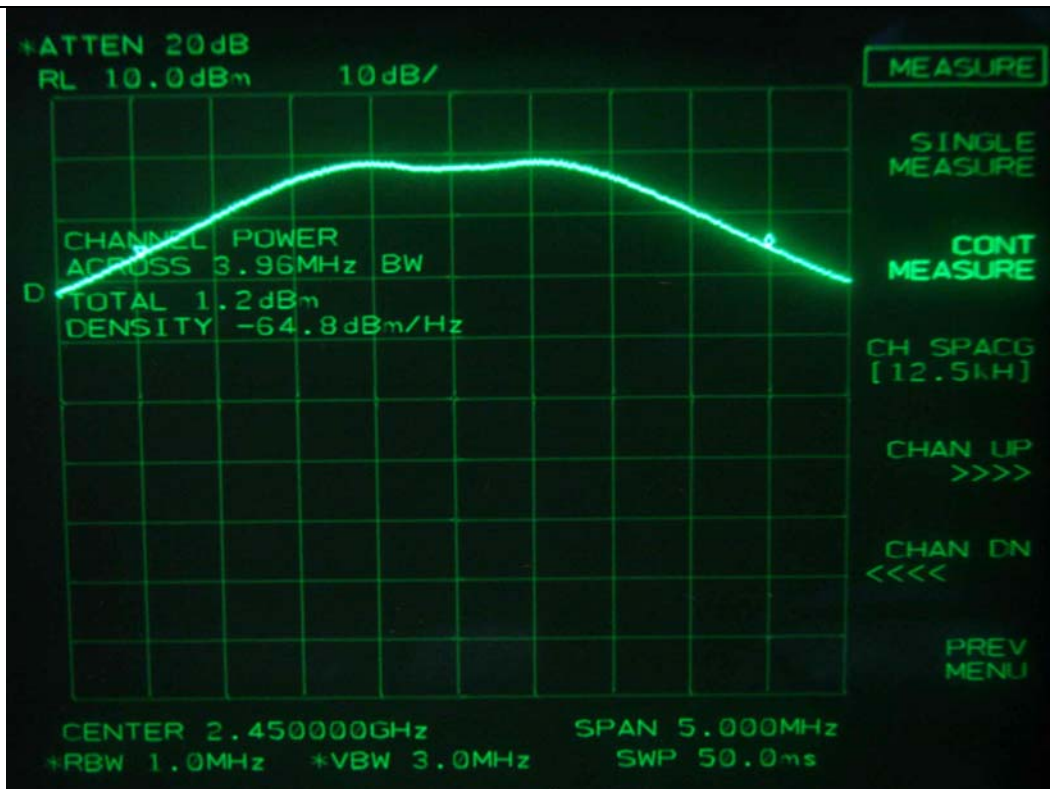


Tested by: Ki-Hong, Nam / Senior Engineer

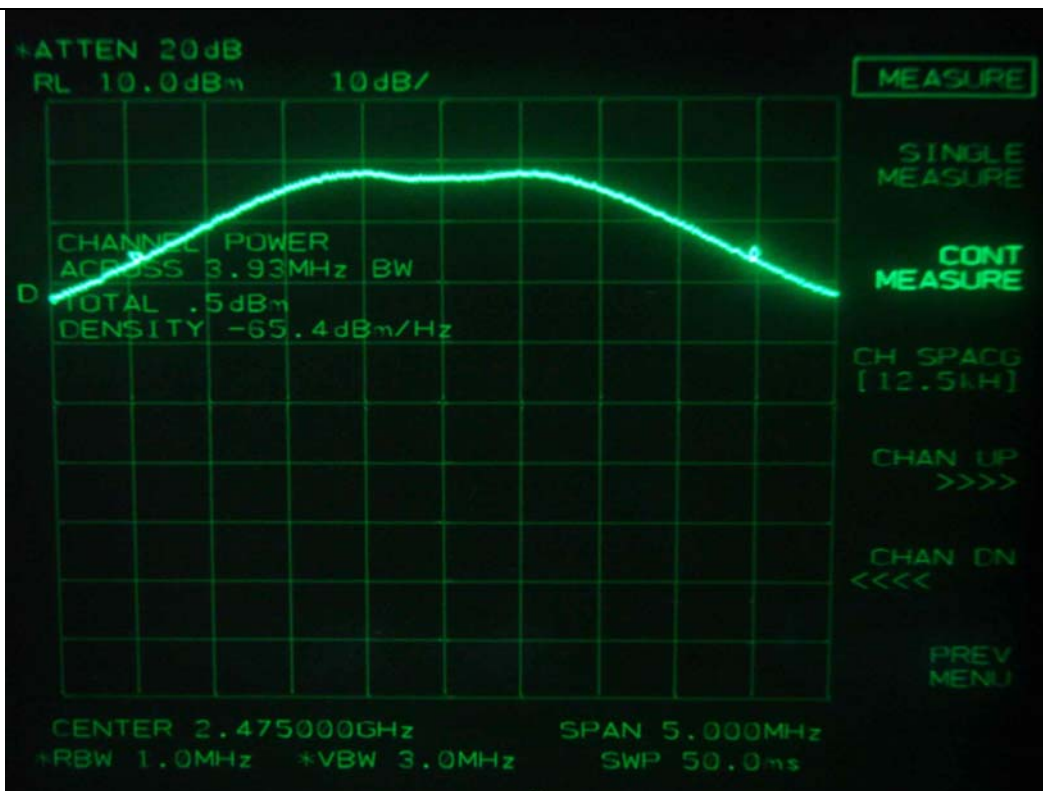




Low Channel



Middle Channel



High Channel



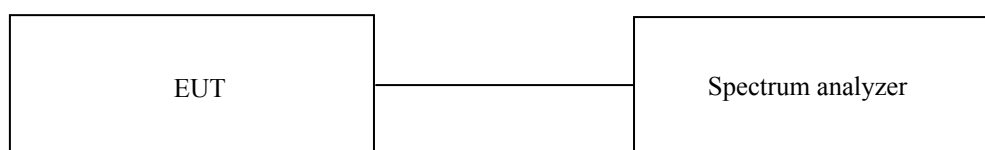
## 9.3 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

### 9.3.1 Operating environment

Temperature : 25 °C  
Relative humidity : 55 % R.H.

### 9.3.2 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.



### 9.3.3 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 25 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.

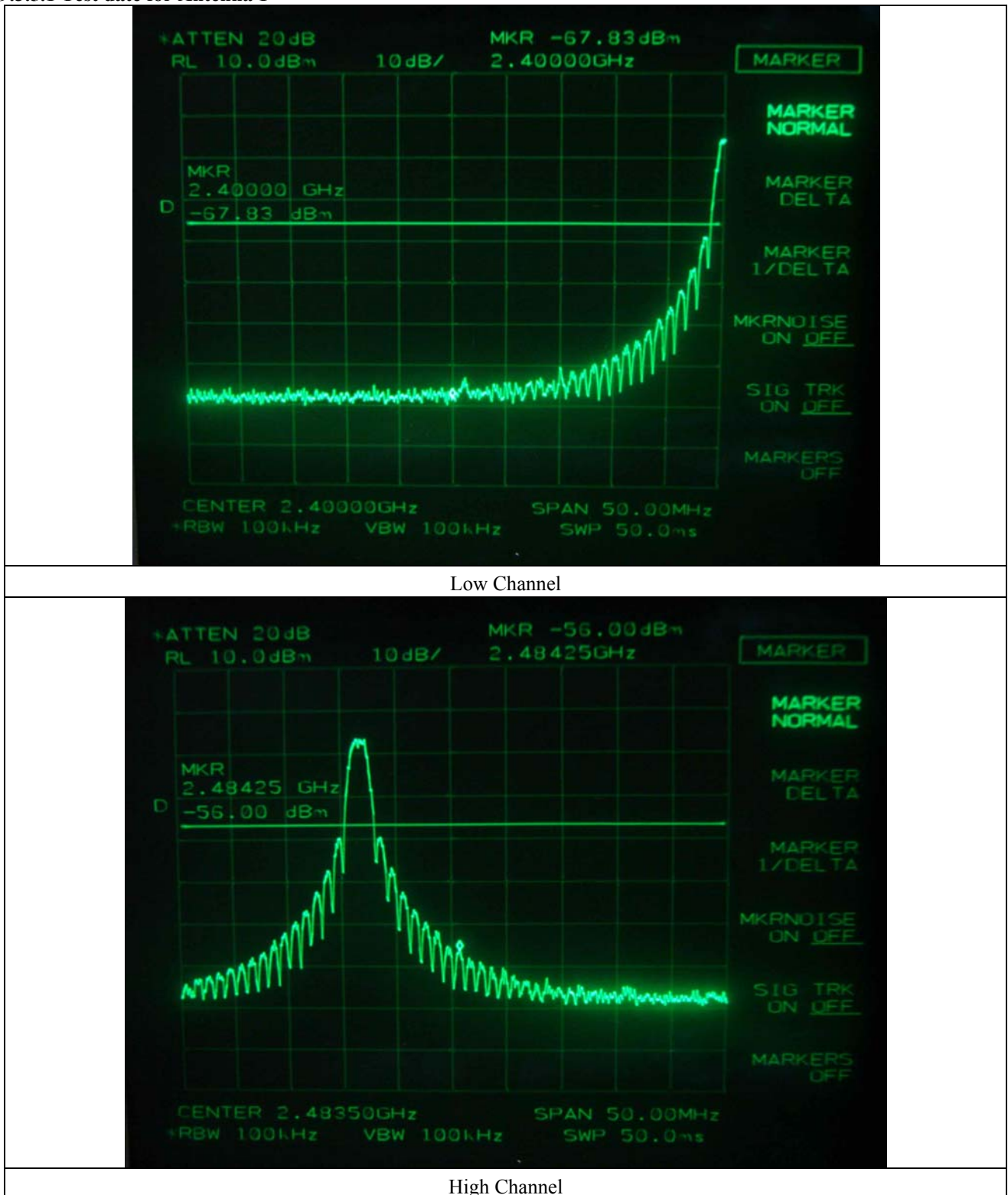
### 9.3.4 Test equipment used

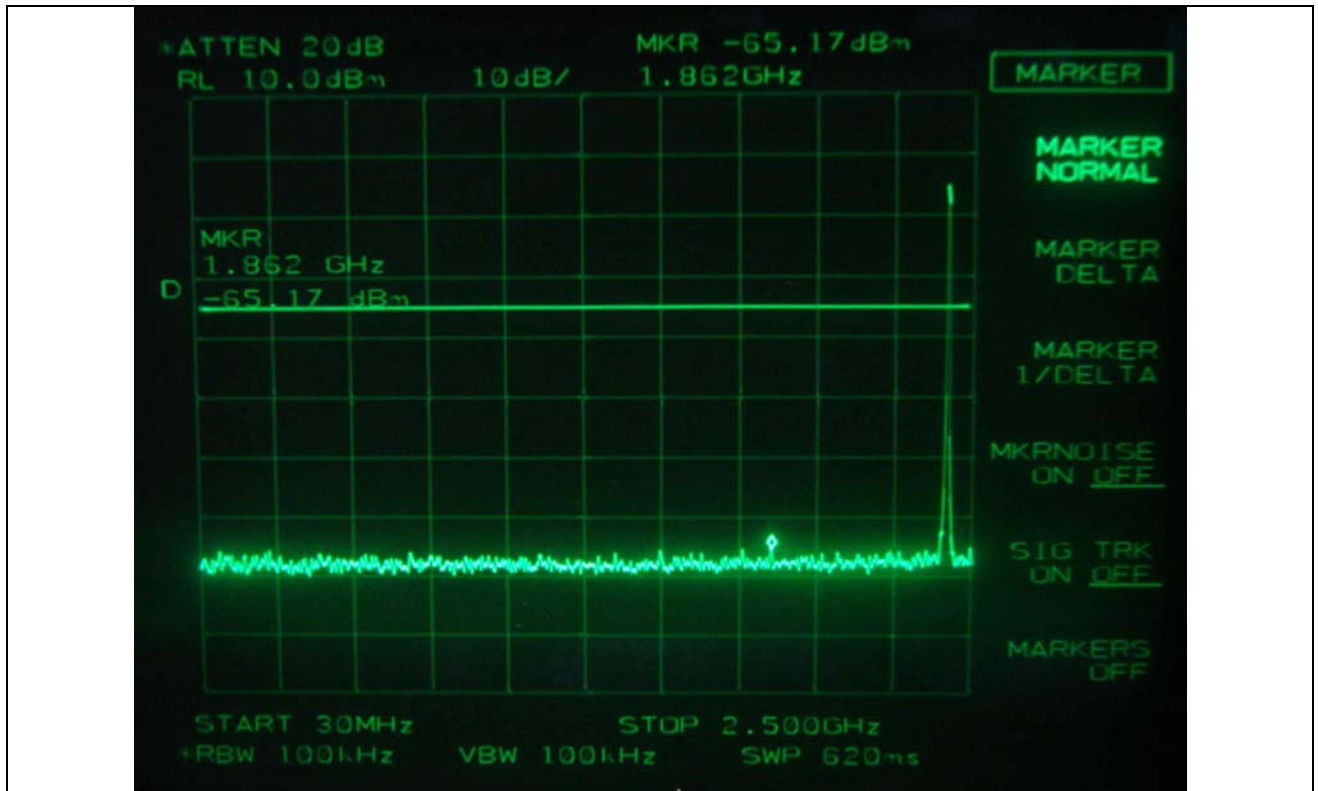
|     | Model Number | Manufacturer      | Description              | Serial Number | Last Cal.(Interval) |
|-----|--------------|-------------------|--------------------------|---------------|---------------------|
| ■ - | 8564E        | HP                | Spectrum Analyzer        | 3650A00756    | April 04, 2012      |
| ■ - | ESU          | Rohde & Schwarz   | EMI Test Receiver        | 100261        | Sep.11, 2012 (1Y)   |
| ■ - | 310N         | Sonoma Instrument | AMPLIFIER                | 312544        | Oct 11, 2012(1Y)    |
| ■ - | FSV30        | Rohde & Schwarz   | Signal Analyzer          | 101372        | May 31, 2012(1Y)    |
| ■ - | SCU-18       | Rohde & Schwarz   | PRE-AMPLIFIER            | 10041         | Dec 15, 2011 (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                 |
| ■ - | VULB9163     | Schwarzbeck       | TRILOG Broadband Antenna | VULB9163-255  | Apr. 24, 2012(2Y)   |
| ■ - | BBHA9120D    | Schwarzbeck       | Horn Antenna             | BBHA9120D294  | Jun. 17, 2011 (2Y)  |
| ■ - | BBHA9170     | Schwarzbeck       | Horn Antenna             | BBHA9170178   | Jun. 17, 2011 (2Y)  |

All test equipment used is calibrated on a regular basis.

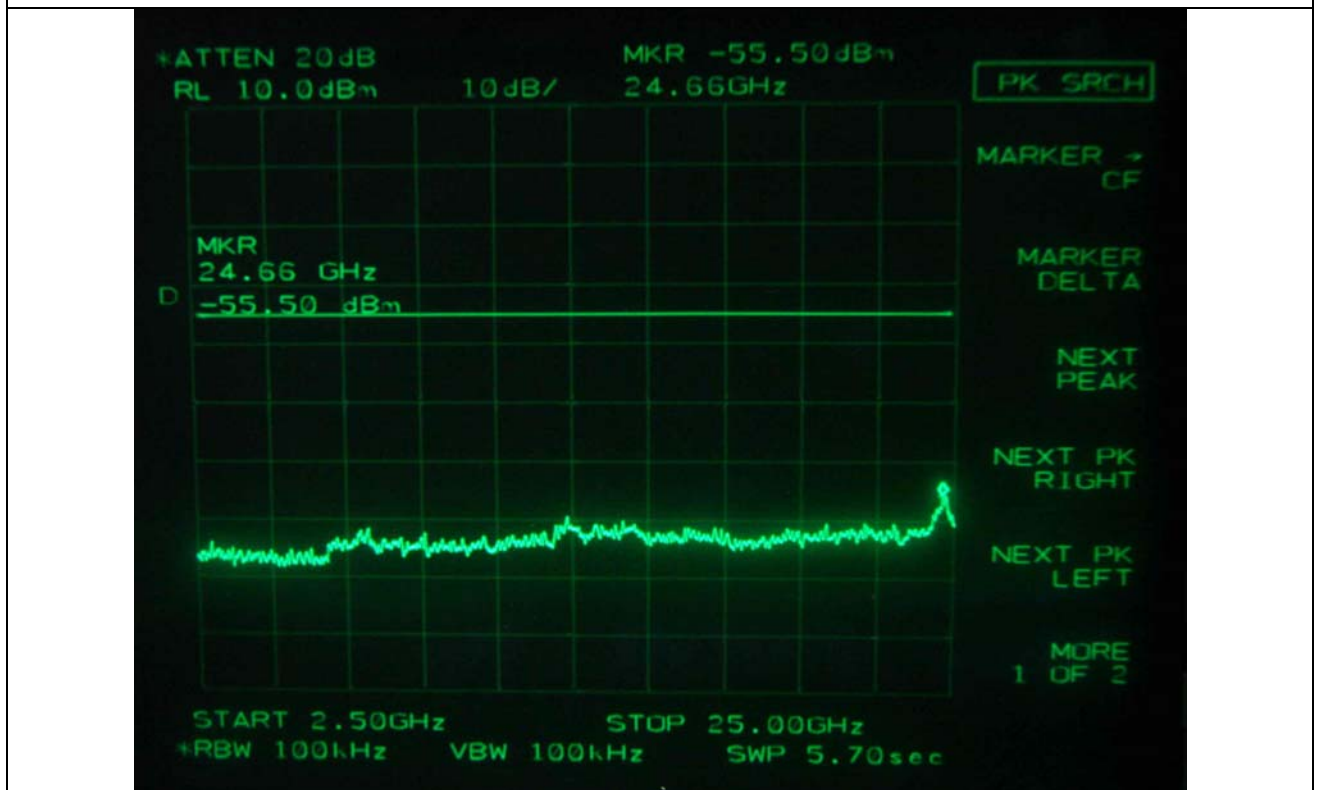
### 9.3.5. Test data for conducted emission

#### 9.3.5.1 Test data for Antenna 1

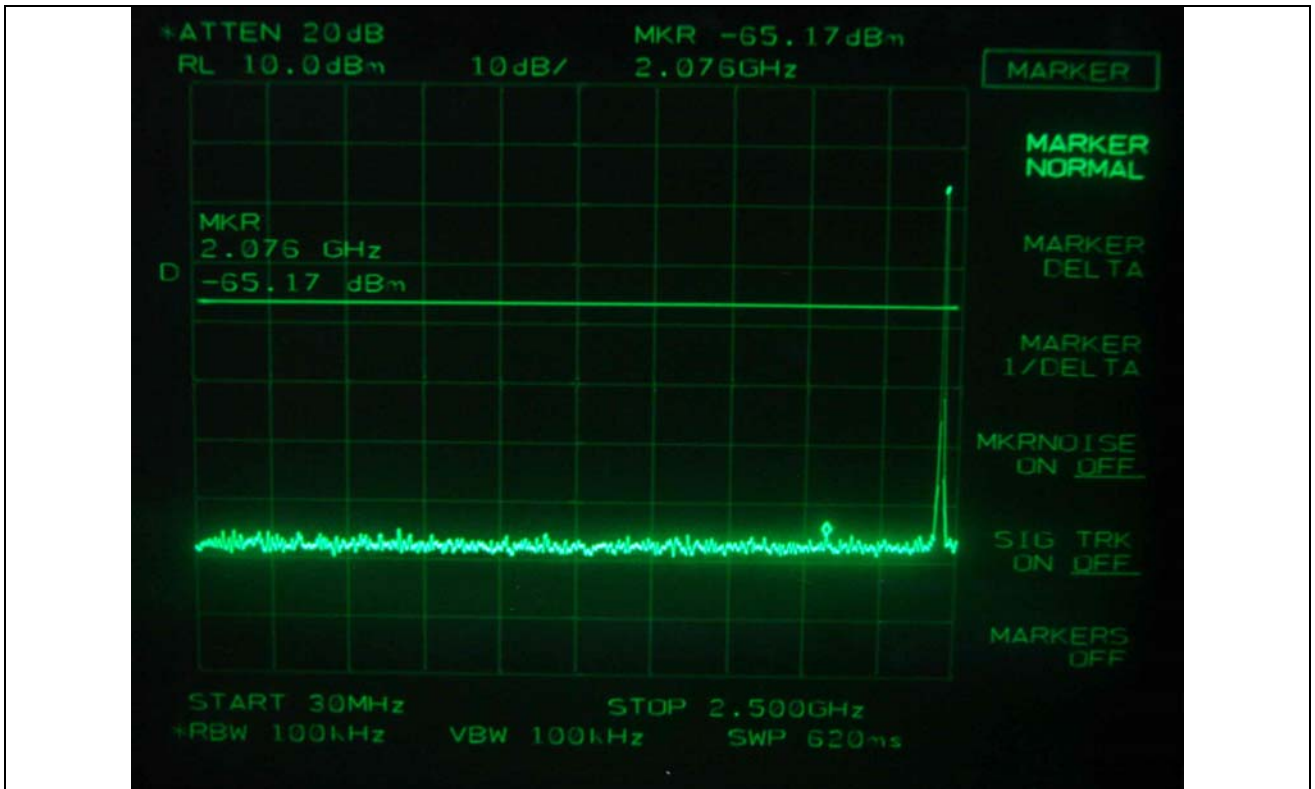




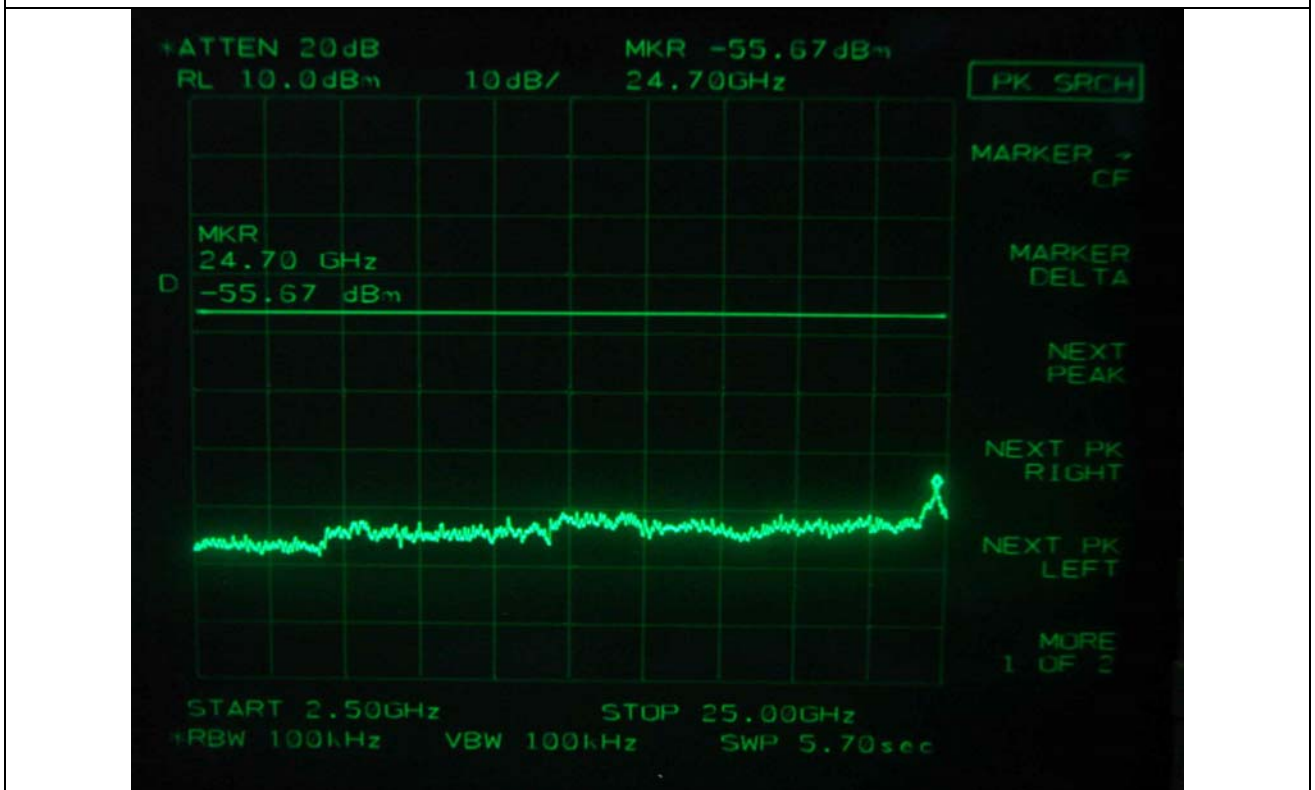
Low Channel



Low Channel

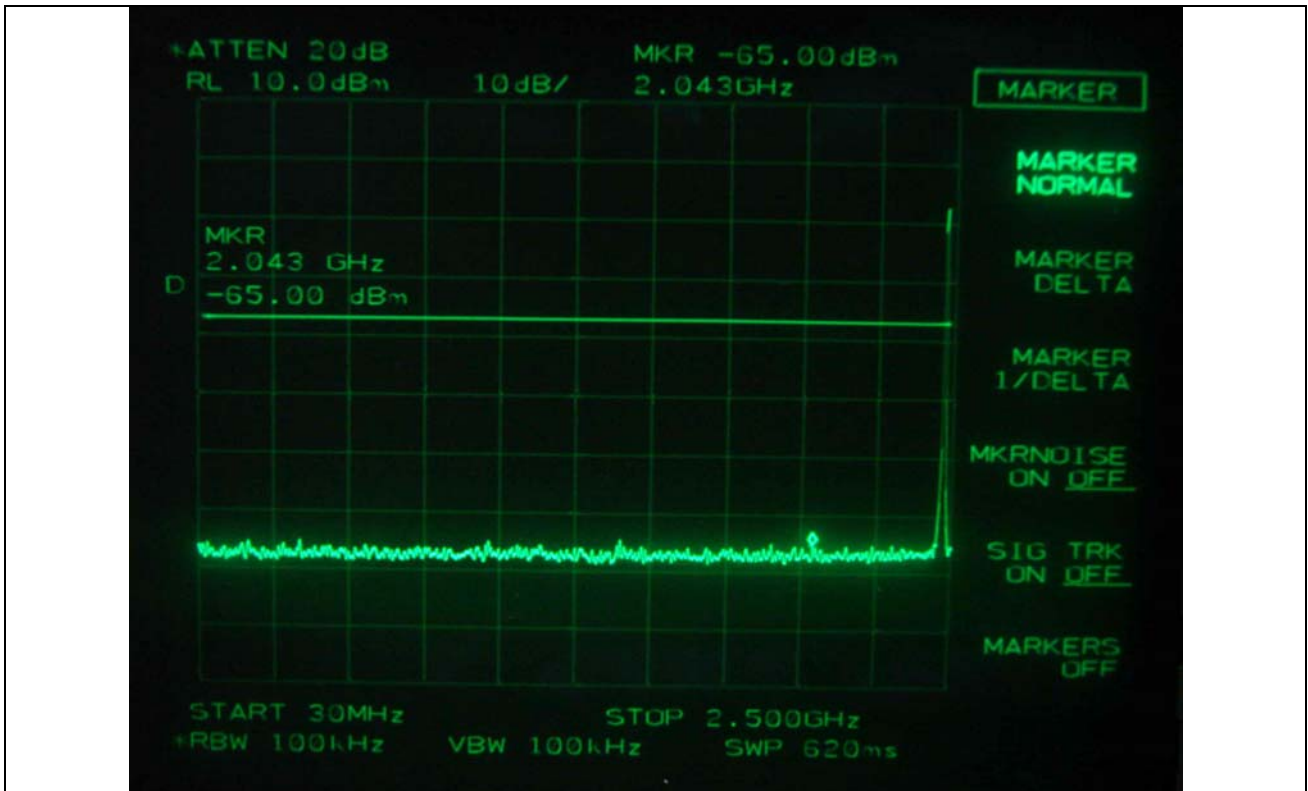


Middle Channel

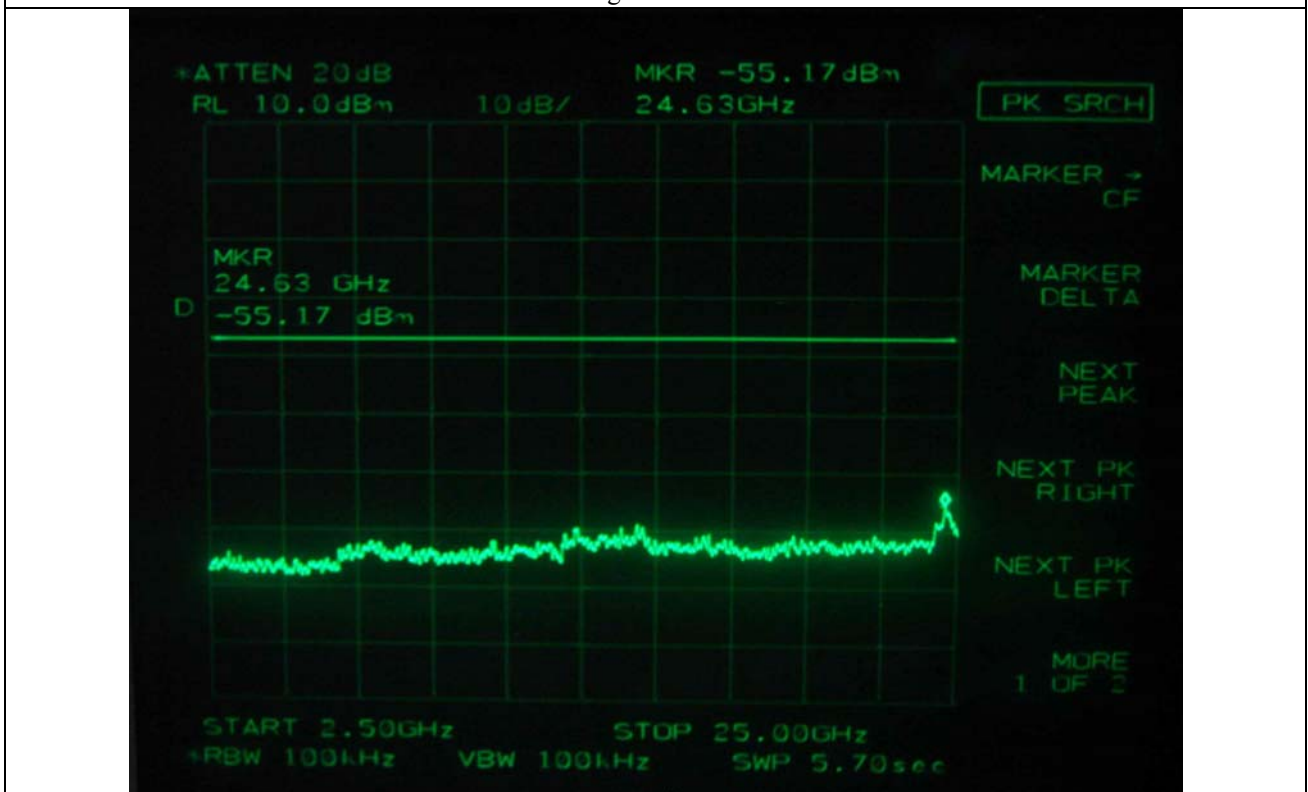


Middle Channel



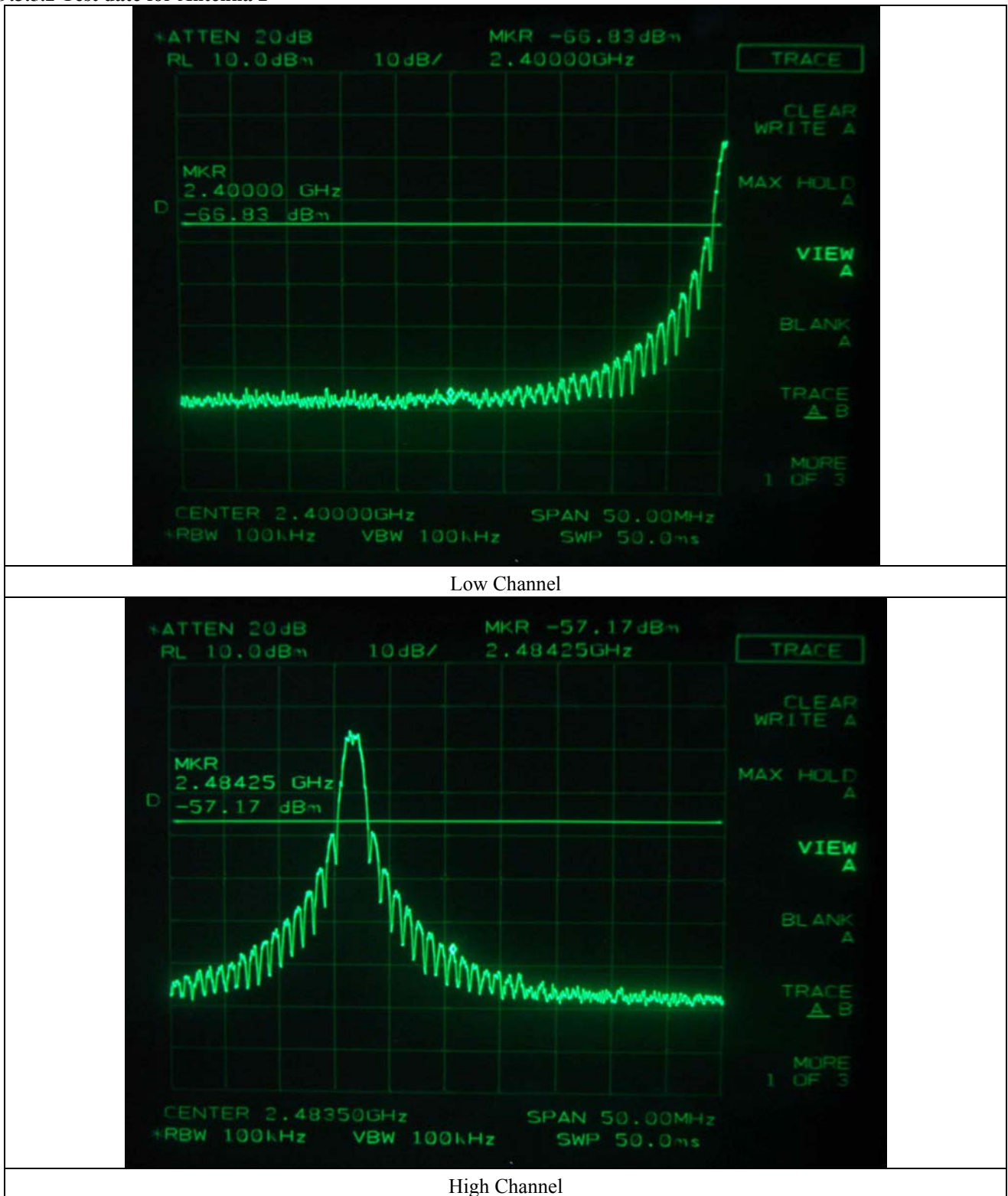


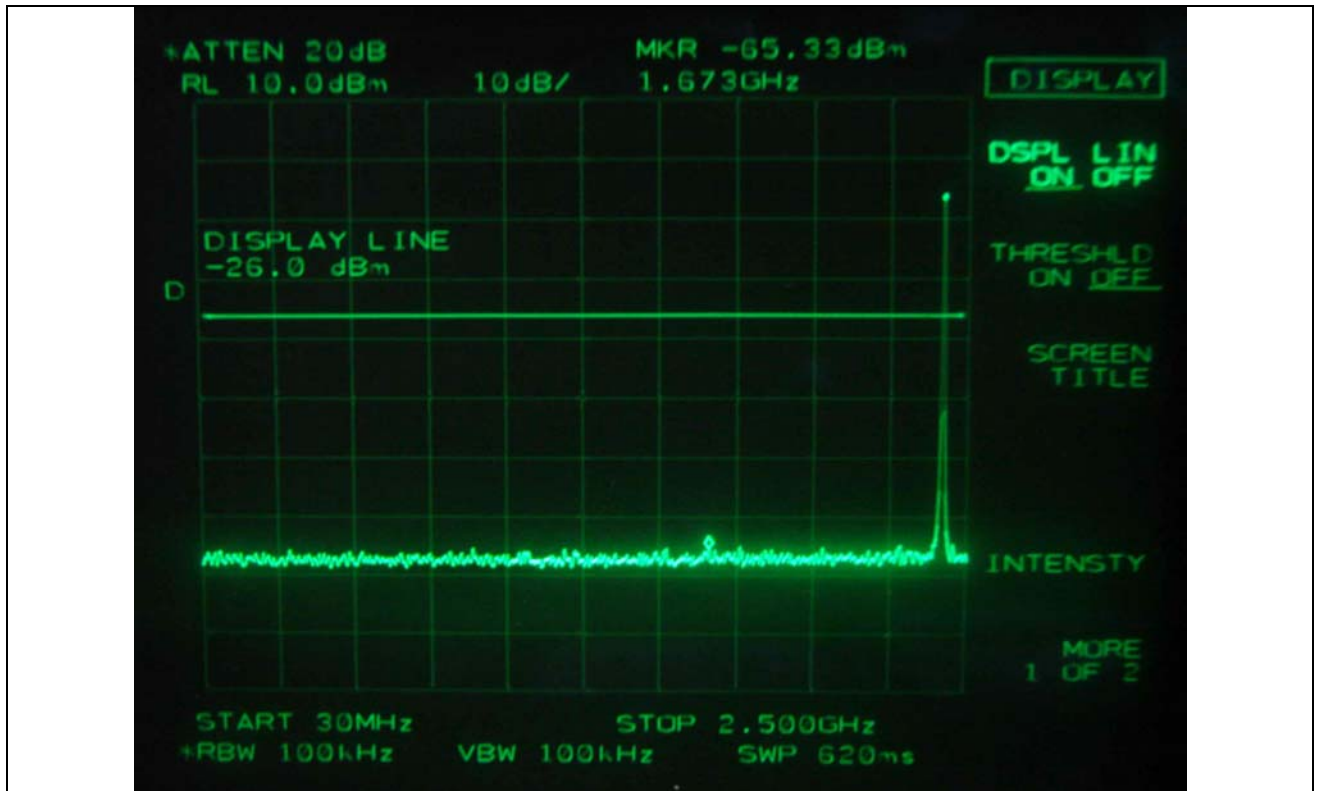
High Channel



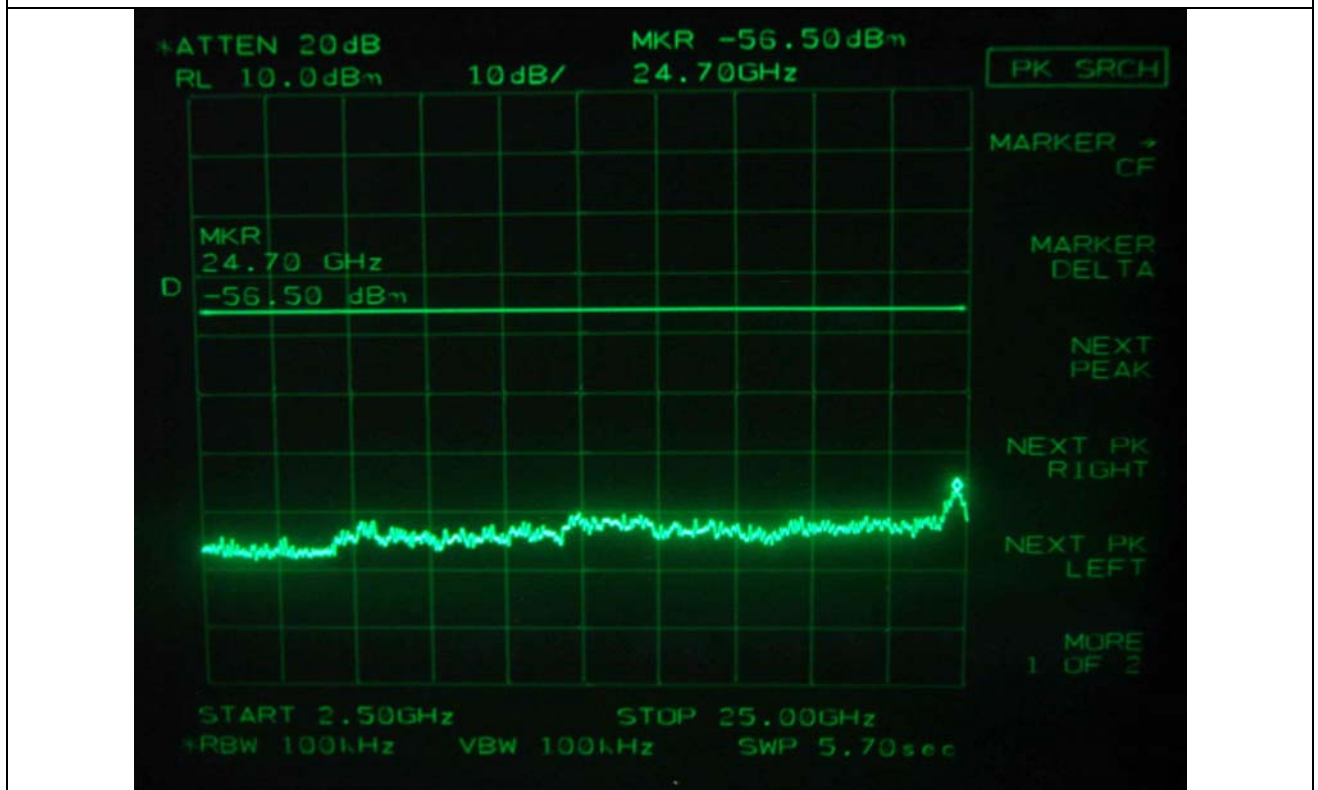
High Channel

### 9.3.5.2 Test date for Antenna 2



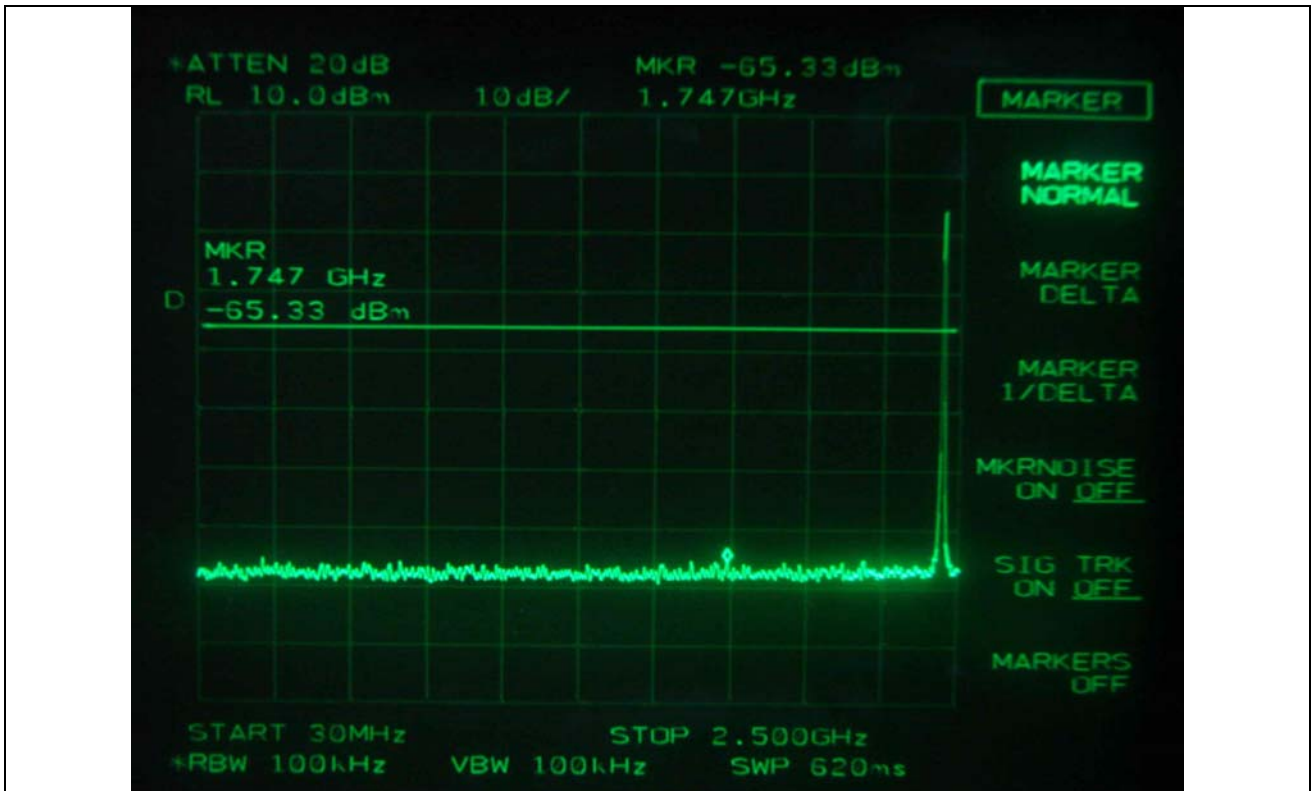


Low Channel

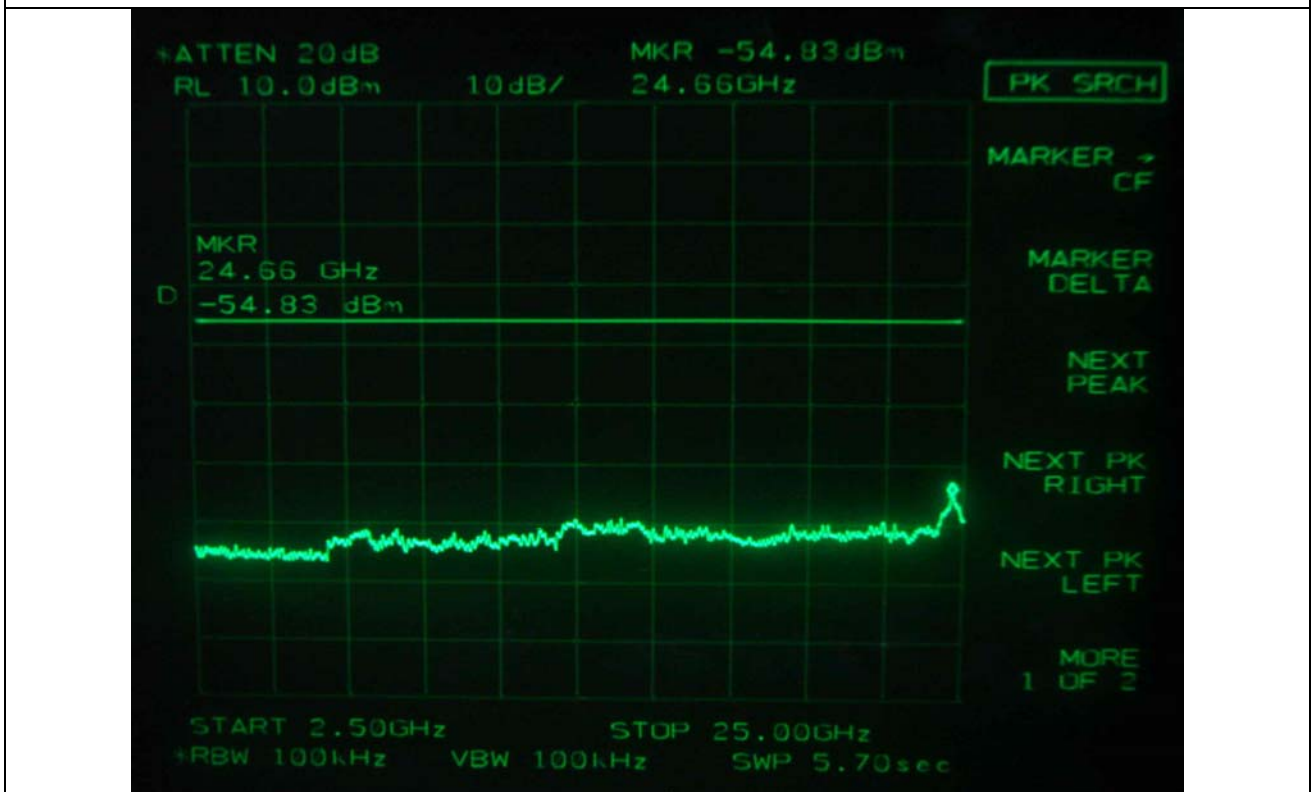


Low Channel



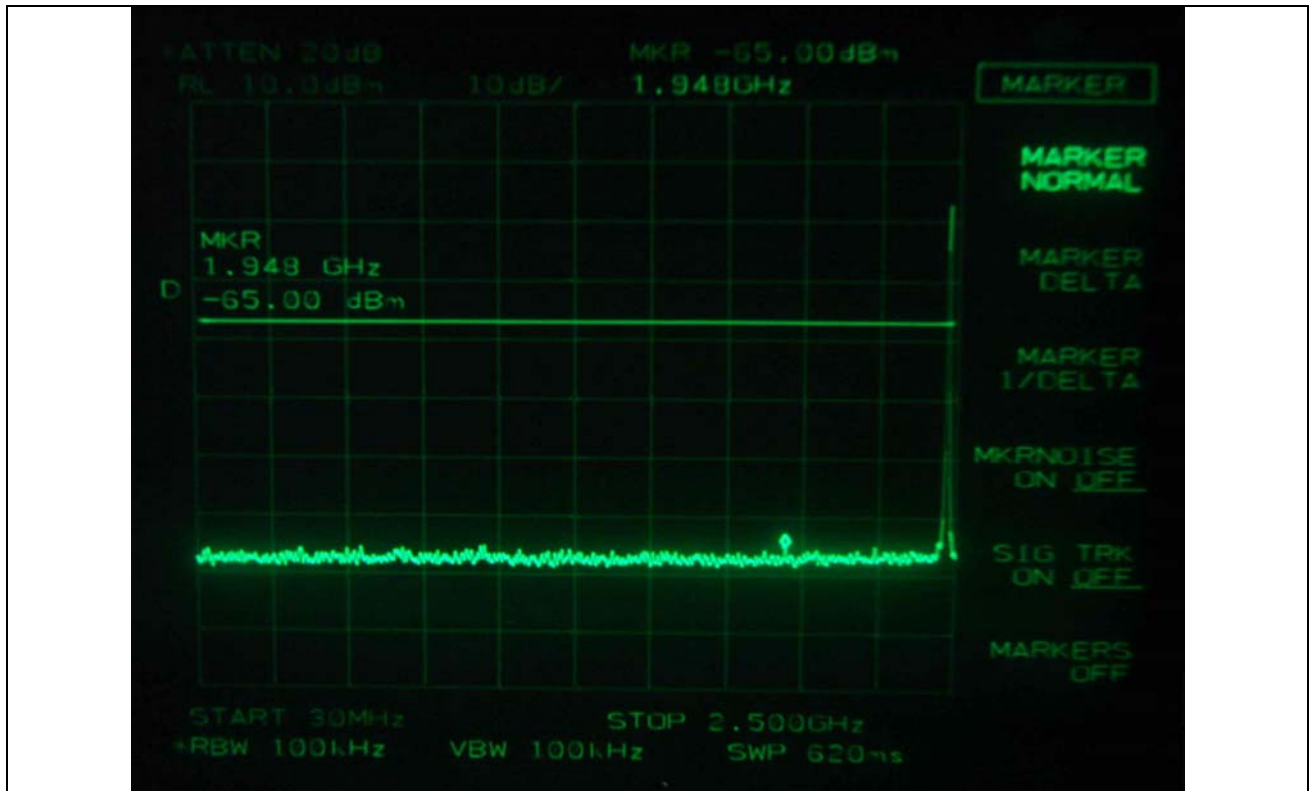


Middle Channel

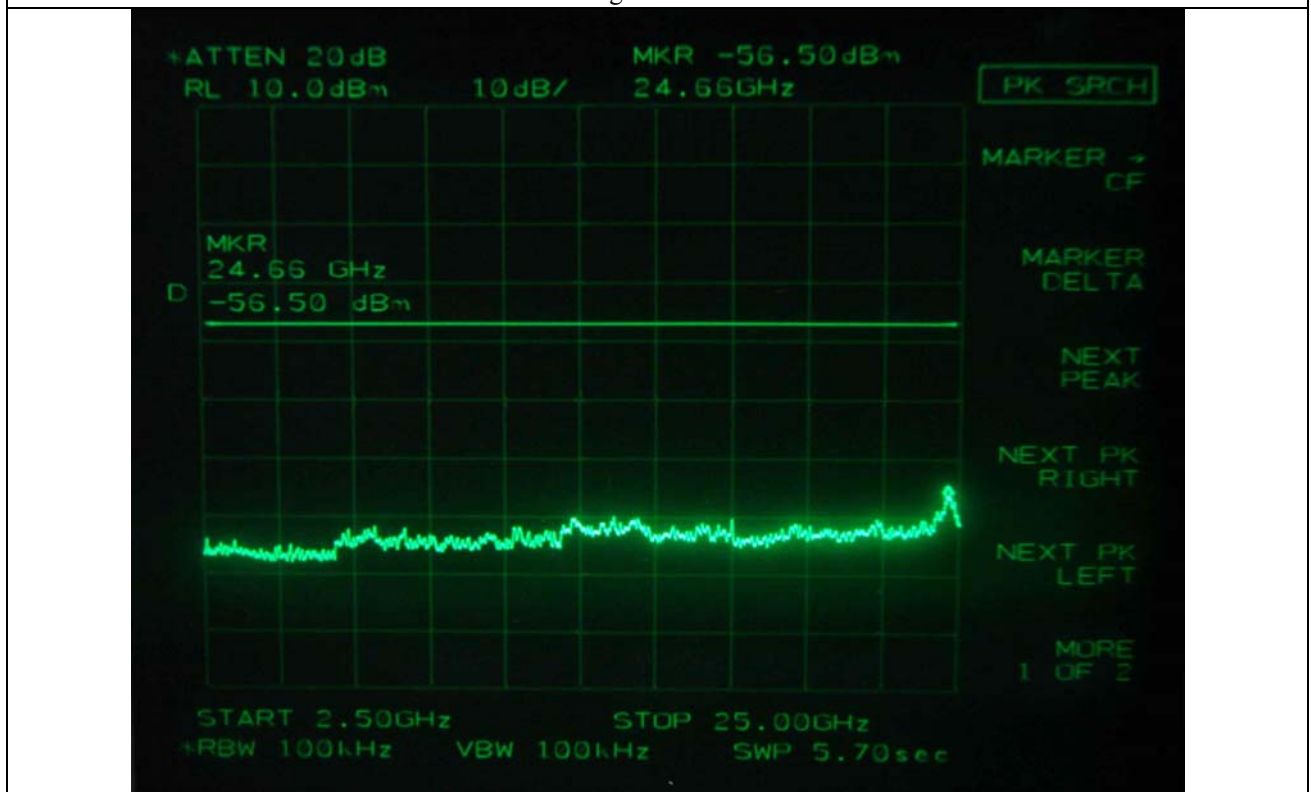


Middle Channel





High Channel



High Channel

### 9.3.6. Test data for radiated emission

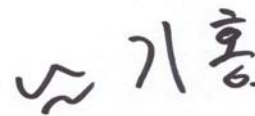
#### 9.3.6.1 Radiated Emission which fall in the Restricted Band for Antenna 1

- Test Date : November 13, 2012
- 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 ~ 25 GHz
- Measurement distance : 3 m
- Operating Condition : Low / High Channel
- Result : PASSED

| Frequency<br>(MHz)         | Reading<br>(dBμV) | Detector<br>Mode | Ant. Pol.<br>(H/V) | Ant.<br>Factor | Cable<br>Loss | Total<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) |
|----------------------------|-------------------|------------------|--------------------|----------------|---------------|-------------------|--------------------|----------------|
| Test Data for Low Channel  |                   |                  |                    |                |               |                   |                    |                |
| 2 374.98                   | 43.46             | Peak             | H                  | 27.05          | 3.14          | 30.55             | 73.98              | -43.43         |
|                            | 34.93             | Average          | H                  |                |               | 22.02             | 53.98              | -31.96         |
| 2 374.98                   | 41.00             | Peak             | V                  |                |               | 28.09             | 73.98              | -45.89         |
|                            | 32.07             | Average          | V                  |                |               | 19.16             | 53.98              | -34.82         |
| Test Data for High Channel |                   |                  |                    |                |               |                   |                    |                |
| 2 483.93                   | 48.66             | Peak             | H                  | 27.31          | 3.17          | 36.04             | 73.98              | -37.94         |
|                            | 41.40             | Average          | H                  |                |               | 28.78             | 53.98              | -25.20         |
| 2 483.85                   | 42.36             | Peak             | V                  |                |               | 29.74             | 73.98              | -44.24         |
|                            | 32.25             | Average          | V                  |                |               | 19.63             | 53.98              | -34.35         |

Tabulated test data for Restricted Band

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



Tested by: Ki-Hong, Nam / Senior Engineer

### 9.3.6.2 Spurious & Harmonic Radiated Emission for Antenna1

- Test Date : November 13, 2012
- 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 ~ 25 GHz
- Measurement distance : 3 m
- Result : PASSED

| Frequency<br>(MHz)           | Reading<br>(dBμV) | Detector<br>Mode | Ant. Pol.<br>(H/V) | Ant.<br>Factor | Cable<br>Loss | Amp<br>Gain | Total<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) |
|------------------------------|-------------------|------------------|--------------------|----------------|---------------|-------------|-------------------|--------------------|----------------|
| Test Data for Low Channel    |                   |                  |                    |                |               |             |                   |                    |                |
| 2 425.00                     | 103.41            | Peak             | H                  | 27.15          | 5.02          |             | 92.48             | -                  |                |
|                              | 100.55            | Peak             | V                  |                |               |             | 89.62             | -                  |                |
| 4 850.00                     | 42.50             | Peak             | H                  | 31.14          | 6.90          | 42.80       | 37.74             | 73.98              | -36.24         |
|                              | 31.17             | Average          | H                  |                |               |             | 26.41             | 53.98              | -27.57         |
|                              | 42.33             | Peak             | V                  |                |               |             | 37.57             | 73.98              | -36.41         |
|                              | 31.00             | Average          | V                  |                |               |             | 26.24             | 53.98              | -27.74         |
| Test Data for Middle Channel |                   |                  |                    |                |               |             |                   |                    |                |
| 2 450.00                     | 102.50            | Peak             | H                  | 27.22          | 5.04          |             | 91.66             | -                  |                |
|                              | 99.83             | Peak             | V                  |                |               |             | 83.16             | -                  |                |
| 4 900.00                     | 42.67             | Peak             | H                  | 31.22          | 6.93          | 42.80       | 38.02             | 73.98              | -35.96         |
|                              | 31.50             | Average          | H                  |                |               |             | 26.85             | 53.98              | -27.13         |
|                              | 42.17             | Peak             | V                  |                |               |             | 37.52             | 73.98              | -36.46         |
|                              | 31.33             | Average          | V                  |                |               |             | 26.68             | 53.98              | -27.30         |
| Test Data for High Channel   |                   |                  |                    |                |               |             |                   |                    |                |
| 2 475.00                     | 100.50            | Peak             | H                  | 27.28          | 5.06          |             | 89.74             | -                  |                |
|                              | 99.17             | Peak             | V                  |                |               |             | 88.41             | -                  |                |
| 4 950.00                     | 42.83             | Peak             | H                  | 31.30          | 6.97          | 42.80       | 38.30             | 73.98              | -35.68         |
|                              | 31.67             | Average          | H                  |                |               |             | 27.14             | 53.98              | -26.84         |
|                              | 42.50             | Peak             | V                  |                |               |             | 37.97             | 73.98              | -36.01         |
|                              | 31.50             | Average          | V                  |                |               |             | 26.97             | 53.98              | -27.01         |

Tabulated test data for Restricted Band

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

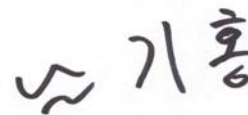
### 9.3.6.3 Radiated Emission which fall in the Restricted Band for Antenna 2

- Test Date : November 13, 2012
- 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 ~ 25 GHz
- Measurement distance : 3 m
- Operating Condition : Low / High Channel
- Result : PASSED

| Frequency<br>(MHz)         | Reading<br>(dBμV) | Detector<br>Mode | Ant. Pol.<br>(H/V) | Ant.<br>Factor | Cable<br>Loss | Total<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) |
|----------------------------|-------------------|------------------|--------------------|----------------|---------------|-------------------|--------------------|----------------|
| Test Data for Low Channel  |                   |                  |                    |                |               |                   |                    |                |
| 2 374.98                   | 43.37             | Peak             | H                  | 27.05          | 3.14          | 30.46             | 73.98              | -43.52         |
|                            | 34.80             | Average          | H                  |                |               | 21.89             | 53.98              | -32.09         |
| 2 375.04                   | 42.95             | Peak             | V                  |                |               | 30.04             | 73.98              | -43.94         |
|                            | 32.25             | Average          | V                  |                |               | 19.34             | 53.98              | -34.64         |
| Test Data for High Channel |                   |                  |                    |                |               |                   |                    |                |
| 2 483.93                   | 44.78             | Peak             | H                  | 27.31          | 3.17          | 32.16             | 73.98              | -41.82         |
|                            | 37.07             | Average          | H                  |                |               | 24.45             | 53.98              | -29.53         |
| 2 483.93                   | 43.30             | Peak             | V                  |                |               | 30.68             | 73.98              | -43.30         |
|                            | 33.58             | Average          | V                  |                |               | 20.96             | 53.98              | -33.02         |

Tabulated test data for Restricted Band

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



Tested by: Ki-Hong, Nam / Senior Engineer

### 9.3.6.4 Spurious & Harmonic Radiated Emission for Antenna 2

- Test Date : November 13, 2012
- 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 ~ 25 GHz
- Measurement distance : 3 m
- Result : PASSED

| Frequency<br>(MHz)           | Reading<br>(dBμV) | Detector<br>Mode | Ant. Pol.<br>(H/V) | Ant.<br>Factor | Cable<br>Loss | Amp<br>Gain | Total<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) |
|------------------------------|-------------------|------------------|--------------------|----------------|---------------|-------------|-------------------|--------------------|----------------|
| Test Data for Low Channel    |                   |                  |                    |                |               |             |                   |                    |                |
| 2 425.00                     | 102.21            | Peak             | H                  | 27.15          | 5.02          | 43.10       | 91.28             | -                  | -              |
|                              | 99.49             | Peak             | V                  |                |               |             | 88.56             | -                  | -              |
| 4 850.00                     | 42.33             | Peak             | H                  | 31.14          | 6.90          | 42.80       | 37.57             | 73.98              | -36.41         |
|                              | 31.33             | Average          | H                  |                |               |             | 26.57             | 53.98              | -27.41         |
|                              | 42.67             | Peak             | V                  |                |               |             | 37.91             | 73.98              | -36.07         |
|                              | 31.25             | Average          | V                  |                |               |             | 26.49             | 53.98              | -27.49         |
| Test Data for Middle Channel |                   |                  |                    |                |               |             |                   |                    |                |
| 2 450.00                     | 100.83            | Peak             | H                  | 27.22          | 5.04          | 43.10       | 89.99             | -                  | -              |
|                              | 98.00             | Peak             | V                  |                |               |             | 87.16             | -                  | -              |
| 4 900.00                     | 42.33             | Peak             | H                  | 31.22          | 6.93          | 42.80       | 37.68             | 73.98              | -36.30         |
|                              | 31.67             | Average          | H                  |                |               |             | 27.02             | 53.98              | -26.96         |
|                              | 42.50             | Peak             | V                  |                |               |             | 37.85             | 73.98              | -36.13         |
|                              | 31.00             | Average          | V                  |                |               |             | 37.68             | 73.98              | -36.30         |
| Test Data for High Channel   |                   |                  |                    |                |               |             |                   |                    |                |
| 2 475.00                     | 99.83             | Peak             | H                  | 27.28          | 5.06          | 43.10       | 89.07             | -                  | -              |
|                              | 96.83             | Peak             | V                  |                |               |             | 86.07             | -                  | -              |
| 4 950.00                     | 42.50             | Peak             | H                  | 31.30          | 6.97          | 42.80       | 37.97             | 73.98              | -36.01         |
|                              | 31.25             | Average          | H                  |                |               |             | 26.72             | 53.98              | -27.26         |
|                              | 42.17             | Peak             | V                  |                |               |             | 37.64             | 73.98              | -36.34         |
|                              | 31.33             | Average          | V                  |                |               |             | 26.80             | 53.98              | -27.18         |

Tabulated test data for Restricted Band

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

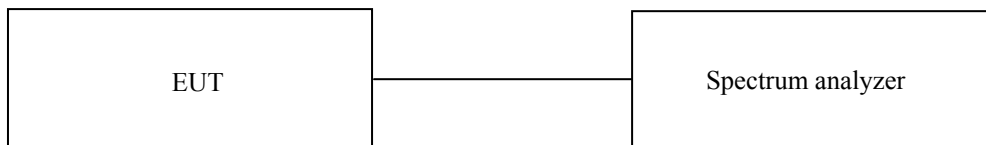
## 9.4 PEAK POWER SPECTRUL DENSITY

### 9.4.1 Operating environment

Temperature : 25 °C  
Relative humidity : 45 % R.H.

### 9.4.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz, the video bandwidth is set to 3 times the resolution bandwidth. Scale the observed power level to an equivalent value 3 kHz by adjusting(reducing) the measured power by a bandwidth correction factor(BWCF) where  $BWCF=10\log(3 \text{ kHz}/100 \text{ kHz})=-15.2 \text{ dB}$ .



### 9.4.3 Test equipment used

| Model Number | Manufacturer | Description       | Serial Number | Last Cal.      |
|--------------|--------------|-------------------|---------------|----------------|
| ■ - 8564E    | HP           | Spectrum Analyzer | 3650A00756    | April 04, 2012 |

All test equipment used is calibrated on a regular basis.



#### 9.4.4 Test data

##### 9.4.4.1 Test data for Antenna 1

- Test Date : November 14, 2012
- Test Result : Pass

| CHANNEL | FREQUENC<br>Y(MHz) | MEASURED VLAUE<br>(dBm) | Correction Factor<br>(dB) | LIMIT<br>(dBm) | MARGIN<br>(dB) |
|---------|--------------------|-------------------------|---------------------------|----------------|----------------|
| Low     | 2 425              | -4.33                   | -15.20                    | 8.00           | -27.53         |
| Middle  | 2 450              | -4.67                   | -15.20                    | 8.00           | -27.87         |
| High    | 2 475              | -5.17                   | -15.20                    | 8.00           | -28.37         |

Remark: See next page for measurement data.

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Middle Channel



High Channel

#### 9.4.4.2 Test data for Antenna 2

- Test Date : November 14, 2012

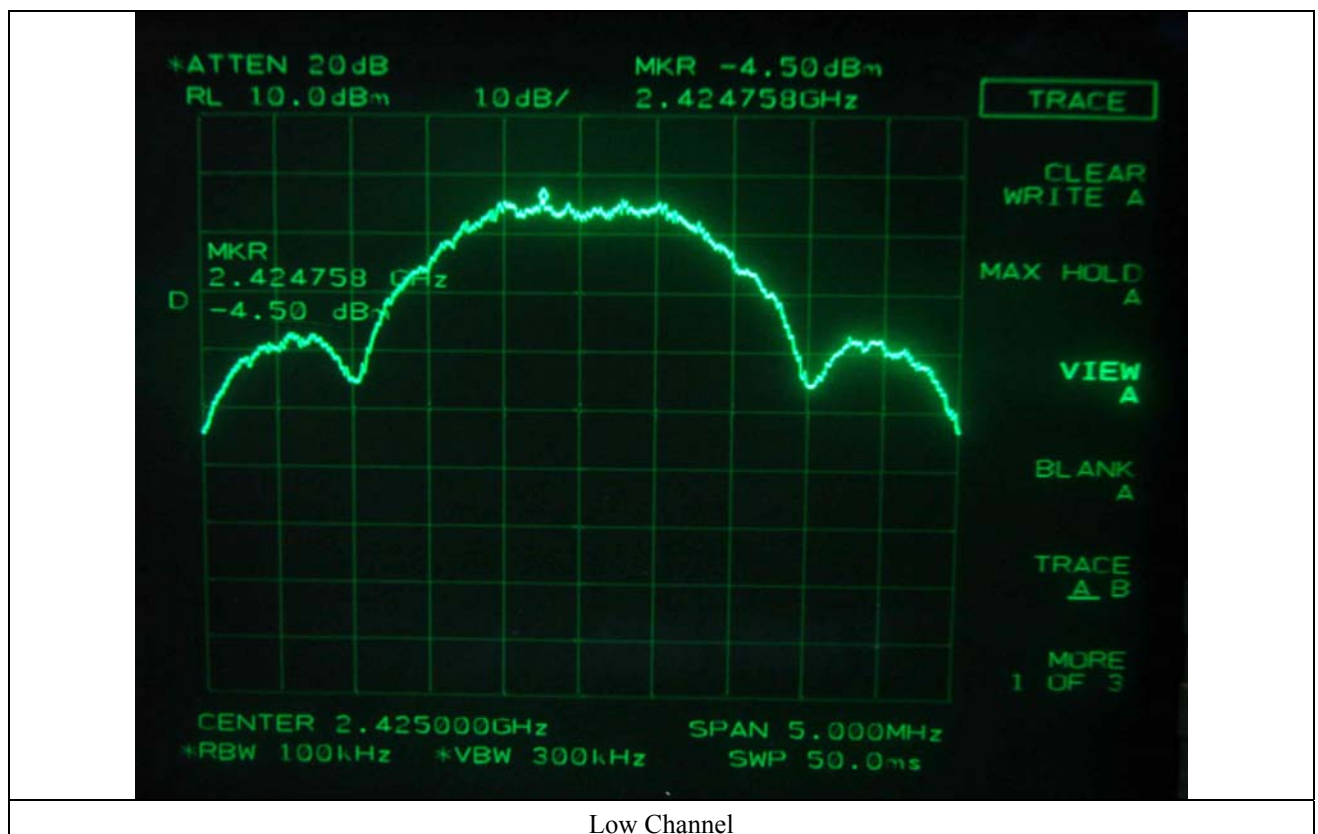
- Test Result : Pass

| CHANNEL | FREQUENC<br>Y(MHz) | MEASURED VLAUE<br>(dBm) | Correction Factor<br>(dB) | LIMIT<br>(dBm) | MARGIN<br>(dB) |
|---------|--------------------|-------------------------|---------------------------|----------------|----------------|
| Low     | 2 425              | -4.50                   | -15.20                    | 8.00           | -27.70         |
| Middle  | 2 450              | -4.67                   | -15.20                    | 8.00           | -27.87         |
| High    | 2 475              | -5.00                   | -15.20                    | 8.00           | -28.20         |

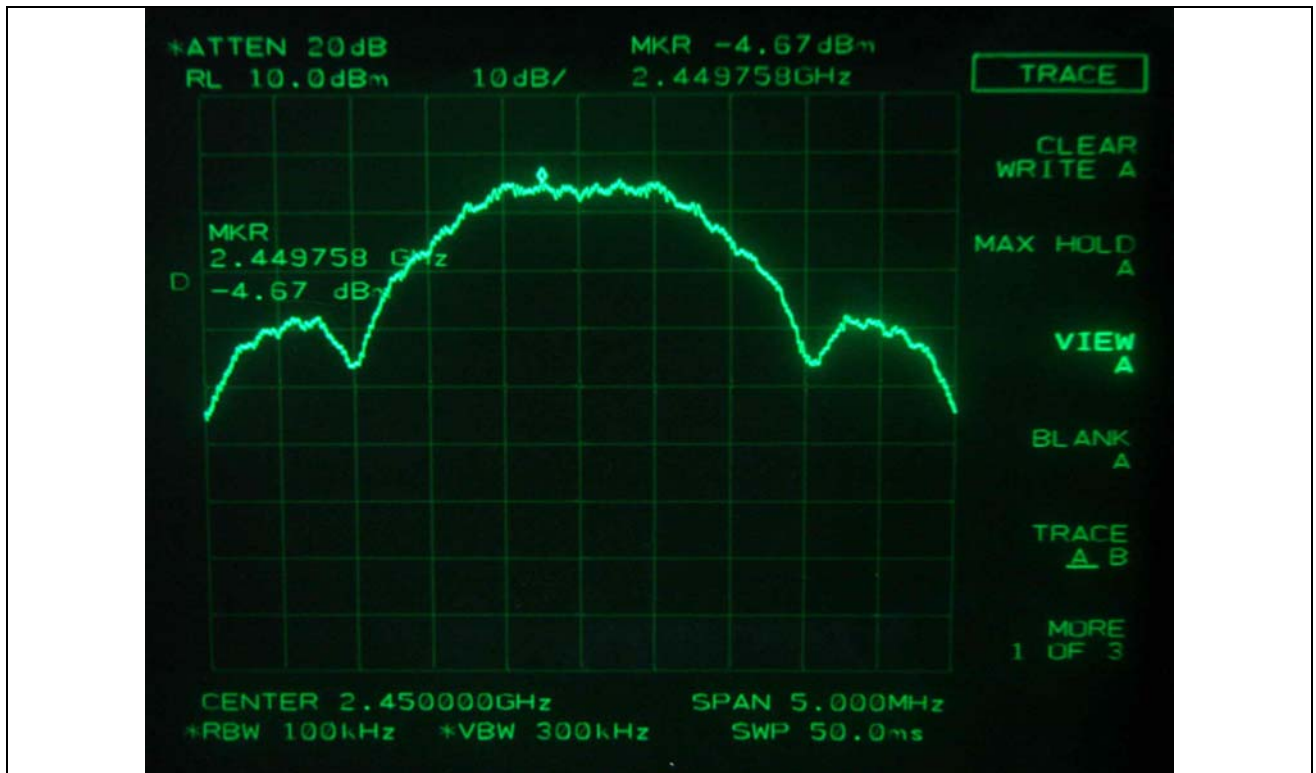
Remark: See next page for measurement data.

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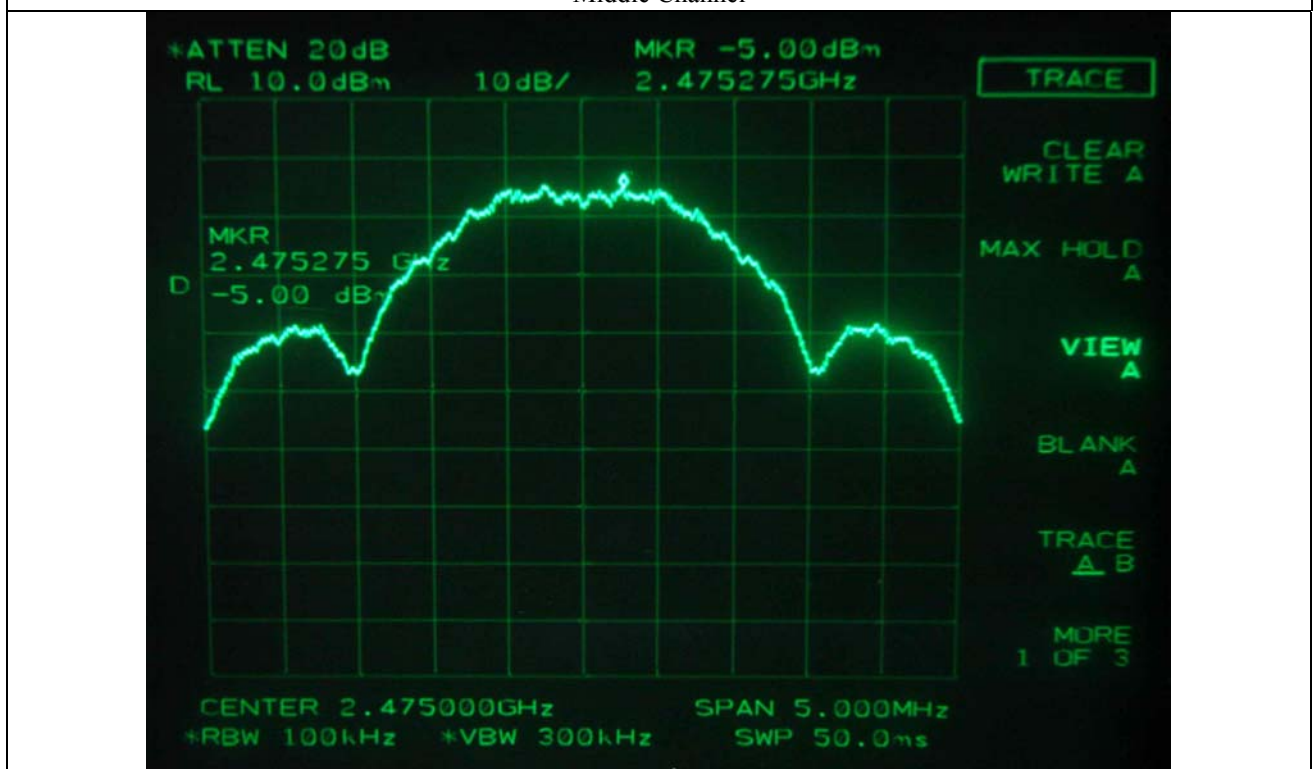
Tested by: Ki-Hong, Nam / Senior Engineer



Low Channel



Middle Channel



High Channel



## 11. RADIATED EMISSION TEST

### 11.1 Operating environment

Temperature : 20 °C  
Relative humidity : 38 % 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.

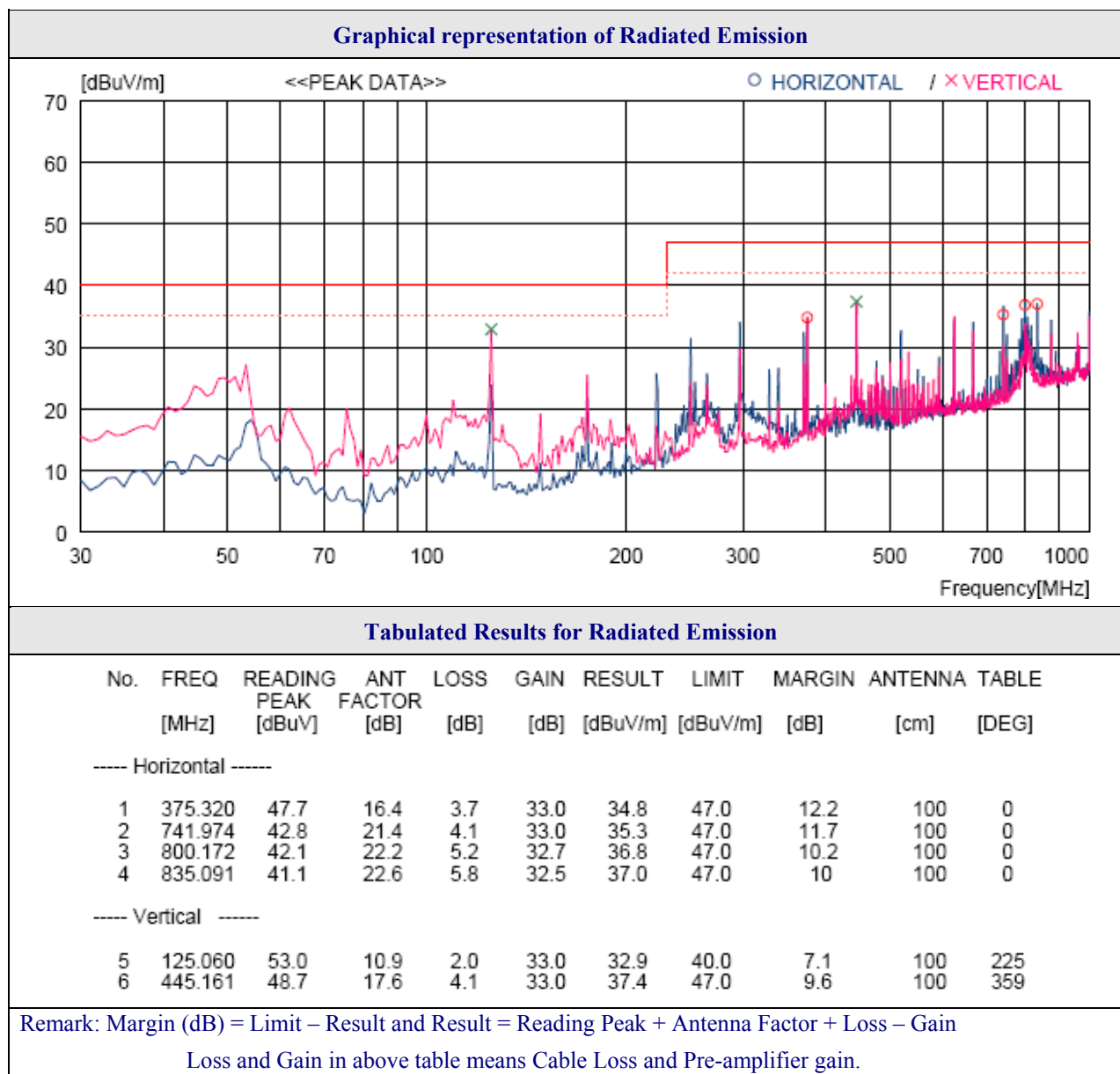
### 11.3 Test equipment used

|     | Model Number | Manufacturer      | Description              | Serial Number | Last Cal.(Interval) |
|-----|--------------|-------------------|--------------------------|---------------|---------------------|
| □ - | ESCI         | Rohde & Schwarz   | EMI Test Receiver        | 101012        | Feb. 06, 2012 (1Y)  |
| ■ - | ESU          | Rohde & Schwarz   | EMI Test Receiver        | 100261        | Sep.11, 2012 (1Y)   |
| ■ - | 310N         | Sonoma Instrument | AMPLIFIER                | 312544        | Oct 11, 2012(1Y)    |
| ■ - | FSV30        | Rohde & Schwarz   | Signal Analyzer          | 101372        | May 31, 2012(1Y)    |
| ■ - | SCU-18       | Rohde & Schwarz   | PRE-AMPLIFIER            | 10041         | Dec 15, 2011 (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                 |
| ■ - | VULB9163     | Schwarzbeck       | TRILOG Broadband Antenna | VULB9163-255  | Apr. 24, 2012(2Y)   |
| ■ - | BBHA9120D    | Schwarzbeck       | Horn Antenna             | BBHA9120D294  | Jun. 17, 2011 (2Y)  |
| ■ - | BBHA9170     | Schwarzbeck       | Horn Antenna             | BBHA9170178   | Jun. 17, 2011 (2Y)  |
| □ - | HFH2-Z2      | Rohde & Schwarz   | Loop Antenna             | 889 285 / 26  | Nov. 08, 2010(2Y)   |

All test equipment used is calibrated on a regular basis.

#### 11.4 Test data

- Test Date : November 13, 2012
- Resolution bandwidth : 120 kHz
- Frequency range : 30 MHz ~ 1 000 MHz
- Measurement distance : 3 m
- Channel : Low



- Channel : Middle

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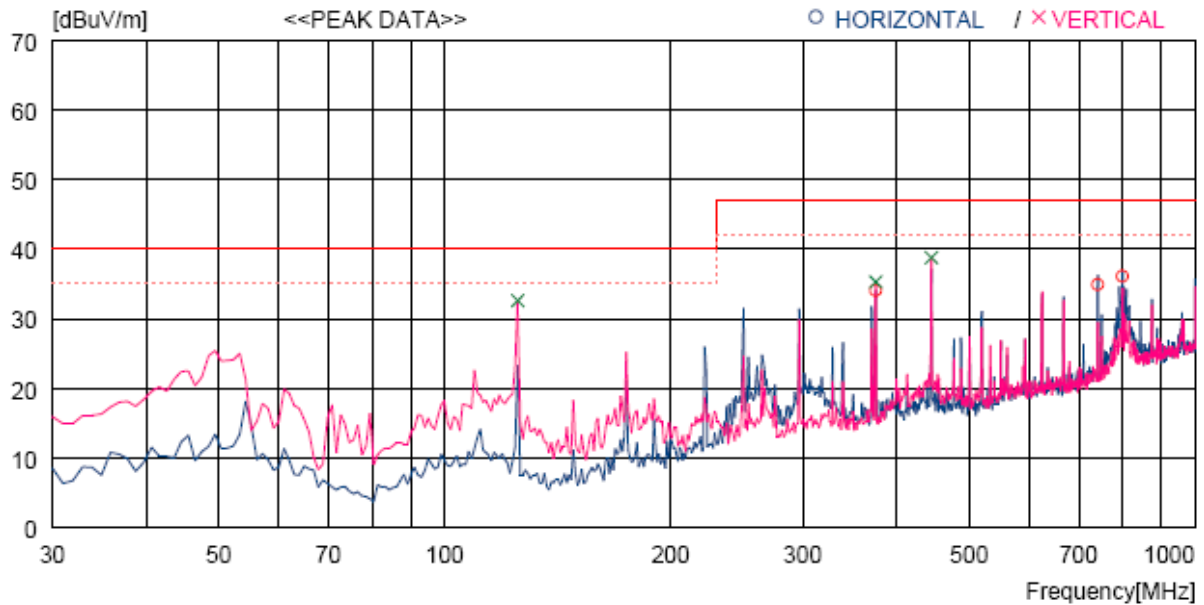
EMC-003 (Rev.2)

**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)



### Graphical representation of Radiated Emission



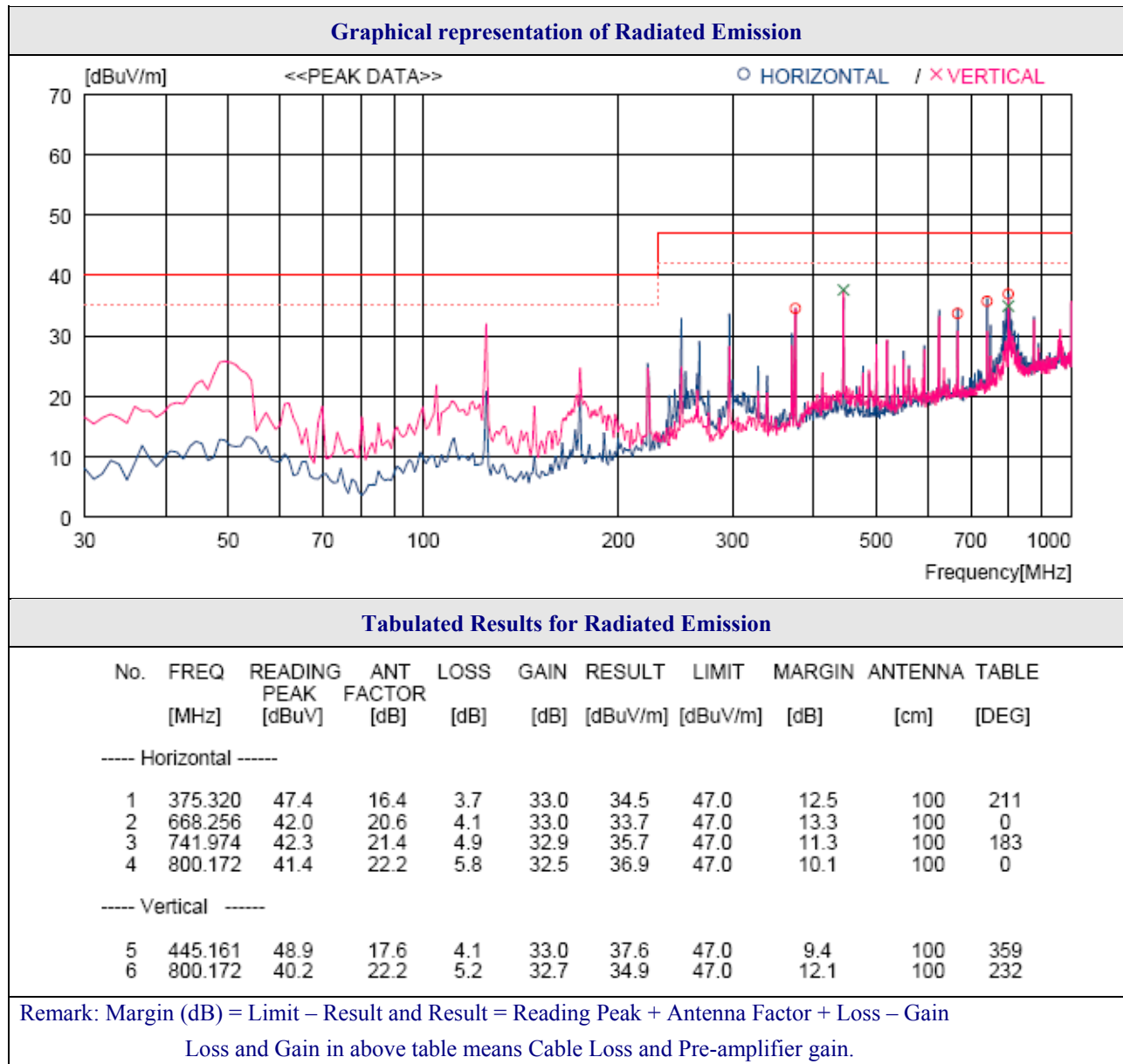
### Tabulated Results for Radiated Emission

| No.                    | FREQ<br>[MHz] | READING<br>PEAK<br>[dBuV] | ANT<br>FACTOR<br>[dB] | LOSS<br>[dB] | GAIN<br>[dB] | RESULT<br>[dBuV/m] | LIMIT<br>[dBuV/m] | MARGIN<br>[dB] | ANTENNA<br>TABLE<br>[cm] | TABLE<br>[DEG] |
|------------------------|---------------|---------------------------|-----------------------|--------------|--------------|--------------------|-------------------|----------------|--------------------------|----------------|
| ----- Horizontal ----- |               |                           |                       |              |              |                    |                   |                |                          |                |
| 1                      | 375.320       | 47.0                      | 16.4                  | 3.7          | 33.0         | 34.1               | 47.0              | 12.9           | 100                      | 0              |
| 2                      | 741.974       | 42.4                      | 21.4                  | 4.1          | 33.0         | 34.9               | 47.0              | 12.1           | 100                      | 183            |
| 3                      | 800.172       | 41.4                      | 22.2                  | 5.2          | 32.7         | 36.1               | 47.0              | 10.9           | 100                      | 0              |
| ----- Vertical -----   |               |                           |                       |              |              |                    |                   |                |                          |                |
| 4                      | 125.060       | 52.7                      | 10.9                  | 2.0          | 33.0         | 32.6               | 40.0              | 7.4            | 100                      | 359            |
| 5                      | 375.320       | 48.2                      | 16.4                  | 3.7          | 33.0         | 35.3               | 47.0              | 11.7           | 100                      | 359            |
| 6                      | 445.161       | 50.1                      | 17.6                  | 4.1          | 33.0         | 38.8               | 47.0              | 8.2            | 100                      | 252            |

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.

-. Channel : High



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Tested by: Ki-Hong, Nam / Senior Engineer

## 12. CONDUCTED EMISSION TEST

### 12.1 Operating environment

Temperature : 24 °C  
Relative humidity : 45 % 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  $\Omega$  / 50  $\mu$ H + 5  $\Omega$  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.     |
|-----|--------------|-----------------|-------------------|---------------|---------------|
| ■ - | ESiB26       | Rohde & Schwarz | EMI Test Receiver | 100296        | Apr. 13, 2012 |
| ■ - | NSLK 8126    | Schwarzbeck     | AMN               | 8126-404      | Jun. 11, 2012 |
| □ - | 3825/2       | EMCO            | AMN               | 9109-1867     | May 30, 2012  |

All test equipment used is calibrated on a regular basis.

## 12.4 Test data

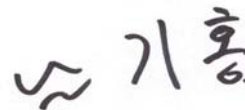
- Test Date : November 12, 2012
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz

| Frequency<br>(MHz) | Line | Quasi-Peak (dBμV) |            | Margin<br>(dB) |
|--------------------|------|-------------------|------------|----------------|
|                    |      | Emission level    | Q.P Limits |                |
| 0.16               | H    | 60.14             | 65.73      | 5.59           |
| 0.15               | N    | 61.80             | 66.00      | 4.20           |
| 0.19               | N    | 53.99             | 64.26      | 10.27          |
| 0.20               | N    | 53.14             | 63.61      | 10.47          |
| 0.24               | H    | 47.08             | 62.27      | 15.19          |
| 0.44               | N    | 40.54             | 57.16      | 16.62          |
| Frequency<br>(MHz) | Line | Average (dBμV)    |            | Margin<br>(dB) |
|                    |      | Emission level    | Limits     |                |
| 0.15               | N    | 41.98             | 56.00      | 14.02          |
| 0.16               | H    | 39.69             | 55.73      | 16.04          |
| 0.20               | N    | 38.48             | 53.61      | 15.13          |
| 0.44               | H    | 30.50             | 47.06      | 16.56          |

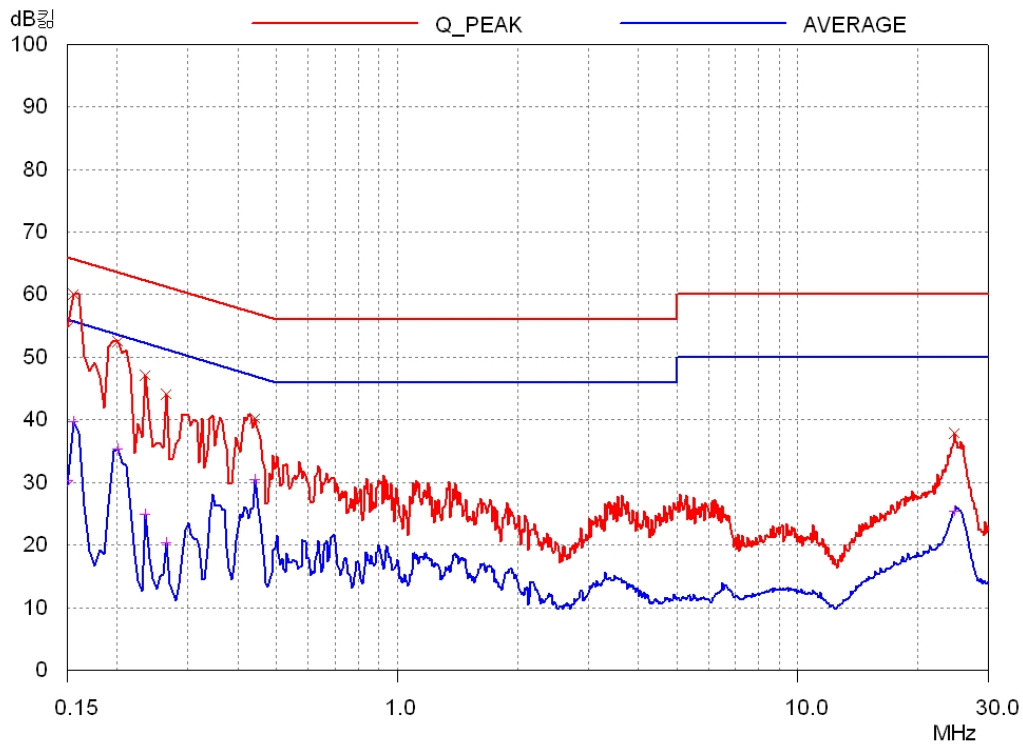
Line Conducted Emissions Tabulated Data

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

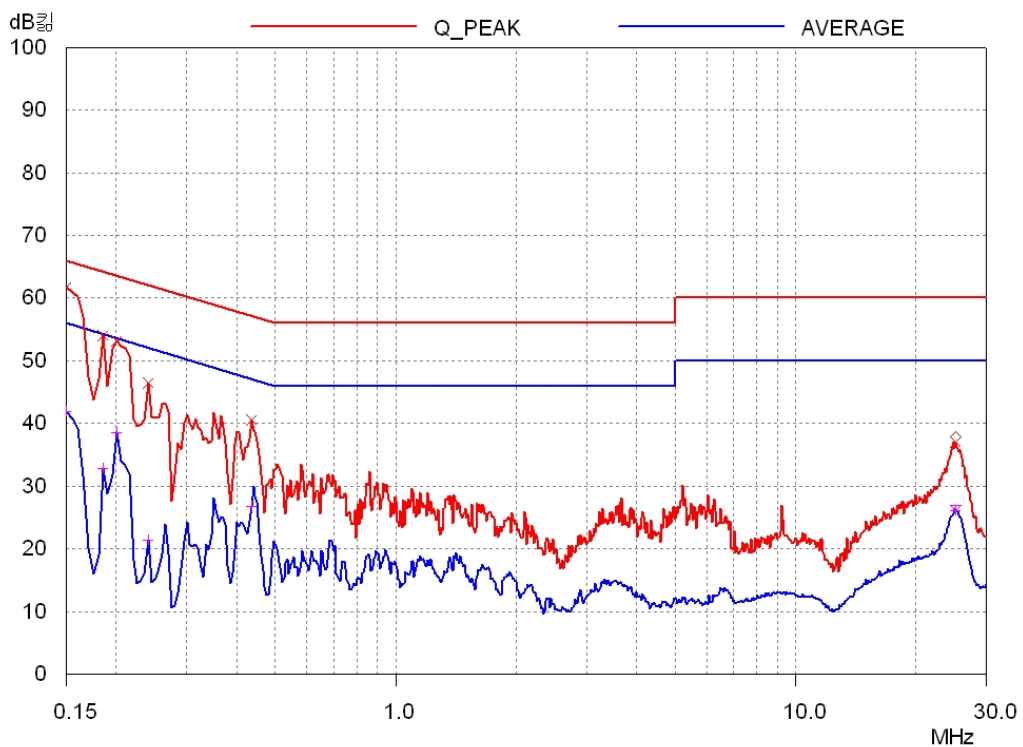
See next page for an overview sweep performed with quasi-peak and average detector modes.



Tested by: Ki-Hong, Nam / Senior Engineer



HOT LINE



NEUTRAL LINE

## 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/cm<sup>2</sup> 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<br>and 498.200 MHz ~ 505.200 MHz<br><input type="checkbox"/> WLAN: 2 412 MHz ~ 2 462 MHz<br><input type="checkbox"/> WLAN: 5 180 MHz ~ 5 320 MHz / 5 500 MHz ~ 5 700 MHz<br><input type="checkbox"/> WLAN: 5 745 MHz ~ 5 825 MHz<br><input type="checkbox"/> Bluetooth: 2 402 MHz ~ 2 480 MHz<br><input checked="" type="checkbox"/> Zigbee: 2 425 MHz ~ 2 475 MHz |
| Device Category             | <input type="checkbox"/> Portable (< 20 cm separation)<br><input type="checkbox"/> Mobile (> 20 cm separation)<br><input checked="" type="checkbox"/> Others                                                                                                                                                                                                                                                                               |
| Max. Output Power           | 1.60 dBm (1.45 mW)                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Used Antenna                | Inverted F Antenna                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Used Antenna Gain           | 3.397 dBi                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Exposure Evaluation Applied | <input type="checkbox"/> MPE<br><input type="checkbox"/> SAR<br><input checked="" type="checkbox"/> N/A                                                                                                                                                                                                                                                                                                                                    |

### 13.3 Test Result

According to the procedure, KDB 447498 D01 General RF Exposure Guidance v05, the limit for using frequency 2450 MHz is 10 mW at minimum 5 mm distance, but the device is fixed device and the output power is 1.45 mW.

Conclusion: The RF output of the device is less than the limit at minimum 5 mm distance, so the device meets the RF Exposure Requirement and excluded SAR Test