

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

Test Report No. : W178R-D010

AGR No. : A178A-003

Applicant : LG Innotek Co., Ltd.

Address : 26, Hanamsandan 5beon-ro Gwangsan-gu, Gwangju, 506-731, South Korea

Manufacturer : LG Innotek Co., Ltd.

Address : 26, Hanamsandan 5beon-ro Gwangsan-gu, Gwangju, 506-731, South Korea

Type of Equipment : 802.11 a/b/g/n/ac WiFi Module

FCC ID. : YZP-TWFM-R003D

Model Name : TWFM-R003D

Multiple Model Name : TWFM-R003D(A)

Serial number : N/A

Total page of Report : 120 pages (including this page)

Date of Incoming : July 10, 2017

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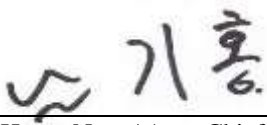
SUMMARY

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

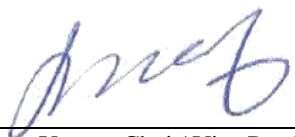
This test report only contains the result of a single test of the sample supplied for the examination.

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

Reviewed by:


Ki-Hong, Nam / Asst, Chief Engineer
ONETECH Corp.

Approved by:


Keun-Young, Choi / Vice President
ONETECH Corp.

CONTENTS

PAGE

| | |
|---|-----------|
| 1. VERIFICATION OF COMPLIANCE | 6 |
| 2. TEST SUMMARY | 7 |
| 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 |
| 3. GENERAL INFORMATION..... | 8 |
| 3.1 PRODUCT DESCRIPTION..... | 8 |
| 3.2 ALTERNATIVE TYPE(S)/MODEL(S); ALSO COVERED BY THIS TEST REPORT..... | 10 |
| 4. EUT MODIFICATIONS..... | 10 |
| 5. SYSTEM TEST CONFIGURATION | 11 |
| 5.1 JUSTIFICATION..... | 11 |
| 5.2 PERIPHERAL EQUIPMENT | 11 |
| 5.3 MODE OF OPERATION DURING THE TEST | 12 |
| 5.4 CONFIGURATION OF TEST SYSTEM..... | 13 |
| 5.5 ANTENNA REQUIREMENT | 13 |
| 6. PRELIMINARY TEST | 14 |
| 6.1 AC POWER LINE CONDUCTED EMISSIONS TESTS..... | 14 |
| 6.2 GENERAL RADIATED EMISSIONS TESTS | 14 |
| 7. MINIMUM 6 DB BANDWIDTH | 15 |
| 7.1 OPERATING ENVIRONMENT | 15 |
| 7.2 TEST SET-UP | 15 |
| 7.3 TEST EQUIPMENT USED..... | 15 |
| 7.4 TEST DATA FOR 802.11B WLAN MODE..... | 16 |
| 7.4.1 Test data for Antenna 0 | 16 |
| 7.4.2 Test data for Antenna 1 | 18 |
| 7.5 TEST DATA FOR 802.11G WLAN MODE | 20 |
| 7.5.1 Test data for Antenna 0 | 20 |
| 7.5.2 Test data for Antenna 1 | 22 |

| | |
|--|-----------|
| 7.6 TEST DATA FOR 802.11N_HT20 WLAN MODE | 24 |
| 7.6.1 Test data for Antenna 0 | 24 |
| 7.6.2 Test data for Antenna 1 | 26 |
| 7.7 TEST DATA FOR 802.11N_HT40 WLAN MODE | 28 |
| 7.7.1 Test data for Antenna 0 | 28 |
| 7.7.2 Test data for Antenna 1 | 30 |
| 8. MAXIMUM PEAK OUTPUT POWER | 32 |
| 8.1 OPERATING ENVIRONMENT | 32 |
| 8.2 TEST SET-UP | 32 |
| 8.3 TEST EQUIPMENT USED | 32 |
| 8.4 TEST DATA FOR 802.11B WLAN MODE | 33 |
| 8.4.1 Test data for Antenna 0 | 33 |
| 8.4.2 Test data for Antenna 1 | 33 |
| 8.4.3 Test data for Multiple Antenna | 34 |
| 8.5 TEST DATA FOR 802.11G WLAN MODE | 35 |
| 8.5.1 Test data for Antenna 0 | 35 |
| 8.5.2 Test data for Antenna 1 | 35 |
| 8.5.3 Test data for Multiple Antenna | 36 |
| 8.6 TEST DATA FOR 802.11N_HT20 WLAN MODE | 37 |
| 8.6.1 Test data for Antenna 0 | 37 |
| 8.6.2 Test data for Antenna 1 | 37 |
| 8.6.3 Test data for Multiple Antenna | 38 |
| 8.7 TEST DATA FOR 802.11N_HT40 WLAN MODE | 39 |
| 8.7.1 Test data for Antenna 0 | 39 |
| 8.7.2 Test data for Antenna 1 | 39 |
| 8.7.3 Test data for Multiple Antenna | 40 |
| 9. 100 KHZ BANDWIDTH OUTSIDE THE FREQUENCY BAND | 41 |
| 9.1 OPERATING ENVIRONMENT | 41 |
| 9.2 TEST SET-UP FOR CONDUCTED MEASUREMENT | 41 |
| 9.3 TEST SET-UP FOR RADIATED MEASUREMENT | 41 |
| 9.4 TEST EQUIPMENT USED | 41 |
| 9.5 TEST DATA FOR CONDUCTED EMISSION | 42 |
| 9.5.1 Test data for 802.11b WLAN Mode | 42 |
| 9.5.2 Test data for 802.11g WLAN Mode | 52 |
| 9.5.3 Test data for 802.11n_HT20 WLAN Mode | 62 |
| 9.5.4 Test data for 802.11n_HT40 WLAN Mode | 72 |
| 9.6 TEST DATA FOR RADIATED EMISSION | 82 |

| | |
|--|------------|
| 9.6.1 Radiated Emission which fall in the Restricted Band..... | 82 |
| 9.6.2 Radiated Emission which fall in the Band Edge | 86 |
| 9.6.3 Spurious & Harmonic Radiated Emission..... | 90 |
| 10. PEAK POWER SPECTRUL DENSITY | 94 |
| 10.1 OPERATING ENVIRONMENT | 94 |
| 10.2 TEST SET-UP | 94 |
| 10.3 TEST EQUIPMENT USED..... | 94 |
| 10.4 TEST DATA FOR 802.11B WLAN MODE..... | 95 |
| 10.4.1 Test data for Antenna 0 | 95 |
| 10.4.2 Test data for Antenna 1 | 97 |
| 10.4.3 Test data for Multiple Antenna | 99 |
| 10.5 TEST DATA FOR 802.11G WLAN MODE | 100 |
| 10.5.1 Test data for Antenna 0 | 100 |
| 10.5.2 Test data for Antenna 1 | 102 |
| 10.5.3 Test data for Multiple Antenna | 104 |
| 10.6 TEST DATA FOR 802.11N_HT20 WLAN MODE..... | 105 |
| 10.6.1 Test data for Antenna 0 | 105 |
| 10.6.2 Test data for Antenna 1 | 107 |
| 10.6.3 Test data for Multiple Antenna | 109 |
| 10.7 TEST DATA FOR 802.11N_HT40 WLAN MODE..... | 110 |
| 10.7.1 Test data for Antenna 0 | 110 |
| 10.7.2 Test data for Antenna 1 | 112 |
| 10.7.3 Test data for Multiple Antenna | 114 |
| 11. RADIATED EMISSION TEST | 115 |
| 11.1 OPERATING ENVIRONMENT | 115 |
| 11.2 TEST SET-UP | 115 |
| 11.3 TEST EQUIPMENT USED..... | 115 |
| 11.4 TEST DATA FOR 30 MHz ~ 1 000 MHz | 116 |
| 11.5 TEST DATA FOR BELOW 30 MHz | 117 |
| 11.6 TEST DATA FOR ABOVE 1 GHz | 117 |
| 12. CONDUCTED EMISSION TEST | 118 |
| 12.1 OPERATING ENVIRONMENT | 118 |
| 12.2 TEST SET-UP | 118 |
| 12.3 TEST EQUIPMENT USED..... | 118 |
| 12.4 TEST DATA..... | 119 |

REVISION HISTORY

| Issued Report No. | Issued Date | Revisions | Effect Section |
|-------------------|-----------------|---------------|----------------|
| W178R-D010 | August 07, 2017 | Initial Issue | All |

1. VERIFICATION OF COMPLIANCE

Applicant : LG Innotek Co., Ltd.
Address : 26, Hanamsandan 5beon-ro Gwangsan-gu, Gwangju, 506-731, South Korea
Contact Person : Inchang Jeong / Senior Research Engineer
Telephone No. : +82-62-950-0332
FCC ID : YZP-TWFM-R003D
Model Name : TWFM-R003D
Serial Number : N/A
Date : August 07, 2017

| | |
|---|--|
| EQUIPMENT CLASS | DTS – DIGITAL TRNSMISSION SYSTEM |
| E.U.T. DESCRIPTION | Modular Transmitter, 802.11 a/b/g/n/ac WiFi Module |
| THIS REPORT CONCERNS | Original Grant |
| MEASUREMENT PROCEDURES | ANSI C63.10: 2013 |
| TYPE OF EQUIPMENT TESTED | Pre-Production |
| KIND OF EQUIPMENT AUTHORIZATION REQUESTED | Certification |
| EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S) | FCC PART 15 SUBPART C Section 15.247 KDB 558074 D01 DTS Meas Guidance |
| 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 |
| 15.209 | Radiated Emission Limits | Met the Limit / PASS |
| 15.207 | Conducted Limits | Met the Limit / PASS |
| 15.203 | Antenna Requirement | Met requirement / PASS |

2.2 Additions, deviations, exclusions from standards

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

2.3 Related Submittal(s) / Grant(s)

Original submittal only

2.4 Purpose of the test

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

2.5 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

2.6 Test Facility

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

The Electromagnetic compatibility measurement facilities are located at 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-4112/ C-4617/ G-10666 / T-1842

IC (Industry Canada) – Registration No. Site# 3736A-3

-. Site Accreditation:

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation NO. KT085

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

3. GENERAL INFORMATION

3.1 Product Description

The LG Innotek Co., Ltd., Model TWFM-R003D (referred to as the EUT in this report) is a 802.11 a/b/g/n/ac WiFi Module. Product specification information described herein was obtained from product data sheet or user's manual.

| DEVICE TYPE | 802.11 a/b/g/n/ac WiFi Module | | |
|---------------------|-------------------------------|---|--|
| Operating Frequency | WLAN | 2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20)) | |
| | 2.4 GHz Band | 2 422 MHz ~ 2 452 MHz (802.11n(HT40)) | |
| | WLAN 5 GHz Band | 5 150 MHz ~ 5 250 MHz Band | 5 180 MHz ~ 5 240 MHz (802.11a/n(HT20)/ac(VHT20)) |
| | | | 5 190 MHz ~ 5 230 MHz (802.11n(HT40)/ac(VHT40)) |
| | | | 5 210 MHz (802.11ac(VHT80)) |
| | | 5 725 MHz ~ 5 850 MHz Band | 5 745 MHz ~ 5 825 MHz (802.11a/n(HT20)/ac(VHT20)) |
| | | | 5 755 MHz ~ 5 795 MHz (802.11n(HT40)/ac(VHT40)) |
| | | | 5 775 MHz (802.11ac(VHT80)) |
| RF Output Power | WLAN 2.4 GHz Band | Antenna 0 | Wi-Fi 802.11b (13.19 dBm) Wi-Fi 802.11g (12.53 dBm) Wi-Fi 802.11n(HT20) (11.20 dBm) Wi-Fi 802.11n(HT40) (11.16 dBm) |
| | | Antenna 1 | Wi-Fi 802.11b (14.32 dBm) Wi-Fi 802.11g (12.84 dBm) Wi-Fi 802.11n(HT20) (10.83 dBm) Wi-Fi 802.11n(HT40) (10.77 dBm) |
| | | Antenna 0 + Antenna 1 | Wi-Fi 802.11b (16.80 dBm) Wi-Fi 802.11g (15.57 dBm) Wi-Fi 802.11n(HT20) (13.99 dBm) Wi-Fi 802.11n(HT40) (13.98 dBm) |

| | | | | |
|-----------------|--------------------|-------------------------------|--------------------------|--|
| RF Output Power | WLAN 5 GHz Band | 5 150 MHz ~ 5 250 MHz Band | Antenna 0 | Wi-Fi 802.11a (10.03 dBm) Wi-Fi 802.11n(HT20) (7.77 dBm) Wi-Fi 802.11n(HT40) (7.80 dBm) Wi-Fi 802.11ac(HT80) (6.25 dBm) |
| | | | Antenna 1 | Wi-Fi 802.11a (10.14 dBm) Wi-Fi 802.11n(HT20) (8.00 dBm) Wi-Fi 802.11n(HT40) (8.43 dBm) Wi-Fi 802.11ac(HT80) (6.10 dBm) |
| | | | Antenna 0 + Antenna 1 | Wi-Fi 802.11a (13.09 dBm) Wi-Fi 802.11n(HT20) (10.90 dBm) Wi-Fi 802.11n(HT40) (11.13 dBm) Wi-Fi 802.11ac(HT80) (9.19 dBm) |
| | | 5 725 MHz ~ 5 850 MHz Band | Antenna 0 | Wi-Fi 802.11a (9.89 dBm) Wi-Fi 802.11n(HT20) (7.78 dBm) Wi-Fi 802.11n(HT40) (7.73 dBm) Wi-Fi 802.11ac(HT80) (6.17 dBm) |
| | | | Antenna 1 | Wi-Fi 802.11a (9.80 dBm) Wi-Fi 802.11n(HT20) (7.71 dBm) Wi-Fi 802.11n(HT40) (7.72 dBm) Wi-Fi 802.11ac(HT80) (5.84 dBm) |
| | | | Antenna 0 + Antenna 1 | Wi-Fi 802.11a (12.86 dBm) Wi-Fi 802.11n(HT20) (10.76 dBm) Wi-Fi 802.11n(HT40) (10.74 dBm) Wi-Fi 802.11ac(HT80) (9.02 dBm) |

| | | | |
|---|-------------------------------|--|----------|
| Modulation Type | WLAN 2.4 GHz Band | DSSS Modulation(DBPSK/DQPSK/CCK) OFDM Modulation(BPSK/QPSK/16QAM/64QAM) | |
| | WLAN 5 GHz Band | OFDM Modulation(BPSK/QPSK/16QAM/64QAM) | |
| Antenna Type | WLAN 2.4 GHz Band | Antenna 0 | 1.61 dBi |
| | | Antenna 1 | 2.13 dBi |
| | | Antenna 0 + Antenna 1 | 4.89 dBi |
| | 5 150 MHz ~ 5 250 MHz Band | Antenna 0 | 1.63 dBi |
| | | Antenna 1 | 1.01 dBi |
| | | Antenna 0 + Antenna 1 | 4.34 dBi |
| | 5 725 MHz ~ 5 850 MHz Band | Antenna 0 | 3.32 dBi |
| | | Antenna 1 | 2.04 dBi |
| | | Antenna 0 + Antenna 1 | 5.74 dBi |
| List of each Osc. or crystal Freq.(Freq. >= 1 MHz) | 40 MHz | | |

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

-. The following lists consist of the added model and their differences.

| Model Name | Differences | Tested |
|---------------|--|-------------------------------------|
| TWFM-R003D | Basic Model | <input checked="" type="checkbox"/> |
| TWFM-R003D(A) | The difference between this model and the basic model is the PDN function added (Main IC Wake-up) and resistance component R6 added. | <input type="checkbox"/> |

Note: 1. Applicant consigns only basic model to test. Therefore this test report just guarantees the units, which have been tested.

2. The Applicant/manufacture is responsible for the compliance of all variants.

4. EUT MODIFICATIONS

-. None

5. SYSTEM TEST CONFIGURATION

5.1 Justification

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

| DEVICE TYPE | MANUFACTURER | MODEL/PART NUMBER | FCC ID |
|-------------|----------------------|-------------------|--------|
| Main Board | LG Innotek Co., Ltd. | TWFM-R003D | - |

5.2 Peripheral equipment

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

| Model | Manufacturer | Description | Connected to |
|------------|----------------------------|-------------------------------------|--------------|
| TWFM-R003D | LG Innotek Co., Ltd. | 802.11 a/b/g/n/ac WiFi Module (EUT) | Notebook PC |
| PP11L | DELL | Notebook PC | EUT |
| WEA504i | Samsung Electronics Co Ltd | WLAN Access Point | EUT |

5.3 Mode of operation during the test

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

| Modulation | DATA RATE | OUTPUT POWER[dBm] | |
|------------------------------|------------|-------------------|-------|
| | | Ant 0 | Ant 1 |
| 802.11 b (Middle Channel) | 1 Mbps | 13.19 | 14.32 |
| | 2 Mbps | 13.01 | 14.19 |
| | 5.5 Mbps | 12.85 | 14.05 |
| | 11 Mbps | 12.72 | 13.92 |
| 802.11g (Middle Channel) | 6 Mbps | 12.53 | 12.84 |
| | 9 Mbps | 12.39 | 12.68 |
| | 12 Mbps | 12.21 | 12.57 |
| | 18 Mbps | 12.07 | 12.39 |
| | 24 Mbps | 11.96 | 12.28 |
| | 36 Mbps | 11.81 | 12.11 |
| | 48 Mbps | 11.65 | 11.99 |
| | 54 Mbps | 11.53 | 11.85 |
| HT 20 (Middle Channel) | 6.5 Mbps | 11.20 | 10.83 |
| | 13 Mbps | 11.03 | 10.72 |
| | 19.5 Mbps | 10.90 | 10.55 |
| | 26 Mbps | 10.78 | 10.38 |
| | 39 Mbps | 10.67 | 10.28 |
| | 52 Mbps | 10.49 | 10.18 |
| | 58.5 Mbps | 10.35 | 10.00 |
| | 65 Mbps | 10.22 | 9.85 |
| HT 40 (Middle Channel) | 13.5 Mbps | 11.16 | 10.77 |
| | 27 Mbps | 10.98 | 10.57 |
| | 40.5 Mbps | 10.84 | 10.45 |
| | 54 Mbps | 10.74 | 10.33 |
| | 81 Mbps | 10.54 | 10.18 |
| | 108 Mbps | 10.39 | 10.07 |
| | 121.5 Mbps | 10.27 | 9.90 |
| | 135 Mbps | 10.14 | 9.74 |

-. The worse case data rate for each modulation is determined 1 Mbps(Ant.0/Ant.1) for IEEE 802.11b, 6 Mbps(Ant.0/Ant.1) for IEEE 802.11g, 6.5 Mbps(Ant.0/Ant.1) for HT20, 13.5 Mbps(Ant.0/Ant.1) for HT40.

-. To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes and the worst case is "XY" axis.

5.4 Configuration of Test System

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

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 meter 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 transmitter antenna of the EUT is WLAN 2.4 GHz Band & WLAN 5 GHz Band is PCB antenna so no consideration of replacement by the user.

6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

During Preliminary Test, the following operating mode was investigated.

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

6.2 General Radiated Emissions Tests

During Preliminary Test, the following operating mode was investigated.

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

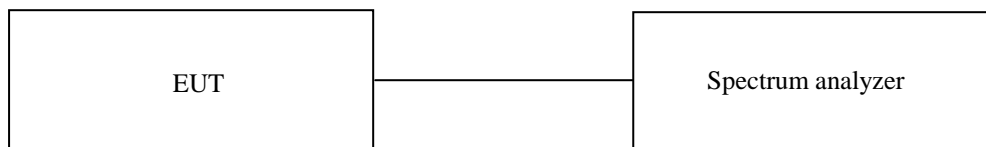
7. MINIMUM 6 dB BANDWIDTH

7.1 Operating environment

Temperature : 23 °C
Relative humidity : 41 % 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. |
|-----|--------------|-----------------|-----------------|---------------|--------------------|
| ■ - | FSV40 | Rohde & Schwarz | Signal Analyzer | 101009 | Apr. 05, 2017 (1Y) |

All test equipment used is calibrated on a regular basis.

7.4 Test data for 802.11b WLAN Mode

7.4.1 Test data for Antenna 0

-. Test Date : July 17, 2017

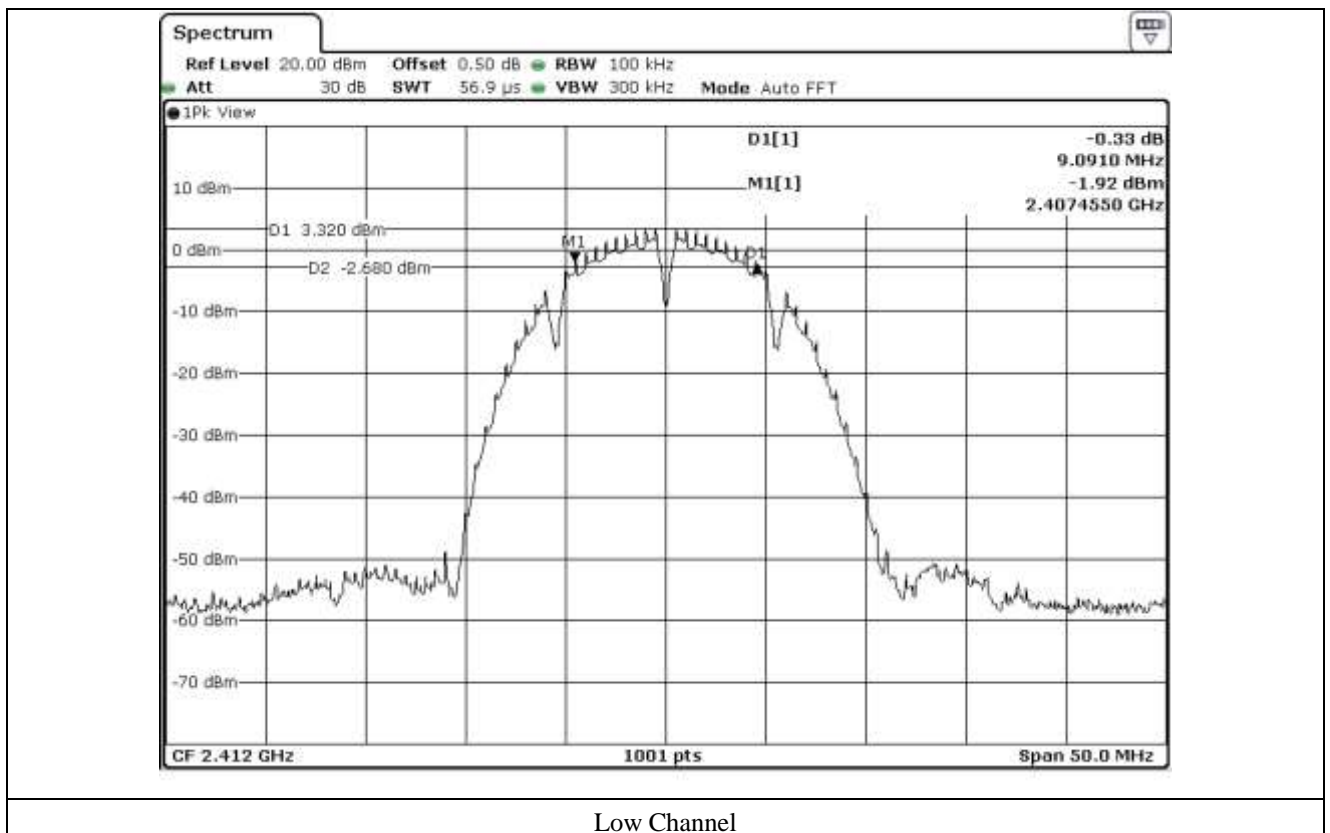
-. Test Result : Pass

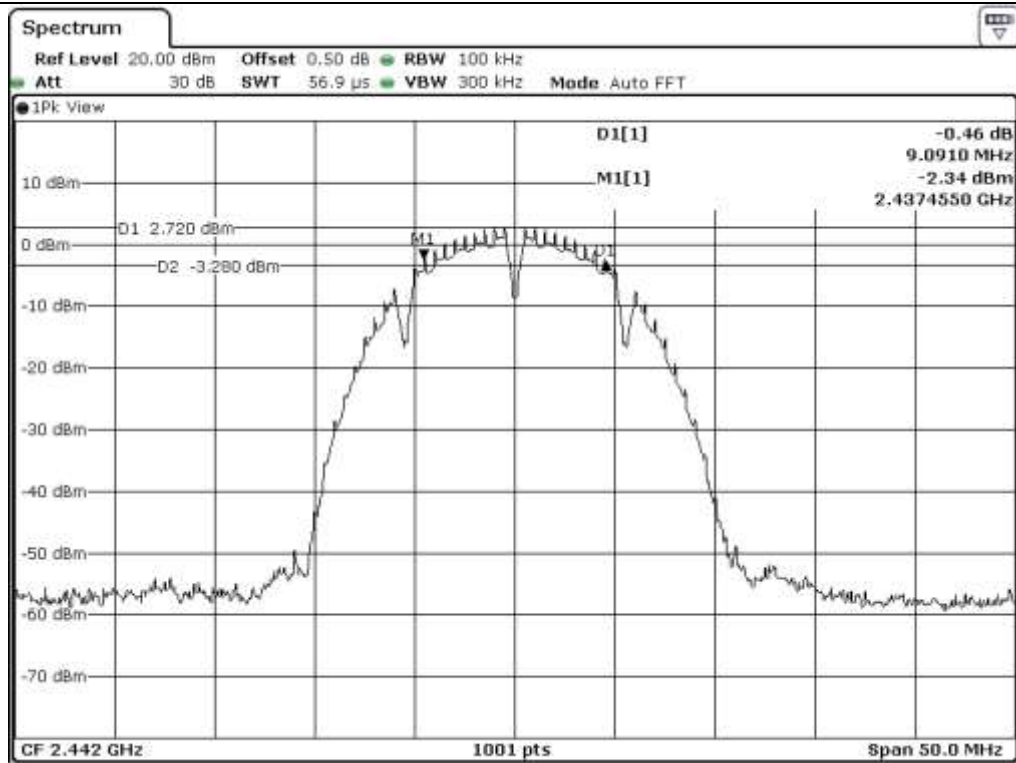
| CHANNEL | FREQUENCY (MHz) | 6 dB Bandwidth (MHz) | LIMIT (MHz) | Margin (MHz) |
|---------|--------------------|-------------------------|----------------|-----------------|
| Low | 2 412.00 | 9.09 | 0.50 | 8.59 |
| Middle | 2 442.00 | 9.09 | 0.50 | 8.59 |
| High | 2 462.00 | 9.09 | 0.50 | 8.59 |

Remark. Margin = Measured Value - Limit

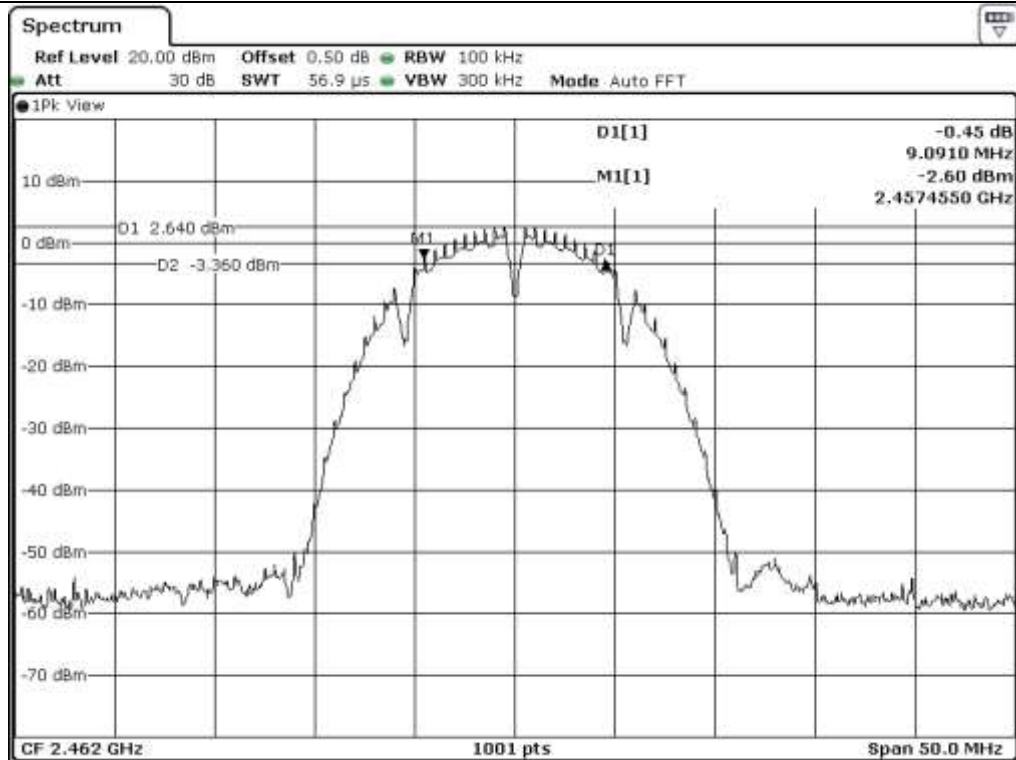


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

7.4.2 Test data for Antenna 1

-. Test Date : July 17, 2017

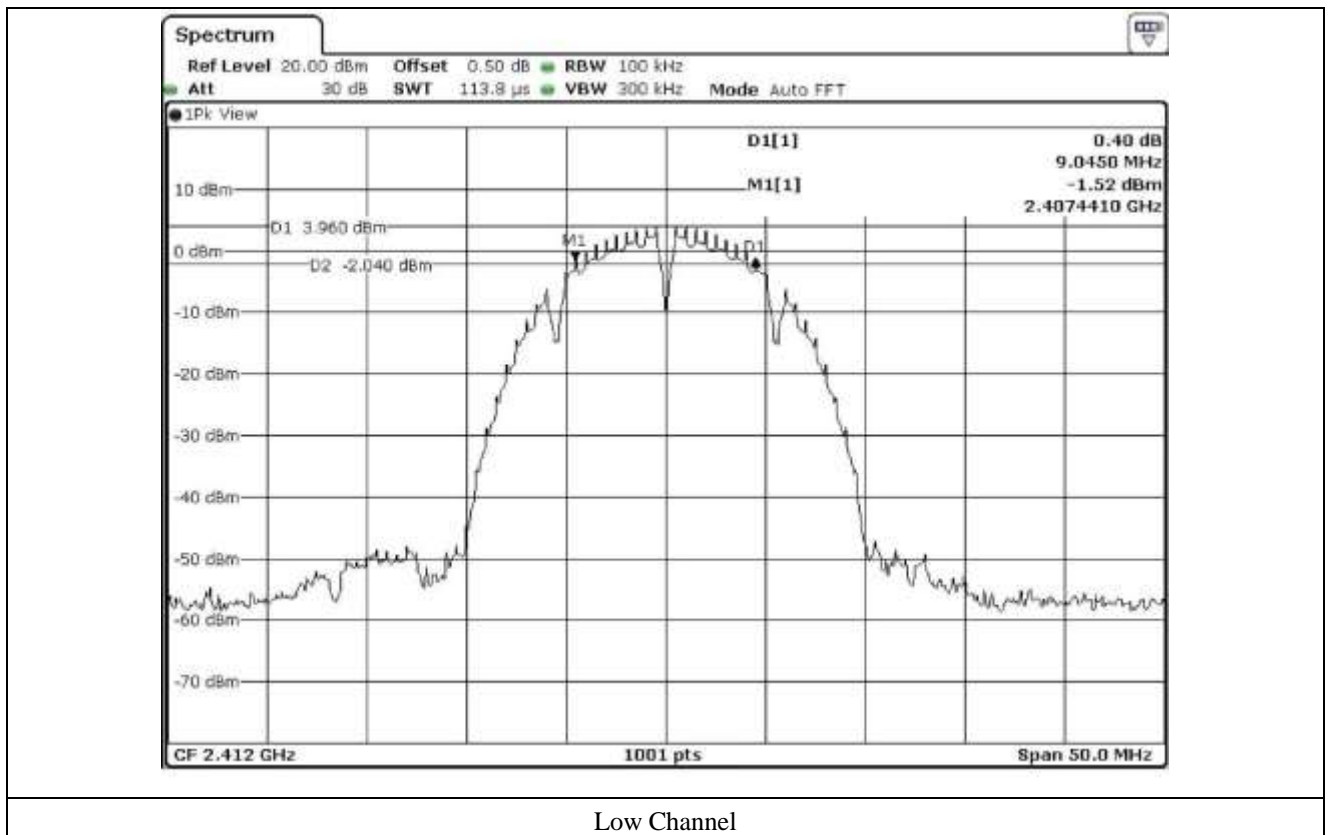
-. Test Result : Pass

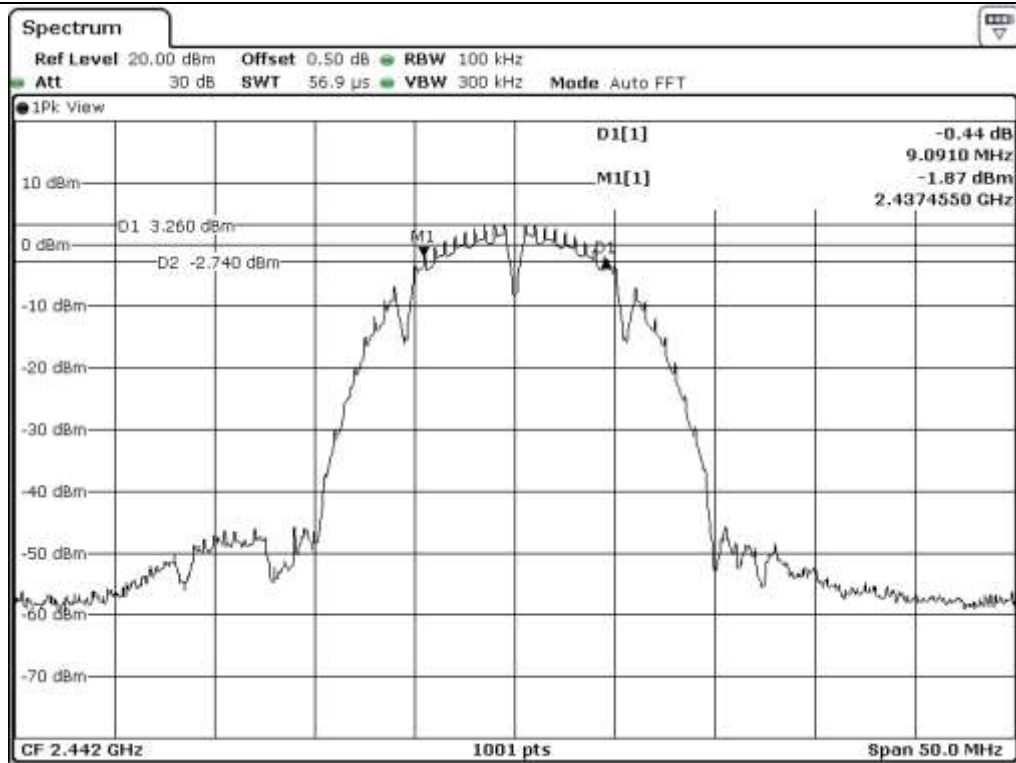
| CHANNEL | FREQUENCY (MHz) | 6 dB Bandwidth (MHz) | LIMIT (MHz) | Margin (MHz) |
|---------|--------------------|-------------------------|----------------|-----------------|
| Low | 2 412.00 | 9.05 | 0.50 | 8.55 |
| Middle | 2 442.00 | 9.09 | 0.50 | 8.59 |
| High | 2 462.00 | 9.09 | 0.50 | 8.59 |

Remark. Margin = Measured Value - Limit

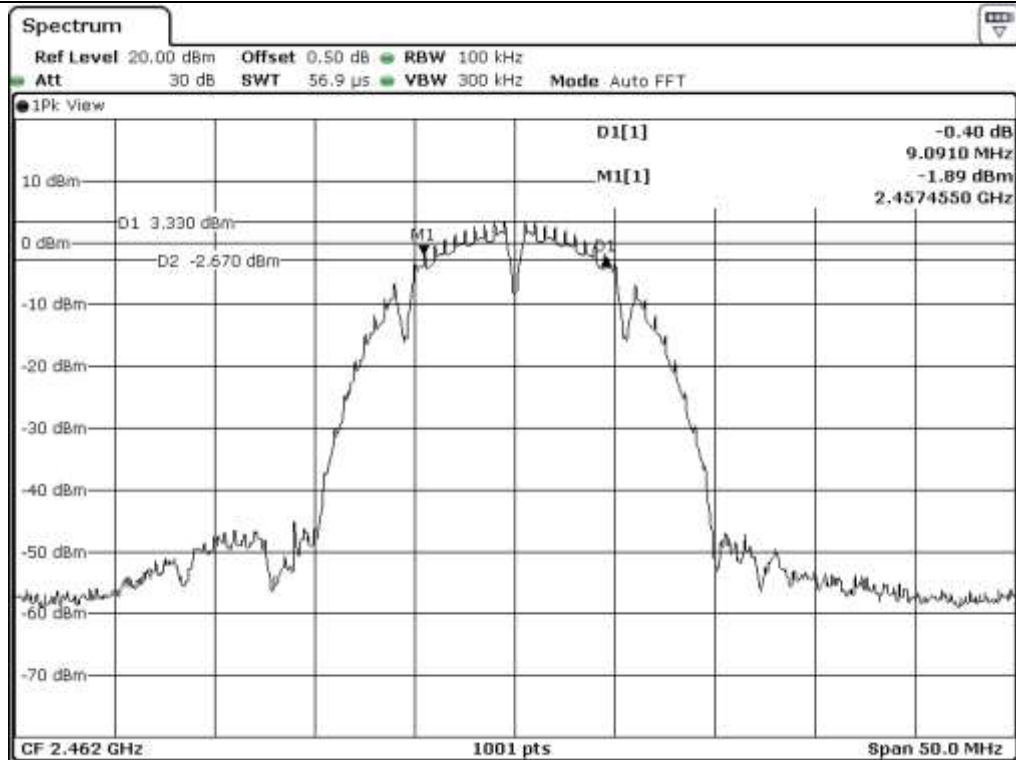


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

7.5 Test data for 802.11g WLAN Mode

7.5.1 Test data for Antenna 0

-. Test Date : July 17, 2017

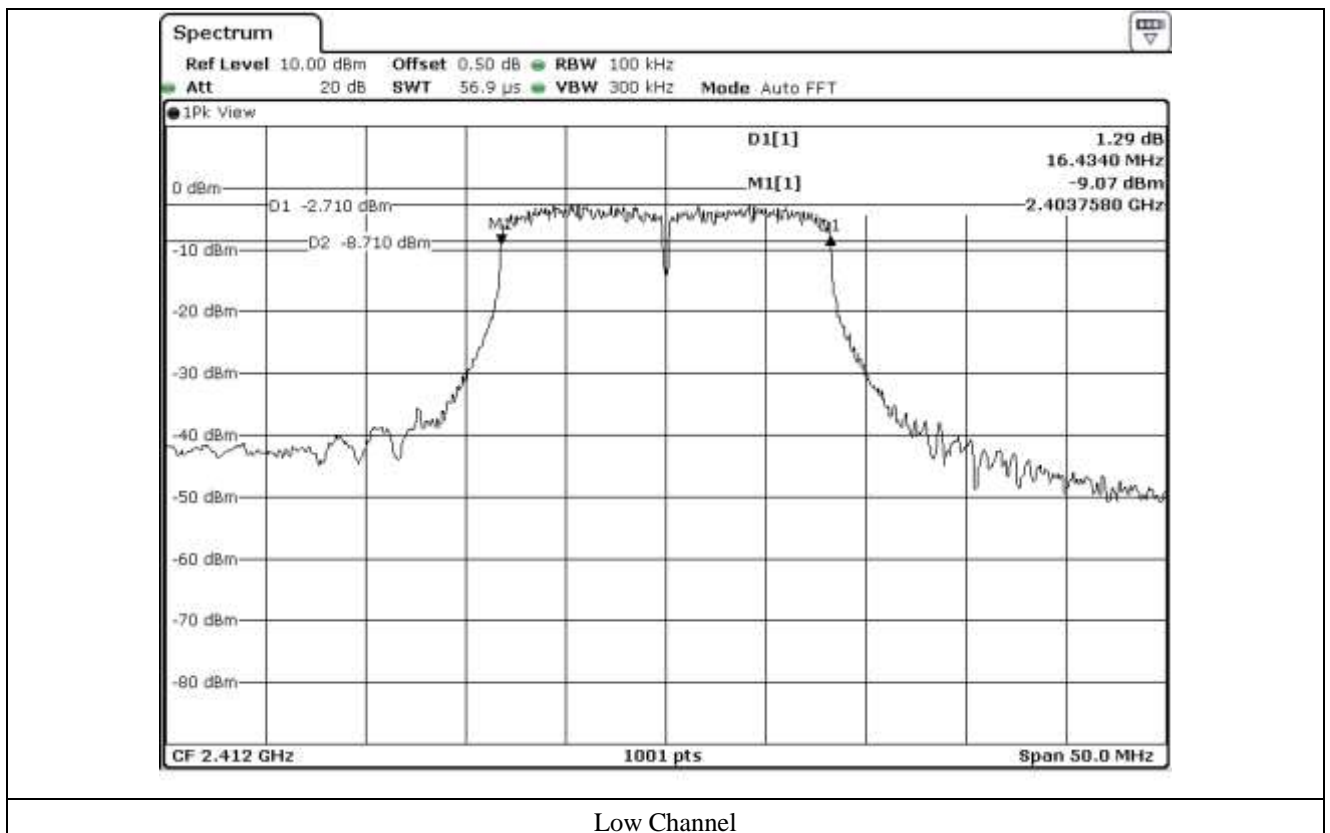
-. Test Result : Pass

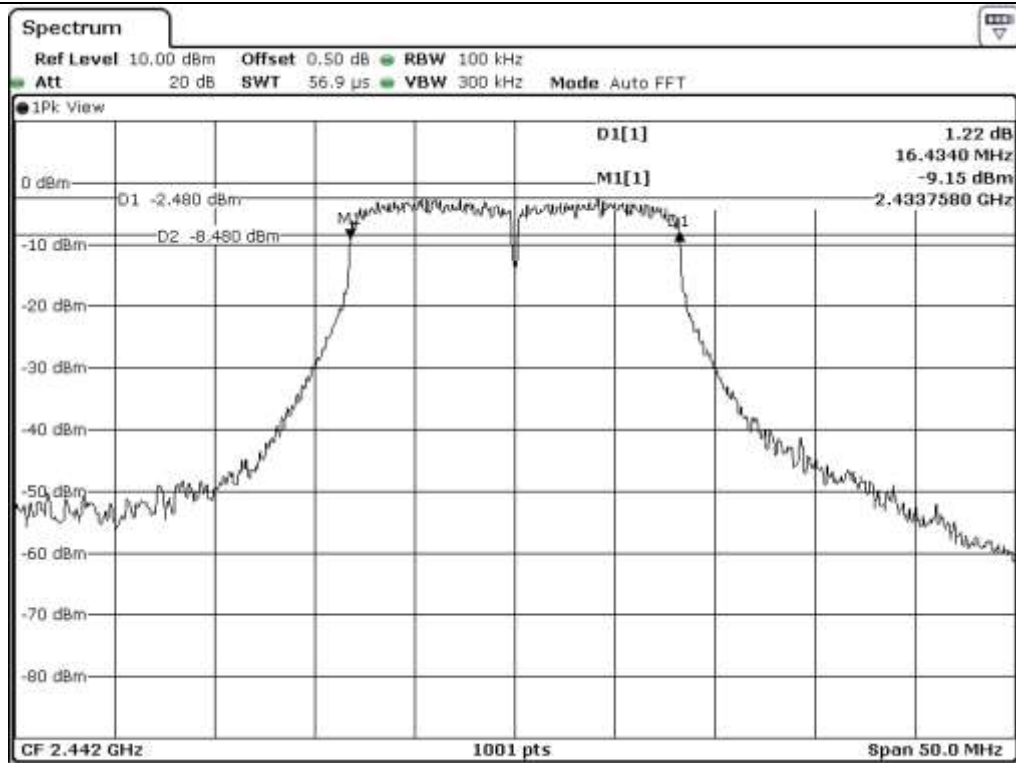
| CHANNEL | FREQUENCY (MHz) | 6 dB Bandwidth (MHz) | LIMIT (MHz) | Margin (MHz) |
|---------|--------------------|-------------------------|----------------|-----------------|
| Low | 2 412.00 | 16.43 | 0.50 | 15.93 |
| Middle | 2 442.00 | 16.43 | 0.50 | 15.93 |
| High | 2 462.00 | 16.43 | 0.50 | 15.93 |

Remark. Margin = Measured Value - Limit

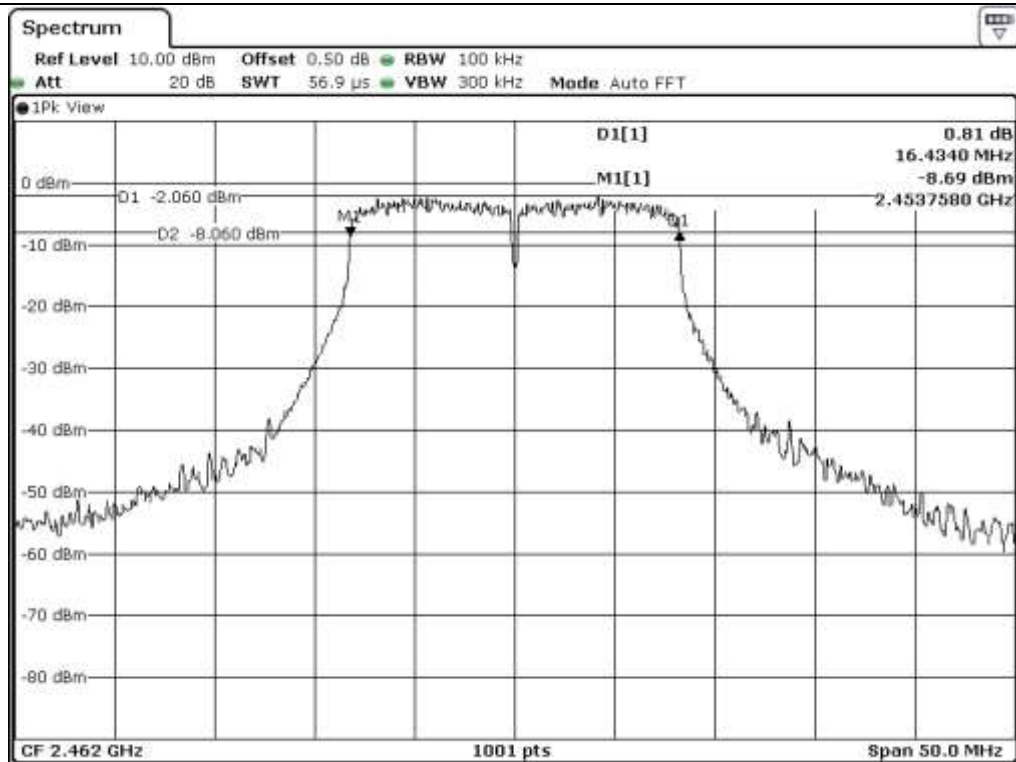


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

7.5.2 Test data for Antenna 1

-. Test Date : July 17, 2017

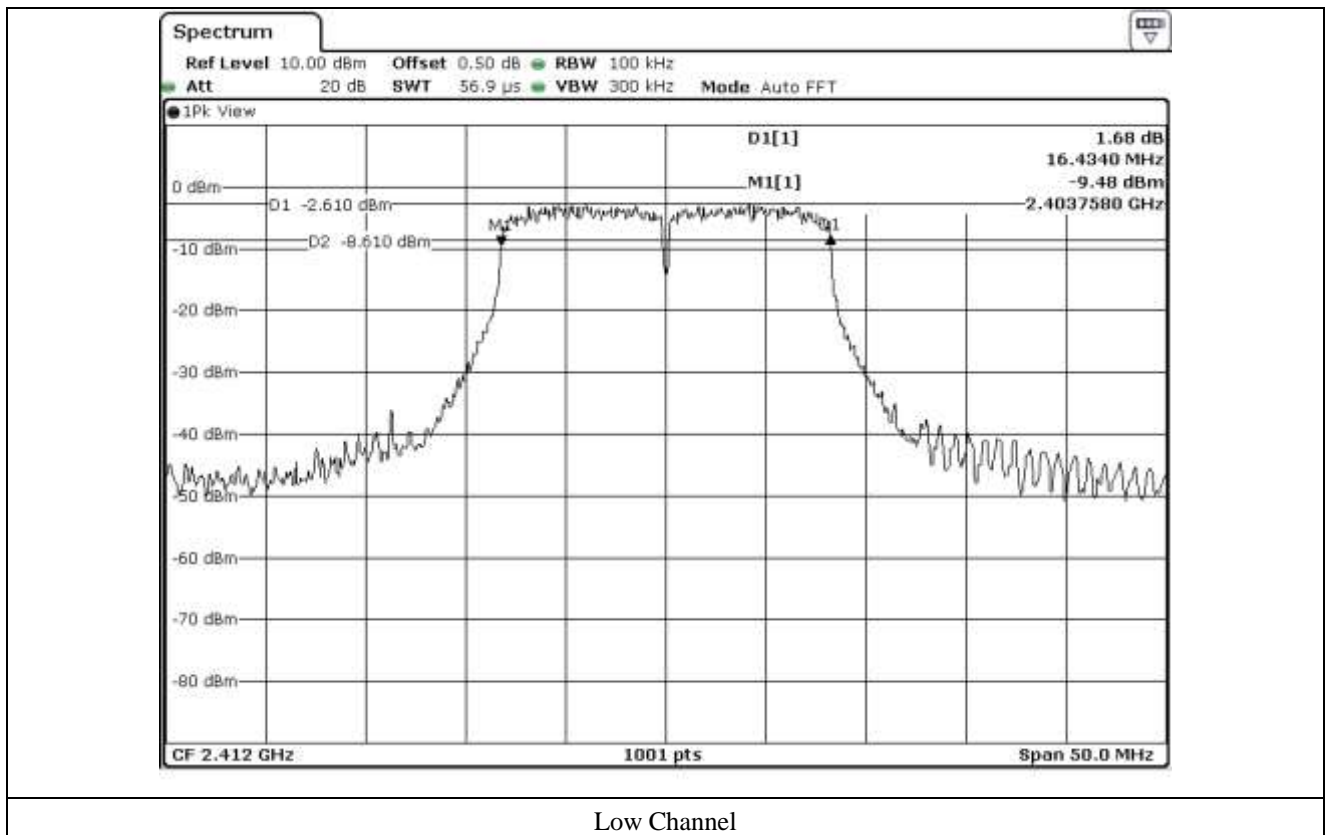
-. Test Result : Pass

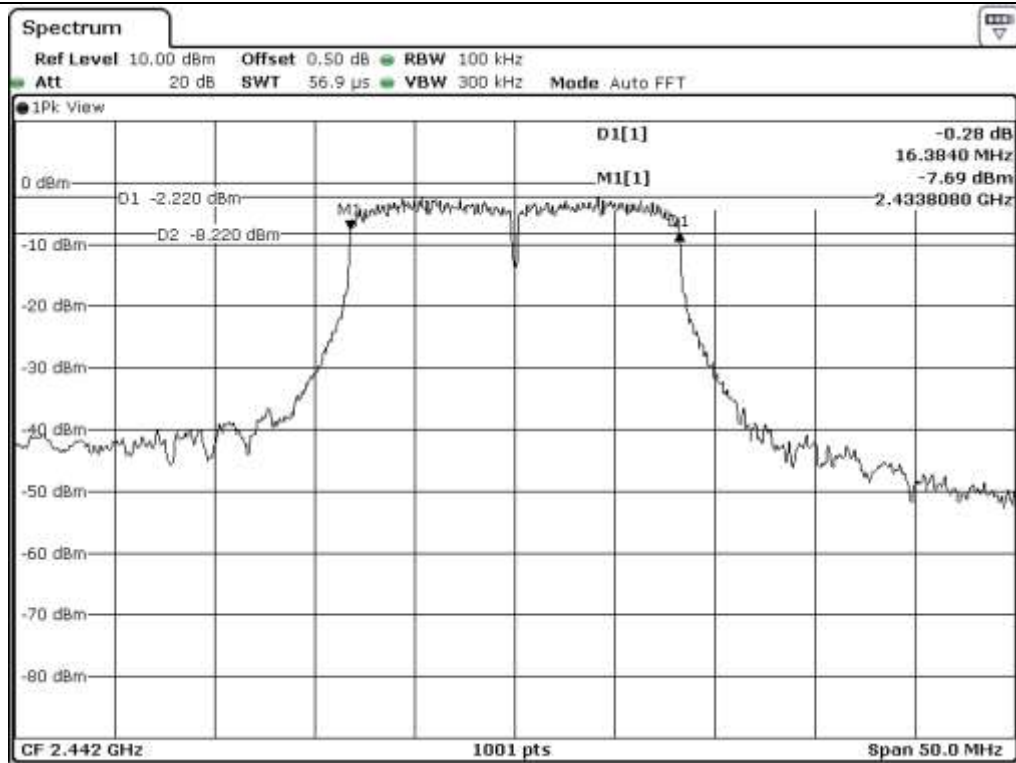
| CHANNEL | FREQUENCY (MHz) | 6 dB Bandwidth (MHz) | LIMIT (MHz) | Margin (MHz) |
|---------|--------------------|-------------------------|----------------|-----------------|
| Low | 2 412.00 | 16.43 | 0.50 | 15.93 |
| Middle | 2 442.00 | 16.38 | 0.50 | 15.88 |
| High | 2 462.00 | 16.43 | 0.50 | 15.93 |

Remark. Margin = Measured Value - Limit

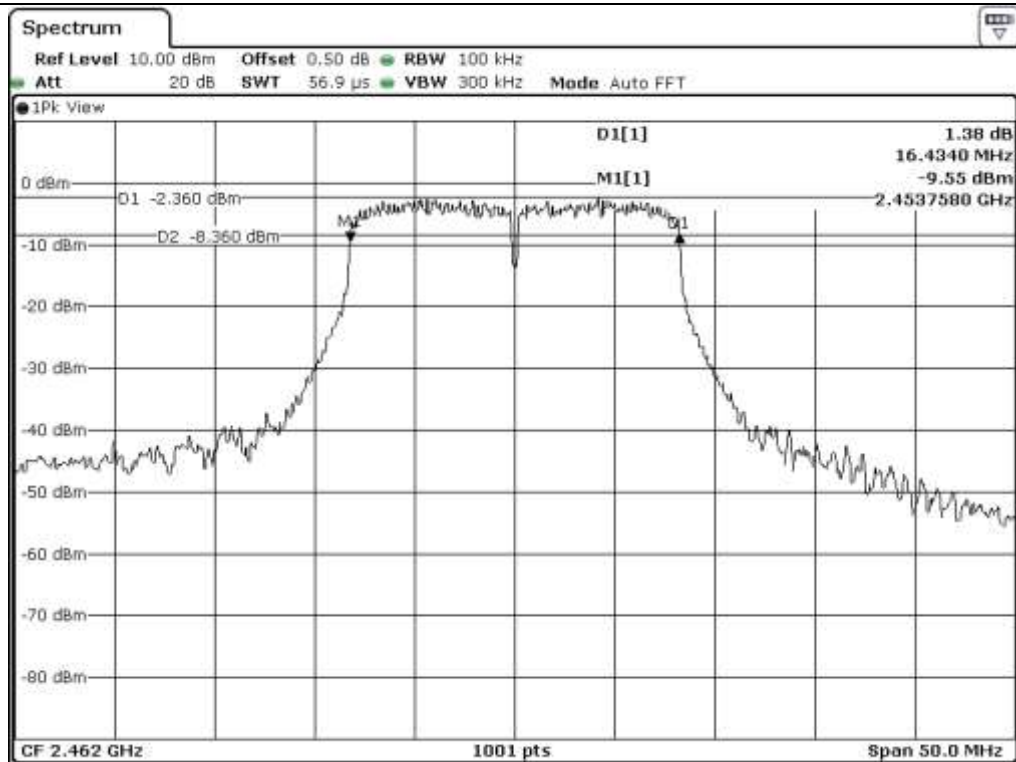


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

7.6 Test data for 802.11n_HT20 WLAN Mode

7.6.1 Test data for Antenna 0

-. Test Date : July 17, 2017

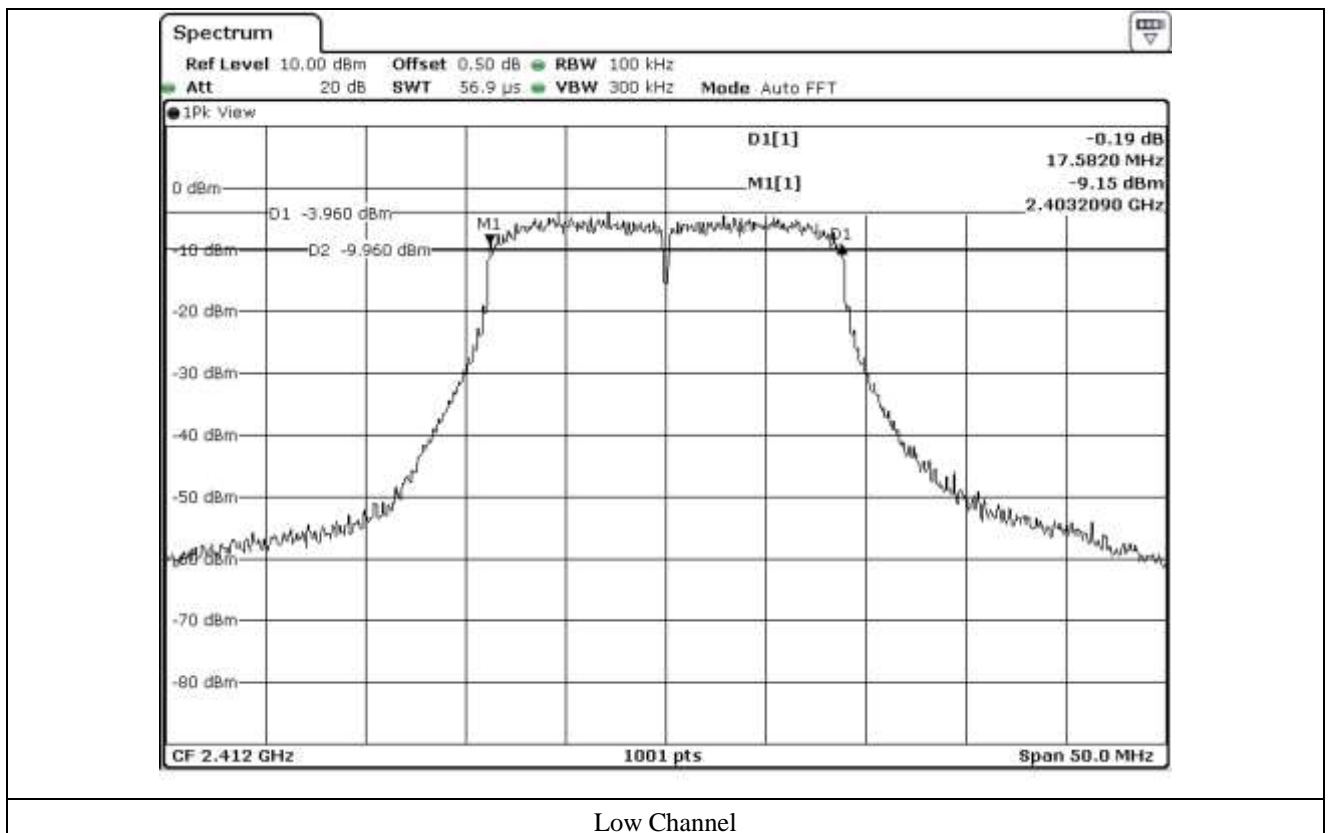
-. Test Result : Pass

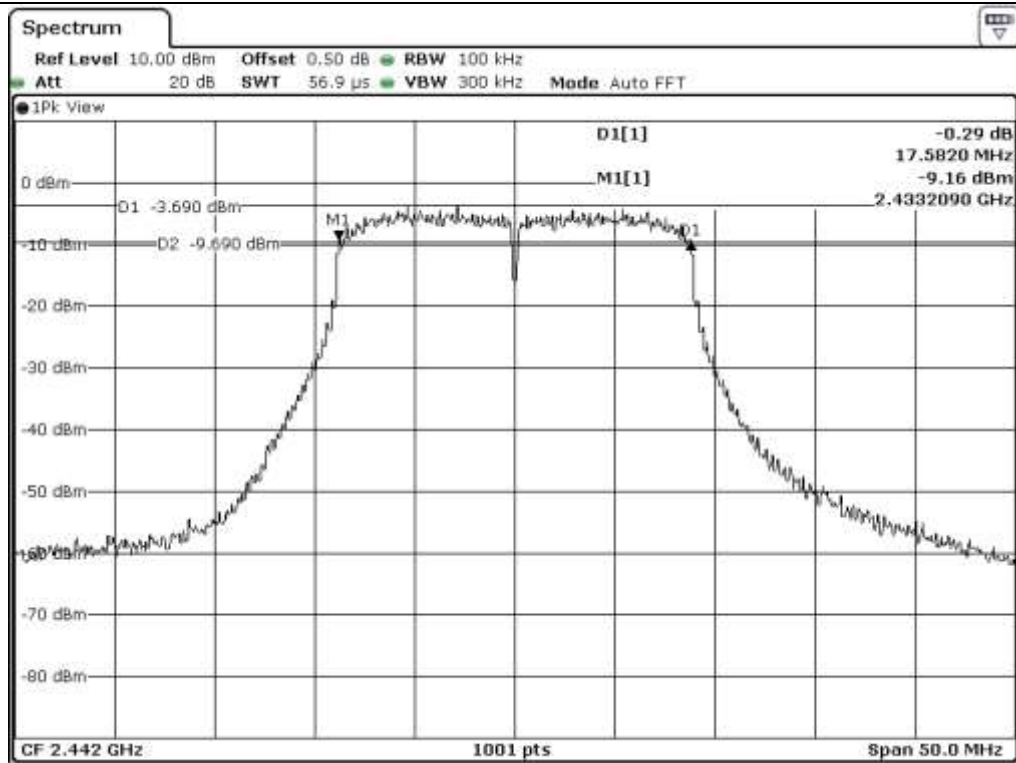
| CHANNEL | FREQUENCY (MHz) | 6 dB Bandwidth (MHz) | LIMIT (MHz) | Margin (MHz) |
|---------|--------------------|-------------------------|----------------|-----------------|
| Low | 2 412.00 | 17.58 | 0.50 | 17.08 |
| Middle | 2 442.00 | 17.58 | 0.50 | 17.08 |
| High | 2 462.00 | 17.58 | 0.50 | 17.08 |

Remark. Margin = Measured Value - Limit

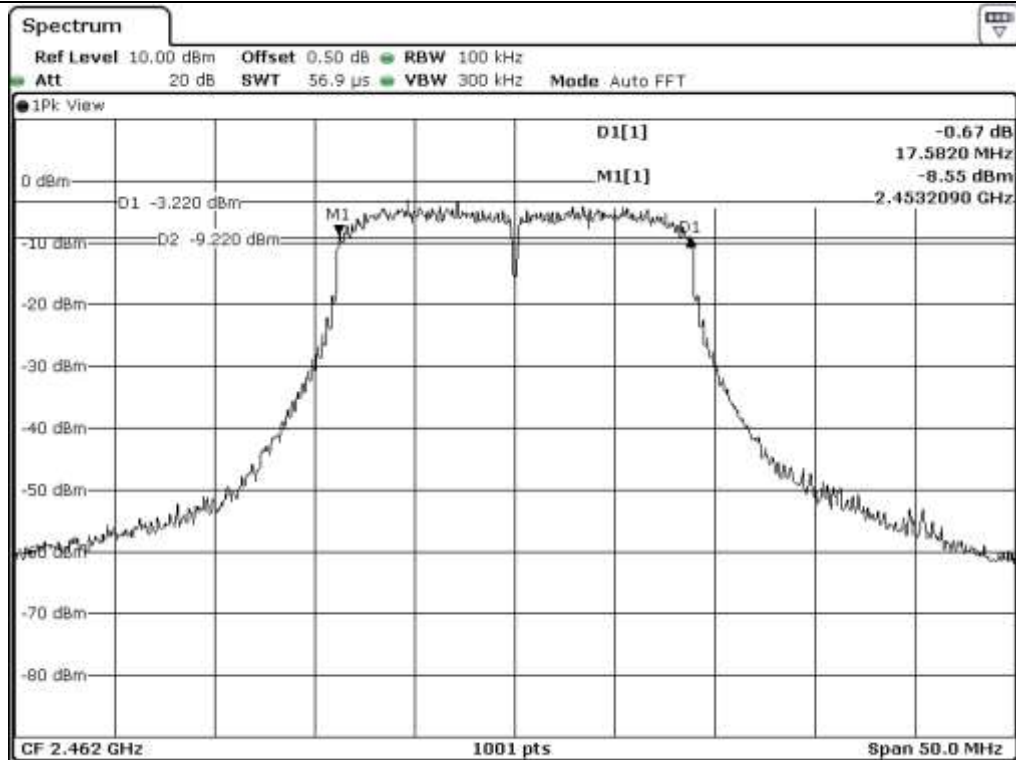


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

7.6.2 Test data for Antenna 1

-. Test Date : July 17, 2017

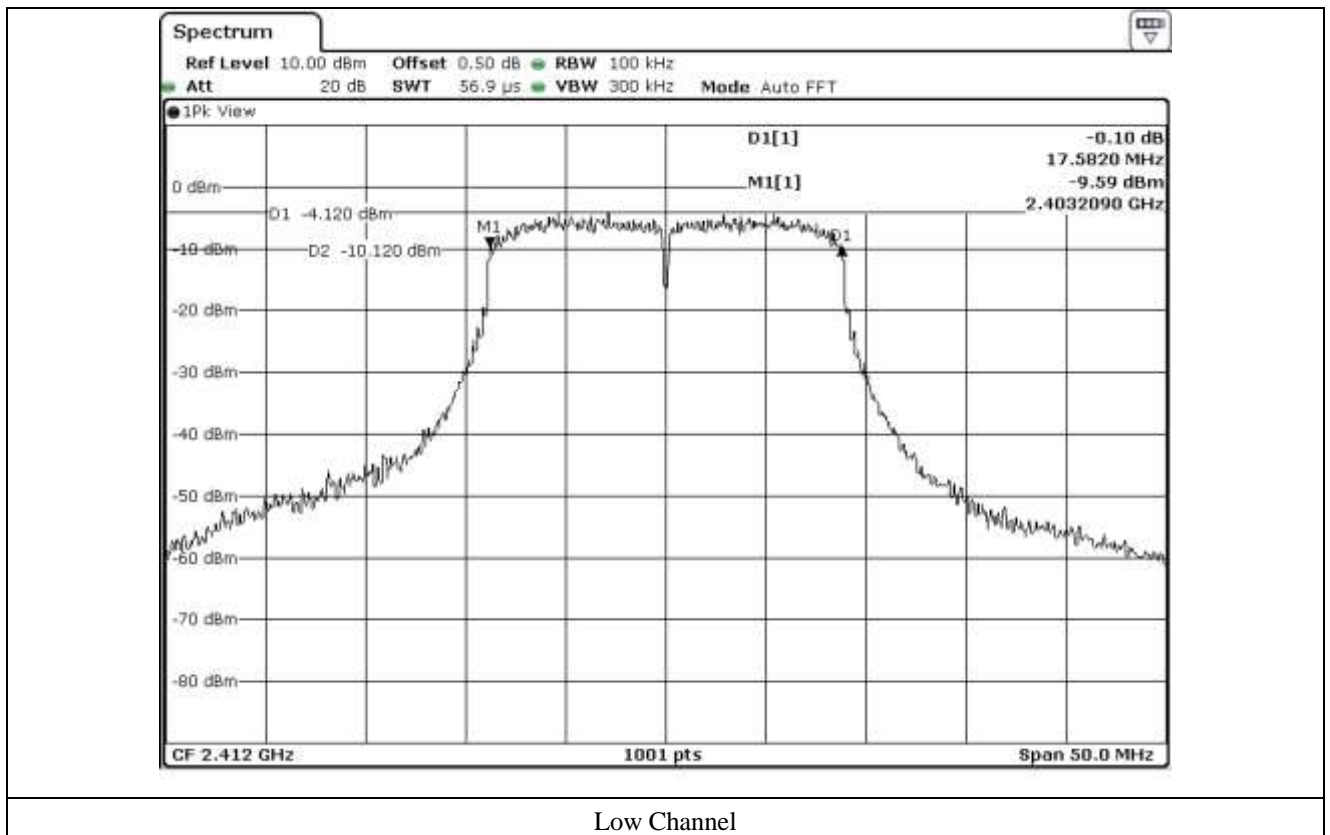
-. Test Result : Pass

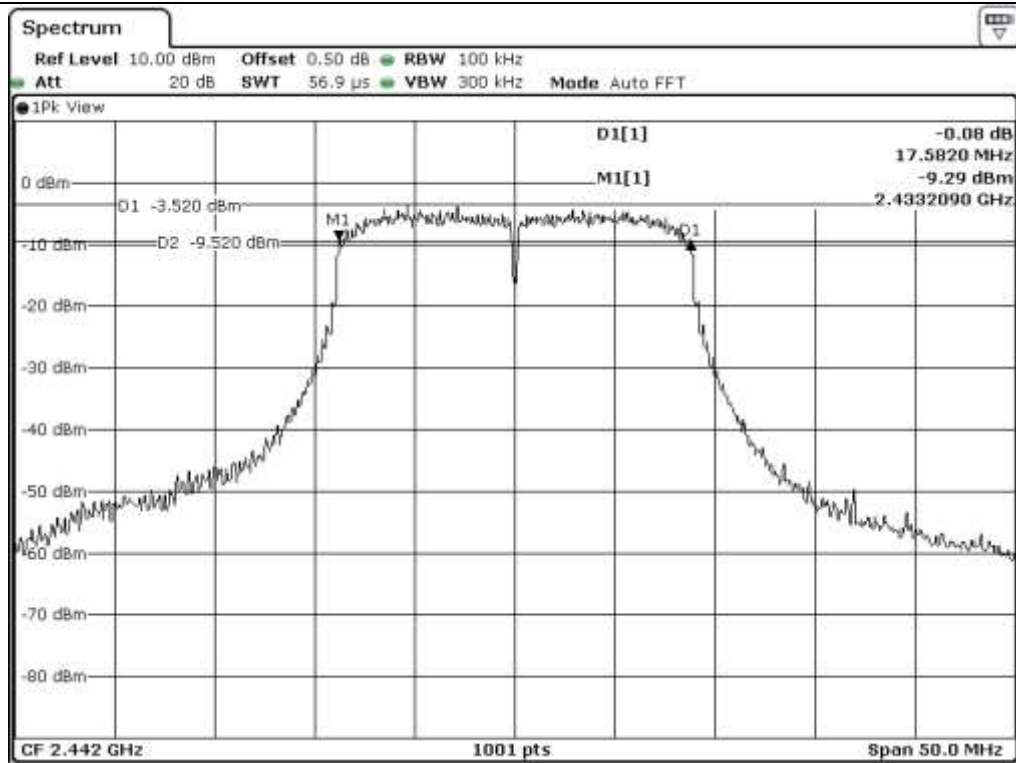
| CHANNEL | FREQUENCY (MHz) | 6 dB Bandwidth (MHz) | LIMIT (MHz) | Margin (MHz) |
|---------|--------------------|-------------------------|----------------|-----------------|
| Low | 2 412.00 | 17.58 | 0.50 | 17.08 |
| Middle | 2 442.00 | 17.58 | 0.50 | 17.08 |
| High | 2 462.00 | 17.53 | 0.50 | 17.03 |

Remark. Margin = Measured Value - Limit

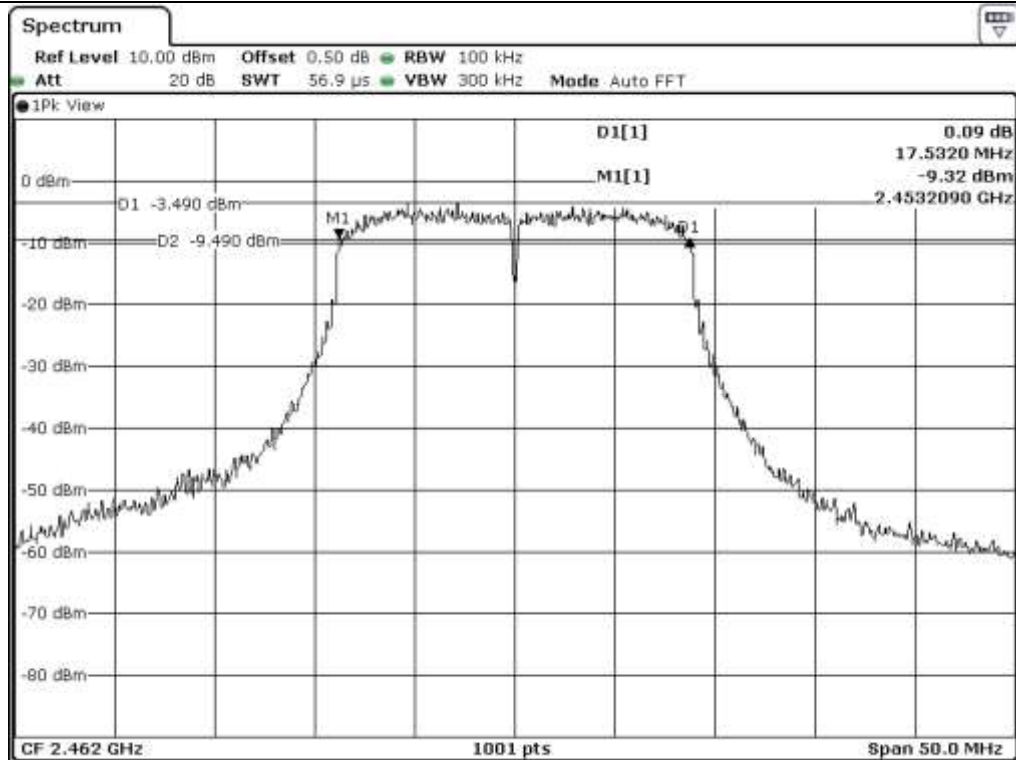


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

7.7 Test data for 802.11n_HT40 WLAN Mode

7.7.1 Test data for Antenna 0

-. Test Date : July 17, 2017

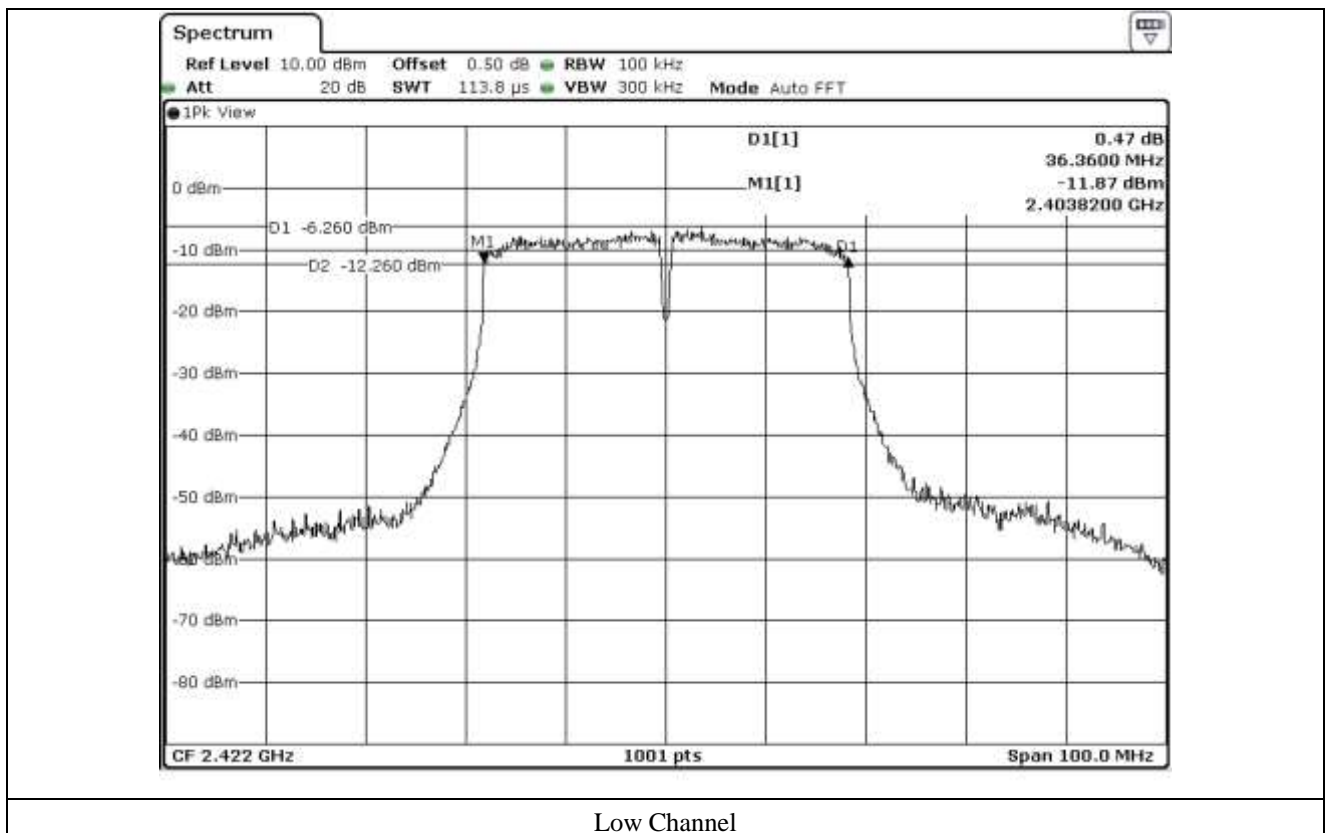
-. Test Result : Pass

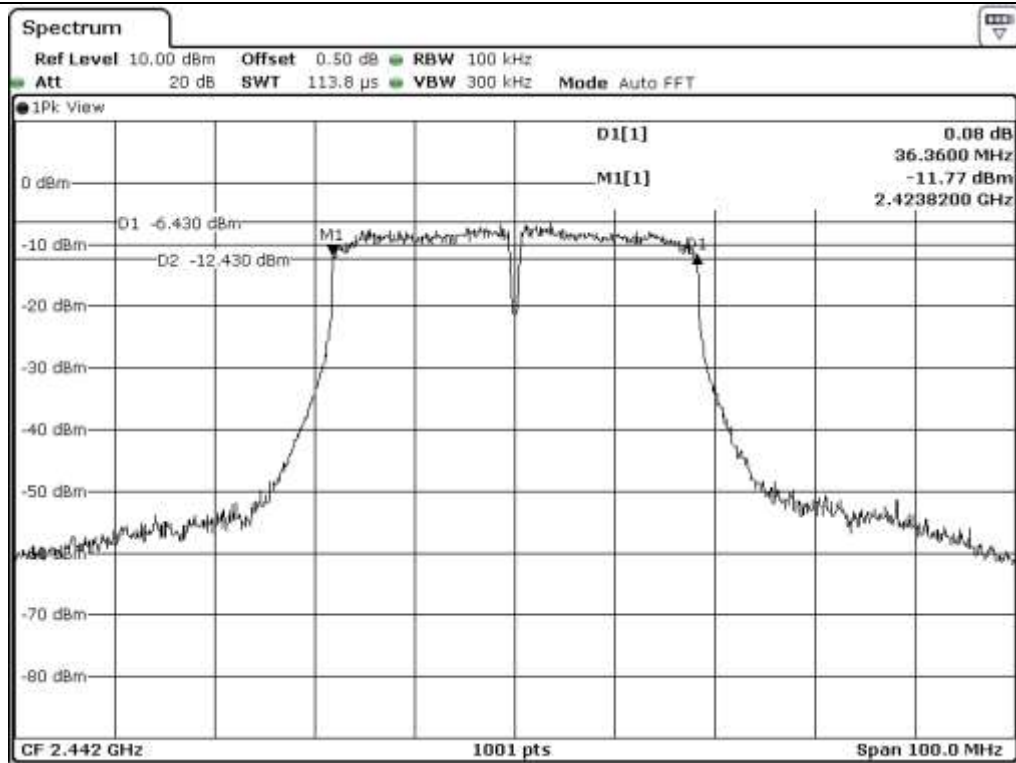
| CHANNEL | FREQUENCY (MHz) | 6 dB Bandwidth (MHz) | LIMIT (MHz) | Margin (MHz) |
|---------|--------------------|-------------------------|----------------|-----------------|
| Low | 2 422.00 | 36.36 | 0.50 | 35.86 |
| Middle | 2 442.00 | 36.36 | 0.50 | 35.86 |
| High | 2 452.00 | 36.36 | 0.50 | 35.86 |

Remark. Margin = Measured Value - Limit

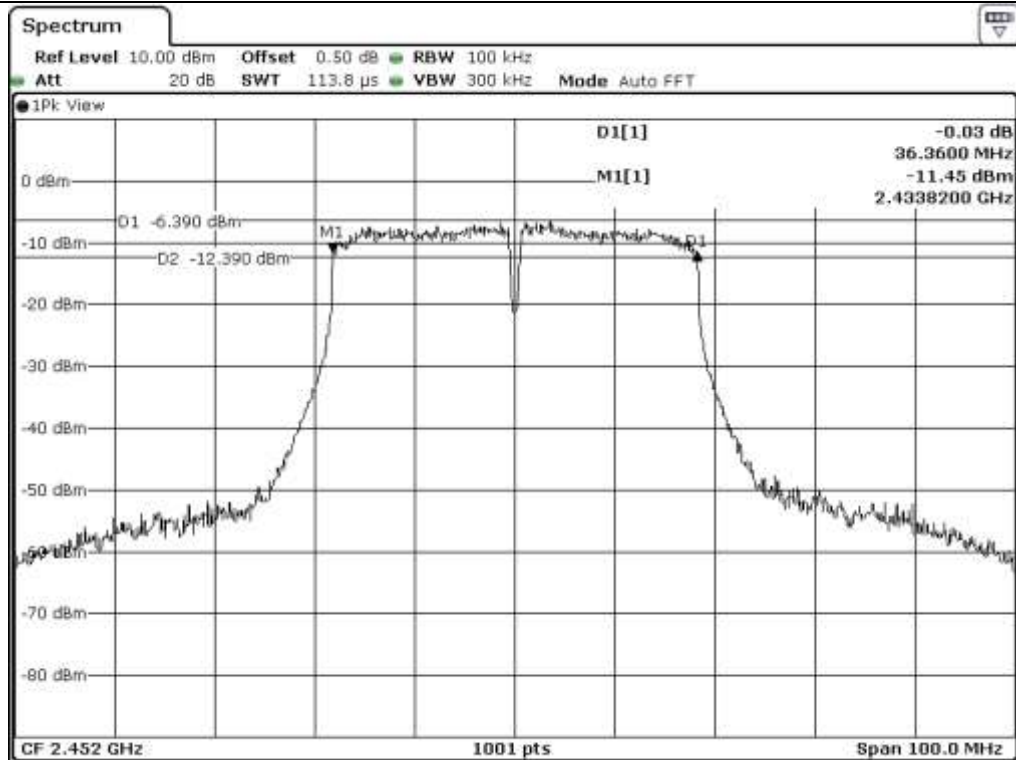


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

7.7.2 Test data for Antenna 1

-. Test Date : July 17, 2017

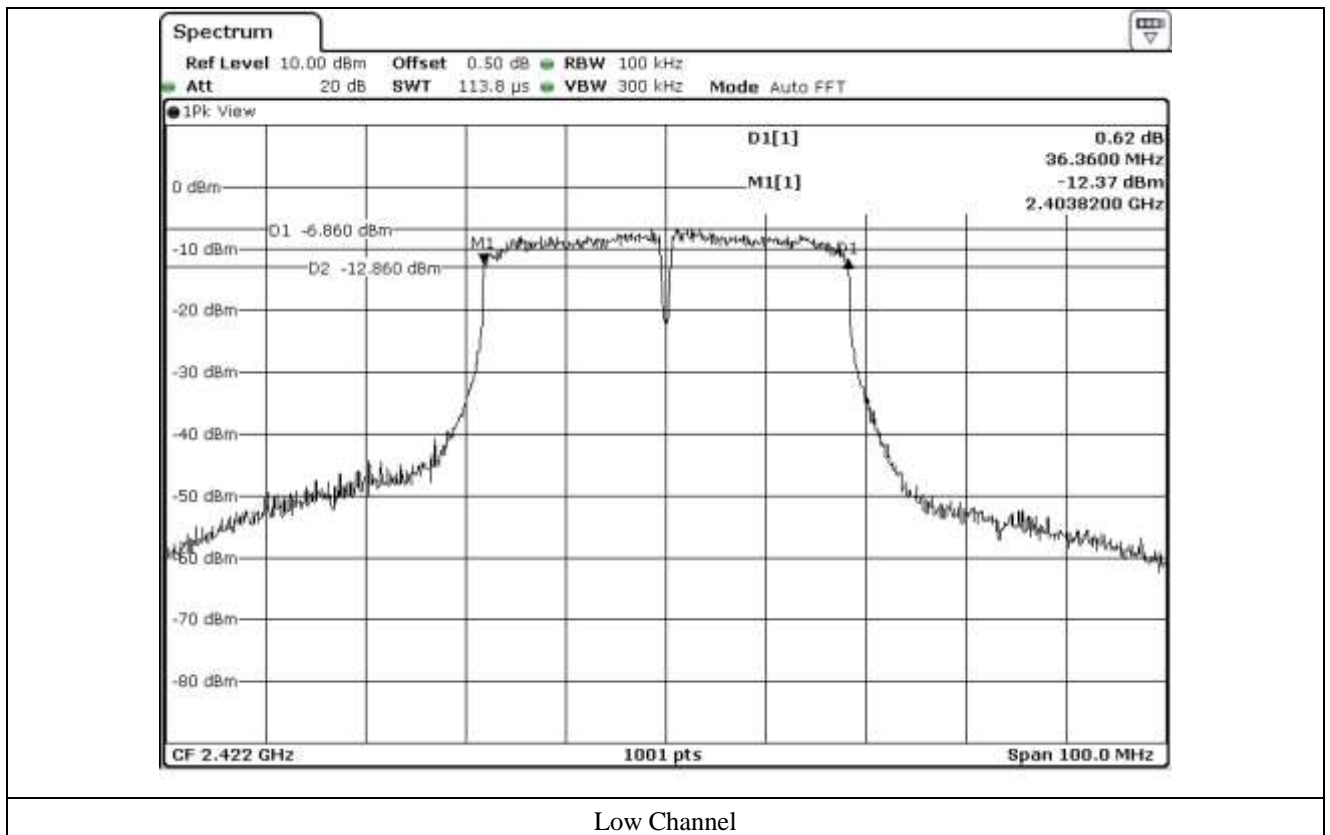
-. Test Result : Pass

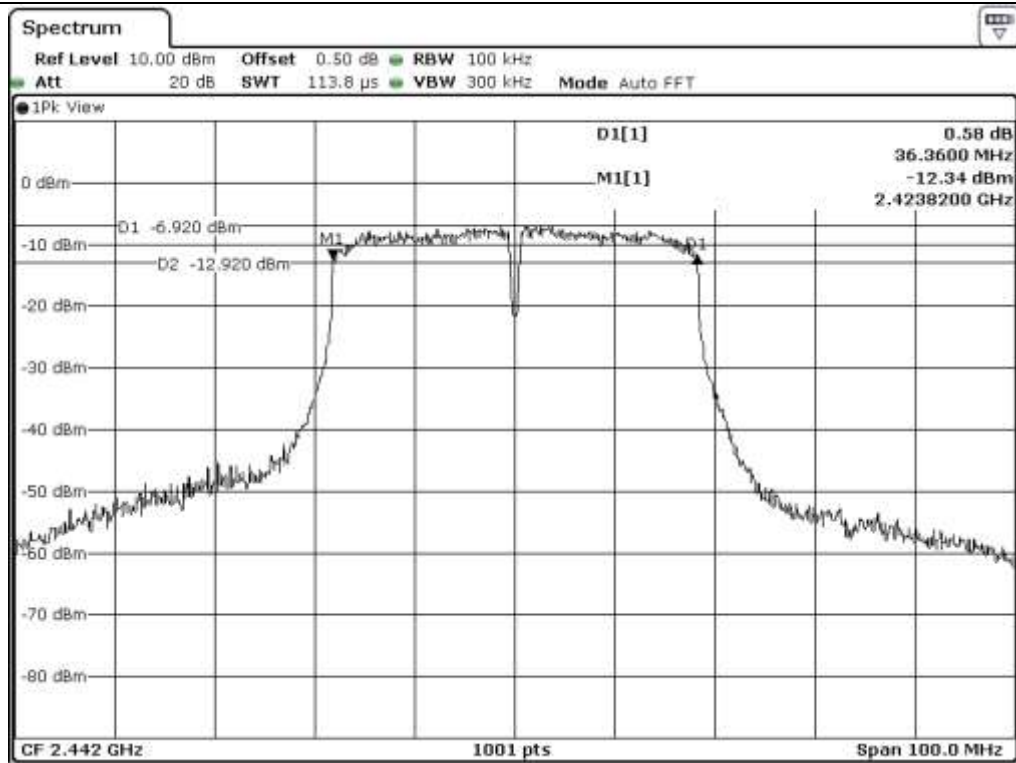
| CHANNEL | FREQUENCY (MHz) | 6 dB Bandwidth (MHz) | LIMIT (MHz) | Margin (MHz) |
|---------|--------------------|-------------------------|----------------|-----------------|
| Low | 2 422.00 | 36.36 | 0.50 | 35.86 |
| Middle | 2 442.00 | 36.36 | 0.50 | 35.86 |
| High | 2 452.00 | 36.36 | 0.50 | 35.86 |

Remark. Margin = Measured Value - Limit

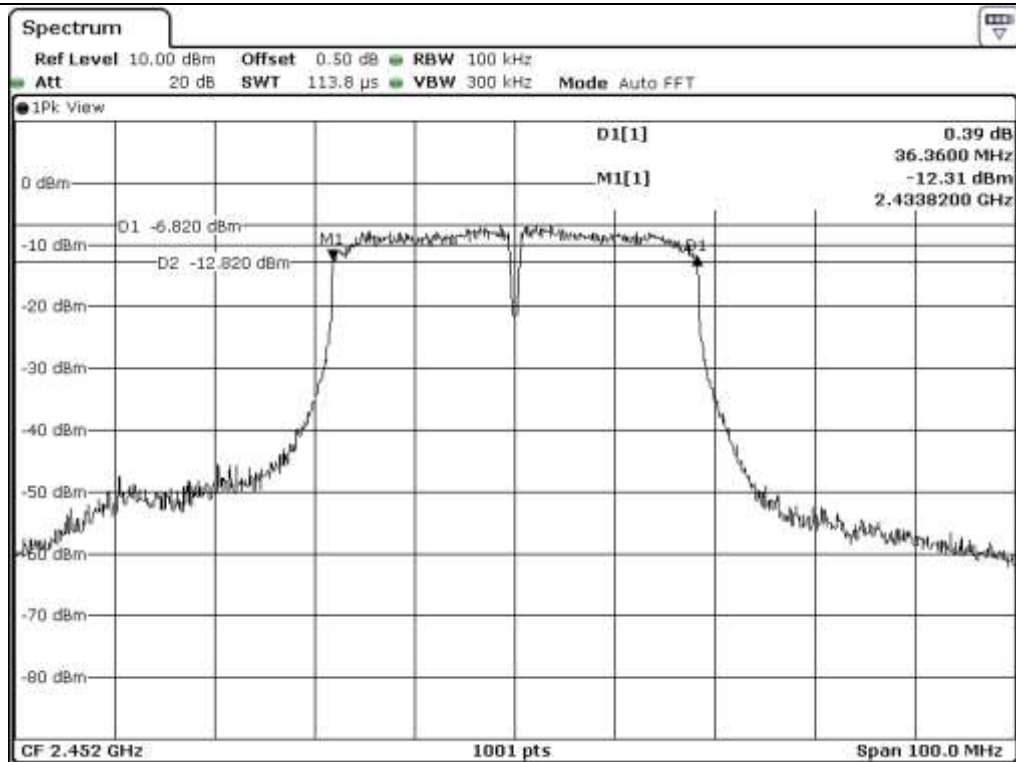


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

8. MAXIMUM PEAK OUTPUT POWER

8.1 Operating environment

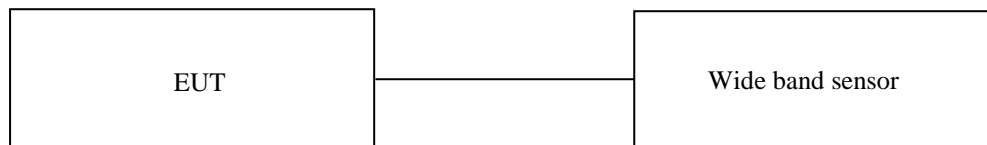
Temperature : 23 °C
Relative humidity : 41 % R.H.

8.2 Test set-up

The maximum peak output power was measured with the wide band sensor connected to the antenna output of the EUT.

The Wide Band Sensor is measured when the EUT is transmitting at the appropriate center frequency its maximum power control level as described in Section 9.2.3(KDB 558074 D01 DTS Meas Guidance V04).

Since this measurement is made only during the ON time of the transmitter, no duty cycle correction is required.



8.3 Test equipment used

| Model Number | Manufacturer | Description | Serial Number | Last Cal. |
|--------------|-----------------|------------------|---------------|---------------------|
| ■ - NRP-Z81 | Rohde & Schwarz | Wide band Sensor | 101975 | April 04, 2017 (1Y) |

All test equipment used is calibrated on a regular basis.

8.4 Test data for 802.11b WLAN Mode

8.4.1 Test data for Antenna 0

-. Test Date : July 17, 2017

-. Test Result : Pass

-. Duty Cycle : > 98 %

| CHANNEL | FREQUENCY (MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|--------------------|-------------------------|----------------|----------------|
| LOW | 2 412.00 | 13.19 | 30.00 | 16.81 |
| MIDDLE | 2 442.00 | 12.85 | 30.00 | 17.15 |
| HIGH | 2 462.00 | 12.86 | 30.00 | 17.14 |

Remark : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)

8.4.2 Test data for Antenna 1

-. Test Date : July 17, 2017

-. Test Result : Pass

-. Duty Cycle : > 98 %

| CHANNEL | FREQUENCY (MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|--------------------|-------------------------|----------------|----------------|
| LOW | 2 412.00 | 14.32 | 30.00 | 15.68 |
| MIDDLE | 2 442.00 | 13.85 | 30.00 | 16.15 |
| HIGH | 2 462.00 | 13.78 | 30.00 | 16.22 |

Remark : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)



Tested by: Hyung-Kwon, Oh / Assistant Manager

8.4.3 Test data for Multiple Antenna

-. Test Date : July 17, 2017

-. Test Result : Pass

-. Duty Cycle : > 98 %

| CHANNEL | FREQUENCY (MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|--------------------|-------------------------|----------------|----------------|
| LOW | 2 412.00 | 16.80 | 30.00 | 13.20 |
| MIDDLE | 2 442.00 | 16.39 | 30.00 | 13.61 |
| HIGH | 2 462.00 | 16.35 | 30.00 | 13.65 |

Remark 1 : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)

Remark 2 : Calculated Output Power= $10\log (10^{(\text{Antenna0 Output Power}/10)} + 10^{(\text{Antenna1 Output Power}/10)})$



Tested by: Hyung-Kwon, Oh / Assistant Manager

8.5 Test data for 802.11g WLAN Mode

8.5.1 Test data for Antenna 0

-. Test Date : July 17, 2017

-. Test Result : Pass

-. Duty Cycle : > 98 %

| CHANNEL | FREQUENCY (MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|--------------------|-------------------------|----------------|----------------|
| LOW | 2 412.00 | 12.24 | 30.00 | 17.76 |
| MIDDLE | 2 442.00 | 12.20 | 30.00 | 17.80 |
| HIGH | 2 462.00 | 12.53 | 30.00 | 17.47 |

Remark : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)

8.5.2 Test data for Antenna 1

-. Test Date : July 17, 2017

-. Test Result : Pass

-. Duty Cycle : > 98 %

| CHANNEL | FREQUENCY (MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|--------------------|-------------------------|----------------|----------------|
| LOW | 2 412.00 | 12.84 | 30.00 | 17.16 |
| MIDDLE | 2 442.00 | 12.68 | 30.00 | 17.32 |
| HIGH | 2 462.00 | 12.59 | 30.00 | 17.41 |

Remark : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)



Tested by: Hyung-Kwon, Oh / Assistant Manager

8.5.3 Test data for Multiple Antenna

-. Test Date : July 17, 2017

-. Test Result : Pass

-. Duty Cycle : > 98 %

| CHANNEL | FREQUENCY (MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|--------------------|-------------------------|----------------|----------------|
| LOW | 2 412.00 | 15.56 | 30.00 | 14.44 |
| MIDDLE | 2 442.00 | 15.46 | 30.00 | 14.54 |
| HIGH | 2 462.00 | 15.57 | 30.00 | 14.43 |

Remark 1 : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)

Remark 2 : Calculated Output Power= $10\log (10^{(\text{Antenna0 Output Power}/10)} + 10^{(\text{Antenna1 Output Power}/10)})$



Tested by: Hyung-Kwon, Oh / Assistant Manager

8.6 Test data for 802.11n_HT20 WLAN Mode

8.6.1 Test data for Antenna 0

-. Test Date : July 17, 2017

-. Test Result : Pass

-. Duty Cycle : > 98 %

| CHANNEL | FREQUENCY (MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|--------------------|-------------------------|----------------|----------------|
| LOW | 2 412.00 | 11.20 | 30.00 | 18.80 |
| MIDDLE | 2 442.00 | 11.00 | 30.00 | 19.00 |
| HIGH | 2 462.00 | 11.12 | 30.00 | 18.88 |

Remark : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)

8.6.2 Test data for Antenna 1

-. Test Date : July 17, 2017

-. Test Result : Pass

-. Duty Cycle : > 98 %

| CHANNEL | FREQUENCY (MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|--------------------|-------------------------|----------------|----------------|
| LOW | 2 412.00 | 10.73 | 30.00 | 19.27 |
| MIDDLE | 2 442.00 | 10.82 | 30.00 | 19.18 |
| HIGH | 2 462.00 | 10.83 | 30.00 | 19.17 |

Remark : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)



Tested by: Hyung-Kwon, Oh / Assistant Manager

8.6.3 Test data for Multiple Antenna

-. Test Date : July 17, 2017

-. Test Result : Pass

-. Duty Cycle : > 98 %

| CHANNEL | FREQUENCY (MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|--------------------|-------------------------|----------------|----------------|
| LOW | 2 412.00 | 13.98 | 30.00 | 16.02 |
| MIDDLE | 2 442.00 | 13.92 | 30.00 | 16.08 |
| HIGH | 2 462.00 | 13.99 | 30.00 | 16.01 |

Remark 1 : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)

Remark 2 : Calculated Output Power= $10\log (10^{(\text{Antenna0 Output Power}/10)} + 10^{(\text{Antenna1 Output Power}/10)})$



Tested by: Hyung-Kwon, Oh / Assistant Manager

8.7 Test data for 802.11n_HT40 WLAN Mode

8.7.1 Test data for Antenna 0

-. Test Date : July 17, 2017

-. Test Result : Pass

-. Duty Cycle : > 98 %

| CHANNEL | FREQUENCY (MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|--------------------|-------------------------|----------------|----------------|
| LOW | 2 422.00 | 10.78 | 30.00 | 19.22 |
| MIDDLE | 2 442.00 | 10.72 | 30.00 | 19.28 |
| HIGH | 2 452.00 | 11.16 | 30.00 | 18.84 |

Remark : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)

8.7.2 Test data for Antenna 1

-. Test Date : July 17, 2017

-. Test Result : Pass

-. Duty Cycle : > 98 %

| CHANNEL | FREQUENCY (MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|--------------------|-------------------------|----------------|----------------|
| LOW | 2 422.00 | 10.68 | 30.00 | 19.32 |
| MIDDLE | 2 442.00 | 10.75 | 30.00 | 19.25 |
| HIGH | 2 452.00 | 10.77 | 30.00 | 19.23 |

Remark : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)



Tested by: Hyung-Kwon, Oh / Assistant Manager

8.7.3 Test data for Multiple Antenna

-. Test Date : July 17, 2017

-. Test Result : Pass

-. Duty Cycle : > 98 %

| CHANNEL | FREQUENCY (MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|--------------------|-------------------------|----------------|----------------|
| LOW | 2 422.00 | 13.74 | 30.00 | 16.26 |
| MIDDLE | 2 442.00 | 13.75 | 30.00 | 16.25 |
| HIGH | 2 452.00 | 13.98 | 30.00 | 16.02 |

Remark 1 : Margin = Limit – Measured Value (=Power Sensor Reading - Cable Loss)

Remark 2 : Calculated Output Power= $10\log (10^{(\text{Antenna0 Output Power}/10)} + 10^{(\text{Antenna1 Output Power}/10)})$



Tested by: Hyung-Kwon, Oh / Assistant Manager

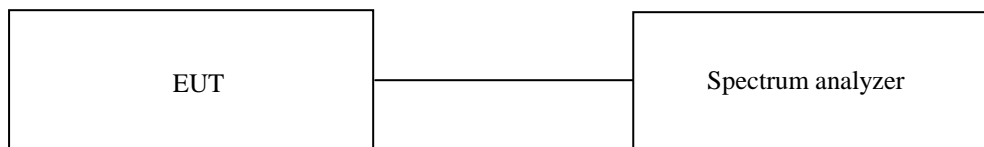
9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

9.1 Operating environment

Temperature : 25 °C
Relative humidity : 44 % 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

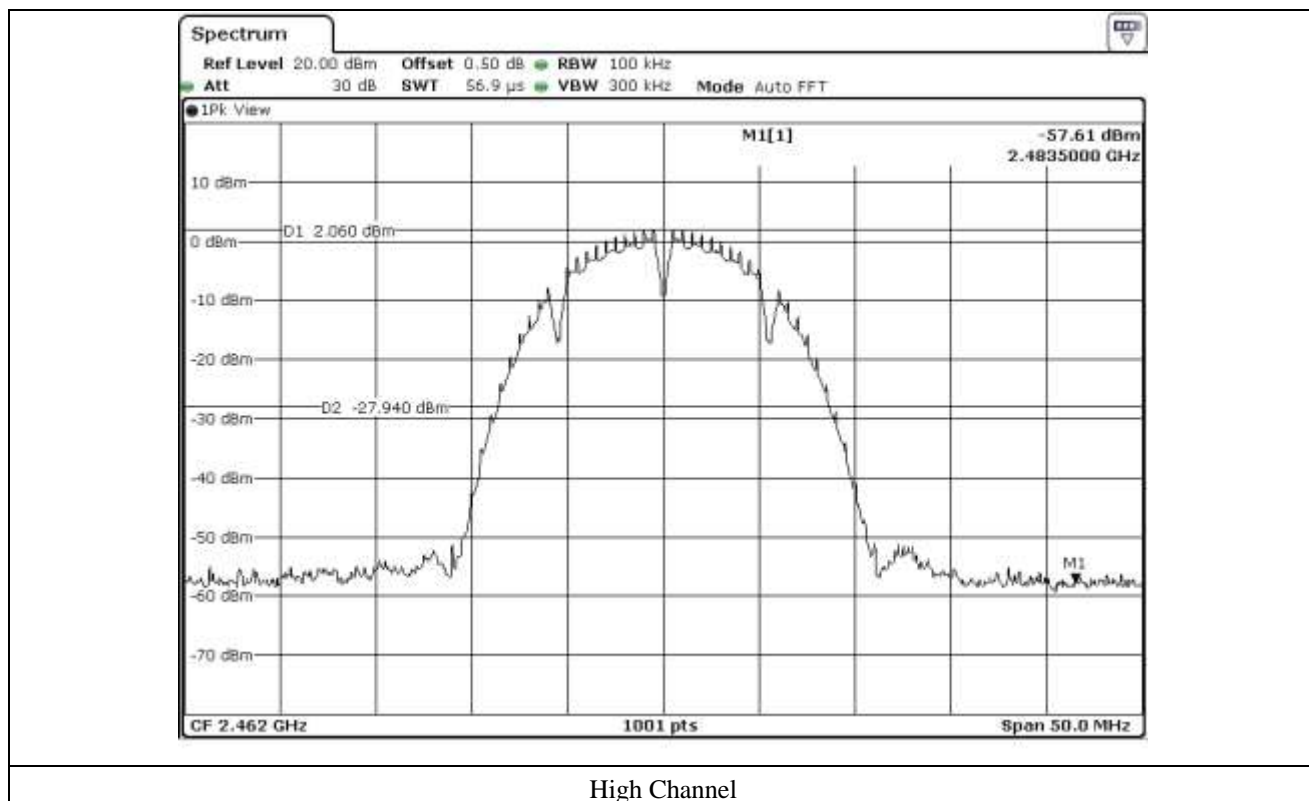
The radiated emissions measurements were performed on the 3 m semi anechoic chamber. The EUT was placed on turntable approximately 1.5 m above the ground plane.

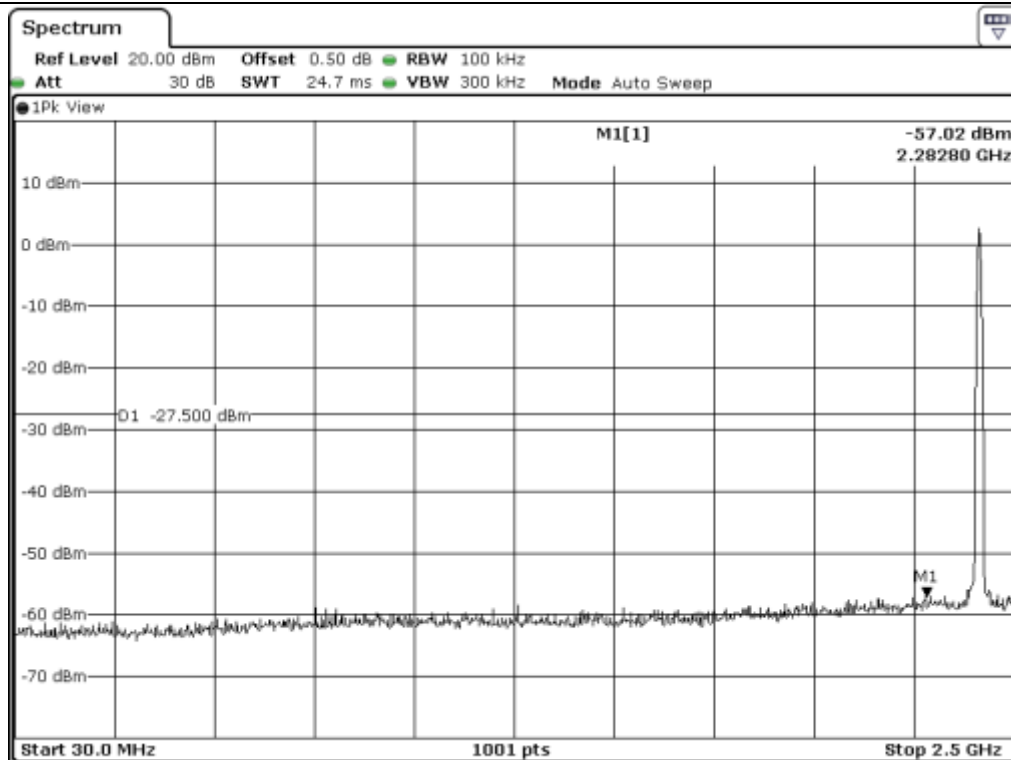
The frequency spectrum from 30 MHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal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

9.4 Test equipment used

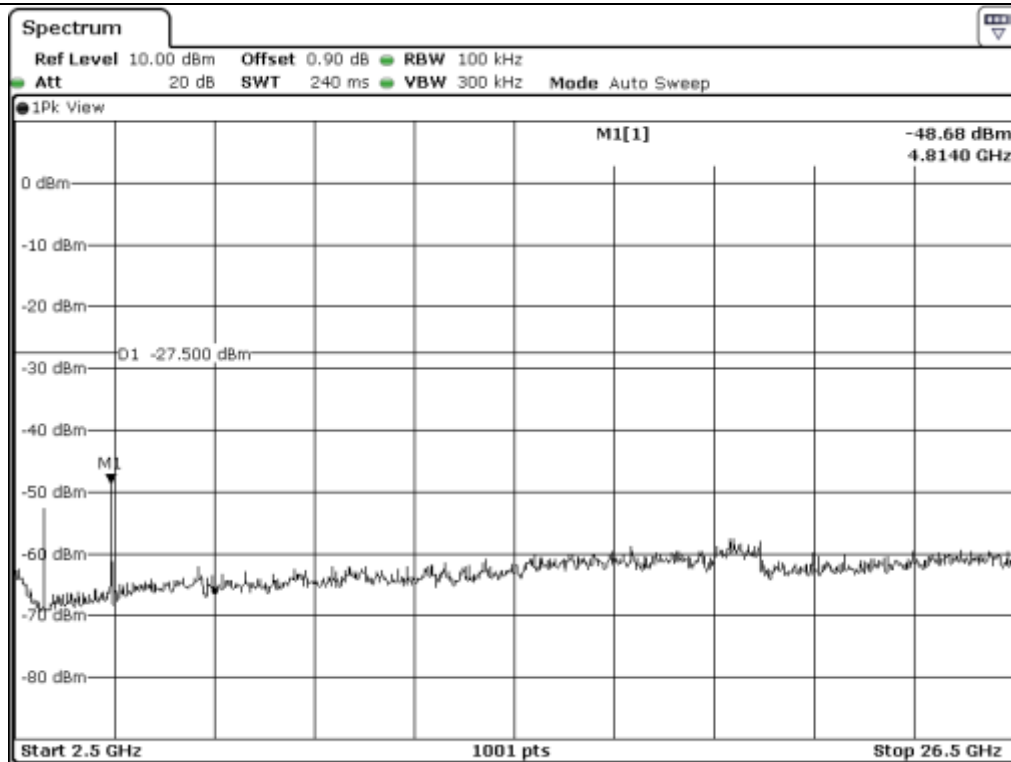
| | Model Number | Manufacturer | Description | Serial Number | Last Cal. |
|-----|--------------|-------------------|--------------------------|---------------|--------------------|
| ■ - | FSV40 | Rohde & Schwarz | Signal Analyzer | 101009 | Apr. 05, 2017 (1Y) |
| ■ - | ESU | Rohde & Schwarz | EMI Test Receiver | 100261 | Apr. 06, 2017 (1Y) |
| ■ - | 310N | Sonoma Instrument | Pre-Amplifier | 312544 | Apr. 05, 2017 (1Y) |
| ■ - | BBV9718 | Schwarzbeck | Amplifier | 310 | Sep. 01, 2016 (1Y) |
| ■ | SCU40A | Rohde & Schwarz | Signal Conditioning unit | 100436 | Apr. 04, 2017 (1Y) |
| ■ - | DT3000-3t | Innco System | Turn Table | DT3000/093 | N/A |
| ■ - | MA-4000XPET | Innco System | Antenna Master | MA4000/509 | N/A |
| ■ - | VULB9163 | Schwarzbeck | TRILOG Broadband Antenna | 9163-421 | Apr. 15, 2016 (2Y) |
| ■ - | BBHA9120D | Schwarzbeck | Horn Antenna | BBHA9120D295 | Aug. 31, 2015 (2Y) |
| ■ - | BBHA9170 | Schwarzbeck | Horn Antenna | BBHA9170178 | Aug. 31, 2015 (2Y) |

All test equipment used is calibrated on a regular basis.

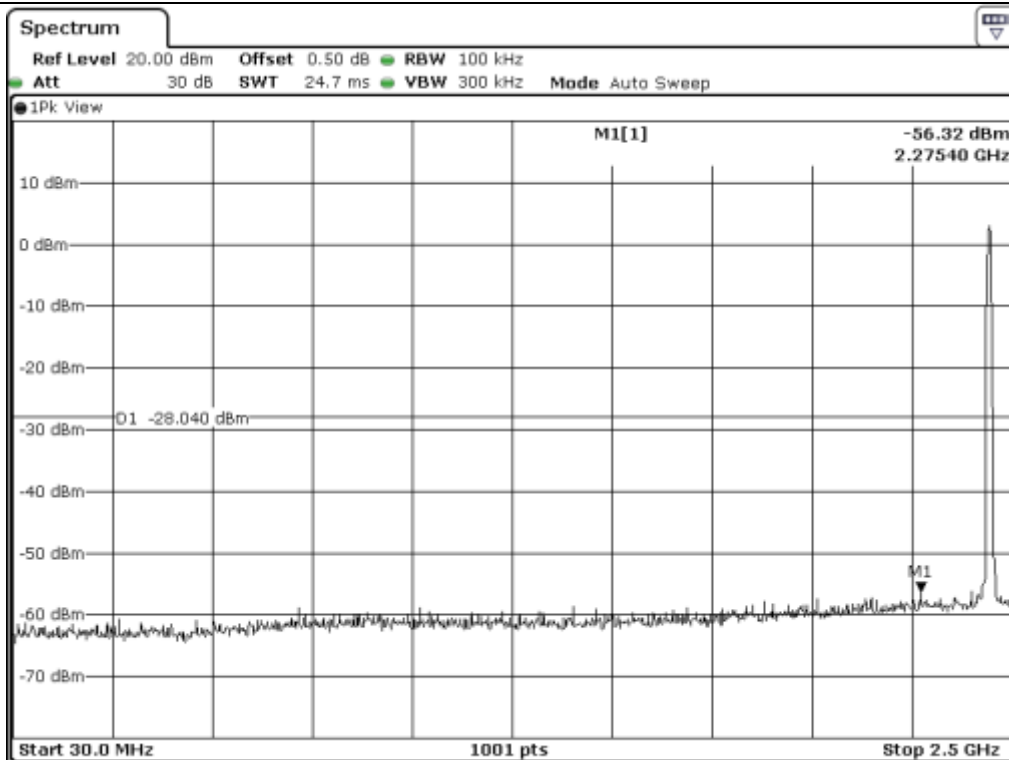




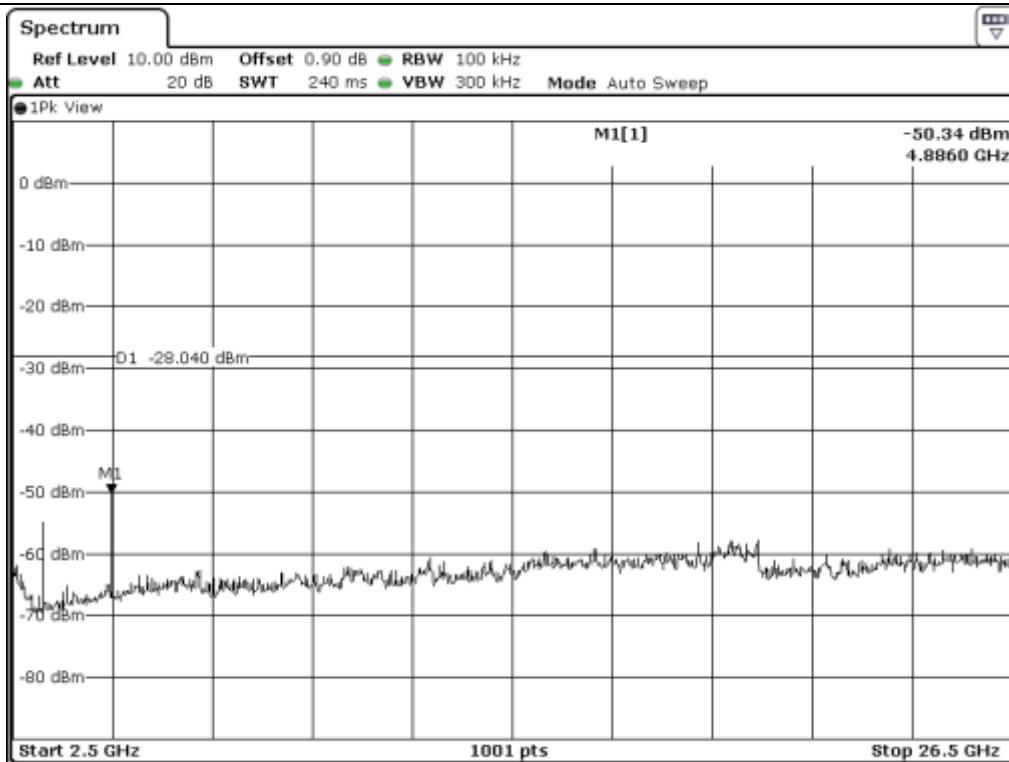
Low Channel



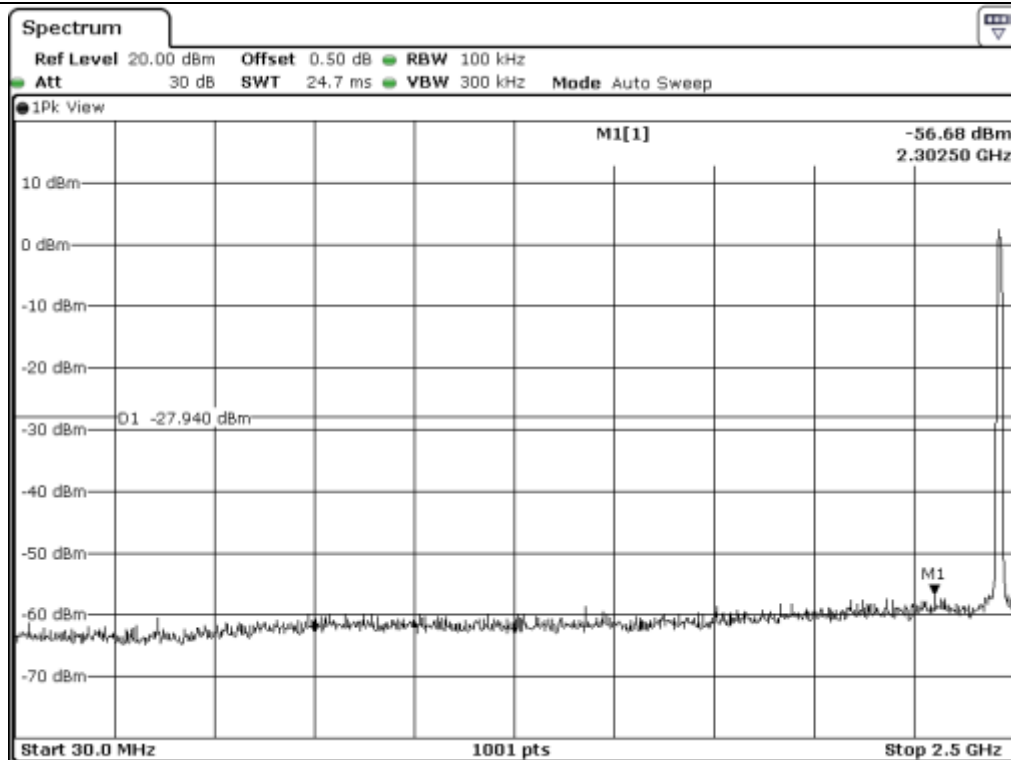
Low Channel



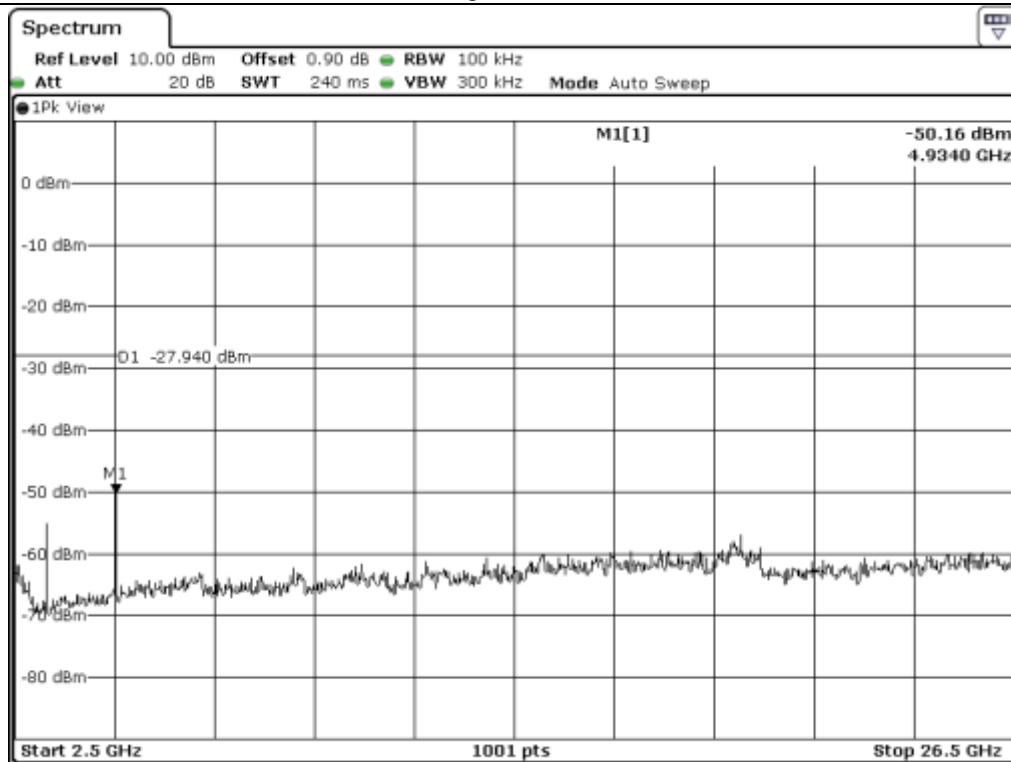
Middle Channel



Middle Channel

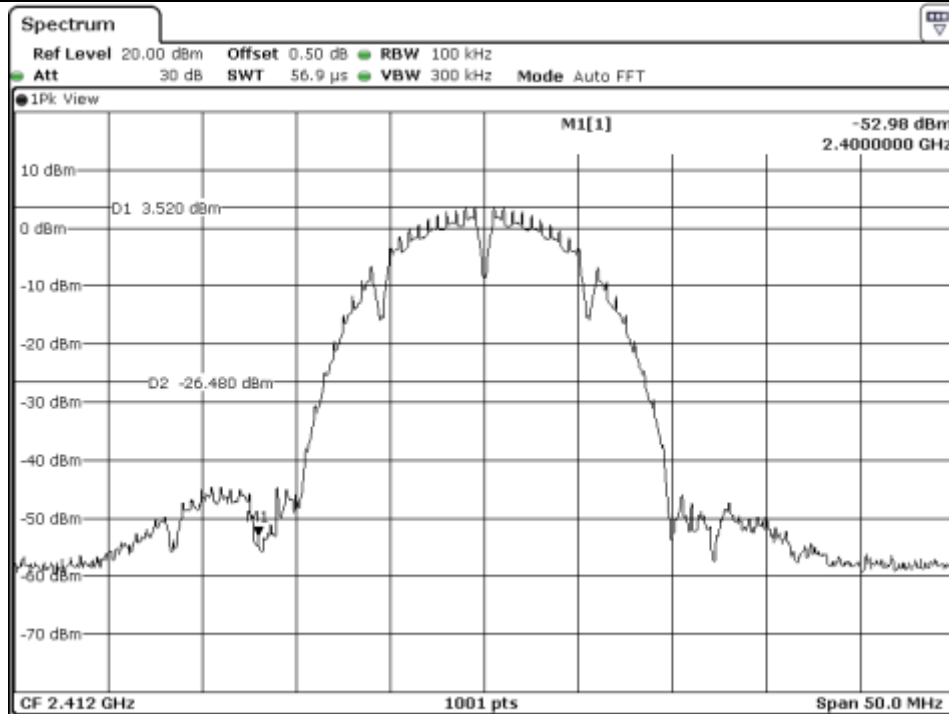


High Channel

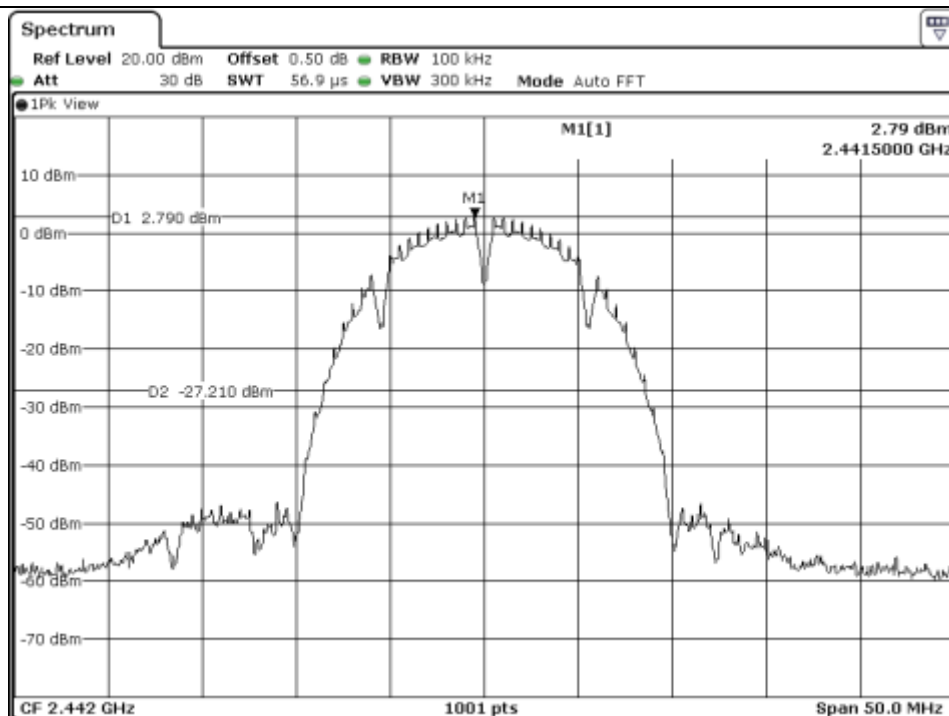


High Channel

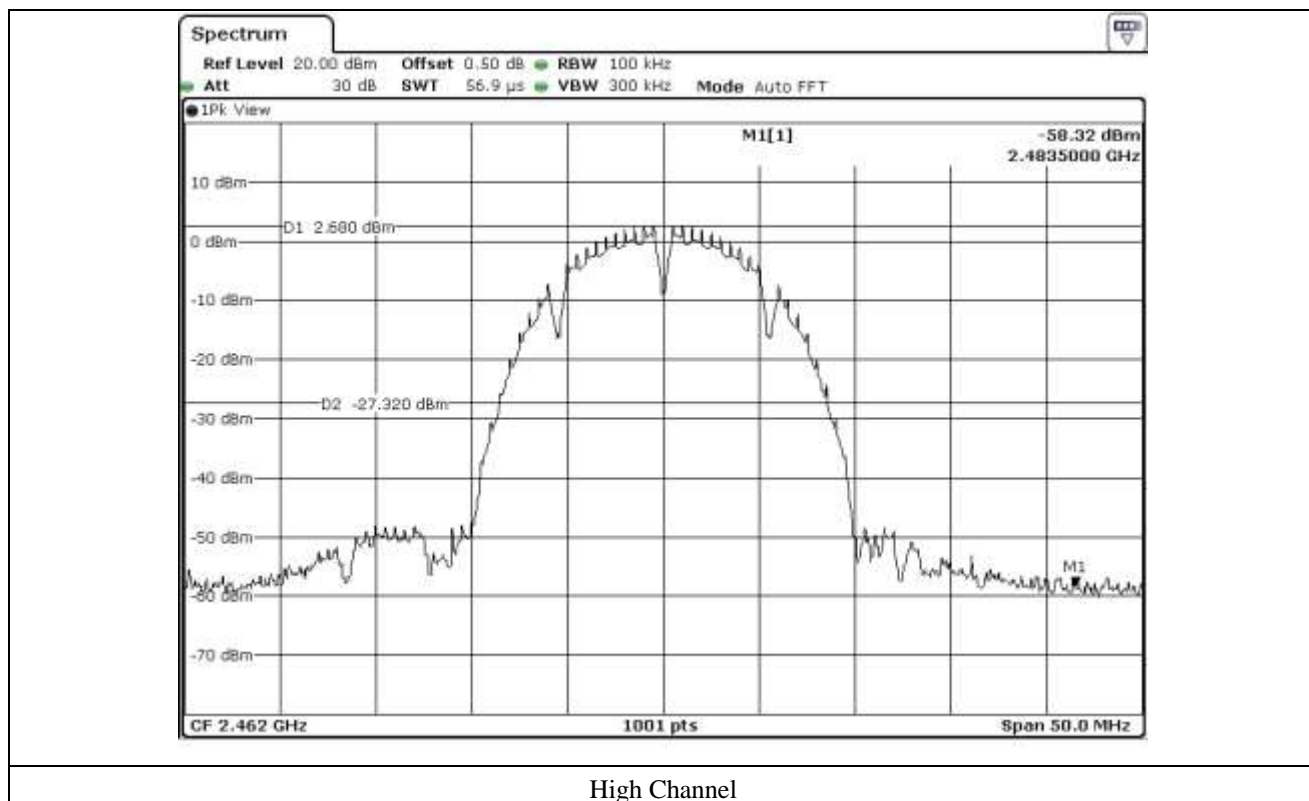
9.5.1.2 Test data for Antenna 1

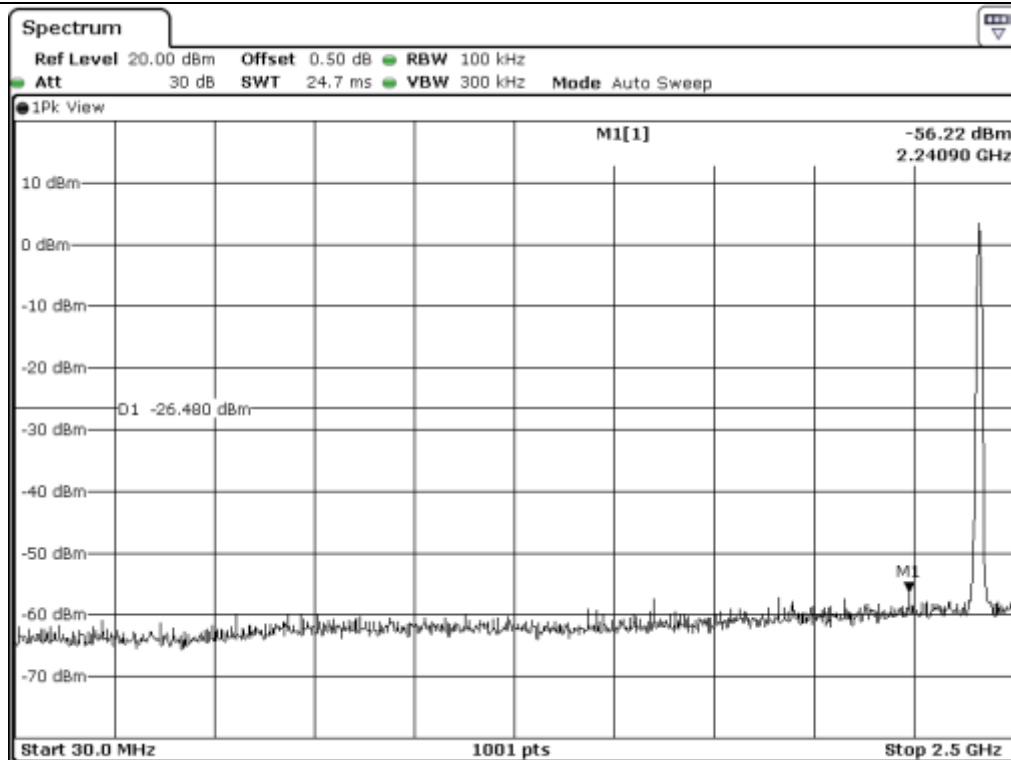


Low Channel

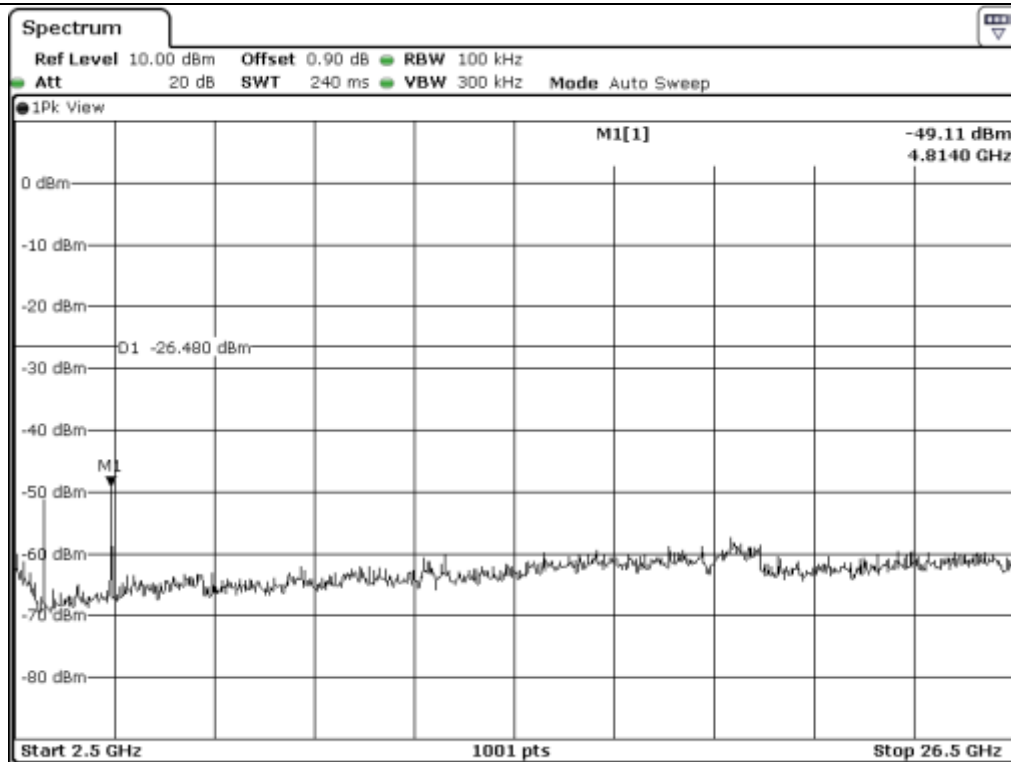


Middle Channel

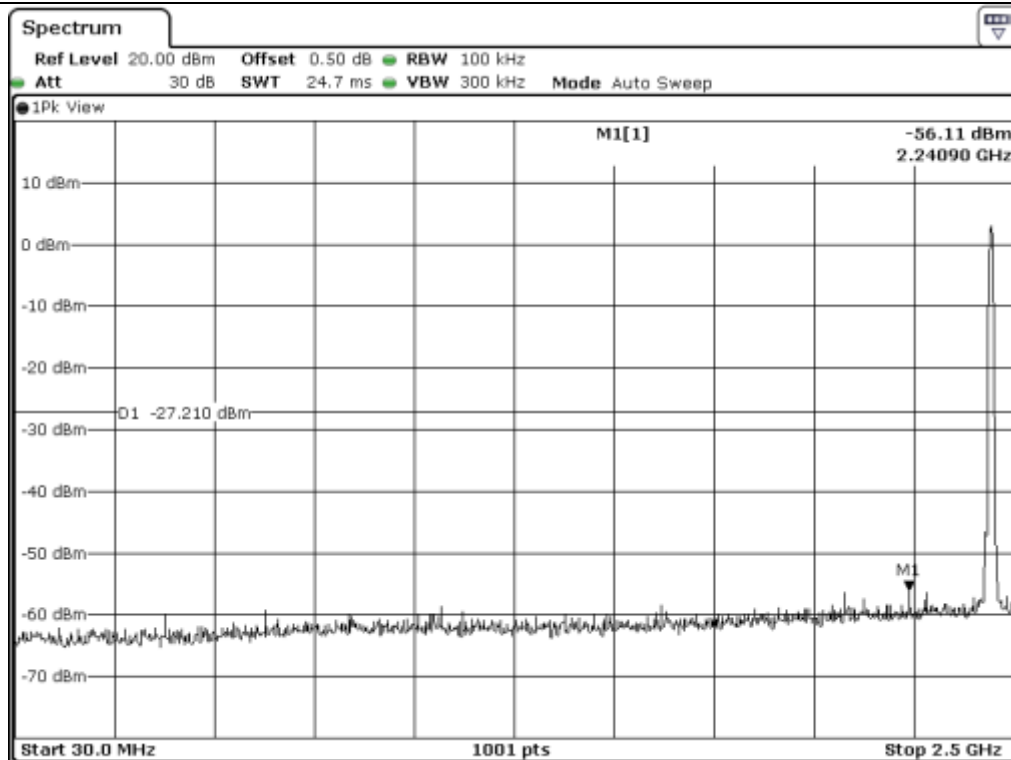




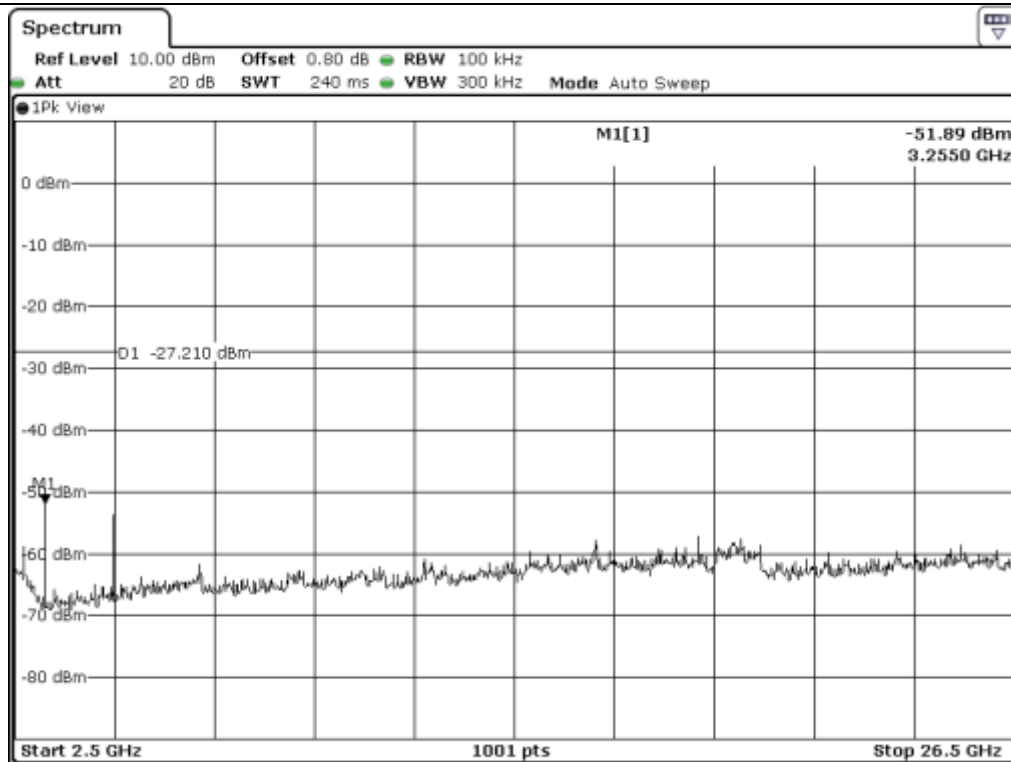
Low Channel



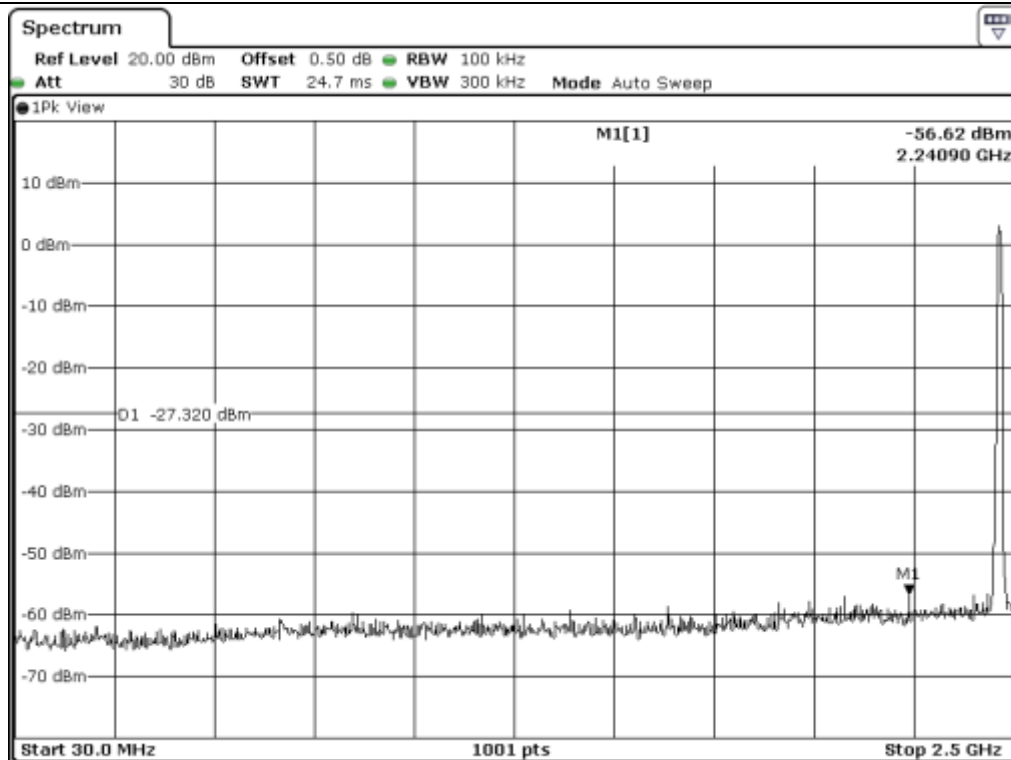
Low Channel



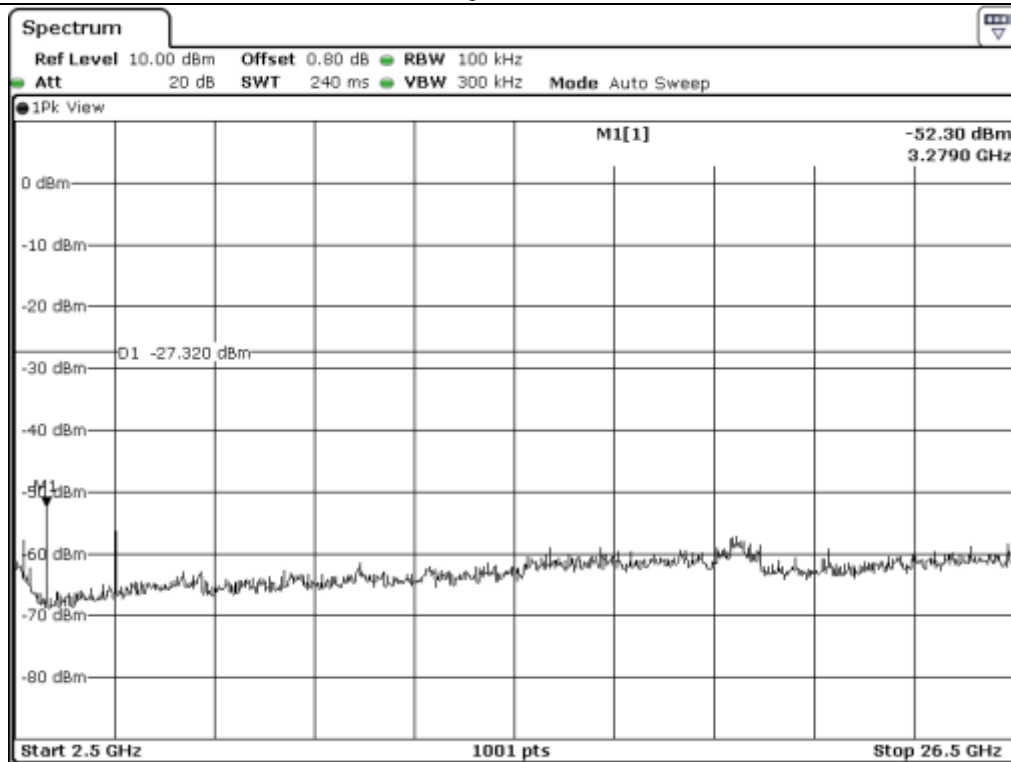
Middle Channel



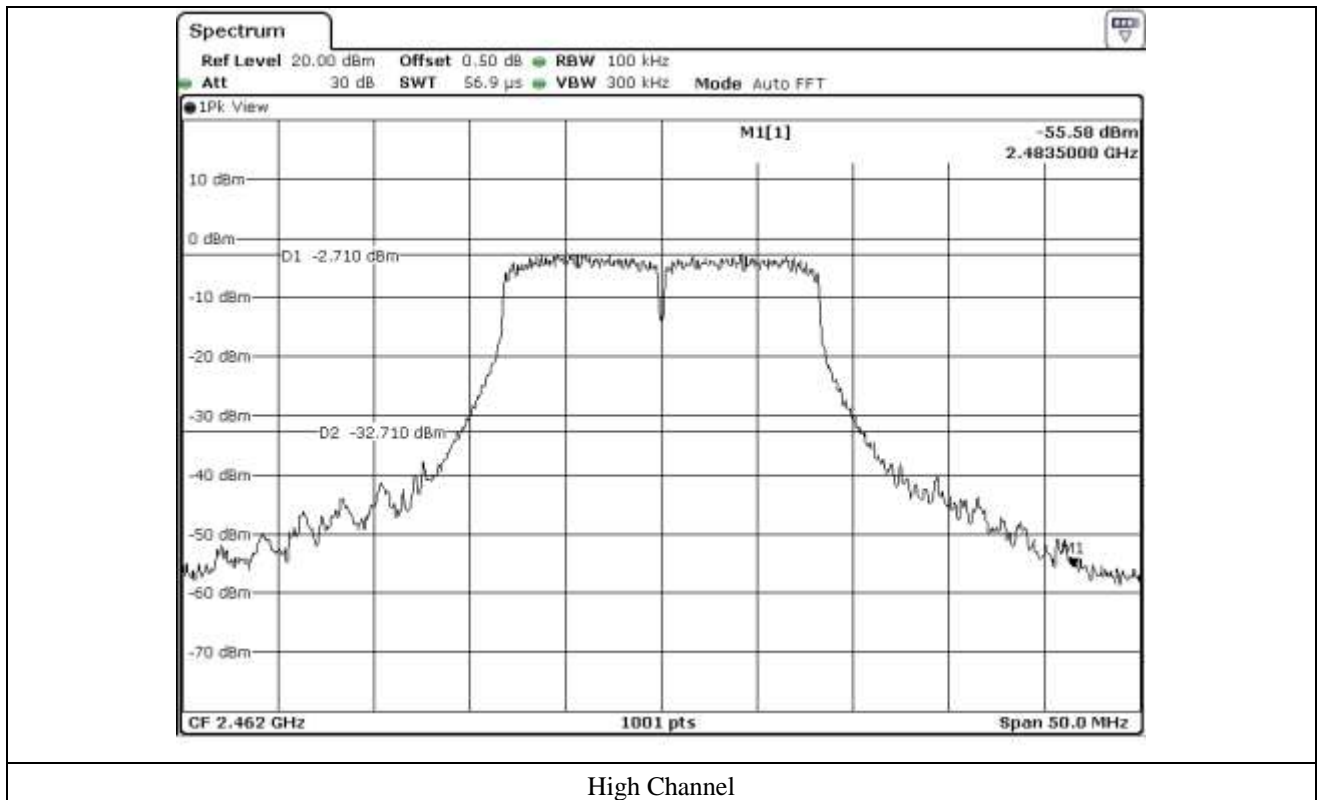
Middle Channel

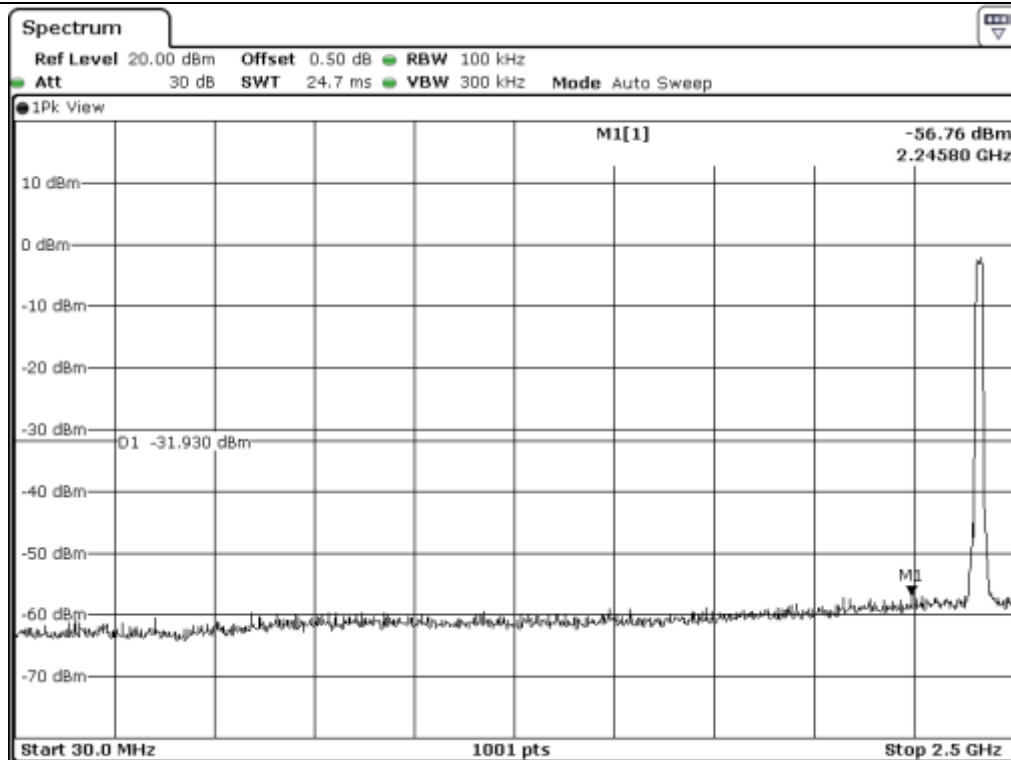


High Channel

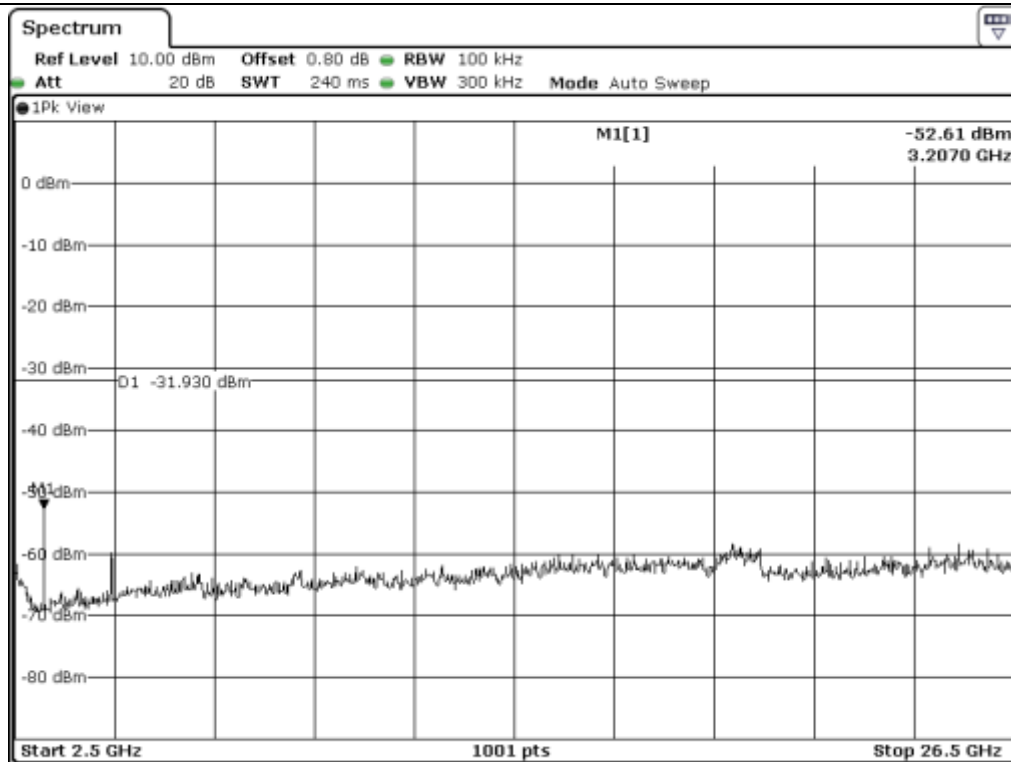


High Channel

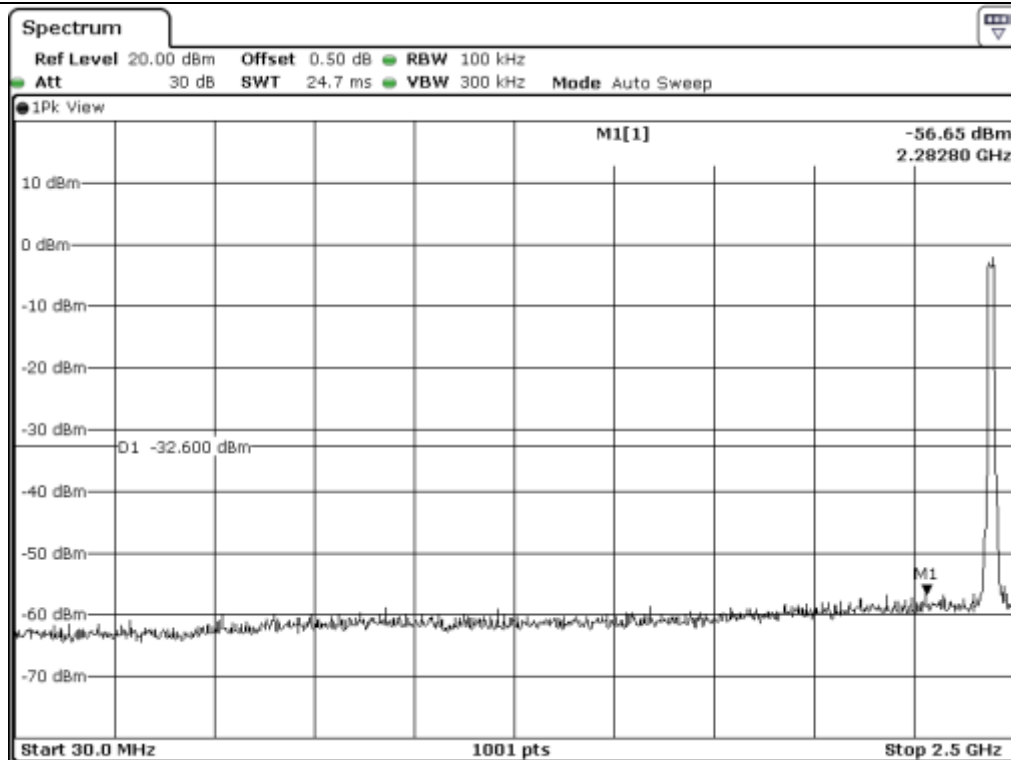




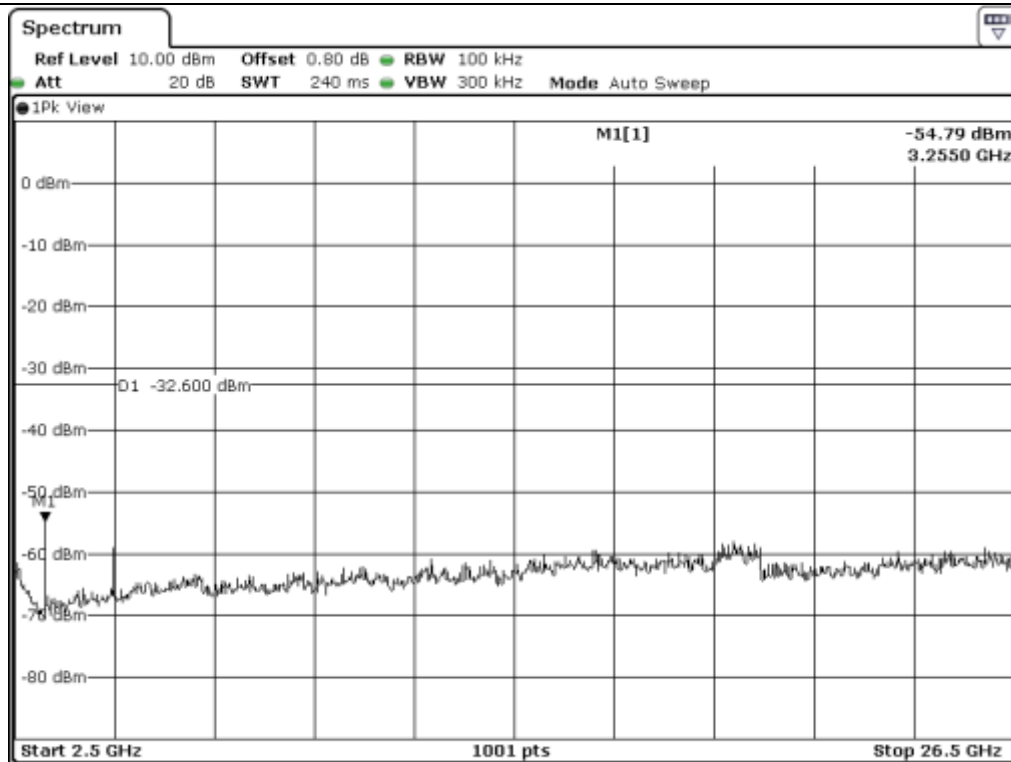
Low Channel



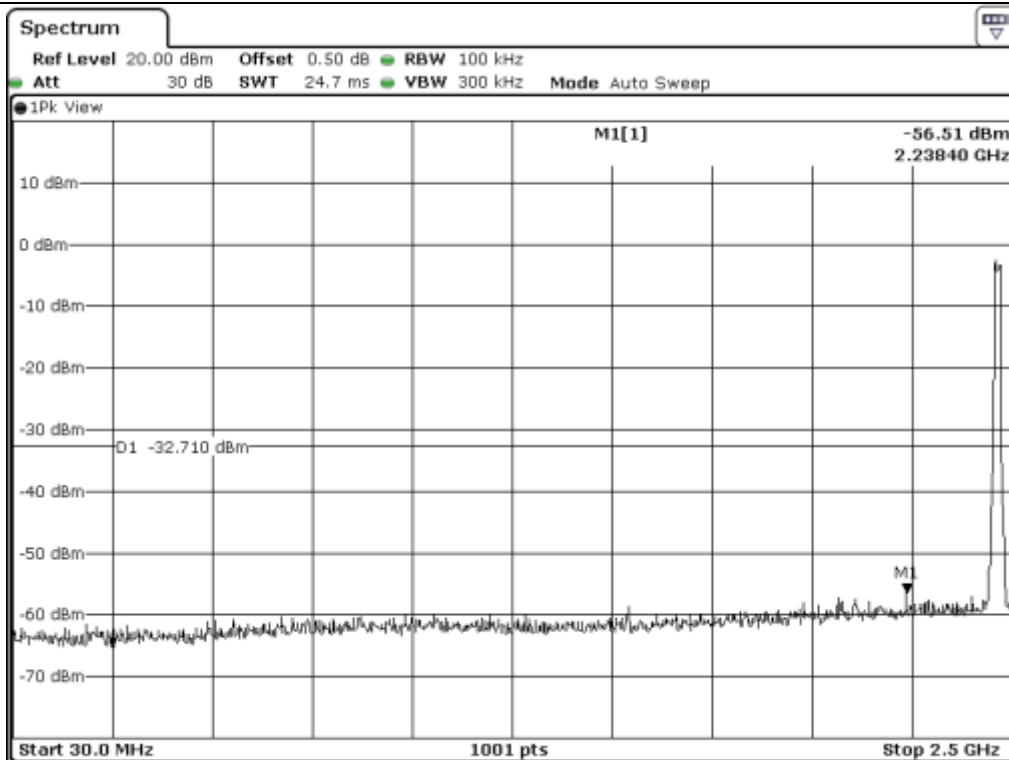
Low Channel



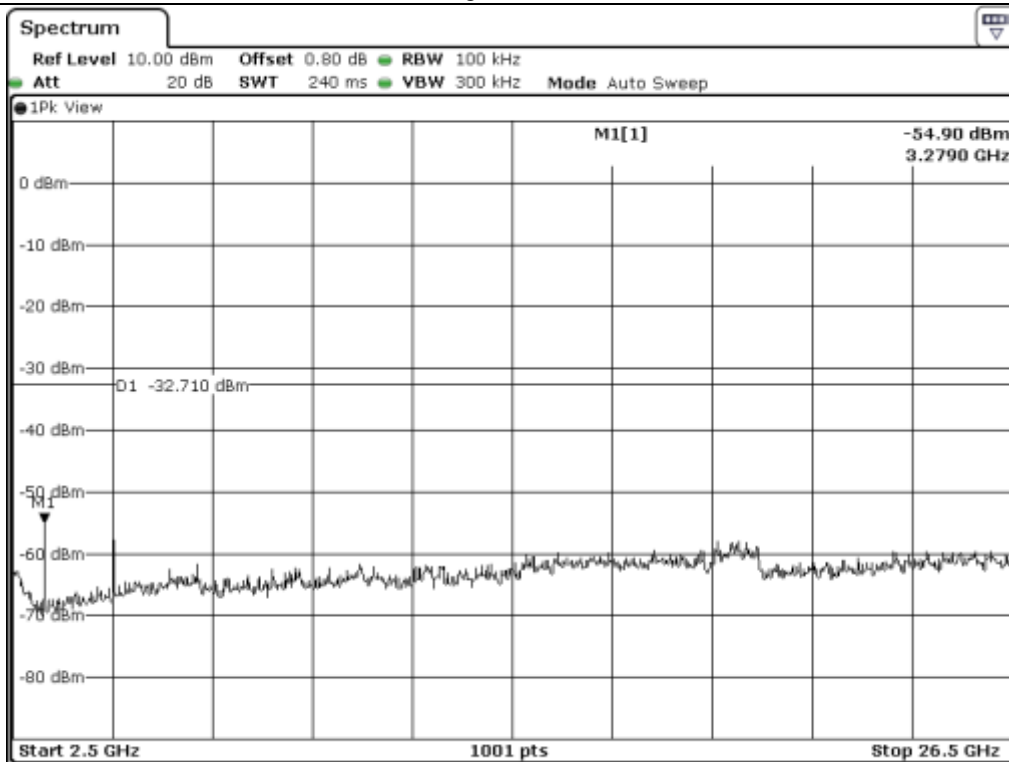
Middle Channel



Middle Channel

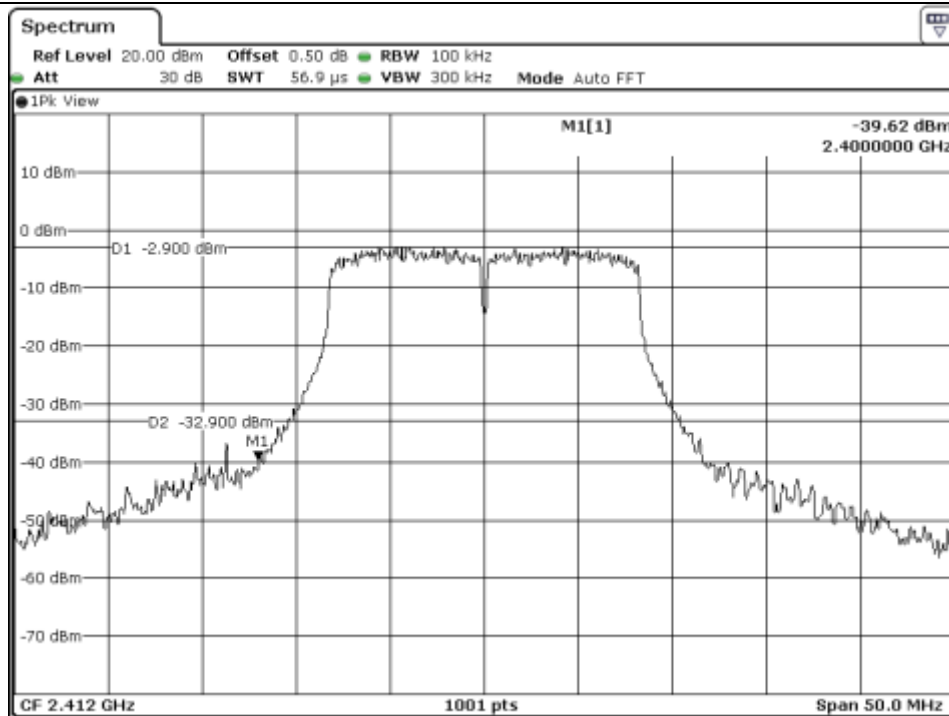


High Channel

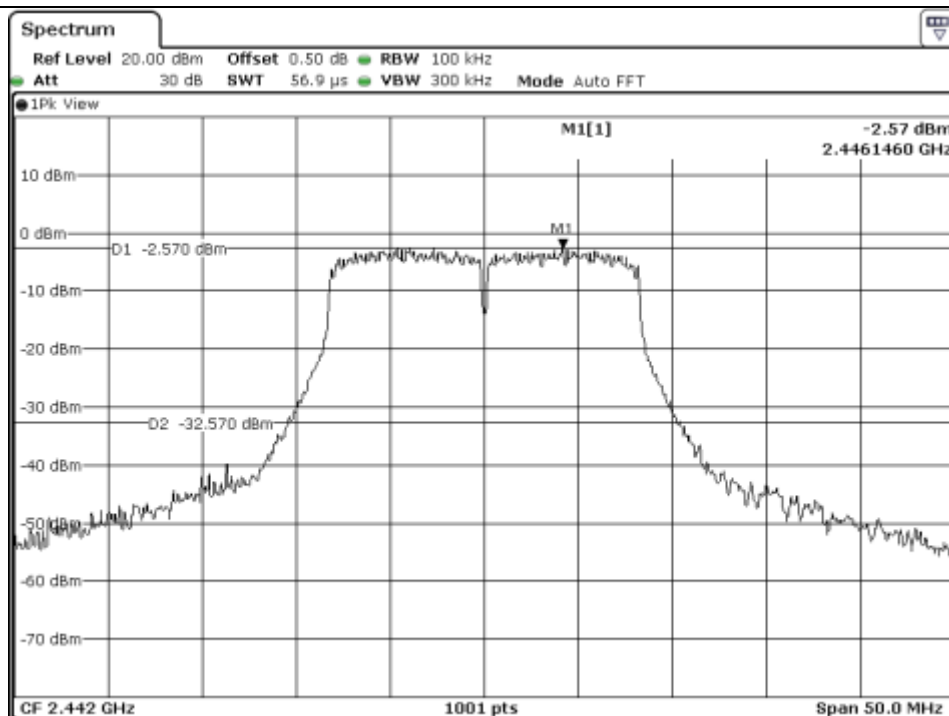


High Channel

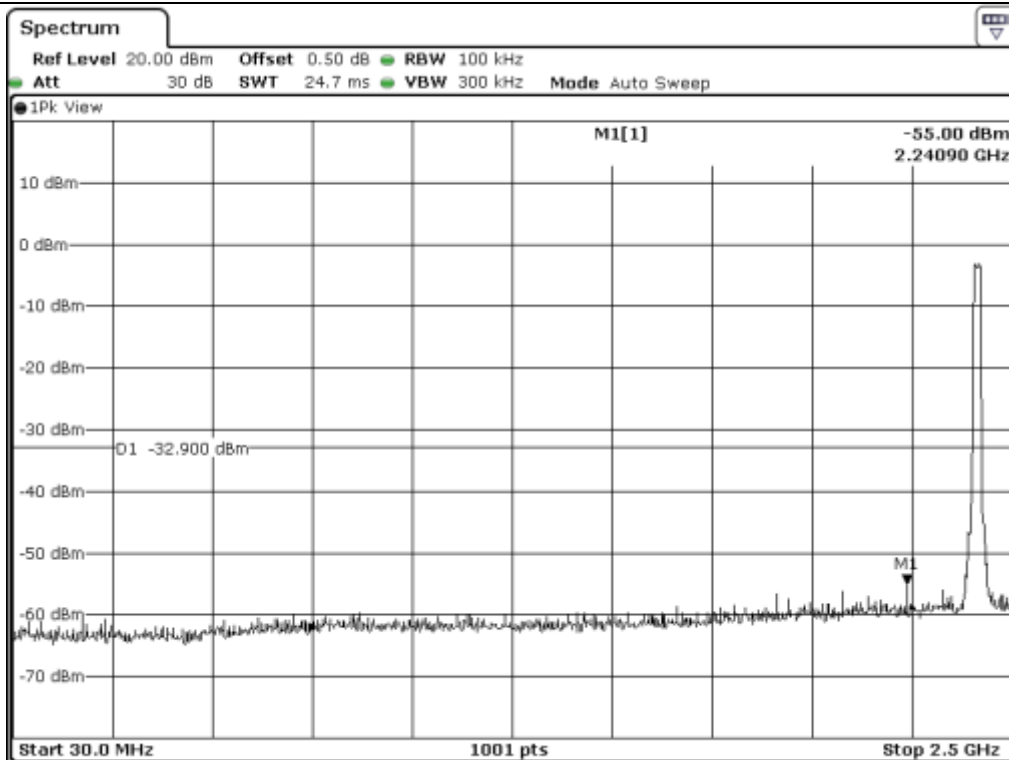
9.5.2.2 Test data for Antenna 1



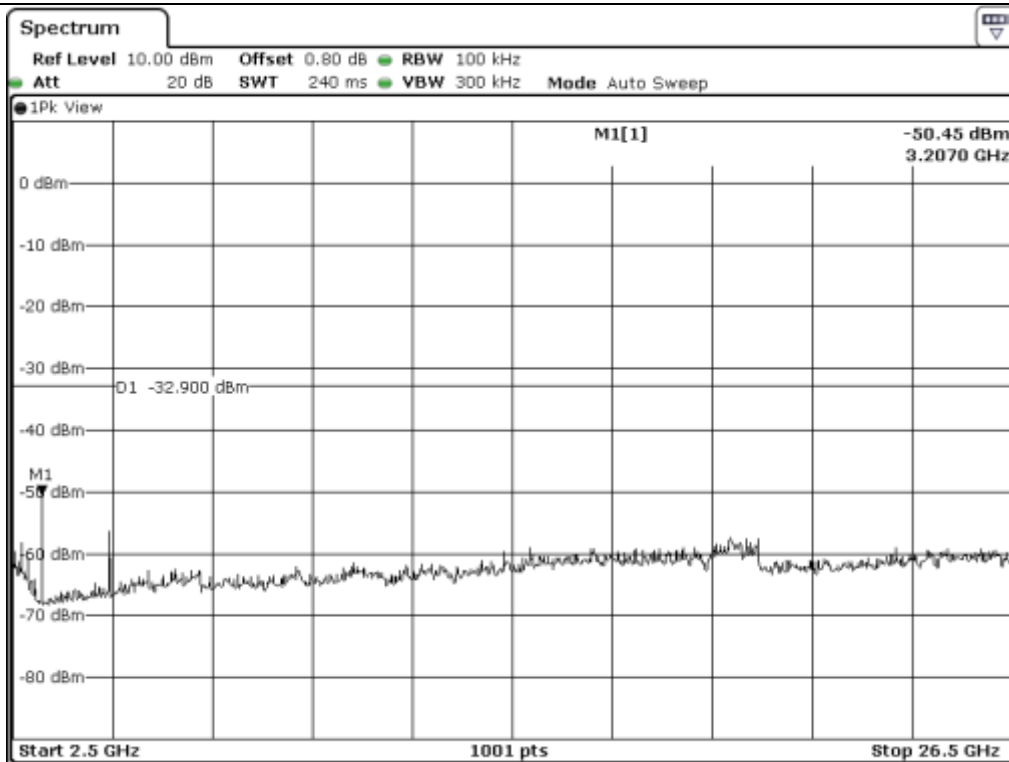
Low Channel



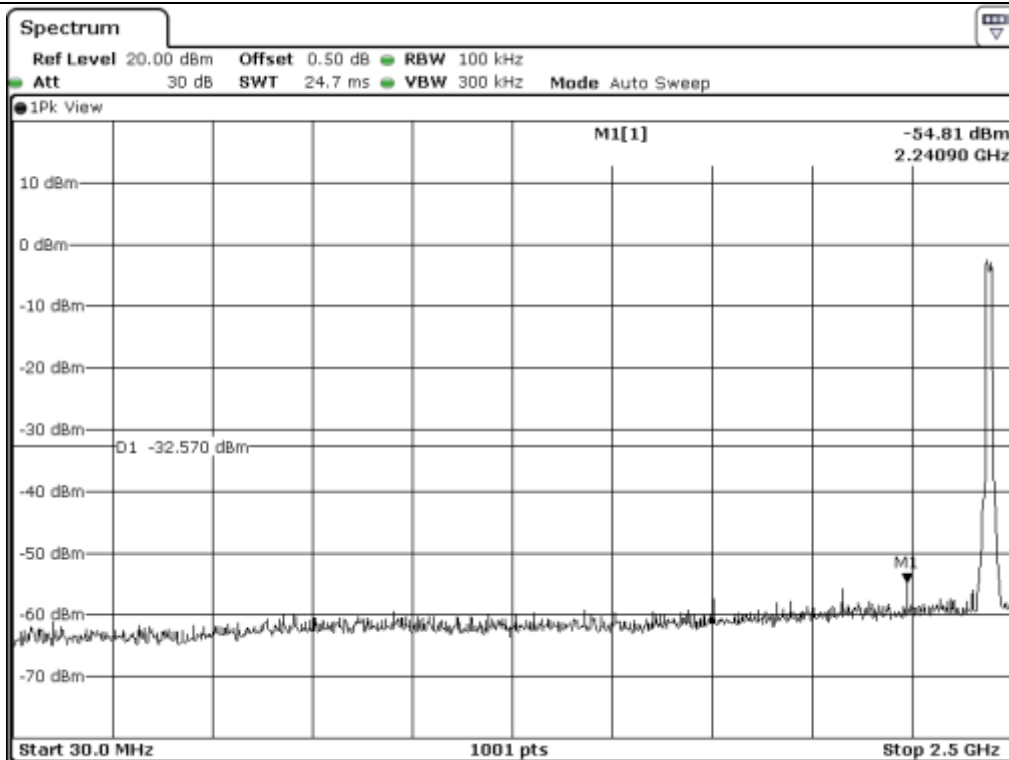
Middle Channel



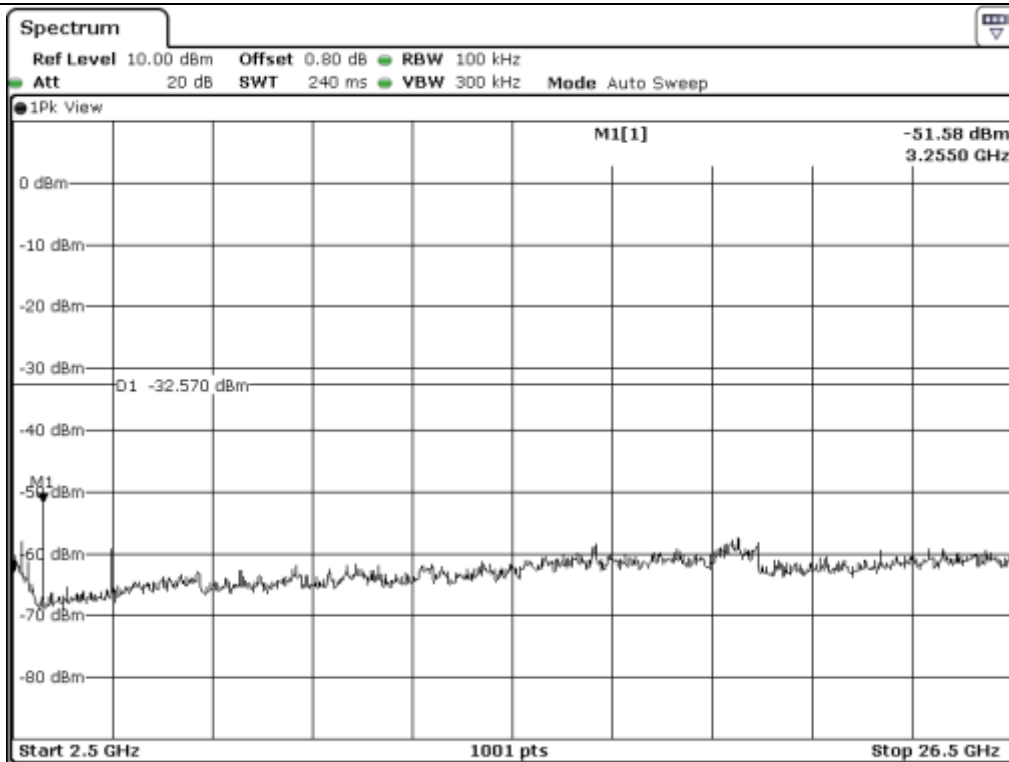
Low Channel



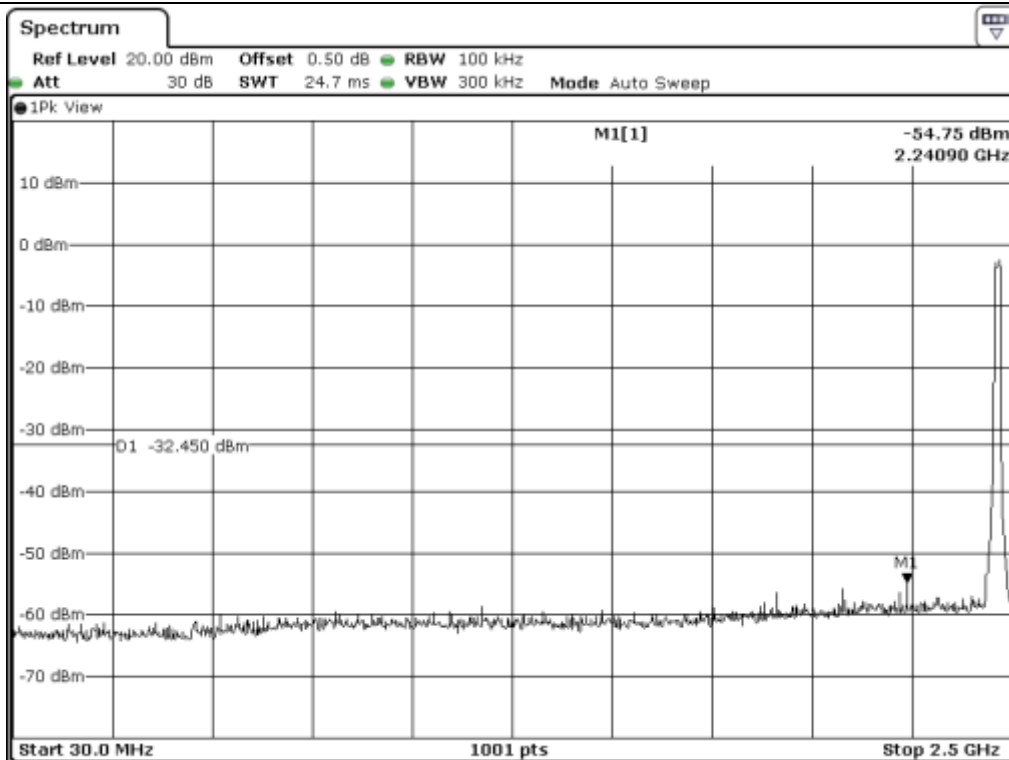
Low Channel



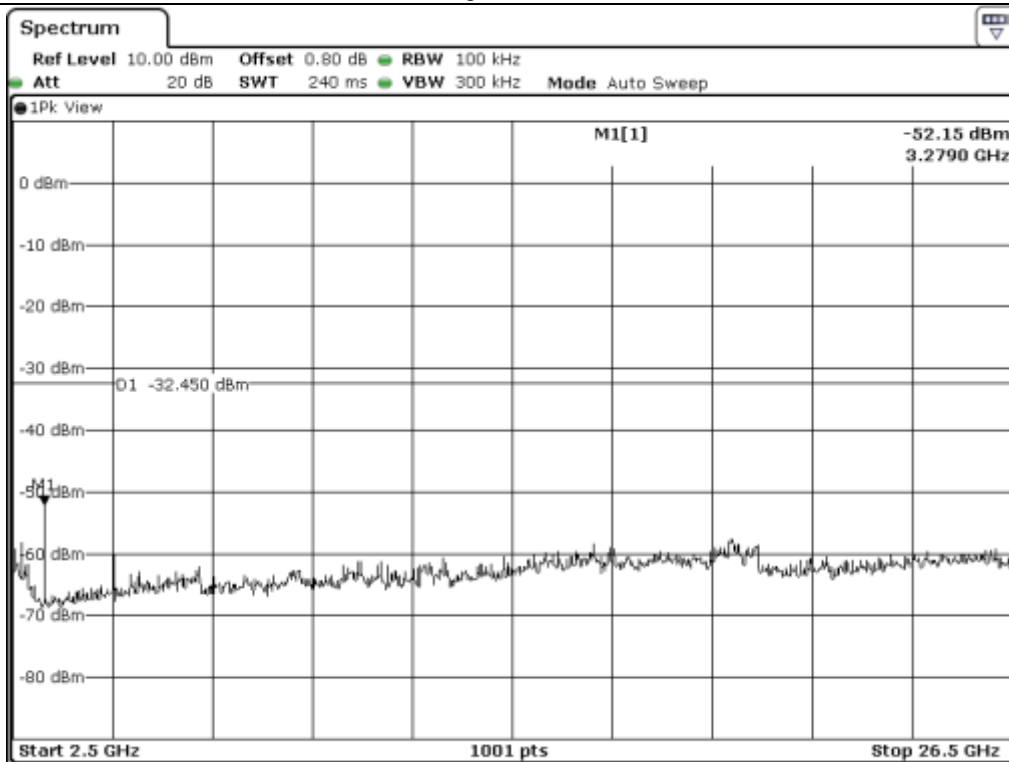
Middle Channel



Middle Channel



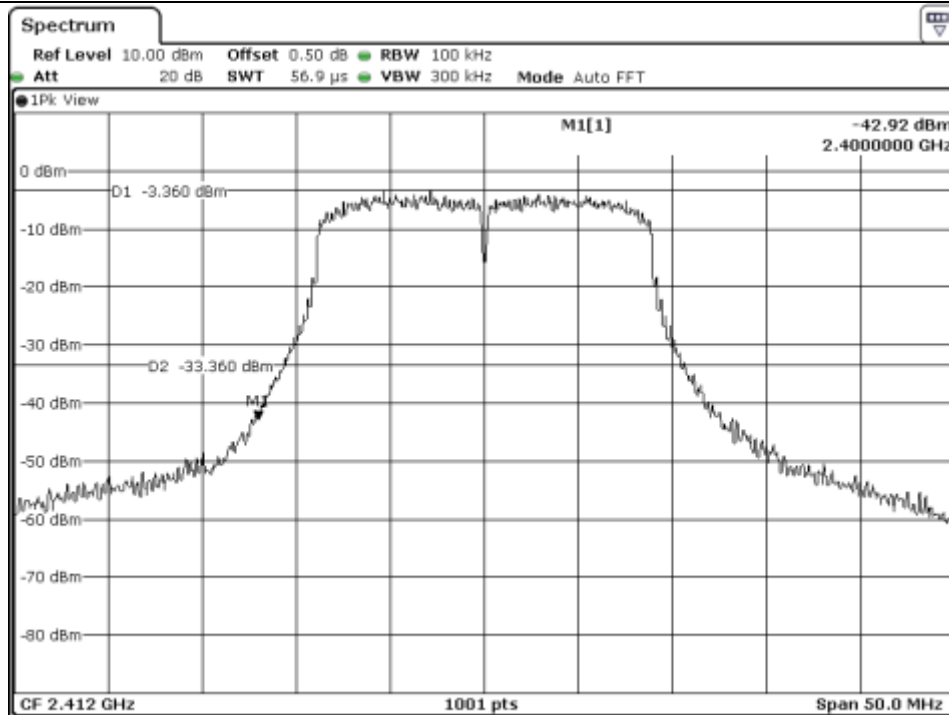
High Channel



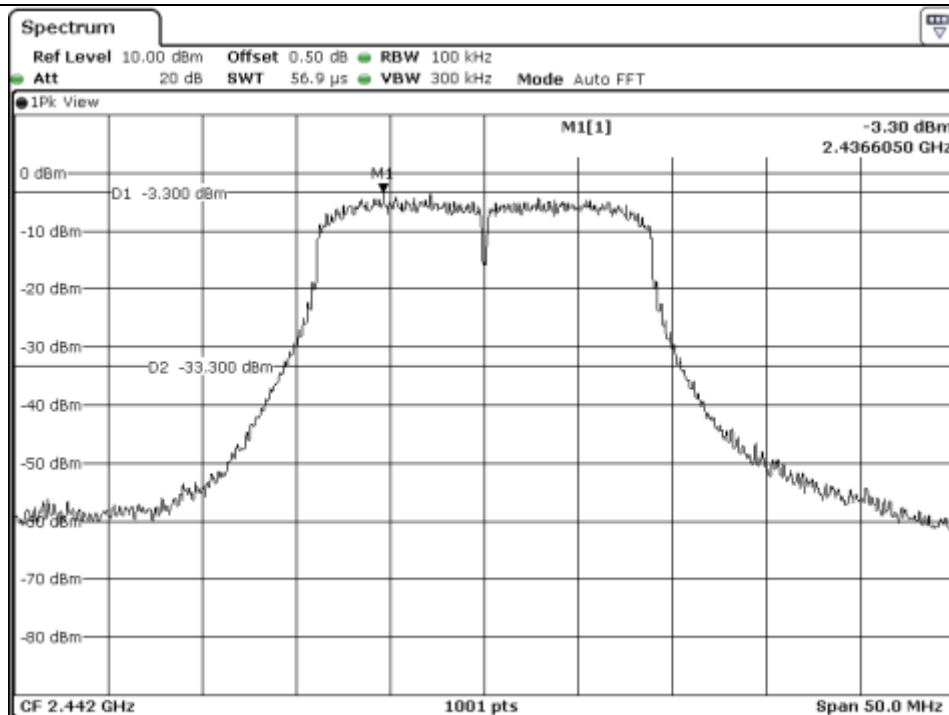
High Channel

9.5.3 Test data for 802.11n_HT20 WLAN Mode

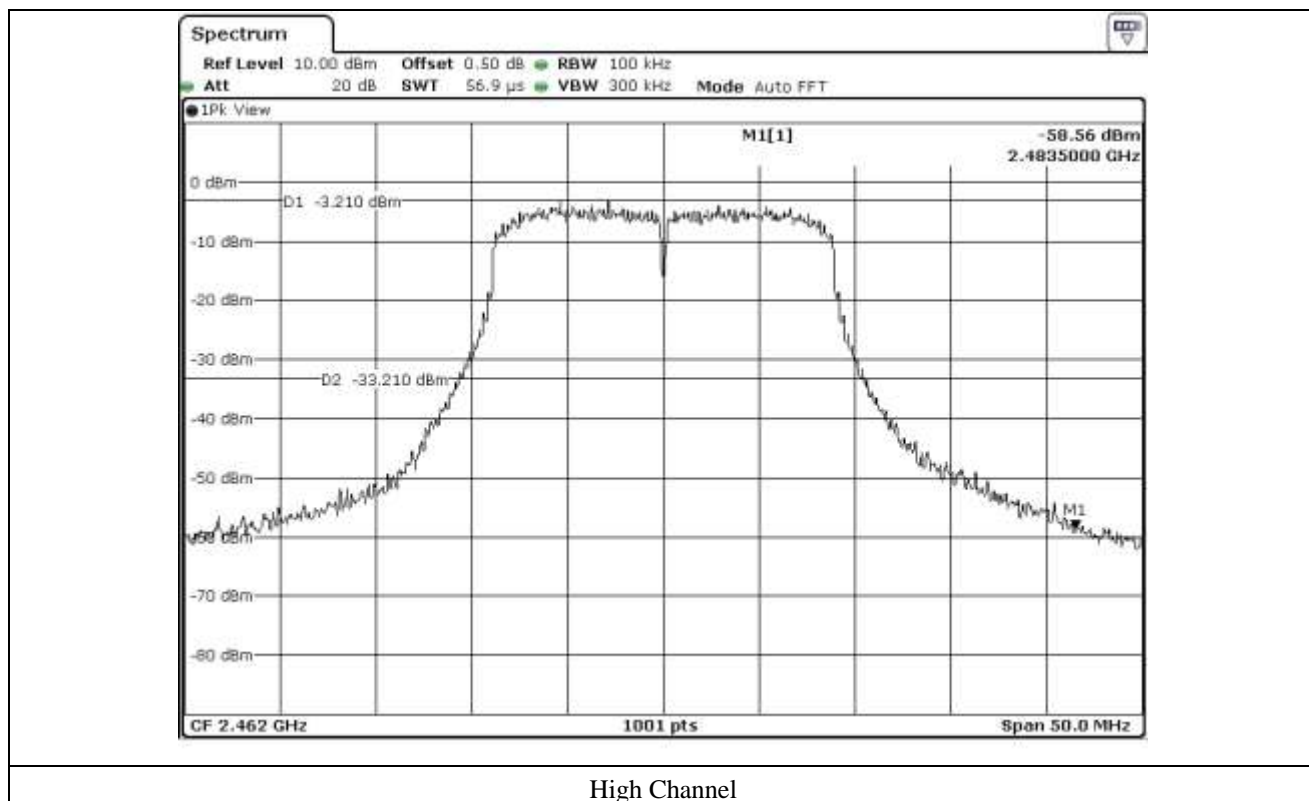
9.5.3.1 Test data for Antenna 0

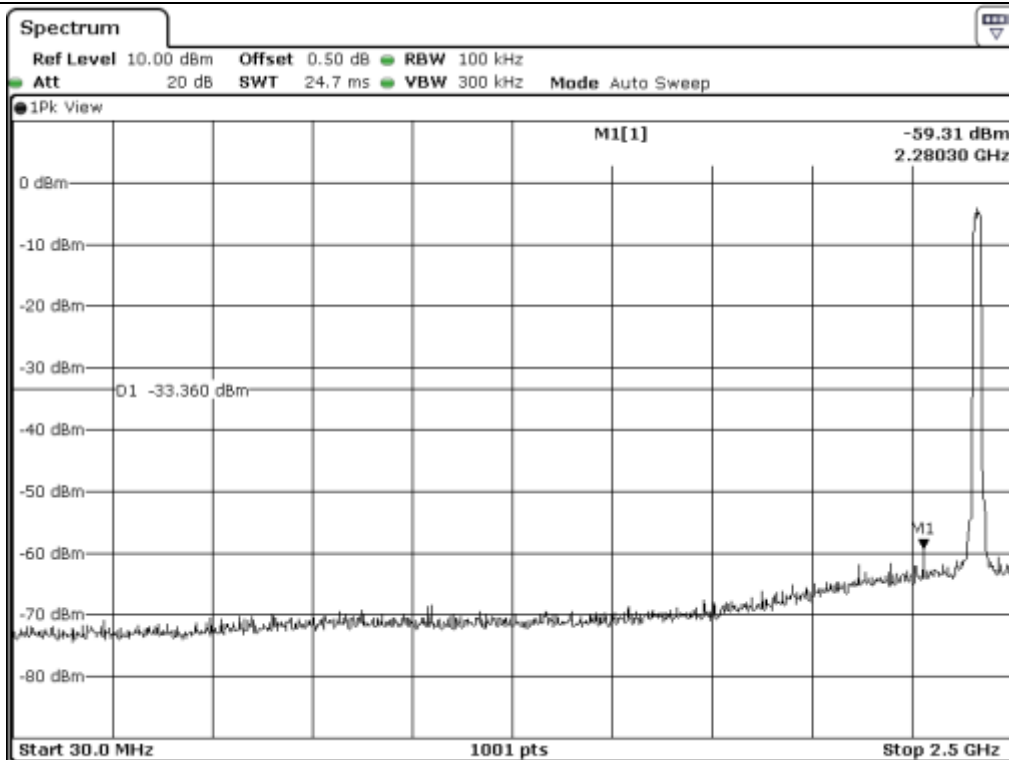


Low Channel

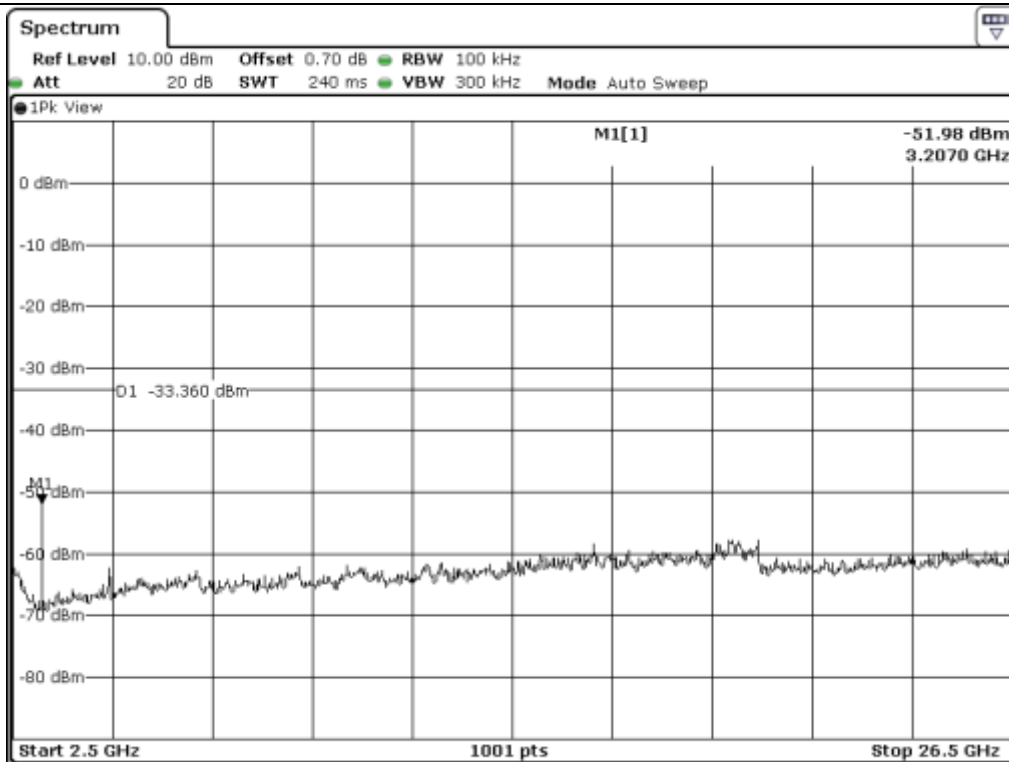


Middle Channel

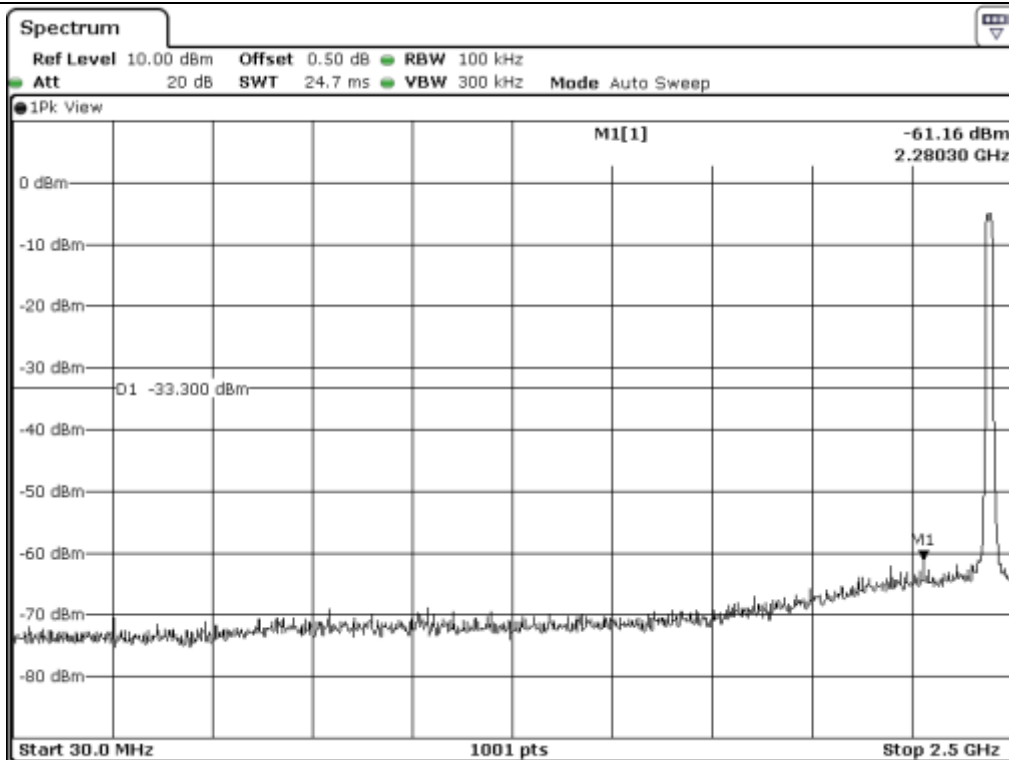




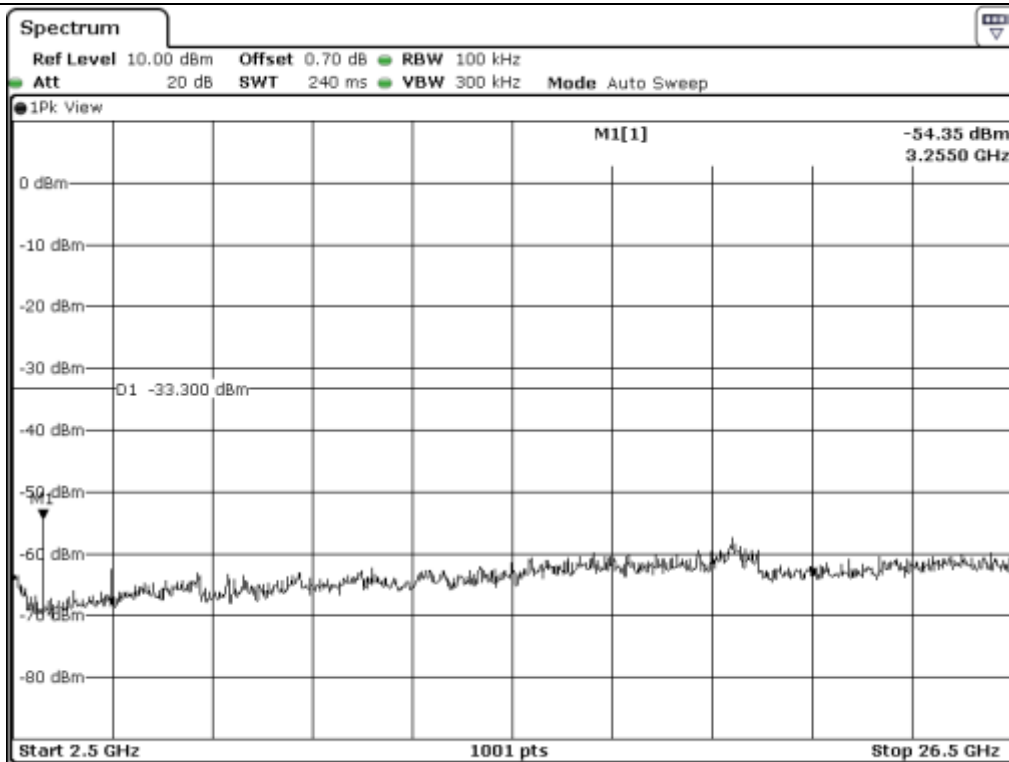
Low Channel



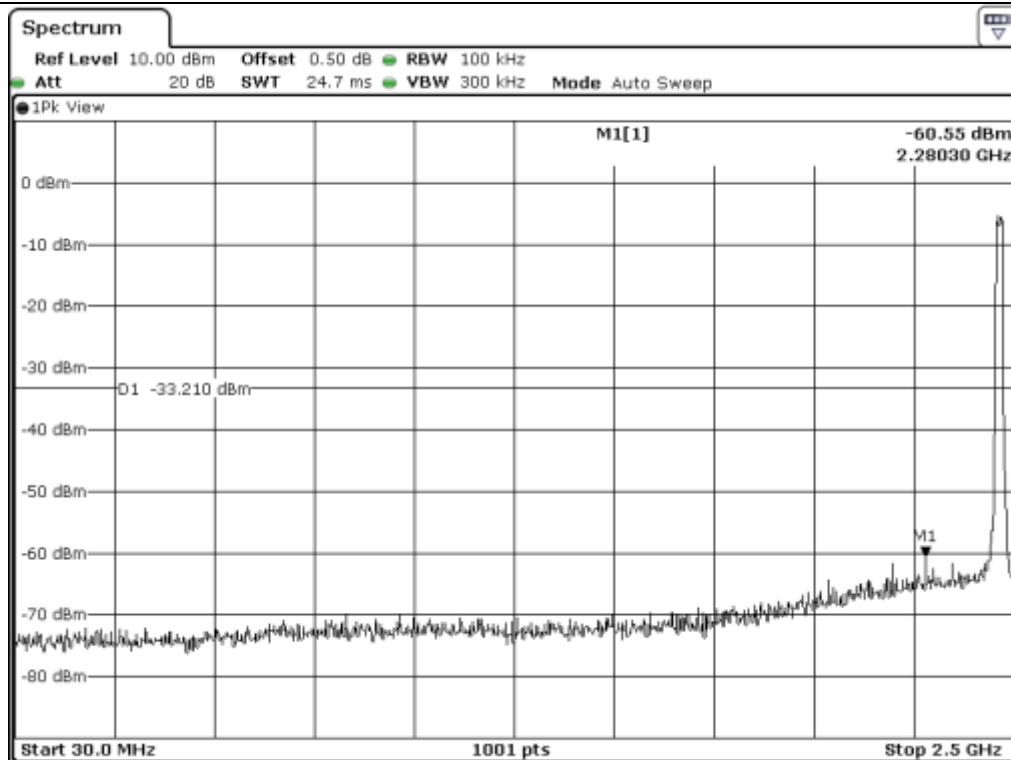
Low Channel



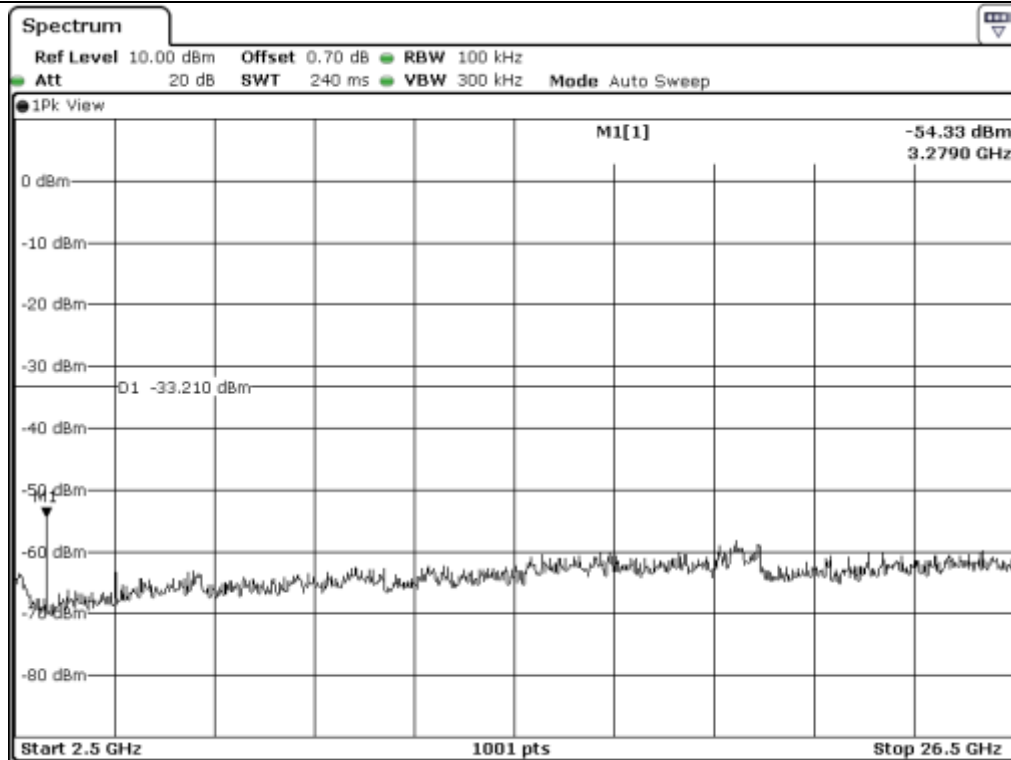
Middle Channel



Middle Channel

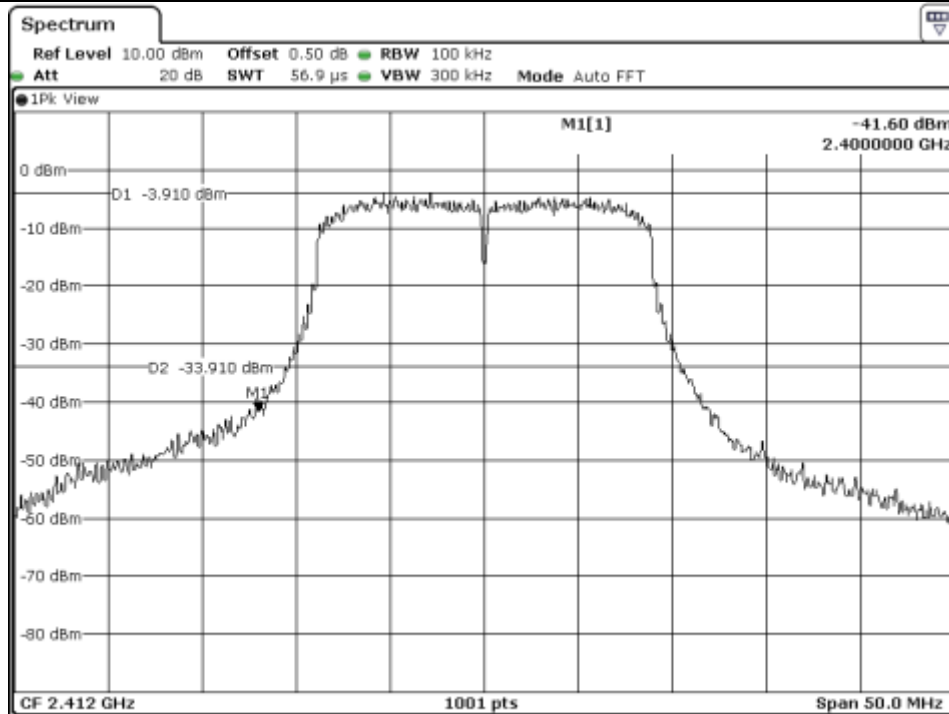


High Channel

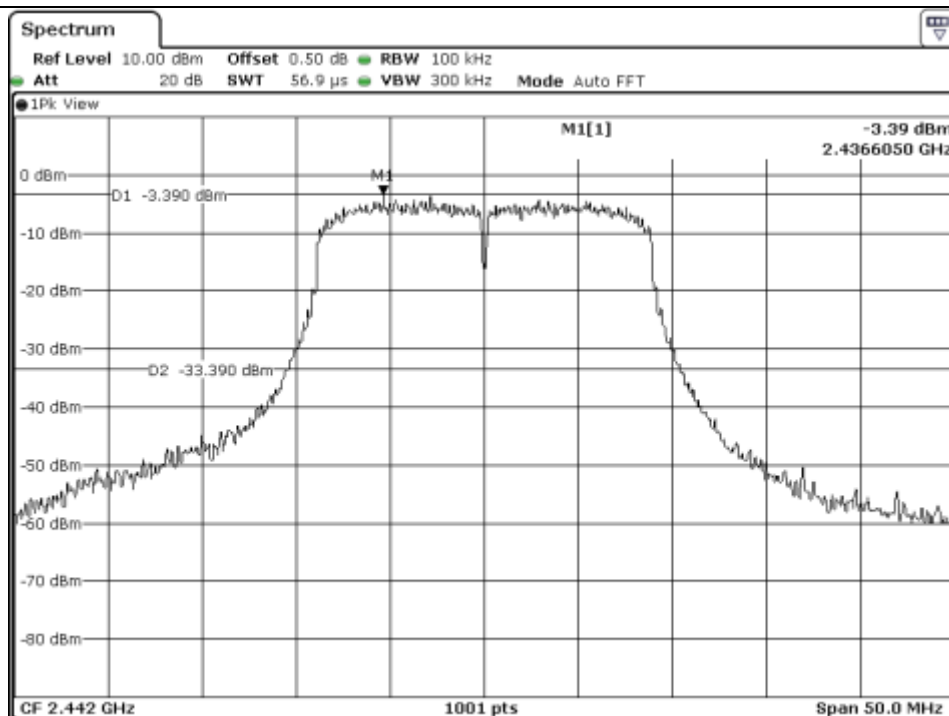


High Channel

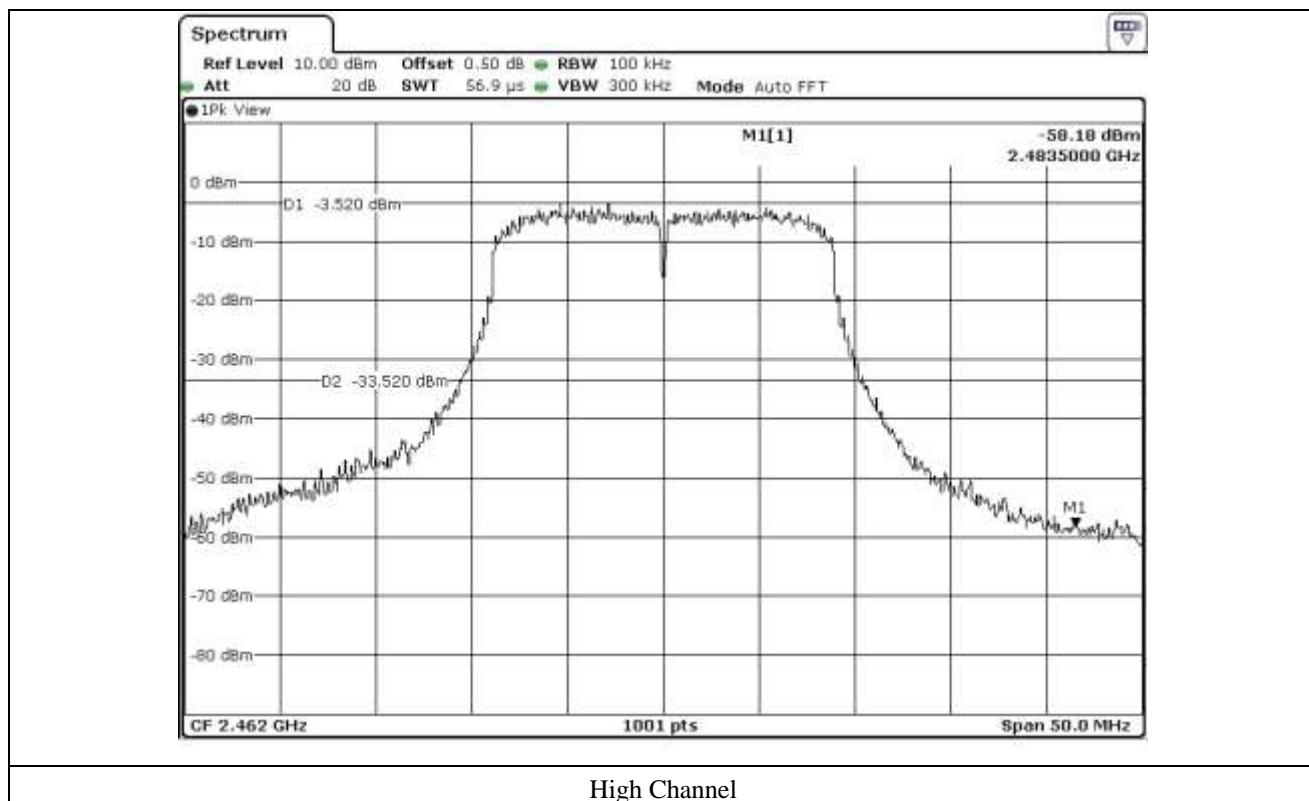
9.5.3.2 Test data for Antenna 1

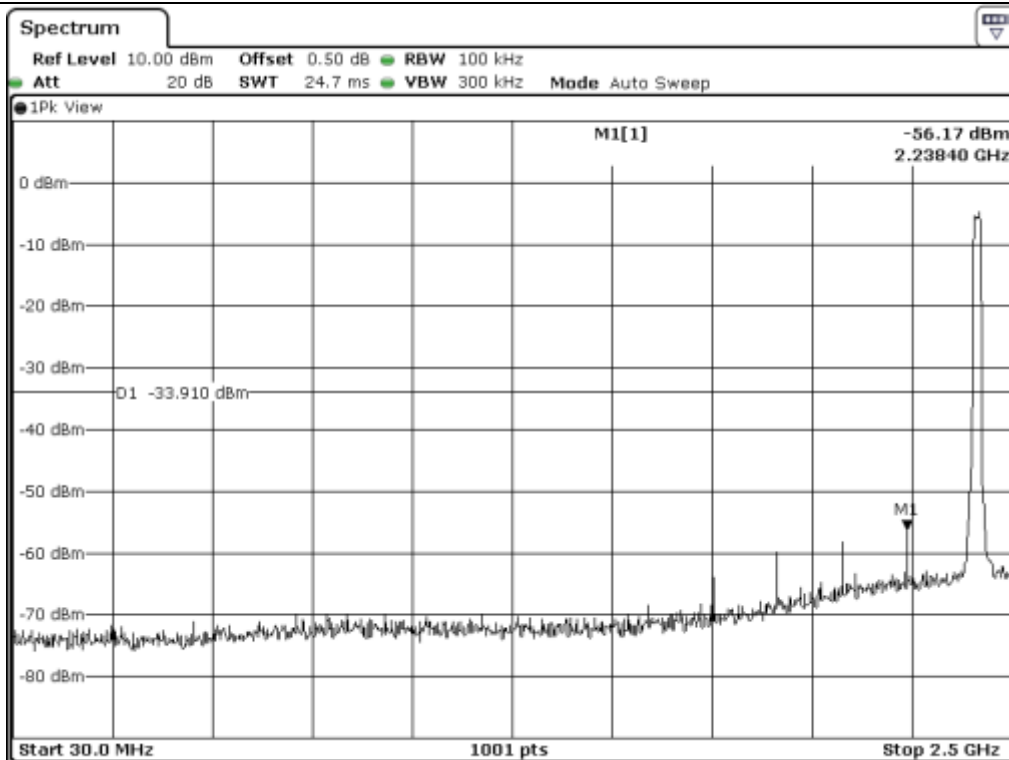


Low Channel

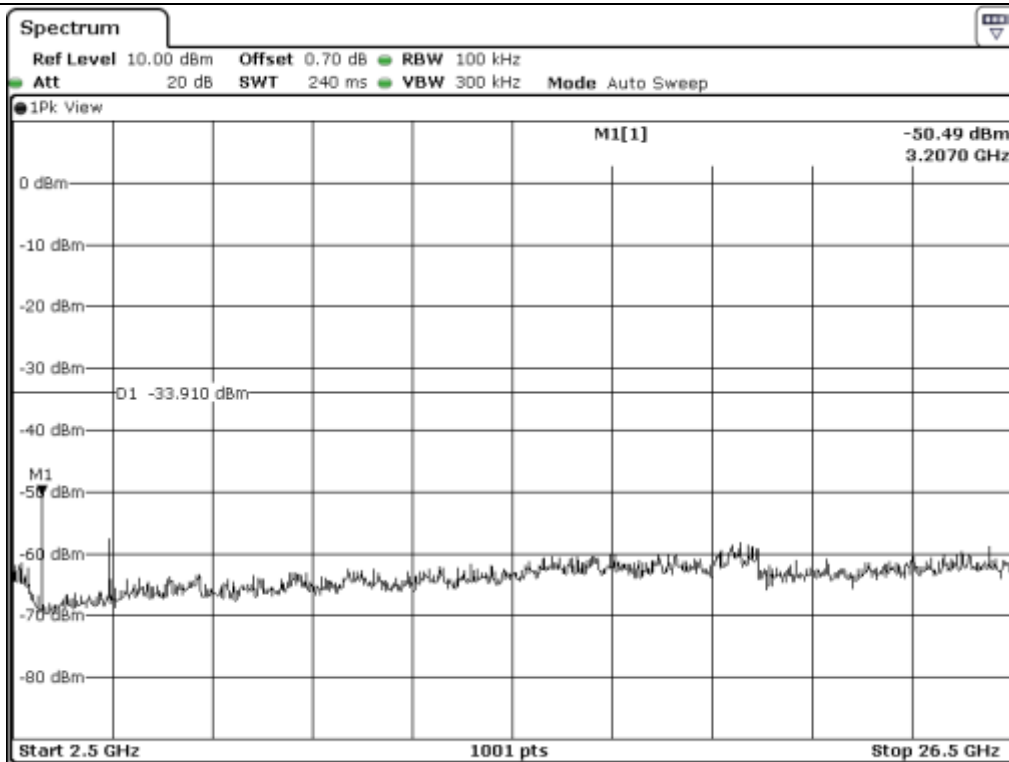


Middle Channel

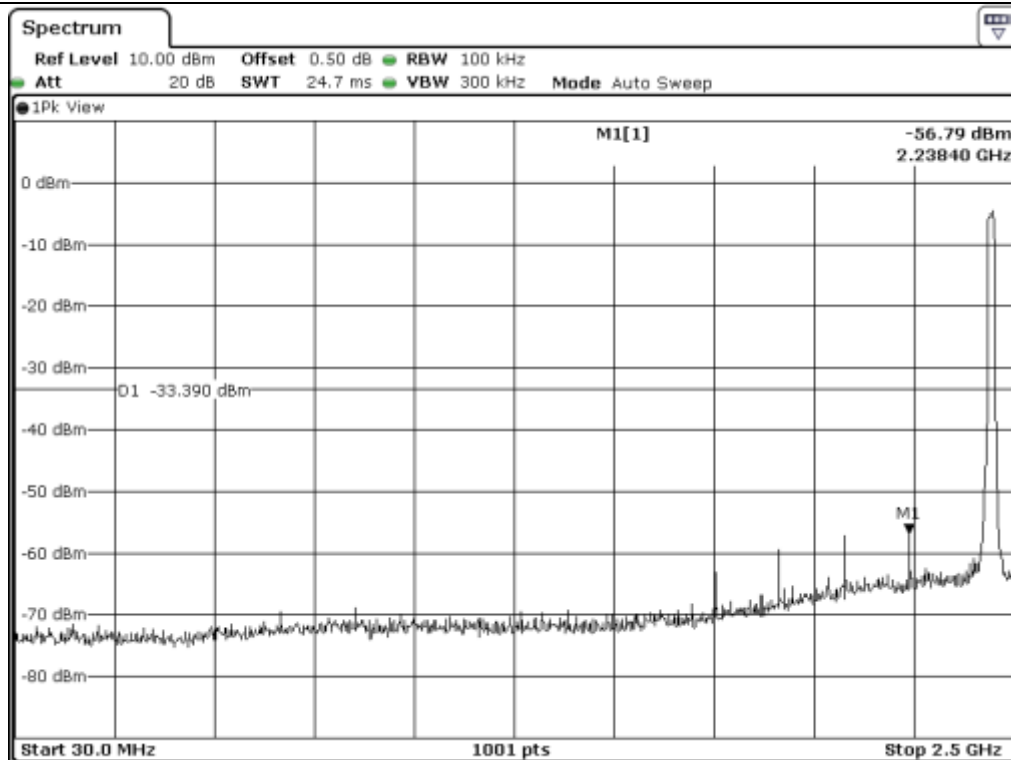




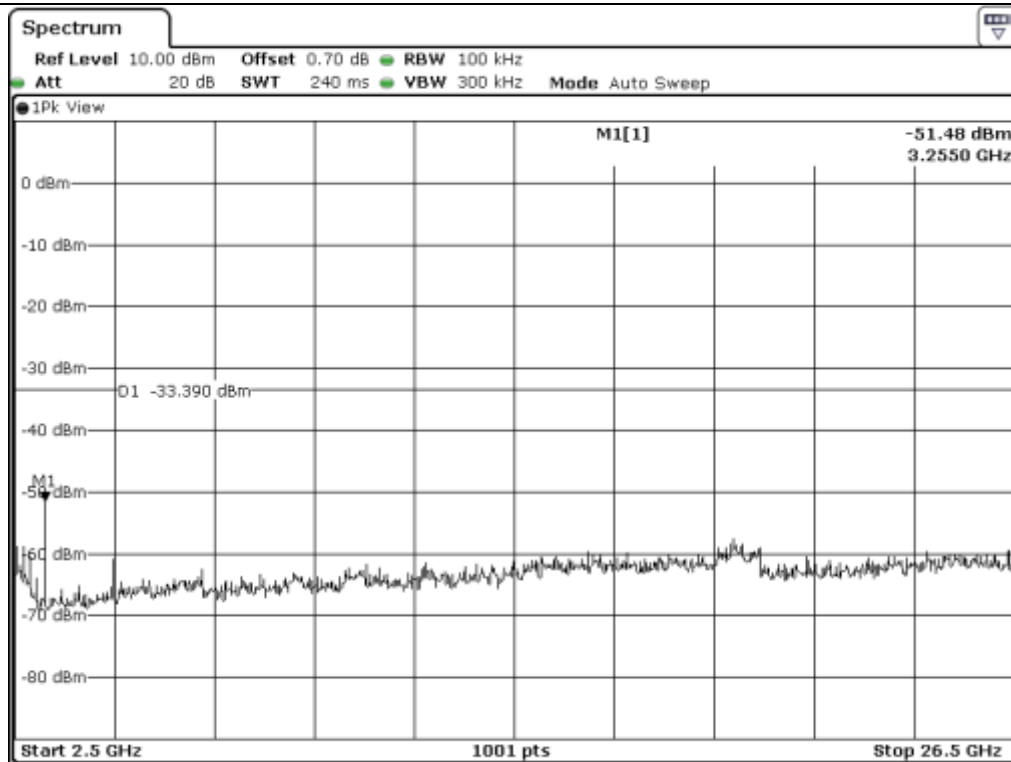
Low Channel



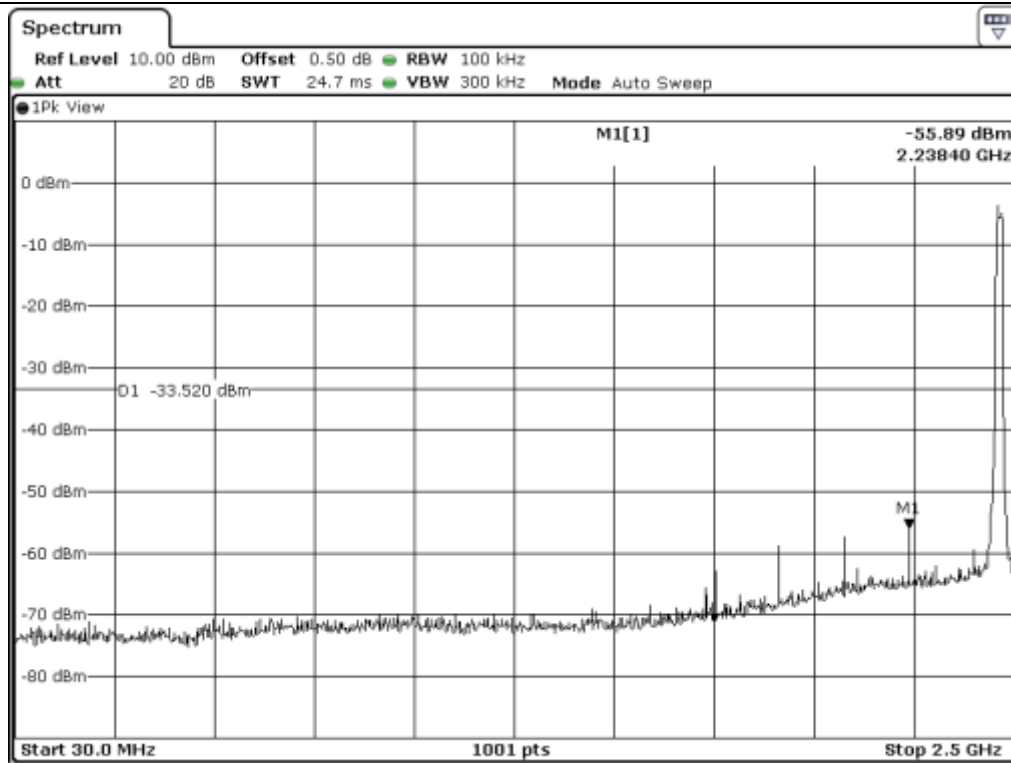
Low Channel



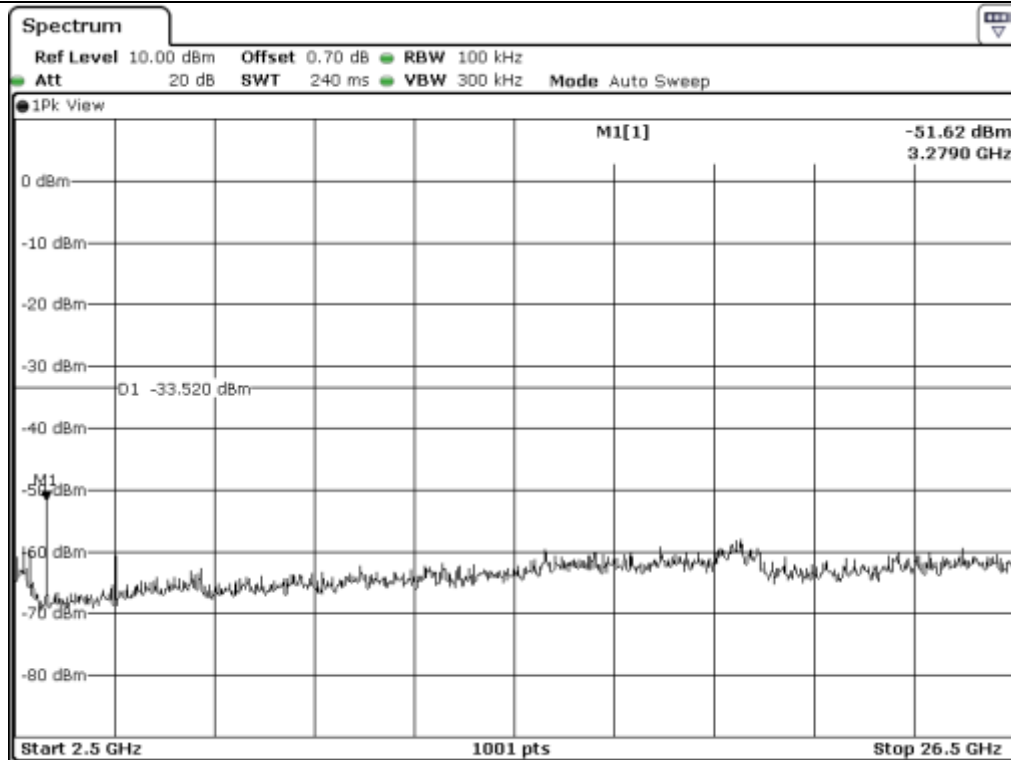
Middle Channel



Middle Channel



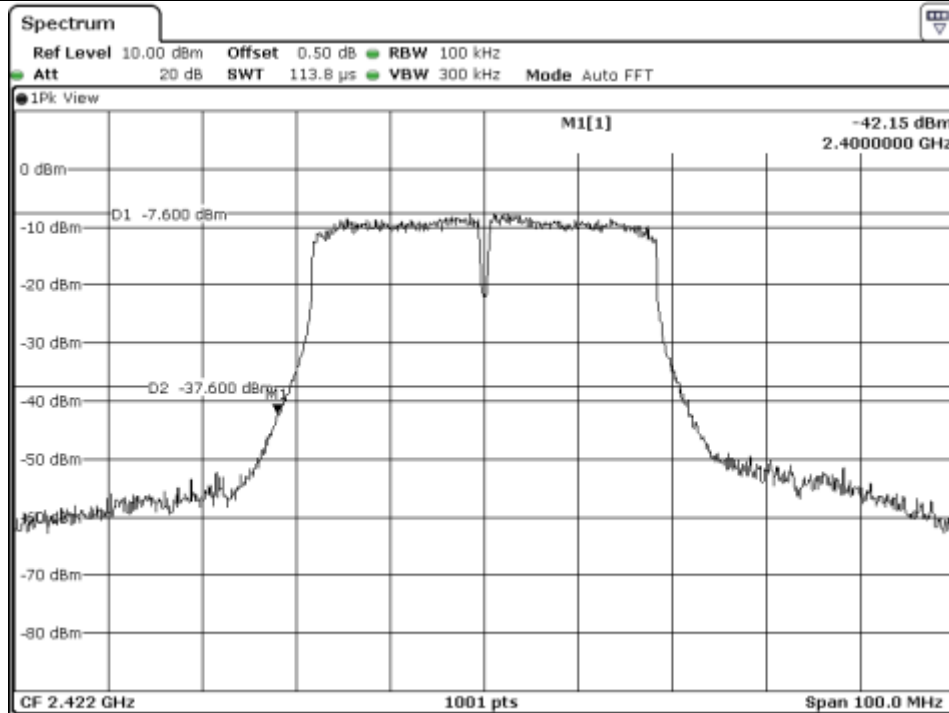
High Channel



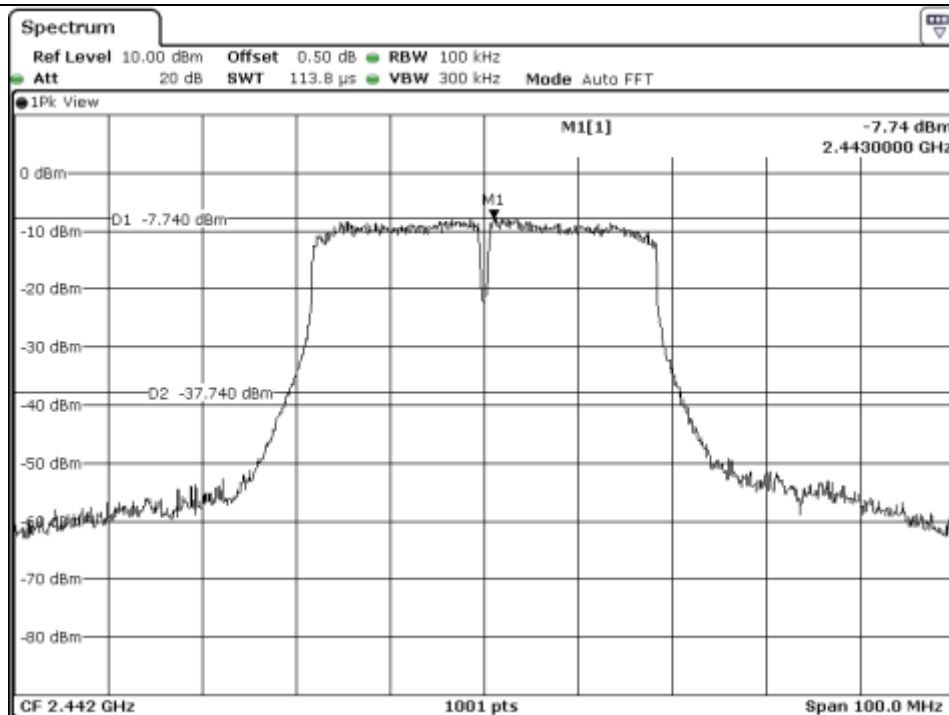
High Channel

9.5.4 Test data for 802.11n_HT40 WLAN Mode

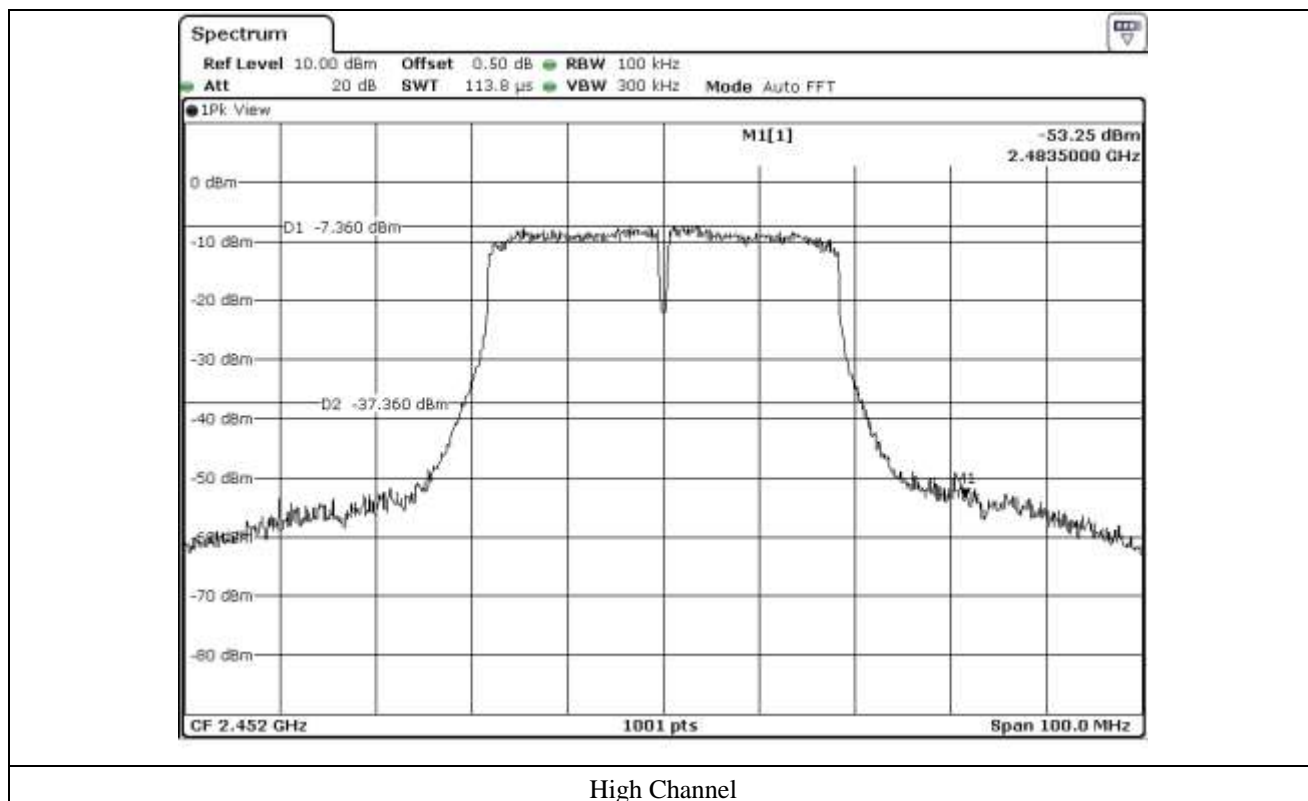
9.5.4.1 Test data for Antenna 0

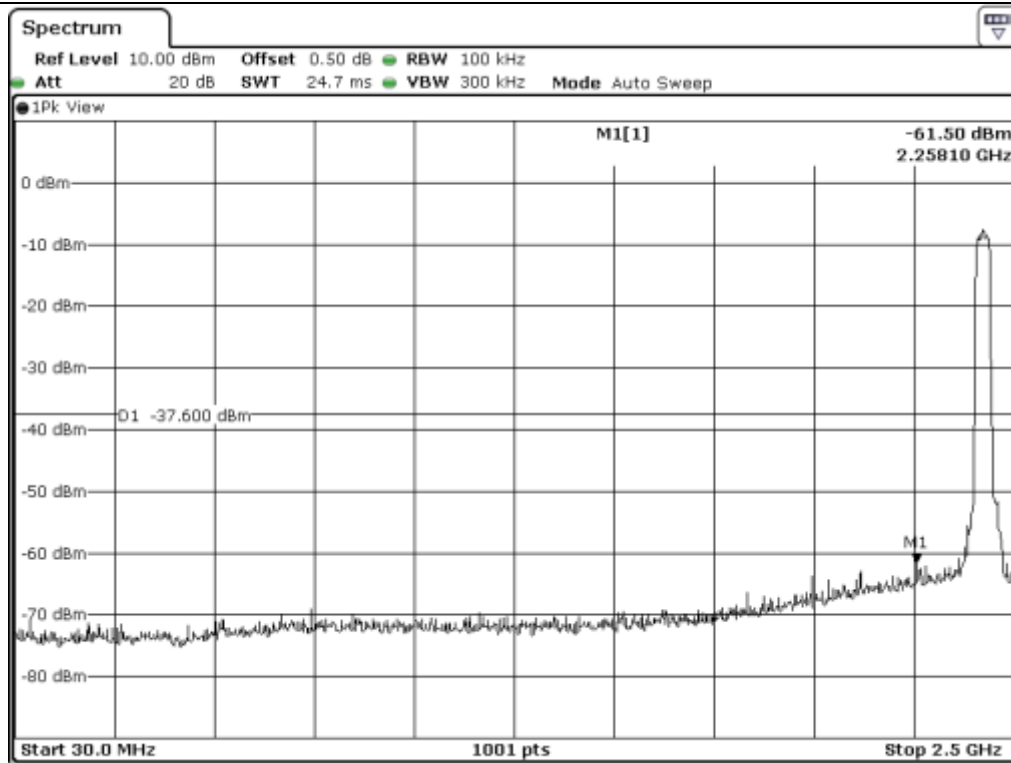


Low Channel

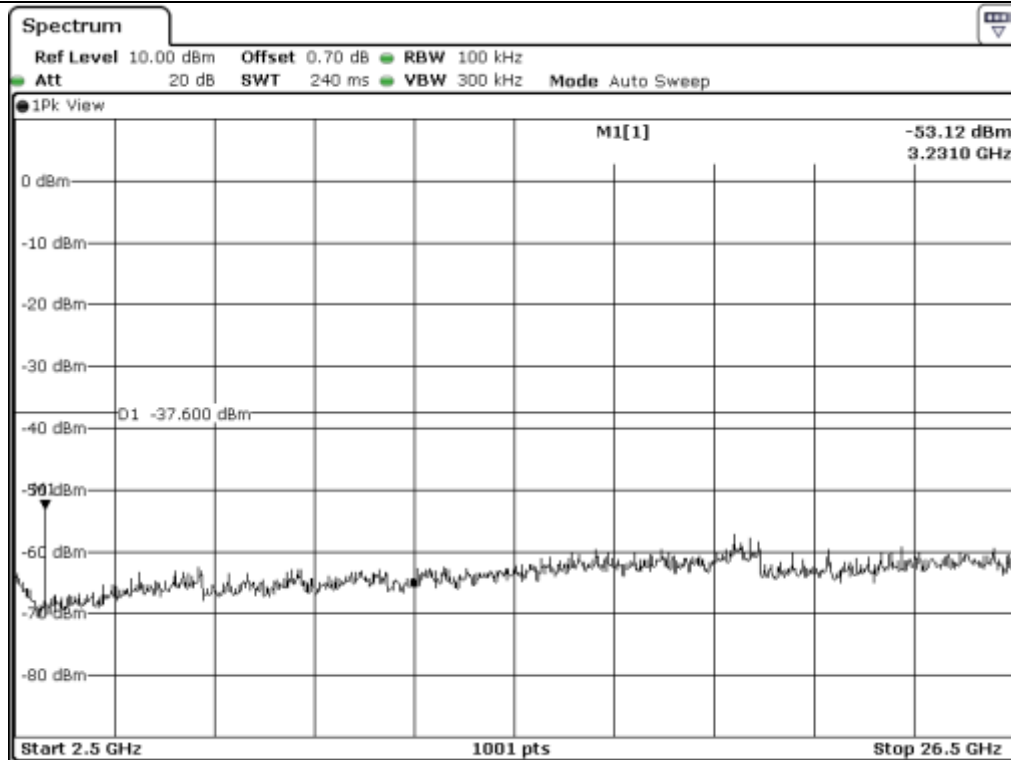


Middle Channel

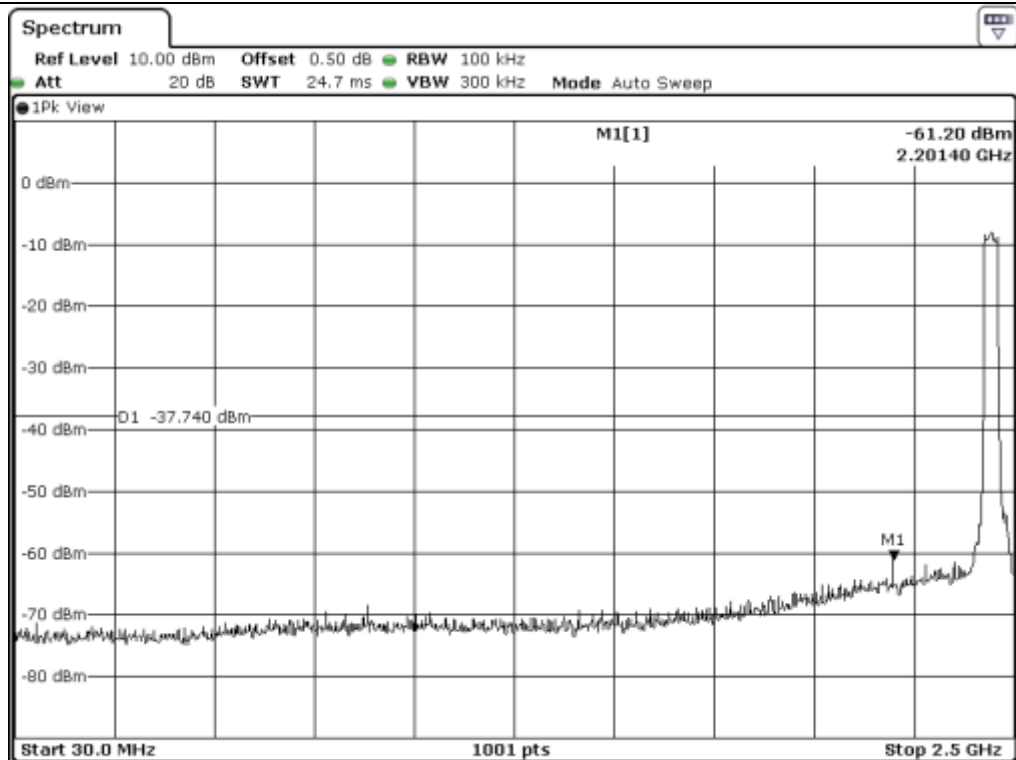




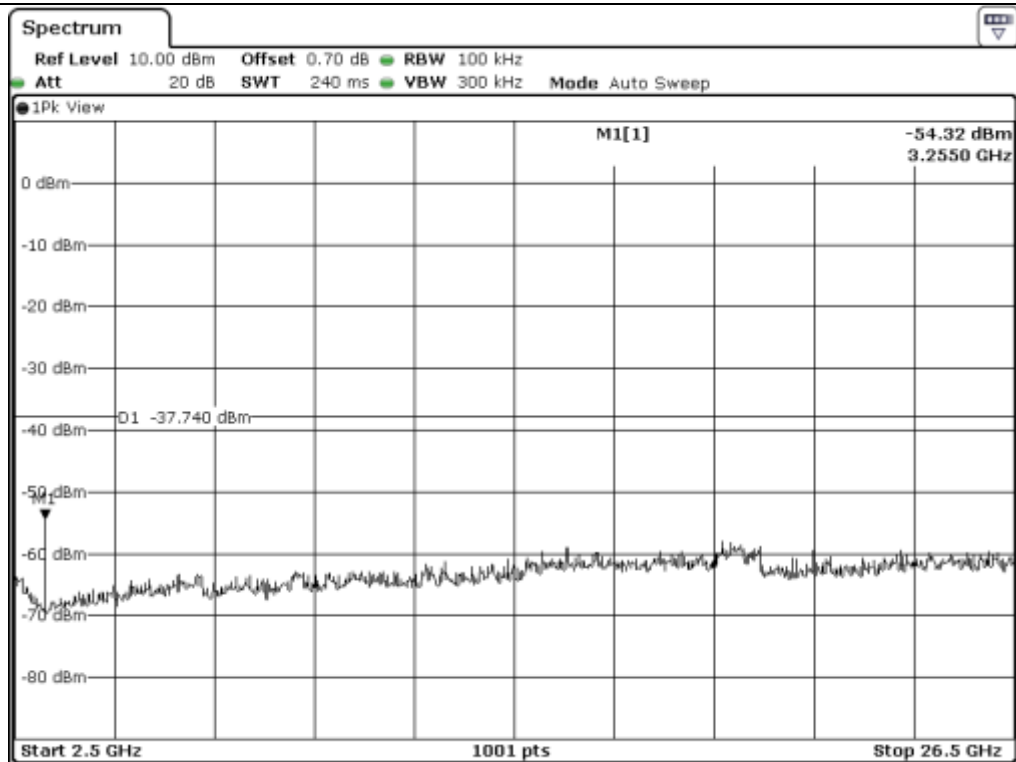
Low Channel



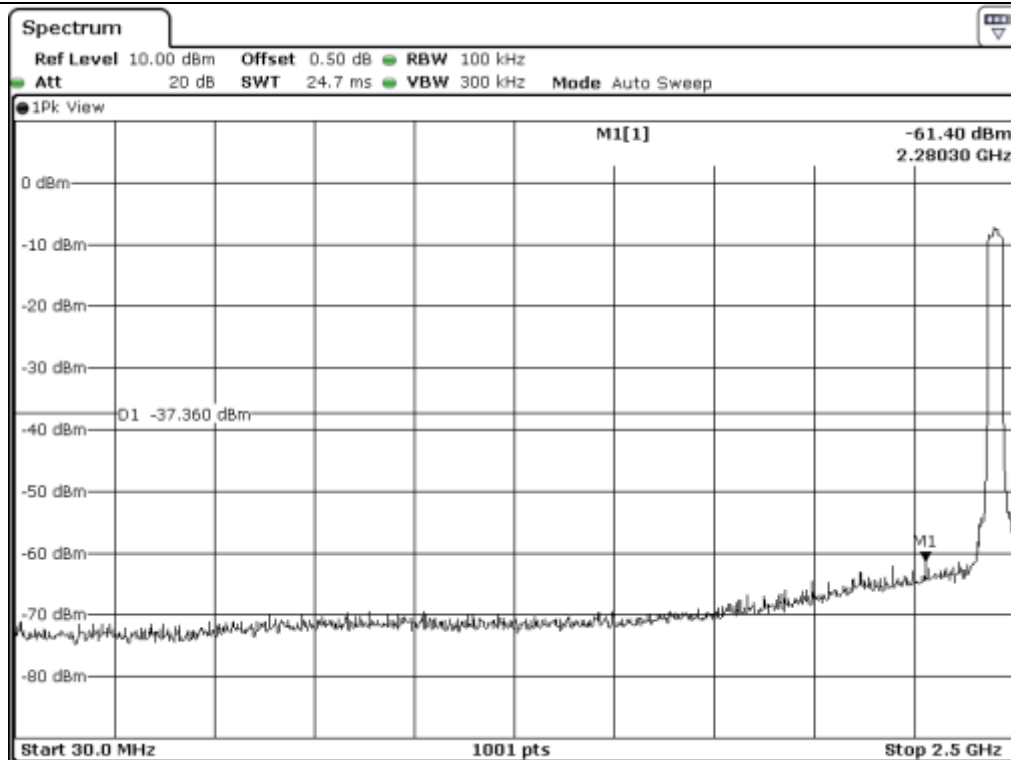
Low Channel



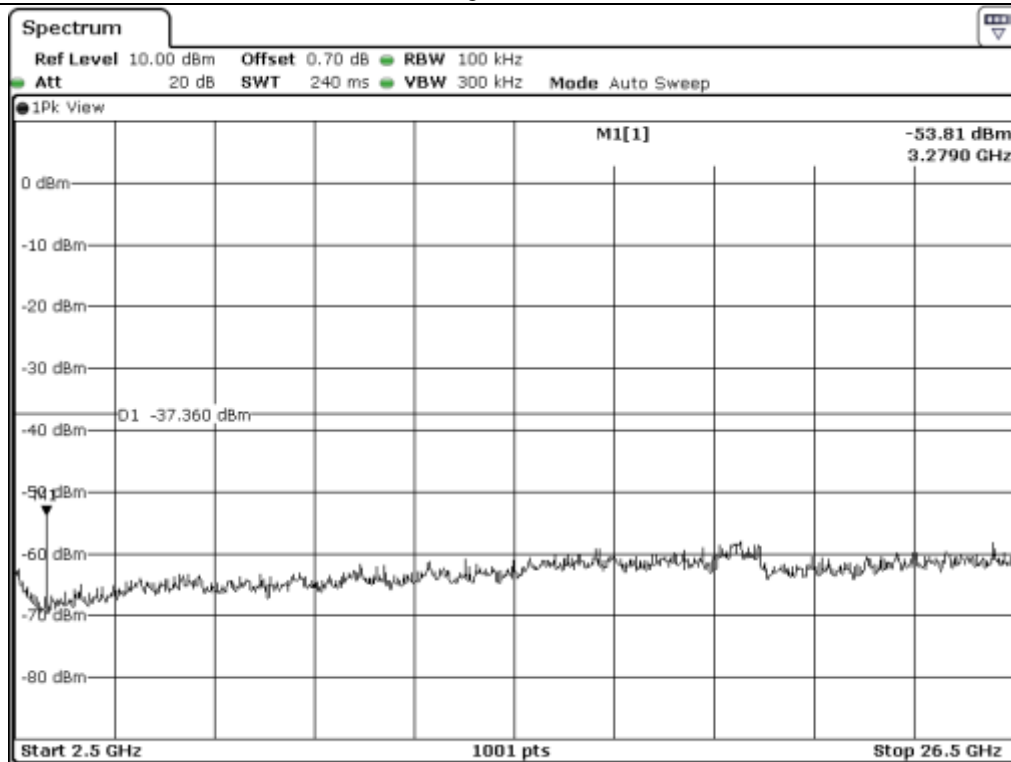
Middle Channel



Middle Channel

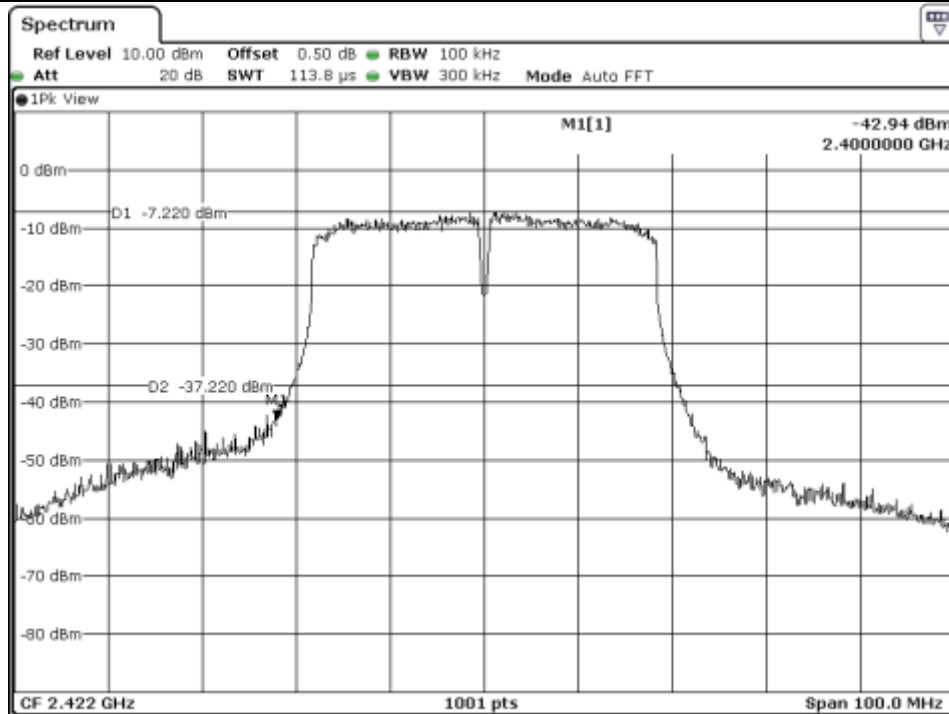


High Channel

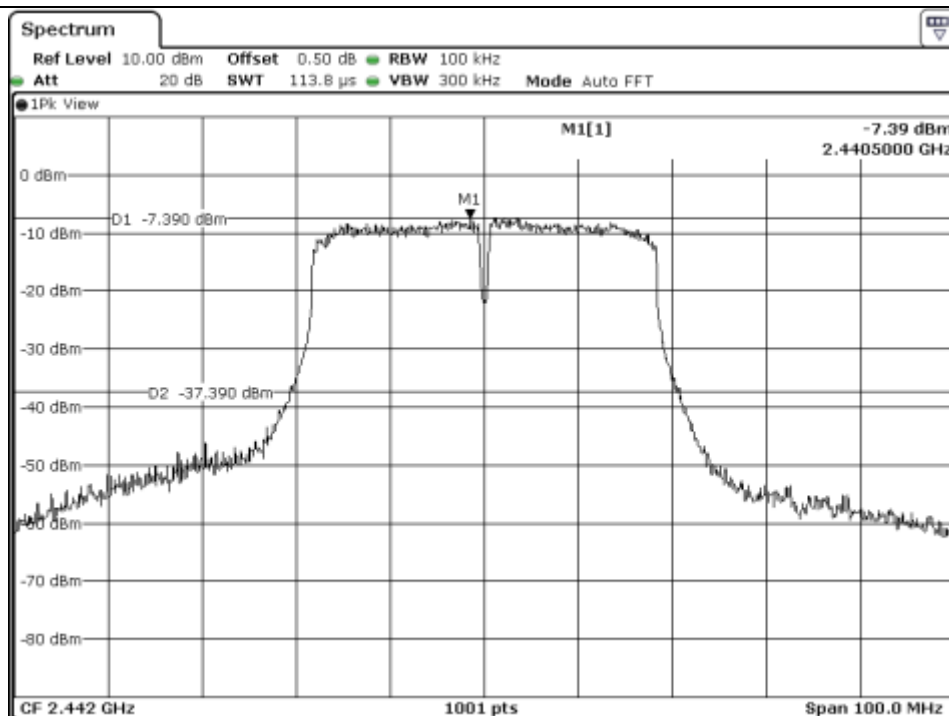


High Channel

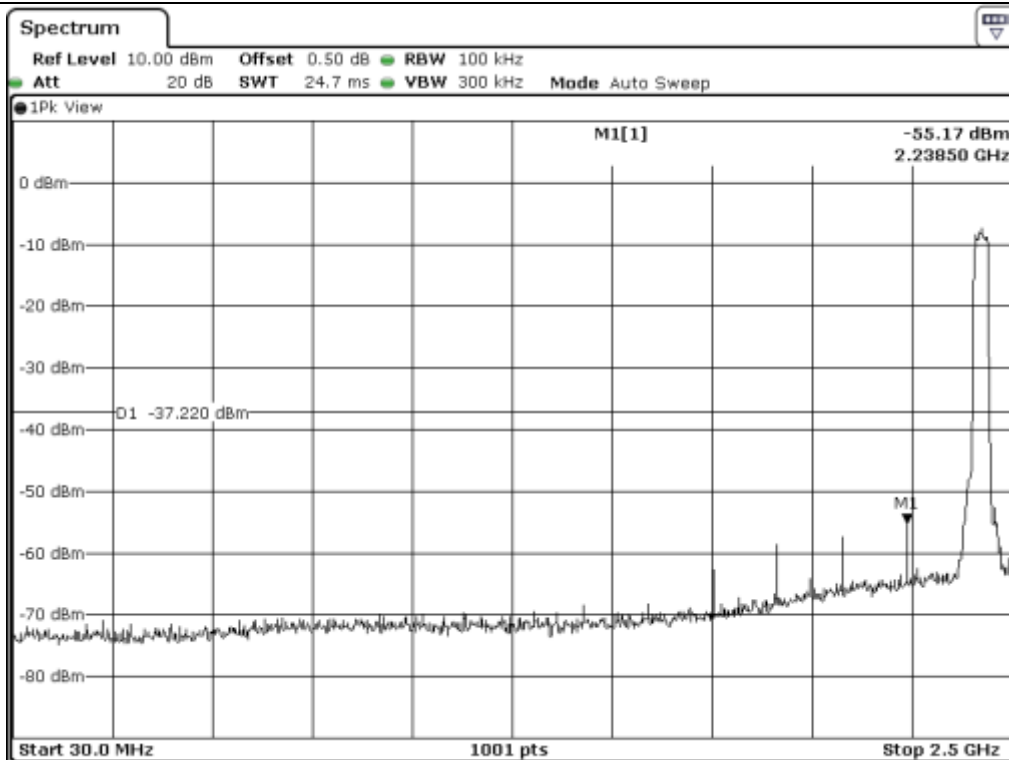
9.5.4.2 Test data for Antenna 1



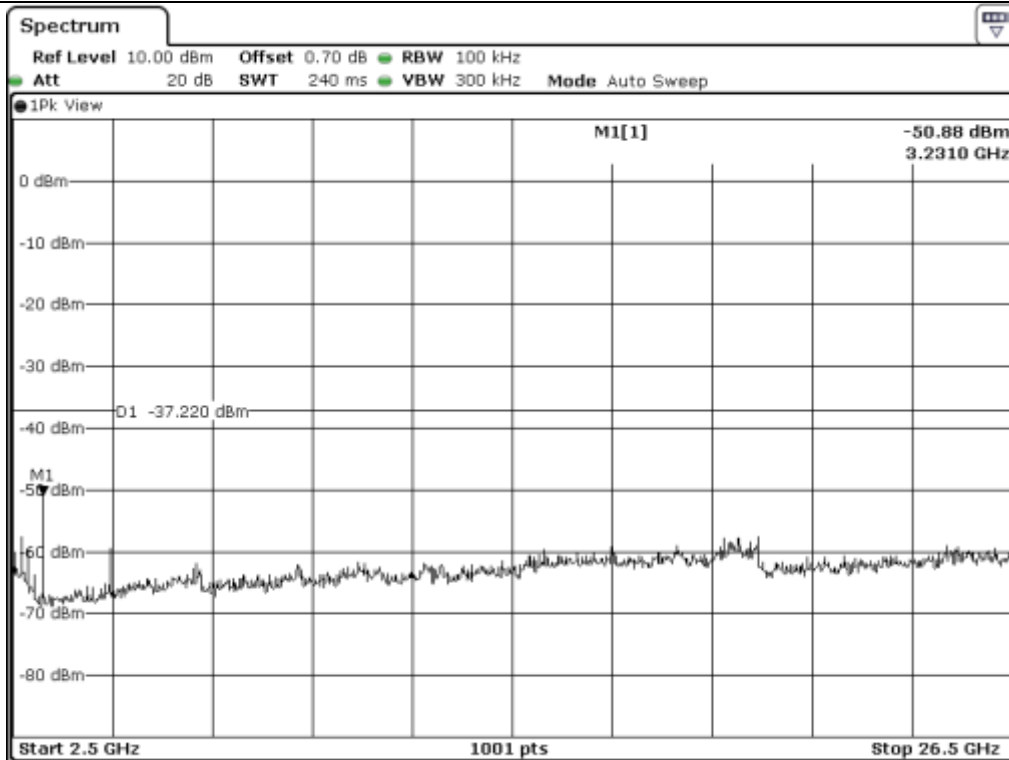
Low Channel



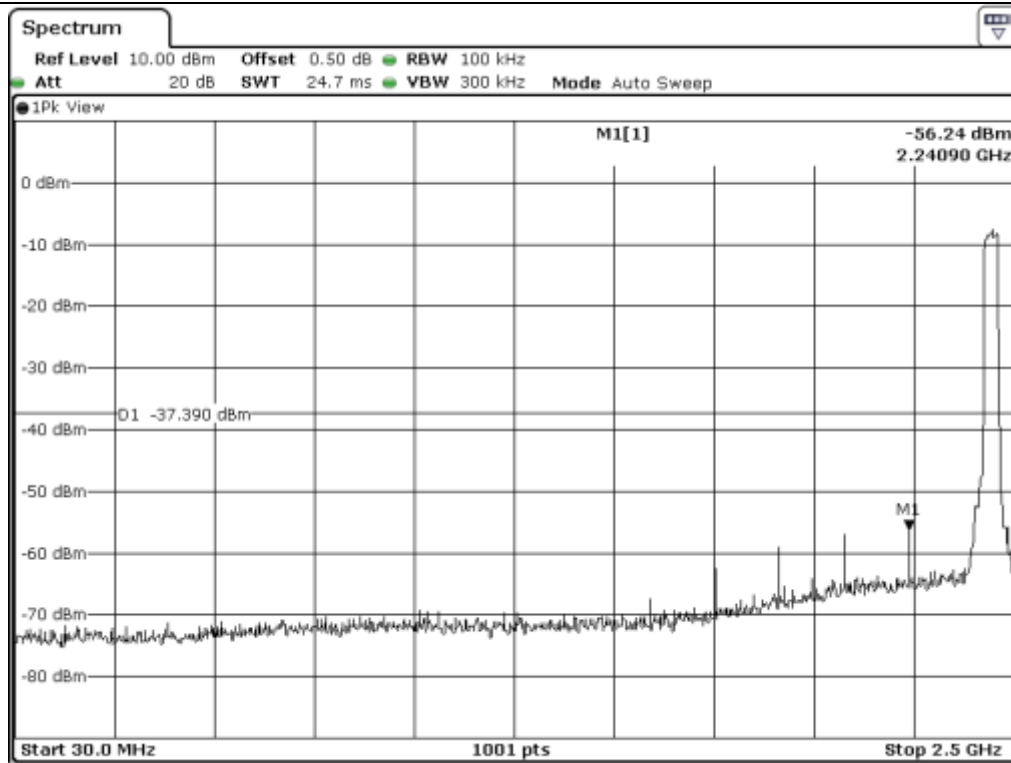
Middle Channel



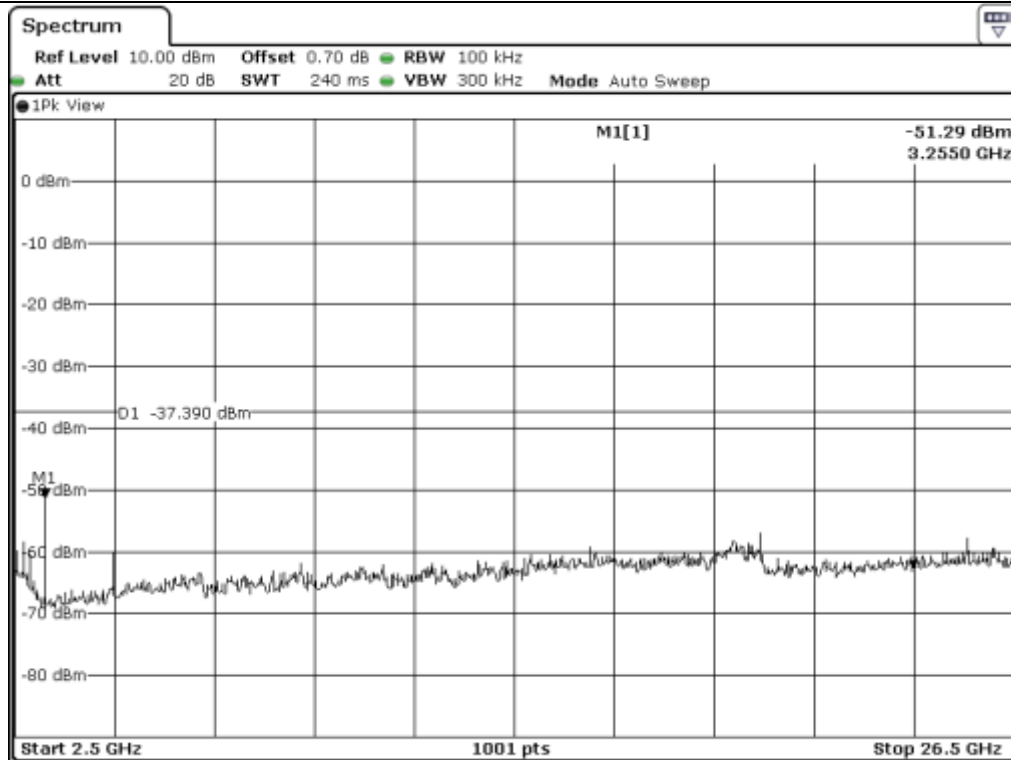
Low Channel



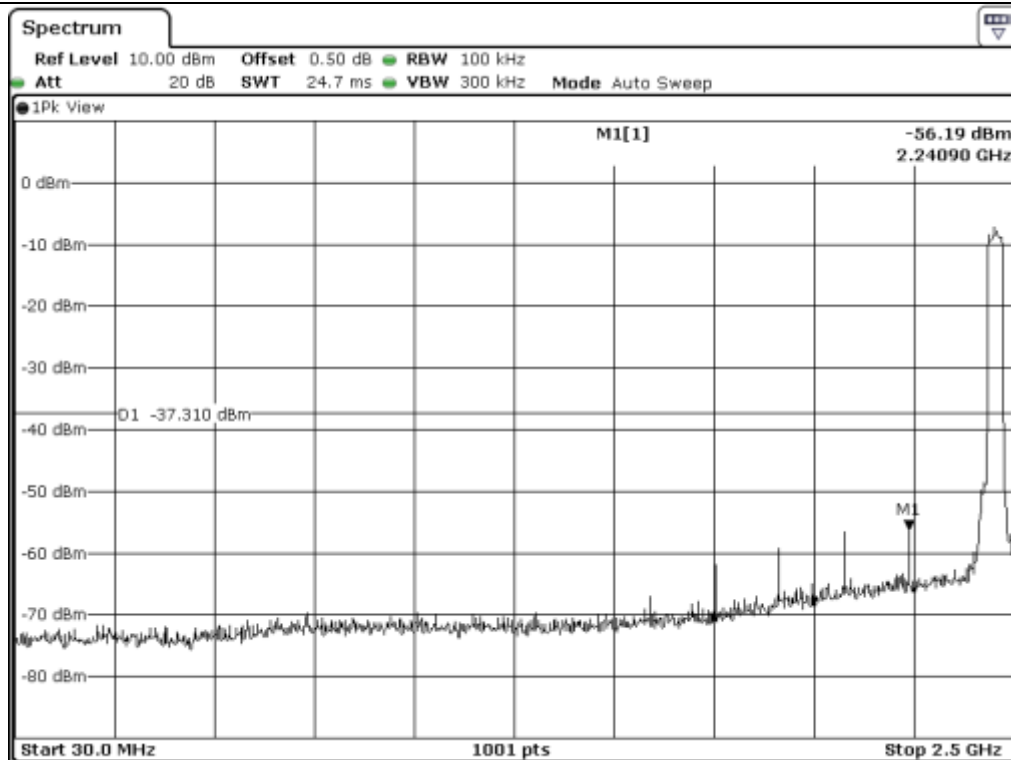
Low Channel



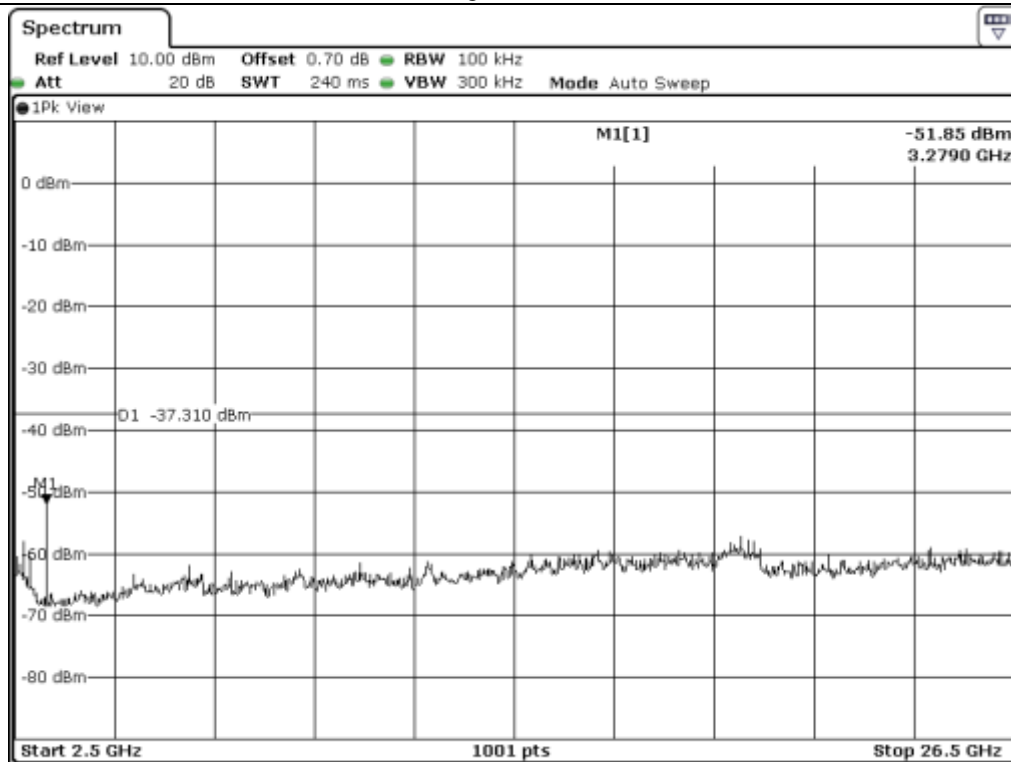
Middle Channel



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 802.11b WLAN Mode

- Test Date : July 20, 2017
- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Measurement distance : 3 m
- Duty Cycle : > 98 %
- 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 | 43.60 | Peak | H | 26.94 | 9.20 | 34.76 | 44.98 | 74.00 | 29.02 |
| | 39.47 | Average | H | | | | 40.85 | 54.00 | 13.15 |
| | 43.49 | Peak | V | | | | 44.87 | 74.00 | 29.13 |
| | 39.12 | Average | V | | | | 40.50 | 54.00 | 13.50 |
| Test Data for High Channel | | | | | | | | | |
| 2 483.50 | 43.26 | Peak | H | 27.47 | 9.49 | 35.51 | 44.71 | 74.00 | 29.29 |
| | 38.76 | Average | H | | | | 40.21 | 54.00 | 13.79 |
| | 42.94 | Peak | V | | | | 44.39 | 74.00 | 29.61 |
| | 38.51 | Average | V | | | | 39.96 | 54.00 | 14.04 |

Tabulated test data for Restricted Band

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

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

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

Tested by: Hyung-Kwon, Oh / Assistant Manager

9.6.1.2 Test data for 802.11g WLAN Mode

- Test Date : July 20, 2017
- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Measurement distance : 3 m
- Duty Cycle : > 98 %
- 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 | 44.21 | Peak | H | 26.94 | 9.20 | 34.76 | 45.59 | 74.00 | 28.41 |
| | 40.17 | Average | H | | | | 41.55 | 54.00 | 12.45 |
| | 44.02 | Peak | V | | | | 45.40 | 74.00 | 28.60 |
| | 39.88 | Average | V | | | | 41.26 | 54.00 | 12.74 |
| Test Data for High Channel | | | | | | | | | |
| 2 483.50 | 42.98 | Peak | H | 27.47 | 9.49 | 35.51 | 44.43 | 74.00 | 29.57 |
| | 38.44 | Average | H | | | | 39.89 | 54.00 | 14.11 |
| | 42.68 | Peak | V | | | | 44.13 | 74.00 | 29.87 |
| | 38.21 | Average | V | | | | 39.66 | 54.00 | 14.34 |

Tabulated test data for Restricted Band

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

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

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



Tested by: Hyung-Kwon, Oh / Assistant Manager

9.6.1.3 Test data for 802.11n_HT20 WLAN Mode

- Test Date : July 20, 2017
- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Measurement distance : 3 m
- Duty Cycle : > 98 %
- 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 | 44.68 | Peak | H | 26.94 | 9.20 | 34.76 | 46.06 | 74.00 | 27.94 |
| | 40.62 | Average | H | | | | 42.00 | 54.00 | 12.00 |
| | 44.77 | Peak | V | | | | 46.15 | 74.00 | 27.85 |
| | 40.34 | Average | V | | | | 41.72 | 54.00 | 12.28 |
| Test Data for High Channel | | | | | | | | | |
| 2 483.50 | 44.37 | Peak | H | 27.47 | 9.49 | 35.51 | 45.82 | 74.00 | 28.18 |
| | 39.82 | Average | H | | | | 41.27 | 54.00 | 12.73 |
| | 44.12 | Peak | V | | | | 45.57 | 74.00 | 28.43 |
| | 38.80 | Average | V | | | | 40.25 | 54.00 | 13.75 |

Tabulated test data for Restricted Band

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

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

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



Tested by: Hyung-Kwon, Oh / Assistant Manager

9.6.1.4 Test data for 802.11n_HT40 WLAN Mode

- Test Date : July 20, 2017
- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode
- Video bandwidth : 3 MHz for Peak and Average Mode
- Measurement distance : 3 m
- Duty Cycle : > 98 %
- 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 | 45.15 | Peak | H | 26.94 | 9.20 | 34.76 | 46.53 | 74.00 | 27.47 |
| | 41.08 | Average | H | | | | 42.46 | 54.00 | 11.54 |
| | 45.17 | Peak | V | | | | 46.55 | 74.00 | 27.45 |
| | 40.88 | Average | V | | | | 42.26 | 54.00 | 11.74 |
| Test Data for High Channel | | | | | | | | | |
| 2 483.50 | 45.00 | Peak | H | 27.47 | 9.49 | 35.51 | 46.45 | 74.00 | 27.55 |
| | 40.74 | Average | H | | | | 42.19 | 54.00 | 11.81 |
| | 44.35 | Peak | V | | | | 45.80 | 74.00 | 28.20 |
| | 40.42 | Average | V | | | | 41.87 | 54.00 | 12.13 |

Tabulated test data for Restricted Band

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

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

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



Tested by: Hyung-Kwon, Oh / Assistant Manager

9.6.2 Radiated Emission which fall in the Band Edge

9.6.2.2 Test data for 802.11b WLAN Mode

- . Test Date : July 20, 2017
- . Resolution bandwidth : 100 kHz and Peak Detector for Peak Mode
100 kHz and RMS Detector for Average Mode
- . Video bandwidth : 300 kHz for Peak and Average Mode
- . Measurement distance : 3 m
- . Duty Cycle : > 98 %
- . 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 | | | | | | | | | |
| 2 400.00 | 50.74 | Peak | H | 27.20 | 9.35 | 34.81 | 52.48 | 74.00 | 21.52 |
| | 45.86 | Average | H | | | | 47.60 | 54.00 | 6.40 |
| | 50.49 | Peak | V | | | | 52.23 | 74.00 | 21.77 |
| | 45.43 | Average | V | | | | 47.17 | 54.00 | 6.83 |

Tabulated test data for Restricted Band

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

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

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



Tested by: Hyung-Kwon, Oh / Assistant Manager

9.6.2.2 Test data for 802.11g WLAN Mode

- Test Date : July 20, 2017
- Resolution bandwidth : 100 kHz and Peak Detector for Peak Mode
100 kHz and RMS Detector for Average Mode
- Video bandwidth : 300 kHz for Peak and Average Mode
- Measurement distance : 3 m
- Duty Cycle : > 98 %
- 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 | | | | | | | | | |
| 2 400.00 | 51.16 | Peak | H | 27.20 | 9.35 | 34.81 | 52.90 | 74.00 | 21.10 |
| | 46.24 | Average | H | | | | 47.98 | 54.00 | 6.02 |
| | 50.89 | Peak | V | | | | 52.63 | 74.00 | 21.37 |
| | 45.72 | Average | V | | | | 47.46 | 54.00 | 6.54 |

Tabulated test data for Restricted Band

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

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

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



Tested by: Hyung-Kwon, Oh / Assistant Manager

9.6.2.3 Test data for 802.11n_HT20 WLAN Mode

- . Test Date : July 20, 2017
- . Resolution bandwidth : 100 kHz and Peak Detector for Peak Mode
100 kHz and RMS Detector for Average Mode
- . Video bandwidth : 300 kHz for Peak and Average Mode
- . Measurement distance : 3 m
- . Duty Cycle : > 98 %
- . 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 | | | | | | | | | |
| 2 400.00 | 51.96 | Peak | H | 27.20 | 9.35 | 34.81 | 53.70 | 74.00 | 20.30 |
| | 47.01 | Average | H | | | | 48.75 | 54.00 | 5.25 |
| | 51.62 | Peak | V | | | | 53.36 | 74.00 | 20.64 |
| | 46.75 | Average | V | | | | 48.49 | 54.00 | 5.51 |

Tabulated test data for Restricted Band

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

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

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



Tested by: Hyung-Kwon, Oh / Assistant Manager

9.6.2.4 Test data for 802.11n_HT40 WLAN Mode

- . Test Date : July 20, 2017
- . Resolution bandwidth : 100 kHz and Peak Detector for Peak Mode
100 kHz and RMS Detector for Average Mode
- . Video bandwidth : 300 kHz for Peak and Average Mode
- . Measurement distance : 3 m
- . Duty Cycle : > 98 %
- . 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 | | | | | | | | | |
| 2 400.00 | 52.57 | Peak | H | 27.20 | 9.35 | 34.81 | 54.31 | 74.00 | 19.69 |
| | 47.61 | Average | H | | | | 49.35 | 54.00 | 4.65 |
| | 52.36 | Peak | V | | | | 54.10 | 74.00 | 19.90 |
| | 47.11 | Average | V | | | | 48.85 | 54.00 | 5.15 |

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: Hyung-Kwon, Oh / Assistant Manager

9.6.3 Spurious & Harmonic Radiated Emission

9.6.3.1 Test data for 802.11b WLAN Mode

- Test Date : July 20, 2017
- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 3 MHz for Peak and Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Duty Cycle : > 98 %
- Result : PASSED

| Frequency (GHz) | Reading (dBμV) | Detector Mode | Ant. Pol. (H/V) | Ant. Factor | Cable Loss | Amp Gain | Total (dBμV/m) | Limits (dBμV/m) | Margin (dB) |
|------------------------------|-------------------|------------------|--------------------|----------------|---------------|-------------|-------------------|--------------------|----------------|
| Test Data for Low Channel | | | | | | | | | |
| 4 824.00 | 41.52 | Peak | H | 30.84 | 12.31 | 35.74 | 48.93 | 74.00 | 25.07 |
| | 37.27 | Average | H | | | | 44.68 | 54.00 | 9.32 |
| | 41.14 | Peak | V | | | | 48.55 | 74.00 | 25.45 |
| | 36.96 | Average | V | | | | 44.37 | 54.00 | 9.63 |
| Test Data for Middle Channel | | | | | | | | | |
| 4 884.00 | 41.60 | Peak | H | 30.01 | 12.43 | 35.80 | 48.24 | 74.00 | 25.76 |
| | 37.38 | Average | H | | | | 44.02 | 54.00 | 9.98 |
| | 41.26 | Peak | V | | | | 47.90 | 74.00 | 26.10 |
| | 36.98 | Average | V | | | | 43.62 | 54.00 | 10.38 |
| Test Data for High Channel | | | | | | | | | |
| 4 924.00 | 41.27 | Peak | H | 31.15 | 12.81 | 35.96 | 49.27 | 74.00 | 24.73 |
| | 37.14 | Average | H | | | | 45.14 | 54.00 | 8.86 |
| | 41.07 | Peak | V | | | | 49.07 | 74.00 | 24.93 |
| | 36.78 | Average | V | | | | 44.78 | 54.00 | 9.22 |

Tabulated test data for Restricted Band

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

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

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

Tested by: Hyung-Kwon, Oh / Assistant Manager

9.6.3.2 Test data for 802.11g WLAN Mode

- Test Date : July 20, 2017
- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 3 MHz for Peak and Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Duty Cycle : > 98 %
- Result : PASSED

| Frequency (GHz) | Reading (dBμV) | Detector Mode | Ant. Pol. (H/V) | Ant. Factor | Cable Loss | Amp Gain | Total (dBμV/m) | Limits (dBμV/m) | Margin (dB) |
|------------------------------|-------------------|------------------|--------------------|----------------|---------------|-------------|-------------------|--------------------|----------------|
| Test Data for Low Channel | | | | | | | | | |
| 4 824.00 | 42.35 | Peak | H | 30.84 | 12.31 | 35.74 | 49.76 | 74.00 | 24.24 |
| | 37.38 | Average | H | | | | 44.79 | 54.00 | 9.21 |
| | 41.37 | Peak | V | | | | 48.78 | 74.00 | 25.22 |
| | 37.20 | Average | V | | | | 44.61 | 54.00 | 9.39 |
| Test Data for Middle Channel | | | | | | | | | |
| 4 884.00 | 42.53 | Peak | H | 30.01 | 12.43 | 35.80 | 49.17 | 74.00 | 24.83 |
| | 37.60 | Average | H | | | | 44.24 | 54.00 | 9.76 |
| | 41.42 | Peak | V | | | | 48.06 | 74.00 | 25.94 |
| | 37.57 | Average | V | | | | 44.21 | 54.00 | 9.79 |
| Test Data for High Channel | | | | | | | | | |
| 4 924.00 | 41.43 | Peak | H | 31.15 | 12.81 | 35.96 | 49.43 | 74.00 | 24.57 |
| | 37.95 | Average | H | | | | 45.95 | 54.00 | 8.05 |
| | 41.45 | Peak | V | | | | 49.45 | 74.00 | 24.55 |
| | 37.84 | Average | V | | | | 45.84 | 54.00 | 8.16 |

Tabulated test data for Restricted Band

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

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

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

Tested by: Hyung-Kwon, Oh / Assistant Manager

9.6.3.3 Test data for 802.11n_HT20 WLAN Mode

- Test Date : July 20, 2017
- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 3 MHz for Peak and Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Duty Cycle : > 98 %
- Result : PASSED

| Frequency (GHz) | Reading (dBμV) | Detector Mode | Ant. Pol. (H/V) | Ant. Factor | Cable Loss | Amp Gain | Total (dBμV/m) | Limits (dBμV/m) | Margin (dB) |
|------------------------------|-------------------|------------------|--------------------|----------------|---------------|-------------|-------------------|--------------------|----------------|
| Test Data for Low Channel | | | | | | | | | |
| 4 824.00 | 42.53 | Peak | H | 30.84 | 12.31 | 35.74 | 49.94 | 74.00 | 24.06 |
| | 37.81 | Average | H | | | | 45.22 | 54.00 | 8.78 |
| | 41.89 | Peak | V | | | | 49.30 | 74.00 | 24.70 |
| | 37.07 | Average | V | | | | 44.48 | 54.00 | 9.52 |
| Test Data for Middle Channel | | | | | | | | | |
| 4 884.00 | 42.93 | Peak | H | 30.01 | 12.43 | 35.80 | 49.57 | 74.00 | 24.43 |
| | 37.74 | Average | H | | | | 44.38 | 54.00 | 9.62 |
| | 42.33 | Peak | V | | | | 48.97 | 74.00 | 25.03 |
| | 37.80 | Average | V | | | | 44.44 | 54.00 | 9.56 |
| Test Data for High Channel | | | | | | | | | |
| 4 924.00 | 41.93 | Peak | H | 31.15 | 12.81 | 35.96 | 49.93 | 74.00 | 24.07 |
| | 37.41 | Average | H | | | | 45.41 | 54.00 | 8.59 |
| | 41.07 | Peak | V | | | | 49.07 | 74.00 | 24.93 |
| | 37.60 | Average | V | | | | 45.60 | 54.00 | 8.40 |

Tabulated test data for Restricted Band

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

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

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

Tested by: Hyung-Kwon, Oh / Assistant Manager

9.6.3.4 Test data for 802.11n_HT40 WLAN Mode

- Test Date : July 20, 2017
- Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 3 MHz for Peak and Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Duty Cycle : > 98 %
- Result : PASSED

| Frequency (GHz) | Reading (dBμV) | Detector Mode | Ant. Pol. (H/V) | Ant. Factor | Cable Loss | Amp Gain | Total (dBμV/m) | Limits (dBμV/m) | Margin (dB) |
|------------------------------|-------------------|------------------|--------------------|----------------|---------------|-------------|-------------------|--------------------|----------------|
| Test Data for Low Channel | | | | | | | | | |
| 4 844.00 | 42.21 | Peak | H | 30.84 | 12.31 | 35.76 | 49.60 | 74.00 | 24.40 |
| | 37.40 | Average | H | | | | 44.79 | 54.00 | 9.21 |
| | 41.15 | Peak | V | | | | 48.54 | 74.00 | 25.46 |
| | 37.19 | Average | V | | | | 44.58 | 54.00 | 9.42 |
| Test Data for Middle Channel | | | | | | | | | |
| 4 884.00 | 42.13 | Peak | H | 30.01 | 12.43 | 35.80 | 48.77 | 74.00 | 25.23 |
| | 37.71 | Average | H | | | | 44.35 | 54.00 | 9.65 |
| | 41.69 | Peak | V | | | | 48.33 | 74.00 | 25.67 |
| | 37.07 | Average | V | | | | 43.71 | 54.00 | 10.29 |
| Test Data for High Channel | | | | | | | | | |
| 4 904.00 | 41.04 | Peak | H | 31.15 | 12.81 | 35.94 | 49.06 | 74.00 | 24.94 |
| | 37.49 | Average | H | | | | 45.51 | 54.00 | 8.49 |
| | 41.05 | Peak | V | | | | 49.07 | 74.00 | 24.93 |
| | 37.06 | Average | V | | | | 45.08 | 54.00 | 8.92 |

Tabulated test data for Restricted Band

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

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

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

Tested by: Hyung-Kwon, Oh / Assistant Manager

10. PEAK POWER SPECTRUL DENSITY

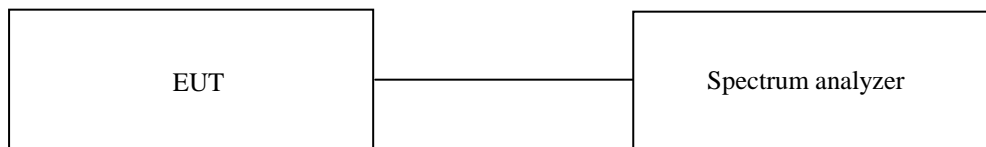
10.1 Operating environment

Temperature : 23 °C
Relative humidity : 41 % 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 $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$, the video bandwidth is set to 3 times the resolution bandwidth.



10.3 Test equipment used

| Model Number | Manufacturer | Description | Serial Number | Last Cal. |
|--------------|-----------------|-----------------|---------------|--------------------|
| ■ - FSV40 | Rohde & Schwarz | Signal Analyzer | 101009 | Apr. 05, 2017 (1Y) |

All test equipment used is calibrated on a regular basis.

10.4 Test data for 802.11b WLAN Mode

10.4.1 Test data for Antenna 0

-. Test Date : July 17, 2017

-. Test Result : Pass

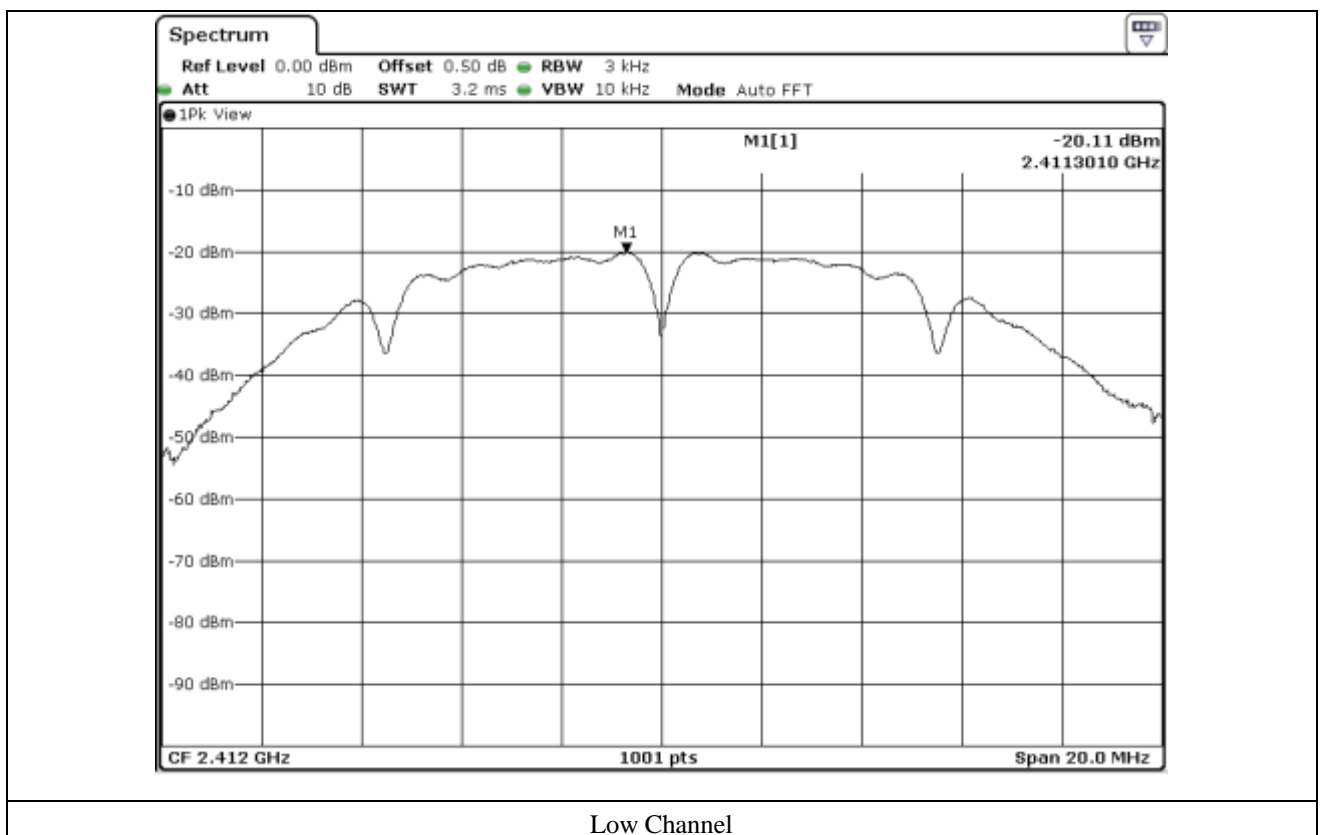
-. Operating Condition : Continuous transmitting mode

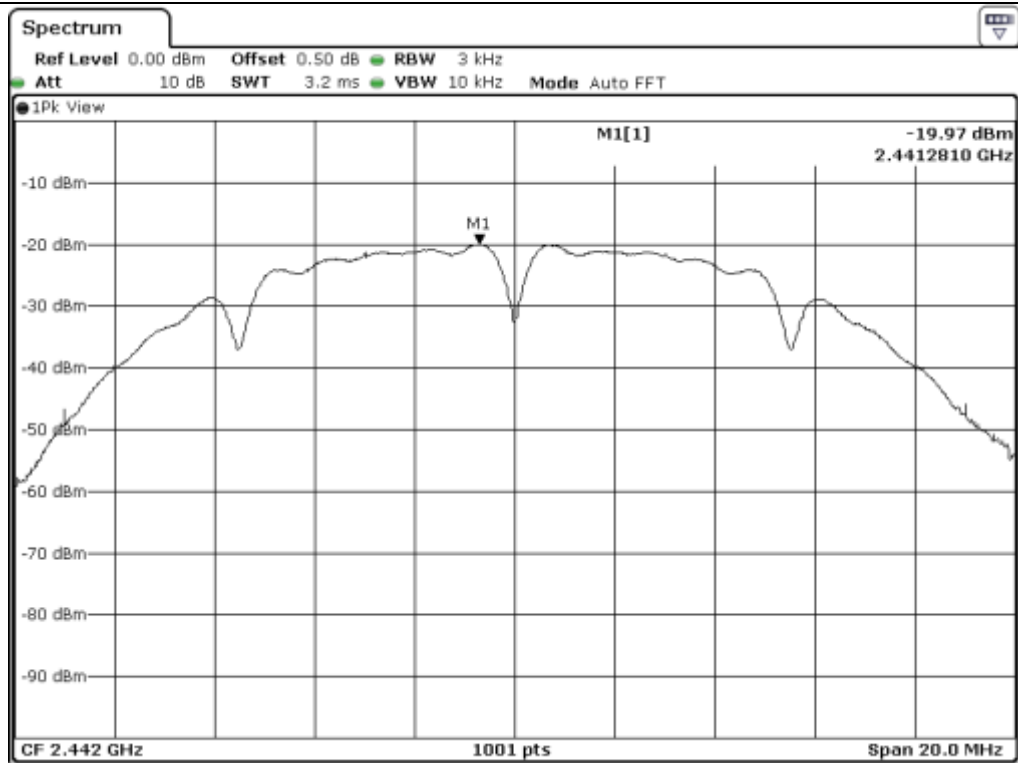
| CHANNEL | FREQUENCY(MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|----------------|----------------------|-------------|-------------|
| Low | 2 412.00 | -20.11 | 8.00 | 28.11 |
| Middle | 2 442.00 | -19.97 | 8.00 | 27.97 |
| High | 2 462.00 | -19.91 | 8.00 | 27.91 |

Remark. Margin = Limit – Measured value

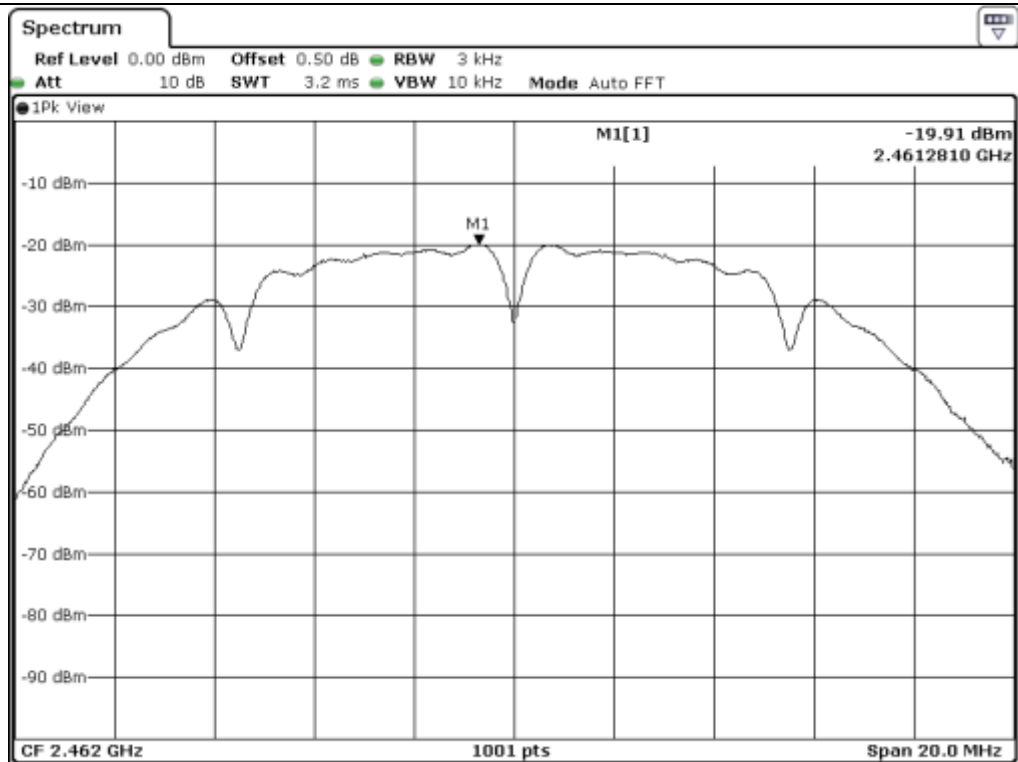


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

10.4.2 Test data for Antenna 1

-. Test Date : July 17, 2017

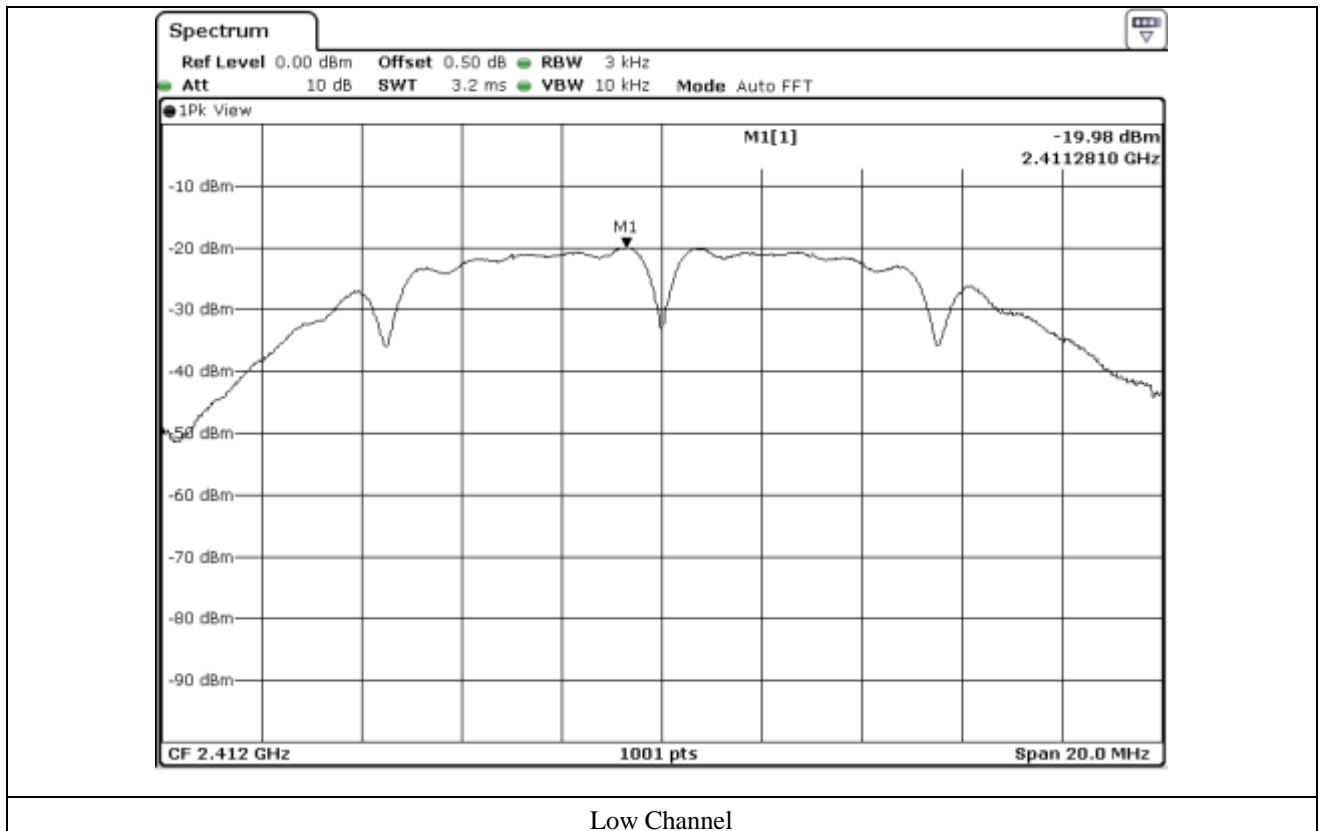
-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

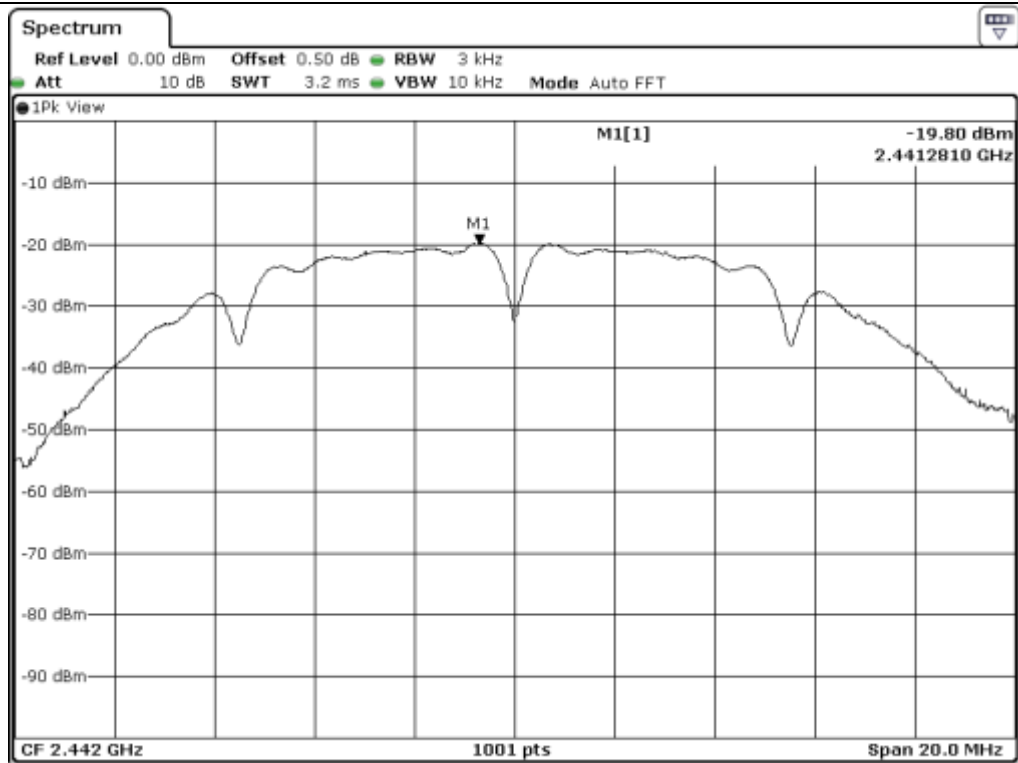
| CHANNEL | FREQUENCY(MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|----------------|----------------------|-------------|-------------|
| Low | 2 412.00 | -19.98 | 8.00 | 27.98 |
| Middle | 2 442.00 | -19.80 | 8.00 | 27.80 |
| High | 2 462.00 | -19.70 | 8.00 | 27.70 |

Remark. Margin = Limit – Measured value

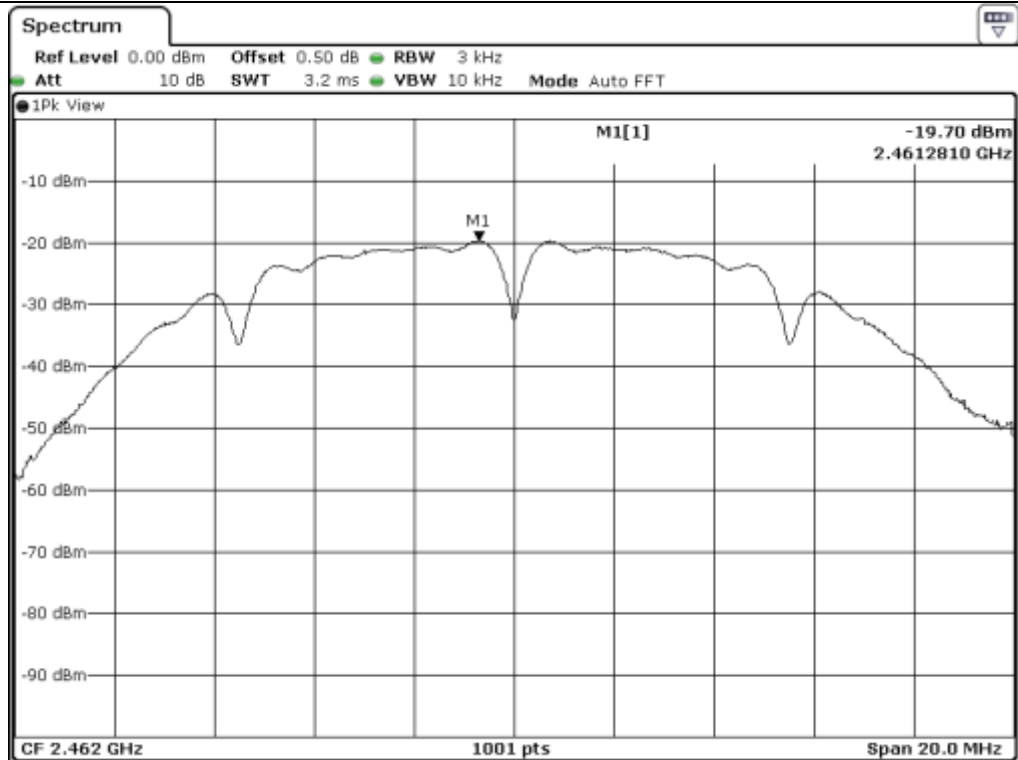
Tested by: Hyung-Kwon, Oh / Assistant Manager



Low Channel



Middle Channel



High Channel

10.4.3 Test data for Multiple Antenna

-. Test Date : July 17, 2017

-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

| CHANNEL | FREQUENCY(MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|----------------|----------------------|-------------|-------------|
| Low | 2 412.00 | -17.03 | 8.00 | 25.03 |
| Middle | 2 442.00 | -16.87 | 8.00 | 24.87 |
| High | 2 462.00 | -16.79 | 8.00 | 24.79 |

Remark 1 : Margin = Limit – Measured value

Remark 2 : Calculated Power Density = $10\log(10^{(\text{Antenna 0 Power Density}/10)} + 10^{(\text{Antenna 1 Power Density}/10)})$



Tested by: Hyung-Kwon, Oh / Assistant Manager

10.5 Test data for 802.11g WLAN Mode

10.5.1 Test data for Antenna 0

-. Test Date : July 17, 2017

-. Test Result : Pass

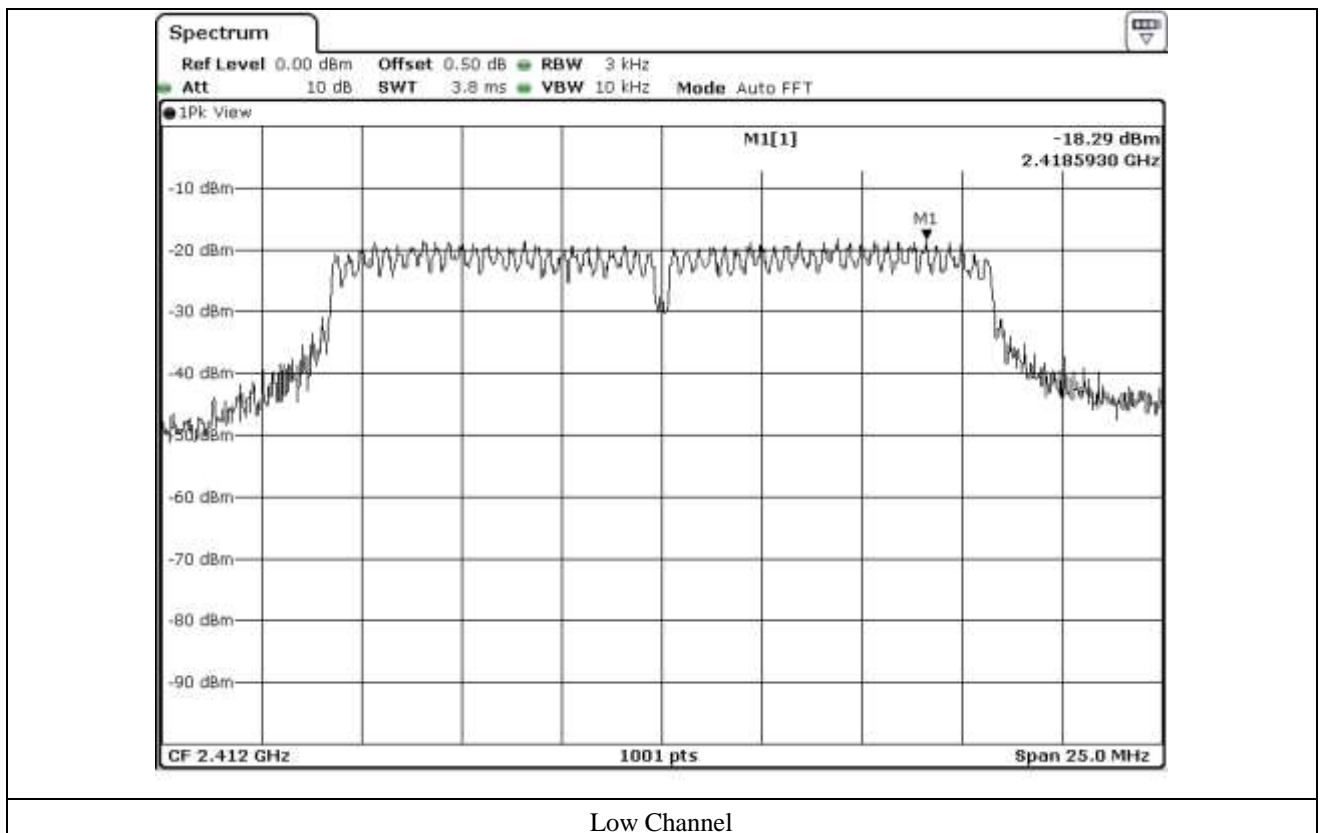
-. Operating Condition : Continuous transmitting mode

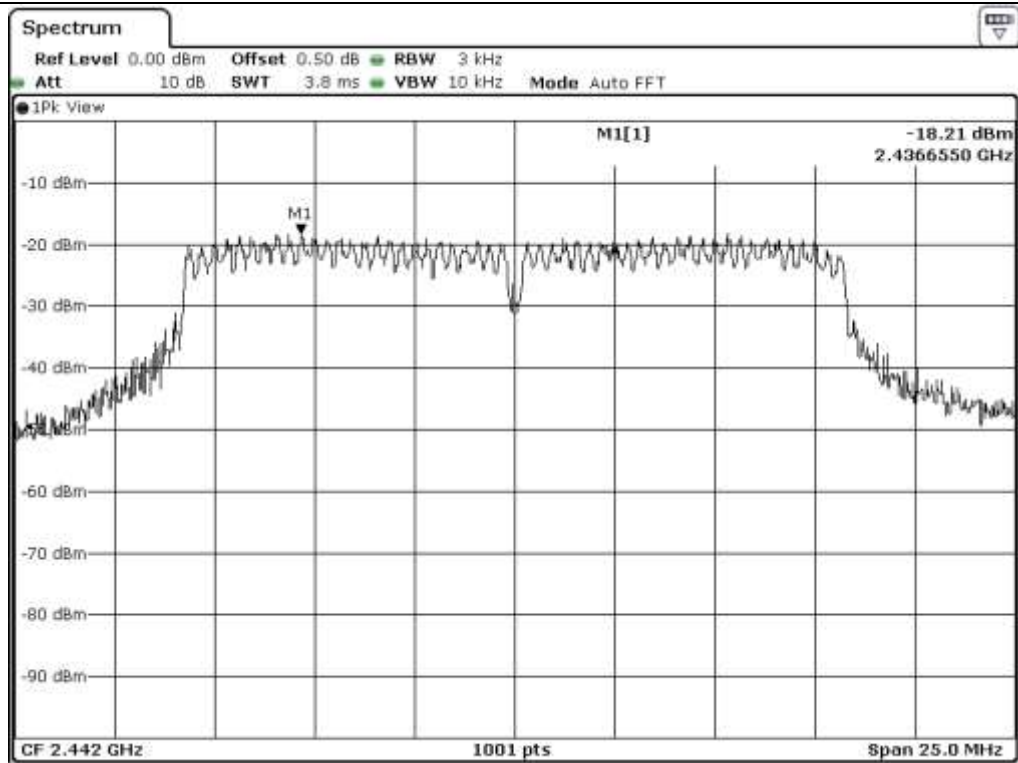
| CHANNEL | FREQUENCY(MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|----------------|----------------------|-------------|-------------|
| Low | 2 412.00 | -18.29 | 8.00 | 26.29 |
| Middle | 2 442.00 | -18.21 | 8.00 | 26.21 |
| High | 2 462.00 | -18.12 | 8.00 | 26.12 |

Remark. Margin = Limit – Measured value

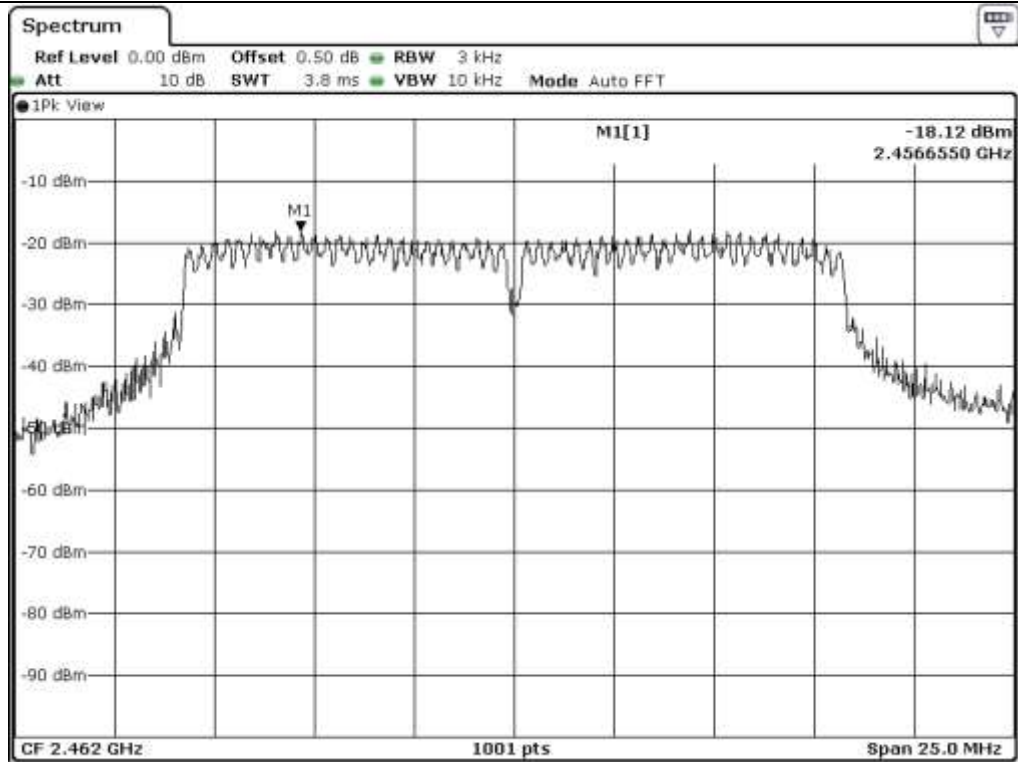


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

10.5.2 Test data for Antenna 1

-. Test Date : July 17, 2017

-. Test Result : Pass

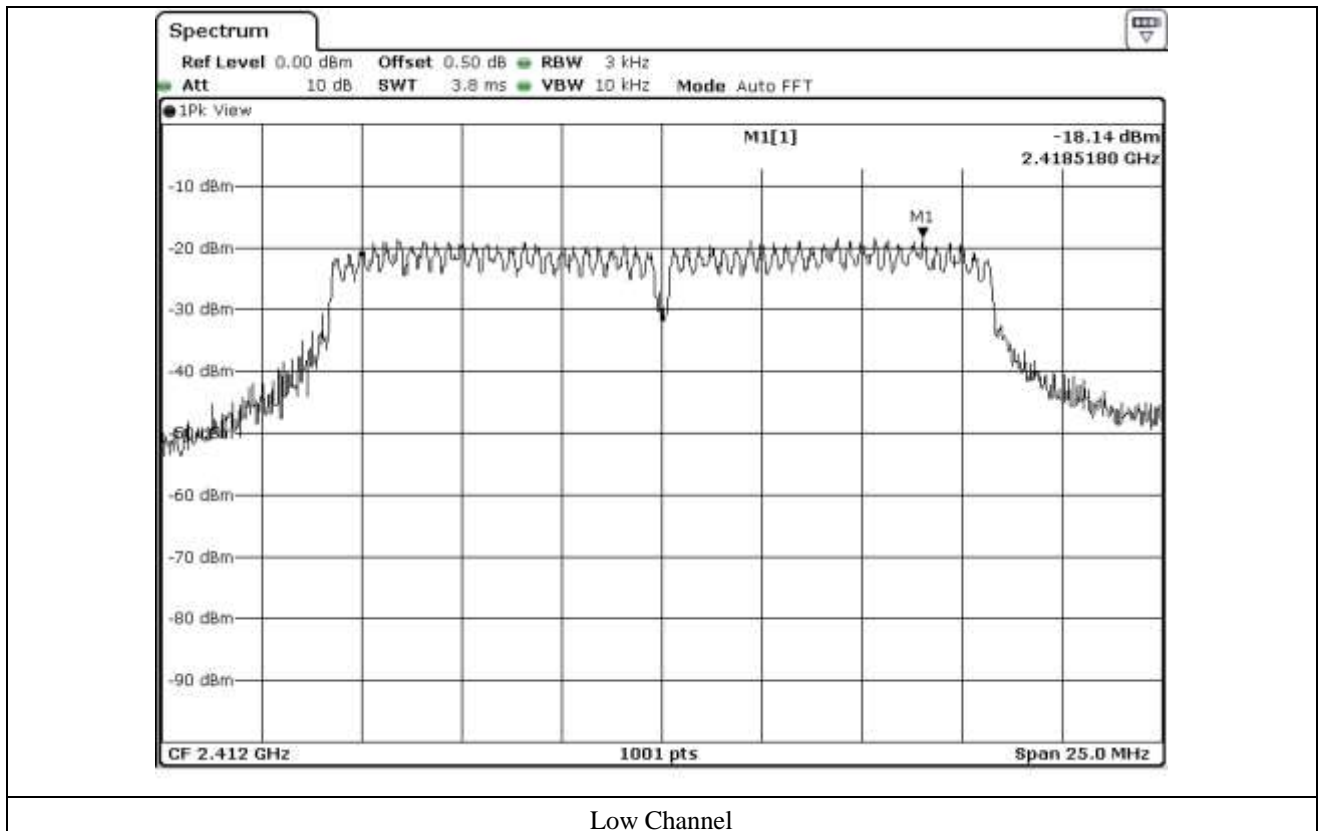
-. Operating Condition : Continuous transmitting mode

| CHANNEL | FREQUENCY(MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|----------------|----------------------|-------------|-------------|
| Low | 2 412.00 | -18.14 | 8.00 | 26.14 |
| Middle | 2 442.00 | -18.27 | 8.00 | 26.27 |
| High | 2 462.00 | -18.15 | 8.00 | 26.15 |

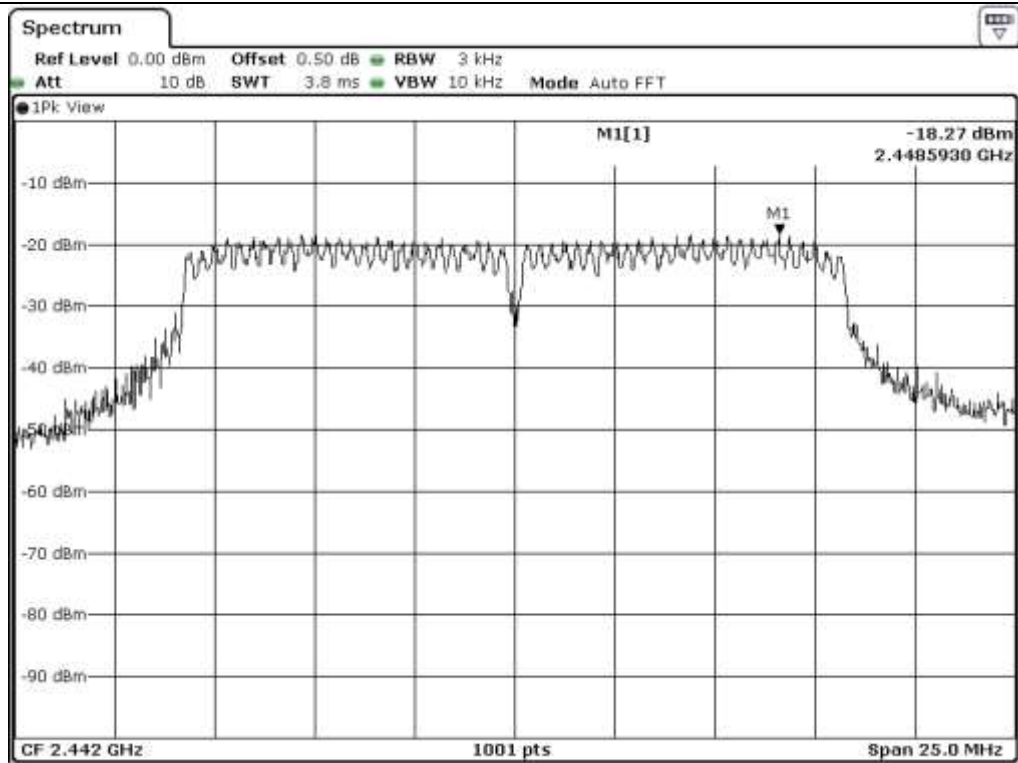
Remark. Margin = Limit – Measured value



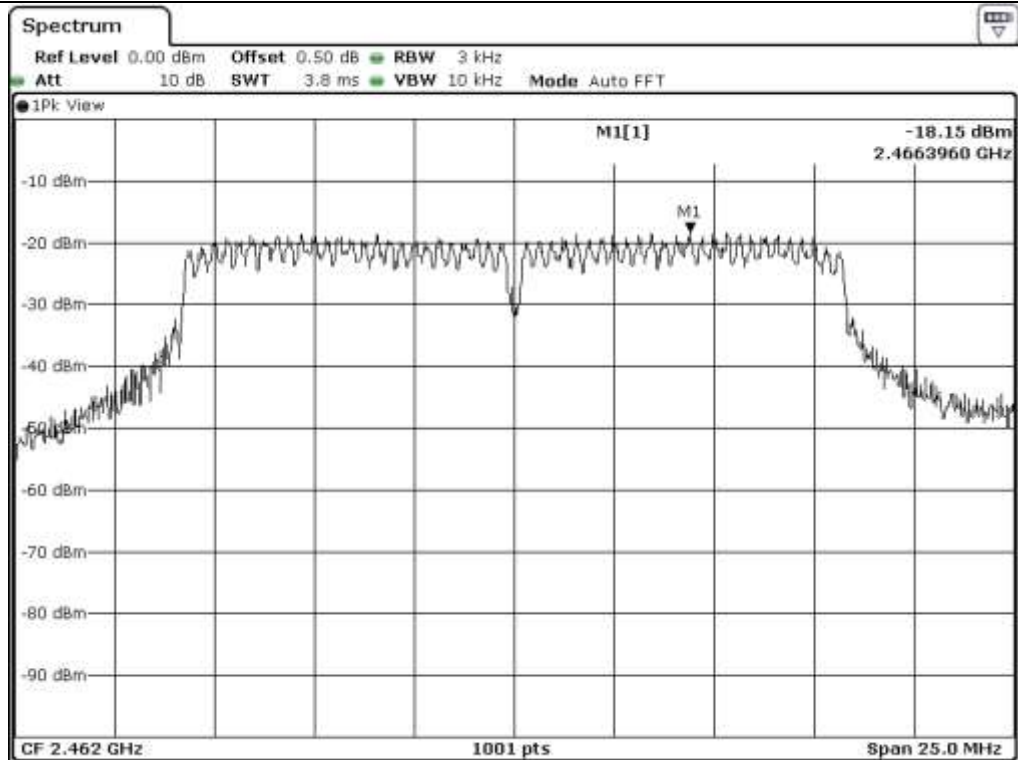
Tested by: Hyung-Kwon, Oh / Assistant Manager



Low Channel



Middle Channel



High Channel

10.5.3 Test data for Multiple Antenna

-. Test Date : July 17, 2017

-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

| CHANNEL | FREQUENCY(MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|----------------|----------------------|-------------|-------------|
| Low | 2 412.00 | -15.20 | 8.00 | 23.20 |
| Middle | 2 442.00 | -15.23 | 8.00 | 23.23 |
| High | 2 462.00 | -15.12 | 8.00 | 23.12 |

Remark 1 : Margin = Limit – Measured value

Remark 2 : Calculated Power Density = $10\log(10^{(\text{Antenna 0 Power Density}/10)} + 10^{(\text{Antenna 1 Power Density}/10)})$



Tested by: Hyung-Kwon, Oh / Assistant Manager

10.6 Test data for 802.11n_HT20 WLAN Mode

10.6.1 Test data for Antenna 0

-. Test Date : July 17, 2017

-. Test Result : Pass

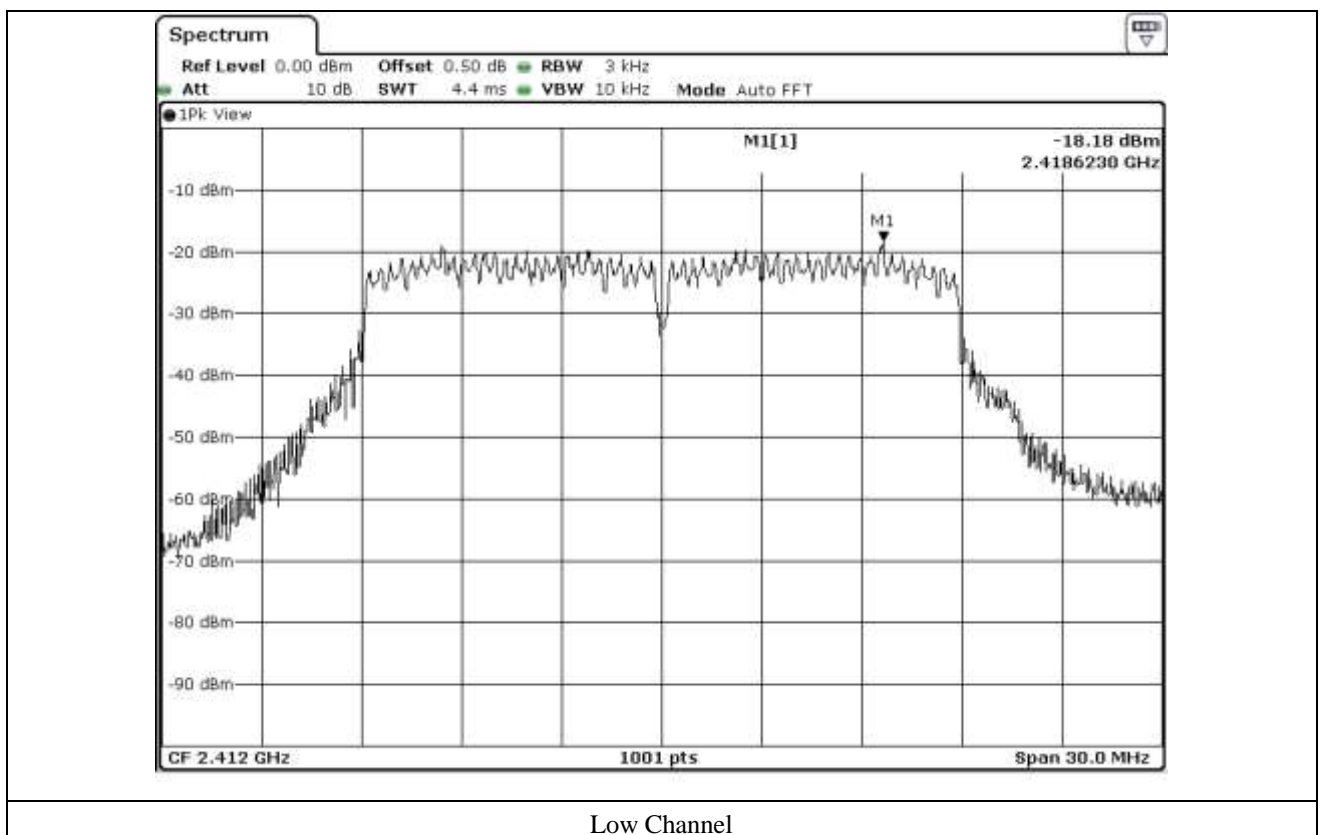
-. Operating Condition : Continuous transmitting mode

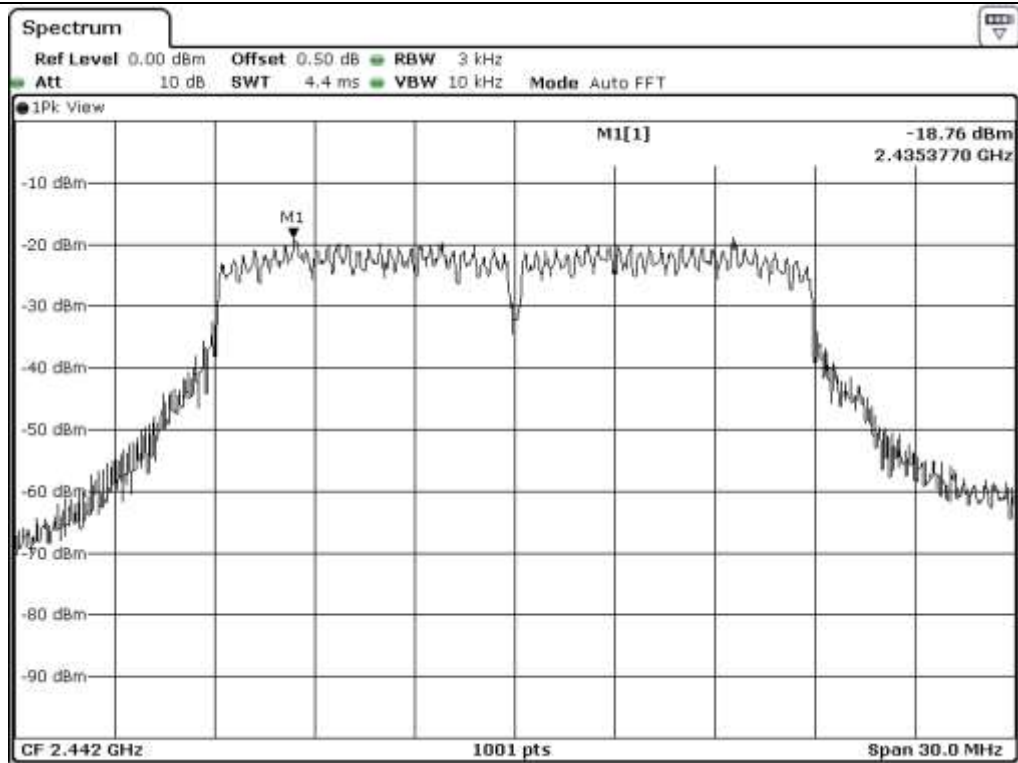
| CHANNEL | FREQUENCY(MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|----------------|----------------------|-------------|-------------|
| Low | 2 412.00 | -18.18 | 8.00 | 26.18 |
| Middle | 2 442.00 | -18.76 | 8.00 | 26.76 |
| High | 2 462.00 | -18.08 | 8.00 | 26.08 |

Remark. Margin = Limit – Measured value

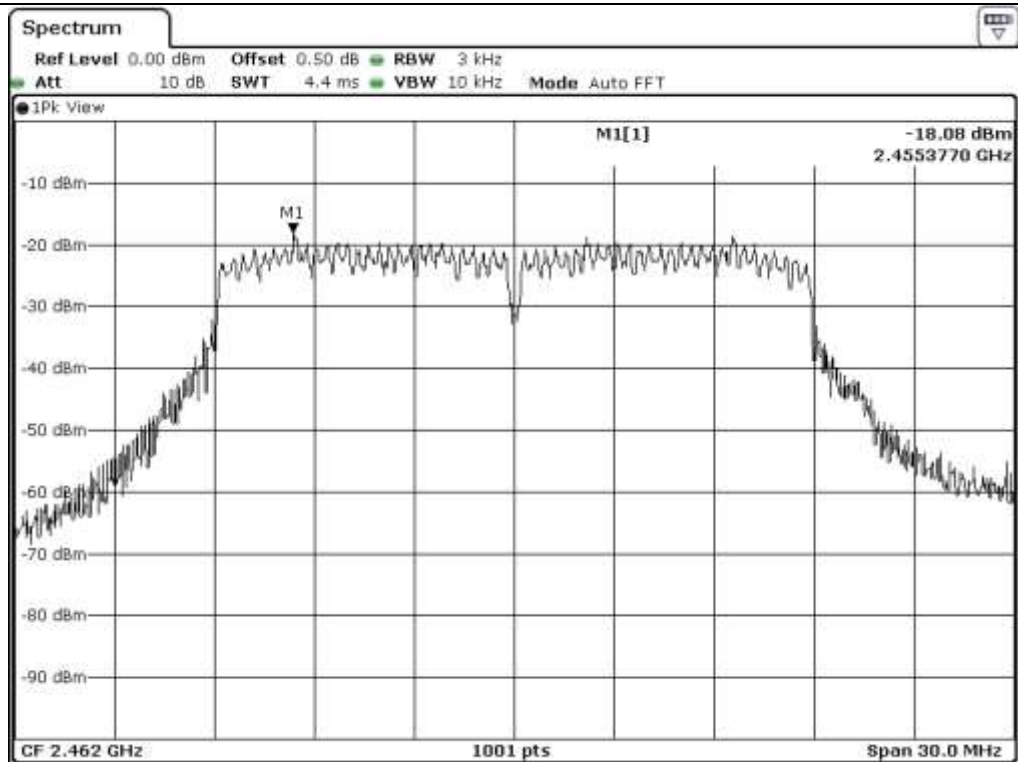


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

10.6.2 Test data for Antenna 1

-. Test Date : July 17, 2017

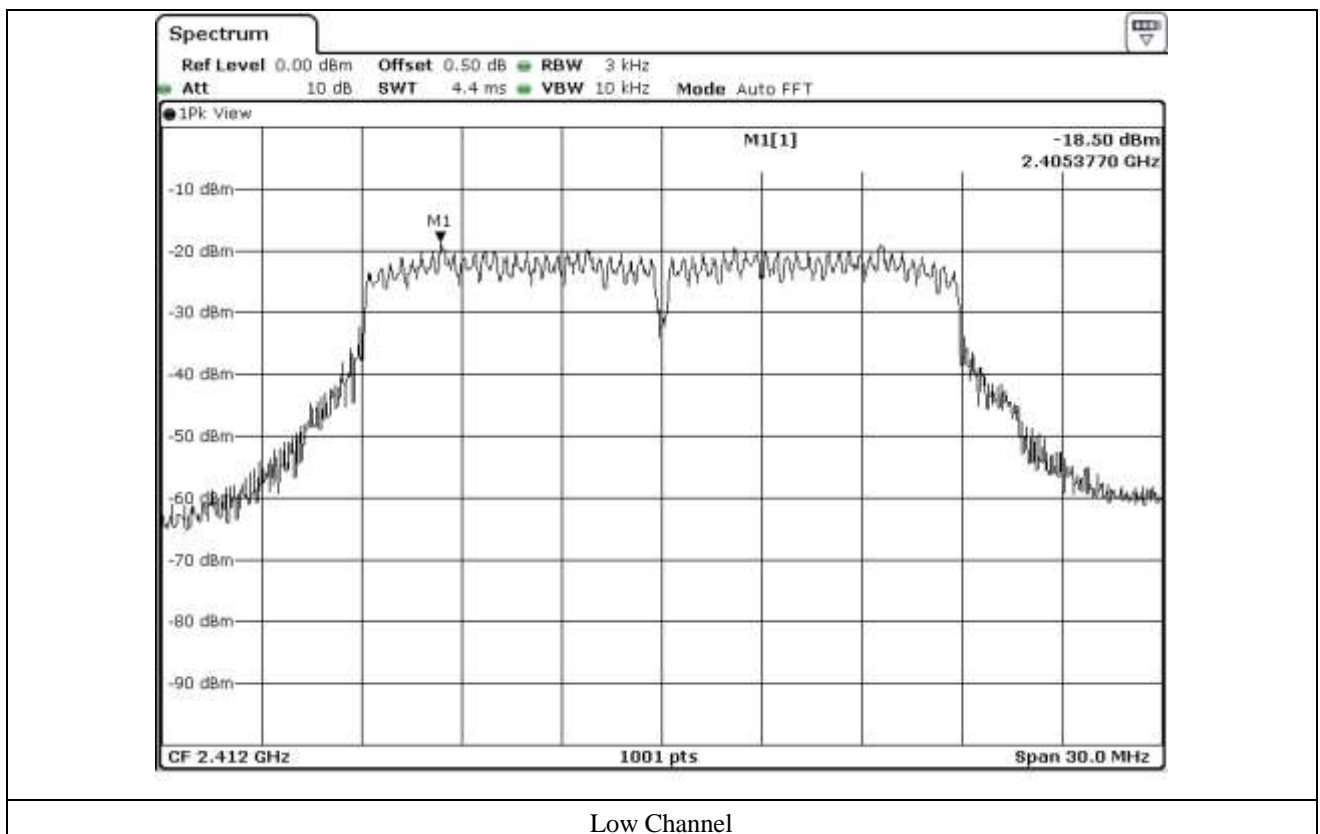
-. Test Result : Pass

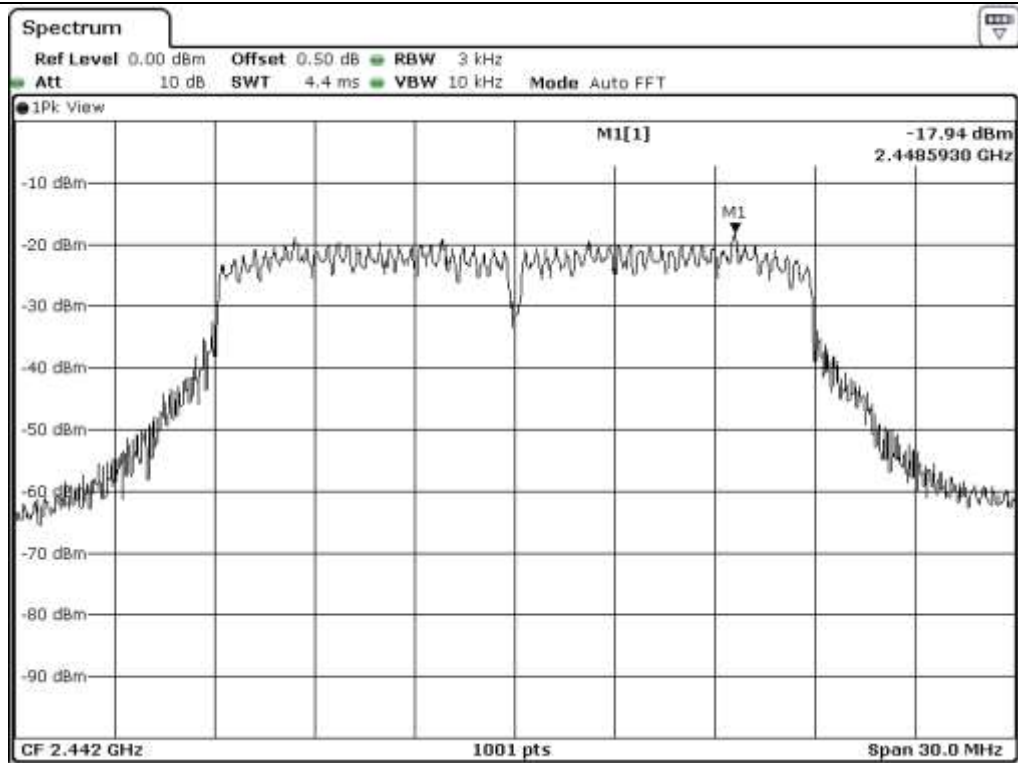
-. Operating Condition : Continuous transmitting mode

| CHANNEL | FREQUENCY(MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|----------------|----------------------|-------------|-------------|
| Low | 2 412.00 | -18.50 | 8.00 | 26.50 |
| Middle | 2 442.00 | -17.94 | 8.00 | 25.94 |
| High | 2 462.00 | -18.85 | 8.00 | 26.85 |

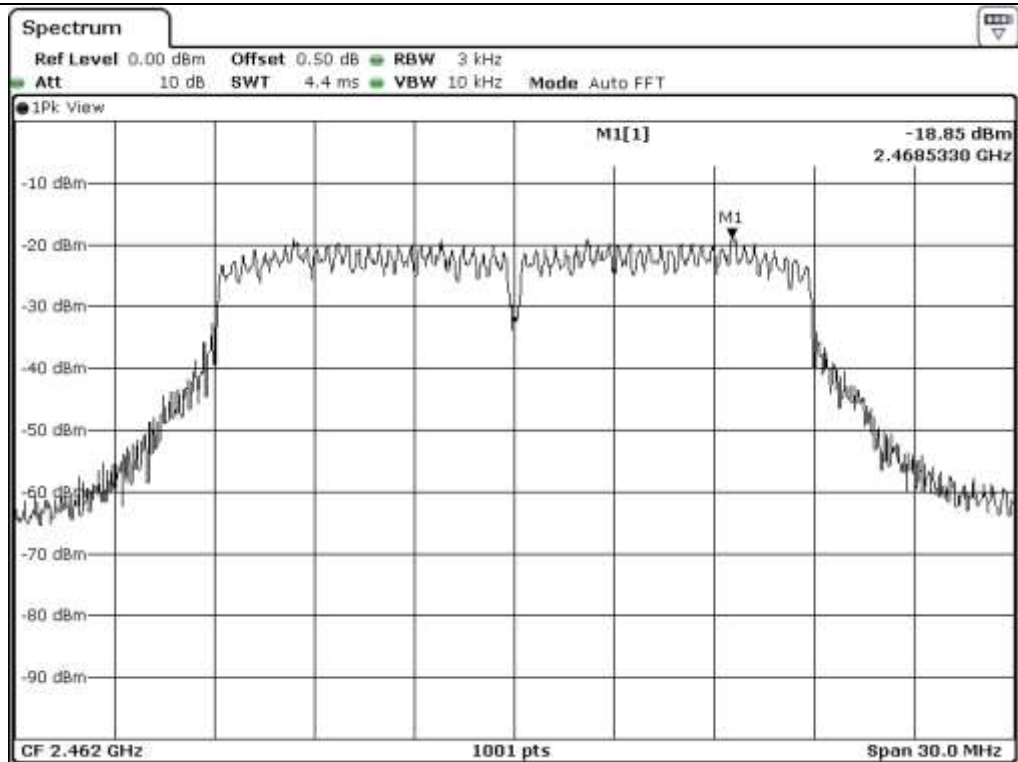
Remark. Margin = Limit – Measured value

Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

10.6.3 Test data for Multiple Antenna

-. Test Date : July 17, 2017

-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

| CHANNEL | FREQUENCY(MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|----------------|----------------------|-------------|-------------|
| Low | 2 412.00 | -15.33 | 8.00 | 23.33 |
| Middle | 2 442.00 | -15.32 | 8.00 | 23.32 |
| High | 2 462.00 | -15.44 | 8.00 | 23.44 |

Remark 1 : Margin = Limit – Measured value

Remark 2 : Calculated Power Density = $10\log(10^{(\text{Antenna 0 Power Density}/10)} + 10^{(\text{Antenna 1 Power Density}/10)})$



Tested by: Hyung-Kwon, Oh / Assistant Manager

10.7 Test data for 802.11n_HT40 WLAN Mode

10.7.1 Test data for Antenna 0

-. Test Date : July 17, 2017

-. Test Result : Pass

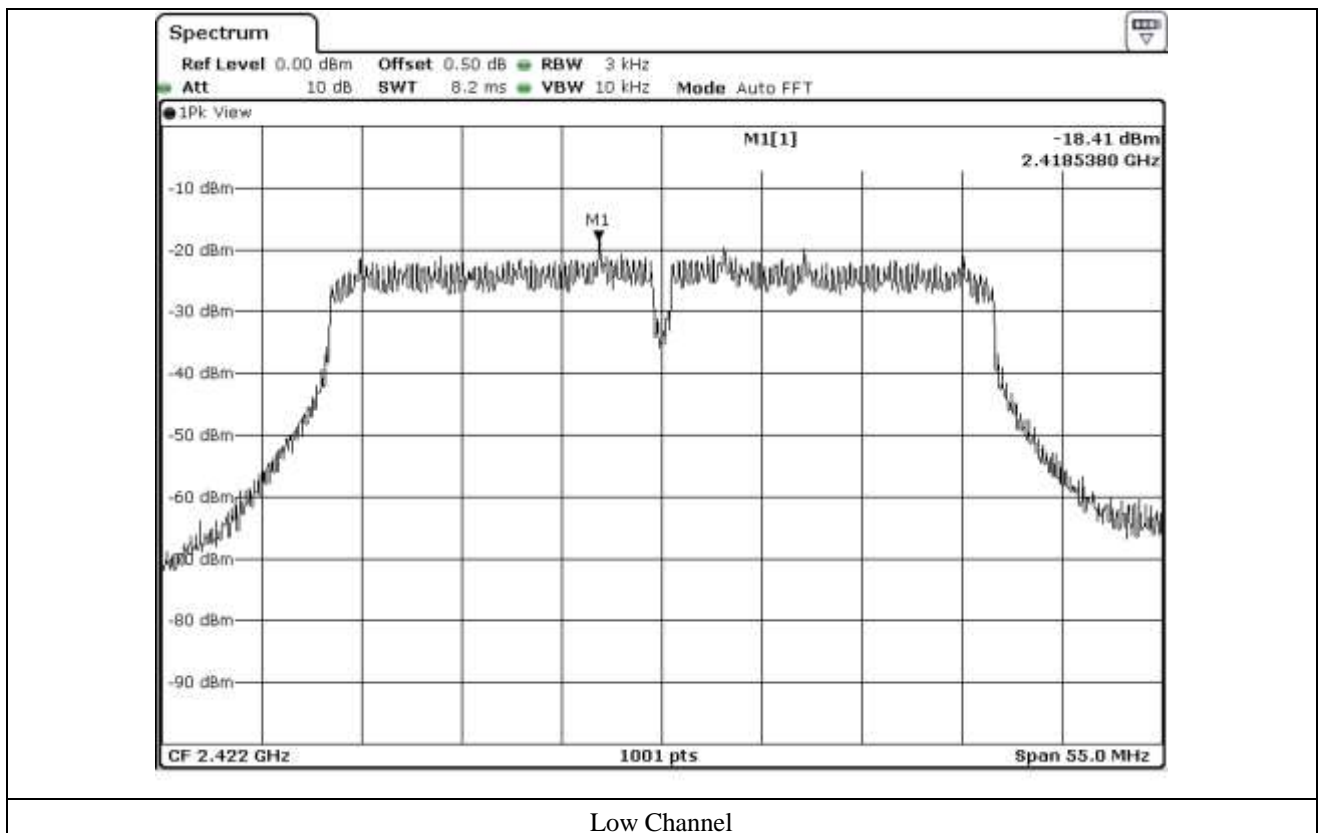
-. Operating Condition : Continuous transmitting mode

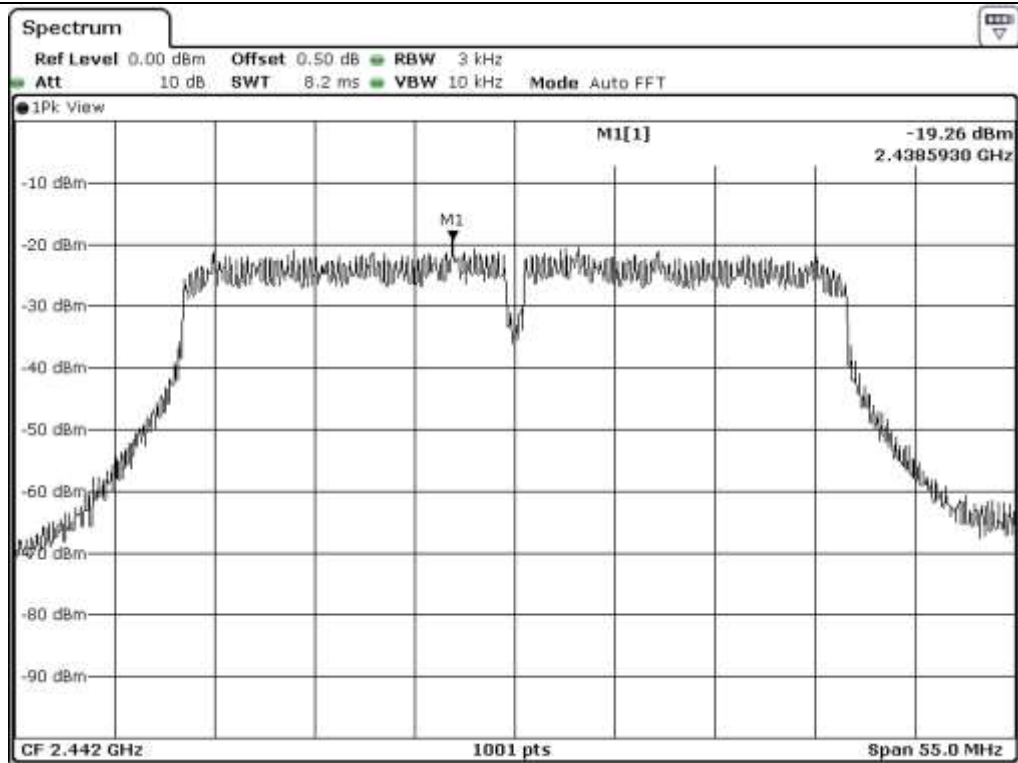
| CHANNEL | FREQUENCY(MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|----------------|----------------------|-------------|-------------|
| Low | 2 422.00 | -18.41 | 8.00 | 26.41 |
| Middle | 2 442.00 | -19.26 | 8.00 | 27.26 |
| High | 2 452.00 | -19.80 | 8.00 | 27.80 |

Remark. Margin = Limit – Measured value

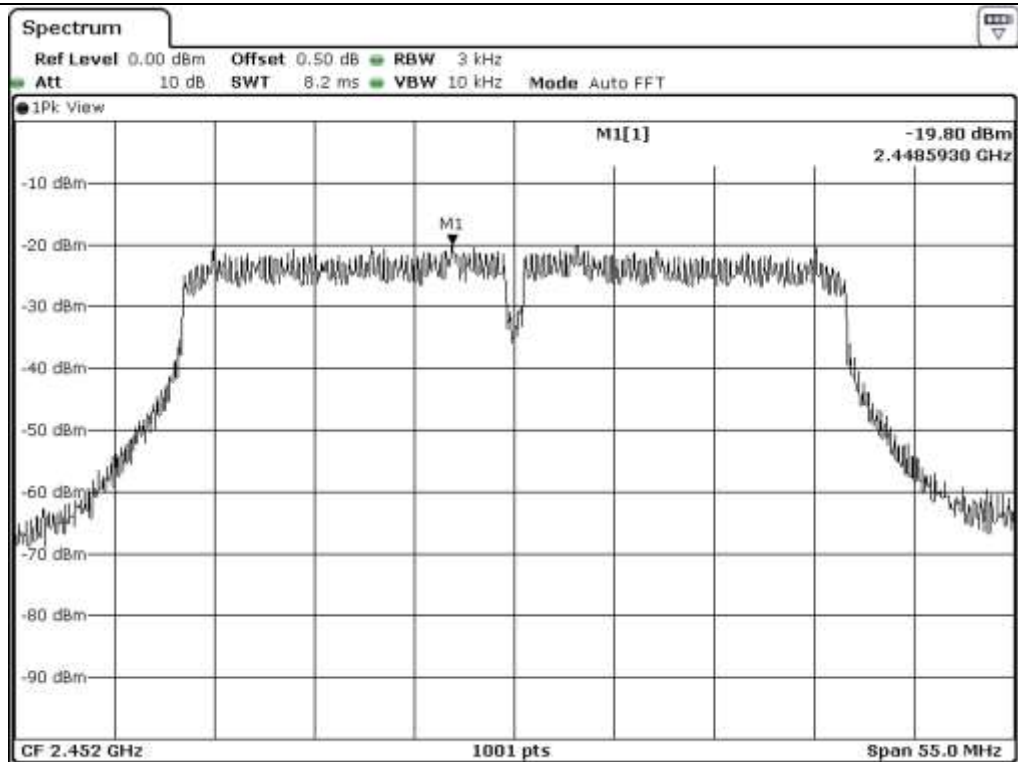


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

10.7.2 Test data for Antenna 1

-. Test Date : July 17, 2017

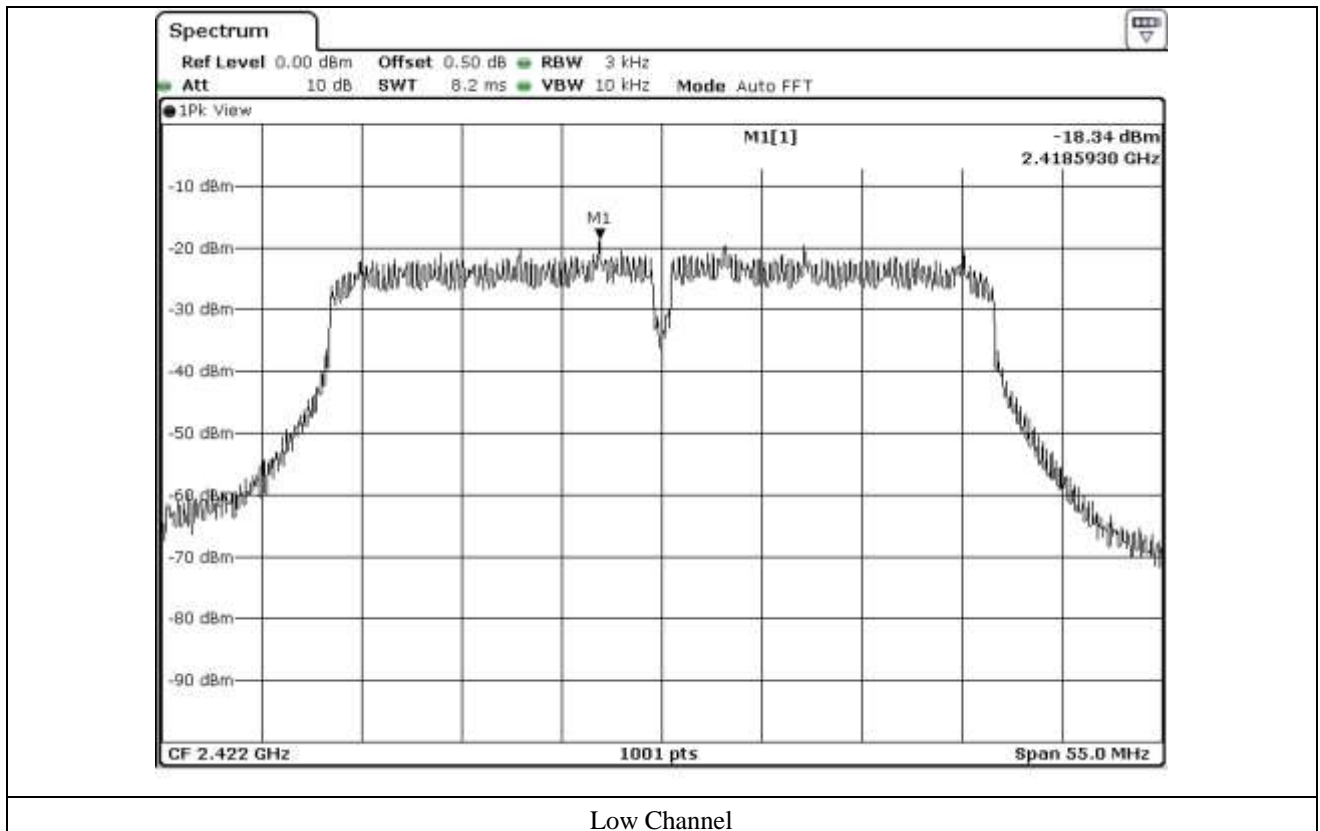
-. Test Result : Pass

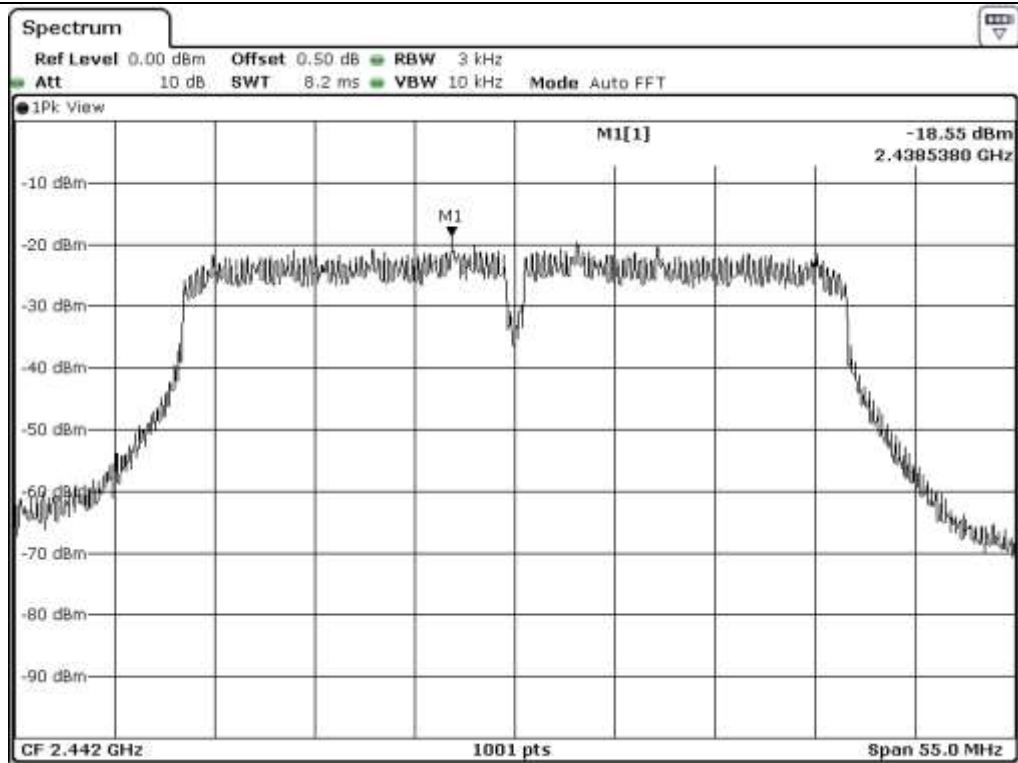
-. Operating Condition : Continuous transmitting mode

| CHANNEL | FREQUENCY(MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|----------------|----------------------|-------------|-------------|
| Low | 2 422.00 | -18.34 | 8.00 | 26.34 |
| Middle | 2 442.00 | -18.55 | 8.00 | 26.55 |
| High | 2 452.00 | -18.68 | 8.00 | 26.68 |

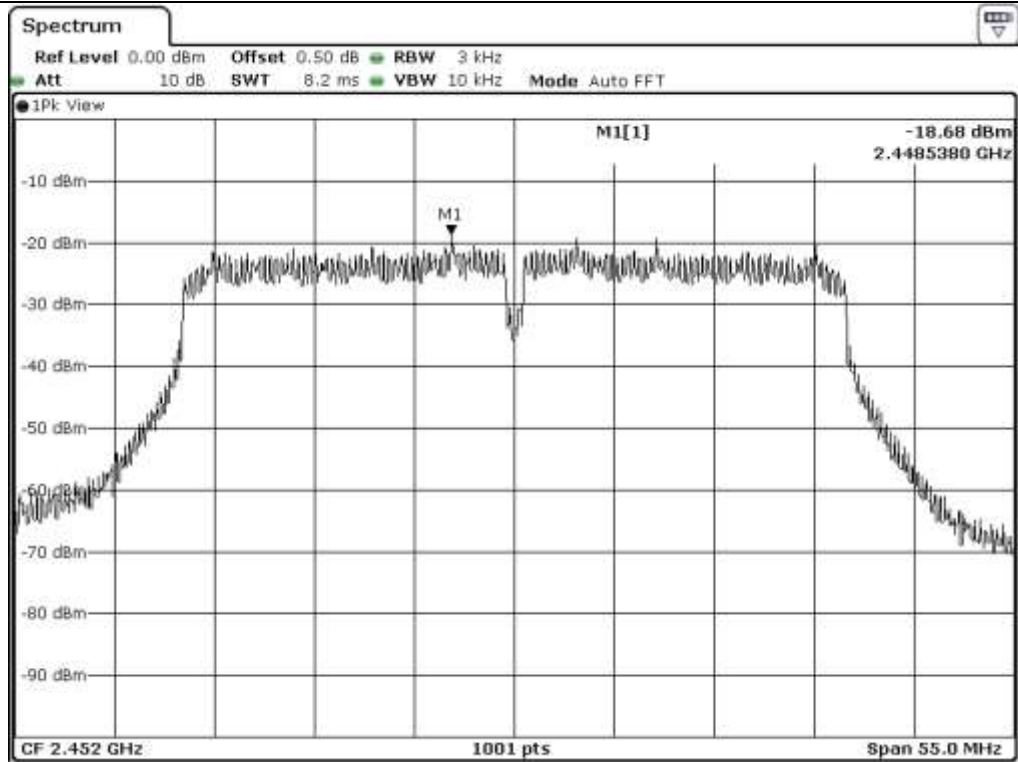
Remark. Margin = Limit – Measured value

Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

10.7.3 Test data for Multiple Antenna

-. Test Date : July 17, 2017

-. Test Result : Pass

-. Operating Condition : Continuous transmitting mode

| CHANNEL | FREQUENCY(MHz) | MEASURED VLAUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|----------------|----------------------|-------------|-------------|
| Low | 2 422.00 | -15.36 | 8.00 | 23.36 |
| Middle | 2 442.00 | -15.88 | 8.00 | 23.88 |
| High | 2 452.00 | -16.19 | 8.00 | 24.19 |

Remark 1 : Margin = Limit – Measured value

Remark 2 : Calculated Power Density = $10\log(10^{(\text{Antenna 0 Power Density}/10)} + 10^{(\text{Antenna 1 Power Density}/10)})$



Tested by: Hyung-Kwon, Oh / Assistant Manager

11. RADIATED EMISSION TEST

11.1 Operating environment

Temperature : 25 °C
Relative humidity : 44 % R.H.

11.2 Test set-up

The radiated emissions measurements were on the 3 m semi anechoic chamber. The EUT and other support equipment were placed on turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

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

11.3 Test equipment used

| Model Number | Manufacturer | Description | Serial Number | Last Cal. |
|-----------------|-------------------|--------------------------|---------------|--------------------|
| ■ - FSV40 | Rohde & Schwarz | Signal Analyzer | 101009 | Apr. 05, 2017 (1Y) |
| ■ - ESU | Rohde & Schwarz | EMI Test Receiver | 100261 | Apr. 06, 2017 (1Y) |
| ■ - 310N | Sonoma Instrument | Pre-Amplifier | 312544 | Apr. 05, 2017 (1Y) |
| ■ - BBV9718 | Schwarzbeck | Amplifier | 310 | Sep. 01, 2016 (1Y) |
| ■ - DT3000-3t | Innco System | Turn Table | DT3000/093 | N/A |
| ■ - MA-4000XPET | Innco System | Antenna Master | MA4000/509 | N/A |
| ■ - VULB9163 | Schwarzbeck | TRILOG Broadband Antenna | 9163-421 | Apr. 15, 2016 (2Y) |
| ■ - BBHA9120D | Schwarzbeck | Horn Antenna | BBHA9120D295 | Aug. 31, 2015 (2Y) |
| ■ - BBHA9170 | Schwarzbeck | Horn Antenna | BBHA9170178 | Aug. 31, 2015 (2Y) |

All test equipment used is calibrated on a regular basis.

11.4 Test data for 30 MHz ~ 1 000 MHz

Humidity Level : 44 % R.H.

Temperature: 25 °C

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

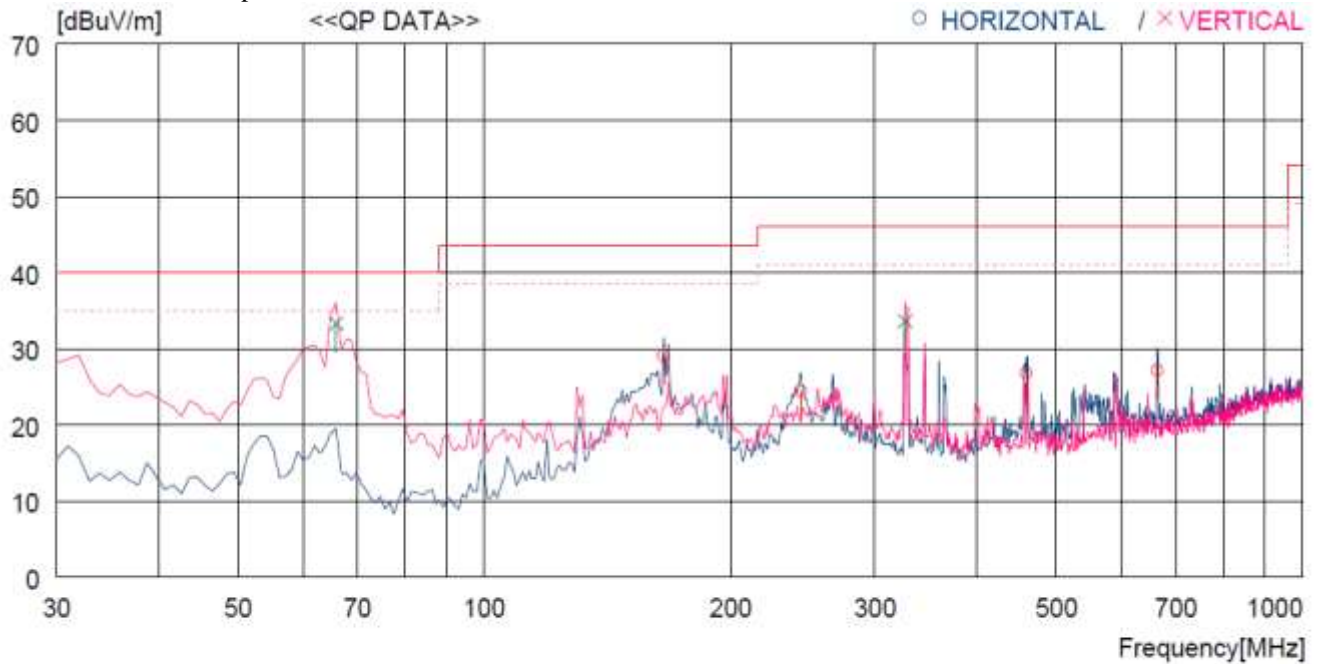
Result : PASSED

EUT : 802.11 a/b/g/n/ac WiFi Module

Date: July 20, 2017

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

-.Ant0, Ant1 and Multiple transmit tested, but the worst data were recorded.



| No. | FREQ | READING | ANT | LOSS | GAIN | RESULT | LIMIT | MARGIN | ANTENNA | TABLE |
|------------------------|---------|---------|--------|------|------|----------|----------|--------|---------|-------|
| | [MHz] | QP | FACTOR | [dB] | [dB] | [dBuV/m] | [dBuV/m] | [dB] | [cm] | [DEG] |
| ----- Horizontal ----- | | | | | | | | | | |
| 1 | 165.800 | 49.8 | 8.9 | 3.4 | 33.0 | 29.1 | 43.5 | 14.4 | 200 | 188 |
| 2 | 243.400 | 41.1 | 12.2 | 4.1 | 33.0 | 24.4 | 46.0 | 21.6 | 200 | 188 |
| 3 | 459.711 | 38.0 | 16.3 | 5.7 | 33.2 | 26.8 | 46.0 | 19.2 | 200 | 188 |
| 4 | 664.376 | 33.9 | 19.6 | 7.0 | 33.4 | 27.1 | 46.0 | 18.9 | 100 | 135 |
| ----- Vertical ----- | | | | | | | | | | |
| 5 | 65.890 | 53.2 | 10.9 | 2.2 | 33.0 | 33.3 | 40.0 | 6.7 | 100 | 99 |
| 6 | 326.820 | 47.6 | 14.2 | 4.8 | 33.0 | 33.6 | 46.0 | 12.4 | 100 | 195 |

Tested by: Hyung-Kwon, Oh / Assistant Manager

11.5 Test data for Below 30 MHz


- . Test Date : July 20, 2017
- . Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)
- . Frequency range : 9 kHz ~ 30 MHz
- . Measurement distance : 3 m
- . Operating mode : Transmitting mode

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

11.6 Test data for above 1 GHz

- . Test Date : July 20, 2017
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Operating mode : Transmitting mode

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


 Tested by: Hyung-Kwon, Oh / Assistant Manager

12. CONDUCTED EMISSION TEST

12.1 Operating environment

Temperature : (25 ~ 26) °C
Relative humidity : (44 ~ 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 Ω / 50 μ H + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

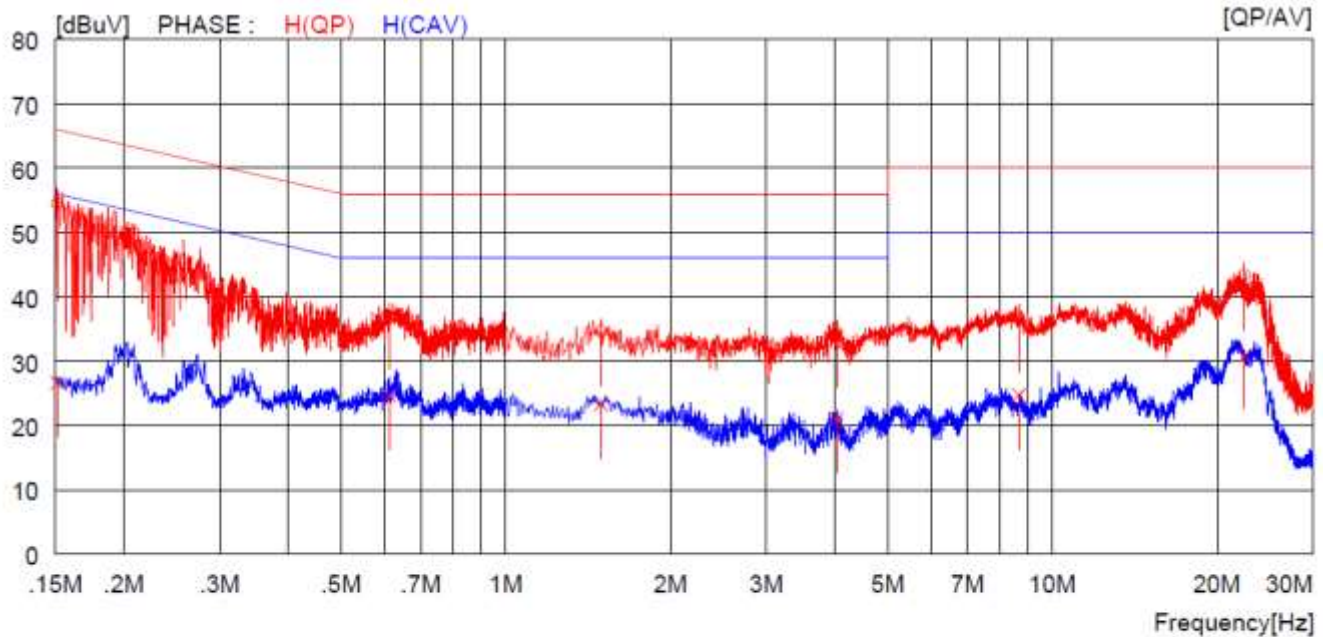
12.3 Test equipment used

| | Model Number | Manufacturer | Description | Serial Number | Last Cal. (Interval) |
|-----|--------------|-----------------|---------------|---------------|----------------------|
| ■ - | ESPI | Rohde & Schwarz | Test Receiver | 101012 | Nov. 01, 2016 (1Y) |
| □ - | ESHS10 | Rohde & Schwarz | Test Receiver | 834467/007 | Apr. 05, 2017 (1Y) |
| □ - | NSLK8128 | Schwarzbeck | AMN | 8128-216 | Apr. 06, 2017 (1Y) |
| ■ - | NSLK8126 | Schwarzbeck | AMN | 8126-404 | Apr. 05, 2017 (1Y) |
| □ - | 3825/2 | EMCO | AMN | 9109-1869 | Apr. 06, 2017 (1Y) |
| ■ - | 3825/2 | EMCO | AMN | 9109-1867 | Apr. 06, 2017 (1Y) |

All test equipment used is calibrated on a regular basis.

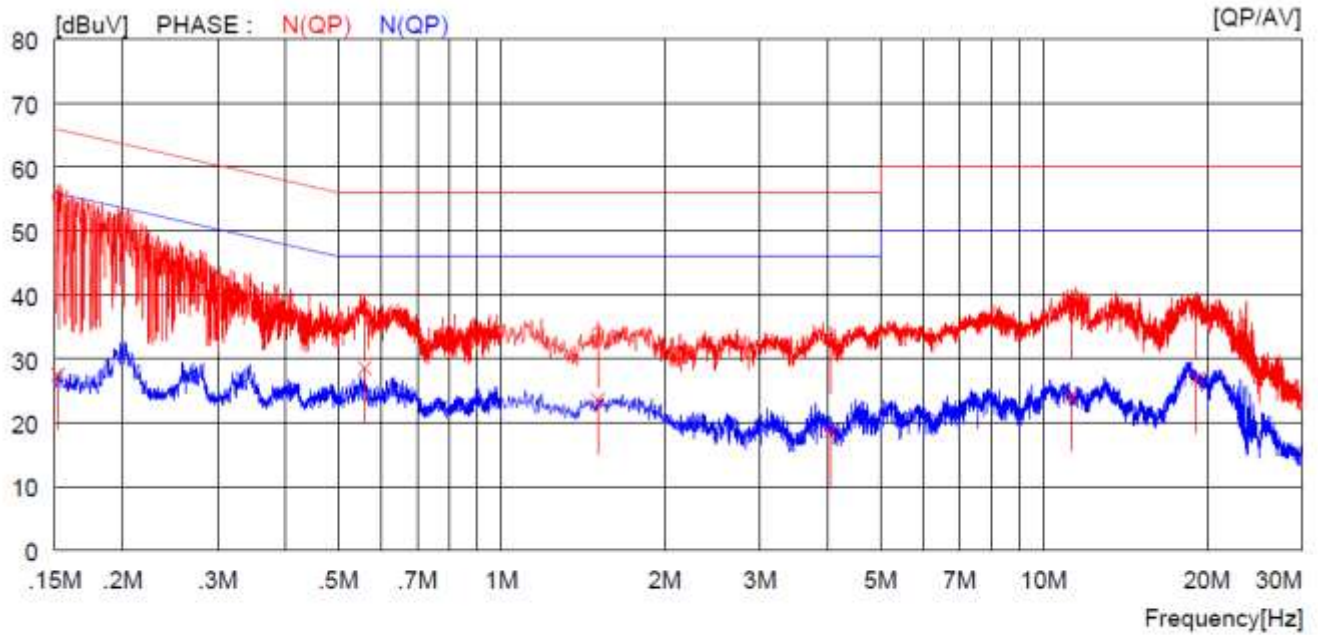
12.4 Test data

- Test Date : July 20, 2017
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Tested Line : HOT LINE
- Ant0, Ant1 and Multiple transmit tested, but the worst data were recorded.



| NO | FREQ [MHz] | READING | | C. FACTOR [dB] | RESULT | | LIMIT | | MARGIN | | PHASE |
|----|---------------|--------------|--------------|-------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------|
| | | QP [dBuV] | AV [dBuV] | | QP [dBuV] | AV [dBuV] | QP [dBuV] | AV [dBuV] | QP [dBuV] | AV [dBuV] | |
| 1 | 0.15100 | 44.5 | ---- | 10.0 | 54.5 | ---- | 65.9 | ---- | 11.4 | ---- | H(QP) |
| 2 | 0.61200 | 26.9 | ---- | 10.1 | 37.0 | ---- | 56.0 | ---- | 19.0 | ---- | H(QP) |
| 3 | 1.49200 | 24.5 | ---- | 10.1 | 34.6 | ---- | 56.0 | ---- | 21.4 | ---- | H(QP) |
| 4 | 4.03200 | 24.2 | ---- | 10.2 | 34.4 | ---- | 56.0 | ---- | 21.6 | ---- | H(QP) |
| 5 | 8.67500 | 26.4 | ---- | 10.4 | 36.8 | ---- | 60.0 | ---- | 23.2 | ---- | H(QP) |
| 6 | 22.47000 | 32.5 | ---- | 10.8 | 43.3 | ---- | 60.0 | ---- | 16.7 | ---- | H(QP) |
| 7 | 0.15100 | ---- | 16.6 | 10.0 | ---- | 26.6 | ---- | 55.9 | ---- | 29.3 | H(CAV) |
| 8 | 0.61200 | ---- | 14.5 | 10.1 | ---- | 24.6 | ---- | 46.0 | ---- | 21.4 | H(CAV) |
| 9 | 1.49200 | ---- | 13.2 | 10.1 | ---- | 23.3 | ---- | 46.0 | ---- | 22.7 | H(CAV) |
| 10 | 4.03200 | ---- | 10.9 | 10.2 | ---- | 21.1 | ---- | 46.0 | ---- | 24.9 | H(CAV) |
| 11 | 8.67500 | ---- | 14.3 | 10.4 | ---- | 24.7 | ---- | 50.0 | ---- | 25.3 | H(CAV) |
| 12 | 22.47000 | ---- | 20.1 | 10.8 | ---- | 30.9 | ---- | 50.0 | ---- | 19.1 | H(CAV) |

-. Tested Line : NEUTRAL LINE



| NO | FREQ [MHz] | READING | | C.FACTOR [dB] | RESULT | | LIMIT | | MARGIN | | PHASE |
|----|---------------|--------------|--------------|------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------|
| | | QP [dBuV] | AV [dBuV] | | QP [dBuV] | AV [dBuV] | QP [dBuV] | AV [dBuV] | QP [dBuV] | AV [dBuV] | |
| 1 | 0.15200 | 45.3 | ---- | 10.0 | 55.3 | ---- | 65.9 | ---- | 10.6 | ---- | N(QP) |
| 2 | 0.55900 | 28.0 | ---- | 10.1 | 38.1 | ---- | 56.0 | ---- | 17.9 | ---- | N(QP) |
| 3 | 1.50400 | 23.9 | ---- | 10.1 | 34.0 | ---- | 56.0 | ---- | 22.0 | ---- | N(QP) |
| 4 | 4.04000 | 22.7 | ---- | 10.2 | 32.9 | ---- | 56.0 | ---- | 23.1 | ---- | N(QP) |
| 5 | 11.23000 | 28.2 | ---- | 10.4 | 38.6 | ---- | 60.0 | ---- | 21.4 | ---- | N(QP) |
| 6 | 19.17000 | 27.5 | ---- | 10.7 | 38.2 | ---- | 60.0 | ---- | 21.8 | ---- | N(QP) |
| 7 | 0.15200 | ---- | 17.5 | 10.0 | ---- | 27.5 | ---- | 55.9 | ---- | 28.4 | N(CAV) |
| 8 | 0.55900 | ---- | 18.4 | 10.1 | ---- | 28.5 | ---- | 46.0 | ---- | 17.5 | N(CAV) |
| 9 | 1.50400 | ---- | 13.5 | 10.1 | ---- | 23.6 | ---- | 46.0 | ---- | 22.4 | N(CAV) |
| 10 | 4.04000 | ---- | 8.4 | 10.2 | ---- | 18.6 | ---- | 46.0 | ---- | 27.4 | N(CAV) |
| 11 | 11.23000 | ---- | 13.7 | 10.4 | ---- | 24.1 | ---- | 50.0 | ---- | 25.9 | N(CAV) |
| 12 | 19.17000 | ---- | 16.2 | 10.7 | ---- | 26.9 | ---- | 50.0 | ---- | 23.1 | N(CAV) |

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

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

Tested by: Hyung-Kwon, Oh / Assistant Manager