

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

Test Report No. : E144R-025

AGR No. : A143A-093

Applicant : Sindoh Co., Ltd.

Address : 3, Seongsuiro24(isipsa)-gil, Seongdong-gu, Seoul, Korea

Manufacturer : LG Innotek Co., Ltd.

Address : 978-1, Jangduk-dong, Gwangsan-gu, Gwangju, Korea

Type of Equipment : Wireless LAN module

FCC ID. : 2AB83-TWFM-M311D

IC Certification No. : 2541A-TWFM-M311D

Model Name : TWFM-M311D

Serial number : N/A

Total page of Report : 141 pages (including this page)

Date of Incoming : March 24, 2014

Date of issue : April 08, 2014

SUMMARY

The equipment complies with the regulation; **FCC PART 15 SUBPART C Section 15.247 and IC RSS-Gen Issue 3 and RSS 210 Issue 8.**

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

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

Prepared by:

Ki-Hong, Nam / Senior Engineer
ONETECH Corp.

Approved by:

Gea-Won, Lee / Managing Director
ONETECH Corp.

CONTENTS

	PAGE
1. VERIFICATION OF COMPLIANCE.....	7
2. TEST SUMMARY.....	8
2.1 TEST ITEMS AND RESULTS.....	8
2.2 ADDITIONS, DEVIATIONS, EXCLUSIONS FROM STANDARDS.....	8
2.3 RELATED SUBMITTAL(S) / GRANT(S)	8
2.4 PURPOSE OF THE TEST	8
2.5 TEST METHODOLOGY.....	8
2.6 TEST FACILITY.....	8
3. GENERAL INFORMATION.....	9
3.1 PRODUCT DESCRIPTION.....	9
3.2 ALTERNATIVE TYPE(S)/MODEL(S); ALSO COVERED BY THIS TEST REPORT.	9
4. EUT MODIFICATIONS	9
5. SYSTEM TEST CONFIGURATION.....	10
5.1 JUSTIFICATION	10
5.2 PERIPHERAL EQUIPMENT.....	10
5.3 MODE OF OPERATION DURING THE TEST.....	11
5.4 CONFIGURATION OF TEST SYSTEM	12
5.5 ANTENNA REQUIREMENT	12
6. PRELIMINARY TEST	12
6.1 AC POWER LINE CONDUCTED EMISSIONS TESTS.....	12
6.2 GENERAL RADIATED EMISSIONS TESTS.....	12
7. MINIMUM 6 DB BANDWIDTH & 99 % OCCUPIED BANDWIDTH	13
7.1 OPERATING ENVIRONMENT	13
7.2 TEST SET-UP	13
7.3 TEST EQUIPMENT USED	13
7.4 TEST DATA FOR 802.11B WLAN MODE.....	14
7.5 TEST DATA FOR 802.11G WLAN MODE.....	18
7.6 TEST DATA FOR 802.11N_HT20 WLAN MODE	22
7.7 TEST DATA FOR 802.11N_HT40 WLAN MODE	26
8. MAXIMUM PEAK OUTPUT POWER.....	30
8.1 OPERATING ENVIRONMENT	30
8.2 TEST SET-UP	30

8.3 TEST EQUIPMENT USED	30
8.4 TEST DATA FOR 802.11B WLAN MODE	31
8.5 TEST DATA FOR 802.11G WLAN MODE	35
8.6 TEST DATA FOR 802.11N_HT20 WLAN MODE	39
8.7 TEST DATA FOR 802.11N_HT40 WLAN MODE	43
9. 100 KHZ BANDWIDTH OUTSIDE THE FREQUENCY BAND	47
9.1 OPERATING ENVIRONMENT	47
9.2 TEST SET-UP FOR CONDUCTED MEASUREMENT	47
9.3 TEST SET-UP FOR RADIATED MEASUREMENT	47
9.4 TEST EQUIPMENT USED	47
9.5 TEST DATA FOR CONDUCTED EMISSION	48
9.5.1 Test data for 802.11b WLAN Mode.....	48
9.5.2 Test data for 802.11g WLAN Mode.....	53
9.5.3 Test data for 802.11n_HT20 WLAN Mode.....	58
9.5.4 Test data for 802.11n_HT40 WLAN Mode.....	63
9.6 TEST DATA FOR RADIATED EMISSION	68
9.6.1 Radiated Emission which fall in the Restricted Band	68
9.6.2 Spurious & Harmonic Radiated Emission.....	72
10. SPURIOUS EMISSION - RECEIVER.....	80
10.1 OPERATING ENVIRONMENT	80
10.2 TEST SET-UP FOR CONDUCTED MEASUREMENT	80
10.3 TEST SET-UP FOR RADIATED MEASUREMENT	80
10.4 TEST EQUIPMENT USED	80
10.5 TEST DATA FOR 802.11B WLAN MODE	81
10.5.1 Test data – Conducted	81
10.5.2 Test data - Radiated	85
10.6 TEST DATA FOR 802.11G WLAN MODE	88
10.6.1 Test data – Conducted	88
10.6.2 Test data - Radiated	92
10.7 TEST DATA FOR 802.11N_HT20 WLAN MODE	95
10.7.1 Test data – Conducted	95
10.7.2 Test data - Radiated	99
10.8 TEST DATA FOR 802.11N_HT40 WLAN MODE	102
10.8.1 Test data– Conducted	102
10.8.2 Test data - Radiated	106
11. PEAK POWER SPECTRUL DENSITY	109

11.1 OPERATING ENVIRONMENT	109
11.2 TEST SET-UP	109
11.3 TEST EQUIPMENT USED	109
11.4 TEST DATA FOR 802.11B WLAN MODE	110
11.5 TEST DATA FOR 802.11G WLAN MODE.....	112
11.6 TEST DATA FOR 802.11N_HT20 WLAN MODE	114
11.7 TEST DATA FOR 802.11N_HT40 WLAN MODE	116
12. RADIATED EMISSION TEST.....	118
12.1 OPERATING ENVIRONMENT	118
12.2 TEST SET-UP	118
12.3 TEST EQUIPMENT USED	118
12.4 TEST DATA FOR 802.11B WLAN MODE	119
<i> 12.4.1 Test data for Below 30 MHz.....</i>	119
<i> 12.4.2 Test data for 30 MHz ~ 1 000 MHz.....</i>	120
<i> 12.4.3 Test data for above 1 GHz</i>	121
12.5 TEST DATA FOR 802.11G WLAN MODE.....	122
<i> 12.5.1 Test data for Below 30 MHz.....</i>	122
<i> 12.5.2 Test data for 30 MHz ~ 1 000 MHz.....</i>	123
<i> 12.5.3 Test data for above 1 GHz</i>	124
12.6 TEST DATA FOR 802.11N_HT20 WLAN MODE	125
<i> 12.6.1Test data for Below 30 MHz.....</i>	125
<i> 12.6.2 Test data for 30 MHz ~ 1 000 MHz.....</i>	126
<i> 12.6.3 Test data for above 1 GHz</i>	127
12.7 TEST DATA FOR 802.11N_HT40 WLAN MODE	128
<i> 12.7.1 Test data for Below 30 MHz.....</i>	128
<i> 12.7.2 Test data for 30 MHz ~ 1 000 MHz.....</i>	129
<i> 12.7.3 Test data for above 1 GHz</i>	130
13. CONDUCTED EMISSION TEST	131
13.1 OPERATING ENVIRONMENT	131
13.2 TEST SET-UP	131
13.3 TEST EQUIPMENT USED	131
13.4 TEST DATA FOR 802.11B WLAN MODE	132
13.5 TEST DATA FOR 802.11G WLAN MODE.....	134
13.6 TEST DATA FOR 802.11N_HT20 WLAN MODE	136
13.7 TEST DATA FOR 802.11N_HT40 WLAN MODE	138
14. MAXIMUM PERMISSIBLE EXPOSURE.....	140

14.1 RF EXPOSURE CALCULATION	140
14.2 CALCULATED MPE SAFE DISTANCE	141
<i>14.2.1 Test data</i>	141

Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
E144R-025	April 08, 2014	Initial Issue	All

1. VERIFICATION OF COMPLIANCE

Applicant : Sindoh Co., Ltd.
Address : 3, Seongsuiro24(isipsa)-gil, Seongdong-gu, Seoul, Korea
Contact Person : Jae-Young, Choi / Manager
Telephone No. : +82-2-460-1583
FCC ID : 2AB83-TWFM-M311D
IC CERTIFICATION NO. : 2541A-TWFM-M311D
Model Name : TWFM-M311D
Serial Number : N/A
Date : April 08, 2014

EQUIPMENT CLASS	FCC: DTS – DIGITAL TRANSMISSION SYSTEM IC: Low Power License-Exempt Radio-communication Device
E.U.T. DESCRIPTION	Modular Transmitter, Wireless LAN module
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2009 and FCC KDB 558074 D01 DTS Meas Guidance v03r01
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT	Certification, Modular Approval
AUTHORIZATION REQUESTED	
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247 and RSS 210 Issue 8, RSS-Gen Issue 3.
Modifications on the Equipment to Achieve Compliance	None
Final Test was Conducted On	3 m open area test site

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

2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.247 (a) (2)	RSS-210, A8.2(a) Minimum 6 dB Bandwidth & 99 % Occupied Bandwidth	Met the Limit / PASS
15.247 (b) (3)	RSS-210, A8.4(4) Maximum Peak Conducted Output Power	Met the Limit / PASS
15.247 (d)	RSS-210, A8.5 100 kHz Bandwidth Outside the Frequency Band	Met the Limit / PASS
15.247 (d)	RSS-210, A8.5 Radiated Emission which fall in the Restricted Band	Met the Limit / PASS
15.247 (e)	RSS-210, A8.2(b) Peak Power Spectral Density	Met the Limit / PASS
15.209	RSS-210, A8.5 Radiated Emission Limits	Met the Limit / PASS
15.207	RSS-Gen, Section 7.2.4 Conducted Limits	Met the Limit / PASS
15.203	RSS-Gen, Section 7.1.2 Antenna Requirement	Met requirement / PASS

2.2 Additions, deviations, exclusions from standards

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

2.3 Related Submittal(s) / Grant(s)

Original submittal only

2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in 2.1.

2.5 Test Methodology

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

2.6 Test Facility

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

3. GENERAL INFORMATION

3.1 Product Description

The Sindoh Co., Ltd., Model TWFM-M311D (referred to as the EUT in this report) is a Wireless LAN module. Product specification information described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	Wireless LAN module	
FREQUENCY RANGE	802.11b/g/n(HT20)	2 412 MHz ~ 2 462 MHz
	802.11n(HT40)	2 422 MHz ~ 2 452 MHz
MAX. RF OUTPUT POWER:	802.11b(11.99 dBm)	
	802.11g (11.47 dBm)	
	802.11n_20 MHz (11.59 dBm)	
	802.11n_40 MHz (9.38 dBm)	
MODULATION TYPE	802.11b: DSSS Modulation(DBPSK/DQPSK/CCK) 802.11a/g/n(HT20)/n(HT40): OFDM Modulation(BPSK/QPSK/16QAM/64QAM)	
Antenna Gain	2.0 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.

- None

4. EUT MODIFICATIONS

- None

5. SYSTEM TEST CONFIGURATION

5.1 Justification

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

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	LG Innotek Co., Ltd.	TWFM-M311D	N/A

5.2 Peripheral equipment

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

Model	Manufacturer	Description	Connected to
TWFM-M311D	LG Innotek Co., Ltd.	Wireless LAN module (EUT)	Note PC
LGR51	LG Electronics	Notebook PC	EUT

5.3 Mode of operation during the test

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

Maximum Output Power

Modulation & Channel selected	DATA RATE	OUTPUT POWER
802.11 b (Middle Channel)	1 Mbps	11.71
	2 Mbps	11.25
	5.5 Mbps	11.07
	11 Mbps	10.90
802.11g (Middle Channel))	6 Mbps	11.14
	9 Mbps	10.66
	12 Mbps	9.86
	18 Mbps	9.35
	24 Mbps	8.99
	36 Mbps	8.85
	48 Mbps	7.89
	54 Mbps	7.52
	6.5 Mbps	11.09
	13 Mbps	10.98
HT 20 (Middle Channel))	19.5 Mbps	10.89
	26 Mbps	10.68
	39 Mbps	10.16
	52 Mbps	10.02
	58.5 Mbps	9.55
	65 Mbps	9.38
	13 Mbps	8.84
	26 Mbps	8.80
HT 40 (Middle Channel))	39 Mbps	8.73
	52 Mbps	8.67
	78 Mbps	8.61
	104 Mbps	8.57
	117 Mbps	8.41
	130 Mbps	8.27

-The worse case data rate for each modulation is determined 1 Mbps for IEEE 802.11b, 6 Mbps for IEEE 802.11g, 6.5 Mbps for IEEE 802.11n(HT20), 13 Mbps for IEEE 802.11n(HT40).

5.4 Configuration of Test System

Line Conducted Test: The EUT was connected to USB and the power of USB was connected to Notebook PC. All supporting equipments were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 2009 7.3.3 to determine the worse operating conditions.

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2009 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 meter open area test site. The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

5.5 Antenna Requirement

- For intentional device, according to section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.
- According to the standard RSS-Gen Issue 3, section 7.1.2, the transmitter antenna shall be internal with the device, or the antenna coupling be so designed that no antenna other than that furnished by the party responsible for compliance shall be used.

Antenna Construction:

The transmitter antenna of the EUT is a PIFA 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
Receiving Mode	-

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
Receiving Mode	-

7. MINIMUM 6 dB BANDWIDTH & 99 % OCCUPIED BANDWIDTH

7.1 Operating environment

Temperature : 24 °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.
■ - FSV30	R/S	Spectrum Analyzer	101372	May 20, 2013

All test equipment used is calibrated on a regular basis.

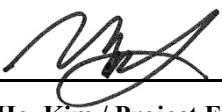
7.4 Test data for 802.11b WLAN Mode

- Test Date : April 01, 2014

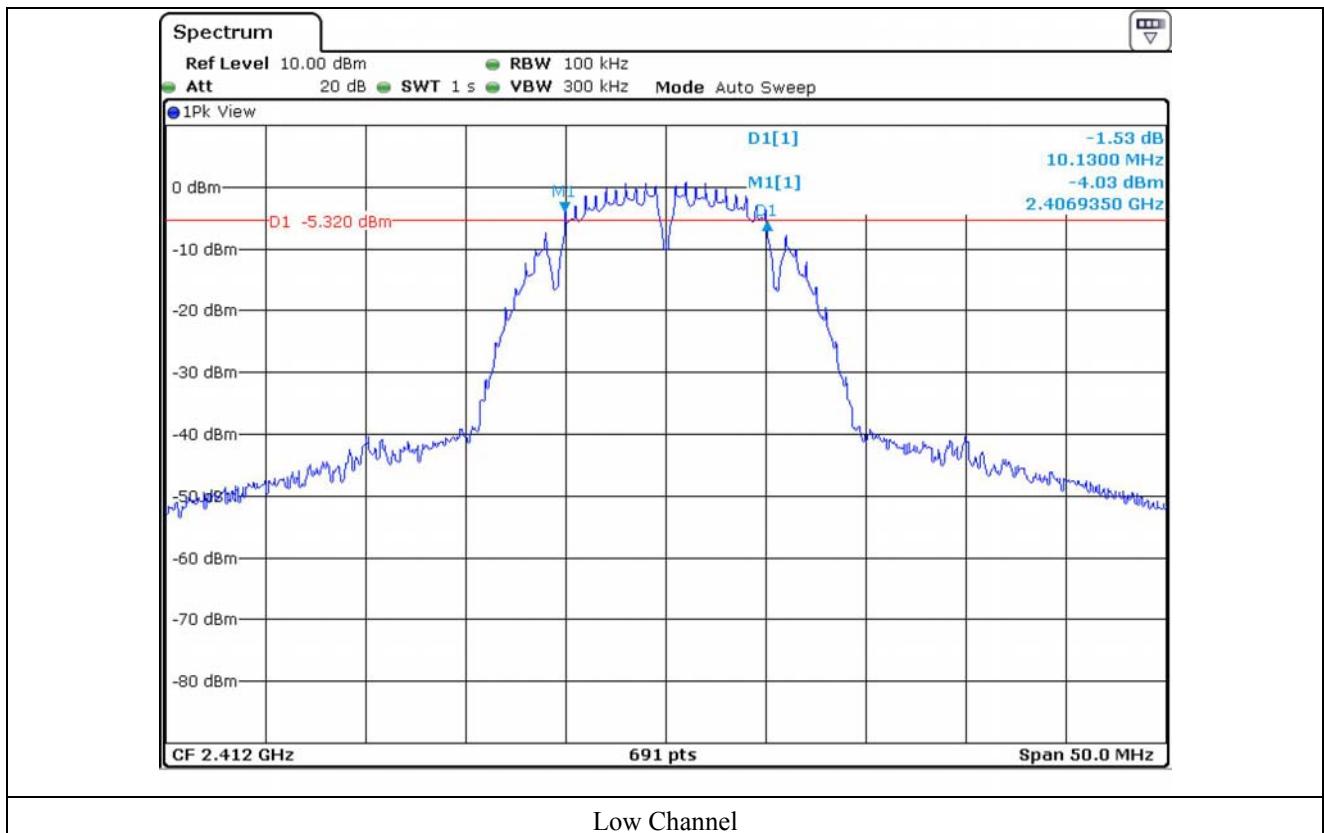
- Test Result : Pass

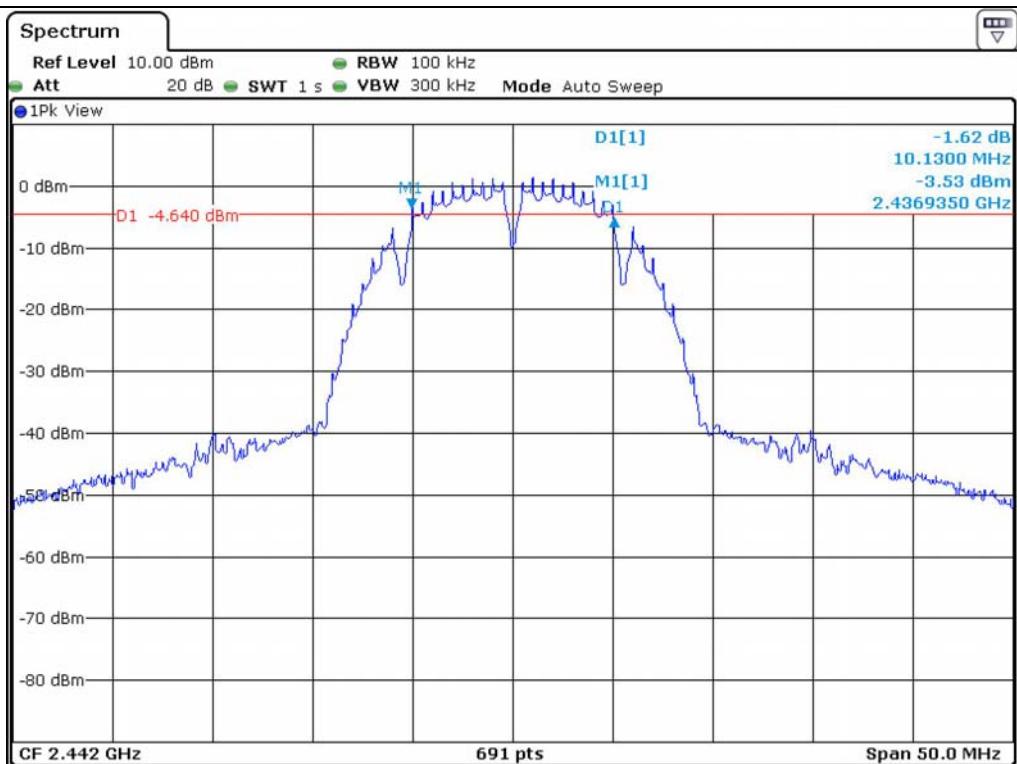
CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	LIMIT (MHz)
Low	2 412	10.13	13.60	0.5
Middle	2 442	10.13	13.60	0.5
High	2 462	10.13	13.60	0.5

Remark. Margin = Measured Value - Limit

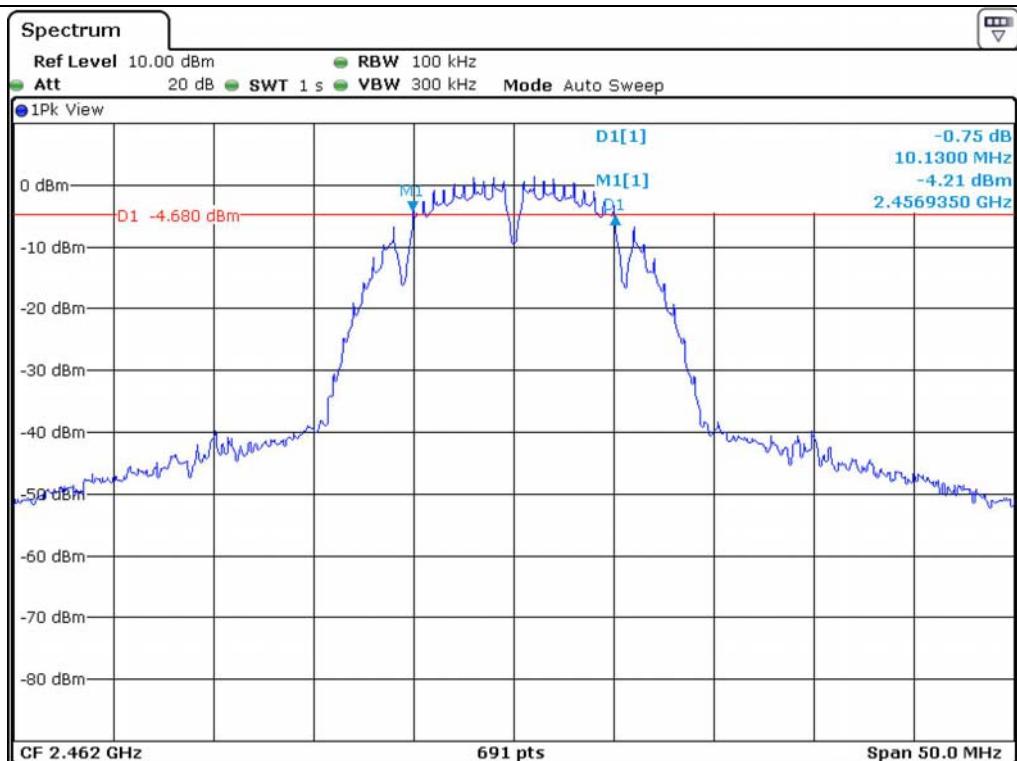


Tested by: Tae-Ho, Kim / Project Engineer

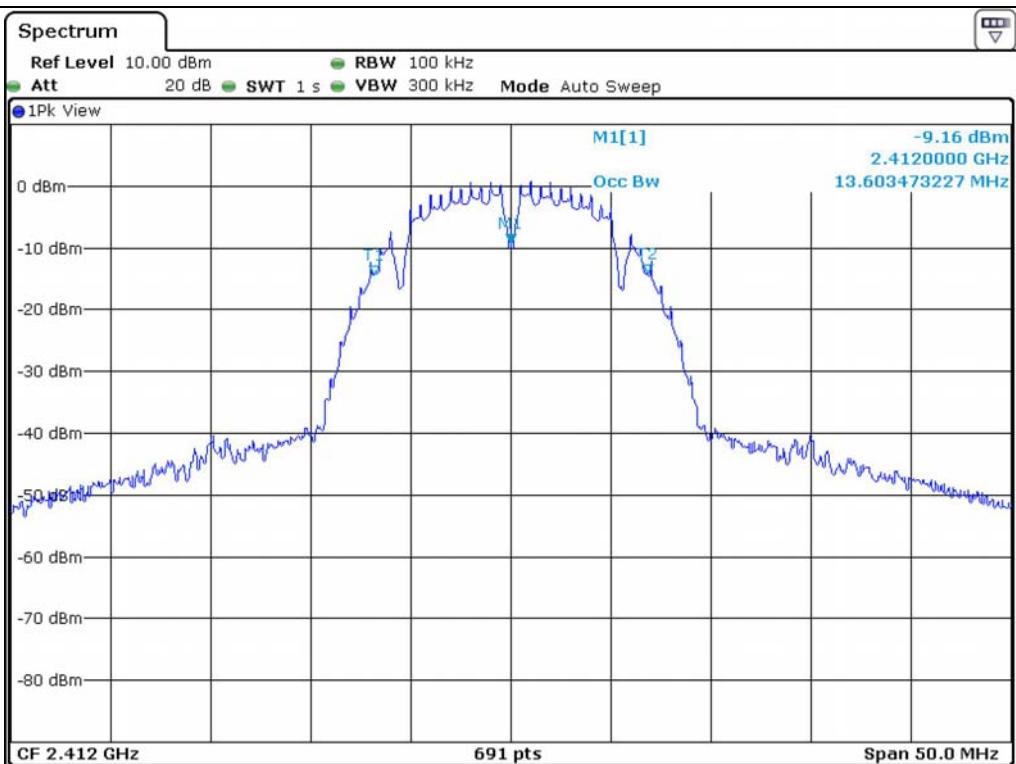
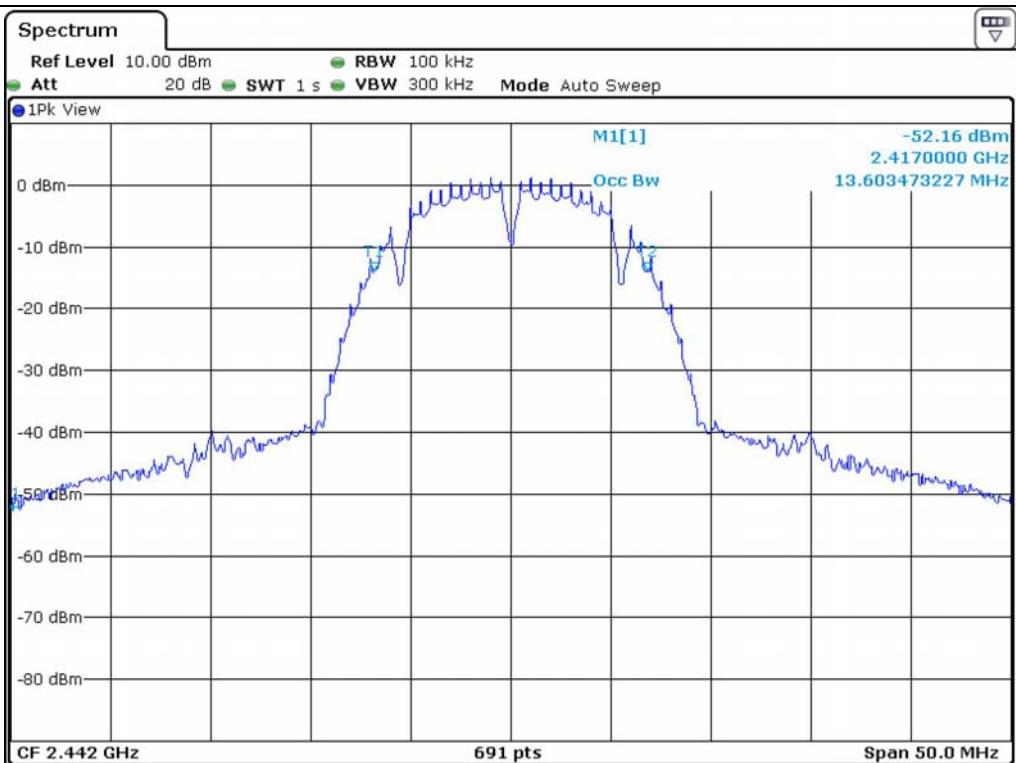


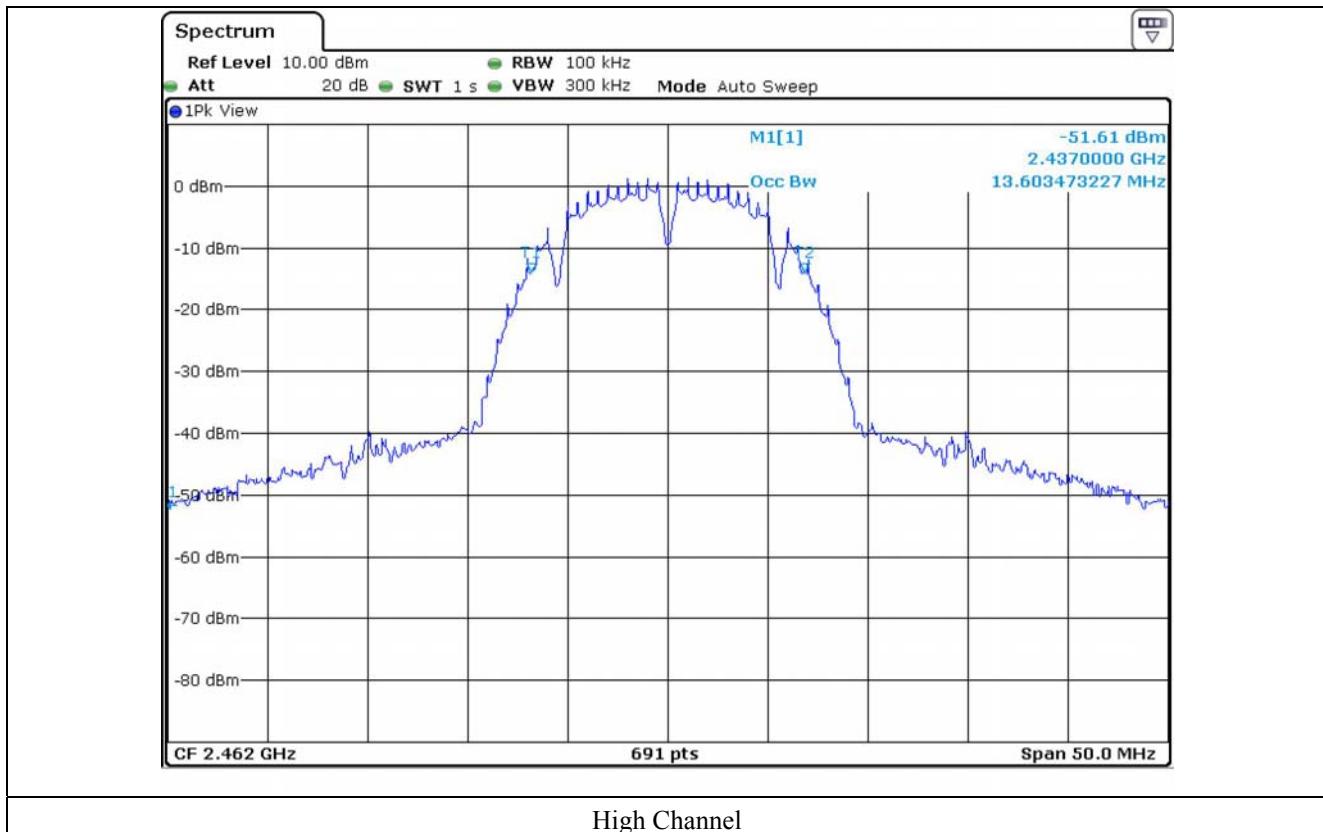


Middle Channel



High Channel

**Low Channel****Middle Channel**



High Channel

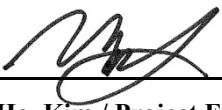
7.5 Test data for 802.11g WLAN Mode

- Test Date : April 01, 2014

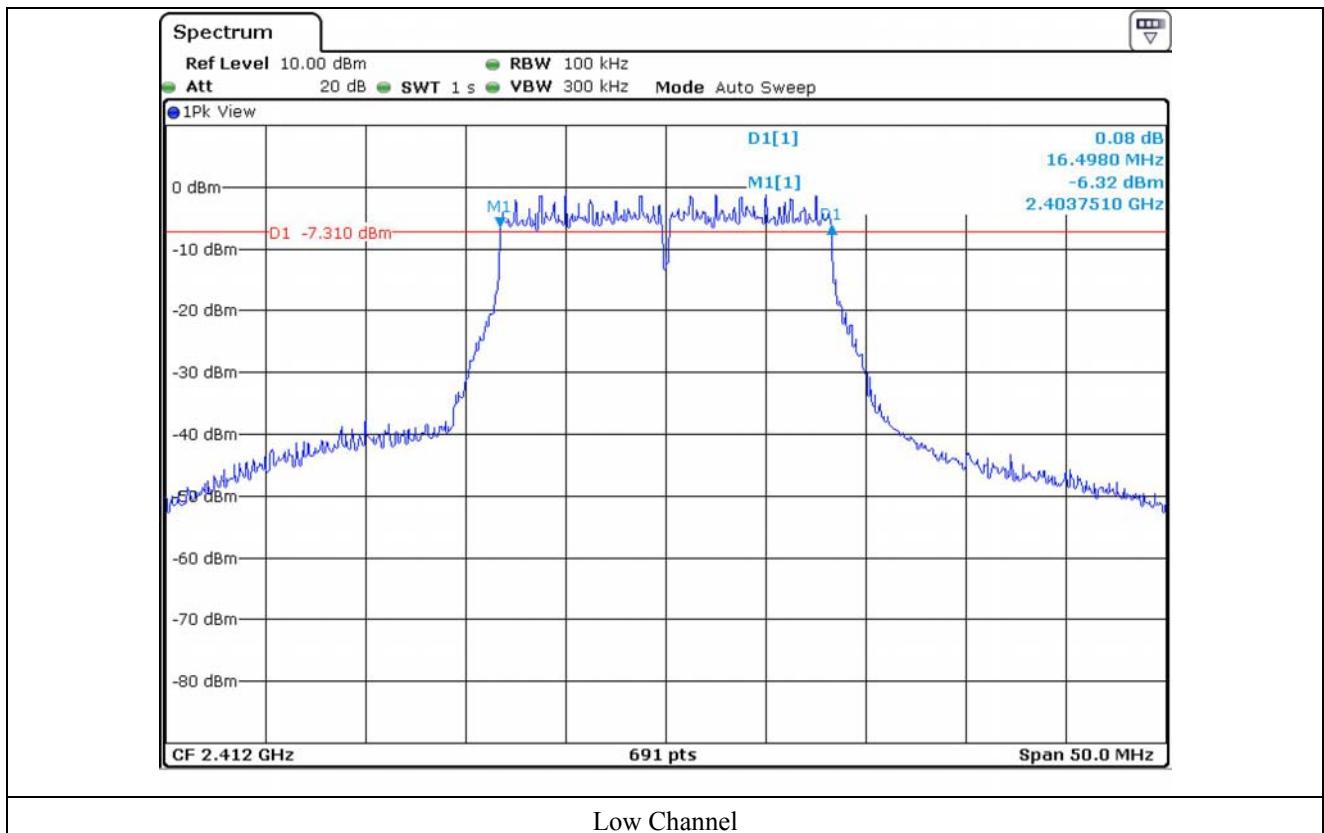
- Test Result : Pass

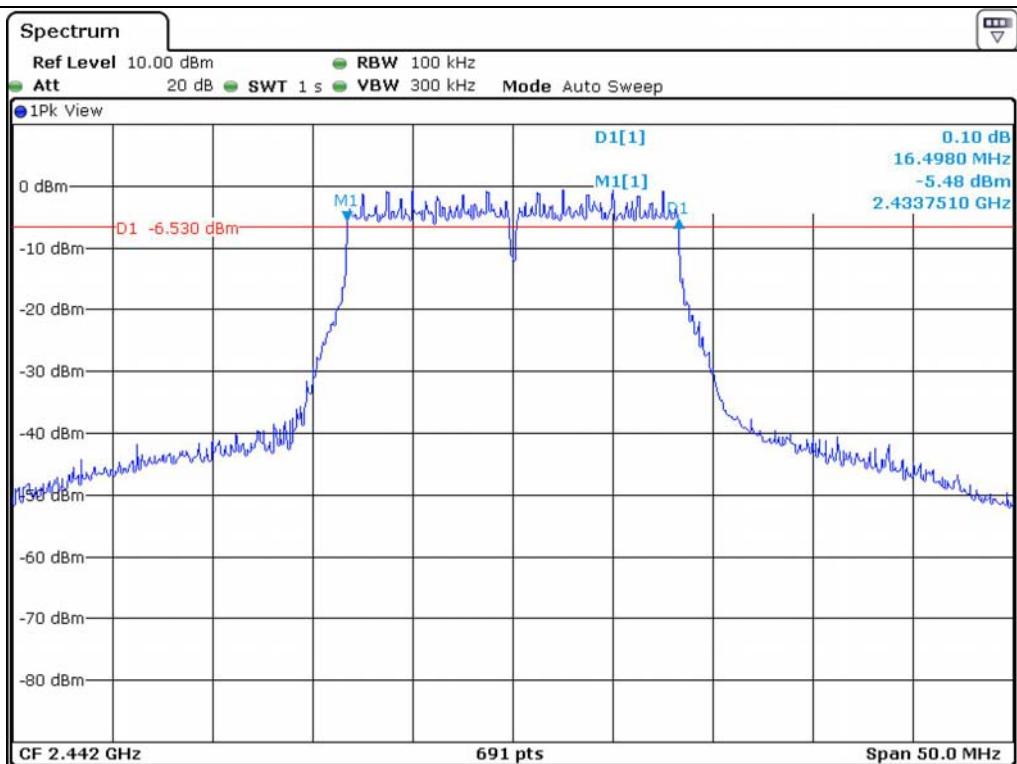
CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	LIMIT (MHz)
Low	2 412	16.50	16.50	0.5
Middle	2 442	16.50	16.50	0.5
High	2 462	16.50	16.50	0.5

Remark. Margin = Measured Value - Limit

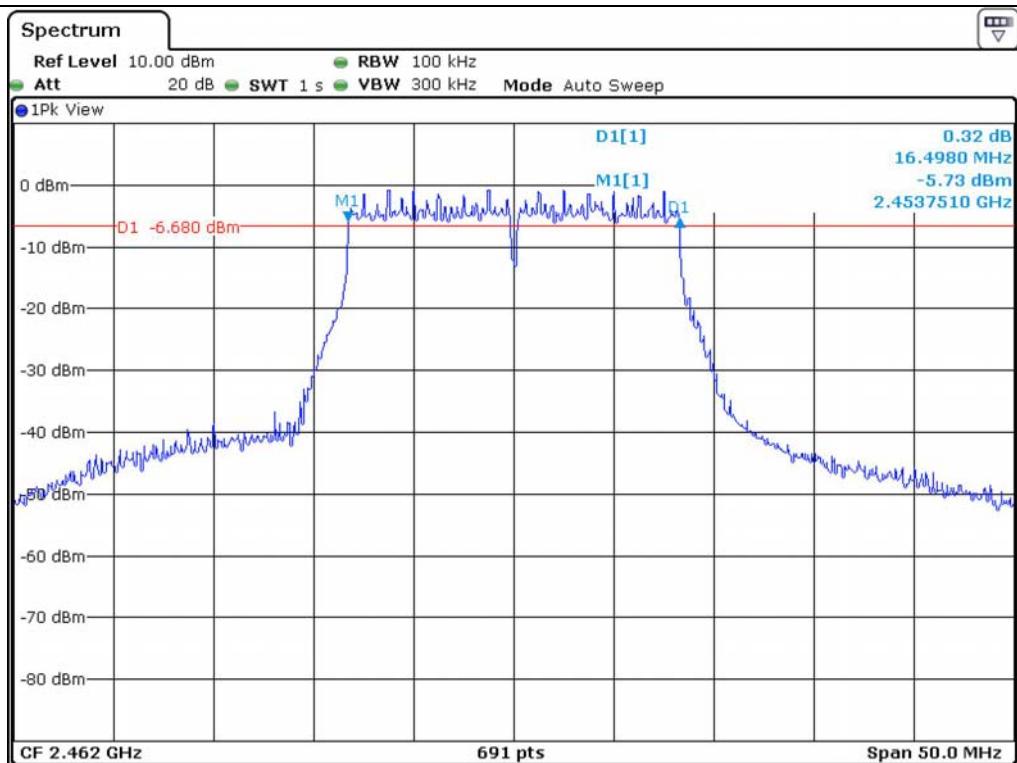


Tested by: Tae-Ho, Kim / Project Engineer

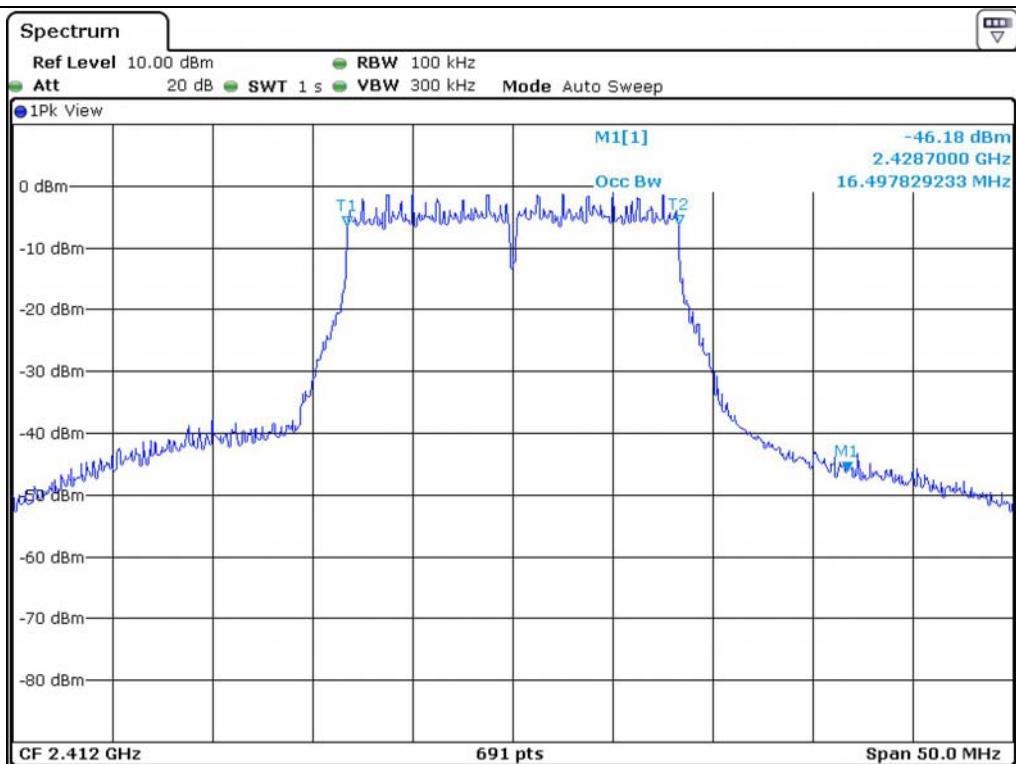




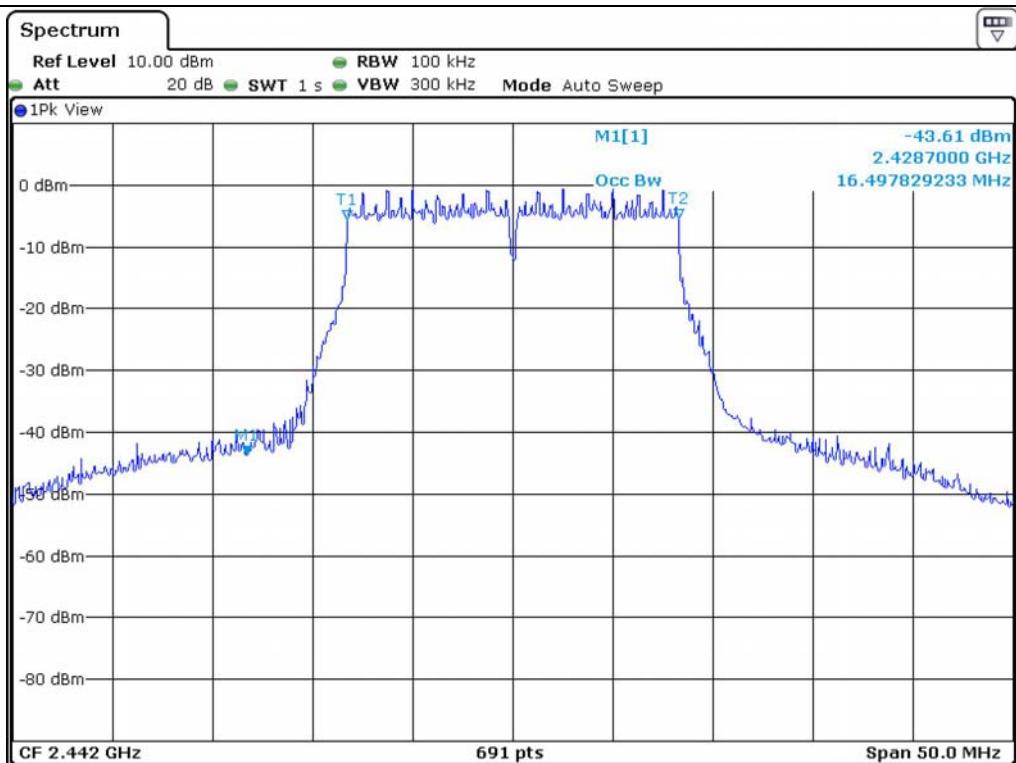
Middle Channel



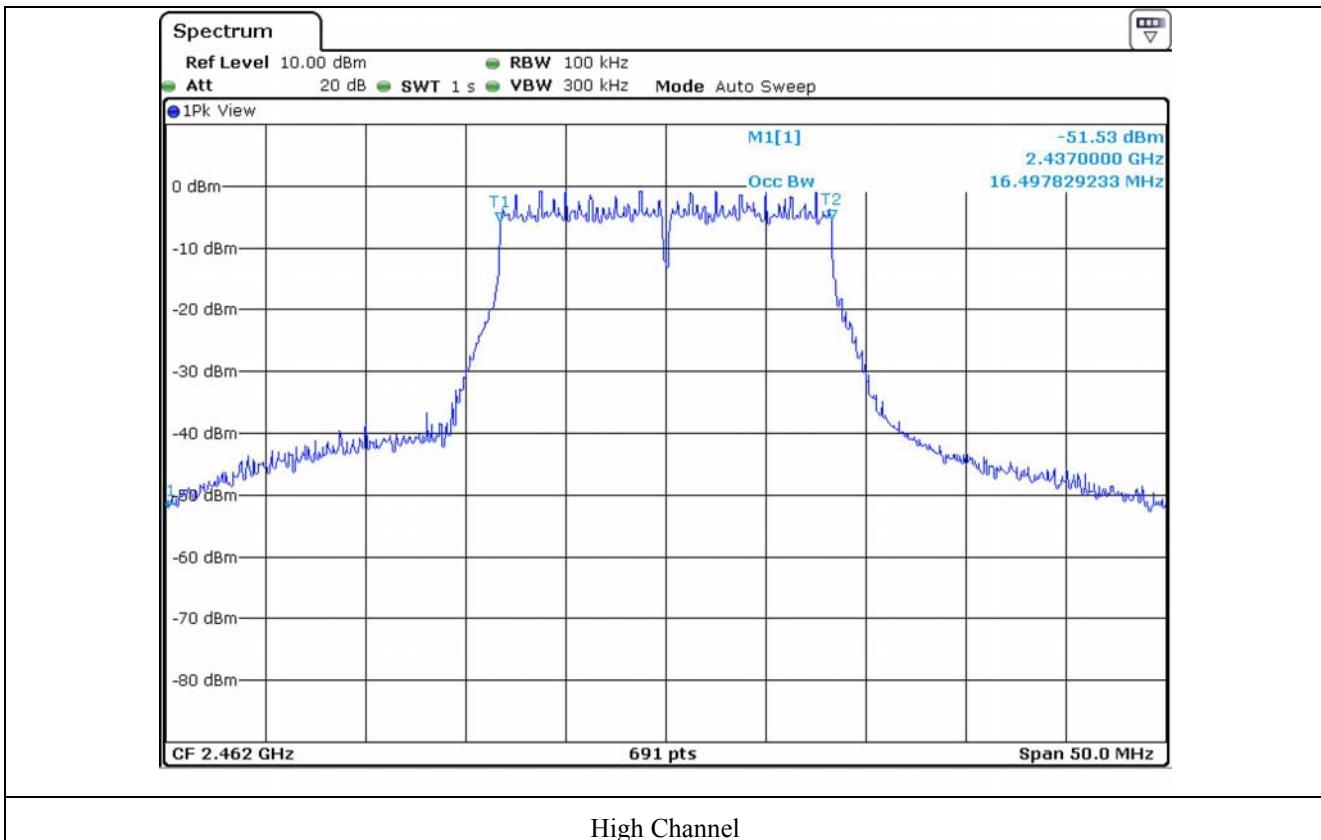
High Channel



Low Channel



Middle Channel



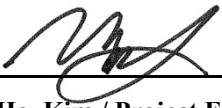
7.6 Test data for 802.11n_HT20 WLAN Mode

- Test Date : April 01, 2014

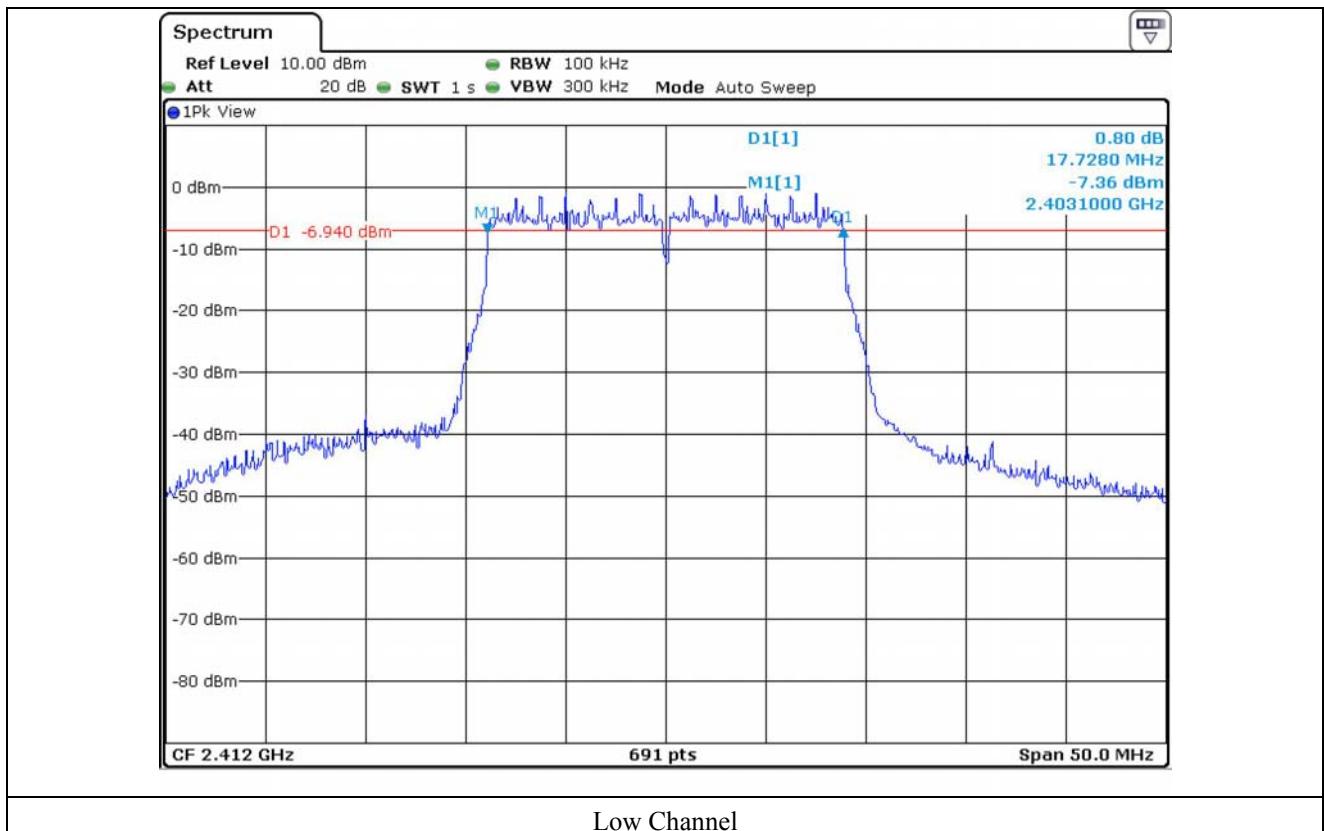
- Test Result : Pass

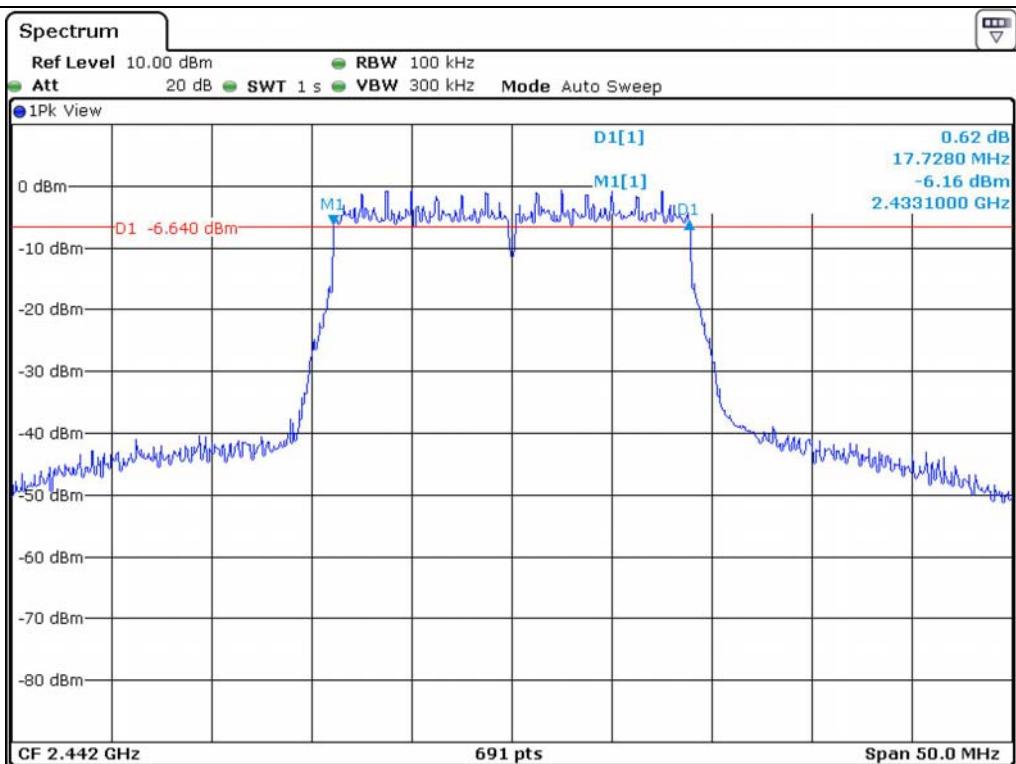
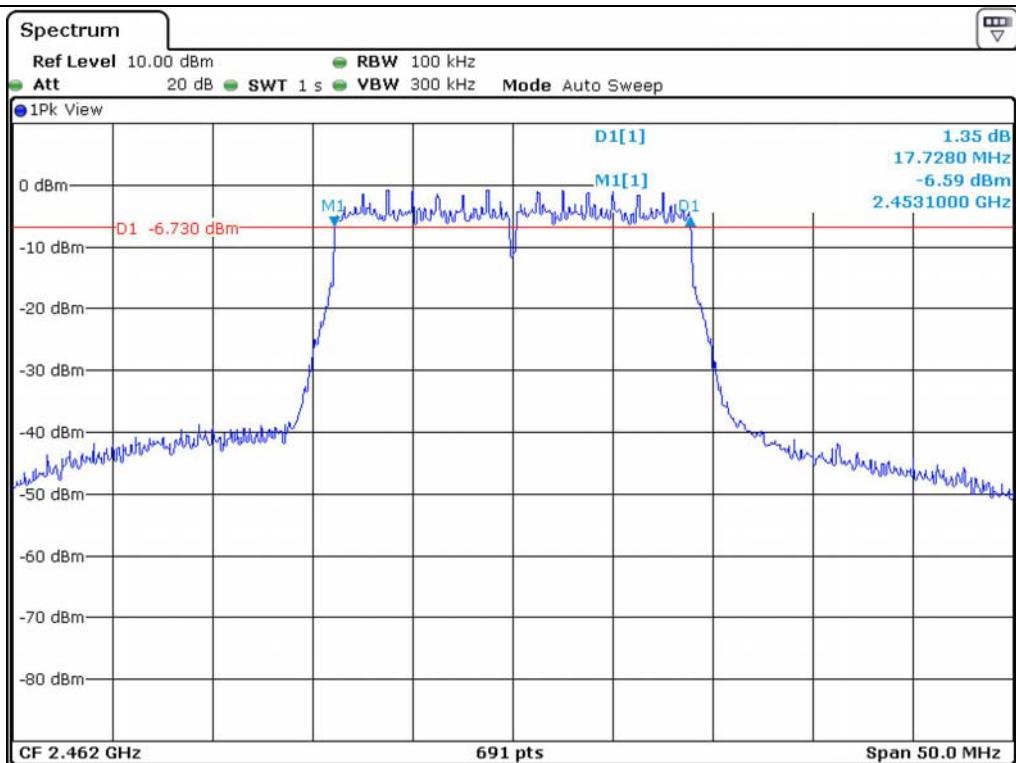
CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	LIMIT (MHz)
Low	2 412	17.73	17.66	0.5
Middle	2 442	17.73	17.66	0.5
High	2 462	17.73	17.66	0.5

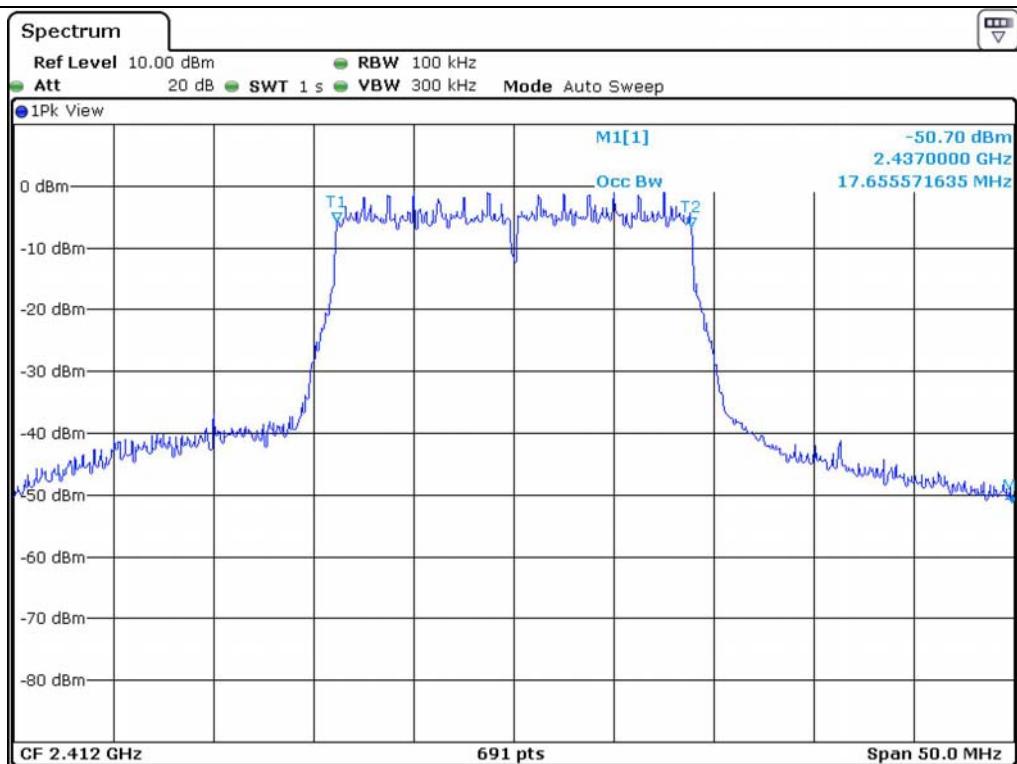
Remark. Margin = Measured Value - Limit



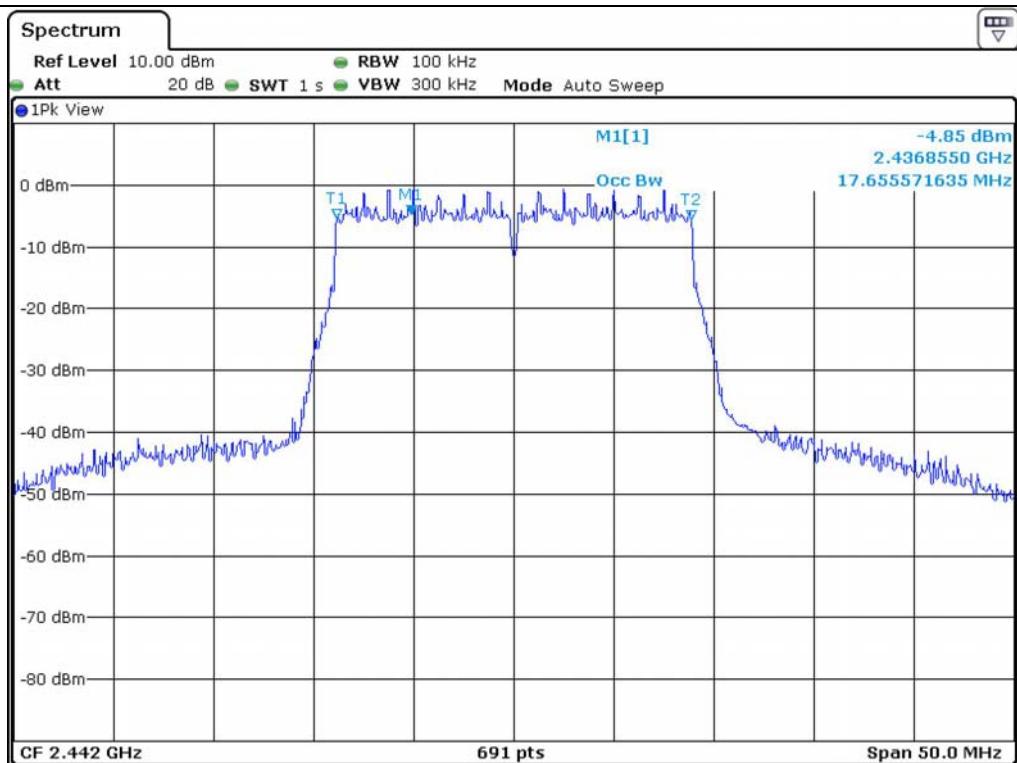
Tested by: Tae-Ho, Kim / Project Engineer



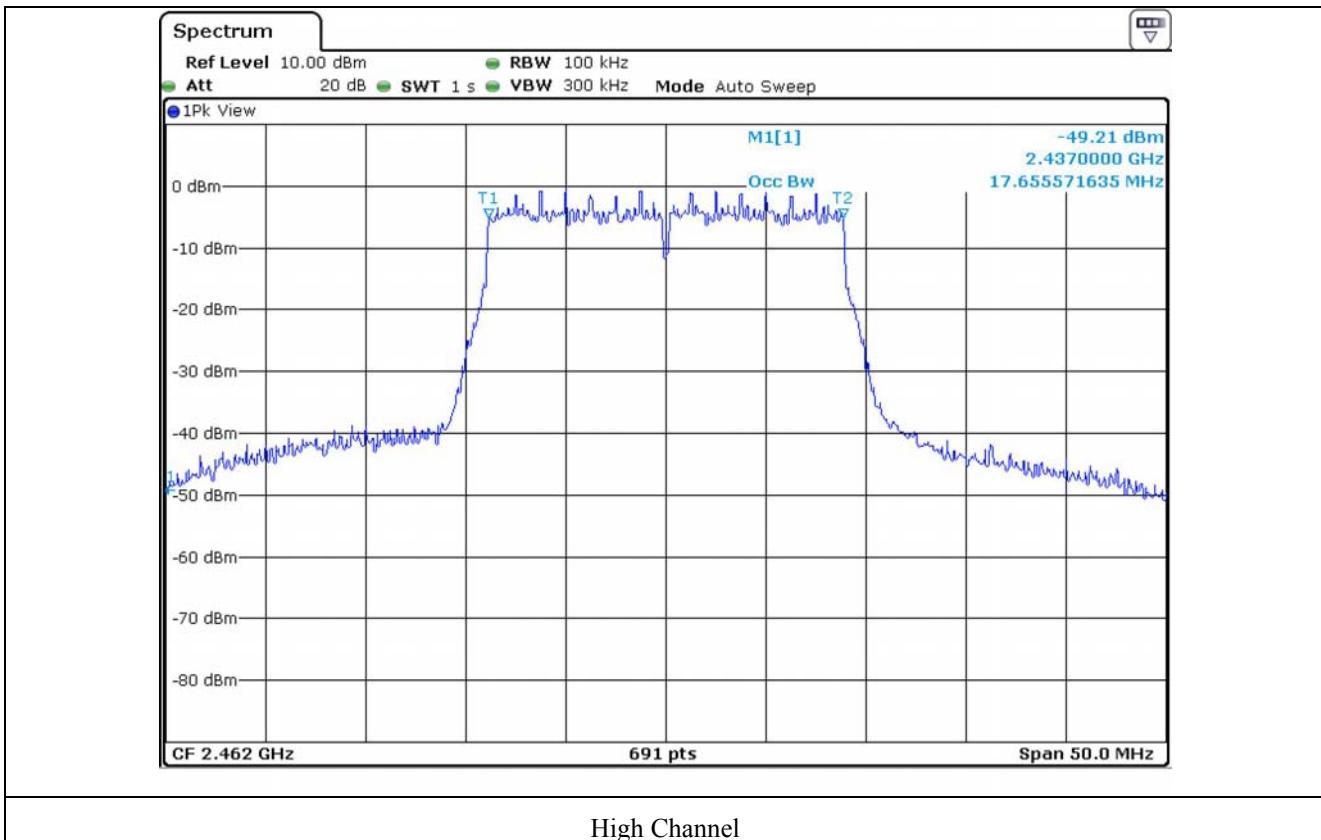
**Middle Channel****High Channel**



Low Channel



Middle Channel



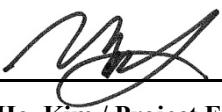
7.7 Test data for 802.11n_HT40 WLAN Mode

- Test Date : April 01, 2014

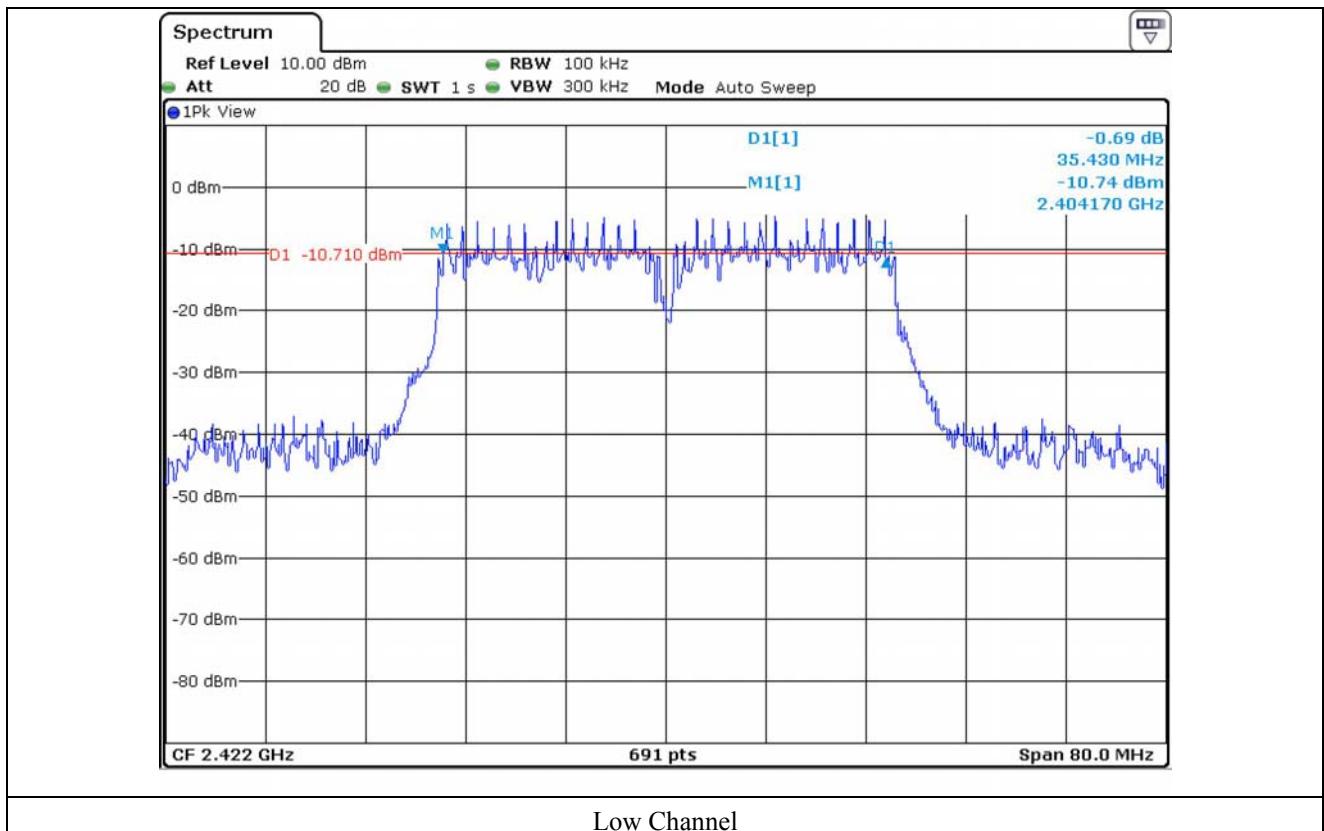
- Test Result : Pass

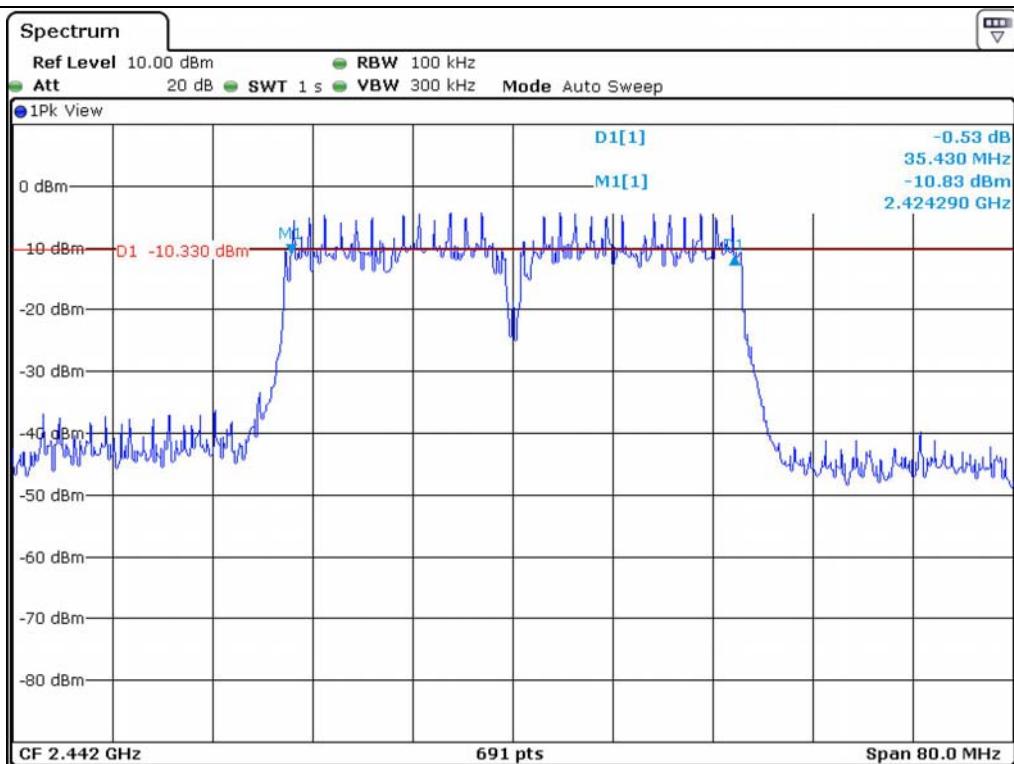
CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	LIMIT (MHz)
Low	2 422	35.43	36.12	0.5
Middle	2 442	35.43	36.12	0.5
High	2 452	35.43	36.12	0.5

Remark. Margin = Measured Value - Limit

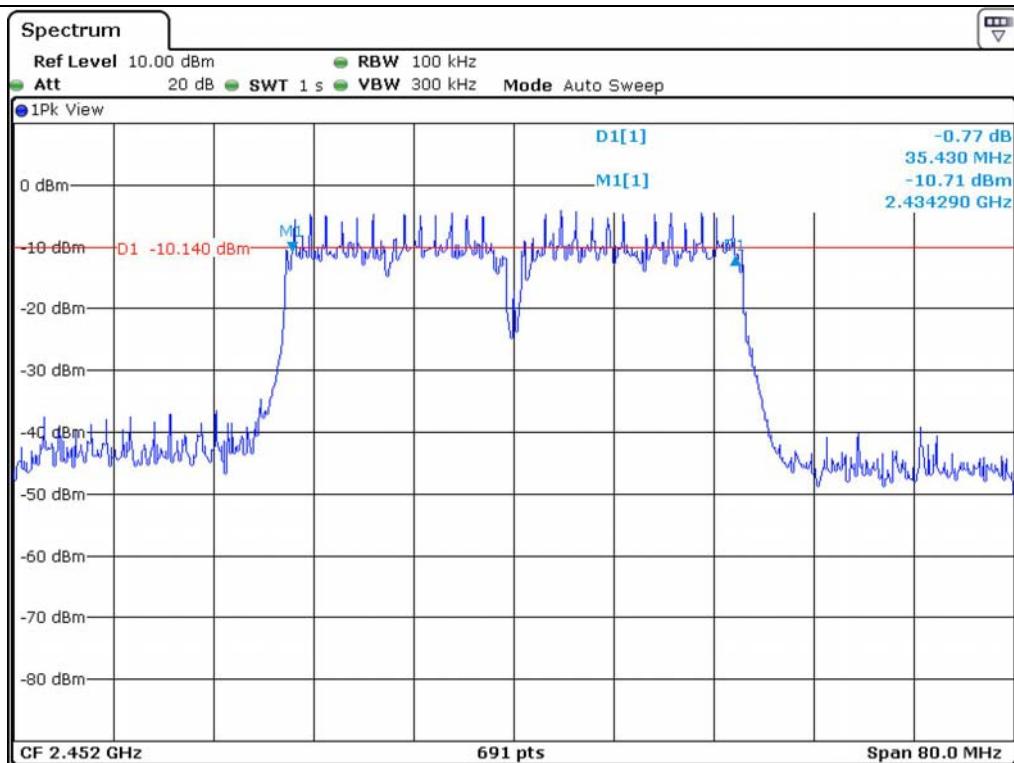


Tested by: Tae-Ho, Kim / Project Engineer

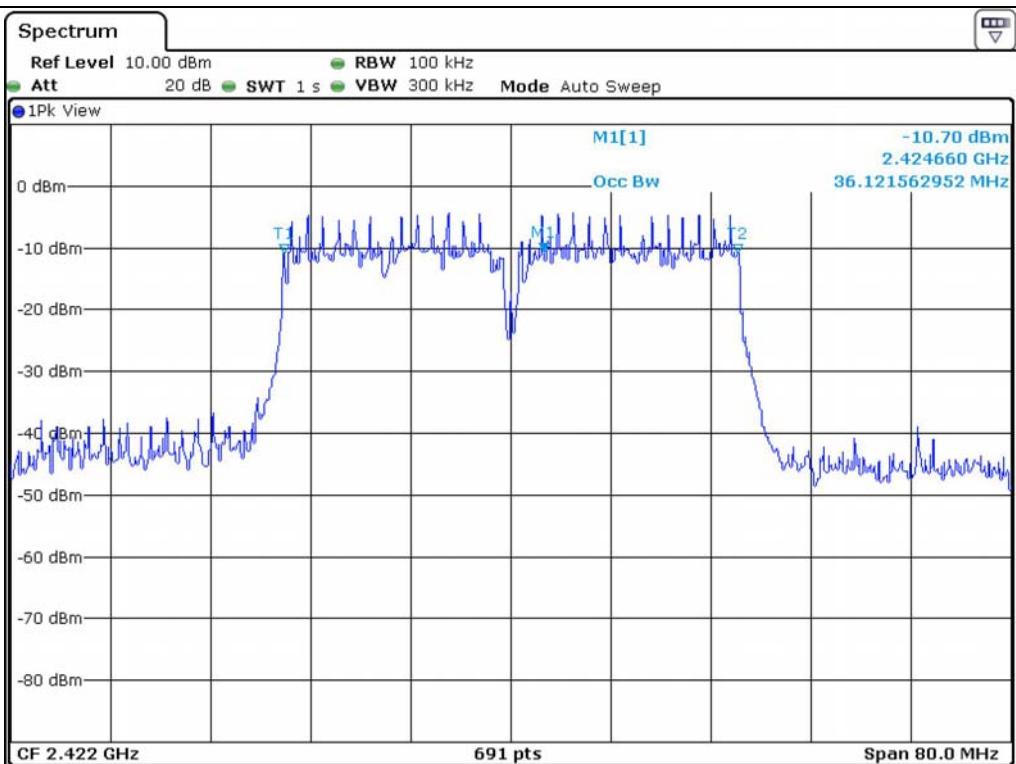




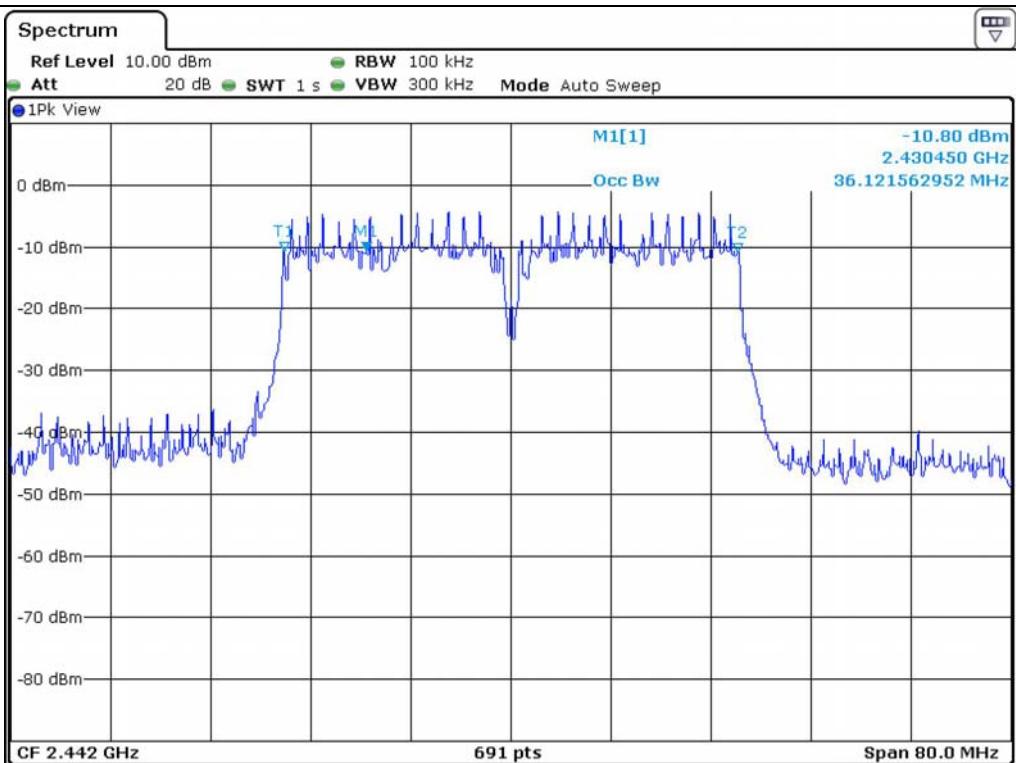
Middle Channel



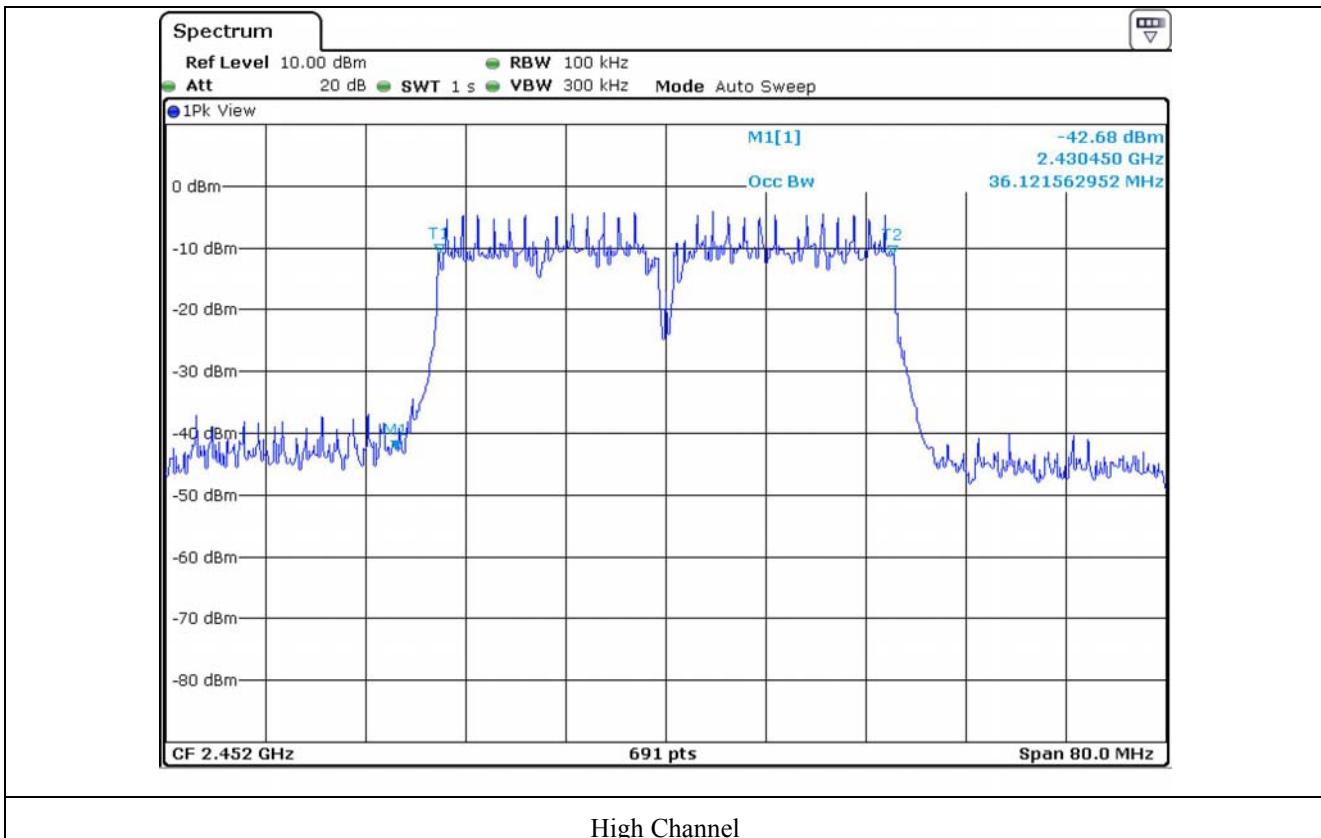
High Channel



Low Channel



Middle Channel



8. MAXIMUM PEAK OUTPUT POWER

8.1 Operating environment

Temperature : 22 °C

Relative humidity : 41 % R.H.

8.2 Test set-up

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



8.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV30	R/S	Spectrum Analyzer	101372	May 20, 2013

All test equipment used is calibrated on a regular basis.

8.4 Test data for 802.11b WLAN Mode

- Test Date : April 01, 2014

- Test Result : Pass

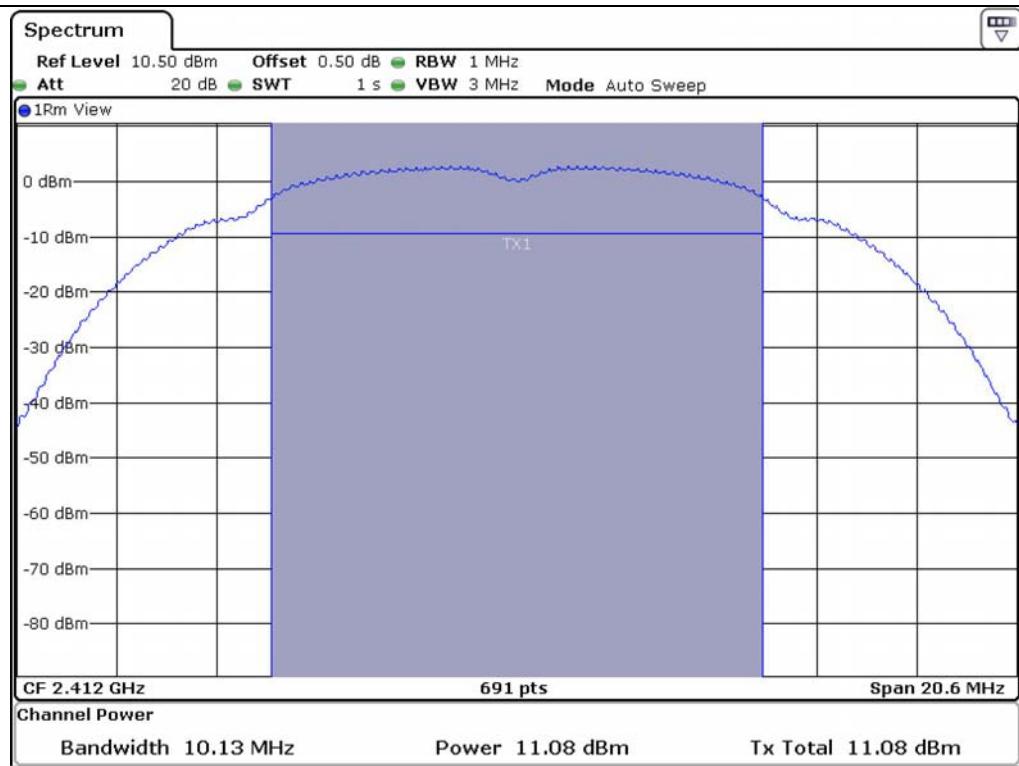
CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412	10.13	11.08	30	18.92
MIDDLE	2 442	10.13	11.71	30	18.29
HIGH	2 462	10.13	11.75	30	18.25

CHANNEL	FREQUENCY (MHz)	99 % bandwidth (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412	13.60	11.21	30	18.79
MIDDLE	2 442	13.60	11.99	30	18.01
HIGH	2 462	13.60	11.98	30	18.02

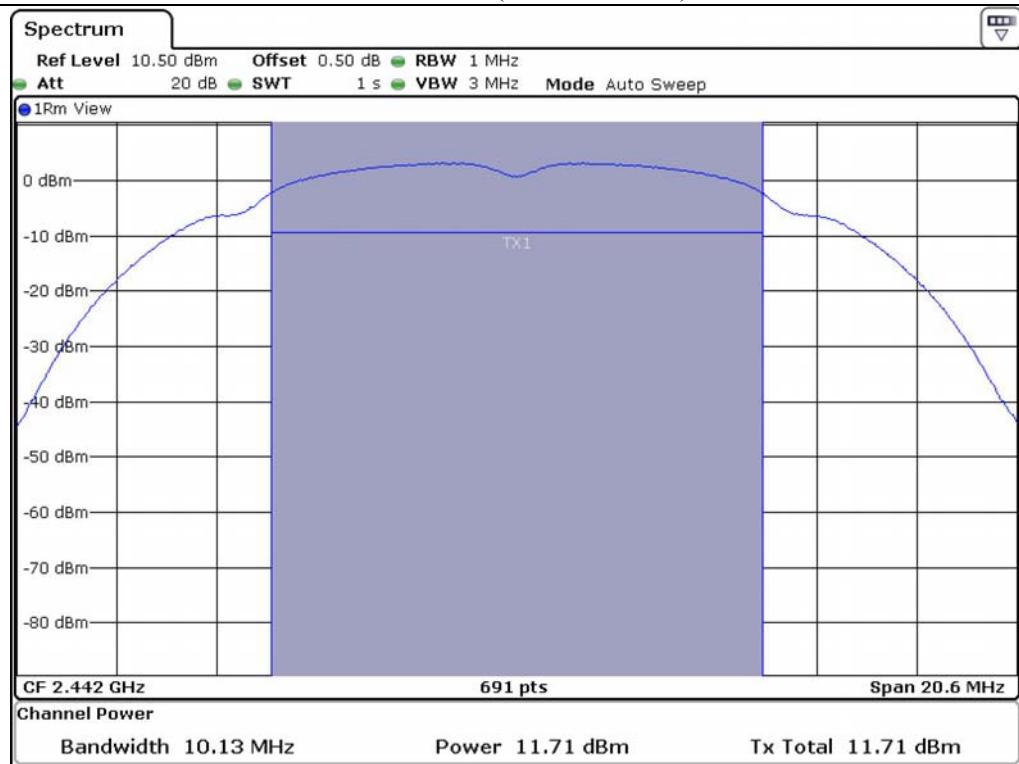
Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)



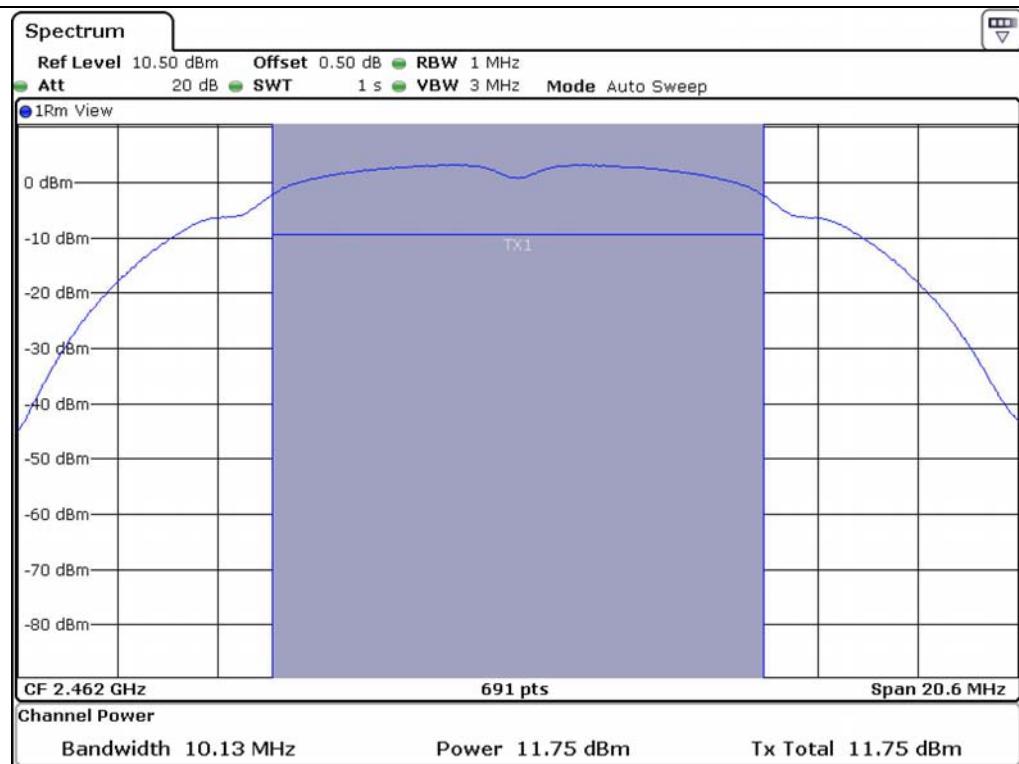
Tested by: Tae-Ho, Kim / Project Engineer



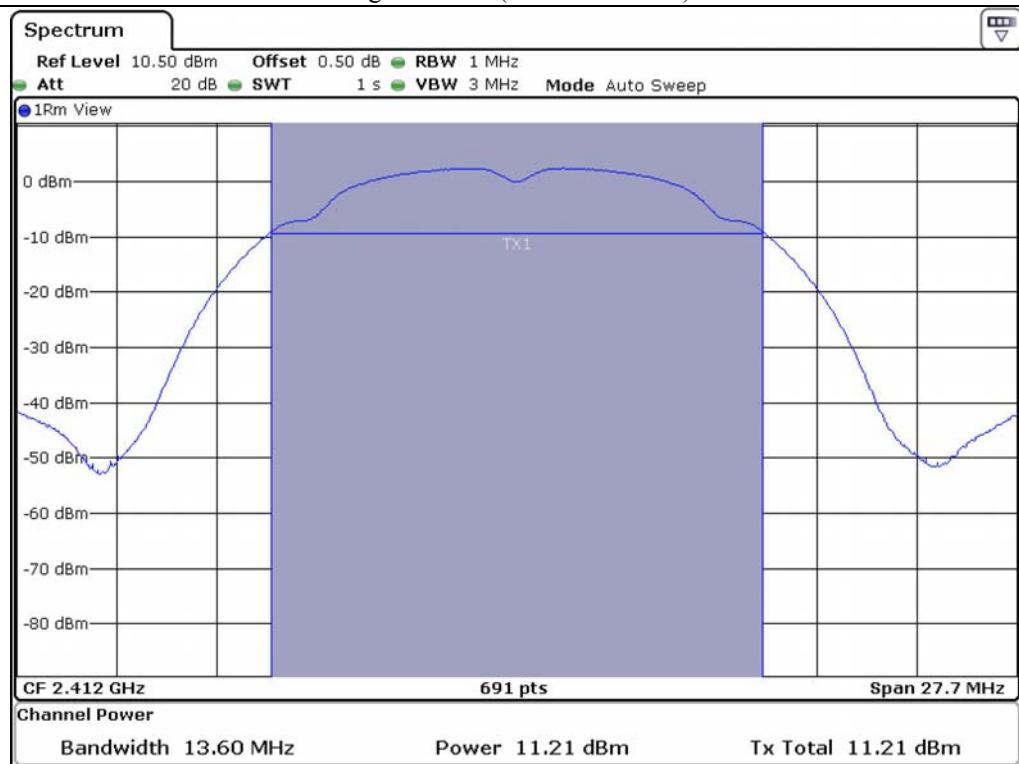
Low Channel (6 dB Bandwidth)



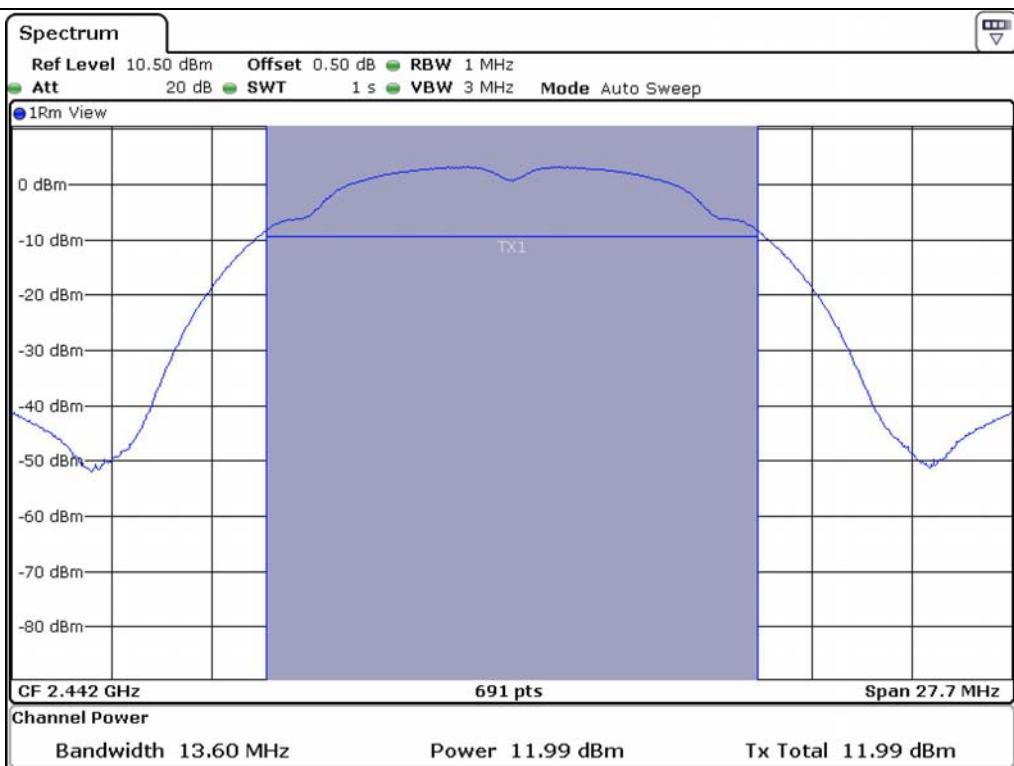
Middle Channel (6 dB Bandwidth)



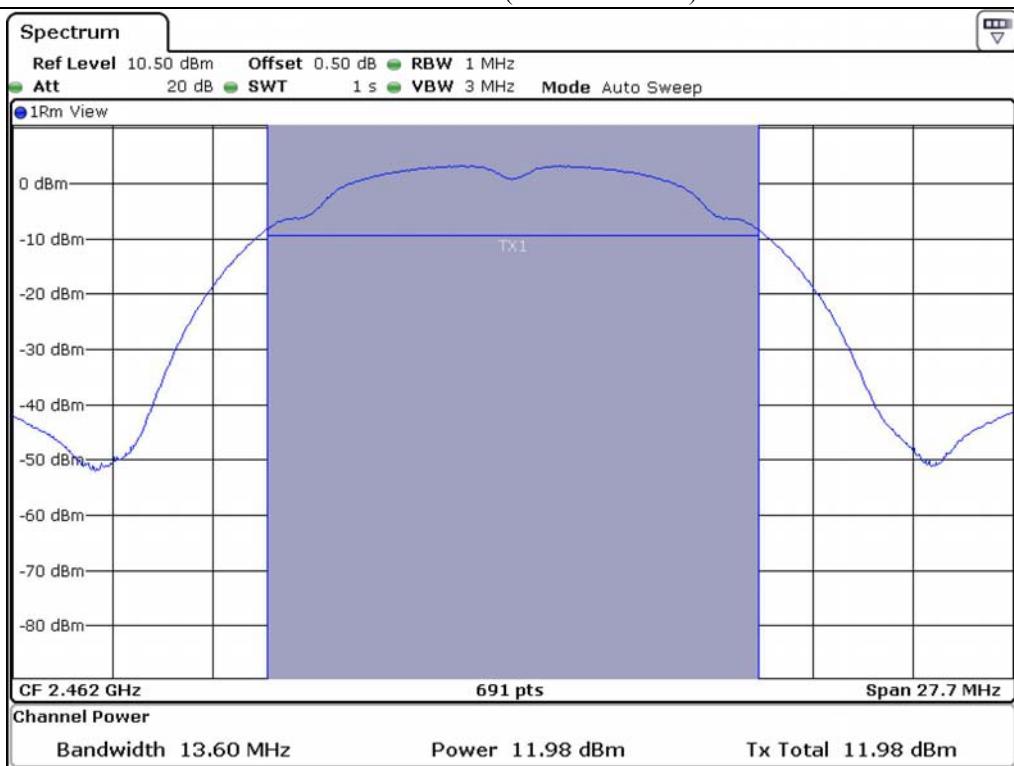
High Channel (6 dB Bandwidth)



Low Channel (99 % bandwidth)



Middle Channel (99 % bandwidth)



High Channel (99 % bandwidth)

8.5 Test data for 802.11g WLAN Mode

- Test Date : April 01, 2014

- Test Result : Pass

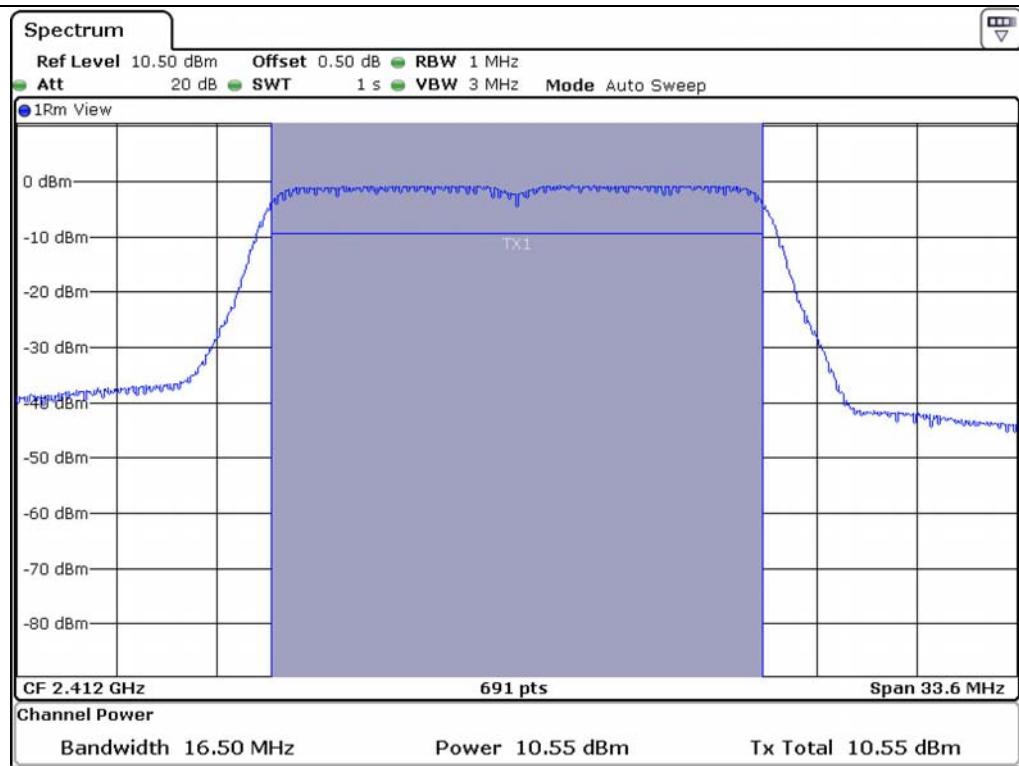
CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412	16.50	10.55	30	19.45
MIDDLE	2 442	16.50	11.14	30	18.86
HIGH	2 462	16.50	11.47	30	18.53

CHANNEL	FREQUENCY (MHz)	99 % bandwidth (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412	16.50	10.53	30	19.47
MIDDLE	2 442	16.50	11.12	30	18.88
HIGH	2 462	16.50	11.43	30	18.57

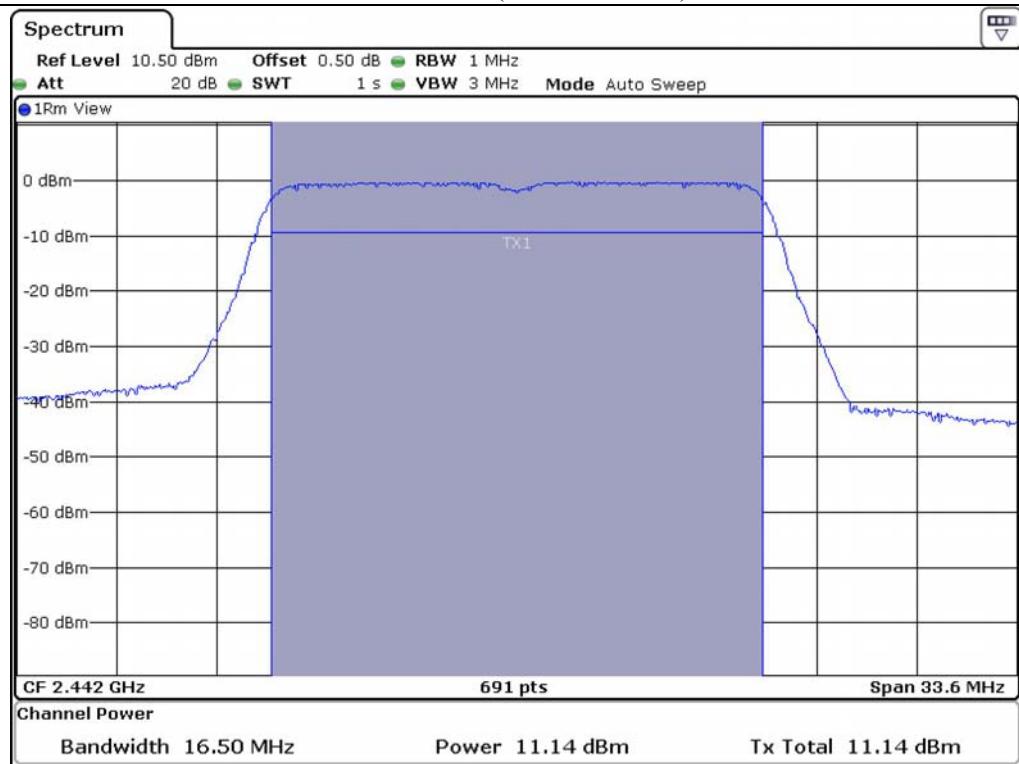
Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)



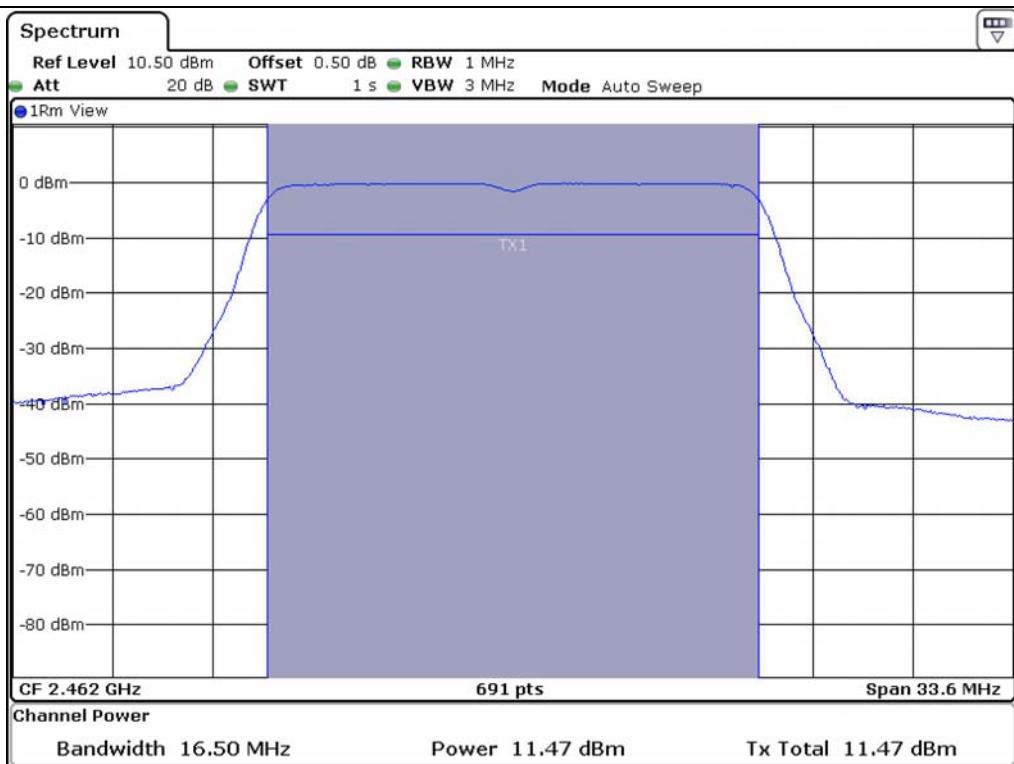
Tested by: Tae-Ho, Kim / Project Engineer



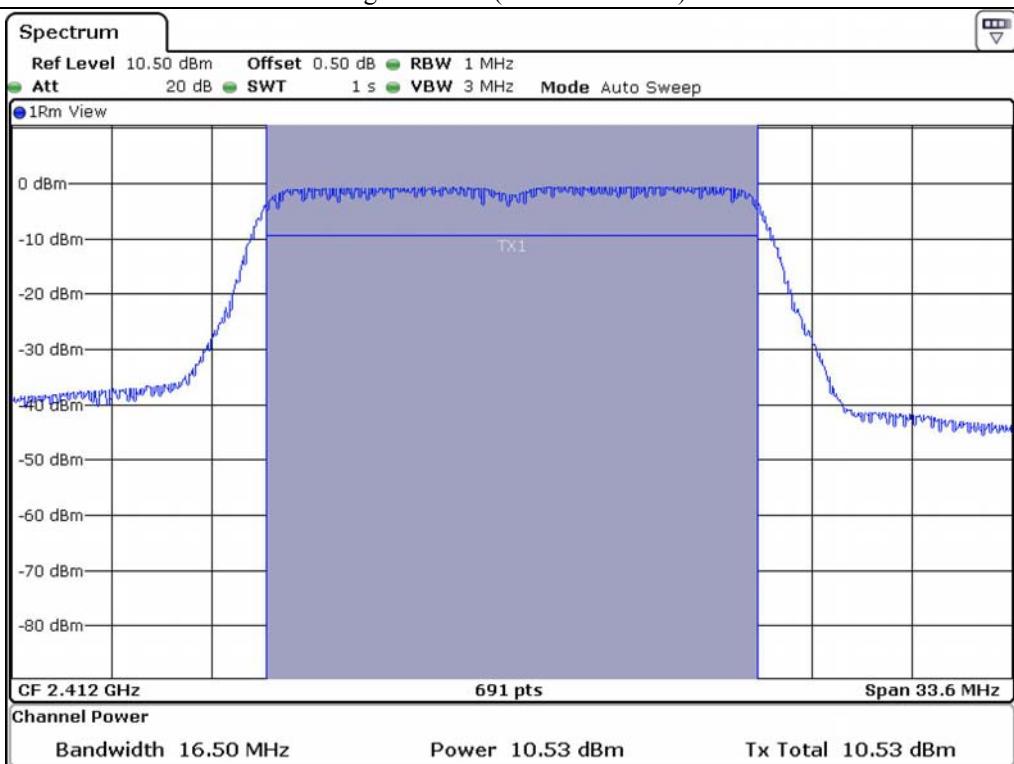
Low Channel (6 dB Bandwidth)



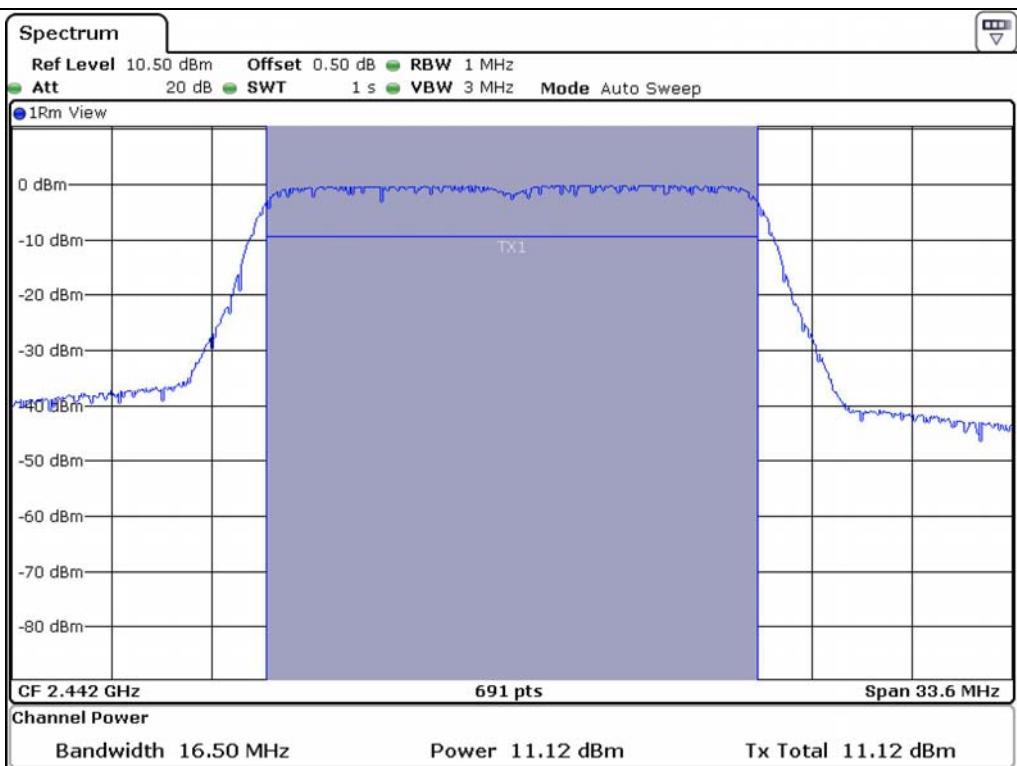
Middle Channel (6 dB Bandwidth)



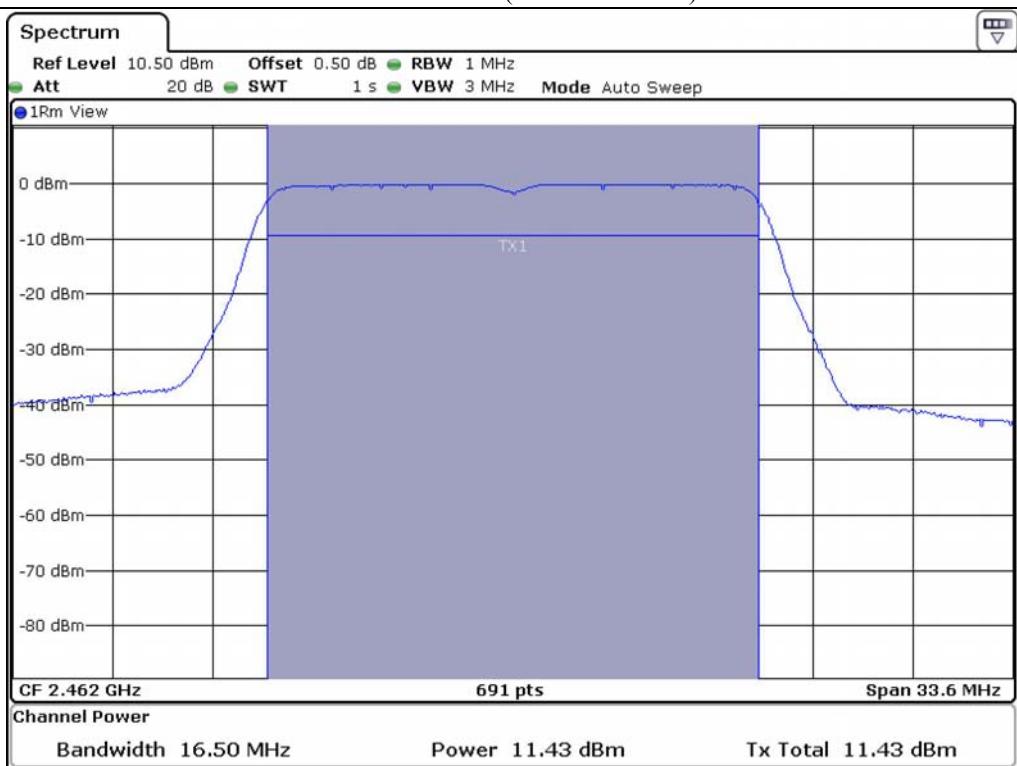
High Channel (6 dB Bandwidth)



Low Channel (99 % bandwidth)



Middle Channel (99 % bandwidth)



High Channel (99 % bandwidth)

8.6 Test data for 802.11n_HT20 WLAN Mode

- . Test Date : April 01, 2014

- . Test Result : Pass

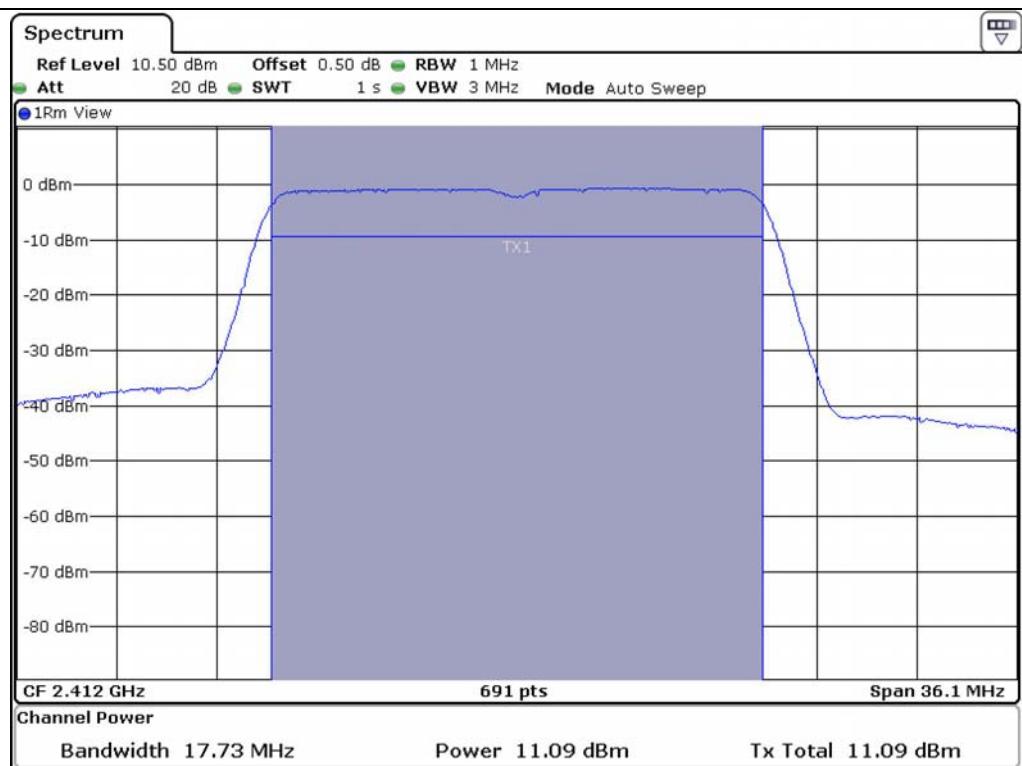
CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412	17.73	11.09	30	18.91
MIDDLE	2 442	17.73	11.44	30	18.56
HIGH	2 462	17.73	11.59	30	18.41

CHANNEL	FREQUENCY (MHz)	99 % bandwidth (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412	17.66	10.97	30	19.03
MIDDLE	2 442	17.66	11.38	30	18.62
HIGH	2 462	17.66	11.55	30	18.45

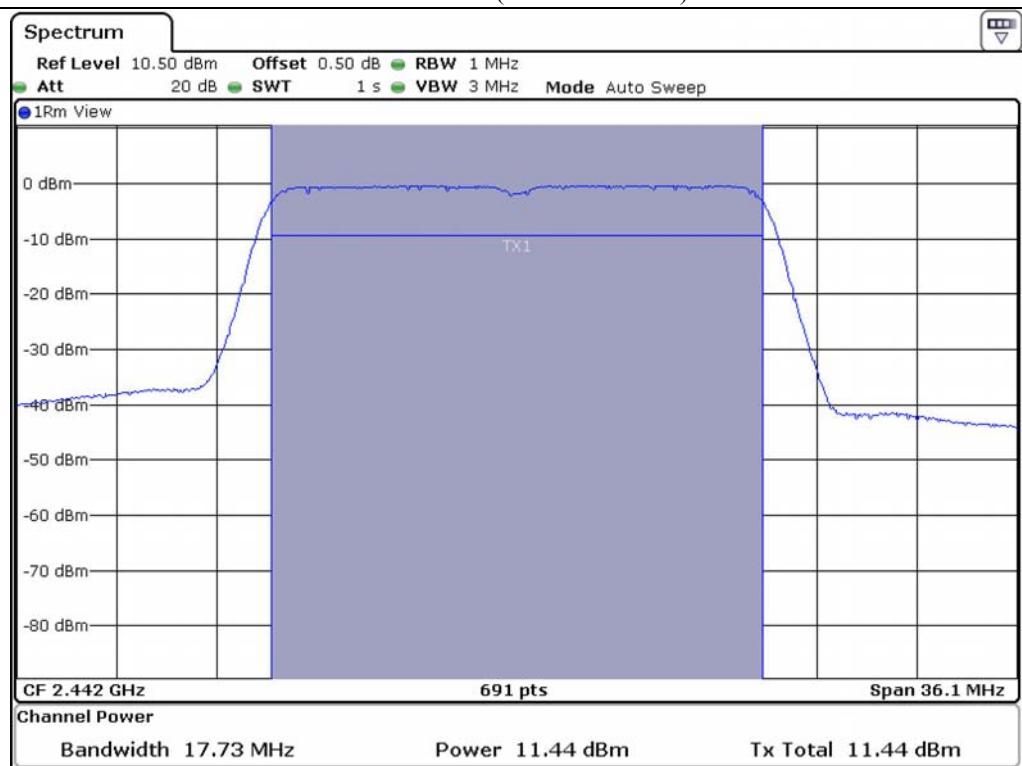
Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)



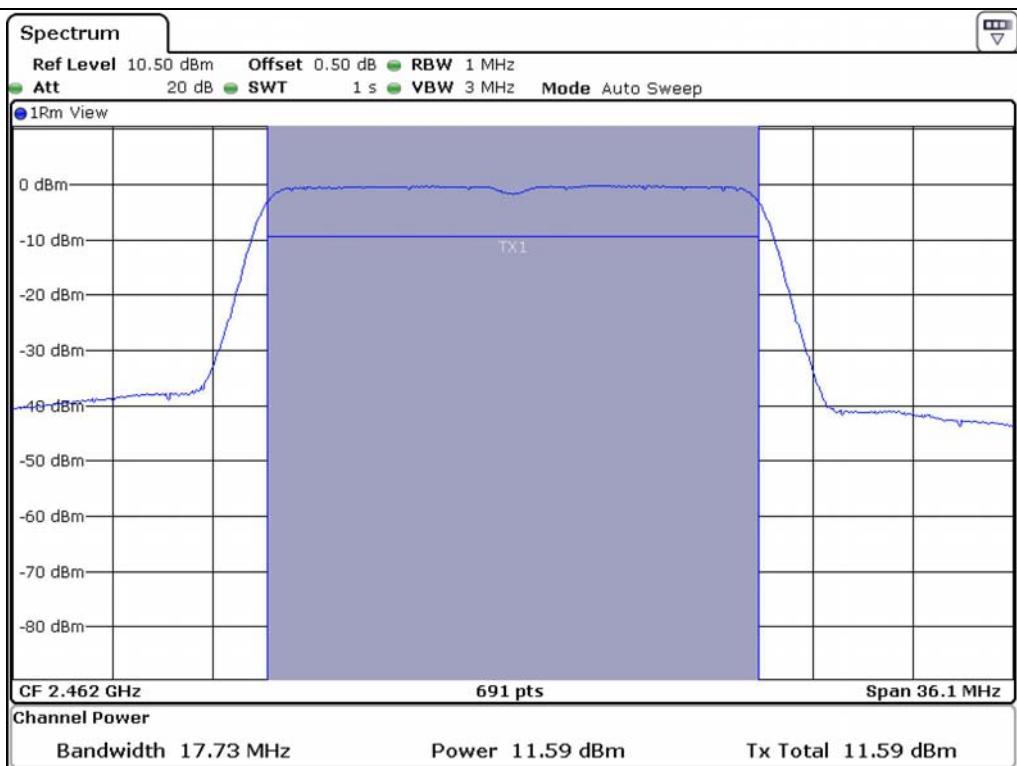
Tae-Ho, Kim / Project Engineer



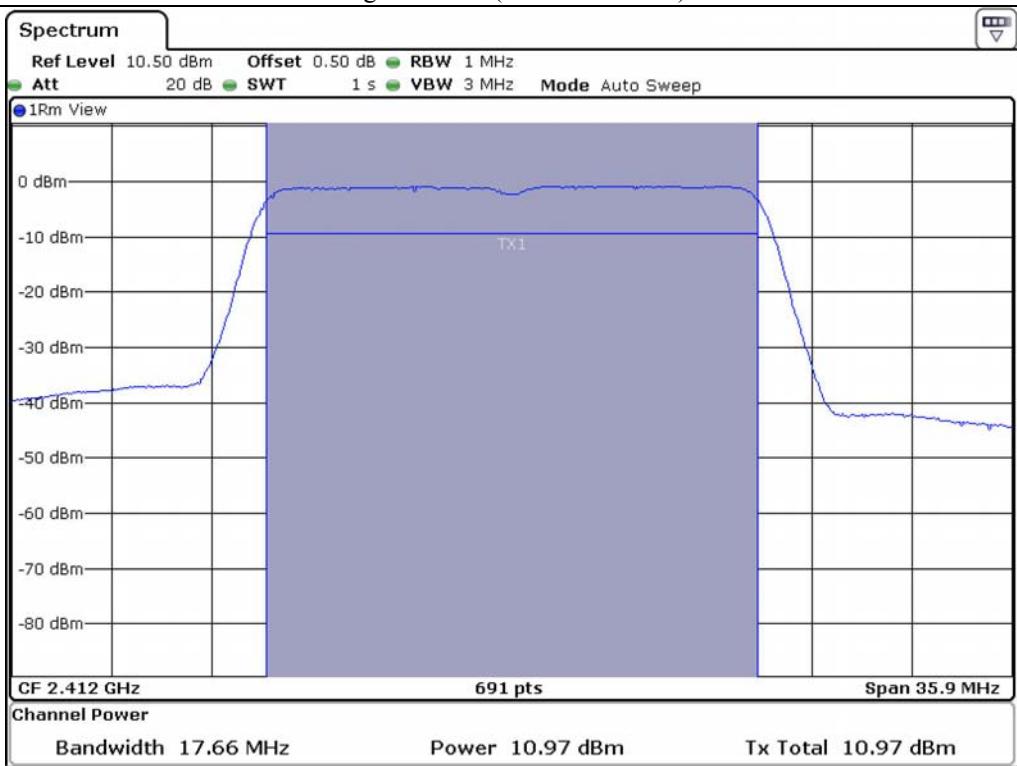
Low Channel (6 dB Bandwidth)



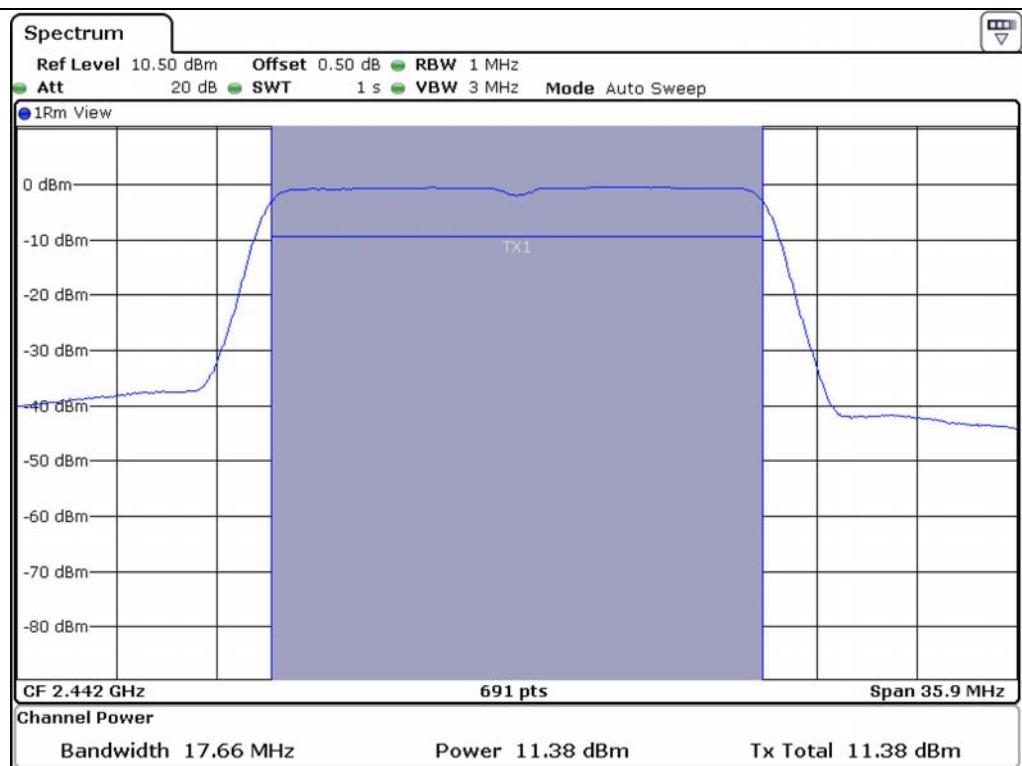
Middle Channel (6 dB Bandwidth)



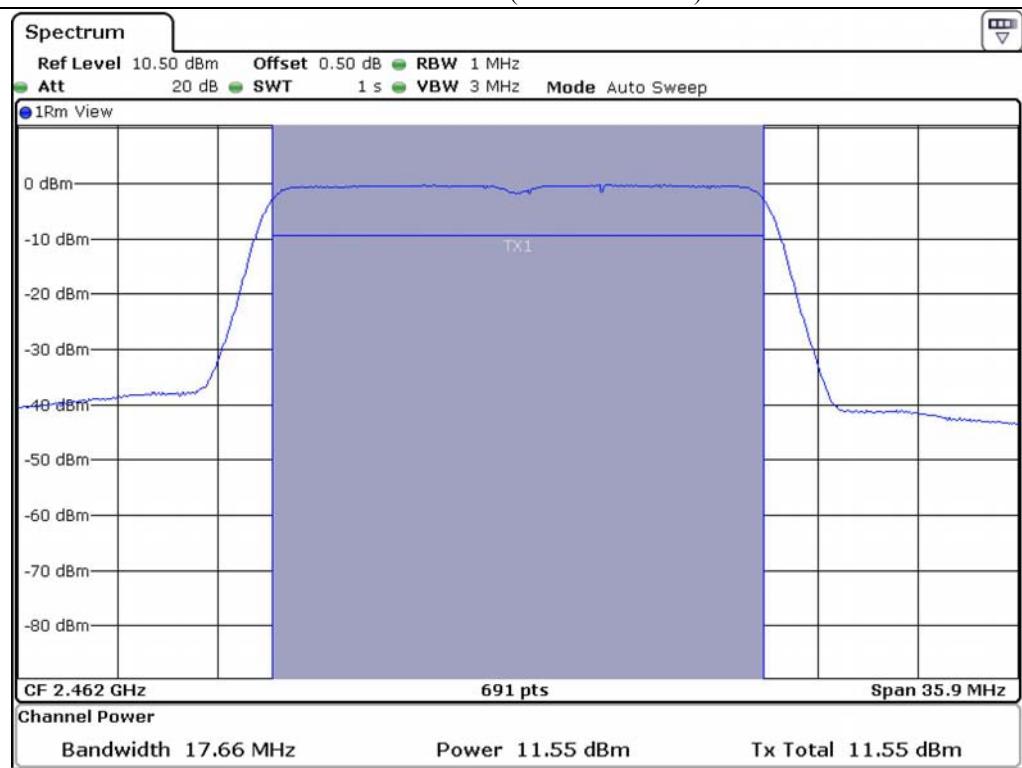
High Channel (6 dB Bandwidth)



Low Channel (99 % bandwidth)



Middle Channel (99 % bandwidth)



High Channel (99 % bandwidth)

8.7 Test data for 802.11n_HT40 WLAN Mode

- Test Date : April 01, 2014

- Test Result : Pass

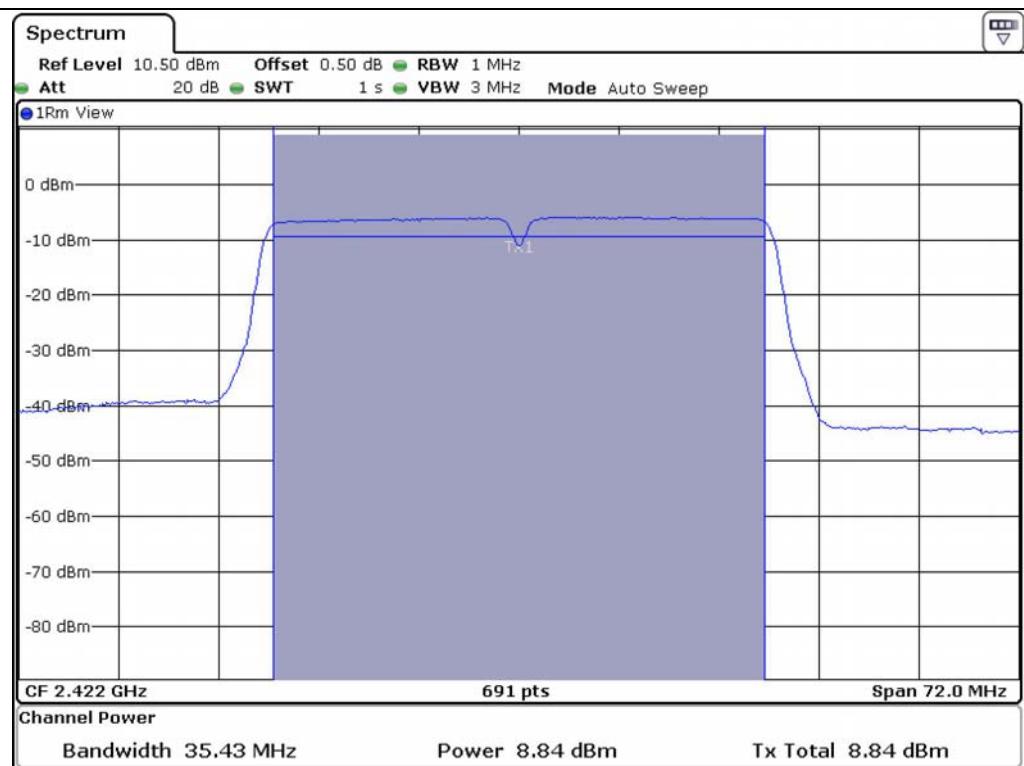
CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 422	35.43	8.84	30	21.16
MIDDLE	2 442	35.43	8.93	30	21.07
HIGH	2 452	35.43	8.97	30	21.03

CHANNEL	FREQUENCY (MHz)	99 % bandwidth (MHz)	MEASURED VLAUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 422	36.12	8.80	30	21.20
MIDDLE	2 442	36.12	9.29	30	20.71
HIGH	2 452	36.12	9.38	30	20.62

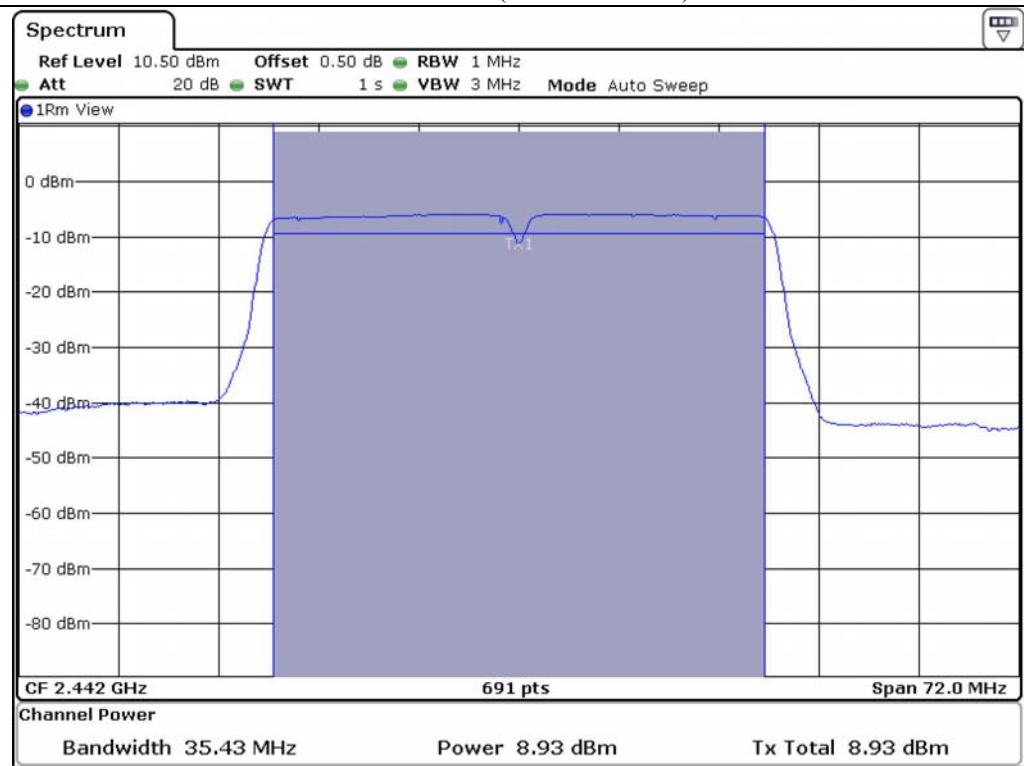
Remark. Margin = Limit – Measured Value (=Receiver Reading + Cable Loss)



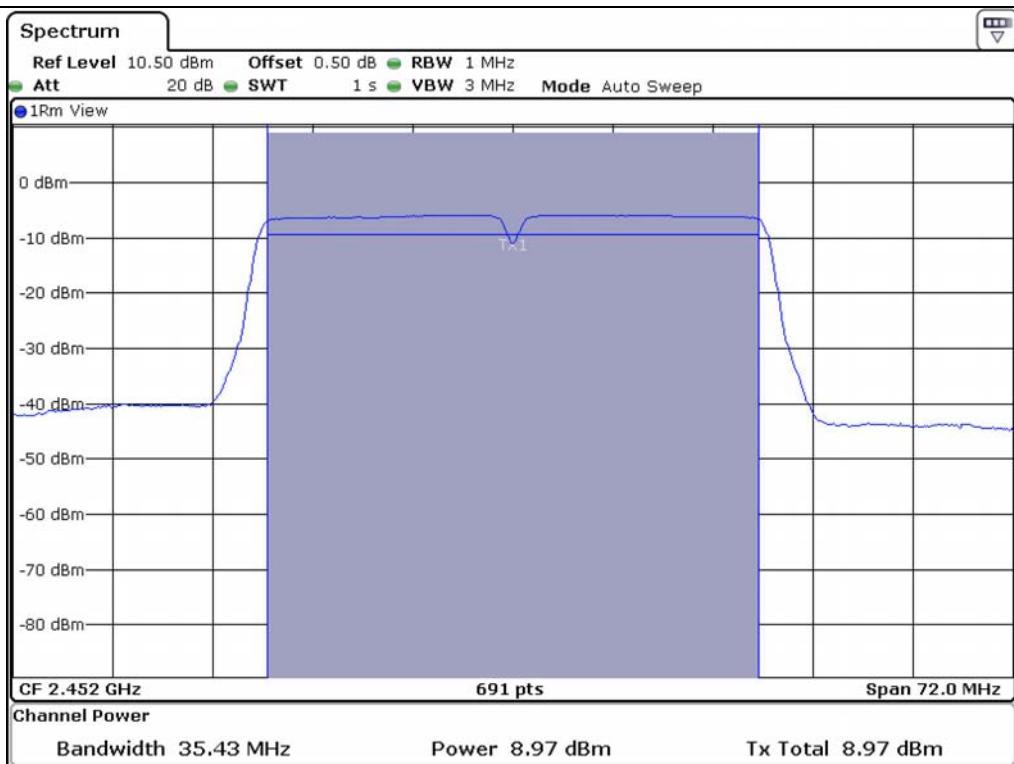
Tested by: Tae-Ho, Kim / Project Engineer



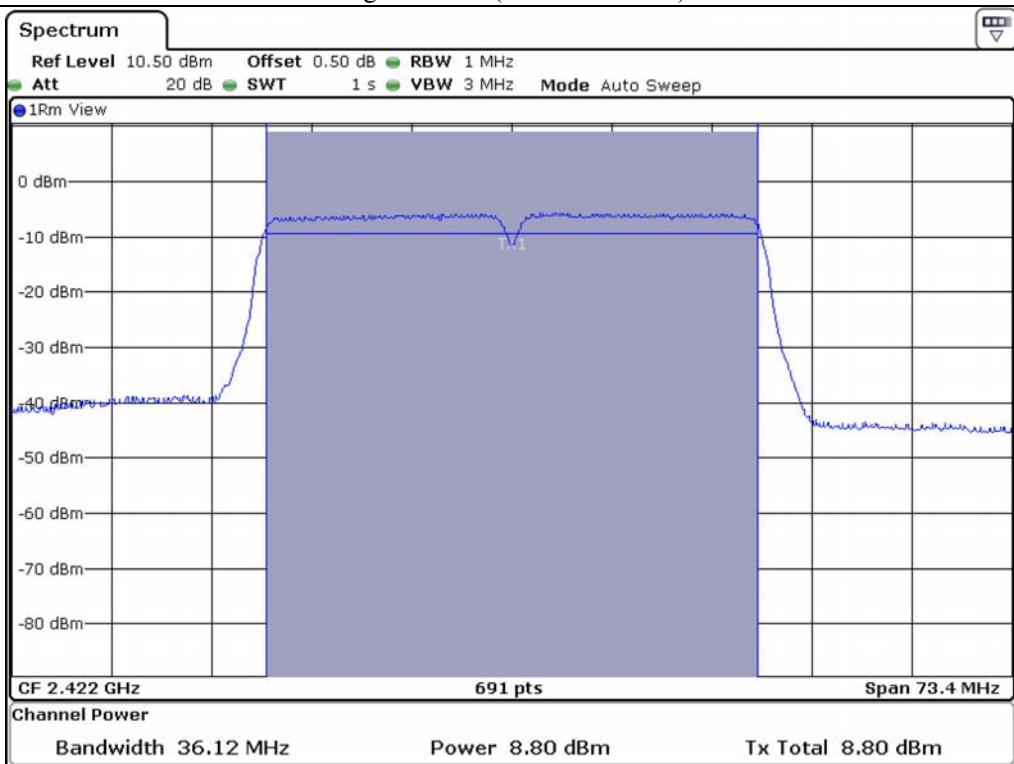
Low Channel (6 dB Bandwidth)



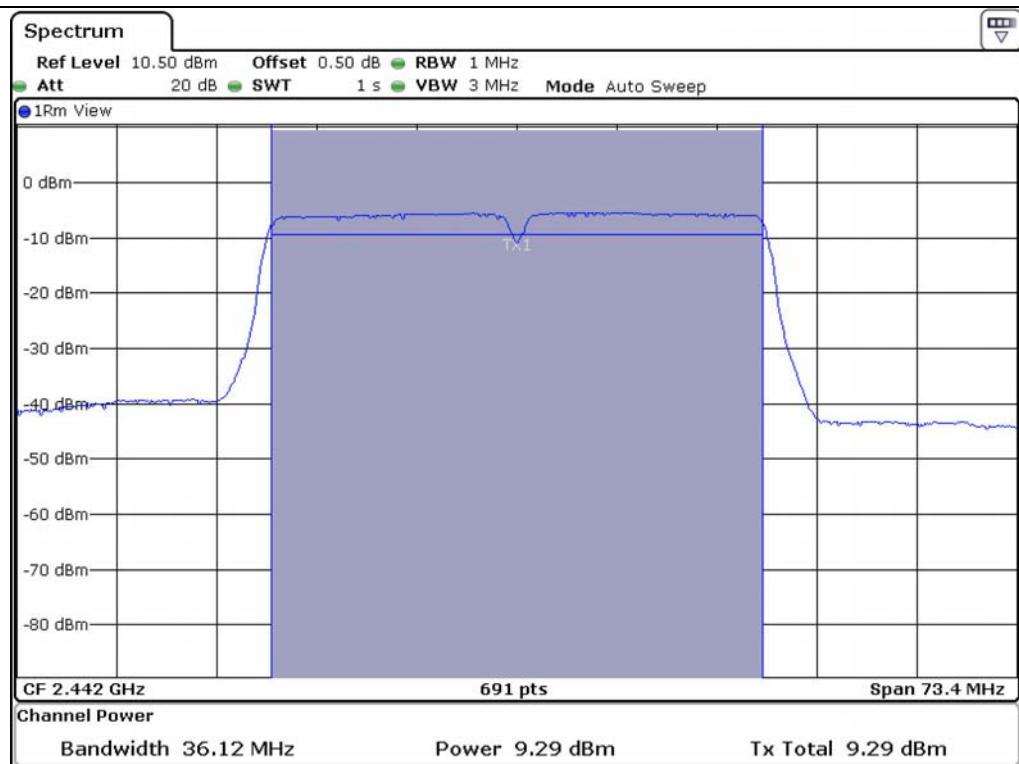
Middle Channel (6 dB Bandwidth)



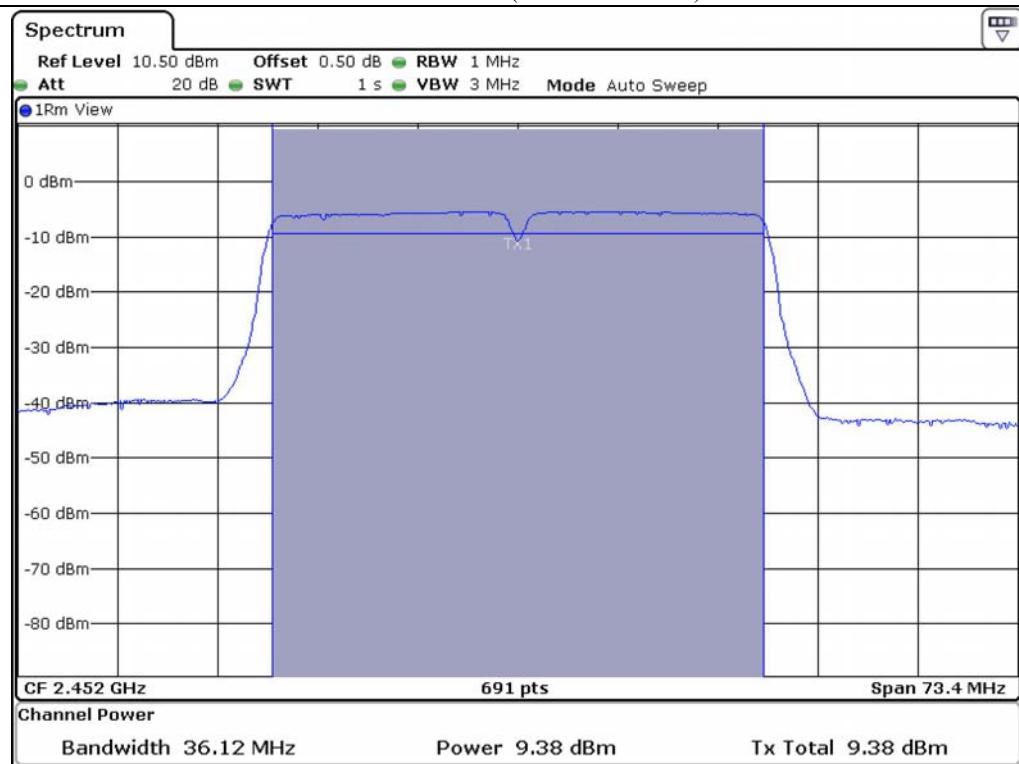
High Channel (6 dB Bandwidth)



Low Channel (99 % bandwidth)



Middle Channel (99 % bandwidth)



High Channel (99 % bandwidth)

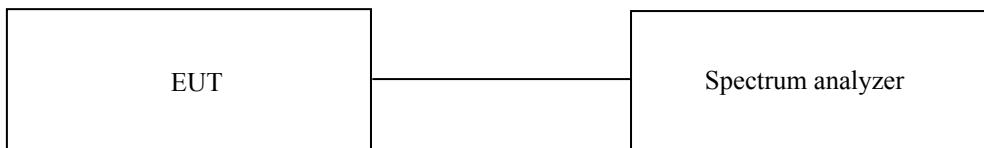
9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

9.1 Operating environment

Temperature : 24 °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, open-field test site. The EUT was placed on a non-conductive turntable approximately 0.8 m above the ground plane. The frequency spectrum from 30 MHz to 40 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

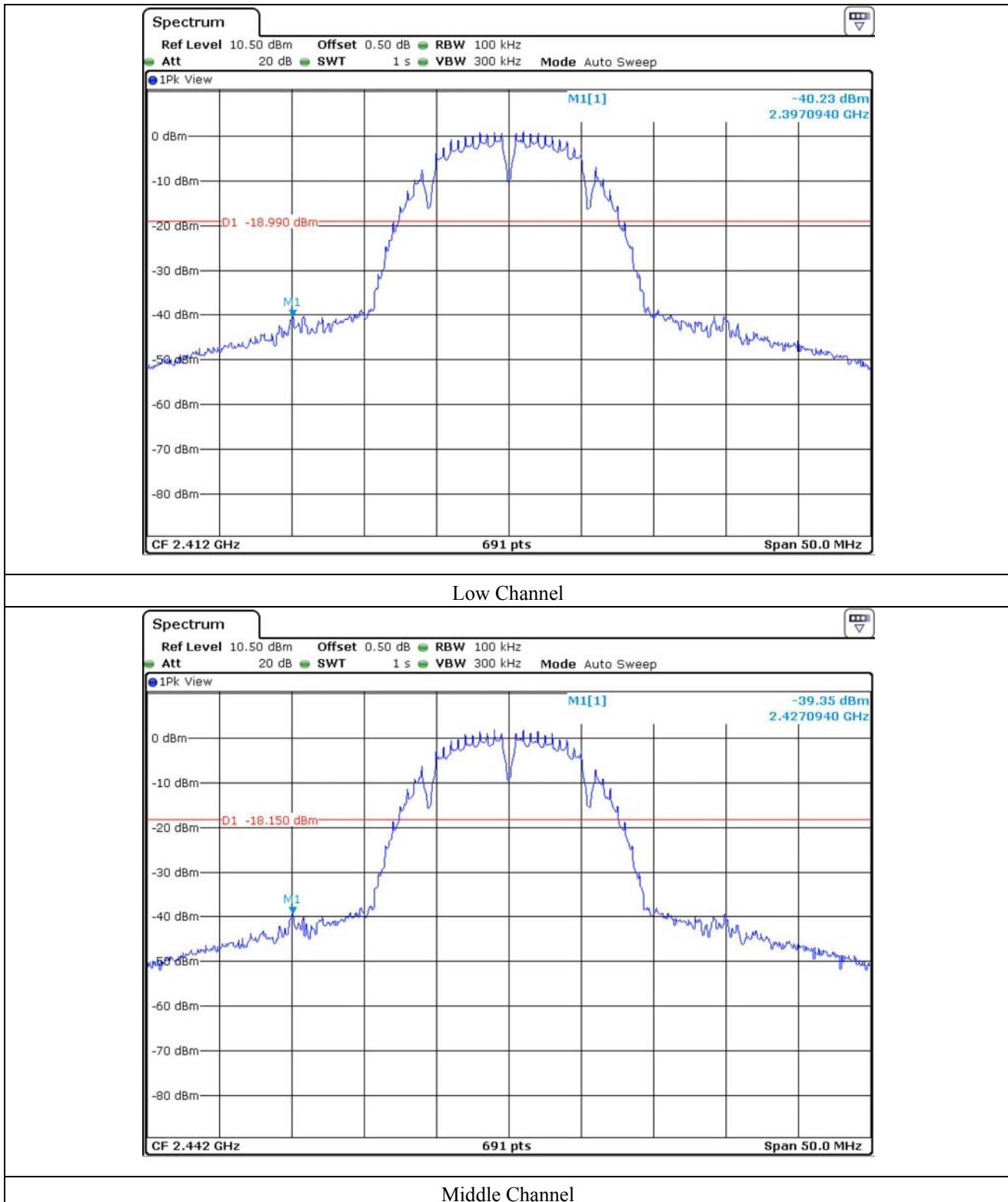
9.4 Test equipment used

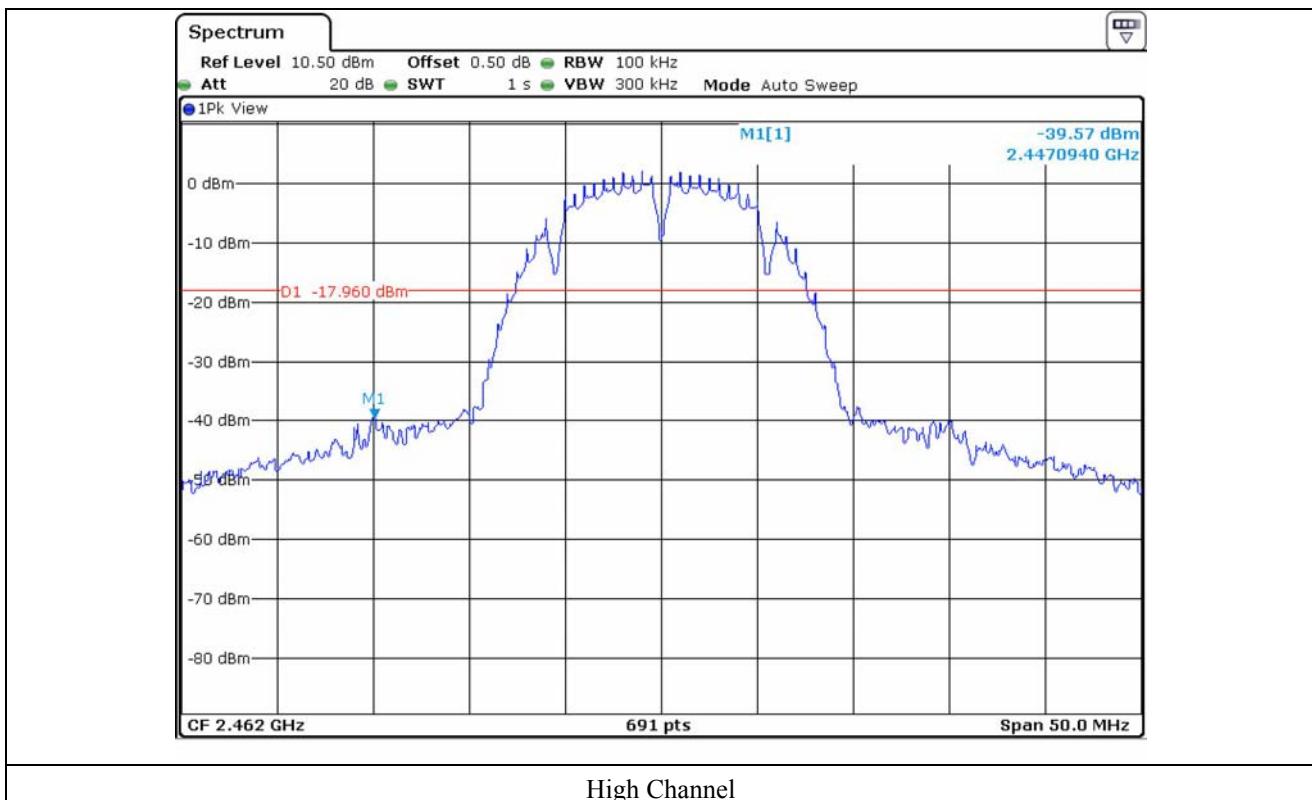
Model Number	Manufacturer	Description	Serial Number	Last Cal.(Interval)
■ - 8564E	HP	Spectrum Analyzer	3650A00756	May 03, 2013(1Y)
■ - ESU	Rohde & Schwarz	EMI Test Receiver	100261	May 27, 2013(1Y)
■ - 310N	Sonoma Instrument	AMPLIFIER	312544	May 21, 2013(1Y)
■ - 83051A	Agilent	Microwave System Preamplifier	3950M00201	May 22, 2013(1Y)
■ - FSV30	Rohde & Schwarz	Signal Analyzer	101372	May 20, 2013(1Y)
■ - SCU-18	Rohde & Schwarz	PRE-AMPLIFIER	10041	Nov. 07, 2013(1Y)
■ - MA220	HD	Turn Table	N/A	N/A
■ - HD240	HD	Antenna Mast	N/A	N/A
■ - VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-421	Jun. 21, 2012(2Y)
■ - BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D294	Sep. 30, 2013 (2Y)
■ - BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Jun. 17, 2013 (2Y)

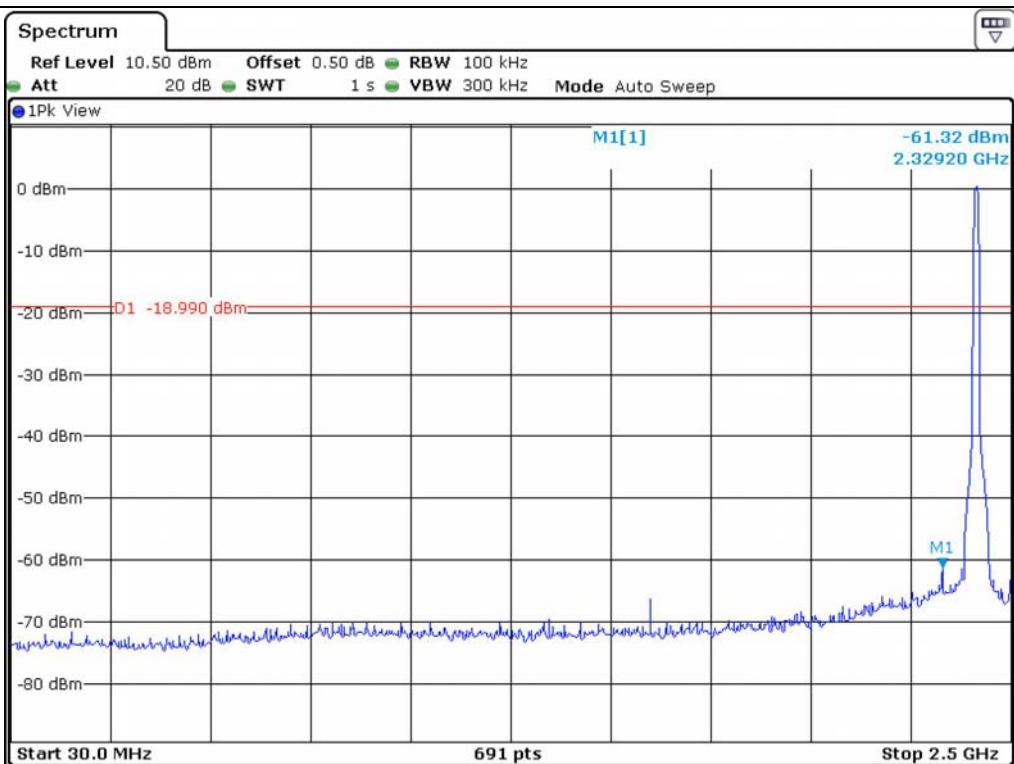
All test equipment used is calibrated on a regular basis.

9.5 Test data for conducted emission

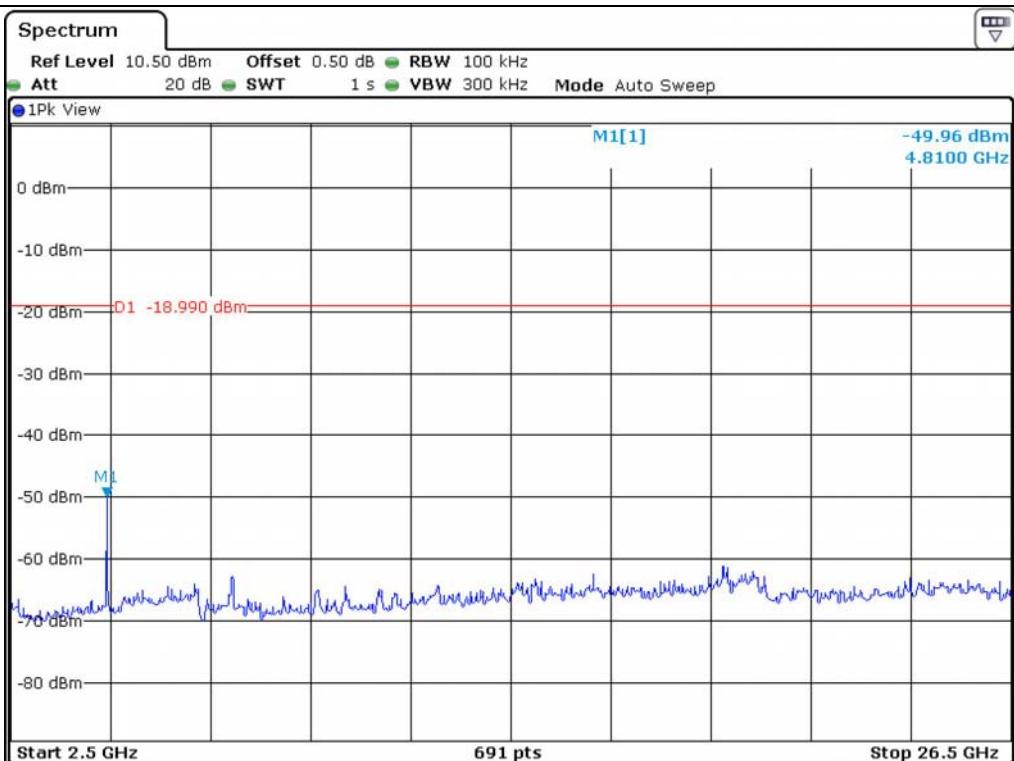
9.5.1 Test data for 802.11b WLAN Mode



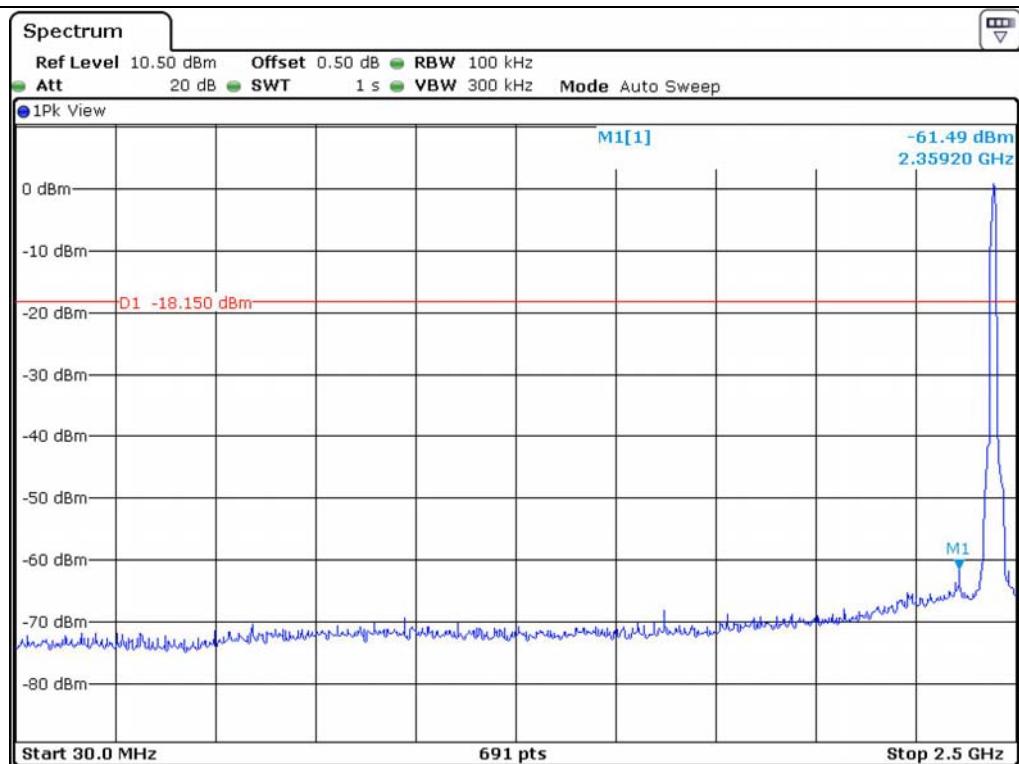




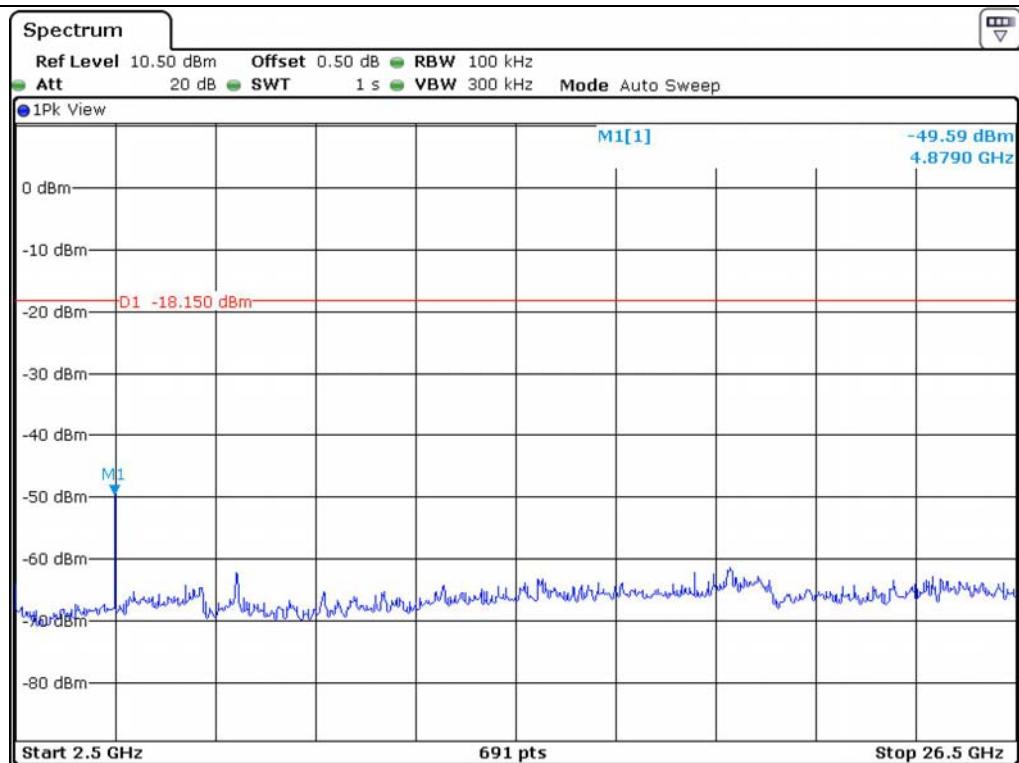
Low Channel



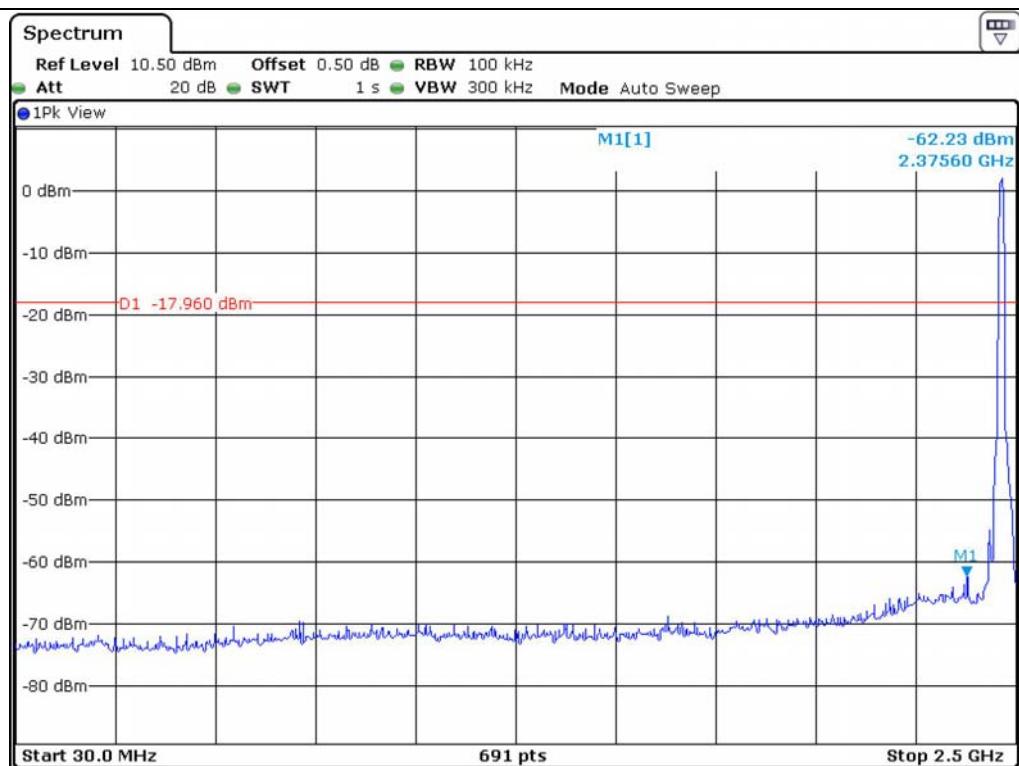
Low Channel



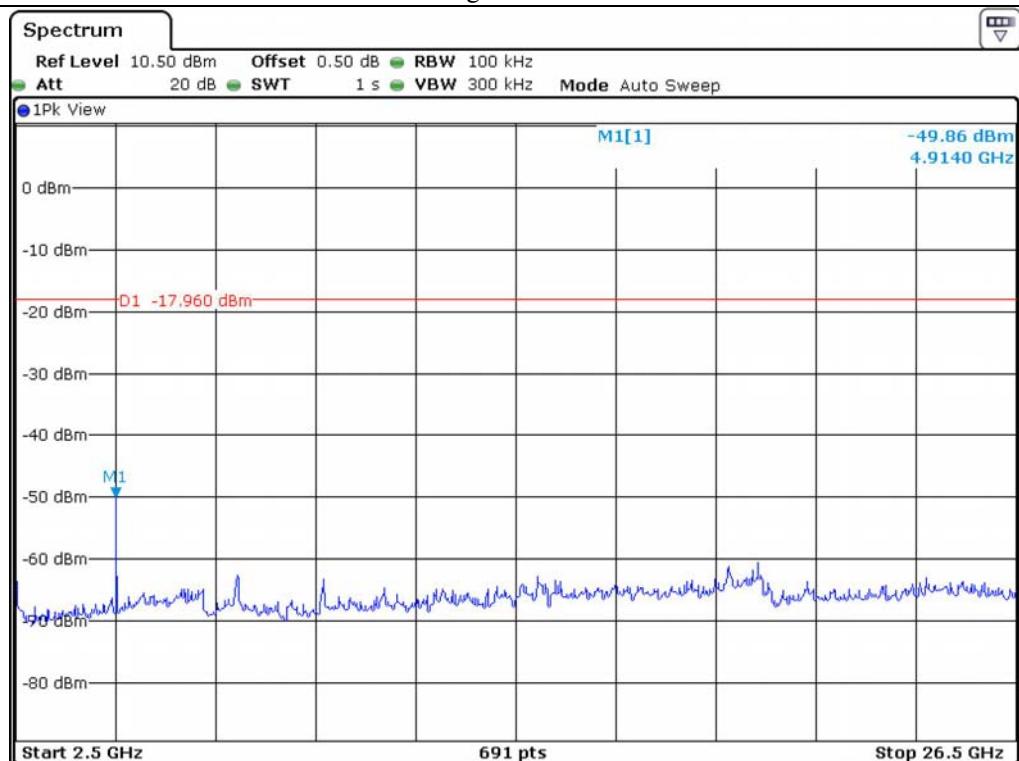
Middle Channel



Middle Channel

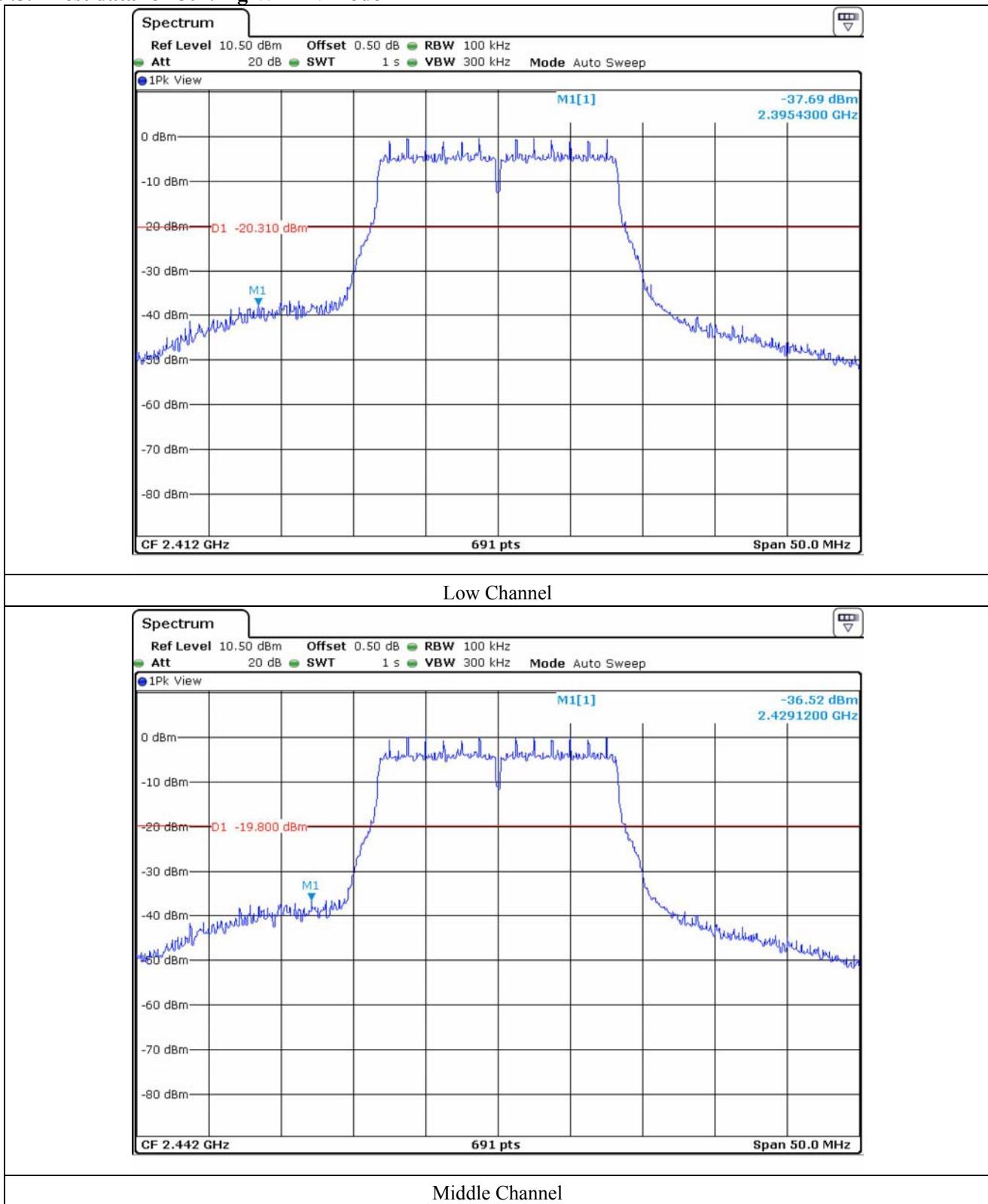


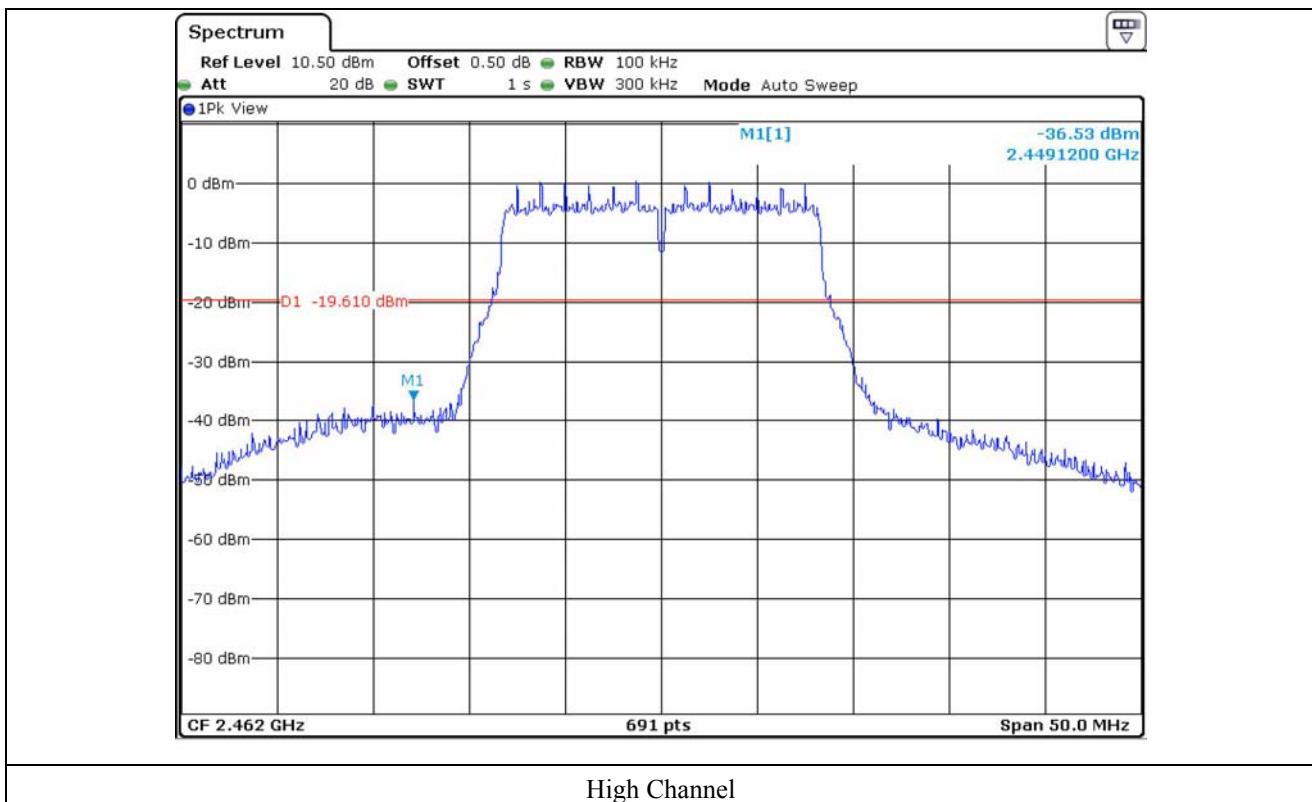
High Channel

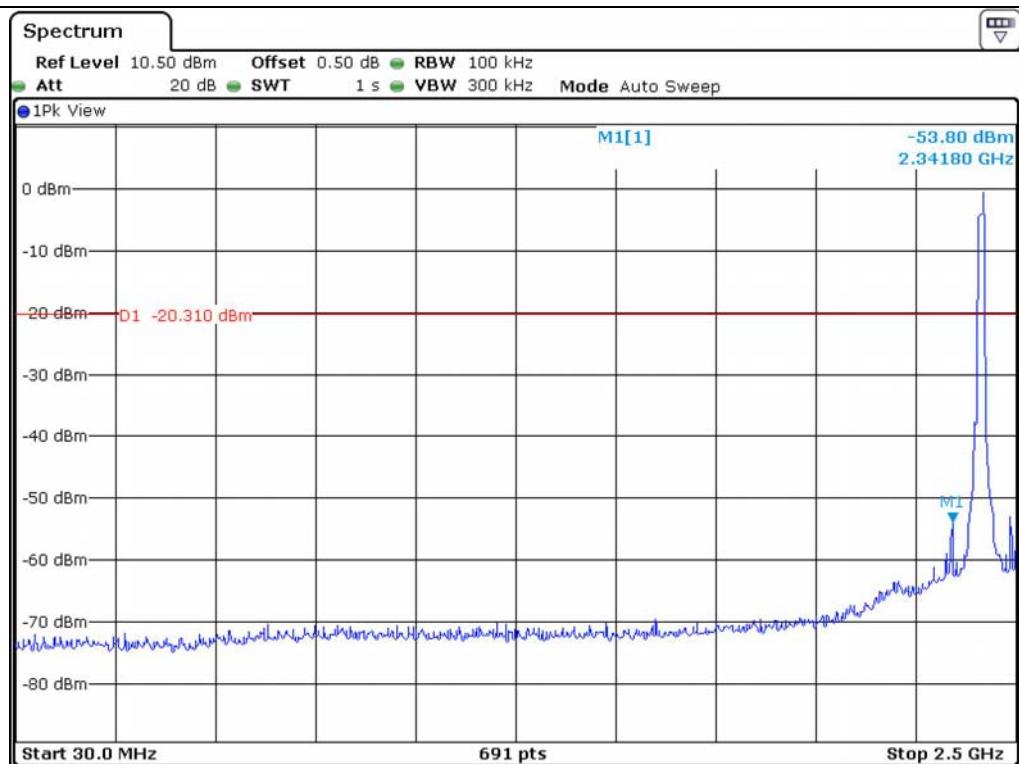


High Channel

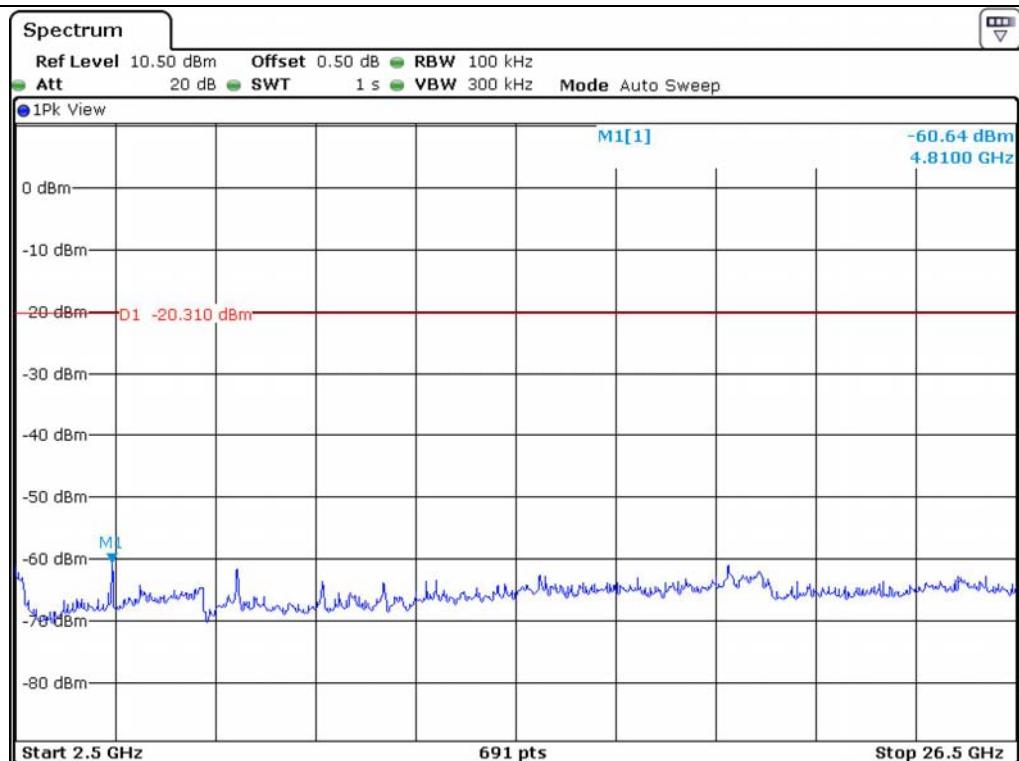
9.5.2 Test data for 802.11g WLAN Mode



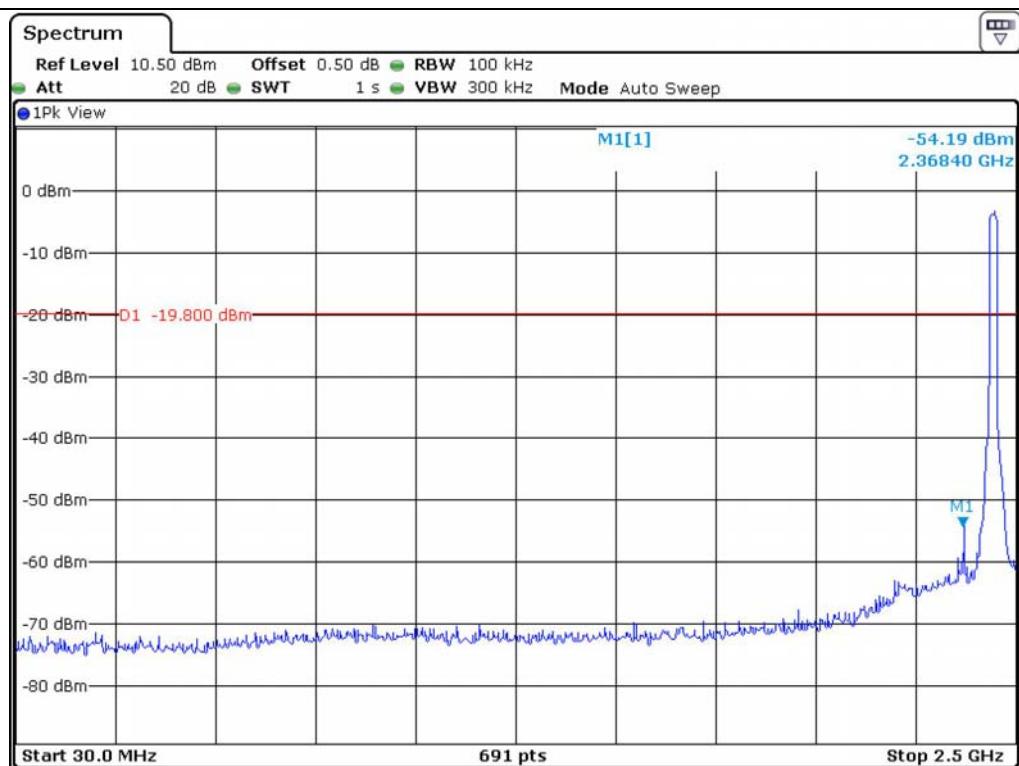




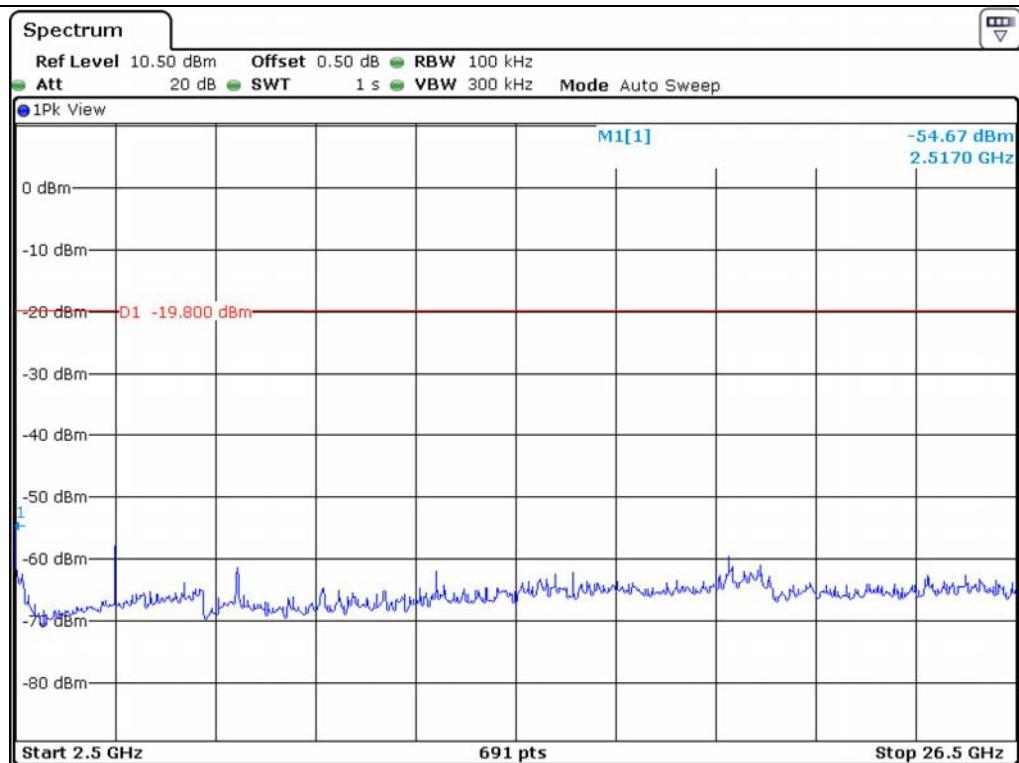
Low Channel



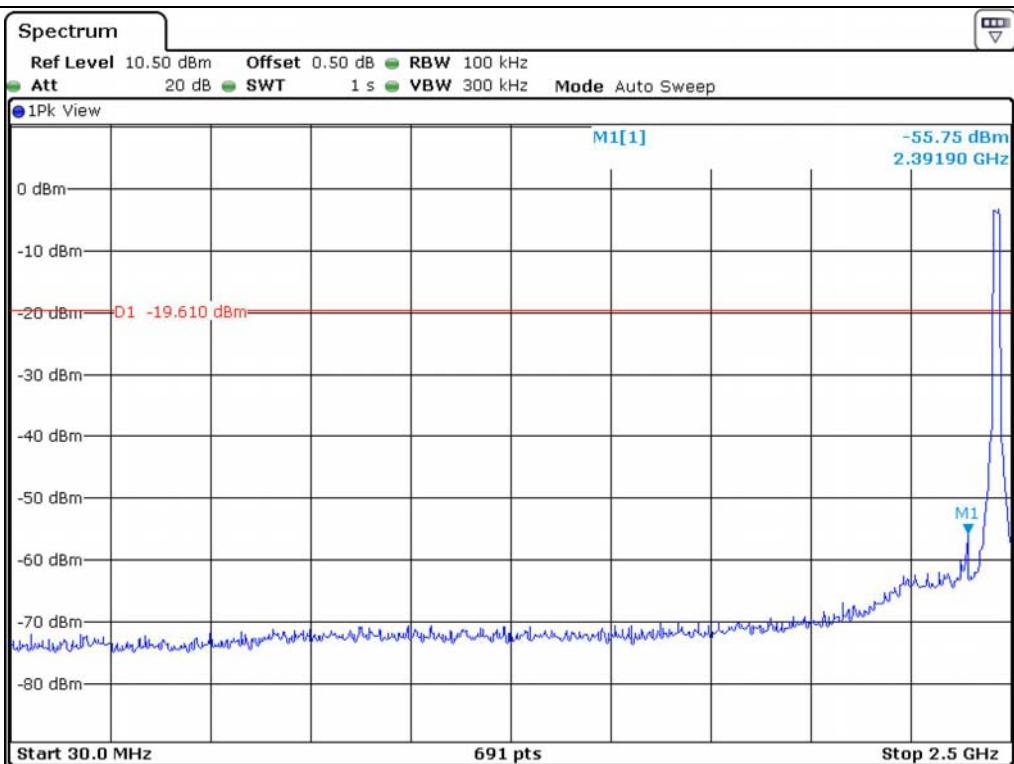
Low Channel



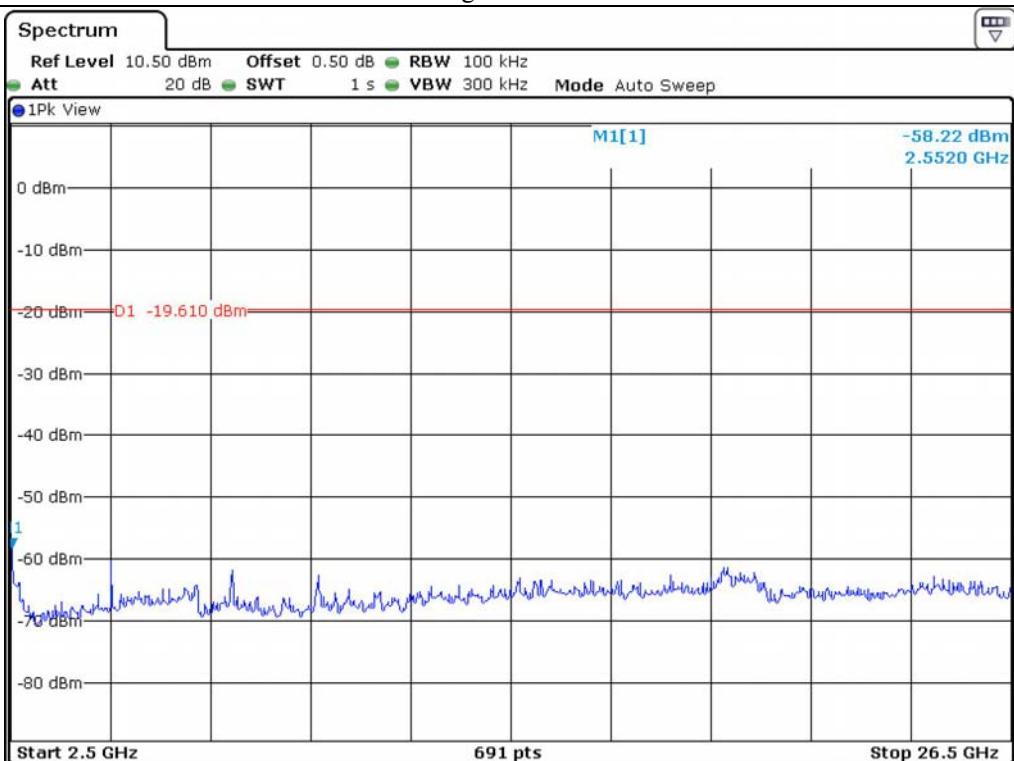
Middle Channel



Middle Channel

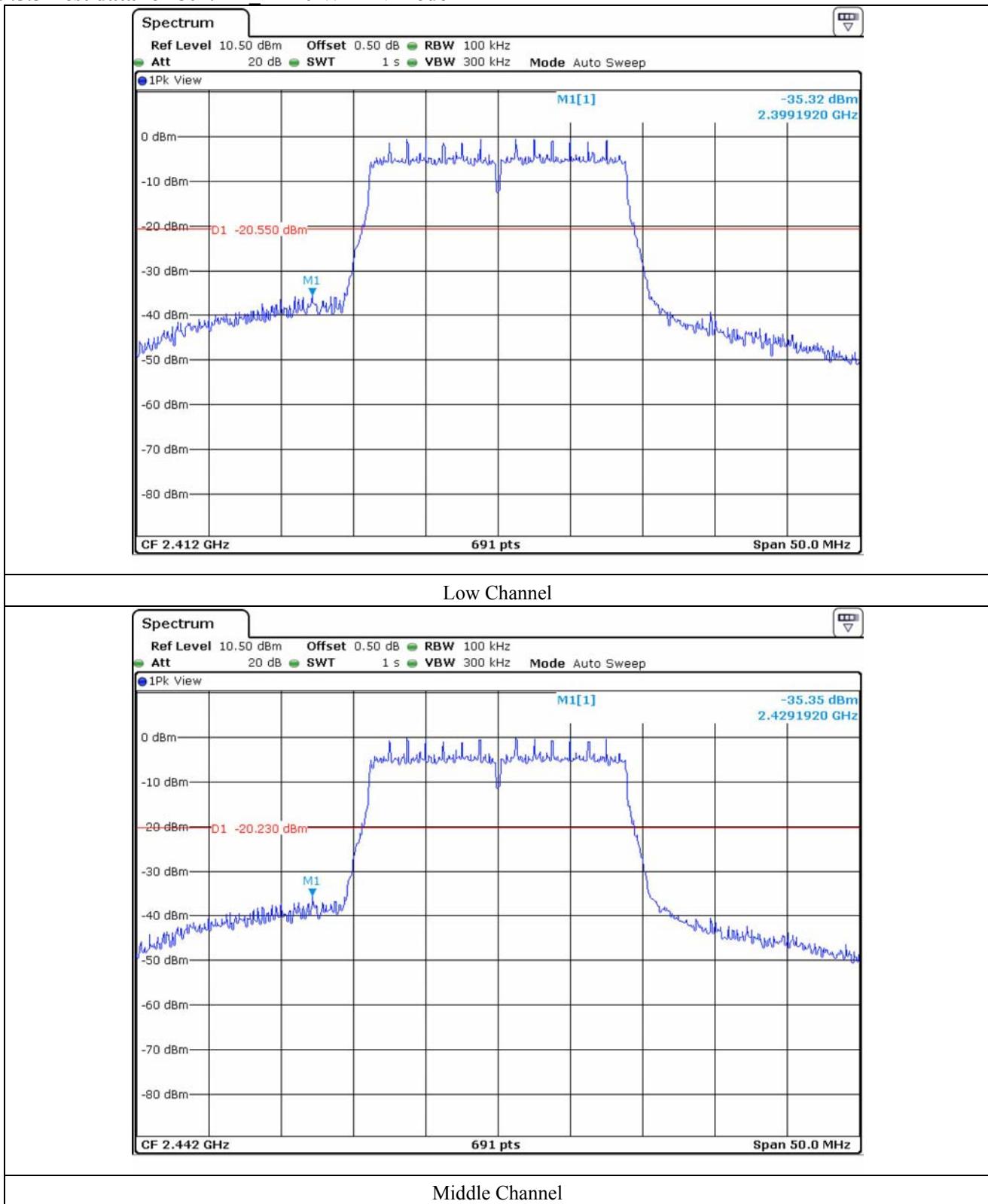


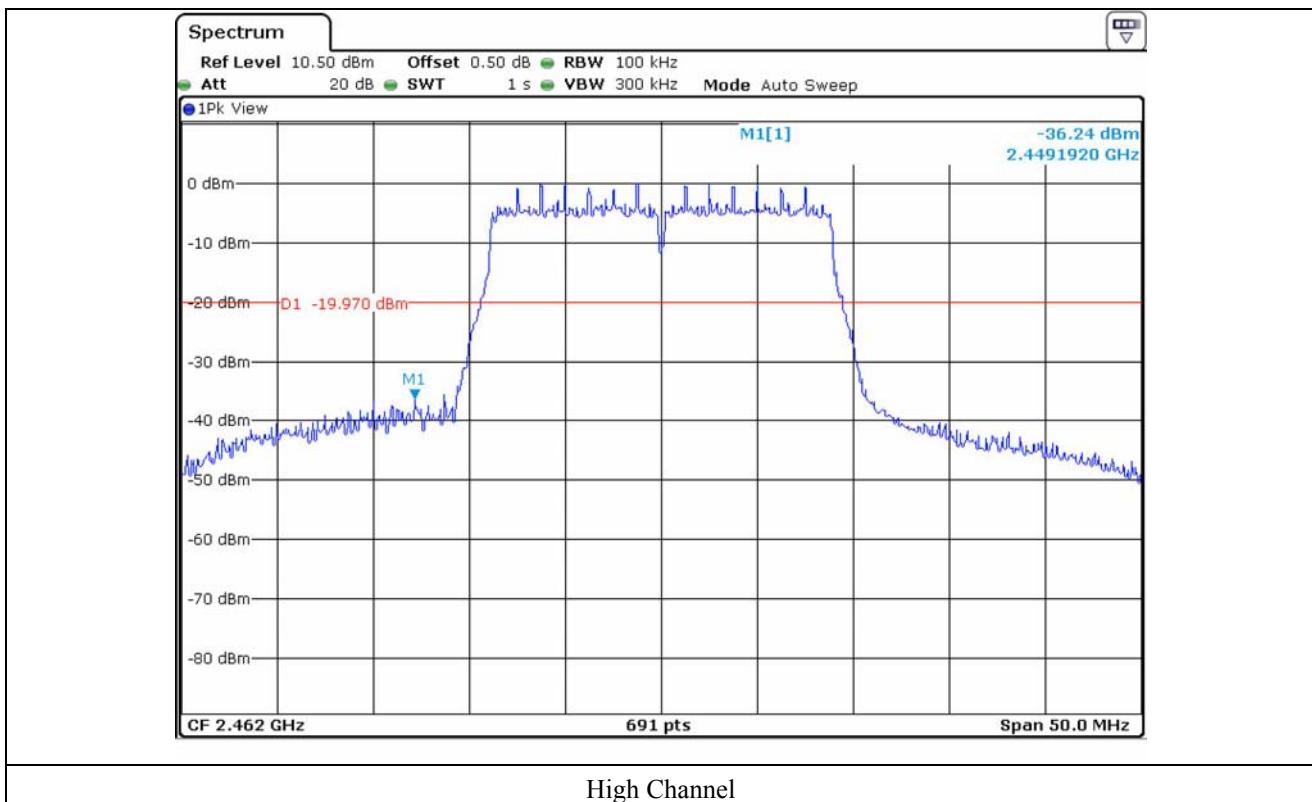
High Channel

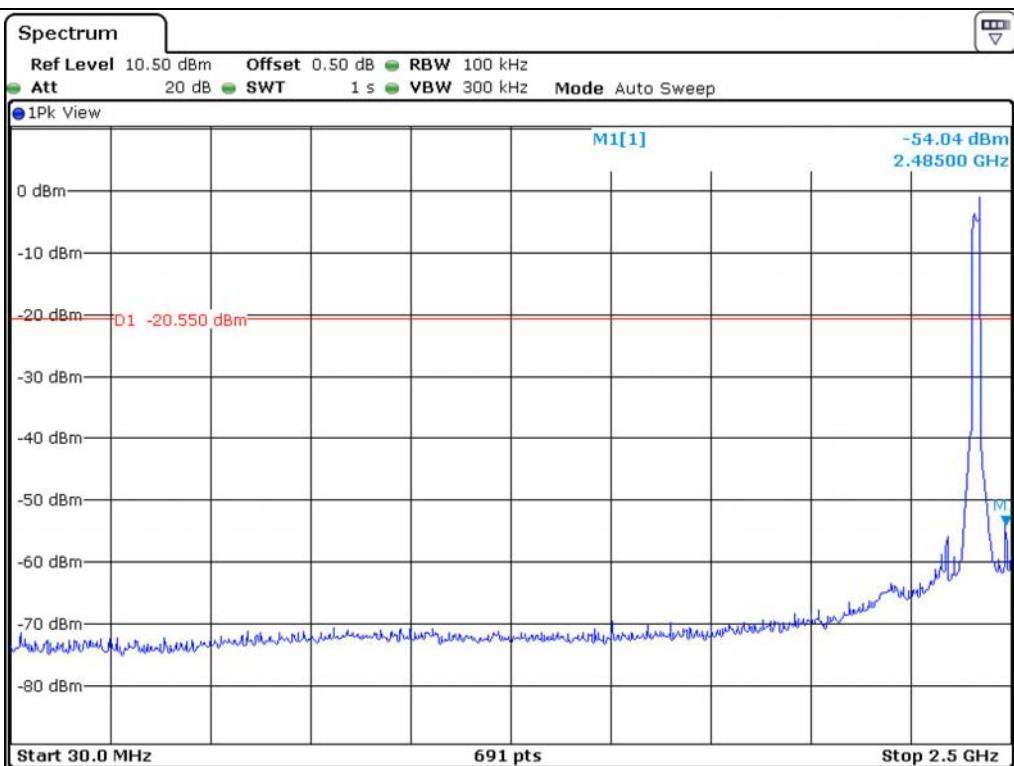


High Channel

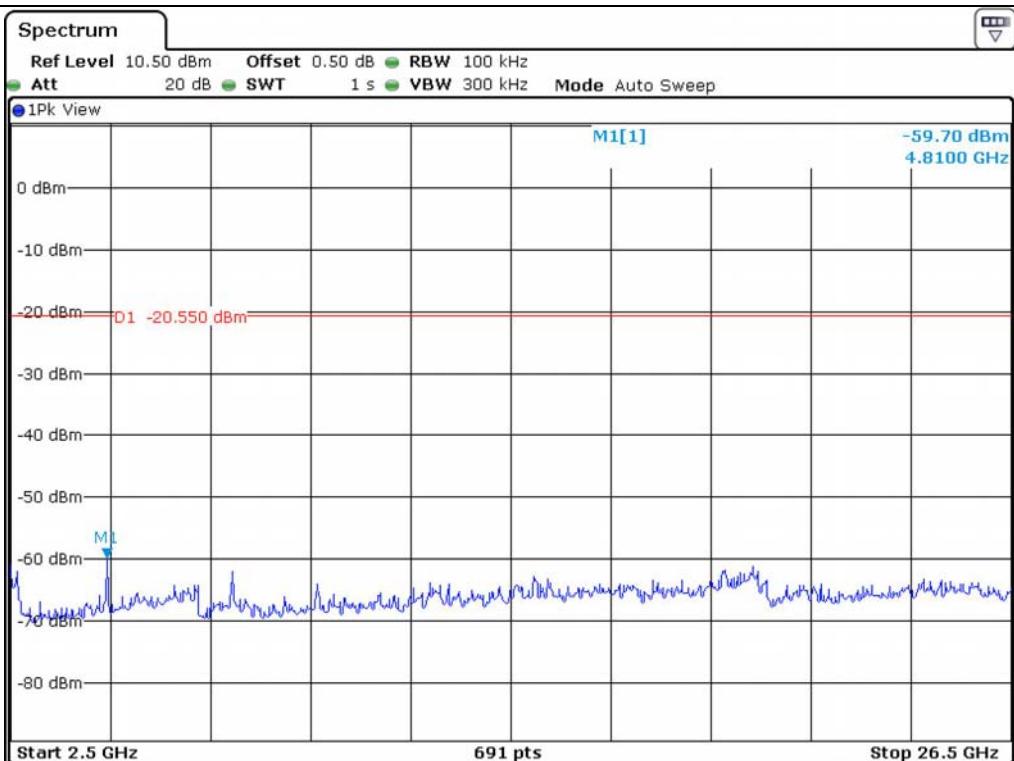
9.5.3 Test data for 802.11n HT20 WLAN Mode



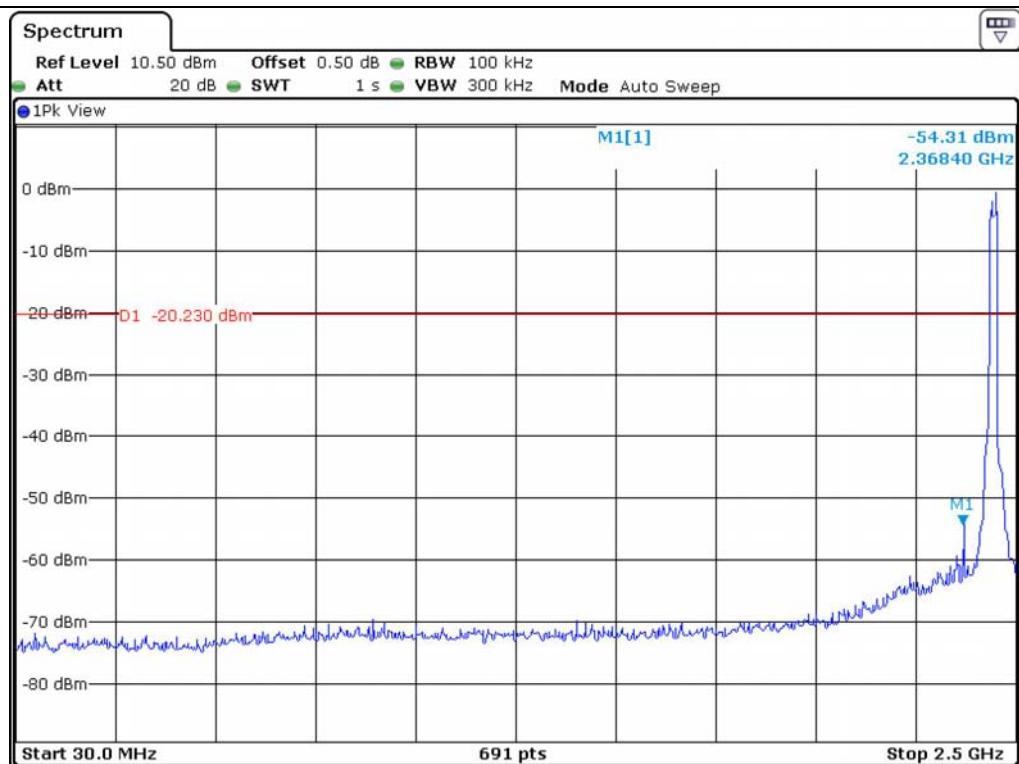




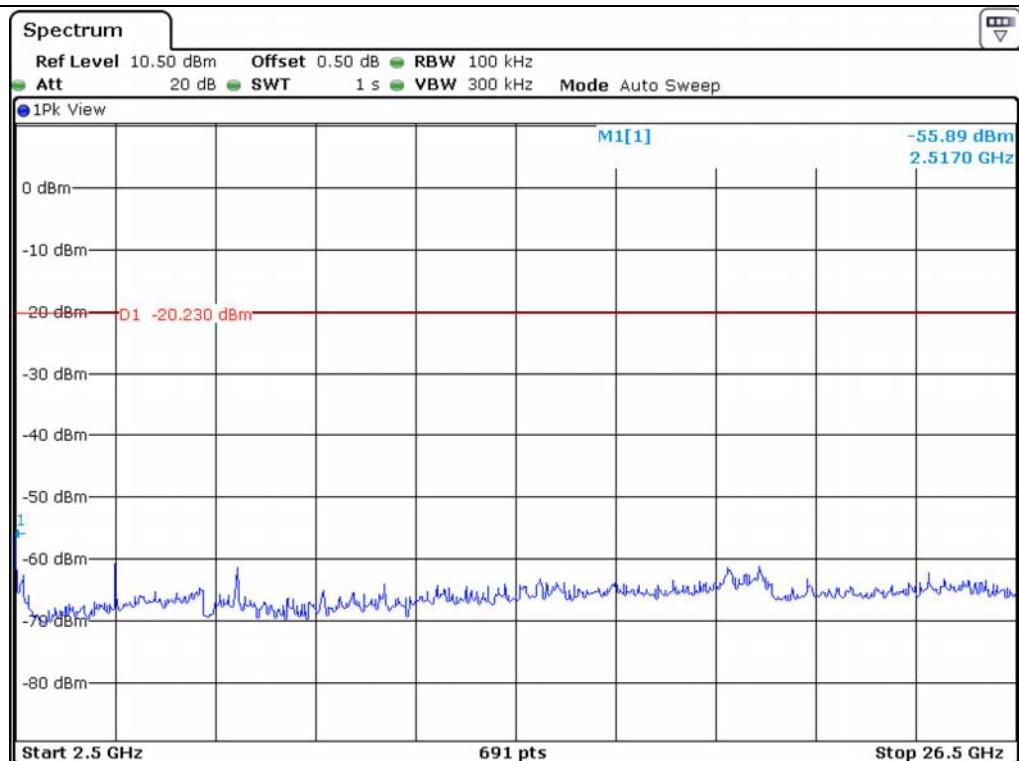
Low Channel



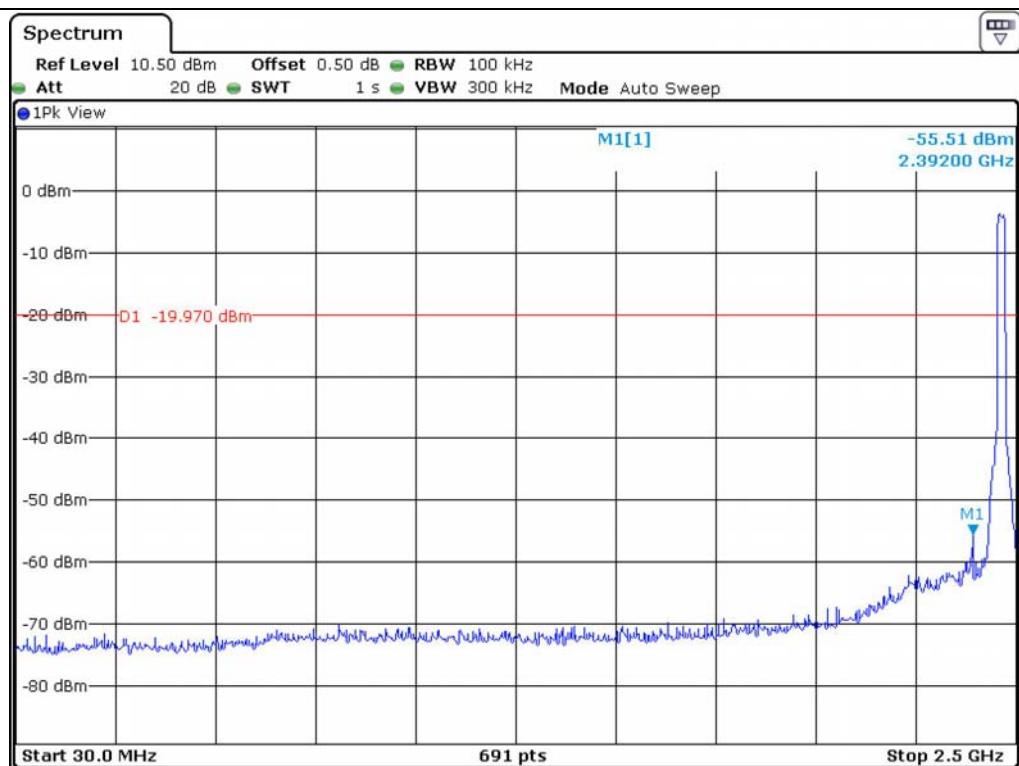
Low Channel



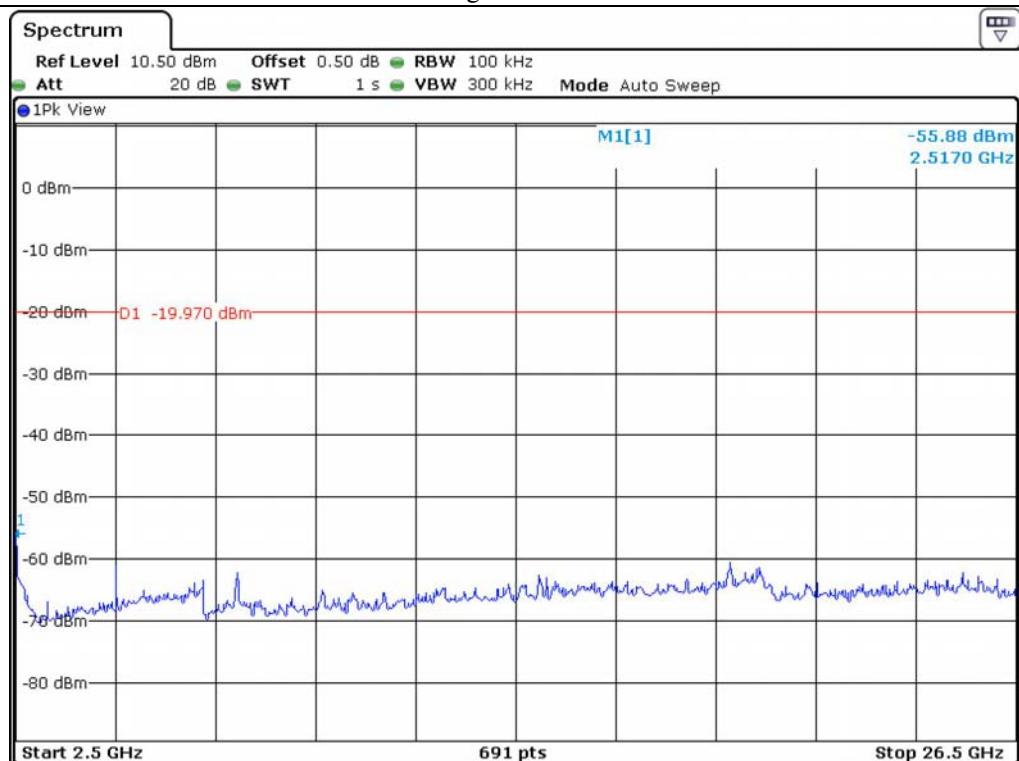
Middle Channel



Middle Channel

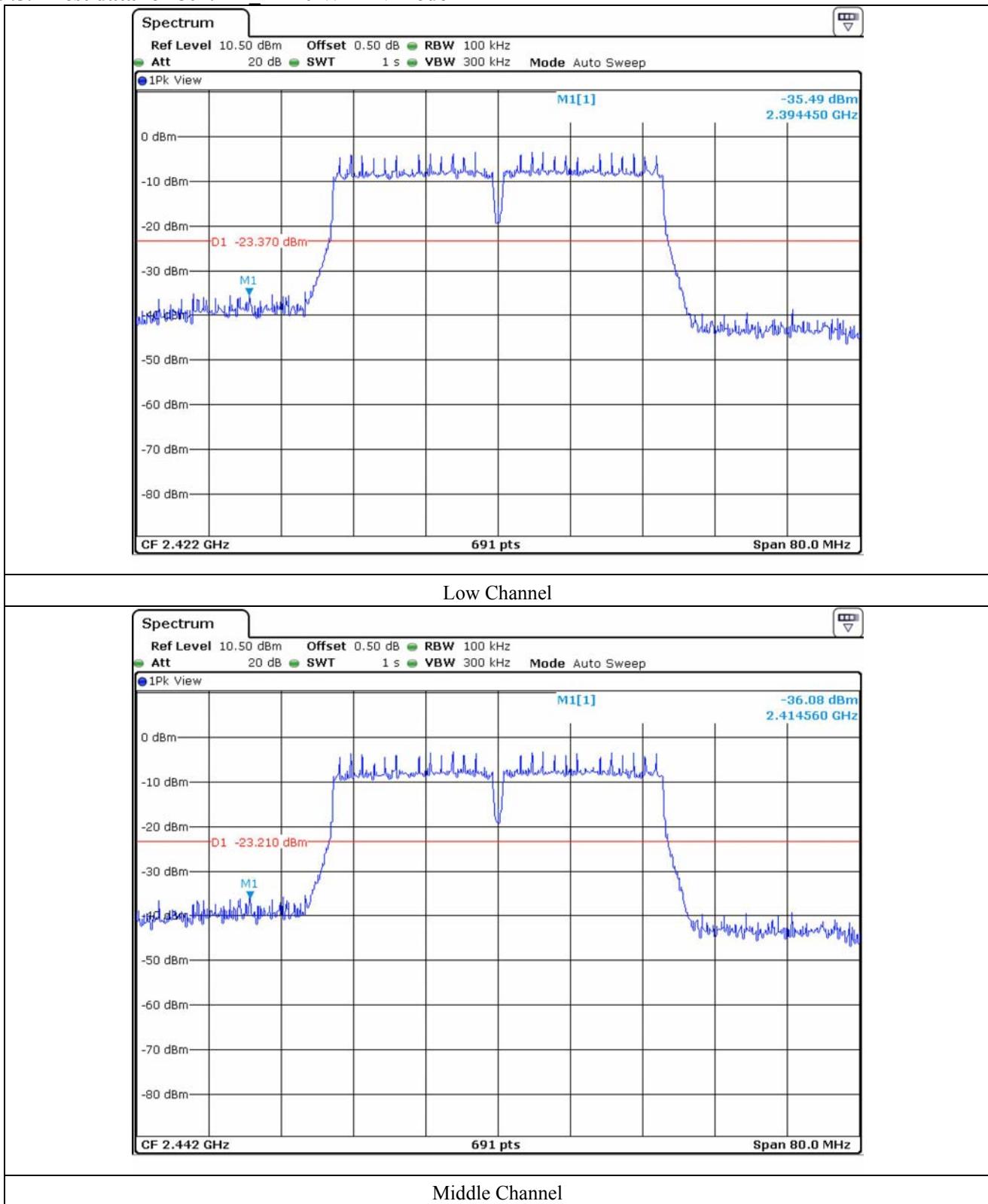


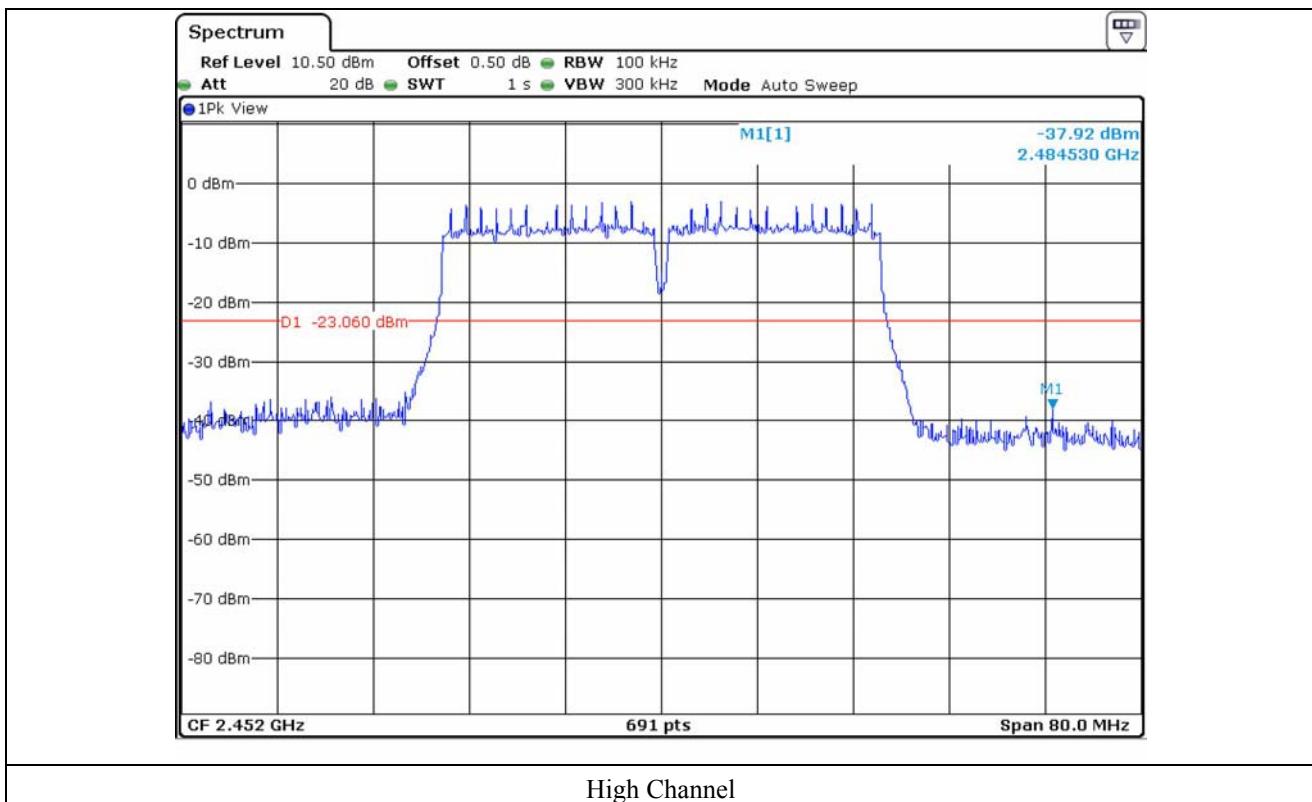
High Channel

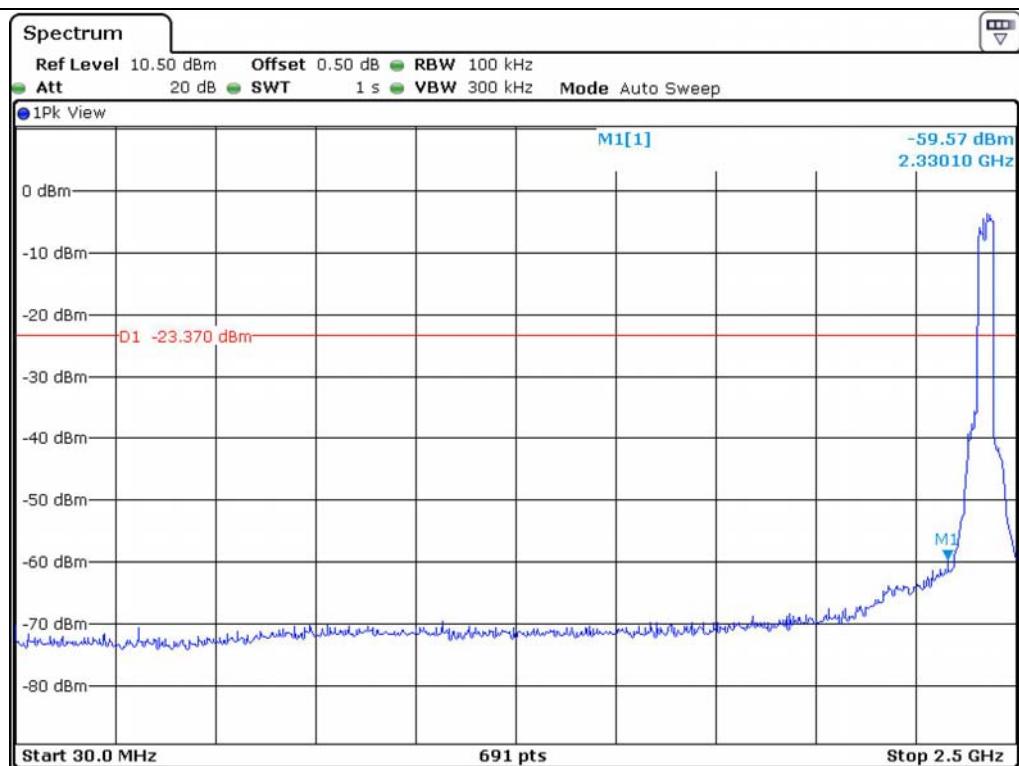


High Channel

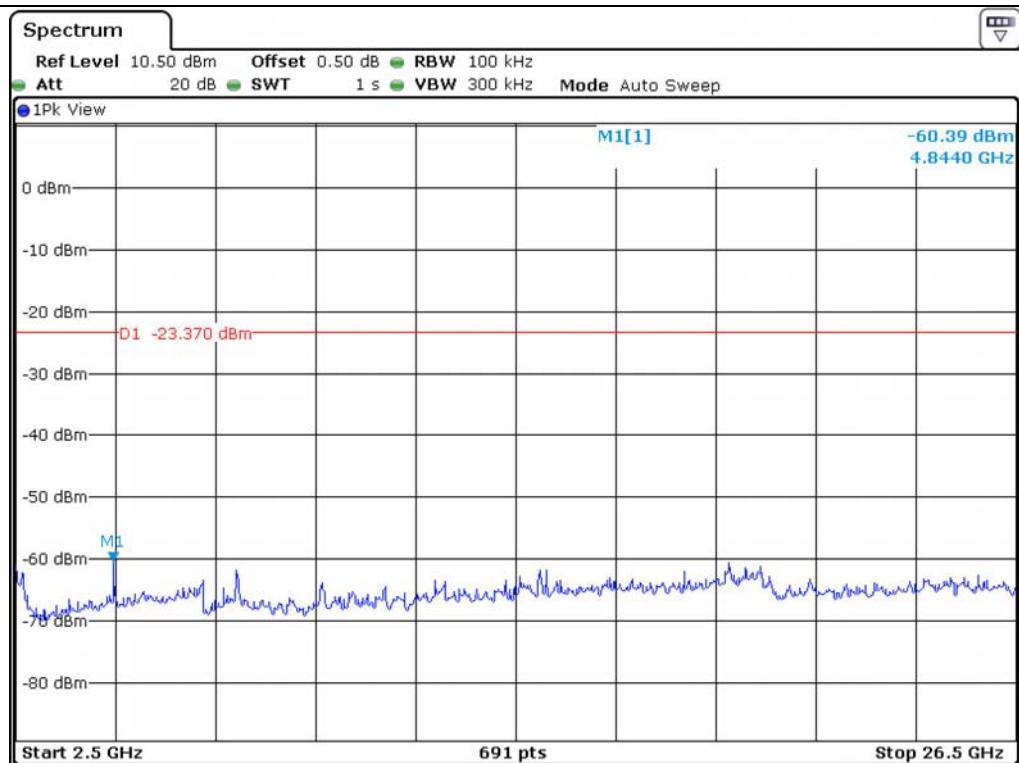
9.5.4 Test data for 802.11n HT40 WLAN Mode



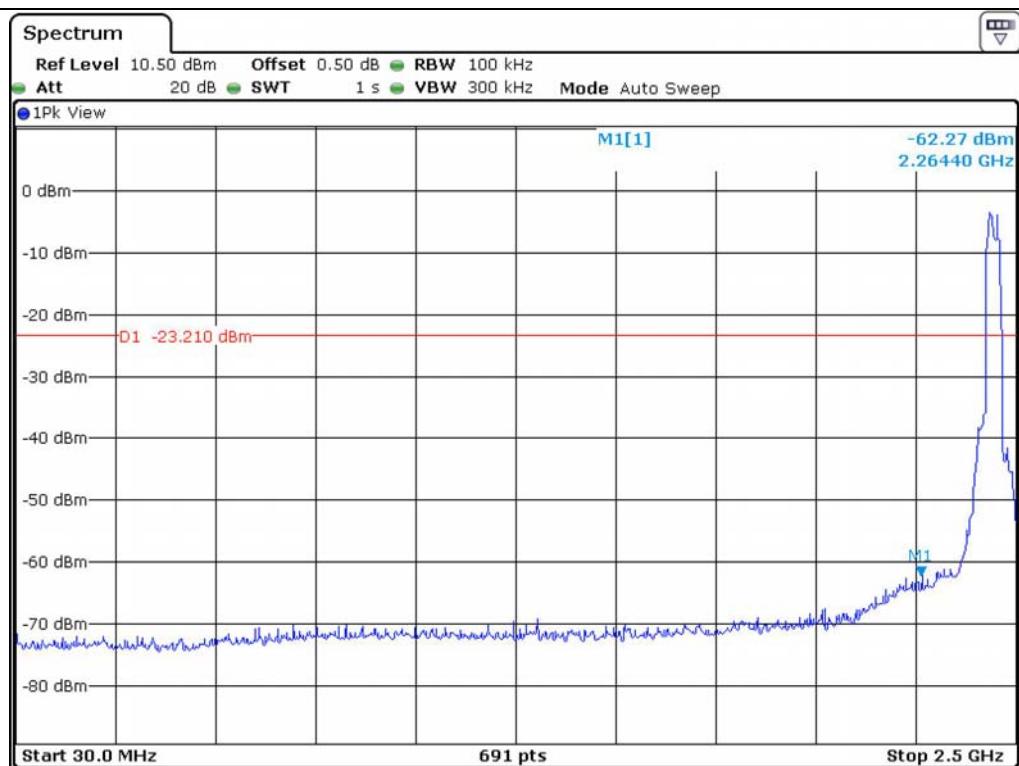




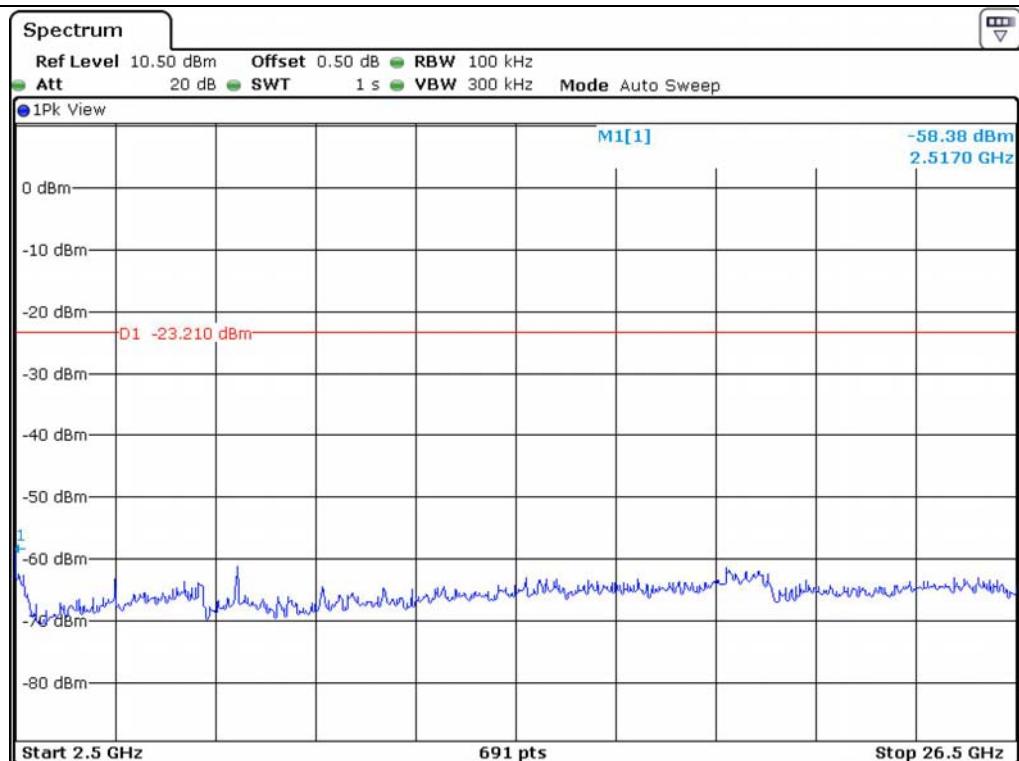
Low Channel



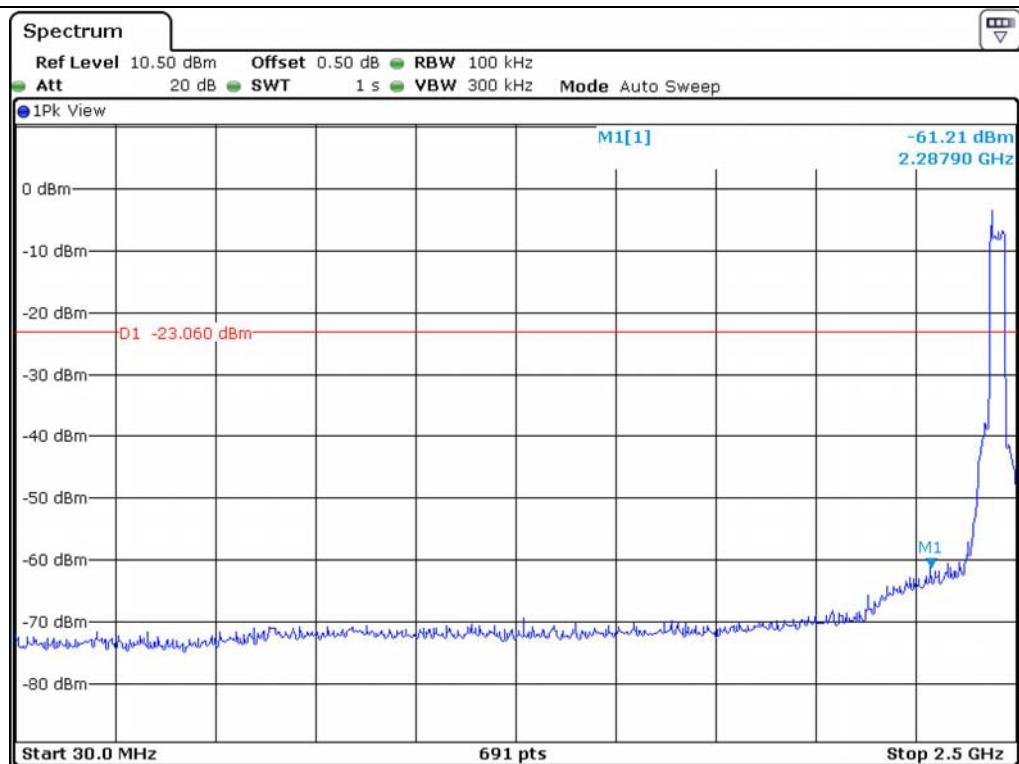
Low Channel



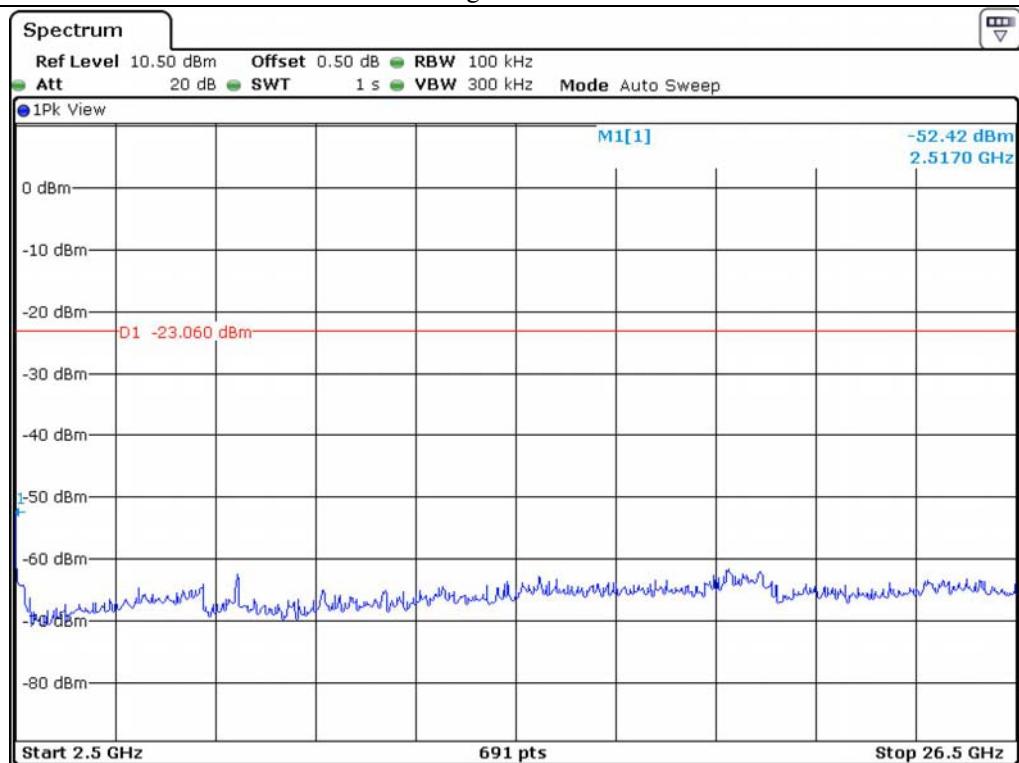
Middle Channel



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 : April 04, 2014
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Frequency range : 30 MHz ~ 26.5 GHz
- Measurement distance : 3 m
- Result : PASSED

Frequency (MHz)	Reading (dB μ V)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
Test Data for Low Channel									
2 390.00	69.36	Peak	H	27.10	7.50	43.00	60.96	74.00	13.04
	34.41	Average	H				26.01	54.00	27.99
	61.32	Peak	V				52.92	74.00	21.08
	33.39	Average	V				24.99	54.00	29.01
Test Data for High Channel									
2 483.50	65.35	Peak	H	27.10	7.50	43.00	56.95	74.00	17.05
	33.89	Average	H				25.49	54.00	28.51
	56.84	Peak	V				48.44	74.00	25.56
	32.84	Average	V				24.44	54.00	29.56

Tabulated test data for Restricted Band

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

Margin (dB) = Limits (dB μ V/m) - Total Level (dB μ V/m)

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

Tested by: Tae-Ho, Kim / Project Engineer

9.6.1.2 Test data for 802.11g WLAN Mode

- Test Date : April 04, 2014
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Frequency range : 30 MHz ~ 26.5 GHz
- Measurement distance : 3 m
- Result : PASSED

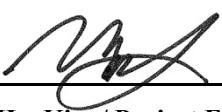
Frequency (MHz)	Reading (dB μ V)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
Test Data for Low Channel									
2 390.00	71.81	Peak	H	27.00	7.50	43.00	63.31	74.00	10.69
	36.41	Average	H				27.91	54.00	26.09
	58.29	Peak	V				49.79	74.00	24.21
	34.40	Average	V				25.90	54.00	28.10
Test Data for High Channel									
2 483.50	68.92	Peak	H	27.40	7.70	43.00	61.02	74.00	12.98
	36.27	Average	H				28.37	54.00	25.63
	52.79	Peak	V				44.89	74.00	29.11
	33.44	Average	V				25.54	54.00	28.46

Tabulated test data for Restricted Band

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

Margin (dB) = Limits (dB μ V/m) - Total Level (dB μ V/m)

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



Tested by: Tae-Ho, Kim / Project Engineer

9.6.1.3 Test data for 802.11n_HT20 WLAN Mode

- Test Date : April 04, 2014
- Resolution bandwidth : 1 MHz for Peak and Average Mode
- Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- Frequency range : 30 MHz ~ 26.5 GHz
- Measurement distance : 3 m
- Result : PASSED

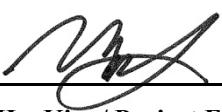
Frequency (MHz)	Reading (dB μ V)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dB μ V/m)	Limits (dB μ V/m)	Margin (dB)
Test Data for Low Channel									
2 390.00	75.21	Peak	H	27.00	7.50	43.00	66.71	74.00	7.29
	40.42	Average	H				31.92	54.00	22.08
	56.61	Peak	V				48.11	74.00	25.89
	36.69	Average	V				28.19	54.00	25.81
Test Data for High Channel									
2 483.50	75.21	Peak	H	27.40	7.70	43.00	67.31	74.00	6.69
	39.55	Average	H				31.65	54.00	22.35
	54.69	Peak	V				46.79	74.00	27.21
	35.17	Average	V				27.27	54.00	26.73

Tabulated test data for Restricted Band

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

Margin (dB) = Limits (dB μ V/m) - Total Level (dB μ V/m)

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



Tested by: Tae-Ho, Kim / Project Engineer