

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

Test Report No. : OT-197-RWD-053
AGR No. : A195A-120
Applicant : LG Electronics USA
Address : 1000 Sylvan Avenue, Englewood Cliffs, New Jersey, 07632, United States
Manufacturer : LG Electronics Inc.
Address : 222 LG-ro, Jinwi-Myeon, Pyeongtaek -Si, Gyeonggi-Do, 451-713, Korea
Type of Equipment : Wireless module
FCC ID. : BEJRBHP-B213B
Model Name : RBHP-B213B
Multiple Model Name : N/A
Serial number : N/A
Total page of Report : 85 pages (including this page)
Date of Incoming : June 20, 2019
Date of issue : July 22, 2019

SUMMARY

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

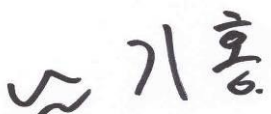
This test report only contains the result of a single test of the sample supplied for the examination.

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

Reviewed by:


 Tae-Ho, Kim / Senior Manager
 ONETECH Corp.

Approved by:


 Ki-Hong, Nam / Chief Engineer
 ONETECH Corp.

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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-197-RWD-053	July 22, 2019	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant : LG Electronics USA
 Address : 1000 Sylvan Avenue, Englewood Cliffs, New Jersey, 07632, United States
 Contact Person : Kyung-Su, Han / Director, Standards & Compliance
 Telephone No. : +201-472-2623
 FCC ID : BEJRBHP-B213B
 Model Name : RBHP-B213B
 Brand Name : N/A
 Serial Number : N/A
 Date : July 22, 2019

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	Wireless 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 558074 D01 15.247 Meas Guidance v05r02 KDB662911 D01 Multiple Transmitter Output v02r01
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-14617/ 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 Electronics USA, Model RBHP-B213B (referred to as the EUT in this report) is a Wireless module. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	Wireless module		
Temperature Range	-20 °C ~ 55 °C		
OPERATING FREQUENCY	Bluetooth	2 402 MHz ~ 2 480 MHz	
	WLAN 2.4 GHz	2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20))	
	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))	
MODULATION TYPE	Bluetooth	GFSK for 1Mbps, $\pi/4$ -DQPSK for 2Mbps, 8-DPSK for 3Mbps	
	WLAN 2.4 GHz	DSSS Modulation(DBPSK/DQPSK/CCK) OFDM Modulation(BPSK/QPSK/16QAM/64QAM)	
	WLAN 5 GHz	OFDM Modulation(BPSK/QPSK/16QAM/64QAM)	
RF OUTPUT POWER'	Bluetooth	1 Mbps	1.03 dBm
		2 Mbps	-2.27 dBm
		3 Mbps	-1.91 dBm
	WLAN 2.4 GHz	14.56 dBm(802.11b)	
		9.90 dBm(802.11g)	
		9.30 dBm(802.11n_HT20)	
	5 725 MHz ~ 5 850 MHz Band	Antenna 0	6.28 dBm(802.11a)
			6.22 dBm(802.11n_HT20)
			6.07 dBm(802.11n_HT40)
			5.74 dBm(802.11ac_VHT80)
		Antenna 1	10.07 dBm(802.11a)
			9.99 dBm(802.11n_HT20)
		Multiple Antenna	10.29 dBm(802.11n_HT40)
			9.62 dBm(802.11ac_VHT80)
			11.51 dBm(802.11n_HT20)
			11.68 dBm(802.11n_HT40)
			11.11 dBm(802.11ac_VHT80)

MODULATION TYPE	Bluetooth	GFSK for 1Mbps, $\pi/4$ -DQPSK for 2Mbps, 8-DPSK for 3Mbps		
	WLAN 2.4 G	DSSS Modulation(DBPSK/DQPSK/CCK) OFDM Modulation(BPSK/QPSK/16QAM/64QAM)		
	WLAN 5 G	OFDM Modulation(BPSK/QPSK/16QAM/64QAM)		
Antenna Type	PCB Antenna			
ANTENNA GAIN	2.4 GHz Band	Antenna 0 (Bluetooth + 5 GHz WiFi)		5.28 dBi
		Antenna 1 (2.4 GHz WiFi + 5 GHz WiFi)		2.29 dBi
	5 GHz Band	5 725 MHz ~ 5 850 MHz	Antenna 0 (Bluetooth + 5 GHz WiFi)	2.47 dBi
			Antenna 1 (2.4 GHz WiFi + 5 GHz WiFi)	2.28 dBi
			Antenna 0 + 1	5.39 dBi
	Intermodulation Mode	Bluetooth + 2.4 GHz WiFi (Antenna 0 + Antenna 1)		7.05 dBi
		Bluetooth + 5 GHz WiFi (Antenna 0 + Antenna 1)		7.04 dBi
List of each Osc. or crystal Freq. (Freq. ≥ 1 MHz)		37.4 MHz		

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

-. None

4. EUT MODIFICATIONS

-. None

5. SYSTEM TEST CONFIGURATION

5.1 Justification

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

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
MAIN BOARD	LG Electronics Inc.	GWANG_SMD	-

5.2 Peripheral equipment

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

Model	Manufacturer	Description	Connected to
RBHP-B213B	LG Electronics Inc.	Wireless module (EUT)	-
N/A	N/A	Jig Board	EUT
HP Pavilion g series	HP	Notebook PC	-
PPP009C	LIE-ON TECHNOLOGY (CHANGZHOU)CO.,LTD.	AC Adapter	-

5.3 Mode of operation during the test

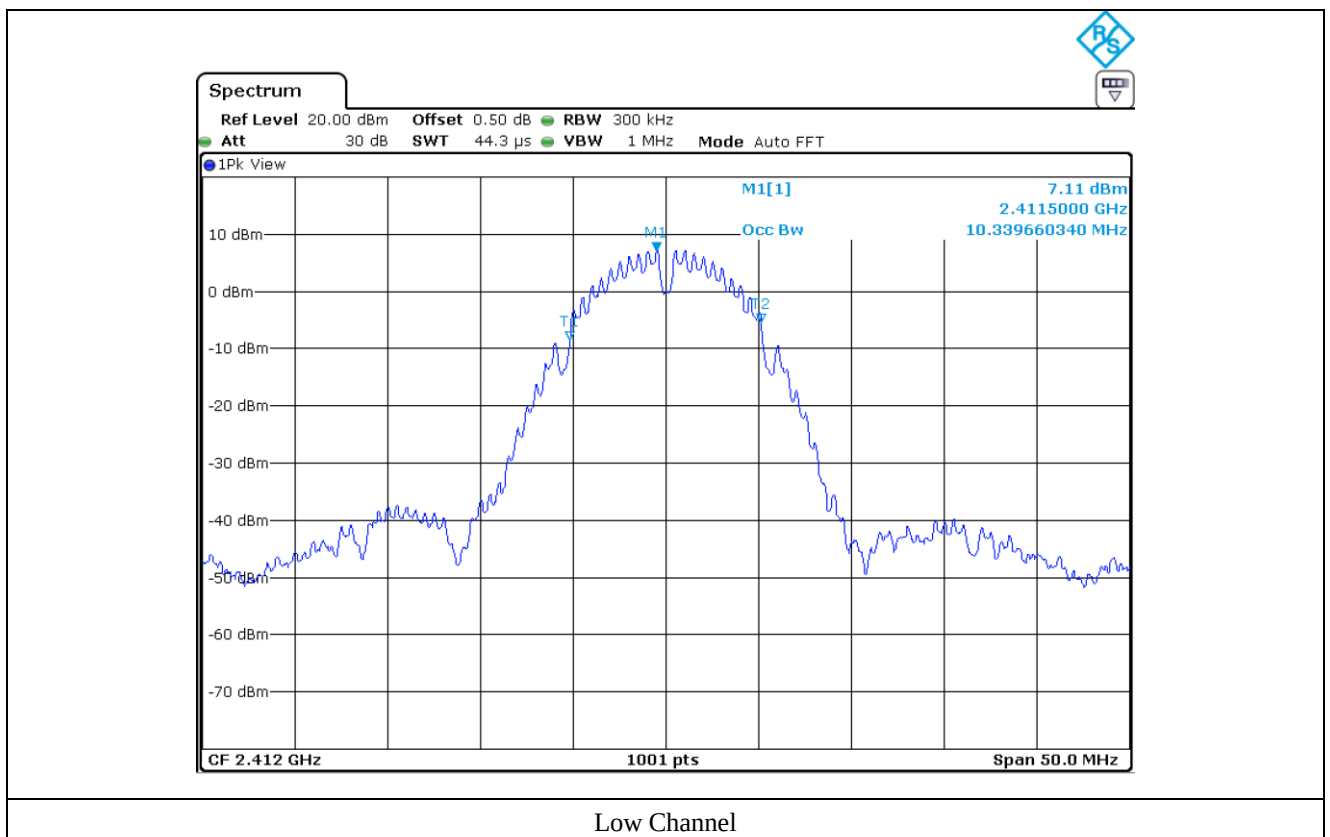
For the testing, software used to control the EUT for staying in continuous transmitting mode is programmed.

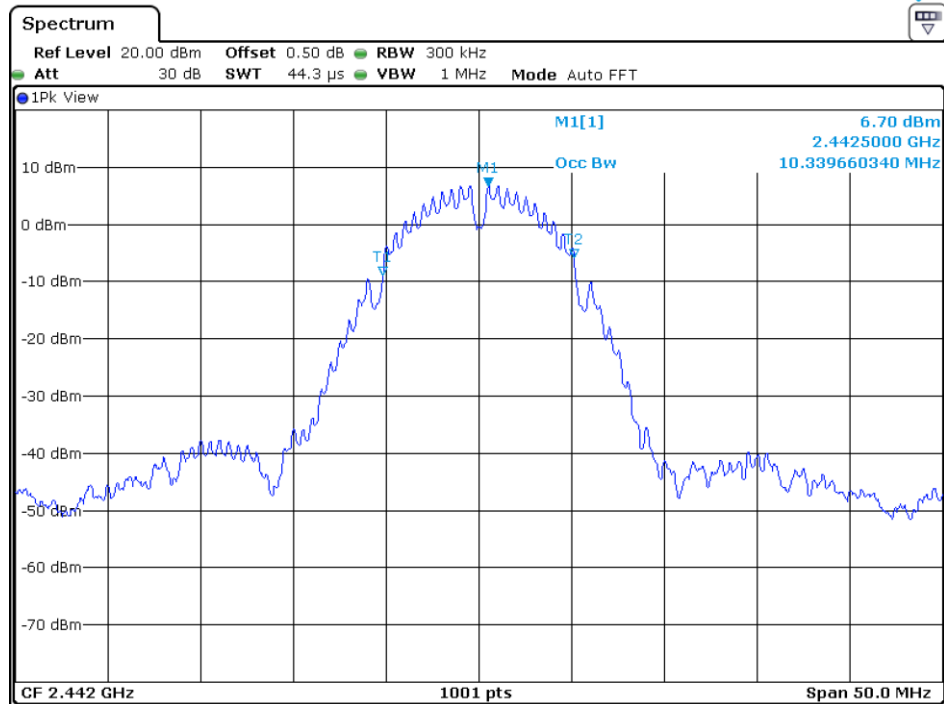
Modulation	DATA RATE	OUTPUT POWER[dBm]
802.11 b (Middle Channel)	1 Mbps	14.21
	2 Mbps	14.13
	5.5 Mbps	14.12
	11 Mbps	13.89
802.11 g (Middle Channel)	6 Mbps	9.09
	9 Mbps	8.97
	12 Mbps	8.92
	18 Mbps	8.84
	24 Mbps	8.80
	36 Mbps	8.77
	48 Mbps	8.69
	54 Mbps	8.60
802.11 n_HT 20 (Middle Channel)	6.5 Mbps	8.48
	13 Mbps	8.26
	19.5 Mbps	8.24
	26 Mbps	8.15
	39 Mbps	8.11
	52 Mbps	8.03
	58.5 Mbps	7.97
	65 Mbps	7.93

- . 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 HT20.
- . 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.

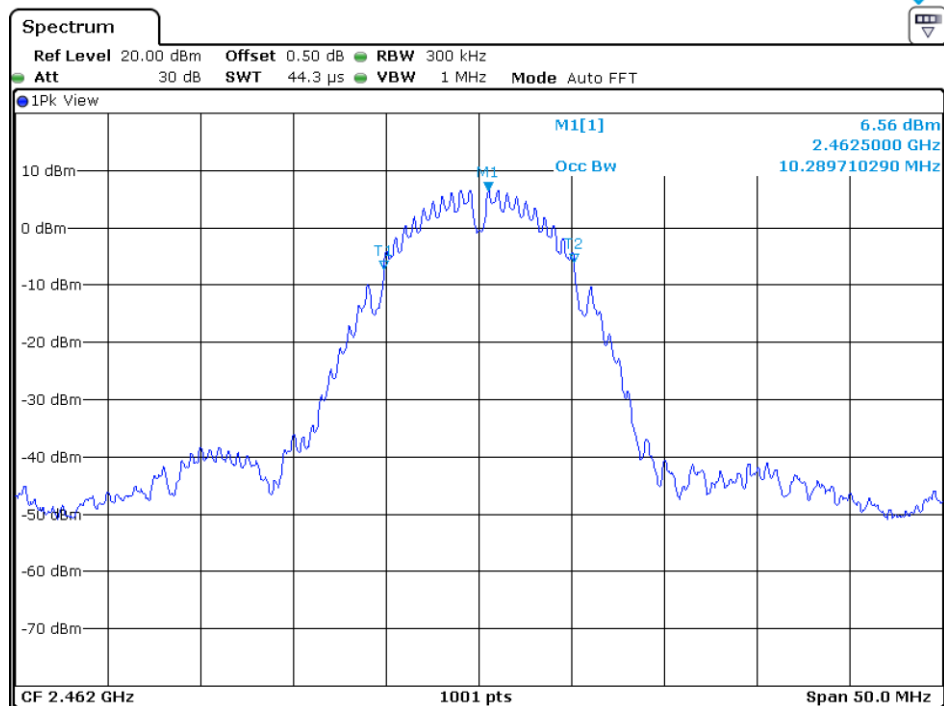
-. Occupied Bandwidth(99 %)

Modulation	CHANNEL	FREQUENCY (MHz)	Occupied Bandwidth(MHz)
802.11 b	Low	2 412	10.34
	Middle	2 442	10.34
	High	2 462	10.29



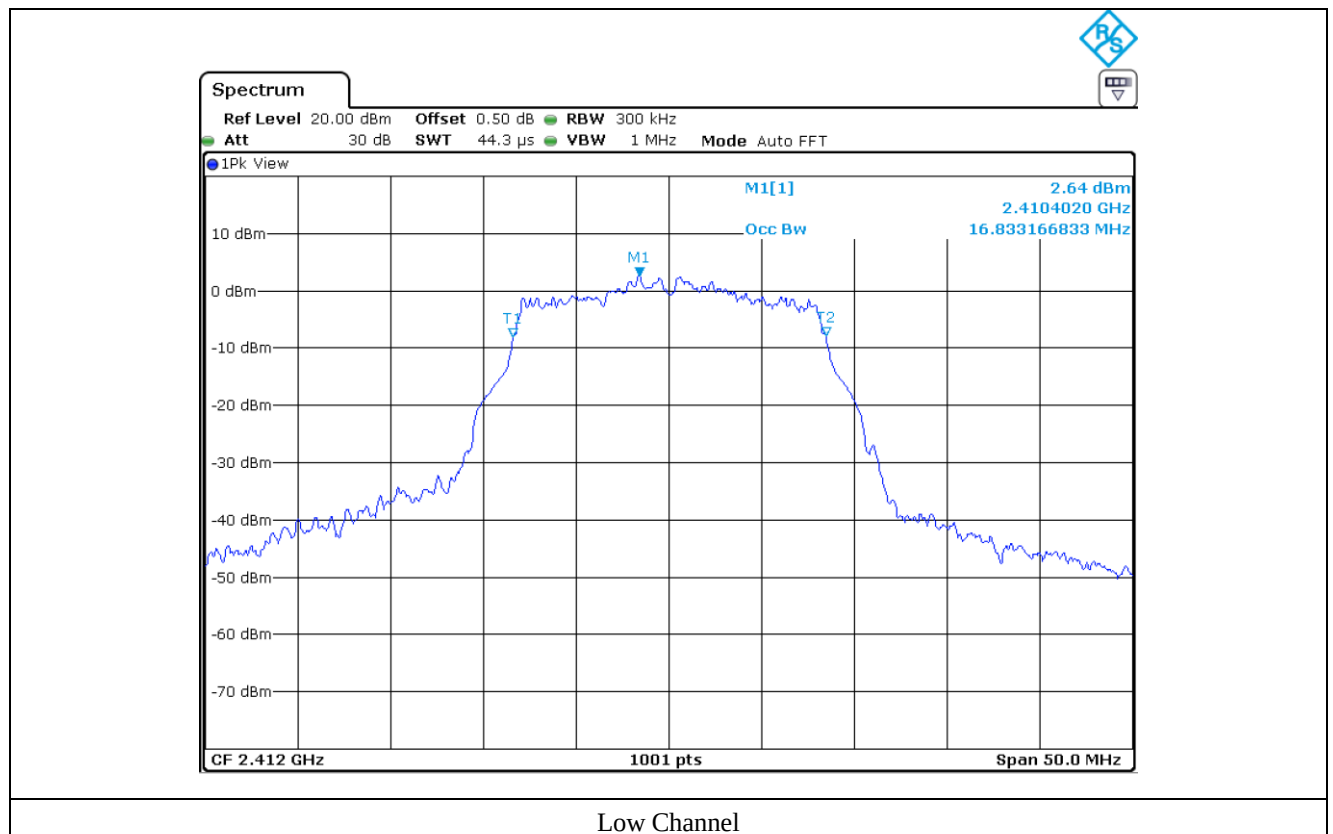


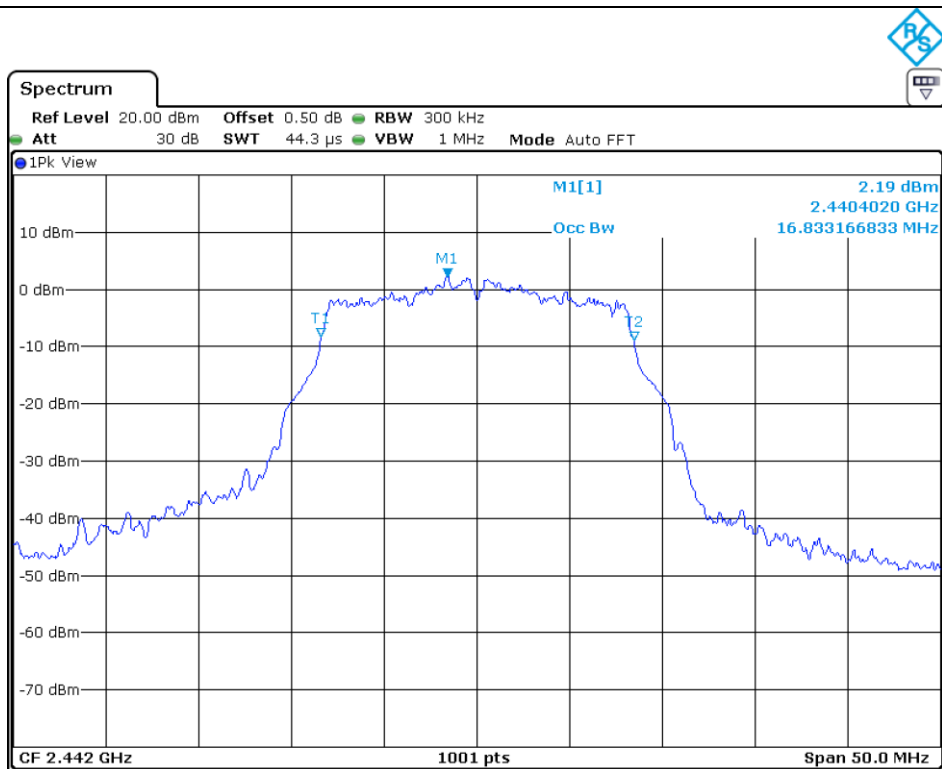
Middle Channel



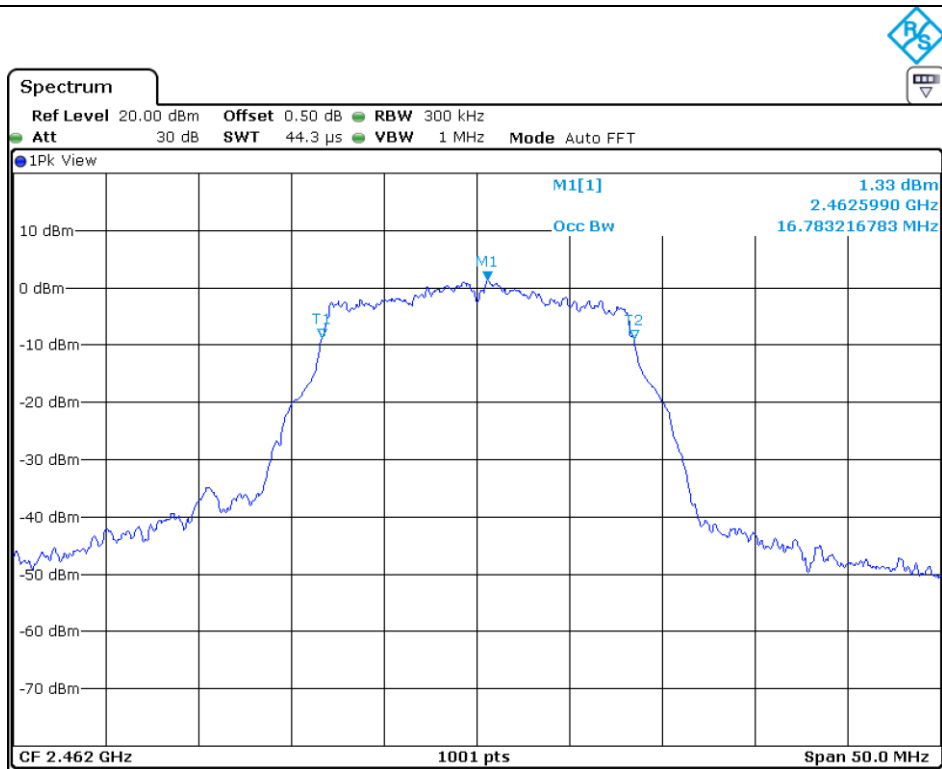
High Channel

Modulation	CHANNEL	FREQUENCY (MHz)	Occupied Bandwidth(MHz)
802.11 g	Low	2 412	16.83
	Middle	2 442	16.83
	High	2 462	16.78



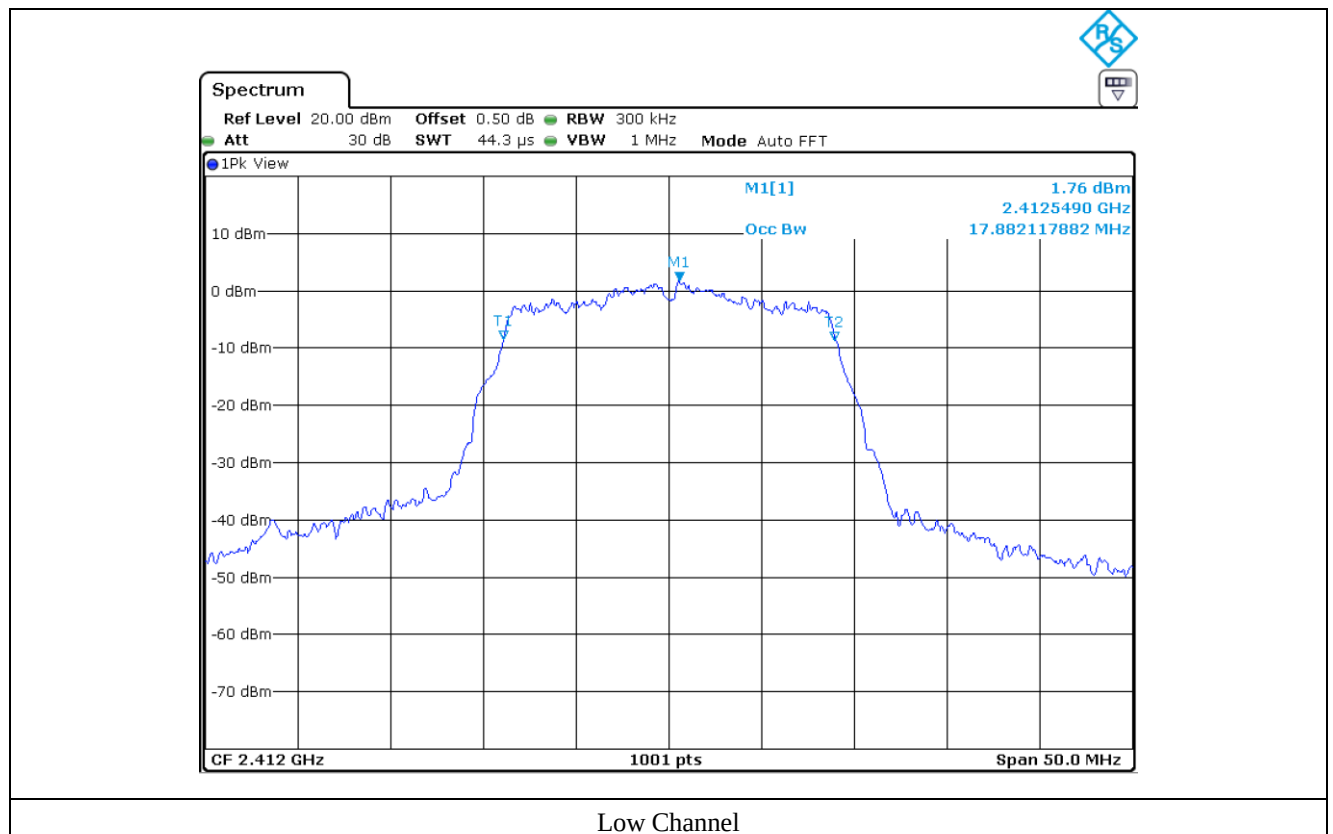


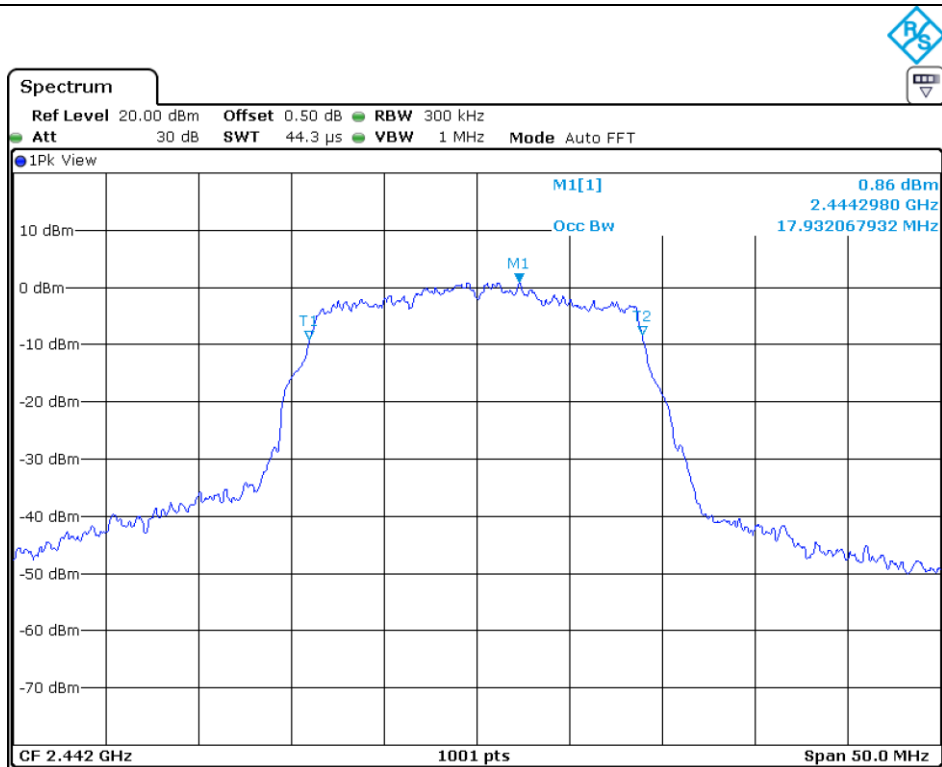
Middle Channel



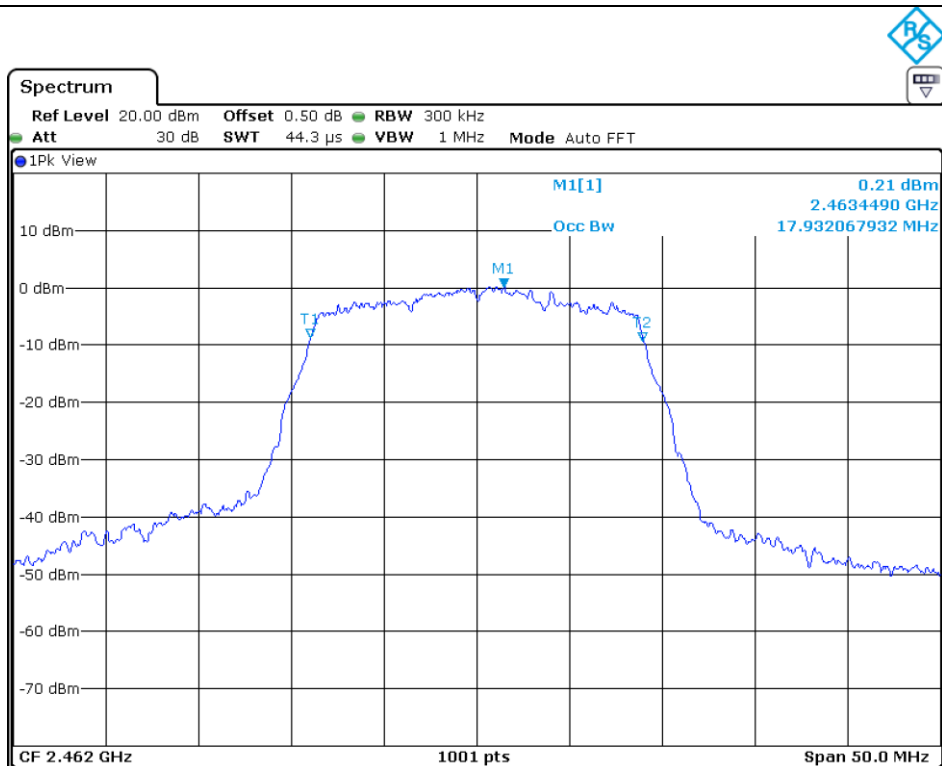
High Channel

Modulation	CHANNEL	FREQUENCY (MHz)	Occupied Bandwidth(MHz)
802.11 n_HT 20	Low	2 412	17.88
	Middle	2 442	17.93
	High	2 462	17.93





Middle Channel



High Channel

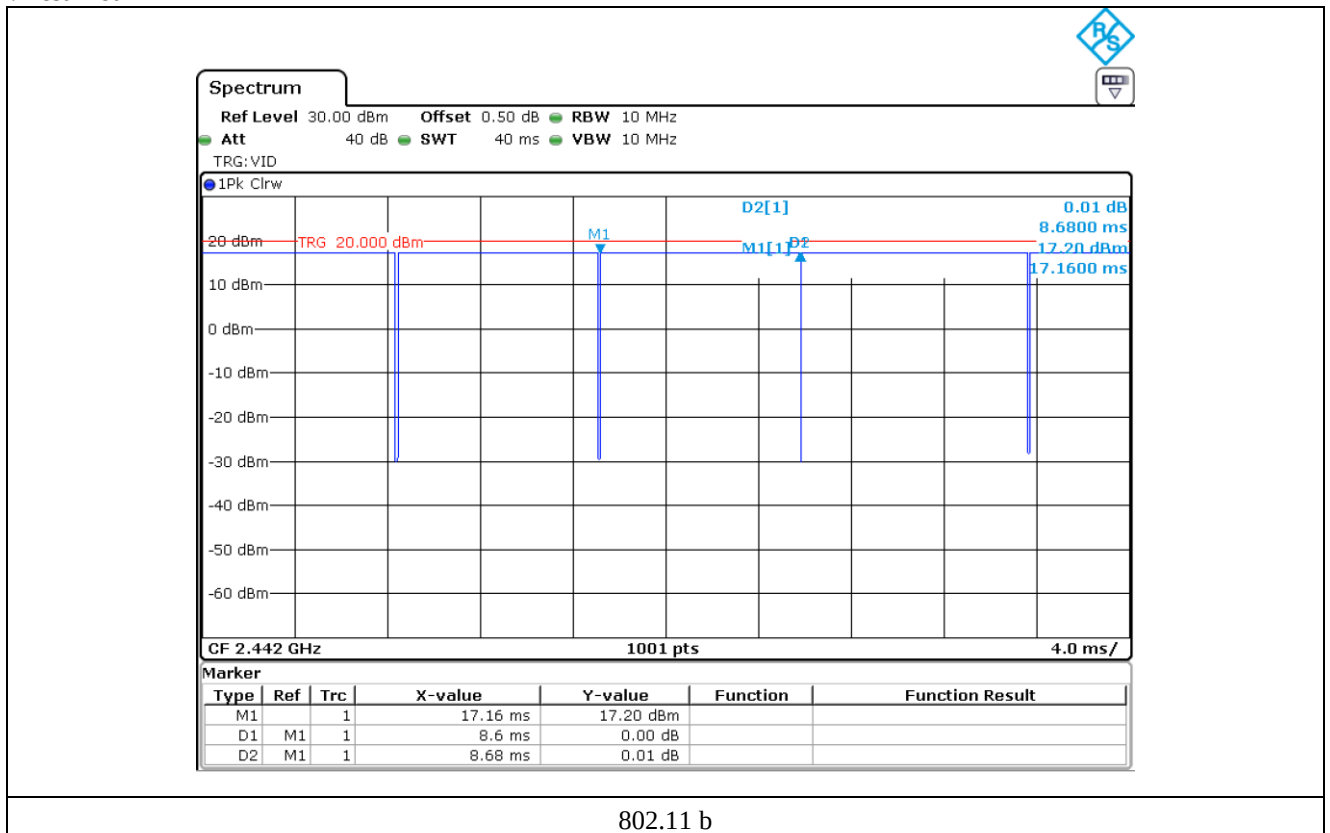
-. Duty Cycle

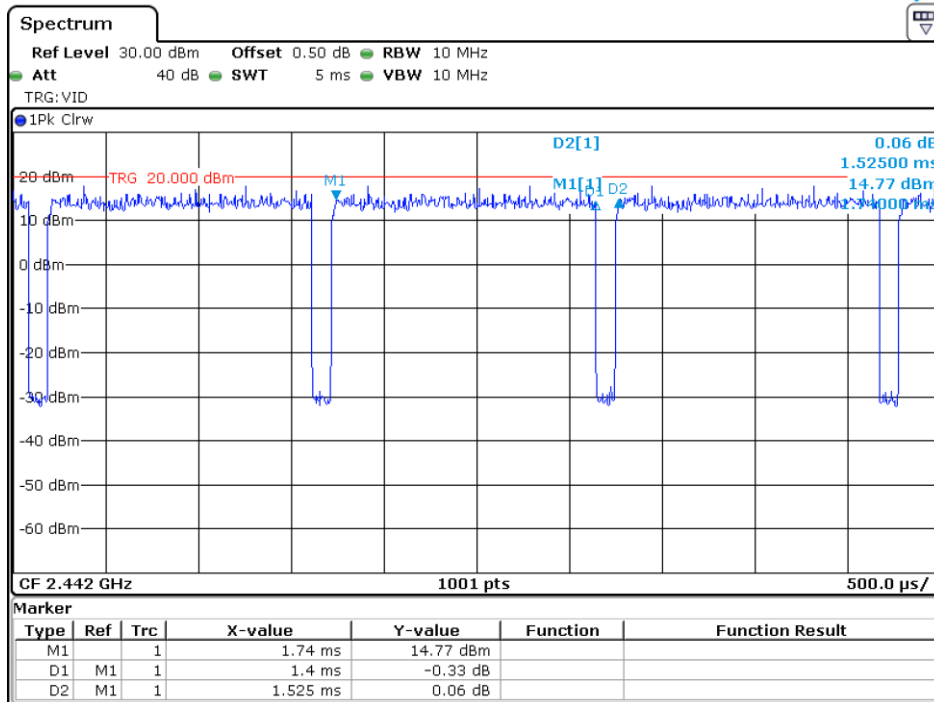
Mode	Duty Cycle [%]	Correction Factor [dB]
802.11 b	99.08	0.04
802.11 g	91.80	0.37
802.11 n(HT20)	91.64	0.38

Note – Duty Cycle : (Tx On Time / (Tx On Time + Tx Off Time)) * 100

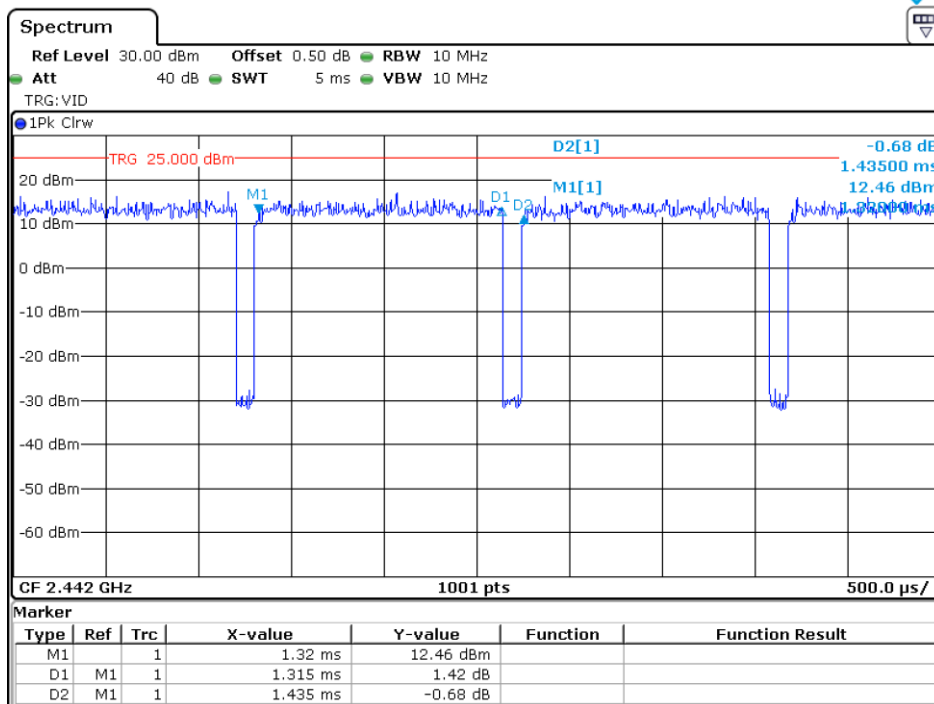
Correction Factor : 10 * Log(1 / (Duty Cycle / 100))

-. Test Plot





802.11 g



802.11 n(HT20)

5.4 Configuration of Test System

Line Conducted Test: The EUT was connected to Jig Board and the power was connected to DC Power Supply. 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 antenna of the EUT is a PCB Antenna on the main board in the EUT, so no consideration of replacement by the user.

6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

During Preliminary 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	Mar. 11, 2019 (1Y)

All test equipment used is calibrated on a regular basis.

7.4 Test data for 802.11b WLAN Mode

-. Test Date : June 20, 2019 ~ June 26, 2019

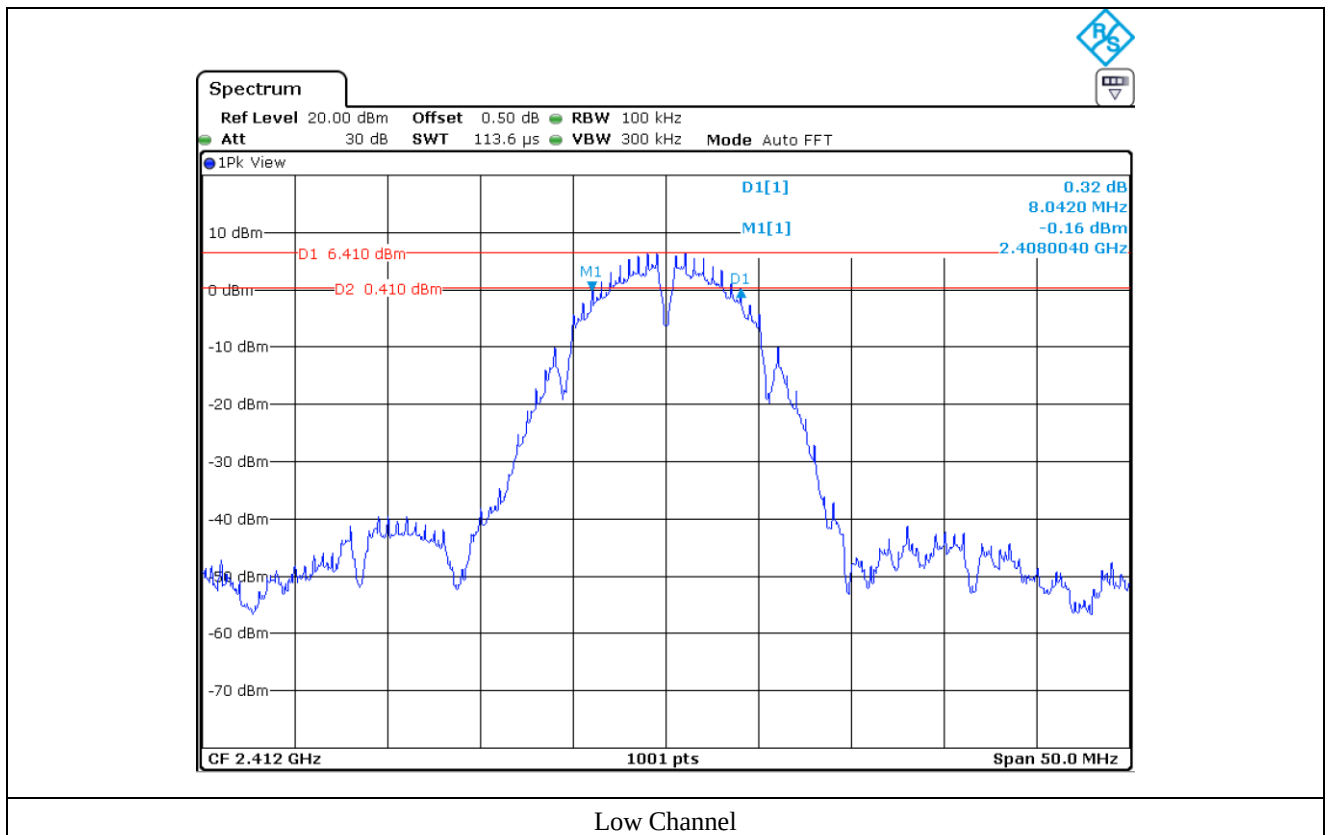
-. Test Result : Pass

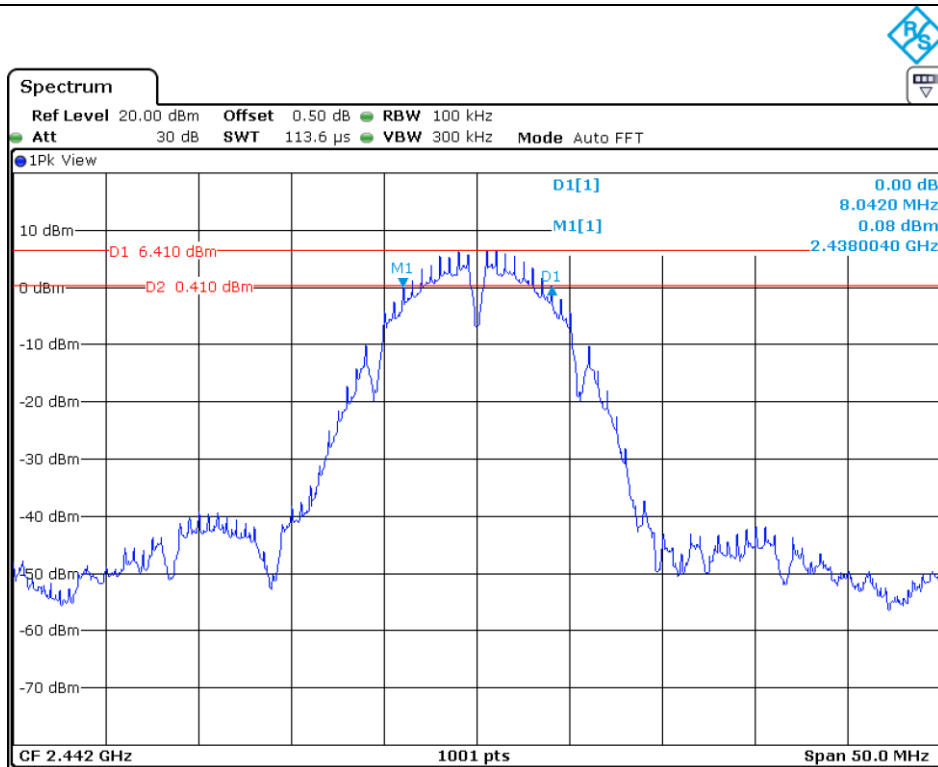
CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 412.00	8.04	0.50	7.54
Middle	2 442.00	8.04	0.50	7.54
High	2 462.00	8.04	0.50	7.54

Remark. Margin = Measured Value - Limit

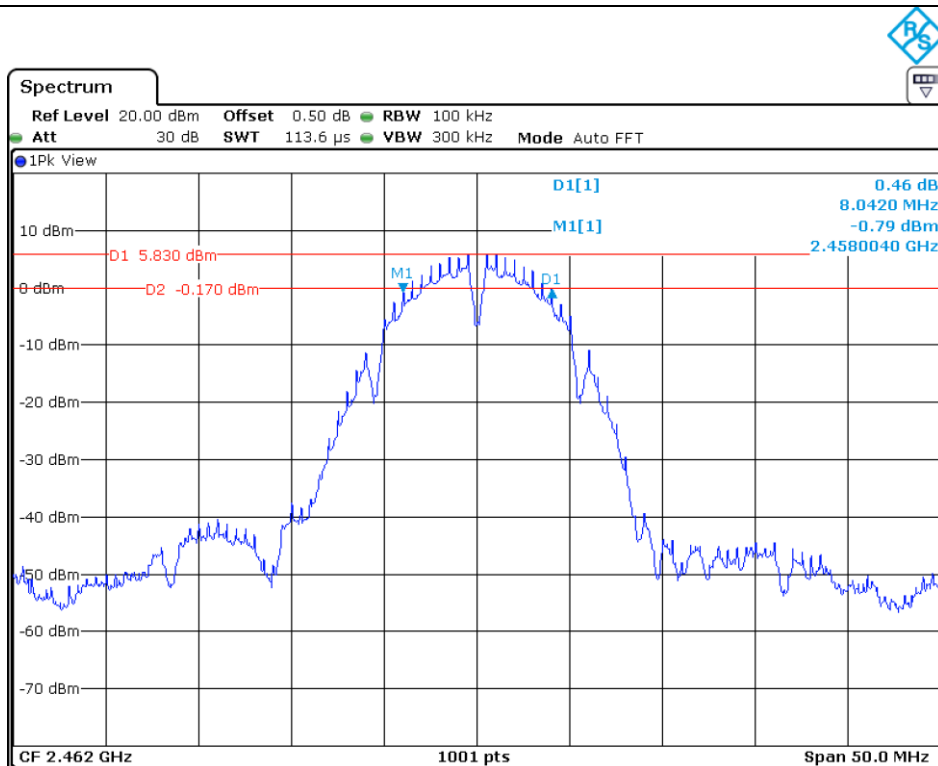


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

7.5 Test data for 802.11g WLAN Mode

-. Test Date : June 20, 2019 ~ June 26, 2019

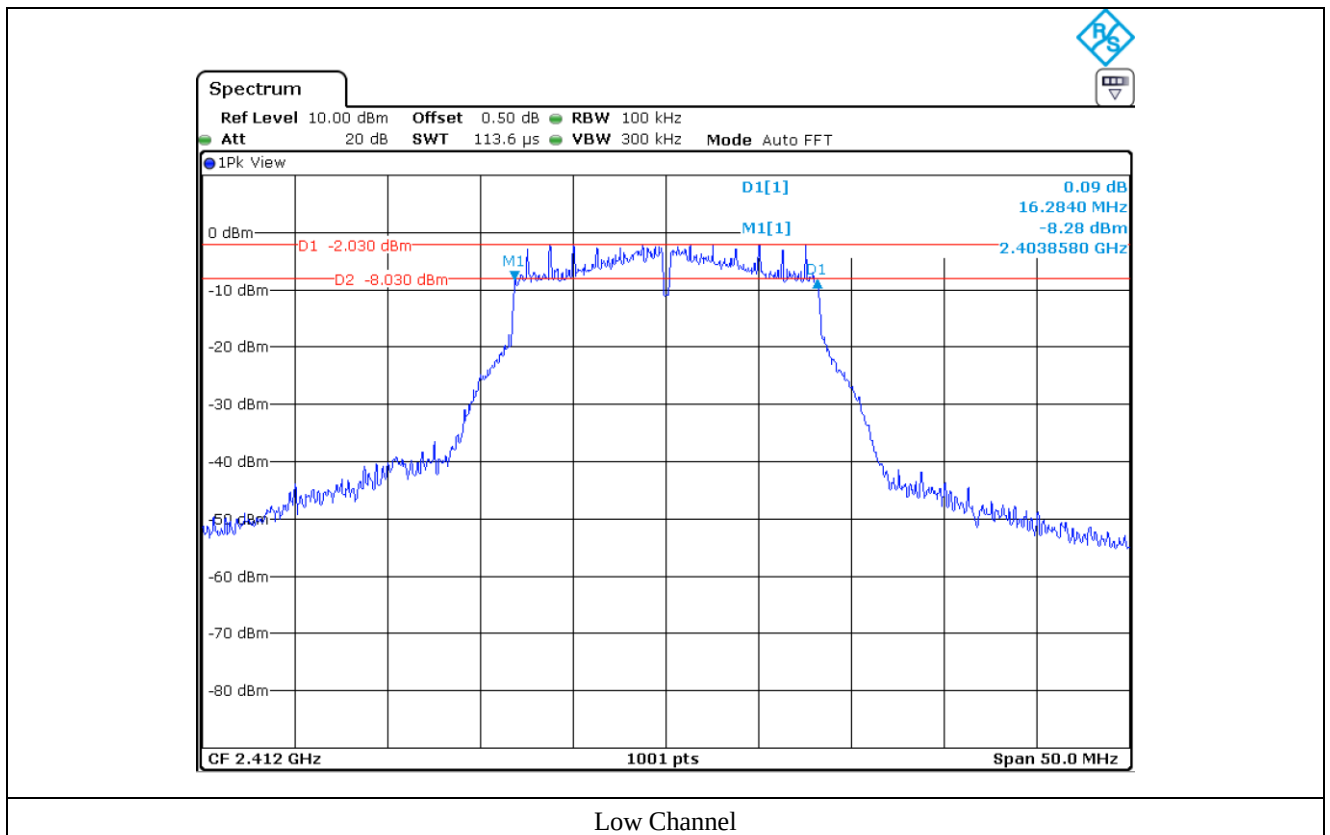
-. Test Result : Pass

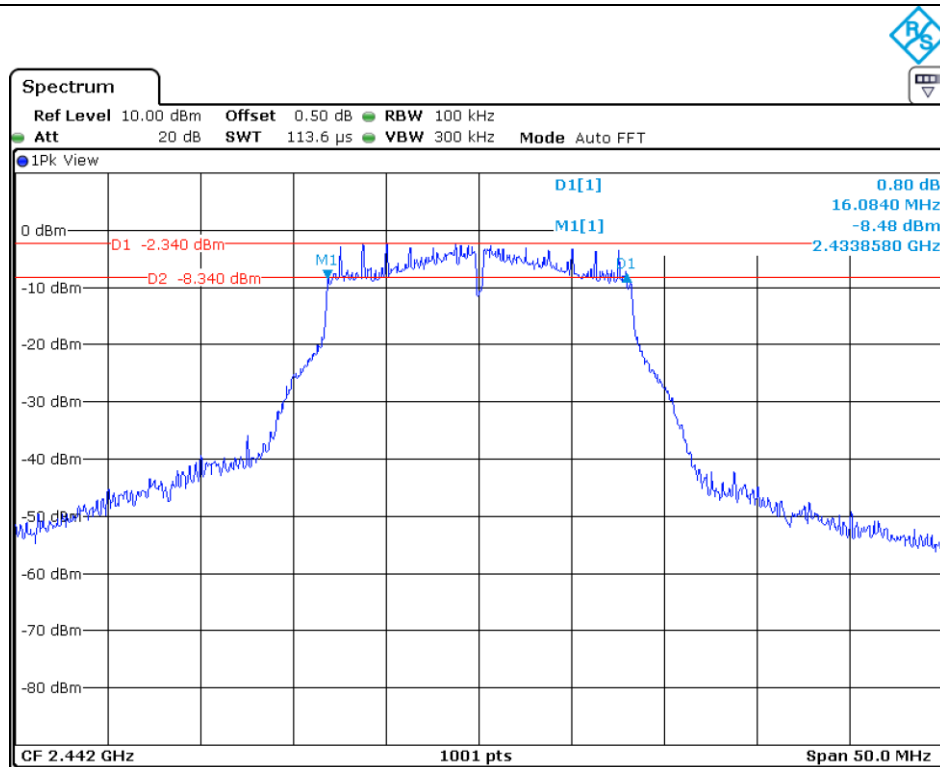
CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 412.00	16.28	0.50	15.78
Middle	2 442.00	16.08	0.50	15.58
High	2 462.00	16.08	0.50	15.58

Remark. Margin = Measured Value - Limit

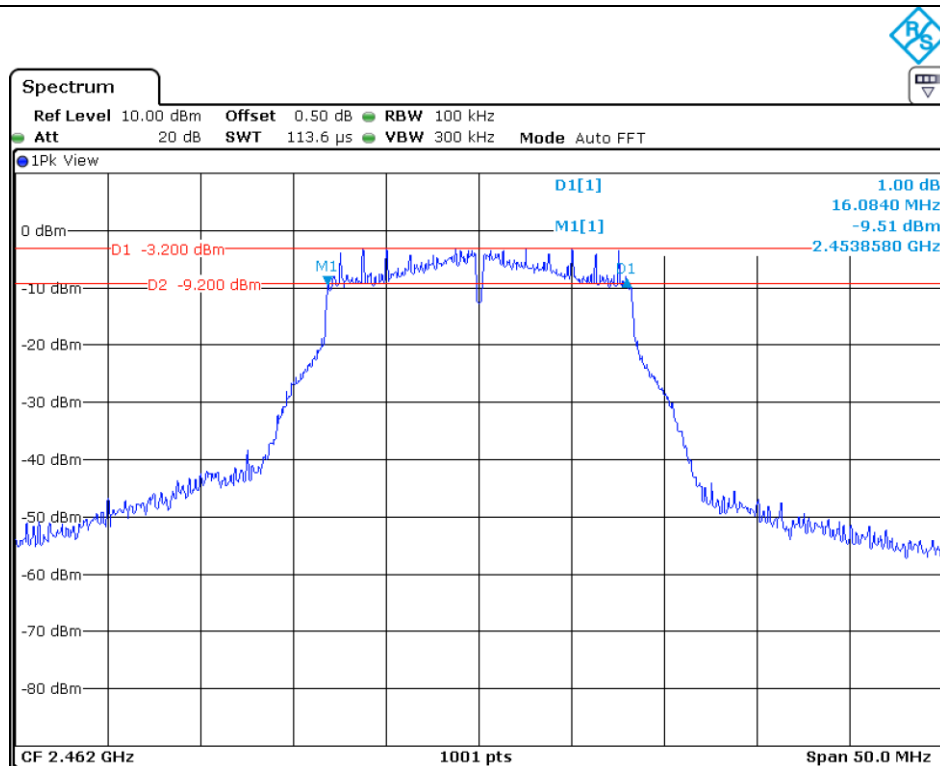


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

7.6 Test data for 802.11n_HT20 WLAN Mode

-. Test Date : June 20, 2019 ~ June 26, 2019

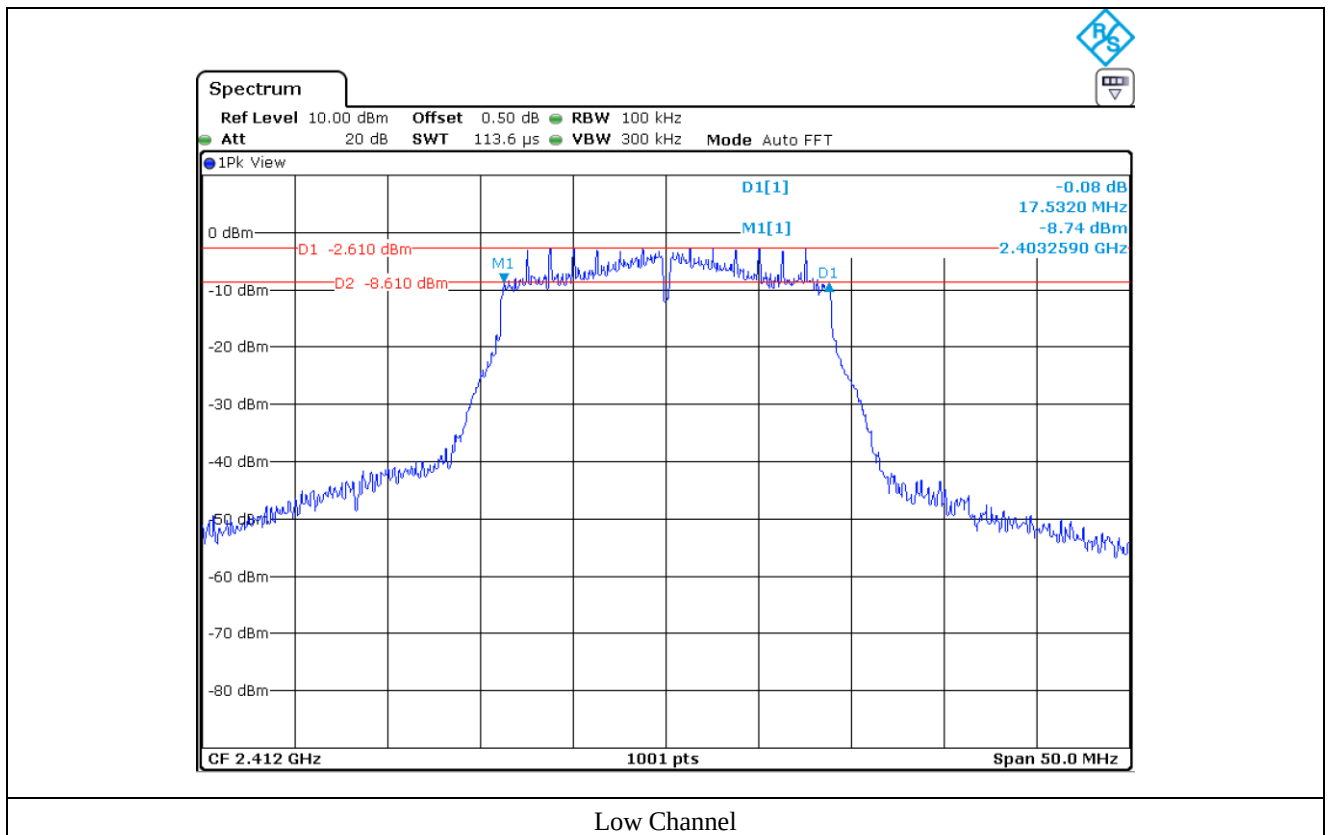
-. Test Result : Pass

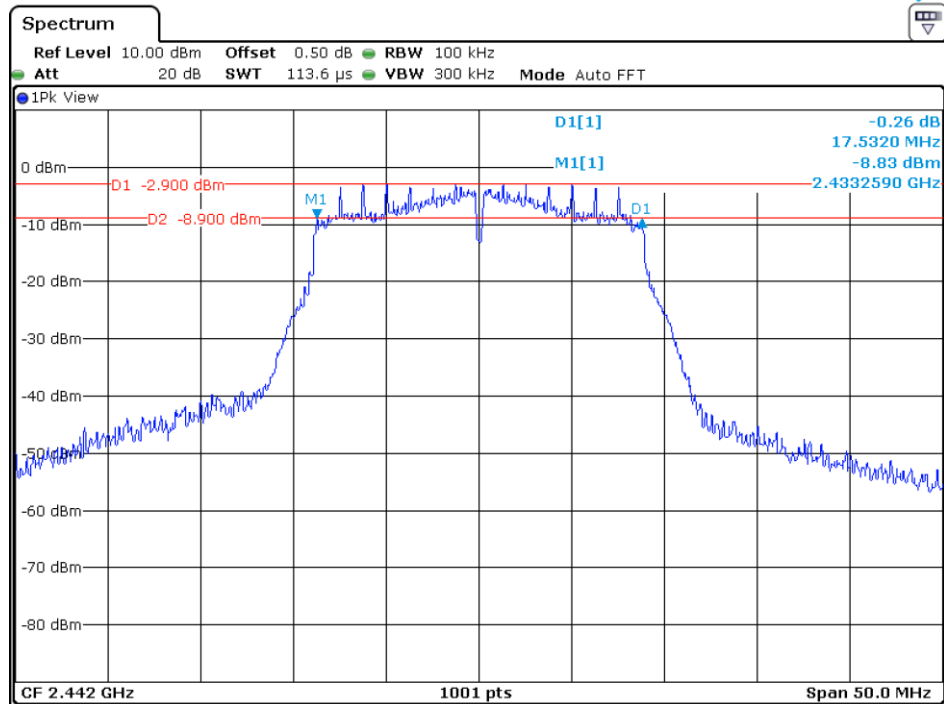
CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	LIMIT (MHz)	Margin (MHz)
Low	2 412.00	17.53	0.50	17.03
Middle	2 442.00	17.53	0.50	17.03
High	2 462.00	17.53	0.50	17.03

Remark. Margin = Measured Value - Limit

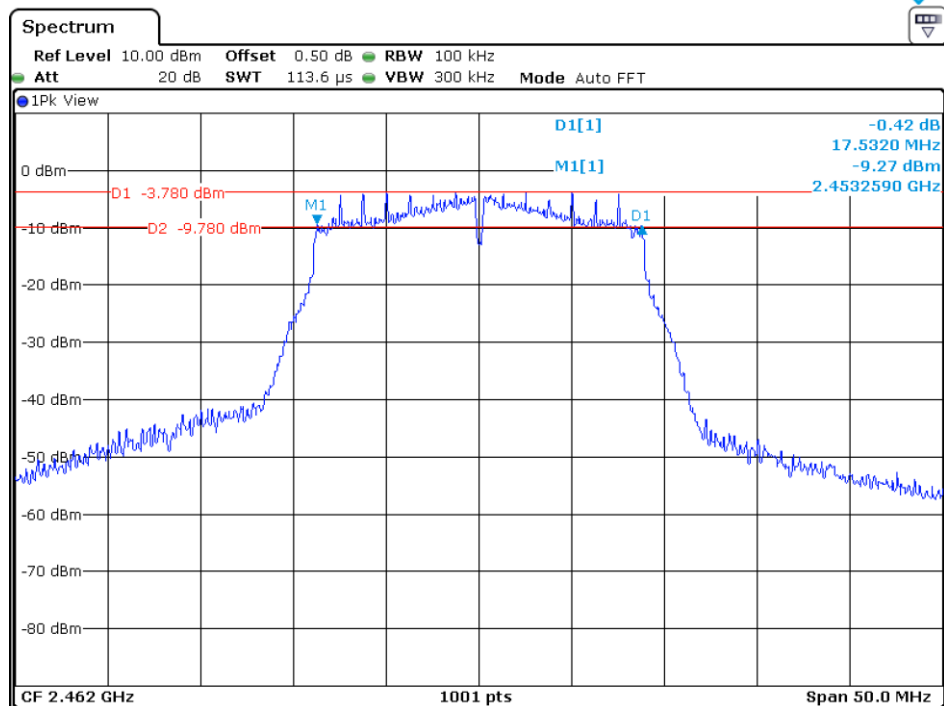


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

8. MAXIMUM PEAK OUTPUT POWER

8.1 Operating environment

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

8.2 Test set-up

The antenna output of the EUT was Connected to the spectrum analyzer.

Uses trace averaging across ON and OFF times of the EUT transmissions, followed by duty cycle correction.



8.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ - FSV40	Rohde & Schwarz	Signal Analyzer	101009	Mar. 11, 2019 (1Y)

All test equipment used is calibrated on a regular basis.

8.4 Test data for 802.11b WLAN Mode

-. Test Date : June 20, 2019 ~ June 26, 2019

-. Test Result : Pass

-. Duty Cycle : 99.08 %

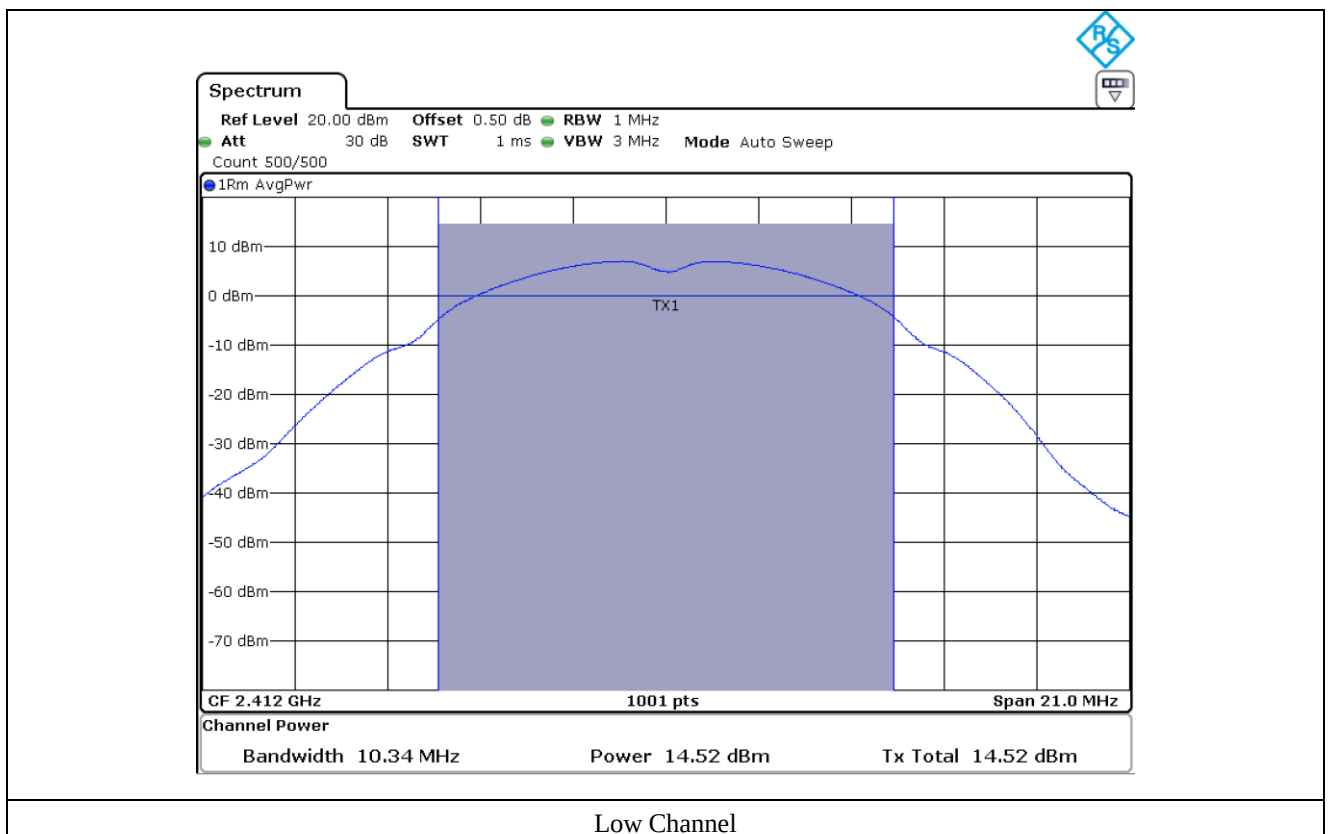
CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	Correction Factor (dB)	Result (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	14.52	0.04	14.56	30.00	15.44
MIDDLE	2 442.00	14.21	0.04	14.25	30.00	15.75
HIGH	2 462.00	13.65	0.04	13.69	30.00	16.31

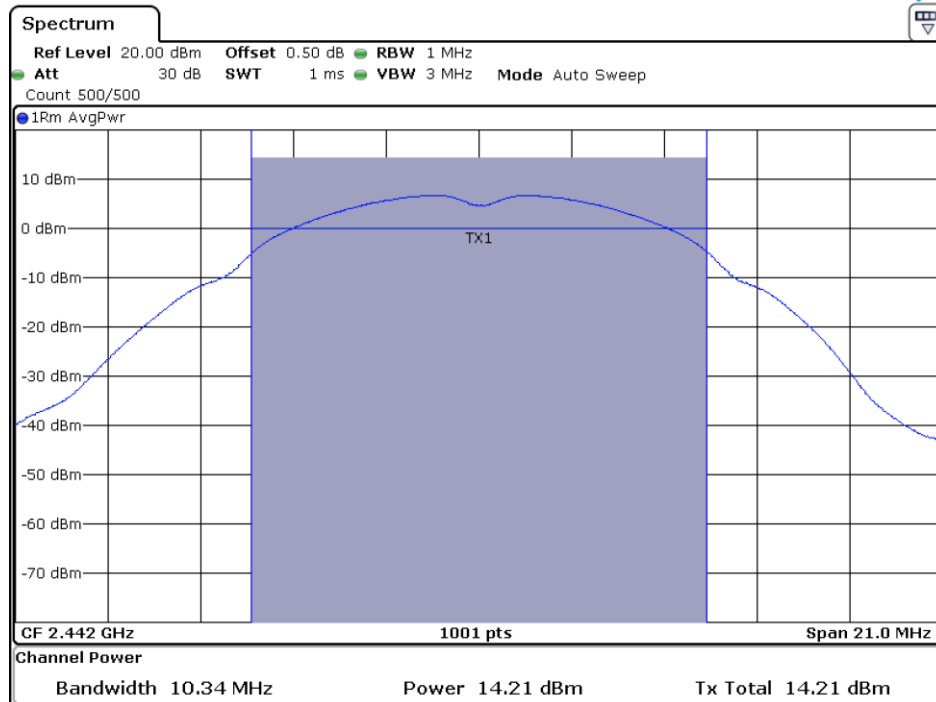
Remark : Margin(dB) = Limit(dBm) – Result(dBm)

Result(dBm) = Measured Value + Correction Factor

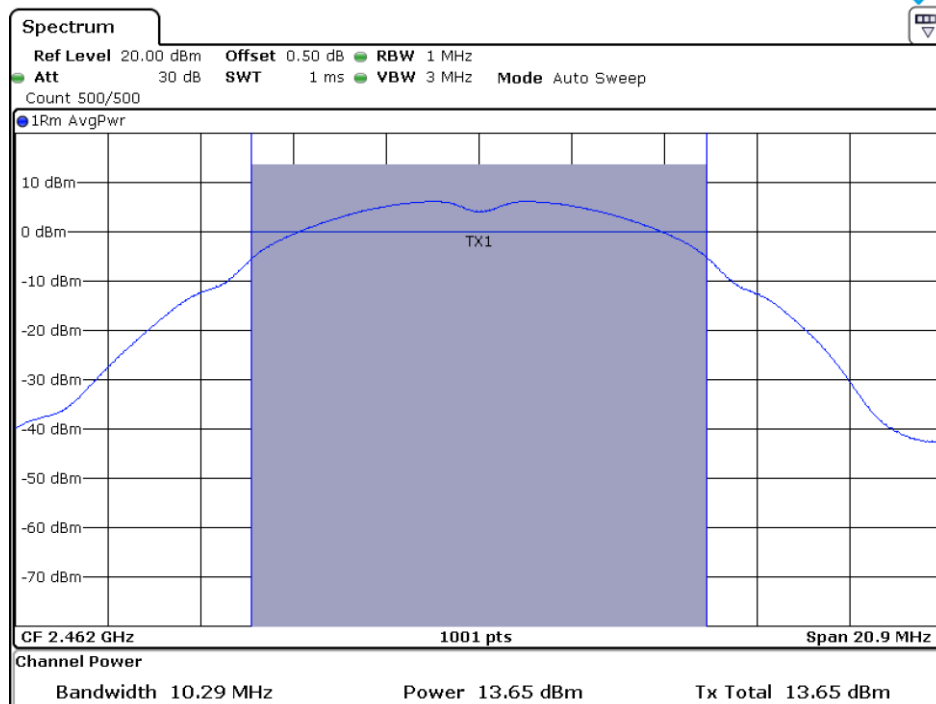


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

8.5 Test data for 802.11g WLAN Mode

-. Test Date : June 20, 2019 ~ June 26, 2019

-. Test Result : Pass

-. Duty Cycle : 91.80 %

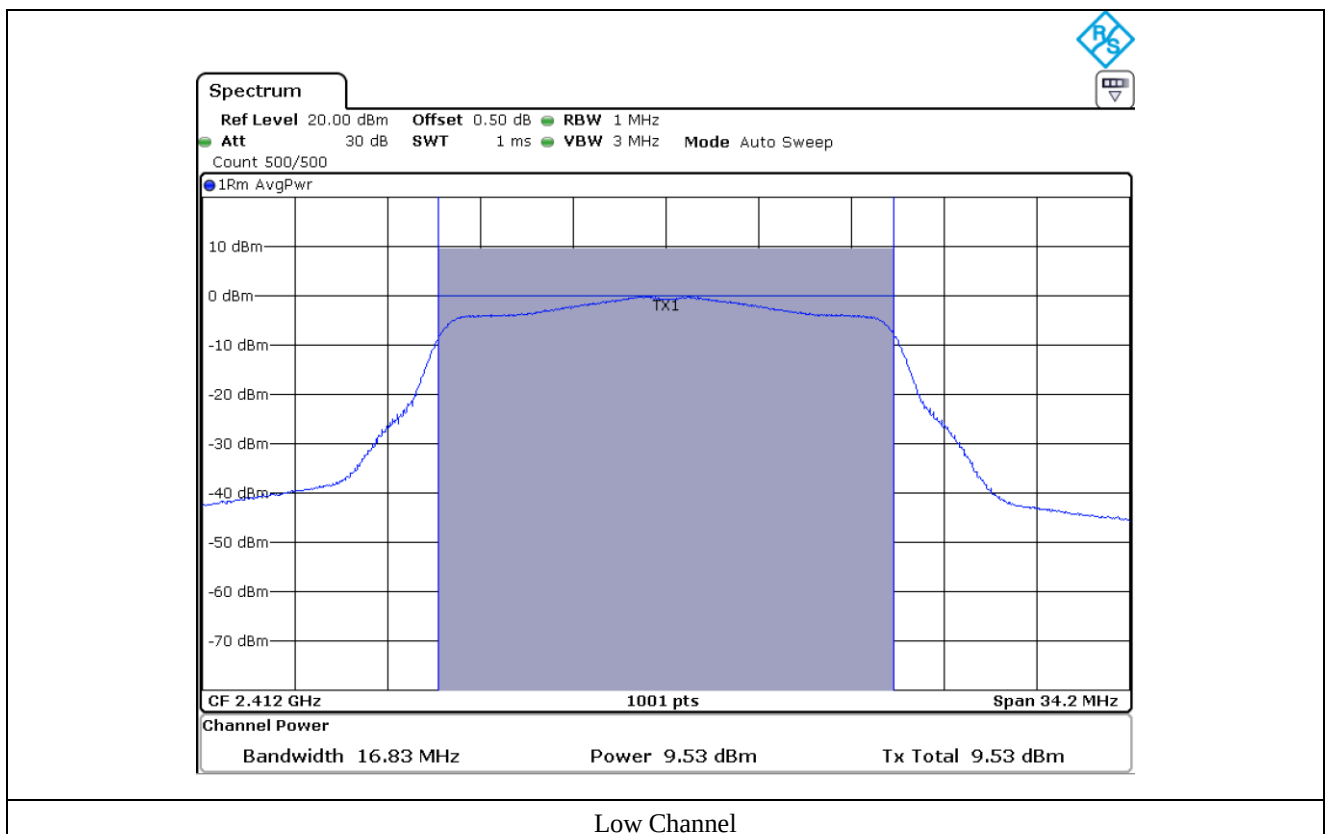
CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	Correction Factor (dB)	Result (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	9.53	0.37	9.90	30.00	20.10
MIDDLE	2 442.00	9.09	0.37	9.46	30.00	20.54
HIGH	2 462.00	8.73	0.37	9.10	30.00	20.90

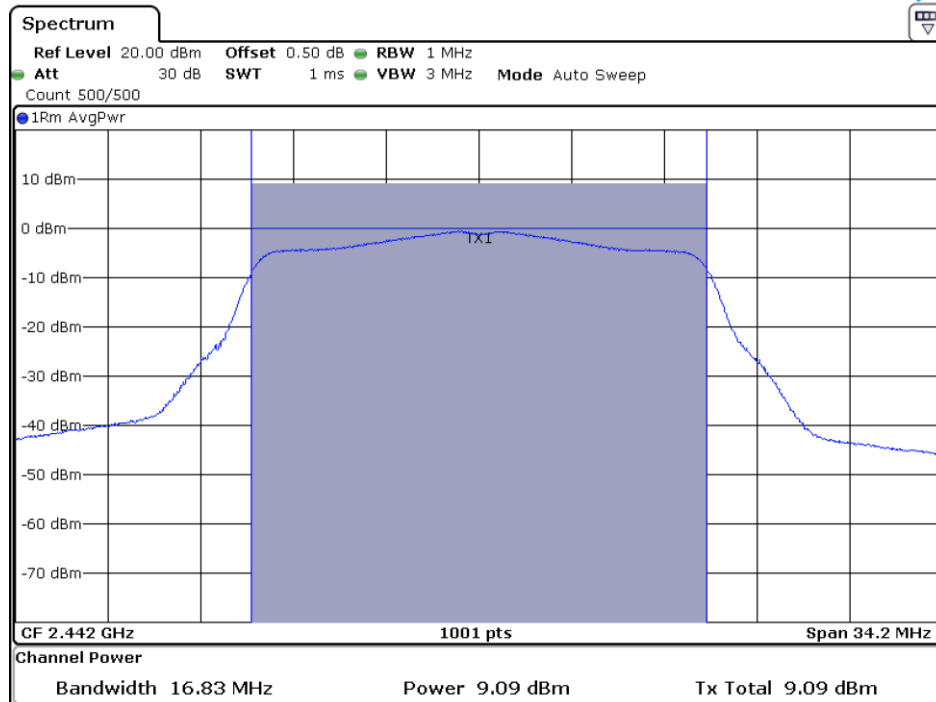
Remark : Margin(dB) = Limit(dBm) – Result(dBm)

Result(dBm) = Measured Value + Correction Factor

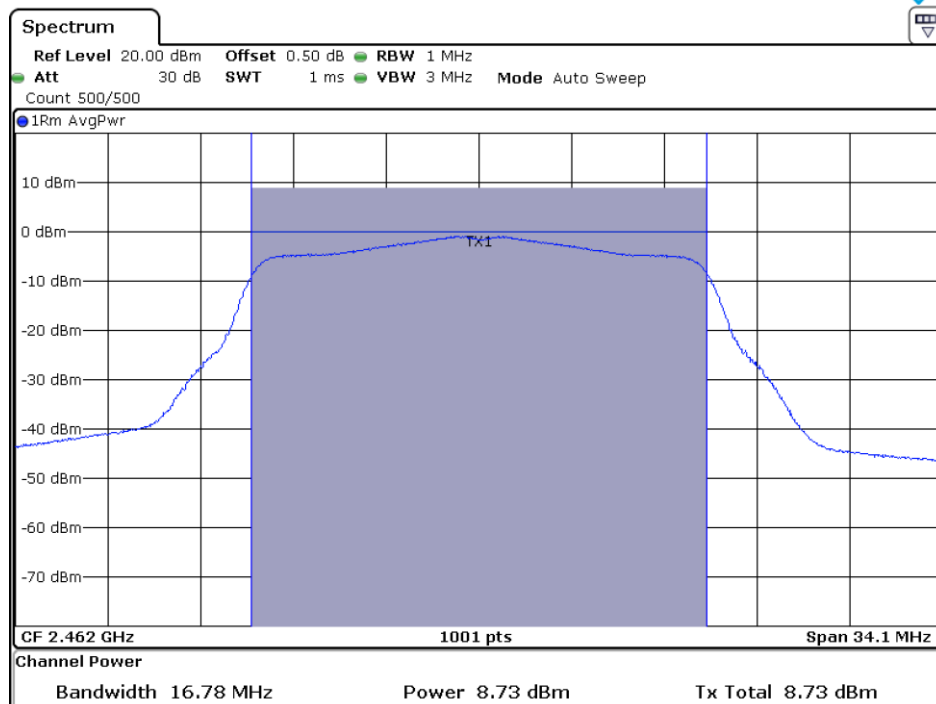


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

8.6 Test data for 802.11n_HT20 WLAN Mode

-. Test Date : June 20, 2019 ~ June 26, 2019

-. Test Result : Pass

-. Duty Cycle : 91.64 %

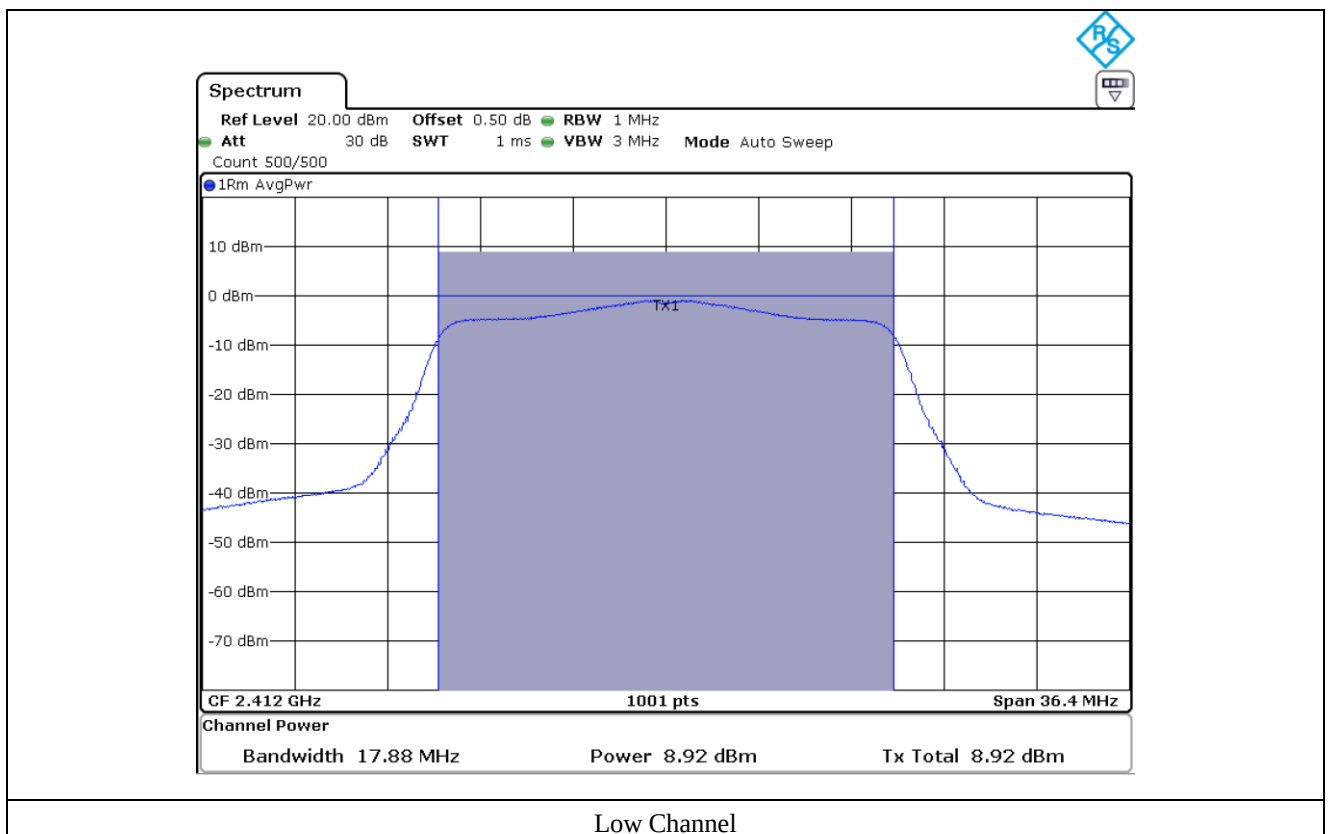
CHANNEL	FREQUENCY (MHz)	MEASURED VLAUE (dBm)	Correction Factor (dB)	Result (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	8.92	0.38	9.30	30.00	20.70
MIDDLE	2 442.00	8.48	0.38	8.86	30.00	21.14
HIGH	2 462.00	7.88	0.38	8.26	30.00	21.74

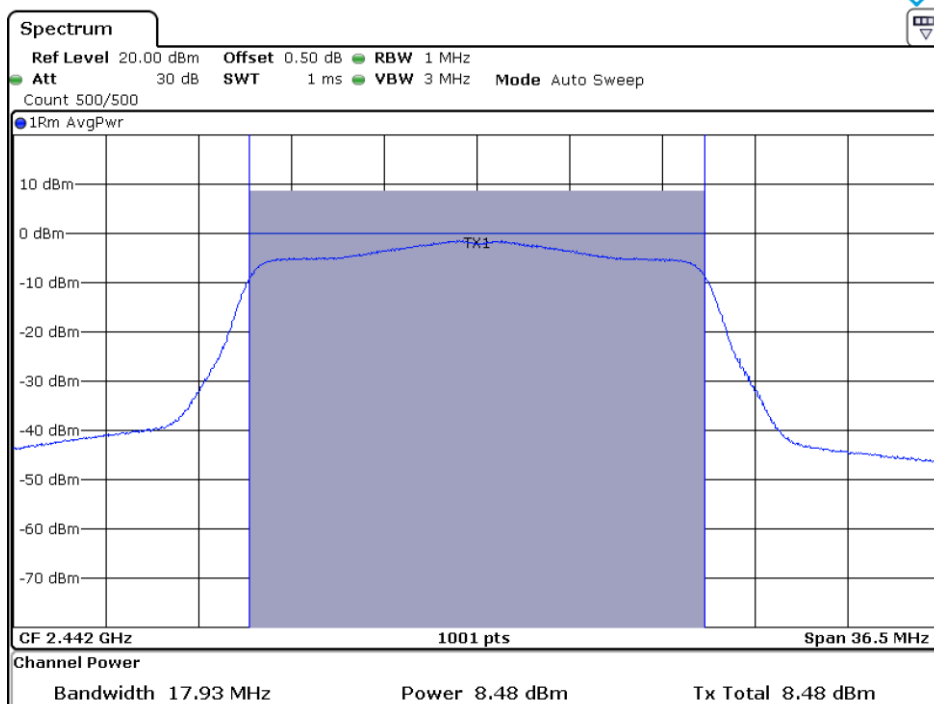
Remark : Margin(dB) = Limit(dBm) – Result(dBm)

Result(dBm) = Measured Value + Correction Factor

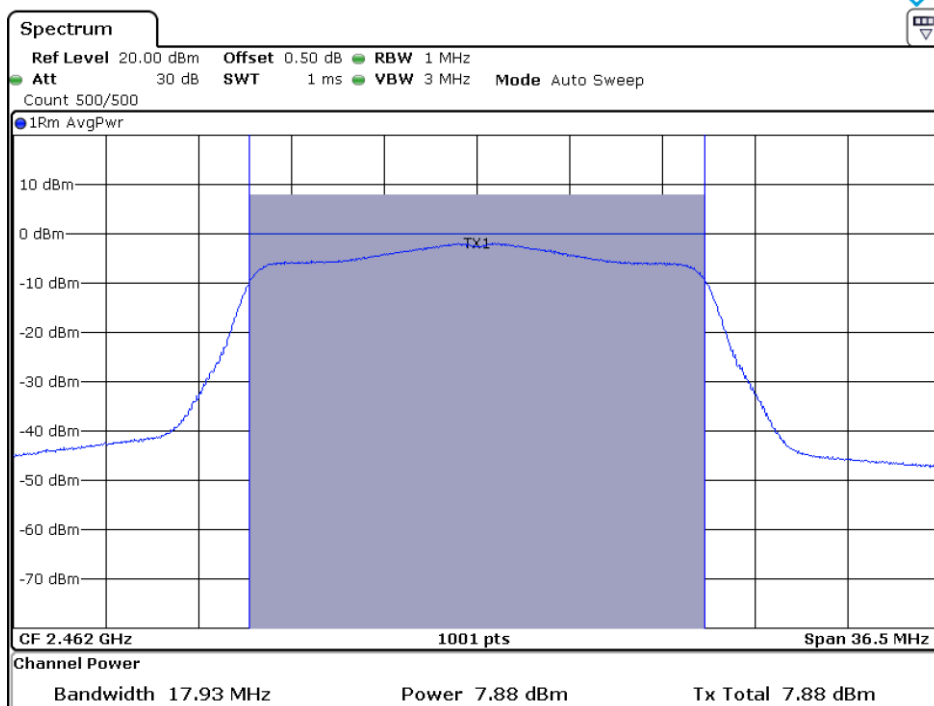


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

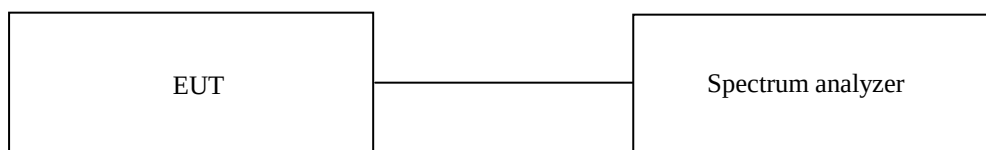
9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

9.1 Operating environment

Temperature : 23 °C
Relative humidity : 41 % 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.

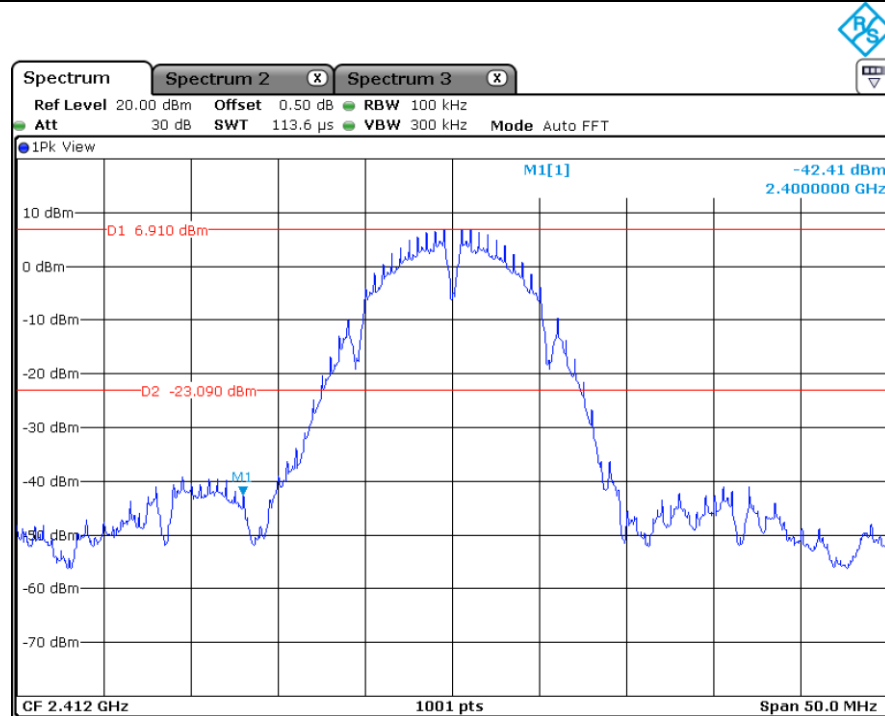
9.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Mar. 11, 2019 (1Y)
■ -	ESR	Rohde & Schwarz	EMI Test Receiver	101470	Oct. 22, 2018 (1Y)
■ -	310N	Sonoma Instrument	Pre-Amplifier	312545	Mar. 18, 2019 (1Y)
■ -	BBV9718B	Schwarzbeck	Amplifier	310	Mar. 20, 2019 (1Y)
■	SCU40A	Rohde & Schwarz	Signal Conditioning unit	100436	Mar. 11, 2019 (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	9163-419	Aug. 09, 2018 (2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 16, 2017 (2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170179	Jan. 16, 2019 (1Y)

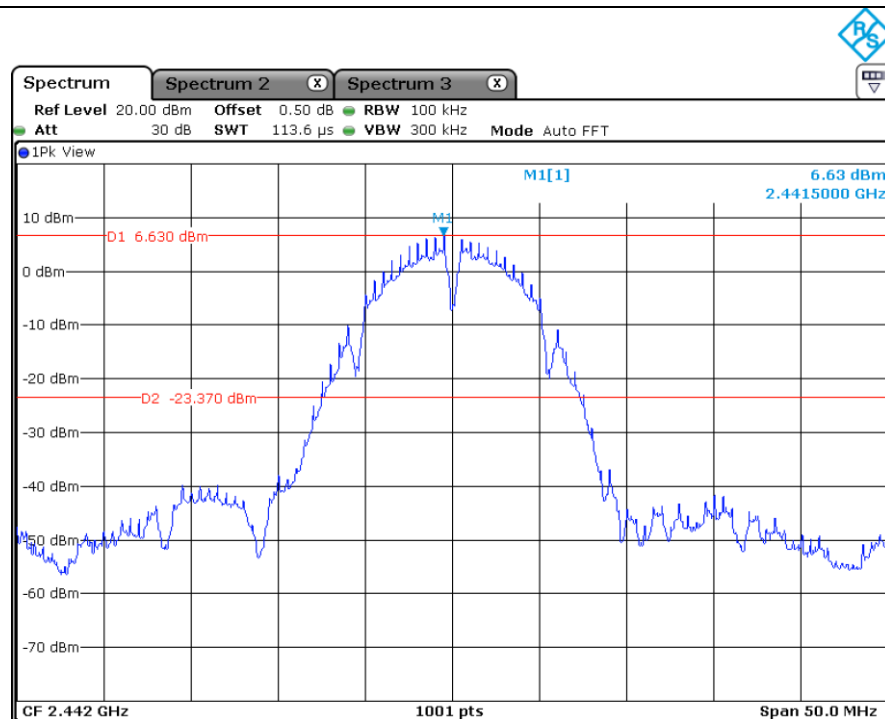
All test equipment used is calibrated on a regular basis.

9.5 Test data for conducted emission

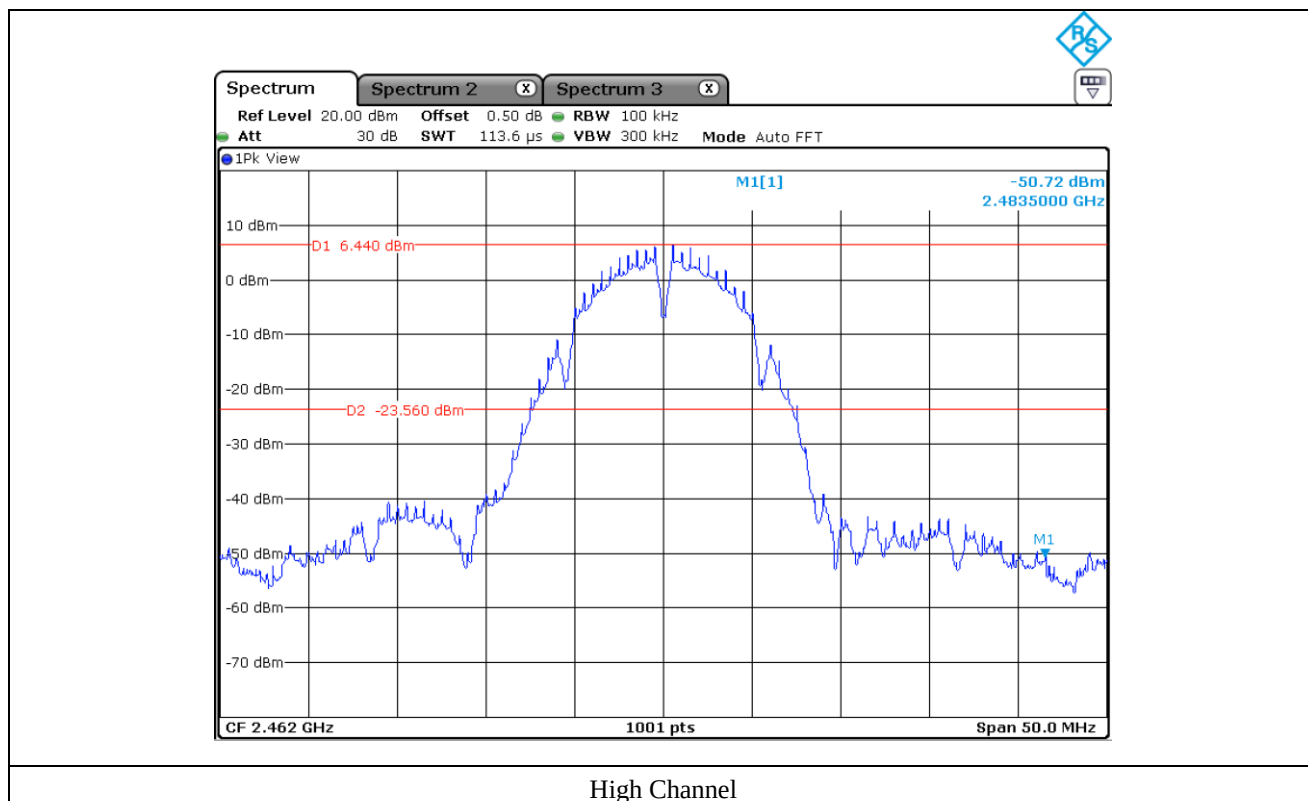
9.5.1 Test data for 802.11b WLAN Mode

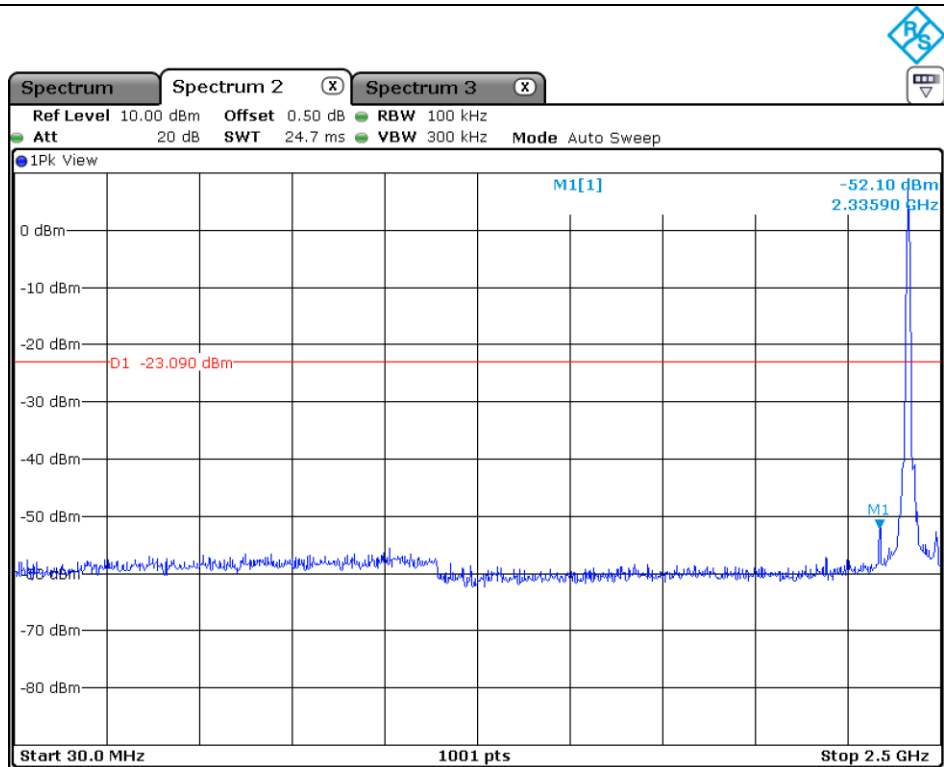


Low Channel

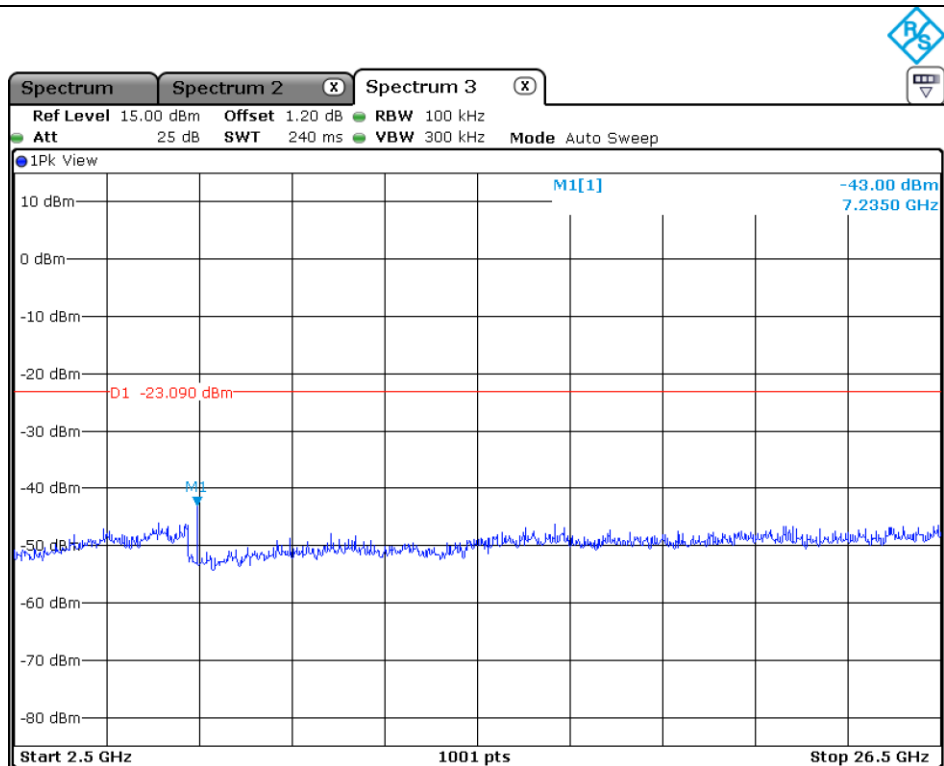


Middle Channel

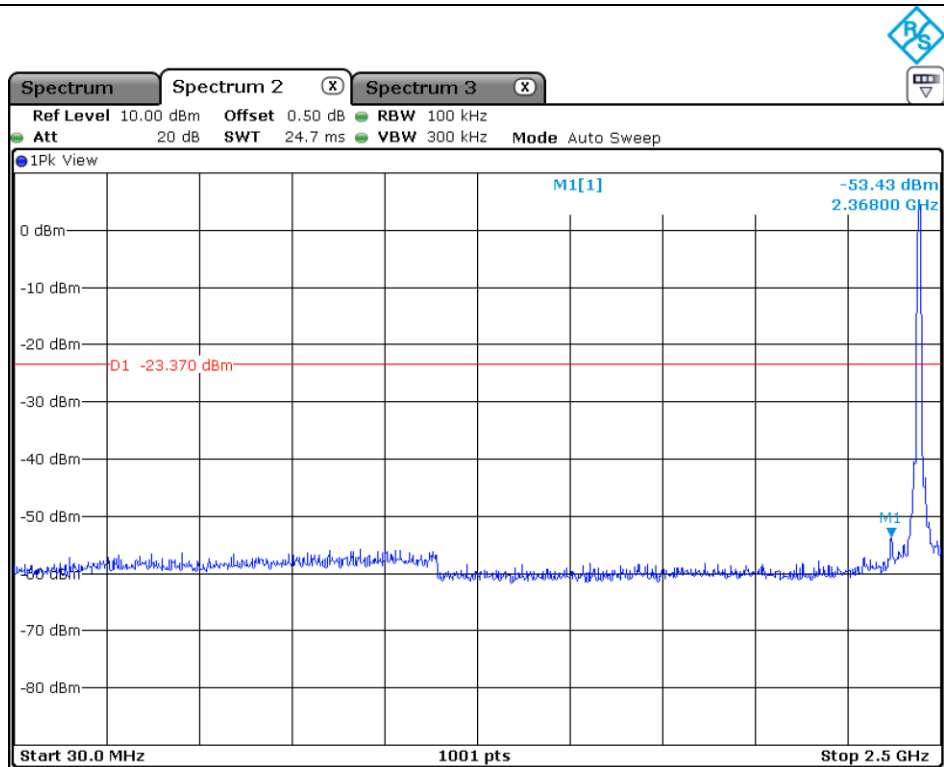




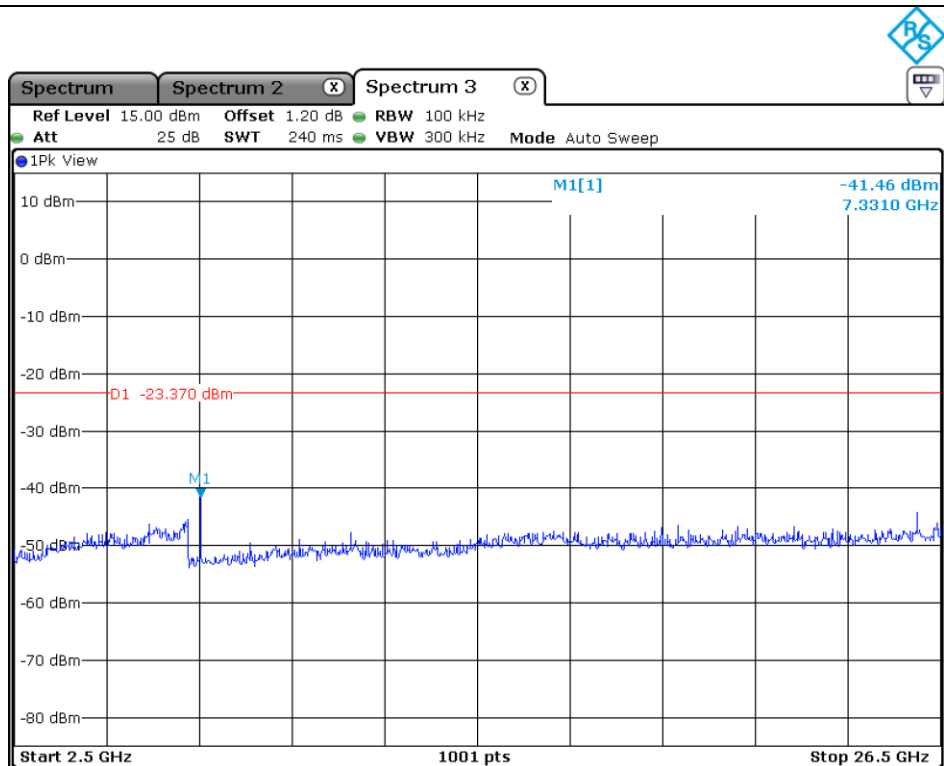
Low Channel



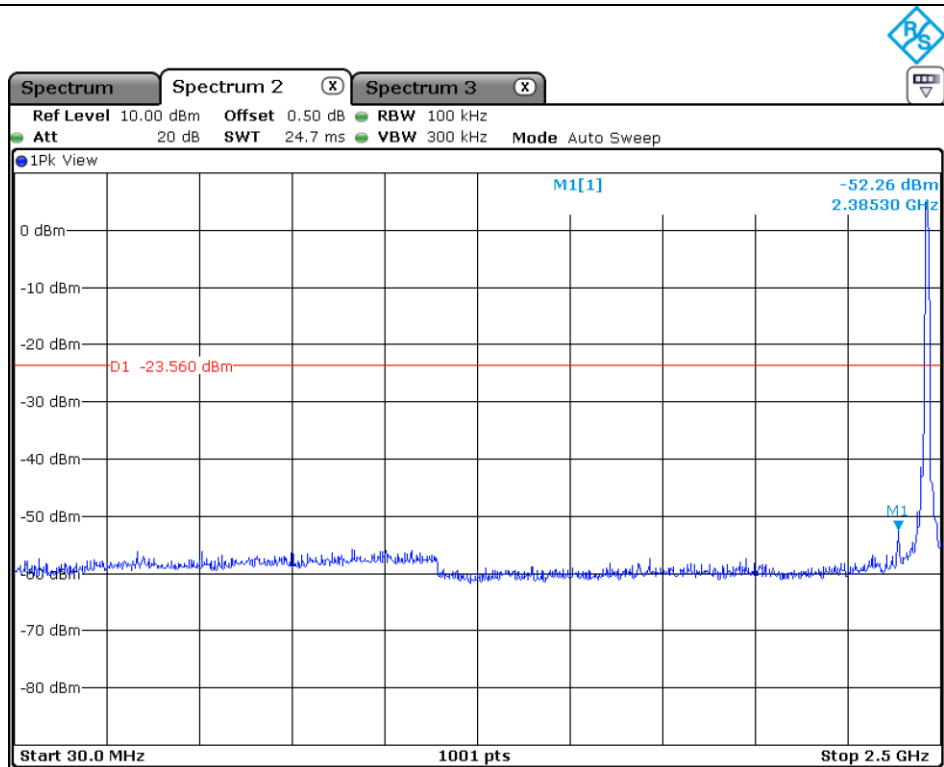
Low Channel



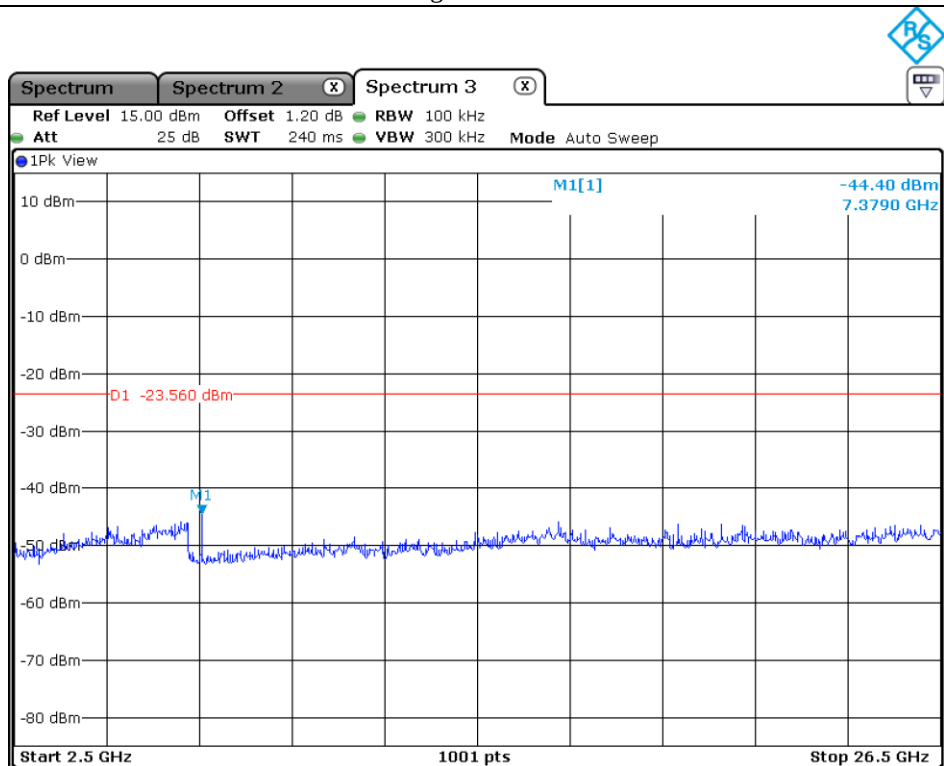
Middle Channel



Middle Channel

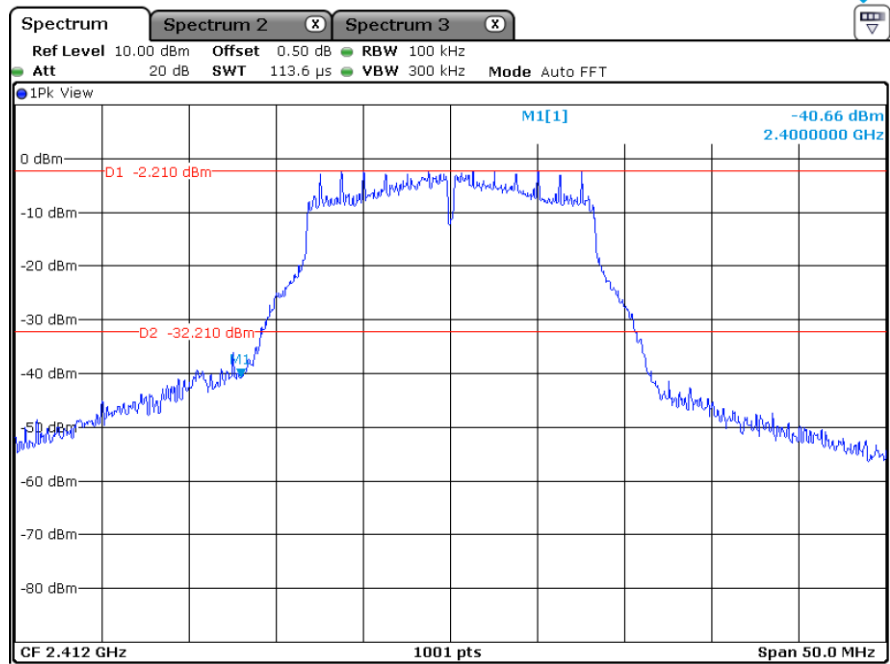


High Channel

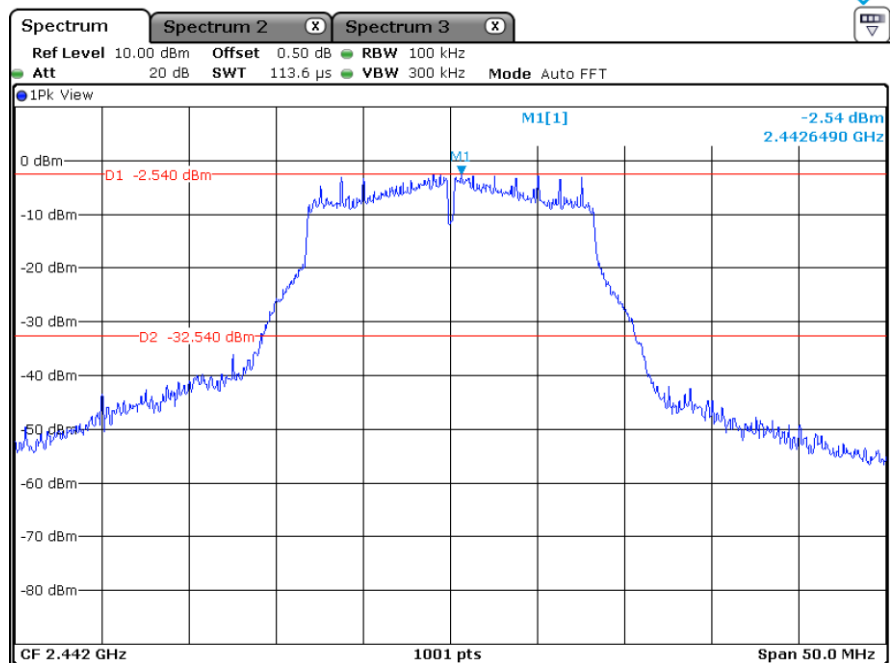


High Channel

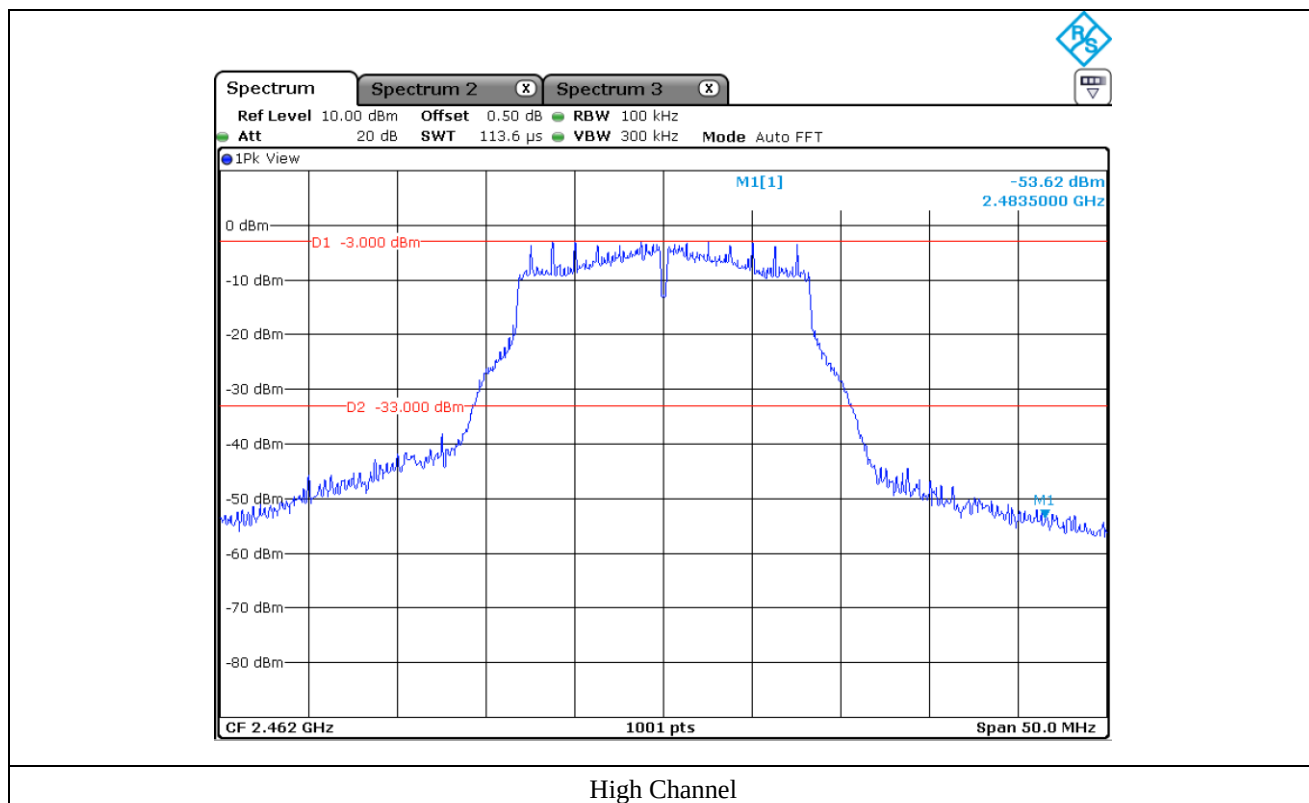
9.5.2 Test data for 802.11g WLAN Mode

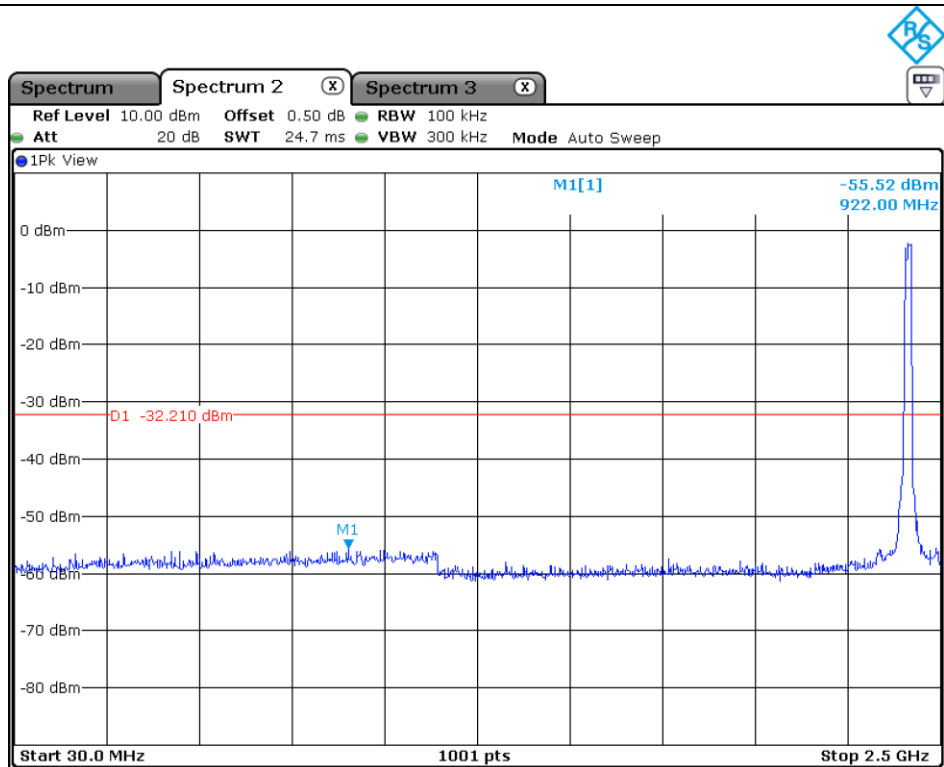


Low Channel

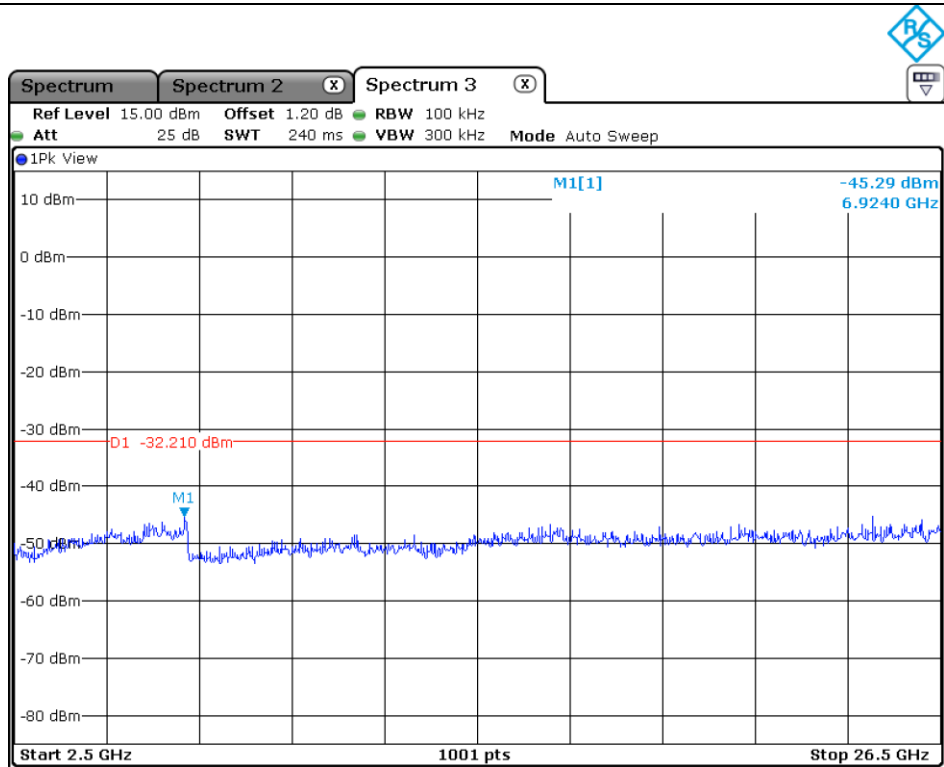


Middle Channel

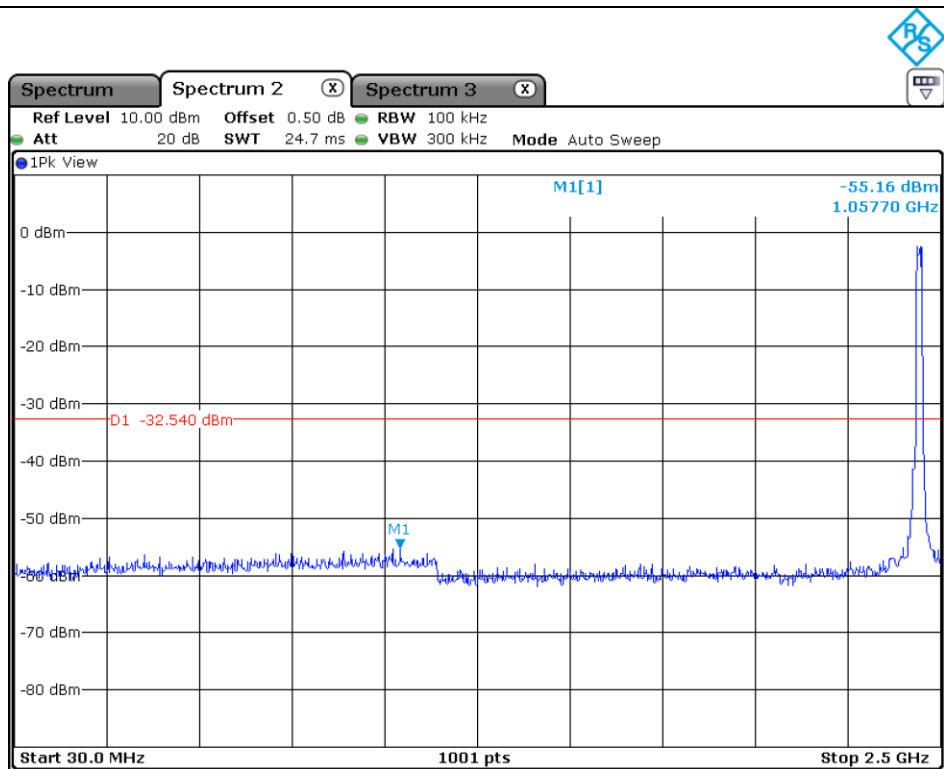




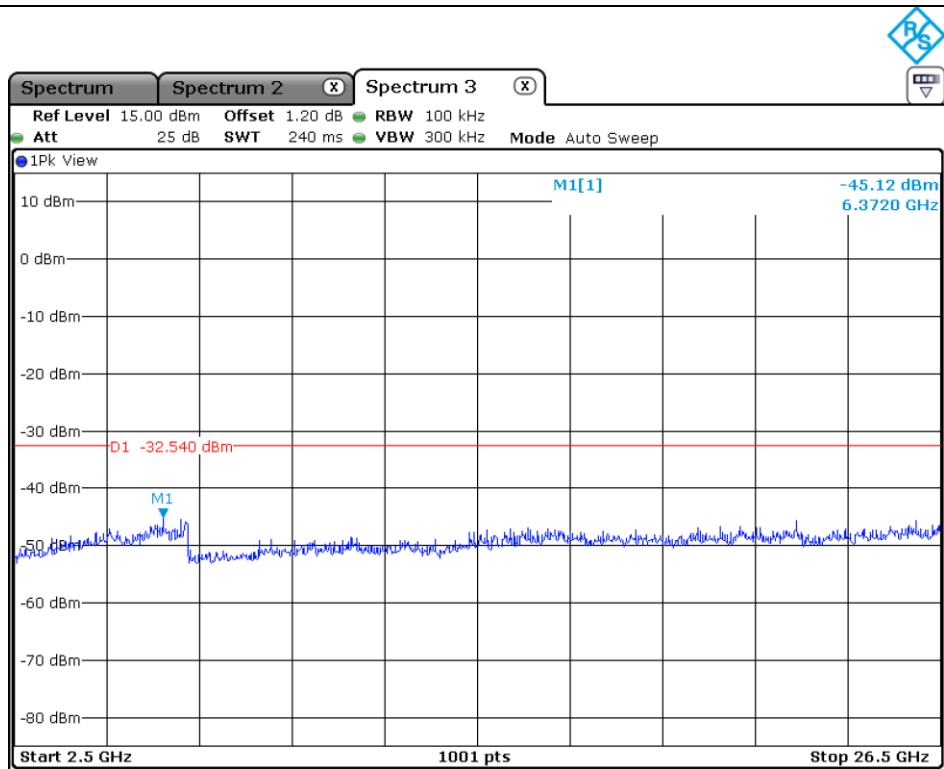
Low Channel



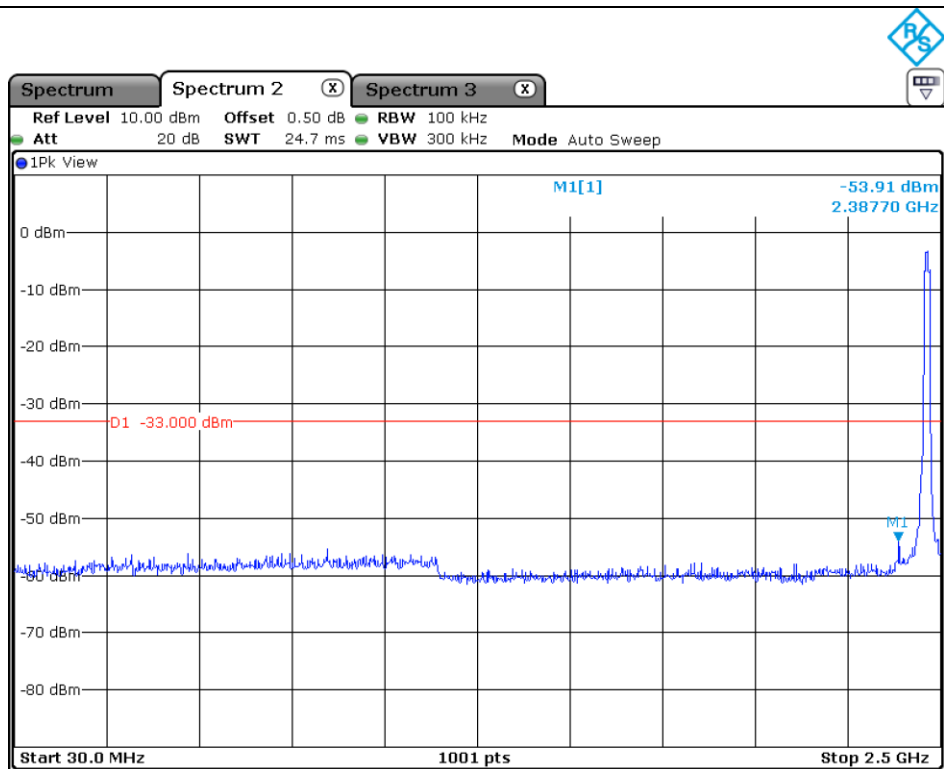
Low Channel



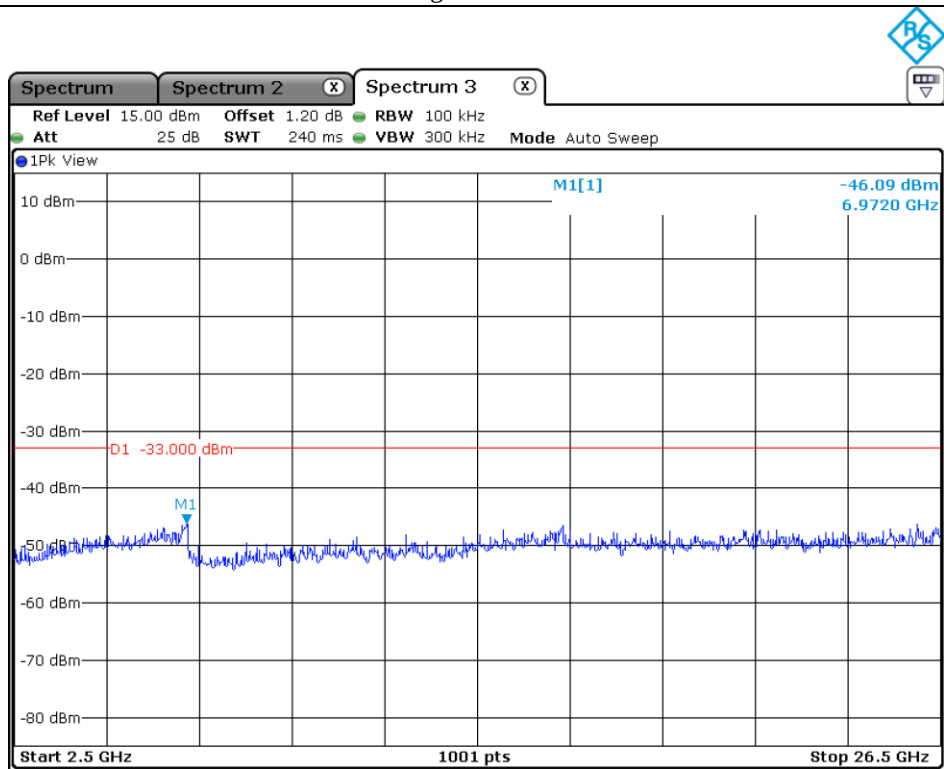
Middle Channel



Middle Channel

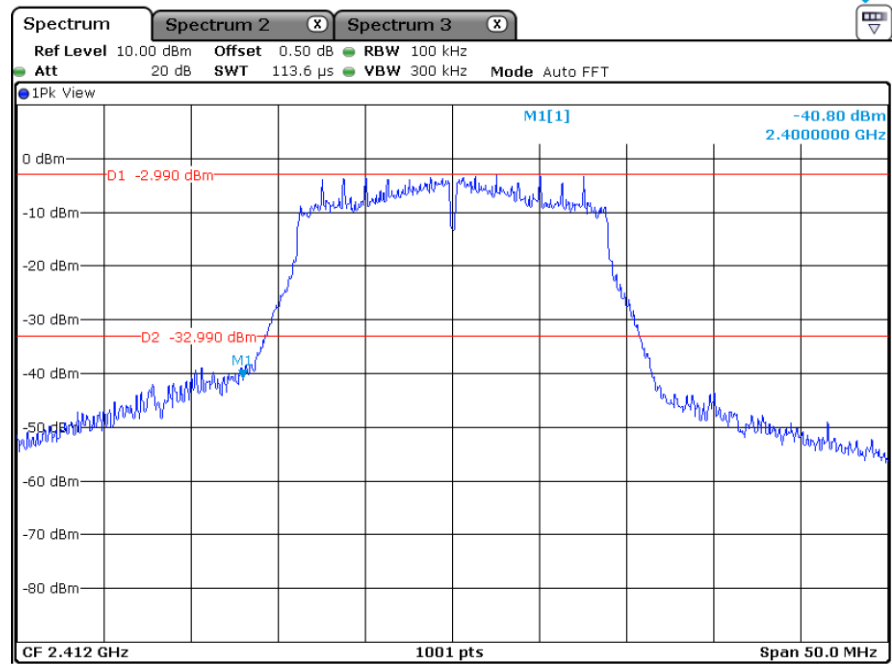


High Channel

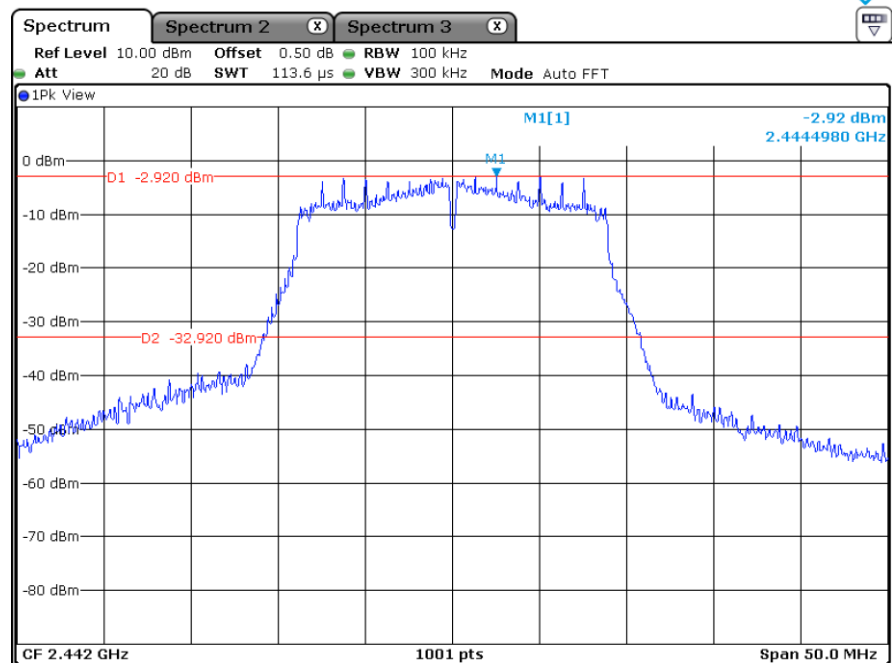


High Channel

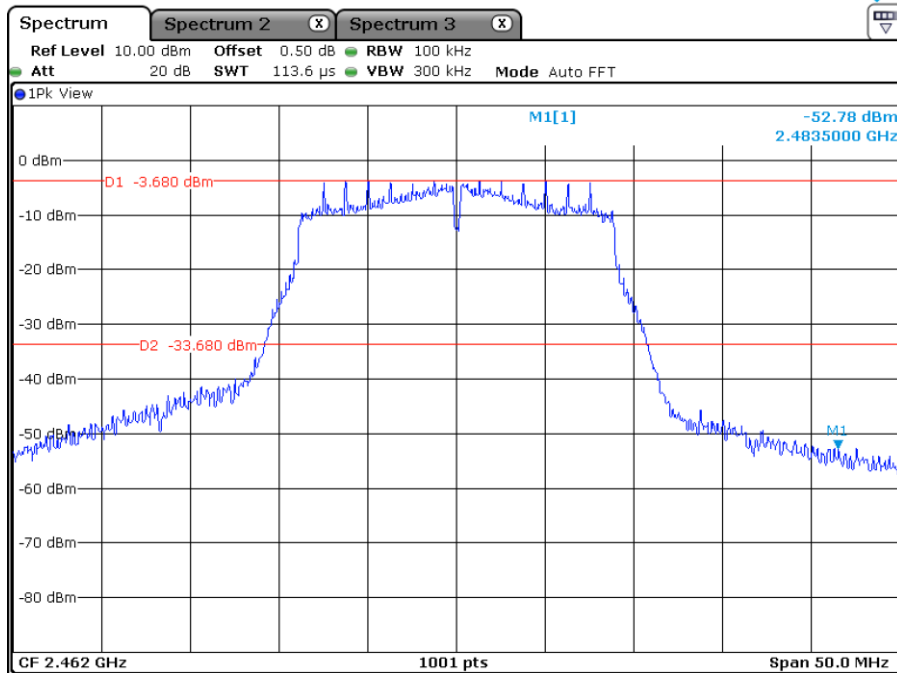
9.5.3 Test data for 802.11n_HT20 WLAN Mode



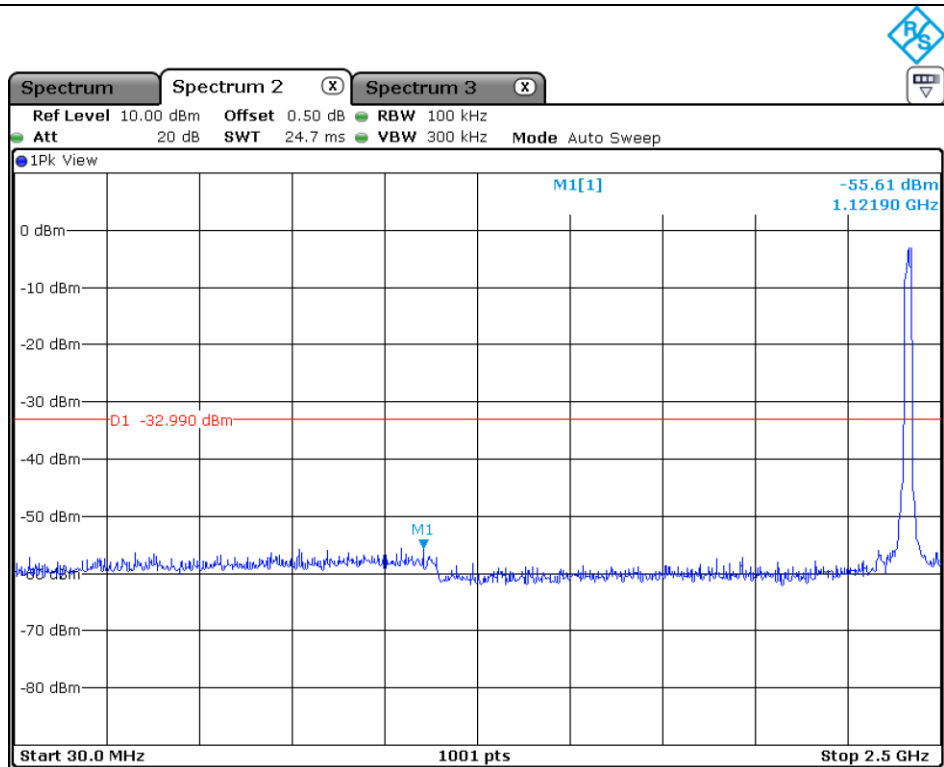
Low Channel



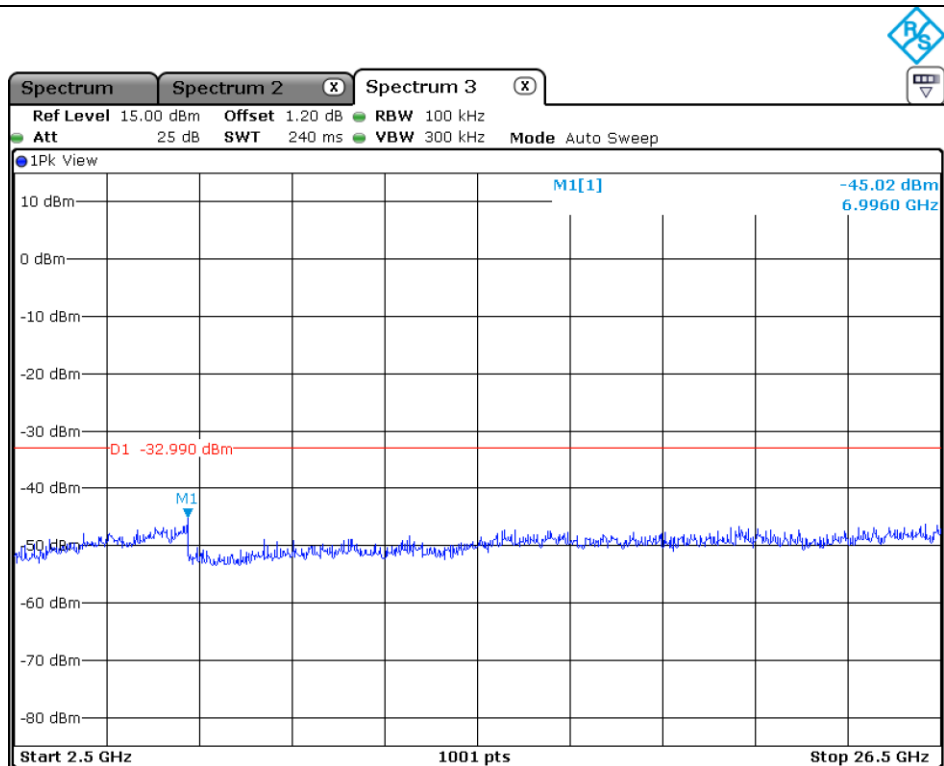
Middle Channel



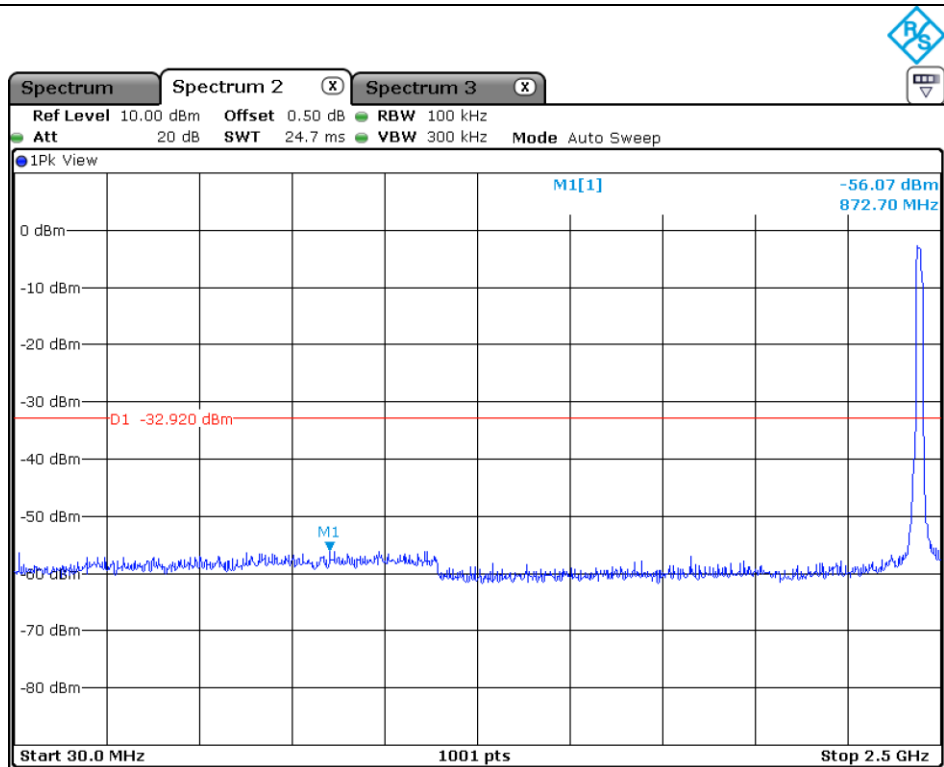
High Channel



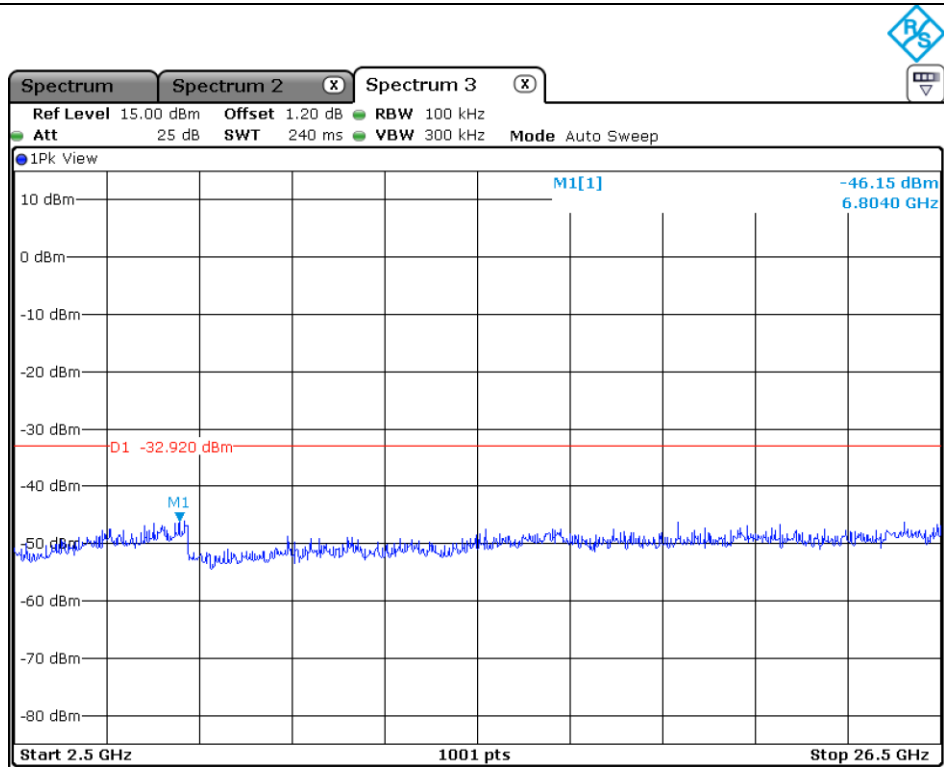
Low Channel



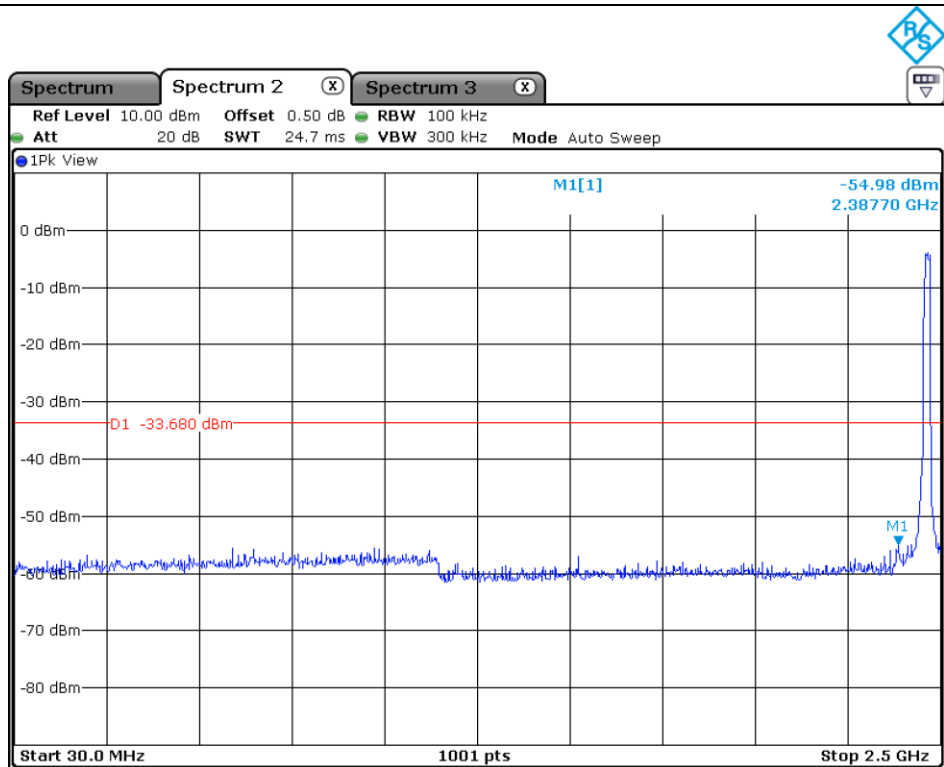
Low Channel



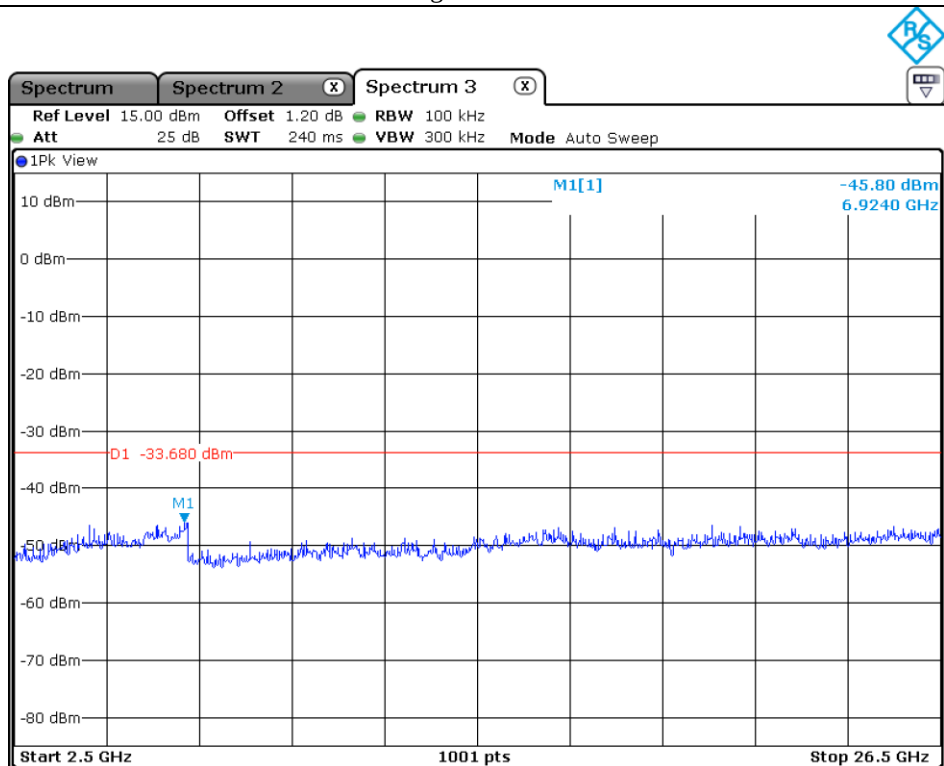
Middle Channel



Middle Channel



High Channel



High Channel