

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

Test Report No. : OT-193-RWD-057
AGR No. : A18DA-151R
Applicant : LG Electronics USA
Address : 1000 Sylvan Avenue, Englewood Cliffs, New Jersey, United States, 07632
Manufacturer : LG Electronics Inc.
Address : 222 LG-ro, Jinwi-Myeon, Pyeongtaek -Si, Gyeonggi-Do, 451-713, Korea
Type of Equipment : Car Navigation
FCC ID. : BEJ-MIB3OI
Model Name : MIB3 OI
Serial number : N/A
Total page of Report : 64 pages (including this page)
Date of Incoming : Janaury 11, 2019
Date of issue : March 26, 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:



Yu-Seog Sim / Assistant Manager
ONETECH Corp.

Approved by:



Jae-Ho Lee / Chief Engineer
ONETECH Corp.

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Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
OT-193-RWD-057	March 26, 2019	Initial Issue	All

Document History

Revision No.	Issued Date	Revisions	Effect Section
Original	March 26, 2019	Initial Issue	-
Rev. 01	June 03, 2019	3.1 Product Description	-

1. VERIFICATION OF COMPLIANCE

Applicant : LG Electronics USA
Address : 1000 Sylvan Avenue, Englewood Cliffs, New Jersey, United States, 07632
Contact Person : Kyung-Su Han / Director
Telephone No. : (201) 266-2215
FCC ID. : BEJ-MIB3OI
Model Name : MIB3 OI
Brand Name : LG, Volkswagen, Seat
Serial Number : N/A
Date : March 26, 2019

EQUIPMENT CLASS	DTS-Digital Transmission System
E.U.T. DESCRIPTION	Car Navigation
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
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.

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2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.247 (a) (2)	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 MIB3 OI (referred to as the EUT in this report) is a Car Navigation. Product specification information described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	Car Navigation			
FREQUENCY RANGE	Bluetooth	2 402 MHz ~ 2 480 MHz		
	WLAN 2.4 GHz Band	2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20))		
	WLAN 5 GHz Band	5 150 MHz ~ 5 250 MHz Band	5 180 MHz ~ 5 240 MHz (802.11a/n/ac(HT20))	
			5 190 MHz ~ 5 230 MHz (802.11n/ac(HT40))	
			5 210 MHz (802.11ac(VHT80))	
		5 725 MHz ~ 5 850 MHz Band	5 745 MHz ~ 5 825 MHz (802.11a/n/ac(HT20))	
			5 755 MHz ~ 5 795 MHz (802.11n/ac(HT40))	
			5 775 MHz (802.11ac(VHT80))	
MAX. RF OUTPUT POWER	Bluetooth	1 Mbps	-1.40 dBm	
		2 Mbps	-0.61 dBm	
		3 Mbps	-0.07 dBm	
	WLAN 2.4 GHz Band	Wi-Fi 802.11b (15.43 dBm) Wi-Fi 802.11g (17.26 dBm) Wi-Fi 802.11n(HT20) (15.97 dBm)		
	WLAN 5 GHz Band	5 150 MHz ~ 5 250 MHz Band	Antenna 0	Wi-Fi 802.11a (10.49 dBm) Wi-Fi 802.11n(HT20) (10.44 dBm) Wi-Fi 802.11n(HT40) (8.21 dBm) Wi-Fi 802.11ac(VHT80) (7.34 dBm)
			Antenna 1	Wi-Fi 802.11a (10.15 dBm) Wi-Fi 802.11n(HT20) (10.07 dBm) Wi-Fi 802.11n(HT40) (8.35 dBm) Wi-Fi 802.11ac(VHT80) (7.68 dBm)
			Multiple transmit	Wi-Fi 802.11n(HT20) (13.24 dBm) Wi-Fi 802.11n(HT40) (11.29 dBm) Wi-Fi 802.11ac(VHT80) (10.52 dBm)

MAX. RF OUTPUT POWER	WLAN 5 GHz Band	5 725 MHz ~ 5 850 MHz Band		Antenna 0	Wi-Fi 802.11a (9.37 dBm) Wi-Fi 802.11n(HT20) (9.39 dBm) Wi-Fi 802.11n(HT40) (7.29 dBm) Wi-Fi 802.11ac(VHT80) (6.34 dBm)		
				Antenna 1	Wi-Fi 802.11a (10.42 dBm) Wi-Fi 802.11n(HT20) (10.52 dBm) Wi-Fi 802.11n(HT40) (8.49 dBm) Wi-Fi 802.11ac(VHT80) (7.74 dBm)		
				Multiple transmit	Wi-Fi 802.11n(HT20) (12.84 dBm) Wi-Fi 802.11n(HT40) (10.94 dBm) Wi-Fi 802.11ac(VHT80) (10.11 dBm)		
MODULATION TYPE	Bluetooth			GFSK for 1 Mbps, $\pi/4$ -DQPSK for 2 Mbps, 8-DPSK for 3 Mbps			
	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	Bluetooth			PCB Antenna			
	WLAN (2.4GHz Band)			Chip Antenna			
	WLAN (5GHz Band)	Antenna 0		PCB Antenna			
		Antenna 1		Chip Antenna			
ANTENNA GAIN	Bluetooth			2.5 dBi			
	WLAN 2.4 GHz Band			3.8 dBi			
	WLAN 5 GHz Band	5 150 MHz ~ 5 250 MHz 5 725 MHz ~ 5 850 MHz		ANT0	3.8 dBi		
				ANT1	1.6 dBi		
				ANT0	5.5 dBi		
				ANT1	2.4 dBi		
	5 GHz Band (ANT 0 + 1)	5 150 MHz ~ 5 250 MHz		5.78 dBi			
		5 725 MHz ~ 5 850 MHz		7.10 dBi			
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)				31.25 MHz, 28.63636 MHz			
RATED SUPPLY VOLTAGE				DC 12.0 V			

- Directional Gain Calculations

$$\text{Directional gain} = 10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20})^2 / N_{\text{ANT}}] \text{ dBi}$$

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

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

Brand	Model	Config	Feature							Tested
			BT	Wi-Fi	RVC	DAB	Amp	Tuner Configuration	Platform	
LG Volkswagen Seat	MIB3 OI	L91VW3-N200	O	O	O	O	4CH	Mercury,Merlin	MQB	☒
		L91VW3-N20A	O	O	O	O	4CH	Titan,Merlin	MQB	☐
		L91VW3-N320	O	O	O	X	4CH	Mercury,Merlin	MQB	☐
		L91VW3-N160	O	O	O	O	4CH	Mercury,Merlin	MQB	☐
		L91VW3-N16A	O	O	O	O	4CH	Titan,Merlin	MQB	☐
		L91VW3-N740	O	O	O	X	4CH	Titan,Merlin	MQB	☐
		L91VW3-N760	O	O	O	X	4CH	Mercury,Merlin	MQB	☐
		L92VW3-N200	O	O	X	O	4CH	Mercury,Titan	MQB37	☐
		L92VW3-N20A	O	O	X	O	4CH	Mercury,Titan	MQB37	☐
		L92VW3-N320	O	O	X	X	4CH	Titan,Merlin	MQB37	☐
		L92VW3-N160	O	O	X	O	4CH	Mercury,Titan	MQB37	☐
		L92VW3-N16A	O	O	X	O	4CH	Mercury,Titan	MQB37	☐
		L92VW3-N740	O	O	X	X	4CH	Titan,Merlin	MQB37	☐
		L92VW3-N760	O	O	X	X	4CH	Titan,Merlin	MQB37	☐
		L91SE3-N200	O	O	O	O	4CH	Mercury,Merlin	MQB	☐
		L91SE3-N20A	O	O	O	O	4CH	Mercury,Merlin	MQB	☐
		L91SE3-N320	O	O	O	X	4CH	Titan,Merlin	MQB	☐
		L91SE3-N620	O	O	O	O	4CH	Mercury,Merlin	MQB	☐
		L91SE3-N62A	O	O	O	O	4CH	Mercury,Merlin	MQB	☐
		L91SE3-N670	O	O	O	X	4CH	Titan,Merlin	MQB	☐
		L91SE3-N680	O	O	O	X	4CH	Titan,Merlin	MQB	☐
		L92SE3-N620	O	O	X	O	4CH	Mercury,Titan	MQB37	☐
		L92SE3-N62A	O	O	X	O	4CH	Mercury,Titan	MQB37	☐
		L92SE3-N670	O	O	X	X	4CH	Titan,Merlin	MQB37	☐
		L92SE3-N680	O	O	X	X	4CH	Titan,Merlin	MQB37	☐

Note: 1. Applicants must delegate only the models with all features applied to be tested, Therefore, this test report only guarantees the unit tested.

2. The Applicant/manufacturer is responsible for the compliance of all configs.

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	N/A	RTL9044AB	-

5.2 Peripheral equipment

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

Model	Manufacturer	Description	Connected to
G6-1121TV	HP	Notebook PC	EUT, AC/DC Adapter
PPP009C	HP	AC/DC Adapter	Notebook PC

5.3 Configuration of Test System

Line Conducted Test: The EUT was connected to LISN. All supporting equipments were connected to another LISN. Preliminary Power line Conducted Emission test was performed by using the procedure in ANSI C63.10: 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 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.

5.4 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 PCB Antenna and Chip Antenna, so no consideration of replacement by the user.

6. PRELIMINARY TEST

6.1 AC Power line Conducted Emissions Tests

- As this product is only using DC power, AC conducted emission test has not been performed.

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

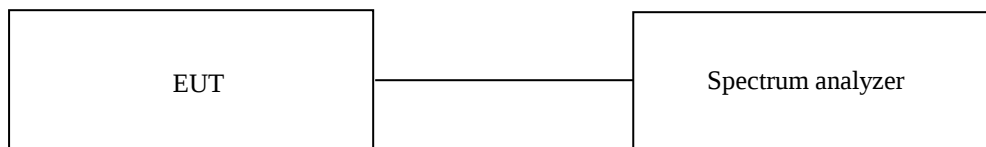
7. MINIMUM 6 dB BANDWIDTH & 99 % OCCUPIED BANDWIDTH

7.1 Operating environment

Temperature : 24 °C
Relative humidity : 45 % 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	Rohde & Schwarz	Signal Analyzer	101200	Aug. 23, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

7.4 Test data for 802.11b WLAN Mode

-. Test Date : February 23, 2019

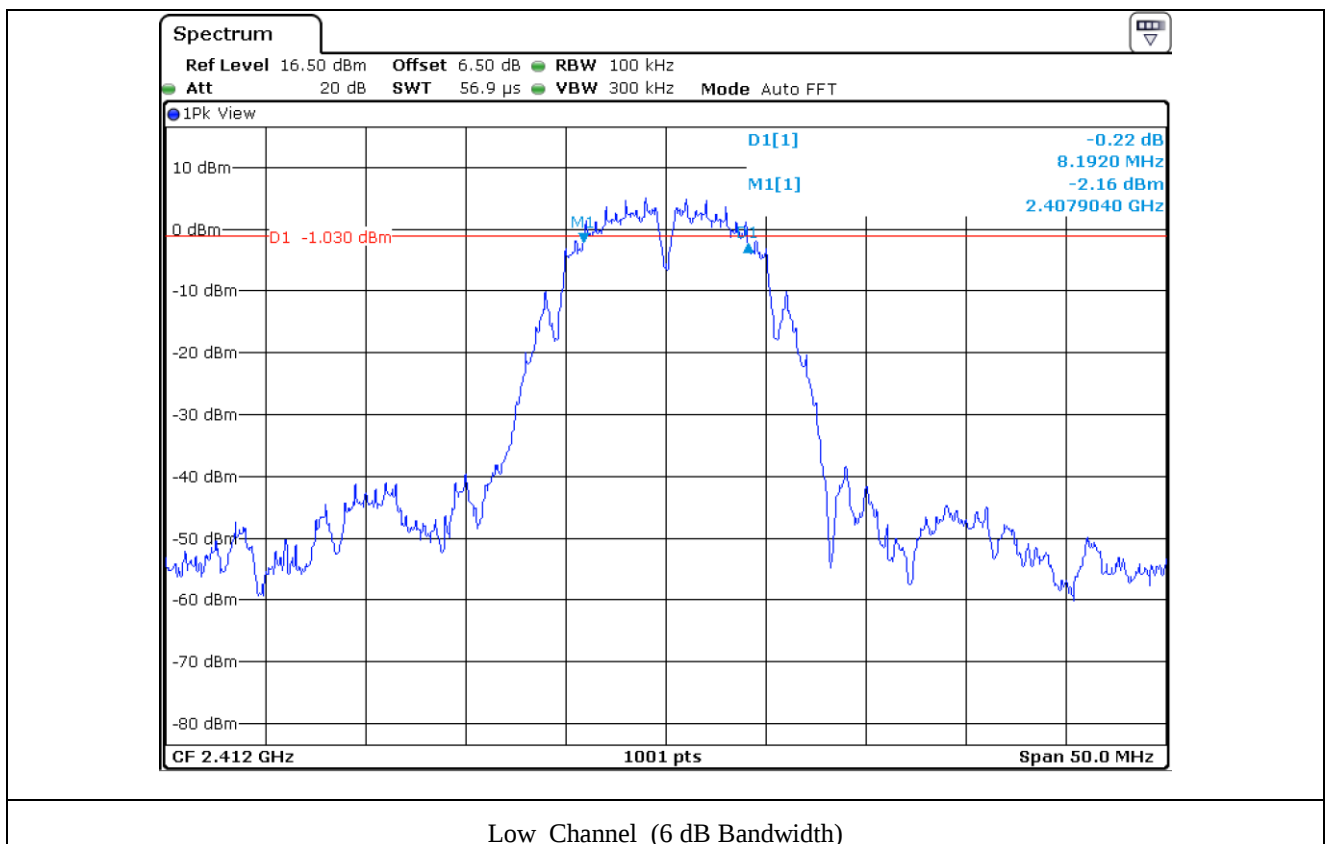
-. Test Result : Pass

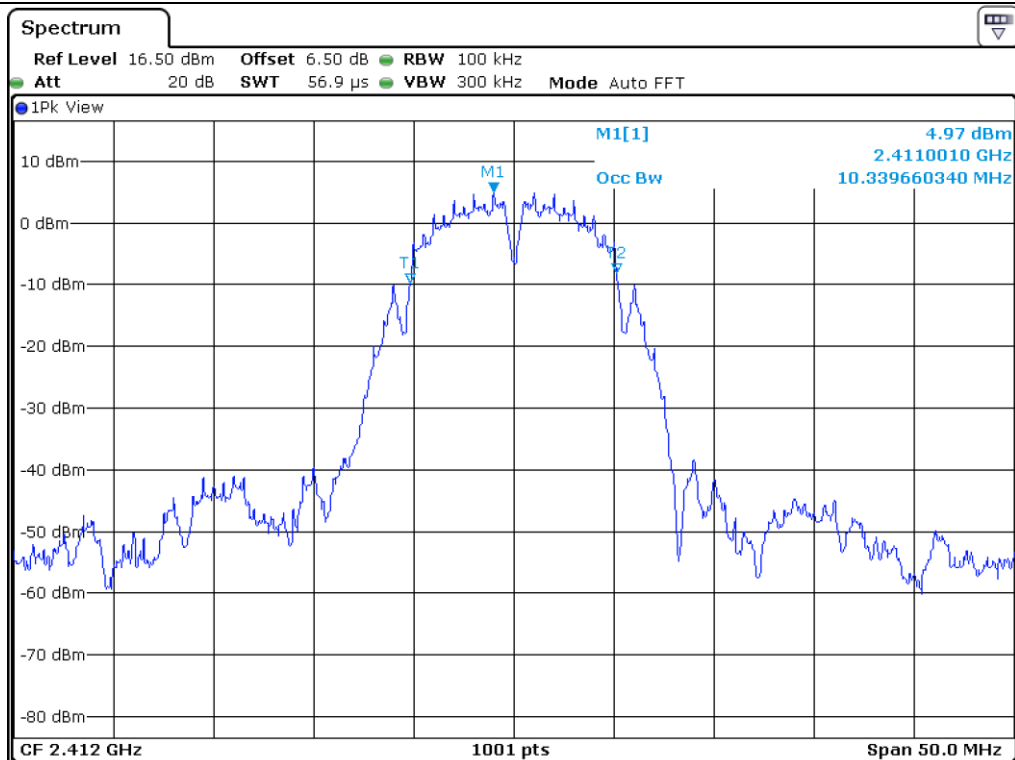
CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)	LIMIT (MHz)	Bandwidth Margin(MHz)	
					6 dB	99 %
Low	2 412.00	8.19	10.34	0.5	7.69	9.84
Middle	2 442.00	8.14	10.34	0.5	7.64	9.84
High	2 462.00	8.24	10.34	0.5	7.74	9.84

Remark. Margin = Measured Value - Limit

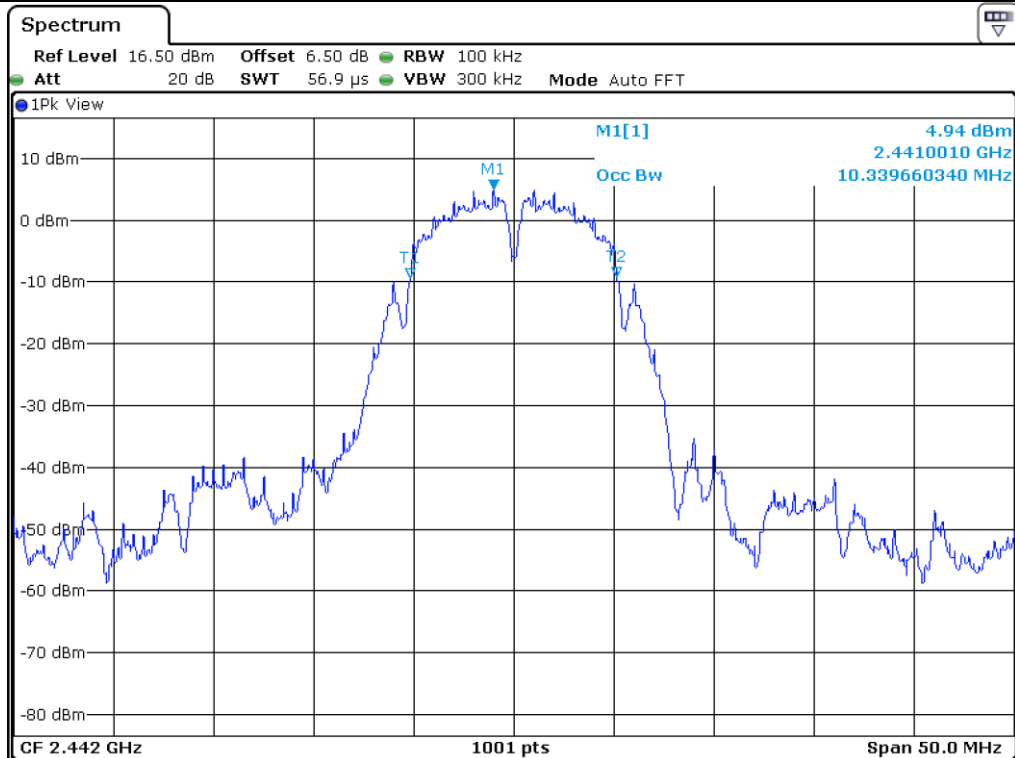


Tested by: Ha-Ram Lee / Assistant Manager

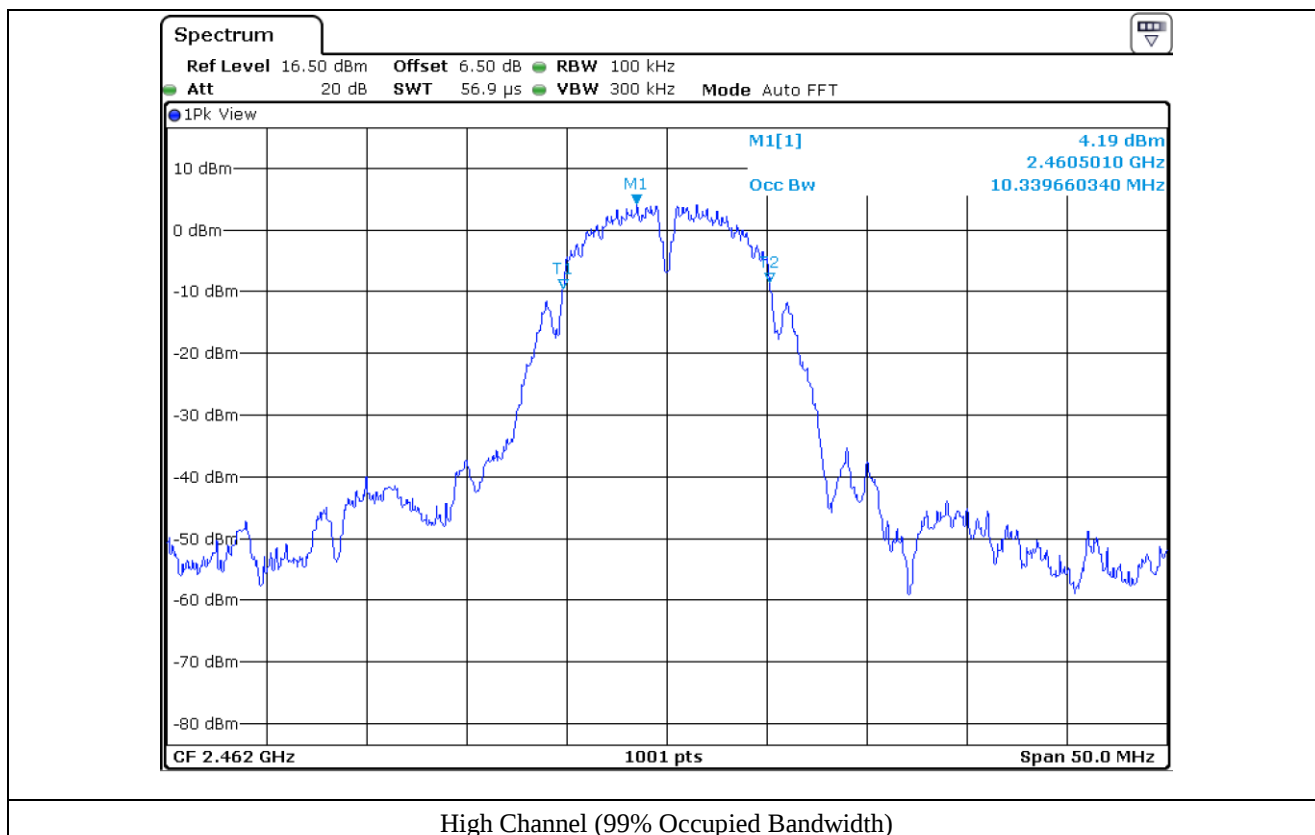




Low Channel (99% Occupied Bandwidth)



Middle Channel (99% Occupied Bandwidth)



7.5 Test data for 802.11g WLAN Mode

-. Test Date : February 23, 2019

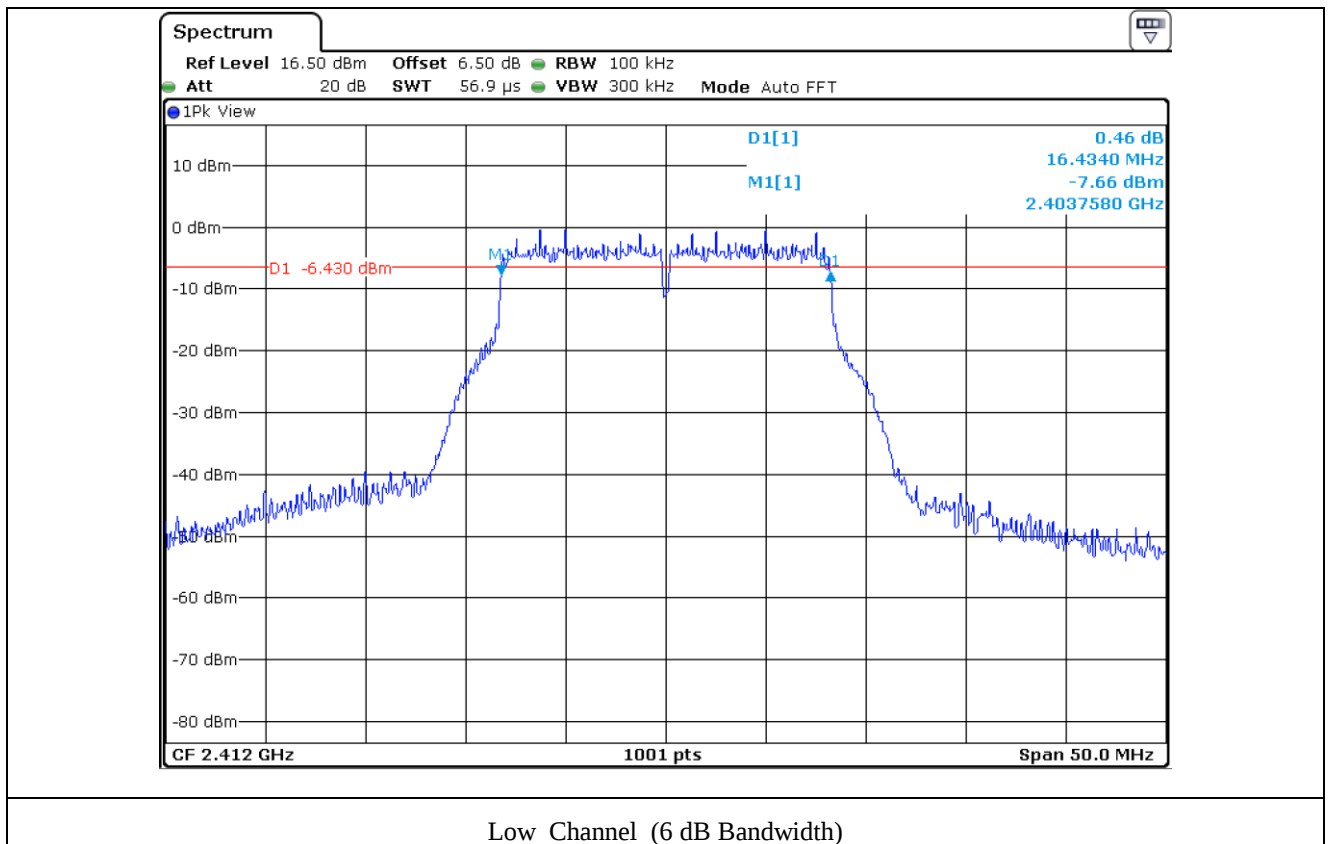
-. Test Result : Pass

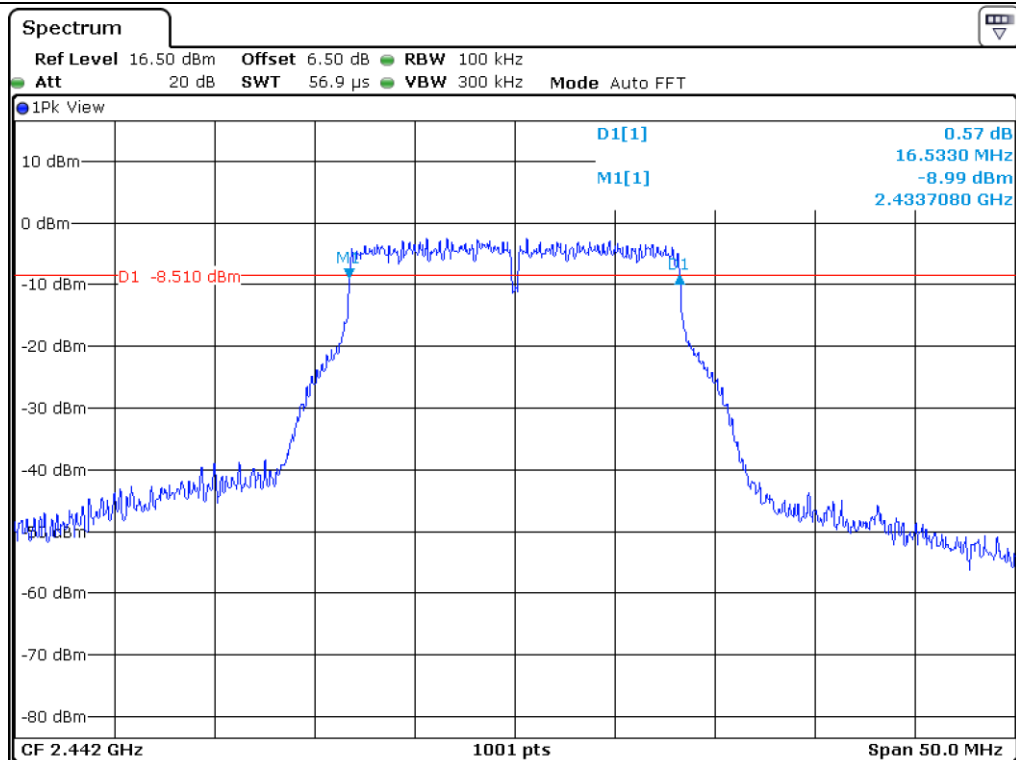
CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)	LIMIT (MHz)	Bandwidth Margin(MHz)	
					6 dB	99 %
Low	2 412.00	16.43	16.43	0.5	15.93	15.93
Middle	2 442.00	16.53	16.43	0.5	16.03	15.93
High	2 462.00	16.53	16.48	0.5	16.03	15.98

Remark. Margin = Measured Value - Limit

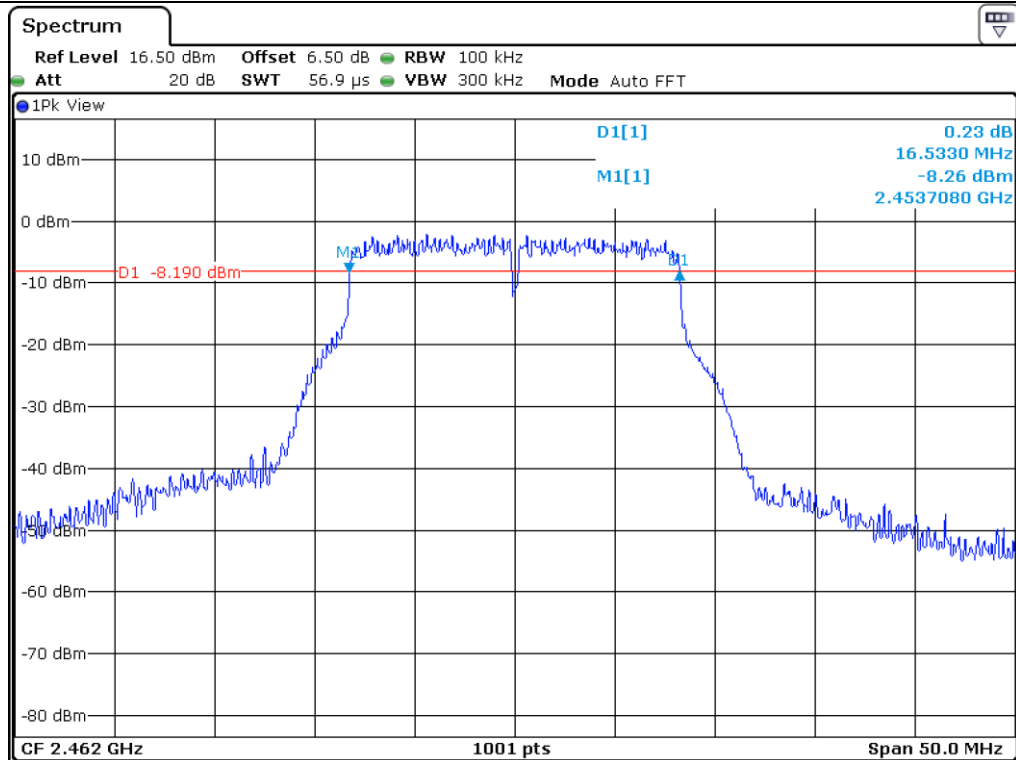


Tested by: Ha-Ram Lee / Assistant Manager

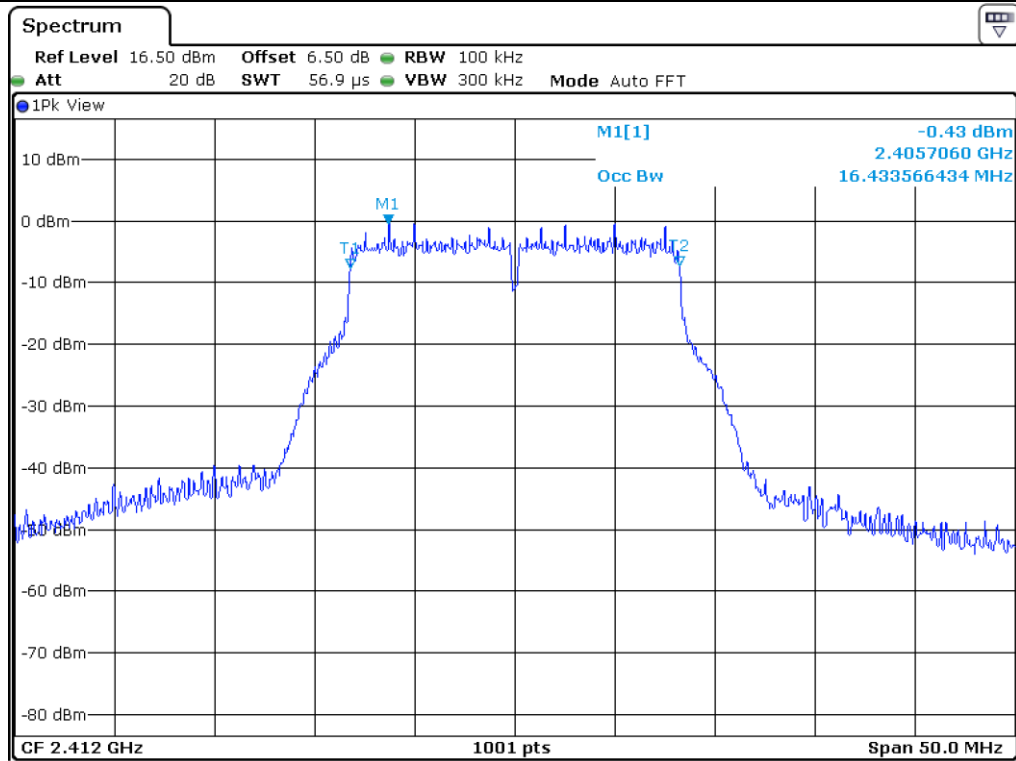




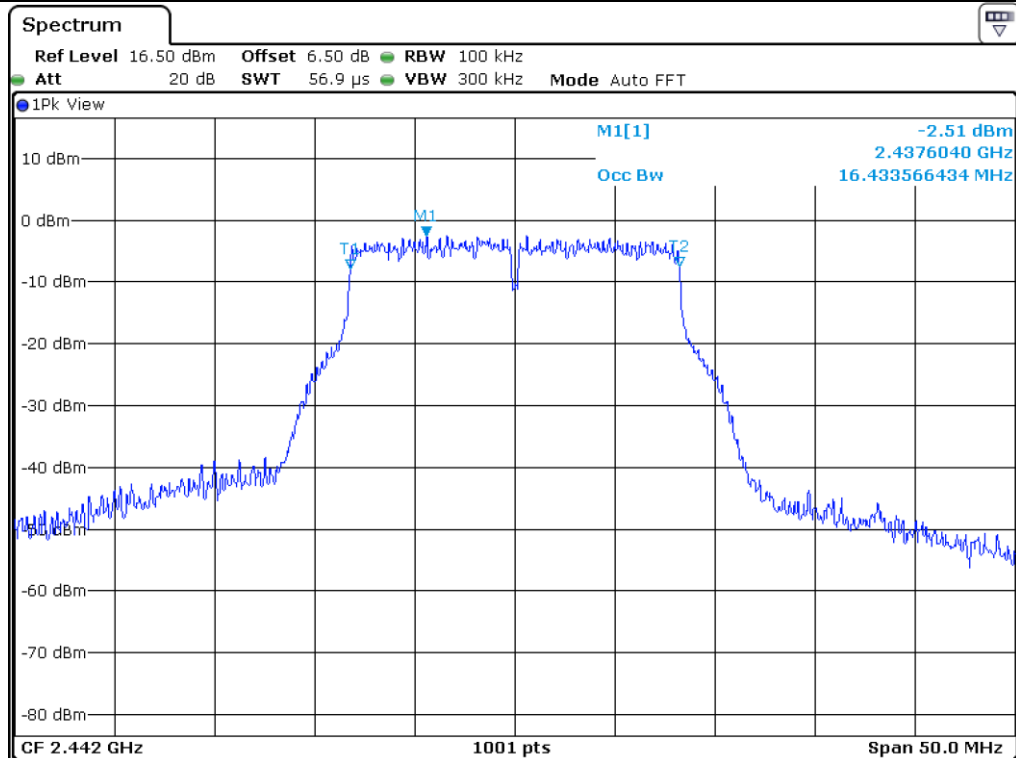
Middle Channel (6 dB Bandwidth)



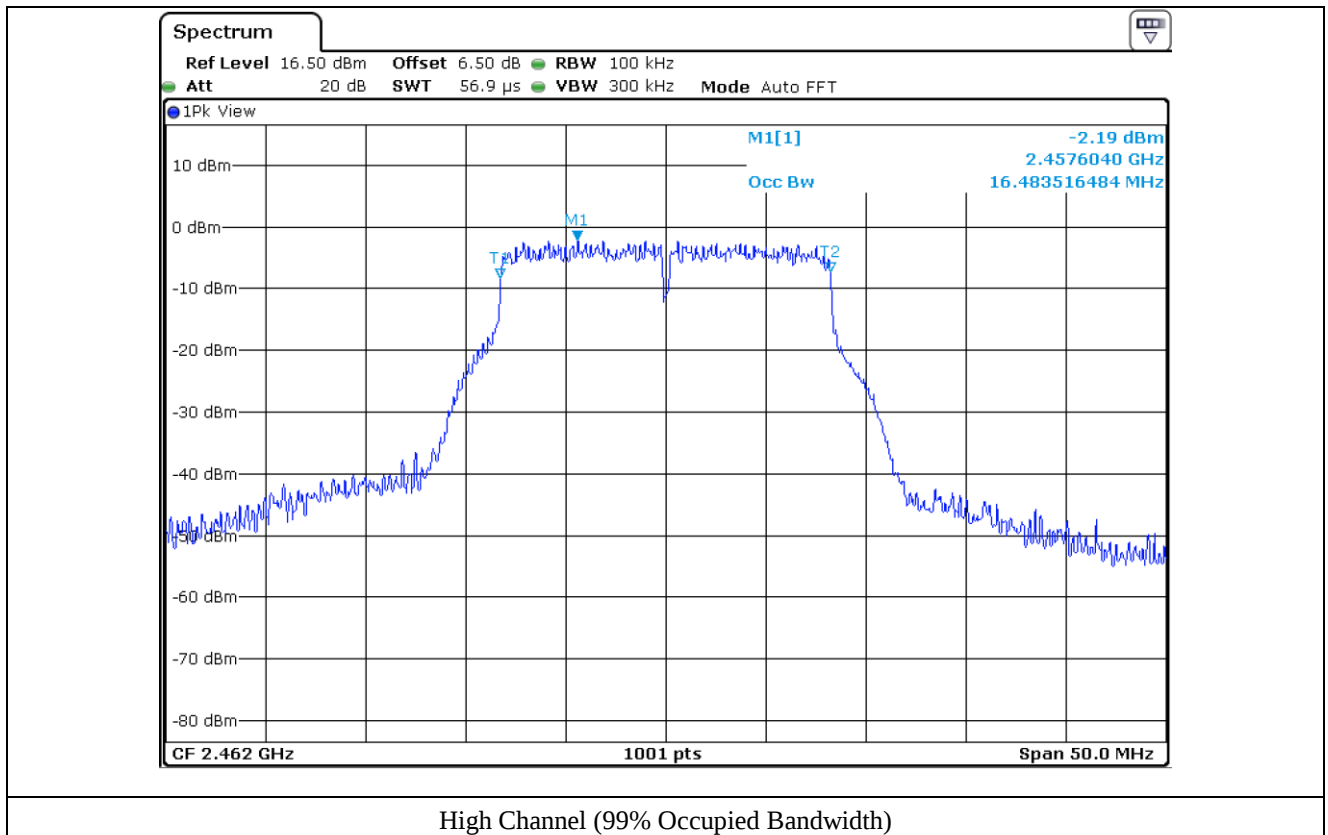
High Channel (6 dB Bandwidth)



Low Channel (99% Occupied Bandwidth)



Middle Channel (99% Occupied Bandwidth)



7.6 Test data for 802.11n (HT 20) WLAN Mode

-. Test Date : February 23, 2019

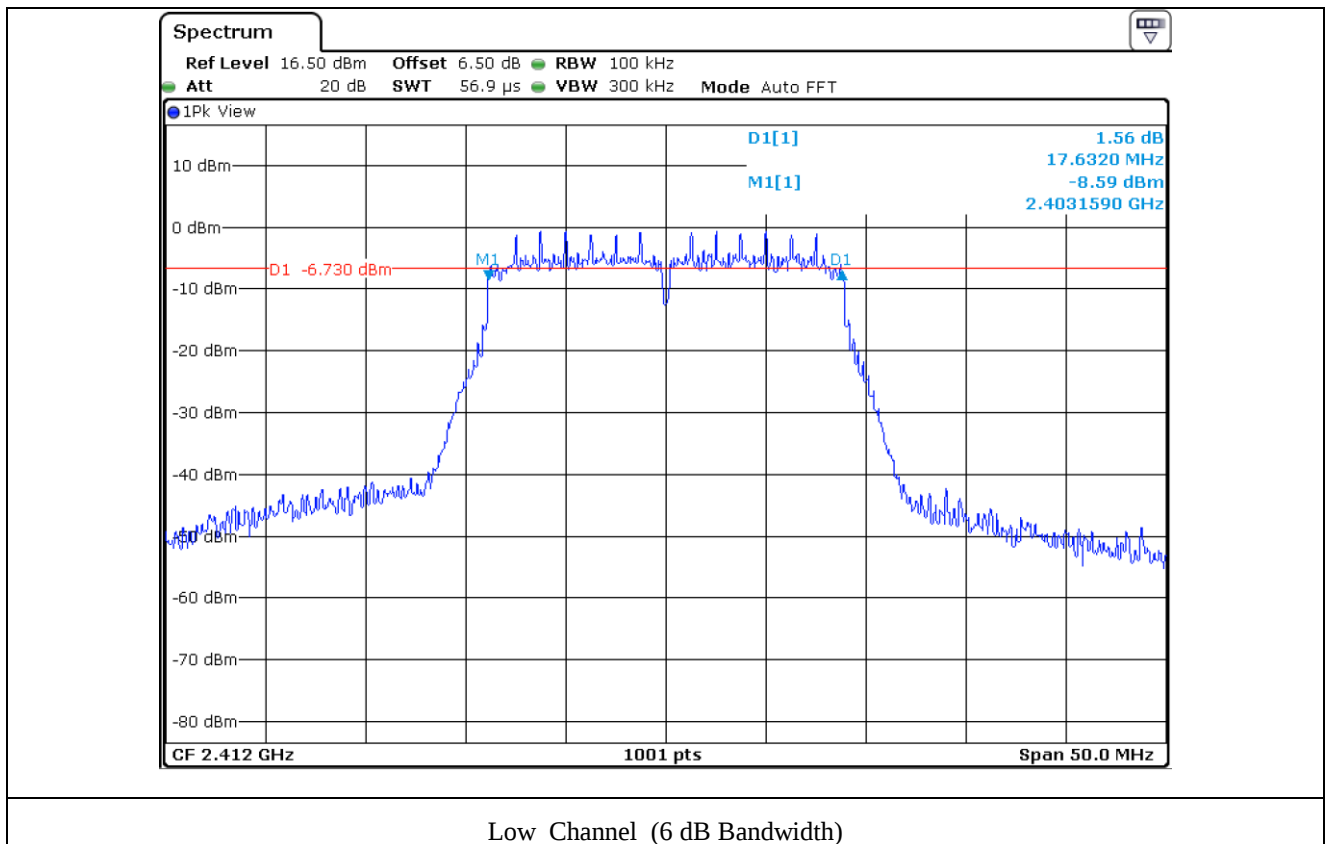
-. Test Result : Pass

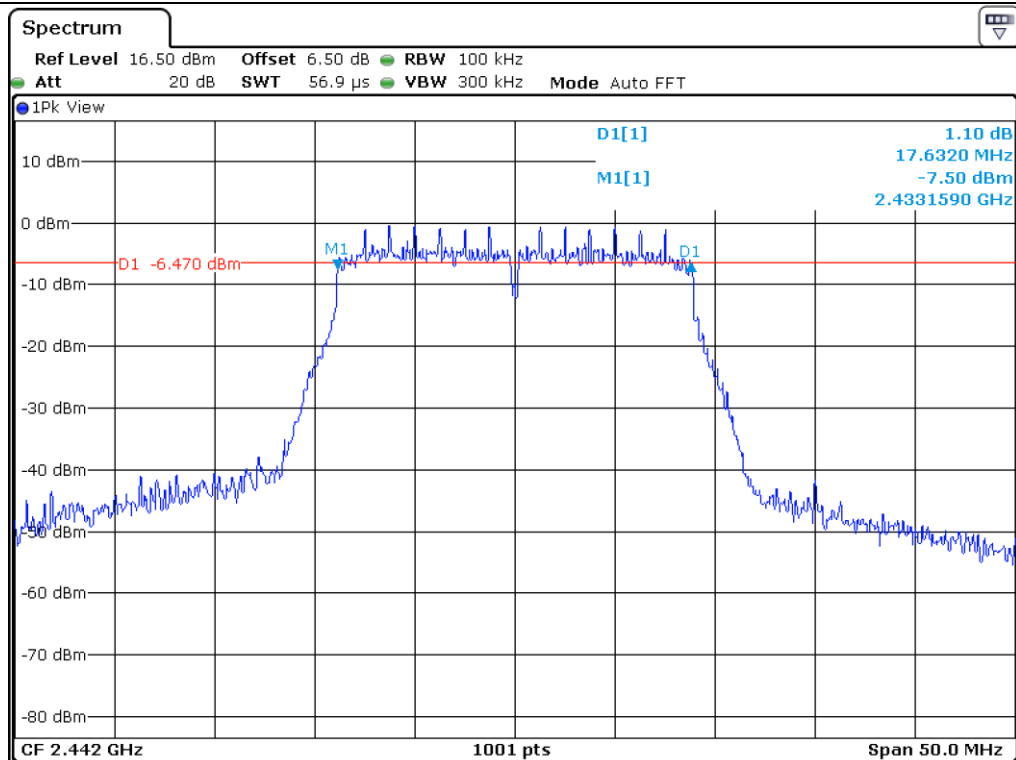
CHANNEL	FREQUENCY (MHz)	6 dB Bandwidth (MHz)	99 % Occupied Bandwidth (MHz)	LIMIT (MHz)	Bandwidth Margin(MHz)	
					6 dB	99 %
Low	2 412.00	17.63	17.68	0.5	17.13	17.18
Middle	2 442.00	17.63	17.68	0.5	17.13	17.18
High	2 462.00	17.63	17.63	0.5	17.13	17.13

Remark. Margin = Measured Value - Limit

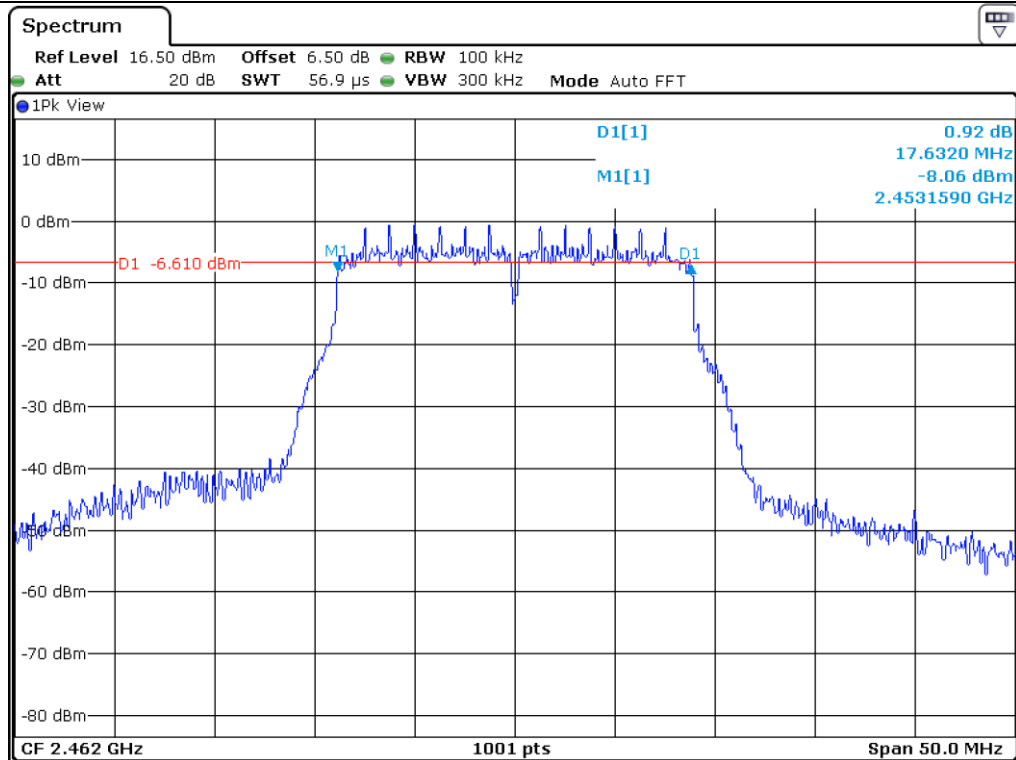


Tested by: Ha-Ram Lee / Assistant Manager

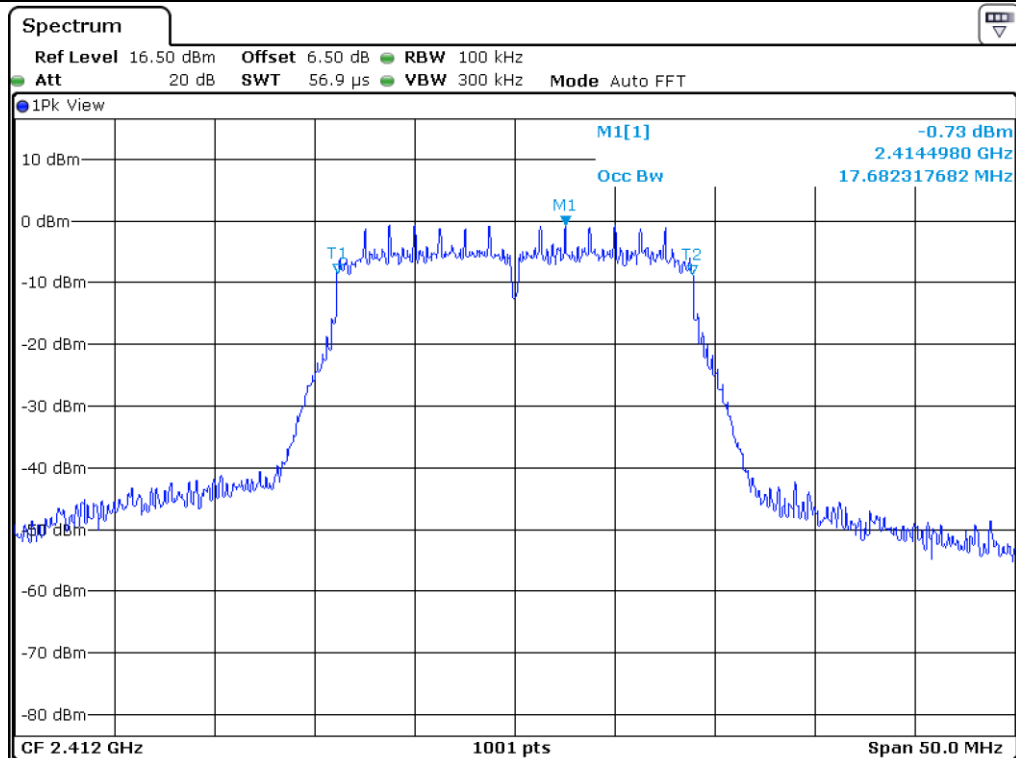




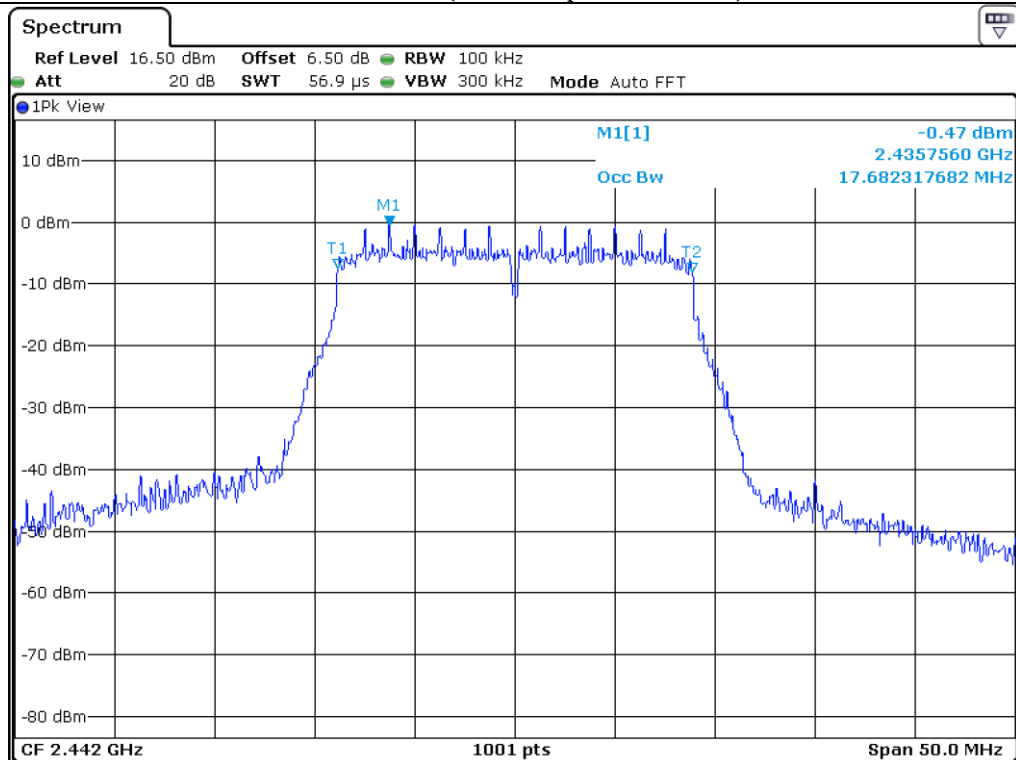
Middle Channel (6 dB Bandwidth)



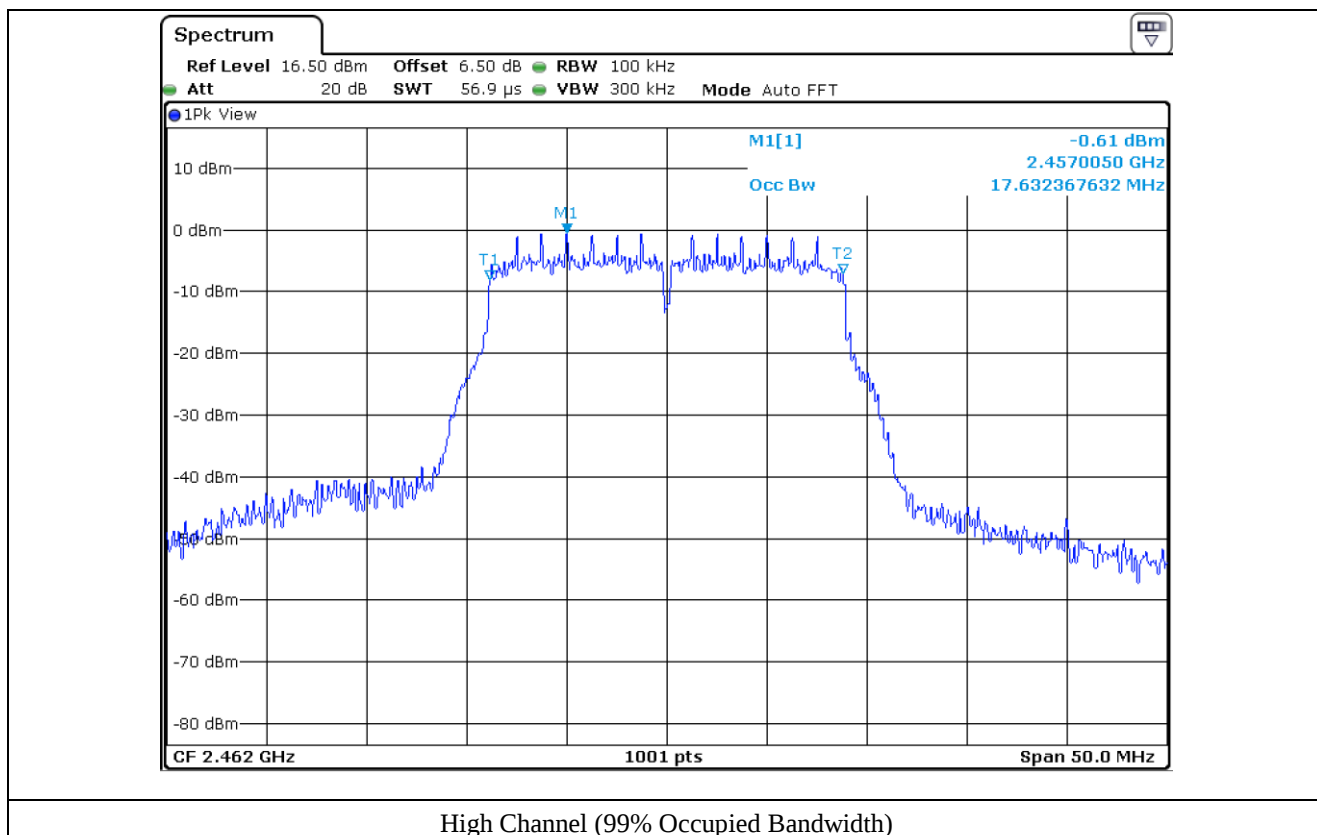
High Channel (6 dB Bandwidth)



Low Channel (99% Occupied Bandwidth)



Middle Channel (99% Occupied Bandwidth)



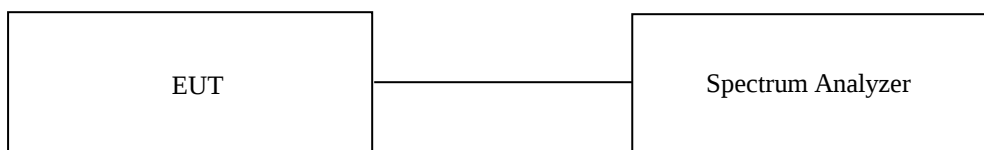
8. MAXIMUM PEAK OUTPUT POWER

8.1 Operating environment

Temperature : 24 °C
Relative humidity : 45 % 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	Rohde & Schwarz	Signal Analyzer	101200	Aug. 23, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

8.4 Test data for 802.11b WLAN Mode

-. Test Date : February 23, 2019

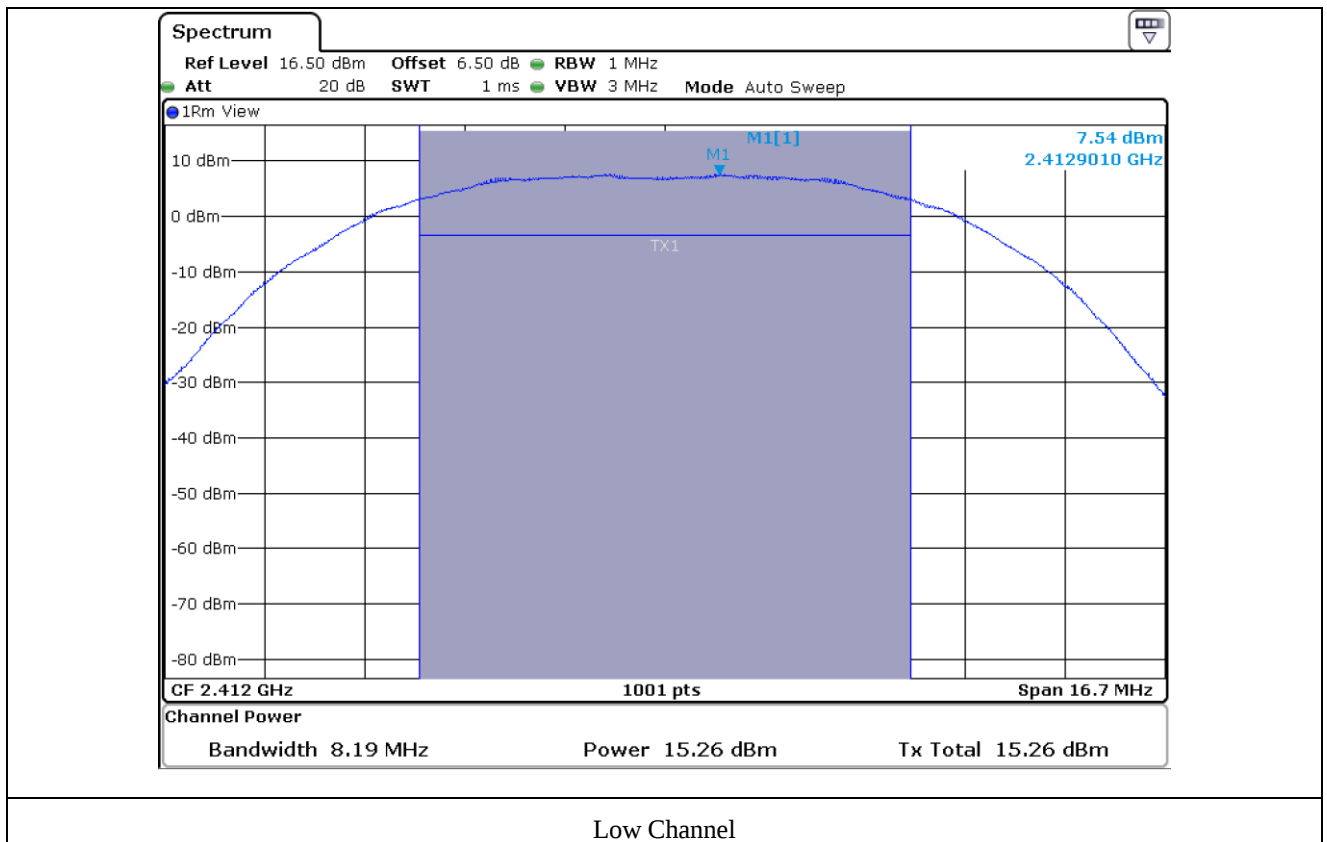
-. Test Result : Pass

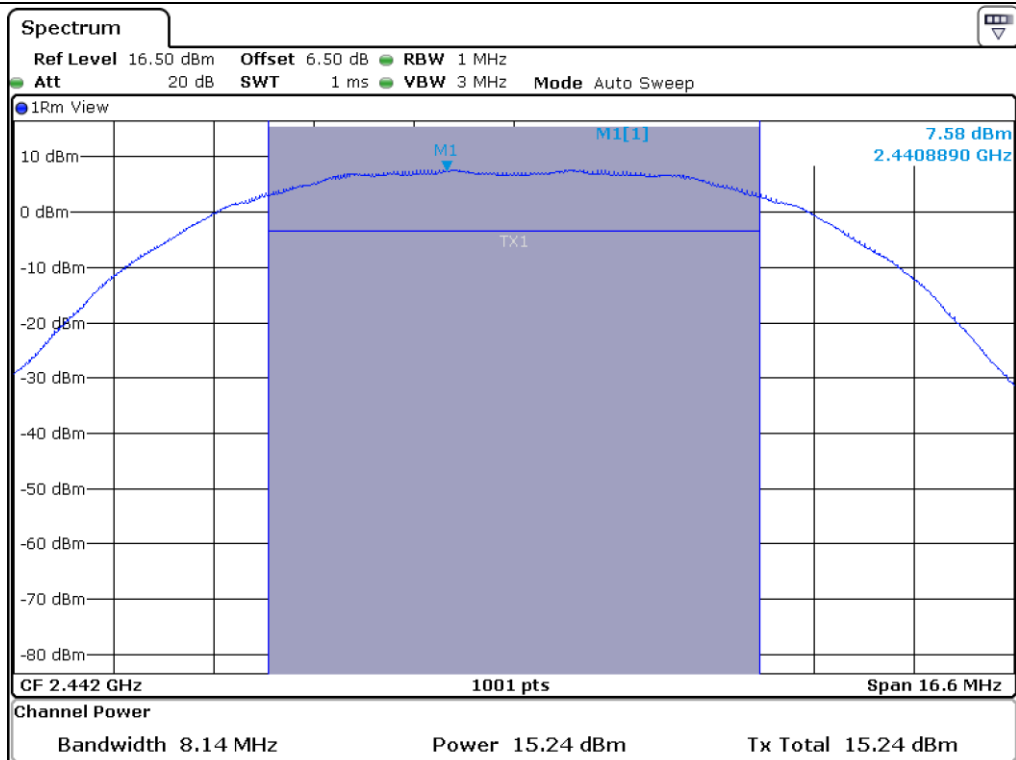
CHANNEL	FREQUENCY (MHz)	6 dB bandwidth (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	8.19	15.26	30.00	14.74
MIDDLE	2 442.00	8.14	15.24	30.00	14.76
HIGH	2 462.00	8.24	15.43	30.00	14.57

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

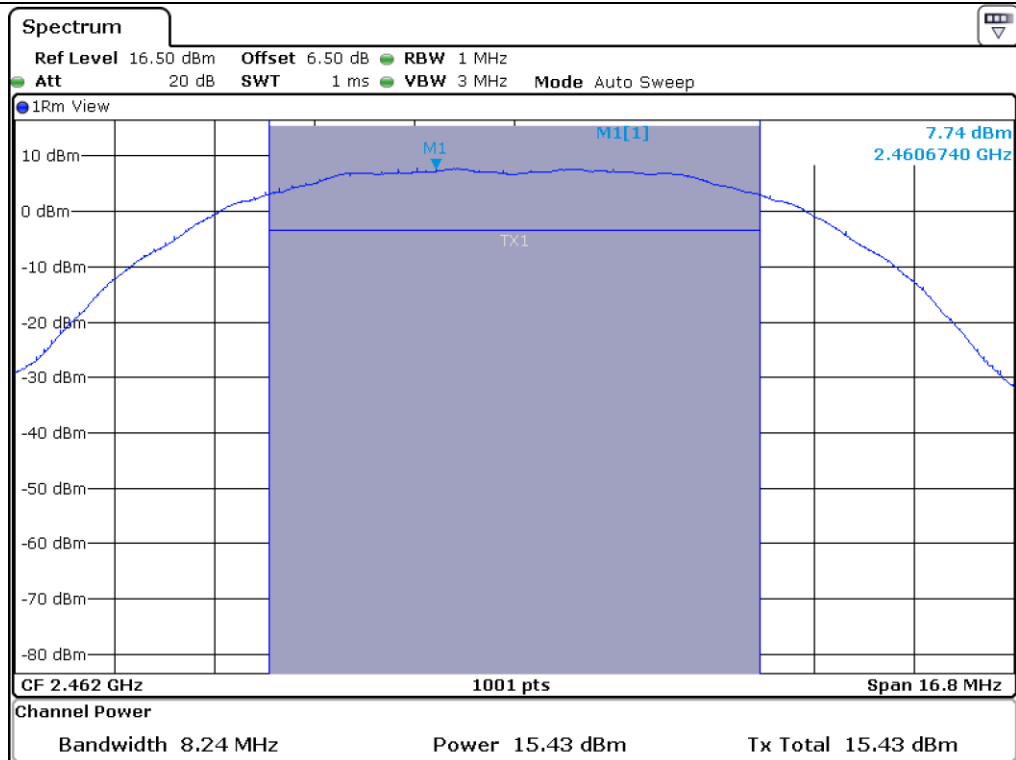


Tested by: Ha-Ram Lee / Assistant Manager





Middle Channel



High Channel

8.5 Test data for 802.11g WLAN Mode

-. Test Date : February 23, 2019

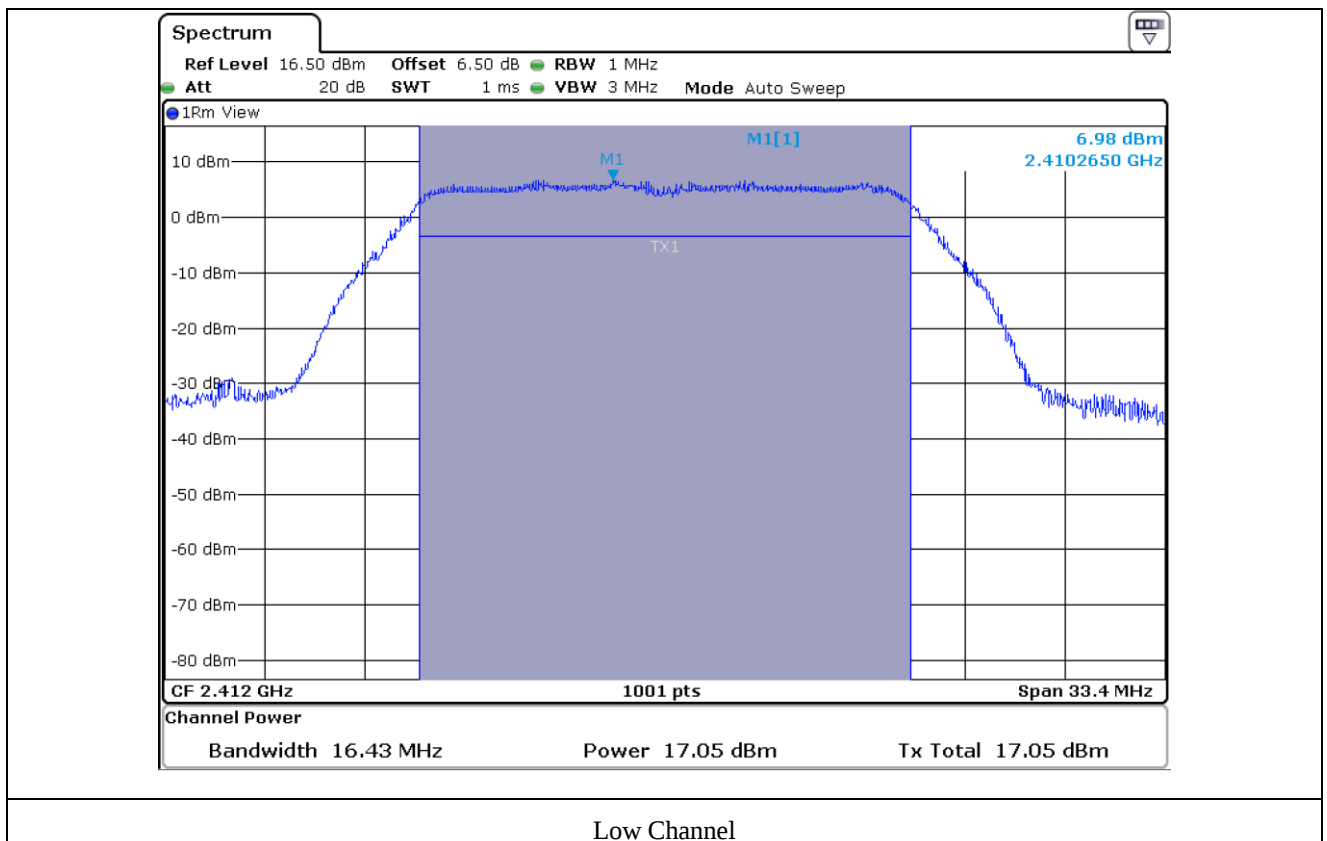
-. Test Result : Pass

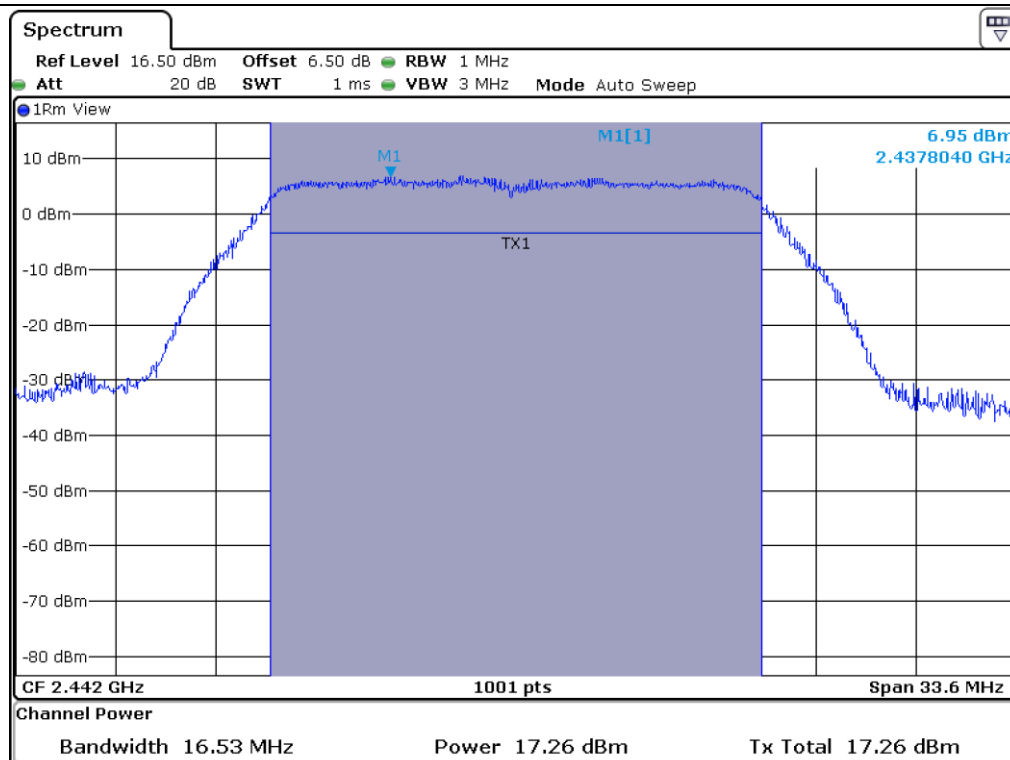
CHANNEL	FREQUENCY (MHz)	6 dB bandwidth (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	16.43	17.05	30.00	12.95
MIDDLE	2 442.00	16.53	17.26	30.00	12.74
HIGH	2 462.00	16.53	17.20	30.00	12.80

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

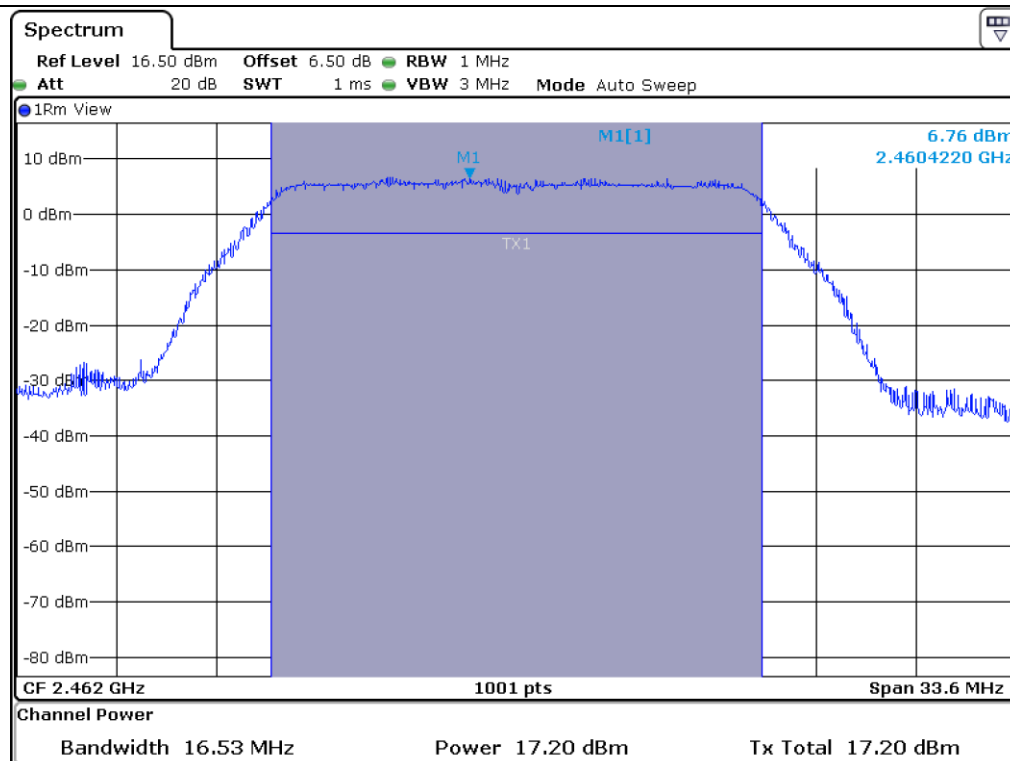


Tested by: Ha-Ram Lee / Assistant Manager





Middle Channel



High Channel

8.6 Test data for 802.11n(HT20) WLAN Mode

-. Test Date : February 23, 2019

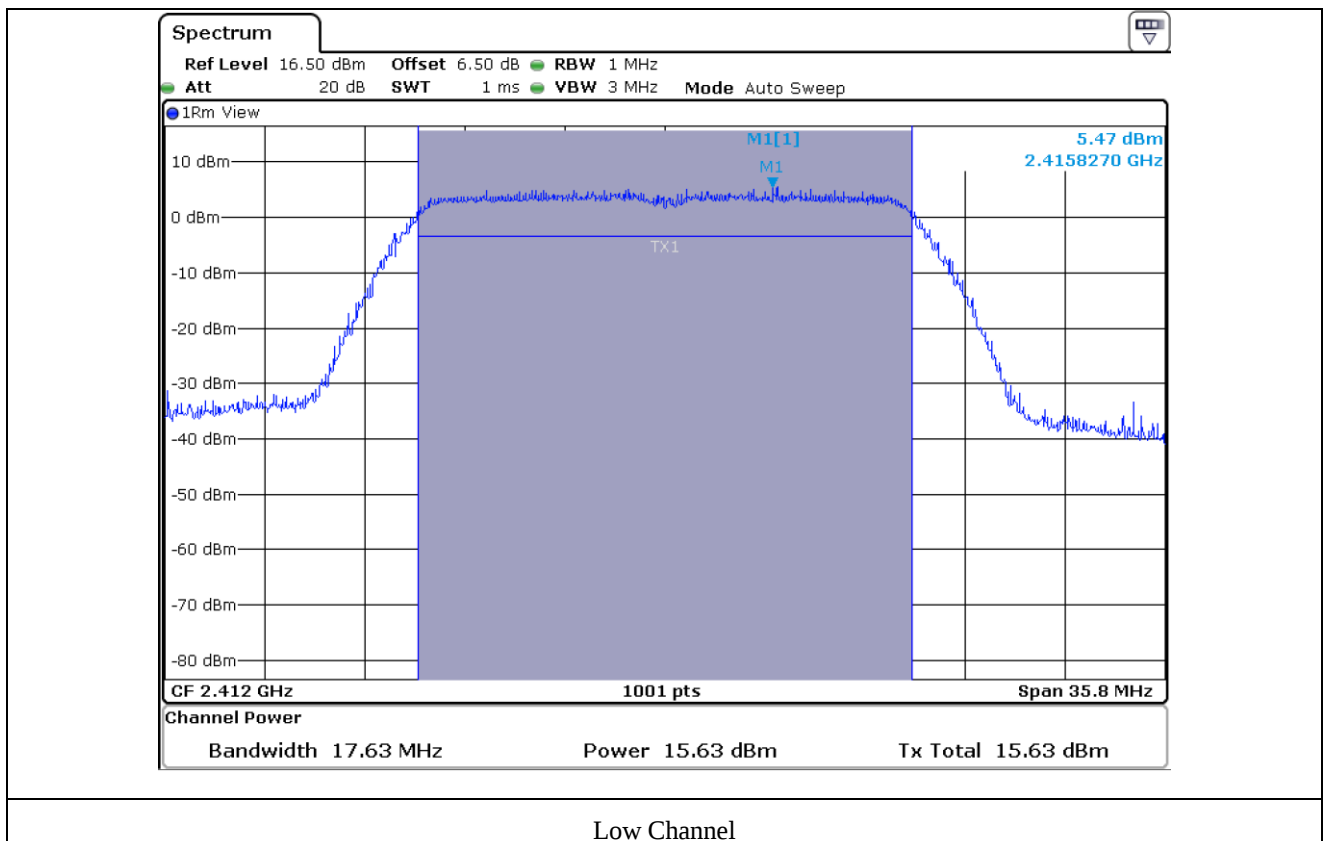
-. Test Result : Pass

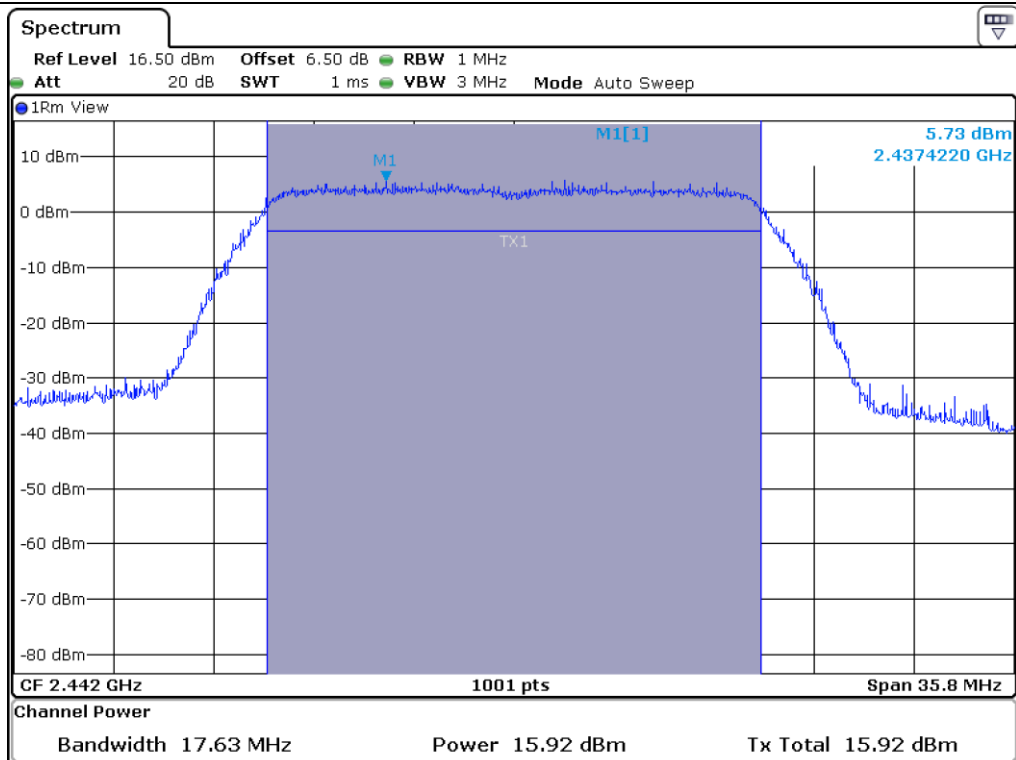
CHANNEL	FREQUENCY (MHz)	6 dB bandwidth (MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
LOW	2 412.00	17.63	15.63	30.00	14.37
MIDDLE	2 442.00	17.63	15.92	30.00	14.08
HIGH	2 462.00	17.63	15.97	30.00	14.03

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

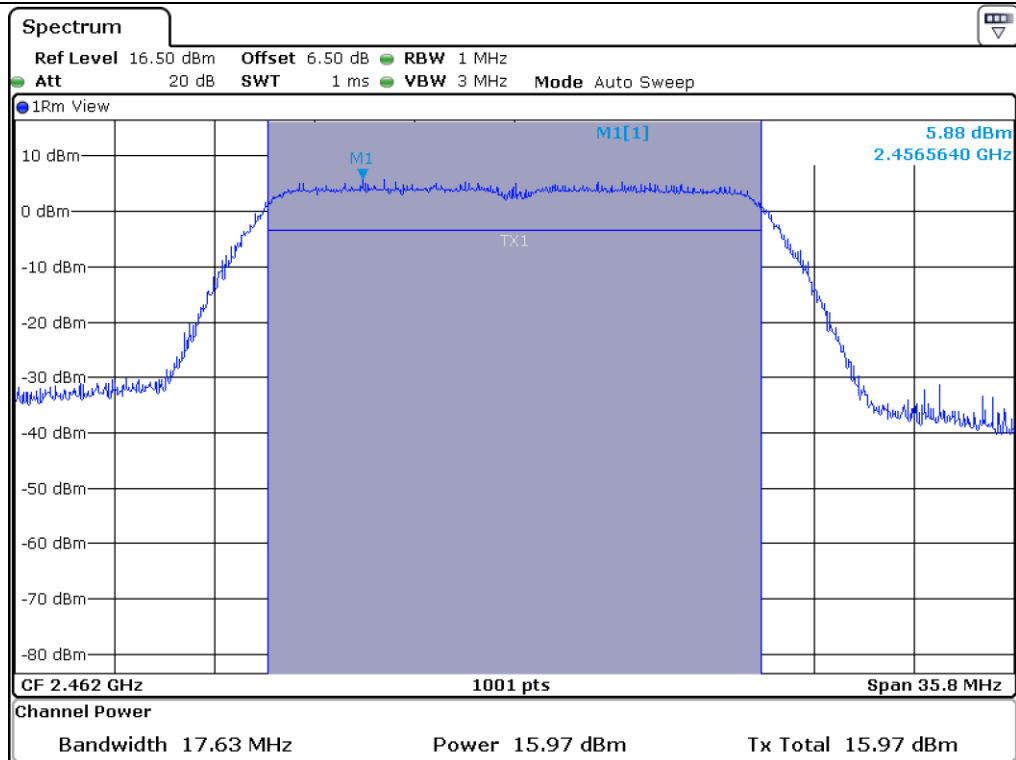


Tested by: Ha-Ram Lee / Assistant Manager





Middle Channel



High Channel

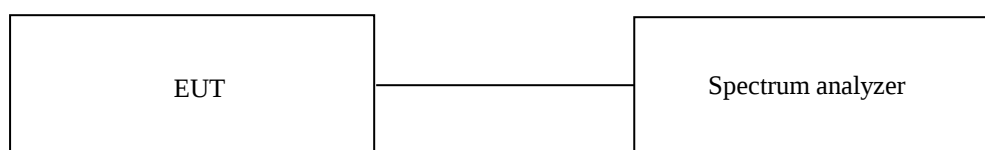
9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

9.1 Operating environment

Temperature : 24 °C
Relative humidity : 52 % 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 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.

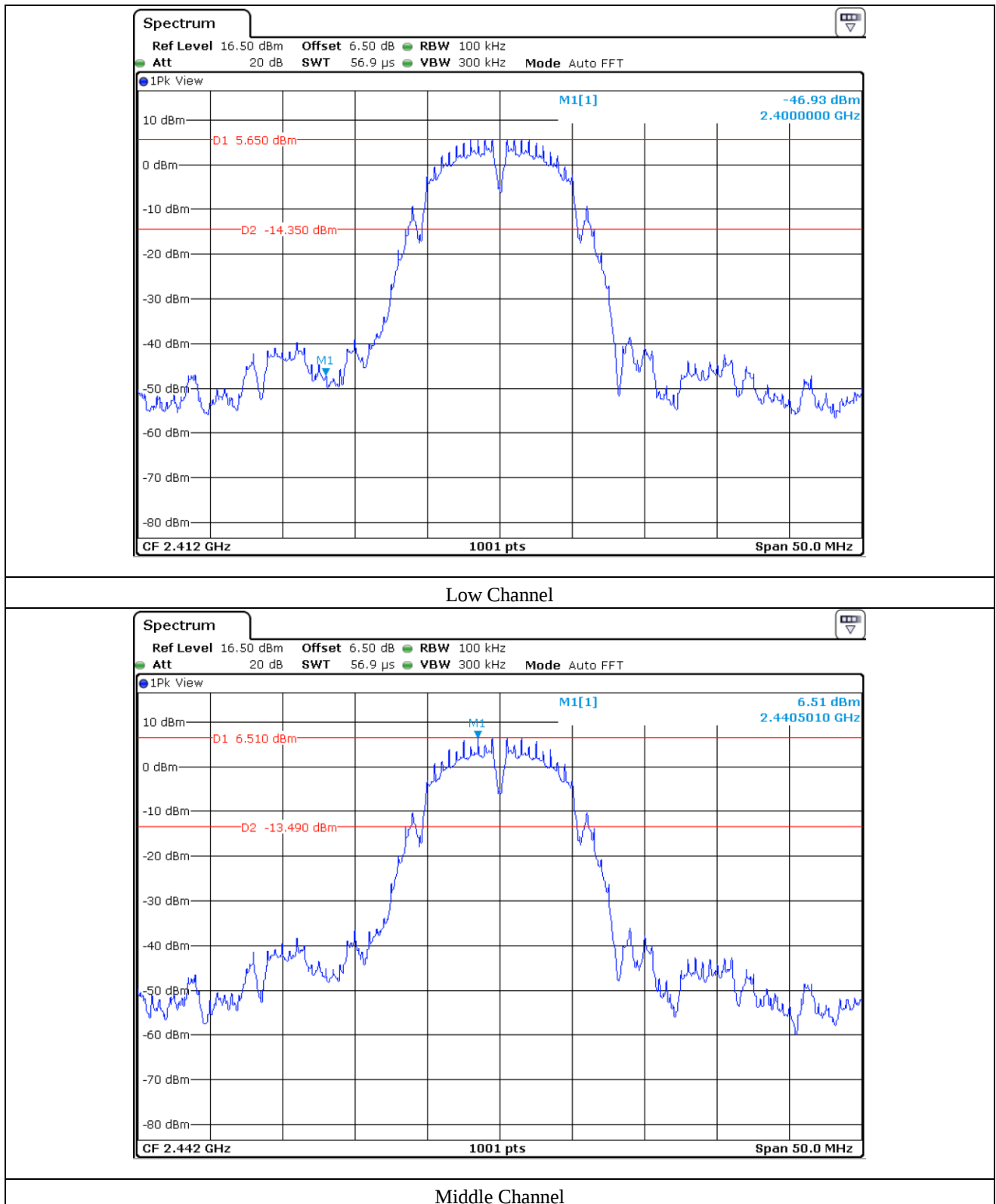
9.4 Test equipment used

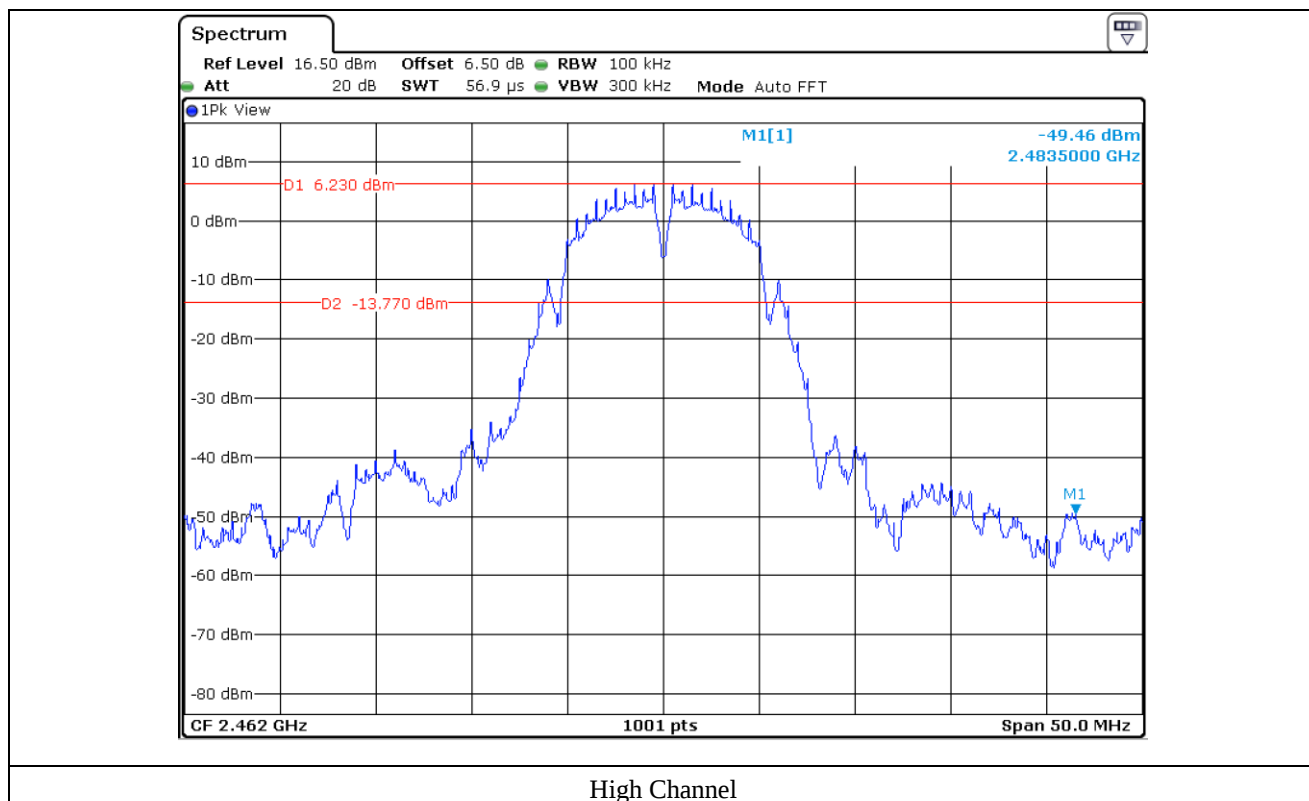
	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
□ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Oct. 22, 2018 (1Y)
■ -	ESR	Rohde & Schwarz	EMI Test Receiver	101470	Oct. 22, 2018 (1Y)
□ -	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Aug. 23, 2018 (1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Mar. 18, 2019 (1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Aug. 23, 2018 (1Y)
■ -	SCU-18	Rohde & Schwarz	Pre-Amplifier	102266	Aug. 24, 2018 (1Y)
■ -	MA-4000XPET	Innco Systems GmbH	Antenna Master	MA4000/509	N/A
□ -	HD100	HD GmbH	Position Controller	N/A	N/A
■ -	DT3000-3t	Innco Systems GmbH	Turn Table	N/A	N/A
□ -	FMZB 1513	Schwarzbeck	LOOP ANTENNA	1513-235	May. 13, 2018 (2Y)
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-419	Aug. 09, 2018 (2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 16, 2017 (2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA91700179	Jul. 28, 2017 (2Y)
■ -	BBV 9718 B	Schwarzbeck	Broadband Preamplifier	009	Mar. 11, 2019(1Y)

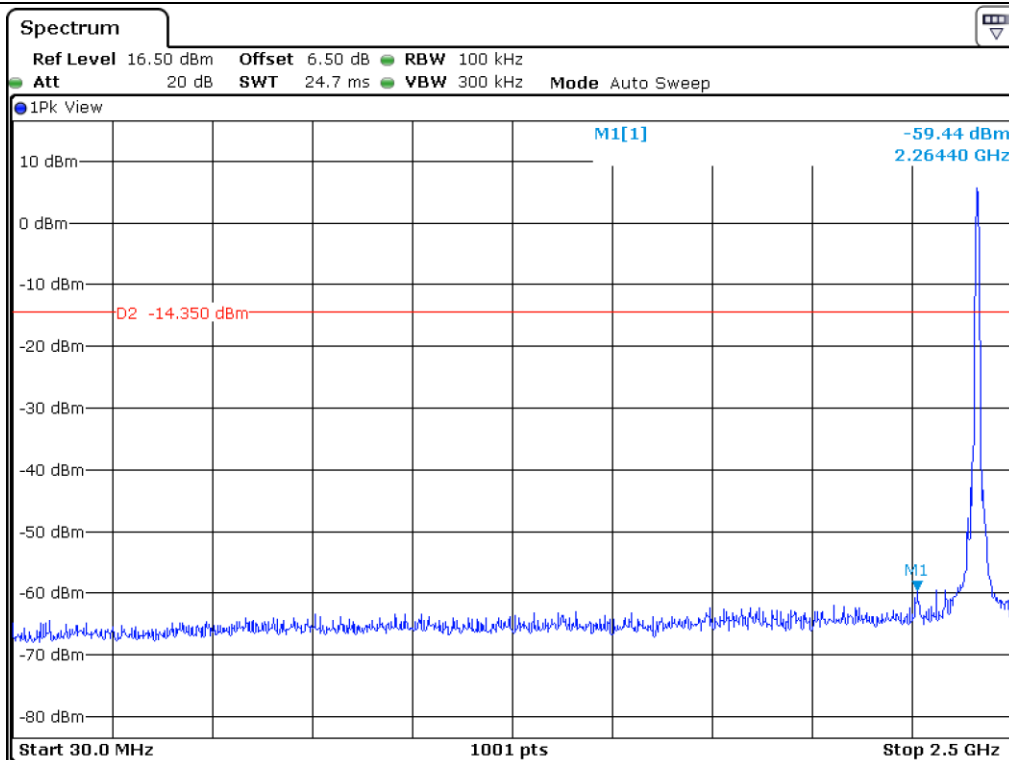
All test equipment used is calibrated on a regular basis.

9.5 Test data for conducted emission

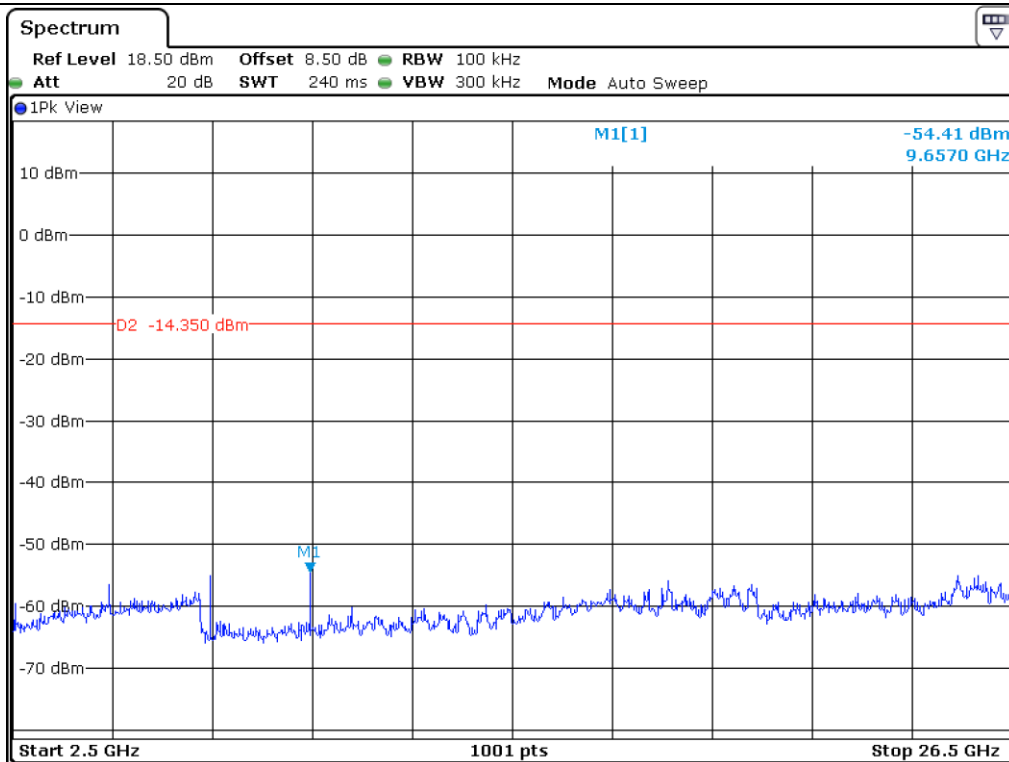
9.5.1 Test data for 802.11b WLAN Mode



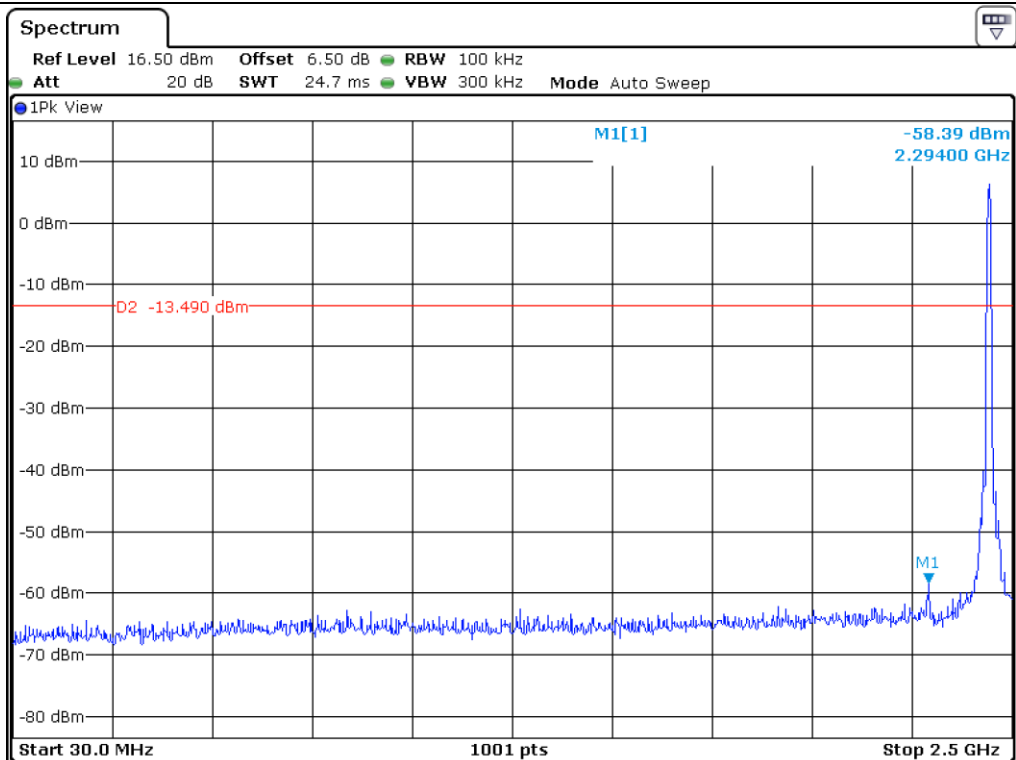




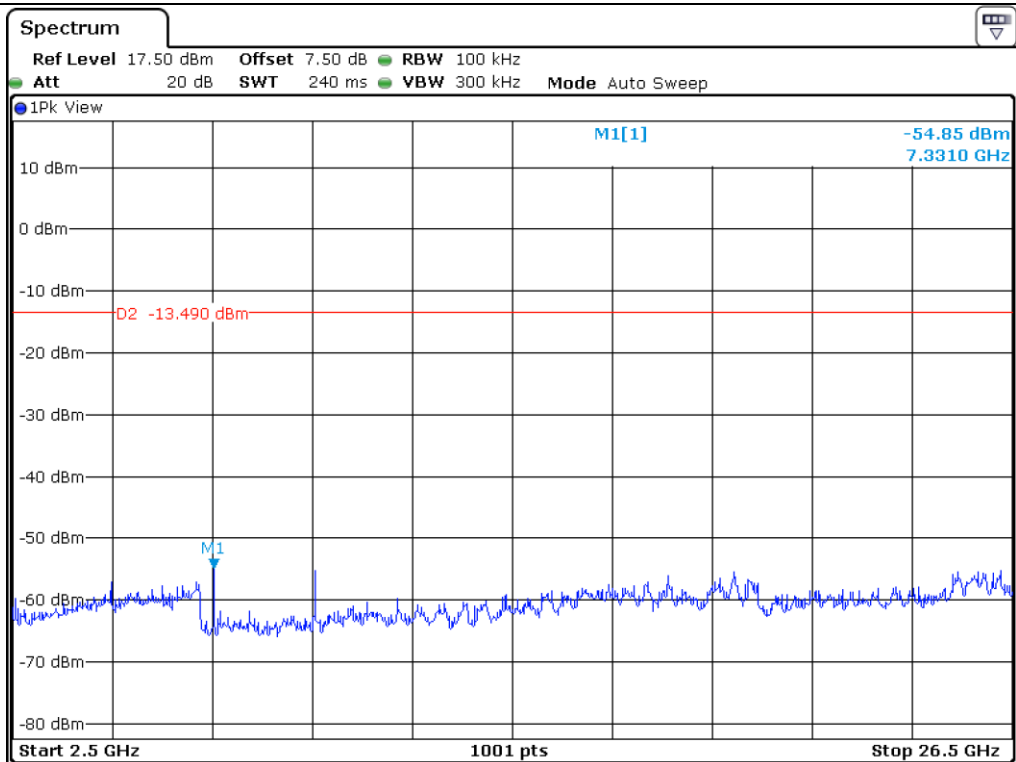
Low Channel



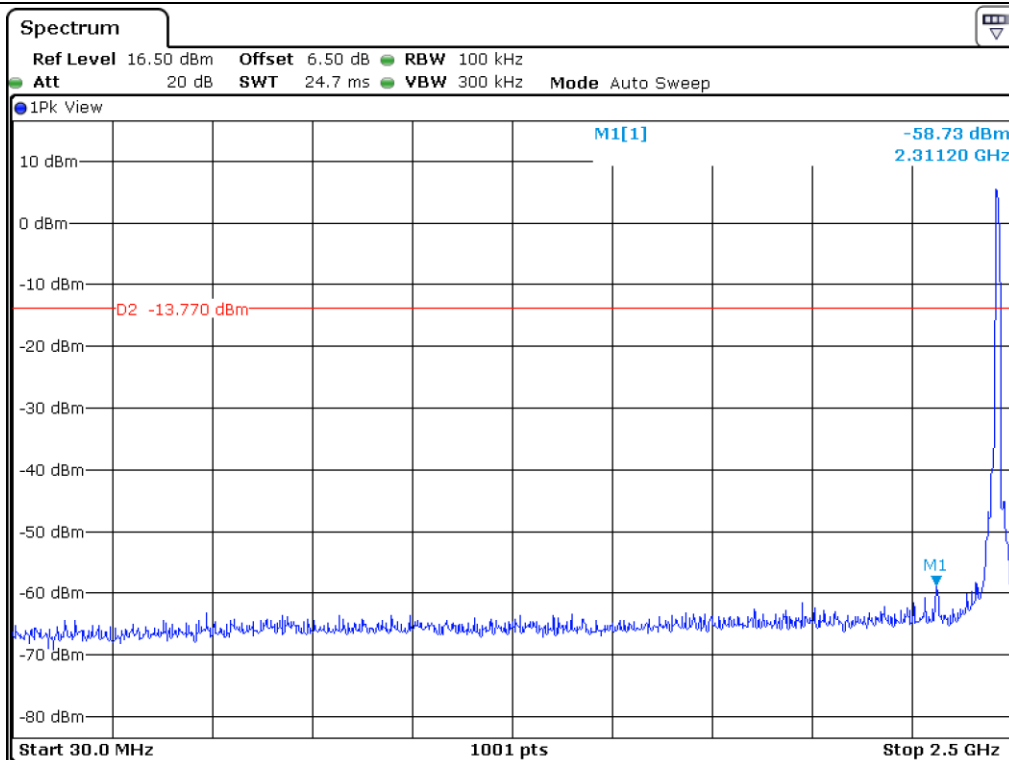
Low Channel



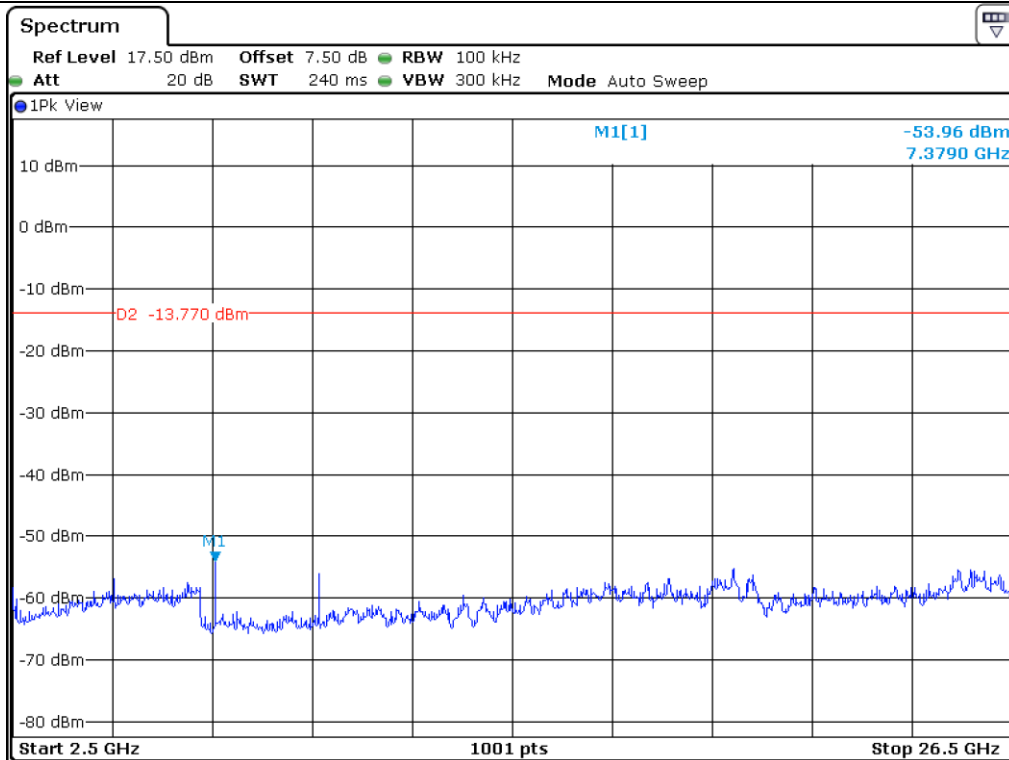
Middle Channel



Middle Channel

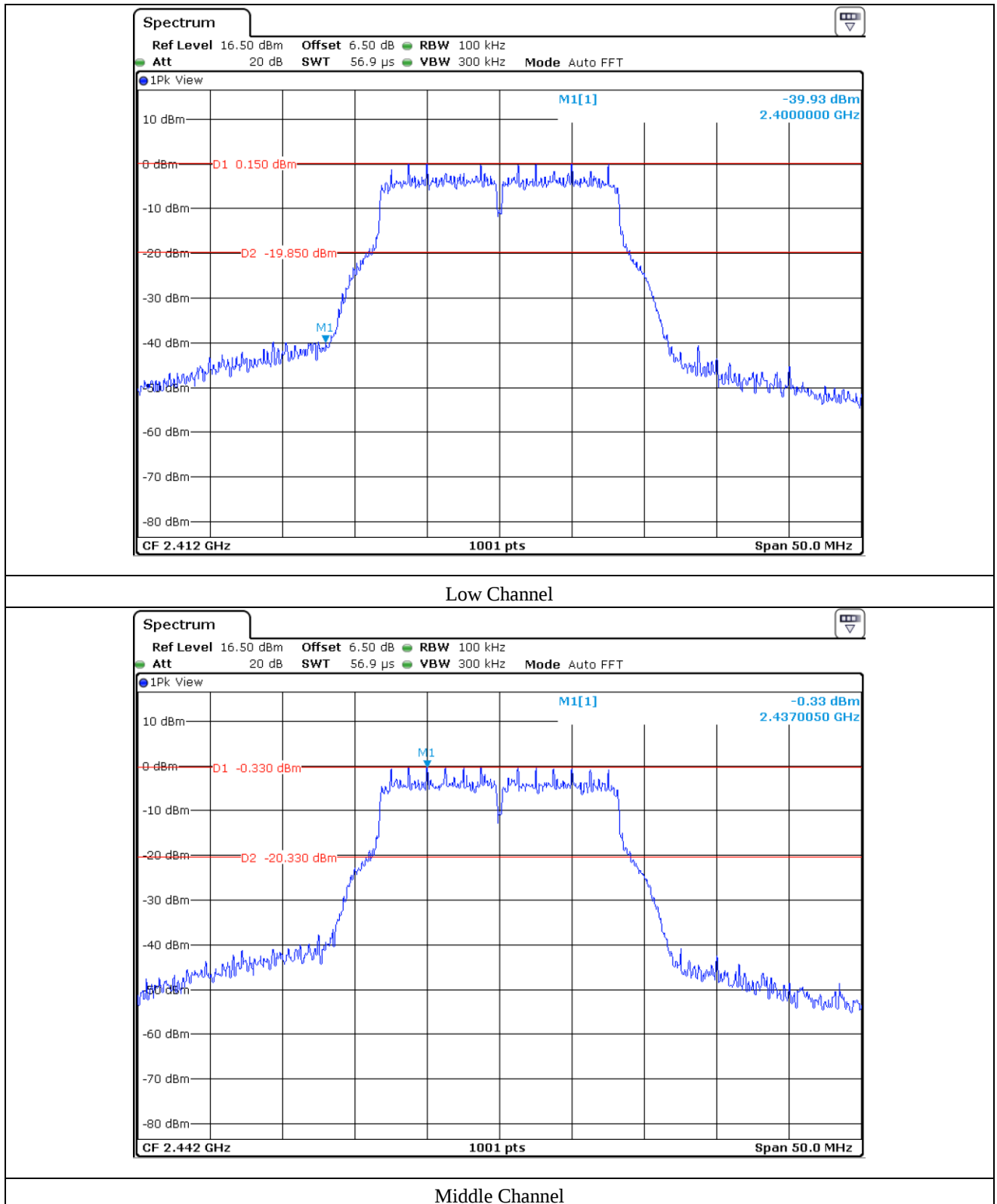


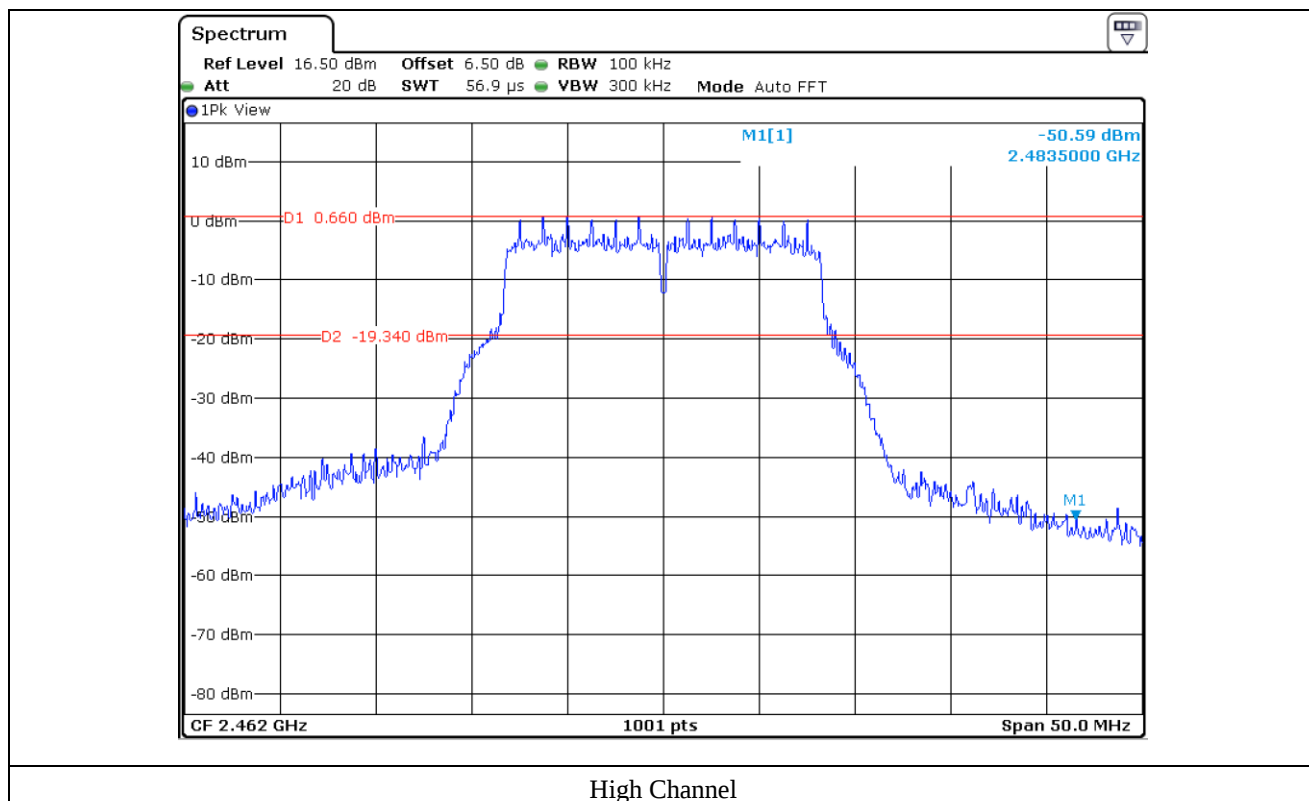
High Channel

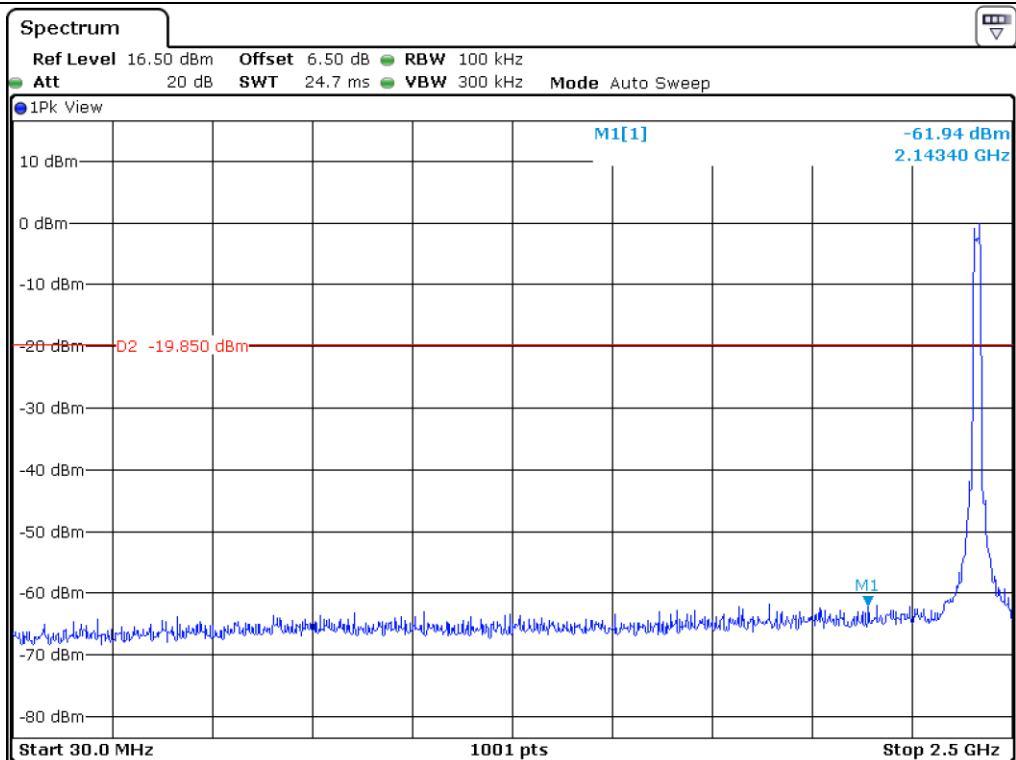


High Channel

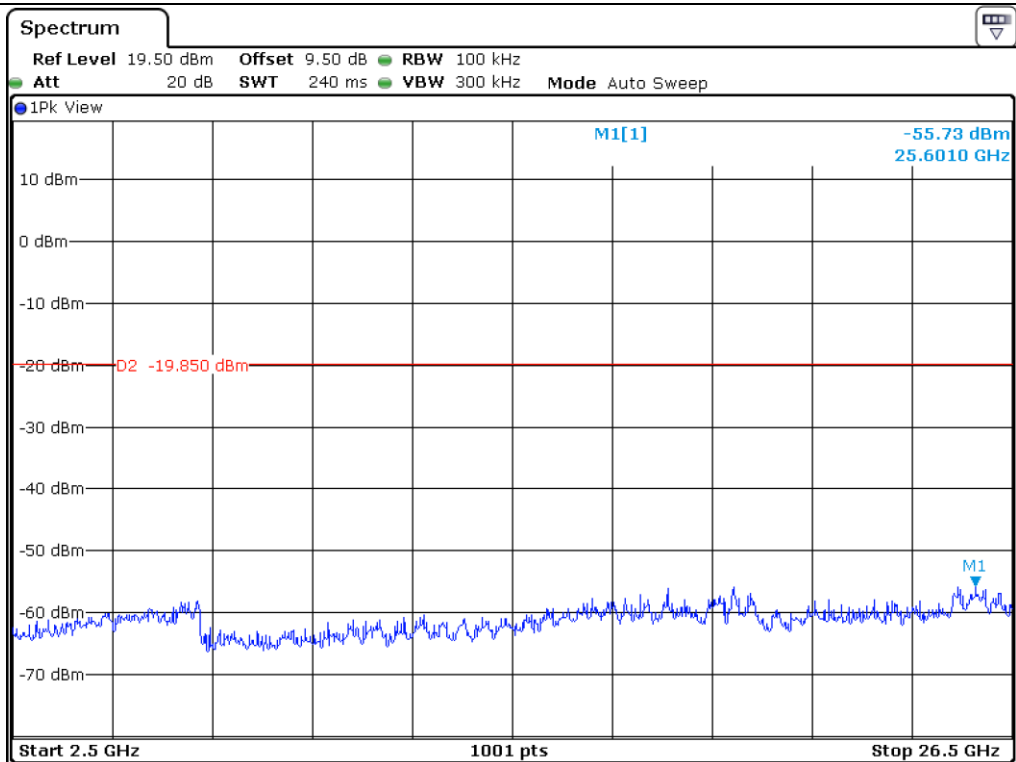
9.5.2 Test data for 802.11g WLAN Mode



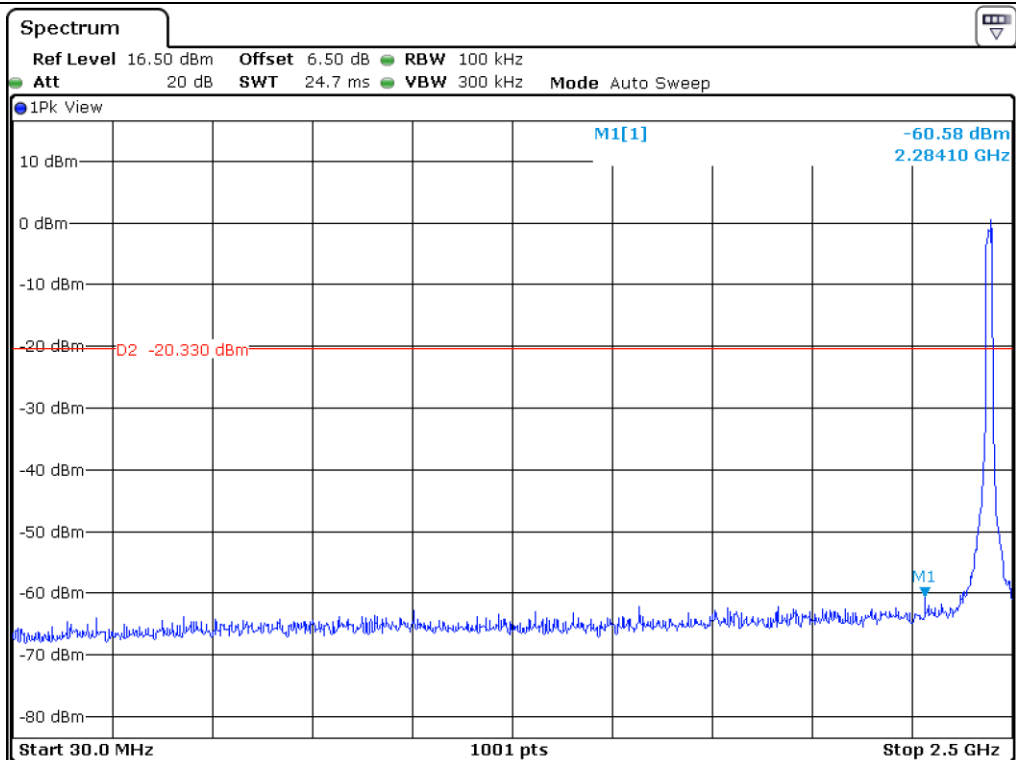




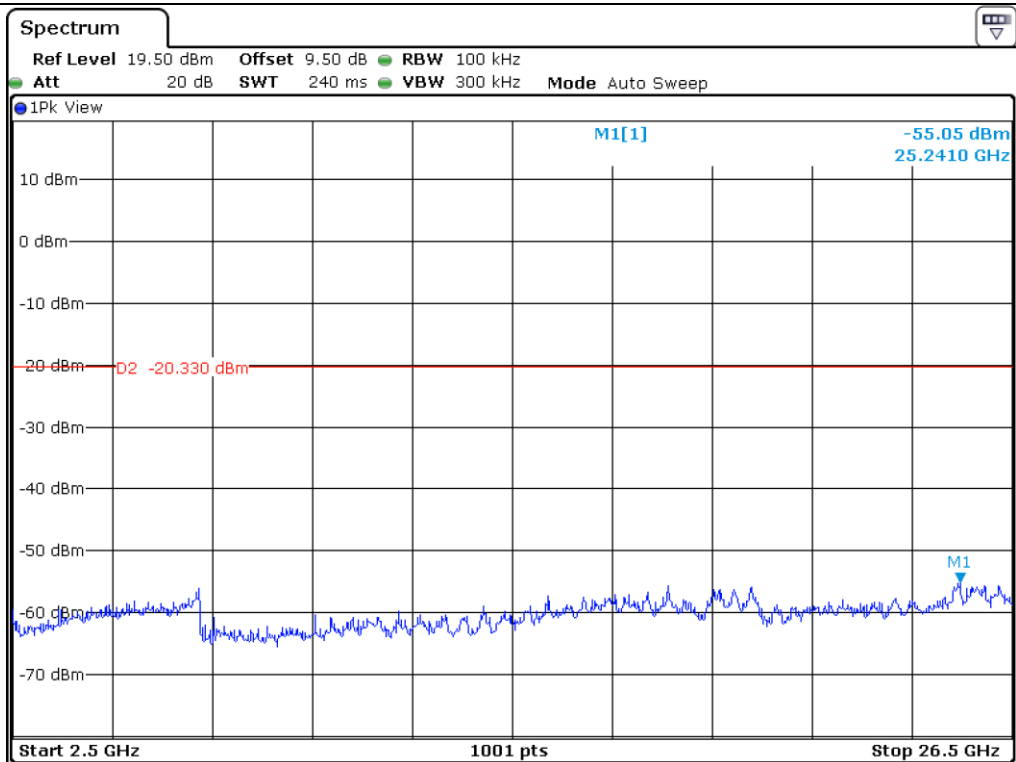
Low Channel



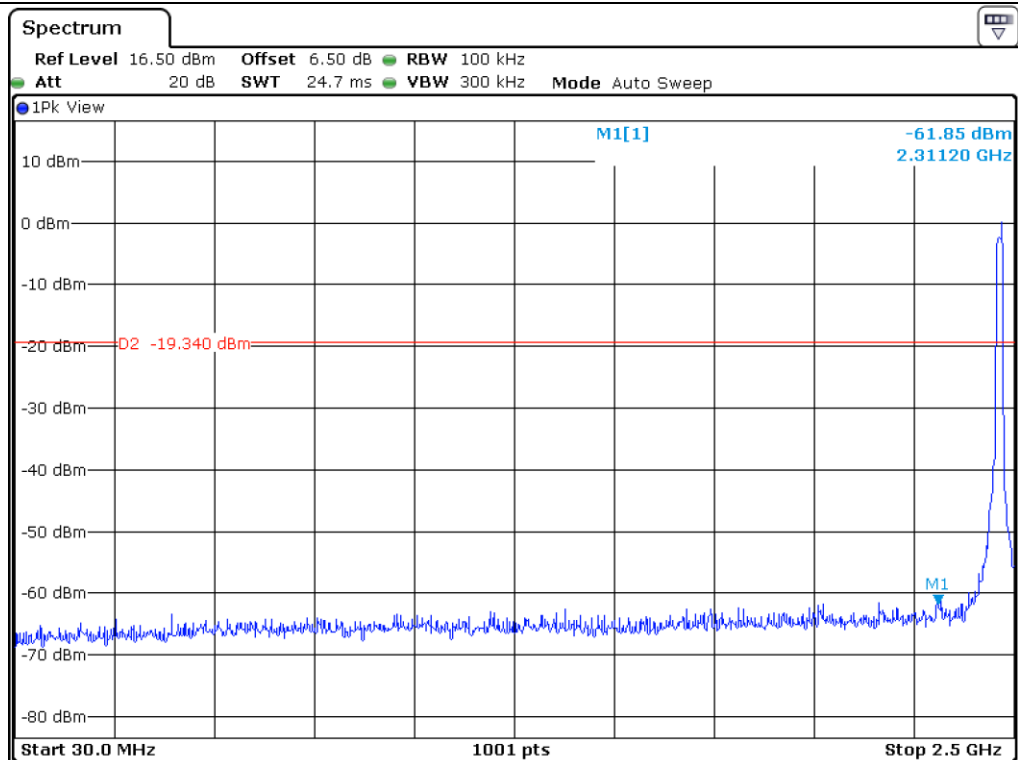
Low Channel



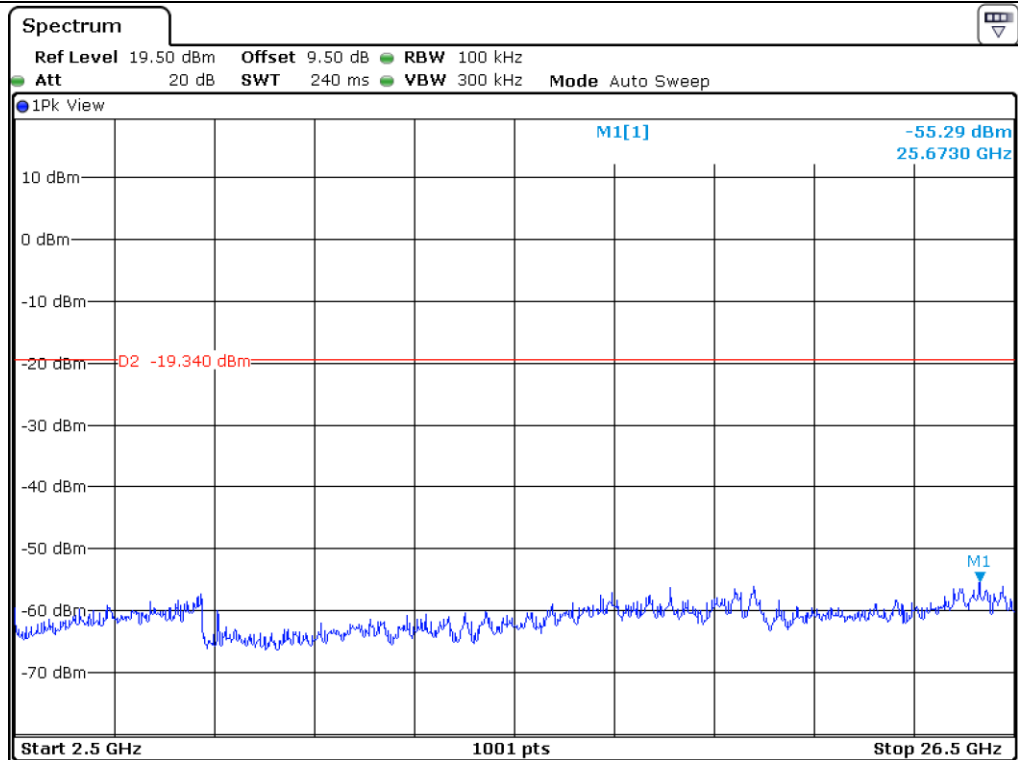
Middle Channel



Middle Channel

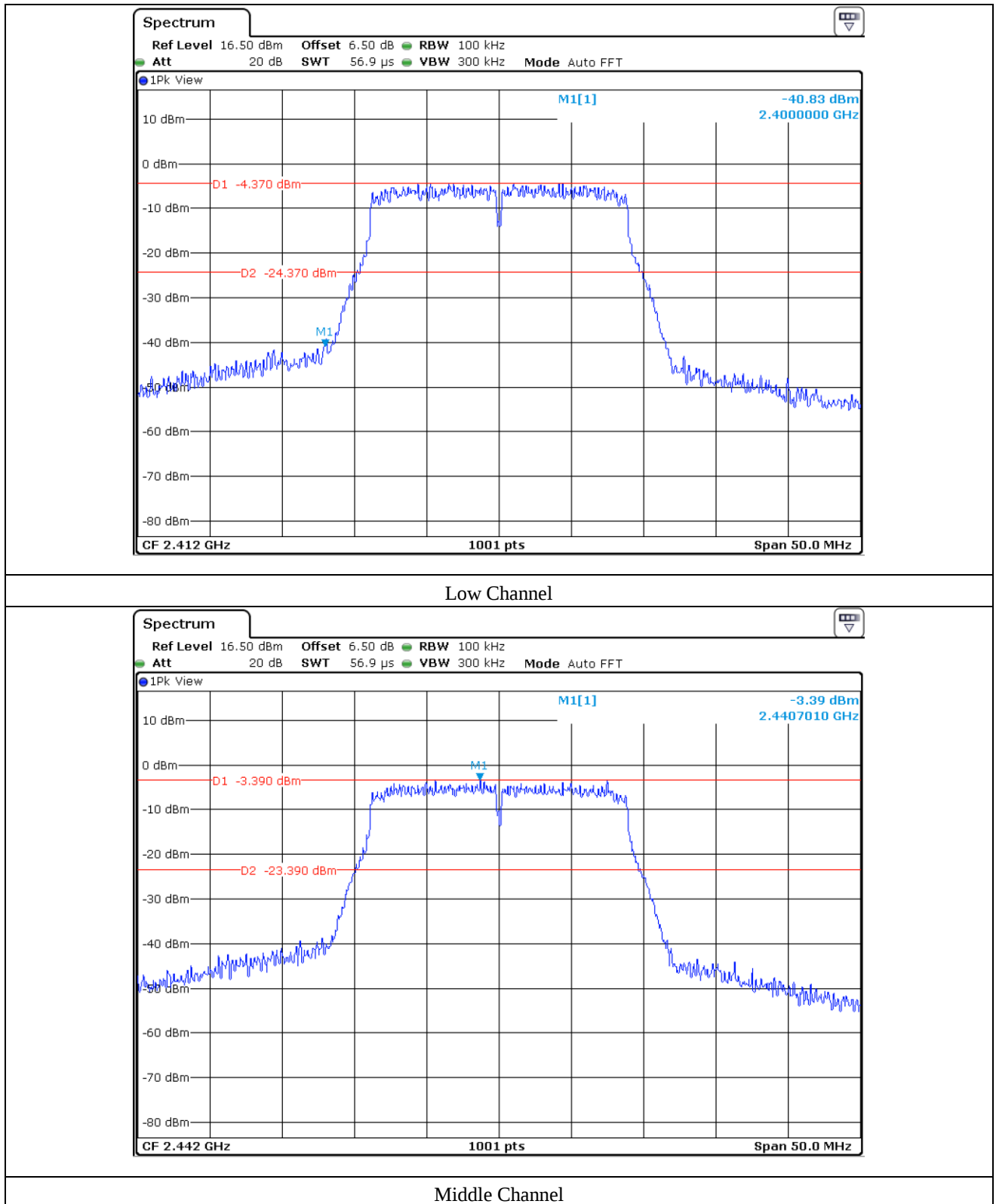


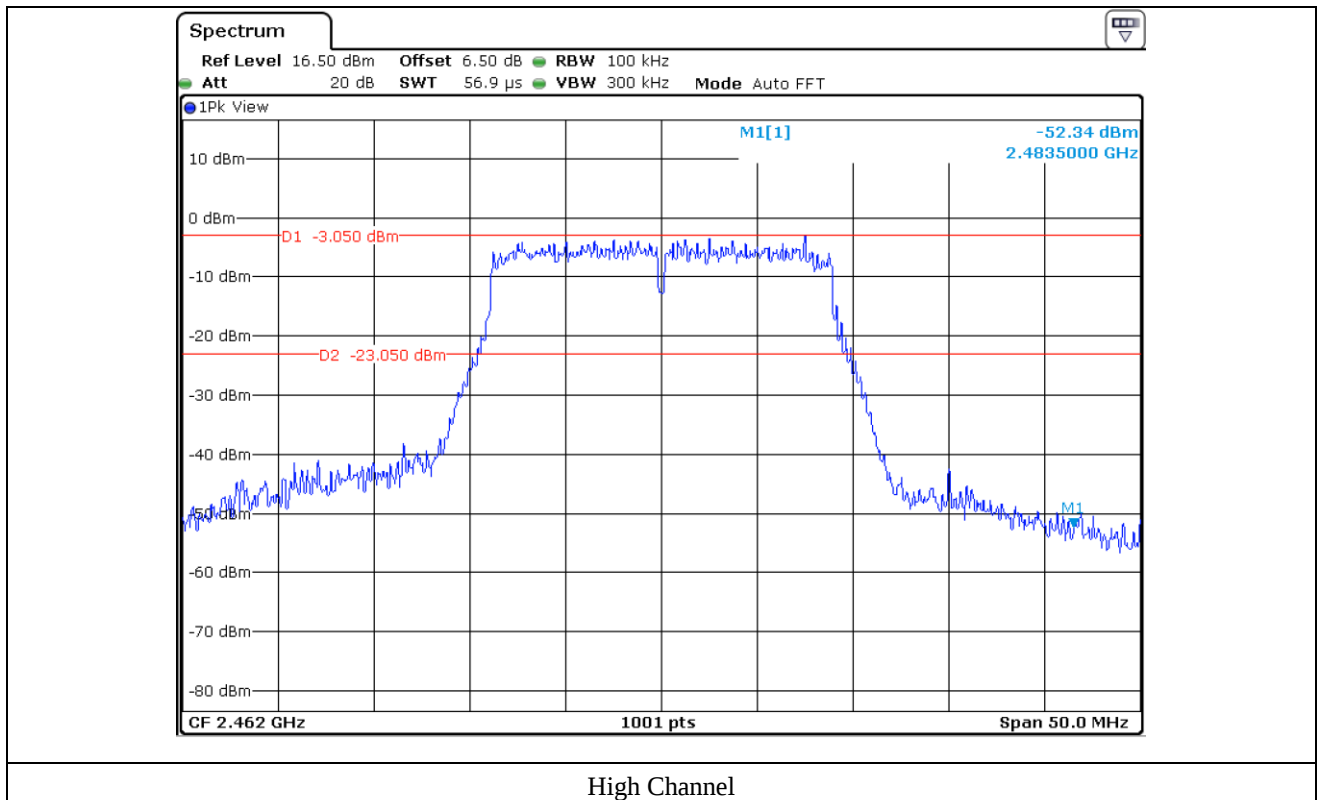
High Channel

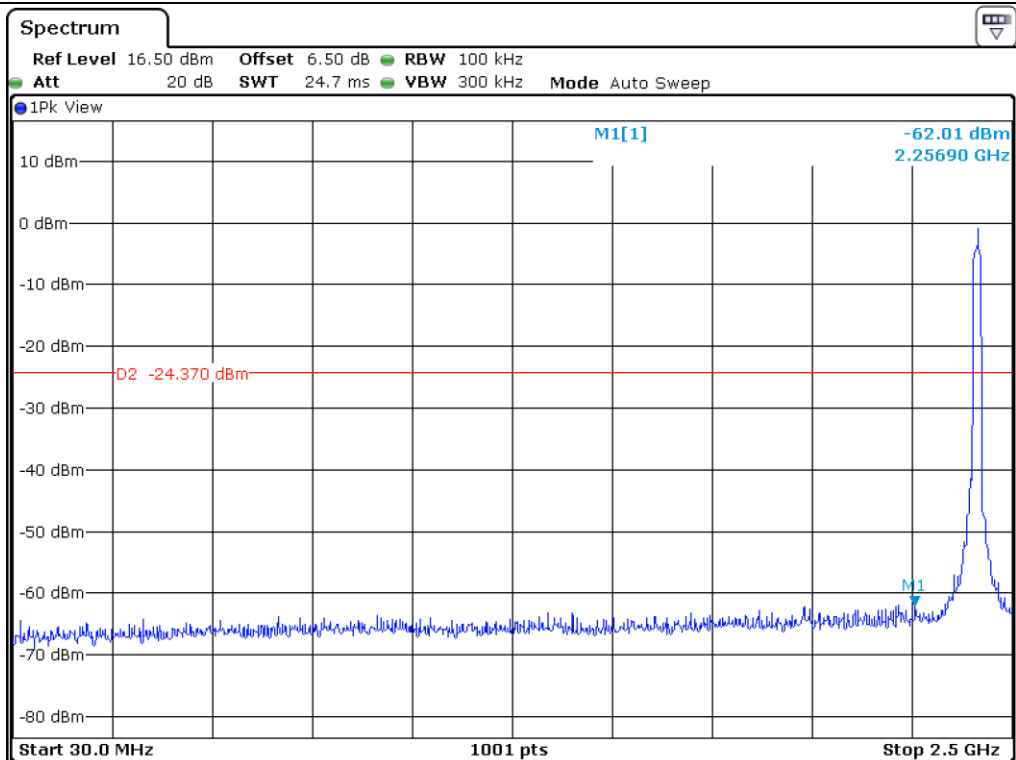


High Channel

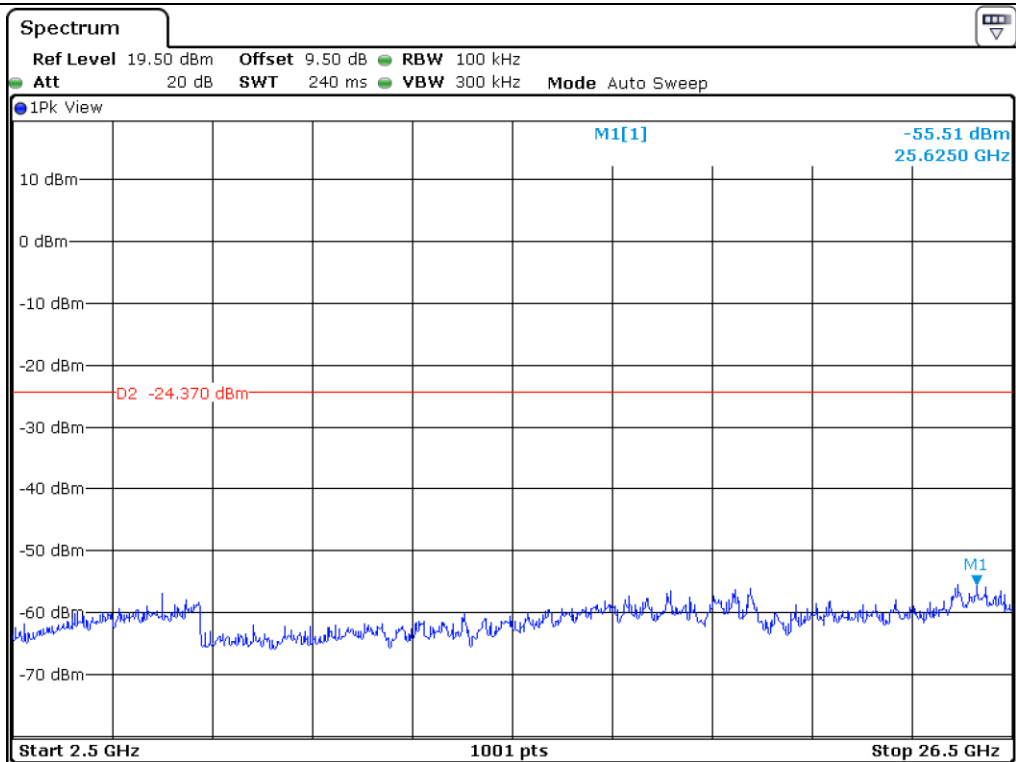
9.5.3 Test data for 802.11n (HT20) WLAN Mode



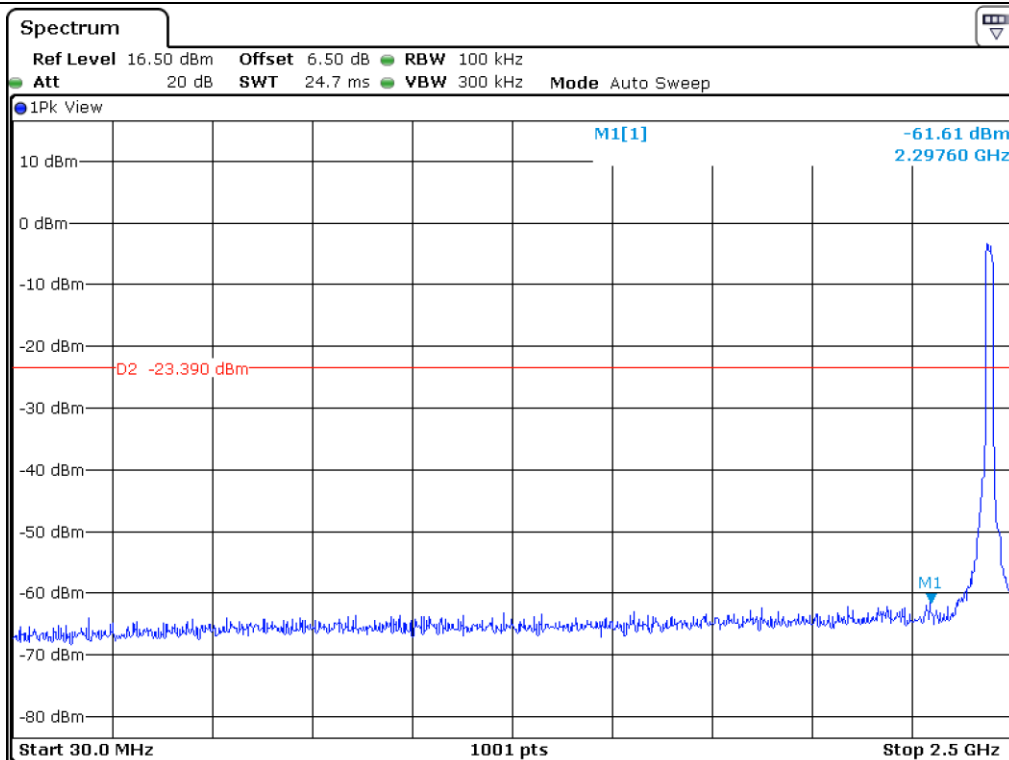




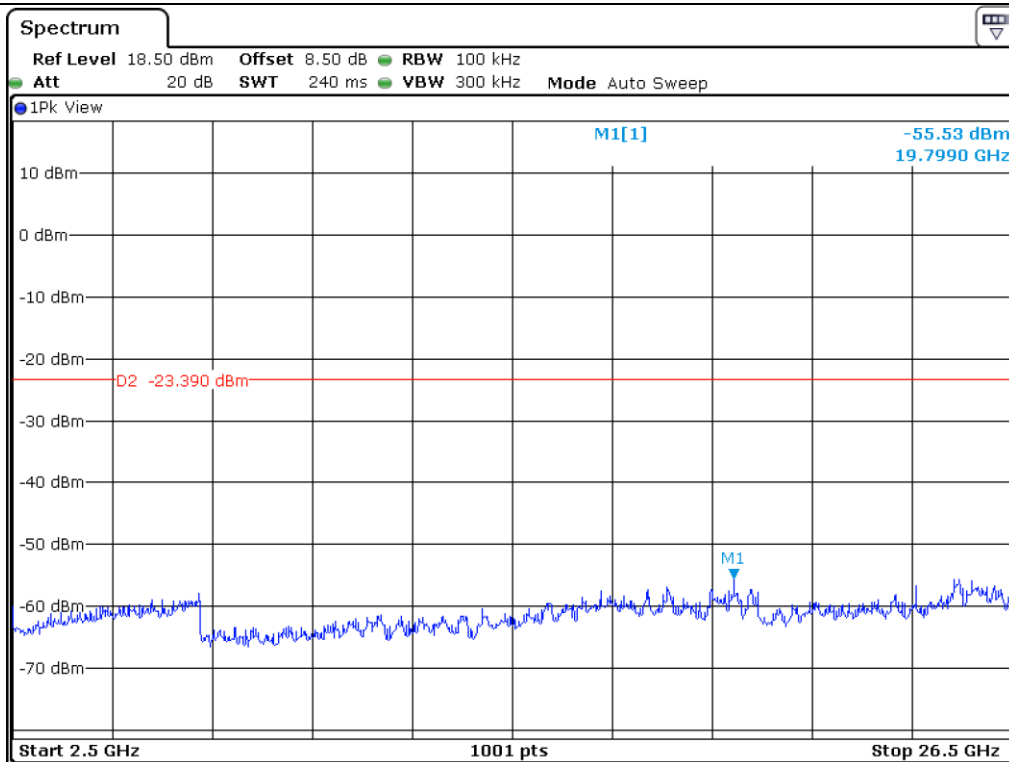
Low Channel



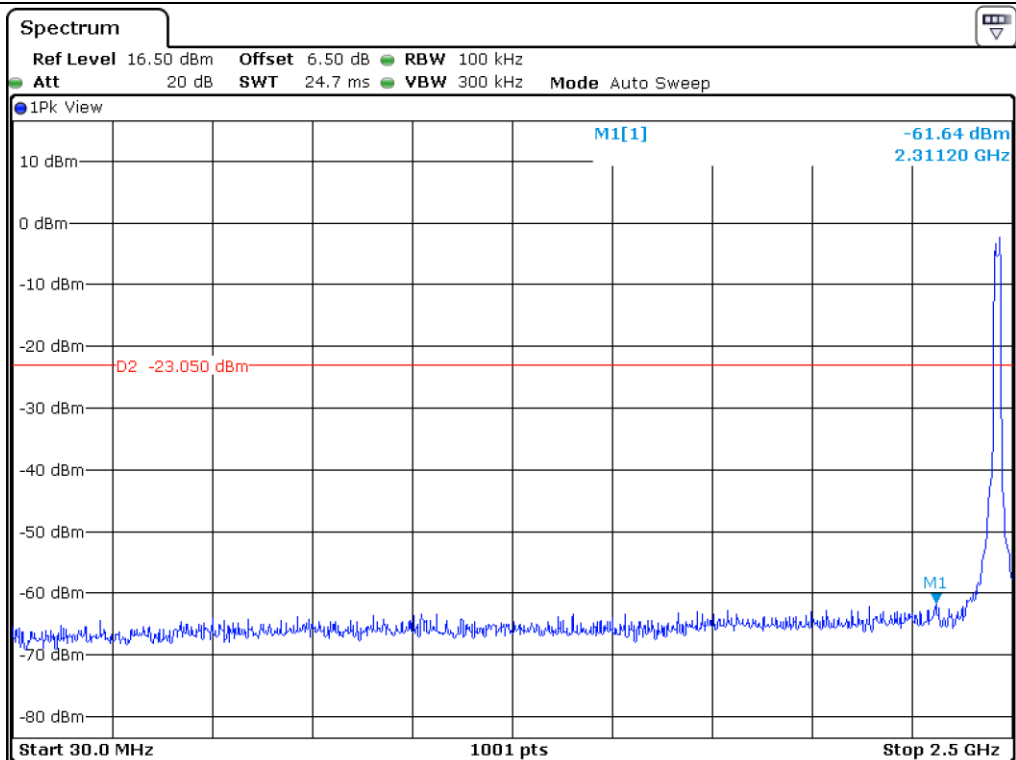
Low Channel



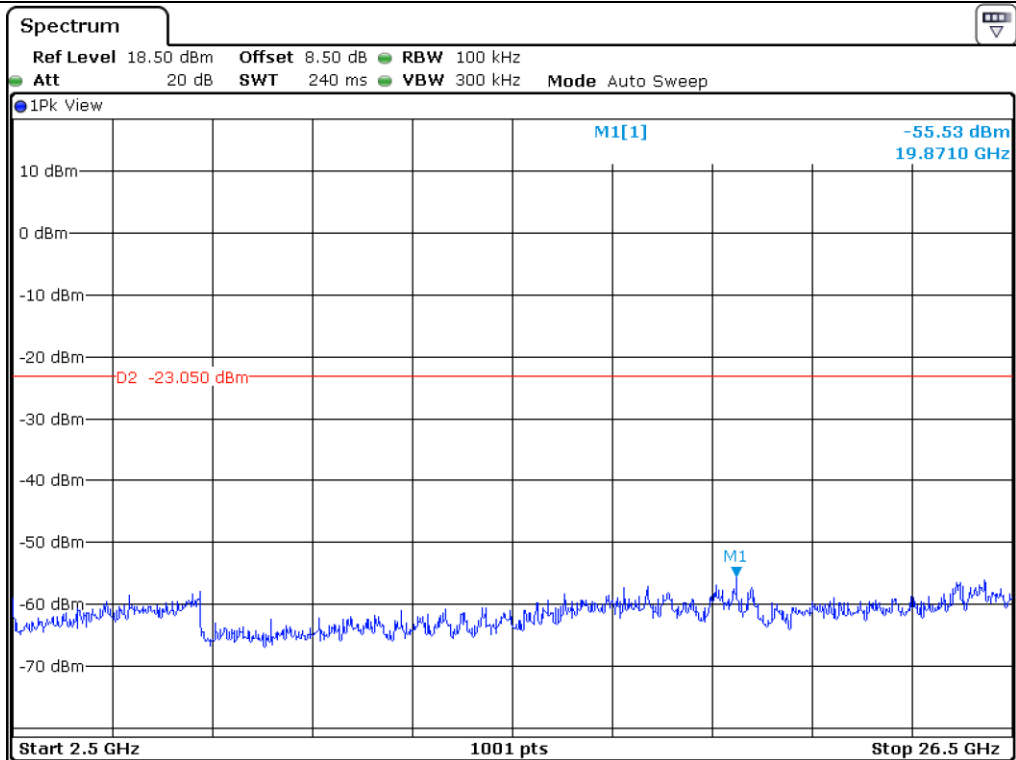
Middle Channel



Middle Channel



High Channel



High Channel

9.6 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 : February 28, 2019
 -. Resolution bandwidth : 1 MHz for Peak and Average Mode
 -. Video bandwidth : 3 MHz for Peak and Average Mode
 -. Detector : Peak Mode(Peak), Average Mode(RMS)
 -. Frequency range : 30 MHz ~ 26.5 GHz
 -. Measurement distance : 3 m
 -. Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 387.08	48.47	Peak	H	27.60	8.80	34.31	50.56	74.00	23.44
2 378.16	42.15	Average	H				44.24	54.00	9.76
2 387.16	43.97	Peak	V				46.06	74.00	27.94
2 387.24	31.54	Average	V				33.63	54.00	20.37
Test Data for High Channel									
2 489.01	54.94	Peak	H	27.80	8.80	34.40	57.14	74.00	16.86
2 483.51	41.80	Average	H				44.00	54.00	10.00
2 487.88	43.52	Peak	V				45.72	74.00	28.28
2 483.51	33.13	Average	V				35.33	54.00	18.67

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: Ha-Ram Lee / Assistant Manager

9.6.1.2 Test data for 802.11g WLAN Mode

- . Test Date : February 28, 2019
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Detector : Peak Mode(Peak), Average Mode(RMS)
- . Frequency range : 30 MHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 389.72	55.73	Peak	H	27.60	8.80	34.31	57.82	74.00	16.18
2 389.24	42.27	Average	H				44.36	54.00	9.64
2 387.16	51.80	Peak	V				53.89	74.00	20.11
2 389.48	33.86	Average	V				35.95	54.00	18.05
Test Data for High Channel									
2 484.10	55.44	Peak	H	27.80	8.80	34.40	57.64	74.00	16.36
2 483.64	39.68	Average	H				41.88	54.00	12.12
2 483.51	50.13	Peak	V				52.33	74.00	21.67
2 483.51	35.08	Average	V				37.28	54.00	16.72

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: Ha-Ram Lee / Assistant Manager

9.6.1.3 Test data for 802.11n (HT 20) WLAN Mode

- . Test Date : February 28, 2019
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Detector : Peak Mode(Peak), Average Mode(RMS)
- . Frequency range : 30 MHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Result : PASSED

Frequency (MHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
2 341.44	56.07	Peak	H	27.60	8.80	34.31	58.16	74.00	15.84
2 389.96	41.94	Average	H				44.03	54.00	9.97
2 389.56	50.31	Peak	V				52.40	74.00	21.60
2 389.08	34.24	Average	V				36.33	54.00	17.67
Test Data for High Channel									
2 483.51	54.67	Peak	H	27.80	8.80	34.40	56.87	74.00	17.13
2 483.54	39.18	Average	H				41.38	54.00	12.62
2 487.27	50.32	Peak	V				52.52	74.00	21.48
2 484.66	34.79	Average	V				36.99	54.00	17.01

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: Ha-Ram Lee / Assistant Manager

9.6.2 Spurious & Harmonic Radiated Emission

9.6.2.1 Test data for 802.11b WLAN Mode

-. Test Date : February 28, 2019
 -. Resolution bandwidth : 1 MHz for Peak and Average Mode
 -. Video bandwidth : 3 MHz for Peak and Average Mode
 -. Detector : Peak Mode(Peak), Average Mode(RMS)
 -. Frequency range : 1 GHz ~ 26.5 GHz
 -. Measurement distance : 3 m
 -. Result : PASSED

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 824.00	31.68	Peak	H	31.30	13.30	35.24	41.04	74.00	32.96
	20.96	Average	H				30.32	54.00	23.68
	31.77	Peak	V				41.13	74.00	32.87
	19.77	Average	V				29.13	54.00	24.87
Test Data for Middle Channel									
4 884.00	30.86	Peak	H	31.30	13.50	35.27	40.39	74.00	33.61
	20.55	Average	H				30.08	54.00	23.92
	31.82	Peak	V				41.35	74.00	32.65
	19.66	Average	V				29.19	54.00	24.81
Test Data for High Channel									
4 924.00	30.90	Peak	H	31.10	13.70	35.29	40.41	74.00	33.59
	20.72	Average	H				30.23	54.00	23.77
	31.45	Peak	V				40.96	74.00	33.04
	19.73	Average	V				29.24	54.00	24.76

Tabulated test data for Spurious & Harmonic

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: Ha-Ram Lee / Assistant Manager

9.6.2.2 Test data for 802.11g WLAN Mode

- . Test Date : February 28, 2019
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Detector : Peak Mode(Peak), Average Mode(RMS)
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Result : PASSED

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 824.00	31.22	Peak	H	31.30	13.30	35.24	40.58	74.00	33.42
	19.55	Average	H				28.91	54.00	25.09
	31.65	Peak	V				41.01	74.00	32.99
	19.15	Average	V				28.51	54.00	25.49
Test Data for Middle Channel									
4 884.00	31.33	Peak	H	31.30	13.50	35.27	40.86	74.00	33.14
	19.41	Average	H				28.94	54.00	25.06
	31.22	Peak	V				40.75	74.00	33.25
	19.43	Average	V				28.96	54.00	25.04
Test Data for High Channel									
4 924.00	31.87	Peak	H	31.10	13.70	35.29	41.38	74.00	32.62
	19.63	Average	H				29.14	54.00	24.86
	31.11	Peak	V				40.62	74.00	33.38
	19.34	Average	V				28.85	54.00	25.15

Tabulated test data for Spurious & Harmonic

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: Ha-Ram Lee / Assistant Manager

9.6.2.3 Test data for 802.11n (HT 20) WLAN Mode

- . Test Date : February 28, 2019
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Detector : Peak Mode(Peak), Average Mode(RMS)
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Result : PASSED

Frequency (GHz)	Reading (dBμV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	Amp Gain	Total (dBμV/m)	Limits (dBμV/m)	Margin (dB)
Test Data for Low Channel									
4 824.00	31.09	Peak	H	31.30	13.30	35.24	40.45	74.00	33.55
	19.48	Average	H				28.84	54.00	25.16
	31.85	Peak	V				41.21	74.00	32.79
	19.26	Average	V				28.62	54.00	25.38
Test Data for Middle Channel									
4 884.00	31.60	Peak	H	31.30	13.50	35.27	41.13	74.00	32.87
	19.68	Average	H				29.21	54.00	24.79
	31.15	Peak	V				40.68	74.00	33.32
	19.31	Average	V				28.84	54.00	25.16
Test Data for High Channel									
4 924.00	32.19	Peak	H	31.10	13.70	35.29	41.70	74.00	32.30
	19.75	Average	H				29.26	54.00	24.74
	31.25	Peak	V				40.76	74.00	33.24
	19.45	Average	V				28.96	54.00	25.04

Tabulated test data for Spurious & Harmonic

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: Ha-Ram Lee / Assistant Manager

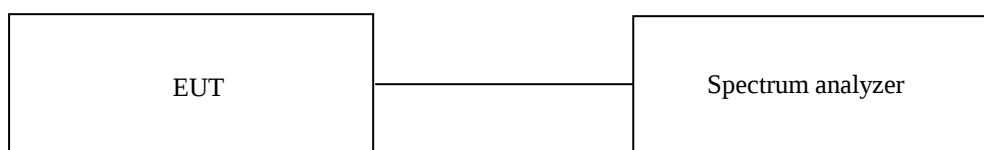
10. PEAK POWER SPECTRAL DENSITY

10.1 Operating environment

Temperature : 24 °C
Relative humidity : 45 % R.H.

10.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 3 kHz, the video bandwidth is set to 3 times the resolution bandwidth.



10.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Aug. 23, 2018 (1Y)

All test equipment used is calibrated on a regular basis.

10.4 Test data for 802.11b WLAN Mode

-. Test Date : February 23, 2019

-. Test Result : Pass

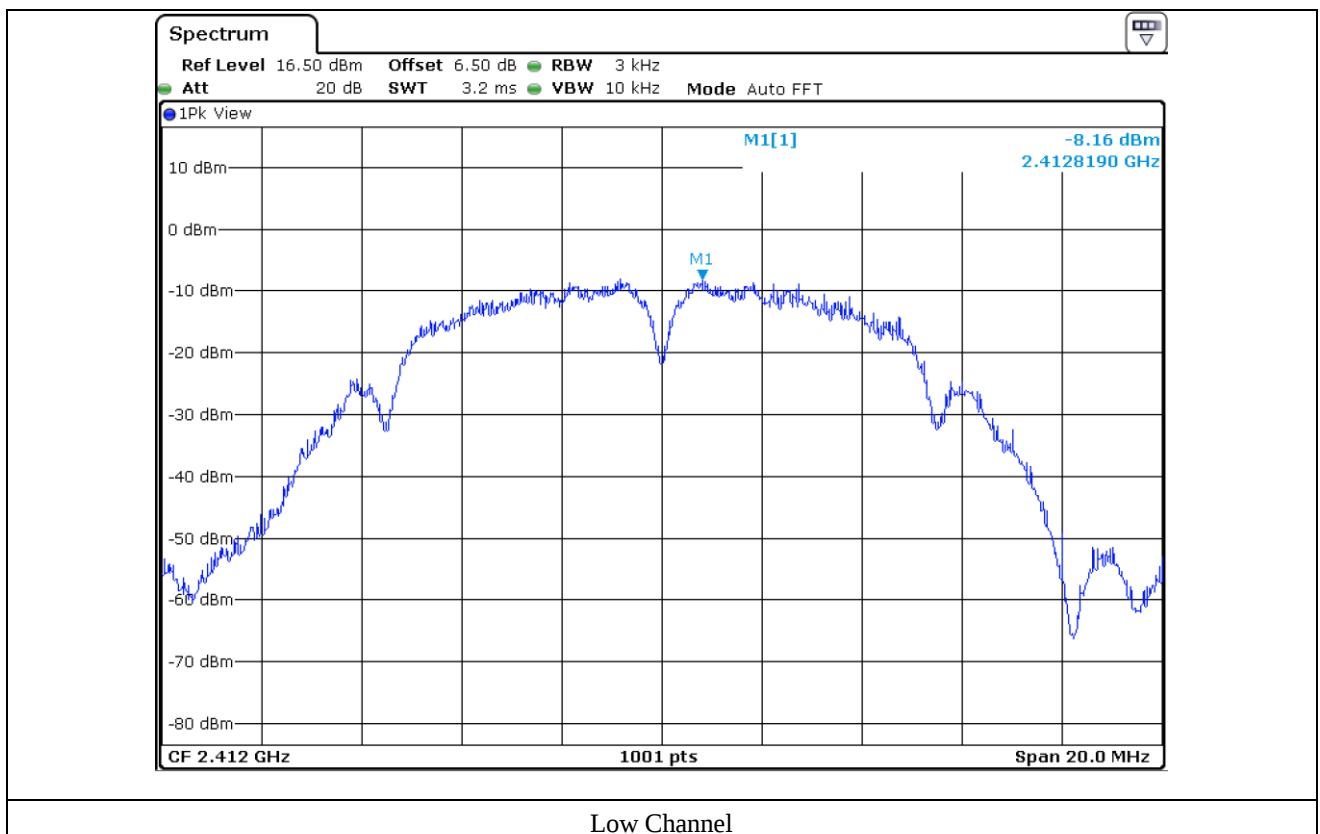
-. Operating Condition : Continuous transmitting mode

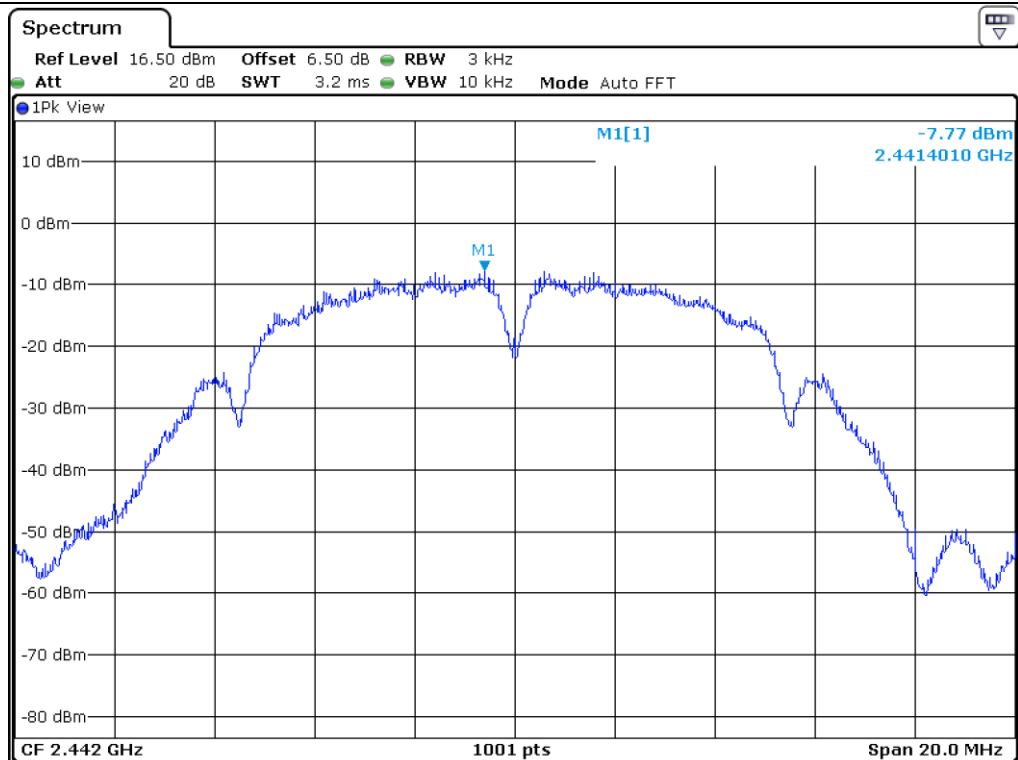
CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 412.00	-8.16	8.00	16.16
Middle	2 442.00	-7.77	8.00	15.77
High	2 462.00	-6.04	8.00	14.04

Remark. Margin = Limit – Measured value

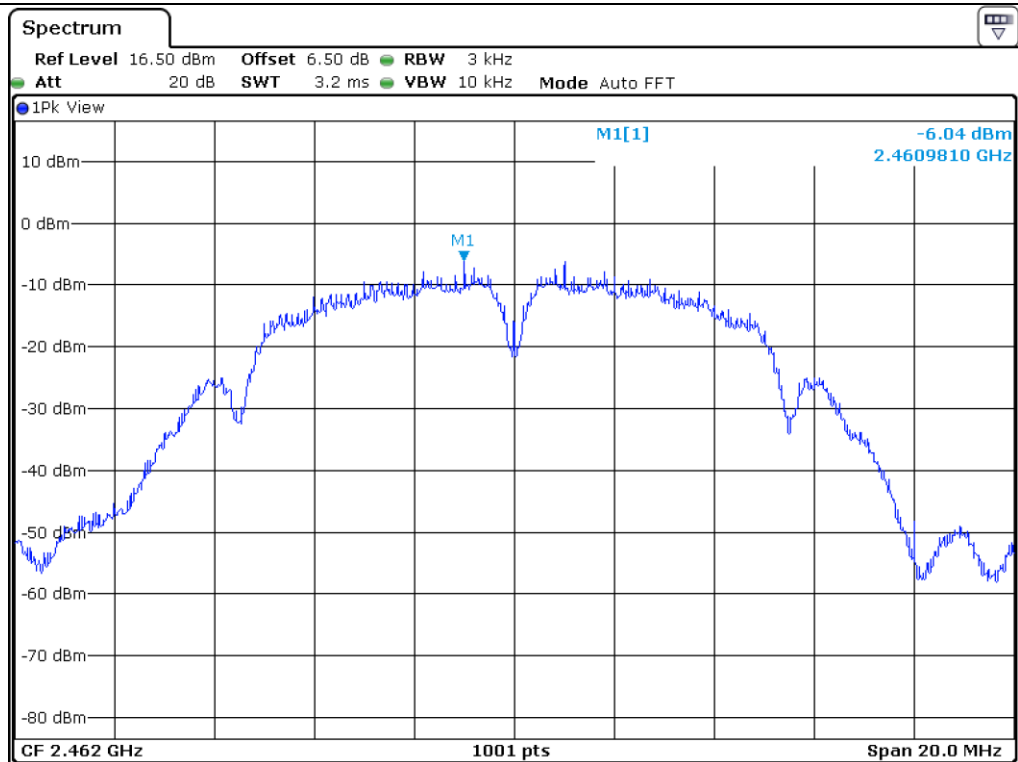


Tested by: Ha-Ram Lee / Assistant Manager





Middle Channel



High Channel

10.5 Test data for 802.11g WLAN Mode

-. Test Date : February 23, 2019

-. Test Result : Pass

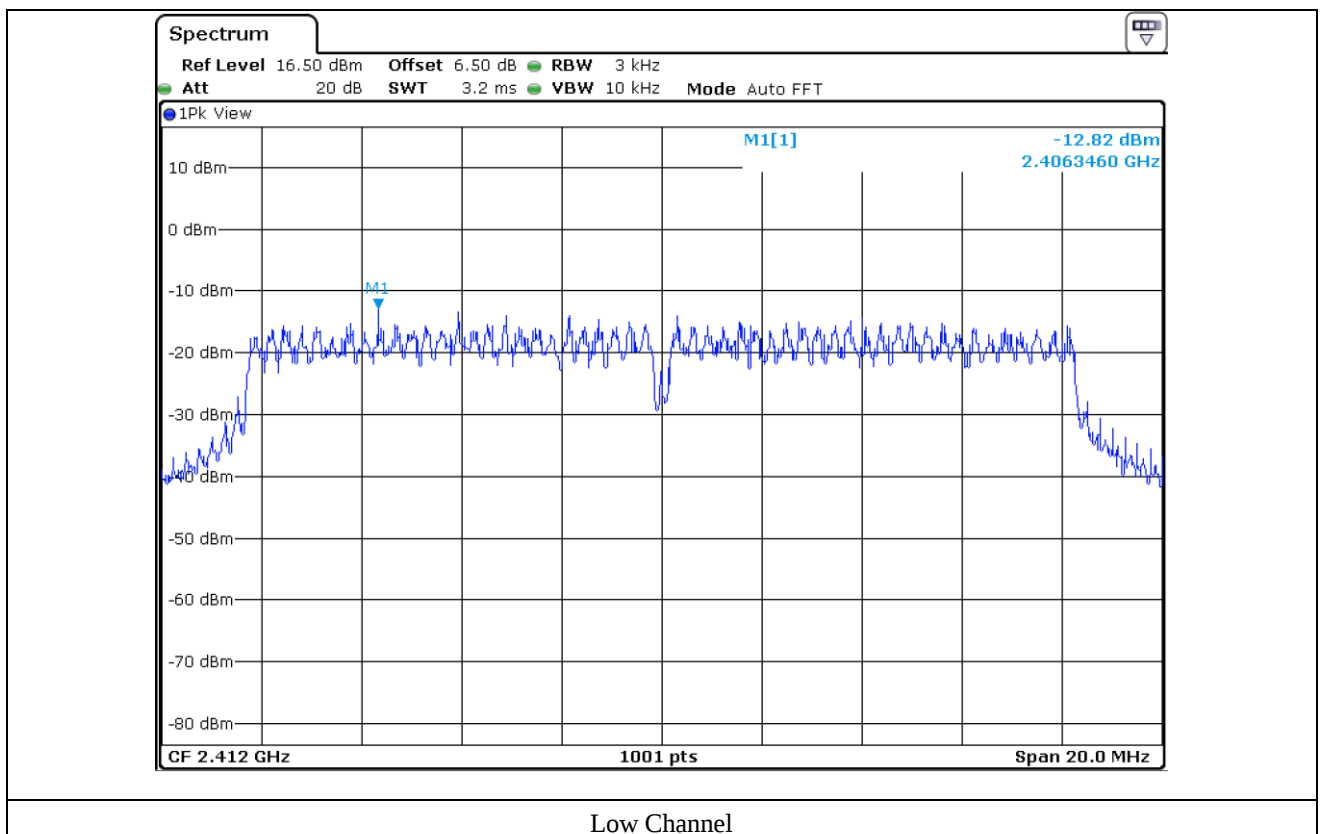
-. Operating Condition : Continuous transmitting mode

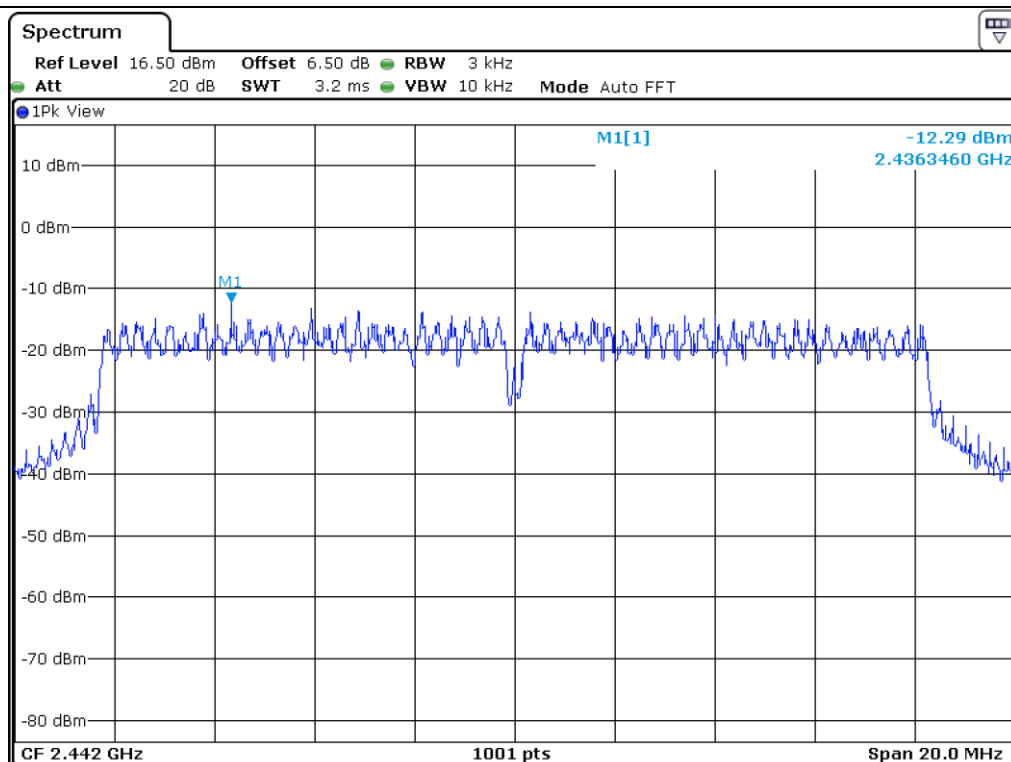
CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 412.00	-12.82	8.00	20.82
Middle	2 442.00	-12.29	8.00	20.29
High	2 462.00	-12.47	8.00	20.47

Remark. Margin = Limit – Measured value

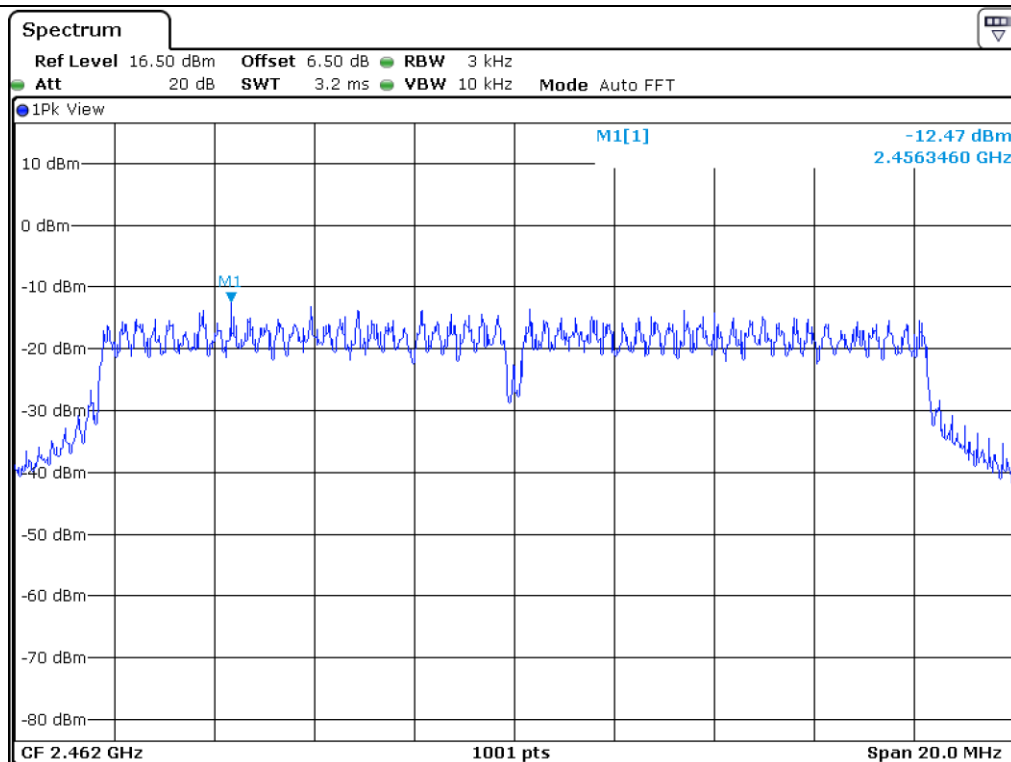


Tested by: Ha-Ram Lee / Assistant Manager





Middle Channel



High Channel

10.6 Test data for 802.11n (HT20) WLAN Mode

-. Test Date : February 23, 2019

-. Test Result : Pass

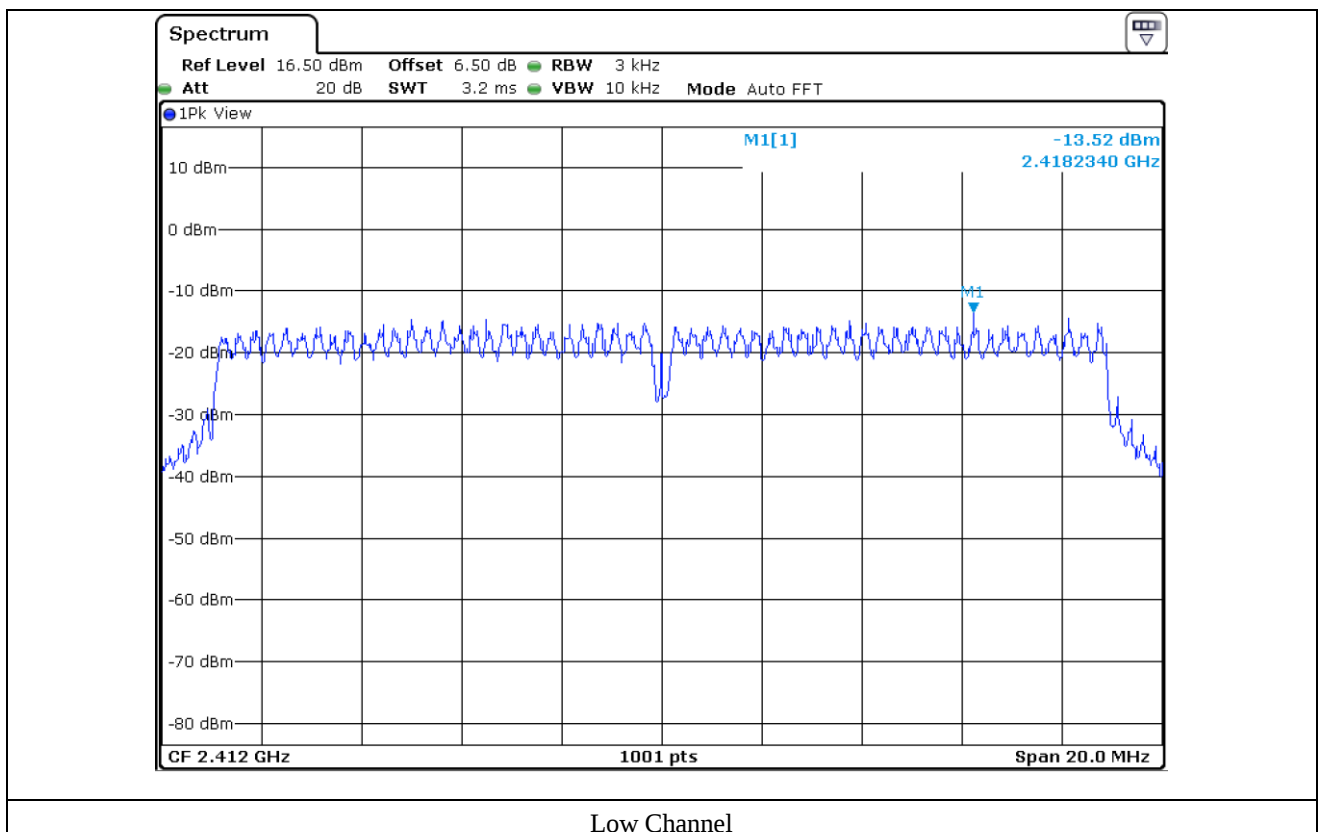
-. Operating Condition : Continuous transmitting mode

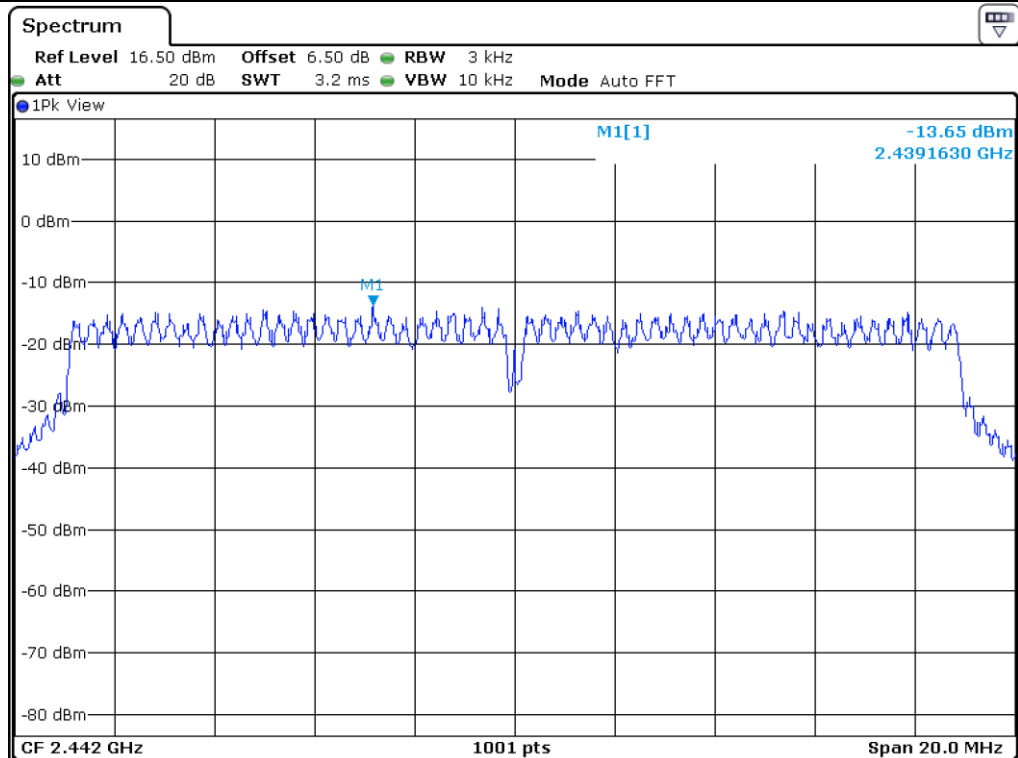
CHANNEL	FREQUENCY(MHz)	MEASURED VALUE (dBm)	LIMIT (dBm)	MARGIN (dB)
Low	2 412.00	-13.52	8.00	21.52
Middle	2 442.00	-13.65	8.00	21.65
High	2 462.00	-13.70	8.00	21.70

Remark. Margin = Limit – Measured value

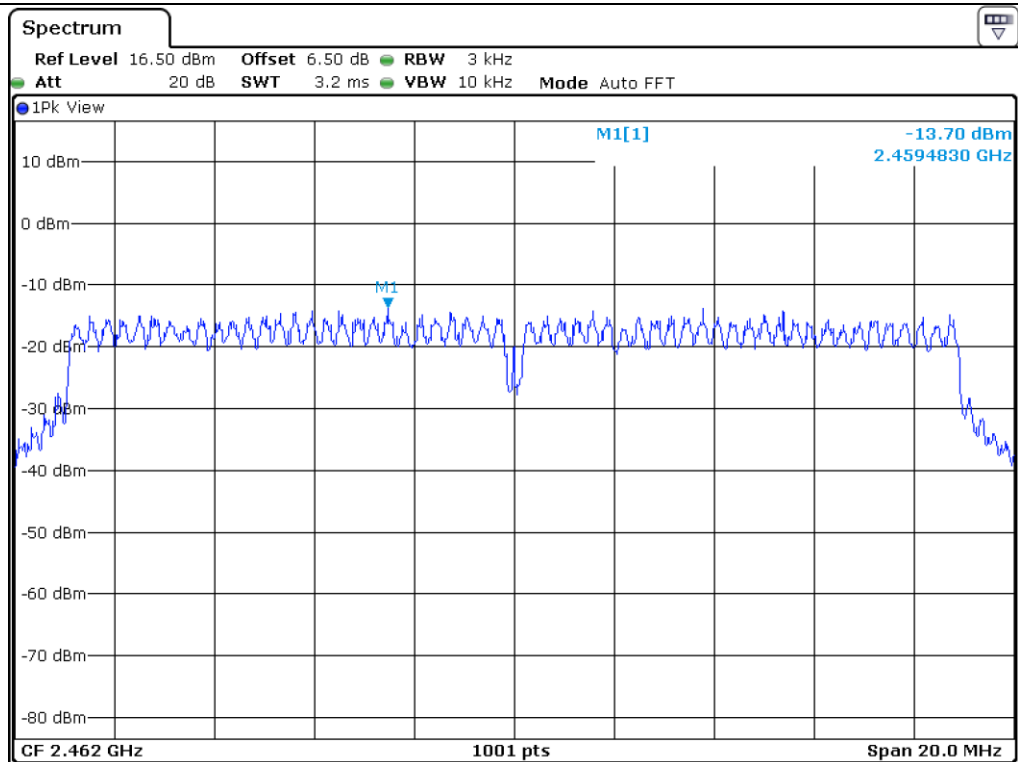


Tested by: Ha-Ram Lee / Assistant Manager





Middle Channel



High Channel

11. RADIATED EMISSION TEST

11.1 Operating environment

Temperature : 24 °C
Relative humidity : 52 % R.H.

11.2 Test set-up

The radiated emissions measurements were on the 3 m, open-field test site. The EUT and other support equipment were placed on a non-conductive turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30 MHz to 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.

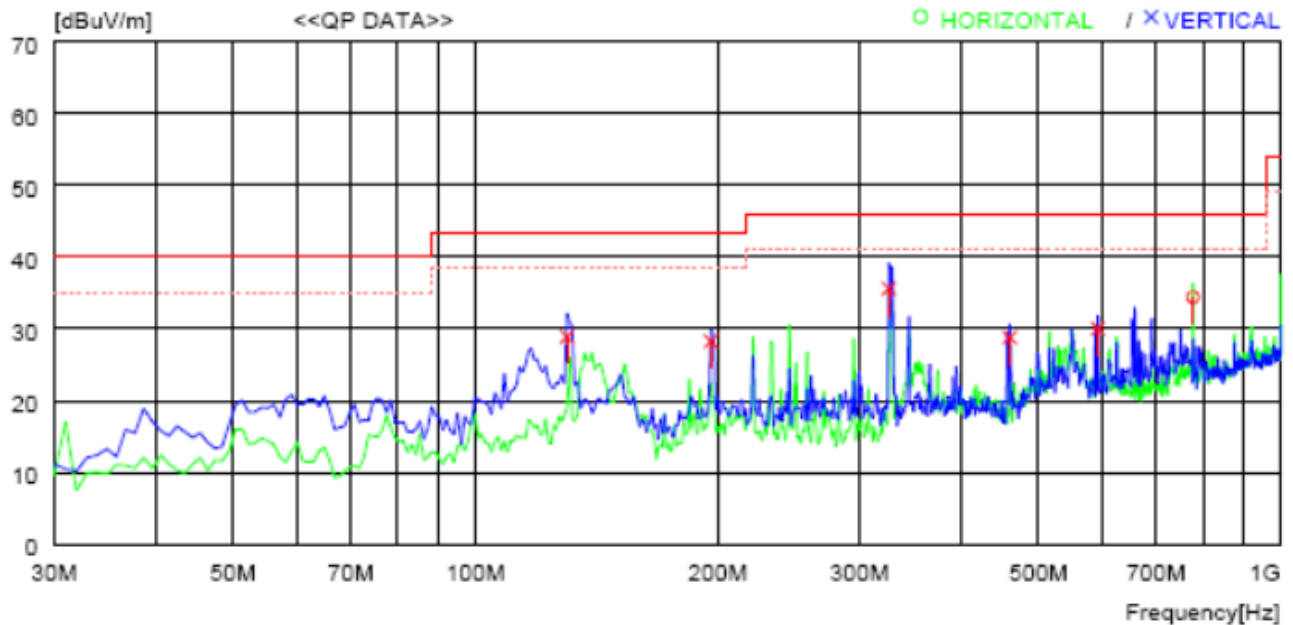
11.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
□ -	ESCI	Rohde & Schwarz	EMI Test Receiver	101012	Oct. 22, 2018 (1Y)
■ -	ESR	Rohde & Schwarz	EMI Test Receiver	101470	Oct. 22, 2018 (1Y)
□ -	FSP	Rohde & Schwarz	Spectrum Analyzer	100017	Aug. 23, 2018 (1Y)
■ -	310N	Sonoma Instrument	AMPLIFIER	312544	Mar. 18, 2019 (1Y)
■ -	FSV30	Rohde & Schwarz	Signal Analyzer	101200	Aug. 23, 2018 (1Y)
■ -	SCU-18	Rohde & Schwarz	Pre-Amplifier	102266	Aug. 24, 2018 (1Y)
■ -	MA-4000XPET	Innco Systems GmbH	Antenna Master	MA4000/509	N/A
□ -	HD100	HD GmbH	Position Controller	N/A	N/A
■ -	DT3000-3t	Innco Systems GmbH	Turn Table	N/A	N/A
□ -	FMZB 1513	Schwarzbeck	LOOP ANTENNA	1513-235	May. 13, 2018 (2Y)
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	9163-419	Aug. 09, 2018 (2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 16, 2017 (2Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA91700179	Jul. 28, 2017 (2Y)
■ -	BBV 9718 B	Schwarzbeck	Broadband Preamplifier	009	Mar. 11, 2019(1Y)

All test equipment used is calibrated on a regular basis.

11.4 Test data for 30 MHz ~ 1 000 MHz

- Test Date : February 28, 2019
- Resolution bandwidth : 120 kHz
- Frequency range : 30 MHz ~ 1 000 MHz
- Measurement distance : 3 m
- Operating mode : Transmitting mode



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	[dBuV]	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
---- Horizontal ----										
1	777.863	40.1	20.9	6.5	33.1	34.4	46.0	11.6	100	301
---- Vertical ----										
2	129.910	50.2	9.1	2.6	33.0	28.9	43.5	14.6	100	250
3	195.870	47.5	10.5	3.3	33.0	28.3	43.5	15.2	100	162
4	325.850	50.3	14.1	4.2	33.0	35.6	46.0	10.4	100	0
5	460.681	40.7	16.3	4.9	33.1	28.8	46.0	17.2	100	0
6	592.598	38.6	19.1	5.6	33.3	30.0	46.0	16.0	100	104

Tested by: Ha-Ram Lee / Assistant Manager

11.5 Test data for Below 30 MHz

- . Test Date : February 28, 2019
- . 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)
All emissions observed were 20dB below the limit and thus not reported.									

11.6 Test data for above 1 GHz

- . Test Date : February 28, 2019
- . 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)
All emissions observed were 20dB below the limit and thus not reported.									



Tested by: Ha-Ram Lee / Assistant Manager