

FCC & ISED CERTIFICATION TEST REPORT

Project Number : EA2001C-025
Test Report Number : TR-W2101-005
Type of Equipment : WIFI module
Model Name : S904-SD-WF
Equipment Class : DTS - Digital Transmission System
FCC ID : OZ5-S904-SD-WF
ISED ID : 21703-S904SDWF
Applicant : Ohsung Electronics Co., Ltd.
Address : #181 Gongdan-Dong, Gumi-Si, Gyeongsangbuk-Do, South Korea
Manufacturer : Ohsung Electronics Co., Ltd.
Address : #181 Gongdan-Dong, Gumi-Si, Gyeongsangbuk-Do, South Korea
Regulation : FCC Part 15 Subpart C Section 15.247, ISED RSS-247 Issue2
Total page of Report : 106 Pages
Date of Receipt : 2020-01-08
Date of Issue : 2021-01-11
Test Result : PASS

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 Song, In-young / Senior Engineer


Signature

2021-01-11

Date

Reviewed by Choi, Yeong-min / Technical Manager


Signature

2021-01-11

Date

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Release Control Record

Issue Report No.	Issued Date	Details/Revisions
TR-W2101-005	2021-01-11	Initial Release
-	-	-

1. TEST SUMMARY

1.1 Regulations and results

The sample submitted for evaluation (Hereafter referred to as the EUT) has been tested in accordance with the following regulations or standards.

FCC Reference Section	ISED Reference Section	Description	Result			
			P	F	N.T.	Note
15.247(a)(2)	RSS-247 5.2 a)	6 dB Bandwidth Occupied Bandwidth	P			
15.247(b)(3)	RSS-247 5.4 d)	Maximum peak output power	P			
15.247(d)	RSS-247 5.5	Band Edge Conducted spurious emission	P			
15.247(e)	RSS-247 5.2 b)	Power spectral density	P			
15.205(a) 15.209(a)	RSS 247 5.5 RSS-GEN 8.9	Radiated spurious emissions	P			
15.207(a)	RSS GEN 8.8	AC power line conducted emissions	P			
Remark: P means Passed F means Failed N.T. means Not Tested						

1.2 Test Methodology

The tests mentioned in clause 1.1 in this test report were performed according to FCC CFR 47 Part 2, CFR 47 Part 15 and ANSI C63.10-2013, and RSS-Gen Issue 4.

KDB 558074 D01DTS Meas. Guidance v05r02: Measurement Procedure PK is used for power measurement.

1.3 Additions, deviations, exclusions from standards

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

1.4 Purpose of the test

The test was performed to determine whether the equipment under test fulfills the requirements of the regulation stated in FCC Part 15 Subpart C Section 15.247, RSS-Gen and RSS-247.

1.5 Test Facility

The measurement facilities are located at 135-60 Gyeongchung-daero, Gonjam-eup, Gwangju-si, Gyeonggi-do 12813, Korea. Our test facilities are accredited as a Conformity Assessment Body (CAB) by the FCC and ISED Canada, designated by the RRA (National Radio Research Agency), and accredited by KOLAS (Korea Laboratory Accreditation Scheme) in Korea and approved by TUV Rheinland, TUV SÜD and Korean Register of Shipping according to the requirement of ISO/IEC 17025.

Laboratory Qualification	Registration No.	Mark
FCC	KR0160	
ISED Canada	12721A	
RRA	KR0160	
TUV Rheinland	UA 50314109-0002	
TUV SÜD	CARAT 094465 0004 Rev.00	
Korean Agency for Technology and Standards	KT733	
KOREAN REGISTER OF SHIPPING	PCT40841-TL001	

Remark. This report is not related to KOLAS accreditation and relevant regulation.

2. EUT (Equipment Under Test) INFORMATION

2.1 General Description

The Ohsung Electronics Co., Ltd., Model S904-SD-WF (referred to as the EUT in this report) is a WIFI module, has function for IEEE 802.11 b/g/n (20 MHz / 40 MHz with integrated PCB antenna. The product specification described herein was obtained from product data sheet or user's manual.

Equipment Class	DTS – Digital Transmission System
Operating Frequency	(802.11b/g/n HT20) 2 412 MHz ~ 2 462 MHz (802.11n HT40): 2 422 MHz ~ 2 452 MHz
Modulation Types	(802.11b): DSSS (DBPSK/DQPSK/CCK) (802.11g/n HT20/HT40): OFDM (BPSK/QPSK/16QAM/64QAM)
Number of Channels	(802.11b/g/n HT20) 11 channels (802.11n HT40): 7 channels
Channel Spacing	5 MHz
Generated or used Freq. in EUT	40 MHz
Type of Antenna	■ Dedicated Type (PCB Pattern Antenna)
Antenna Gain	Max. 2.39 dBi @ 2 445 MHz
Operating Temperature	-20 °C ~ +70 °C
Normal Test Voltage	DC 5 V
Electrical Rating	DC 5 V (USB)
Test SW Version	MPTool
Test SW Power Setting	(802.11b: 32/35/35), (802.11g: 30/47/35), (802.11n HT20: 30/45/35), (802.11n HT40: 26/45/32)
Software Version	Rev v2.5
Hardware Version	v4.3.23.1_16377.20151216

2.2 Additional Model

None

2.3 Available channel number and frequency

Operating Mode: 802.11 b/g/n HT20/HT40, 5 MHz Channel Spacing					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2 412	5	2 432	9	2 452
2	2 417	6	2 437	10	2 457
3	2 422	7	2 442	11	2 462
4	2 427	8	2 447		

3. TEST CONDITION

3.1 Equipment Used During Test

The following peripheral devices and/or interface cables were connected during the measurement:

Description	Model No.	Serial No.	Manufacturer.
WIFI module (EUT)	S904-SD-WF	N/A	Ohsung Electronics Co., Ltd.
Notebook PC	15s-du0069TU	CND9503W22	HP
Adapter for Notebook PC	TPN-CA14	N/A	Chicony Power Technology (Chongqing) Co., Ltd.

3.2 Mode of operation during the test

Software used to control the EUT for staying in continuous transmitting mode is programmed.

The used modulation type for the testing is BPSK (DSSS & OFDM)

3.3 Preliminary Testing for Worst case configuration

For finding worst case configuration and operating mode, preliminary testing was performed and radiated emission and conducted emission tests were performed with the EUT set to transmit and receive at the channel with the highest output power as worst case scenario. All spurious emission tests were performed in X, Y and Z axis direction. And ***the worst Y-axis (9 kHz ~ 30 MHz, 30 MHz ~ 1 GHz), Z-axis (above 1 GHz) test condition was recorded in this test report.***

Based on preliminary testing following operating modes were selected for the final test as listed below.

3.3.1 Conducted & Radiated Test Channel and Frequency

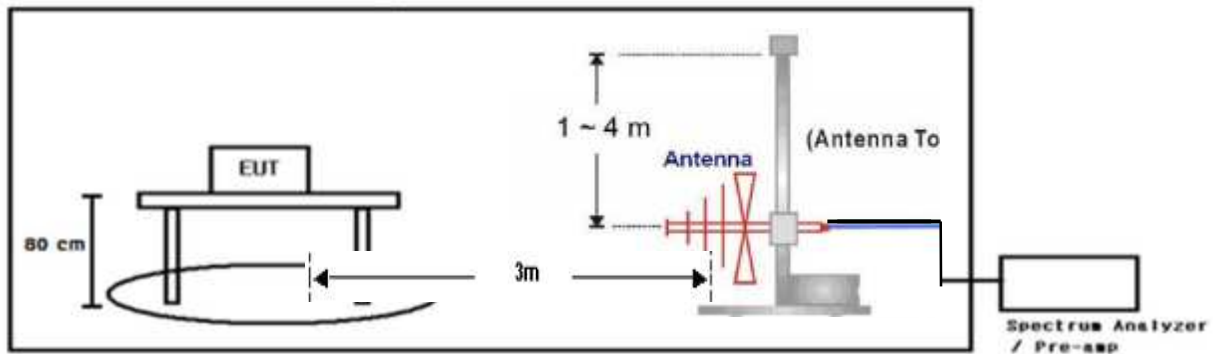
Operating Mode	Channel	Frequency (MHz)	Data rate (Mbps)	Output Power (dBm)
802.11b	1	2 412	11	11.36
	6	2 437	11	12.48
	11	2 462	11	12.28
802.11g	1	2 412	36	6.56
	6	2 437	36	14.41
	11	2 462	36	8.48
802.11n HT20	1	2 412	MCS4	7.69
	6	2 437	MCS4	13.70
	11	2 462	MCS4	8.56
802.11n HT40	3	2 422	MCS7	6.33
	6	2 437	MCS7	14.18
	9	2 452	MCS7	8.40

3.3.2 AC Power-Line Conducted Emission Test Mode

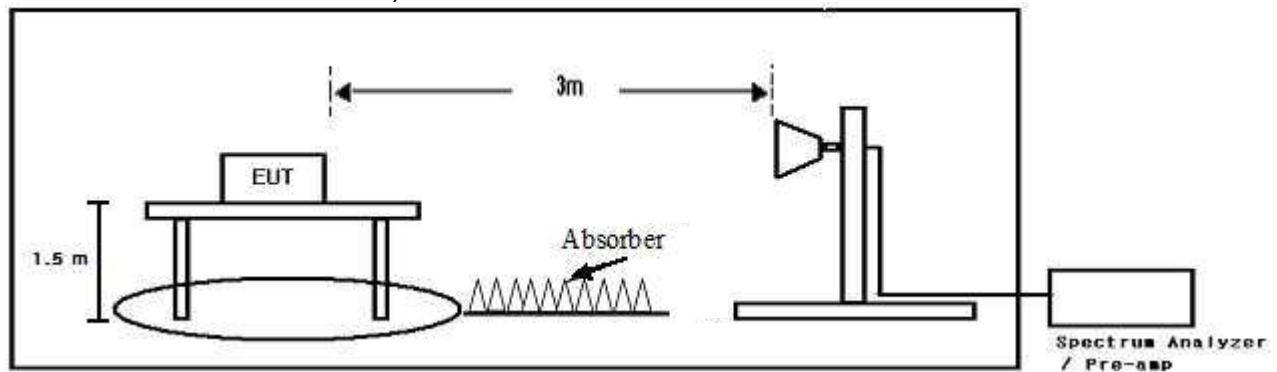
Operating Mode	Tested Channel	Data rate (Mbps)	Output Power (dBm)
802.11b	6	11	12.48
802.11g	6	36	14.41
802.11n HT20	6	MCS4	13.70
802.11n HT40	6	MCS7	14.18

3.4 Test Setup Drawing

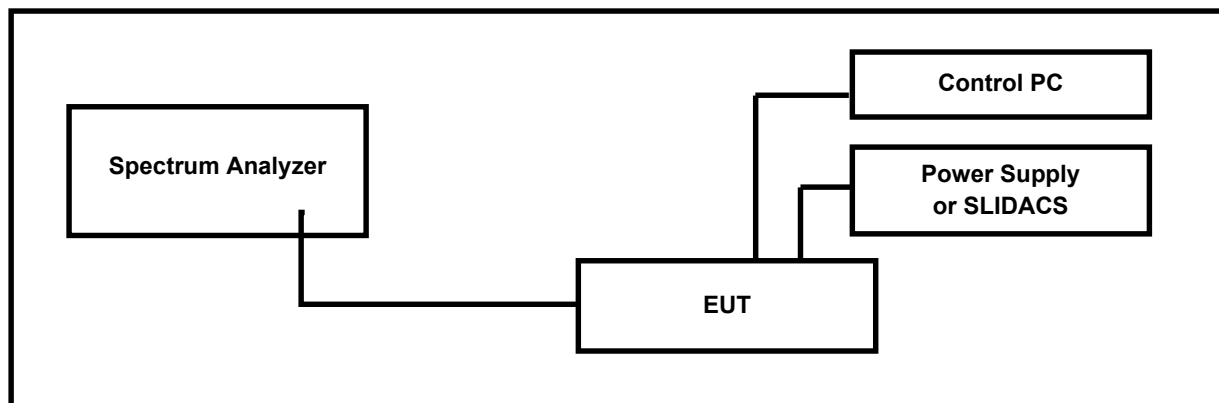
(Radiated Test below 1 GHz)



(Radiated Test above 1 GHz)



(Conducted Test)



3.5 EUT Modifications

- No EMC Relevant Modifications were performed by this test laboratory.

4. ANTENNA REQUIREMENT

According to FCC CFR 47 Part 15 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provision of this section.

4.1 Antenna Description

Frequency Band (GHz)	Antenna Type	Max Peak Gain (dBi)	Connector Type
2.4 – 2.5	PCB Pattern Antenna	2.39	-

4.2 Conclusion

The antenna connector type of the EUT is PCB Pattern Antenna, so the EUT met the requirement.

5. TEST RESULT

5.1 6 dB Bandwidth

5.1.1 Limit

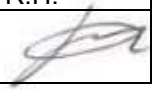
The minimum 6 dB bandwidth shall be at least 500 kHz acc to Section 15.247 (a) (2), and RSS-247 5.2 (a).

5.1.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05r02: 8.2

The transmitter output is connected to a spectrum analyzer with the RBW set to 100 kHz, VBW $\geq 3 \times$ RBW, peak detector and max hold.

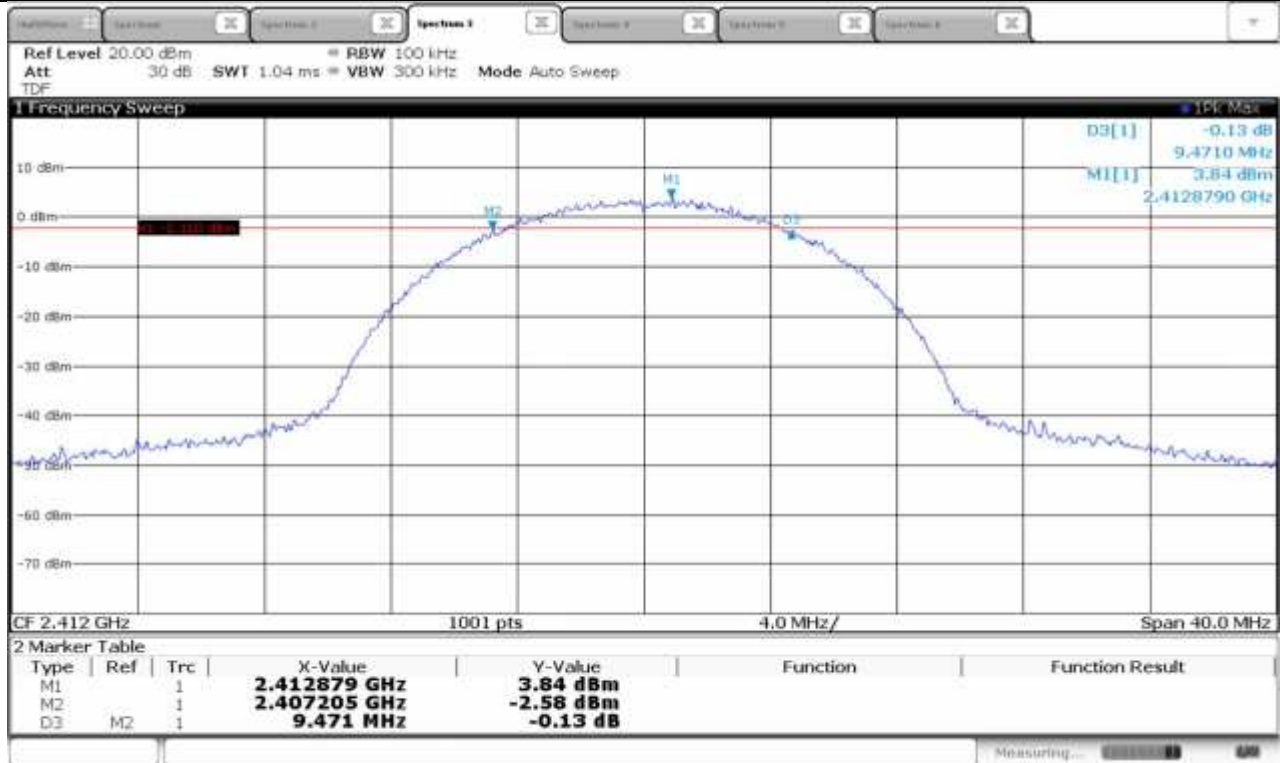
5.1.3 Test Data

Date of Test	2021-01-11	Temperature	(20.3 $\pm$ 0.9) °C
		Relative humidity	(41.6 $\pm$ 0.4) % R.H.
Test Result	PASS	Tested by	Do-heon, Kim 

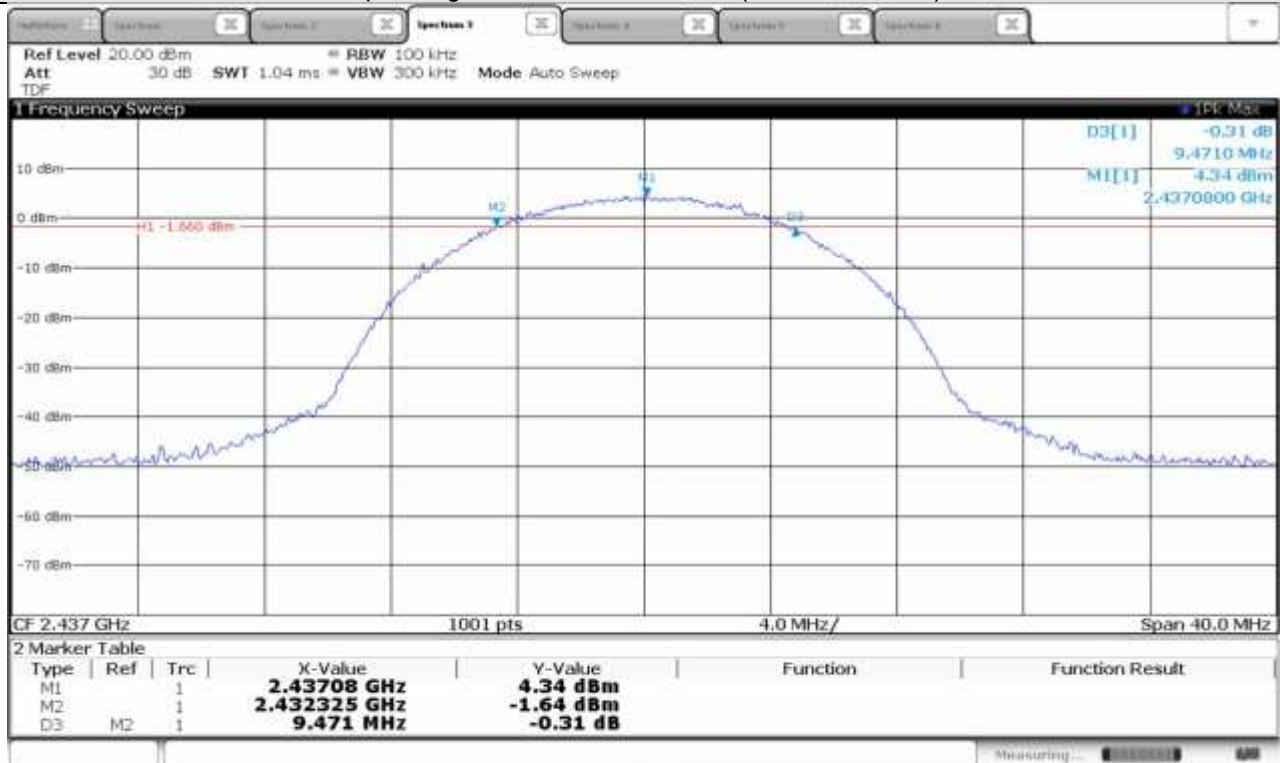
Operating Mode: WLAN 802.11b			
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2 412	9.471	0.5
Middle	2 437	9.471	
High	2 462	8.472	
Operating Mode: WLAN 802.11g			
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2 412	16.503	0.5
Middle	2 437	16.518	
High	2 462	16.494	
Operating Mode: WLAN 802.11n HT20			
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2 412	17.692	0.5
Middle	2 437	17.717	
High	2 462	17.692	
Operating Mode: WLAN 802.11n HT40			
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2 422	36.474	0.5
Middle	2 437	36.419	
High	2 452	36.499	

5.1.4 Test Plots

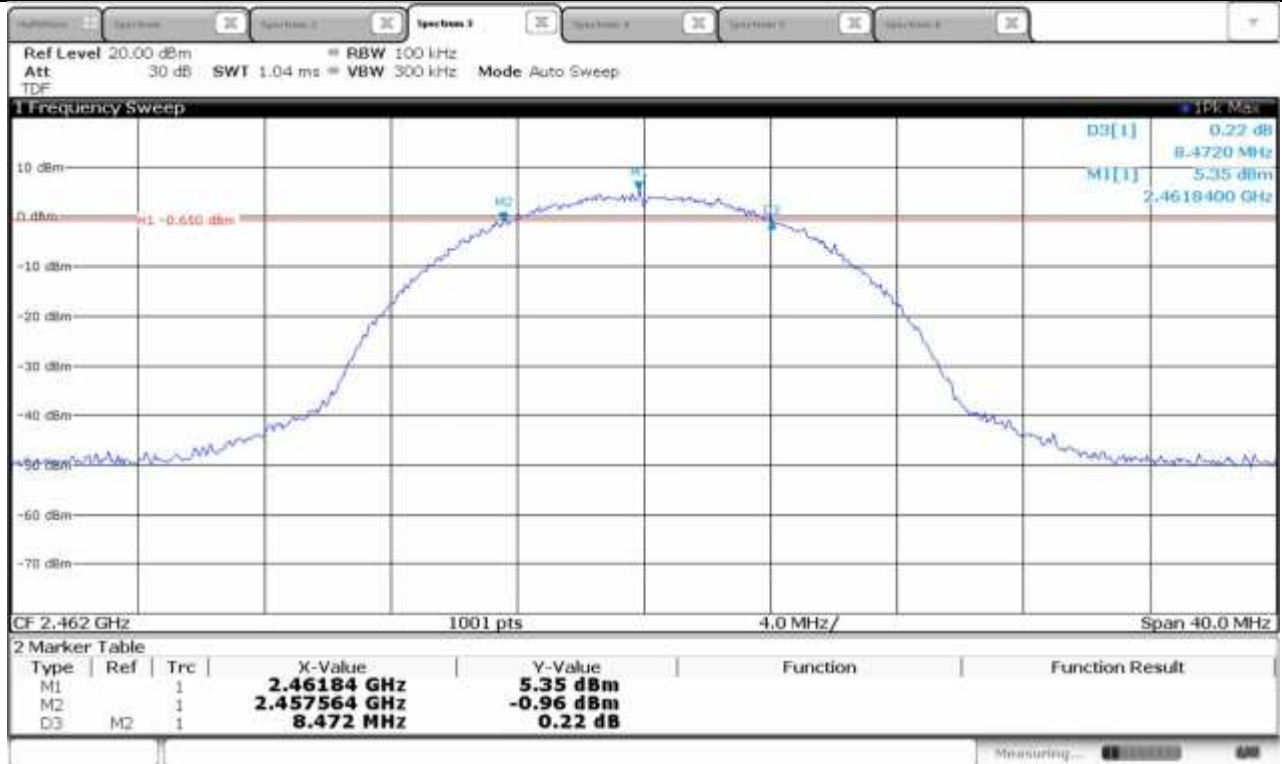
Operating Mode: WLAN 802.11b (Low Channel)



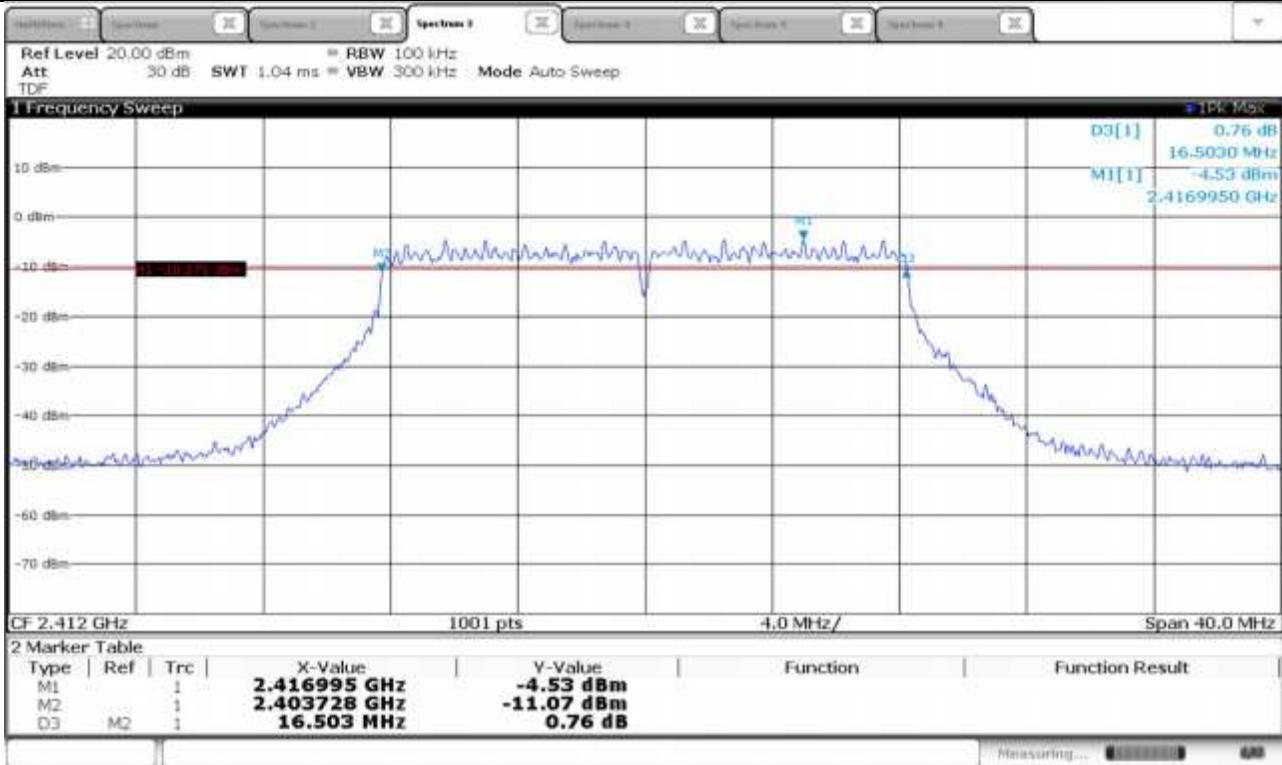
Operating Mode: WLAN 802.11b (Middle Channel)



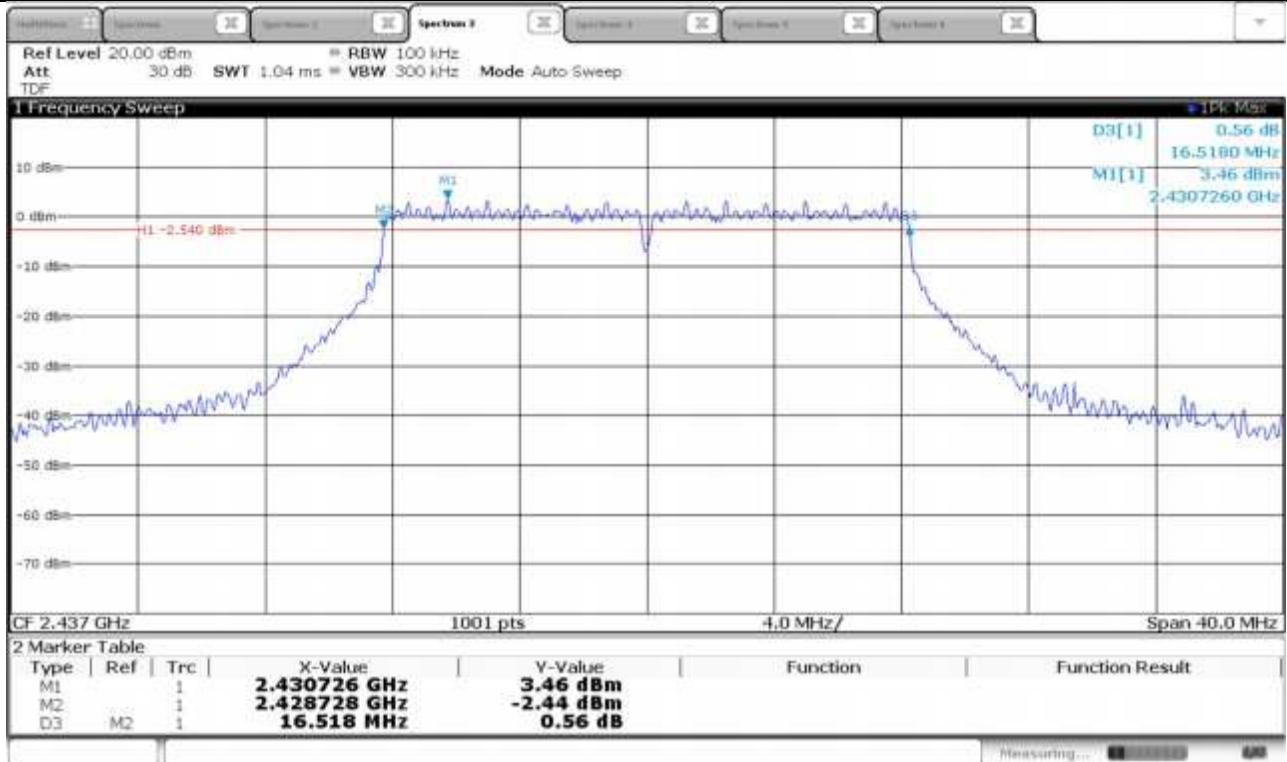
Operating Mode: WLAN 802.11b (High Channel)



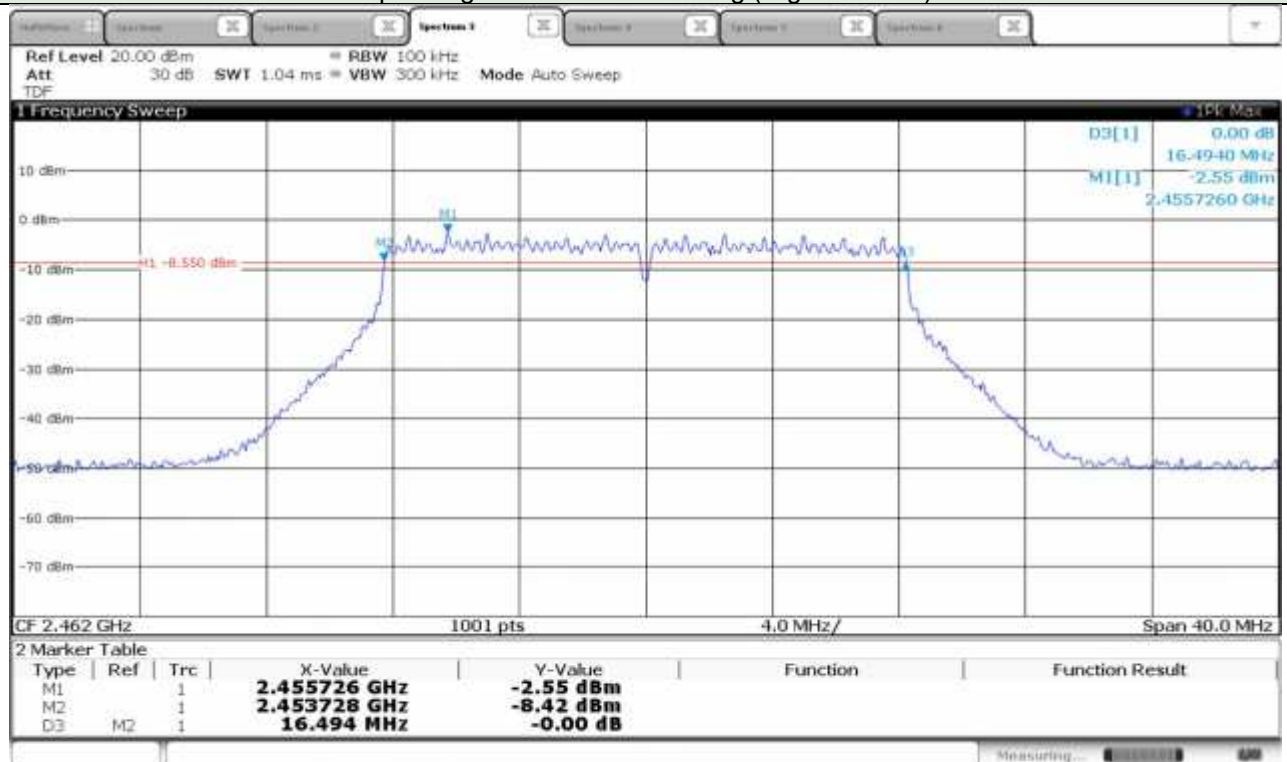
Operating Mode: WLAN 802.11g (Low Channel)



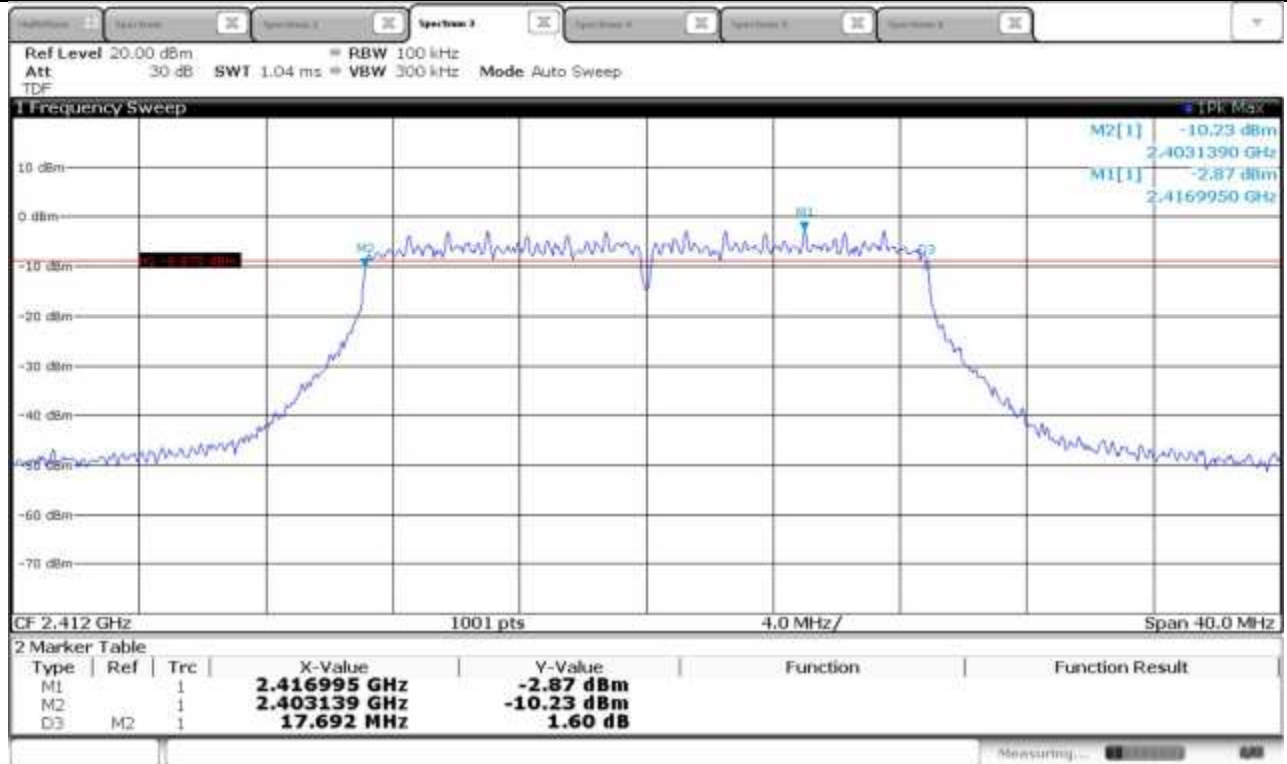
Operating Mode: WLAN 802.11g (Middle Channel)



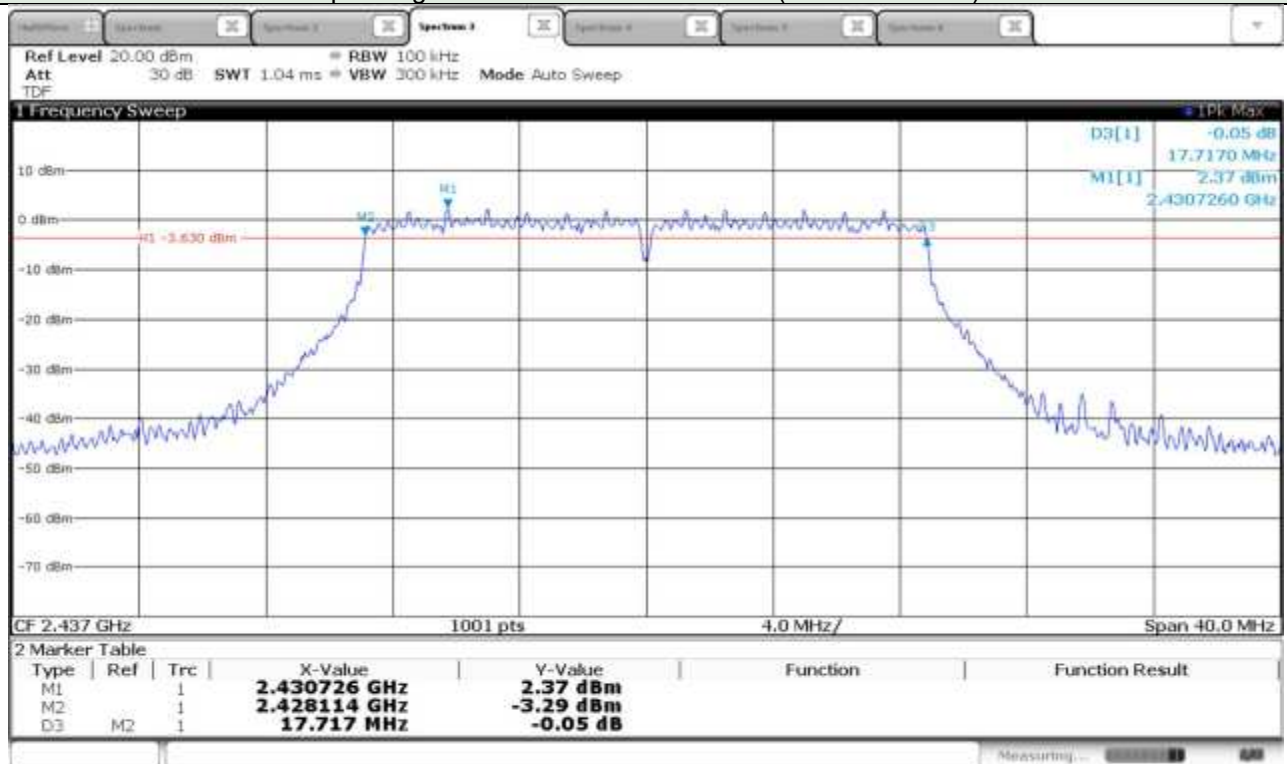
Operating Mode: WLAN 802.11g (High Channel)



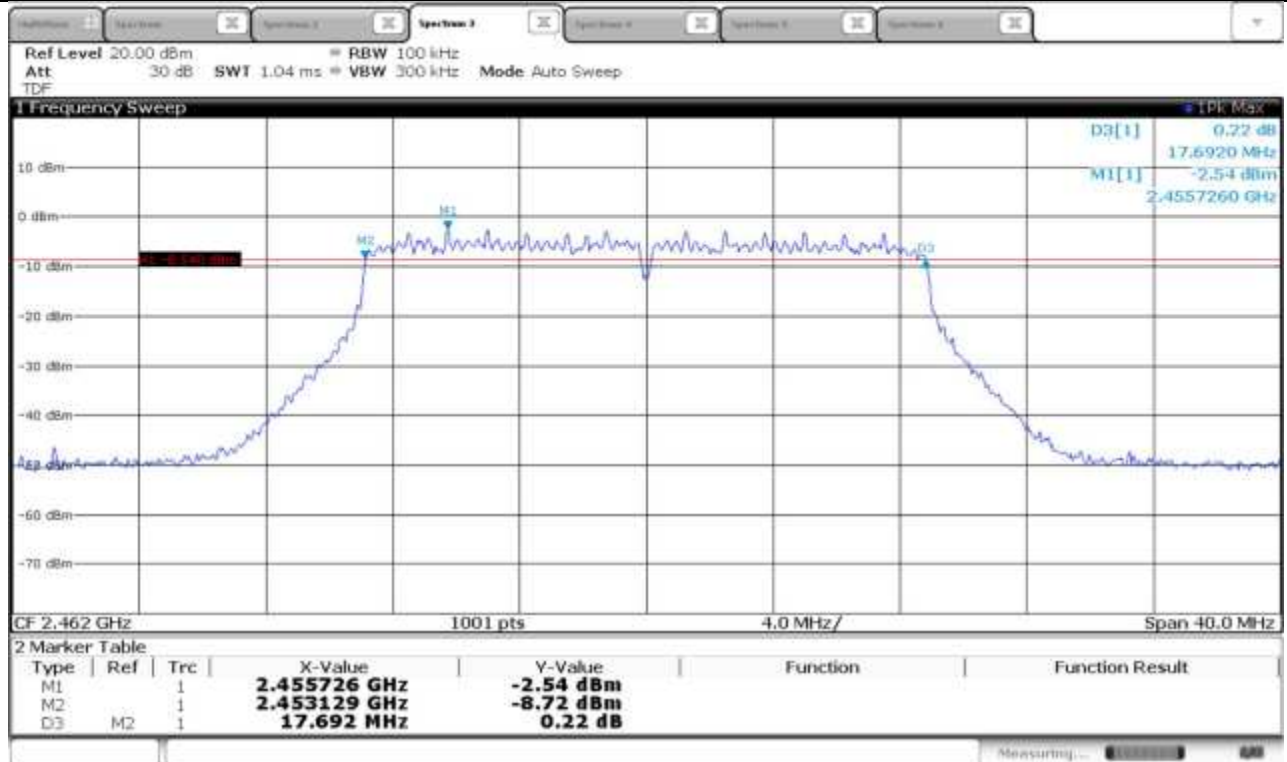
Operating Mode: WLAN 802.11n HT20 (Low Channel)



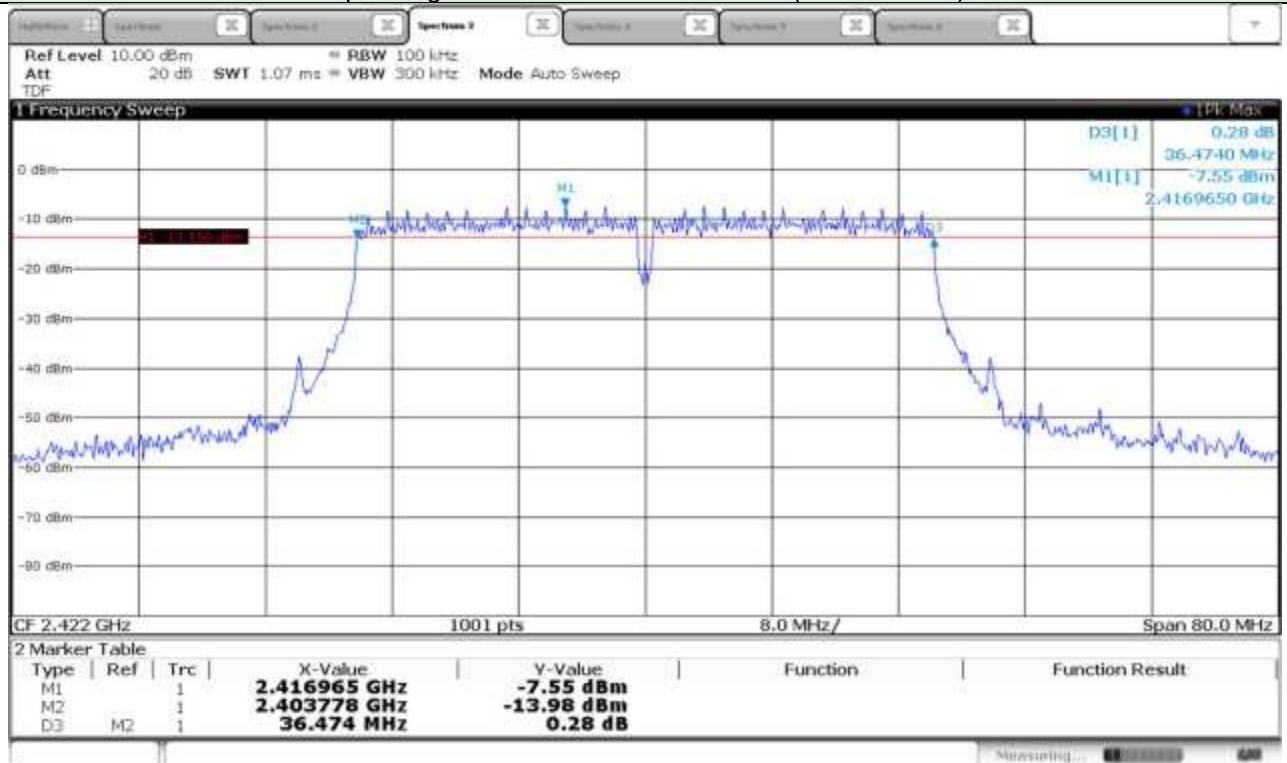
Operating Mode: WLAN 802.11n HT20 (Middle Channel)



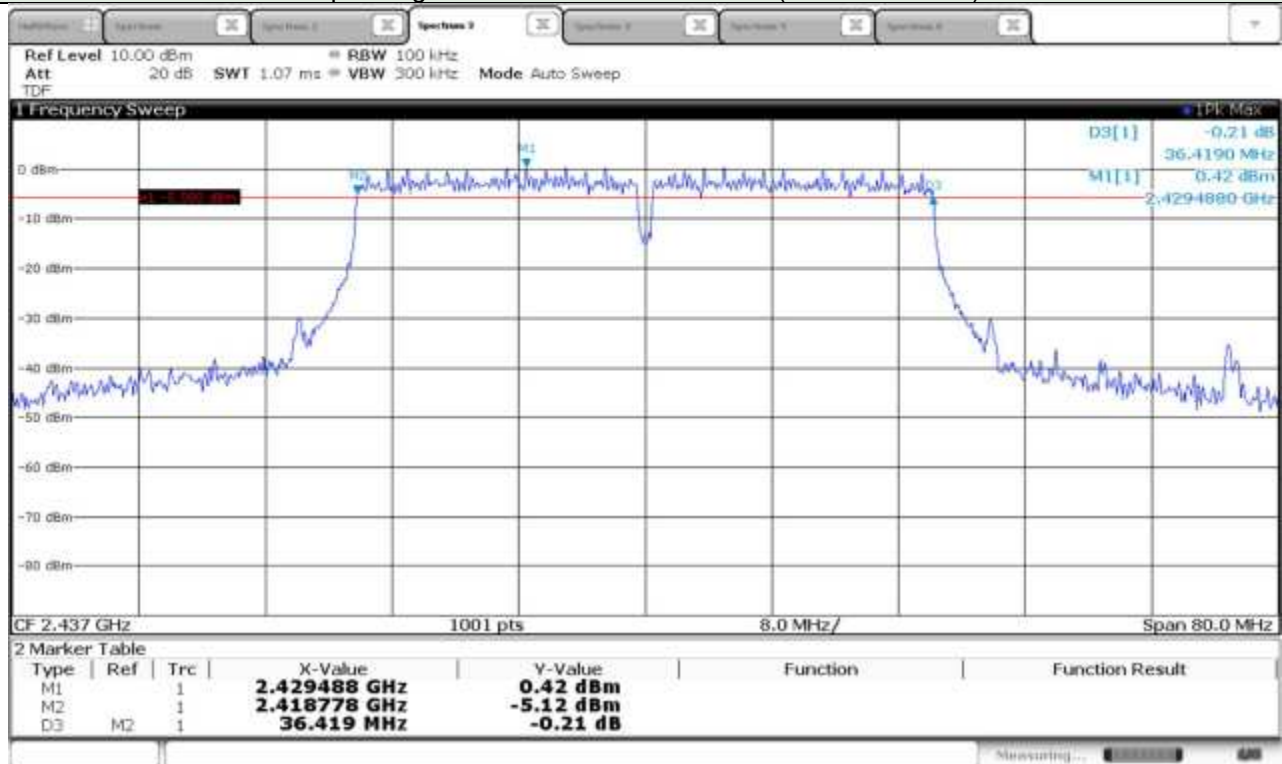
Operating Mode: WLAN 802.11n HT20 (High Channel)



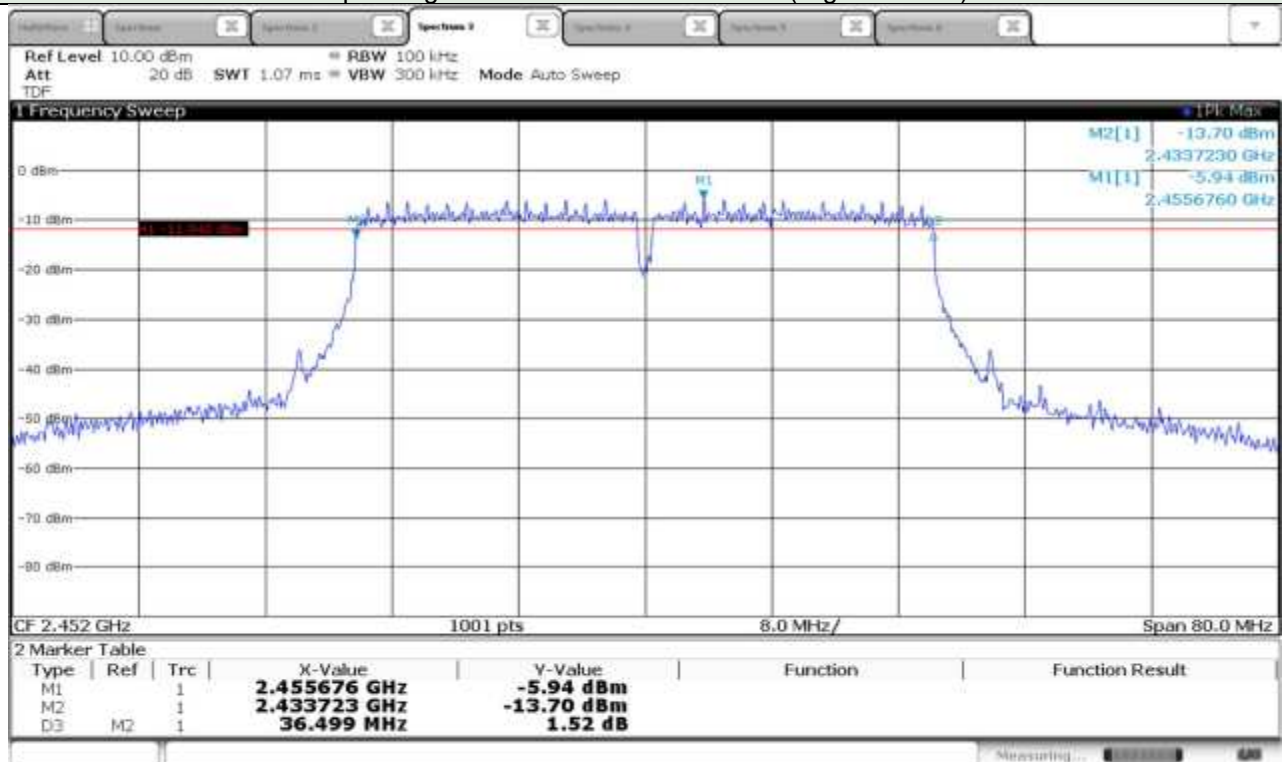
Operating Mode: WLAN 802.11n HT40 (Low Channel)



Operating Mode: WLAN 802.11n HT40 (Middle Channel)



Operating Mode: WLAN 802.11n HT40 (High Channel)



5.2 99 % Bandwidth

5.2.1 Limit

Not applicable.

5.2.2 Method of Measurement

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1 % to 5 % of the OBW.

The span is set to capture all products of the modulation process, including the emission skirts.

The VBW is set to 3 times the RBW. The sweep time is coupled and peak detection and max hold mode is used. The spectrum analyzer internal 99% bandwidth function is utilized.

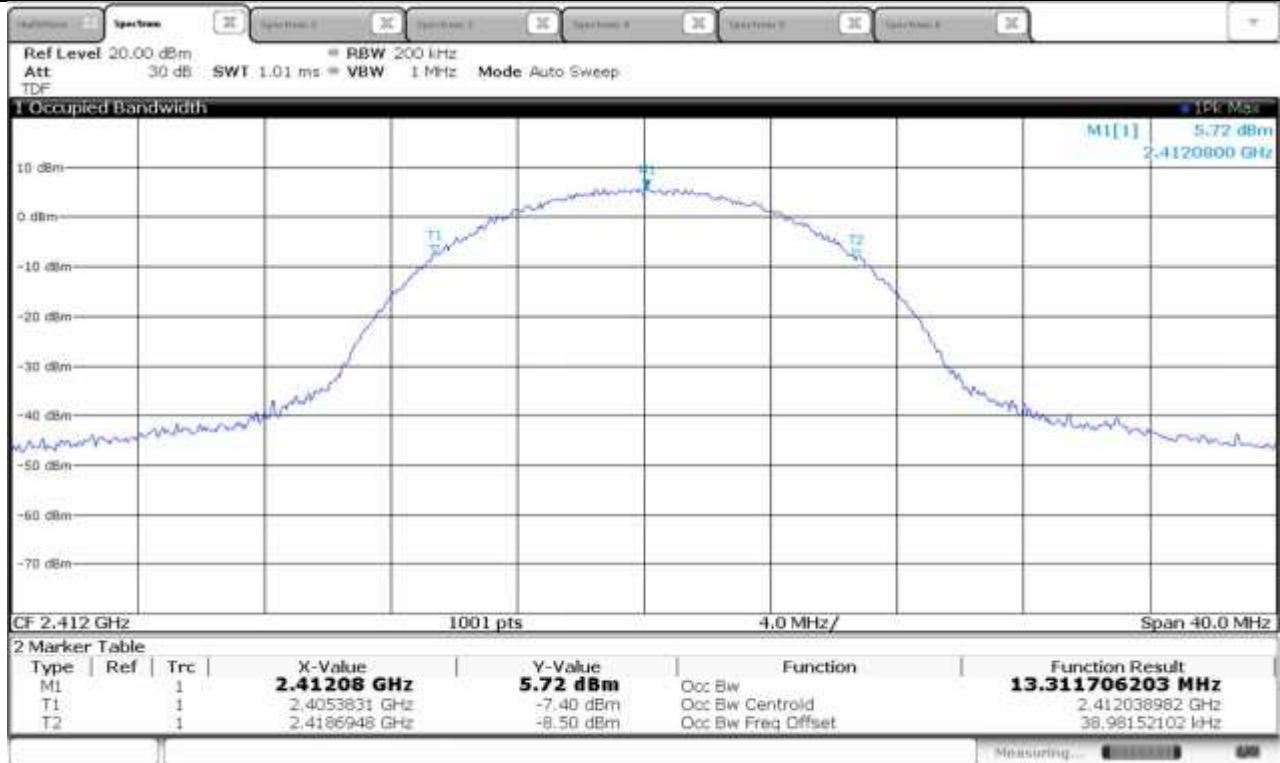
5.2.3 Test Data

Date of Test	2021-01-11	Temperature	(20.3 ± 0.9) °C
		Relative humidity	(41.6 ± 0.4) % R.H.
Test Result	PASS	Tested by	Do-heon Kim 

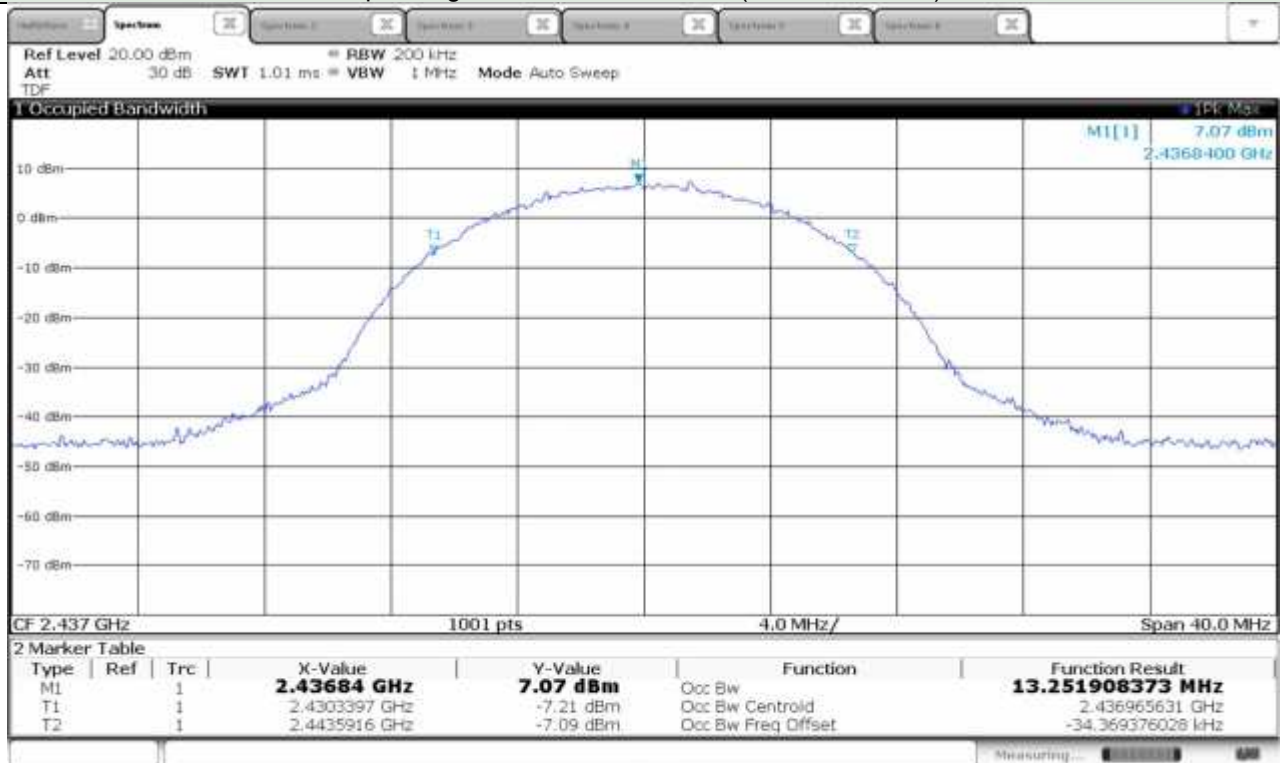
Operational Mode: WLAN 802.11b		
Channel	Frequency (MHz)	99 % Bandwidth (MHz)
Low	2 412	13.312
Middle	2 437	13.252
High	2 462	13.252
Operational Mode: WLAN 802.11g		
Channel	Frequency (MHz)	99 % Bandwidth (MHz)
Low	2 412	16.525
Middle	2 437	16.520
High	2 462	16.492
Operational Mode: WLAN 802.11n HT20		
Channel	Frequency (MHz)	99 % Bandwidth (MHz)
Low	2 412	17.683
Middle	2 437	17.680
High	2 462	17.645
Operational Mode: WLAN 802.11n HT40		
Channel	Frequency (MHz)	99 % Bandwidth (MHz)
Low	2 422	36.242
Middle	2 437	36.345
High	2 452	36.266

5.2.4 Test Plots

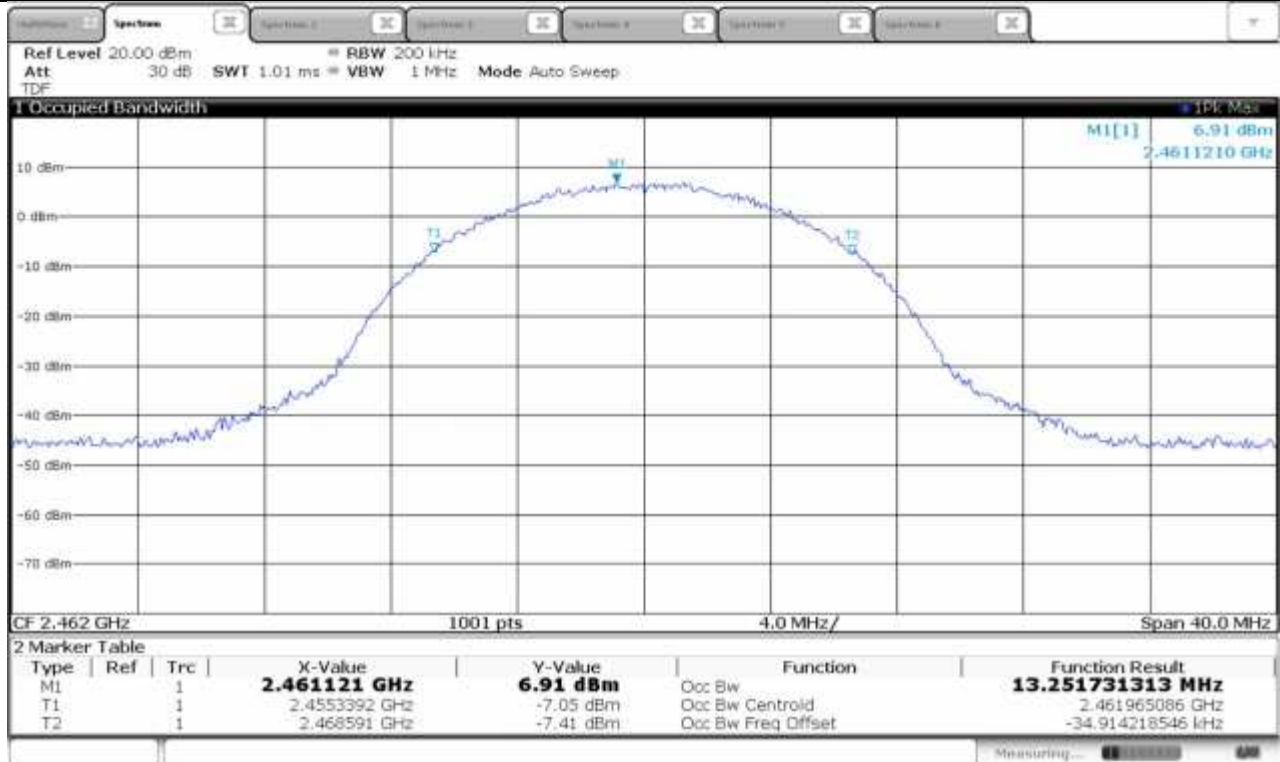
Operating Mode: WLAN 802.11b (Low Channel)



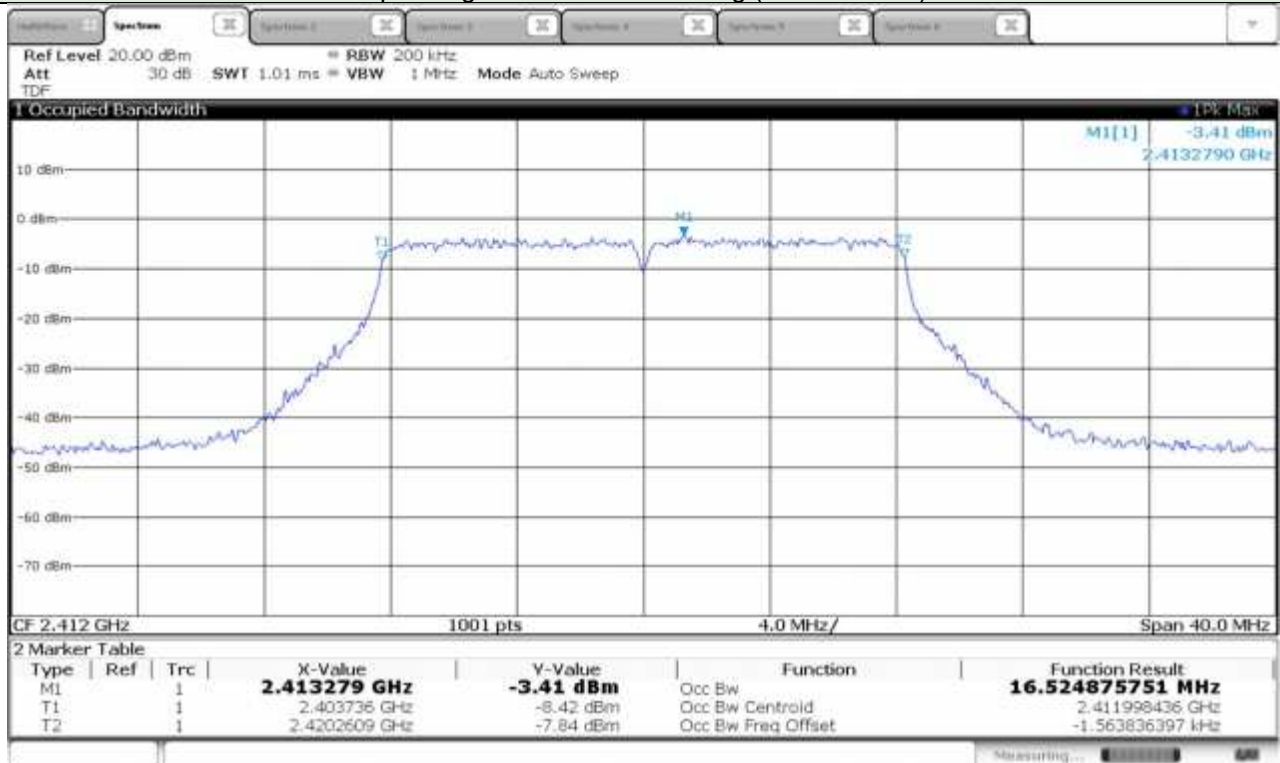
Operating Mode: WLAN 802.11b (Middle Channel)



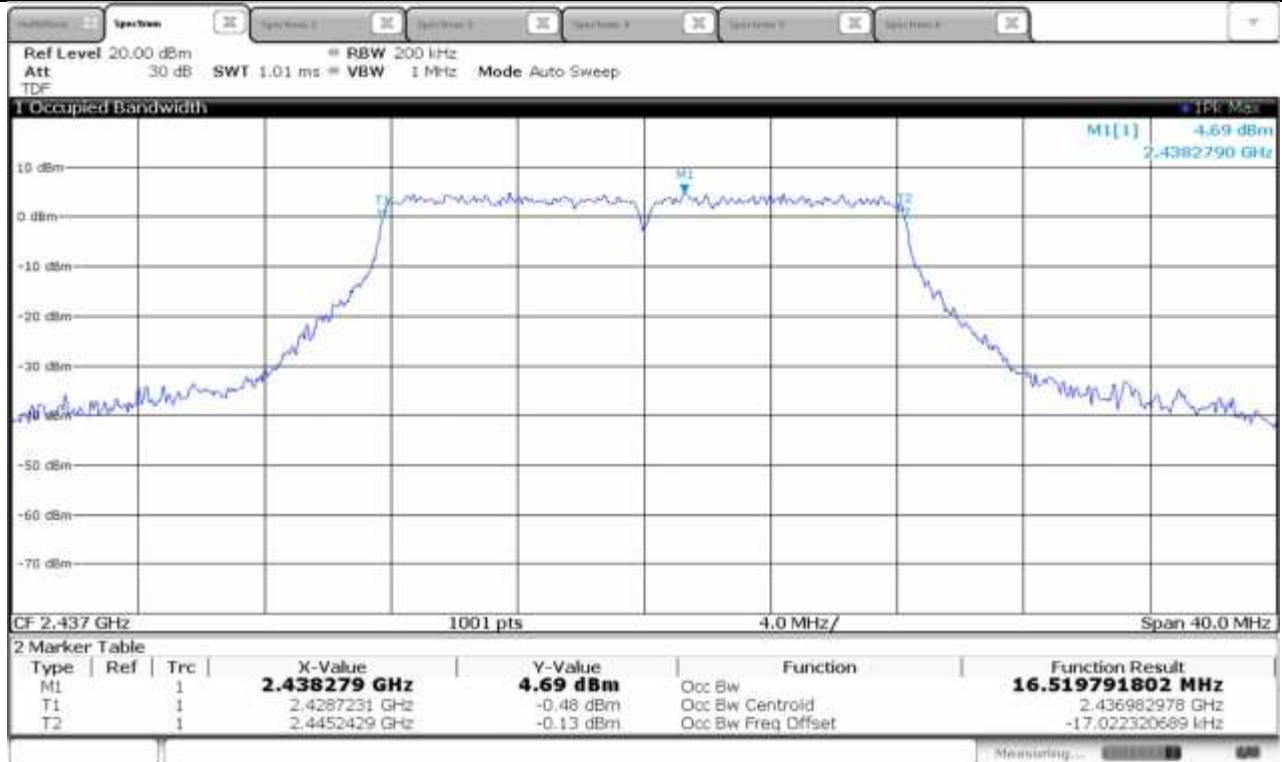
Operating Mode: WLAN 802.11b (High Channel)



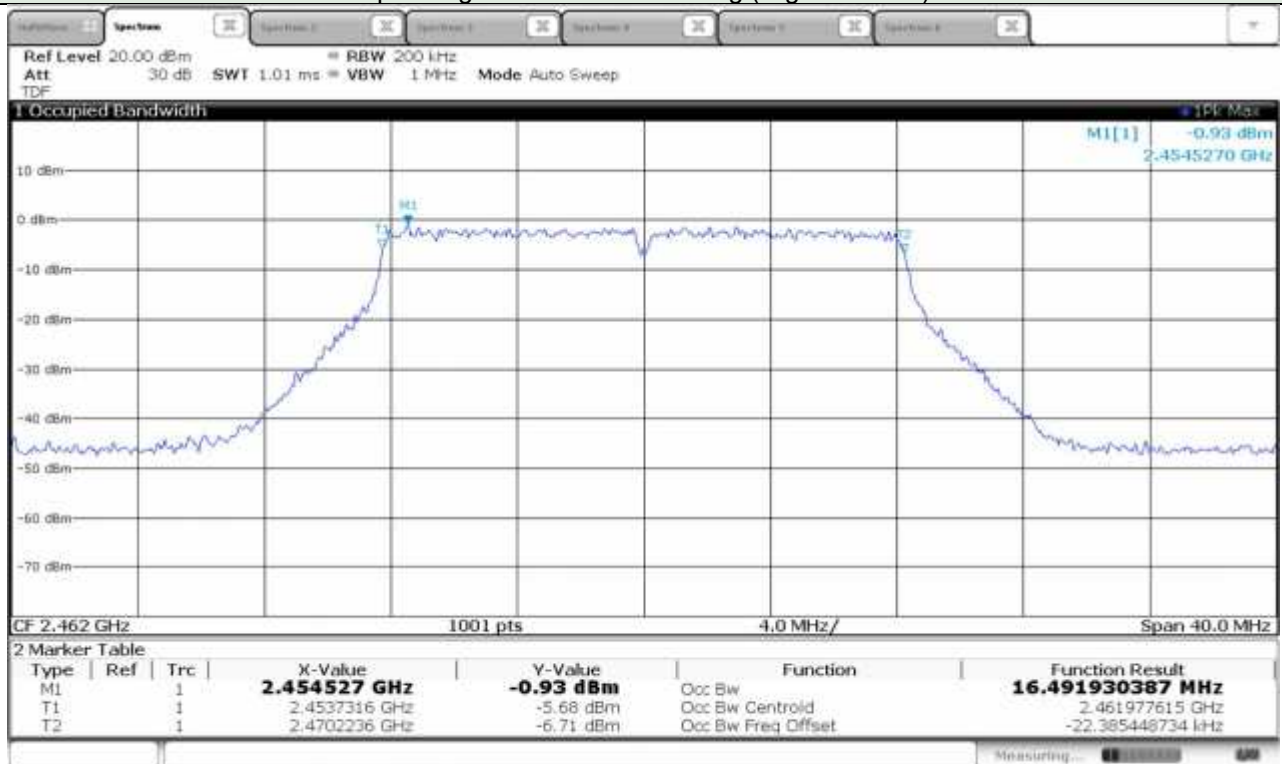
Operating Mode: WLAN 802.11g (Low Channel)



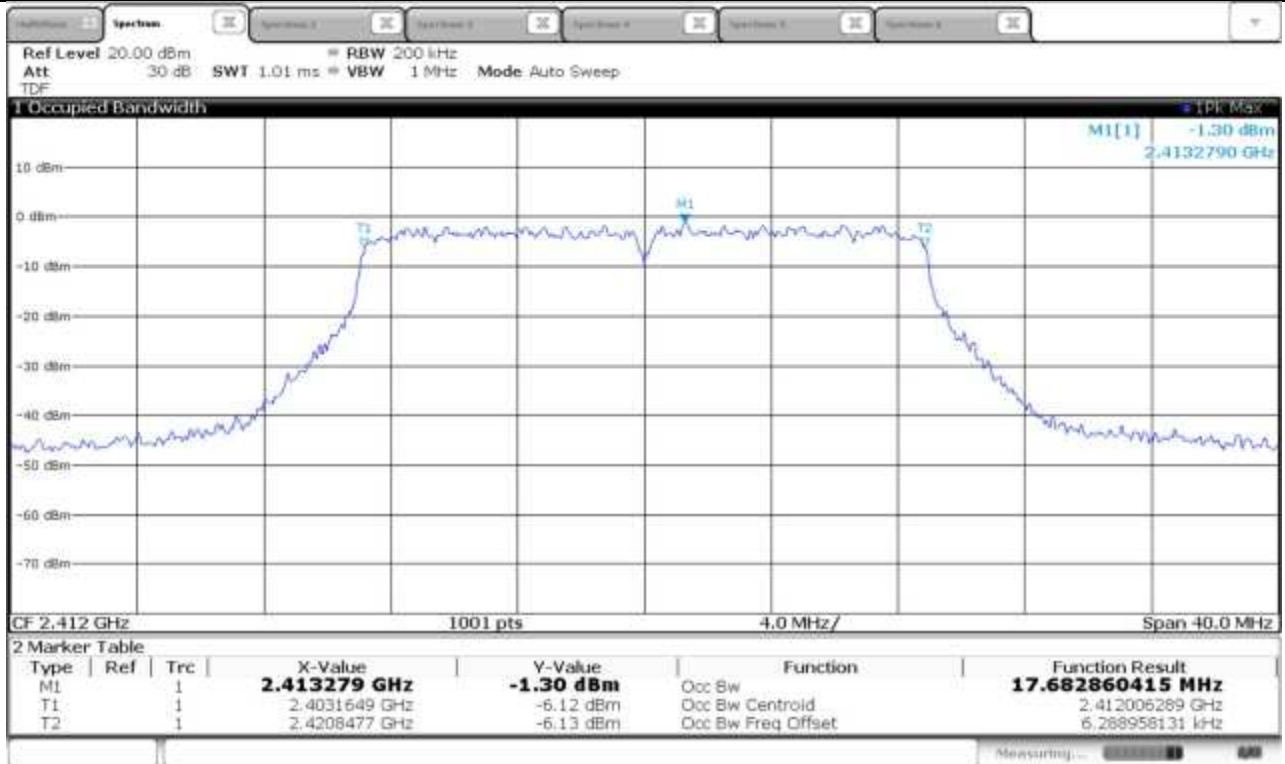
Operating Mode: WLAN 802.11g (Middle Channel)



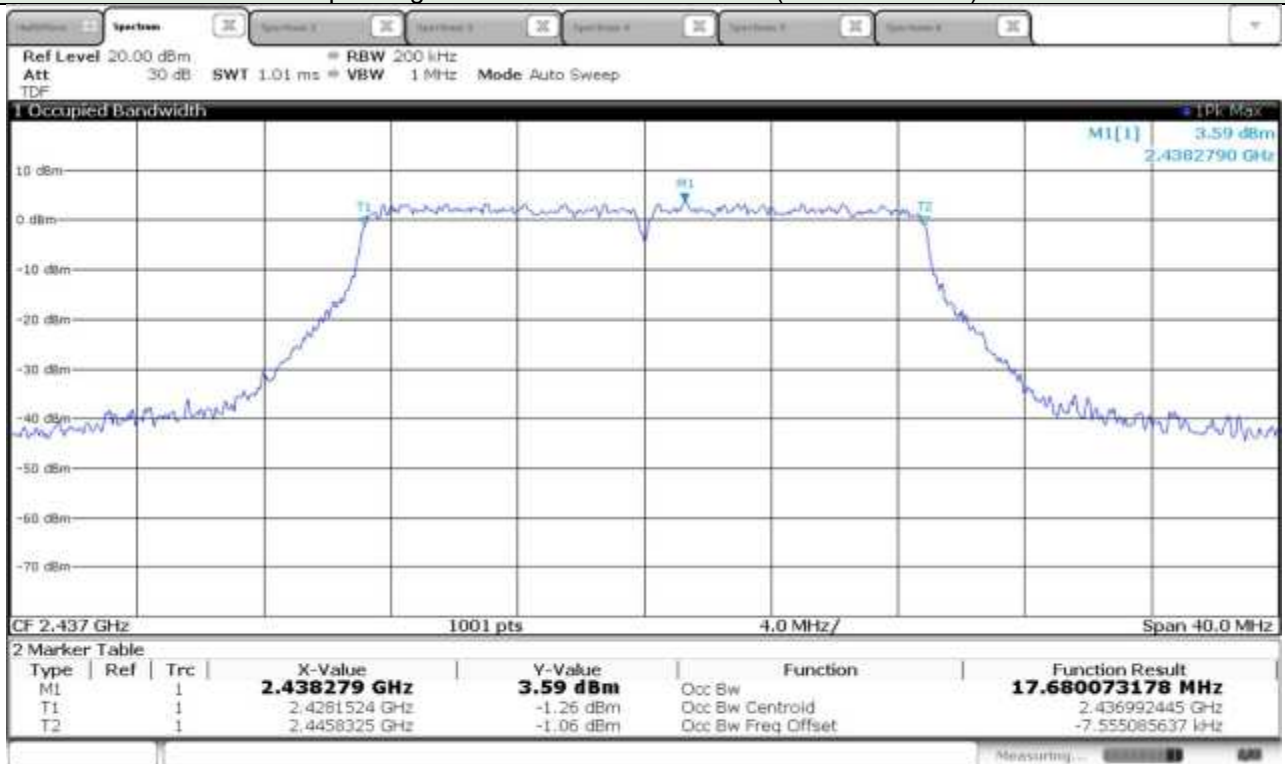
Operating Mode: WLAN 802.11g (High Channel)



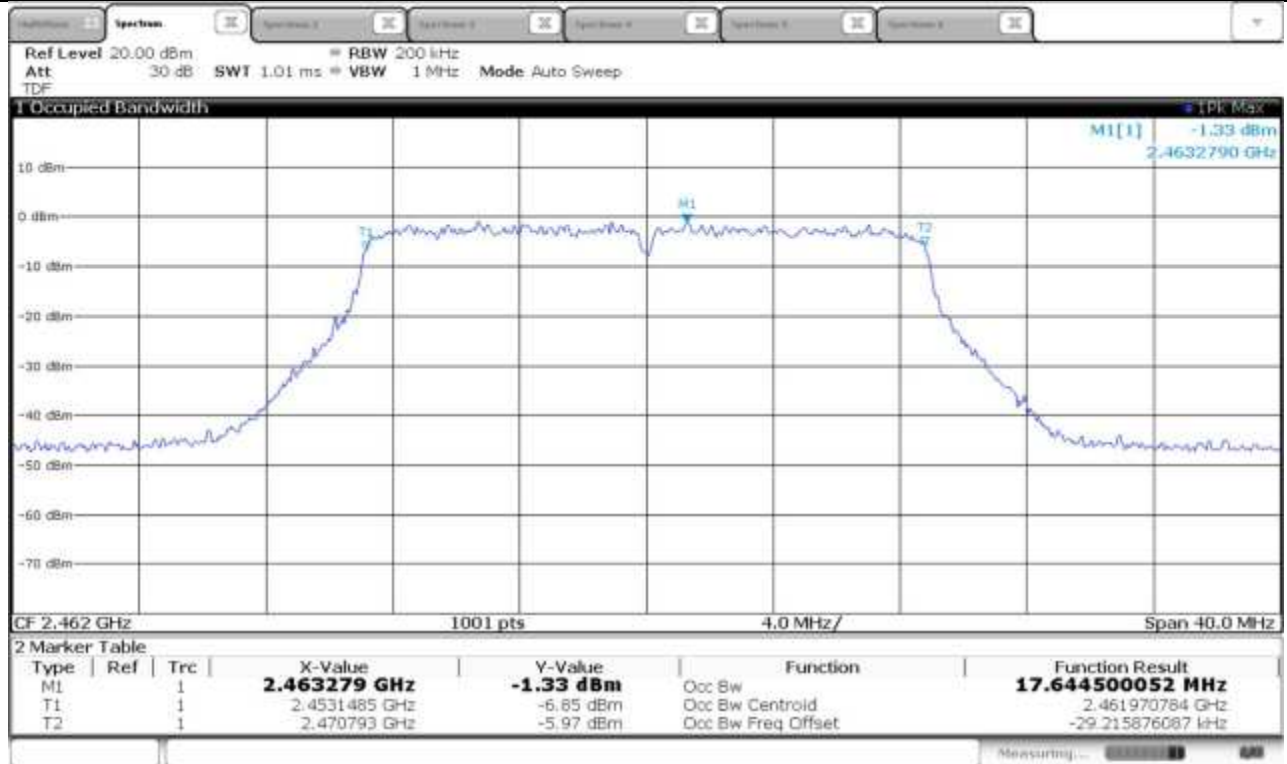
Operating Mode: WLAN 802.11n HT20 (Low Channel)



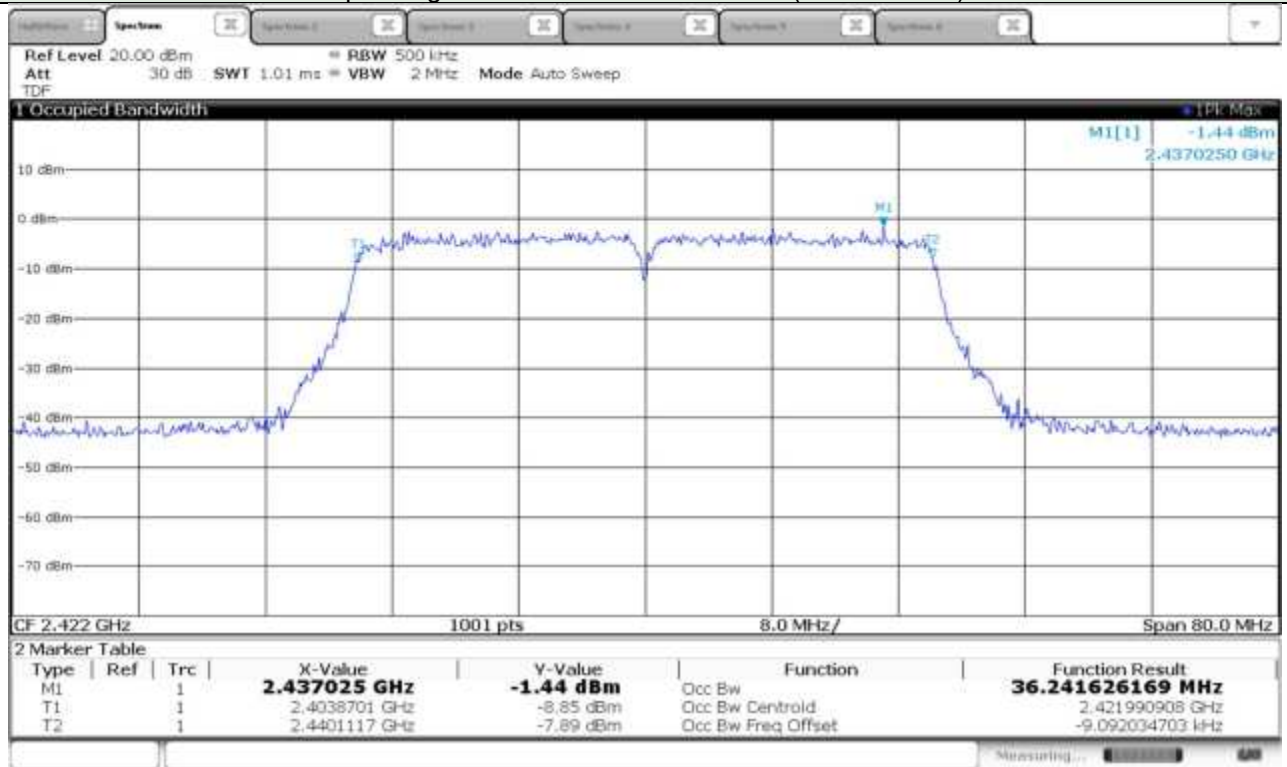
Operating Mode: WLAN 802.11n HT20 (Middle Channel)



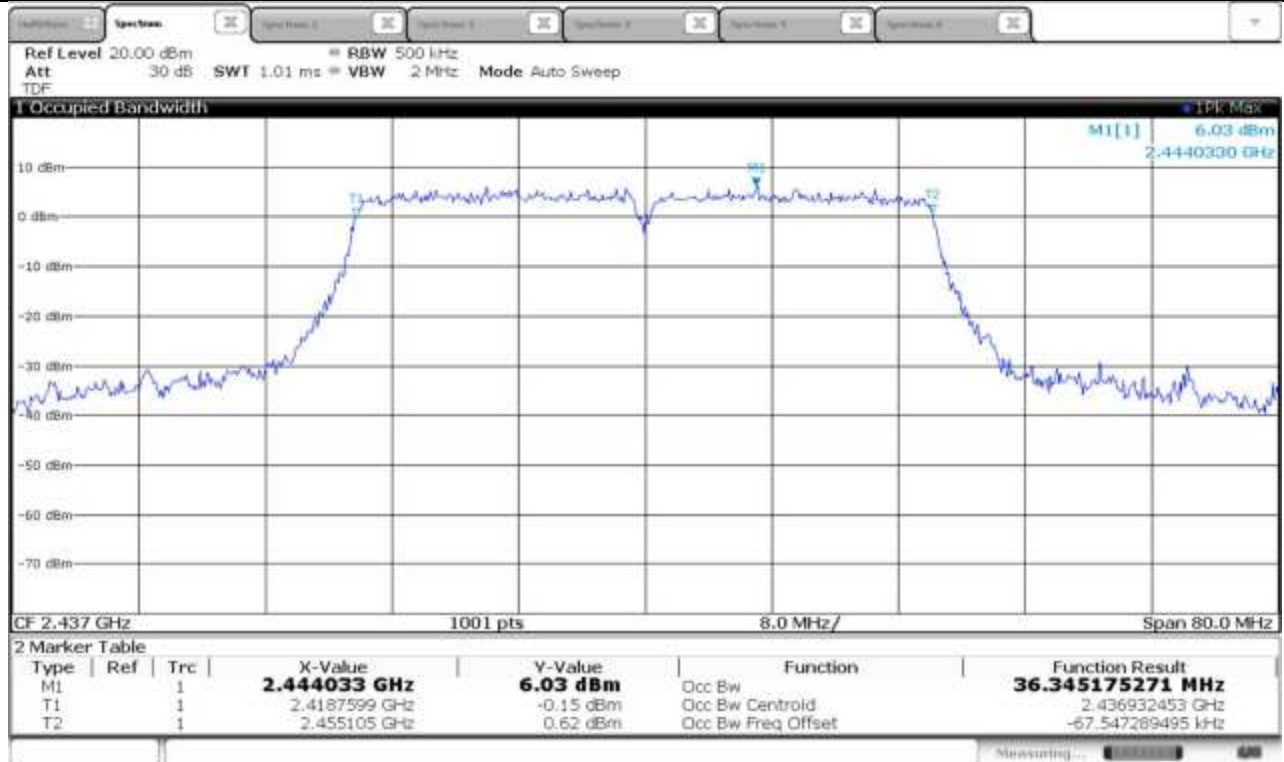
Operating Mode: WLAN 802.11n HT20 (High Channel)



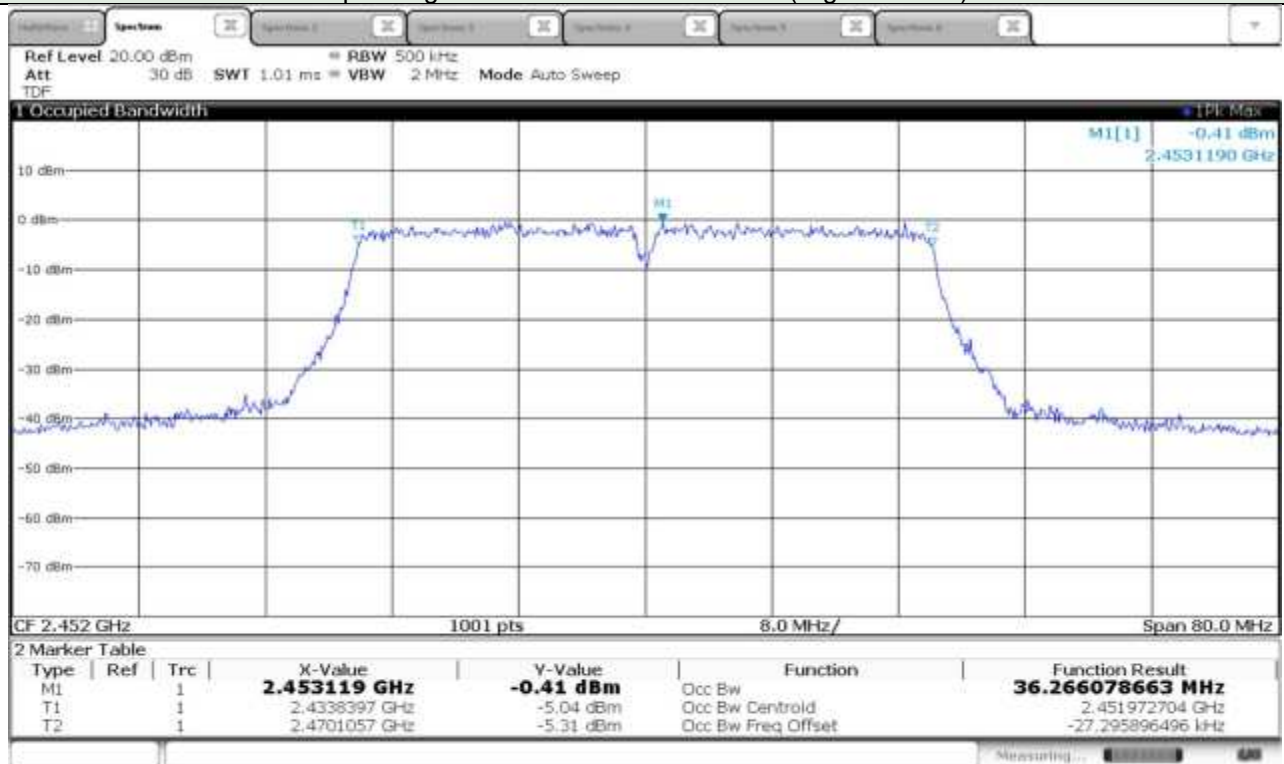
Operating Mode: WLAN 802.11n HT40 (Low Channel)



Operating Mode: WLAN 802.11n HT40 (Middle Channel)



Operating Mode: WLAN 802.11n HT40 (High Channel)



5.3 Maximum Conducted Average Output Power

5.3.1 Limit

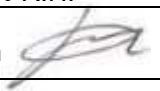
Acc. To section 15.247 and RSS-247 5.4 d), For system using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt, based on the use of antennas with directional gains that do not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.3.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas. Guidance v05r02: 8.3.2.2 Measurement using a spectrum analyzer(SA) and ANSI C63.10-2013 11.9.2.2.4 Method AVGSA-2

The cable assembly insertion loss was entered as an offset in the spectrum analyzer to allow for direct reading of power.

5.3.3 Test Data for Output Power

Date of Test	2021-01-11	Temperature	(20.3 ± 0.9) °C
		Relative humidity	(41.6 ± 0.4) % R.H.
Test Result	PASS	Tested by	Do-heon Kim 

Operating Mode: WLAN 802.11b						
Channel	Frequency (MHz)	Measured Value (dBm)	Duty Factor (dB)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	2 412	10.36	1.00	11.36	30.00	18.64
Middle	2 437	11.48	1.00	12.48	30.00	17.52
High	2 462	11.28	1.00	12.28	30.00	17.72

Note. 1. Margin = Limit – Total Power Value
 2. Total Power = Measured value + Duty Factor
 3. Duty cycle (x): 0.7937
 4 Duty factor (10log 1/x): 1.00

Operating Mode: WLAN 802.11g						
Channel	Frequency (MHz)	Measured Value (dBm)	Duty Factor (dB)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	2 412	-0.21	6.77	6.56	30.00	23.44
Middle	2 437	7.64	6.77	14.41	30.00	15.59
High	2 462	1.71	6.77	8.48	30.00	21.52

Note. 1. Margin = Limit – Total Power Value
 2. Total Power = Measured value + Duty Factor
 3. Duty cycle (x): 0.210 5
 4 Duty factor (10log 1/x): 6.77 dB

Operating Mode: WLAN 802.11n HT20						
Channel	Frequency (MHz)	Measured Value (dBm)	Duty Factor (dB)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	2 412	0.96	6.73	7.69	30.00	22.31
Middle	2 437	6.97	6.73	13.70	30.00	16.30
High	2 462	1.83	6.73	8.56	30.00	21.44

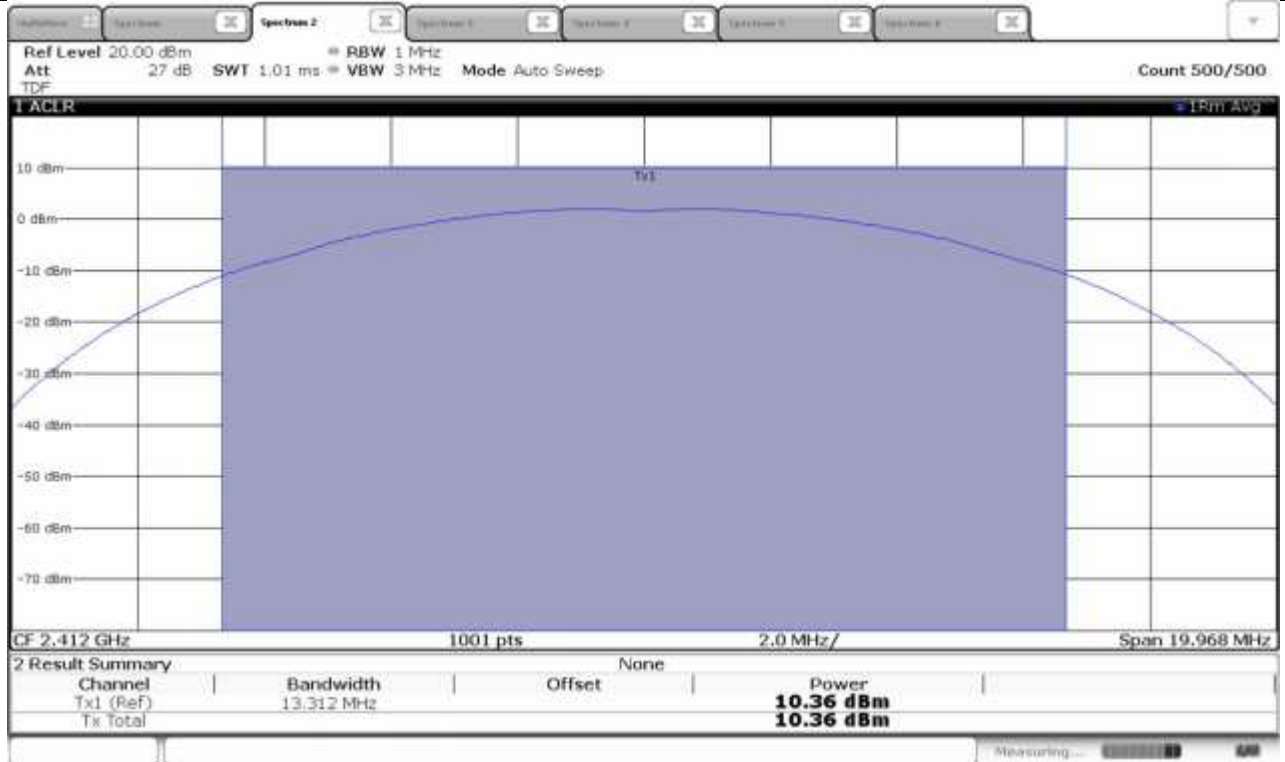
Note. 1. Margin = Limit – Total Power Value
 2. Total Power = Measured value + Duty Factor
 3. Duty cycle (x): 0.212 5
 4 Duty factor (10log 1/x): 6.73 dB

Operating Mode: WLAN 802.11n HT40						
Channel	Frequency (MHz)	Measured Value (dBm)	Duty Factor (dB)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	2 422	-4.58	10.91	6.33	30.00	23.67
Middle	2 437	3.27	10.91	14.18	30.00	15.82
High	2 452	-2.51	10.91	8.40	30.00	21.60

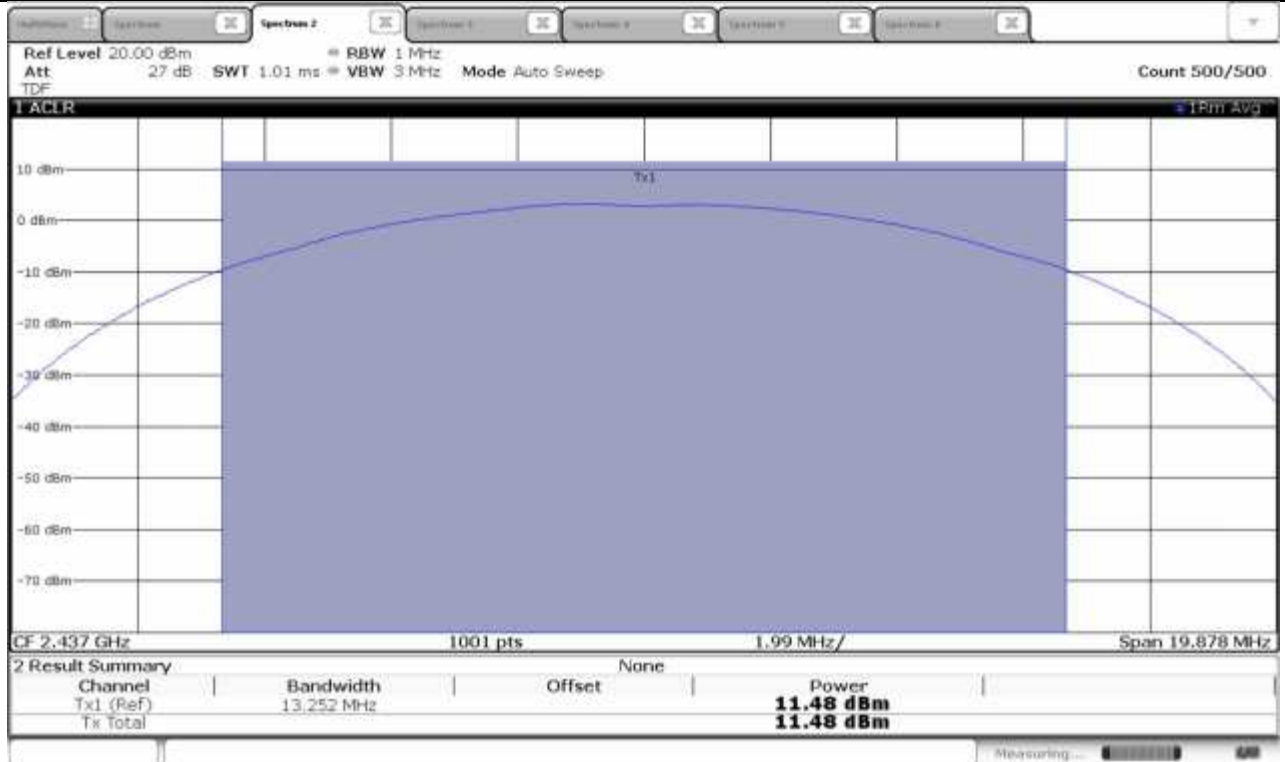
Note. 1. Margin = Limit – Total Power Value
 2. Total Power = Measured value + Duty Factor
 3. Duty cycle (x): 0.081 2
 4 Duty factor (10log 1/x): 10.91 dB

5.3.4 Test Plots

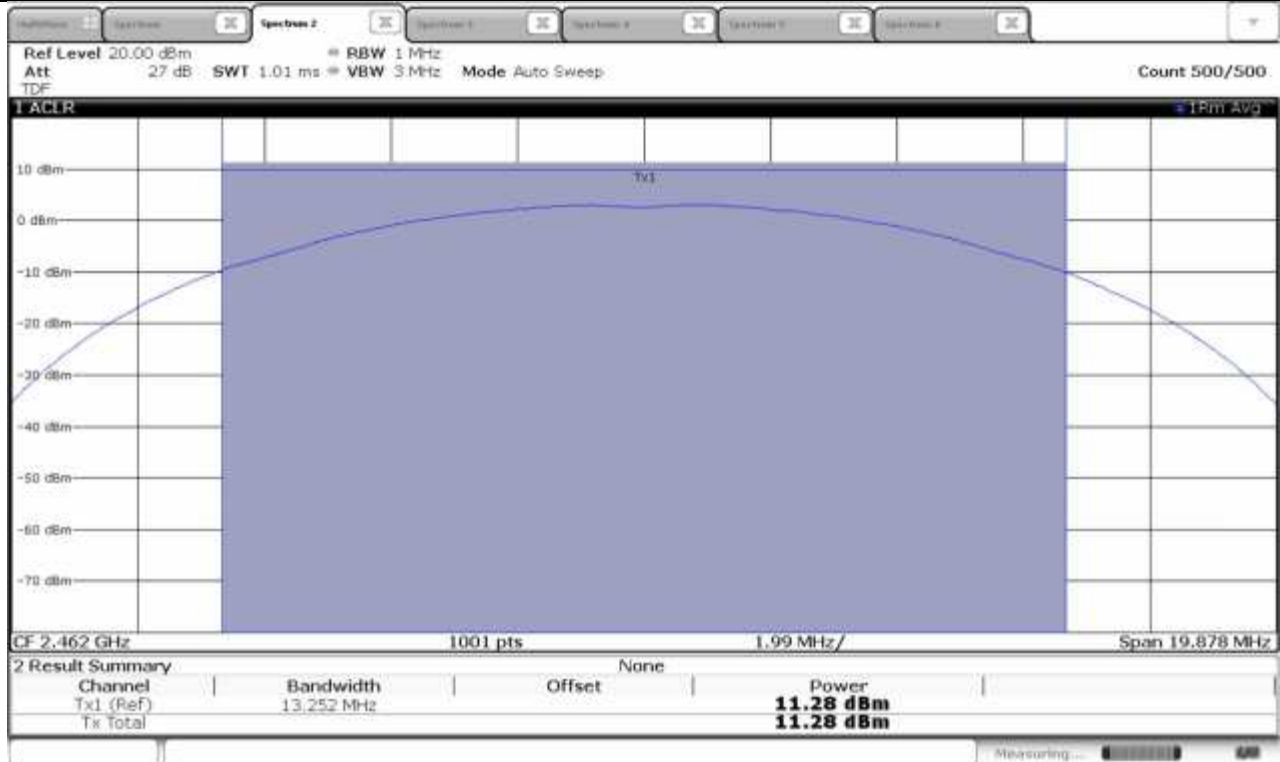
Operating Mode: WLAN 802.11b (Low Channel)



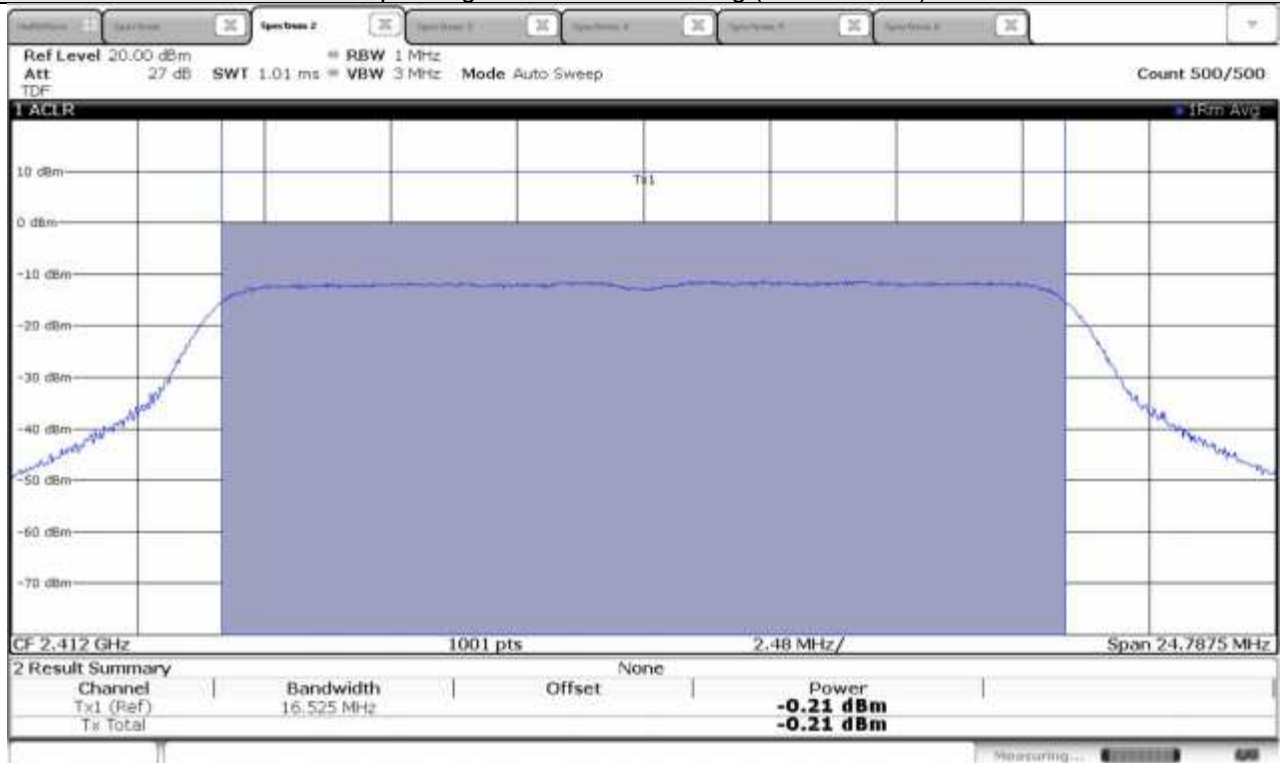
Operating Mode: WLAN 802.11b (Middle Channel)



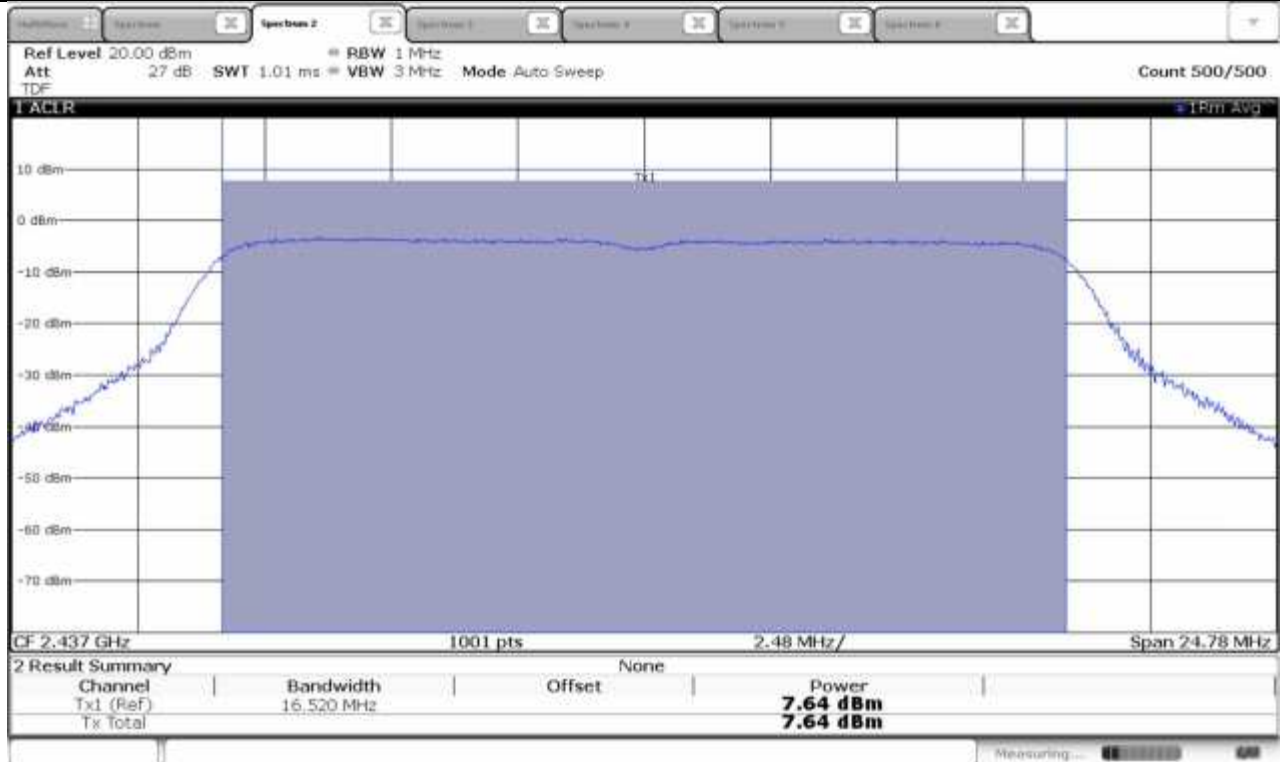
Operating Mode: WLAN 802.11b (High Channel)



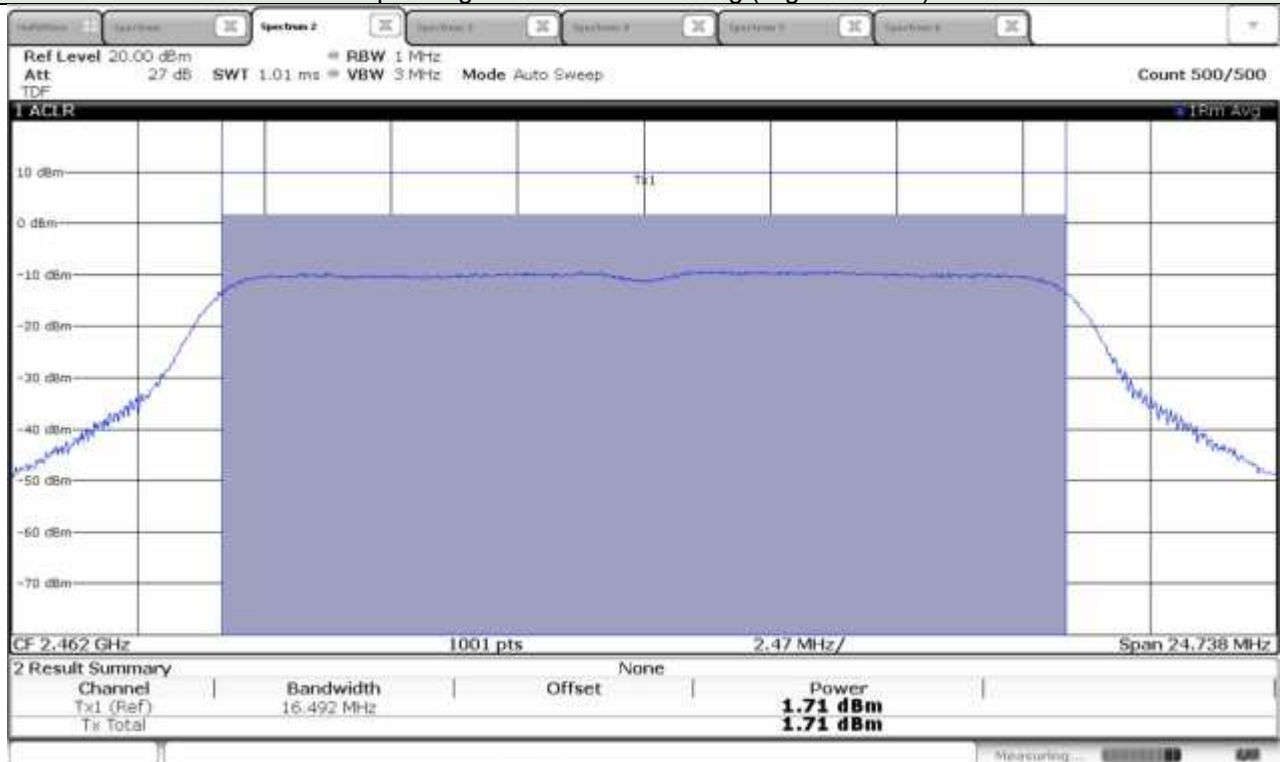
Operating Mode: WLAN 802.11g (Low Channel)



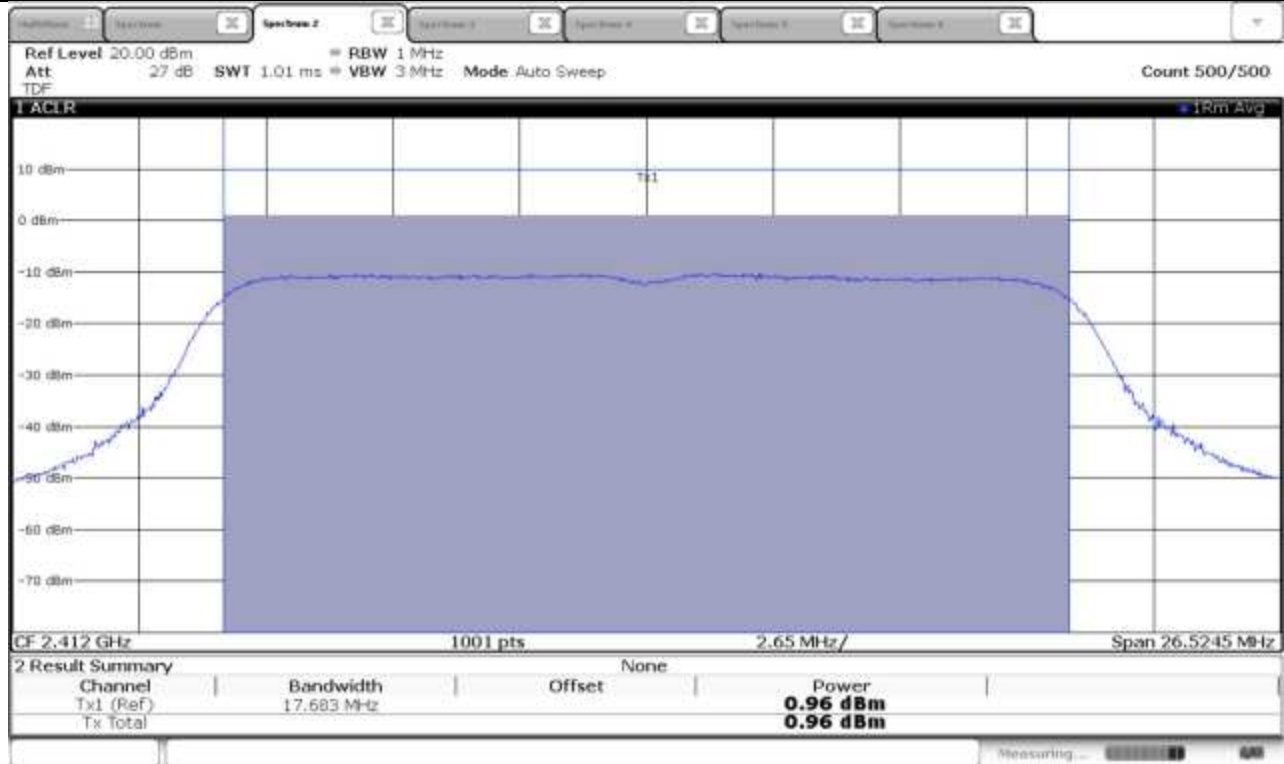
Operating Mode: WLAN 802.11g (Middle Channel)



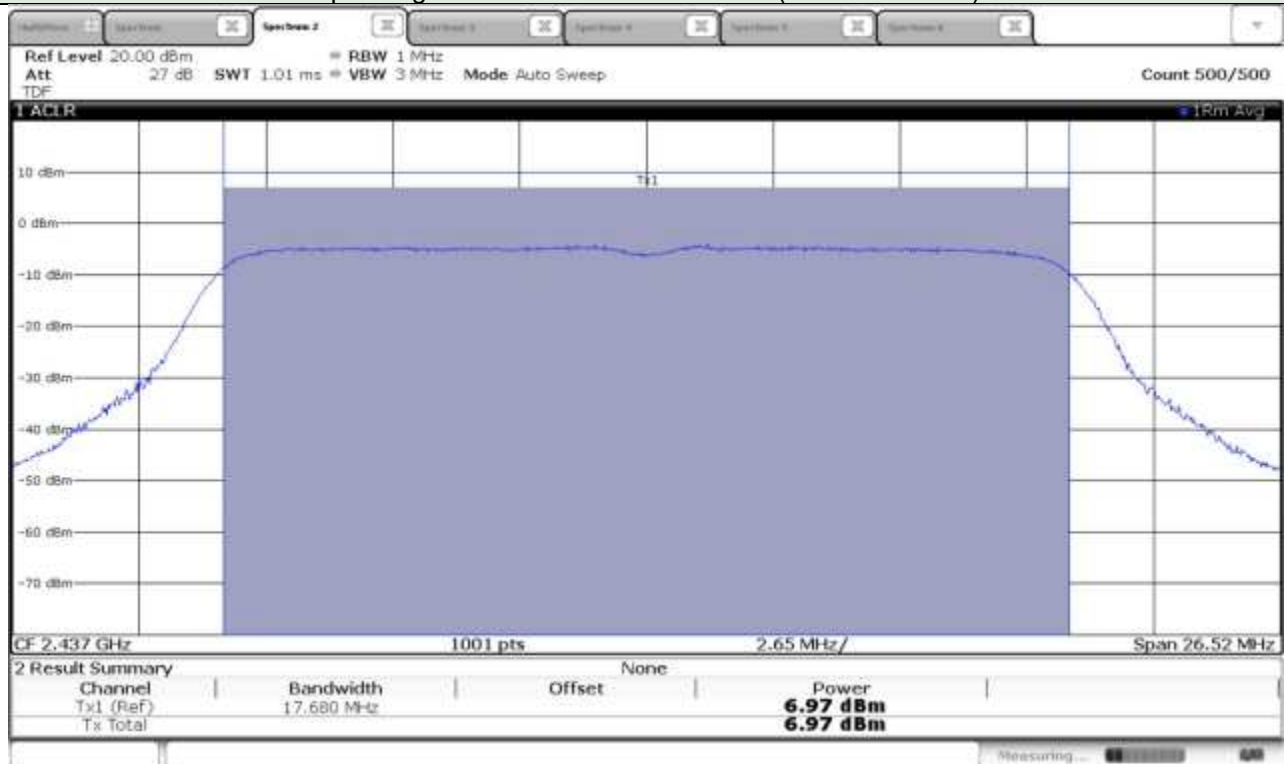
Operating Mode: WLAN 802.11g (High Channel)



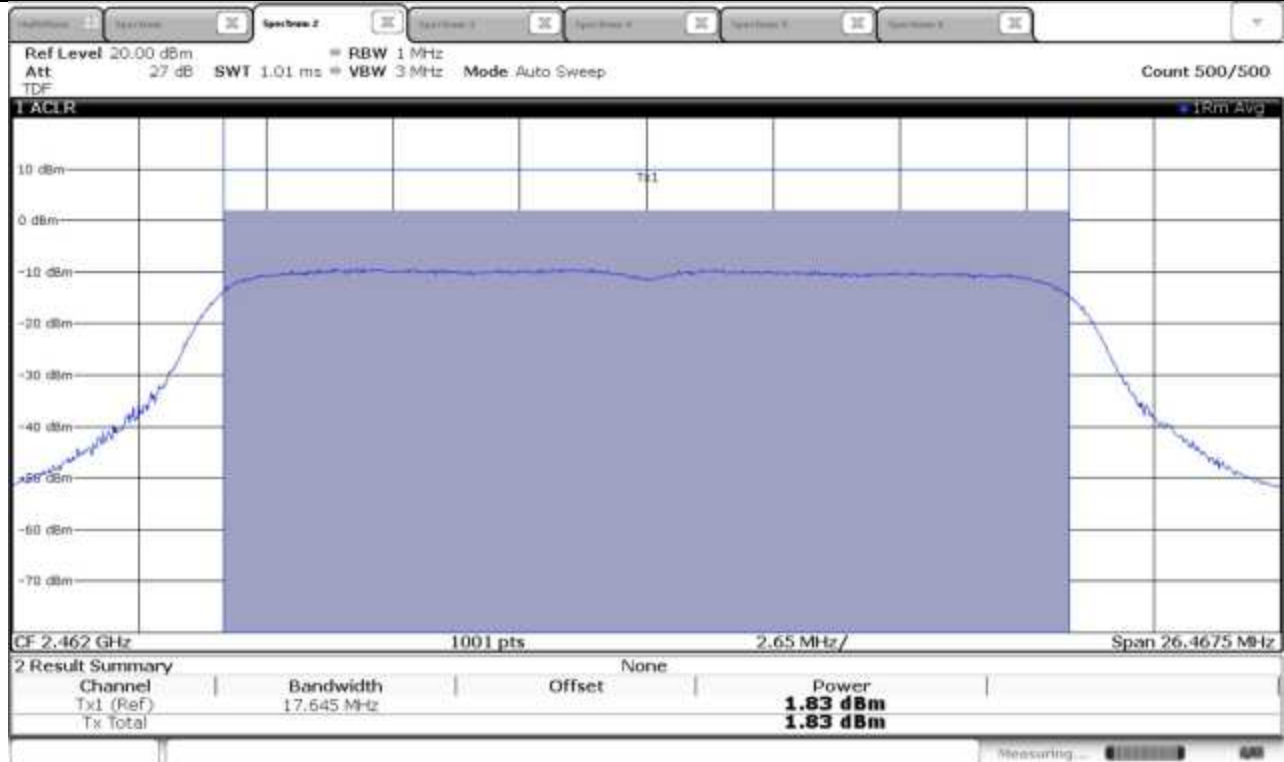
Operating Mode: WLAN 802.11n HT20 (Low Channel)



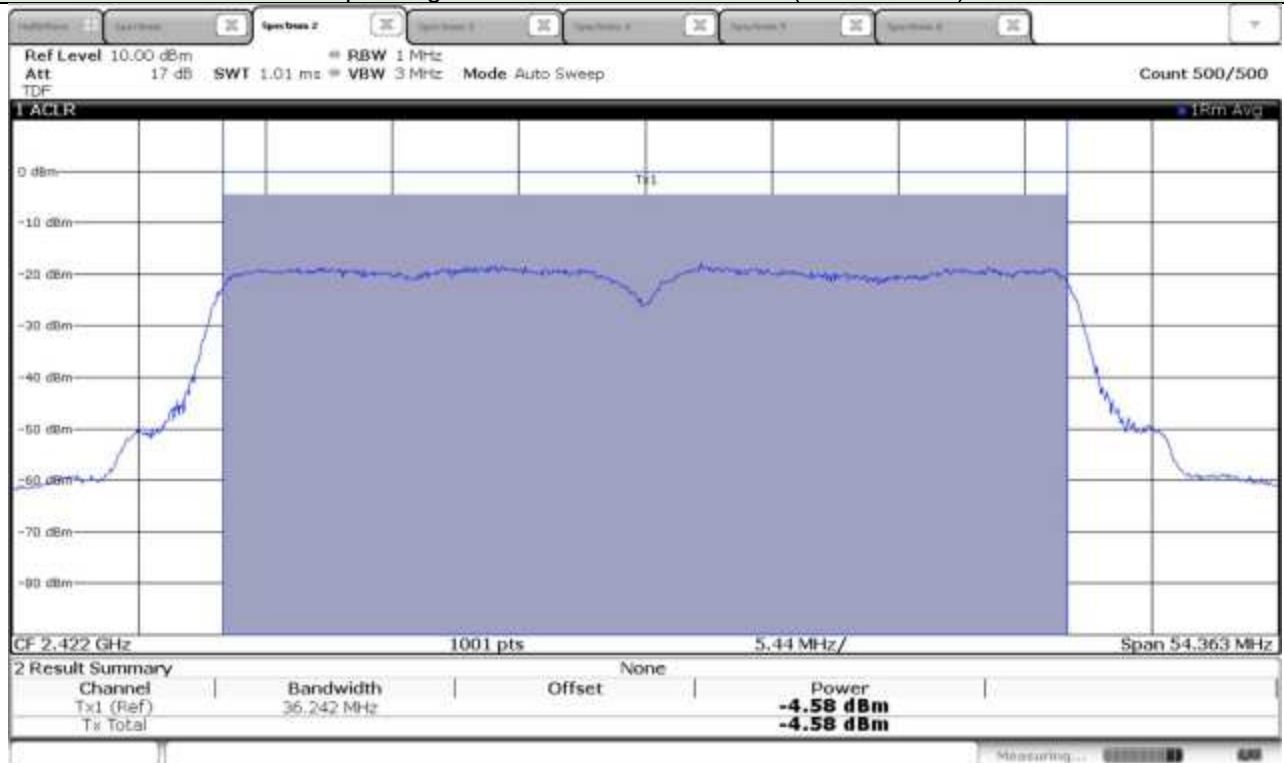
Operating Mode: WLAN 802.11n HT20 (Middle Channel)



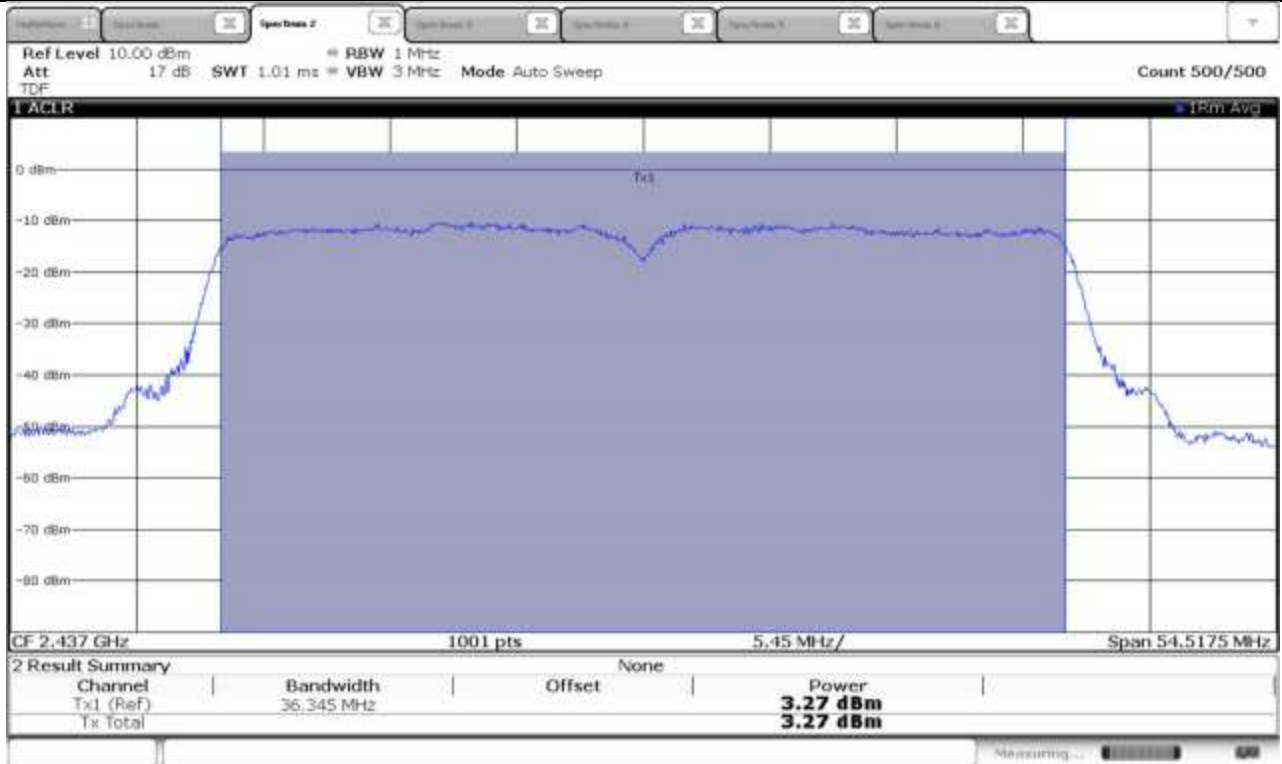
Operating Mode: WLAN 802.11n HT20 (High Channel)



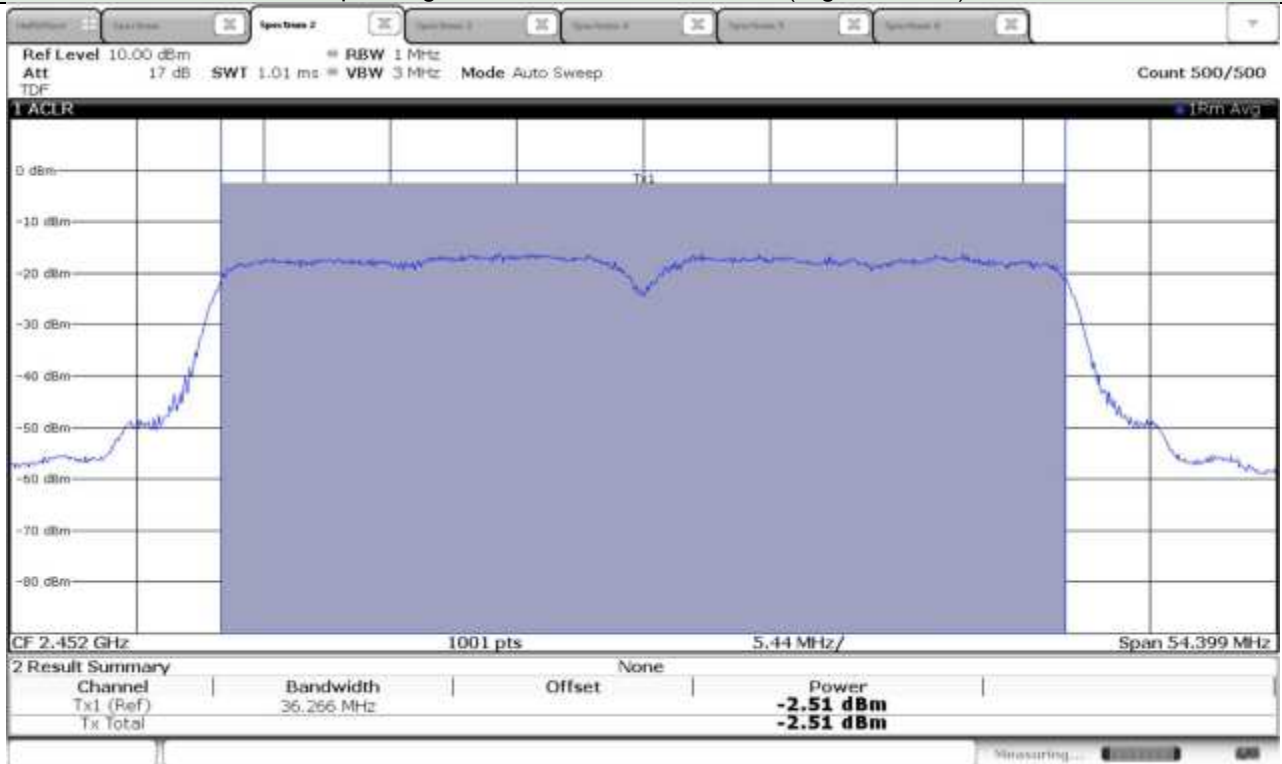
Operating Mode: WLAN 802.11n HT40 (Low Channel)



Operating Mode: WLAN 802.11n HT40 (Middle Channel)



Operating Mode: WLAN 802.11n HT40 (High Channel)



5.4 Peak Power Spectral Density

5.4.1 Limit

Acc. To section 15.247 and RSS-247 5.2 b), the power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

5.4.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05r02: 8.4 Method PKPSD (peak PSD).

The transmitter output is connected to a spectrum analyzer with the RBW set from 3 kHz to 100 kHz,
VBW $\geq$ 3 X RBW, peak detector and max hold.

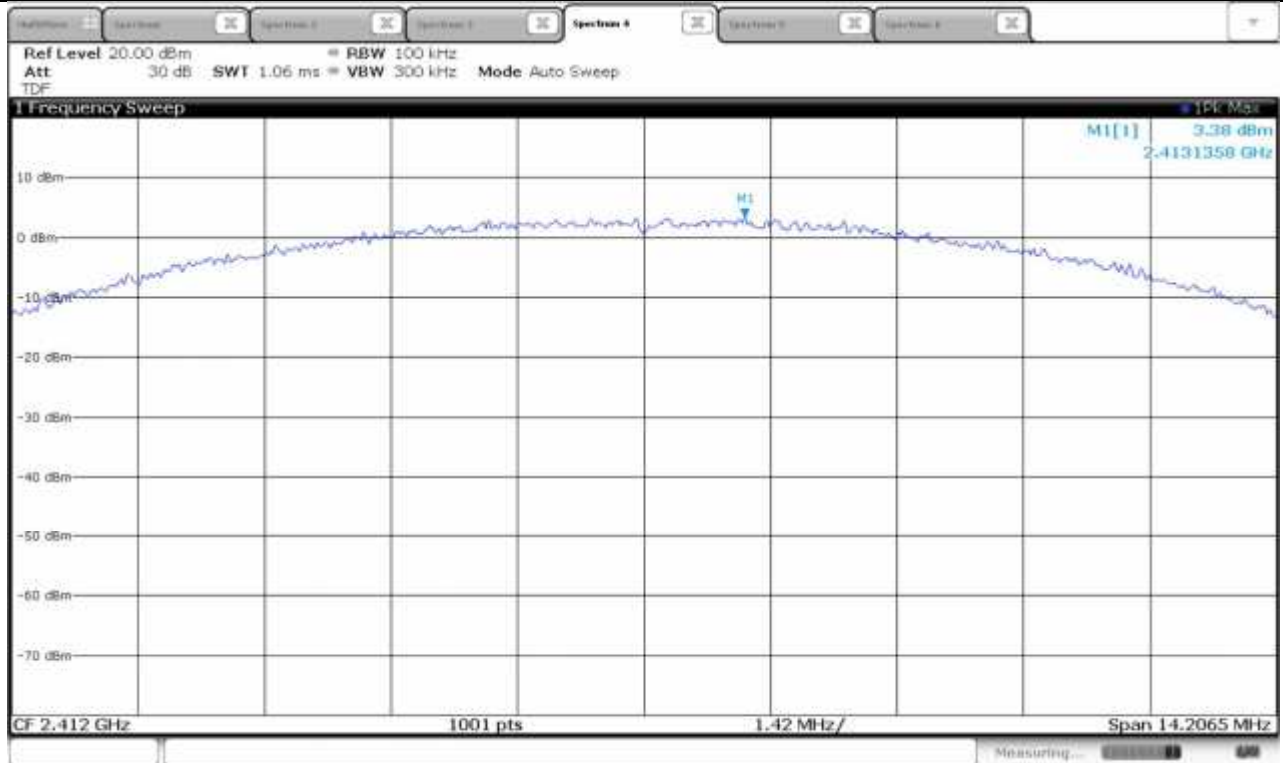
5.4.3 Test Data

Date of Test		2021-01-11	Temperature	(20.3 ± 0.9) °C
			Relative humidity	(41.6 ± 0.4) % R.H.
Test Result		PASS	Tested by	Do-heon, Kim 
Operating Mode: WLAN 802.11b				
Channel	Frequency (MHz)	Measured Value (dBm)	Limit (dBm)	Margin (dB)
Low	2 412	3.38	8	4.62
Middle	2 437	4.57		3.43
High	2 462	4.19		3.81
Operating Mode: WLAN 802.11g				
Channel	Frequency (MHz)	Measured Value (dBm)	Limit (dBm)	Margin (dB)
Low	2 412	-4.43	8	12.43
Middle	2 437	3.35		4.65
High	2 462	-2.66		10.66
Operating Mode: WLAN 802.11n HT20				
Channel	Frequency (MHz)	Measured Value (dBm)	Limit (dBm)	Margin (dB)
Low	2 412	-3.16	8	11.16
Middle	2 437	2.33		5.67
High	2 462	-2.61		10.61
Operating Mode: WLAN 802.11n HT40				
Channel	Frequency (MHz)	Measured Value (dBm)	Limit (dBm)	Margin (dB)
Low	2 422	-7.45	8	15.45
Middle	2 437	0.32		7.68
High	2 452	-5.85		13.85

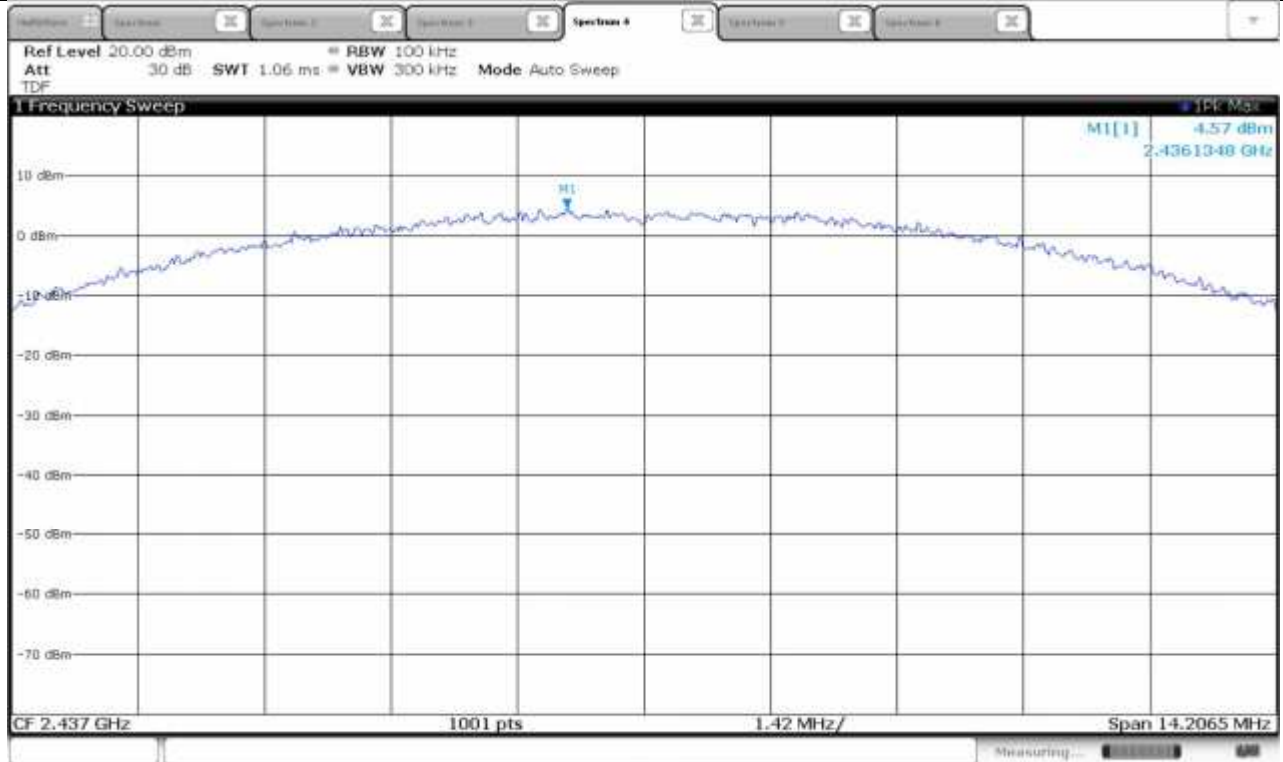
Remark. Margin = Limit – Measured Value

5.4.4 Test Plots

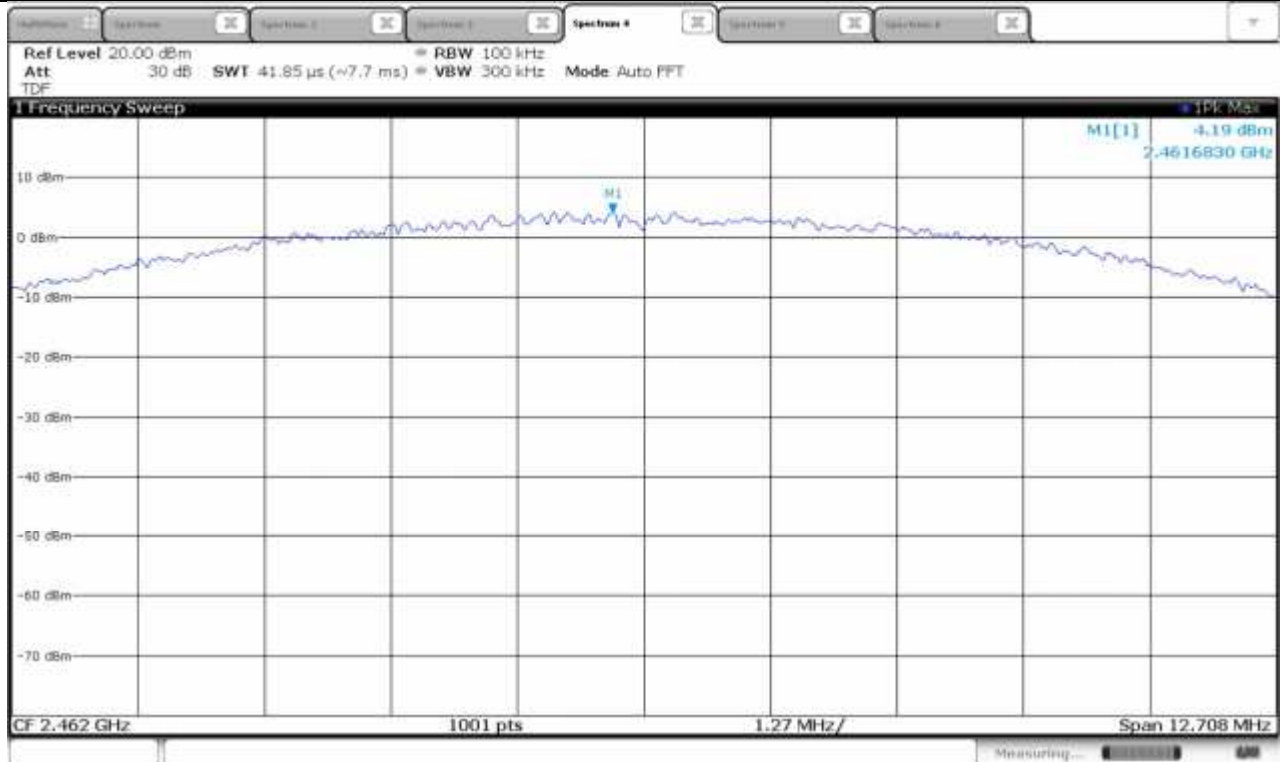
Operating Mode: WLAN 802.11b (Low Channel)



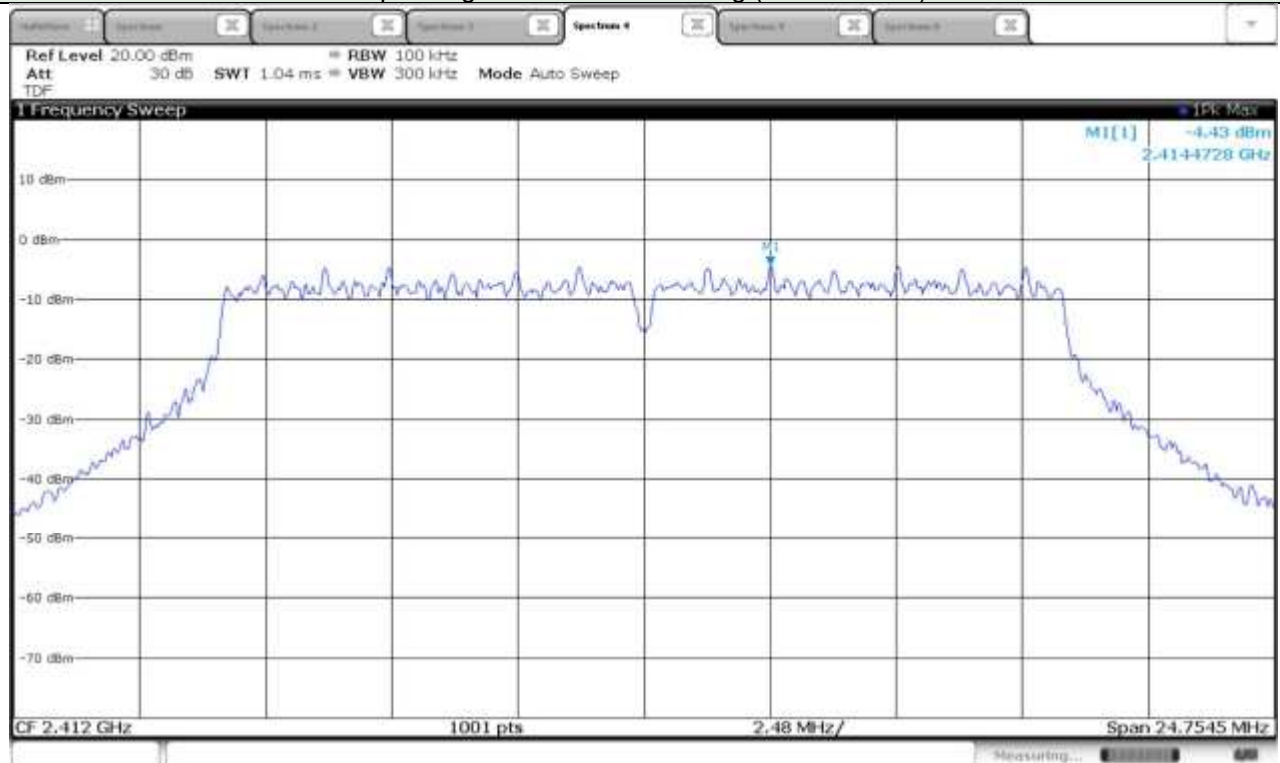
Operating Mode: WLAN 802.11b (Middle Channel)



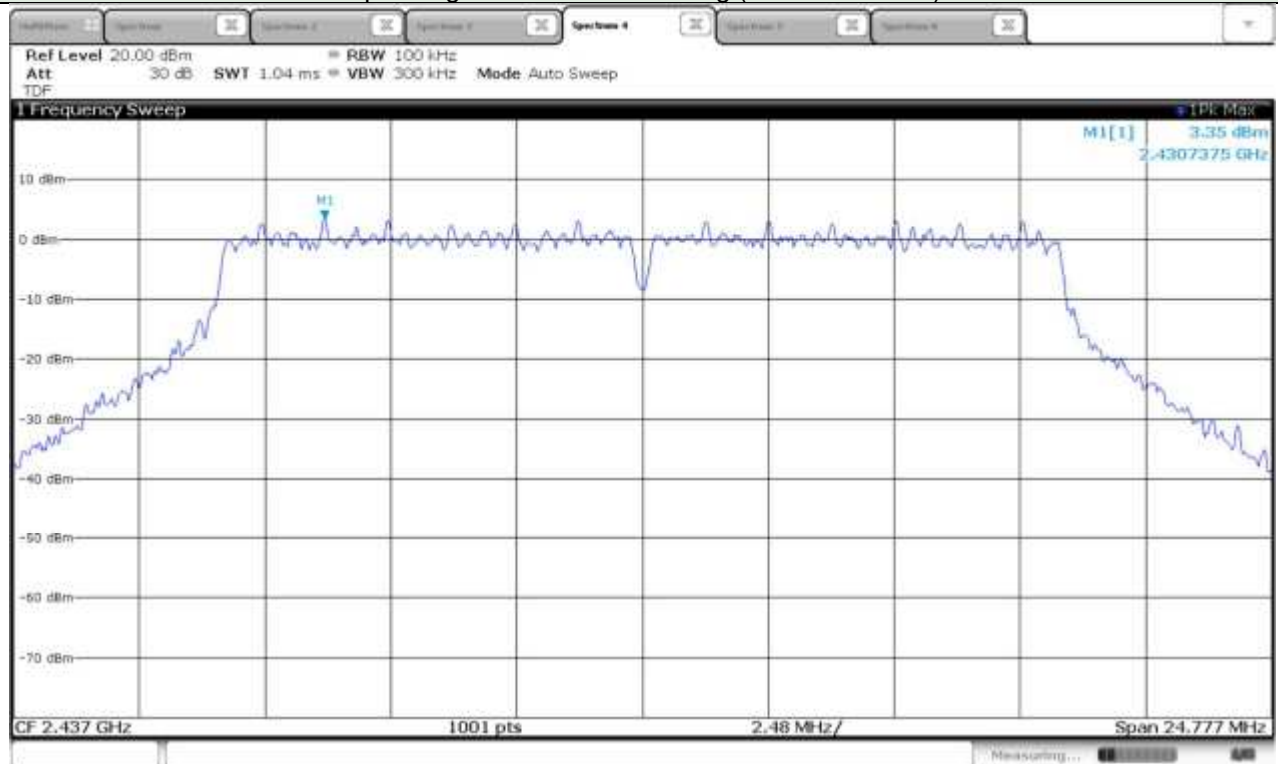
Operating Mode: WLAN 802.11b (High Channel)



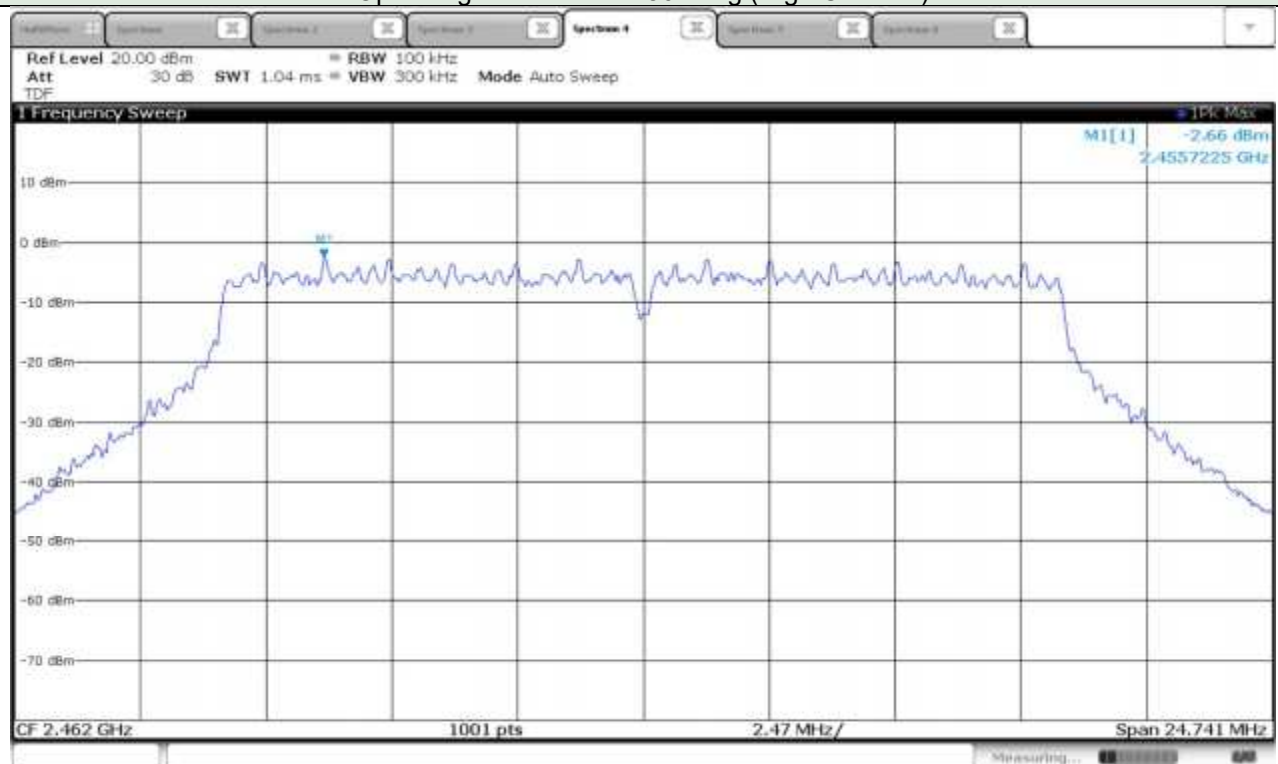
Operating Mode: WLAN 802.11g (Low Channel)



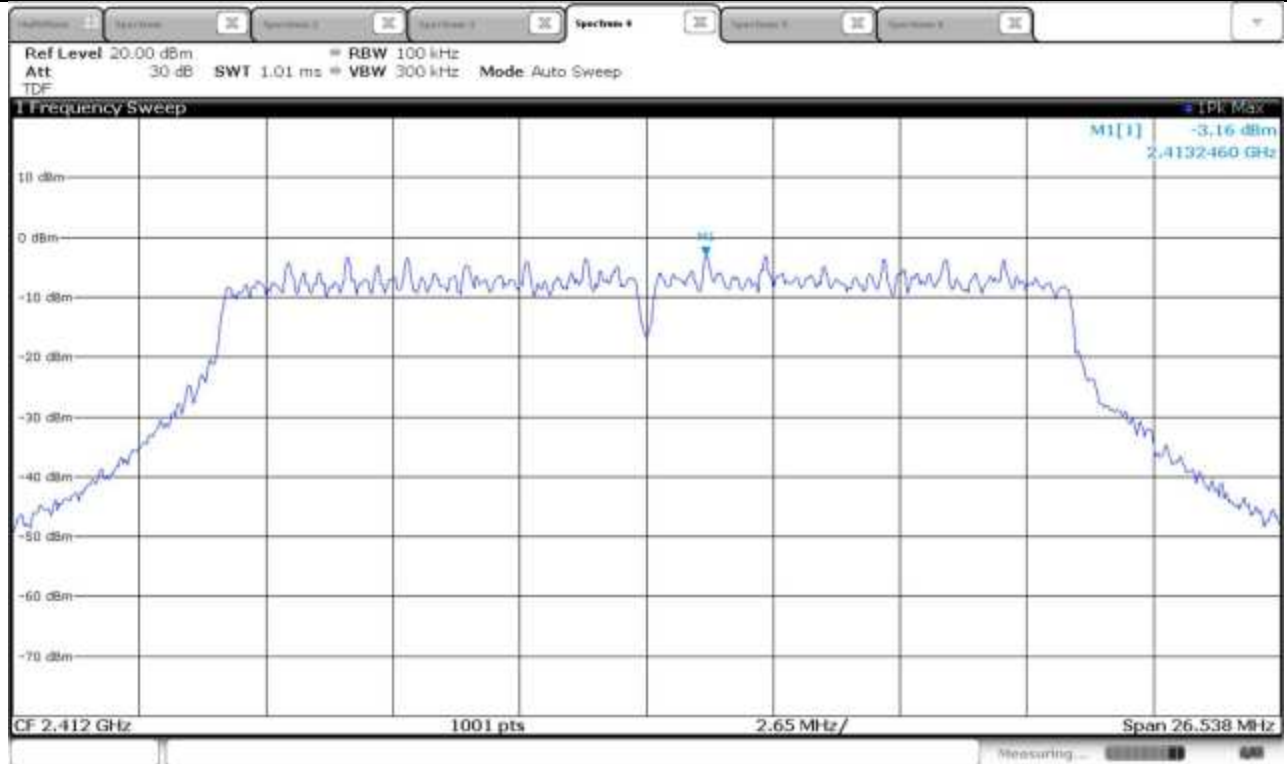
Operating Mode: WLAN 802.11g (Middle Channel)



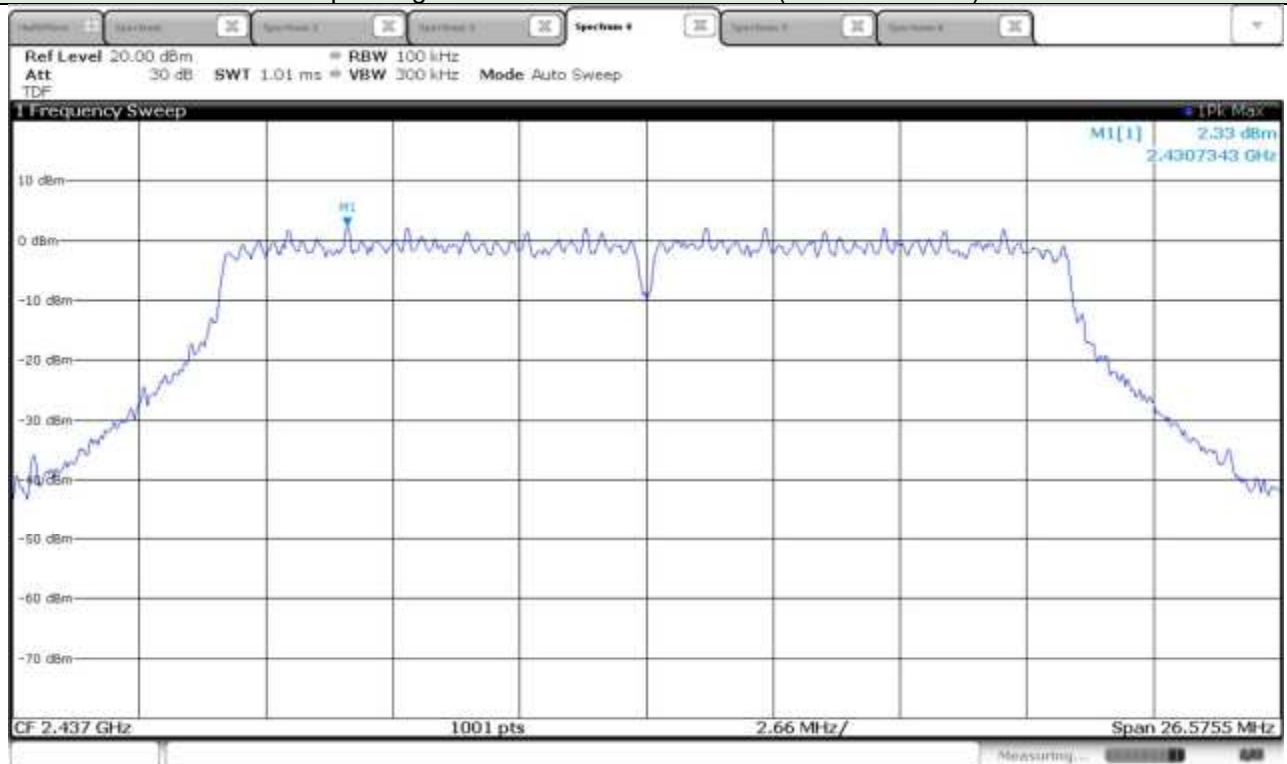
Operating Mode: WLAN 802.11g (High Channel)



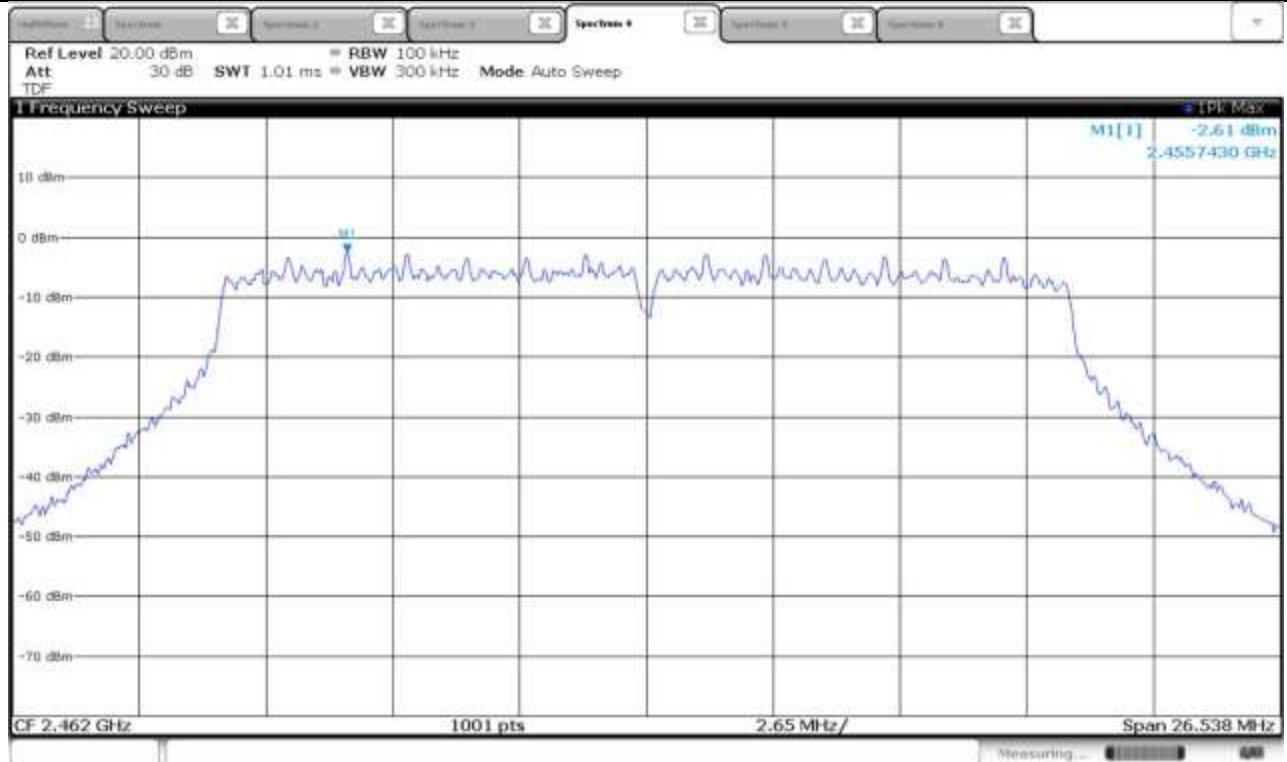
Operating Mode: WLAN 802.11n HT20 (Low Channel)



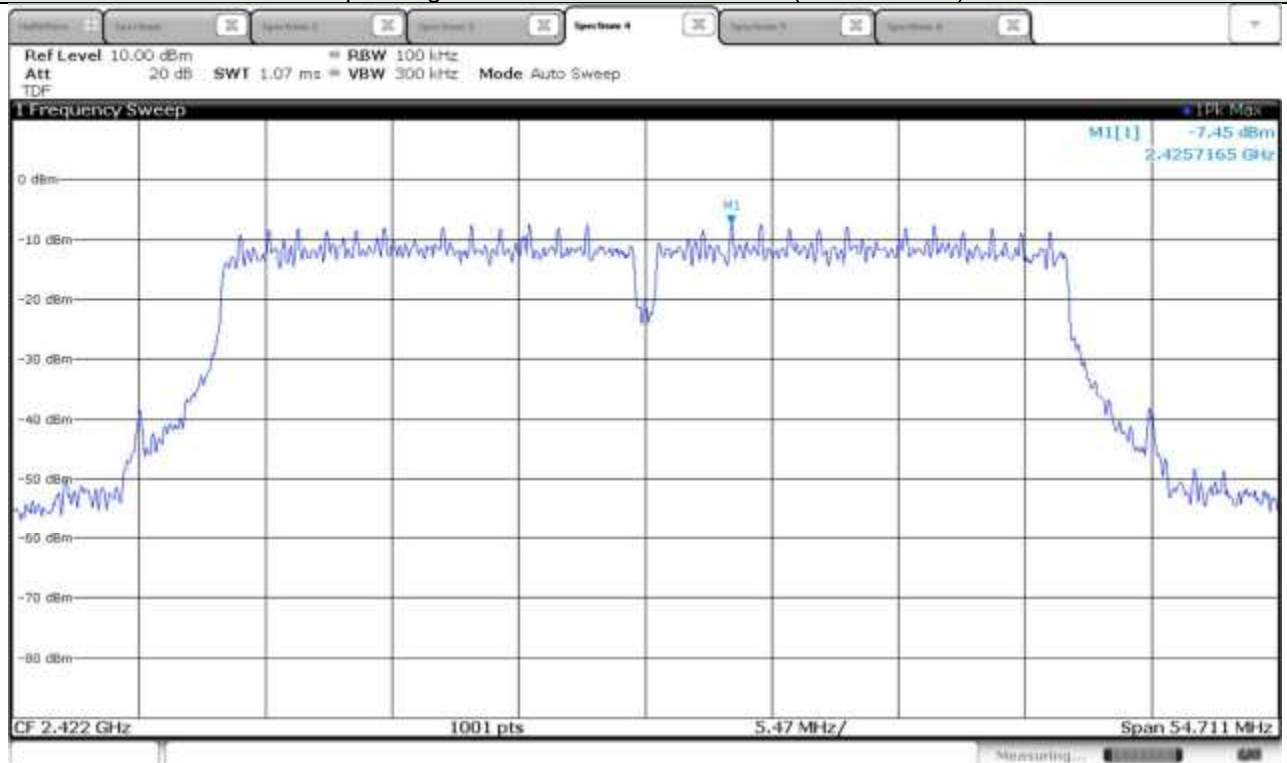
Operating Mode: WLAN 802.11n HT20 (Middle Channel)



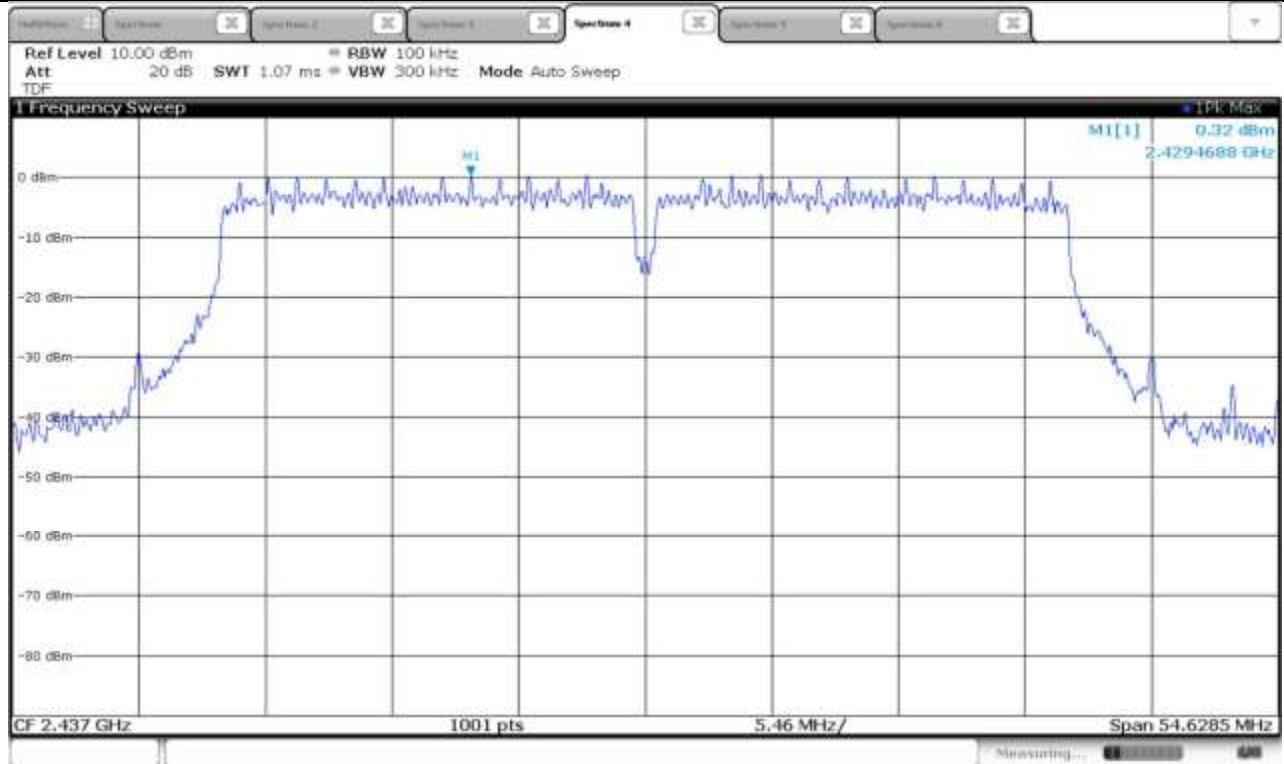
Operating Mode: WLAN 802.11n HT20 (High Channel)



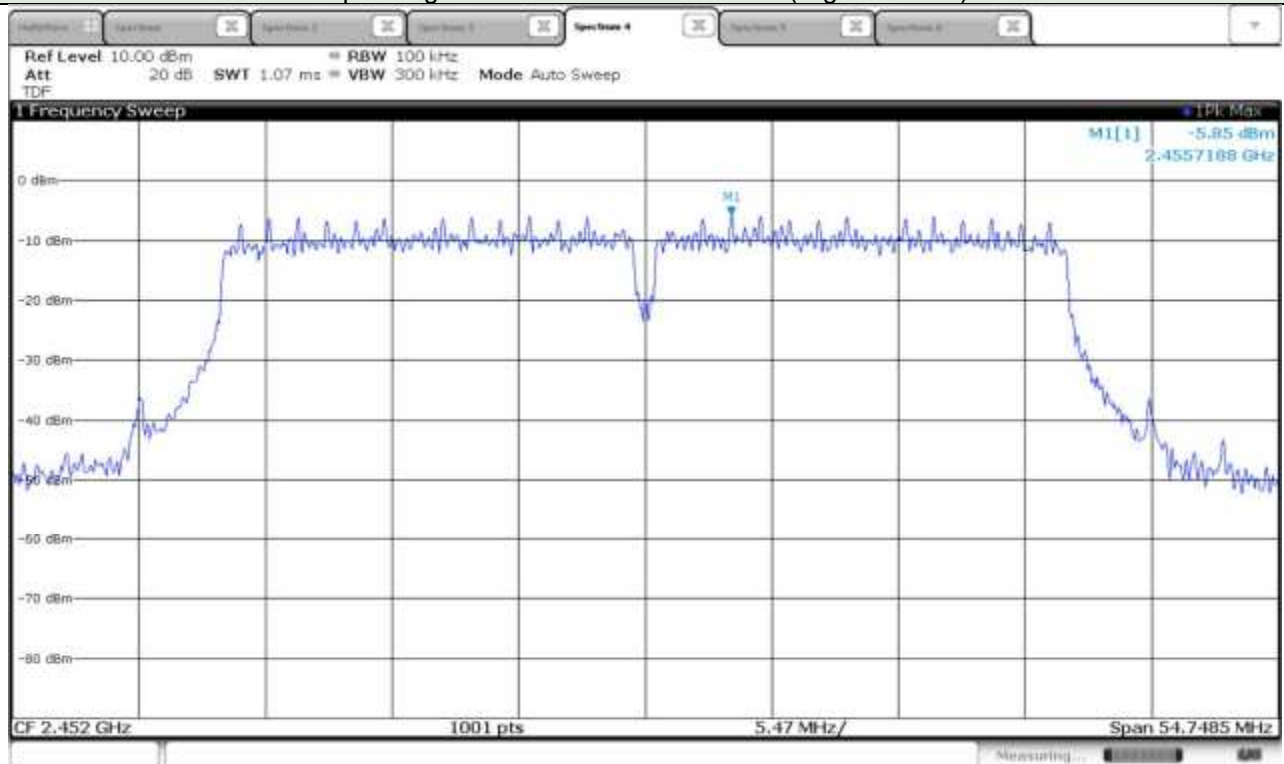
Operating Mode: WLAN 802.11n HT40 (Low Channel)



Operating Mode: WLAN 802.11n HT40 (Middle Channel)



Operating Mode: WLAN 802.11n HT40 (High Channel)



5.5 Out of Band Emission

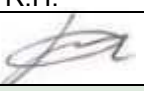
5.5.1 Limit

Acc. To section 15.247(d) and RSS-247 5.5, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in 15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

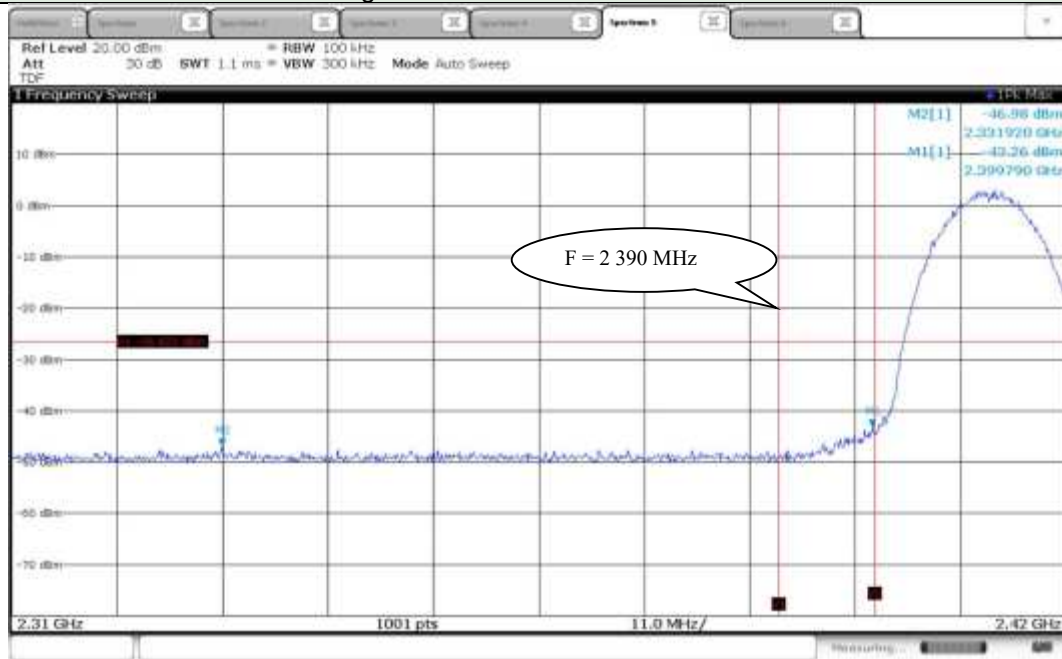
5.5.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas. Guidance v05r02: 8.5 Emissions in non-restricted frequency bands. The transmitter output is connected to a spectrum analyzer with the RBW set to 100 kHz, VBW $\geq 3 \times$ RBW, peak detector and max hold. Measurements utilizing these settings are made of the in-band reference level, band-edge (where measurements to the general radiated limits will not be made) and out-of-band emissions.

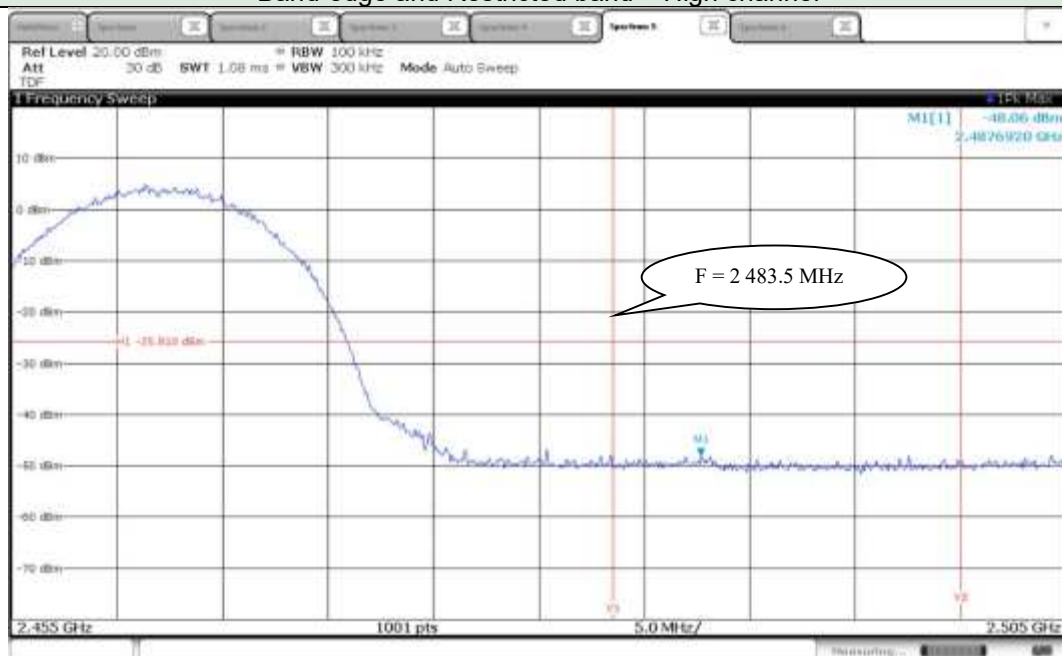
5.5.3 Test Data for Operating mode: WLAN 802.11b

Date of Test	2021-01-11	Temperature	(20.3 ± 0.9) °C
		Relative humidity	(41.6 ± 0.4) % R.H.
Test Result	PASS	Tested by	Do-heon Kim 

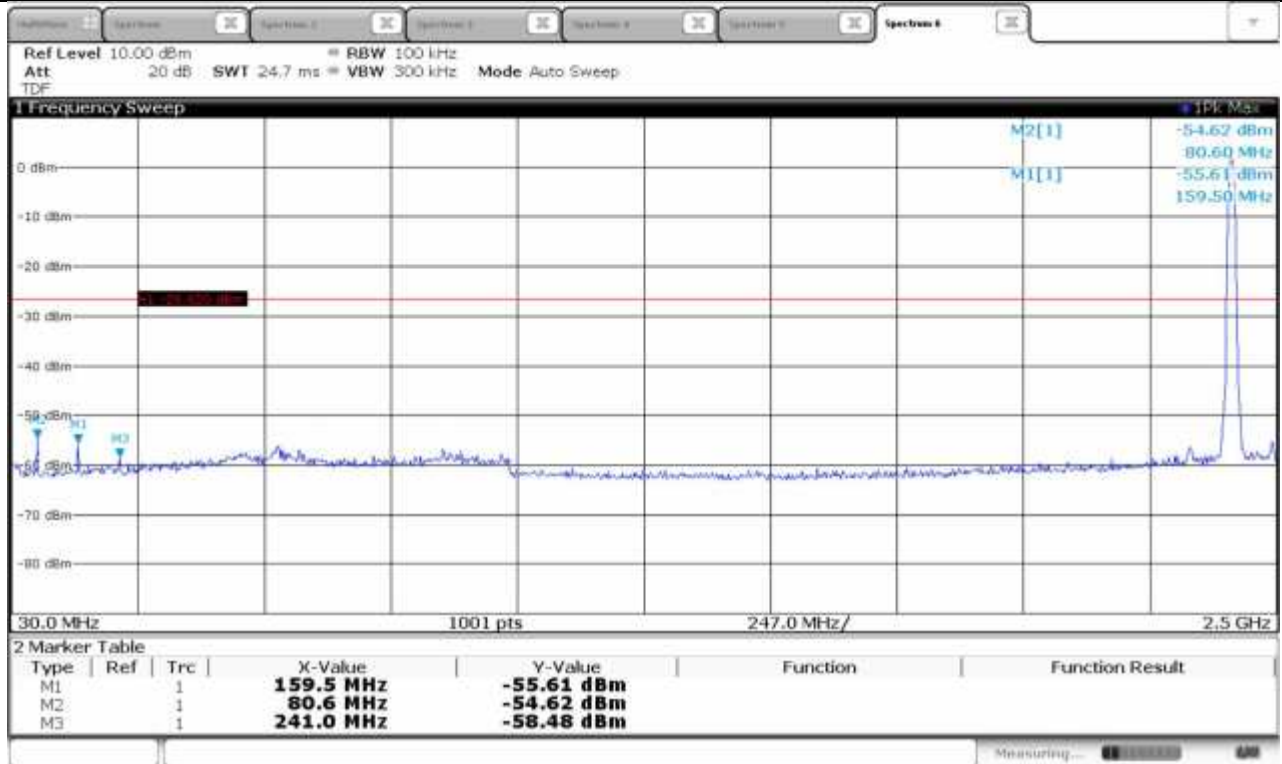
Band-edge and Restricted band – Low channel



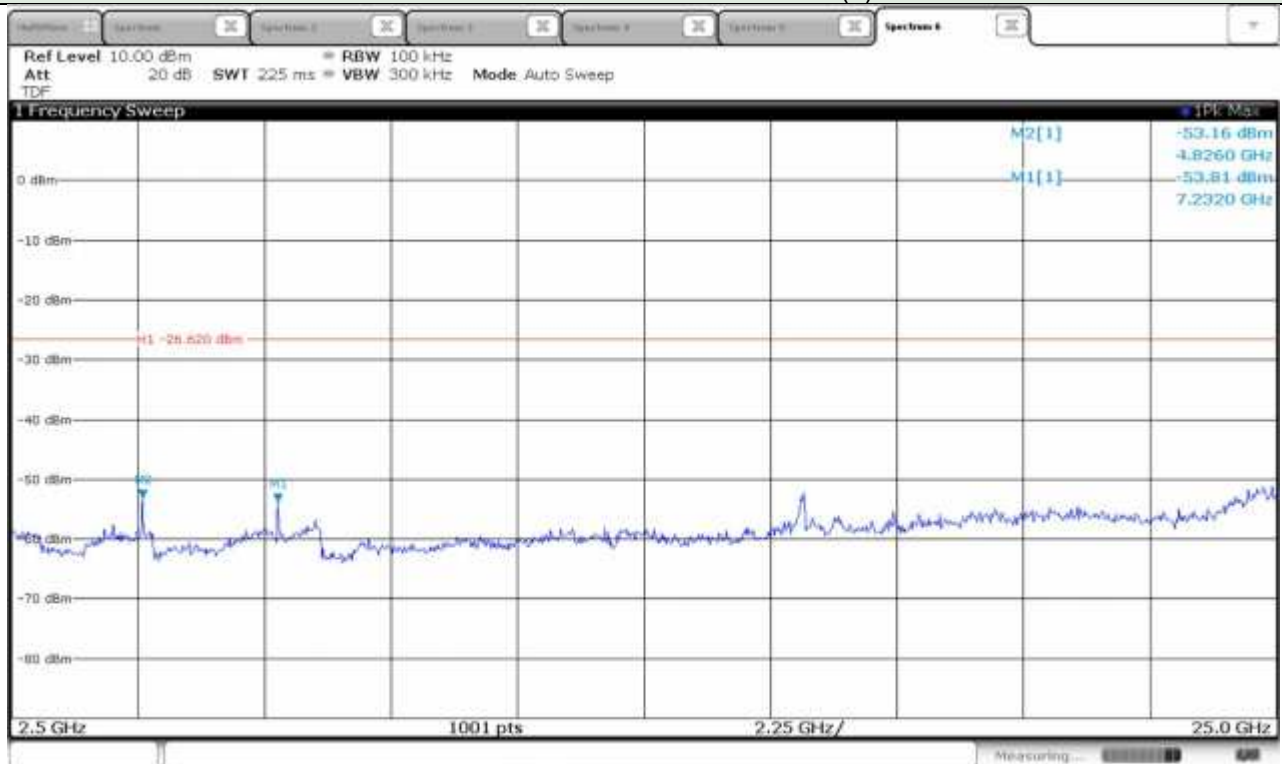
Band-edge and Restricted band – High channel



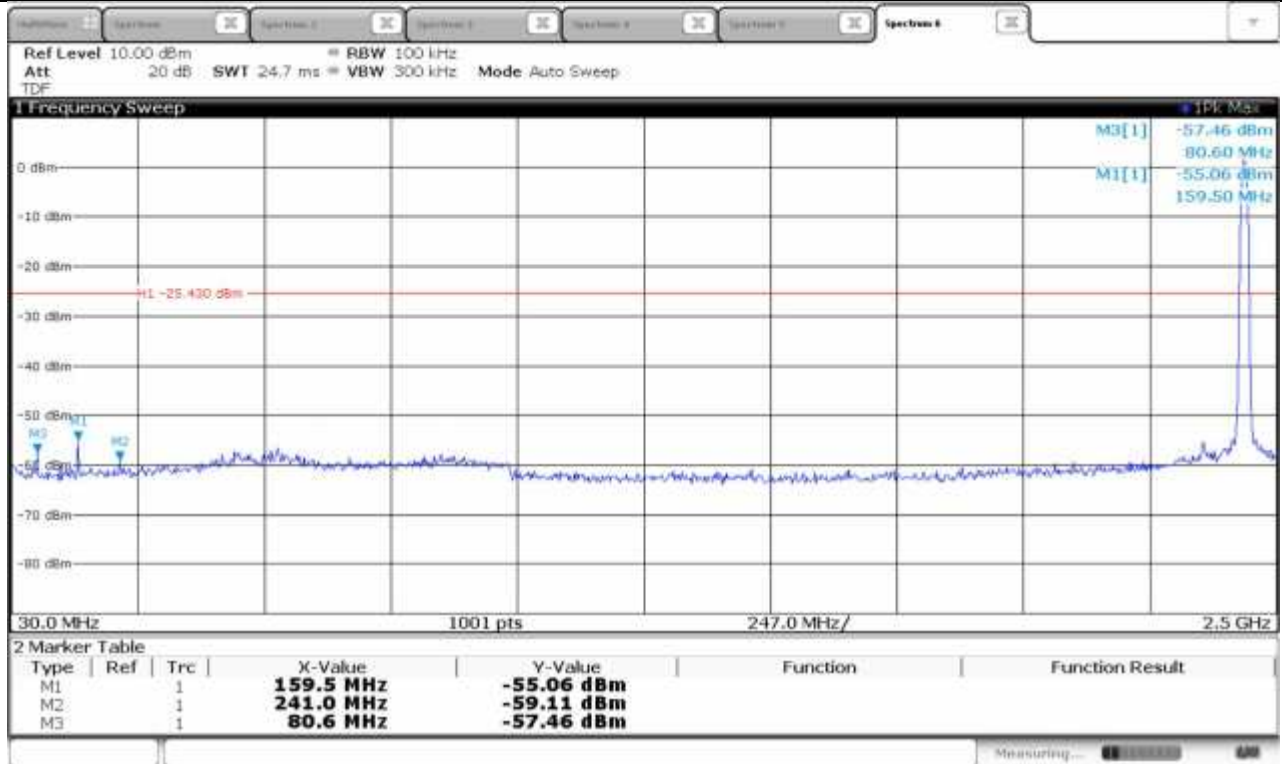
Non-restricted band – Low Channel (1)



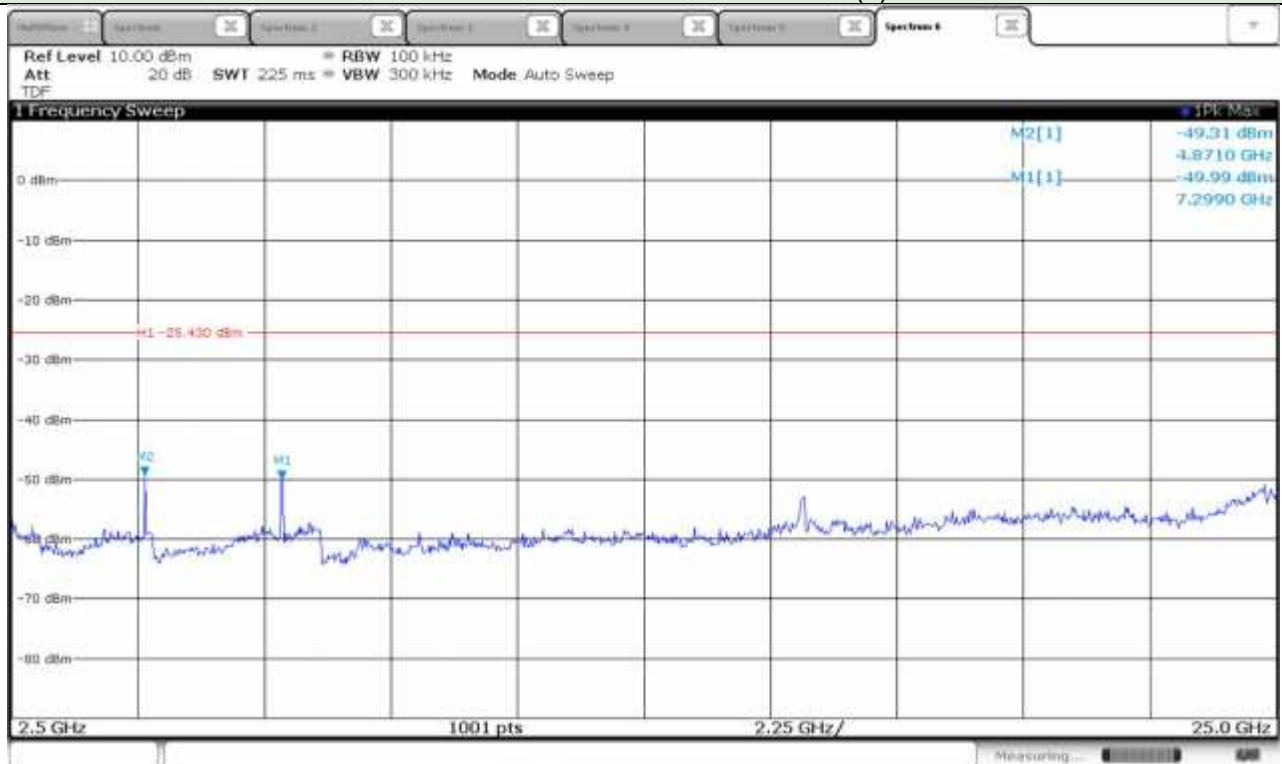
Non-restricted band – Low Channel (2)



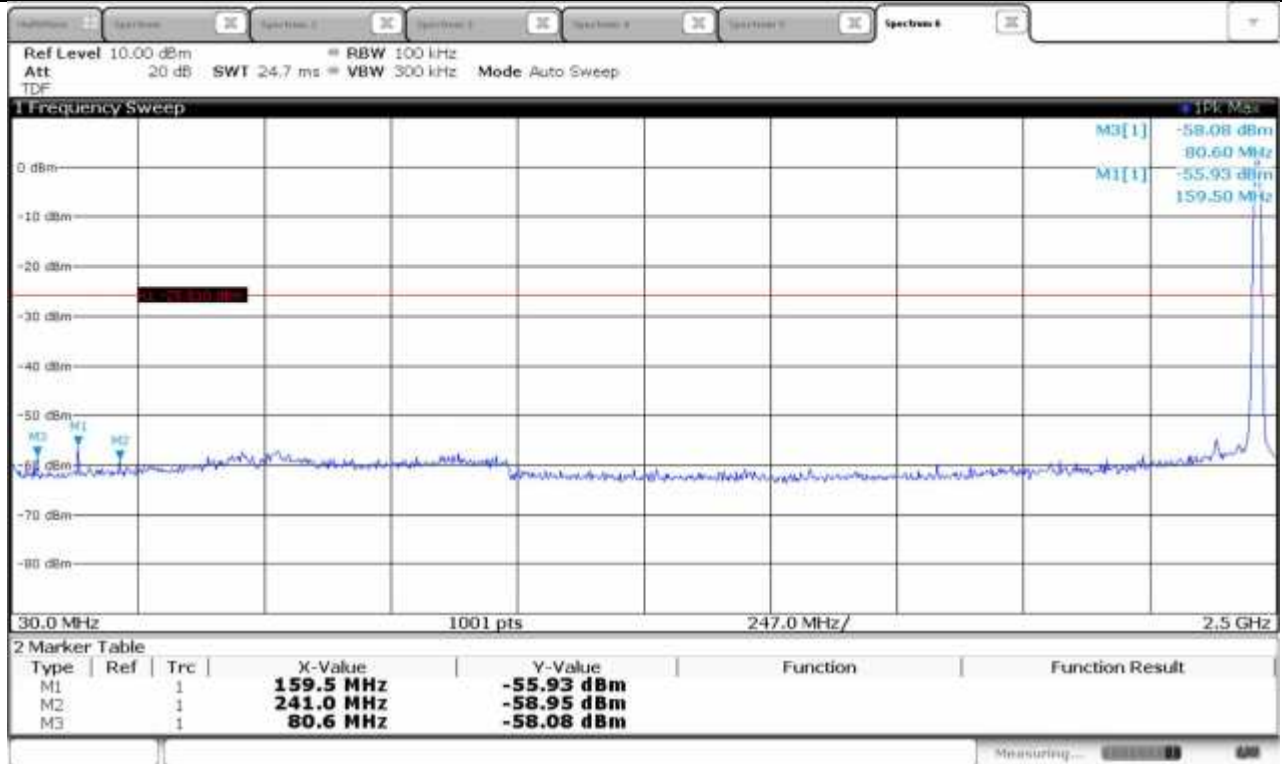
Non-restricted band – Middle Channel (1)



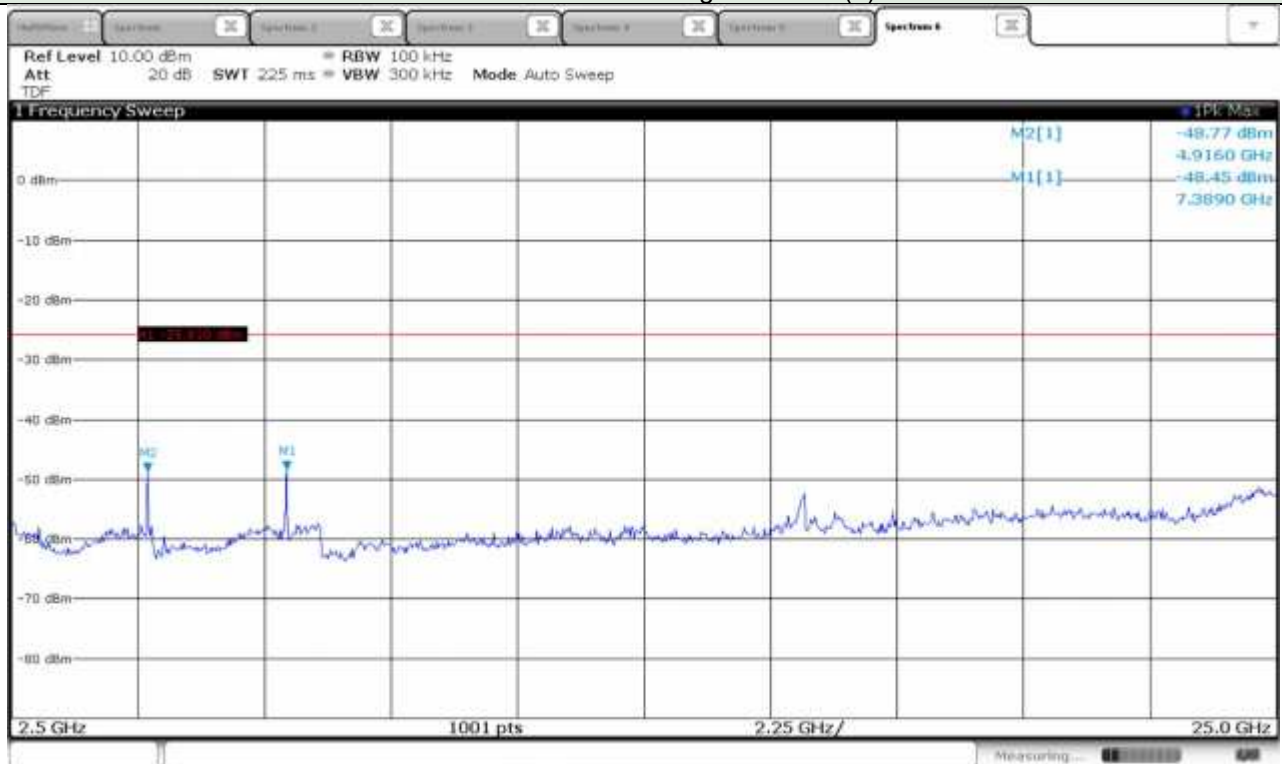
Non-restricted band – Middle Channel (2)



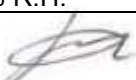
Non-restricted band – High Channel (1)



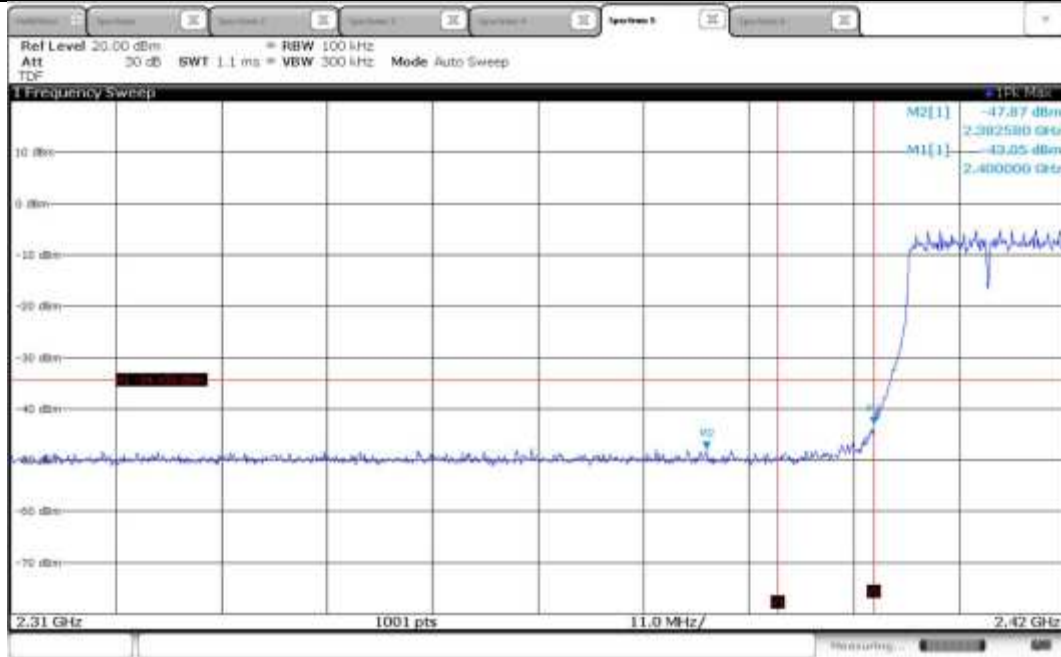
Non-restricted band – High Channel (2)



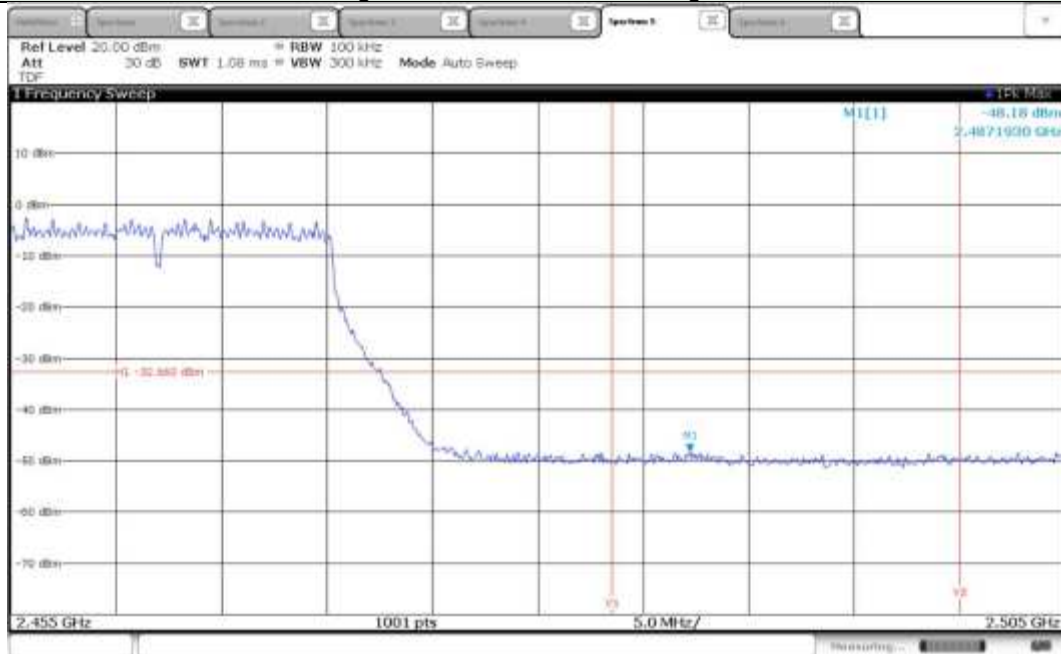
5.5.4 Test Data for Operating mode: WLAN 802.11g

Date of Test	2021-01-11	Temperature	(20.3 ± 0.9) °C
		Relative humidity	(41.6 ± 0.4) % R.H.
Test Result	PASS	Tested by	Do-heon Kim 

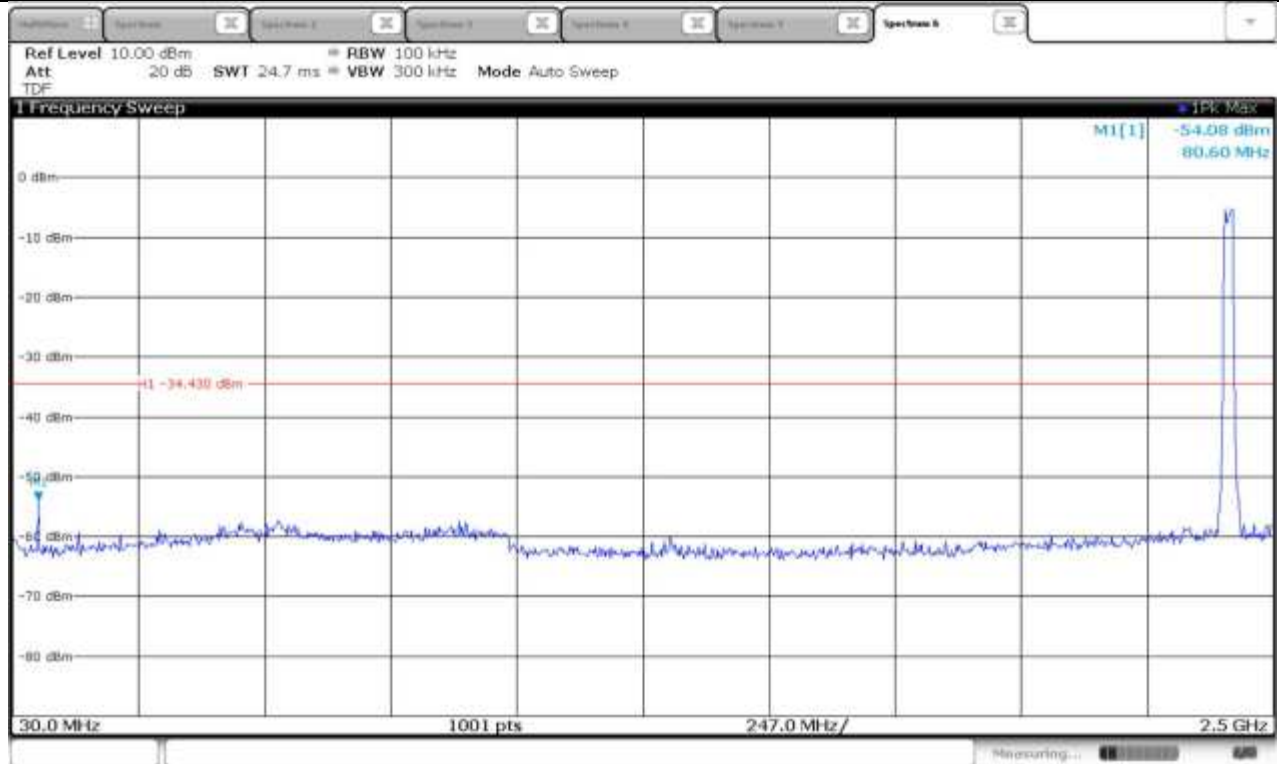
Band-edge and Restricted band – Low channel



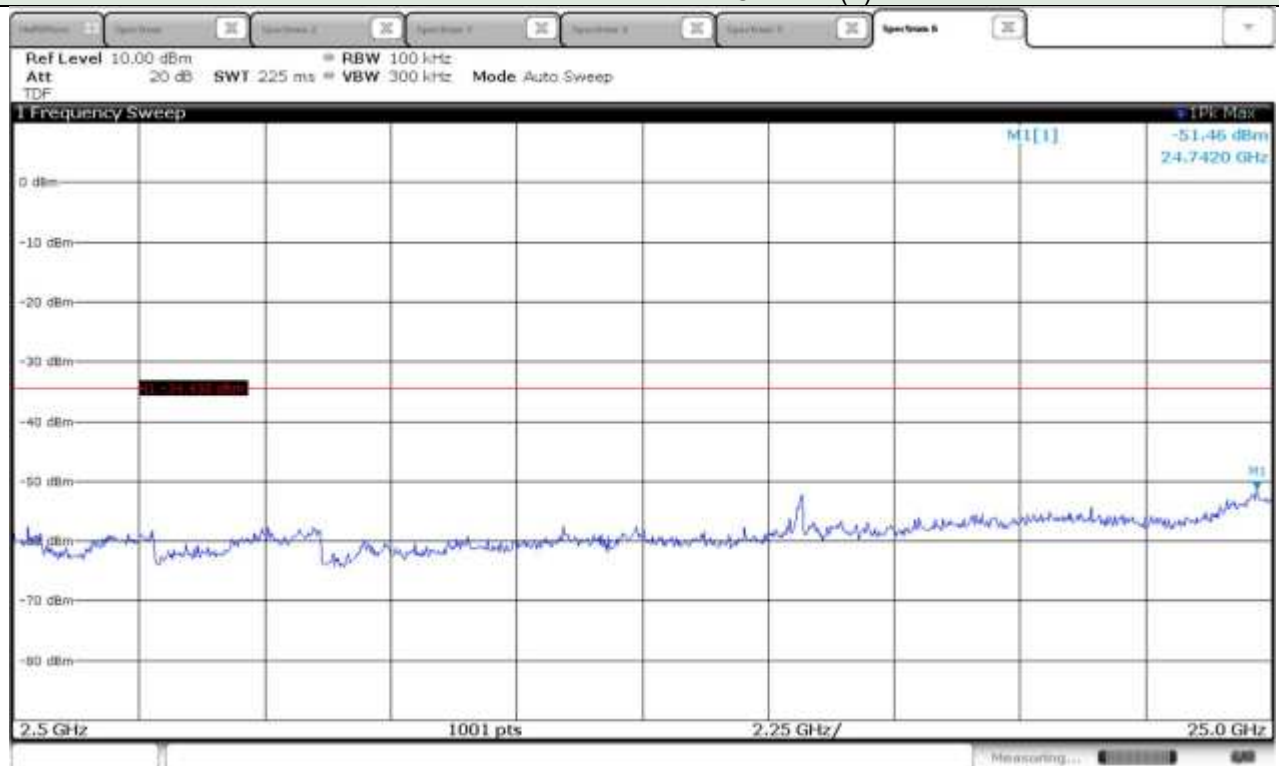
Band-edge and Restricted band – High channel



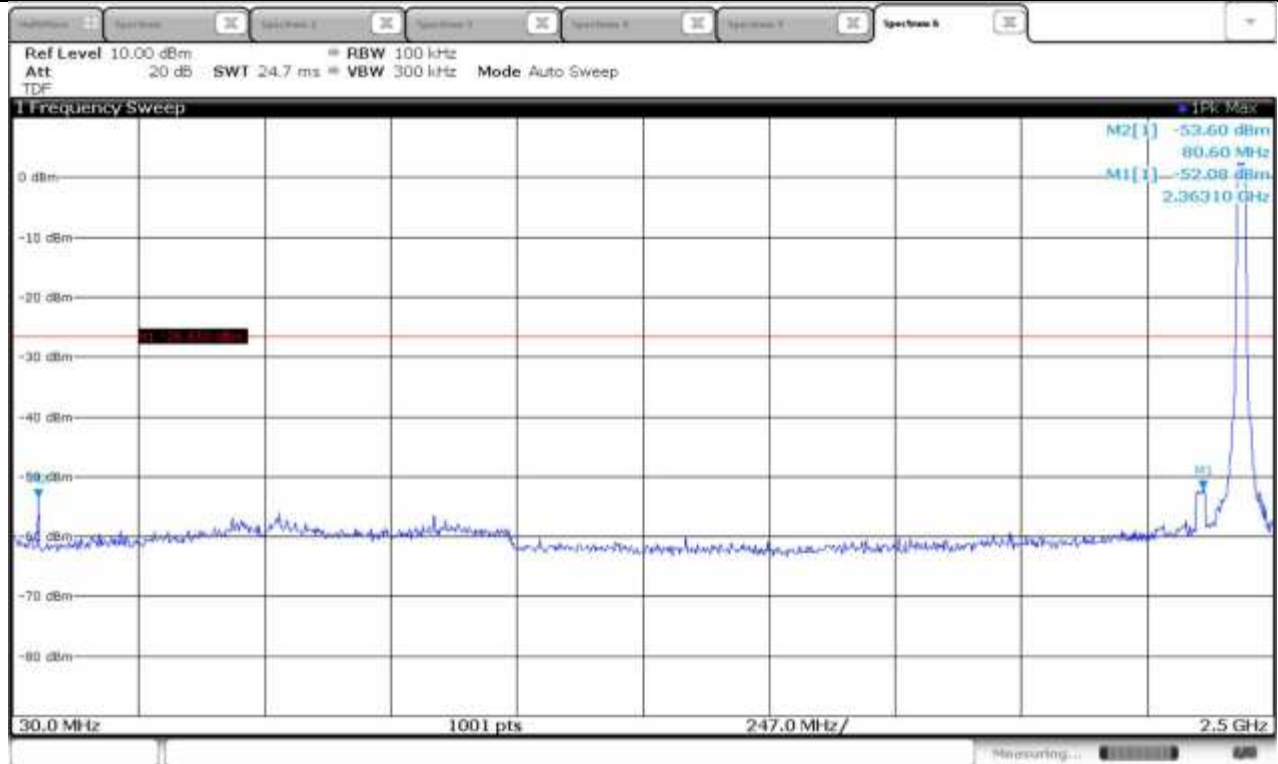
Non-restricted band – Low Channel (1)



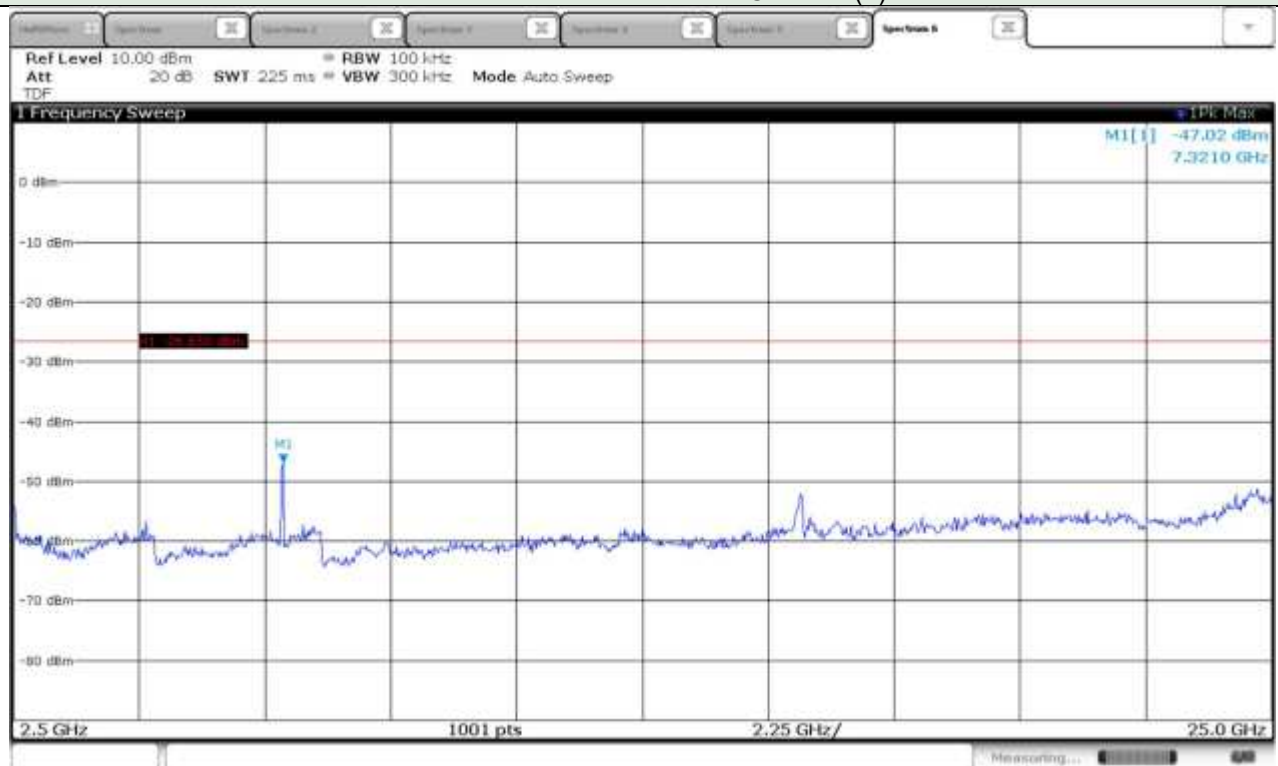
Non-restricted band – Low Channel (2)



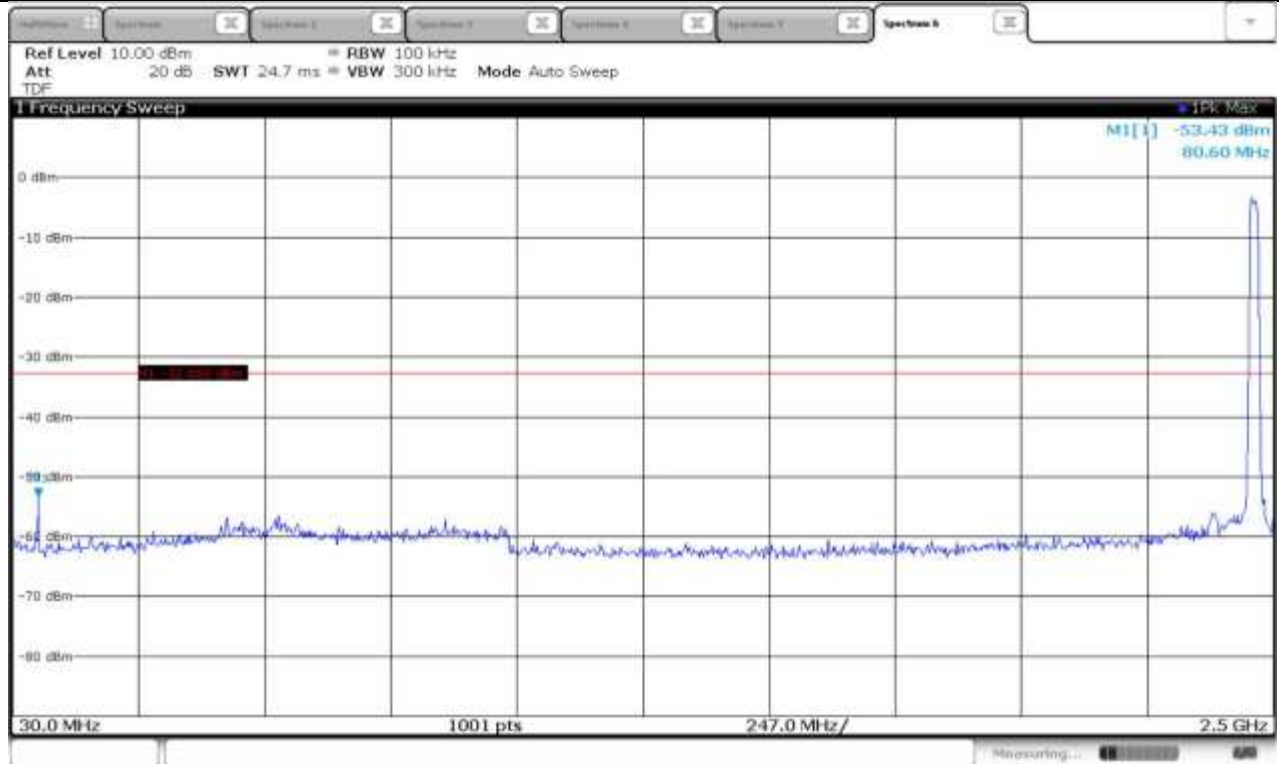
Non-restricted band – Middle Channel (1)



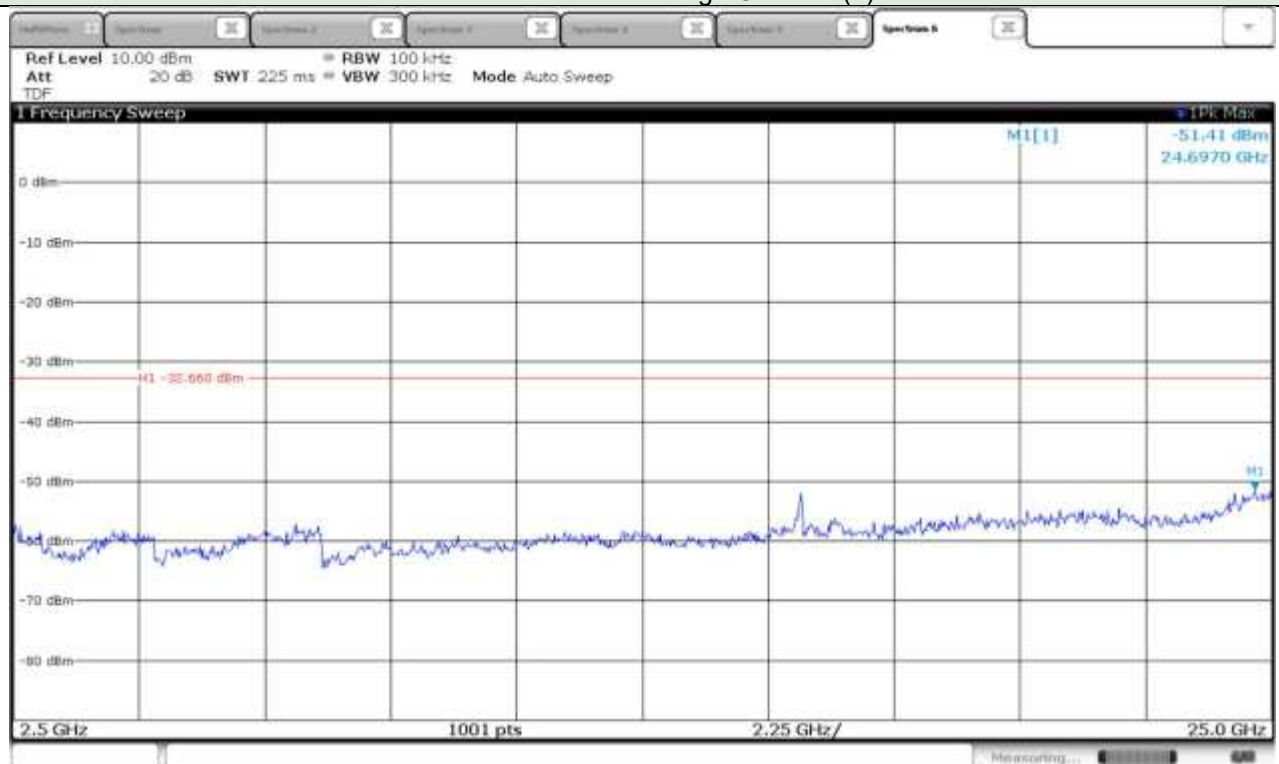
Non-restricted band – Middle Channel (2)



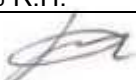
Non-restricted band – High Channel (1)



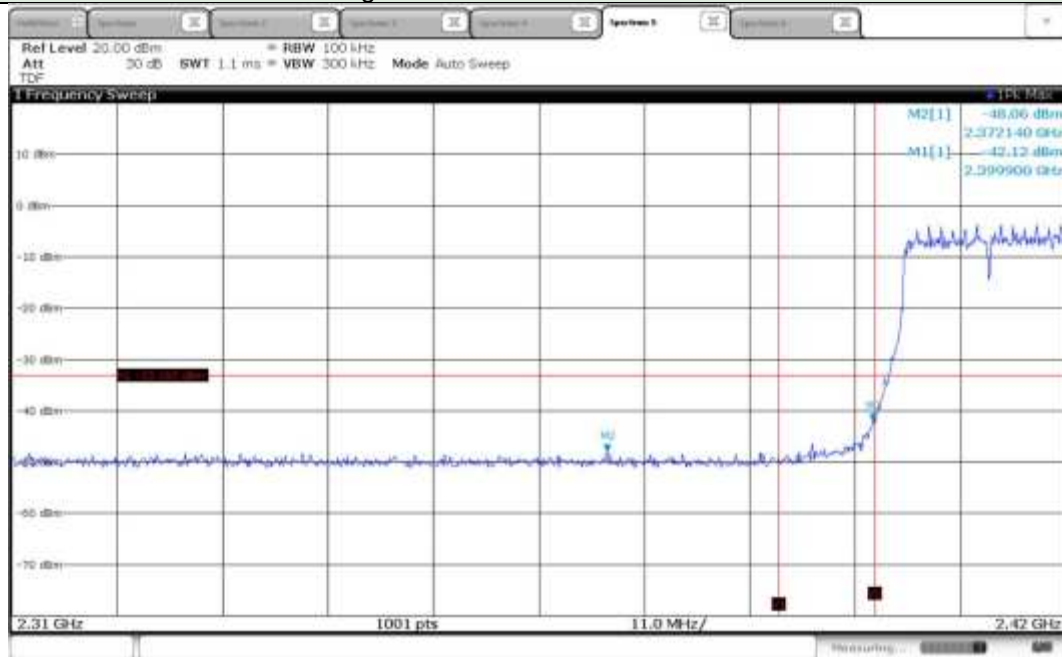
Non-restricted band – High Channel (2)



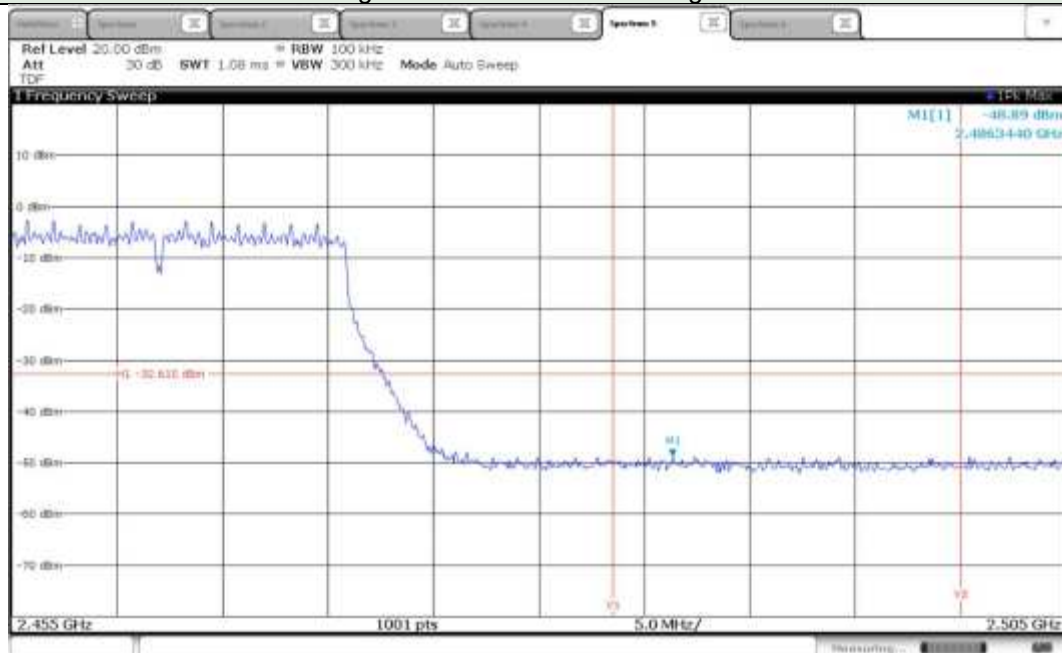
5.5.5 Test Data for Operating mode: WLAN 802.11n HT20

Date of Test	2021-01-11	Temperature	(20.3 ± 0.9) °C
		Relative humidity	(41.6 ± 0.4) % R.H.
Test Result	PASS	Tested by	Do-heon Kim 

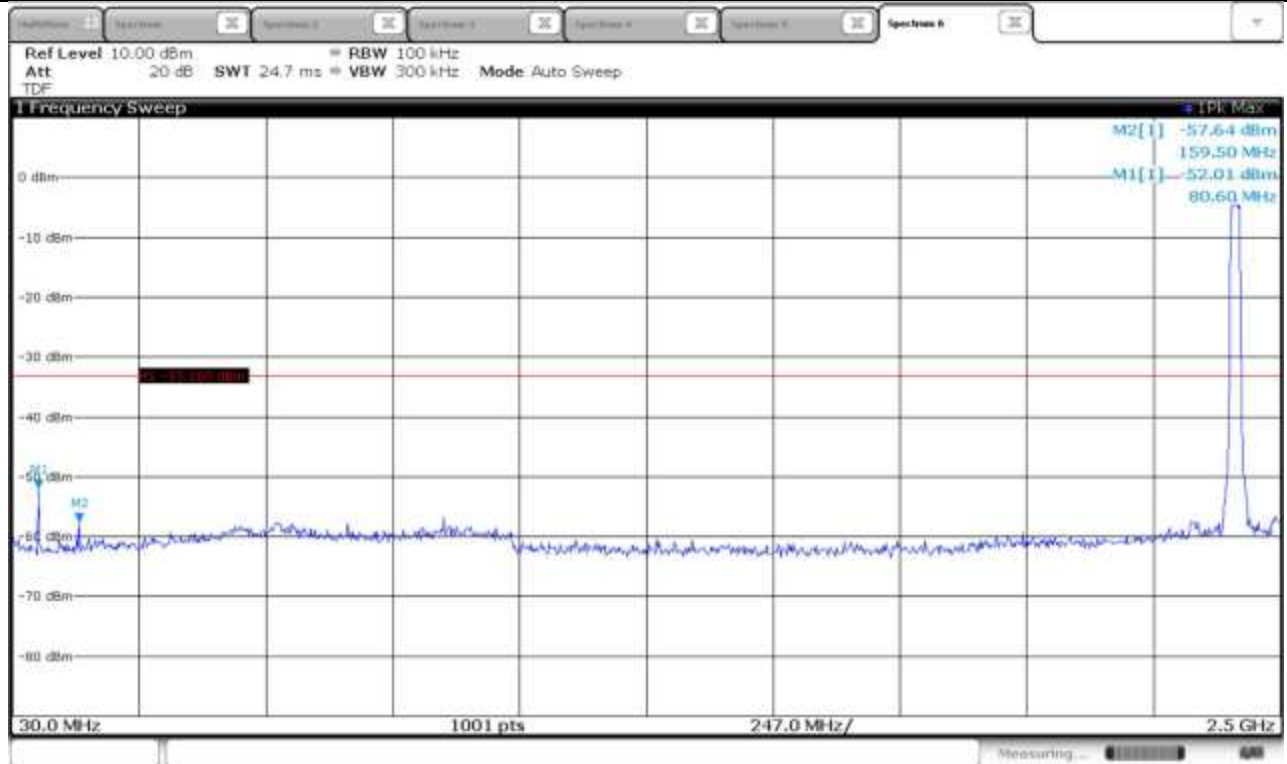
Band-edge and Restricted band – Low channel



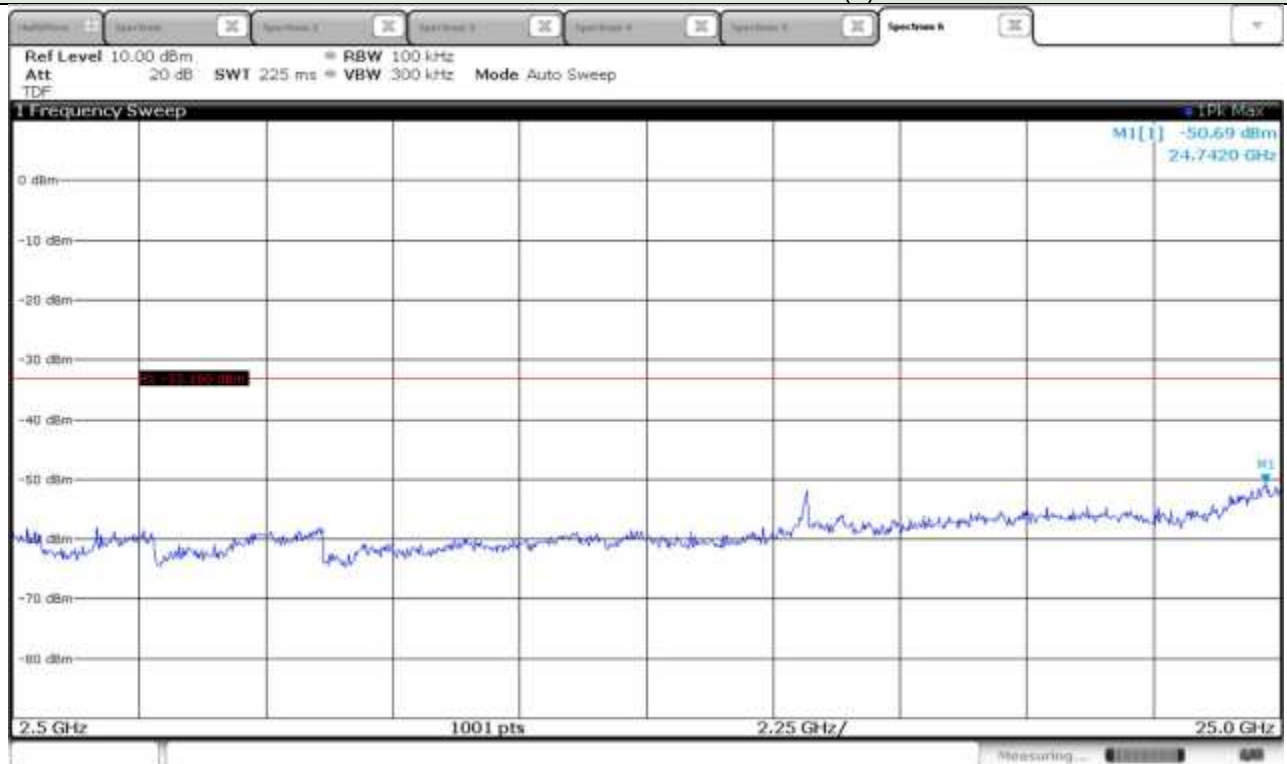
Band-edge and Restricted band – High channel



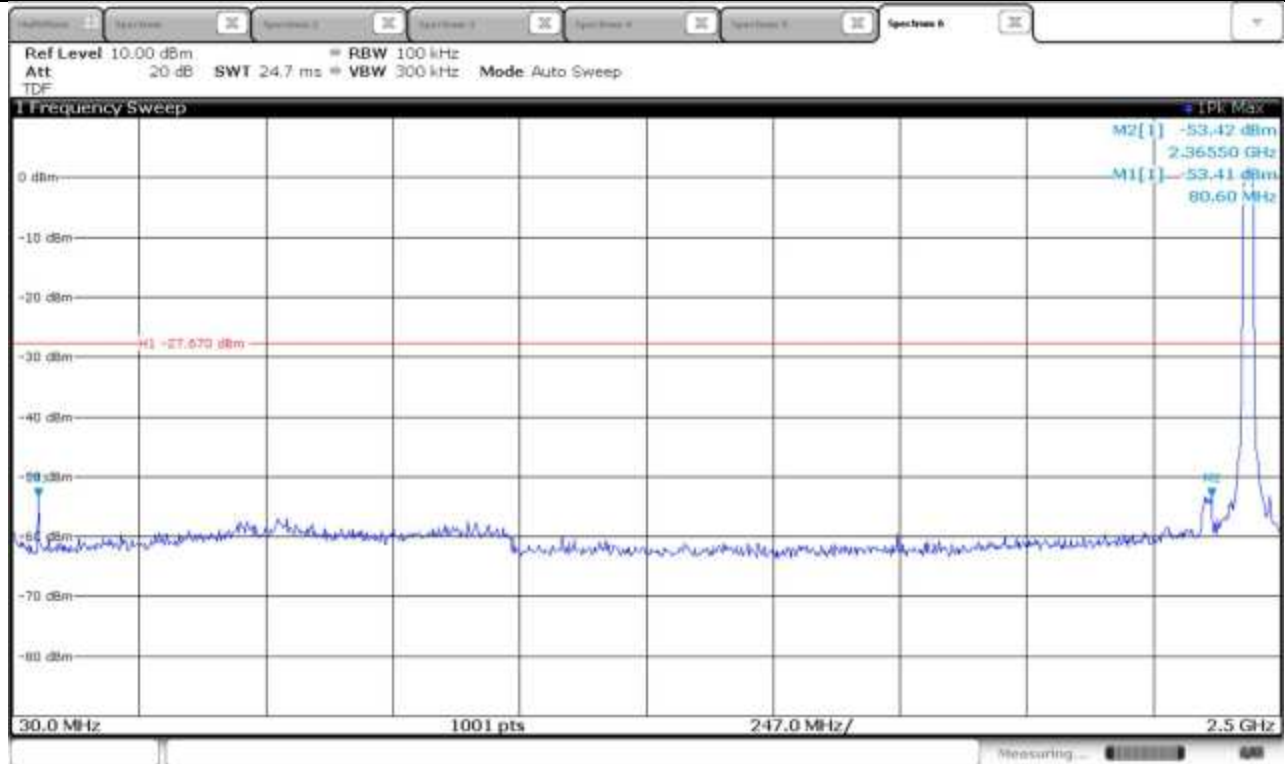
Non-restricted band – Low Channel (1)



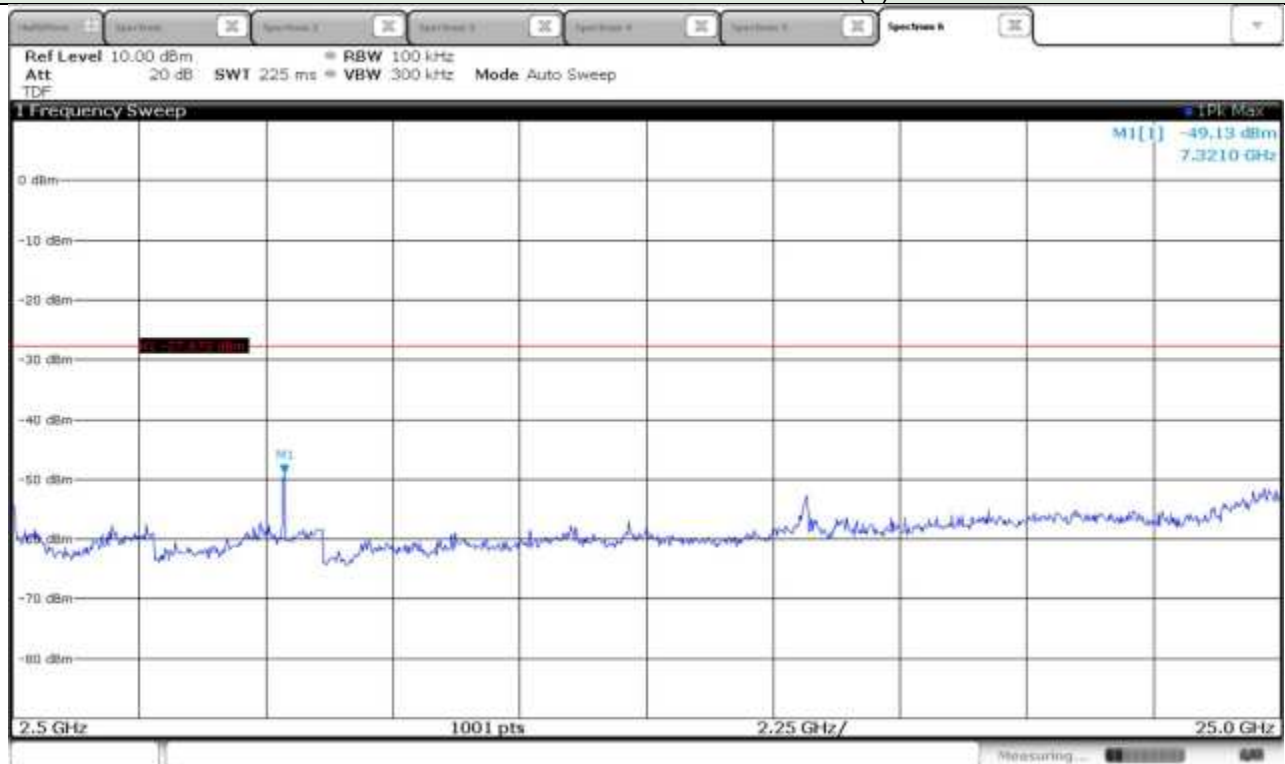
Non-restricted band – Low Channel (2)



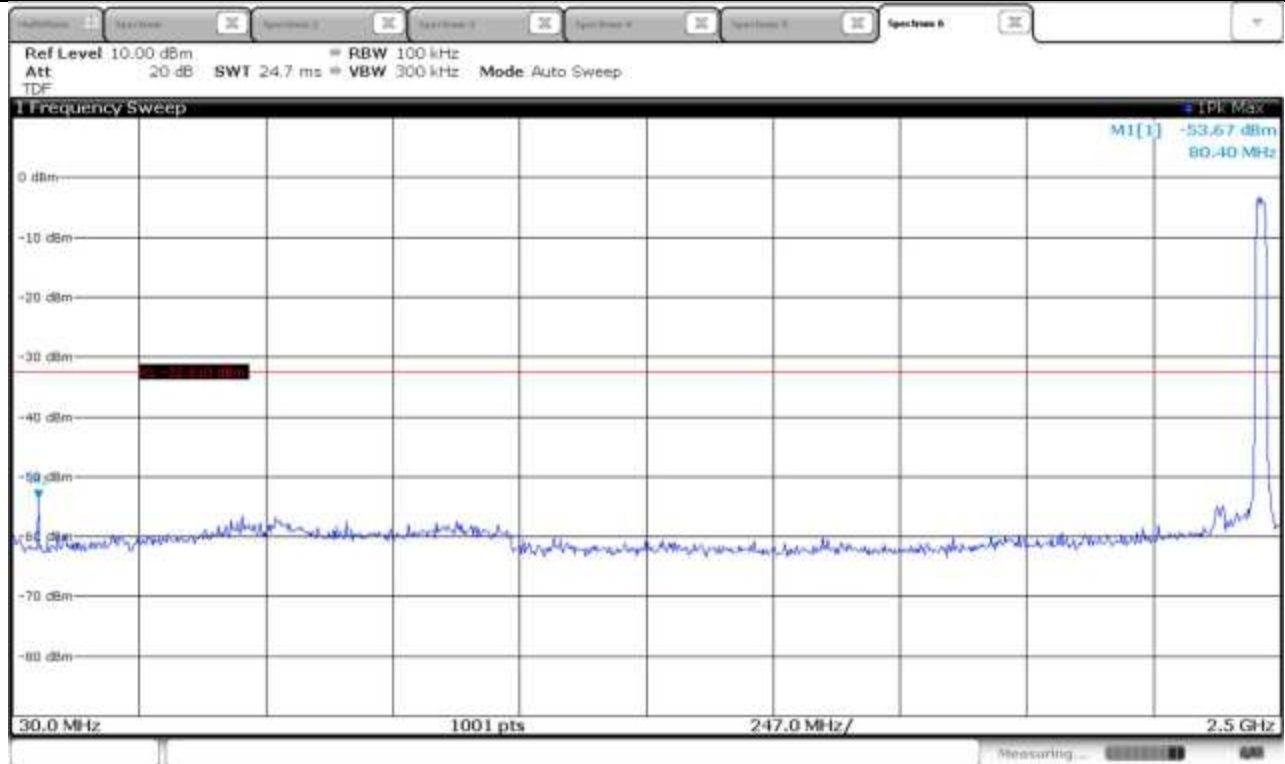
Non-restricted band – Middle Channel (1)



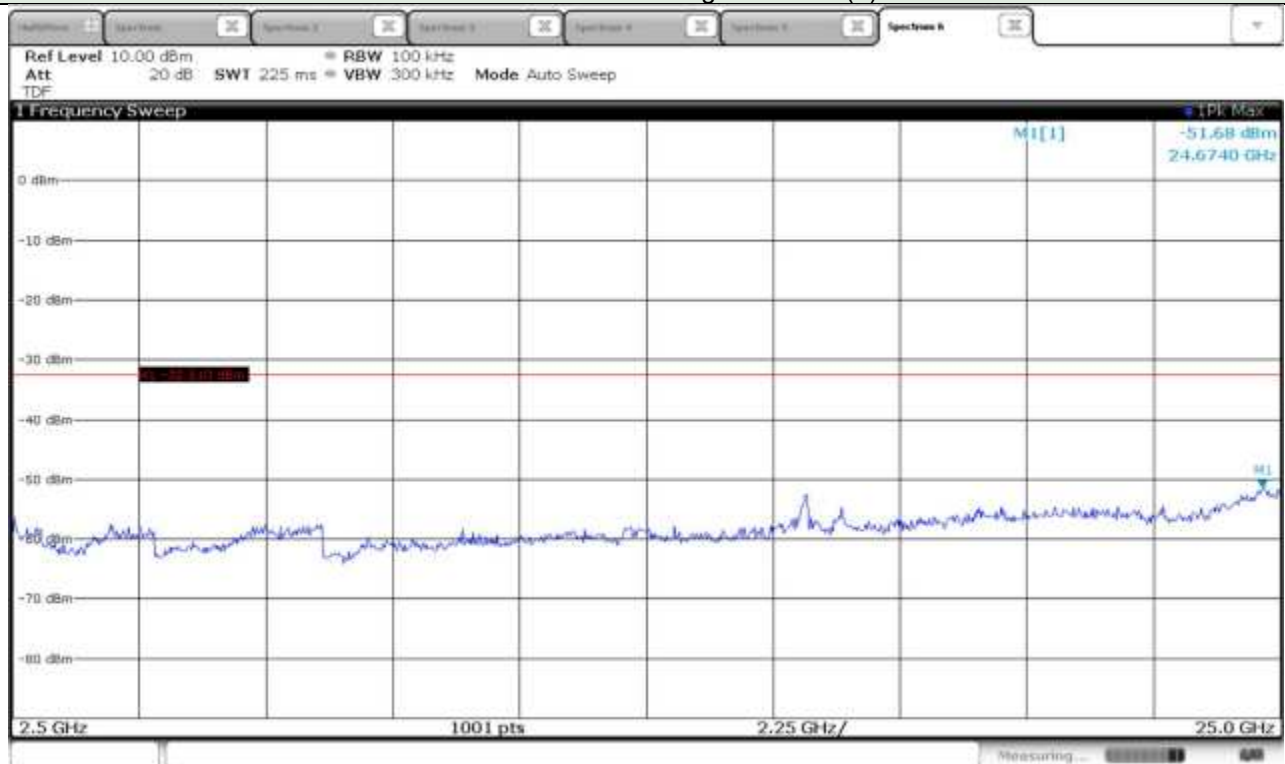
Non-restricted band – Middle Channel (2)



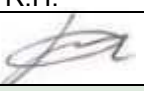
Non-restricted band – High Channel (1)



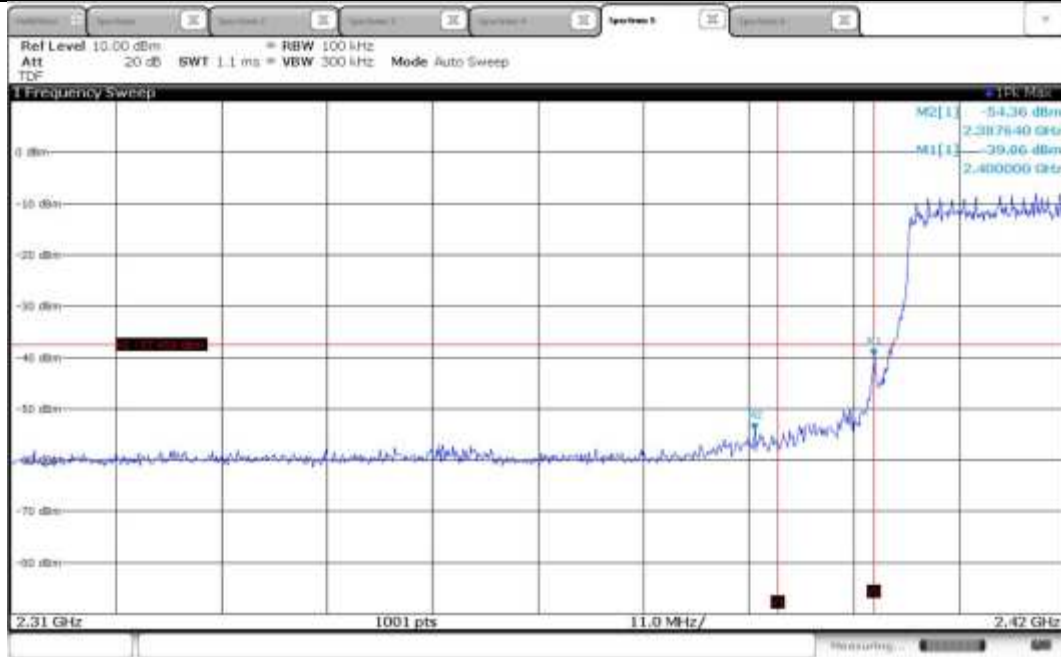
Non-restricted band – High Channel (2)



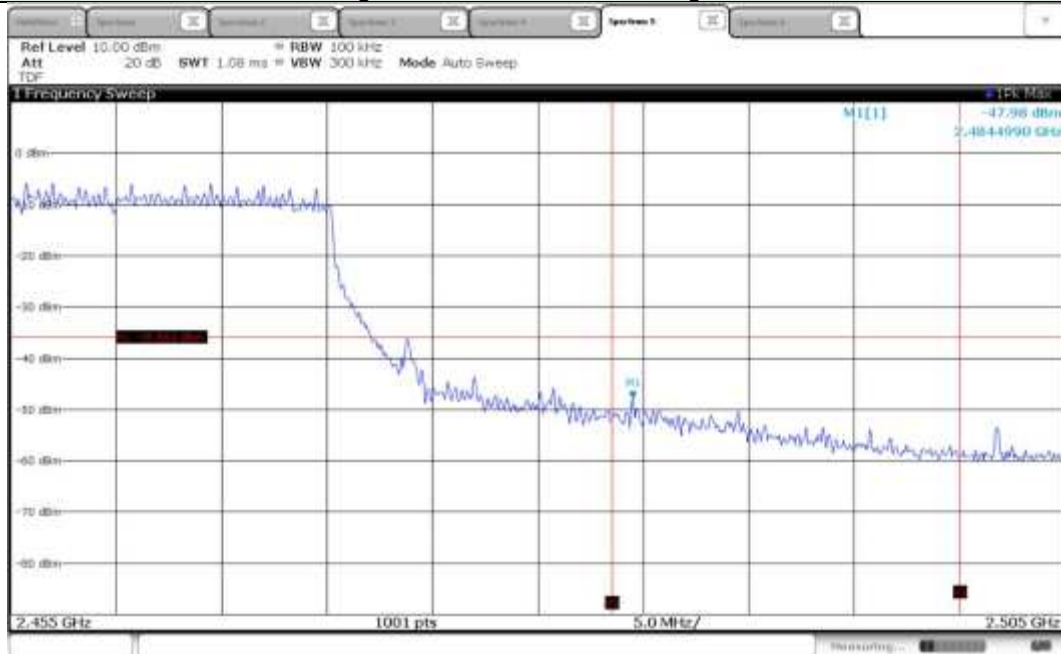
5.5.6 Test Data for Operating mode: WLAN 802.11n HT40

Date of Test	2021-01-11	Temperature	(20.3 ± 0.9) °C
		Relative humidity	(41.6 ± 0.4) % R.H.
Test Result	PASS	Tested by	Do-heon Kim 

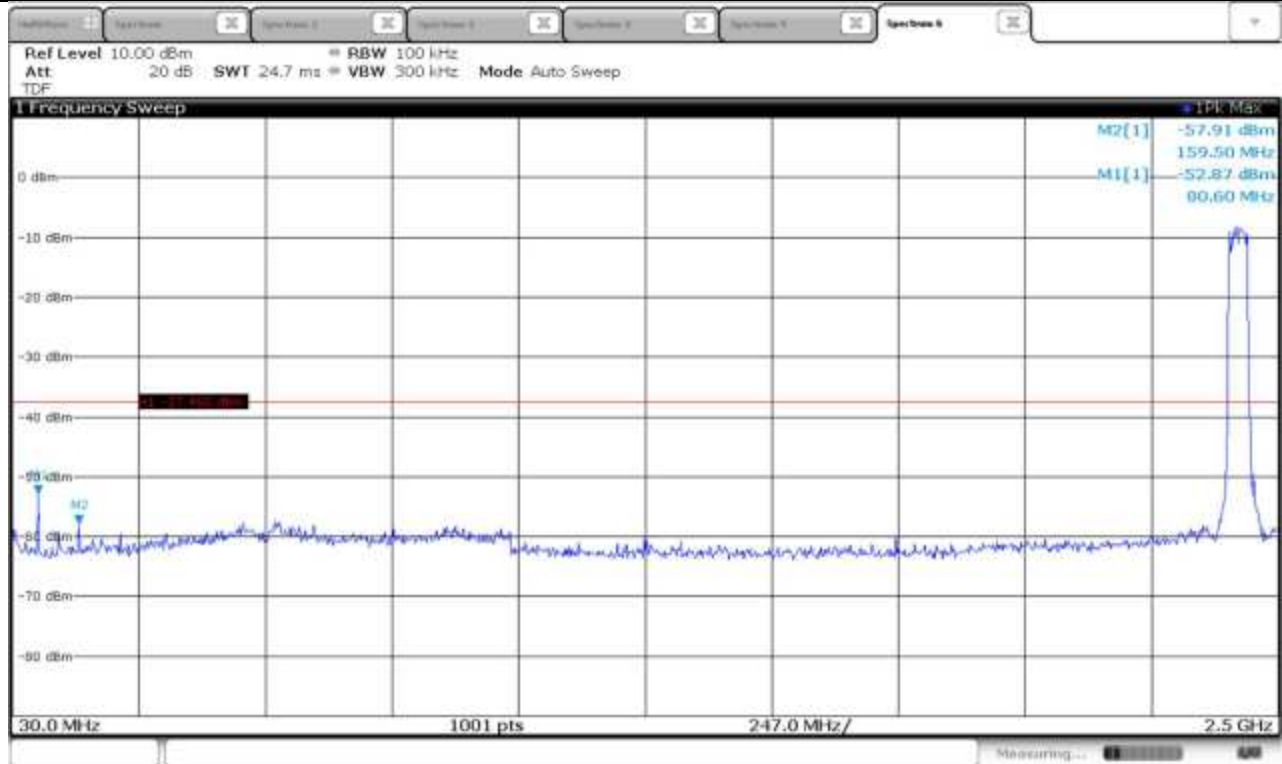
Band-edge and Restricted band – Low channel



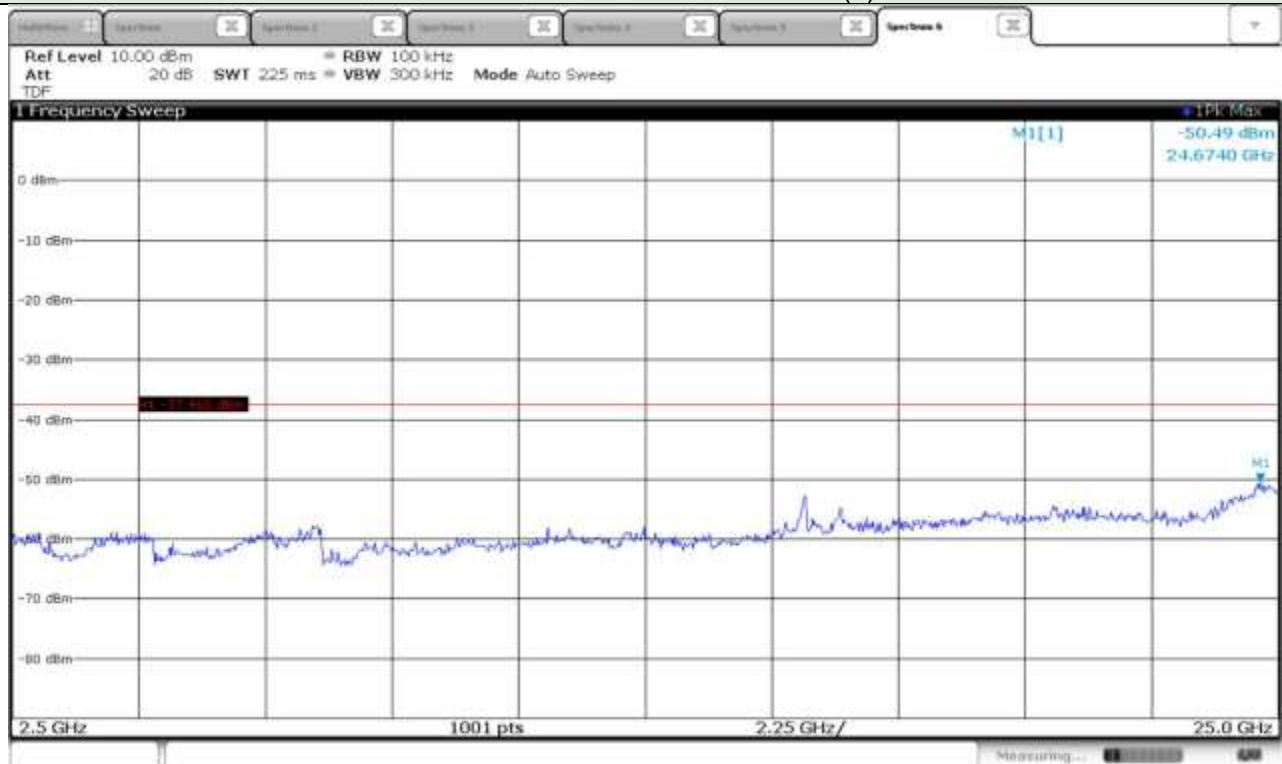
Band-edge and Restricted band – High channel



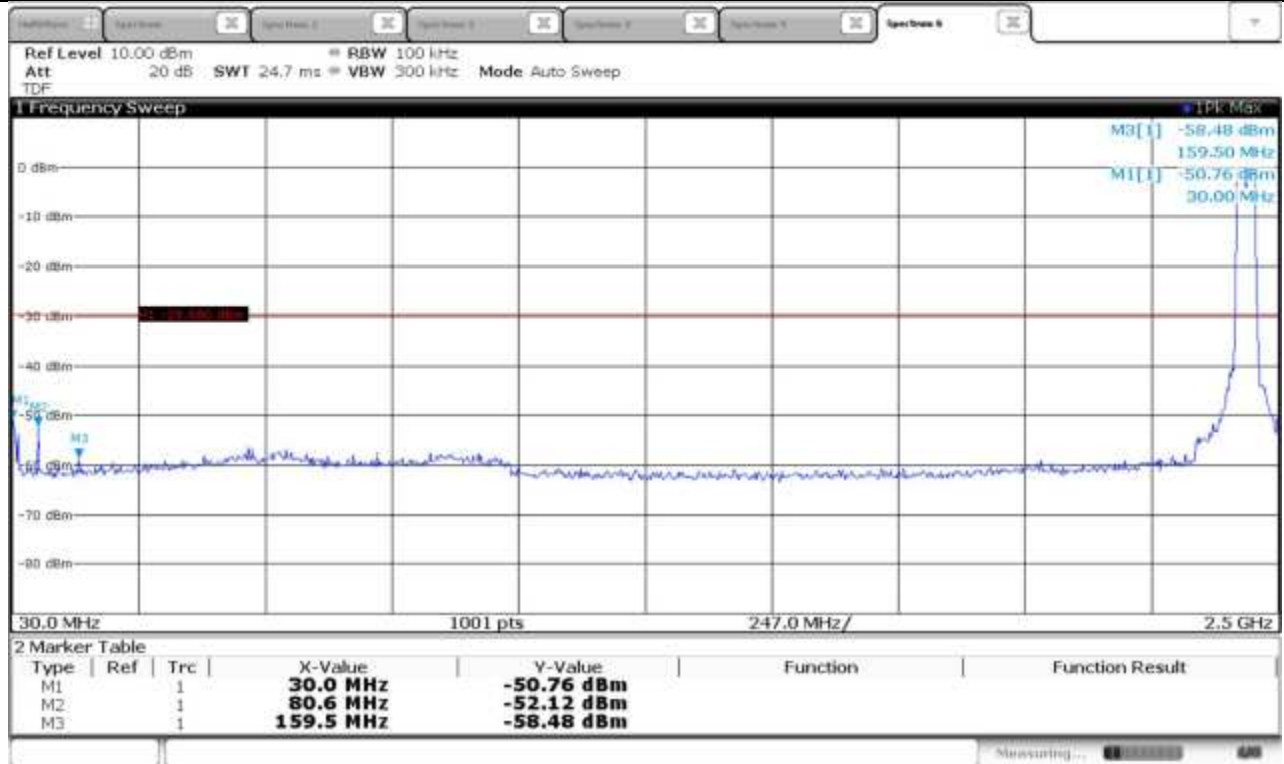
Non-restricted band – Low Channel (1)



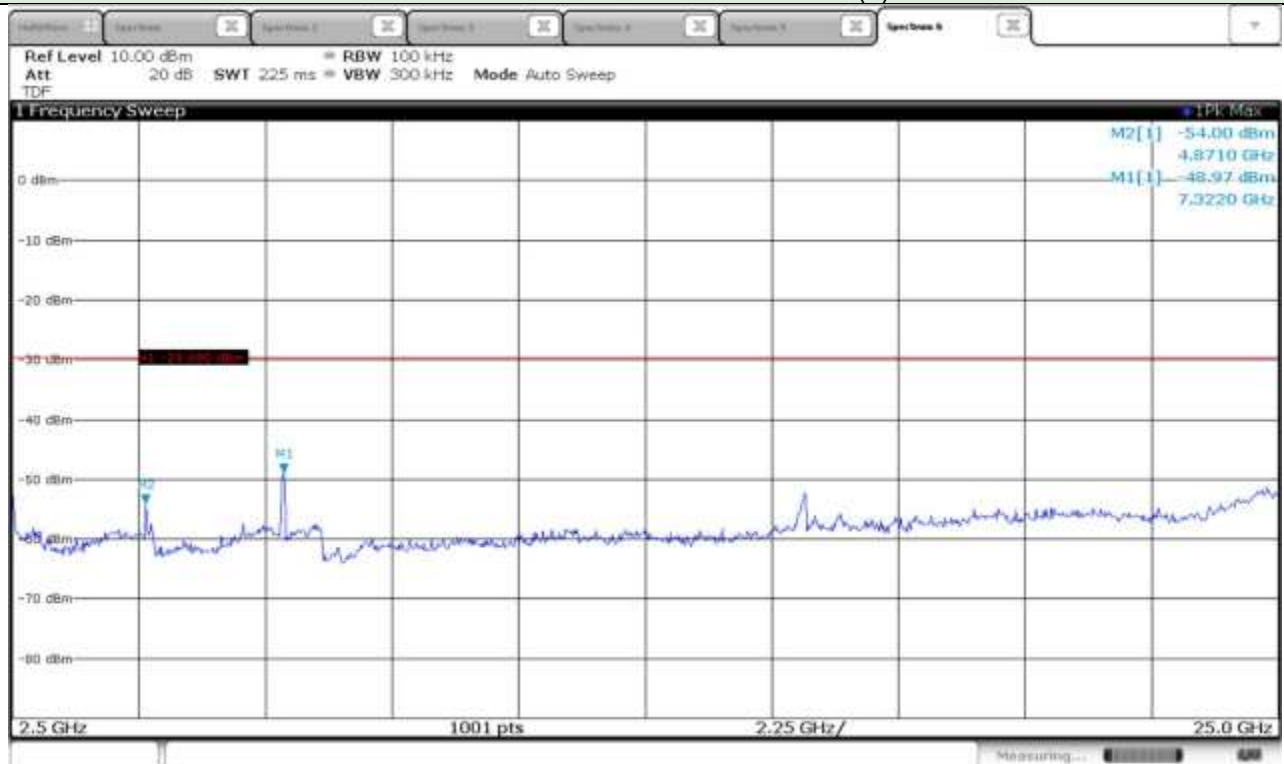
Non-restricted band – Low Channel (2)



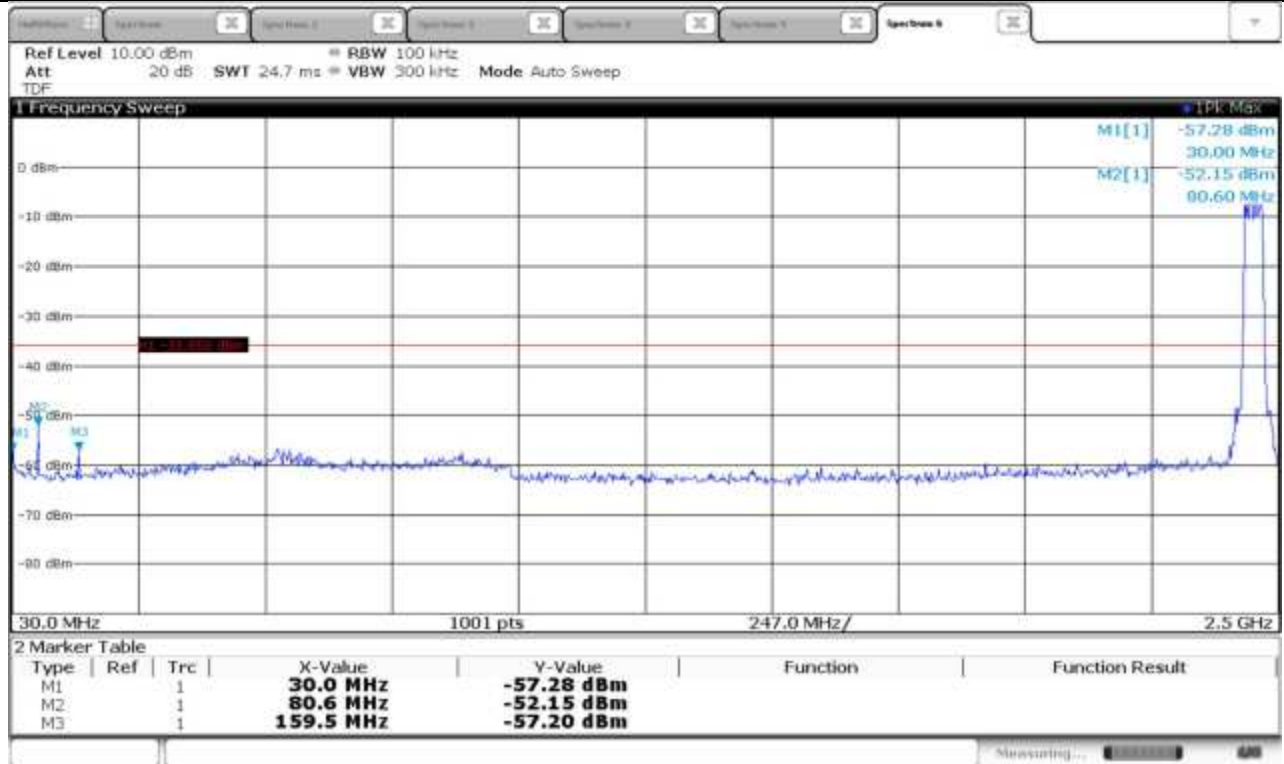
Non-restricted band – Middle Channel (1)



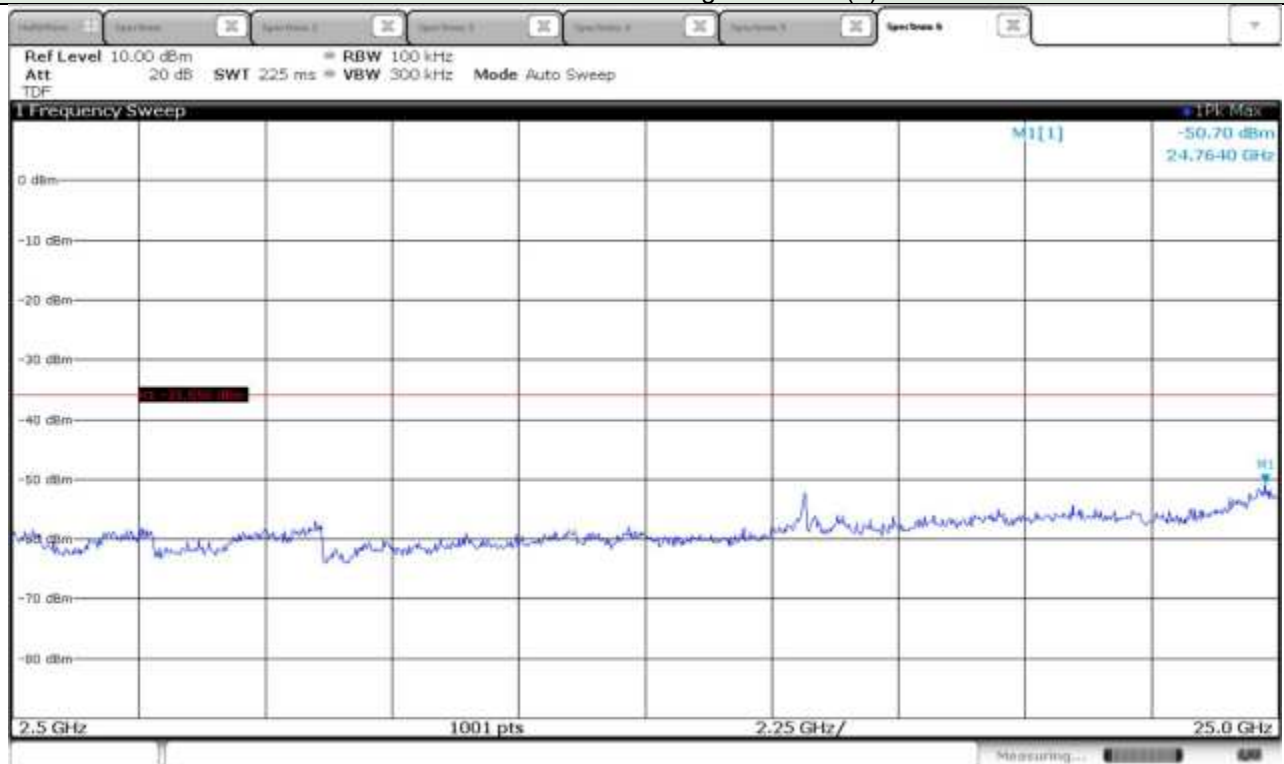
Non-restricted band – Middle Channel (2)



Non-restricted band – High Channel (1)



Non-restricted band – High Channel (2)



5.6 Radiated Emission

5.6.1 Limit

Acc. To section 15.205, 15.209, RSS-GEN 8.9, following table shall be applied.

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 – 88	100	40
88 – 216	150	43.5
216 – 960	200	46
Above 960	500	24

5.6.2 Method of Measurement

Reference to KDB 558074 D01 DTS Meas Guidance v05r02: 8.6 Radiated emission measurements.

The radiated emissions measurements were on 3 m, semi-anechoic chamber. The EUT and other support equipment were placed on a non-conductive table 80 cm for below 1 GHz and 1.5 m for above 1 GHz 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 25 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.

For measurement below 1 GHz, the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For peak emission measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz and for average measurement, resolution bandwidth is set to 1 MHz; and the video bandwidth is set to 10 Hz, when duty cycle is more than 98 %. If duty cycle is less than 98 %, the video bandwidth is set to $\geq 1/T$, where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz. The spectrum from 30 MHz to 25 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

5.6.3 Test Site Requirement for KDB 414788 D01

Acc. to KDB 414788 D01 Radiated Test Site v01, Semi Anechoic Chamber (SAC) shall be verified test results below 30 MHz with Open Area Test Site (OATS), so we compared test results between the measurements from our SAC and an OATS and found test results almost same, so we **declare test result for below 30 MHz from our SAC is valid and met the requirement acc. to KDB 414788 D01 Radiated Test Site v01.**

5.6.4 Measurement Uncertainty

Measurement uncertainties were not taken into account and following uncertainty levels have been estimated for tests performed on the apparatus. The measurement uncertainties are given with at least 95 % confidence.

Frequency Range	Uncertainty	Frequency Range	Uncertainty
9 kHz ~ 30 MHz	± 2.9 dB	30 MHz ~ 1 GHz	± 4.7 dB
1 GHz ~ 18 GHz	± 4.7 dB	18 GHz ~ 25 GHz	± 5.2 dB

5.6.5 Sample Calculated Example

At 80 MHz

Limit = 40.0 dBuV/m

Result (dBuV/m)

= Receiver Reading (dBuV) + Antenna Factor (dB/m) - Pre-amplifier Gain (dB) + Cable Loss (dB) = 30

Margin = Limit – Result = 40 – 30 = 10

so the EUT has 10.0 dB margin at 80 MHz

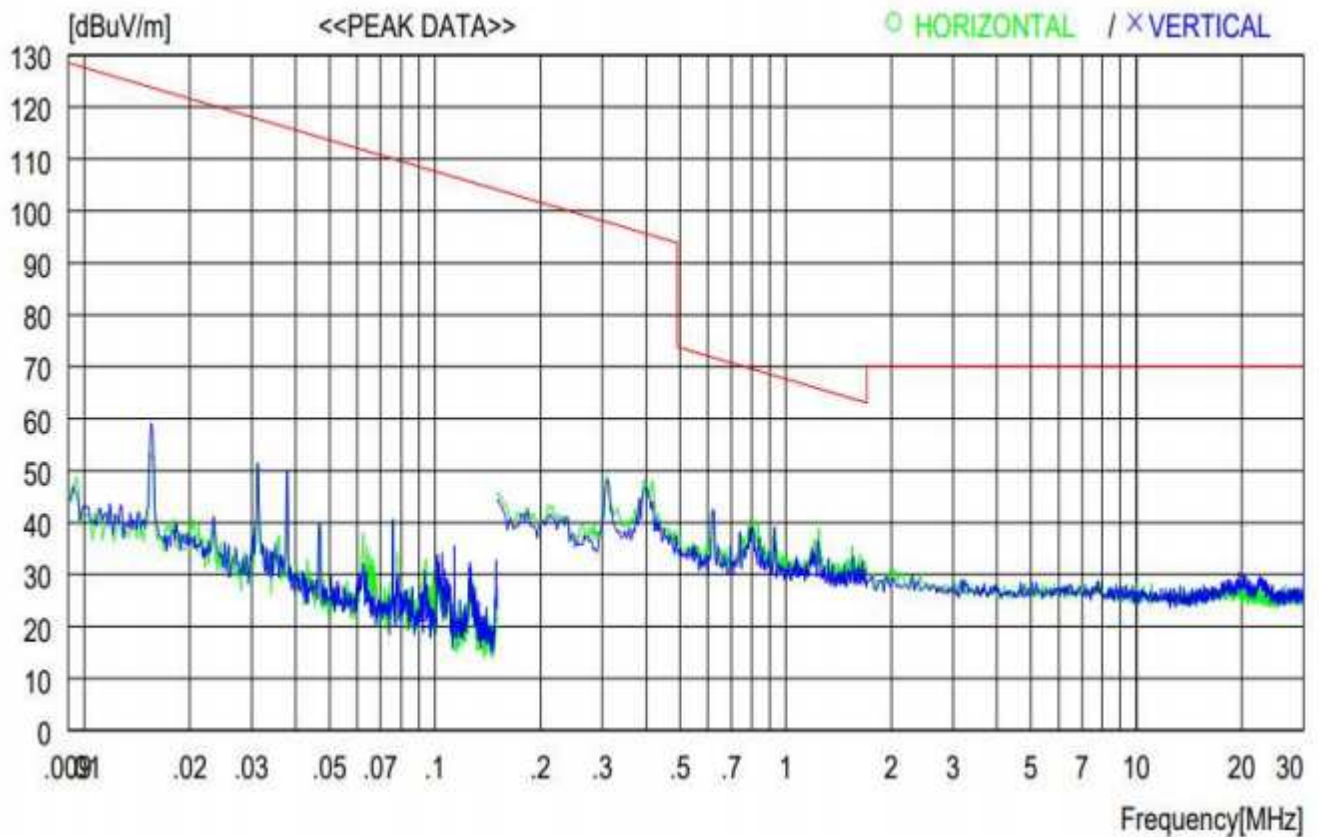
5.6.6 Test Data

Date of Test	2021-01-05, 2021-01-06, 2020-01-07	Temperature	(20.8 ± 1.8) °C		
		Relative humidity	(40.5 ± 1.0) % R.H.		
Measurement Frequency Range		9 kHz ~ 25 GHz			
Test Result	PASS	Tested By	Do-heon Kim 		
Frequency range	Detector Mode	Resolution BW	Video BW	Video Filtering	Measurement distance
Below 30 MHz	Peak or Q.P.	9 kHz	100 kHz	-	3 m
30 MHz ~ 1 000 MHz	Peak or Q.P.	100 kHz	300 kHz	-	3 m
Above 1 GHz	Peak	1 MHz	3 MHz		3 m
	Average	1 MHz	3 MHz		3 m

5.6.6.1 Test Data below 30 MHz

5.6.6.1.1 Operating mode: WLAN 802.11b

Graphical Test Data – WLAN 802.11b - Below 30 MHz



Tabulated Test Data – WLAN 802.11b Low / Middle / High Channel

Frequency (MHz)	Receiver Reading (dBuV)	Detector Mode	Pol.	Ant. Factor (dB/m)	Corr. Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Degree)
* Spurious emissions that 20 dB below the limits didn't be recorded										

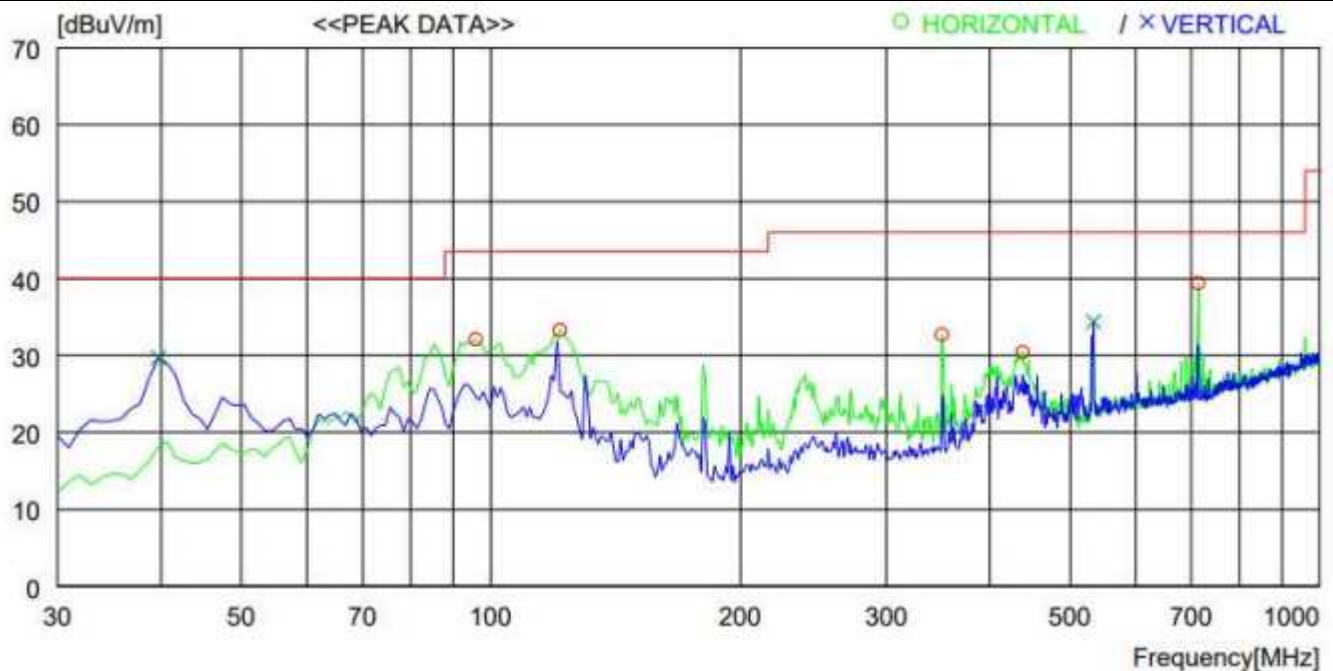
Note. Middle channel at WLAN 802.11b is worst case operating mode.

Test plots for 802.11g/n HT20/n HT40 are almost same with above test data, so the plots are not reported.

5.6.6.2 Test Data from 30 MHz to 1 GHz

5.6.6.2.1 Operating mode: WLAN 802.11b

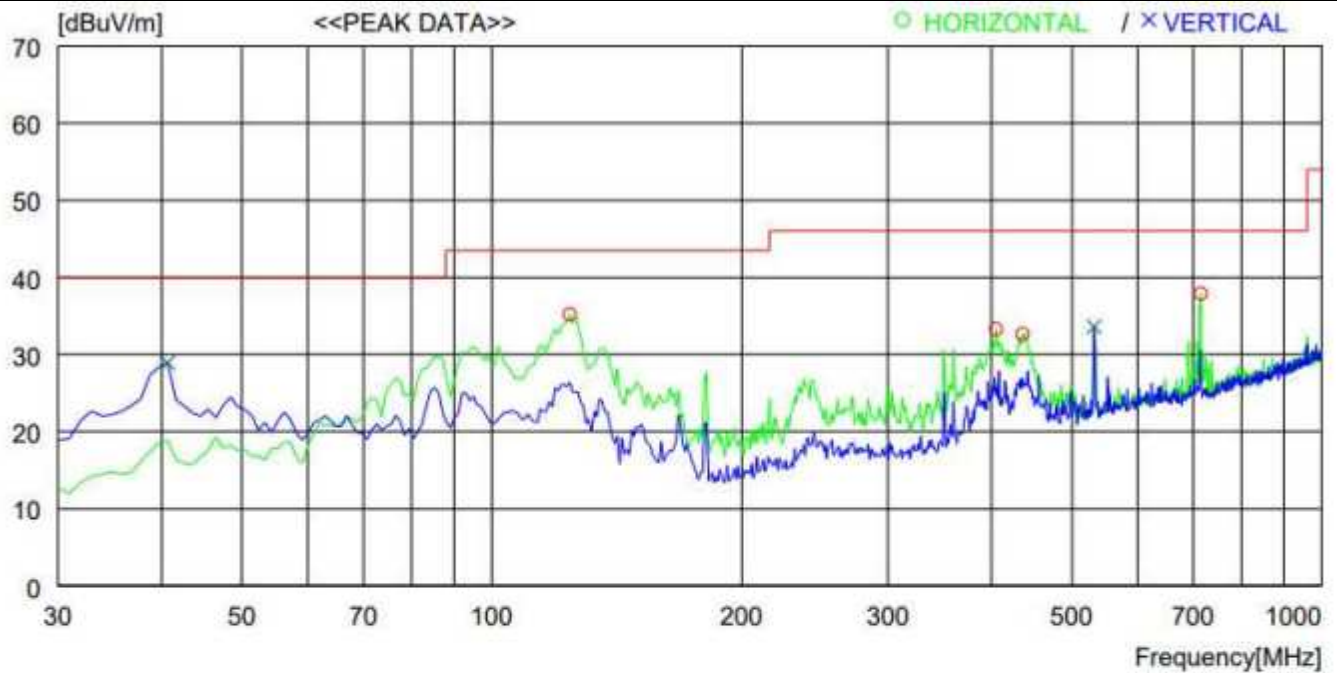
Graphical Test Data – Below 1 GHz – (WLAN 802.11b, **Low channel**)



No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA TABLE [cm]	TABLE [DEG]
----- Horizontal -----										
1	95.960	46.1	10.7	8.0	32.7	32.1	43.5	11.4	400	154
2	121.180	48.1	9.6	8.2	32.6	33.3	43.5	10.2	300	359
3	350.100	41.0	14.5	9.9	32.7	32.7	46.0	13.3	100	359
4	438.371	36.4	16.3	10.5	32.8	30.4	46.0	15.6	100	108
5	713.845	40.5	20.1	11.8	33.0	39.4	46.0	6.6	100	359
----- Vertical -----										
6	39.700	42.2	13.0	7.2	32.7	29.7	40.0	10.3	100	0
7	533.430	38.3	18.0	11.0	32.9	34.4	46.0	11.6	100	0

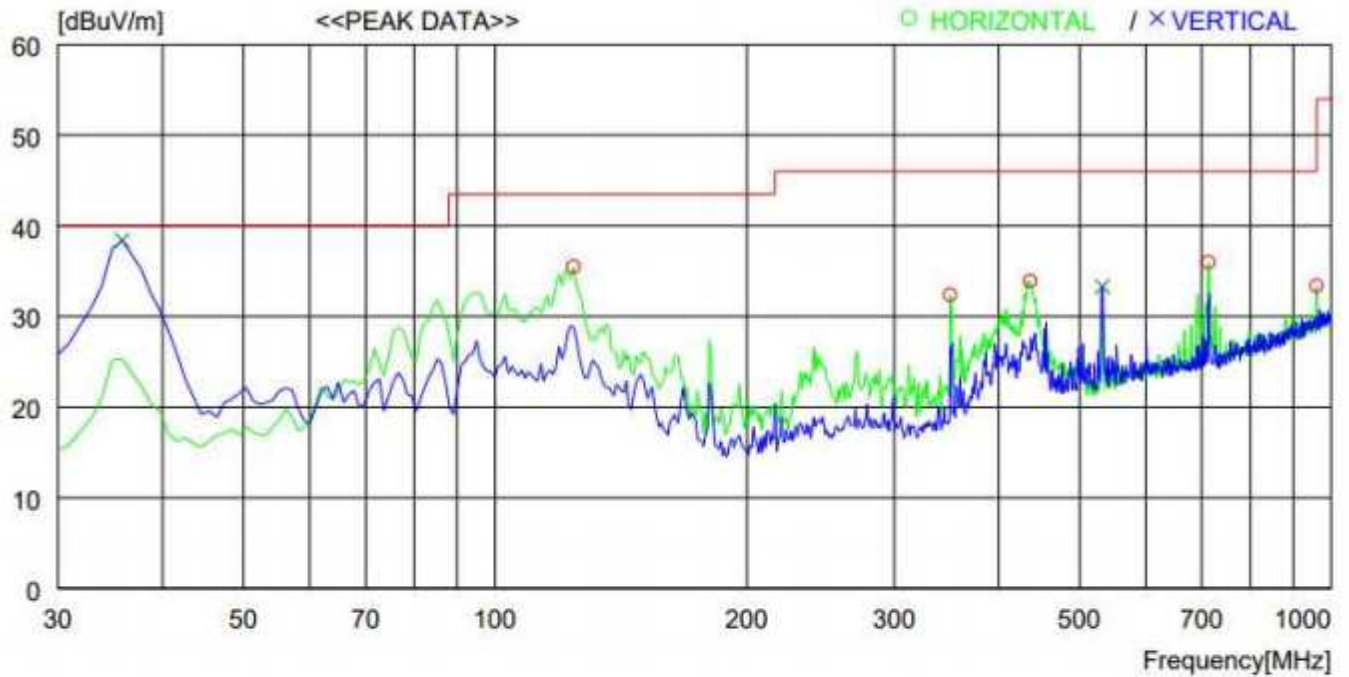
Note. Test plots for 802.11g/n HT20/n HT40 are almost same with above test data, so the plots are not reported.

Graphical Test Data – Below 1 GHz – (WLAN 802.11b, **Middle channel**)



No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	124.090	50.2	9.3	8.3	32.6	35.2	43.5	8.3	200	354
2	405.390	39.9	15.8	10.3	32.7	33.3	46.0	12.7	100	3
3	436.431	38.6	16.3	10.5	32.8	32.6	46.0	13.4	100	129
4	714.815	39.0	20.1	11.8	33.0	37.9	46.0	8.1	200	0
----- Vertical -----										
5	40.670	41.1	13.3	7.2	32.7	28.9	40.0	11.1	100	0
6	531.490	37.5	18.0	11.0	32.9	33.6	46.0	12.4	100	0

Graphical Test Data – Below 1 GHz – (WLAN 802.11b, **High channel**)



No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	124.090	50.5	9.3	8.3	32.6	35.5	43.5	8	200	4
2	350.100	40.7	14.5	9.9	32.7	32.4	46.0	13.6	100	338
3	436.431	39.9	16.3	10.5	32.8	33.9	46.0	12.1	100	358
4	712.875	37.2	20.0	11.8	33.0	36.0	46.0	10	100	253
5	960.217	30.1	22.4	12.7	31.8	33.4	54.0	20.6	200	237
----- Vertical -----										
6	35.820	52.6	11.4	7.1	32.7	38.4	40.0	1.6	100	0
7	532.460	37.2	18.0	11.0	32.9	33.3	46.0	12.7	100	221

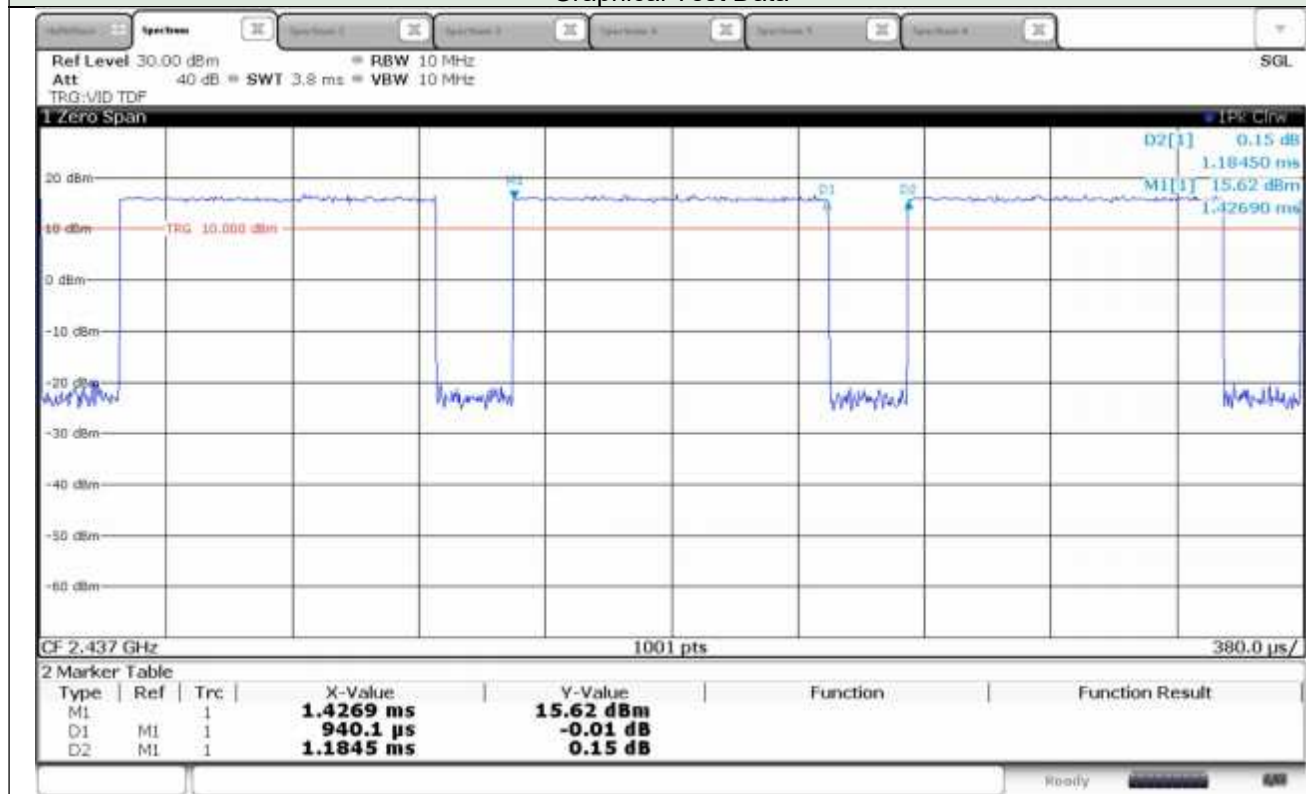
5.6.6.3 Test Data above 1 GHz

5.6.6.3.1 Operating mode: WLAN 802.11b

Duty Cycle

Date of Test	2021-01-05	Temperature	(20.8 ± 1.8) °C
		Relative humidity	(40.5 ± 1.0) % R.H.
Measurement Distance	3 m	Tested By	Do-heon Kim 
Detector Mode	Resolution BW	Video BW	Sweep Time
PEAK	1 MHz	3 MHz	Auto
AVERAGE	1 MHz	3 MHz	Auto

Graphical Test Data



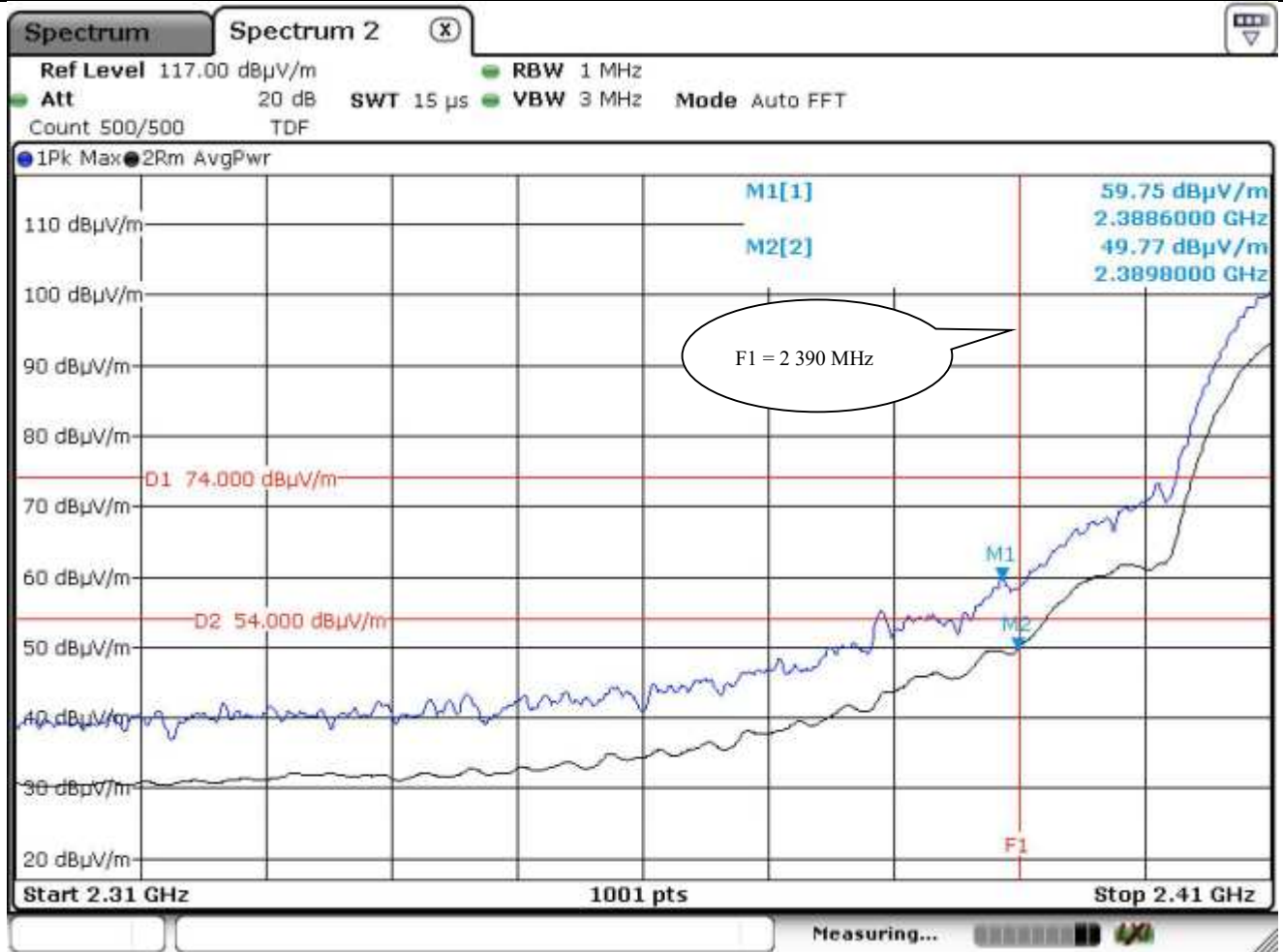
Tabulated Test Data

Operating Mode	On Time (ms)	On + Off Time (ms)	Duty Cycle (%)	Duty Factor (dB)
WLAN 802.11b	0.940	1.185	79.37	1.00

Band edge (Restricted band)

Graphical Test Data – Low Channel (Horizontal)

Peak & Average



Tabulated Test Data – Low Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 388.6	Peak	H	59.75	-	59.75	74.00	14.25	170	210
2 389.8	RMS	H	49.77	1.00	50.77	54.00	3.23	170	210

NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – Low Channel (Vertical)

Peak & Average



Tabulated Test Data – Low Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 390.0	Peak	V	61.45	-	61.45	74.00	12.55	100	125
2 387.5	RMS	V	50.22	1.00	51.22	54.00	2.78	100	125

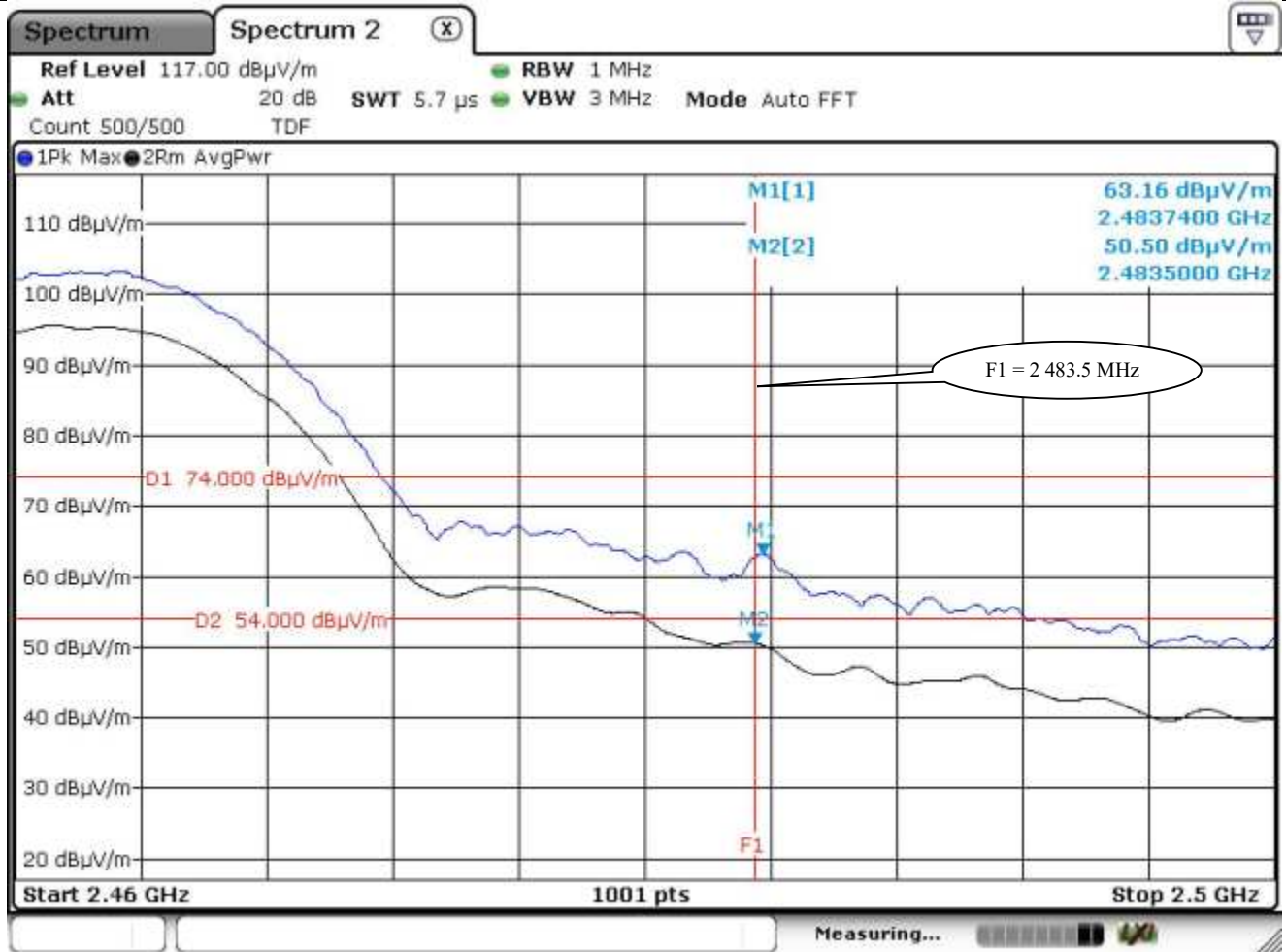
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – High Channel (Horizontal)

Peak & Average



Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.7	Peak	H	63.16	-	63.16	74.00	10.84	170	210
2 483.5	RMS	H	50.50	1.00	51.50	54.00	2.50	170	210

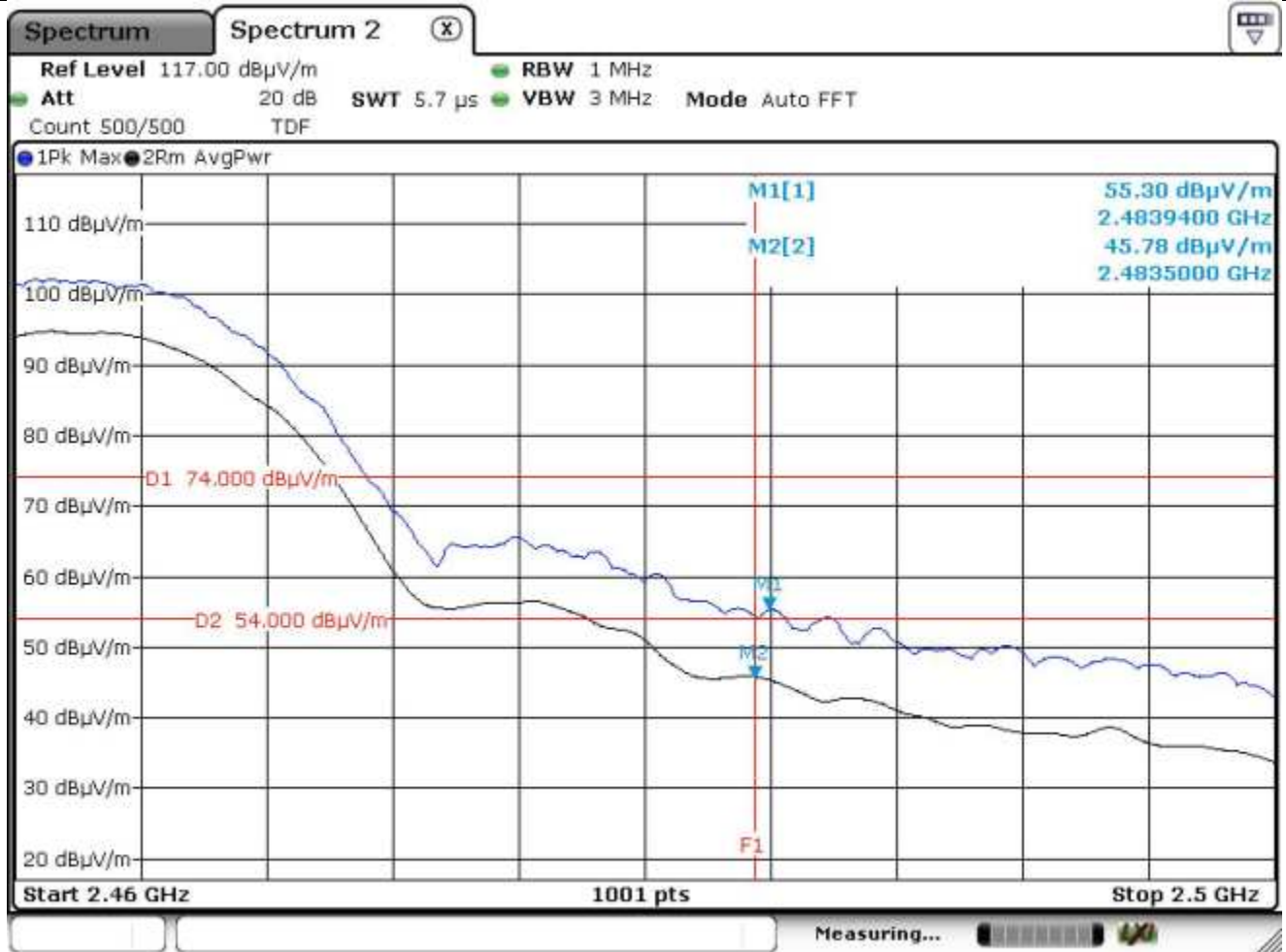
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – High Channel (Vertical)

Peak & Average



Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.9	Peak	V	55.30	-	55.30	74.00	18.70	100	125
2 483.5	RMS	V	45.78	1.00	45.78	54.00	7.22	100	125

NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

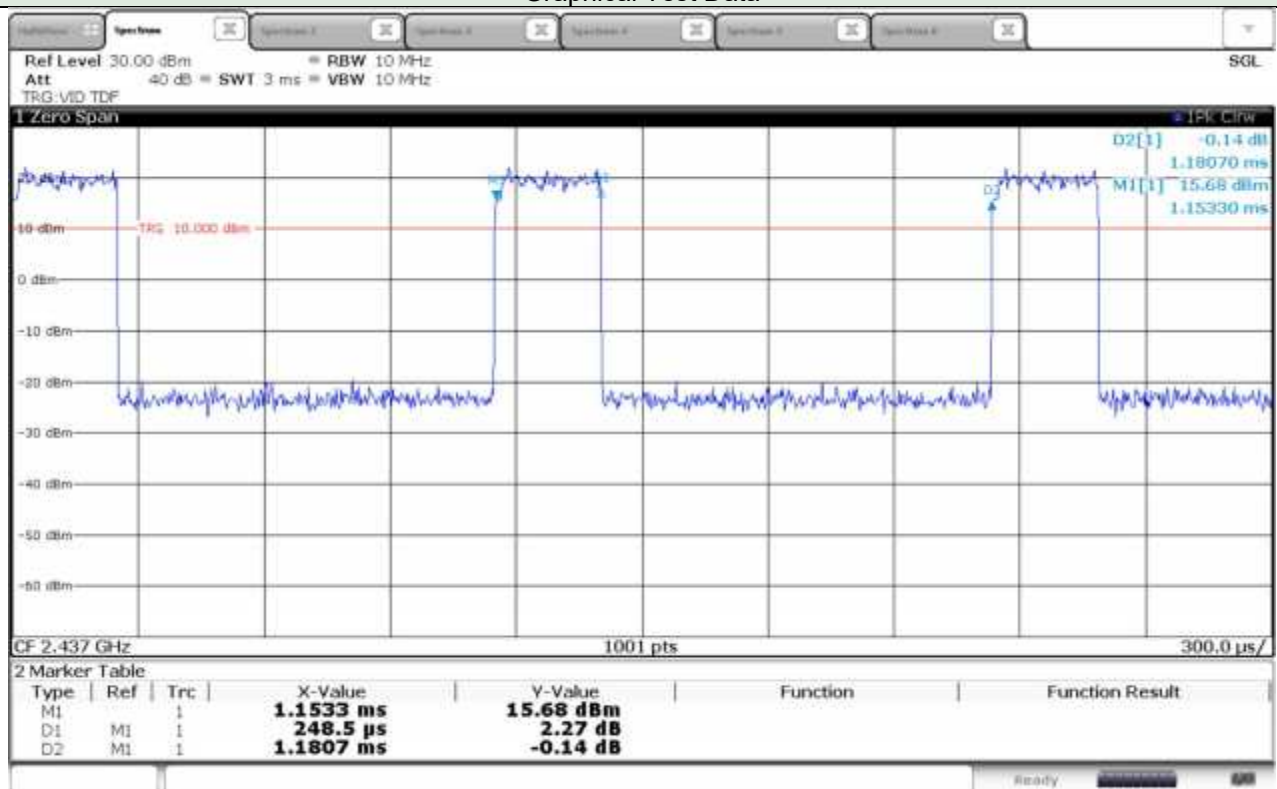
Result = Measured Value + Duty Factor

5.6.6.3.2 Operating mode: WLAN 802.11g

Duty Cycle

Date of Test	2021-01-05	Temperature	(20.8 ± 1.8) °C
		Relative humidity	(40.5 ± 1.0) % R.H.
Measurement Distance	3 m	Tested By	Do-heon Kim 
Detector Mode	Resolution BW	Video BW	Sweep Time
PEAK	1 MHz	3 MHz	Auto
AVERAGE	1 MHz	3 MHz	Auto

Graphical Test Data



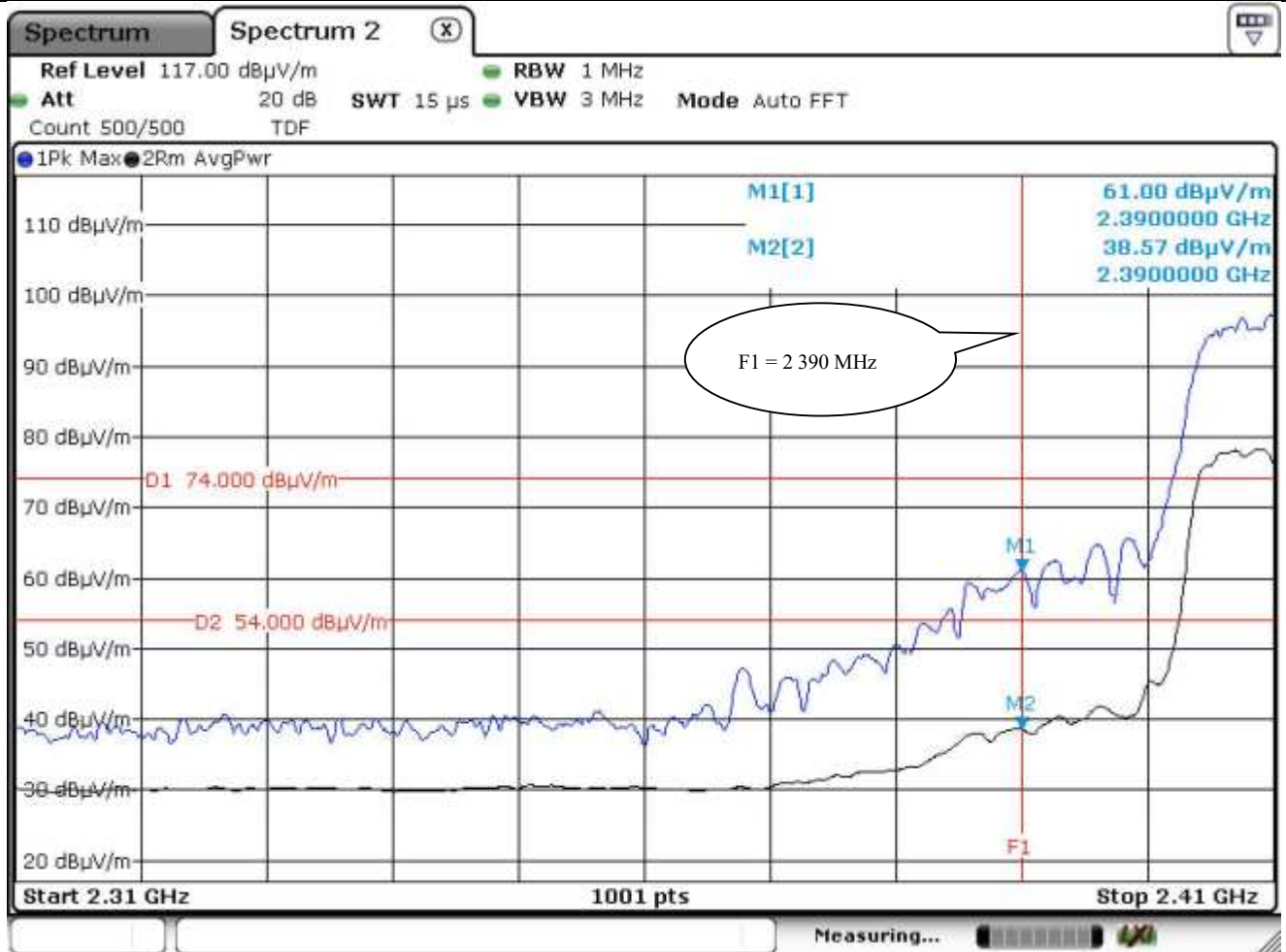
Tabulated Test Data

Operating Mode	On Time (ms)	On + Off Time (ms)	Duty Cycle (%)	Duty Factor (dB)
WLAN 802.11g	0.249	1.181	21.05	6.77

Band edge (Restricted band)

Graphical Test Data – Low Channel (Horizontal)

Peak & Average



Tabulated Test Data – Low Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 390.0	Peak	H	61.00	-	61.00	74.00	13.00	170	210
2 390.0	RMS	H	38.57	6.77	45.34	54.00	8.66	170	210

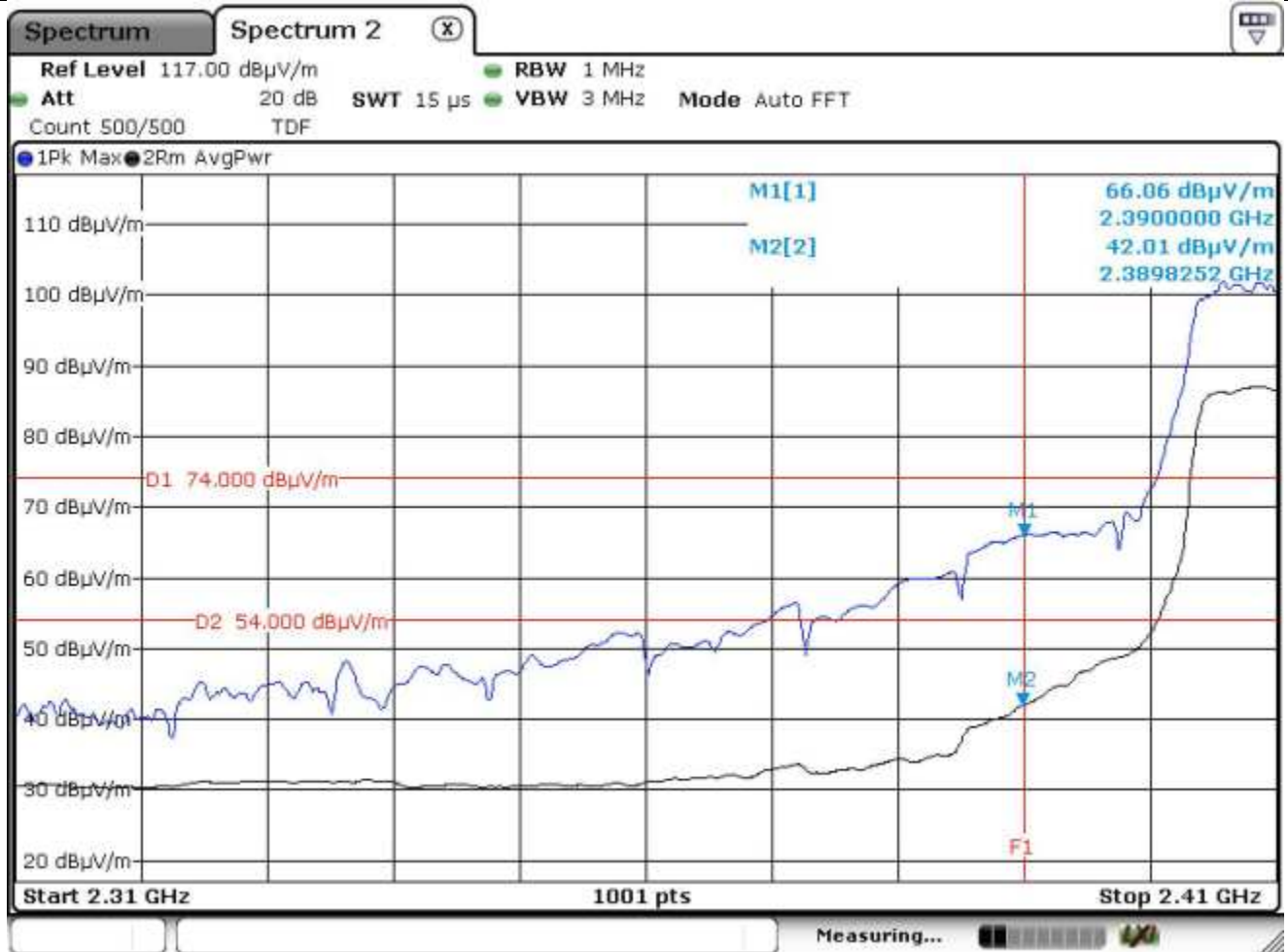
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – Low Channel (Vertical)

Peak & Average



Tabulated Test Data – Low Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBμV/m)	Duty Factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 390.0	Peak	V	66.06	-	66.06	74.00	7.94	100	125
2 389.8	RMS	V	42.01	6.77	48.78	54.00	5.22	100	125

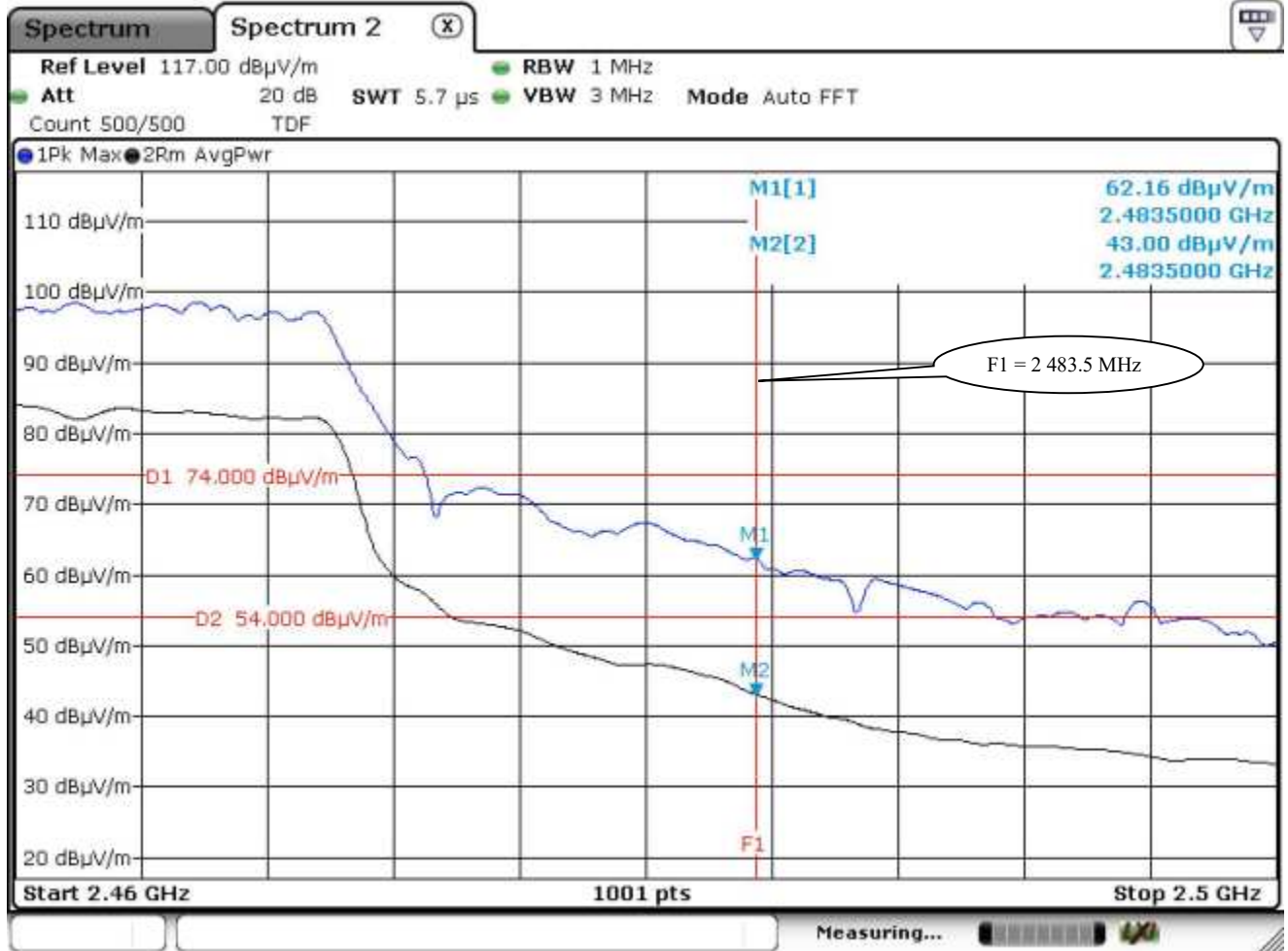
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – High Channel (Horizontal)

Peak & Average



Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.5	Peak	H	62.16	-	62.16	74.00	11.84	170	210
2 483.5	RMS	H	43.00	6.77	49.77	54.00	4.23	170	210

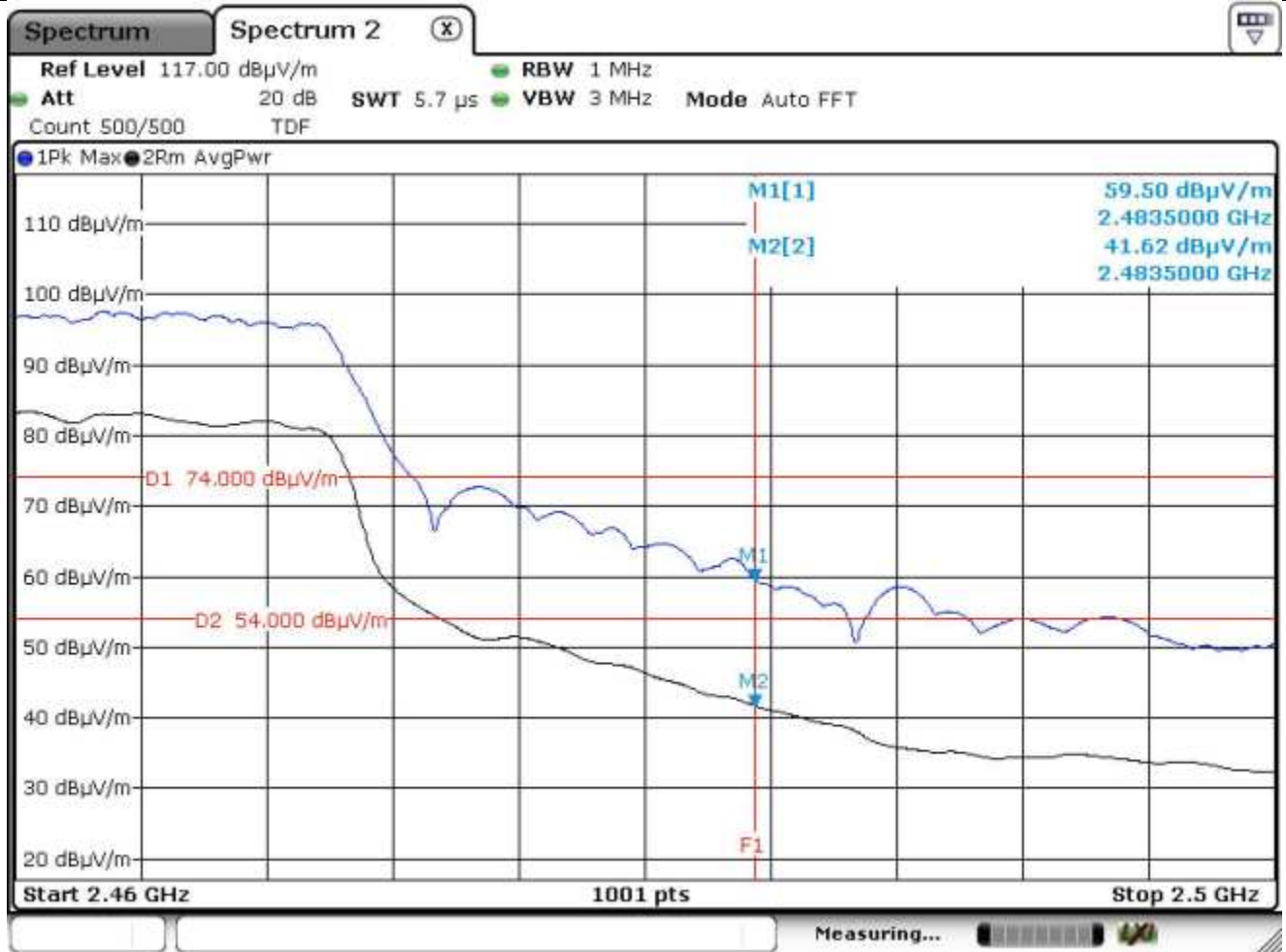
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – High Channel (Vertical)

Peak & Average



Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.5	Peak	V	59.50	-	59.50	74.00	14.50	100	125
2 483.5	RMS	V	41.62	6.77	48.39	54.00	5.61	100	125

NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

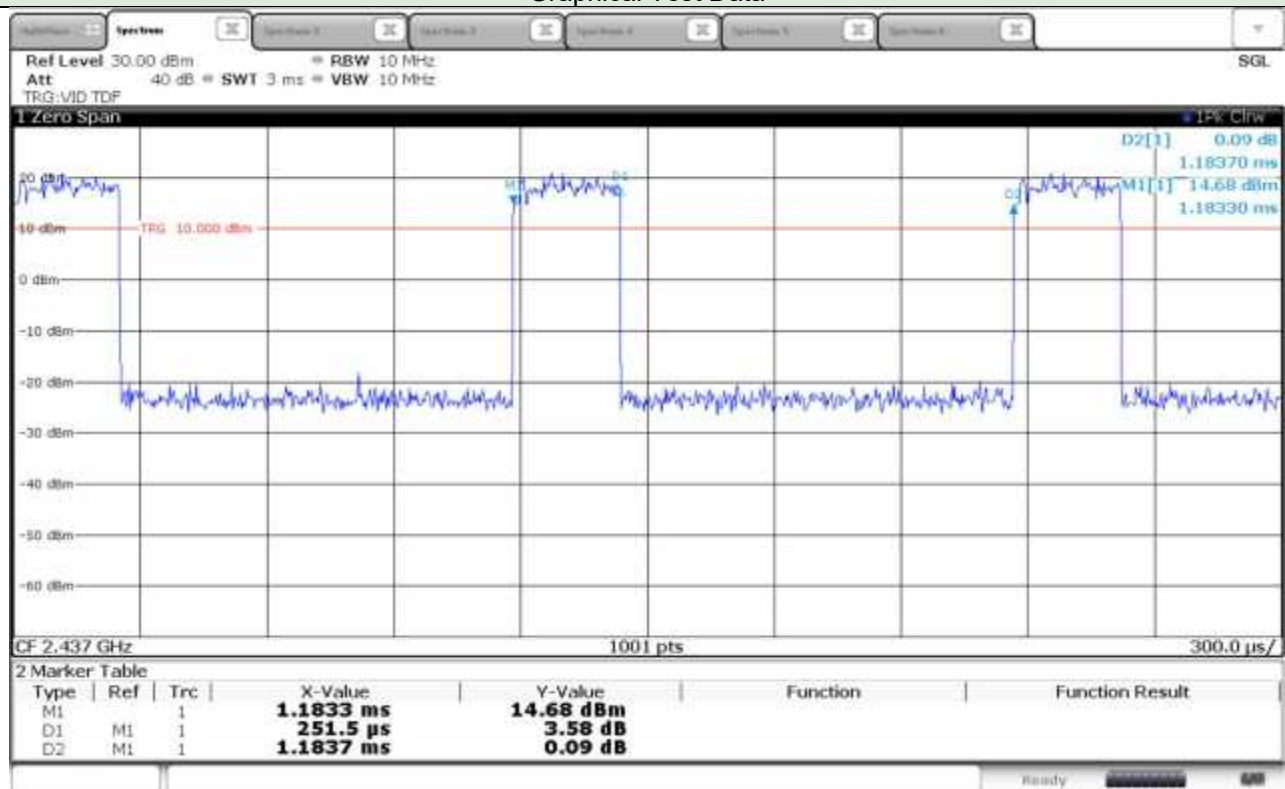
Result = Measured Value + Duty Factor

5.6.6.3.3 Operating mode: WLAN 802.11n HT20

Duty Cycle

Date of Test	2021-01-05	Temperature	(20.8 ± 1.8) °C
		Relative humidity	(40.5 ± 1.0) % R.H.
Measurement Distance	3 m	Tested By	Do-heon Kim 
Detector Mode	Resolution BW	Video BW	Sweep Time
PEAK	1 MHz	3 MHz	Auto
AVERAGE	1 MHz	3 MHz	Auto

Graphical Test Data



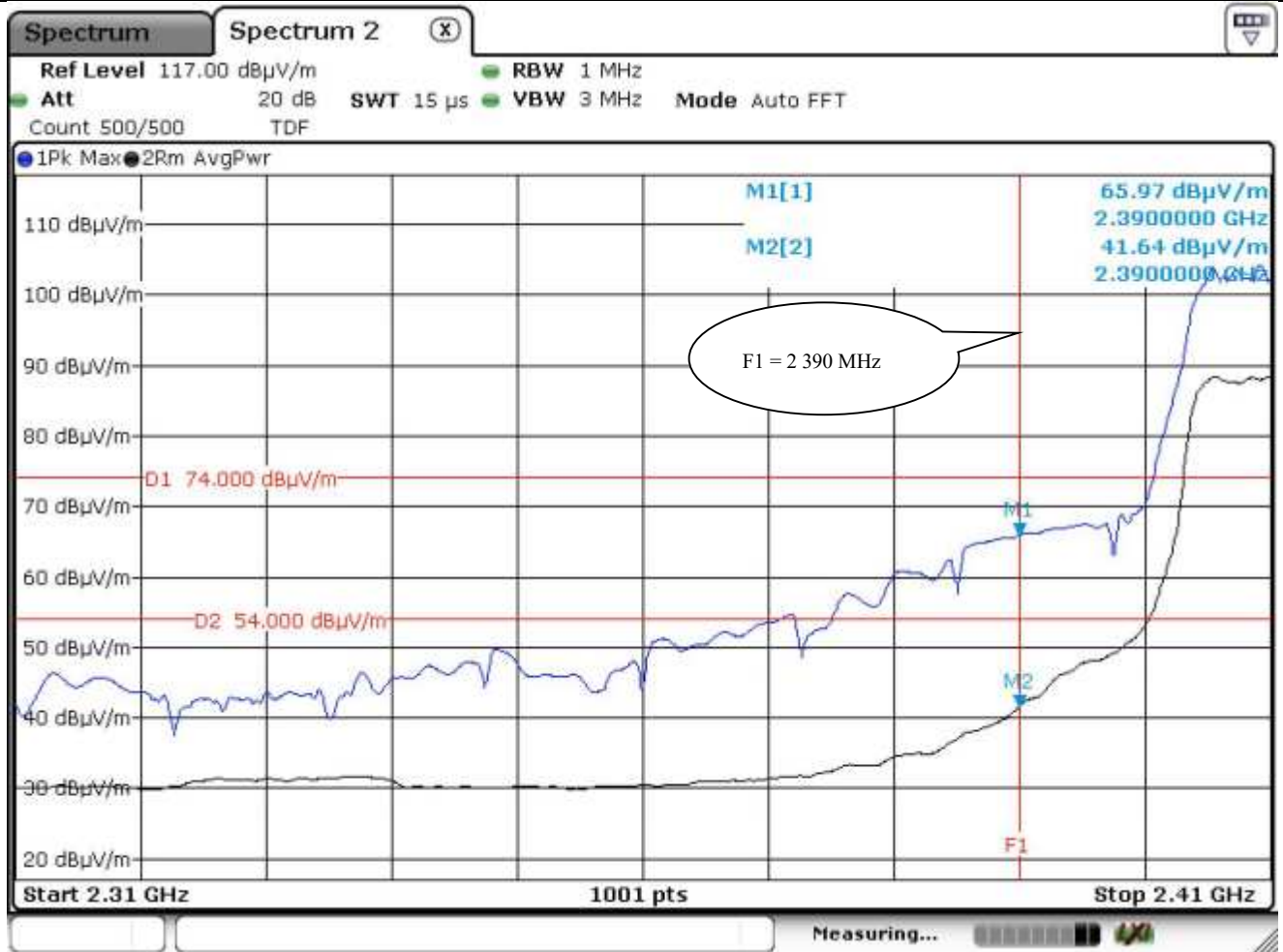
Tabulated Test Data

Operating Mode	On Time (ms)	On + Off Time (ms)	Duty Cycle (%)	Duty Factor (dB)
WLAN 802.11n HT20	0.252	1.184	21.25	6.73

Band edge (Restricted band)

Graphical Test Data – Low Channel (Horizontal)

Peak & Average



Tabulated Test Data – Low Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 390.0	Peak	H	65.97	-	65.97	74.00	8.03	170	210
2 390.0	RMS	H	41.64	6.73	48.37	54.00	5.63	170	210

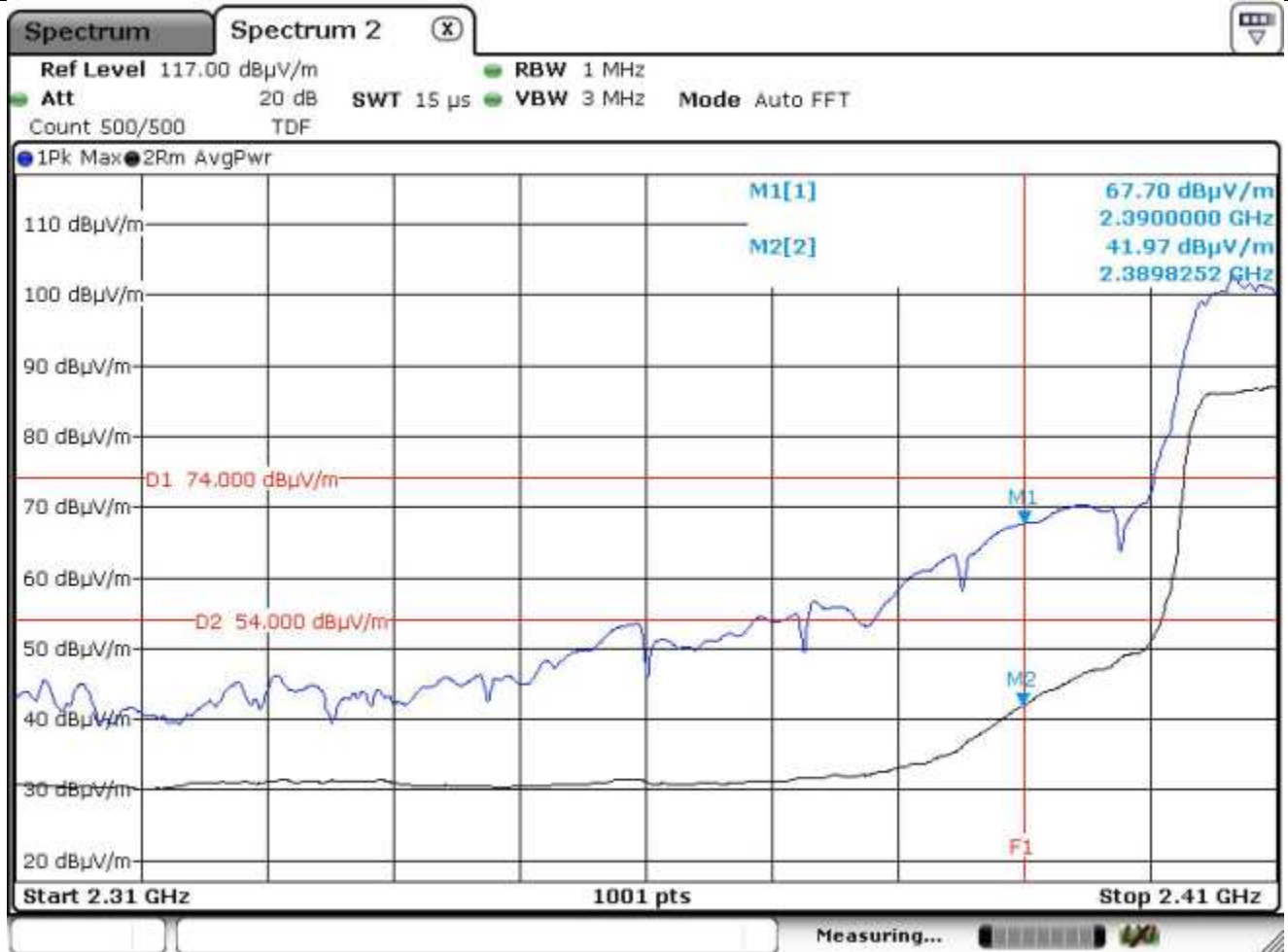
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – Low Channel (Vertical)

Peak & Average



Tabulated Test Data – Low Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBμV/m)	Duty Factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 390.0	Peak	V	67.70	-	67.70	74.00	6.30	100	125
2 389.8	RMS	V	41.97	6.73	48.70	54.00	5.30	100	125

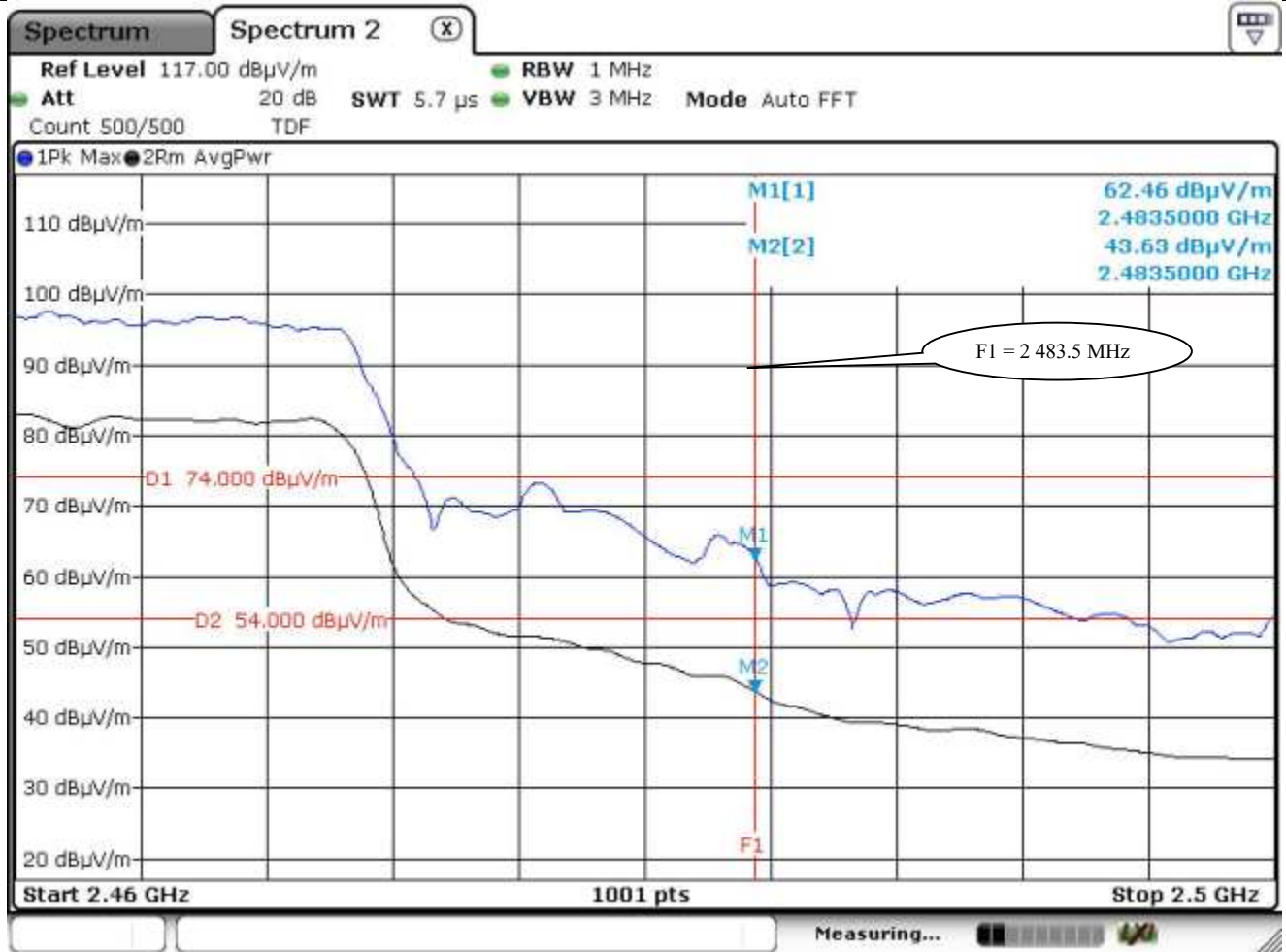
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – High Channel (Horizontal)

Peak & Average



Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.5	Peak	H	62.46	-	62.46	74.00	11.54	100	125
2 483.5	RMS	H	43.63	6.73	50.36	54.00	3.64	100	125

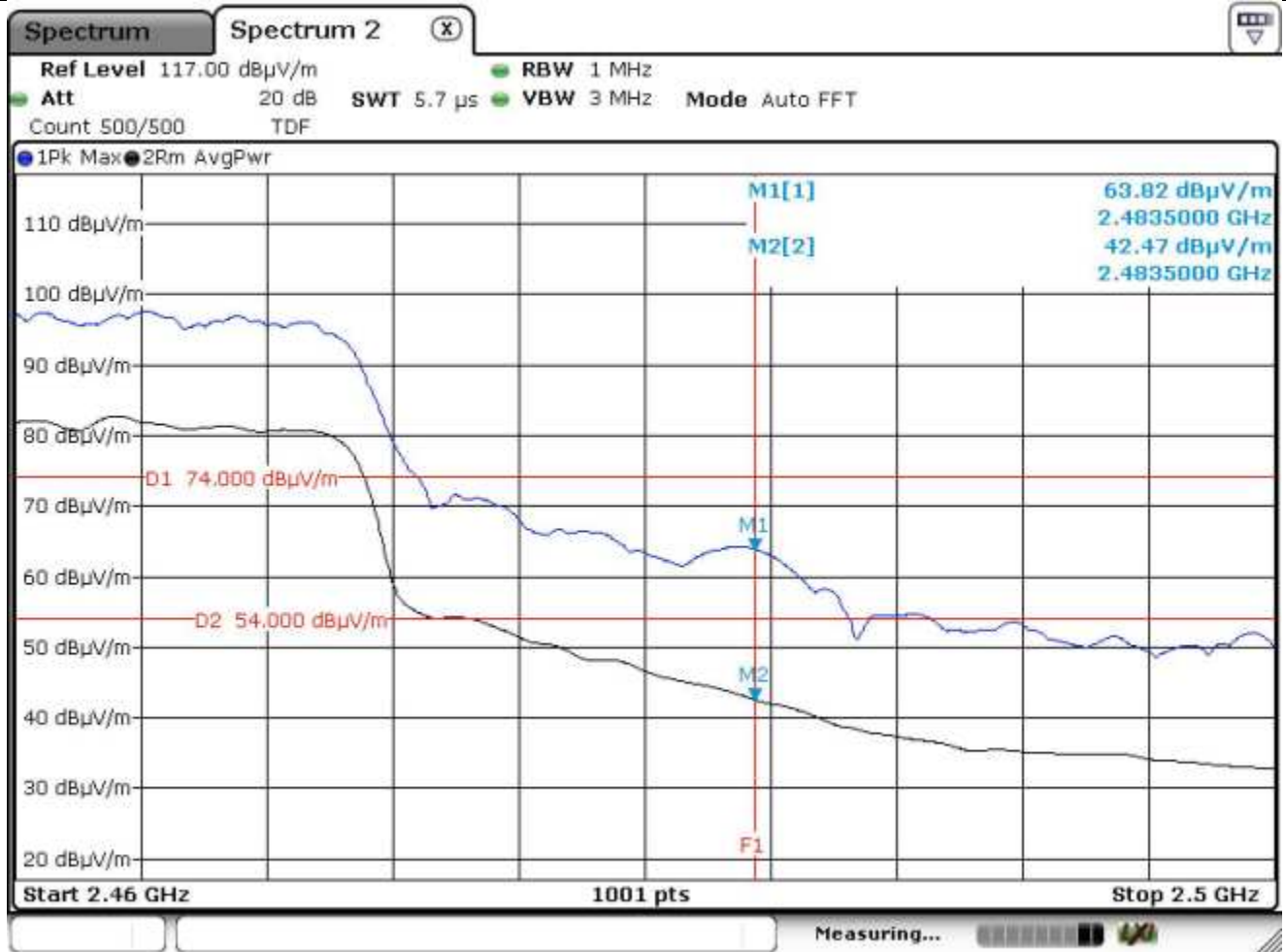
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – High Channel (Vertical)

Peak & Average



Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.5	Peak	V	63.82	-	63.82	74.00	10.18	100	125
2 483.5	RMS	V	42.47	6.73	49.20	54.00	4.80	100	125

NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

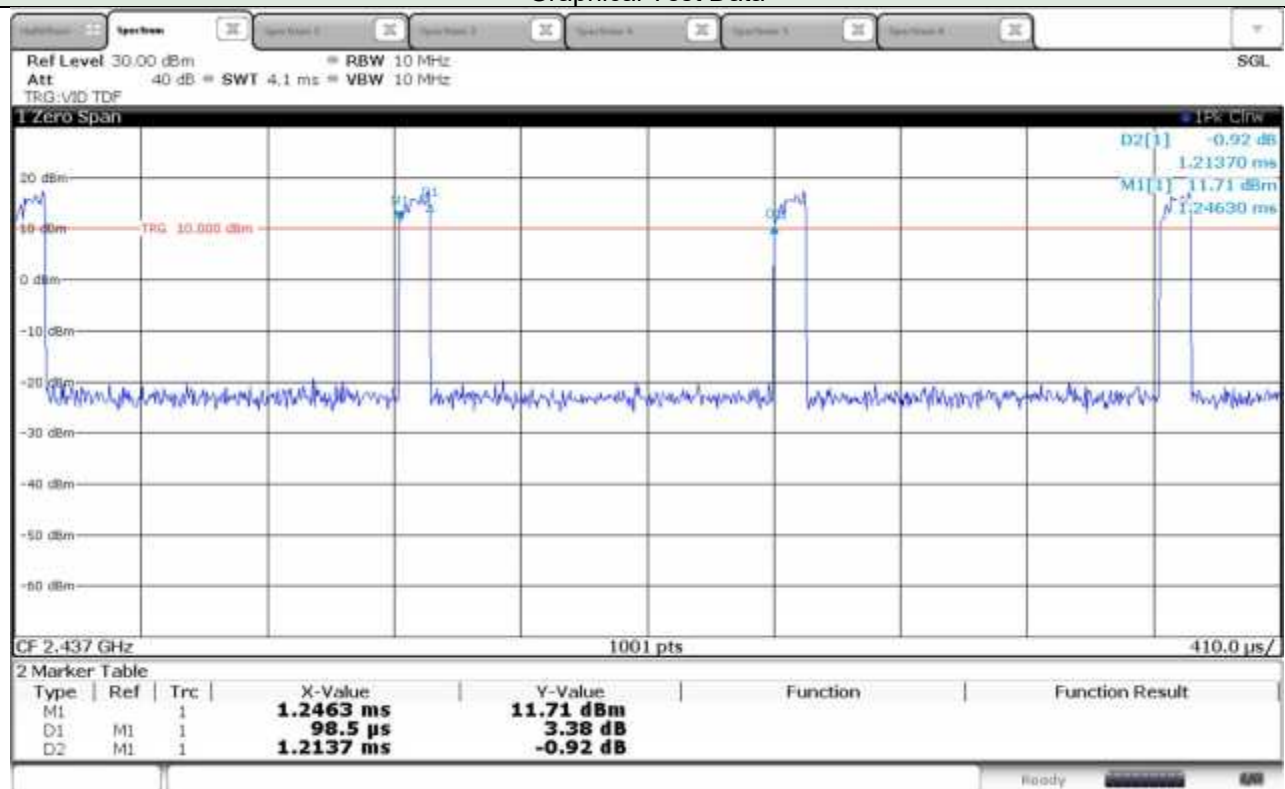
Result = Measured Value + Duty Factor

5.6.6.3.4 Operating mode: WLAN 802.11n HT40

Duty Cycle

Date of Test	2021-01-05	Temperature	(20.8 ± 1.8) °C
		Relative humidity	(40.5 ± 1.0) % R.H.
Measurement Distance	3 m	Tested By	Do-heon Kim 
Detector Mode	Resolution BW	Video BW	Sweep Time
PEAK	1 MHz	3 MHz	Auto
AVERAGE	1 MHz	3 MHz	Auto

Graphical Test Data



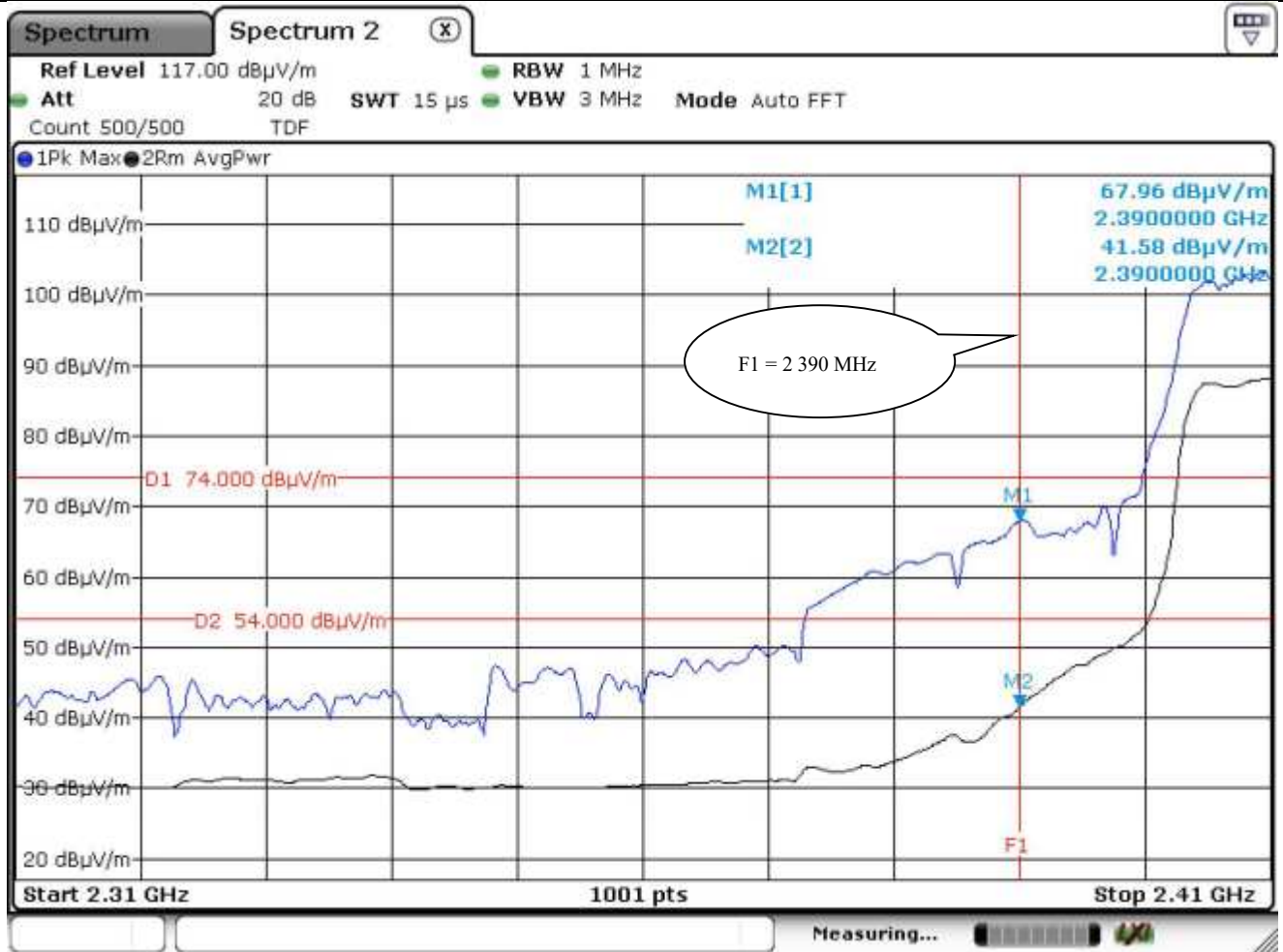
Tabulated Test Data

Operating Mode	On Time (ms)	On + Off Time (ms)	Duty Cycle (%)	Duty Factor (dB)
WLAN 802.11n HT40	0.099	1.214	8.12	10.91

Band edge (Restricted band)

Graphical Test Data – Low Channel (Horizontal)

Peak & Average



Tabulated Test Data – Low Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 390.0	Peak	H	67.96	-	67.96	74.00	6.04	170	210
2 390.0	RMS	H	41.58	10.91	52.49	54.00	1.51	170	210

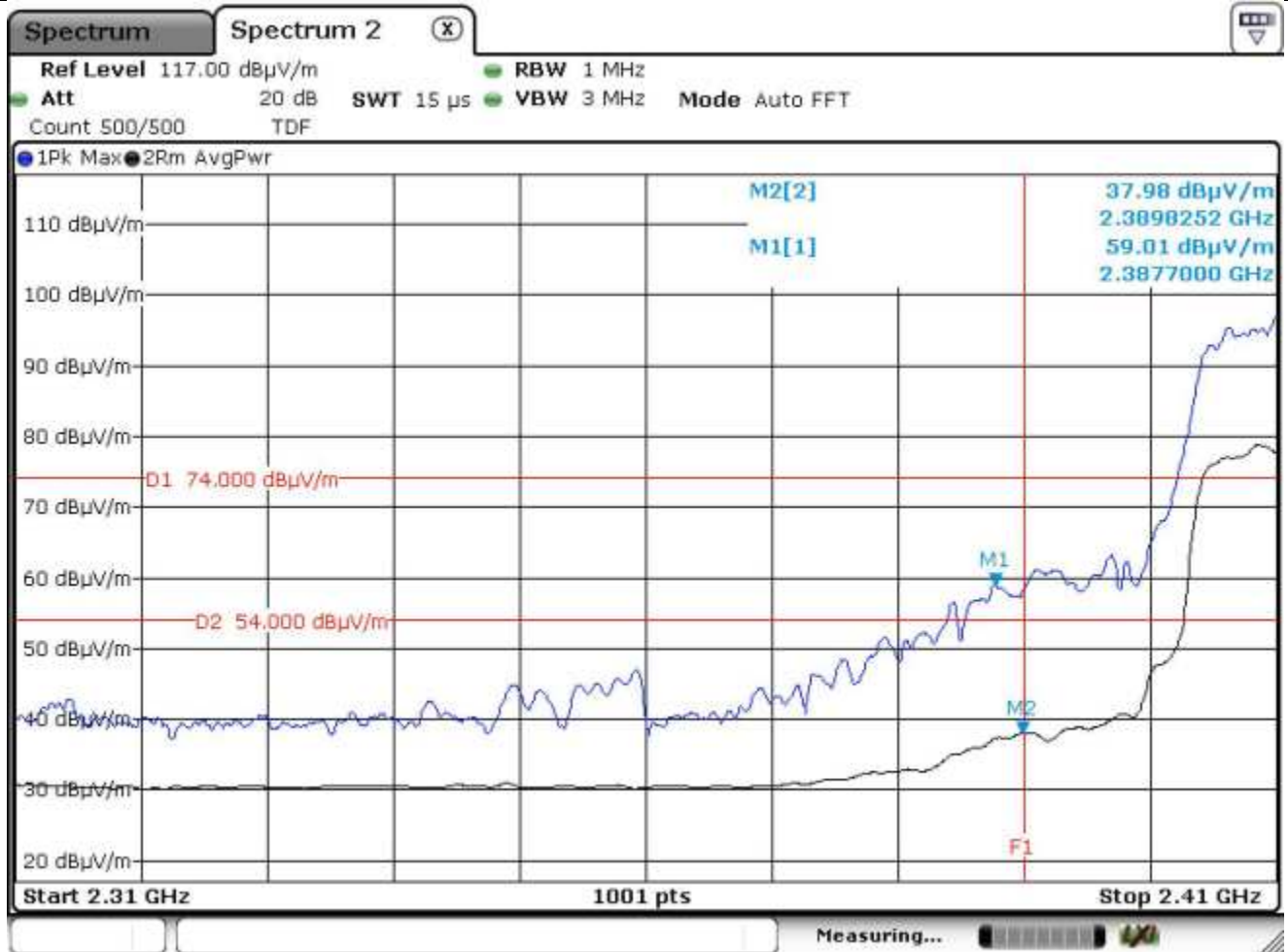
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – Low Channel (Vertical)

Peak & Average



Tabulated Test Data – Low Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 389.8	Peak	V	59.01	-	59.01	74.00	14.99	100	125
2 387.7	RMS	V	37.98	10.91	48.89	54.00	5.11	100	125

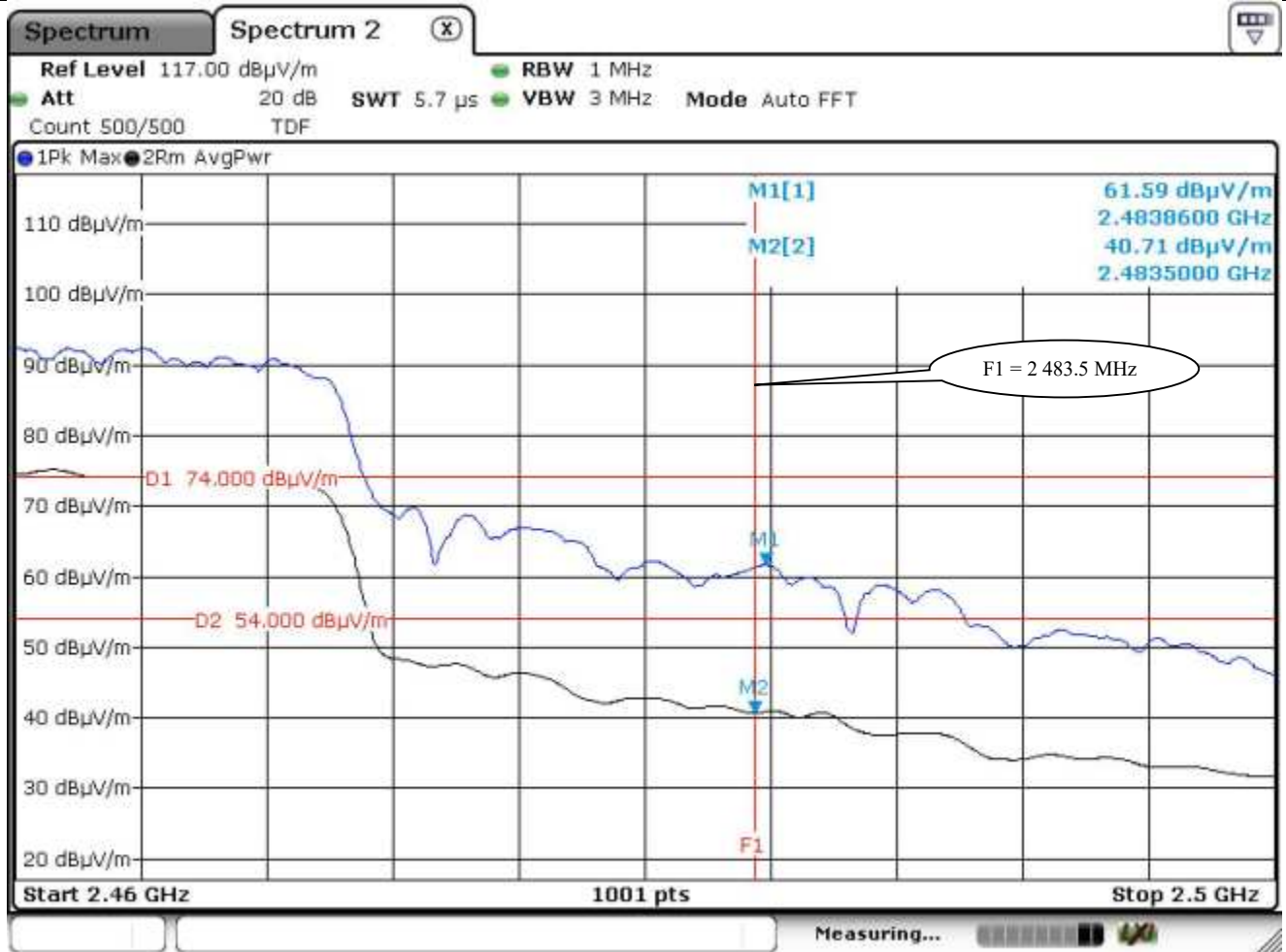
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – High Channel (Horizontal)

Peak & Average



Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 483.9	Peak	H	61.59	-	61.59	74.00	12.41	170	210
2 483.5	RMS	H	40.71	10.91	51.62	54.00	2.38	170	210

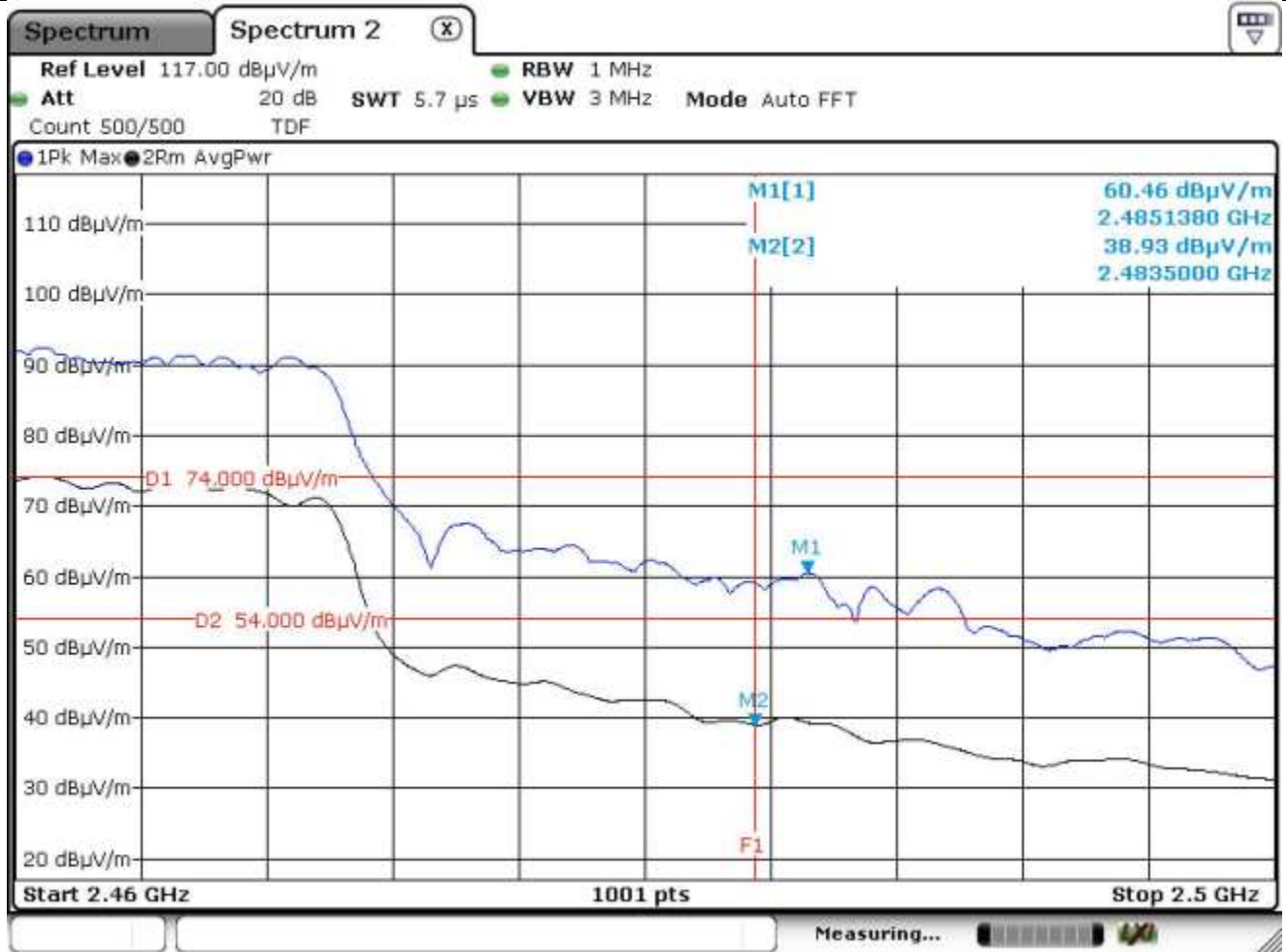
NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

Graphical Test Data – High Channel (Vertical)

Peak & Average



Tabulated Test Data – High Channel

Freq. (MHz)	Detector Mode	Pol.	Measured Value (dBuV/m)	Duty Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Azimuth (Deg)
2 485.1	Peak	V	60.46	-	60.46	74.00	13.54	100	125
2 483.5	RMS	V	38.93	10.91	49.84	54.00	4.16	100	125

NOTE: “H” means Horizontal polarity, “V” means Vertical polarity.

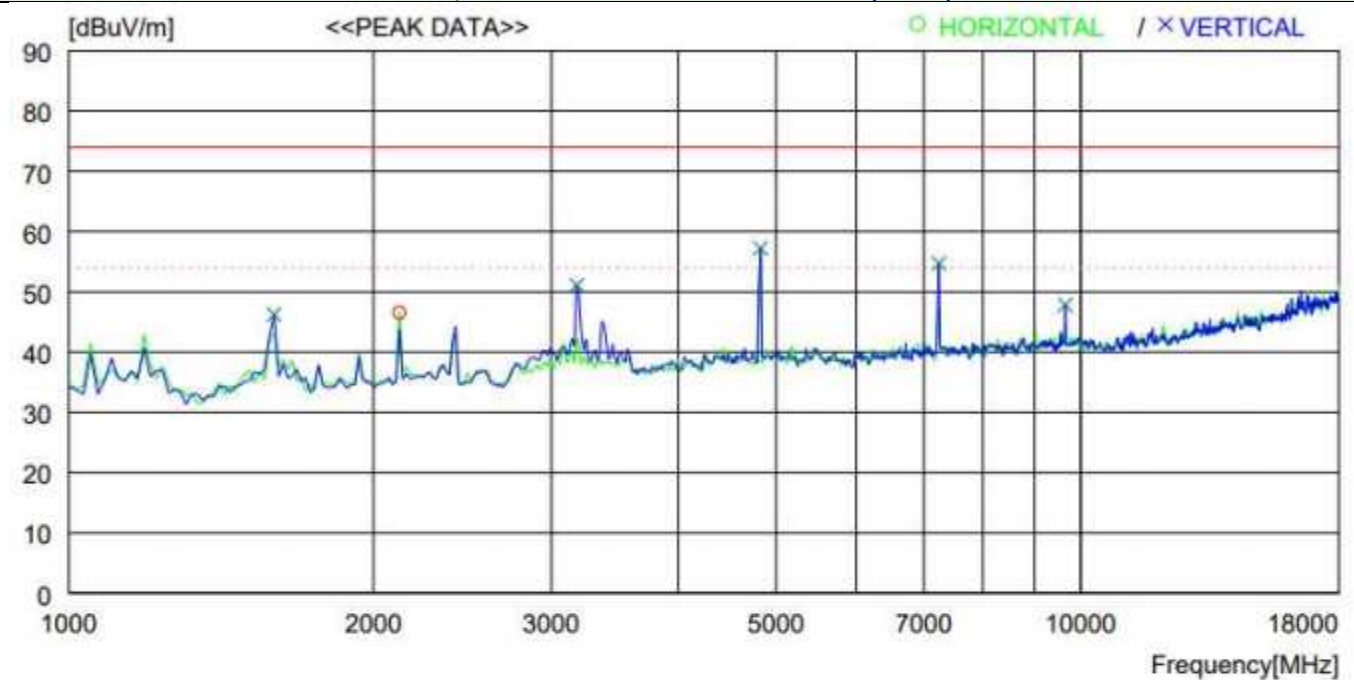
Measured Value = Receiver reading + Antenna Factor + Cable Loss - Pre-amplifier Gain

Result = Measured Value + Duty Factor

5.6.6.4 Test Data for Harmonic & Spurious emission (1 GHz to 18 GHz)

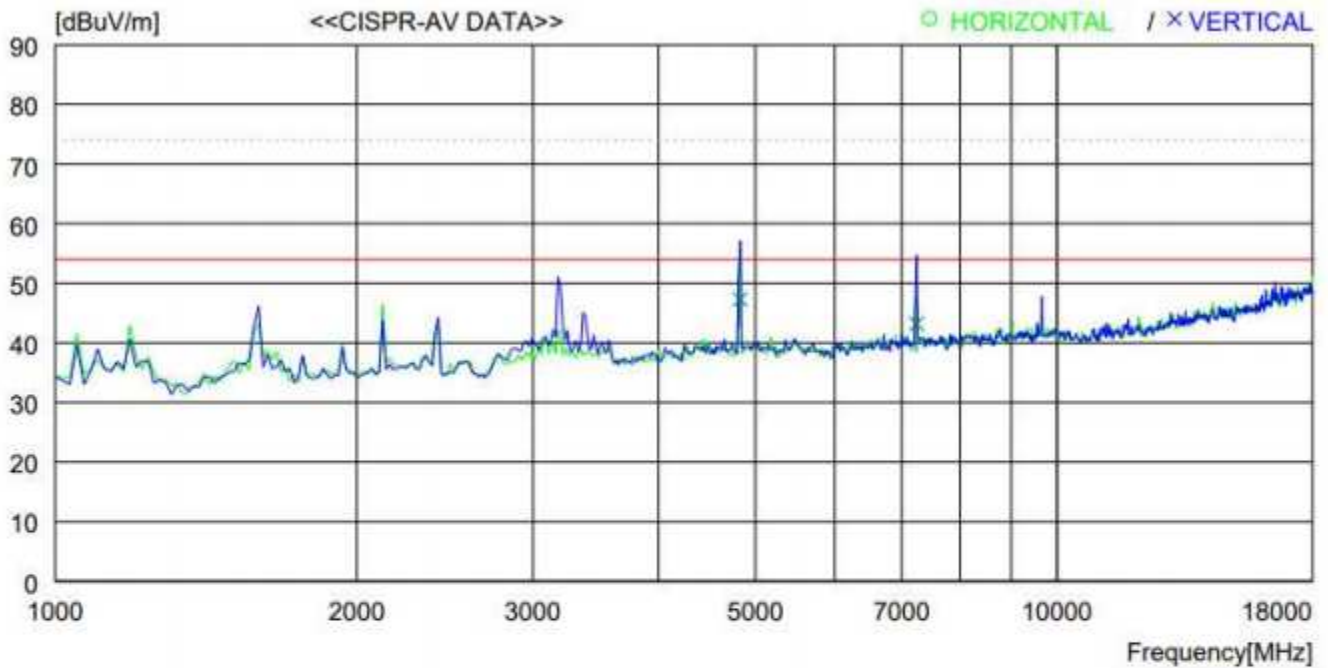
5.6.6.4.1 Operating mode: WLAN 802.11b

Graphical Test Data – Low Channel (Peak)



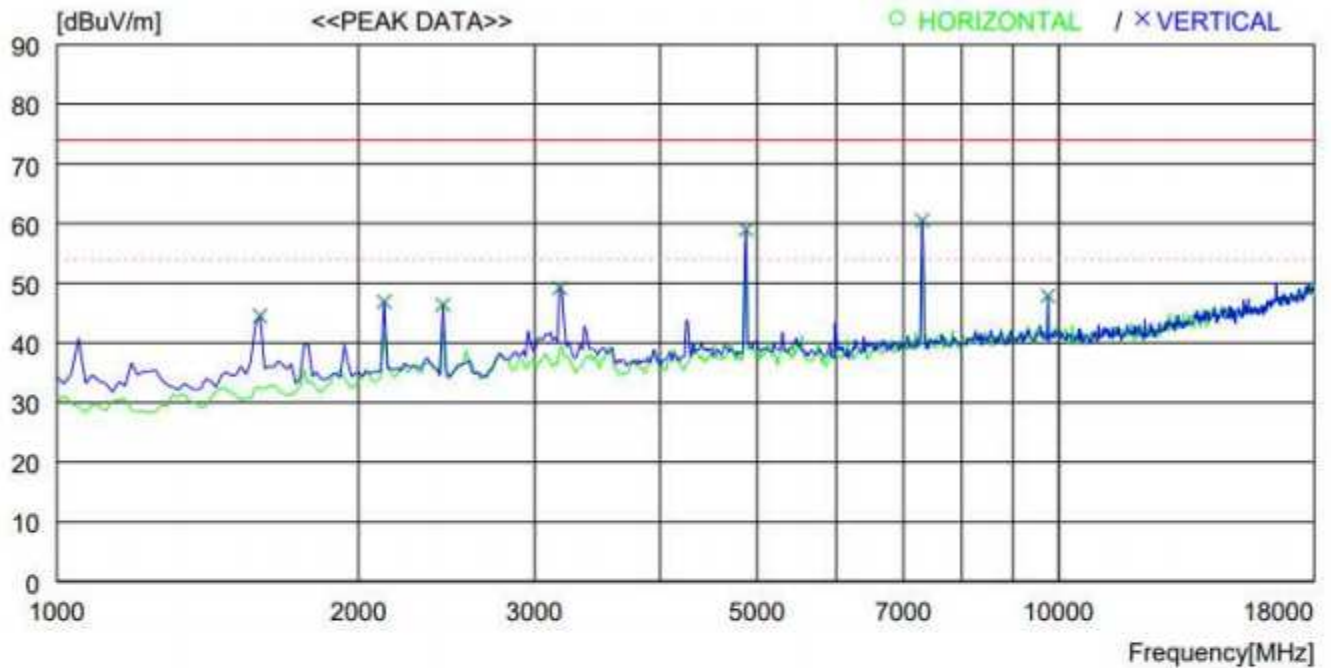
No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	2122.000	53.3	28.2	4.9	39.9	46.5	74.0	27.5	100	81
----- Vertical -----										
2	1595.000	56.0	26.5	3.6	39.9	46.2	74.0	27.8	100	114
3	3176.000	55.0	31.2	4.8	39.9	51.1	74.0	22.9	200	0
4	4825.000	57.2	34.1	5.7	39.8	57.2	74.0	16.8	200	3
5	7239.000	51.9	35.7	6.8	39.7	54.7	74.0	19.3	100	308
6	9653.000	43.2	37.2	7.9	40.5	47.8	74.0	26.2	100	359

Graphical Test Data – Low Channel (Average)



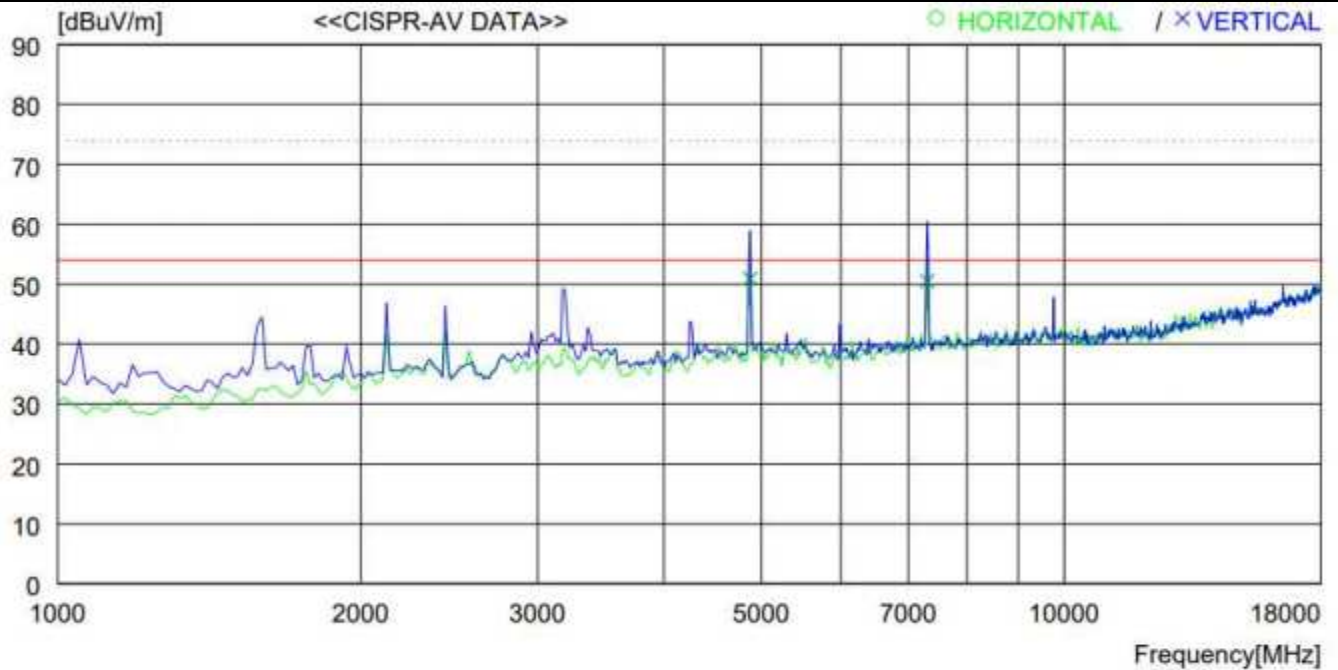
No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	[dBuV]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Vertical -----										
1	4825.000	47.7	34.1	5.3	39.8	47.3	54.0	6.7	200	3
2	7239.000	40.6	35.7	6.6	39.7	43.2	54.0	10.8	100	308

Graphical Test Data – Middle Channel (Peak)



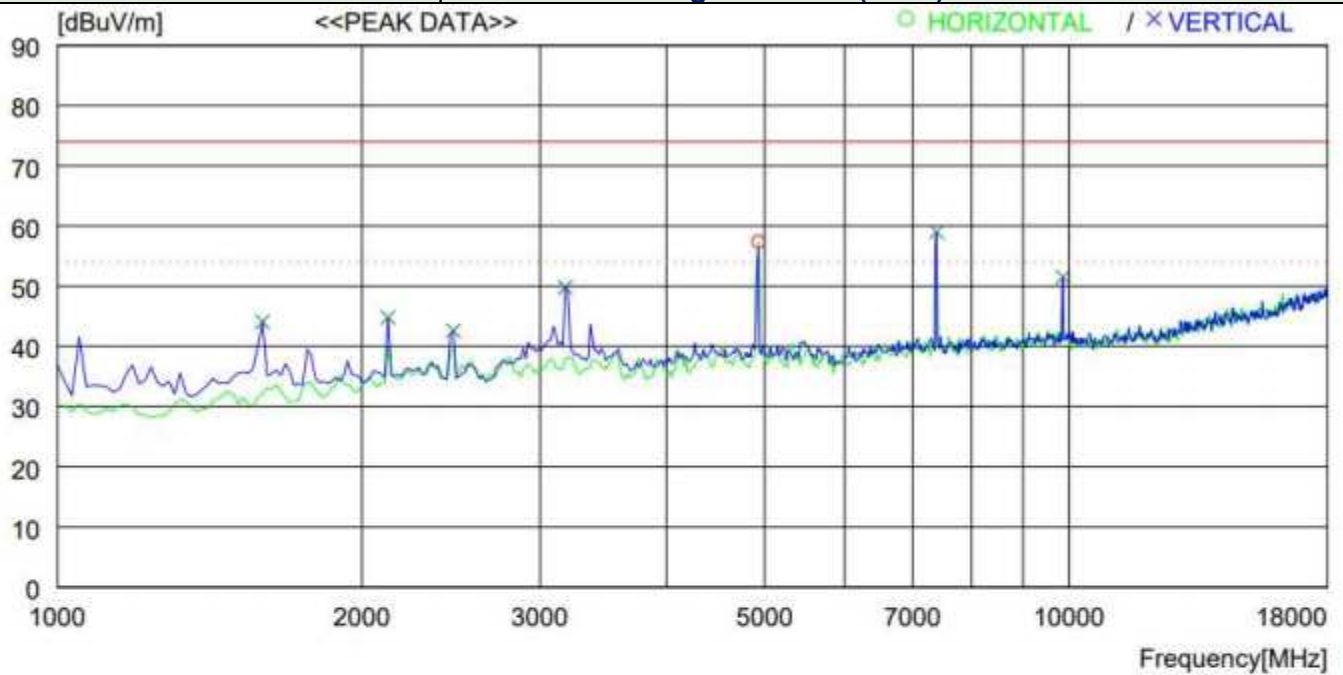
No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Vertical -----										
1	1595.000	54.3	26.5	3.6	39.9	44.5	74.0	29.5	100	110
2	2122.000	53.7	28.2	4.9	39.9	46.9	74.0	27.1	154	216
3	2428.000	51.2	29.1	5.9	39.8	46.4	74.0	27.6	154	256
4	3176.000	53.1	31.2	4.8	39.9	49.2	74.0	24.8	154	192
5	4876.000	58.8	34.2	5.8	39.8	59.0	74.0	15	154	145
6	7307.000	57.5	35.8	6.9	39.7	60.5	74.0	13.5	100	258
7	9755.000	43.3	37.2	7.9	40.5	47.9	74.0	26.1	100	204

Graphical Test Data – Middle Channel (Average)



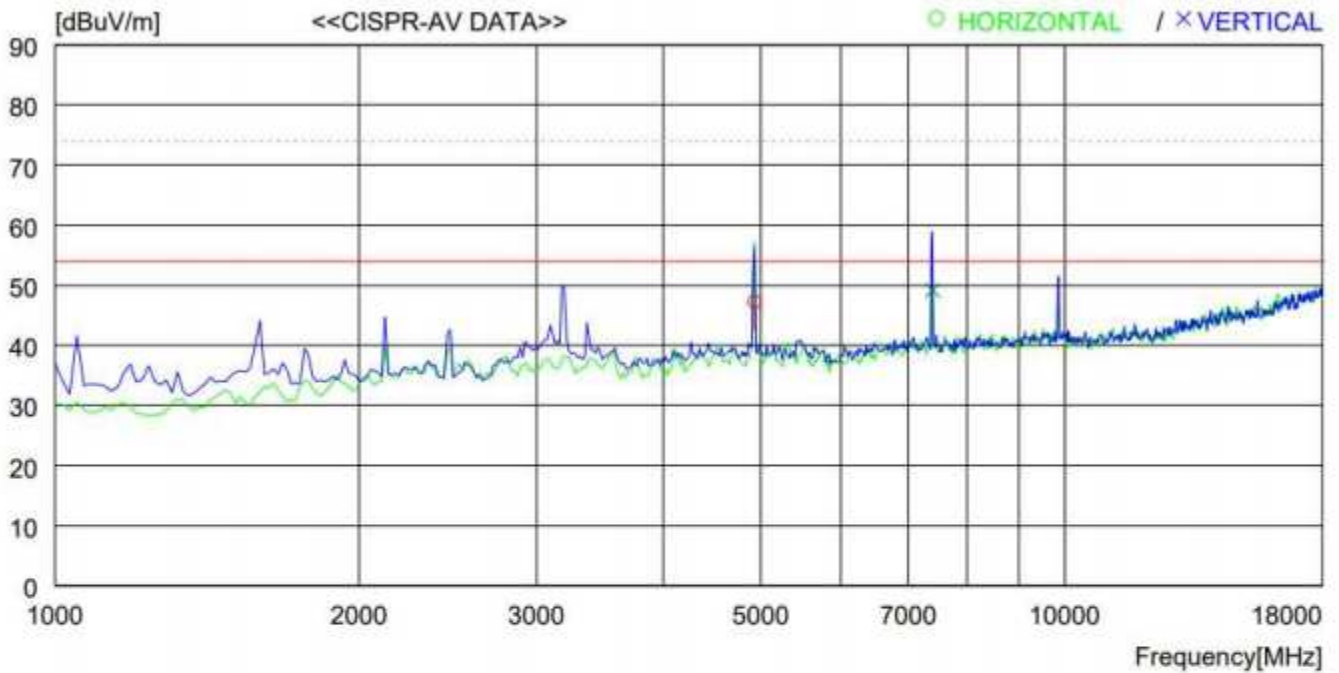
No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	CAV	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Vertical -----										
1	4876.000	50.7	34.2	5.8	39.8	50.9	54.0	3.1	154	145
2	7307.000	47.5	35.8	6.9	39.7	50.5	54.0	3.5	100	258

Graphical Test Data – High Channel (Peak)



No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	4927.000	57.0	34.3	5.9	39.8	57.4	74.0	16.6	100	57
----- Vertical -----										
2	1595.000	53.9	26.5	3.6	39.9	44.1	74.0	29.9	155	359
3	2122.000	51.6	28.2	4.9	39.9	44.8	74.0	29.2	100	61
4	2462.000	47.3	29.2	5.9	39.8	42.6	74.0	31.4	100	224
5	3176.000	53.7	31.2	4.8	39.9	49.8	74.0	24.2	155	359
6	7392.000	56.0	35.8	6.9	39.7	59.0	74.0	15	155	359
7	9857.000	46.7	37.3	8.0	40.5	51.5	74.0	22.5	100	0

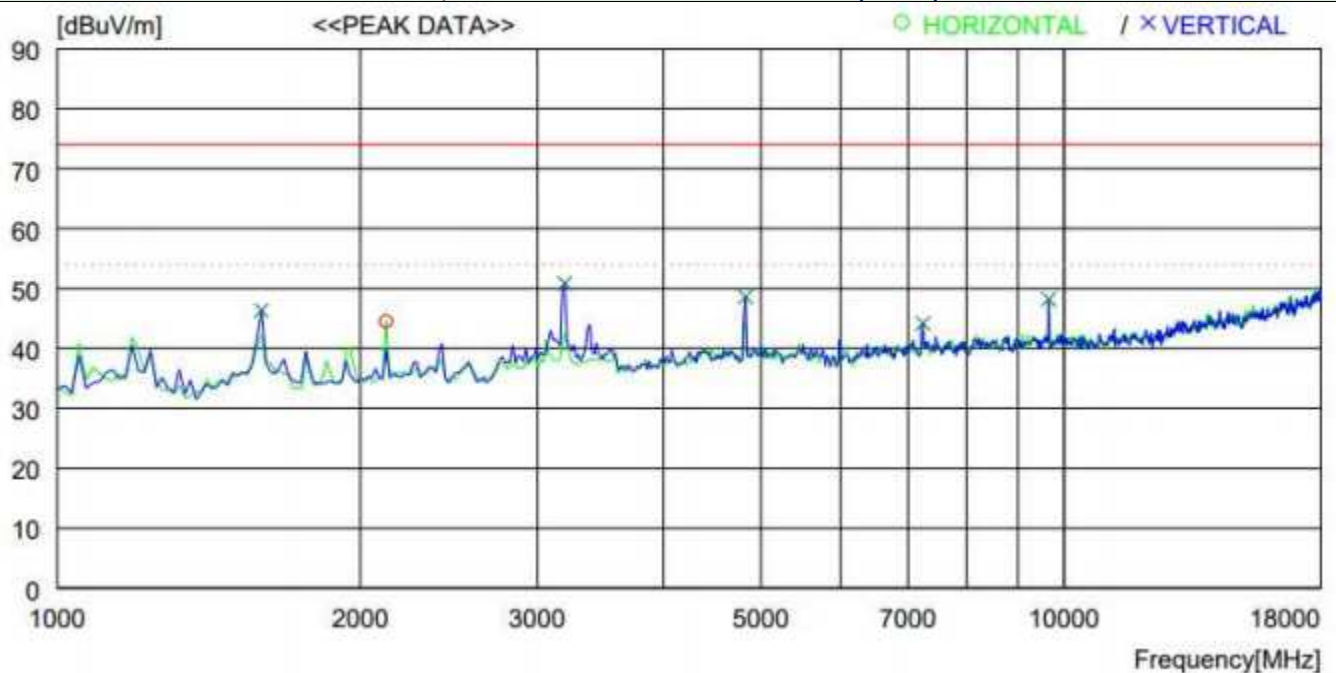
Graphical Test Data – High Channel (Average)



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	CAV	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Horizontal -----										
1	4927.000	46.8	34.3	5.9	39.8	47.2	54.0	6.8	100	57
----- Vertical -----										
2	7392.000	46.2	35.8	6.9	39.7	49.2	54.0	4.8	155	359

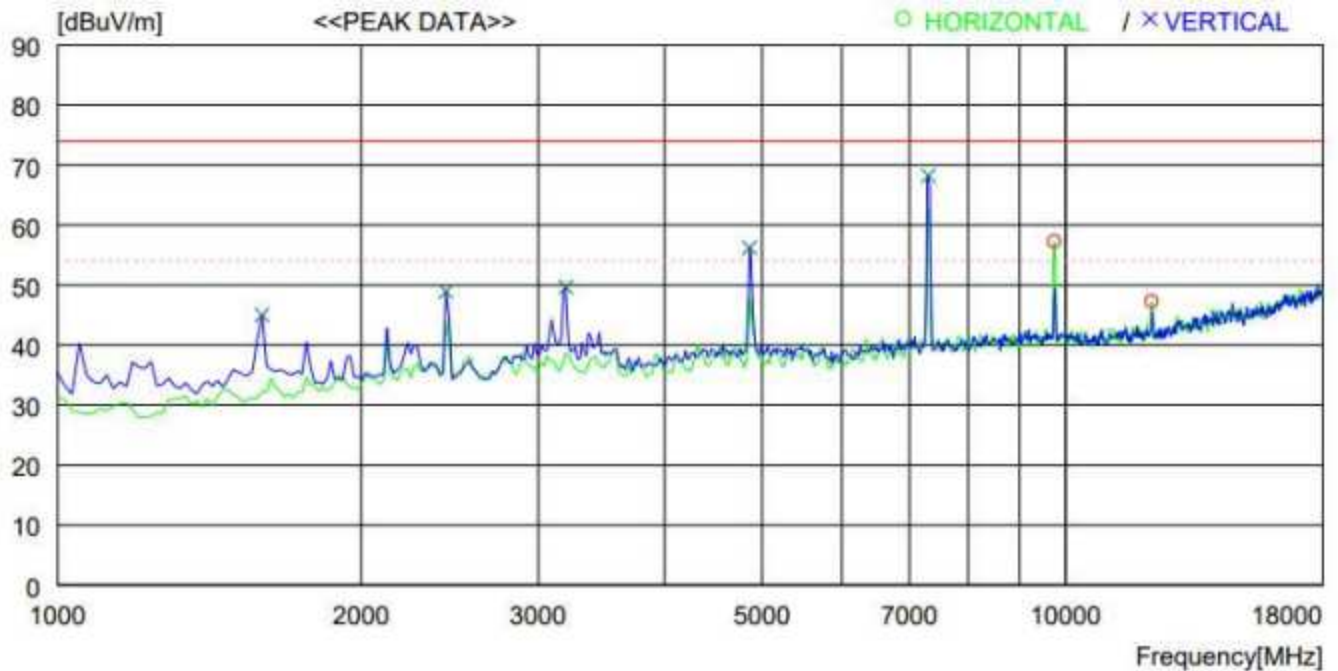
5.6.6.4.2 Operating mode: WLAN 802.11g

Graphical Test Data – Low Channel (Peak)



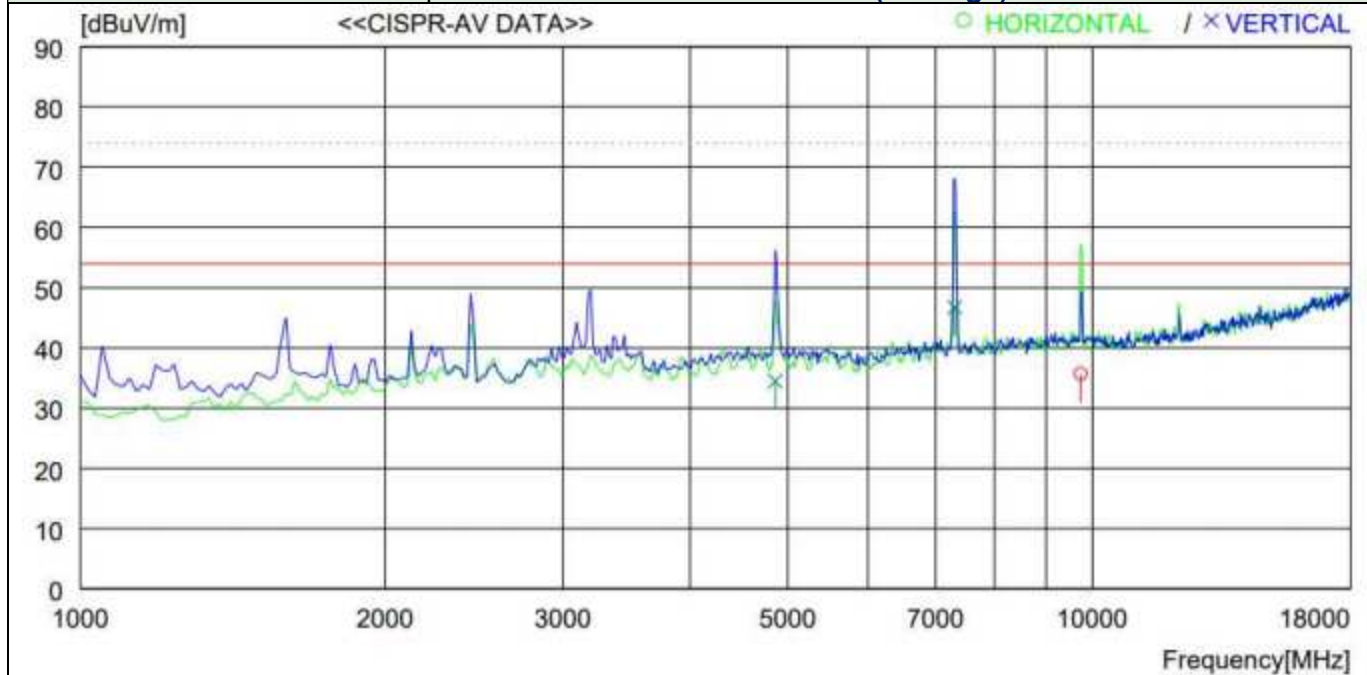
No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	2122.000	51.3	28.2	4.9	39.9	44.5	74.0	29.5	100	89
----- Vertical -----										
2	1595.000	56.1	26.5	3.6	39.9	46.3	74.0	27.7	100	120
3	3193.000	54.8	31.2	4.8	40.0	50.8	74.0	23.2	200	0
4	4825.000	48.6	34.1	5.7	39.8	48.6	74.0	25.4	200	0
5	7239.000	41.4	35.7	6.8	39.7	44.2	74.0	29.8	100	359
6	9653.000	43.6	37.2	7.9	40.5	48.2	74.0	25.8	100	222

Graphical Test Data – Middle Channel (Peak)



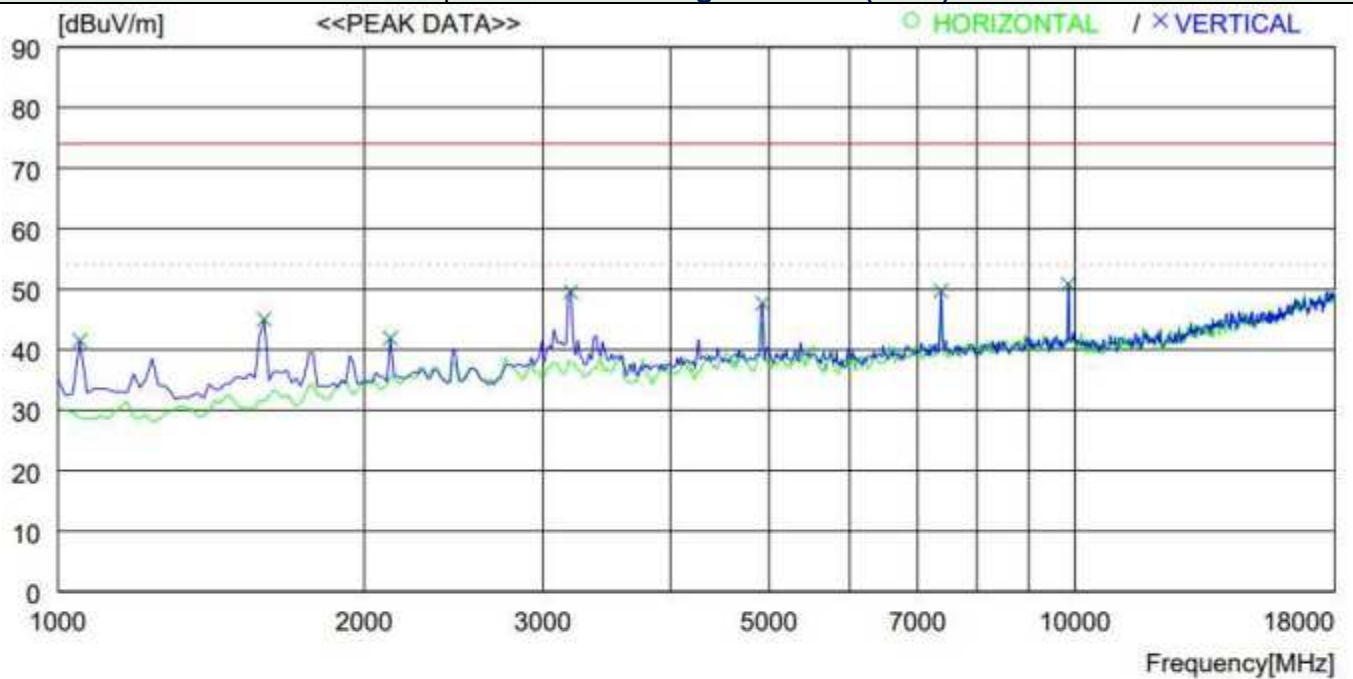
No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	9738.000	52.7	37.2	7.9	40.5	57.3	74.0	16.7	151	359
2	12169.000	40.7	37.6	9.0	40.0	47.3	74.0	26.7	151	359
----- Vertical -----										
3	1595.000	54.8	26.5	3.6	39.9	45.0	74.0	29	155	121
4	2428.000	53.7	29.1	5.9	39.8	48.9	74.0	25.1	155	197
5	3193.000	53.7	31.2	4.8	40.0	49.7	74.0	24.3	155	359
6	4859.000	56.0	34.2	5.8	39.8	56.2	74.0	17.8	100	358
7	7307.000	65.2	35.8	6.9	39.7	68.2	74.0	5.8	100	280

Graphical Test Data – Middle Channel (Average)



No.	FREQ [MHz]	READING CAV [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	9738.000	31.5	37.2	7.5	40.5	35.7	54.0	18.3	151	359
----- Vertical -----										
2	4859.000	34.8	34.2	5.3	39.8	34.5	54.0	19.5	100	358
3	7307.000	44.0	35.8	6.6	39.7	46.7	54.0	7.3	100	280

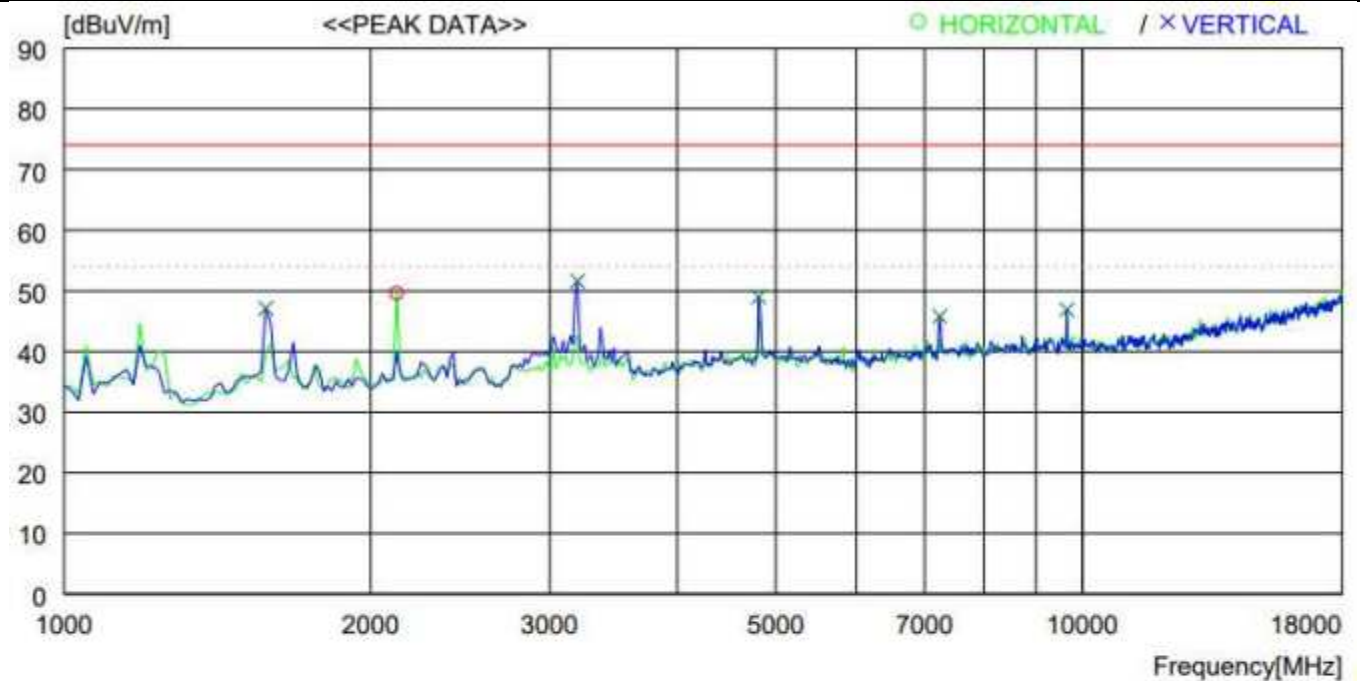
Graphical Test Data – High Channel (Peak)



No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA TABLE [cm]	TABLE [DEG]
----- Vertical -----										
1	1051.000	54.6	24.2	2.7	40.0	41.5	74.0	32.5	100	0
2	1595.000	54.8	26.5	3.6	39.9	45.0	74.0	29	100	258
3	2122.000	48.7	28.2	4.9	39.9	41.9	74.0	32.1	100	17
4	3193.000	53.5	31.2	4.8	40.0	49.5	74.0	24.5	151	157
5	4927.000	47.3	34.3	5.9	39.8	47.7	74.0	26.3	151	142
6	7375.000	46.7	35.8	6.9	39.7	49.7	74.0	24.3	100	0
7	9840.000	46.0	37.3	8.0	40.5	50.8	74.0	23.2	100	227

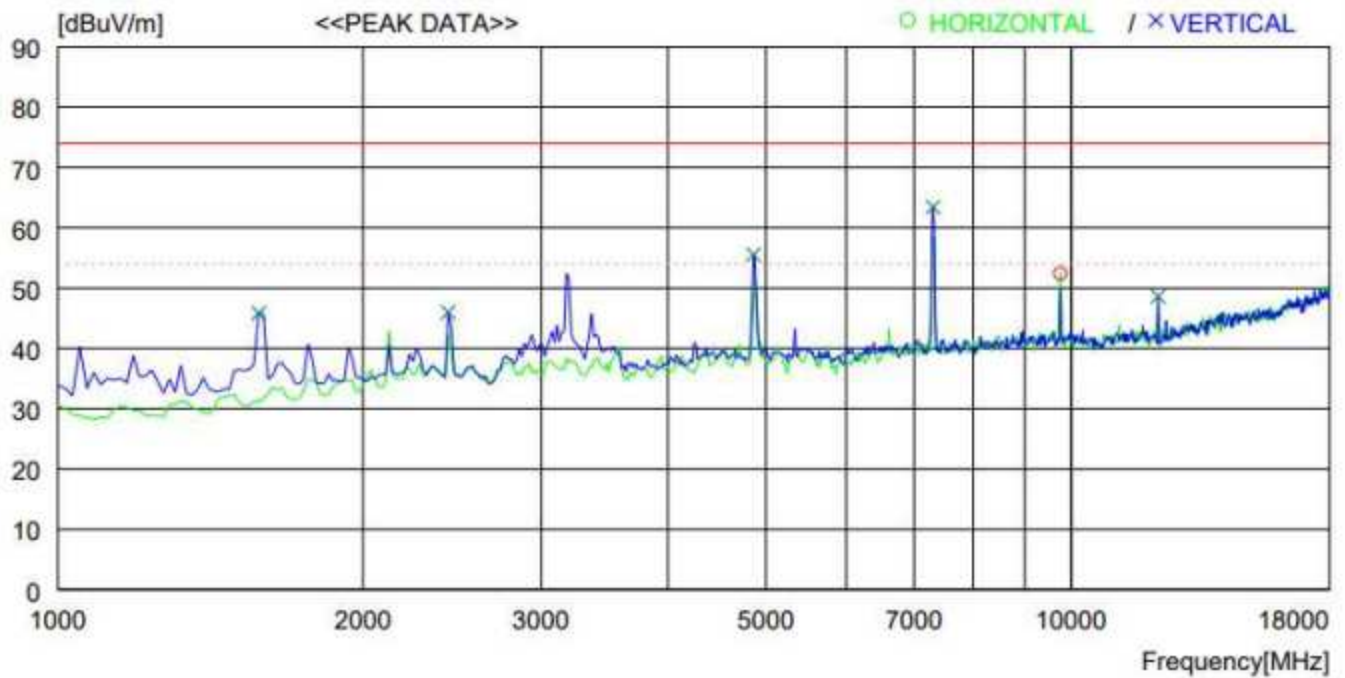
5.6.6.4.3 Operating mode: WLAN 802.11n HT20

Graphical Test Data – Low Channel (Peak)



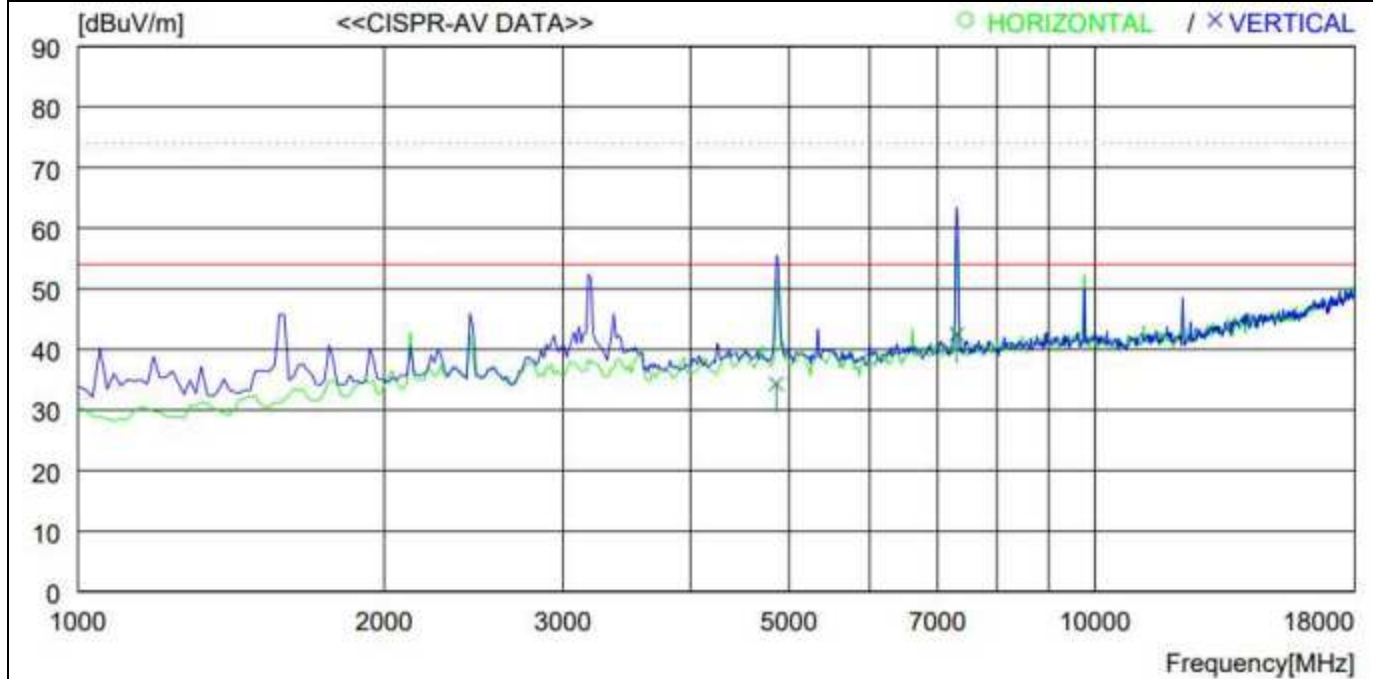
No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	2122.000	56.4	28.2	4.9	39.9	49.6	74.0	24.4	100	359
----- Vertical -----										
2	1578.000	57.1	26.4	3.5	39.9	47.1	74.0	26.9	100	112
3	3193.000	55.6	31.2	4.8	40.0	51.6	74.0	22.4	200	168
4	4808.000	49.0	34.1	5.7	39.8	49.0	74.0	25	200	0
5	7239.000	43.0	35.7	6.8	39.7	45.8	74.0	28.2	100	359
6	9653.000	42.3	37.2	7.9	40.5	46.9	74.0	27.1	100	227

Graphical Test Data – Middle Channel (Peak)



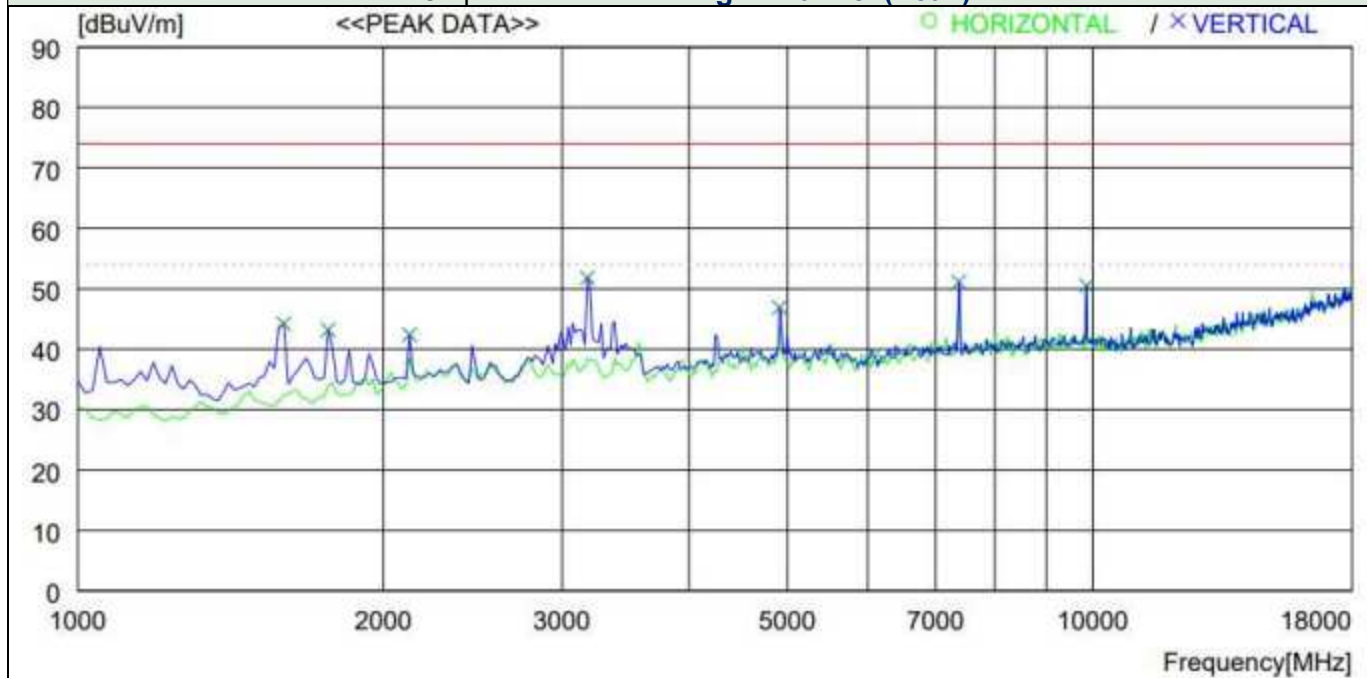
No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA TABLE [cm]	[DEG]
----- Horizontal -----										
1	9755.000	47.8	37.2	7.9	40.5	52.4	74.0	21.6	154	0
----- Vertical -----										
2	1578.000	55.8	26.4	3.5	39.9	45.8	74.0	28.2	200	124
3	2428.000	50.8	29.1	5.9	39.8	46.0	74.0	28	200	0
4	4859.000	55.3	34.2	5.8	39.8	55.5	74.0	18.5	200	0
5	7307.000	60.4	35.8	6.9	39.7	63.4	74.0	10.6	100	275
6	12186.000	42.0	37.6	9.0	40.0	48.6	74.0	25.4	100	136

Graphical Test Data – Middle Channel (Average)



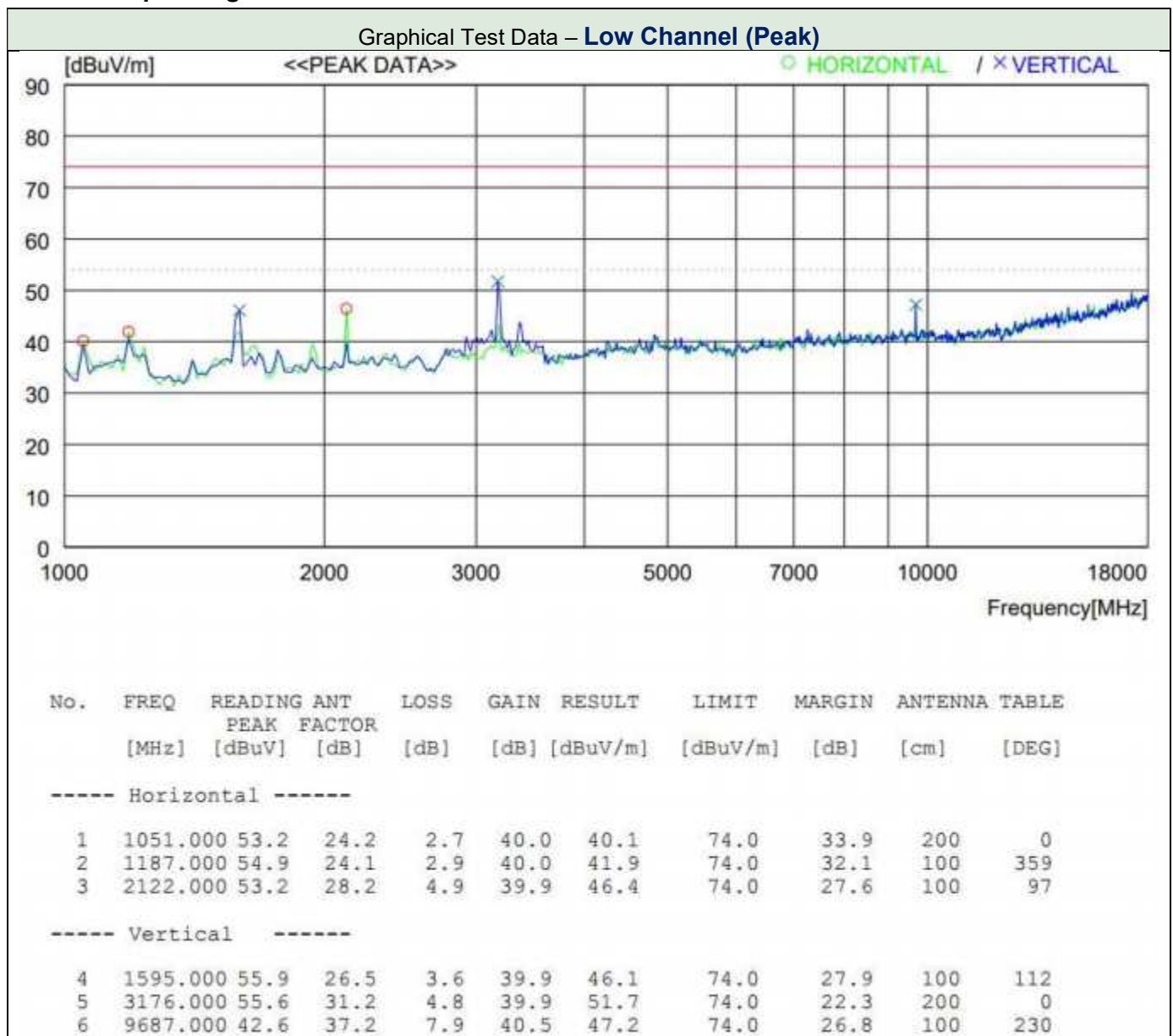
No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	[dBuV]	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Vertical -----										
1	4859.000	34.1	34.2	5.8	39.8	34.3	54.0	19.7	200	0
2	7307.000	39.5	35.8	6.9	39.7	42.5	54.0	11.5	100	275

Graphical Test Data – High Channel (Peak)

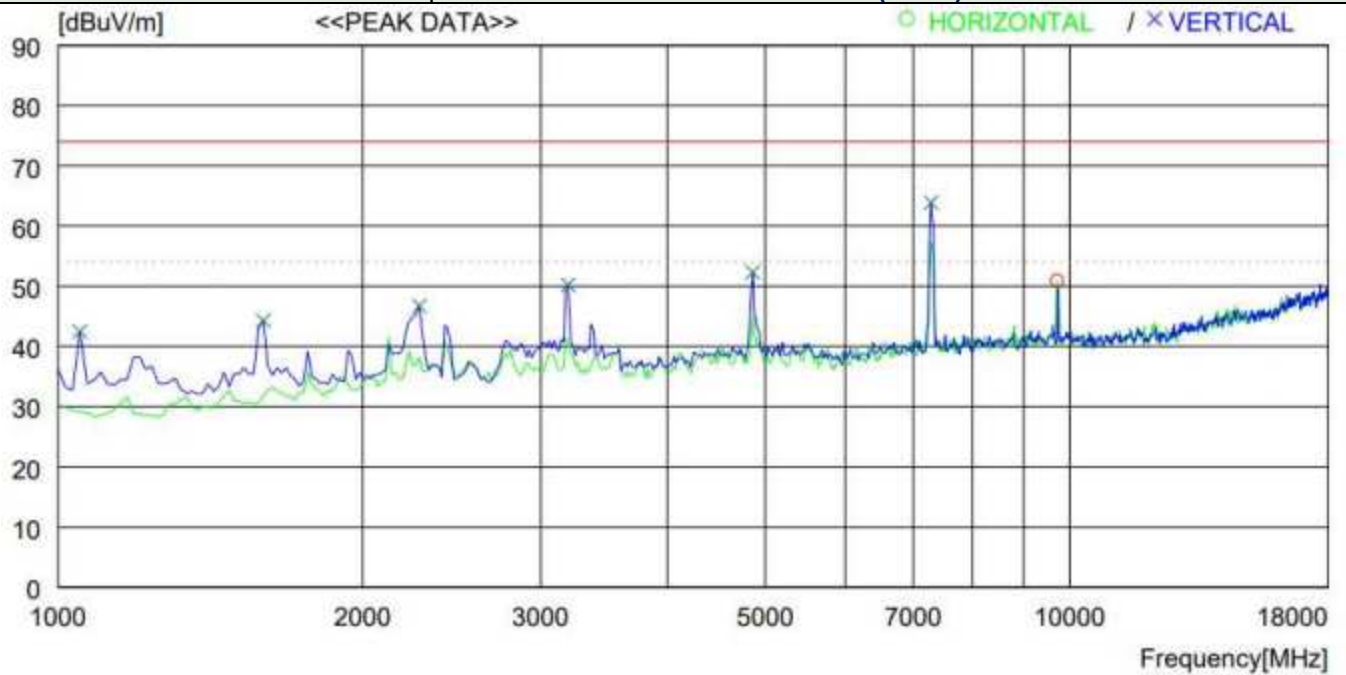


No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Vertical -----										
1	1595.000	54.0	26.5	3.6	39.9	44.2	74.0	29.8	200	13
2	1765.000	52.1	27.3	3.7	39.9	43.2	74.0	30.8	200	174
3	2122.000	49.2	28.2	4.9	39.9	42.4	74.0	31.6	100	141
4	3176.000	55.7	31.2	4.8	39.9	51.8	74.0	22.2	200	359
5	4910.000	46.5	34.3	5.9	39.8	46.9	74.0	27.1	200	106
6	7375.000	48.1	35.8	6.9	39.7	51.1	74.0	22.9	100	0
7	9857.000	45.7	37.3	8.0	40.5	50.5	74.0	23.5	100	218

5.6.6.4.4 Operating mode: WLAN 802.11n HT40

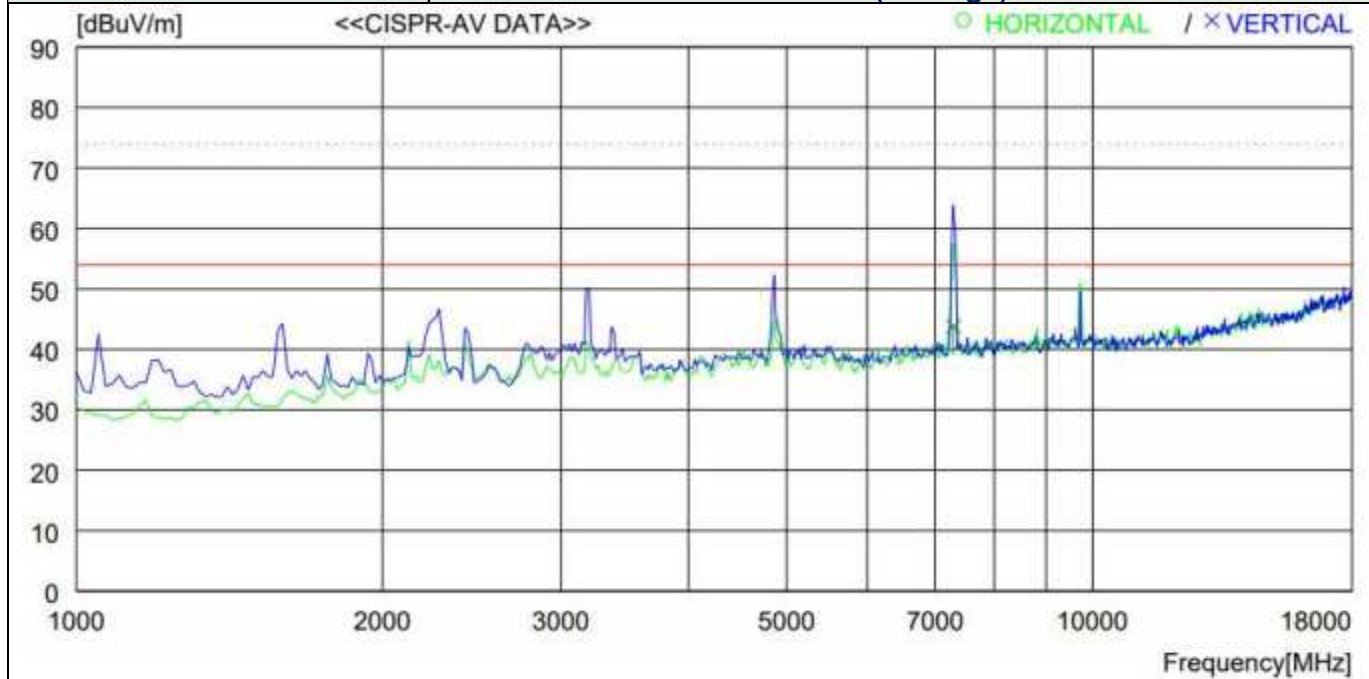


Graphical Test Data – Middle Channel (Peak)



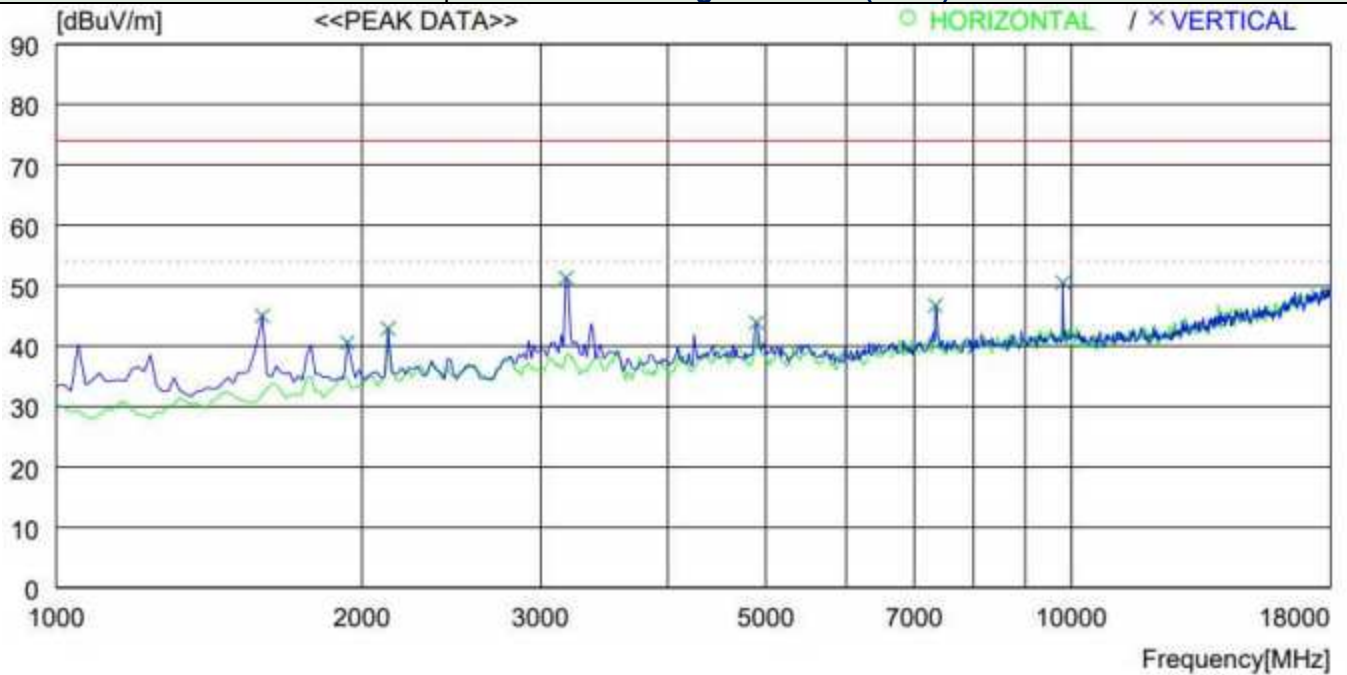
No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal -----										
1	9704.000	46.3	37.2	7.9	40.5	50.9	74.0	23.1	152	13
----- Vertical -----										
2	1051.000	55.6	24.2	2.7	40.0	42.5	74.0	31.5	152	359
3	1595.000	54.1	26.5	3.6	39.9	44.3	74.0	29.7	100	0
4	2275.000	52.3	28.5	5.7	39.8	46.7	74.0	27.3	152	359
5	3193.000	54.2	31.2	4.8	40.0	50.2	74.0	23.8	152	359
6	4859.000	52.1	34.2	5.8	39.8	52.3	74.0	21.7	152	359
7	7290.000	61.0	35.8	6.8	39.7	63.9	74.0	10.1	100	300

Graphical Test Data – Middle Channel (Average)



No.	FREQ	READING	ANT	LOSS	GAIN	RESULT	LIMIT	MARGIN	ANTENNA	TABLE
	[MHz]	CAV	FACTOR	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dB]	[cm]	[DEG]
----- Vertical -----										
1	7290.000	40.9	35.8	6.8	39.7	43.8	54.0	10.2	100	300

Graphical Test Data – High Channel (Peak)



No.	FREQ [MHz]	READING [dBuV]	ANT PEAK FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Vertical -----										
1	1595.000	54.8	26.5	3.6	39.9	45.0	74.0	29	100	0
2	1935.000	48.3	28.1	4.1	39.9	40.6	74.0	33.4	152	159
3	2122.000	49.7	28.2	4.9	39.9	42.9	74.0	31.1	152	222
4	3176.000	55.2	31.2	4.8	39.9	51.3	74.0	22.7	152	167
5	4893.000	43.6	34.2	5.9	39.8	43.9	74.0	30.1	152	113
6	7341.000	43.7	35.8	6.9	39.7	46.7	74.0	27.3	100	0
7	9806.000	45.7	37.3	8.0	40.5	50.5	74.0	23.5	100	216

5.6.6.5 Test Data for Harmonic & Spurious emission (18 GHz to 25 GHz)

5.6.6.5.1 Operating mode: WLAN 802.11b



Note. Middle channel at WLAN 802.11b is worst case operating mode.

Test plots for 802.11g/n HT20/n HT40 are almost same with above test data, so the plots are not reported.

5.7 AC Power Line Conducted Emission

5.7.1 Limit

Acc. to section 15.207 (a), RSS-GEN 8.8 following table shall be applied.

Frequency Range (MHz)	Quasi-Peak (dBuV)	Average (dBuV)
0.15 - 0.5	66 to 56	56 to 46
0.5 - 5	56	46
5 -30	60	50

5.7.2 Method of Measurement

The EUT was placed on a wooden table, 0.8 m height above the horizontal ground plane and 40 cm from the vertical ground plane. Power was fed to the EUT through a 50 Ω / 50 μ H + 5 Ω Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

The test was performed for both Neutral and Hot lines.

5.7.3 Measurement Uncertainty

Measurement uncertainties were not taken into account and following uncertainty levels have been estimated for tests performed on the apparatus. The measurement uncertainties are given with at least 95 % confidence.

Frequency Range	Uncertainty	Frequency Range	Uncertainty
9 kHz ~ 150 kHz	$\pm$ 2.0 dB	150 kHz ~ 30 MHz	$\pm$ 2.0 dB

5.7.4 Sample Calculated Example

At 5.31 MHz

QP Limit = 60.0 dBuV

Correction Factor (C. Factor) of LISN, Pulse Limiter and cable loss at 5.31 MHz = 9.7 dB

Q.P Reading from the Test receiver = 20.8 dBuV

(Calculated value for system losses by software EMC32 manufactured by Rohde & Schwarz)

Therefore Q.P Margin = 60 - 20.8 = 39.2

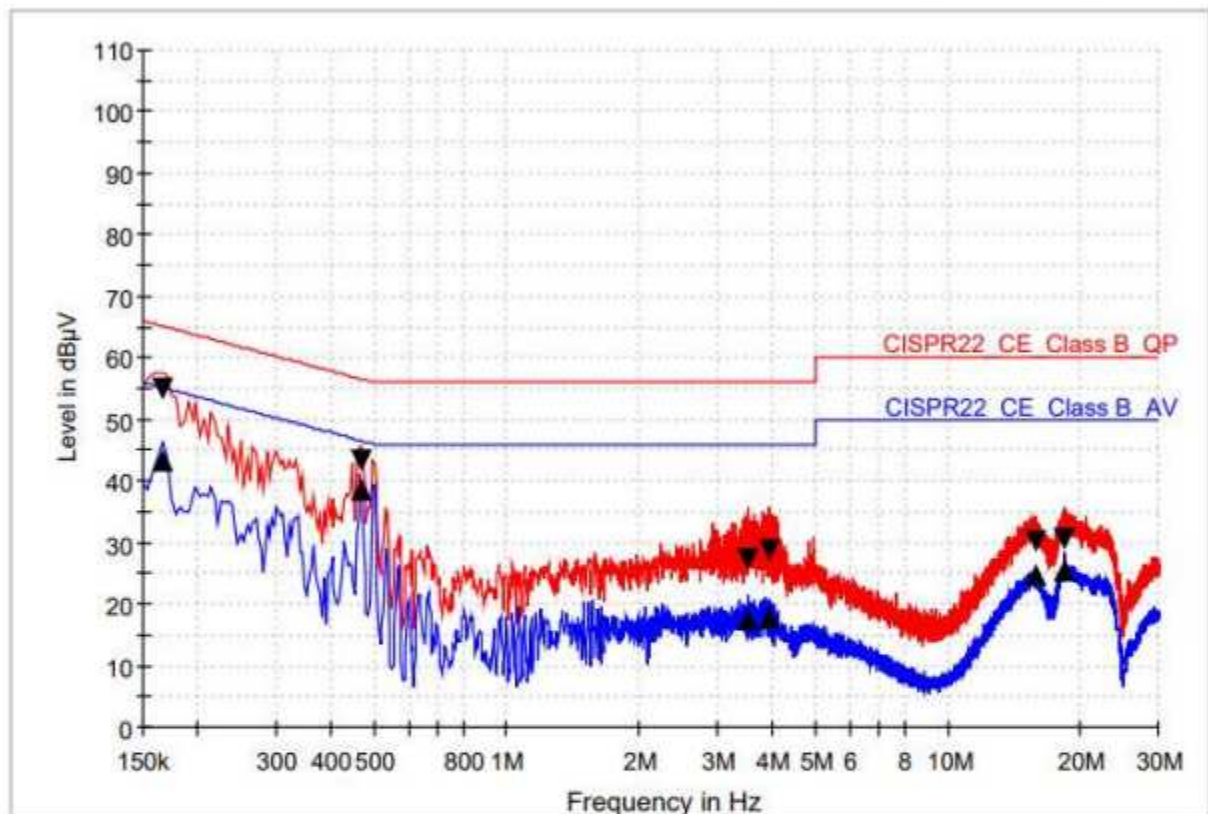
so the EUT has 39.2 dB margin at 5.31 MHz

5.7.5 Worst Case Test Data

5.7.5.1 Operating mode: WLAN 802.11b

Date of Test	2021-01-08	Temperature	(20.9 ± 0.9) °C
		Relative humidity	(42.5 ± 0.8) % R.H.
Measurement Frequency Range		9 kHz ~ 30MHz	
Test Result	PASS	Tested By	Do-heon Kim 

Hot Line



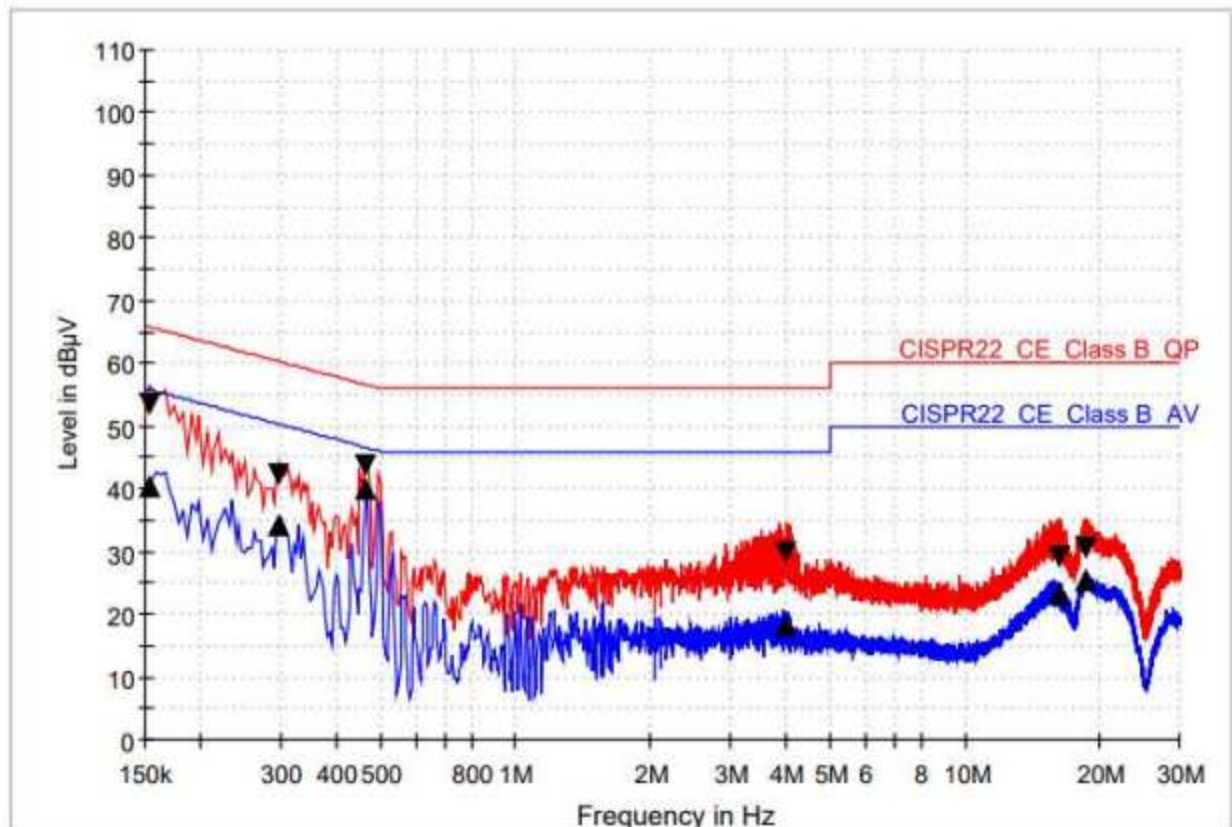
Limit and Margin1

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV)	Margin - CAV (dB)	Limit - CAV (dBμV)
0.166000	55.1	43.3	9.000	L1	9.7	10.1	65.2	11.9	55.2
0.470000	43.4	38.4	9.000	L1	9.7	13.1	56.5	8.1	46.5
3.530000	27.4	17.4	9.000	L1	9.8	28.6	56.0	28.6	46.0
3.942000	28.7	17.7	9.000	L1	9.8	27.3	56.0	28.3	46.0
15.814000	30.1	24.6	9.000	L1	10.1	29.9	60.0	25.4	50.0
18.430000	30.5	25.5	9.000	L1	10.2	29.5	60.0	24.5	50.0

Note. Middle channel at WLAN 802.11b is worst case operating mode.

Test plots for 802.11g/n HT20/n HT40 are almost same with above test data, so the plots are not reported.

Neutral Line



Limit and Margin1

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBμV)	Margin - CAV (dB)	Limit - CAV (dBμV)
0.154000	53.6	40.5	9.000	N	9.7	12.2	65.8	15.3	55.8
0.298000	42.2	34.2	9.000	N	9.7	18.1	60.3	16.1	50.3
0.466000	43.6	40.0	9.000	N	9.7	13.0	56.6	6.6	46.6
3.986000	29.8	18.1	9.000	N	9.8	26.2	56.0	27.9	46.0
16.258000	29.0	23.5	9.000	N	10.1	31.0	60.0	26.5	50.0
18.690000	30.6	25.6	9.000	N	10.2	29.4	60.0	24.4	50.0

Appendix I – Test Instrumentation

Description	Model No.	Serial No.	Manufacturer.	Due for Cal. Date	Cal. Interval
Signal & Spectrum Analyzer	FSW 43	100578	Rohde & Schwarz	2021-04-20	1 Y
Signal Generator	SMF100A	257560	Rohde & Schwarz	2021-01-26	1 Y
Attenuator	56-10	58769	WEINSCHTEL	2021-01-20	1 Y
Test Receiver	ESU 26	100303	Rohde & Schwarz	2021-01-21	1 Y
Loop Antenna	HFH2-Z2	100341	Rohde & Schwarz	2021-06-21	2 Y
TRILOG Broadband Antenna	VULB9163	9163.799	Schwarzbeck	2021-09-17	2 Y
Horn Antenna	HF 907	102426	Rohde & Schwarz	2021-01-11	2 Y
Horn Antenna	BBHA 9170	BBHA 9170 #783	Schwarzbeck	2021-10-29	2 Y
Notch Filter	BRM50702	G318	MICRO-TRONICS	2021-11-04	1 Y
Attenuator	6dB	272.4110.50	Rohde & Schwarz	2021-01-16	1 Y
Pre-Amplifier	310N	344015	Sonoma Instrument	2021-01-16	1 Y
Pre-Amplifier	SCU 18D	19006450	Rohde & Schwarz	2021-04-17	1 Y
Pre-Amplifier	CBL18265035	28706	CERNEX	2021-03-24	1 Y
Turn Table	DT3000-3t	1310814	INNCO SYSTEM	-	N/A
Antenna Master	MA4000-EP	4600814	INNCO SYSTEM	-	N/A
Antenna Master	MA4000-XP-ET	-	INNCO SYSTEM	-	N/A
Camera Controller	HDCon4102	6531445048	PONTIS	-	N/A
CO3000 Controller	Co3000-4Port	CO3000/806/34130814/L	INNCO SYSTEM	-	N/A
CO3000 Controller	Co3000-4Port	CO3000/807/34130814/L	INNCO SYSTEM	-	N/A
EMI Test Receiver	ESCI 7	100722	Rohde & Schwarz	2021-01-16	1 Y
LISN	ENV216	100110	Rohde & Schwarz	2021-01-22	1 Y

The measuring equipment utilized to perform the tests documented in this test report has been calibrated in accordance with manufacturer's recommendations, and is traceable to recognized national standards.