

Test report No:  
 NIE: 65408RRF.008

## Test Report

USA FCC Part 15.407, 15.209

CANADA RSS-247, RSS-Gen


Unlicensed National Information Infrastructure (U-NII) Devices.

General technical requirements.

Radiated emission limits; general requirements.

Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices.

General Requirements and Information for the Certification of Radio Apparatus.

(*) Identification of item tested	Automotive infotainment system		
(*) Trademark	BMW		
(*) Model and /or type reference	MGU21 APN		
Other identification of the product	HW version: 1.4 SW version: 20w37.5-1 FCC ID: A269ZUA163 IC: 700B-UA163		
(*) Features	BT, WiFi, USB2/3, GPS		
Applicant	ALPSALPINE INC. 20-1 YOSHIMA INDUSTRIAL PARK, IWAKI, FUKUSHIMA 970-1192, JAPAN		
Test method requested, standard	USA FCC Part 15.407 (10-1-19) Edition: Unlicensed National Information Infrastructure (U-NII) Devices. General technical requirements. USA FCC Part 15.209 (10-1-19) Edition: Radiated emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5 Amendment 1 (March 2019). Guidance for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec 14, 2017. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.		
Summary	IN COMPLIANCE		
Approved by (name / position & signature)	Rafael López EMC/RF Lab. Manager		RAFAEL LÓPEZ MARTÍN 2021.03.05 13:04:17 +01'00'
Date of issue	2021-03-05		
Report template No	FDT08_23 (* "Data provided by the client")		

## Index

Competences and guarantees .....	3
General conditions .....	3
Uncertainty .....	3
Data provided by the client.....	3
Usage of samples .....	4
Test sample description .....	5
Identification of the client.....	6
Testing period and place.....	7
Document history .....	7
Environmental conditions .....	7
Remarks and comments .....	8
Testing verdicts.....	9
Summary .....	9
Appendix A: Test Common requirements for all bands .....	11
Appendix B: Tests results for the U-NII-1 Band 5.15 – 5.25 GHz .....	39
Appendix C: Test results for the U-NII-3 Band 5.725 – 5.85 GHz.....	85

## Competences and guarantees

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DEKRA Testing and Certification is a testing laboratory accredited by the National Accreditation Body (ENAC - Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 147.

DEKRA Testing and Certification is a FCC-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

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In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification at the time of performance of the test.

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The results presented in this Test Report apply only to the particular item under test established in this document.

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## General conditions

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1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Testing and Certification.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification and the Accreditation Bodies.

## Uncertainty

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Uncertainty (factor  $k=2$ ) was calculated according to the DEKRA Testing and Certification internal document PODT000.

## Data provided by the client

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The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").
2. The sample of the model MGU21 APN is a device for entertainment and communication inside the car, this includes playing music from several external sources or internal flash-memory, connecting mobile devices (e.g. Apple Car Play) and a Navigation system.

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of result.

## Usage of samples

Samples undergoing test have been selected by: The client.

- Sample S/01 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
65408/001	Automotive infotainment system	MGU21 APN	ALB458L1300040	2020/10/06
65408/006	Main Wireharness	--	--	2020/10/06

Auxiliary elements used with the Sample S/01:

Control Nº	Description	Model	Serial Nº	Date of reception
65408/002	CAN-Box	--	80008154	2020/10/06
65408/003	OABR-Converter Board	--	--	2020/10/06
65408/004	OABR-Converter Cable	--	--	2020/10/06
65408/005	Ethernet / USB Adaptor	EU-4306	--	2020/10/06
65408/028	SMA Cable	--	--	2020/10/06

Sample S/01 has undergone the following test(s): All Conducted tests indicated in the Appendixes A, B, C.

- Sample S/02 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
65408/001	Automotive infotainment system	MGU21 APN	ALB458L1300040	2020/10/06
65408/006	Main Wireharness	--	--	2020/10/06
65408/018	BT / WLAN Antenna	--	--	2020/10/06

Auxiliary elements used with the Sample S/02:

Control Nº	Description	Model	Serial Nº	Date of reception
65408/002	CAN-Box	--	80008154	2020/10/06
65408/003	OABR-Converter Board	--	--	2020/10/06
65408/004	OABR-Converter Cable	--	--	2020/10/06
65408/005	Ethernet / USB Adaptor	EU-4306	--	2020/10/06

Sample S/02 has undergone the following test(s): All Radiated tests indicated in the Appendixes A, B, C.

## Test sample description

Ports.....:	Port name and description	Cable					
		Specified max length [m]	Attached during test	Shielded	Coupled to patient <sup>(3)</sup>		
	BT/WLAN		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	GPS		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	USB2		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	APIX		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	AR-CAM		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	OABR		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Gbit Ethernet		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
Supplementary information to the ports.....:	-						
Rated power supply .....	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	<input type="checkbox"/>	AC:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	AC:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/>	DC:					
<input type="checkbox"/>	DC:						
Rated Power .....	12V						
Clock frequencies.....:	-						
Other parameters .....	-						
Software version .....	20w37.5-1						
Hardware version .....	1.4						
Dimensions in cm (W x H x D) .....	-						
Mounting position .....	<input type="checkbox"/>	Table top equipment					
	<input type="checkbox"/>	Wall/Ceiling mounted equipment					
	<input type="checkbox"/>	Floor standing equipment					
	<input type="checkbox"/>	Hand-held equipment					

	<input checked="" type="checkbox"/>	Other: Installed in cars		
Modules/parts.....:	Module/parts of test item		Type	Manufacturer
	BT			WNC
	WiFi			WNC
	-			
	-			
Accessories (not part of the test item) .....	Description		Type	Manufacturer
	Can Box			Harman
	Display			Visteon
	OABR-converter			Harman
	-			
	-			
	-			
Documents as provided by the applicant .....	Description		File name	Issue date
	Testing manual for BT and WLAN		I&K MGU_Testing Manual (Radio_WLAN_BT)_v1 1_2018-01-18	18.1.2018
	-			
	-			

<sup>(3)</sup> Only for Medical Equipment

## Identification of the client

ALPS ALPINE EUROPE GmbH  
 Ohmstrasse 4, 85716 Unterschleißheim, Germany

## Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2020-10-14
Date (finish)	2020-10-30

## Document history

Report number	Date	Description
65408RRF.008	2021-03-05	First release.

## Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

In the semianechoic chamber, the following limits were not exceeded during the test.

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 35 %

## Remarks and comments

The tests have been performed by the technical personnel: Miguel Manuel, Alfonso Gutiérrez, Pablo Redondo, Cristina Calle, Verónica García and José Manuel Jiménez.

Used instrumentation:

### Conducted Measurements

	Last Calibration	Due Calibration
1. Shielded Room ETS LINDGREN S101	N.A.	N.A.
2. DC Power Supply 40V/40A Rohde & Schwarz NGPE40	2018/03	2021/03
3. Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2019/09	2021/09
4. Digital Multimeter FLUKE 179	2020/10	2021/10

### Radiated Measurements:

	Last Calibration	Due Calibration
1. Semianechoic Absorber Lined Chamber ETS LINDGREN FACT 3 200 STP	N.A.	N.A.
2. Shielded Room ETS LINDGREN S101	N.A.	N.A.
3. Hybrid Bilog Antenna 30MHz-6GHz SUNOL SCIENCES CORPORATION JB6	2018/10	2021/10
4. Attenuator 3 dB 2W, DC-6GHz, JFW 50HN-03	2020/10	2021/10
5. RF Pre-amplifier 40 dB, 10 MHz - 6 GHz BONN ELEKTRONIK BLNA 0160-01N	2020/02	2021/02
6. EMI Test Receiver 7 GHz ROHDE AND SCHWARZ ESR7	2019/10	2021/10
7. Low Pass Filter DC - 1 GHz TEMSTRON / TEMWELL ST-1GA3250-LS	2020/11	2021/11
8. DC Power Supply 150V/22A, AGILENT TECHNOLOGIES N8740A	---	---
9. Horn Antenna 1-18GHz SCHWARZBECK MESS- ELEKTRONIK BBHA 9120 D	2020/08	2023/08
10. Broadband Horn Antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2018/07	2021/07
11. RF Pre-amplifier, 30 dB ,1-18 GHz BONN ELEKTRONIK BLMA 0118-3A	2020/10	2021/10
12. Low Noise Amplifier G>30dB, 18 - 40 GHz BONN ELEKTRONIK BLMA 1840-1M	2019/02	2021/02
13. Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV40	2019/10	2021/10
14. Digital Multimeter FLUKE 179	2020/11	2021/11



## Testing verdicts

Not applicable:	N/A
Pass:	P
Fail:	F
Not measured:	N/M

## Summary

### A. Common requirements for all bands

FCC PART 15 PARAGRAPH / RSS-247		
Test case	Verdict	Remark
Duty Cycle	N/A	
99% Occupied Bandwidth	N/A	
26 dB Emission Bandwidth (EBW)	N/A	
<u>Supplementary information and remarks:</u>		
(1) None.		

### B. U-NII-1 Band: 5.15 - 5.25 GHz

FCC PART 15 PARAGRAPH / RSS-247		
Requirement – Test case	Verdict	Remark
FCC 15.407 (a)(1)(iv) Transmitter Maximum conducted Output Power	P	
RSS-247 6.2.1.1 Transmitter Maximum Equivalent Isotropically Radiated Power EIRP	P	
FCC 15.407 (a)(1)(iv) Transmitter Maximum Power Spectral Density	P	
RSS-247 6.2.1.1 Transmitter EIRP Spectral Density	P	
FCC 15.407 (b)(1)(6) / RSS-247 6.2.1.2 Transmitter Out of Band Radiated Emissions	P	
FCC 15.407 (b)(1) / RSS-247 6.2.1.2 Transmitter Band Edge Radiated Emissions	P	
<u>Supplementary information and remarks:</u>		
None.		

### C. U-NII-3 Band: 5.725 - 5.85 GHz

FCC PART 15 PARAGRAPH / RSS-247		Verdict	Remark
Requirement – Test case			
FCC 15.407 (a)(3) / RSS-247 6.2.4.1	Transmitter Maximum conducted Output Power	P	
FCC 15.407 (e) / RSS-247 6.2.4.1	6 dB bandwidth.	P	
FCC 15.407 (a)(3) / RSS-247 6.2.4.1	Transmitter Maximum Power Spectral Density	P	
FCC 15.407 (b)(4)(6) / RSS-247 6.2.4.2	Transmitter Out of Band Radiated Emissions	P	
FCC 15.407 (b)(4) / RSS-247 6.2.4.2	Transmitter Band Edge Radiated Emissions	P	
<u>Supplementary information and remarks:</u>			
None			

## Appendix A: Test Common requirements for all bands

## INDEX

FCC 15.35 (c) / RSS-Gen 6.10. Transmitter Duty Cycle.....	13
RSS-Gen 6.6 / RSS-247 6.2. Transmitter 99% Occupied Bandwidth .....	20
FCC 15.403(i) Transmitter 26 dB Emission Bandwidth (EBW) .....	22

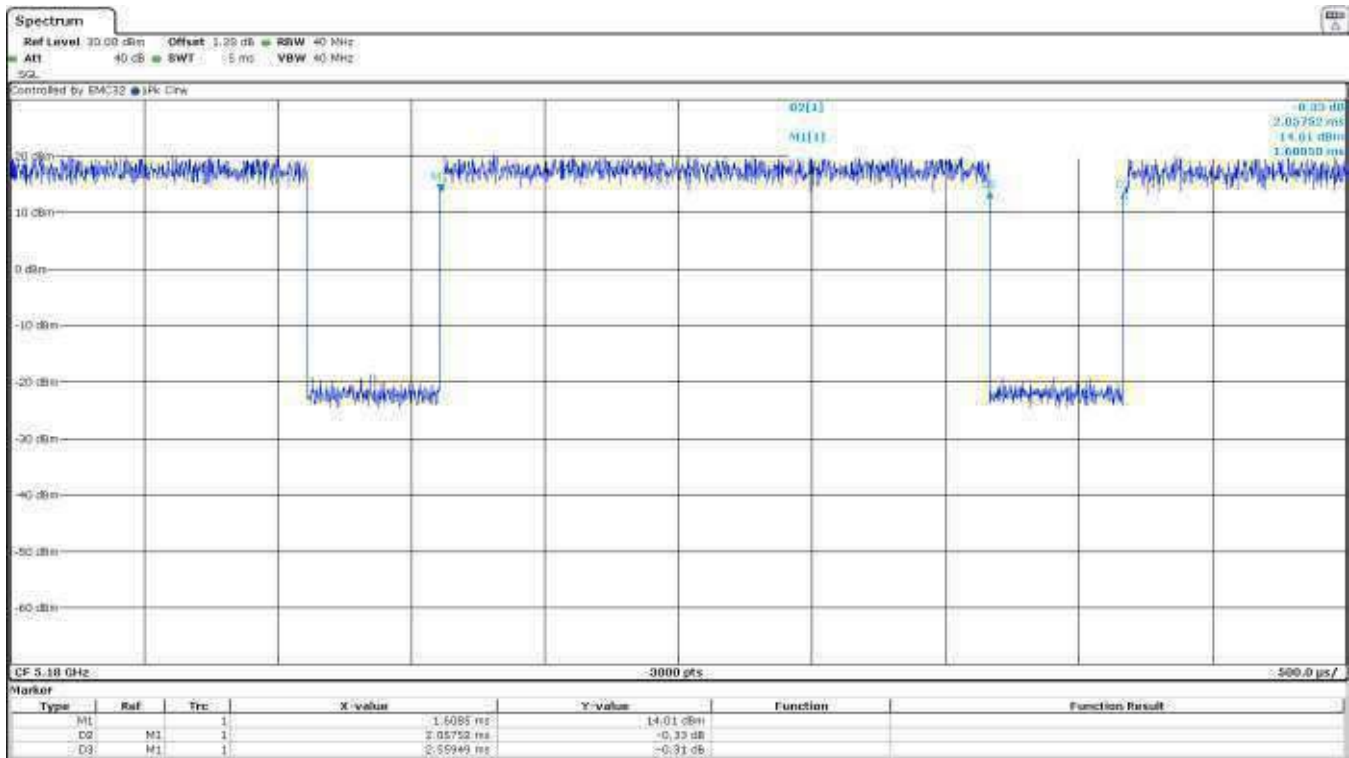
## Transmitter Duty Cycle

### RESULTS:

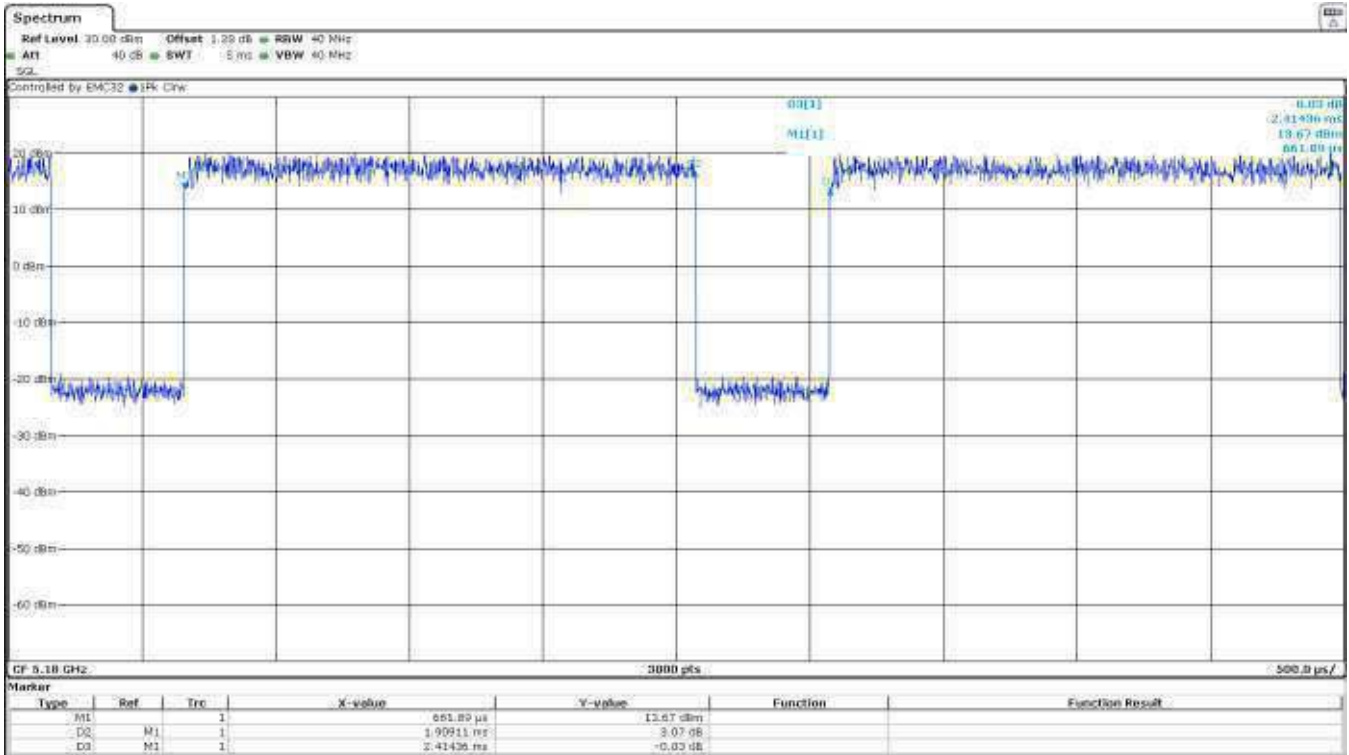
The results below are for data rates with a duty cycle less than 98%. The results for all rest of modes having a value > 98%.

Mode	Sub-band U-NII-1			Sub-band U-NII-3		
	Pulse Duration (ms)	Period (ms)	Duty Cycle Correction (dB)	Pulse Duration (ms)	Period (ms)	Duty Cycle Correction (dB)
802.11a20	2.05752	2.55949	0.948093717	2.05402	2.57417	0.980325566
802.11n20	1.90911	2.41436	1.019710748	1.89375	2.41487	1.055711104
802.11ac20	1.92342	2.42384	1.004298207	1.9056	2.42736	1.051024469
802.11n40	0.93887	1.44601	1.875658342	0.91044	1.44032	1.992076611
802.11ac40	0.94454	1.44473	1.845663366	0.92711	1.44865	1.938322053
802.11ac80	0.459617	0.962045	3.207993031	0.43528	0.95682	3.420615317

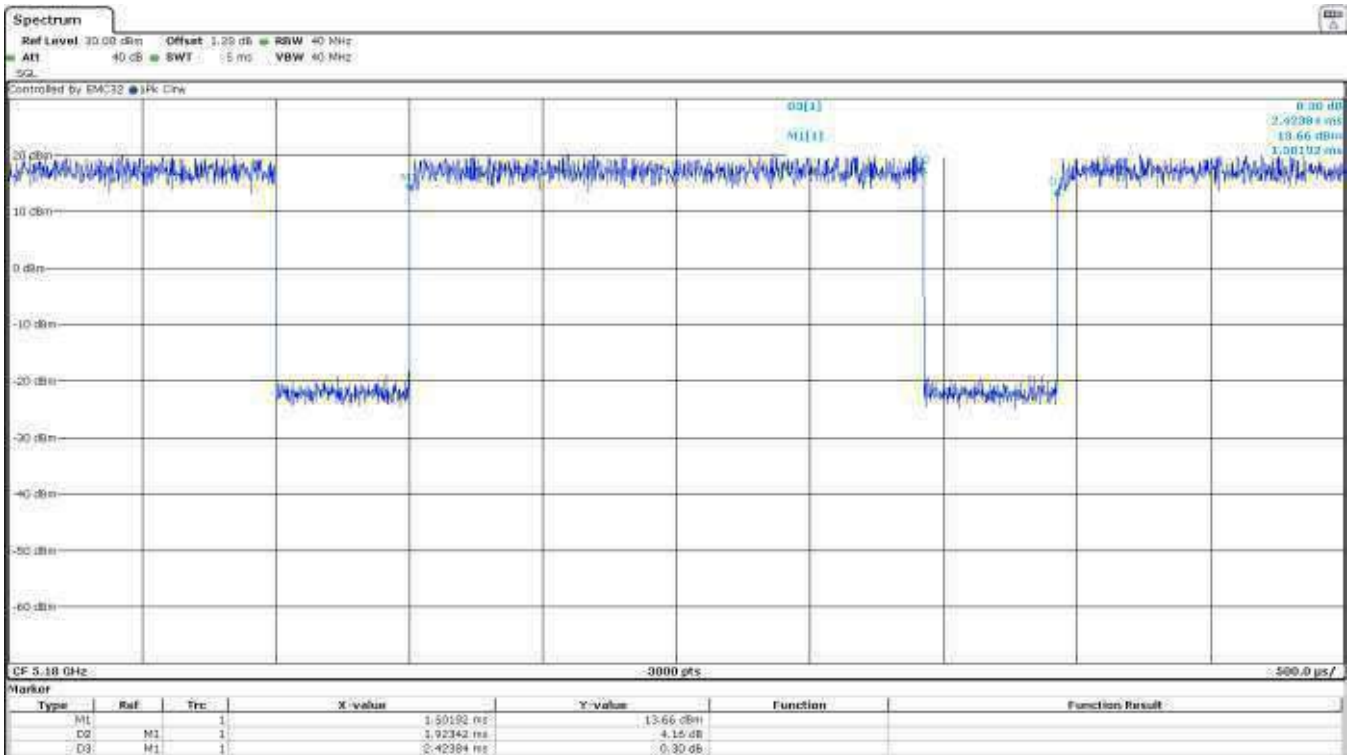
### Mode 802.11 a20 (U-NII-1):



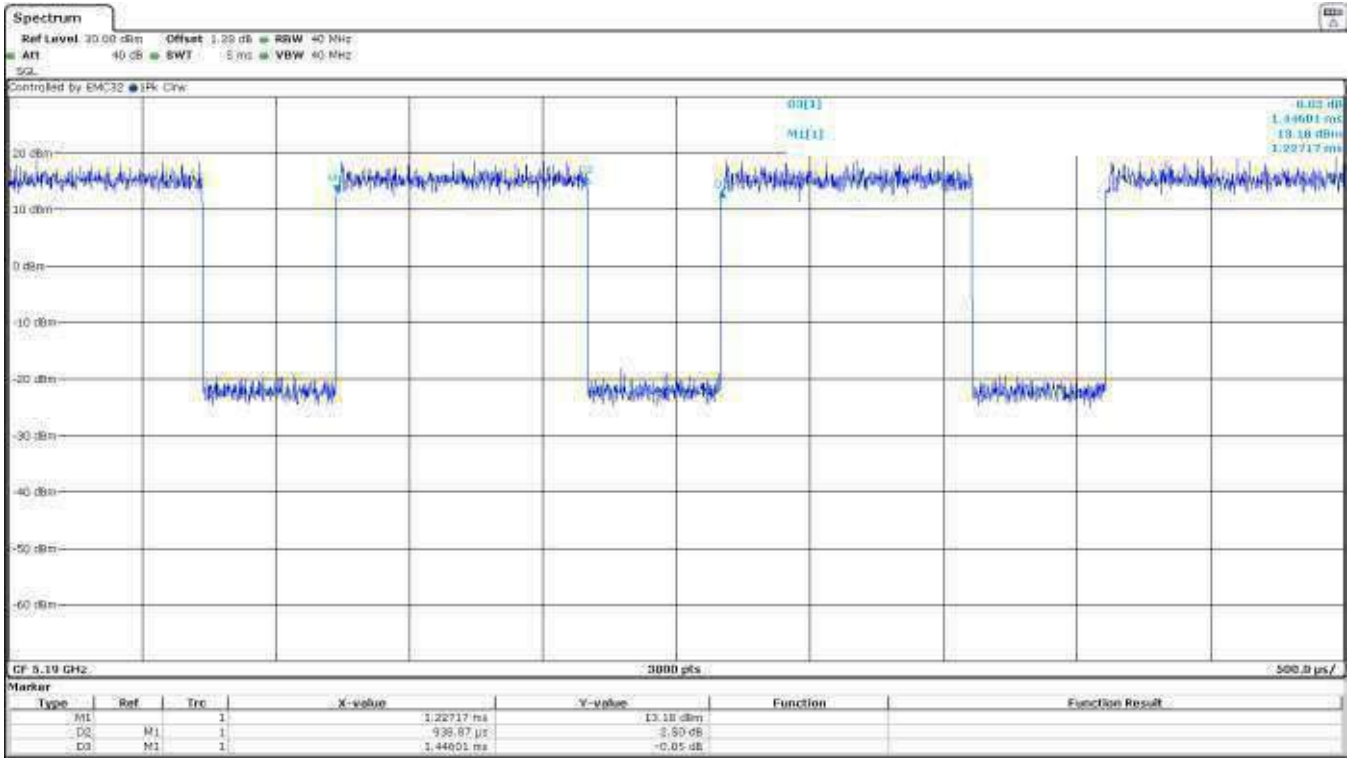
**Mode 802.11 n20 (U-NII-1):**



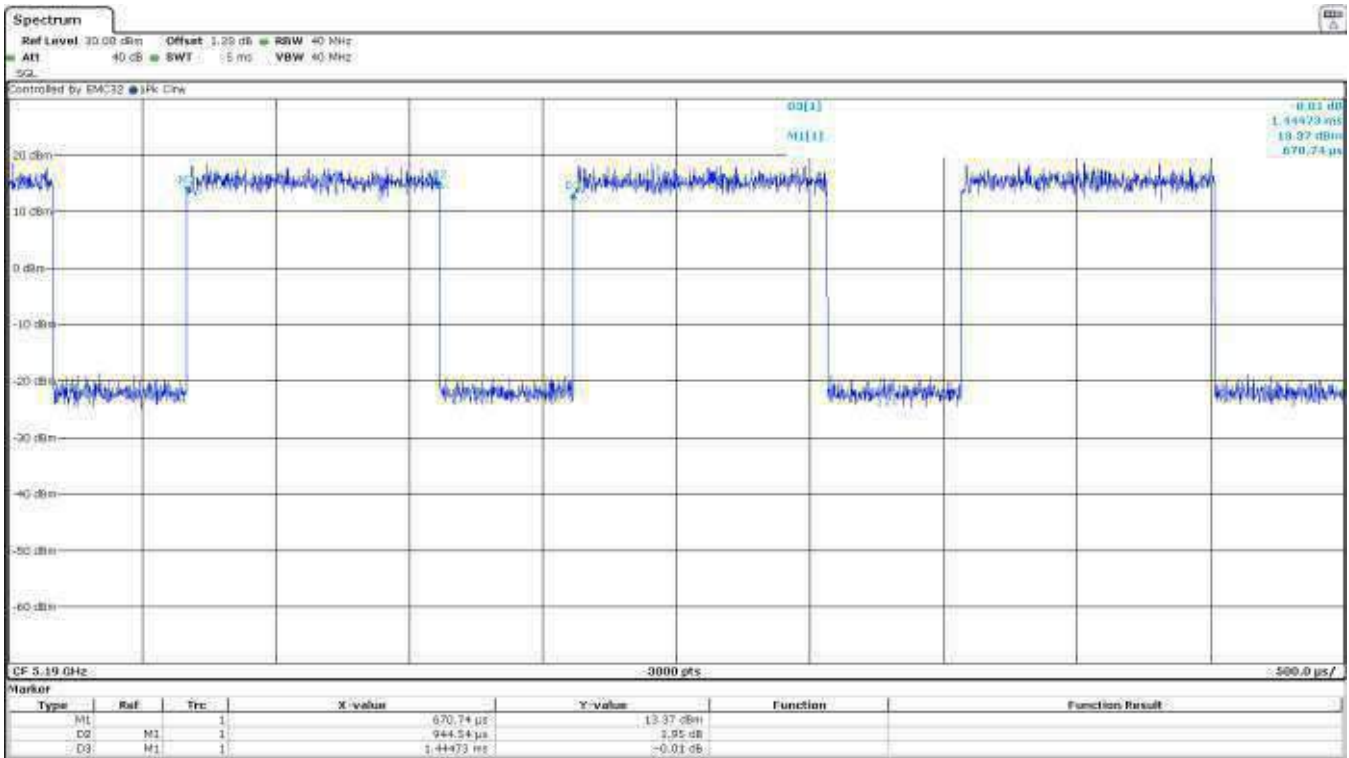
**Mode 802.11 ac20 (U-NII-1):**



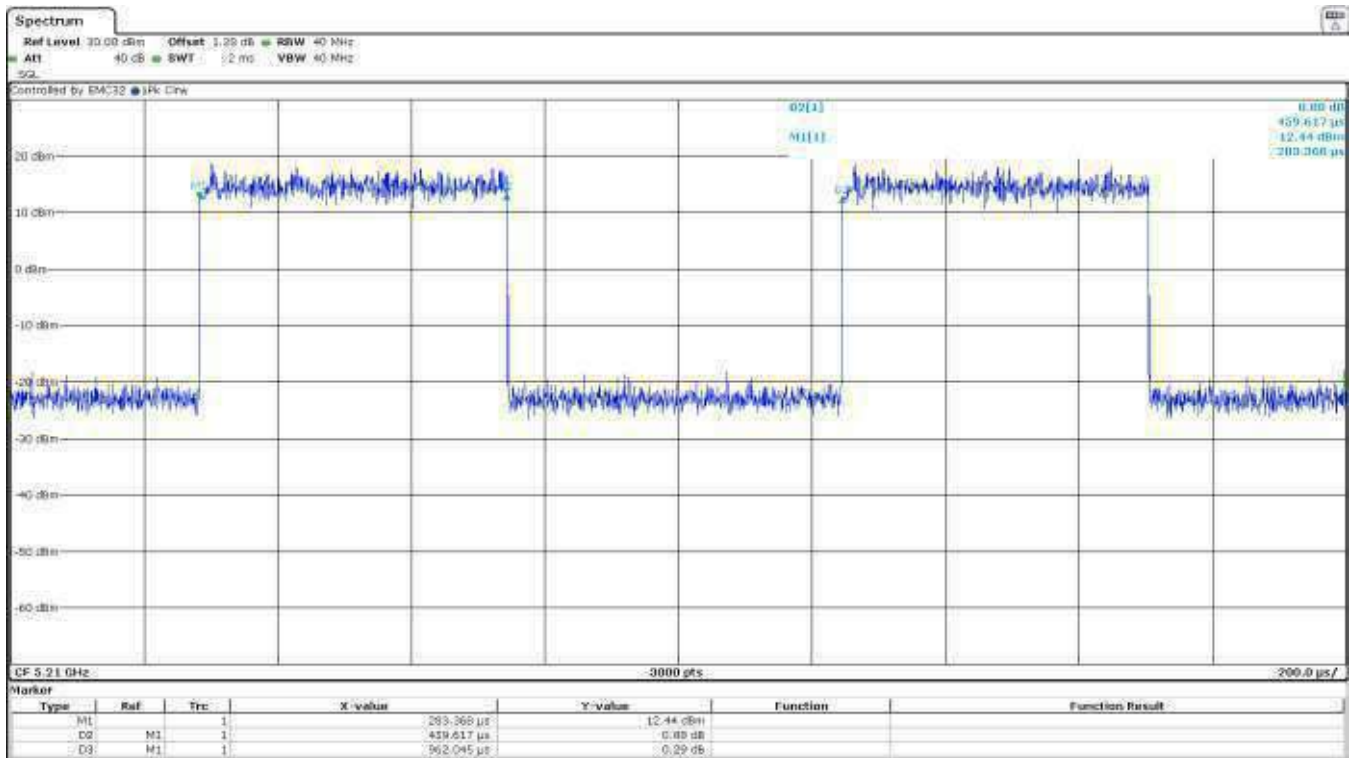
**Mode 802.11 n40 (U-NII-1):**



**Mode 802.11 ac40 (U-NII-1):**

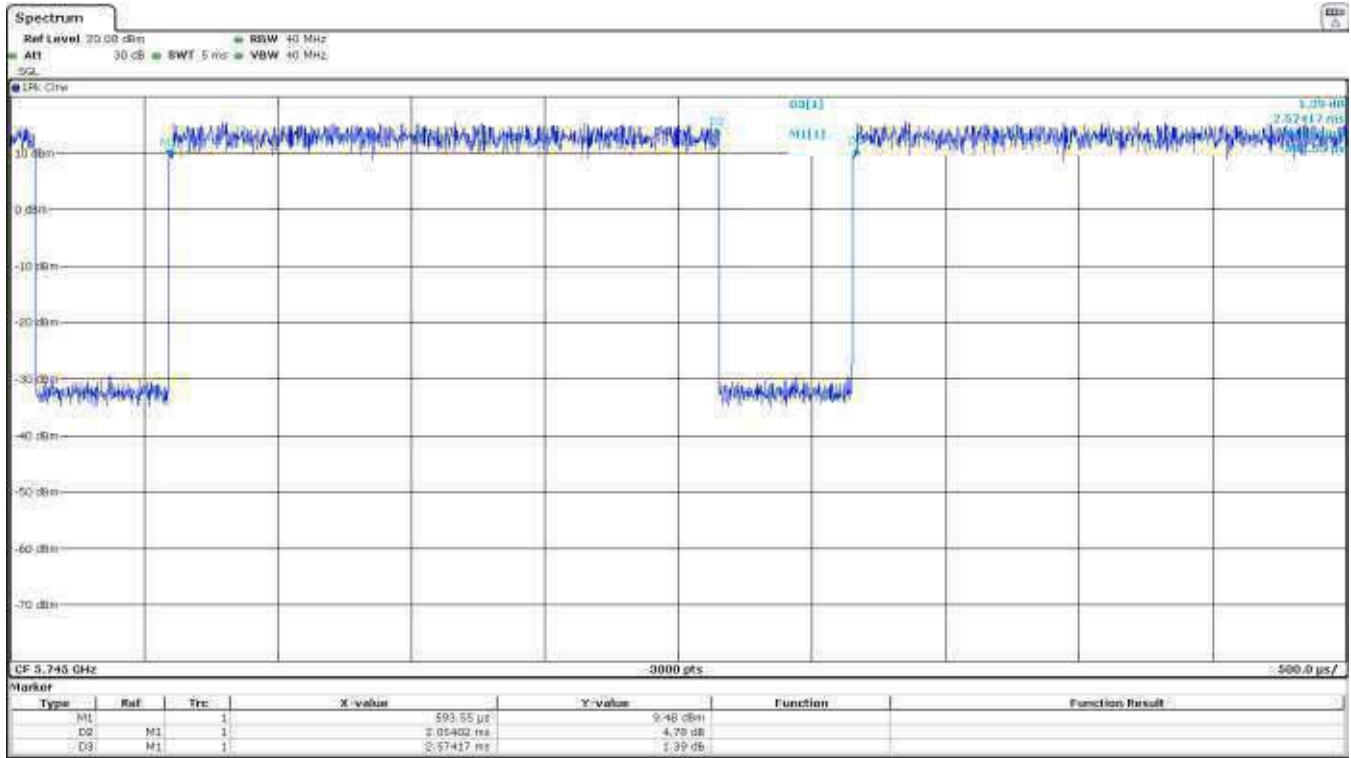


**Mode 802.11 ac80 (U-NII-1):**

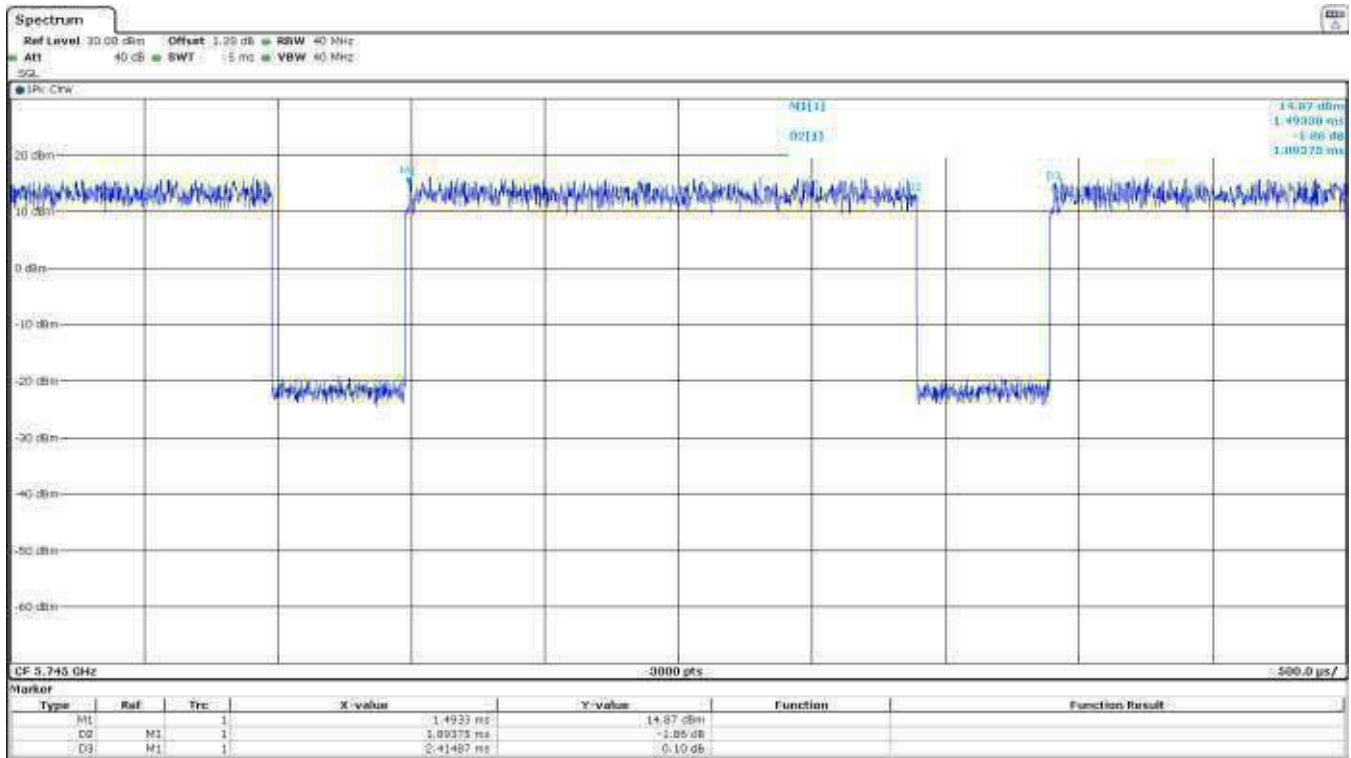




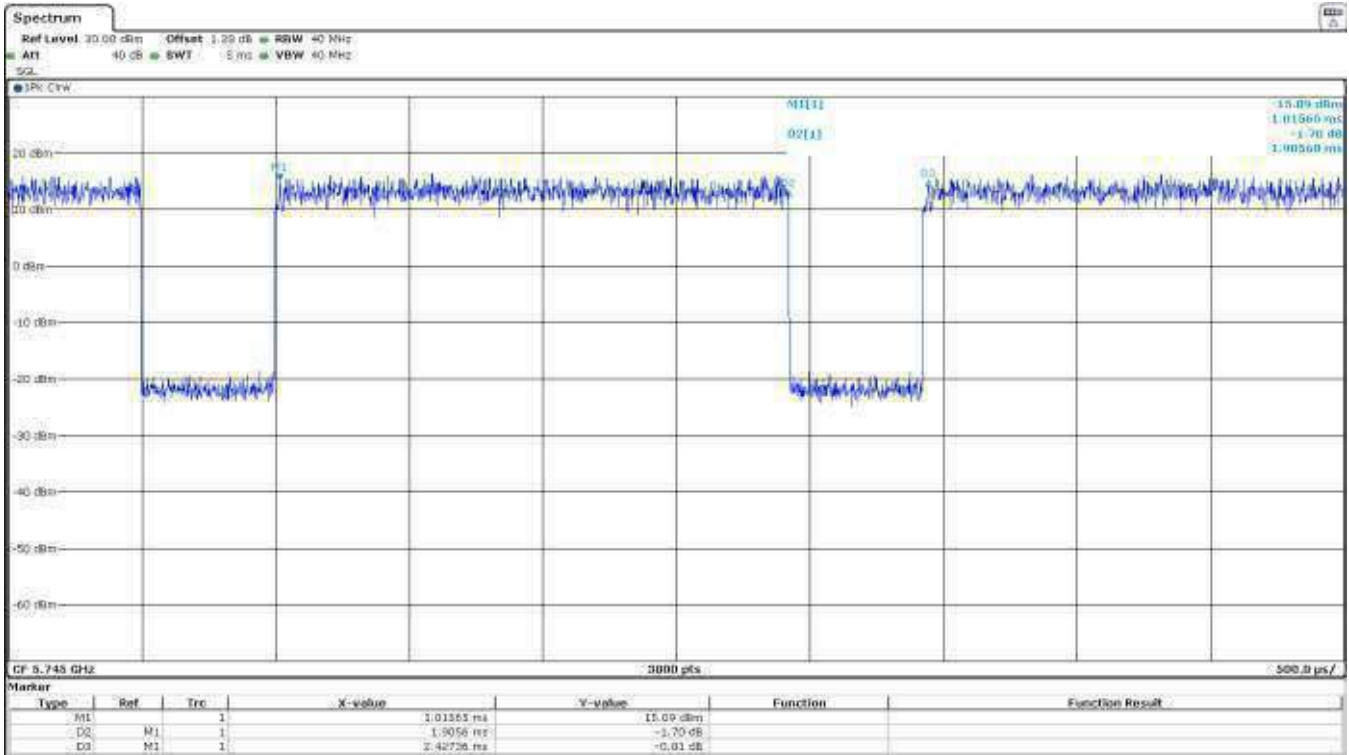
**Mode 802.11 a20 (U-NII-3):**



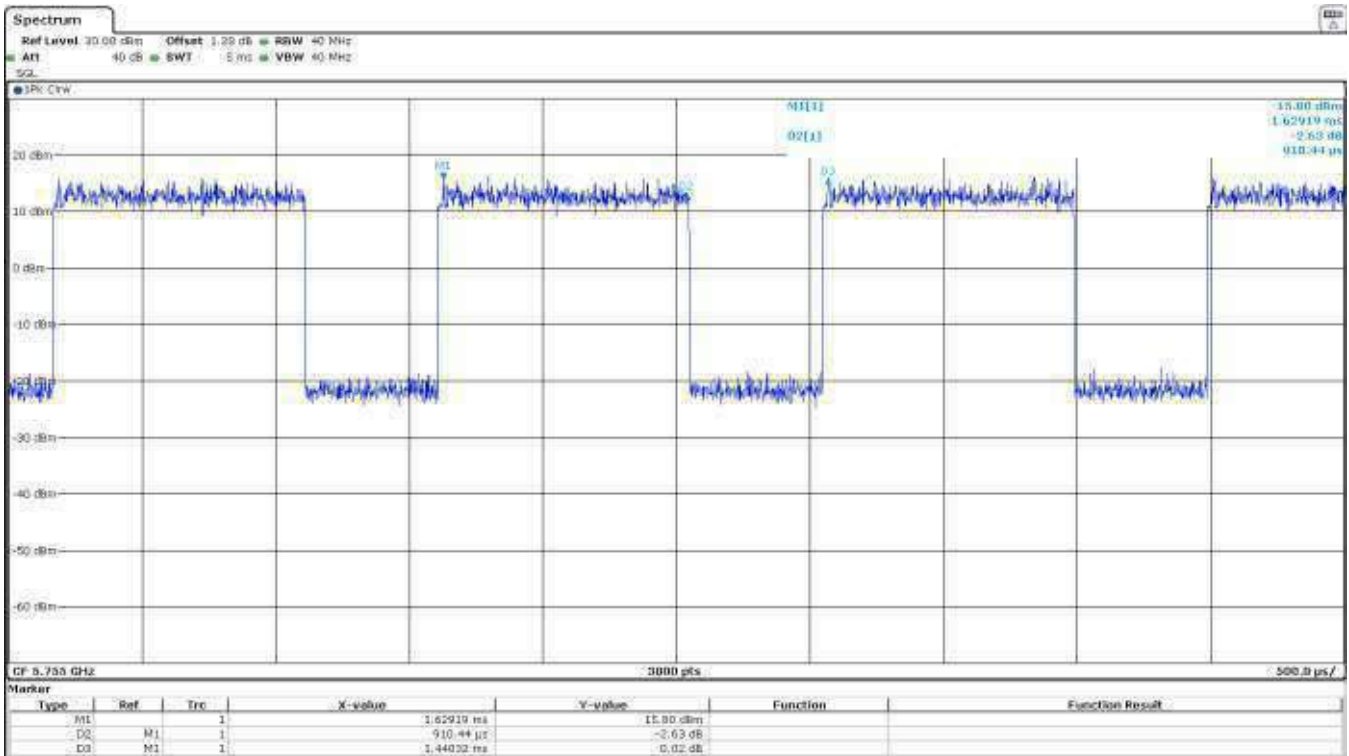
**Mode 802.11 n20 (U-NII-3):**



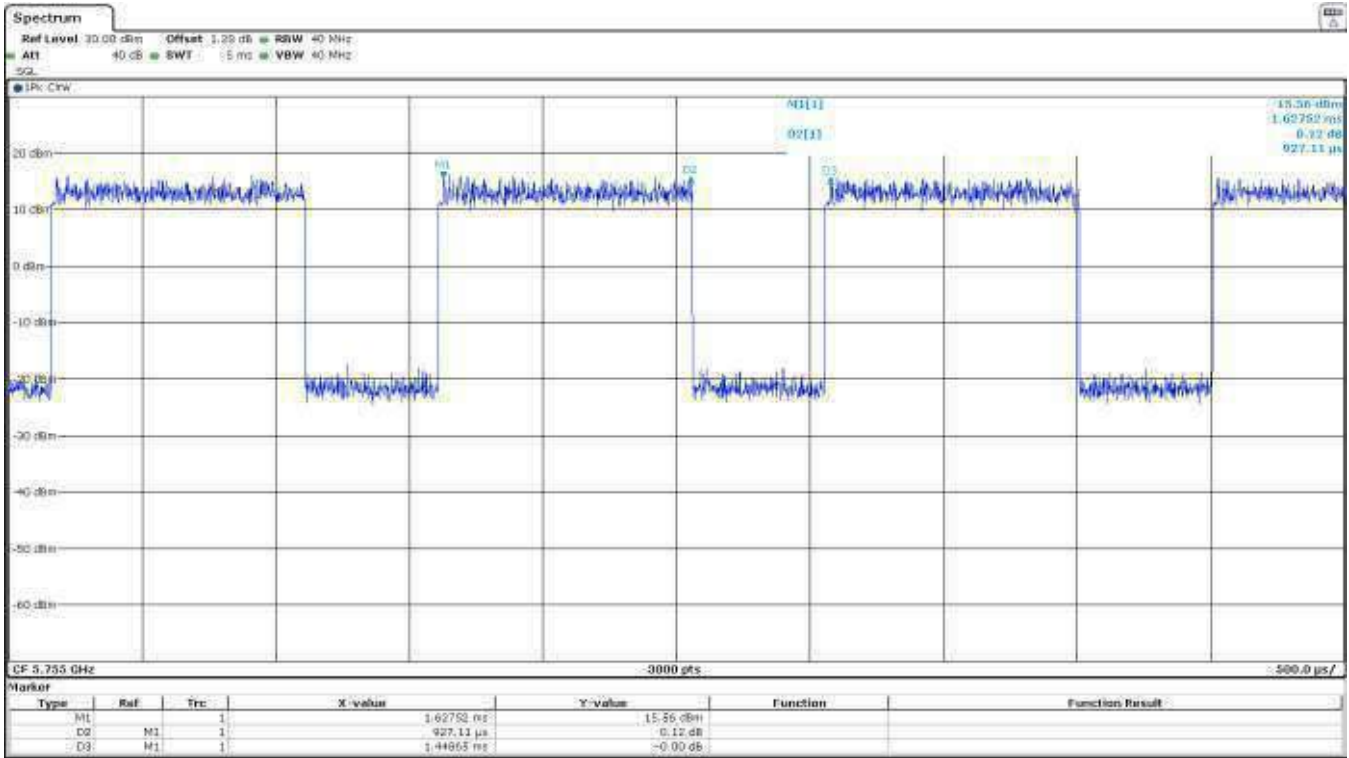
**Mode 802.11 ac20 (U-NII-3):**



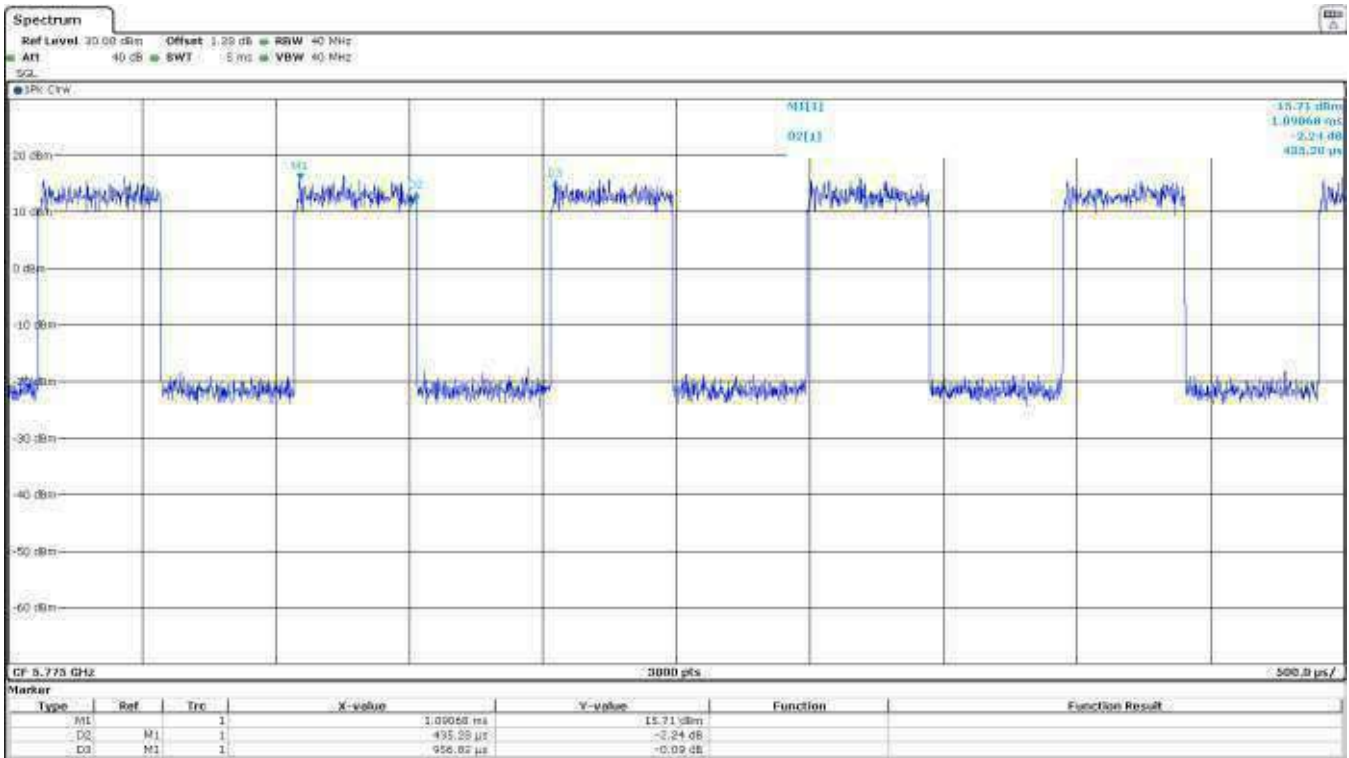
**Mode 802.11 n40 (U-NII-3):**



**Mode 802.11 ac40 (U-NII-3):**



**Mode 802.11 ac80 (U-NII-3):**



## Transmitter 99% Occupied Bandwidth

### RESULTS

#### Mode 802.11 a20:

##### U-NII-1 (5150-5250 MHz)

Channels	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
99% Occupied Bandwidth (MHz)	17.060	17.044	17.028
Measurement uncertainty (kHz)	<±36.95		

##### U-NII-3 (5725-5850 MHz)

Channels	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
99% Occupied Bandwidth (MHz)	17.084	17.08	17.06
Measurement uncertainty (kHz)	<±36.95		

#### Mode 802.11 n20 (HT20):

##### U-NII-1 (5150-5250 MHz)

Channels	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
99% Occupied Bandwidth (MHz)	18.196	18.188	18.14
Measurement uncertainty (kHz)	<±36.95		

##### U-NII-3 (5725-5850 MHz)

Channels	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
99% Occupied Bandwidth (MHz)	18.292	18.180	18.172
Measurement uncertainty (kHz)	<±36.95		

#### Mode 802.11 ac20 (VHT20):

##### U-NII-1 (5150-5250 MHz)

Channels	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
99% Occupied Bandwidth (MHz)	18.148	18.164	18.188
Measurement uncertainty (kHz)	<±36.95		

##### U-NII-3 (5725-5850 MHz)

Channels	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
99% Occupied Bandwidth (MHz)	18.180	18.196	18.172
Measurement uncertainty (kHz)	<±36.95		

**Mode 802.11 n40 (HT40):**

**U-NII-1 (5150-5250 MHz)**

Channels	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
99% Occupied Bandwidth (MHz)	36.32	36.224
Measurement uncertainty (kHz)	<±65.36	

**U-NII-3 (5725-5850 MHz)**

Channels	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
99% Occupied Bandwidth (MHz)	36.352	36.256
Measurement uncertainty (kHz)	<±65.36	

**Mode 802.11 ac40 (VHT40):**

**U-NII-1 (5150-5250 MHz)**

Channels	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
99% Occupied Bandwidth (MHz)	36.328	36.128
Measurement uncertainty (kHz)	<±65.36	

**U-NII-3 (5725-5850 MHz)**

Channels	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
99% Occupied Bandwidth (MHz)	36.344	36.232
Measurement uncertainty (kHz)	<±65.36	

**Mode 802.11 ac80 (VHT80):**

**U-NII-1 (5150-5250 MHz)**

Channel	Single Channel 42 (5210 MHz)
99% Occupied Bandwidth (MHz)	75.872
Measurement uncertainty (kHz)	<±124.71

**U-NII-3 (5725-5850 MHz)**

Channels	Single Channel 155 (5775 MHz)
99% Occupied Bandwidth (MHz)	75.632
Measurement uncertainty (kHz)	<±124.71

## Transmitter 26 dB Emission Bandwidth (EBW)

### RESULTS:

The 26 dB Emission Bandwidth was measured using the method according to point C) 1) of 789033 D02 General UNII Test Procedures New Rules v02r01.

#### Mode 802.11 a20:

##### U-NII-1 (5150-5250 MHz)

Channels	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
-26 dBc bandwidth (MHz)	21.5309	21.5292	21.4167
Measurement uncertainty (kHz)	<±36.95		

##### U-NII-3 (5725-5850 MHz)

Channels	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
-26 dBc bandwidth (MHz)	21.5082	21.4932	21.4047
Measurement uncertainty (kHz)	<±36.95		

#### Mode 802.11 n20 (HT20):

##### U-NII-1 (5150-5250 MHz)

Channels	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
-26 dBc bandwidth (MHz)	21.9228	21.8746	22.4615
Measurement uncertainty (kHz)	<±36.95		

##### U-NII-3 (5725-5850 MHz)

Channels	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
-26 dBc bandwidth (MHz)	22.040	21.876	21.908
Measurement uncertainty (kHz)	<±36.95		

#### Mode 802.11 ac20 (VHT20):

##### U-NII-1 (5150-5250 MHz)

Channels	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
-26 dBc bandwidth (MHz)	21.923	22.6063	23.183
Measurement uncertainty (kHz)	<±36.95		

**U-NII-3 (5725-5850 MHz)**

Channels	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
-26 dBc bandwidth (MHz)	22.028	22.368	21.928
Measurement uncertainty (kHz)	<±36.95		

**Mode 802.11 n40 (HT40):**

**U-NII-1 (5150-5250 MHz)**

Channels	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
-26 dBc bandwidth (MHz)	40.2017	39.9173
Measurement uncertainty (kHz)	<±65.36	

**U-NII-3 (5725-5850 MHz)**

Channels	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
-26 dBc bandwidth (MHz)	40.344	40.140
Measurement uncertainty (kHz)	<±65.36	

**Mode 802.11 ac40 (VHT40):**

**U-NII-1 (5150-5250 MHz)**

Channels	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
-26 dBc bandwidth (MHz)	40.241	39.993
Measurement uncertainty (kHz)	<±65.36	

**U-NII-3 (5725-5850 MHz)**

Channels	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
-26 dBc bandwidth (MHz)	40.216	40.052
Measurement uncertainty (kHz)	<±65.36	

**Mode 802.11 ac80 (VHT80):**

**U-NII-1 (5150-5250 MHz)**

Channel	Single Channel 42 (5210 MHz)
-26 dBc bandwidth (MHz)	87.006
Measurement uncertainty (kHz)	<±124.71

**U-NII-3 (5725-5850 MHz)**

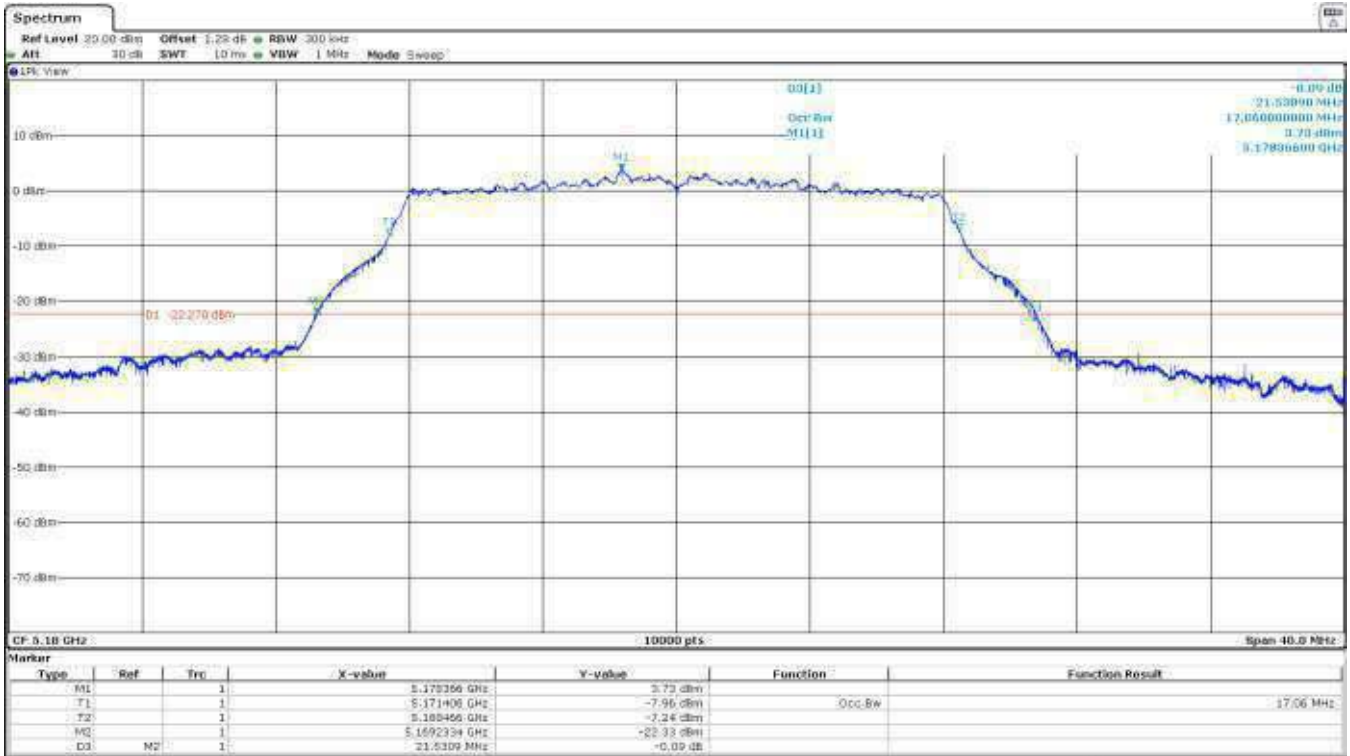
Channels	Single Channel 155 (5775 MHz)
-26 dBc bandwidth (MHz)	82.207
Measurement uncertainty (kHz)	<±124.71



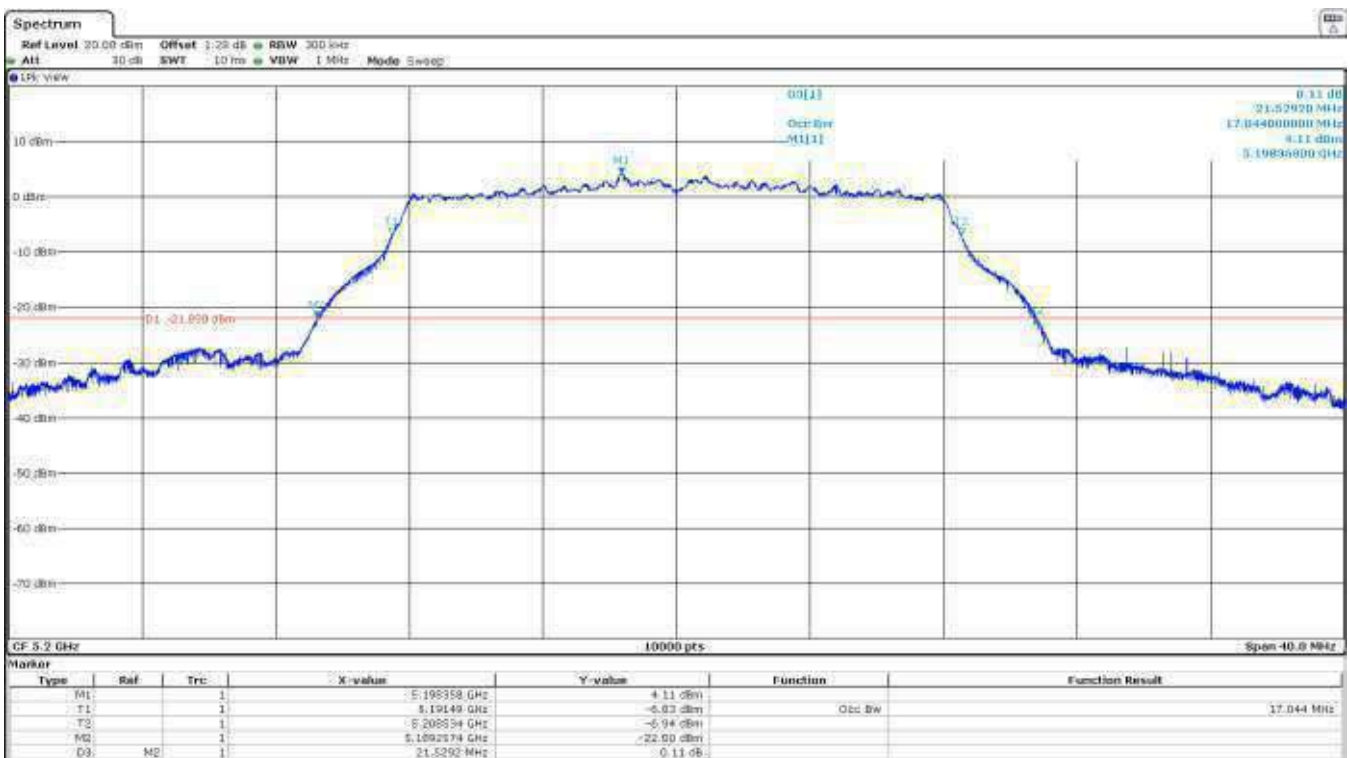
**Mode 802.11 a20:**

**U-NII-1 (5150-5250 MHz)**

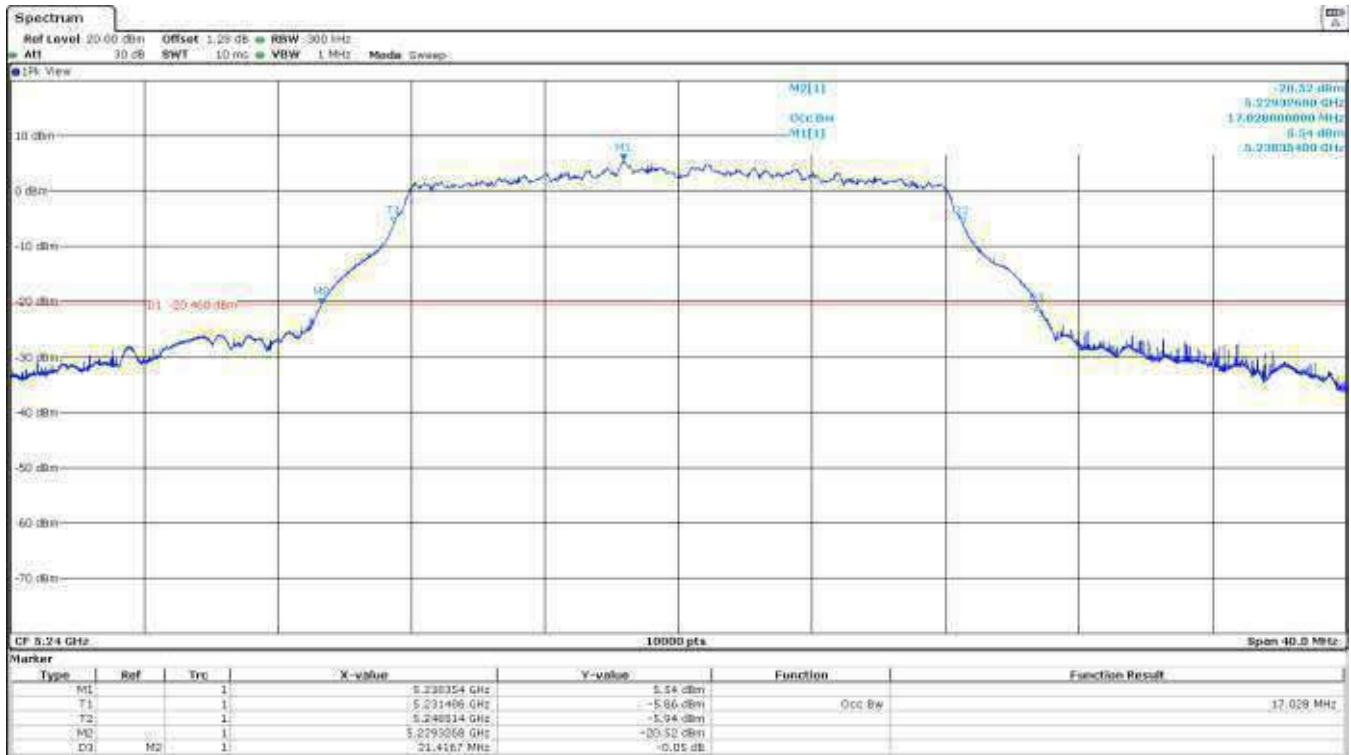
- Low Channel 36 (5180 MHz):



- Middle Channel 40 (5200 MHz):

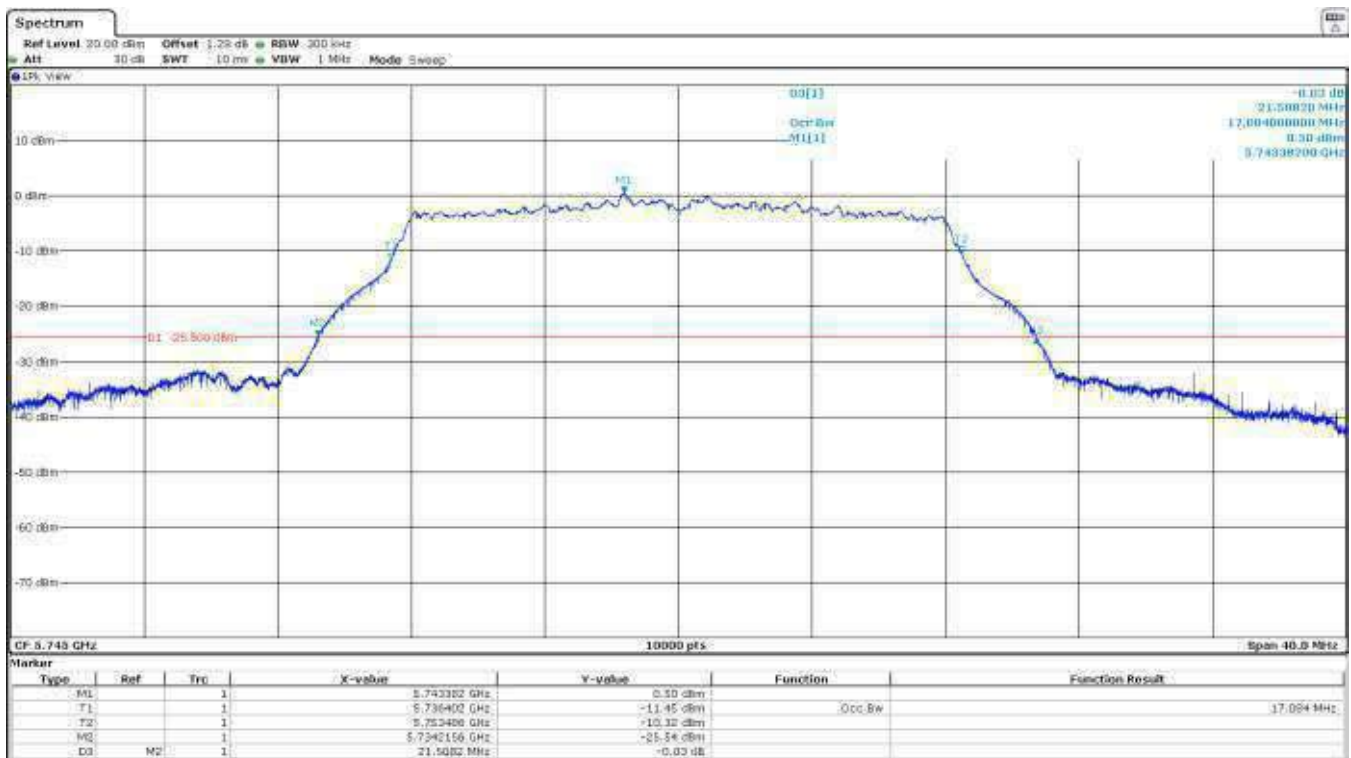


- High Channel 48 (5240 MHz):

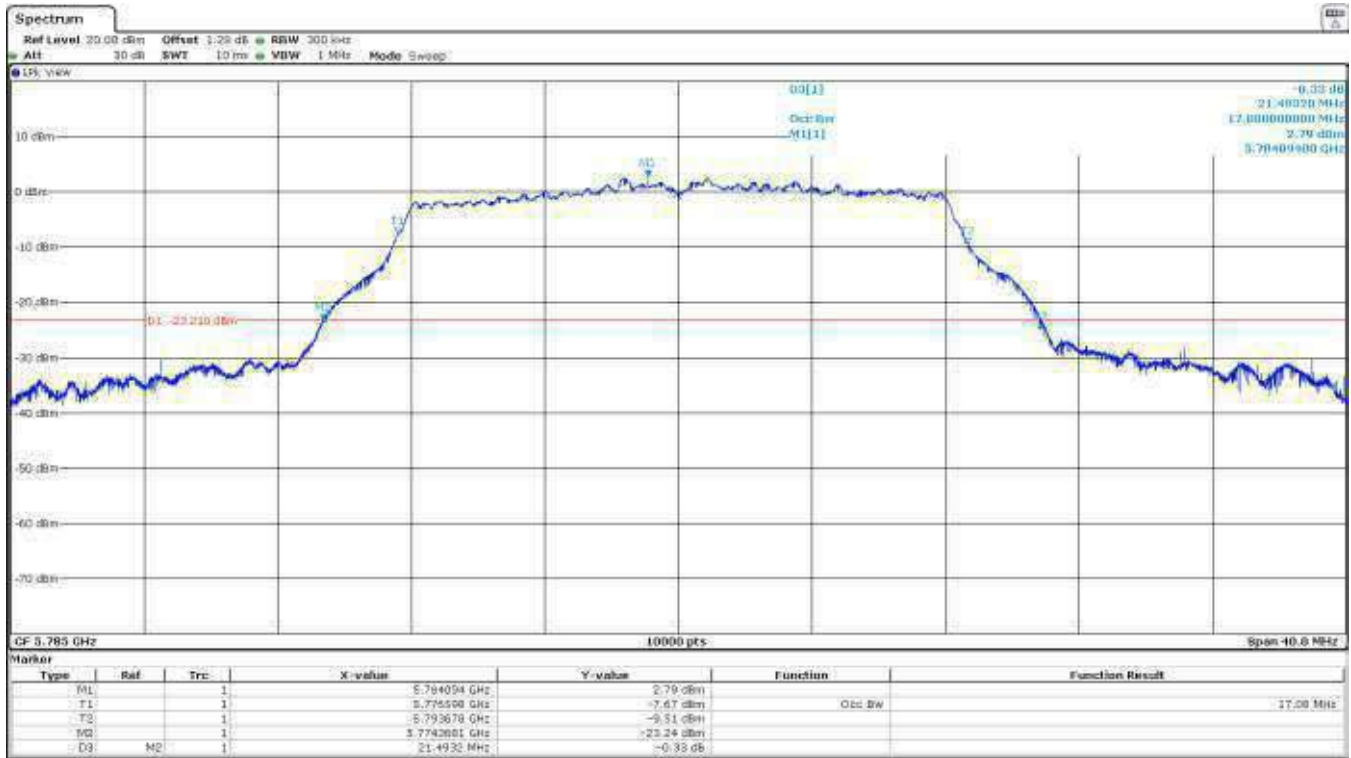


**U-NII-3 (5725-5850 MHz)**

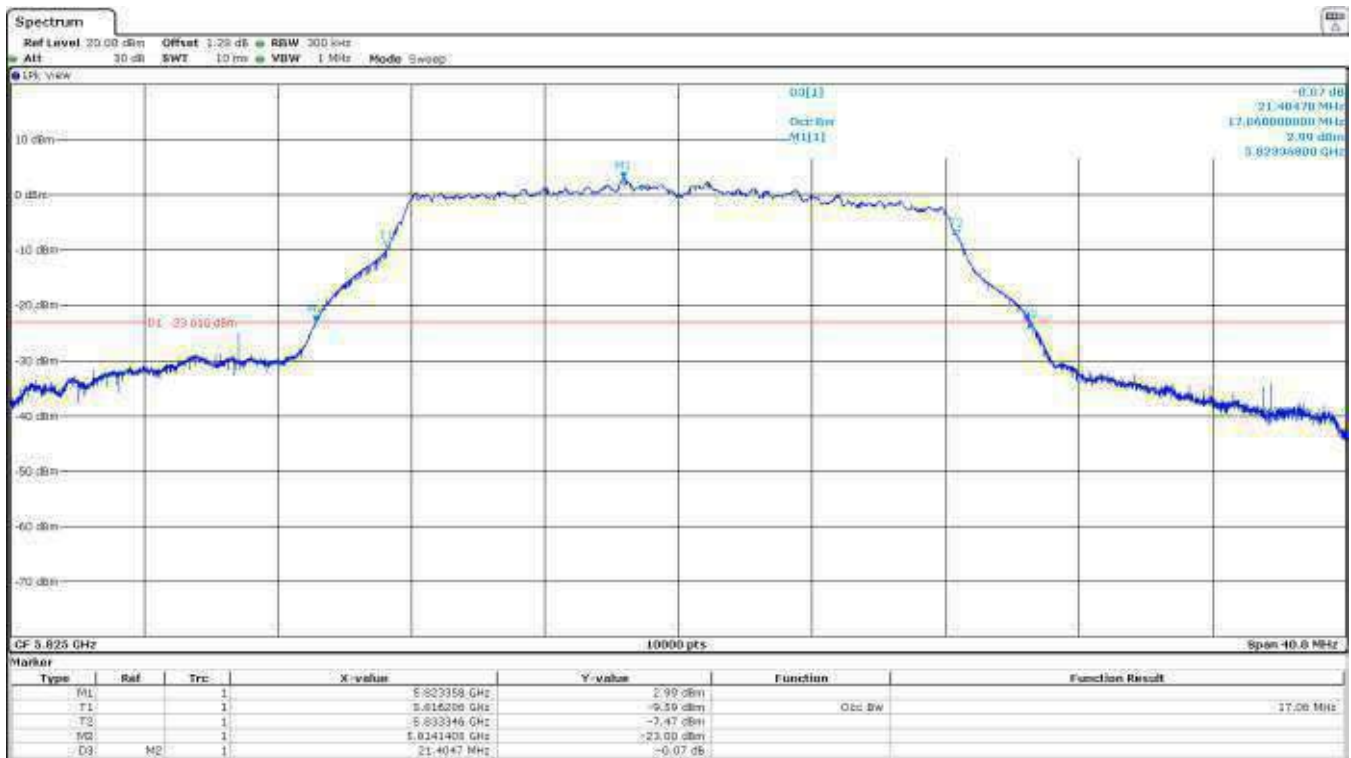
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



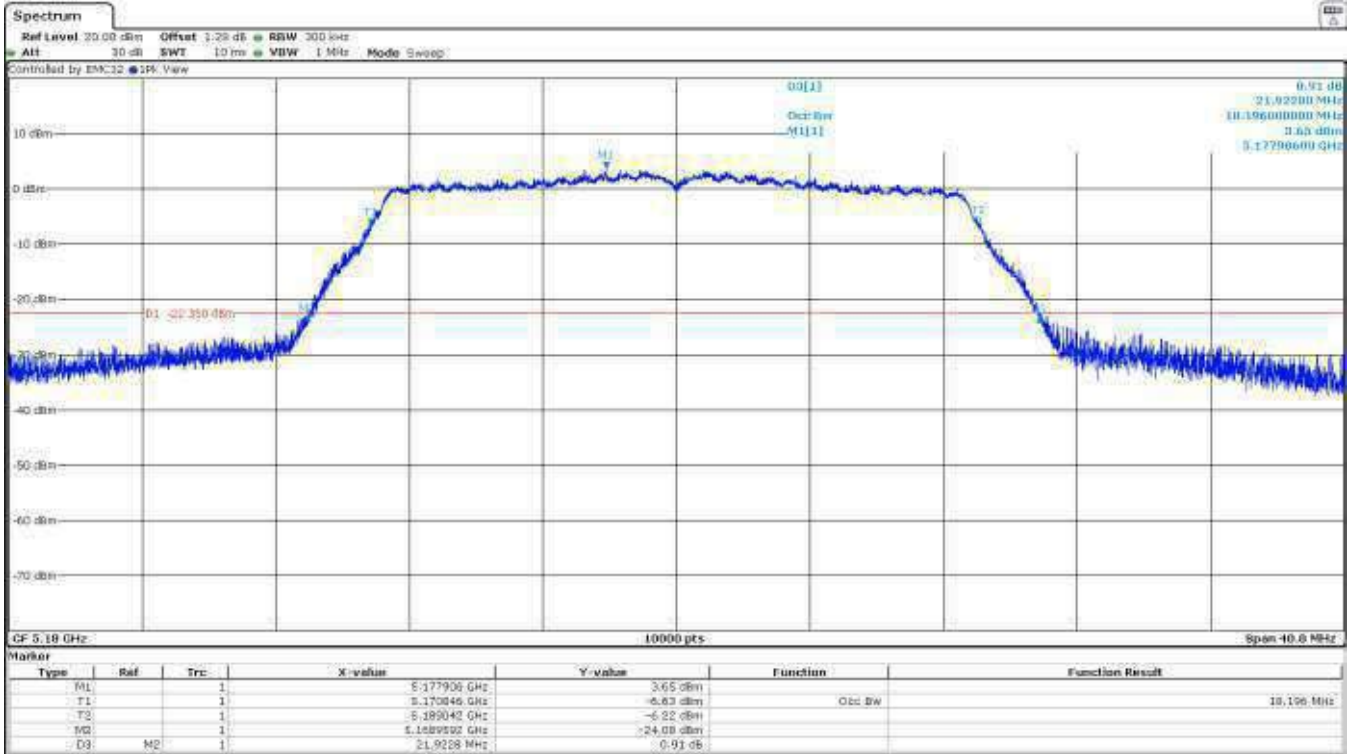
- High Channel 165 (5825 MHz):



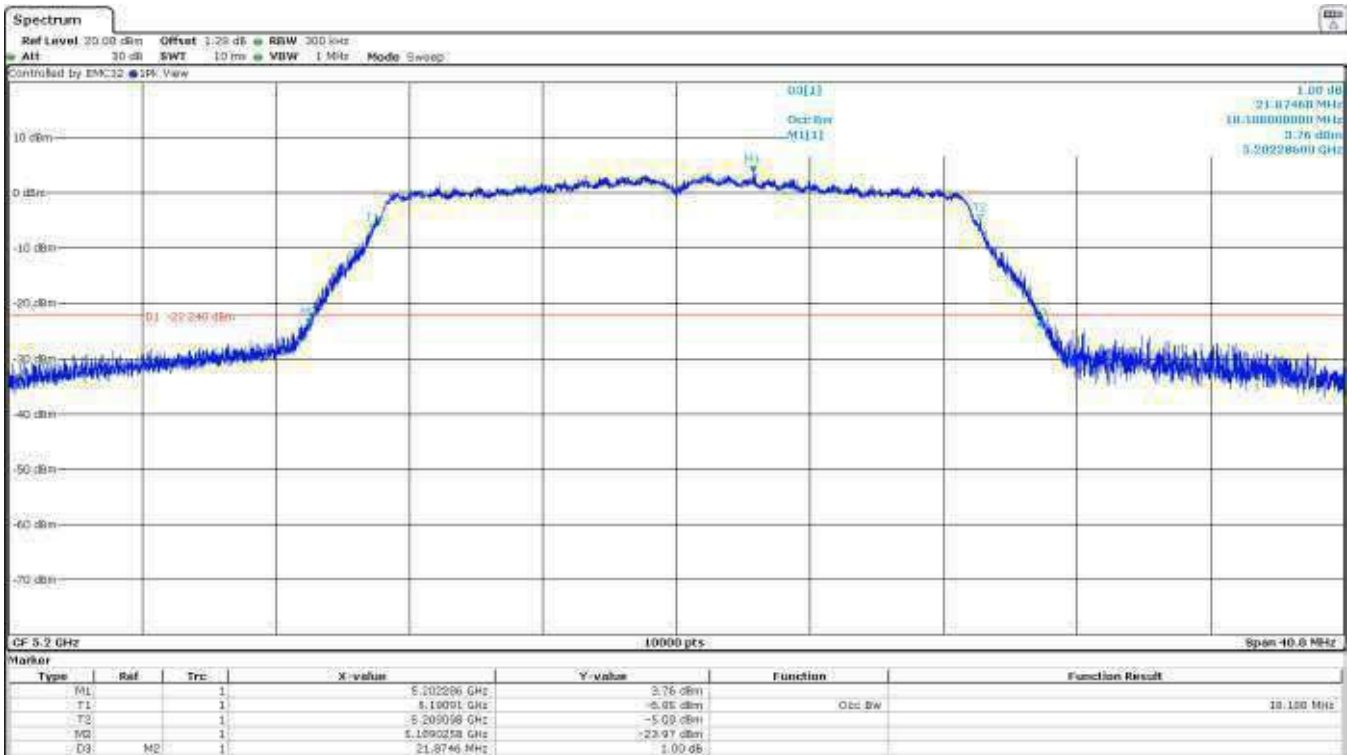
**Mode 802.11 n20 (HT20):**

**U-NII-1 (5150-5250 MHz)**

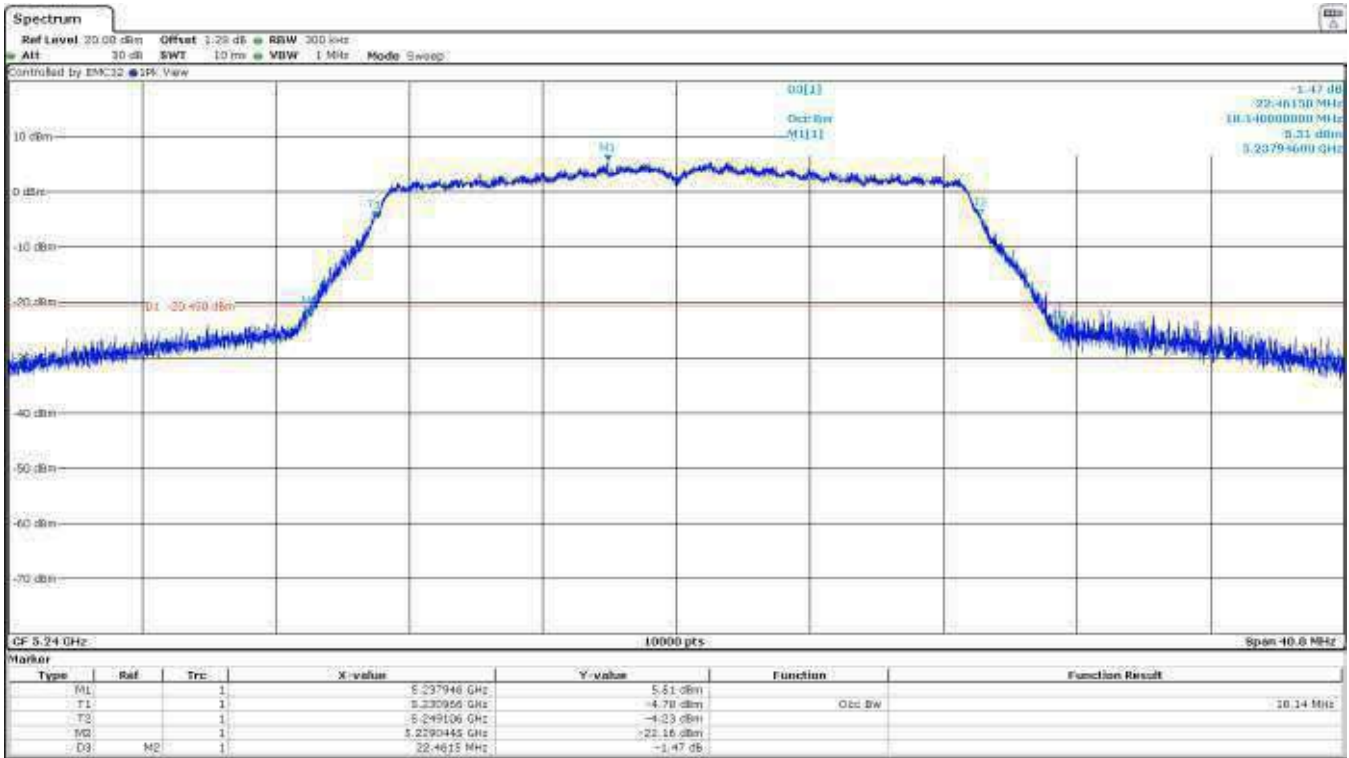
- Low Channel 36 (5180 MHz):



- Middle Channel 40 (5200 MHz):

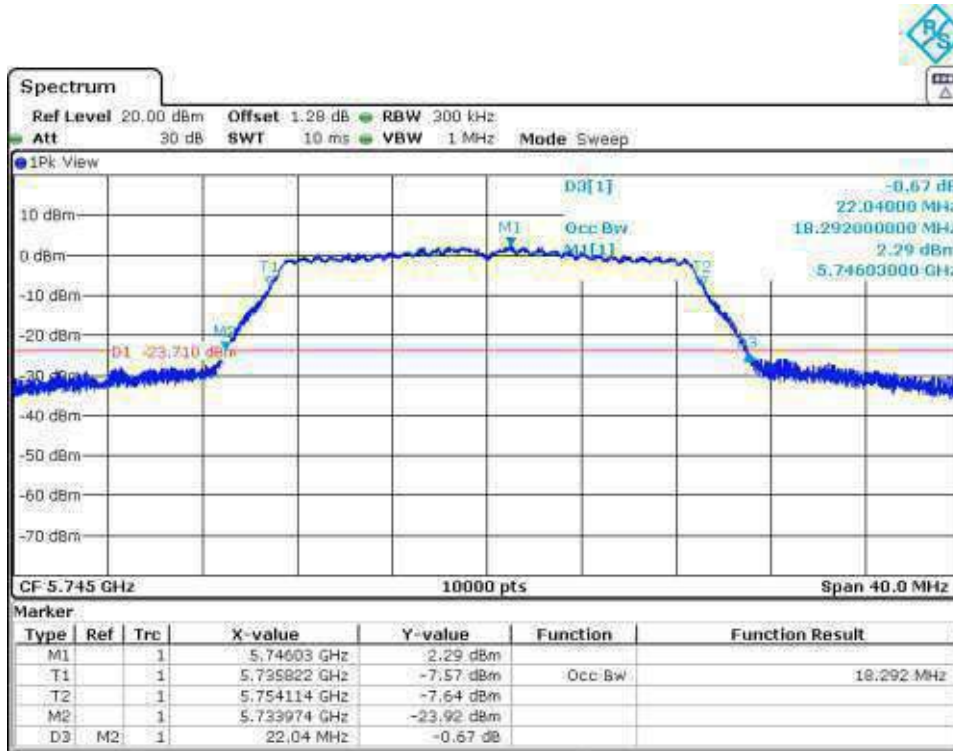


- High Channel 48 (5240 MHz):

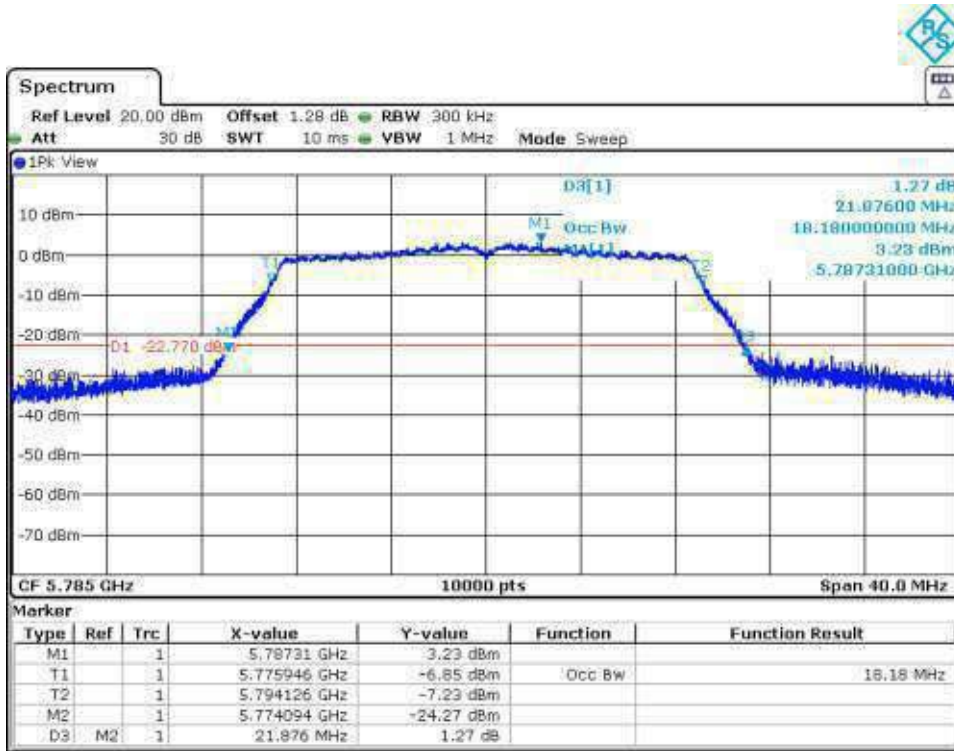


**U-NII-3 (5725-5850 MHz)**

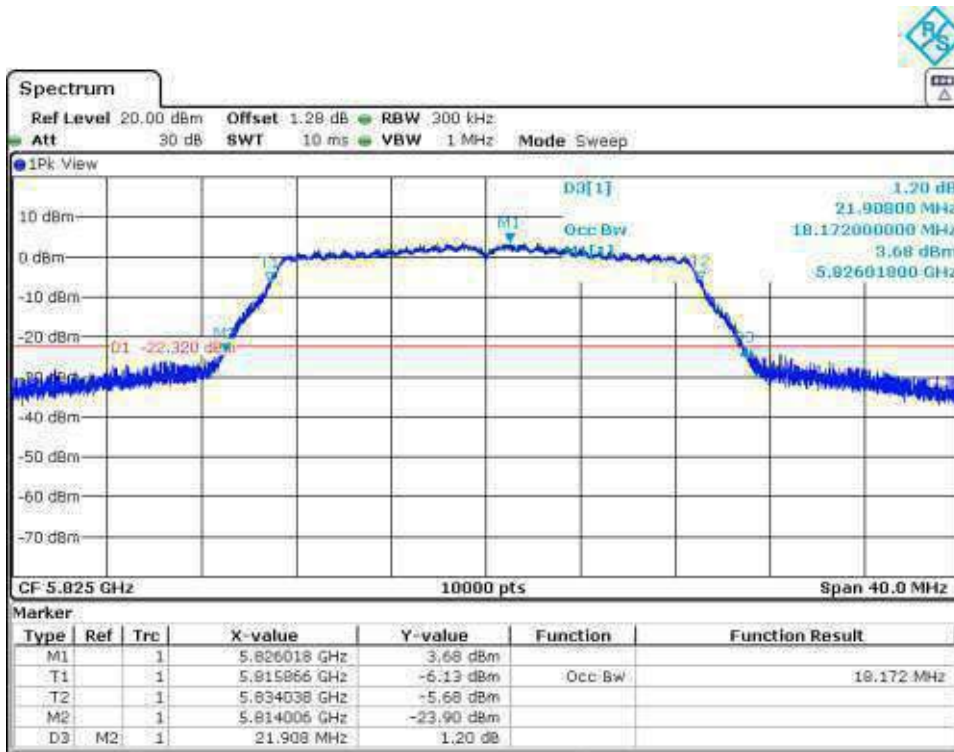
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



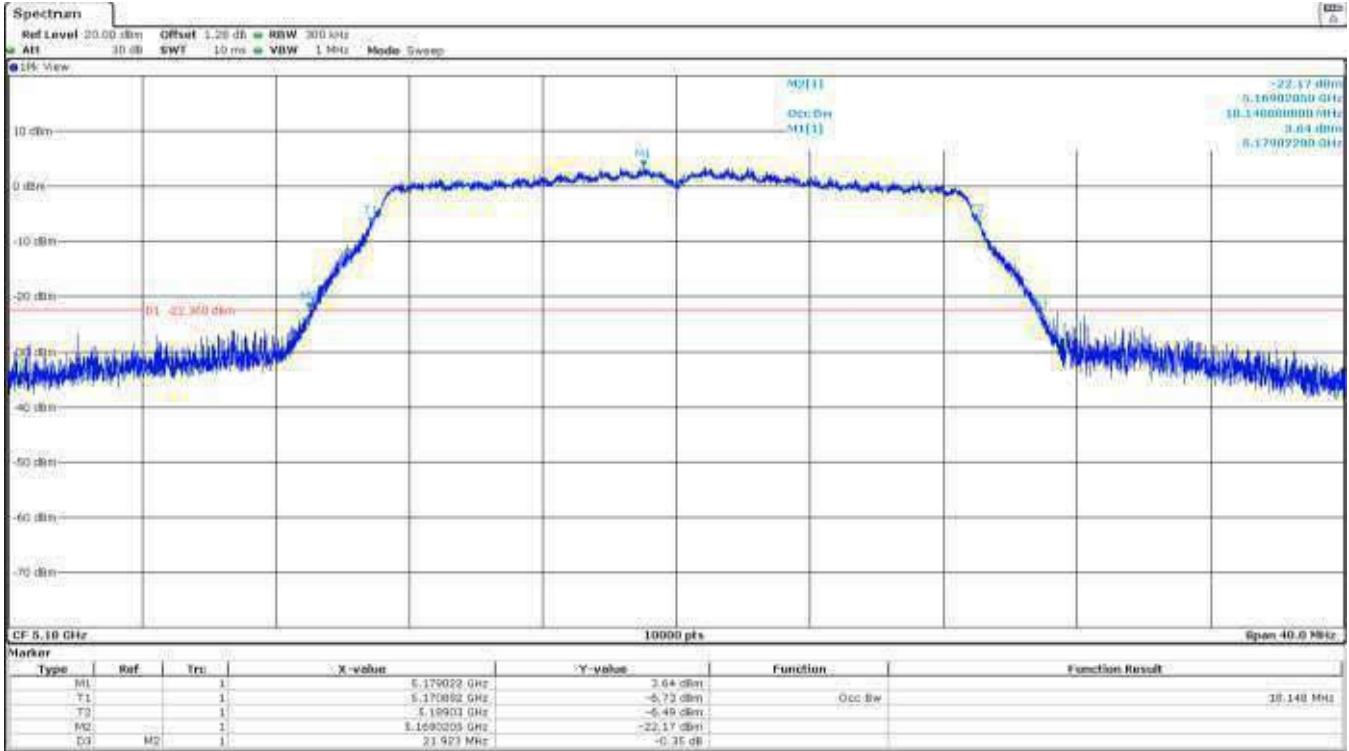
- High Channel 165 (5825 MHz):



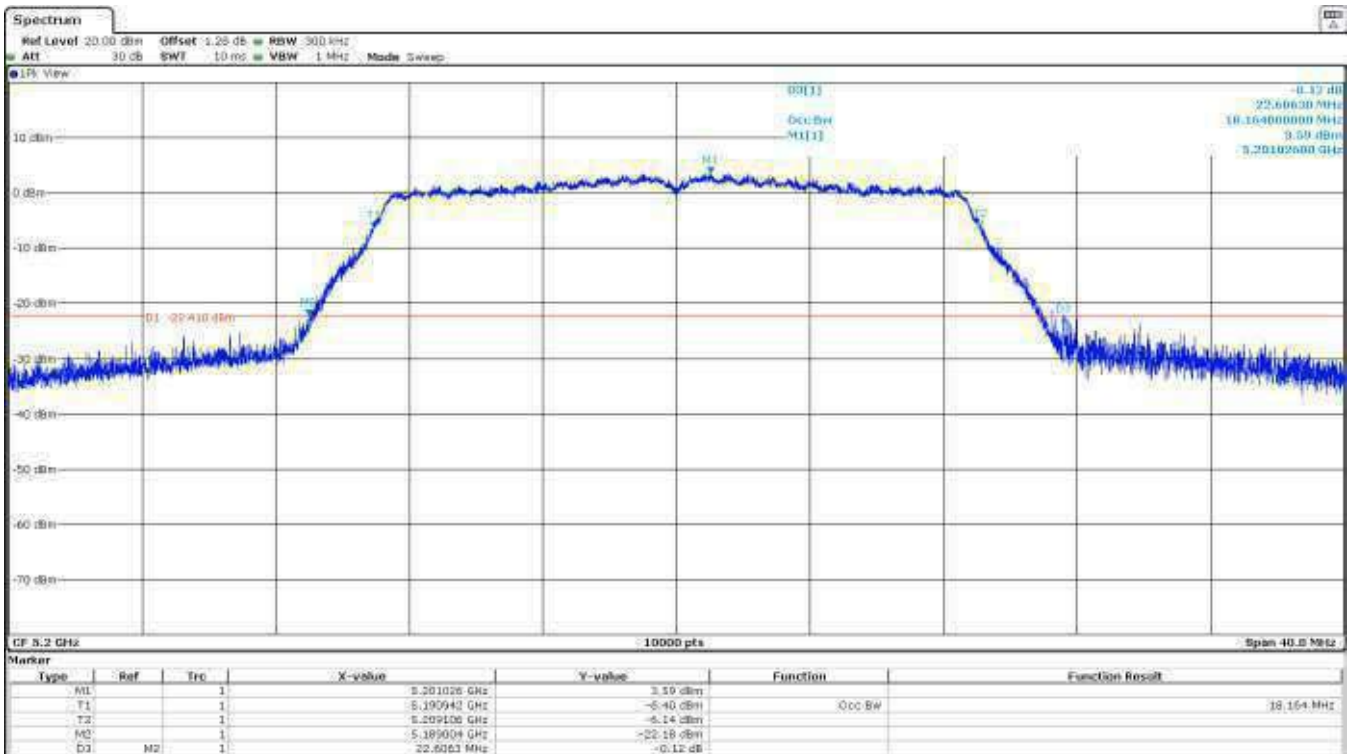
**Mode 802.11 ac20 (VHT20):**

**U-NII-1 (5150-5250 MHz)**

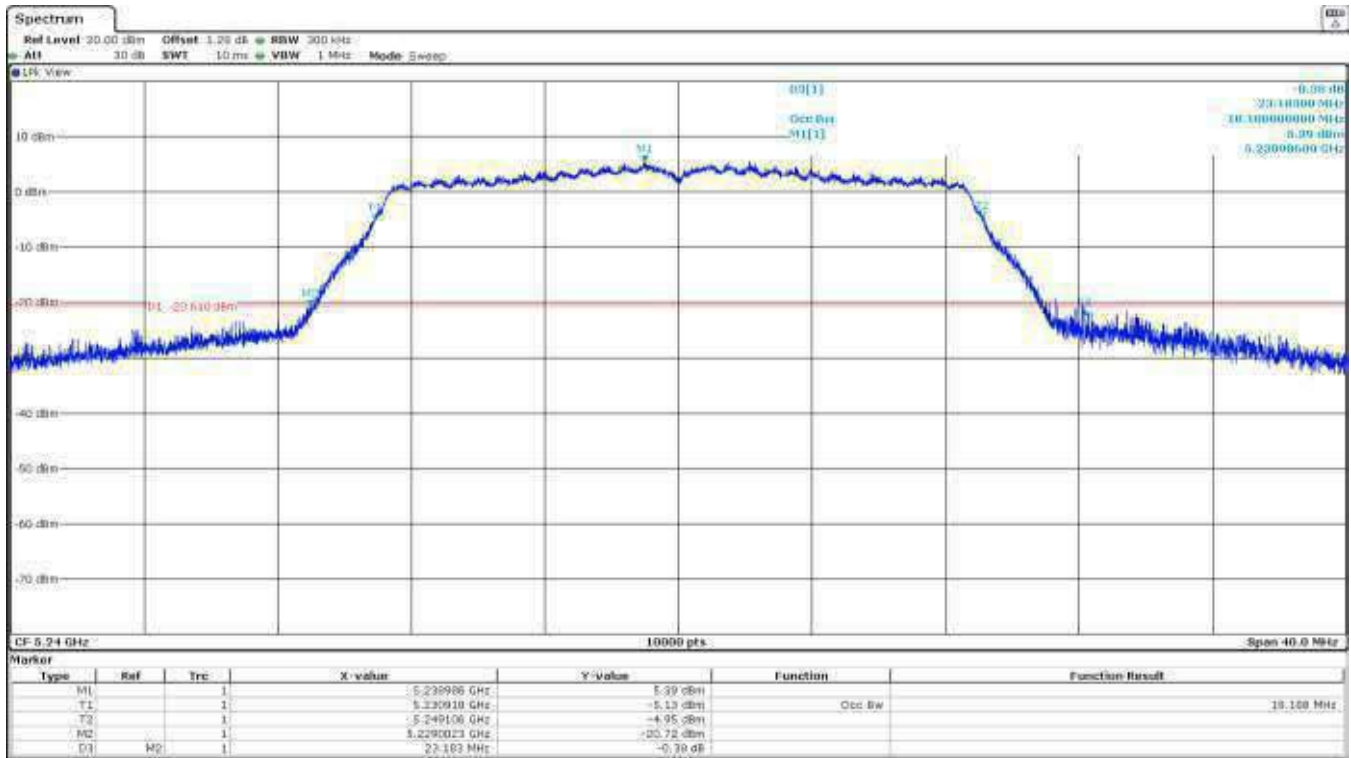
- Low Channel 36 (5180 MHz):



- Middle Channel 40 (5200 MHz):

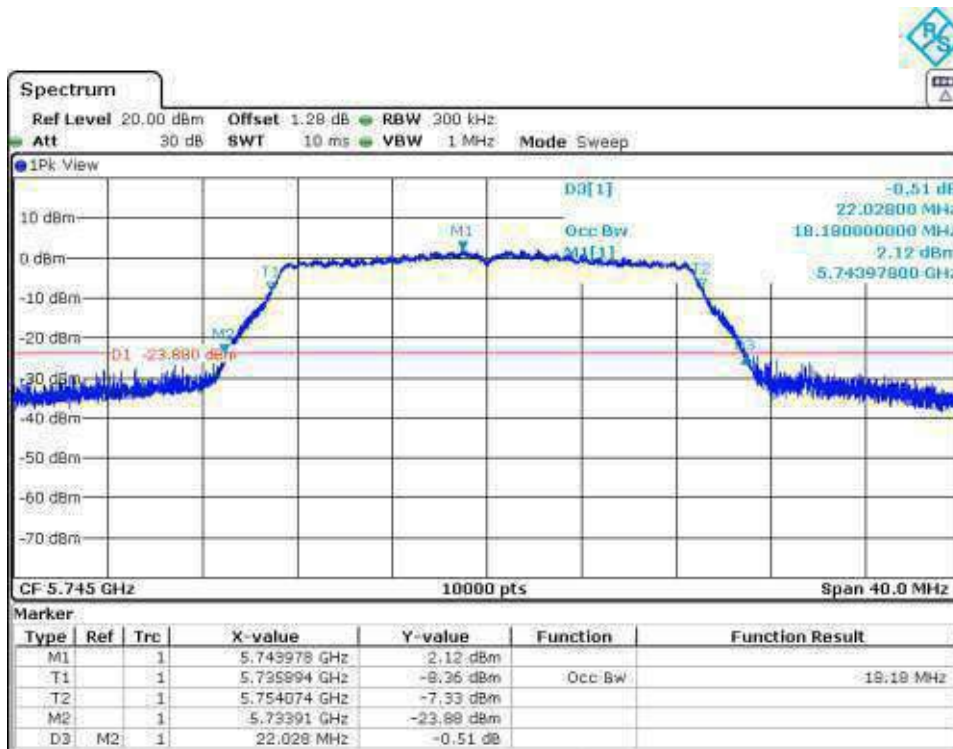


- High Channel 48 (5240 MHz):



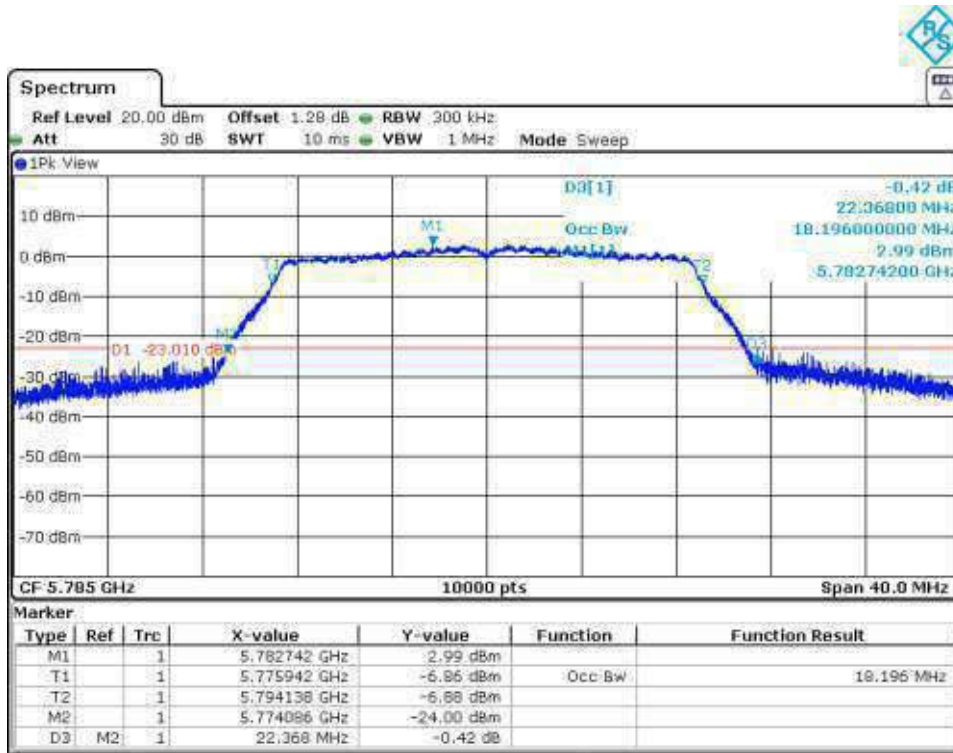
**U-NII-3 (5725-5850 MHz)**

- Low Channel 149 (5745 MHz):

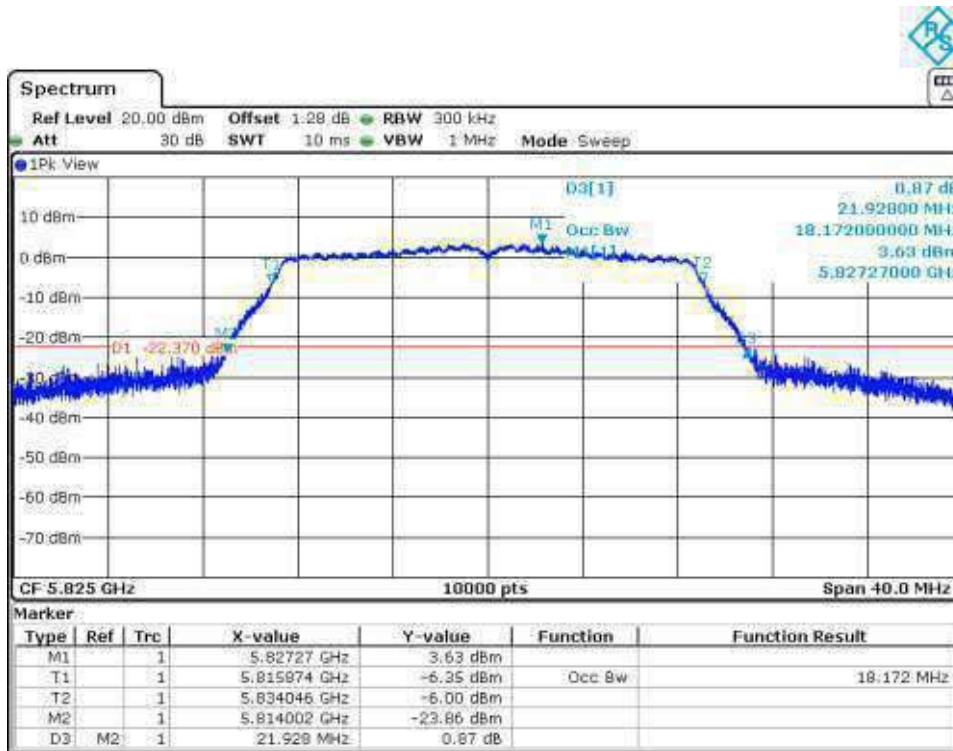




- Middle Channel 157 (5785 MHz):



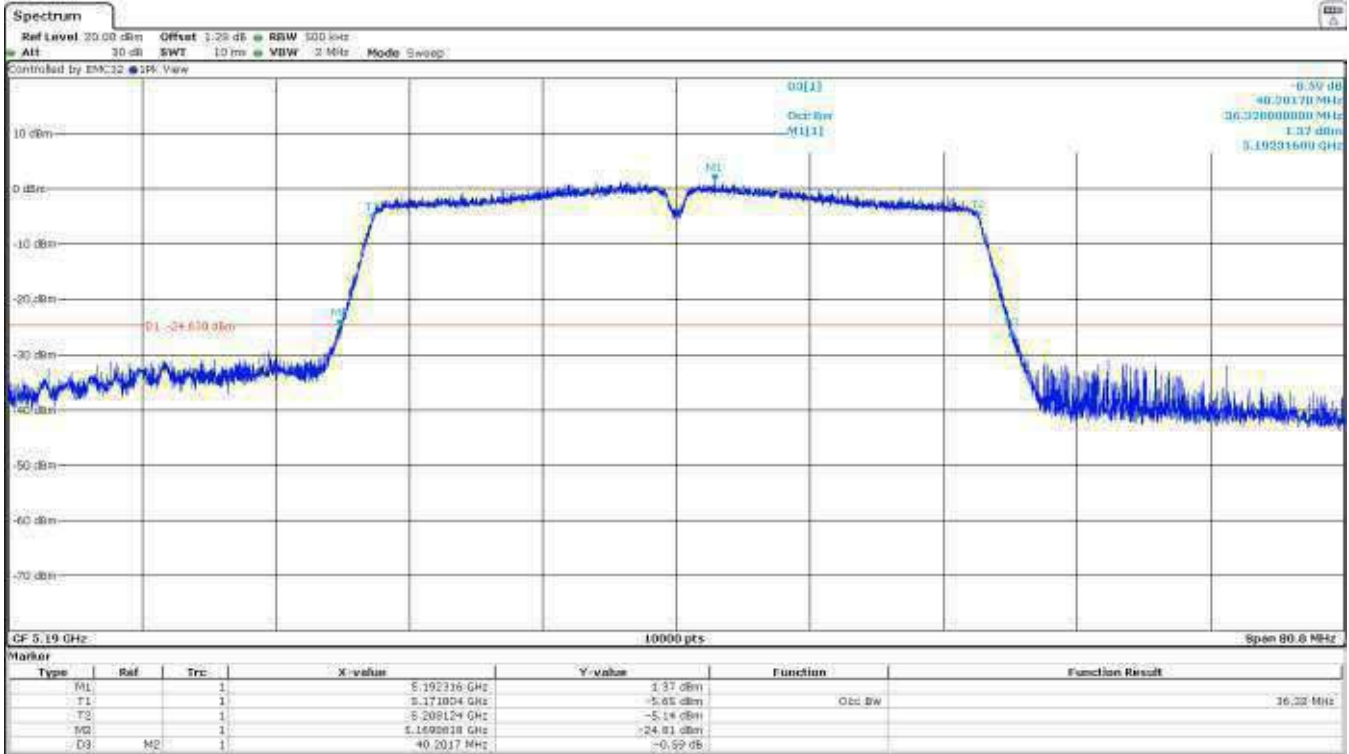
- High Channel 165 (5825 MHz):



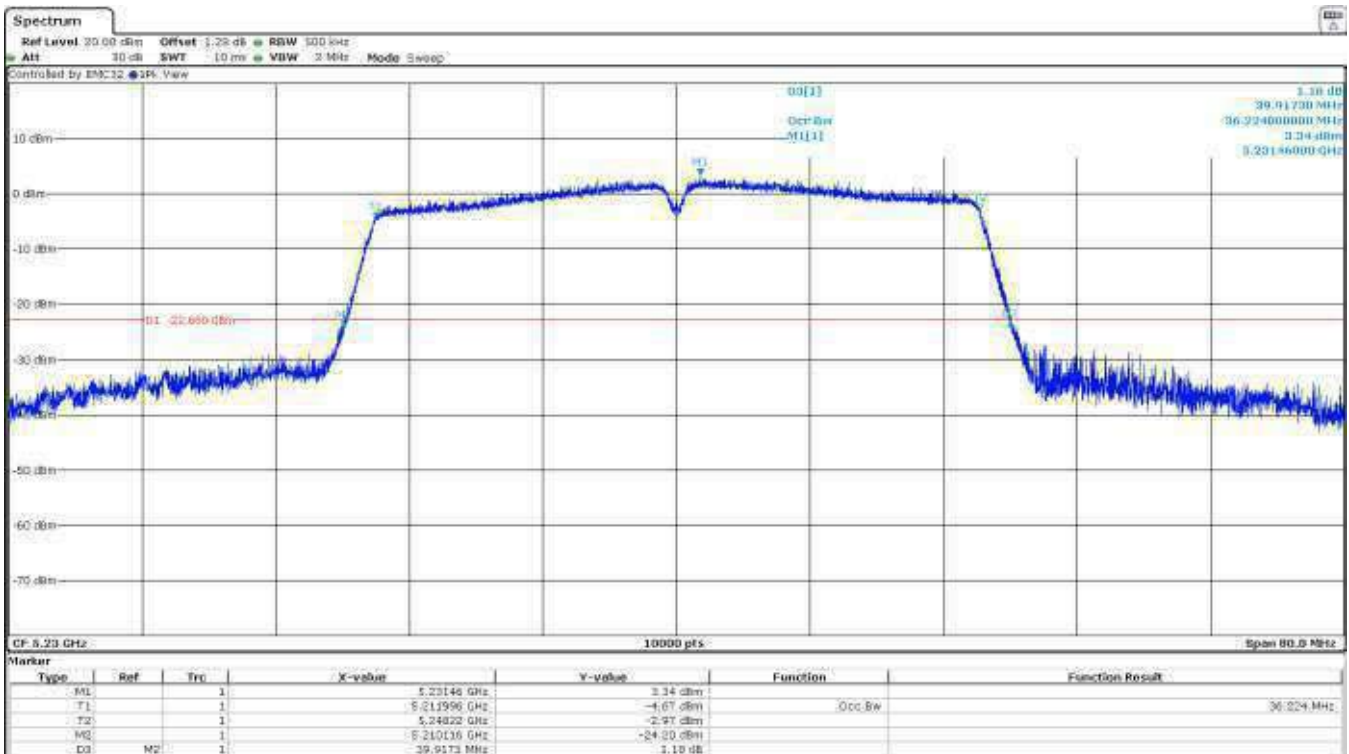
**Mode 802.11 n40 (HT40):**

**U-NII-1 (5150-5250 MHz)**

- Low Channel 38 (5190 MHz):

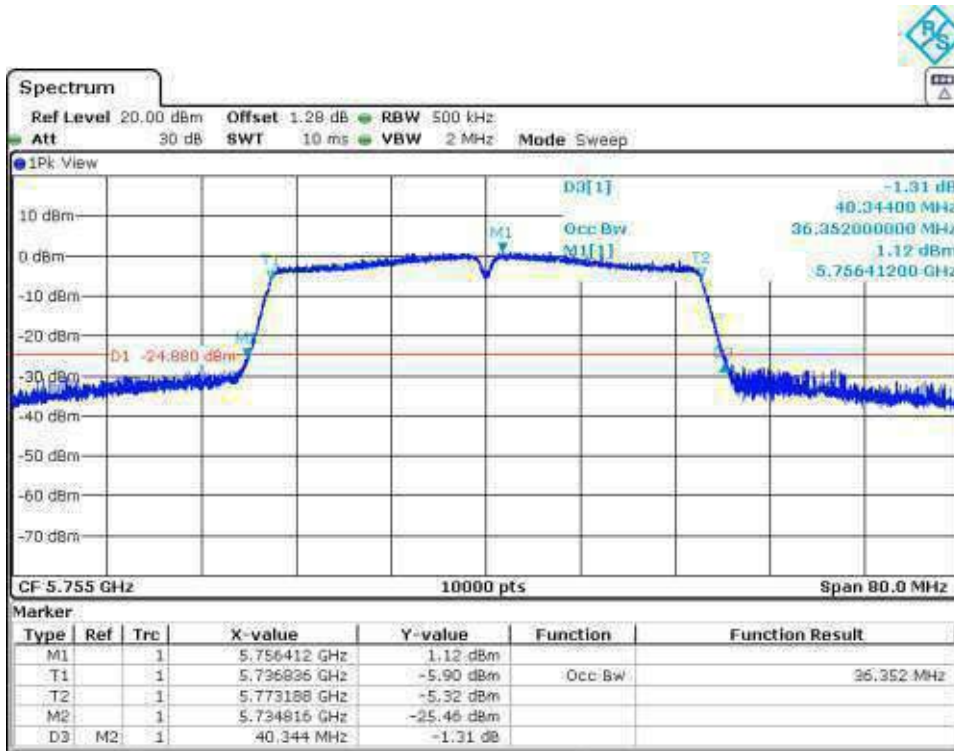


- High Channel 46 (5230 MHz):

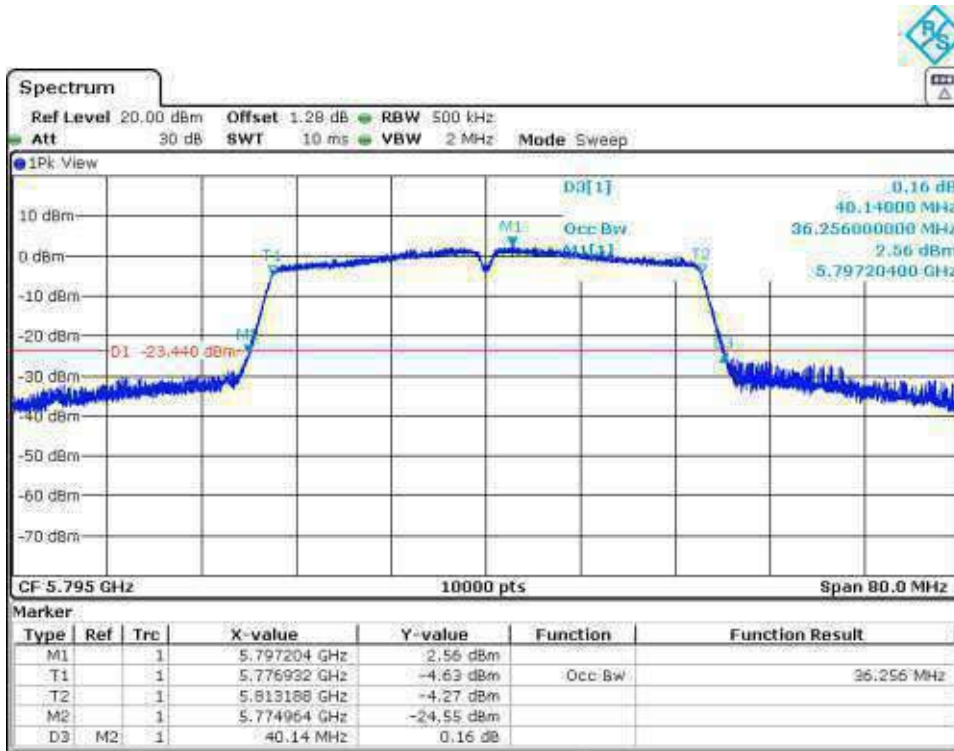


**U-NII-3 (5725-5850 MHz)**

- Low Channel 151 (5755 MHz):



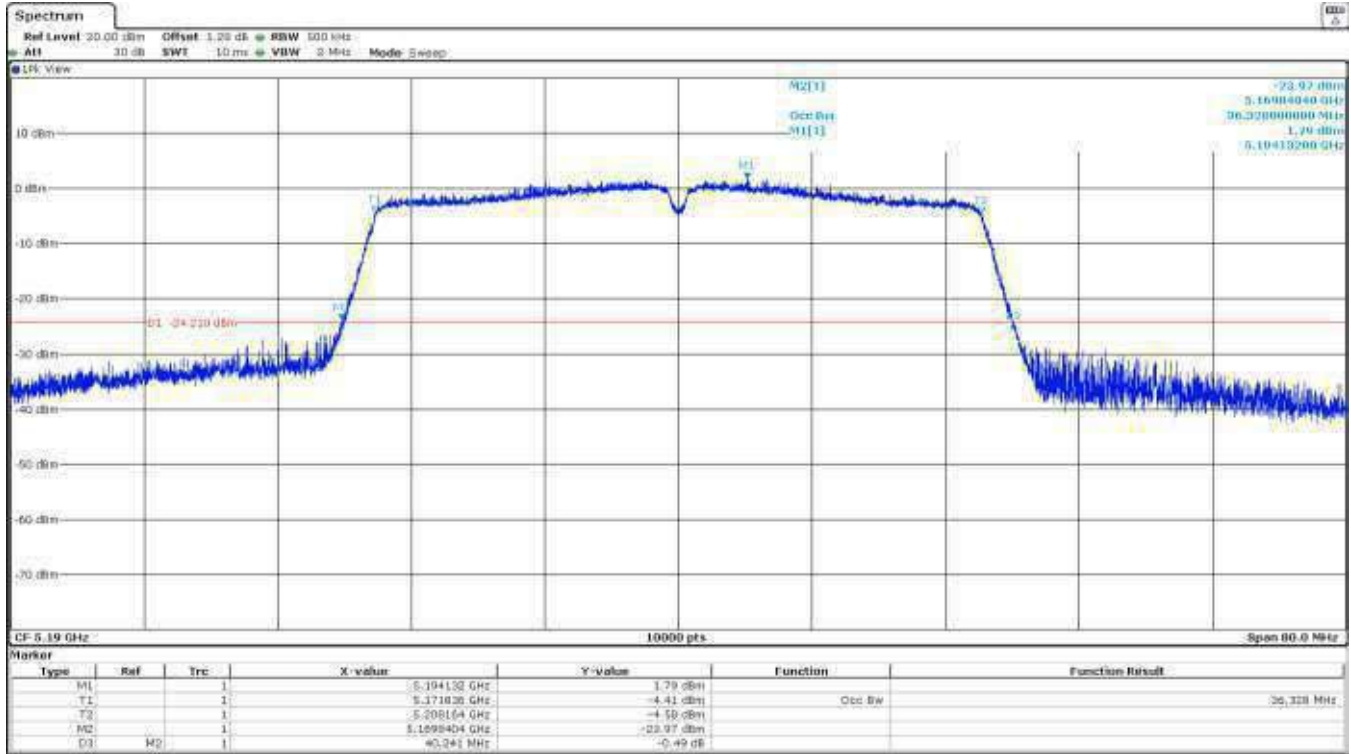
- High Channel 159 (5795 MHz):



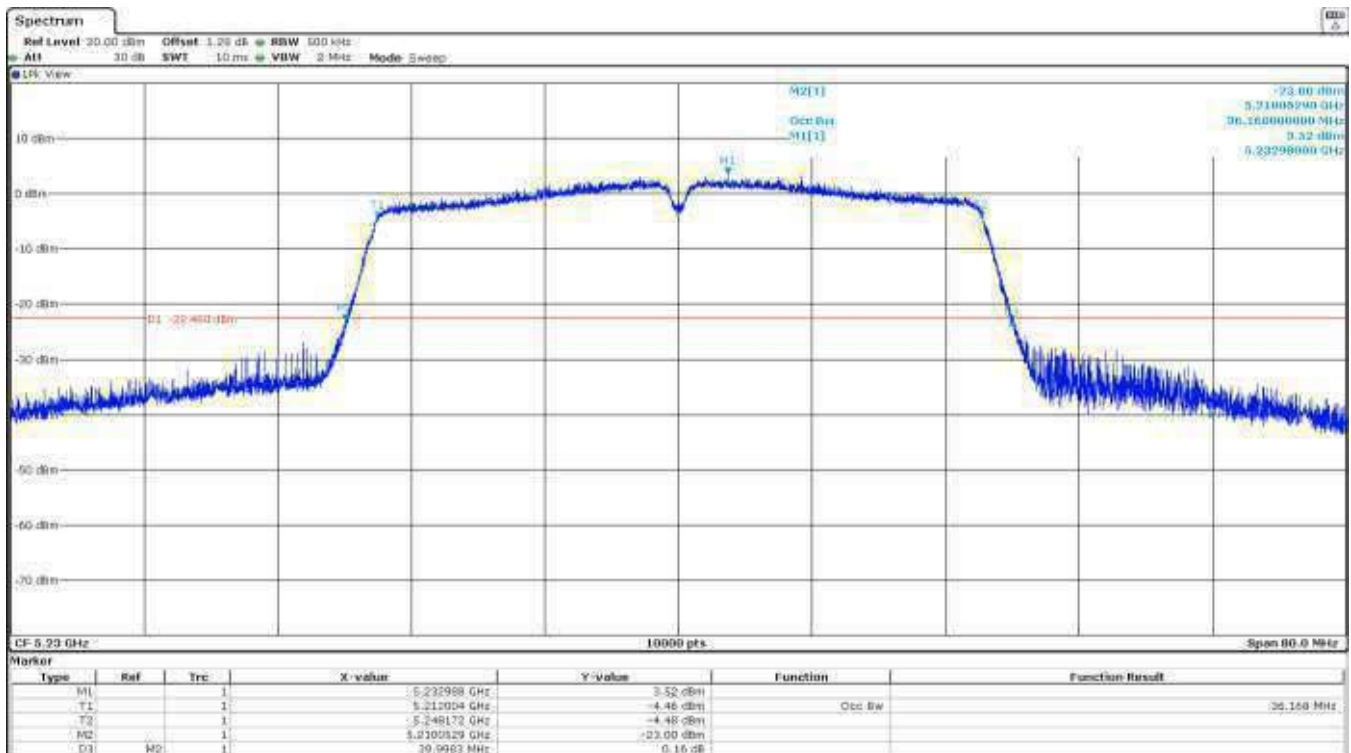
**Mode 802.11 ac40 (VHT40):**

**U-NII-1 (5150-5250 MHz)**

- Low Channel 38 (5190 MHz):

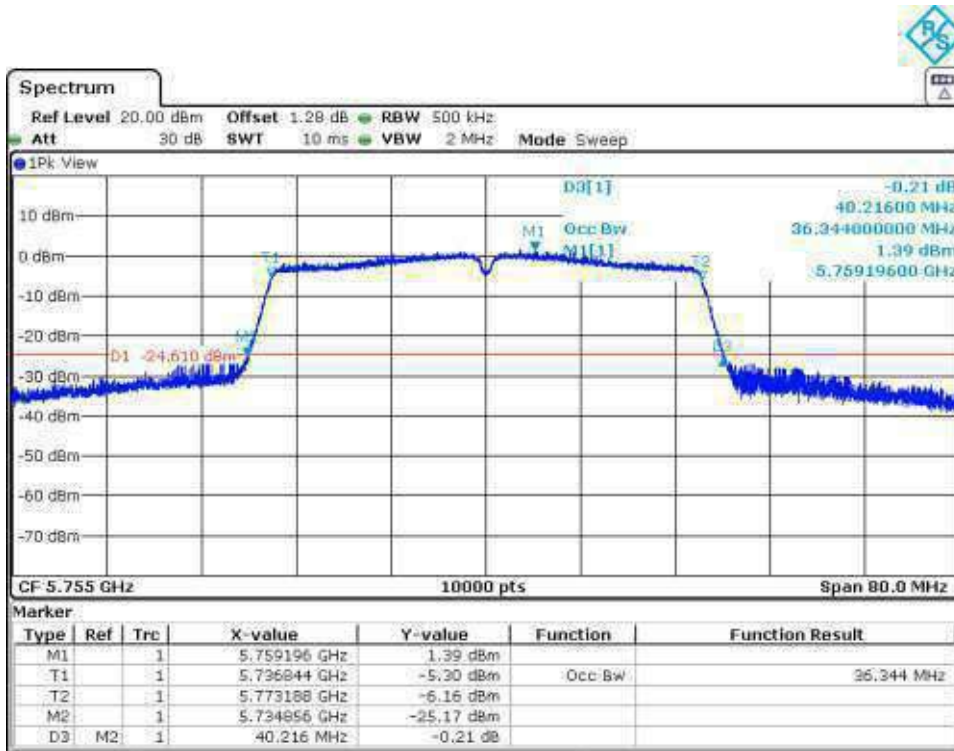


- High Channel 46 (5230 MHz):

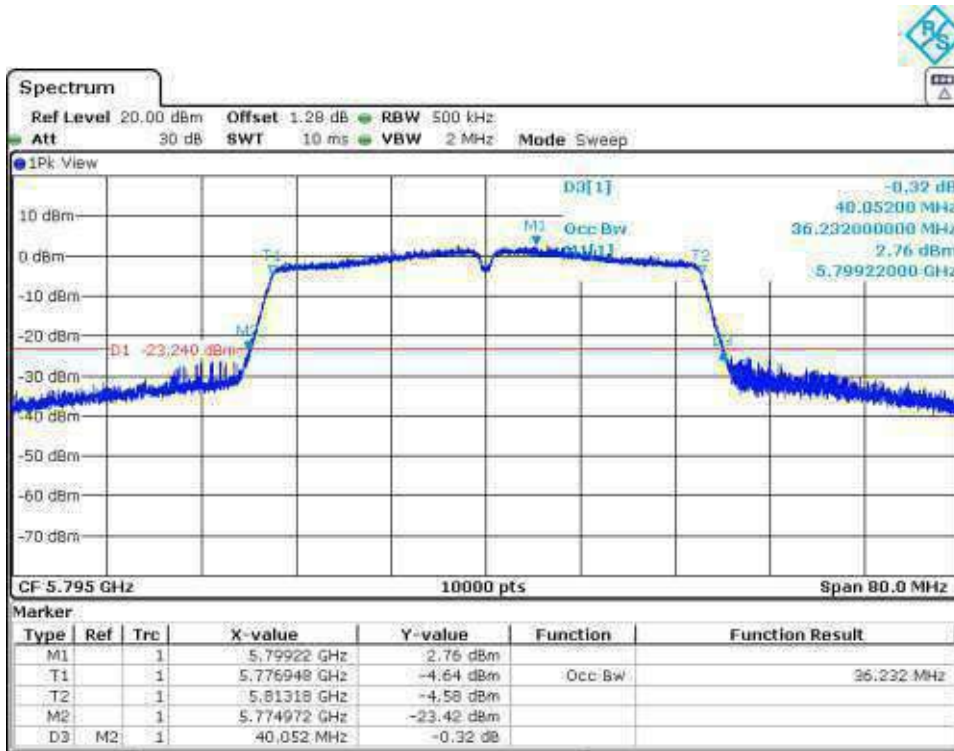


**U-NII-3 (5725-5850 MHz)**

- Low Channel 151 (5755 MHz):



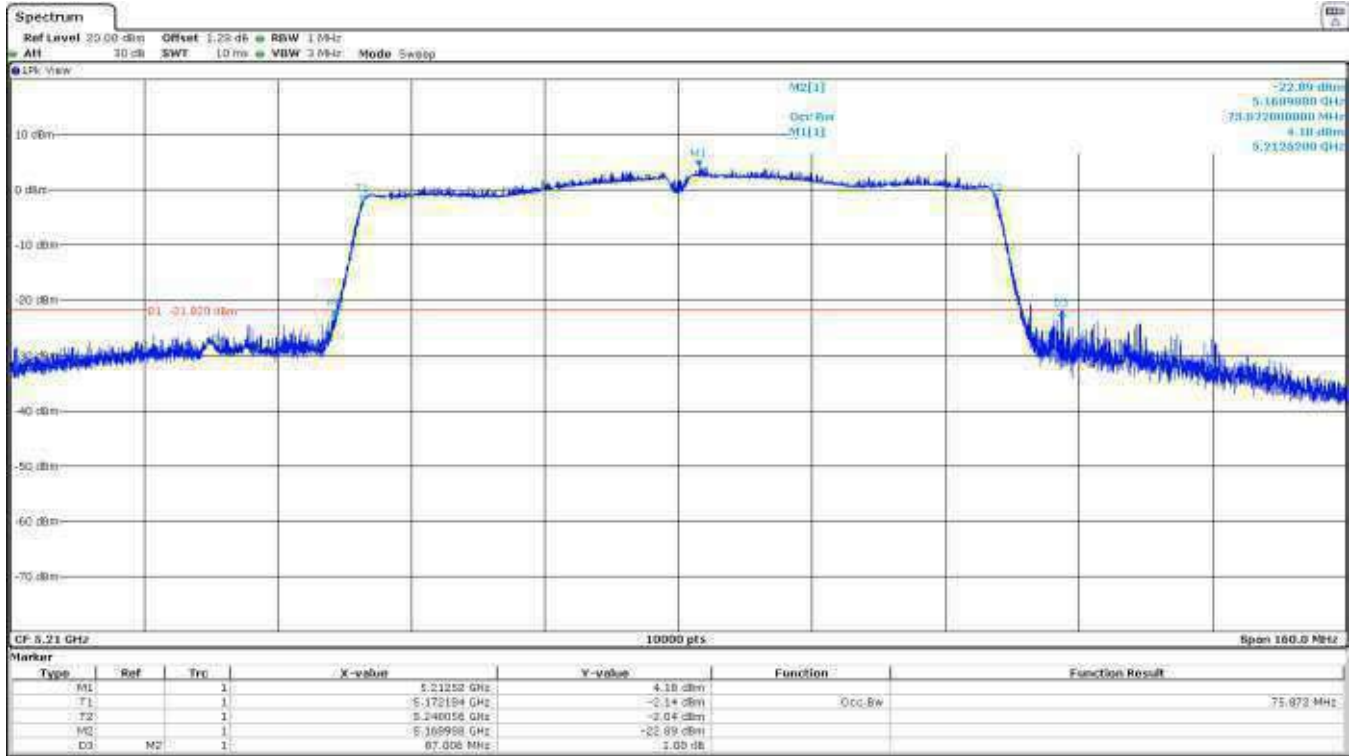
- High Channel 159 (5795 MHz):



**Mode 802.11 ac80 (VHT80):**

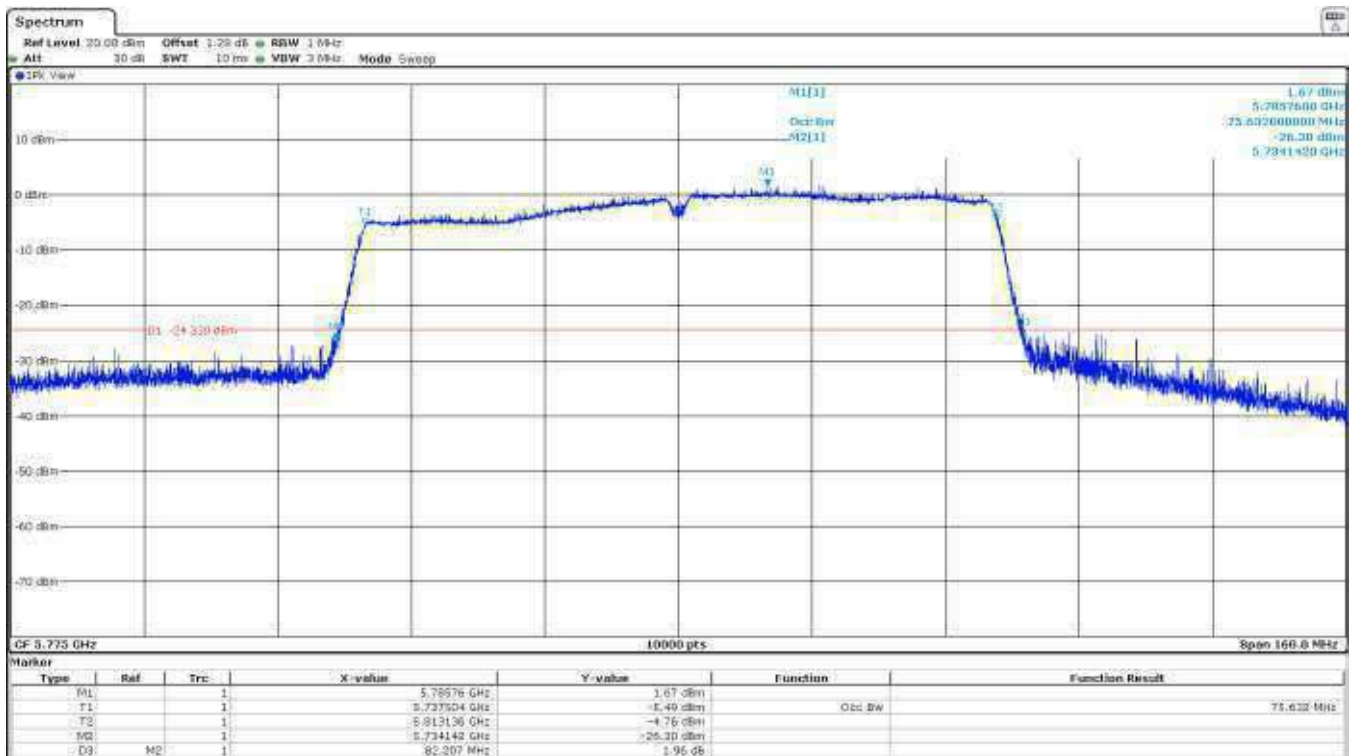
**U-NII-1 (5150-5250 MHz)**

- Single Channel 42 (5210 MHz):



**U-NII-3 (5725-5850 MHz)**

- Single Channel 155 (5775 MHz):



## **Appendix B: Tests results for the U-NII-1 Band 5.15 – 5.25 GHz**

## INDEX

TEST CONDITIONS .....	41
FCC 15.407 (a)(1)(iv). Transmitter Maximum Conducted Output Power / RSS-247 6.2.1.1. Transmitter Maximum Equivalent Isotropically Radiated Power .....	46
FCC 15.407 (a)(1)(iv). Transmitter Maximum Power Spectral Density / RSS-247 6.2.1.1. Transmitter EIRP Spectral Density .....	58
FCC 15.407 (b)(1)(6) / RSS-247 6.2.1.2. Transmitter Out of Band Radiated Emissions.....	60
FCC 15.407 (b)(1) / RSS-247 6.2.1.2. Transmitter Band Edge Radiated Emissions .....	70



## TEST CONDITIONS

### POWER SUPPLY (V):

V nominal: 12 Vdc.  
 Type of Power Supply: DC External (Car Battery).

### ANTENNA:

Type of Antenna: External antenna.  
 Maximum Declared Antenna Gain: -5.4 dBi (antenna gain plus antenna cable loss).

### TEST FREQUENCIES:

Technology Tested:	WLAN (IEEE 802.11 a,n,ac) / U-NII-1	
Modes:	802.11a20: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps	
	802.11n HT20: MCS0 to MCS7	
	802.11n HT40: MCS0 to MCS7	
	802.11ac VHT20: MCS0 to MCS9	
	802.11ac VHT40: MCS0 to MCS9	
	802.11ac VHT80: MCS0 to MCS9	
Setting of cores / ports:	One port.	
Beamforming:	No.	
Frequency Range:	5150 MHz to 5250 MHz	
Channel Spacing:	20 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Low: 36	5180
	Middle: 40	5200
	High: 48	5240
Channel Spacing:	40 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Low: 38	5190
	High: 46	5230
Channel Spacing:	80 MHz	
Transmit Channels	Middle: 42	5210

The test set-up was made in accordance to the general provisions of FCC Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec 14, 2017.

The EUT was tested in the following operating mode:

- Continuously transmitting with a modulated carrier at maximum power in all required channels using the supported data rates/modulations types.

The field strength at the band edges was evaluated for each mode on the lowest and highest channels at the rated power for the channel under test.

For all modes, the EUT was configured in test mode using a software application. The application was used to enable a continuous transmission and to select the test channels as required. The client supplied instructions to configure the EUT. The customer supplied a document containing the setup instructions.

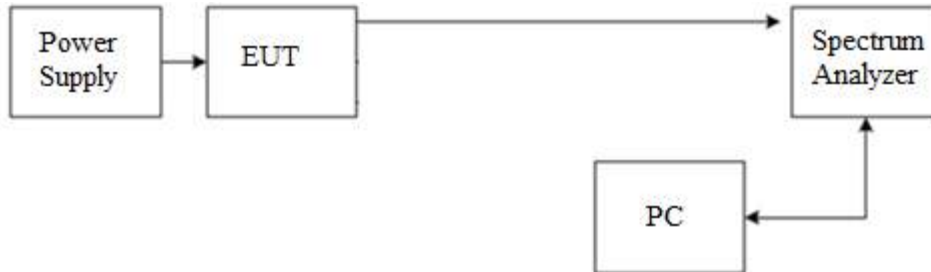
The worst cases for testing were identified for output power and spurious levels at the band edges which were selected based on preliminary testing that correspond to next data rates:

- 802.11 a20: 6 Mbps
- 802.11 n HT20: MCS0
- 802.11 n HT40: MCS0
- 802.11 ac VHT20: MCS0
- 802.11 ac VHT40: MCS0
- 802.11 ac VHT80: MCS0

## CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and connected to the spectrum analyzer using a low loss RF cable. The reading in the spectrum analyzer is corrected taking into account the internal and external RF cable loss.

For all modes:



The DC supply voltage is applied using an external power supply.

## RADIATED MEASUREMENTS:

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz and 1 GHz-17 GHz Double ridge horn antenna) is situated at a distance of 3 m for the frequency range 30 MHz-17 GHz and at a distance of 1m for the frequency range 17 GHz-40 GHz (17 GHz-40 GHz horn antenna).

For radiated emissions in the range 17 GHz-40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

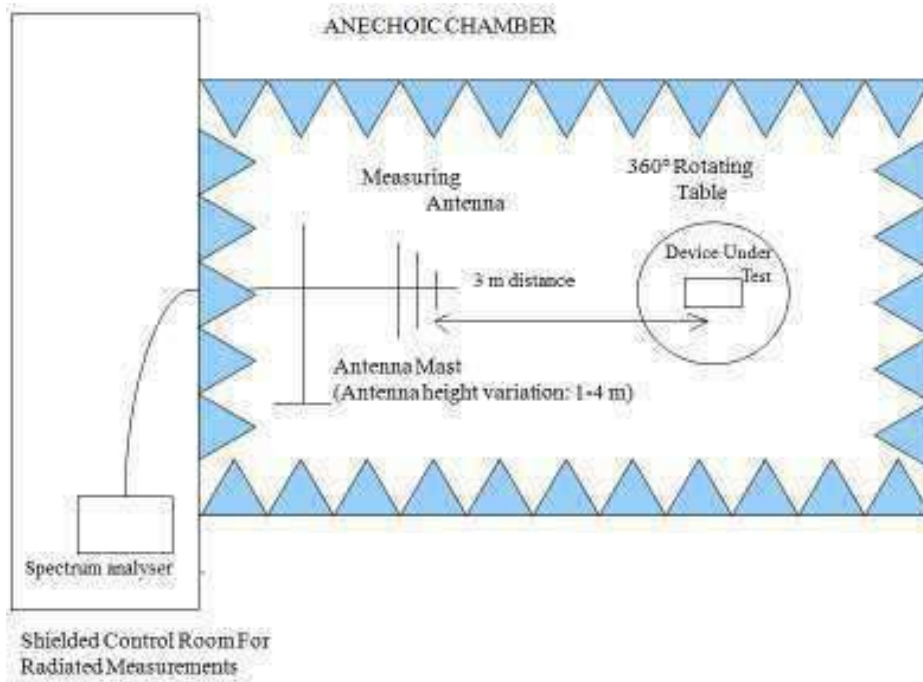
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

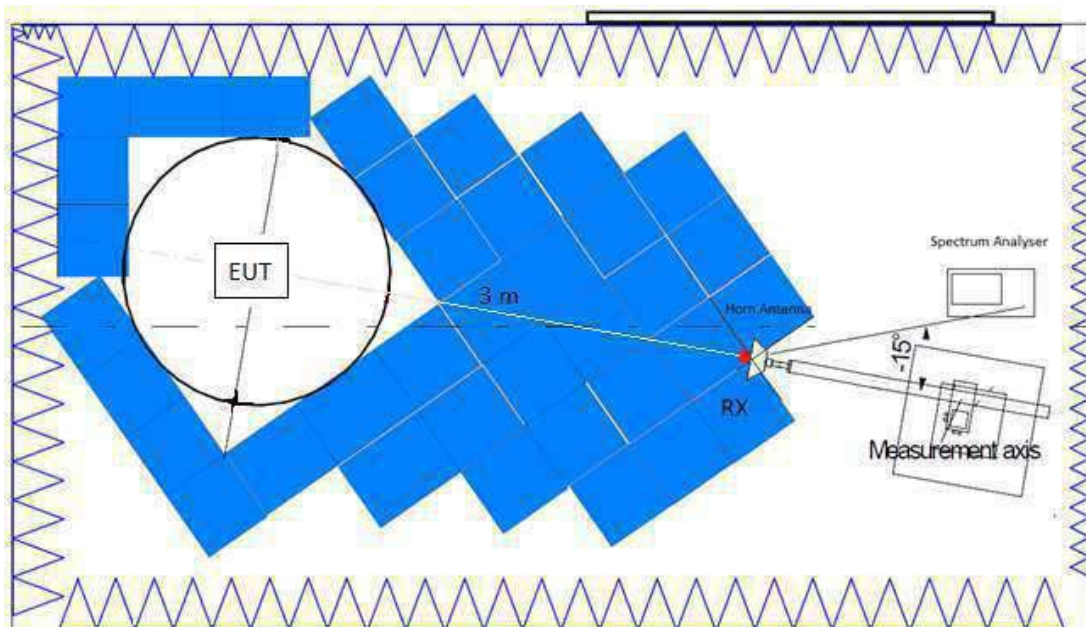
The final measured value, for the given emission, in the tables below incorporates the calibrated antenna factor and cable loss.

A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

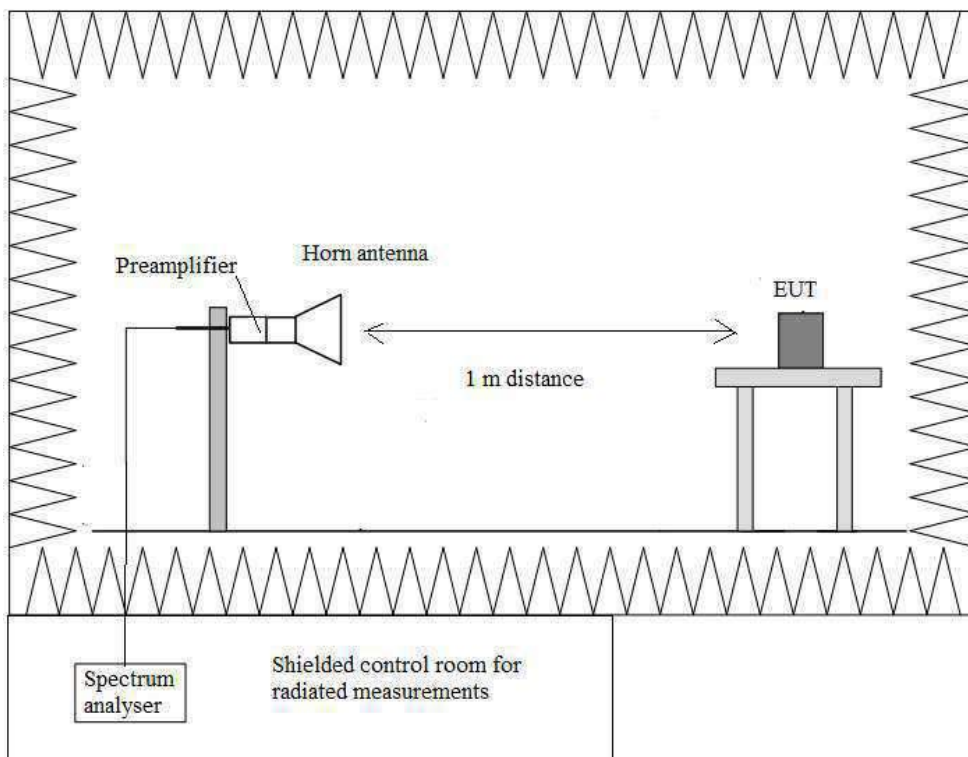
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup  $f > 17$  GHz:



## FCC 15.407 (a)(1)(iv). Transmitter Maximum Conducted Output Power / RSS-247

### 6.2.1.1. Transmitter Maximum Equivalent Isotropically Radiated Power

#### SPECIFICATION:

FCC 15.407: For client devices in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW (24 dBm) provided the maximum antenna gain does not exceed 6 dBi. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS-247: For OEM devices installed in vehicles, the maximum e.i.r.p. shall not exceed 30 mW or  $1.76 + 10 \log_{10} B$ , dBm, whichever is less. Devices shall implement transmitter power control (TPC) in order to have the capability to operate at least 3 dB below the maximum permitted e.i.r.p. of 30 mW.

#### RESULTS:

The maximum conducted output power was measured using the channel power integration method according to point E) 2) b) (Method SA-1) of 789033 D02 General UNII Test Procedures New Rules v02r01 when the duty cycle is >98% and the channel power integration method according to point E) 2) d) (Method SA-2) of 789033 D02 General UNII Test Procedures New Rules v02r01 when the duty cycle is <98%.

For data rates where the EUT was transmitting at <98% duty cycle, the duty calculated in Appendix A was added to the measured power in order to calculate the total average power during the actual transmission time.

The e.i.r.p. levels are calculated by adding the declared maximum antenna gain (dBi).

For all modes of operation, the antenna gain is less than 6 dBi.

Maximum Declared Antenna Gain: -5.4 dBi (antenna gain plus antenna cable loss).

**Mode 802.11 a20:**

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Max. Conducted Power (dBm)	9.85	10.19	11.54
Duty Cycle Correction Factor (dB)	0.948		
Max. Conducted Power Corrected (dBm)	10.798	11.138	12.488
Max. EIRP Power Corrected (dBm)	5.398	5.738	7.088
Measurement uncertainty (dB)	<±2.57		

**Mode 802.11 n20 (HT20):**

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Max. Conducted Power (dBm)	9.80	9.85	11.74
Duty Cycle Correction Factor (dB)	1.020		
Max. Conducted Power Corrected (dBm)	10.820	10.870	12.760
Max. EIRP Power Corrected (dBm)	5.420	5.470	7.360
Measurement uncertainty (dB)	<±2.57		

**Mode 802.11 ac20 (VHT20):**

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Max. Conducted Power (dBm)	9.77	10.05	11.49
Duty Cycle Correction Factor (dB)	1.004		
Max. Conducted Power Corrected (dBm)	10.774	11.054	12.494
Max. EIRP power Corrected (dBm)	5.374	5.654	7.094
Measurement uncertainty (dB)	<±2.57		

**Mode 802.11 n40 (HT40):**

	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
Max. Conducted Power (dBm)	7.21	8.80
Duty Cycle Correction Factor (dB)	1.876	
Max. Conducted Power Corrected (dBm)	9.086	10.676
Max. EIRP power Corrected (dBm)	3.686	5.276
Measurement uncertainty (dB)	<±2.57	

**Mode 802.11 ac40 (VHT40):**

	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
Max. Conducted Power (dBm)	7.31	8.82
Duty Cycle Correction Factor (dB)	1.846	
Max. Conducted Power Corrected (dBm)	9.156	10.666
Max. EIRP Power Corrected (dBm)	3.756	5.266
Measurement uncertainty (dB)	<±2.57	

**Mode 802.11 ac80 (VHT80):**

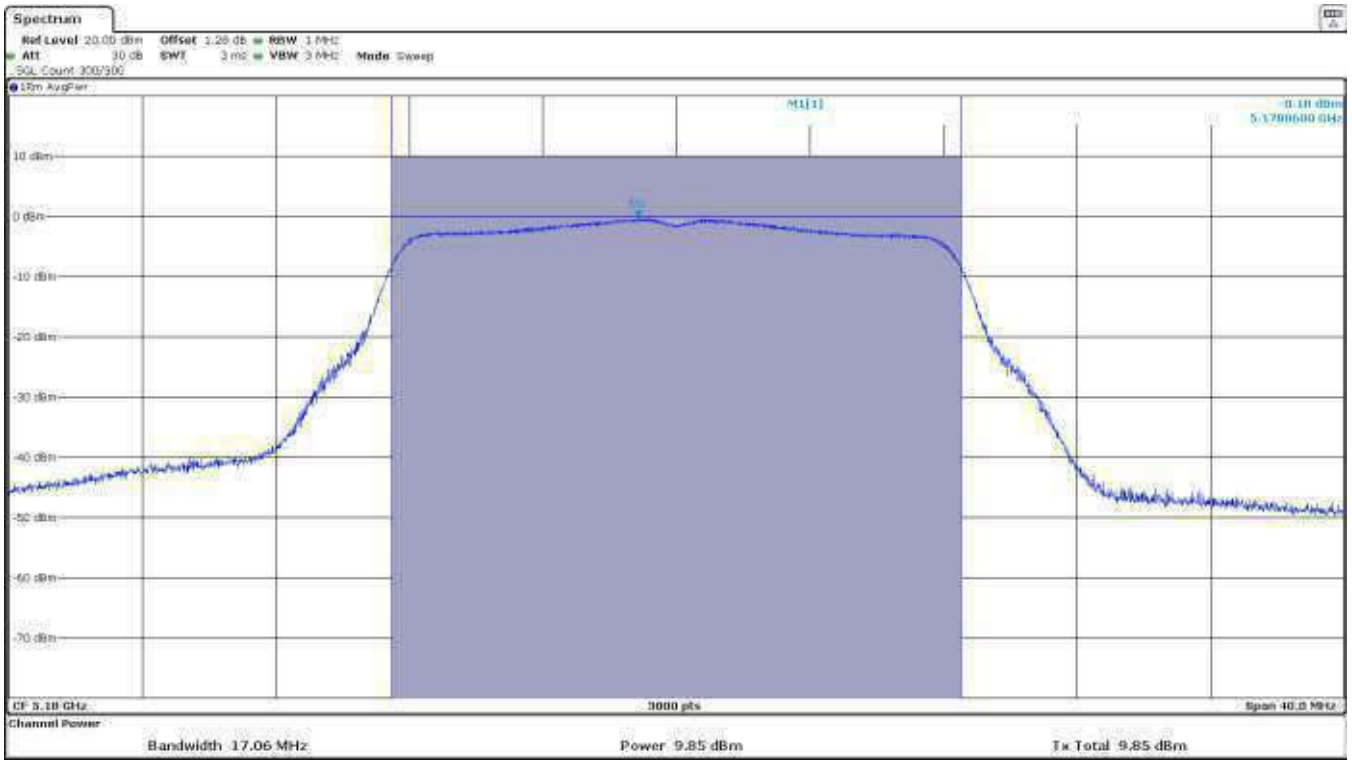
	Single Channel 42 (5210 MHz)
Max. Conducted Power (dBm)	7.82
Duty Cycle Correction Factor (dB)	3.208
Max. Conducted Power Corrected (dBm)	11.028
Max. EIRP Power Corrected (dBm)	5.628
Measurement uncertainty (dB)	<±2.57

Verdict: PASS

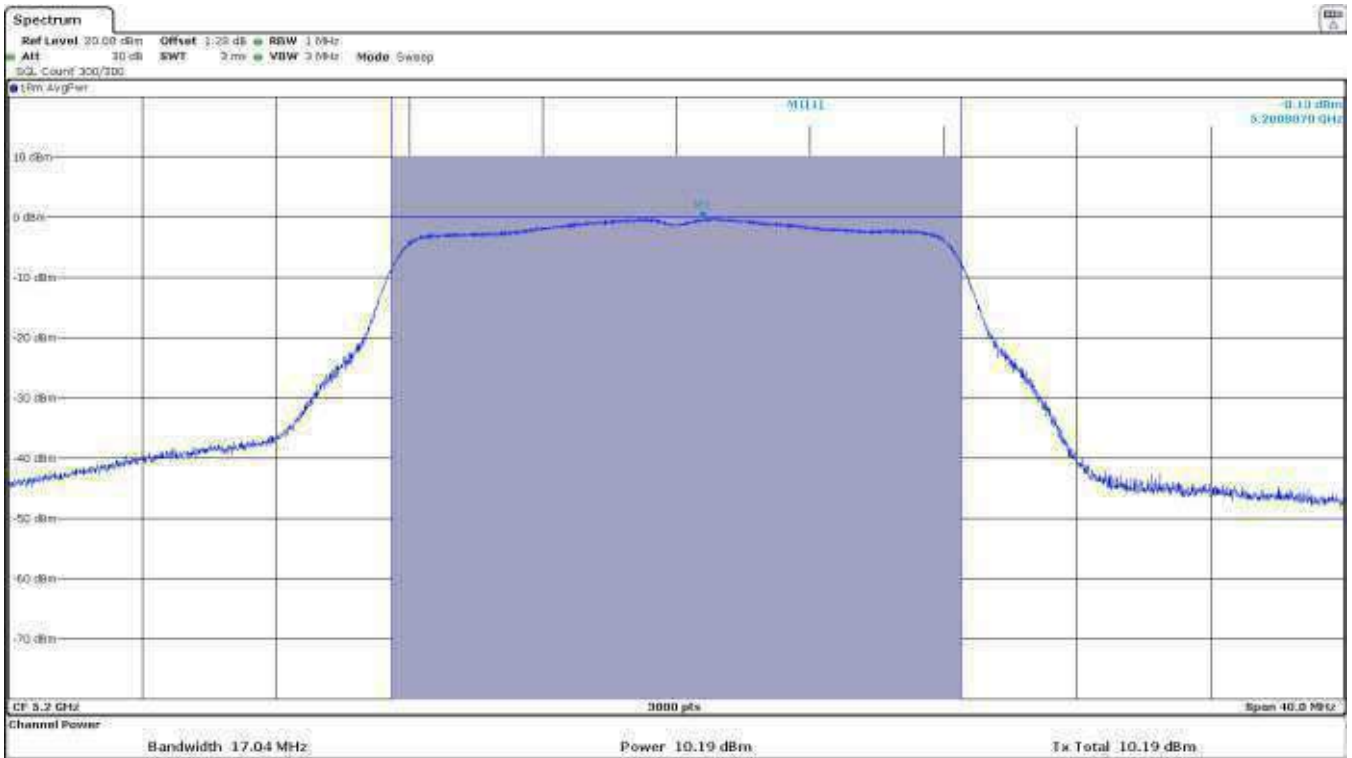


### Mode 802.11 a20:

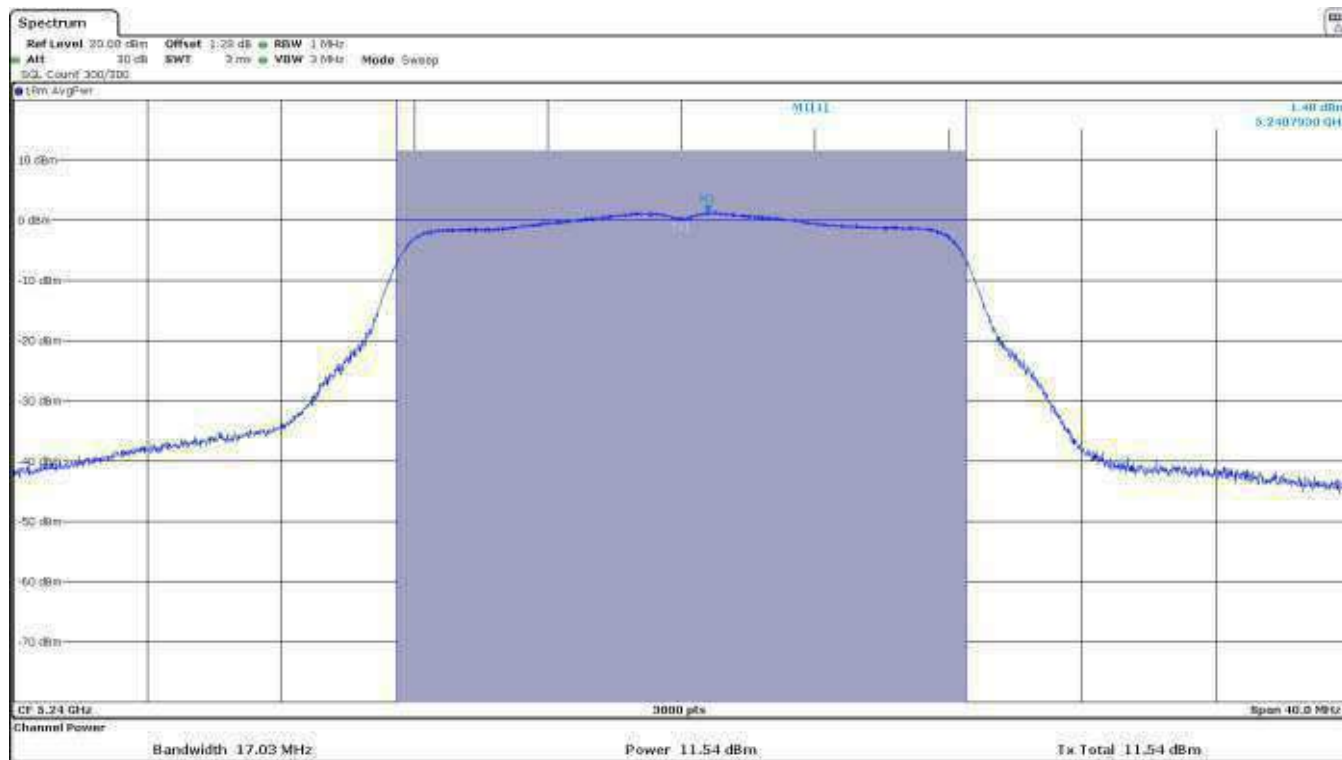
- Low Channel:



- Middle Channel:

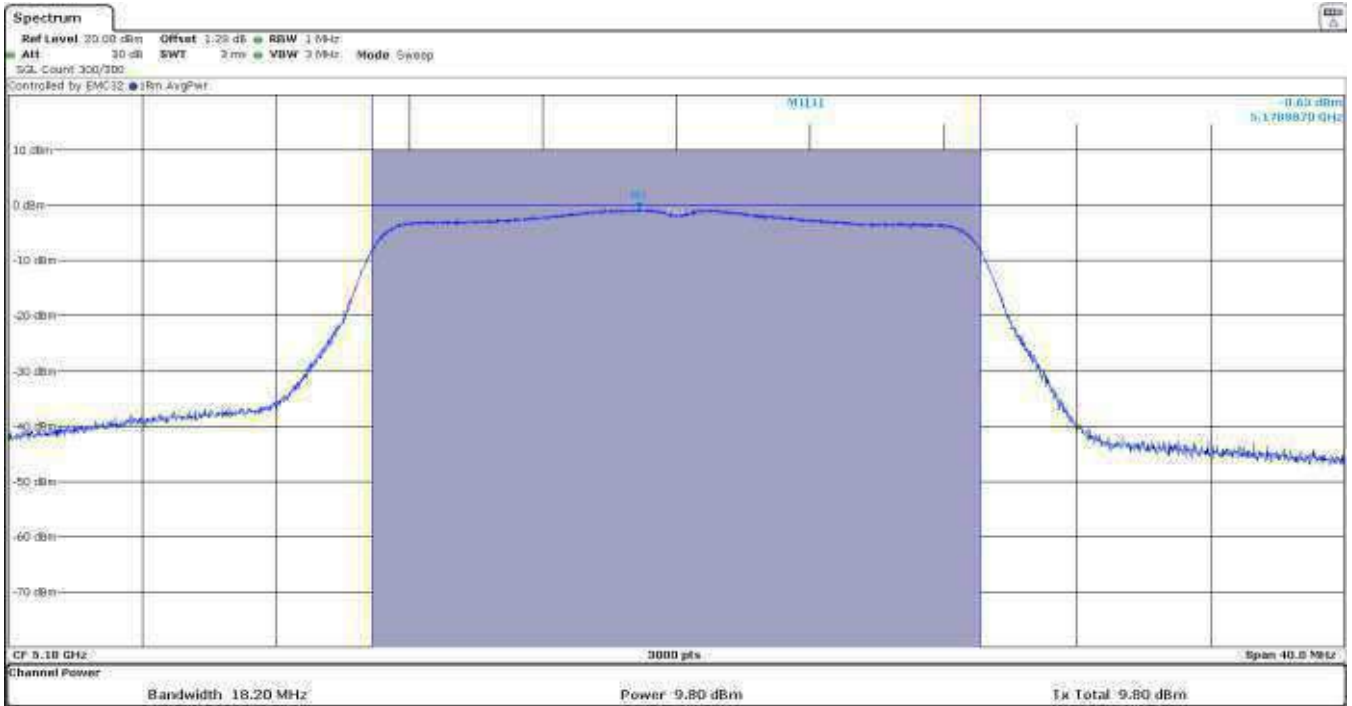


- High Channel:

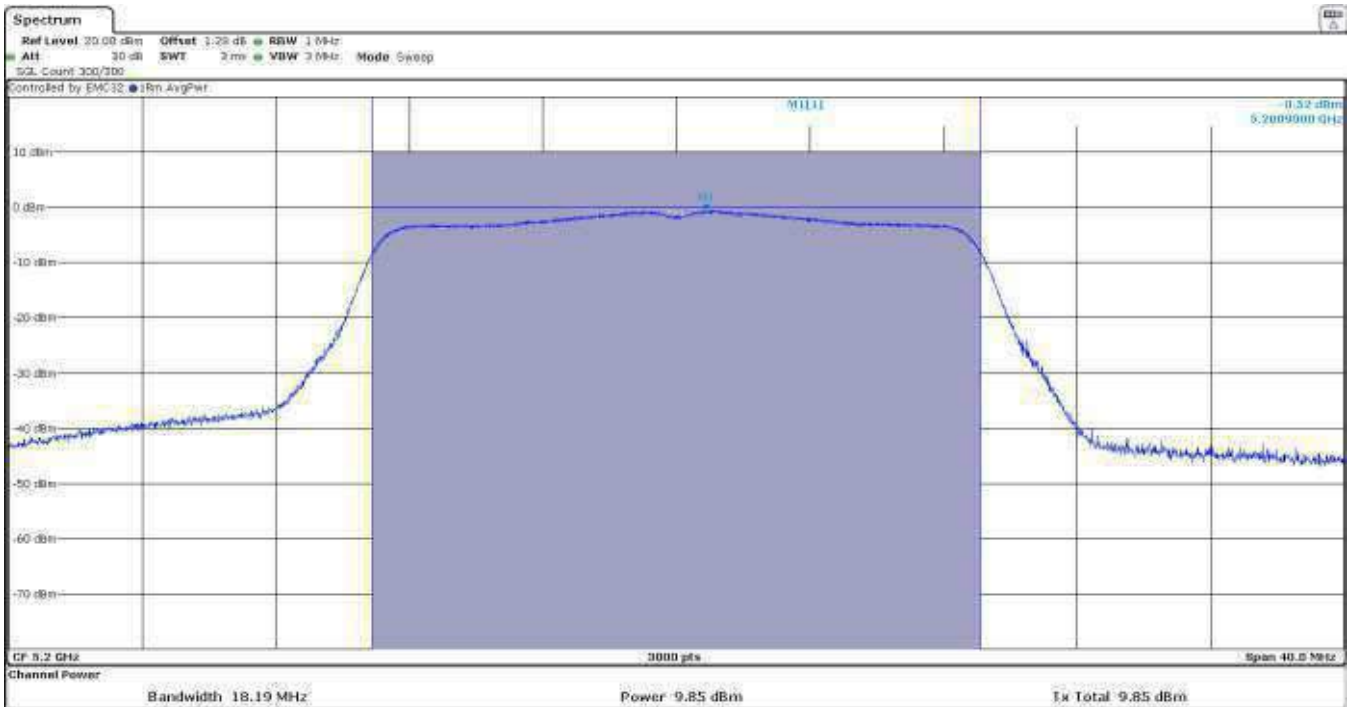


### Mode 802.11 n20 (HT20):

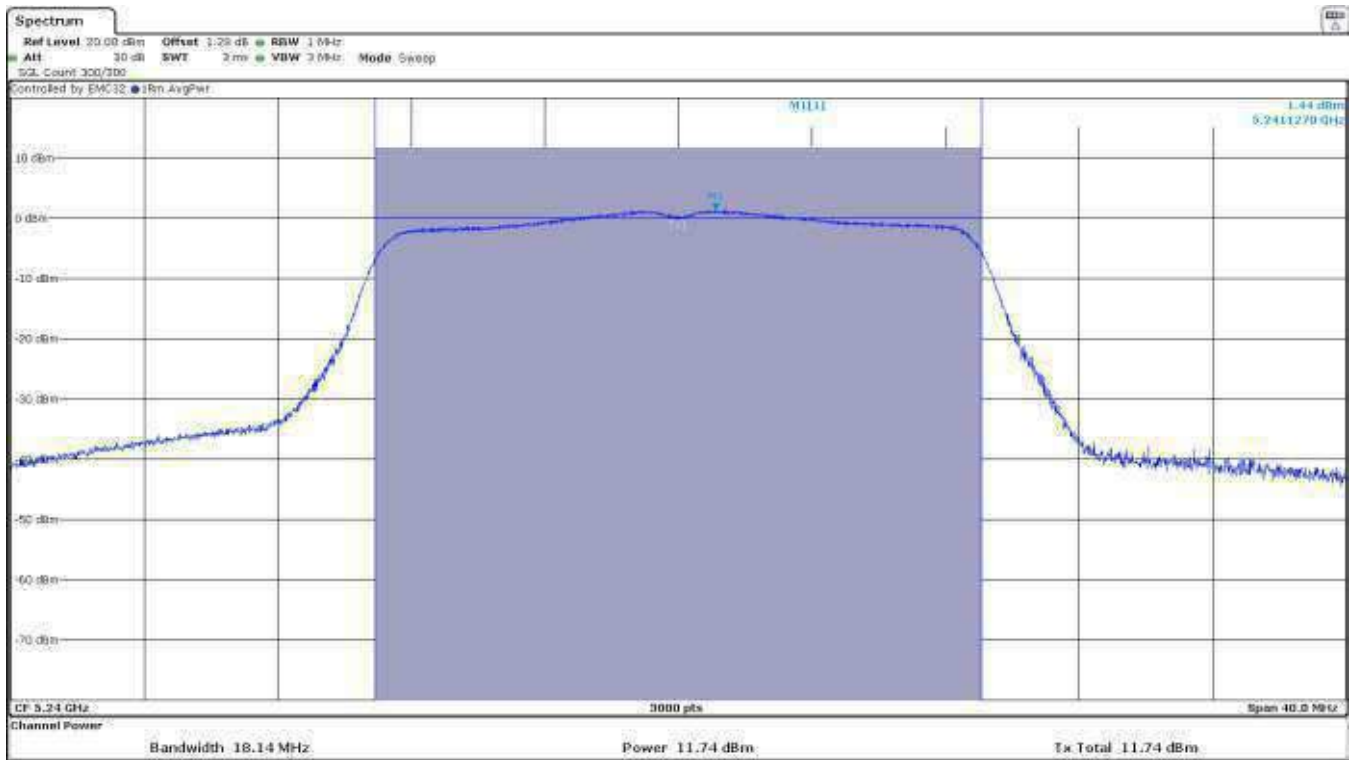
- Low Channel:



- Middle Channel:

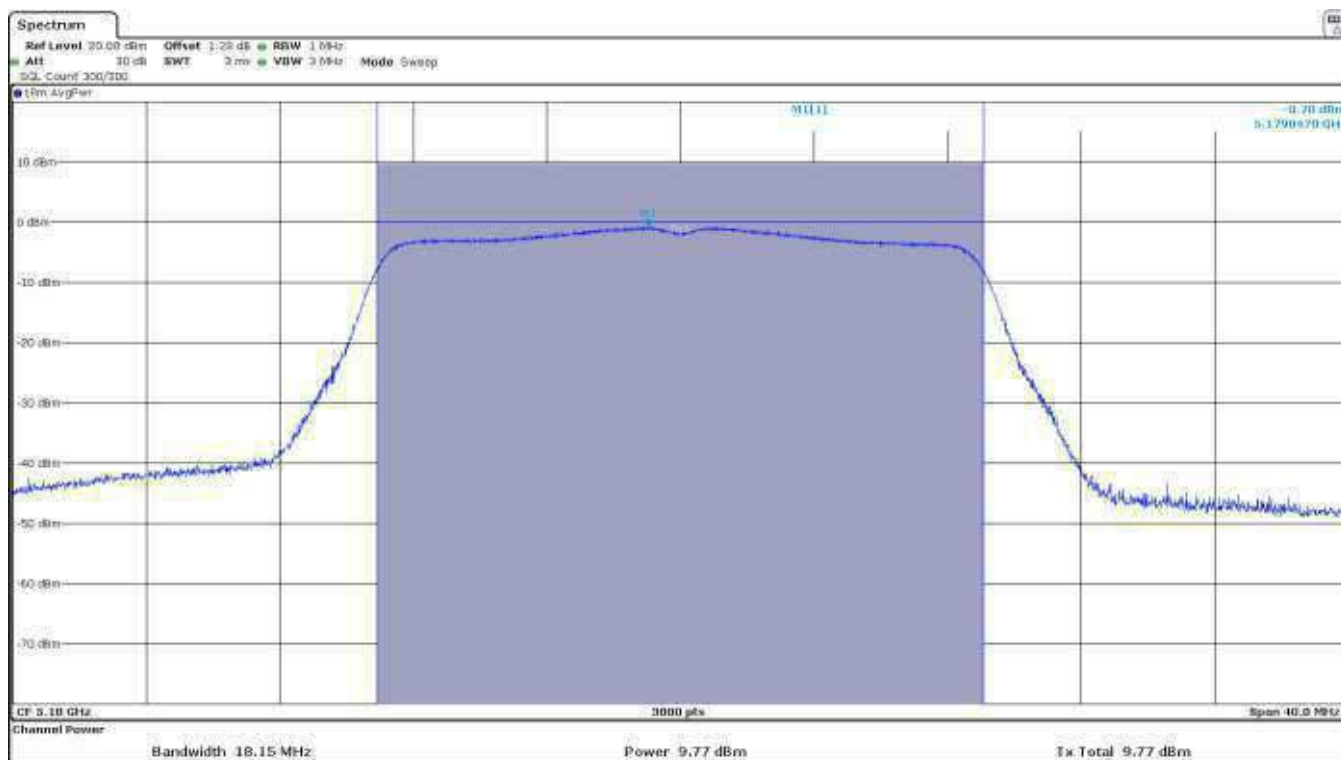


- High Channel:

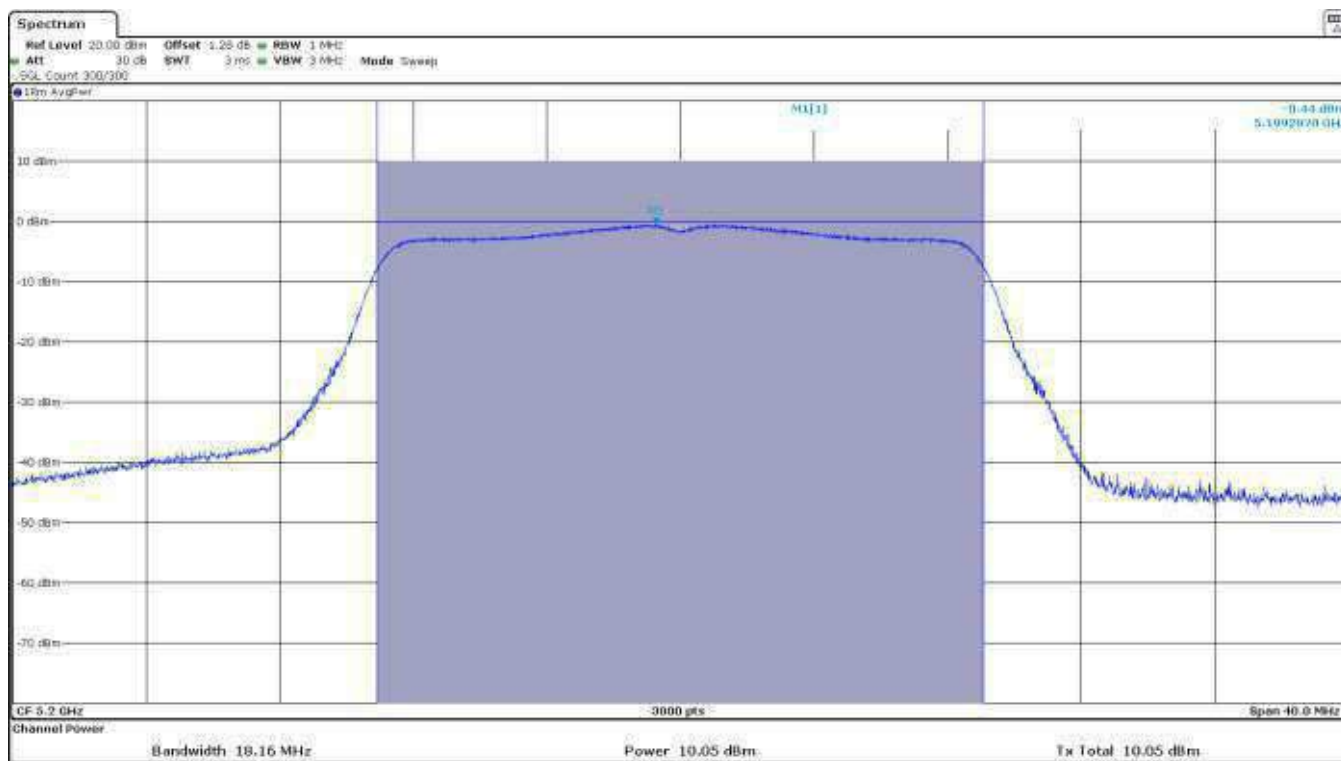


### Mode 802.11 ac20 (VHT20):

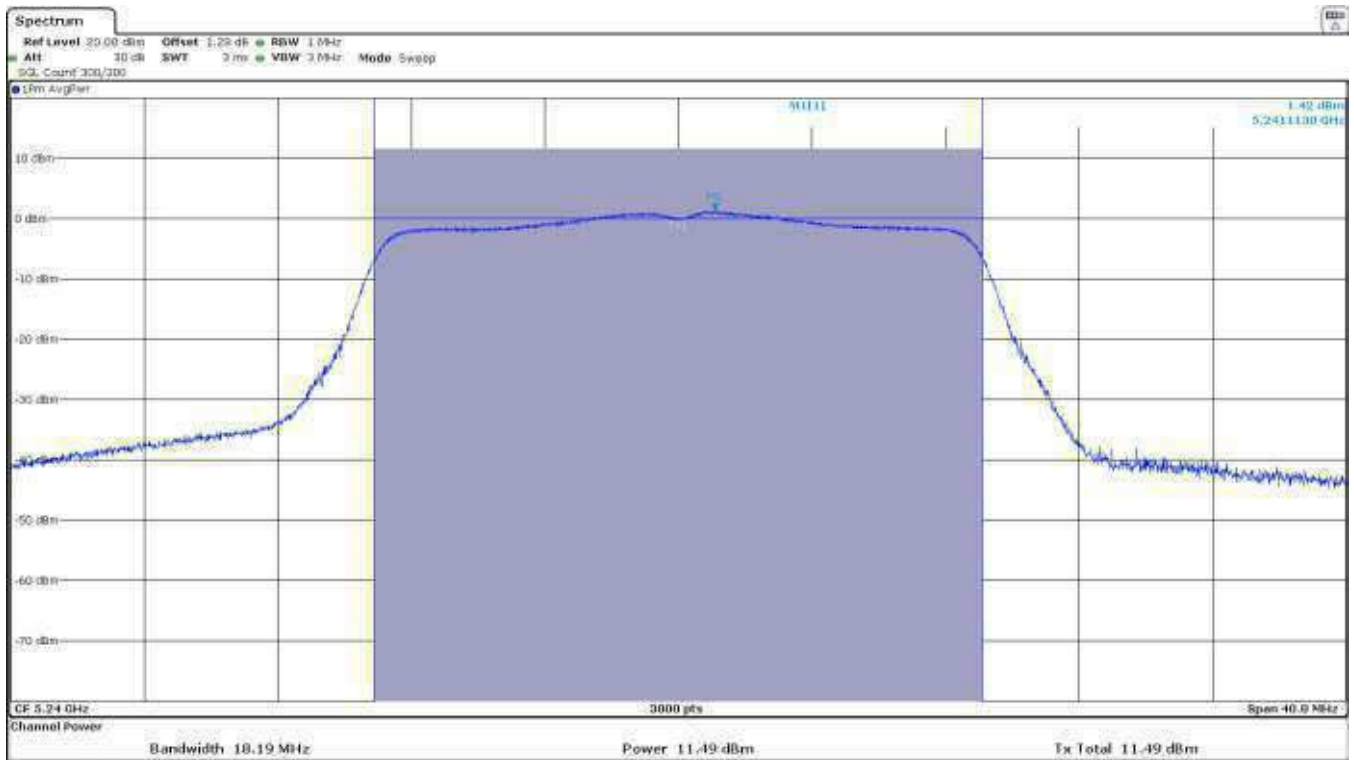
- Low Channel:



- Middle Channel:

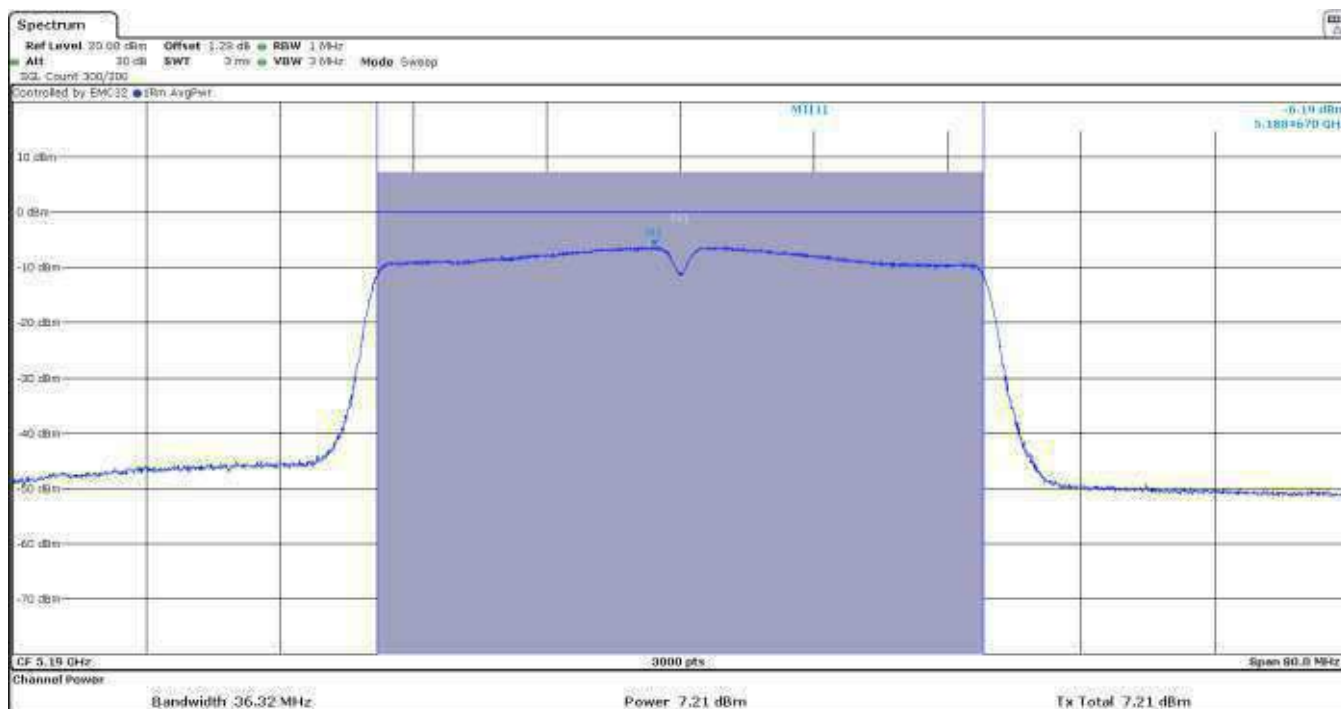


- High Channel:

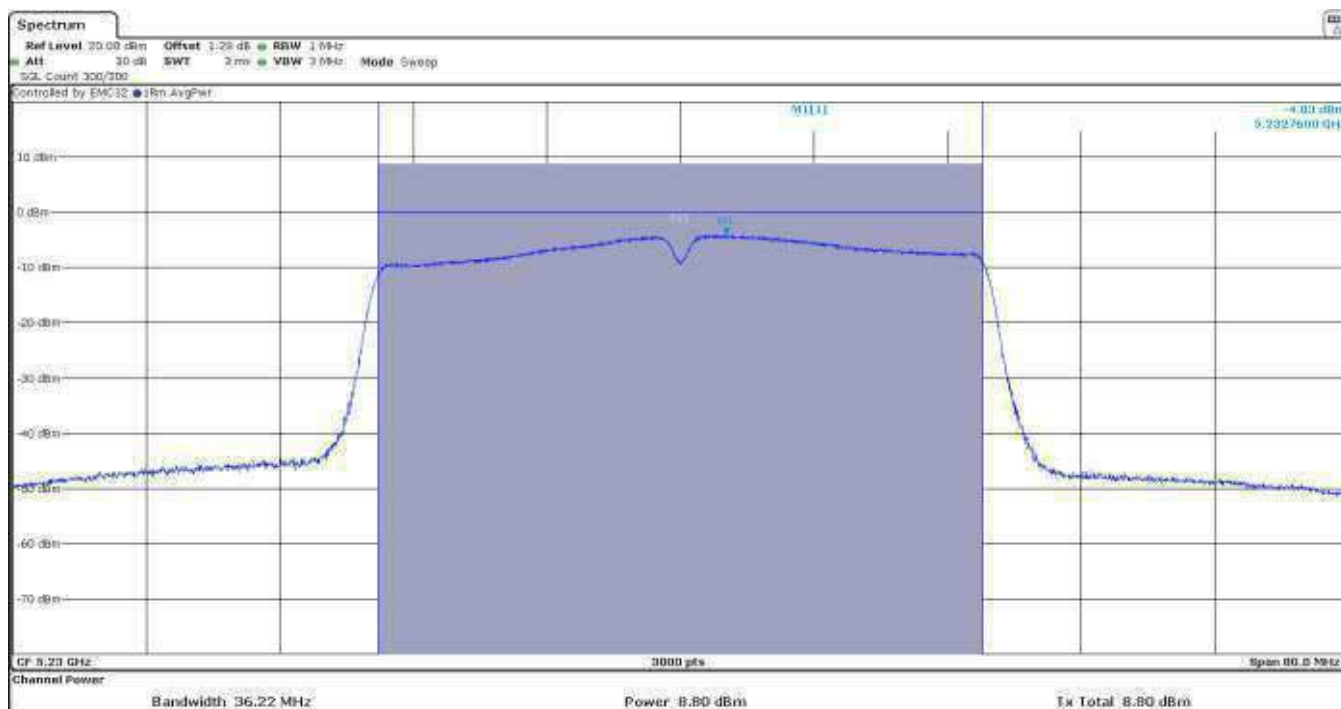


### Mode 802.11 n40 (HT40):

- Low Channel:

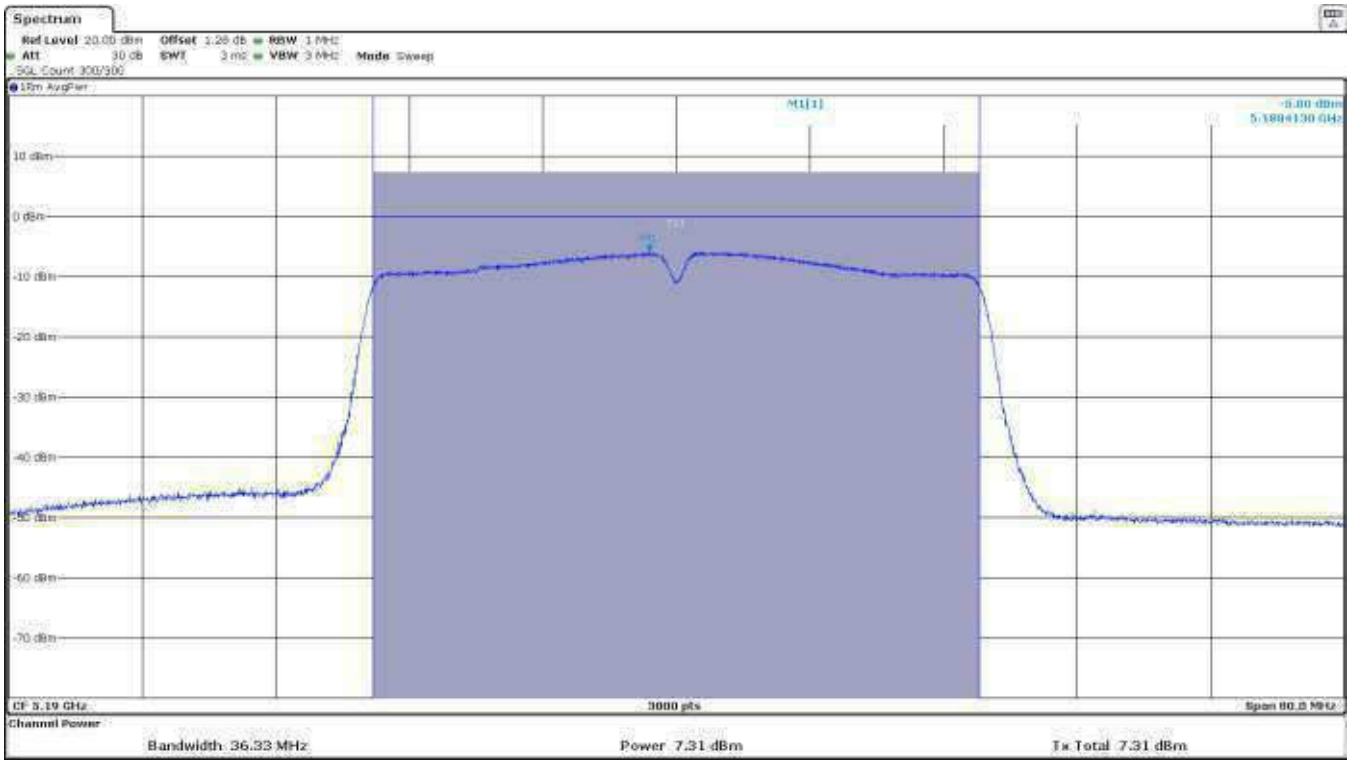


- High Channel:

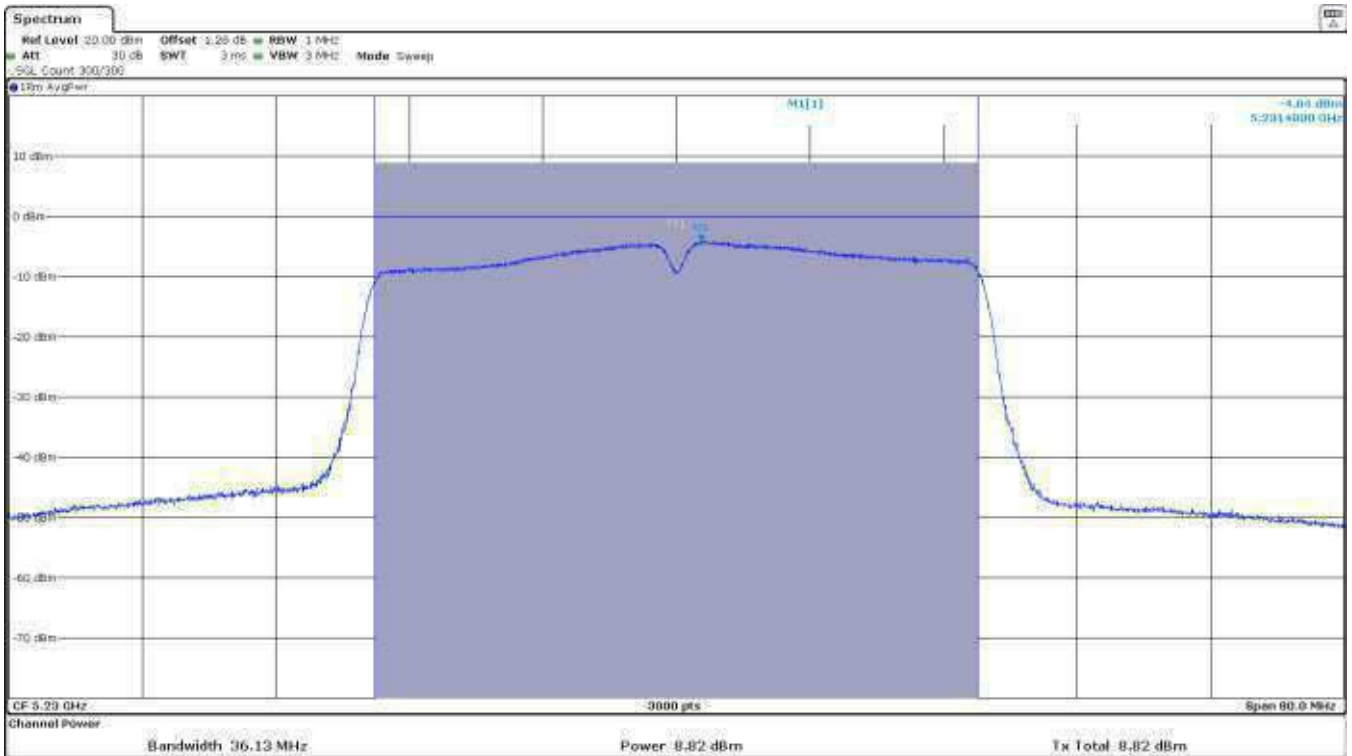


### Mode 802.11 ac40 (VHT40):

- Low Channel:



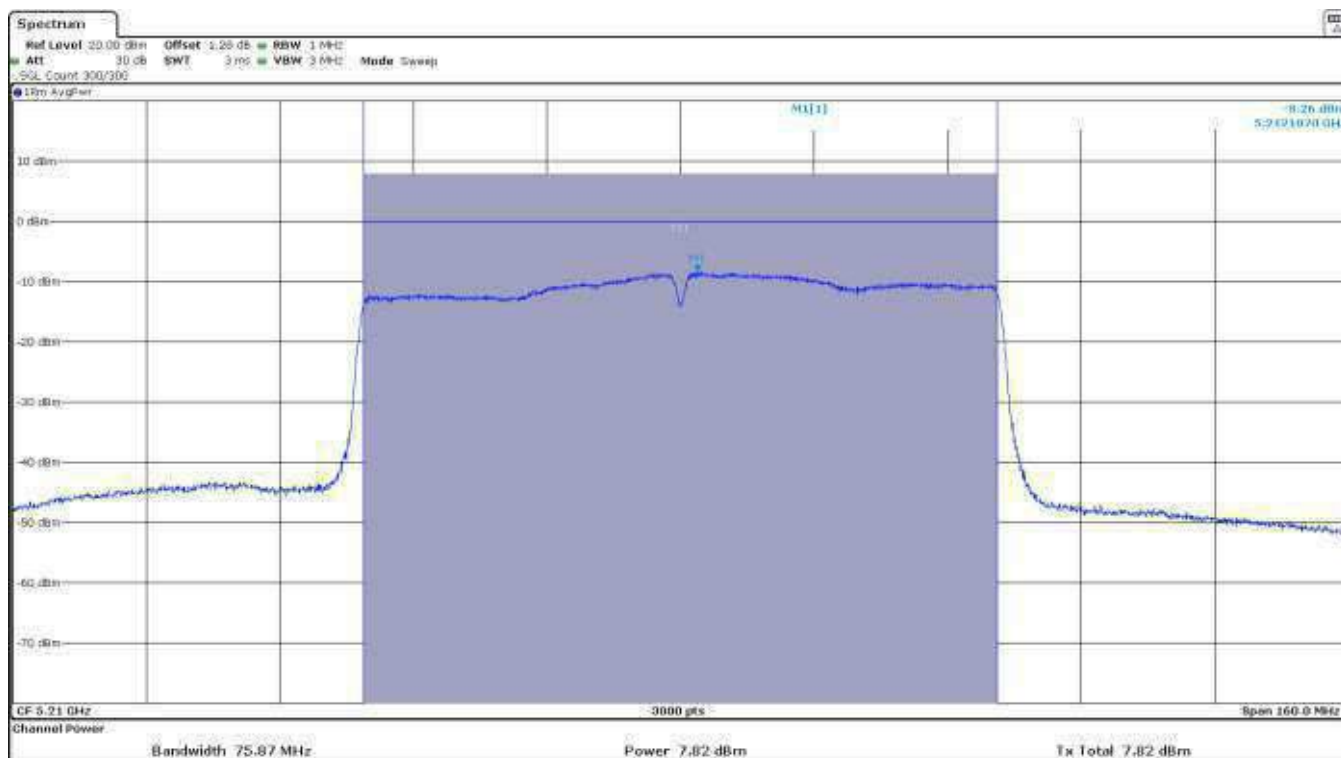
- High Channel:





### Mode 802.11 ac80 (VHT80):

- Single Channel:



## FCC 15.407 (a)(1)(iv). Transmitter Maximum Power Spectral Density / RSS-247

### 6.2.1.1. Transmitter EIRP Spectral Density

#### SPECIFICATION:

FCC 15.407: The maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS-247: The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

#### RESULTS:

The maximum power spectral density (PSD) was measured using the method according to point F) referencing E.2.b) (Method SA-1) and E.2.b) (Method SA-2) of Guidance 789033 D02 General UNII Test Procedures New Rules v02r01.

The PSD test uses the same setup as the transmitter maximum conducted output power test. The result of the Peak PSD was measured by colocation a maker on the peak of the signal and the results are in the tables below.

The e.i.r.p. levels are calculated by adding the declared maximum antenna gain (dBi).

For all modes of operation, the antenna gain is < 6 dBi.

Maximum Declared Antenna Gain: -5.4 dBi (antenna gain plus antenna cable loss).

#### Mode 802.11 a20:

	Low Channel	Middle Channel	High Channel
Maximum Average PSD (dBm/MHz)	-0.18	-0.13	1.48
Duty Cycle Correction Factor (dB)	0.948		
Maximum Average PSD Corrected (dBm/MHz)	0.768	0.818	2.428
Maximum EIRP PSD Corrected (dBm/MHz)	-4.632	-4.582	-2.972
Measurement uncertainty (dB)	<±2.57		

#### Mode 802.11 n20 (HT20):

	Low Channel	Middle Channel	High Channel
Maximum Average PSD (dBm/MHz)	-0.63	-0.52	1.44
Duty Cycle Correction Factor (dB)	1.020		
Maximum Average PSD Corrected (dBm/MHz)	0.390	0.500	2.460
Maximum EIRP PSD Corrected (dBm/MHz)	-5.01	-4.900	-2.940
Measurement uncertainty (dB)	<±2.57		

**Mode 802.11 ac20 (VHT20):**

	Low Channel	Middle Channel	High Channel
Maximum Average PSD (dBm/MHz)	-0.7	-0.44	1.42
Duty Cycle Correction Factor (dB)	1.004		
Maximum Average PSD Corrected (dBm/MHz)	0.304	0.564	2.424
Maximum EIRP PSD Corrected (dBm/MHz)	-5.096	-4.836	-2.976
Measurement uncertainty (dB)	<±2.57		

**Mode 802.11 n40 (HT40):**

	Low Channel	High Channel
Maximum Average PSD (dBm/MHz)	-6.19	-4.03
Duty Cycle Correction Factor (dB)	1.876	
Maximum Average PSD Corrected (dBm/MHz)	-4.314	-2.154
Maximum EIRP PSD Corrected (dBm/MHz)	-9.714341658	-7.554
Measurement uncertainty (dB)	<±2.57	

**Mode 802.11 ac40 (VHT40):**

	Low Channel	High Channel
Maximum Average PSD (dBm/MHz)	-5.8	-4.04
Duty Cycle Correction Factor (dB)	1.846	
Maximum Average PSD Corrected (dBm/MHz)	-3.954	-2.194
Maximum EIRP PSD Corrected (dBm/MHz)	-9.354	-7.594
Measurement uncertainty (dB)	<±2.57	

**Mode 802.11 ac80 (VHT80):**

	Low Channel
Maximum Average PSD (dBm/MHz)	-8.26
Duty Cycle Correction Factor (dB)	3.208
Maximum Average PSD Corrected (dBm/MHz)	-5.052
Maximum EIRP PSD Corrected (dBm/MHz)	-10.452
Measurement uncertainty (dB)	<±2.57

Verdict: PASS

## FCC 15.407 (b)(1)(6) / RSS-247 6.2.1.2. Transmitter Out of Band Radiated Emissions

### SPECIFICATION:

For transmitters operating in the 5.15–5.25 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz (68.23 dBμV/m at 3 m distance).

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)):

Frequency Range (MHz)	Field strength (μV/m)	Field strength (dBμV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	300
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 40000	500	54	3

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

### RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

All tests were performed in a semi-anechoic chamber at a distance of 1m for the frequency range 17 GHz-40 GHz and a distance of 3m for frequency range 30MHz-17GHz.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

- **Test performed on the worst case: 802.11 ac20, with an index MCS0.**

The worst case was determined by measuring the eirp density (radiated).

**Frequency range 30 MHz - 1 GHz (worst case):**

The spurious emissions below 1 GHz do not depend on either the operating channel or the modulation mode selected in the EUT.

No spurious frequencies detected at less than 20 dB below the limit.

Measurement Uncertainty (dB):  $<\pm 5.08$

**Frequency range 1 - 40 GHz (worst case):**

The results in the next tables show the maximum measured levels in the 1-40 GHz frequency range.

The Low, Middle and High Channels were measured for out-of-band emissions for the worst mode.

Spurious frequencies in the restricted bands with peak levels above the average limit (54 dB $\mu$ V/m at 3 m) are measured with an average detector for checking compliance with the average limit.

- 802.11 ac20 (worst case):**

- LOW CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dB $\mu$ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
9.0	48.75	V	Peak	$<\pm 5.13$
10.3600	58.46	V	Peak	$<\pm 5.13$
34.20323	52.12	H	Peak	$<\pm 5.14$
39.59673	58.16	H	Peak	$<\pm 5.14$
	49.57		Average	$<\pm 5.14$

- MIDDLE CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dB $\mu$ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
9.0	49.8	V	Peak	$<\pm 5.13$
10.3995	59.33	V	Peak	$<\pm 5.13$
31.3037	52.4	V	Peak	$<\pm 5.14$
39.6250	58.9	H	Peak	$<\pm 5.14$
	48.50		Average	$<\pm 5.14$

- HIGH CHANNEL. Spurious frequencies closest to the limit:

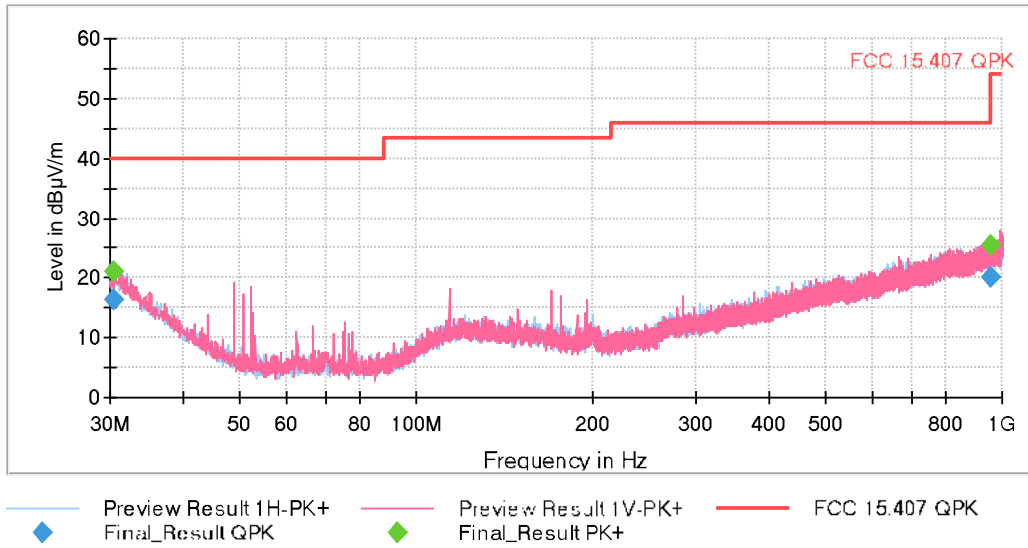
Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
9.0	51.49	V	Peak	<± 5.13
10.48050	57.06	V	Peak	<± 5.13
31.29603	50.58	V	Peak	<± 5.14
39.56913	59.07	V	Peak	<± 5.14
	48.98		Average	<± 5.14
34.19940	51.8	H	Peak	<± 5.14

Measurement Uncertainty (dB): 1 GHz – 17 GHz <± 5.13  
 17 GHz – 26.5 GHz <± 4.82  
 26.5 GHz – 40 GHz <± 5.14

Verdict: PASS

**FREQUENCY RANGE 30 MHz - 1 GHz (worst case):**

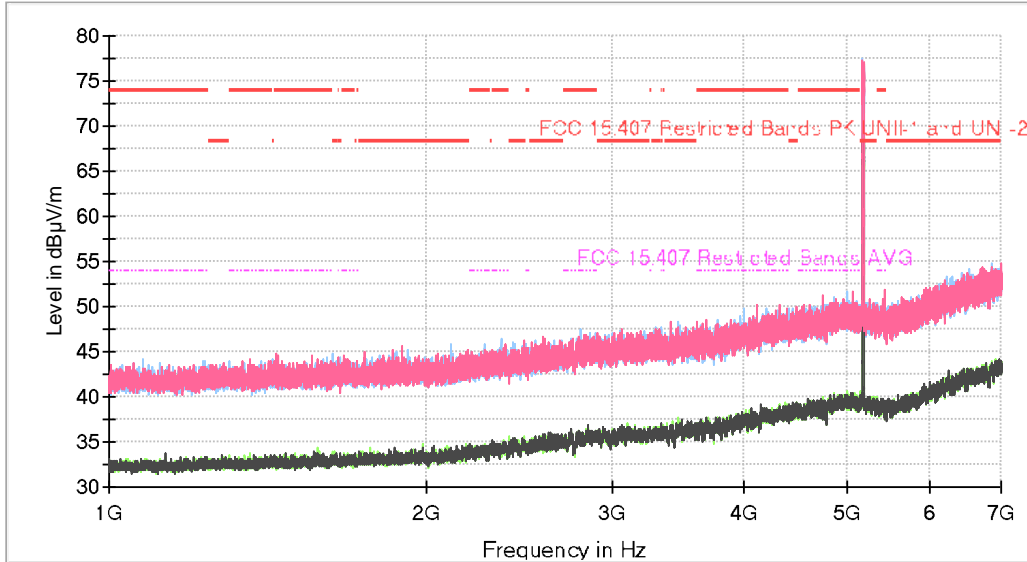
This plot is valid for the Low, Middle and High Channels and all the modulation modes.



**FREQUENCY RANGE 1 - 7 GHz (worst case):**

- Low Channel:

Full Spectrum



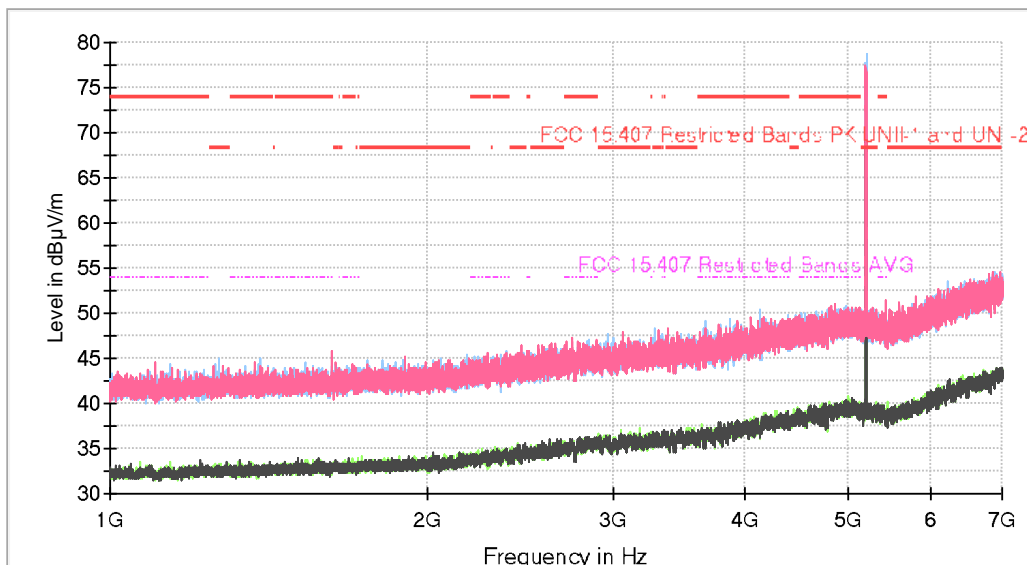
- Preview Result 2H-AVG
- Preview Result 1H-PK+
- Preview Result 2V-AVG
- Preview Result 1V-PK+
- FCC 15.407 Restricted Bands PK UNII-T and UN -2
- FCC 15.407 Restricted Bands AVG
- ◆ Final\_Result PK+
- ◆ Final\_Result AVG

The peak shown in the plot above the limit is the carrier frequency.



- Middle Channel:

Full Spectrum

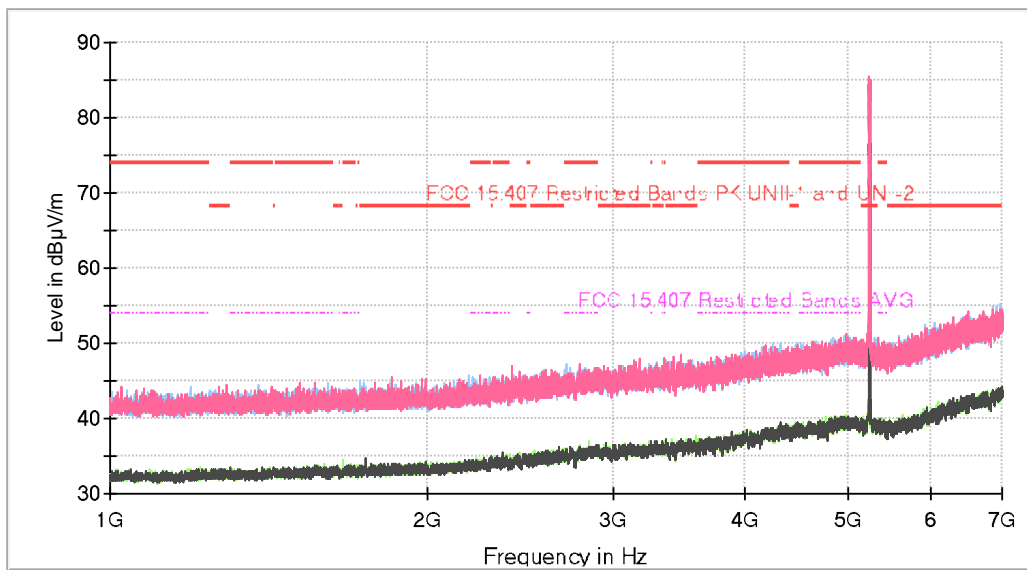


- Preview Result 2H-AVG
- Preview Result 1H-PK+
- Preview Result 2V-AVG
- Preview Result 1V-PK+
- FCC 15.407 Restricted Bands PK UNII-1 and UN-2
- FCC 15.407 Restricted Bands AVG
- Final\_Result PK+
- Final\_Result AVG

The peak shown in the plot above the limit is the carrier frequency.

- High Channel:

Full Spectrum



- Preview Result 2H-AVG
- Preview Result 1H-PK+
- Preview Result 2V-AVG
- Preview Result 1V-PK+
- FCC 15.407 Restricted Bands PK UNII-1 and UN-2
- FCC 15.407 Restricted Bands AVG
- Final\_Result PK+
- Final\_Result AVG

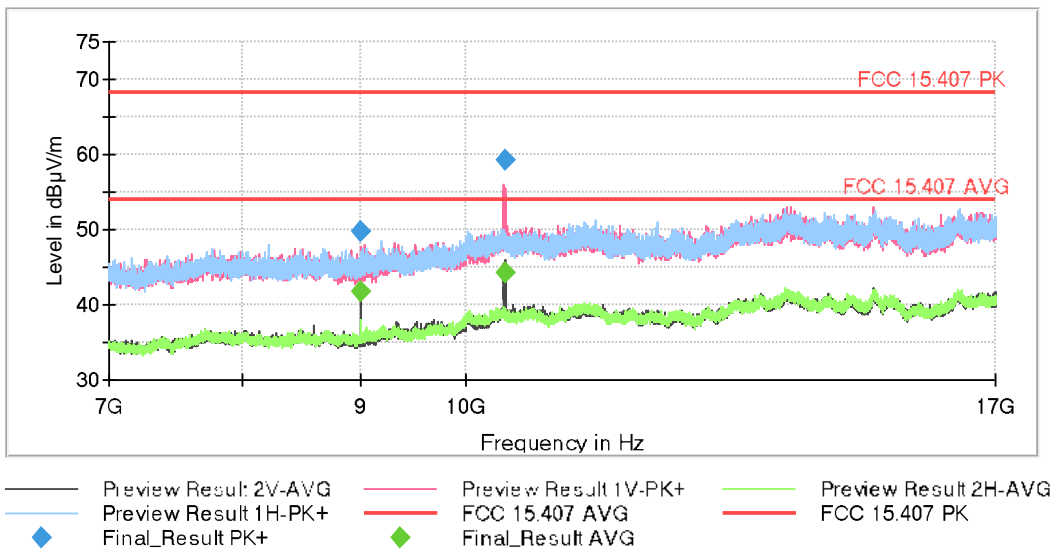
The peak shown in the plot above the limit is the carrier frequency.

**FREQUENCY RANGE 7 - 17 GHz (worst case):**

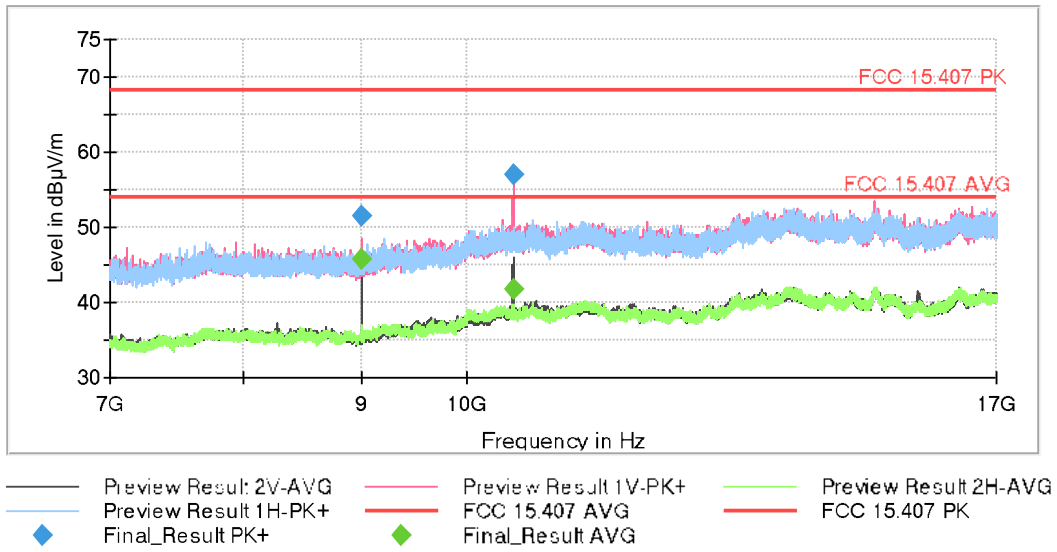
- Low Channel:



- Middle Channel:

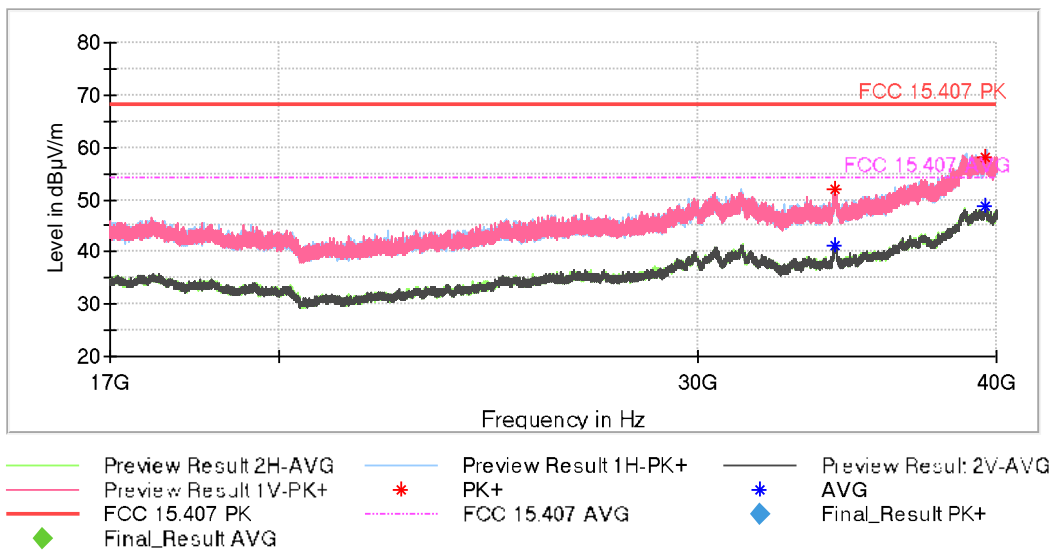


- High Channel:

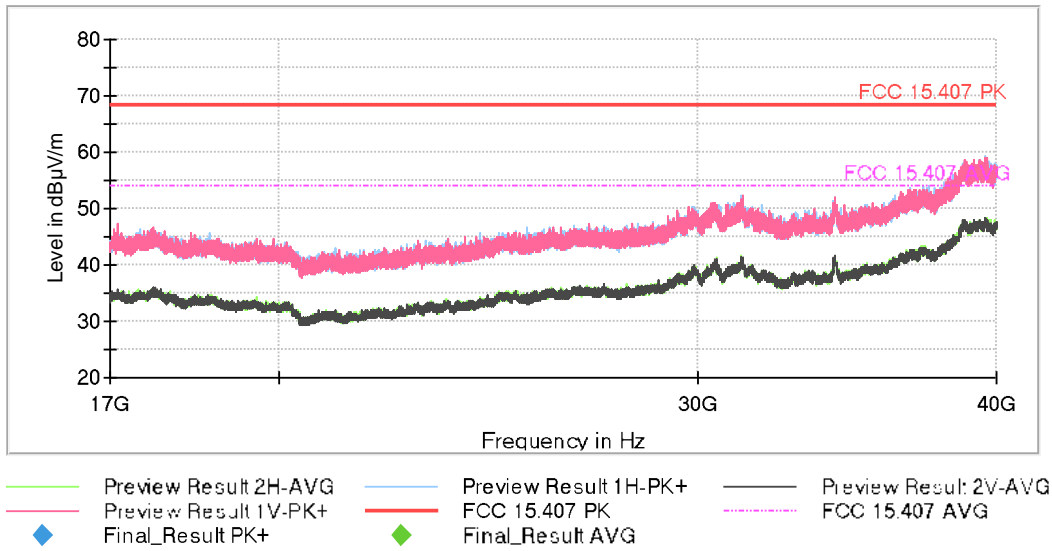


**FREQUENCY RANGE 17 - 40 GHz (worst case):**

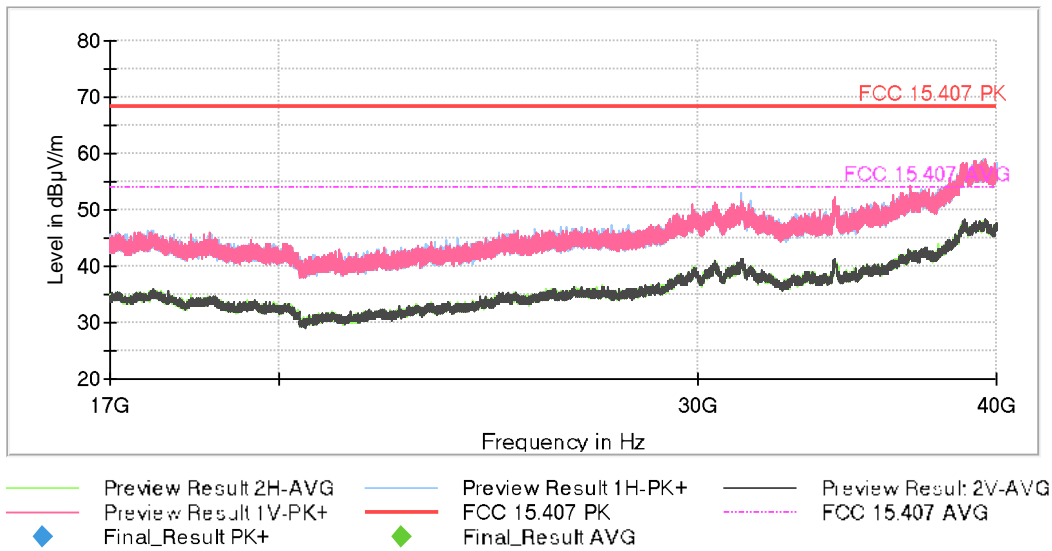
- Low Channel:



- Middle Channel:



- High Channel:



## FCC 15.407 (b)(1) / RSS-247 6.2.1.2. Transmitter Band Edge Radiated Emissions

### SPECIFICATION:

For transmitters operating in the 5.15–5.25 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz (68.23 dBμV/m at 3 m distance).

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)):

Frequency Range (MHz)	Field strength (μV/m)	Field strength (dBμV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	300
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 40000	500	54	3

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

### RESULTS:

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

All emissions outside of the 5.15-5.35GHz band shall not exceed an EIRP of -27dBm/MHz. There are restricted bands of operation below band edge at 4.5-5.15 GHz also above the upper band edge at 5.35-5.46GHz therefore the provision of FCC Part 15.205 apply.

Field strength measurements using peak and average detector performed in the restricted bands below 5.15GHz and above 5.35 GHz.

Test performed on the following worst cases modes in all relevant tests channels:

- 802.11a: 6 Mbit/s.
- 802.11n HT20: MCS0.
- 802.11ac VHT20: MCS0.
- 802.11n HT40: MCS0.
- 802.11ac VHT40: MCS0.
- 802.11ac VHT80: MCS0.

- **802.11 a20:**

- Lower Band Edge Channel 36 (5180 MHz): Inside 4.50-5.15 GHz.

- No spurious frequencies at less than 20 dB below the limit.

- Upper Band Edge Channel 48 (5240 MHz): Inside 5.35-5.46 GHz.

- No spurious frequencies at less than 20 dB below the limit.

- **802.11 n20:**

- Lower Band Edge Channel 36 (5180 MHz): Inside 4.50-5.15 GHz.

- No spurious frequencies at less than 20 dB below the limit.

- Upper Band Edge Channel 48 (5240 MHz): Inside 5.35-5.46 GHz.

- No spurious frequencies at less than 20 dB below the limit.

- **802.11 ac20:**

- Lower Band Edge Channel 36 (5180 MHz): Inside 4.50-5.15 GHz.

- No spurious frequencies at less than 20 dB below the limit.

- Upper Band Edge Channel 48 (5240 MHz): Inside 5.35-5.46 GHz.

- No spurious frequencies at less than 20 dB below the limit.

- **802.11 n40:**

- Lower Band Edge Channel 38 (5190 MHz): Inside 4.50-5.15 GHz.

- No spurious frequencies at less than 20 dB below the limit.

- Upper Band Edge Channel 46 (5230 MHz): Inside 5.35-5.46 GHz.

- No spurious frequencies at less than 20 dB below the limit.

- **802.11 ac40:**

- Lower Band Edge Channel 38 (5190 MHz): Inside 4.50-5.15 GHz.

No spurious frequencies at less than 20 dB below the limit.

- Upper Band Edge Channel 46 (5230 MHz): Inside 5.35-5.46 GHz.

No spurious frequencies at less than 20 dB below the limit.

- **802.11 ac80:**

- Lower Band Edge Channel 42 (5210 MHz): Inside 4.50-5.15 GHz.

No spurious frequencies at less than 20 dB below the limit.

- Upper Band Edge Channel 42 (5210 MHz): Inside 5.35-5.46 GHz.

No spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB):  $<\pm 5.13$

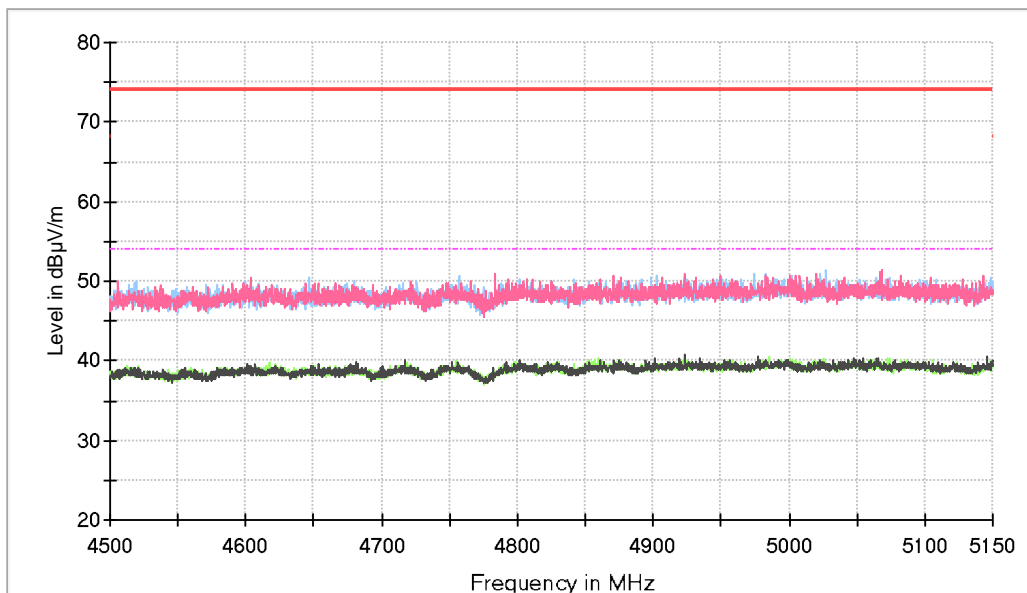
Verdict: PASS



• 802.11 a20:

**Radiated spurious emissions at band-edges and inside adjacent band 4.50 - 5.15 GHz**

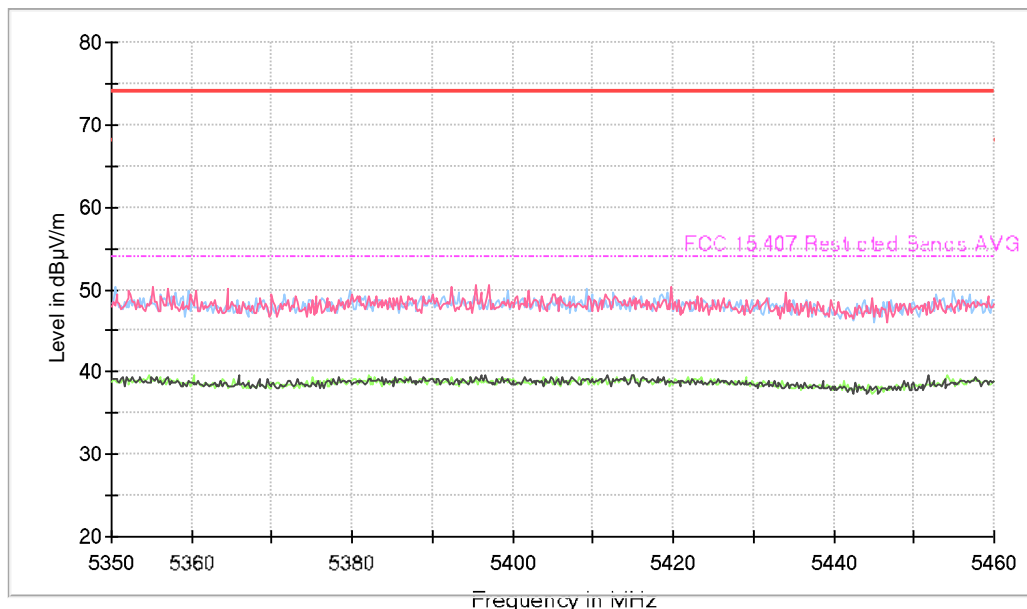
- Lower Band Edge Channel 36 (4500 to 5150 MHz)



- Preview Result 2H-AVG
- Preview Result 1H-PK+
- Preview Result 2V-AVG
- Preview Result 1V-PK+
- FCC 15.407 Restricted Bands PK UNII-1 and UN-2
- - - - - FCC 15.407 Restricted Bands AVG
- ◆ Final\_Result PK+
- ◆ Final\_Result AVG

### Radiated spurious emissions at band-edges and inside adjacent band 5.35 - 5.46 GHz

- Upper Band Edge Channel 48 (5350 to 5460 MHz)

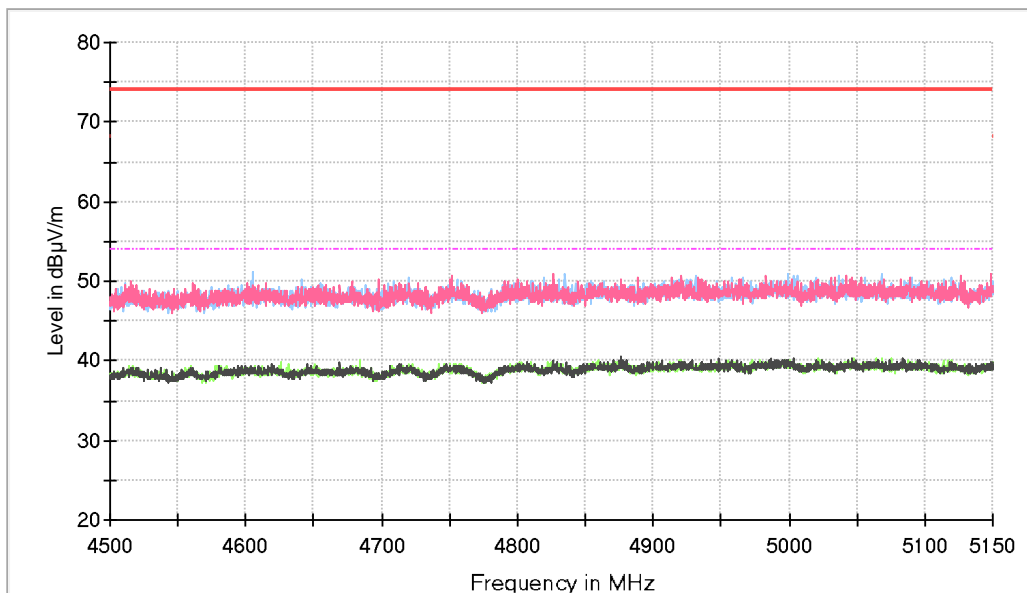


- Preview Result 2H-AVG
- Preview Result 1H-PK+
- Preview Result 2V-AVG
- Preview Result 1V-PK+
- FCC 15.407 Restricted Bands PK UNII-1 and UN -2
- - - FCC 15.407 Restricted Bands AVG
- ◆ Final\_Result PK+
- ◆ Final\_Result AVG

• 802.11 n20:

**Radiated spurious emissions at band-edges and inside adjacent band 4.50 - 5.15 GHz**

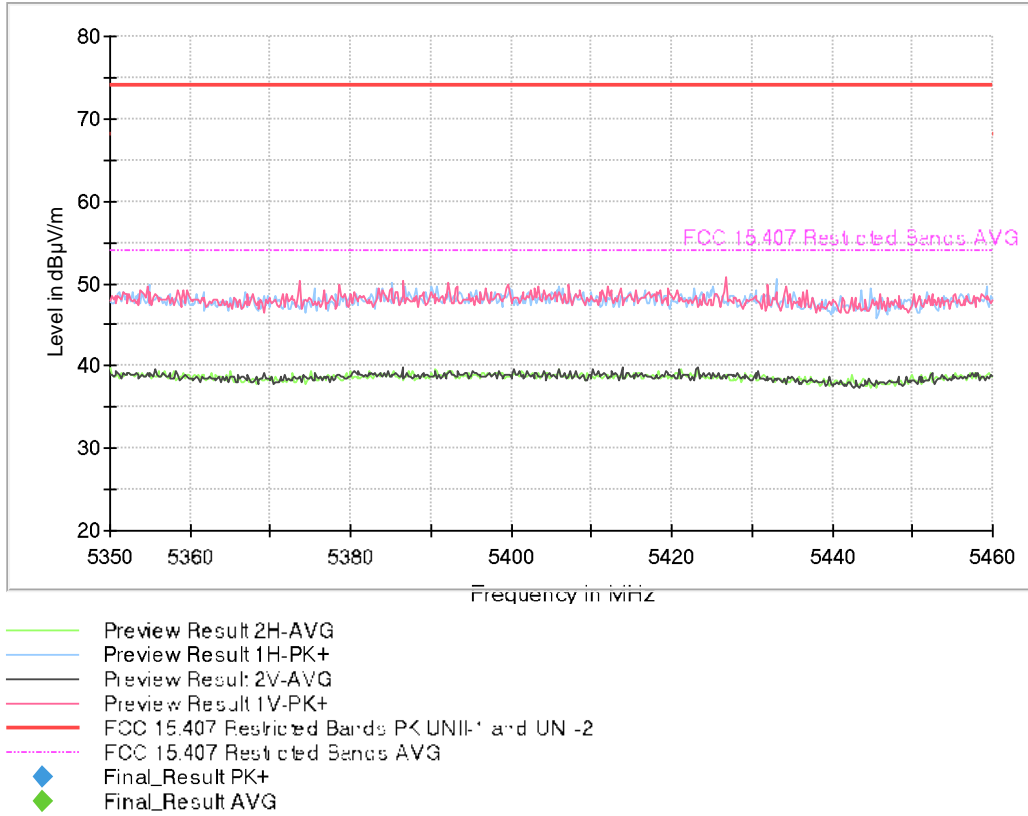
- Lower Band Edge Channel 36 (4500 to 5150 MHz)



- Preview Result 2H-AVG
- Preview Result 1H-PK+
- Preview Result 2V-AVG
- Preview Result 1V-PK+
- FCC 15.407 Restricted Bands PK UNII-1 and UN-2
- - - - - FCC 15.407 Restricted Bands AVG
- ◆ Final\_Result PK+
- ◆ Final\_Result AVG

### Radiated spurious emissions at band-edges and inside adjacent band 5.35 - 5.46 GHz

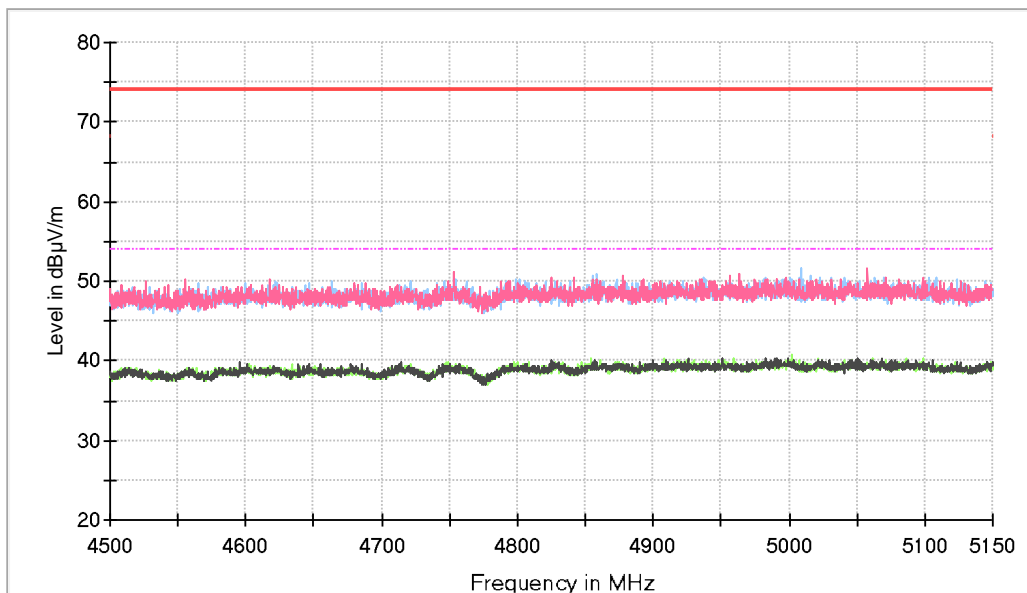
- Upper Band Edge Channel 48 (5350 to 5460 MHz)



• 802.11 ac20:

**Radiated spurious emissions at band-edges and inside adjacent band 4.50 - 5.15 GHz**

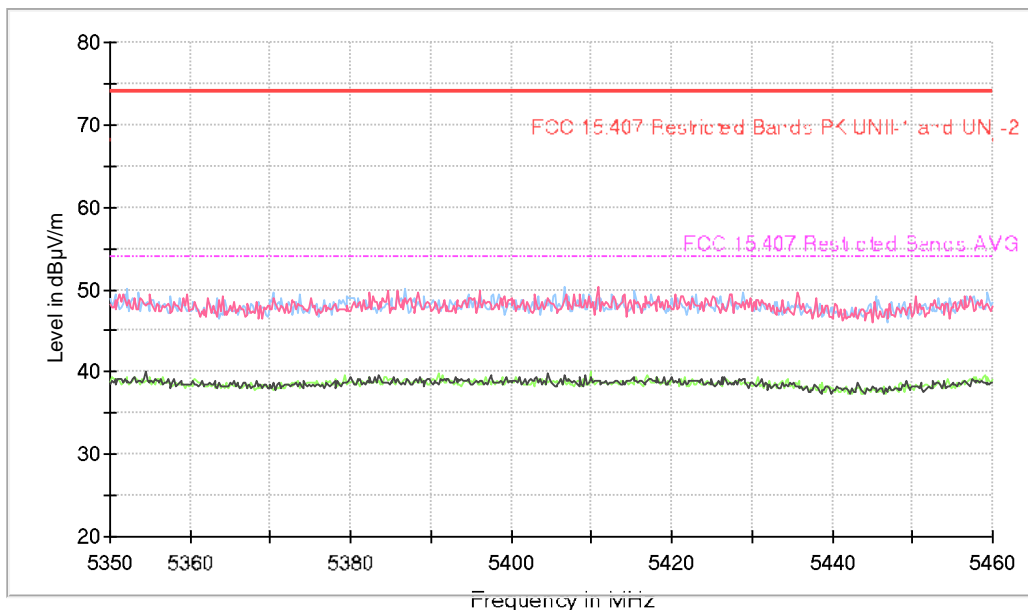
- Lower Band Edge Channel 36 (4500 to 5150 MHz)



- Preview Result 2H-AVG
- Preview Result 1H-PK+
- Preview Result 2V-AVG
- Preview Result 1V-PK+
- FCC 15.407 Restricted Bands PK UNII-1 and UN-2
- - - - - FCC 15.407 Restricted Bands AVG
- ◆ Final\_Result PK+
- ◆ Final\_Result AVG

### Radiated spurious emissions at band-edges and inside adjacent band 5.35 - 5.46 GHz

- Upper Band Edge Channel 48 (5350 to 5460 MHz)

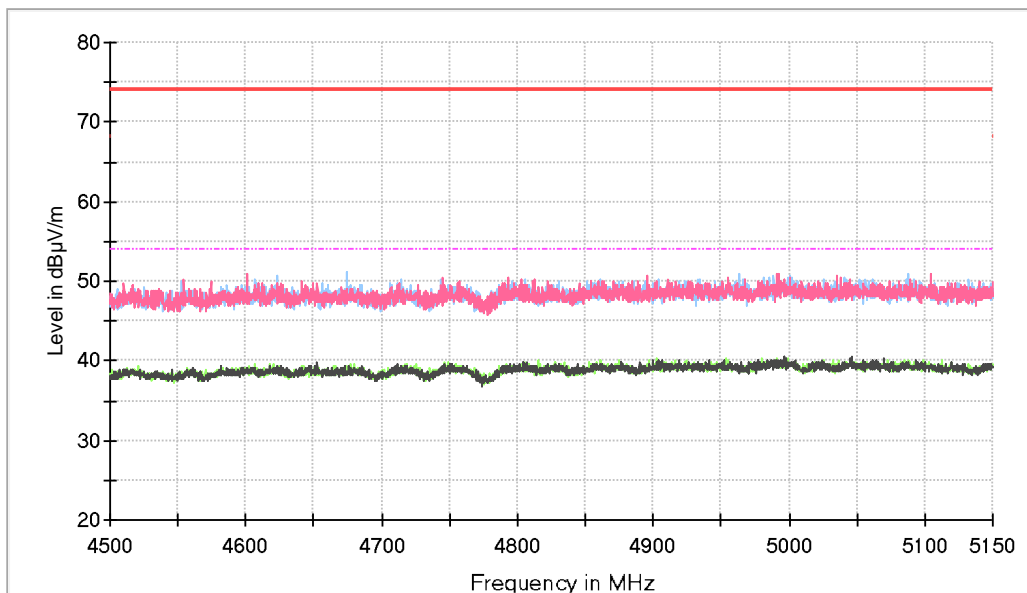


- Preview Result 2H-AVG
- Preview Result 1H-PK+
- Preview Result 2V-AVG
- Preview Result 1V-PK+
- FCC 15.407 Restricted Bands PK<UNII-1 and UN-2
- - - FCC 15.407 Restricted Bands AVG
- ◆ Final\_Result PK+
- ◆ Final\_Result AVG

• 802.11 n40:

**Radiated spurious emissions at band-edges and inside adjacent band 4.50 - 5.15 GHz**

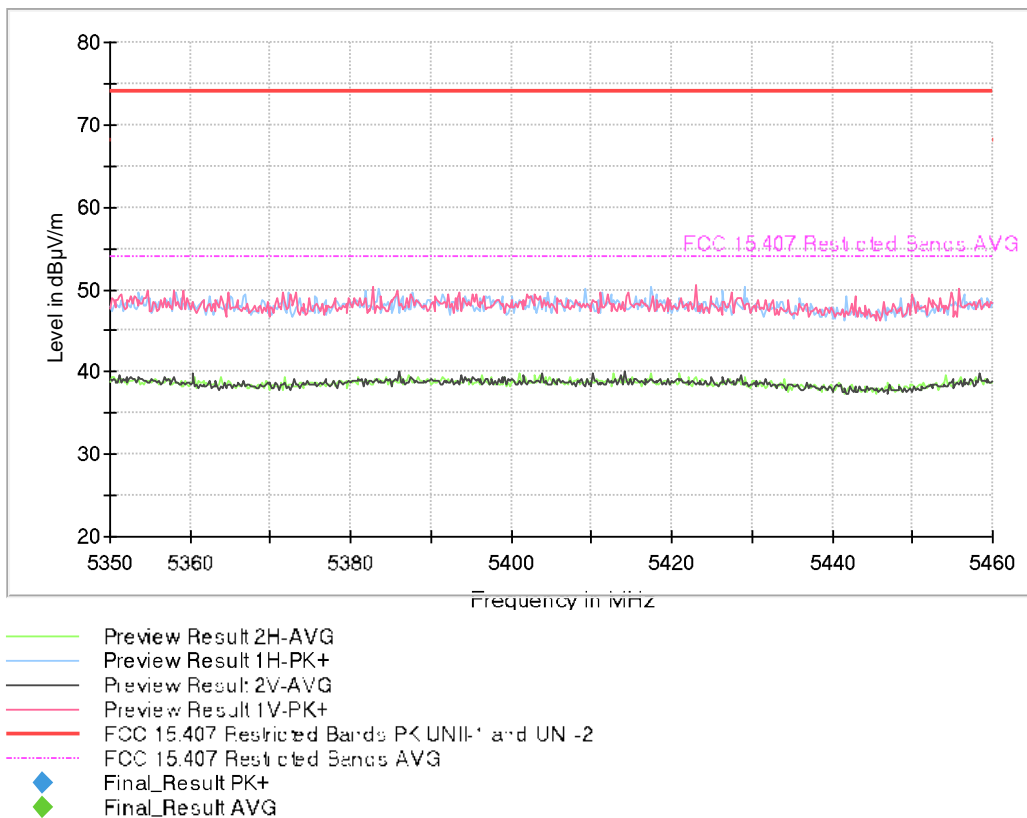
- Lower Band Edge Channel 38 (4500 to 5150 MHz)



- Preview Result 2H-AVG
- Preview Result 1H-PK+
- Preview Result 2V-AVG
- Preview Result 1V-PK+
- FCC 15.407 Restricted Bands PK UNII-1 and UN-2
- - - - - FCC 15.407 Restricted Bands AVG
- ◆ Final\_Result PK+
- ◆ Final\_Result AVG

### Radiated spurious emissions at band-edges and inside adjacent band 5.35 - 5.46 GHz

- Upper Band Edge Channel 46 (5350 to 5460 MHz)

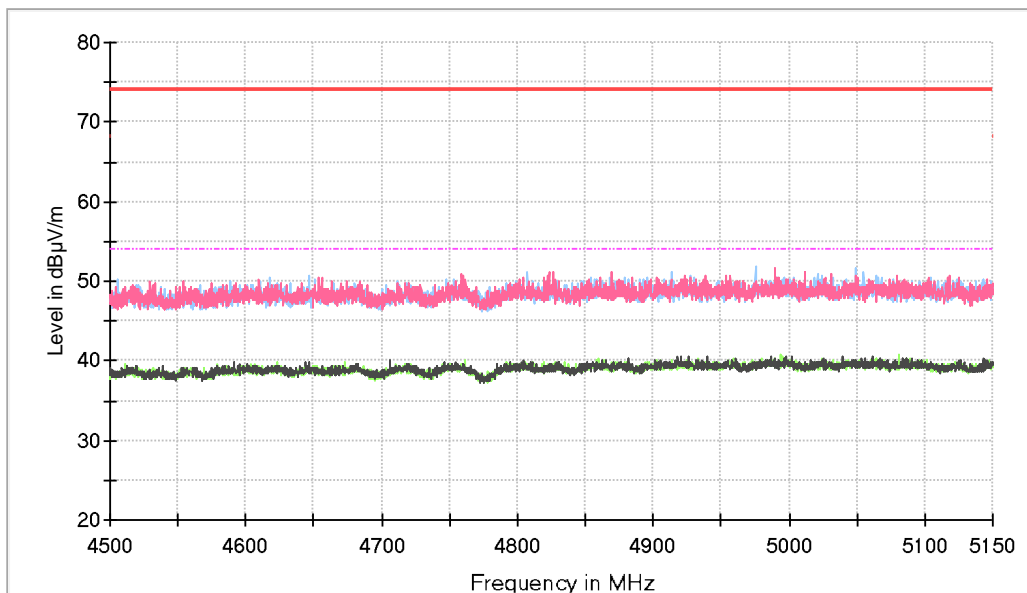




• 802.11 ac40:

**Radiated spurious emissions at band-edges and inside adjacent band 4.50 - 5.15 GHz**

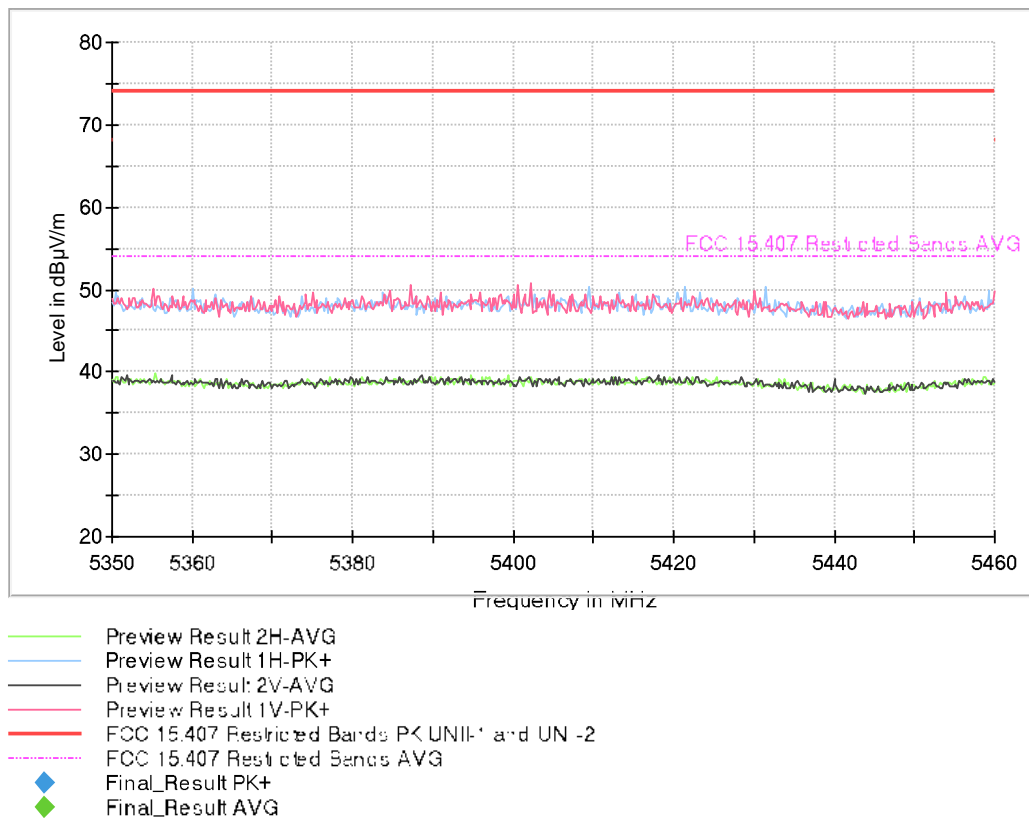
- Lower Band Edge Channel 38 (4500 to 5150 MHz)



- Preview Result 2H-AVG
- Preview Result 1H-PK+
- Preview Result 2V-AVG
- Preview Result 1V-PK+
- FCC 15.407 Restricted Bands PK UNII-1 and UN-2
- - - - - FCC 15.407 Restricted Bands AVG
- ◆ Final\_Result PK+
- ◆ Final\_Result AVG

### Radiated spurious emissions at band-edges and inside adjacent band 5.35 - 5.46 GHz

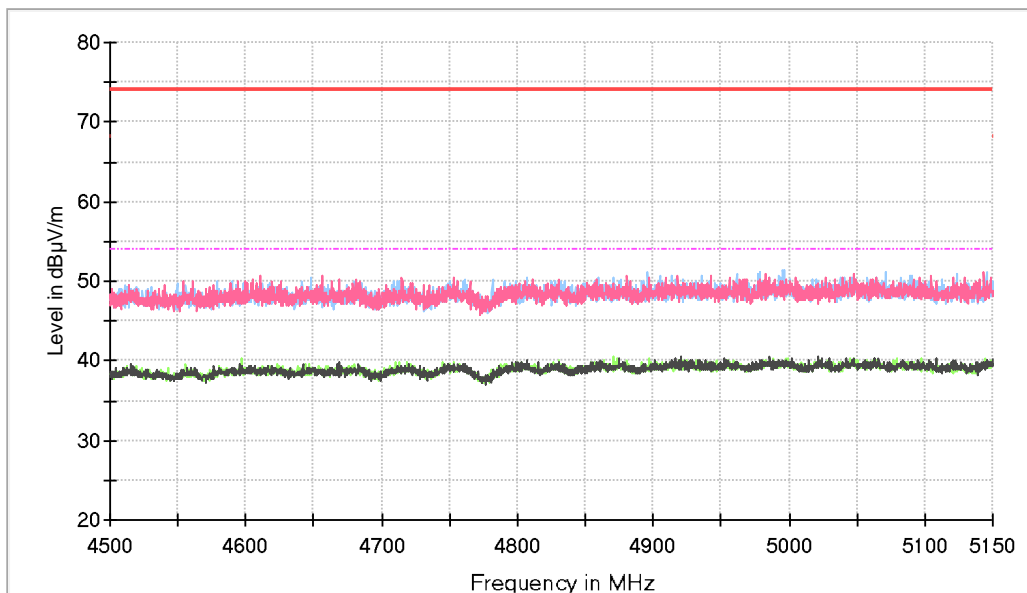
- Upper Band Edge Channel 46 (5350 to 5460 MHz)



- **802.11 ac80:**

**Radiated spurious emissions at band-edges and inside adjacent band 4.50 - 5.15 GHz**

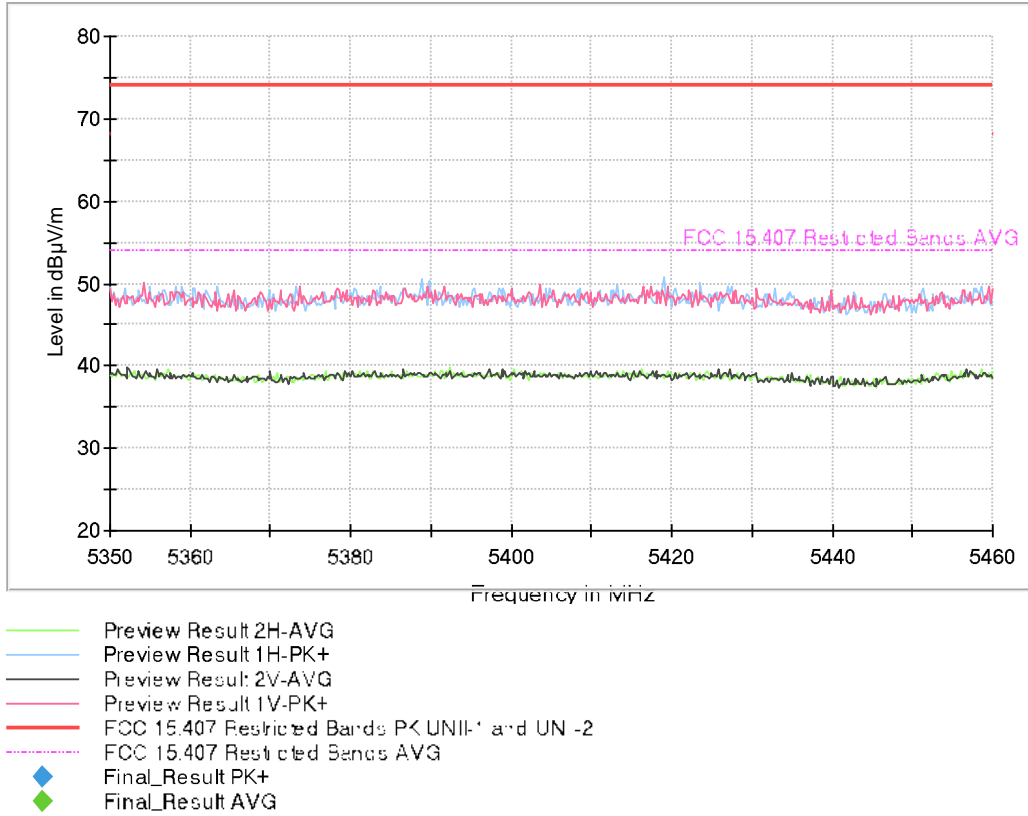
- Lower Band Edge Channel 42 (4500 to 5150 MHz)



- Preview Result 2H-AVG
- Preview Result 1H-PK+
- Preview Result 2V-AVG
- Preview Result 1V-PK+
- FCC 15.407 Restricted Bands PK UNII-1 and UN-2
- FCC 15.407 Restricted Bands AVG
- Final\_Result PK+
- Final\_Result AVG

### Radiated spurious emissions at band-edges and inside adjacent band 5.35 - 5.46 GHz

- Upper Band Edge Channel 42 (5350 to 5460 MHz)



## **Appendix C: Test results for the U-NII-3 Band 5.725 – 5.85 GHz**

## INDEX

TEST CONDITIONS .....	87
FCC 15.247 (e) / RSS-247 6.2.4.1. 6 dB Bandwidth .....	92
FCC 15.407 (a)(3) / RSS-247 6.2.4.1. Transmitter Maximum Conducted Output Power .....	101
FCC 15.407 (a)(3) / RSS-247 6.2.4.1. Transmitter Maximum Power Spectral Density .....	111
FCC 15.407(b)(4)(6) / RSS-247 6.2.4.2. Transmitter Out of Band Radiated Emissions and Transmitter Band Edge Radiated Emissions .....	113

## TEST CONDITIONS

### POWER SUPPLY (V):

V nominal: 12 Vdc.  
 Type of Power Supply: DC External (Car Battery).

### ANTENNA:

Type of Antenna: External antenna.  
 Maximum Declared Antenna Gain: -5.4 dBi (antenna gain plus antenna cable loss).

Technology Tested:	WLAN (IEEE 802.11 a/n/ac): U-NII-3 band	
Modes:	802.11a: 6, 9, 12, 18, 24, 36, 48 & 54 Mbps	
	802.11n HT20: MCS0 to MCS7	
	802.11n HT40: MCS0 to MCS7	
	802.11ac VHT20: MCS0 to MCS8	
	802.11ac VHT40: MCS0 to MCS9	
	802.11ac VHT80: MCS0 to MCS9	
Setting of cores / ports:	One port.	
Beamforming:	No	
Frequency Range:	5725 MHz to 5850 MHz	
Channel Spacing:	20 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Low: 149	5745
	Middle: 157	5785
	High: 165	5825
Channel Spacing:	40 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Low: 151	5755
	High: 159	5795
Channel Spacing:	80 MHz	
Transmit Channels	Middle: 155	5775

The test set-up was made in accordance to the general provisions of ANSI C63.10: 2013 and FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01 dated 12/14/2017.

The EUT was tested in the following operating mode:

- Continuously transmitting with a modulated carrier at maximum power in all required channels using the supported data rates/modulations types.

The field strength at the band edges was evaluated for each mode individually on the lowest and highest channels at the rated power for the channel under test.

For all modes, the EUT was configured in test mode using a software application. The application was used to enable a continuous transmission and to select the test channels as required. The client supplied scripts to configure the EUT. The customer supplied a document containing the setup instructions.

The worst cases for testing were identified for output power and spurious levels at the band edges which were selected based on preliminary testing that correspond to next data rates:

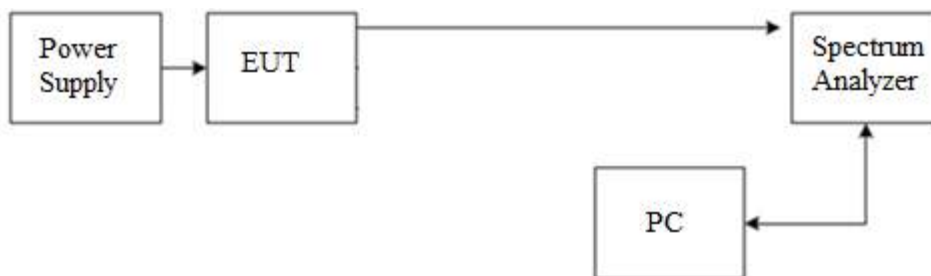
- 802.11a20: 6 Mbit/s
- 802.11n HT20: MCS0
- 802.11n HT40: MCS0
- 802.11ac VHT20: MCS0
- 802.11ac VHT40: MCS0
- 802.11ac VHT80: MCS0



### CONDUCTED MEASUREMENTS:

The equipment under test was set up in a shielded room and connected to the spectrum analyzer using a low loss RF cable. The reading in the spectrum analyzer is corrected taking into account the internal and external RF cable loss.

For all modes:



The DC supply voltage is applied using an external power supply.

### RADIATED MEASUREMENTS:

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz and 1 GHz-17 GHz Double ridge horn antenna) is situated at a distance of 3 m in the range 30 MHz – 17 GHz and at a distance of 1m for the frequency range 17 GHz-40 GHz (17 GHz-40 GHz horn antenna).

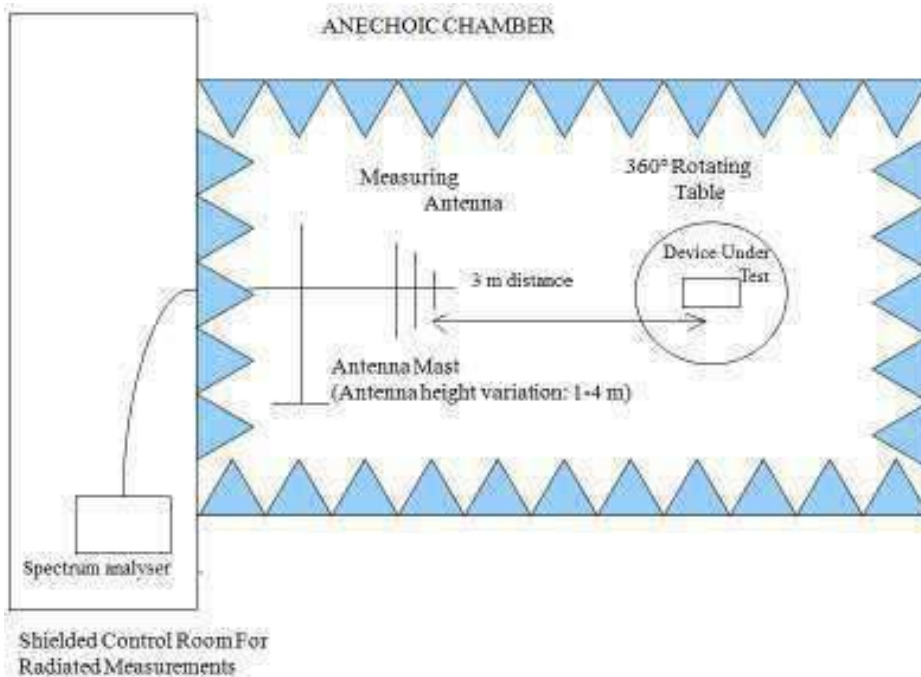
For radiated emissions in the range 17 GHz-40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find the maximum radiated emission.

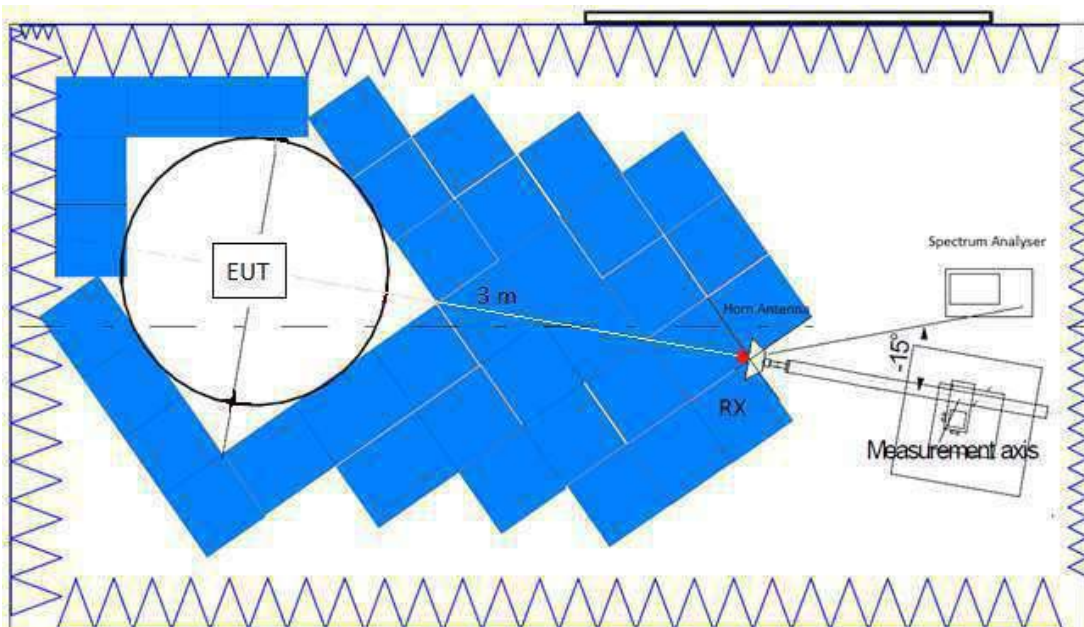
Measurements were made in both horizontal and vertical planes of polarization.

A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

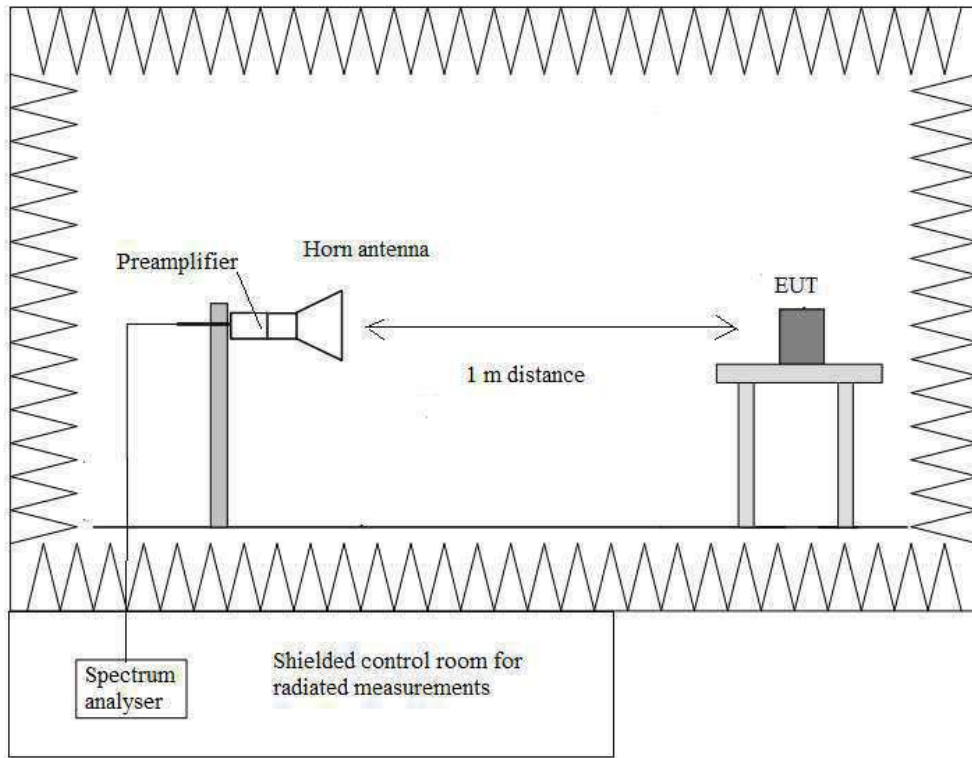
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup  $f > 17$  GHz:



## FCC 15.247 (e) / RSS-247 6.2.4.1. 6 dB Bandwidth

### SPECIFICATION:

The minimum 6 dB bandwidth shall be at least 500 kHz.

### RESULTS:

The following modes and data rates were selected based on preliminary testing that identified those corresponding to the worst cases:

- 802.11a20: 6 Mbit/s
- 802.11n HT40: MCS0
- 802.11ac VHT20: MCS0
- 802.11ac VHT80: MCS0

#### Mode 802.11 a20:

	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
6 dB Bandwidth (MHz)	16.3358	15.7402	16.0619
Measurement uncertainty (kHz)	<±13.86		

#### Mode 802.11 n20 (HT20):

	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
6 dB Bandwidth (MHz)	17.5726	16.66986	16.66637
Measurement uncertainty (kHz)	<±13.86		

#### Mode 802.11 ac20 (VHT20):

	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
6 dB Bandwidth (MHz)	17.5667	16.6643	16.54591
Measurement uncertainty (kHz)	<±13.86		

#### Mode 802.11 n40 (HT40):

	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
6 dB Bandwidth (MHz)	36.21813	35.51944
Measurement uncertainty (kHz)	<±16.16	

**Mode 802.11 ac40 (VHT40):**

	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
6 dB Bandwidth (MHz)	35.746	35.734
Measurement uncertainty (kHz)	<±16.16	

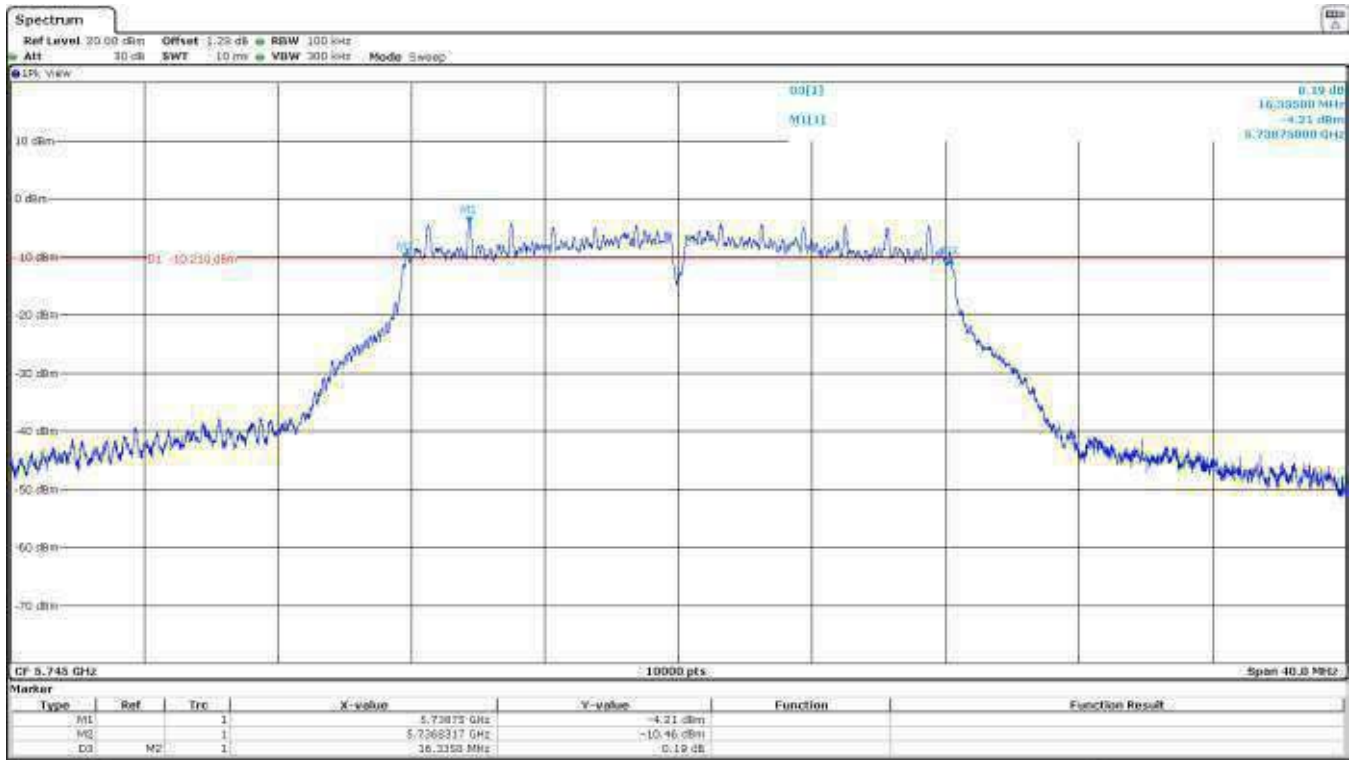
**Mode 802.11 ac80 (VHT80):**

	Single Channel 155 (5775 MHz)
6 dB bandwidth (MHz)	75.926
Measurement uncertainty (kHz)	<±20.79

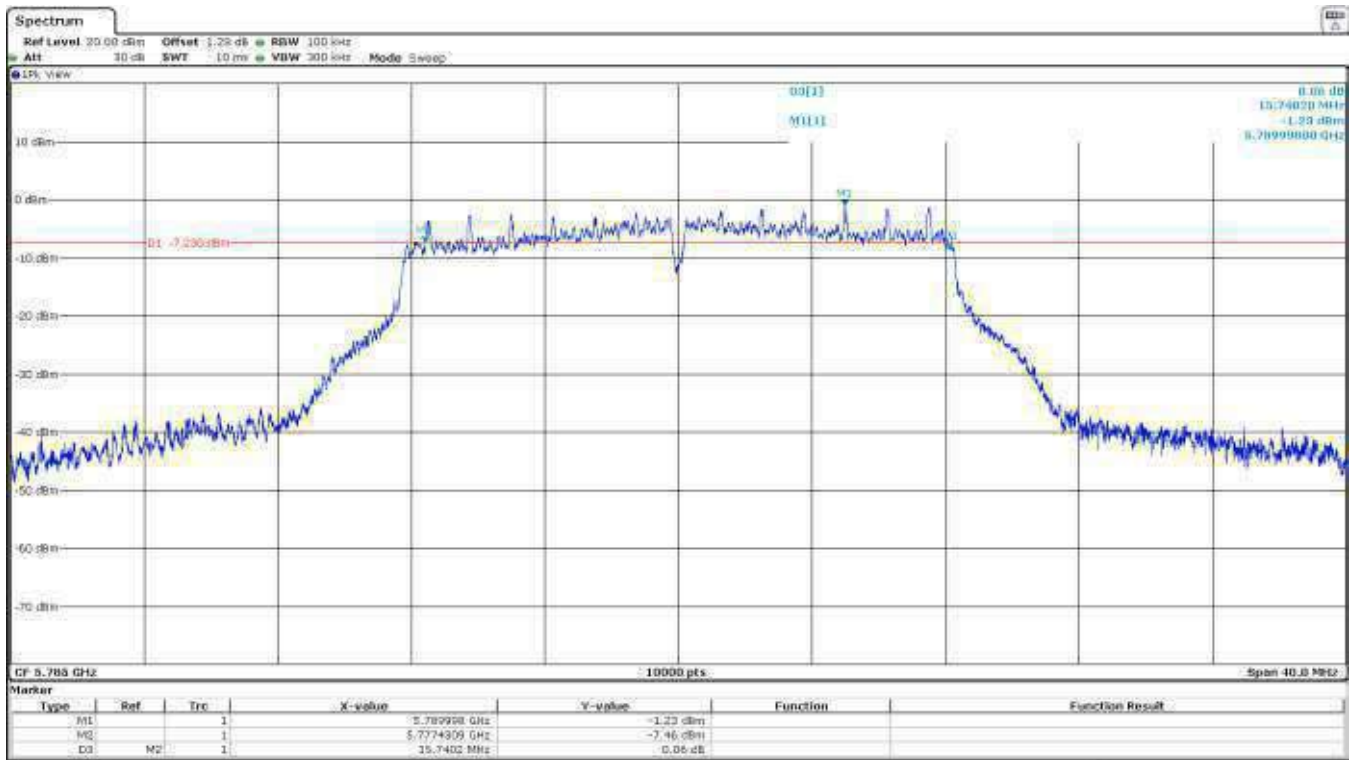
Verdict: PASS

**Mode 802.11 a20:**

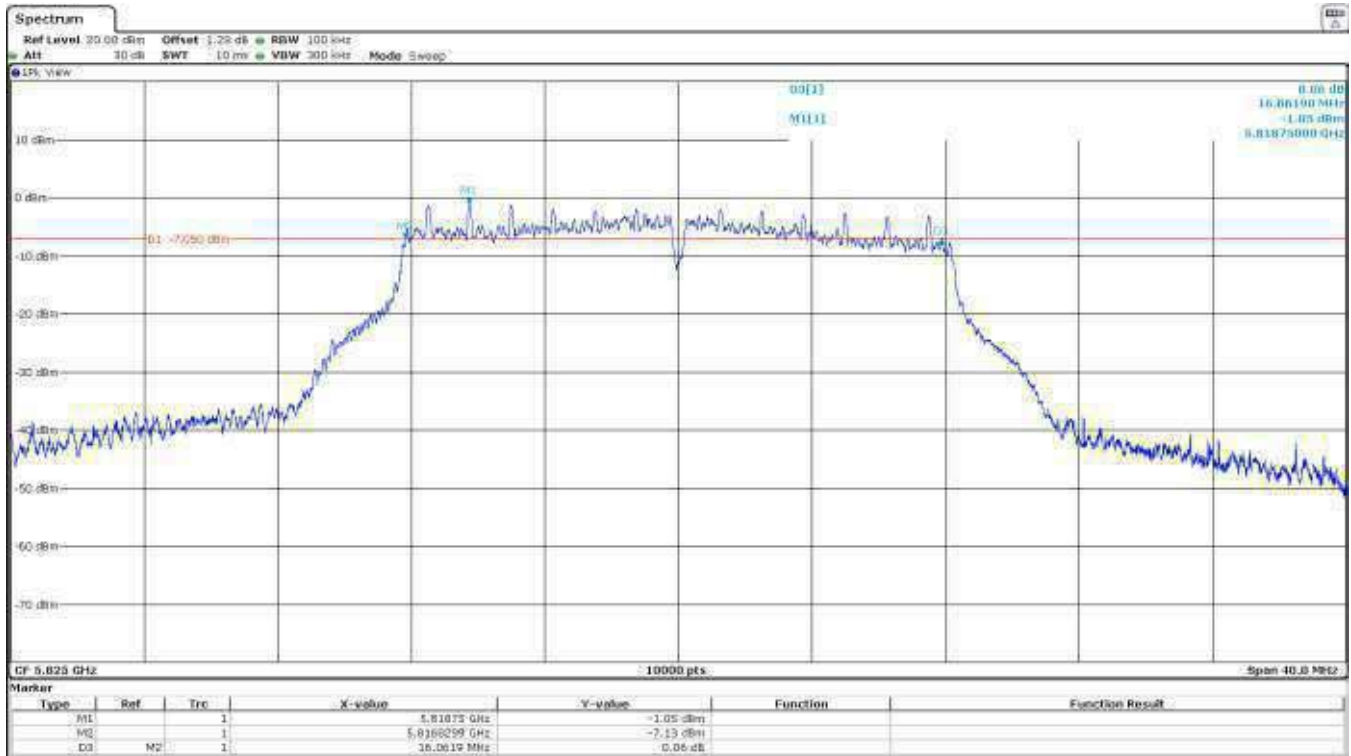
- Low Channel:



- Middle Channel:

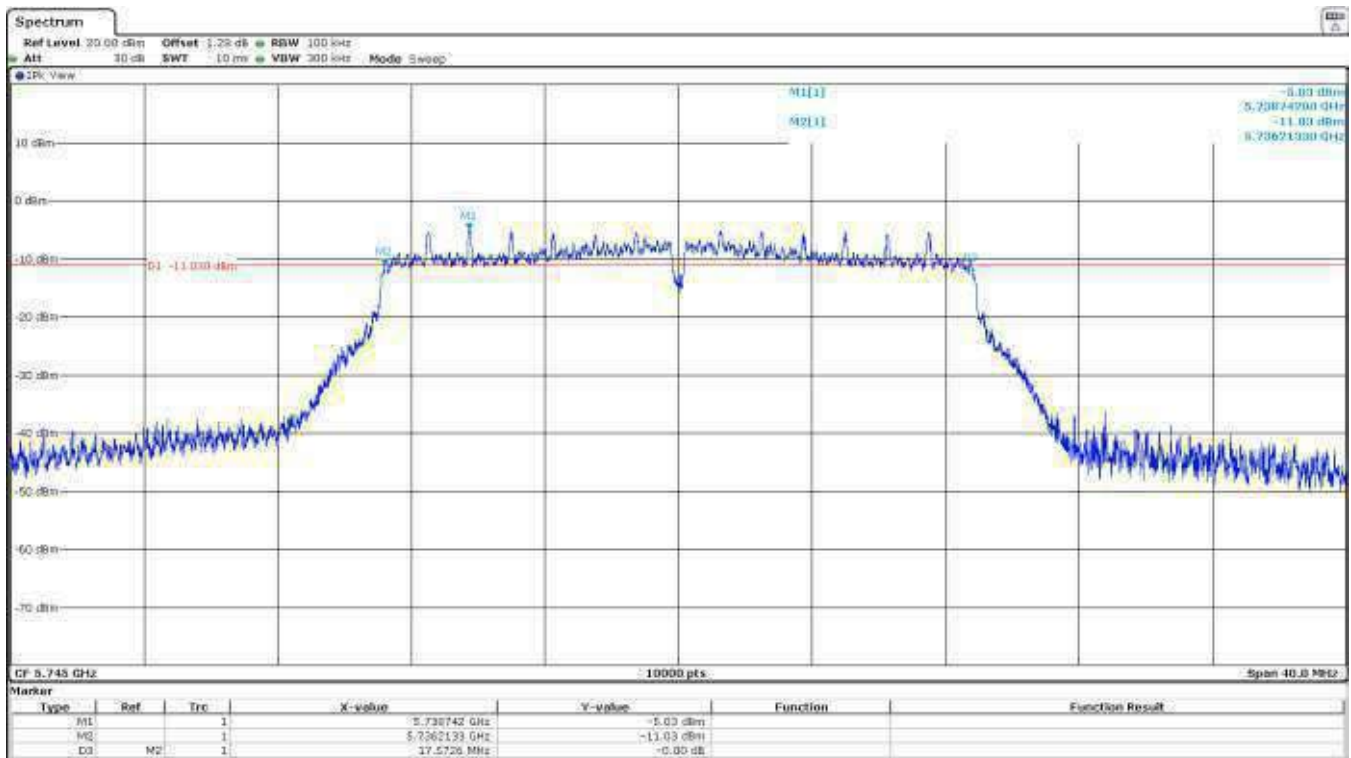


- High Channel:

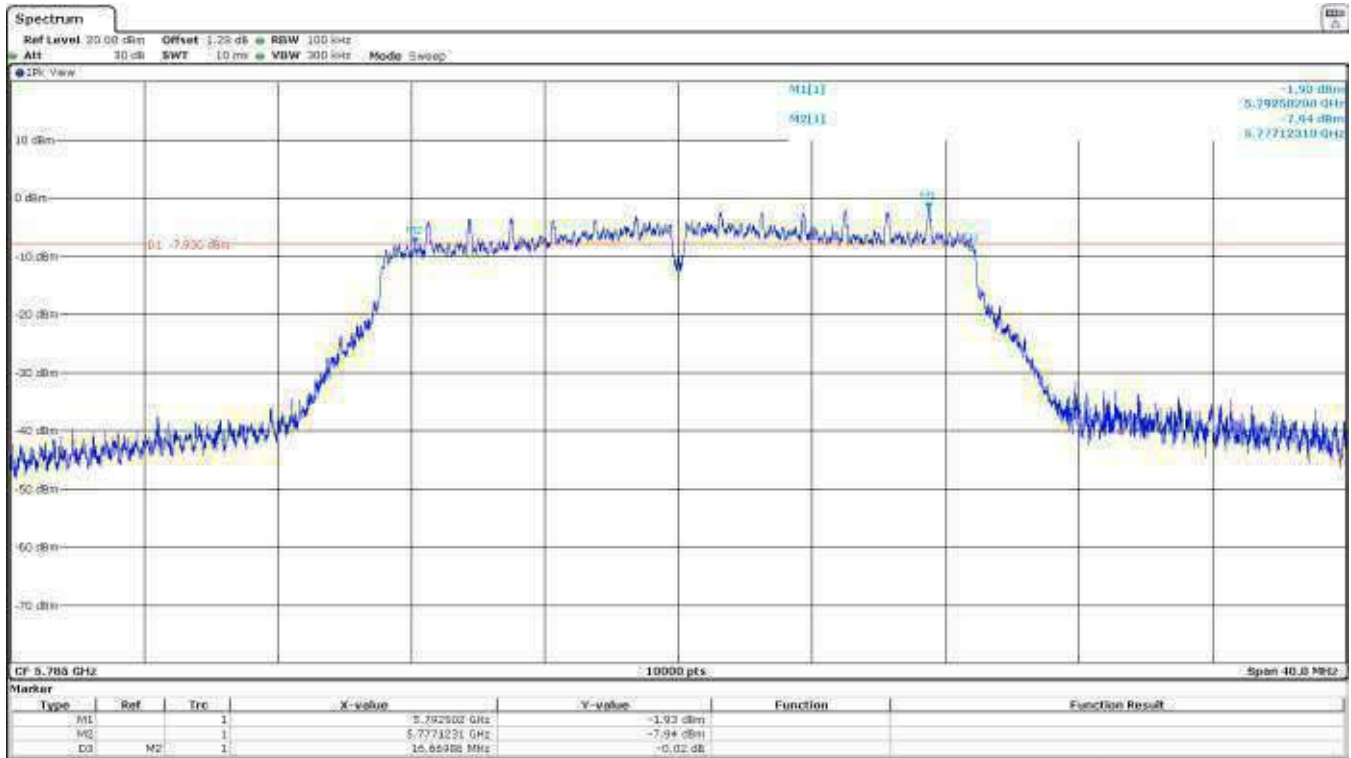


Mode 802.11 n20 (HT20):

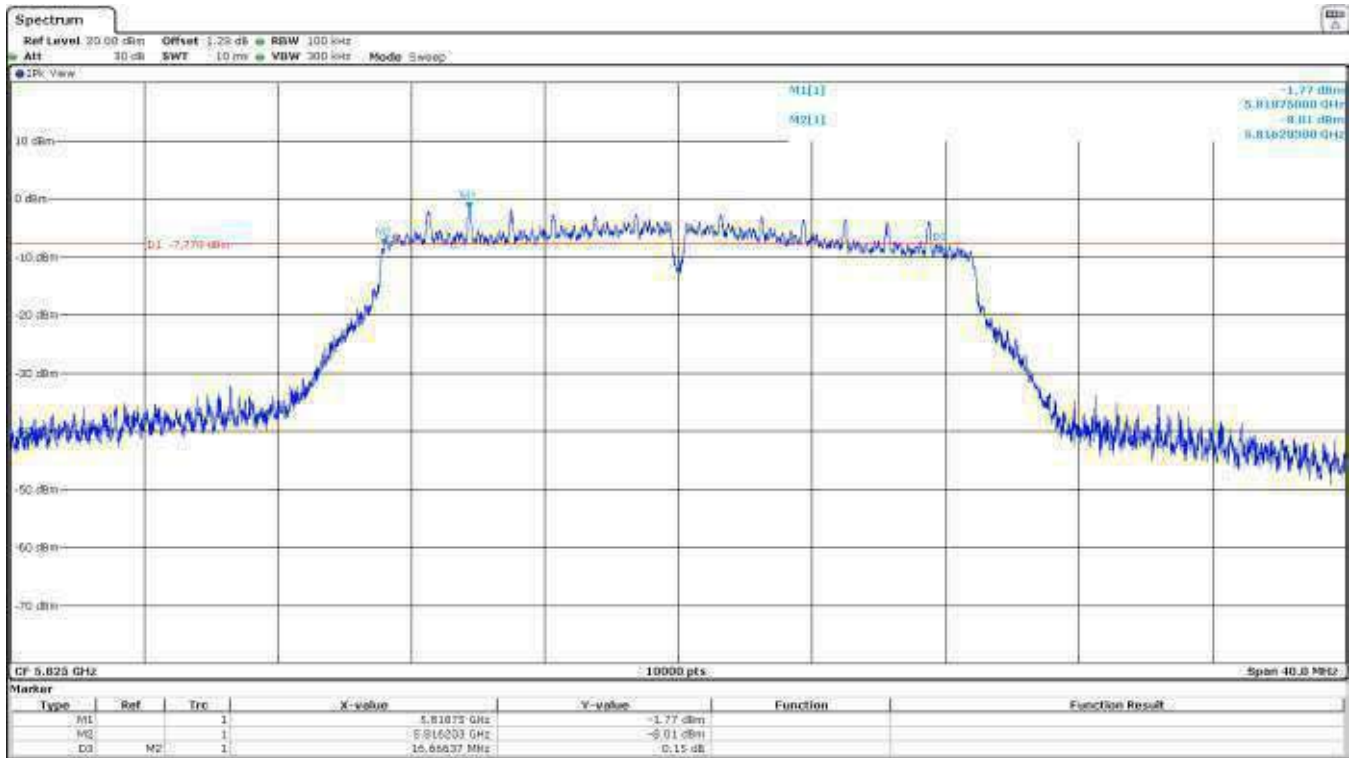
- Low Channel:



- Middle Channel:



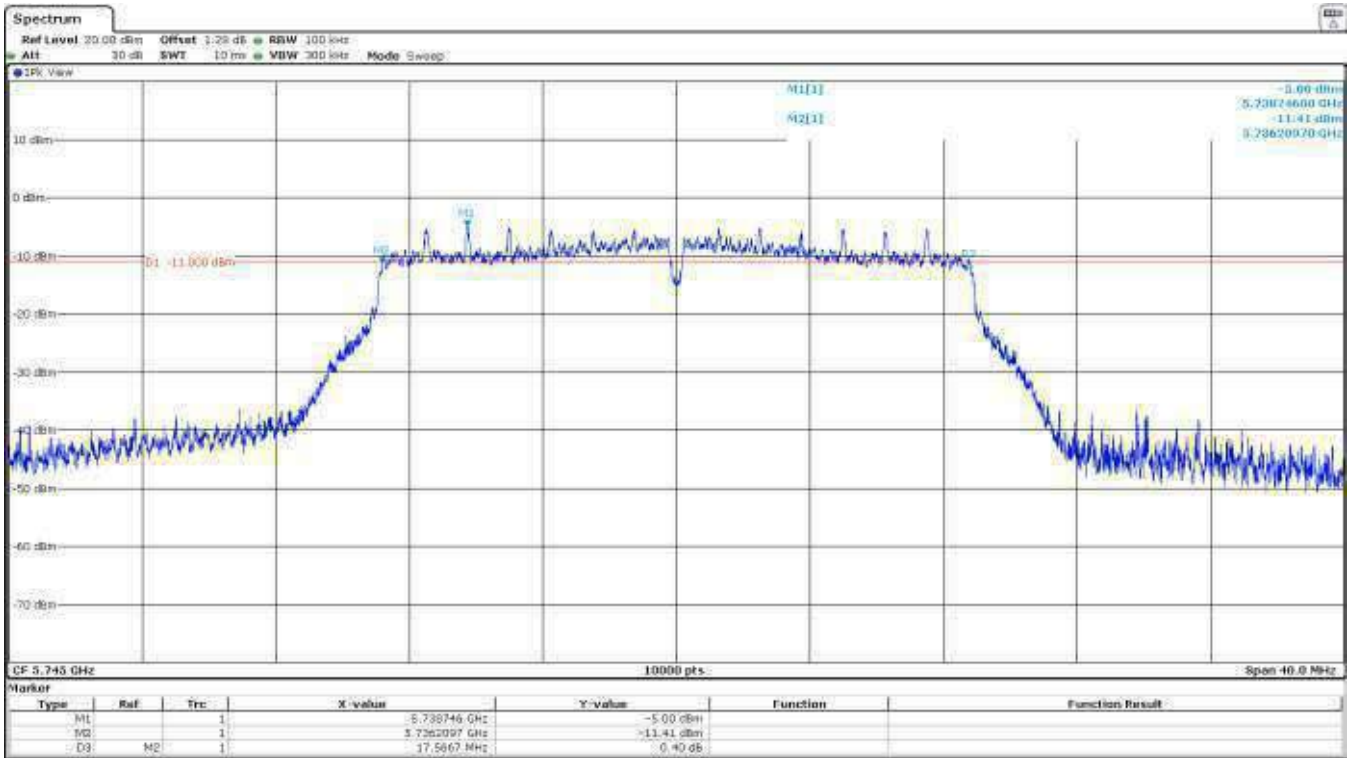
- High Channel:



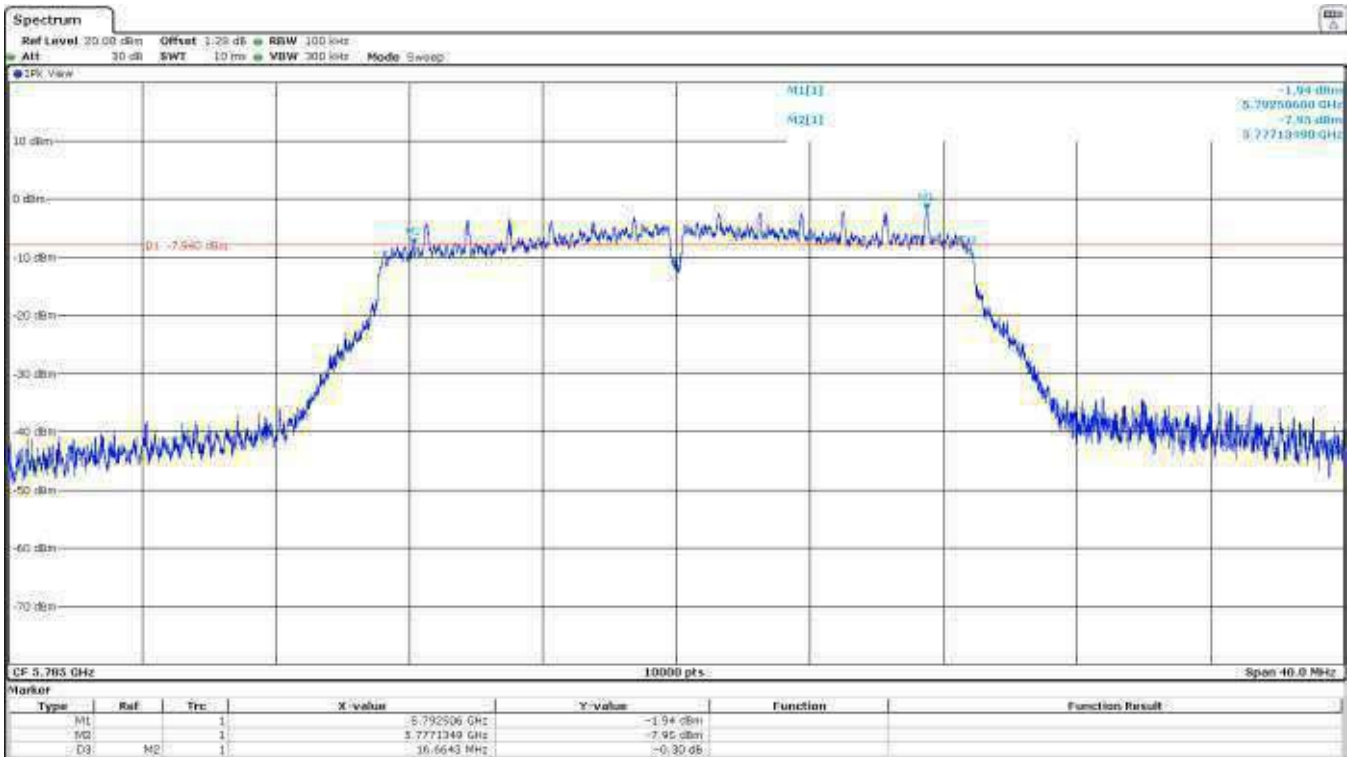


**Mode 802.11 ac20 (VHT20):**

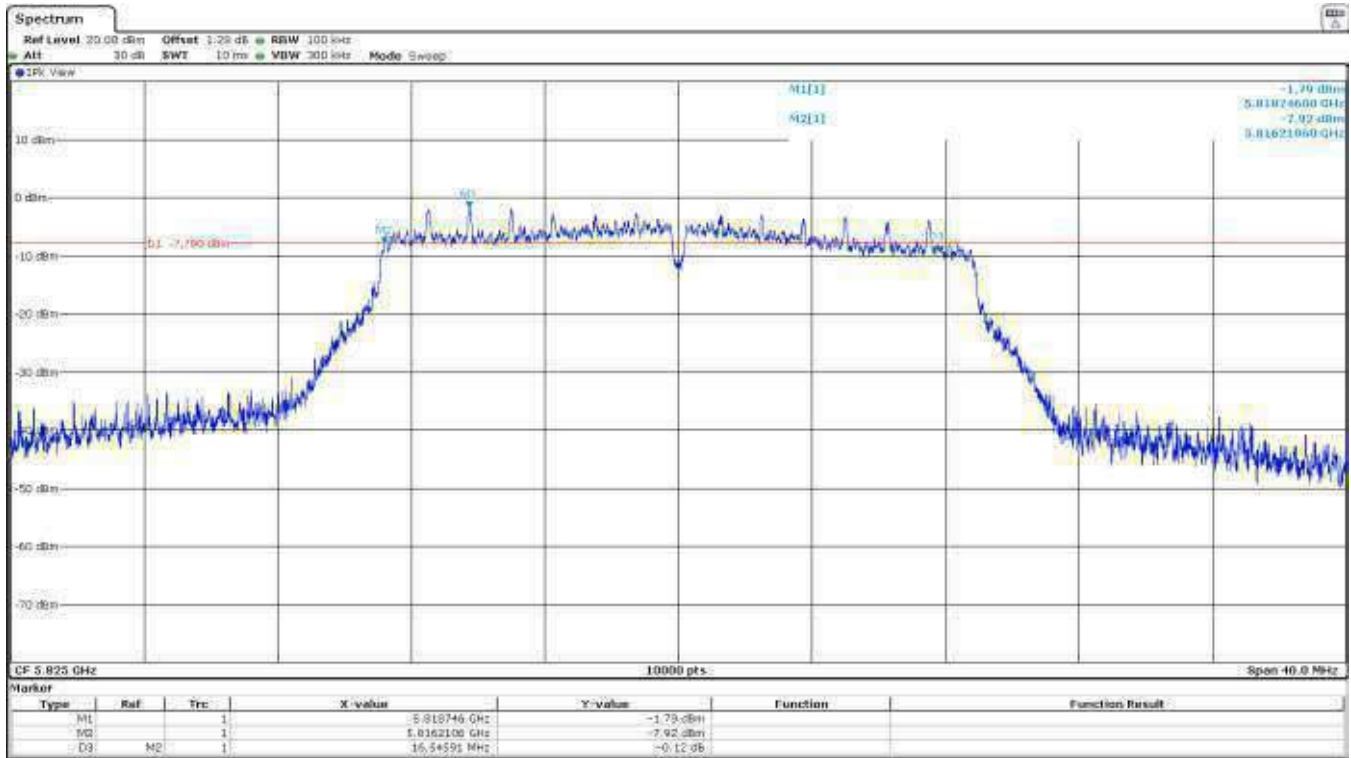
- Low Channel:



- Middle Channel:

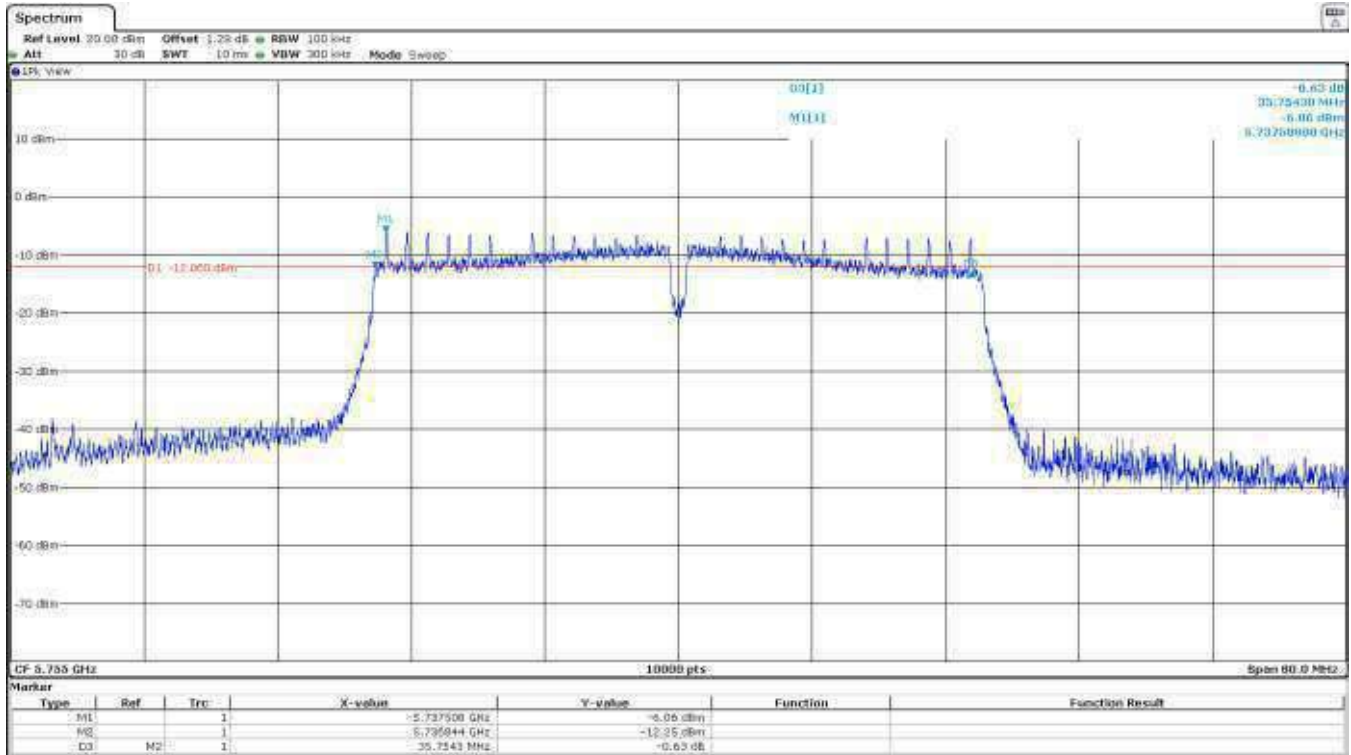


- High Channel:

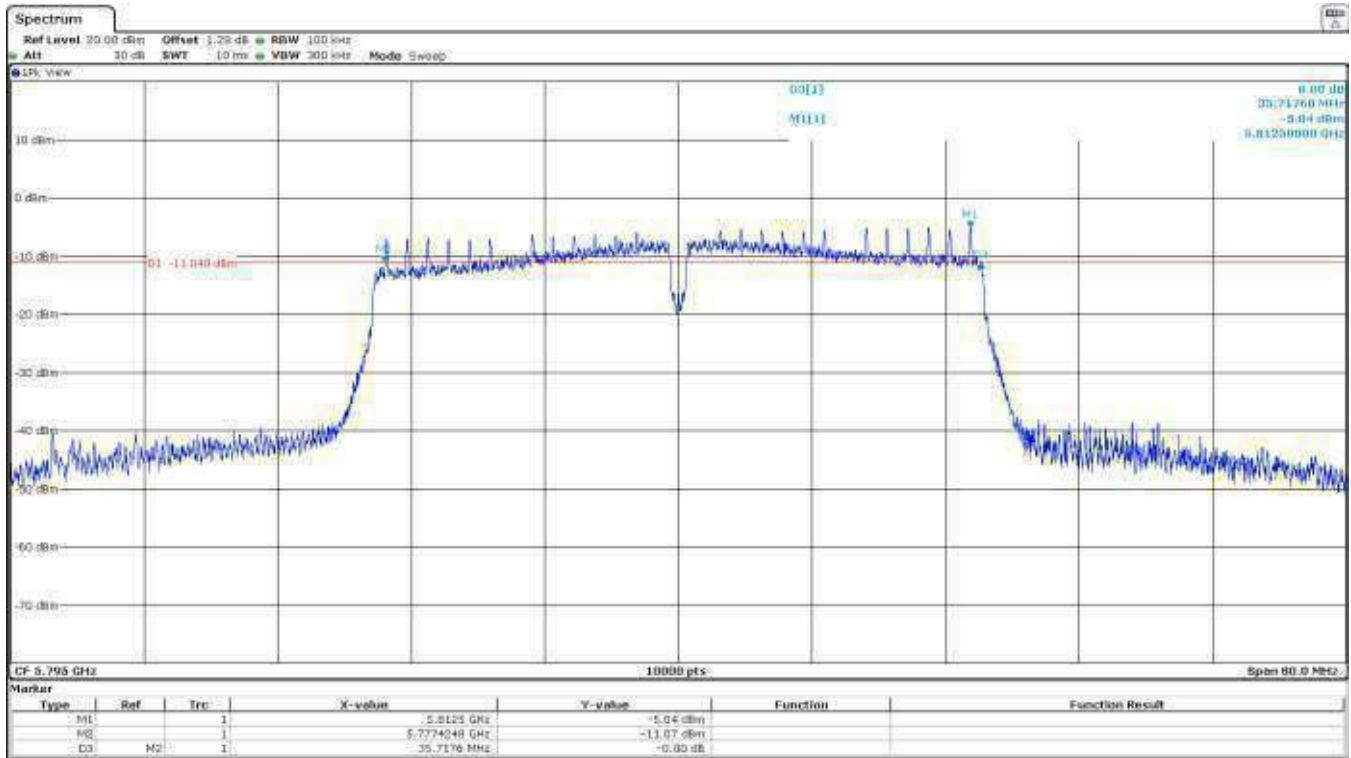


Mode 802.11 n40 (HT40):

- Low Channel:

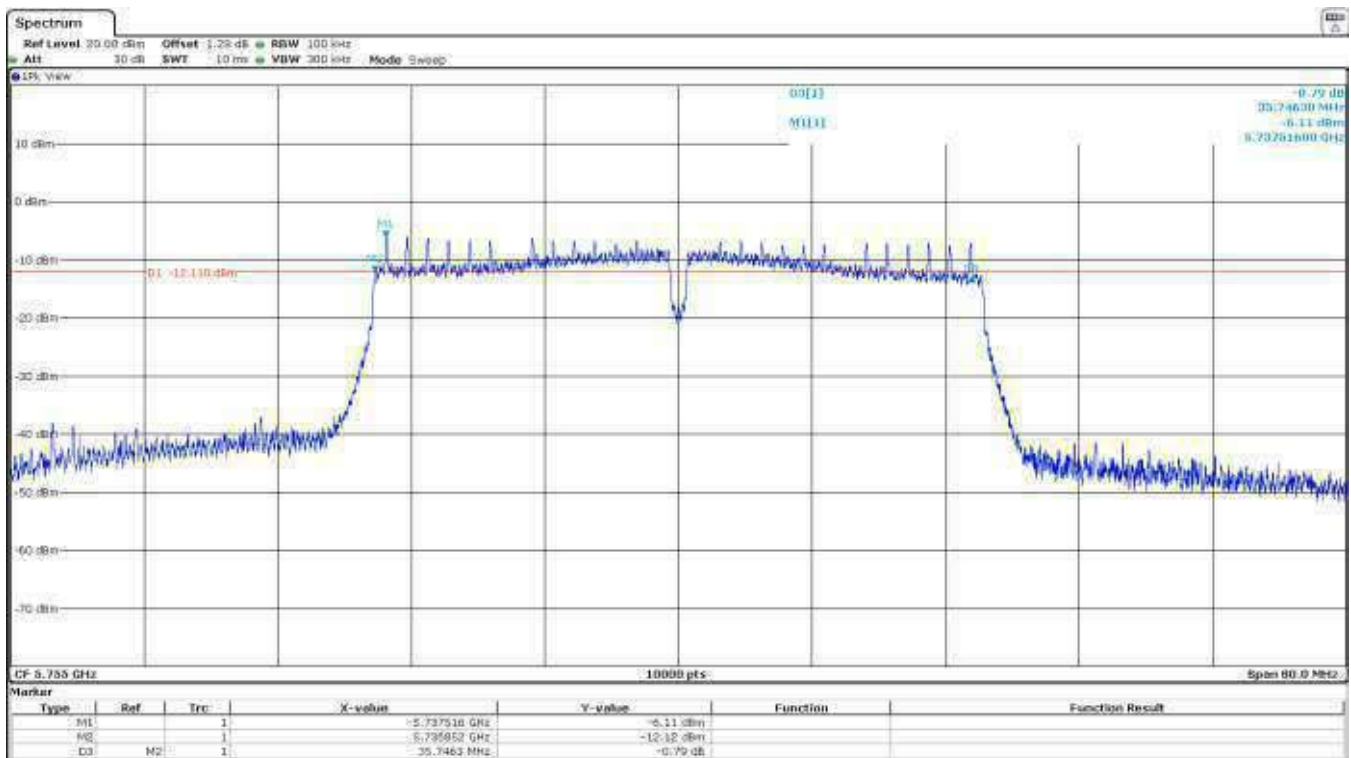


- High Channel:

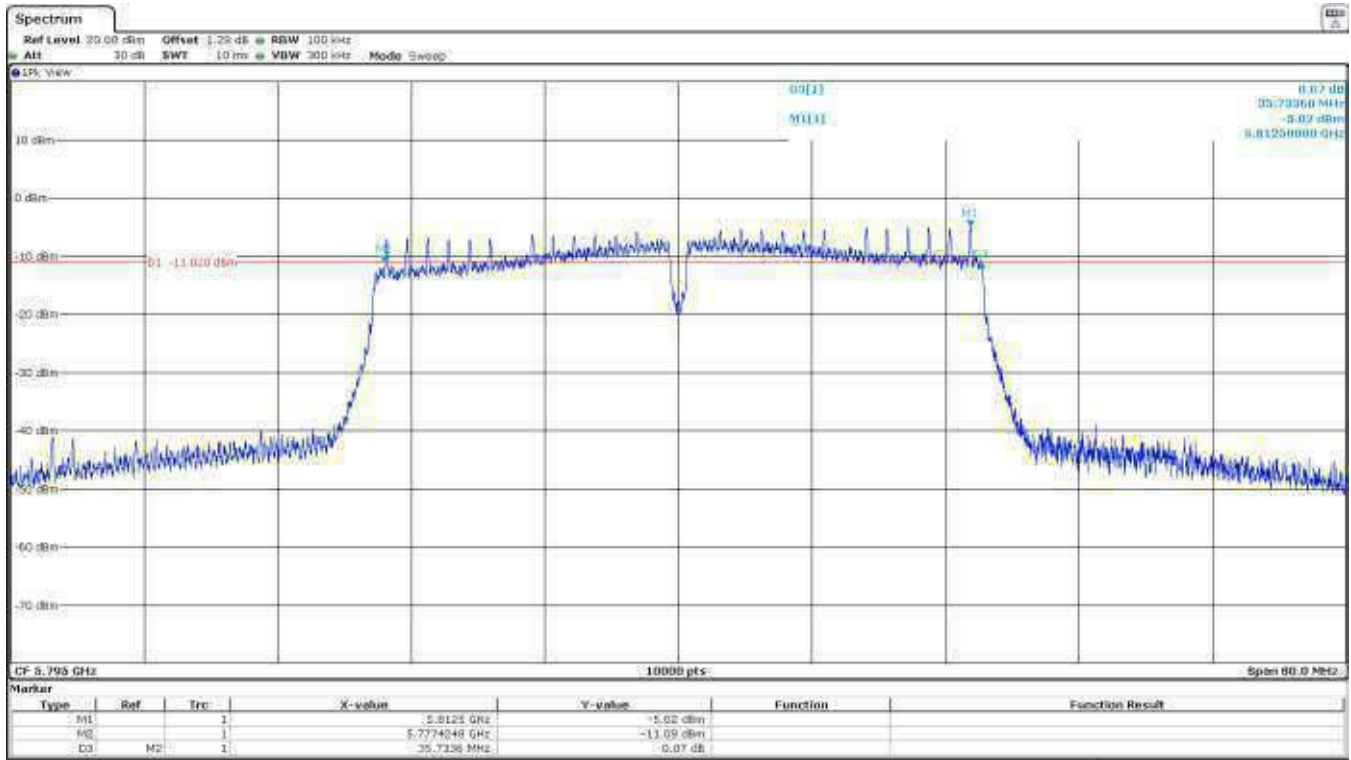


Mode 802.11 ac40 (VHT40):

- Low Channel:

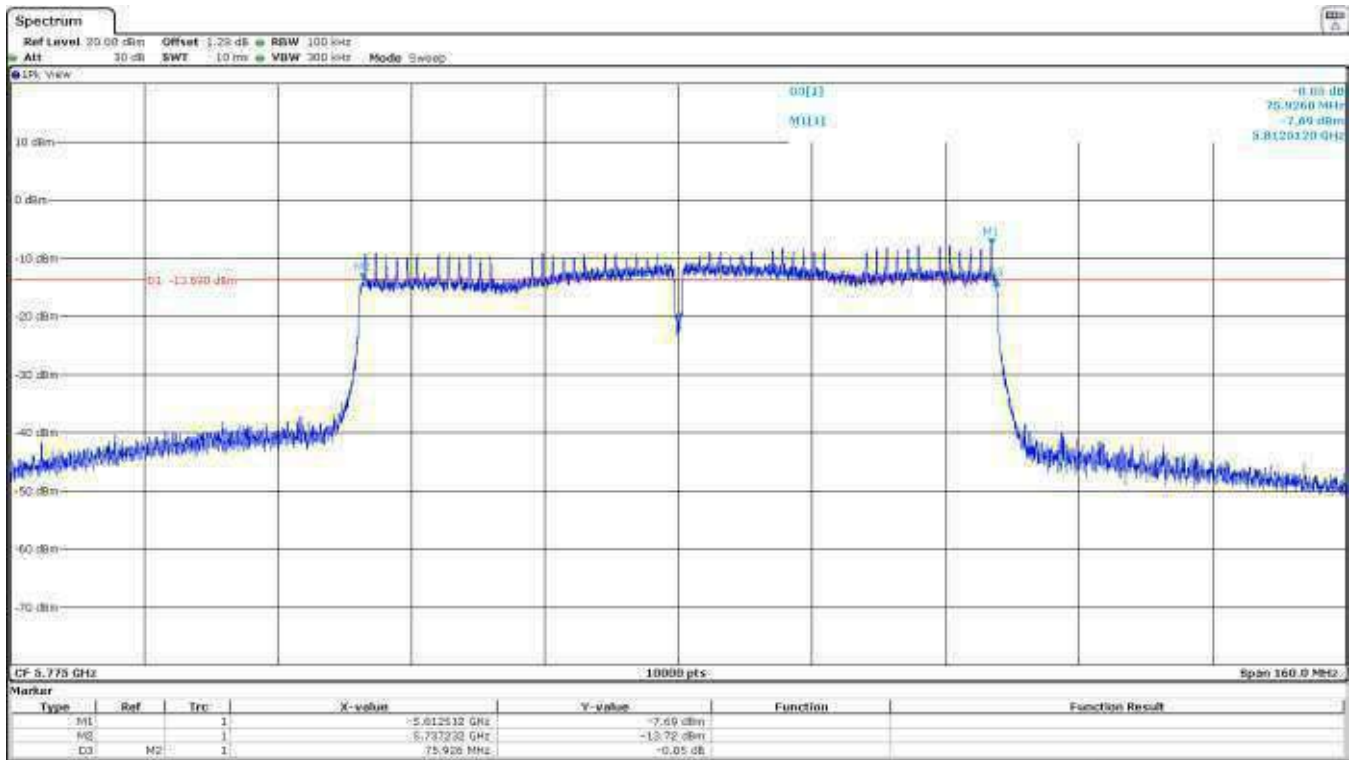


- High Channel:



Mode 802.11 ac80 (VHT80):

- Single Channel:



## FCC 15.407 (a)(3) / RSS-247 6.2.4.1. Transmitter Maximum Conducted Output Power

### SPECIFICATION:

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1W (30 dBm). If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### RESULTS:

The maximum conducted output power was measured using the channel power integration method according to point E) 2) b) (Method SA-1) of 789033 D02 General UNII Test Procedures New Rules v02r01 when the duty cycle is >98% and the channel power integration method according to point E) 2) d) (Method SA-2) of 789033 D02 General UNII Test Procedures New Rules v02r01 when the duty cycle is <98%.

For data rates where the EUT was transmitting at <98% duty cycle, the duty calculated in Appendix A was added to the measured power in order to calculate the total average power during the actual transmission time.

For all modes of operation, the antenna gain is less than 6 dBi.

The e.i.r.p. levels are calculated by adding the declared maximum antenna gain (dBi).

Maximum Declared Antenna Gain:        -5.4 dBi

**Mode 802.11 a20:**

	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
Max. Conducted Power (dBm)	5.93	8.32	8.43
Duty Cycle Correction Factor (dB)	0.980		
Max. Conducted Power Corrected (dBm)	6.910	9.300	9.410
Maximum EIRP power Corrected (dBm)	1.510	3.900	4.010
Measurement uncertainty (dB)	<±2.57		

**Mode 802.11 n20 (HT20):**

	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
Max. Conducted Power (dBm)	8.42	9.19	9.77
Duty Cycle Correction Factor (dB)	1.056		
Max. Conducted Power Corrected (dBm)	9.476	10.246	10.826
Maximum EIRP power Corrected (dBm)	4.076	4.846	5.426
Measurement uncertainty (dB)	<±2.57		

**Mode 802.11 ac20 (VHT20):**

	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
Max. Conducted Power (dBm)	8.18	9.35	9.76
Duty Cycle Correction Factor (dB)	1.051		
Max. Conducted Power Corrected (dBm)	9.231	10.401	10.811
Maximum EIRP power Corrected (dBm)	3.831	5.001	5.411
Measurement uncertainty (dB)	<±2.57		

**Mode 802.11 n40 (HT40):**

	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
Max. Conducted Power (dBm)	7.02	8.21
Duty Cycle Correction Factor (dB)	1.992	
Max. Conducted Power Corrected (dBm)	9.012	10.202
Maximum EIRP power Corrected (dBm)	3.612	4.802
Measurement uncertainty (dB)	<±2.57	

**Mode 802.11 ac40 (VHT40):**

	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
Max. Conducted Power (dBm)	7.07	8.16
Duty Cycle Correction Factor (dB)	1.938	
Max. Conducted Power Corrected (dBm)	9.008	10.098
Maximum EIRP power Corrected (dBm)	3.608	4.698
Measurement uncertainty (dB)	<±2.57	

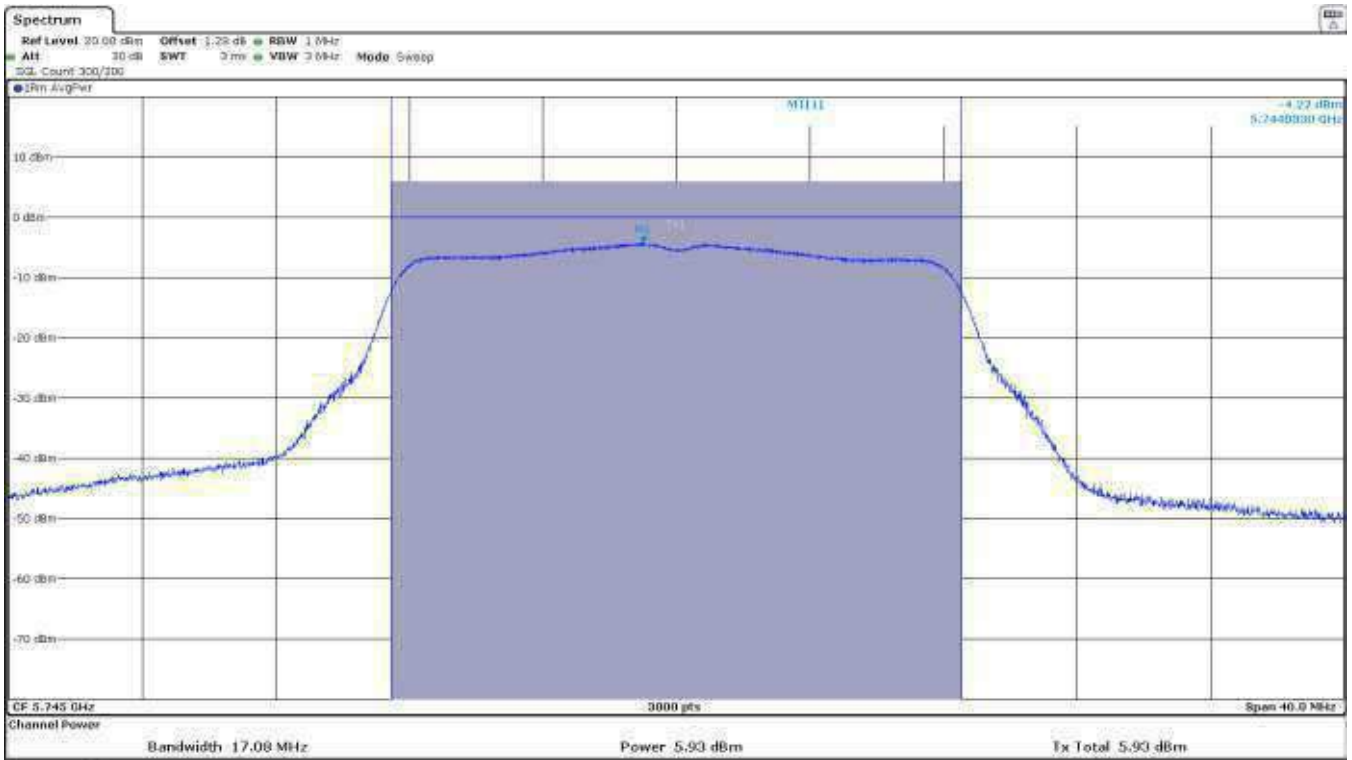
**Mode 802.11 ac80 (VHT80):**

	Low Channel 155 (5775 MHz)
Max. Conducted Power (dBm)	5.48
Duty Cycle Correction Factor (dB)	3.420615317
Max. Conducted Power Corrected (dBm)	8.901
Maximum EIRP power Corrected (dBm)	3.501
Measurement uncertainty (dB)	<±2.57

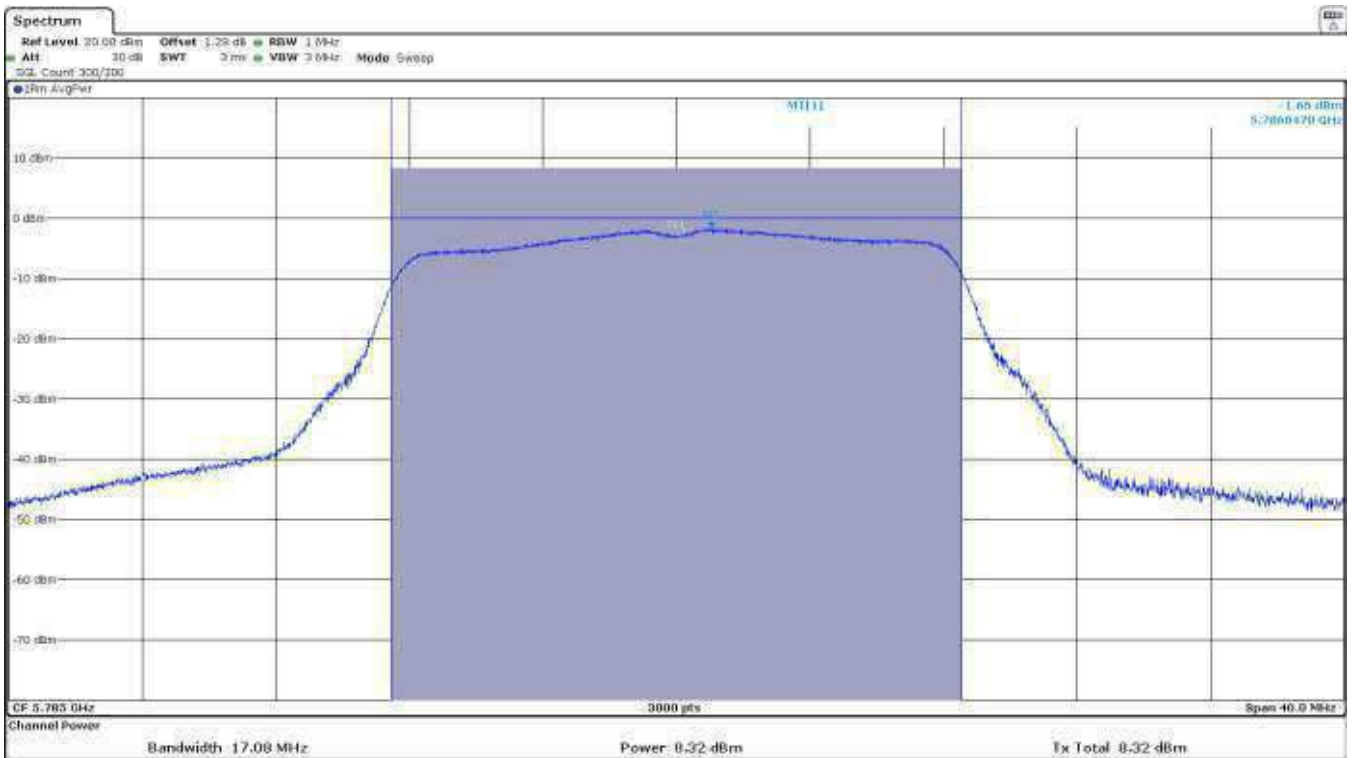
Verdict: PASS

**Mode 802.11 a20:**

- Low Channel:

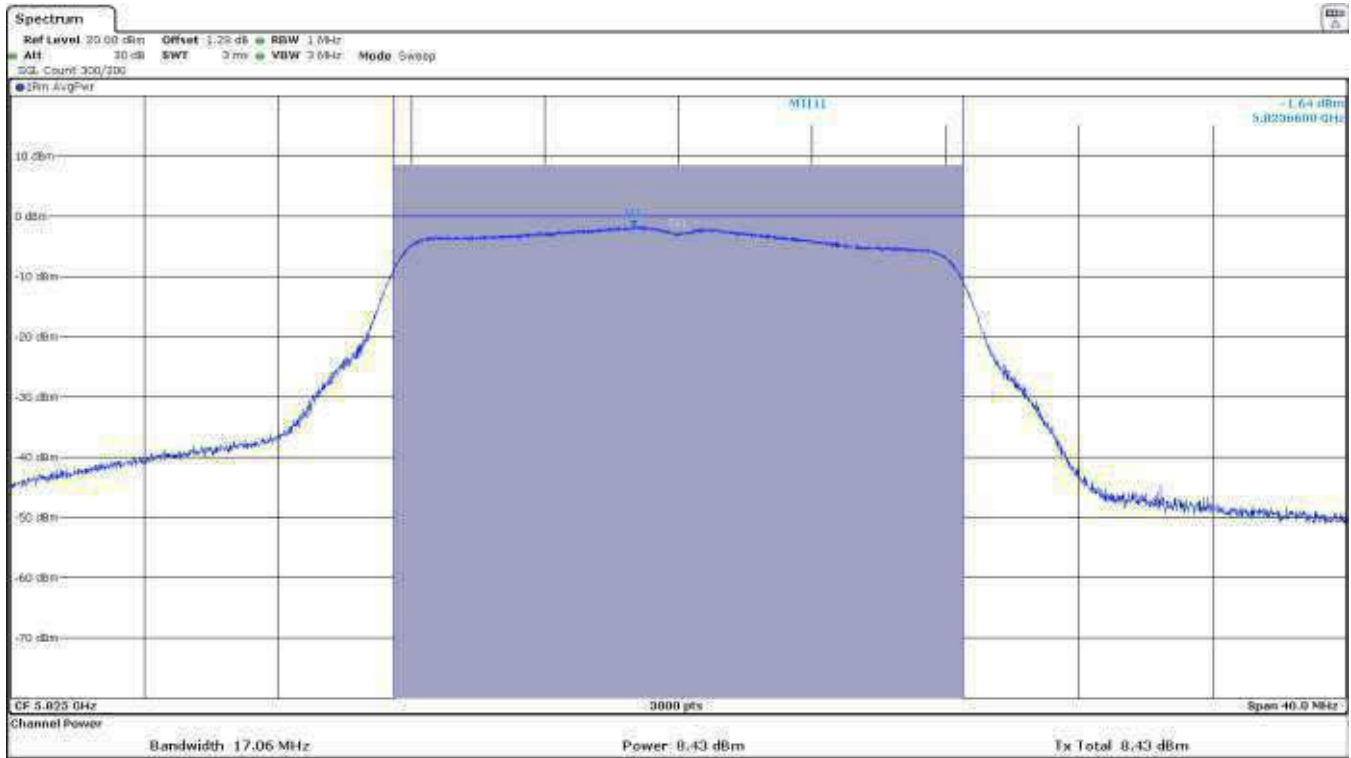


- Middle Channel:



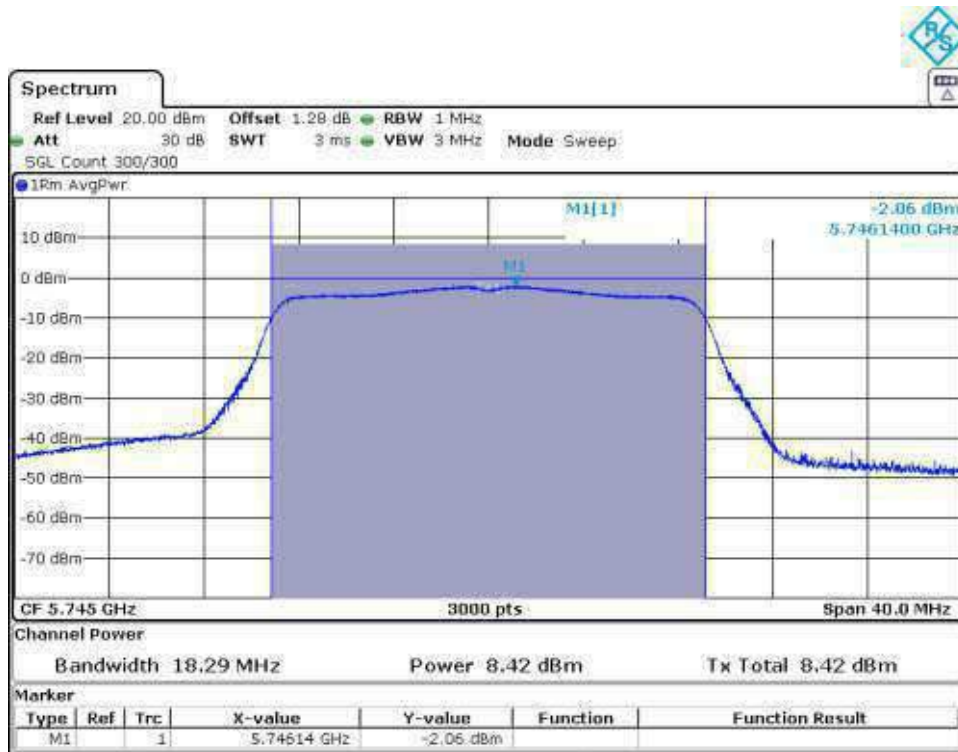


- High Channel:

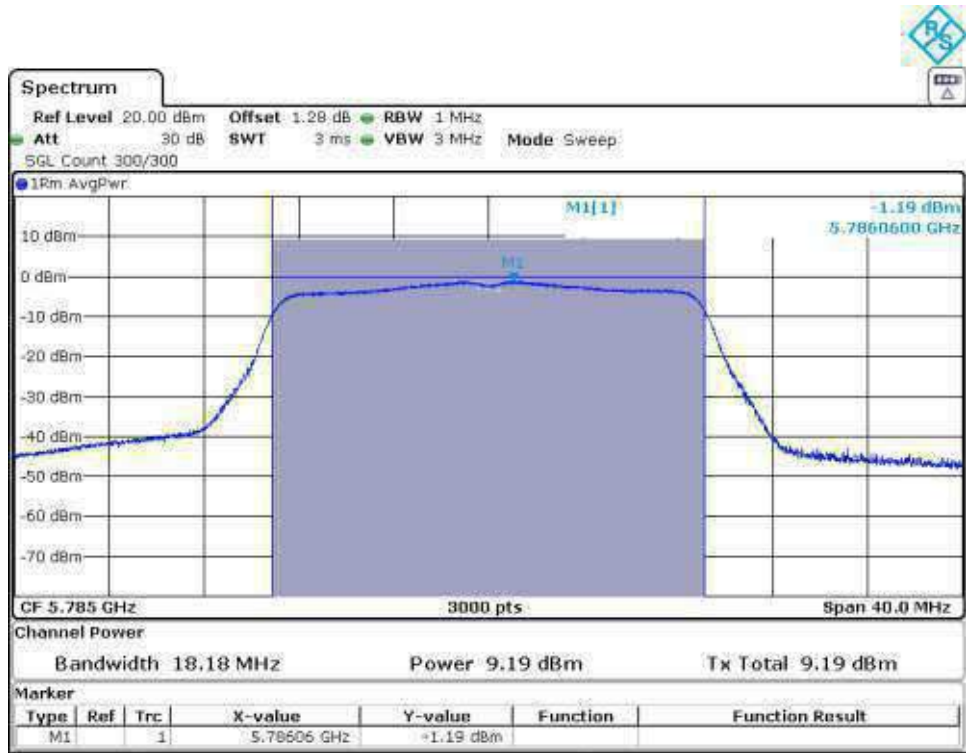


Mode 802.11 n20 (HT20):

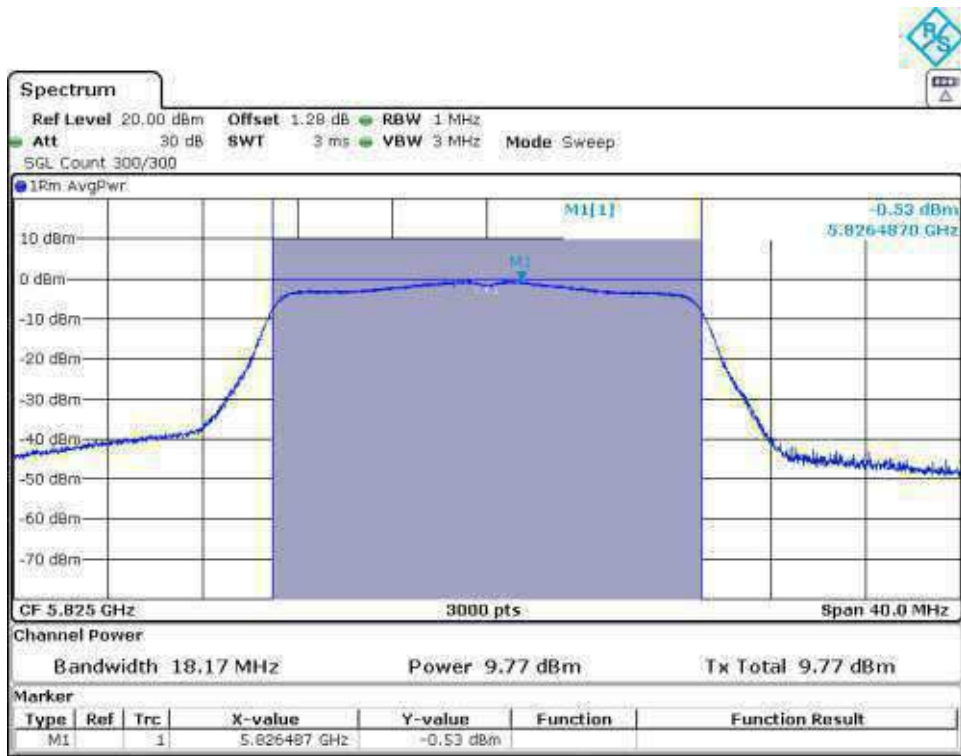
- Low Channel:



- Middle Channel:



- High Channel:

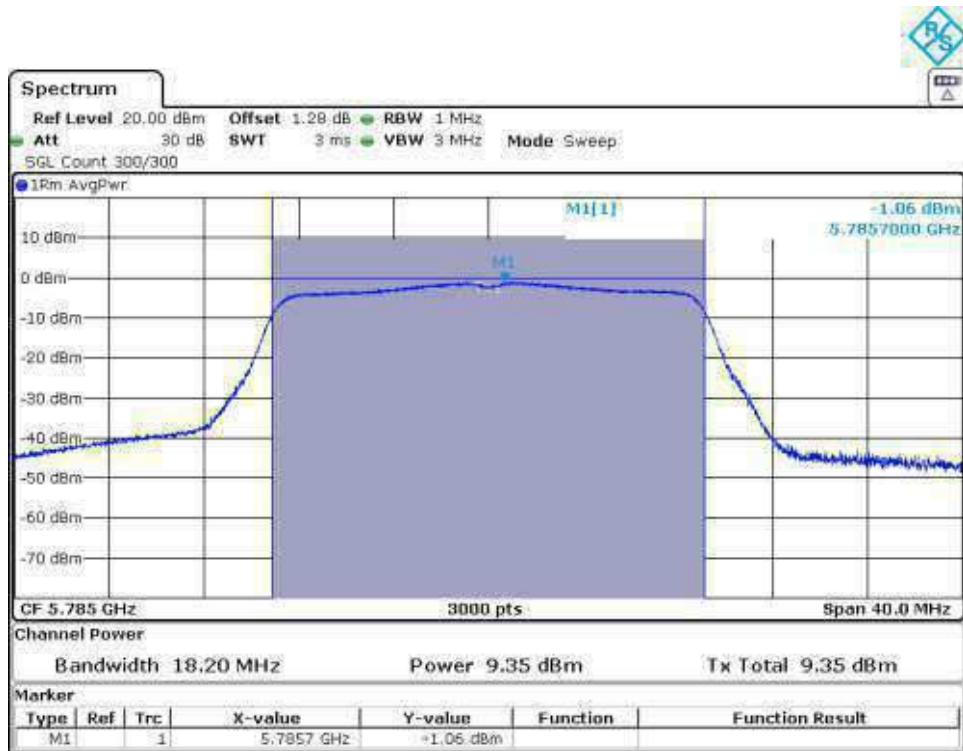


**Mode 802.11 ac20 (VHT20):**

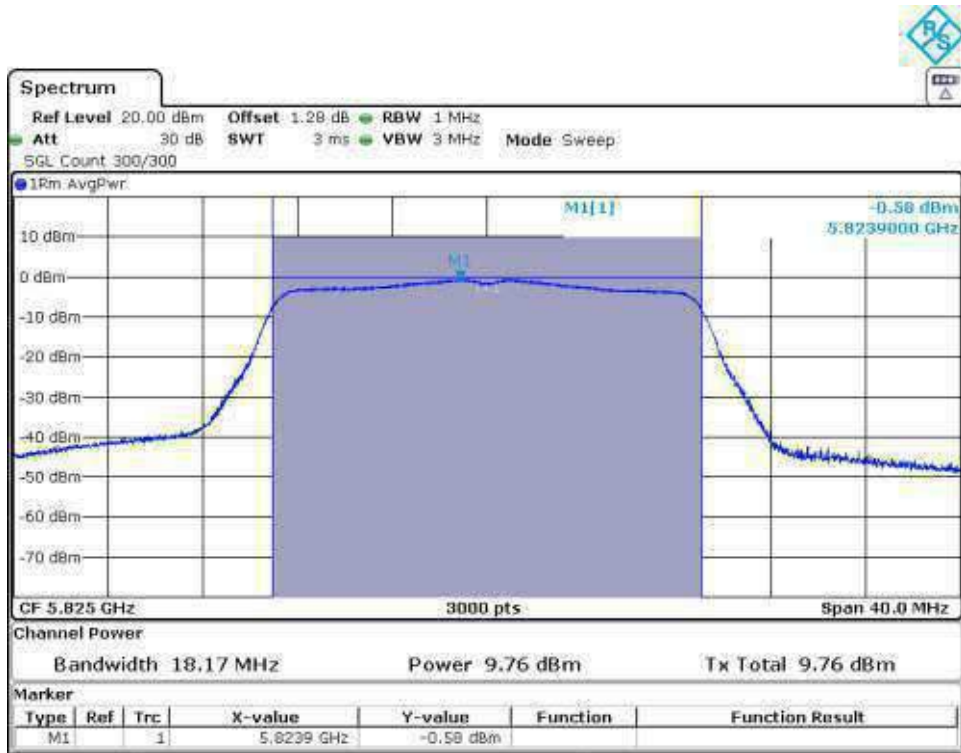
- Low Channel:



- Middle Channel:

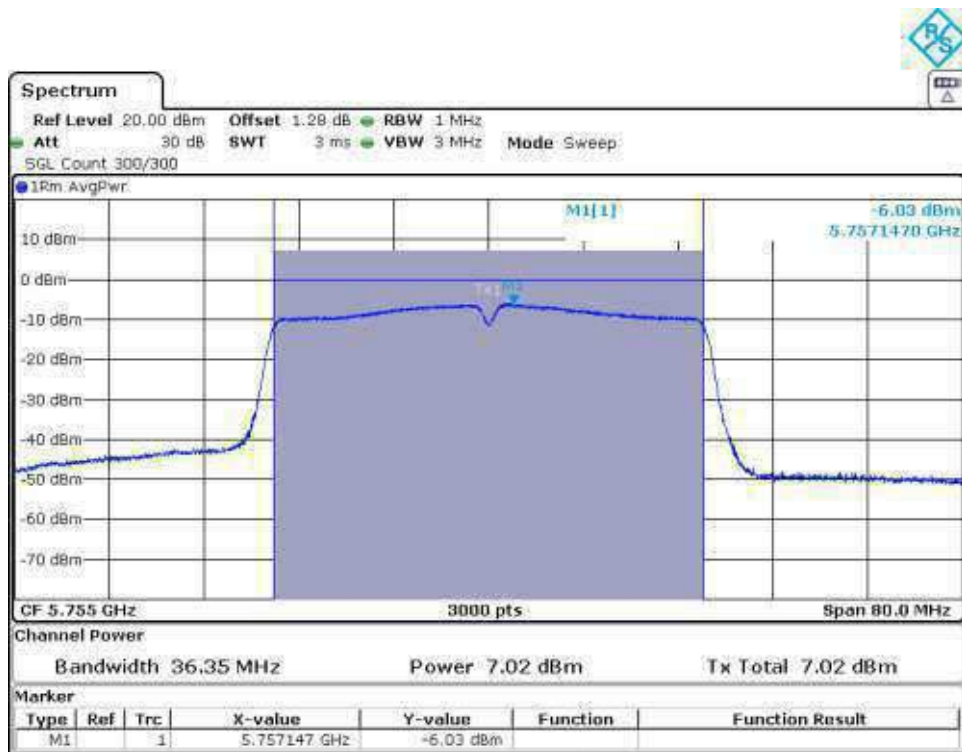


- High Channel:

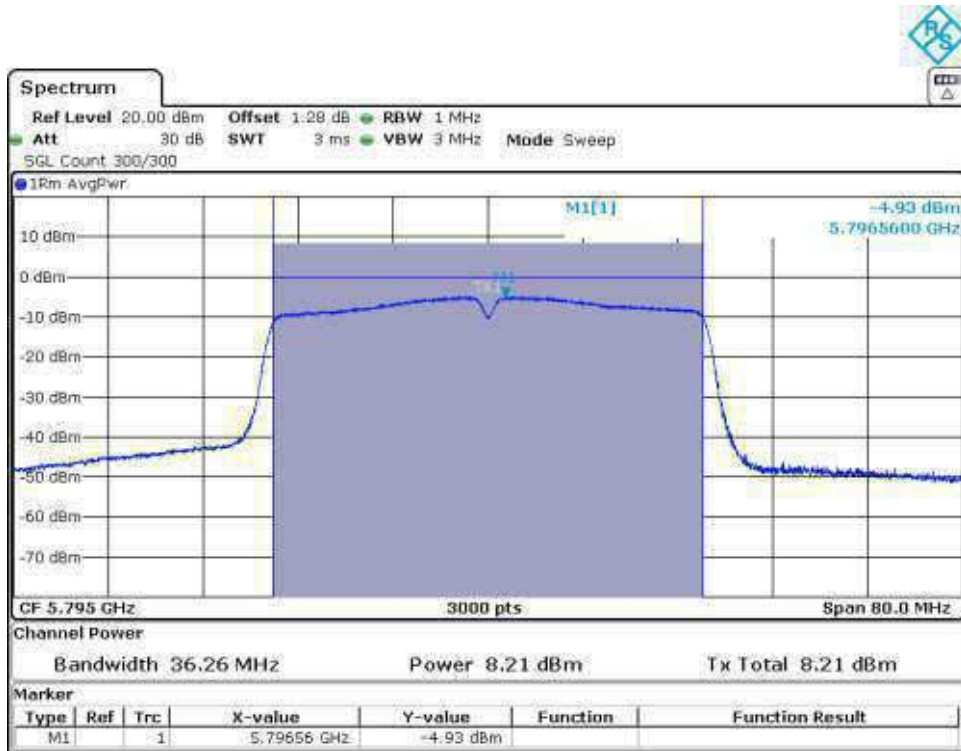


**Mode 802.11 n40 (HT40):**

- Low Channel:

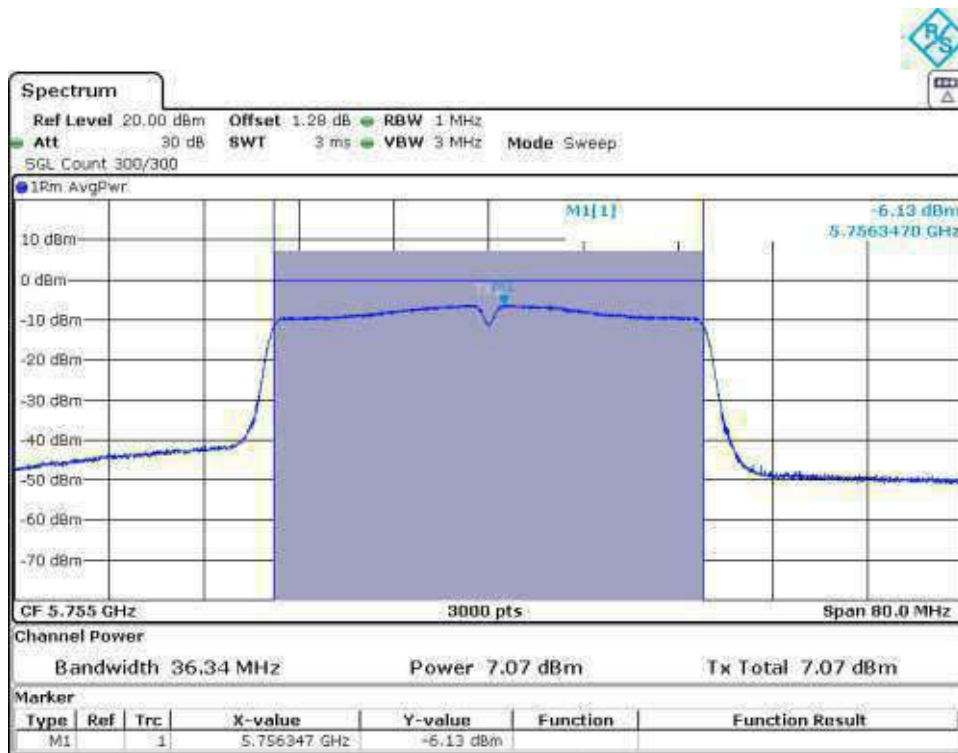


- High Channel:

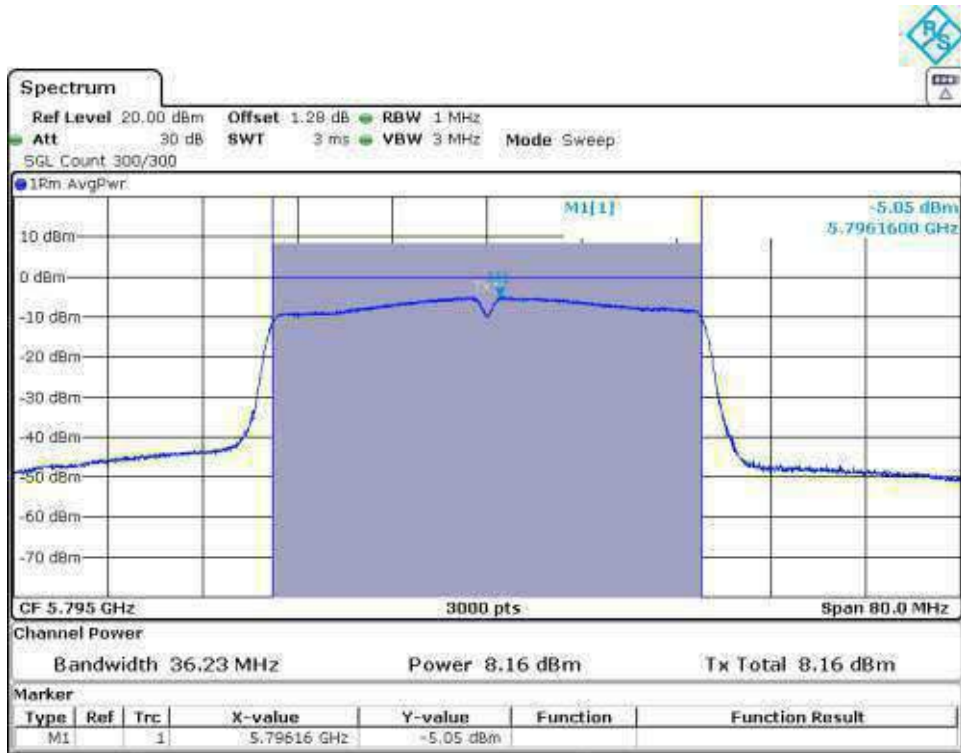


Mode 802.11 ac40 (VHT40):

- Low Channel:

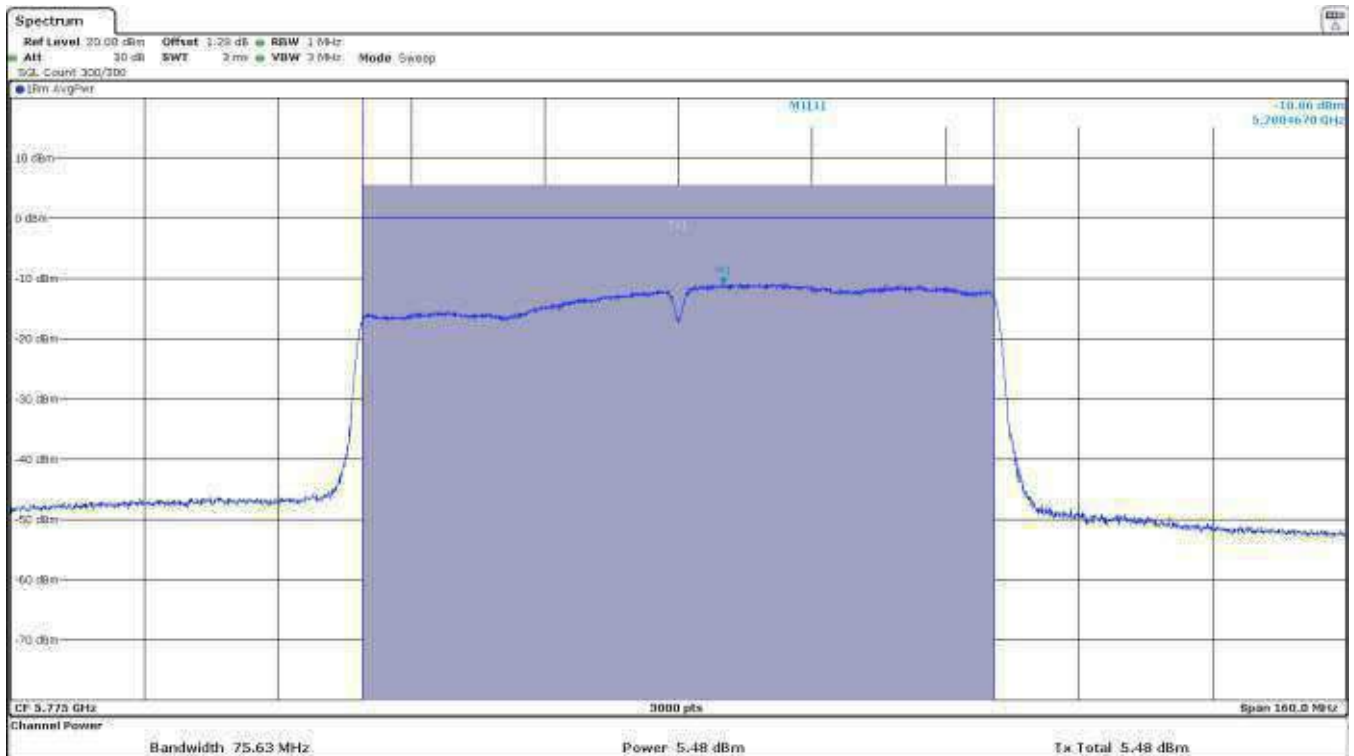


- High Channel:



**Mode 802.11 ac80 (VHT80):**

- Single Channel:



## FCC 15.407 (a)(3) / RSS-247 6.2.4.1. Transmitter Maximum Power Spectral Density

### SPECIFICATION:

The maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### RESULTS:

The maximum power spectral density (PSD) was measured using the method according to point F) referencing E.2.b) (Method SA-1) and E.2.b) (Method SA-2) of Guidance 789033 D02 General UNII Test Procedures New Rules v02r01.

In accordance with ANSI C63.10 Section 4.1.4.1, use of bandwidths greater than those specified can produce higher readings. Compliance against the applicable limits is shown using a 1 MHz resolution bandwidth. This was deemed a worst case.

The PSD test uses the same setup than the transmitter maximum conducted output power test. The result of the Peak PSD was measured by collocation a marker on the peak of the signal and the results are in the tables below.

For all modes of operation, the antenna gain is < 6 dBi.

Maximum Declared Antenna Gain: -5.4 dBi

#### **Mode 802.11 a20:**

	Low Channel	Middle Channel	High Channel
Maximum Average PSD (dBm/MHz)	-4.27	-1.65	-1.64
Duty Cycle Correction Factor (dB)	0.980		
Maximum Average PSD Corrected (dBm/MHz)	-3.290	-0.670	-0.660
Maximum EIRP PSD Corrected (dBm/MHz)	-8.690	-6.070	-6.060
Measurement uncertainty (dB)	<±1.20		

#### **Mode 802.11 n20 (HT20):**

	Low Channel	Middle Channel	High Channel
Maximum Average PSD (dBm/MHz)	-2.06	-1.19	-0.53
Duty Cycle Correction Factor (dB)	1.056		
Maximum Average PSD Corrected (dBm/MHz)	-1.004	-0.134	0.526
Maximum EIRP PSD Corrected (dBm/MHz)	-6.504	-5.534	-4.874
Measurement uncertainty (dB)	<±1.20		

**Mode 802.11 ac20 (VHT20):**

	Low Channel	Middle Channel	High Channel
Maximum Average PSD (dBm/MHz)	-2.17	-1.06	-0.58
Duty Cycle Correction Factor (dB)	1.051		
Maximum Average PSD Corrected (dBm/MHz)	-1.119	-0.009	0.471
Maximum EIRP PSD Corrected (dBm/MHz)	-6.519	-5.409	-4.929
Measurement uncertainty (dB)	<±1.20		

**Mode 802.11 n40 (HT40):**

	Low Channel	High Channel
Maximum Average PSD (dBm/MHz)	-6.03	-4.93
Duty Cycle Correction Factor (dB)	1.992	
Maximum Average PSD Corrected (dBm/MHz)	-4.038	-2.938
Maximum EIRP PSD Corrected (dBm/MHz)	-9.438	-8.338
Measurement uncertainty (dB)	<±1.20	

**Mode 802.11 ac40 (VHT40):**

	Low Channel	High Channel
Maximum Average PSD (dBm/MHz)	-6.13	-5.05
Duty Cycle Correction Factor (dB)	1.938	
Maximum Average PSD Corrected (dBm/MHz)	-4.192	-3.112
Maximum EIRP PSD Corrected (dBm/MHz)	-9.592	-8.512
Measurement uncertainty (dB)	<±1.20	

**Mode 802.11 ac80 (VHT80):**

	Low Channel
Maximum Average PSD (dBm/MHz)	-10.86
Duty Cycle Correction Factor (dB)	3.421
Maximum Average PSD Corrected (dBm/MHz)	-7.439
Maximum EIRP PSD Corrected (dBm/MHz)	-12.839
Measurement uncertainty (dB)	<±1.20

Verdict: PASS



## FCC 15.407(b)(4)(6) / RSS-247 6.2.4.2. Transmitter Out of Band Radiated Emissions and Transmitter Band Edge Radiated Emissions.

### SPECIFICATION:

For transmitters operating in the 5.725–5.85 GHz band:

All emissions shall be limited to a level of -27 dBm/MHz (68.23 dBμV/m at 3 m distance) at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)):

Frequency Range (MHz)	Field strength (μV/m)	Field strength (dBμV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	300
1.705 - 30.0	30	-	30
30 – 88	100	40	3
88 – 216	150	43.5	3
216 - 960	200	46	3
960 - 40000	500	54	3

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

### RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

Measurements were made in both horizontal and vertical planes of polarization.

All tests were performed in a semi-anechoic chamber at a distance of 1m for the frequency range 17 GHz-40 GHz and a distance of 3m for frequency range 30MHz-17GHz.

The field strength is calculated by adding correction factor to the measured level from the spectrum analyzer. This correction factor includes antenna factor, cable loss and pre-amplifiers gain.

- **Test performed on the worst case: 802.11 a20 with a bit rate of 6 Mbit/s.**

The worst case was determined by measuring the eirp density (radiated).

**Frequency range 30 MHz - 1 GHz:**

The spurious emissions below 1 GHz do not depend on either the operating channel or the modulation mode selected in the EUT.

No spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB):  $<\pm 5.08$

**Frequency range 1 - 40 GHz:**

The results in the next tables show the maximum measured levels in the 1-40 GHz range except the 5.65-5.725 GHz and 5.85-5.925GHz adjacent bands. The results in the adjacent bands was evaluated on the next section.

Spurious frequencies with peak levels above the average limit (54 dB $\mu$ V/m at 3 m) are measured with an average detector for checking compliance with the average limit.

OUT OF BAND EMISSIONS: Spurious emissions out of the band 5.65 - 5.925 GHz only the OFDM worst mode case determined after preliminary measurements was tested in the Low, Middle and High Channels.

BAND EDGES EMISSIONS: Spurious band edge emissions within 5.65 – 5.725 and 5.850 - 5.925 GHz all modes were tested in the Low Middle and High Channels.

OUT OF BAND EMISSIONS: Spurious emissions out of the band 5.65 - 5.925 GHz:

- **802.11 a20 (worst case):**

- LOW CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Emission Level (dB $\mu$ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
9.0	48.76	V	Peak	$<\pm 5.13$
34.22623	52.27	H	Peak	$<\pm 5.14$
38.79020	59.23	H	Peak	$<\pm 5.14$
	48.71		Average	$<\pm 5.14$

- MIDDLE CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Corrected Emission Level (dB $\mu$ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
9.0	50.06	V	Peak	$<\pm 5.13$
38.821633	58.09	V	Peak	$<\pm 5.14$
	48.38		Average	$<\pm 5.14$
34.214733	51.62	H	Peak	$<\pm 5.14$

- HIGH CHANNEL. Spurious frequencies closest to the limit:

Spurious frequency (GHz)	Corrected Emission Level (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
9.0	51.03	V	Peak	<± 5.13
38.821633	58.09	V	Peak	<± 5.14
	48.38		Average	<± 5.14
34.214733	51.62	H	Peak	<± 5.14

Measurement Uncertainty (dB): 1 GHz – 17 GHz <± 5.13  
 17 GHz – 26.5 GHz <± 4.82  
 26.5 GHz – 40 GHz <± 5.14

Verdict: PASS

BAND EDGE EMISSIONS: Spurious band edge emissions within 5.65 - 5.925 GHz and 5.850 – 5.925 GHz:

• **802.11 a20:**

Inside band spurious emissions in 5.65-5.925 GHz adjacent band.

- Low Channel 149 (5745 MHz):

No radiated spurious frequencies at less than 20 dB below the limit.

- Middle Channel 157 (5785 MHz):

No radiated spurious frequencies at less than 20 dB below the limit.

- High Channel 165 (5825 MHz):

No radiated spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB):  $<\pm 5.13$

• **802.11 n20:**

Inside band spurious emissions in 5.65-5.925 GHz adjacent band.

- Low Channel 149 (5745 MHz):

No radiated spurious frequencies at less than 20 dB below the limit.

- Middle Channel 157 (5785 MHz):

No radiated spurious frequencies at less than 20 dB below the limit.

- High Channel 165 (5825 MHz):

No radiated spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB):  $<\pm 5.13$

• **802.11 ac20:**

Inside band spurious emissions in 5.65-5.925 GHz adjacent band.

- Low Channel 149 (5745 MHz):

No radiated spurious frequencies at less than 20 dB below the limit.

- Middle Channel 157 (5785 MHz):

No radiated spurious frequencies at less than 20 dB below the limit.

- High Channel 165 (5825 MHz):

No radiated spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB):  $<\pm 5.13$

- **802.11 n40:**

Inside band spurious emissions in 5.65-5.925 GHz adjacent band.

- Low Channel 151 (5755 MHz):

No radiated spurious frequencies at less than 20 dB below the limit.

- High Channel 159 (5795 MHz):

No radiated spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB):  $<\pm 5.13$

- **802.11 ac40:**

Inside band spurious emissions in 5.65-5.925 GHz adjacent band.

- Low Channel 151 (5755 MHz):

No radiated spurious frequencies at less than 20 dB below the limit.

- High Channel 159 (5795 MHz):

No radiated spurious frequencies at less than 20 dB below the limit.

Measurement Uncertainty (dB):  $<\pm 5.13$

- **802.11 ac80:**

Inside band spurious emissions in 5.65-5.925 GHz adjacent band.

- Middle Channel 155 (5775 MHz):

No radiated spurious frequencies at less than 20 dB below the limit.

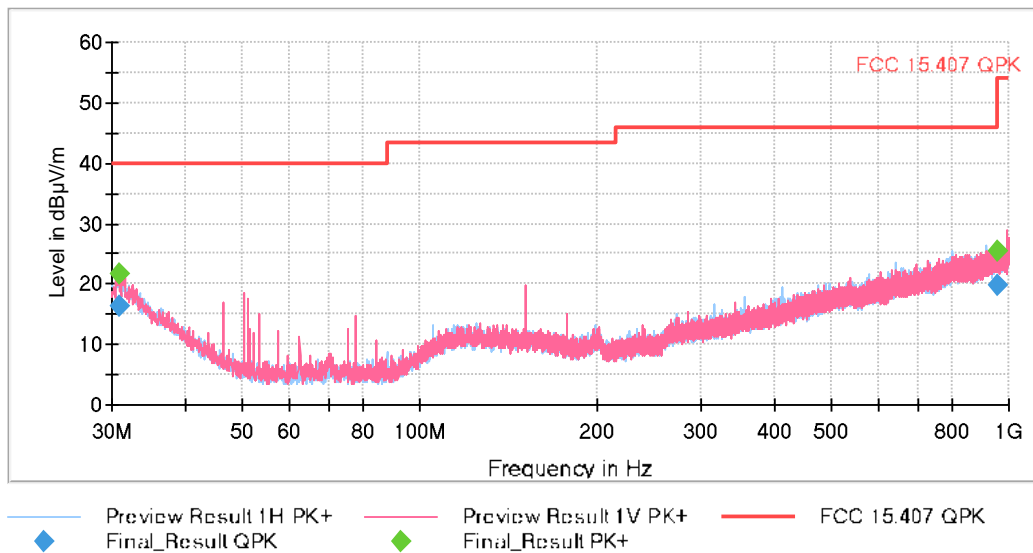
Measurement Uncertainty (dB):  $<\pm 5.13$

Verdict: PASS

## OUT OF BAND EMISSIONS

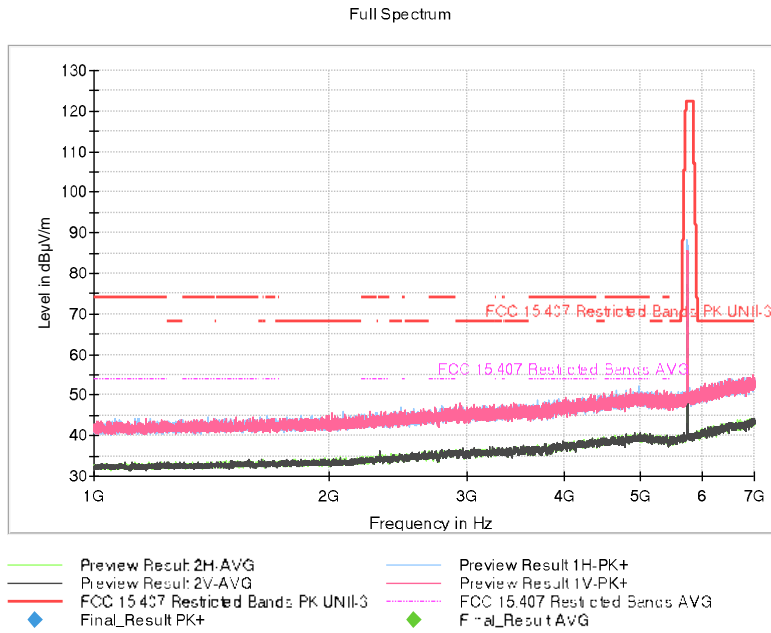
### FREQUENCY RANGE 30 MHz - 1 GHz (worst case):

This plot is valid for the Low, Middle and High Channels and all the modulation modes.



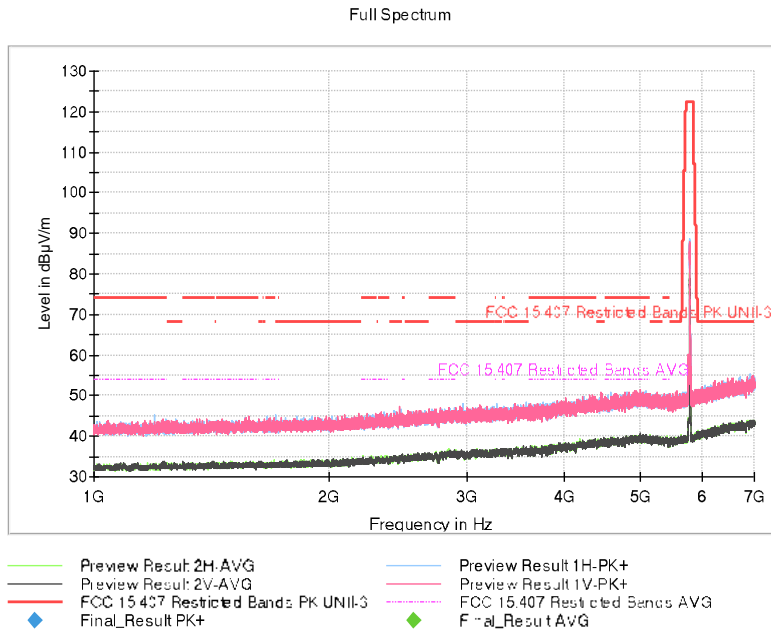
**FREQUENCY RANGE 1 - 7 GHz (worst case):**

- Low Channel:



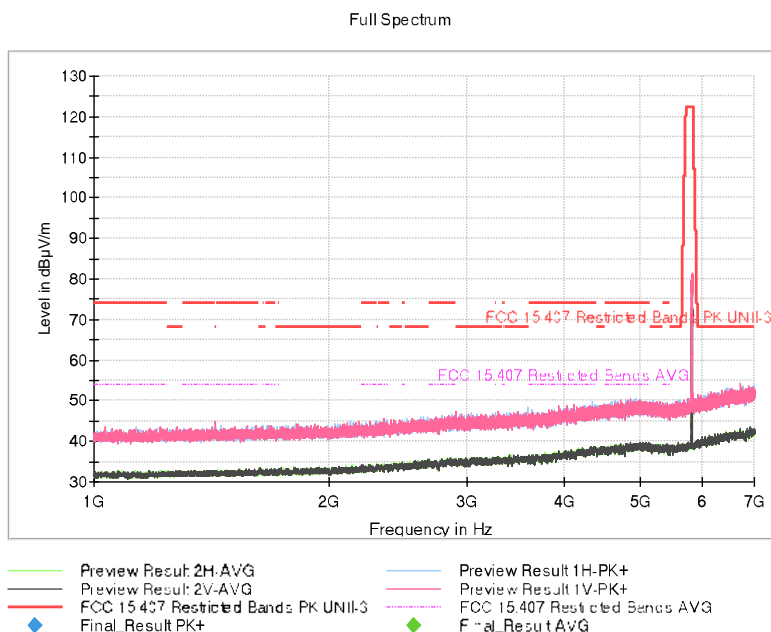
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

- High Channel:

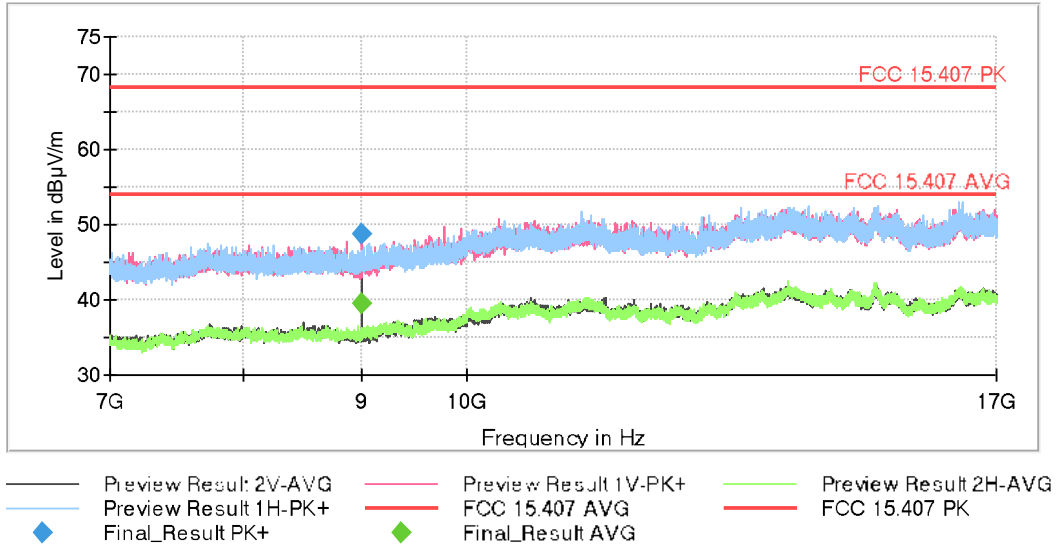


The peak above the limit is the carrier frequency.



**FREQUENCY RANGE 7 - 17 GHz (worst case):**

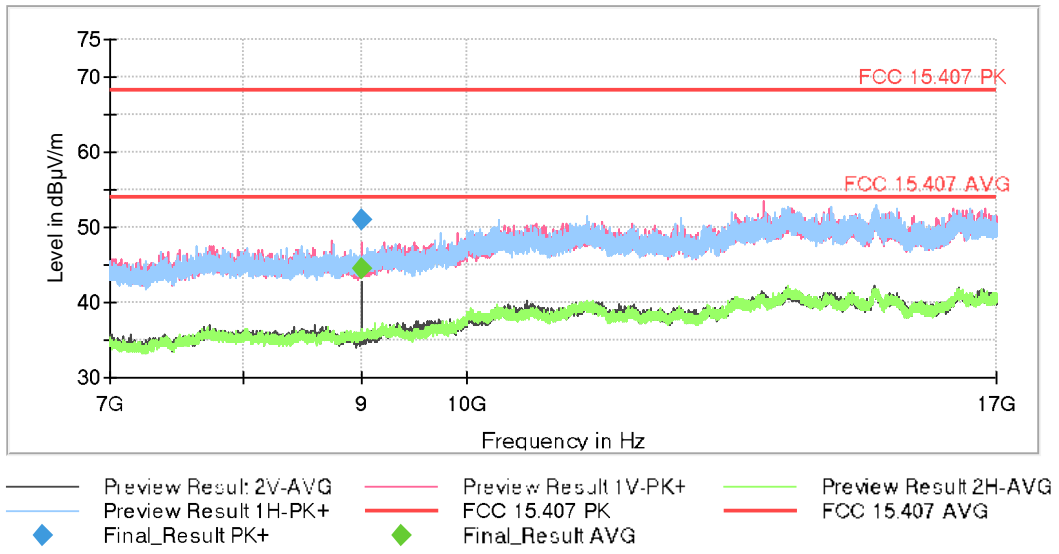
- Low Channel:



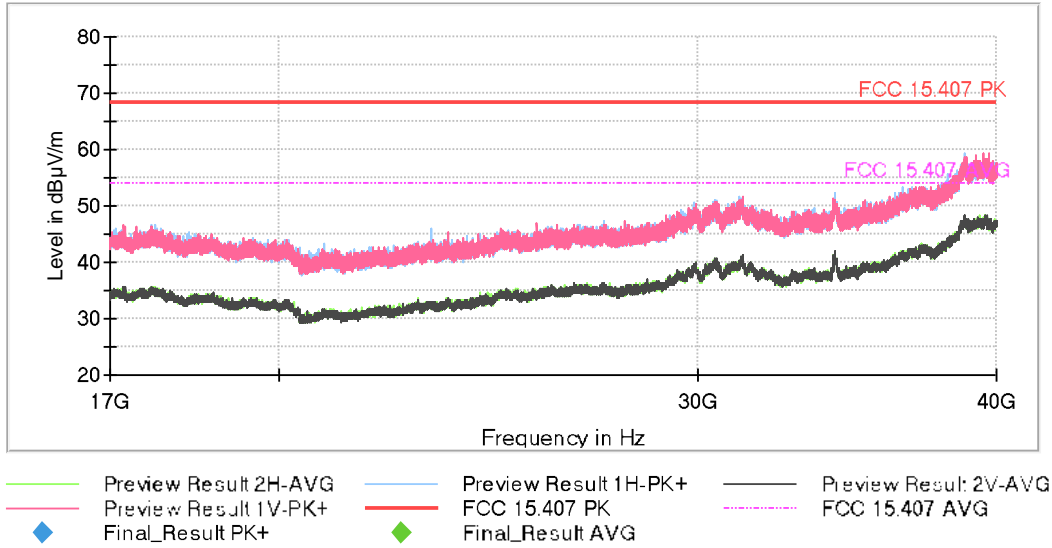
- Middle Channel:



- High Channel:



**FREQUENCY RANGE 17 - 40 GHz:**



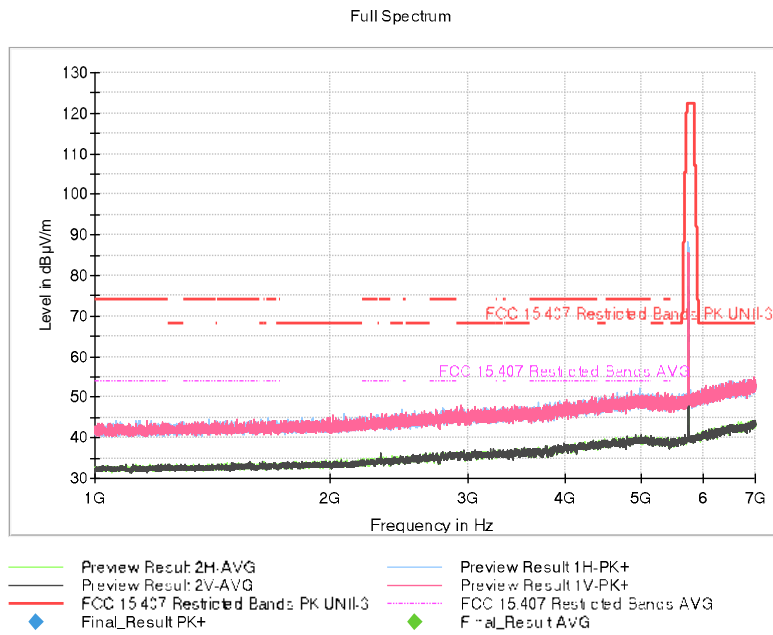
Note: This plot is valid for all channels and all modulation modes.

**BAND EDGES EMISSIONS:**

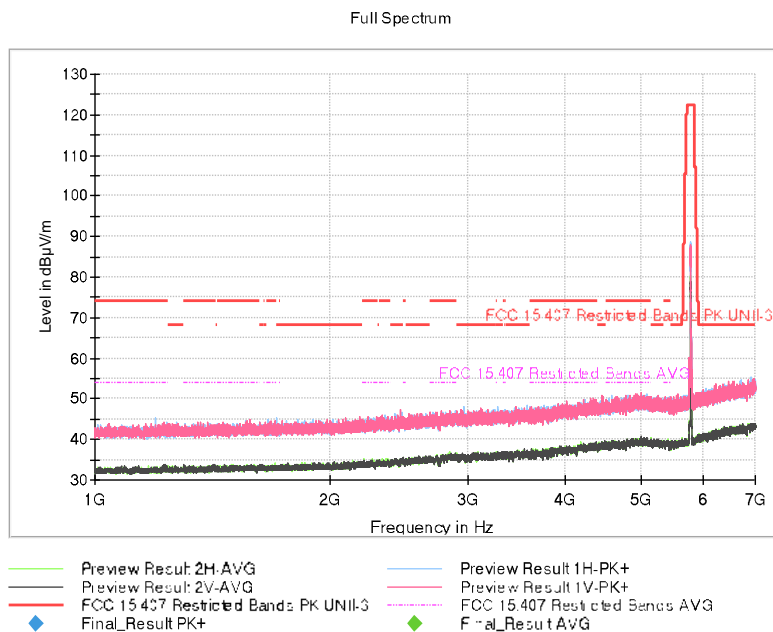
- Mode 802.11 a20:

**Radiated spurious emissions at band edges and inside adjacent band 5.65 – 5.897 GHz and 5.898 – 5.925GHz**

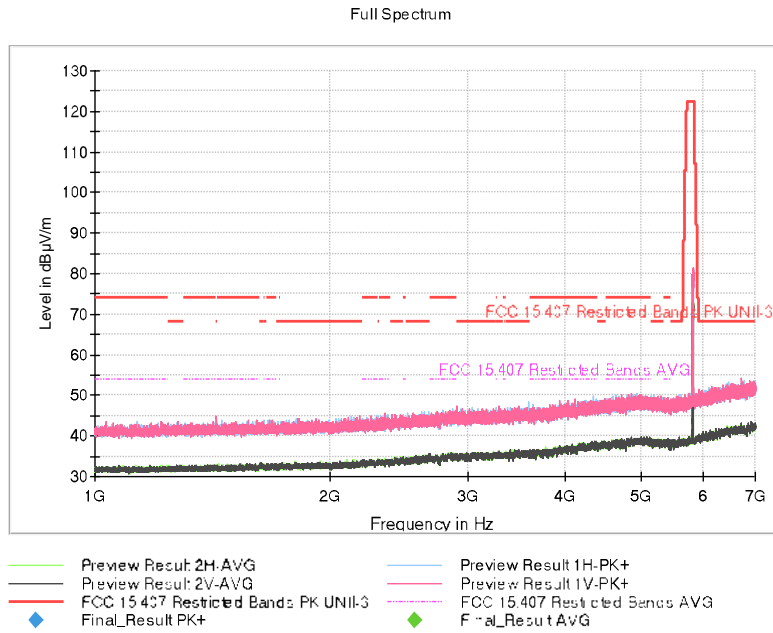
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):

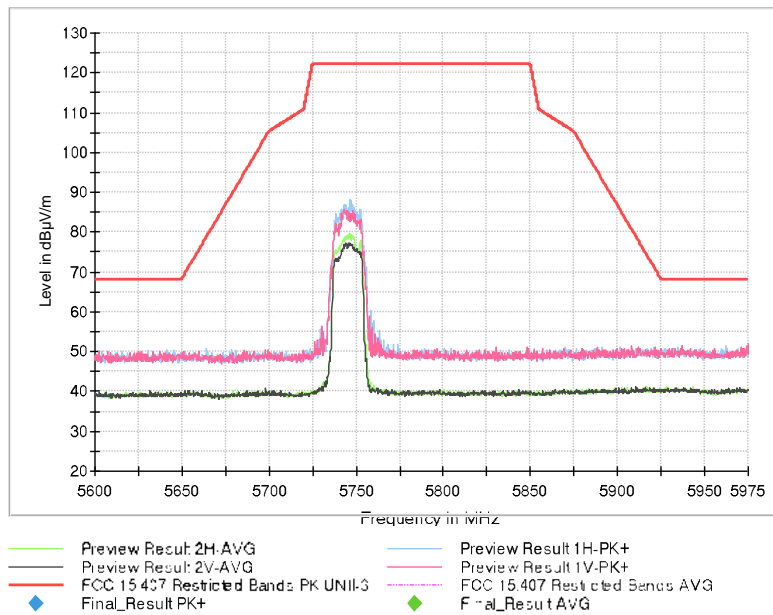


- High Channel 165 (5825 MHz):

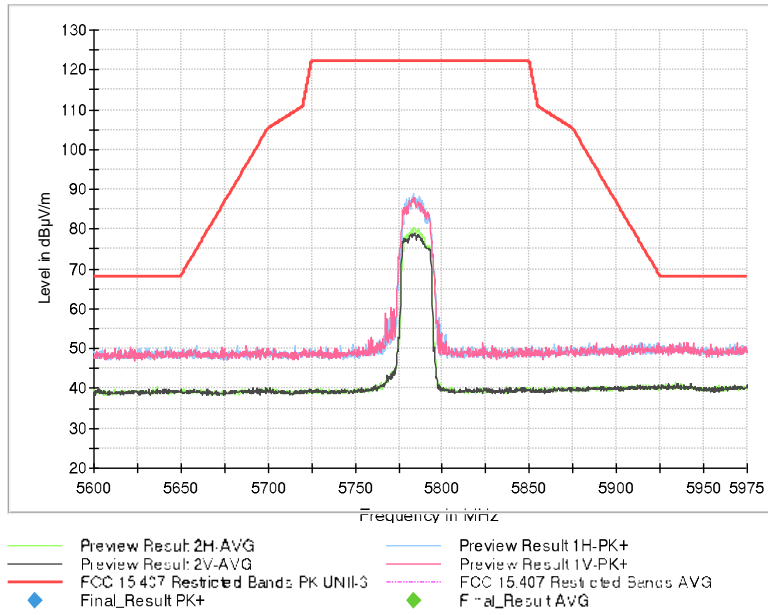


**Radiated spurious emissions at band edges and inside adjacent band 5.68 – 5.898 GHz**

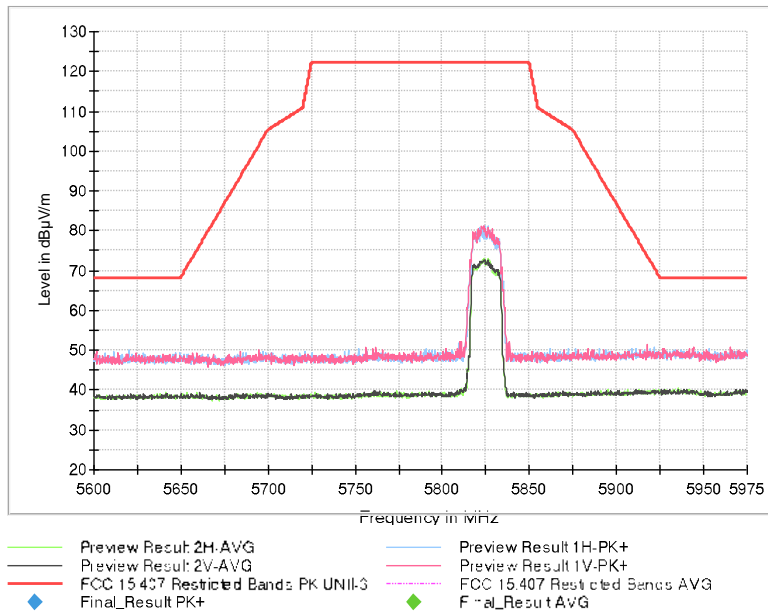
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



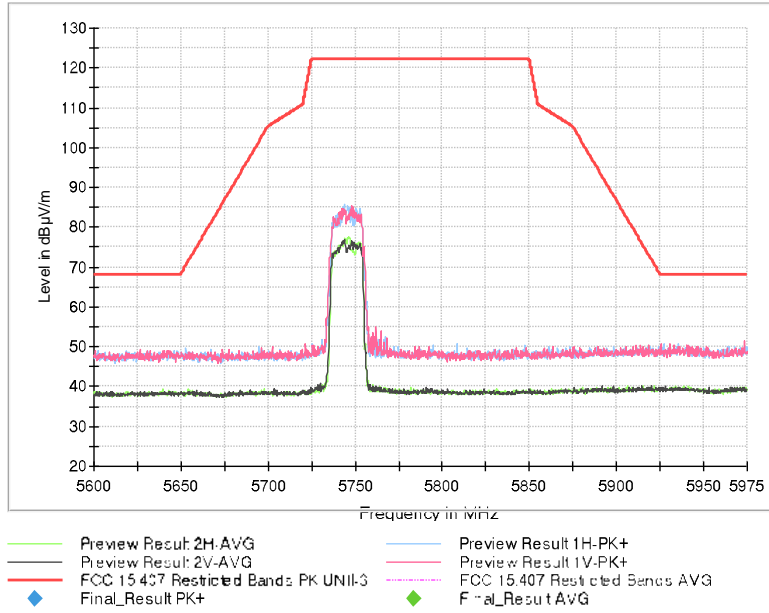
- High Channel 165 (5825 MHz):



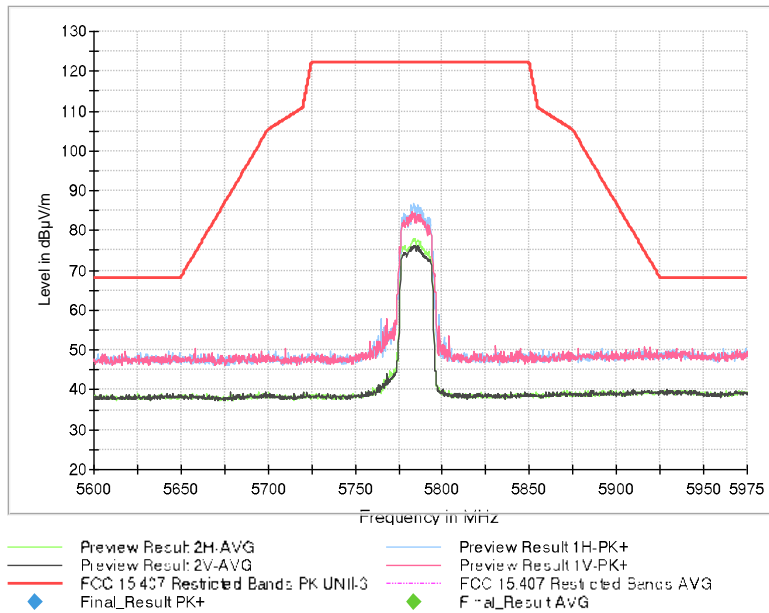
• **Mode 802.11 n20:**

**Radiated spurious emissions at band edges and inside adjacent band 5.65 – 5.897 GHz and 5.898 – 5.925GHz**

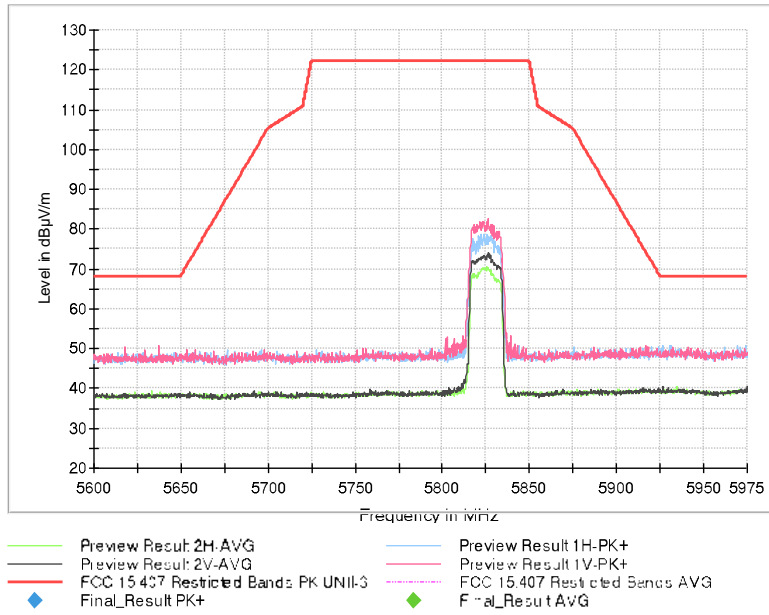
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):

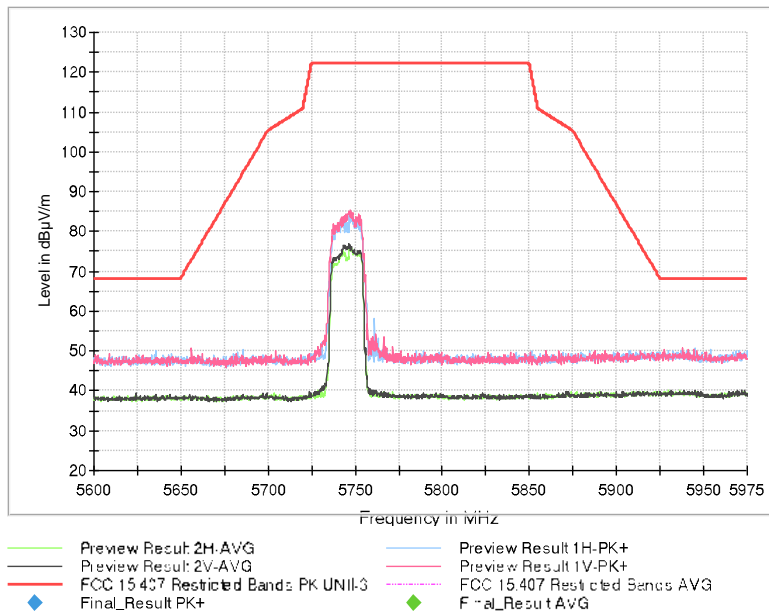


- High Channel 165 (5825 MHz):



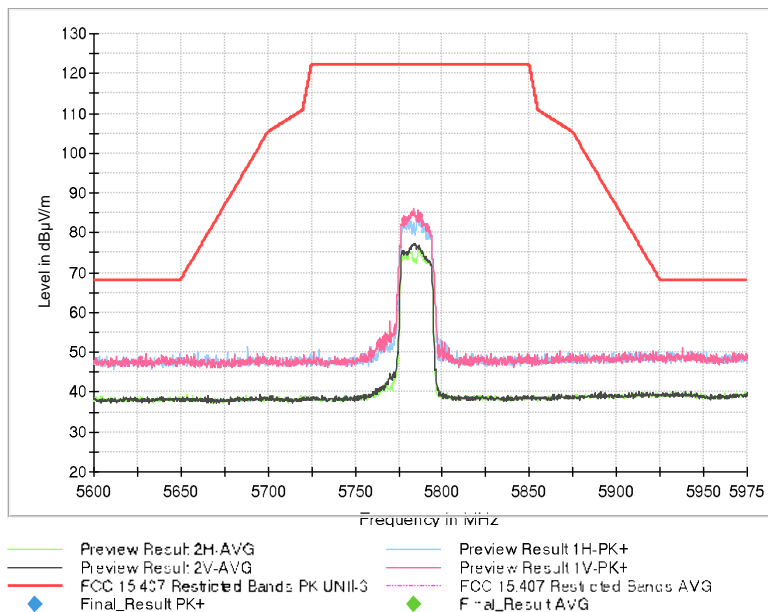
• Mode 802.11 ac20:

- Low Channel 149 (5745 MHz):

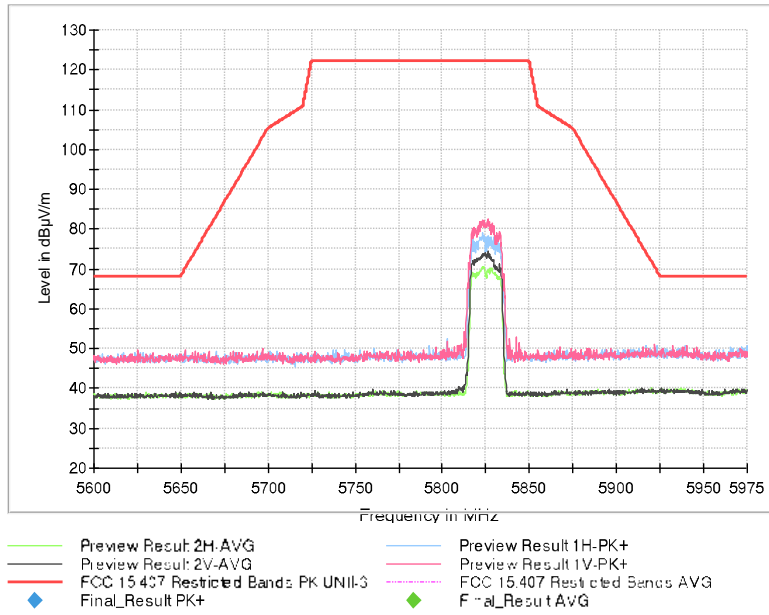




- Middle Channel 157 (5785 MHz):

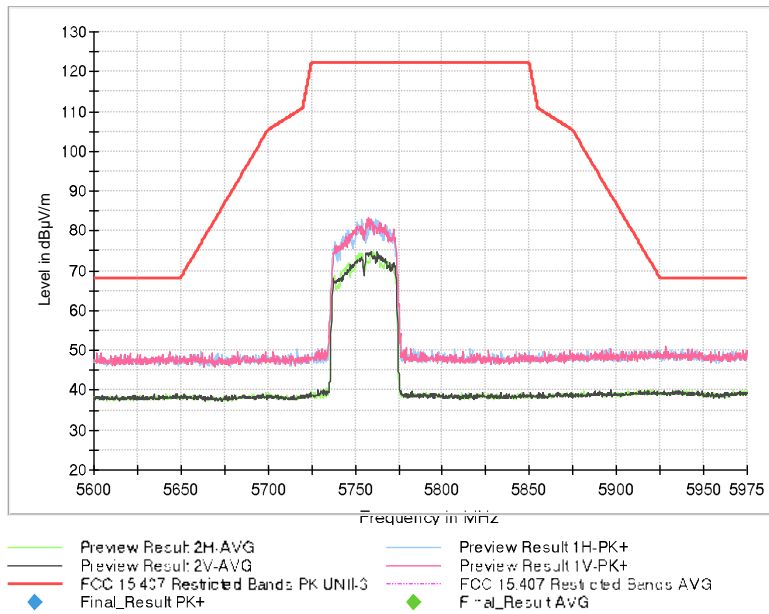


- High Channel 165 (5825 MHz):

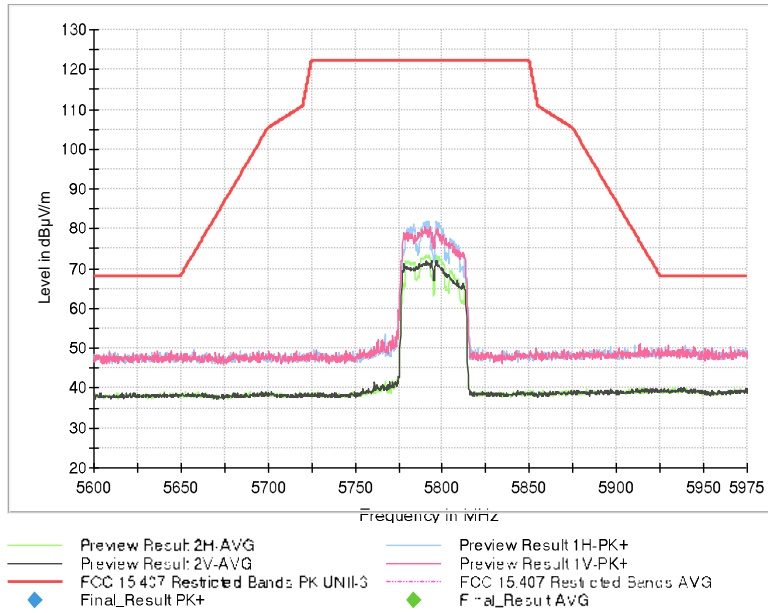


- **Mode 802.11 n40:**

- Low Channel 151 (5755 MHz):

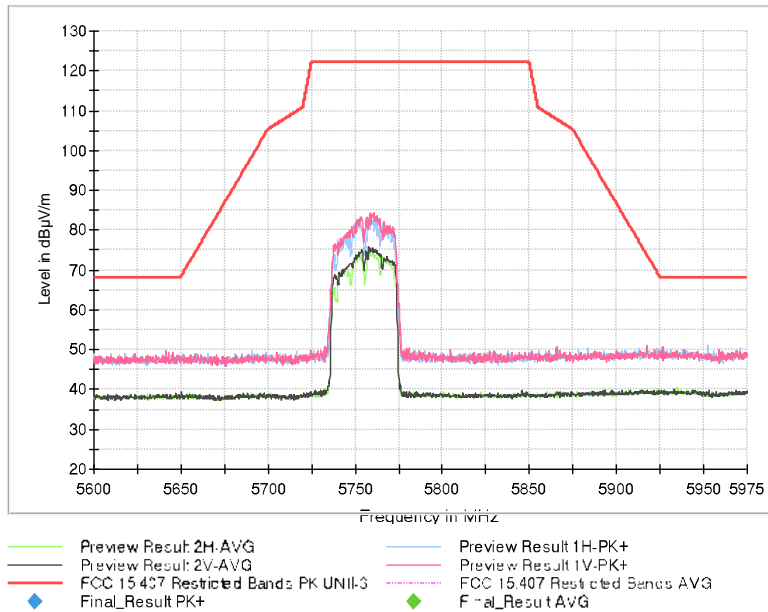


- High Channel 159 (5795 MHz):

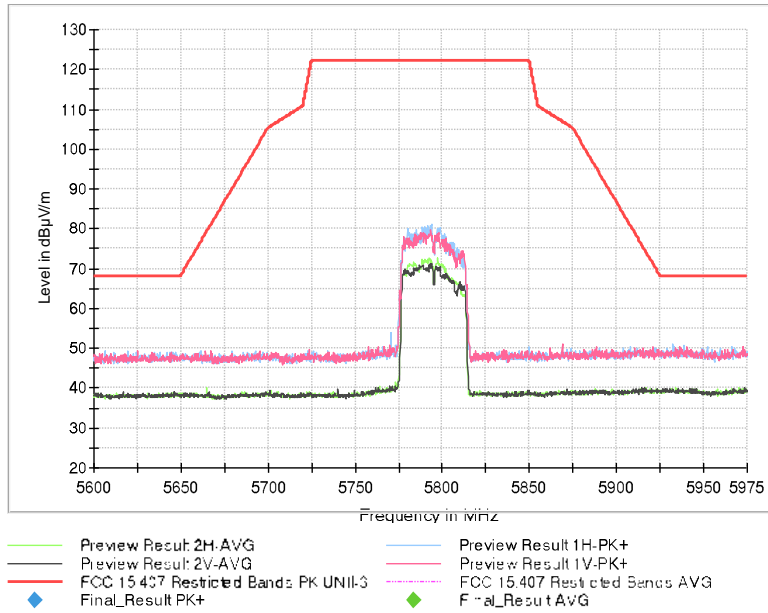


• Mode 802.11 ac40:

- Low Channel 151 (5755 MHz):



- High Channel 159 (5795 MHz):



- **Mode 802.11 ac80**

- Middle Channel 155 (5775 MHz):

