



Test report No:  
 NIE: 63175RRF.006

## 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	
Other identification of the product	HW version: 1.3 SW version: 20w27.4-1-15 FCC ID: T8GMGU21 IC: 6434A-MGU21	
(*) Features	USB 2.0 (including support for Apple Devices), Bluetooth, WLAN Modul 2.4 / 5 GHz, GNSS, AR-CAM input, Video-out APIX3, CAN, 100Base-T1 and 1000Base-T1	
Applicant	HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH BECKER-GOERING-STR. 16; 76307 KARLSBAD, GERMANY	
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)	José Carlos Luque RF Lab. Supervisor	74841983Y JOSE CARLOS LUQUE (C:A29507456) (C:A29507456)
Date of issue	2020-09-04	
Report template No	FDT08_22	
	(*) "Data provided by the client"	

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## Competences and guarantees

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

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

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.
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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.

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 is an Automotive infotainment System.

MGU Head-Unit. The main functionalities are: Navigation, USB, voice recognition and several interfaces to the vehicle and Bluetooth / WLAN.

The Head-unit provides different interfaces like: AR-CAM input, Videoout APIX3 (for the connection of an external Display), 3 USB interfaces (including support for Apple devices), CAN, 100Base-T1 and 1000Base-T1.

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 N°	Description	Model	Serial N°	Date of reception
63175C/001	Automotive infotainment System	MGU21	B382C00L7512617	2020/05/25

Auxiliary elements used with the Sample S/01:

Control N°	Description	Model	Serial N°	Date of reception
63175C/010	OABR Cable	--	--	2020/05/25
63175C/021	SMA Adapter Cable	--	--	2020/05/25
63175C/017	Ethernet Cable	--	--	2020/05/25
63175C/003	OABR Converter Board	--	--	2020/05/25
63175C/006	Ethernet/USB Adapter	EU-4306	EU430685MA02183	2020/05/25

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

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

Control N°	Description	Model	Serial N°	Date of reception
63175C/001	Automotive infotainment System	MGU21	B382C00L7512617	2020/05/25
63175C/027	GNSS Antenna	Magma AA.171	171TT17311936	2020/06/02

Auxiliary elements used with the Sample S/02:

Control N°	Description	Model	Serial N°	Date of reception
63175C/003	OABR Converter Board	--	--	2020/05/25
63175C/008	Power Cable DC for OABR board	--	--	2020/05/25
63175C/010	OABR Cable	--	--	2020/05/25
63175C/013	APIX Cable	--	--	2020/05/25
63175C/018	Power Cable DC for headunit	--	--	2020/05/25

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

## Test sample description

Ports..... :	Port name and description	Cable					
		Specified max length [m]	Attached during test	Shielded	Coupled to patient <sup>(3)</sup>		
	<b>BT/WIFI connector</b> – CONM 4POL ROS BMW209-40MT1-A PCN2944		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	<b>USB1 connector</b> – CONM-SM 4POL ROS D4S20Y-40MA5-B		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	<b>USB2 connector</b> – CONM-SM 4POL ROS D4S20Y-40MA5-C		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	<b>USB3 connector</b> – CONM-SM 4POL ROS D4S20Y-40MA5-E		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	<b>APIX3 connector</b> – CONM-SM 4+2POL ROS 99S22A-40MA5-D		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	<b>Car Main-connector</b> – CONM 16POL TYC 2300483-s		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	<b>AR-CAM connector</b> – CONM 1POL ROS 59S2FT-40MA5-K		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	<b>Ethernet BroadR-Reach</b> , 100 BASE-T1		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	<b>Ethernet</b> , 1000 BASE-T1		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<b>GNSS connector</b>		<input checked="" type="checkbox"/>	<input checked="" 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 type="checkbox"/>	DC:					
<input type="checkbox"/>	DC:						
Rated Power .....							
Clock frequencies.....							
Other parameters .....							
Software version .....	20w27.4-1-15						
Hardware version .....	1.3						

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: automotive dashboard	
Modules/parts .....	Module/parts of test item	Type	Manufacturer
Accessories (not part of the test item) .....	Description	Type	Manufacturer
Documents as provided by the applicant .....	Description	File name	Issue date

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

## Identification of the client

HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH  
BECKER-GOERING-STR. 16; 76307 KARLSBAD, GERMANY

## Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2020-06-09
Date (finish)	2020-08-05

## Document history

Report number	Date	Description
63175RRF.006	2020-09-04	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 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

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 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

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. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

## Remarks and comments

The tests have been performed by the technical personnel: Javier Miguel Nadales, Nicolás Salguero, Pablo Redondo, José Gabriel Pendón and Miguel Ángel Torres.

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	2019/09	2020/09
5. DC Power Supply 30V/5A KEYSIGHT TECHNOLOGIES U8002A	N.A.	N.A.
6. EMI Test Receiver 7 GHz ROHDE AND SCHWARZ ESR7	2018/10	2020/10

### Radiated Measurements:

	Last Calibration	Due Calibration
1. Semianechoic Absorber Lined Chamber FRANKONIA SAC-3	N.A.	N.A.
2. Shielded Room FRANKONIA	N.A.	N.A.
3. Biconical/Log Antenna 30 MHz - 6 GHz ETS LINDGREN 3142E	2018/07	2021/07
4. RF Pre-amplifier 40 dB, 10 MHz - 6 GHz BONN ELEKTRONIK BLNA 0160-01N	2019/09	2020/09
5. EMI Test Receiver 20Hz-40GHz ROHDE AND SCHWARZ ESU40	2019/09	2021/09
6. EMI Test Receiver 20Hz-26.5GHz ROHDE AND SCHWARZ ESU26	2020/05	2022/05
7. DC Power Supply, 30V/5A KEYSIGHT TECHNOLOGIES U8002A	N.A.	N.A.
8. Digital multimeter FLUKE 179	2020/06	2021/06
9. Horn Antenna 1-18GHz SCHWARZBECK MESS- ELEKTRONIK BBHA 9120 D	2018/06	2021/06
10. Broadband Horn Antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2018/07	2021/07
11. RF Pre-amplifier, 30dB 500MHz-18GHz, NARDA AMF-3D-00501800-24-10P	2019/12	2020/12
12. Pre-amplifier, G>55dB 1-18GHz NARDA AMF-7D-01001800-22-10P	2020/05	2021/05
13. Low Noise Amplifier G>30dB, 18 - 40 GHz BONN ELEKTRONIK BLMA 1840-1M	2019/02	2021/02
14. DC Power Supply 150V/22A, AGILENT TECHNOLOGIES N8740A	N.A.	N.A.



## 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			
Requirement – Test case		Verdict	Remark
FCC 15.35 (c) / RSS-Gen 6.10	Duty Cycle	P	
RSS-Gen 6.6 / RSS-247 6.2.	99% Occupied Bandwidth	P	
FCC 15.403 (i)	26 dB Emission Bandwidth (EBW)	P	
FCC 15.407 (g) / RSS-Gen 6.11	Frequency Stability (Temperature & Voltage Variation)	N/M	(1)
<u>Supplementary information and remarks:</u>			
(1) The manufacturer is responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user manual.			

### 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	
FCC 15.407 (h) (1) / RSS-247 6.2.1.1	Transmitter Power Control	N/A	
<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	
FCC 15.40 (h)(1) / RSS-247 6.2.4.1	Transmitter Power Control	N/A	
<u>Supplementary information and remarks:</u>			
None			

## Appendix A: Test Common requirements for all bands

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## FCC 15.35 (c) / RSS-Gen 6.10. Transmitter Duty Cycle

### SPECIFICATION:

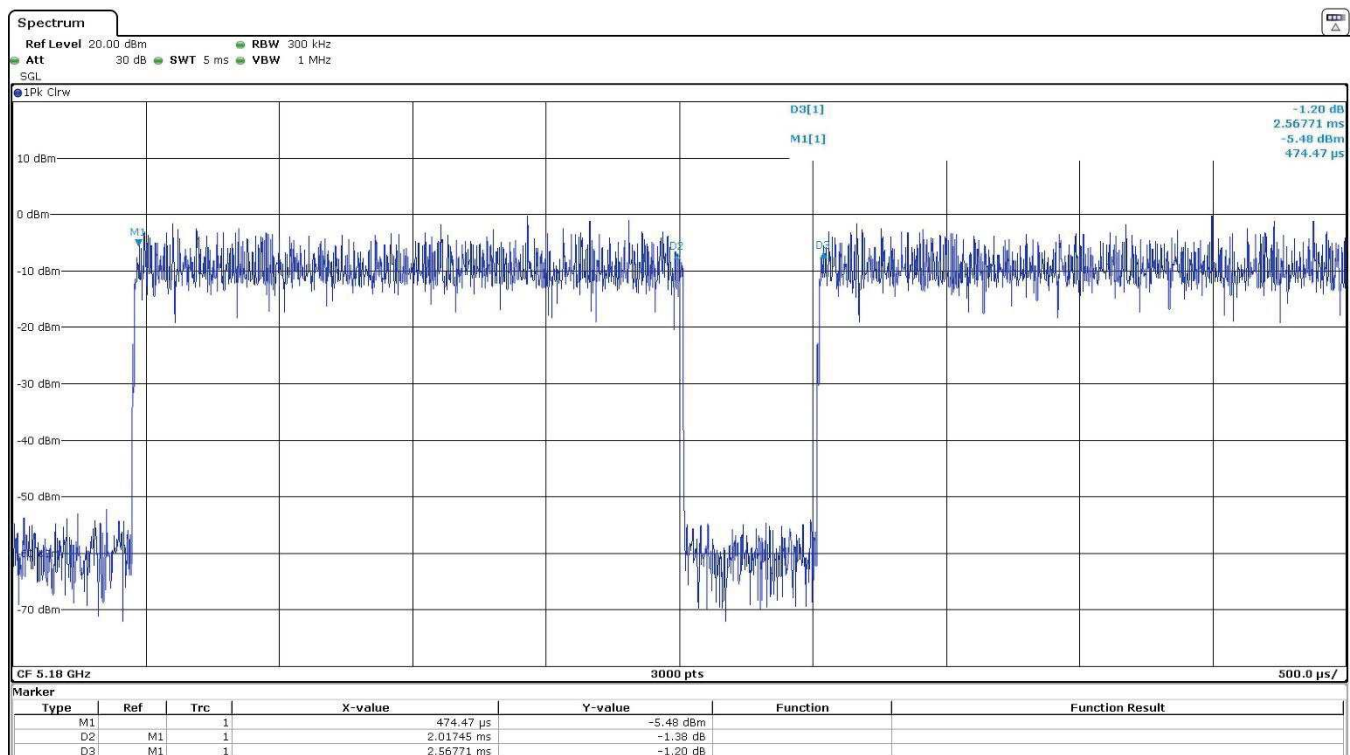
When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.

### RESULTS:

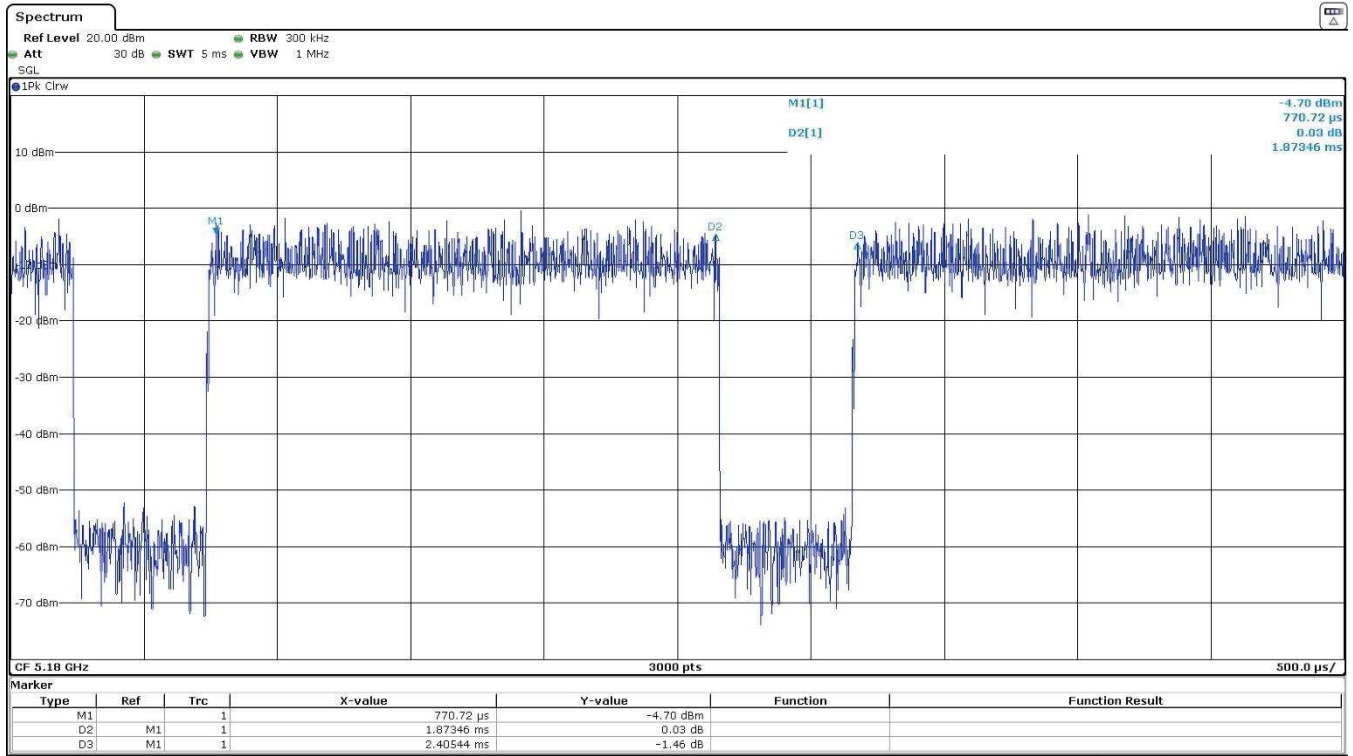
The results below are for data rates with a duty cycle less than 98%. The results for all rest of modes having a value > 98%.

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	2.01745	2.56771	1.047431924	2.03073	2.5661	1.01621392
802.11n20	1.87346	2.40544	1.085501036	1.90192	2.42545	1.056000808
802.11ac20	1.88863	2.43406	1.101843955	1.91531	2.4339	1.040636545
802.11n40	0.92037	1.46574	2.020944858	0.92787	1.44508	1.924047571
802.11ac40	0.93204	1.44907	1.916548142	0.93145	1.45345	1.932405492
802.11ac80	0.42201	0.9526	3.53587835	0.434815	0.961878	3.44815474

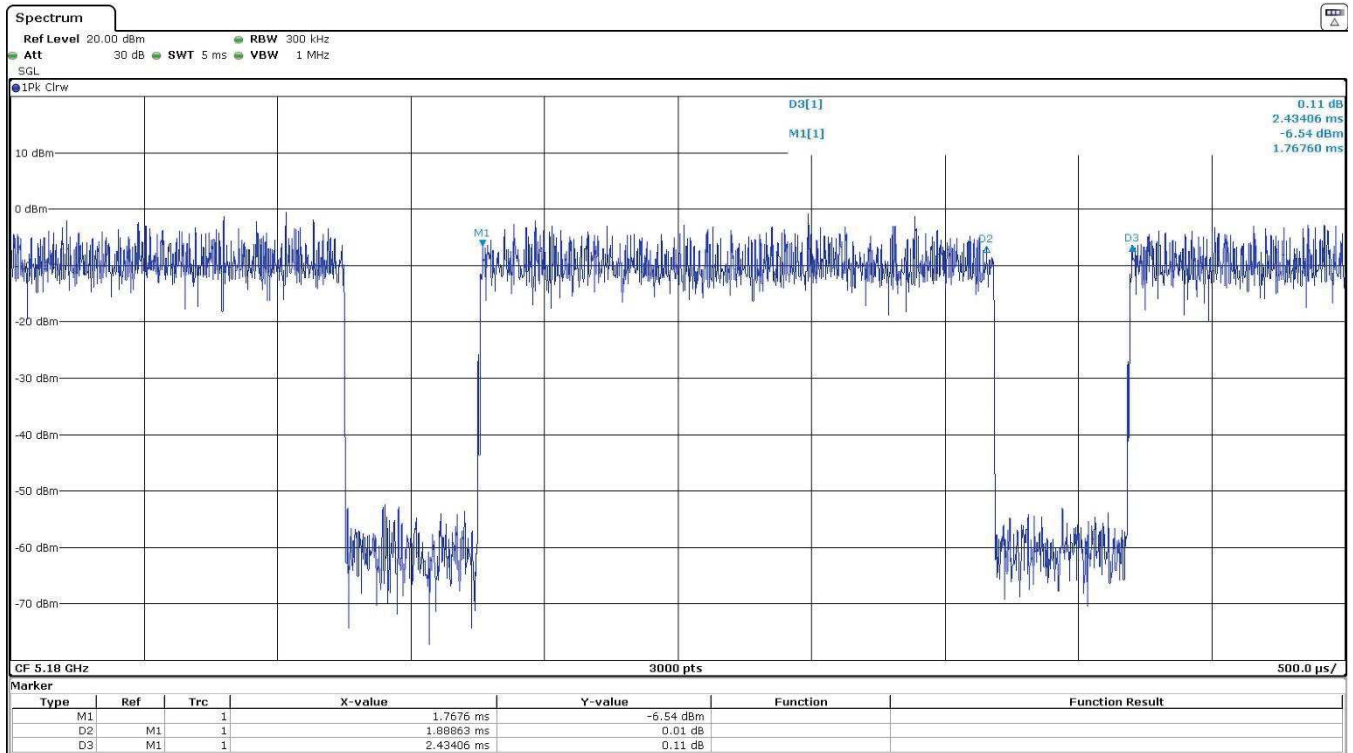
### Mode 802.11 a20 (U-NII-1):



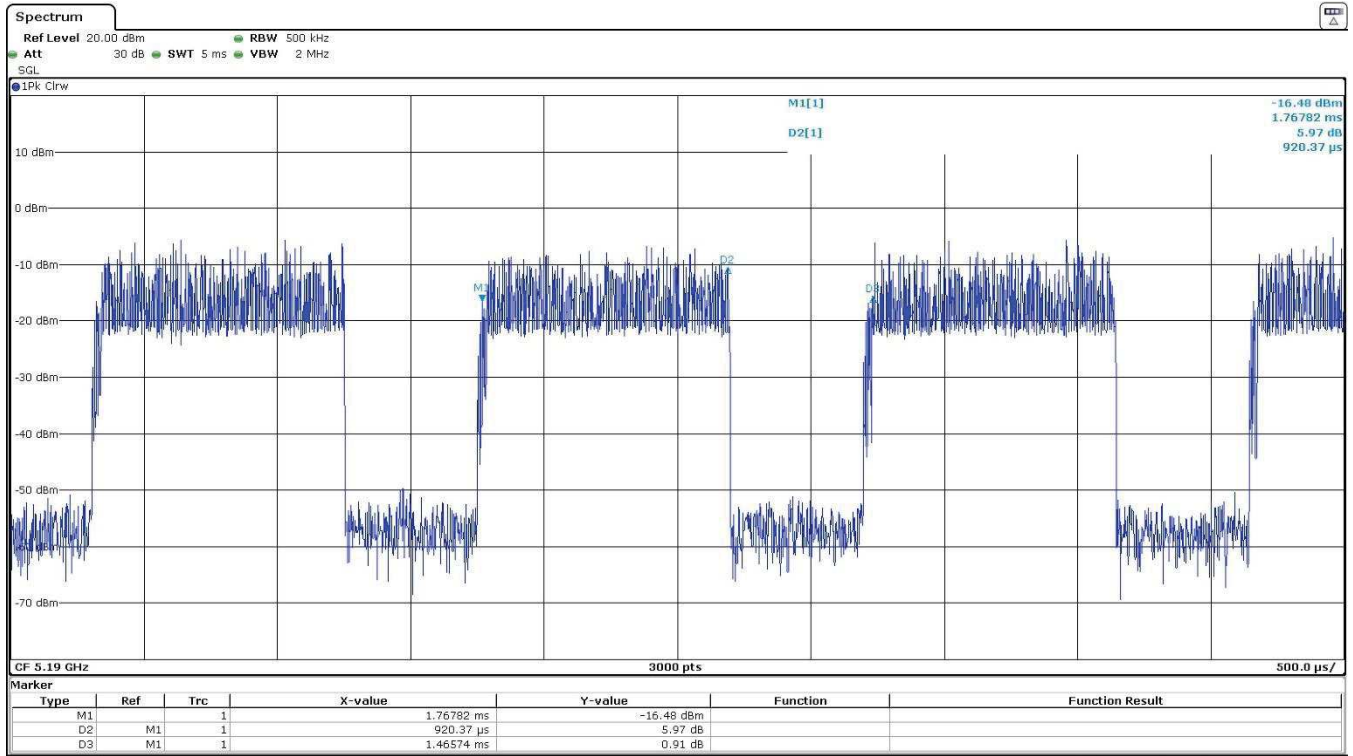
Mode 802.11 n20 (U-NII-1):



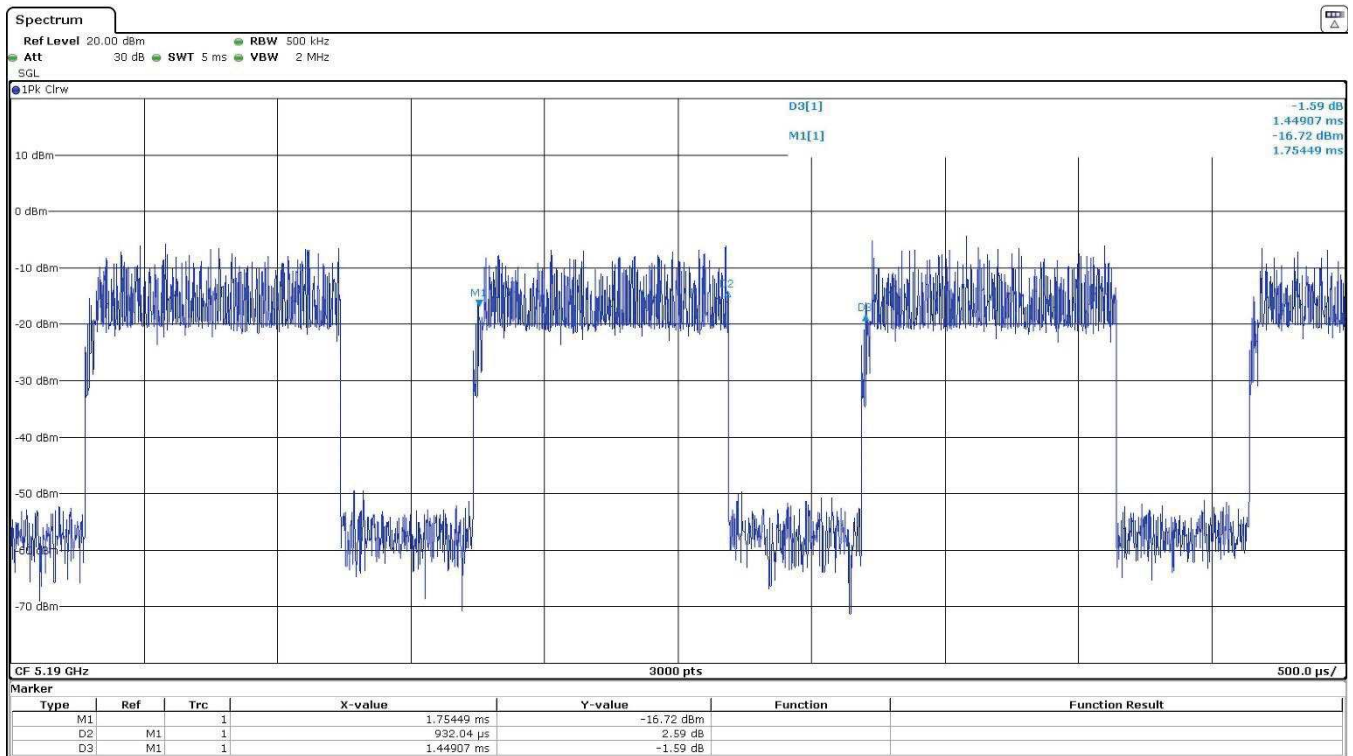
Mode 802.11 ac20 (U-NII-1):



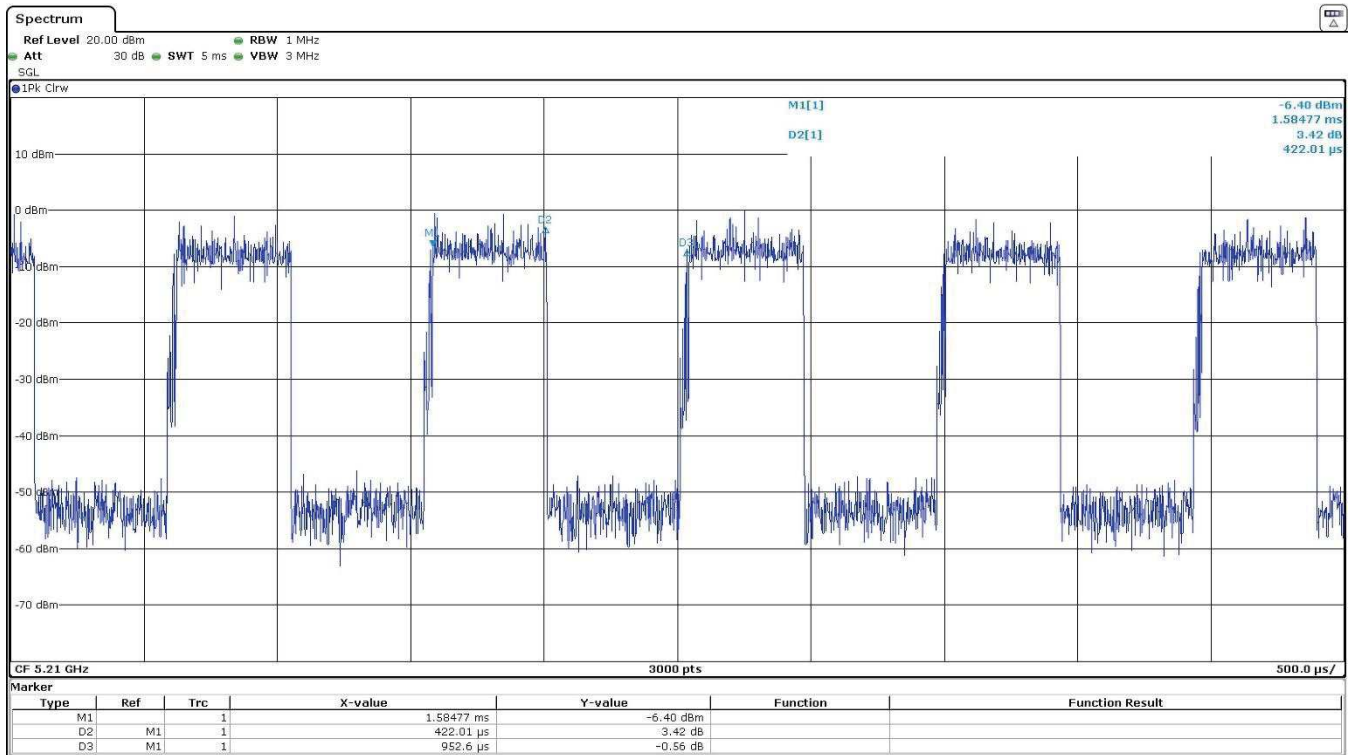
Mode 802.11 n40 (U-NII-1):



Mode 802.11 ac40 (U-NII-1):

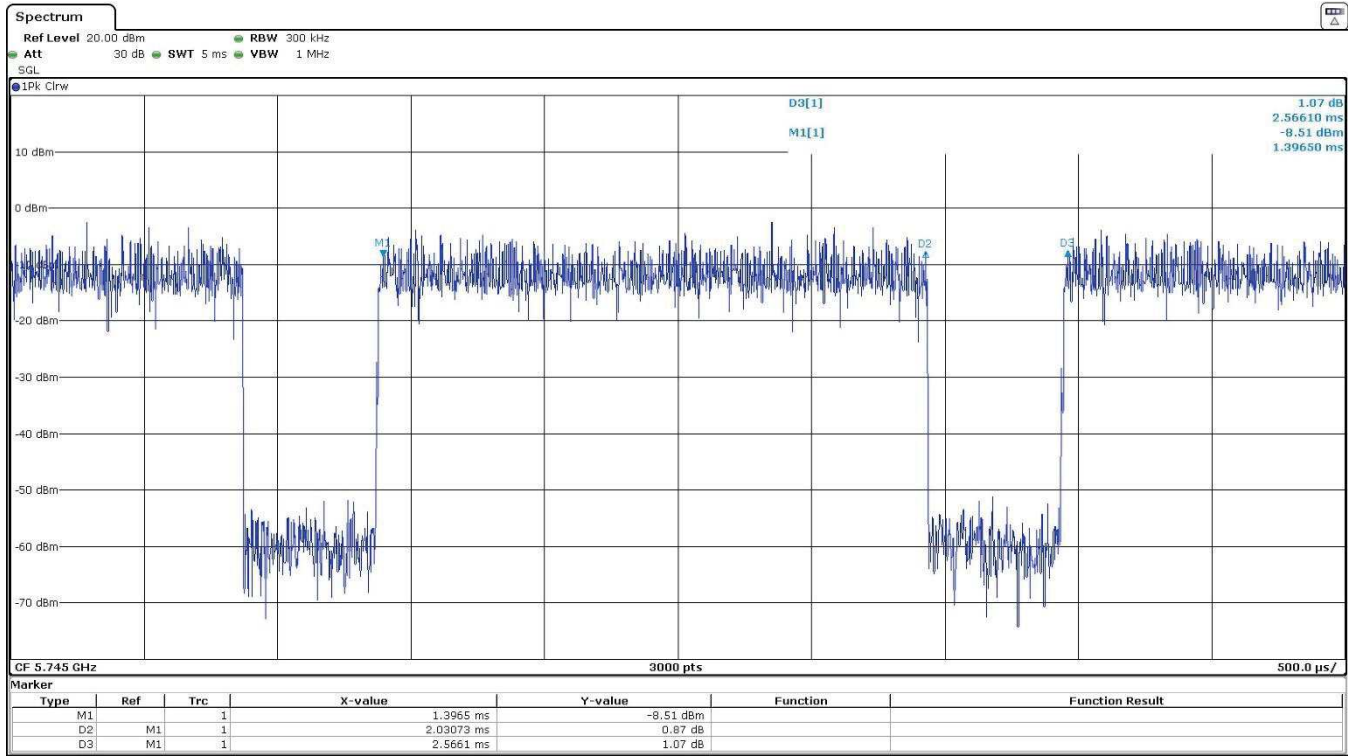


Mode 802.11 ac80 (U-NII-1):

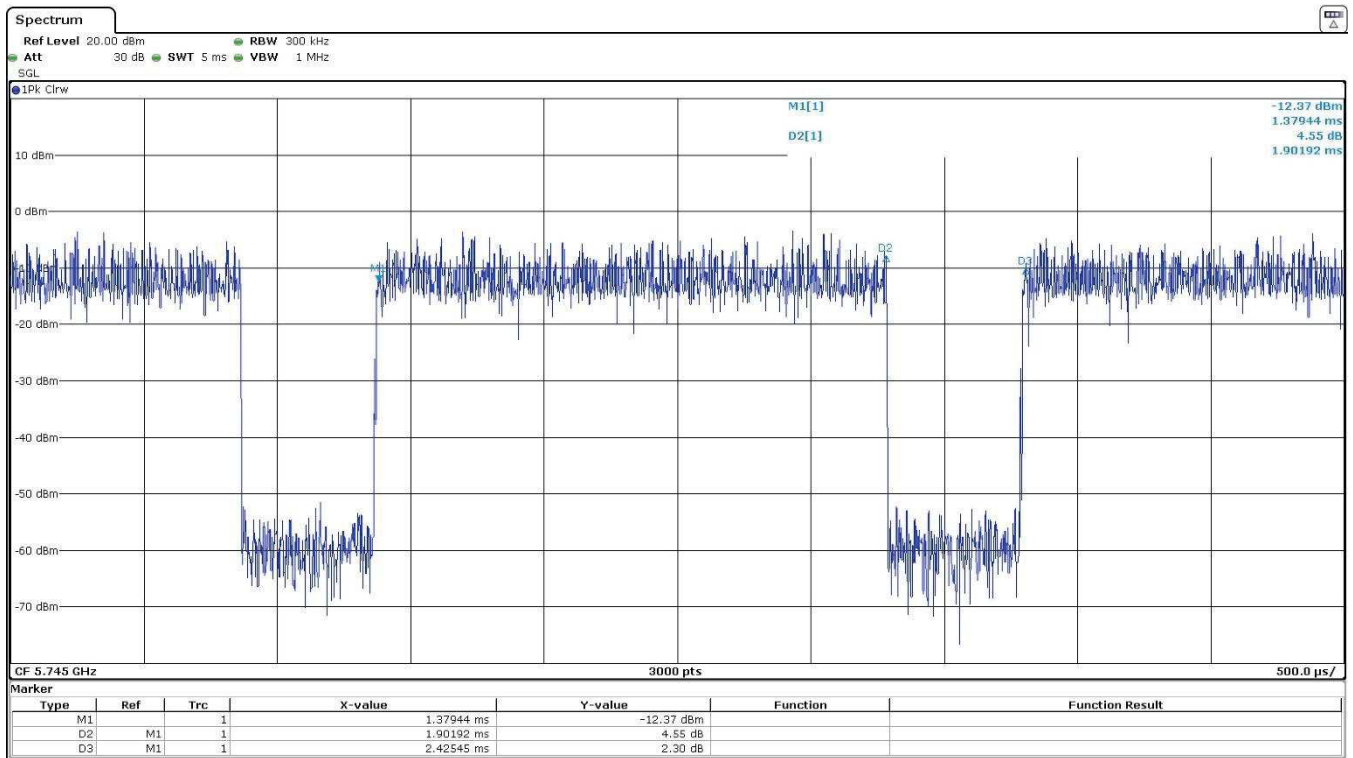




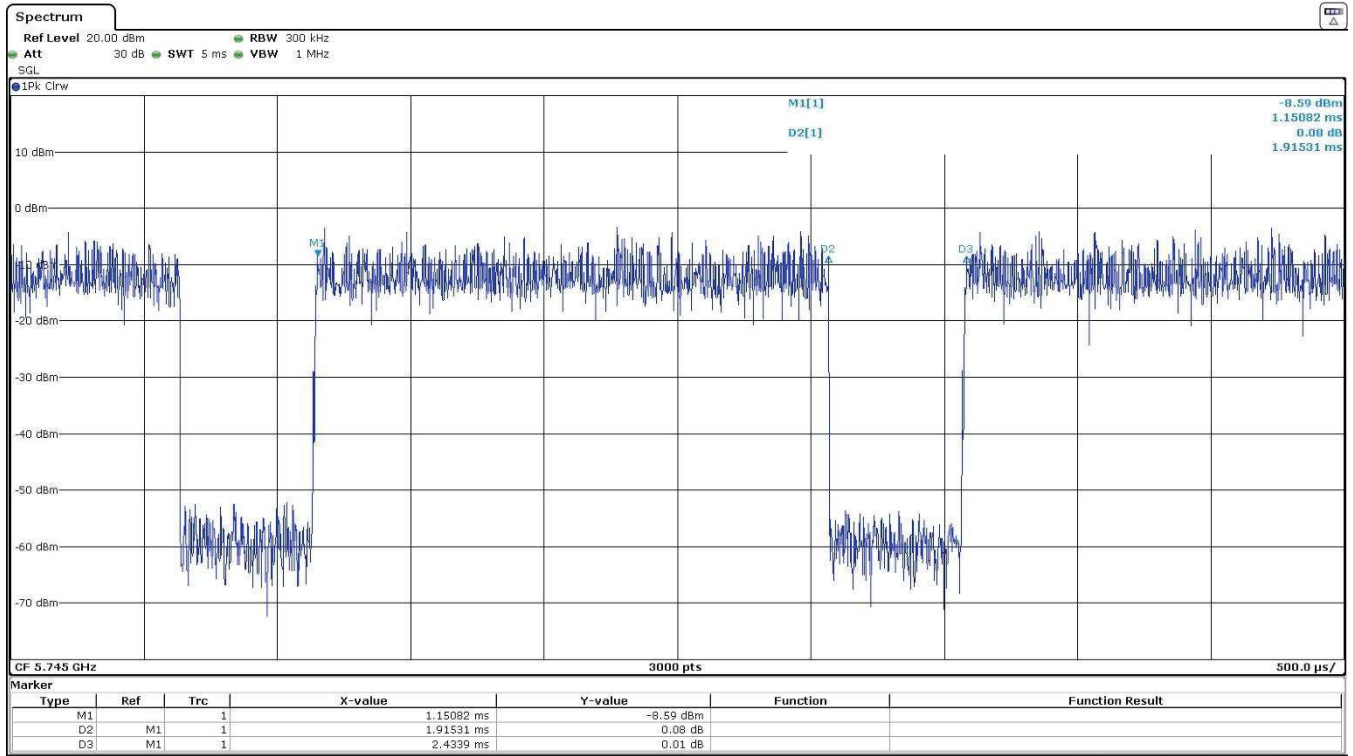
**Mode 802.11 a20 (U-NII-3):**



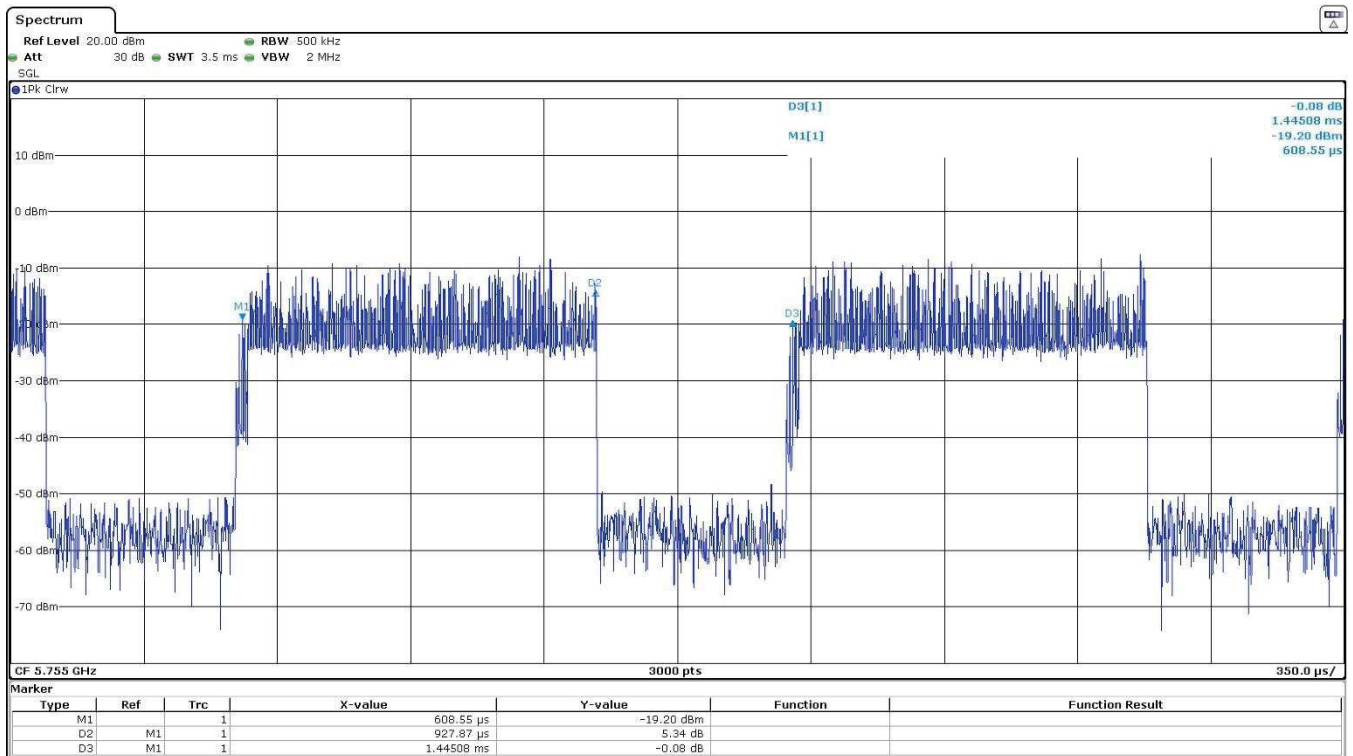
**Mode 802.11 n20 (U-NII-3):**



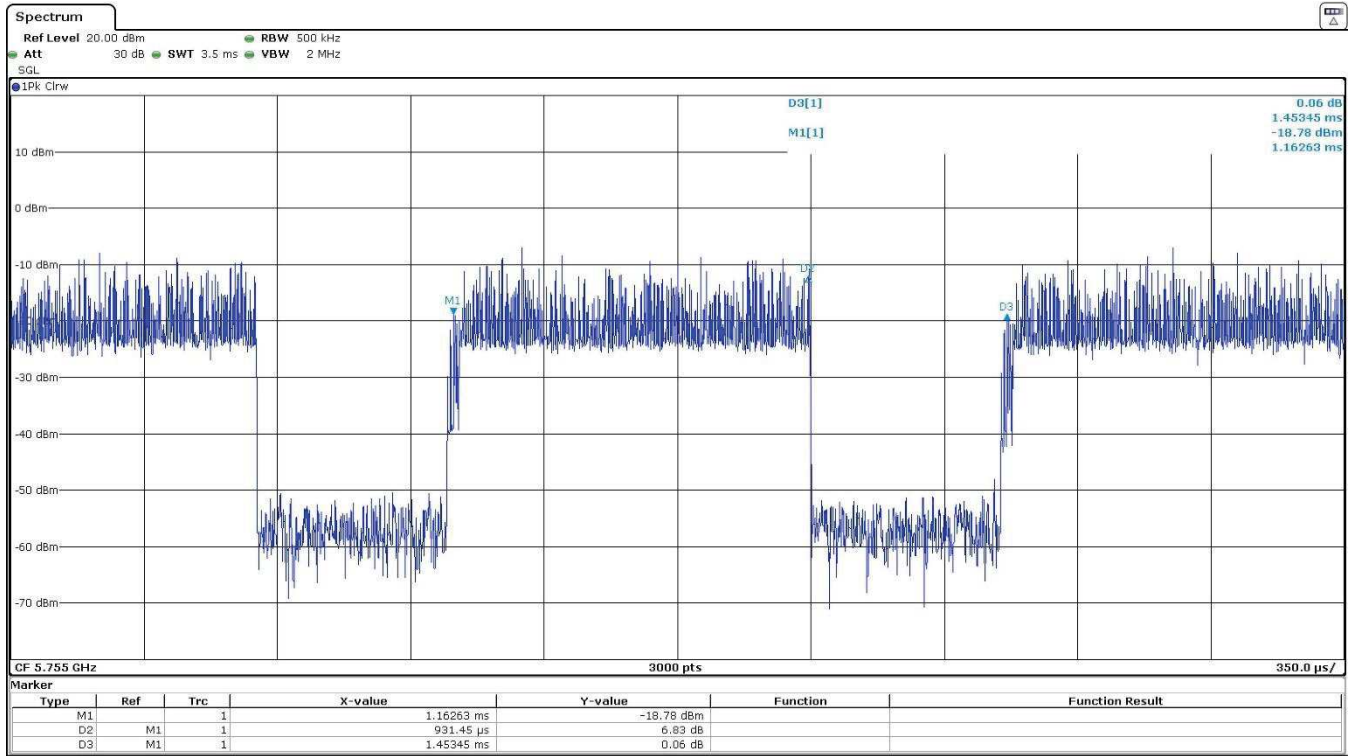
**Mode 802.11 ac20 (U-NII-3):**



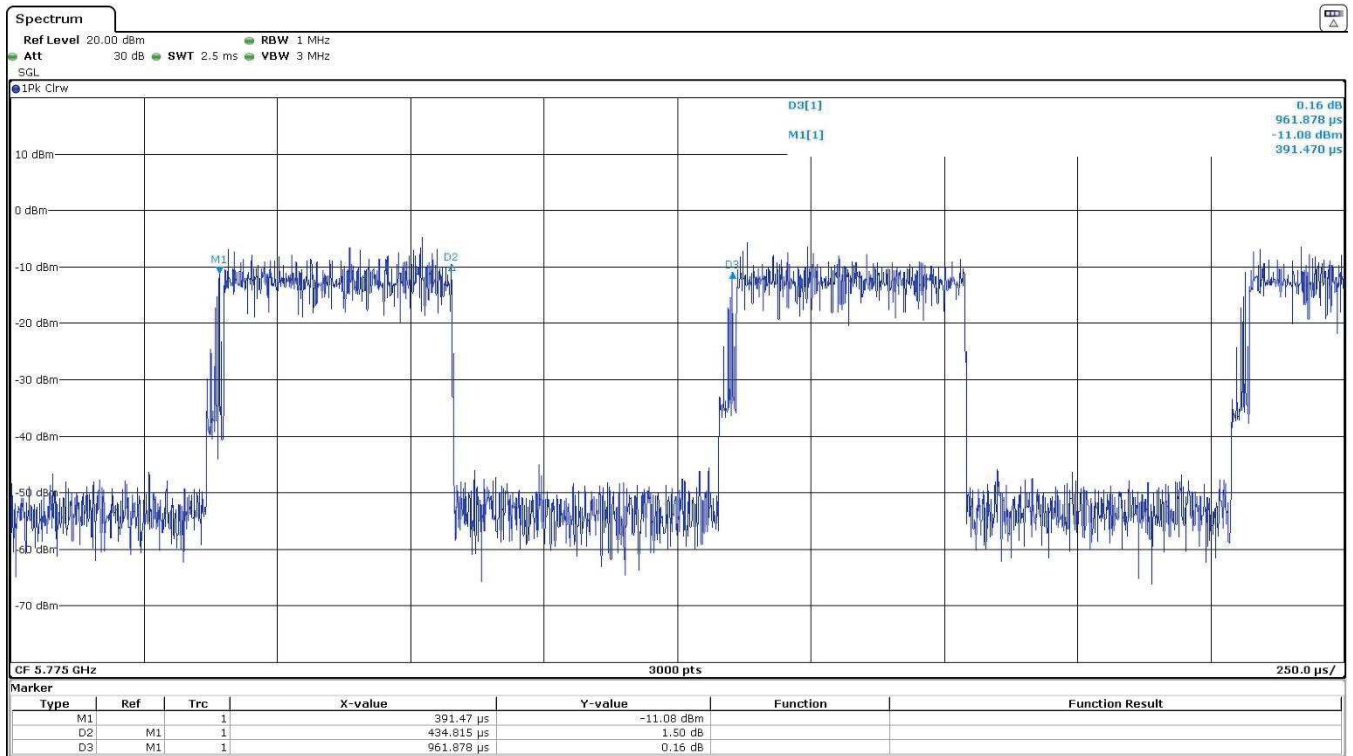
**Mode 802.11 n40 (U-NII-3):**



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



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



## RSS-Gen 6.6 / RSS-247 6.2. Transmitter 99% Occupied Bandwidth

### 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)	17.032	17	17.056
Measurement uncertainty (kHz)	<±40.51		

#### 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)	17.064	17.036	16.948
Measurement uncertainty (kHz)	<±42.41		

### 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)	18.168	18.164	18.128
Measurement uncertainty (kHz)	<±42.39		

#### 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)	17.04	17.06	18.18
Measurement uncertainty (kHz)	<±42.41		

**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)	36.216	36.224
Measurement uncertainty (kHz)	<±73.17	

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

Channels	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
99% Occupied Bandwidth (MHz)	36.792	36.696
Measurement uncertainty (kHz)	<±73.18	

**Mode 802.11 ac80 (VHT80):**

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

Channel	Single Channel 42 (5210 MHz)
99% Occupied Bandwidth (MHz)	75.264
Measurement uncertainty (kHz)	<±146.29

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

Channels	Single Channel 155 (5775 MHz)
99% Occupied Bandwidth (MHz)	77.056
Measurement uncertainty (kHz)	<±146.30

## FCC 15.403(i) 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 dB Emission Bandwidth (MHz)	21.5132	21.4358	21.4804
Measurement uncertainty (kHz)	<±40.51		

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

Channels	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
26 dB Emission Bandwidth (MHz)	21.5121	21.5256	21.4296
Measurement uncertainty (kHz)	<±42.41		

#### 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 dB Emission Bandwidth (MHz)	21.8612	21.9278	21.9404
Measurement uncertainty (kHz)	<±42.39		

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

Channels	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
26 dB Emission Bandwidth (MHz)	21.4699	21.5089	21.9055
Measurement uncertainty (kHz)	<±42.41		

**Mode 802.11 n40 (HT40):**

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

Channels	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
26 dB Emission Bandwidth (MHz)	40.1128	40.0391
Measurement uncertainty (kHz)	<±73.17	

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

Channels	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
26 dB Emission Bandwidth (MHz)	41.0512	41.7157
Measurement uncertainty (kHz)	<±73.18	

**Mode 802.11 ac80 (VHT80):**

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

Channel	Single Channel 42 (5210 MHz)
26 dB Emission Bandwidth (MHz)	81.246
Measurement uncertainty (kHz)	<±146.29

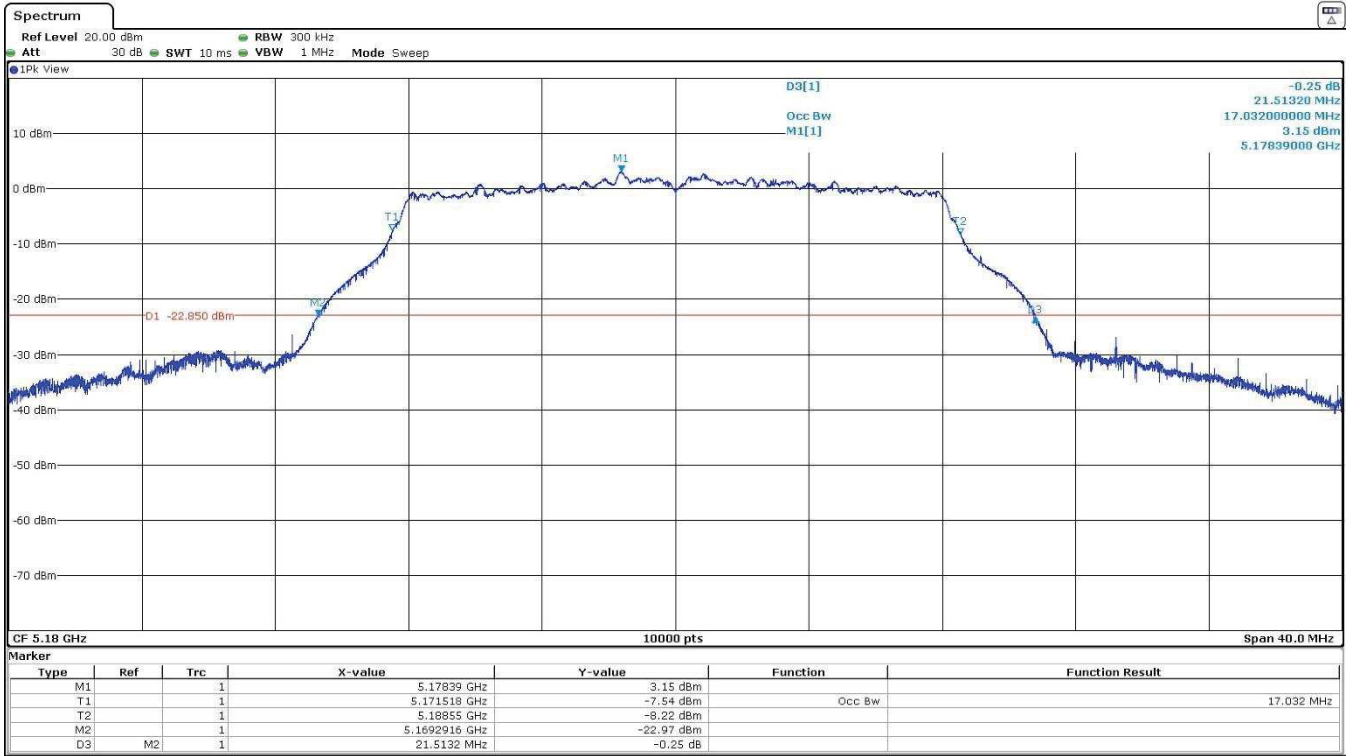
**U-NII-3 (5725-5850 MHz)**

Channel	Single Channel 155 (5775 MHz)
26 dB Emission Bandwidth (MHz)	88.931
Measurement uncertainty (kHz)	<±146.30

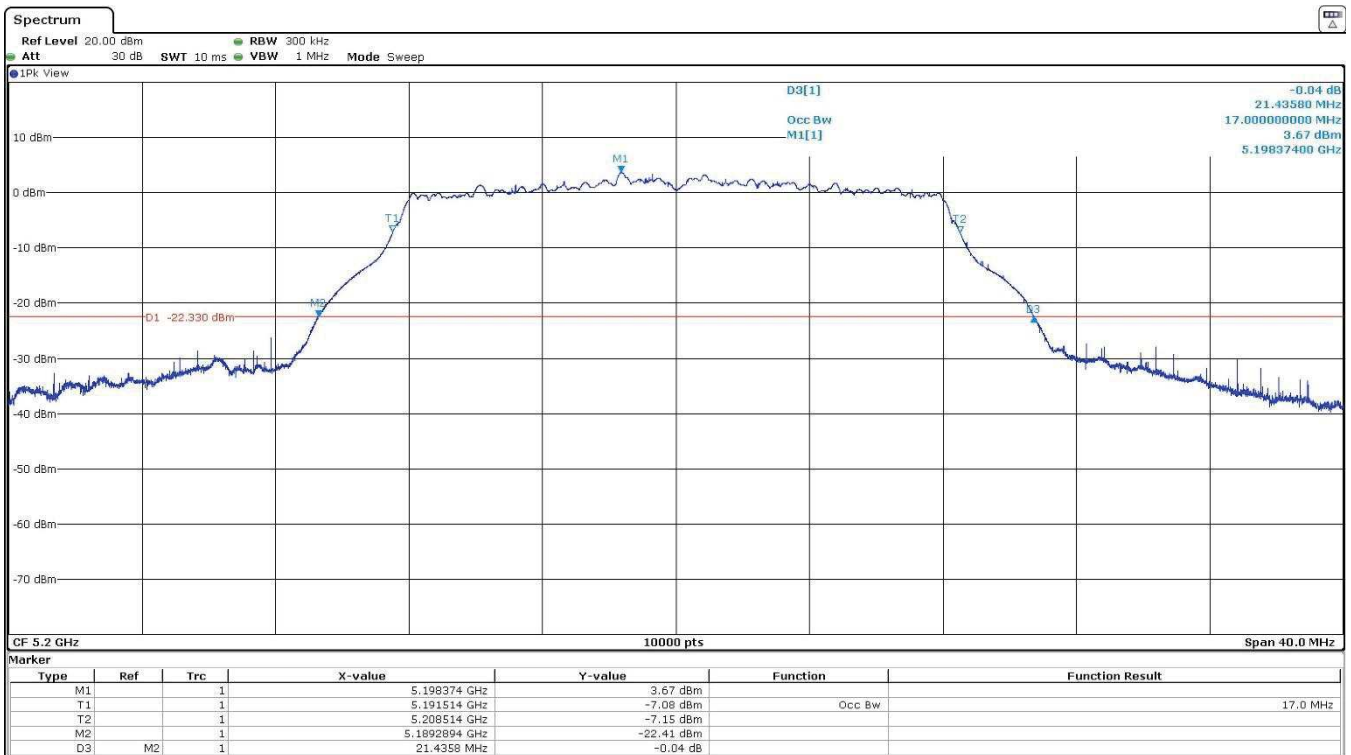
Mode 802.11 a20:

U-NII-1 (5150-5250 MHz)

- Low Channel 36 (5180 MHz):

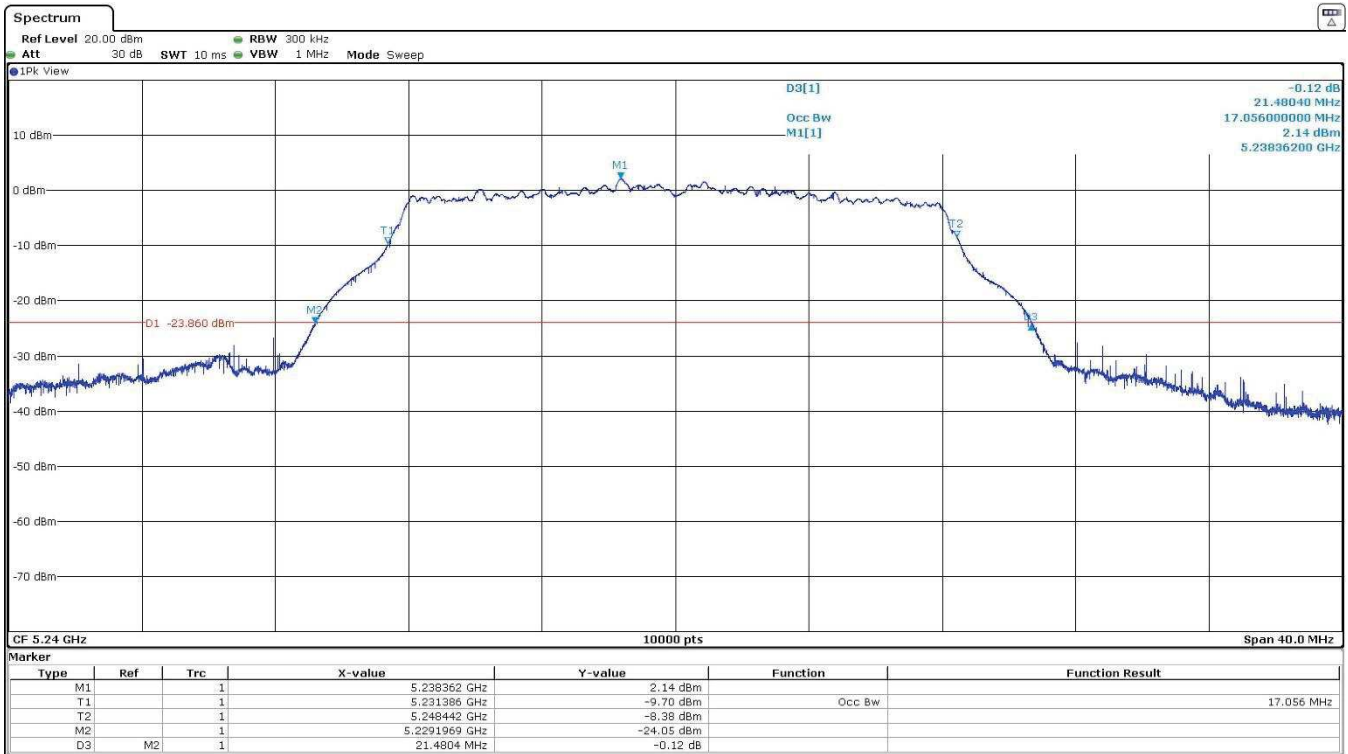


- Middle Channel 40 (5200 MHz):



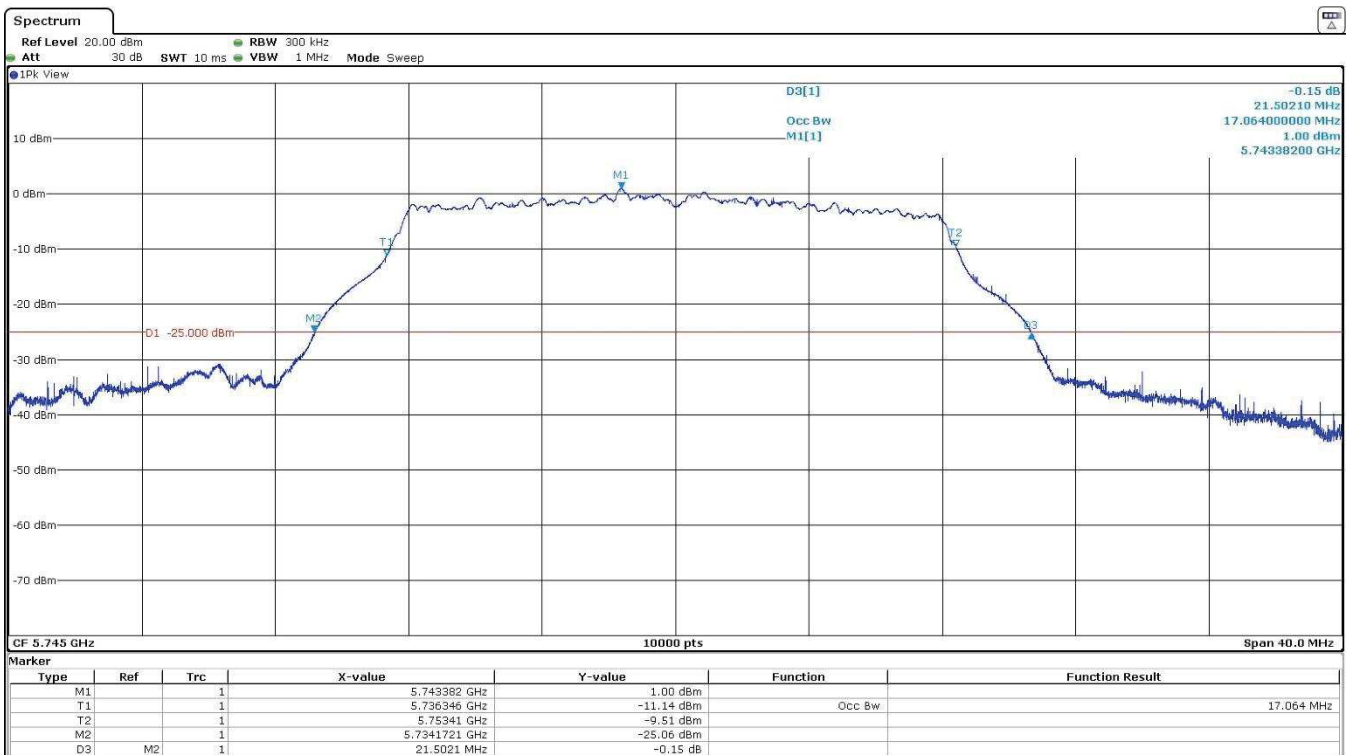


- High Channel 48 (5240 MHz):

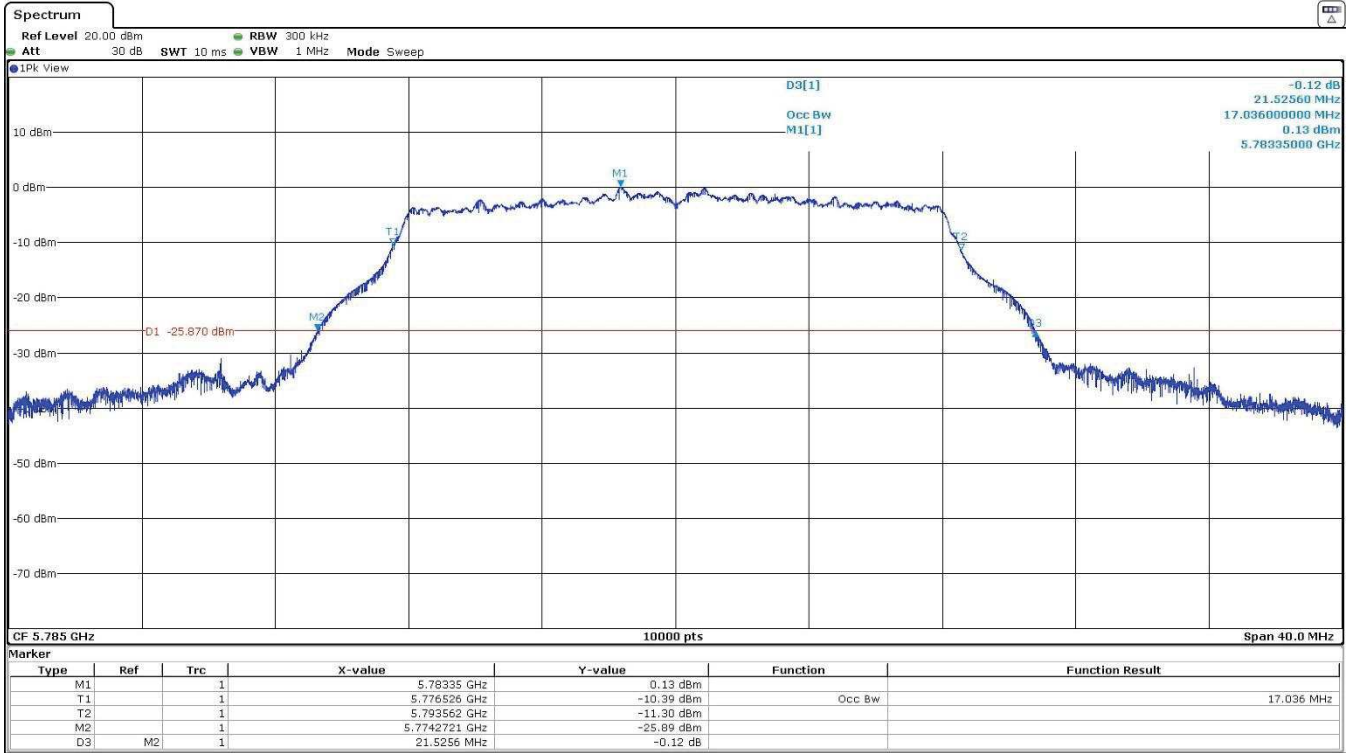


**U-NII-3 (5725-5850 MHz)**

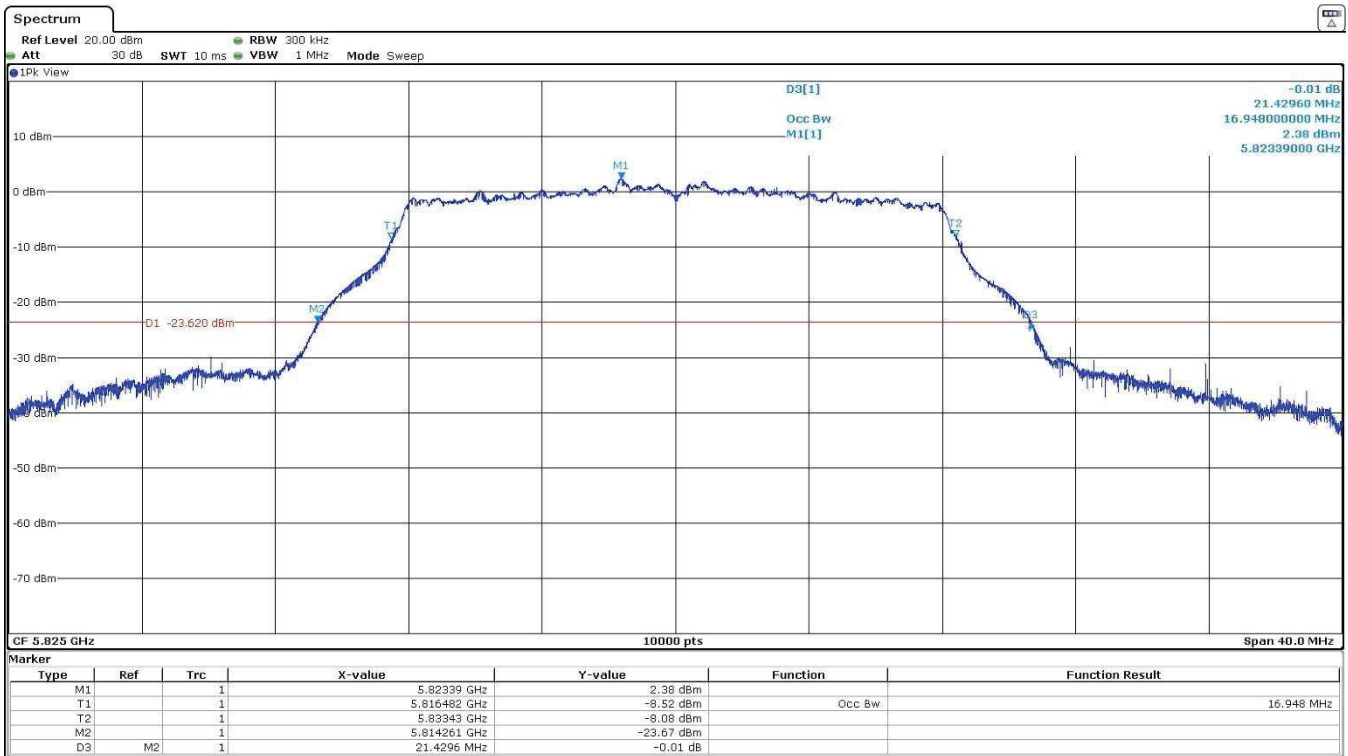
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



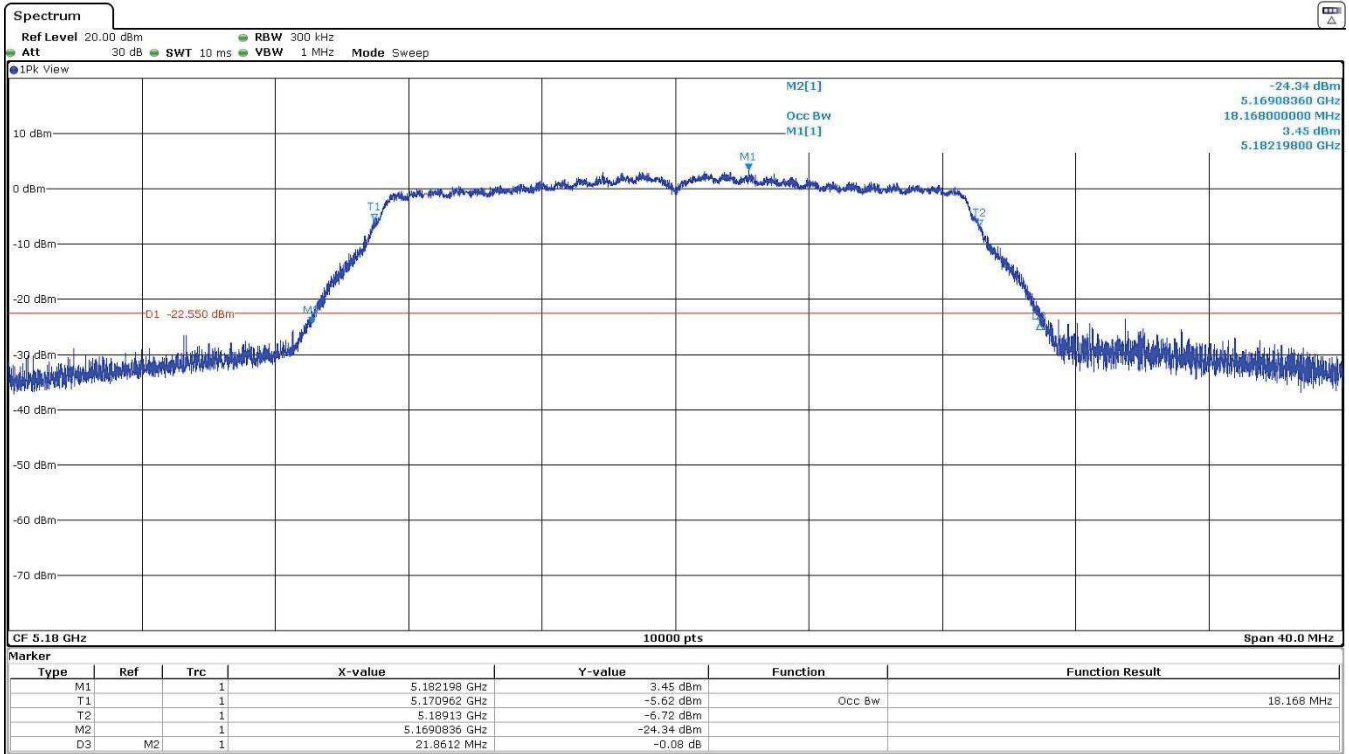
- High Channel 165 (5825 MHz):



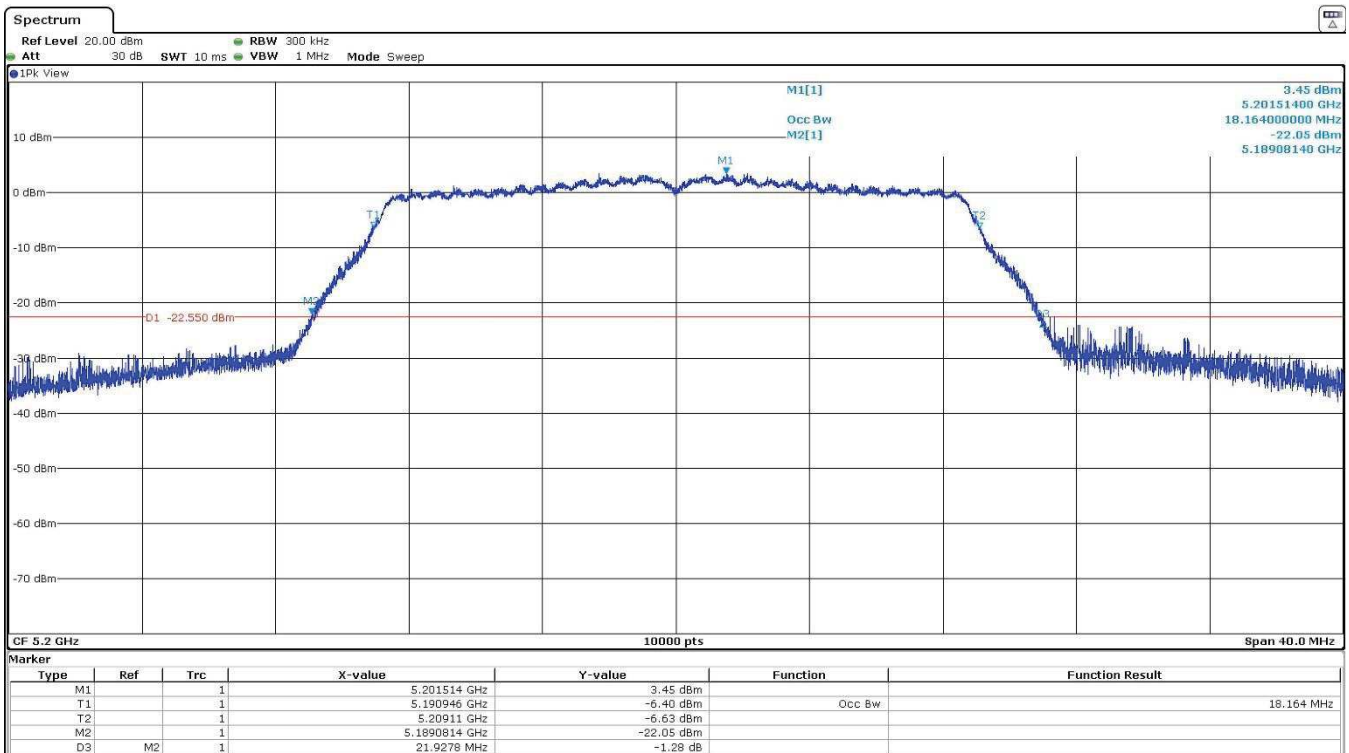
**Mode 802.11 ac20 (VHT20):**

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

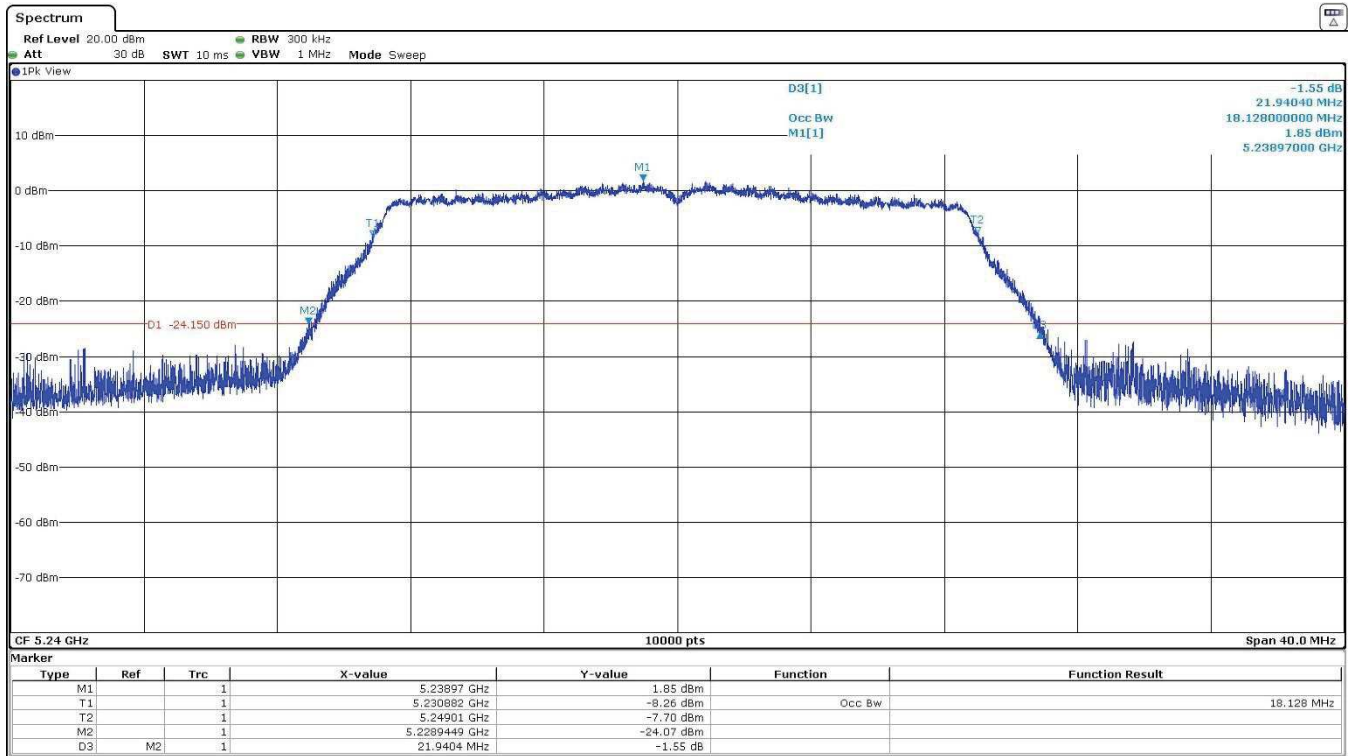
- Low Channel 36 (5180 MHz):



- Middle Channel 40 (5200 MHz):

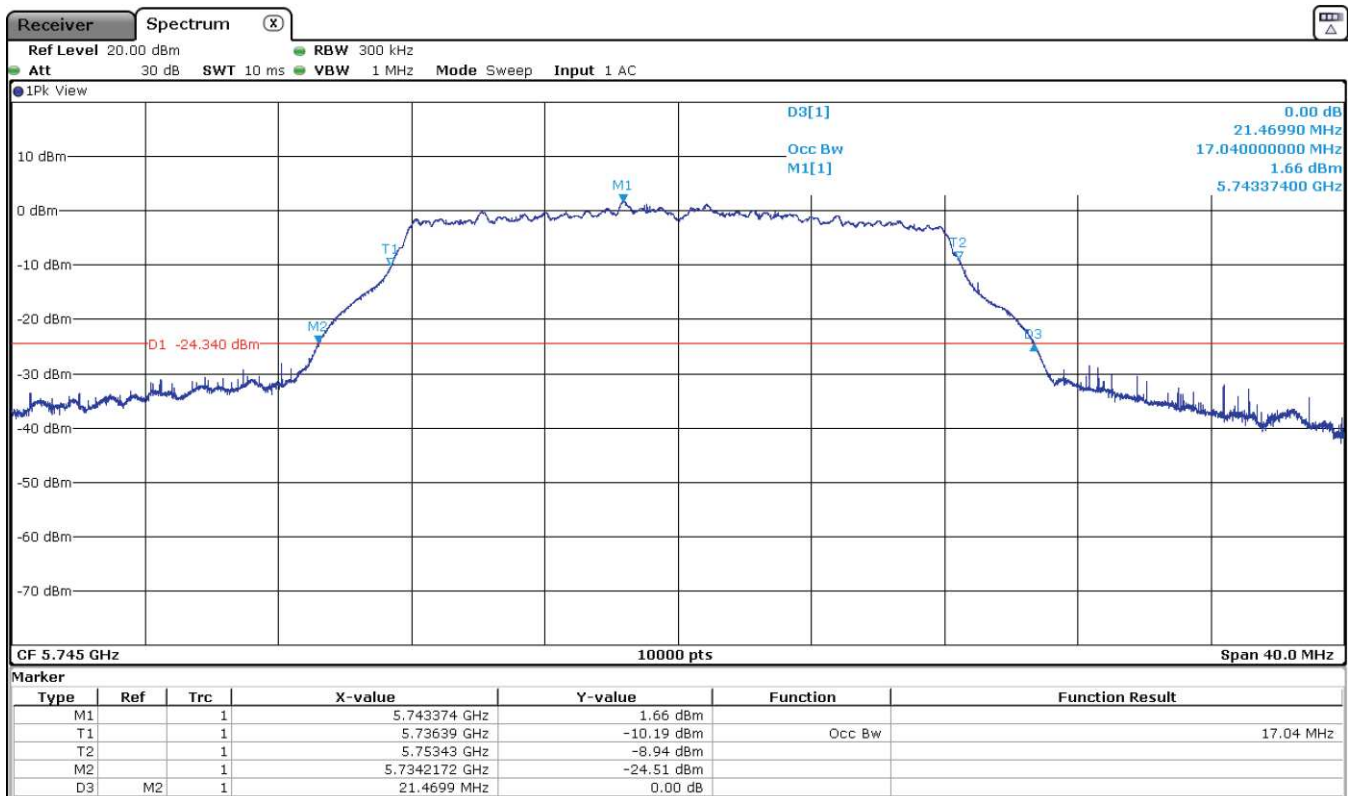


- High Channel 48 (5240 MHz):

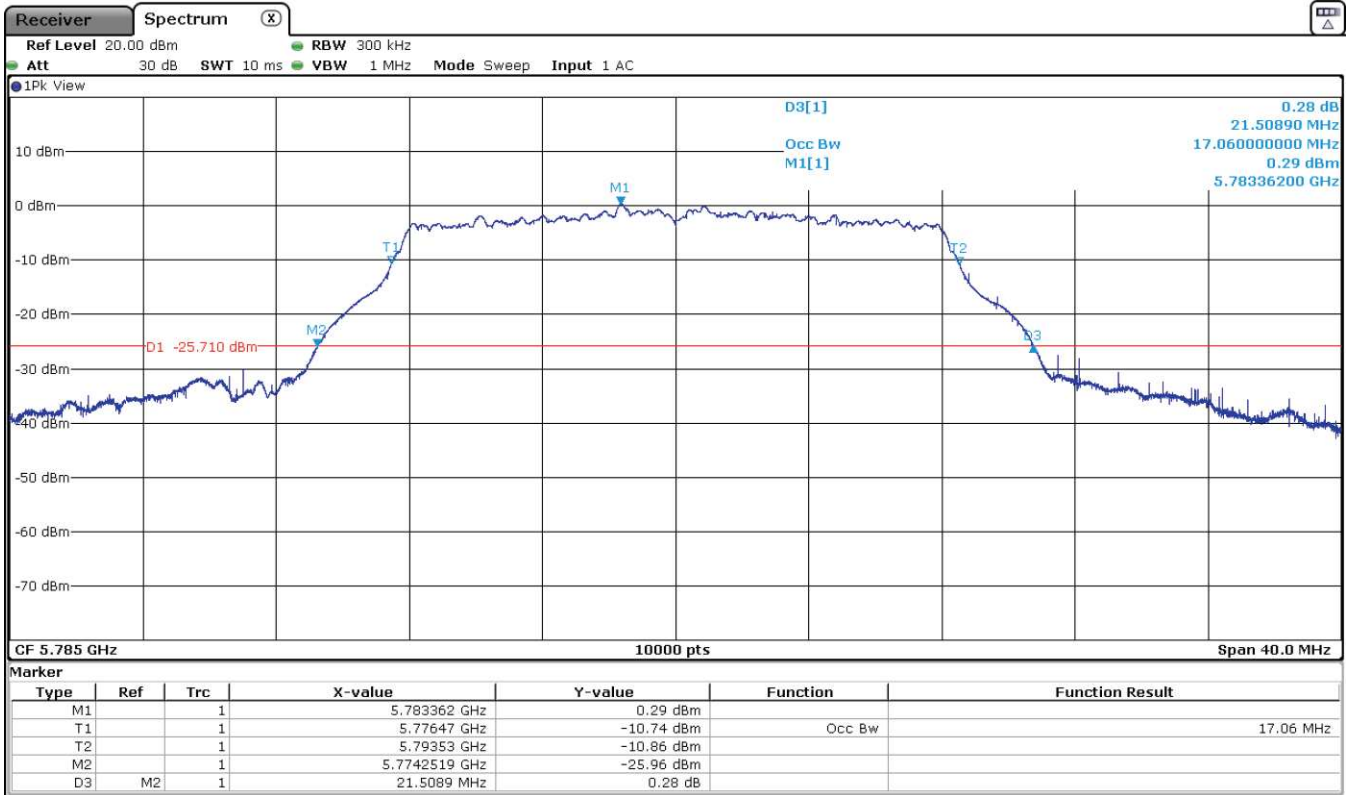


**U-NII-3 (5725-5850 MHz)**

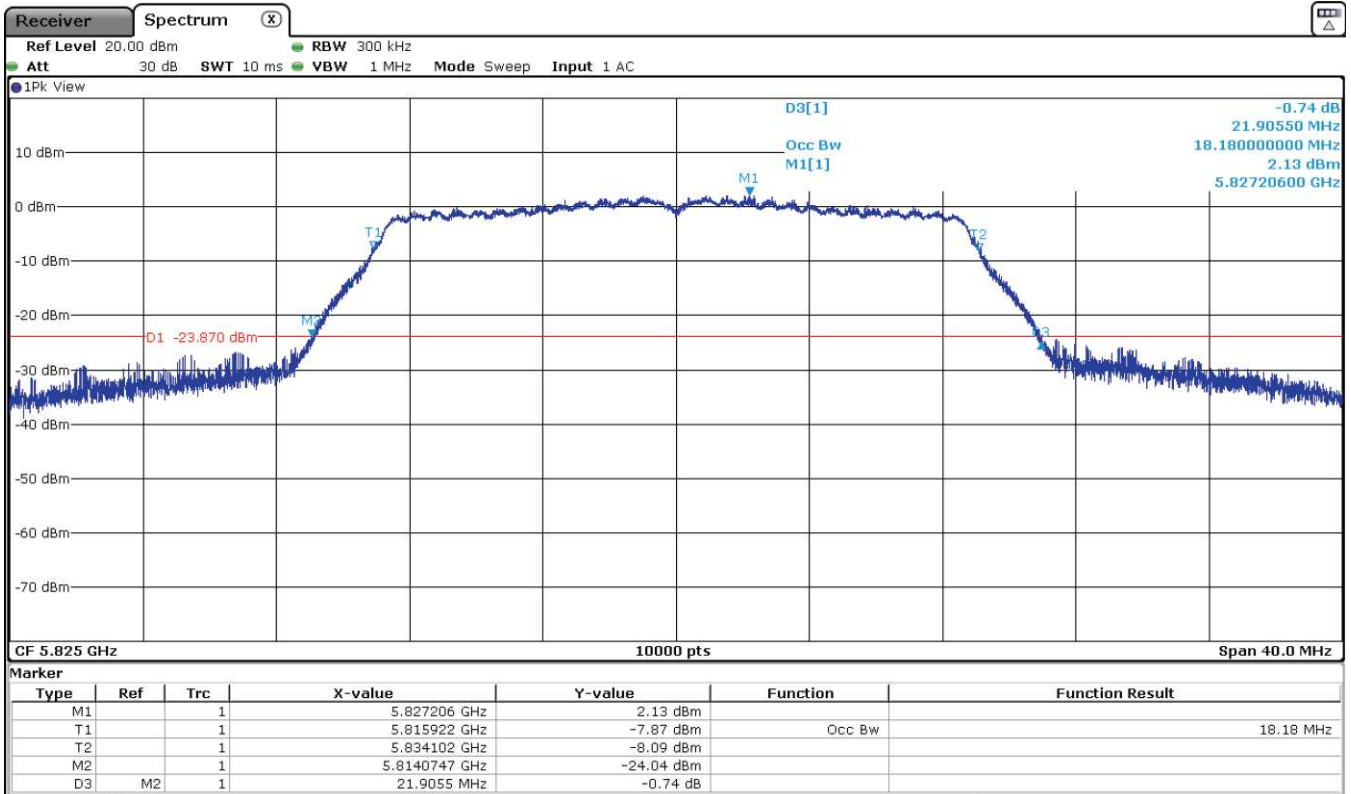
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



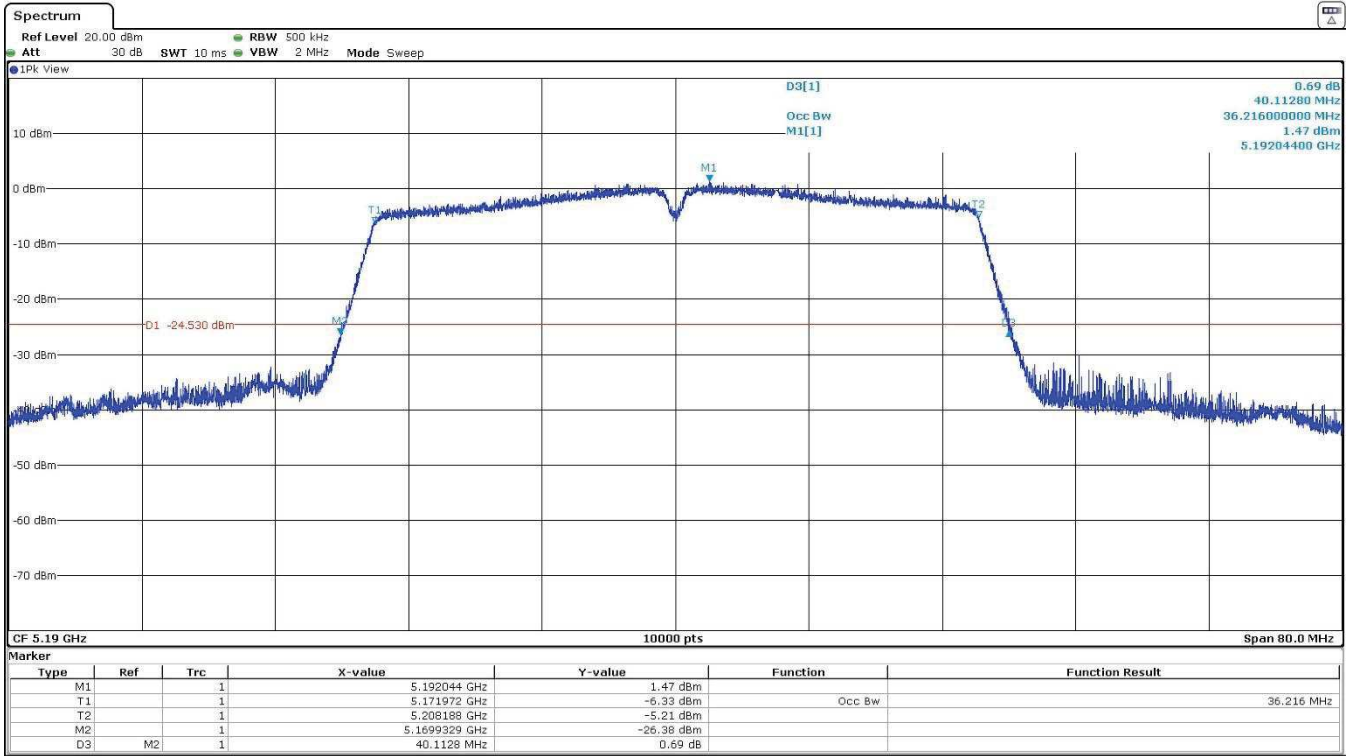
- High Channel 165 (5825 MHz):



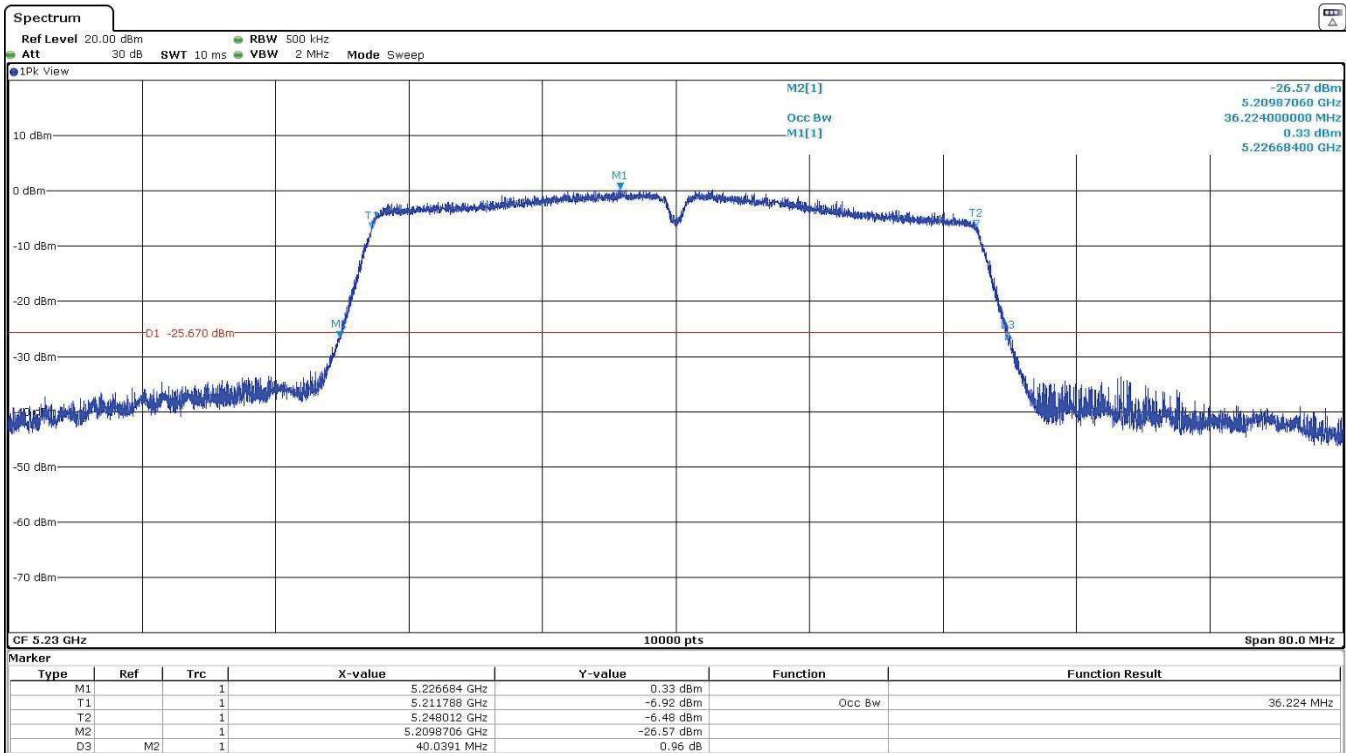
**Mode 802.11 n40 (HT40):**

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

- Low Channel 38 (5190 MHz):

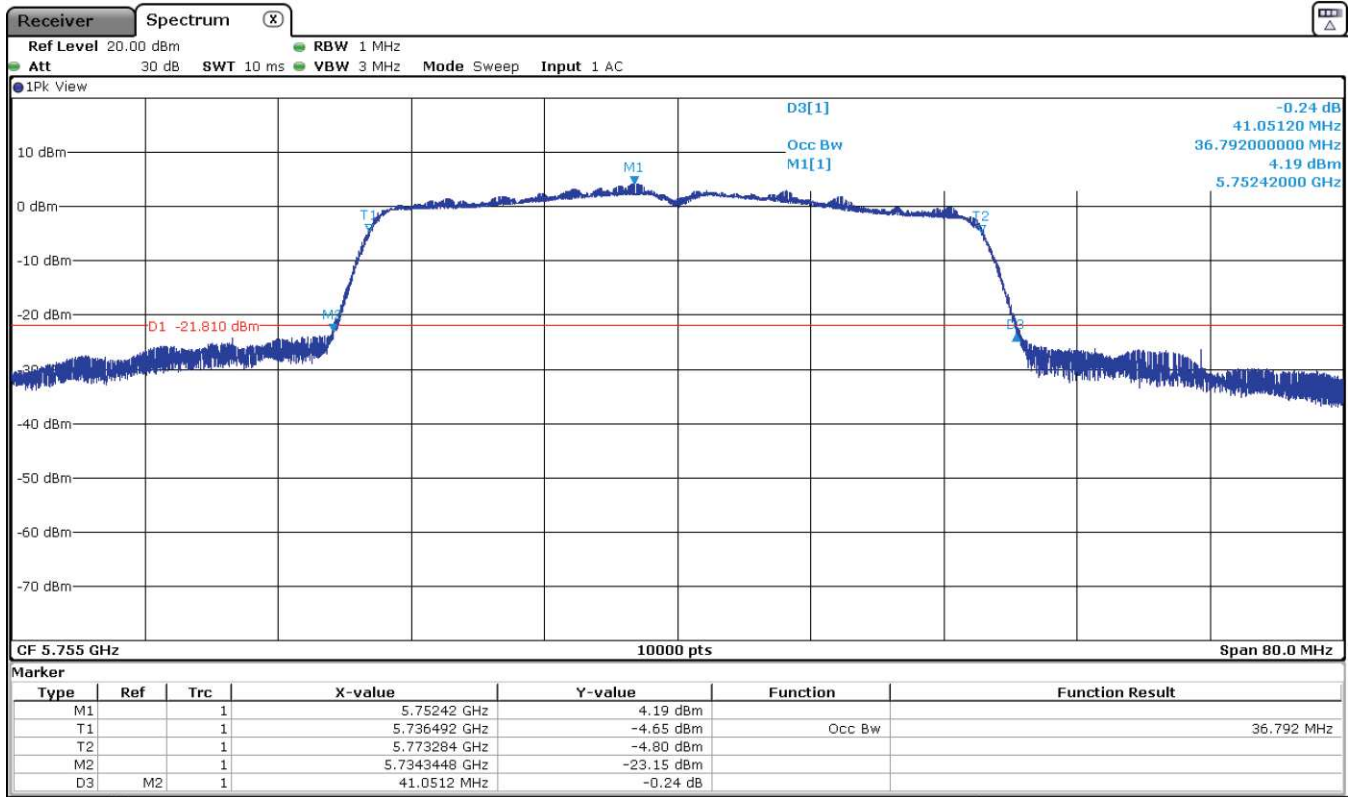


- High Channel 46 (5230 MHz):

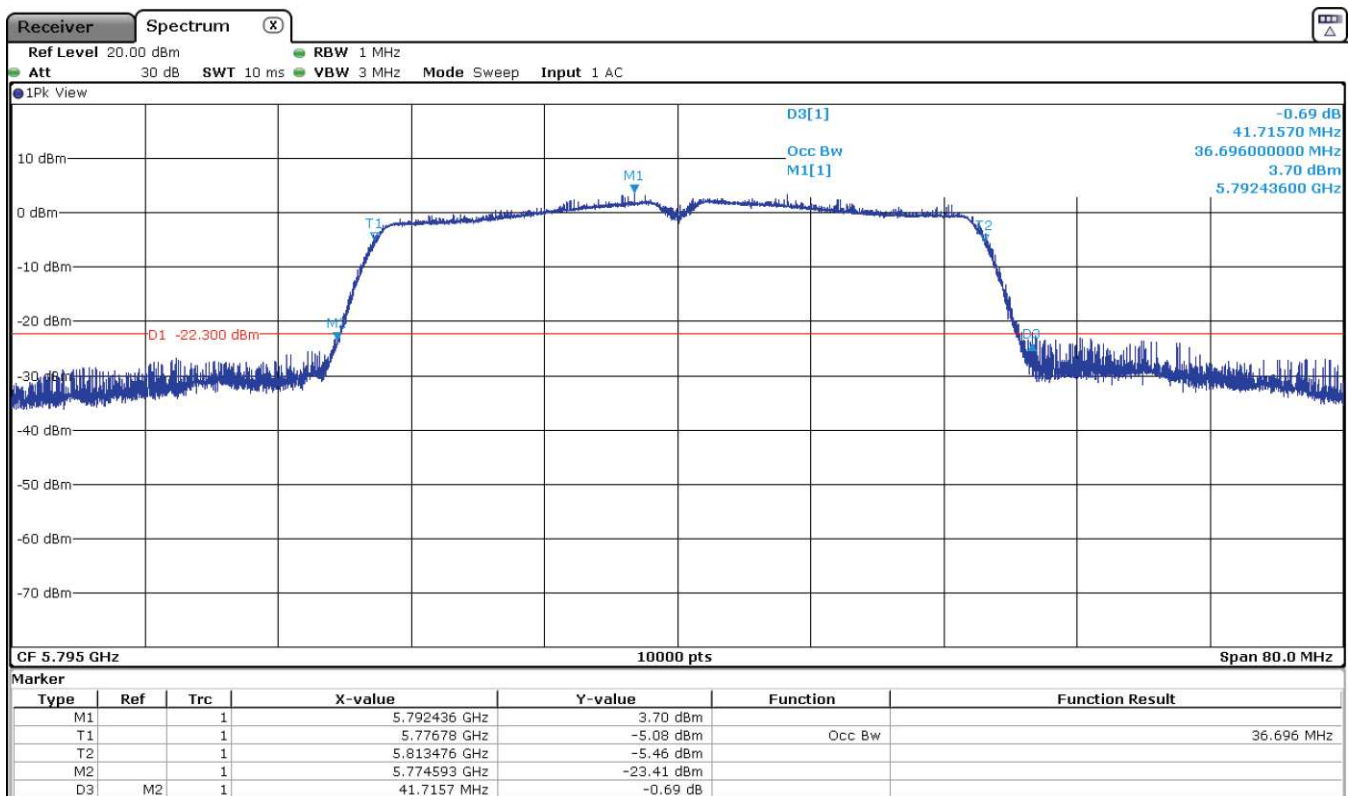


**U-NII-3 (5725-5850 MHz)**

- Low Channel 151 (5755 MHz):



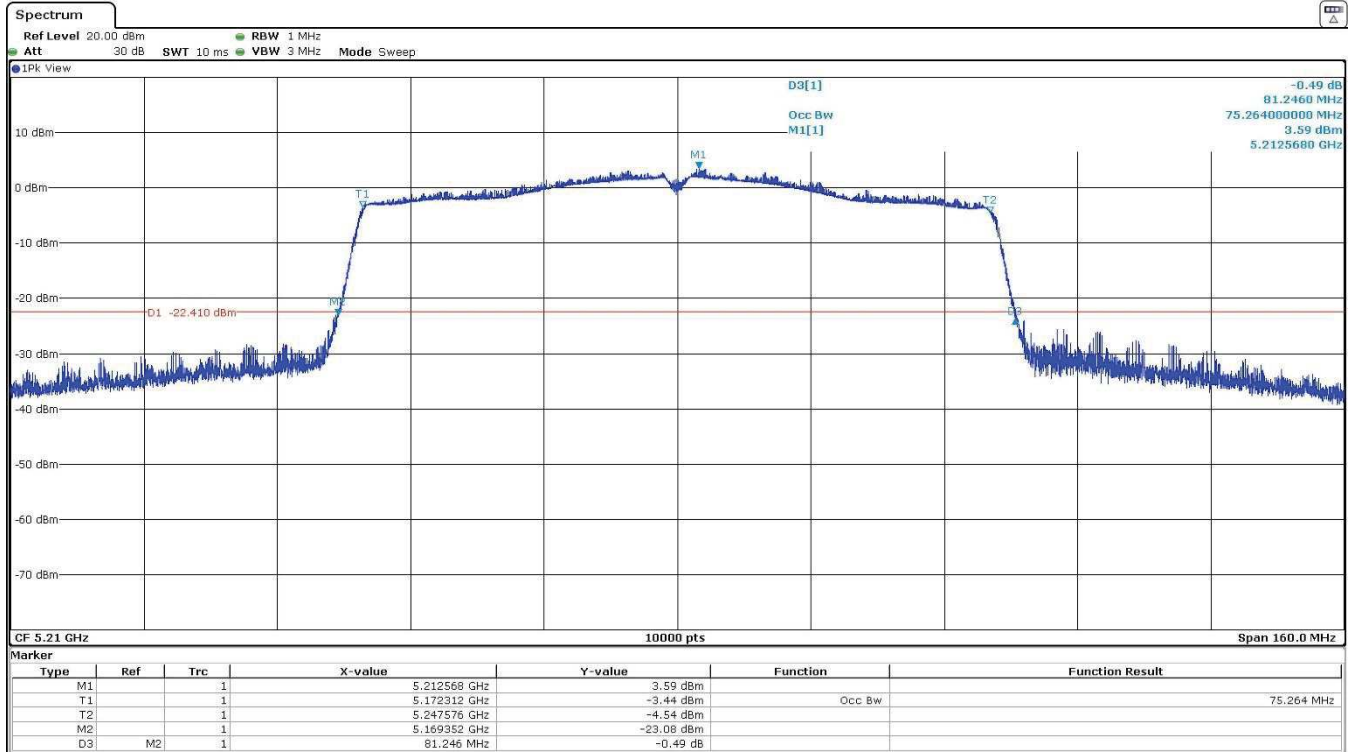
- High Channel 159 (5795 MHz):



**Mode 802.11 ac80 (VHT80):**

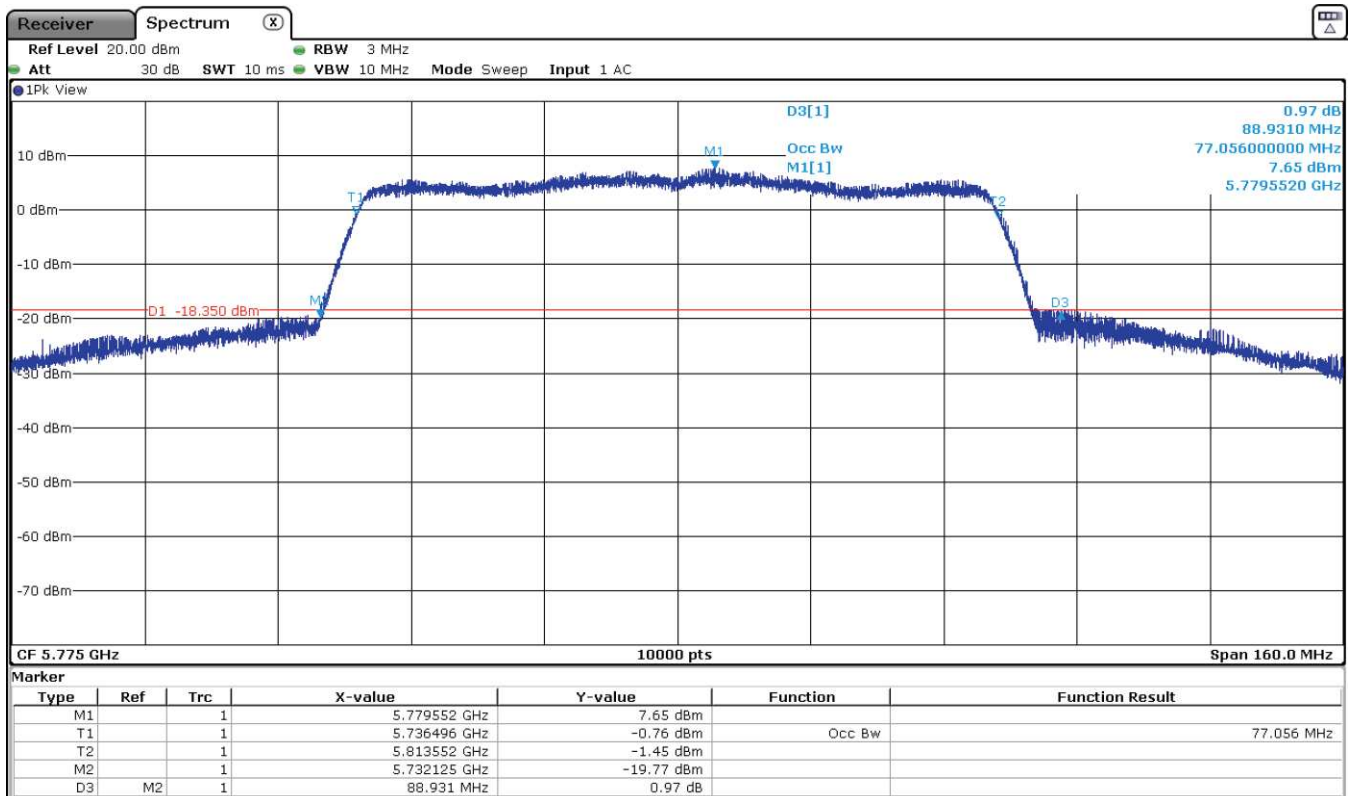
**U-NII-1 (5150-5250 MHz)**

- 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

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## 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)
	Lowest: 36	5180
	Middle: 40	5200
	Highest: 48	5240
Channel Spacing:	40 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Lowest: 38	5190
	Highest: 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-18 GHz Double ridge horn antenna is situated at a distance of 3 m and a distance of 1m for the frequency range 17 GHz-40 GHz (18 GHz-40 GHz horn antenna).

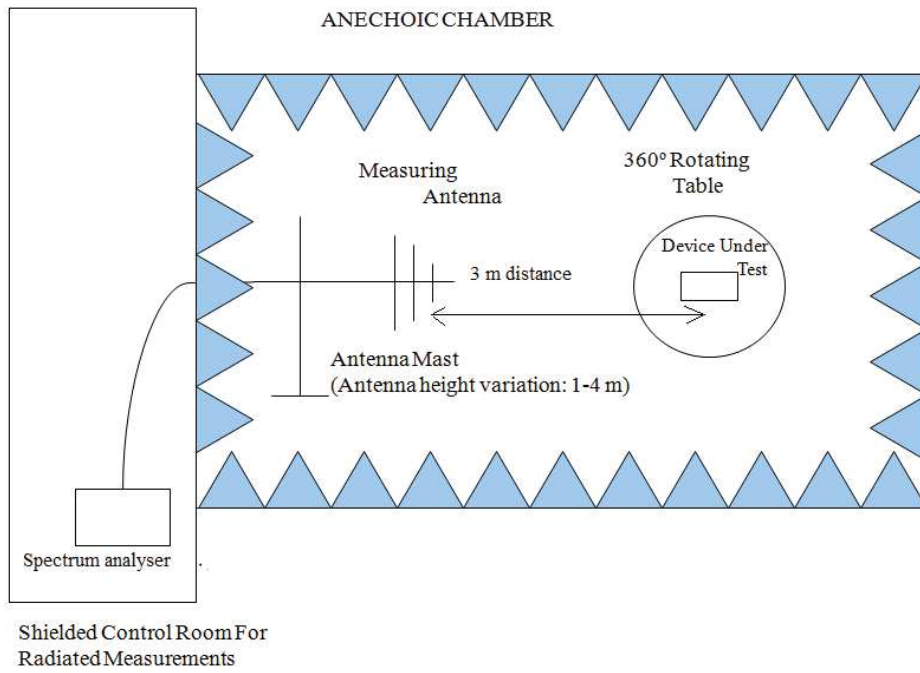
For radiated emissions in the range 17 GHz-40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

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.

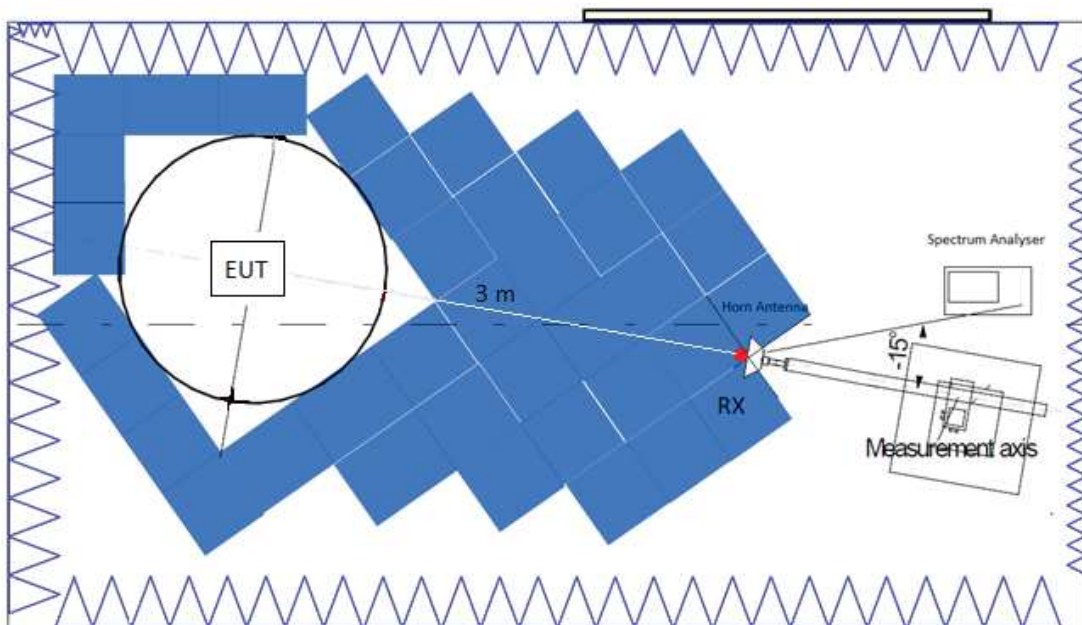
Measurements were made in both horizontal and vertical planes of polarization.

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

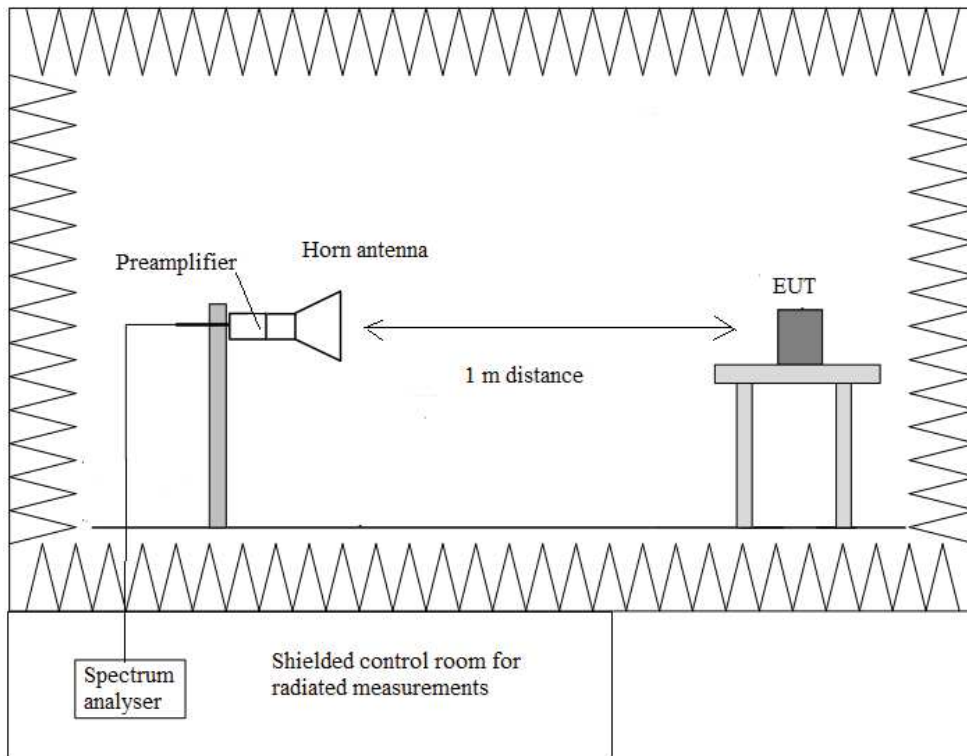
Radiated measurements setup from 30 MHz to 1 GHz:



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: The maximum e.i.r.p. shall not exceed 200 mW (23 dBm) or  $10 + 10 \log_{10} B$ , dBm, whichever power is less. B is the 99% emission bandwidth in MHz.

#### 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)	10.14	10.83	8.89
Duty Cycle Correction Factor (dB)	1.047431924		
Max. Conducted Power Corrected (dBm)	11.18743192	11.87743192	9.937431924
Max. EIRP power Corrected (dBm)	5.787431924	6.477431924	4.537431924
Measurement uncertainty (dB)	<±1.20		

**Mode 802.11 ac20 (VHT20):**

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Max. Conducted Power (dBm)	10.11	10.48	8.85
Duty Cycle Correction Factor (dB)	1.101843955		
Max. Conducted Power Corrected (dBm)	11.21184395	11.58184395	9.951843955
Max. EIRP power Corrected (dBm)	5.811843955	6.181843955	4.551843955
Measurement uncertainty (dB)	<±1.20		

**Mode 802.11 n40 (HT40):**

	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
Max. Conducted Power (dBm)	7.8	6.78
Duty Cycle Correction Factor (dB)	2.020944858	
Max. Conducted Power Corrected (dBm)	9.820944858	8.800944858
Max. EIRP power Corrected (dBm)	4.420944858	3.400944858
Measurement uncertainty (dB)	<±1.20	

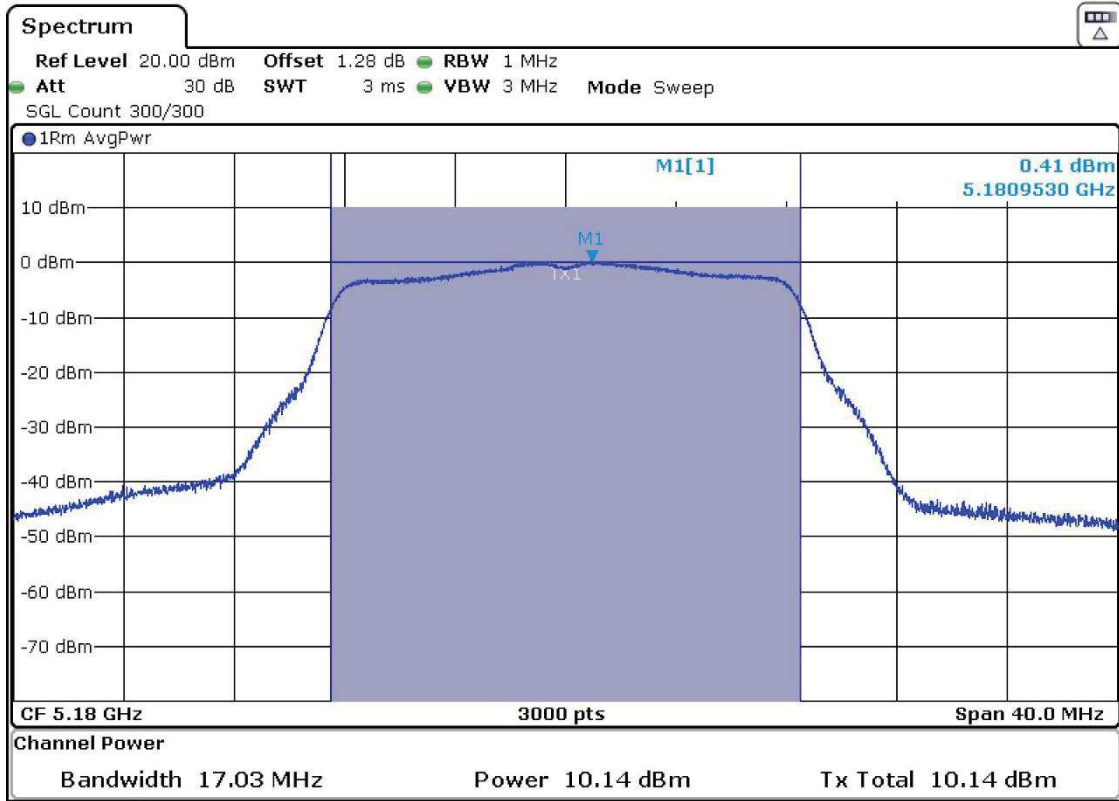
**Mode 802.11 ac80 (VHT80):**

	Single Channel 42 (5210 MHz)
Max. Conducted Power (dBm)	7.27
Duty Cycle Correction Factor (dB)	3.53587835
Max. Conducted Power Corrected (dBm)	10.80587835
Max. EIRP power Corrected (dBm)	5.40587835
Measurement uncertainty (dB)	<±1.20

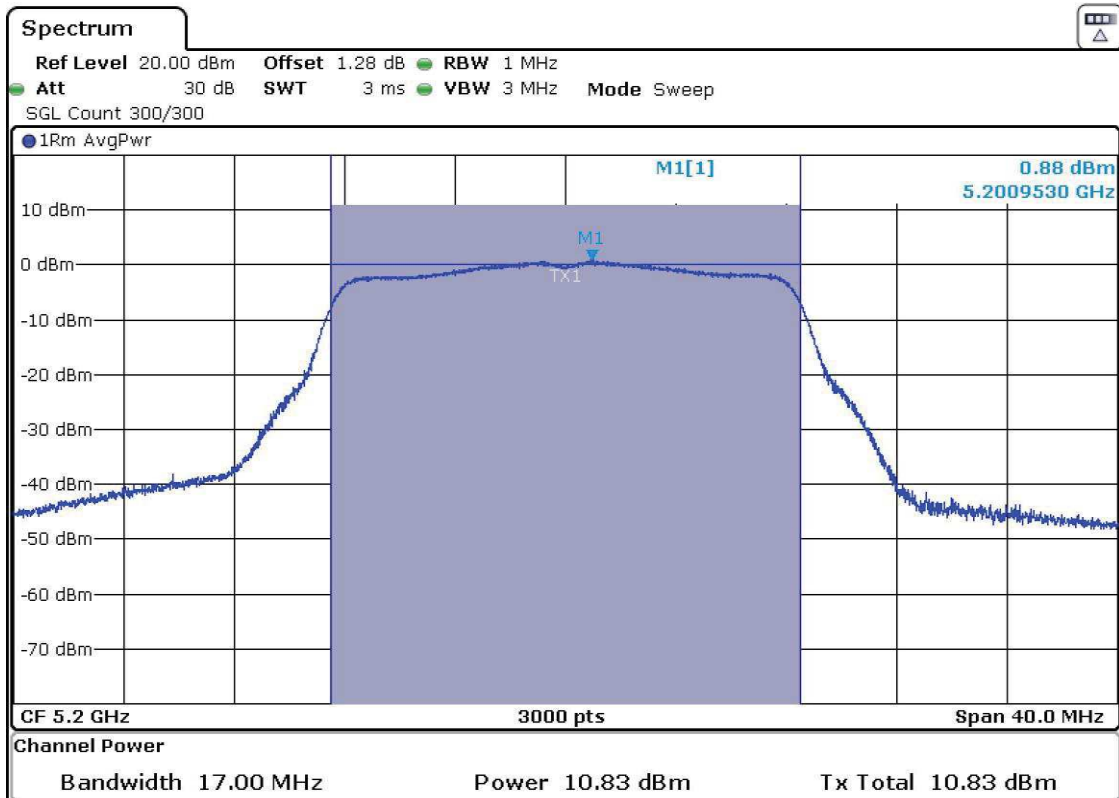
Verdict: PASS

**Mode 802.11 a20:**

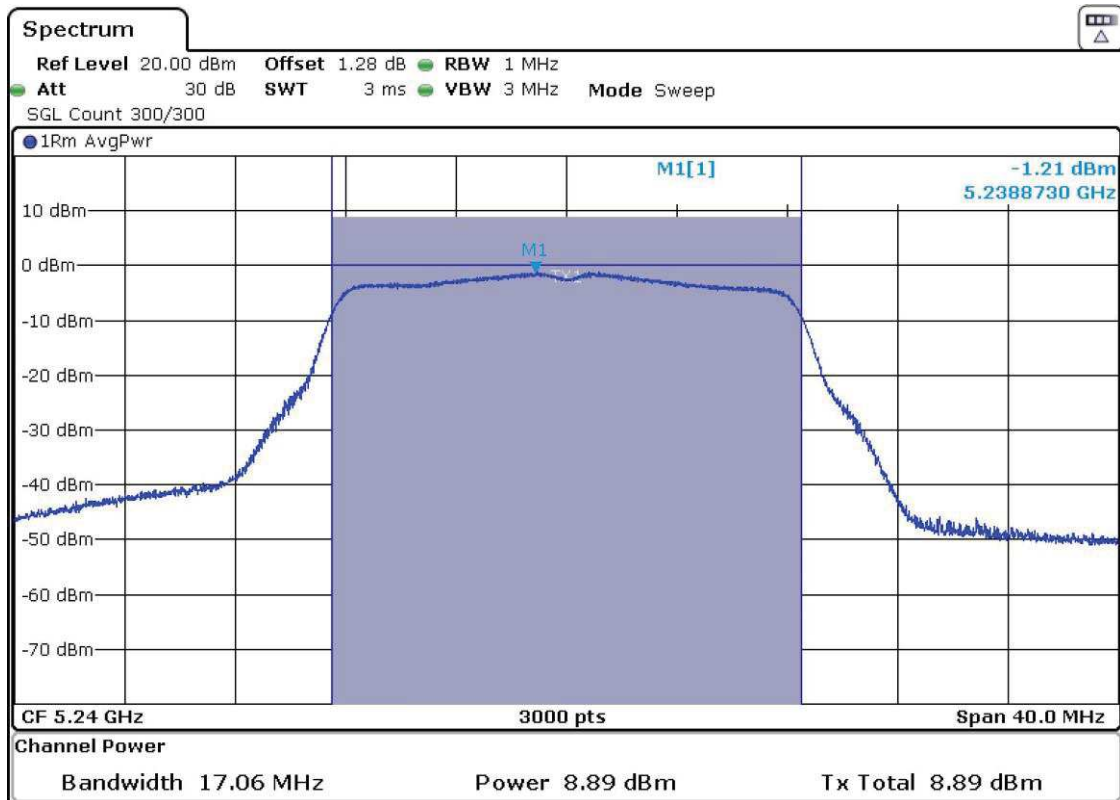
- Low Channel:



- Middle Channel:

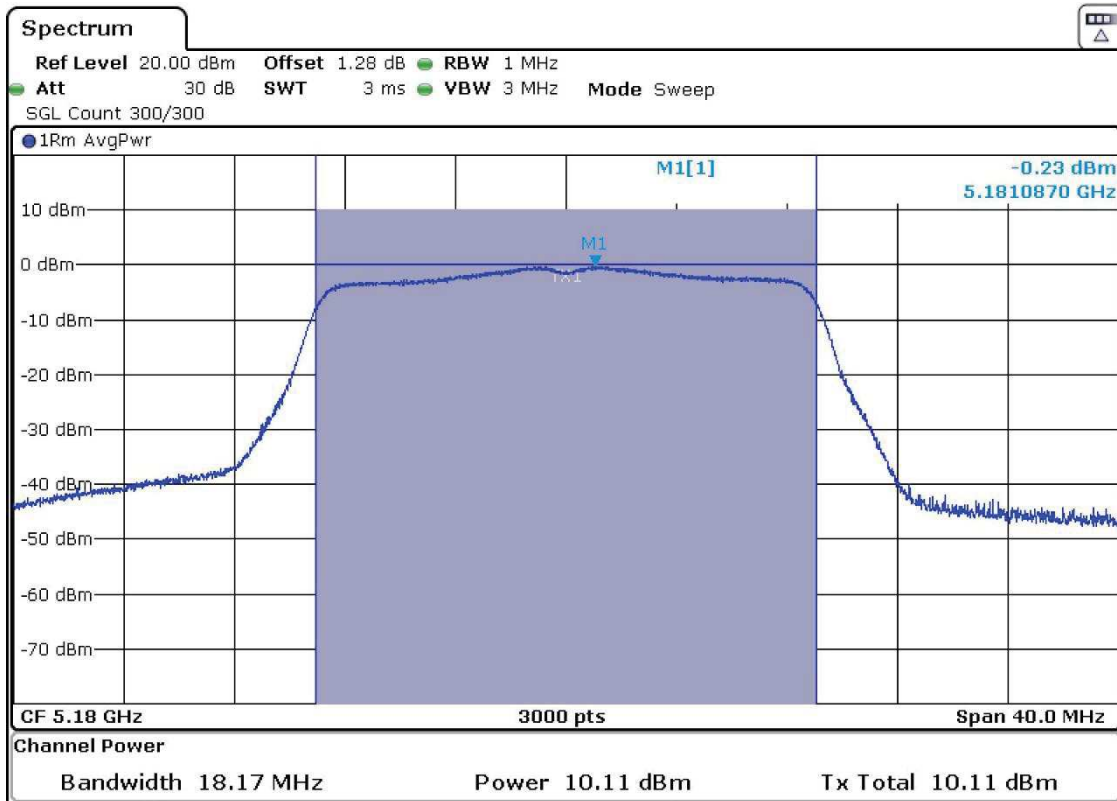


- High Channel:

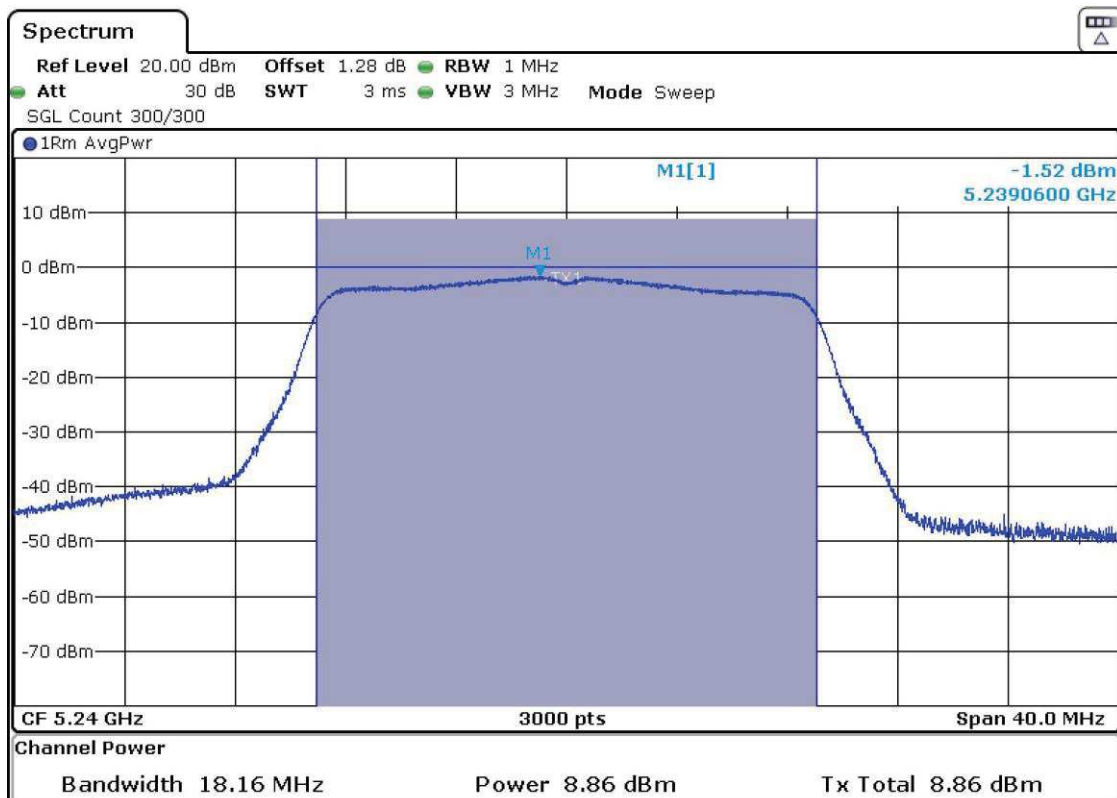


**Mode 802.11 ac20 (VHT20):**

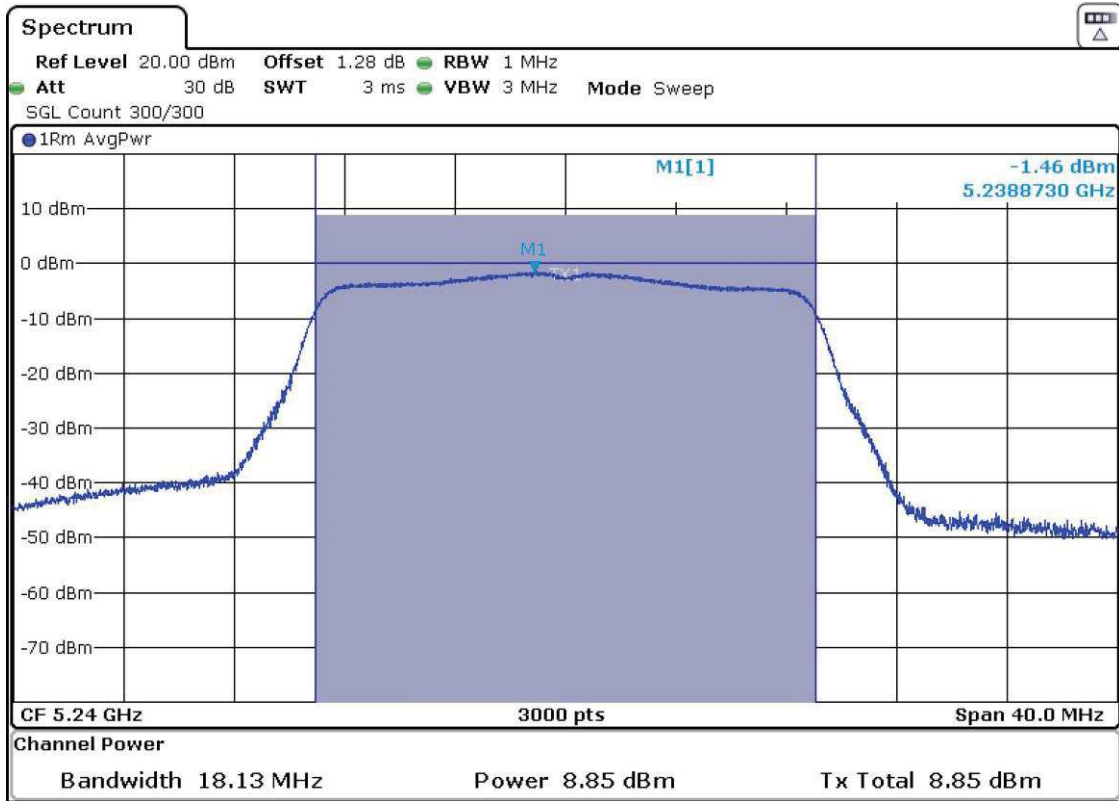
- Low Channel:



- Middle Channel:

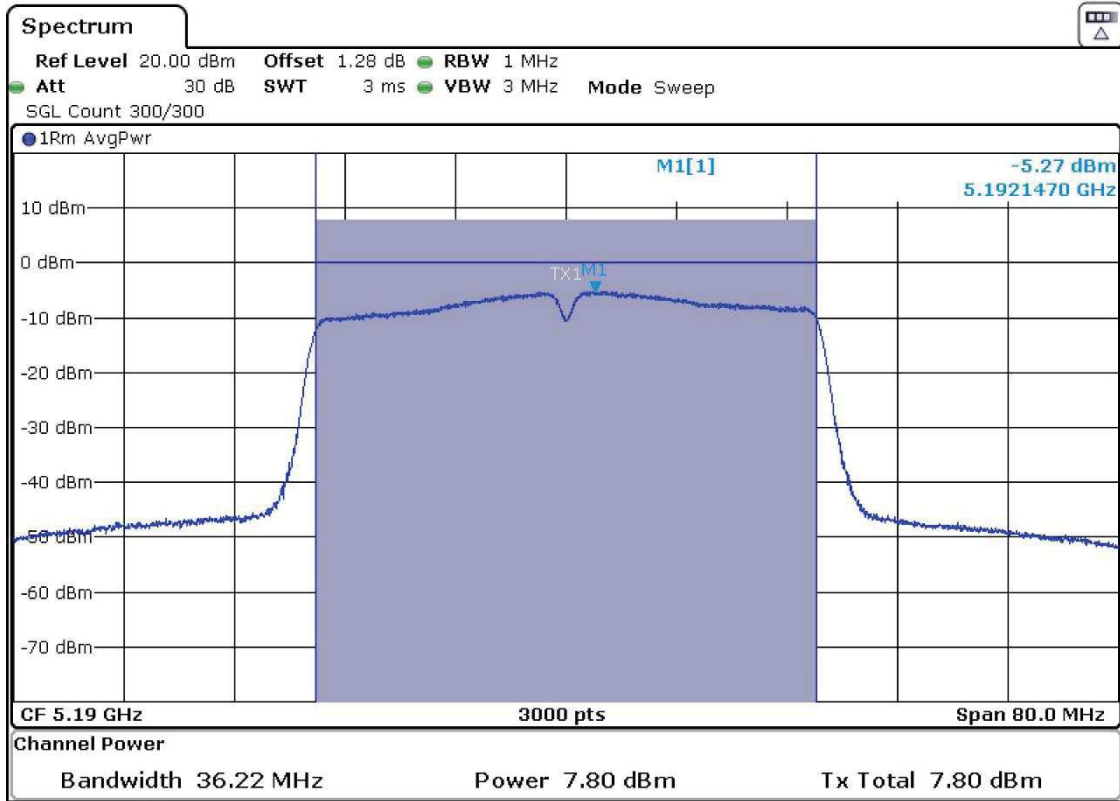


- High Channel:

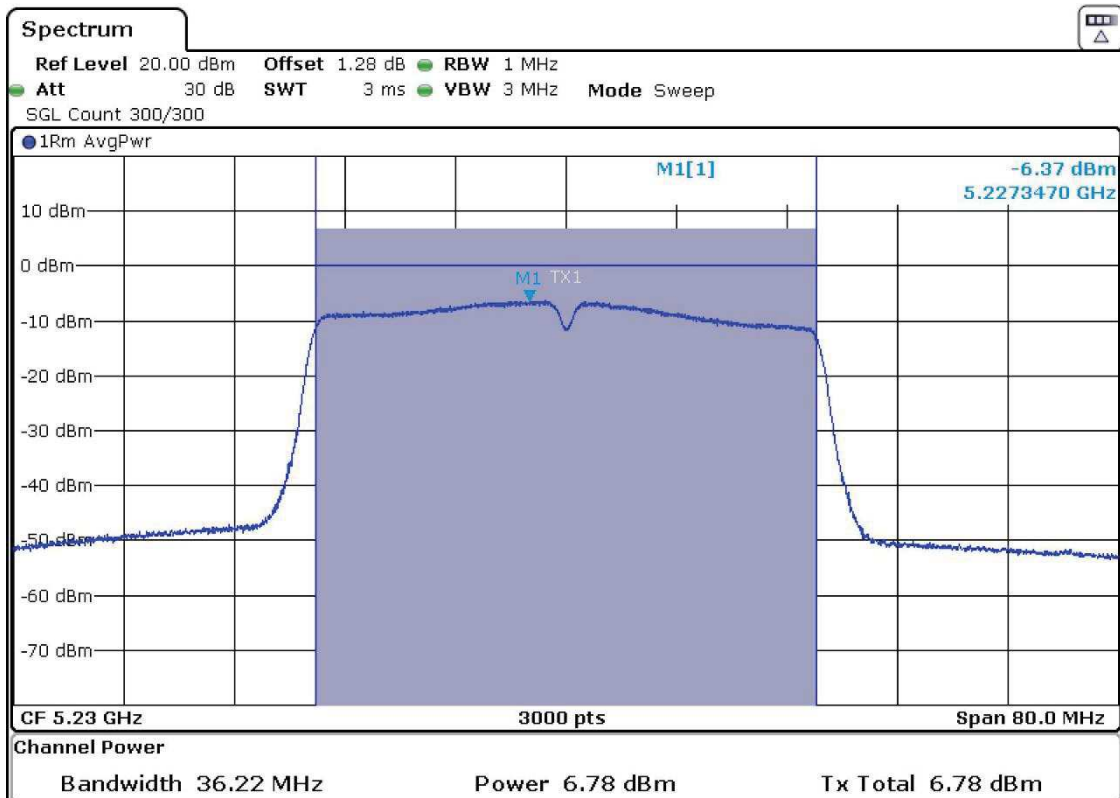


**Mode 802.11 n40 (HT40):**

- Low Channel:



- High Channel:



### Mode 802.11 ac80 (VHT80):

- Single Channel:

