

Test report No:

NIE: 66084RRF.007

Test Report

USA FCC Part 15.407, 15.209

CANADA RSS-247, RSS-Gen

(*) Identification of item tested	Automotive infotainment System
(*) Trademark	Mercedes-Benz
(*) Model and /or type reference	NTG6N ENTRY/MID
Other identification of the product	HW version: D9 SW version: E870 FCC ID: T8GNTG6NEM IC: 6434A-NTG6NEM
(*) Features	FM, AM, DAB, USB, Bluetooth, WLAN, GPS
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)	Rafael López EMC Consumer & RF Lab. Manager  2021.03.12 13:25:21 +01'00'
Date of issue	2021-03-12
Report template No	FDT08_23 (*) "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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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

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

Data provided by the client

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 NTG6N ENTRY/MID is an automotive head unit to be installed in cars with the following features: FM, AM, DAB, USB, Bluetooth, WLAN and GPS.

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
66084B/184	Automotive infotainment System	NTG6N ENTRY/MID	HBM580M4997004	2021/01/22
56848G/050	Harness	--	--	2019/01/11

Auxiliary elements used with the Sample S/01:

Control N°	Description	Model	Serial N°	Date of reception
56848G/014	Ethernet Cable	--	--	2019/01/08
56848G/144	HMI-CAN Box	--	H0034731	2019/01/11

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

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

Control N°	Description	Model	Serial N°	Date of reception
66084B/184	Automotive infotainment System	NTG6N ENTRY/MID	HBM580M4997004	2021/01/22
54022/152	Harness	--	--	2017/10/19

Auxiliary elements used with the Sample S/02:

Control N°	Description	Model	Serial N°	Date of reception
54022/133	Ethernet Cable	--	--	2017/10/19
54022/058	HMI-CAN Box	NTG6 HMI-CAN	H0034761	2017/09/26
56848G/102	Antenna	--	--	2019/01/11
56848G/109	Antenna	--	--	2019/01/11
56848G/110	Antenna	--	--	2019/01/11
56848G/111	Antenna	--	--	2019/01/11

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

Test sample description

Ports..... :	Port name and description	Cable				
		Specified max length [m]	Attached during test	Shielded	Coupled to patient ⁽³⁾	
		Car Connector A	>3m ^(x1)	☒	☐	
		Car Connector B	>3m ^(x1)	☒	☐	
		Display Connector CID/PIP / RVC	>3m ^(x1)	☒	☐	
		USB Connector	<3m ^(x2)	☒	☐	
		Eth Connector	>3m ^(x1)	☒	☐	
		BT/WLAN-Antenna	>3m ^(x1)	☒	☐	
		FM/AM, TV/SDARS Ant	>3m ^(x1)	☒	☐	
		GPS Antenna	>3m ^(x1)	☒	☐	
Supplementary information to the ports..... :	For EMC-Testing all cables should be connected to the connectors!					
Rated power supply	Voltage and Frequency		Reference poles			
			L1	L2	L3	N PE
	☐	AC:	☐	☐	☐	☐
	☐	AC:	☐	☐	☐	☐
	☒	DC: 12V Car battery / attenuator (9,5-15,5V normal operation)				
	☐	DC:				
Rated Power	9,5-15,5V normal operation					
Clock frequencies.....	see schematics					
Other parameters	FCC ID: T8GNTG6NH / IC: 6434A-NTG6NH					
Software version	E807					
Hardware version	D9					
Dimensions in cm (W x H x D)	182 x 78 x 160 mm					
Mounting position	☐	Table top equipment				
	☐	Wall/Ceiling mounted equipment				
	☐	Floor standing equipment				
	☐	Hand-held equipment				
	☒	Other: automotive headunit				
Modules/parts.....	Module/parts of test item		Type	Manufacturer		
	N/A					
Accessories (not part of the test item)	Description		Type	Manufacturer		
	Display		A247 905 69	Daimler OEM Displ.		
	CAN-Box		-	HBAS		
	Cable harness		-	HBAS		
	BT/WLAN-Antenna		A247 905 83	Hirschmann		
	-					
Documents as provided by the applicant.....	Description		File name	Issue date		
	Technical Description					
	-					

⁽³⁾ 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)	2021-01-28
Date (finish)	2021-02-25

Document history

Report number	Date	Description
66084RRF.007	2021-03-12	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. = 75 %

Remarks and comments

The tests have been performed by the technical personnel: Miguel Manuel López, Verónica García, Cristina Calle, Pablo Redondo and Rosa María Gallardo.

Used instrumentation:

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. Biconical/Log Antenna 30MHz - 6GHz ETS LINDGREN 3142E	2020/10	2023/10
4. RF Preamplifier 40 dB, 10 MHz - 6 GHz BONN ELEKTRONIK BLNA 0160-01N	2020/02	2021/02
5. EMI Test Receiver 7 GHz ROHDE AND SCHWARZ ESR7	2019/10	2021/10
6. DC Power Supply, 30V/5A KEYSIGHT TECHNOLOGIES U8002A	N.A.	N.A.
7. Digital Multimeter, FLUKE 175	2020/11	2021/11
8. Horn Antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2020/08	2023/08
9. Horn Antenna 18-40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2020/05	2023/05
10. RF Preamplifier G>30dB, 1-18GHz BONN ELEKTRONIK BLMA 0118-3A	2020/10	2021/10
11. Low Noise Amplifier G>30dB, 18 - 40 GHz BONN ELEKTRONIK BLMA 1840-1M	2019/02	2021/02
12. Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2019/10	2021/10

Conducted Measurements:

	Last Calibration	Due Calibration
1. Shielded Room ETS LINDGREN S101	N.A.	N.A.
2. Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2019/09	2021/09
3. DC Power Supply, 30V/5A KEYSIGHT TECHNOLOGIES U8002A	N.A.	N.A.
4. Digital Multimeter FLUKE 179	2020/10	2021/10

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	P	
99% Occupied Bandwidth	P	
26 dB Emission Bandwidth (EBW)	P	
<u>Supplementary information and remarks:</u> 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			
Requirement – Test case		Verdict	Remark
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

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Transmitter Duty Cycle	12
Transmitter 99% Occupied Bandwidth	19
Transmitter 26 dB Emission Bandwidth (EBW)	22

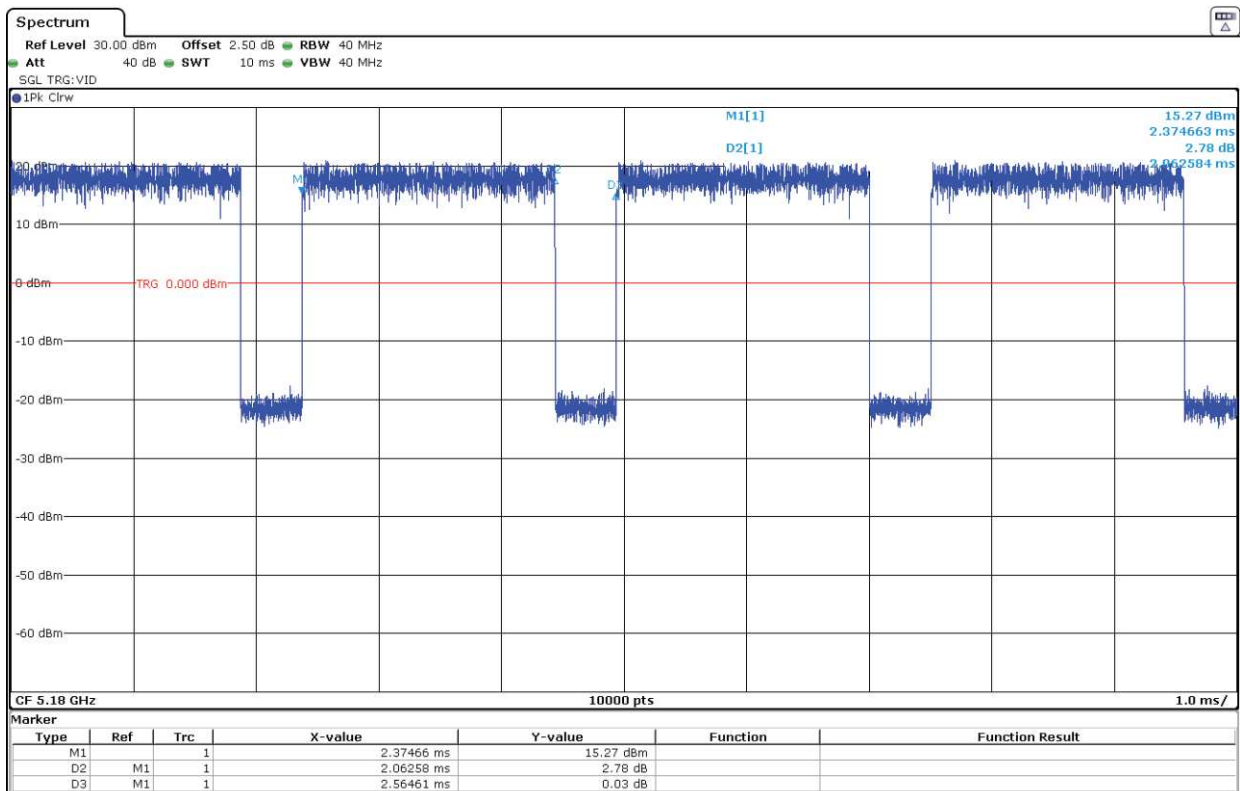
Transmitter Duty Cycle

RESULTS:

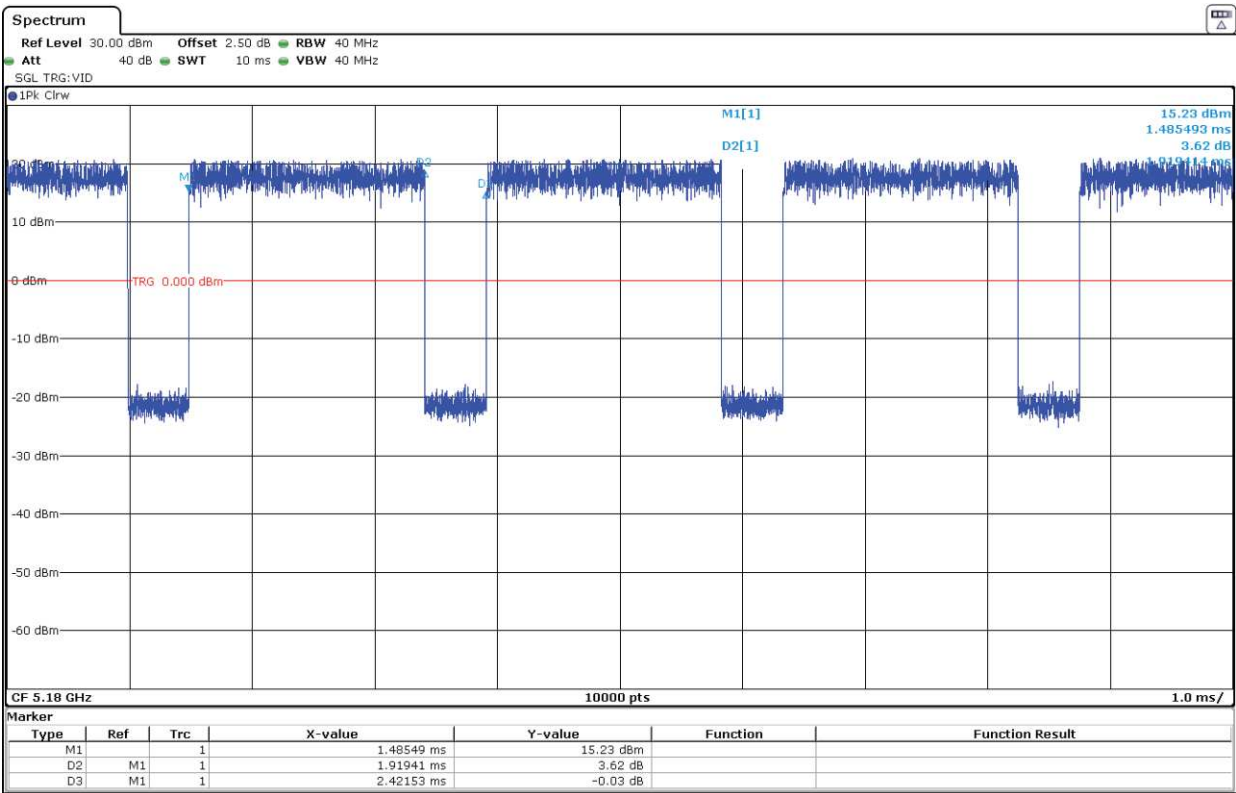
The results below are for data rates with a duty cycle less than 98%. The results for all rest of modes having a value > 98%.

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	2.06258	2.56461	0.946105291	2.06747	2.56876	0.942843135
802.11n20	1.91941	2.42153	1.009221007	1.91892	2.42537	1.01721132
802.11ac20	1.93142	2.43334	1.00326071	1.93132	2.43672	1.0095139
802.11n40	0.94427	1.4453	1.848618106	0.94497	1.44679	1.849874772
802.11ac40	0.95056	1.45249	1.84133616	0.95153	1.45404	1.841538686
802.11ac80	0.460075	0.961599	3.201653682	0.45753	0.9628	3.231165058

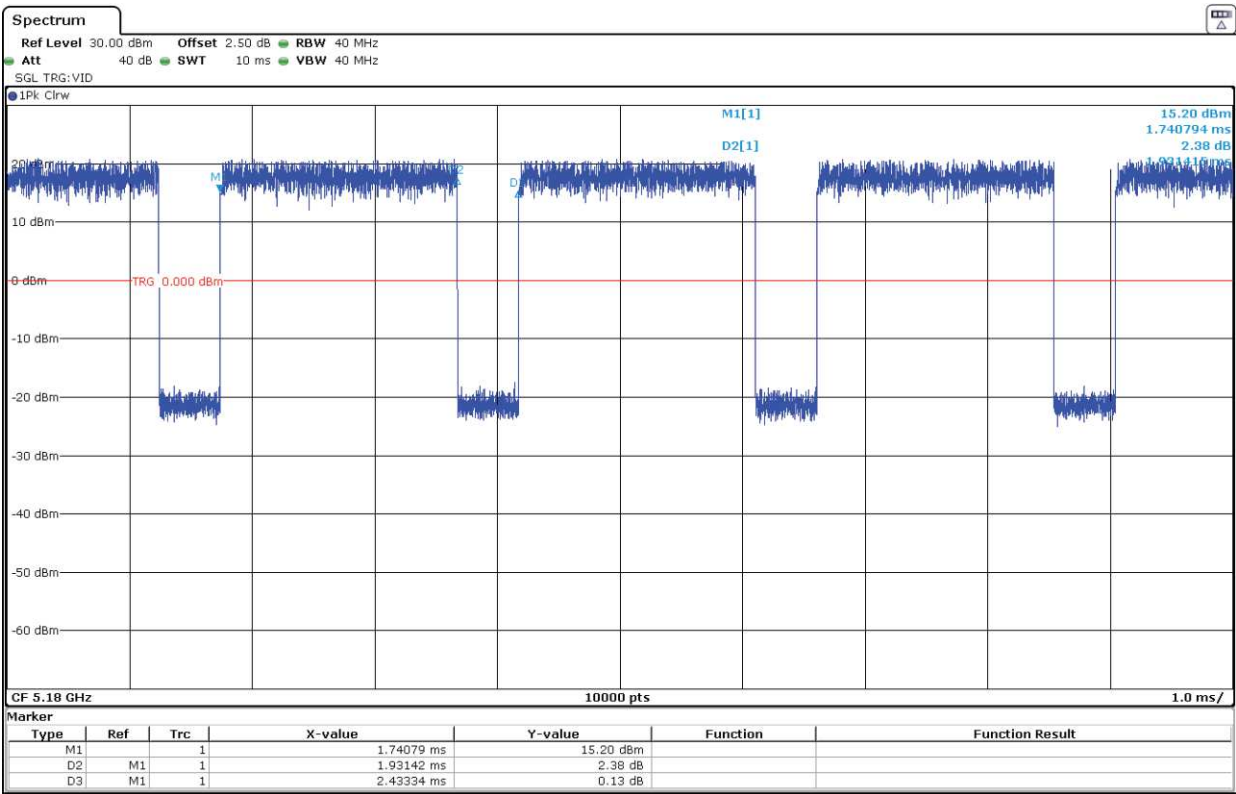
Mode 802.11 a20 (U-NII-1):



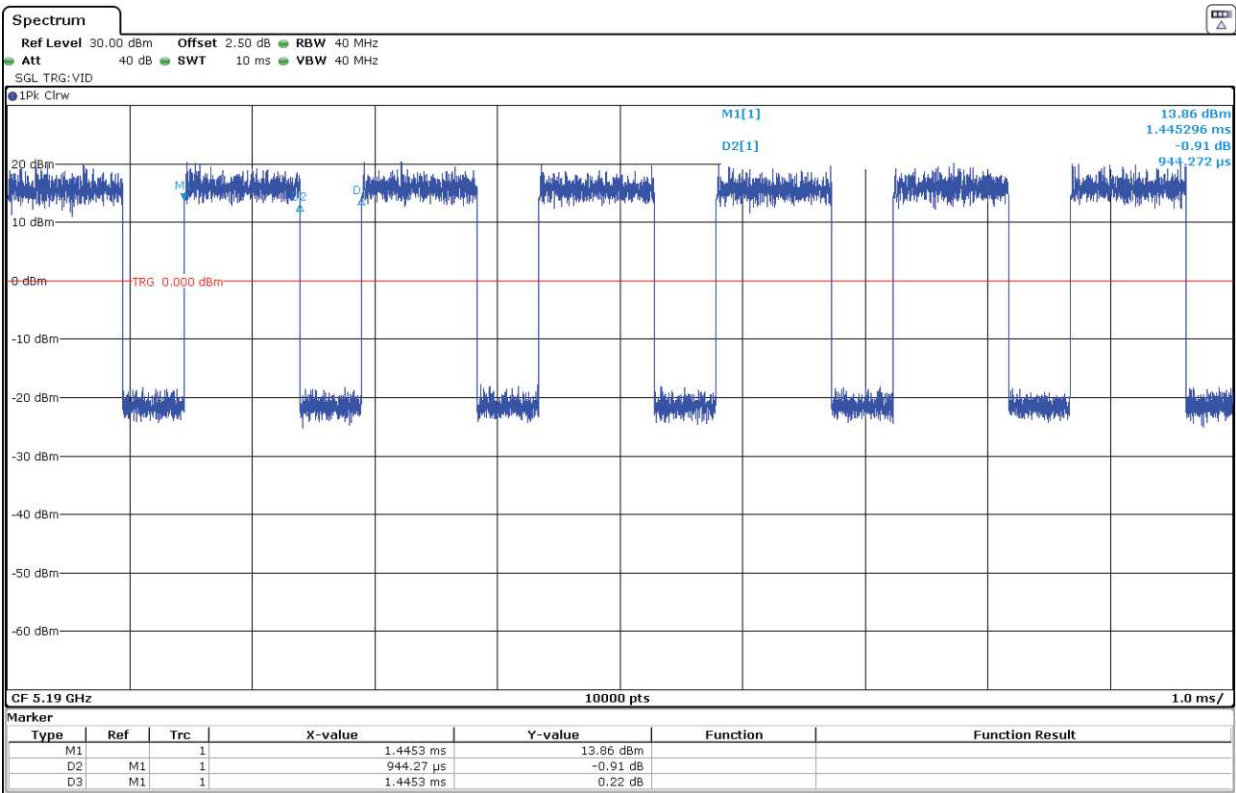
Mode 802.11 n20 (U-NII-1):



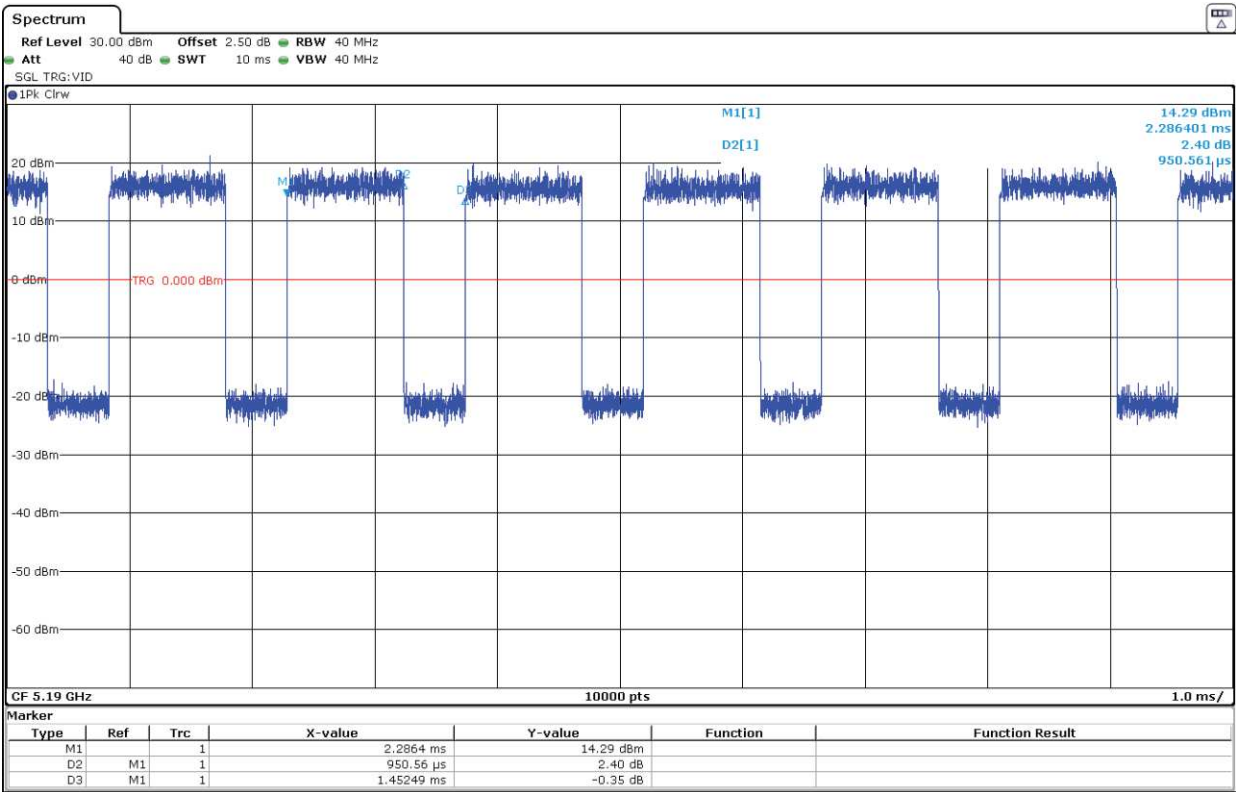
Mode 802.11 ac20 (U-NII-1):



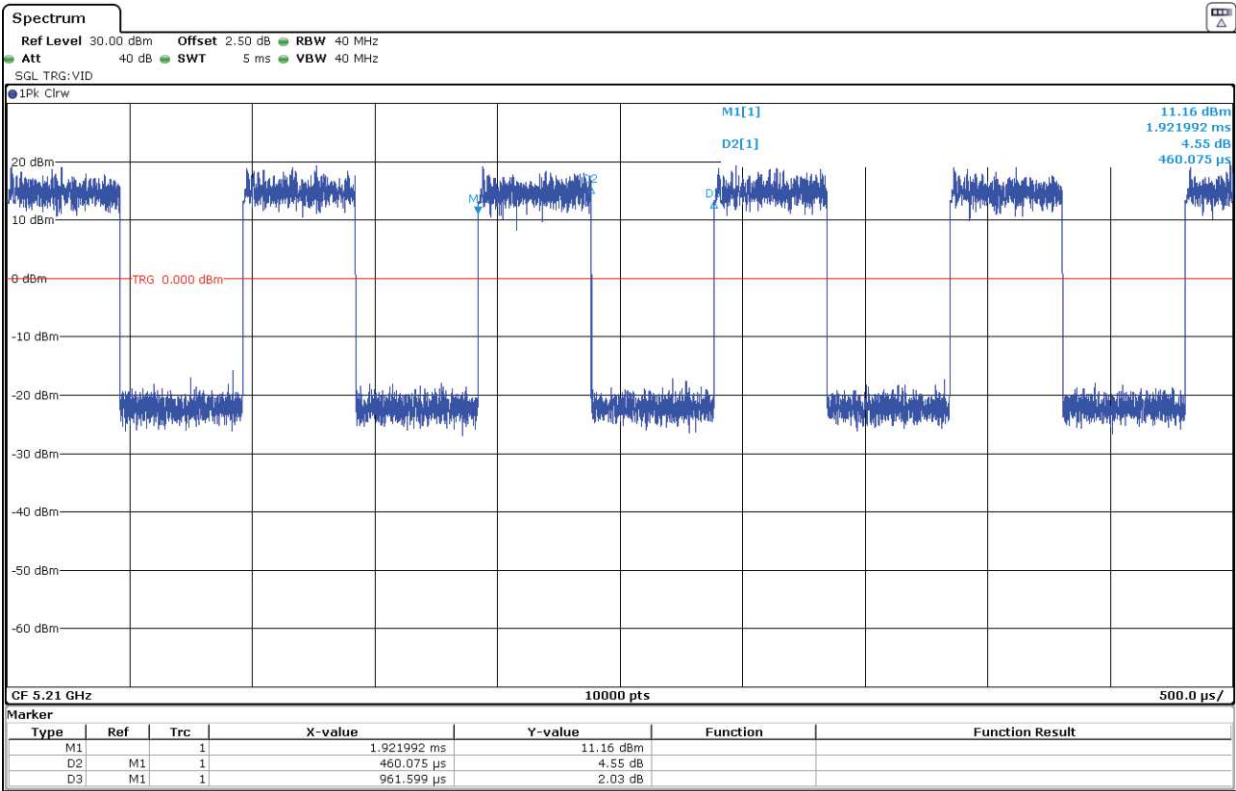
Mode 802.11 n40 (U-NII-1):



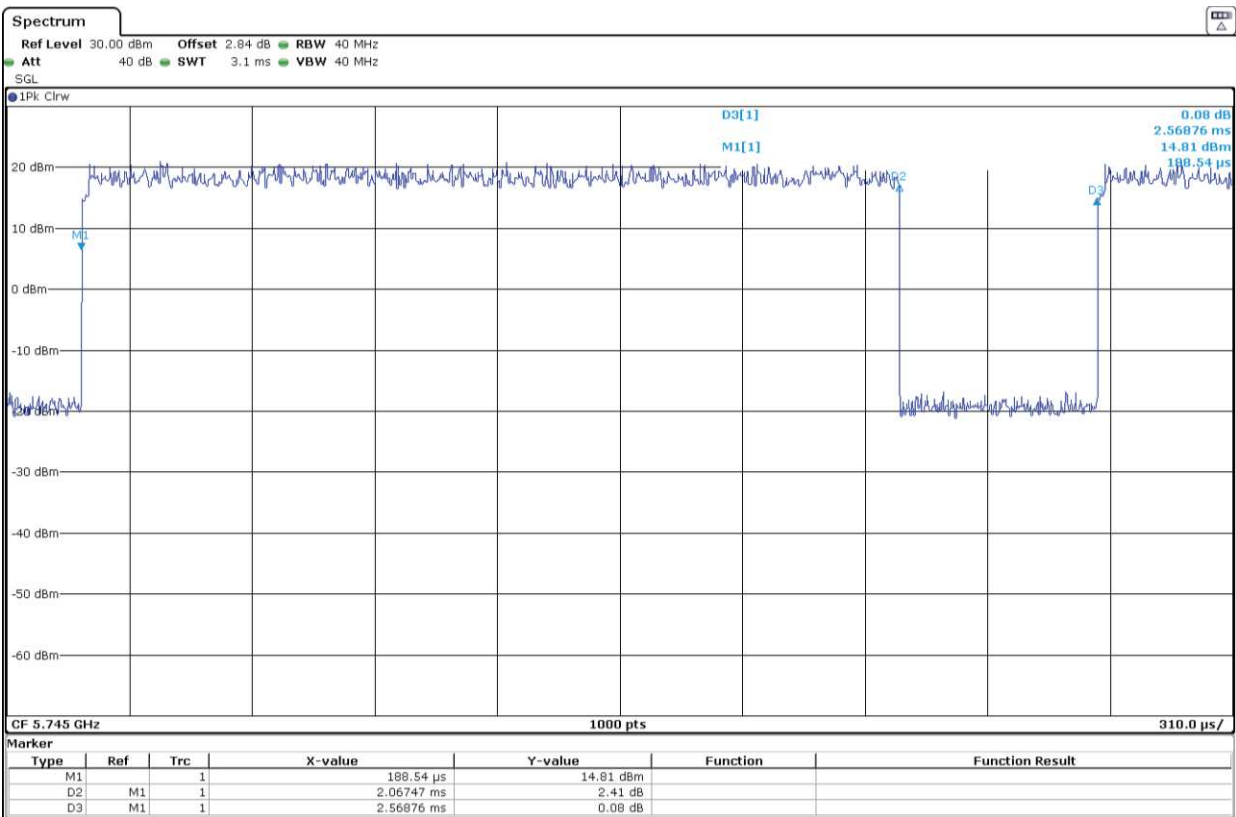
Mode 802.11 ac40 (U-NII-1):



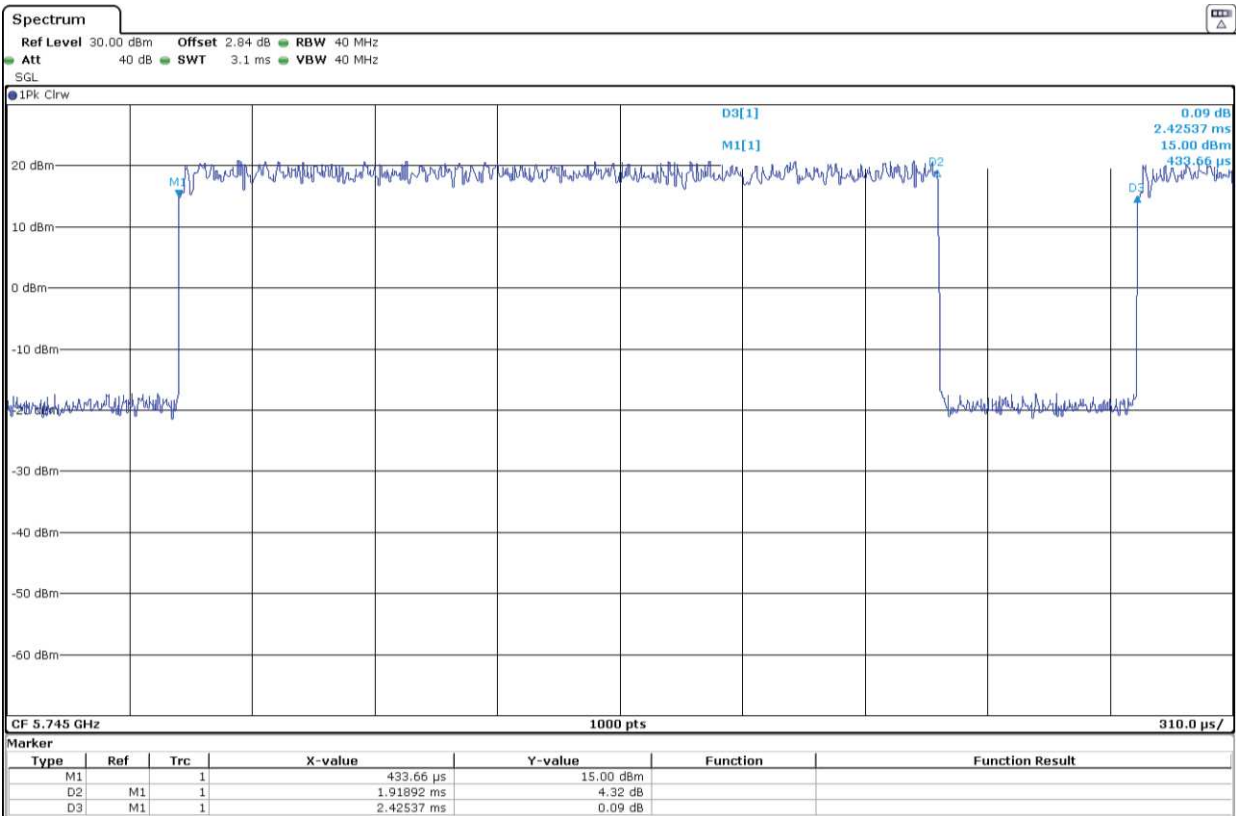
Mode 802.11 ac80 (U-NII-1):



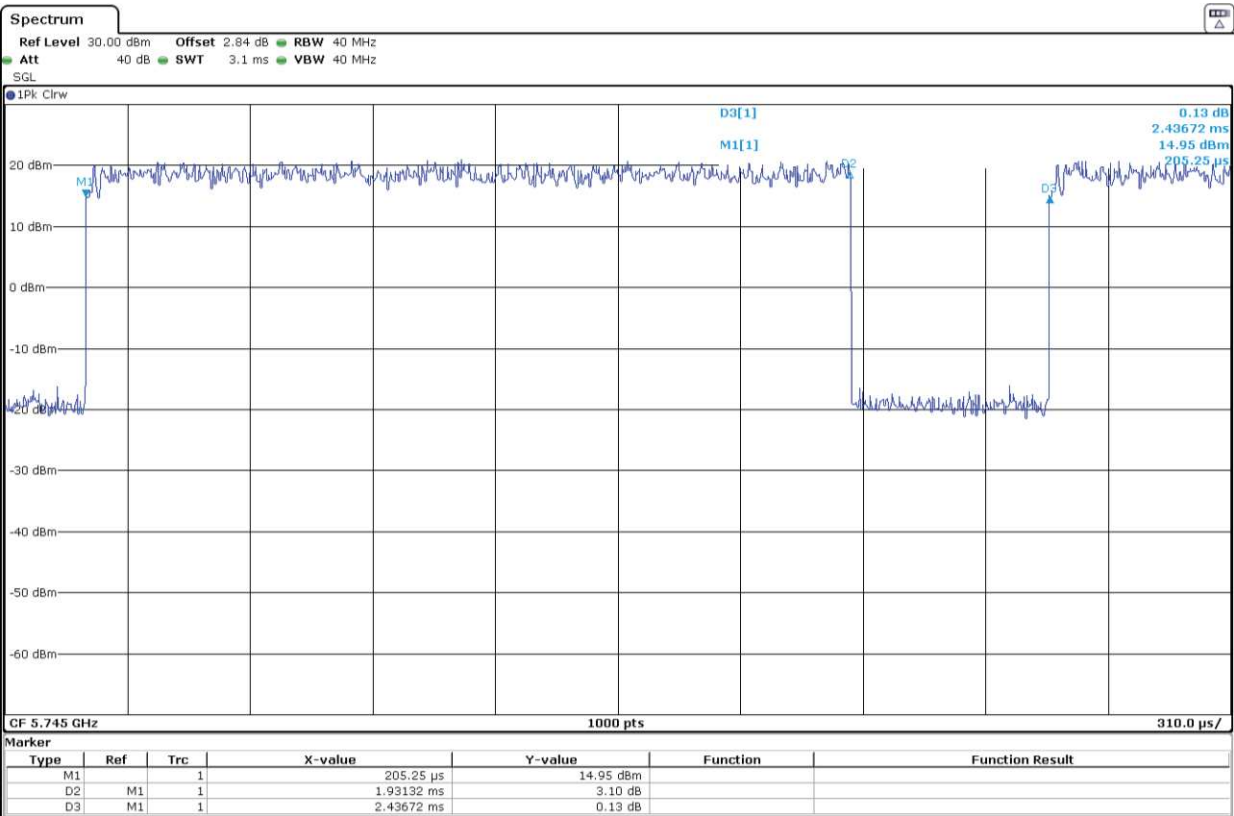
Mode 802.11 a20 (U-NII-3):



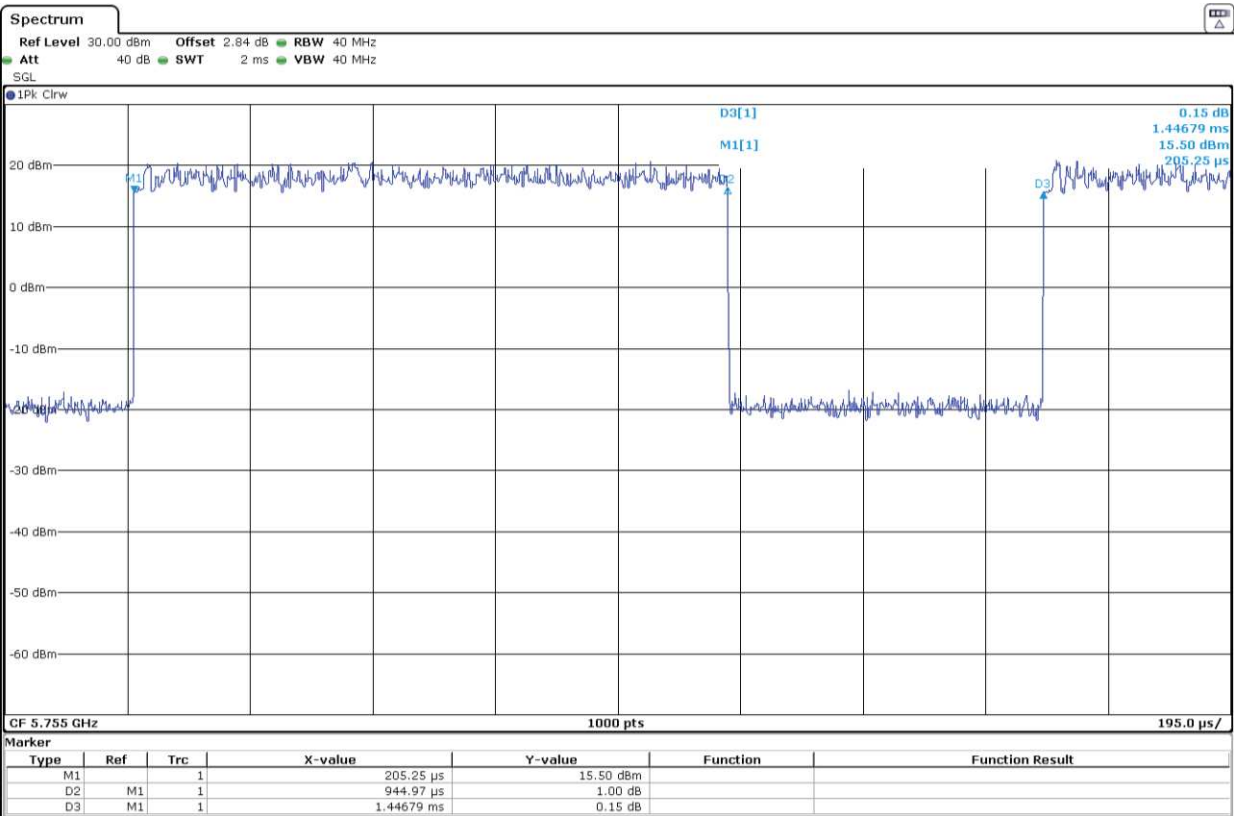
Mode 802.11 n20 (U-NII-3):



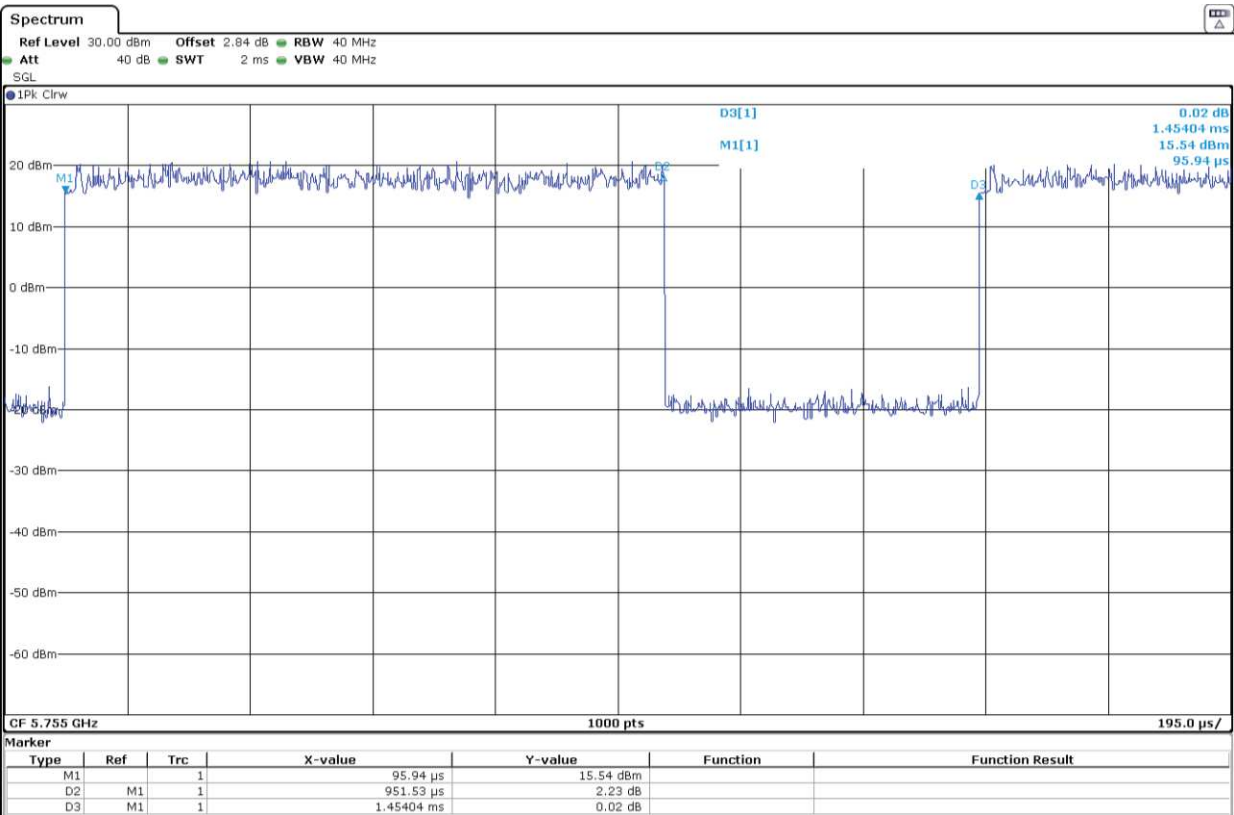
Mode 802.11 ac20 (U-NII-3):



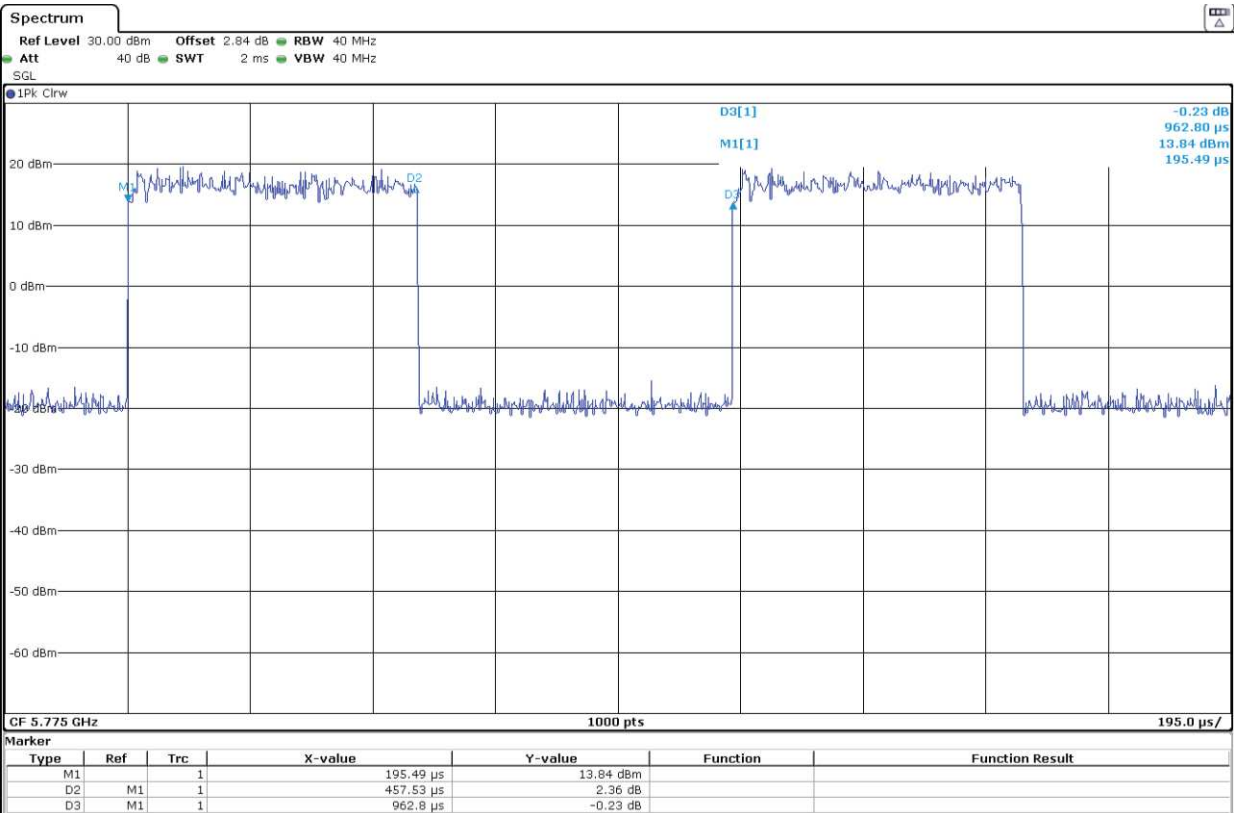
Mode 802.11 n40 (U-NII-3):



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)	17.048	17.024	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)	17.060	17.06	17.032
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	18.136	18.168
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)	18.204	18.208	18.196
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)	18.164	18.156	18.152
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)	18.192	18.176	18.328
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)	36.312	36.336
Measurement uncertainty (kHz)	<±62.36	

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
99% Occupied Bandwidth (MHz)	36.336	36.408
Measurement uncertainty (kHz)	<±62.36	

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)	36.296	36.336
Measurement uncertainty (kHz)	<±62.36	

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
99% Occupied Bandwidth (MHz)	36.328	36.368
Measurement uncertainty (kHz)	<±62.36	

Mode 802.11 ac80 (VHT80):

U-NII-1 (5150-5250 MHz)

Channel	Single Channel 42 (5210 MHz)
99% Occupied Bandwidth (MHz)	75.744
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)	21.5031	21.4764	21.4886
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)	21.5343	21.5135	21.4282
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)	22.2491	22.2545	21.8411
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)	22.1002	21.9887	22.2218
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)	22.5341	22.6284	21.8833
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)	21.9831	22.04912	23.1113
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)	40.2827	40.3095
Measurement uncertainty (kHz)	<±62.36	

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
-26 dBc bandwidth (MHz)	40.4169	40.8243
Measurement uncertainty (kHz)	<±62.36	

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)	40.1789	40.1806
Measurement uncertainty (kHz)	<±62.36	

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
-26 dBc bandwidth (MHz)	40.2304	40.3196
Measurement uncertainty (kHz)	<±62.36	

Mode 802.11 ac80 (VHT80):

U-NII-1 (5150-5250 MHz)

Channel	Single Channel 42 (5210 MHz)
-26 dBc bandwidth (MHz)	87.208
Measurement uncertainty (kHz)	<±124.71

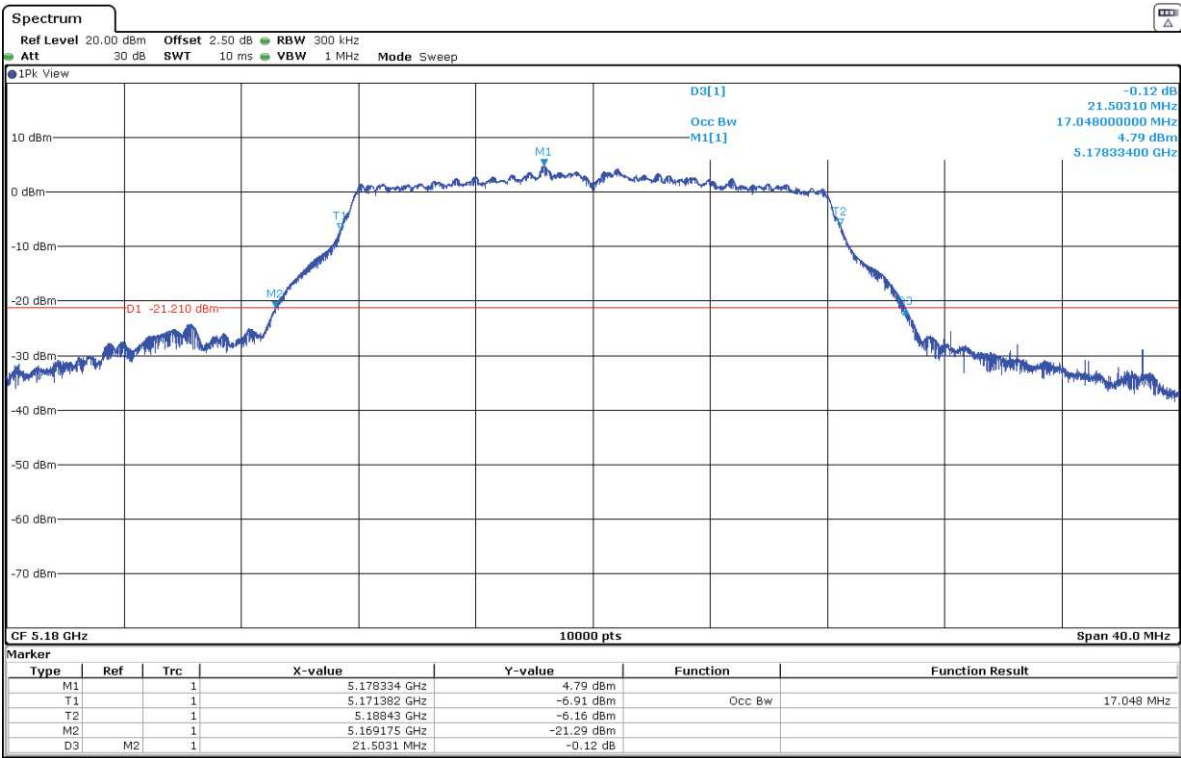
U-NII-3 (5725-5850 MHz)

Channels	Single Channel 155 (5775 MHz)
-26 dBc bandwidth (MHz)	81.602
Measurement uncertainty (kHz)	<±124.71

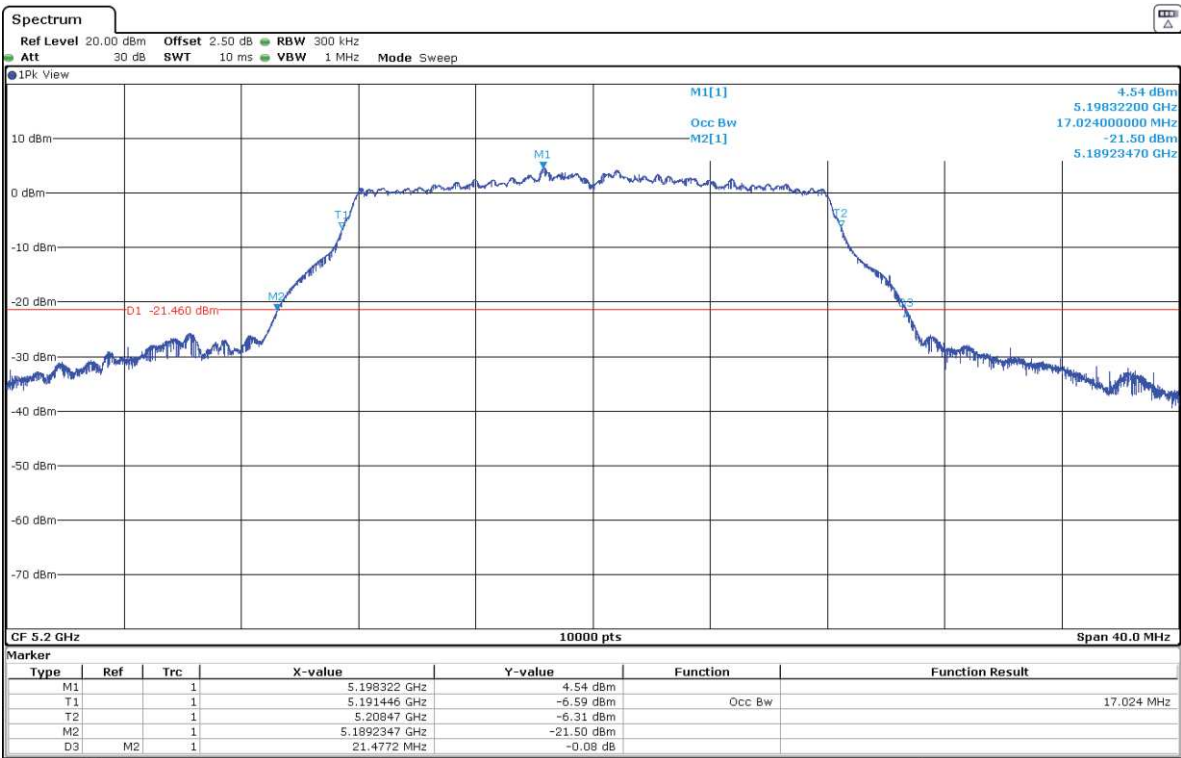
Mode 802.11 a20:

U-NII-1 (5150-5250 MHz)

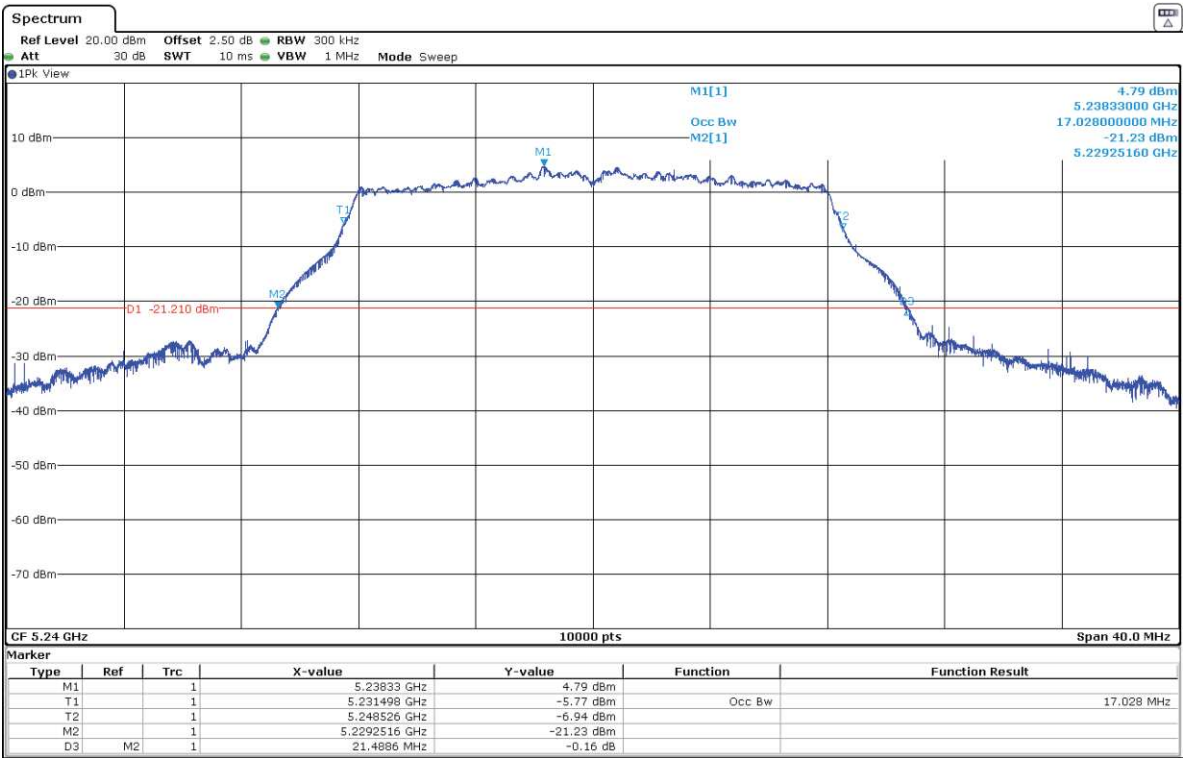
- Low Channel 36 (5180 MHz):



- Middle Channel 40 (5200 MHz):

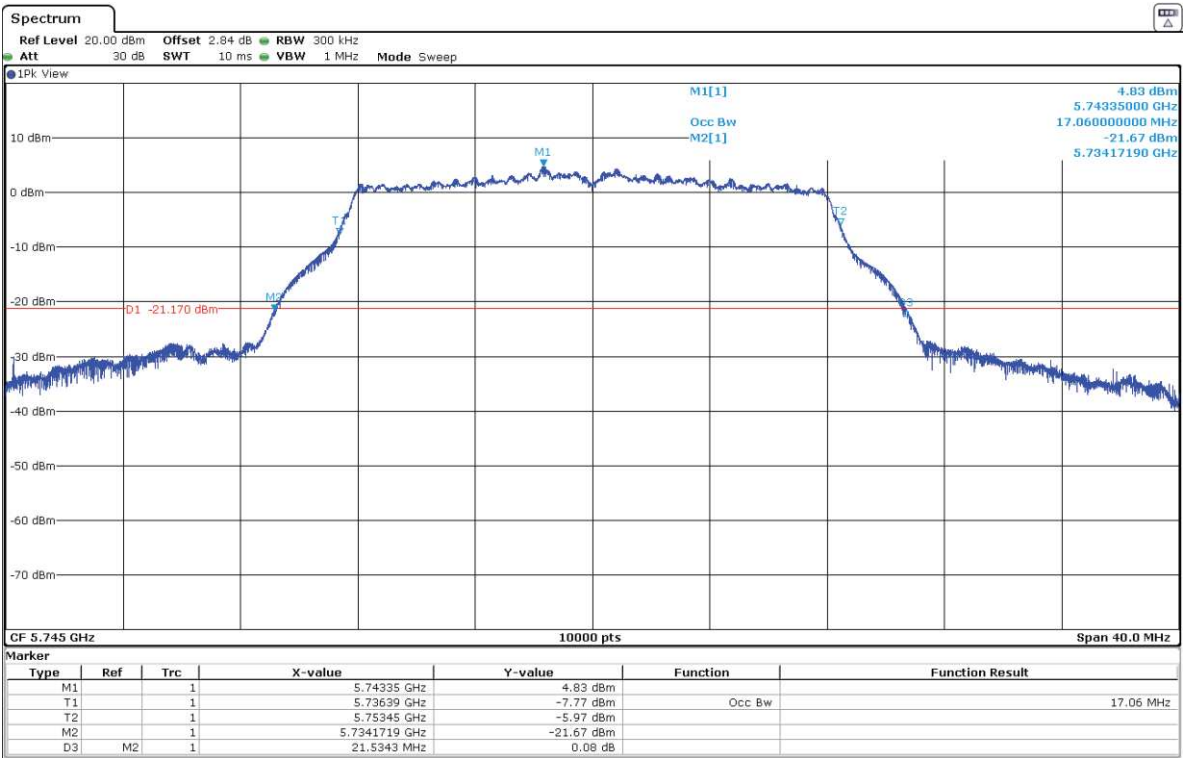


- High Channel 48 (5240 MHz):

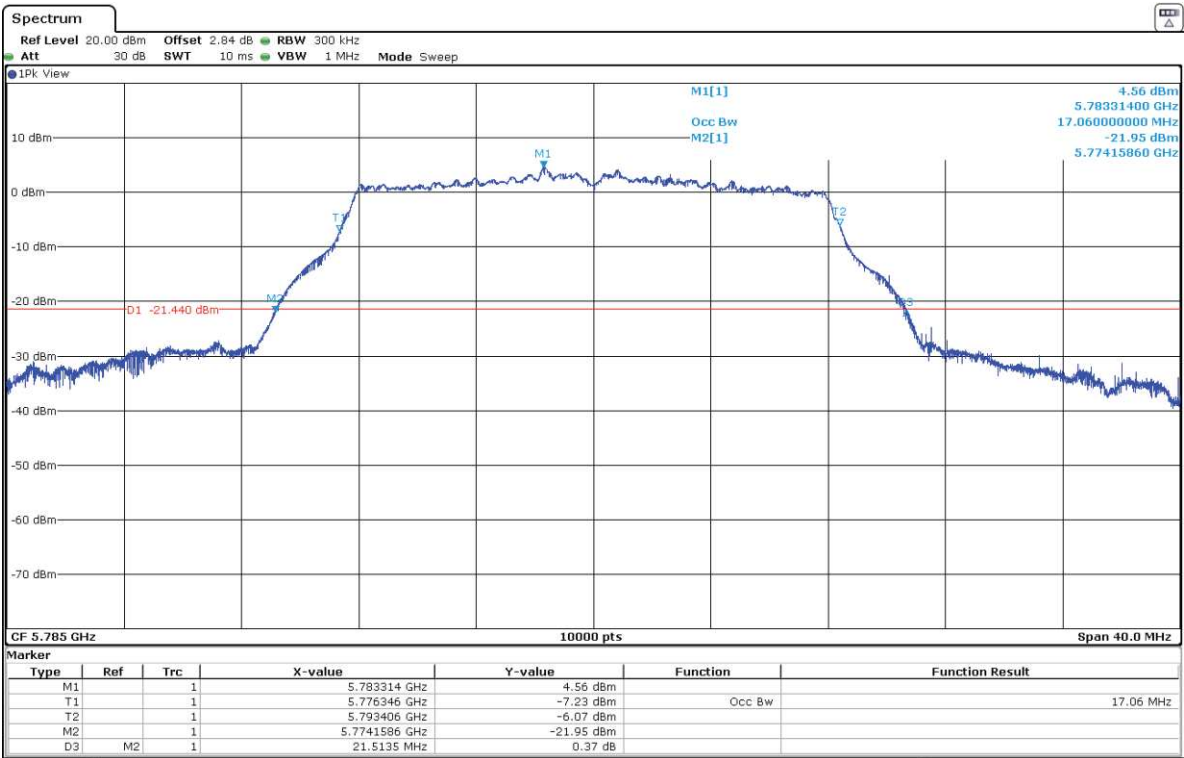


U-NII-3 (5725-5850 MHz)

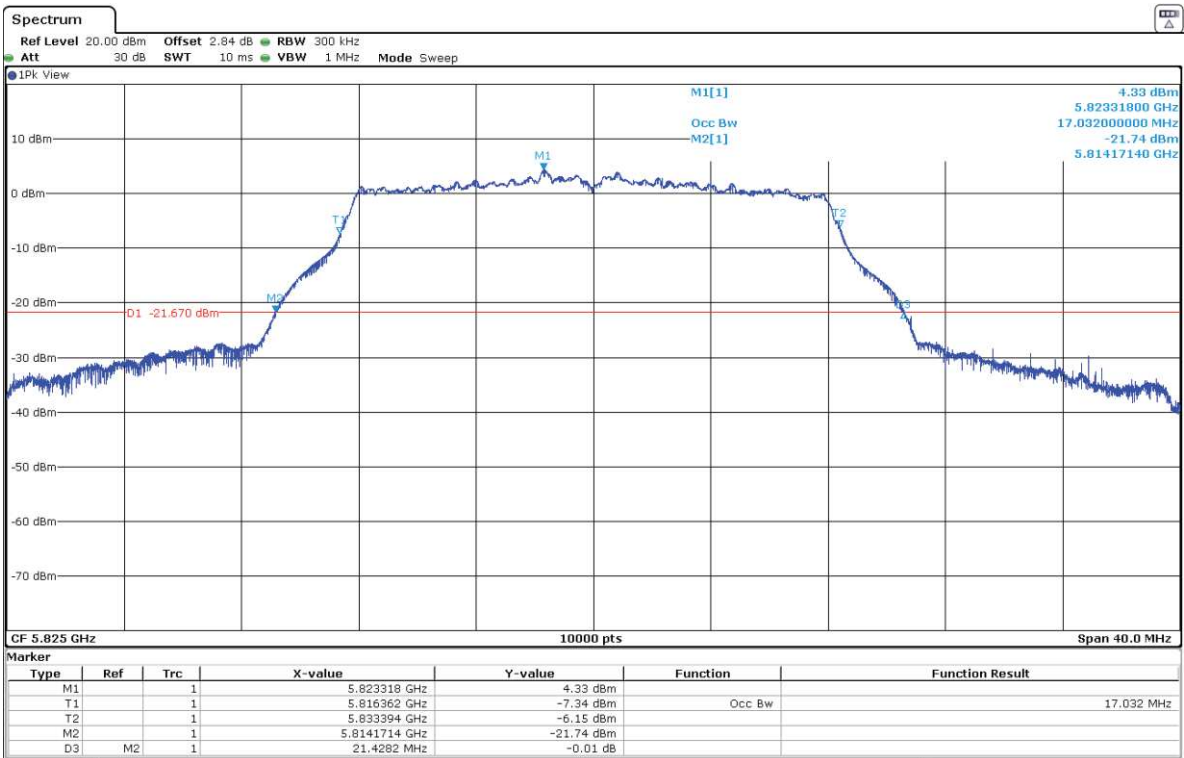
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



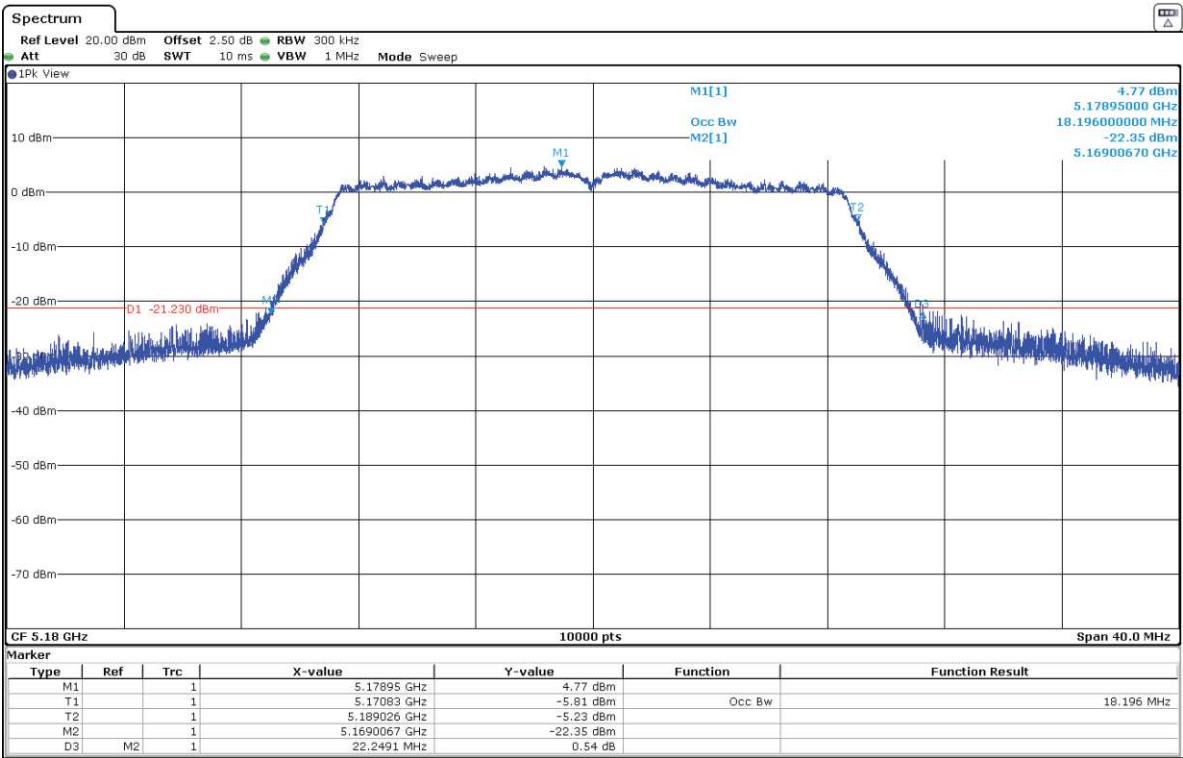
- High Channel 165 (5825 MHz):



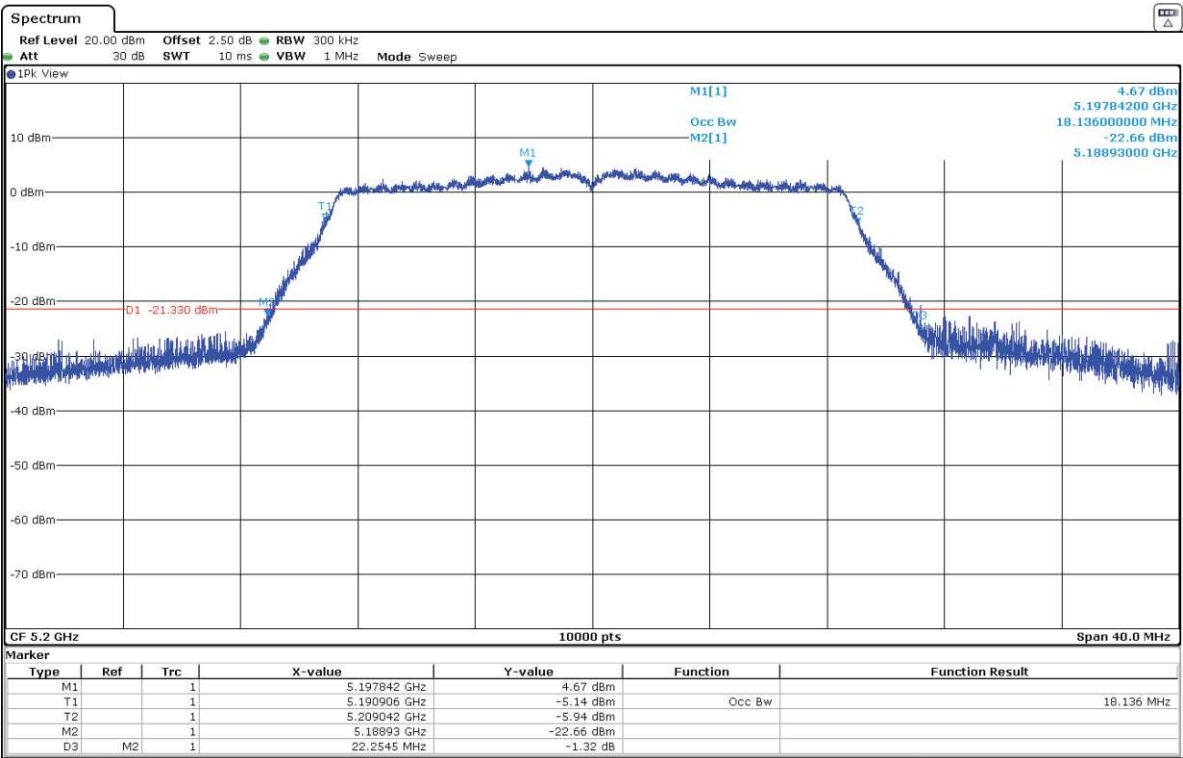
Mode 802.11 n20 (HT20):

U-NII-1 (5150-5250 MHz)

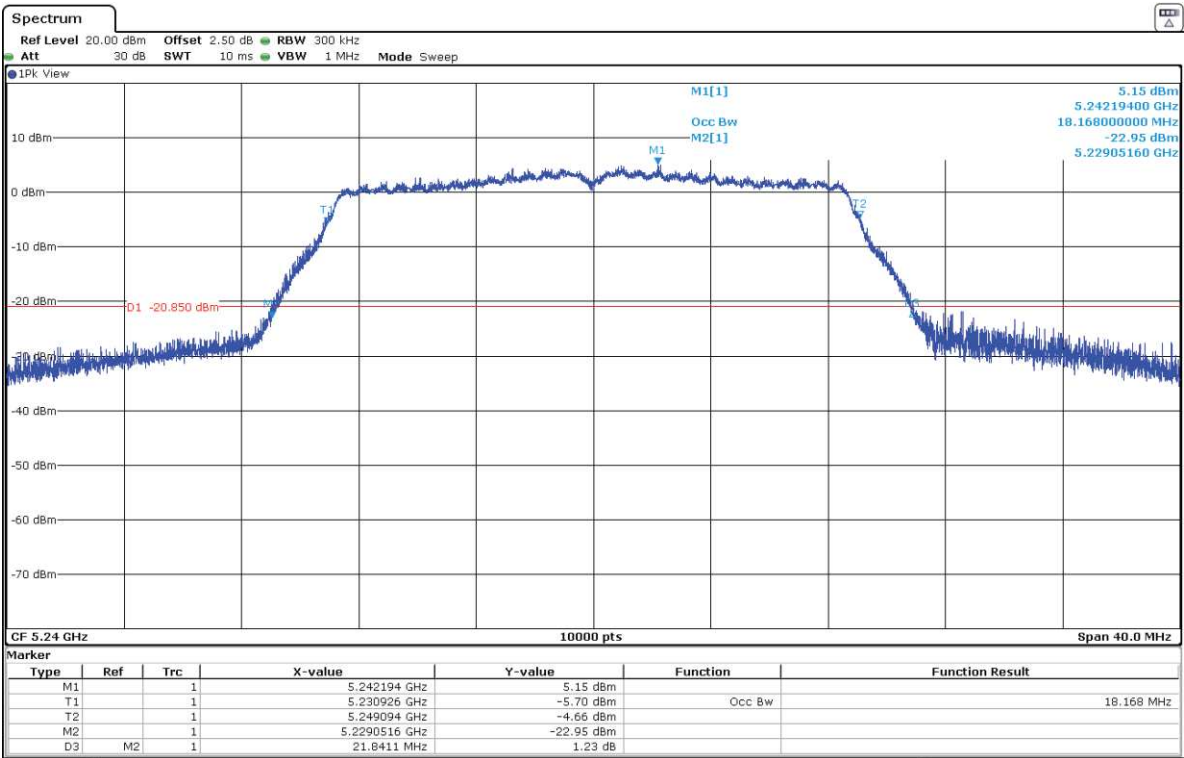
- Low Channel 36 (5180 MHz):



- Middle Channel 40 (5200 MHz):

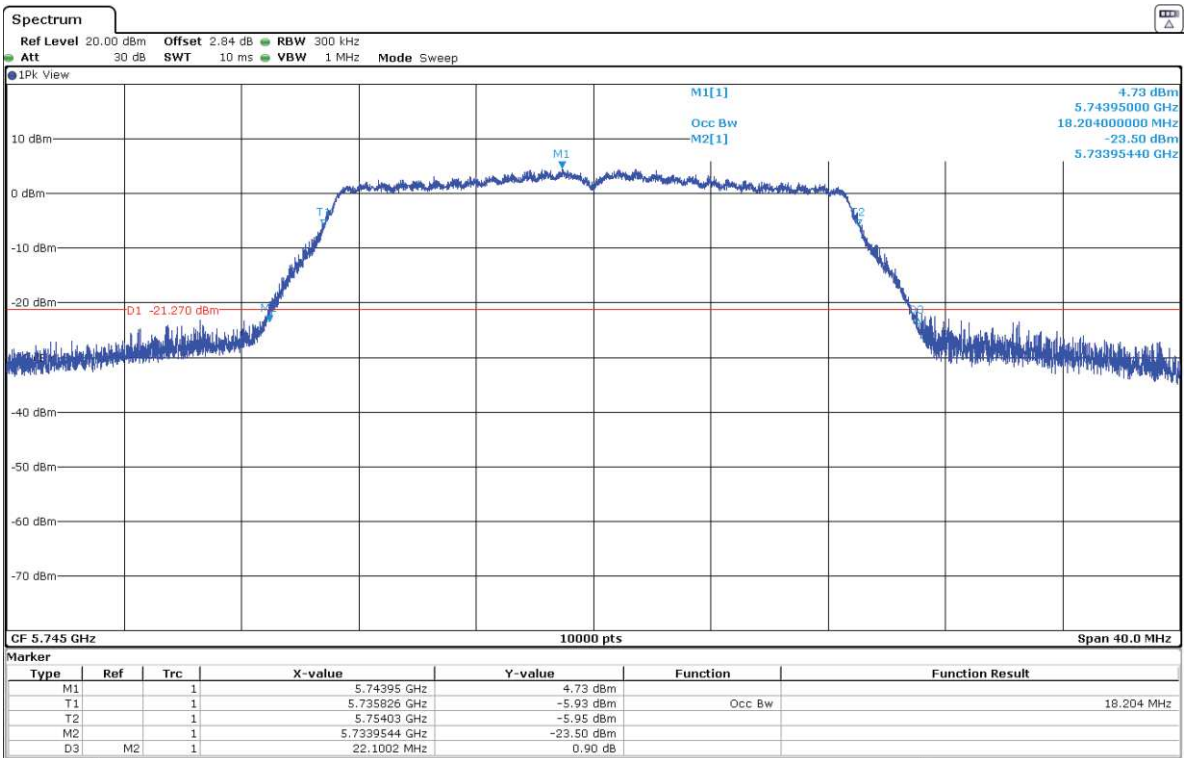


- High Channel 48 (5240 MHz):

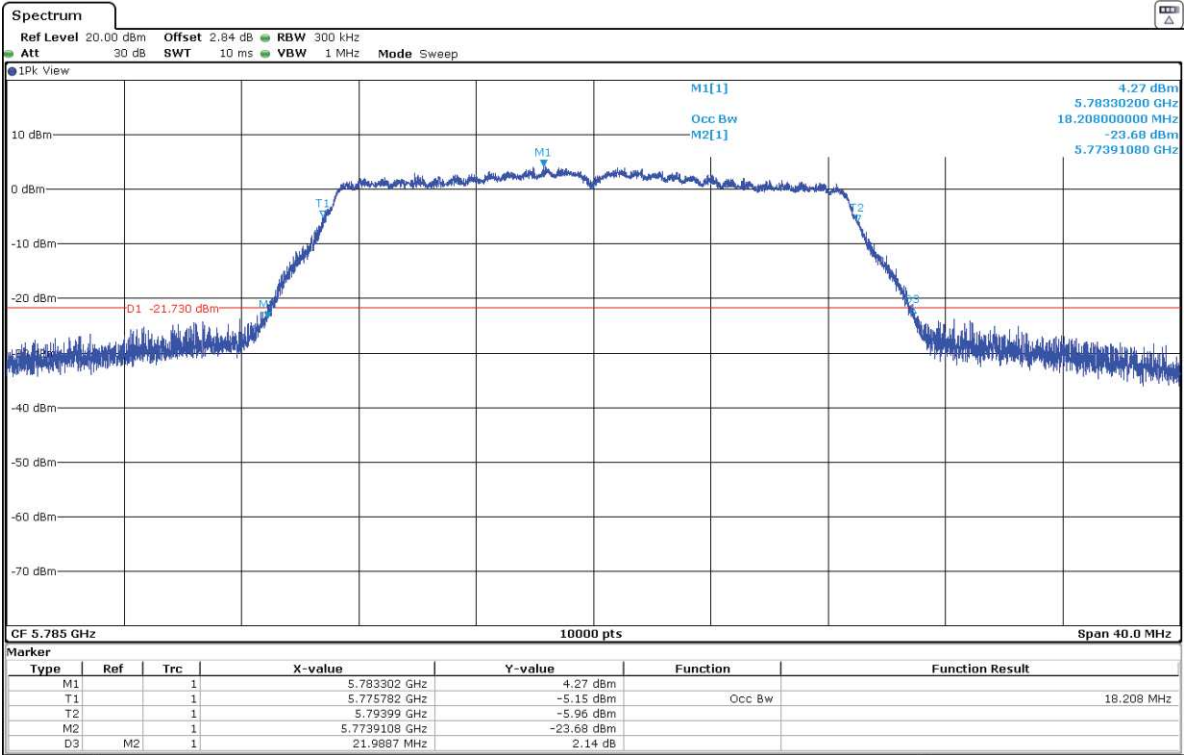


U-NII-3 (5725-5850 MHz)

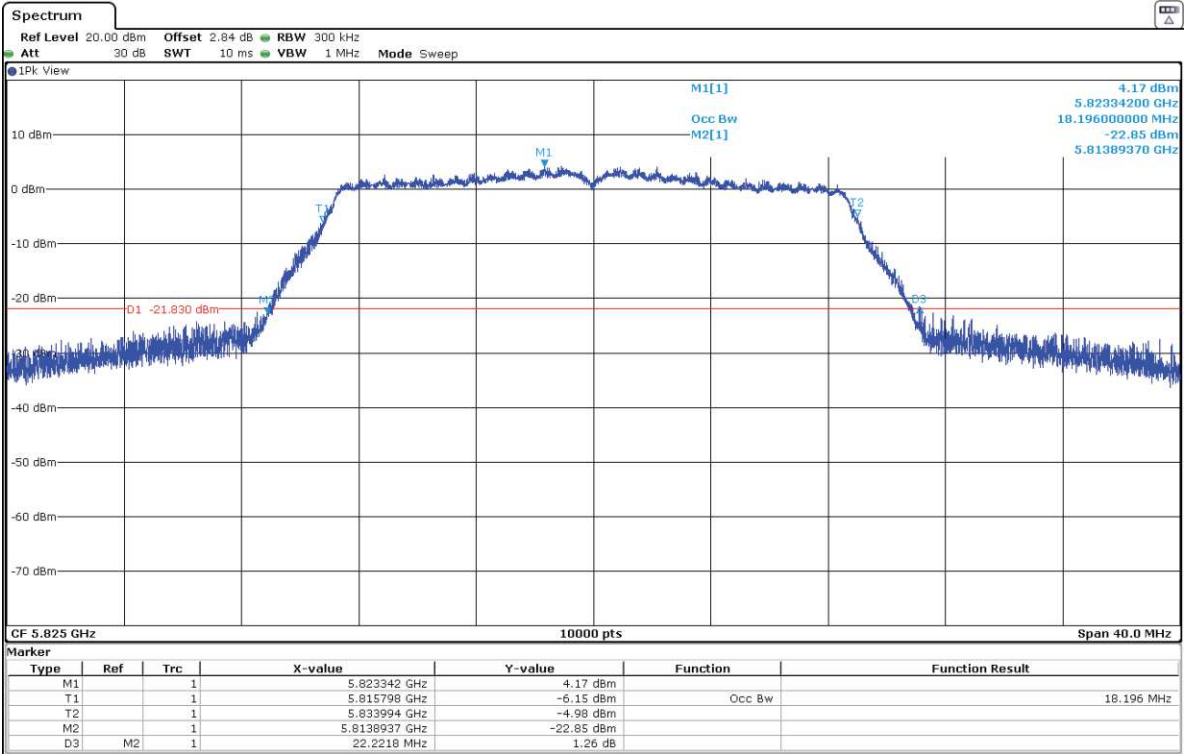
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



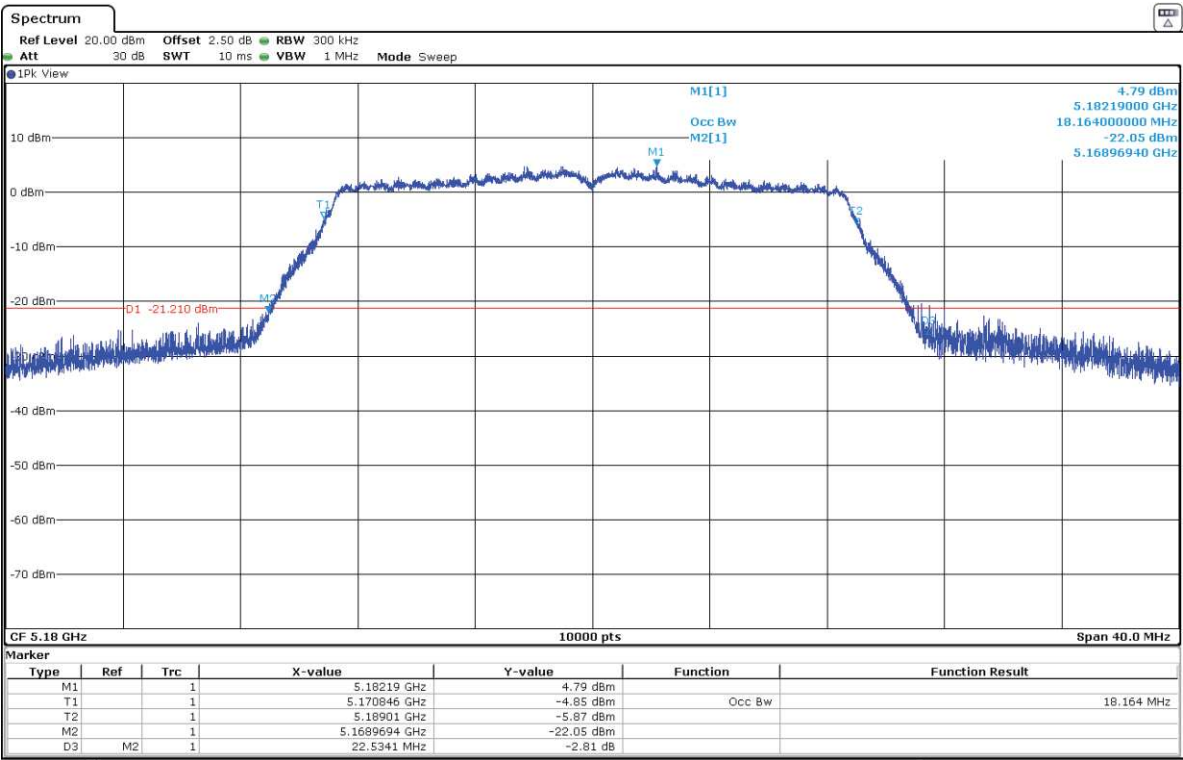
- High Channel 165 (5825 MHz):



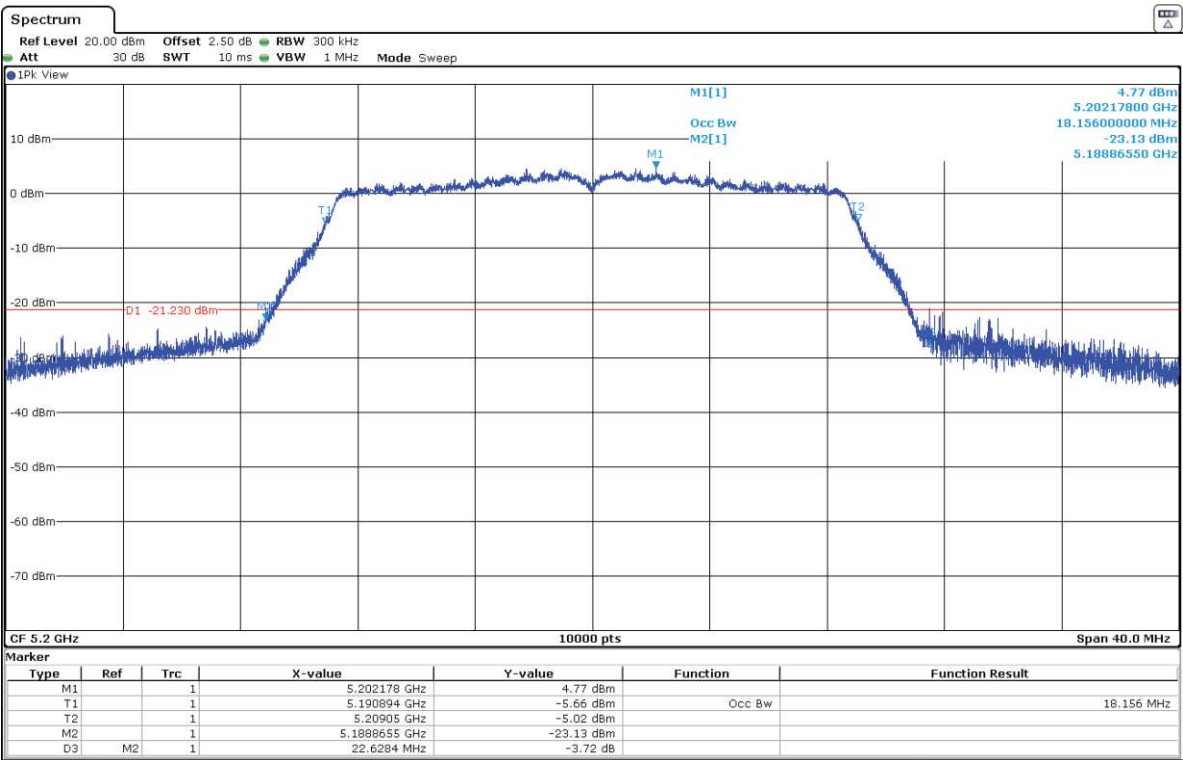
Mode 802.11 ac20 (VHT20):

U-NII-1 (5150-5250 MHz)

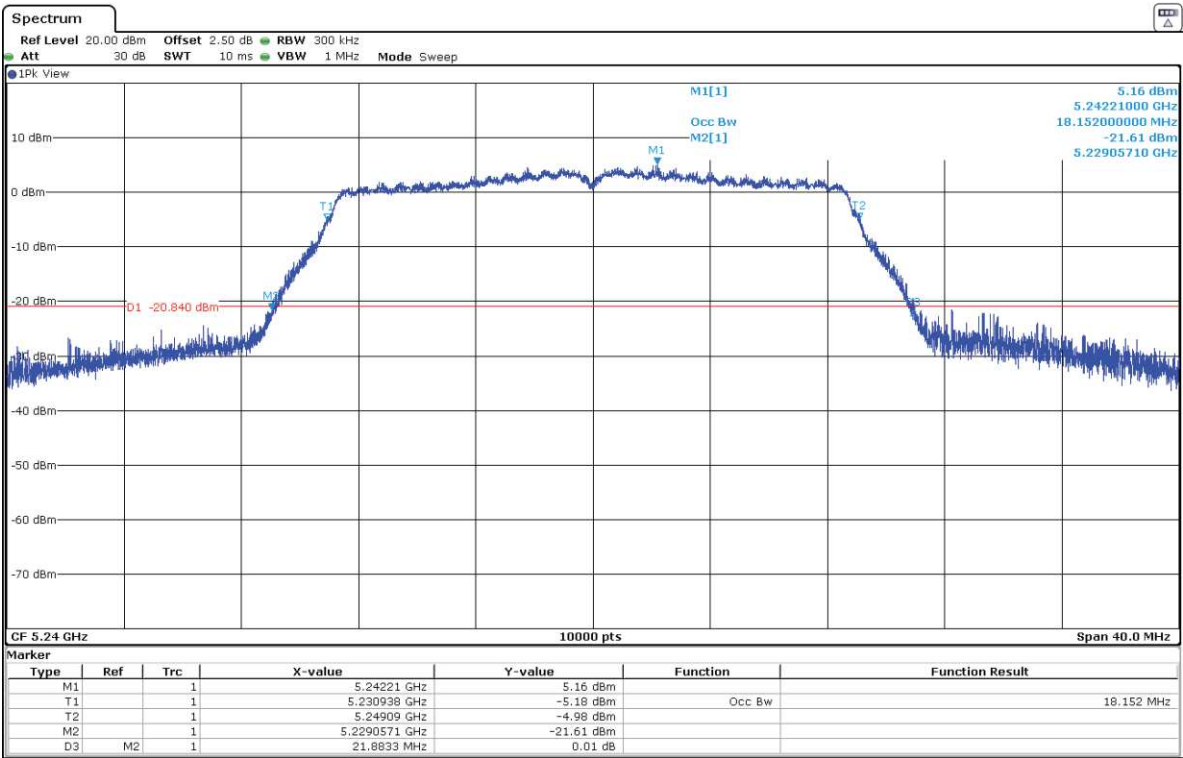
- Low Channel 36 (5180 MHz):



- Middle Channel 40 (5200 MHz):

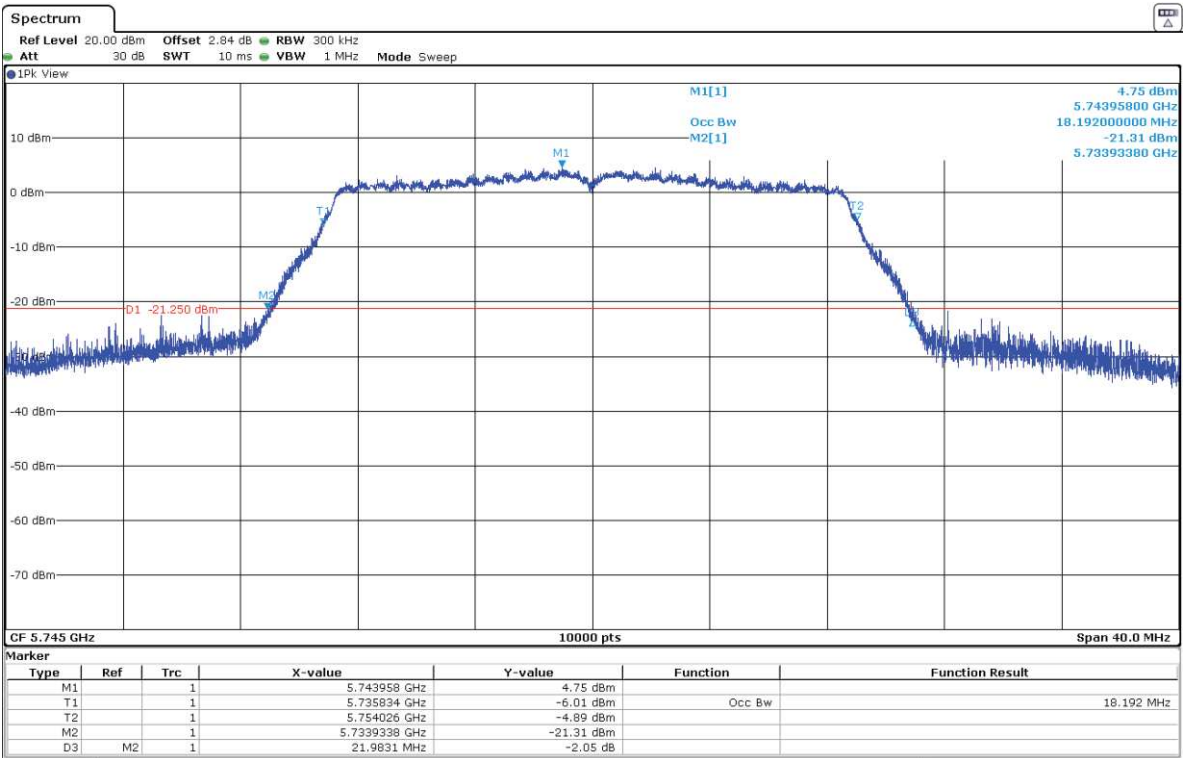


- High Channel 48 (5240 MHz):



U-NII-3 (5725-5850 MHz)

- Low Channel 149 (5745 MHz):



Spectrum

Ref Level 20.00 dBm Offset 2.84 dB RBW 300 kHz
 Att 30 dB SWT 10 ms VBW 1 MHz Mode Sweep

● 1PK View

0.15 dBm
 22.04913 MHz
 18.176000000 MHz
 4.32 dBm
 5.78395400 GHz

D3[1]
 Occ Bw
 M1[1]

M1
 T1
 T2
 D1 -21.680 dBm

CF 5.785 GHz 10000 pts Span 40.0 MHz

Marker	Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1			1	5.783954 GHz	4.32 dBm		
T1			1	5.775806 GHz	-6.94 dBm		
T2			1	5.793982 GHz	-5.82 dBm	Occ Bw	18.176 MHz
M2			1	5.7738932 GHz	-22.93 dBm		
D3	M2	1		22.04912 MHz	0.15 dB		

Spectrum

Ref Level 20.00 dBm Offset 2.84 dB RBW 300 kHz
 Att 30 dB SWT 10 ms VBW 1 MHz Mode Sweep

1PK View

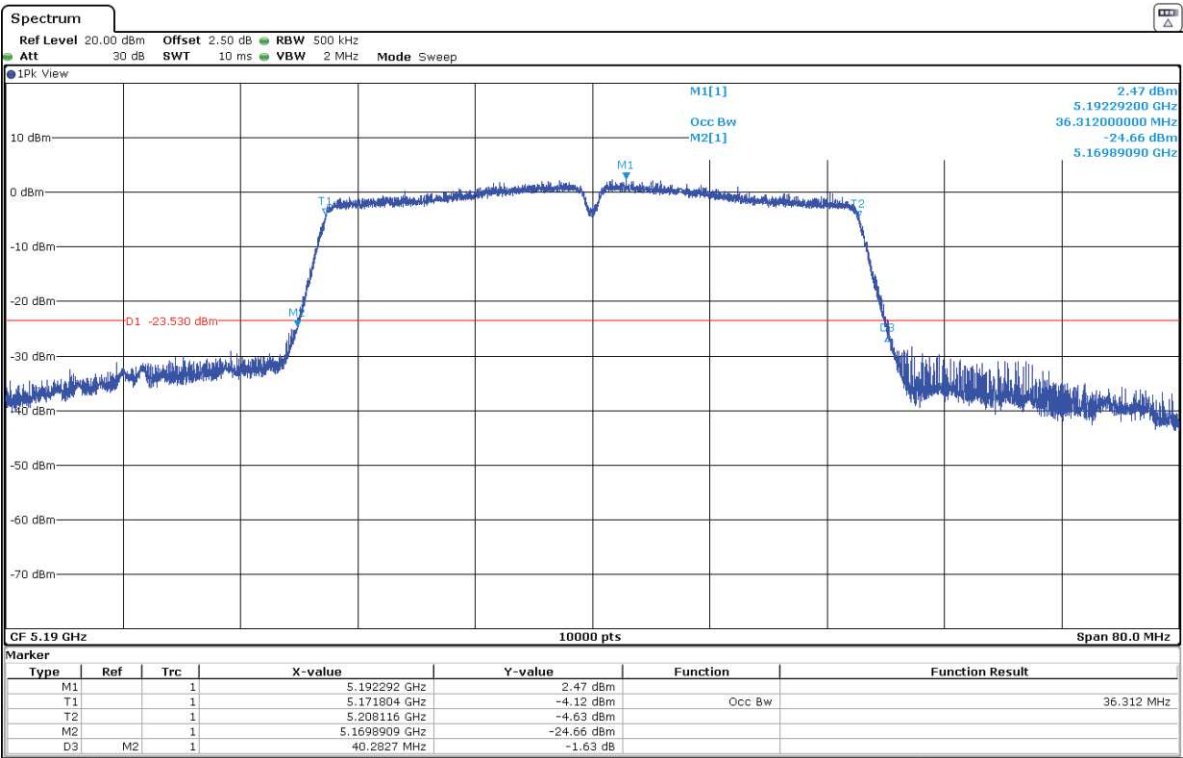
CF 5.825 GHz 10000 pts Span 40.0 MHz

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	5.822718 GHz	4.32 dBm		
T1		1	5.815718 GHz	-6.77 dBm		
T2		1	5.834046 GHz	-5.35 dBm	Occ Bw	18.328 MHz
M2		1	5.81336569 GHz	-21.87 dBm		
D3	M2	1	23.1113 MHz	-0.20 dB		

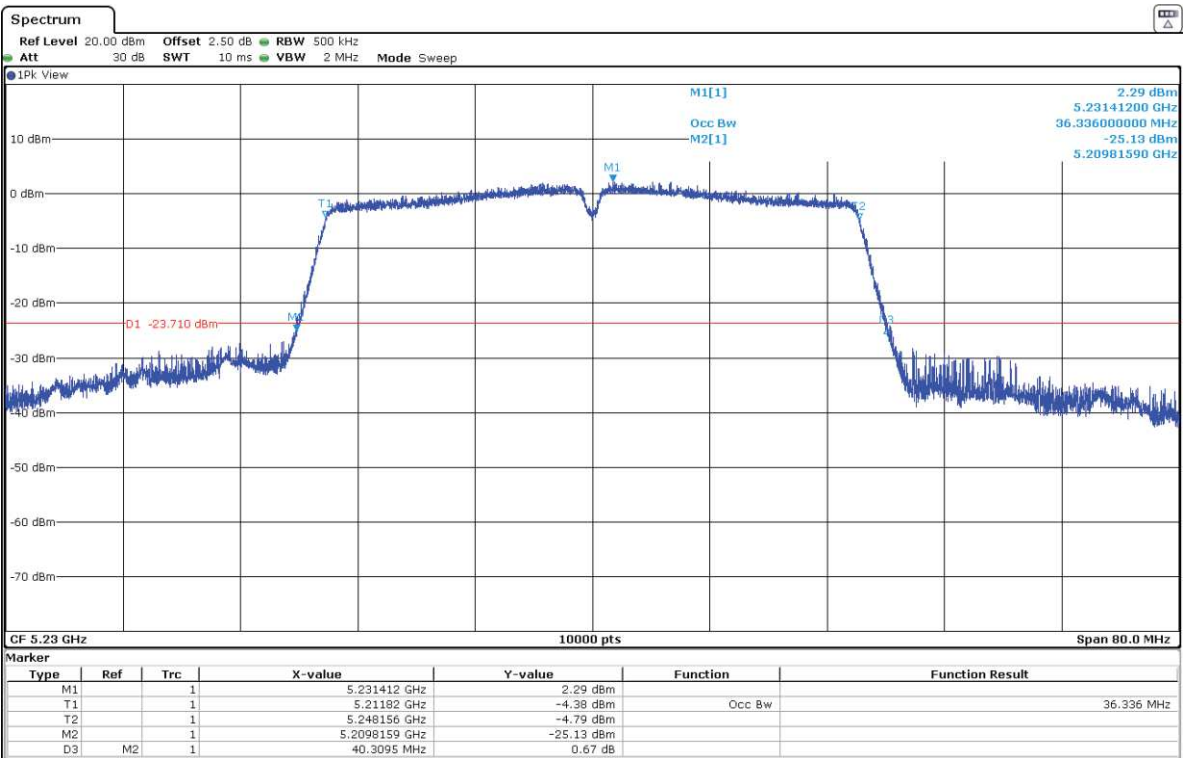
Mode 802.11 n40 (HT40):

U-NII-1 (5150-5250 MHz)

- Low Channel 38 (5190 MHz):

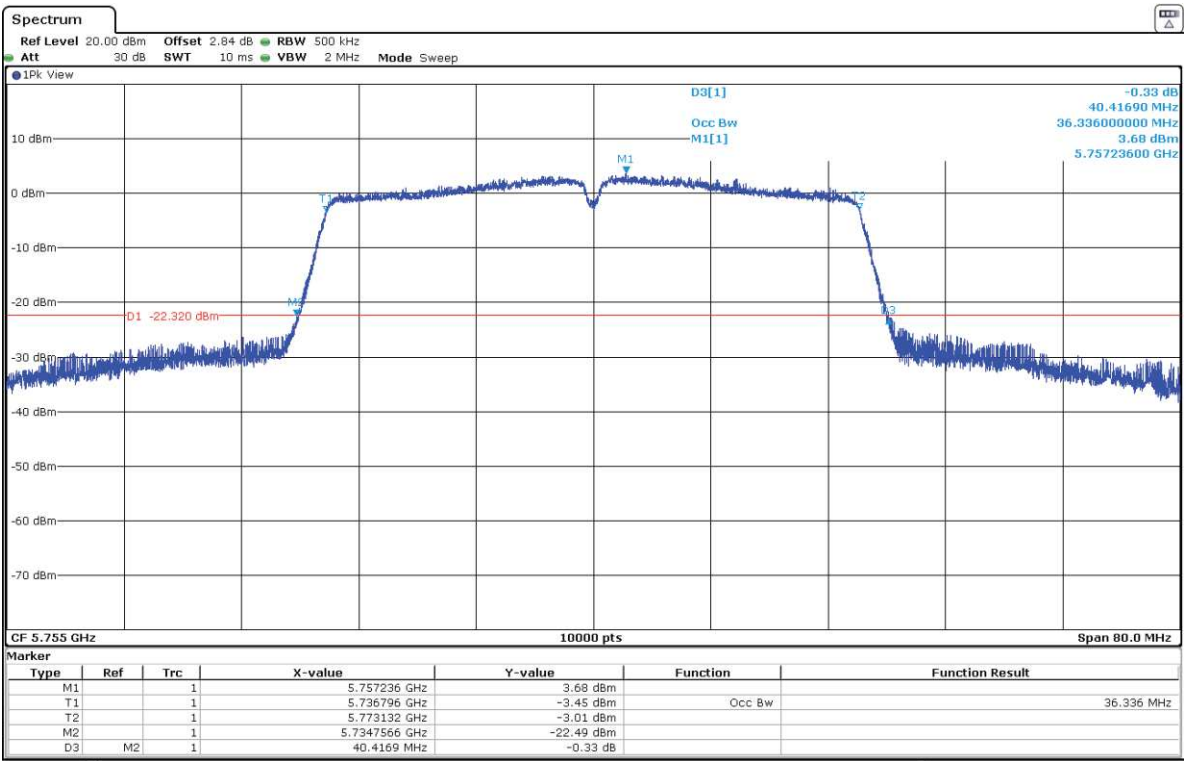


- High Channel 46 (5230 MHz):

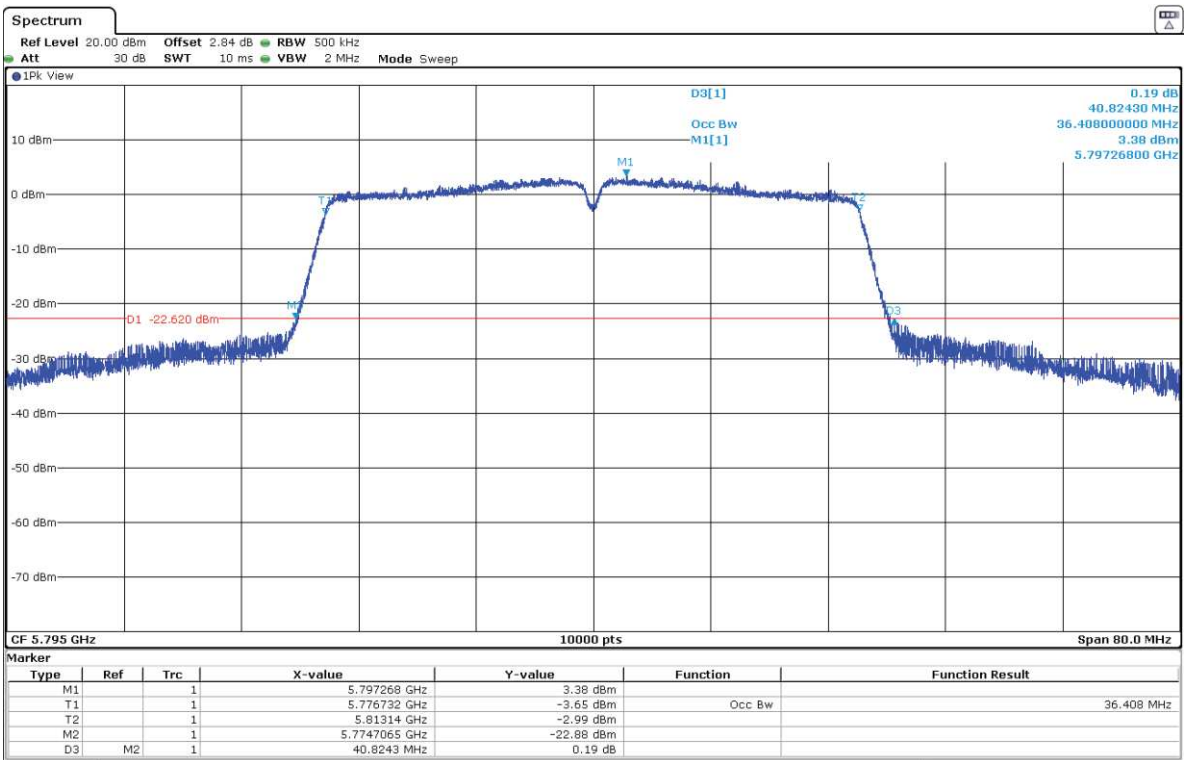


U-NII-3 (5725-5850 MHz)

- Low Channel 151 (5755 MHz):



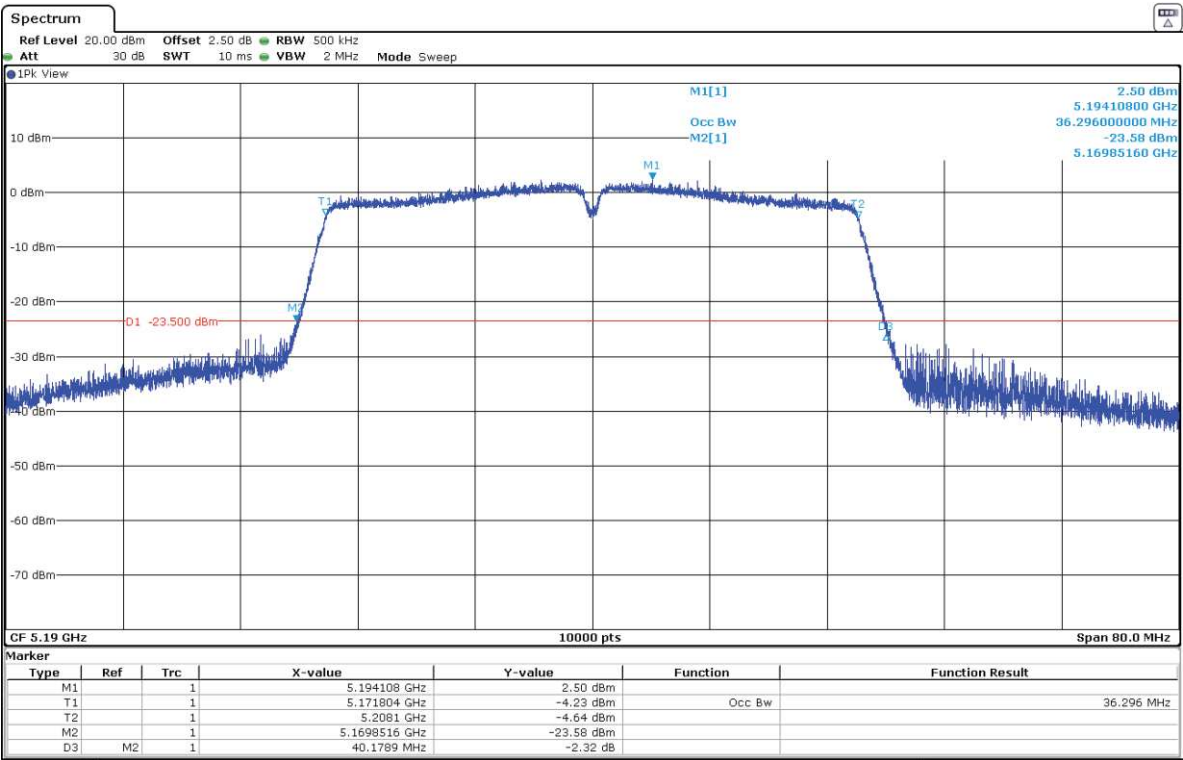
- High Channel 159 (5795 MHz):



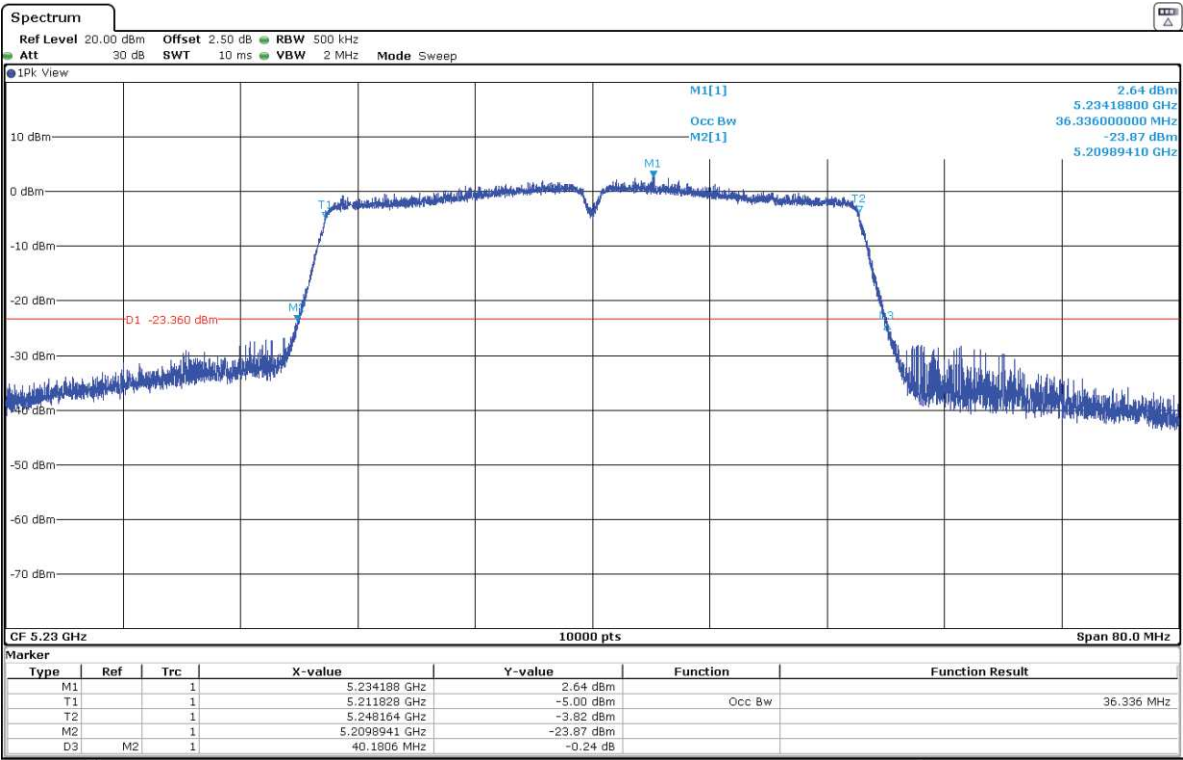
Mode 802.11 ac40 (VHT40):

U-NII-1 (5150-5250 MHz)

- Low Channel 38 (5190 MHz):

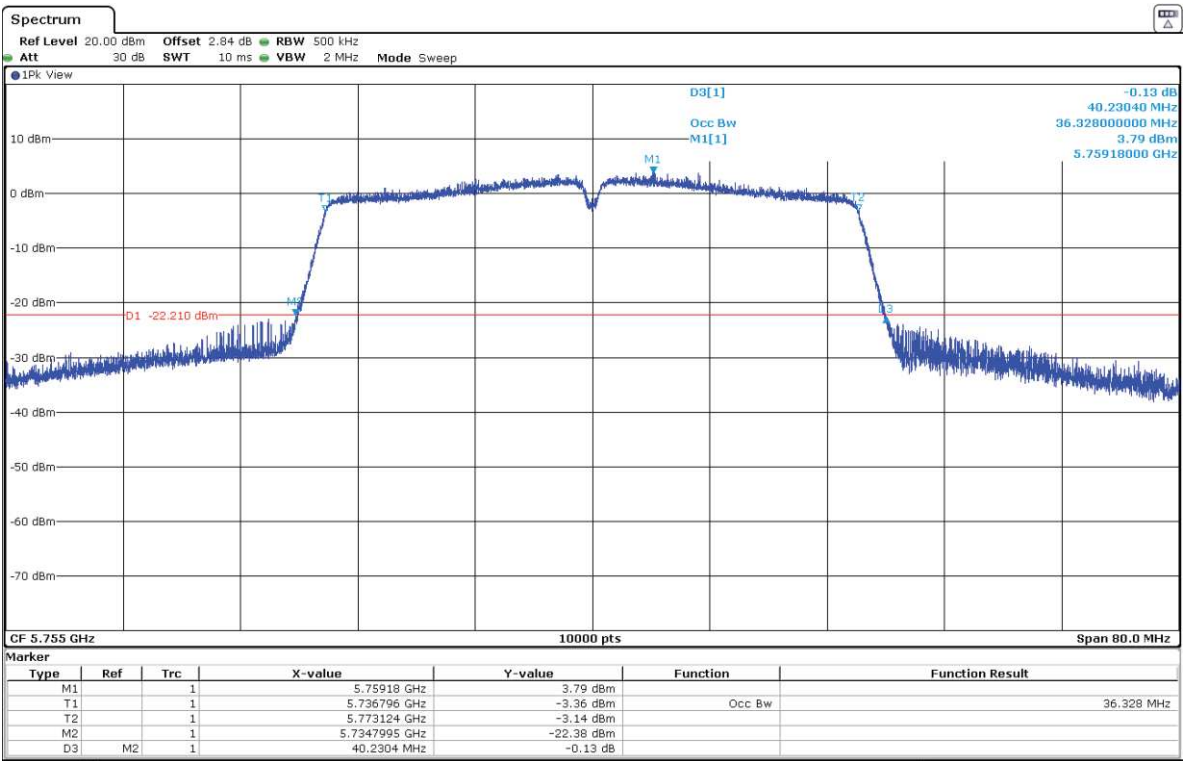


- High Channel 46 (5230 MHz):

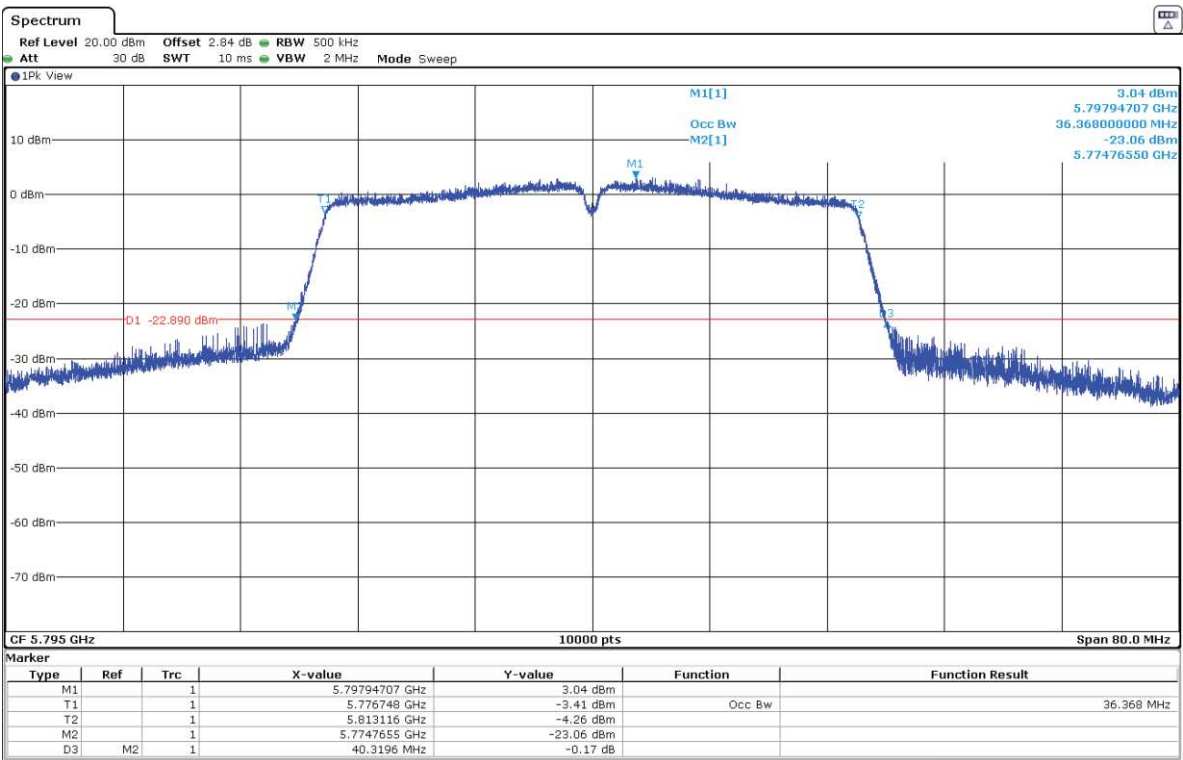


U-NII-3 (5725-5850 MHz)

- Low Channel 151 (5755 MHz):



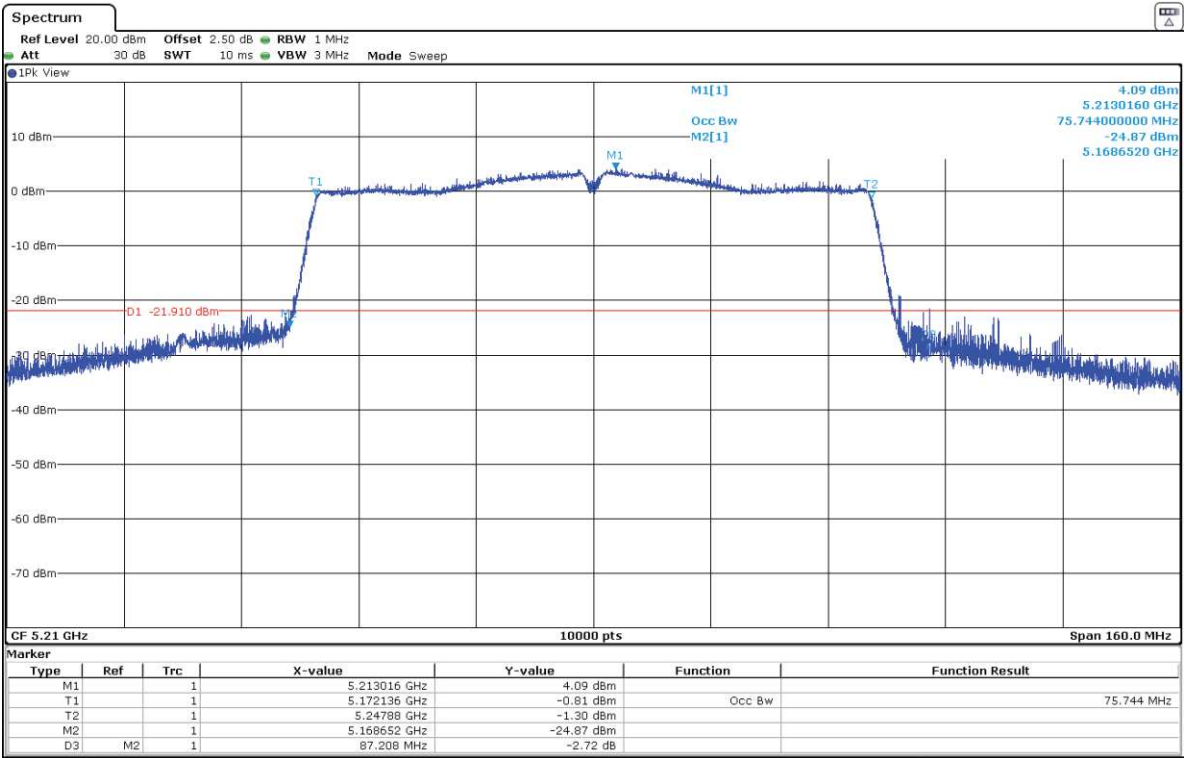
- High Channel 159 (5795 MHz):



Mode 802.11 ac80 (VHT80):

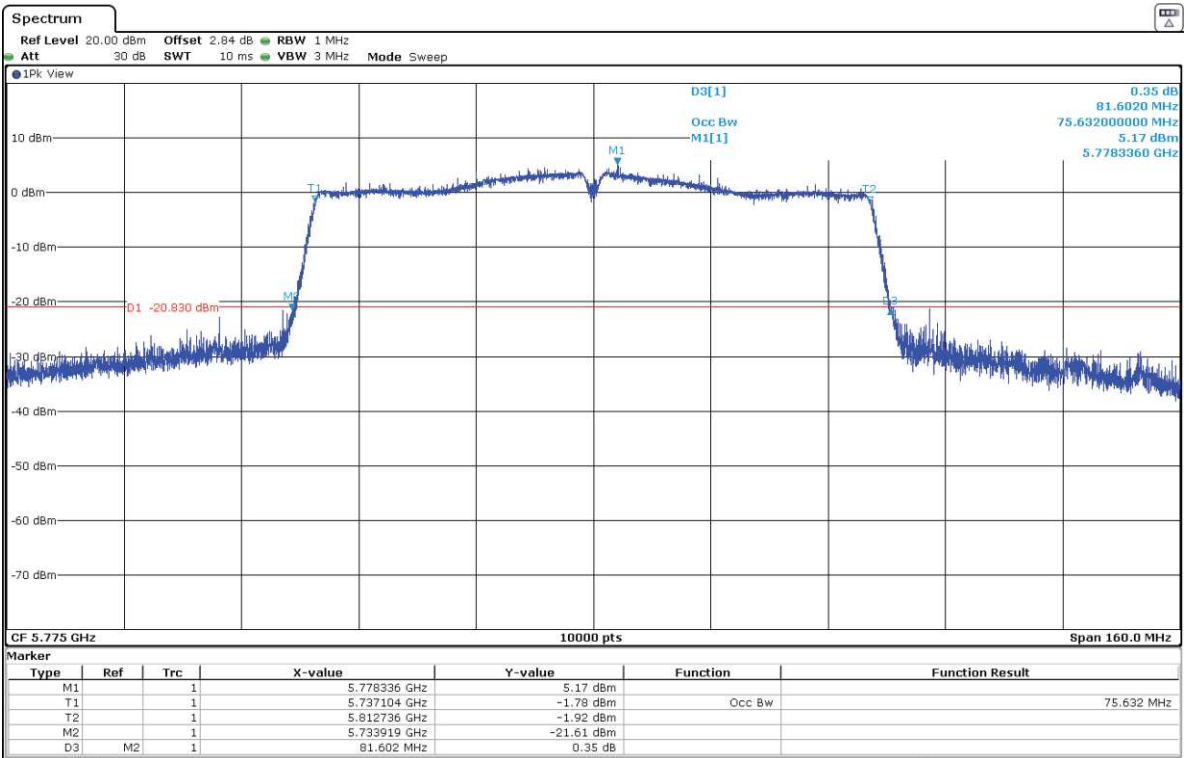
U-NII-1 (5150-5250 MHz)

- 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

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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.
Maximum Declared Antenna Gain: +0.9 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.

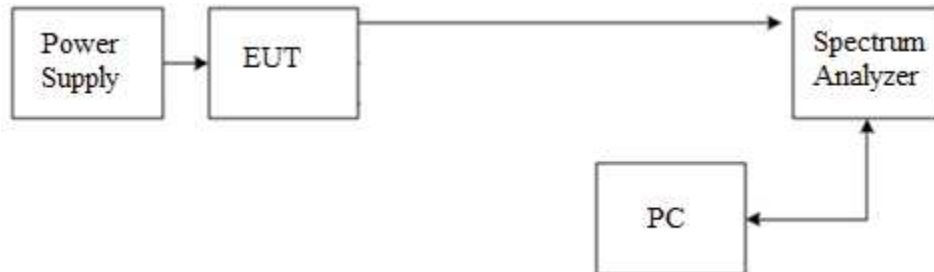
The worst cases for testing were identified for output power and spurious levels at the band edges which were selected based on preliminary testing that correspond to next data rates:

- 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-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.

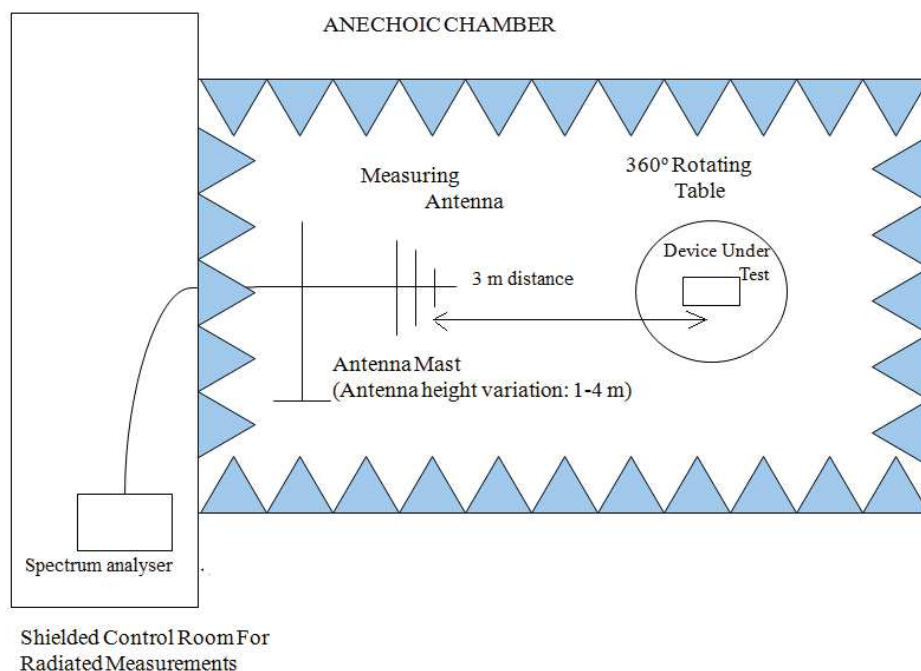
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find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

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

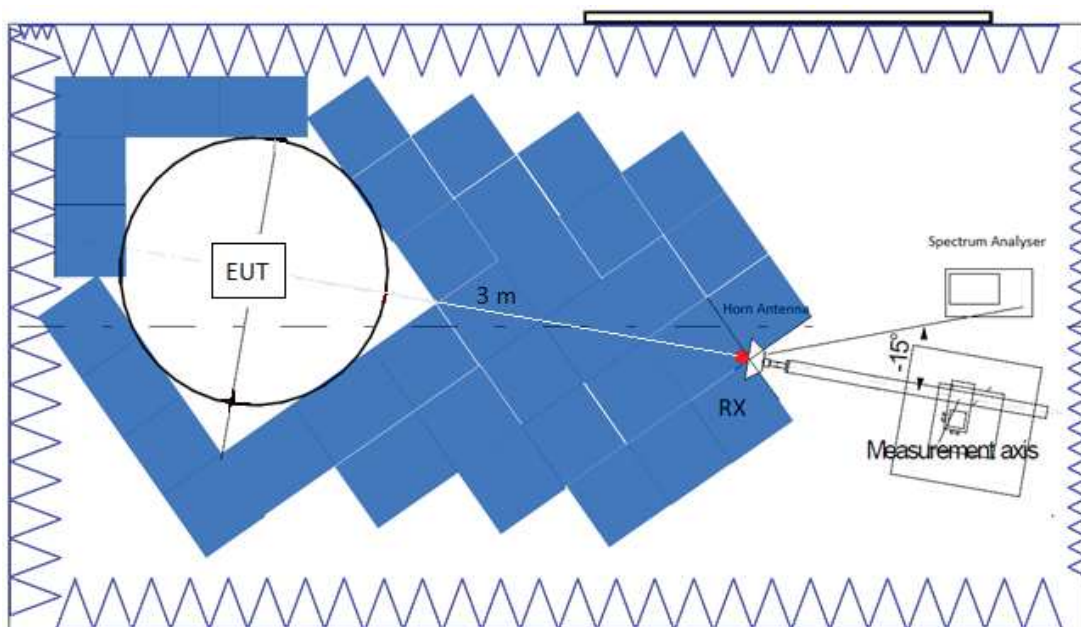
The final measured value, for the given emission, in the tables below incorporates the calibrated antenna factor and cable loss.

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.

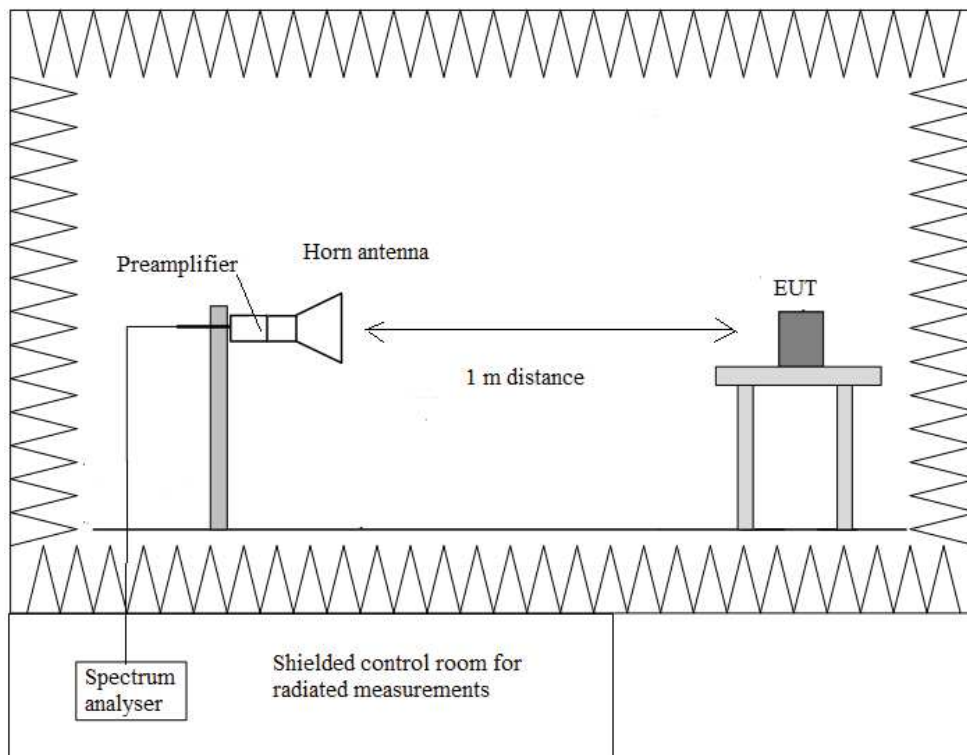
Radiated measurements setup from 30 MHz to 1 GHz:



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: +0.9 dBi

Mode 802.11 a20:

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Max. Conducted Power (dBm)	11.11	10.99	11.4
Duty Cycle Correction Factor (dB)	0.946		
Max. Conducted Power Corrected (dBm)	12.056	11.936	12.346
Max. EIRP power Corrected (dBm)	12.956	12.836	13.246
Measurement uncertainty (dB)	<±2.00		

Mode 802.11 n20 (HT20):

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Max. Conducted Power (dBm)	10.87	10.96	11.12
Duty Cycle Correction Factor (dB)	1.009		
Max. Conducted Power Corrected (dBm)	11.879	11.969	12.129
Max. EIRP power Corrected (dBm)	12.779	12.869	13.029
Measurement uncertainty (dB)	<±2.00		

Mode 802.11 ac20 (VHT20):

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Max. Conducted Power (dBm)	10.9	10.81	11.01
Duty Cycle Correction Factor (dB)	1.0033		
Max. Conducted Power Corrected (dBm)	11.903	11.813	12.013
Max. EIRP power Corrected (dBm)	12.803	12.713	12.913
Measurement uncertainty (dB)	<±2.00		

Mode 802.11 n40 (HT40):

	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
Max. Conducted Power (dBm)	8.2	8.29
Duty Cycle Correction Factor (dB)	1.849	
Max. Conducted Power Corrected (dBm)	10.049	10.139
Max. EIRP power Corrected (dBm)	10.949	11.039
Measurement uncertainty (dB)	<±2.00	

Mode 802.11 ac40 (VHT40):

	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
Max. Conducted Power (dBm)	8.32	8.25
Duty Cycle Correction Factor (dB)	1.841	
Max. Conducted Power Corrected (dBm)	10.161	10.091
Max. EIRP Power Corrected (dBm)	11.061	10.991
Measurement uncertainty (dB)	<±2.00	

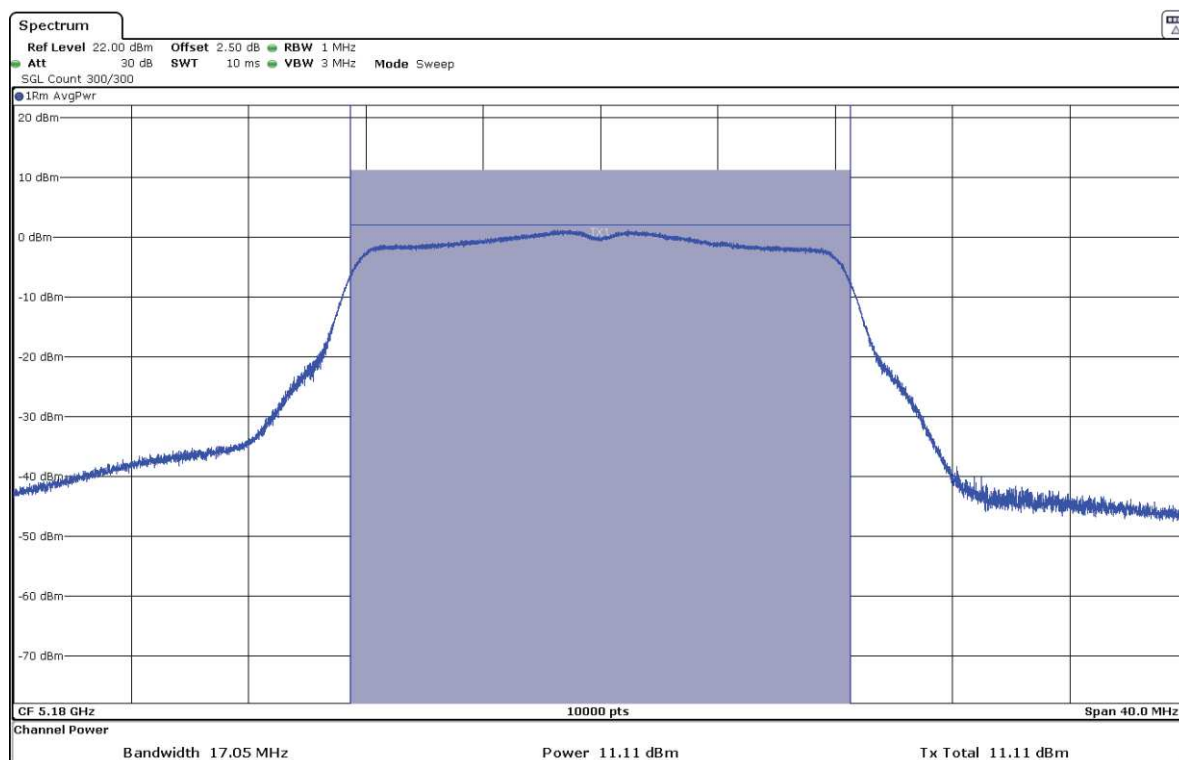
Mode 802.11 ac80 (VHT80):

	Single Channel 42 (5210 MHz)
Max. Conducted Power (dBm)	8.24
Duty Cycle Correction Factor (dB)	3.202
Max. Conducted Power Corrected (dBm)	11.442
Max. EIRP Power Corrected (dBm)	12.342
Measurement uncertainty (dB)	<±2.00

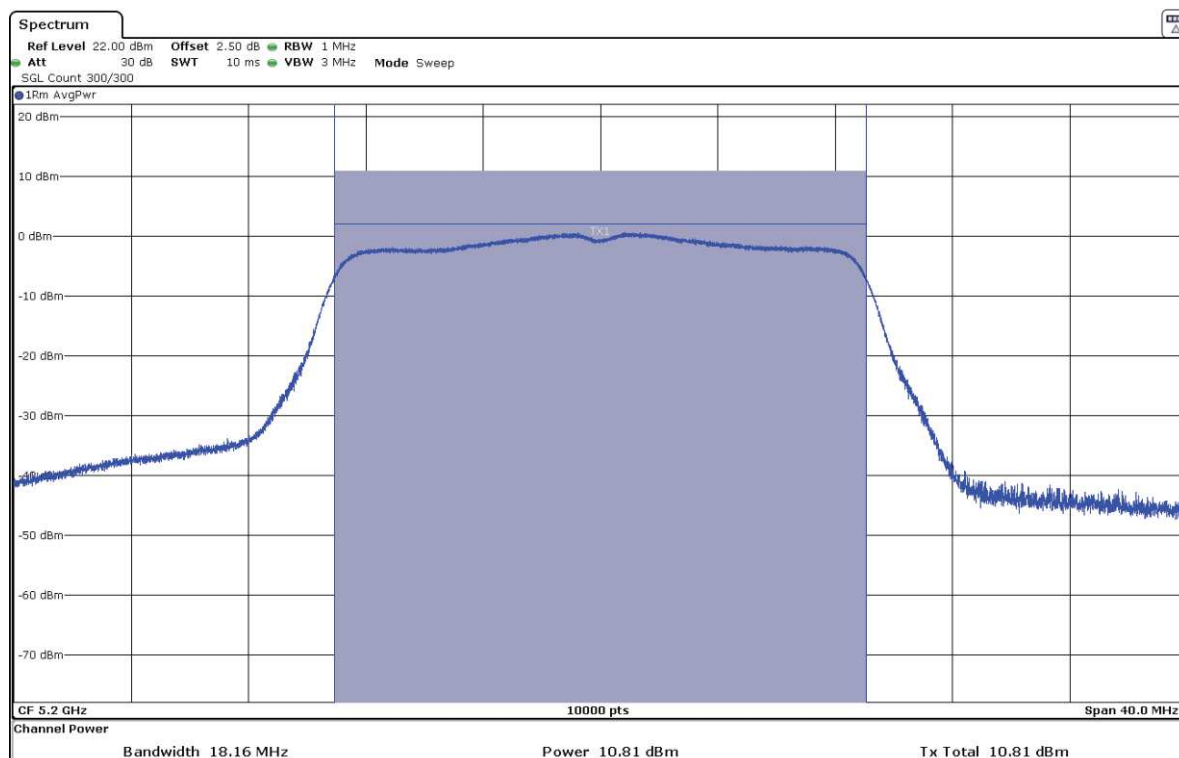
Verdict: PASS

Mode 802.11 a20:

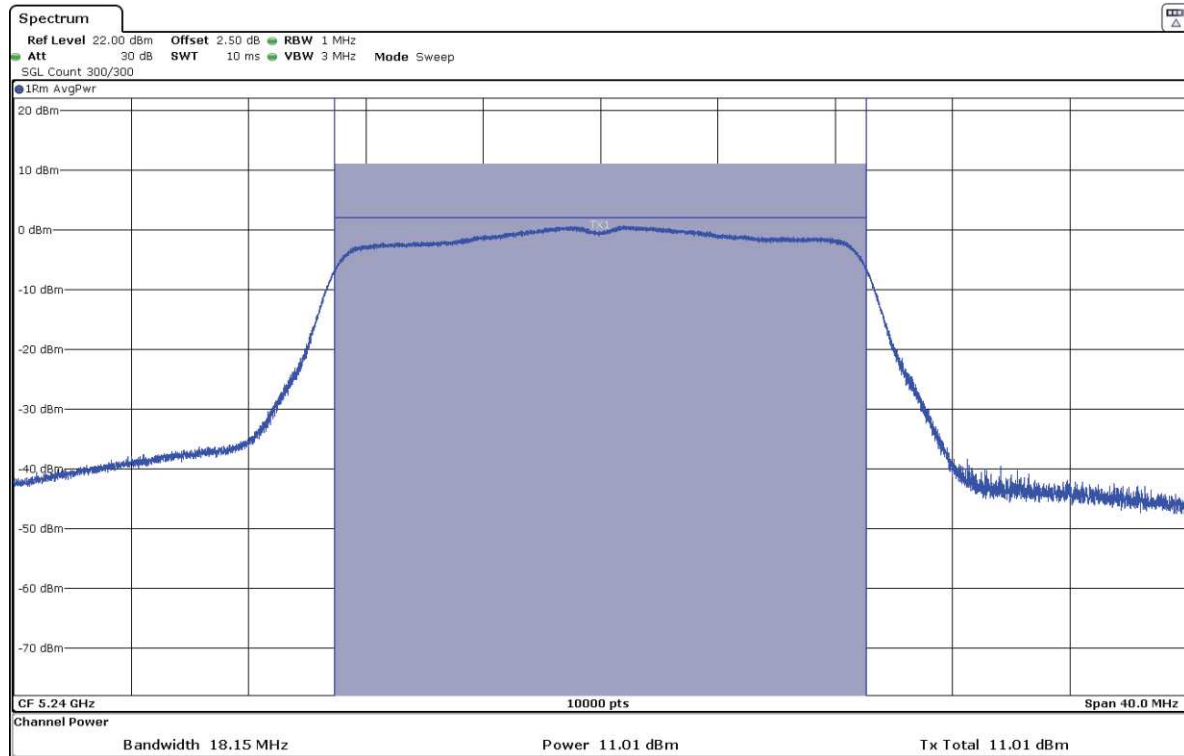
- Low Channel:



- Middle Channel:

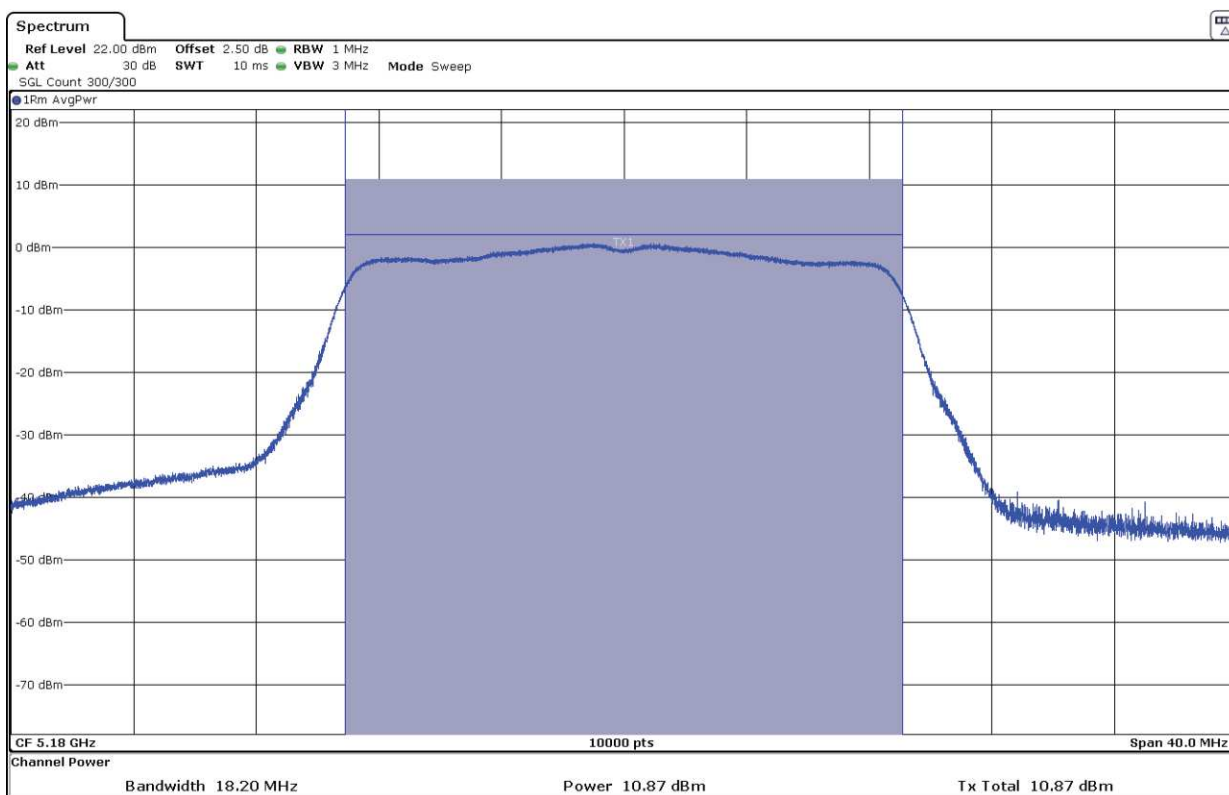


- High Channel:

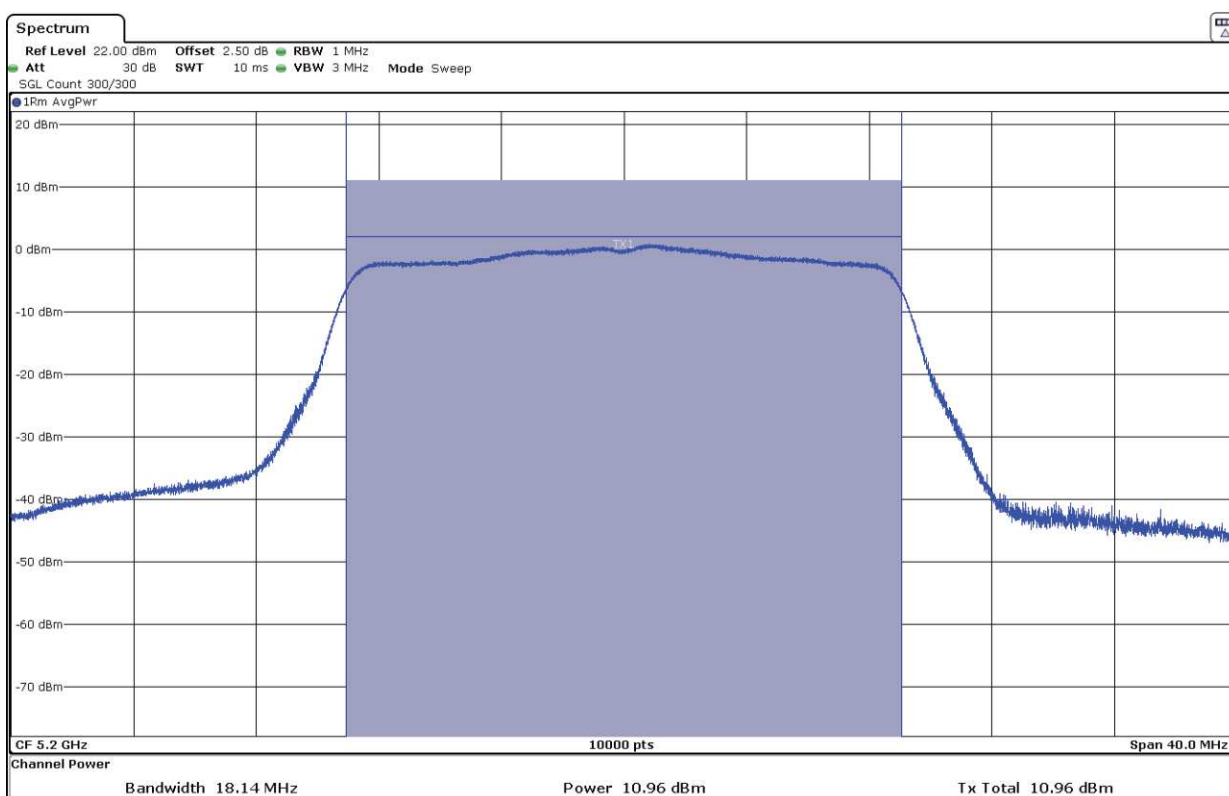


Mode 802.11 n20 (HT20):

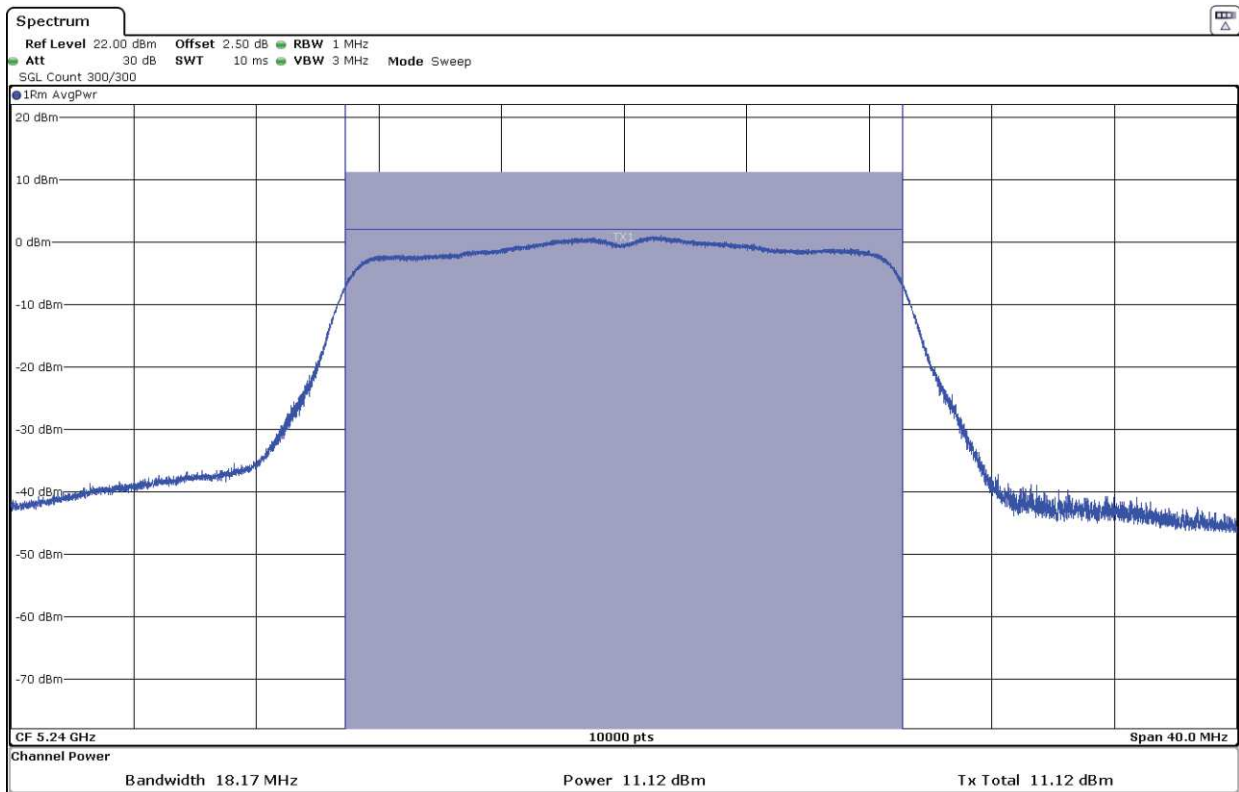
- Low Channel:



- Middle Channel:

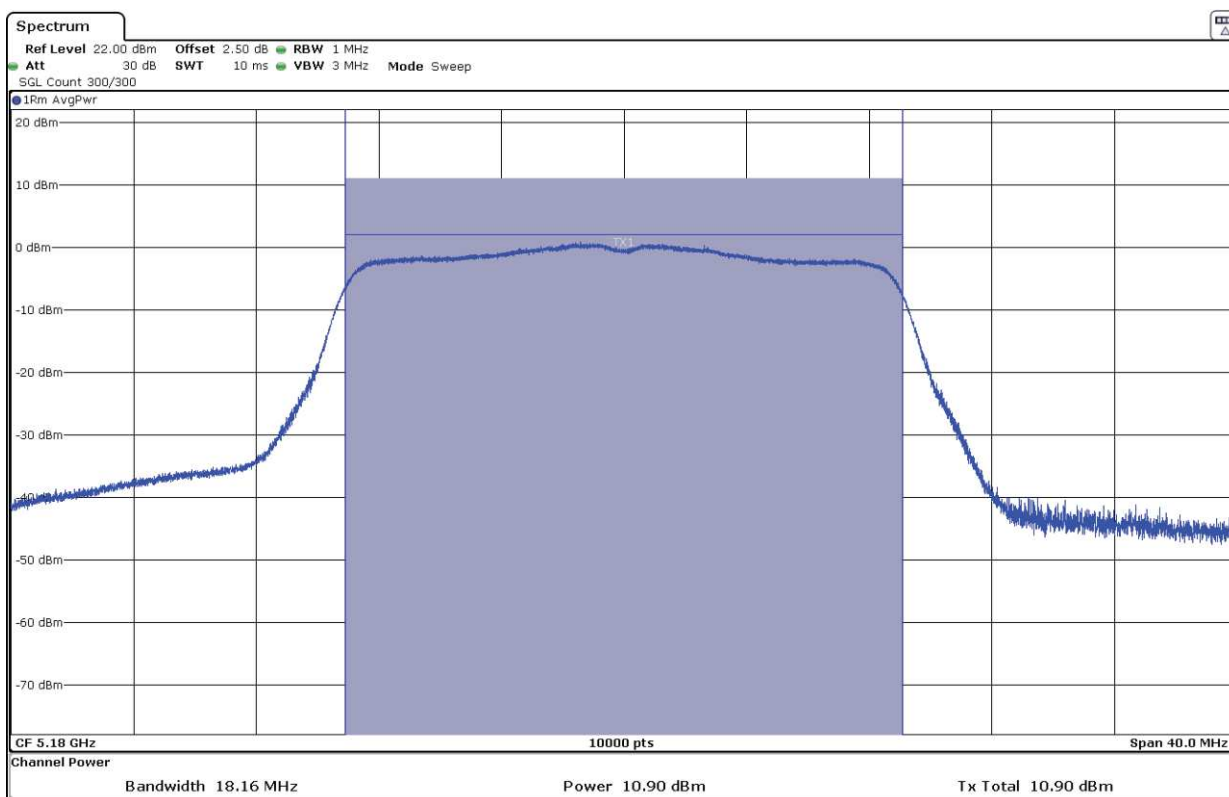


- High Channel:

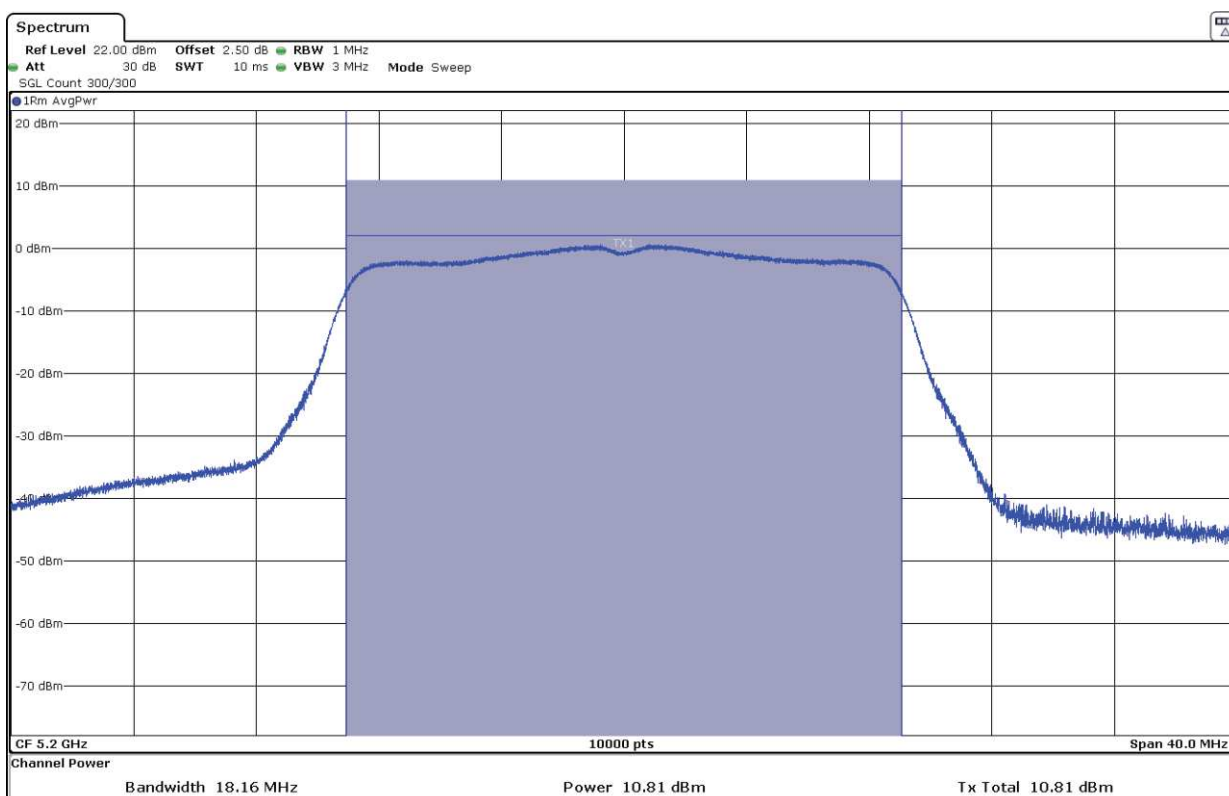


Mode 802.11 ac20 (VHT20):

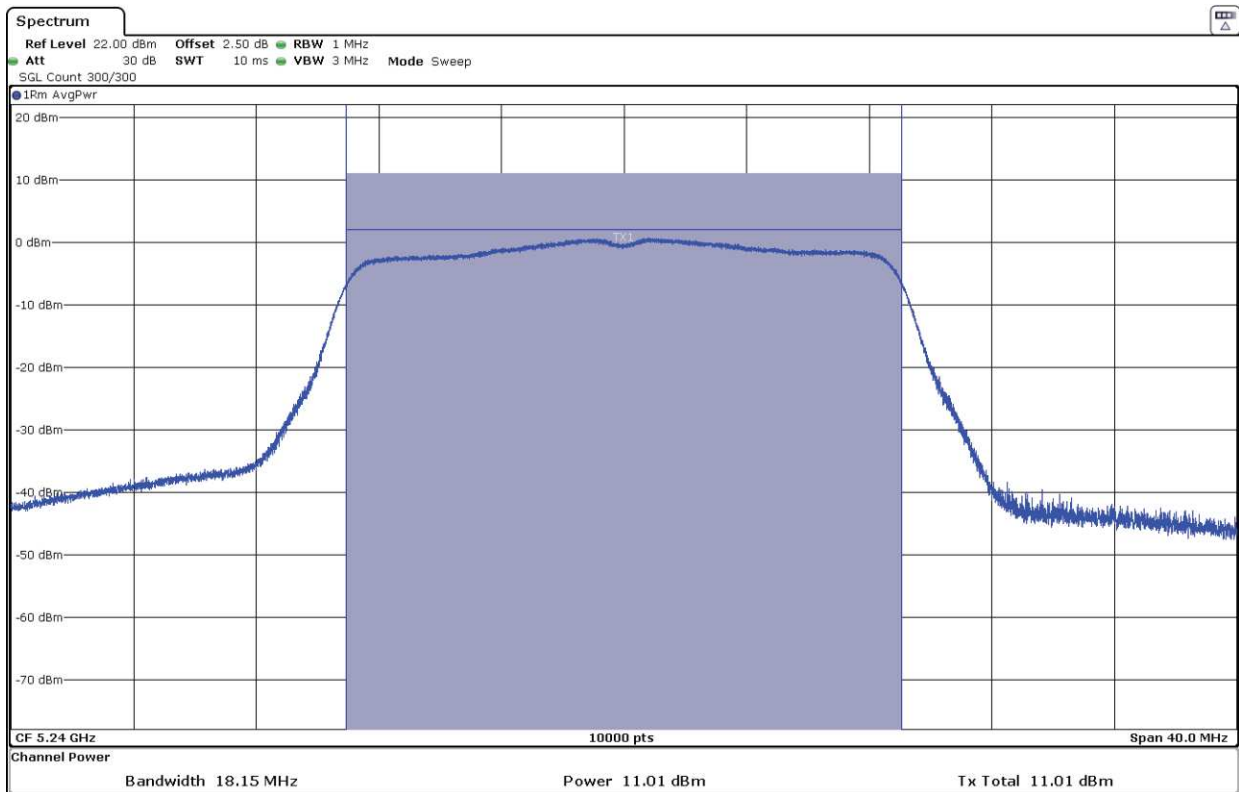
- Low Channel:



- Middle Channel:

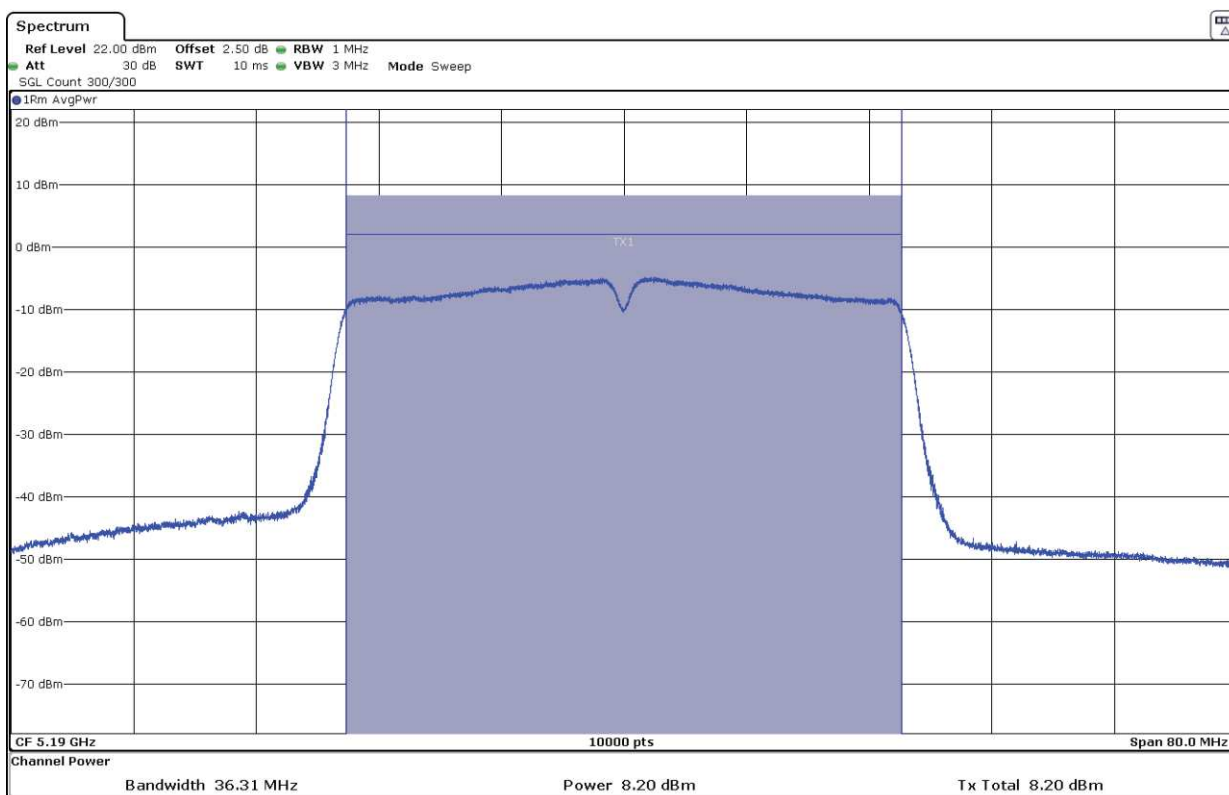


- High Channel:

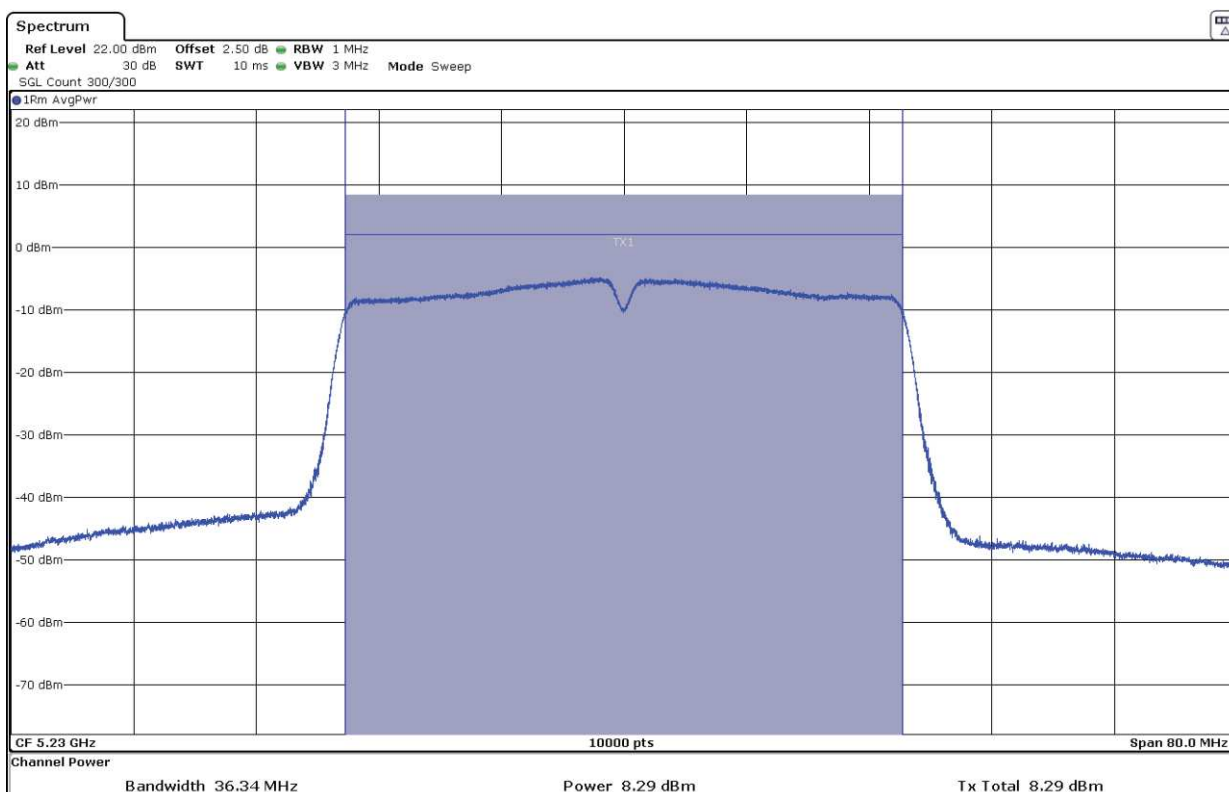


Mode 802.11 n40 (HT40):

- Low Channel:

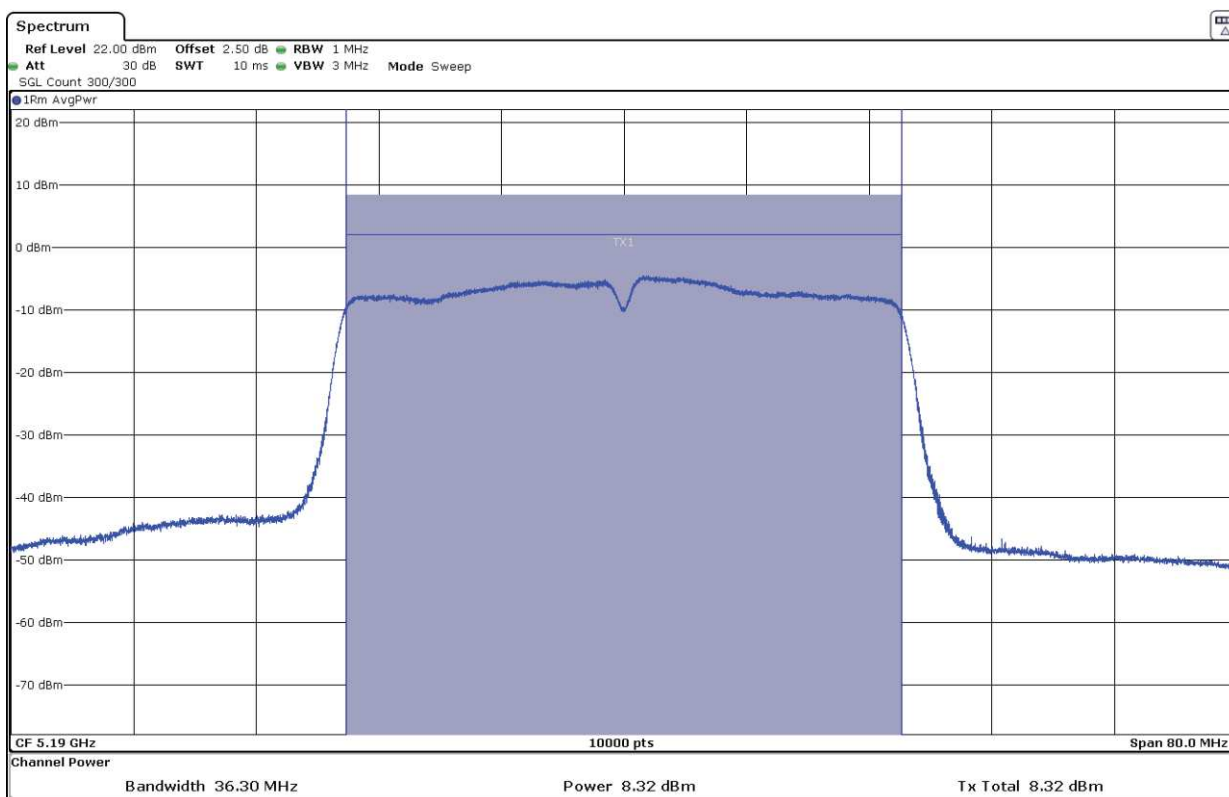


- High Channel:

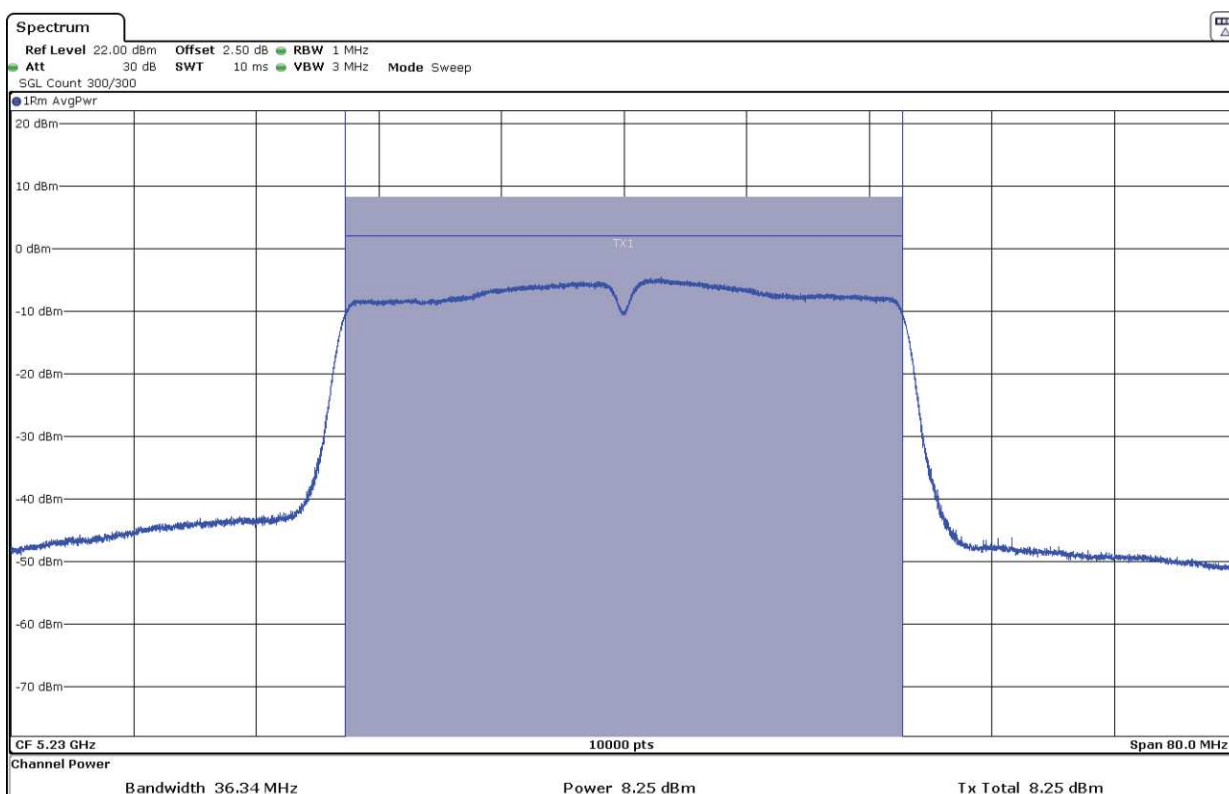


Mode 802.11 ac40 (VHT40):

- Low Channel:

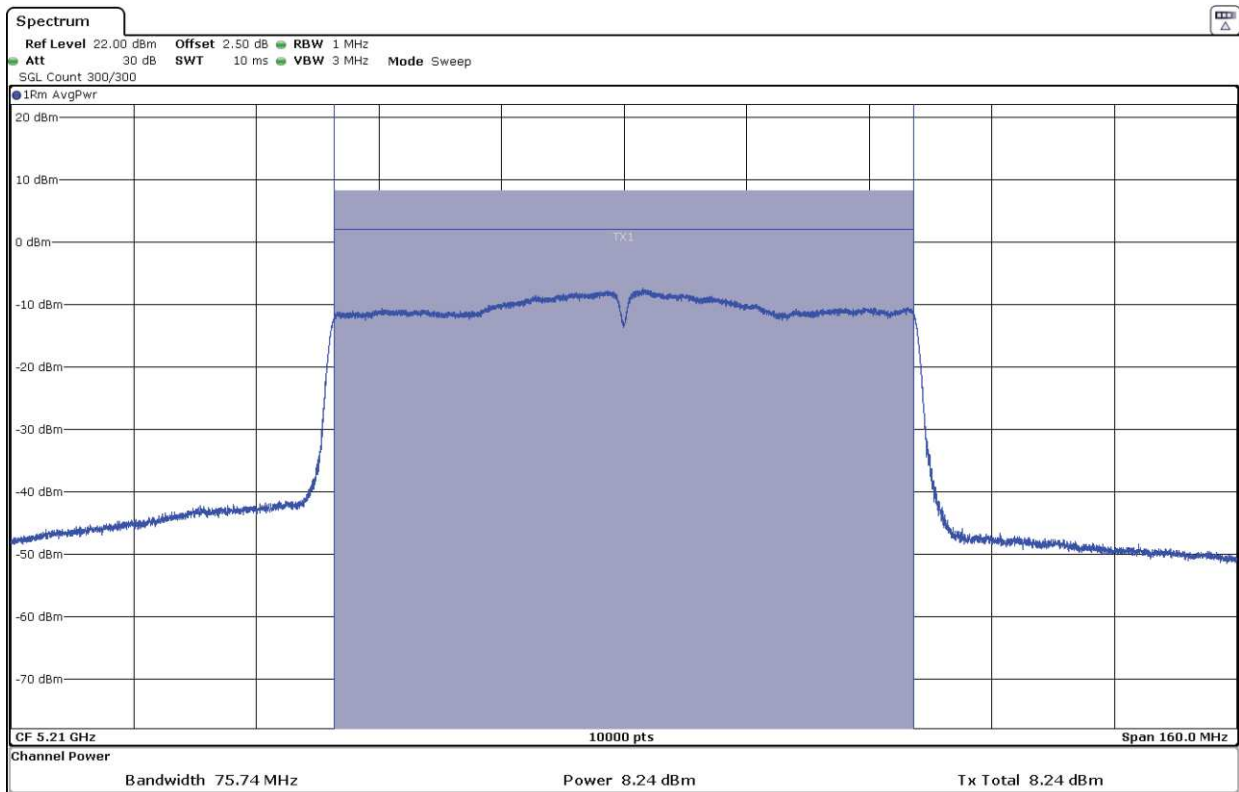


- High Channel:



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 marker 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: +0.9 dBi

Mode 802.11 a20:

	Low Channel	Middle Channel	High Channel
Maximum Average PSD (dBm/MHz)	1.21	1.3	1.19
Duty Cycle Correction Factor (dB)	0.946		
Maximum Average PSD Corrected (dBm/MHz)	2.156	2.246	2.136
Maximum EIRP PSD Corrected (dBm/MHz)	3.056	3.146	3.036
Measurement uncertainty (dB)	<±2.00		

Mode 802.11 n20 (HT20):

	Low Channel	Middle Channel	High Channel
Maximum Average PSD (dBm/MHz)	0.78	0.58	0.77
Duty Cycle Correction Factor (dB)	1.009		
Maximum Average PSD Corrected (dBm/MHz)	1.789	1.589	1.779
Maximum EIRP PSD Corrected (dBm/MHz)	2.689	2.489	2.679
Measurement uncertainty (dB)	<±2.00		

Mode 802.11 ac20 (VHT20):

	Low Channel	Middle Channel	High Channel
Maximum Average PSD (dBm/MHz)	0.63	0.61	0.75
Duty Cycle Correction Factor (dB)	1.003		
Maximum Average PSD Corrected (dBm/MHz)	1.633	1.613	1.753
Maximum EIRP PSD Corrected (dBm/MHz)	2.533	2.513	2.653
Measurement uncertainty (dB)	<±2.00		

Mode 802.11 n40 (HT40):

	Low Channel	High Channel
Maximum Average PSD (dBm/MHz)	-4.77	-4.97
Duty Cycle Correction Factor (dB)	1.849	
Maximum Average PSD Corrected (dBm/MHz)	-2.921	-3.121
Maximum EIRP PSD Corrected (dBm/MHz)	-2.021	-2.221
Measurement uncertainty (dB)	<±2.00	

Mode 802.11 ac40 (VHT40):

	Low Channel	High Channel
Maximum Average PSD (dBm/MHz)	-4.58	-4.64
Duty Cycle Correction Factor (dB)	1.841	
Maximum Average PSD Corrected (dBm/MHz)	-2.739	-2.799
Maximum EIRP PSD Corrected (dBm/MHz)	-1.839	-1.899
Measurement uncertainty (dB)	<±2.00	

Mode 802.11 ac80 (VHT80):

	Low Channel
Maximum Average PSD (dBm/MHz)	-7.57
Duty Cycle Correction Factor (dB)	3.202
Maximum Average PSD Corrected (dBm/MHz)	-4.368
Maximum EIRP PSD Corrected (dBm/MHz)	-3.468
Measurement uncertainty (dB)	<±2.00

Verdict: PASS