DEKRA Testing and Certification, S.A.U.
Parque Tecnológico de Andalucía,
c/ Severo Ochoa nº 2 · 29590 Campanillas · Málaga · España
C.I.F. A29 507 456

Test report No:
NIE: 61299RRF.002

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	MGU_F APN
Other identification of the product	HW version: HW 3.1 SW version: 19w20.5-1-16 FCC ID: A269ZUA160 IC: 700B-UA160
(*) Features	BT, WiFi, USB2/3
Applicant	ALPSALPINE INC. 20-1 YOSHIMA INDUSTRIAL PARK, IWAKI, FUKUSHIMA 970-1192, JAPAN
Test method requested, standard	USA FCC Part 15.407 (10-1-18) Edition: Unlicensed National Information Infrastructure (U-NII) Devices. General technical requirements. USA FCC Part 15.209 (10-1-18) Edition: Radiated emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5 (April 2018). 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)	Jose Carlos Luque RF Lab. Supervisor 74841983Y JOSE CARLOS LUQUE (C:A29507456) Firmado digitalmente por 74841983Y JOSE CARLOS LUQUE (C:A29507456) Fecha: 2020.01.27 13:26:07 +01'00'
Date of issue	2020-01-27
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.

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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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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 MGU_F 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
61299/057	Automotive Infotainment System	MGU_F APN	ALB314K0673026	2019/07/24
61299/046	Display	--	--	2019/07/16
61299/059	CAN Box	--	80008147	2019/07/24
61299/061	Ethernet Board	--	--	2019/07/24
61299/064	Ethernet-USB Adapter	EU-4306	EU430693MA00744	2019/07/24
61299/065	Harness	--	--	2019/07/24
61299/111	Antenna			2019/08/30
61299/112	Antenna			2019/08/30

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

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

Control Nº	Description	Model	Serial Nº	Date of reception
61299/057	Automotive Infotainment System	MGU_F APN	ALB314K0673026	2019/07/24
61299/046	Display	--	--	2019/07/16
61299/059	CAN Box	--	80008147	2019/07/24
61299/061	Ethernet Board	--	--	2019/07/24
61299/064	Ethernet-USB Adapter	EU-4306	EU430693MA00744	2019/07/24
61299/065	Harness	--	--	2019/07/24

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

Test sample description

Ports…… :	Port name and description	Cable					
		Specified length [m]	Attached during test	Shielded			
	BT		☒	☐			
	WLAN		☒	☐			
	USB2		☒	☐			
	USB3		☒	☐			
	APIX		☒	☐			
	OABR		☒	☐			
Supplementary information to the ports…… :	N/A						
Rated power supply .....:	Voltage and Frequency	Reference poles					
		L1	L2	L3	N	PE	
	☒ DC: 12Vdc.						
Rated Power .....:	12V						
Clock frequencies.....:	Not provided data						
Other parameters .....:	FCC ID: A269ZUA160 IC: 700B-UA160						
Software version .....:	19w20.5-1-16						
Hardware version .....:	HW 3.1						
Dimensions in cm (L x W x D).....:	Not provided data						
Mounting position .....:	☒ Table top equipment						
	☒ Other: Vehicular environment equipment						
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-concerter		Harman				
	Description	File name	Issue date				

Documents as provided by the applicant.....:	Testing manual for BT and WLAN	I&k-MGU_Testing Manual (Radio_WLAN-BT)_v11_2018-01-18	18.1.2018
	-		
	-		

Identification of the client

ALPINE ELECTRONICS GMBH
Ohmstrasse 4, 85716 Unterschleiβheim, Germany

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2019-09-06
Date (finish)	2019-12-11

Document history

Report number	Date	Description
61299RRF.002	2020-01-27	First release

Environmental conditions

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

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

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

Temperature	Min. = 15 ºC Max. = 35 ºC
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 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 35 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

Remarks and comments

The tests have been performed by the technical personnel: Nicolás Salguero, José Gabriel Pendón, Verónica García, Ignacio Cabra, Jesús García, Cristina Calle, Jaime Barranquero and Miguel Ángel Torres.

Used instrumentation:

Radiated Measurements:

		Last Calibration	Due Calibration
1.	Semianechoic Absorber Lined Chamber ETS FACT3 200STP	N.A.	N.A.
2.	EMI Test Receiver ROHDE AND SCHWARZ ESR7	2018/10	2020/10
3.	BiconicalLog antenna ETS LINDGREN 3142E	2017/09	2020/09
4.	RF Pre-amplifier 40 dB, 10 MHz-6 GHz BONN ELEKTRONIK BLNA 0160-01N	2019/02	2020/08
5.	Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV40	2018/02	2020/02
6.	RF Pre-amplifier, 30 dB ,1-18 GHz BONN ELEKTRONIK BLMA 0118-3A	2019/04	2020/04
7.	Broadband Horn antenna 1-18 GHz SCHWARZBECK BBHA 9120 D	2018/01	2021/01
8.	Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSW50	2018/02	2020/02
9.	RF pre-amplifier 1-18 GHz Bonn Elektronik BLMA 0118-1M	2019/04	2020/04
10.	Broadband Horn antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2016/11	2019/11
11.	RF Pre-amplifier 30 dB, 18 GHz-40 GHz BONN ELEKTRONIK BLMA 1840-1M	2019/02	2021/02
12.	Broadband Horn antenna 18-40 GHz SCHWARZBECK BBHA 9170	2018/07	2021/07
13.	DC Power Supply Keysight Technologies U8002A	---	---
14.	Digital multimeter FLUKE 179	2019/06	2020/06

Conducted Measurements

		Last Calibration	Due Calibration
1.	Shielded Room ETS LINDGREN S101	N.A.	N.A.
2.	EMI Test Receiver 7 GHz ROHDE AND SCHWARZ ESR7	2018/10	2020/10
3.	DC power supply R&S NGPE 40/40	2018/02	2021/02
4.	Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV40	2017/10	2019/10

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			
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)
Supplementary information and remarks:			
(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	
Supplementary information and remarks:			
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 Clause 6.2.4.1	6 dB bandwidth.	P	
FCC 15.407 (a)(3) / RSS-247 Clause 6.2.4.1	Transmitter Maximum Power Spectral Density	P	
FCC 15.407 (b)(4) / RSS-247 6.2.4.2	Transmitter Band Edge Radiated Emissions	P	
FCC 15.407 (b)(4)(6) / RSS-247 6.2.4.2	Transmitter Out of Band Radiated Emissions	P	
FCC 15.40 (h) (1) / RSS-247 6.2.4.1	Transmitter Power Control	N/A	
Supplementary information and remarks: None			

Appendix A: Test Common requirements for all bands

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Section 15.35 Subclause (c) / RSS-Gen 6.10. Transmitter Duty Cycle.

SPECIFICATION:

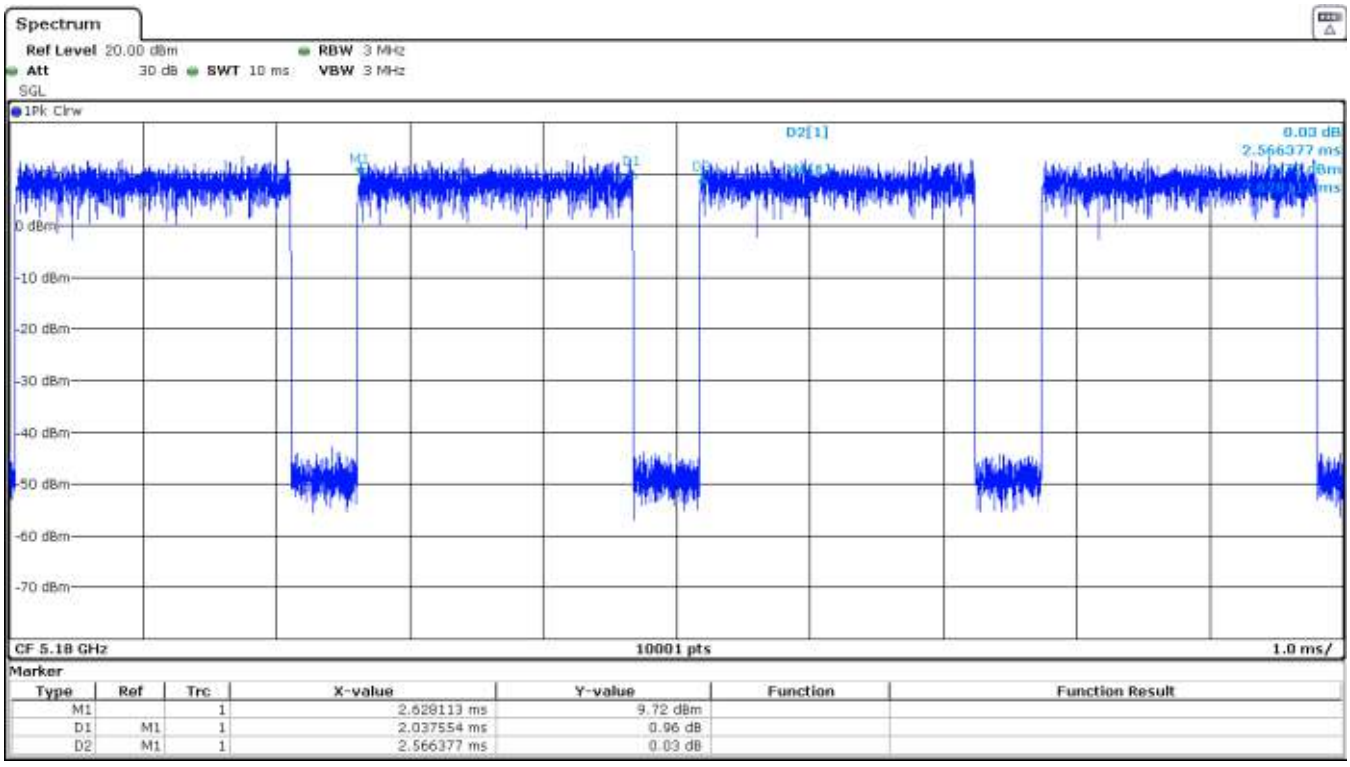
When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 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:

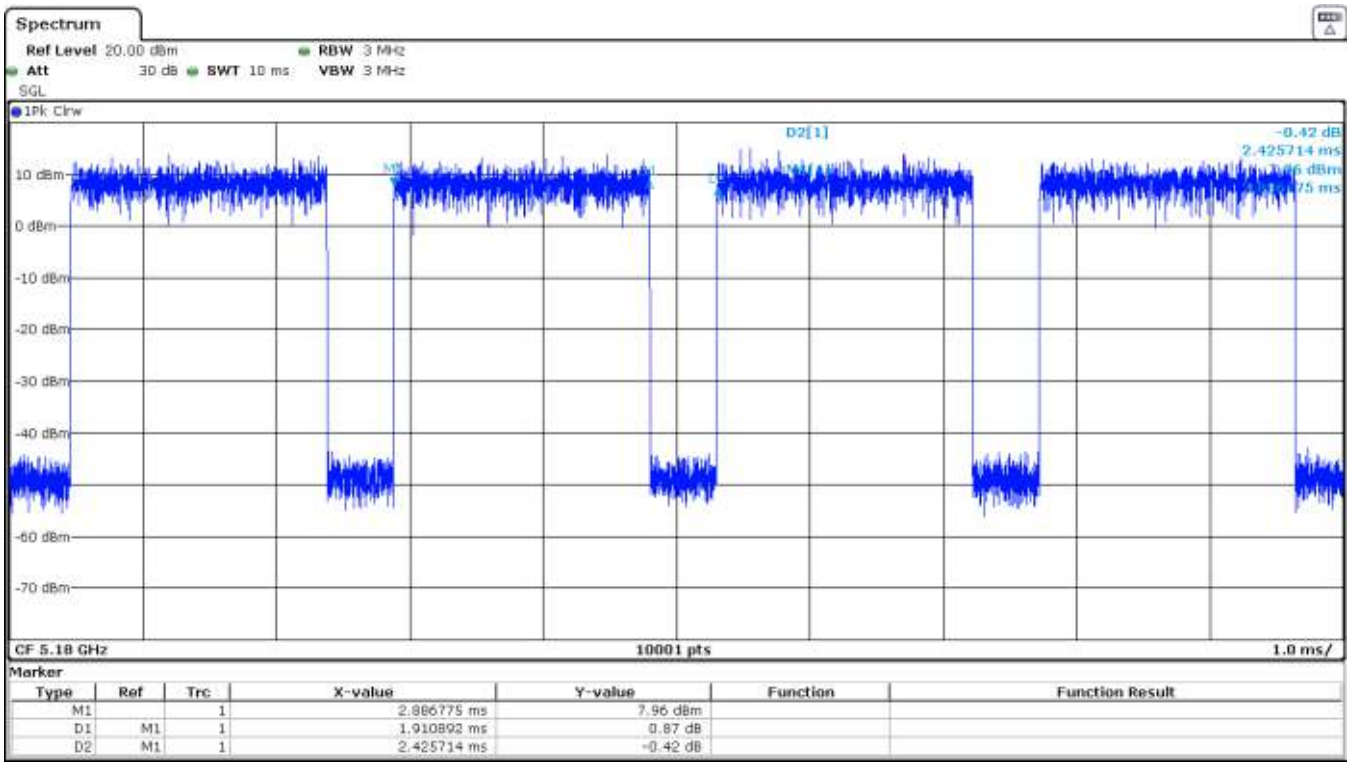
The results below are for data rates with a duty cycle less than 98%. The results for all rest of modes having a value > 98%.

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	2.037554	2.566377	1.002113271	2.0171	2.5701	1.052225922
802.11n20	1.910892	2.425714	1.036034525	1.8587	2.4217	1.149110428
802.11ac20	1.919892	2.430714	1.024570634	1.8902	2.4288	1.088839954
802.11n40	0.935894	1.446861	1.892001474	0.9013	1.4476	2.057792034
802.11ac40	0.939078	1.459716	1.91566702	0.91023	1.45186	2.02773595
802.11ac80	0.450953	0.961544	3.288378818	0.4337	0.95979	3.449867986

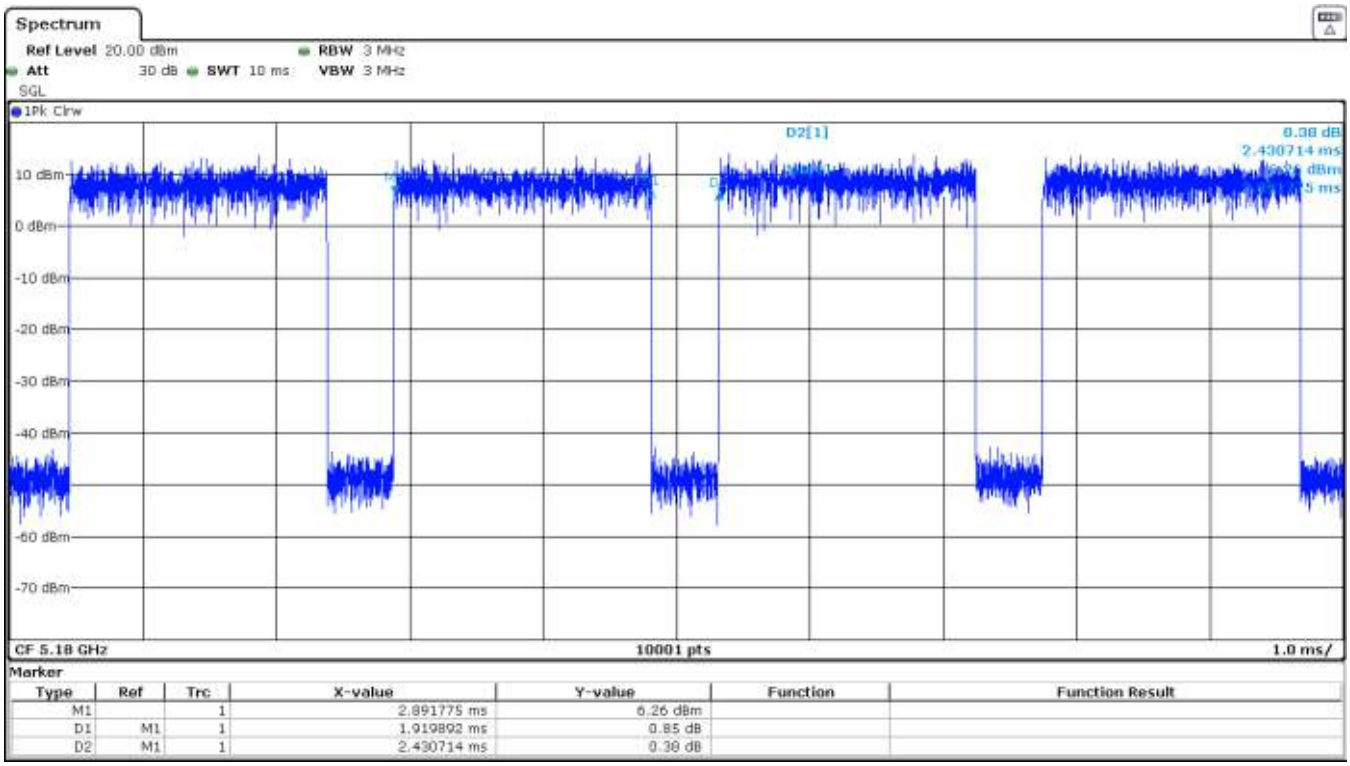
Mode 802.11 a20 (U-NII-1)**:**



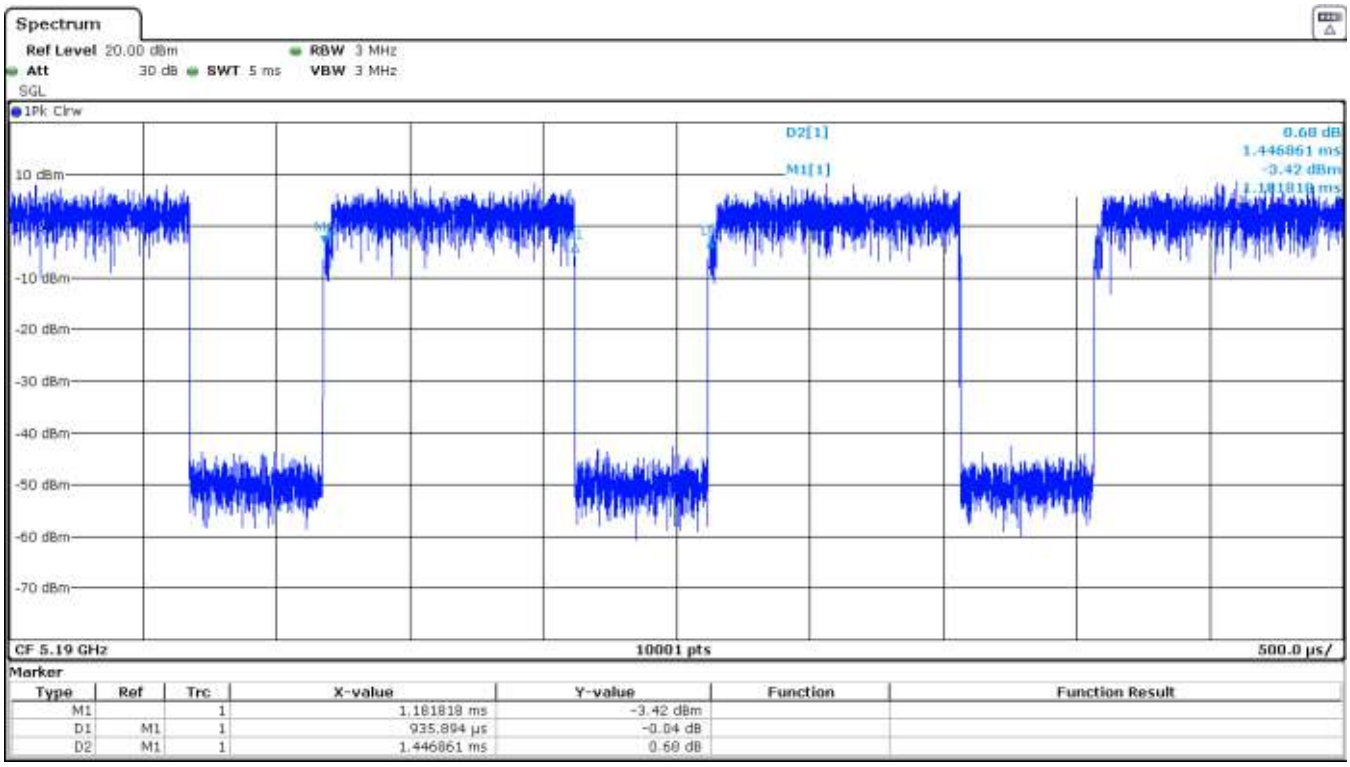
Mode 802.11 n20 (U-NII-1)**:**



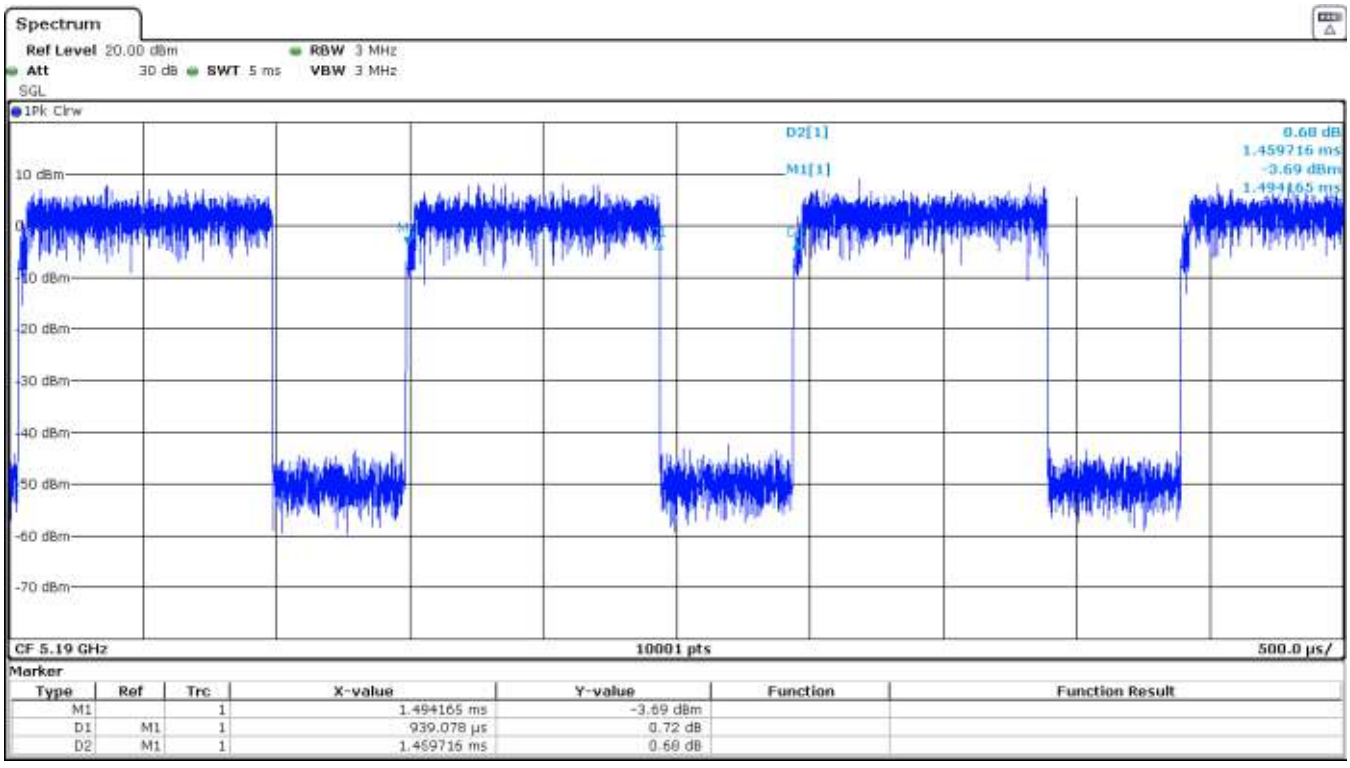
Mode 802.11 ac20 (U-NII-1)**:**



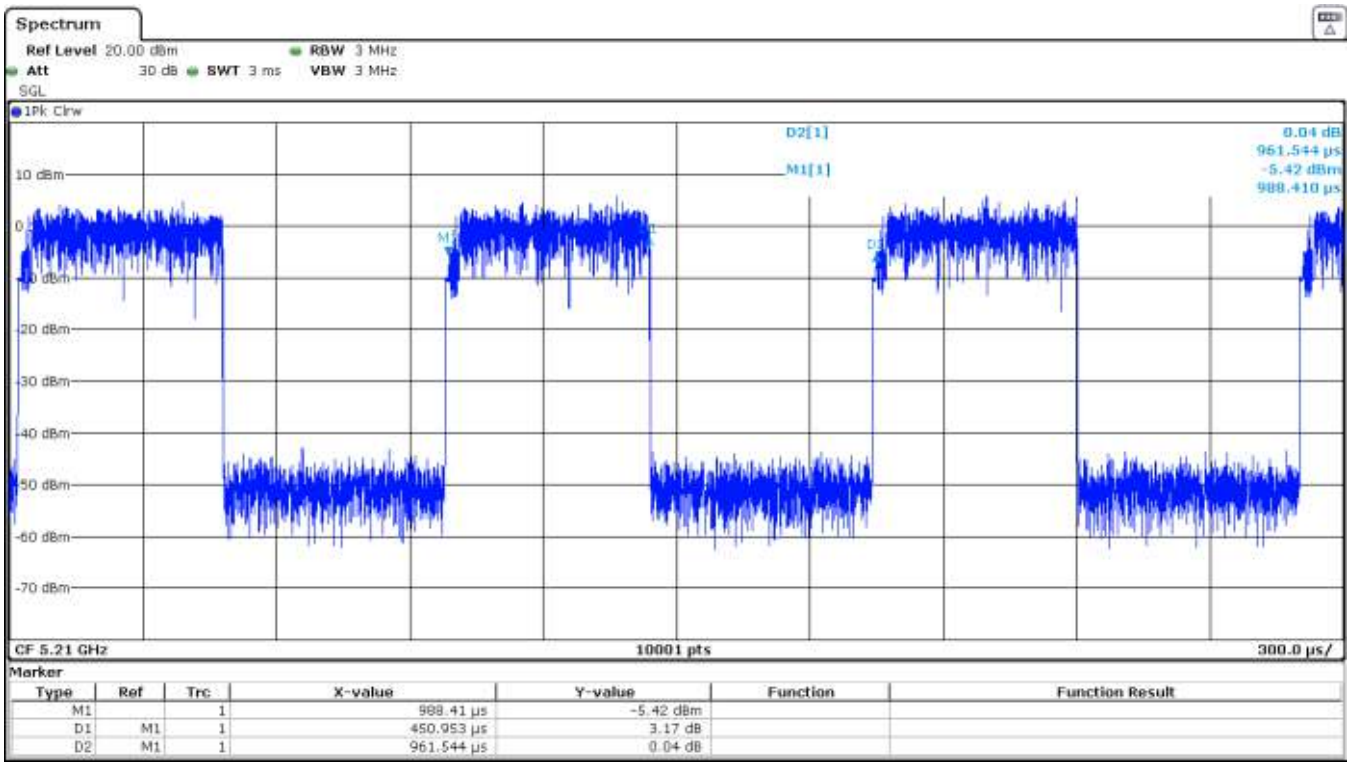
Mode 802.11 n40 (U-NII-1)**:**



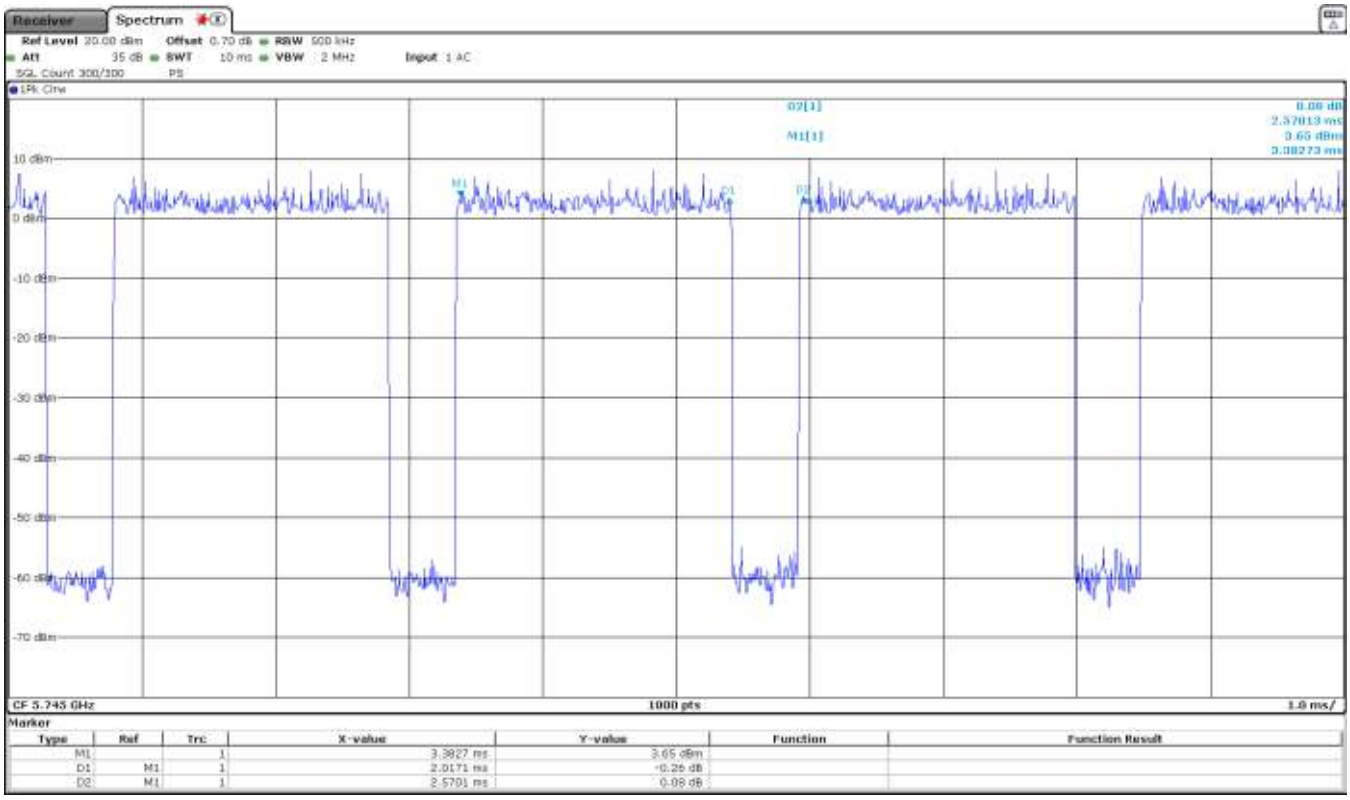
Mode 802.11 ac40 (U-NII-1)**:**



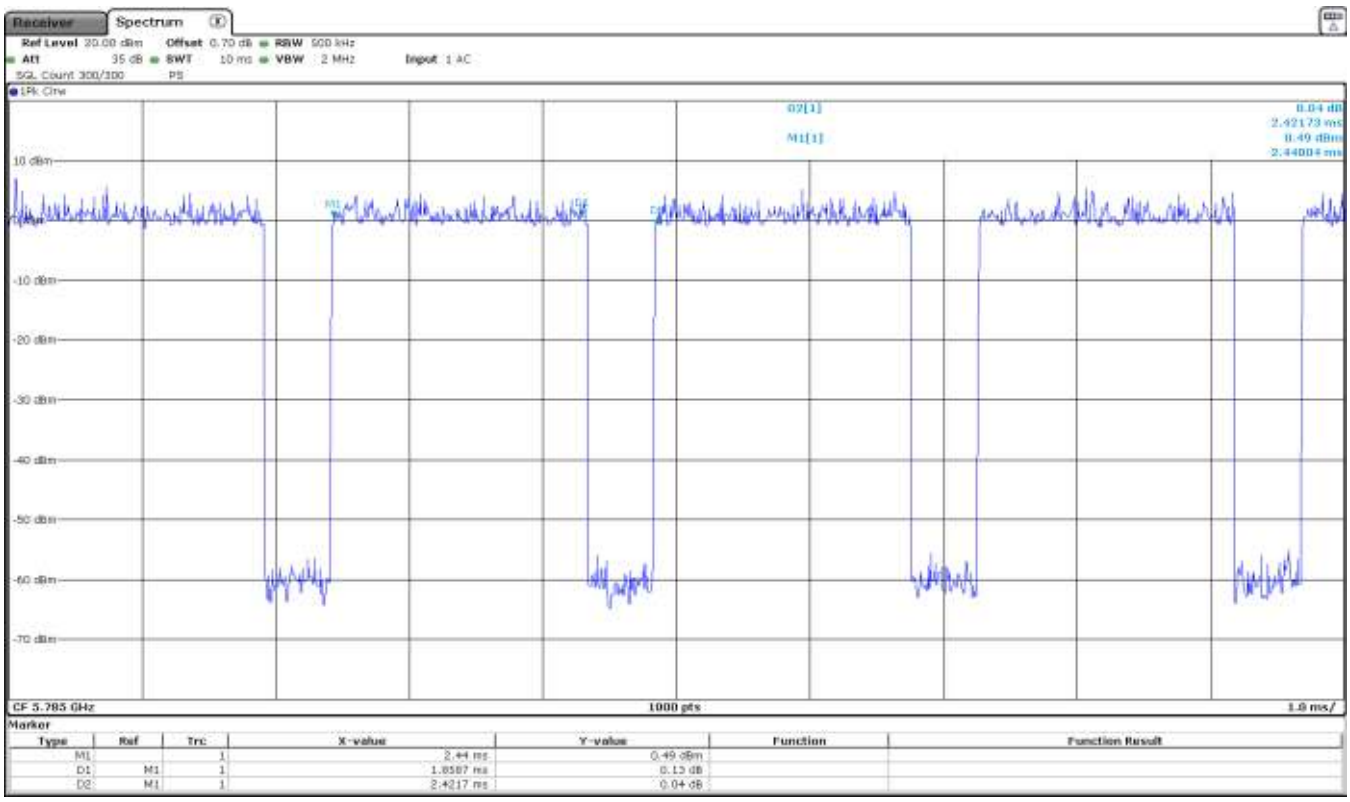
Mode 802.11 ac80 (U-NII-1)**:**



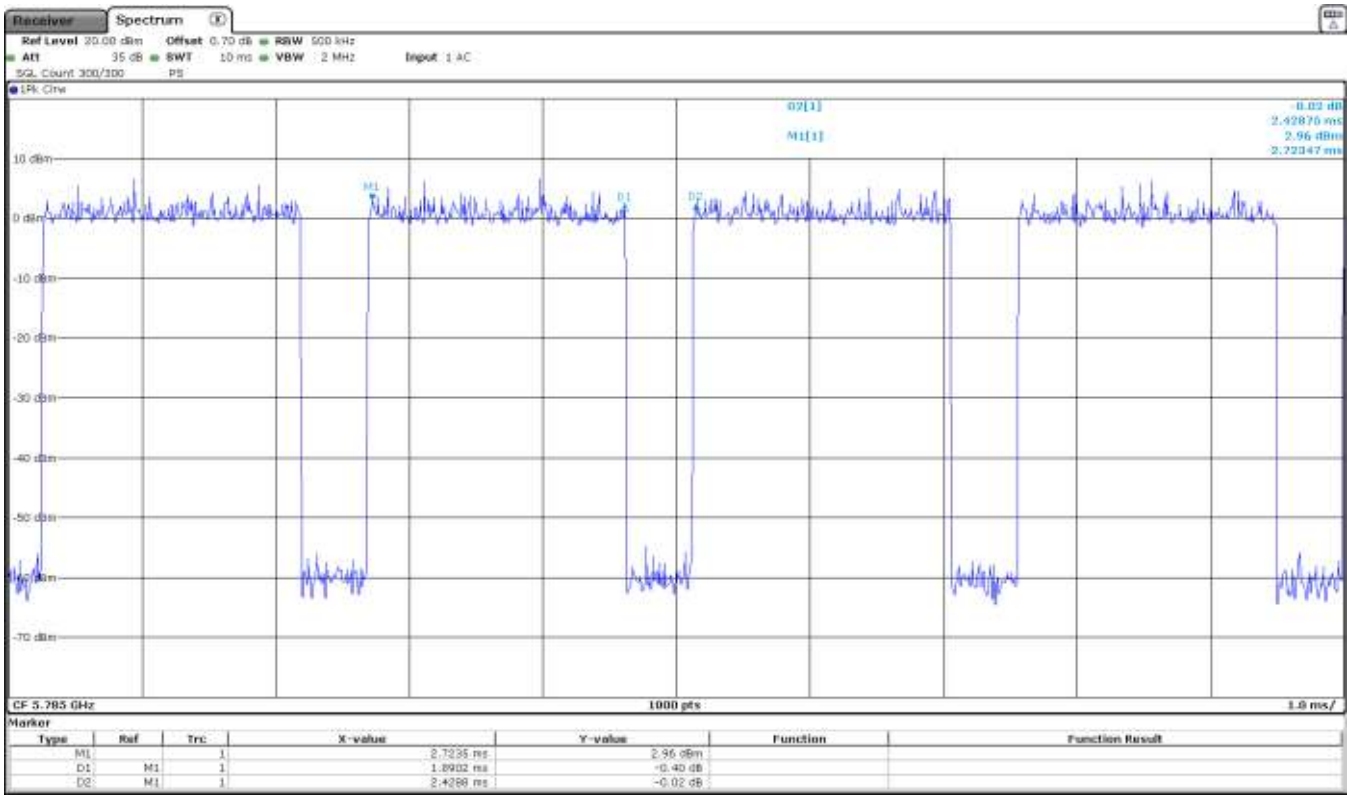
Mode 802.11 a20 (U-NII-3)**:**



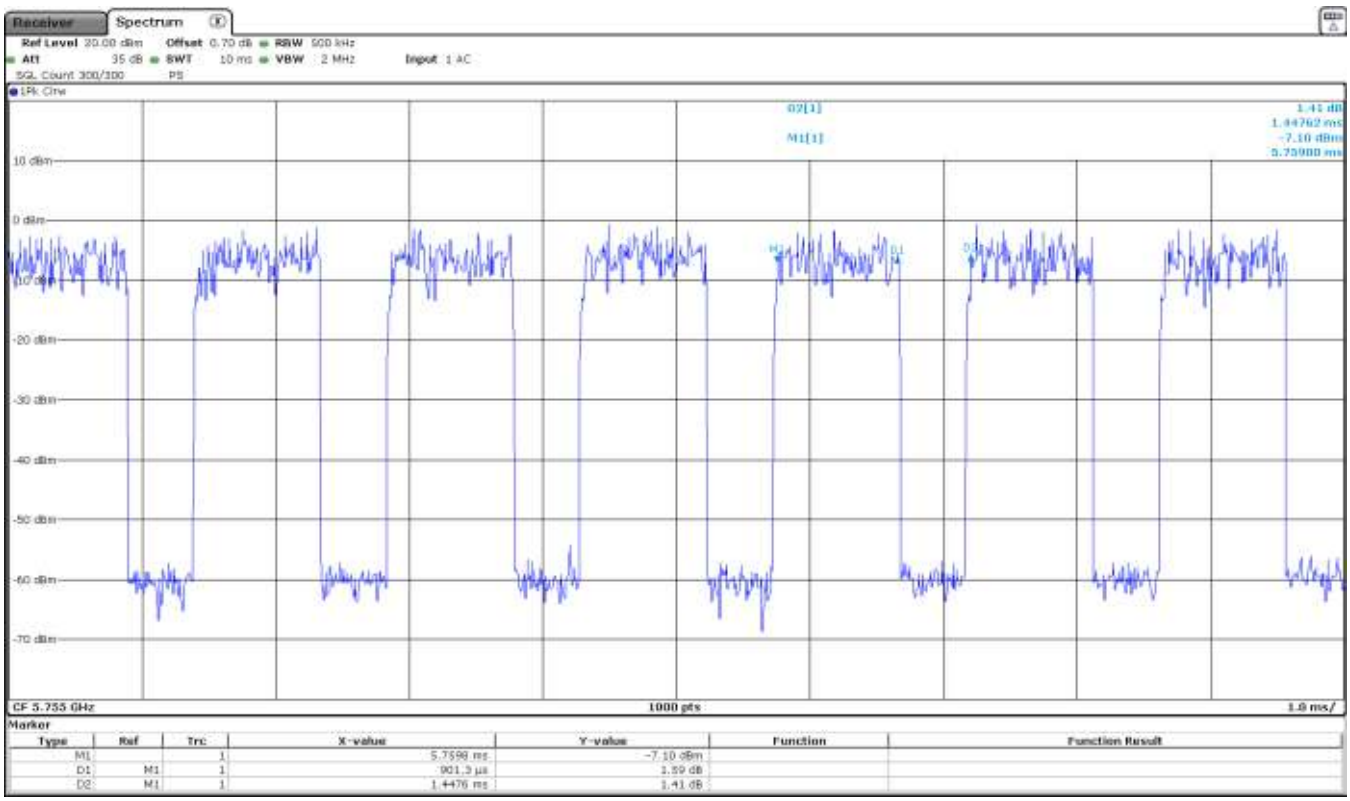
Mode 802.11 n20 (U-NII-3)**:**



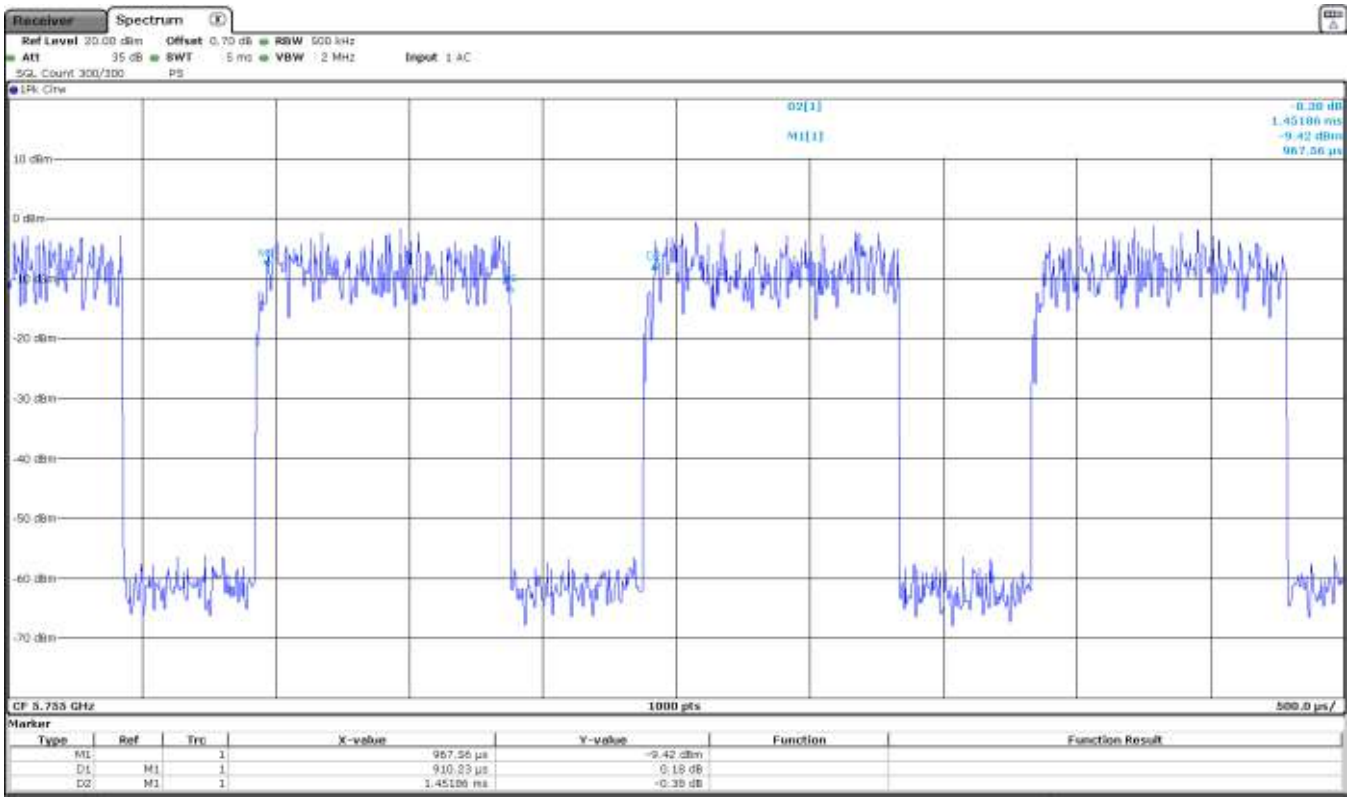
Mode 802.11 ac20 (U-NII-3)**:**



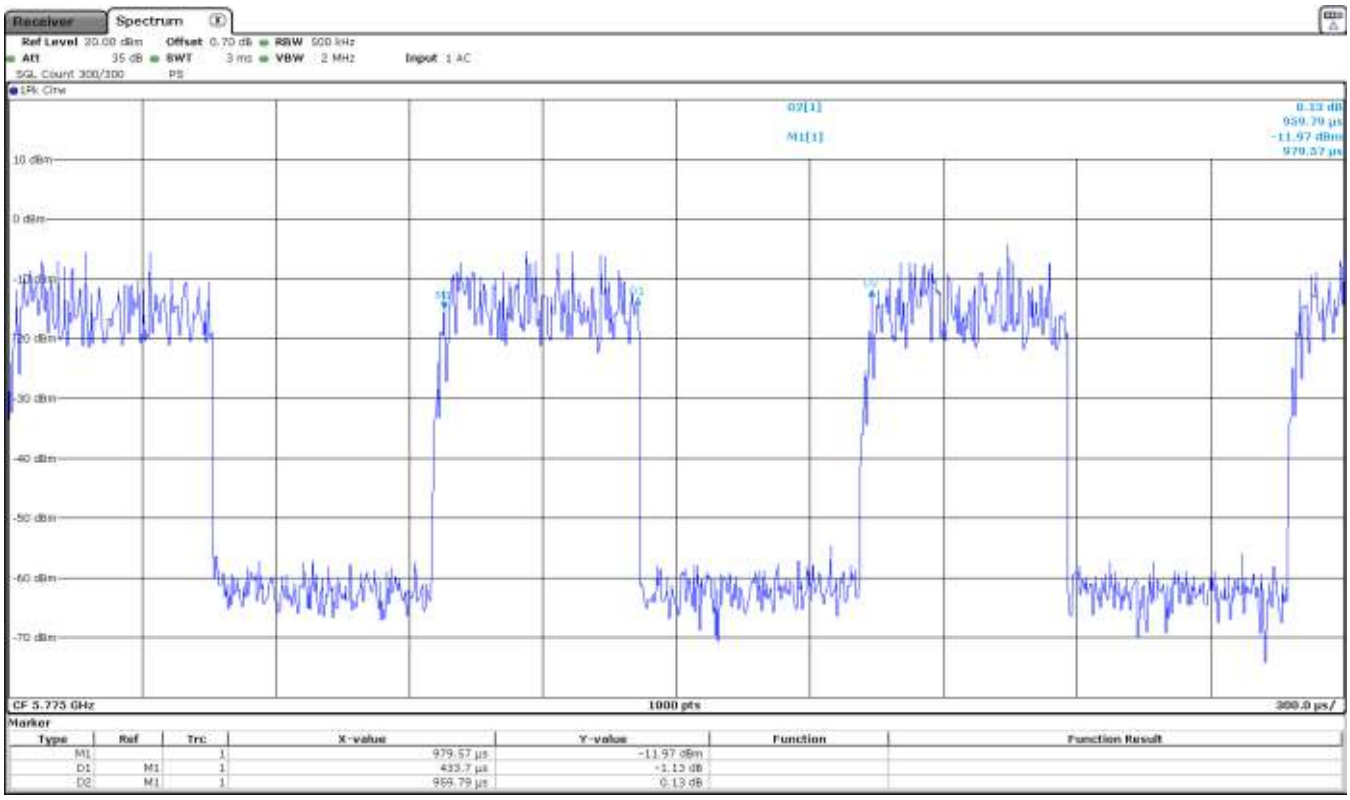
Mode 802.11 n40 (U-NII-3)**:**



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)	16.983	16.983	17.023
Measurement uncertainty (kHz)	<±40.04		

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)	17.440	17.400	17.400
Measurement uncertainty (kHz)	<±23.02		

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)	18.102	18.182	18.222
Measurement uncertainty (kHz)	<±40.04		

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)	18.600	18.640	18.640
Measurement uncertainty (kHz)	<±23.02		

Mode 802.11 ac20 (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)	18.142	18.222	18.222
Measurement uncertainty (kHz)	<±40.04		

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)	18.680	18.680	18.680
Measurement uncertainty (kHz)	<±23.02		

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)	36.288	36.288
Measurement uncertainty (kHz)	<±70.07	

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
99% Occupied Bandwidth (MHz)	37.200	37.600
Measurement uncertainty (kHz)	<±55.05	

Mode 802.11 ac40 (HT40):

U-NII-1 (5150-5250 MHz)

Channels	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
99% Occupied Bandwidth (MHz)	36.204	36.284
Measurement uncertainty (kHz)	<±70.07	

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
99% Occupied Bandwidth (MHz)	36.960	37.680
Measurement uncertainty (kHz)	<±55.05	

Mode 802.11 ac80 (VHT80):

U-NII-1 (5150-5250 MHz)

Channel	Single Channel 42 (5210 MHz)
99% Occupied Bandwidth (MHz)	75.644
Measurement uncertainty (kHz)	<±110.11

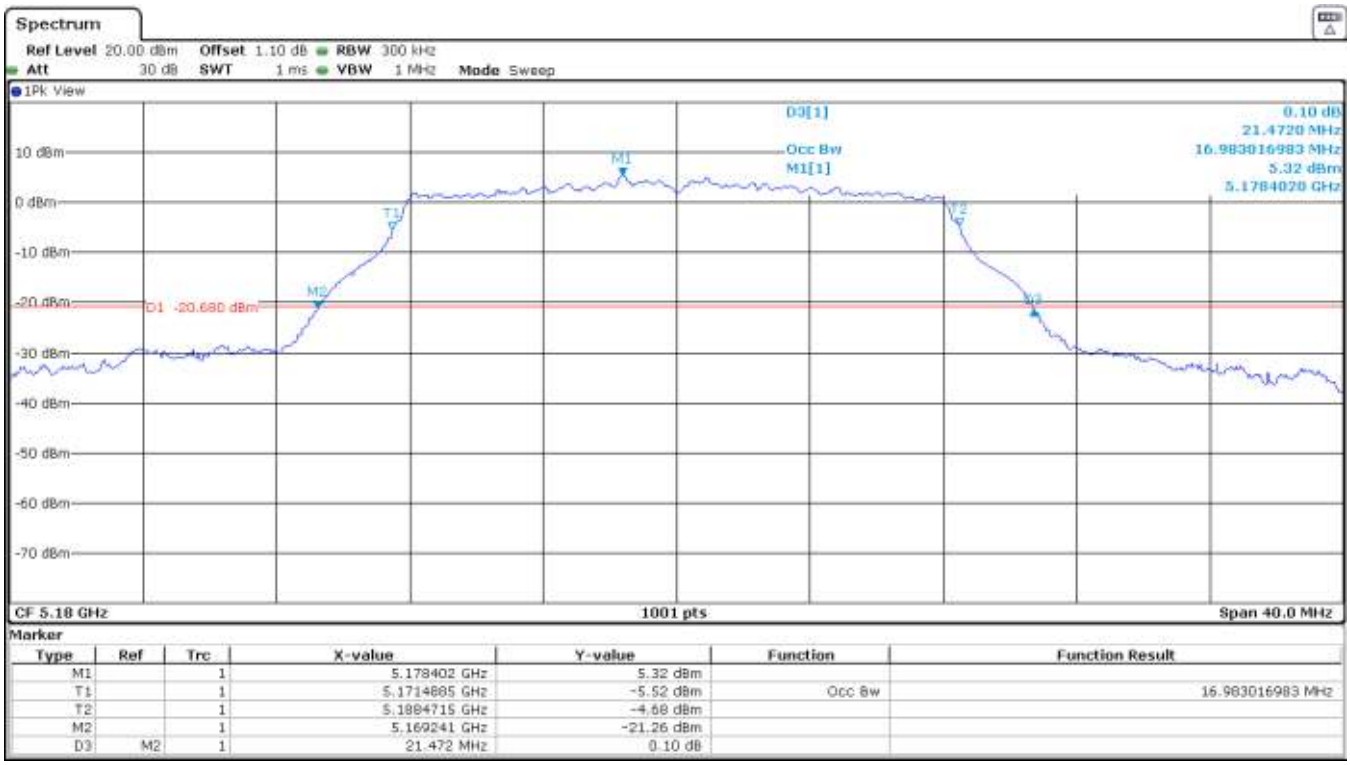
U-NII-3 (5725-5850 MHz)

Channels	Single Channel 155 (5775 MHz)
99% Occupied Bandwidth (MHz)	76.320
Measurement uncertainty (kHz)	<±103.05

Mode 802.11 a20:

U-NII-1 (5150-5250 MHz)

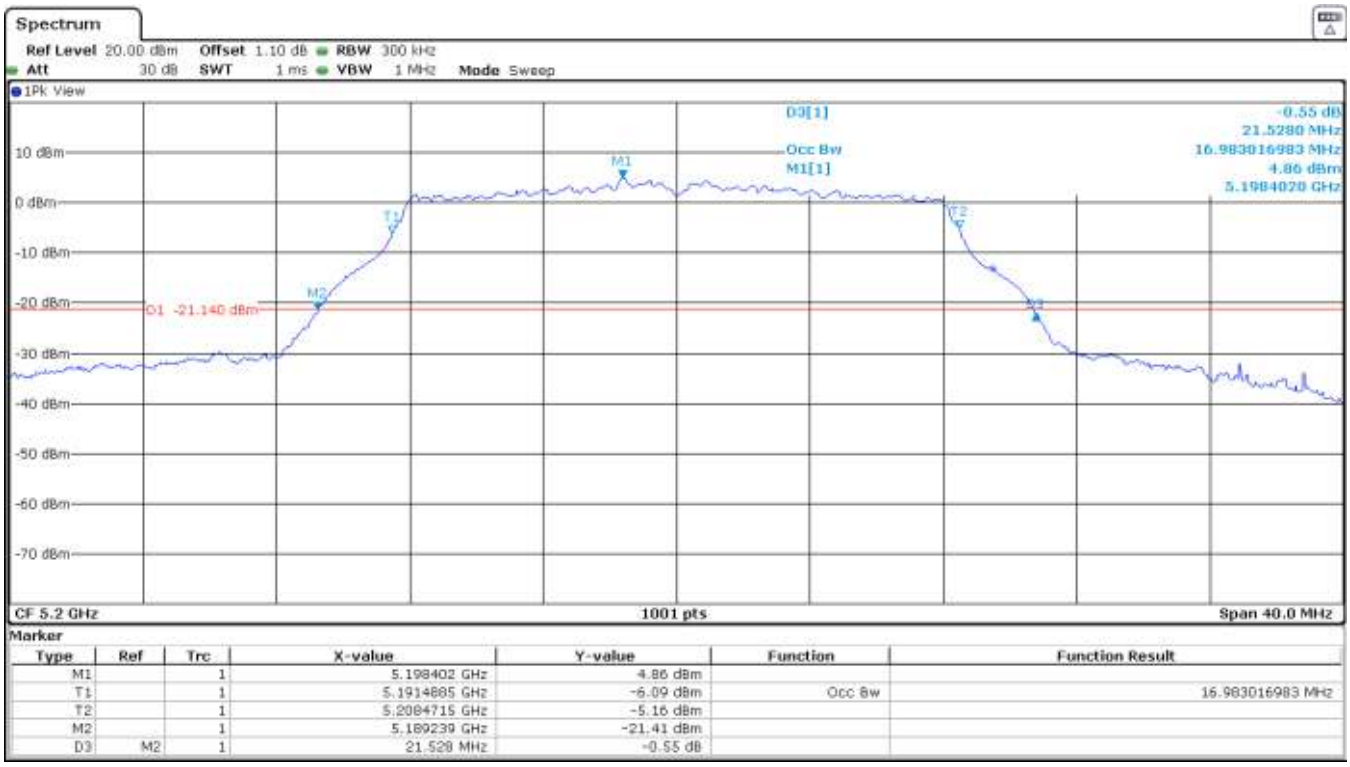
- Low Channel 36 (5180 MHz):



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	5.178402 GHz	5.32 dBm		
T1		1	5.1714685 GHz	-5.52 dBm	Occ Bw	16.983016983 MHz
T2		1	5.1884715 GHz	-4.68 dBm		
M2		1	5.169241 GHz	-21.26 dBm		
D3	M2	1	21.472 MHz	0.10 dB		

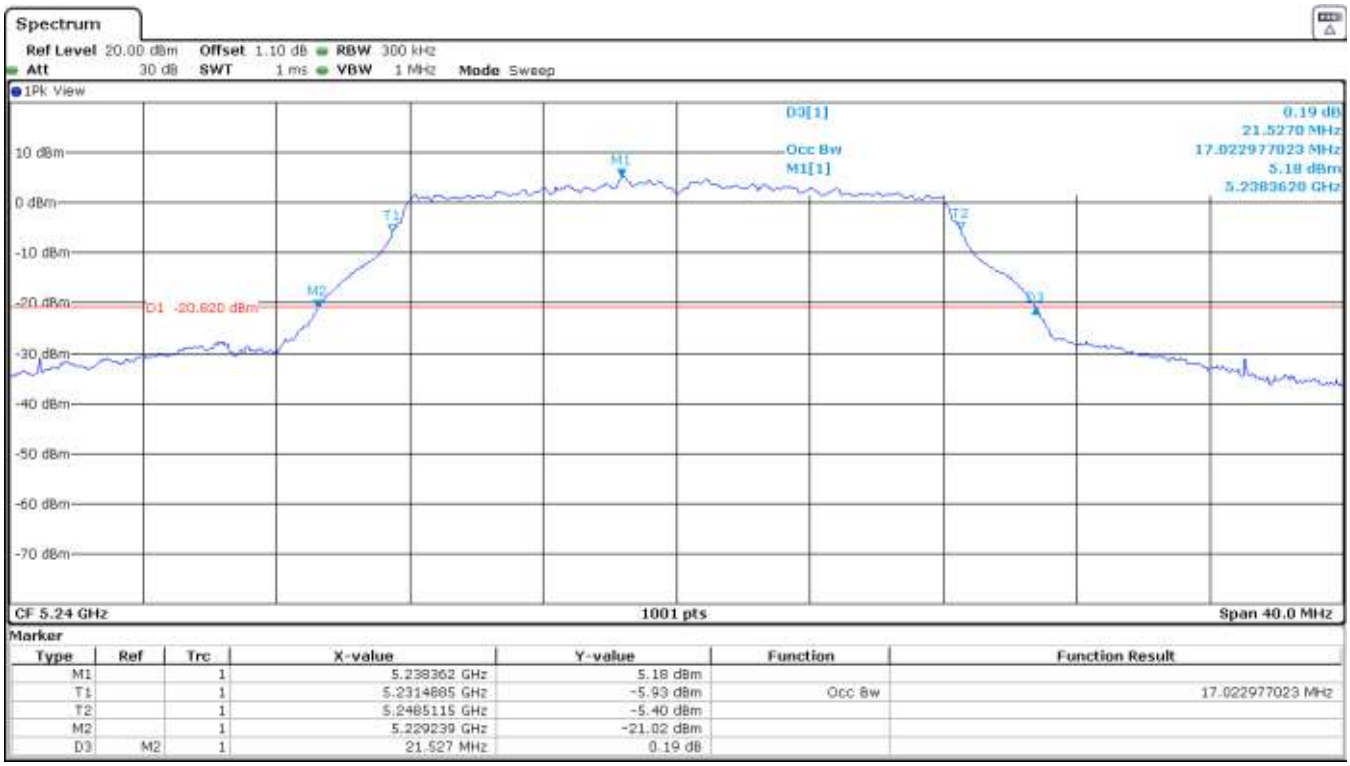
- Middle Channel 40 (5200 MHz):



Marker

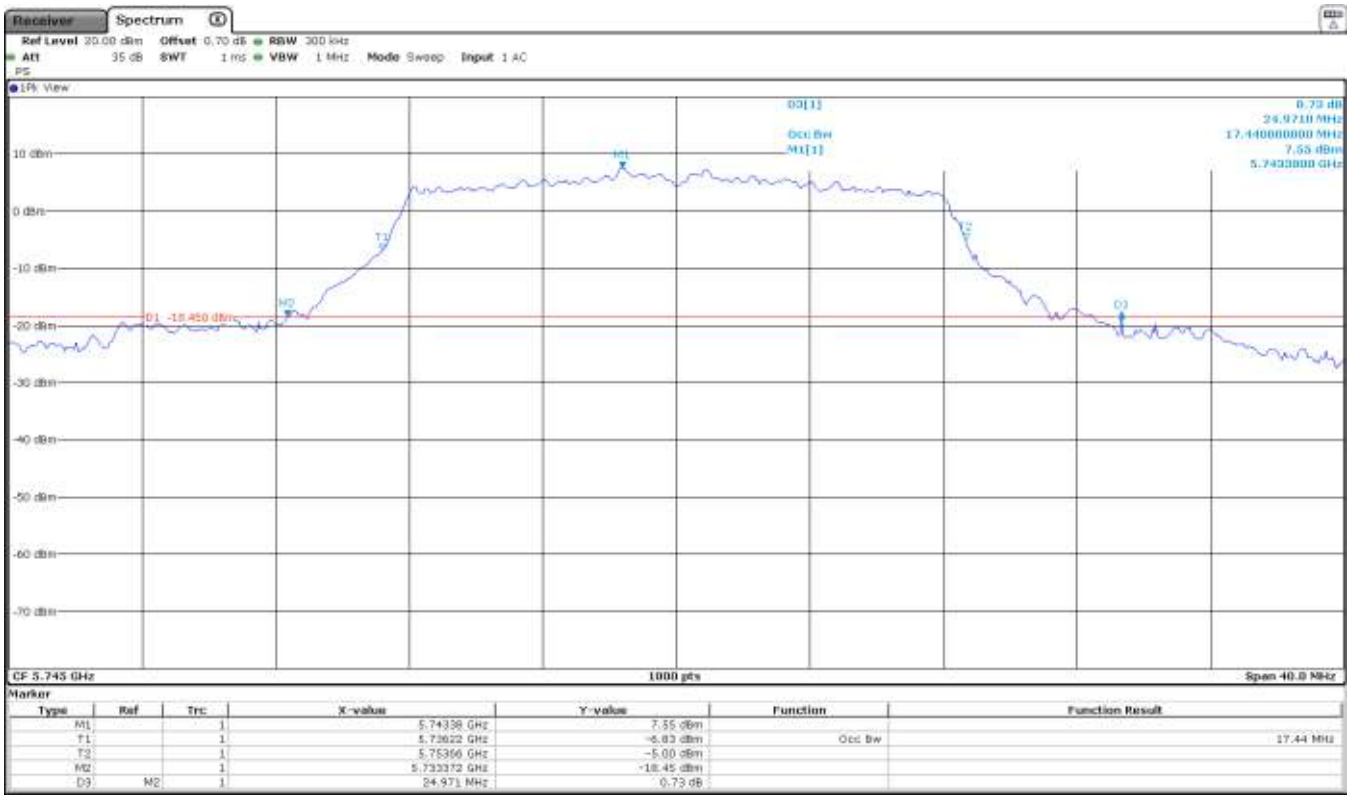
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	5.198402 GHz	4.86 dBm		
T1		1	5.1914685 GHz	-6.09 dBm	Occ Bw	16.983016983 MHz
T2		1	5.2084715 GHz	-5.16 dBm		
M2		1	5.189239 GHz	-21.41 dBm		
D3	M2	1	21.528 MHz	-0.55 dB		

- High Channel 48 (5240 MHz):

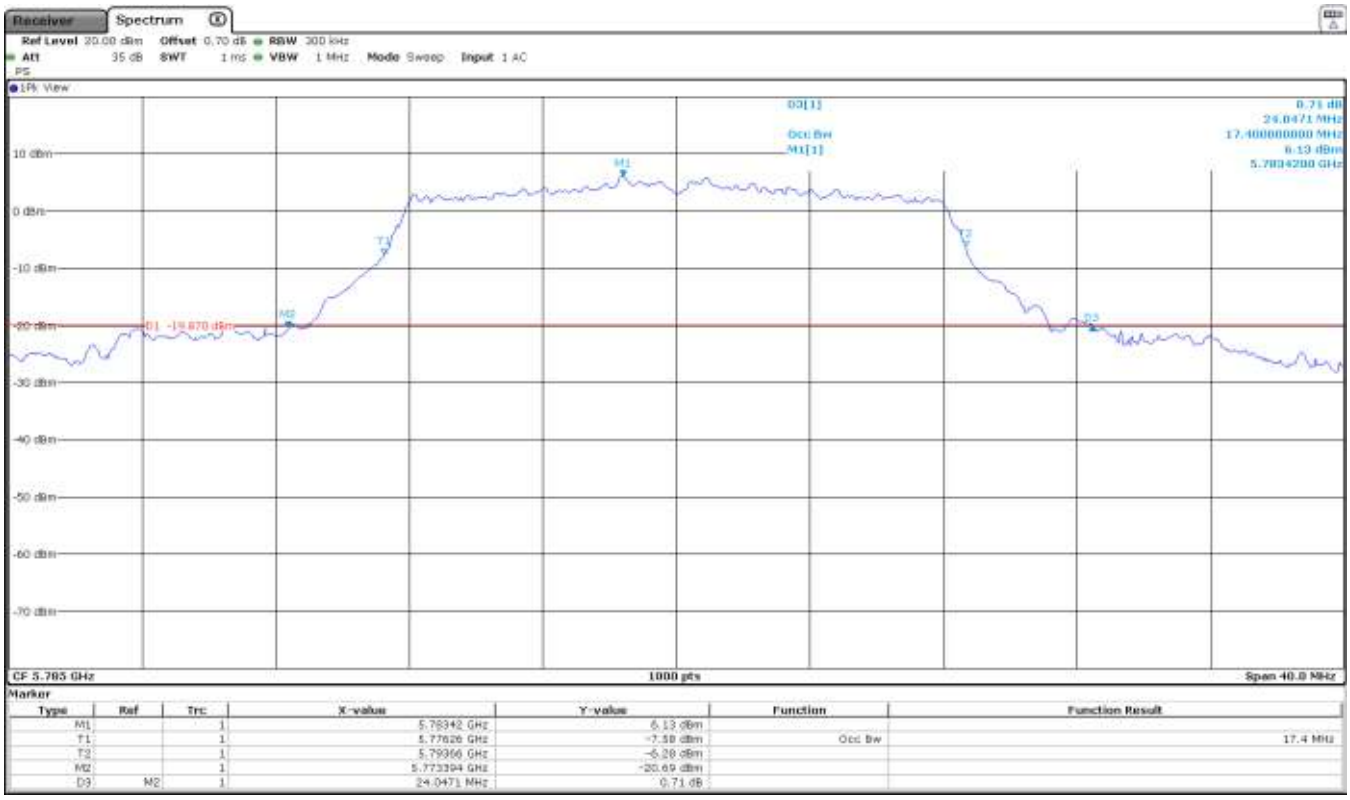


U-NII-3 (5725-5850 MHz)

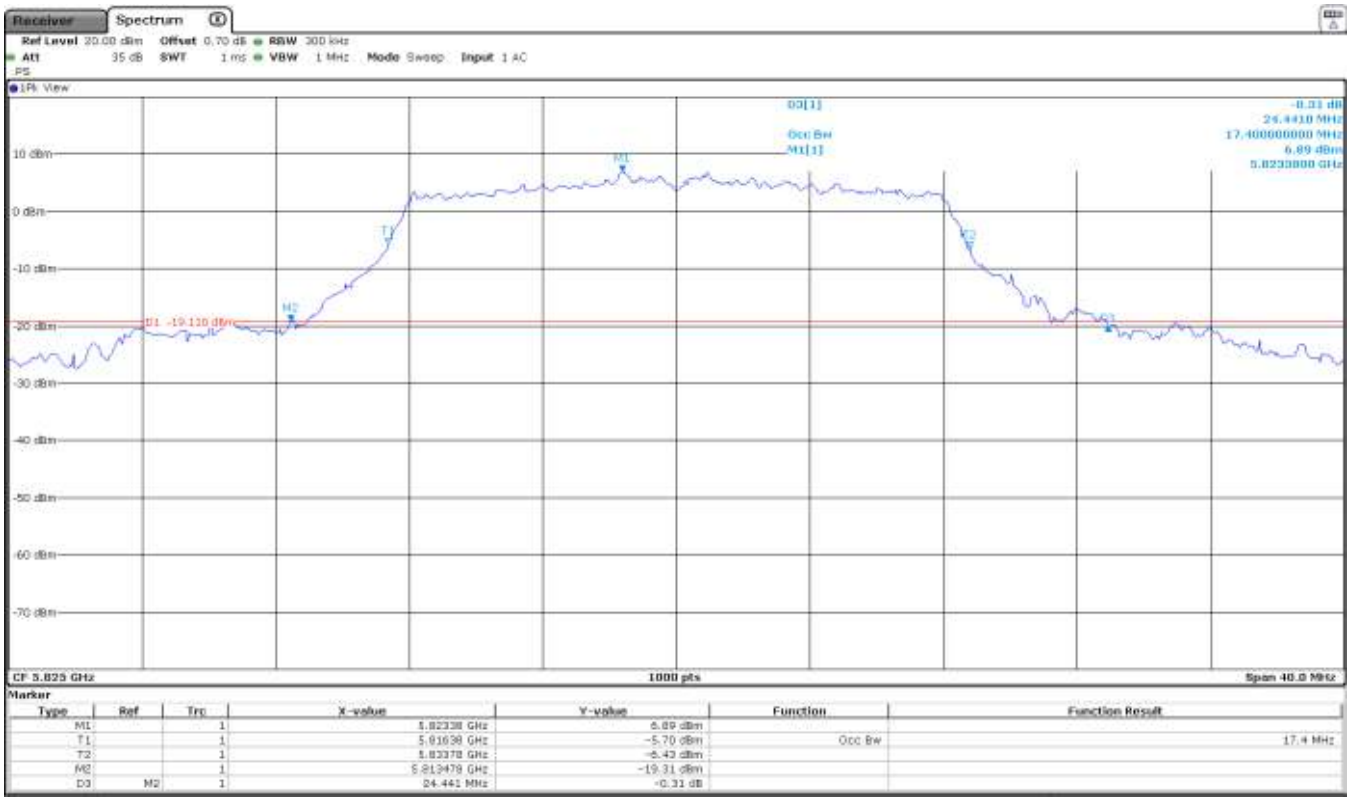
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



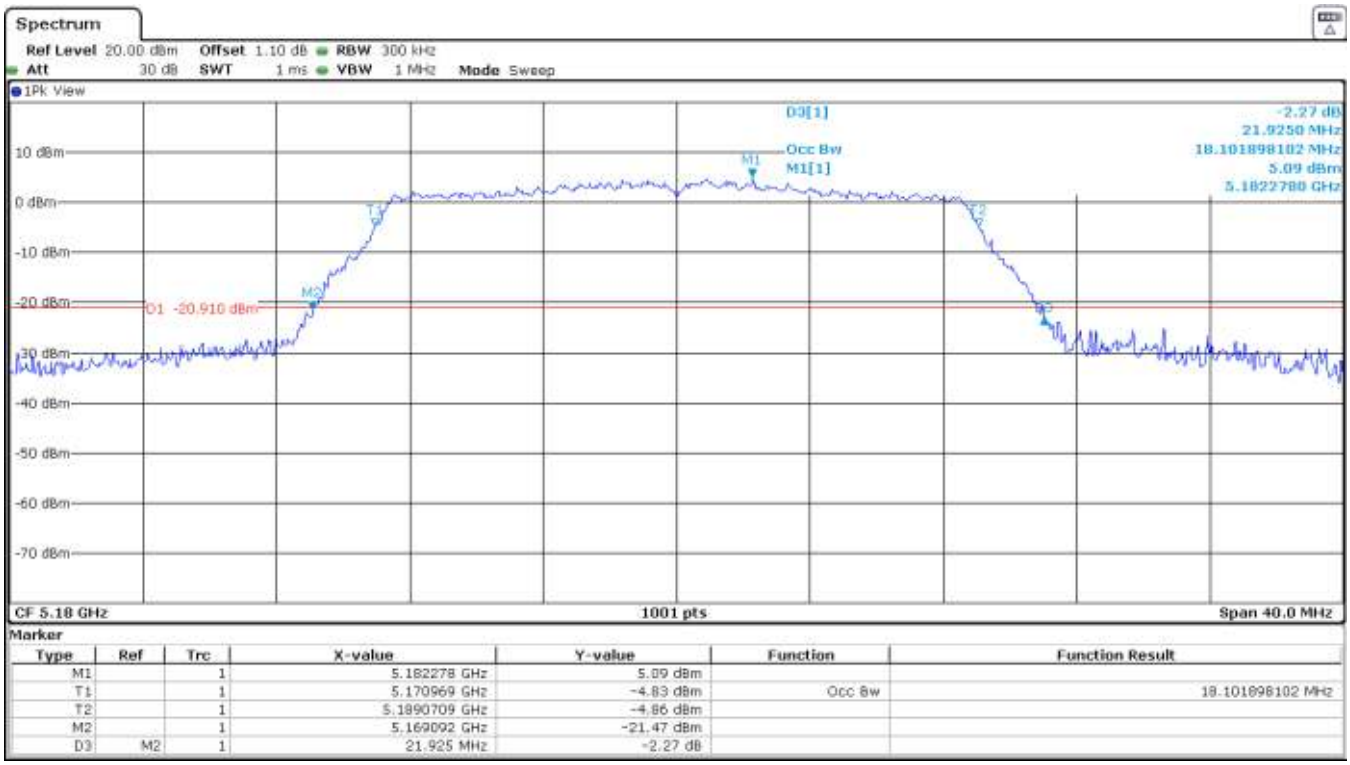
- High Channel 165 (5825 MHz):



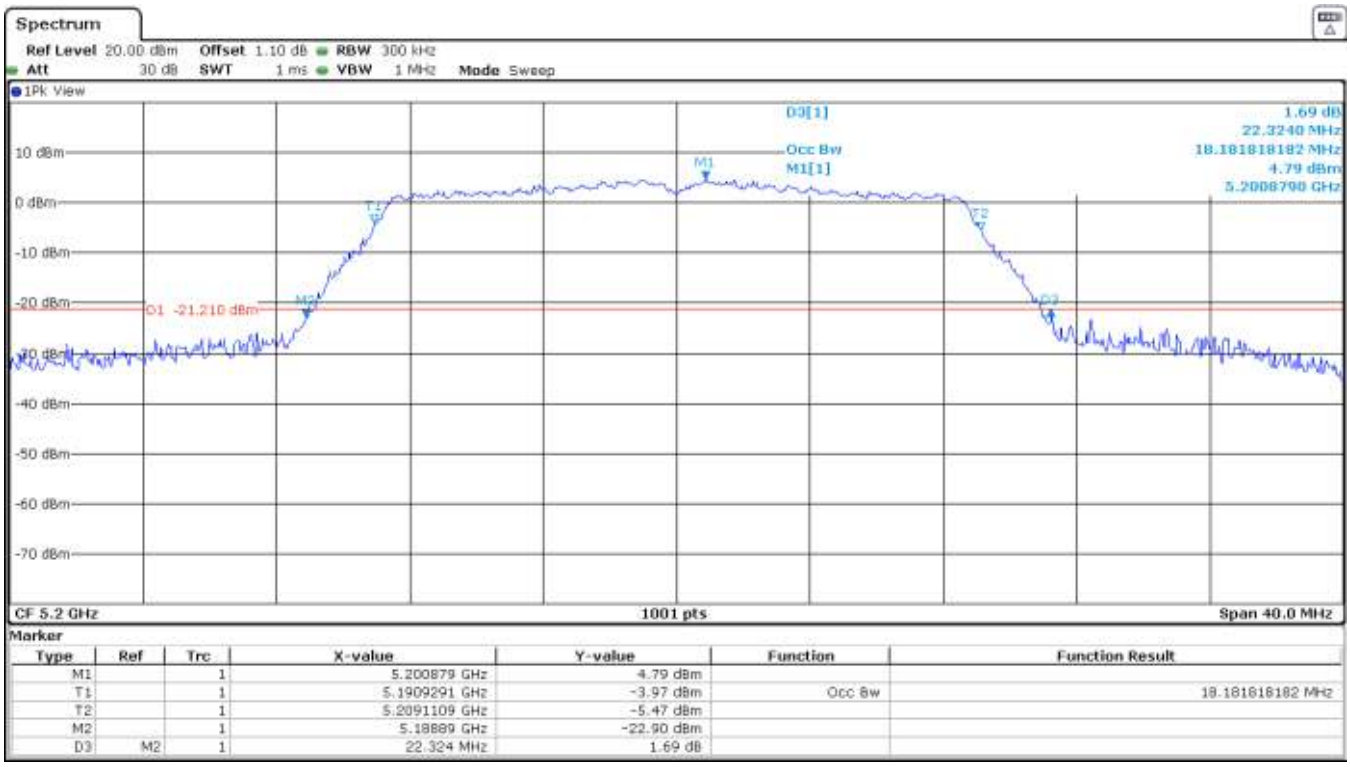
Mode 802.11 n20 HT20:

U-NII-1 (5150-5250 MHz)

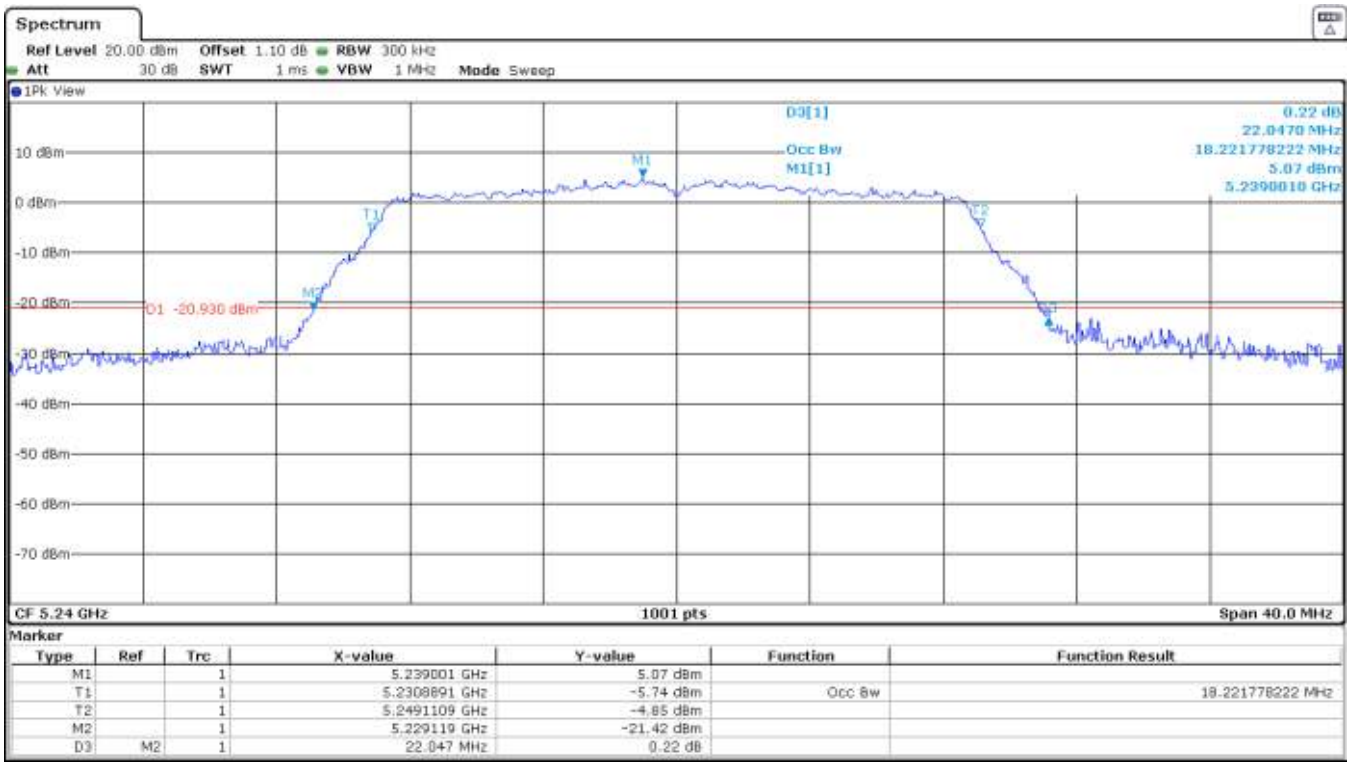
- Low Channel 36 (5180 MHz):



- Middle Channel 40 (5200 MHz):

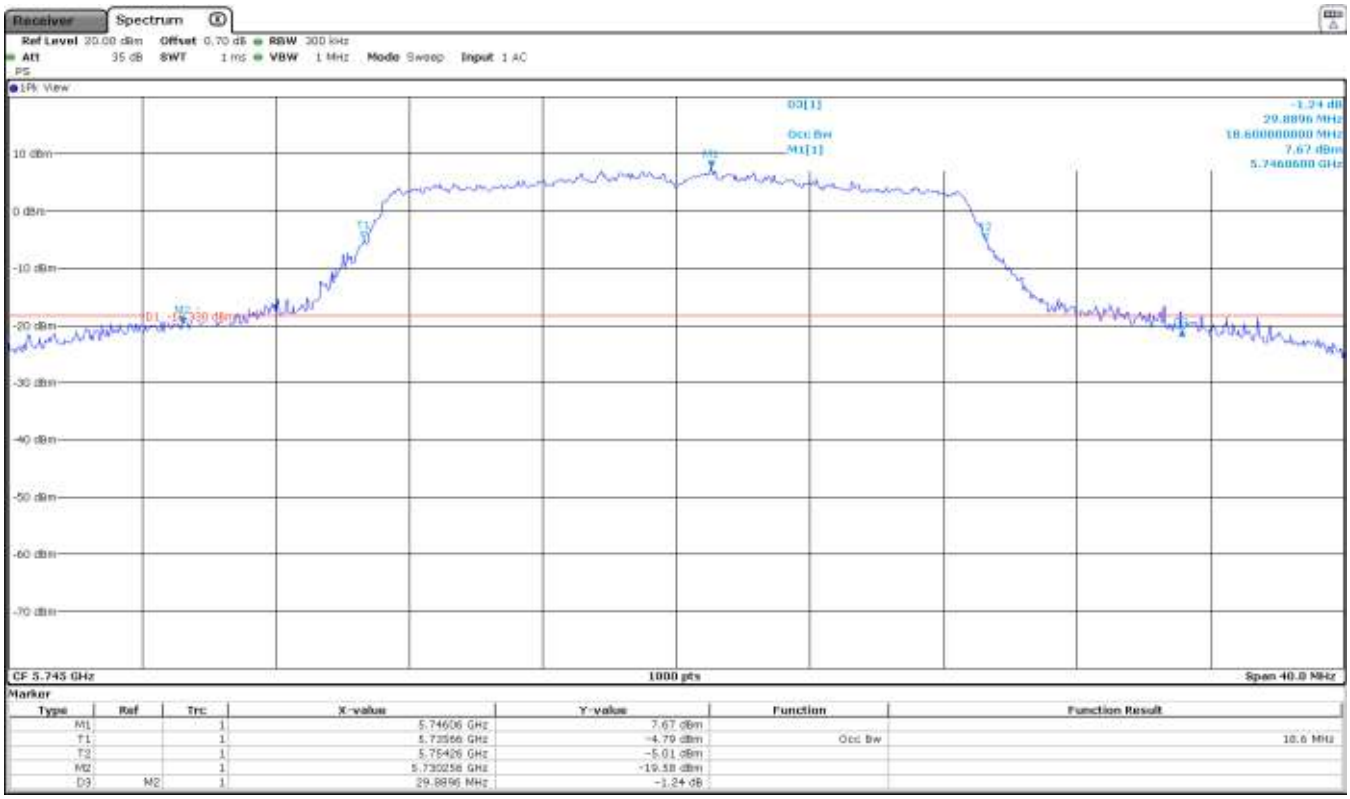


- High Channel 48 (5240 MHz):

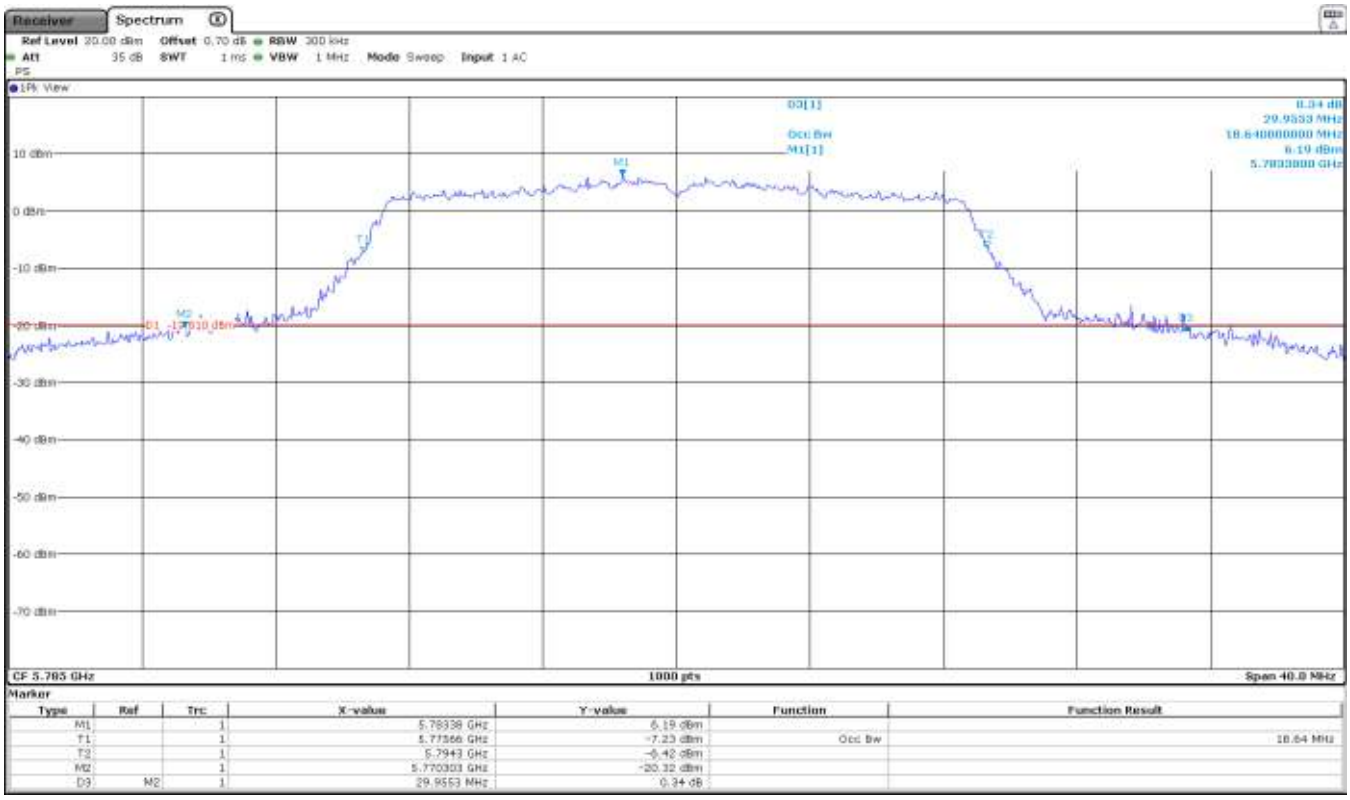


U-NII-3 (5725-5850 MHz)

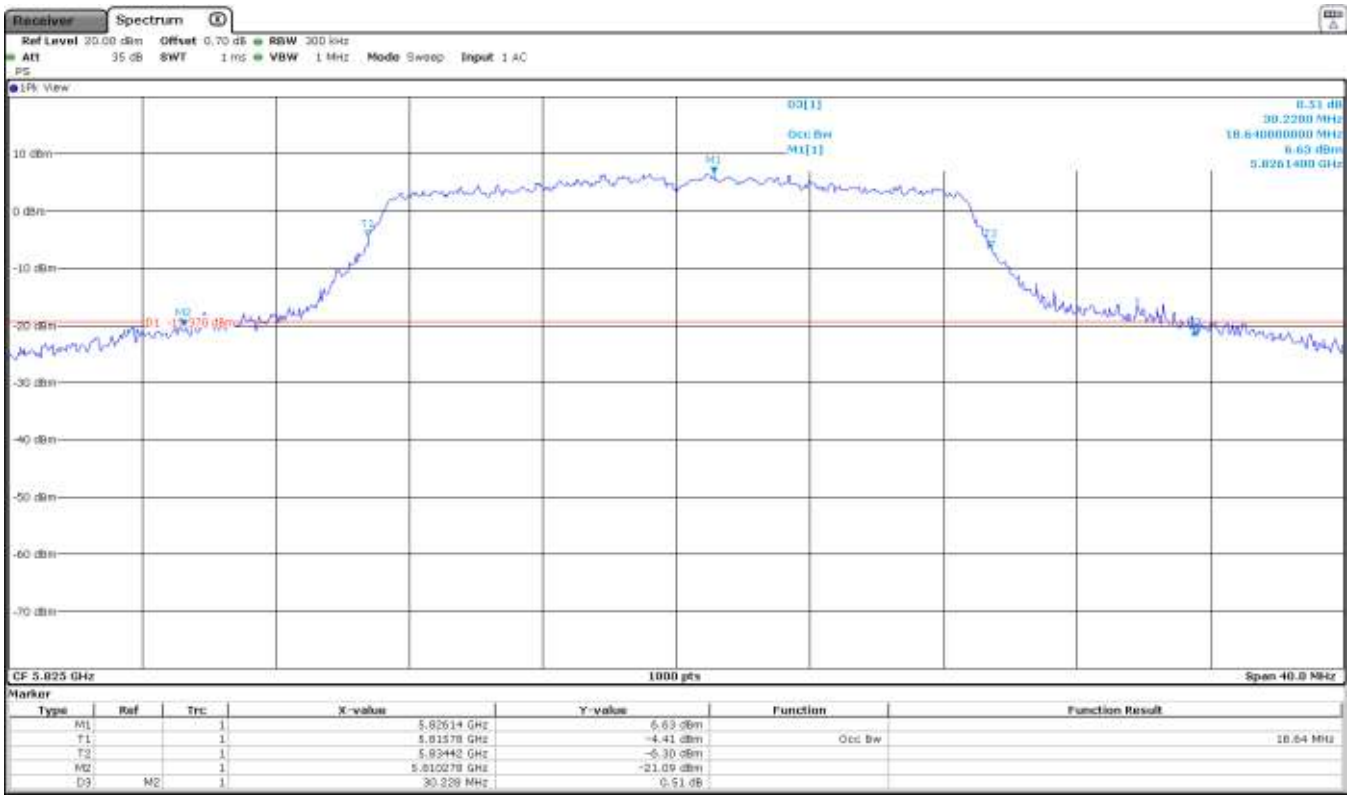
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



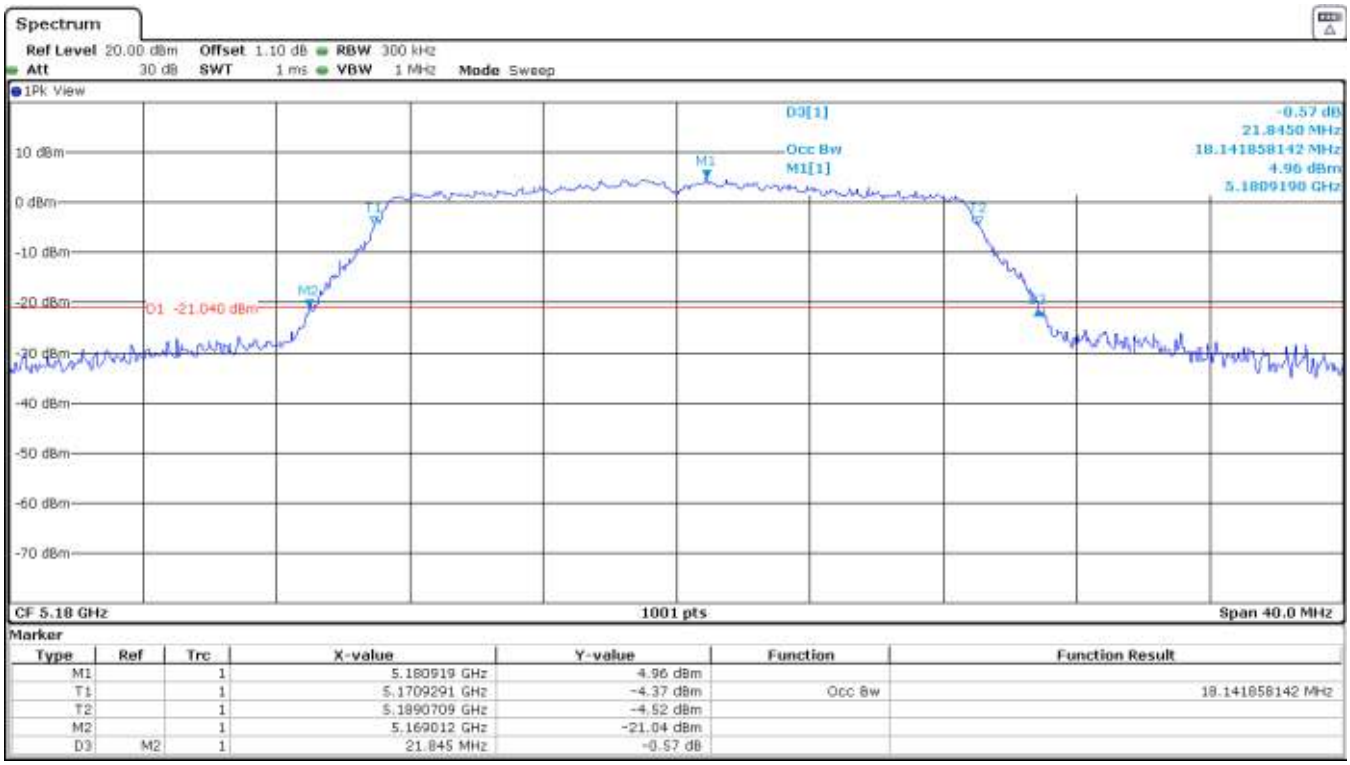
- High Channel 165 (5825 MHz):



Mode 802.11 ac20 HT20:

U-NII-1 (5150-5250 MHz)

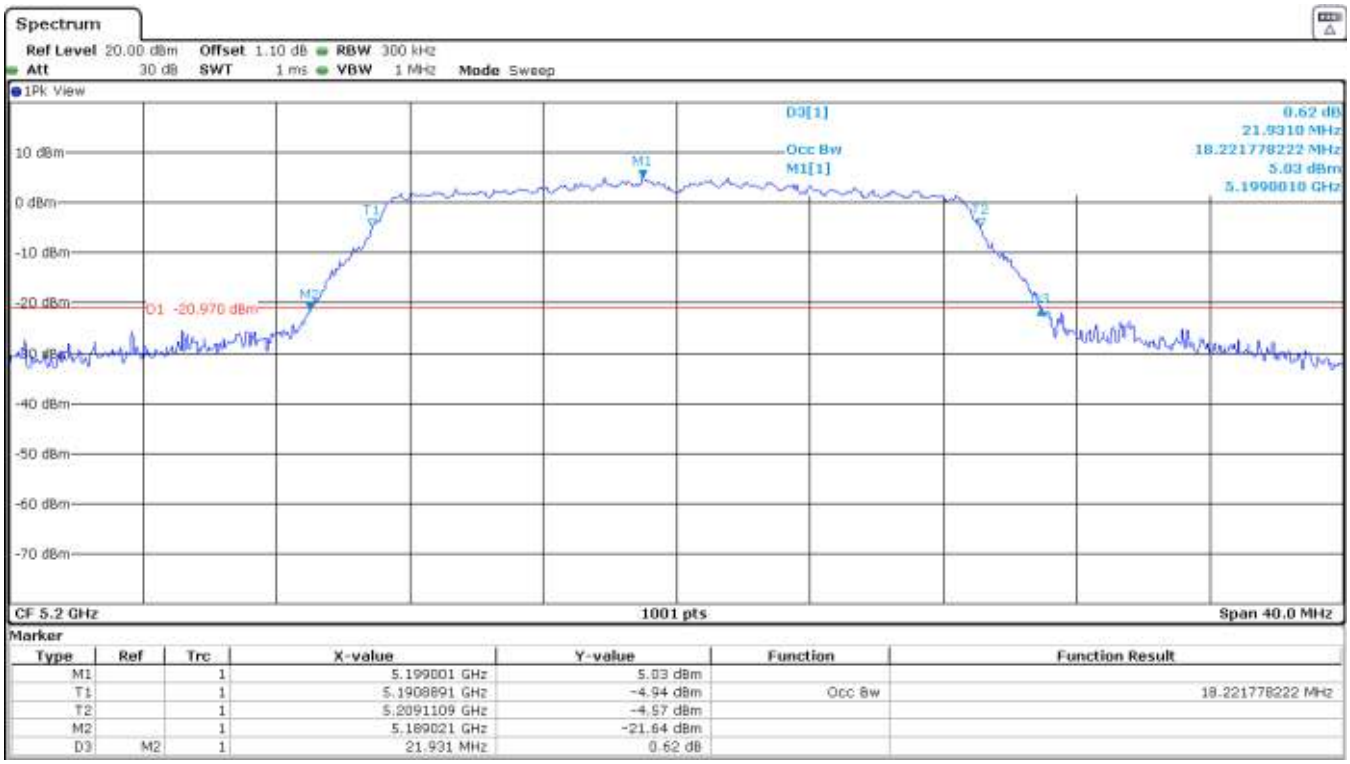
- Low Channel 36 (5180 MHz):



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	5.180919 GHz	4.96 dBm		
T1		1	5.1709291 GHz	-4.37 dBm	Occ Bw	18.141858142 MHz
T2		1	5.1890709 GHz	-4.52 dBm		
M2		1	5.169012 GHz	-21.04 dBm		
D3	M2	1	21.845 MHz	-0.57 dB		

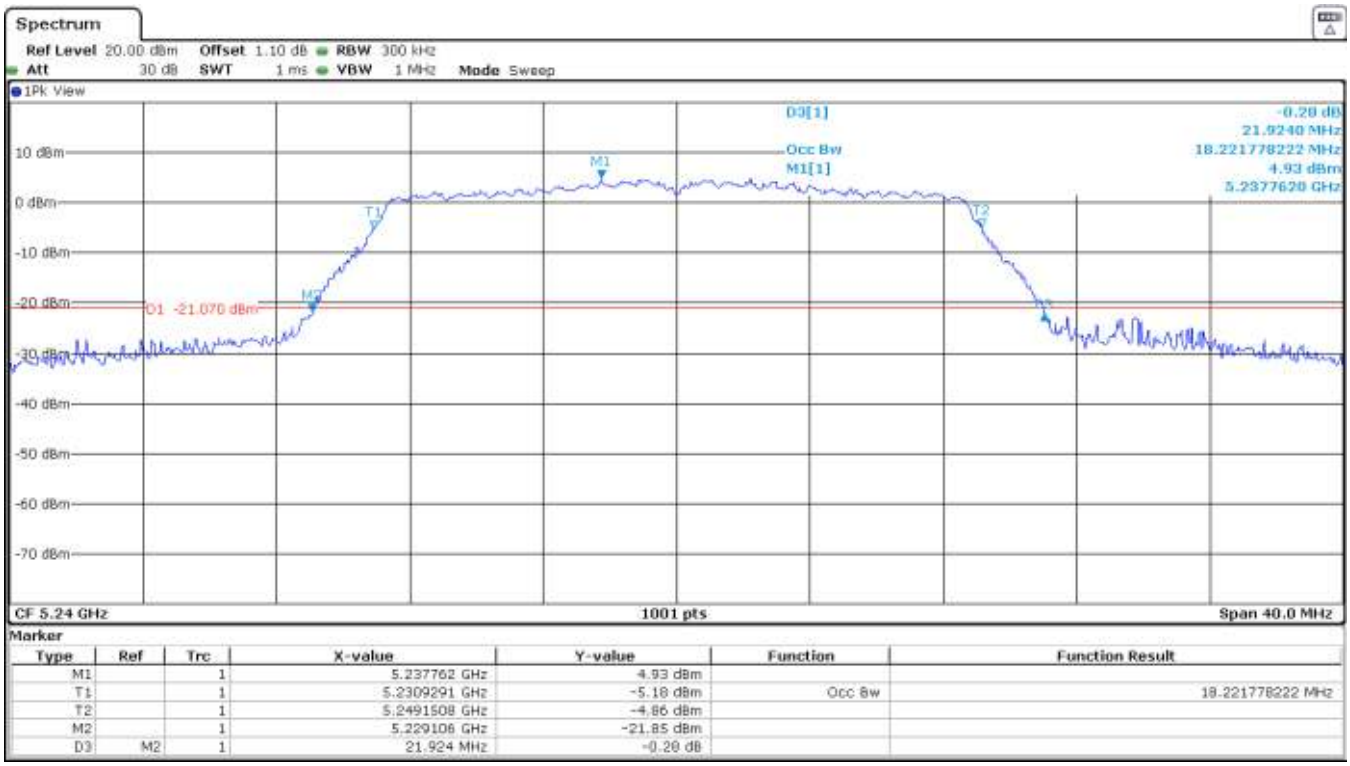
- Middle Channel 40 (5200 MHz):



Marker

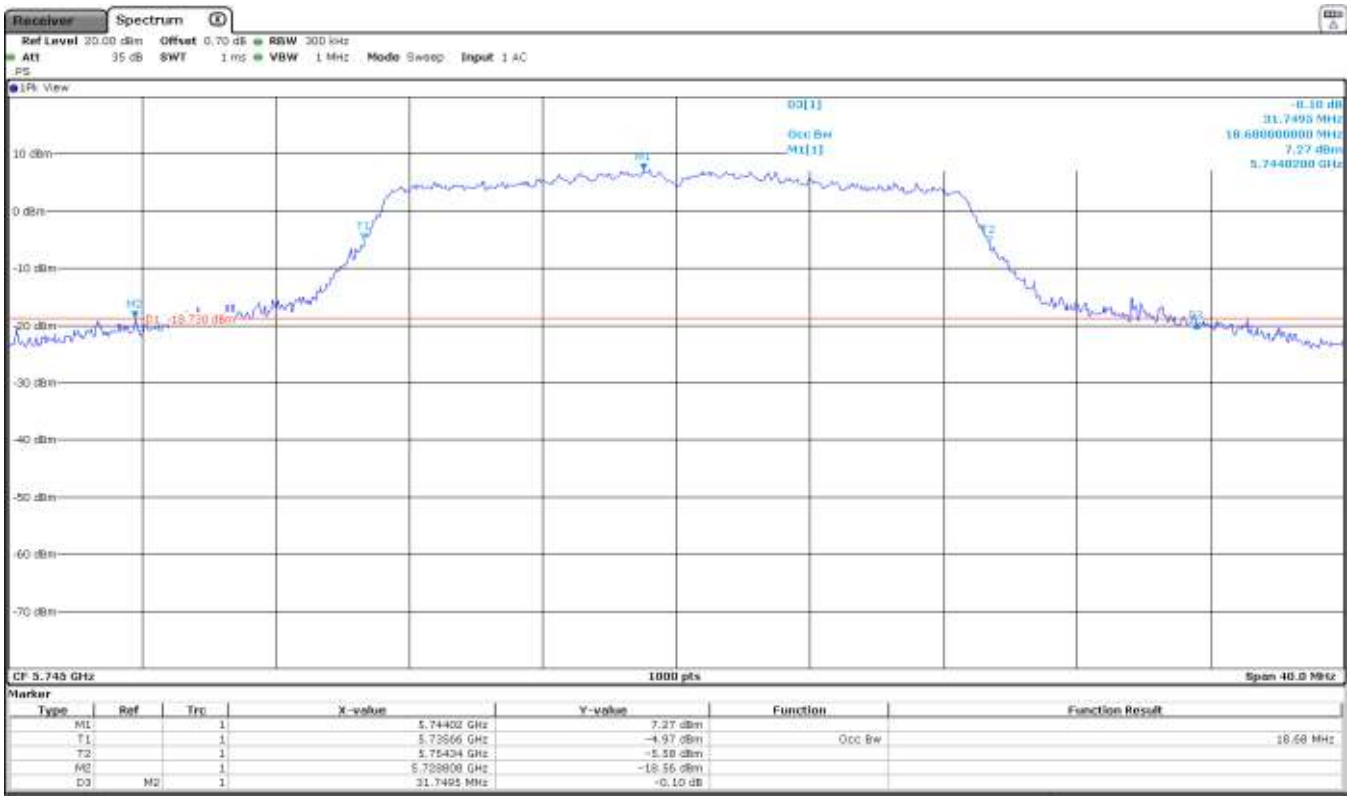
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	5.199001 GHz	5.03 dBm		
T1		1	5.1908891 GHz	-4.94 dBm	Occ Bw	18.221778222 MHz
T2		1	5.2091109 GHz	-4.97 dBm		
M2		1	5.189021 GHz	-21.64 dBm		
D3	M2	1	21.931 MHz	0.62 dB		

- High Channel 48 (5240 MHz):

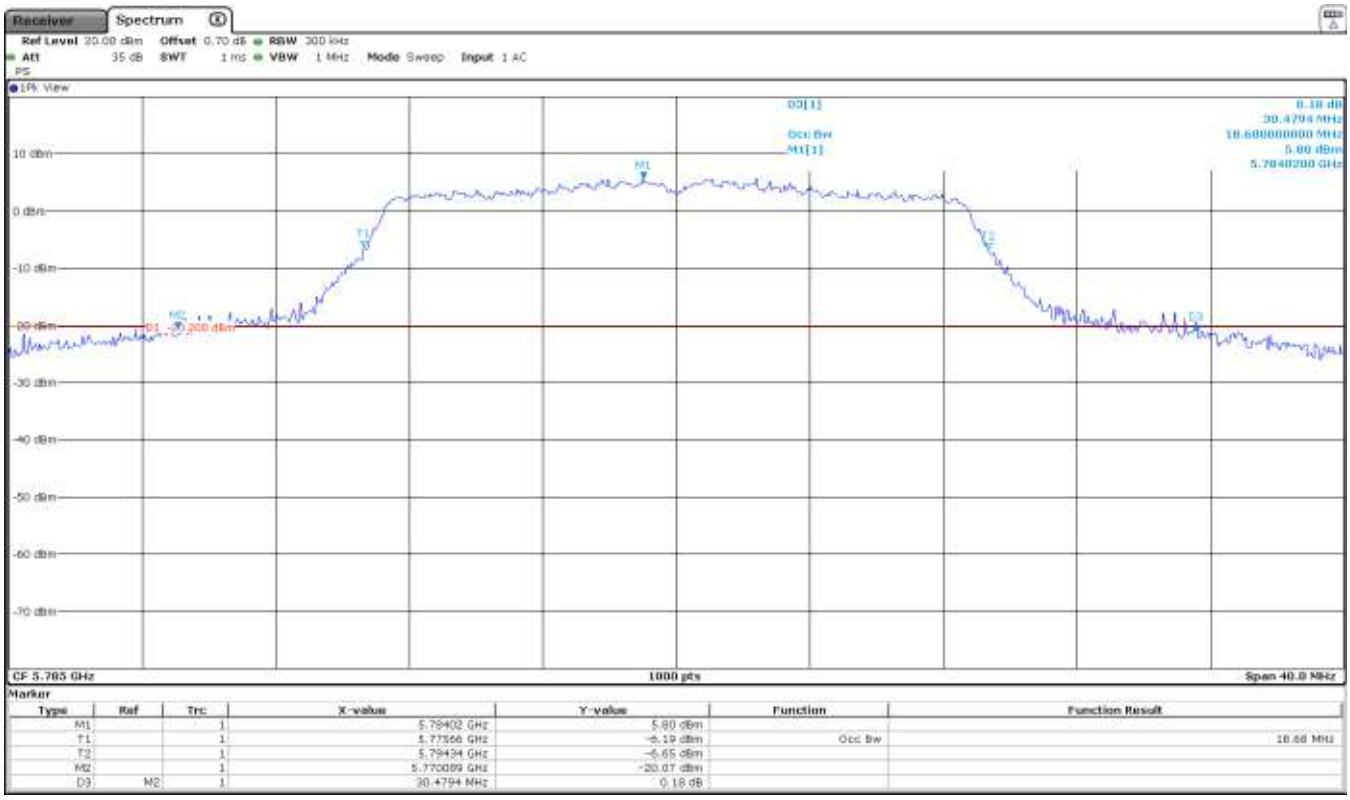


U-NII-3 (5725-5850 MHz)

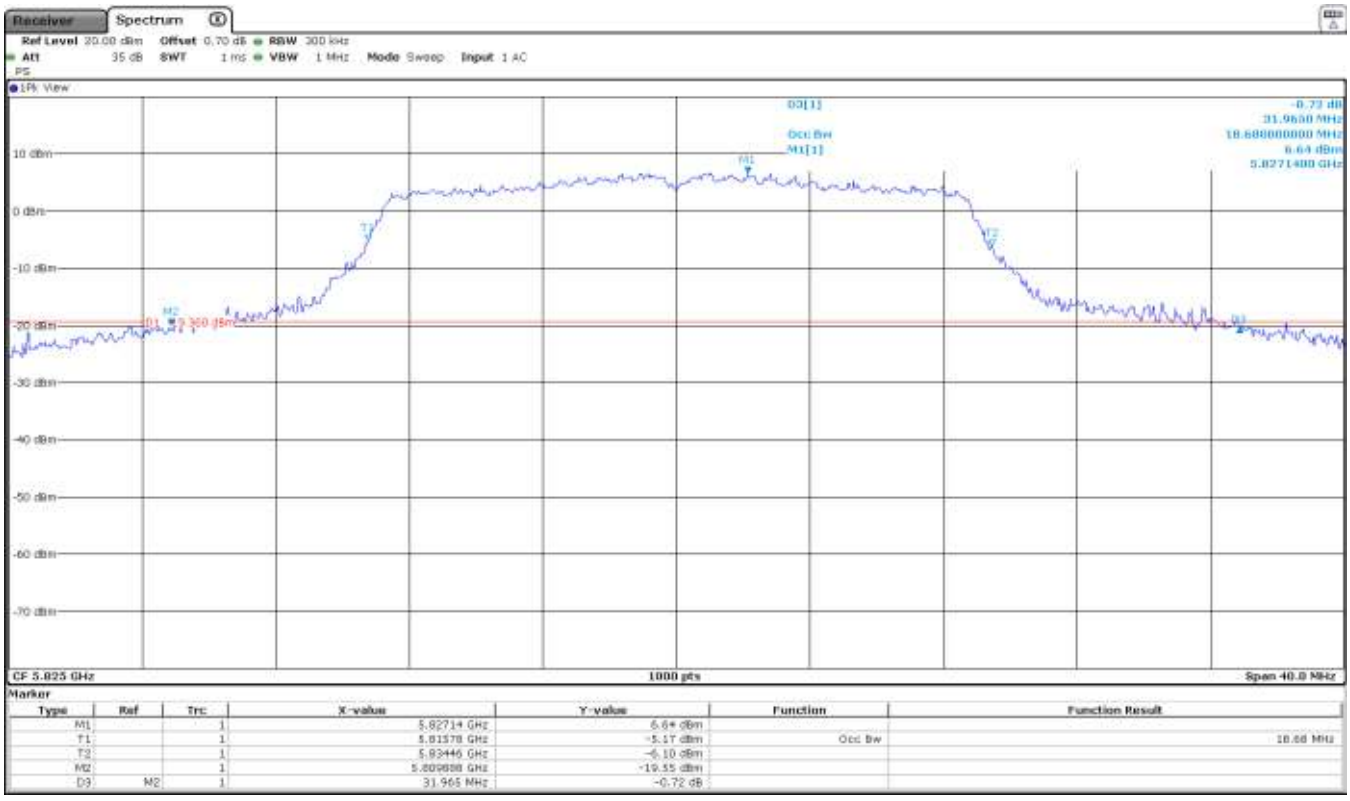
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



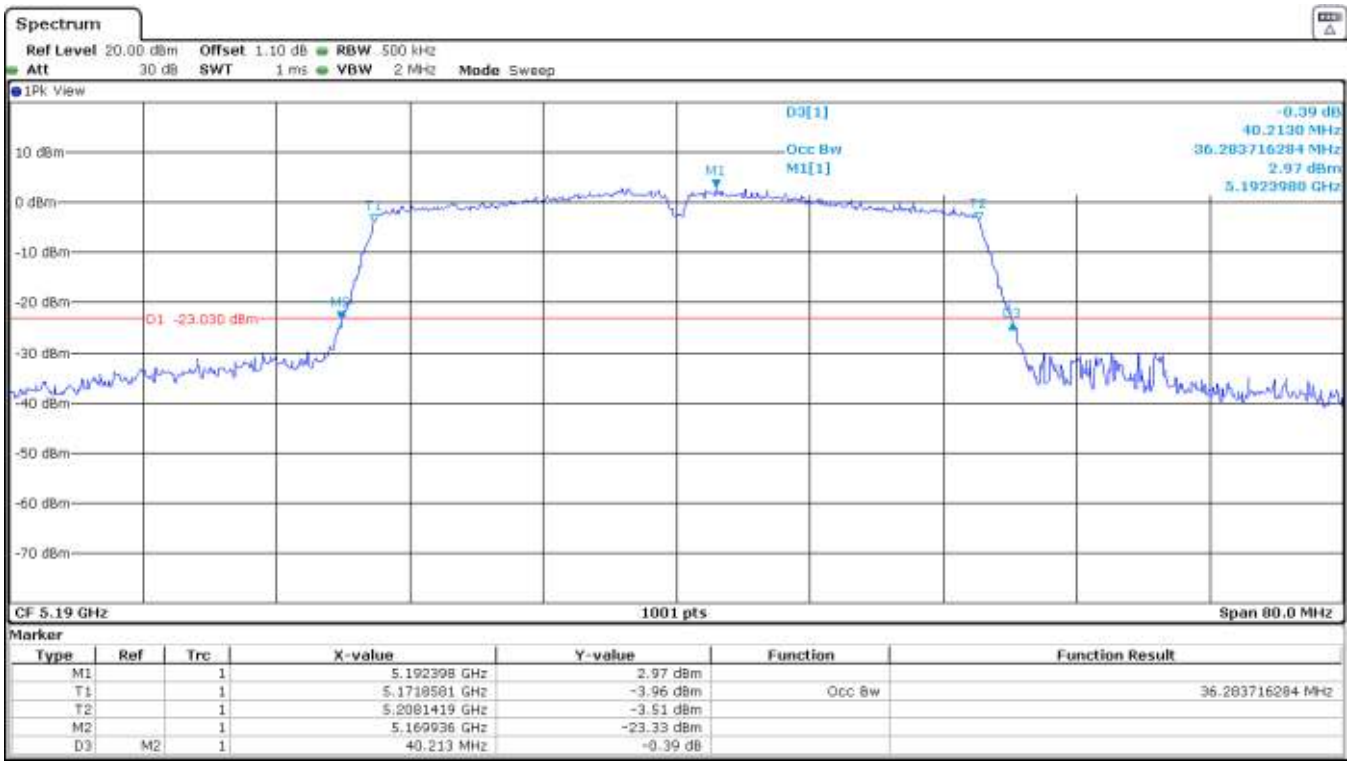
- High Channel 165 (5825 MHz):



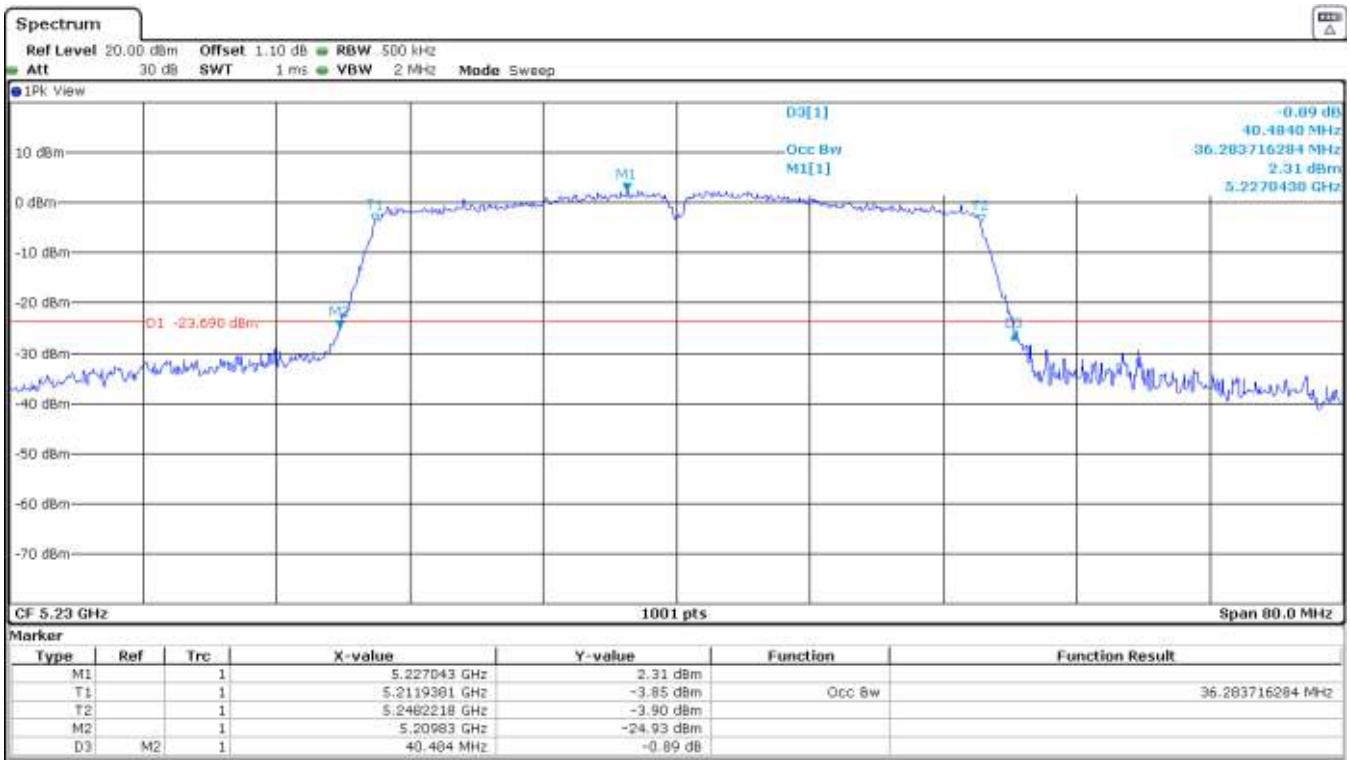
Mode 802.11 n40 (HT40):

U-NII-1 (5150-5250 MHz)

- Low Channel 38 (5190 MHz):

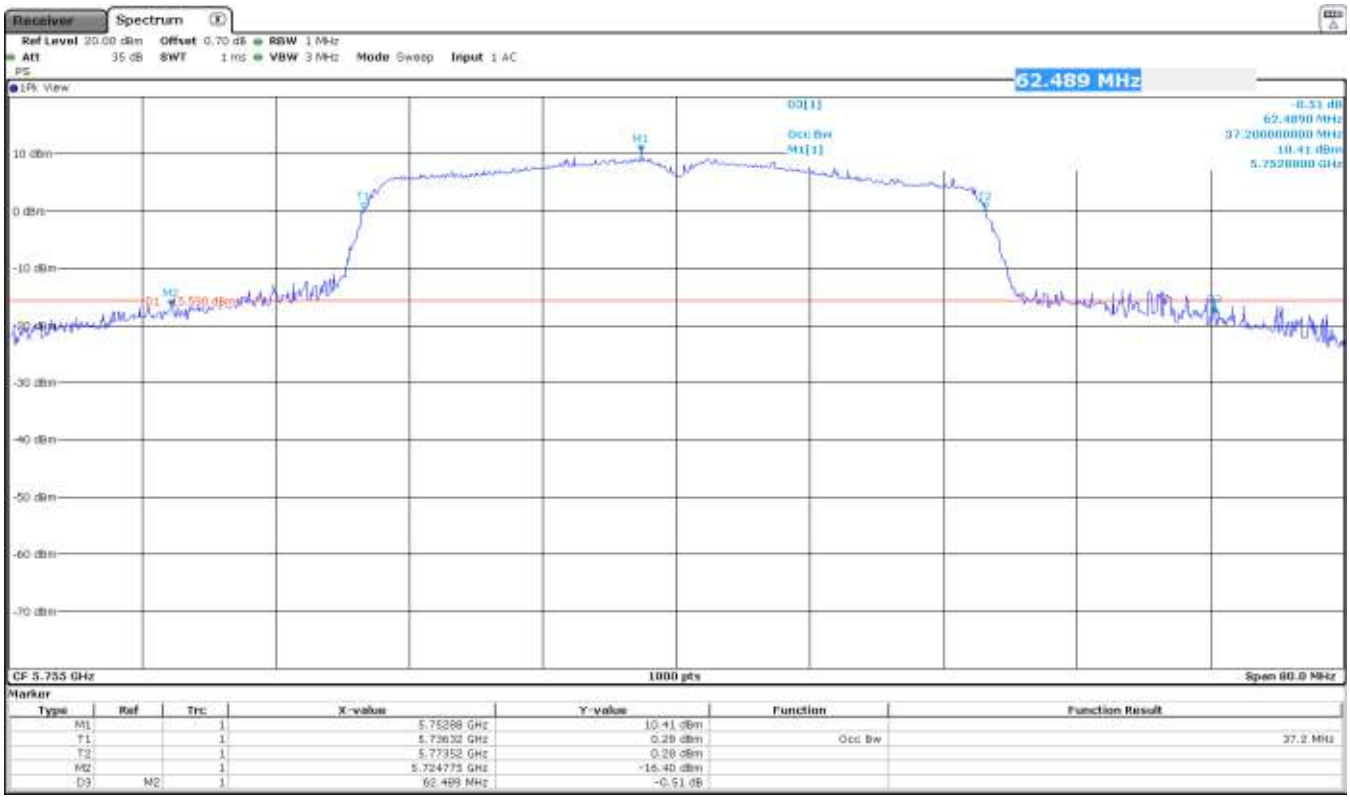


- High Channel 46 (5230 MHz):

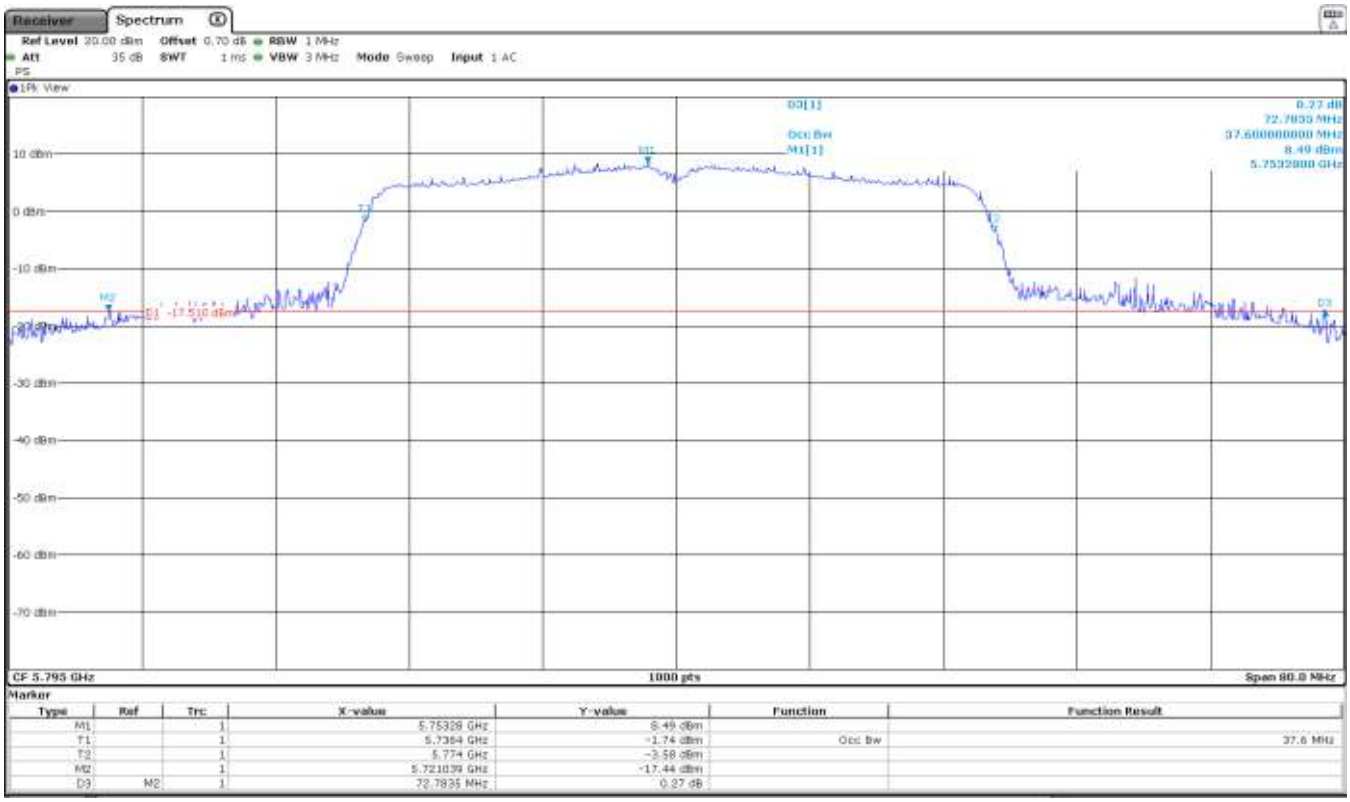


U-NII-3 (5725-5850 MHz)

- Low Channel 151 (5755 MHz):



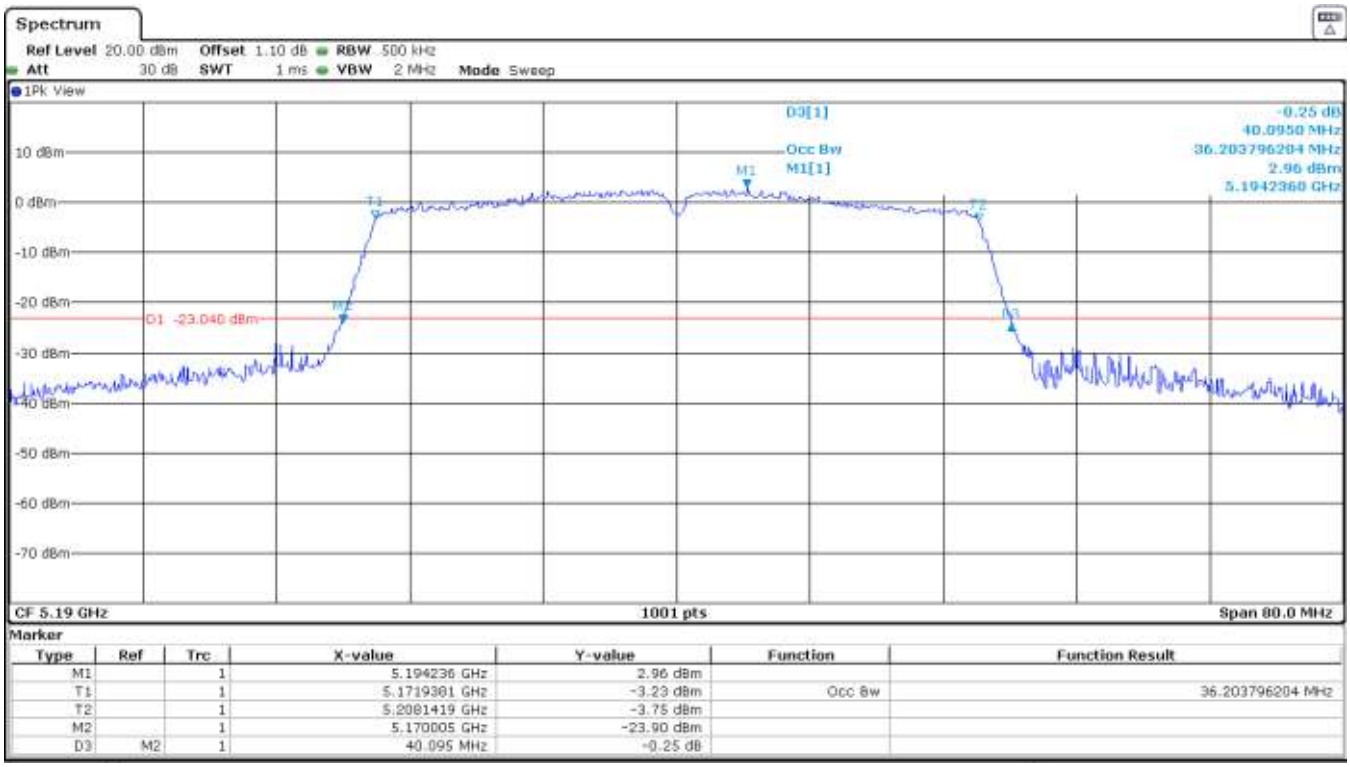
- High Channel 159 (5795 MHz):



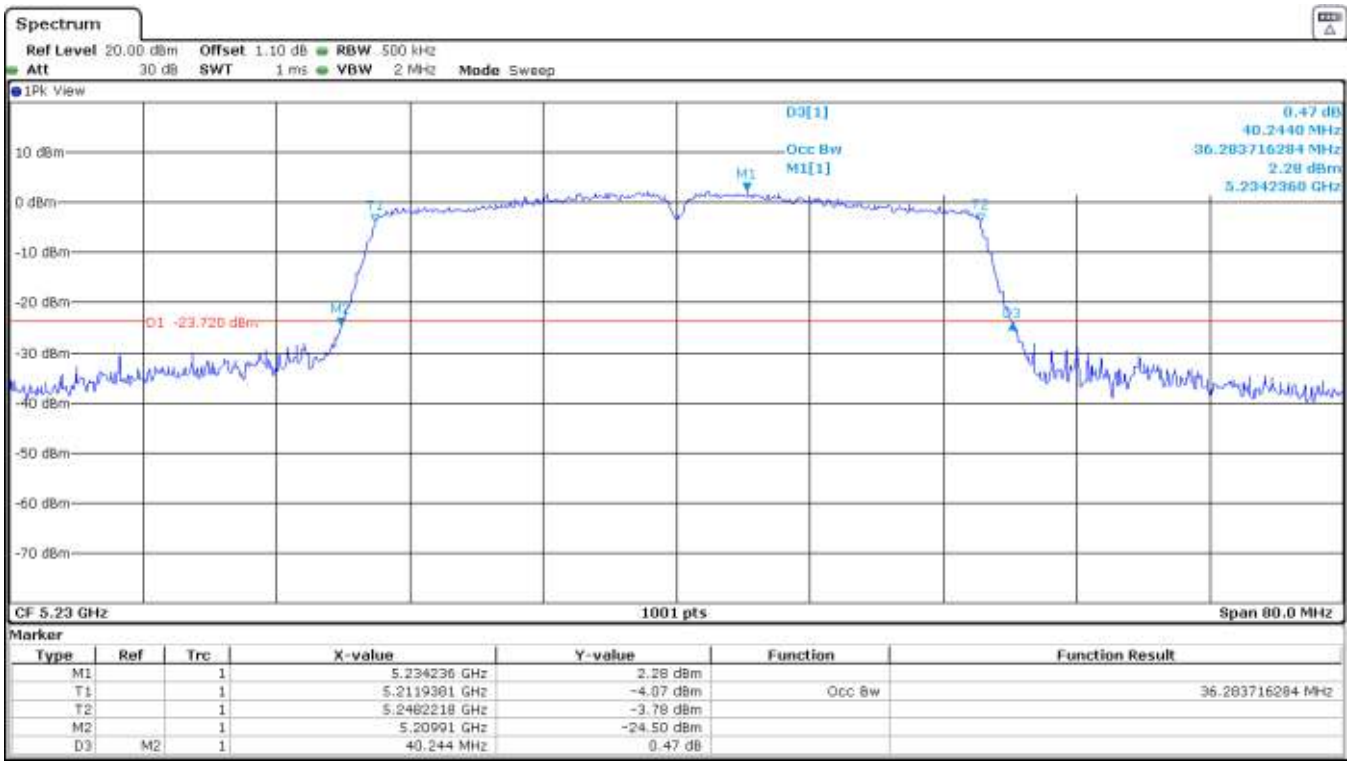
Mode 802.11 ac40 (HT40):

U-NII-1 (5150-5250 MHz)

- Low Channel 38 (5190 MHz):

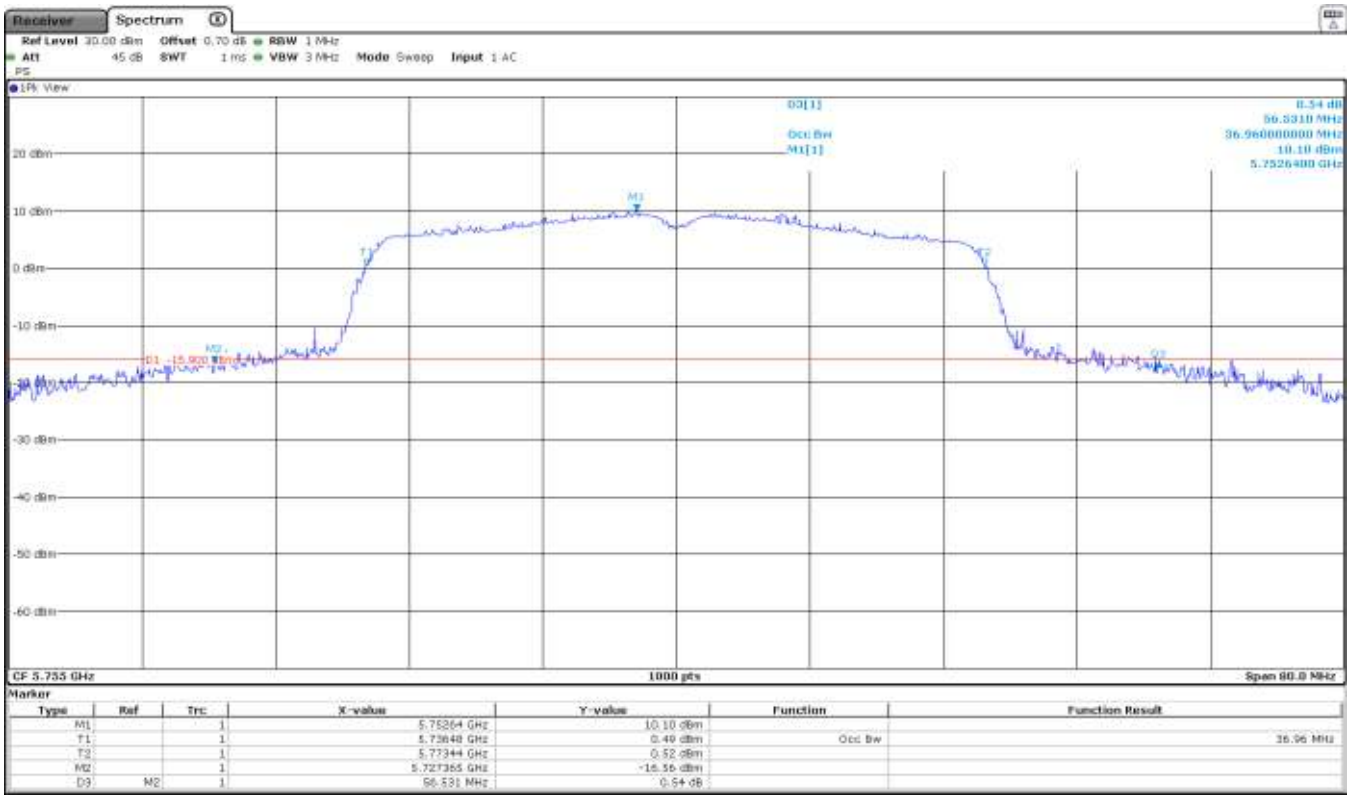


- High Channel 46 (5230 MHz):

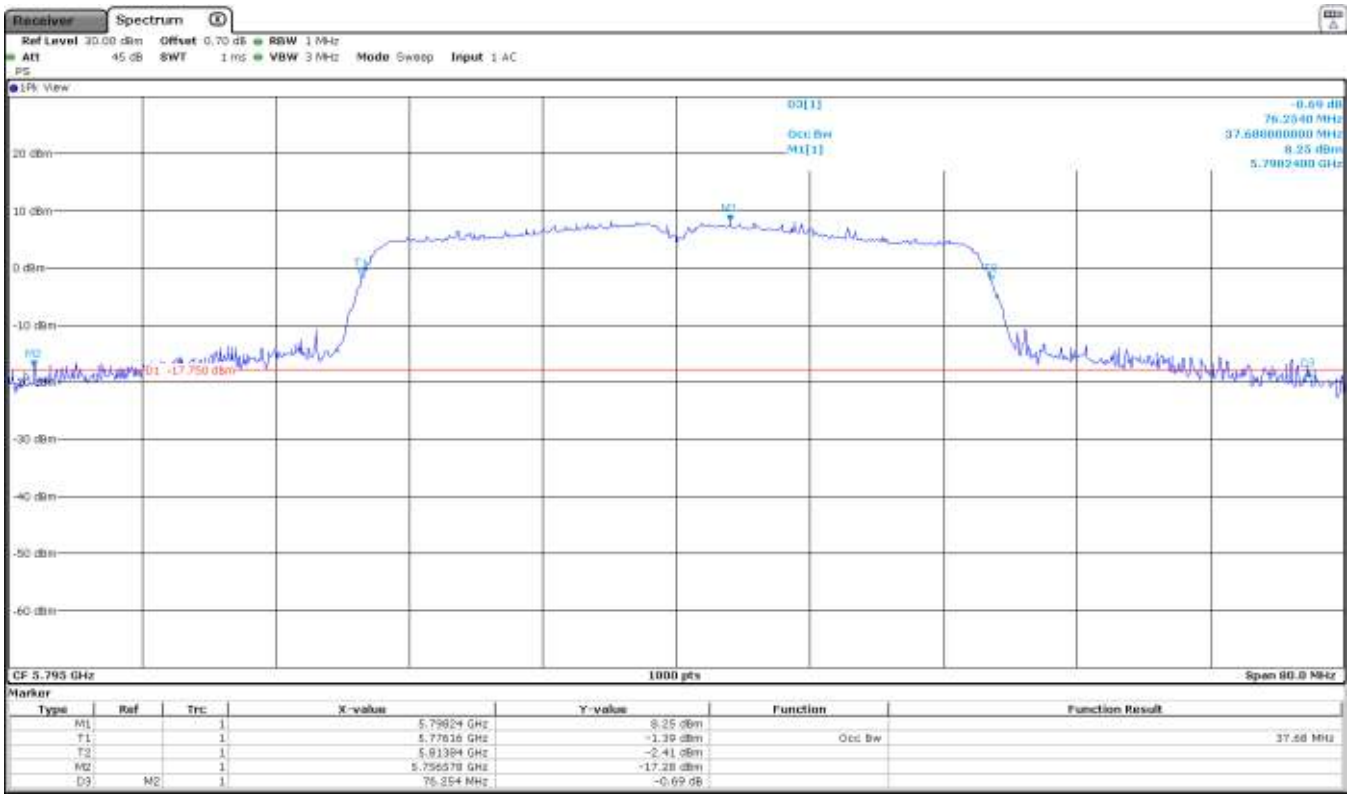


U-NII-3 (5725-5850 MHz)

- Low Channel 151 (5755 MHz):



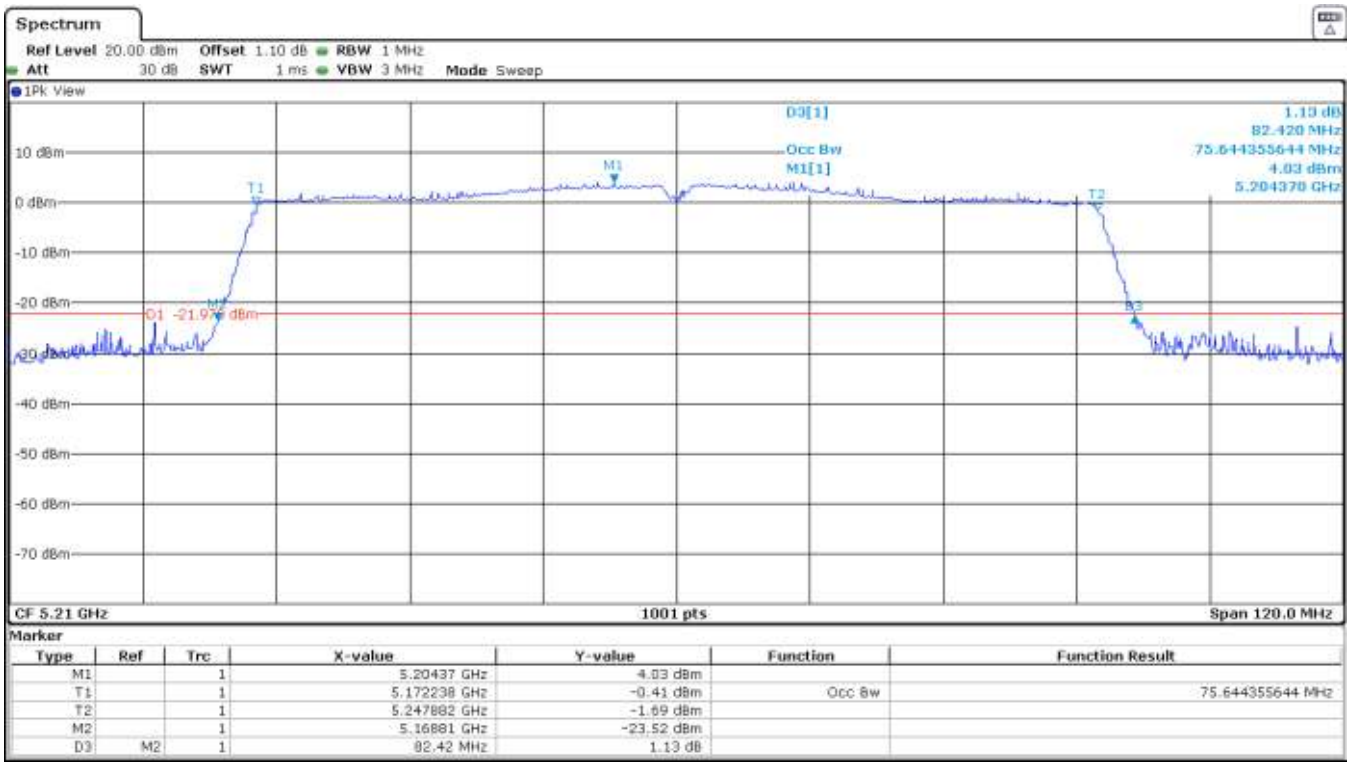
- High Channel 159 (5795 MHz):



Mode 802.11 ac80 (VHT80):

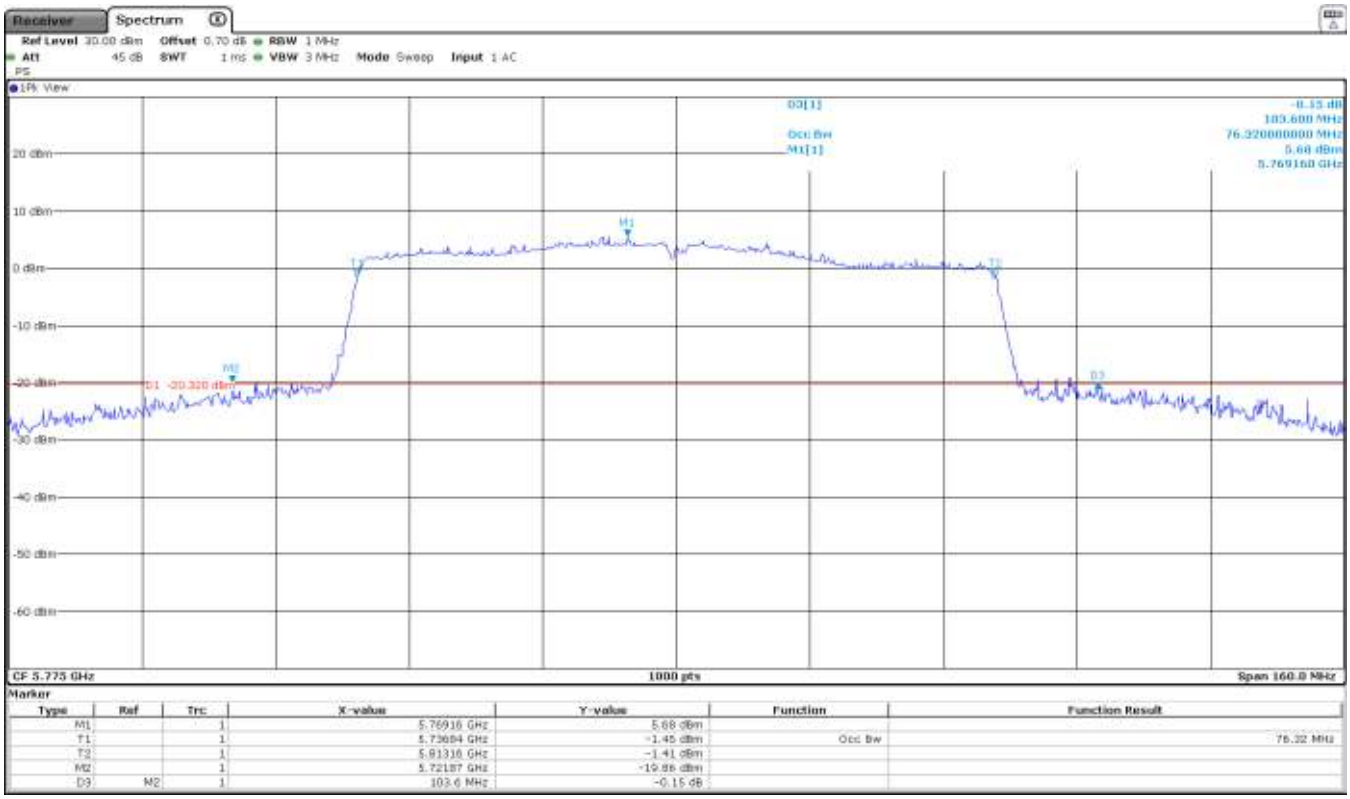
U-NII-1 (5150-5250 MHz)

- Single Channel 42 (5210 MHz):



U-NII-3 (5725-5850 MHz)

- Single Channel 155 (5775 MHz):



Section 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)	21.472	21.528	21.527
Measurement uncertainty (kHz)	<±40.04		

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)	24.971	24.047	24.440
Measurement uncertainty (kHz)	<±23.02		

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 dB Emission Bandwidth (MHz)	21.925	22.324	22.047
Measurement uncertainty (kHz)	<±40.04		

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)	29.890	29.955	30.228
Measurement uncertainty (kHz)	<±23.02		

Mode 802.11 ac20 (HT20):

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)	21.845	21.931	21.924
Measurement uncertainty (kHz)	<±40.04		

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)	31.749	30.479	31.965
Measurement uncertainty (kHz)	<±23.02		

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)	40.213	40.484
Measurement uncertainty (kHz)	<±70.07	

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
26 dB Emission Bandwidth (MHz)	62.489	72.7835
Measurement uncertainty (kHz)	<±55.05	

Mode 802.11 ac40 (HT40):

U-NII-1 (5150-5250 MHz)

Channels	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
26 dB Emission Bandwidth (MHz)	40.095	40.244
Measurement uncertainty (kHz)	<±70.07	

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
26 dB Emission Bandwidth (MHz)	56.531	76.254
Measurement uncertainty (kHz)	<±55.05	

Mode 802.11 ac80 (VHT80):

U-NII-1 (5150-5250 MHz)

Channel	Single Channel 42 (5210 MHz)
26 dB Emission Bandwidth (MHz)	82.42
Measurement uncertainty (kHz)	<±110.11

U-NII-3 (5725-5850 MHz)

Channel	Single Channel 155 (5775 MHz)
26 dB Emission Bandwidth (MHz)	103.6
Measurement uncertainty (kHz)	<±103.05

The 26 dB Emission Bandwidth plot for each mode can be seen in the plots of the previous test case “RSS-Gen 6.6 / RSS-247 6.2. Transmitter 99% Occupied Bandwidth”.

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

INDEX

TEST CONDITIONS

POWER SUPPLY (V):

V nonimal: 12 Vdc.

Type of Power Supply: External power supply (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:

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

WIFI FCC:

tx_test.sh -a wlan0 stop

a20 - Core0

tx_test.sh -a wlan0 36 0 -d x -r 6 20 –c US

tx_test.sh -a wlan0 40 0 -d x -r 6 20 -c US

tx_test.sh -a wlan0 48 0 -d x -r 6 20 -c US

n20 - Core0

tx_test.sh -a wlan0 36 0 -d x -h 0 20 -c US

tx_test.sh -a wlan0 40 0 -d x -h 0 20 -c US

tx_test.sh -a wlan0 48 0 -d x -h 0 20 -c US

ac20 - Core0

tx_test.sh -a wlan0 36 0 -d x -v 0 20 -c US

tx_test.sh -a wlan0 40 0 -d x -v 0 20 -c US

tx_test.sh -a wlan0 48 0 -d x -v 0 20 -c US

n40 - Core0

tx_test.sh -a wlan0 40 0 -d x -h 0 40 -c US

tx_test.sh -a wlan0 48 0 -d x -h 0 40 -c US

ac40 - Core0

tx_test.sh -a wlan0 40 0 -d x -v 0 40 -c US

tx_test.sh -a wlan0 48 0 -d x -v 0 40 -c US

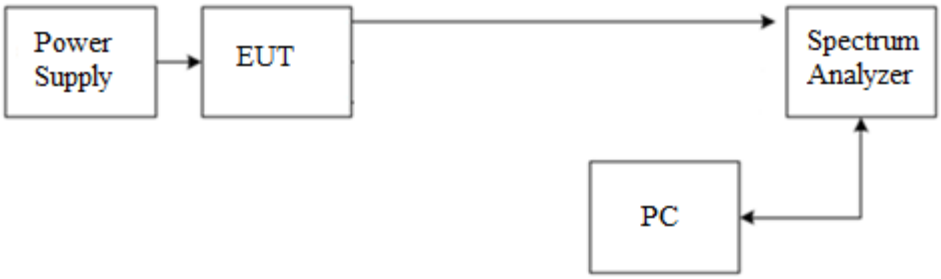
ac80 - Core0

tx_test.sh -a wlan0 40 0 -d x -v 0 80 -c US

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 is situated at a distance of 1 m for the frequency range 1 GHz-40 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

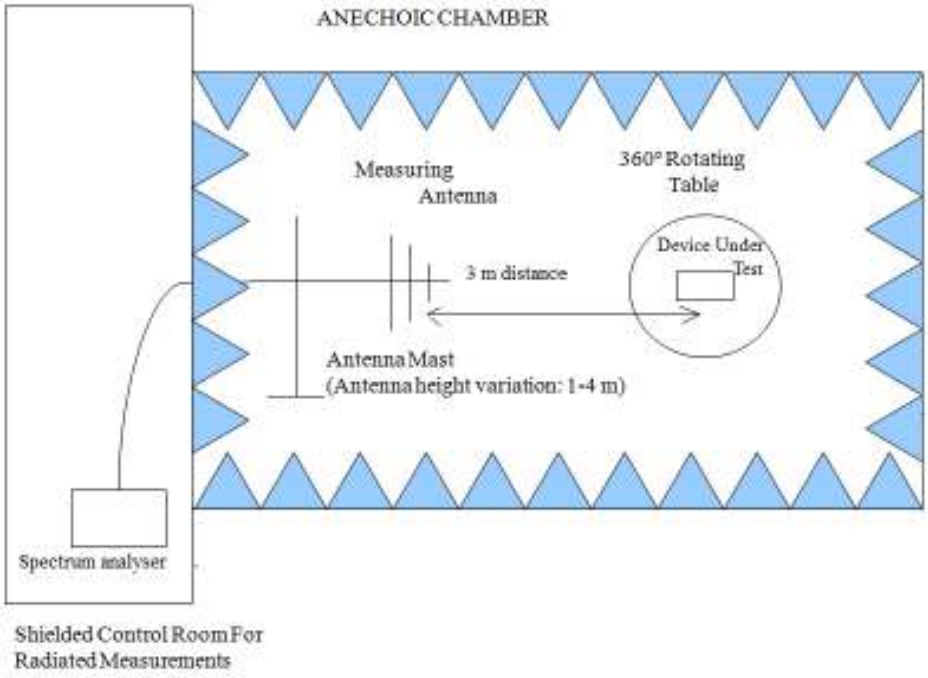
For radiated emissions in the range 1 GHz-40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The EUT was placed at a height of 80 cm above the reference ground plane in the center of the chamber turntable to perform the measurements below 1GHz and the EUT was placed at a height of 1.5 meters above the test chamber floor in the center of the chamber turntable to perform the measurements above 1GHz. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

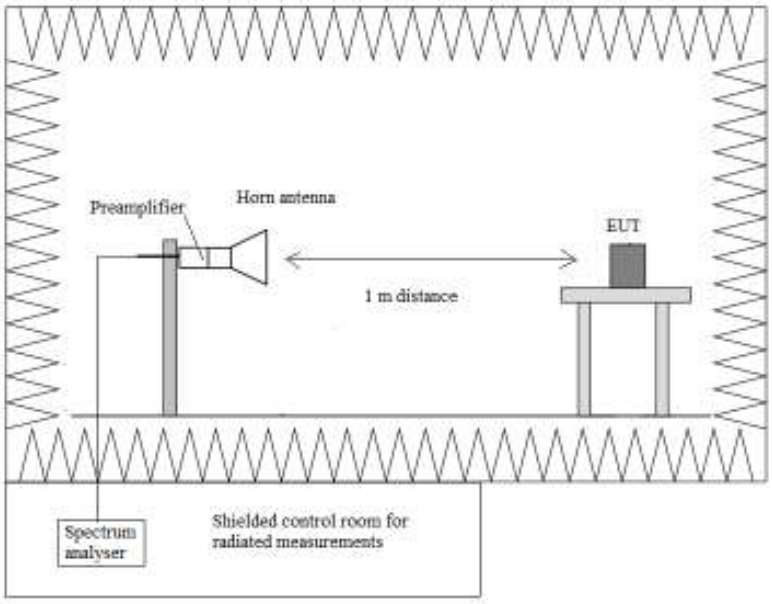
Measurements were made in both horizontal and vertical planes of polarization.

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

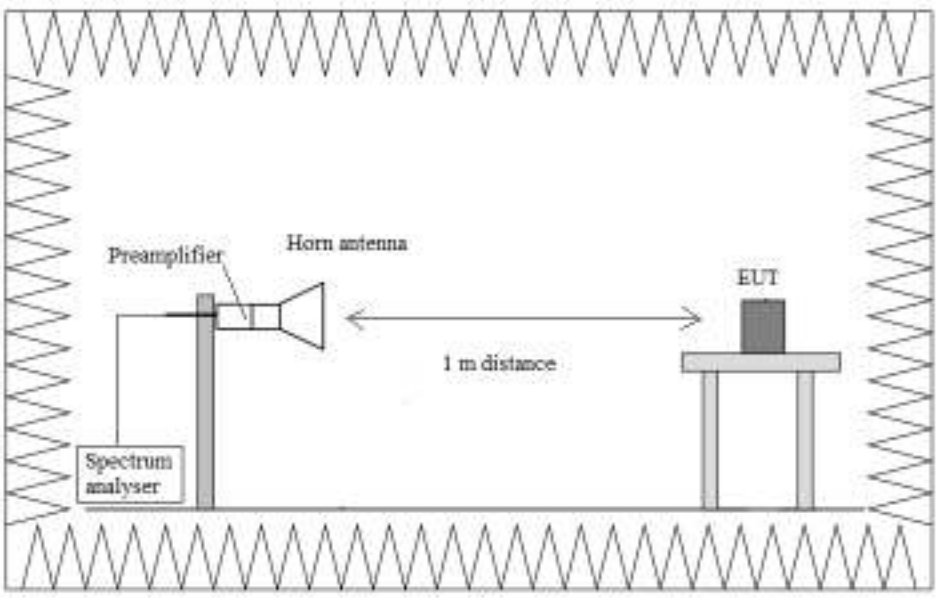
Radiated measurements setup f < 1 GHz.



Radiated measurements setup f > 1 GHz up to 18 GHz.



Radiated measurements setup f > 18 GHz up to 40 GHz.



FCC Section 15.407 Subclause (a)(1)(iv). Transmitter Maximum Conducted Output Power / RSS-247 Clause 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 30mW 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 30mW.

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).

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

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

Mode 802.11 a20

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Max. Conducted Power (dBm)	11.16	11.04	11.54
Duty Cycle Correction Factor (dB)	1.002113271		
Max. Conducted Power Corrected (dBm)	12.16211327	12.04211327	12.54211327
Max. EIRP power Corrected (dBm)	6.762113271	6.642113271	7.142113271
Measurement uncertainty (dB)	<±1.20		

Mode 802.11 n20 (HT20)

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Max. Conducted Power (dBm)	10.8	11.01	11.15
Duty Cycle Correction Factor (dB)	1.036034525		
Max. Conducted Power Corrected (dBm)	11.83603452	12.04603452	12.18603452
Max. EIRP power Corrected (dBm)	6.436034525	6.646034525	6.786034525
Measurement uncertainty (dB)	<±1.20		

Mode 802.11 ac20 (HT20)

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Max. Conducted Power (dBm)	11.25	11.14	11.26
Duty Cycle Correction Factor (dB)	1.024570634		
Max. Conducted Power Corrected (dBm)	12.27457063	12.16457063	12.28457063
Max. EIRP power Corrected (dBm)	6.874570634	6.764570634	6.884570634
Measurement uncertainty (dB)	<±1.20		

Mode 802.11 n40 (HT40)

	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
Max. Conducted Power (dBm)	8.81	8.6
Duty Cycle Correction Factor (dB)	1.892001474	
Max. Conducted Power Corrected (dBm)	10.70200147	10.49200147
Max. EIRP power Corrected (dBm)	5.302001474	5.092001474
Measurement uncertainty (dB)	<±1.20	

Mode 802.11 ac40 (HT40)

	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
Max. Conducted Power (dBm)	8.95	8.56
Duty Cycle Correction Factor (dB)	1.91566702	
Max. Conducted Power Corrected (dBm)	10.86566702	10.47566702
Max. EIRP power Corrected (dBm)	5.46566702	5.07566702
Measurement uncertainty (dB)	<±1.20	

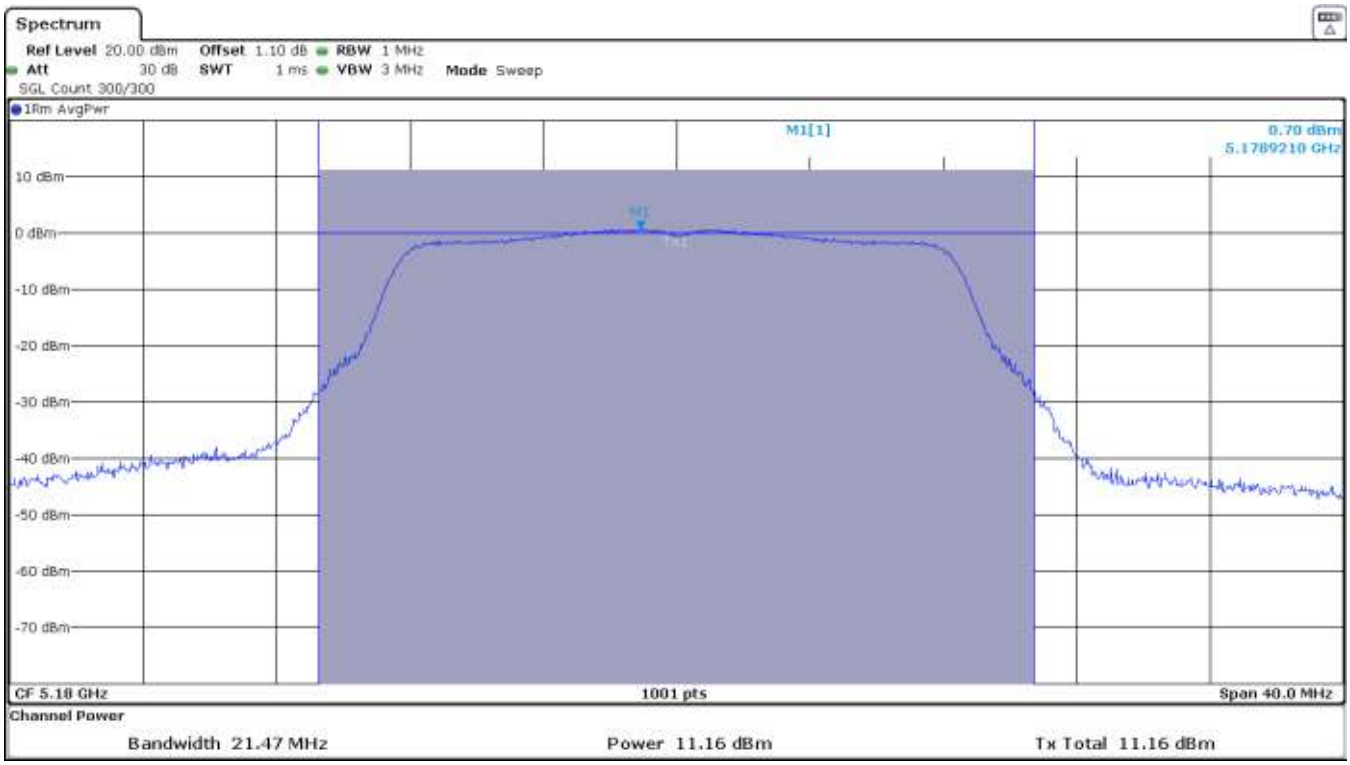
Mode 802.11 ac80 (VHT80)

	Single Channel 42 (5210 MHz)
Max. Conducted Power (dBm)	8.44
Duty Cycle Correction Factor (dB)	3.288378818
Max. Conducted Power Corrected (dBm)	11.72837882
Max. EIRP power Corrected (dBm)	6.328378818
Measurement uncertainty (dB)	<±1.20

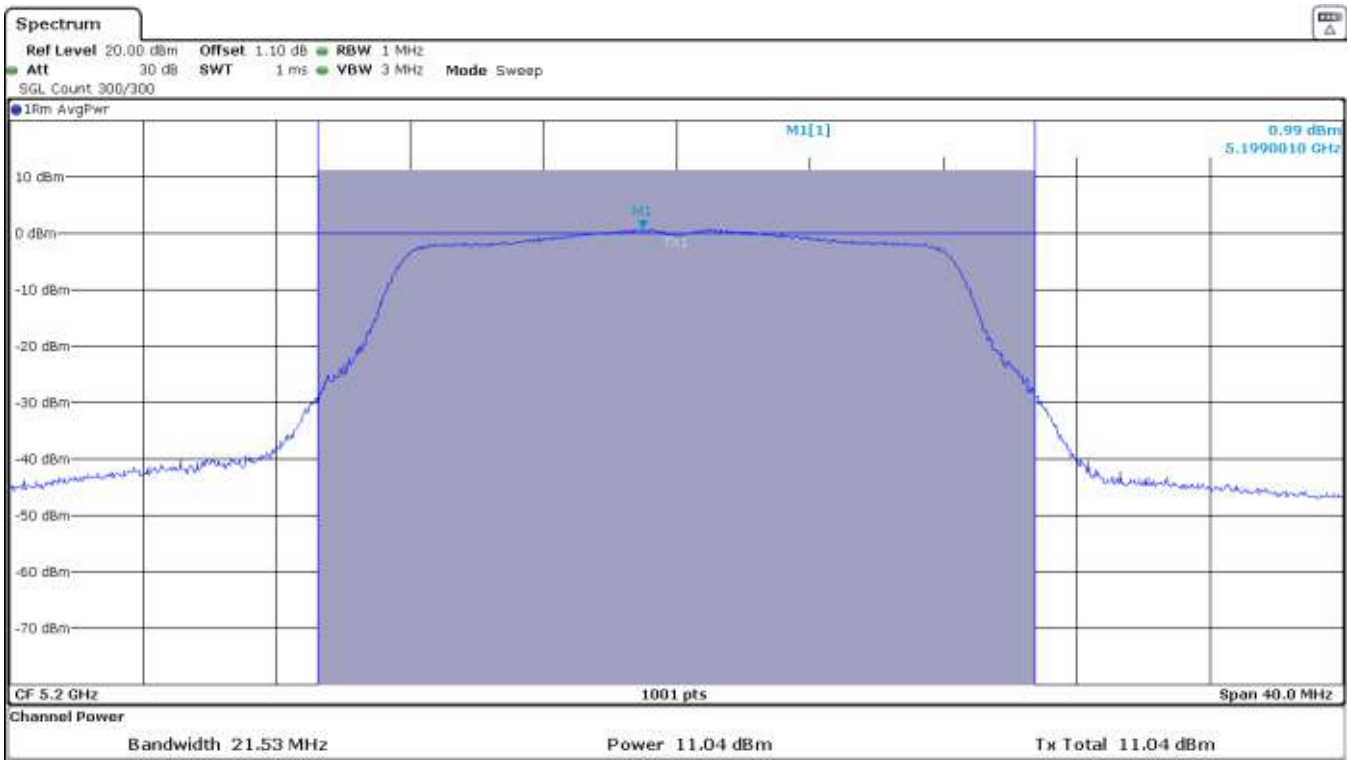
Verdict: PASS

Mode 802.11 a20

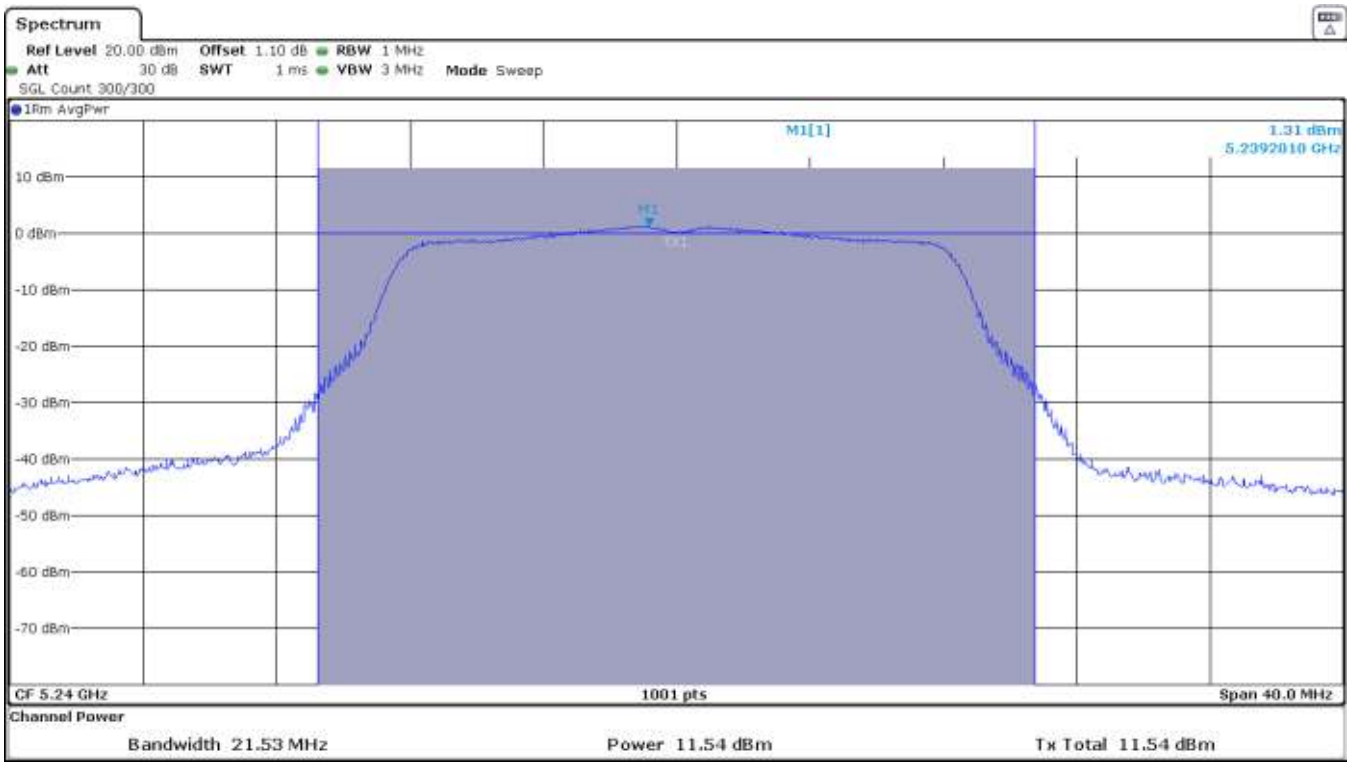
- Low Channel 36:



- Middle Channel 40:

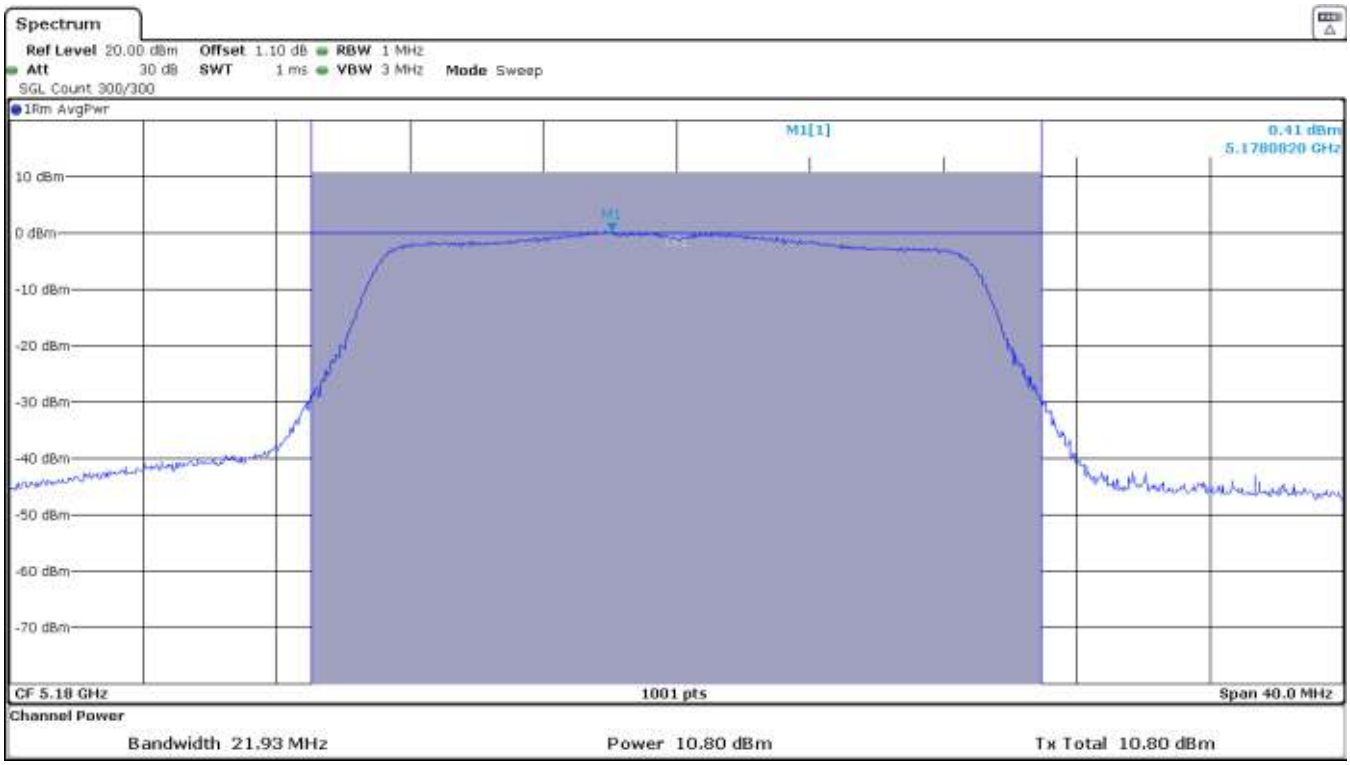


- High Channel 48:

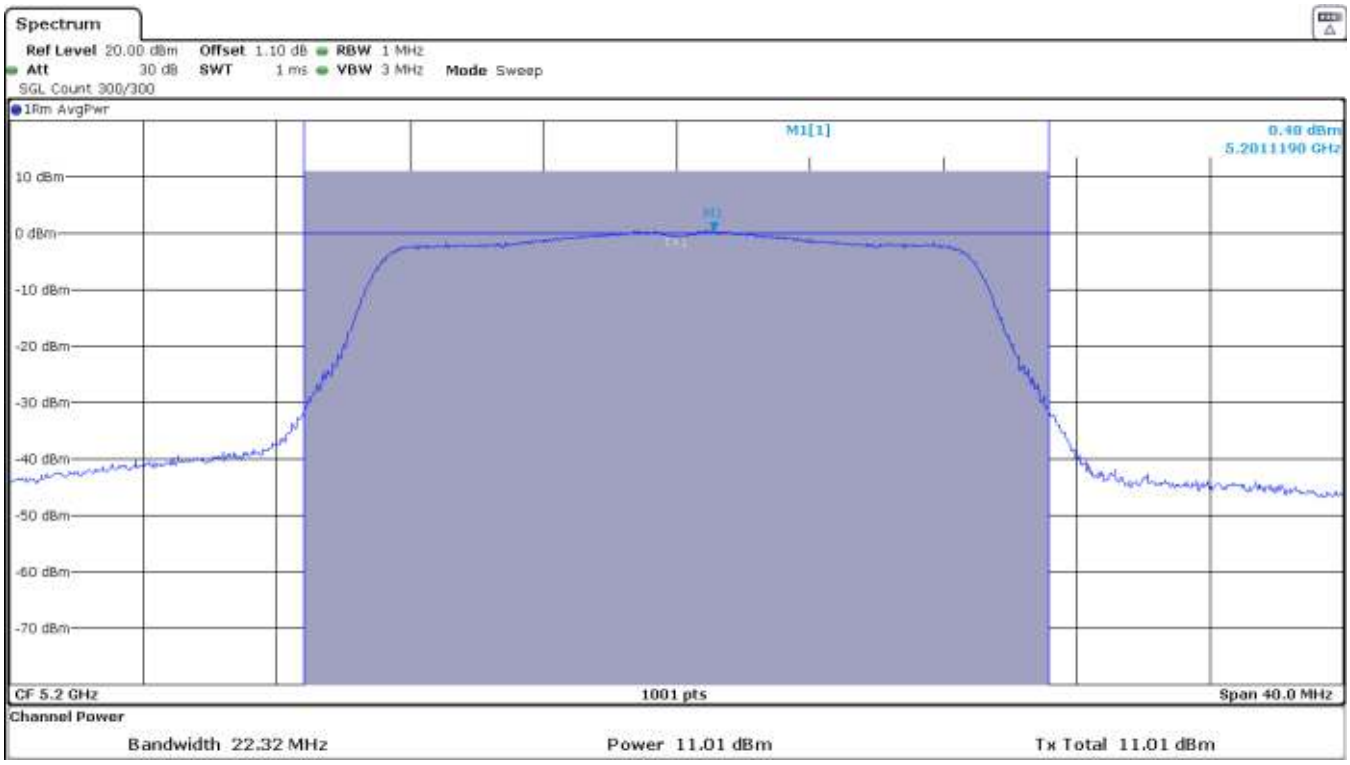


Mode 802.11 n20 (HT20)

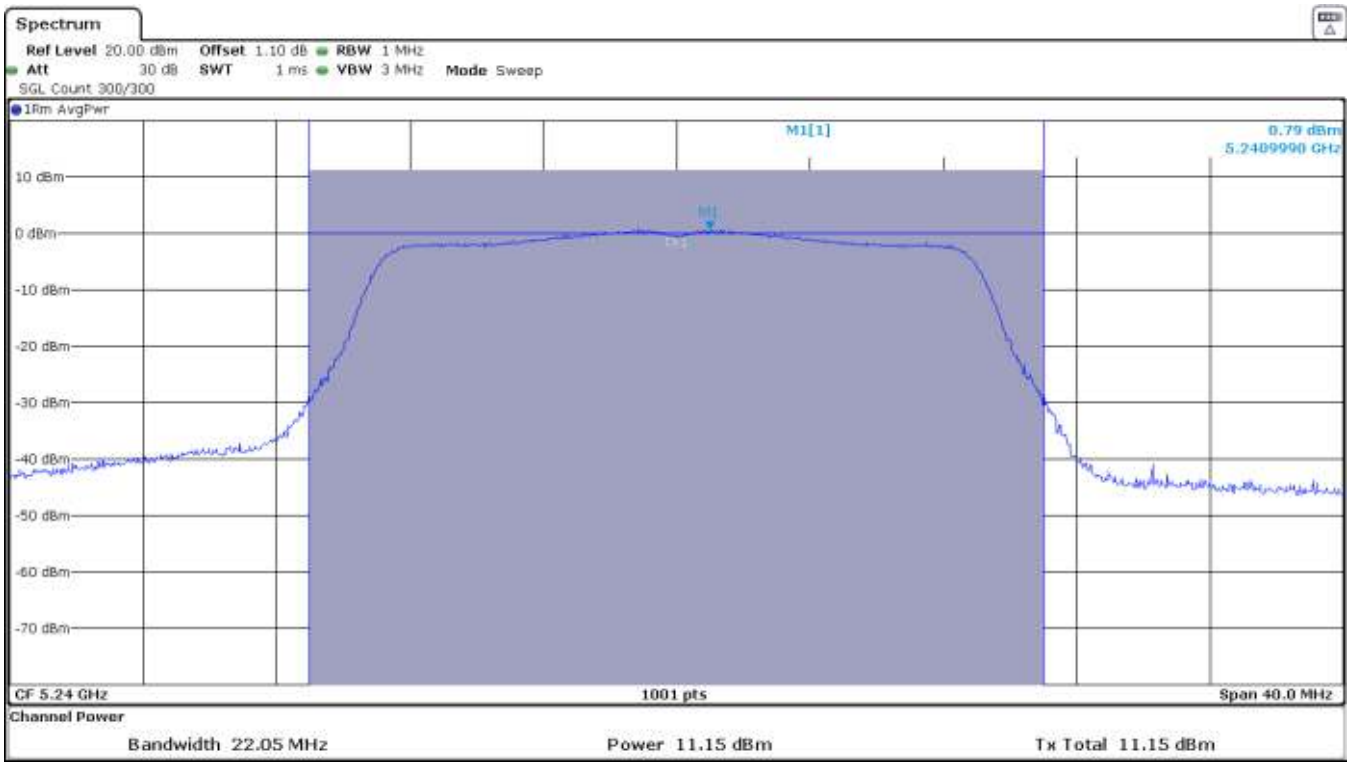
- Low Channel 36:



- Middle Channel 40:

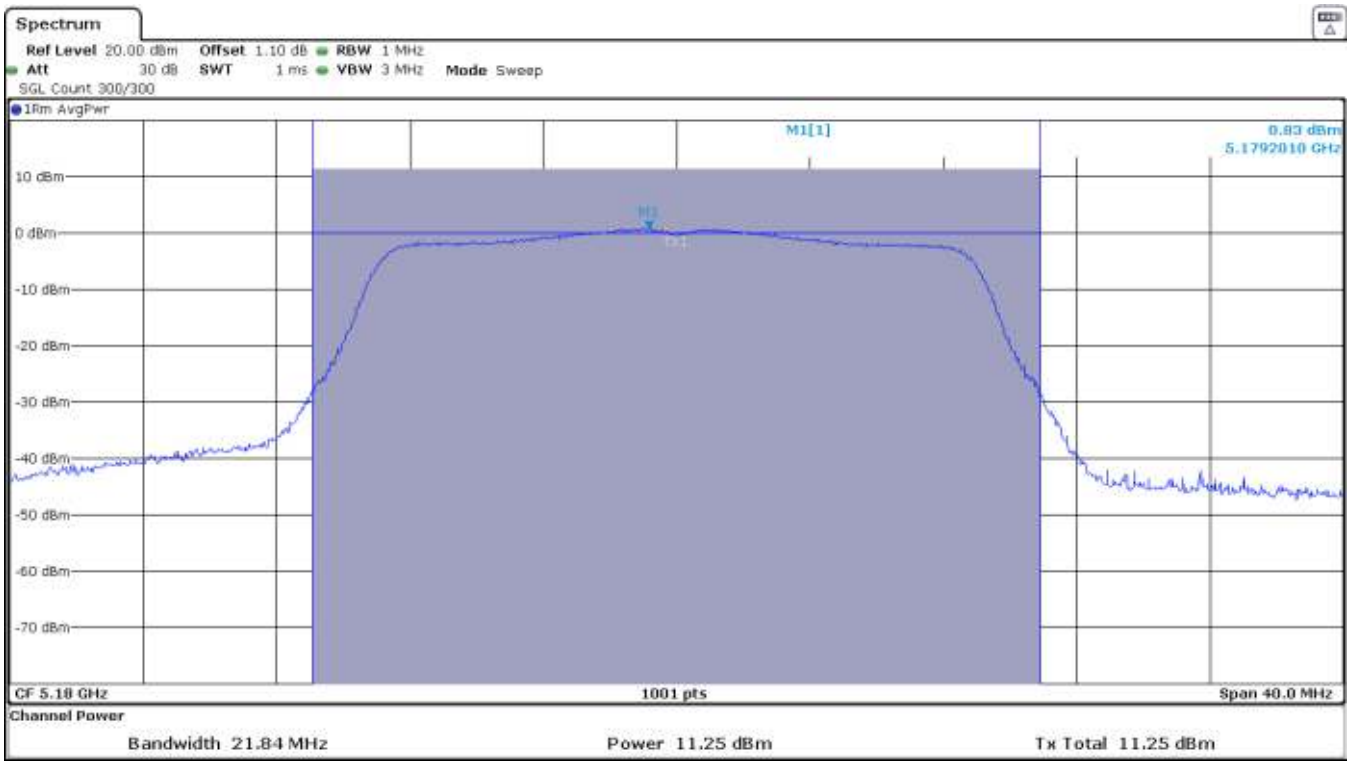


- High Channel 48:

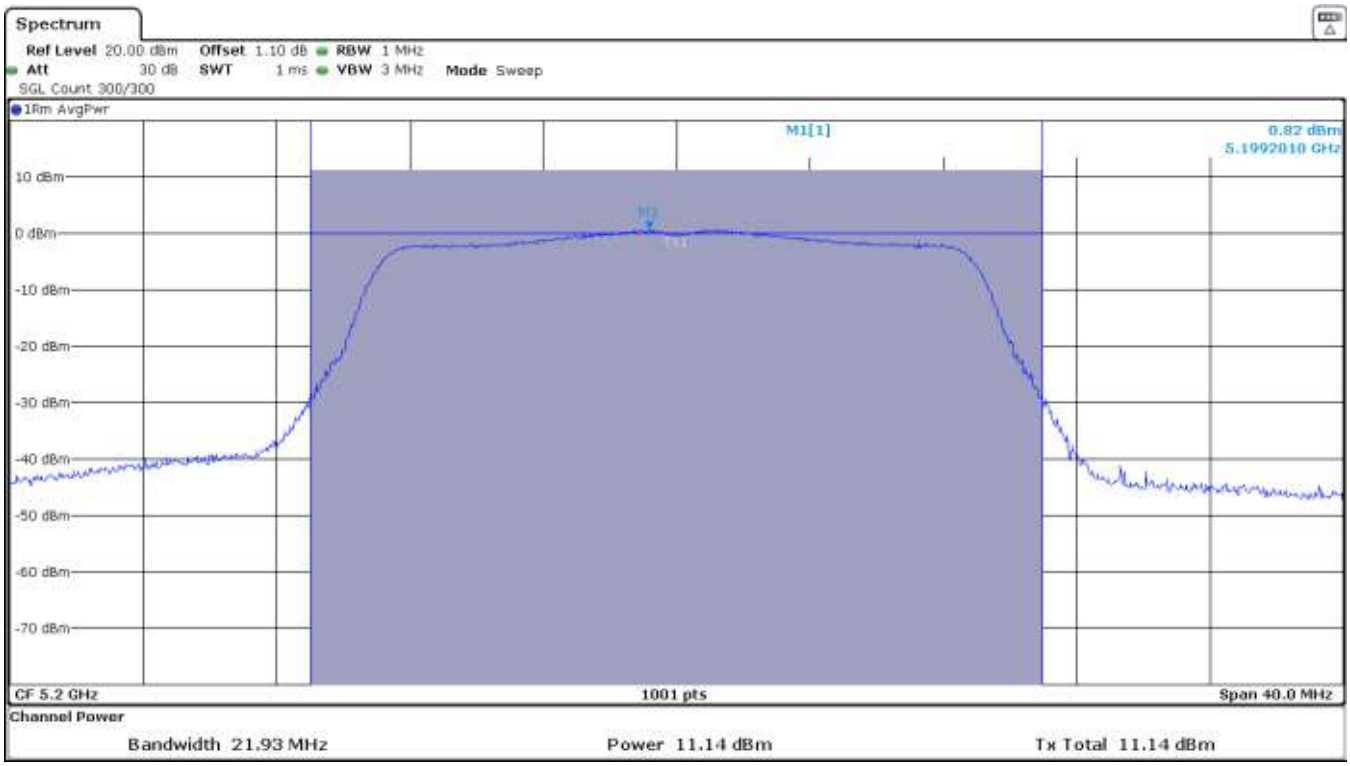


Mode 802.11 ac20 (HT20)

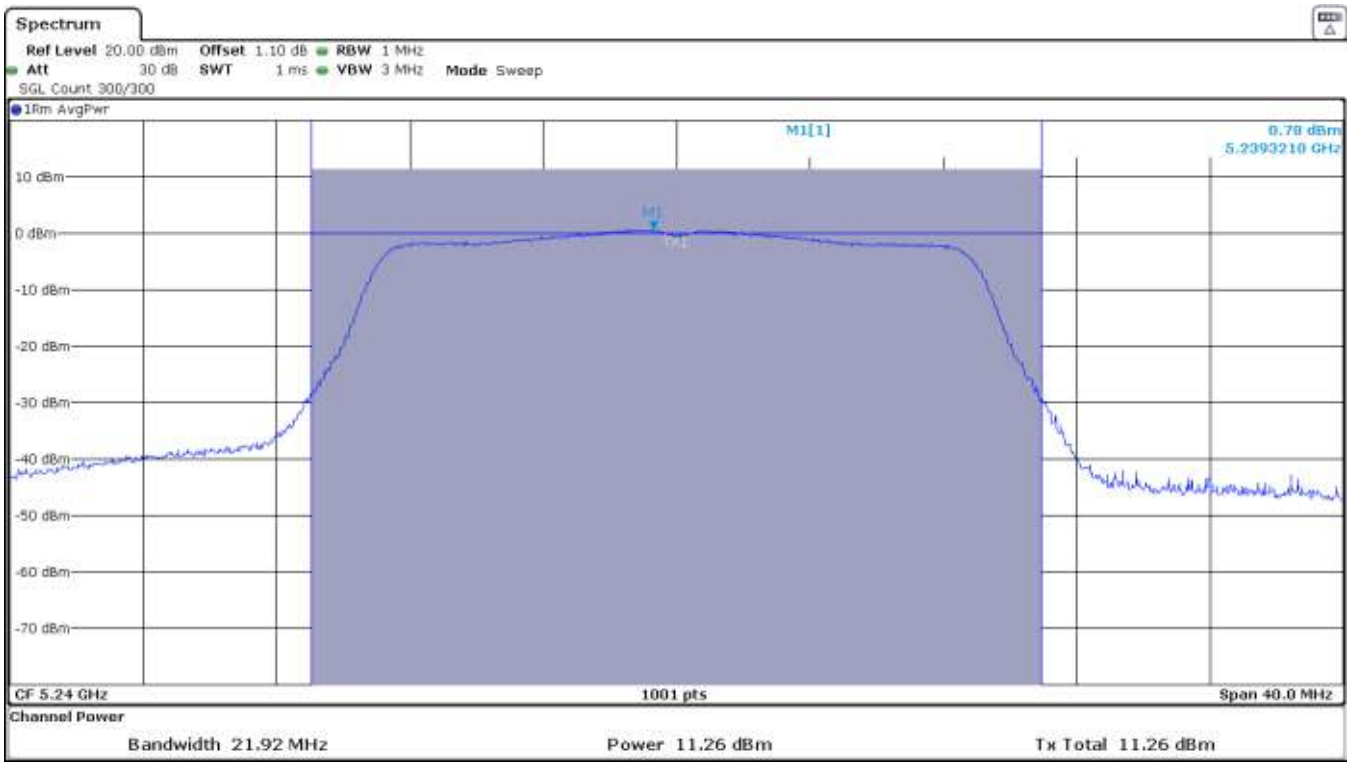
- Low Channel 36:



- Middle Channel 40:

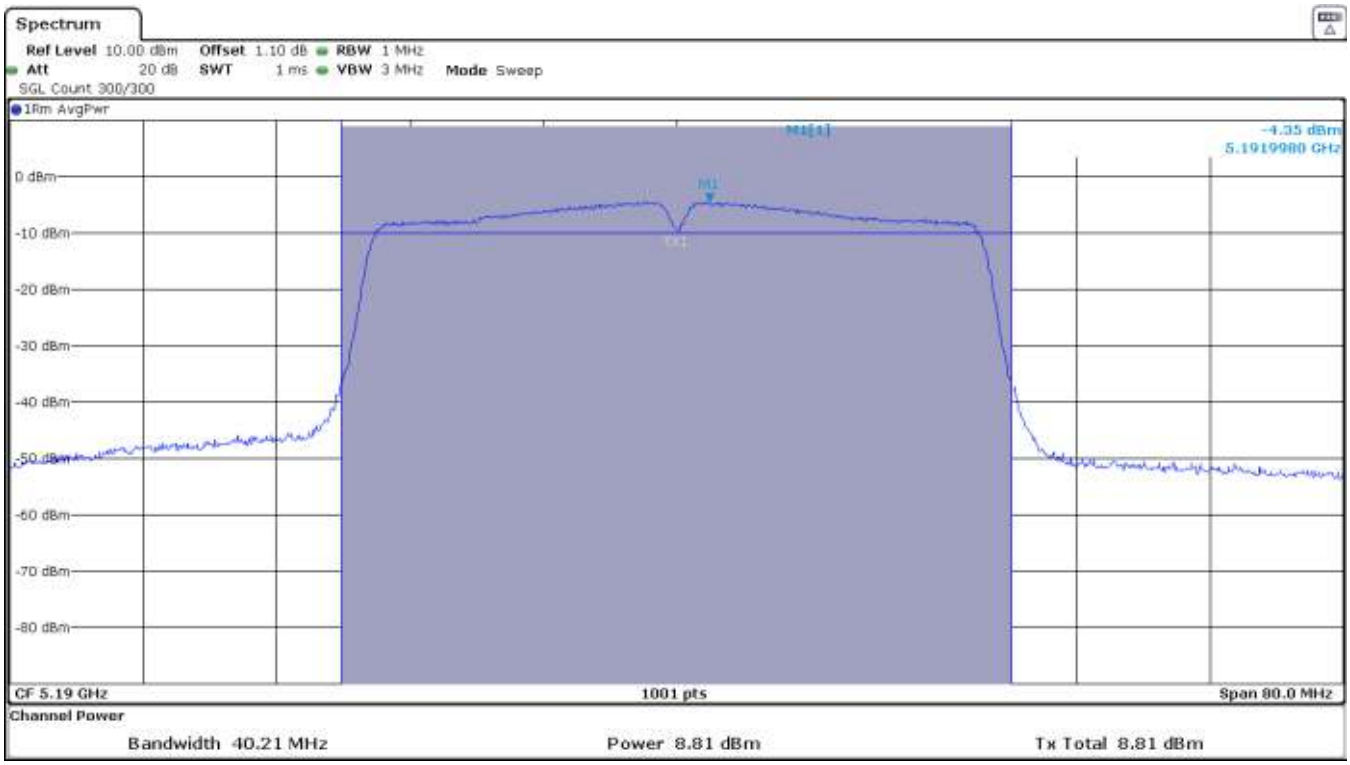


- High Channel 48:

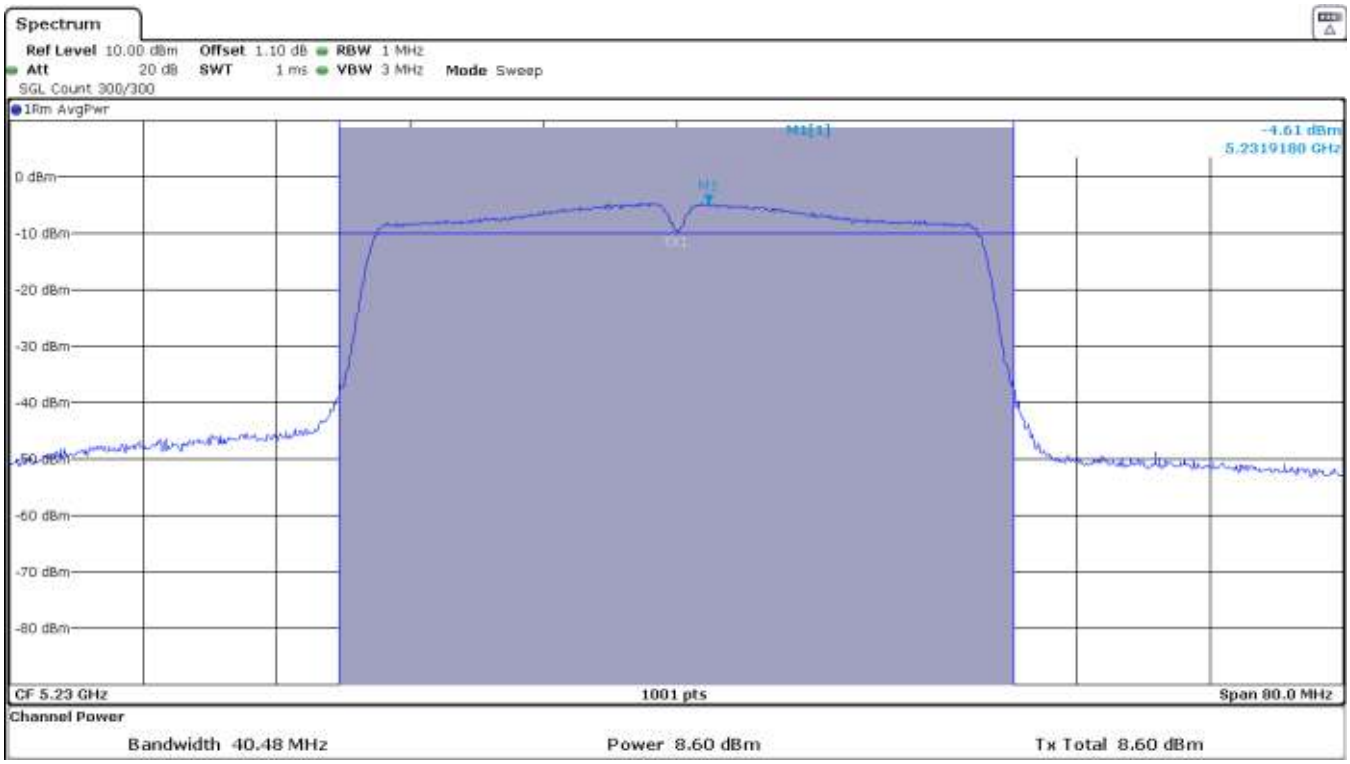


Mode 802.11 n40 (HT40)

- Low Channel 38:

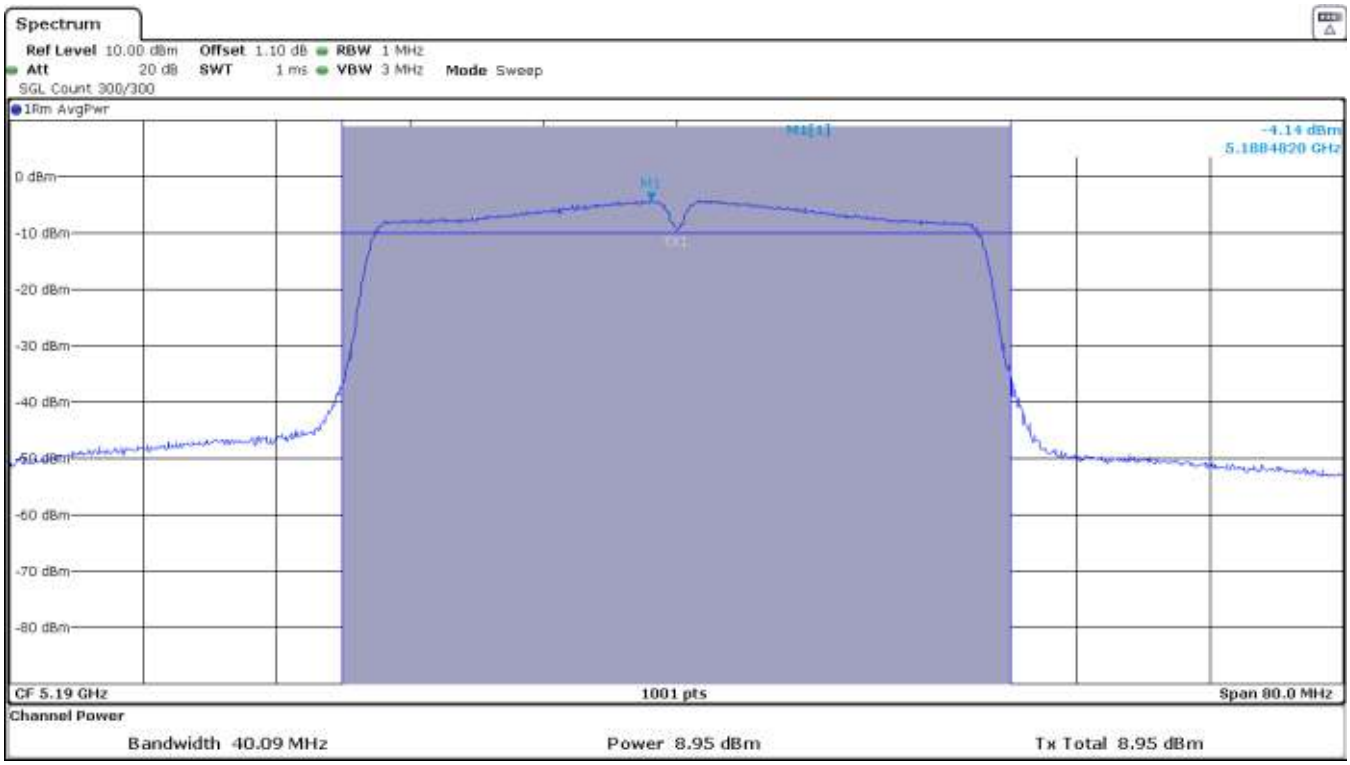


- High Channel 46:

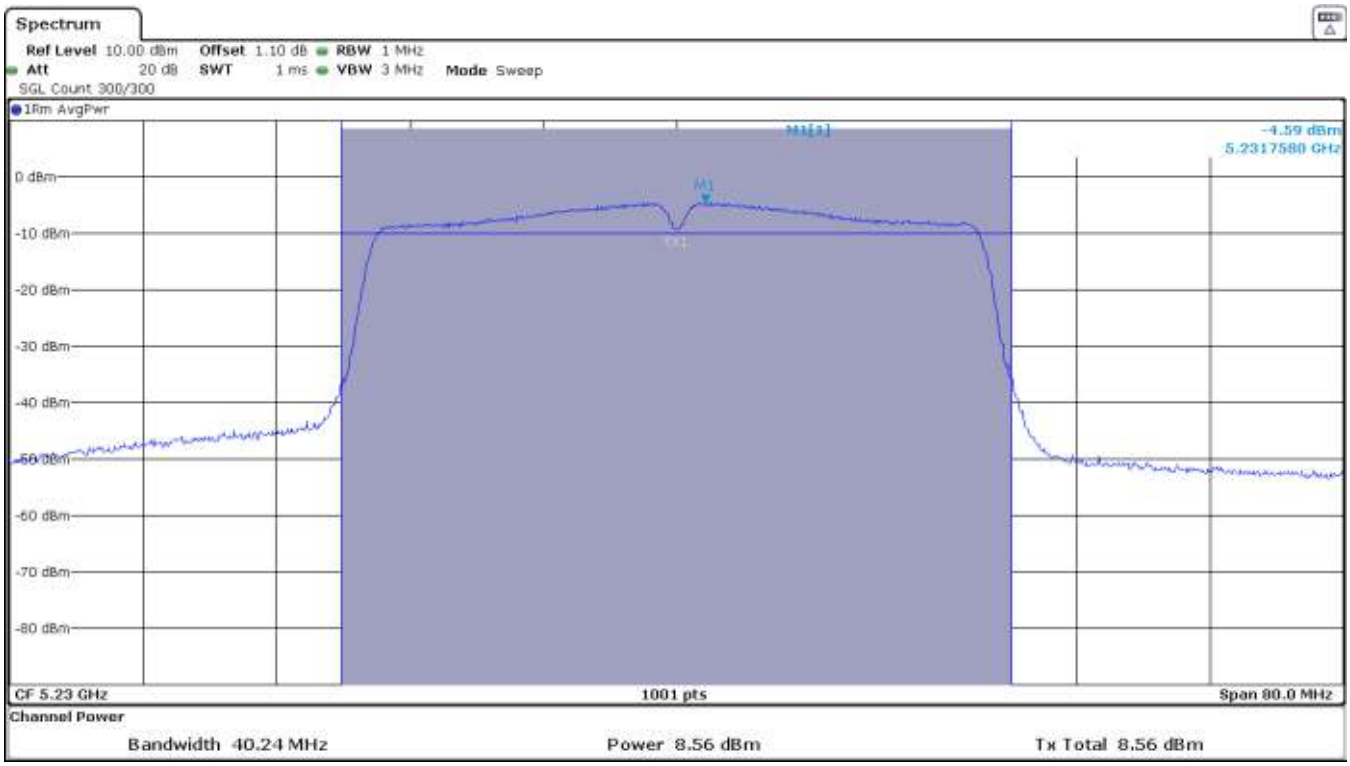


Mode 802.11 ac40 (HT40)

- Low Channel 38:

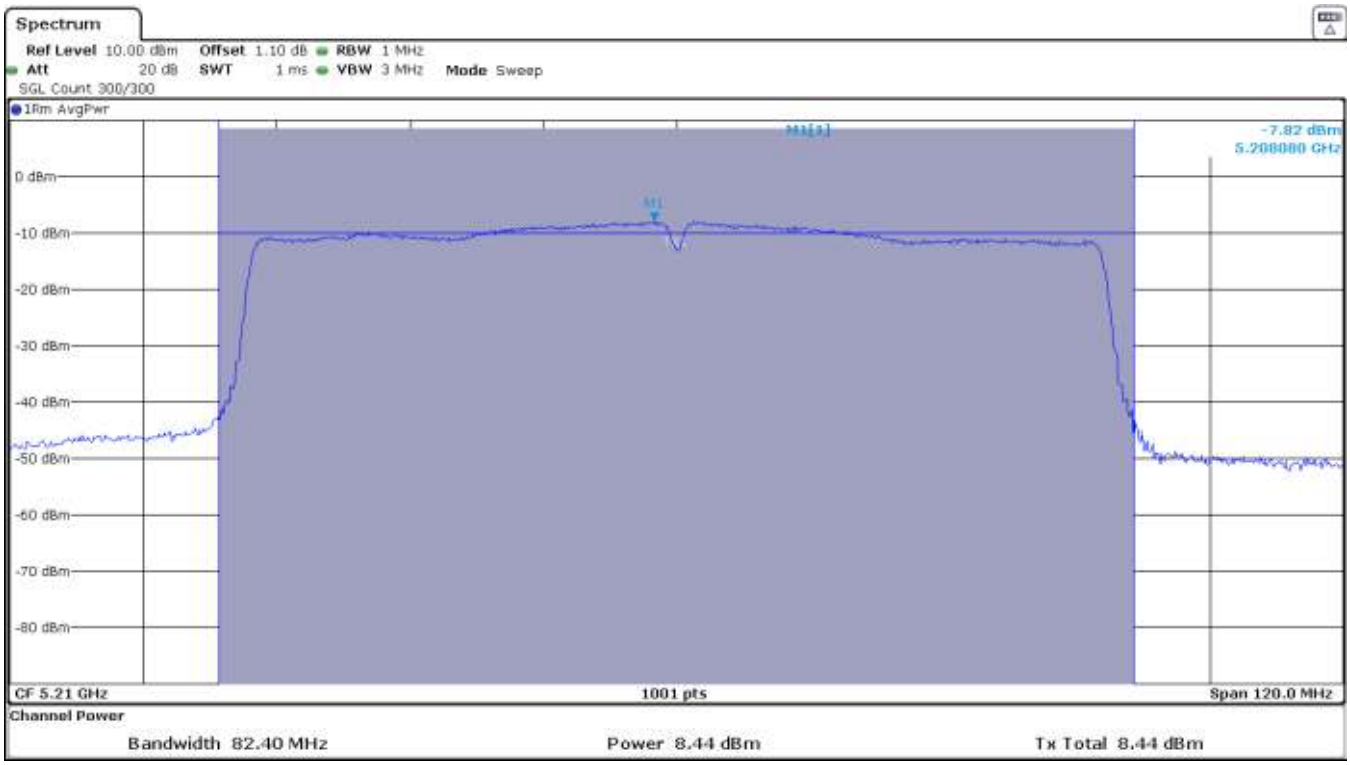


- High Channel 46:



Mode 802.11 ac80 (VHT80)

- Single Channel 42:



FCC Section 15.407 Subclause (a) (1) (iv). Transmitter Maximum Power Spectral Density / RSS-247 Clause 6.2.1.1. Transmitter EIRP Spectral Density

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).

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

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

Mode 802.11 a20

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Maximum Average PSD (dBm/MHz)	0.7	0.99	1.31
Duty Cycle Correction Factor (dB)	1.002113271		
Maximum Average PSD Corrected (dBm/MHz)	1.702113271	1.992113271	2.312113271
Maximum EIRP PSD Corrected (dBm/MHz)	-3.697886729	-3.407886729	-3.087886729
Measurement uncertainty (dB)	<±1.20		

Mode 802.11 n20 (HT20)

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Maximum Average PSD (dBm/MHz)	0.41	0.48	0.79
Duty Cycle Correction Factor (dB)	1.036034525		
Maximum Average PSD Corrected (dBm/MHz)	1.446034525	1.516034525	1.826034525
Maximum EIRP PSD Corrected (dBm/MHz)	-3.953965475	-3.883965475	-3.573965475
Measurement uncertainty (dB)	<±1.20		

Mode 802.11 ac20 (HT20)

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Maximum Average PSD (dBm/MHz)	0.83	0.82	0.78
Duty Cycle Correction Factor (dB)	1.024570634		
Maximum Average PSD Corrected (dBm/MHz)	1.854570634	1.844570634	1.804570634
Maximum EIRP PSD Corrected (dBm/MHz)	-3.545429366	-3.555429366	-3.595429366
Measurement uncertainty (dB)	<±1.20		

Mode 802.11 n40 (HT40)

	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
Maximum Average PSD (dBm/MHz)	-4.35	-4.61
Duty Cycle Correction Factor (dB)	1.892001474	
Maximum Average PSD Corrected (dBm/MHz)	-2.457998526	-2.717998526
Maximum EIRP PSD Corrected (dBm/MHz)	-7.857998526	-8.117998526
Measurement uncertainty (dB)	<±1.20	

Mode 802.11 ac40 (HT40)

	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
Maximum Average PSD (dBm/MHz)	-4.14	-4.59
Duty Cycle Correction Factor (dB)	1.91566702	
Maximum Average PSD Corrected (dBm/MHz)	-2.22433298	-2.67433298
Maximum EIRP PSD Corrected (dBm/MHz)	-7.62433298	-8.07433298
Measurement uncertainty (dB)	<±1.20	

Mode 802.11 ac80 (VHT80)

	Low Channel 42 (5210 MHz)
Maximum Average PSD (dBm/MHz)	-7.82
Duty Cycle Correction Factor (dB)	3.288378818
Maximum Average PSD Corrected (dBm/MHz)	-4.531621182
Maximum EIRP PSD Corrected (dBm/MHz)	-9.931621182
Measurement uncertainty (dB)	<±1.20

Verdict: PASS

FCC Section 15.407 Subclause (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 360º 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 1 GHz-40 GHz and a distance of 3m for frequency range 30MHz-1GHz.

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 following worst case: 802.11a20: 6 Mbits. 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.

Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
50.451	35.3	40	V	Quasi-Peak	<±3.81
70.853	28.7	40	V	Quasi-Peak	<±3.81
98.466	26.4	43.5	V	Quasi-Peak	<±3.81
125.012	24.4	43.5	V	Quasi-Peak	<±3.81
139.206	23.6	43.5	V	Quasi-Peak	<±3.81

Frequency range 1 - 40 GHz

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 dBµV/m at 3 m) are measured with an average detector for checking compliance with the average limit.

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

  - LOW CHANNEL. Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.39866	49.58	68.23	H	Peak	<±2.78
	37.02	54		Average	<±2.78
10.36383	57.47	68.23	V	Peak	<±4.72

  - MIDDLE CHANNEL. Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.39884	49.51	68.23	H	Peak	<±2.78
	38.18	54		Average	<±2.78
10.0001	46.67	68.23	V	Peak	<±4.72
10.40233	59.83	68.23	V	Peak	<±4.72

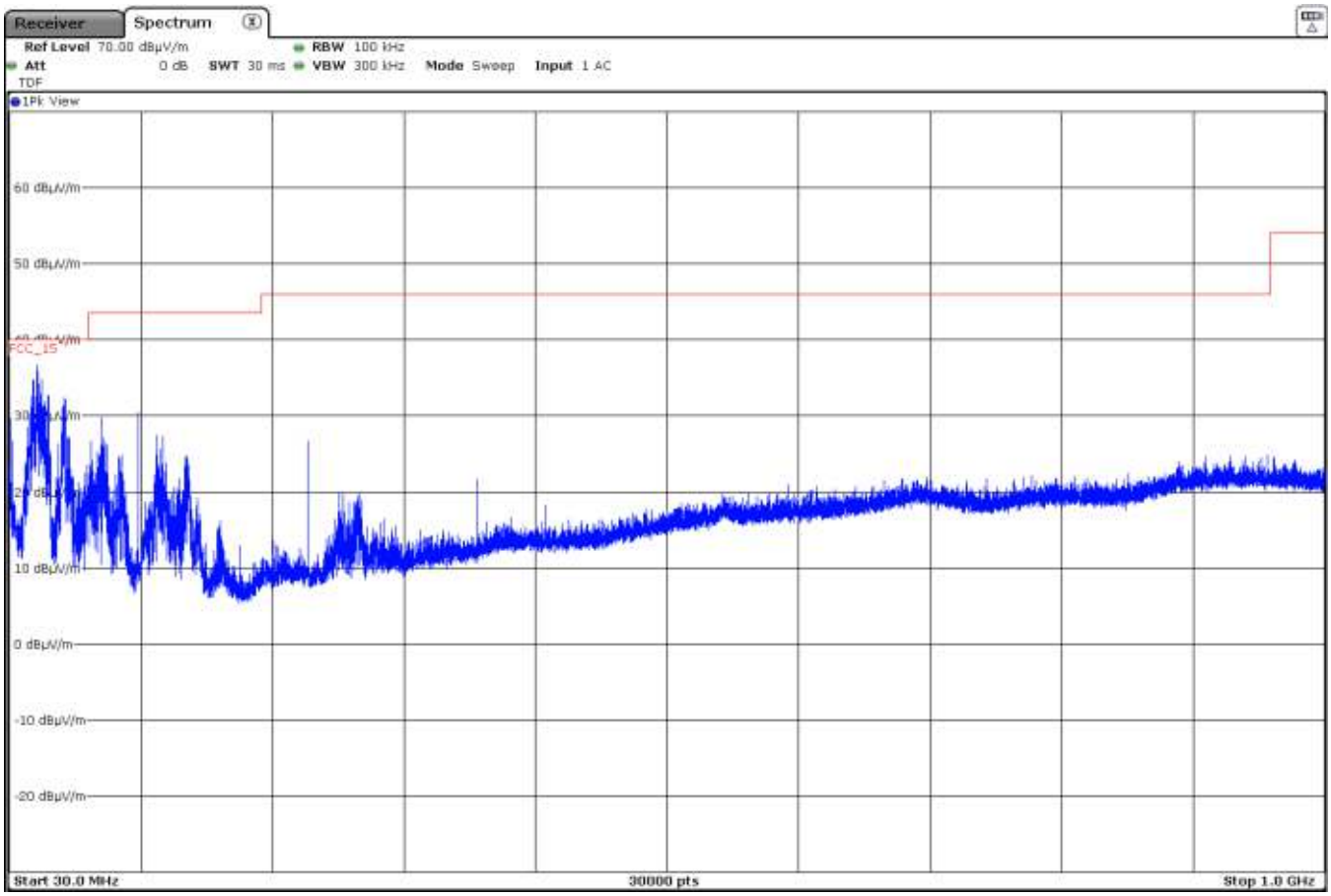
- HIGH CHANNEL. Spurious frequencies detected at less than 20 dB below the limit:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.39958	49.05	68.23	H	Peak	<±2.78
	36.98	54		Average	<±2.78
10.43978	57.66	68.23	V	Peak	<±4.72

Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz

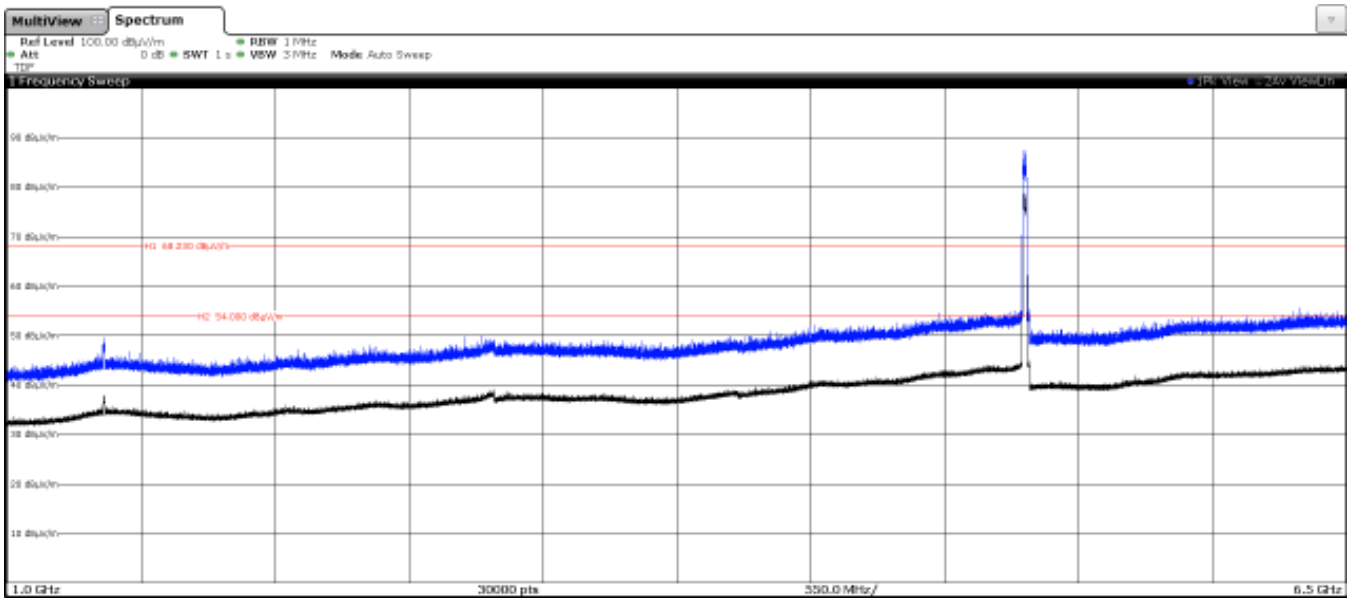
This plot is valid for the Low, Middle and High Channels and all the modulation modes.



- **Mode 802.11 a20.**

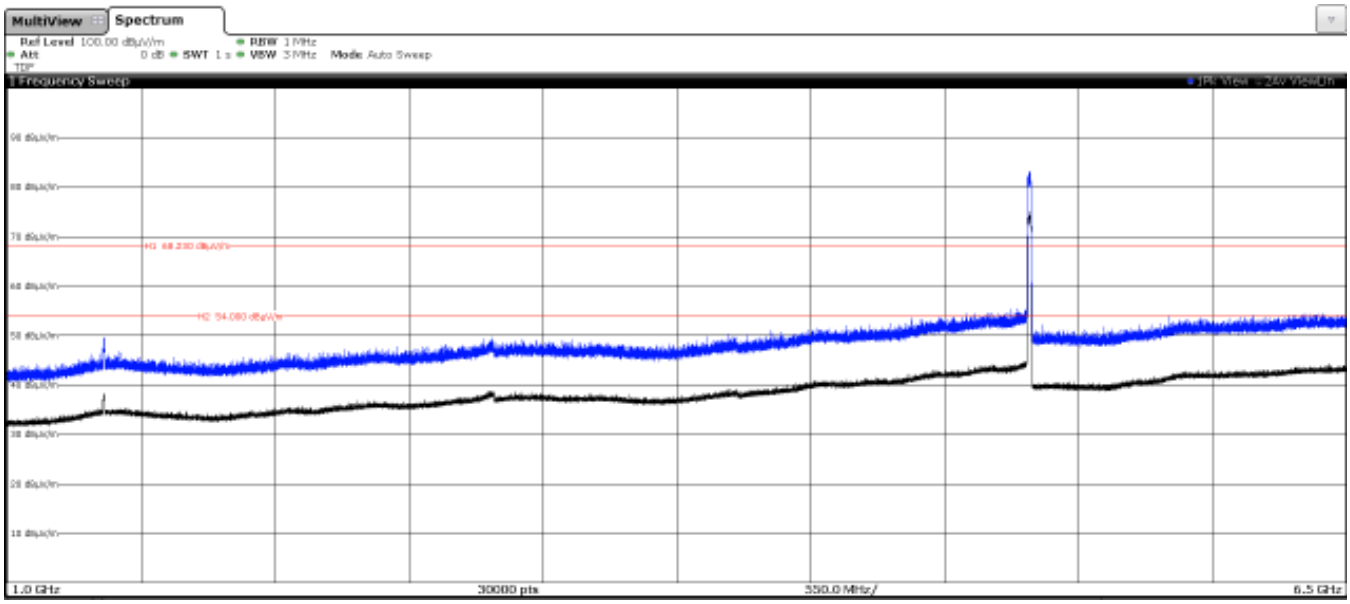
FREQUENCY RANGE 1 – 6.5 GHz (worst mode)

- Low Channel:



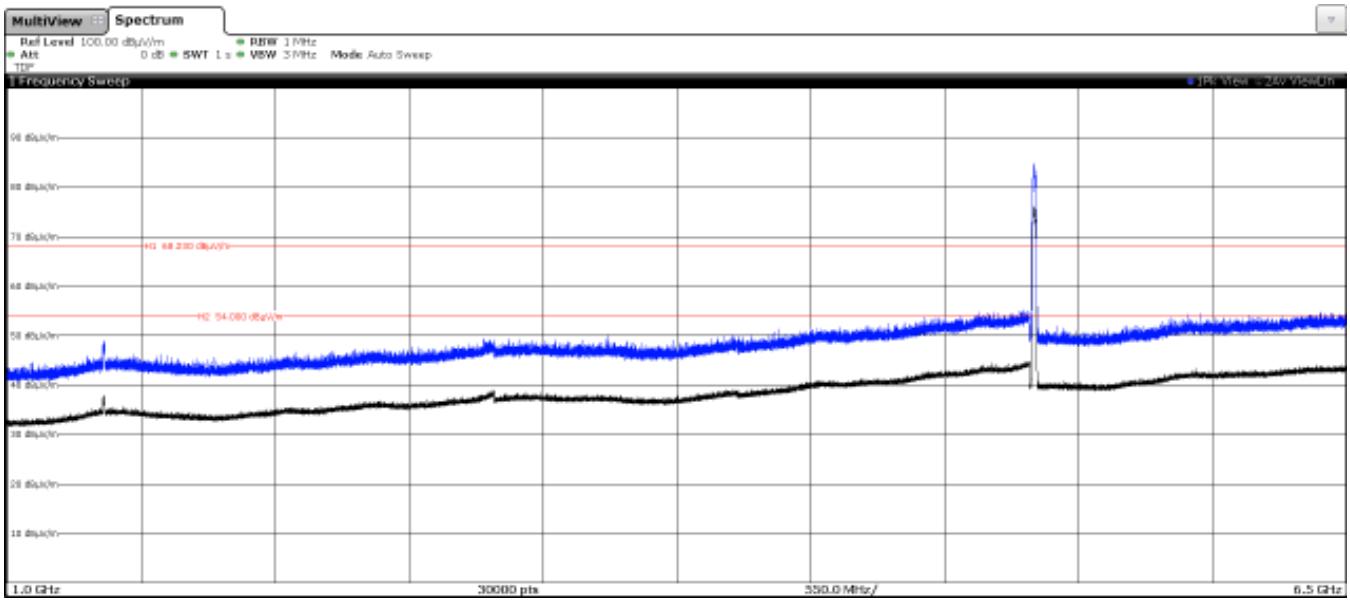
Note: The peak shown in the plot above the limit is the carrier frequency.

- Middle Channel:



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

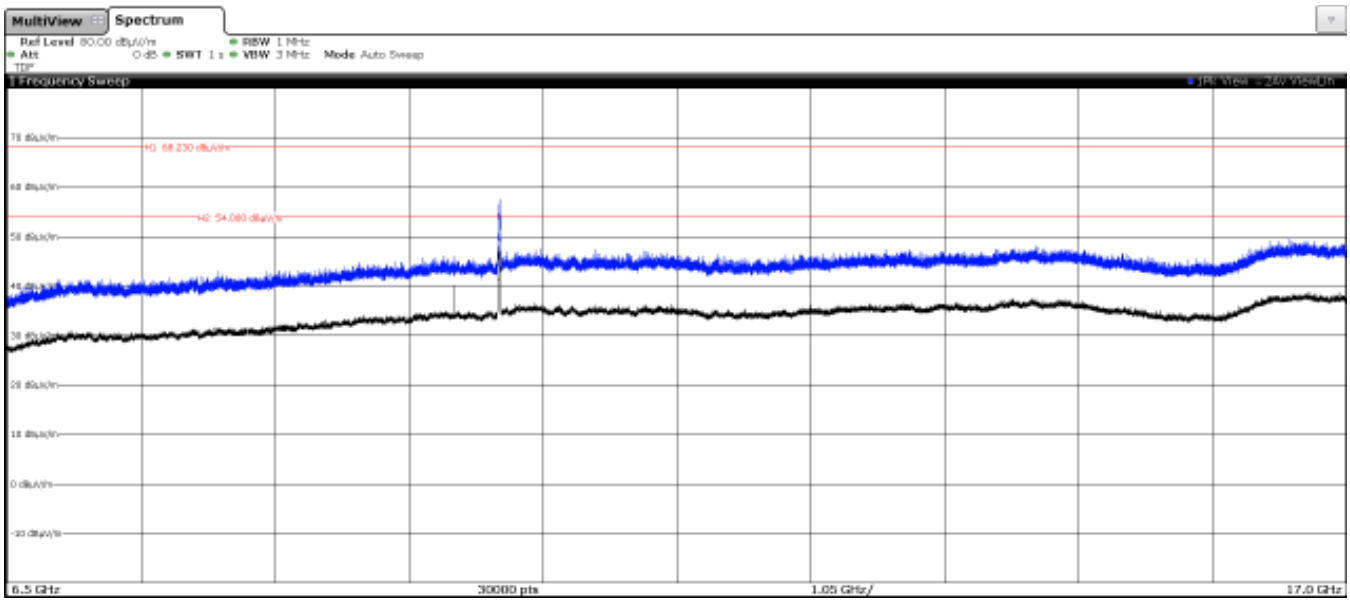
- High Channel:



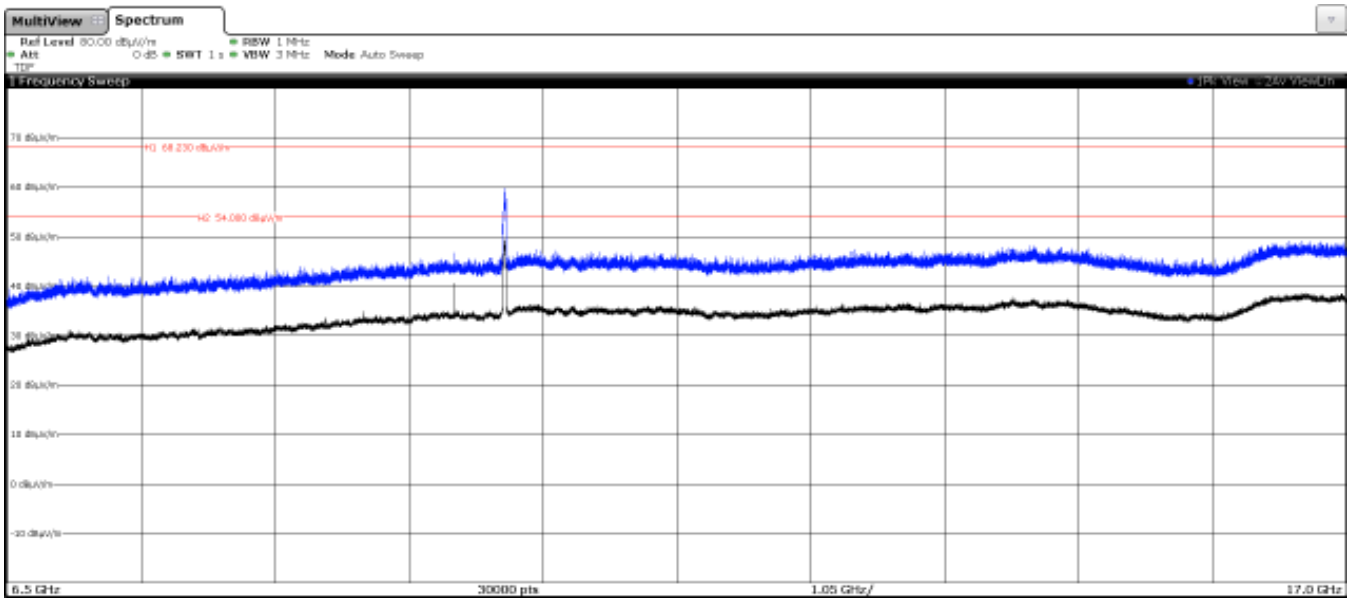
Note: The peak shown in the plot above the limit is the carrier frequency.

FREQUENCY RANGE 6.5 - 17 GHz. (worst mode)

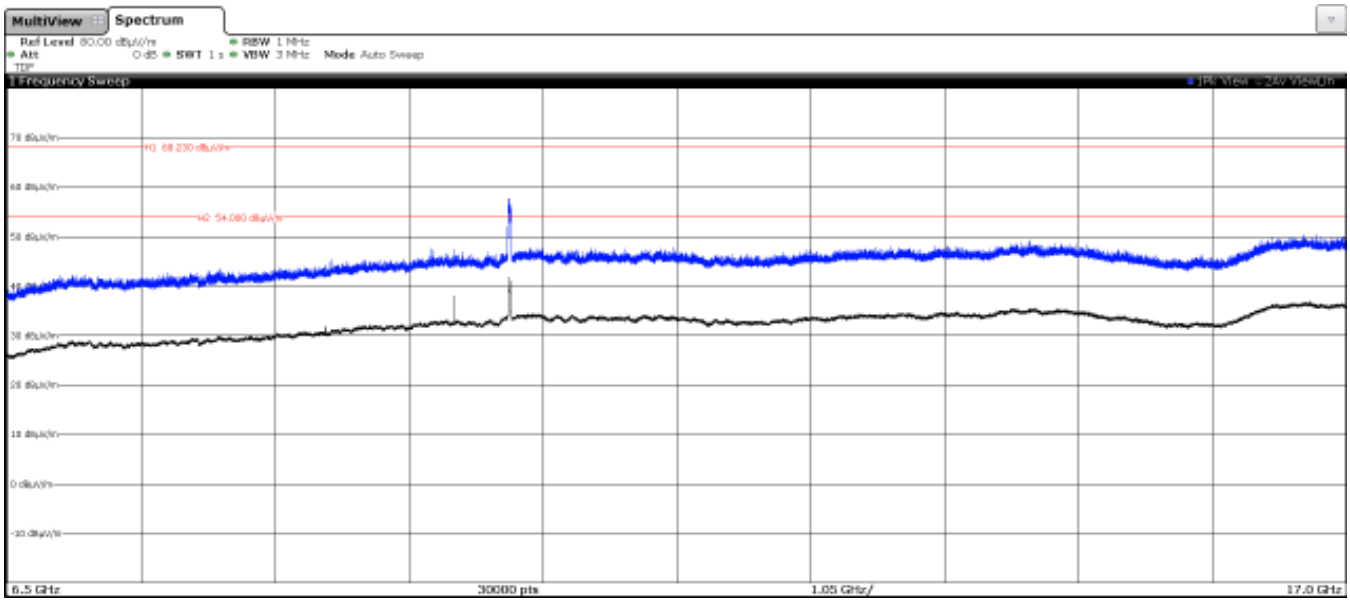
- Low Channel:



- Middle Channel:

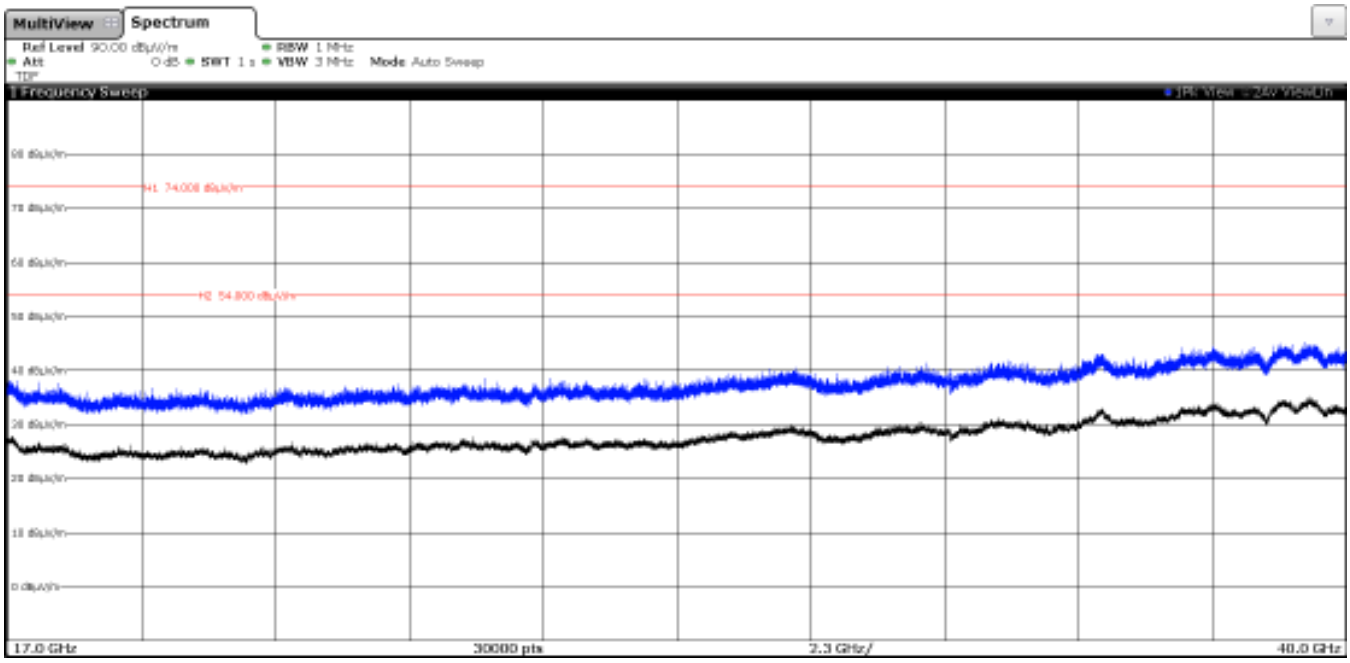


- High Channel:



FREQUENCY RANGE 17 - 40 GHz

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



FCC Section 15.407 Subclause (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.

- **Mode 802.11 a20**

- Lower Band Edge Channel 36 (5180 MHz):

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5.04113	52.9	74	H	Peak	<±2.78
	42.27	54	H	Average	<±2.78

- Upper Band Edge Channel 48 (5240 MHz):

No radiated spurious frequencies detected.

- **Mode 802.11 n20 (HT20)**

- Lower Band Edge Channel 36 (5180 MHz):

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5.12953	53.31	74	H	Peak	<±2.78
	42.09	54	H	Peak	<±2.78

- Upper Band Edge Channel 48 (5240 MHz):

No radiated spurious frequencies detected.

- **Mode 802.11 ac20 (HT20)**

- Lower Band Edge Channel 36 (5180 MHz):

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5.14491	53.82	74	V	Peak	<±2.78
	42.28	54	V	Peak	<±2.78

- Upper Band Edge Channel 48 (5240 MHz):

No radiated spurious frequencies detected.

- **Mode 802.11 n40 (HT40)**

- Lower Band Edge Channel 38 (5190 MHz):

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5.12866	53.7	74	H	Peak	<±2.78
	42.14	54	H	Average	<±2.78

- Upper Band Edge Channel 46 (5230 MHz):

No radiated spurious frequencies detected.

- **Mode 802.11 ac40 (VHT40)**

- Lower Band Edge Channel 38 (5190 MHz):

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5.14708	53.59	74	V	Peak	<±2.78
	42.08	54	V	Average	<±2.78

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

No radiated spurious frequencies detected.

- **Mode 802.11 ac80 (VHT80)**

- Lower Band Edge Channel 42 (5210 MHz):

Spurious frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
5.03983	53.09	74	V	Peak	<±2.78
	42.30	54	V	Average	<±2.78

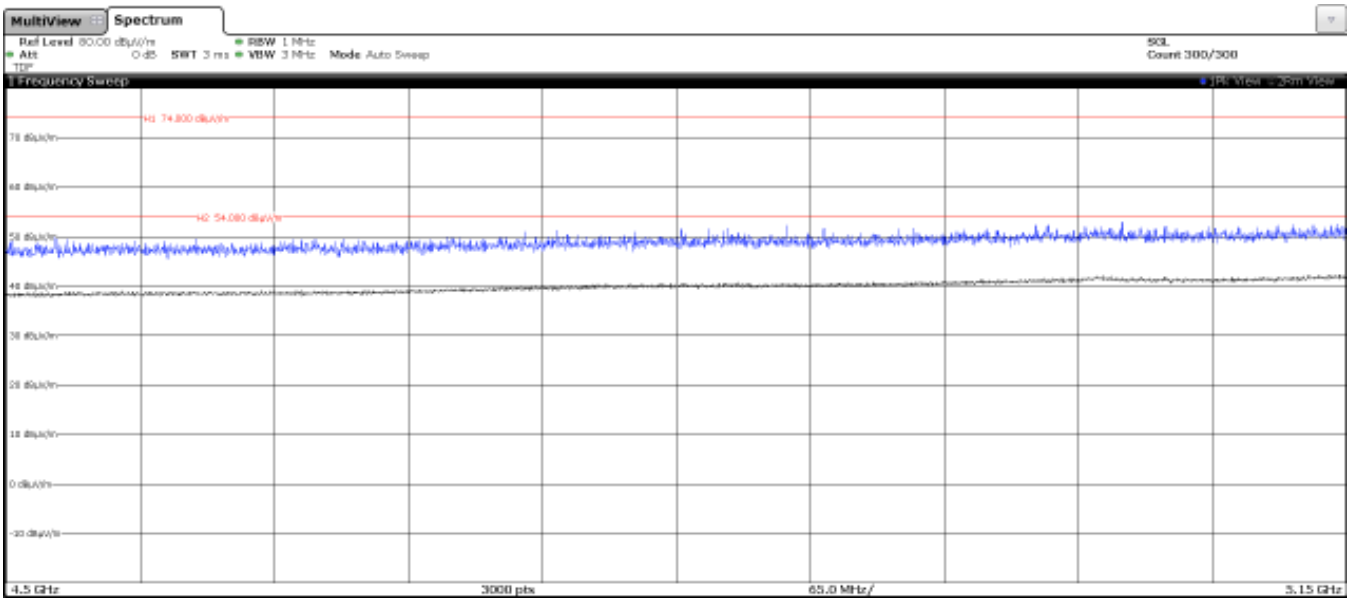
- Upper Band Edge Channel 42 (5210 MHz):

No radiated spurious frequencies detected.

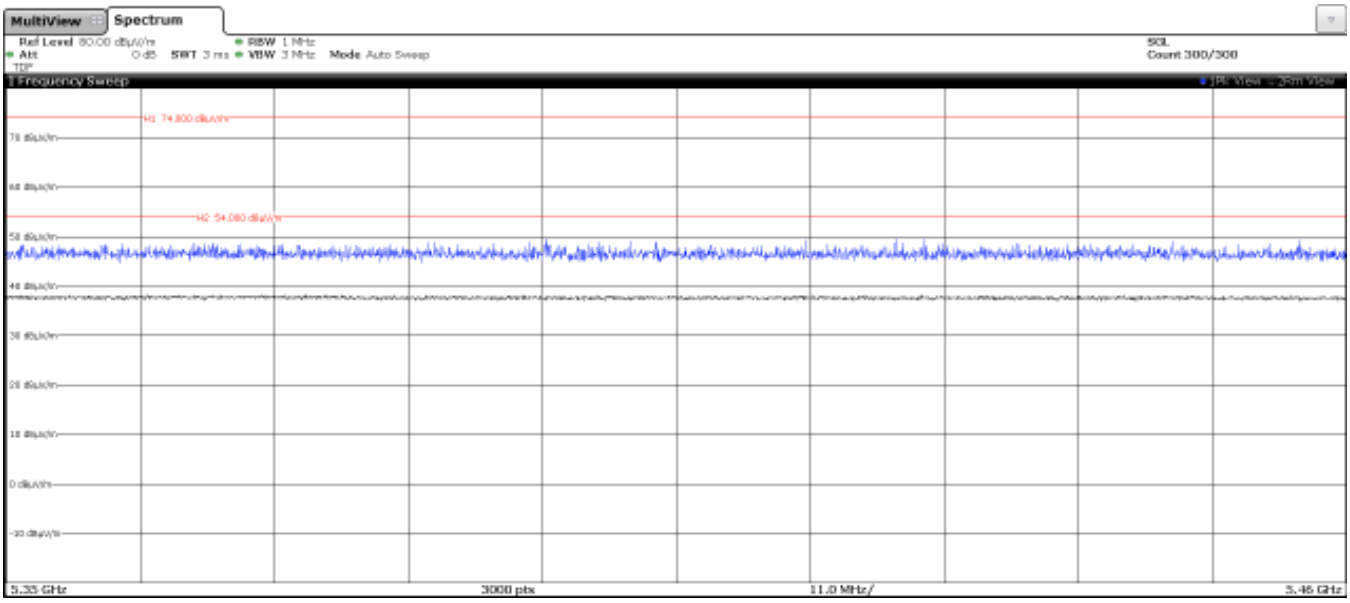
Verdict: PASS

- **Mode 802.11 a20**

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

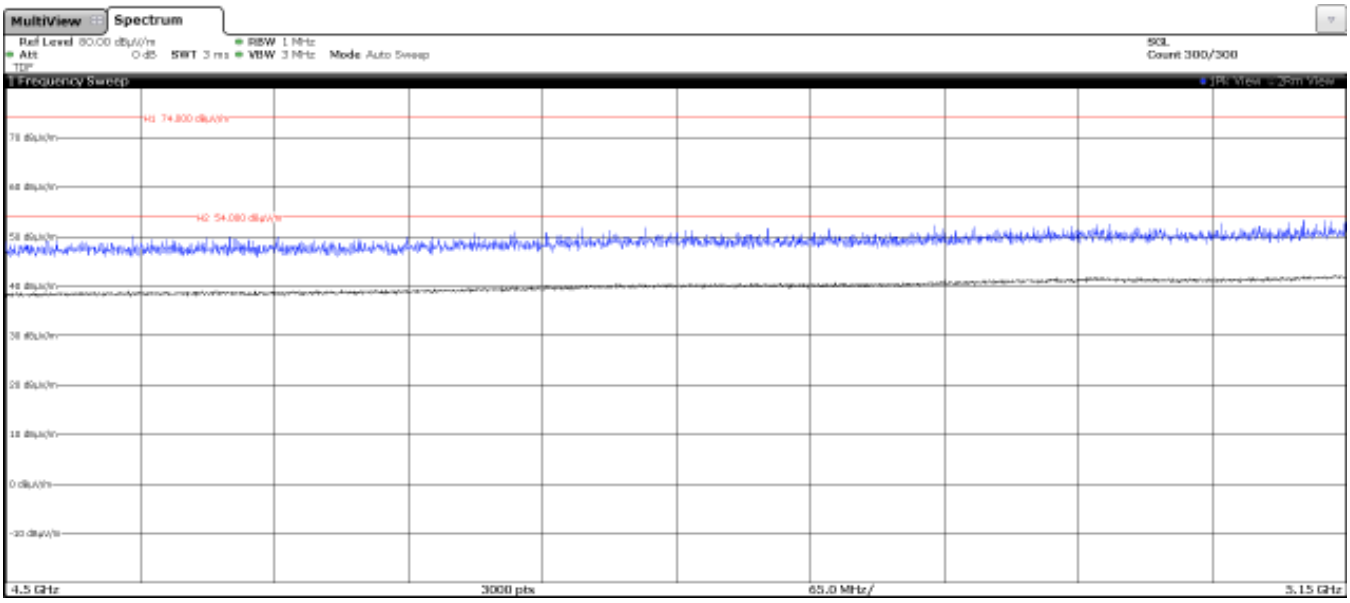


  - Upper Band Edge Channel 48 (5350 to 5460 MHz)

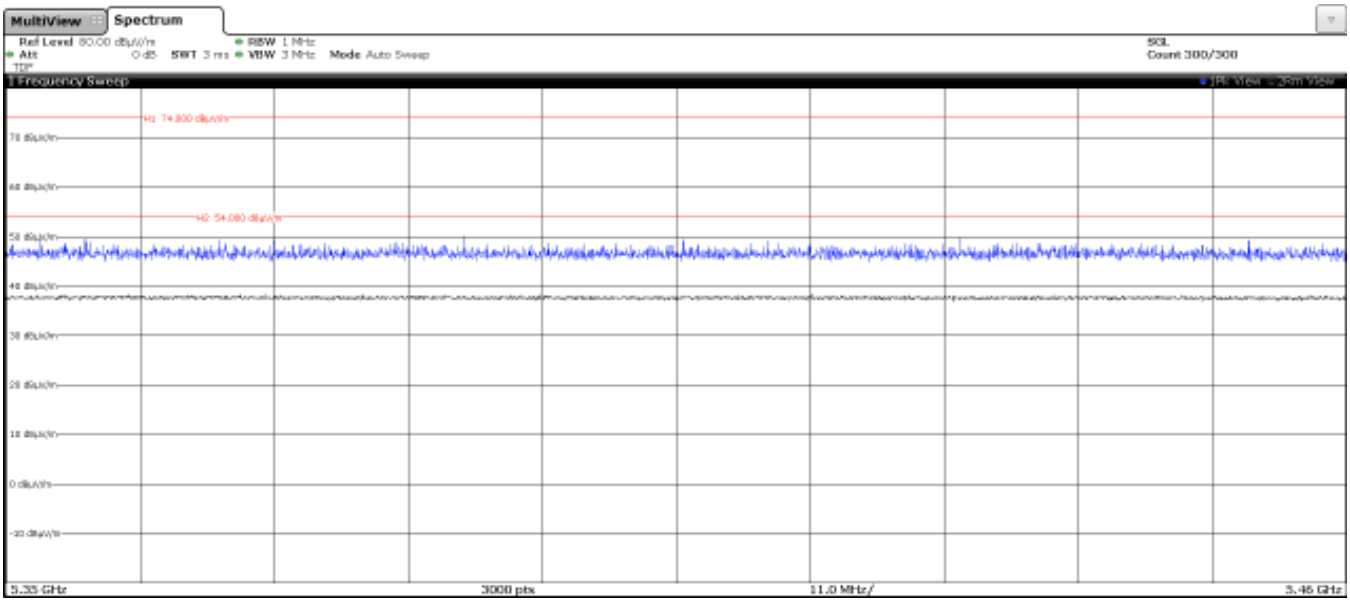


- **Mode 802.11 n20 (HT20)**

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

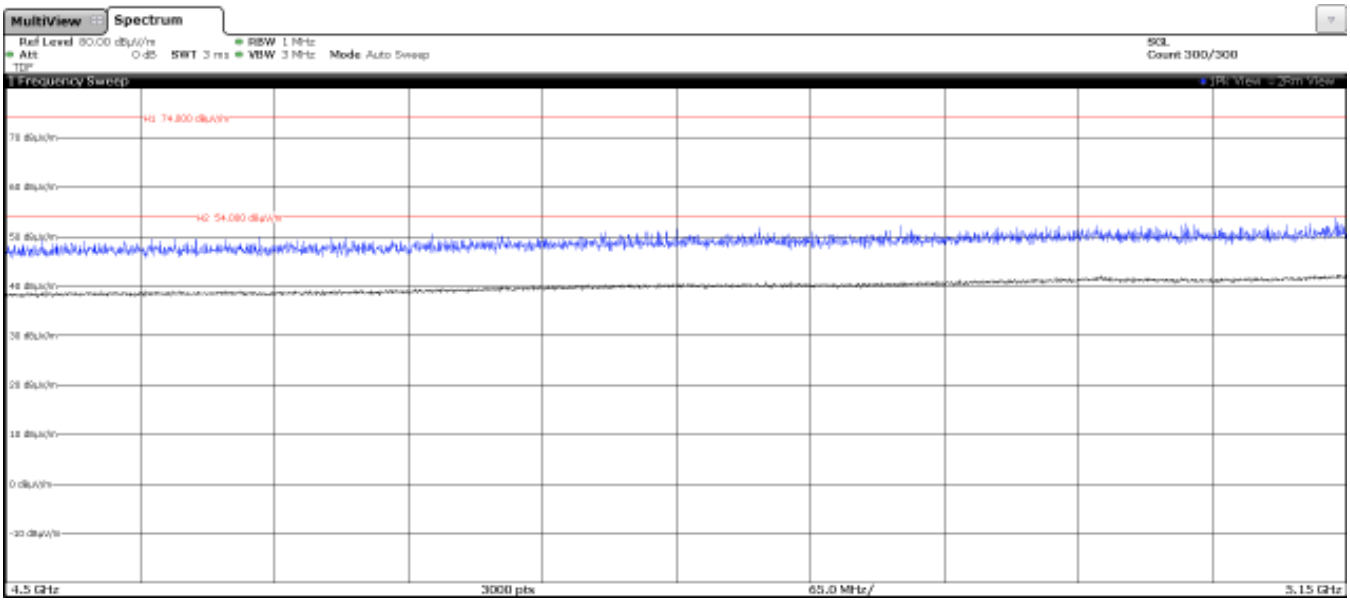


  - Upper Band Edge Channel 48 (5350 to 5460 MHz)

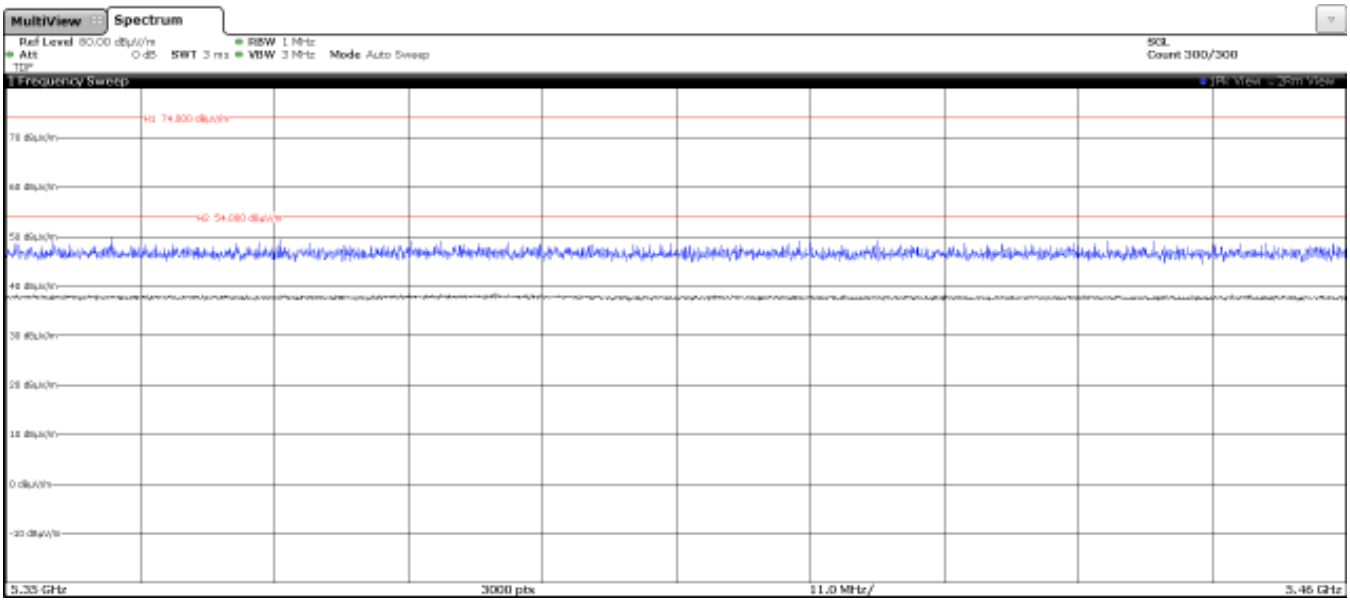


- **Mode 802.11 ac20 (VHT20)**

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

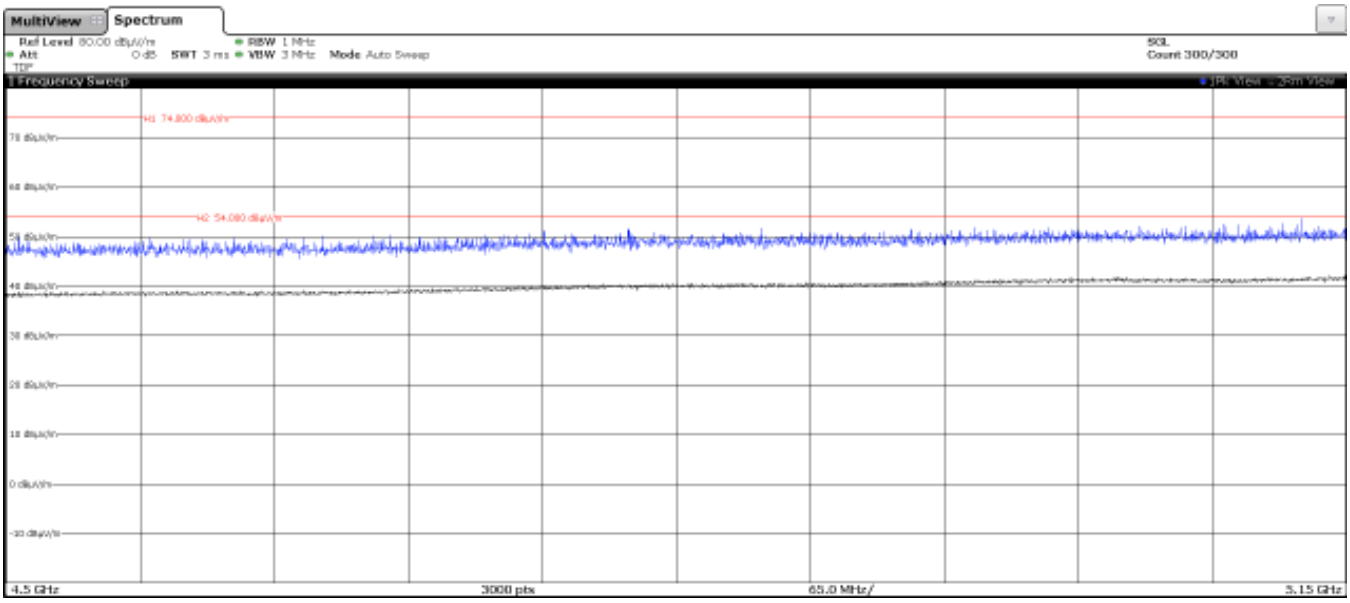


- Upper Band Edge Channel 48 (5350 to 5460 MHz)

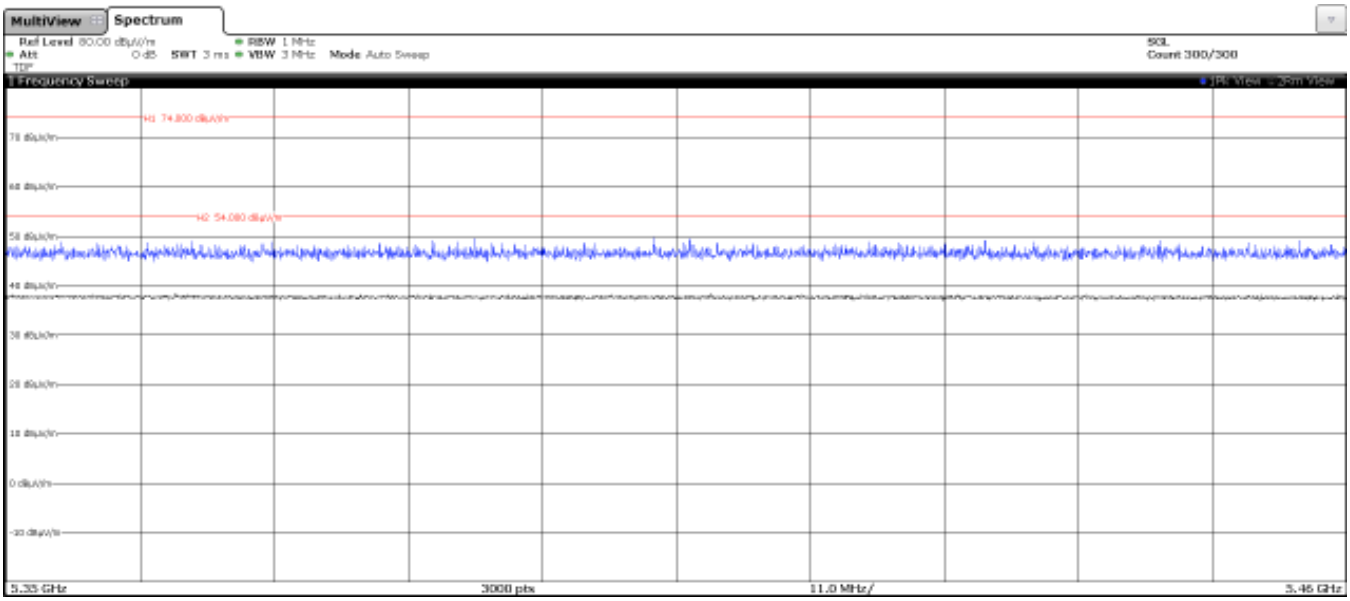


- **Mode 802.11 n40 (HT40)**

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

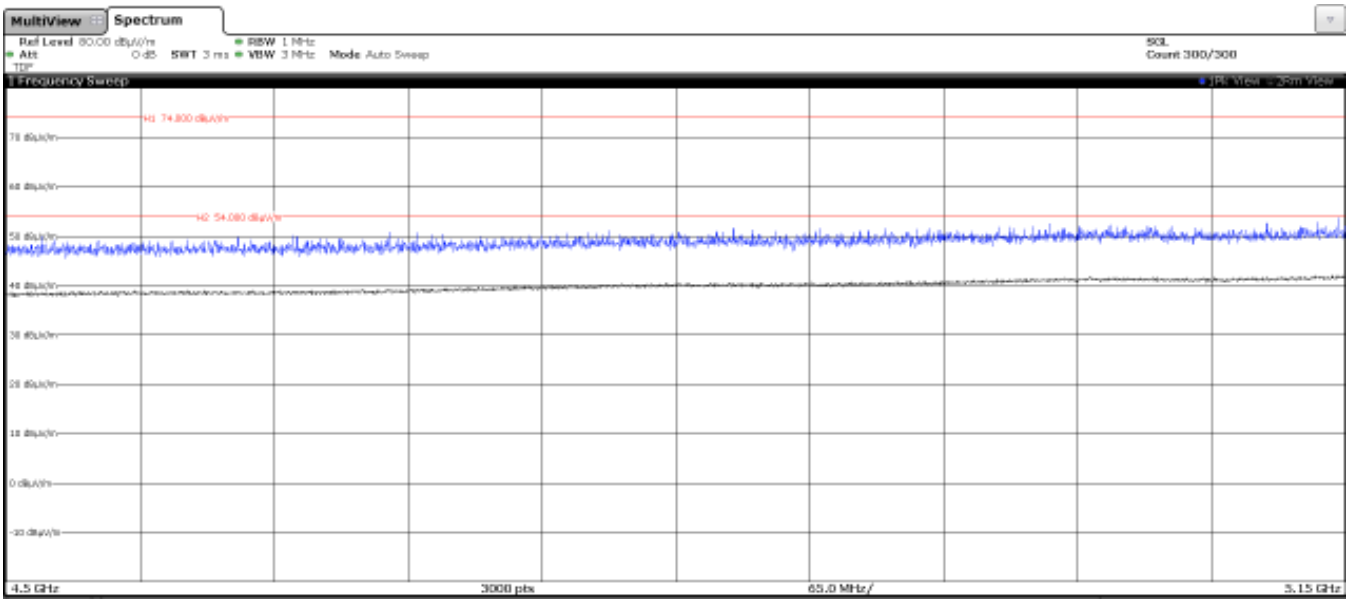


- Upper Band Edge Channel 46 (5350 to 5460 MHz)

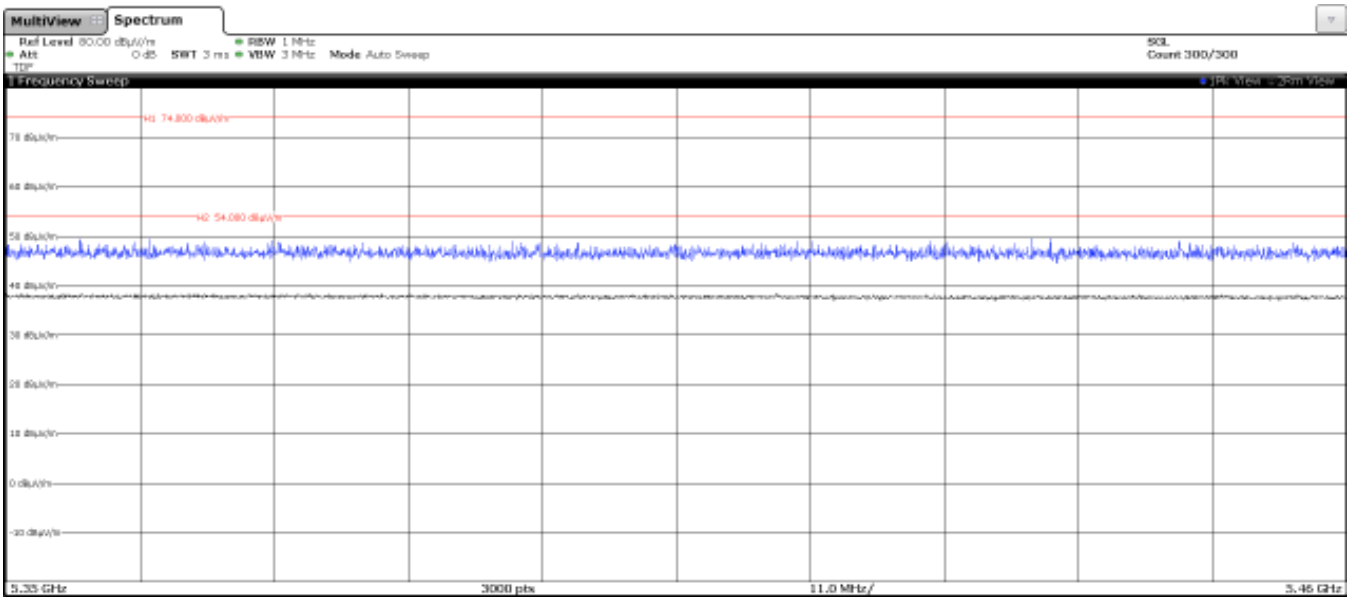


- **Mode 802.11 ac40 (VHT40)**

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

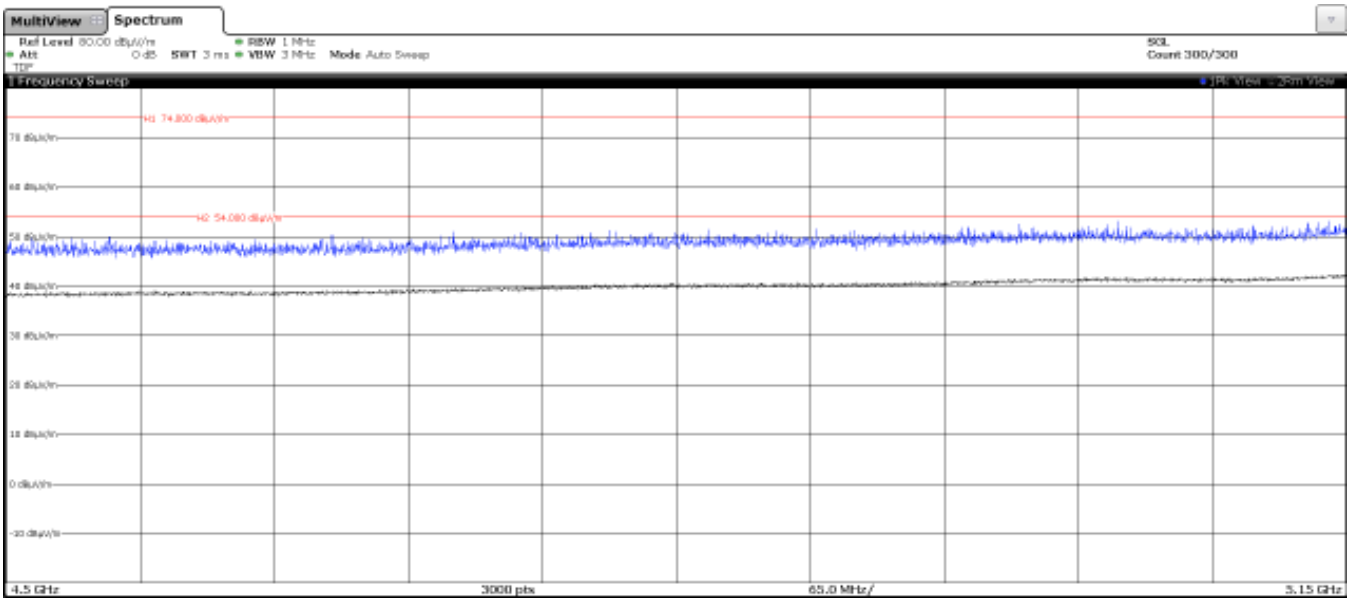


- Upper Band Edge Channel 46 (5350 to 5460 MHz)

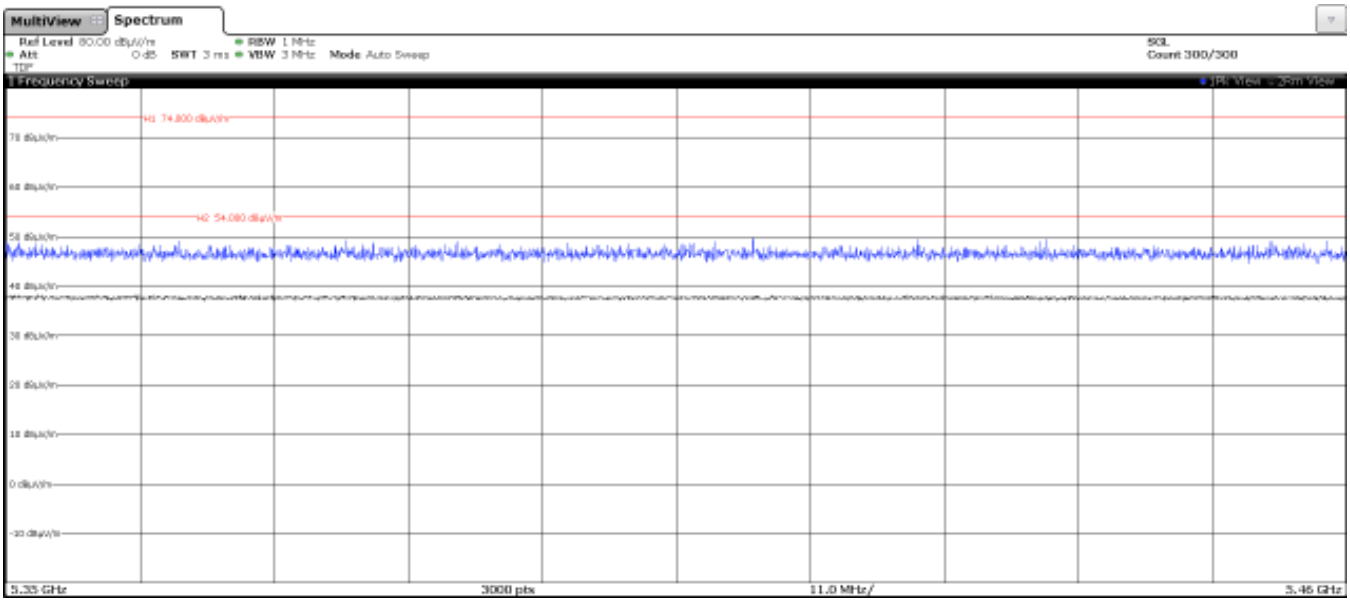


- **Mode 802.11 ac80 (VHT80)**

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



- 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

POWER SUPPLY (V):

V nonimal: 12 Vdc.

Type of Power Supply: External power supply (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)
	Lowest: 149	5745
	Middle: 157	5785
	Highest: 165	5825
Channel Spacing:	40 MHz	
Transmit Channels	Channel	Channel Frequency (MHz)
	Lowest: 151	5755
	Highest: 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 and FCC KBD 662911 D01 Multiple Transmitter Output v02r01 dated 10/31/2013.

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 Mbits
- 802.11n HT20: MCS0
- 802.11n HT40: MCS0
- 802.11ac VHT20: MCS0
- 802.11ac VHT40: MCS0
- 802.11ac VHT80: MCS0

WIFI FCC:

tx_test.sh -a wlan0 stop

a20 - Core0

tx_test.sh -a wlan0 149 0 -d x -r 6 20 –c US

tx_test.sh -a wlan0 157 0 -d x -r 6 20 -c US

tx_test.sh -a wlan0 165 0 -d x -r 6 20 -c US

n20 - Core0

tx_test.sh -a wlan0 149 0 -d x -h 0 20 -c US

tx_test.sh -a wlan0 157 0 -d x -h 0 20 -c US

tx_test.sh -a wlan0 165 0 -d x -h 0 20 -c US

ac20 - Core0

tx_test.sh -a wlan0 149 0 -d x -v 0 20 -c US

tx_test.sh -a wlan0 157 0 -d x -v 0 20 -c US

tx_test.sh -a wlan0 165 0 -d x -v 0 20 -c US

n40 - Core0

tx_test.sh -a wlan0 153 0 -d x -h 0 40 -c US

tx_test.sh -a wlan0 161 0 -d x -h 0 40 -c US

ac40 - Core0

tx_test.sh -a wlan0 153 0 -d x -v 0 40 -c US

tx_test.sh -a wlan0 161 0 -d x -v 0 40 -c US

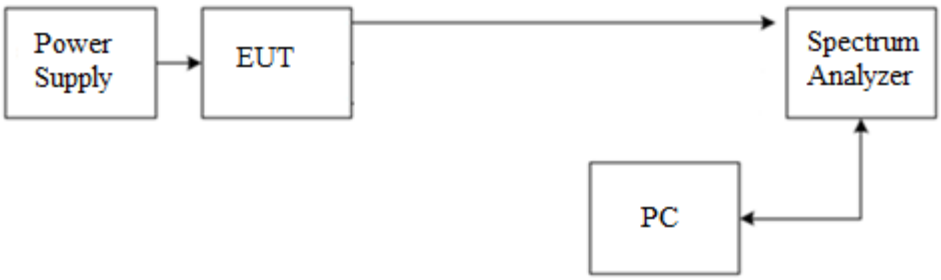
ac80 - Core0

tx_test.sh -a wlan0 161 0 -d x -v 0 80 -c US

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 is situated at a distance of 1 m for the frequency range 1 GHz-40 GHz (1 GHz-18 GHz Double ridge horn antenna and 18 GHz-40 GHz horn antenna).

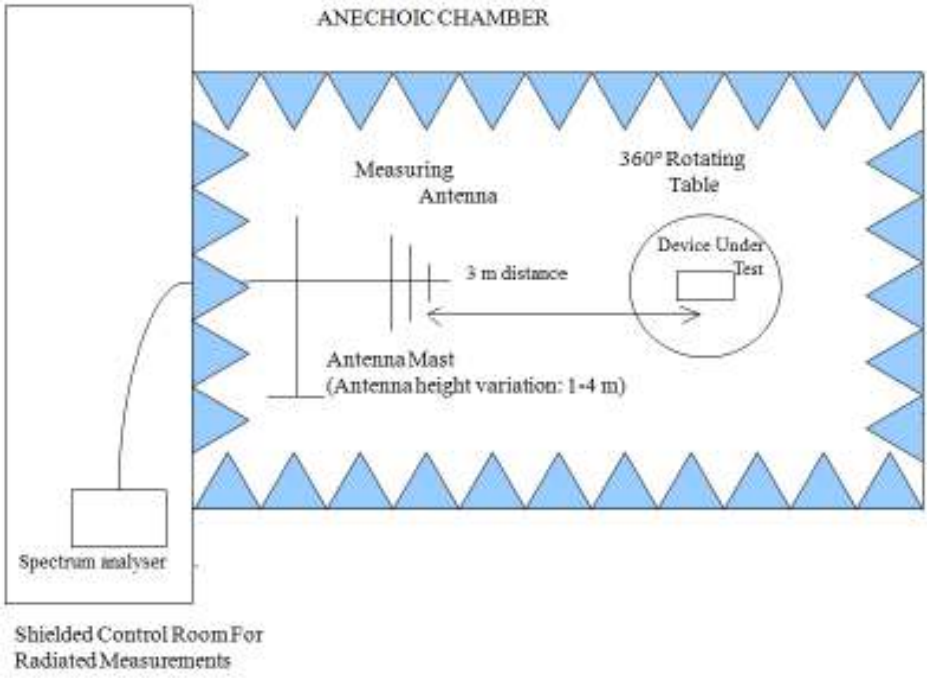
For radiated emissions in the range 1 GHz-40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The EUT was placed at a height of 80 cm above the reference ground plane in the center of the chamber turntable to perform the measurements below 1GHz and the EUT was placed at a height of 1.5 meters above the test chamber floor in the center of the chamber turntable to perform the measurements above 1GHz. It was also rotated 360º and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

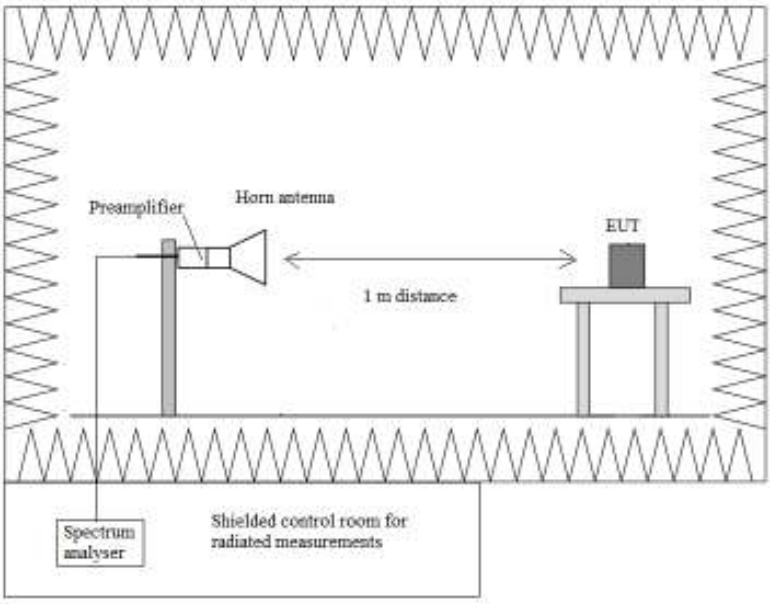
Measurements were made in both horizontal and vertical planes of polarization.

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

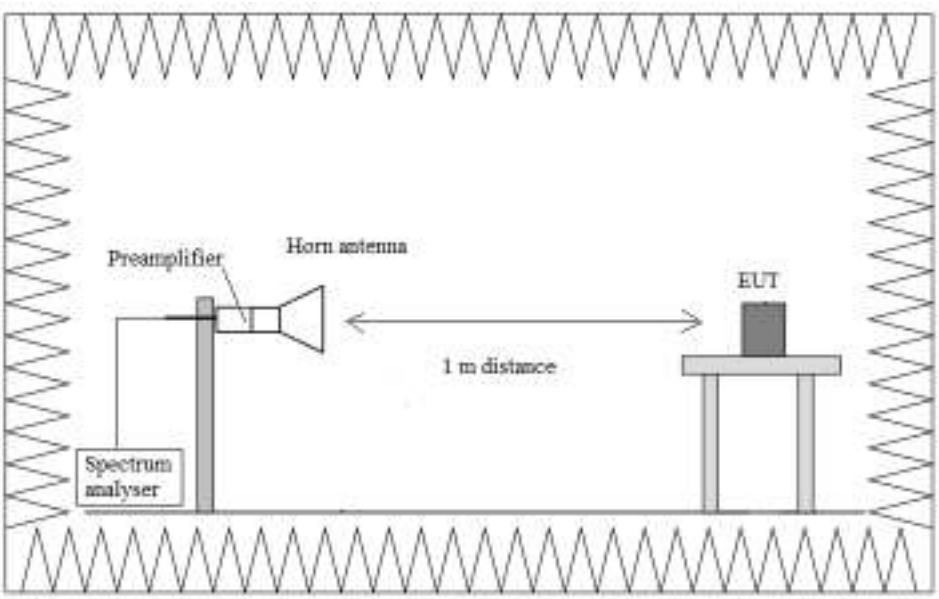
Radiated measurements setup f < 1 GHz



Radiated measurements setup f > 1 GHz up to 18 GHz.



Radiated measurements setup f > 18 GHz up to 40 GHz.



FCC Section 15.247 Subclause (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 Mbits
- 802.11n HT20: MCS0
- 802.11n HT40: MCS0
- 802.11ac VHT20: MCS0
- 802.11ac VHT40: 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)	16.347	16.396	16.442
Measurement uncertainty (kHz)	<±23.02		

Mode 802.11 n20 (HT20)

	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
6 dB Bandwidth (MHz)	17.632	17.631	17.64
Measurement uncertainty (kHz)	<±23.02		

Mode 802.11 ac20 (VHT20)

	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
6 dB Bandwidth (MHz)	17.632	17.622	17.609
Measurement uncertainty (kHz)	<±23.02		

Mode 802.11 n40 (HT40)

	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
6 dB Bandwidth (MHz)	36.103	35.868
Measurement uncertainty (kHz)	<±53.05	

Mode 802.11 ac40 (VHT40)

	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
6 dB Bandwidth (MHz)	35.998	36.028
Measurement uncertainty (kHz)	<±53.05	

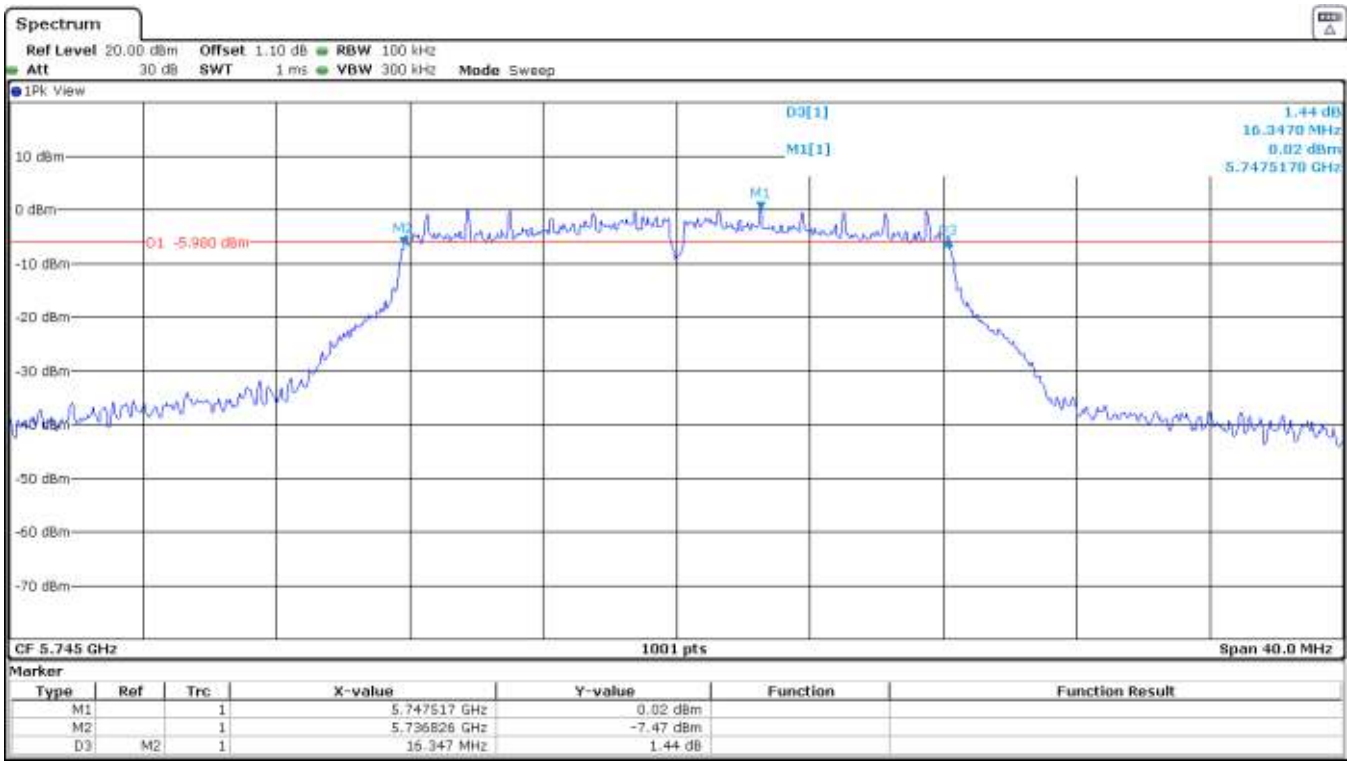
Mode 802.11 ac80 (VHT80)

	Single Channel 155 (5775 MHz)
6 dB bandwidth (MHz)	75.69
Measurement uncertainty (kHz)	<±103.10

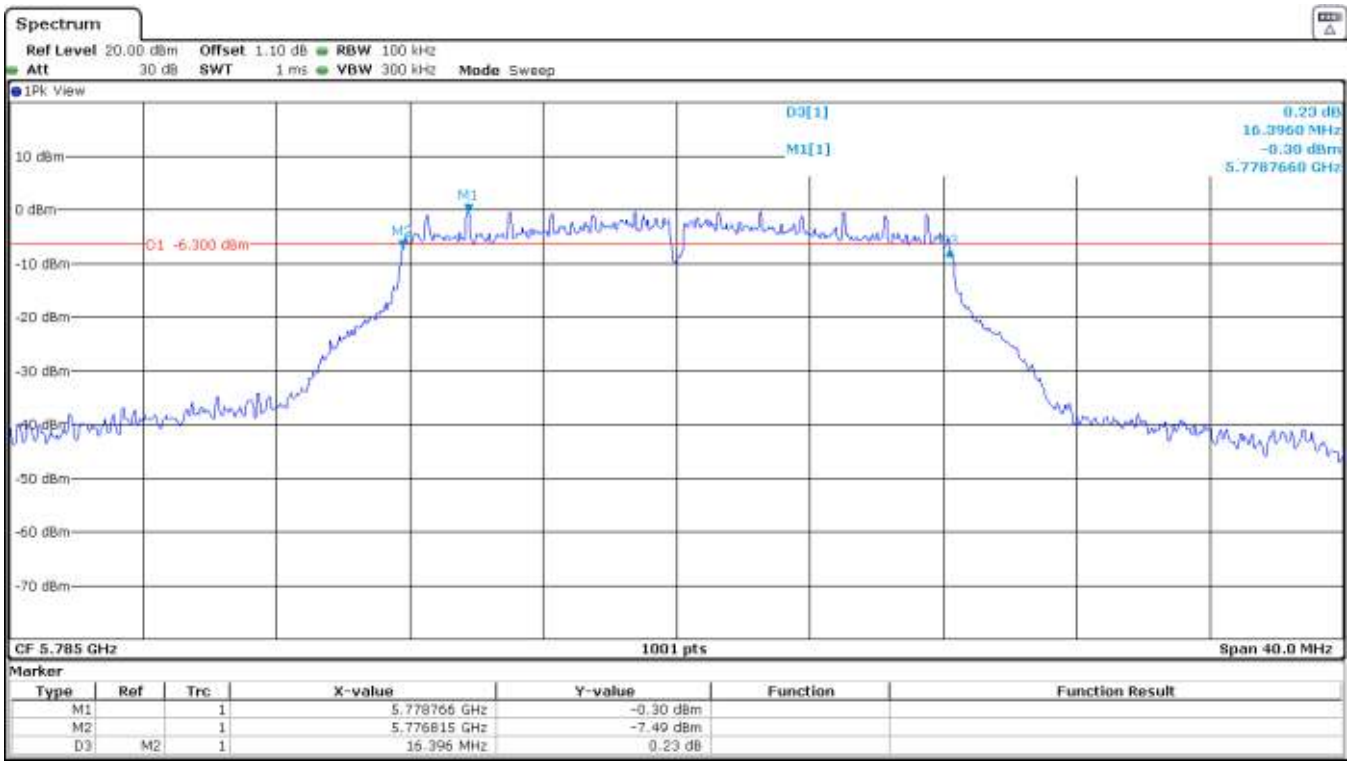
Verdict: PASS

Mode 802.11 a20

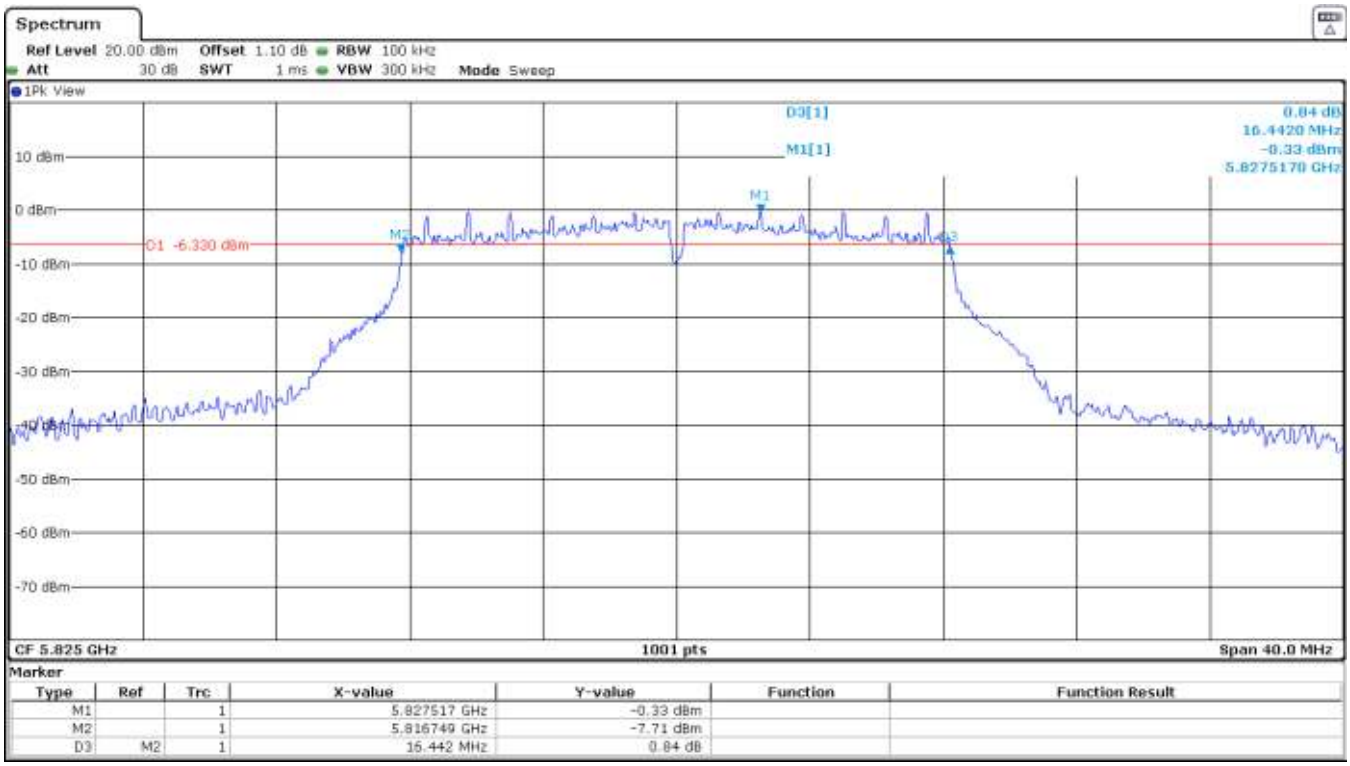
- Low Channel 149:



- Middle Channel 157:

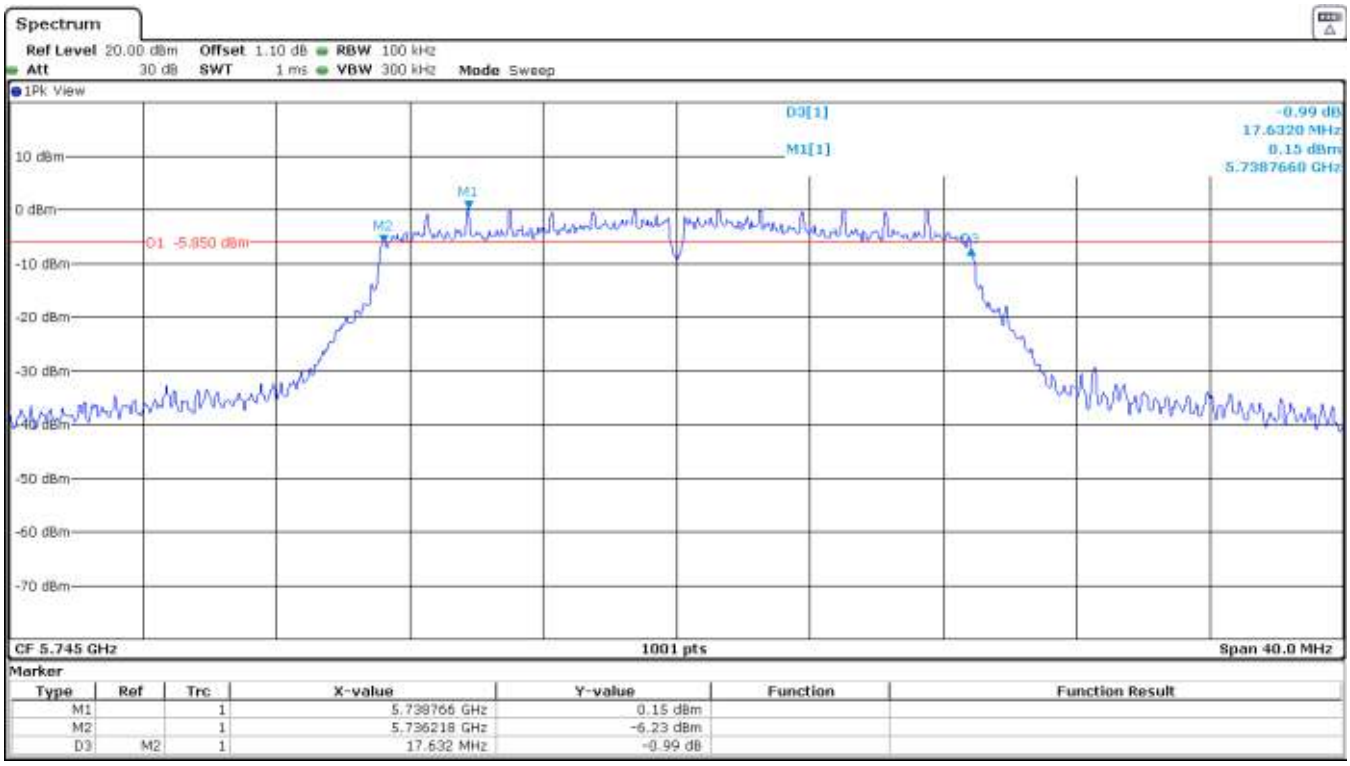


- High Channel 165:

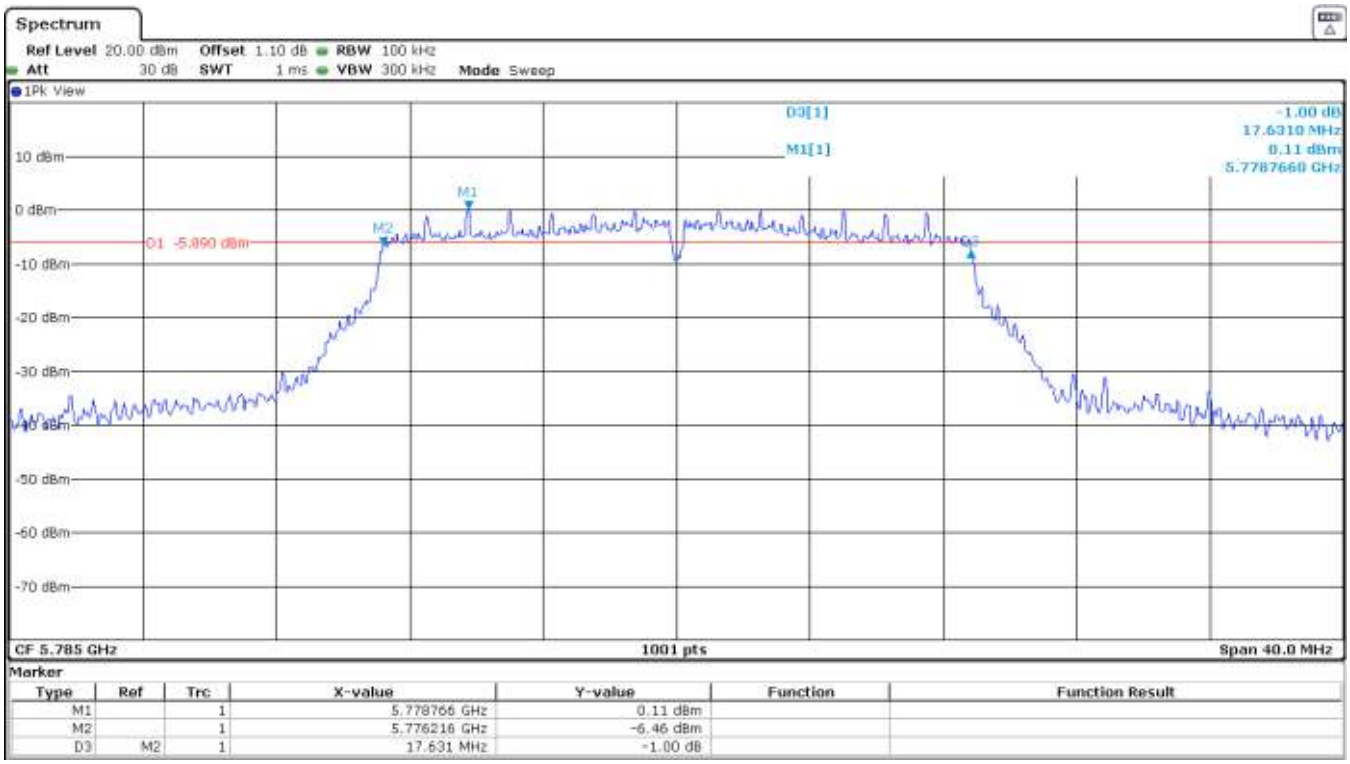


Mode 802.11 n20 (HT20)

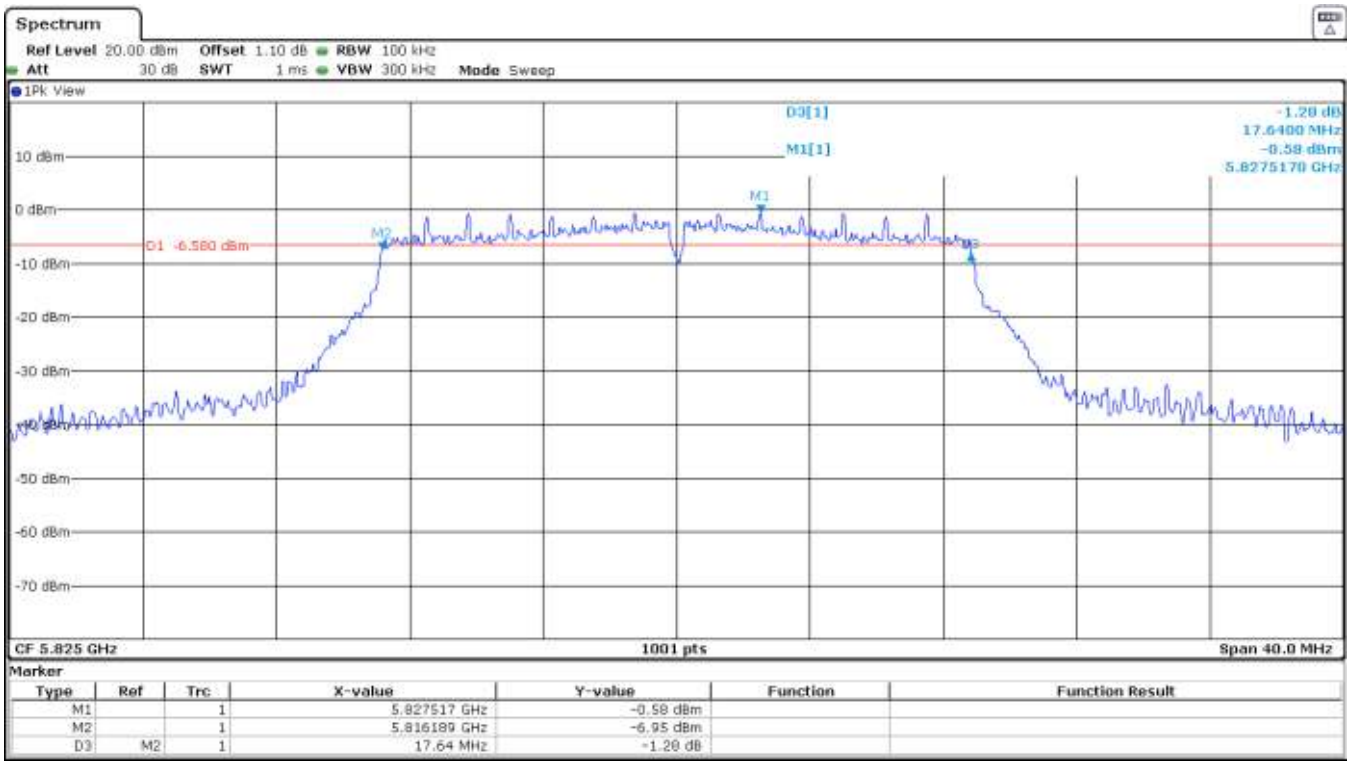
- Low Channel 149:



- Middle Channel 157:

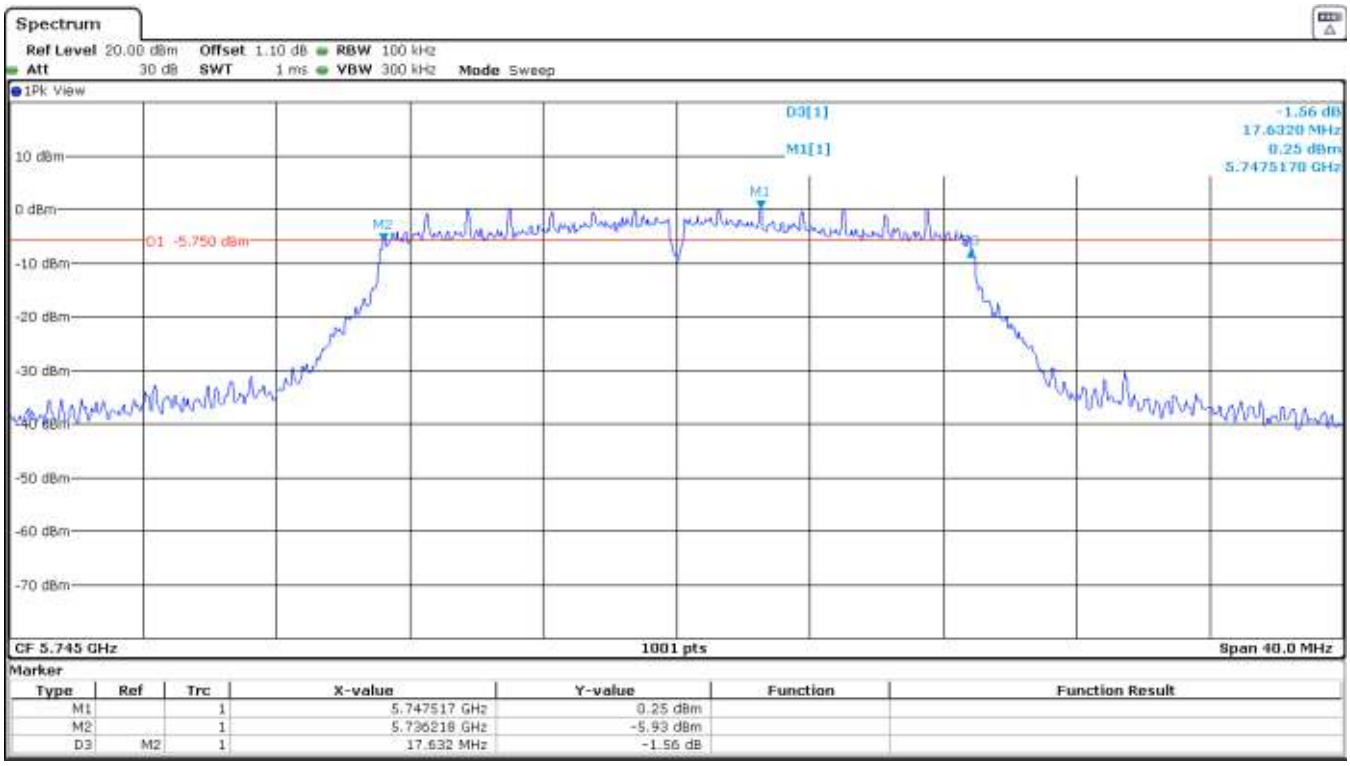


- High Channel 165:

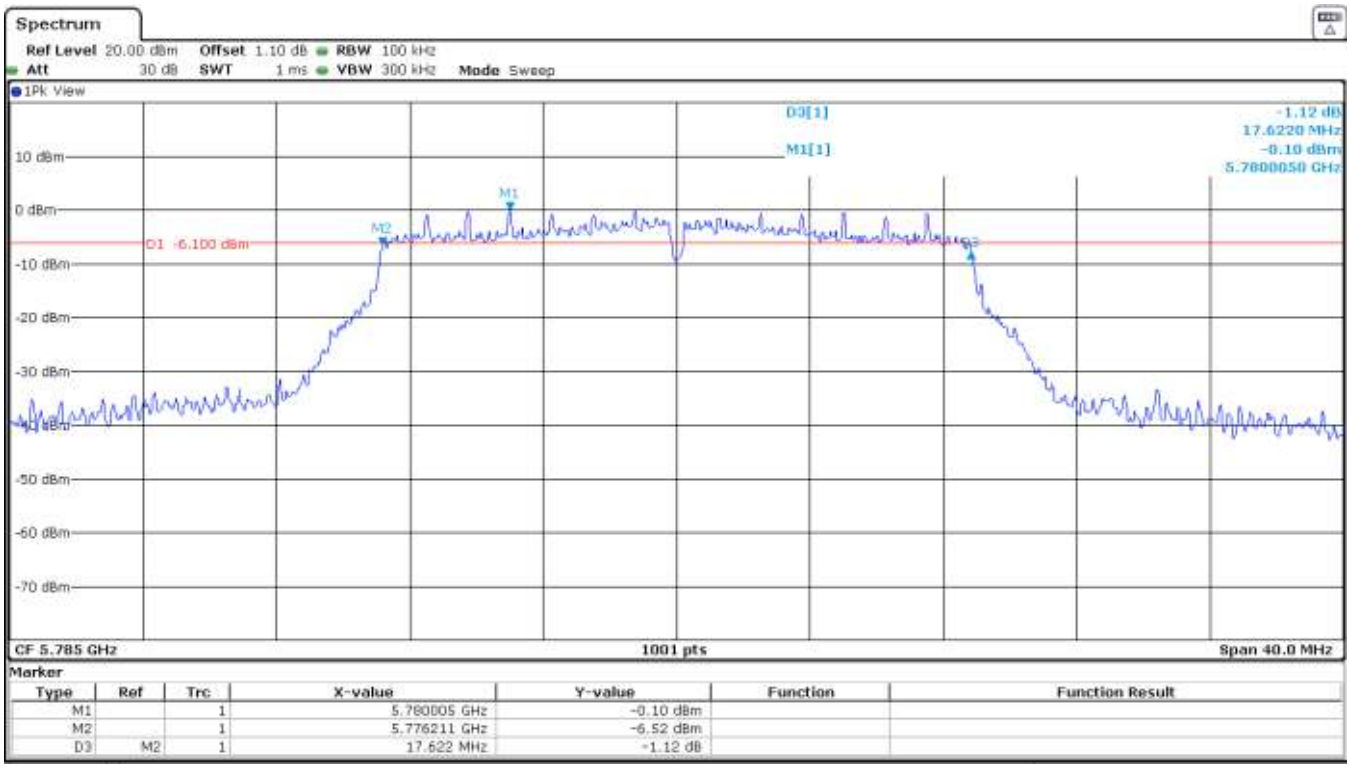


Mode 802.11 ac20 (VHT20)

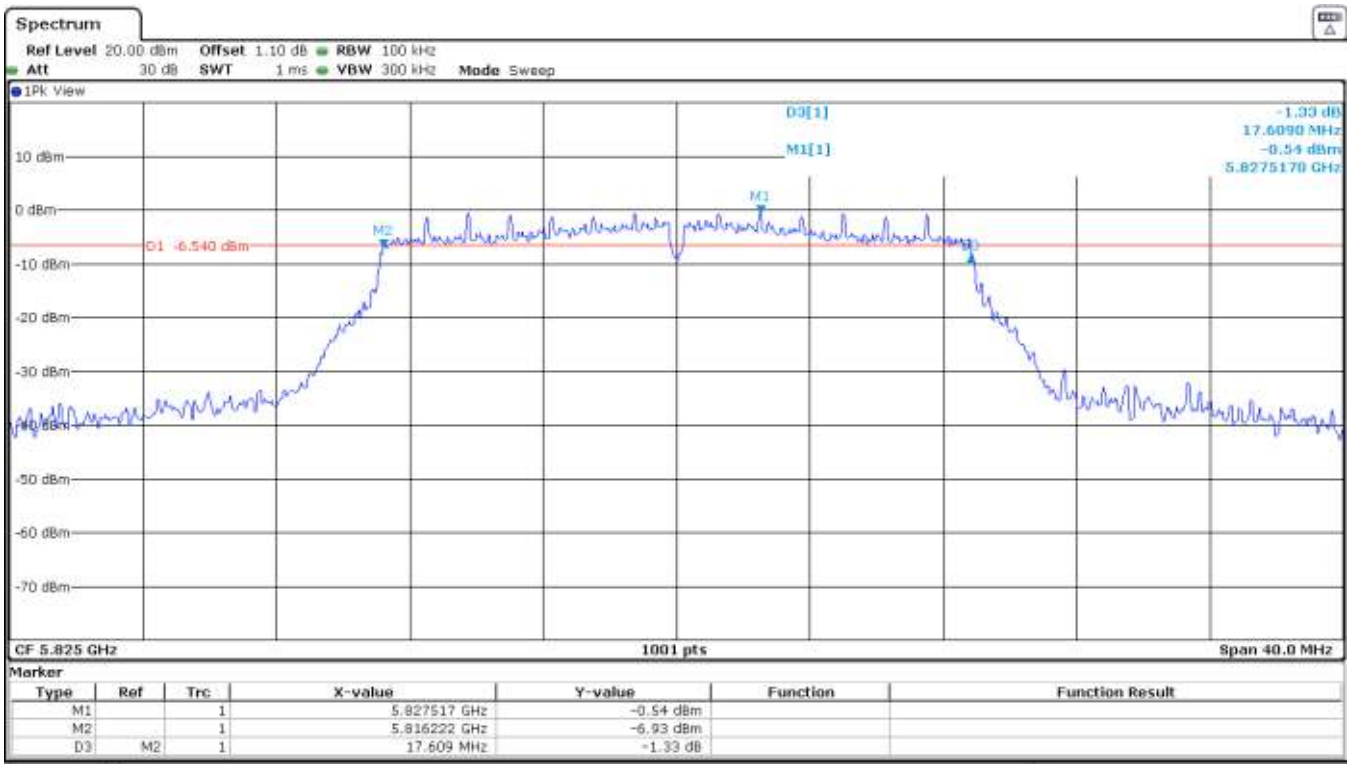
- Low Channel 149:



- Middle Channel 157:

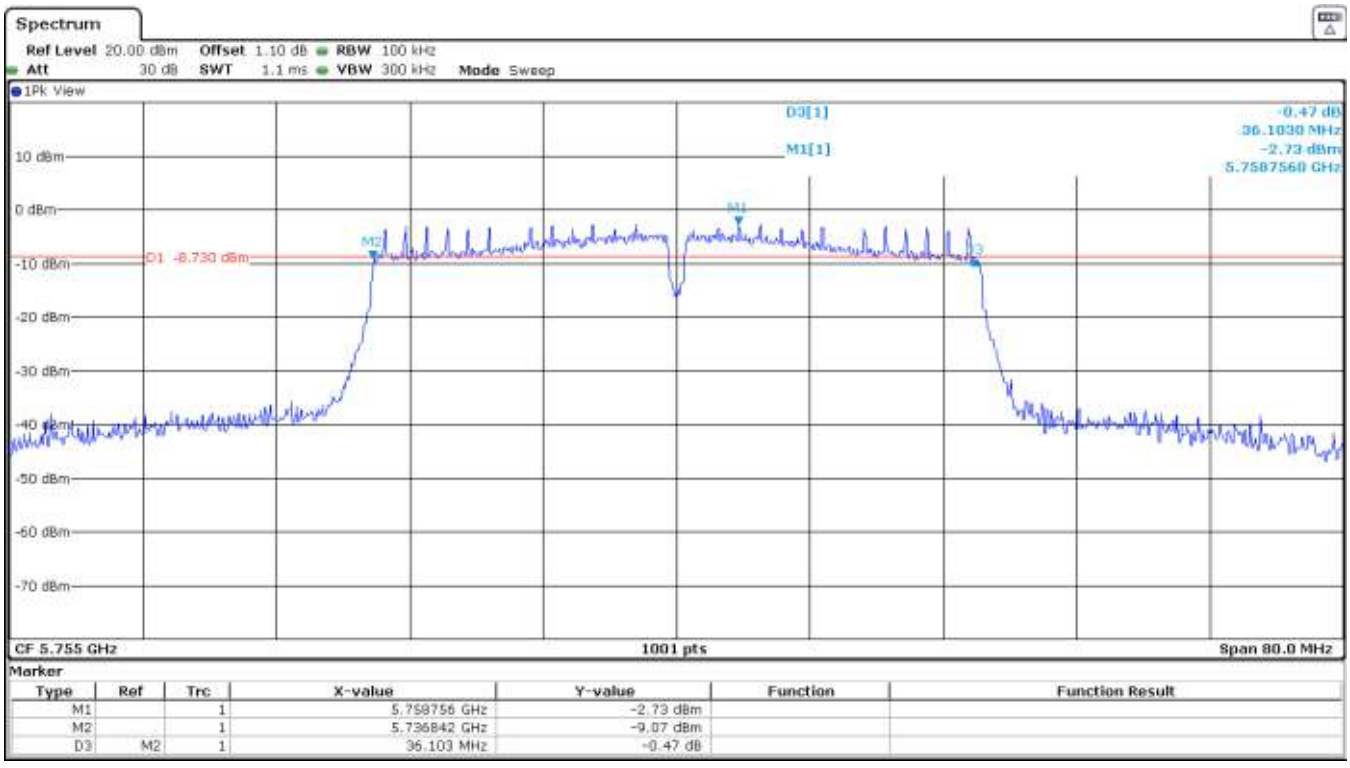


- High Channel 165:

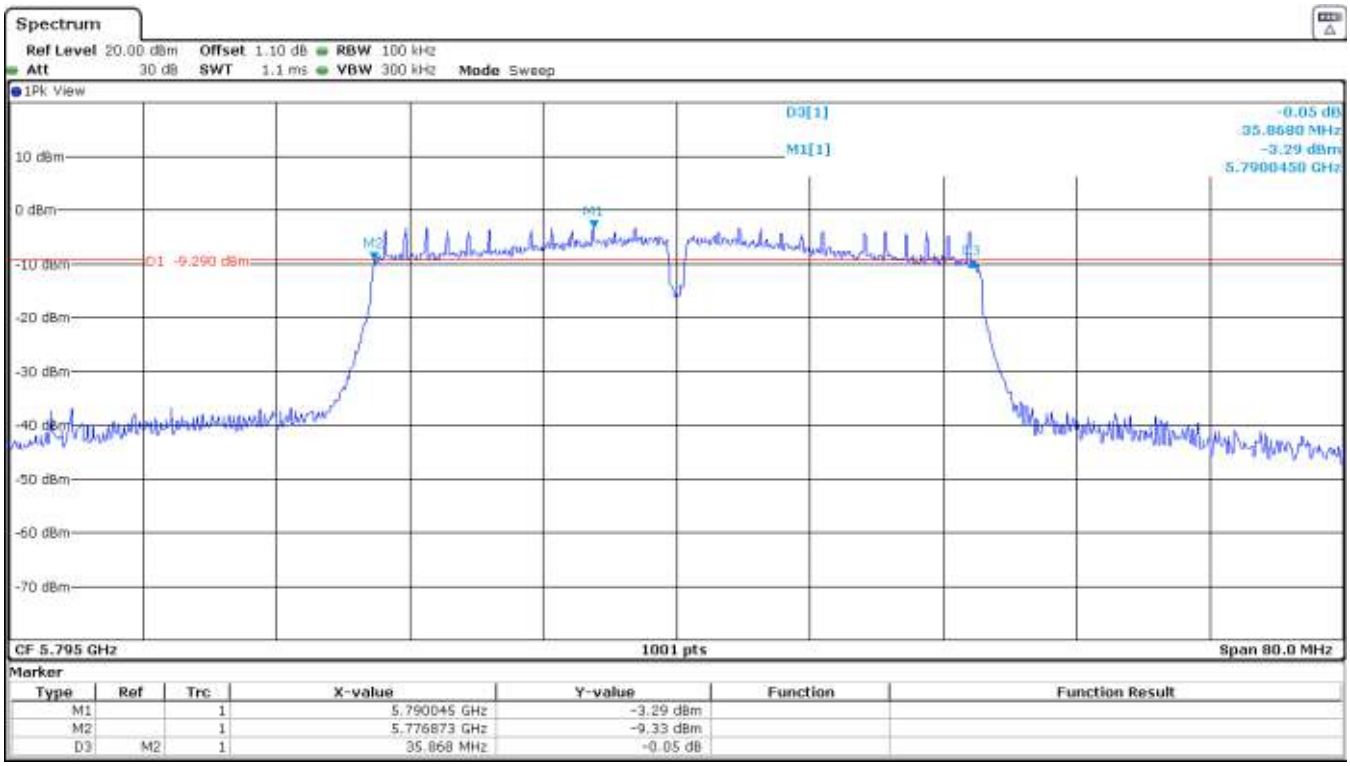


Mode 802.11 n40 (HT40)

- Low Channel 151:

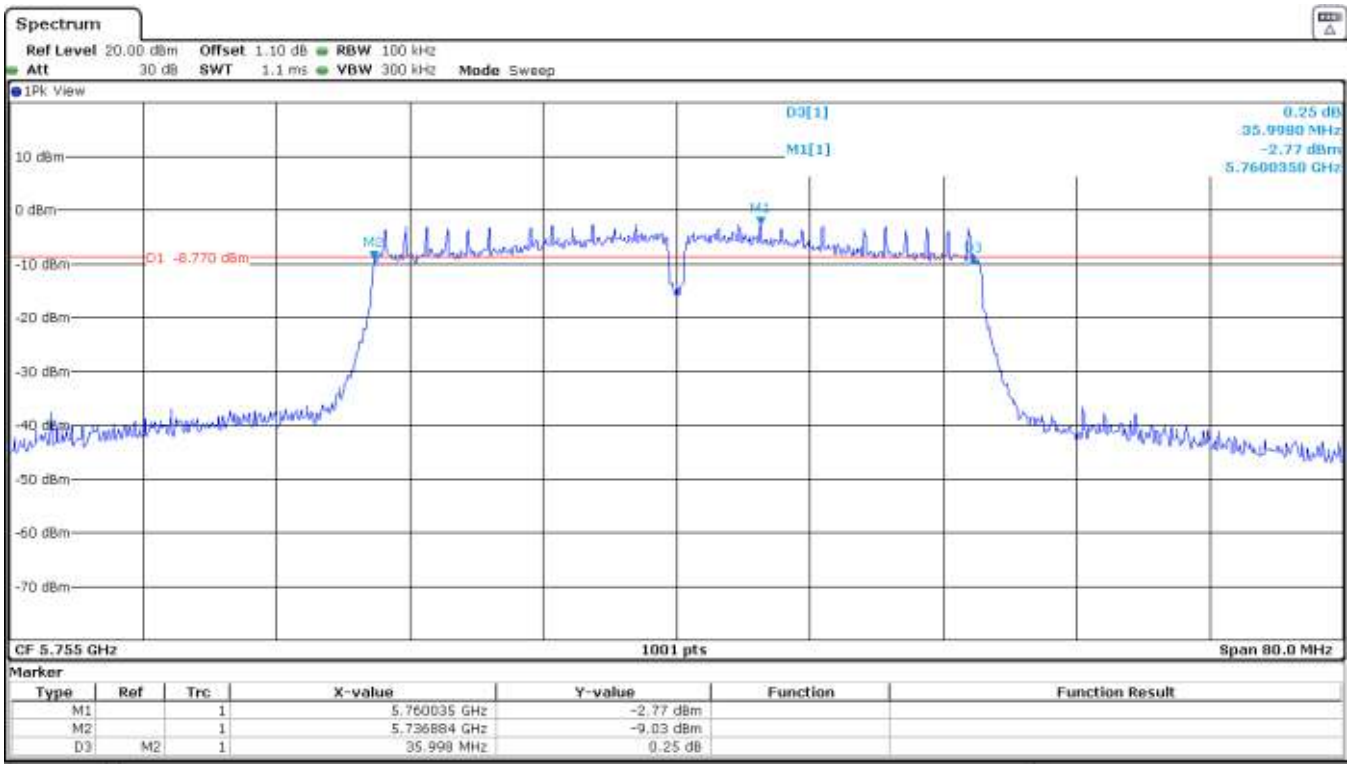


- High Channel 159:

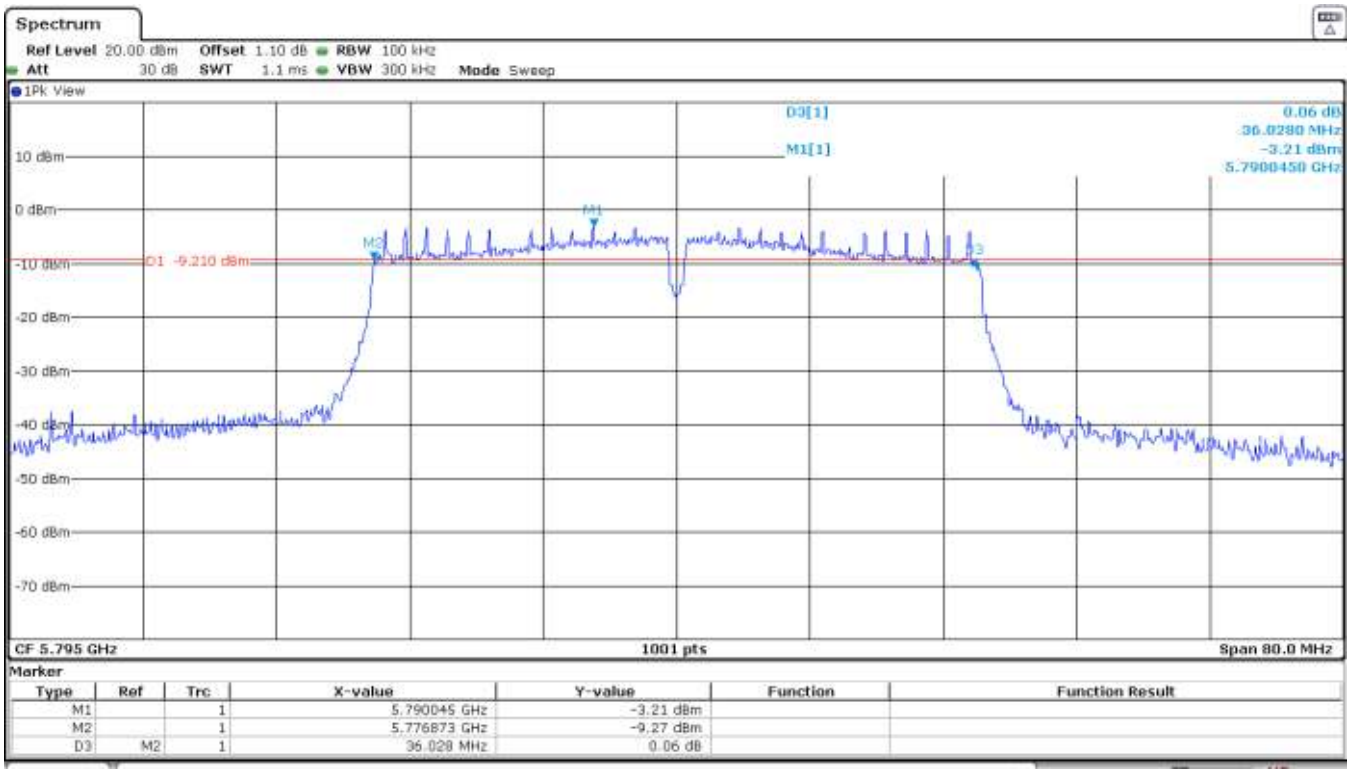


Mode 802.11 ac40 (VHT40)

- Low Channel 151:

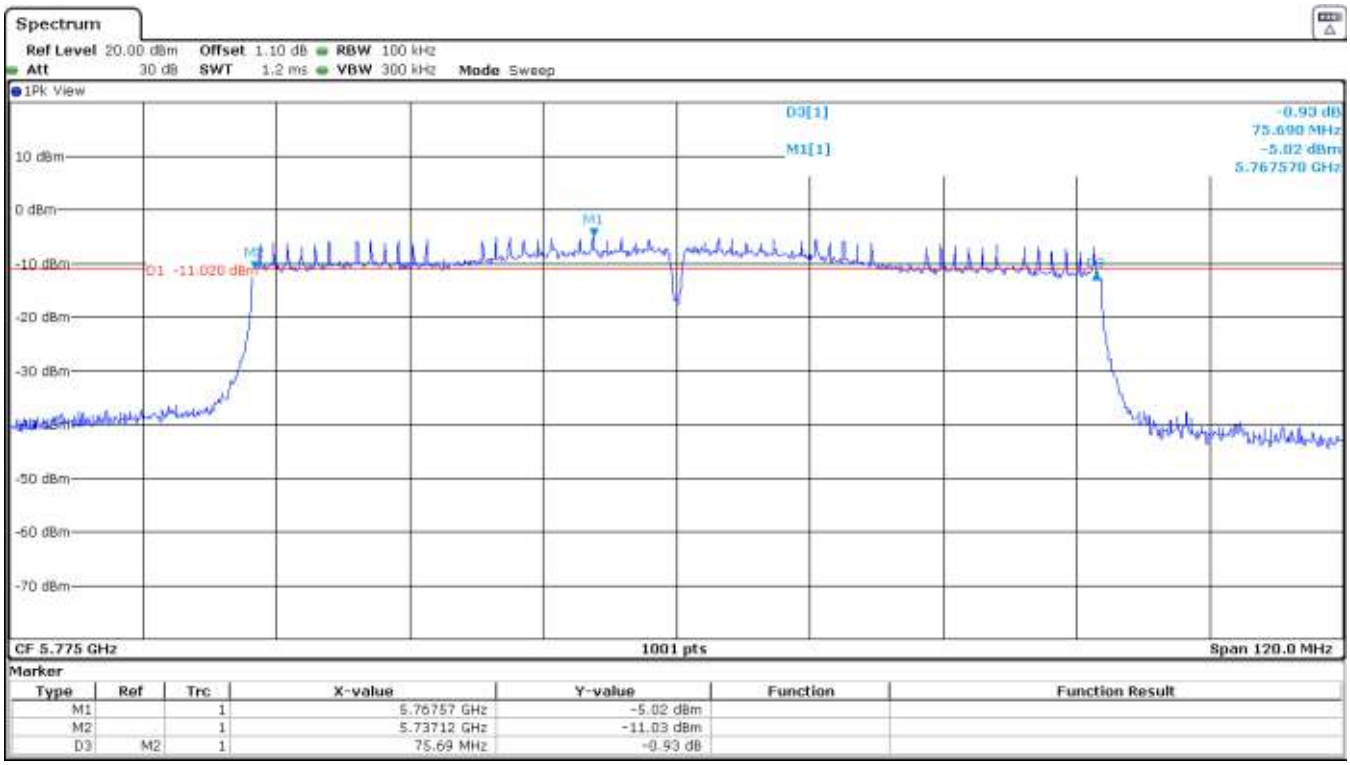


- High Channel 159:



Mode 802.11 ac80 (VHT80)

- Single Channel 155:



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

SPECIFICATION:

FCC 15.407/RSS-247: 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)	13.03	12.08	12.7
Duty Cycle Correction Factor (dB)	1.052225922		
Max. Conducted Power Corrected (dBm)	14.08222592	13.13222592	13.75222592
Maximum EIRP power Corrected (dBm)	8.68222592	7.73222592	8.35222592
Measurement uncertainty (dB)	<±1.20		

Mode 802.11 n20 (HT20)

	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
Max. Conducted Power (dBm)	13.72	12.33	13.15
Duty Cycle Correction Factor (dB)	1.149110428		
Max. Conducted Power Corrected (dBm)	14.86911043	13.47911043	14.29911043
Maximum EIRP power Corrected (dBm)	9.46911043	8.07911043	8.89911043
Measurement uncertainty (dB)	<±1.20		

Mode 802.11 ac20 (HT20)

	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
Max. Conducted Power (dBm)	13.82	12.38	12.23
Duty Cycle Correction Factor (dB)	1.088839954		
Max. Conducted Power Corrected (dBm)	14.90883995	13.46883995	13.31883995
Maximum EIRP power Corrected (dBm)	9.50883995	8.06883995	7.91883995
Measurement uncertainty (dB)	<±1.20		

Mode 802.11 n40 (HT40)

	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
Max. Conducted Power (dBm)	11.49	10.63
Duty Cycle Correction Factor (dB)	2.057792034	
Max. Conducted Power Corrected (dBm)	13.54779203	12.68779203
Maximum EIRP power Corrected (dBm)	8.14779203	7.28779203
Measurement uncertainty (dB)	<±1.20	

Mode 802.11 ac40 (HT40)

	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
Max. Conducted Power (dBm)	11.48	10.48
Duty Cycle Correction Factor (dB)	2.02773595	
Max. Conducted Power Corrected (dBm)	13.50773595	12.50773595
Maximum EIRP power Corrected (dBm)	8.10773595	7.10773595
Measurement uncertainty (dB)	<±1.20	

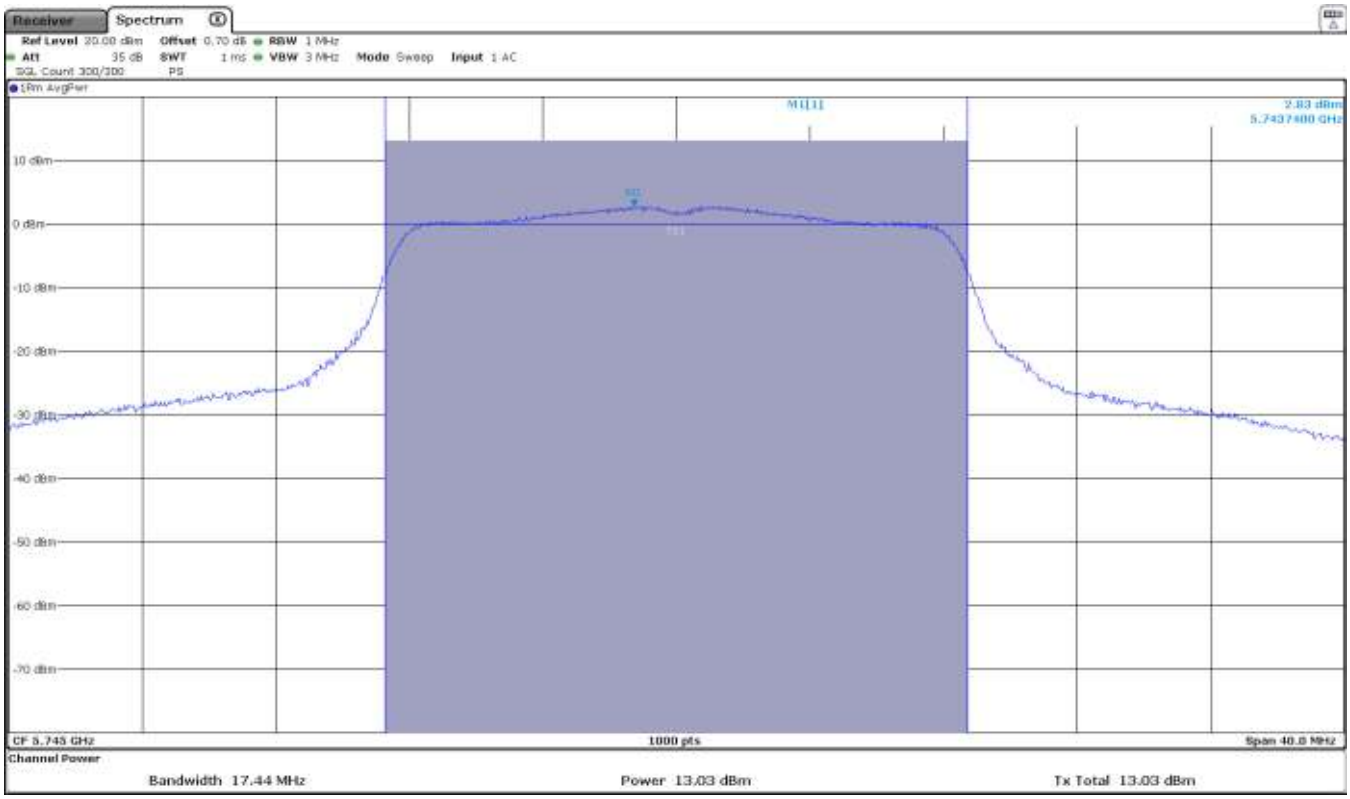
Mode 802.11 ac80 (VHT80)

	Low Channel 155 (5775 MHz)
Max. Conducted Power (dBm)	8.87
Duty Cycle Correction Factor (dB)	3.449867986
Max. Conducted Power Corrected (dBm)	12.31986799
Maximum EIRP power Corrected (dBm)	6.91986799
Measurement uncertainty (dB)	<±1.20

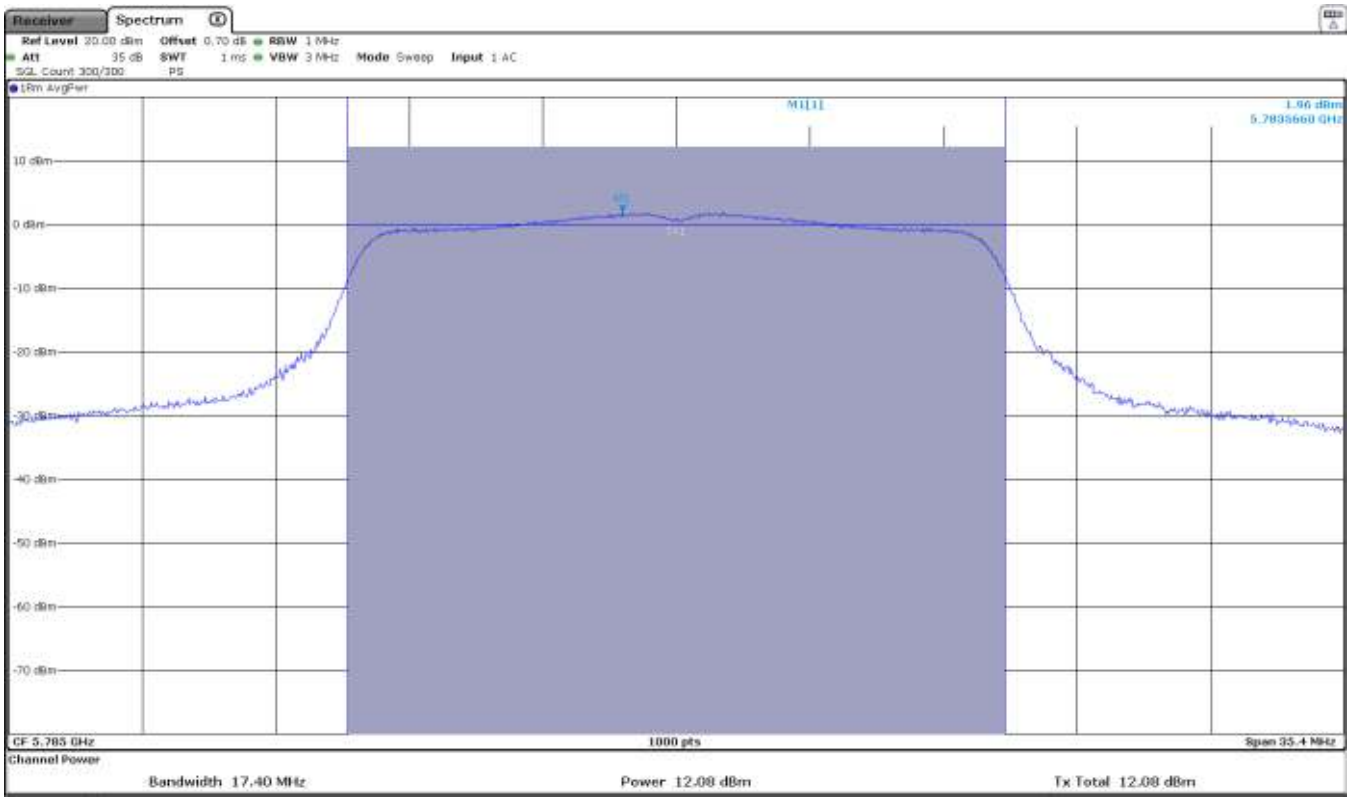
Verdict: PASS

Mode 802.11 a20

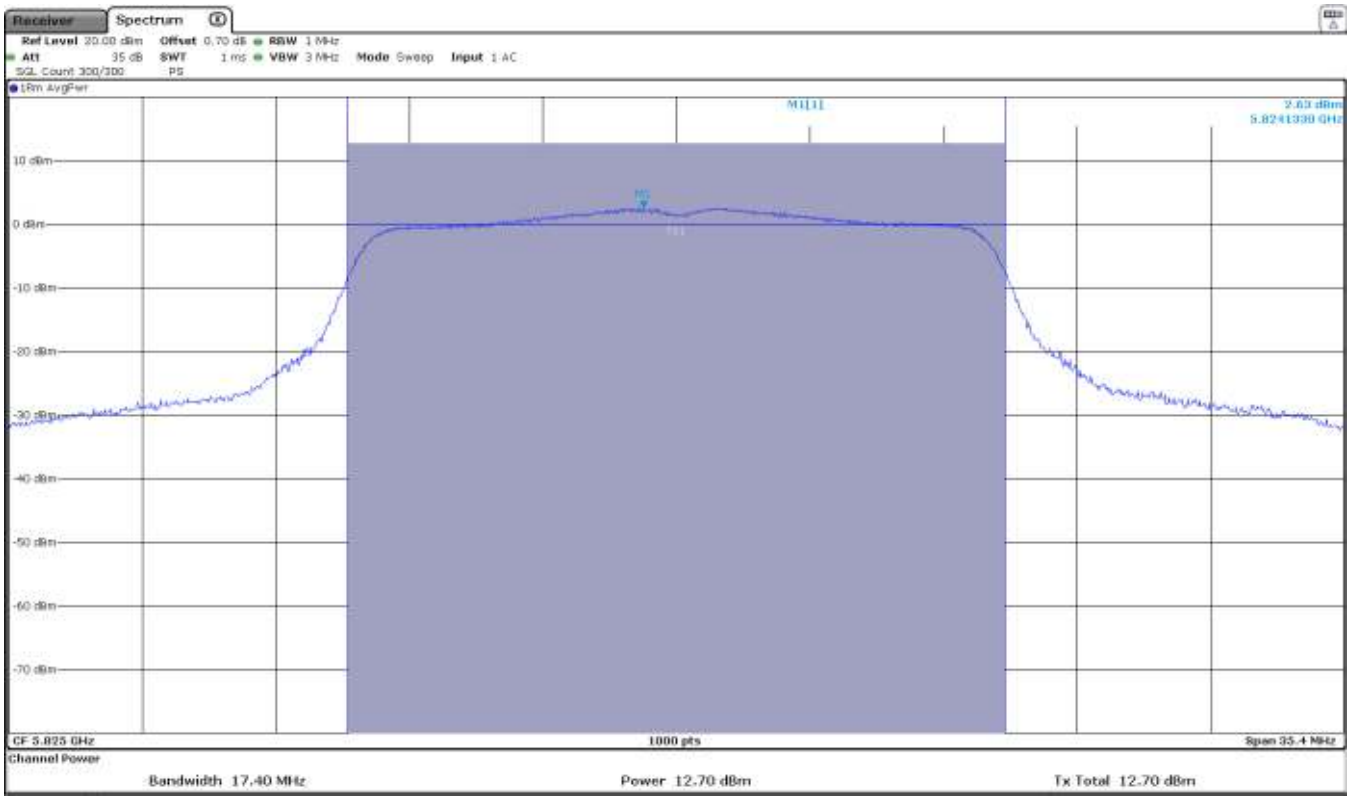
- Low Channel 149:



- Middle Channel 157:

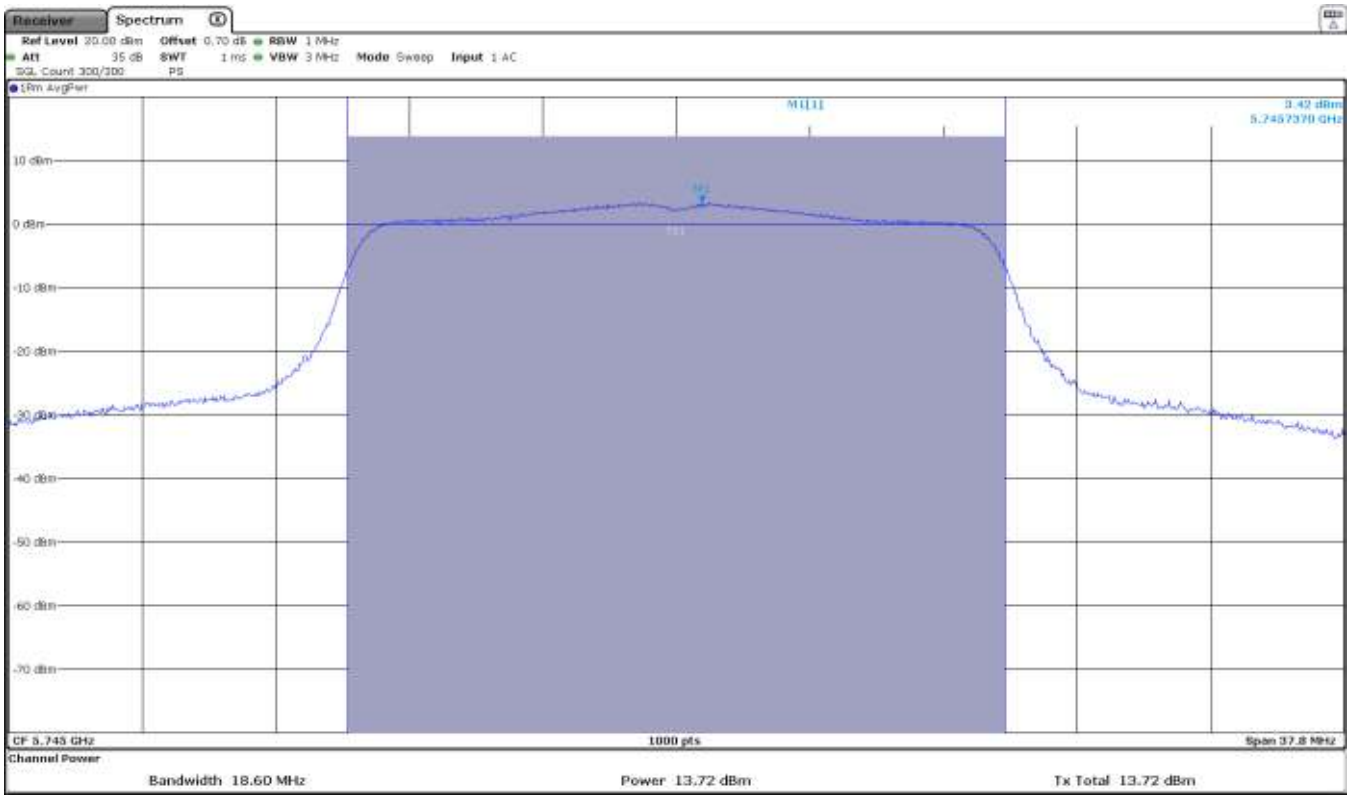


- High Channel 165:

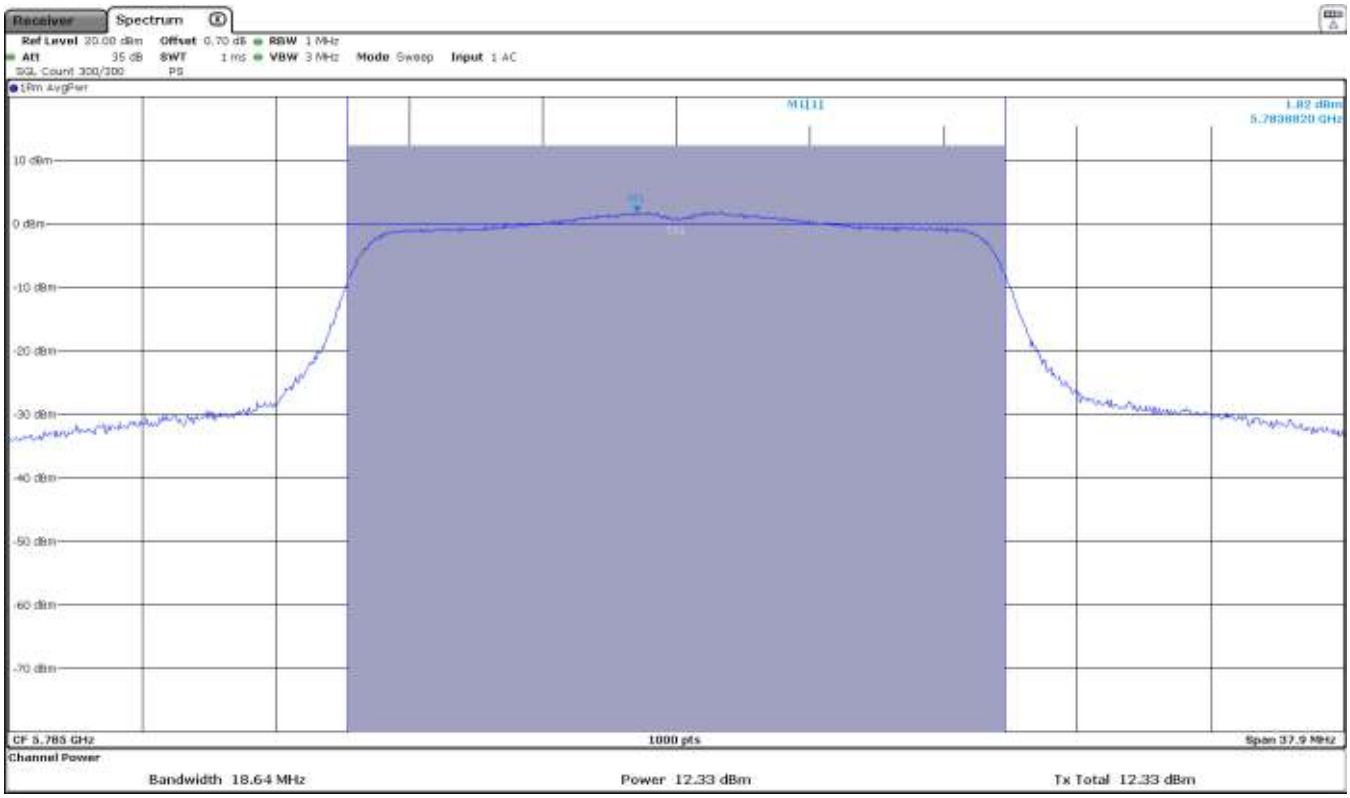


Mode 802.11 n20 (HT20)

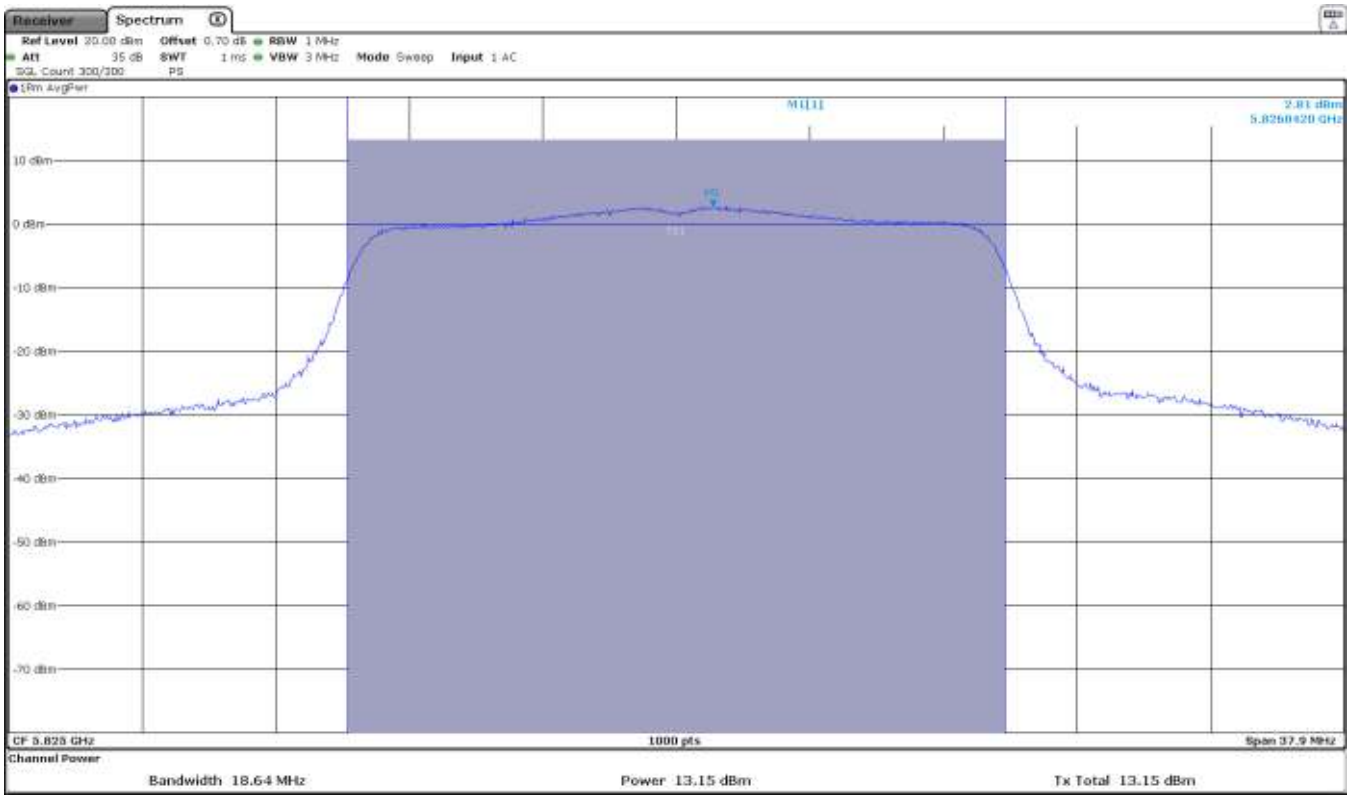
- Low Channel 149:



- Middle Channel 157:

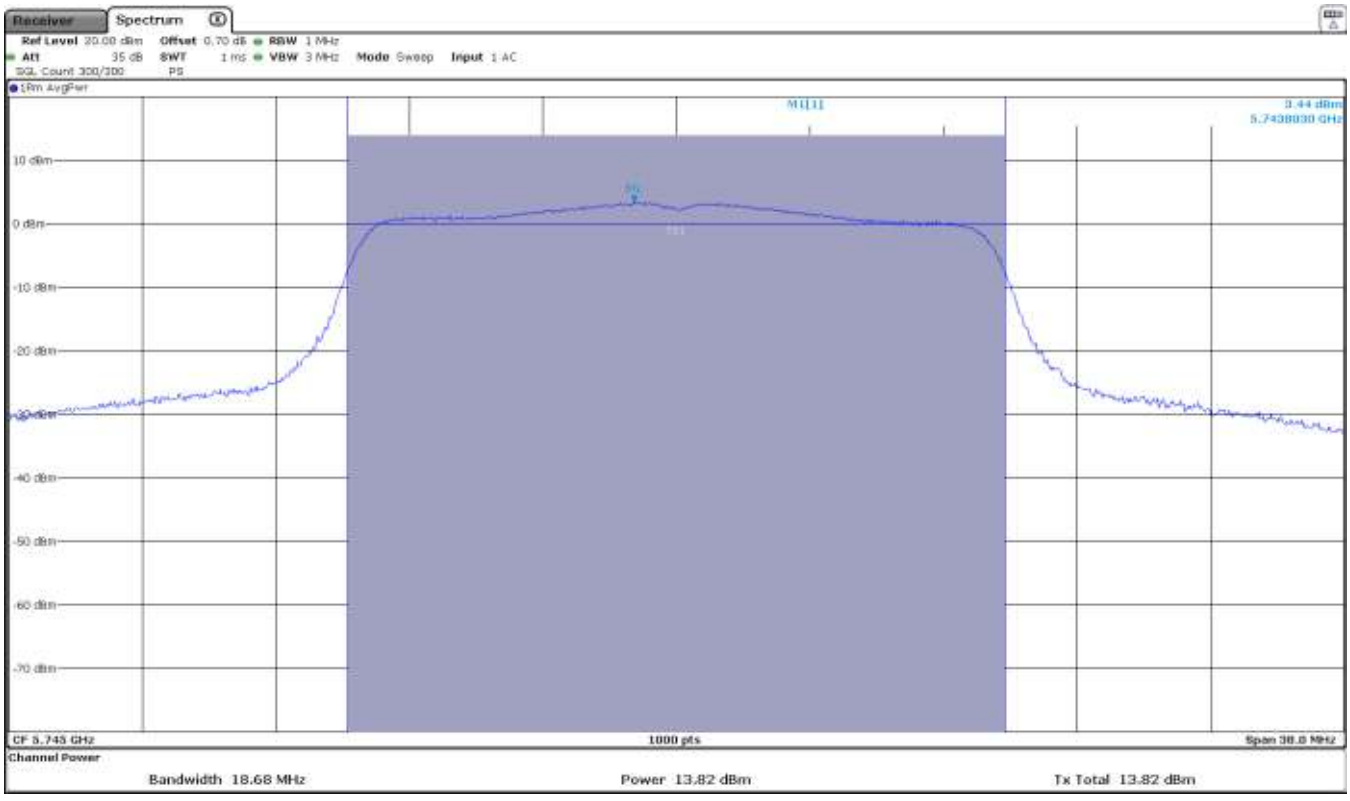


- High Channel 165:

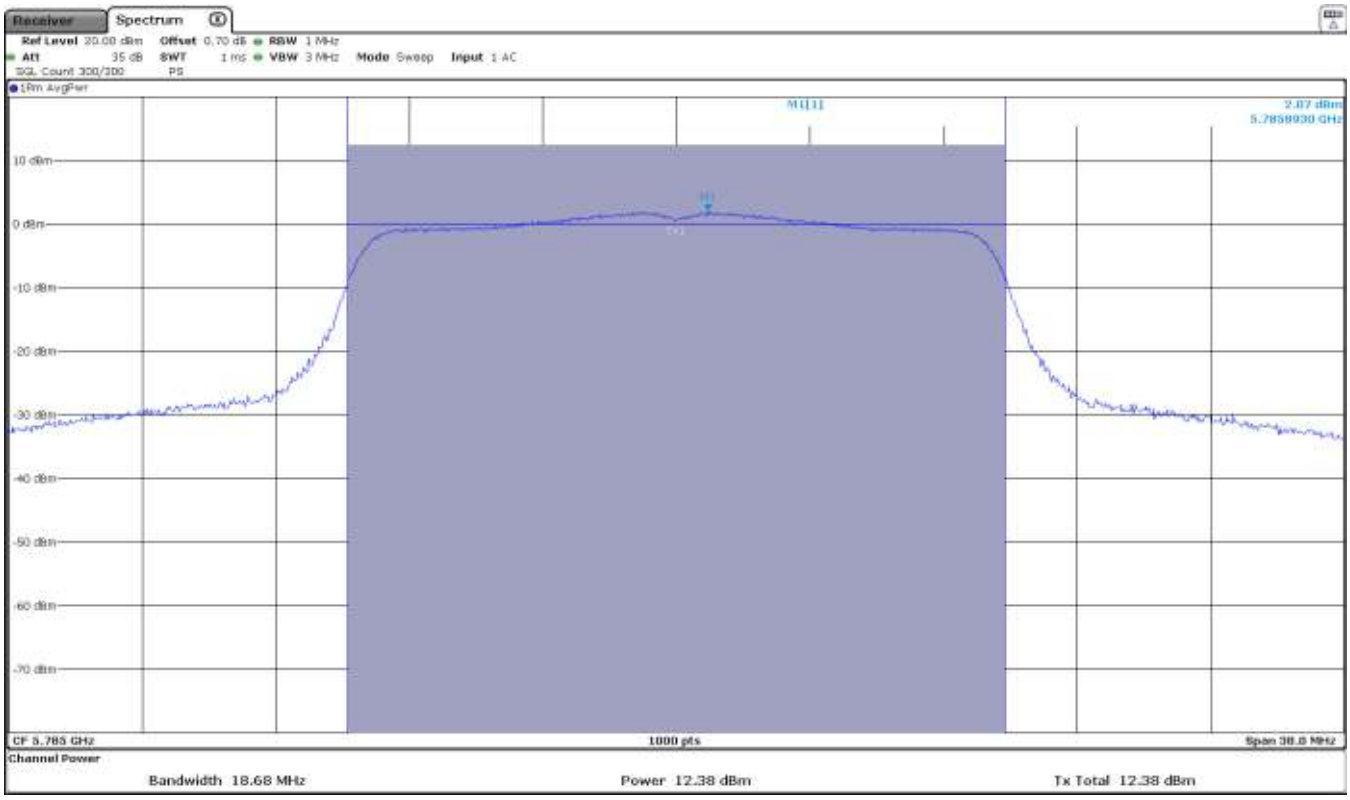


Mode 802.11 ac20 (HT20)

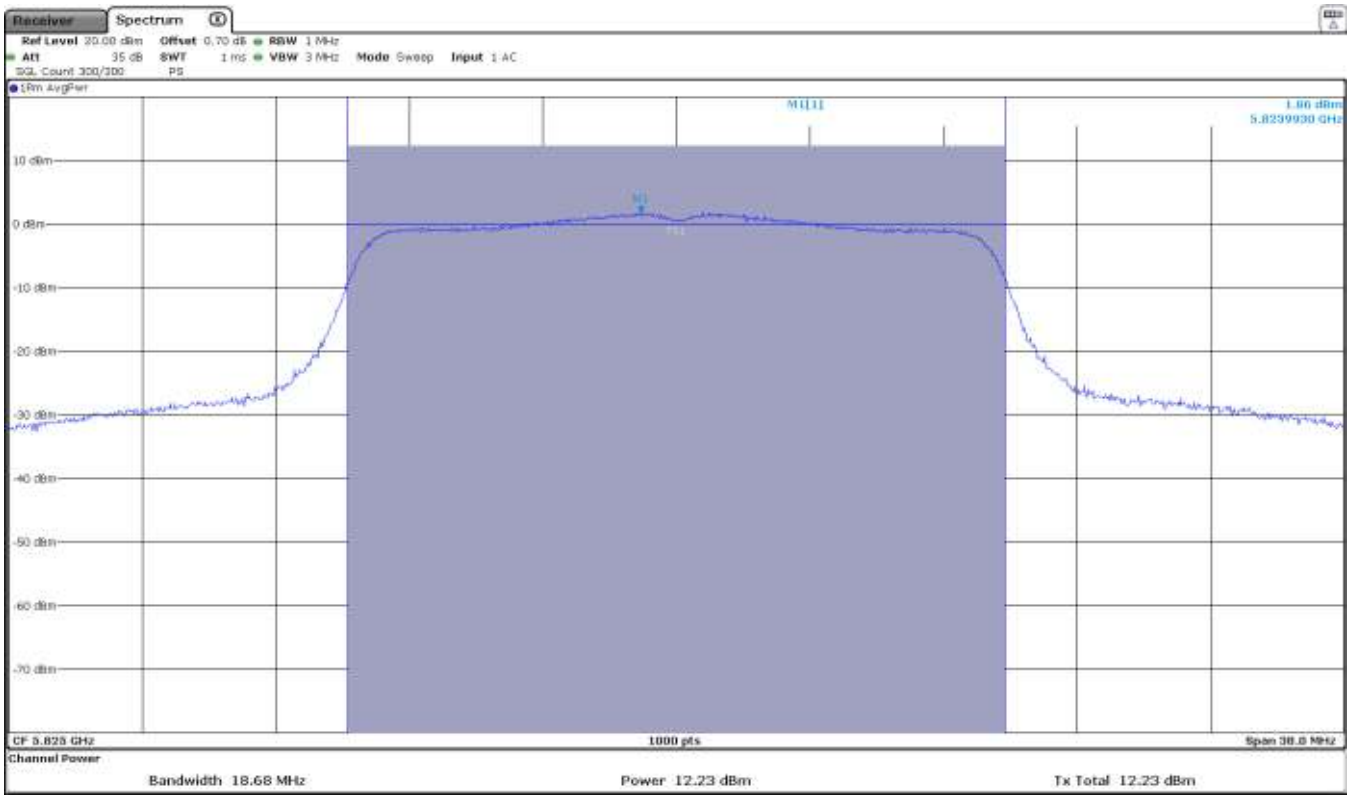
- Low Channel 149:



- Middle Channel 157:

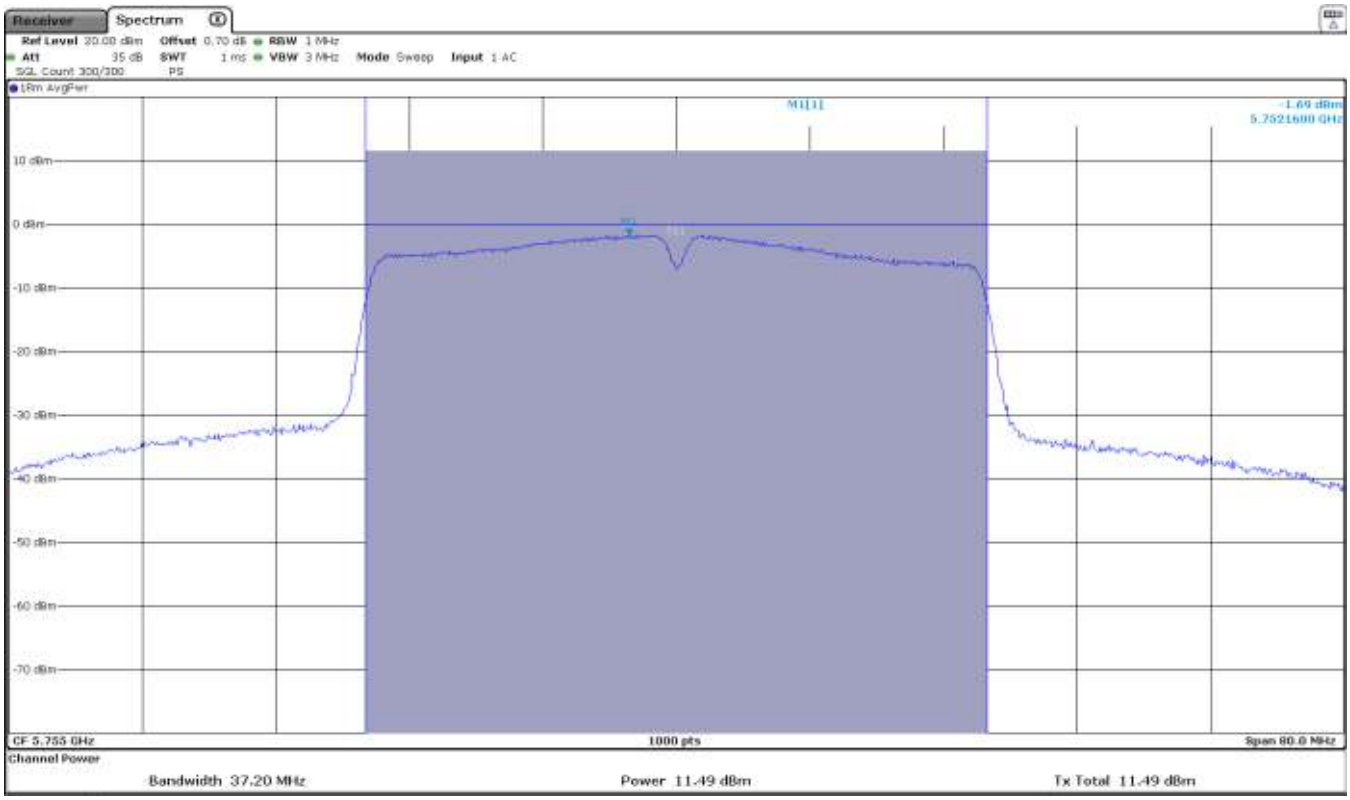


- High Channel 165:

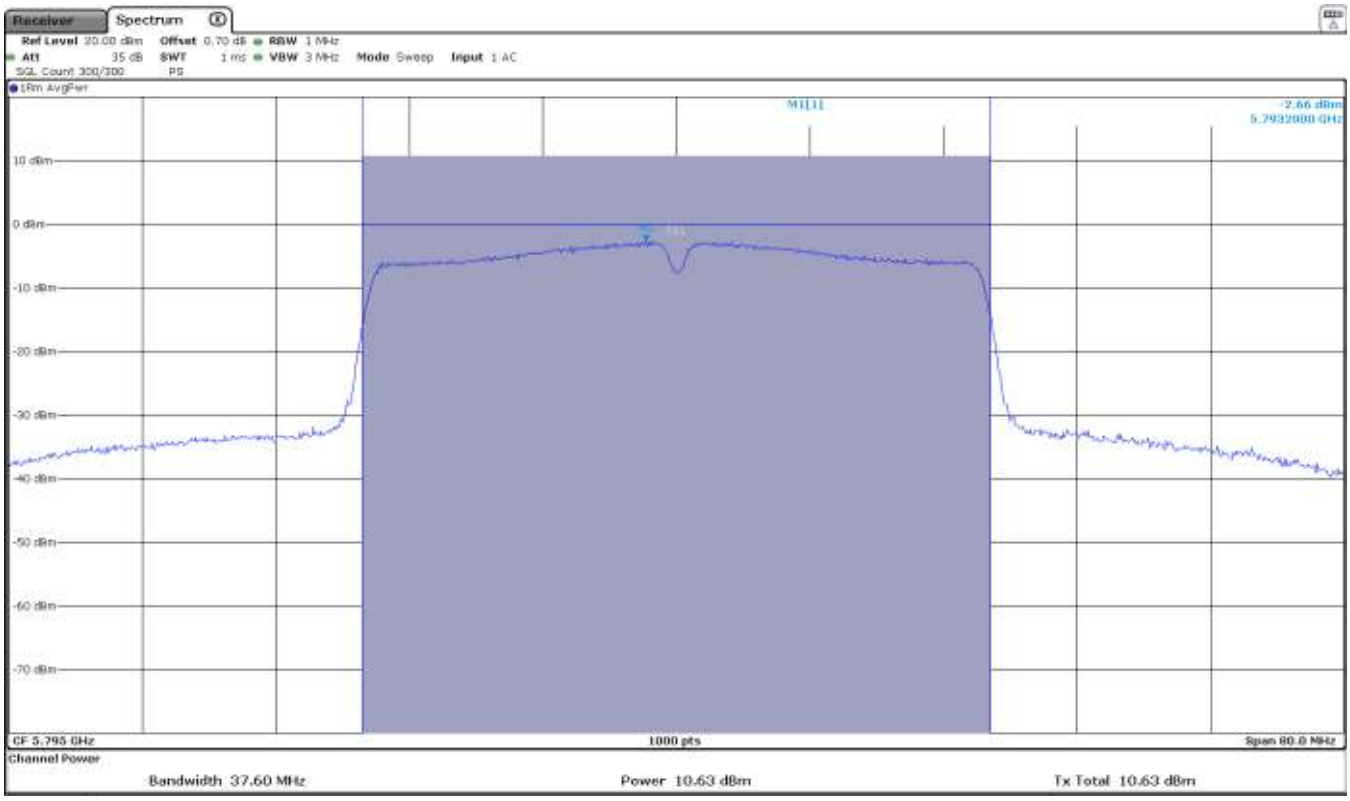


Mode 802.11 n40 (HT40)

- Low Channel 151:

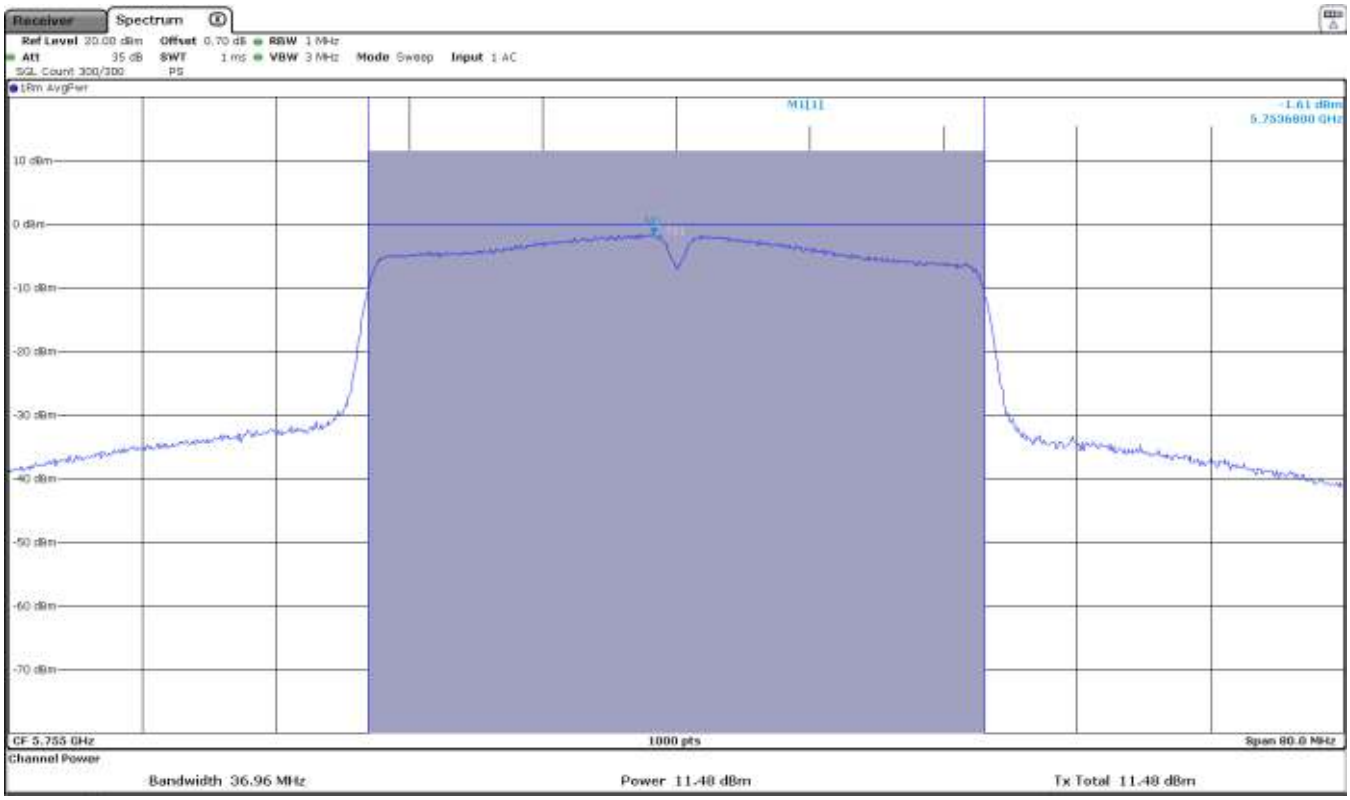


- High Channel 159:

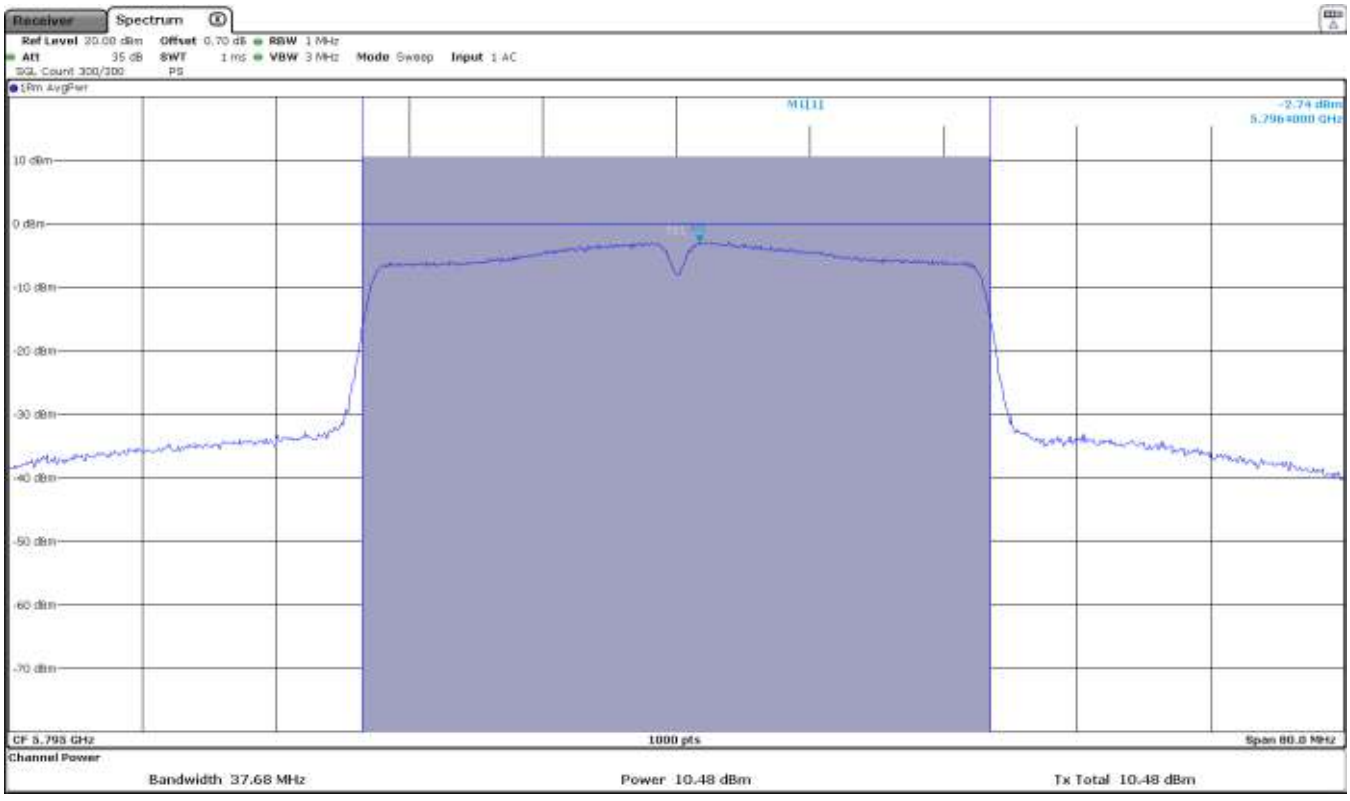


Mode 802.11 ac40 (HT40)

- Low Channel 151:

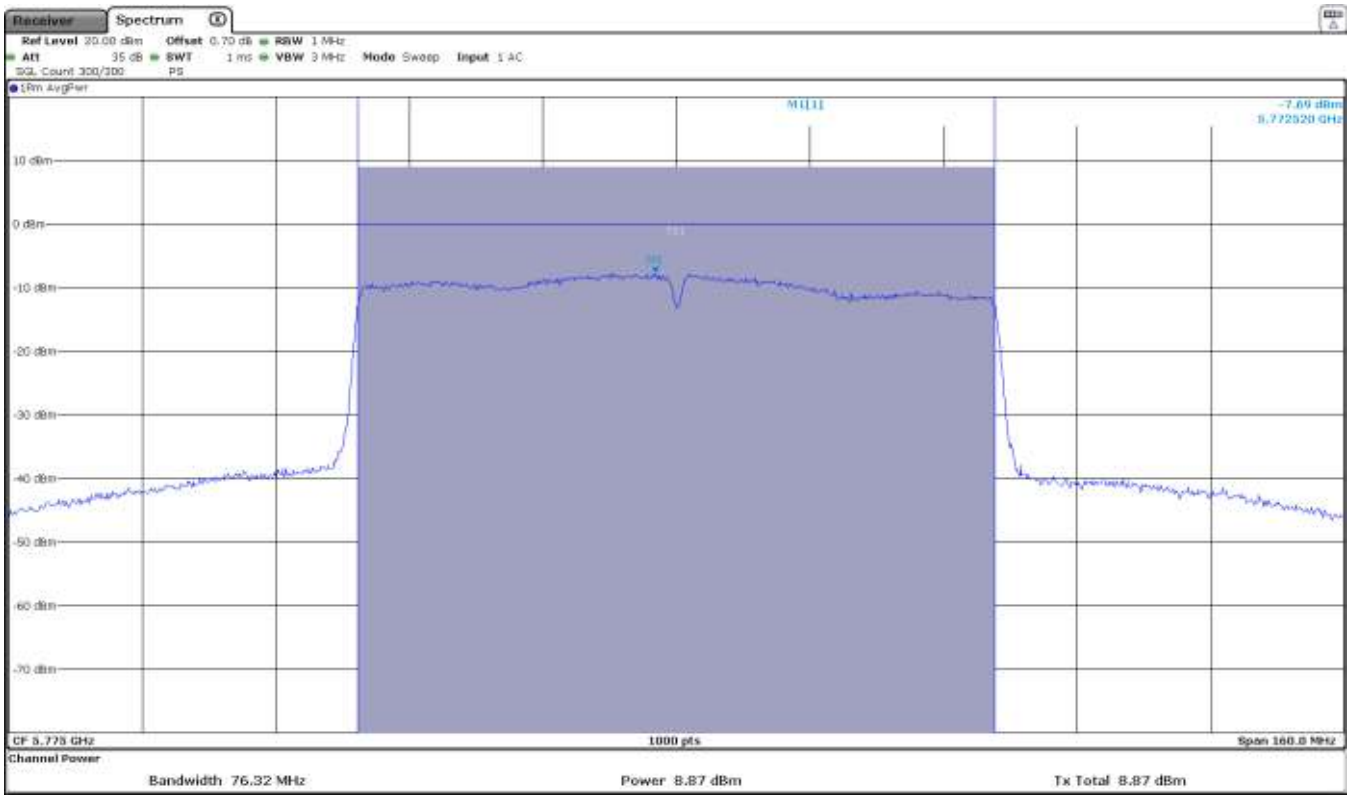


- High Channel 159:



Mode 802.11 ac80 (VHT80)

- Single Channel 155:



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

SPECIFICATION:

FCC 15.407 / RSS-247: 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 showns using a 1 MHz resolution bandwidth. This was deemed 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 colocation a maker 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 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
Maximum PSD (dBm/MHz)	2.83	1.96	2.63
Duty Cycle Correction Factor (dB)	1.05		
Maximum PSD Corrected (dBm/MHz)	3.88	3.01	3.68
Measurement uncertainty (dB)	<±1.20		

Mode 802.11 n20 (HT20)

	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
Maximum PSD (dBm/MHz)	3.42	1.82	2.81
Duty Cycle Correction Factor (dB)	1.15		
Maximum PSD Corrected (dBm/MHz)	4.57	2.97	3.96
Measurement uncertainty (dB)	<±1.20		

Mode 802.11 ac20 (HT20)

	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
Maximum PSD (dBm/MHz)	3.44	2.07	1.86
Duty Cycle Correction Factor (dB)	1.09		
Maximum PSD Corrected (dBm/MHz)	4.53	3.16	2.95
Measurement uncertainty (dB)	<±1.20		

Mode 802.11 n40 (HT40)

	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
Maximum PSD (dBm/MHz)	-1.69	-2.66
Duty Cycle Correction Factor (dB)	2.06	
Maximum PSD Corrected (dBm/MHz)	0.37	-0.60
Measurement uncertainty (dB)	<±1.20	

Mode 802.11 ac40 (HT40)

	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
Maximum PSD (dBm/MHz)	-1.61	-2.74
Duty Cycle Correction Factor (dB)	2.03	
Maximum PSD Corrected (dBm/MHz)	0.42	-0.71
Measurement uncertainty (dB)	<±1.20	

Mode 802.11 ac80 (VHT80)

	Low Channel 155 (5775 MHz)
Maximum PSD (dBm/MHz)	-7.69
Duty Cycle Correction Factor (dB)	3.45
Maximum PSD Corrected (dBm/MHz)	-4.24
Measurement uncertainty (dB)	<±1.20

Verdict: PASS

FCC Section 15.407(b)(4)(6) / RSS-247 6.2.4.2. Transmitter Out of Band 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 360º 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 1 GHz-40 GHz and a distance of 3m for frequency range 30MHz-1GHz.

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 following worst case: 802.11a20: 6 Mbits. 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.

Spurious frequencies operating (radiated) at less than 20 dB below the limit:

Spurious frequency (MHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
30.34	24	40	V	Quasi-Peak	± 3.81
88.54	28.4	43.5	V	Quasi-Peak	± 3.81
542.241	27.2	46	V	Quasi-Peak	± 3.81
562.514	30.3	46	H	Quasi-Peak	± 3.81
674.969	34.6	46	H	Quasi-Peak	± 3.81
937.516	32.7	46	H	Quasi-Peak	± 3.81

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.

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

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

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

  - Low Channel:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
11.48983	54.75	V	Peak	± 4.72
	44.56		Average	± 4.72

  - Middle Channel:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
11.5695	63.6	V	Peak	± 4.72
	53.59		Average	± 4.72

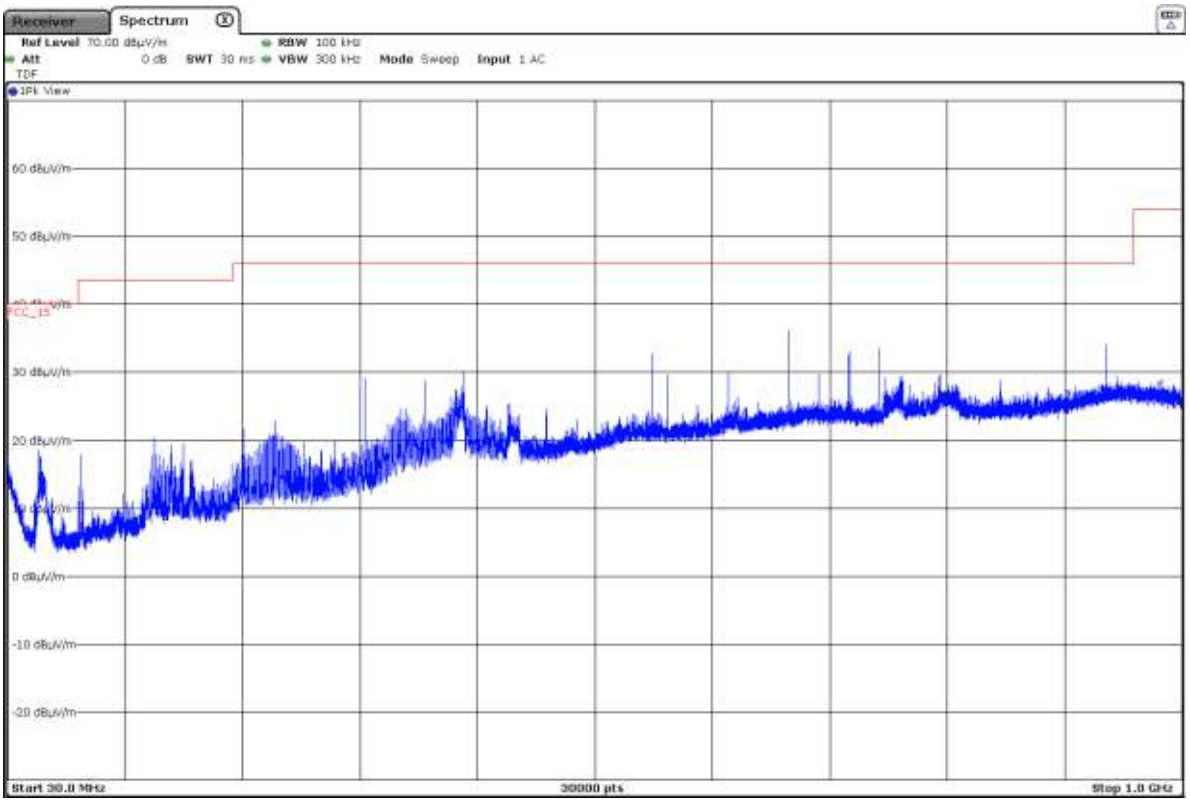
  - High Channel:

Spurious frequency (GHz)	Emission Level (dBµV/m)	Polarization	Detector	Measurement Uncertainty (dB)
11.6485	61.76	V	Peak	± 4.72
	52.04		Average	± 4.72

Verdict: PASS

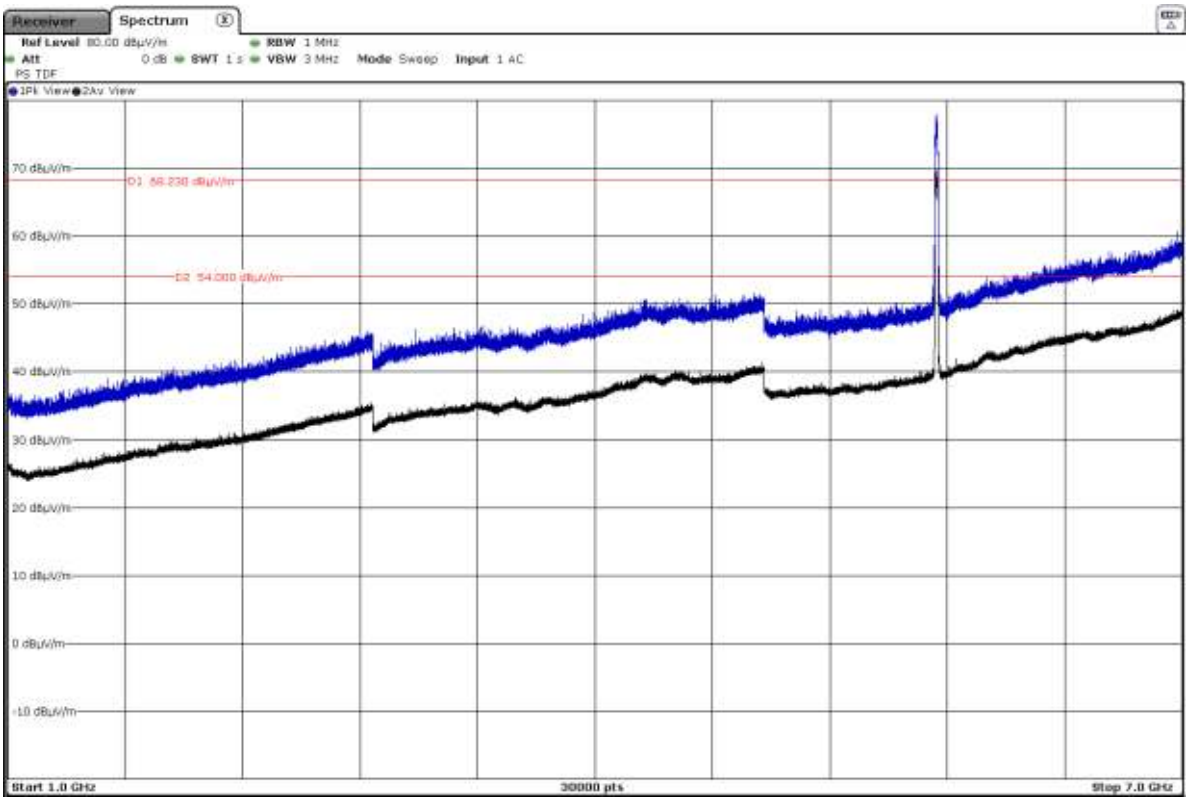
FREQUENCY RANGE 30 MHz - 1 GHz

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



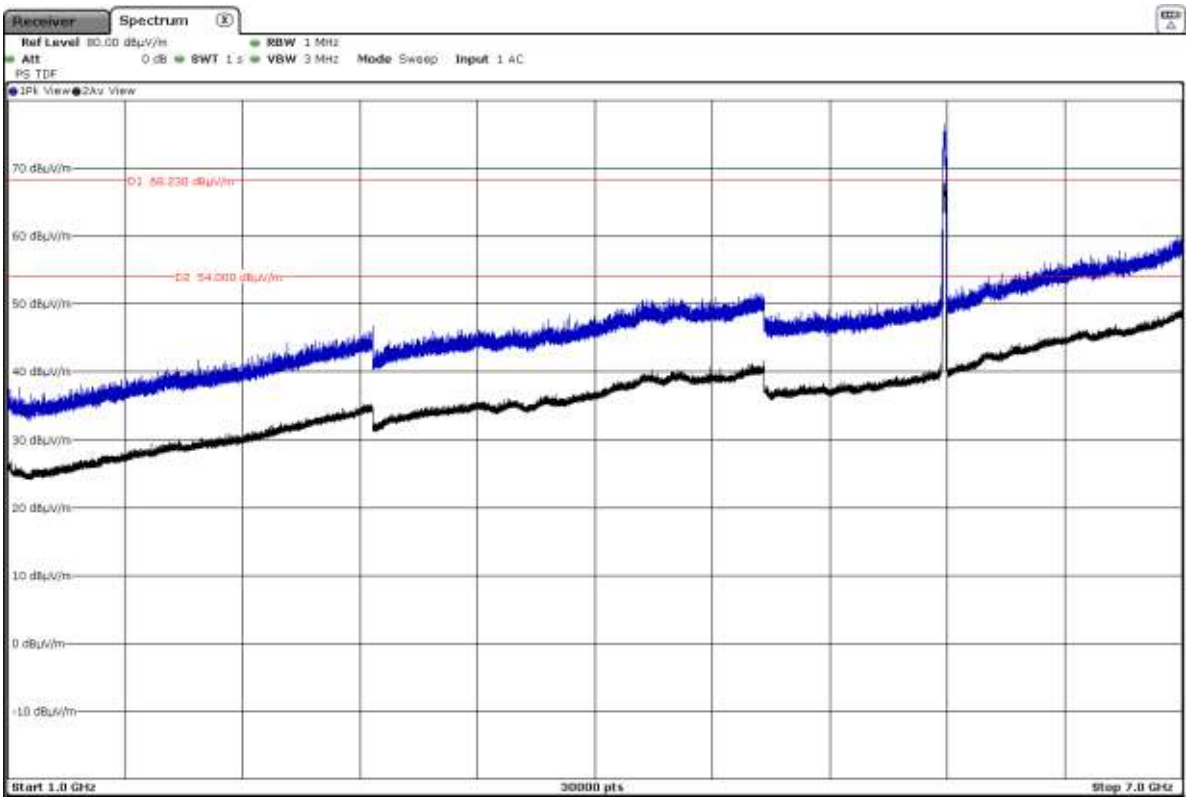
FREQUENCY RANGE 1 – 7 GHz (worst case)

- Low Channel:



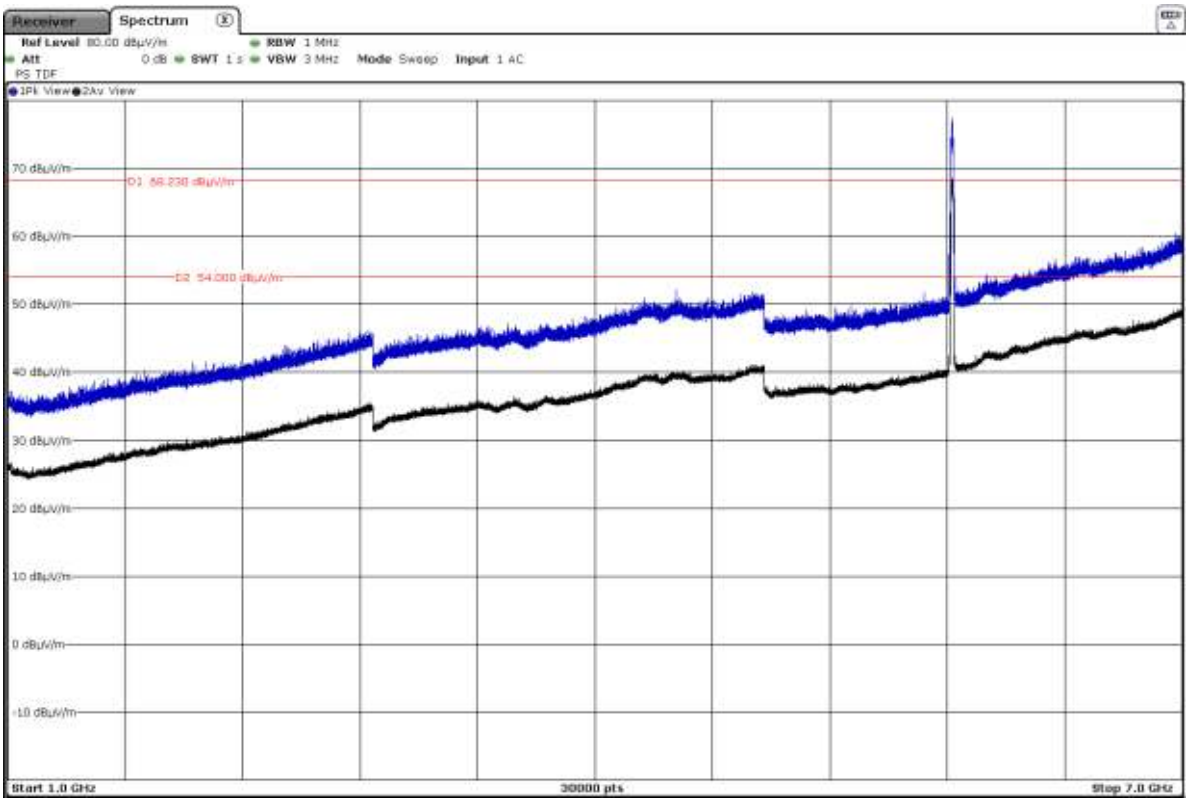
The peak above the limit is the carrier frequency.

- Middle Channel:



The peak above the limit is the carrier frequency.

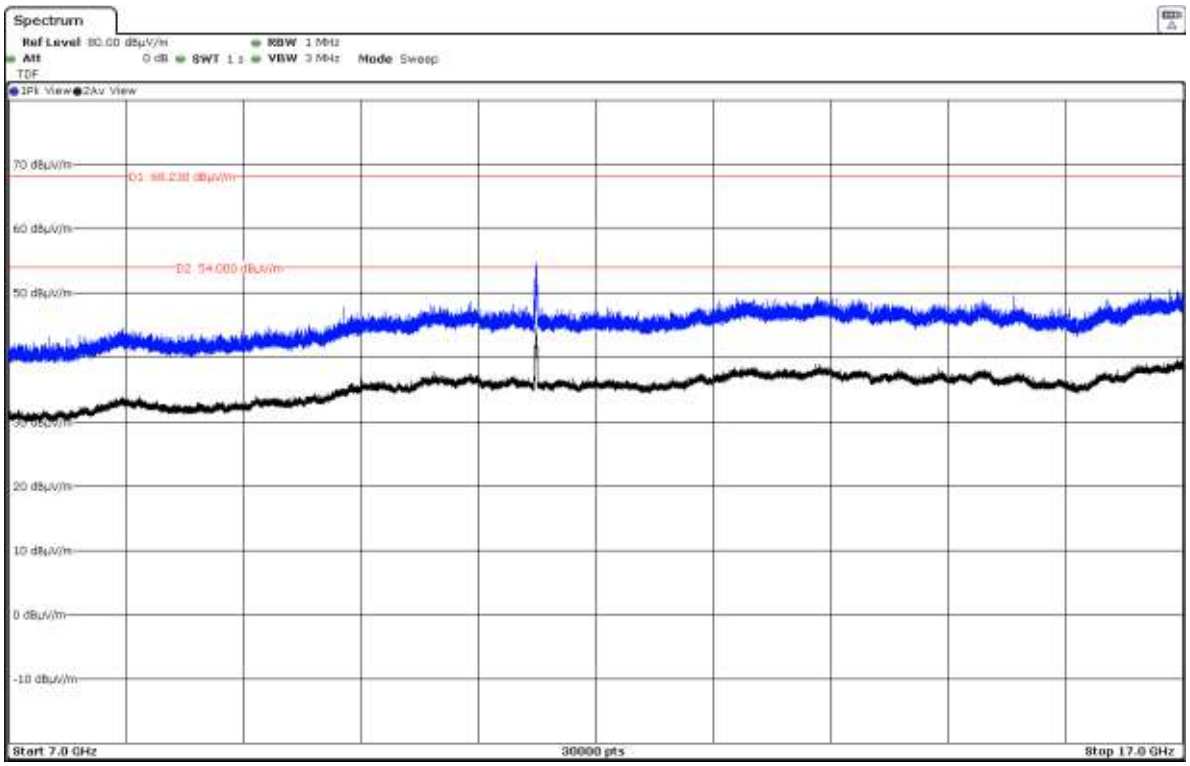
- High Channel:



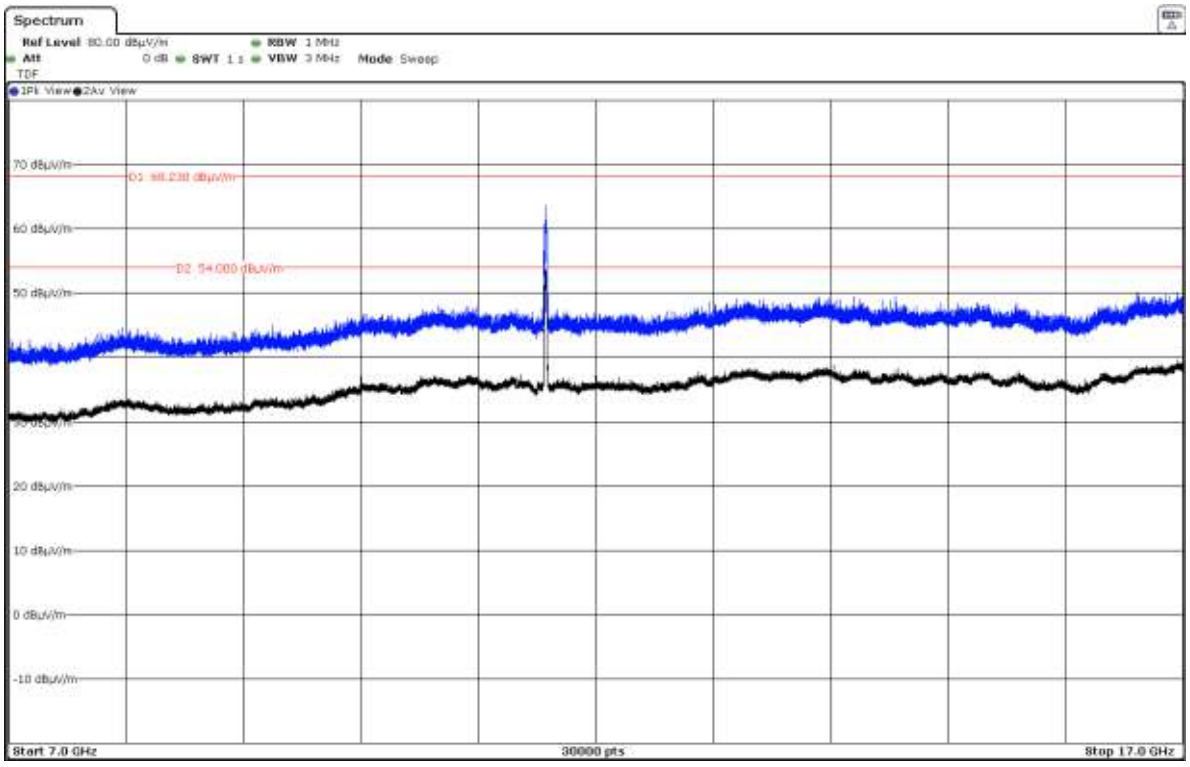
The peak above the limit is the carrier frequency.

FREQUENCY RANGE 7 - 17 GHz. (worst case)

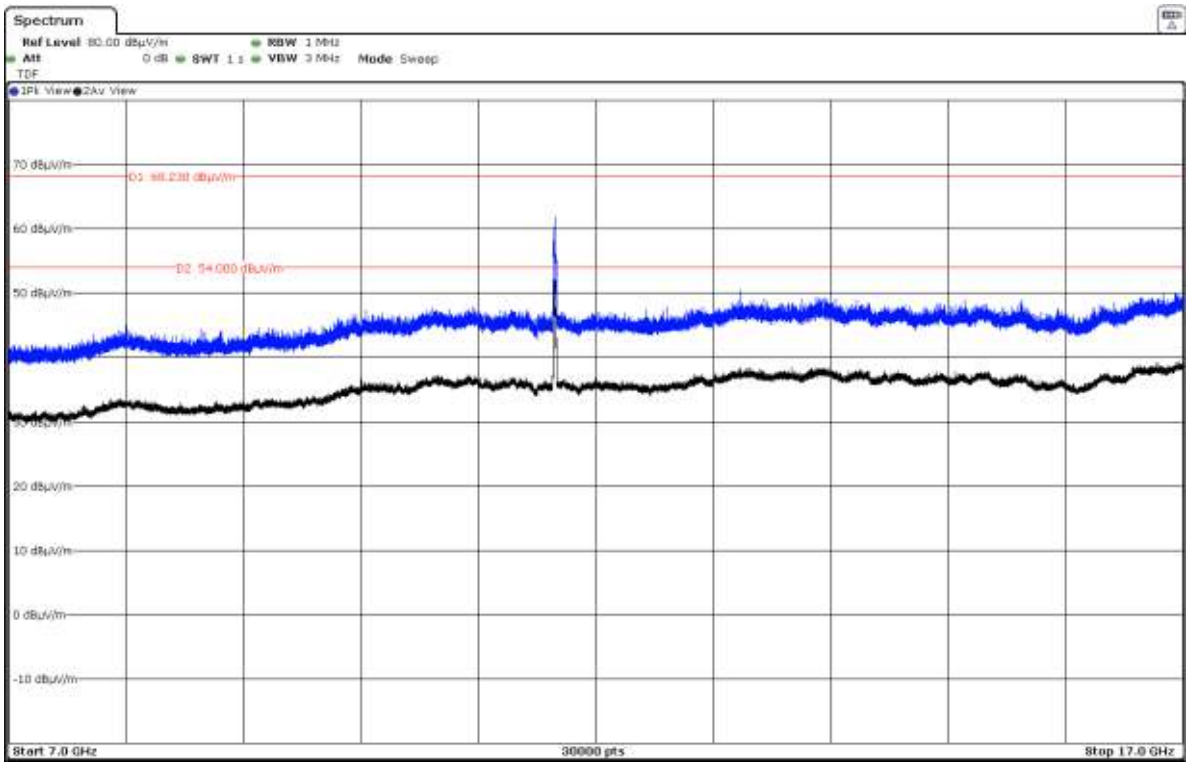
- Low Channel:



- Middle Channel:

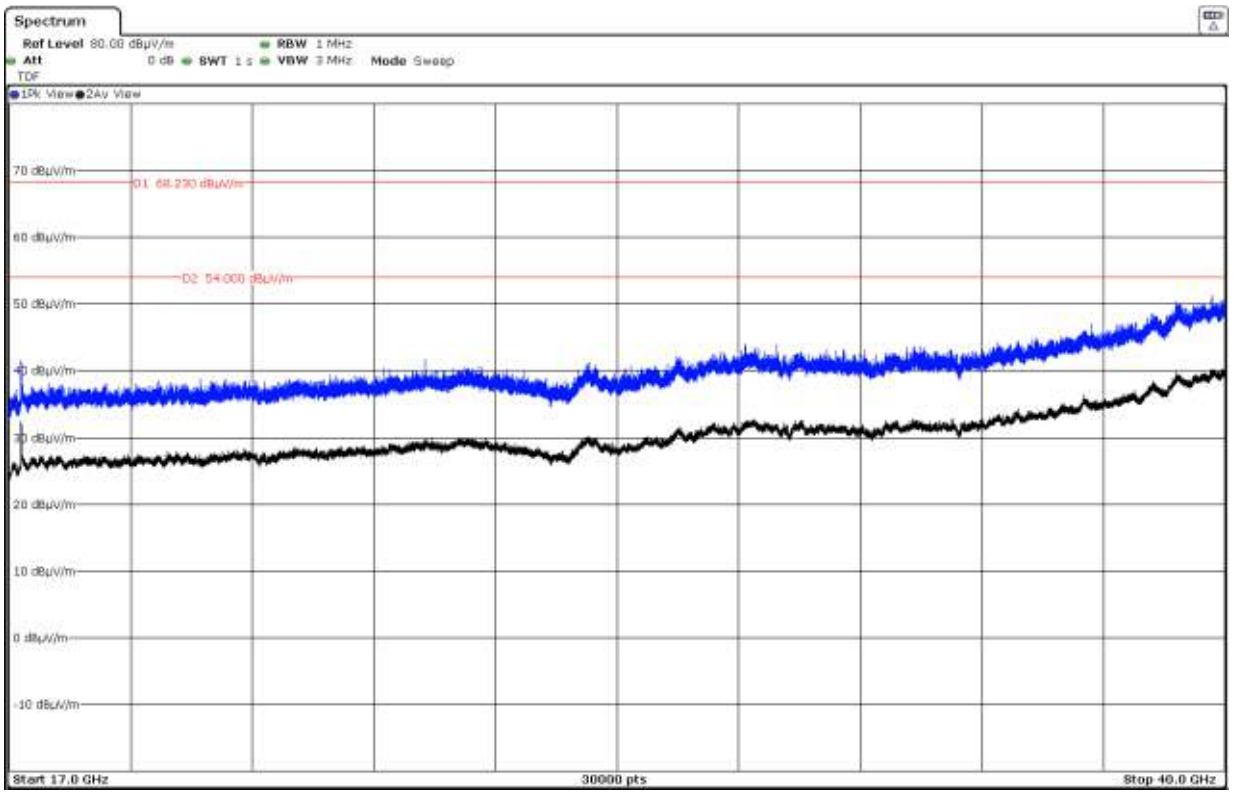


- High Channel:

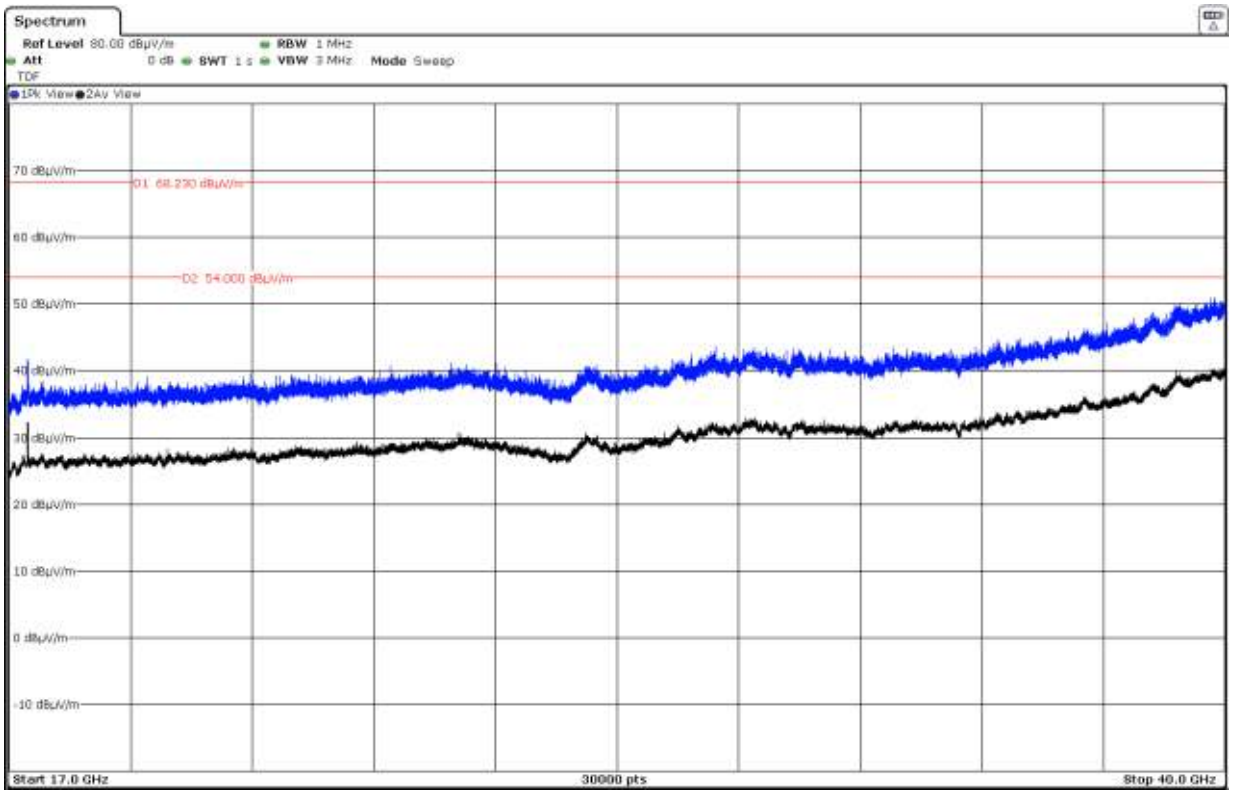


FREQUENCY RANGE 17 - 40 GHz

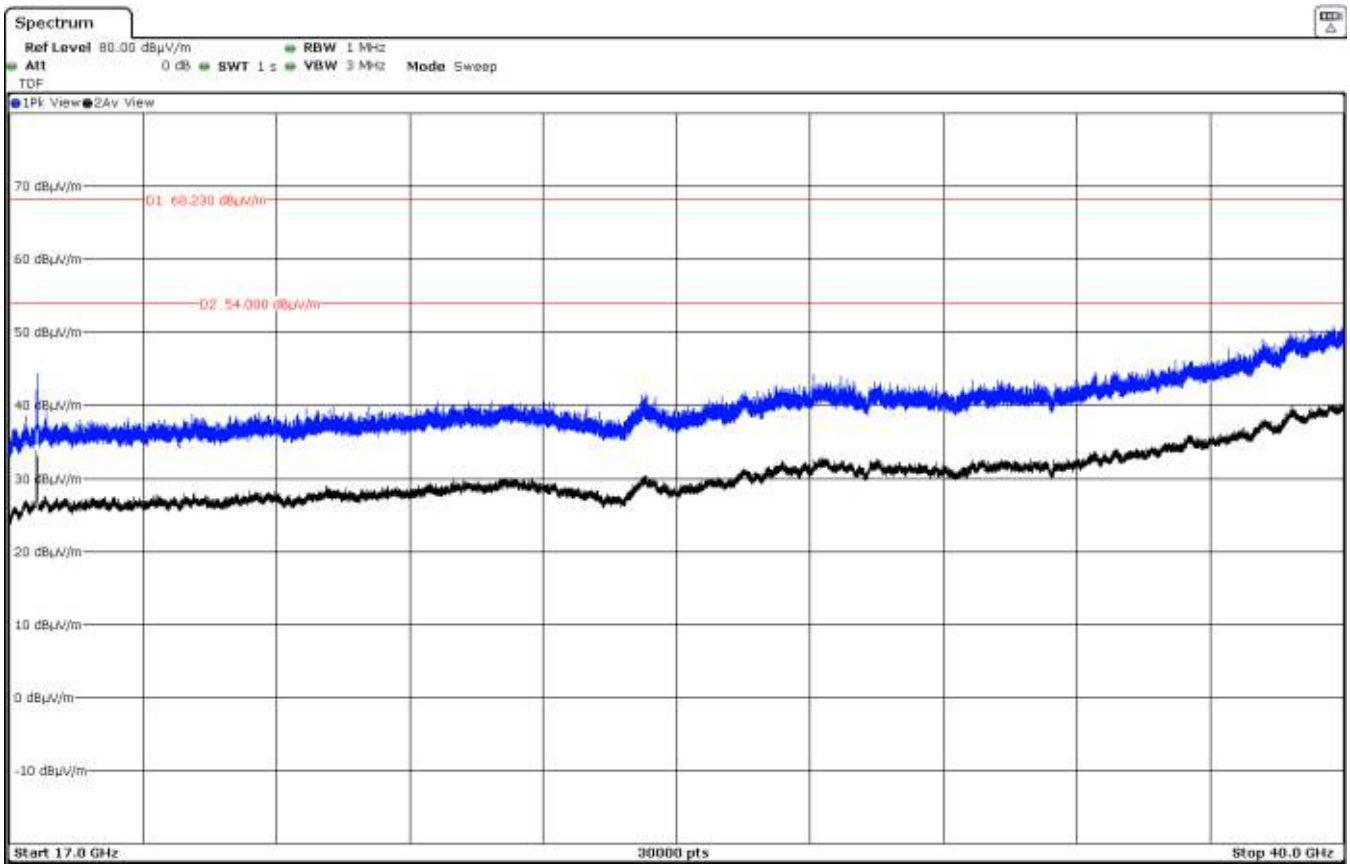
- Low Channel:



- Middle Channel:



- High Channel:



FCC Section 15.407 Subclause (b) (4) / RSS-247 6.2.4.2. 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 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 following worst cases modes in all relevant tests channels:

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

Mode 802.11 a20

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

- Lower Channel 149 (5745 MHz):

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

- Middle Channel 157 (5785 MHz):

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

- High Channel 165 (5825 MHz):

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

Mode 802.11 n20 (HT20)

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

- Lower Channel 149 (5745 MHz):

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

- Middle Channel 157 (5785 MHz):

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

- High Channel 165 (5825 MHz):

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

Mode 802.11 n40 (HT40)

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

- Low Channel 151 (5755 MHz):

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

- High Channel 159 (5795 MHz):

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

Mode 802.11 ac40

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

- Low Channel 151 (5755 MHz):

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

- High Channel 159 (5795 MHz):

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

Mode 802.11 ac80 (VHT80)

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

- Middle Channel 155 (5775 MHz):

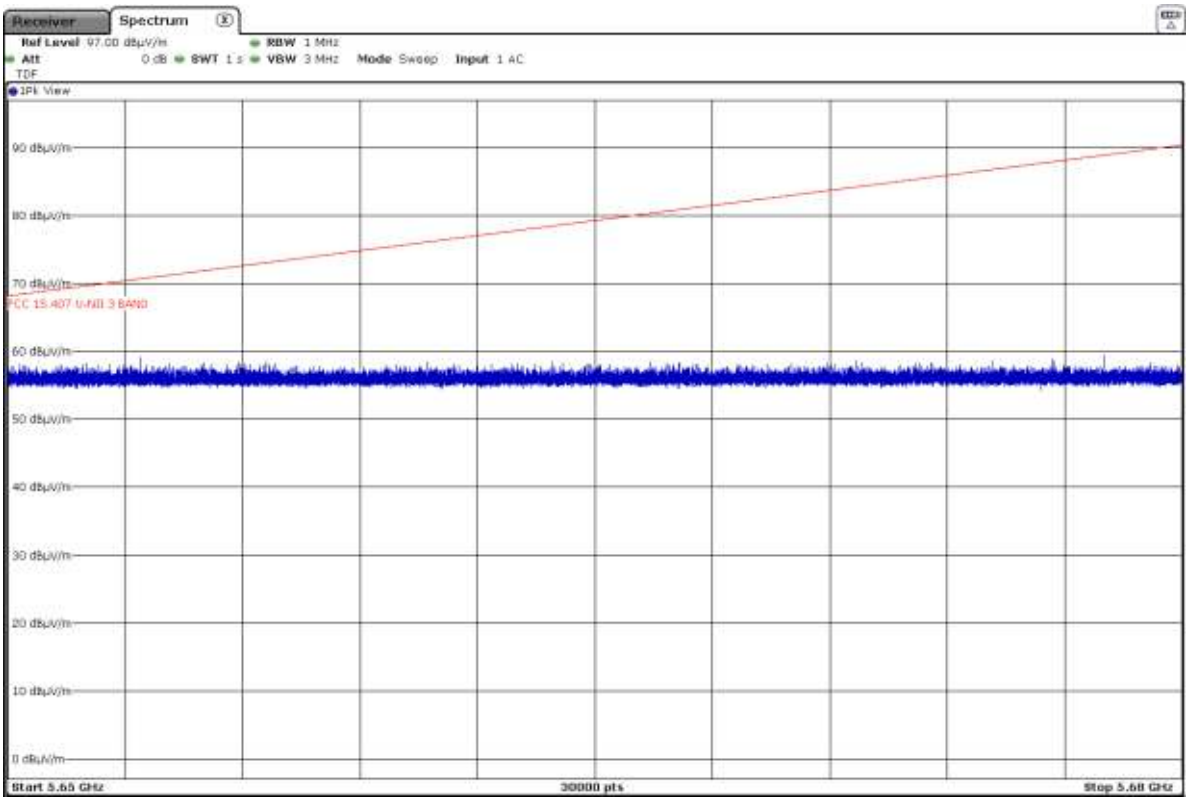
No radiated spurious frequencies detected at less than 20 dB below the limit.

Verdict: PASS

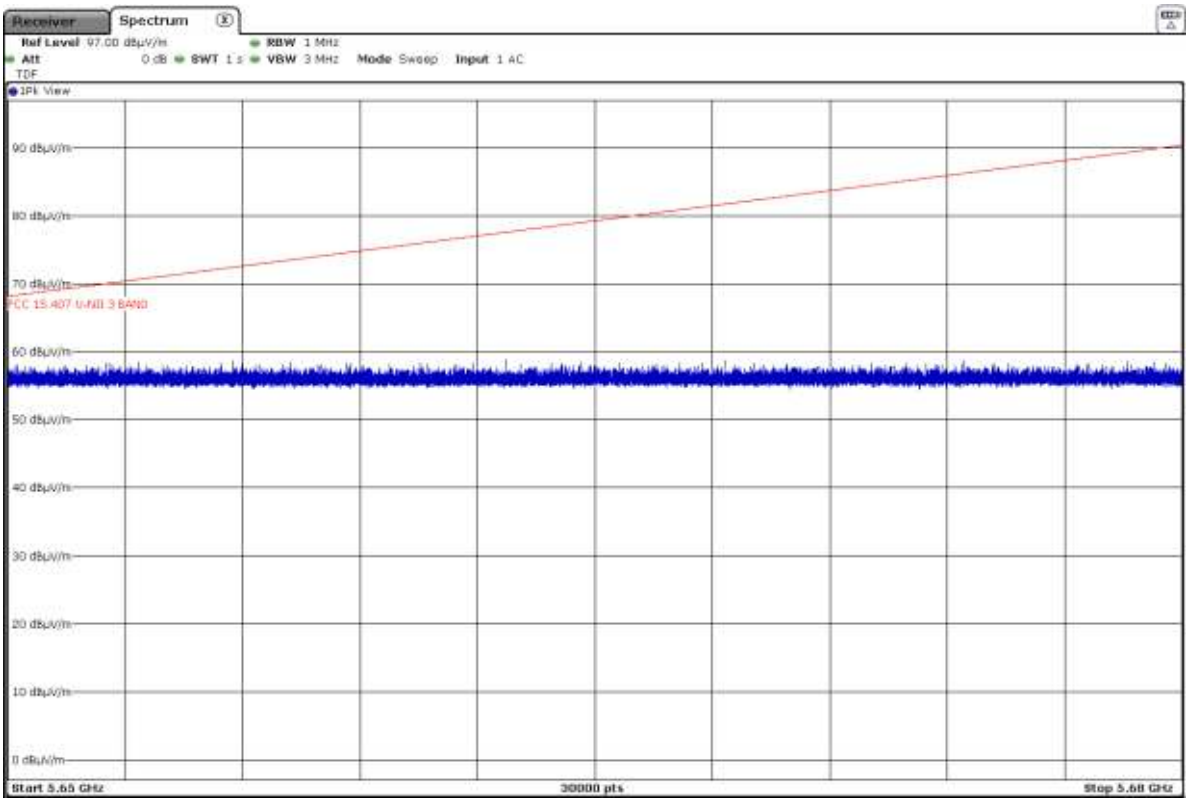
- **Mode 802.11 a20**

  Radiated spurious emissions at band-edges and inside adjacent band 5.65 – 5.68 GHz

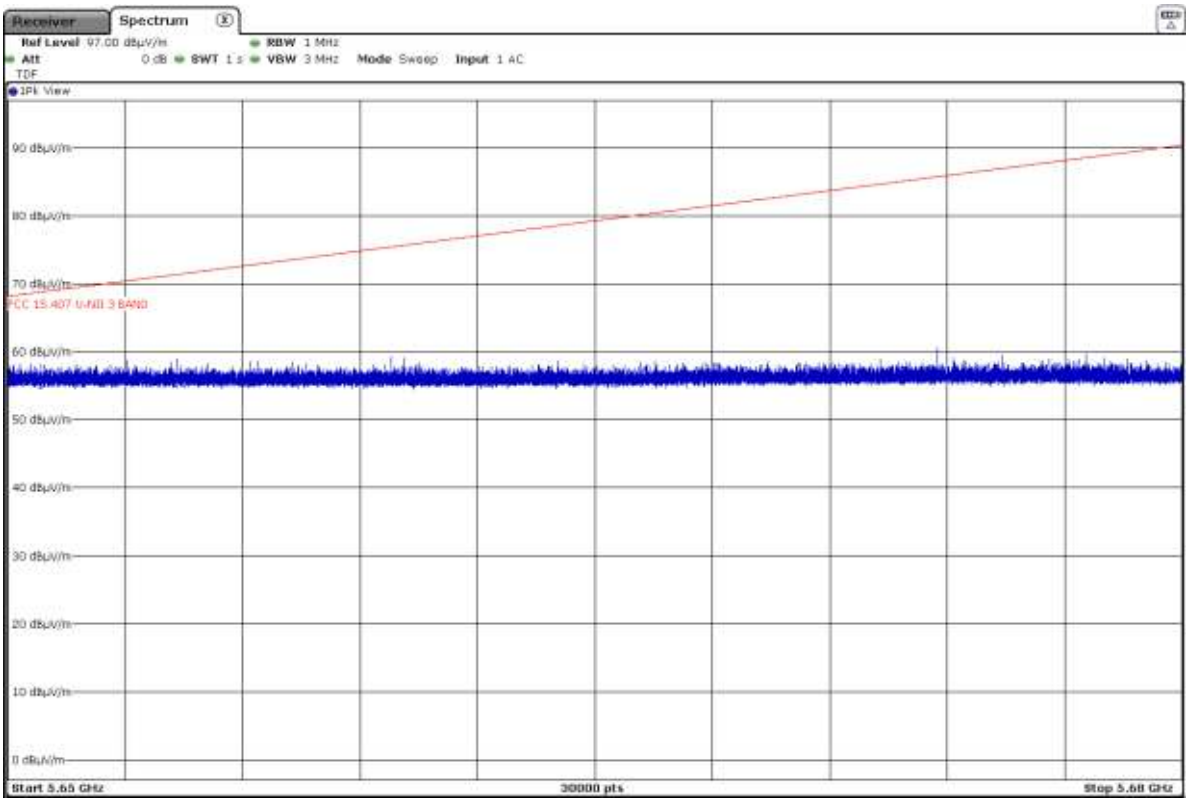
  - Low Channel 149 (5745 MHz):



  - Middle Channel 157 (5785 MHz):

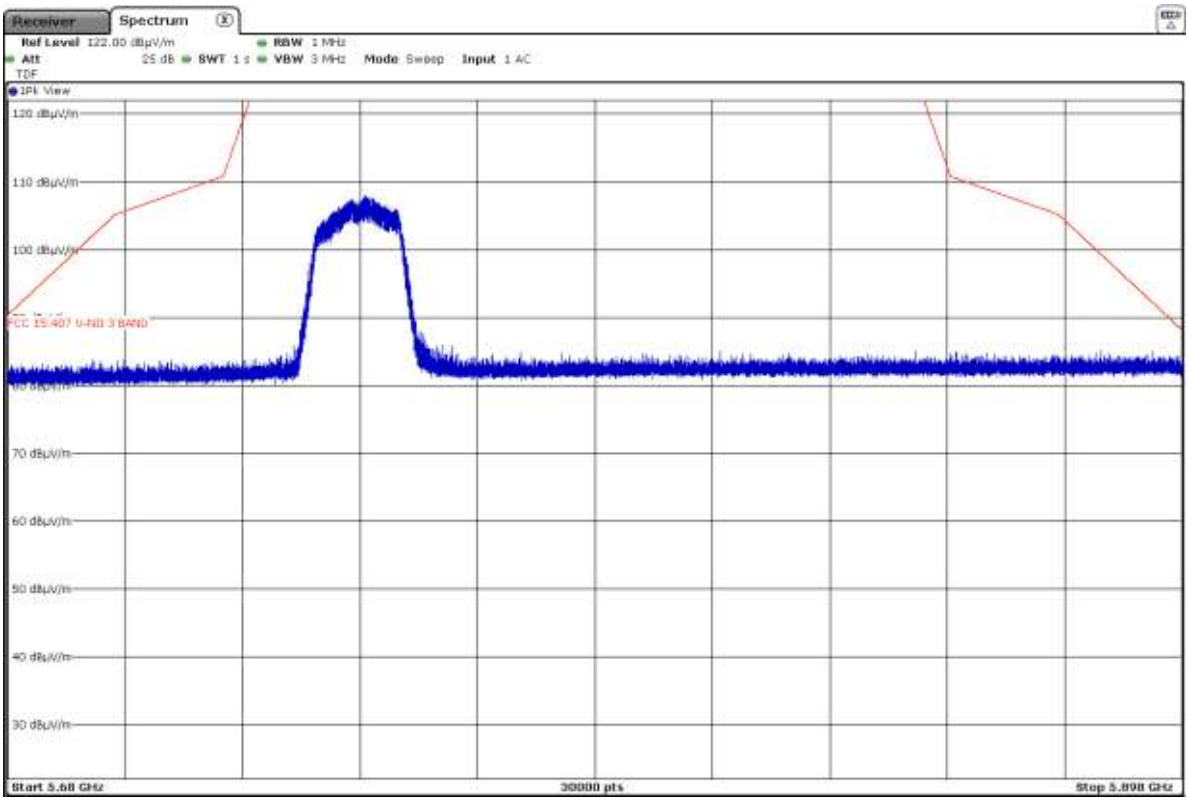


- High Channel 165 (5825 MHz):

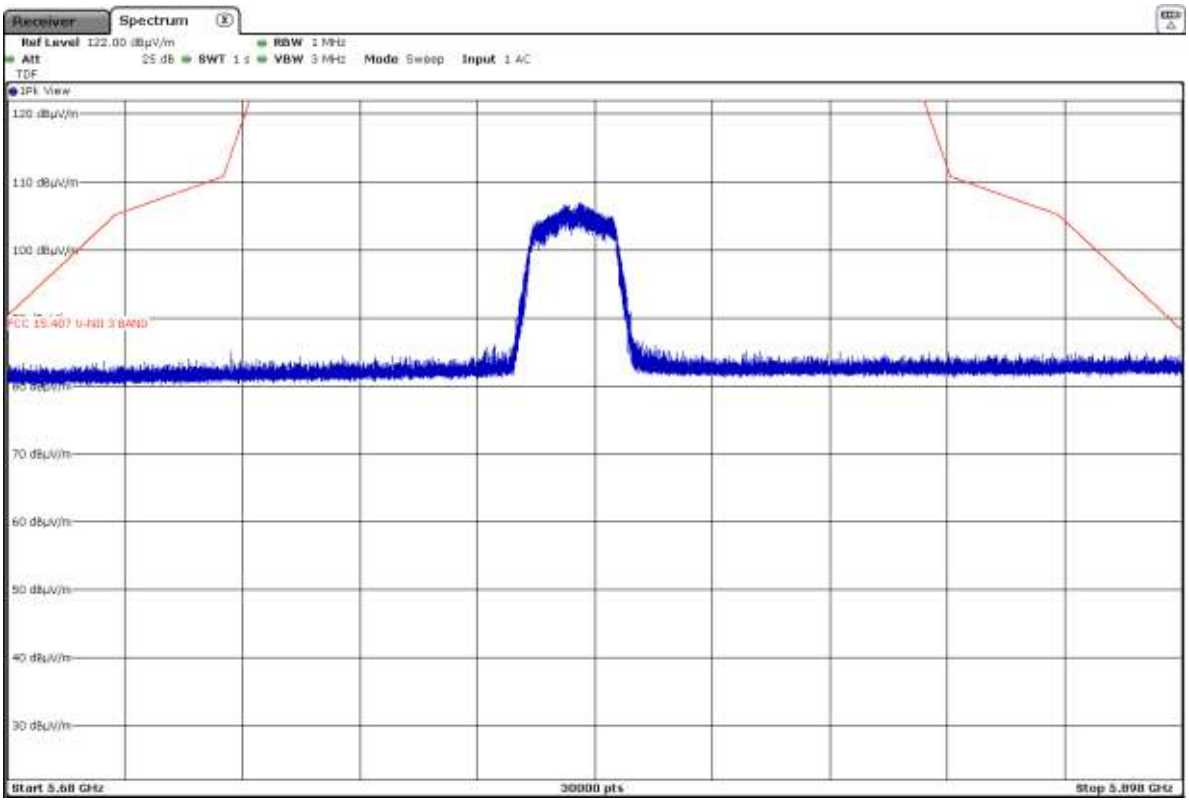


Radiated spurious emissions at band-edges and inside adjacent band 5.68 – 5.898 GHz

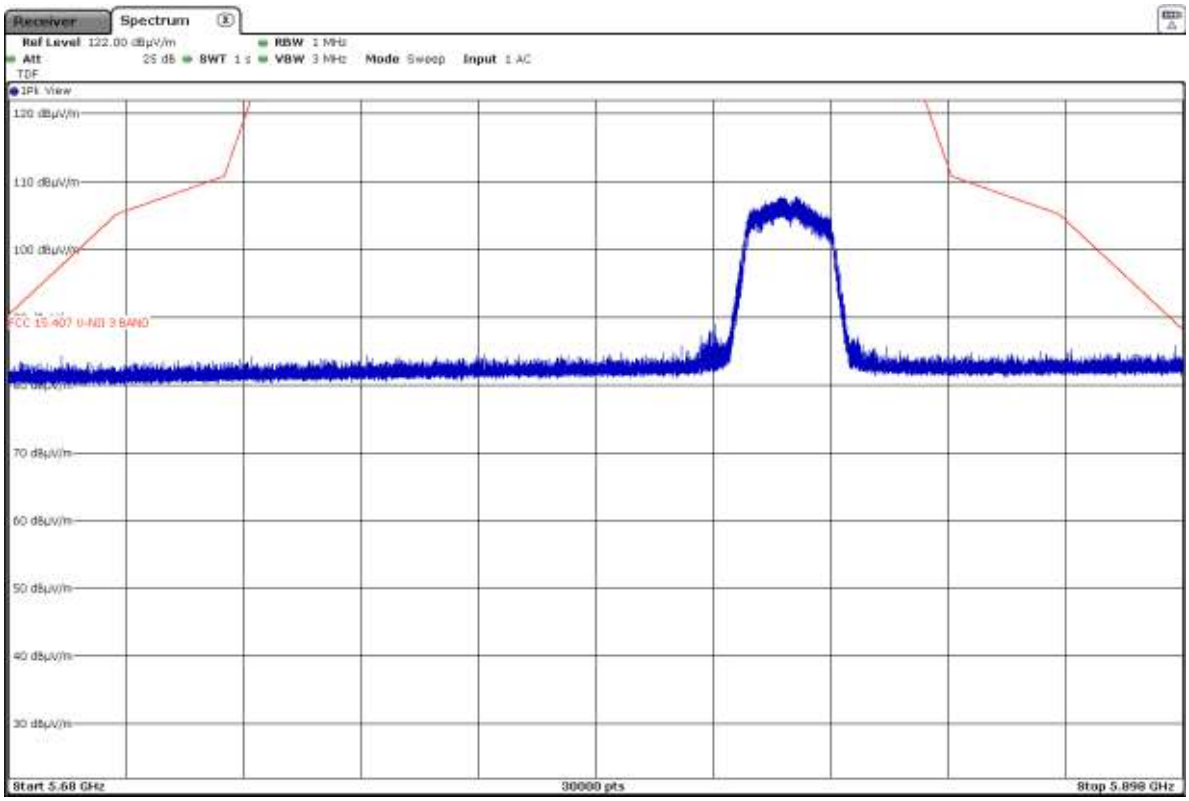
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):

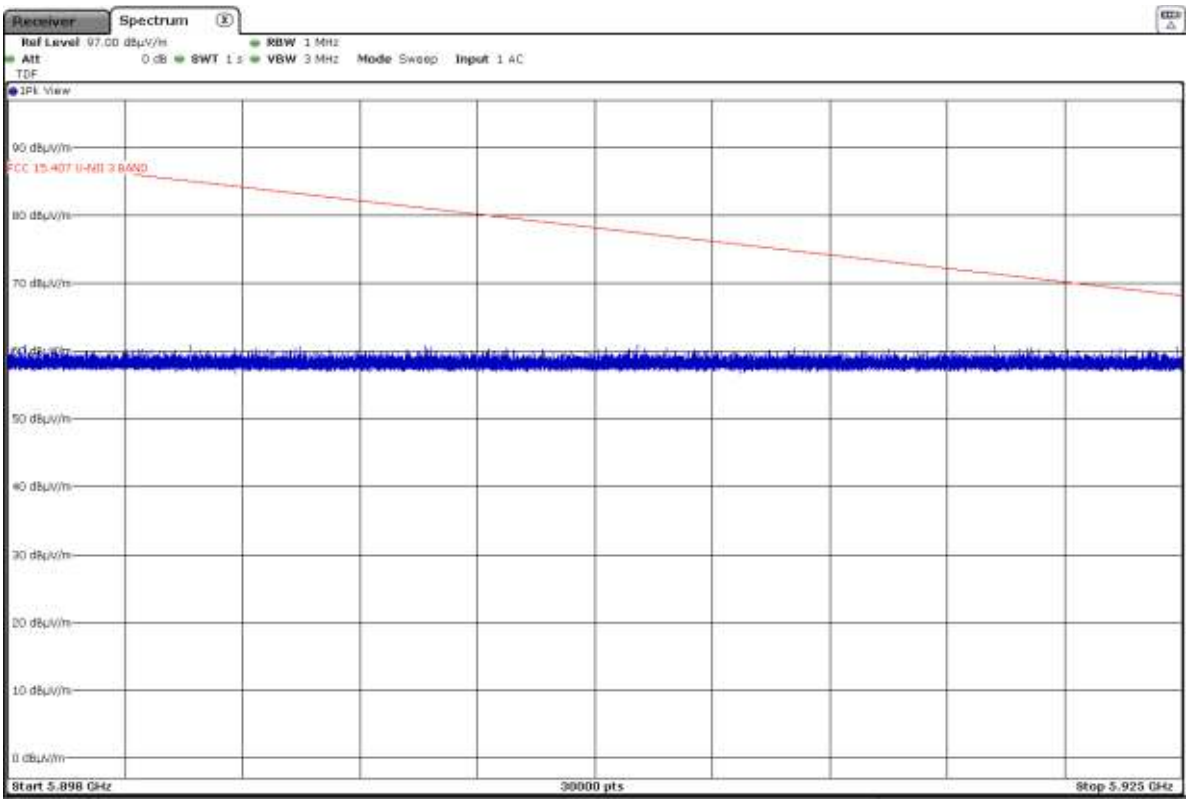


- High Channel 165 (5825 MHz):

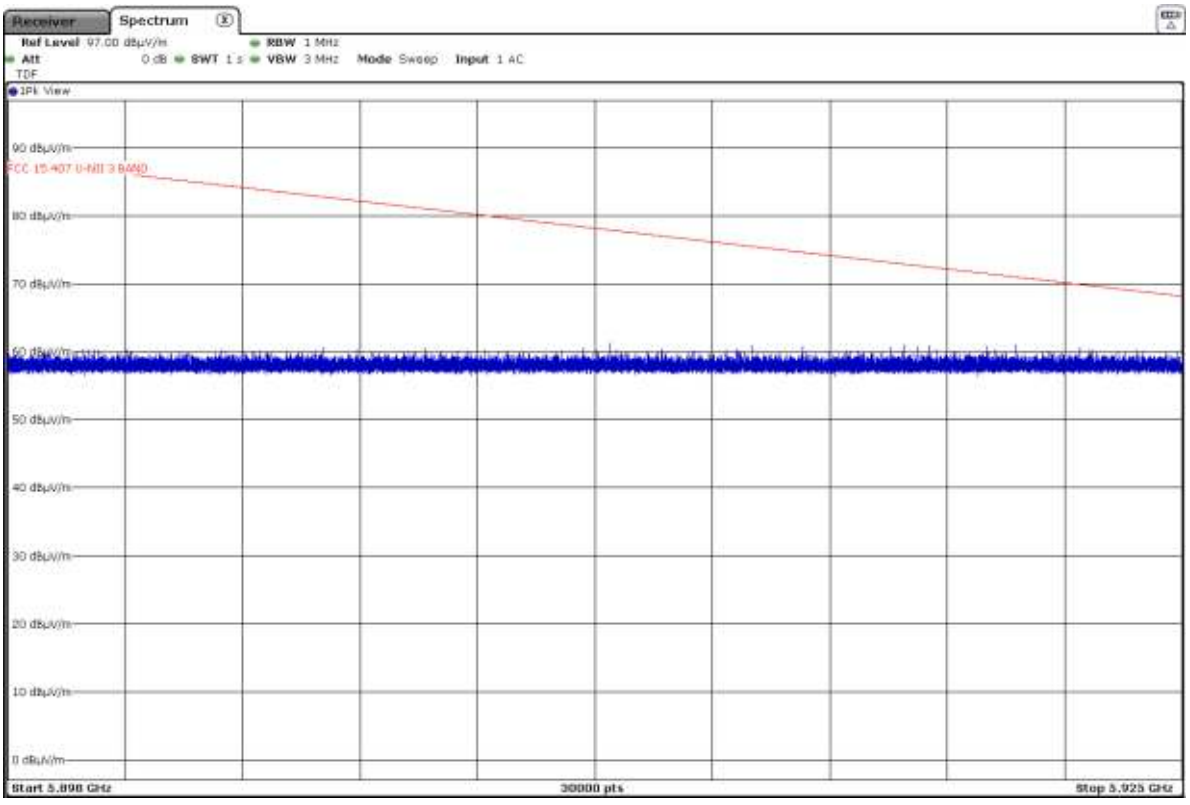


Radiated spurious emissions at band-edges and inside adjacent band 5.898 – 5.925 GHz

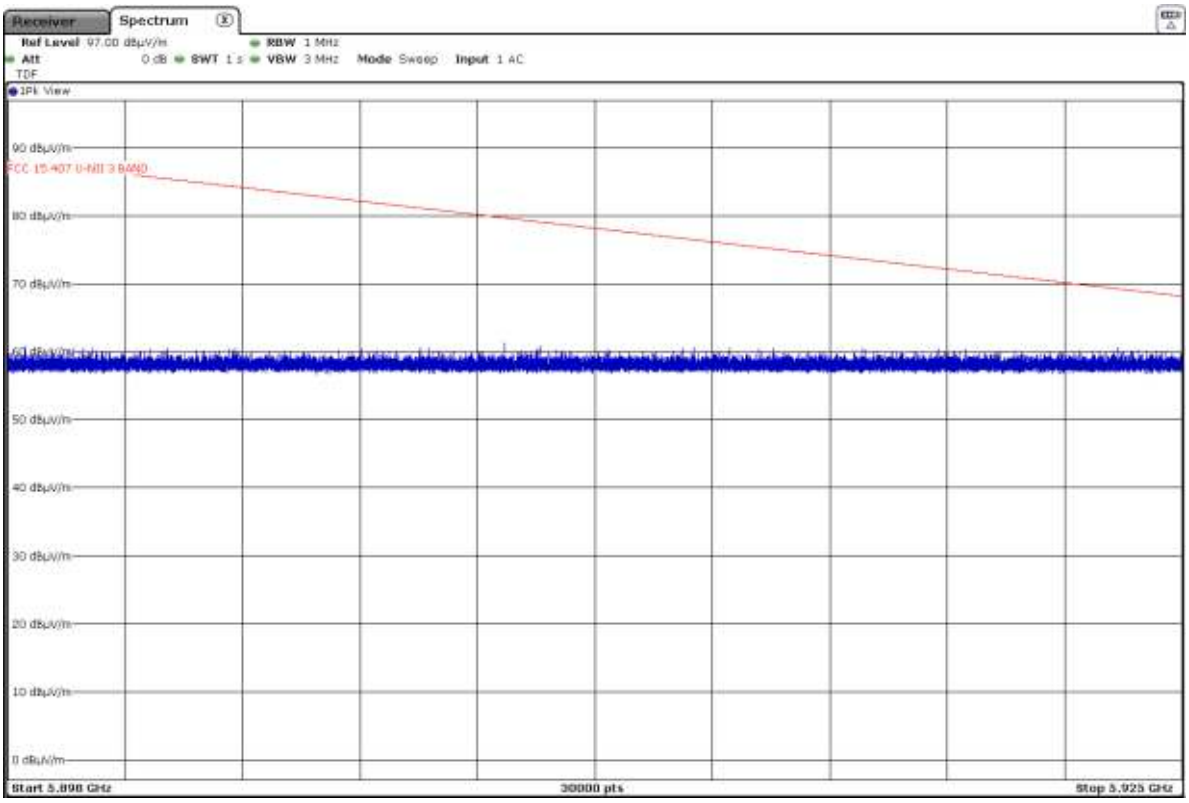
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



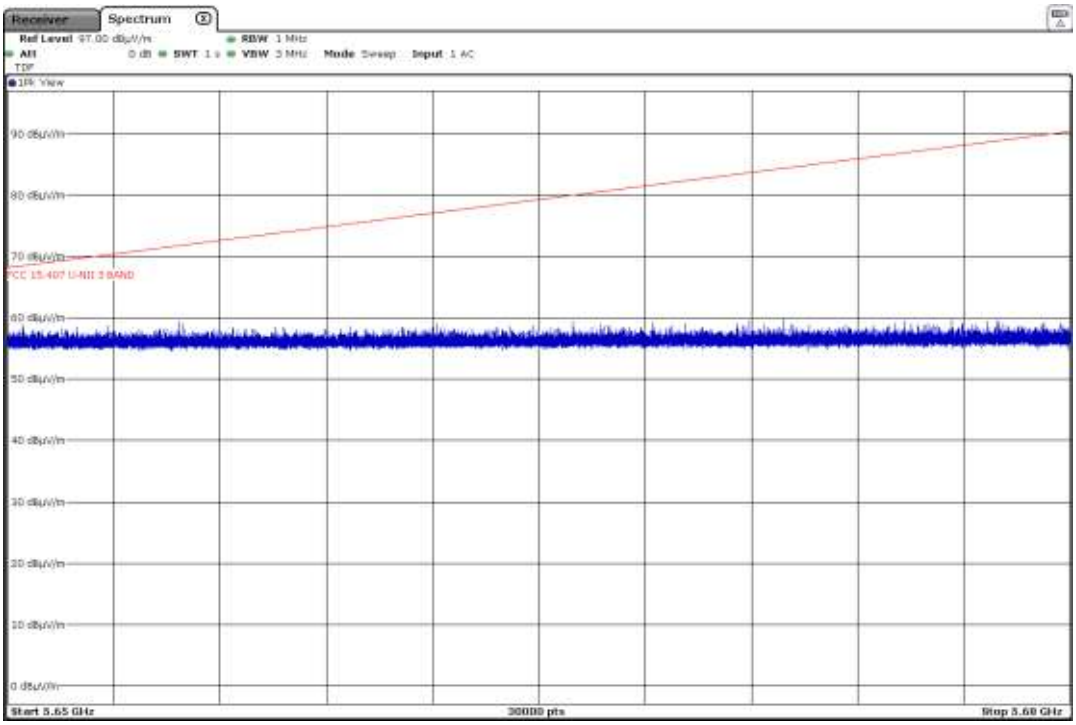
- High Channel 165 (5825 MHz):



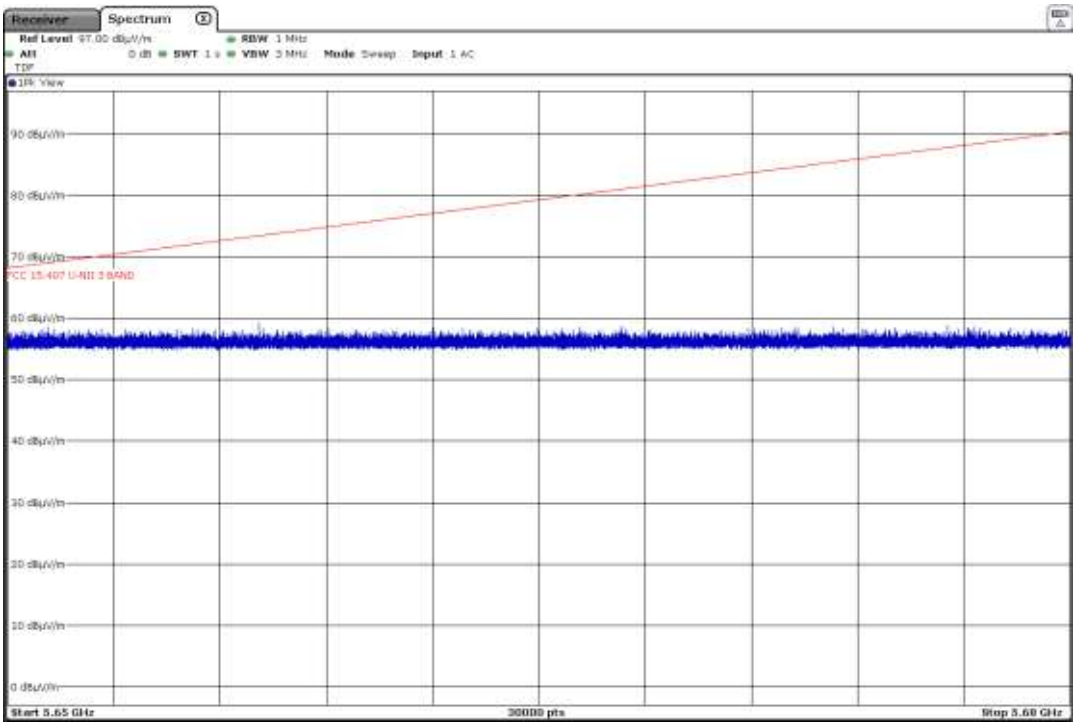
- **Mode 802.11 n20 (HT20)**

  Radiated spurious emissions at band-edges and inside adjacent band 5.65 – 5.68 GHz

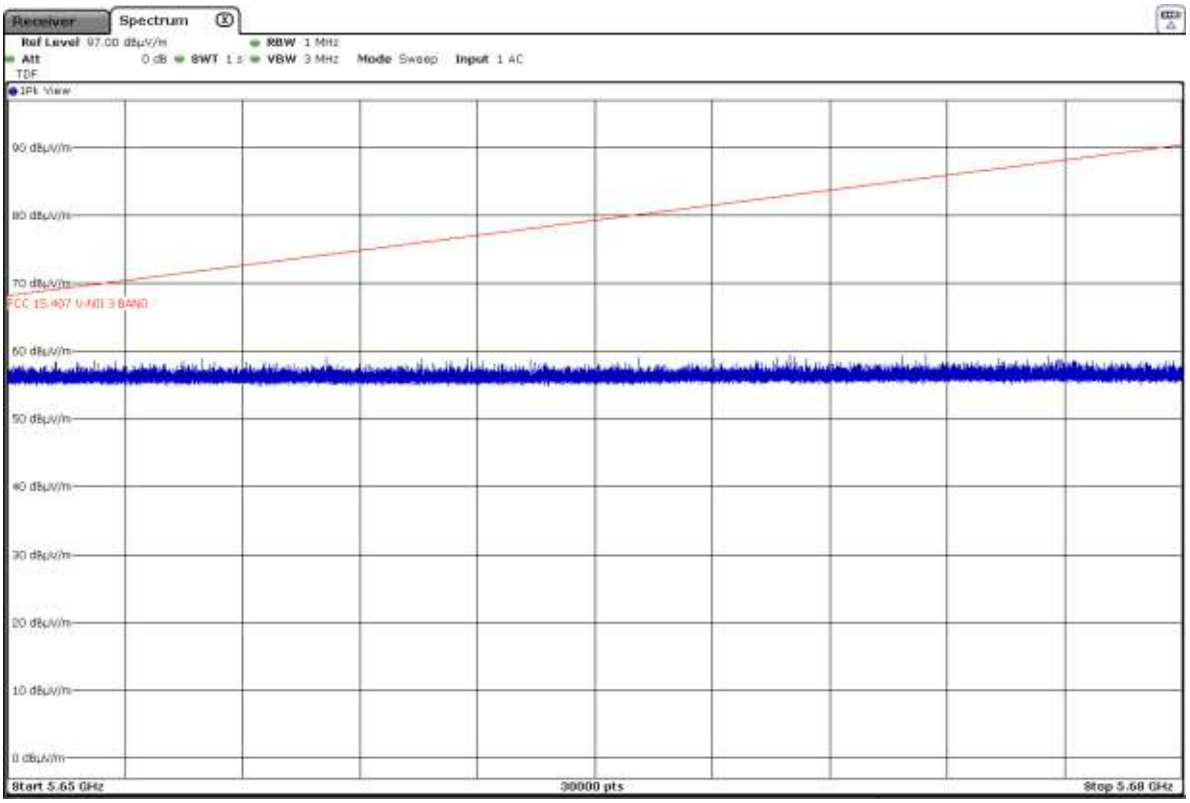
  - Low Channel 149 (5745 MHz):



  - Middle Channel 157 (5785 MHz):

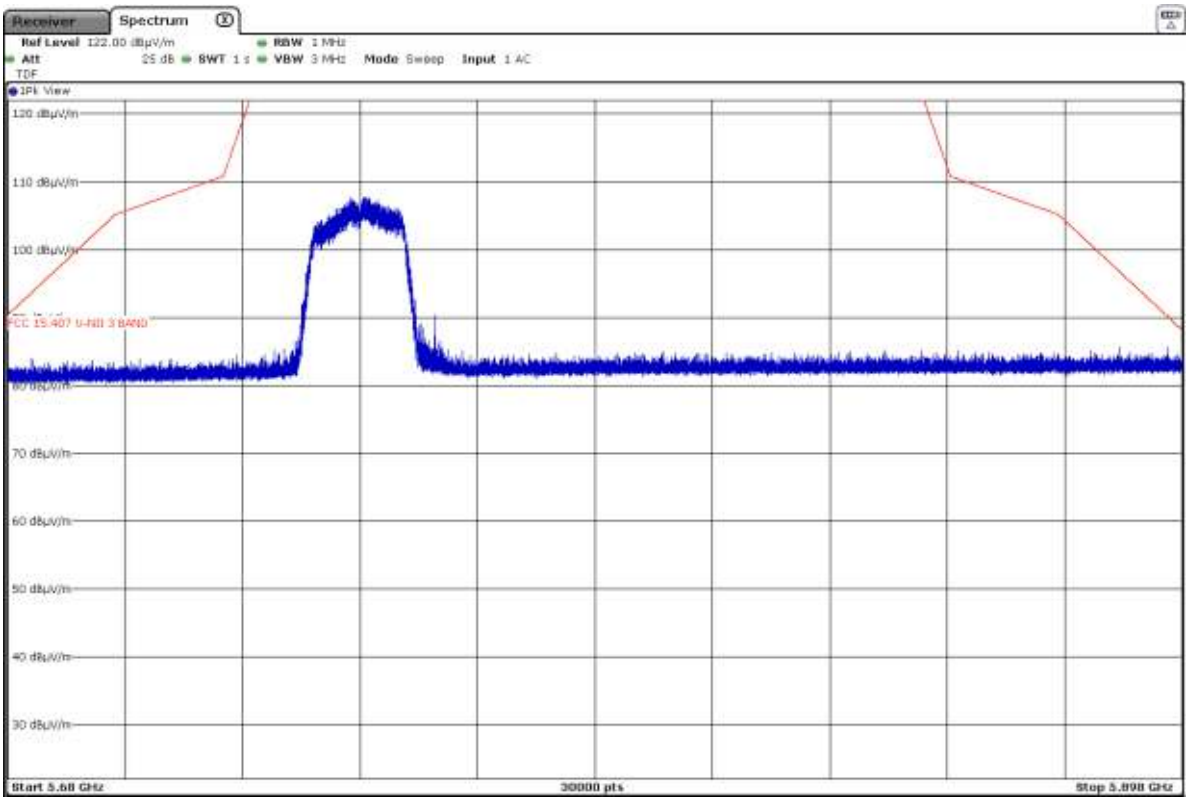


- High Channel 165 (5825 MHz):

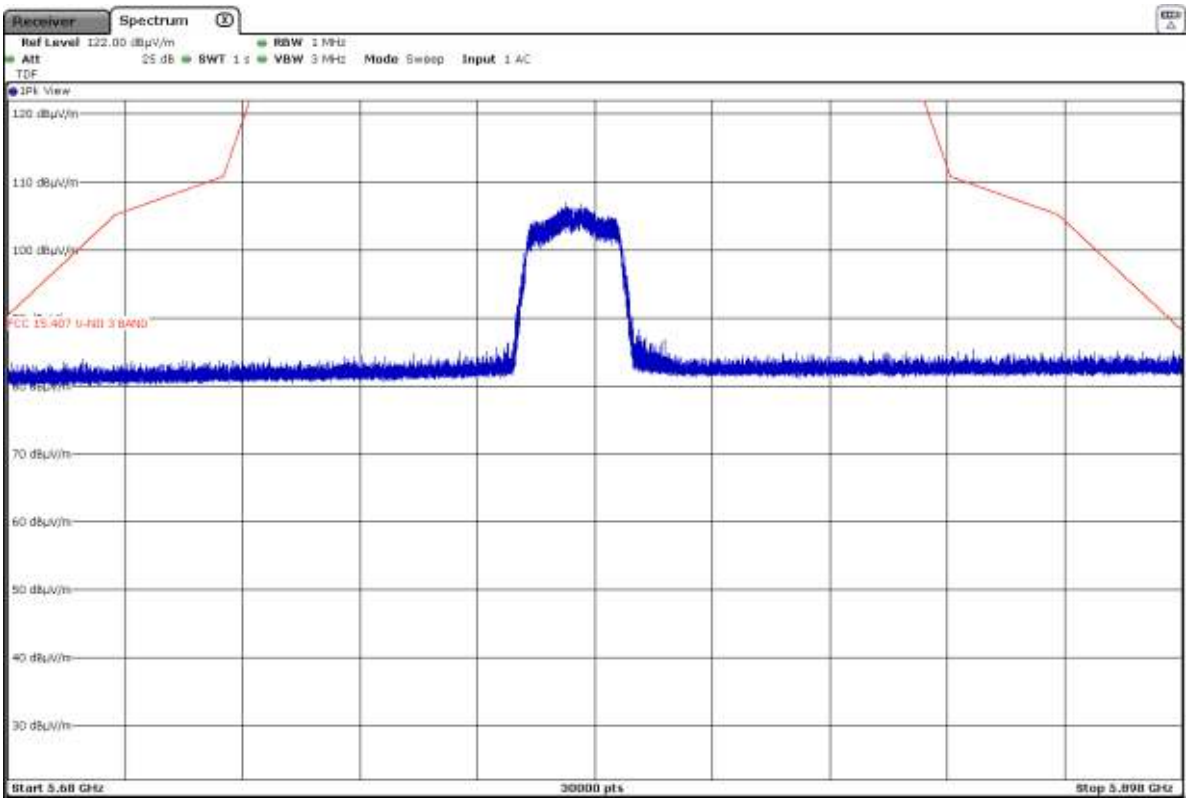


Radiated spurious emissions at band-edges and inside adjacent band 5.68 – 5.898 GHz

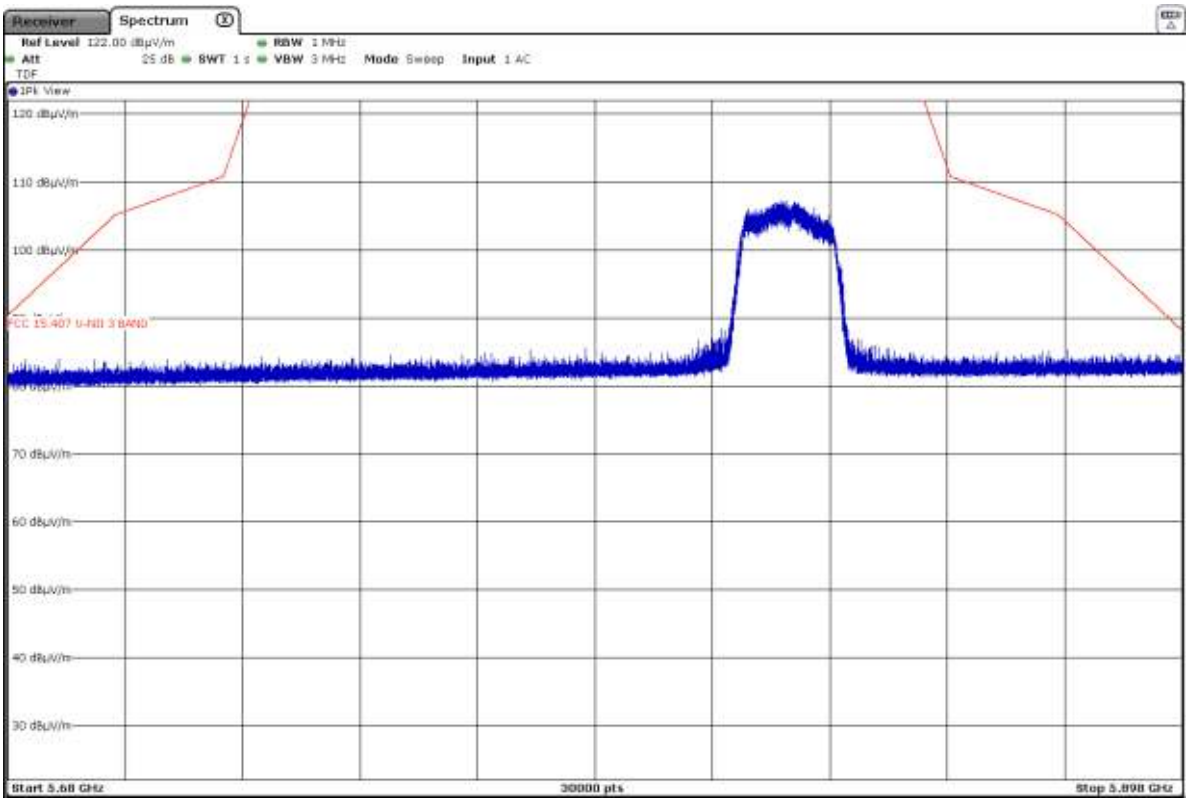
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):

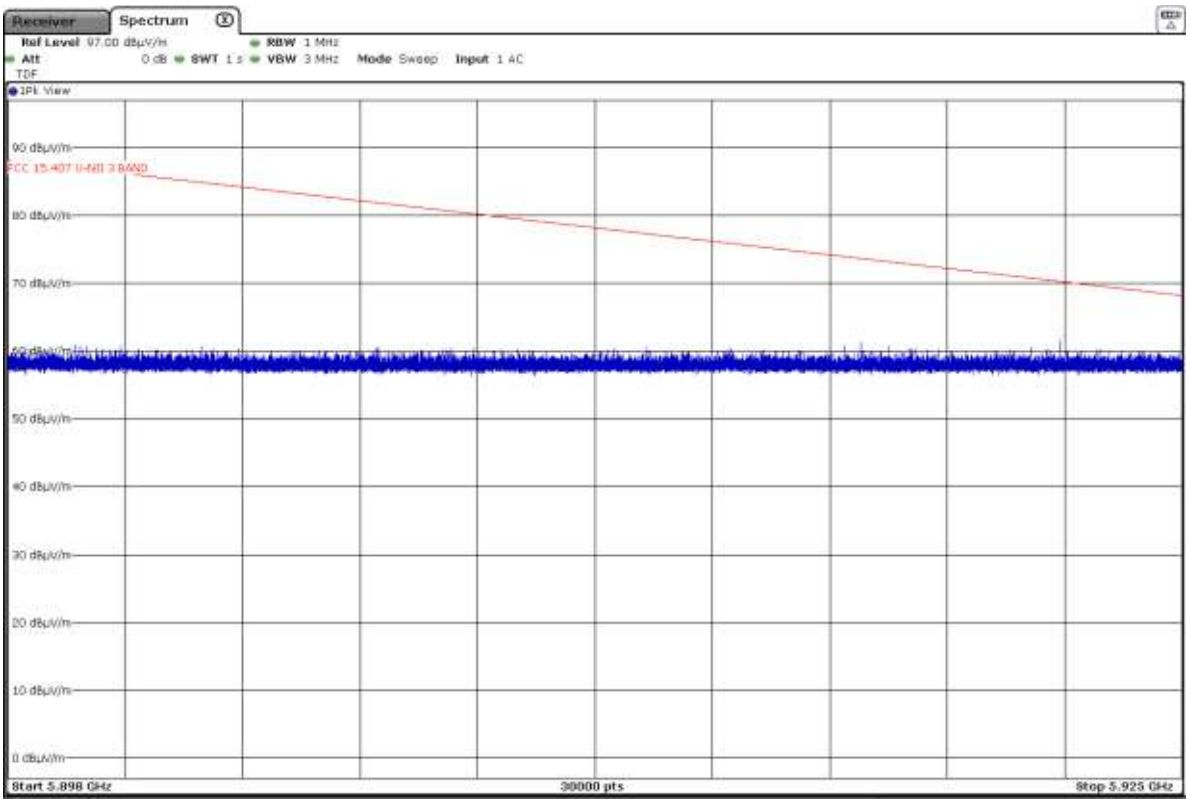


- High Channel 165 (5825 MHz):

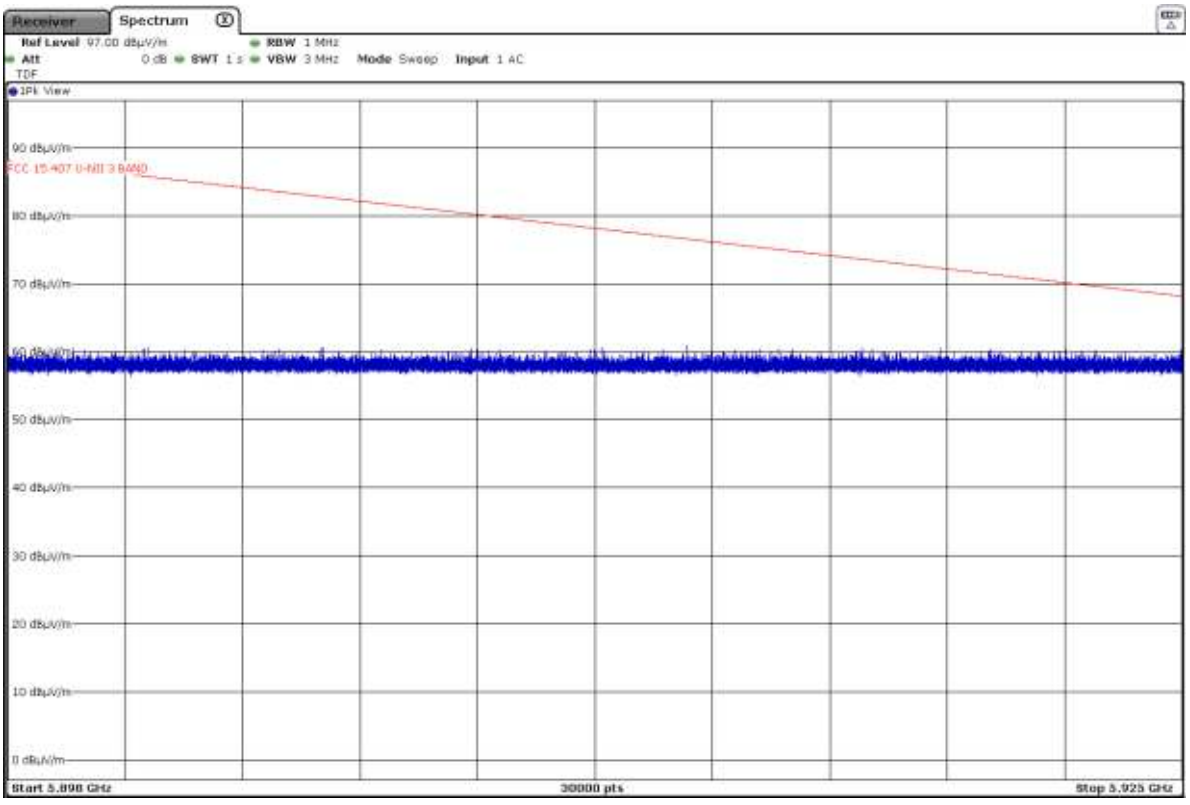


Radiated spurious emissions at band-edges and inside adjacent band 5.898 – 5.925 GHz

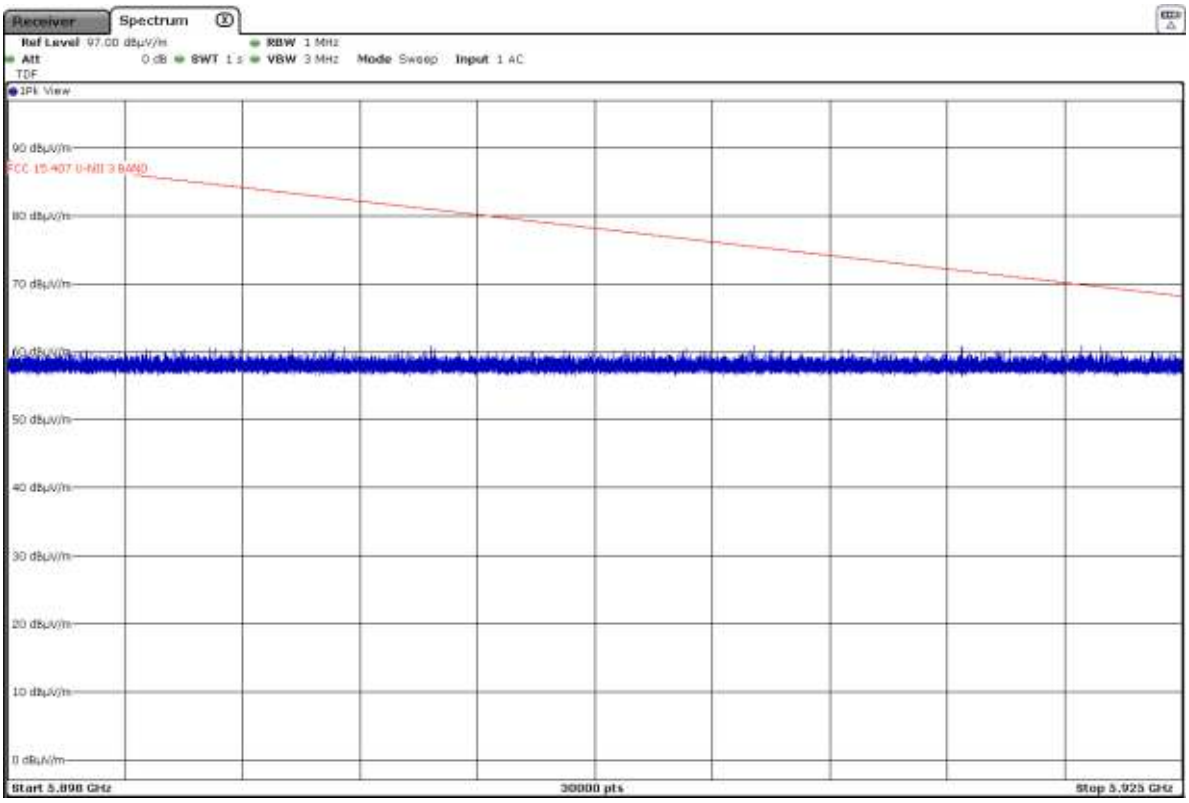
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



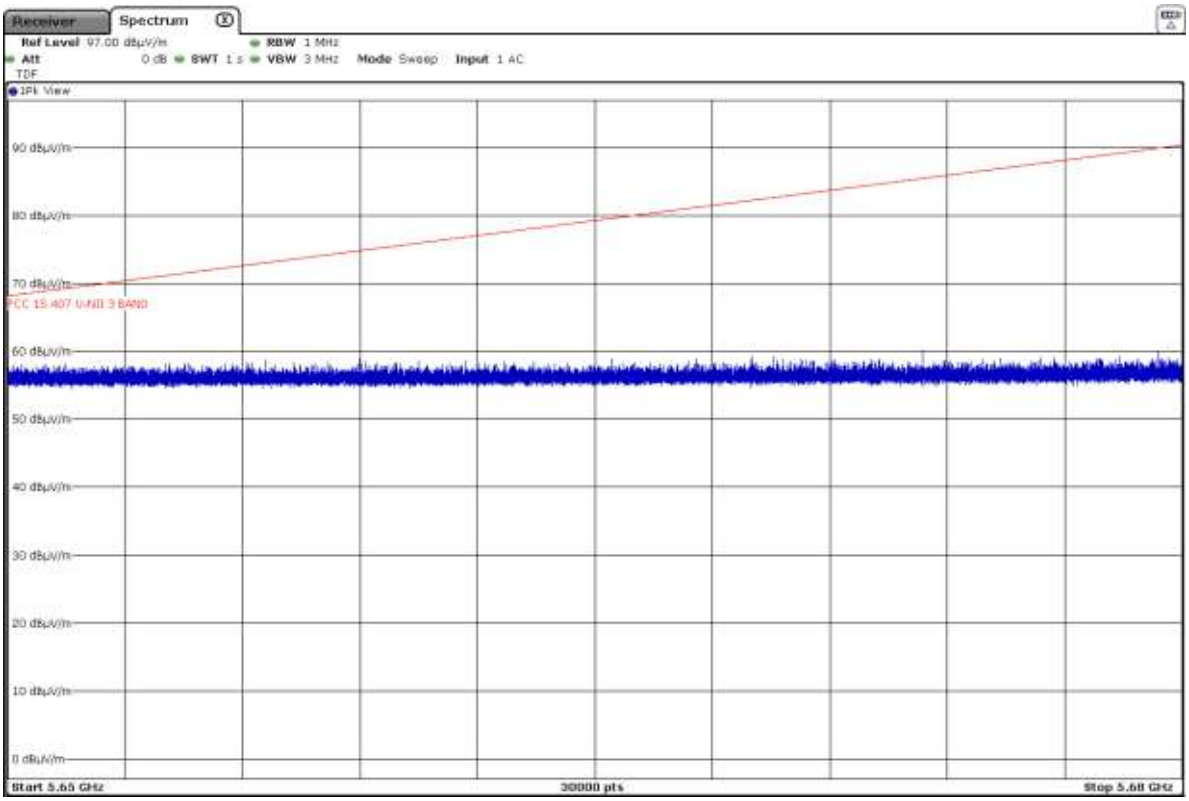
- High Channel 165 (5825 MHz):



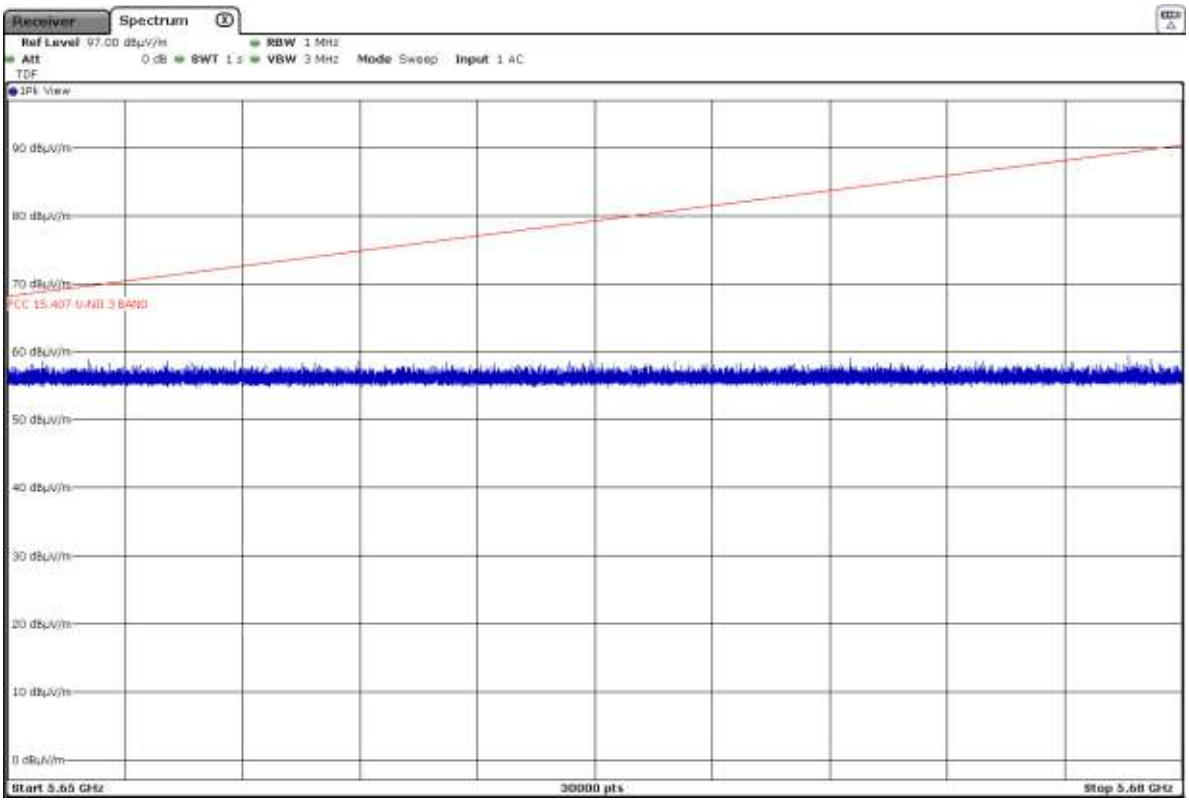
- **Mode 802.11 ac20**

  Radiated spurious emissions at band-edges and inside adjacent band 5.65 – 5.68 GHz

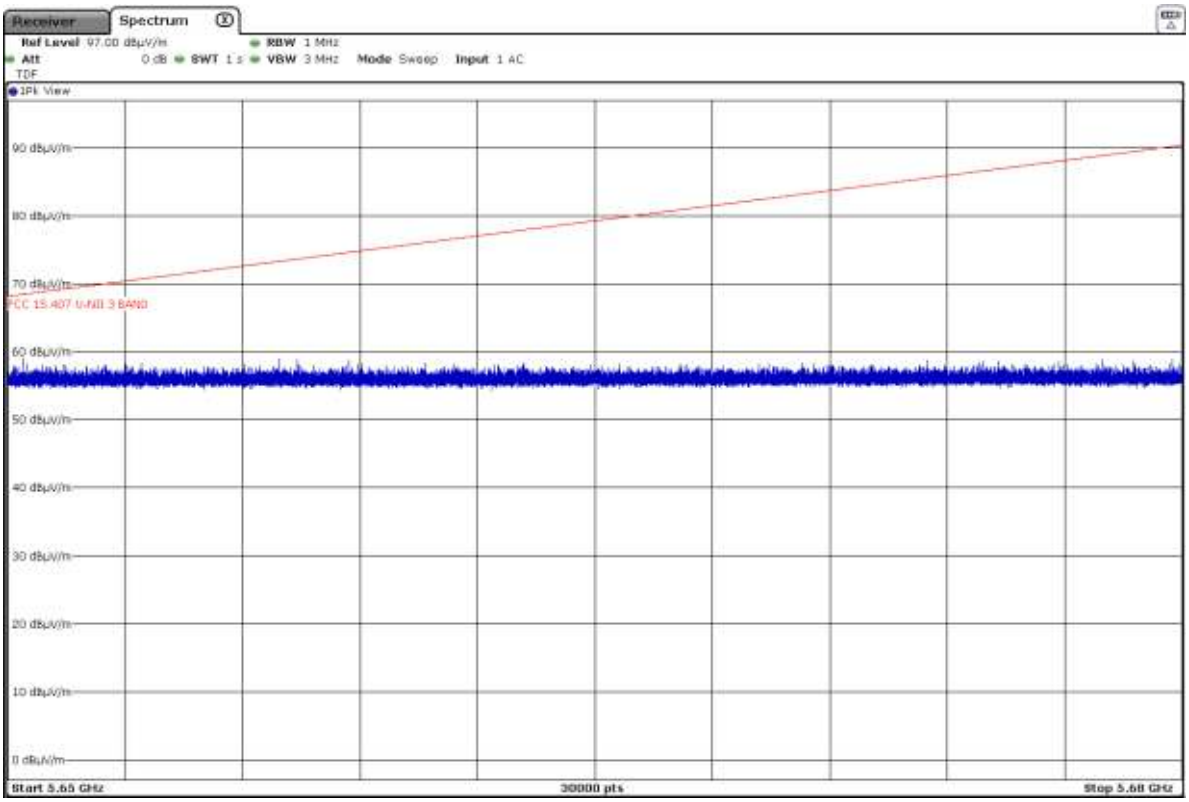
  - Low Channel 149 (5745 MHz):



  - Middle Channel 157 (5785 MHz):

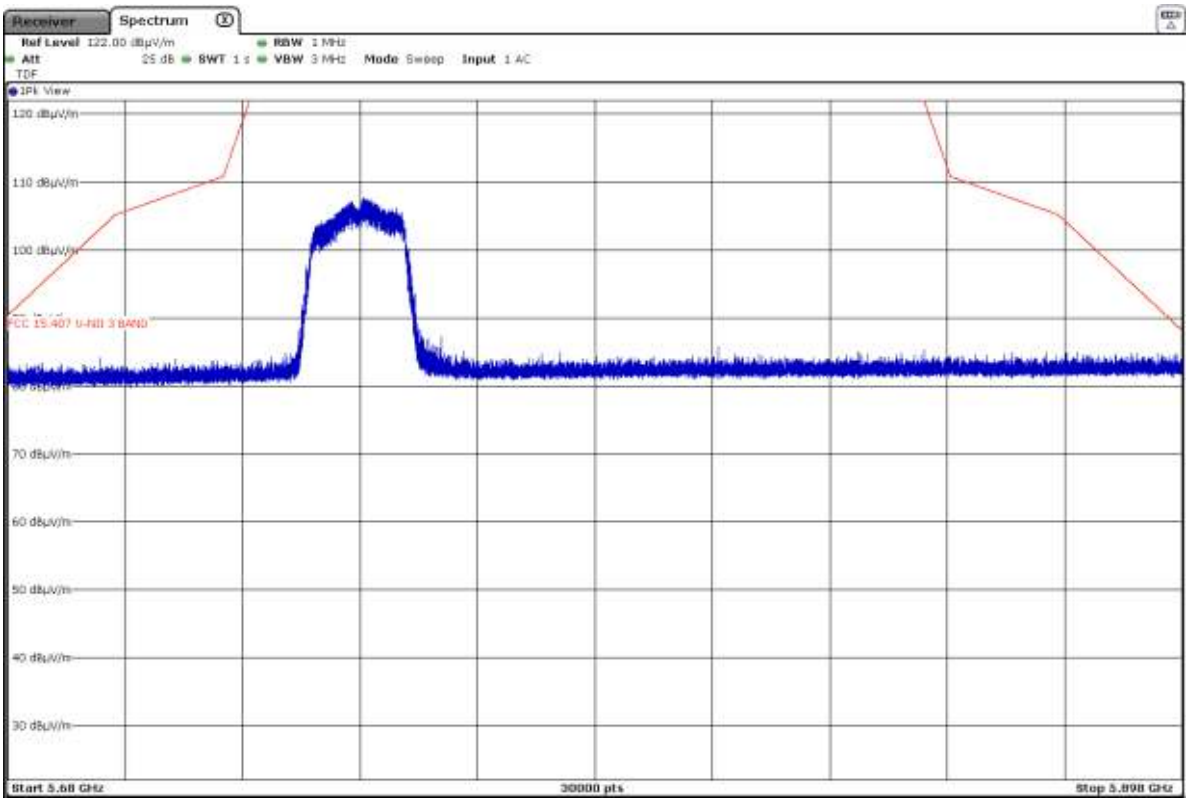


- High Channel 165 (5825 MHz):

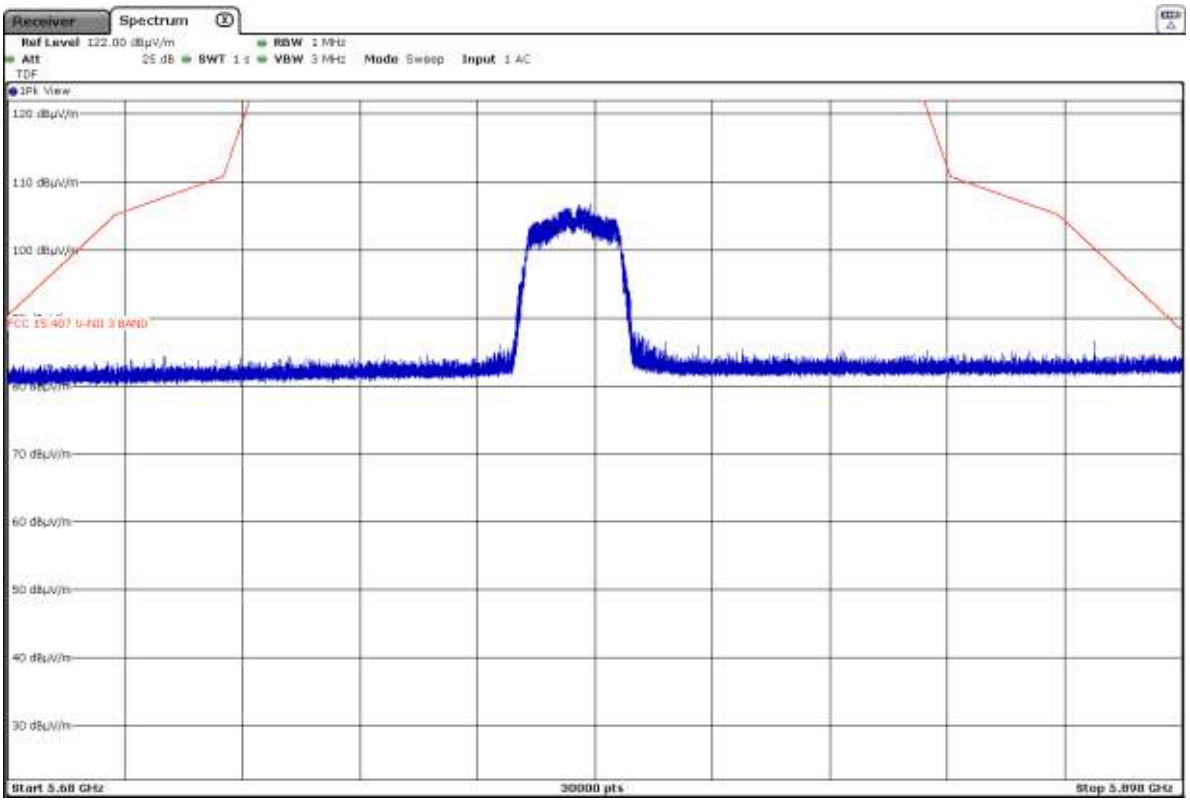


Radiated spurious emissions at band-edges and inside adjacent band 5.68 – 5.898 GHz

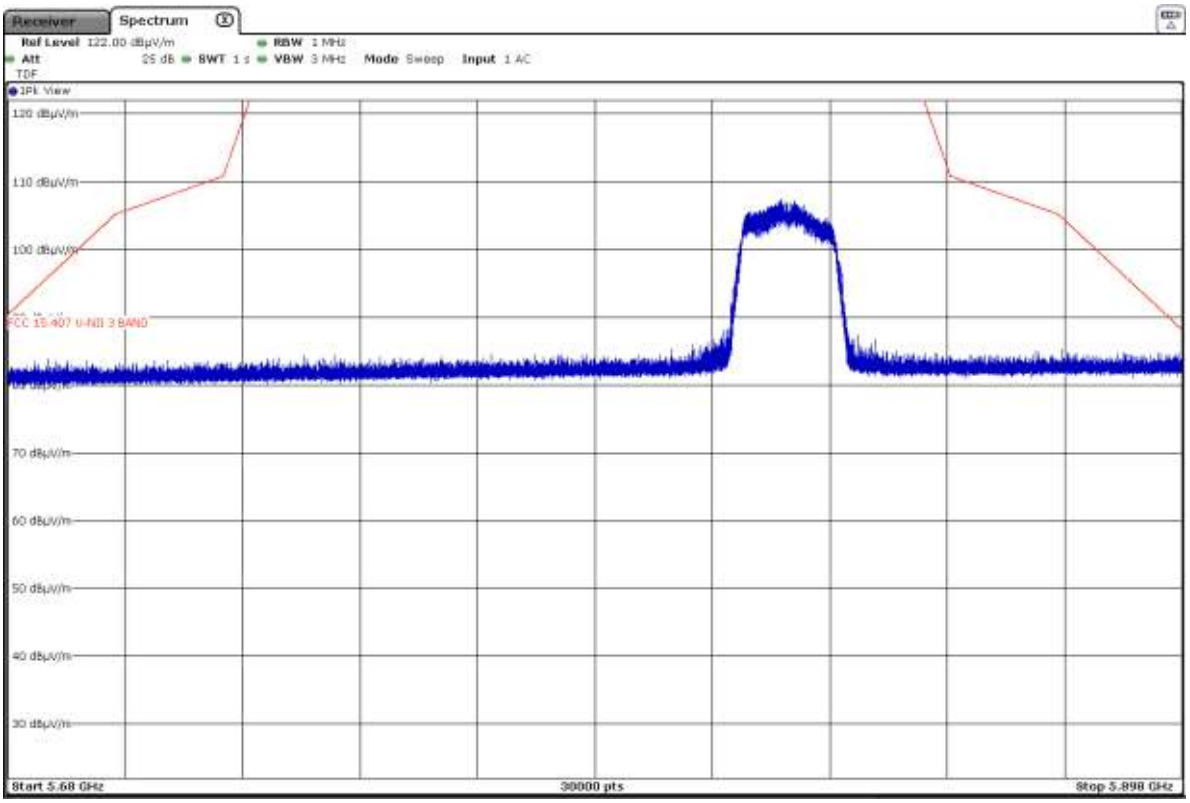
- Low Channel 149 (5745MHz):



- Middle Channel 157 (5785MHz):

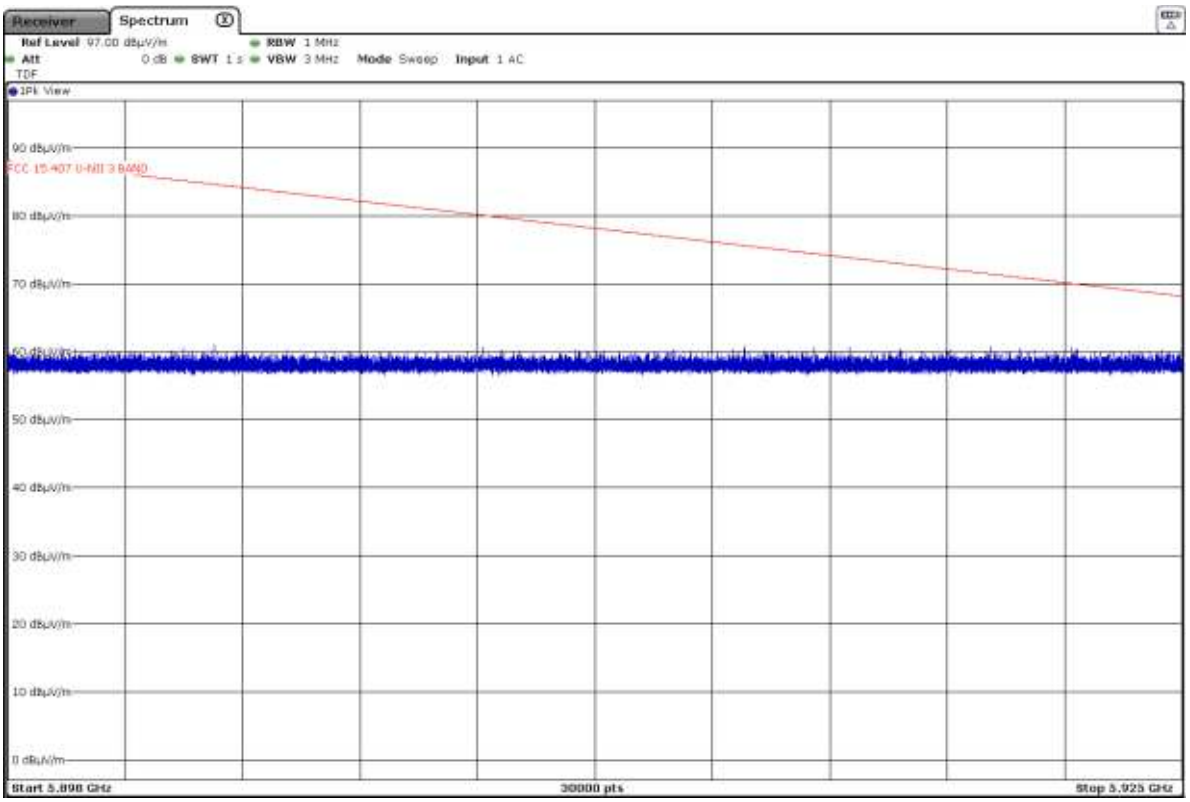


- High Channel 165 (5825MHz):

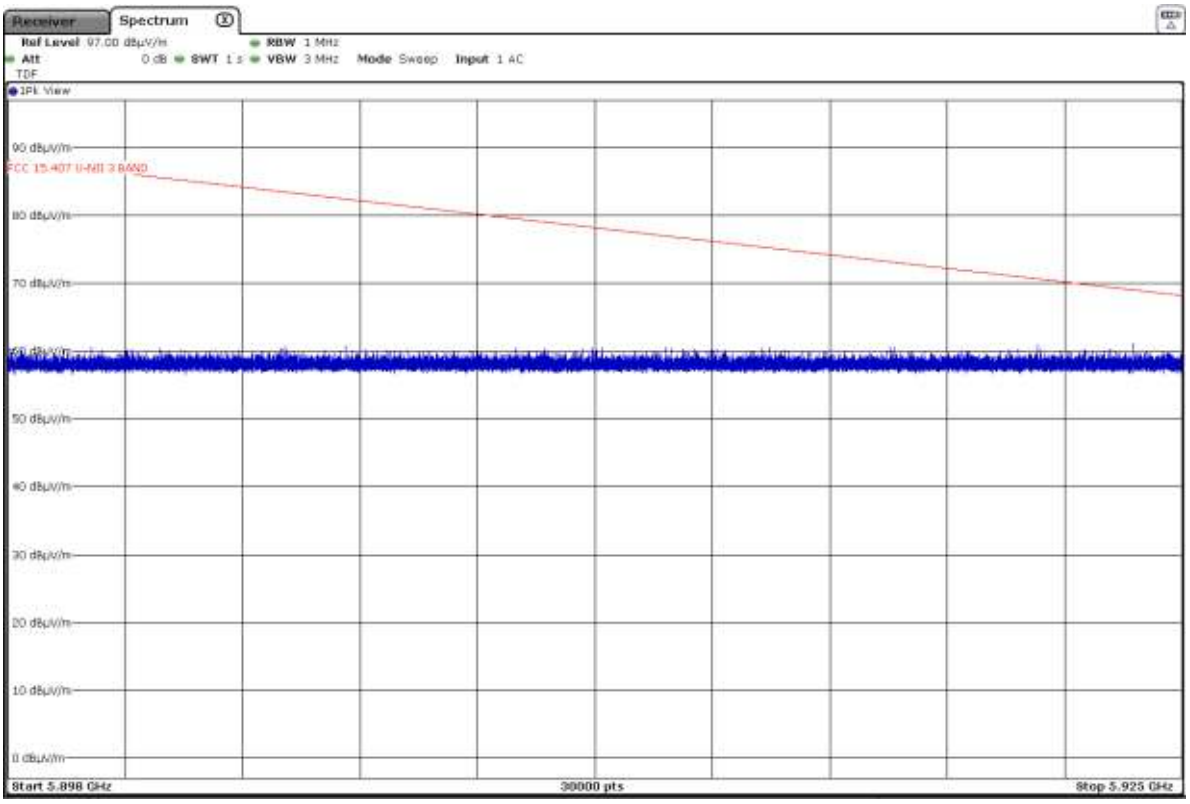


Radiated spurious emissions at band-edges and inside adjacent band 5.898 – 5.925 GHz

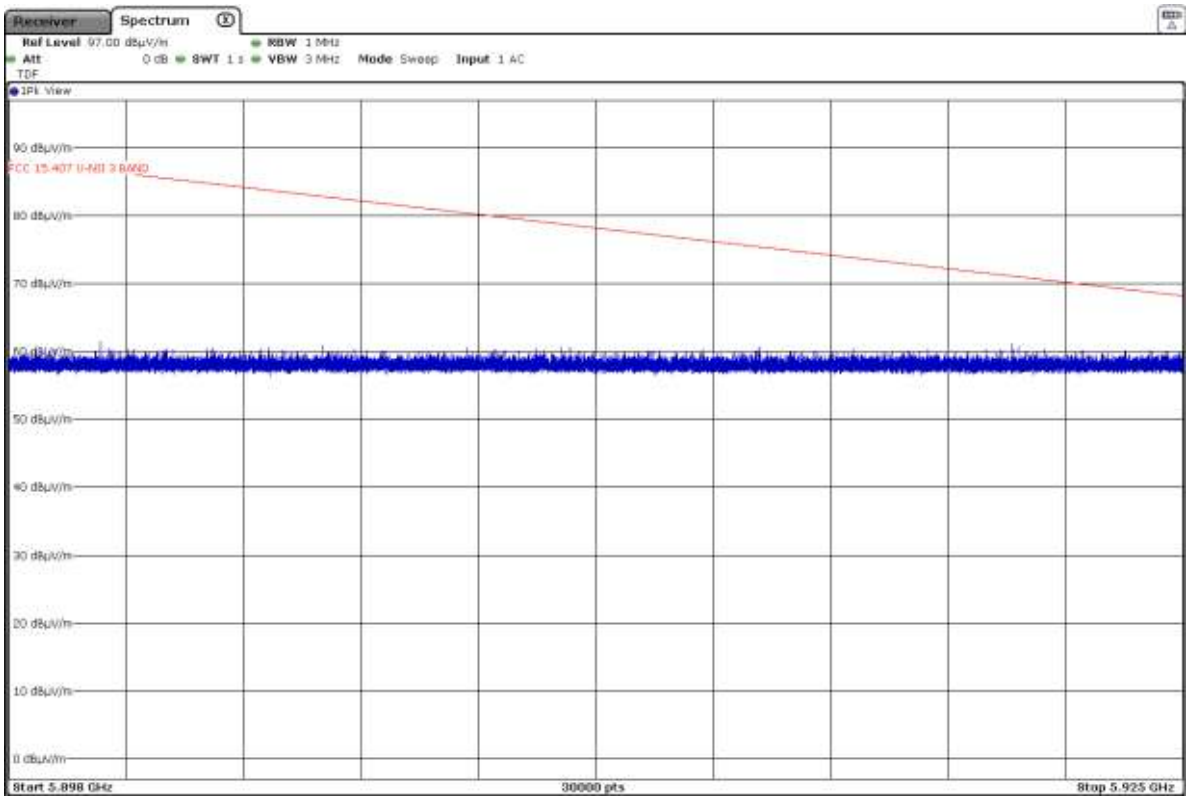
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



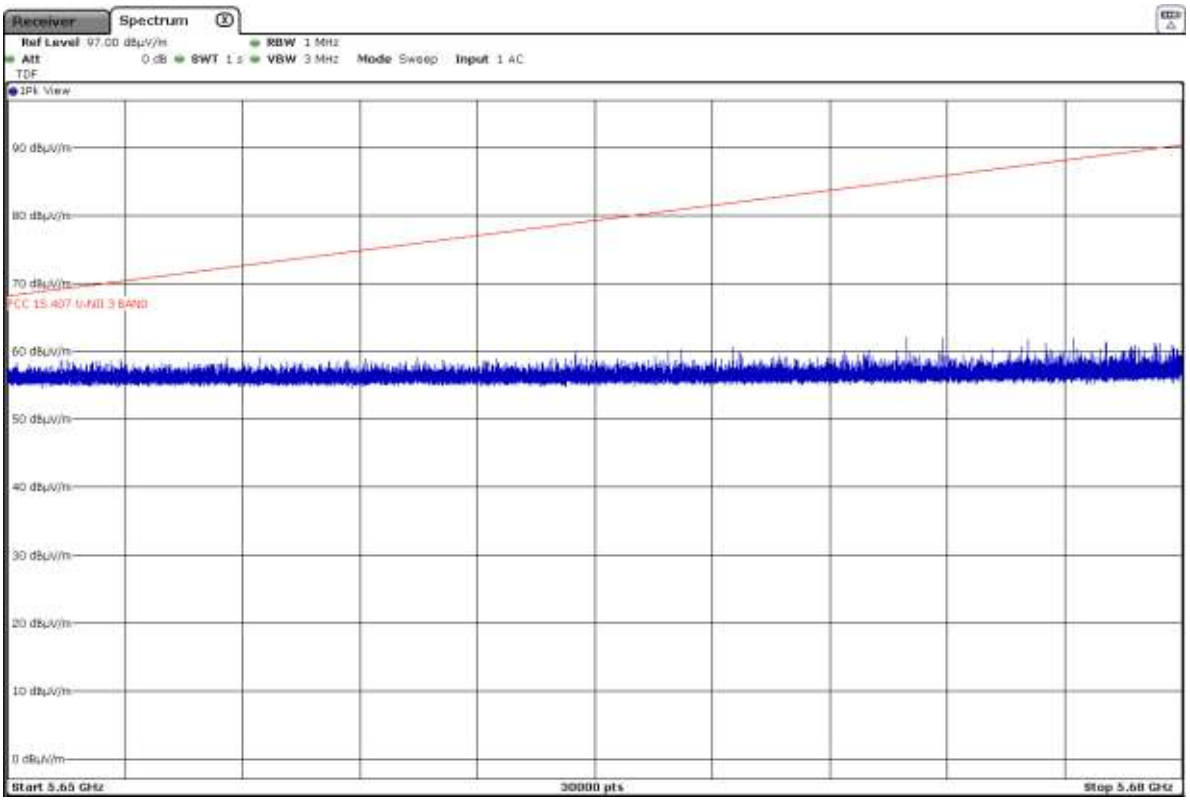
- High Channel 165 (5825 MHz):



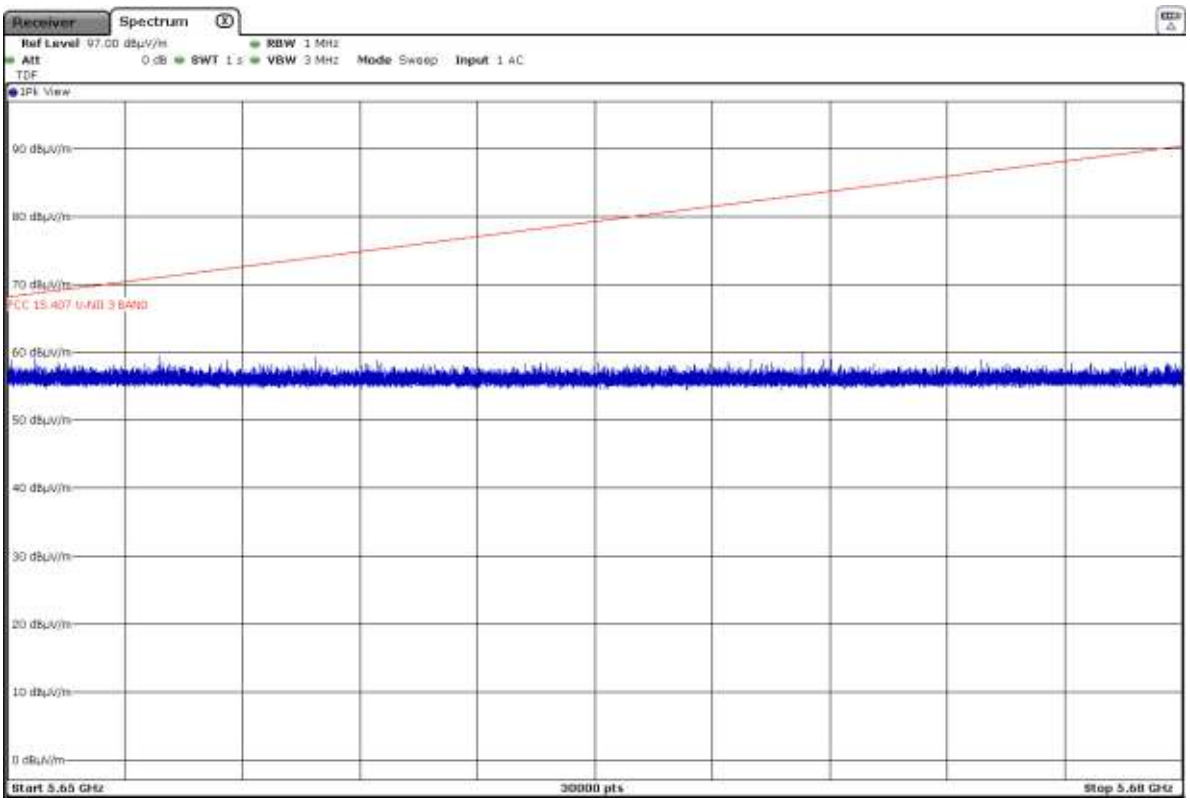
- **Mode 802.11 n40 (HT40)**

  Radiated spurious emissions at band-edges and inside adjacent band 5.65 – 5.68 GHz

  - Low Channel 151 (5755 MHz):

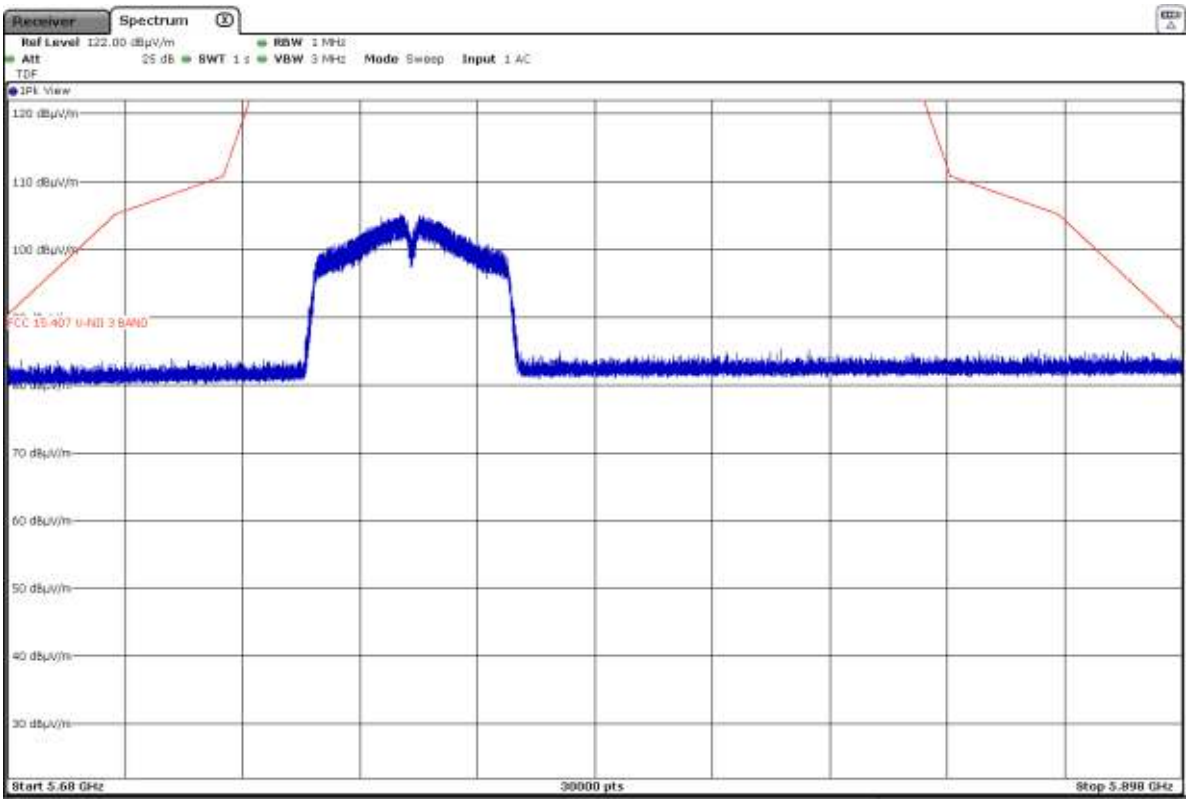


  - High Channel 159 (5795 MHz):

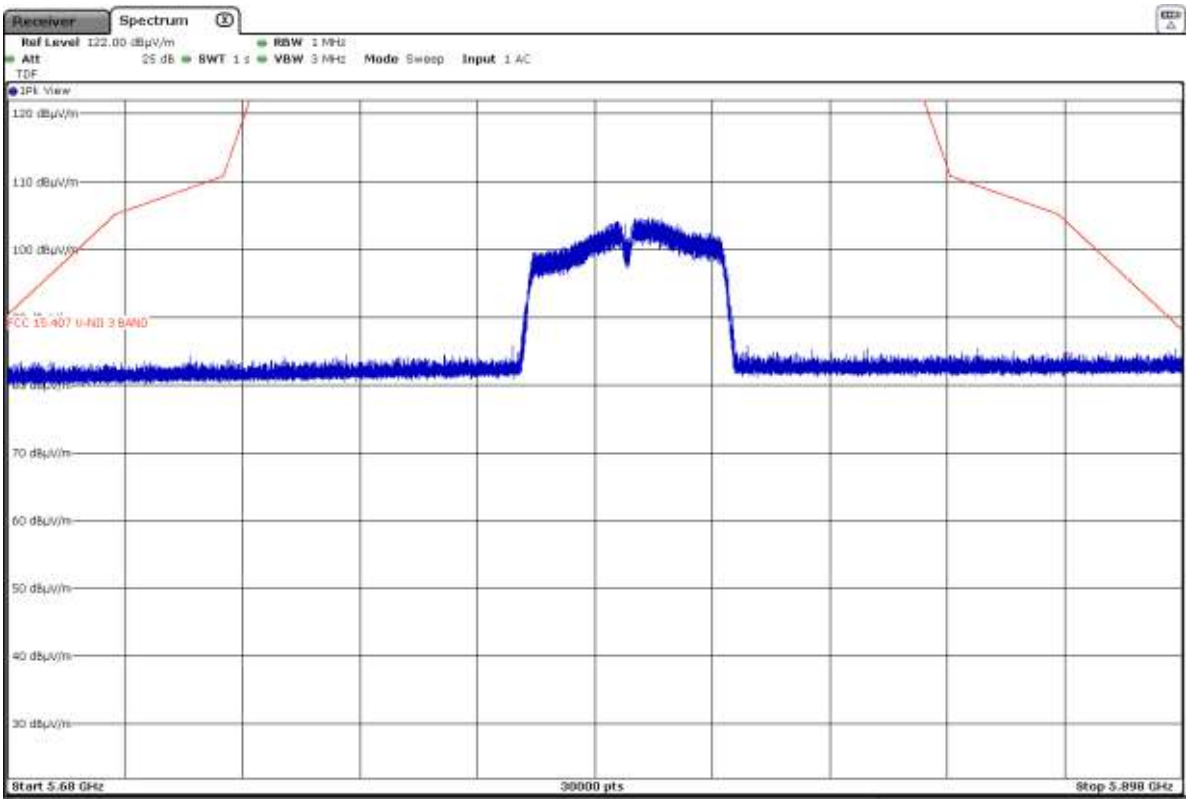


Radiated spurious emissions at band-edges and inside adjacent band 5.68 – 5.898 GHz

- Low Channel 151 (5755 MHz):

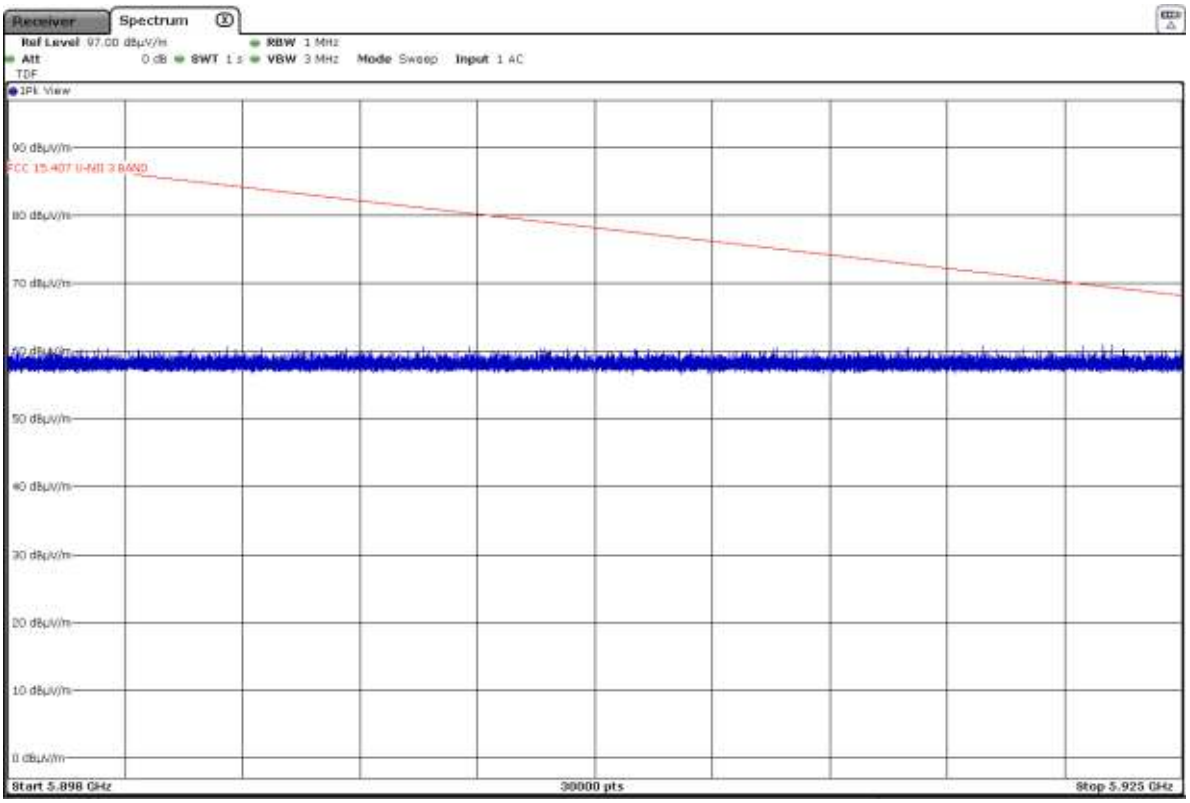


- High Channel 159 (5795 MHz):

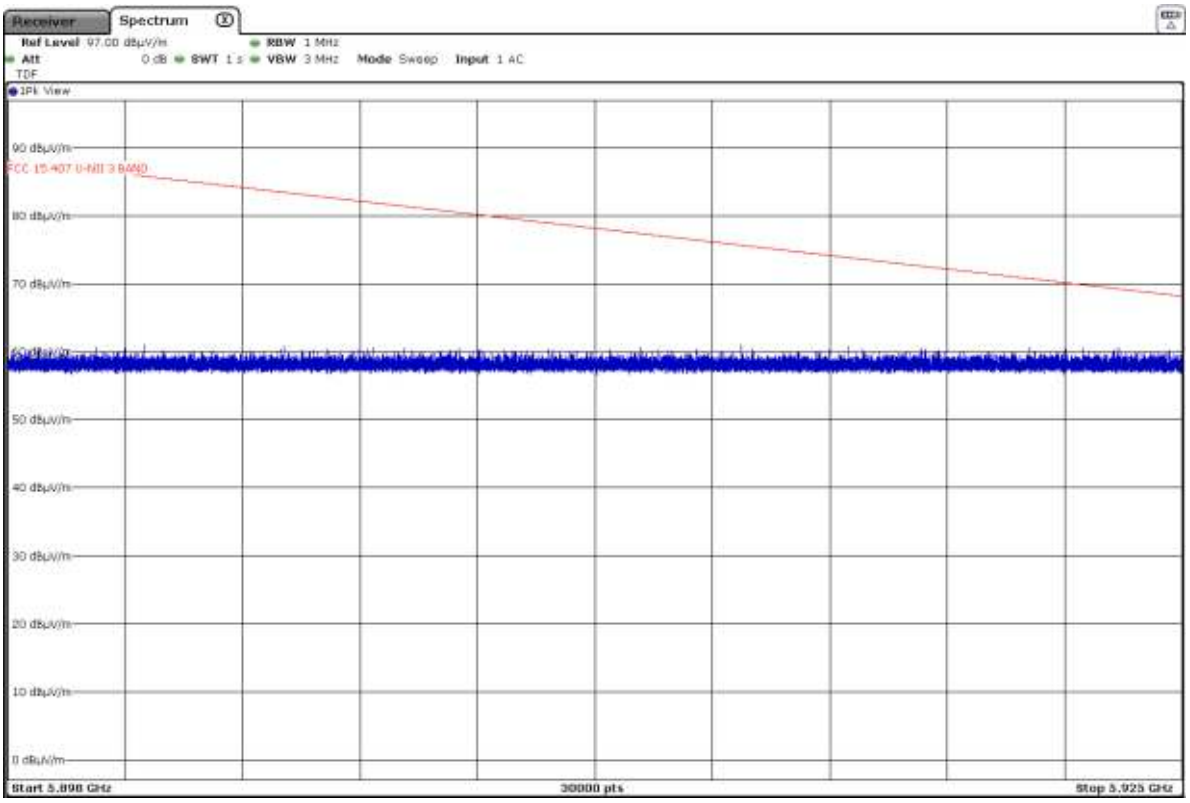


Radiated spurious emissions at band-edges and inside adjacent band 5.898 – 5.925 GHz

- Low Channel 151 (5755 MHz):



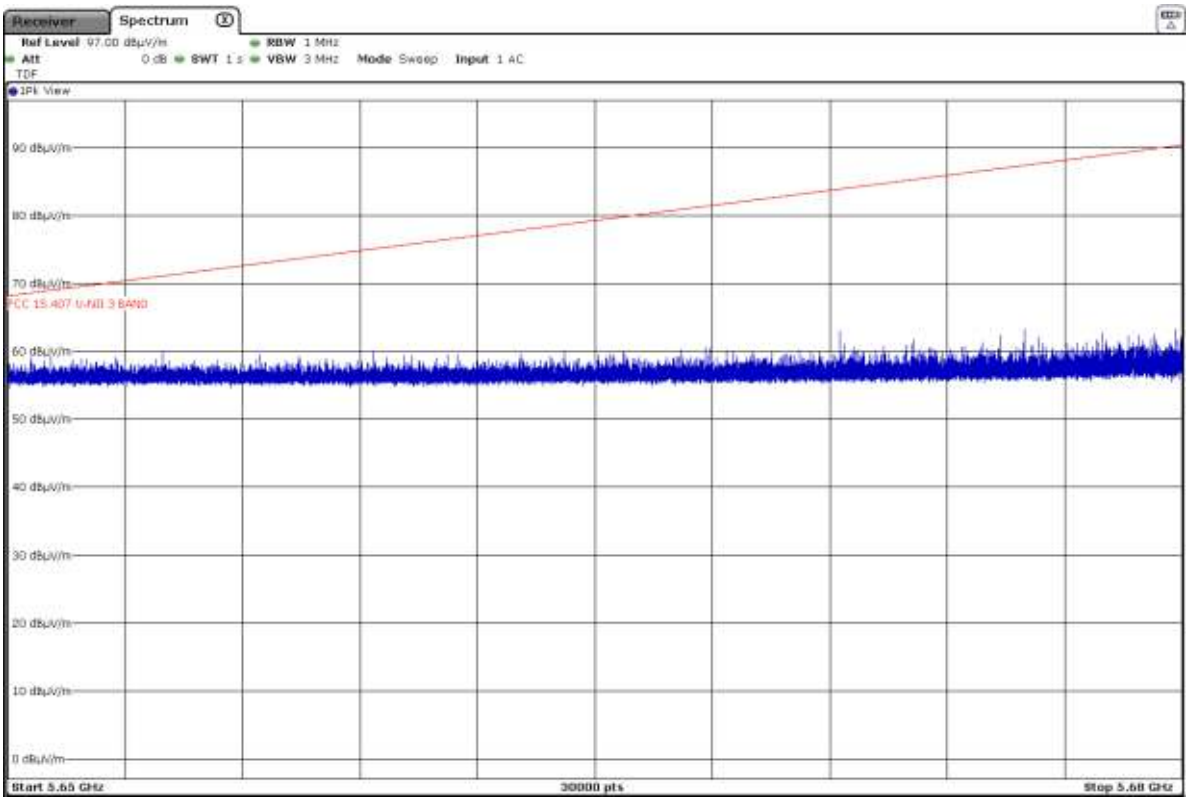
- High Channel 159 (5795 MHz):



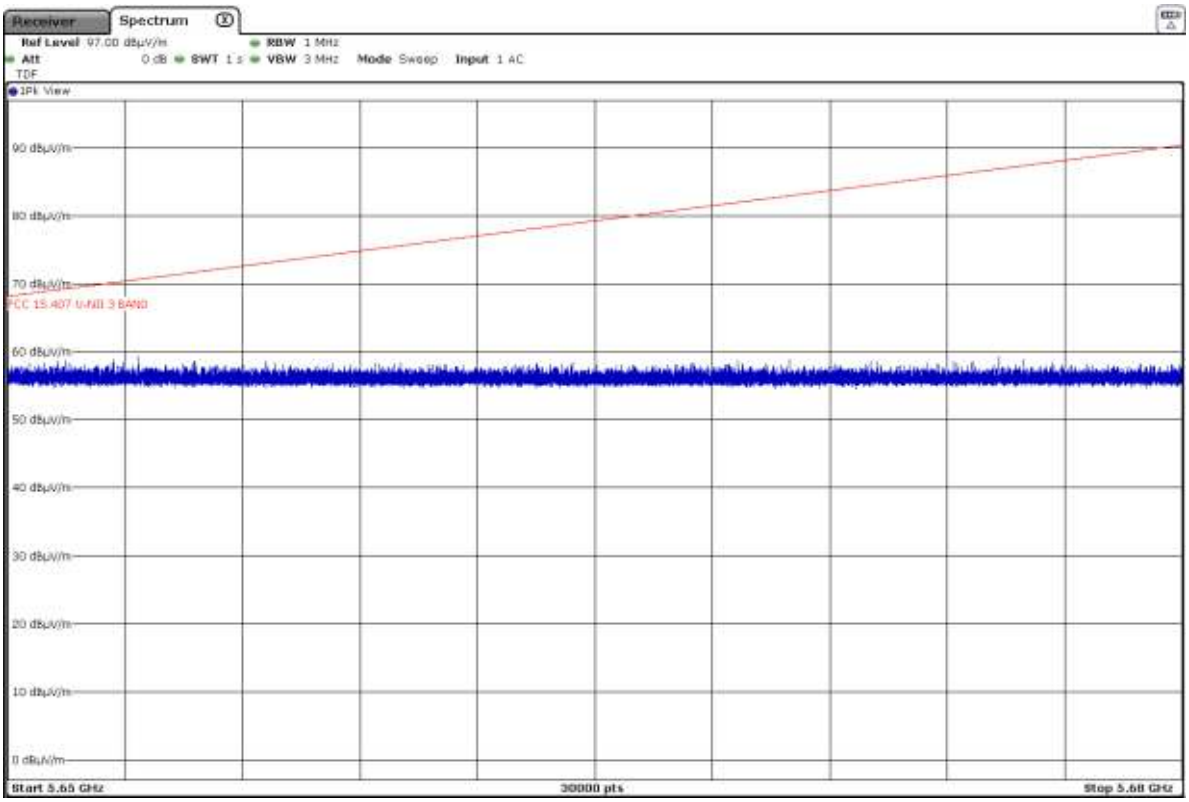
- **Mode 802.11 ac40**

  Radiated spurious emissions at band-edges and inside adjacent band 5.65 – 5.68 GHz

  - Low Channel 149 (5745 MHz):

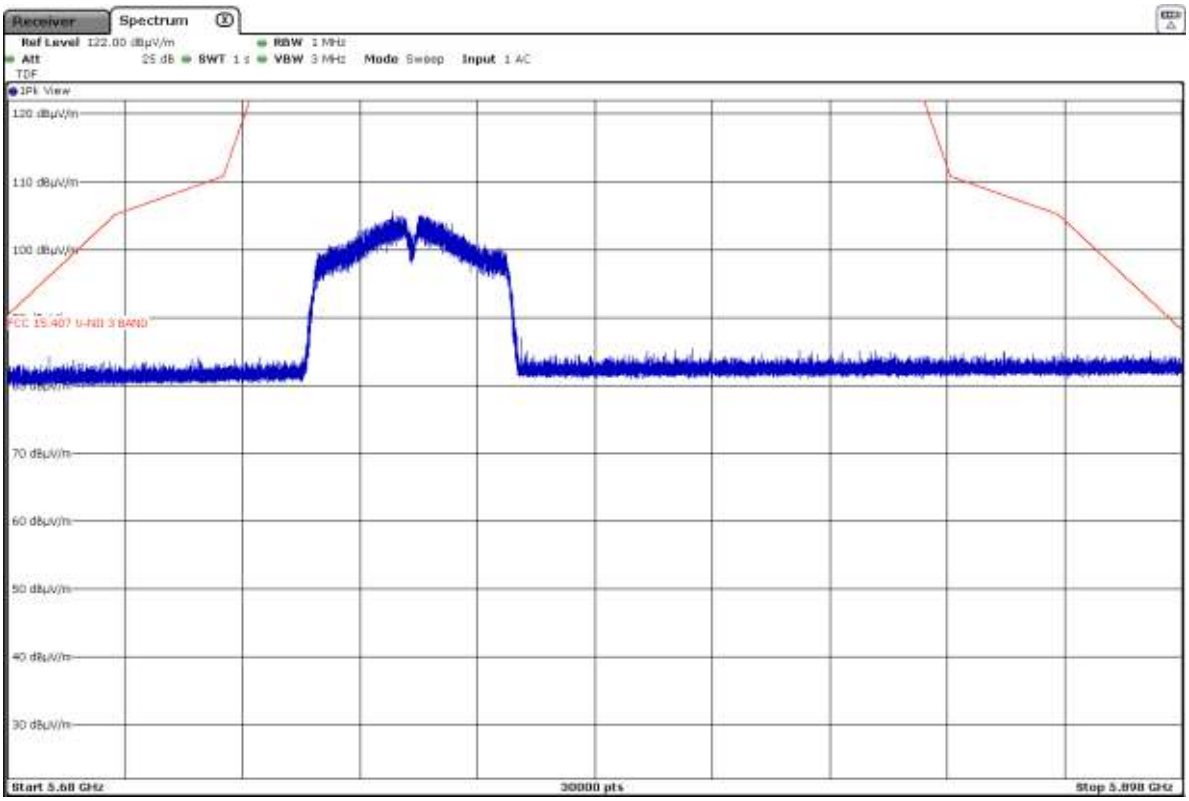


  - High Channel 165 (5825 MHz):

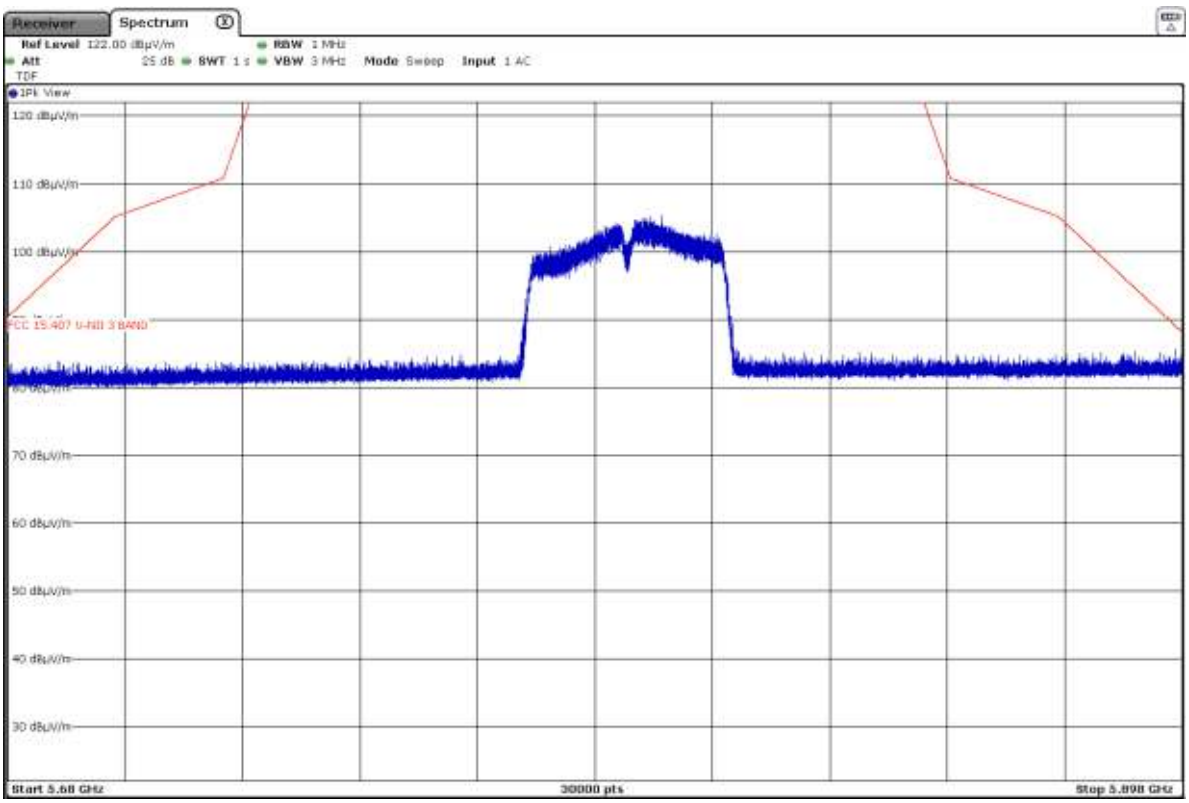


Radiated spurious emissions at band-edges and inside adjacent band 5.68 – 5.898 GHz

- Low Channel 149 (5745 MHz):

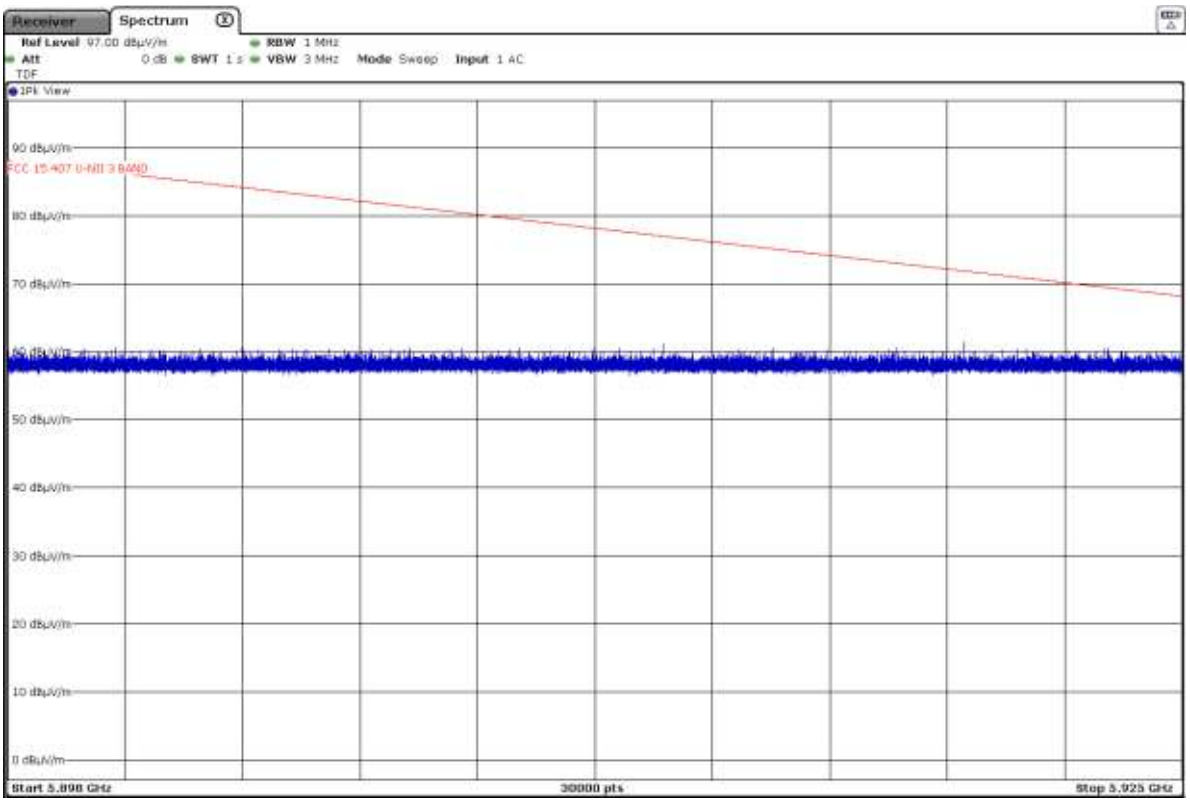


- High Channel 165 (5825MHz):

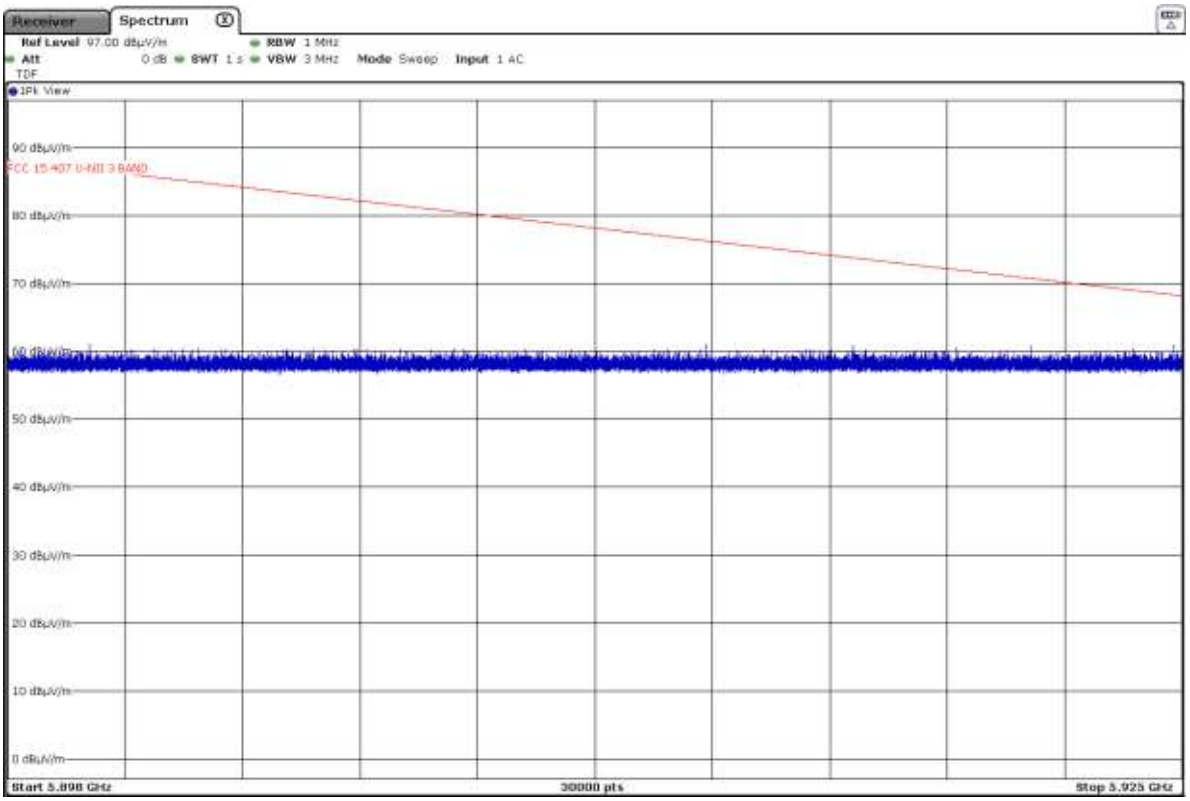


Radiated spurious emissions at band-edges and inside adjacent band 5.898 – 5.925 GHz

- Low Channel 149 (5745 MHz):



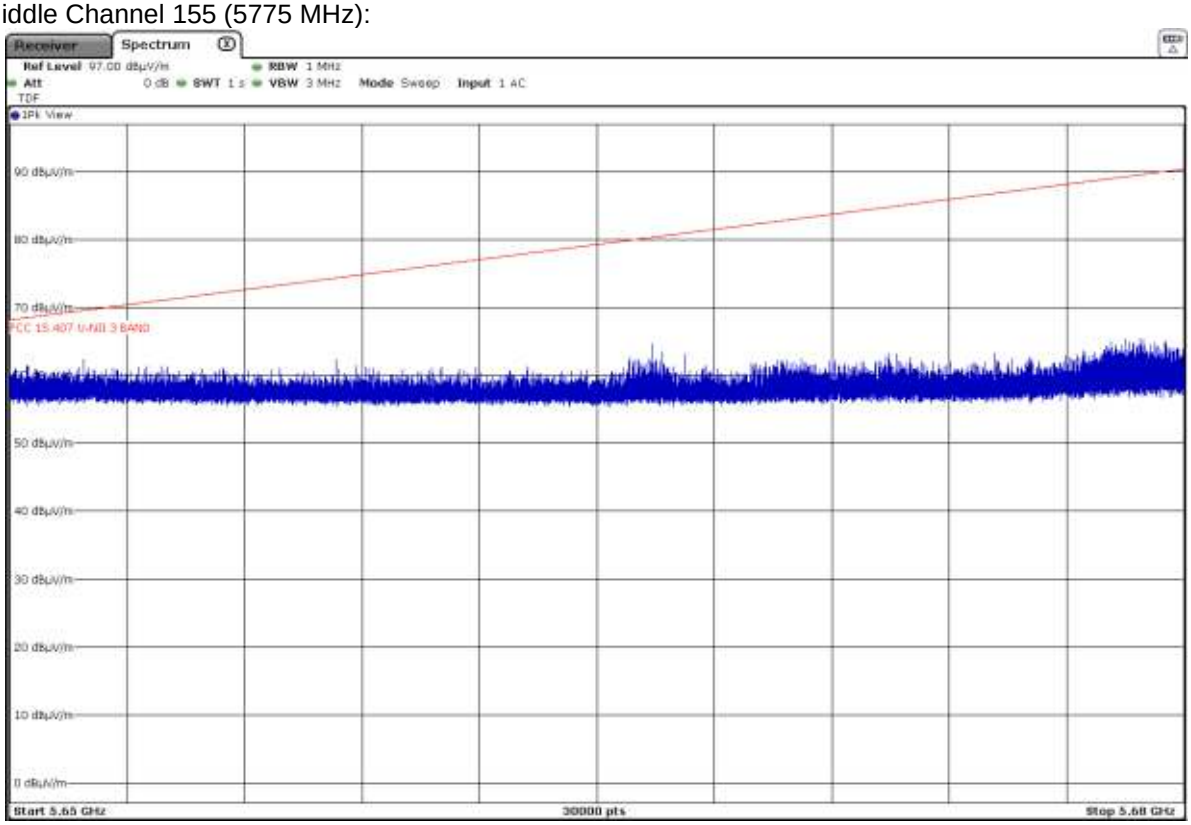
- High Channel 165 (5825 MHz):



- **Mode 802.11 ac80 (VHT80)**

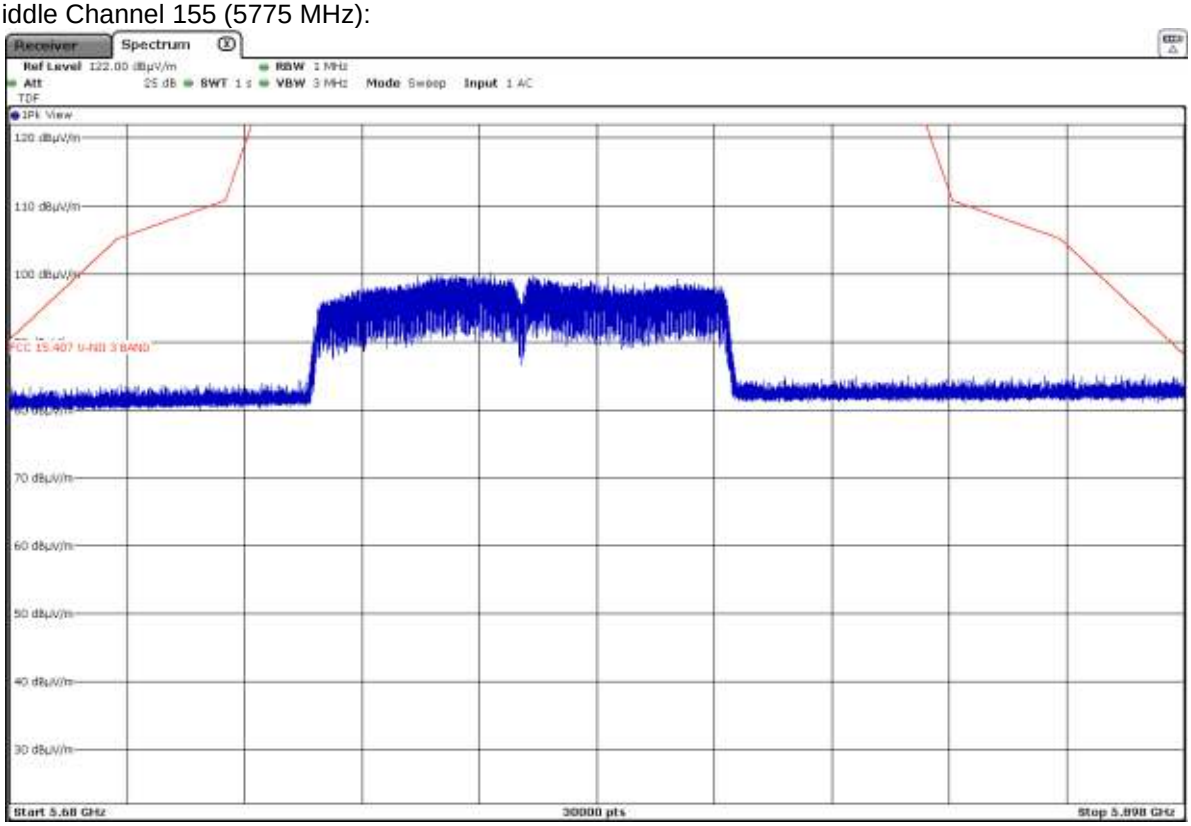
Radiated spurious emissions at band-edges and inside adjacent band 5.65 – 5.68 GHz

- Middle Channel 155 (5775 MHz):



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

- Middle Channel 155 (5775 MHz):



Radiated spurious emissions at band-edges and inside adjacent band 5.898 – 5.925 GHz

- Middle Channel 155 (5775 MHz):