

Test report No:

NIE: 64848RRF.006

Test Report

USA FCC Part 15.407, 15.209

CANADA RSS-247, RSS-Gen

Unlicensed National Information Infrastructure (U-NII) Devices.

General technical requirements.

Radiated emission limits; general requirements.

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

General Requirements and Information for the Certification of Radio Apparatus.

(*) Identification of item tested	Automotive infotainment System
(*) Trademark	Audi
(*) Model and /or type reference	SCON2
Other identification of the product	HW version: C1 SW version: 0107 FCC ID: T8GSCON2 IC: 6434A-SCON2
(*) Features	Wi-Fi
Applicant	HARMAN BECKER AUTOMOTIVE SYSTEMS GMBH BECKER-GOERING-STR. 16, 76307 KARLSBAD, GERMANY
Test method requested, standard	USA FCC Part 15.407 (10-1-19) Edition: Unlicensed National Information Infrastructure (U-NII) Devices. General technical requirements. USA FCC Part 15.209 (10-1-19) Edition: Radiated emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5 Amendment 1 (March 2019). Guidance for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices 789033 D02 General U-NII Test Procedures New Rules v02r01 dated Dec 14, 2017. ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	José Carlos Luque RF Lab. Supervisor 
Date of issue	2021-02-18
Report template No	FDT08_23
	(*) "Data provided by the client"

Firmado digitalmente
por 74841983Y JOSE
CARLOS LUQUE
(CA29507456)
Fecha: 2021.02.18
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Competences and guarantees

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

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

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

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

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

DEKRA Testing and Certification is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

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

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General conditions

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

Uncertainty

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

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").
2. The sample of the model SCON2 is a Rear Seat Control Unit.

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

Usage of samples

Samples undergoing test have been selected by: The client.

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

Control N°	Description	Model	Serial N°	Date of reception
64848/100	Automotive infotainment System	SCON2	HBV066L666RPWY8	2021/01/21
64848/009	Harness	--	--	2020/12/15

Auxiliary elements used with the Sample S/01:

Control N°	Description	Model	Serial N°	Date of reception
64848/014	USB Adapter	--	--	2020/12/15

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

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

Control N°	Description	Model	Serial N°	Date of reception
64848/005	Automotive infotainment System	SCON2	HBC006L673MZ58	2020/12/15
64848/011	Harness	--	--	2020/12/15

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

Test sample description

Ports..... :	Port name and description		Cable			
			Specified max length [m]	Attached during test	Shielded	Coupled to patient ⁽³⁾
	Harness			☐	☐	☐
	-			☐	☐	☐
Supplementary information to the ports..... :		-				
Rated power supply		Voltage and Frequency				
		☒ DC: DC: 12V Car battery / attenuator (9,5-15,5V normal operation)				
Rated Power		-				
Clock frequencies..... :		-				
Other parameters		-				
Software version		0107				
Hardware version		C1				
Dimensions in cm (W x H x D)		-				
Mounting position		☐ Table top equipment ☐ Wall/Ceiling mounted equipment ☐ Floor standing equipment ☐ Hand-held equipment ☒ Other:				
Modules/parts..... :		Module/parts of test item		Type	Manufacturer	
		-				
Accessories (not part of the test item)		Description		Type	Manufacturer	
		-				
Documents as provided by the applicant..... :		Description		File name	Issue date	
		-				

³⁾ Only for Medical Equipment

Identification of the client

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

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2021-02-09
Date (finish)	2021-02-15

Document history

Report number	Date	Description
64848RRF.006	2021-02-18	First release.

Environmental conditions

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

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

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

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

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

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

Remarks and comments

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

Used instrumentation:

Conducted Measurements

		Last Calibration	Due Calibration
1.	Shielded Room ETS LINDGREN S101	N.A.	N.A.
2.	DC Power Supply 40V/40A Rohde & Schwarz NGPE40	2018/03	2021/03
3.	Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2020/03	2022/03
4.	Digital Multimeter FLUKE 179	2020/10	2021/10
5.	DC Power Supply, GW INSTEK GPS-3030D	N.A.	N.A.
6.	Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2019/09	2021/09

Radiated Measurements:

		Last Calibration	Due Calibration
1.	Semianechoic Absorber Lined Chamber ETS LINDGREN FACT 3 200 STP	N.A.	N.A.
2.	Shielded Room ETS LINDGREN S101	N.A.	N.A.
3.	Biconical/Log Antenna 30MHz - 6GHz ETS LINDGREN 3142E	2020/10	2023/10
4.	RF Preamplifier 40 dB, 10 MHz - 6 GHz BONN ELEKTRONIK BLNA 0160-01N	2020/02	2021/02
5.	EMI Test Receiver 7 GHz ROHDE AND SCHWARZ ESR7	2019/10	2021/10
6.	DC Power Supply, 30V/5A KEYSIGHT TECHNOLOGIES U8002A	N.A.	N.A.
7.	Digital Multimeter, FLUKE 175	2020/11	2021/11
8.	Attenuator 3 dB 2W, DC-6GHz, JFW 50HN-03	2020/10	2021/10
9.	Horn Antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2020/08	2023/08
10.	Horn Antenna 18-40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2020/05	2023/05
11.	RF Preamplifier G>30dB, 1-18GHz BONN ELEKTRONIK BLMA 0118-3A	2020/10	2021/10
12.	Low Noise Amplifier G>30dB, 18 - 40 GHz BONN ELEKTRONIK BLMA 1840-1M	2019/02	2021/02
13.	Signal and Spectrum Analyzer 10 Hz - 40 GHz ROHDE AND SCHWARZ FSV40	2019/10	2021/10

Testing verdicts

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

Summary

A. Common requirements for all bands

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

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

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

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

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

Appendix A: Test Common requirements for all bands

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FCC 15.35 (c) / RSS-Gen 6.10. Transmitter Duty Cycle.....	12
RSS-Gen 6.6 / RSS-247 6.2. Transmitter 99% Occupied Bandwidth	16
FCC 15.403(i) Transmitter 26 dB Emission Bandwidth (EBW)	19

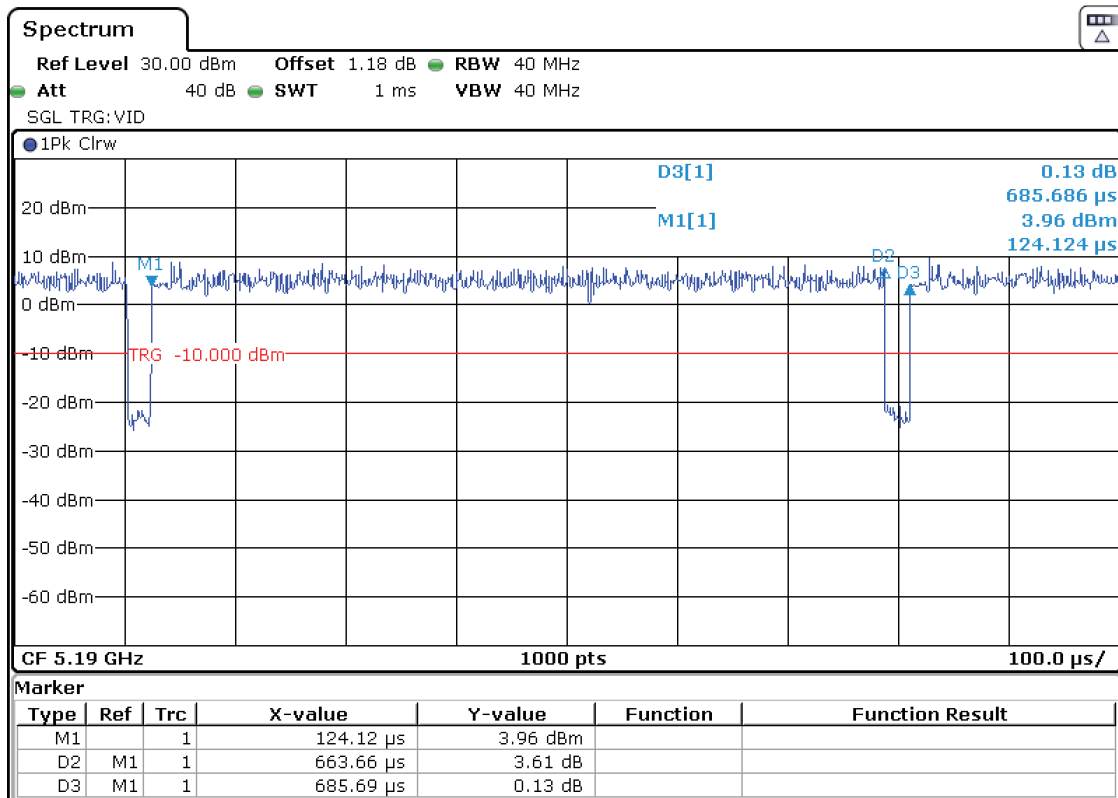
Transmitter Duty Cycle

RESULTS:

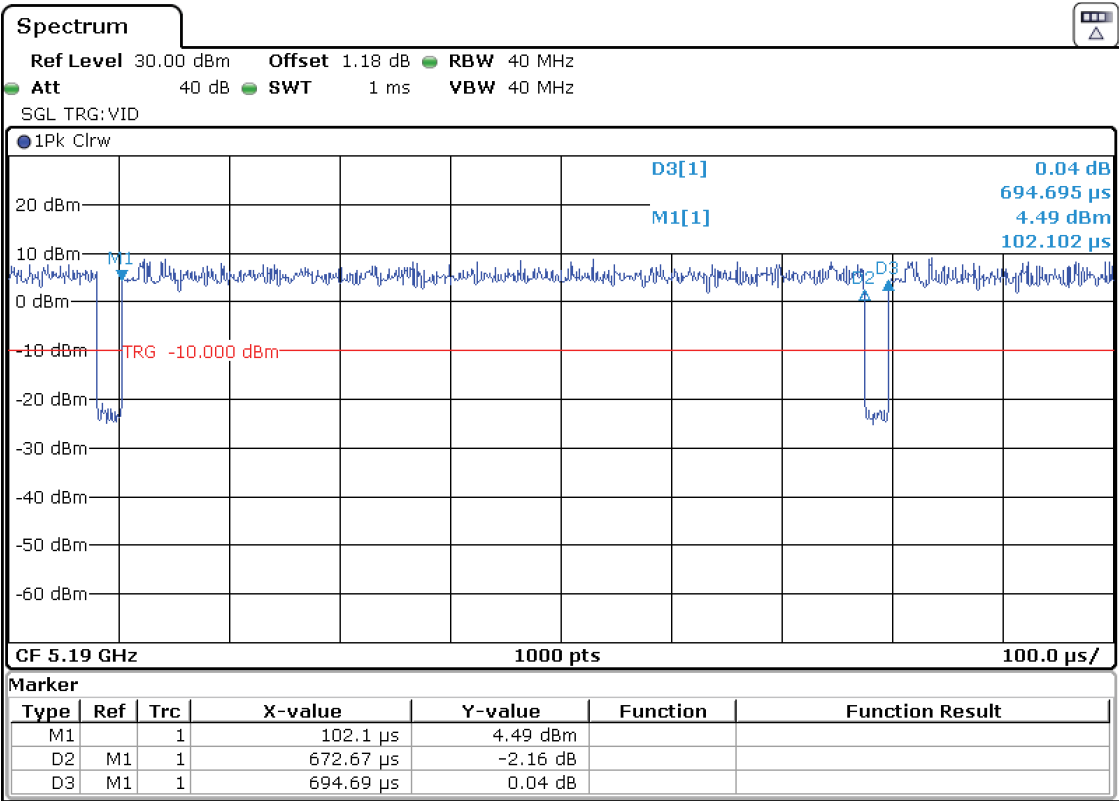
The results below are for data rates with a duty cycle less than 98%. The results for all rest of modes having a value > 98%.

Mode	Sub-band U-NII-1			Sub-band U-NII-3		
	Pulse Duration (ms)	Period (ms)	Duty Cycle Correction (dB)	Pulse Duration (ms)	Period (ms)	Duty Cycle Correction (dB)
802.11n40	0.66366	0.68569	0.141821731	0.66446	0.68609	0.139122475
802.11ac40	0.67267	0.69469	0.13988988	0.67247	0.69409	0.137428729
802.11ac80	0.331532	0.353754	0.281759057	0.332132	0.353754	0.273906386

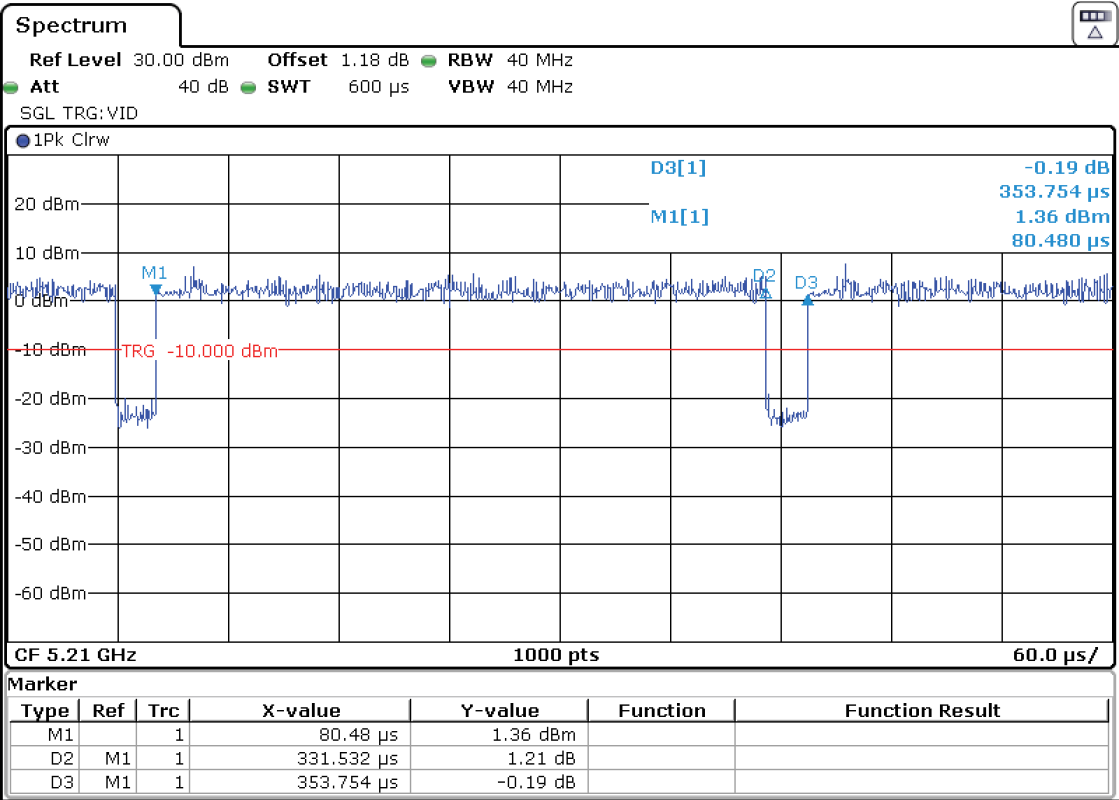
Mode 802.11 n40 (U-NII-1):



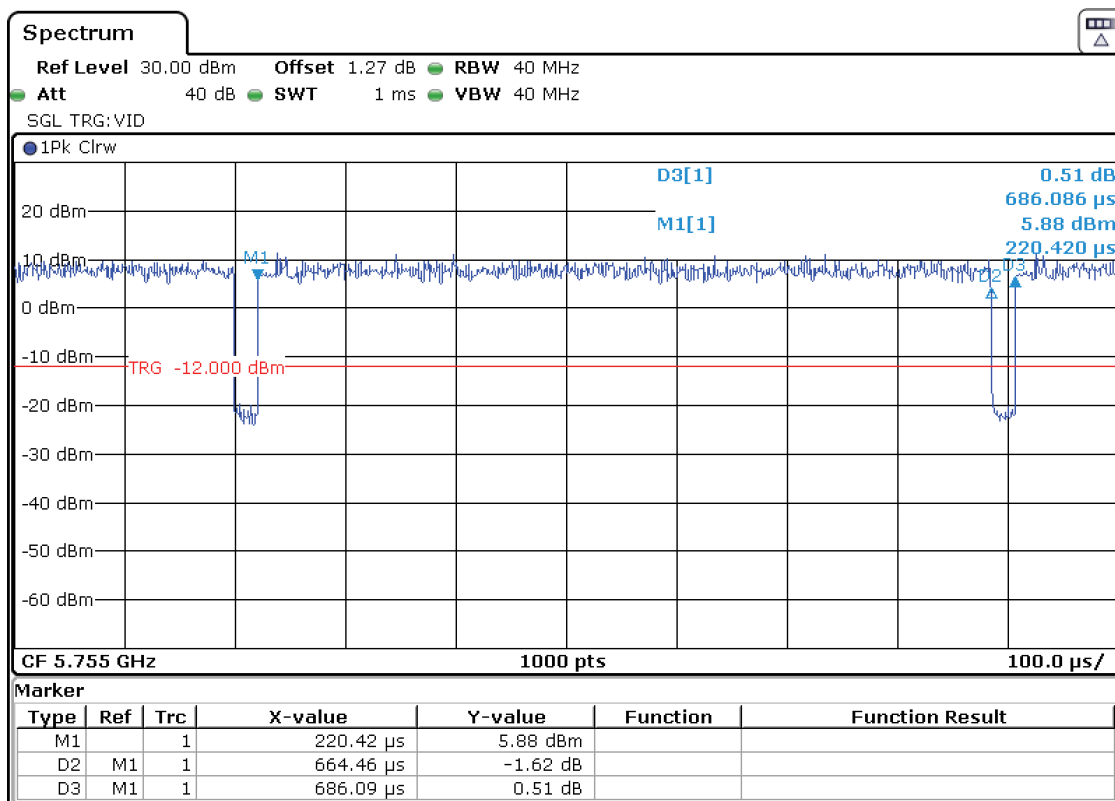
Mode 802.11 ac40 (U-NII-1):



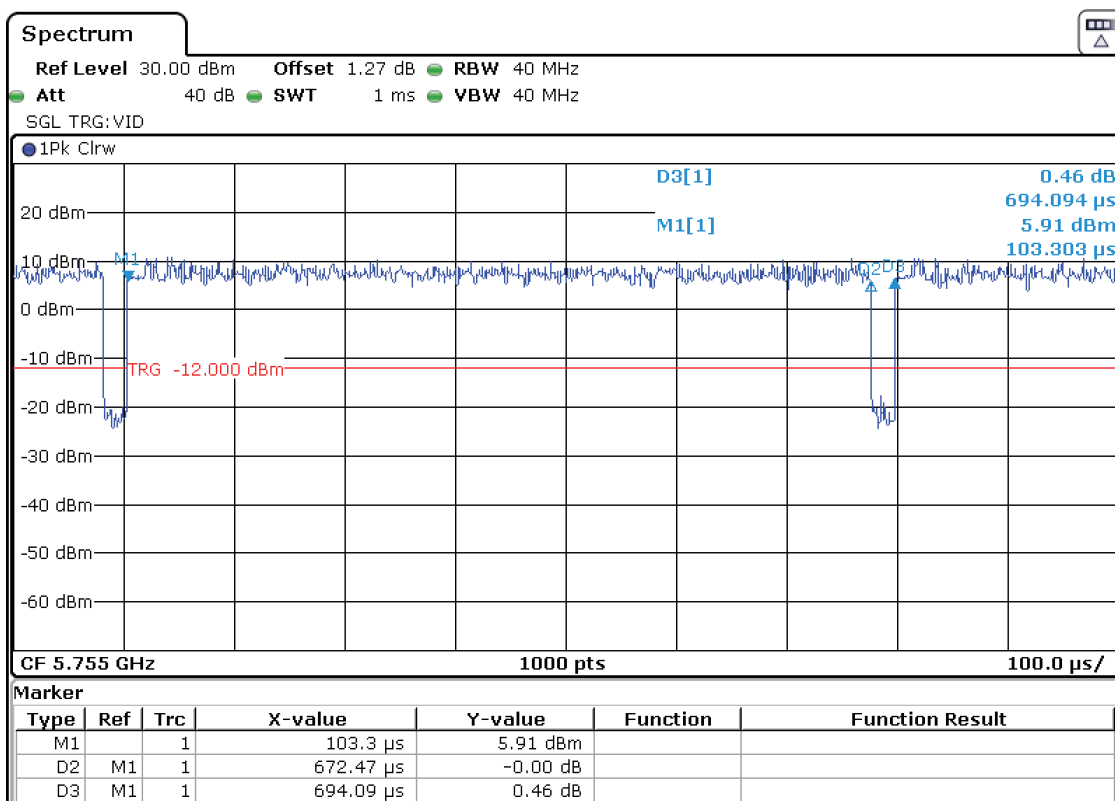
Mode 802.11 ac80 (U-NII-1):



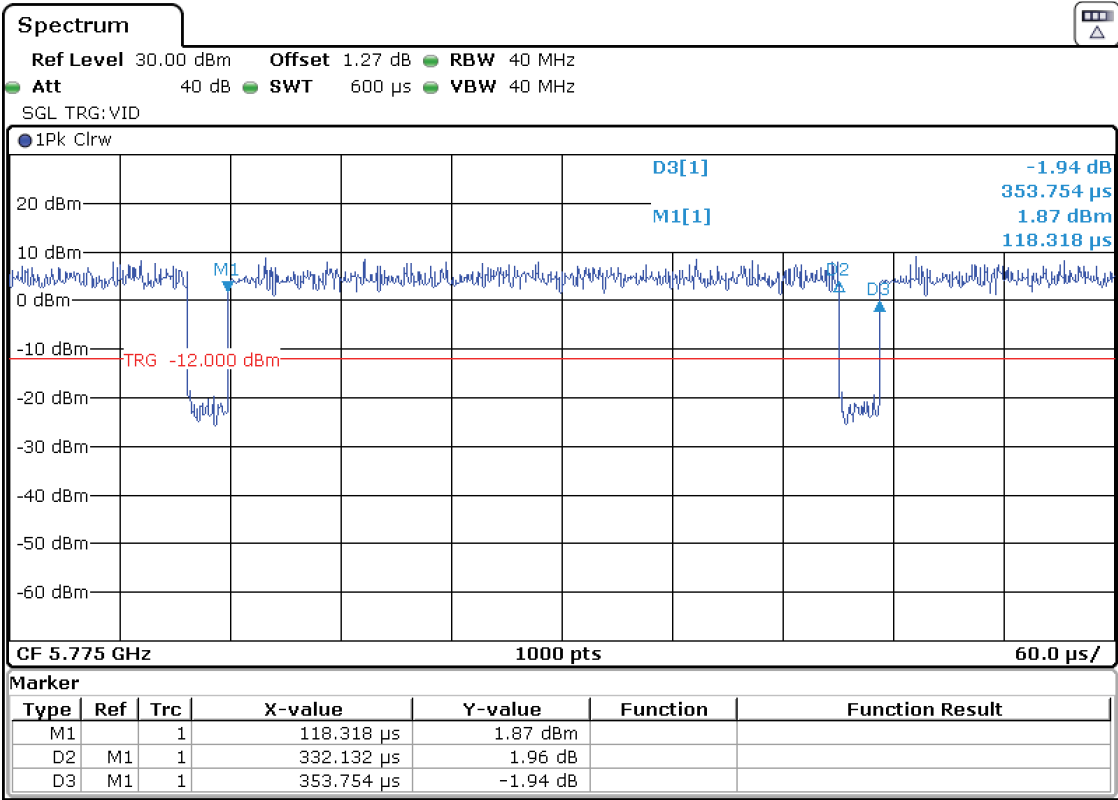
Mode 802.11 n40 (U-NII-3):



Mode 802.11 ac40 (U-NII-3):



Mode 802.11 ac80 (U-NII-3):



Transmitter 99% Occupied Bandwidth

RESULTS:

Mode 802.11 a20:

U-NII-1 (5150-5250 MHz)

Channels	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
99% Occupied Bandwidth (MHz)	16.896	16.924	16.904
Measurement uncertainty (kHz)	<±36.95		

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
99% Occupied Bandwidth (MHz)	16.920	16.933	16.907
Measurement uncertainty (kHz)	<±42.34		

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)	17.688	17.708	17.704
Measurement uncertainty (kHz)	<±36.95		

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
99% Occupied Bandwidth (MHz)	17.747	17.733	17.707
Measurement uncertainty (kHz)	<±42.34		

Mode 802.11 ac20 (VHT20):

U-NII-1 (5150-5250 MHz)

Channels	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
99% Occupied Bandwidth (MHz)	17.7	17.716	17.688
Measurement uncertainty (kHz)	<±36.95		

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
99% Occupied Bandwidth (MHz)	17.707	17.747	17.747
Measurement uncertainty (kHz)	<±42.34		

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	36.248
Measurement uncertainty (kHz)	<±62.36	

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
99% Occupied Bandwidth (MHz)	36.32	36.32
Measurement uncertainty (kHz)	<±73.14	

Mode 802.11 ac40 (VHT40):

U-NII-1 (5150-5250 MHz)

Channels	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
99% Occupied Bandwidth (MHz)	36.272	36.224
Measurement uncertainty (kHz)	<±62.36	

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
99% Occupied Bandwidth (MHz)	36.24	36.293
Measurement uncertainty (kHz)	<±73.14	

Mode 802.11 ac80 (VHT80):

U-NII-1 (5150-5250 MHz)

Channel	Single Channel 42 (5210 MHz)
99% Occupied Bandwidth (MHz)	76.38
Measurement uncertainty (kHz)	<±124.71

U-NII-3 (5725-5850 MHz)

Channels	Single Channel 155 (5775 MHz)
99% Occupied Bandwidth (MHz)	78.72
Measurement uncertainty (kHz)	<±292.55

Transmitter 26 dB Emission Bandwidth (EBW)

RESULTS:

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

Mode 802.11 a20:

U-NII-1 (5150-5250 MHz)

Channels	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
-26 dBc bandwidth (MHz)	20.1778	20.3241	20.1703
Measurement uncertainty (kHz)	<±36.95		

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
-26 dBc bandwidth (MHz)	20.182	20.253	20.173
Measurement uncertainty (kHz)	<±42.34		

Mode 802.11 n20 (HT20):

U-NII-1 (5150-5250 MHz)

Channels	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
-26 dBc bandwidth (MHz)	20.4151	20.7801	20.6383
Measurement uncertainty (kHz)	<±36.95		

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
-26 dBc bandwidth (MHz)	20.64	20.627	20.64
Measurement uncertainty (kHz)	<±42.34		

Mode 802.11 ac20 (VHT20):

U-NII-1 (5150-5250 MHz)

Channels	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
-26 dBc bandwidth (MHz)	20.4431	20.5881	20.6223
Measurement uncertainty (kHz)	<±36.95		

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 149 (5745 MHz)	Middle Channel 157 (5785 MHz)	High Channel 165 (5825 MHz)
-26 dBc bandwidth (MHz)	20.52	20.56	20.467
Measurement uncertainty (kHz)	<±42.34		

Mode 802.11 n40 (HT40):

U-NII-1 (5150-5250 MHz)

Channels	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
-26 dBc bandwidth (MHz)	41.2998	41.0722
Measurement uncertainty (kHz)	<±62.36	

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
-26 dBc bandwidth (MHz)	41.146	47.84
Measurement uncertainty (kHz)	<±73.14	

Mode 802.11 ac40 (VHT40):

U-NII-1 (5150-5250 MHz)

Channels	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
-26 dBc bandwidth (MHz)	41.1078	41.0322
Measurement uncertainty (kHz)	<±62.36	

U-NII-3 (5725-5850 MHz)

Channels	Low Channel 151 (5755 MHz)	High Channel 159 (5795 MHz)
-26 dBc bandwidth (MHz)	41.146	41.133
Measurement uncertainty (kHz)	<±73.14	

Mode 802.11 ac80 (VHT80):

U-NII-1 (5150-5250 MHz)

Channel	Single Channel 42 (5210 MHz)
-26 dBc bandwidth (MHz)	84.571
Measurement uncertainty (kHz)	<±124.71

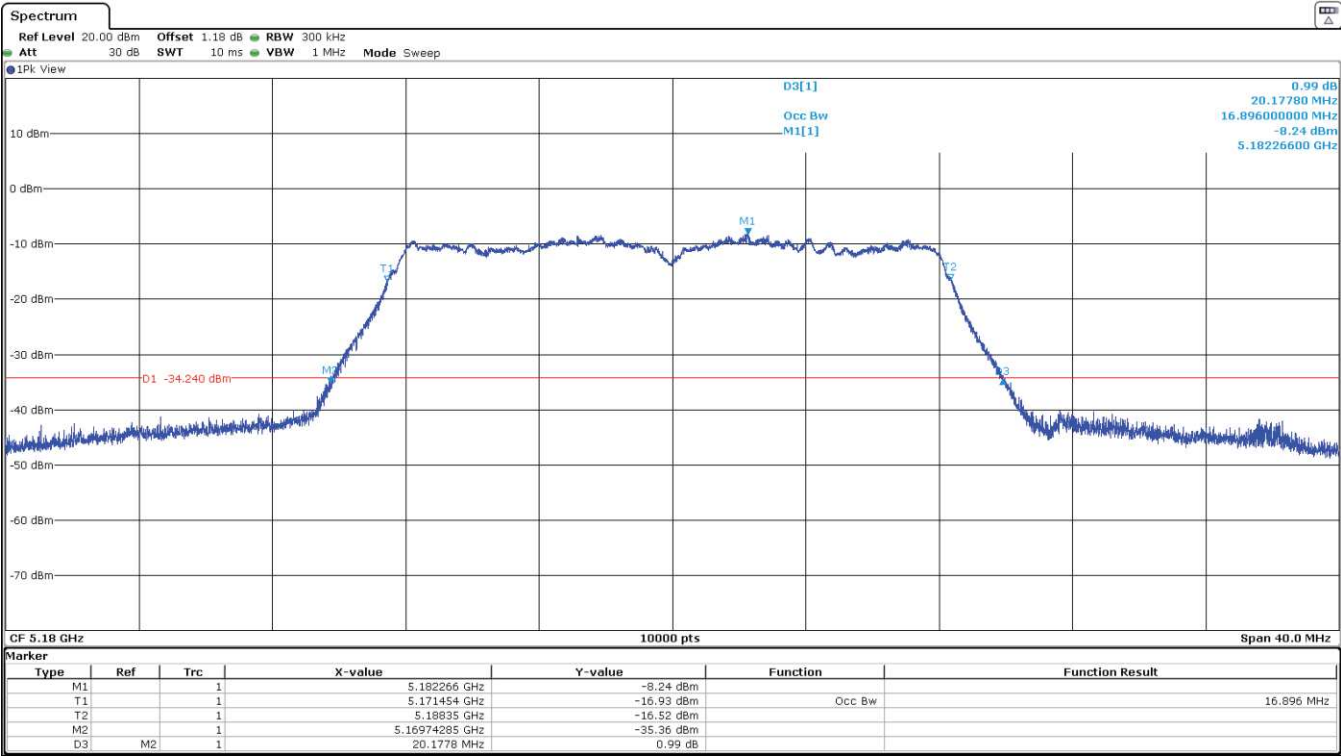
U-NII-3 (5725-5850 MHz)

Channels	Single Channel 155 (5775 MHz)
-26 dBc bandwidth (MHz)	174.22
Measurement uncertainty (kHz)	<±292.55

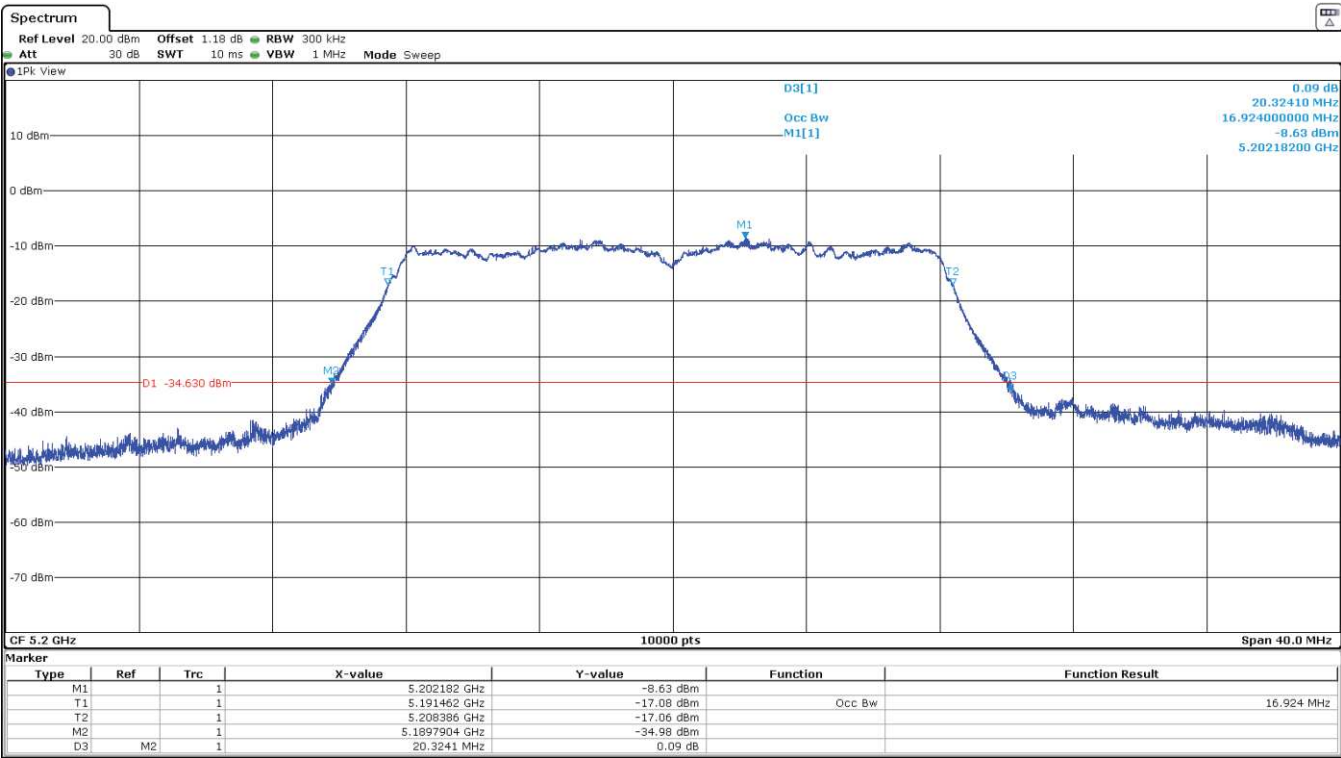
Mode 802.11 a20:

U-NII-1 (5150-5250 MHz)

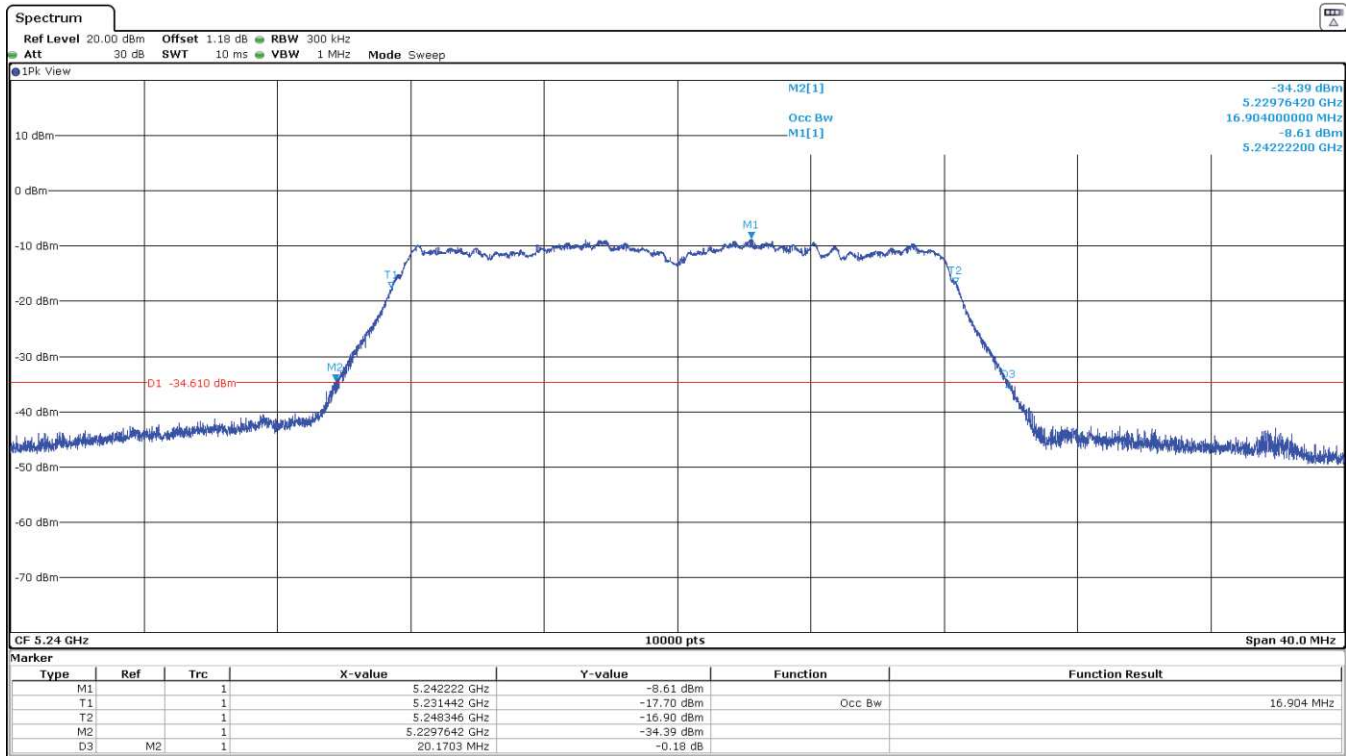
- Low Channel 36 (5180 MHz):



- Middle Channel 40 (5200 MHz):

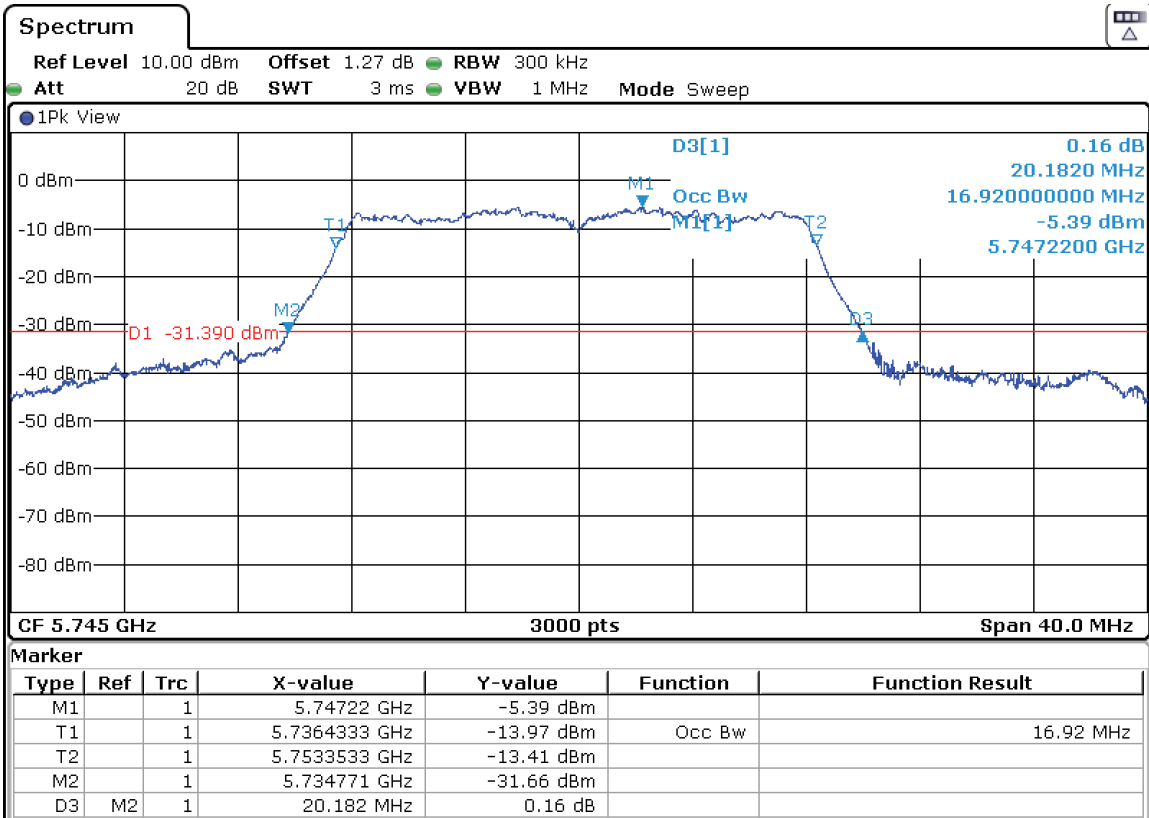


- High Channel 48 (5240 MHz):

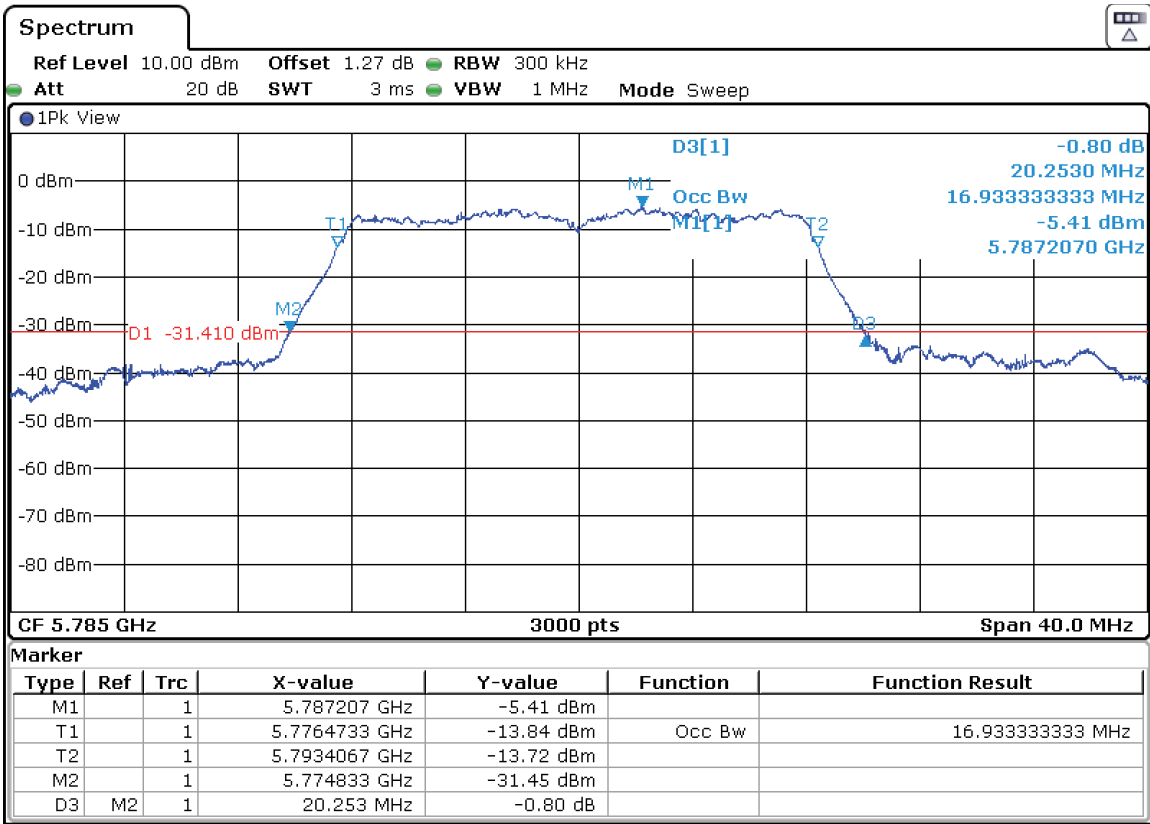


U-NII-3 (5725-5850 MHz)

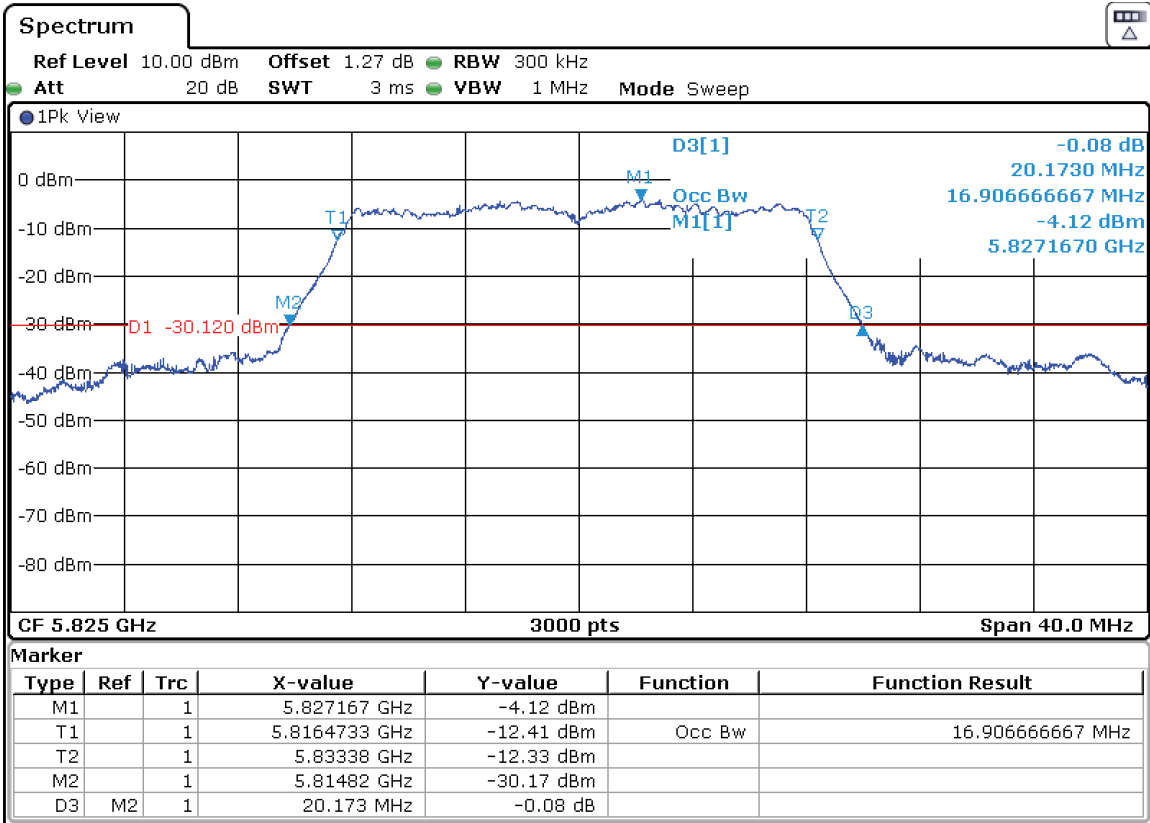
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



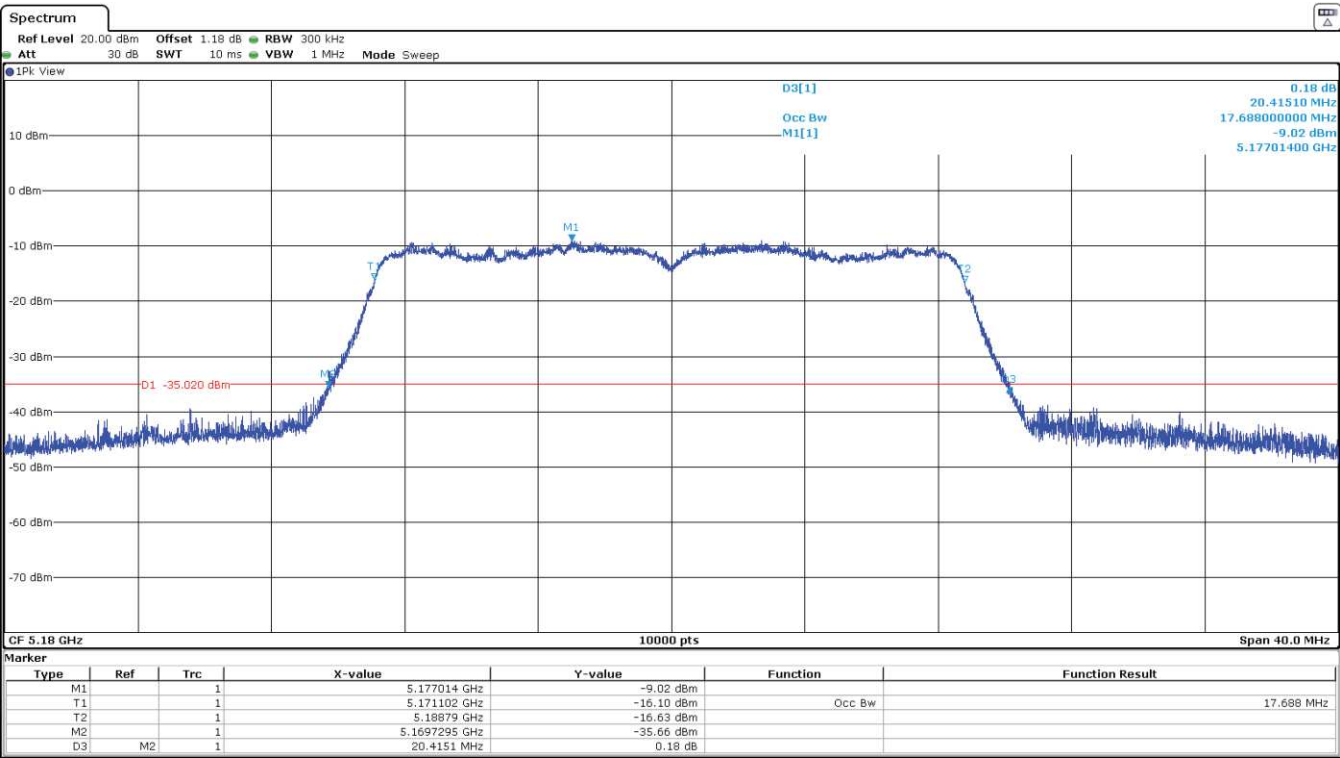
- High Channel 165 (5825 MHz):



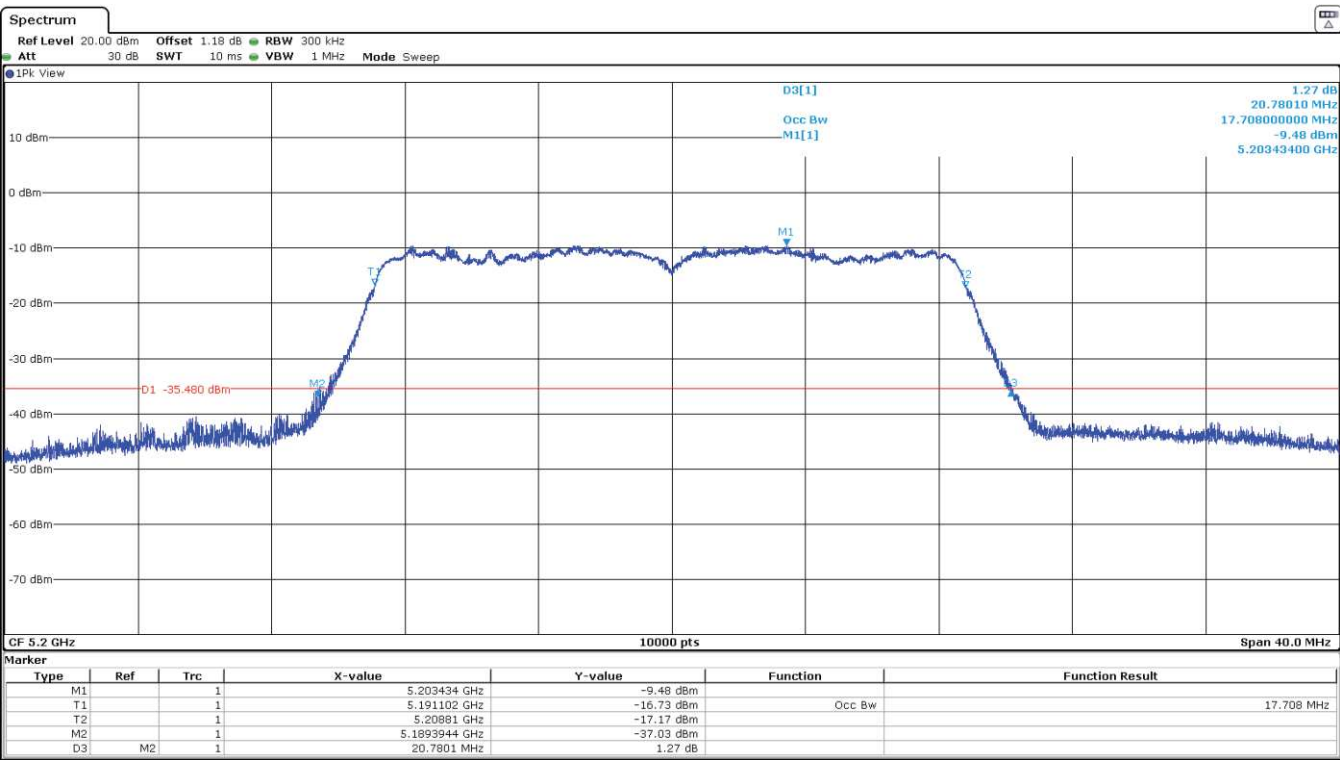
Mode 802.11 n20 (HT20):

U-NII-1 (5150-5250 MHz)

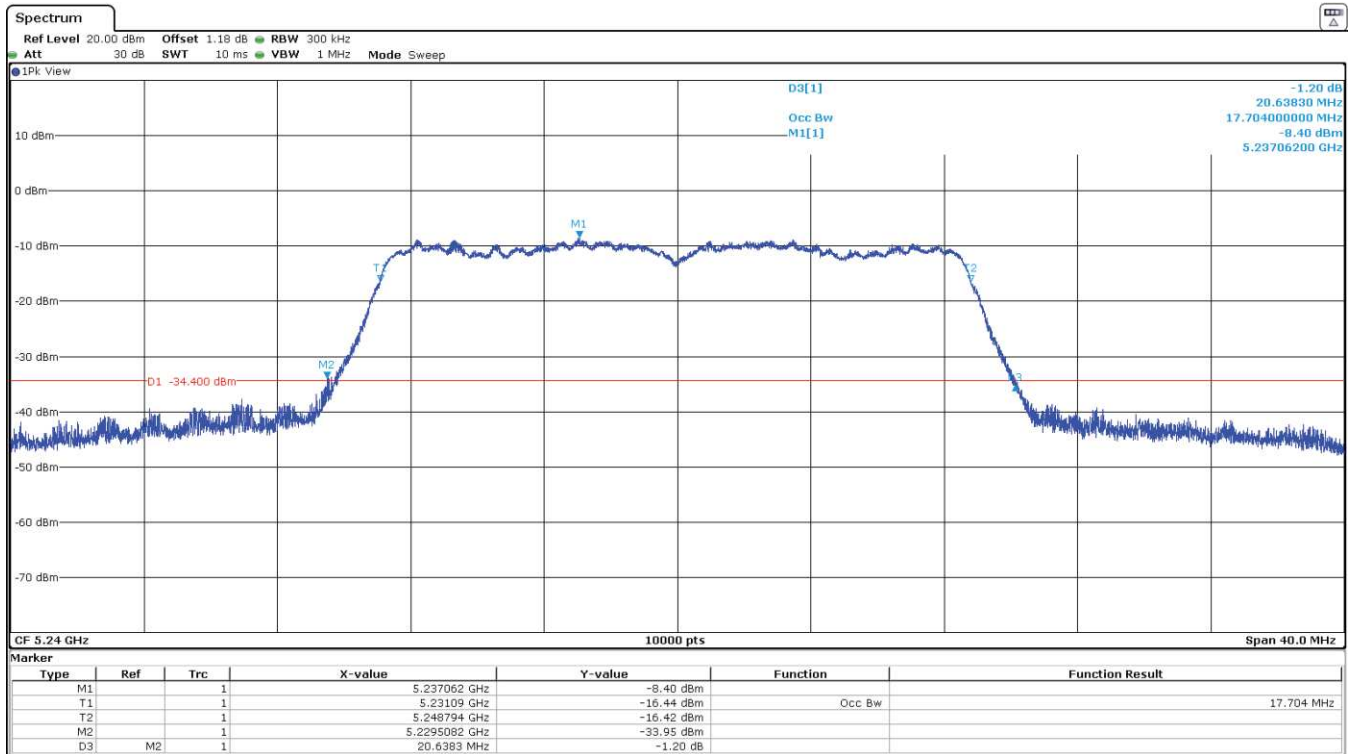
- Low Channel 36 (5180 MHz):



- Middle Channel 40 (5200 MHz):

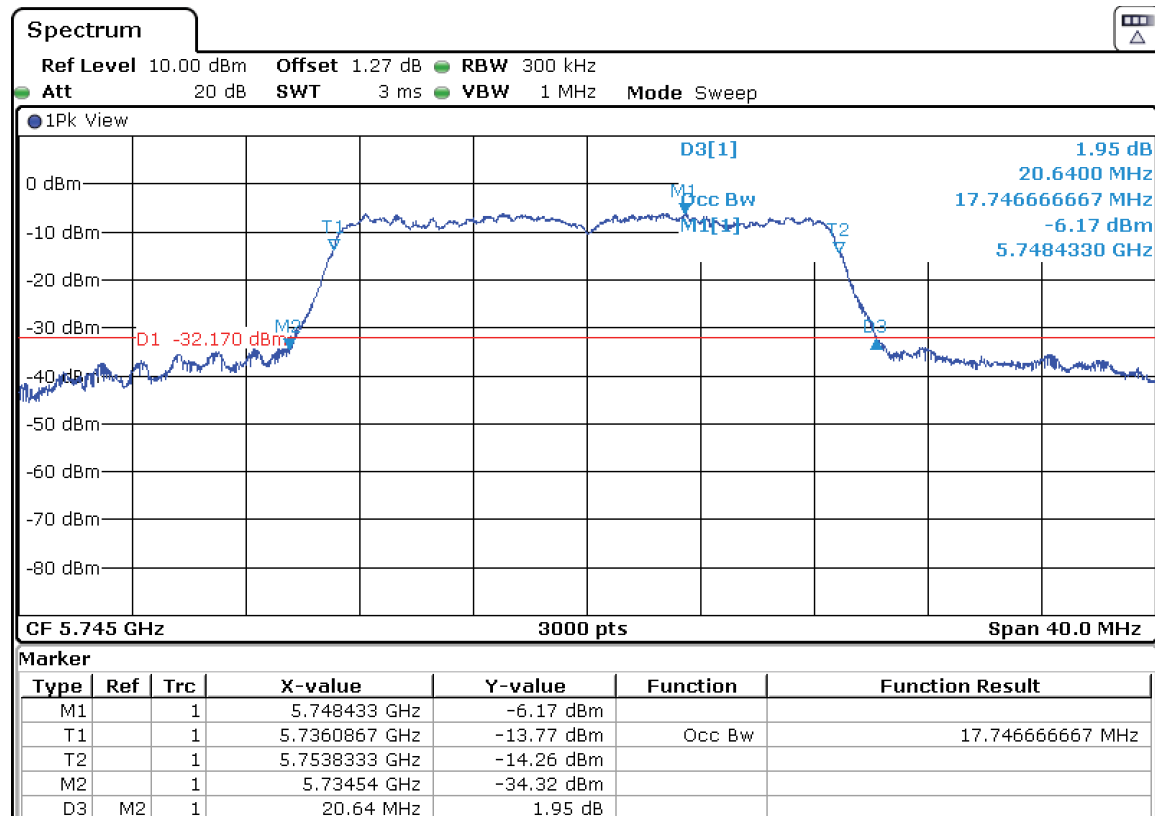


- High Channel 48 (5240 MHz):

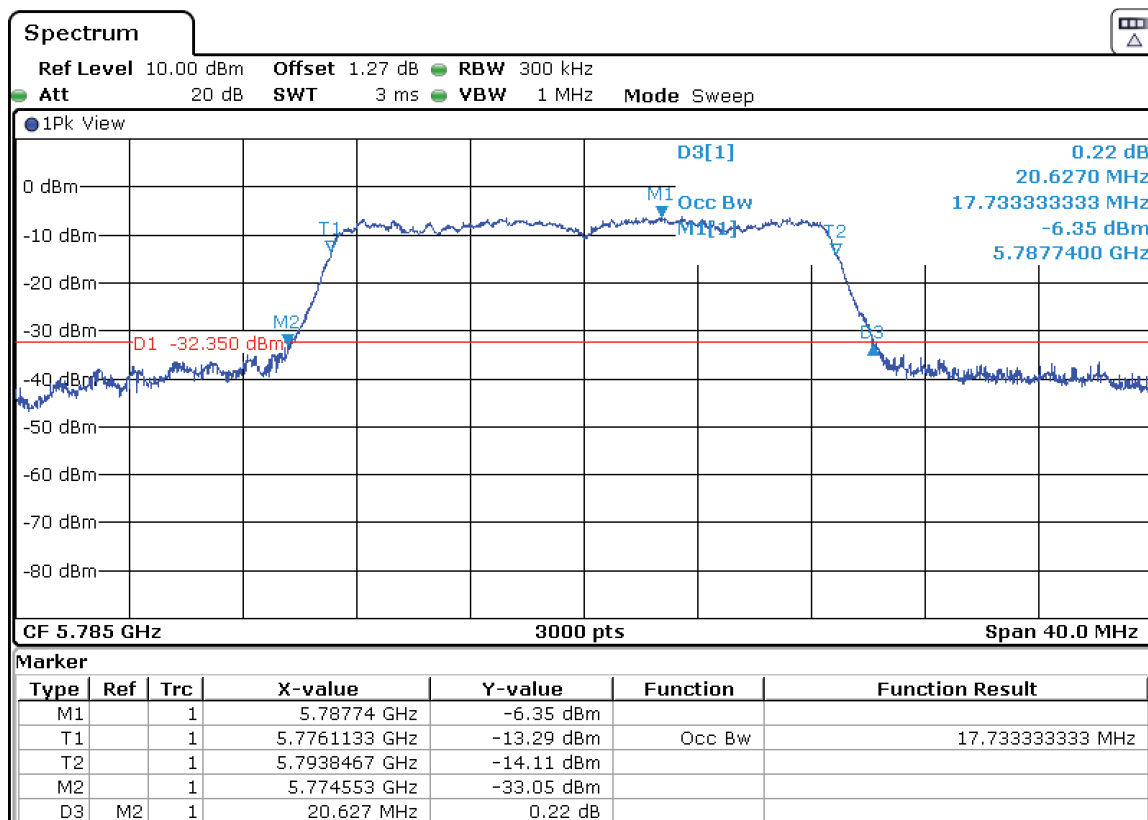


U-NII-3 (5725-5850 MHz)

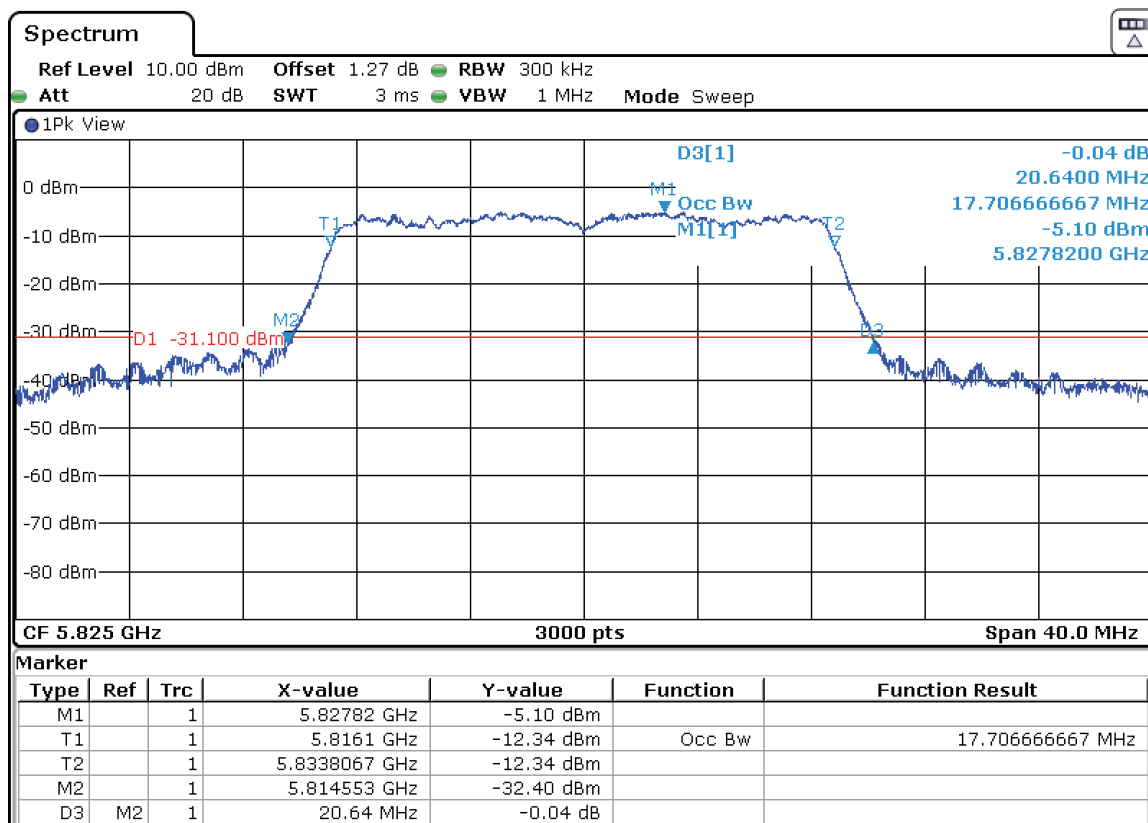
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



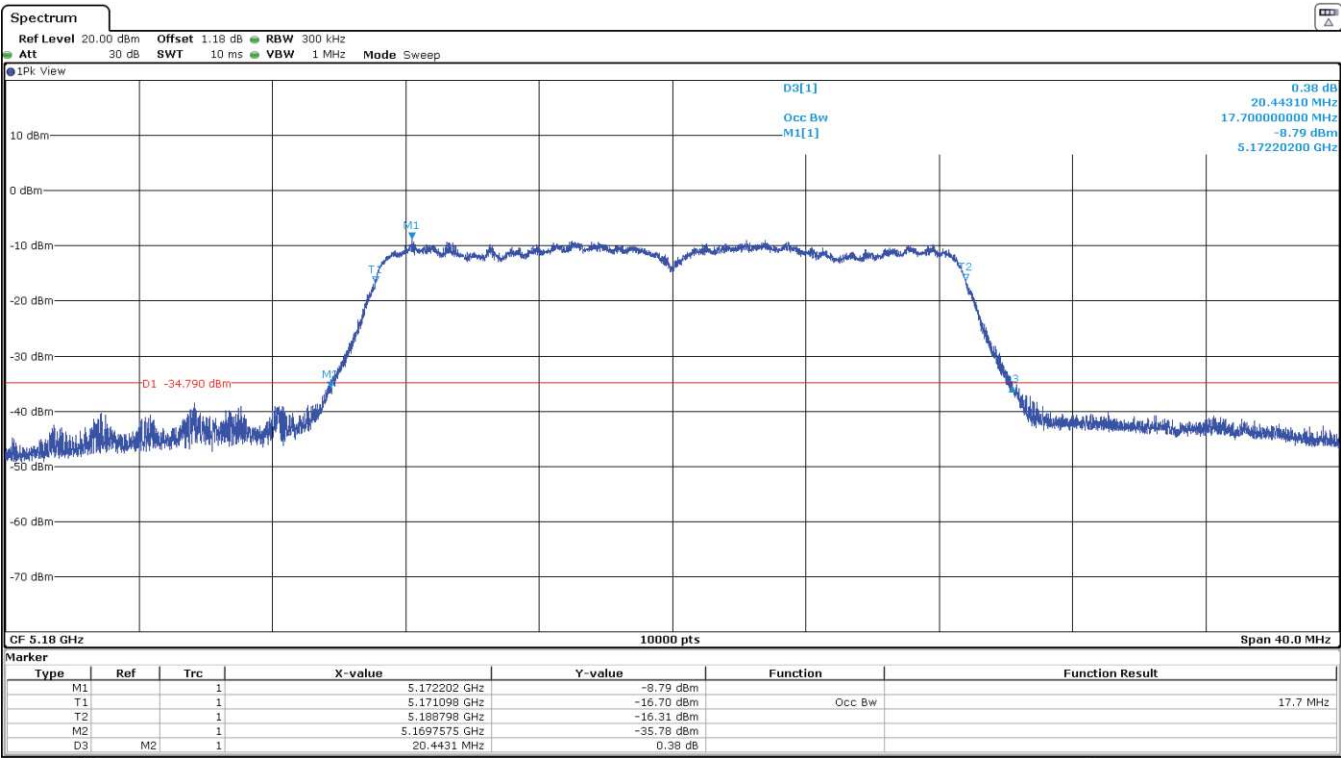
- High Channel 165 (5825 MHz):



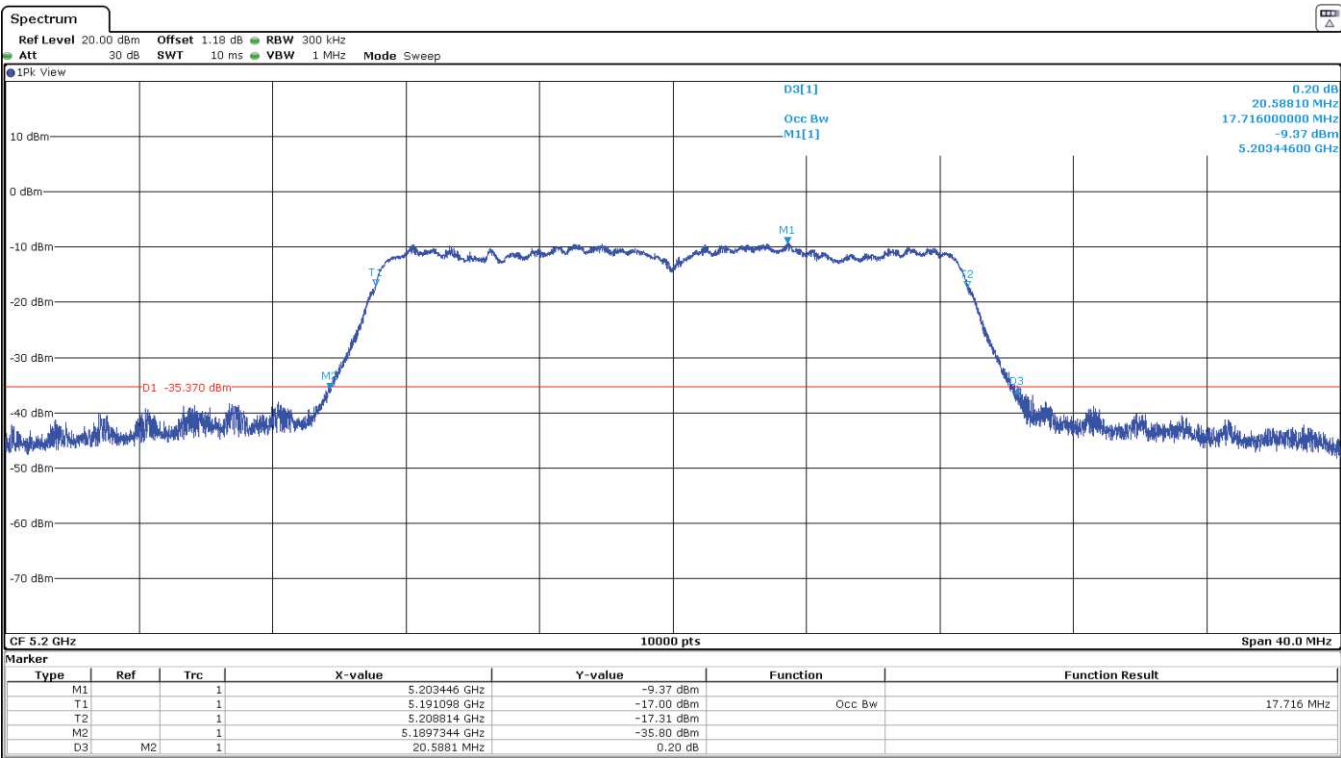
Mode 802.11 ac20 (VHT20):

U-NII-1 (5150-5250 MHz)

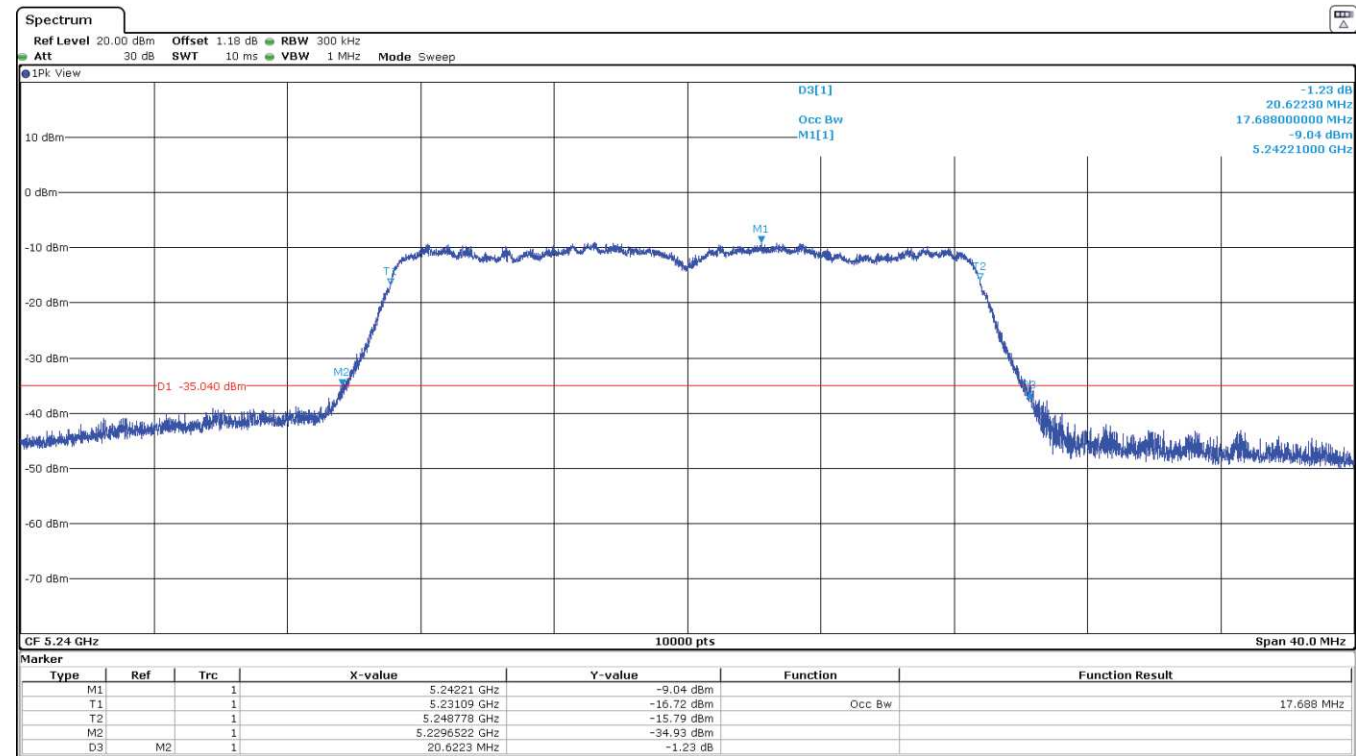
- Low Channel 36 (5180 MHz):



- Middle Channel 40 (5200 MHz):

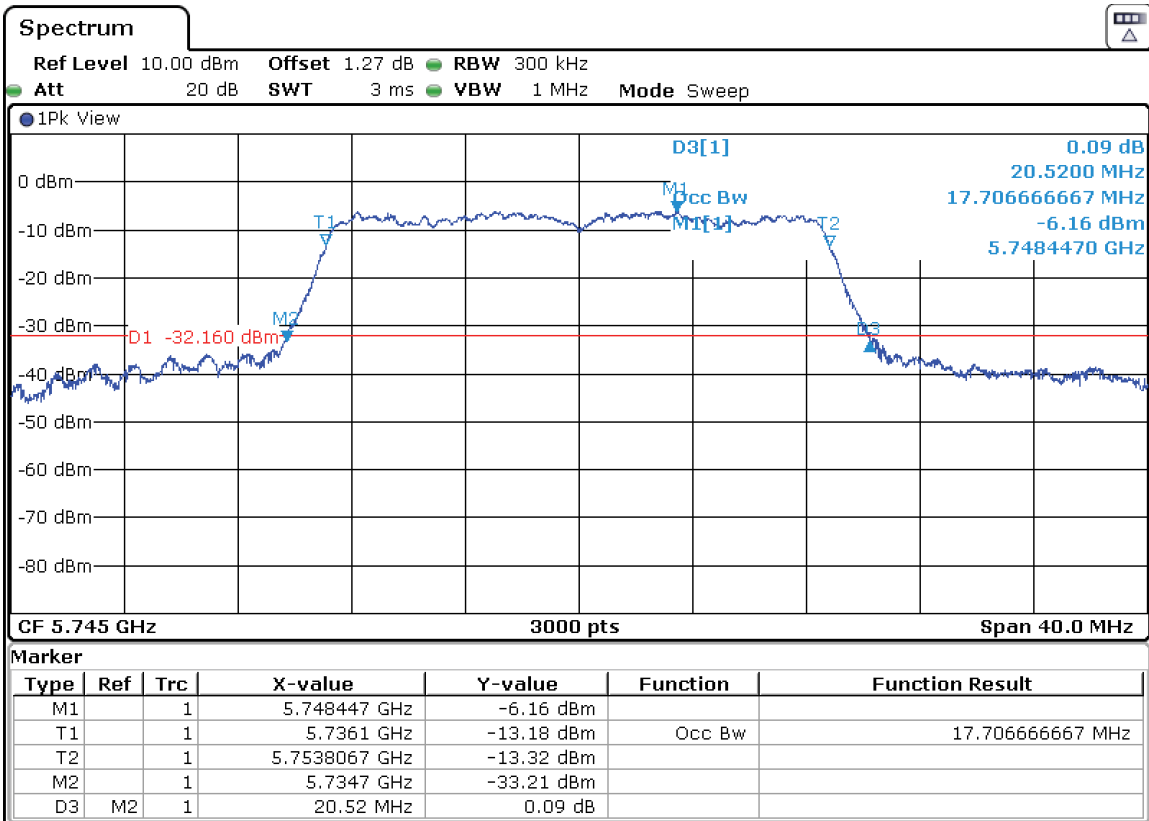


- High Channel 48 (5240 MHz):

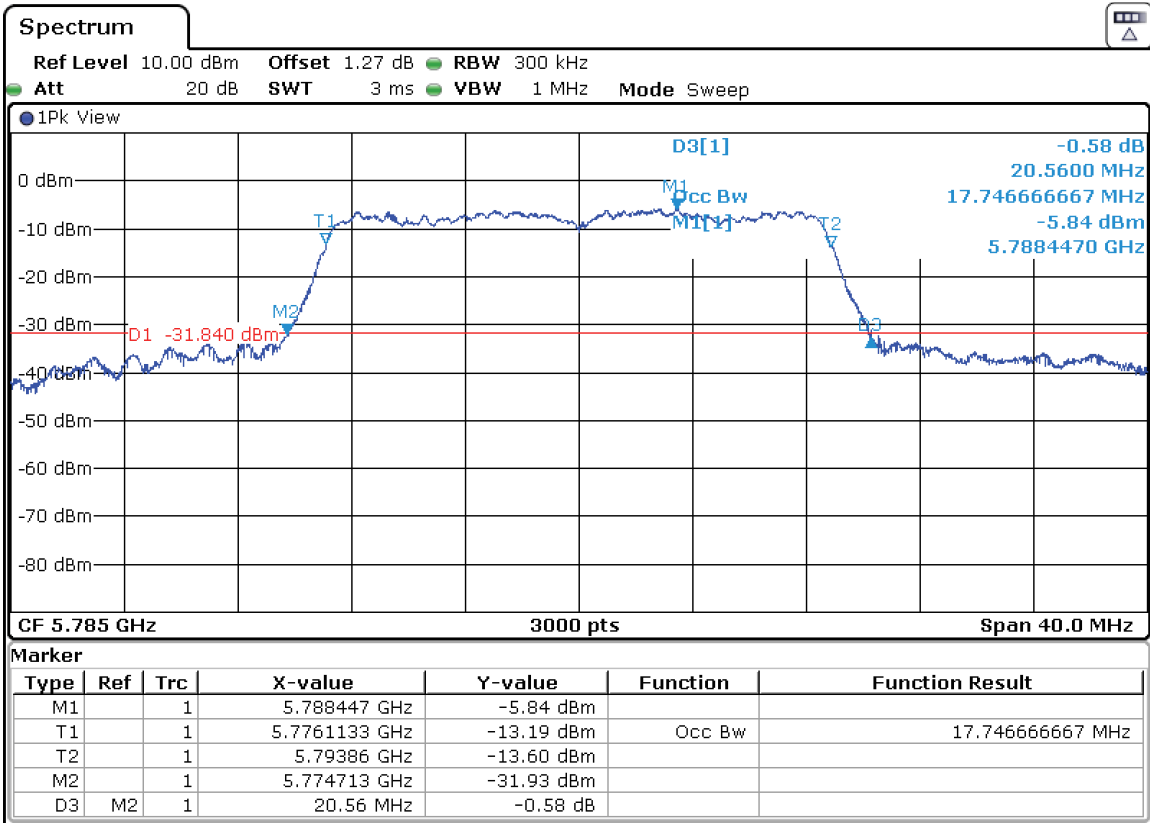


U-NII-3 (5725-5850 MHz)

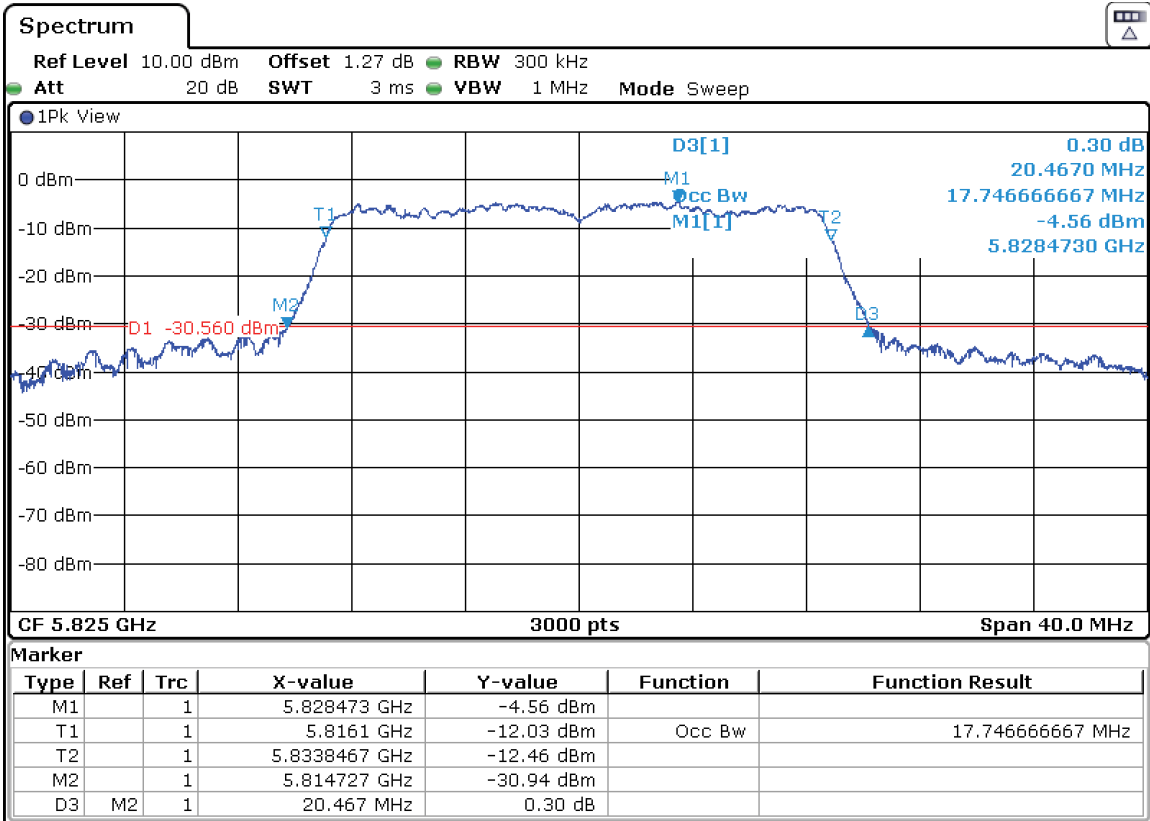
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



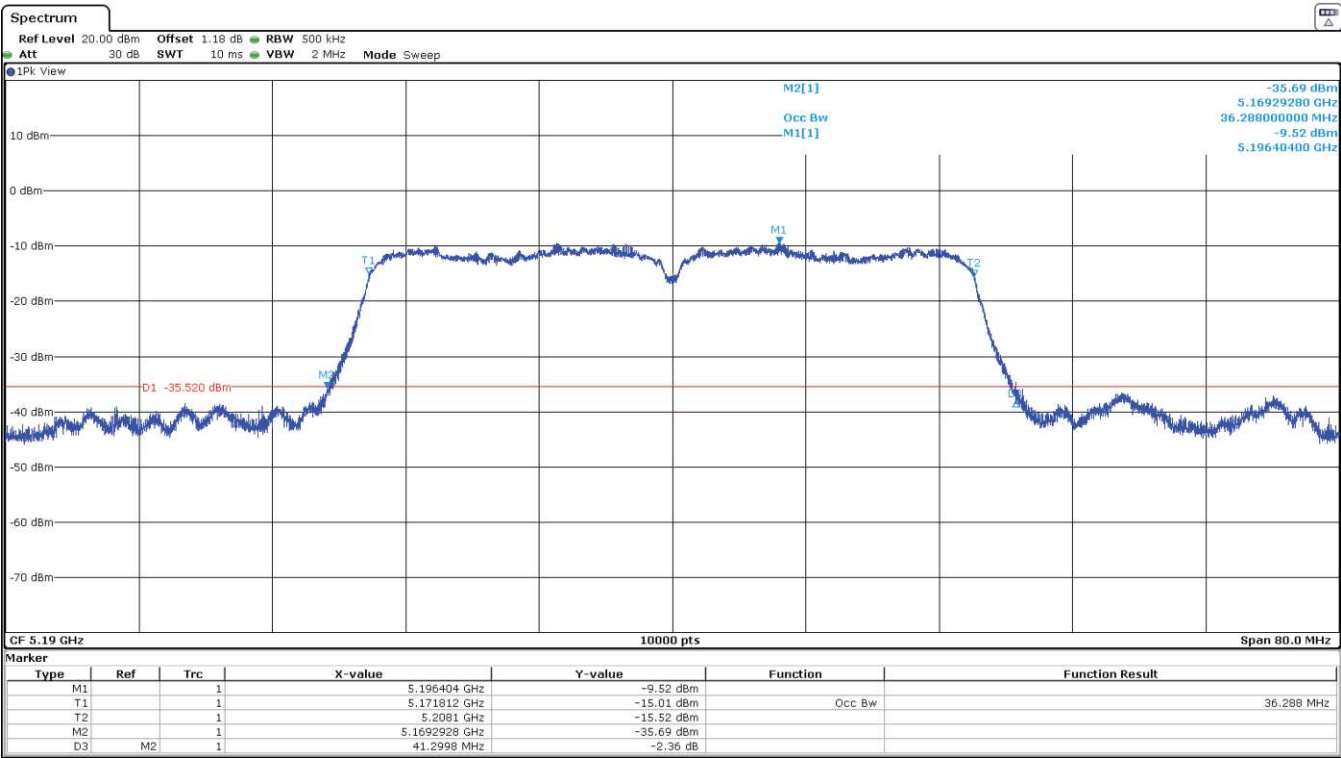
- High Channel 165 (5825 MHz):



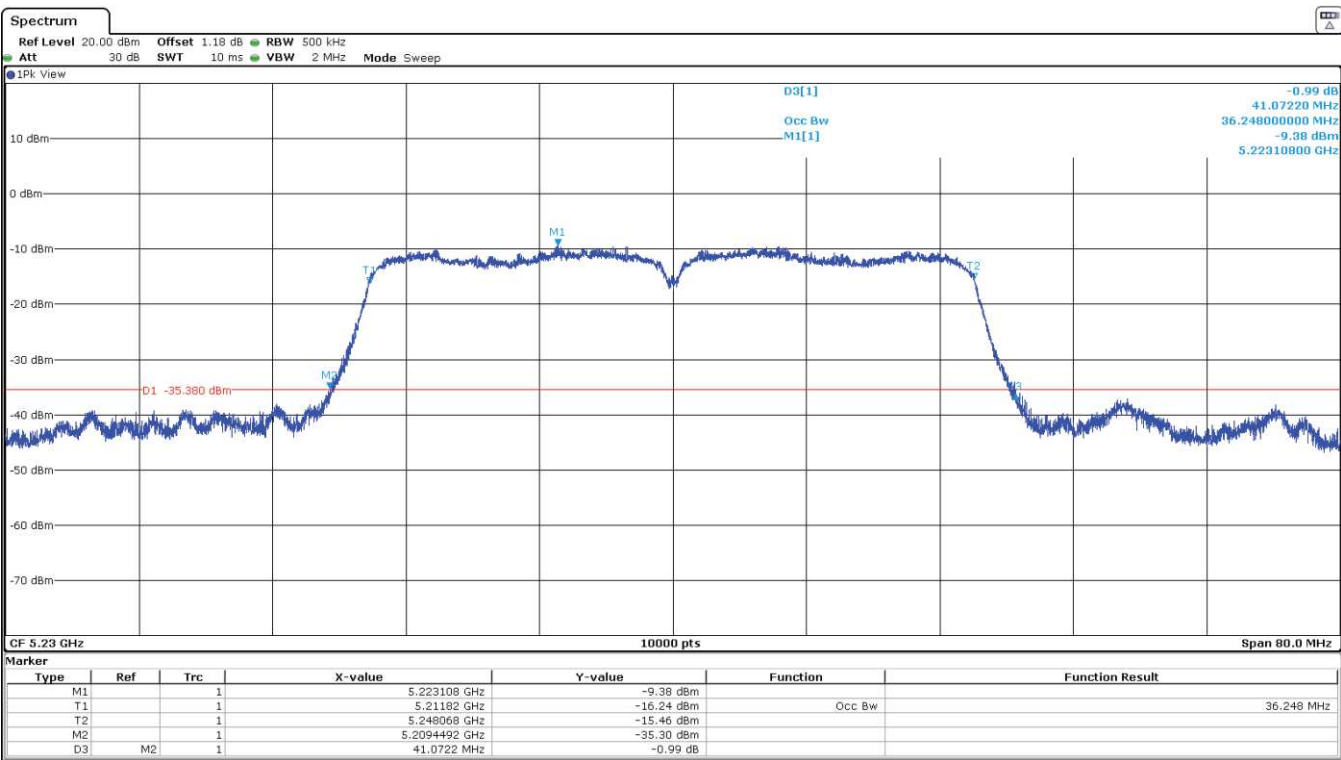
Mode 802.11 n40 (HT40):

U-NII-1 (5150-5250 MHz)

- Low Channel 38 (5190 MHz):

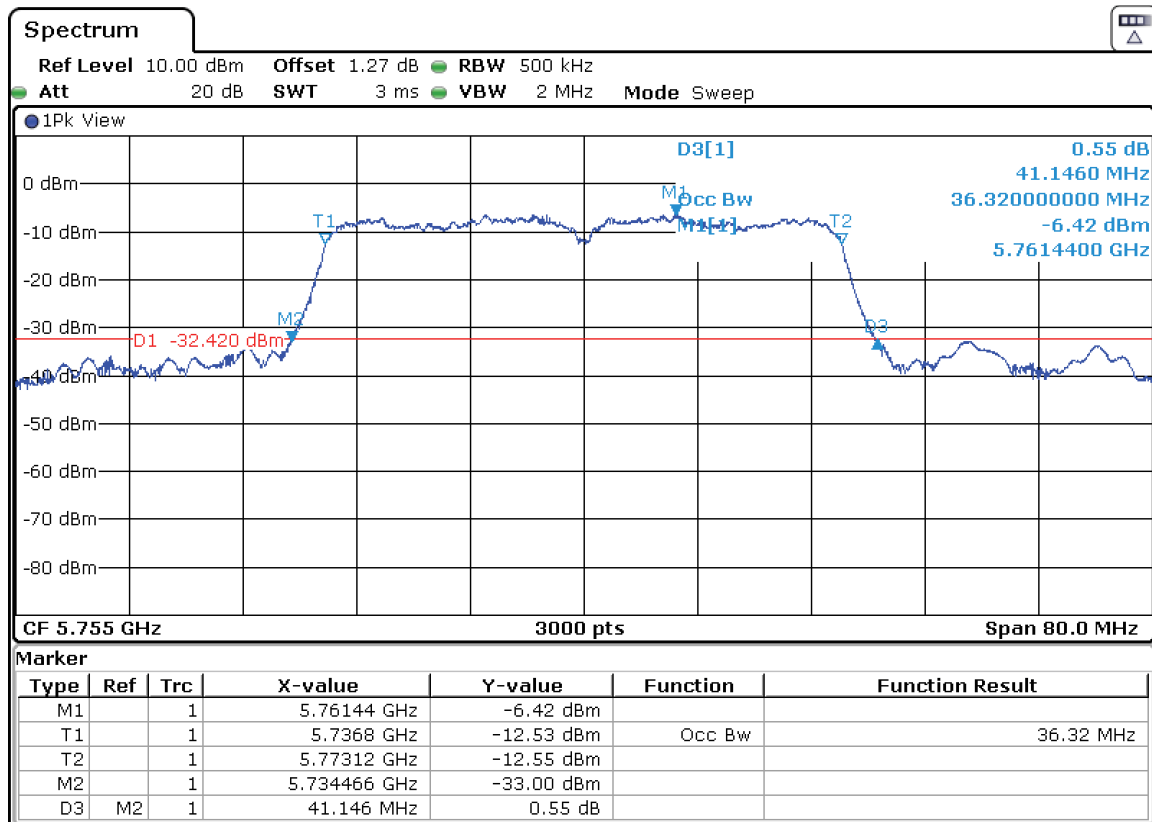


- High Channel 46 (5230 MHz):

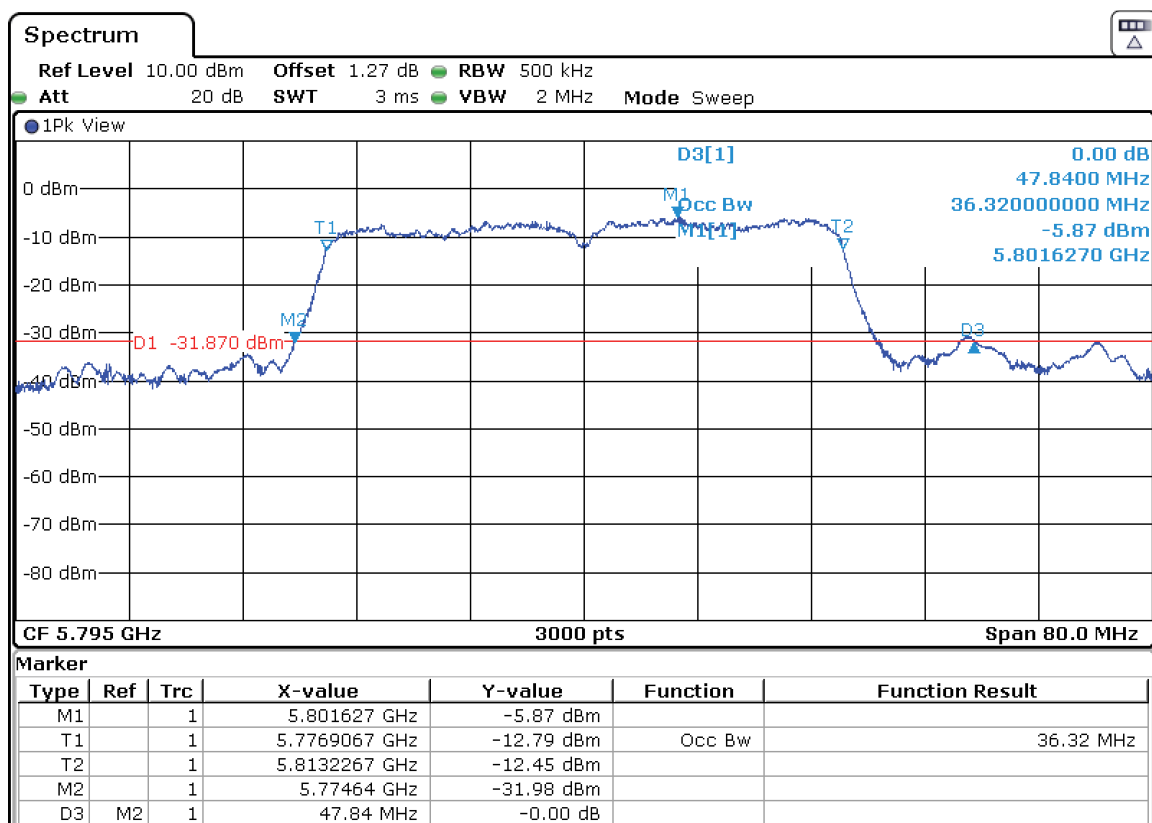


U-NII-3 (5725-5850 MHz)

- Low Channel 151 (5755 MHz):



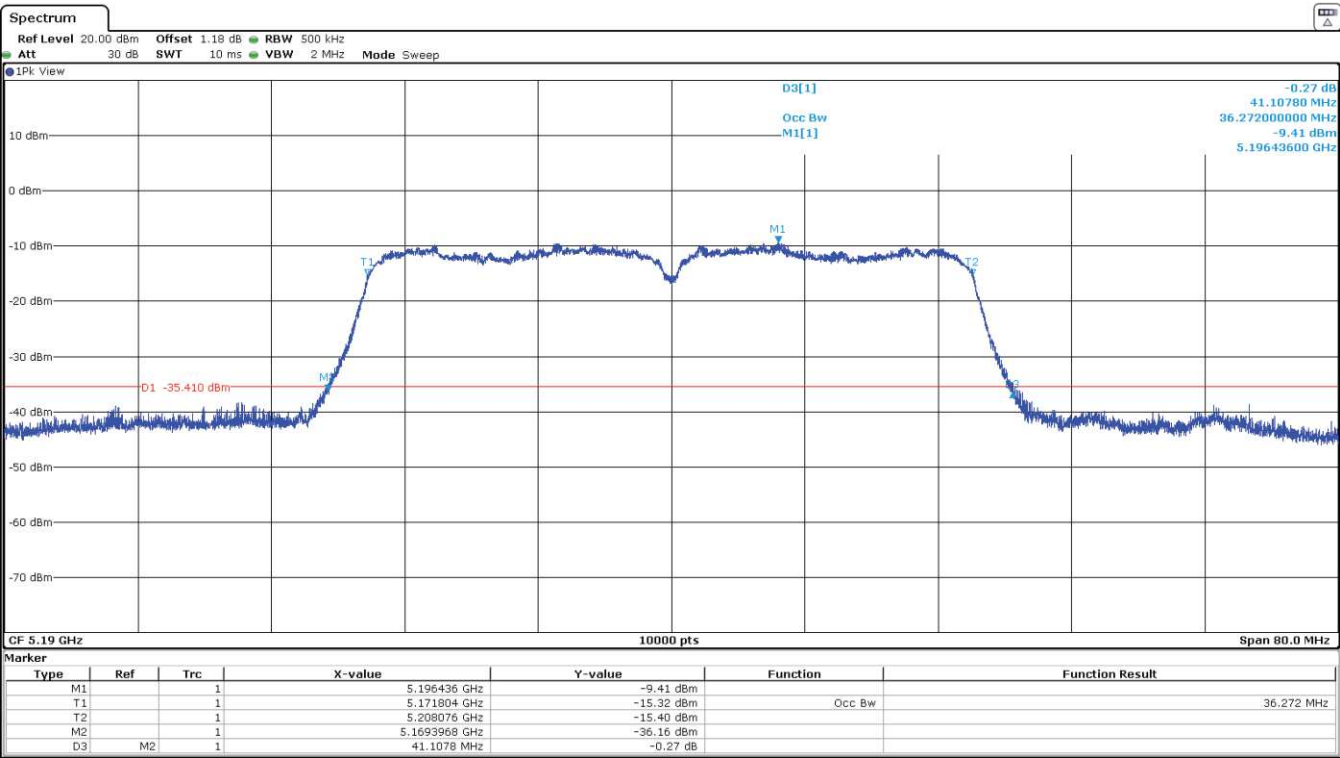
- High Channel 159 (5795 MHz):



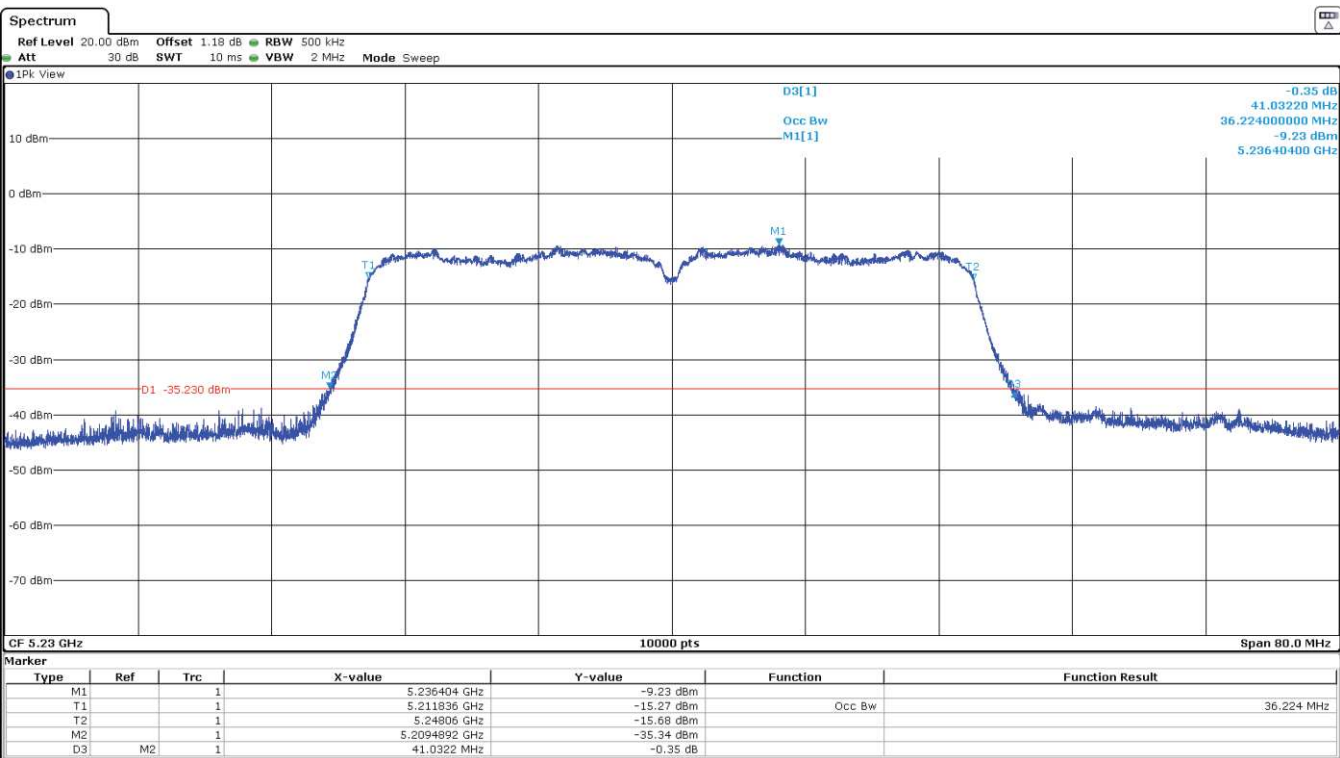
Mode 802.11 ac40 (VHT40):

U-NII-1 (5150-5250 MHz)

- Low Channel 38 (5190 MHz):

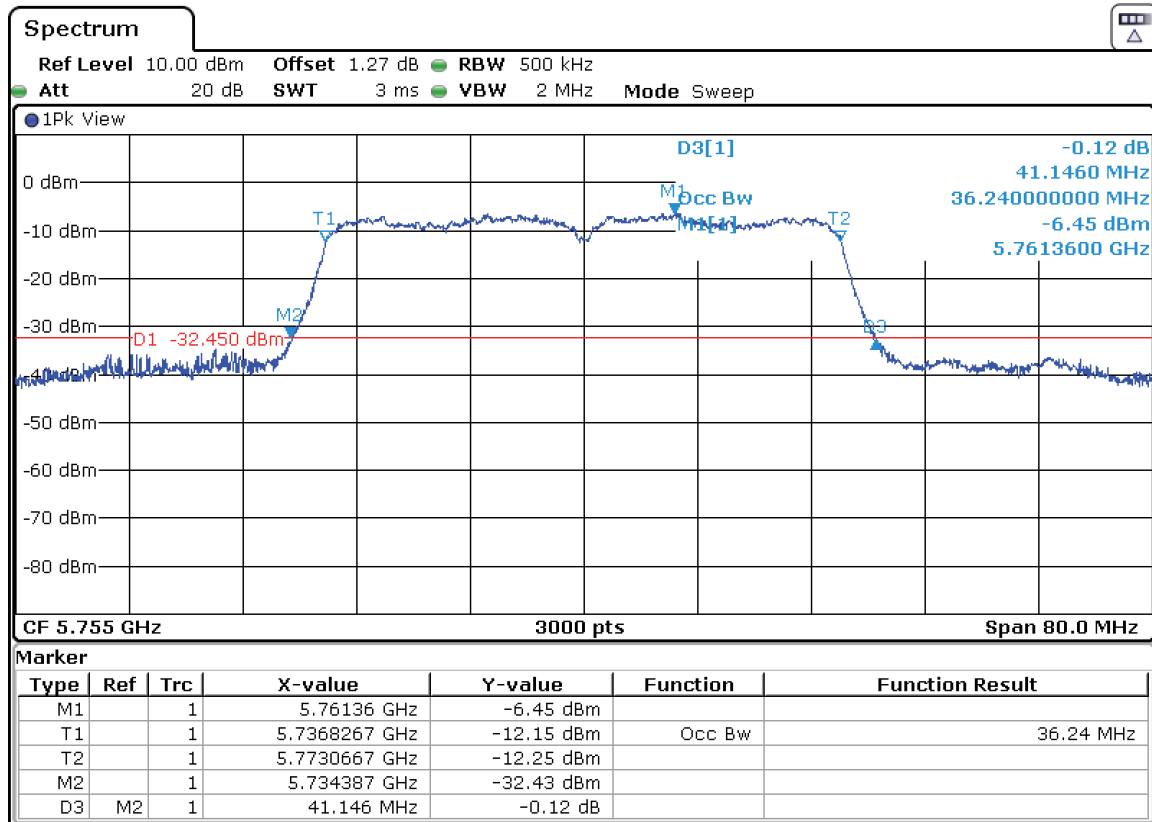


- High Channel 46 (5230 MHz):

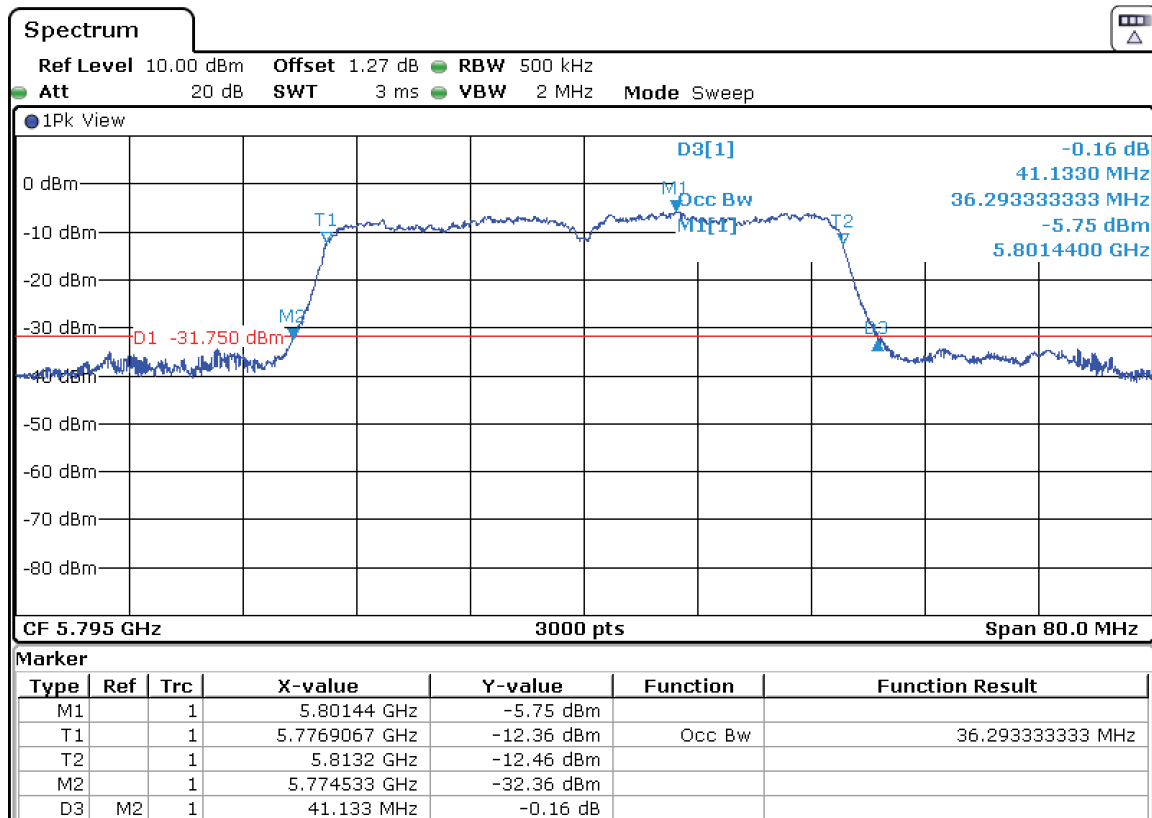


U-NII-3 (5725-5850 MHz)

- Low Channel 151 (5755 MHz):



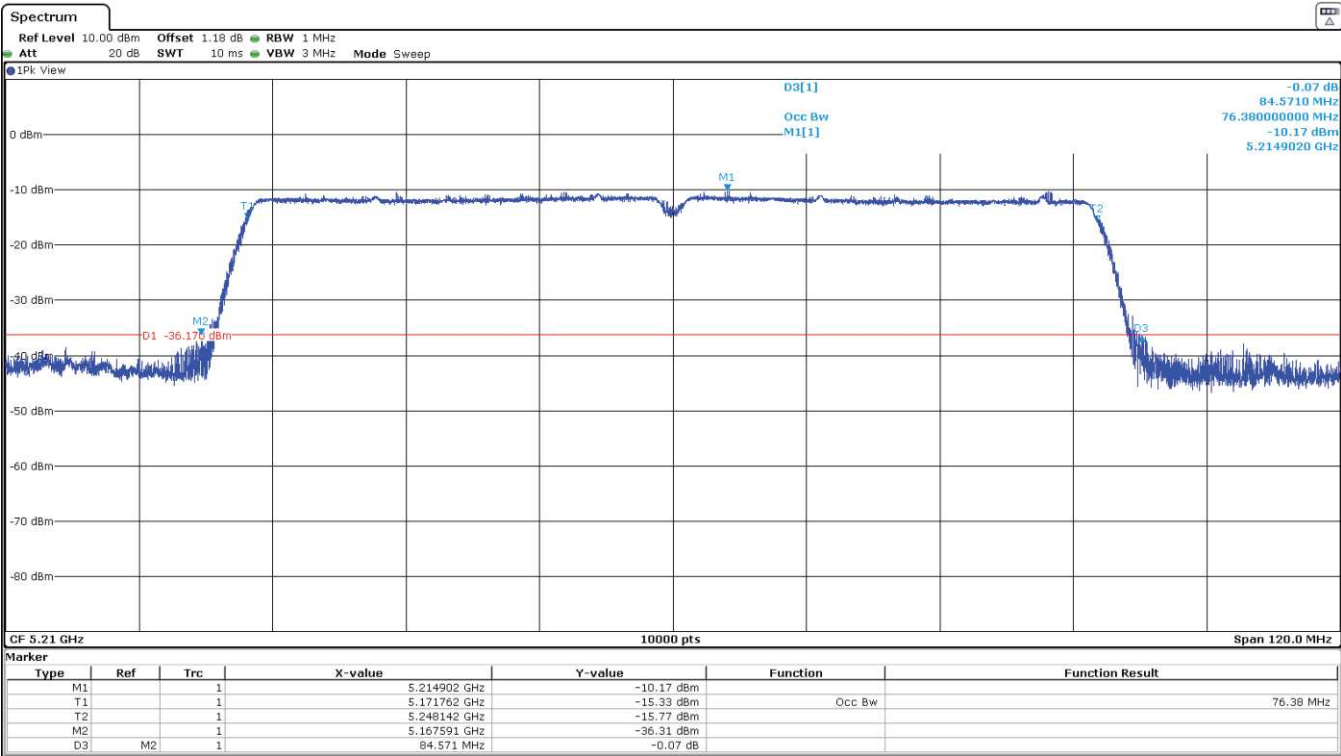
- High Channel 159 (5795 MHz):



Mode 802.11 ac80 (VHT80):

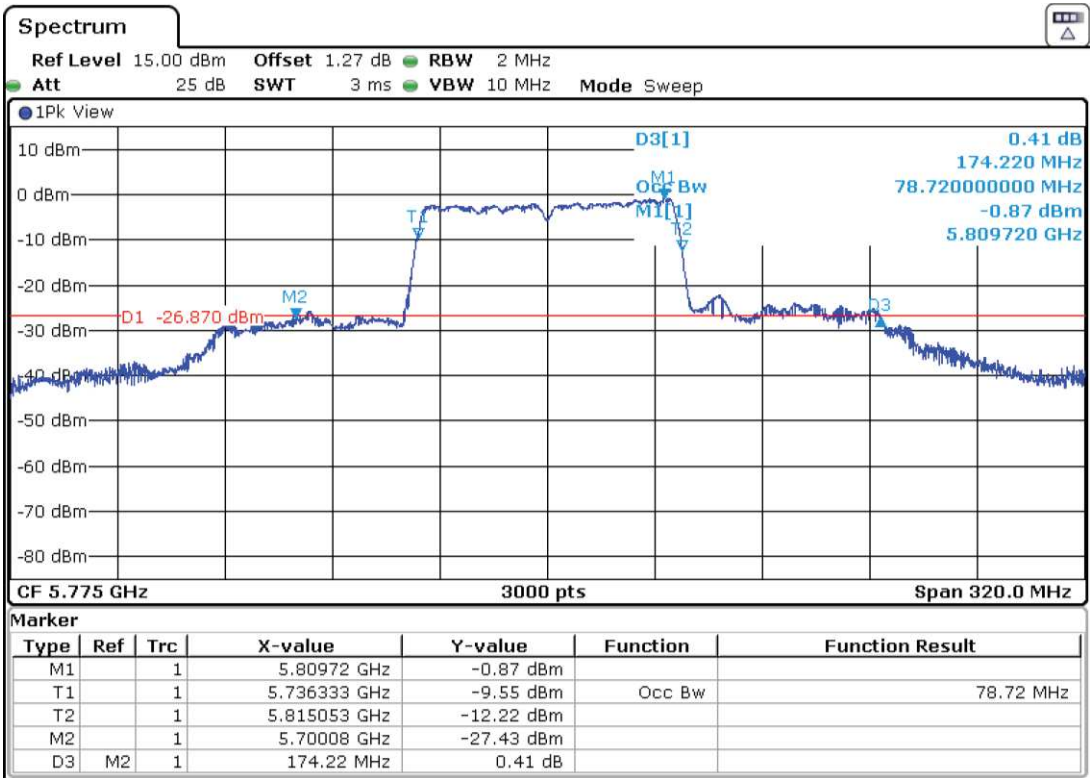
U-NII-1 (5150-5250 MHz)

- Single Channel 42 (5210 MHz):



U-NII-3 (5725-5850 MHz)

- Single Channel 155 (5775 MHz):



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

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TEST CONDITIONS

POWER SUPPLY (V):

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

ANTENNA:

Type of Antenna: Internal.
Maximum Declared Antenna Gain: +3 dBi.

TEST FREQUENCIES:

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

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

The EUT was tested in the following operating mode:

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

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

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

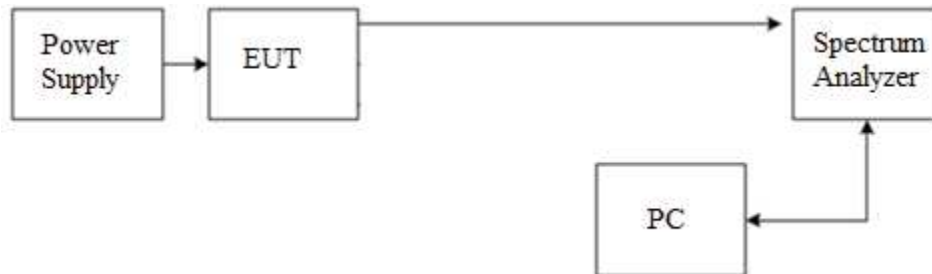
The worst cases for testing were identified for output power and spurious levels at the band edges which were selected based on preliminary testing that correspond to next data rates:

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

CONDUCTED MEASUREMENTS

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

For all modes:



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

RADIATED MEASUREMENTS:

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz) and 1 GHz-18 GHz Double ridge horn antenna is situated at a distance of 3 m and a distance of 1m for the frequency range 17 GHz-40 GHz (18 GHz-40 GHz horn antenna).

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

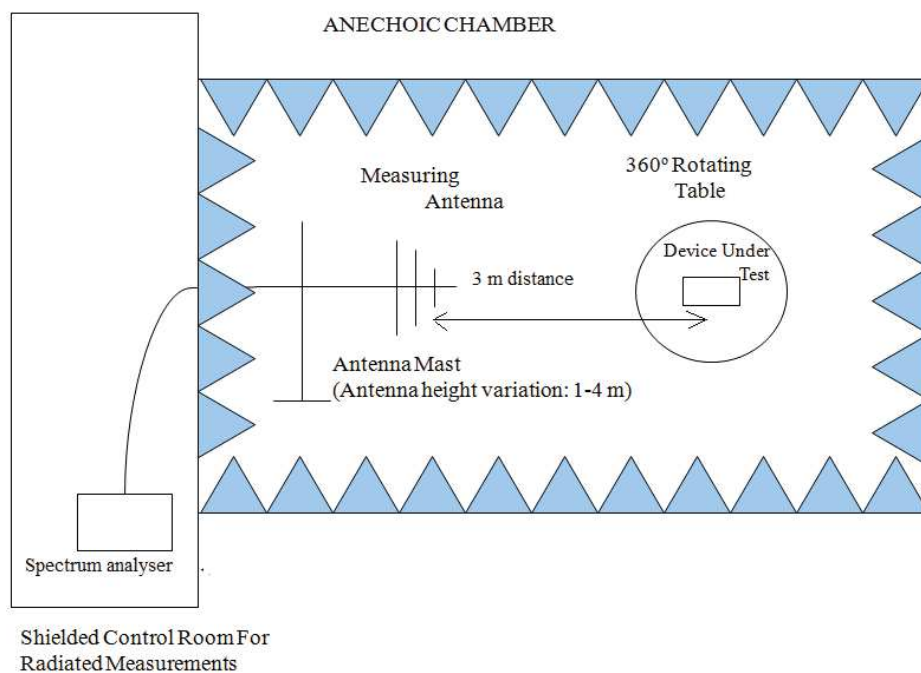
The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find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

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

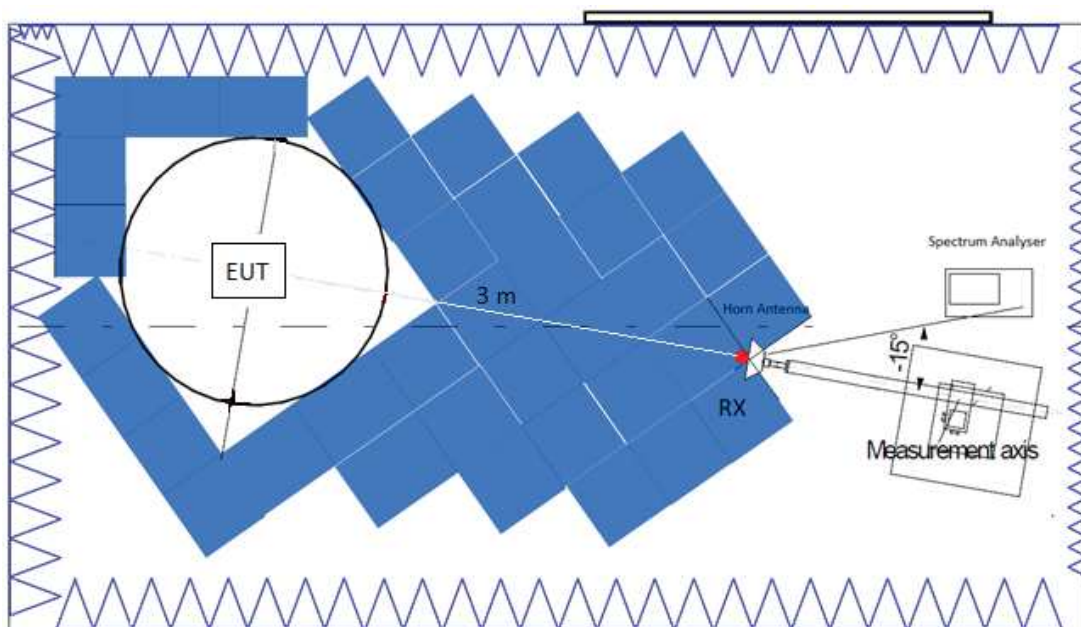
The final measured value, for the given emission, in the tables below incorporates the calibrated antenna factor and cable loss.

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

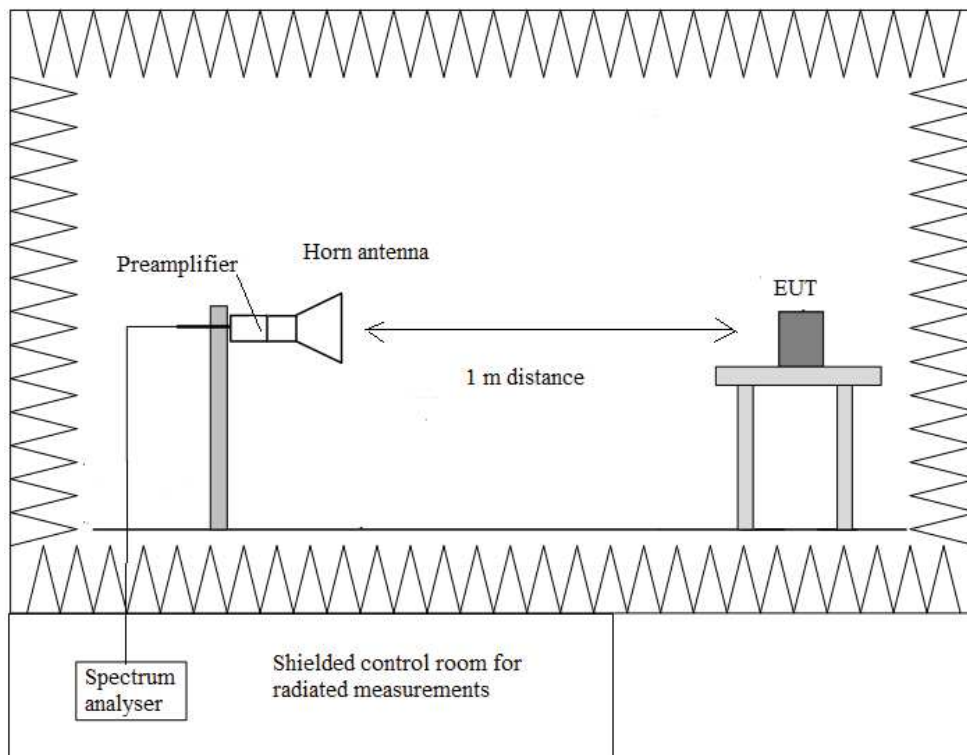
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



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

6.2.1.1. Transmitter Maximum Equivalent Isotropically Radiated Power

SPECIFICATION:

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

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

RESULTS:

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

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

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

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

Maximum Declared Antenna Gain: +3 dBi

Mode 802.11 a20:

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Max. Conducted Power (dBm)	-0.96	-0.41	-1.09
Max. EIRP Power (dBm)	2.04	2.59	1.91
Measurement uncertainty (dB)	<±2.00		

Mode 802.11 n20 (HT20):

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Max. Conducted Power (dBm)	-1.06	-0.67	-1.47
Max. EIRP Power (dBm)	1.94	2.33	1.53
Measurement uncertainty (dB)	<±2.00		

Mode 802.11 ac20 (VHT20):

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Max. Conducted Power (dBm)	-1.07	-0.66	-1.41
Max. EIRP power (dBm)	1.93	2.34	1.59
Measurement uncertainty (dB)	<±2.00		

Mode 802.11 n40 (HT40):

	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
Max. Conducted Power (dBm)	-0.52	-0.83
Duty Cycle Correction Factor (dB)	0.142	
Max. Conducted Power Corrected (dBm)	-0.378	-0.688
Max. EIRP power Corrected (dBm)	2.622	2.312
Measurement uncertainty (dB)	<±2.00	

Mode 802.11 ac40 (VHT40):

	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
Max. Conducted Power (dBm)	-0.65	-0.87
Duty Cycle Correction Factor (dB)	0.140	
Max. Conducted Power Corrected (dBm)	-0.510	-0.730
Max. EIRP Power Corrected (dBm)	2.490	2.270
Measurement uncertainty (dB)	<±2.00	

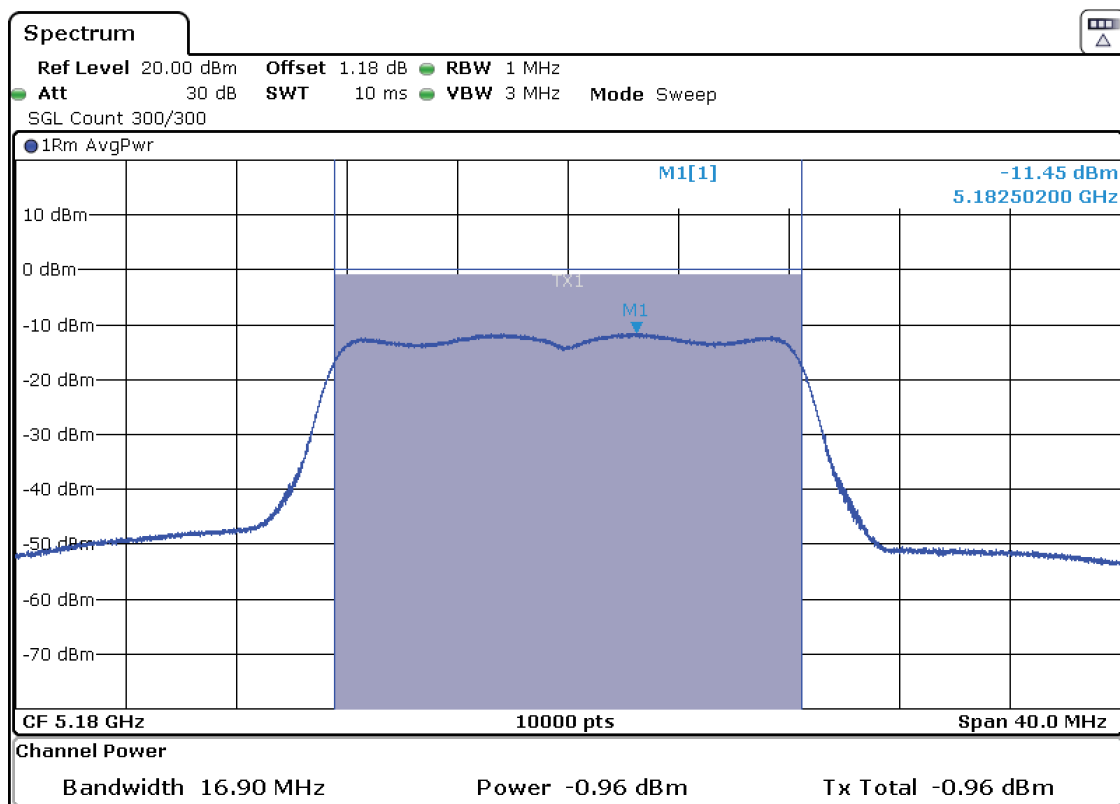
Mode 802.11 ac80 (VHT80):

	Single Channel 42 (5210 MHz)
Max. Conducted Power (dBm)	-1.91
Duty Cycle Correction Factor (dB)	0.282
Max. Conducted Power Corrected (dBm)	-1.618
Max. EIRP Power Corrected (dBm)	1.382
Measurement uncertainty (dB)	<±2.00

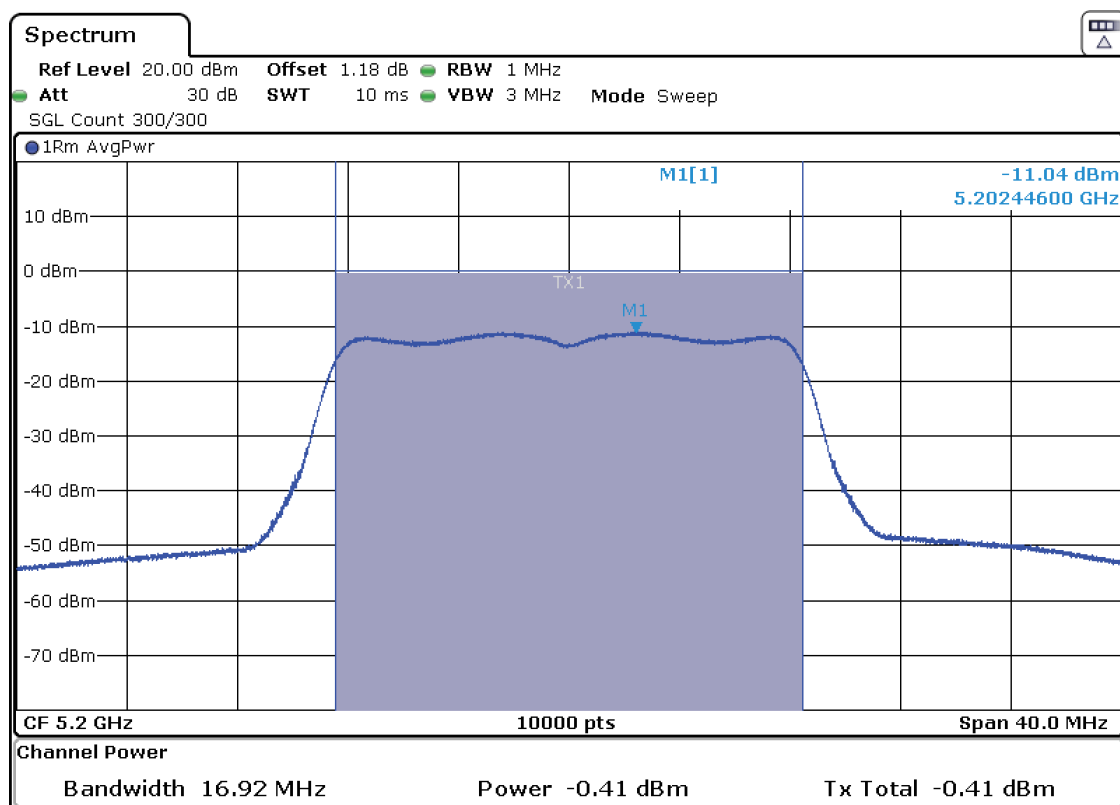
Verdict: PASS

Mode 802.11 a20:

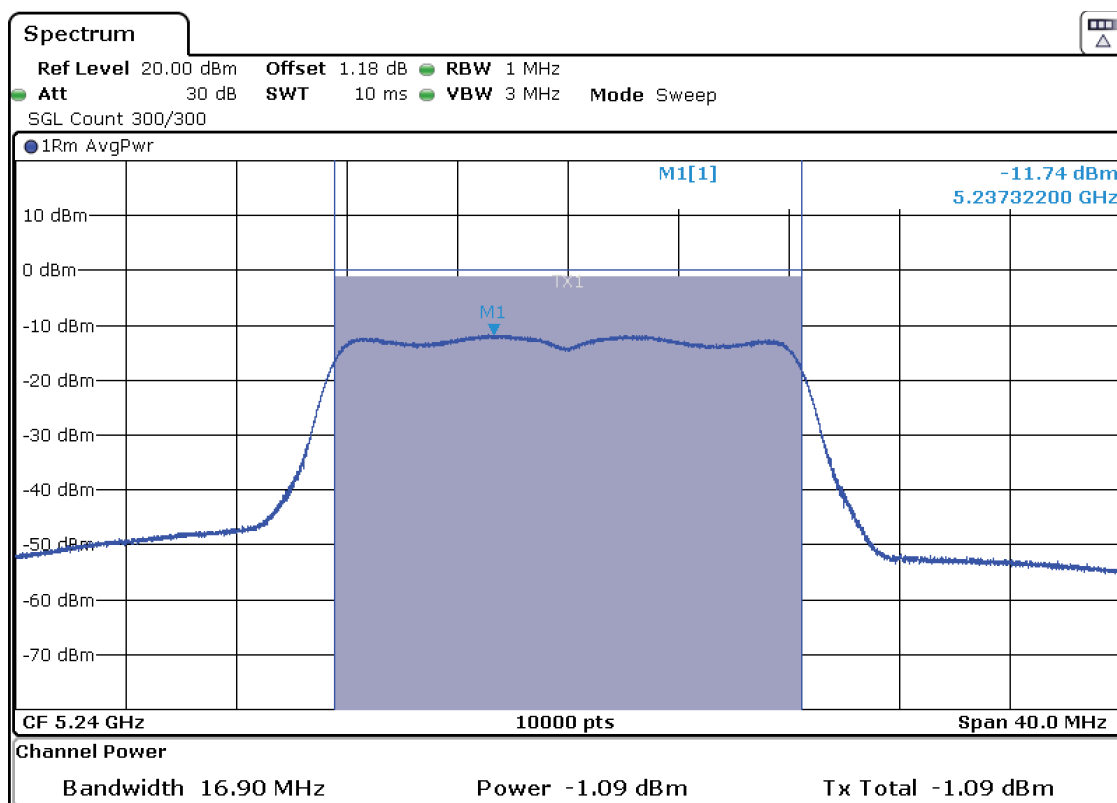
- Low Channel:



- Middle Channel:

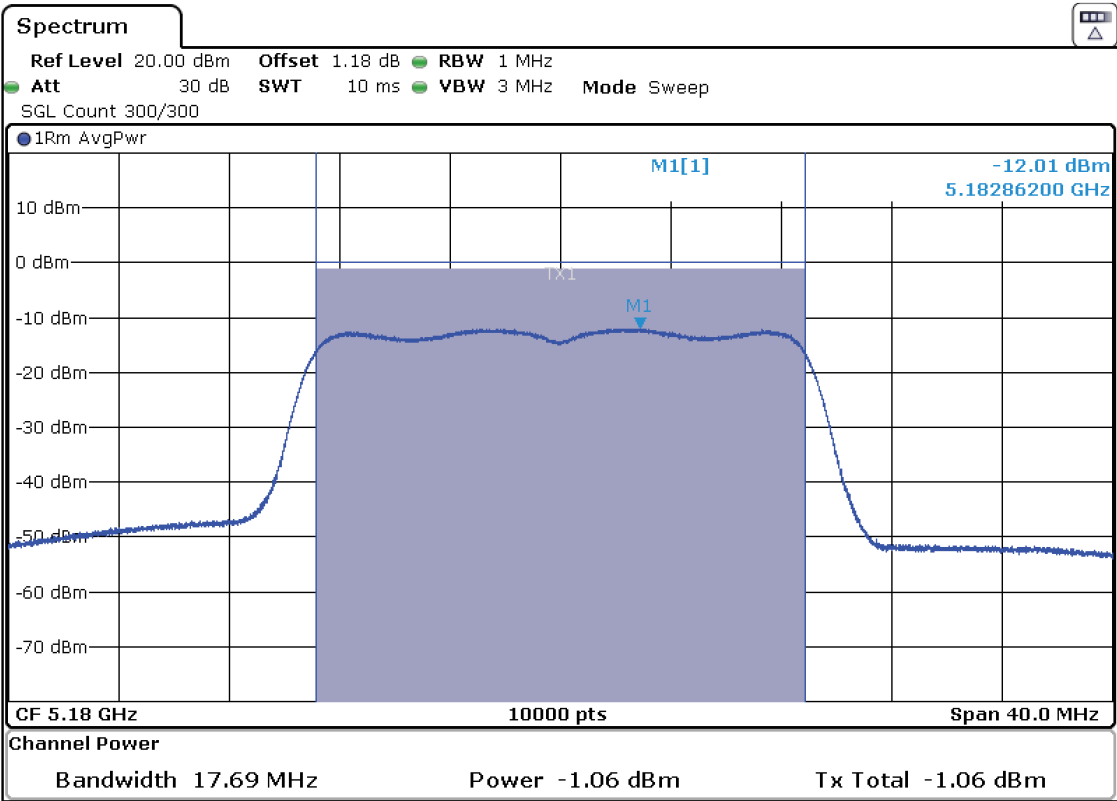


- High Channel:

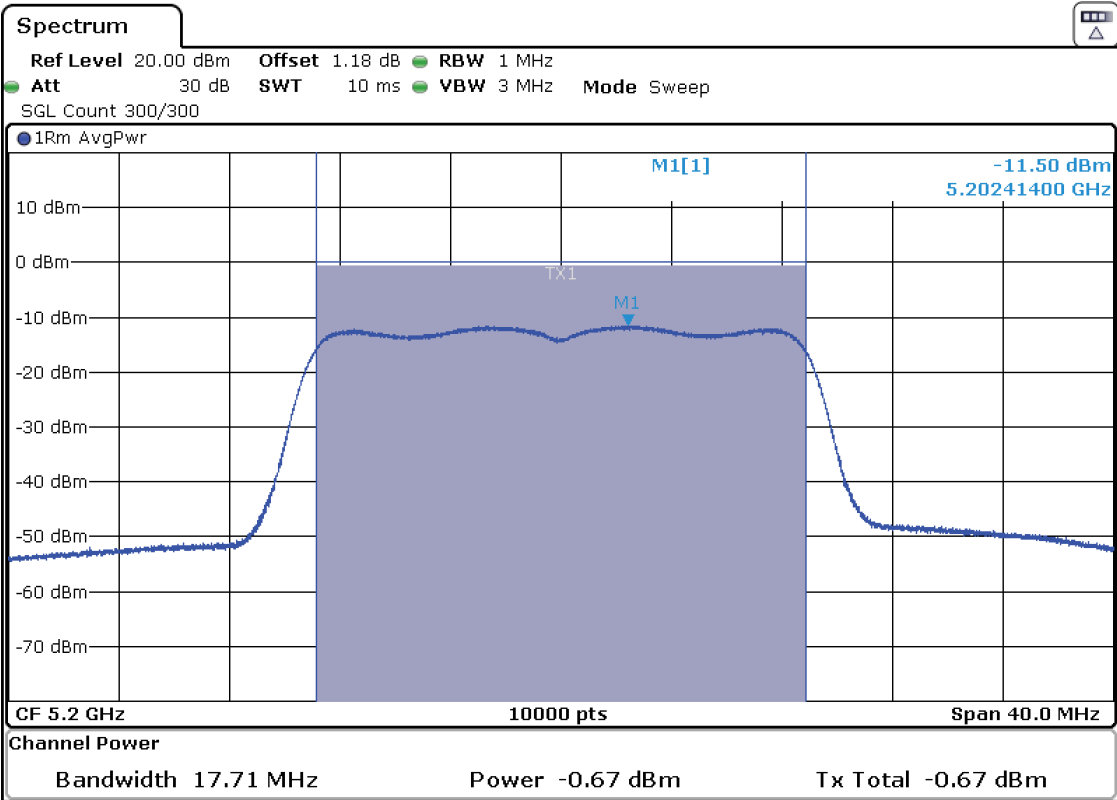


Mode 802.11 n20 (HT20):

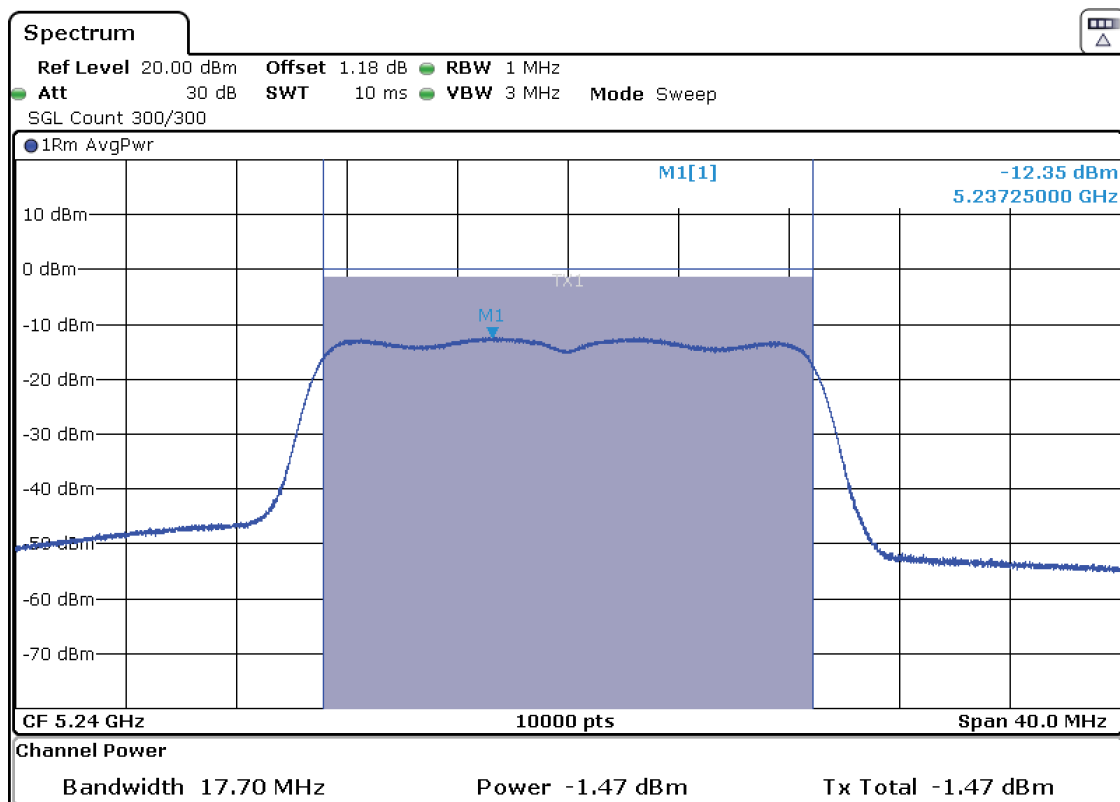
- Low Channel:



- Middle Channel:

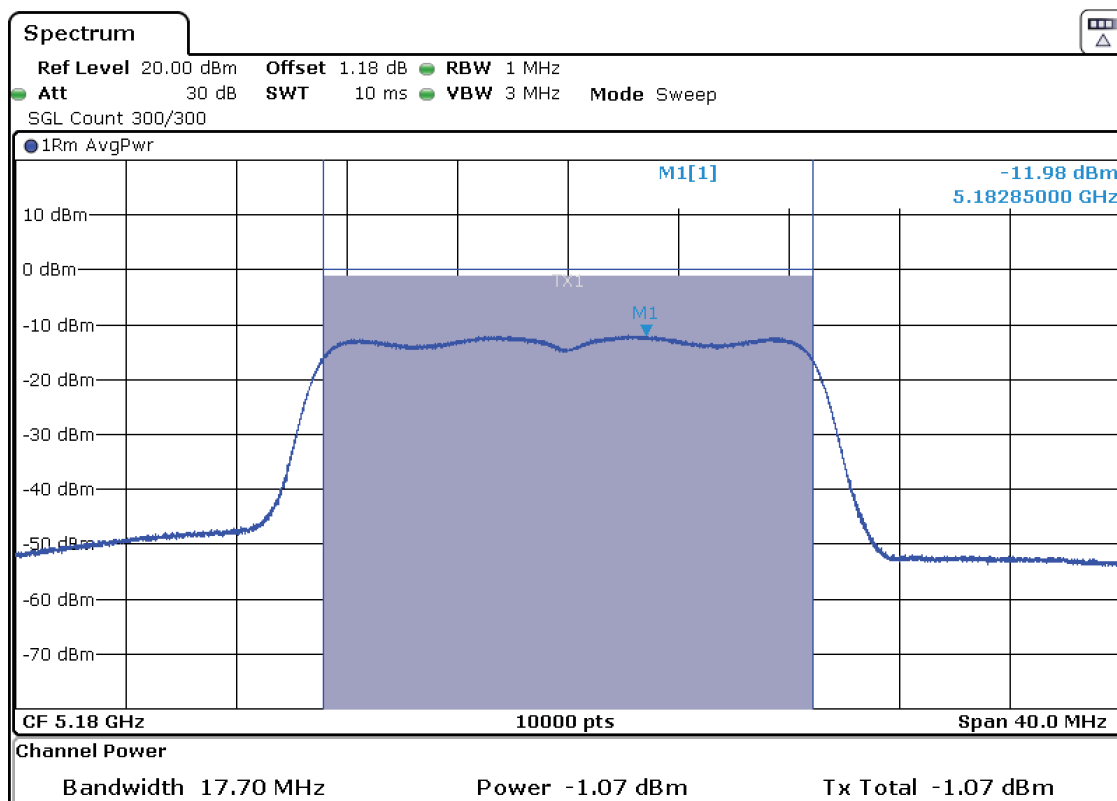


- High Channel:

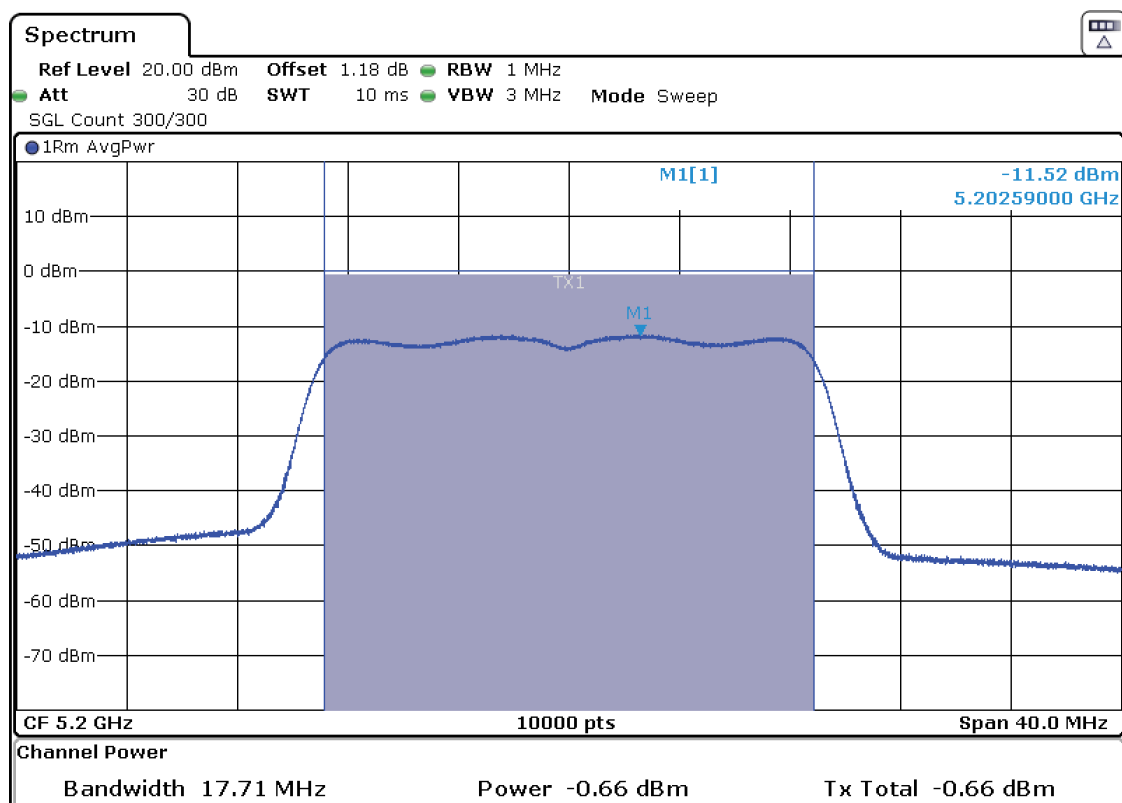


Mode 802.11 ac20 (VHT20):

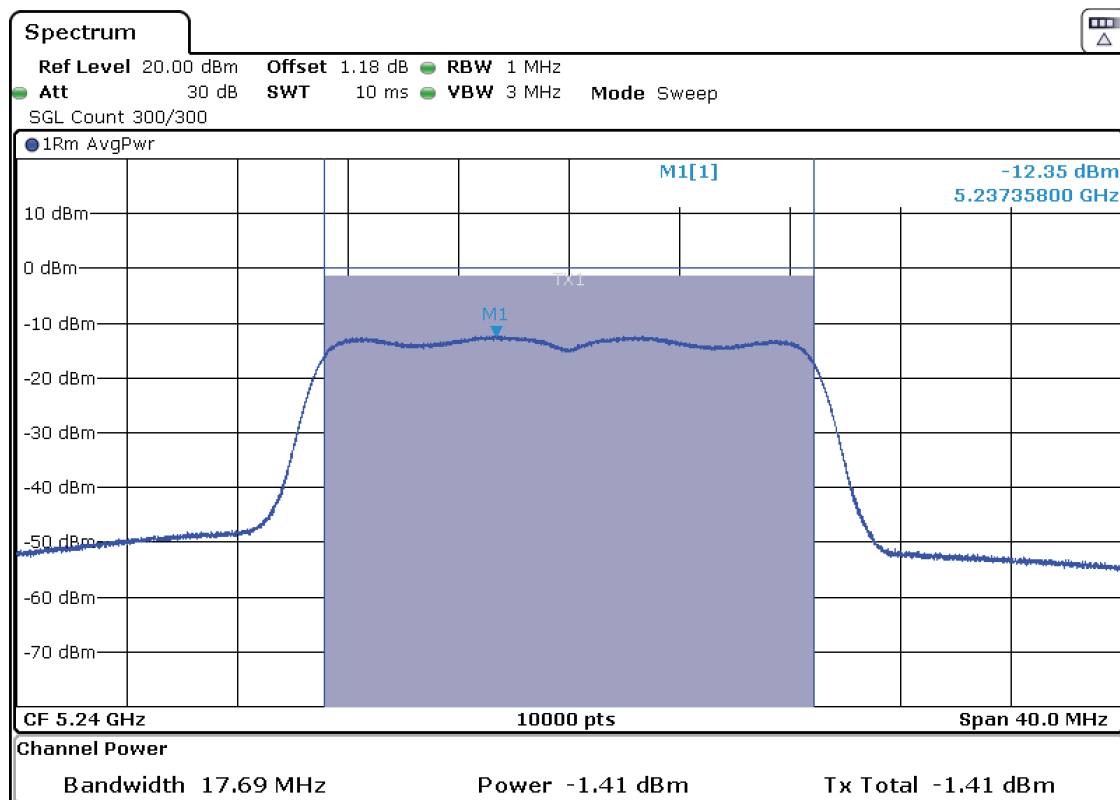
- Low Channel:



- Middle Channel:

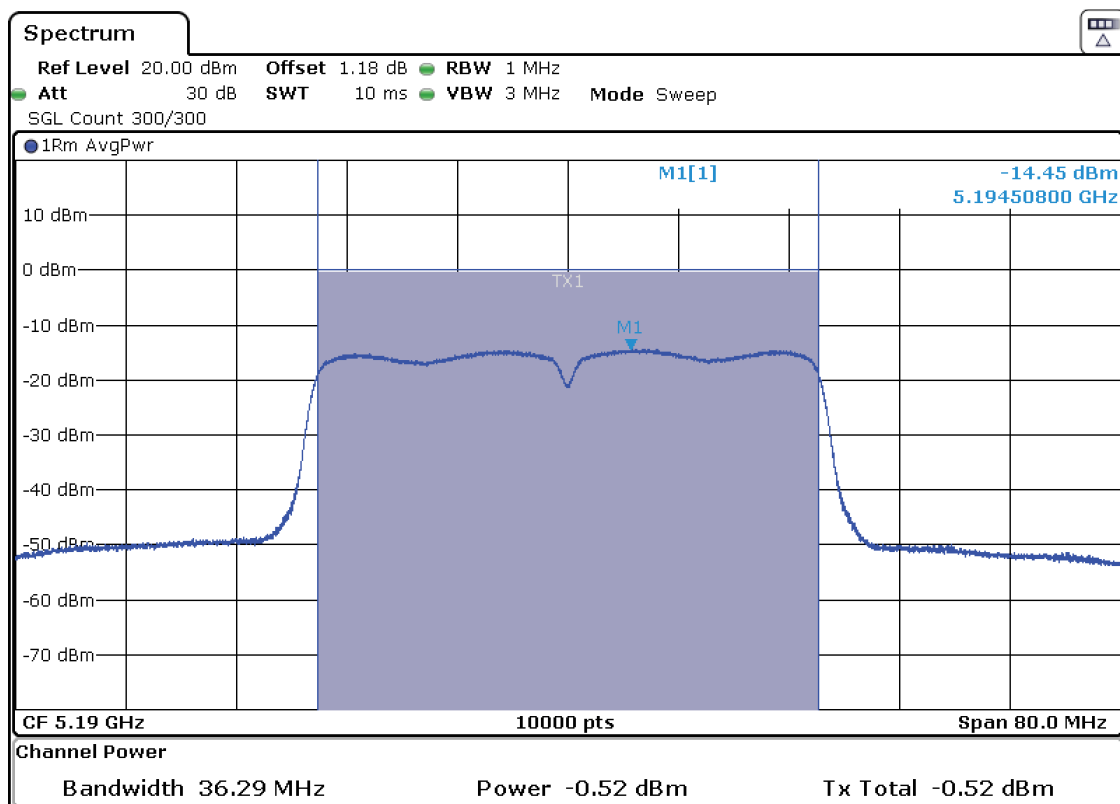


- High Channel:

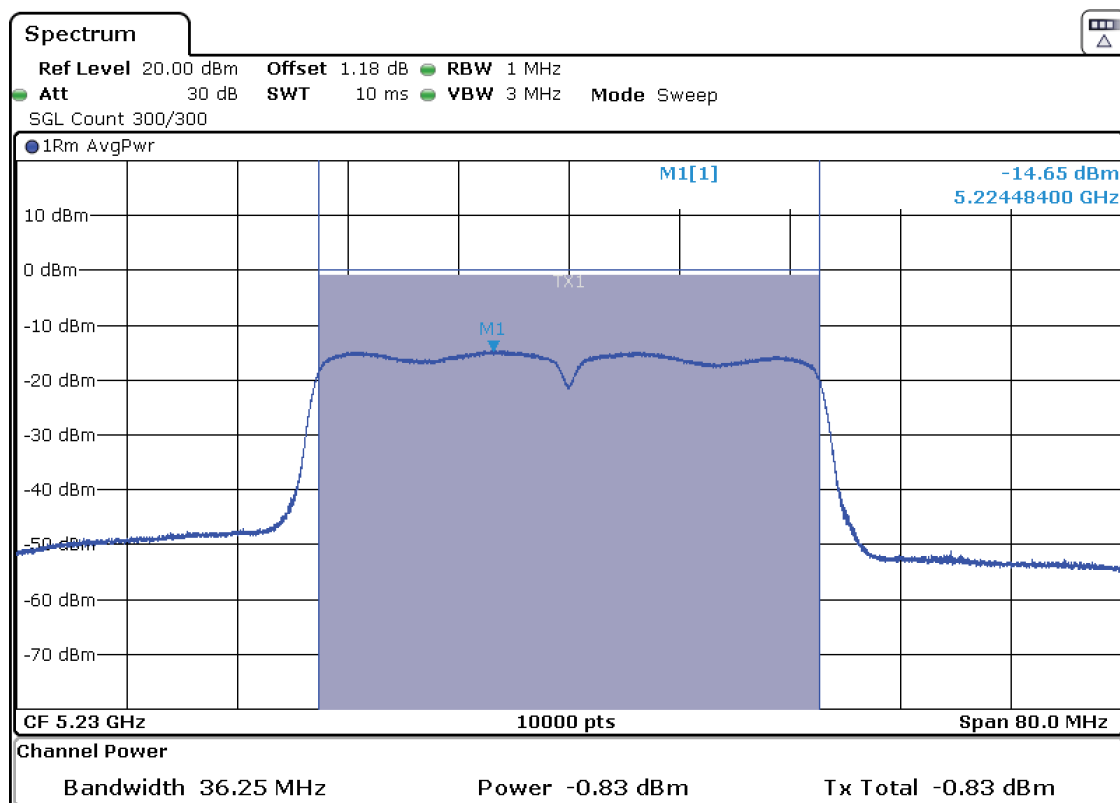


Mode 802.11 n40 (HT40):

- Low Channel:

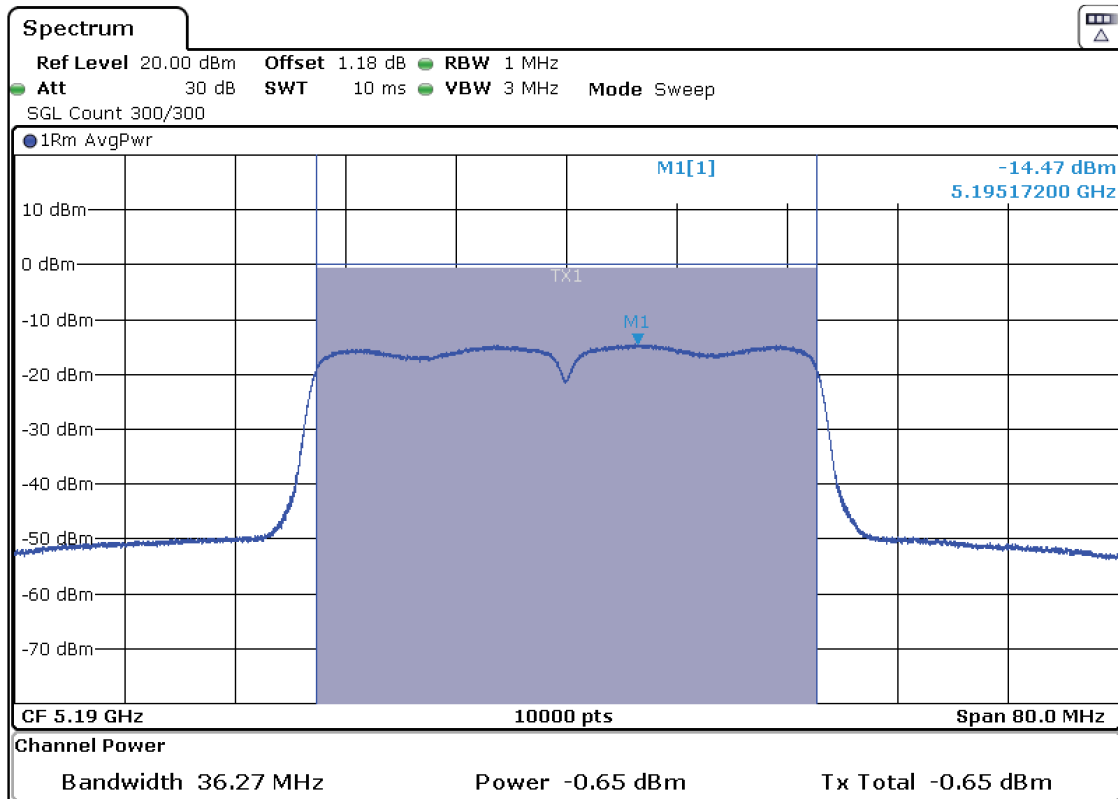


- High Channel:

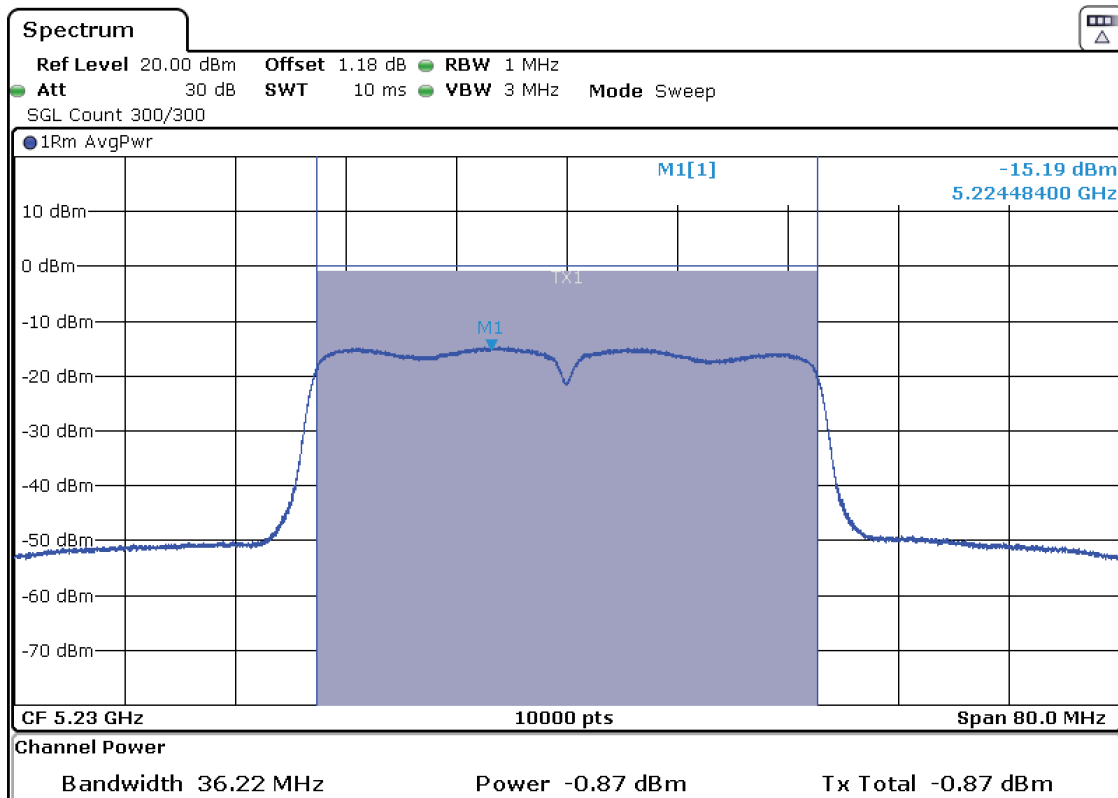


Mode 802.11 ac40 (VHT40):

- Low Channel:

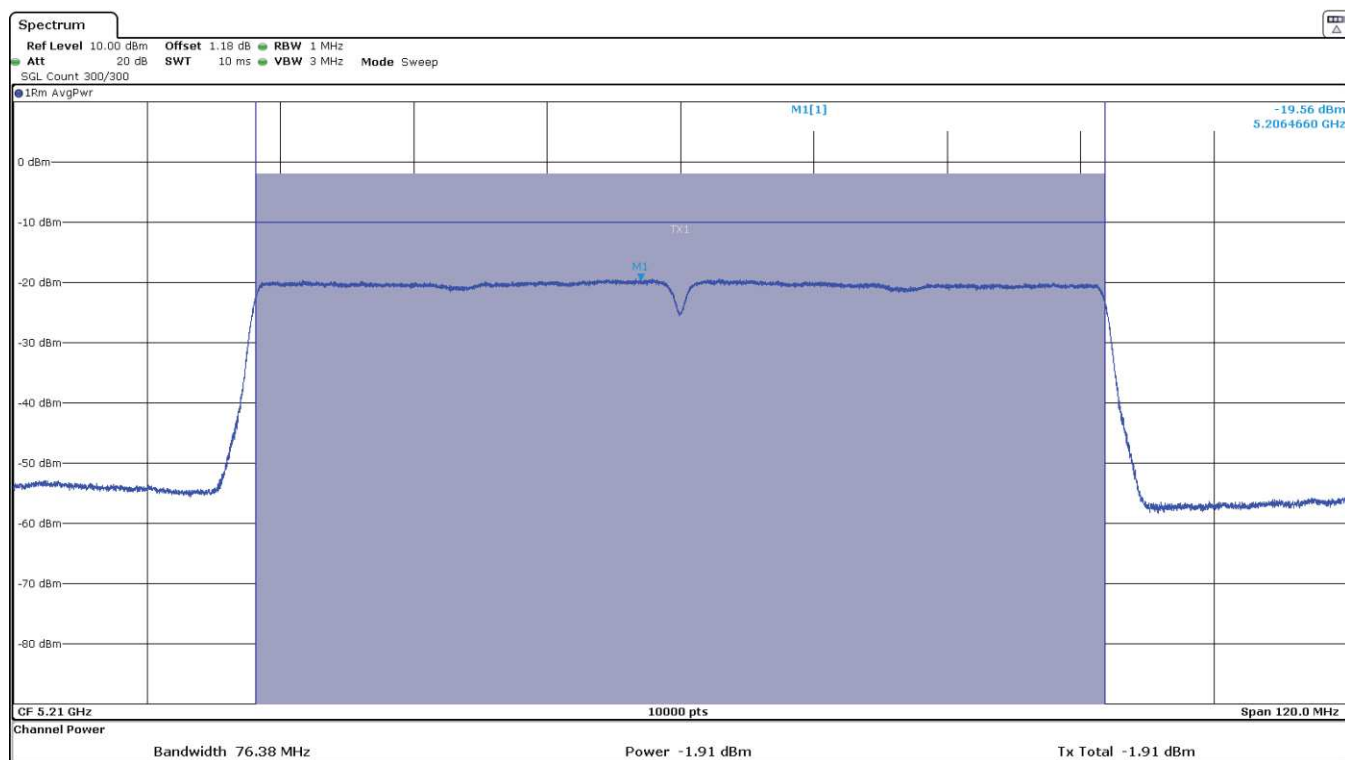


- High Channel:



Mode 802.11 ac80 (VHT80):

- Single Channel:



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

6.2.1.1. Transmitter EIRP Spectral Density

SPECIFICATION:

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

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

RESULTS:

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

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

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

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

Maximum Declared Antenna Gain: +3 dBi

Mode 802.11 a20:

	Low Channel	Middle Channel	High Channel
Maximum Average PSD (dBm/MHz)	-11.45	-11.04	-11.74
Maximum EIRP PSD (dBm/MHz)	-8.45	-8.04	-8.74
Measurement uncertainty (dB)	<±2.00		

Mode 802.11 n20 (HT20):

	Low Channel	Middle Channel	High Channel
Maximum Average PSD (dBm/MHz)	-12.01	-11.50	-12.35
Maximum EIRP PSD (dBm/MHz)	-9.01	-8.50	-9.35
Measurement uncertainty (dB)	<±2.00		

Mode 802.11 ac20 (VHT20):

	Low Channel	Middle Channel	High Channel
Maximum Average PSD (dBm/MHz)	-11.98	-11.52	-12.35
Maximum EIRP PSD (dBm/MHz)	-8.98	-8.52	-9.35
Measurement uncertainty (dB)	<±2.00		

Mode 802.11 n40 (HT40):

	Low Channel	High Channel
Maximum Average PSD (dBm/MHz)	-14.45	-14.65
Duty Cycle Correction Factor (dB)	0.142	
Maximum Average PSD Corrected (dBm/MHz)	-14.308	-14.508
Maximum EIRP PSD Corrected (dBm/MHz)	-11.308	-11.508
Measurement uncertainty (dB)	<±2.00	

Mode 802.11 ac40 (VHT40):

	Low Channel	High Channel
Maximum Average PSD (dBm/MHz)	-14.47	-15.19
Duty Cycle Correction Factor (dB)	0.140	
Maximum Average PSD Corrected (dBm/MHz)	-14.330	-15.050
Maximum EIRP PSD Corrected (dBm/MHz)	-11.330	-12.050
Measurement uncertainty (dB)	<±2.00	

Mode 802.11 ac80 (VHT80):

	Low Channel
Maximum Average PSD (dBm/MHz)	-19.56
Duty Cycle Correction Factor (dB)	0.282
Maximum Average PSD Corrected (dBm/MHz)	-19.278
Maximum EIRP PSD Corrected (dBm/MHz)	-16.278
Measurement uncertainty (dB)	<±2.00

Verdict: PASS