

FCC & ISCED CERTIFICATION TEST REPORT

Project Number : EA2002C-029
Test Report Number : TR-W2006-011
Type of Equipment : WiFi/BT Combo Module
Model Name : SBW-M3
Equipment Class : NII - Unlicensed National Information Instructure TX
FCC ID : WF5SBWM3
ISED Canada ID : 9080A-SBWM3
Multiple Model Name : N/A
Applicant : Aroot Co., Ltd.
Address : 28-6, Gajangsaneopdong-ro, Osan-si, Gyeonggi-do, Republic of Korea
Manufacturer : Aroot Co., Ltd.
Address : 28-6, Gajangsaneopdong-ro, Osan-si, Gyeonggi-do, Republic of Korea
Regulation : FCC Part 15 Subpart E Section 15.407, ISCED RSS-247 Issue2
Total page of Report : 139 Pages
Date of Receipt : 2020-02-10
Date of Issue : 2020-06-09
Test Result : PASS

This test report only contains the result of a single test of the sample supplied for the examination.
 It is not a generally valid assessment of the features of the respective products of the mass-production.

Prepared by	Song, In-young / Senior Engineer		2020-06-09
		Signature	Date
Reviewed by	Choi, Yeong-min / Technical Manager		2020-06-09
		Signature	Date

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Release Control Record

Issue Report No.	Issued Date	Details/Revisions
TR-W2006-011	2020-06-09	Initial Release
-	-	-

1. TEST SUMMARY

1.1 Regulations and results

The sample submitted for evaluation (Hereafter referred to as the EUT) has been tested in accordance with the following regulations or standards.

FCC Reference Section	ISED Reference Section	Description	Result			
			P	F	N.T.	Note
15.203	RSS-247 6.2	Antenna Requirement	P			
15.205, 15.209,15.407(b)	RSS-GEN 8.9	Radiated Unwanted Emissions	P			
15.407 (a)	RSS-247 6.2	26 dB Bandwidth	P			
15.407 (a)	RSS-247 6.2	Maximum Conducted Output Power	P			Note 1
15.407 (a)	RSS-247 6.2	Power Spectral Density	P			
15.407 (b)	RSS-247 6.2	Undesirable Emissions	P			
15.407 (C)	RSS-247 6.4(a)-	Automatically Discontinue Transmission				
15.407 (e)	RSS-247 6.2.4.1	6 dB Occupied Bandwidth	P			
15.407(g)	-	Frequency Stability	P			
15.207, 15.407(b)	RSS GEN 8.8	AC-Line Conducted Emission	P			

Remark:

P means Passed

F means Failed

N.T. means Not Tested

Note 1: e.i.r.p. of the EUT is less than 500 mW, so the TPC mechanism is not required.

1.2 Test Methodology

The tests mentioned in clause 1.1 in this test report were performed according to FCC CFR 47 Part 2, CFR 47 Part 15, ANSI C63.10-2013, RSS-247 and RSS-Gen Issue 4.

KDB 789033 D02 General U-NII Test Procedures New Rules v02r01

1.3 Additions, deviations, exclusions from standards

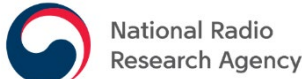
No additions, deviations or exclusions have been made from standard.

1.4 Purpose of the test

The test was performed to determine whether the equipment under test fulfills the requirements of the regulation stated in FCC Part 15 Subpart E Section 15.407, RSS-Gen and RSS-247.

1.5 Test Facility

The measurement facilities are located at 135-60 Gyeongchung-daero, Gonjam-eup, Gwangju-si, Gyeonggi-do 12813, Korea. Our test facilities are accredited as a Conformity Assessment Body (CAB) by the FCC and ISED Canada, designated by the RRA (National Radio Research Agency), and accredited by KOLAS (Korea Laboratory Accreditation Scheme) in Korea and approved by TUV Rheinland, TUV SÜD and Korean Register of Shipping according to the requirement of ISO/IEC 17025.

Laboratory Qualification	Registration No.	Mark
FCC	KR0160	
ISED Canada	12721A	
RRA	KR0160	
TUV Rheinland	UA 50314109-0002	
TUV SÜD	CARAT 094465 0004 Rev.00	
Korean Agency for Technology and Standards	KT733	
KOREAN REGISTER OF SHIPPING	PCT40841-TL001	

Remark. This report is not related to KOLAS accreditation and relevant regulation.

2. EUT (Equipment Under Test) INFORMATION

2.1 General Description

The Aroot Co., Ltd., Model SBW-M3 (referred to as the EUT in this report) is a WiFi/BT Combo Module. which has 3 Equipment Class, DSS, DTS, and NII. This test report covers NII portion only and other functions are covered by other test report. The product specification described herein was obtained from product data sheet or user's manual.

Equipment Class		NII – Unlicensed National Information Instructure TX
Operating Frequency	Bluetooth LE	2 402 MHz – 2 480 MHz
	Bluetooth	2 402 MHz – 2 480 MHz
	WLAN 2.4 GHz	2 412 MHz – 2 462 MHz (802.11b/g/n HT20)
		2 422 MHz – 2 452 MHz (802.11n HT40)
	UNII 1 band 5 150 MHz – 5 250 MHz	5 180 MHz – 5 240 MHz (802.11a/n HT20/ac VHT20)
		5 190 MHz – 5 230 MHz (802.11n HT40/ac VHT40)
		5 210 MHz (802.11ac VHT80)
	UNII 2-A band 5 250 MHz – 5 350 MHz	5 260 MHz – 5 320 MHz (802.11a/n HT20/ac VHT20)
		5 270 MHz – 5 310 MHz (802.11n HT40/ac VHT40)
		5 290 MHz (802.11ac VHT80)
	UNII 2-C band 5 470 MHz – 5 725 MHz	5 500 MHz – 5 700 MHz (802.11a/n HT20/ac VHT20)
		5 510 MHz – 5 670 MHz (802.11n HT40/ac VHT40)
		5 530 MHz – 5 610 MHz (802.11ac VHT80)
	UNII 3 band 5 725 MHz – 5 850 MHz	5 745 MHz – 5 825 MHz (802.11a/n HT20/ac VHT20)
		5 755 MHz – 5 795 MHz (802.11n HT40/ac VHT40)
		5 775 MHz (802.11ac VHT80)
	Straddle channel UNII 2-C to 3 band	5 720 MHz (802.11a/n HT20/ac VHT20)
		5 710 MHz (802.11n HT40/ac VHT40)
		5 690 MHz (802.11ac VHT80)
Modulation Type	Bluetooth LE	GFSK
	Bluetooth	GFSK, $\pi/4$ DQPSK, 8DPSK
	WLAN 2.4 GHz	802.11b: DSSS (DBPSK, DQPSK, CCK)
		802.11g/n HT20/HT40: OFDM (BPSK, QPSK, 16-QAM, 64-QAM)
	WLAN 5 GHz	802.11g/n HT20/HT40: OFDM (BPSK, QPSK, 16-QAM, 64-QAM)
		802.11ac VHT20/VHT40/VHT80: OFDM (BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM)

RF Output Power	Bluetooth LE	1 Mbps	5.06dBm
	Bluetooth	1 Mbps	6.21 dBm
		2 Mbps	5.69 dBm
		3 Mbps	5.86 dBm
	WLAN 2.4 GHz	802.11b	11.92 dBm
		802.11g	10.65 dBm
		802.11n HT20	8.97 dBm
		802.11n HT40	6.94 dBm
	UNII 1 band 5 150 MHz – 5 250 MHz	802.11a	12.53 dBm
		802.11n HT20	12.57 dBm / 12.53 dBm
		802.11n HT40	7.91 dBm / 7.82 dBm
		802.11n VHT80	7.93 dBm
	UNII 2-A band 5 250 MHz – 5 350 MHz	802.11a	12.98 dBm
		802.11n HT20	12.80 dBm / 12.81 dBm
		802.11n HT40	7.95 dBm / 8.04 dBm
		802.11n VHT80	8.72 dBm
	UNII 2-C band 5 470 MHz – 5 725 MHz	802.11a	12.87 dBm
		802.11n HT20	12.90 dBm / 12.91 dBm
		802.11n HT40	9.64 dBm / 9.59 dBm
		802.11n VHT80	5.91 dBm
	UNII 3 band 5 725 MHz – 5 850 MHz	802.11a	7.47 dBm
		802.11n HT20	7.28 dBm / 7.24 dBm
		802.11n HT40	5.28 dBm / 5.26 dBm
		802.11n VHT80	5.65 dBm
	Straddle channel UNII 2-C to 3 band	802.11a	10.80 dBm
		802.11n HT20	10.60 dBm / 10.58 dBm
		802.11n HT40	8.14 dBm / 8.08 dBm
		802.11n VHT80	5.01 dBm
Number of Channels	Bluetooth LE	40	
	Bluetooth	79	
	WLAN 2.4 GHz	802.11b	11
		802.11g	11
		802.11n HT20	11
		802.11n HT40	7

	UNII 1 band 5 150 MHz – 5 250 MHz	802.11a	4
		802.11n HT20	4
		802.11n HT40	2
		802.11n VHT80	1
	UNII 2-A band 5 250 MHz – 5 350 MHz	802.11a	4
		802.11n HT20	4
		802.11n HT40	2
		802.11n VHT80	1
	UNII 2-C band 5 470 MHz – 5 725 MHz	802.11a	17
		802.11n HT20	17
		802.11n HT40	3
		802.11n VHT80	1
	UNII 3 band 5 725 MHz – 5 850 MHz	802.11a	5
		802.11n HT20	5
		802.11n HT40	2
		802.11n VHT80	1
	Straddle channel UNII 2-C to 3 band	802.11a	1
		802.11n HT20	1
		802.11n HT40	1
		802.11n VHT80	1
Generated or used Freq. in EUT		32.768 kHz, 37.4 MHz	
Type of Antenna		☐ Integrated Type ☒ Dedicated Type	
Antenna Gain		4.61 dBi	
Operating Temperature		- 20 °C ~ + 55 °C	
Normal Test Voltage		DC 3.3 V	
Electrical Rating		DC 3.3 V	
Test SW Version		DBGMon version: unknown	
Software Version		Ver 1.0	
Hardware Version		Ver 1.0	

2.2 Additional Model

None

3. TEST CONDITION

3.1 Equipment Used During Test

The following peripheral devices and/or interface cables were connected during the measurement:

Description	Model No.	Serial No.	Manufacturer.
WiFi/BT Combo Module (EUT)	SBW-M3	N/A	Aroot Co., Ltd.
Notebook PC	15s-du0069TU	CND9503W22	HP
Adapter for Notebook PC	TPN-CA14	N/A	Chicony Power Technology (Chongqing) Co., Ltd.
Wireless Access Point	WA730	4D7689EP000FB (FCC ID: PY315300320) (IC: 4054A-15300320)	NETGEAR

3.2 Mode of operation during the test

Software used to control the EUT for staying in continuous transmitting mode is programmed.

The used modulation type for the testing is OFDM

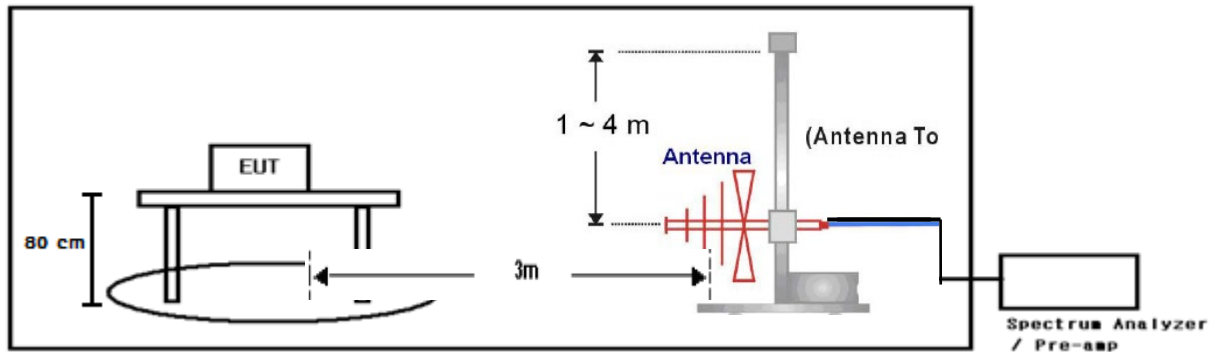
3.3 Preliminary Testing for Worst case configuration

For finding worst case configuration and operating mode, preliminary testing was performed and radiated emission and conducted emission tests were performed with the EUT set to transmit and receive at the channel with the highest output power as worst case scenario. All spurious emission tests were performed in X, Y and Z axis direction. And the worst X-axis (9 kHz ~ 30 MHz), X-axis (30 MHz ~ 1 GHz, Above 1 GHz) test condition was recorded in this test report.

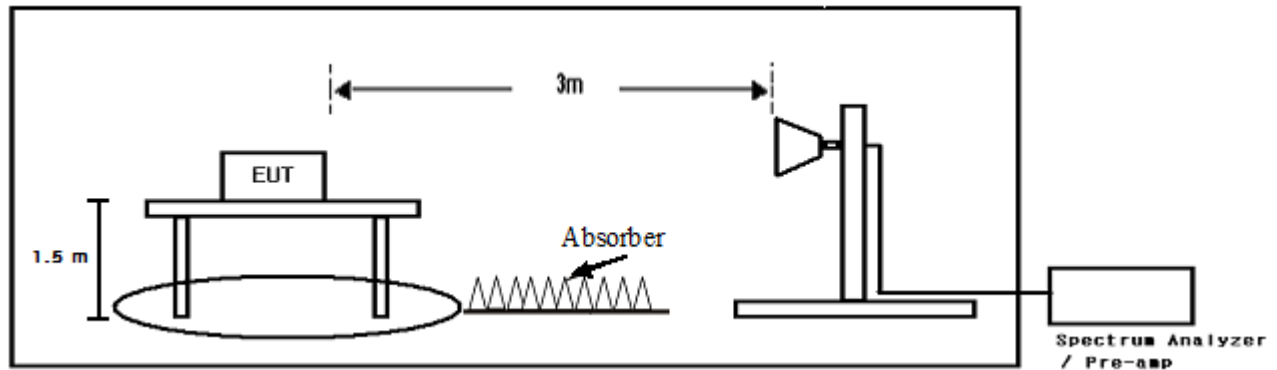
Based on preliminary testing following operating modes were selected for the final test as listed below.

Operating Mode	Channel	Frequency (MHz)	Data rate(Mbps)	Output Power(dBm)
802.11a (U-NII 1 Band)	36	5 180	6	12.38
	44	5 220	6	12.53
	48	5 240	6	12.45
802.11a (U-NII 2-A Band)	52	5 260	6	12.60
	60	5 300	6	12.74
	64	5 320	6	12.98
802.11a (U-NII 2-C Band)	100	5 500	6	12.87
	112	5 560	6	12.60
	140	5 700	6	12.20
802.11a (U-NII 3 Band)	149	5 745	6	7.47
	157	5 785	6	6.71
	161	5 805	6	6.07

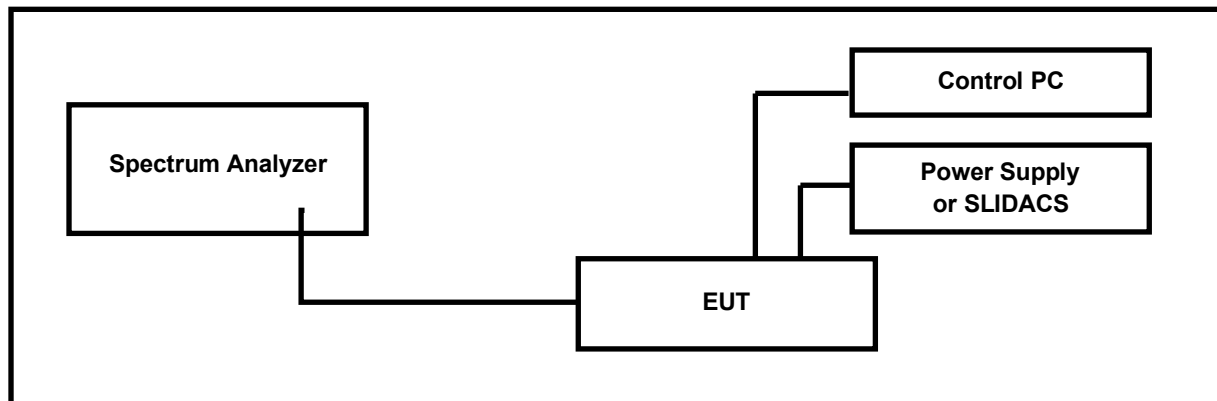
3.4 Test Setup Drawing (Radiated Test below 1 GHz)



(Radiated Test above 1 GHz)



(Conducted Test)



3.5 EUT Modifications

- No EMC Relevant Modifications were performed by this test laboratory.

4. ANTENNA REQUIREMENT

According to FCC CFR 47 Part 15 section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provision of this section.

4.1 Antenna Description

Frequency Band (GHz)	Antenna Type	Max Peak Gain (dBi)	Connector Type
5	PCB Pattern Antenna	4.61	IPEX

4.2 Conclusion

The antenna type of the EUT is PCB Pattern Antenna, so the EUT met the requirement.

5. TEST RESULT

5.1 26 dB Bandwidth

5.1.1 Limit

This clause is for reporting purpose only and there is no restriction limits for 26 dB and 99 % bandwidth

5.1.2 Method of Measurement

Reference to KDB 789033 D02 General UNII Test Procedures New Rules v02r01 Section C.1 EBW

The transmitter output is connected to a spectrum analyzer with the RBW set to approximately 1 % of the EBW, VBW > RBW, peak detector and max hold.

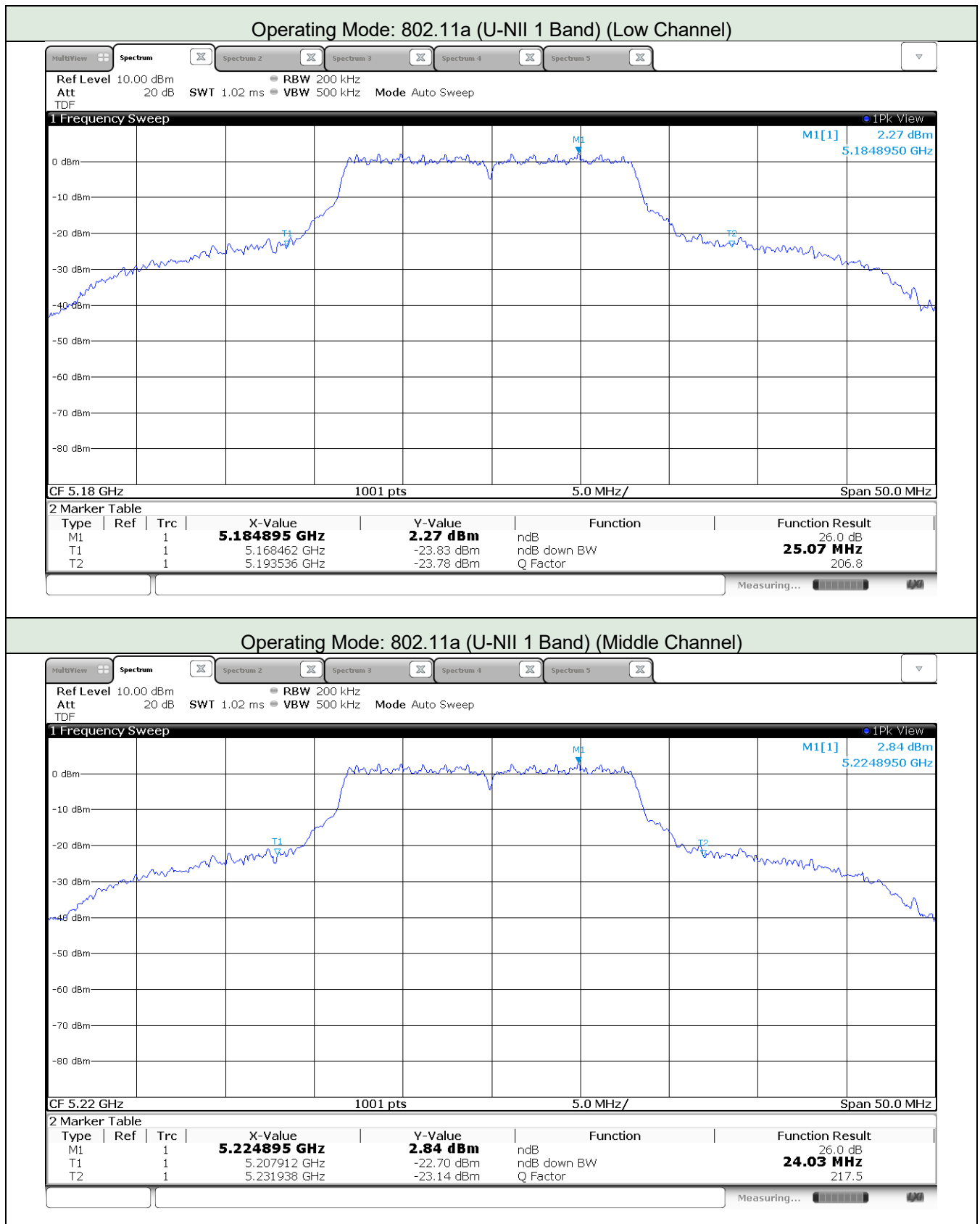
5.1.3 Test Data - Operating Mode: 802.11a

5.1.3.1 Tabulated Test Data

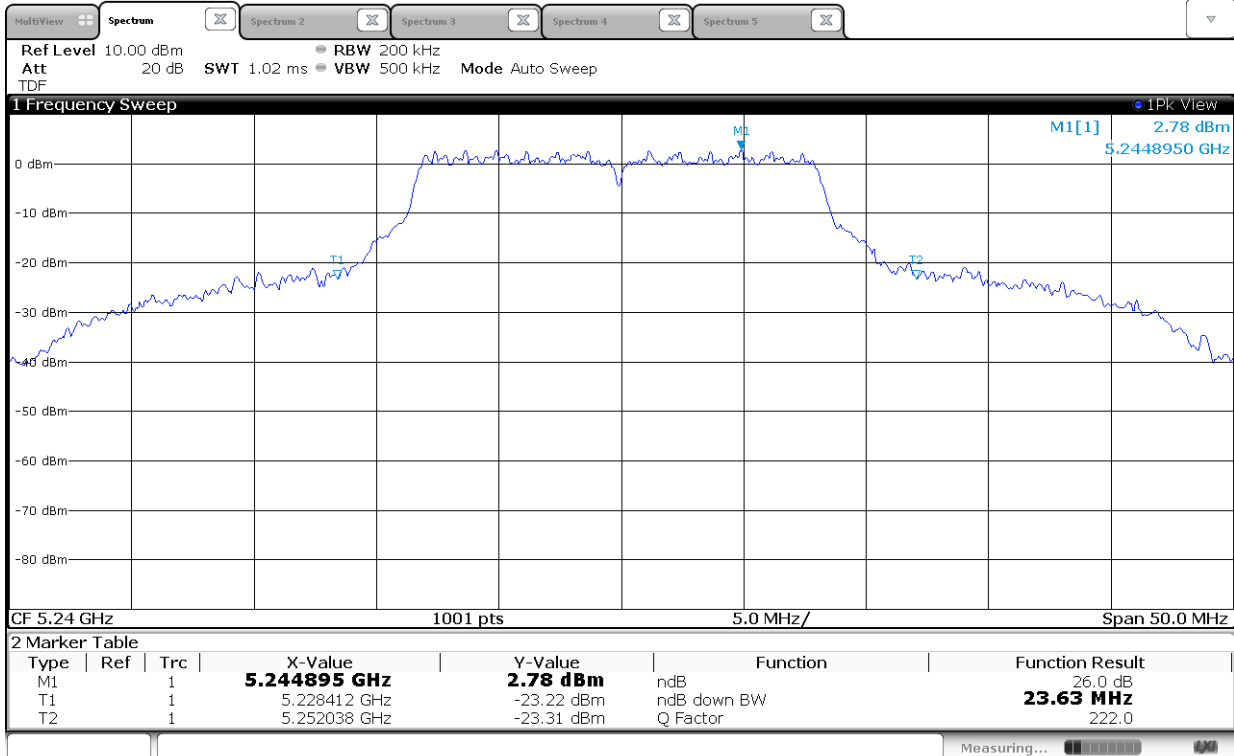
Date of Test		2020-04-09 – 2020.04.10		Temperature	(23.0 ± 1.0) °C
				Relative humidity	(50.0 ± 3.0) % R.H.
Test Result		PASS		Tested by	In-yong Song 
Operating Mode: 802.11a (U-NII Band 1)					
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	-	
Low	5 180	25.07	17.71		
Middle	5 220	24.03	17.62		
High	5 240	23.63	17.62		
Operating Mode: 802.11a (U-NII Band 2-A)					
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	-	
Low	5 260	23.53	17.57		
Middle	5 300	24.57	17.60		
High	5 320	23.48	17.51		
Operating Mode: 802.11a (U-NII Band 2-C)					
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	-	
Low	5 500	23.58	17.55		
Middle	5 560	22.38	17.33		
High	5 700	23.93	17.60		

Operating Mode: 802.11a (U-NII Band 3)				
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result
Low	5 745	22.13	17.10	-
Middle	5 785	22.38	17.24	
High	5 825	22.63	17.32	

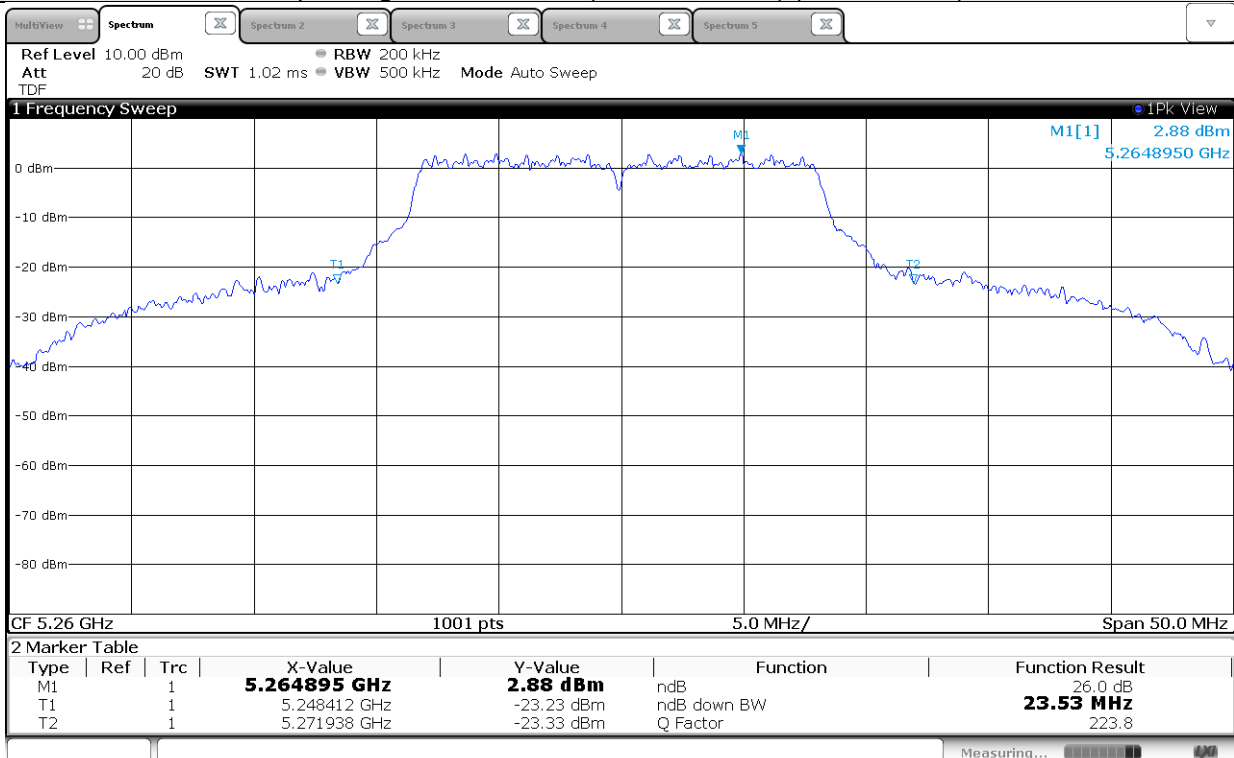
5.1.3.2 Graphic Test Data – 26 dB bandwidth



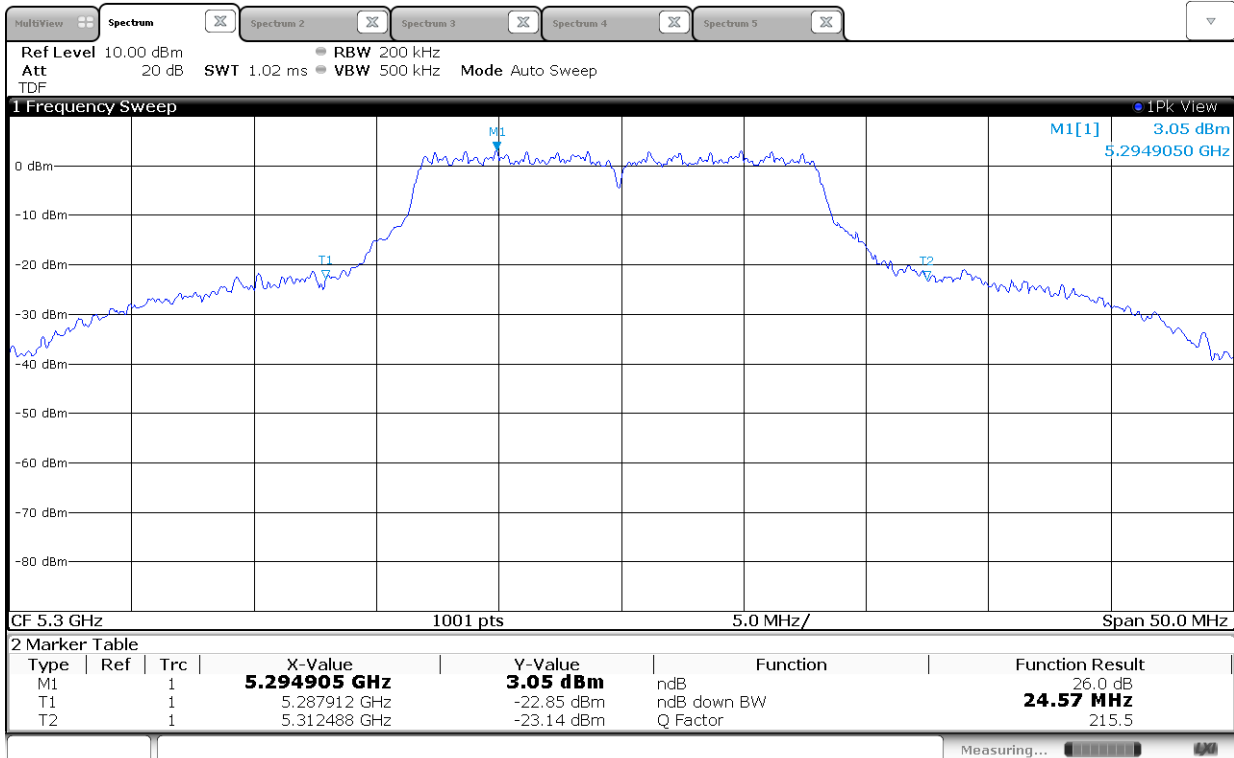
Operating Mode: 802.11a (U-NII 1 Band) (High Channel)



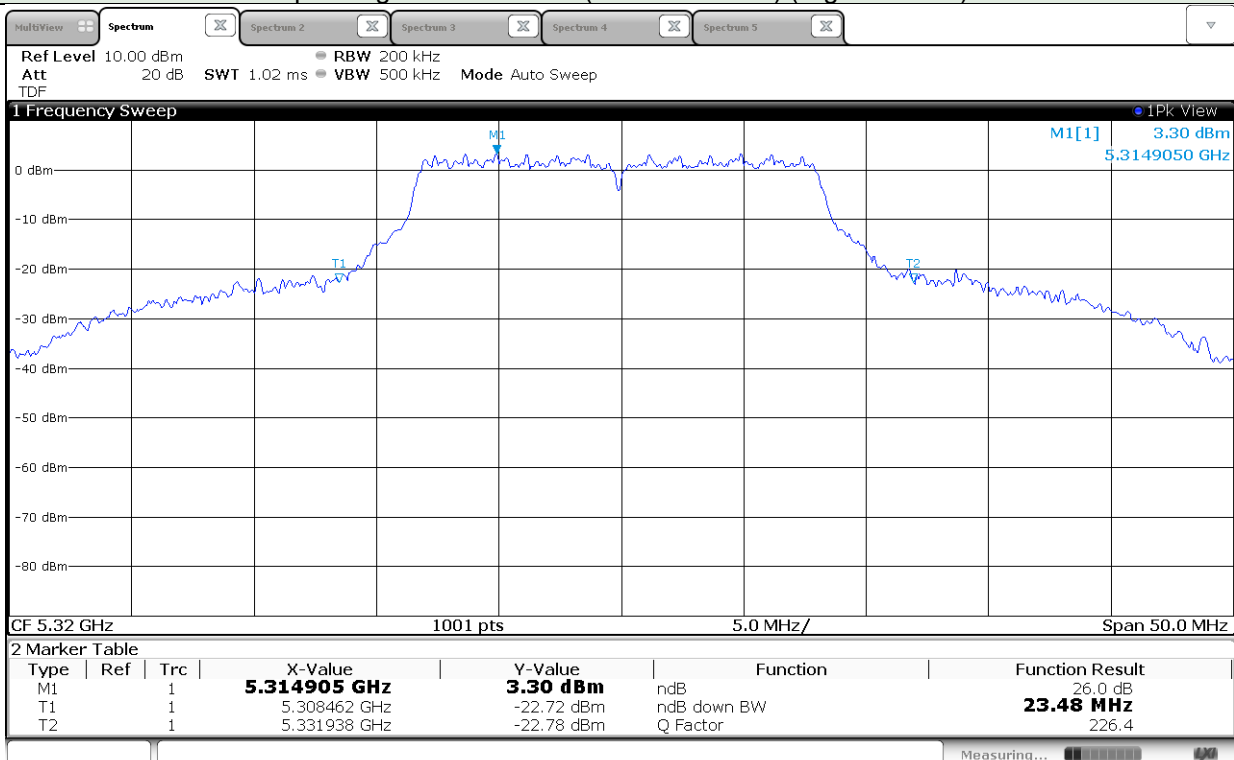
Operating Mode: 802.11a (U-NII 2-A Band) (Low Channel)



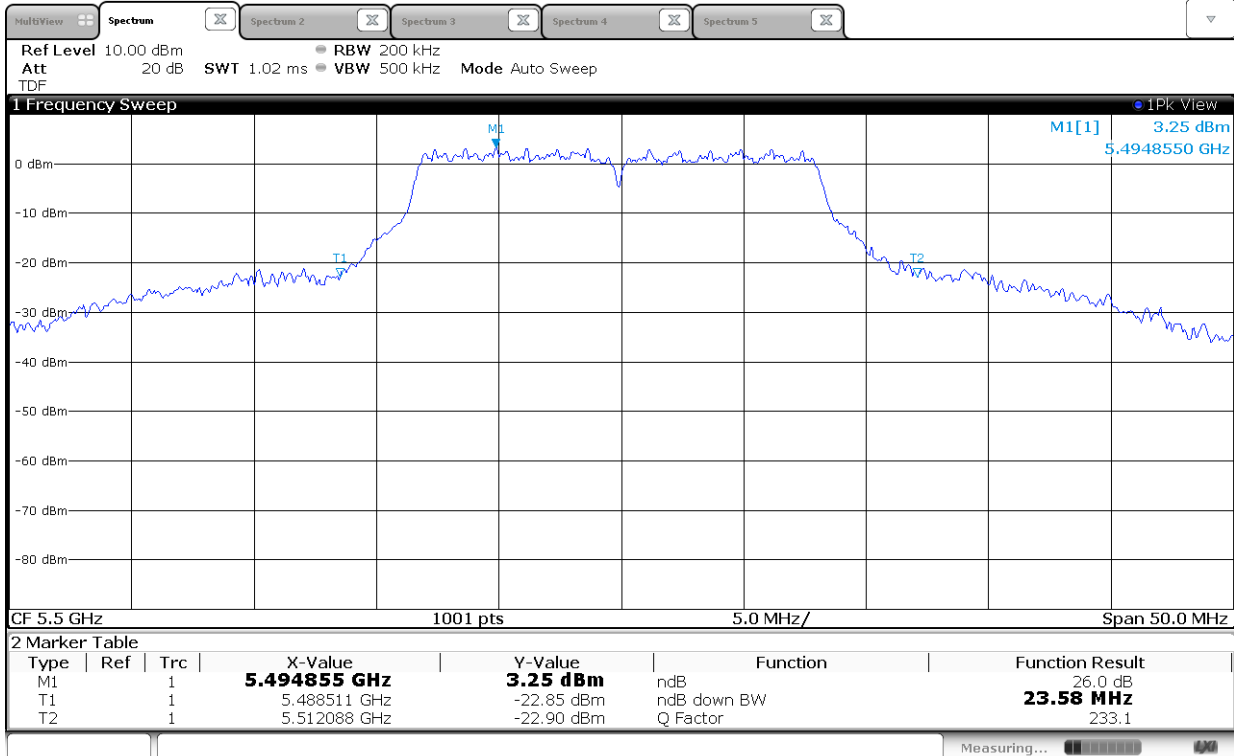
Operating Mode: 802.11a (U-NII 2-A Band) (Middle Channel)



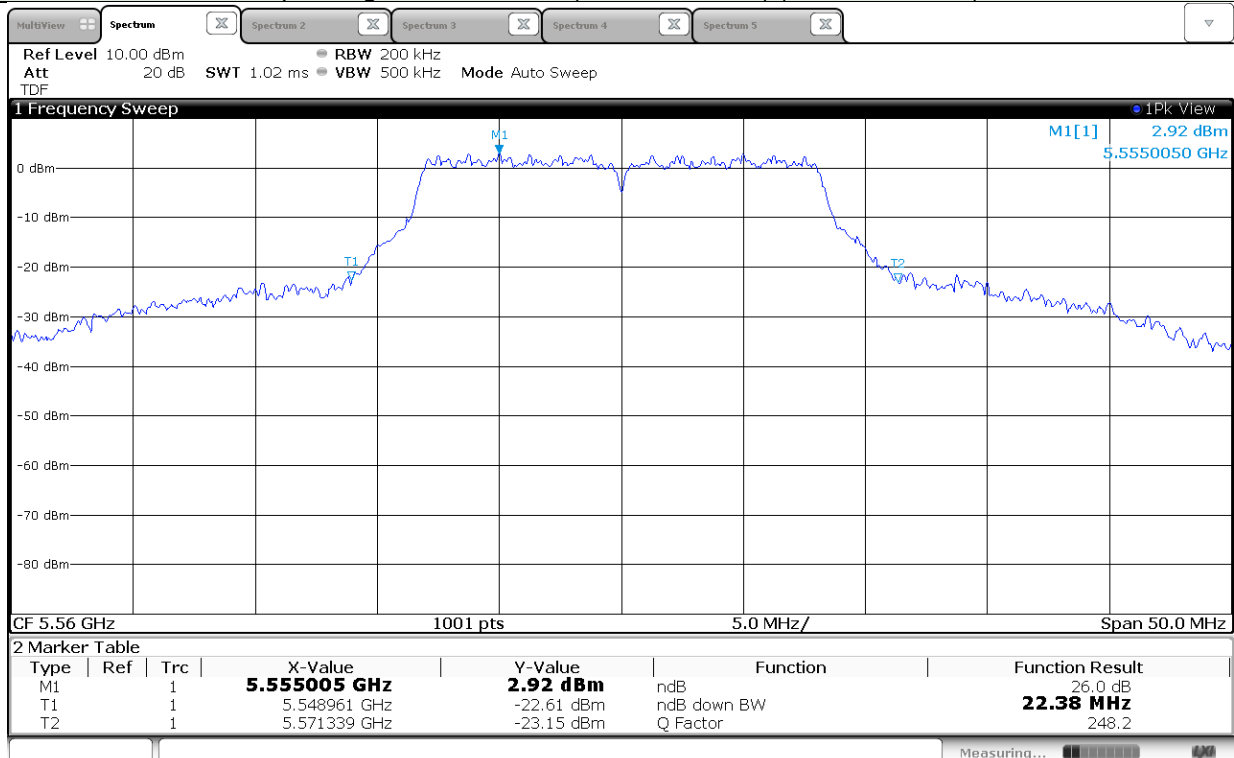
Operating Mode: 802.11a (U-NII 2-A Band) (High Channel)



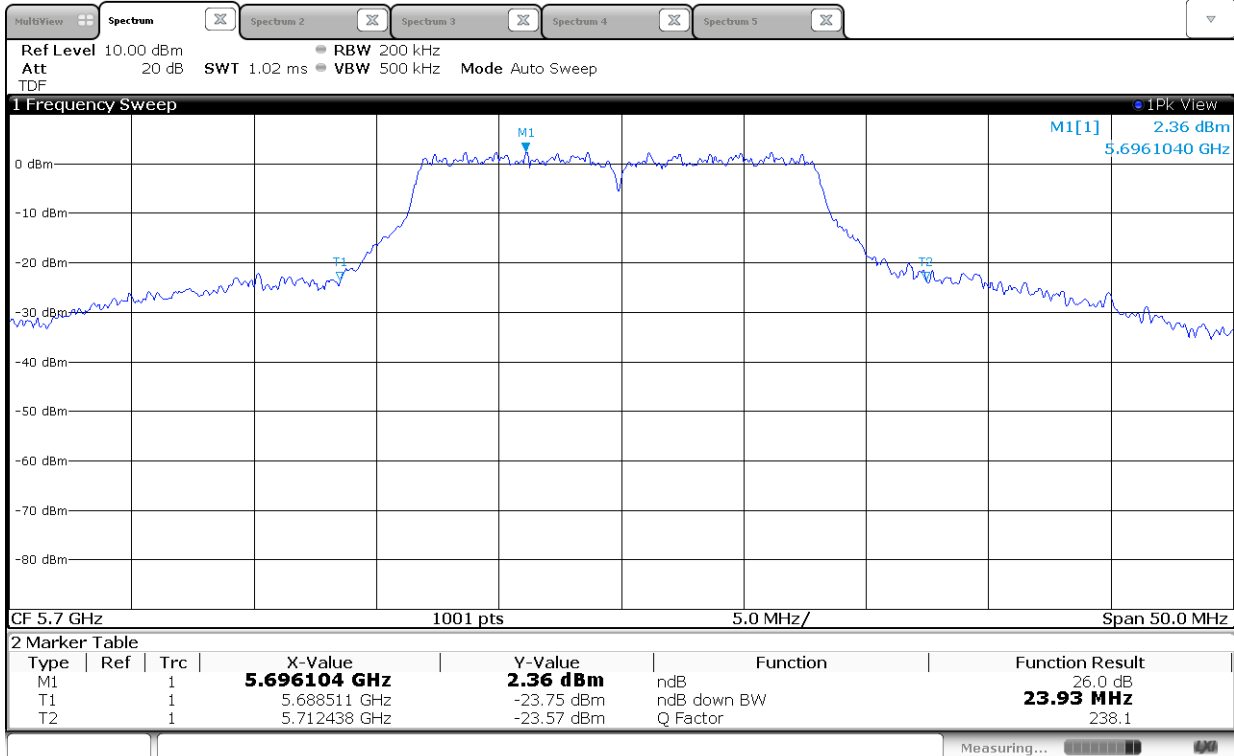
Operating Mode: 802.11a (U-NII 2-C Band) (Low Channel)



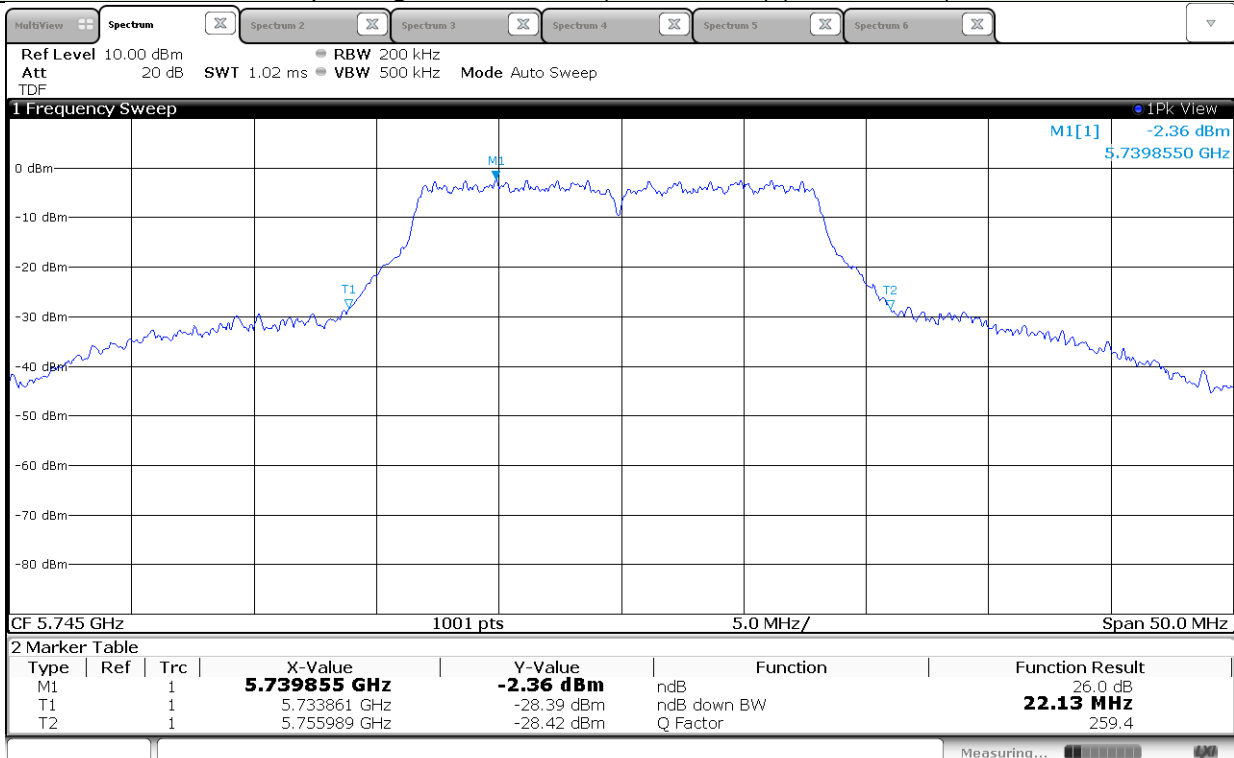
Operating Mode: 802.11a (U-NII 2-C Band) (Middle Channel)



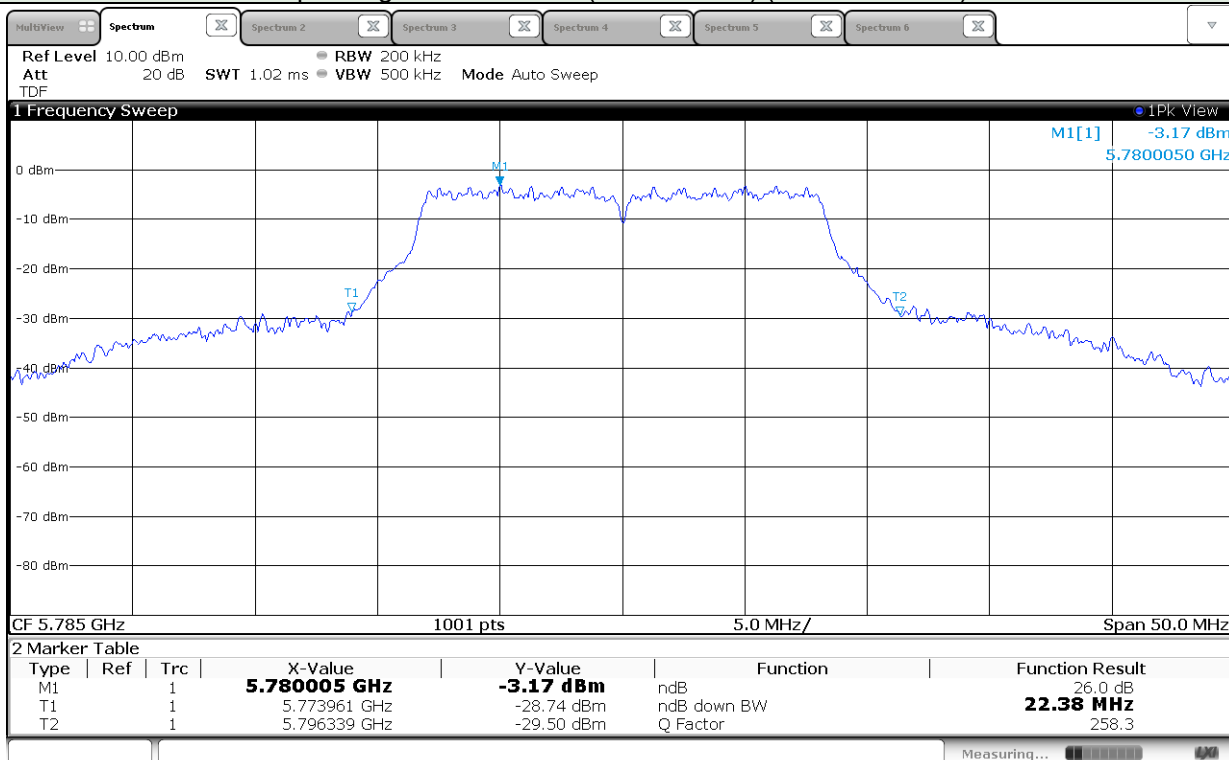
Operating Mode: 802.11a (U-NII 2-C Band) (High Channel)



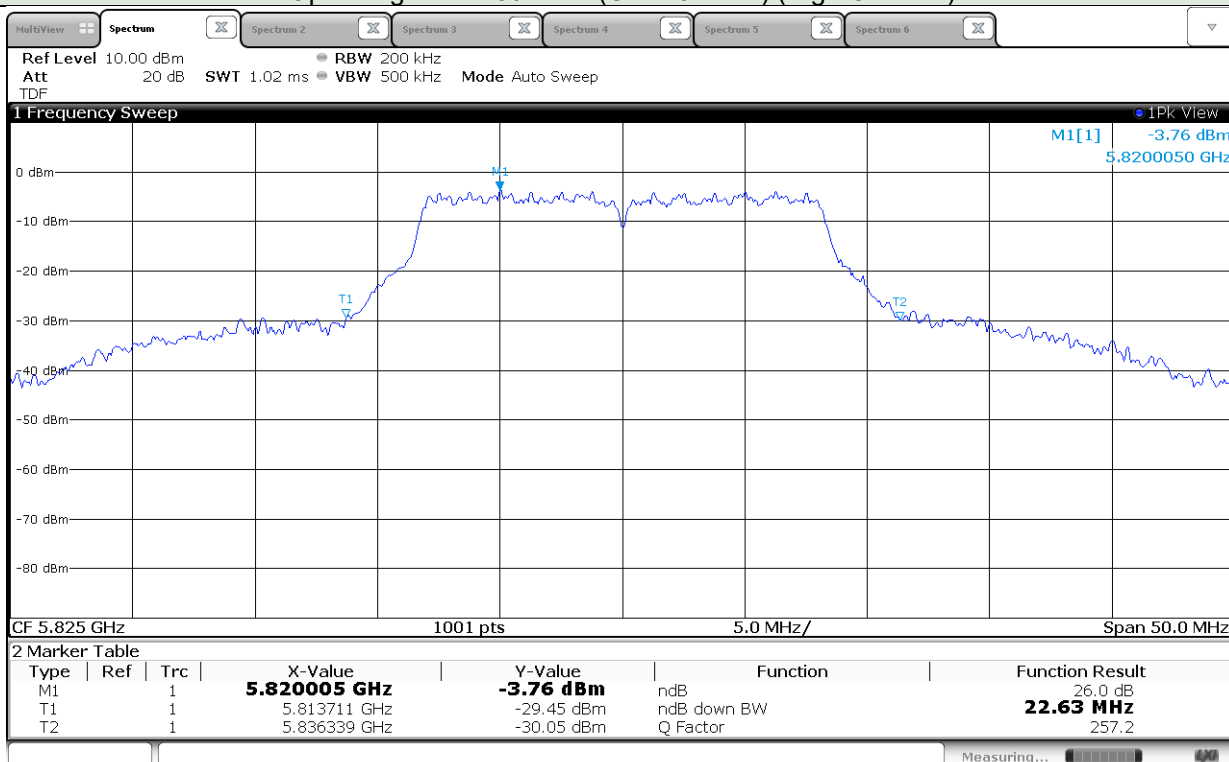
Operating Mode: 802.11a (U-NII 3 Band) (Low Channel)



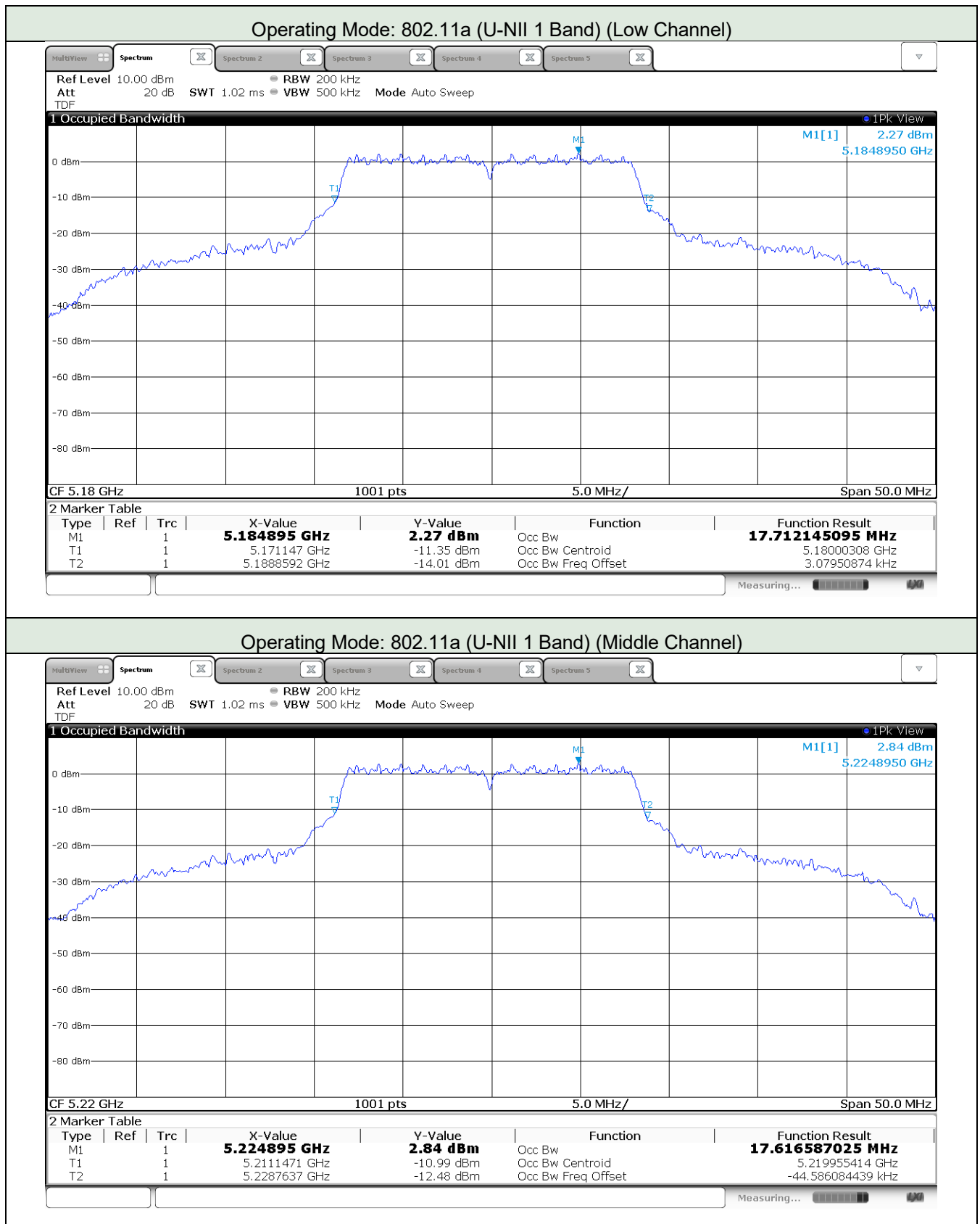
Operating Mode: 802.11a (U-NII 3 Band) (Middle Channel)



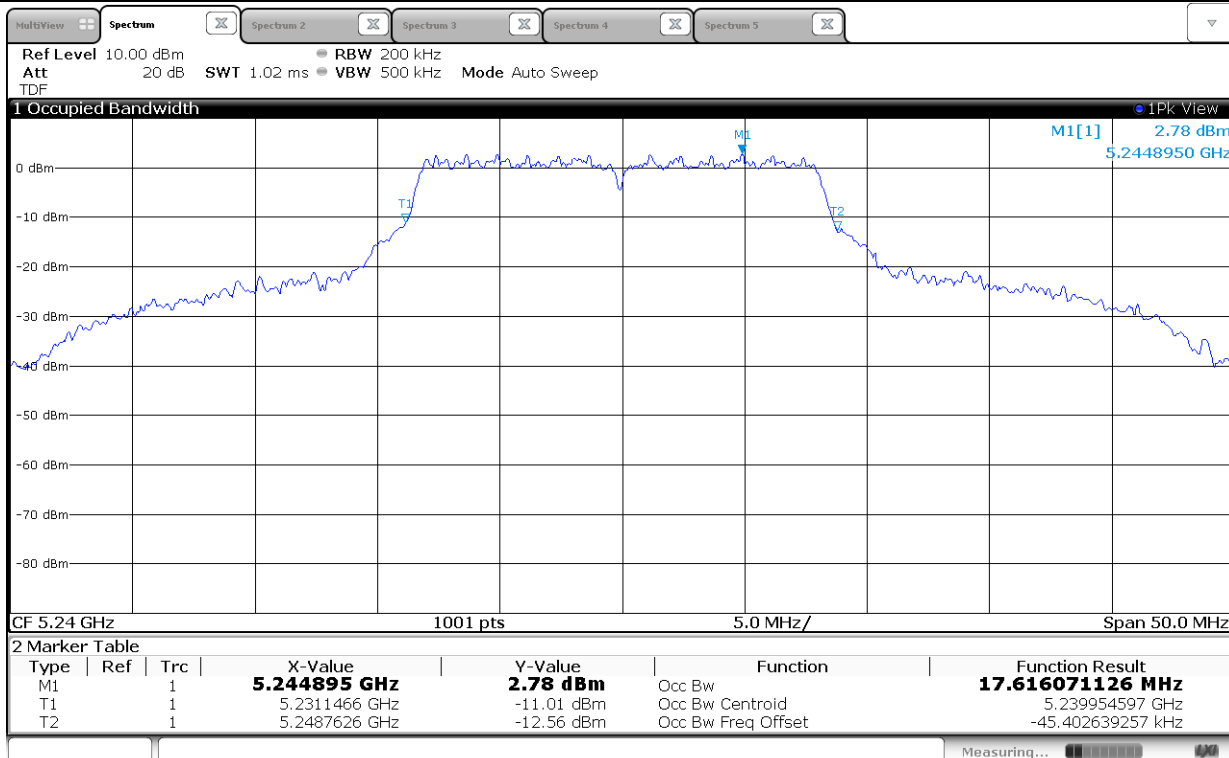
Operating Mode: 802.11a (U-NII 3 Band) (High Channel)



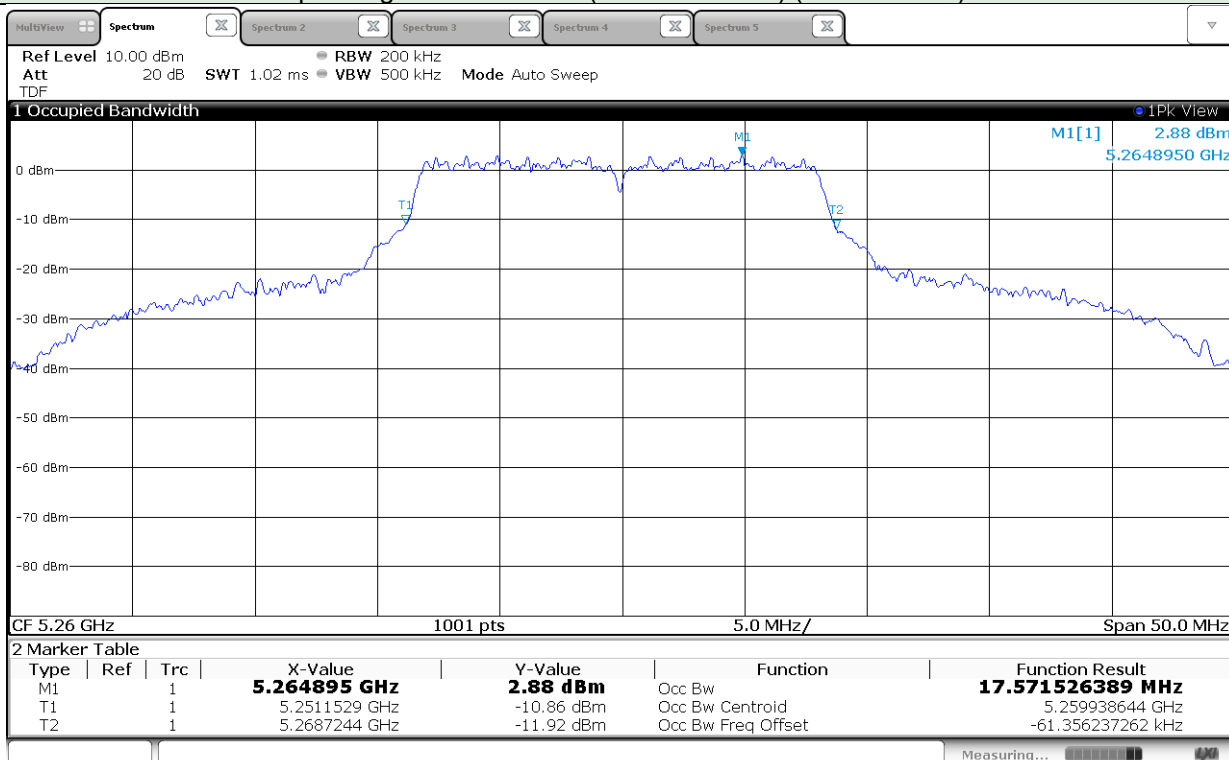
5.1.3.3 Graphic Test Data – 99 % occupied bandwidth



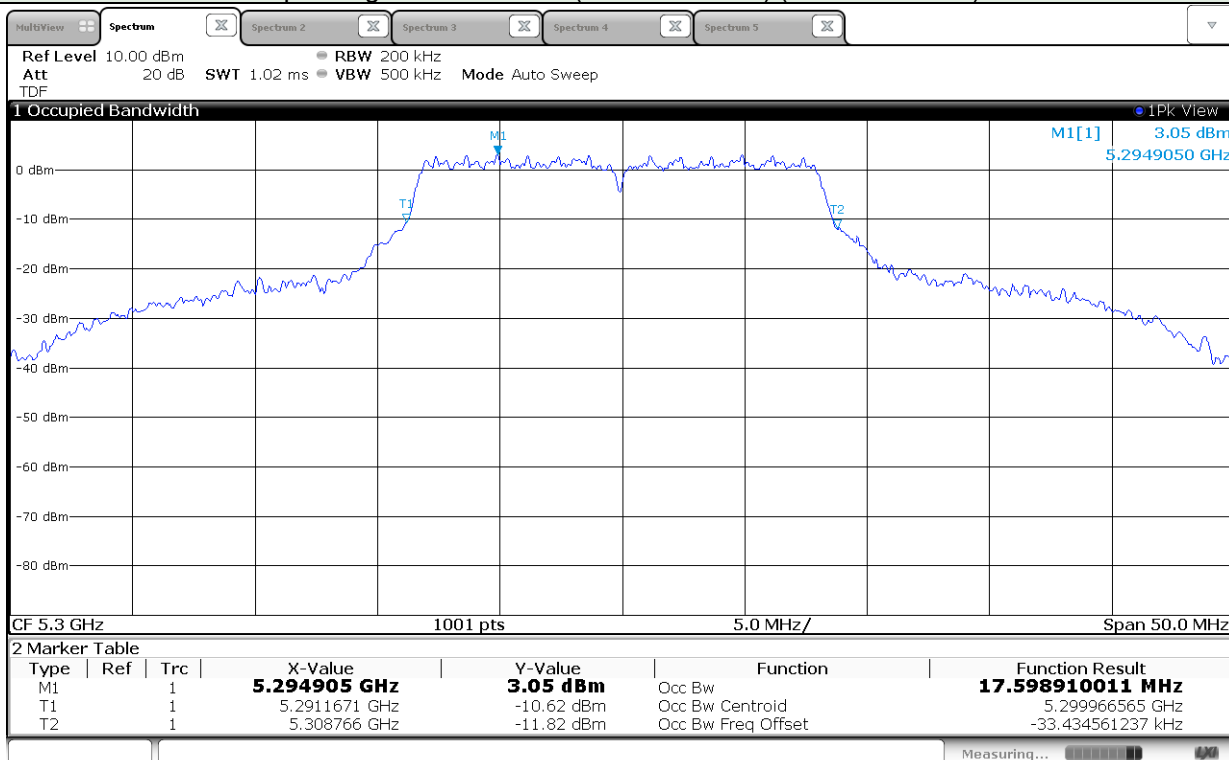
Operating Mode: 802.11a (U-NII 1 Band) (High Channel)



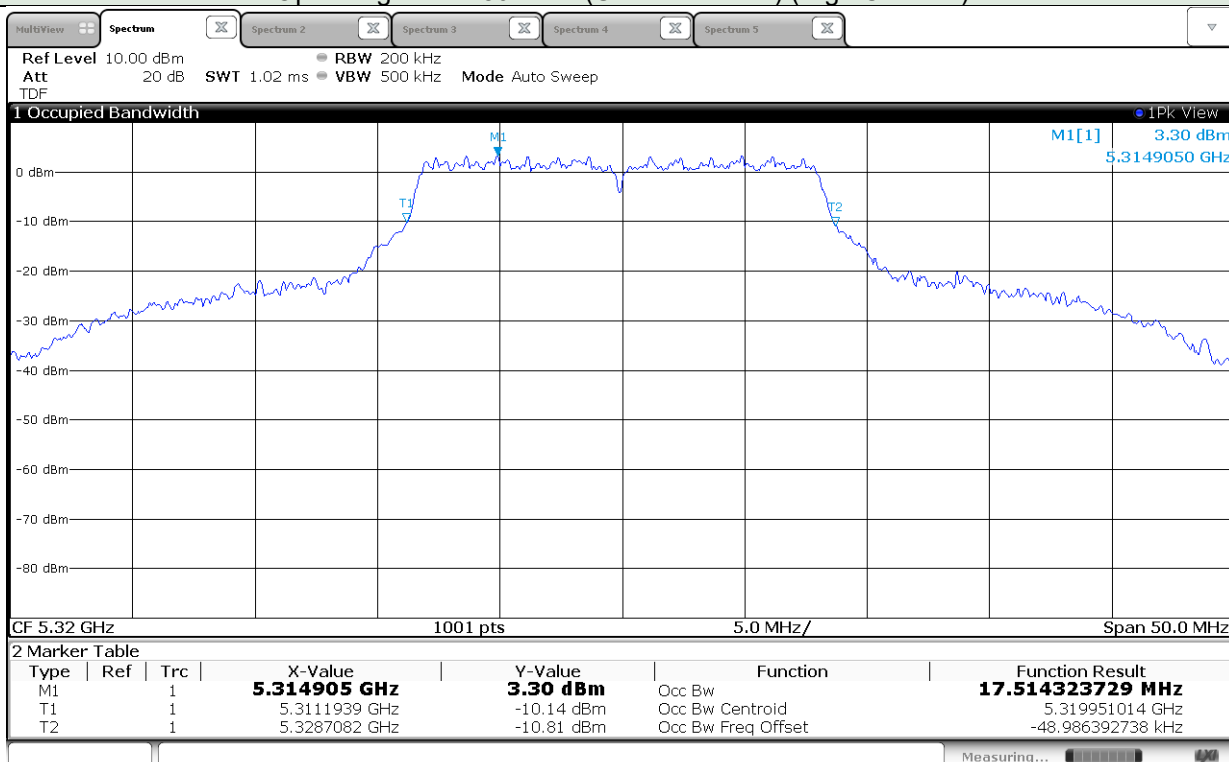
Operating Mode: 802.11a (U-NII 2-A Band) (Low Channel)



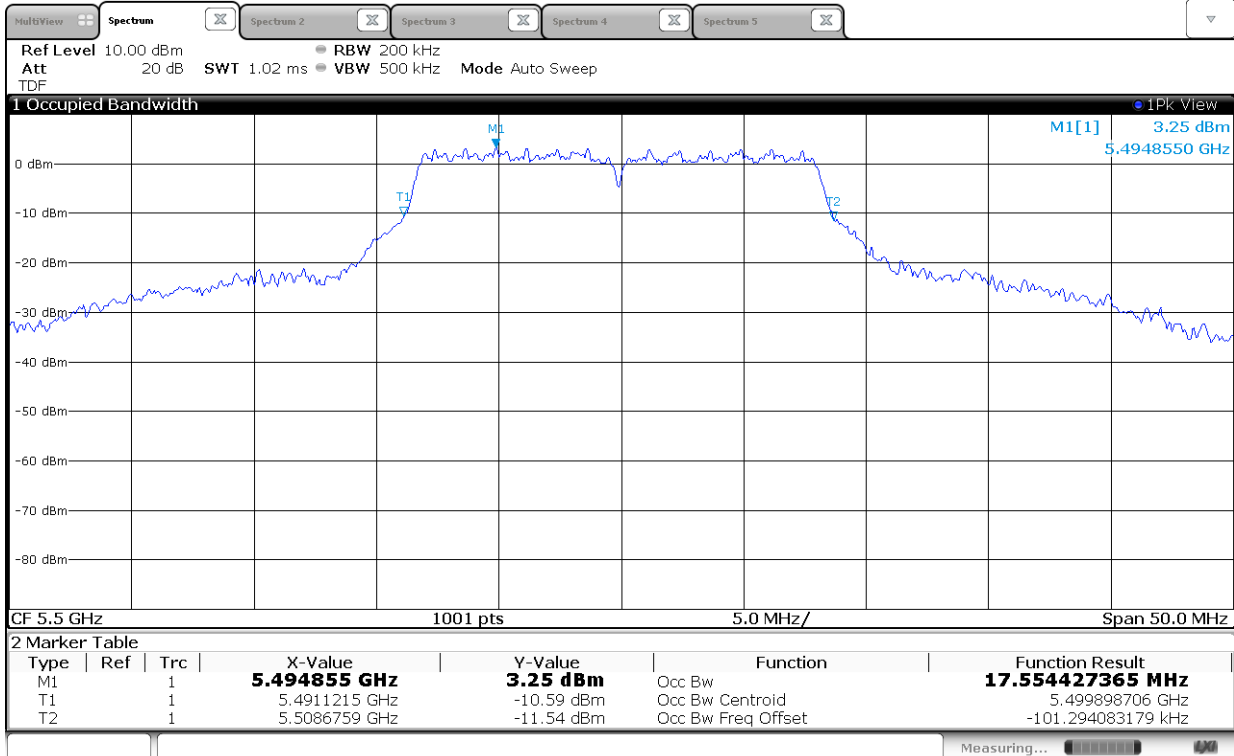
Operating Mode: 802.11a (U-NII 2-A Band) (Middle Channel)



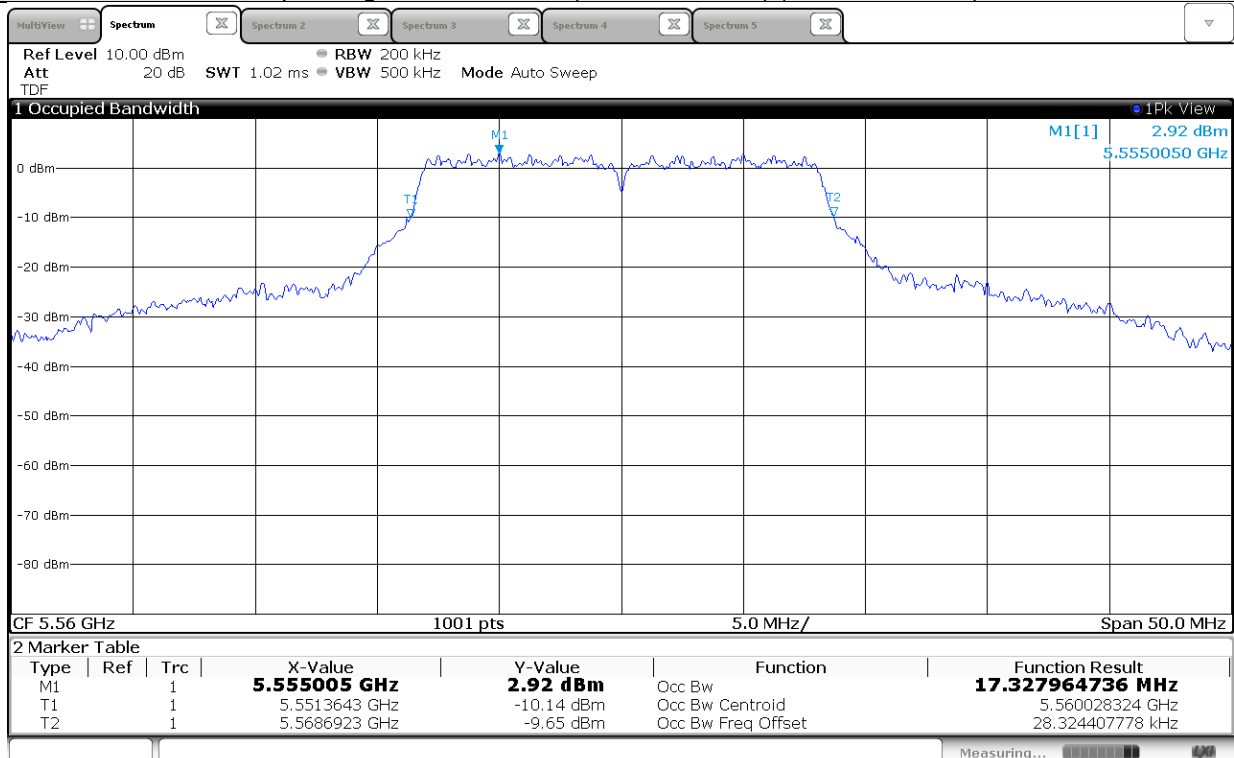
Operating Mode: 802.11a (U-NII 2-A Band) (High Channel)



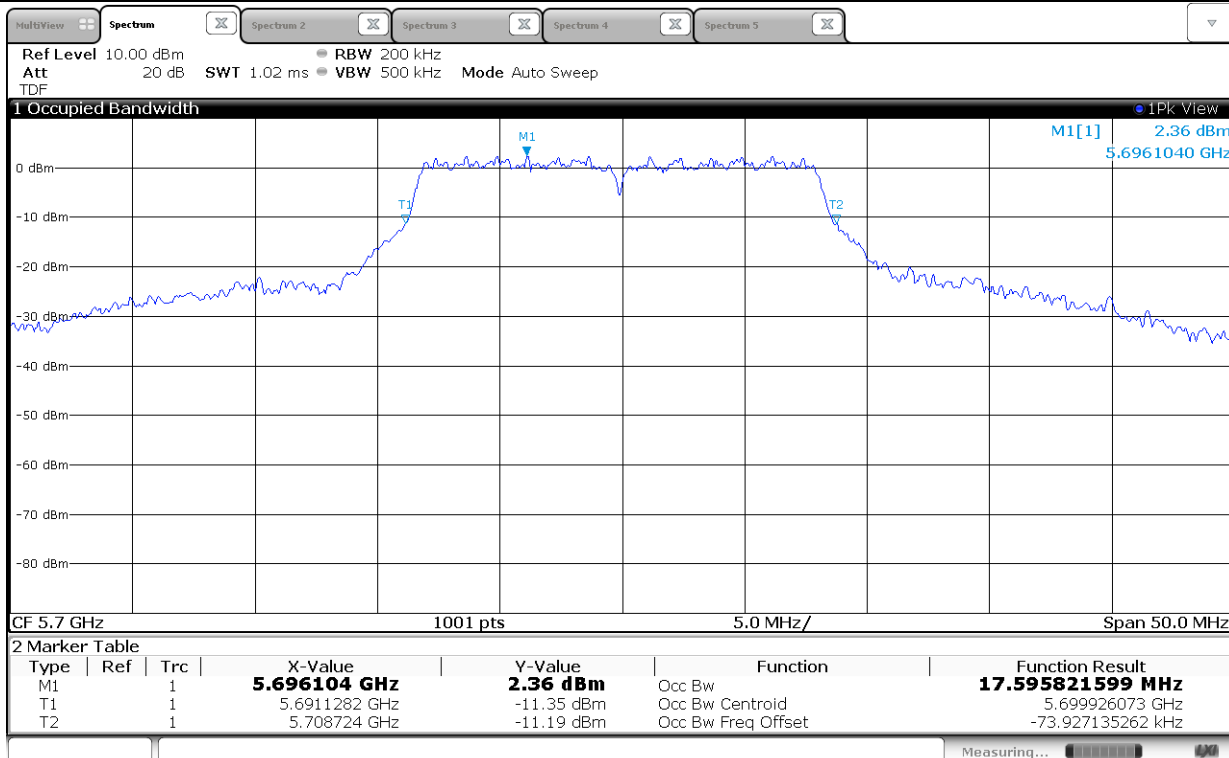
Operating Mode: 802.11a (U-NII 2-C Band) (Low Channel)



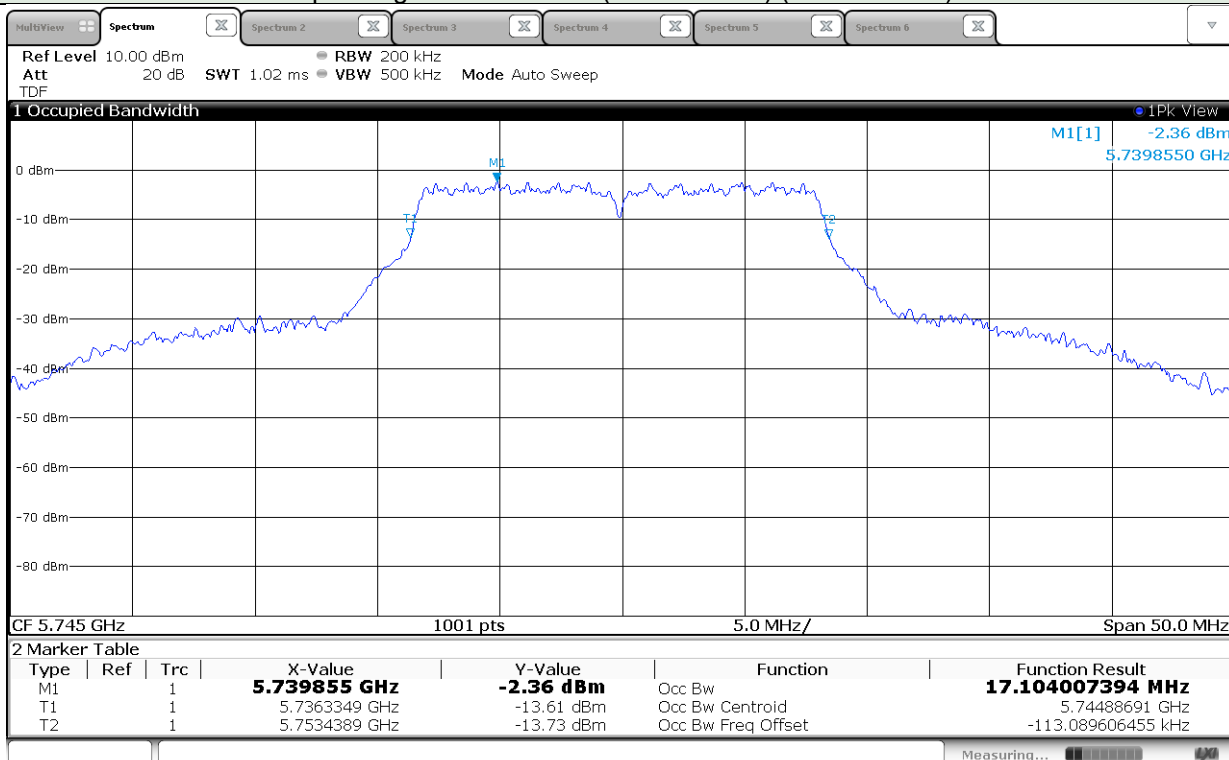
Operating Mode: 802.11a (U-NII 2-C Band) (Middle Channel)



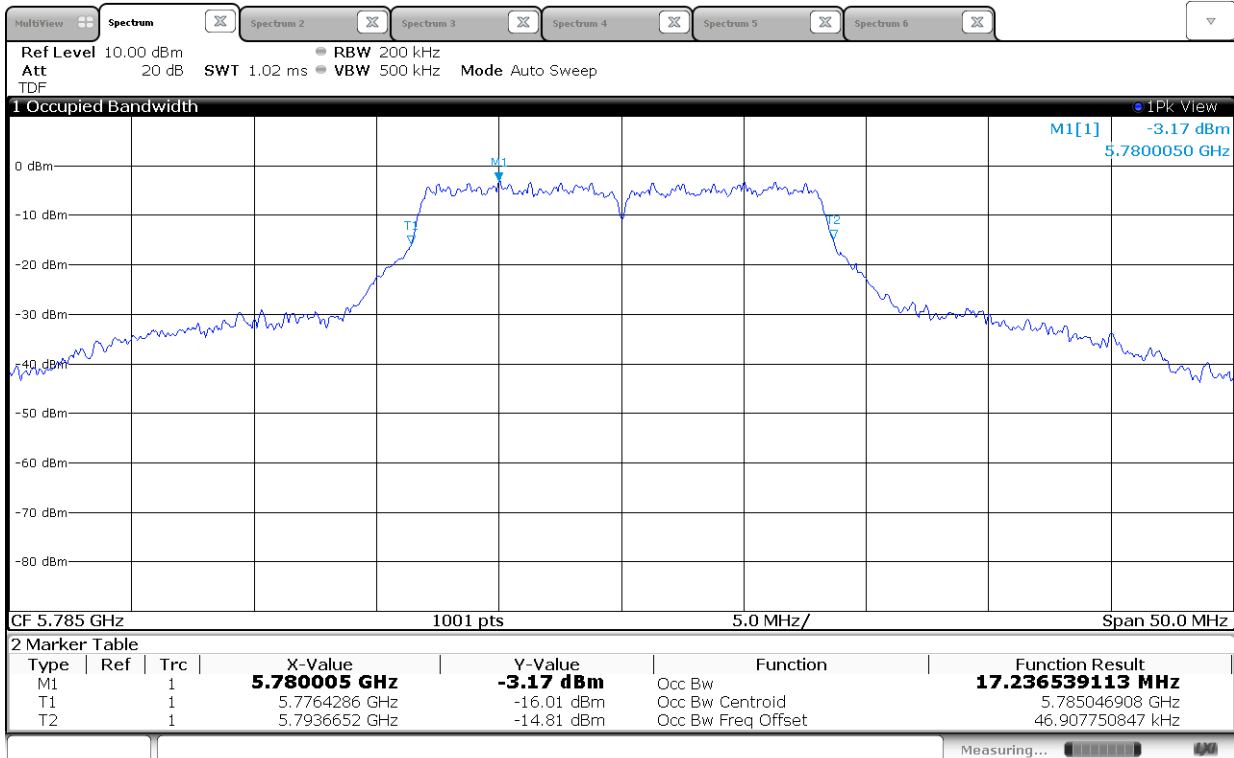
Operating Mode: 802.11a (U-NII 2-C Band) (High Channel)



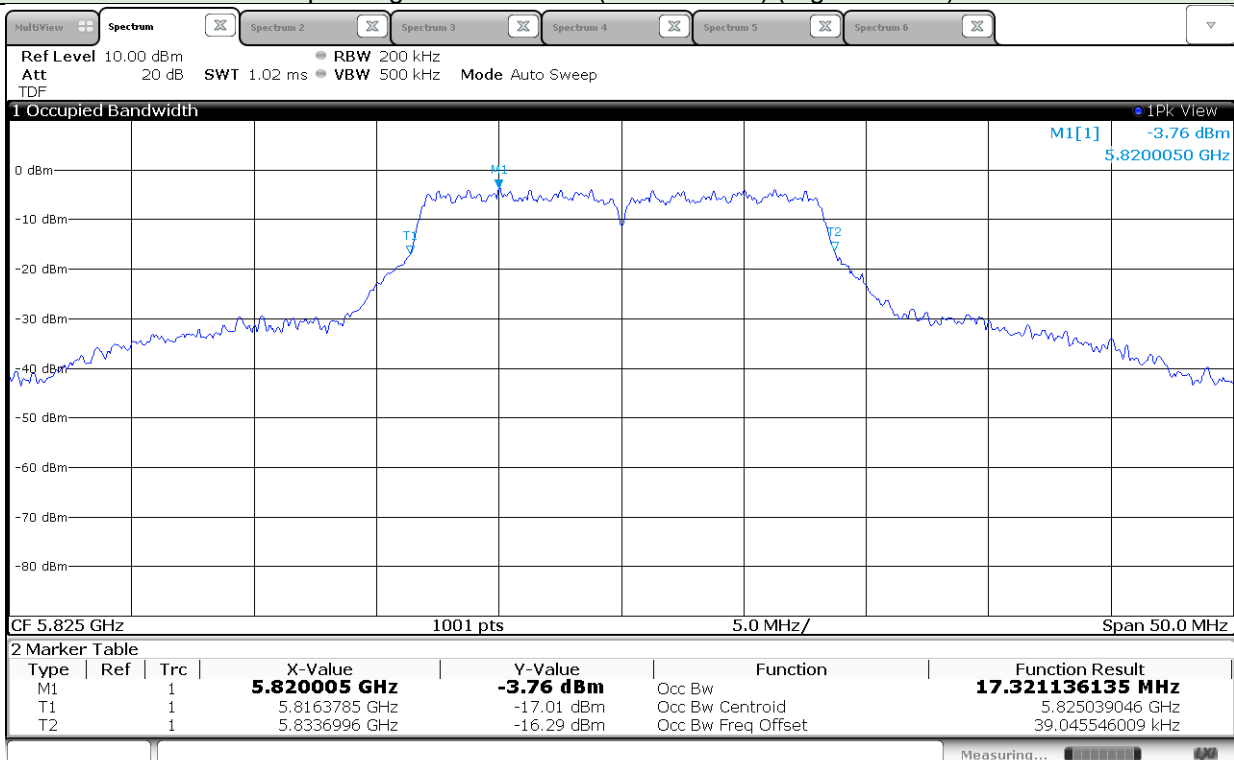
Operating Mode: 802.11a (U-NII 3 Band) (Low Channel)



Operating Mode: 802.11a (U-NII 3 Band) (Middle Channel)



Operating Mode: 802.11a (U-NII 3 Band) (High Channel)

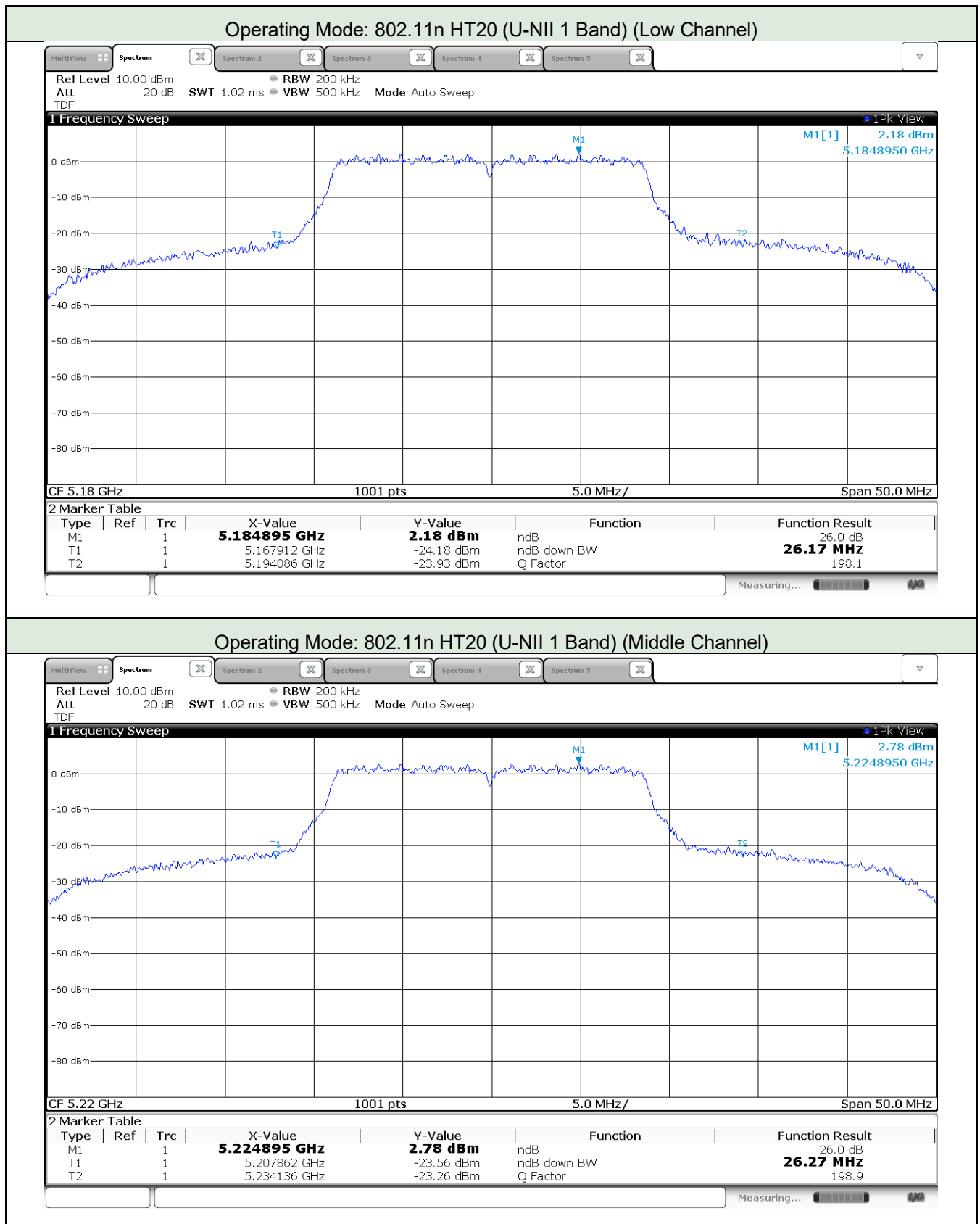


5.1.4 Test Data - Operating Mode: 802.11n HT20

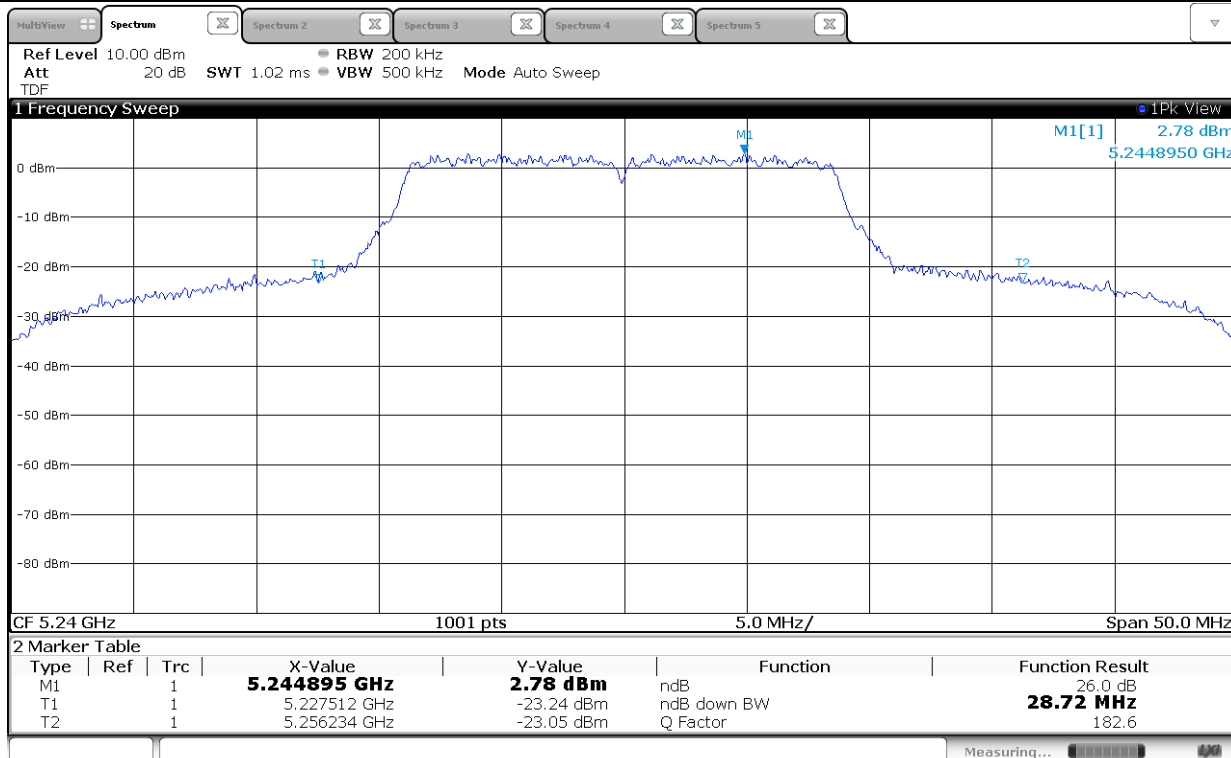
5.1.4.1 Tabulated Test Data

Date of Test		2020-04-09	–	Temperature	(23.0 ± 1.0) °C
		2020.04.10		Relative humidity	(50.0 ± 3.0) % R.H.
Test Result		PASS		Tested by	In-yong Song 
Operating Mode: 802.11n HT20 (U-NII Band 1)					
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result	
Low	5 180	26.17	18.60	-	
Middle	5 220	26.27	18.67		
High	5 240	28.72	18.81		
Operating Mode: 802.11n HT20 (U-NII Band 2-A)					
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result	
Low	5 260	26.22	18.60	-	
Middle	5 300	27.57	18.70		
High	5 320	26.22	18.58		
Operating Mode: 802.11n HT20 (U-NII Band 2-C)					
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result	
Low	5 500	28.27	18.86	-	
Middle	5 560	26.87	18.70		
High	5 700	28.02	18.78		
Operating Mode: 802.11n HT20 (U-NII Band 3)					
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result	
Low	5 745	23.03	18.34	-	
Middle	5 785	25.07	18.50		
High	5 825	25.23	18.55		

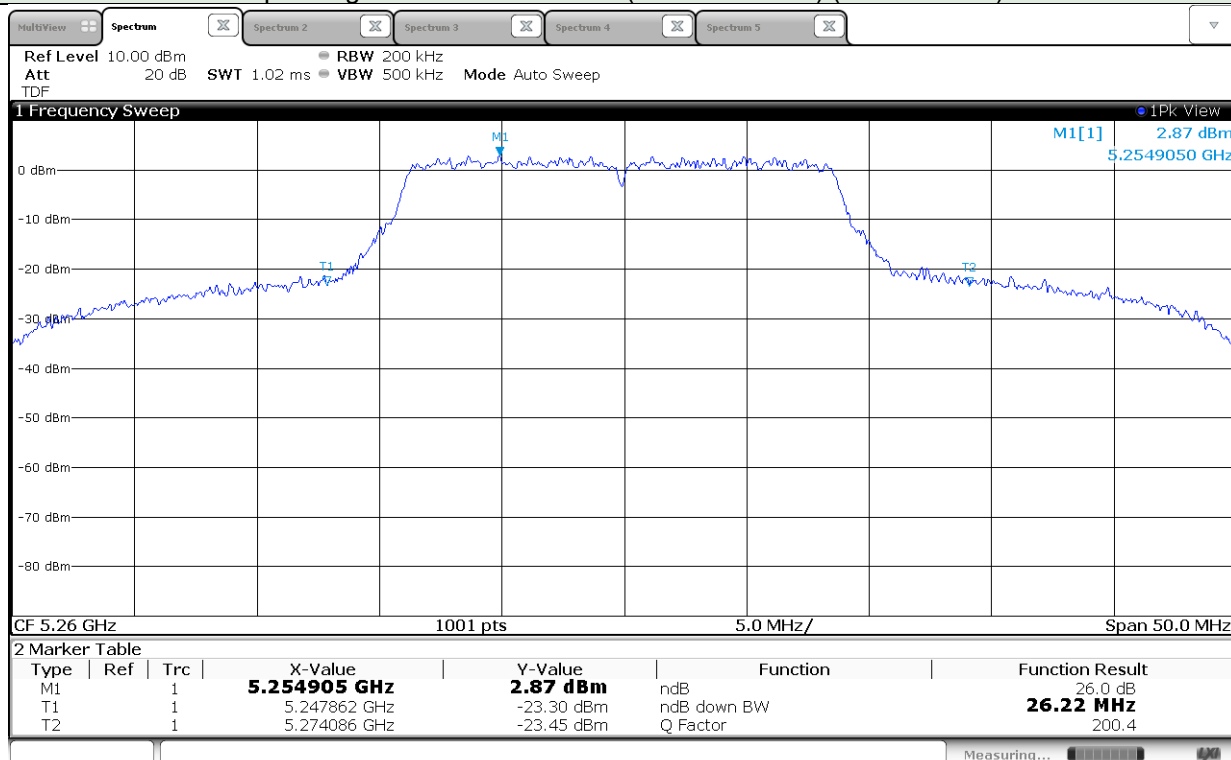
5.1.4.2 Graphic Test Data – 26 dB bandwidth



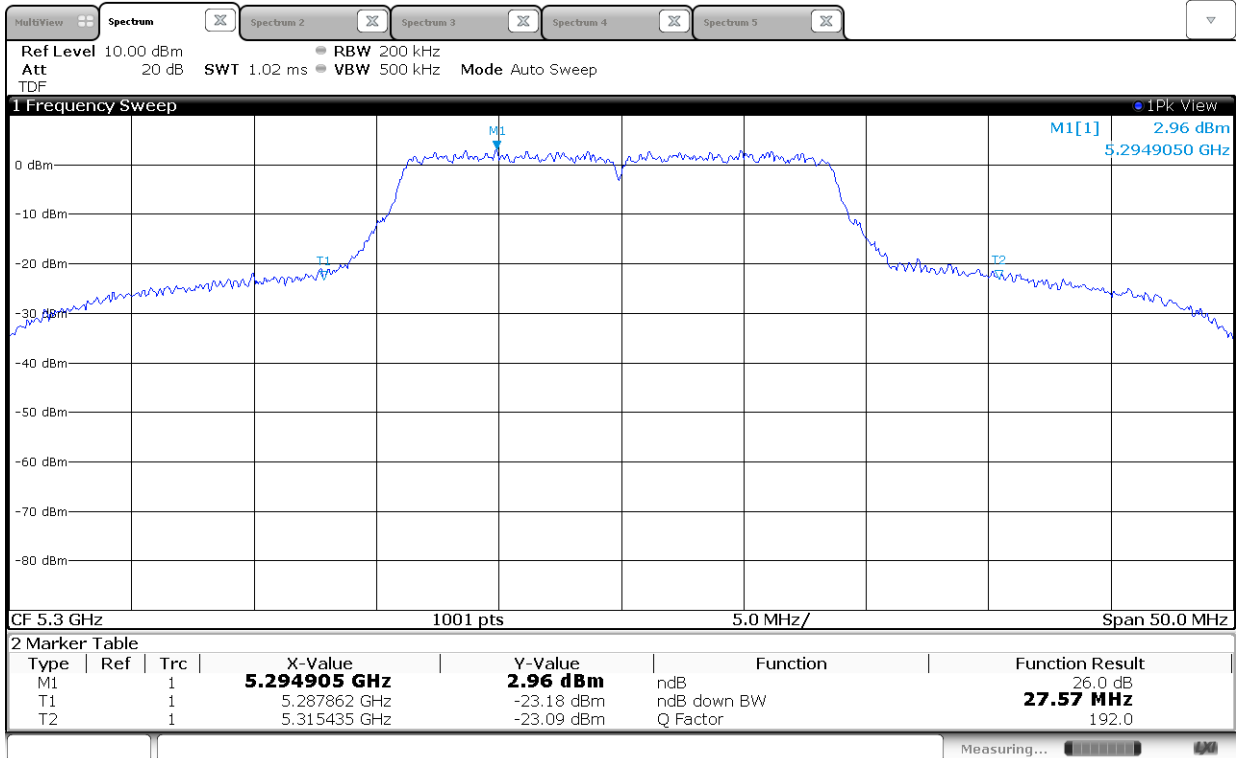
Operating Mode: 802.11n HT20 (U-NII 1 Band) (High Channel)



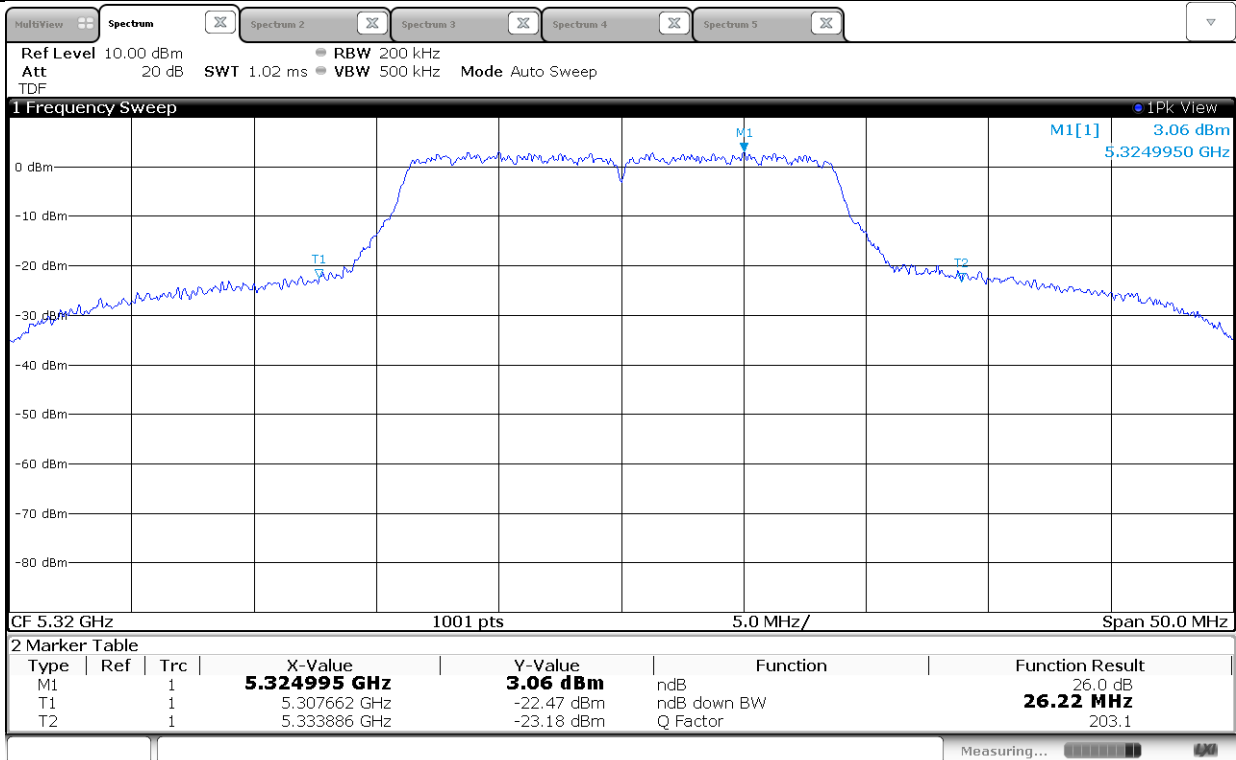
Operating Mode: 802.11n HT20 (U-NII 2-A Band) (Low Channel)



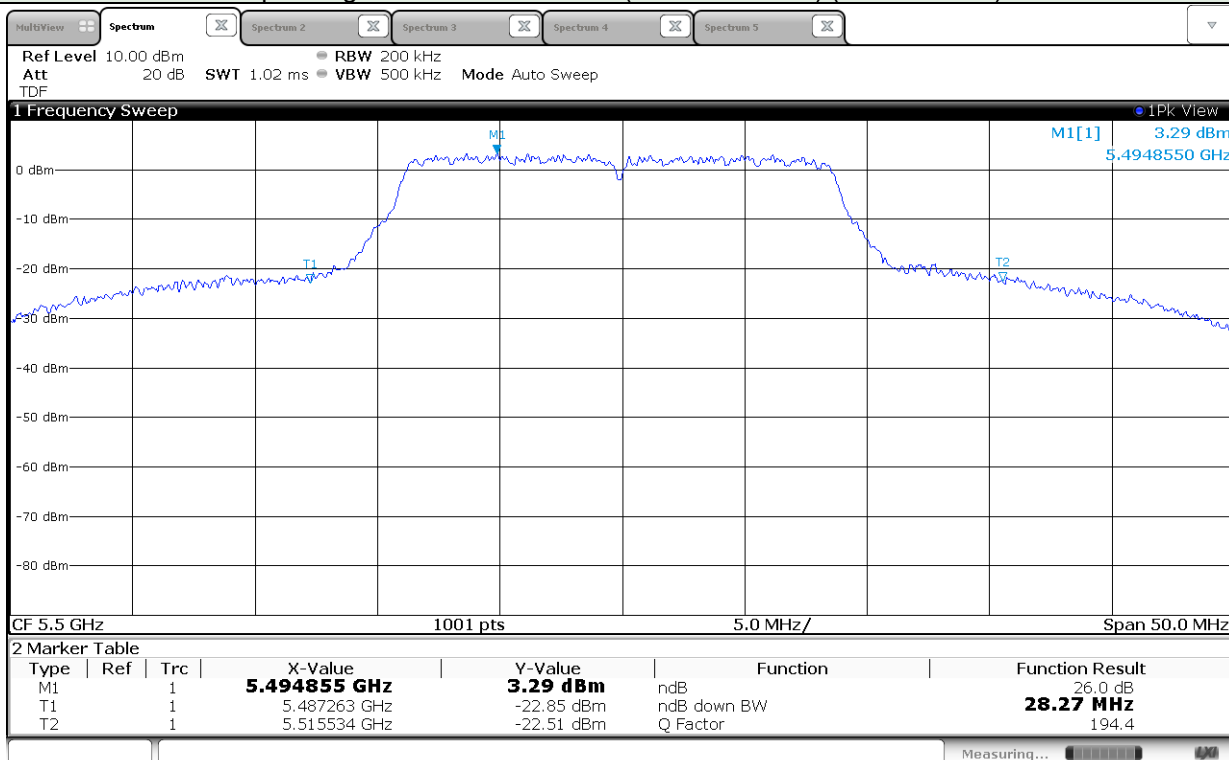
Operating Mode: 802.11n HT20 (U-NII 2-A Band) (Middle Channel)



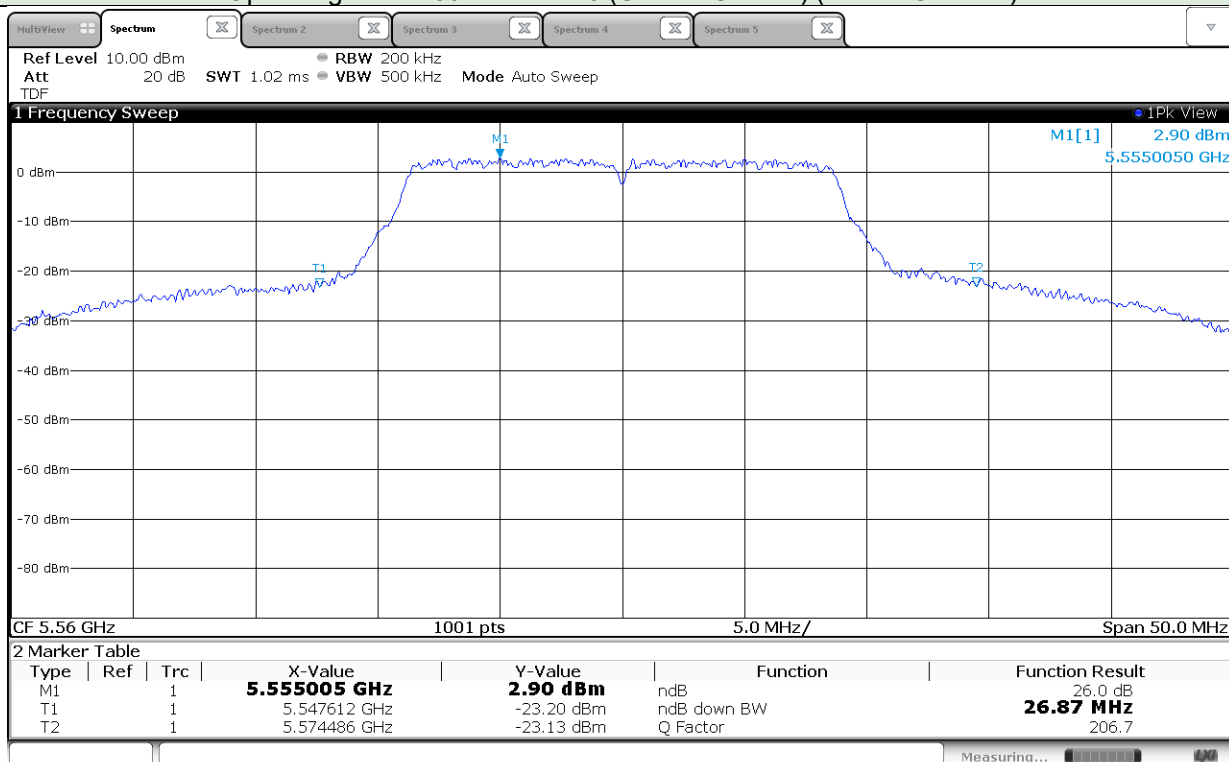
Operating Mode: 802.11n HT20 (U-NII 2-A Band) (High Channel)



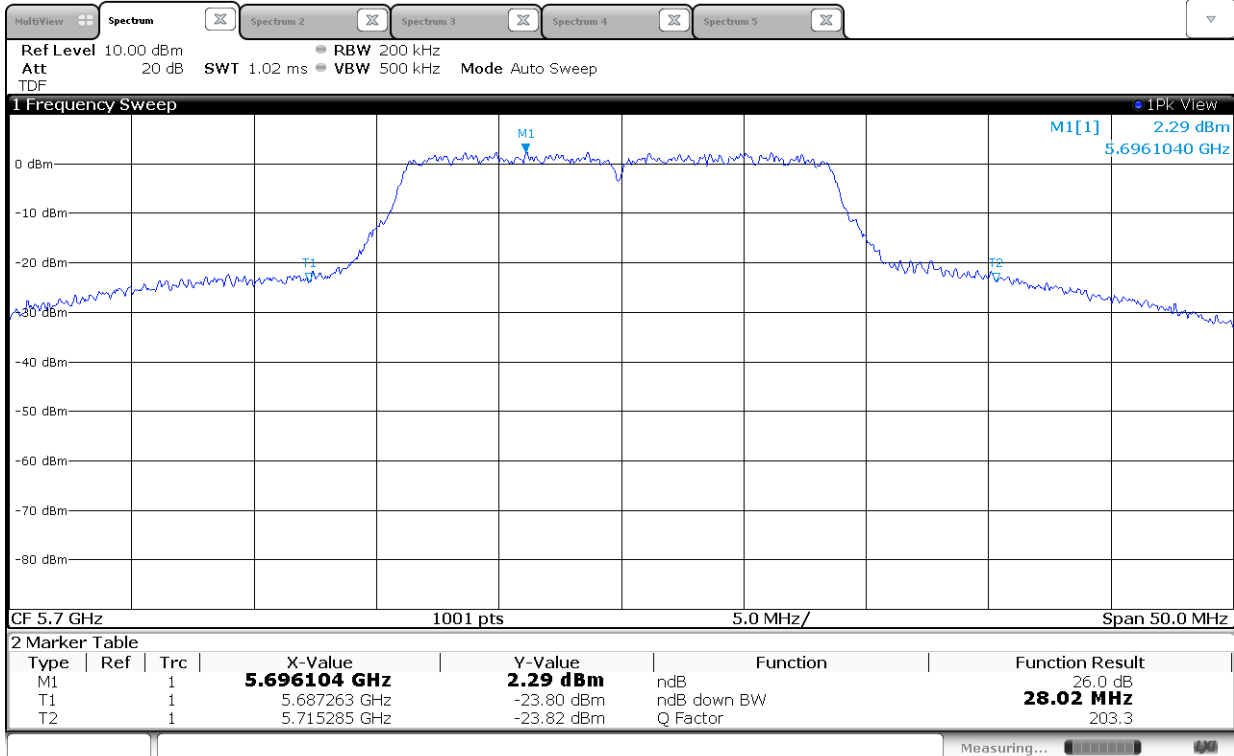
Operating Mode: 802.11n HT20 (U-NII 2-C Band) (Low Channel)



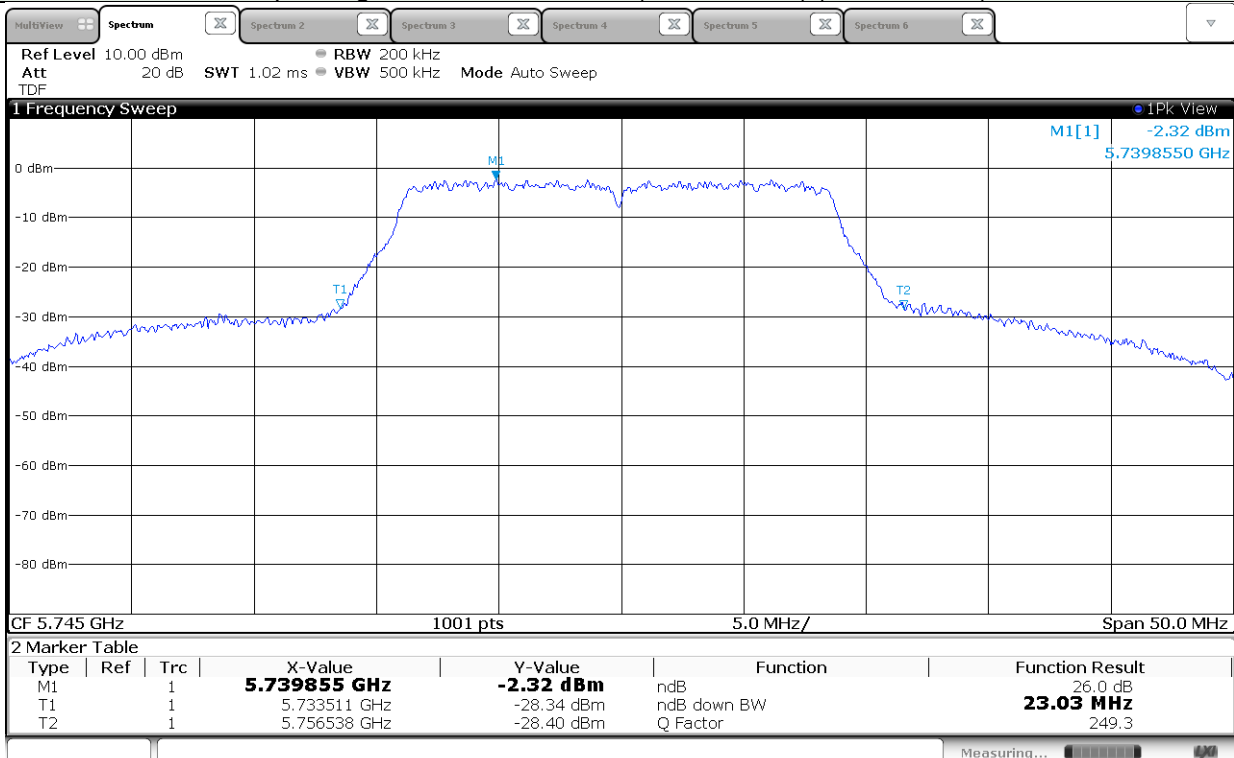
Operating Mode: 802.11n HT20 (U-NII 2-C Band) (Middle Channel)



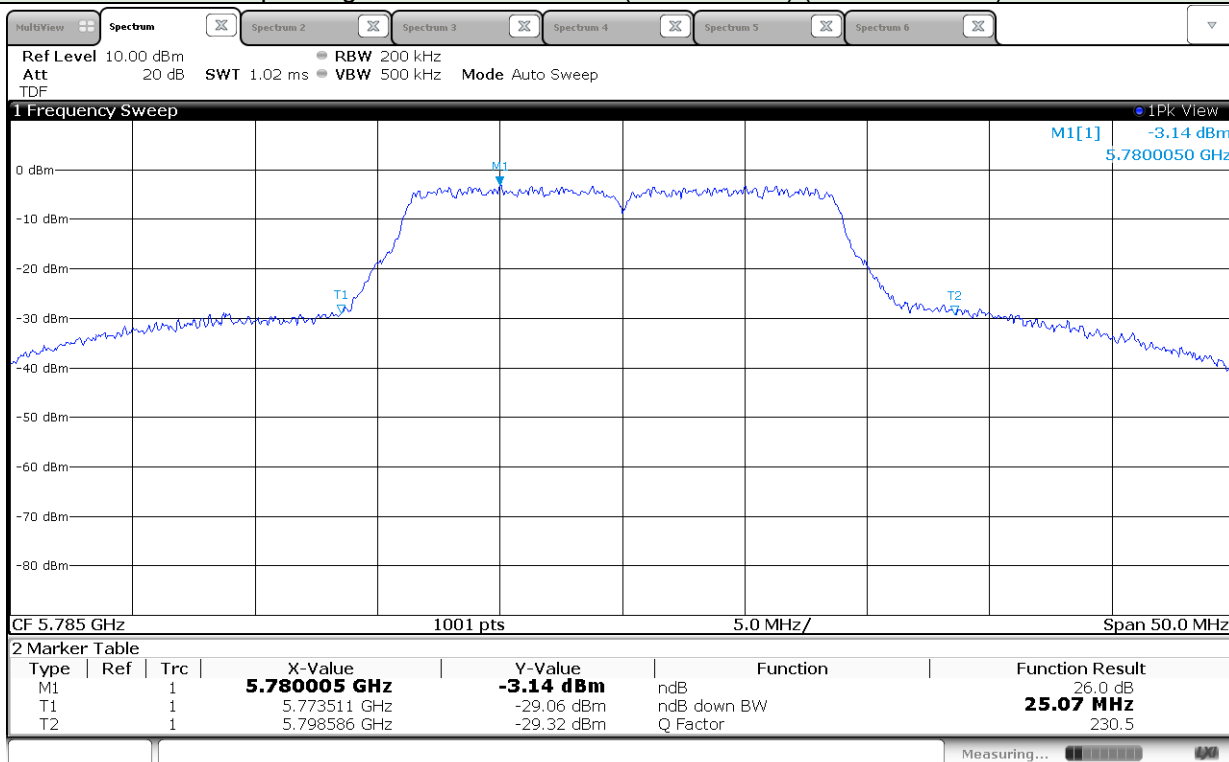
Operating Mode: 802.11n HT20 (U-NII 2-C Band) (High Channel)



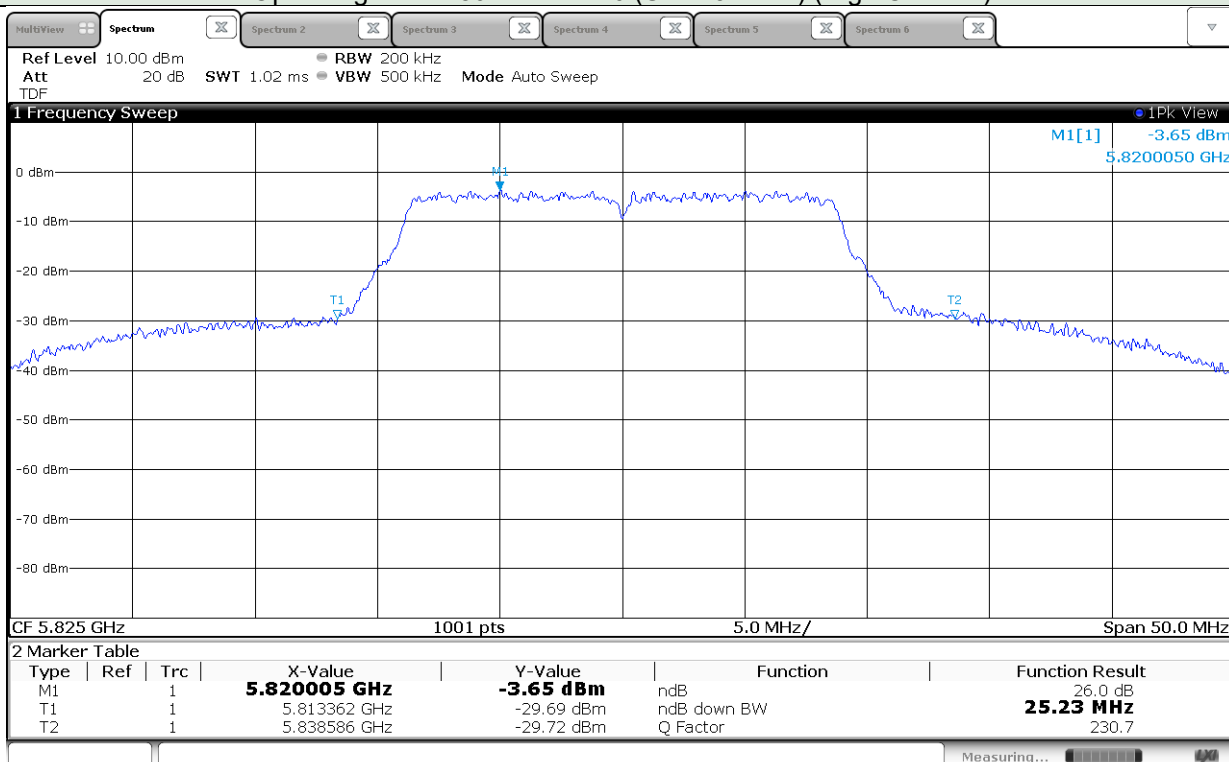
Operating Mode: 802.11n HT20 (U-NII 3 Band) (Low Channel)



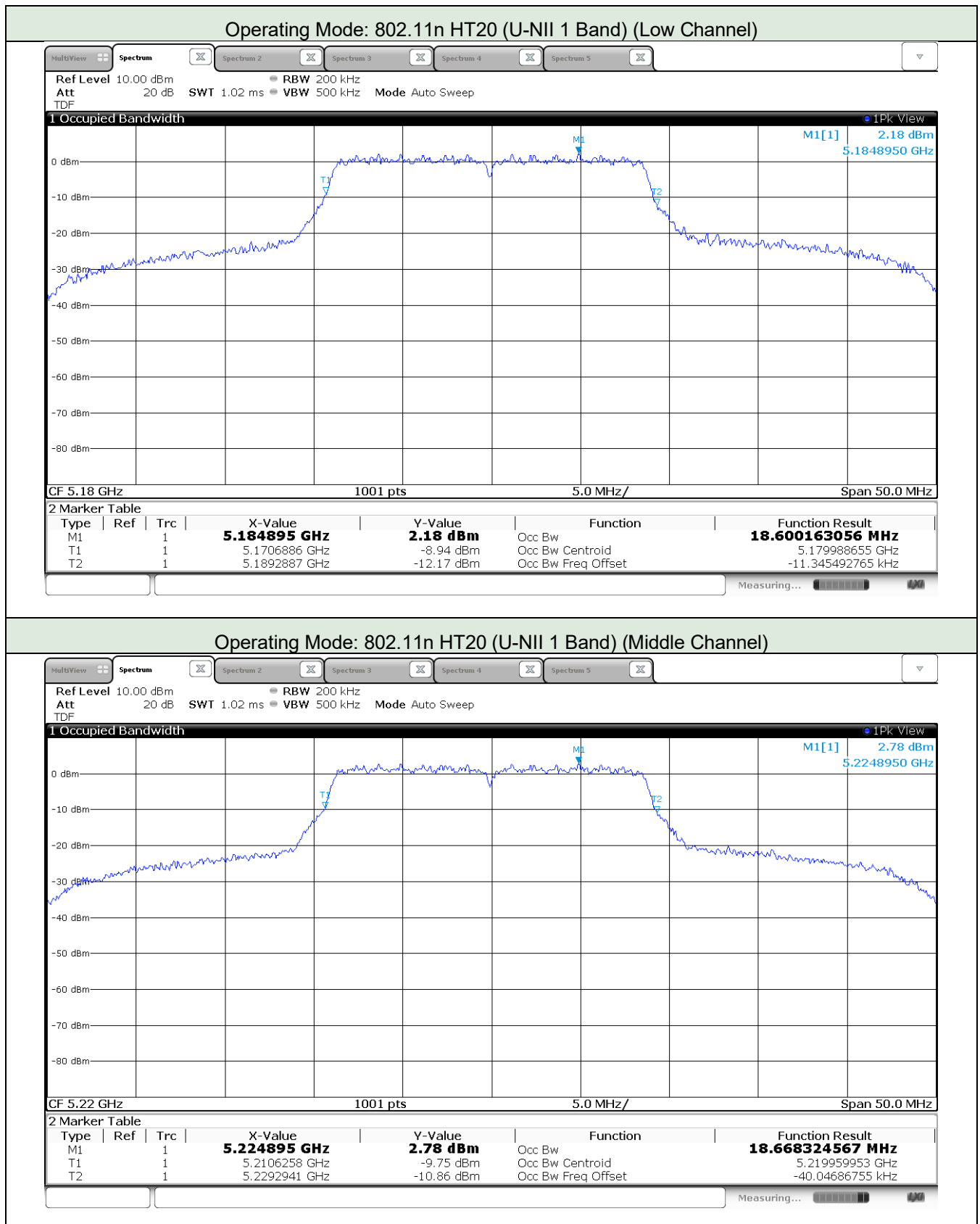
Operating Mode: 802.11n HT20 (U-NII 3 Band) (Middle Channel)



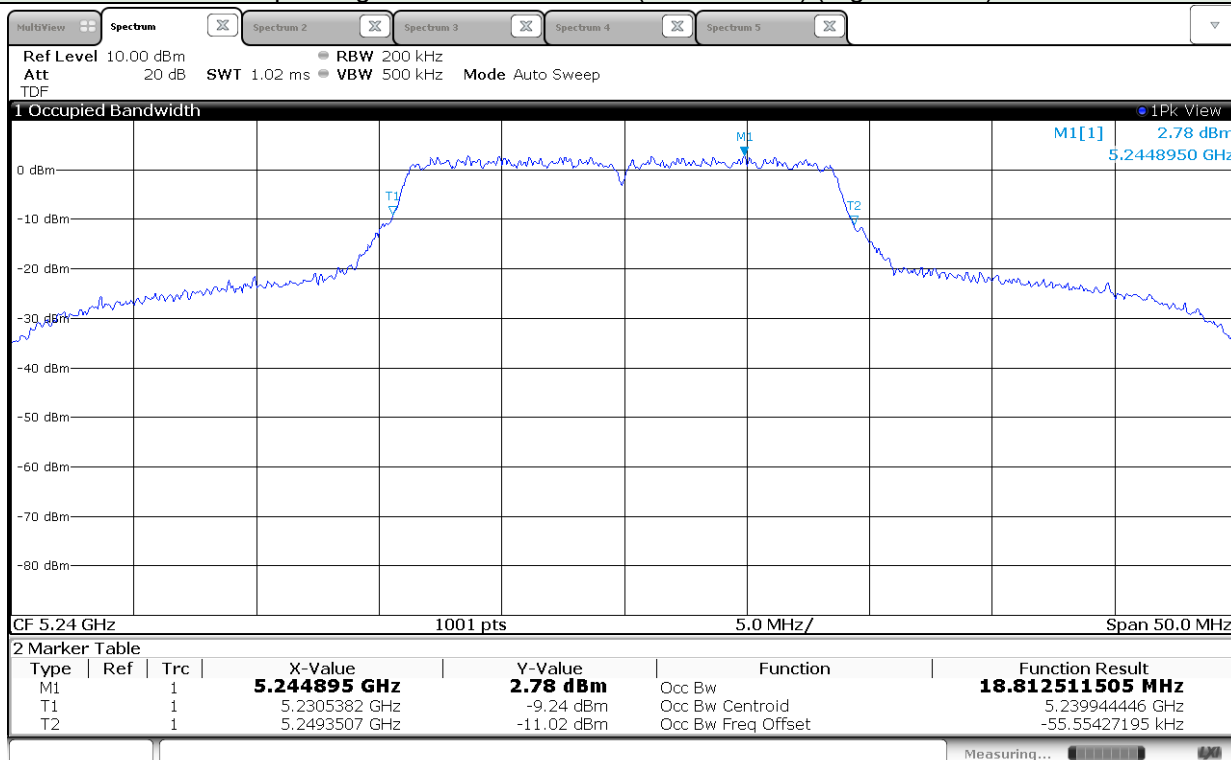
Operating Mode: 802.11n HT20 (U-NII 3 Band) (High Channel)



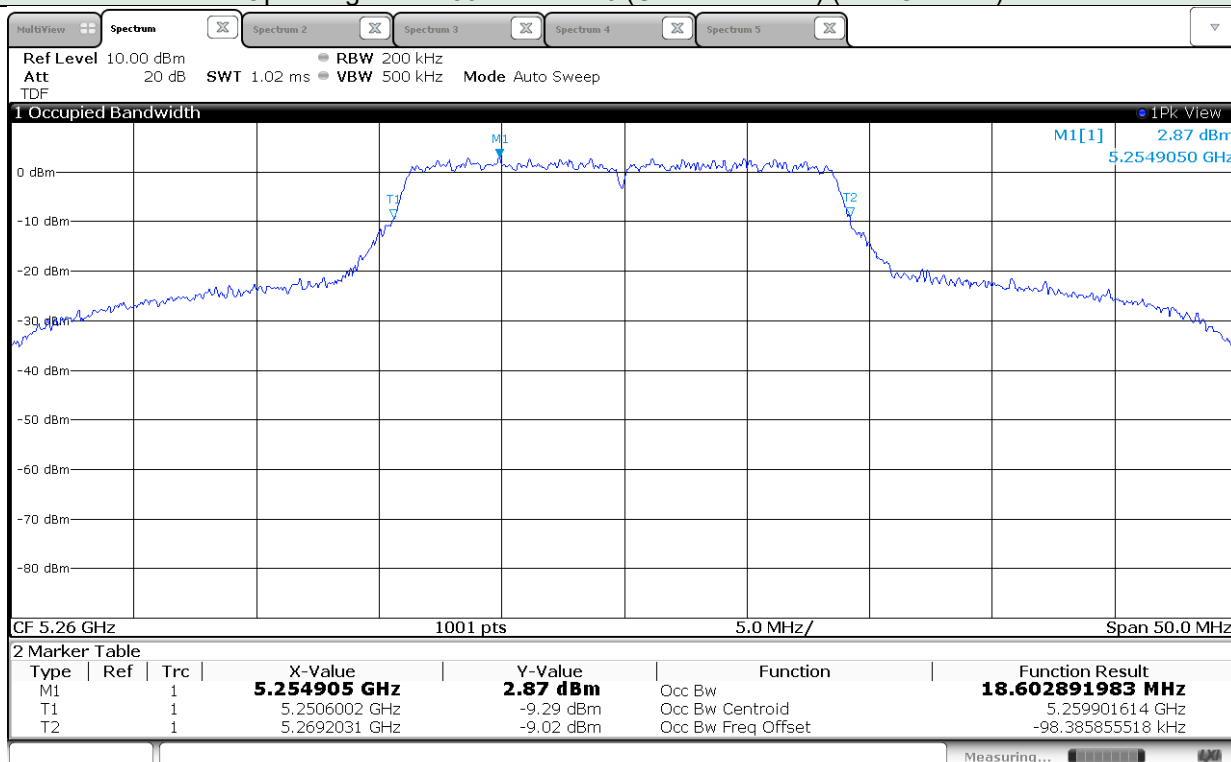
5.1.4.3 Graphic Test Data – 99 % occupied bandwidth



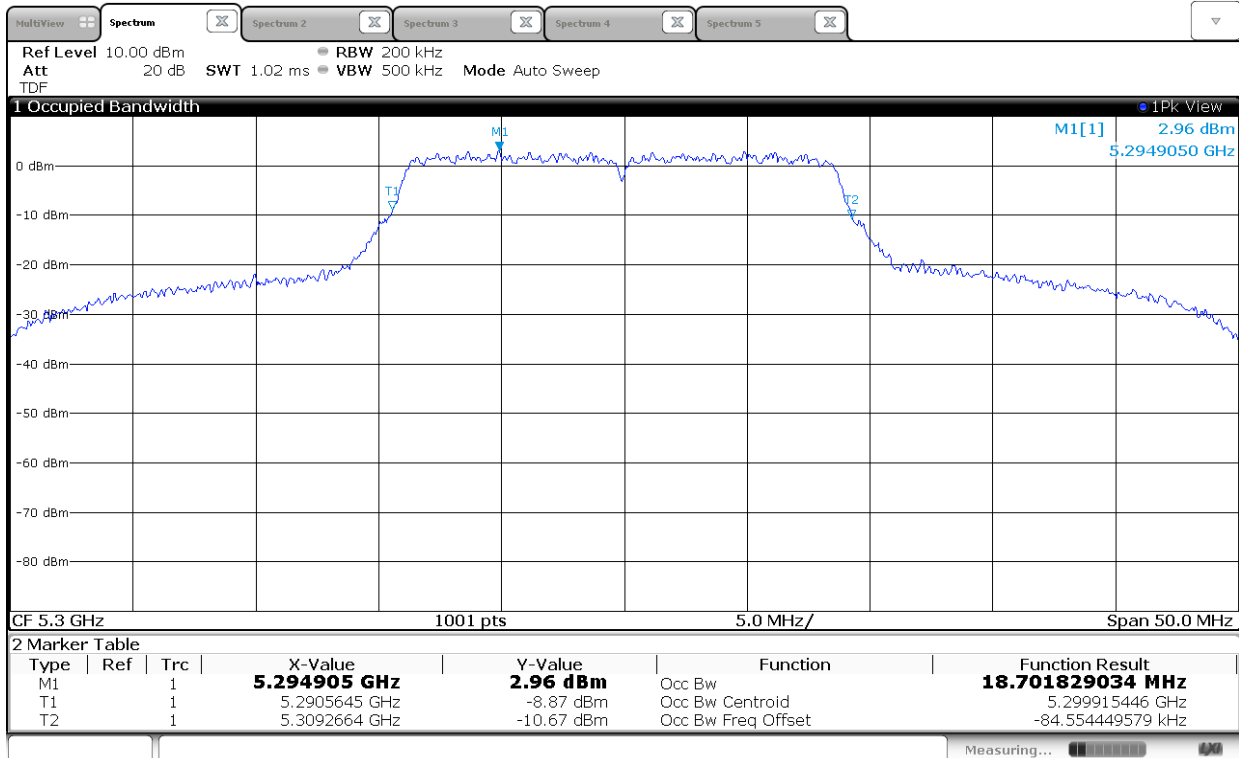
Operating Mode: 802.11n HT20 (U-NII 1 Band) (High Channel)



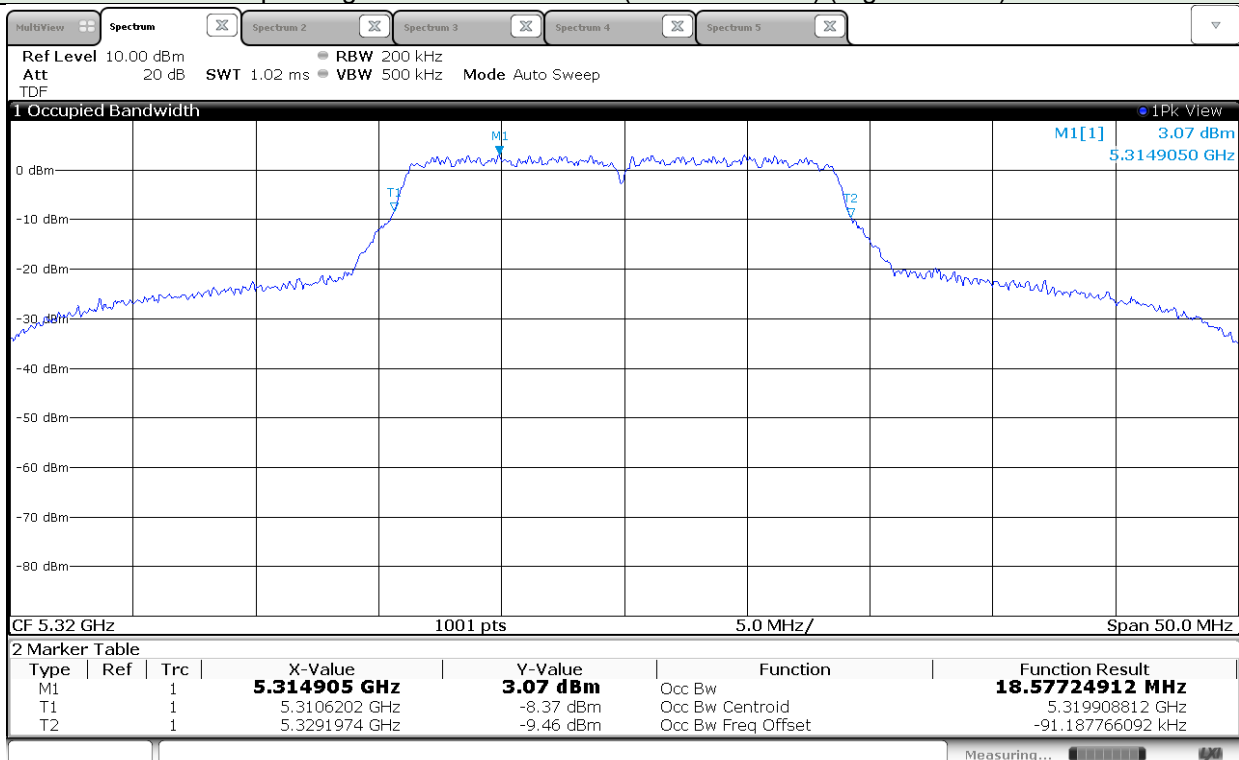
Operating Mode: 802.11n HT20 (U-NII 2-A Band) (Low Channel)



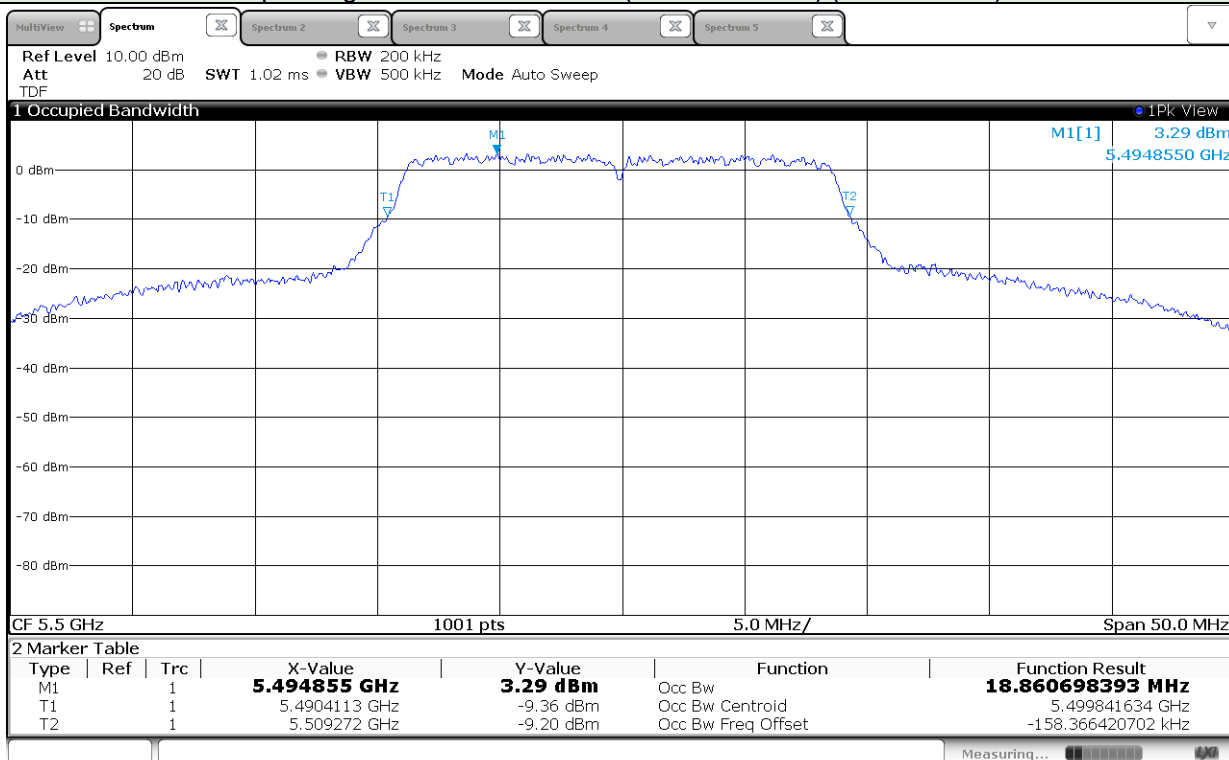
Operating Mode: 802.11n HT20 (U-NII 2-A Band) (Middle Channel)



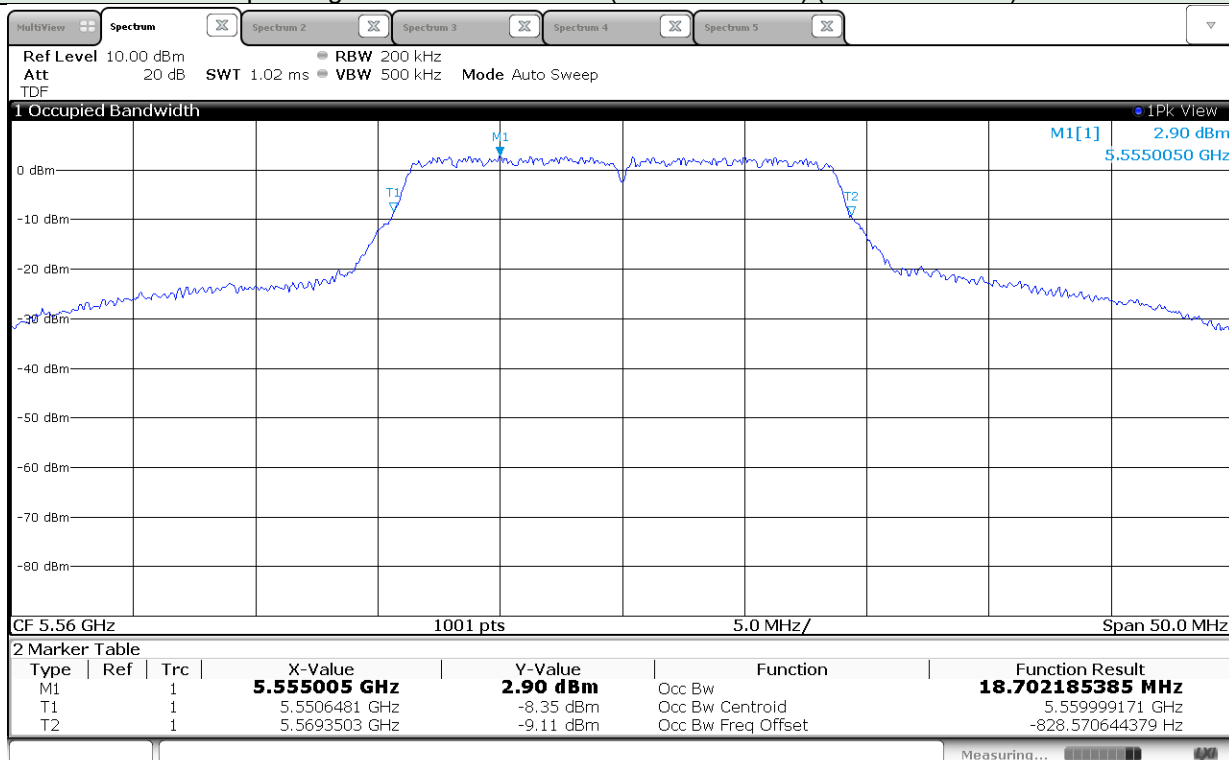
Operating Mode: 802.11n HT20 (U-NII 2-A Band) (High Channel)



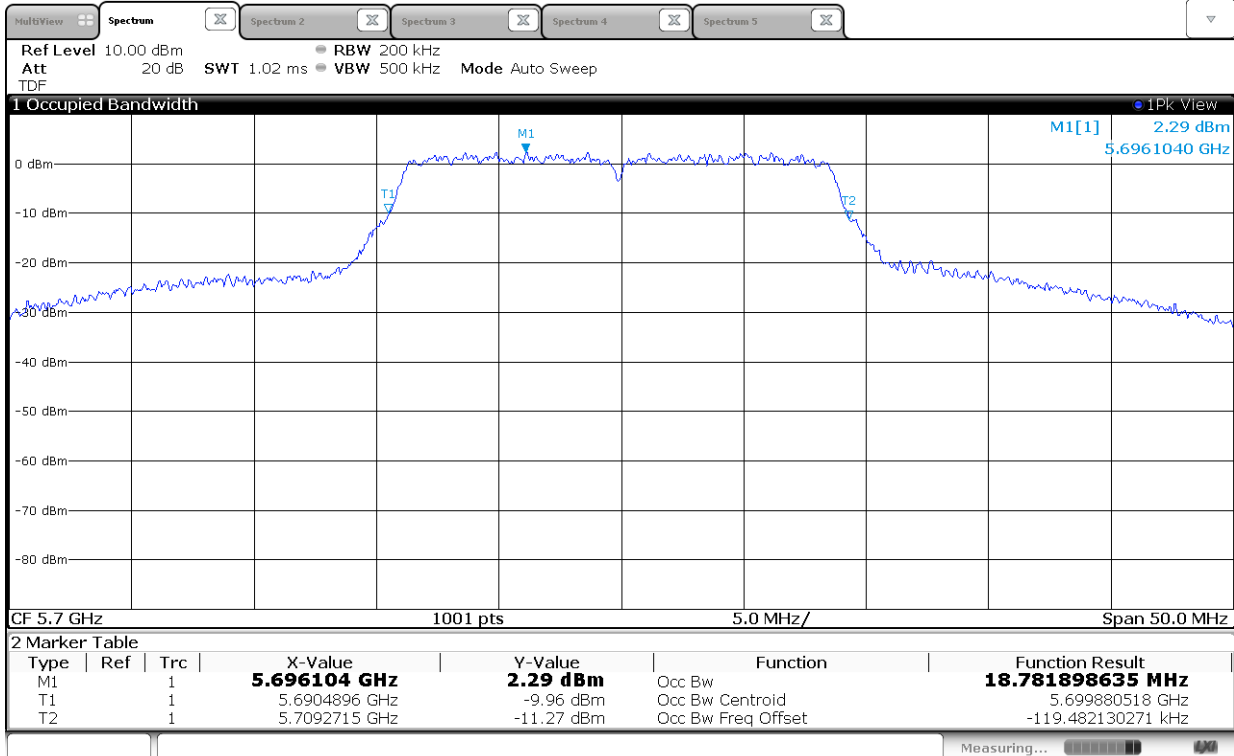
Operating Mode: 802.11n HT20 (U-NII 2-C Band) (Low Channel)



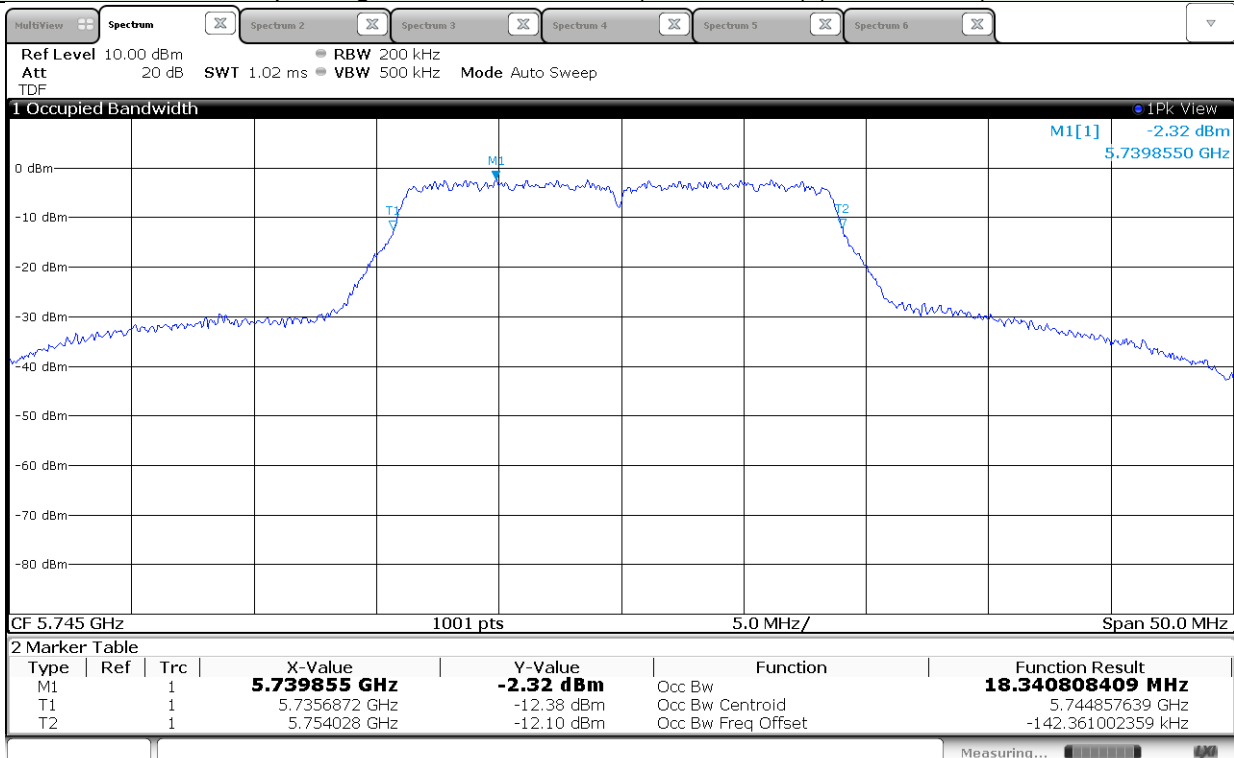
Operating Mode: 802.11n HT20 (U-NII 2-C Band) (Middle Channel)



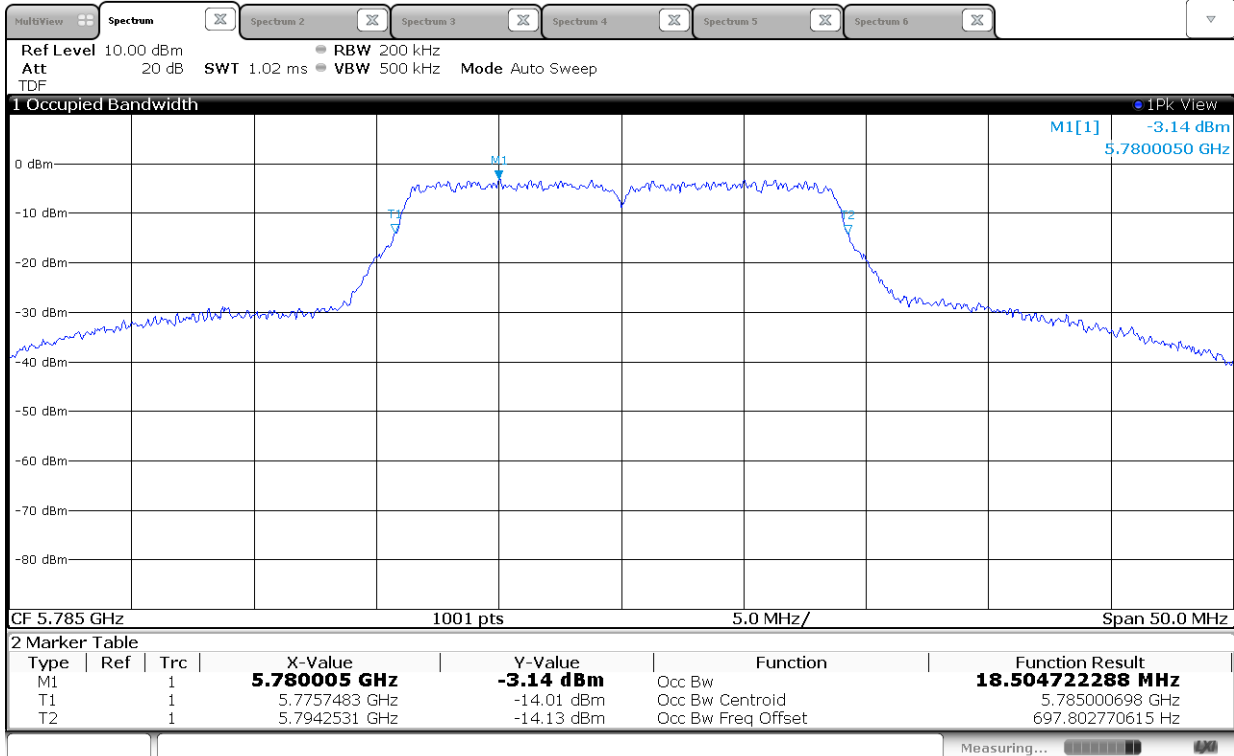
Operating Mode: 802.11n HT20 (U-NII 2-C Band) (High Channel)



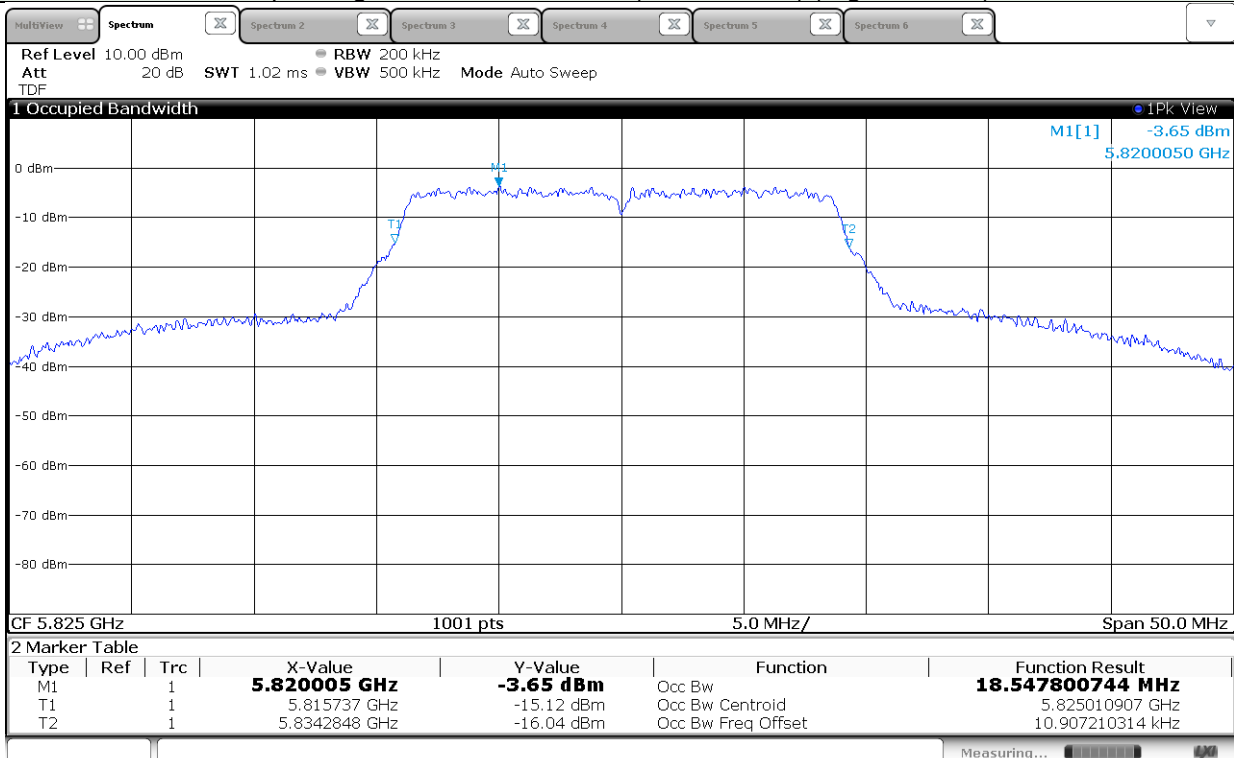
Operating Mode: 802.11n HT20 (U-NII 3 Band) (Low Channel)



Operating Mode: 802.11n HT20 (U-NII 3 Band) (Middle Channel)



Operating Mode: 802.11n HT20 (U-NII 3 Band) (High Channel)

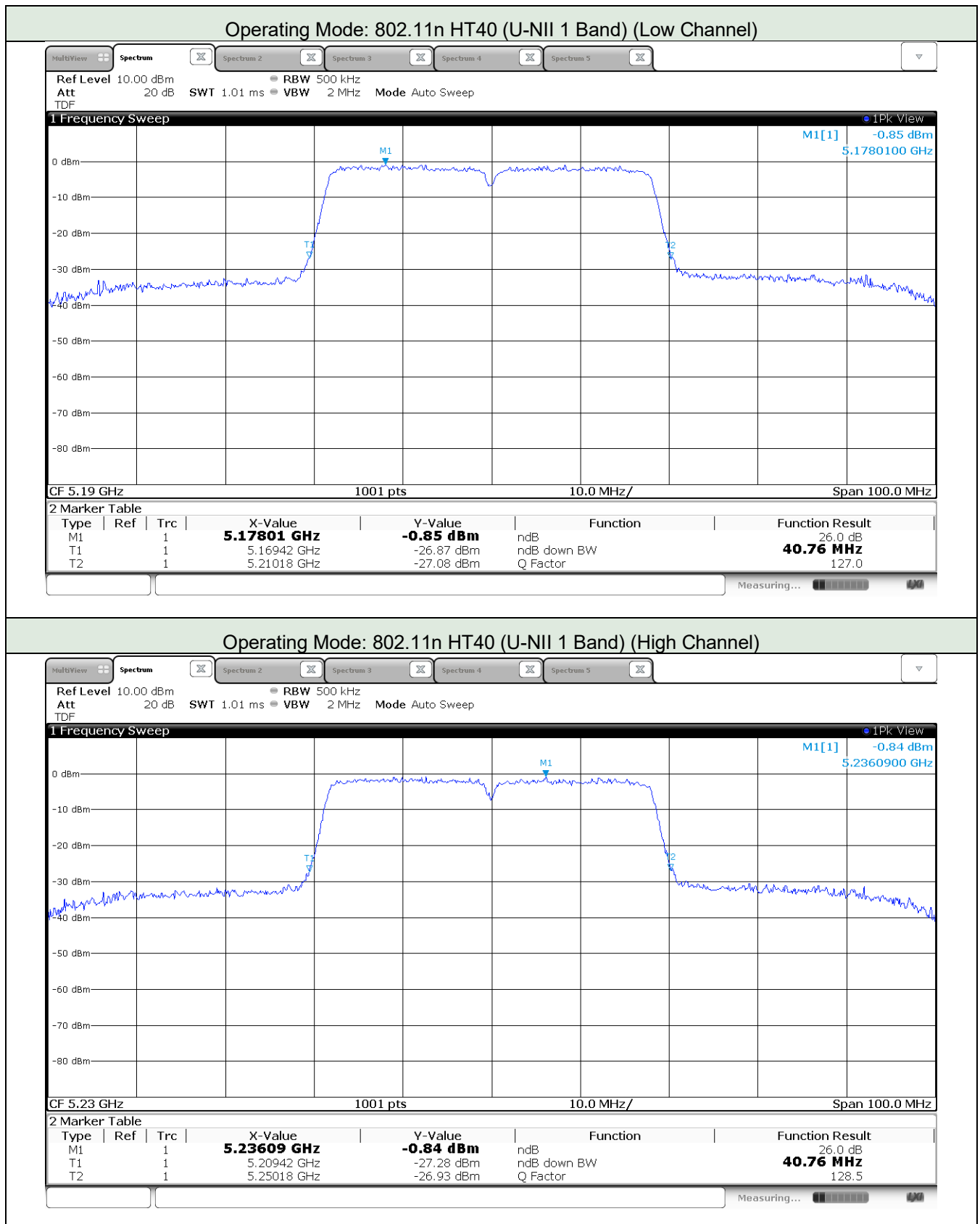


5.1.5 Test Data - Operating Mode: 802.11n HT40

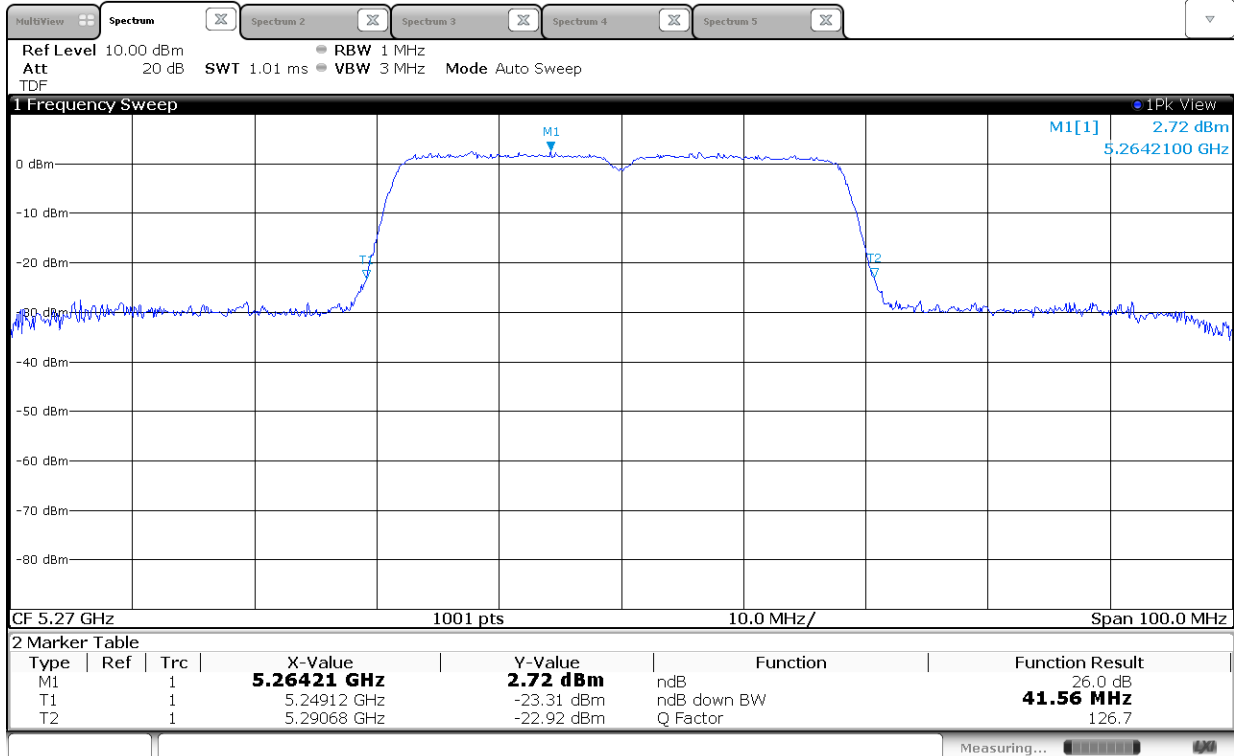
5.1.5.1 Tabulated Test Data

Date of Test		2020-04-09 – 2020.04.10	Temperature		(23.0 ± 1.0) °C
			Relative humidity		(50.0 ± 3.0) % R.H.
Test Result		PASS	Tested by		In-yong Song 
Operating Mode: 802.11n HT40 (U-NII Band 1)					
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result -	
Low	5 190	40.76	36.68		
High	5 230	40.76	36.69		
Operating Mode: 802.11n HT40 (U-NII Band 2-A)					
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result -	
Low	5 270	41.56	37.19		
High	5 310	41.56	37.20		
Operating Mode: 802.11n HT40 (U-NII Band 2-C)					
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result -	
Low	5 510	41.76	36.88		
Middle	5 550	41.76	37.00		
High	5 670	41.66	36.99		
Operating Mode: 802.11n HT40 (U-NII Band 3)					
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result -	
Low	5 755	41.16	36.84		
High	5 795	41.06	36.83		

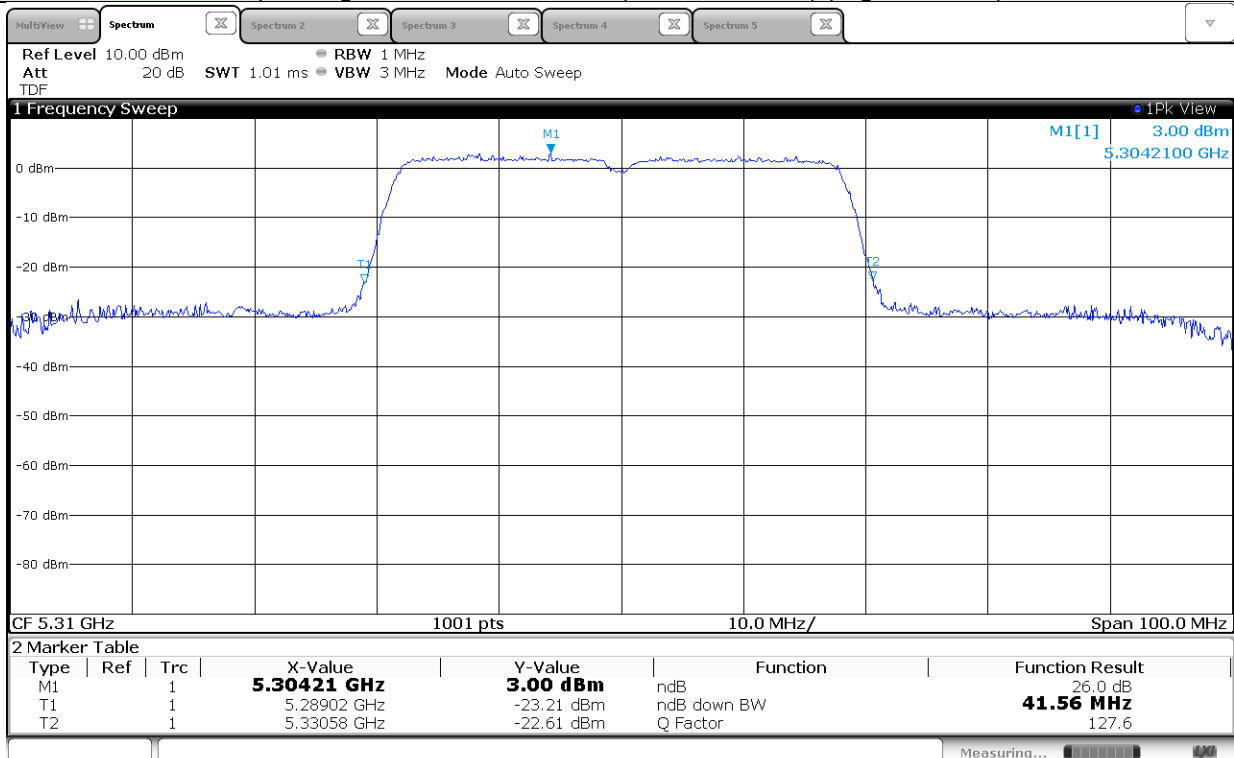
5.1.5.2 Graphic Test Data – 26 dB bandwidth



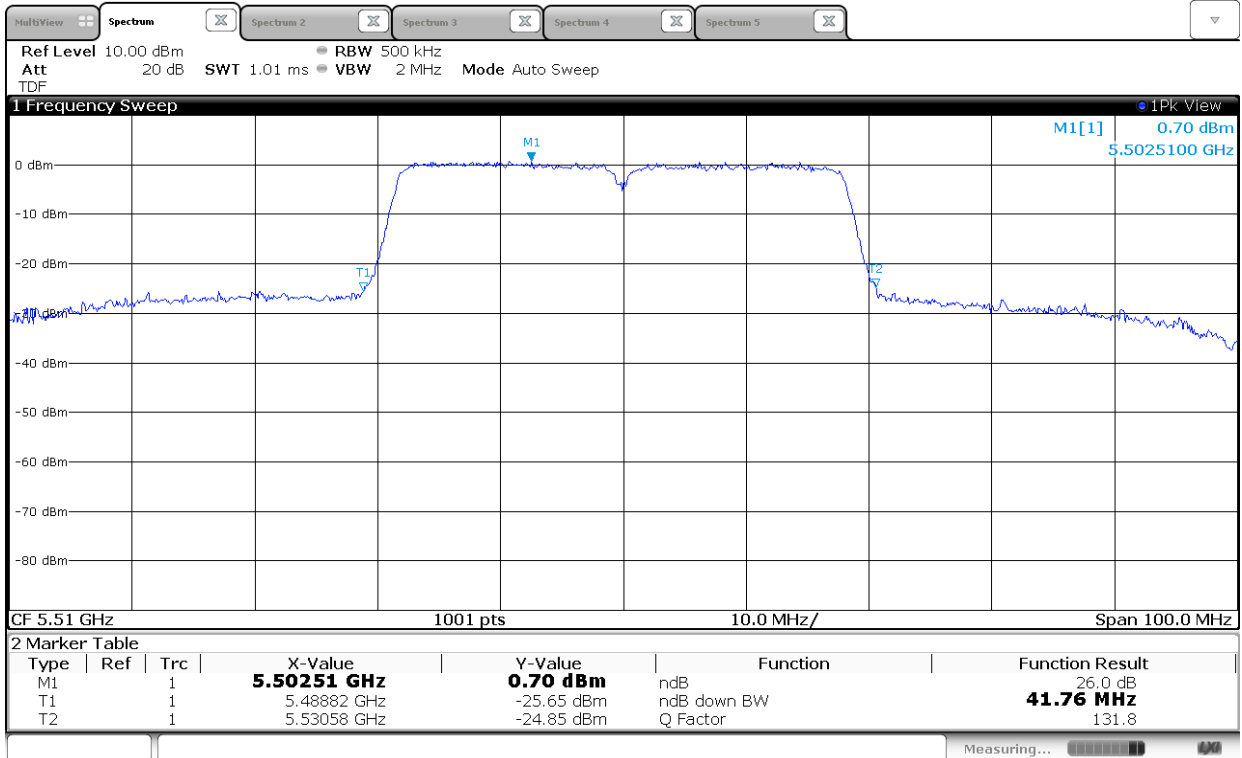
Operating Mode: 802.11n HT40 (U-NII 2-A Band) (Low Channel)



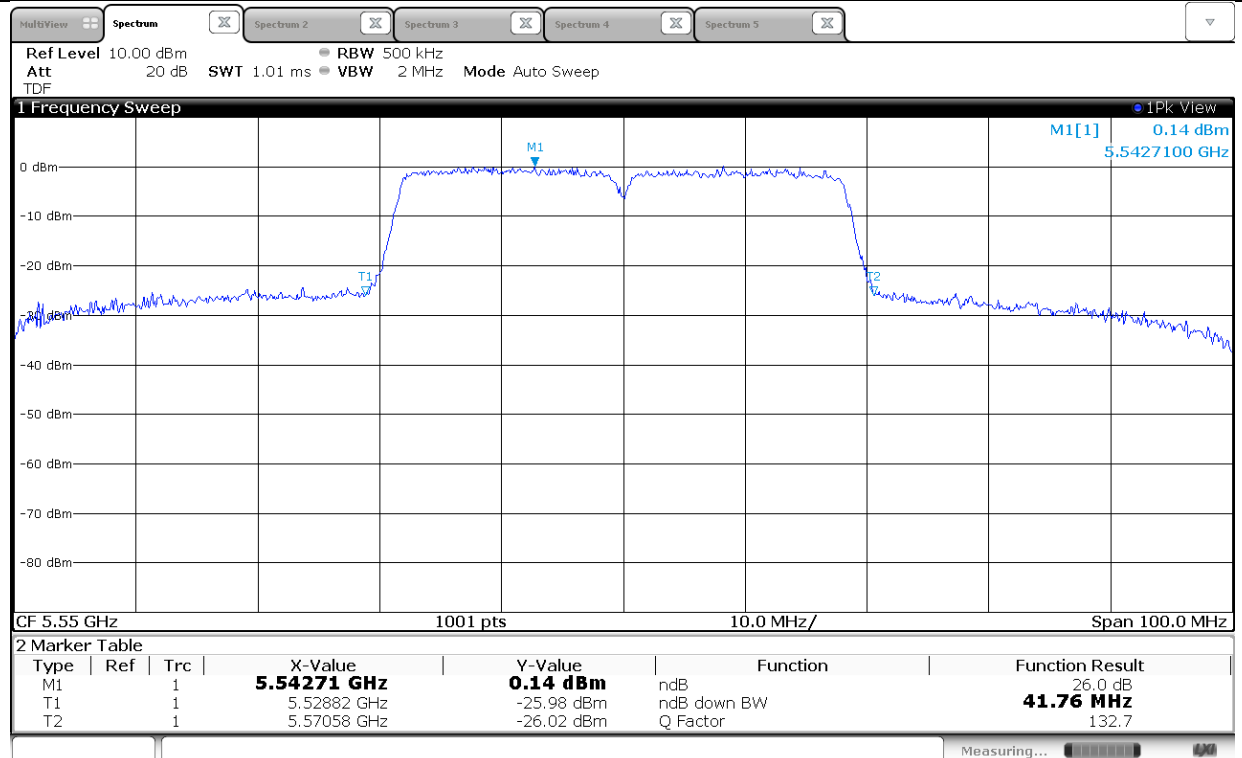
Operating Mode: 802.11n HT40 (U-NII 2-A Band) (High Channel)



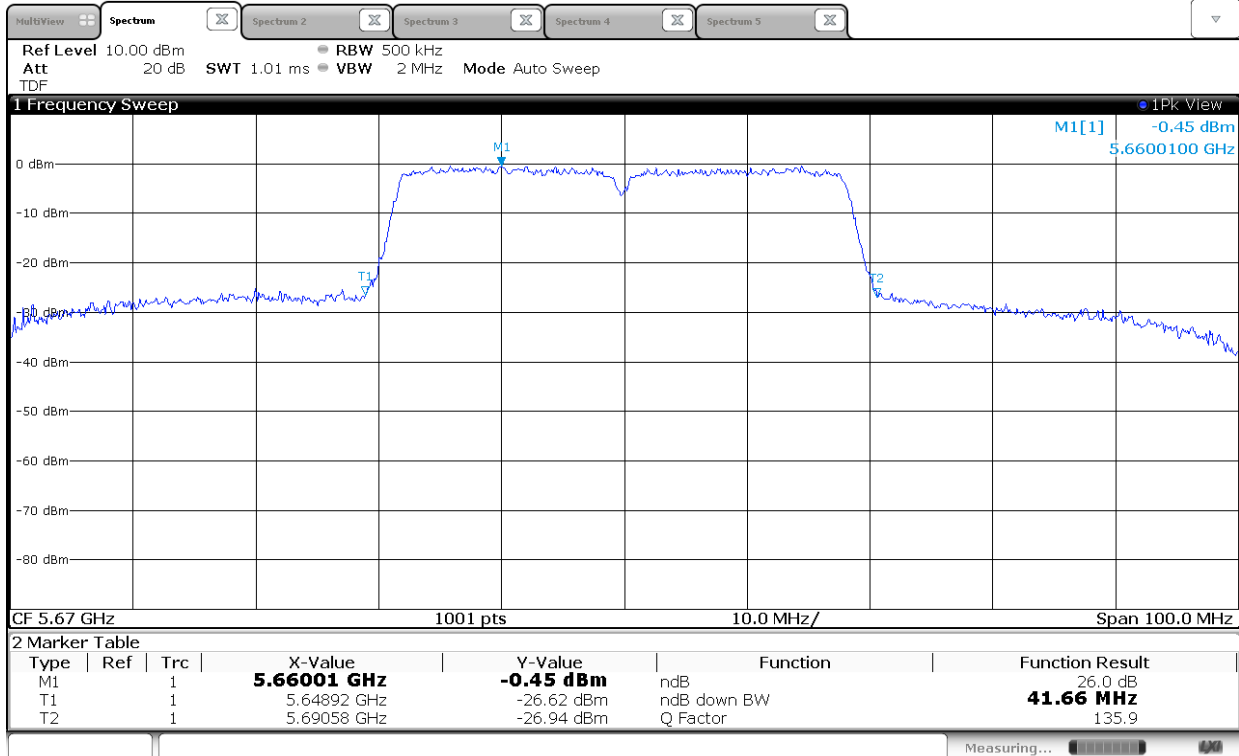
Operating Mode: 802.11n HT40 (U-NII 2-C Band) (Low Channel)



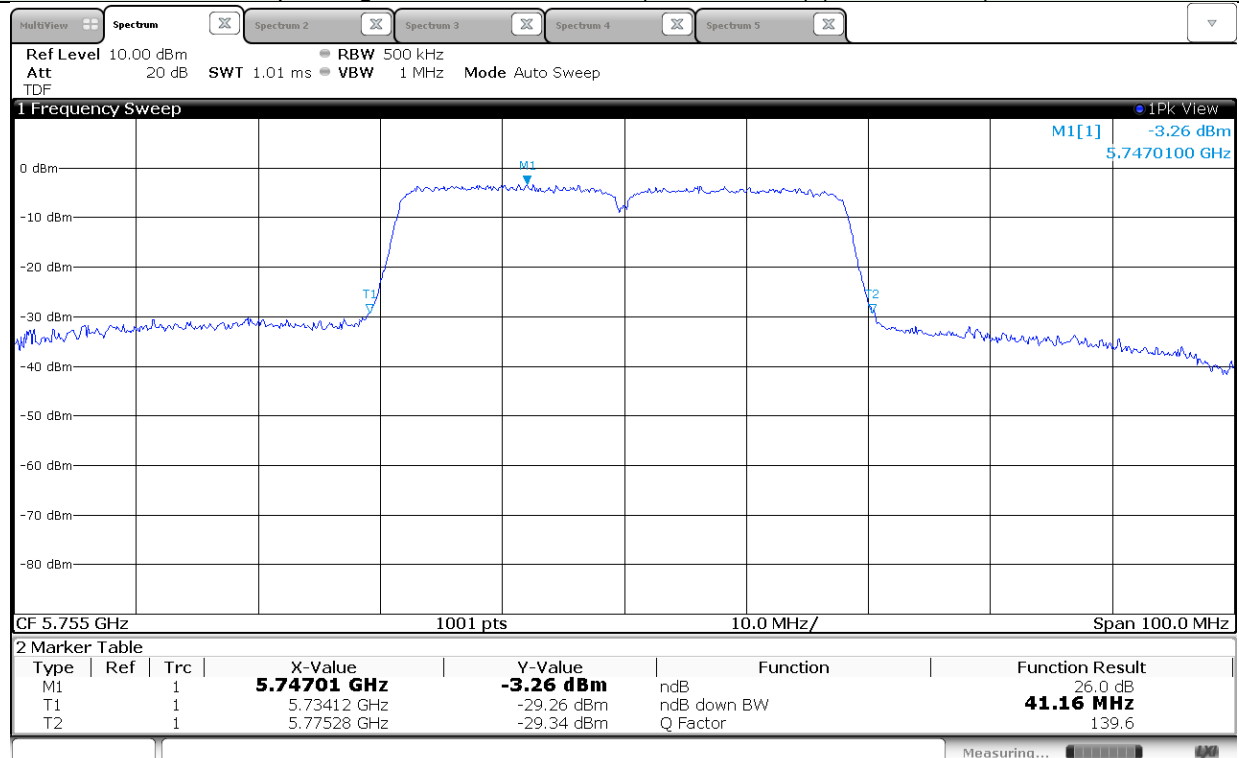
Operating Mode: 802.11n HT40 (U-NII 2-C Band) (Middle Channel)



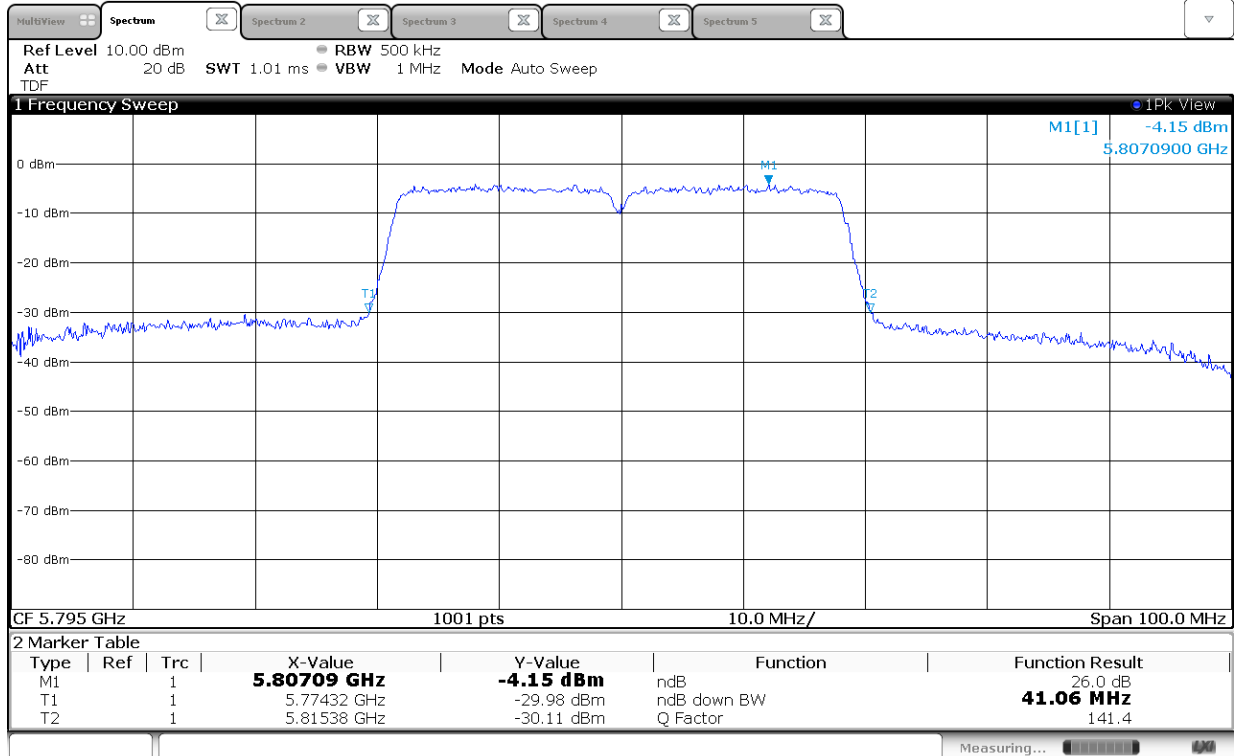
Operating Mode: 802.11n HT40 (U-NII 2-C Band) (High Channel)



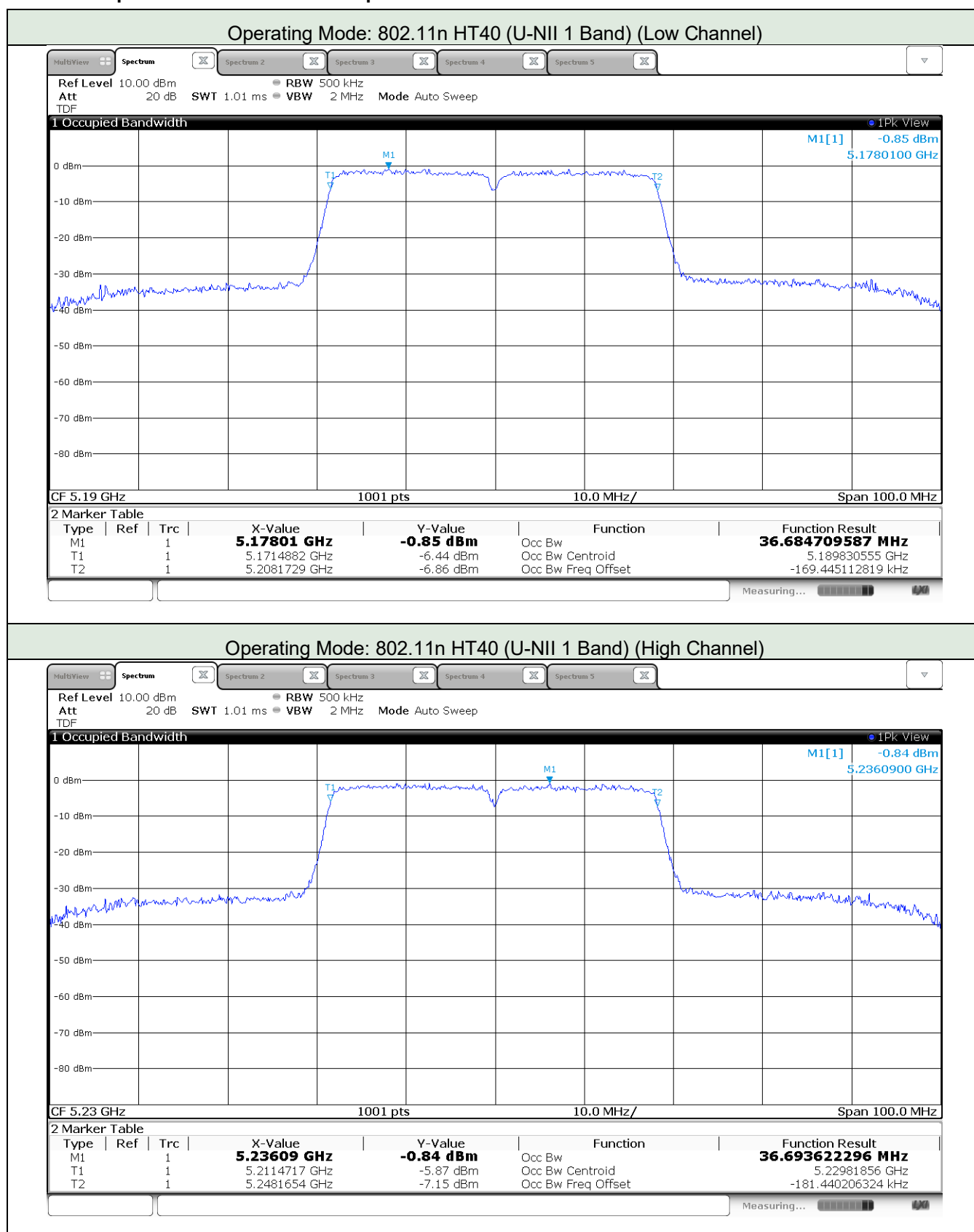
Operating Mode: 802.11n HT40 (U-NII 3 Band) (Low Channel)



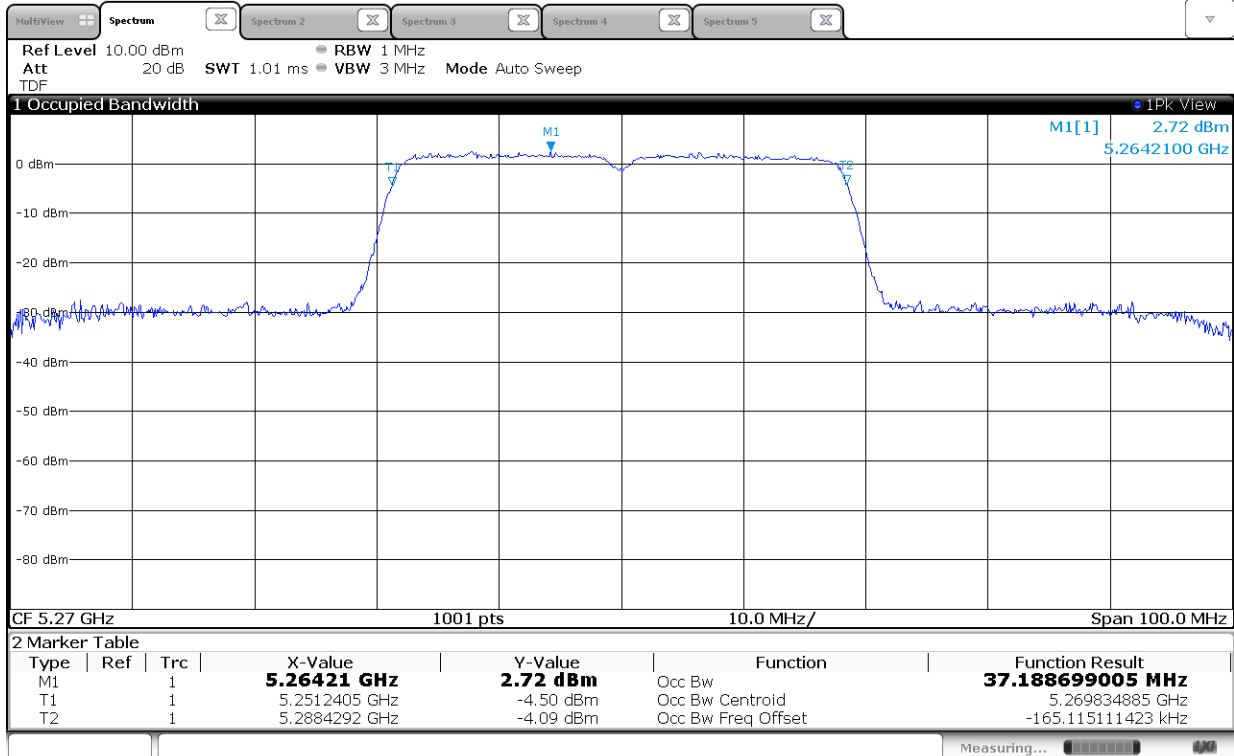
Operating Mode: 802.11n HT40 (U-NII 3 Band) (High Channel)



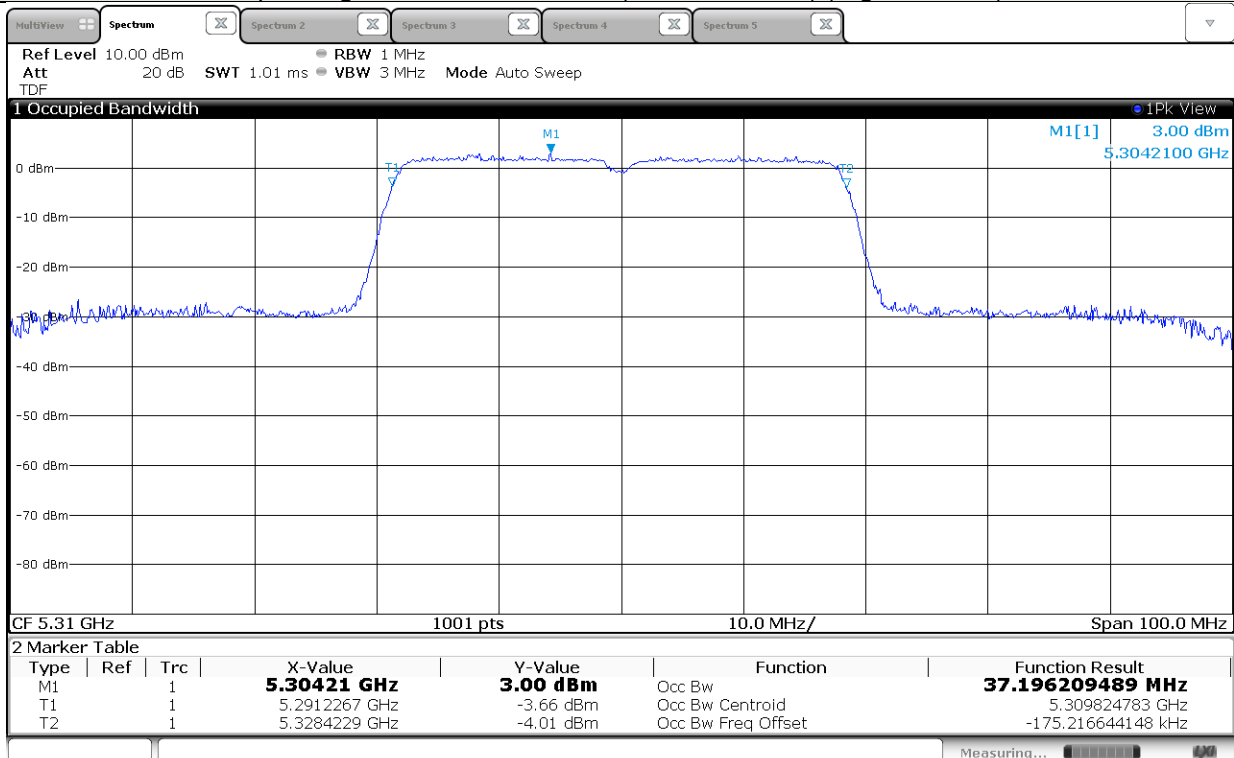
5.1.5.3 Graphic Test Data – 99 % occupied bandwidth



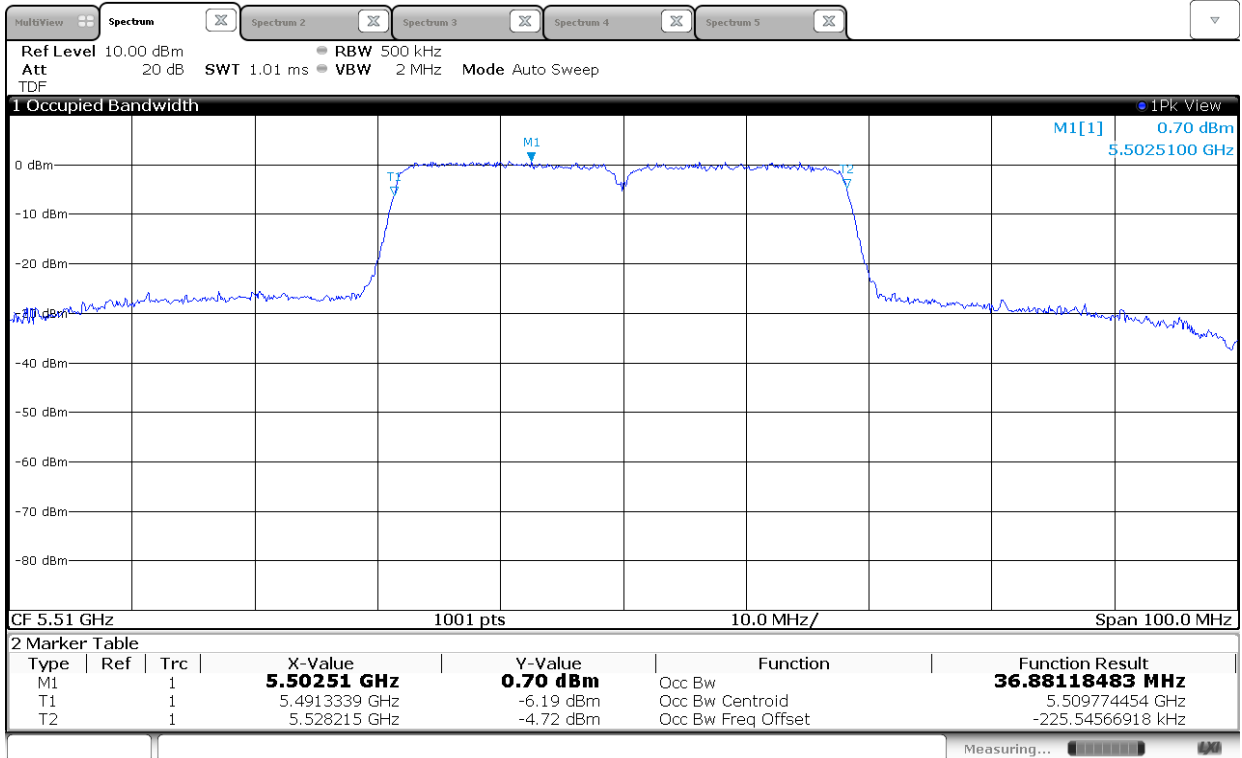
Operating Mode: 802.11n HT40 (U-NII 2-A Band) (Low Channel)



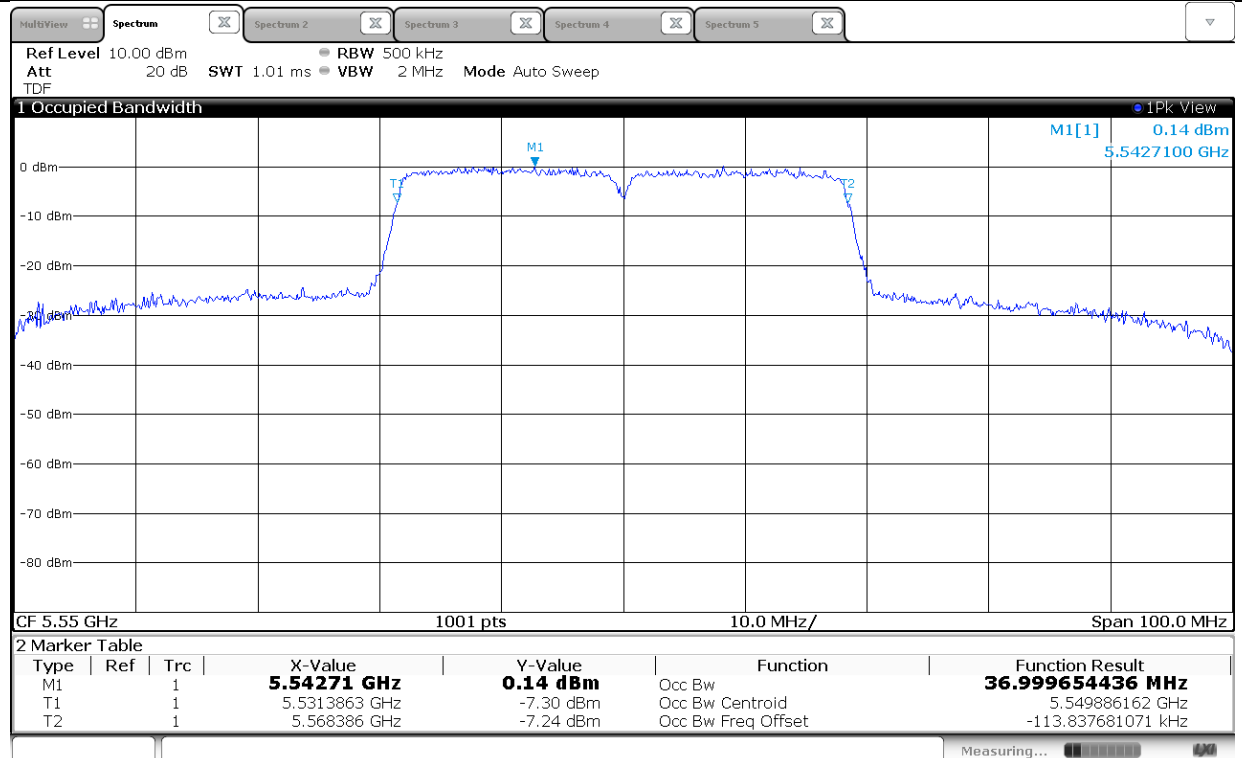
Operating Mode: 802.11n HT40 (U-NII 2-A Band) (High Channel)



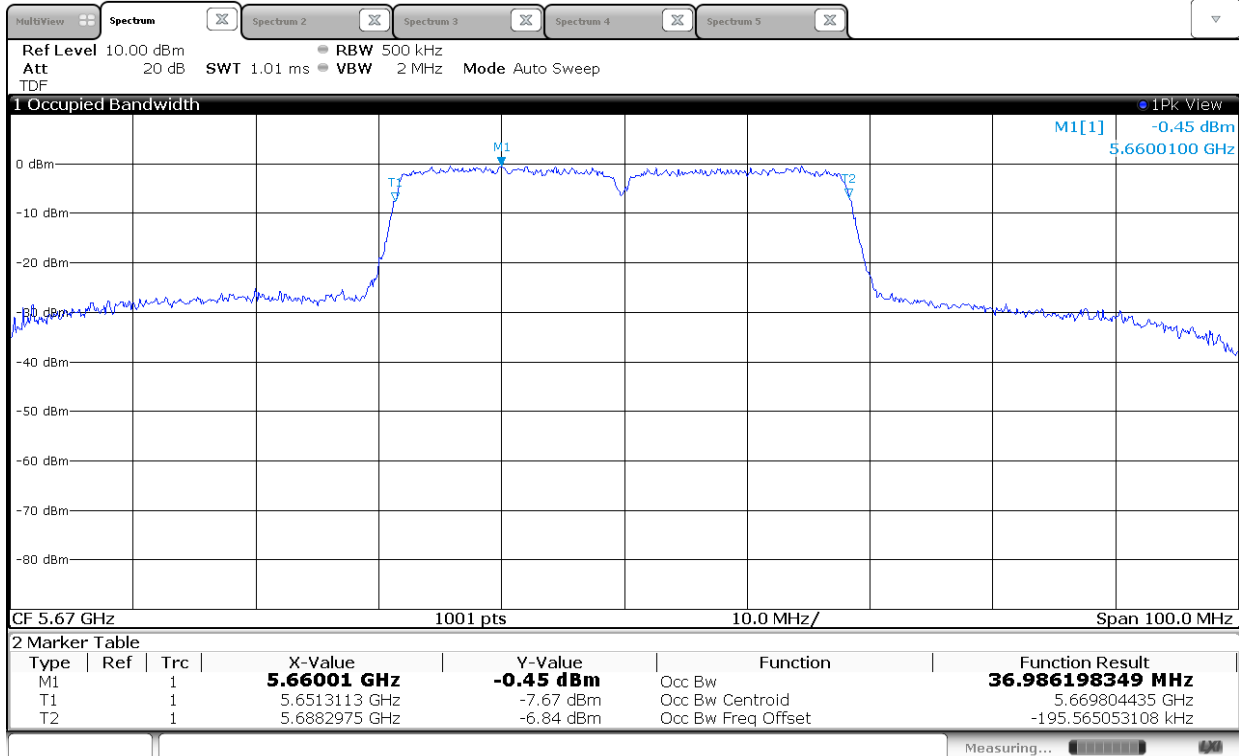
Operating Mode: 802.11n HT40 (U-NII 2-C Band) (Low Channel)



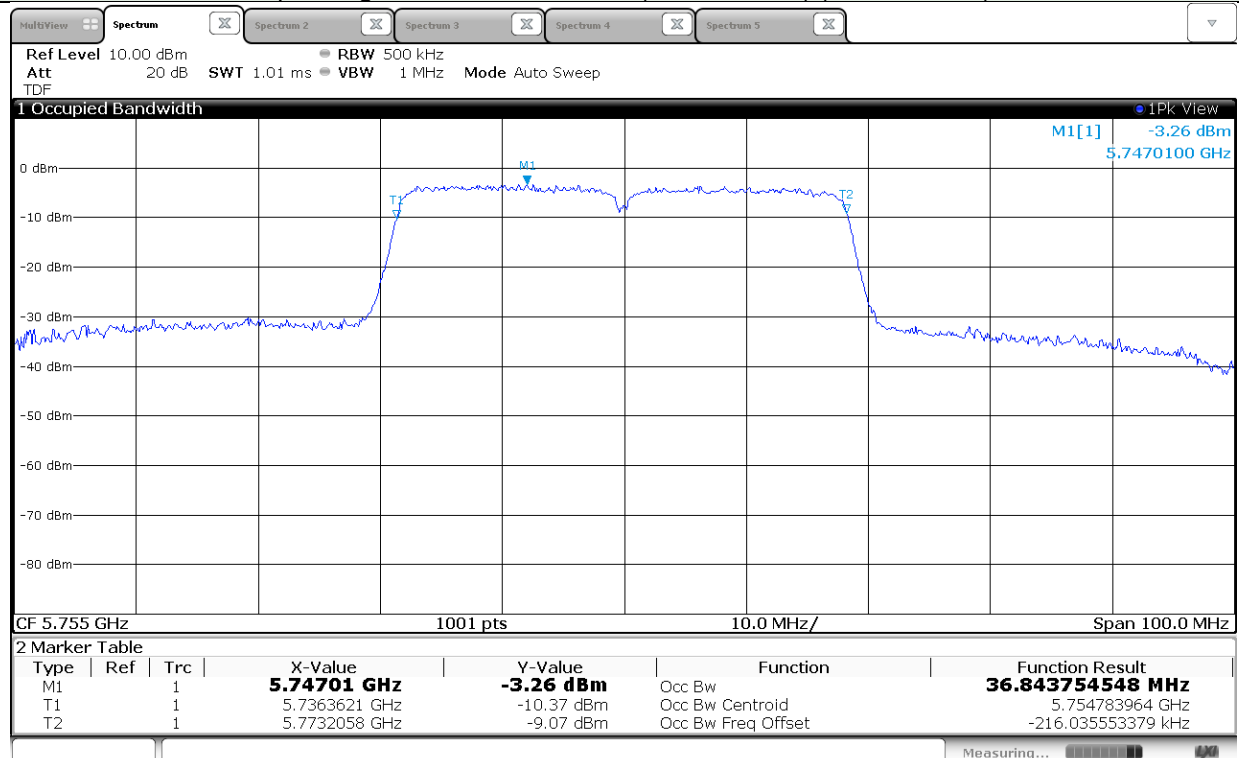
Operating Mode: 802.11n HT40 (U-NII 2-C Band) (Middle Channel)



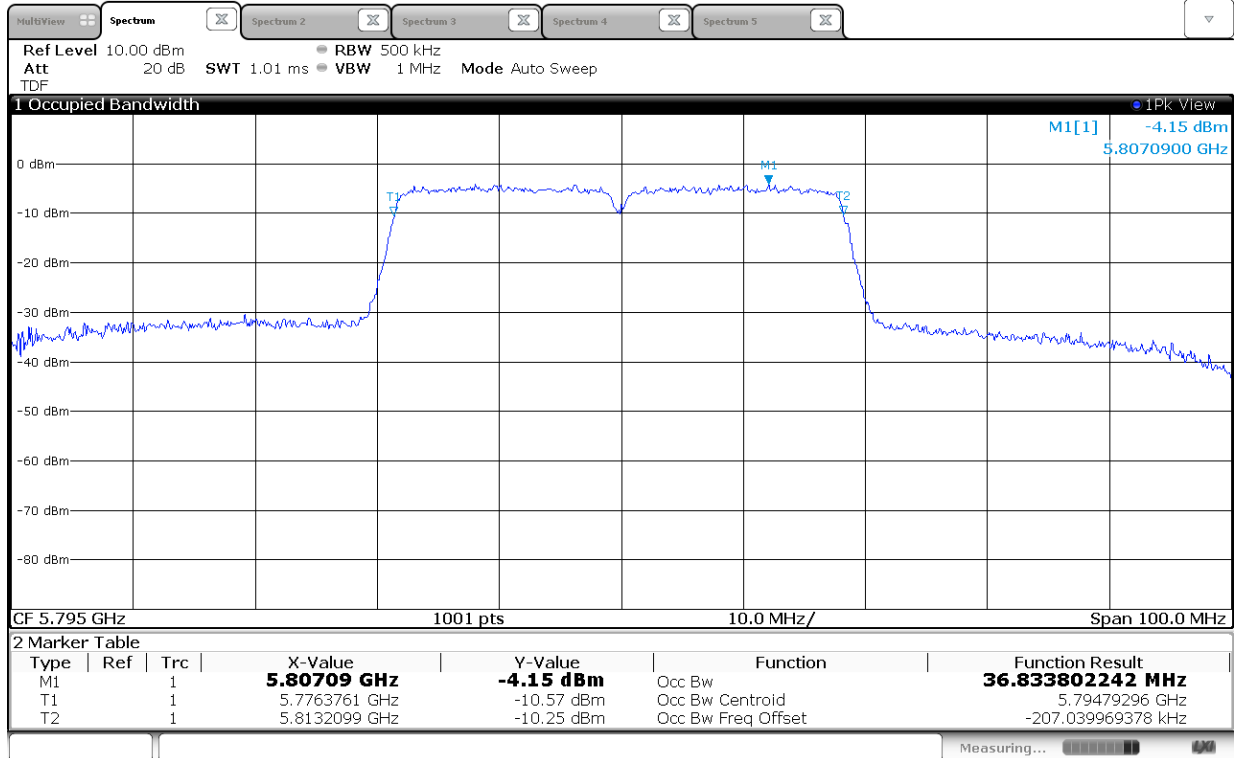
Operating Mode: 802.11n HT40 (U-NII 2-C Band) (High Channel)



Operating Mode: 802.11n HT40 (U-NII 3 Band) (Low Channel)



Operating Mode: 802.11n HT40 (U-NII 3 Band) (High Channel)

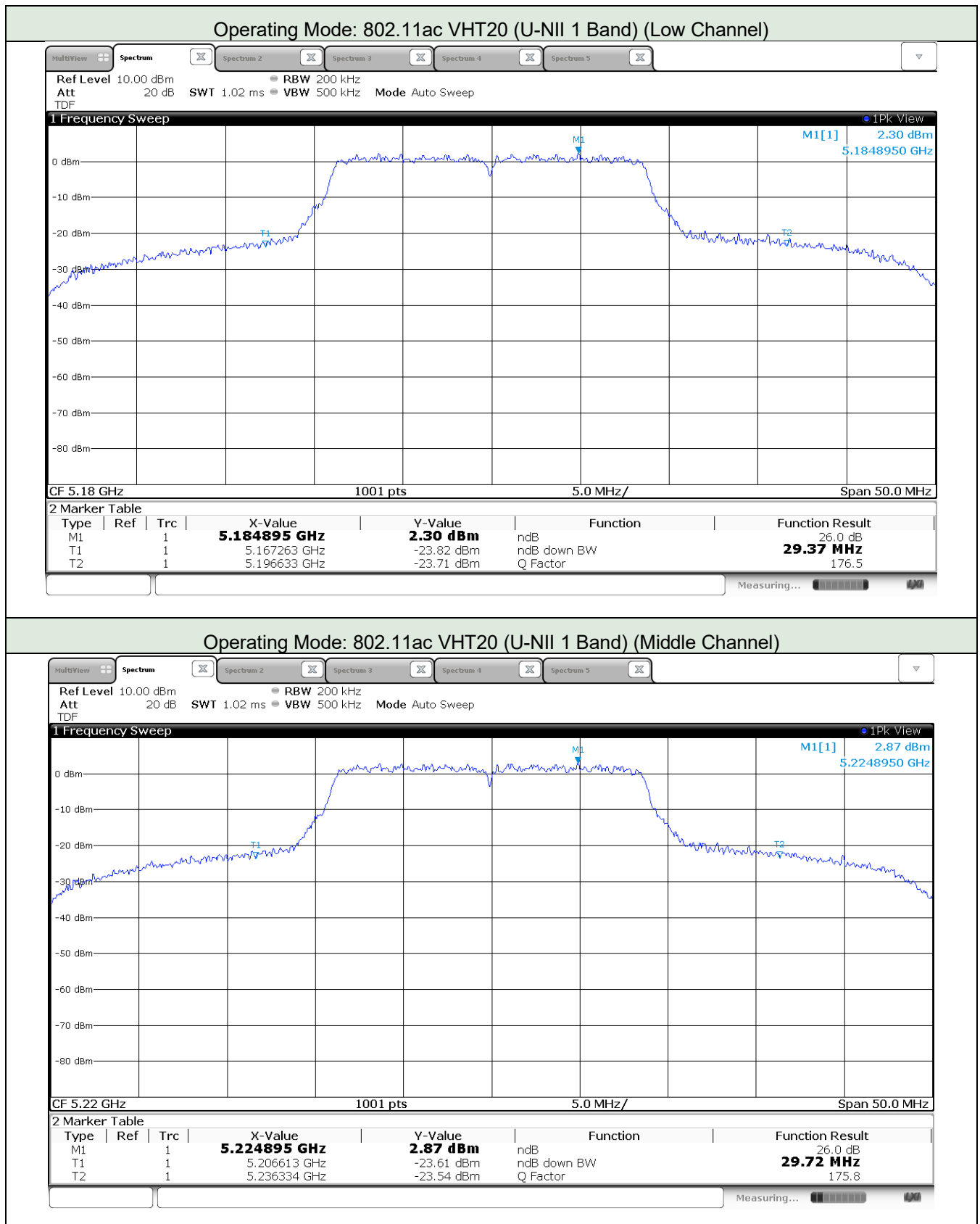


5.1.6 Test Data - Operating Mode: 802.11ac VHT20

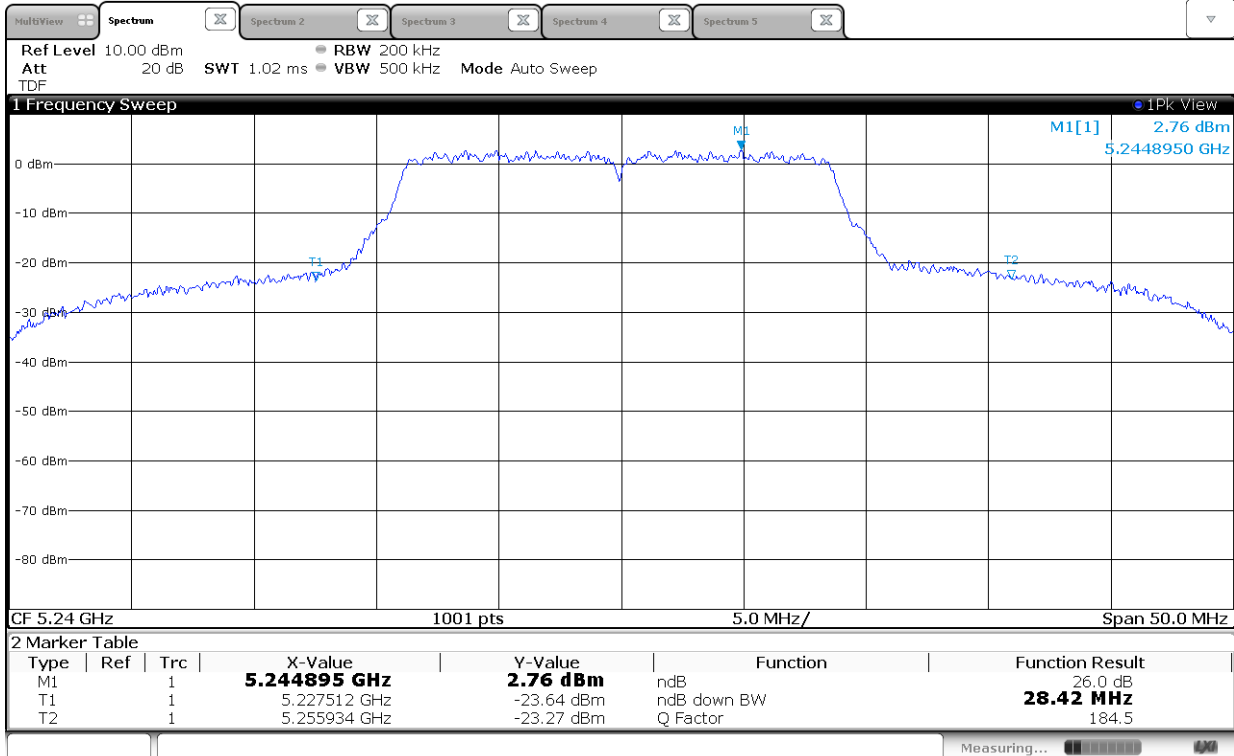
5.1.6.1 Tabulated Test Data

Date of Test		2020.04.09 – 2020.04.10	Temperature		(23.0 ± 1.0) °C
			Relative humidity		(50.0 ± 3.0) % R.H.
Test Result		PASS		Tested by In-yong Song 	
Operating Mode: 802.11ac VHT20 (U-NII Band 1)					
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result	
Low	5 180	29.37	18.88	-	
Middle	5 220	29.72	18.77		
High	5 240	28.42	18.69		
Operating Mode: 802.11ac VHT20 (U-NII Band 2-A)					
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result	
Low	5 260	26.97	18.63	-	
Middle	5 300	27.07	18.62		
High	5 320	26.52	18.59		
Operating Mode: 802.11ac VHT20 (U-NII Band 2-C)					
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result	
Low	5 500	27.57	18.79	-	
Middle	5 560	27.07	18.63		
High	5 700	27.42	18.79		
Operating Mode: 802.11ac VHT20 (U-NII Band 3)					
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result	
Low	5 745	23.43	18.42	-	
Middle	5 785	23.88	18.48		
High	5 825	23.43	18.44		

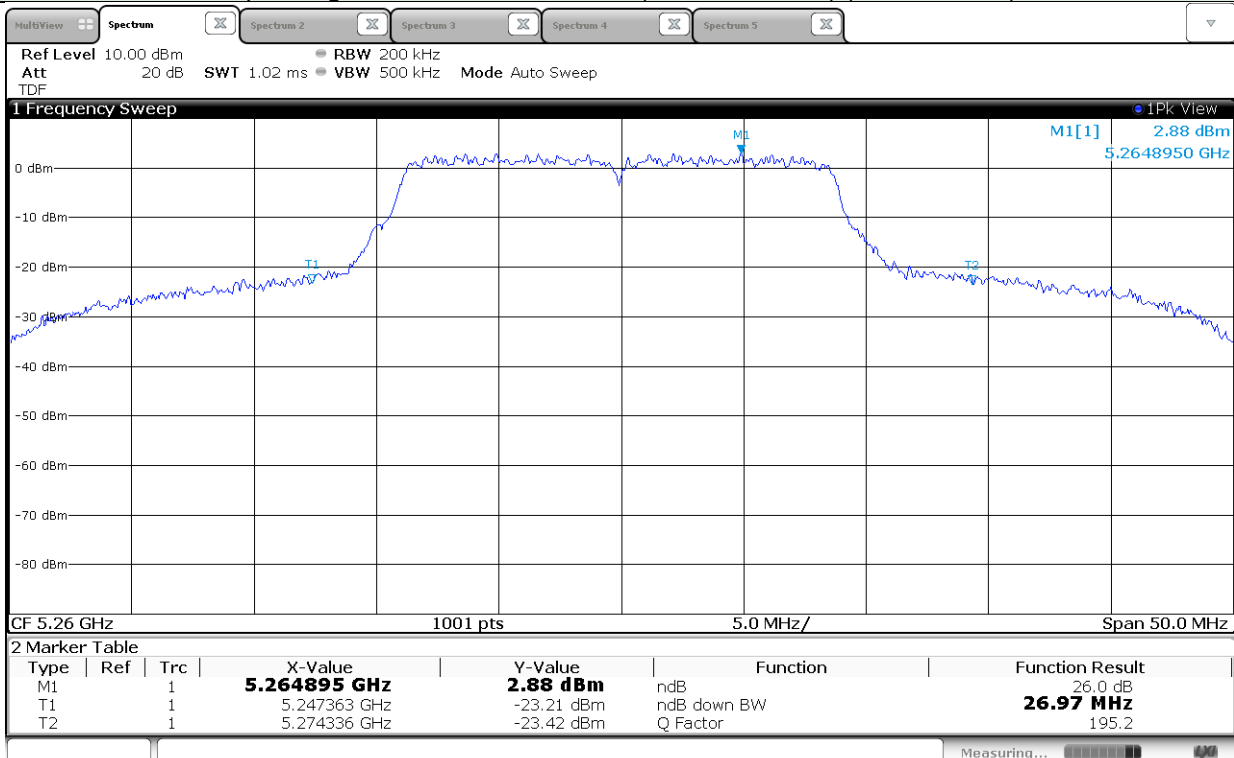
5.1.6.2 Graphic Test Data – 26 dB bandwidth



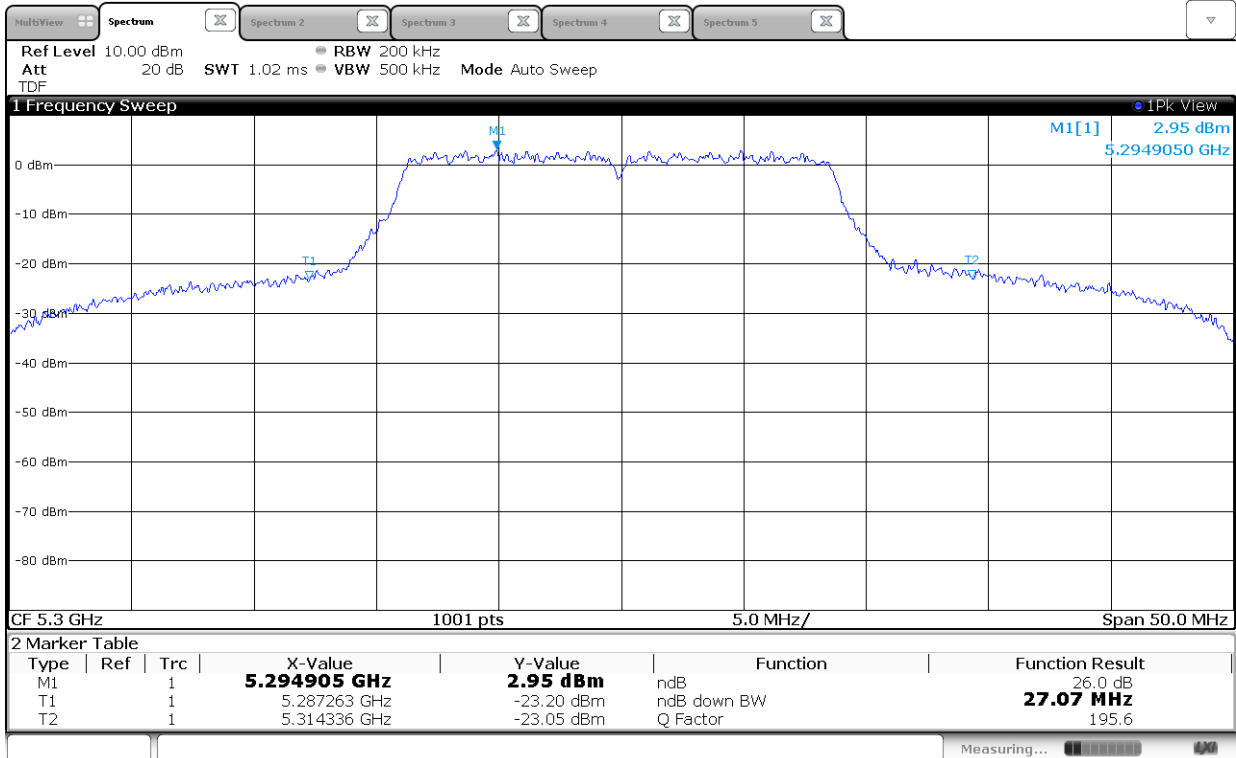
Operating Mode: 802.11ac VHT20 (U-NII 1 Band) (High Channel)



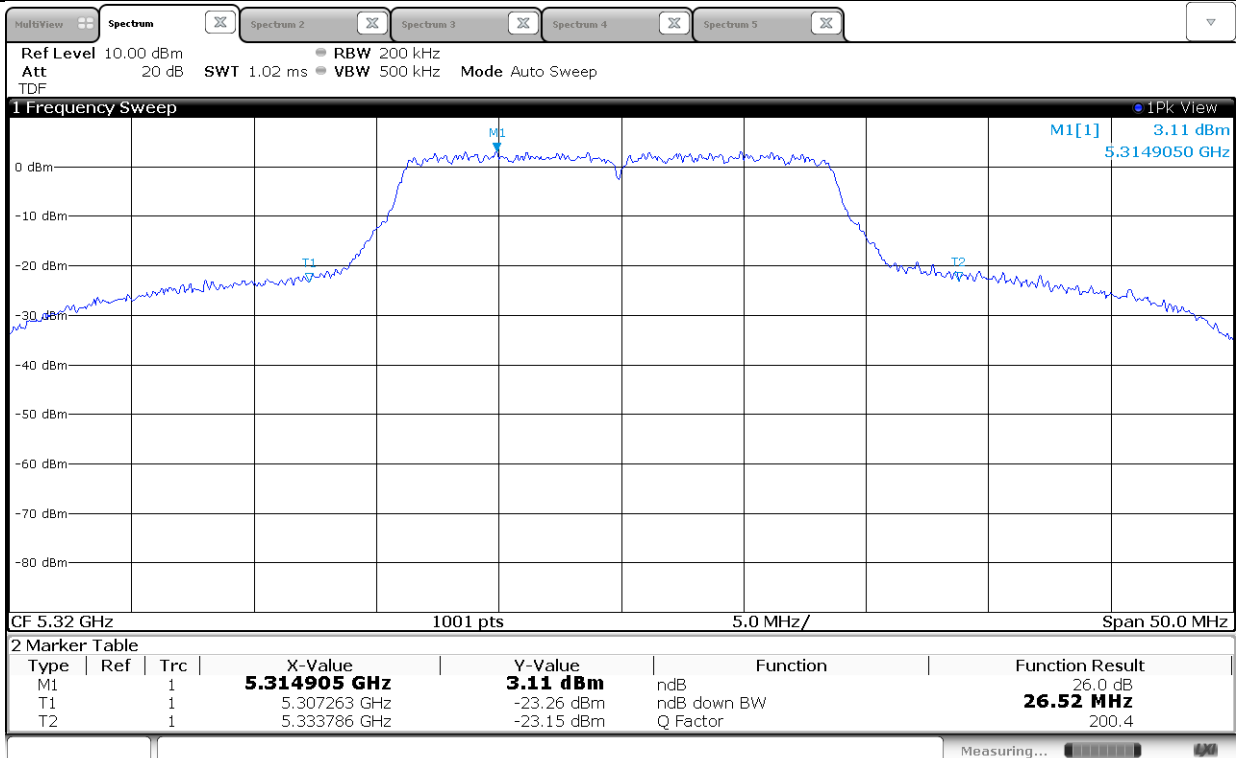
Operating Mode: 802.11ac VHT20 (U-NII 2-A Band) (Low Channel)



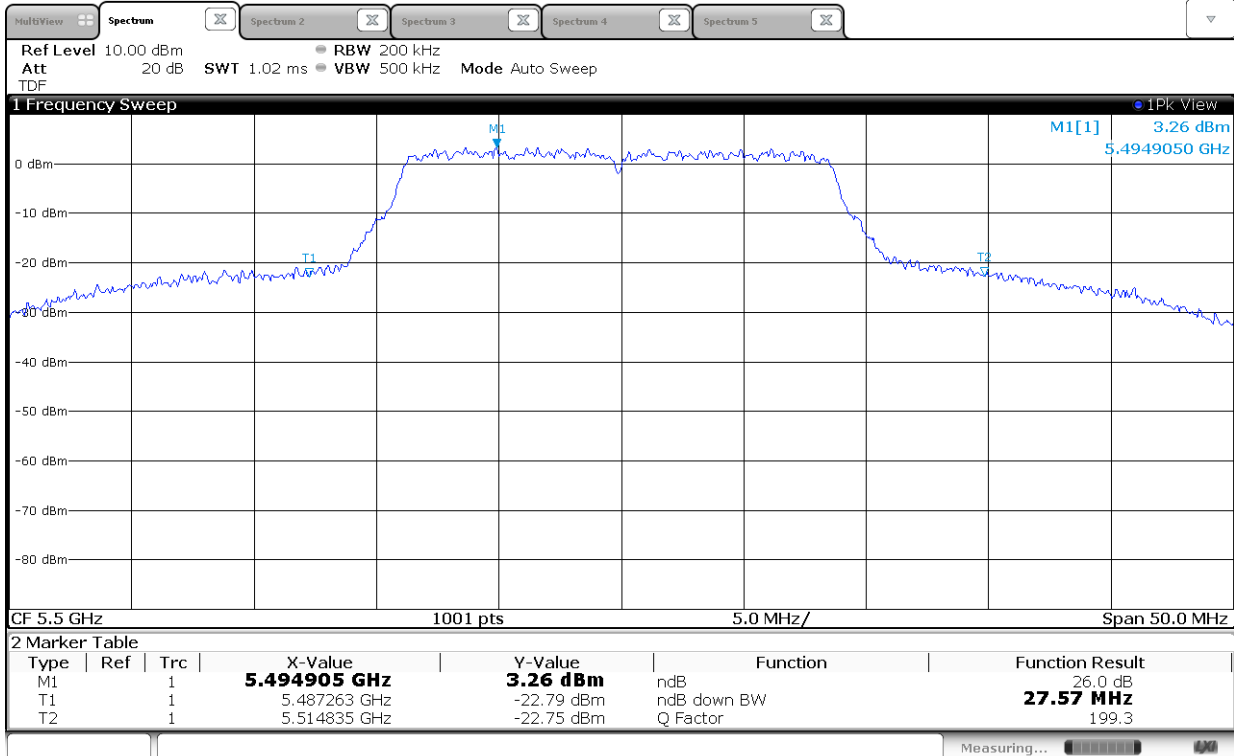
Operating Mode: 802.11ac VHT20 (U-NII 2-A Band) (Middle Channel)



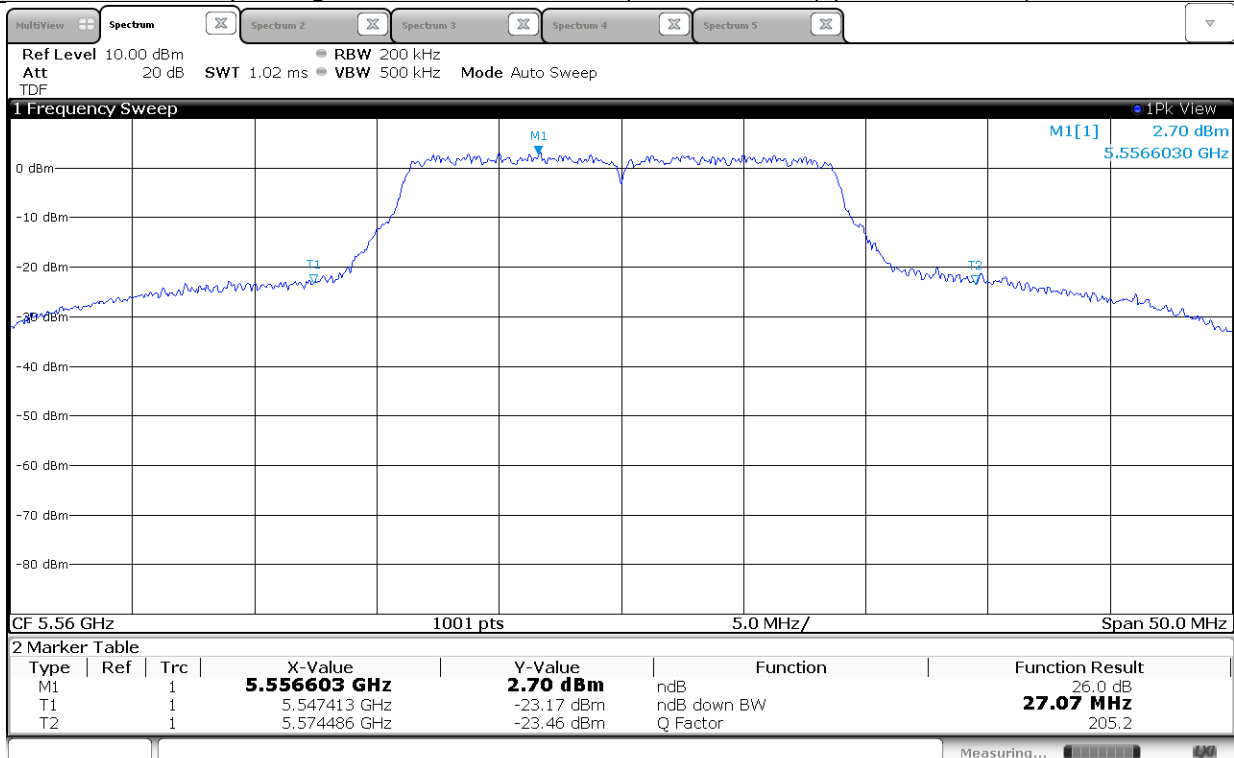
Operating Mode: 802.11ac VHT20 (U-NII 2-A Band) (High Channel)



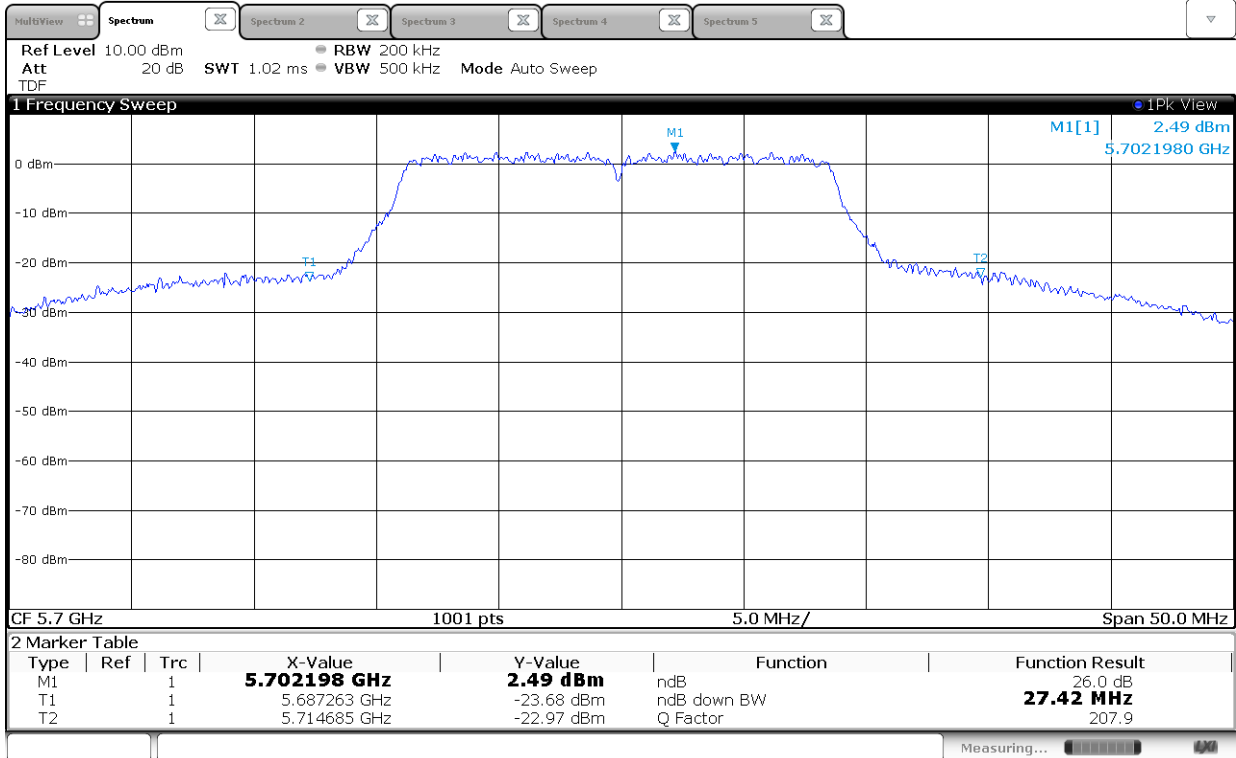
Operating Mode: 802.11ac VHT20 (U-NII 2-C Band) (Low Channel)



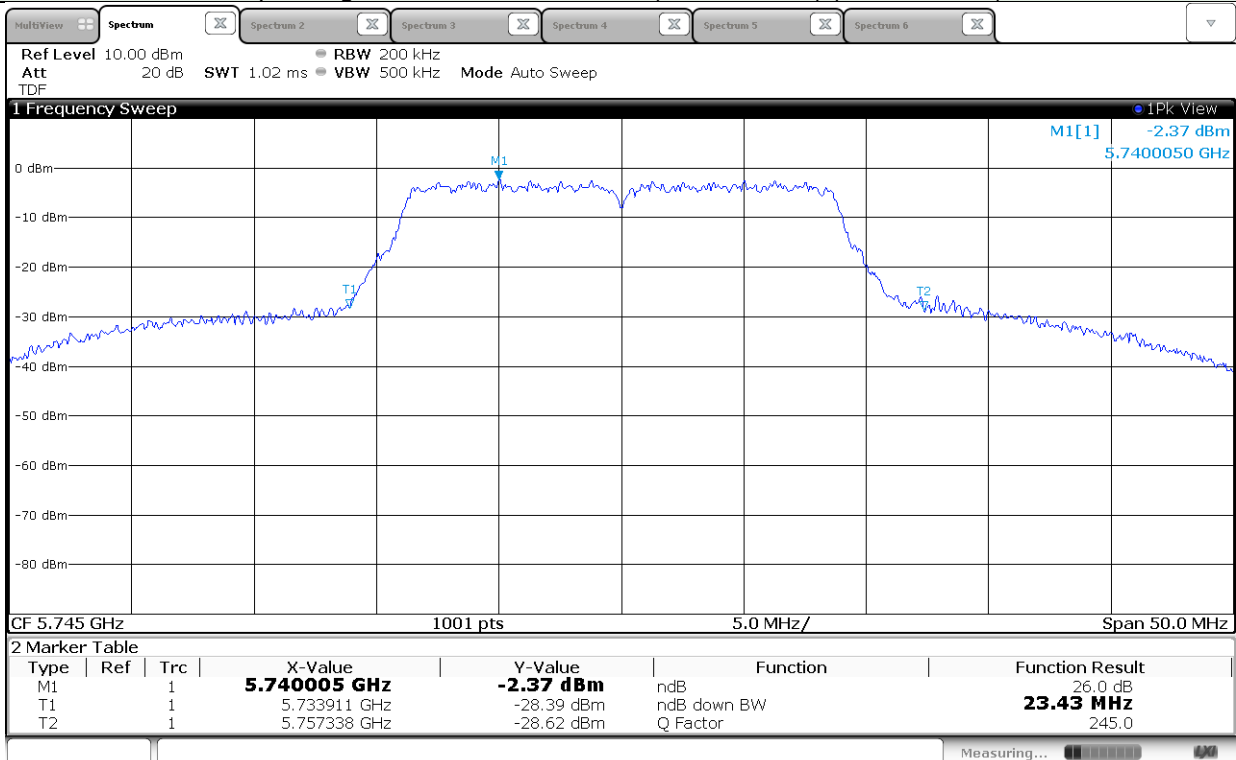
Operating Mode: 802.11ac VHT20 (U-NII 2-C Band) (Middle Channel)



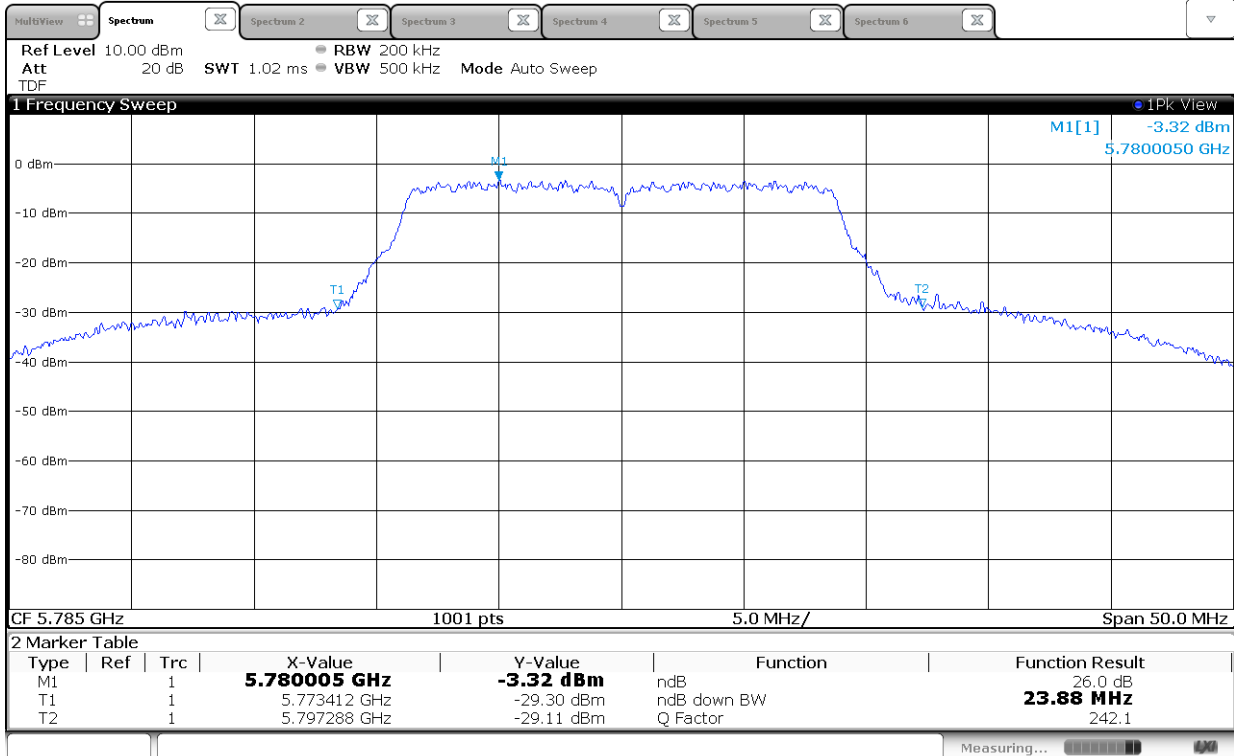
Operating Mode: 802.11ac VHT20 (U-NII 2-C Band) (High Channel)



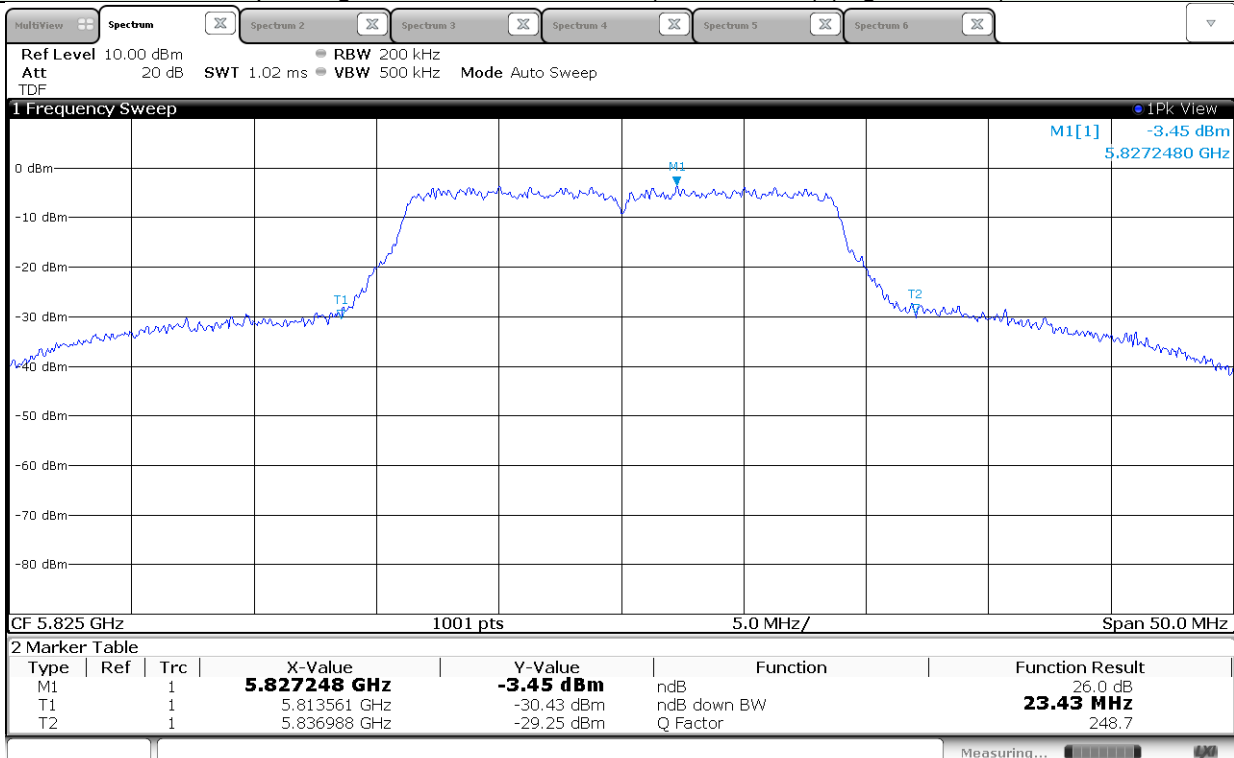
Operating Mode: 802.11ac VHT20 (U-NII 3 Band) (Low Channel)



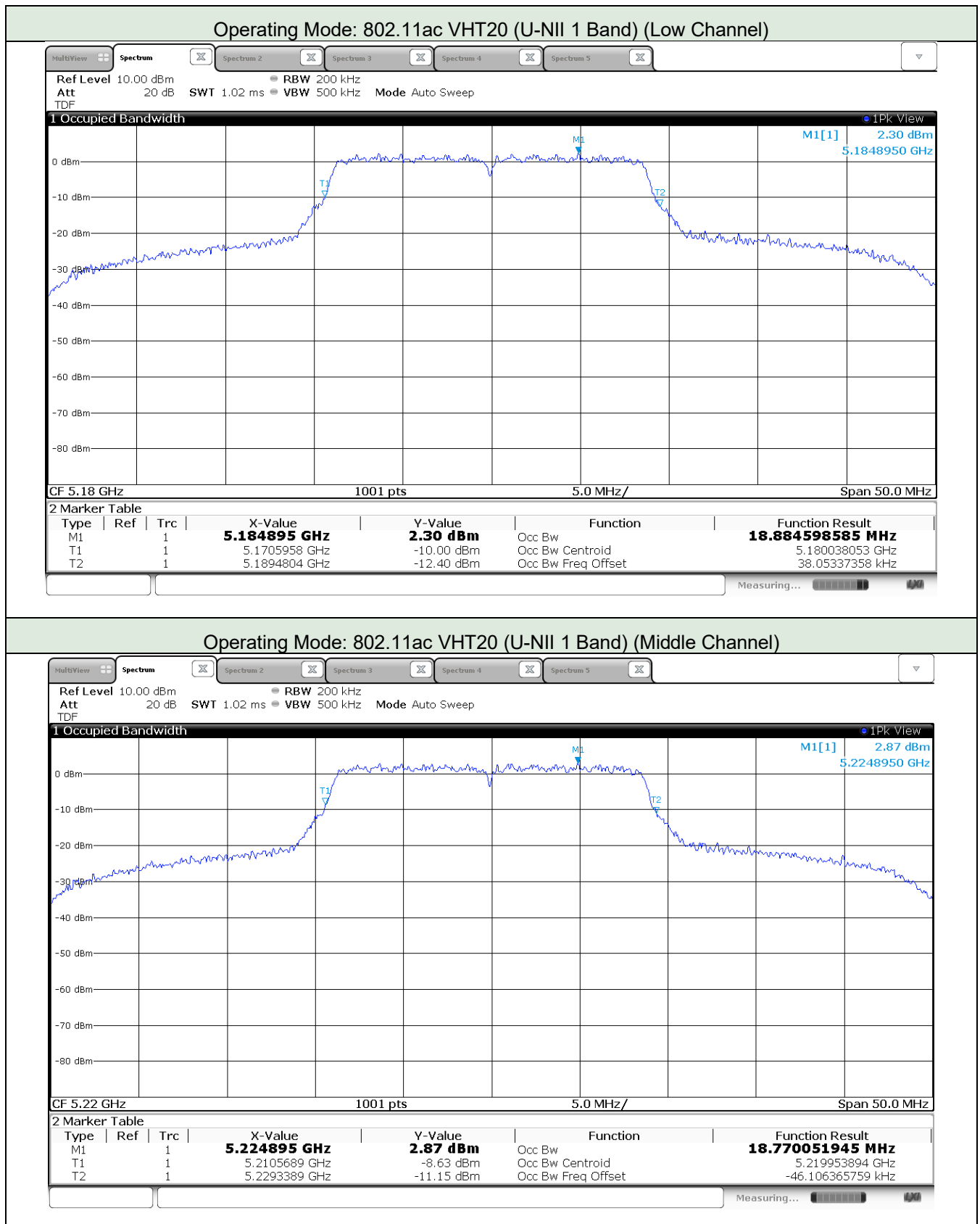
Operating Mode: 802.11ac VHT20 (U-NII 3 Band) (Middle Channel)



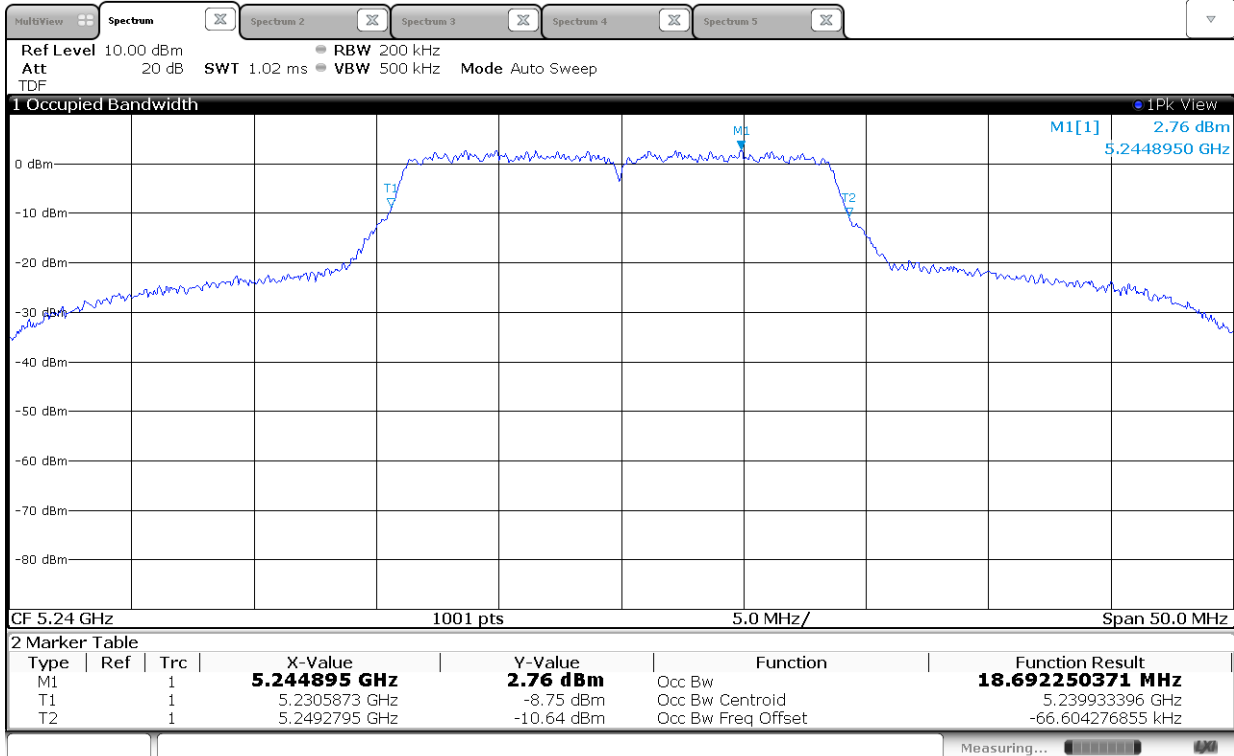
Operating Mode: 802.11ac VHT20 (U-NII 3 Band) (High Channel)



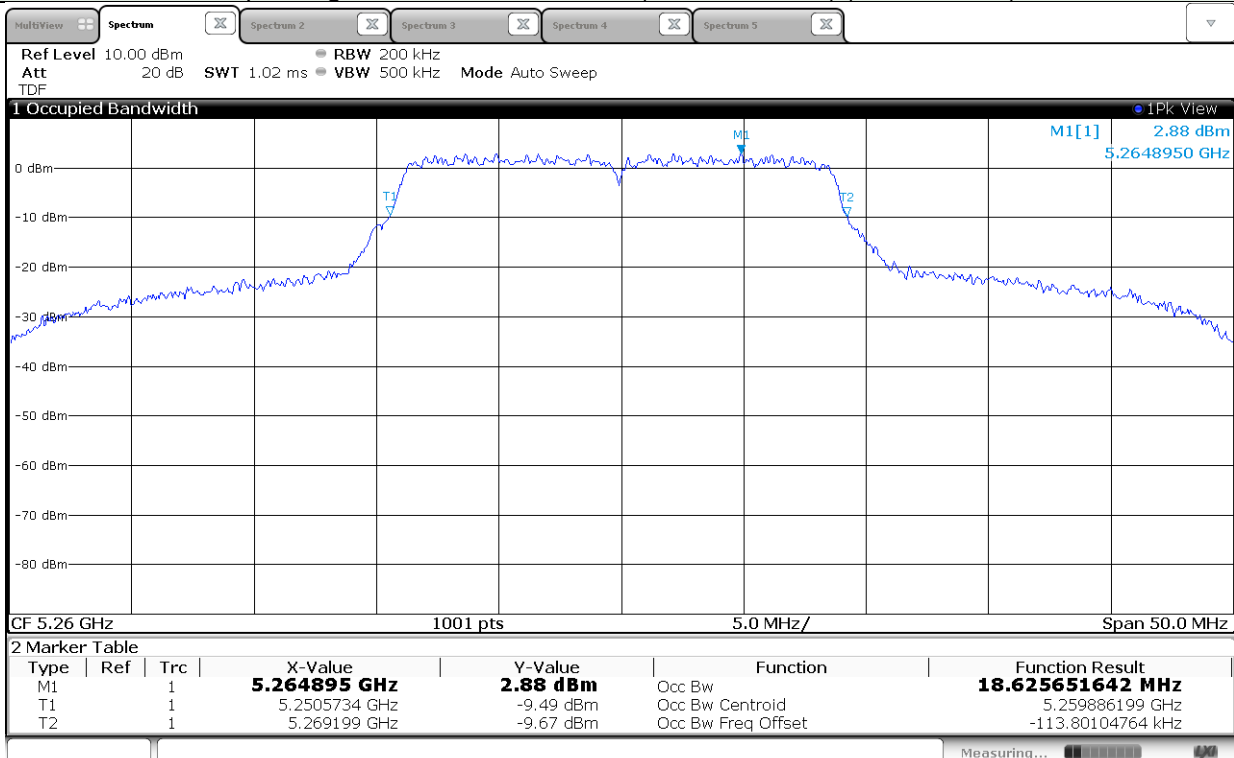
5.1.6.3 Graphic Test Data – 99 % occupied bandwidth



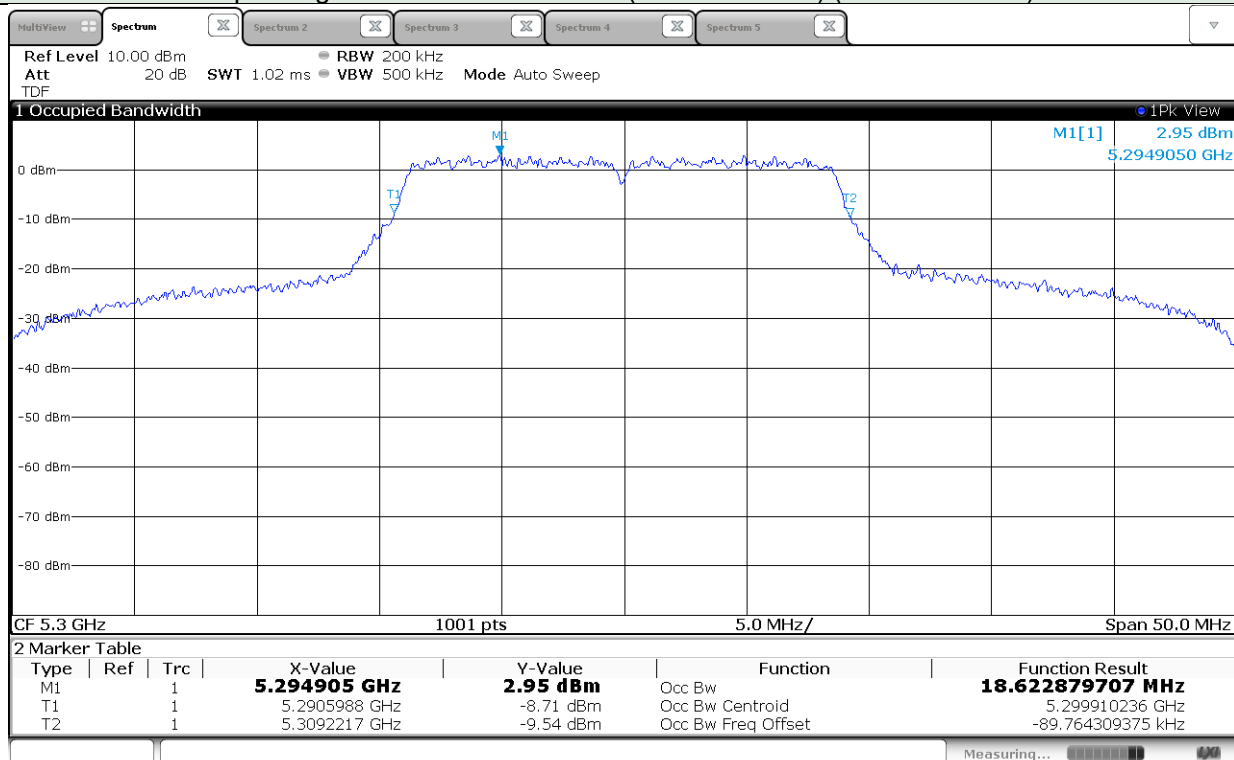
Operating Mode: 802.11ac VHT20 (U-NII 1 Band) (High Channel)



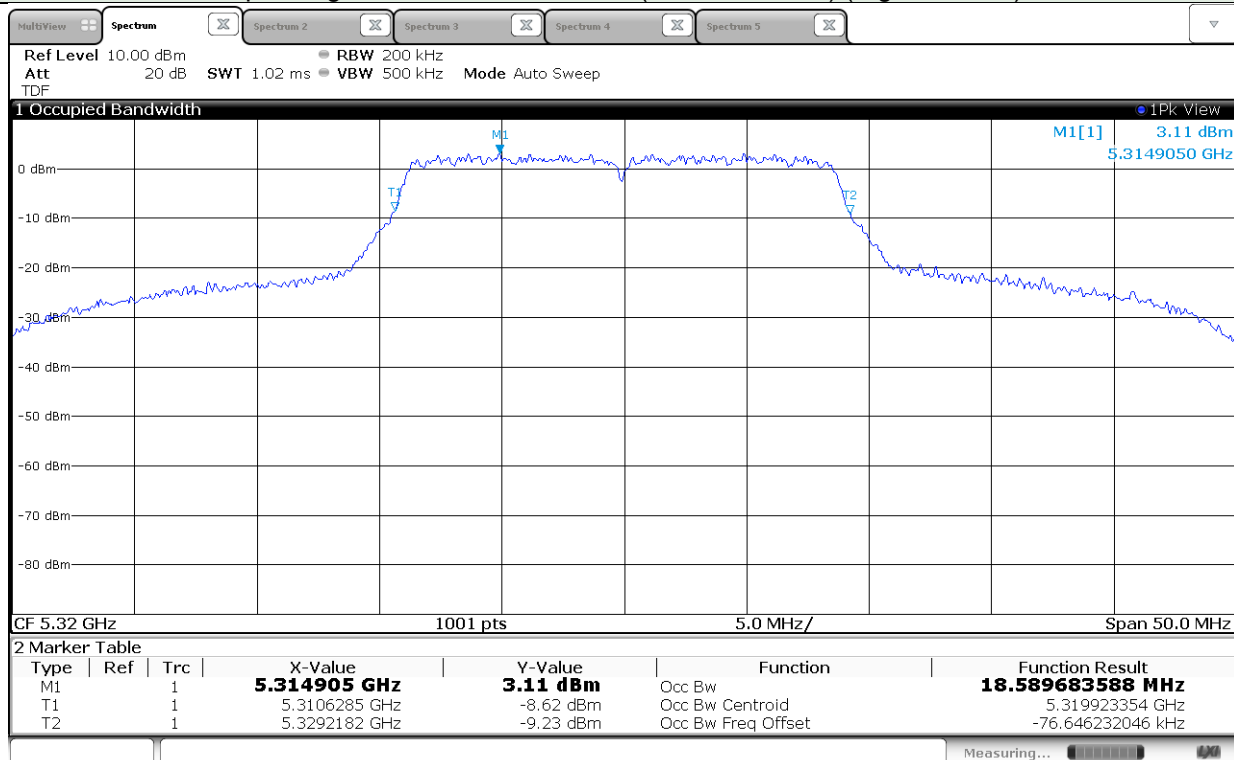
Operating Mode: 802.11ac VHT20 (U-NII 2-A Band) (Low Channel)



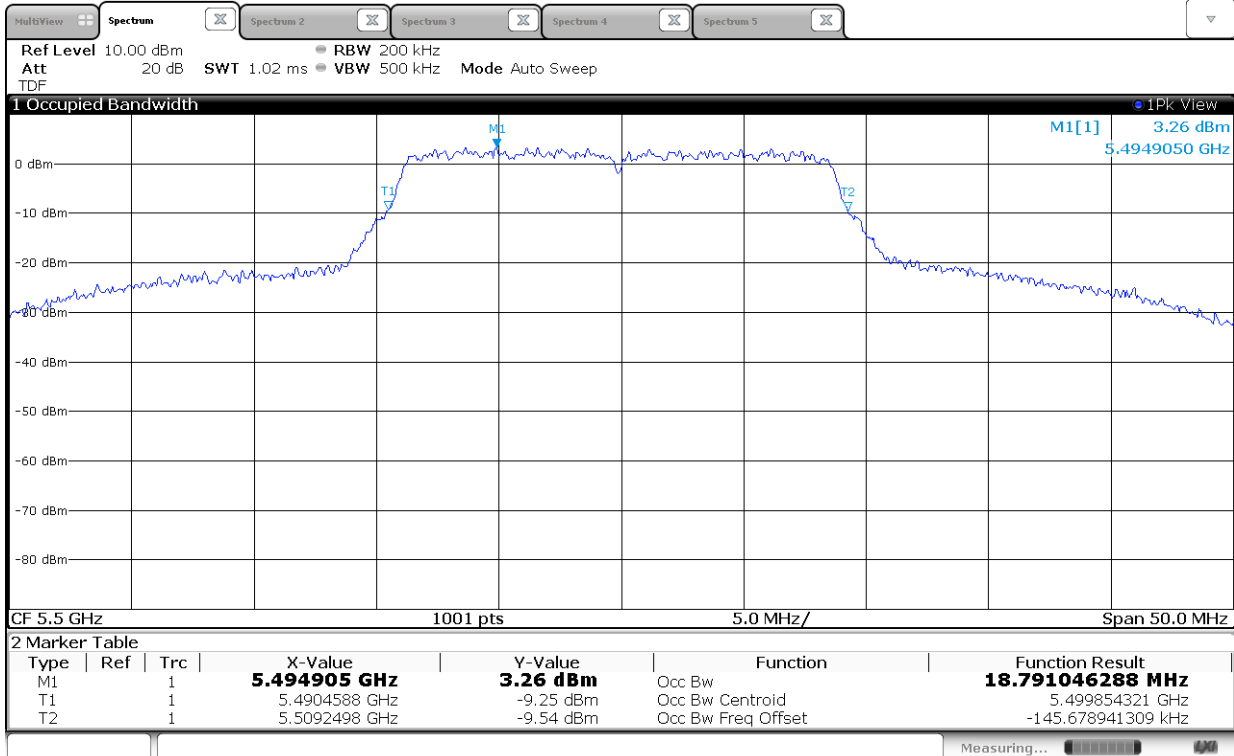
Operating Mode: 802.11ac VHT20 (U-NII 2-A Band) (Middle Channel)



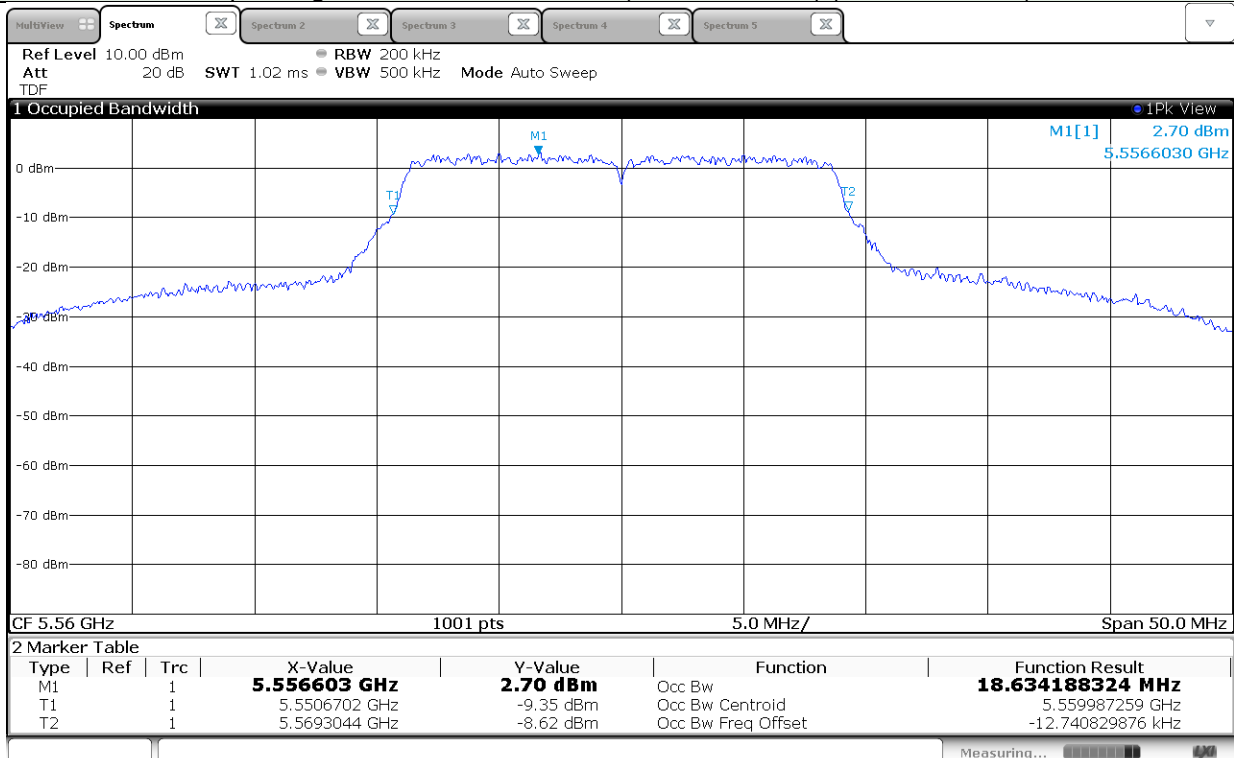
Operating Mode: 802.11ac VHT20 (U-NII 2-A Band) (High Channel)



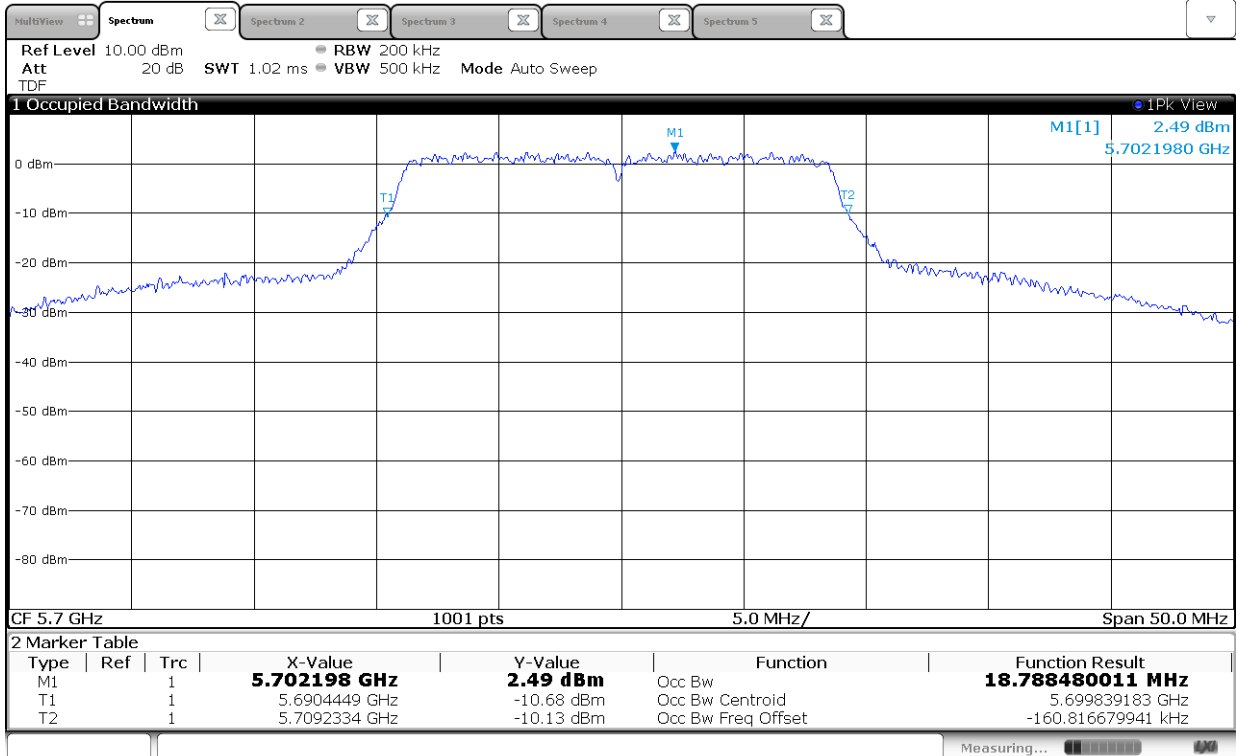
Operating Mode: 802.11ac VHT20 (U-NII 2-C Band) (Low Channel)



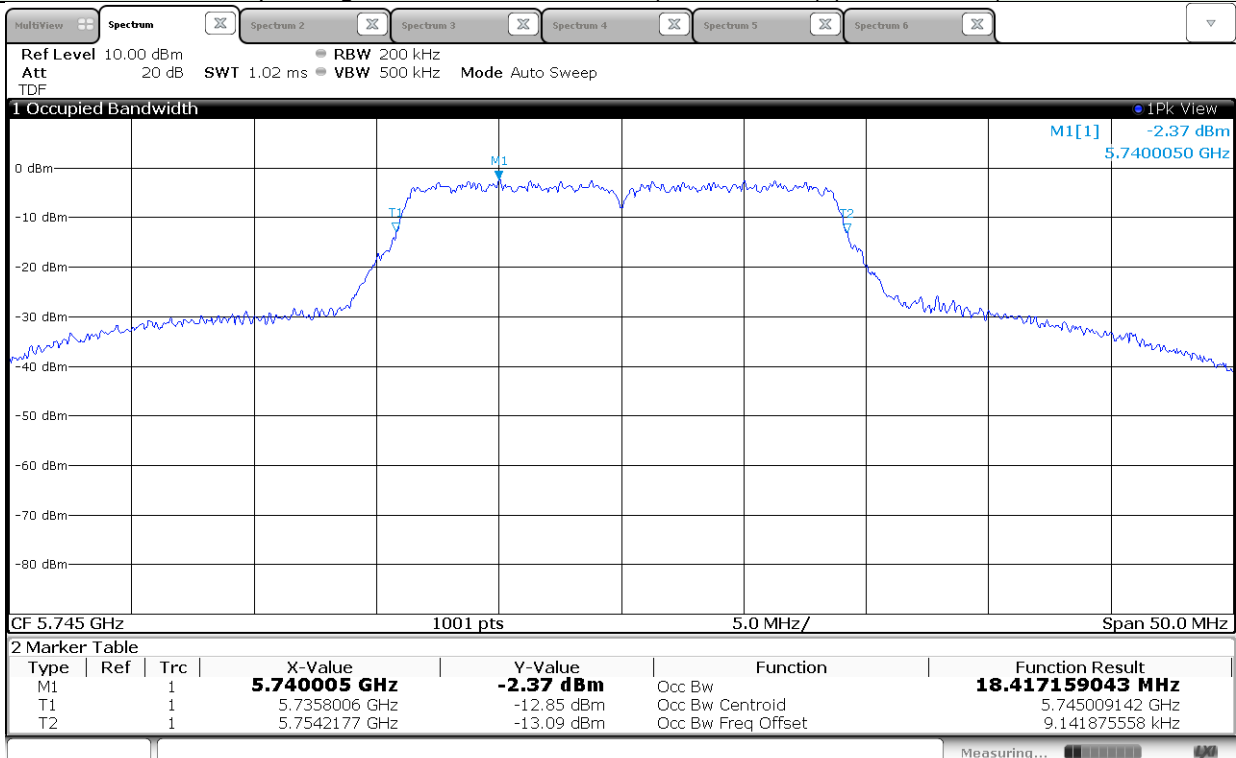
Operating Mode: 802.11ac VHT20 (U-NII 2-C Band) (Middle Channel)



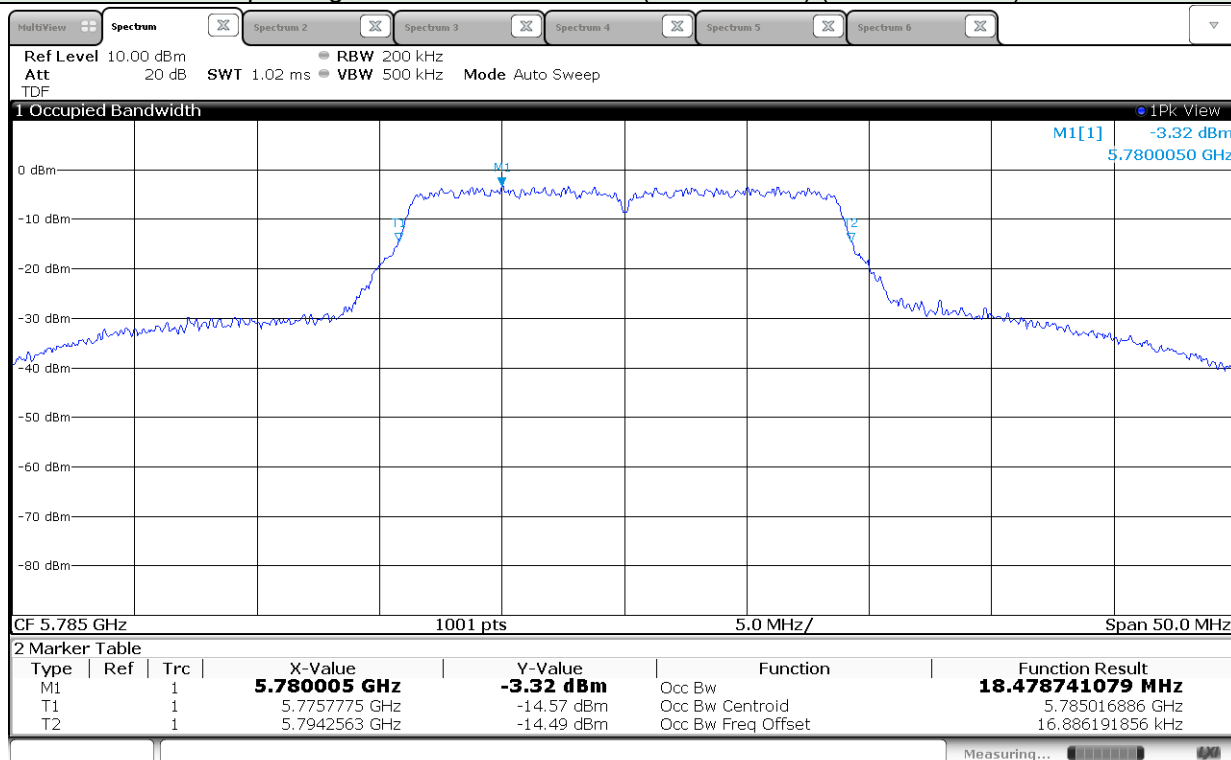
Operating Mode: 802.11ac VHT20 (U-NII 2-C Band) (High Channel)



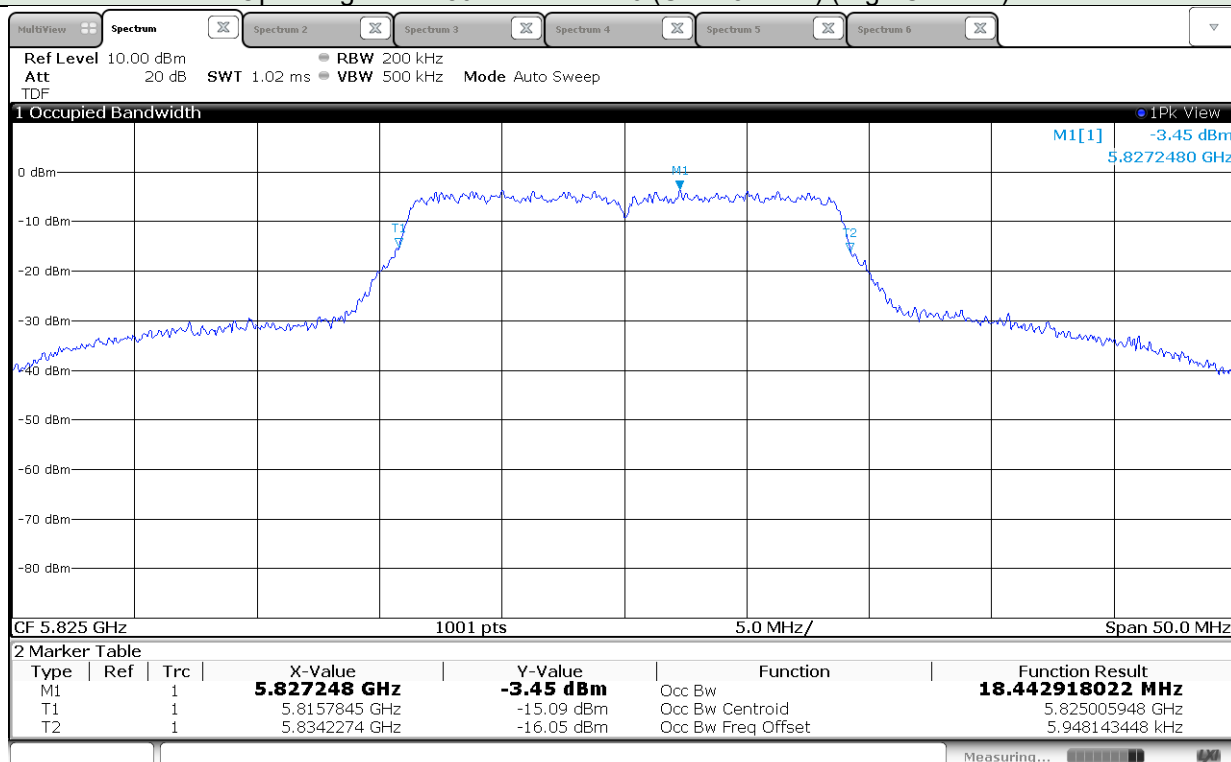
Operating Mode: 802.11ac VHT20 (U-NII 3 Band) (Low Channel)



Operating Mode: 802.11ac VHT20 (U-NII 3 Band) (Middle Channel)



Operating Mode: 802.11ac VHT20 (U-NII 3 Band) (High Channel)

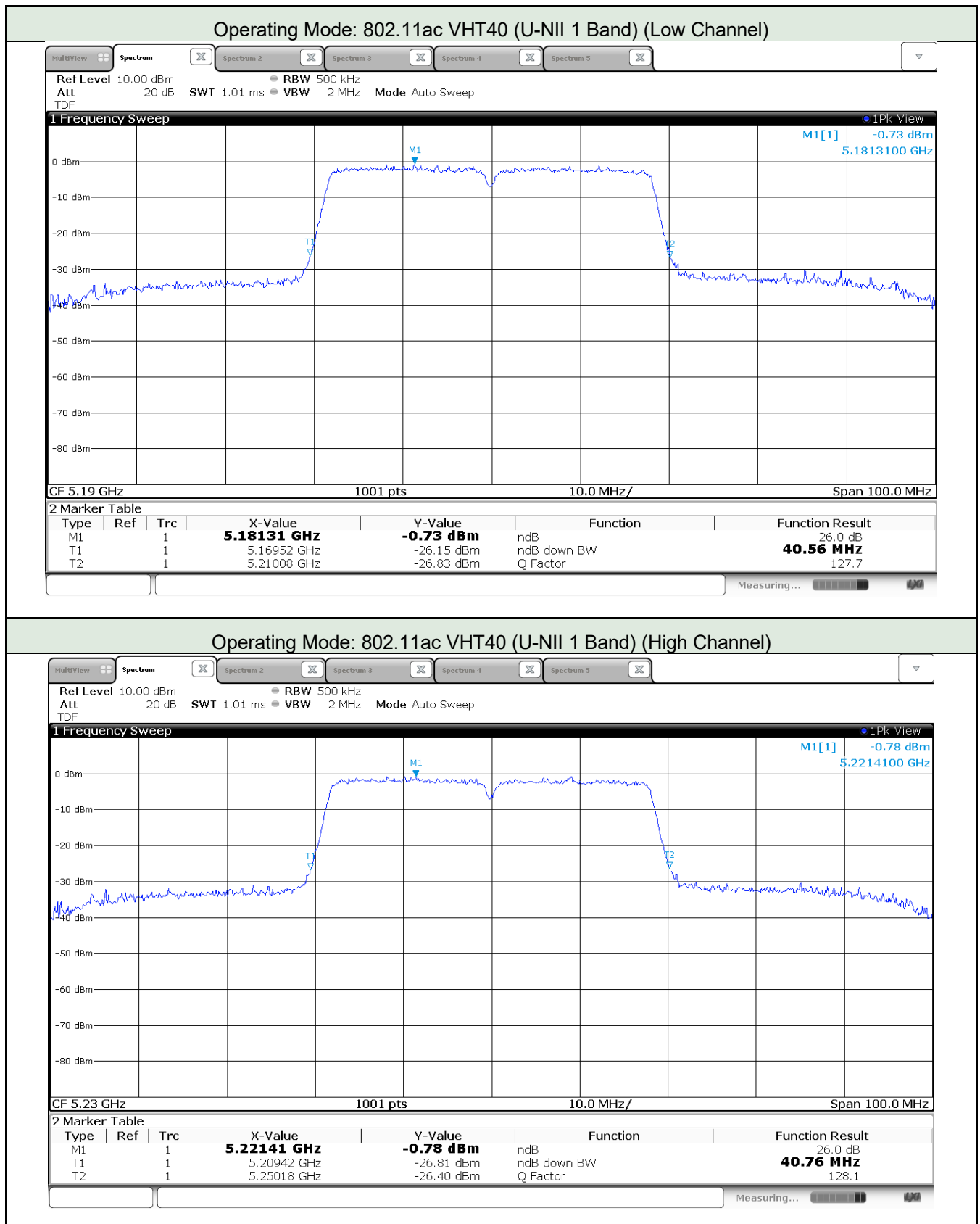


5.1.7 Test Data - Operating Mode: 802.11ac VHT40

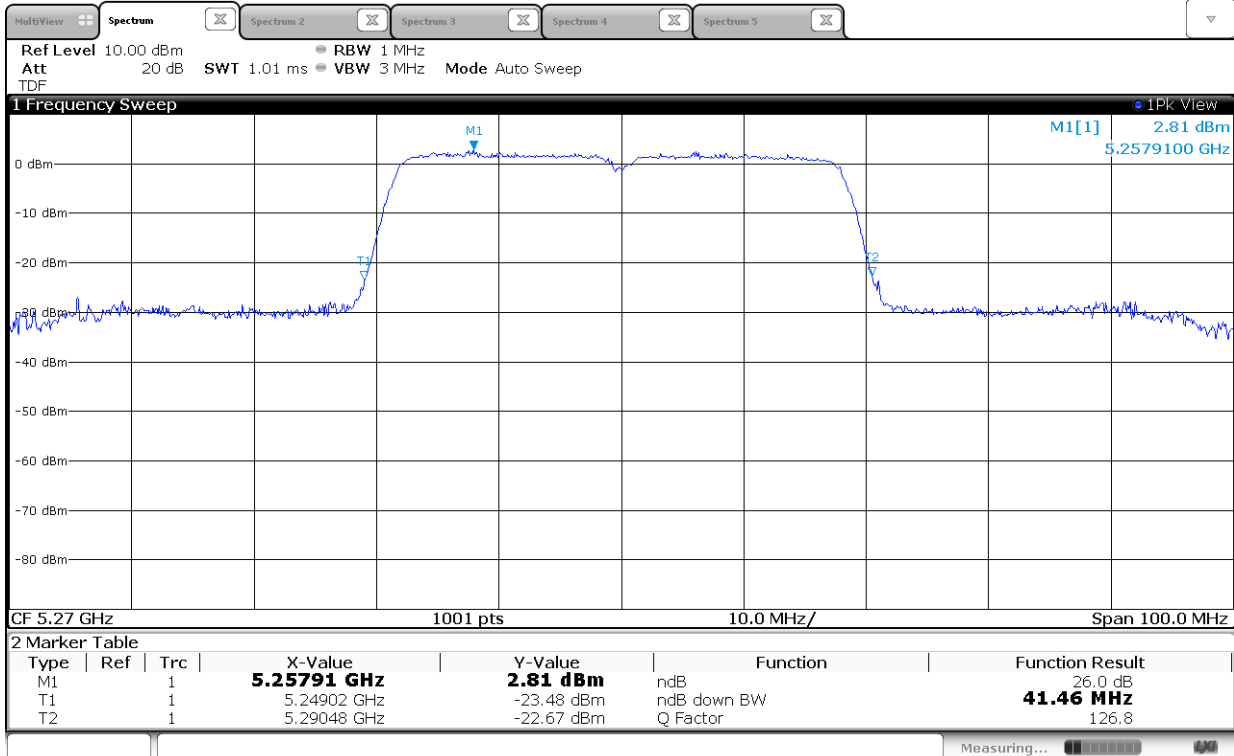
5.1.7.1 Tabulated Test Data

Date of Test		2020.04.09 – 2020.04.10	Temperature		(23.0 ± 1.0) °C	
			Relative humidity		(50.0 ± 3.0) % R.H.	
Test Result		PASS		Tested by		In-yong Song
Operating Mode: 802.11ac VHT40 (U-NII Band 1)						
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result		
Low	5 190	40.56	36.65	-		
High	5 230	40.76	36.63			
Operating Mode: 802.11ac VHT40 (U-NII Band 2-A)						
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result		
Low	5 270	41.46	37.10	-		
High	5 310	41.86	37.21			
Operating Mode: 802.11ac VHT40 (U-NII Band 2-C)						
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result		
Low	5 510	41.76	36.88	-		
Middle	5 550	42.36	37.02			
High	5 670	42.36	37.00			
Operating Mode: 802.11ac VHT40 (U-NII Band 3)						
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result		
Low	5 755	41.16	36.75	-		
High	5 795	41.36	36.76			

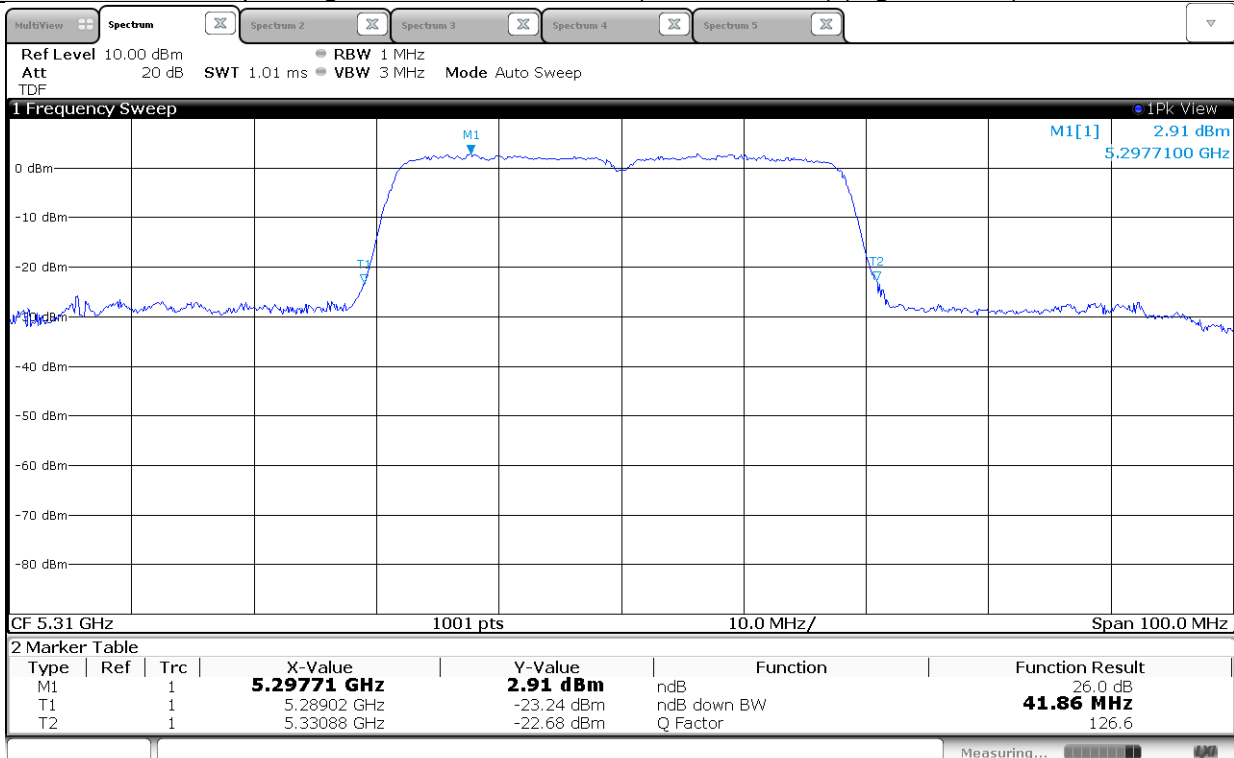
5.1.7.2 Graphic Test Data – 26 dB bandwidth



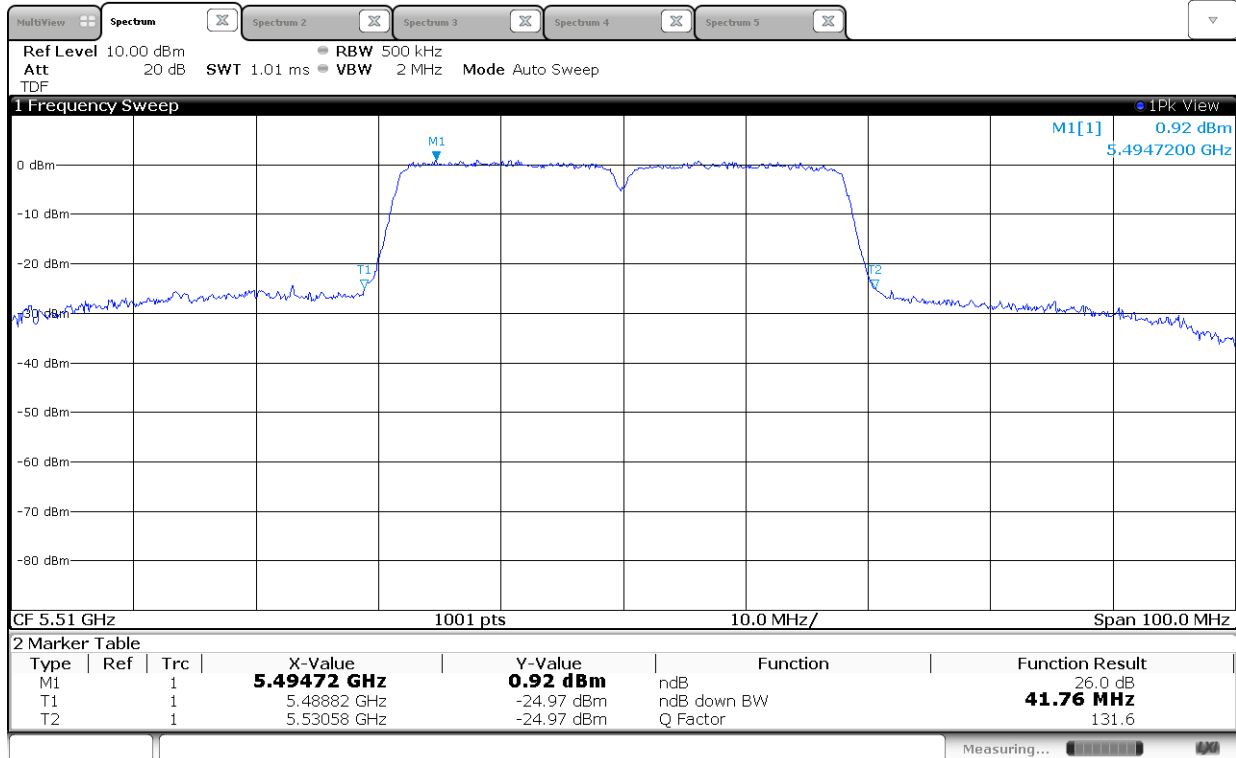
Operating Mode: 802.11ac VHT40 (U-NII 2-A Band) (Low Channel)



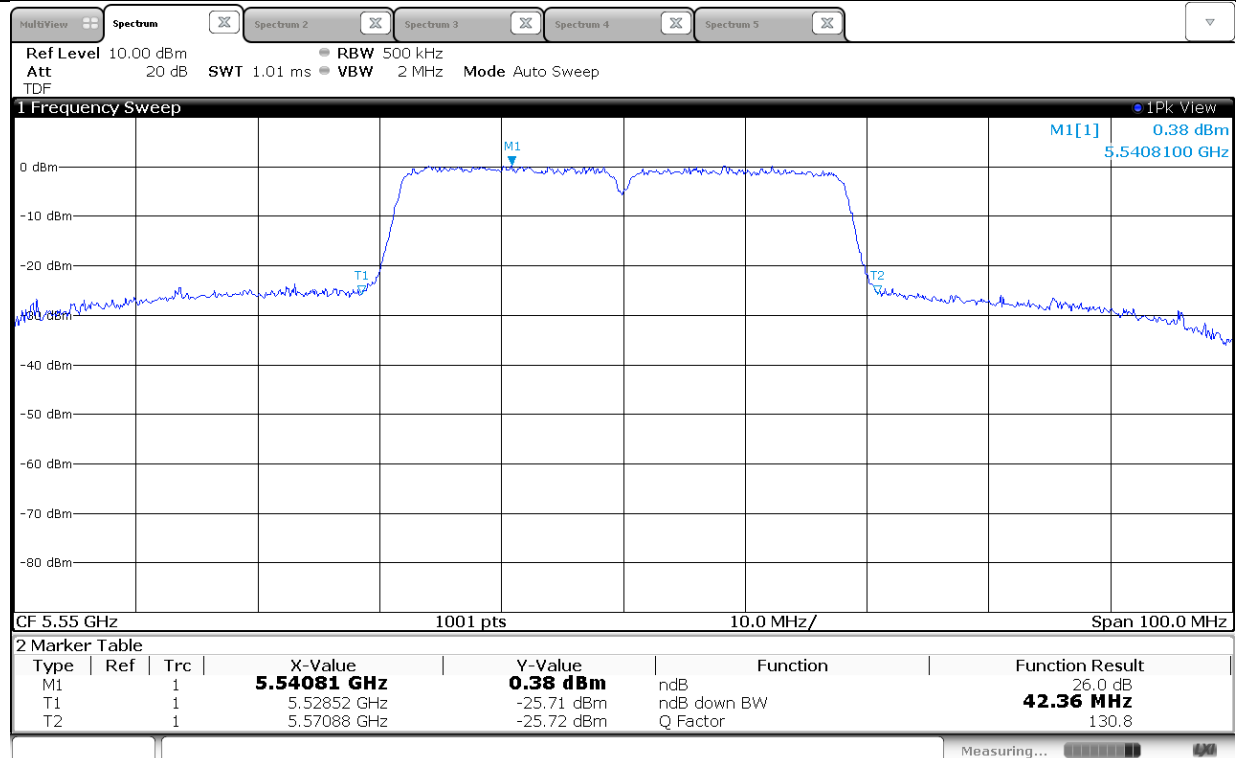
Operating Mode: 802.11ac VHT40 (U-NII 2-A Band) (High Channel)



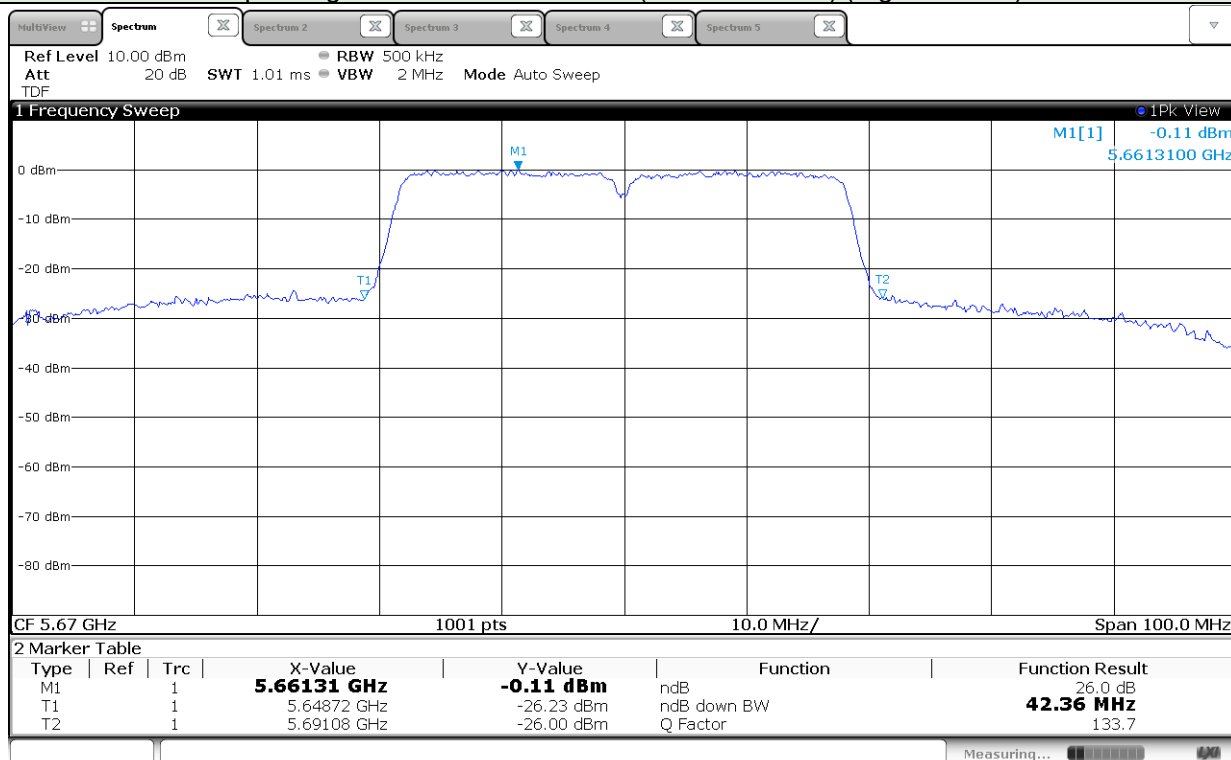
Operating Mode: 802.11ac VHT40 (U-NII 2-C Band) (Low Channel)



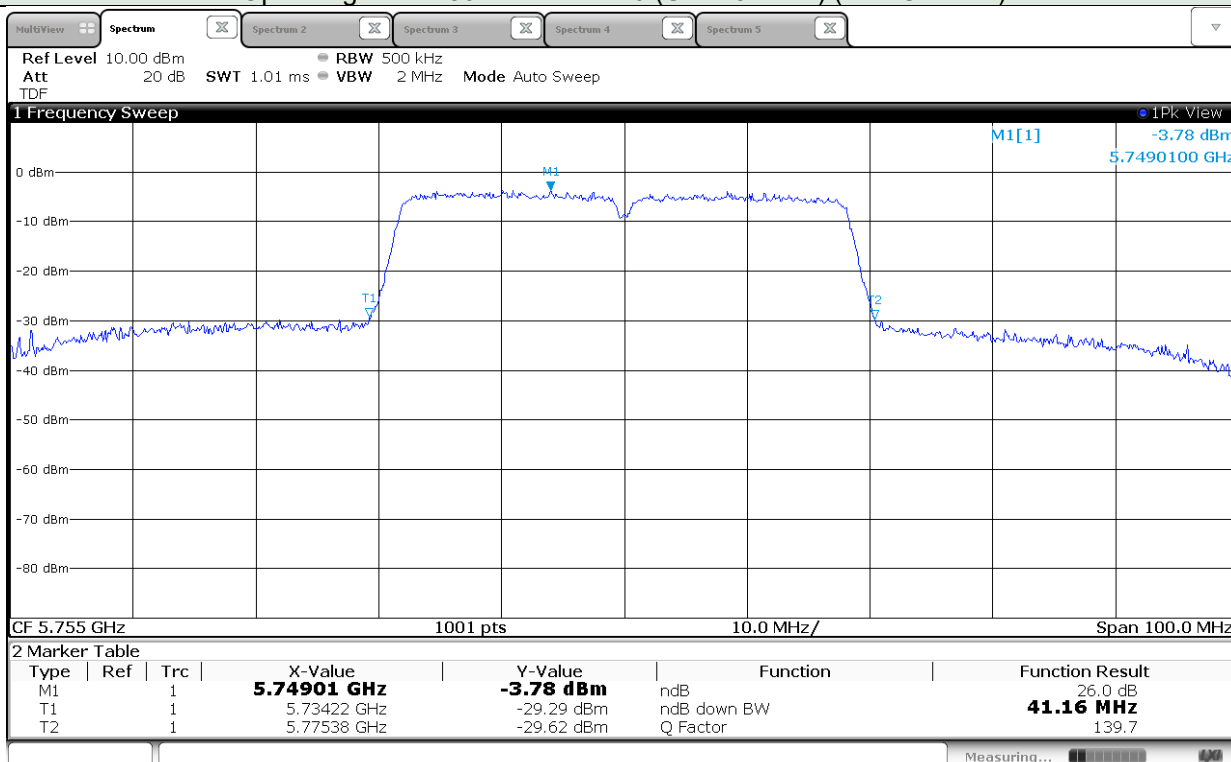
Operating Mode: 802.11ac VHT40 (U-NII 2-C Band) (Middle Channel)



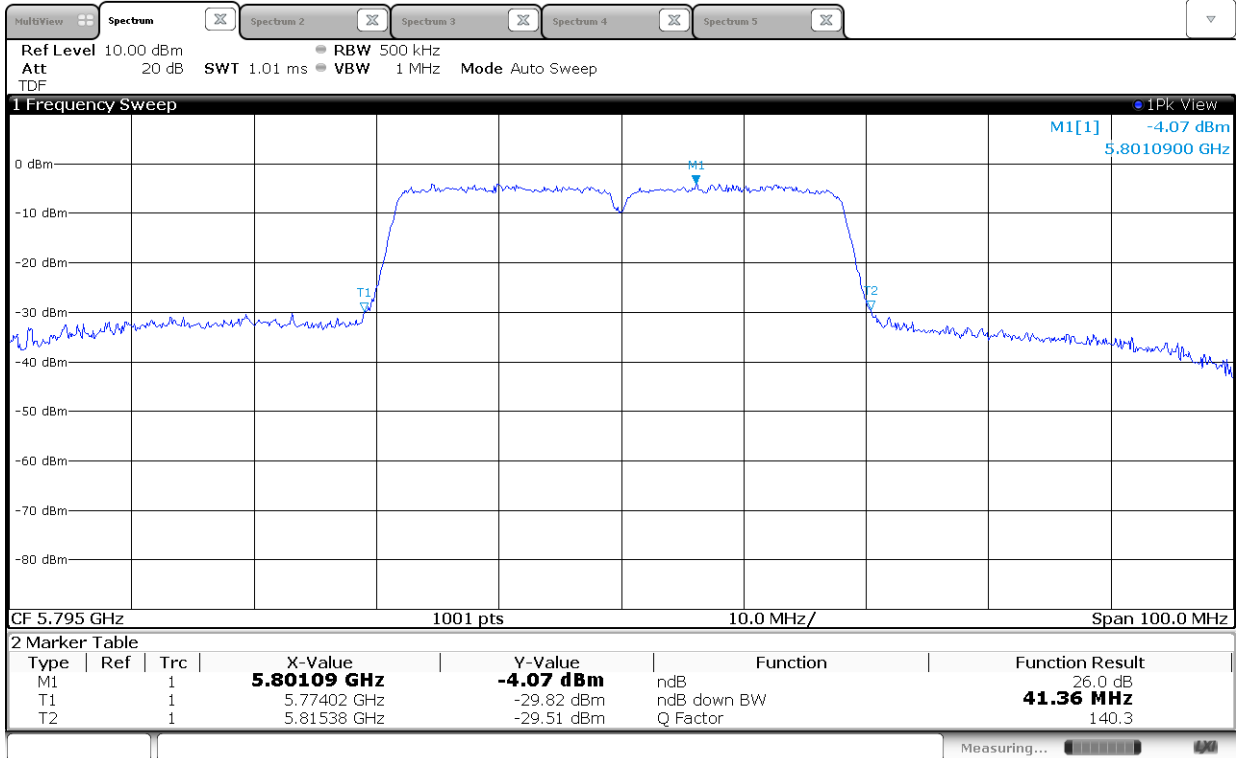
Operating Mode: 802.11ac VHT40 (U-NII 2-C Band) (High Channel)



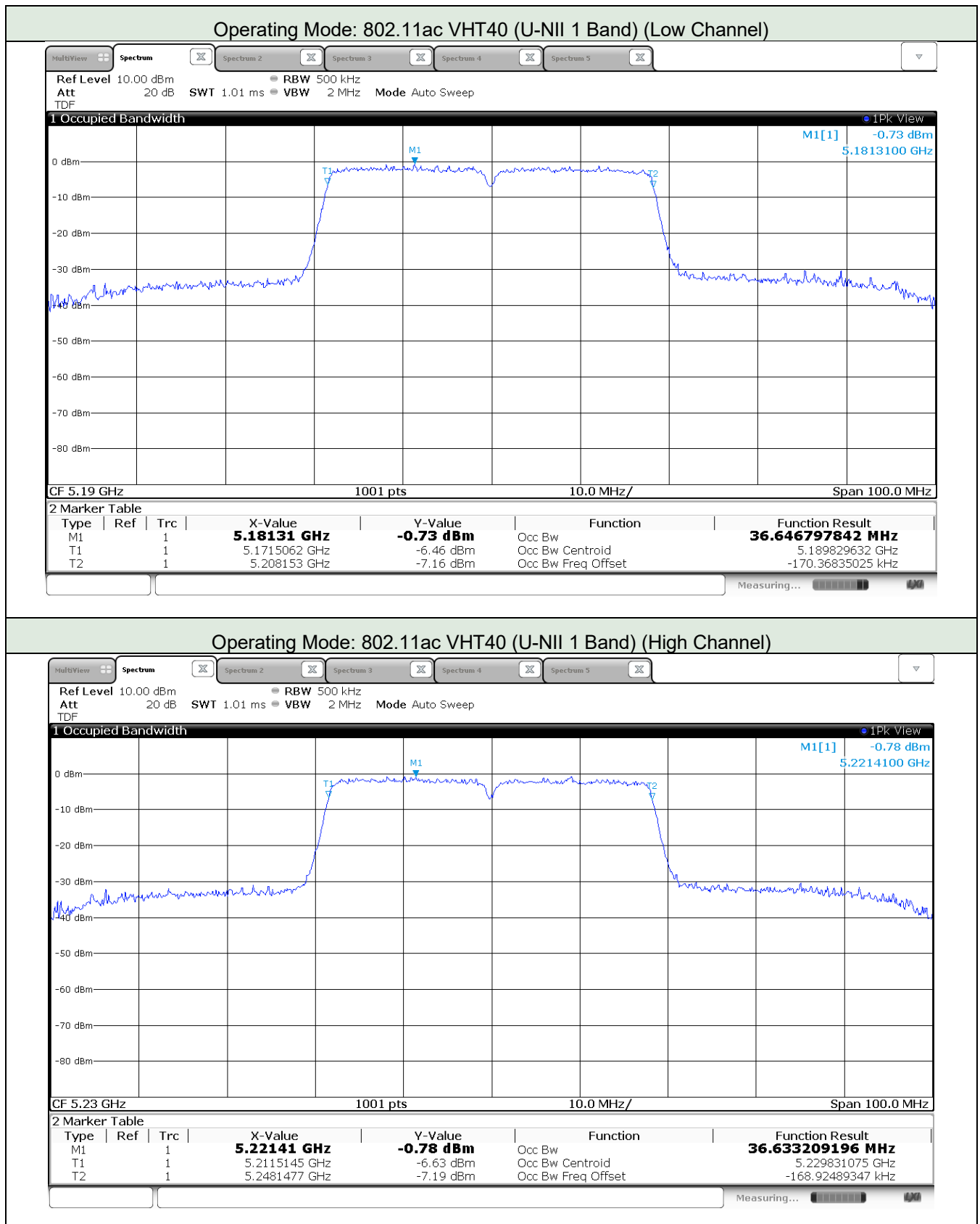
Operating Mode: 802.11ac VHT40 (U-NII 3 Band) (Low Channel)



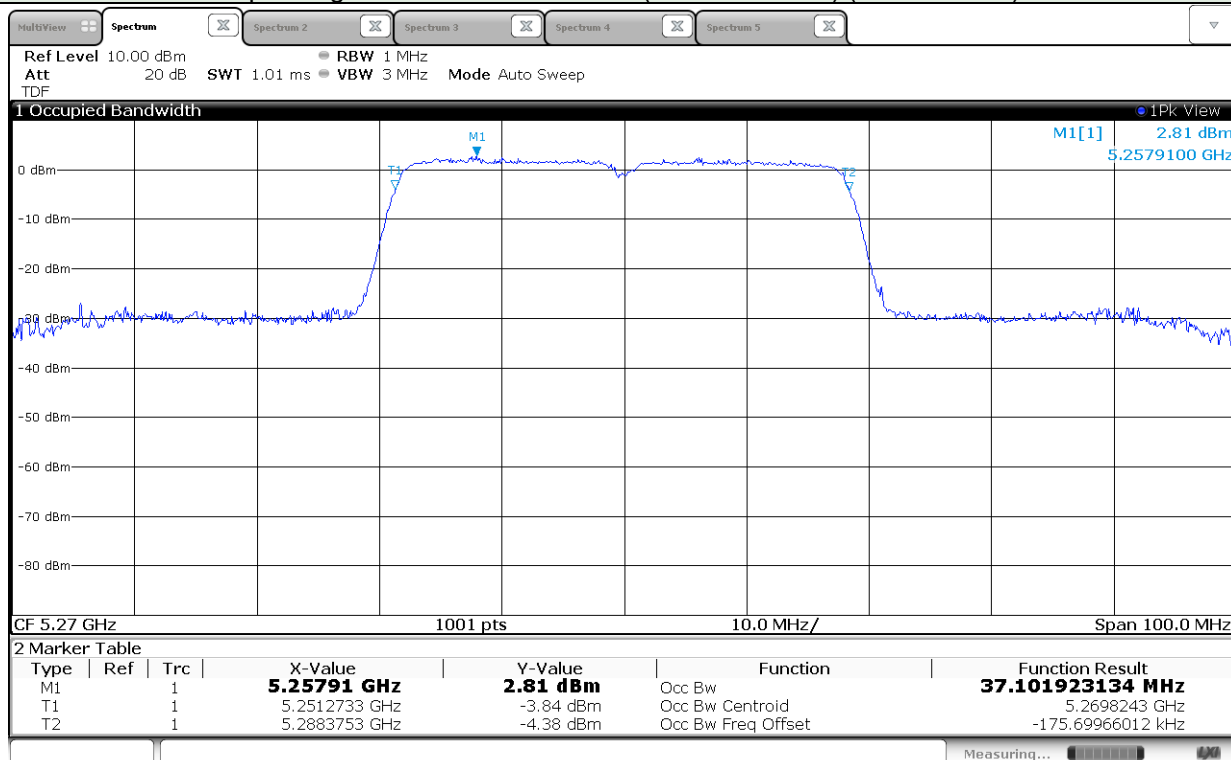
Operating Mode: 802.11ac VHT40 (U-NII 3 Band) (High Channel)



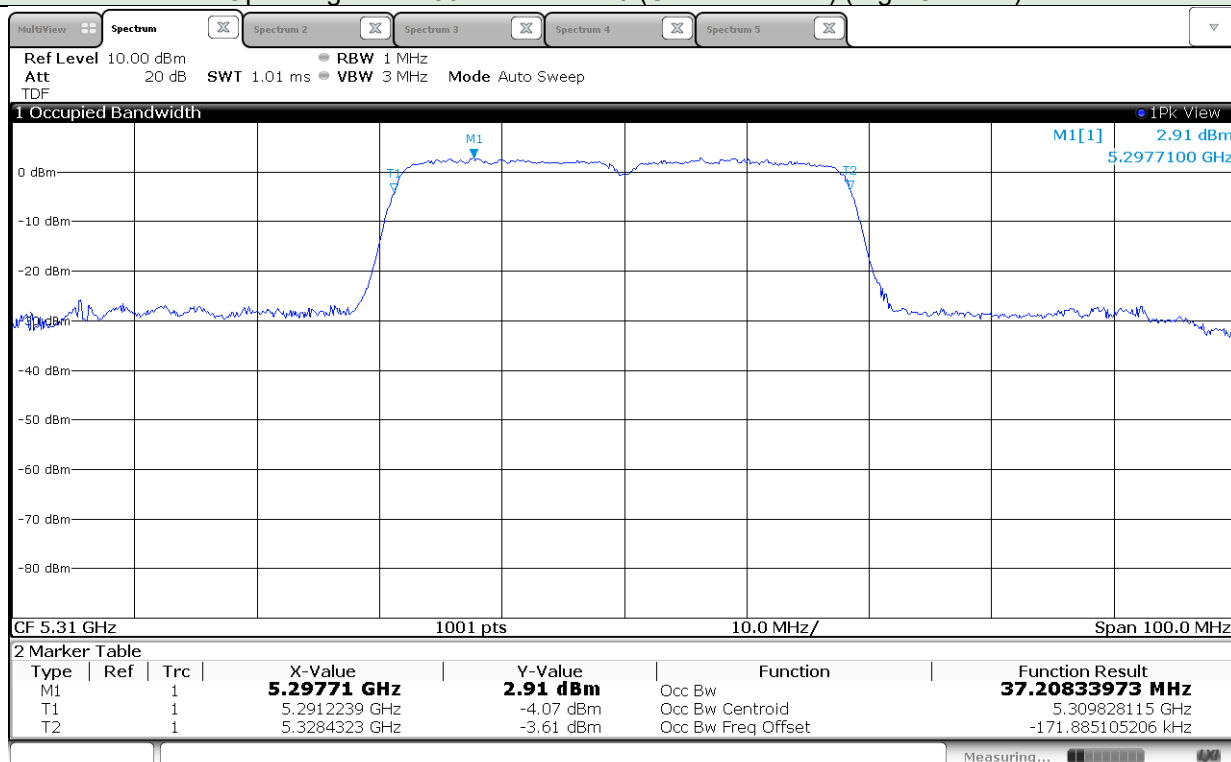
5.1.7.3 Graphic Test Data – 99 % occupied bandwidth



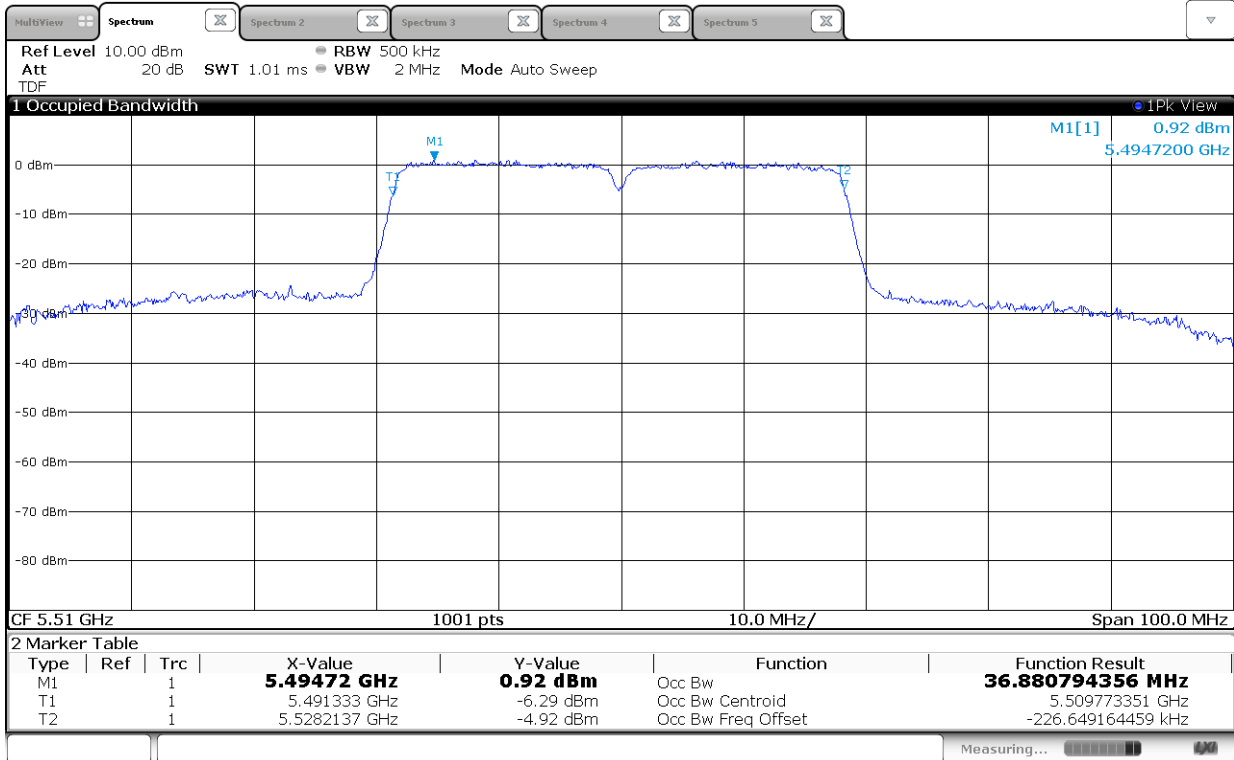
Operating Mode: 802.11ac VHT40 (U-NII 2-A Band) (Low Channel)



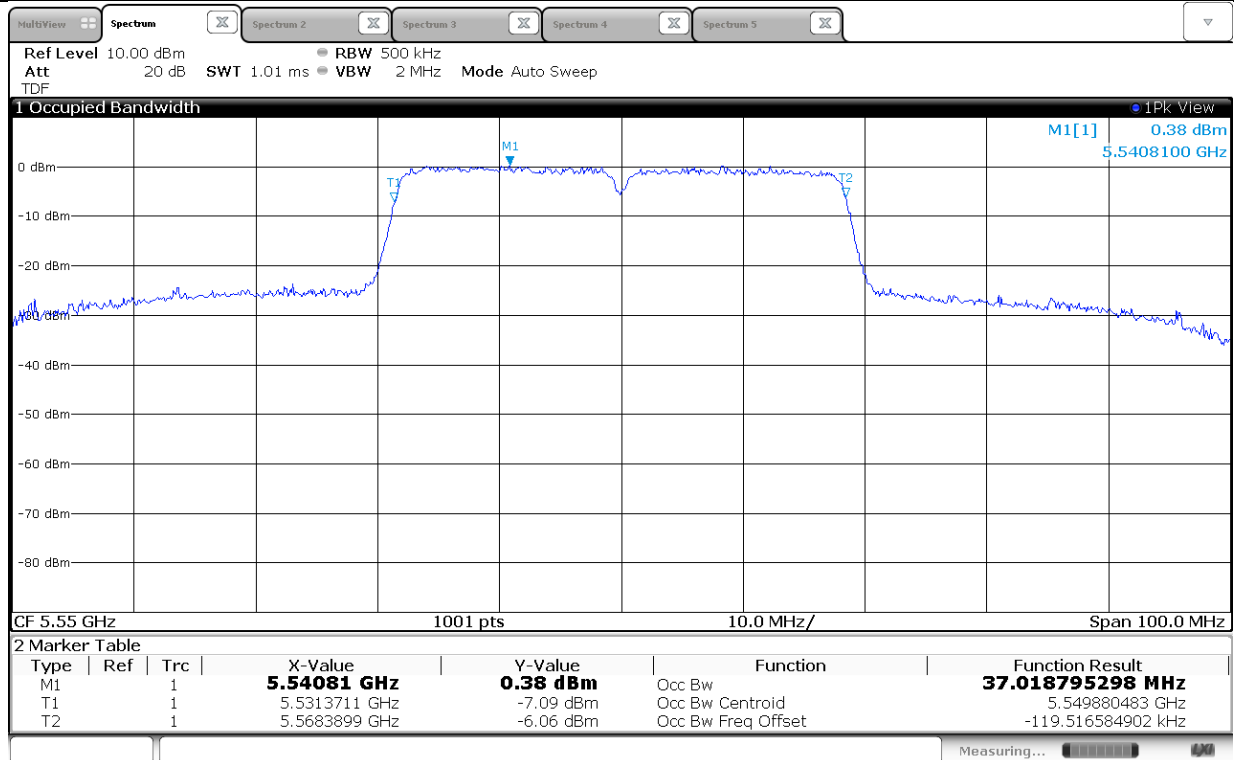
Operating Mode: 802.11ac VHT40 (U-NII 2-A Band) (High Channel)



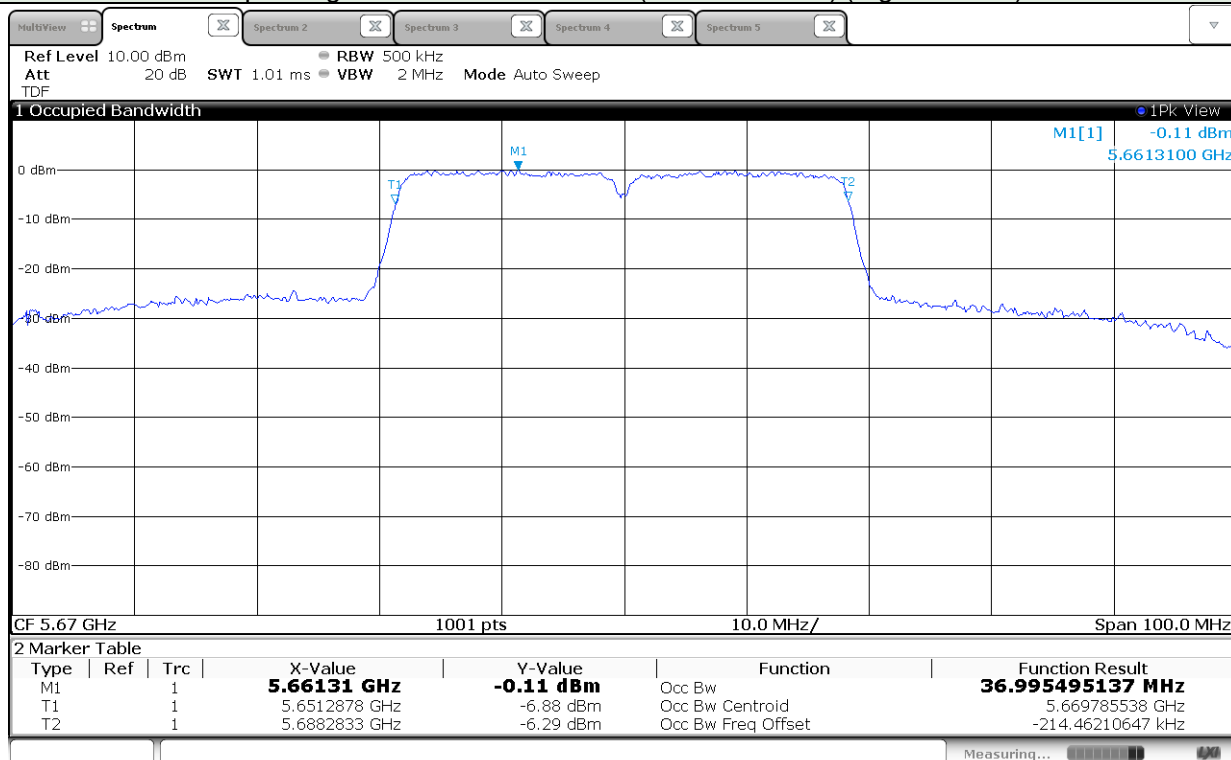
Operating Mode: 802.11ac VHT40 (U-NII 2-C Band) (Low Channel)



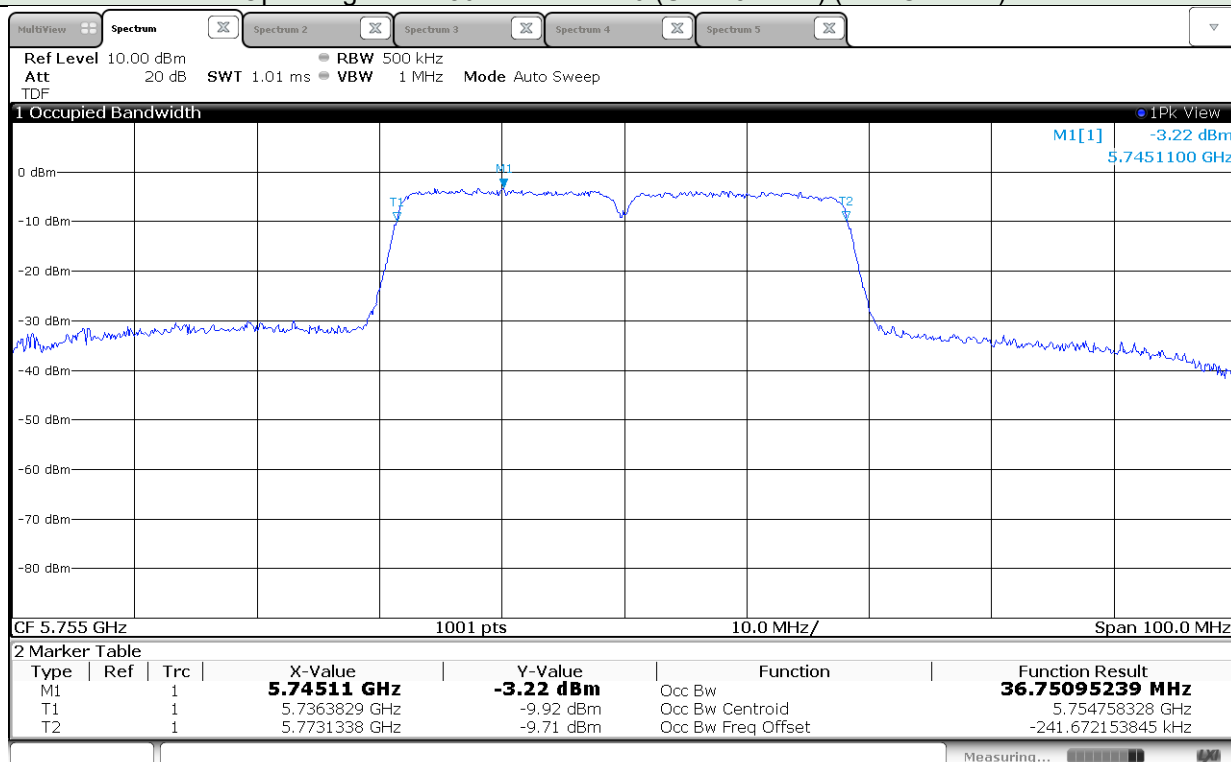
Operating Mode: 802.11ac VHT40 (U-NII 2-C Band) (Middle Channel)



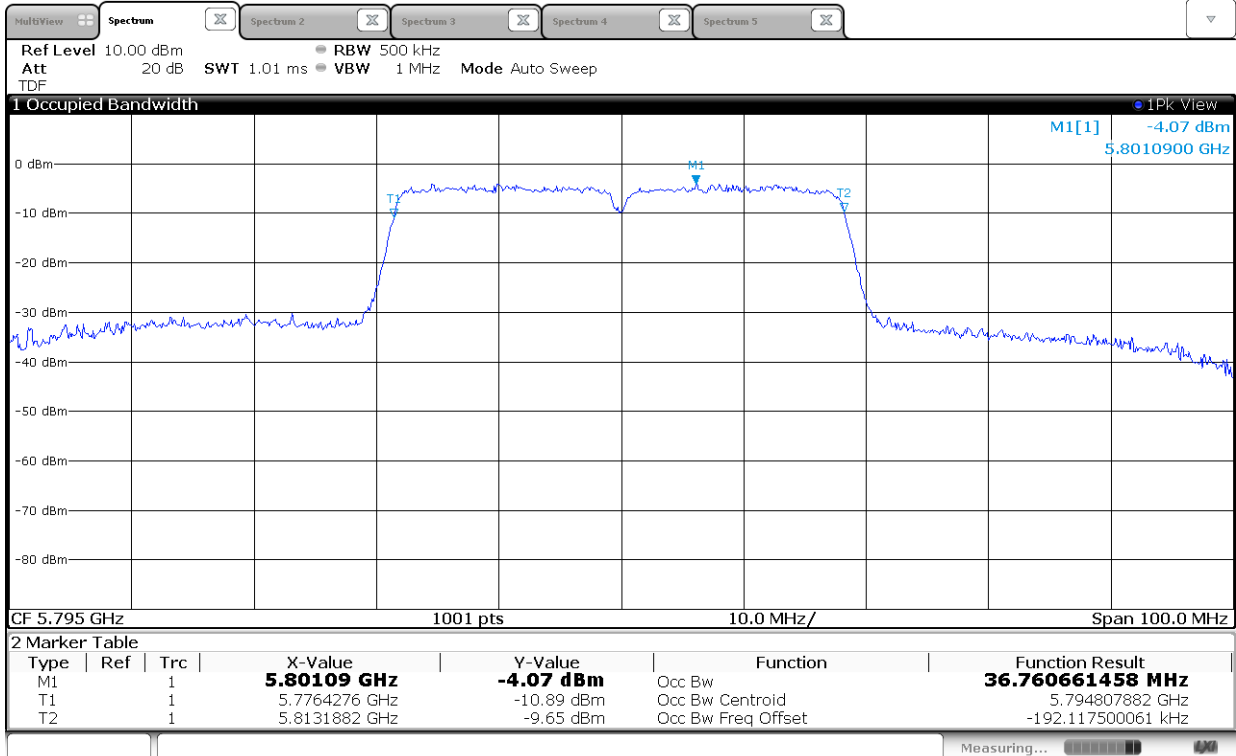
Operating Mode: 802.11ac VHT40 (U-NII 2-C Band) (High Channel)



Operating Mode: 802.11ac VHT40 (U-NII 3 Band) (Low Channel)



Operating Mode: 802.11ac VHT40 (U-NII 3 Band) (High Channel)

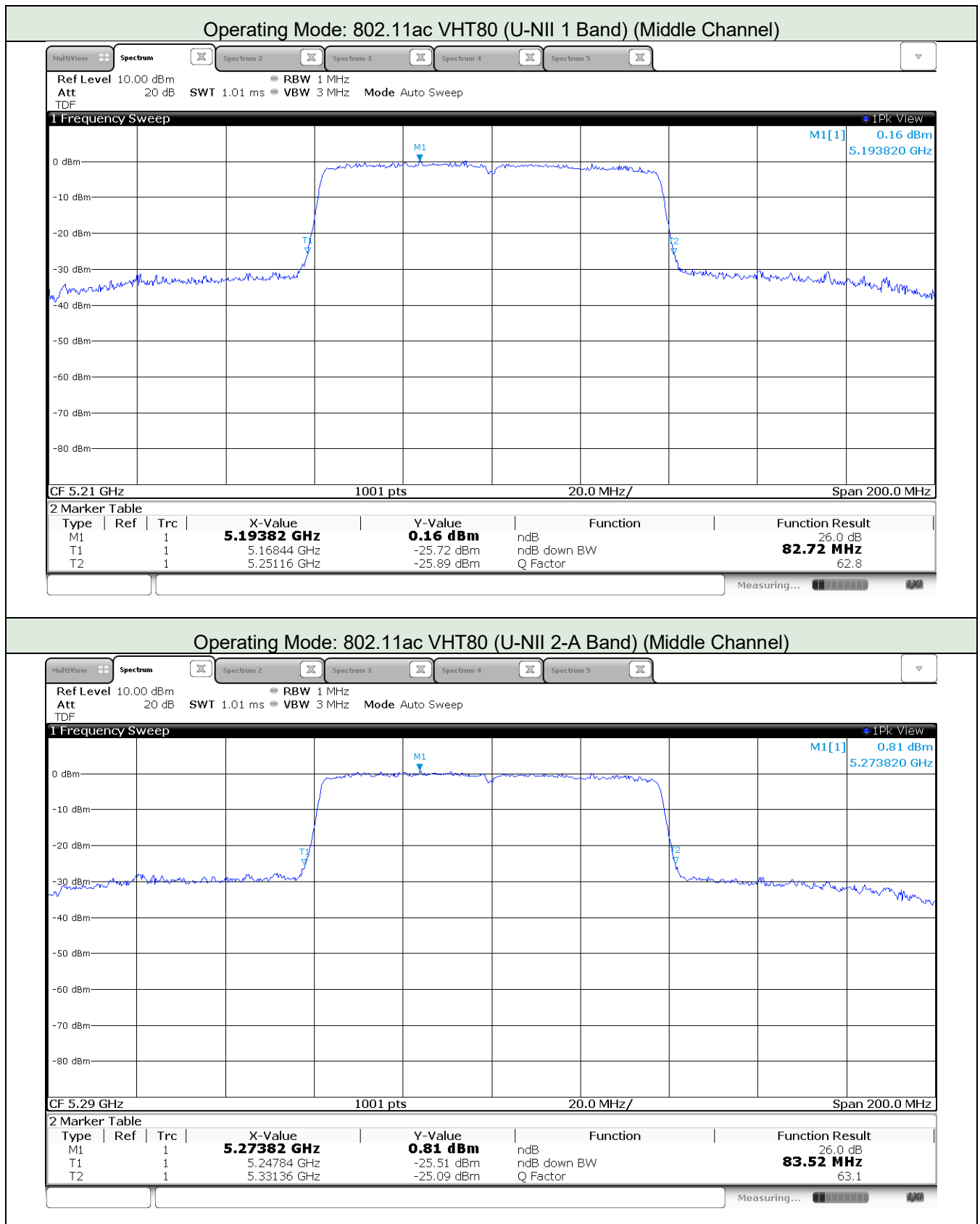


5.1.8 Test Data - Operating Mode: 802.11ac VHT80

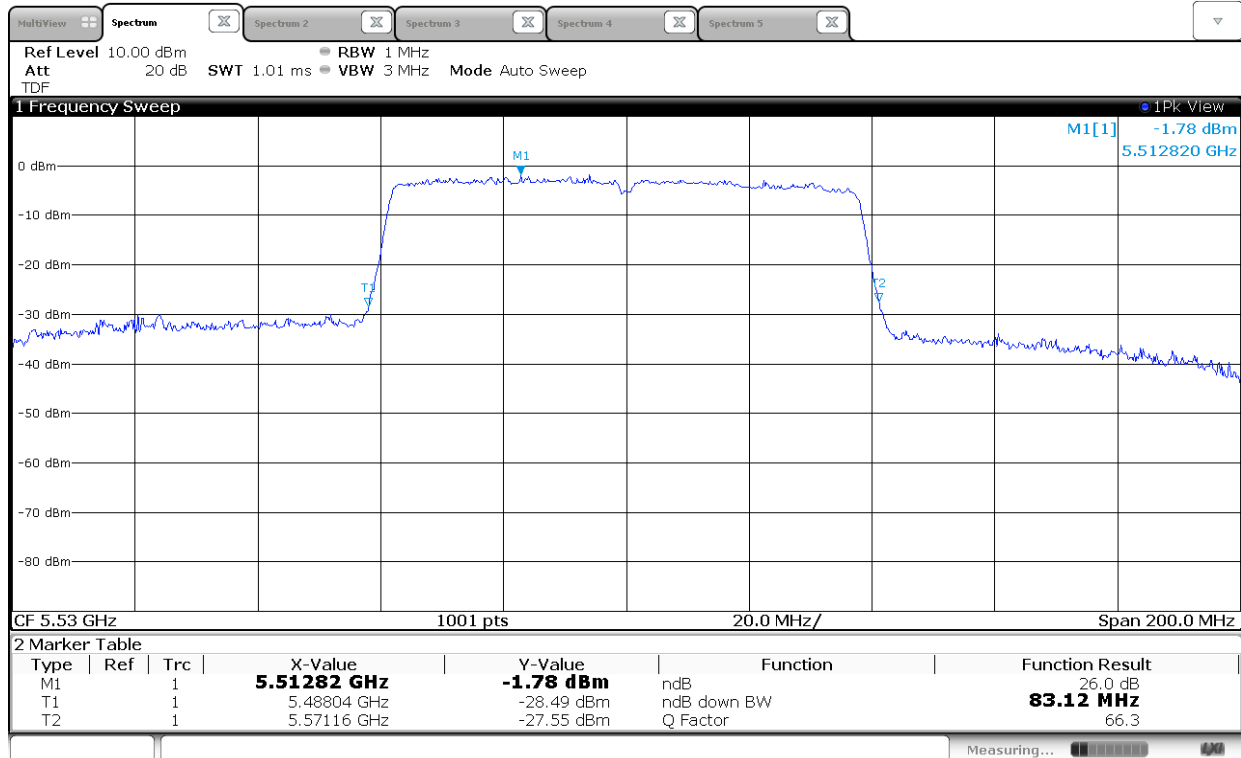
5.1.8.1 Tabulated Test Data

Date of Test		2020.04.09 – 2020.04.10	Temperature		(23.0 ± 1.0) °C
			Relative humidity		(50.0 ± 3.0) % R.H.
Test Result		PASS	Tested by		In-yong Song 
Operating Mode: 802.11ac VHT80 (U-NII Band 1)					
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result	
Middle	5 210	82.72	76.26	-	
Operating Mode: 802.11ac VHT80 (U-NII Band 2-A)					
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result	
Middle	5 290	83.52	76.33	-	
Operating Mode: 802.11ac VHT80 (U-NII Band 2-C)					
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result	
Low	5 530	83.12	76.30	-	
High	5 610	83.92	76.45		
Operating Mode: 802.11ac VHT80 (U-NII Band 3)					
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)	99 % Bandwidth (MHz)	Result	
Middle	5 775	84.12	76.52	-	

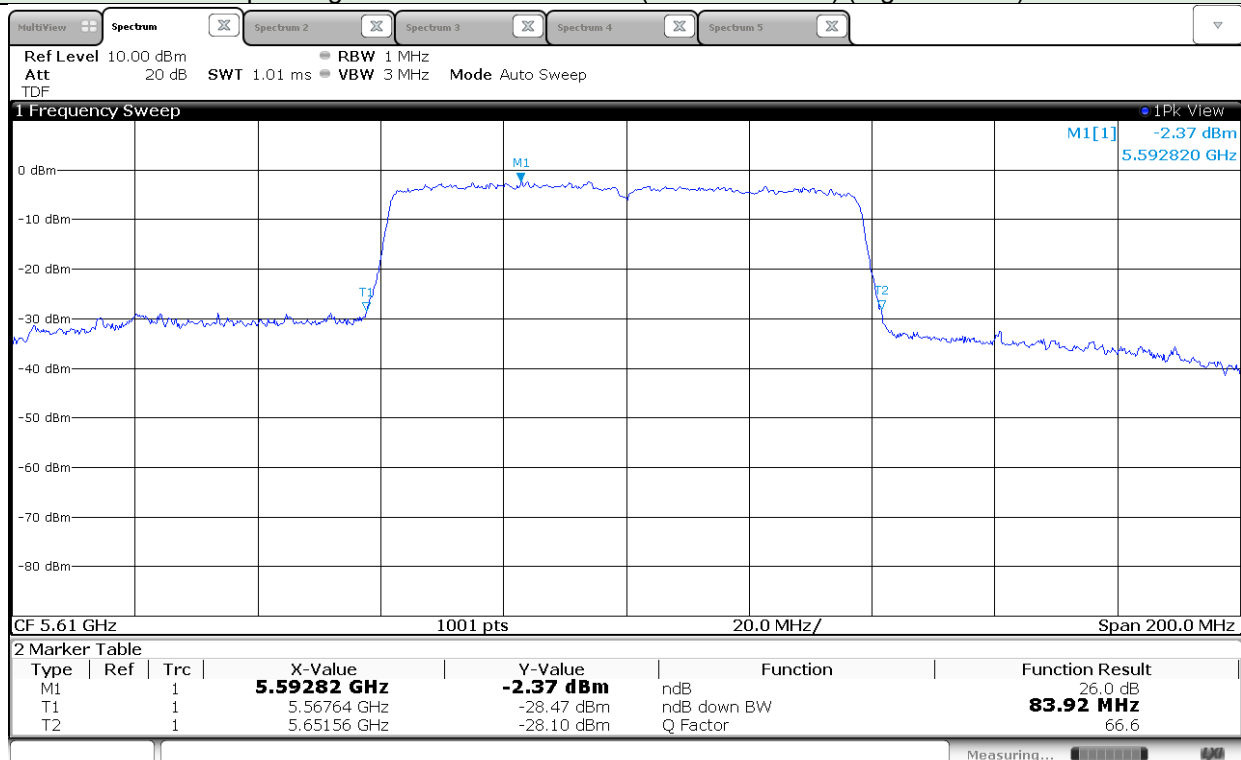
5.1.8.2 Graphic Test Data – 26 dB bandwidth



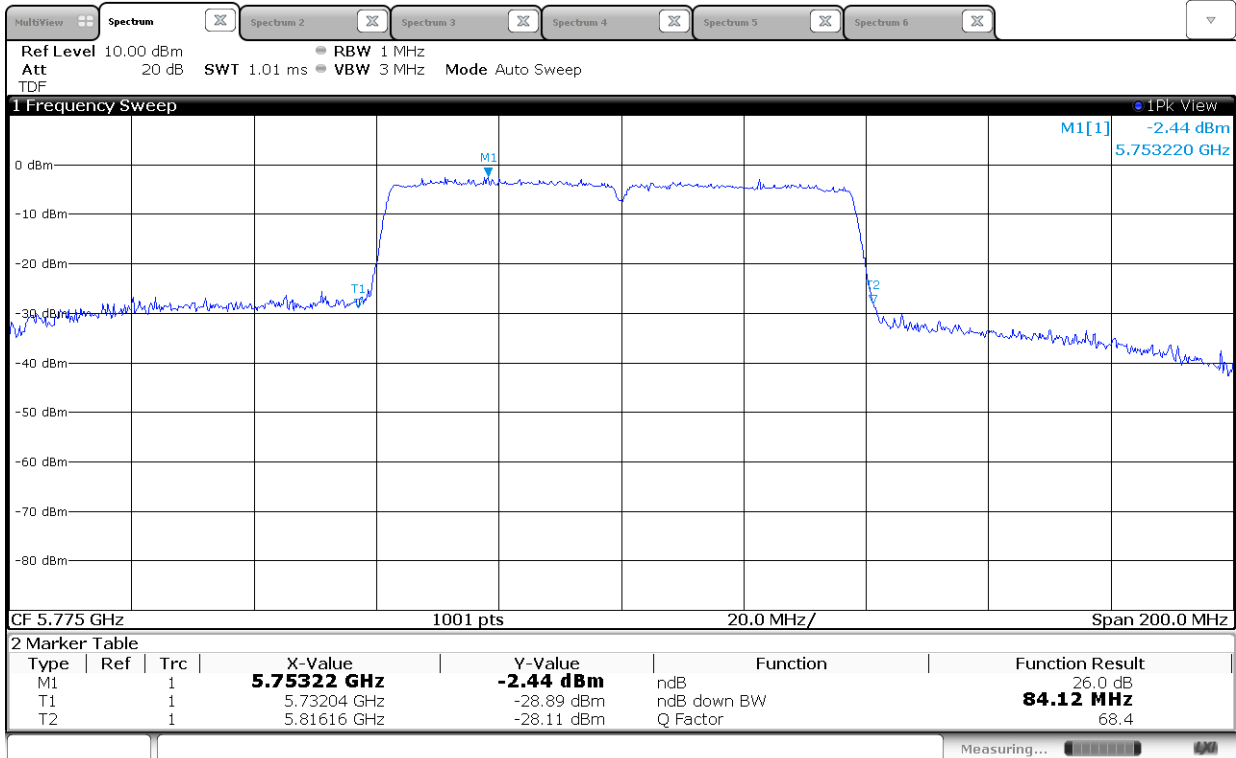
Operating Mode: 802.11ac VHT80 (U-NII 2-C Band) (Low Channel)



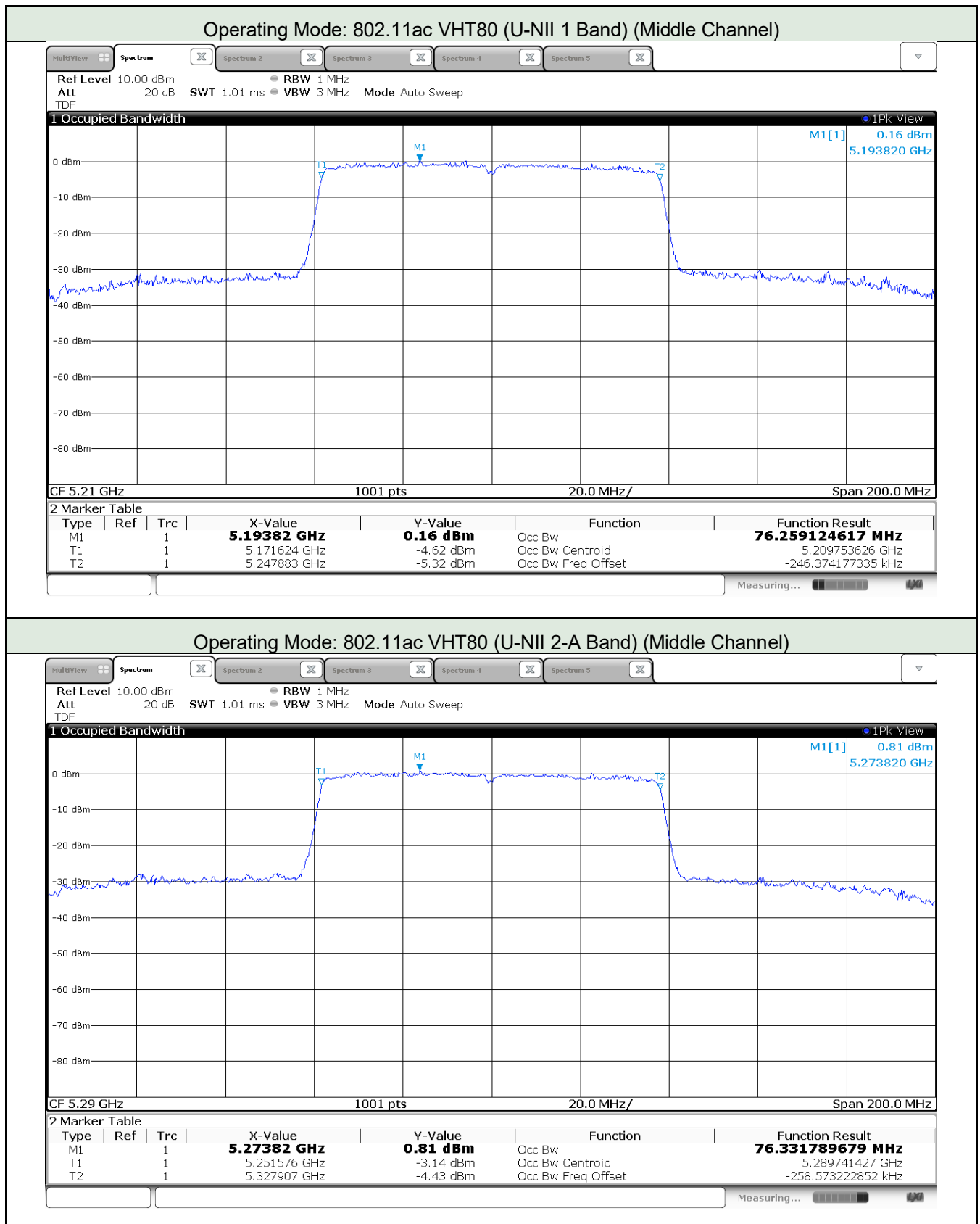
Operating Mode: 802.11ac VHT80 (U-NII 2-C Band) (High Channel)



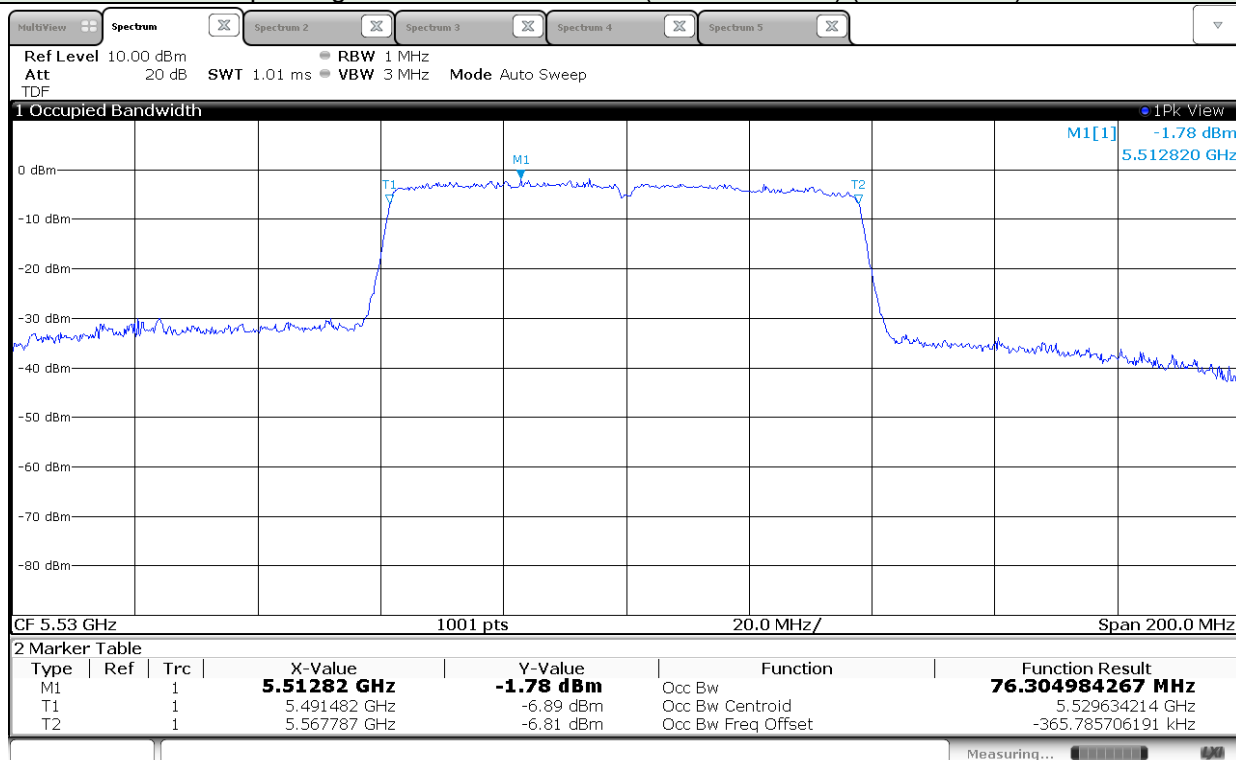
Operating Mode: 802.11ac VHT80 (U-NII 3 Band) (Middle Channel)



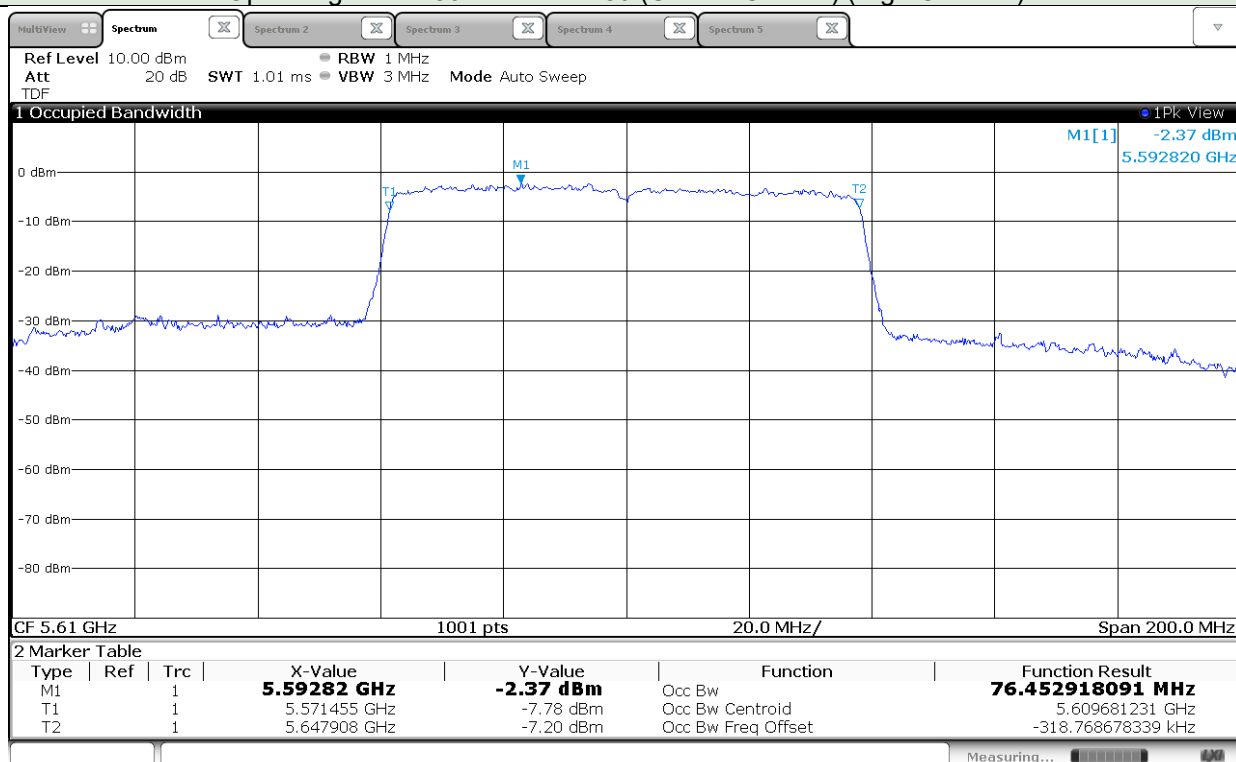
5.1.8.3 Graphic Test Data – 99 % occupied bandwidth



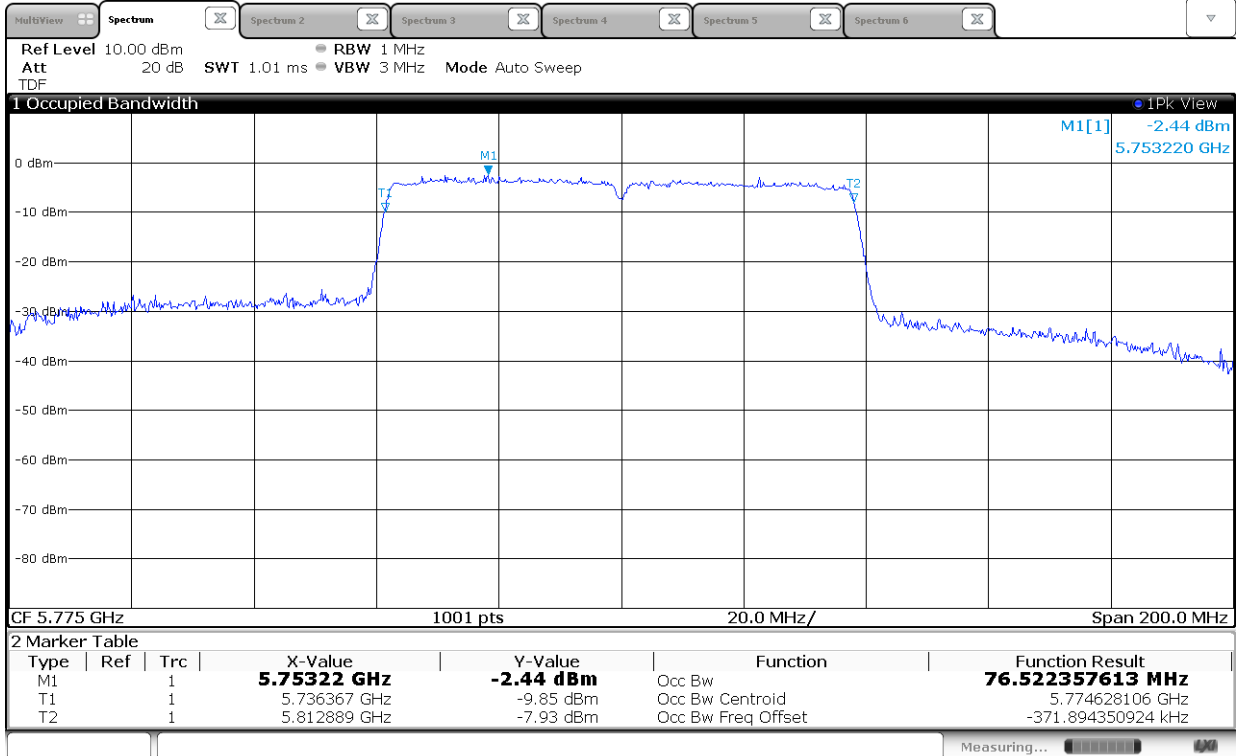
Operating Mode: 802.11ac VHT80 (U-NII 2-C Band) (Low Channel)



Operating Mode: 802.11ac VHT80 (U-NII 2-C Band) (High Channel)

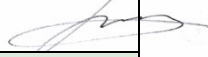


Operating Mode: 802.11ac VHT80 (U-NII 3 Band) (Middle Channel)

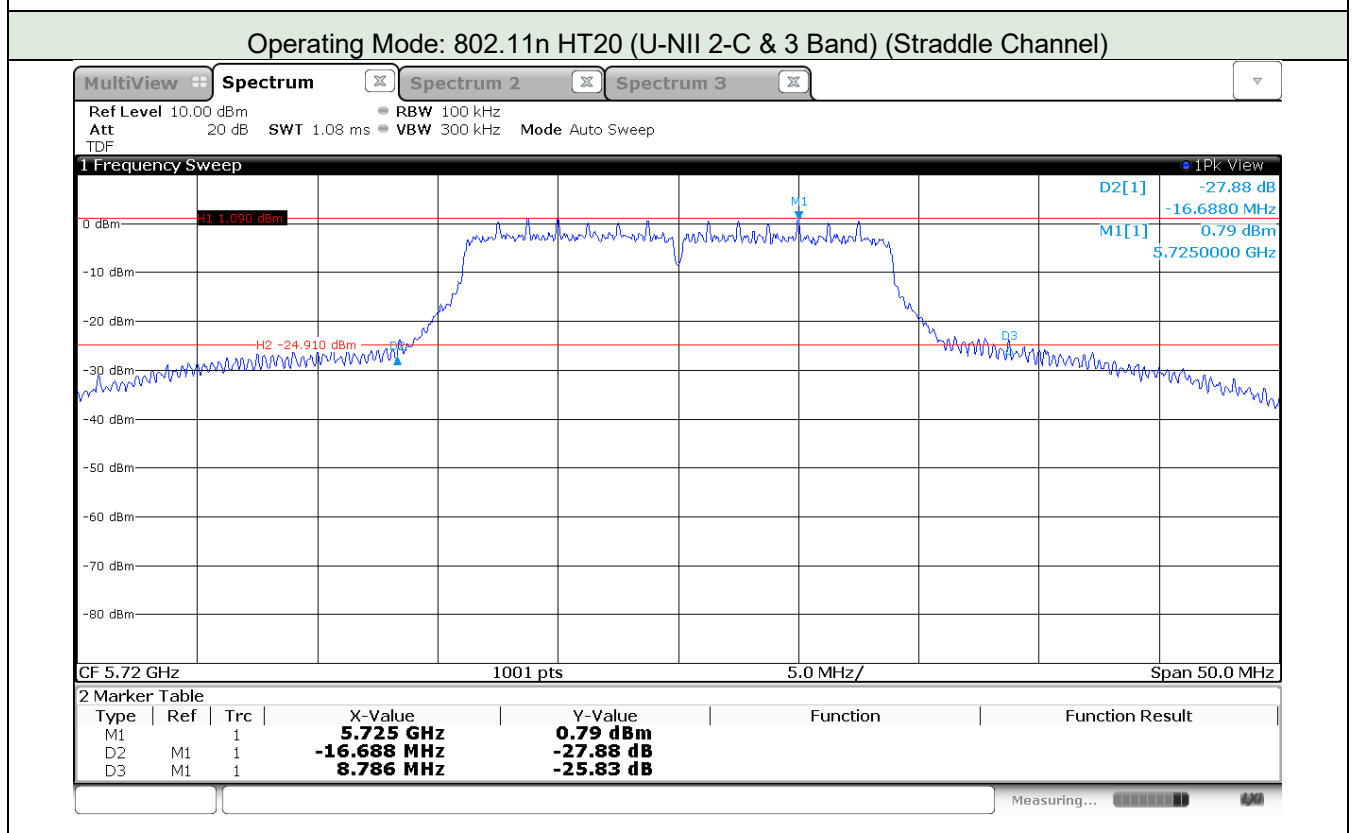
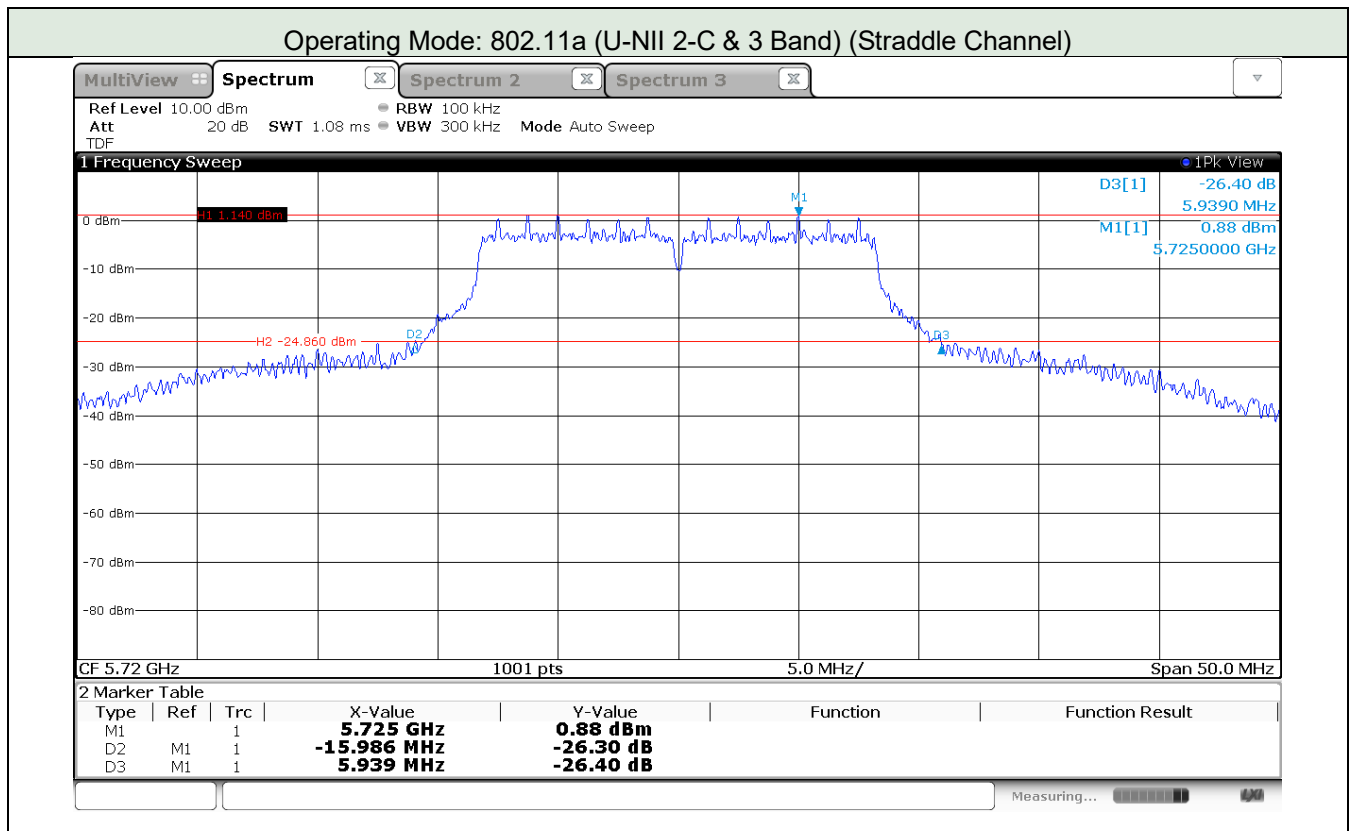


5.1.9 Test Data - Operating Mode: Straddle Channel

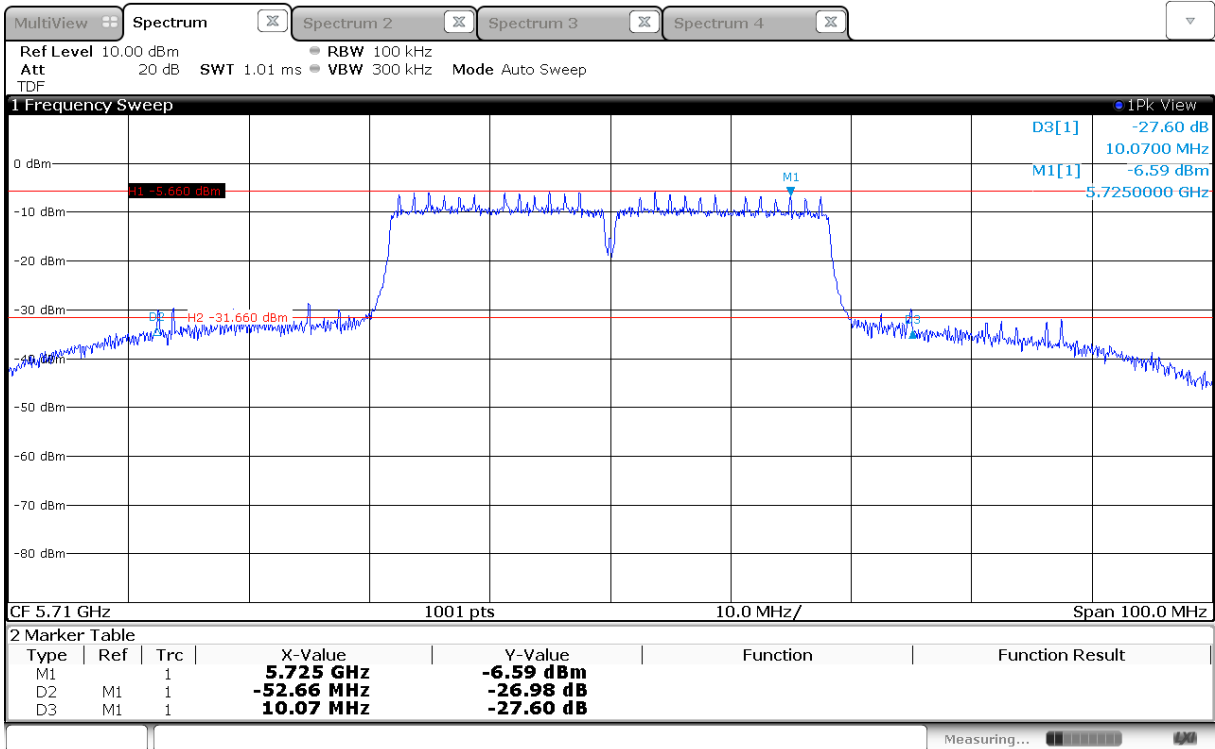
5.1.9.1 Tabulated Test Data

Date of Test	2020.04-10	Temperature	(23.0 ± 1.0) °C
		Relative humidity	(50.0 ± 3.0) % R.H.
Test Result	PASS	Tested by	In-yong Song 
Operating Mode: 802.11a ((U-NII 2-C & 3 Band)			
Frequency Range (MHz)	Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
5 470 – 5 725	Straddle	5 720	15.99
5 725 – 5 850	Straddle	5 720	5.94
Operating Mode: 802.11n HT20 ((U-NII 2-C & 3 Band)			
Frequency Range (MHz)	Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
5 470 – 5 725	Straddle	5 720	16.69
5 725 – 5 850	Straddle	5 720	8.79
Operating Mode: 802.11n HT40 ((U-NII 2-C & 3 Band)			
Frequency Range (MHz)	Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
5 470 – 5 725	Straddle	5 710	52.66
5 725 – 5 850	Straddle	5 710	10.07
Operating Mode: 802.11ac VHT20 ((U-NII 2-C & 3 Band)			
Frequency Range (MHz)	Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
5 470 – 5 725	Straddle	5 720	16.34
5 725 – 5 850	Straddle	5 720	8.74
Operating Mode: 802.11ac VHT40 (U-NII 2-C & 3 Band)			
Frequency Range (MHz)	Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
5 470 – 5 725	Straddle	5 710	52.65
5 725 – 5 850	Straddle	5 710	10.07
Operating Mode: 802.11ac VHT80 (U-NII 2-C & 3 Band)			
Frequency Range (MHz)	Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
5 470 – 5 725	Straddle	5 690	75.03
5 725 – 5 850	Straddle	5 690	4.48

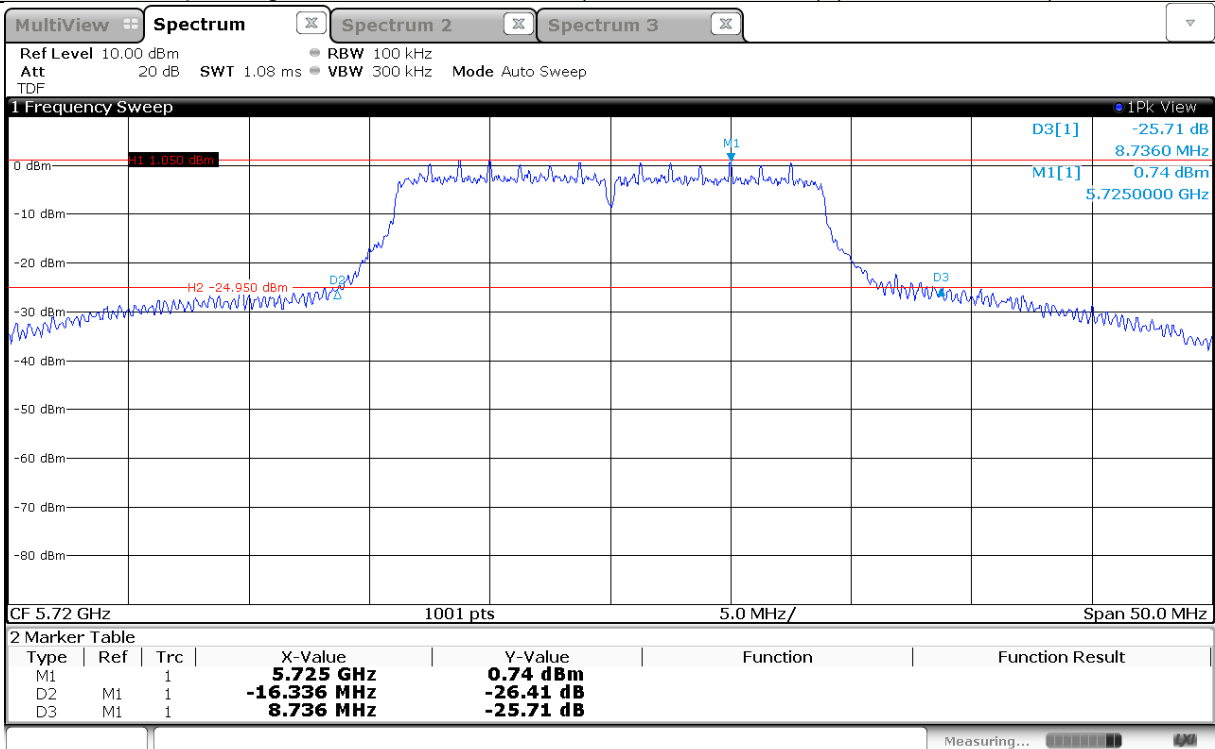
5.1.9.2 Graphic Test Data – 26 dB bandwidth



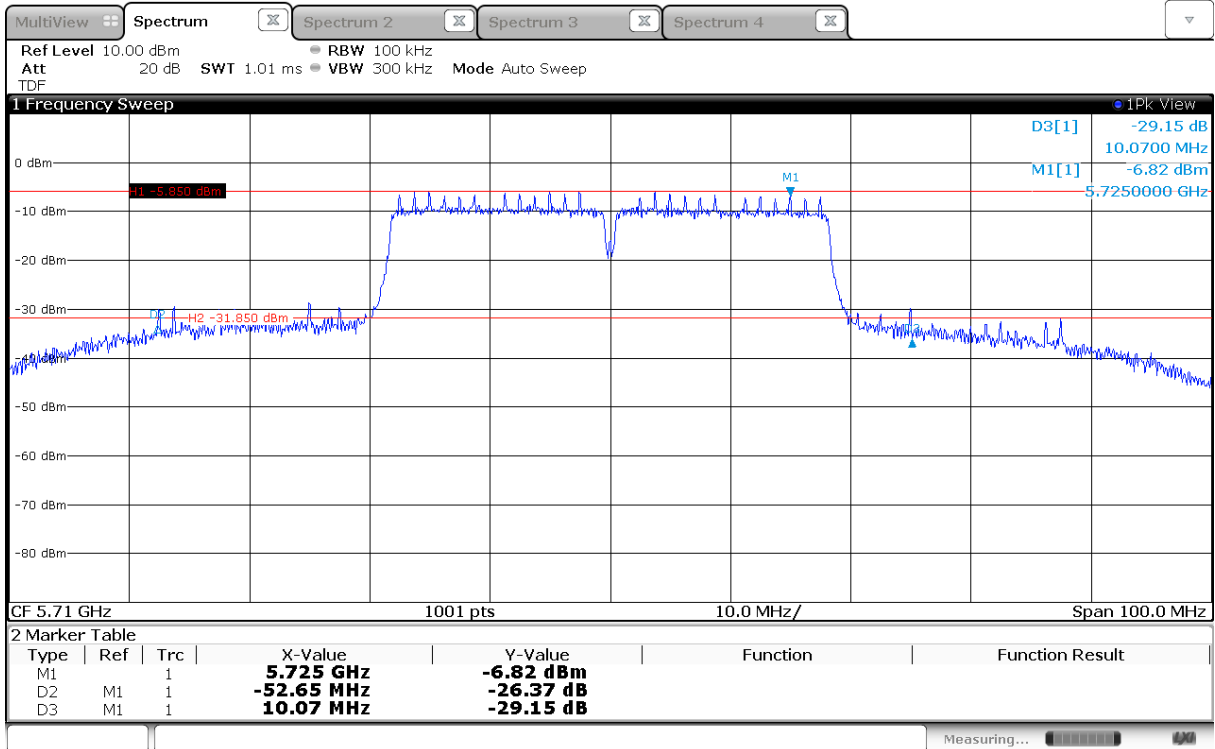
Operating Mode: 802.11n HT40 (U-NII 2-C & 3 Band) (Straddle Channel)



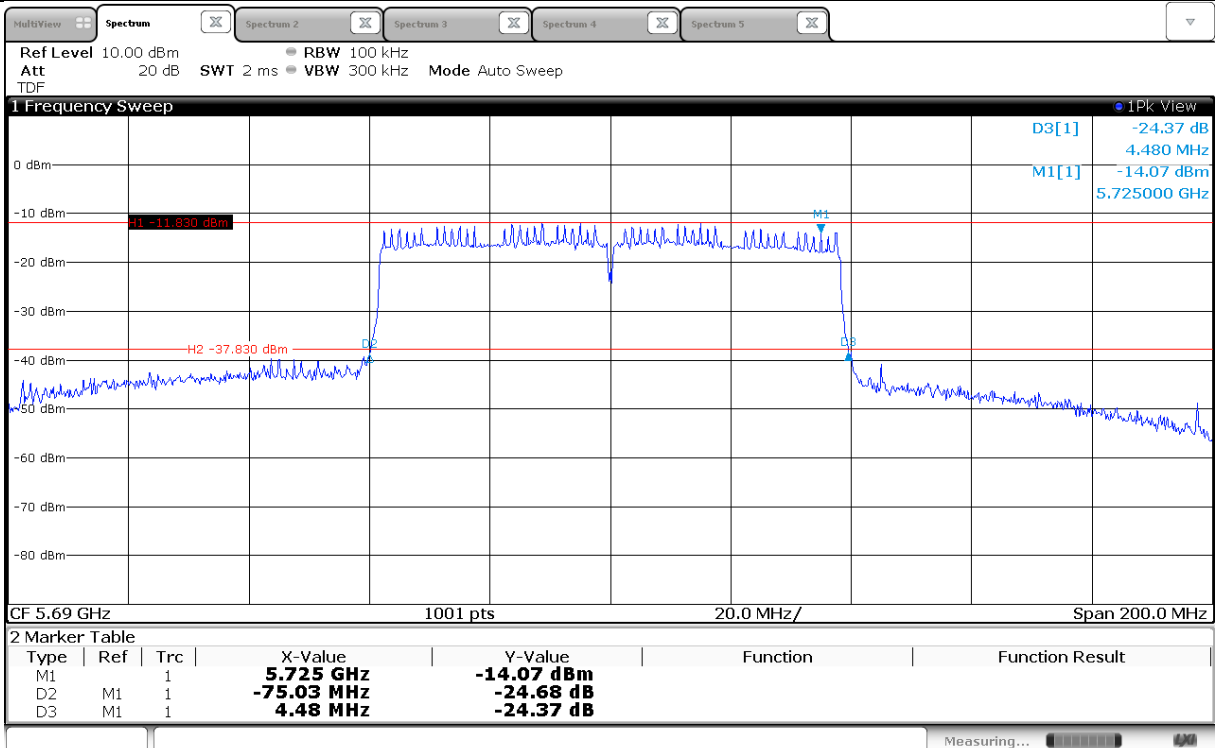
Operating Mode: 802.11ac VHT20 (U-NII 2-C & 3 Band) (Straddle Channel)



Operating Mode: 802.11ac VHT40 (U-NII 2-C & 3 Band) (Straddle Channel)



Operating Mode: 802.11ac VHT80 (U-NII 2-C & 3 Band) (Straddle Channel)



5.2 6 dB Bandwidth

5.2.1 Limit

The minimum 6 dB bandwidth shall be at least 500 kHz within the (5.725 ~ 5.825) GHz band.

5.2.2 Method of Measurement

Reference to KDB 789033 D02 General UNII Test Procedures New Rules v02r01 Section C.2

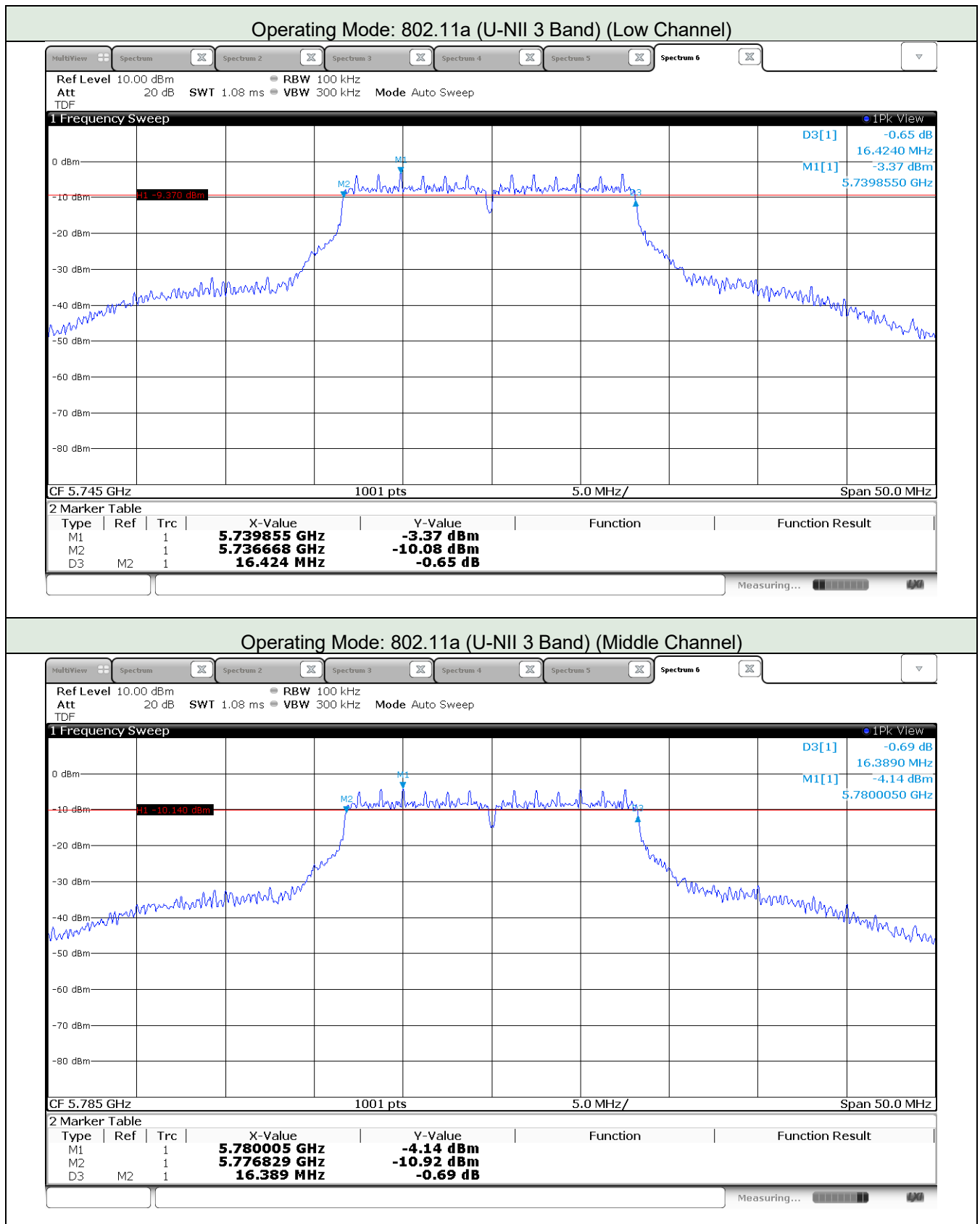
The transmitter output is connected to a spectrum analyzer with the RBW set to 100 kHz, VBW $\geq 3 \times$ RBW, peak detector and max hold.

5.2.3 Tabulated Test Data

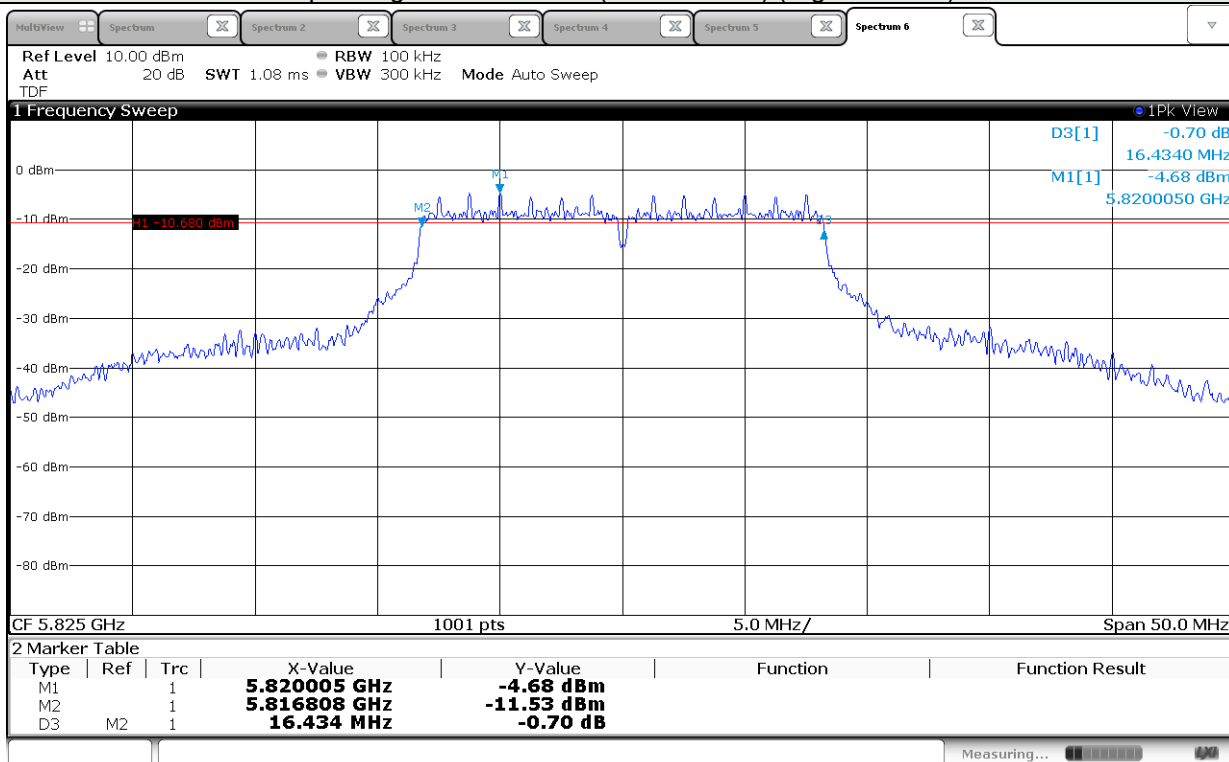
Date of Test		2020-04-10	Temperature	(23.0 ± 1.0) °C	
			Relative humidity	(50.0 ± 3.0) % R.H.	
Test Result		PASS	Tested by	In-yong Song 	
Operating Mode: 802.11a (U-NII 3 Band)					
Channel	Frequency (MHz)	Measured Value (MHz)	Limit (MHz)	Result	
Low	5 745	16.42	≥ 0.5	PASS	
Middle	5 785	16.39		PASS	
High	5 805	16.43		PASS	
Operating Mode: 802.11n HT20 (U-NII 3 Band)					
Channel	Frequency (MHz)	Measured Value (MHz)	Limit (MHz)	Result	
Low	5 745	17.70	≥ 0.5	PASS	
Middle	5 785	17.67		PASS	
High	5 805	17.68		PASS	
Operating Mode: 802.11n HT40 (U-NII 3 Band)					
Channel	Frequency (MHz)	Measured Value (MHz)	Limit (MHz)	Result	
Low	5 755	36.46	≥ 0.5	PASS	
High	5 795	36.46		PASS	
Operating Mode: 802.11ac VHT20 (U-NII 3 Band)					
Channel	Frequency (MHz)	Measured Value (MHz)	Limit (MHz)	Result	
Low	5 745	17.68	≥ 0.5	PASS	
Middle	5 785	17.68		PASS	
High	5 805	17.68		PASS	

Operating Mode: 802.11ac VHT40 (U-NII 3 Band)				
Channel	Frequency (MHz)	Measured Value (MHz)	Limit (MHz)	Result
Low	5 745	36.46	≥ 0.5	PASS
High	5 785	36.46		PASS
Operating Mode: 802.11ac VHT80 (U-NII 3 Band)				
Channel	Frequency (MHz)	Measured Value (MHz)	Limit (MHz)	Result
Low	5 775	76.43	≥ 0.5	PASS

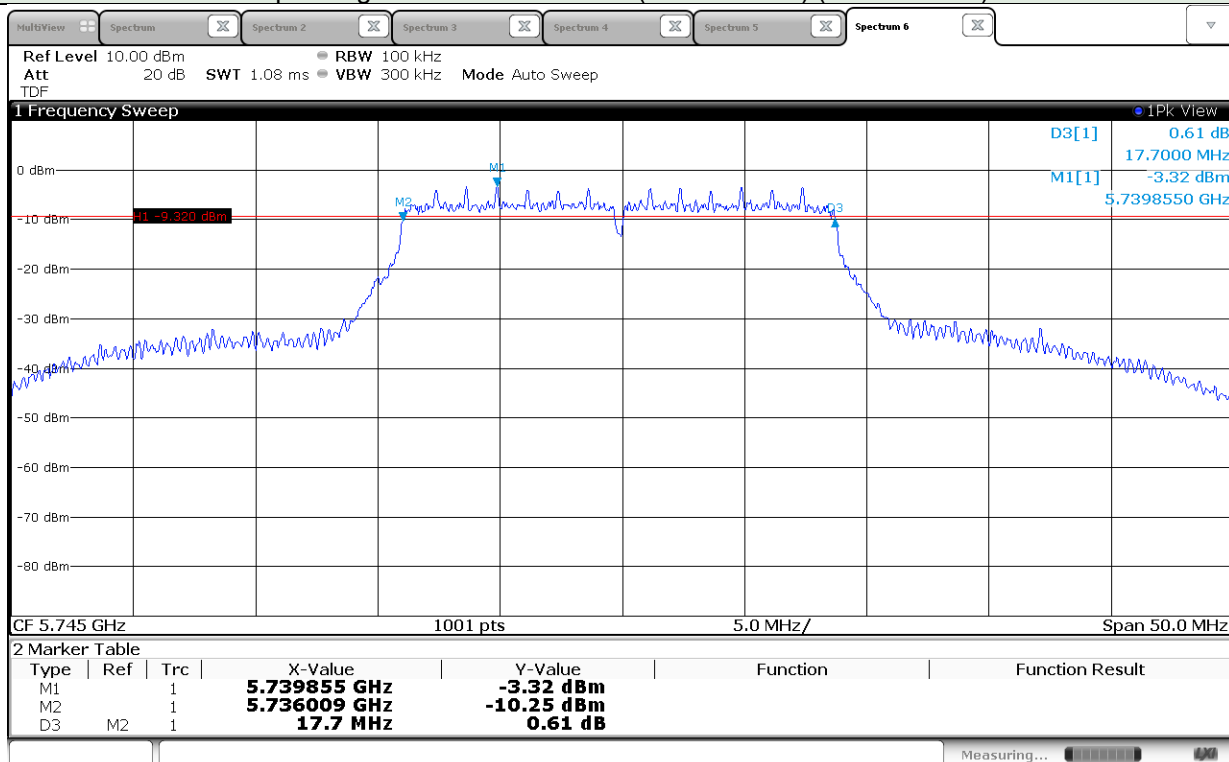
5.2.4 Graphic Test Data



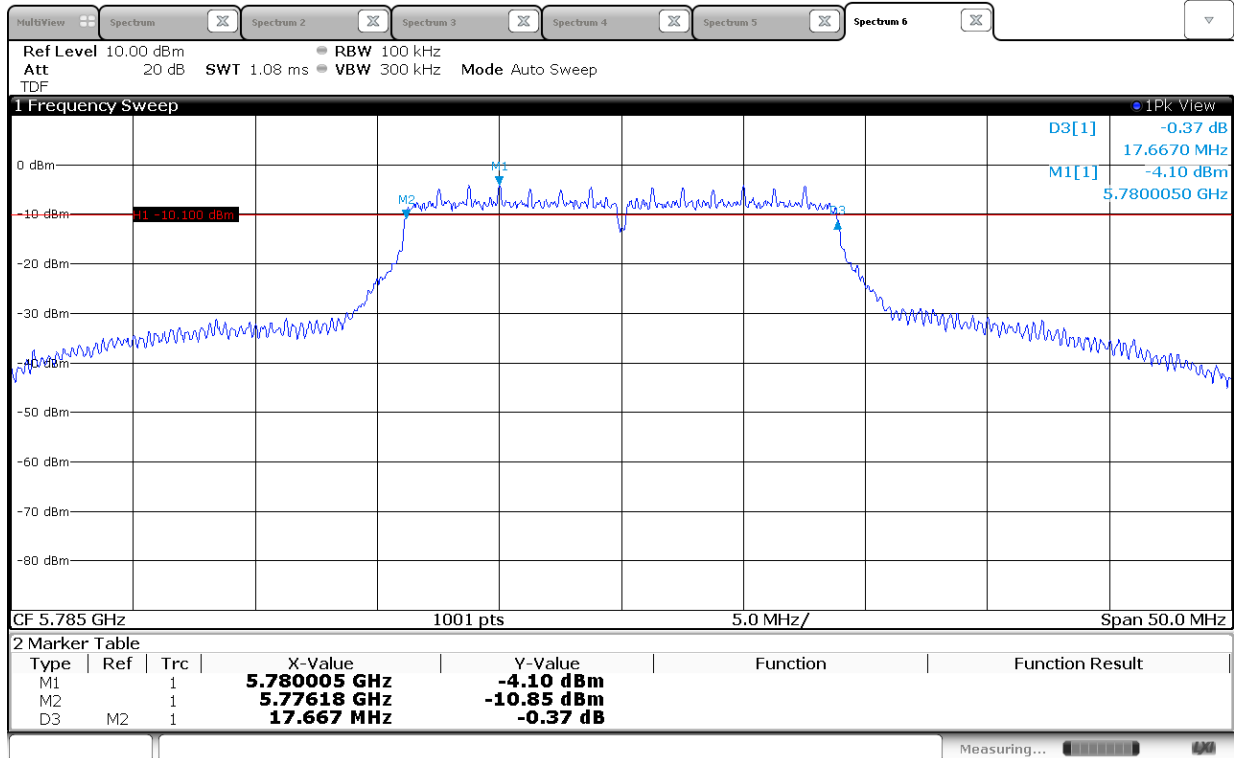
Operating Mode: 802.11a (U-NII 3 Band) (High Channel)



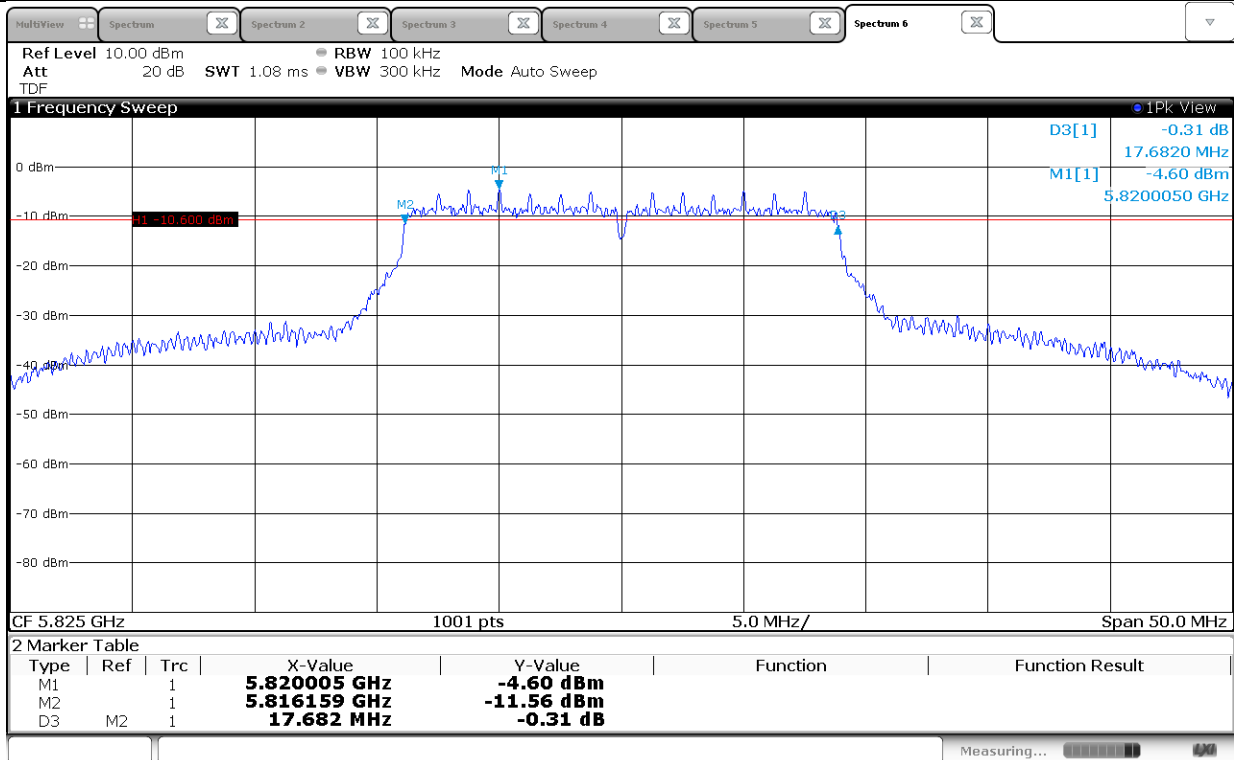
Operating Mode: 802.11n HT20 (U-NII 3 Band) (Low Channel)



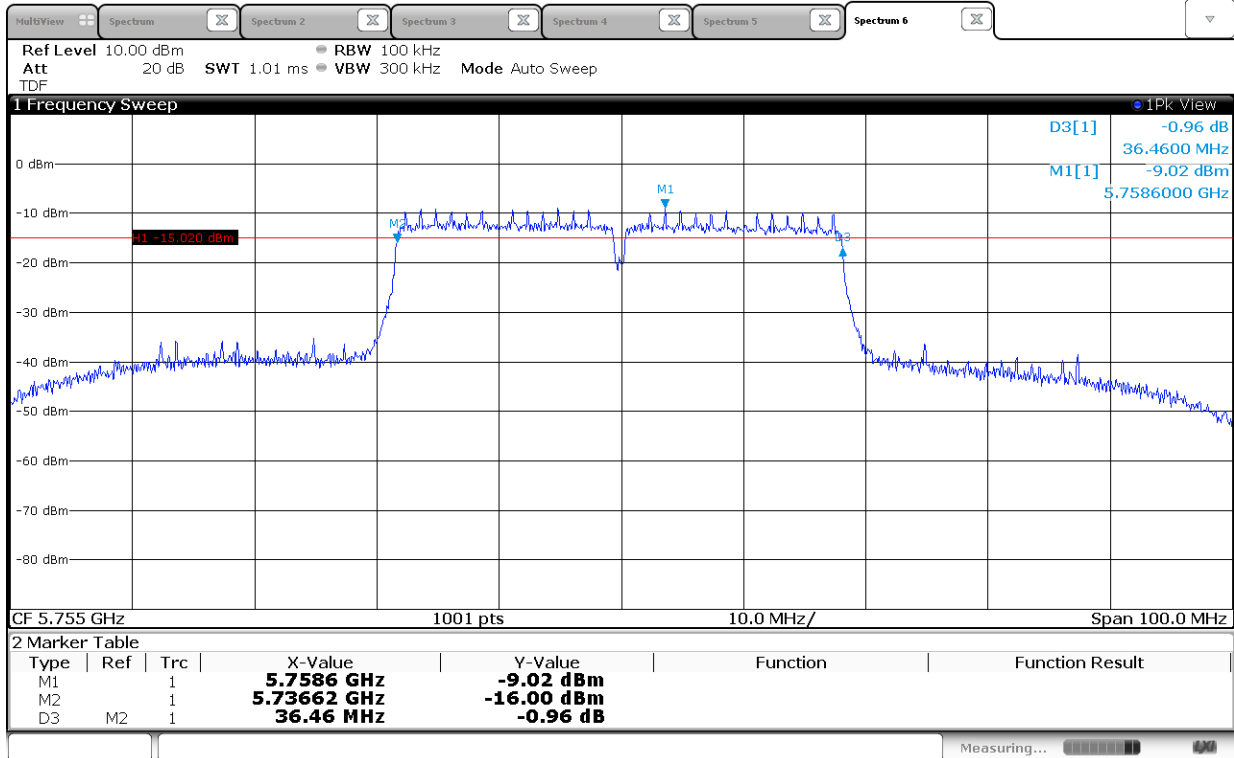
Operating Mode: 802.11n HT20 (U-NII 3 Band) (Middle Channel)



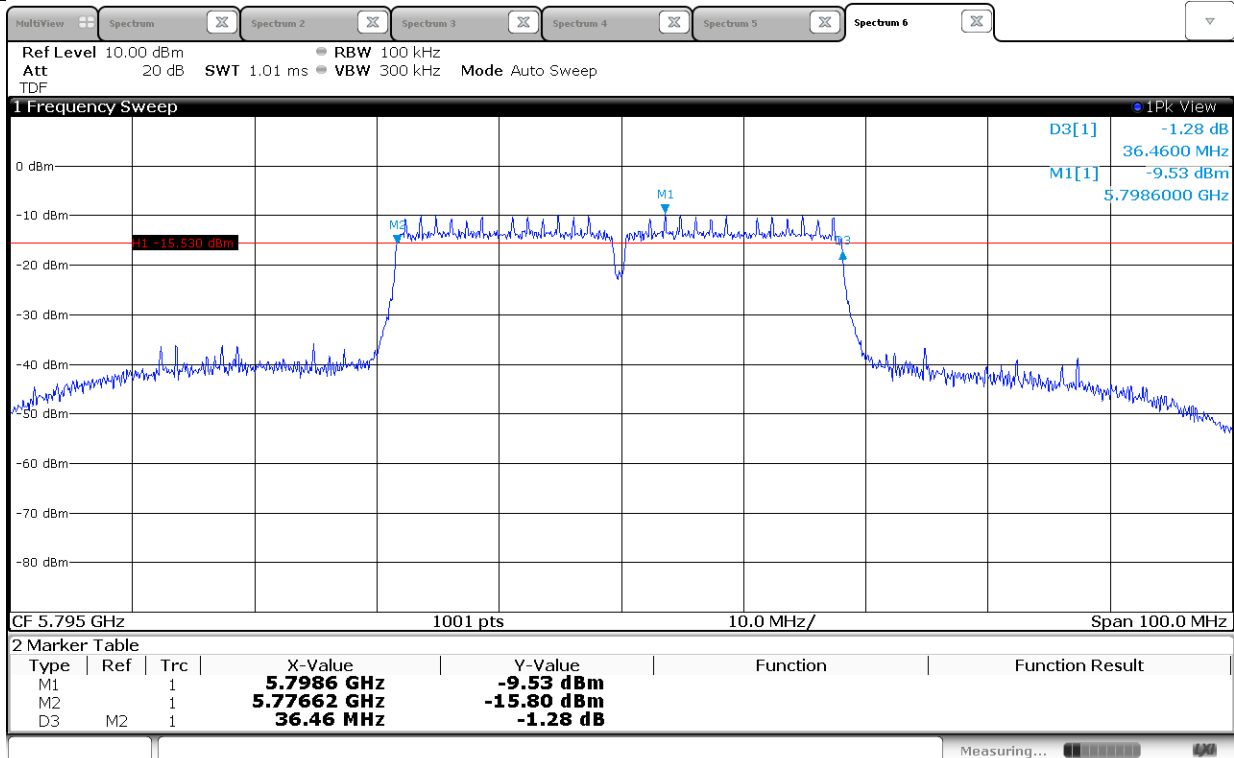
Operating Mode: 802.11n HT20 (U-NII 3 Band) (High Channel)



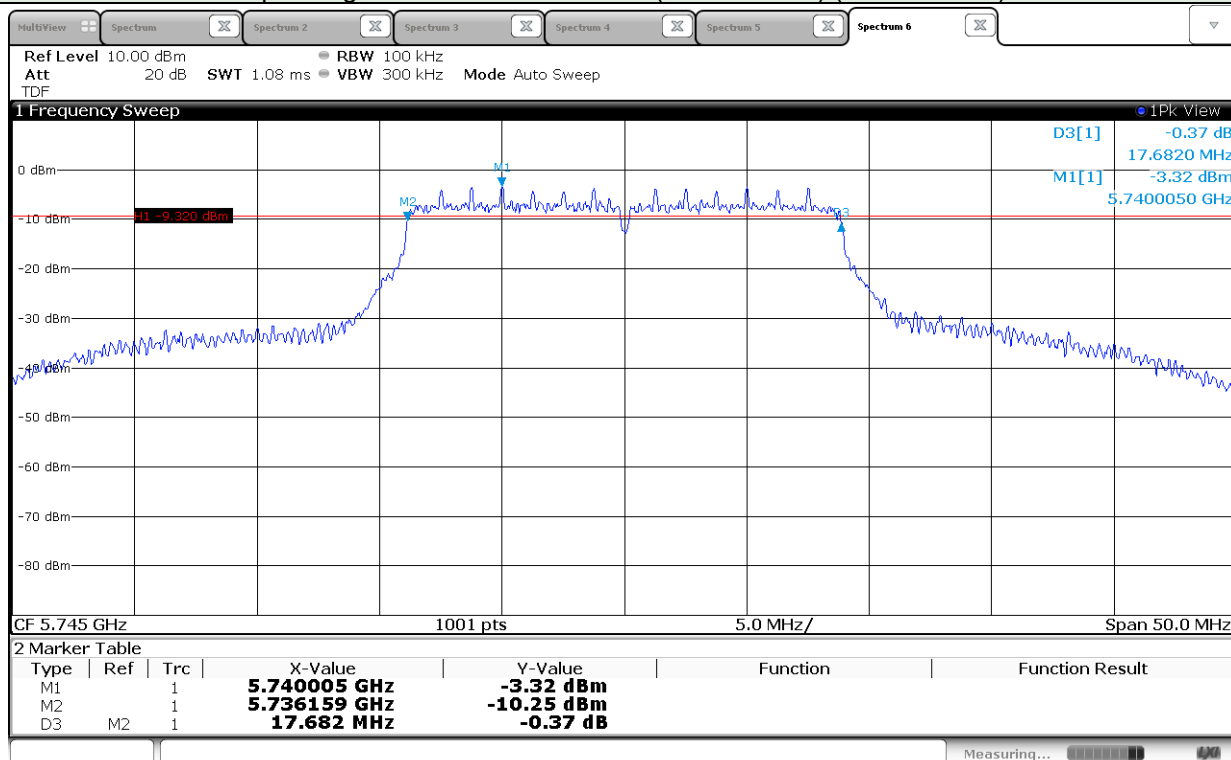
Operating Mode: 802.11n HT40 (U-NII 3 Band) (Low Channel)



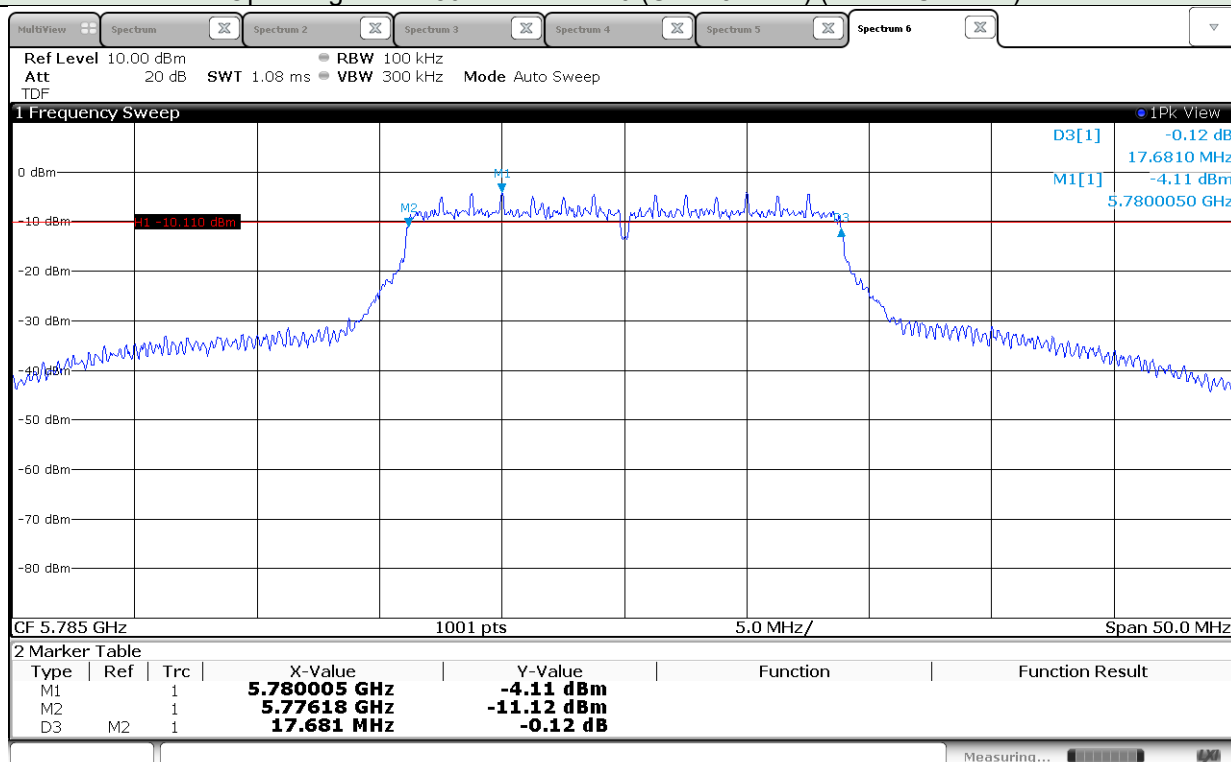
Operating Mode: 802.11n HT40 (U-NII 3 Band) (High Channel)



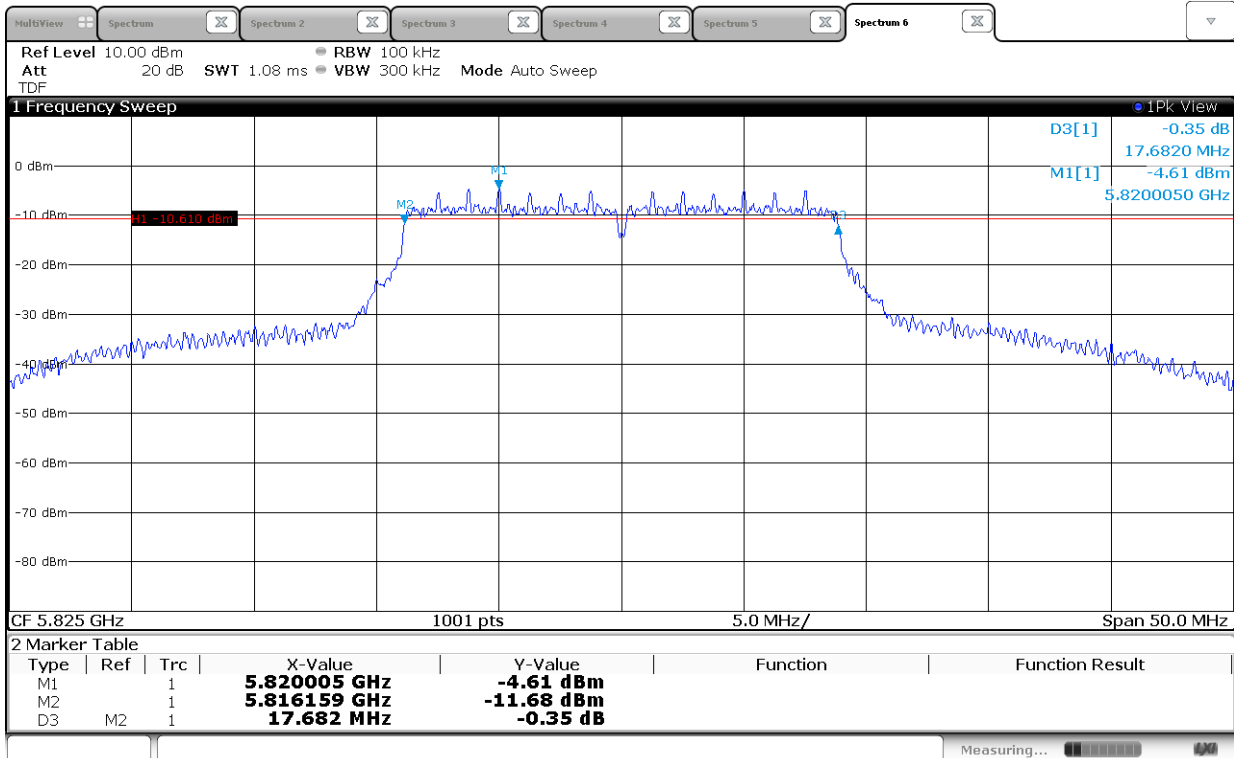
Operating Mode: 802.11ac VHT20 (U-NII 3 Band) (Low Channel)



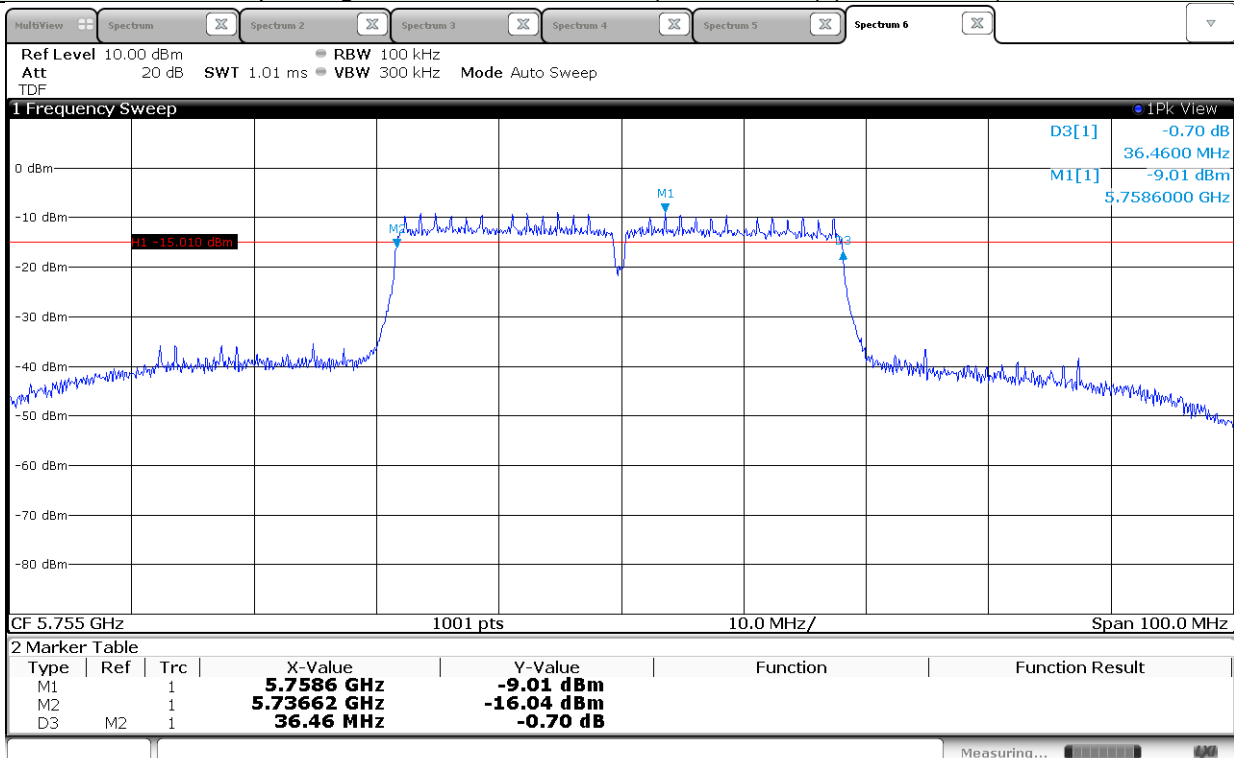
Operating Mode: 802.11ac VHT20 (U-NII 3 Band) (Middle Channel)



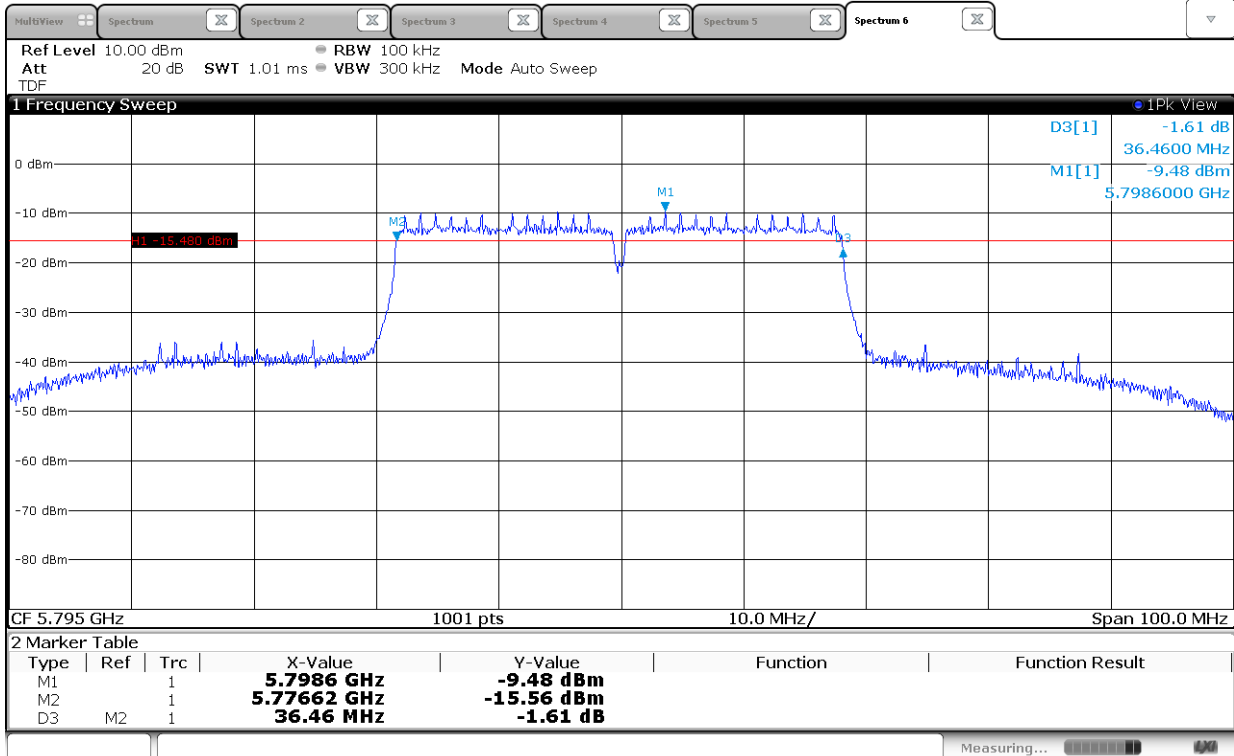
Operating Mode: 802.11ac VHT20 (U-NII 3 Band) (High Channel)



Operating Mode: 802.11ac VHT40 (U-NII 3 Band) (Low Channel)



Operating Mode: 802.11ac VHT40 (U-NII 3 Band) (High Channel)



Operating Mode: 802.11ac VHT80 (U-NII 3 Band) (Middle Channel)

