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## Competences and guarantees

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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

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1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
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

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

## Data provided by the client

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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 NTG7 PREMIUM is an automotive head unit to be installed in cars with the following features: FM/AM/DAB/DVBT, USB, Bluetooth, WLAN and GNSS.

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
60268/015	Automotive Infotainment System	NTG7 PREMIUM	HBM239GQ0KS000354	2019/08/26
60268/048	Radio Controller of Automotive Infotainment System	--	--	2019/08/28
60268/017	Harness	--	--	2019/08/26
60268/245	Antennas	--	--	2019/08/26

Sample S/01 has undergone the following test(s): All RADIATED tests above 1 GHz indicated in Appendixes B and C.

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

Control N°	Description	Model	Serial N°	Date of reception
60268/059	Automotive Infotainment System	NTG7 PREMIUM	HBM239KS000361	2019/09/23
60268/025	Cable RF Harness Short	--	--	2019/08/28
60268/245	Antennas	--	--	2019/08/26

Sample S/02 has undergone the following test(s): All RADIATED tests above below 1 GHz indicated in Appendixes B and C.

- Sample S/03 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
60268/015	Automotive Infotainment System	NTG7 PREMIUM	HBM239GQ0KS000354	2019/08/26
60268/048	Radio Controller of Automotive Infotainment System	--	--	2019/08/28
60268/026	Cable RF Harness Short	--	--	2019/08/28

Sample S/03 has undergone the following test(s): All CONDUCTED tests indicated in Appendixes A, B and C for SISO MODE.

- Sample S/04 is composed of the following elements:

Control N°	Description	Model	Serial N°	Date of reception
60268/059	Automotive Infotainment System	NTG7 PREMIUM	HBM239K\$000361	2019/09/23
60268/026	Cable RF Harness Short	--	--	2019/08/28

Sample S/04 has undergone the following test(s): All CONDUCTED tests indicated in Appendixes A, B and C for MIMO MODE.

## Test sample description

Ports..... :	Port name and description	Cable					
		Specified max length [m]	Attached during test	Shielded	Coupled to patient <sup>(3)</sup>		
	Car Connector A	>3m <sup>(x1)</sup>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	Car Connector B	>3m <sup>(x1)</sup>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	Display Connector CID/PIP / RVC	>3m <sup>(x1)</sup>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	USB Connector	<3m <sup>(x2)</sup>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	Eth Connector	>3m <sup>(x1)</sup>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
	BT/WLAN-Antenna	>3m <sup>(x1)</sup>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	FM/AM, TV/SDARS Ant	>3m <sup>(x1)</sup>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
	GNSS Antenna	>3m <sup>(x1)</sup>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>		
Supplementary information to the ports..... :	-						
Rated power supply .....	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	<input checked="" type="checkbox"/>	DC: 12V Car battery / attenuator (9,5-15,5V normal operation)					
Rated Power .....	9,5-15,5V normal operation						
Clock frequencies..... :	see schematics						
Other parameters .....	See Technical Description						
Software version .....	E13.300						
Hardware version .....	D4						
Dimensions in cm (W x H x D) .....	182 x 78 x 160 mm						
Mounting position .....	<input checked="" type="checkbox"/>	Other: automotive headunit					
Modules/parts..... :	Module/parts of test item			Type	Manufacturer		
	n/a			-			
Accessories (not part of the test item) .....	Description			Type	Manufacturer		
	Display			-	LG.		

	HARMANeco RasPi	-	HBAS
	Cable harness	-	HBAS
	BT/WLAN-Antenna	-	Hirschmann
Documents as provided by the applicant .....	Description	File name	Issue date
	Technical Description		
	-		

## 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)	2019-09-04
Date (finish)	2019-11-26

## Document history

Report number	Date	Description
60268RRF.003	2019-12-05	First release

## Environmental conditions

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

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

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

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

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

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

## Remarks and comments

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

Used instrumentation:

### Radiated Measurements:

	Last Calibration	Due Calibration
1. Semianechoic Absorber Lined Chamber ETS LINDGREN FACT 3 200 STP	N.A.	N.A.
2. Shielded Room ETS LINDGREN S101	N.A.	N.A.
3. EMI Test Receiver 7 GHz ROHDE AND SCHWARZ ESR7	2018/10	2020/10
4. RF Pre-amplifier, 38 dB, 30 MHz-6 GHz BONN ELEKTRONIK BLNA 0360-01N	2019/02	2020/02
5. Biconical/Log Antenna 30 MHz - 6 GHz ETS LINDGREN 3142E	2017/04	2020/04
6. Spectrum Analyzer ROHDE AND SCHWARZ FSW50	2018/02	2020/02
7. RF Pre-amplifier, 40 dB ,1-18 GHz BONN ELEKTRONIK BLMA 0118-1M	2019/04	2020/04
8. RF Pre-amplifier, G>48dB, 18-40GHz NARDA JS44-18004000-33-8P	2018/02	2020/02
9. Broadband Horn antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2016/11	2019/11
10. Broadband Horn antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2018/07	2021/07
11. Pre-Amplifier G>40dB 10MHz-6GHz, BONN ELEKTRONIK, BLNA 0160-01N	2019/02	2020/02
12. DC Power Supply Keysight Technologies U8002A	---	---
13. 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.	Signal Analyzer 20 Hz to 8 GHz ROHDE AND SCHWARZ FSQ8	2018/08	2020/08
3.	DC Power Supply 40V/40A Rohde & Schwarz NGPE40	2018/02	2021/02
4.	Signal and Spectrum Analyzer 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			
Requirement – Test case		Verdict	Remark
FCC 15.35 (c) / RSS-Gen 6.10	Duty Cycle	P	
RSS-Gen 6.6 / RSS-247 6.2.	Transmitter 99% Occupied Bandwidth	P	
FCC 15.403 (i)	Transmitter 26 dB Emission Bandwidth (EBW)	P	
FCC 15.407 (g) / RSS-Gen 6.11	Frequency Stability (Temperature & Voltage Variation)	N/M	(1)
<u>Supplementary information and remarks:</u>			
(1) The manufacturer is responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user manual.			



## B. 5.15 GHz – 5.25 GHz Band

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. 5.725 GHz – 5.85 GHz Band

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		Verdict	Remark
FCC 15.407 (e) / RSS-247 Clause 6.2.4.1	6 dB Bandwidth.	P	
FCC 15.407 (a)(3) / RSS-247 6.2.4.1	Transmitter Maximum conducted Output Power	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	
<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. Duty Cycle .....	13
RSS-Gen 6.6 / RSS-247 6.2. 99% Occupied Bandwidth .....	24
FCC 15.403 (i) 26 dB Emission Bandwidth (EBW).....	34

## FCC 15.35 (c) / RSS-Gen 6.10. 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%.

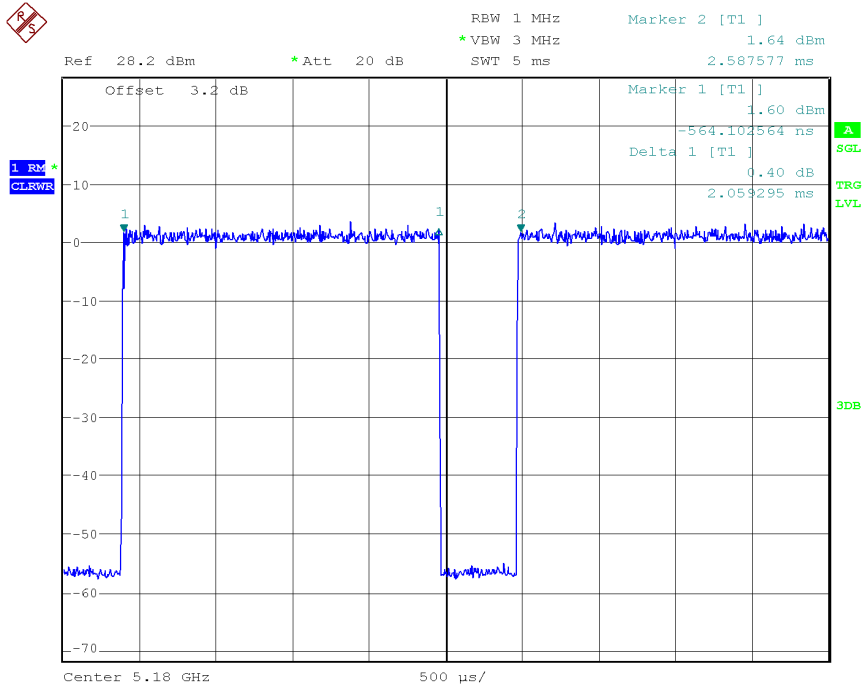
Tests performed on the SISO mode CORE-0\_Port3 Antenna.

Tests performed on the MIMO mode CORE-MIMO\_Port1 & Port4 Antennas.

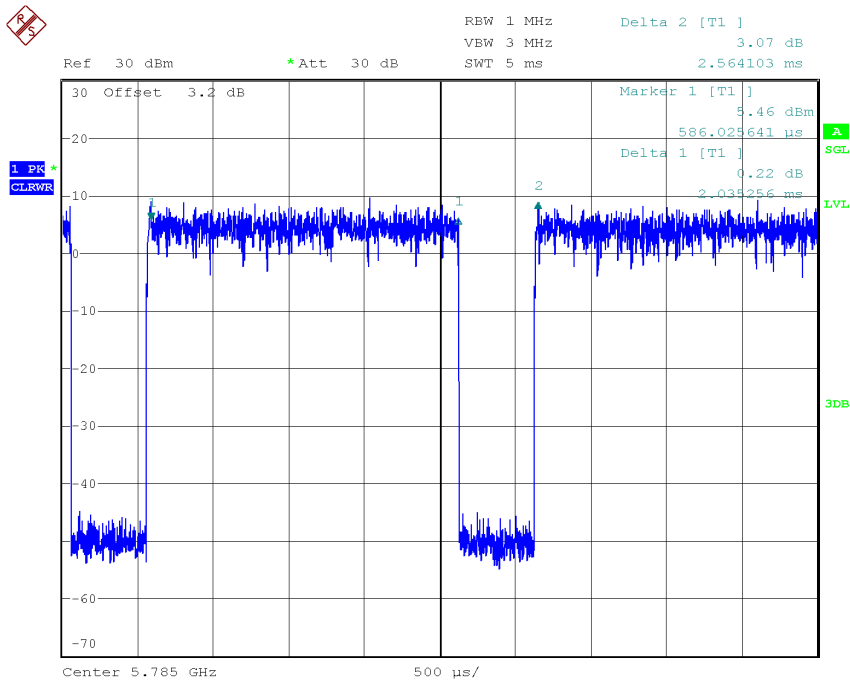
Sub-band	Technique	Mode	Pulse Duration (us)	Period (us)	Duty Cycle correction (dB)
U-NII-1	SISO (*)	802.11a / 20 MHz	2059.295	2587.577	0.992
U-NII-3	SISO (*)	802.11a / 20 MHz	2035.256	2564.103	1.003
U-NII-1	SISO	802.11n / 20 MHz	1891.026	2427.885	1.085
U-NII-3	SISO	802.11n / 20 MHz	1850.962	2403.846	1.135
U-NII-1	SISO	802.11n / 40 MHz	902.307692	1455.192	2.076
U-NII-3	SISO	802.11n / 40 MHz	884.76859	1455.641	2.162
U-NII-1	SISO	802.11ac / 80 MHz	420.025	966.858974	3.621
U-NII-3	SISO	802.11ac / 80 MHz	420.025	966.858974	3.621
U-NII-1	MIMO 2x2 Port1	802.11n / 20 MHz	959.260	1480.480	1.885
	MIMO 2x2 Port4		972.270	1485.480	1.841
U-NII-3	MIMO 2x2 Port1	802.11n / 20 MHz	975.000	1491.026	1.845
	MIMO 2x2 Port4		983.012821	1499.038	1.832
U-NII-1	MIMO 2x2 Port1	802.11n / 40 MHz	498.922288	598.490	3.020
	MIMO 2x2 Port4		496.276344	994.990	3.043
U-NII-3	MIMO 2x2 Port1	802.11n / 40 MHz	465.384615	1003.205	3.336
	MIMO 2x2 Port4		465.384615	1003.205	3.336
U-NII-1	MIMO 2x2 Port1	802.11ac / 80 MHz	60.360	559.460	9.671
	MIMO 2x2 Port4		60.360	559.960	9.674
U-NII-3	MIMO 2x2 Port1	802.11ac / 80 MHz	64.102564	564.102564	9.445
	MIMO 2x2 Port4		64.102564	560.897435	9.42

\*: Mode a20 not supported in MIMO.

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

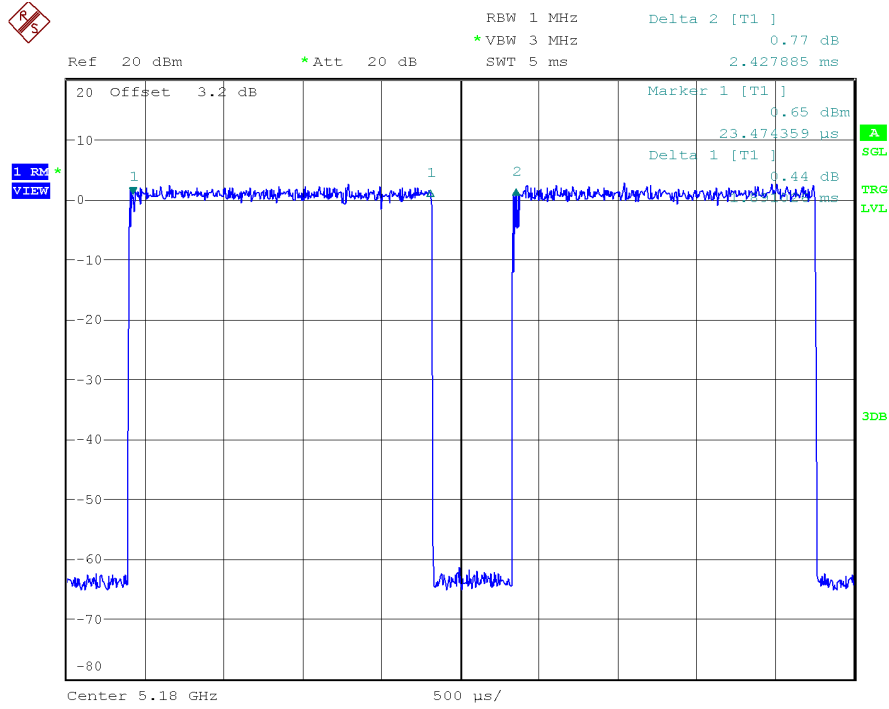


**Mode SISO 802.11 a20 (U-NII-3):**

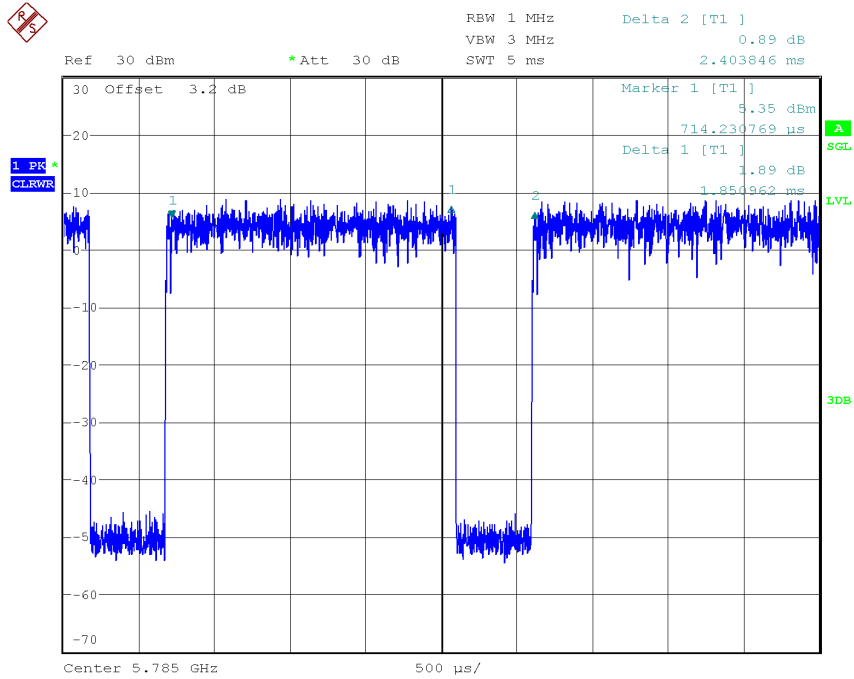


### SISO CORE-0\_Port3 Antenna

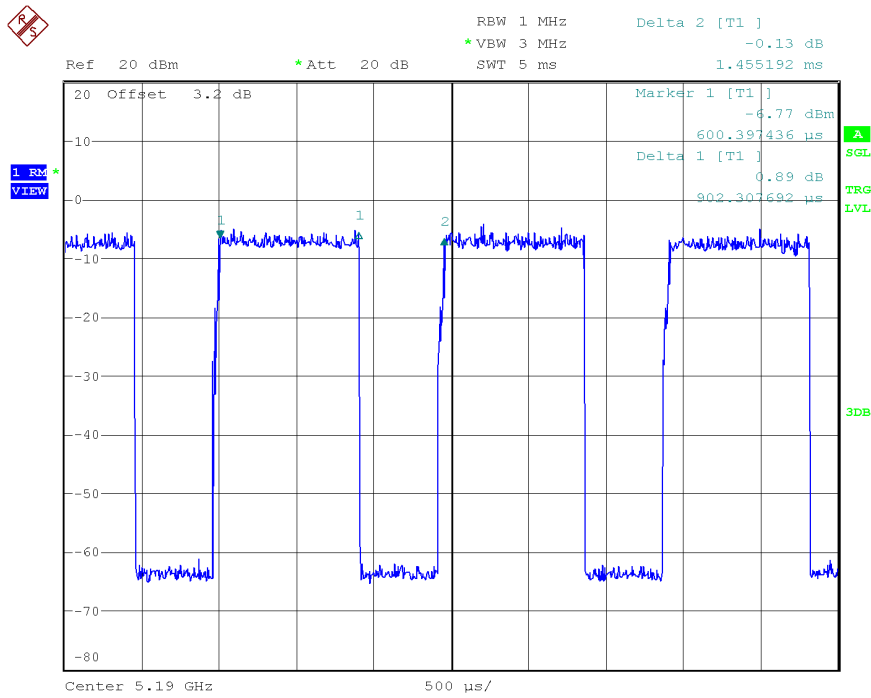
#### Mode 802.11 n20 (U-NII-1):



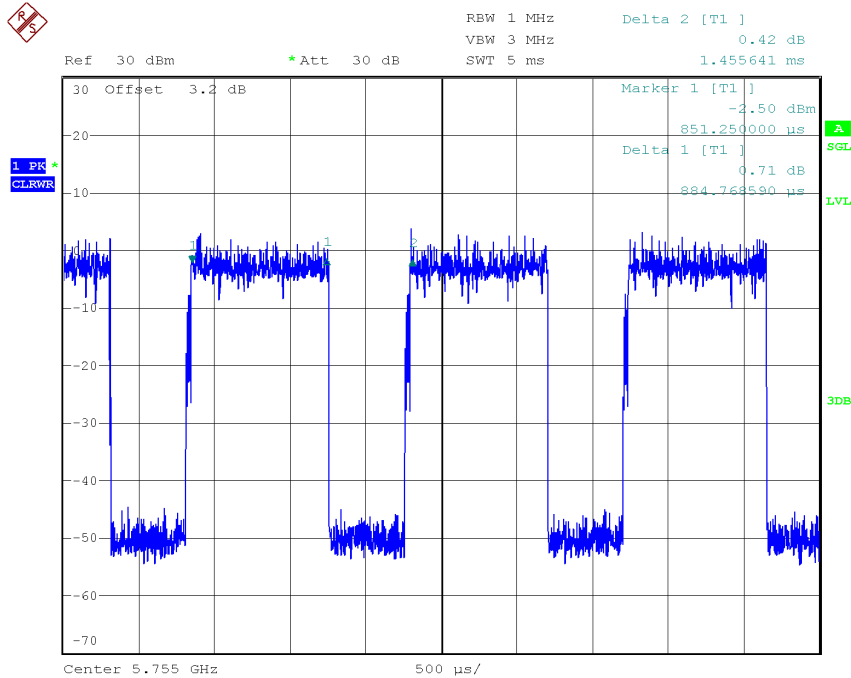
#### Mode 802.11 n20 (U-NII-3):



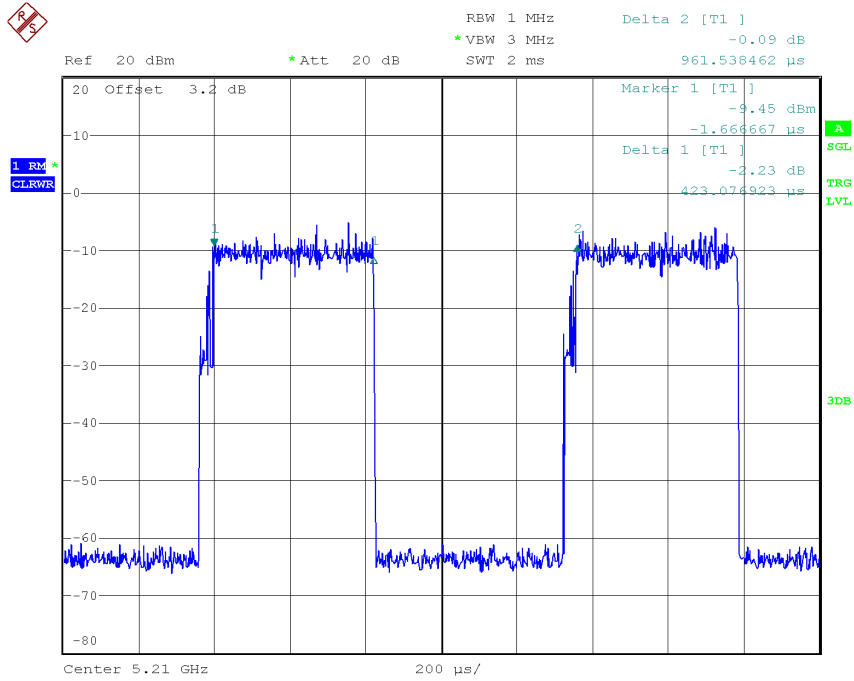
**Mode 802.11 n40 (U-NII-1):**



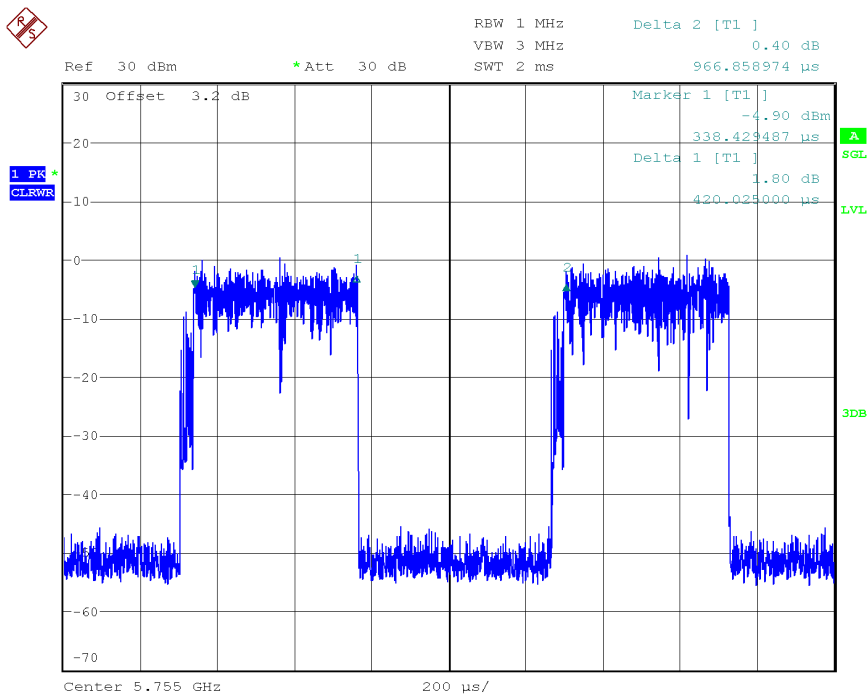
**Mode 802.11 n40 (U-NII-3):**



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



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

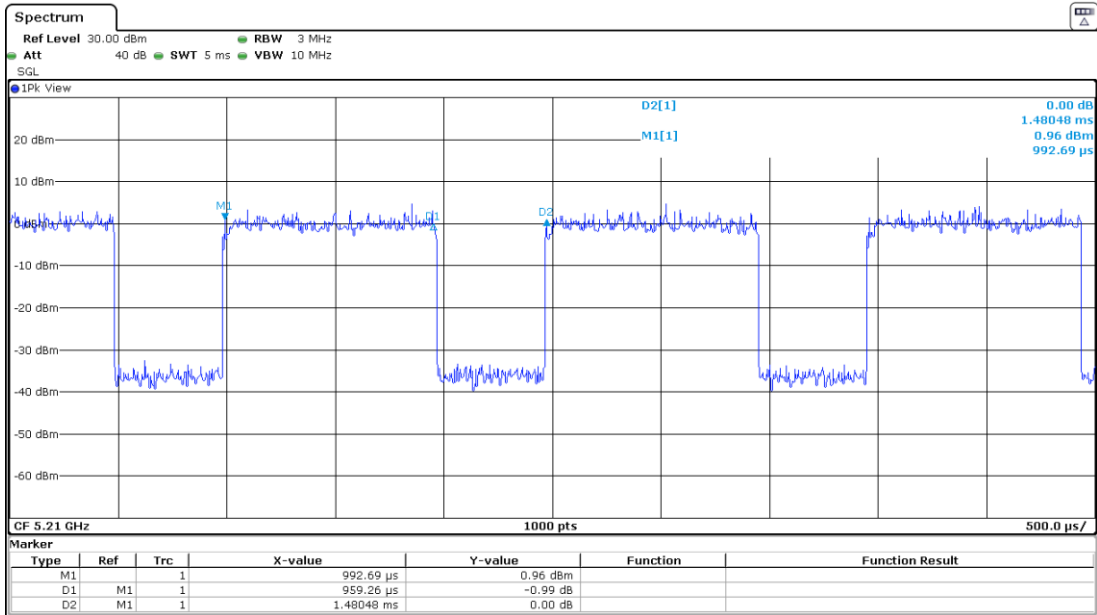




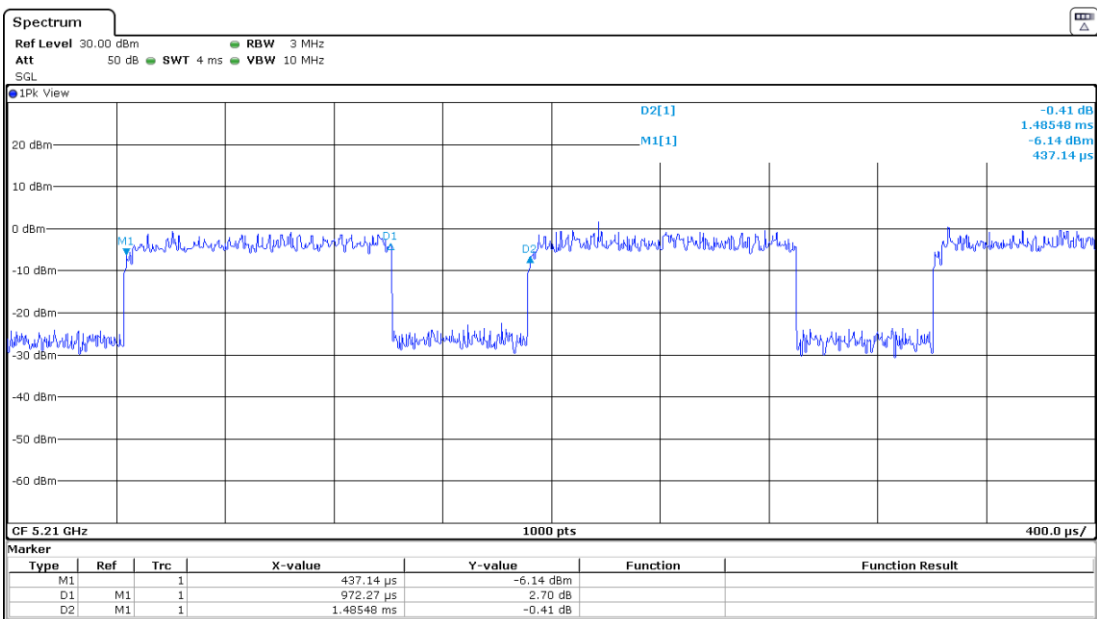
### MIMO CORE-MIMO\_Port1 & Port4 Antennas

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

Port 1:

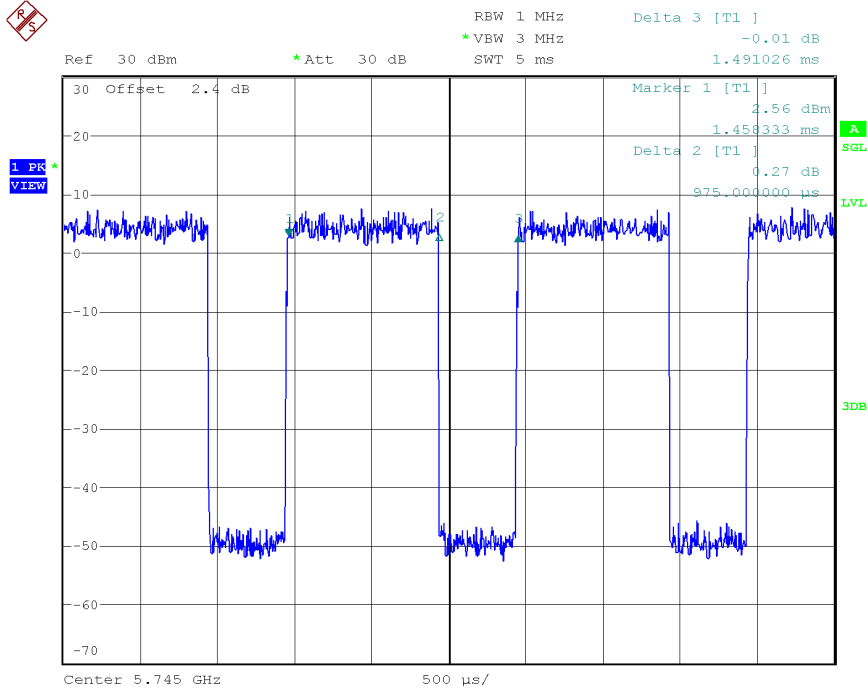


Port 4:

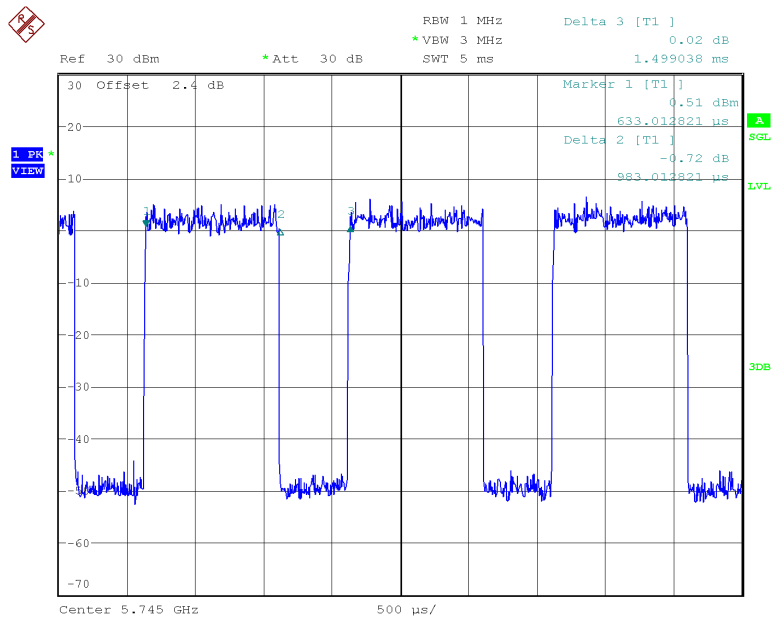


**Mode 802.11 n20 (U-NII-3):**

Port 1:

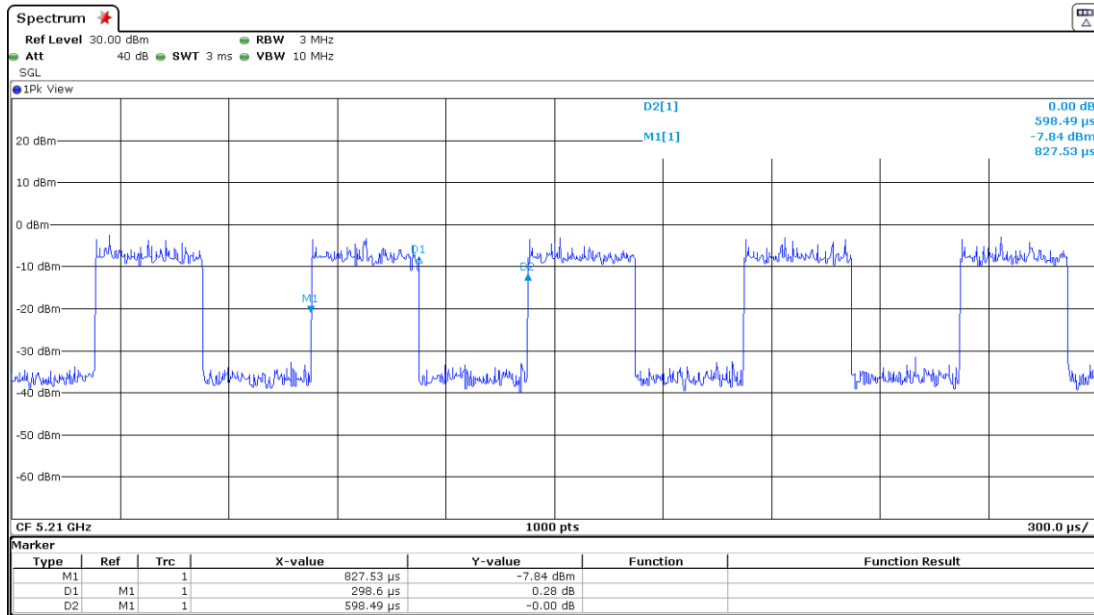


Port 4:

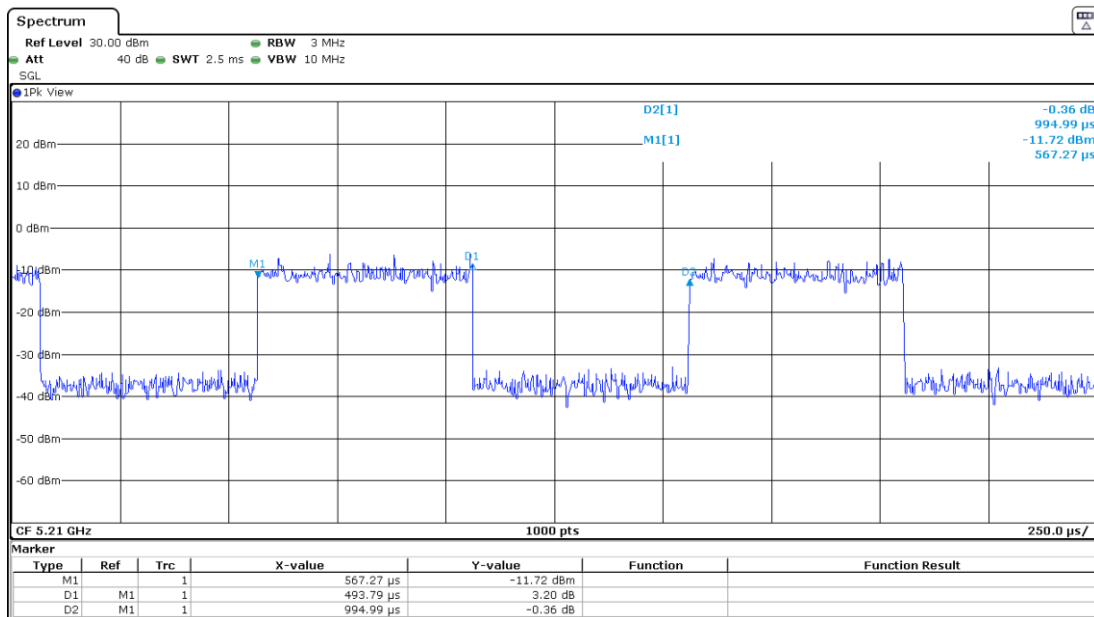


**Mode 802.11 n40 (U-NII-1):**

Port 1:

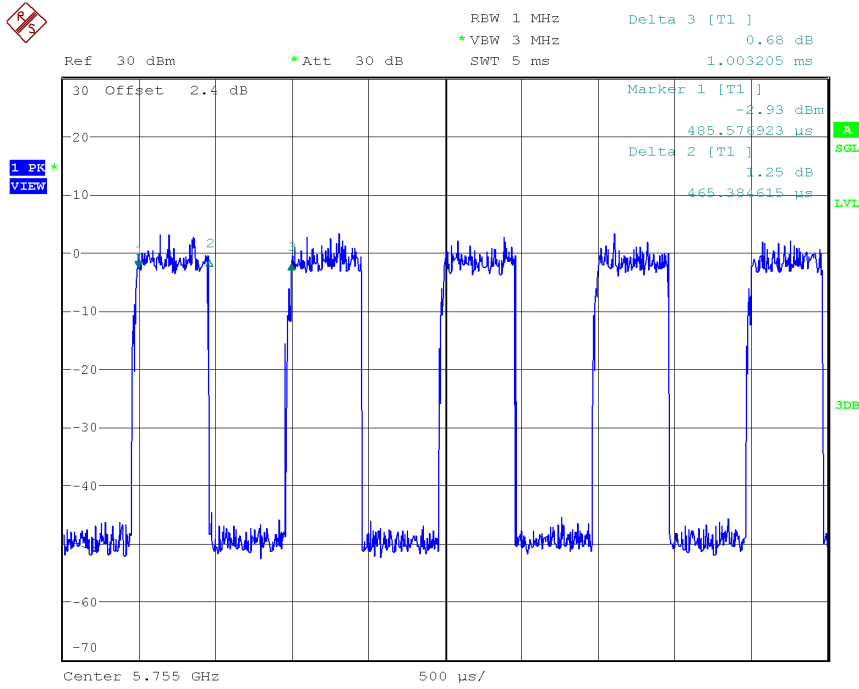


Port 4:

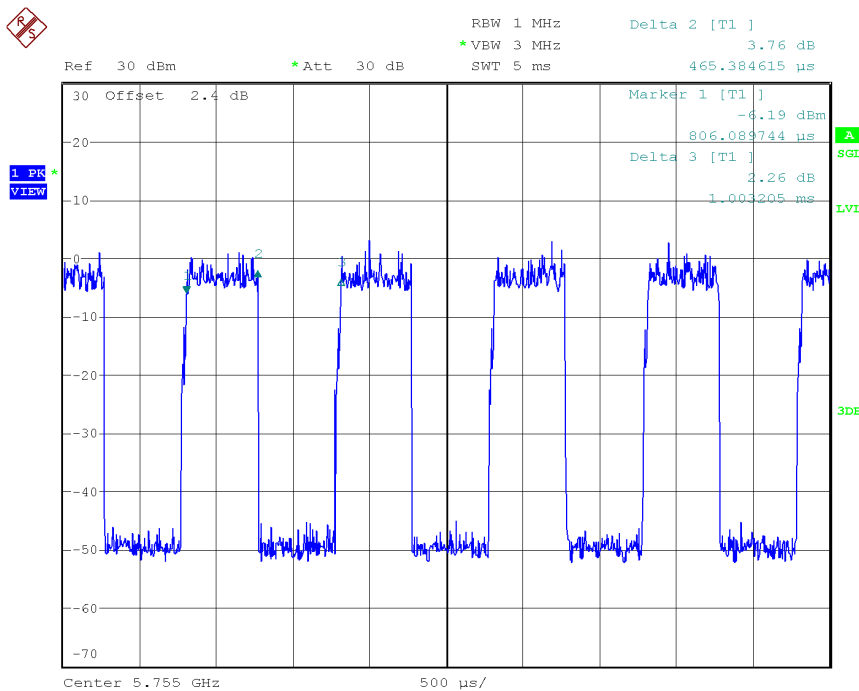


**Mode 802.11 n40 (U-NII-3):**

Port 1:

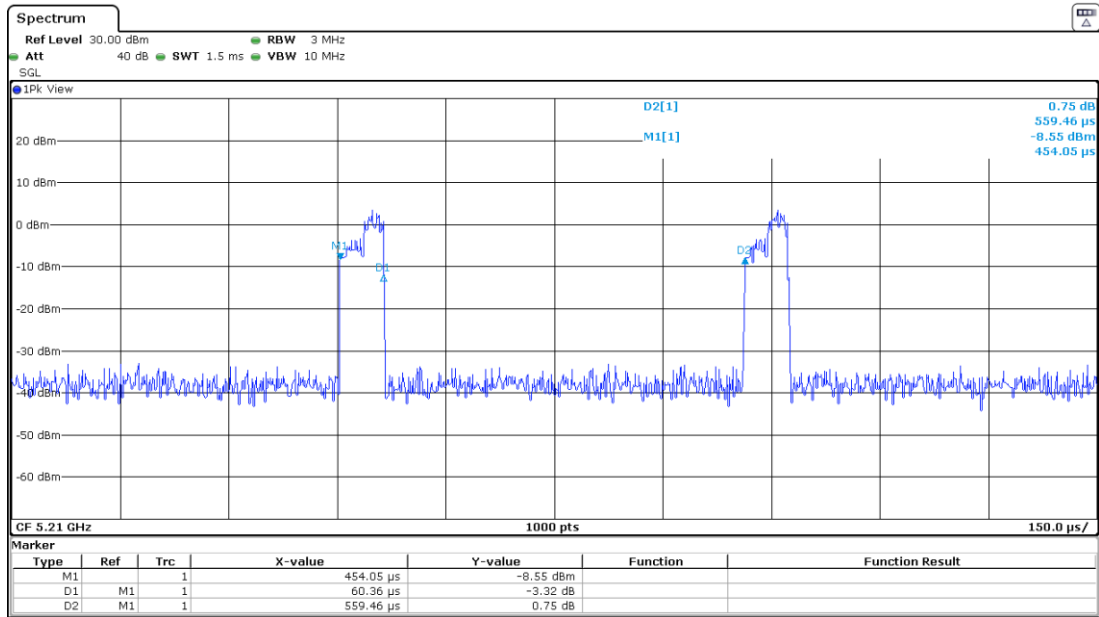


Port 4:

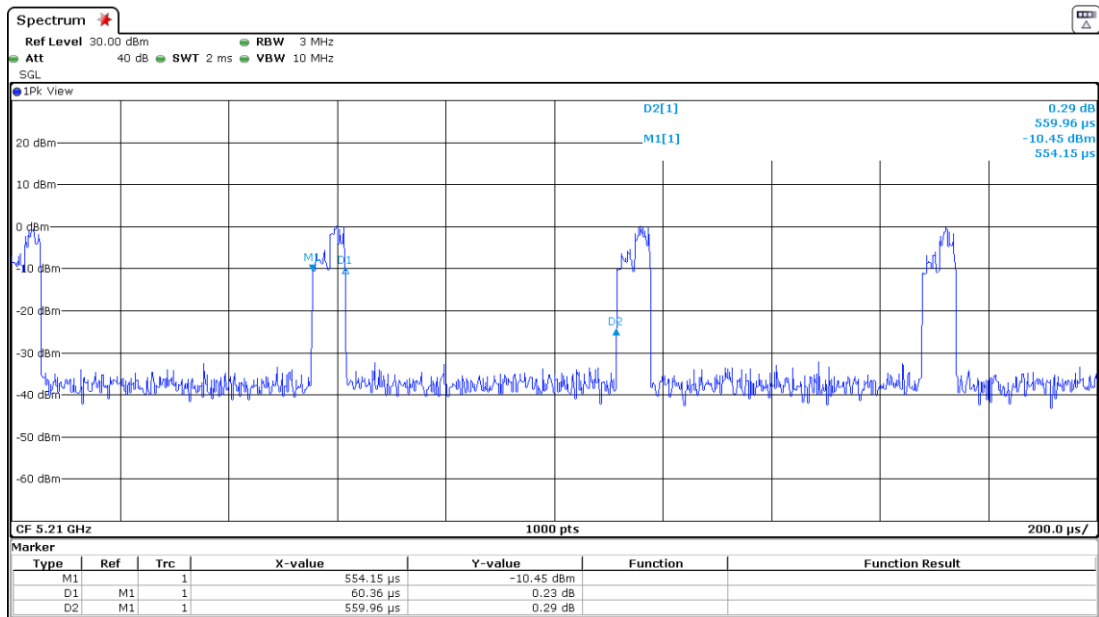


**Mode 802.11 ac80 (U-NII-1):**

Port 1:

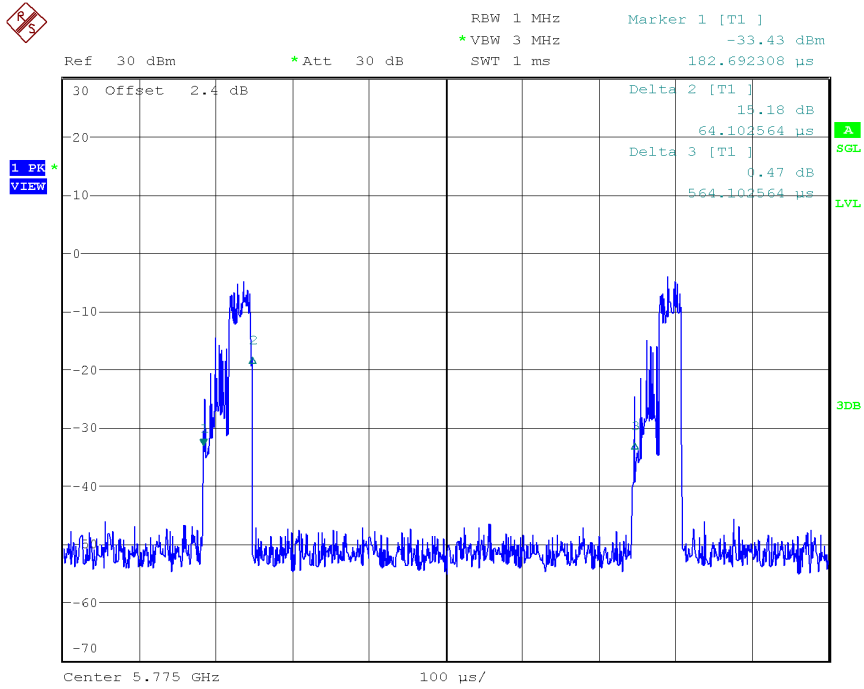


Port 4:

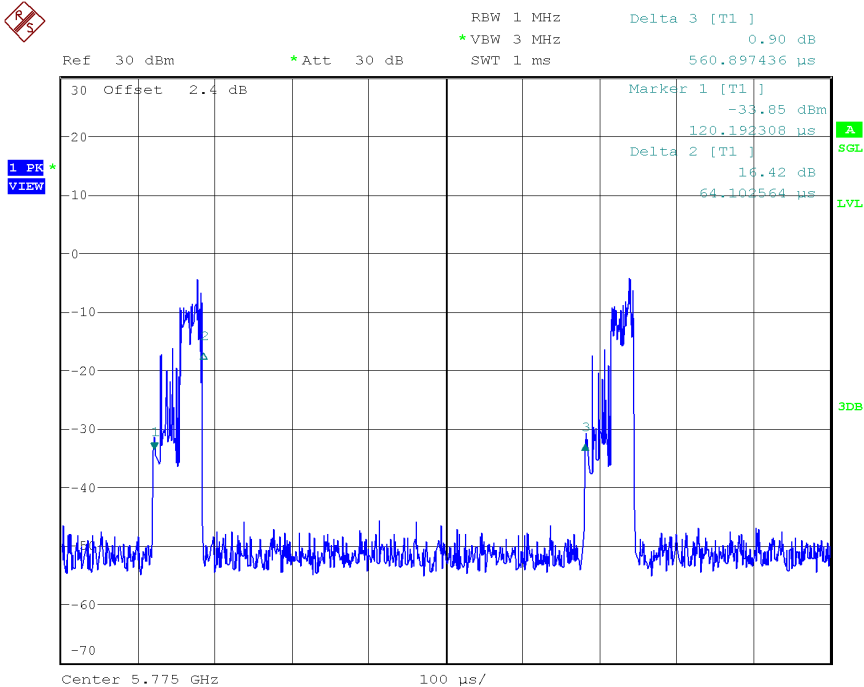


**Mode 802.11 ac80 (U-NII-3):**

Port 1:



Port 4:



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

The following modes and data rates were selected based on preliminary testing that identified those corresponding to the worst cases:

- 802.11a: 6 Mbit/s.
- 802.11n HT20: MCS0.
- 802.11n HT40: MCS0.
- 802.11ac VHT80: MCS0

Tests performed on the SISO mode CORE-0\_Port3 Antenna.

### SISO CORE-0\_Port3 Antenna:

#### Mode 802.11 a20:

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

Channels	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
99% Occupied Bandwidth (MHz)	17.12	17.16	17.12
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)	17.08	17.13333333	17.08
Measurement uncertainty (kHz)	<±40.04		

**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)	18.32	18.32	18.36
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)	18.2	18.24	18.2
Measurement uncertainty (kHz)	<±40.04		

**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)	36.24	36.4
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)	36.29333333	36.32
Measurement uncertainty (kHz)	<±70.07	



**Mode 802.11 ac80 (VHT80):**

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

Channel	Single Channel 42 (5210 MHz)
99% Occupied Bandwidth (MHz)	75.84
Measurement uncertainty (kHz)	<±110.11

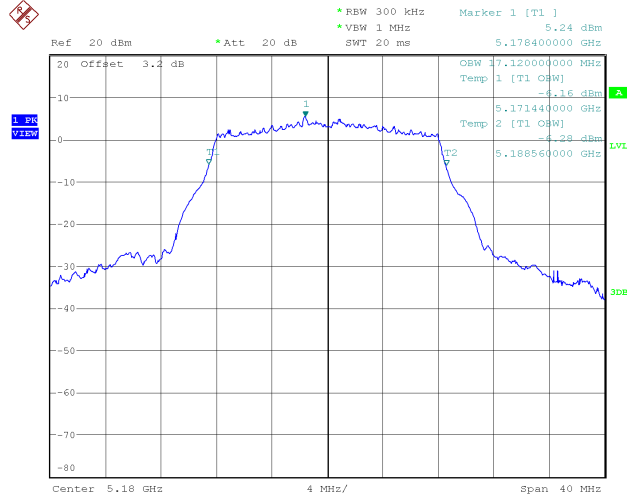
**U-NII-3 (5725-5850 MHz)**

Channel	Single Channel 155 (5775 MHz)
99% Occupied Bandwidth (MHz)	75.78666666
Measurement uncertainty (kHz)	<±110.11

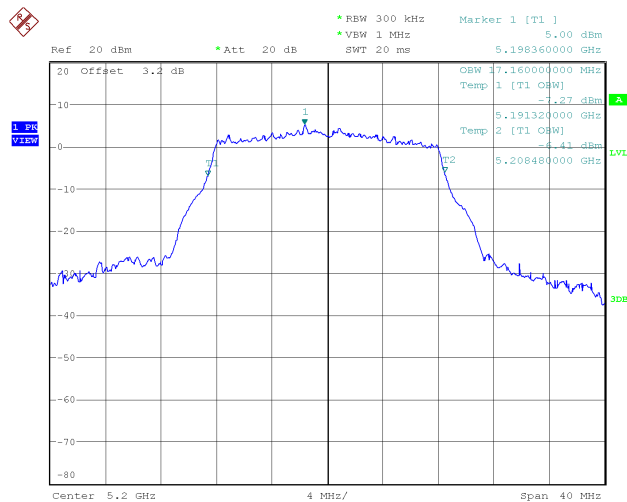
Mode 802.11 a20:

U-NII-1 (5150-5250 MHz)

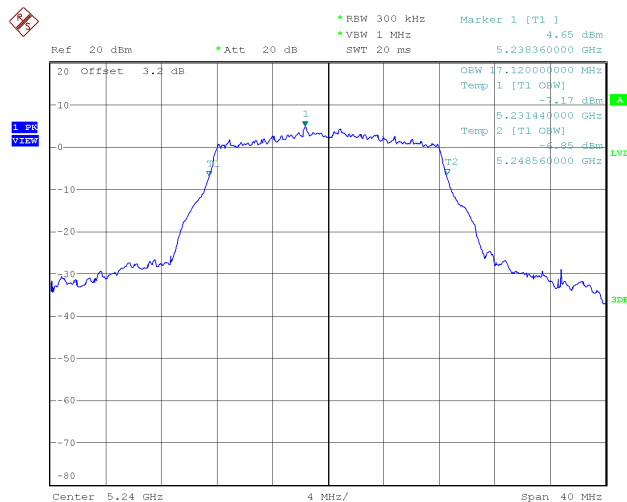
- Low Channel 36 (5180 MHz):



- Middle Channel 40 (5200 MHz):

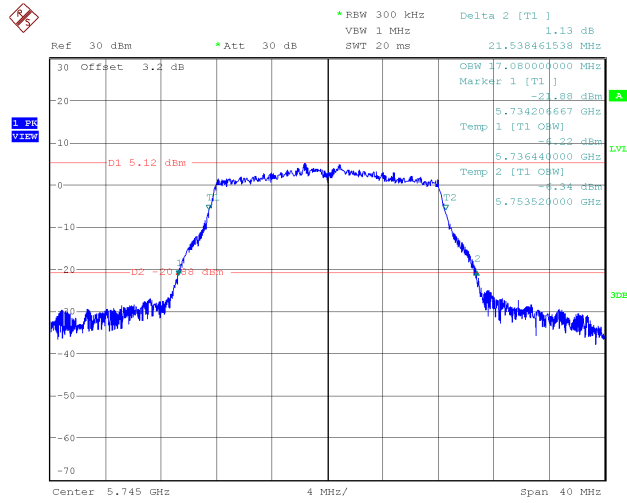


- High Channel 48 (5240 MHz):

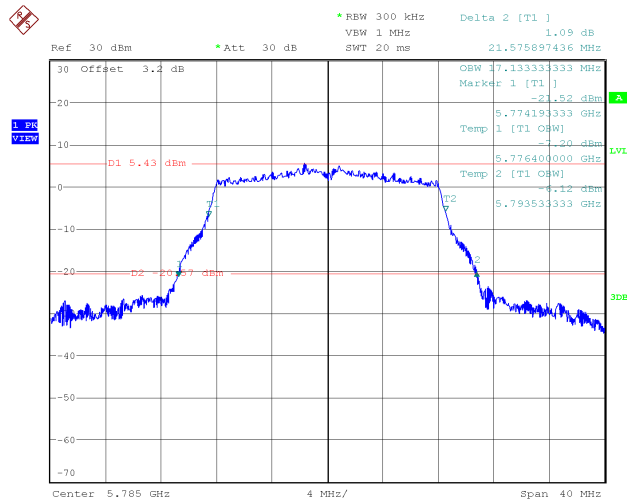


### U-NII-3 (5725-5850 MHz)

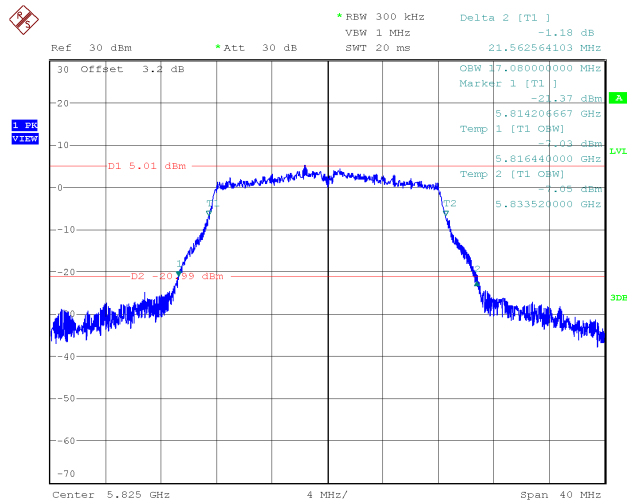
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



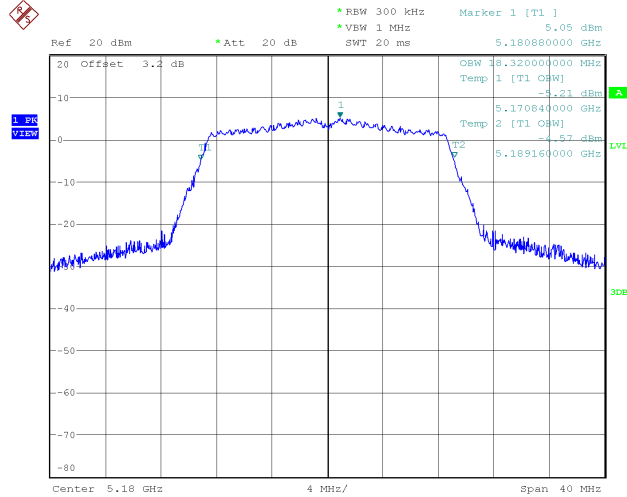
- High Channel 165 (5825 MHz):



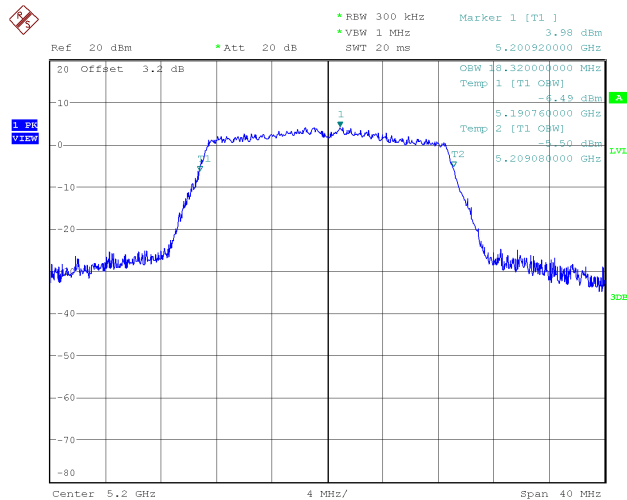
**Mode 802.11 n20 HT20:**

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

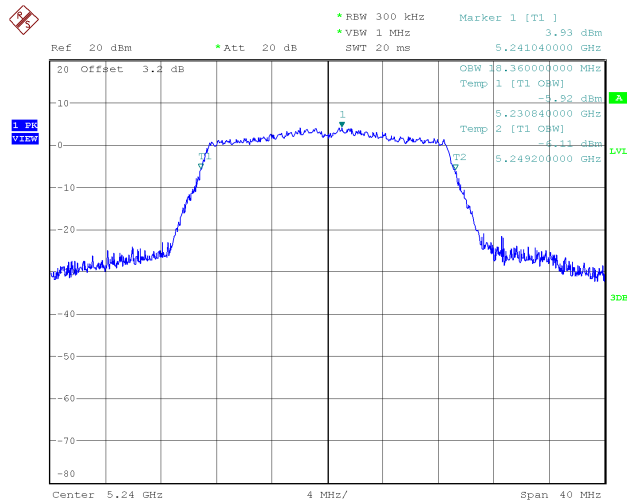
- Low Channel 36 (5180 MHz):



- Middle Channel 40 (5200 MHz):

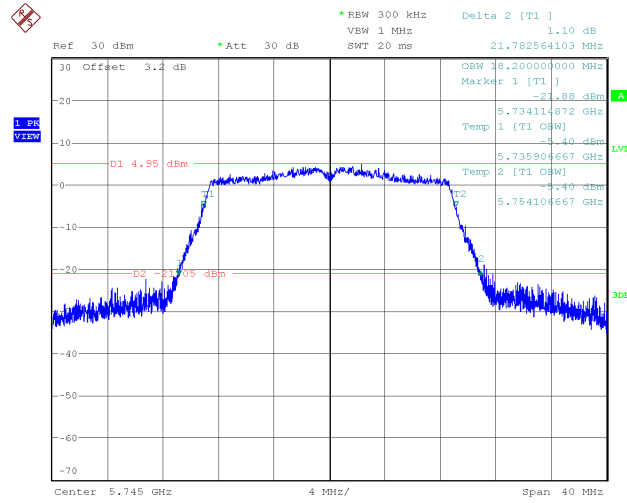


- High Channel 48 (5240 MHz):

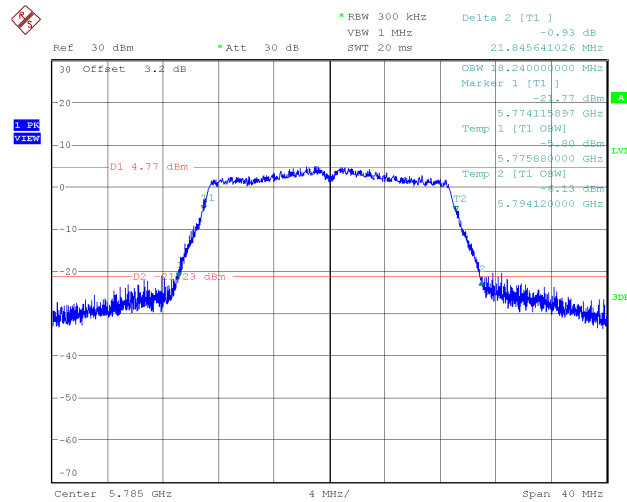


### U-NII-3 (5725-5850 MHz)

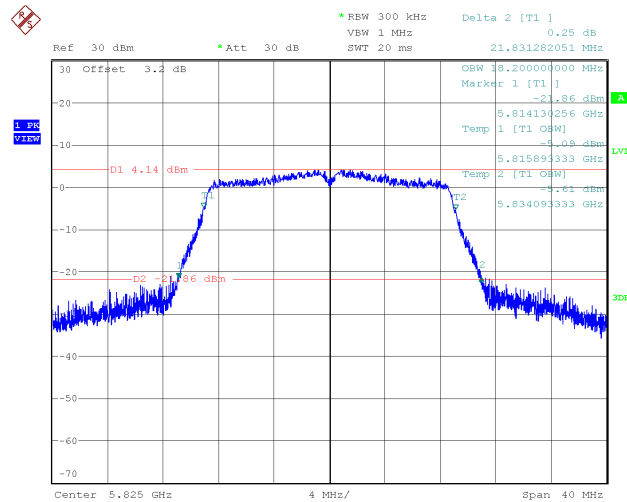
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



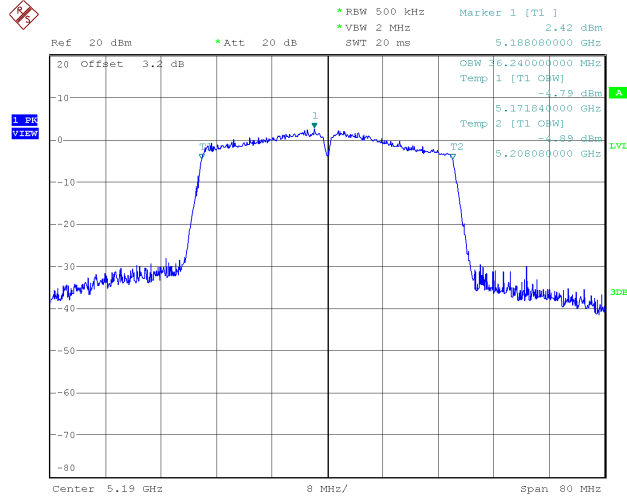
- High Channel 165 (5825 MHz):



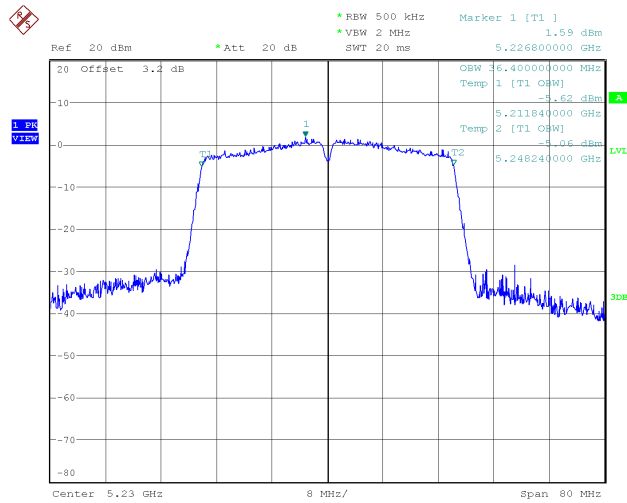
**Mode 802.11 n40 (HT40):**

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

- Low Channel 38 (5190 MHz):

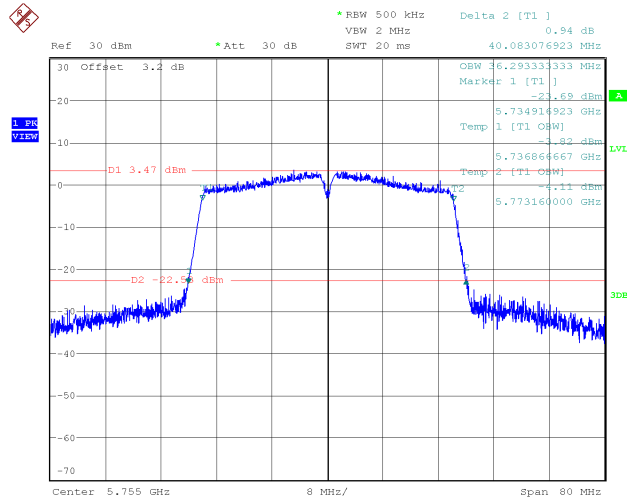


- High Channel 46 (5230 MHz):

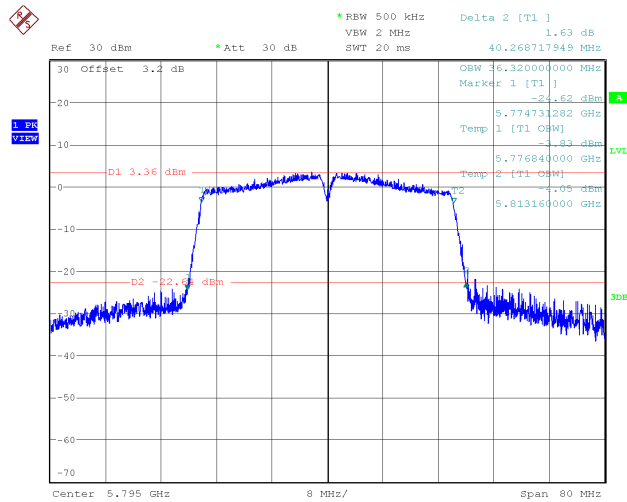


### U-NII-3 (5725-5850 MHz)

- Low Channel 151 (5755 MHz):



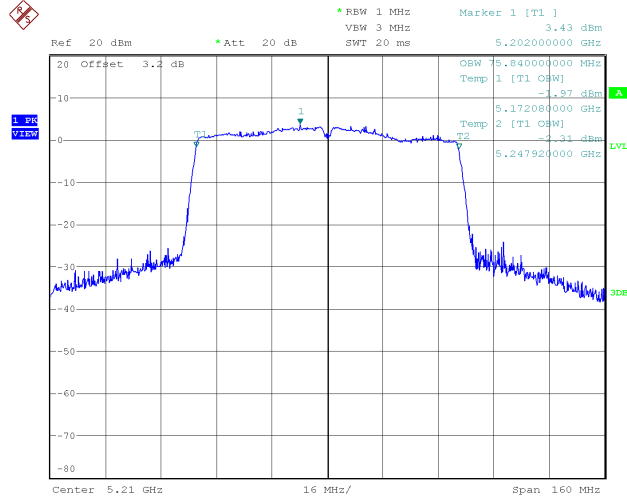
- High Channel 159 (5795 MHz):



**Mode 802.11 ac80 (VHT80):**

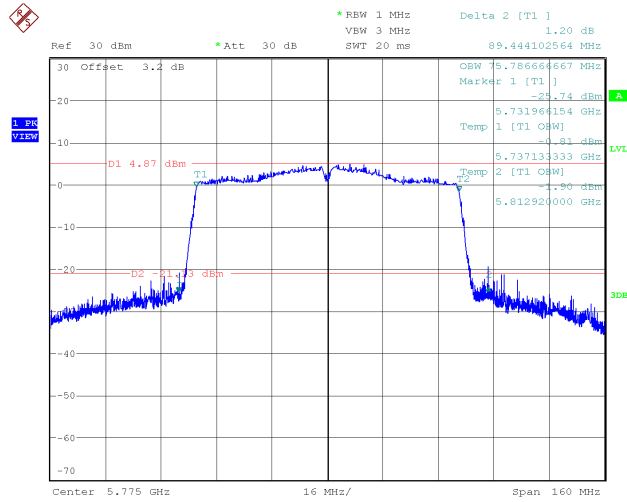
**U-NII-1 (5150-5250 MHz)**

- Single Channel 42 (5210 MHz):



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

- Single Channel 155 (5775 MHz):





## FCC 15.403 (j) 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.

The following modes and data rates were selected based on preliminary testing that identified those corresponding to the worst cases:

- 802.11a: 6 Mbit/s.
- 802.11n HT20: MCS0.
- 802.11n HT40: MCS0.
- 802.11ac VHT80: MCS0

Tests performed on the SISO mode CORE-0\_Port3 Antenna.

Tests performed on the MIMO mode CORE-MIMO\_Port1 & Port4 Antennas.

### SISO CORE-0\_Port3 Antenna:

#### 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)	21.53846154	21.60000000	21.66410256
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)	21.53846153	21.57589743	21.5625641
Measurement uncertainty (kHz)	<±40.04		

**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)	21.98717948	21.98717948	22.70974359
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)	21.7825641	21.84564102	21.83128205
Measurement uncertainty (kHz)	<±40.04		

**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)	40.000000	40.12820513
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)	40.08307692	40.26871794
Measurement uncertainty (kHz)	<±70.07	

**Mode 802.11 ac80 (VHT80):**

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

Channel	Single Channel 42 (5210 MHz)
26 dB Emission Bandwidth (MHz)	82.62717948
Measurement uncertainty (kHz)	<±110.11

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

Channel	Single Channel 155 (5775 MHz)
26 dB Emission Bandwidth (MHz)	89.44410256
Measurement uncertainty (kHz)	<±110.11

**MIMO CORE-MIMO\_Port1 & Port4 Antennas:**

**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)	
	CORE- MIMO_ Port 4	CORE- MIMO_ Port 1	CORE- MIMO_ Port 4	CORE- MIMO_ Port 1	CORE- MIMO_ Port 4	CORE- MIMO_ Port 1
26 dB Emission Bandwidth (MHz)	21.629	22.48	21.72	23.68	21.716	21.996
Measurement uncertainty (kHz)	<±23.02					

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

Channels	Low Channel 149 (5745 MHz)		Middle Channel 157 (5785 MHz)		High Channel 165 (5825 MHz)	
	CORE- MIMO_ Port 4	CORE- MIMO_ Port 1	CORE- MIMO_ Port 4	CORE- MIMO_ Port 1	CORE- MIMO_ Port 4	CORE- MIMO_ Port 1
26 dB Emission Bandwidth (MHz)	21.78	21.8	21.72	21.84	21.76	21.96
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)	
	CORE- MIMO_ Port 4	CORE- MIMO_ Port 1	CORE- MIMO_ Port 4	CORE- MIMO_ Port 1
26 dB Emission Bandwidth (MHz)	40.693	41.223	40.697	41.117
Measurement uncertainty (kHz)	<±53.05			

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

Channels	Low Channel 151 (5755 MHz)		High Channel 159 (5795 MHz)	
	CORE- MIMO_ Port 4	CORE- MIMO_ Port 1	CORE- MIMO_ Port 4	CORE- MIMO_ Port 1
26 dB Emission Bandwidth (MHz)	39.5	40.1	39.53	40.65
Measurement uncertainty (kHz)	<±53.05			

**Mode 802.11 ac80 (VHT80):**

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

Channel	Single Channel 42 (5210 MHz)	
	CORE- MIMO_ Port 4	CORE- MIMO_ Port 1
26 dB Emission Bandwidth (MHz)	81.69	81.69
Measurement uncertainty (kHz)	<±103.10	

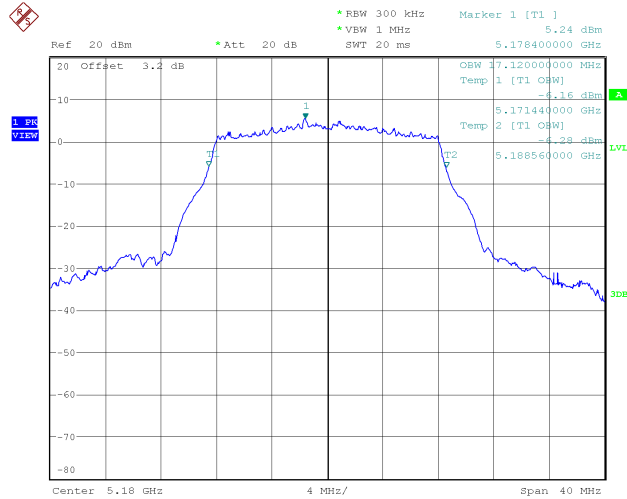
**U-NII-3 (5725-5850 MHz)**

Channel	Single Channel 155 (5775 MHz)	
	CORE- MIMO_ Port 4	CORE- MIMO_ Port 1
26 dB Emission Bandwidth (MHz)	81.12	81.84
Measurement uncertainty (kHz)	<±103.10	

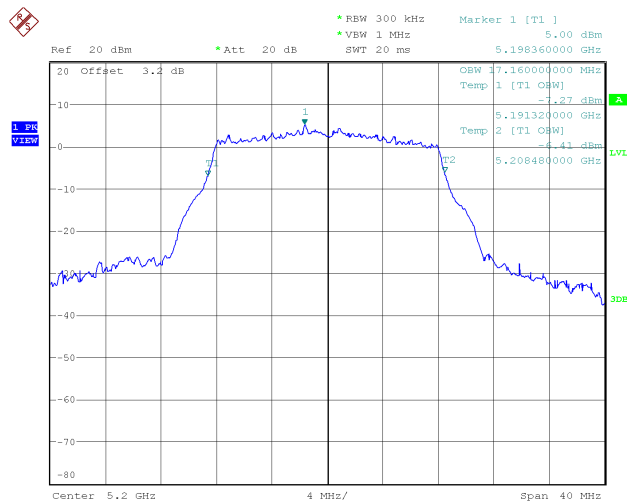
**Mode 802.11 a20:**

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

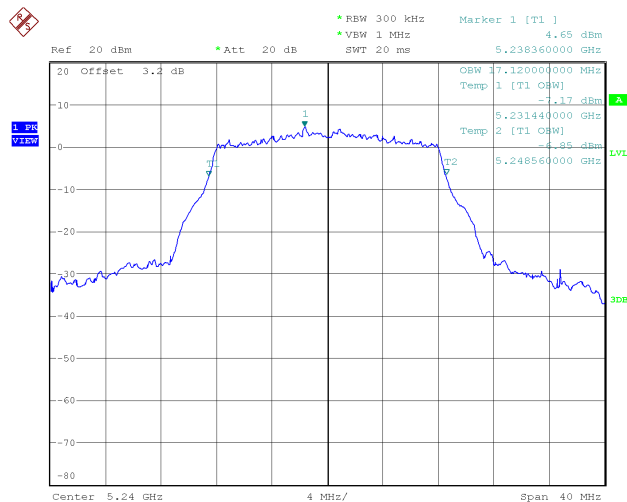
- Low Channel 36 (5180 MHz):



- Middle Channel 40 (5200 MHz):

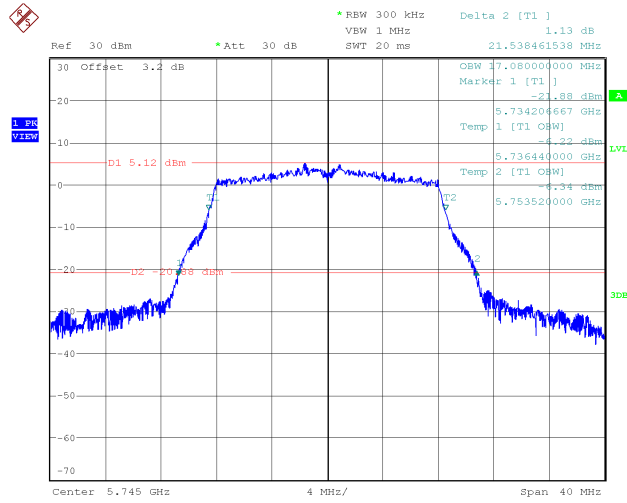


- High Channel 48 (5240 MHz):

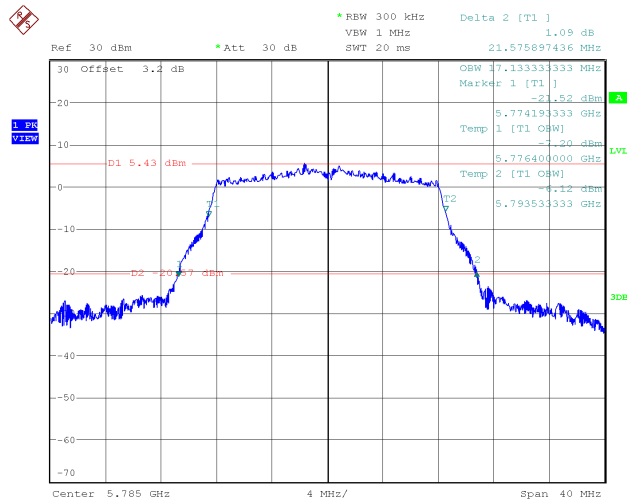


### U-NII-3 (5725-5850 MHz)

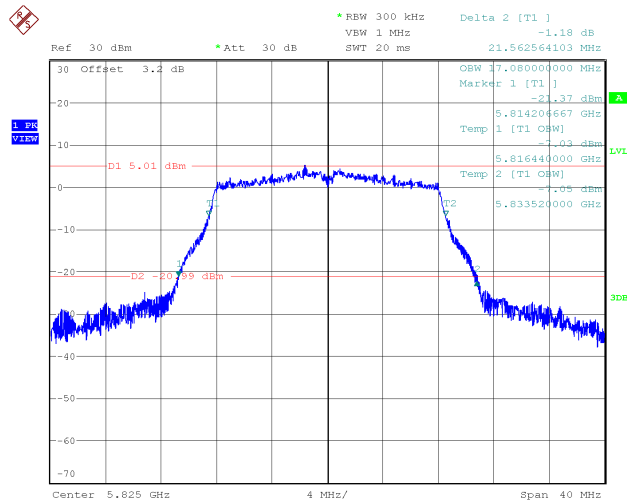
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



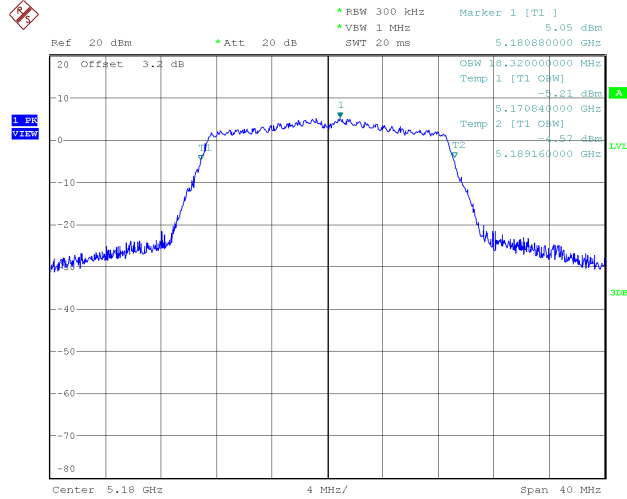
- High Channel 165 (5825 MHz):



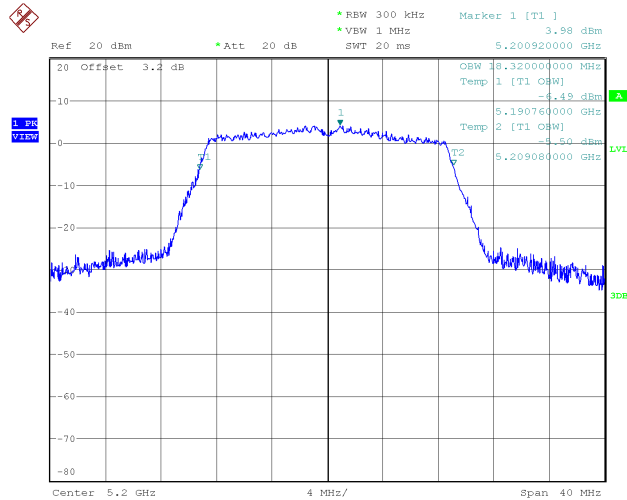
**Mode 802.11 n20 HT20:**

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

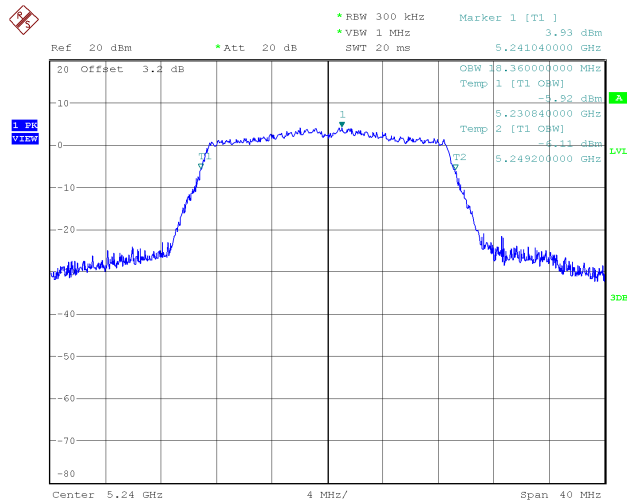
- Low Channel 36 (5180 MHz):



- Middle Channel 40 (5200 MHz):

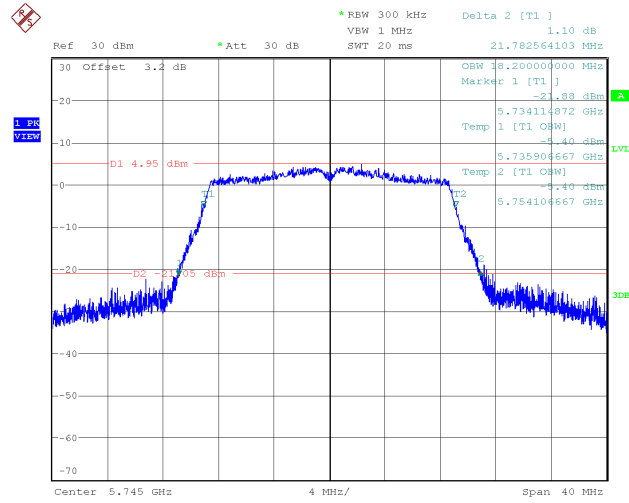


- High Channel 48 (5240 MHz):

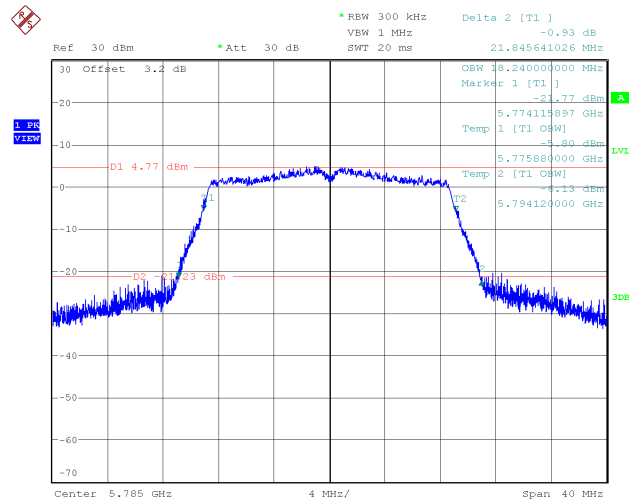


**U-NII-3 (5725-5850 MHz)**

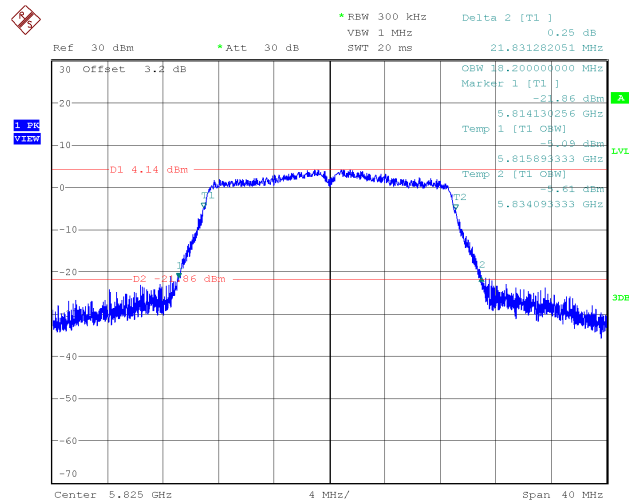
- Low Channel 149 (5745 MHz):



- Middle Channel 157 (5785 MHz):



- High Channel 165 (5825 MHz):

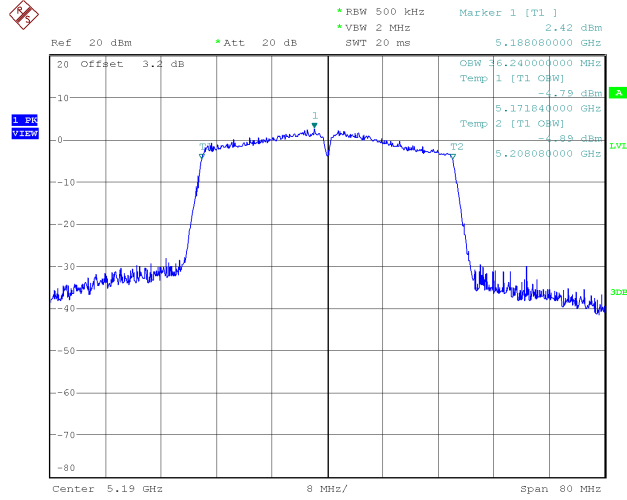




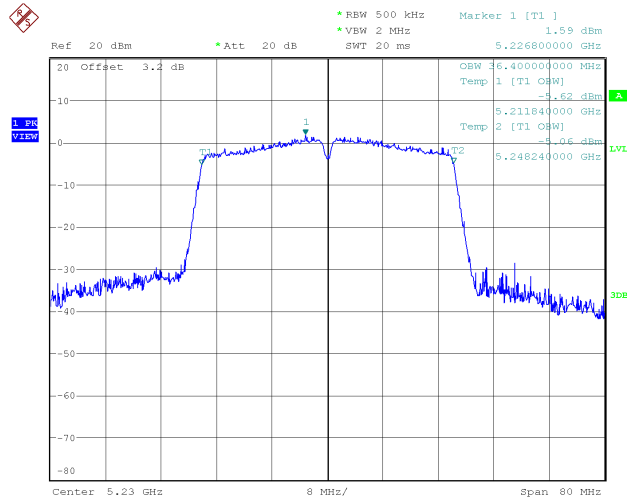
**Mode 802.11 n40 (HT40):**

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

- Low Channel 38 (5190 MHz):

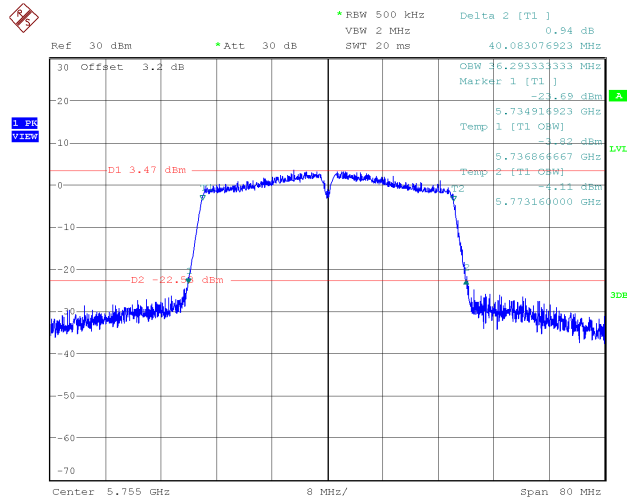


- High Channel 46 (5230 MHz):

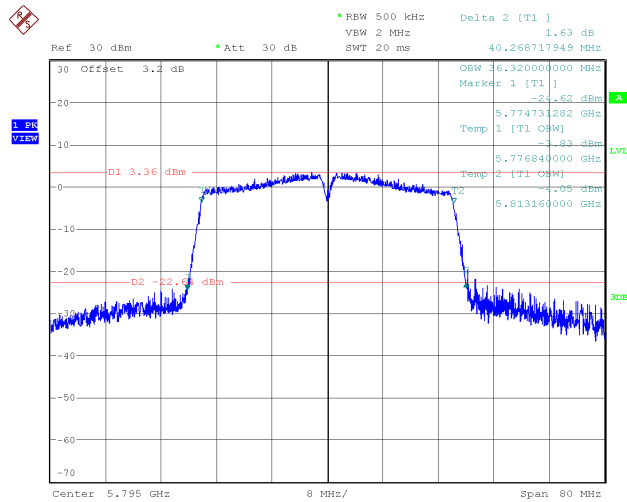


### U-NII-3 (5725-5850 MHz)

- Low Channel 151 (5755 MHz):



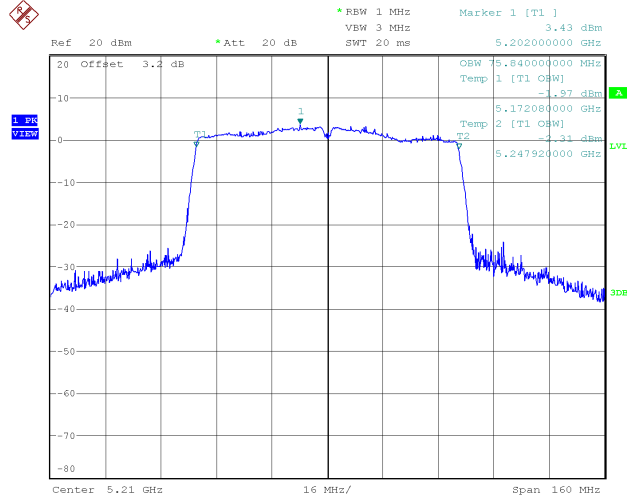
- High Channel 159 (5795 MHz):



**Mode 802.11 ac80 (VHT80):**

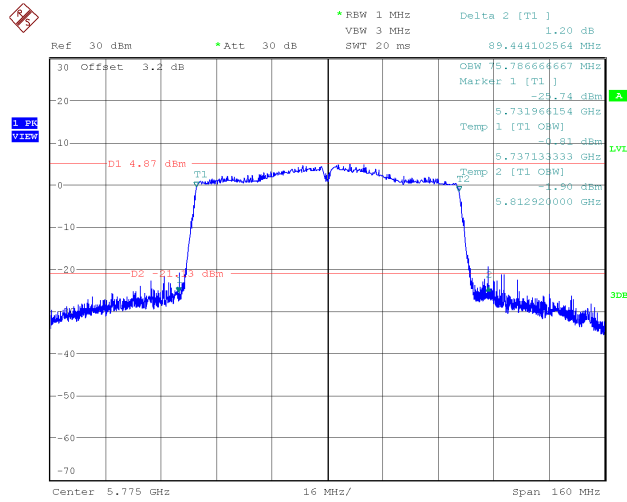
**U-NII-1 (5150-5250 MHz)**

- Single Channel 42 (5210 MHz):



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

- Single Channel 155 (5775 MHz):



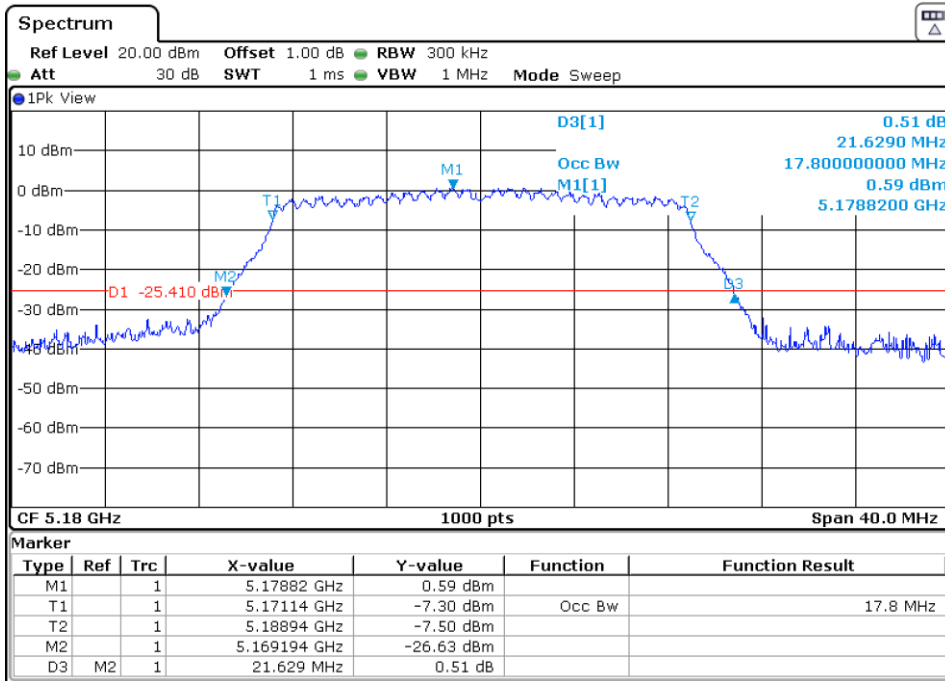
**MIMO CORE-MIMO\_Port1 & Port4 Antennas:**

**Mode 802.11 n20 HT20:**

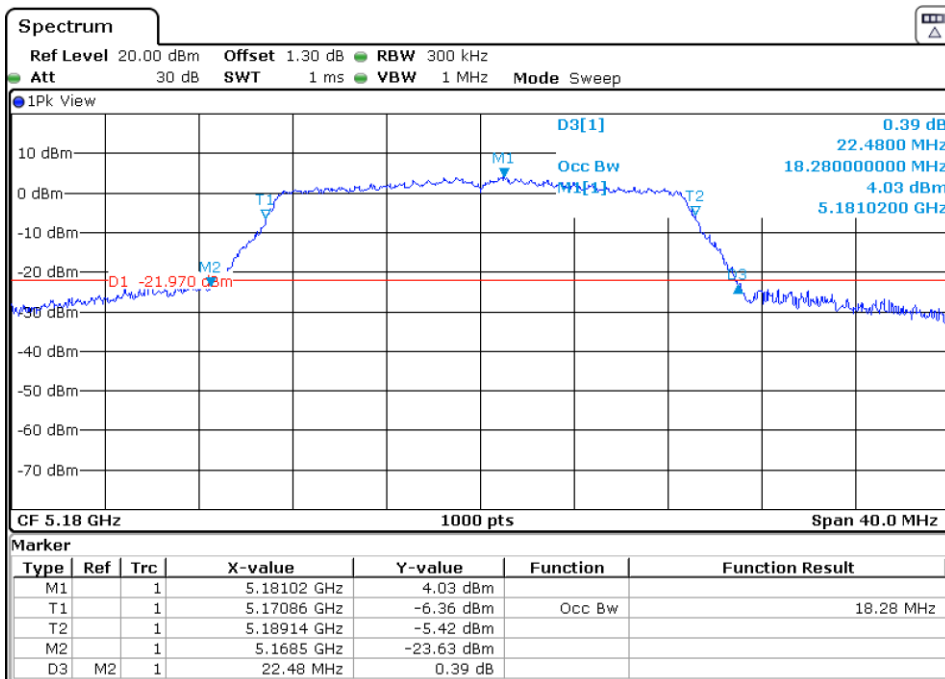
**U-NII-1 (5150-5250 MHz)**

- Low Channel 36 (5180 MHz):

Port 4 Antenna

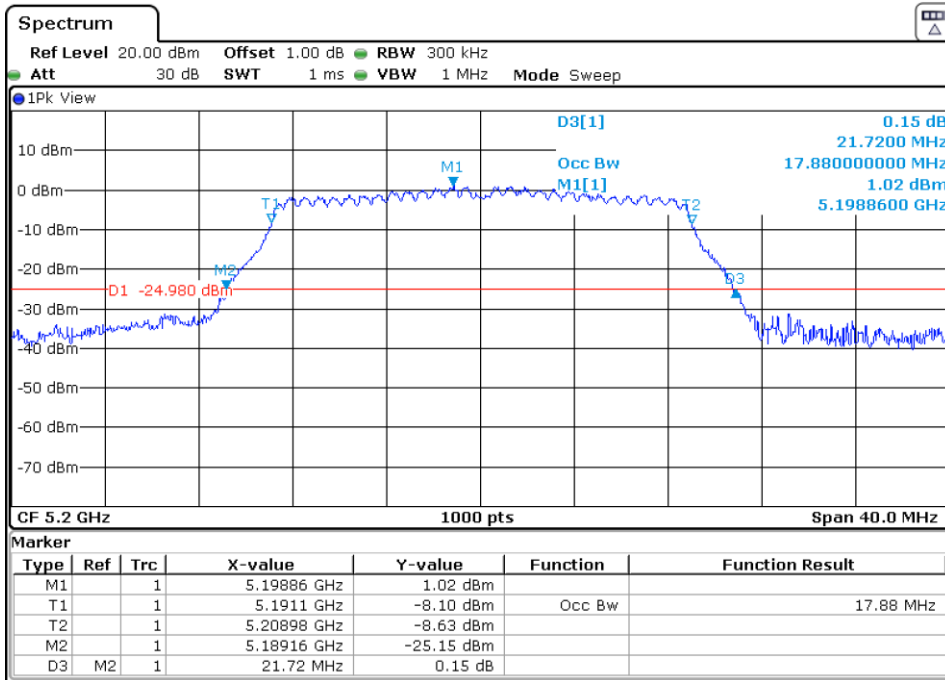


Port 1 Antenna

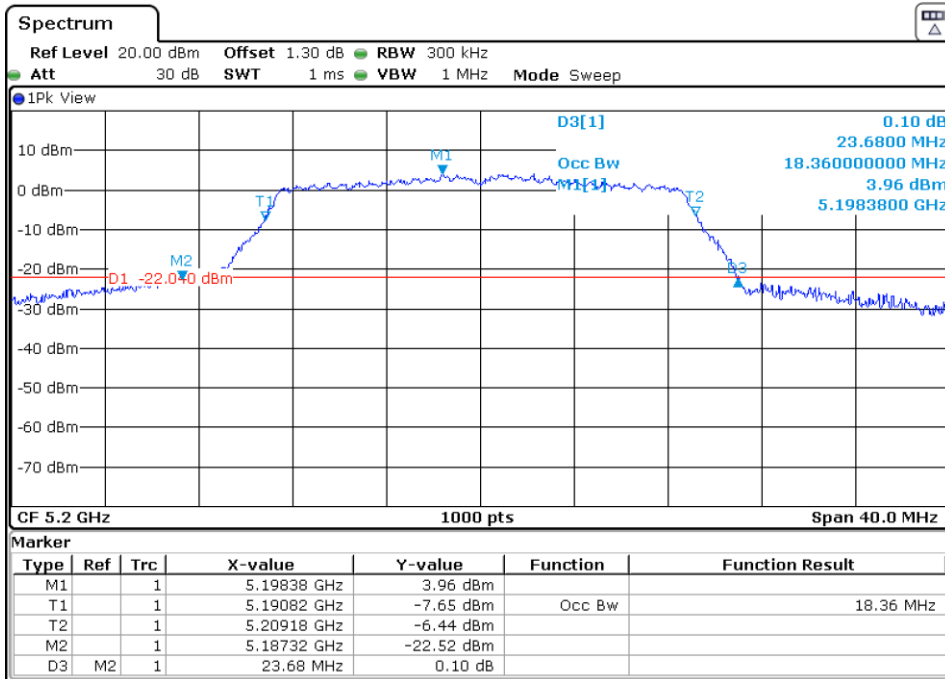


- Middle Channel 40 (5200 MHz):

Port 4 Antenna

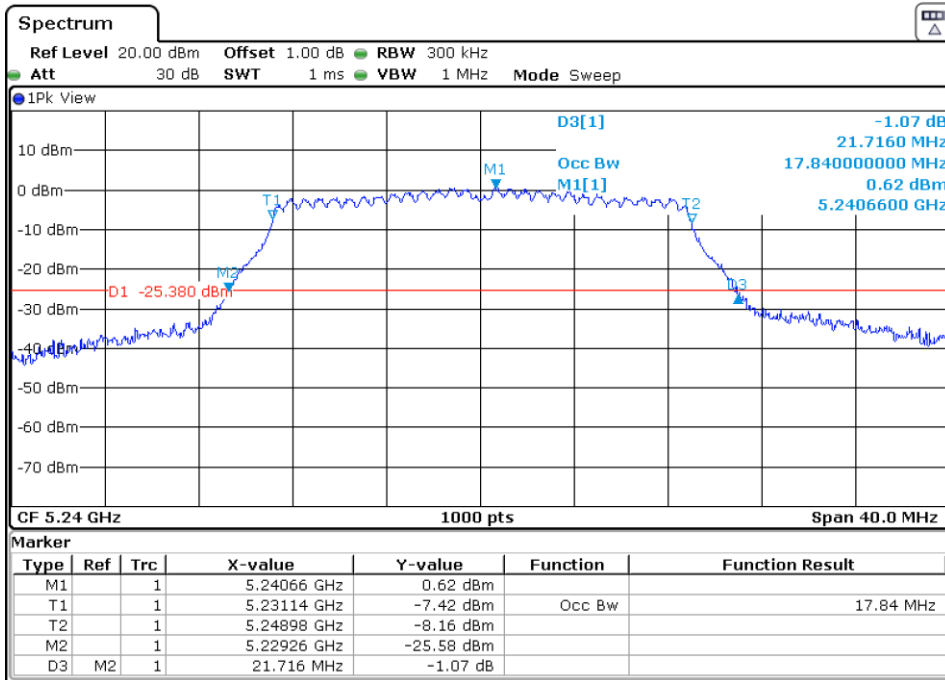


Port 1 Antenna

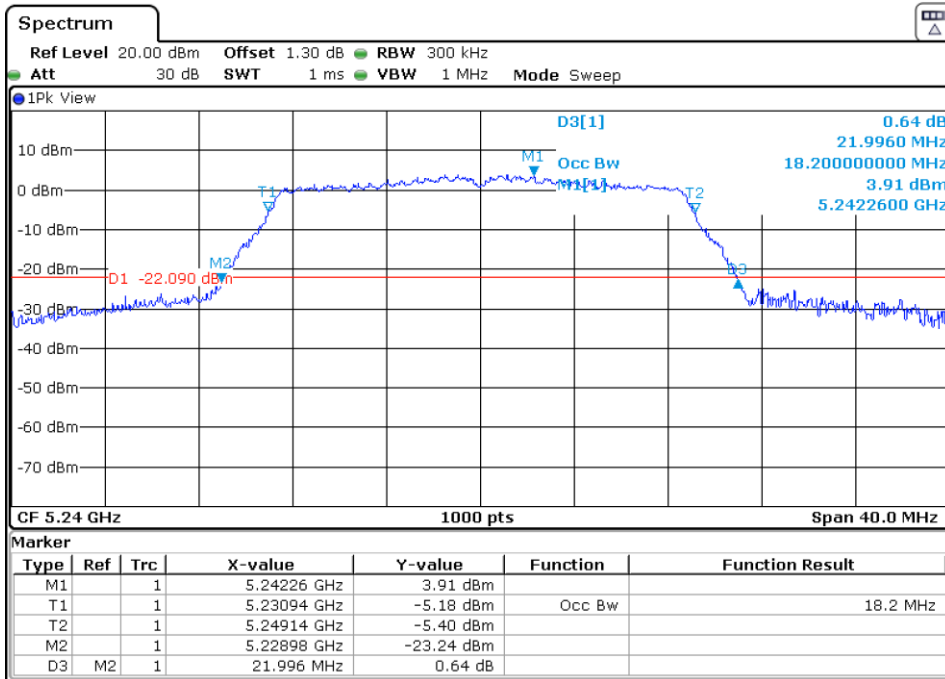


- High Channel 48 (5240 MHz):

Port 4 Antenna



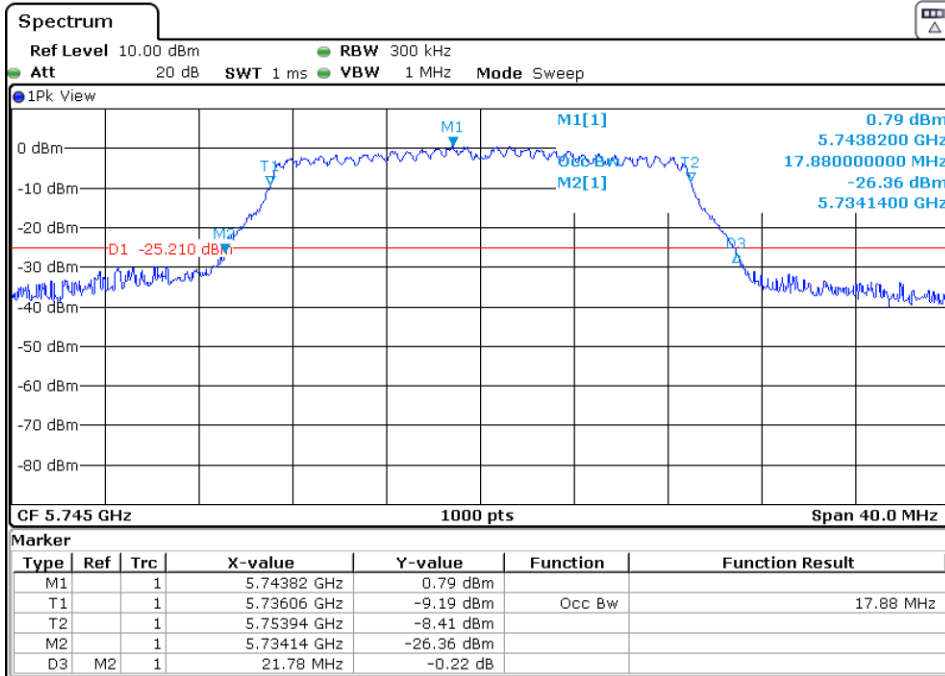
Port 1 Antenna



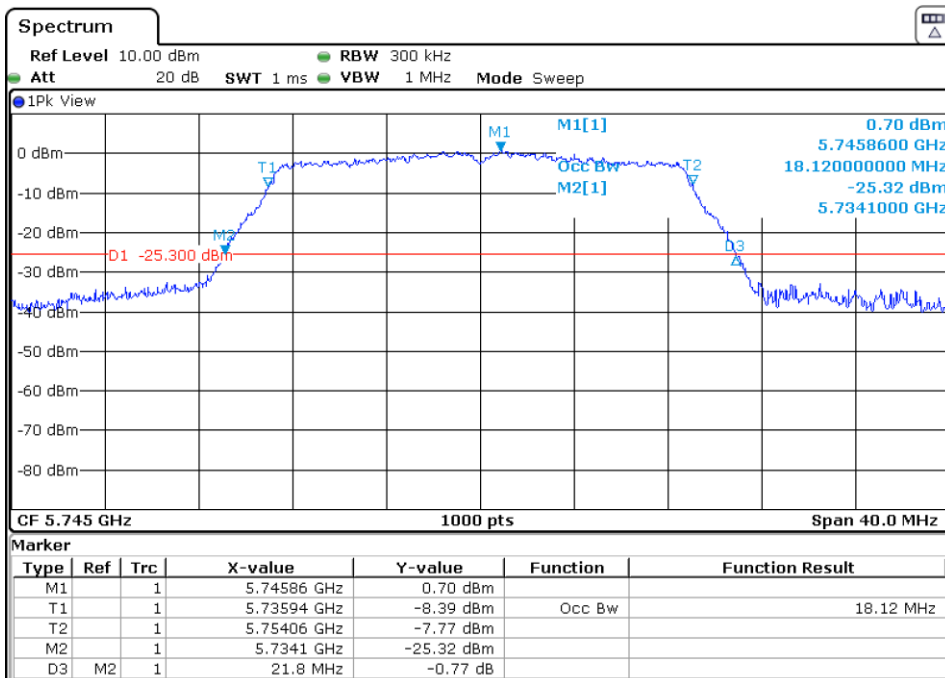
**U-NII-3 (5725-5850 MHz)**

- Low Channel 149 (5745 MHz):

Port 4 Antenna

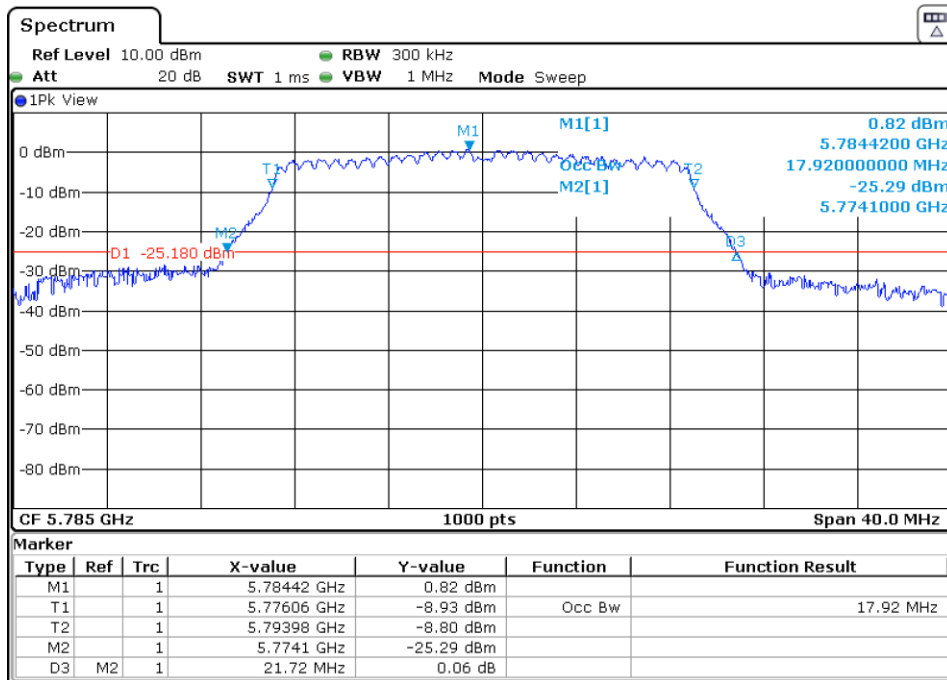


Port 1 Antenna

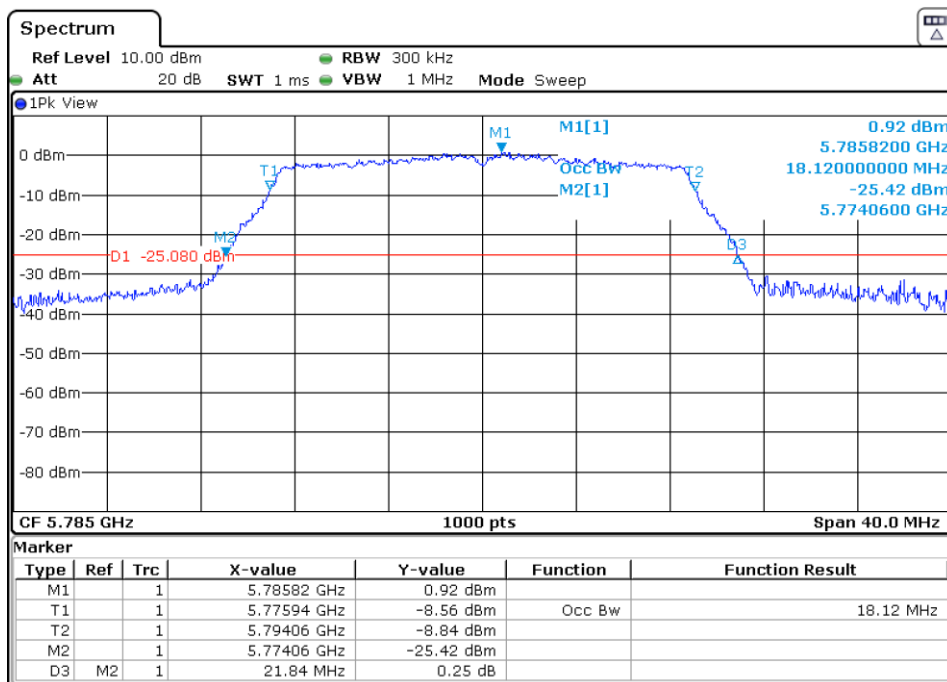


- Middle Channel 157 (5785 MHz):

Port 4 Antenna



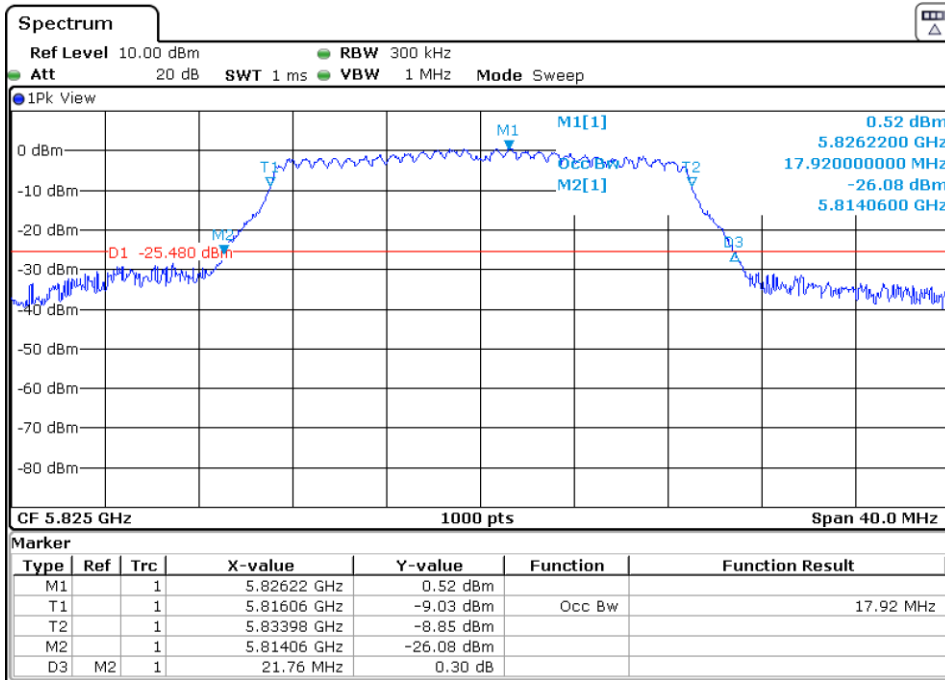
Port 1 Antenna



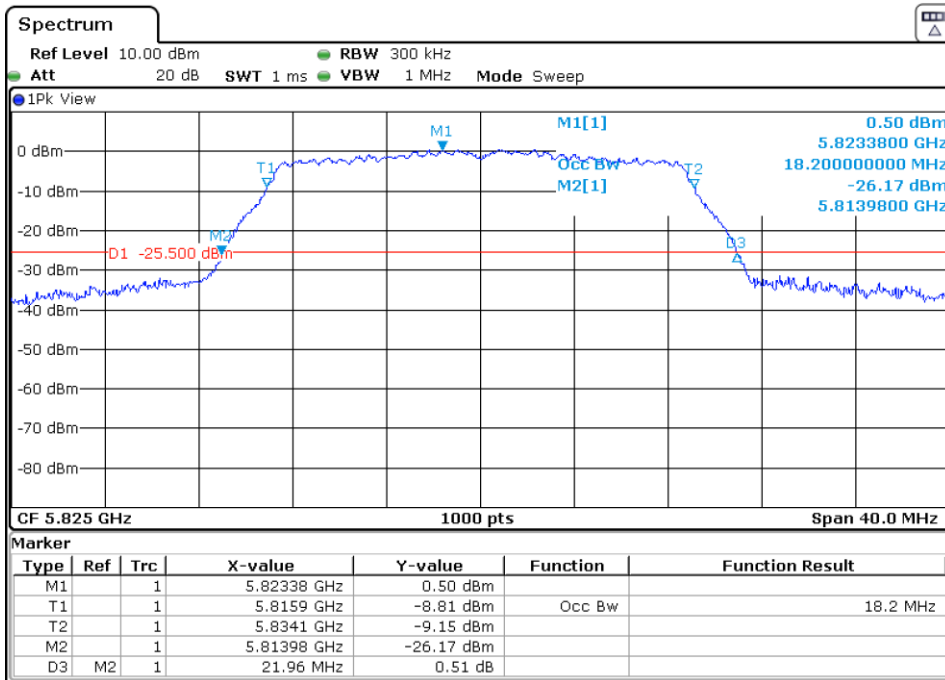


- High Channel 165 (5825 MHz):

Port 4 Antenna



Port 1 Antenna

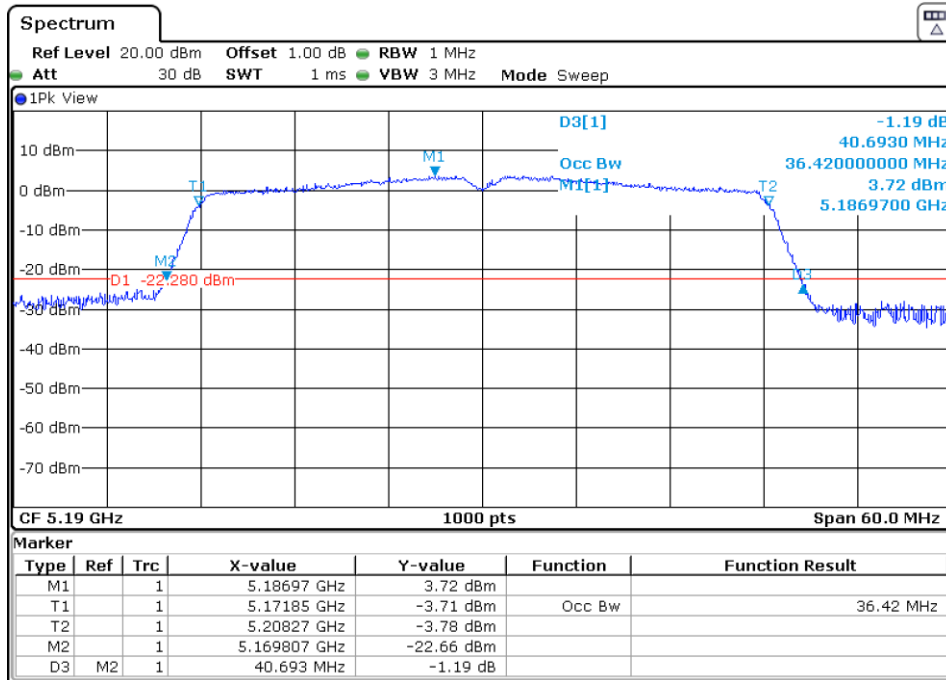


**Mode 802.11 n40 (HT40):**

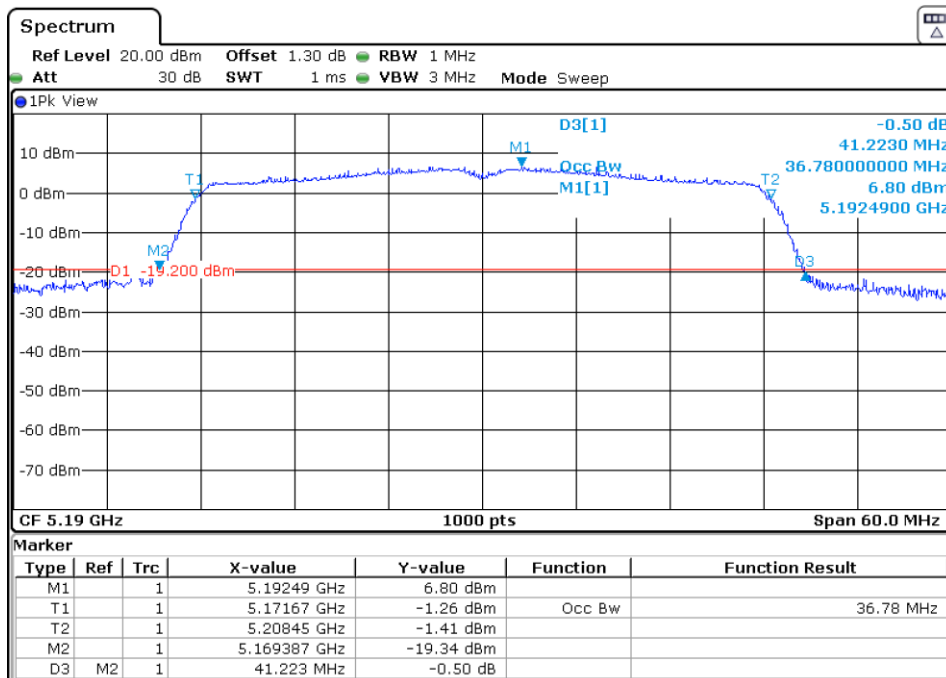
**U-NII-1 (5150-5250 MHz)**

- Low Channel 38 (5190 MHz):

Port 4 Antenna

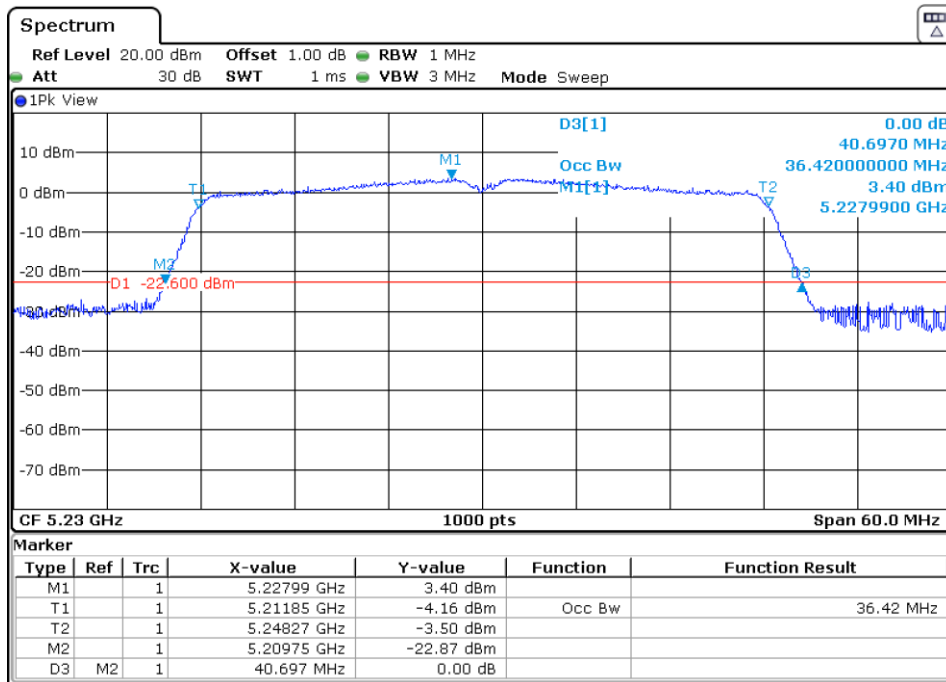


Port 1 Antenna

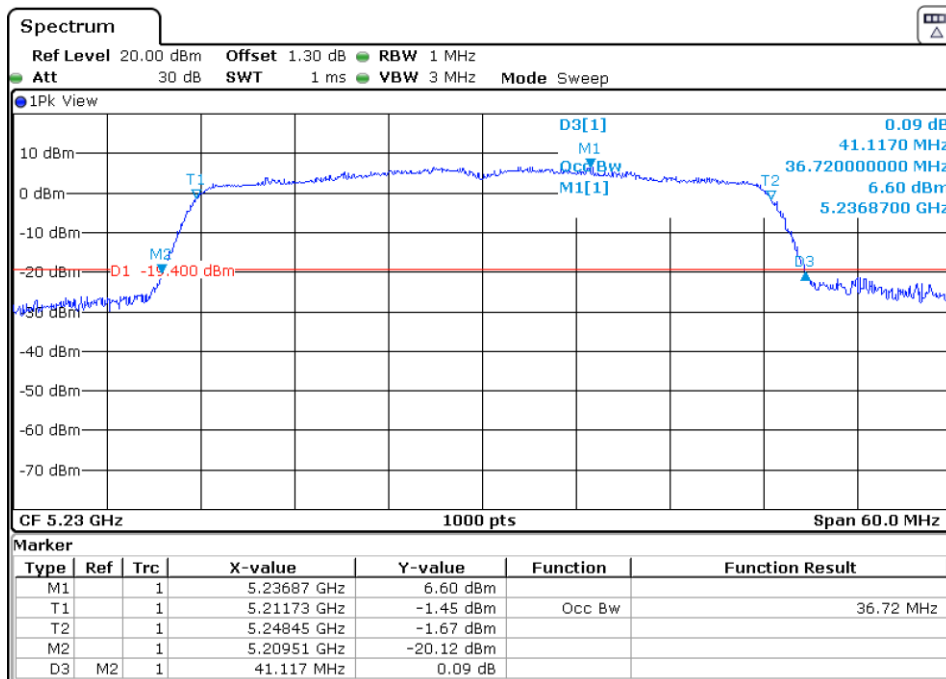


- High Channel 46 (5230 MHz):

Port 4 Antenna



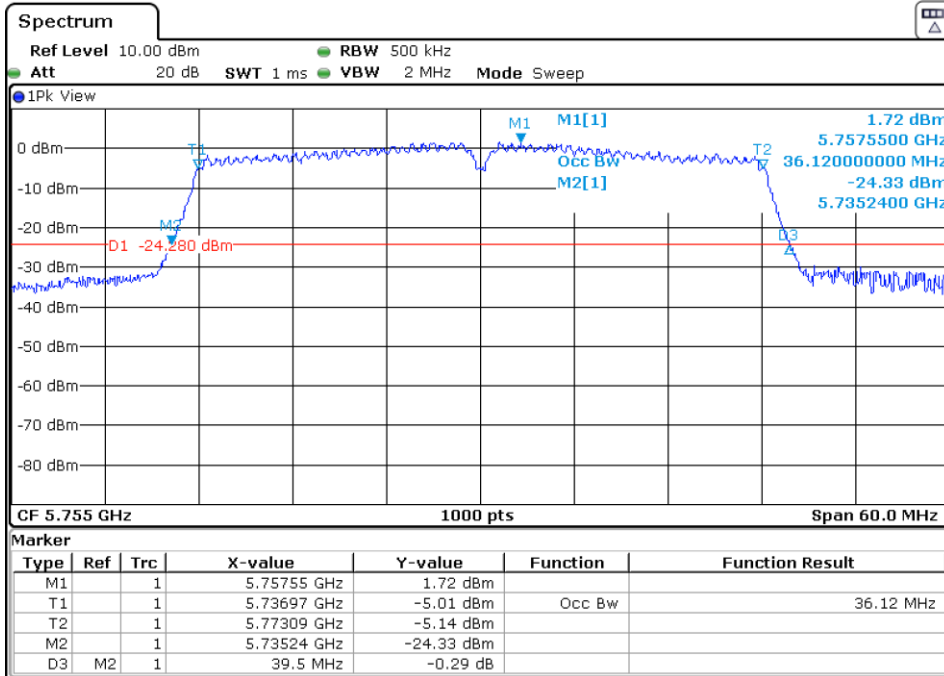
Port 1 Antenna



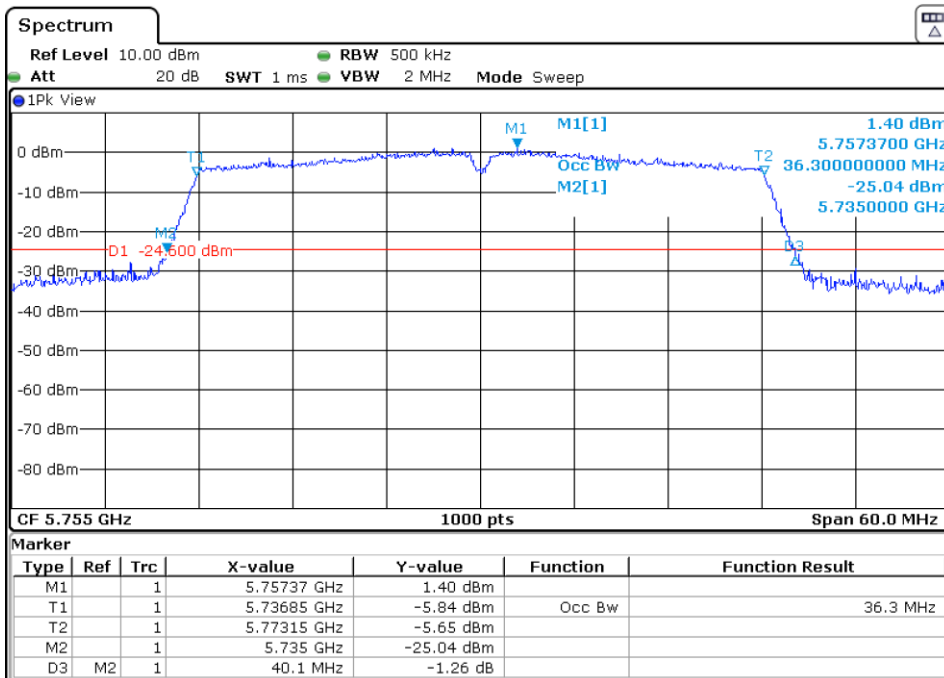
**U-NII-3 (5725-5850 MHz)**

- Low Channel 151 (5755 MHz):

Port 4 Antenna

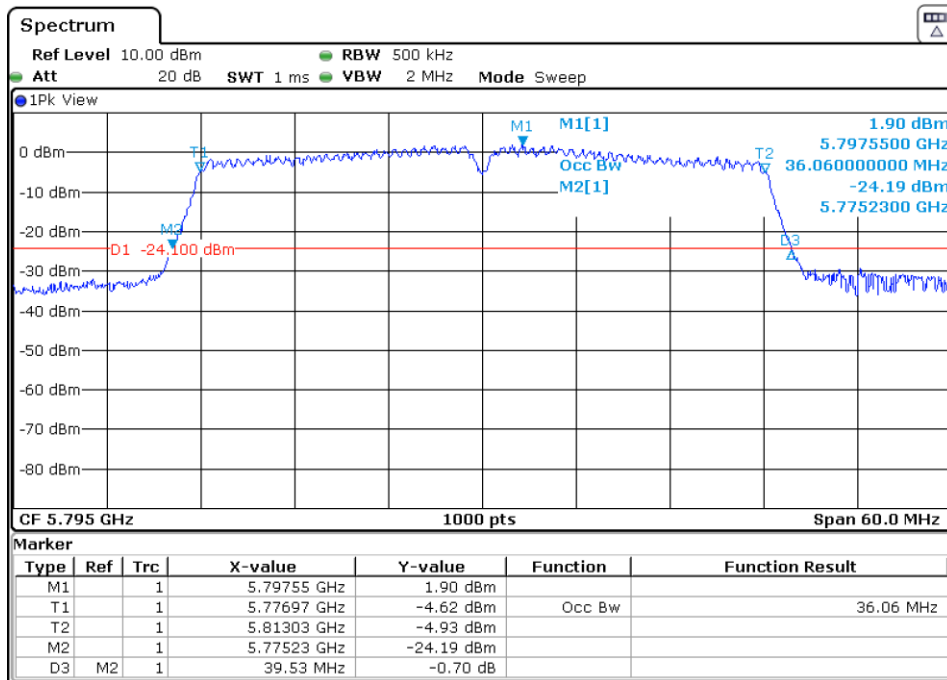


Port 1 Antenna

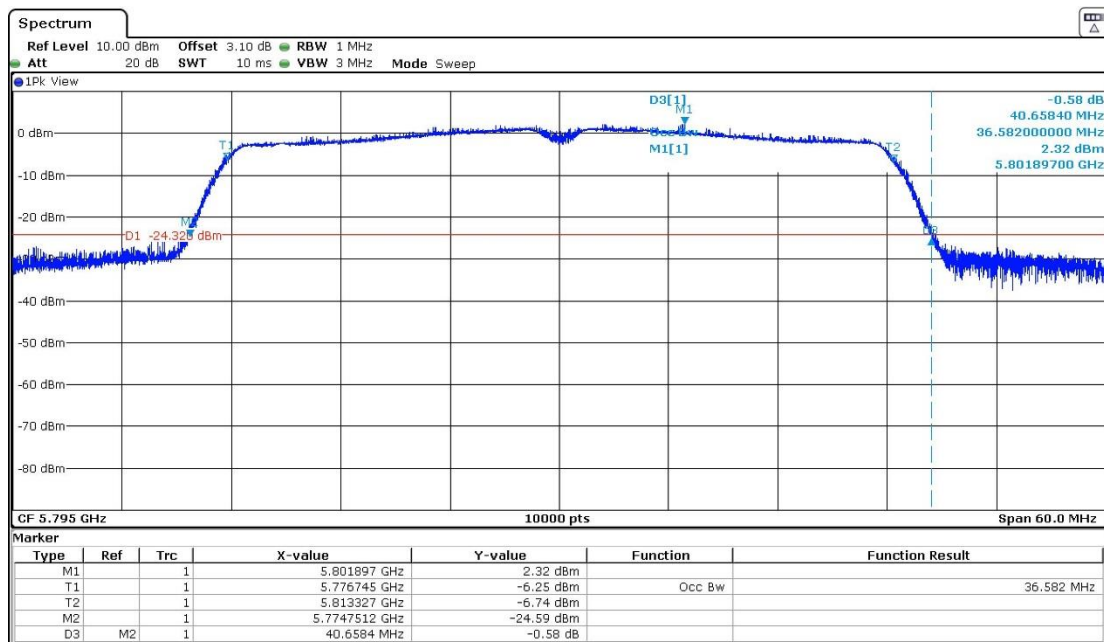


- High Channel 159 (5795 MHz):

Port 4 Antenna



Port 1 Antenna

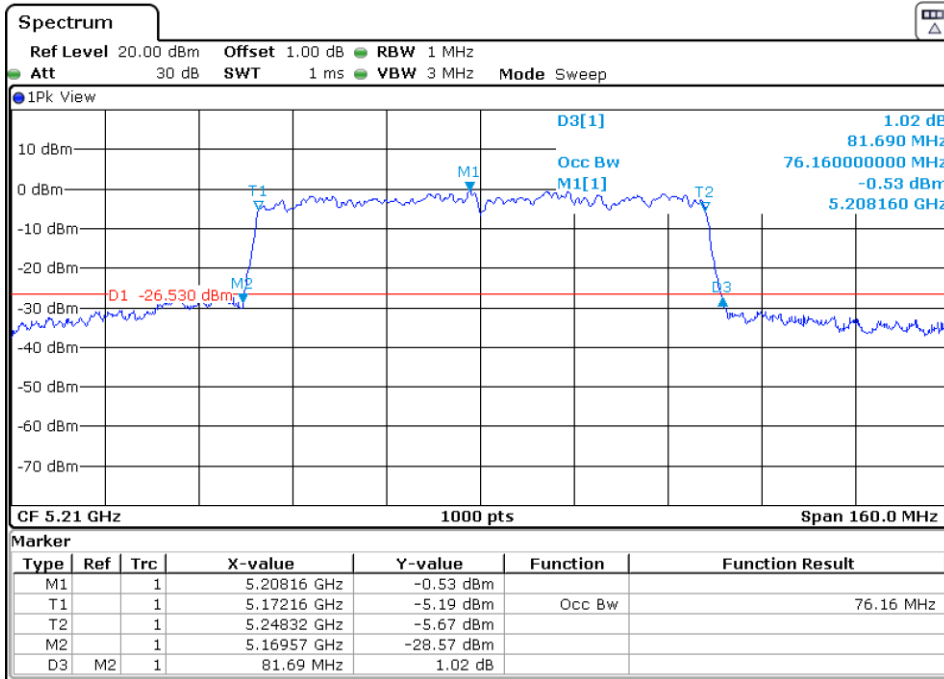


**Mode 802.11 ac80 (VHT80):**

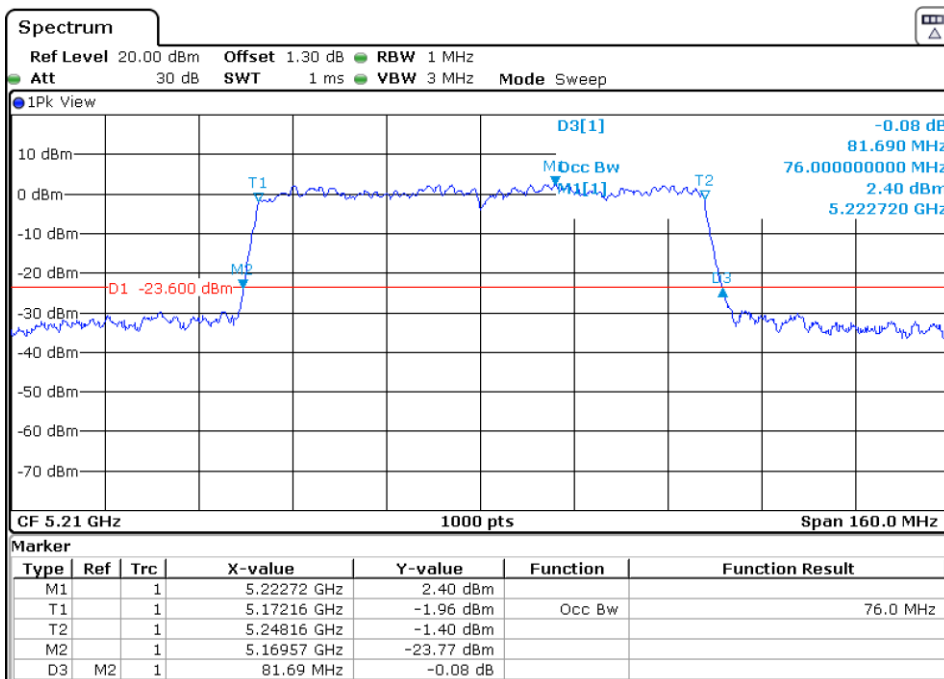
**U-NII-1 (5150-5250 MHz)**

- Single Channel 42 (5210 MHz):

Port 4 Antenna



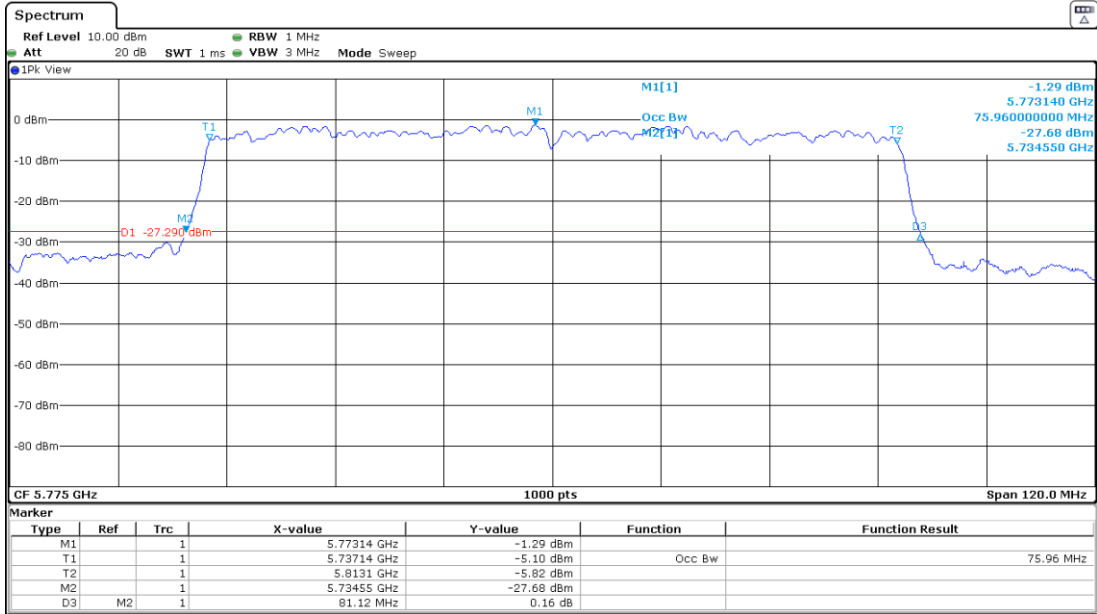
Port 1 Antenna



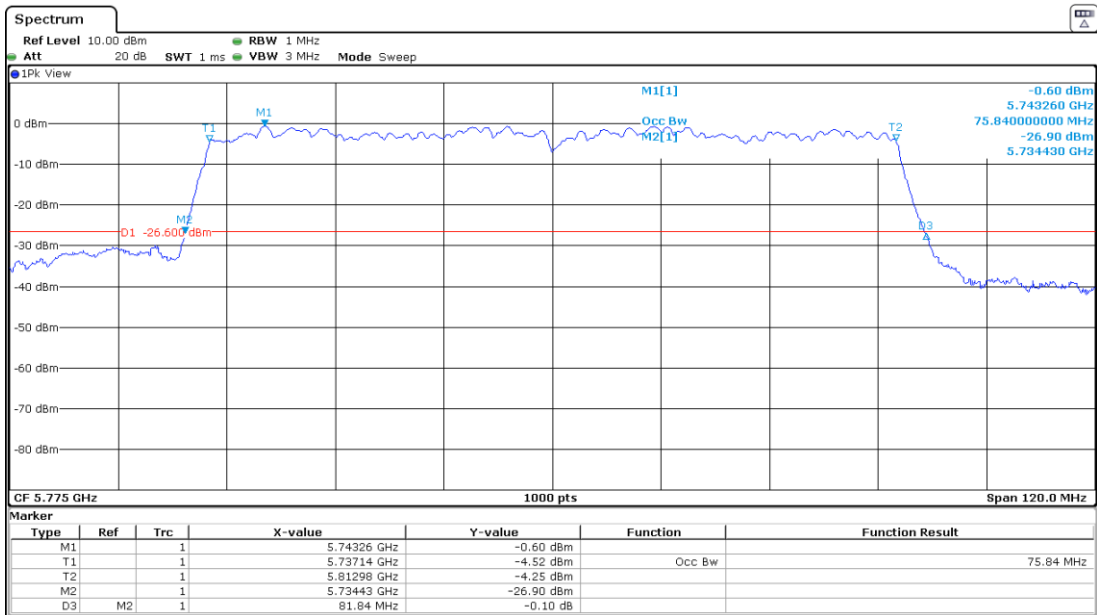
**U-NII-3 (5725-5850 MHz)**

- Single Channel 155 (5775 MHz):

Port 4 Antenna



Port 1 Antenna



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



## INDEX

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## TEST CONDITIONS

### POWER SUPPLY (V):

V nominal: 12 Vdc  
Type of Power Supply: DC voltage from external power supply (car battery).

### ANTENNAS:

Type of Antenna: External.

Antennas Gain:

- SISO – CORE-0\_Port3 Antenna – Declared Maximum Antenna Gain: +2.5 dBi
- MIMO – CORE-MIMO\_Port1 & Port4 Antennas – Declared Maximum Antenna Gain:
  - Port4 – Declared Maximum Antenna Gain: +4.5 dBi
  - Port1 – Declared Maximum Antenna Gain: +4.5 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 MCS23	
	802.11n HT40: MCS0 to MCS23	
	802.11ac VHT20: MCS0 to MCS9	
	802.11ac VHT40: MCS0 to MCS9	
	802.11ac VHT80: MCS0 to MCS9	
Setting of cores / ports:	3, 1+4.	
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
```

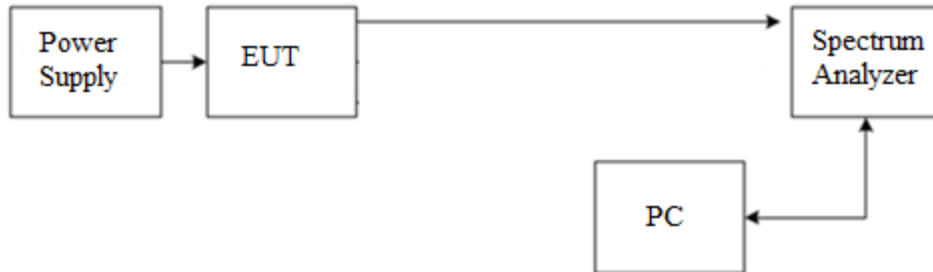
ac80 - Core0

```
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).

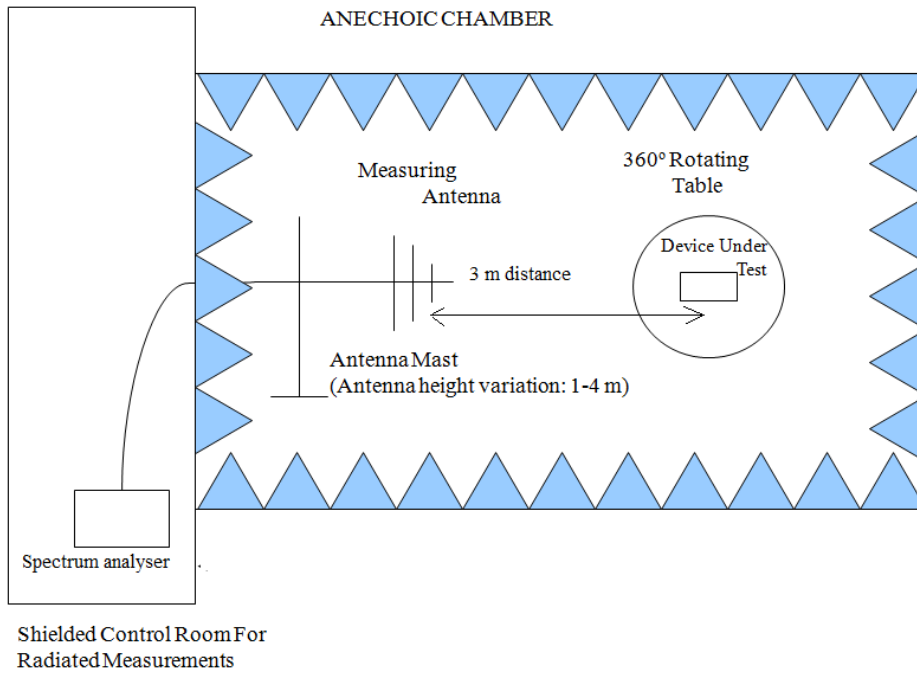
For radiated emissions in the range 1 GHz-40 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

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 360° and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission.

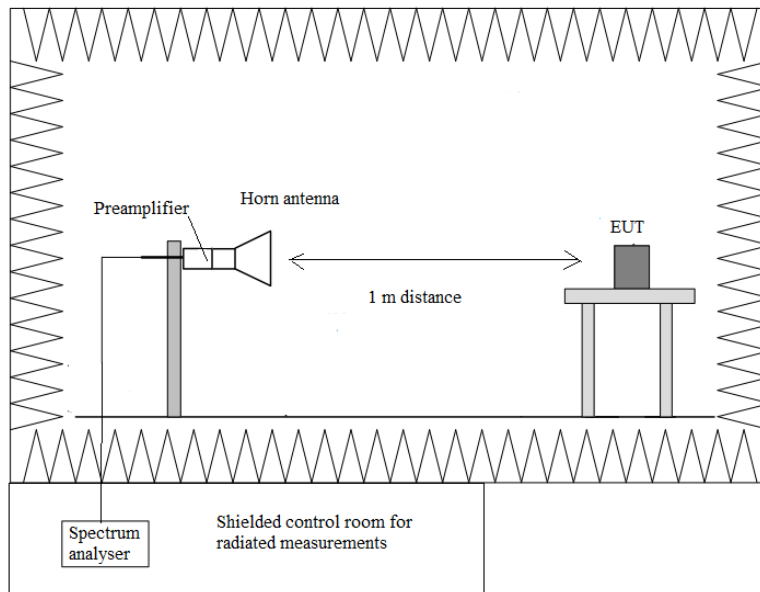
Measurements were made in both horizontal and vertical planes of polarization.

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

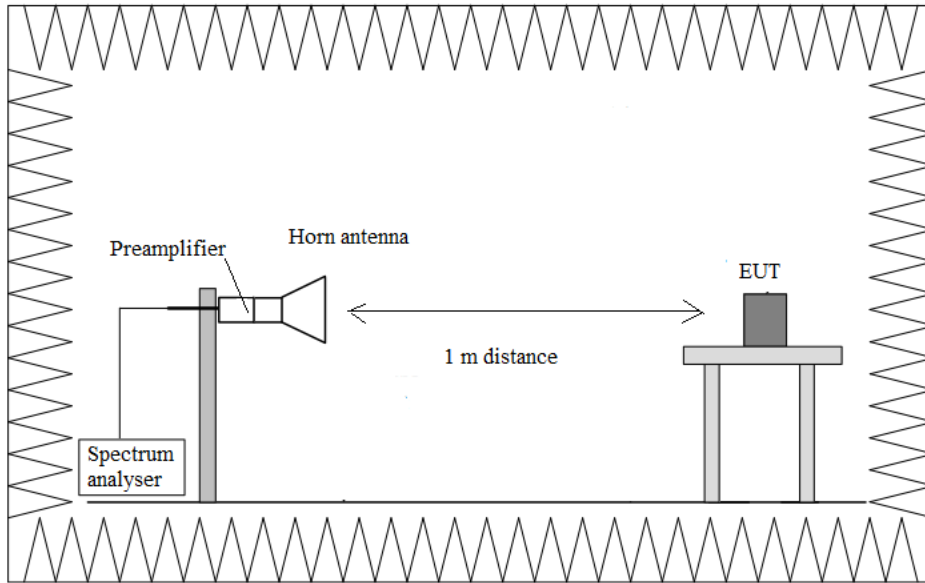
Radiated measurements setup  $f < 1$  GHz.



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



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



## FCC 15.407 (a)(1)(ii) / RSS-247 6.2.1.1 Transmitter Maximum Conducted Output Power

### SPECIFICATION:

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

RSS-247: The maximum e.i.r.p. shall not exceed 200 mW (23 dBm) or  $10 + 10 \log_{10} B$ , dBm, whichever power is less. B is the 99% emission bandwidth in MHz.

### RESULTS:

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

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

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

Preliminary tests determined the SISO worst case is CORE-0\_Port3 Antenna.

Preliminary tests determined the MIMO worst case is CORE-MIMO\_Port1 & Port4 Antennas.

- SISO – CORE-0\_Port3 Antenna – Declared Maximum Antenna Gain: +2.5 dBi
- MIMO – CORE-MIMO\_Port1 & Port4 Antennas – Declared Maximum Antenna Gain:
  - Port4 – Declared Maximum Antenna Gain: +4.5 dBi
  - Port1 – Declared Maximum Antenna Gain: +4.5 dBi

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



**SISO – CORE-0\_Port3 Antenna:**

**Mode 802.11 a20**

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Max. Conducted Power (dBm)	11.14	10.42	10.51
Maximum EIRP power (dBm)	13.64	12.92	13.01
Duty Cycle Correction Factor (dB)	0.992		
Max. Conducted Power Corrected (dBm)	12.132	11.412	11.503
Max. EIRP power Corrected (dBm)	14.632	13.912	14.002
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)	11.17	10.2	10.31
Maximum EIRP power (dBm)	13.67	12.7	12.81
Duty Cycle Correction Factor (dB)	1.085		
Max. Conducted Power Corrected (dBm)	12.255	11.285	11.396
Max. EIRP power Corrected (dBm)	14.755	13.785	13.896
Measurement uncertainty (dB)	<±1.20		

**Mode 802.11 n40 (HT40)**

	Low Channel 38 (5190 MHz)	High Channel 46 (5230 MHz)
Max. Conducted Power (dBm)	8.15	7.36
Maximum EIRP power (dBm)	10.65	9.86
Duty Cycle Correction Factor (dB)	2.076	
Max. Conducted Power Corrected (dBm)	10.226	9.436
Max. EIRP power Corrected (dBm)	12.726	11.936
Measurement uncertainty (dB)	<±1.20	

**Mode 802.11 ac80 (VHT80)**

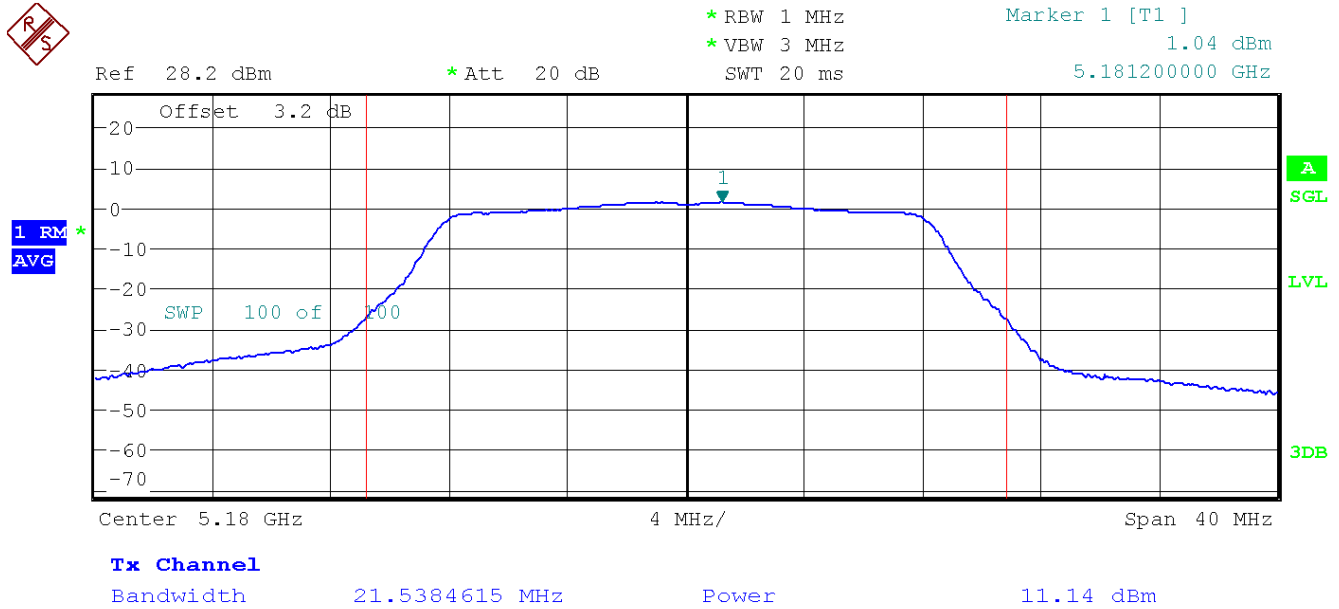
	Single Channel 42 (5210 MHz)
Max. Conducted Power (dBm)	7.67
Maximum EIRP power (dBm)	10.17
Duty Cycle Correction Factor (dB)	3.565
Max. Conducted Power Corrected (dBm)	11.235
Max. EIRP power Corrected (dBm)	13.735
Measurement uncertainty (dB)	<±1.20

Verdict: PASS

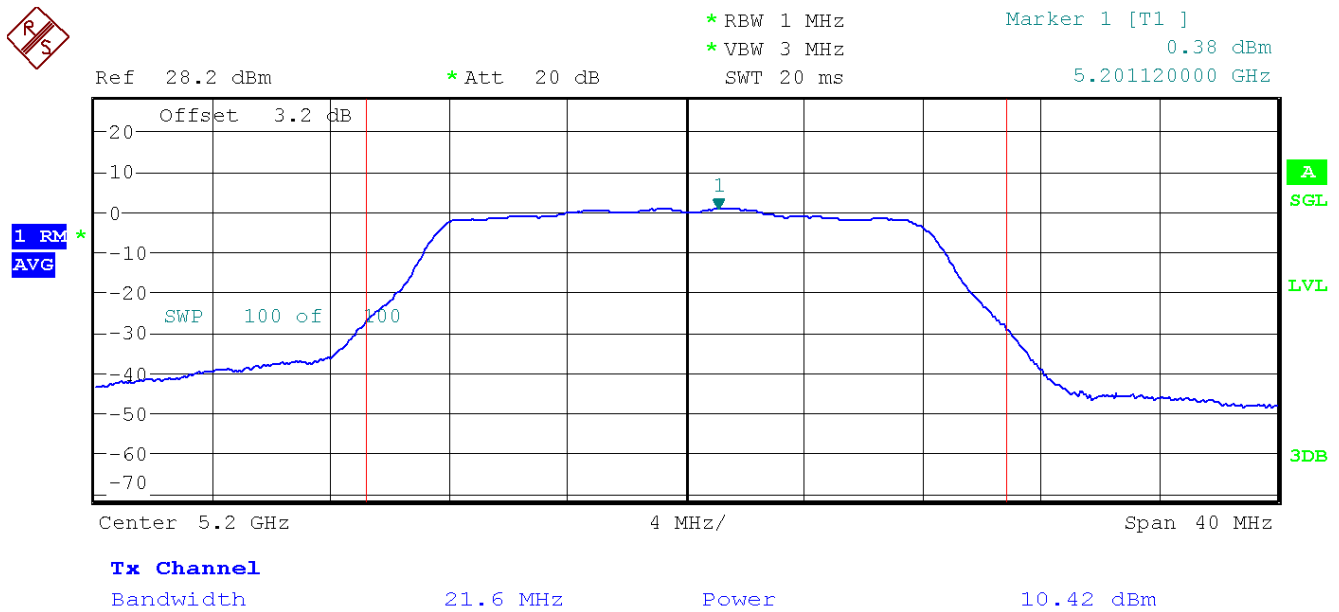
**SISO – CORE-0\_Port3 Antenna:**

**Mode 802.11 a20**

**- Low Channel 36:**



**- Middle Channel 40:**



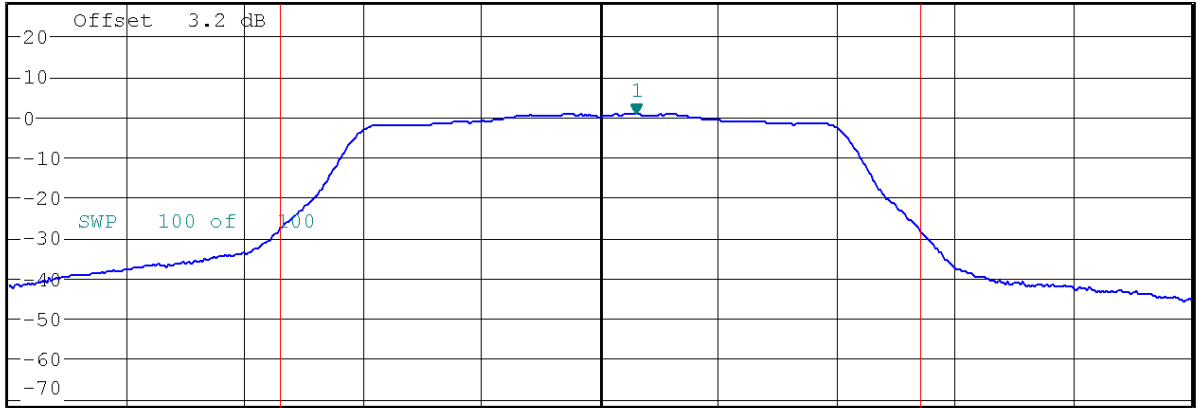
- High Channel 48:



\* RBW 1 MHz  
 \* VBW 3 MHz  
 SWT 20 ms  
 Marker 1 [T1 ]  
 0.28 dBm  
 5.241200000 GHz

Ref 28.2 dBm

\* Att 20 dB



1 RM \*  
 AVG

A  
 SGL  
 LVL  
 3DB

**Tx Channel**

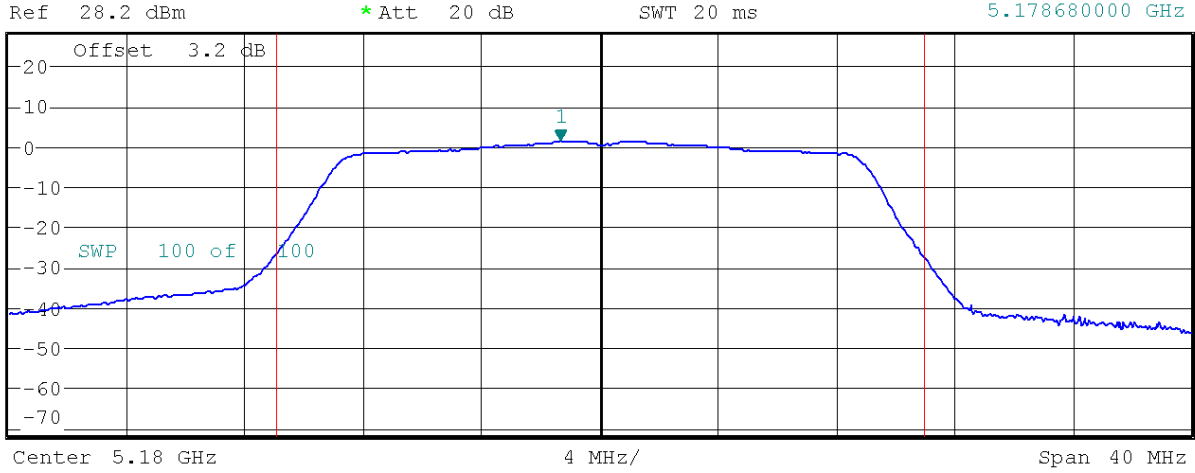
Bandwidth 21.6641026 MHz Power 10.51 dBm

### Mode 802.11 n20 (HT20)

- Low Channel 36:



\* RBW 1 MHz  
 \* VBW 3 MHz  
 Marker 1 [T1 ]  
 1.08 dBm  
 5.178680000 GHz



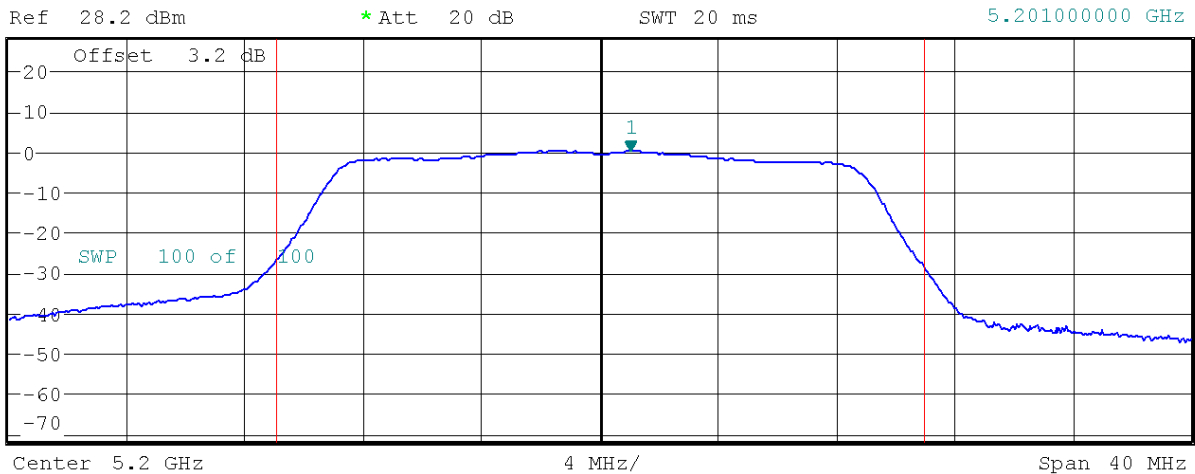
#### Tx Channel

Bandwidth 21.9871795 MHz Power 11.17 dBm

- Middle Channel 40:



\* RBW 1 MHz  
 \* VBW 3 MHz  
 Marker 1 [T1 ]  
 -0.20 dBm  
 5.201000000 GHz



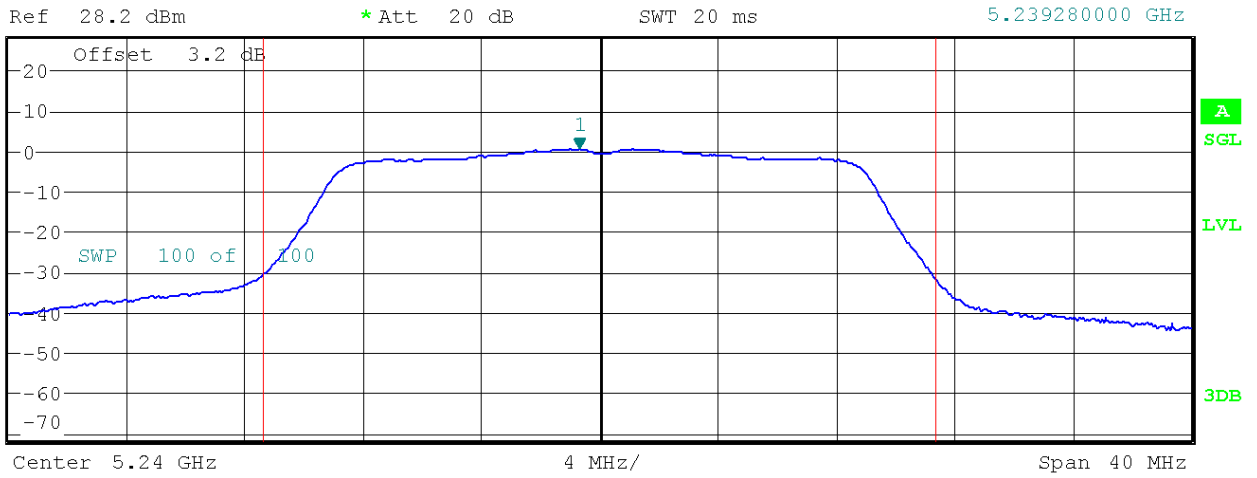
#### Tx Channel

Bandwidth 21.9871795 MHz Power 10.20 dBm

- High Channel 48:



\* RBW 1 MHz  
 \* VBW 3 MHz  
 \* Att 20 dB  
 SWT 20 ms  
 Marker 1 [T1 ]  
 0.08 dBm  
 5.239280000 GHz

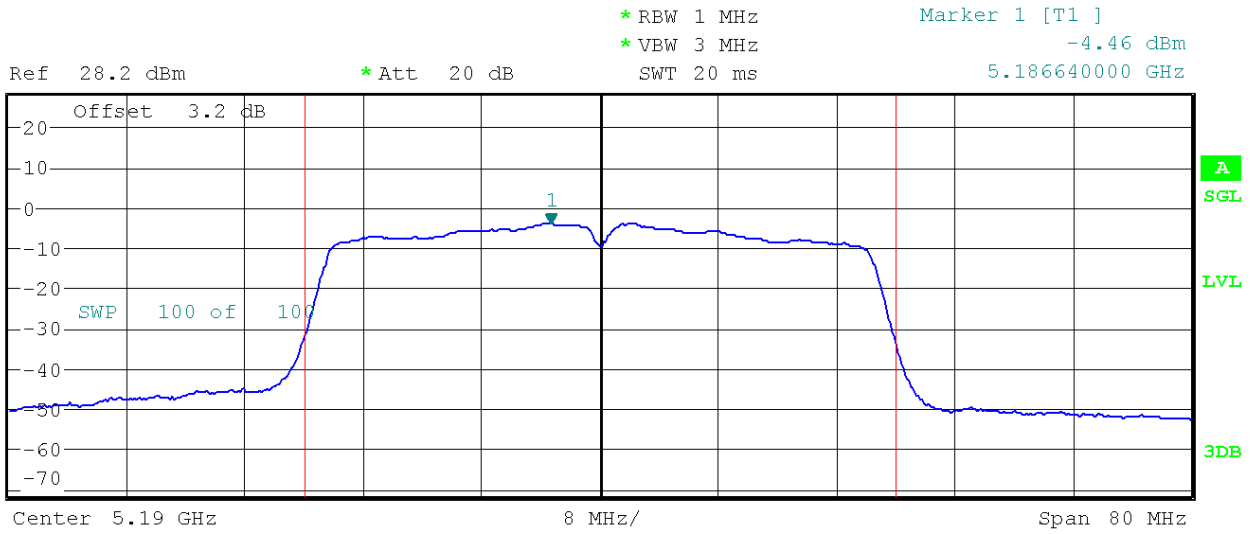


**Tx Channel**

Bandwidth 22.7097436 MHz Power 10.31 dBm

### Mode 802.11 n40 (HT40)

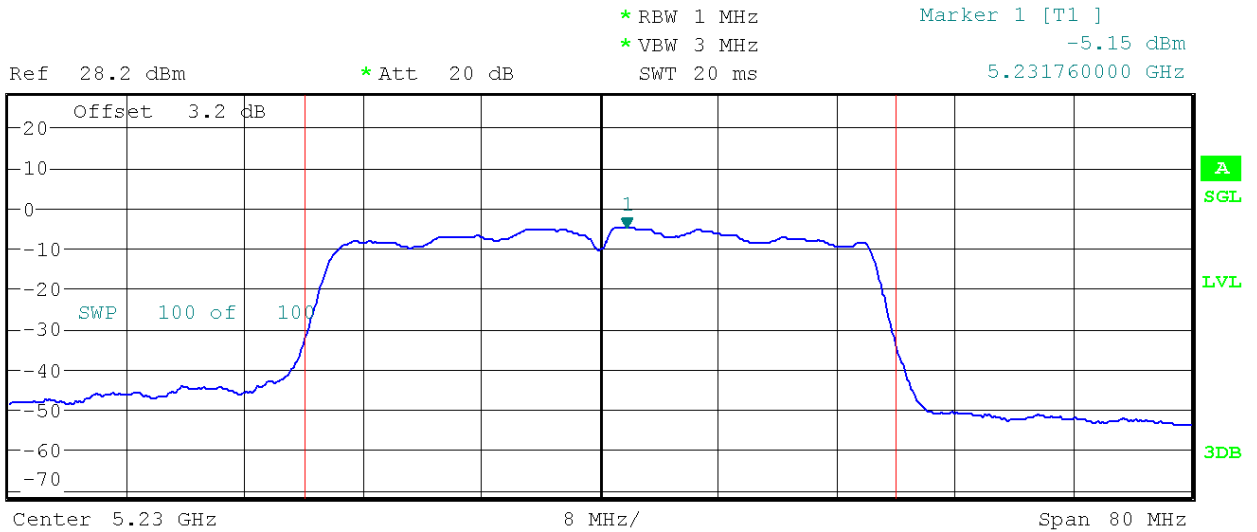
- Low Channel 38:



#### Tx Channel

Bandwidth 40 MHz      Power 8.15 dBm

- High Channel 46:

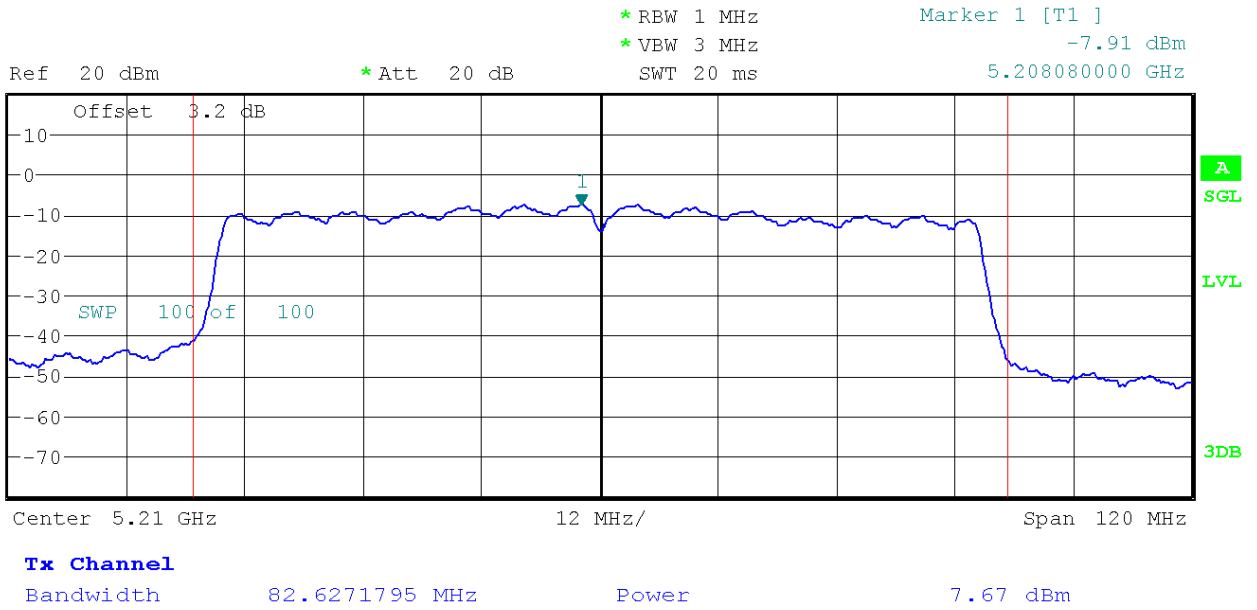


#### Tx Channel

Bandwidth 40.1282051 MHz      Power 7.36 dBm

**Mode 802.11 ac80 (VHT80)**

- Single Channel 42:



**MIMO – CORE-MIMO\_Port1 & Port4 Antennas:**

**Mode 802.11 n20 (HT20)**

	Low Channel MHz		Middle Channel MHz		High Channel MHz	
	CORE- MIMO_Port 1	CORE- MIMO_Port 4	CORE- MIMO_Port 1	CORE- MIMO_Port 1	CORE- MIMO_Port 1	CORE- MIMO_Port 1
Maximum Average Conducted Power (dBm)	9.09	5.19	8.89	4.85	8.98	4.39
Duty Cycle Correction Factor (dB)	1.88	1.84	1.88	1.84	1.88	1.84
Max. Conducted Power Corrected (dBm)	10.97	7.03	10.77	6.69	10.86	6.23
	CORE-MIMO_Port4 + CORE-MIMO_Port1		CORE-MIMO_Port4 + CORE-MIMO_Port1		CORE-MIMO_Port4 + CORE-MIMO_Port1	
Maximum Combined Average Conducted Power (dBm)	12.45		12.21		12.15	
Maximum Combined EIRP Power (dBm)	16.95		16.71		16.65	
Measurement uncertainty (dB)	<±1.20					

**Mode 802.11 n40 (HT40)**

	Low Channel MHz		High Channel MHz	
	CORE- MIMO_Port 1	CORE- MIMO_Port 4	CORE- MIMO_Port 1	CORE- MIMO_Port 1
Maximum Average Conducted Power (dBm)	7.71	3.90	7.24	3.91
Duty Cycle Correction Factor (dB)	3.02	3.04	3.02	3.04
Max. Conducted Power Corrected (dBm)	10.73	6.94	10.26	6.95
	CORE-MIMO_Port4 + CORE-MIMO_Port1		CORE-MIMO_Port4 + CORE-MIMO_Port1	
Maximum Combined Average Conducted Power (dBm)	12.25		11.92	
Maximum Combined EIRP Power (dBm)	16.75		16.42	
Measurement uncertainty (dB)	<±1.20			



**Mode 802.11 ac80 (VHT80)**

	Single Channel MHz	
	CORE- MIMO_Port 1	CORE- MIMO_Port 4
Maximum Average Conducted Power (dBm)	1.11	-2.00
Duty Cycle Correction Factor (dB)	9.67	9.67
Max. Conducted Power Corrected (dBm)	10.78	7.67
	CORE-MIMO_Port4 + CORE-MIMO_Port1	
Maximum Combined Average Conducted Power (dBm)	12.51	
Maximum Combined EIRP Power (dBm)	17.01	
Measurement uncertainty (dB)	<±1.20	

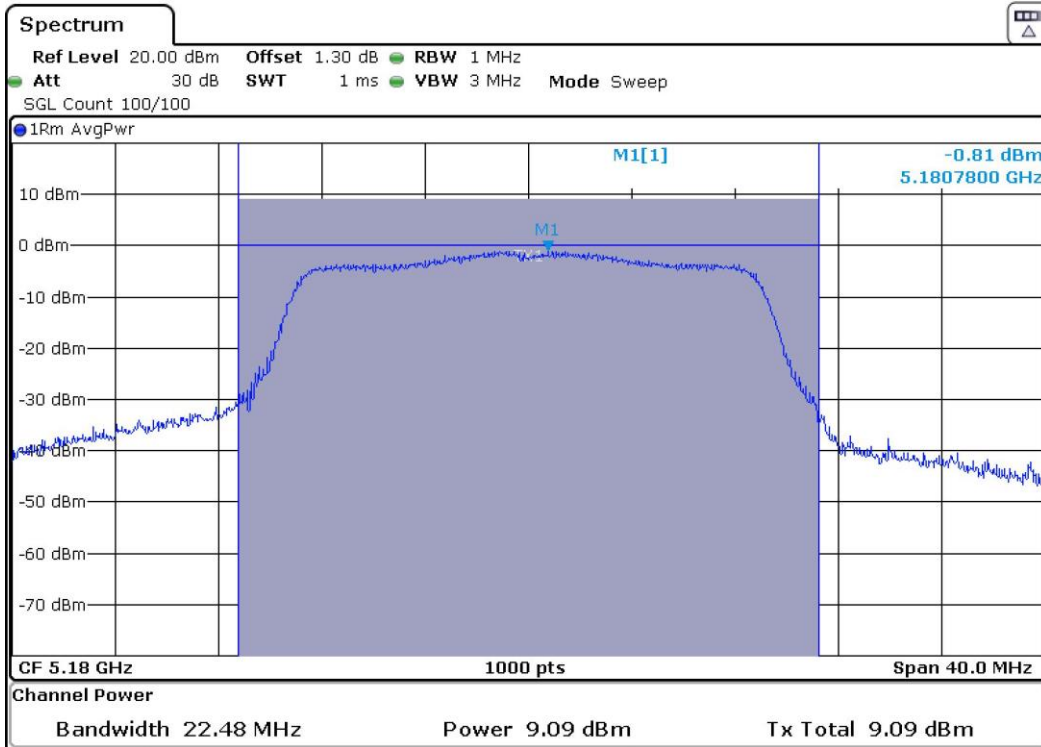
Verdict: PASS

**MIMO – CORE-MIMO\_Port1 & Port4 Antennas:**

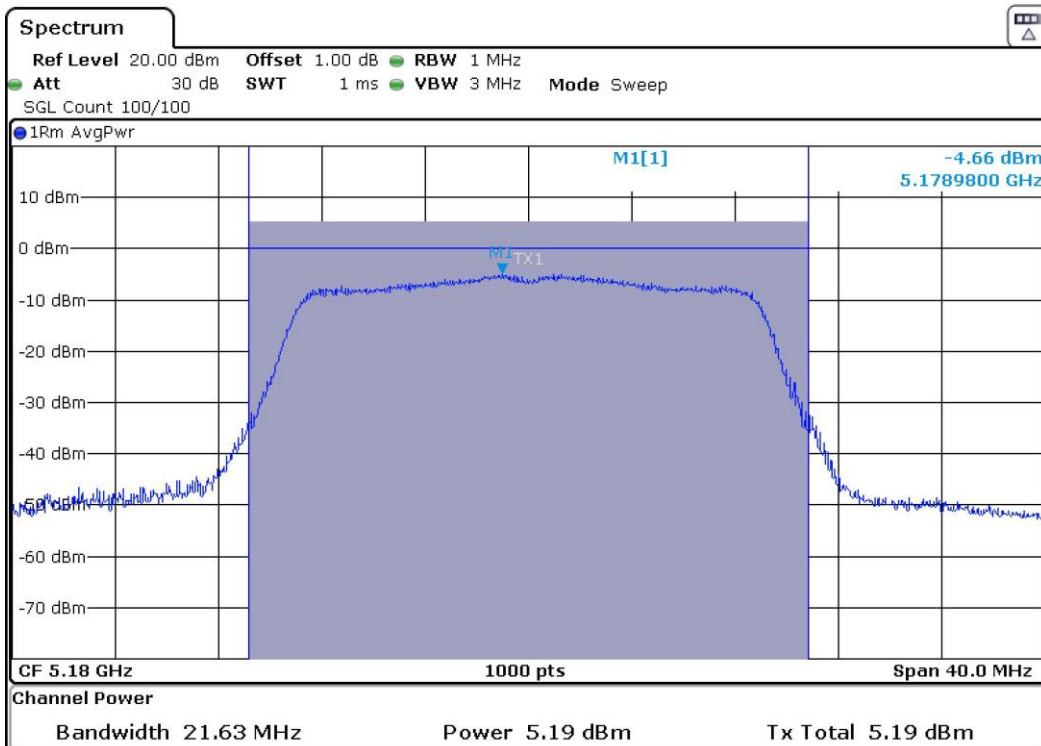
**Mode 802.11 n20 (HT20)**

- Low Channel 36:

Port 1

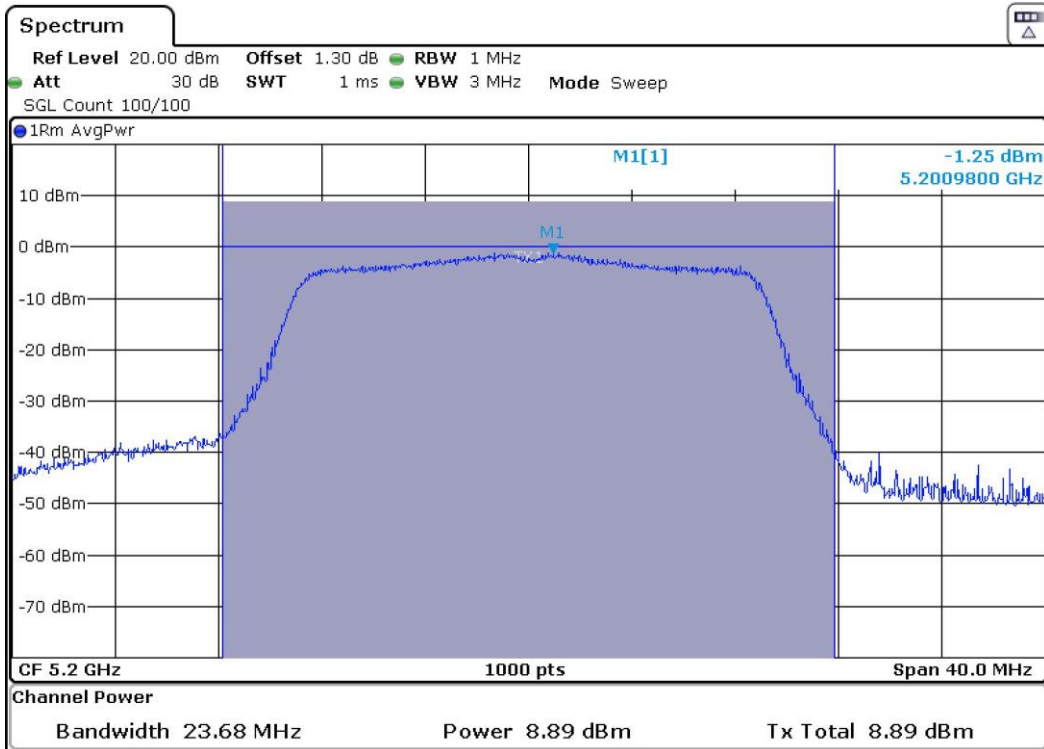


Port 4

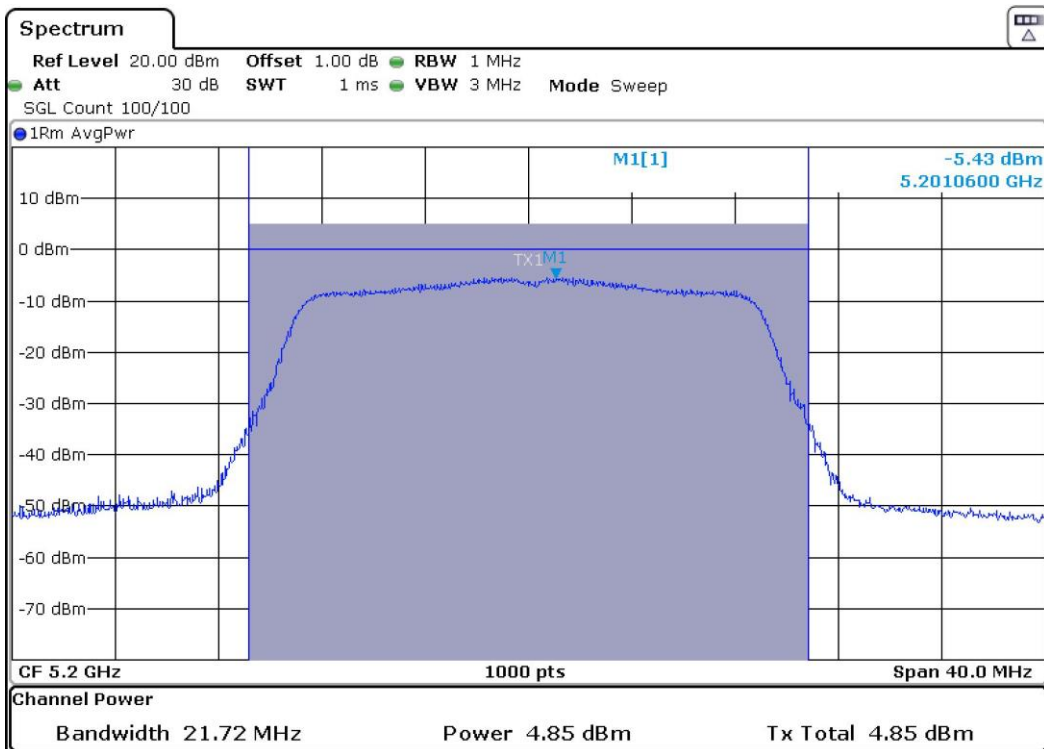


- Middle Channel 40:

Port 1

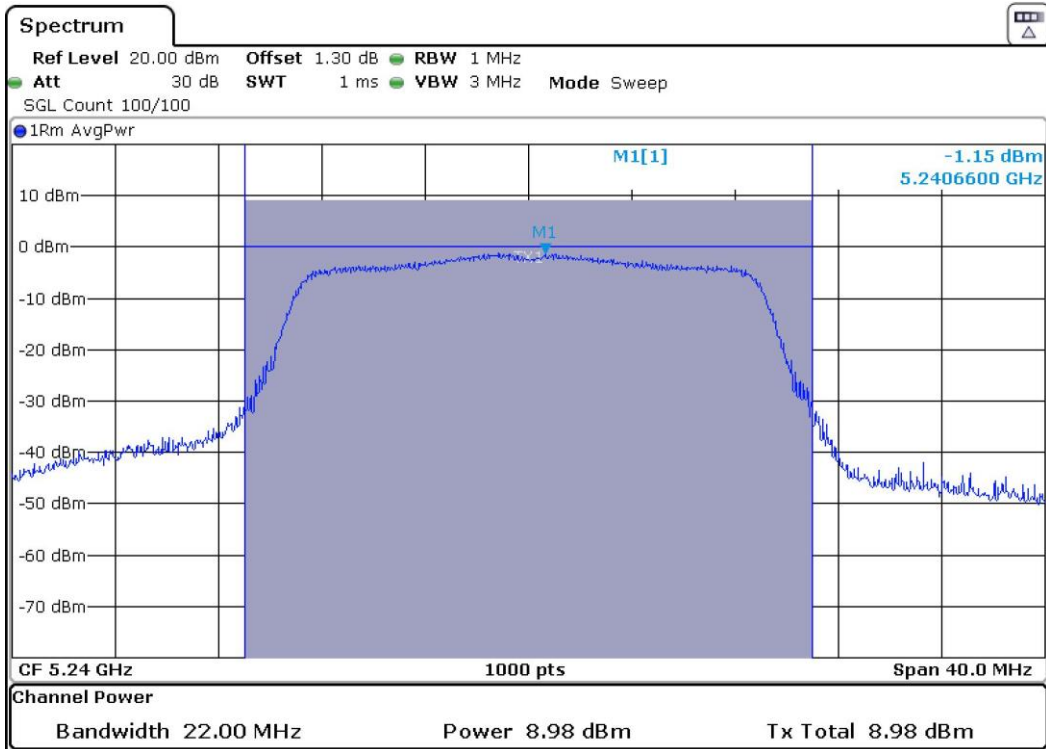


Port 4

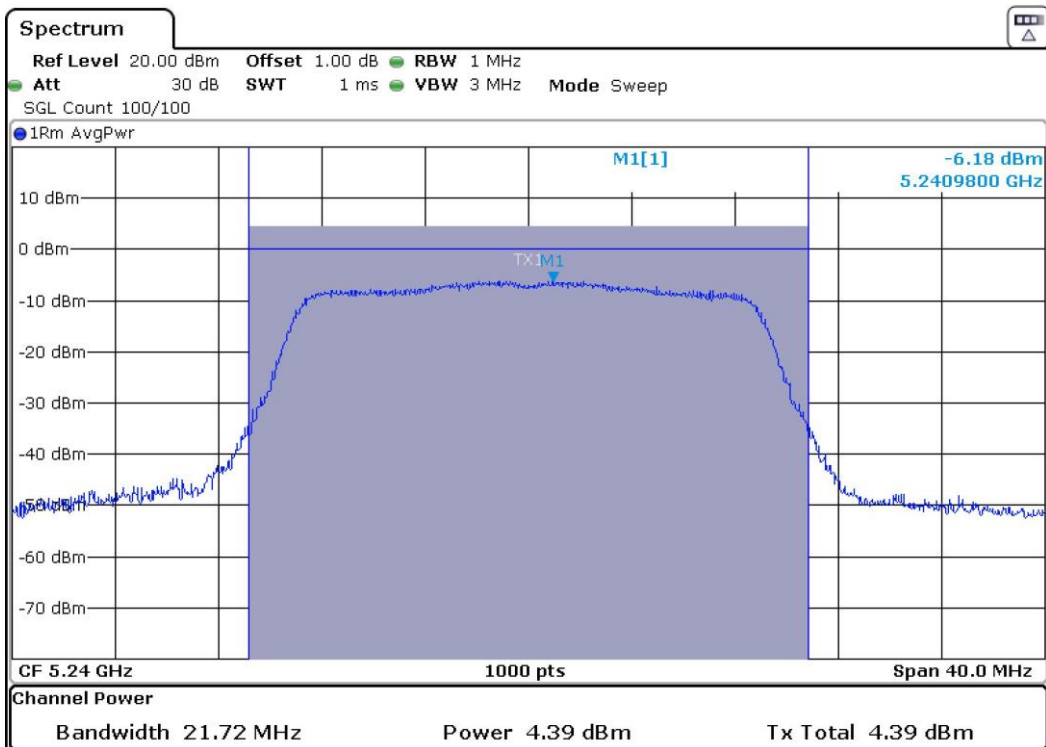


- High Channel 48:

Port 1



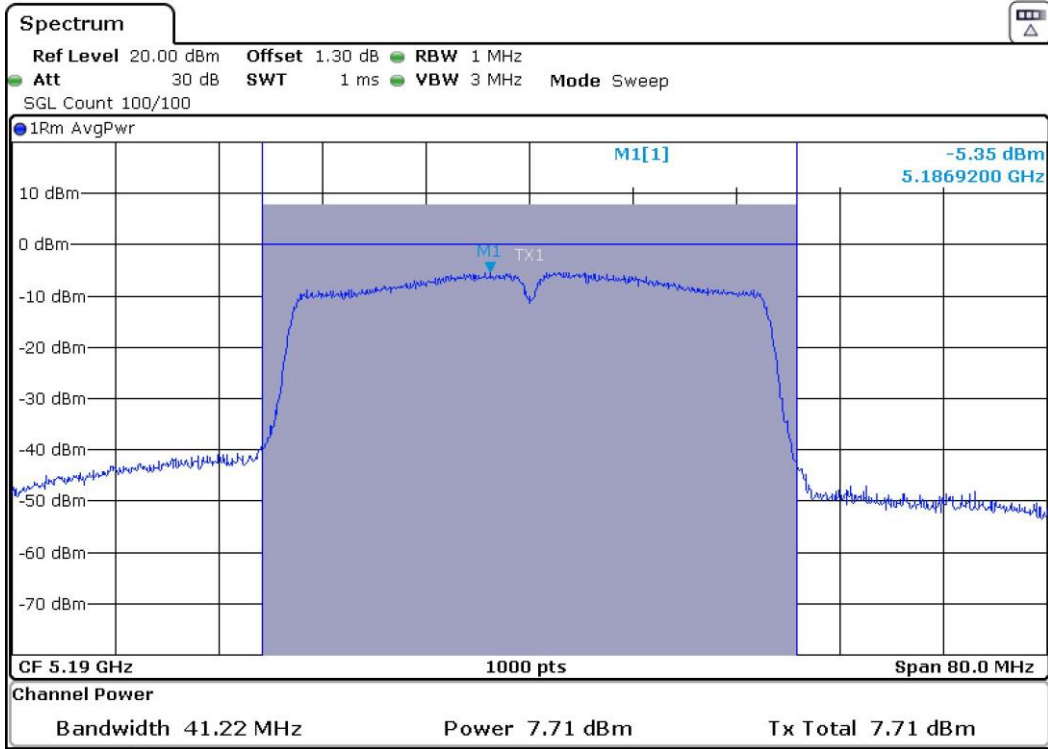
Port 4



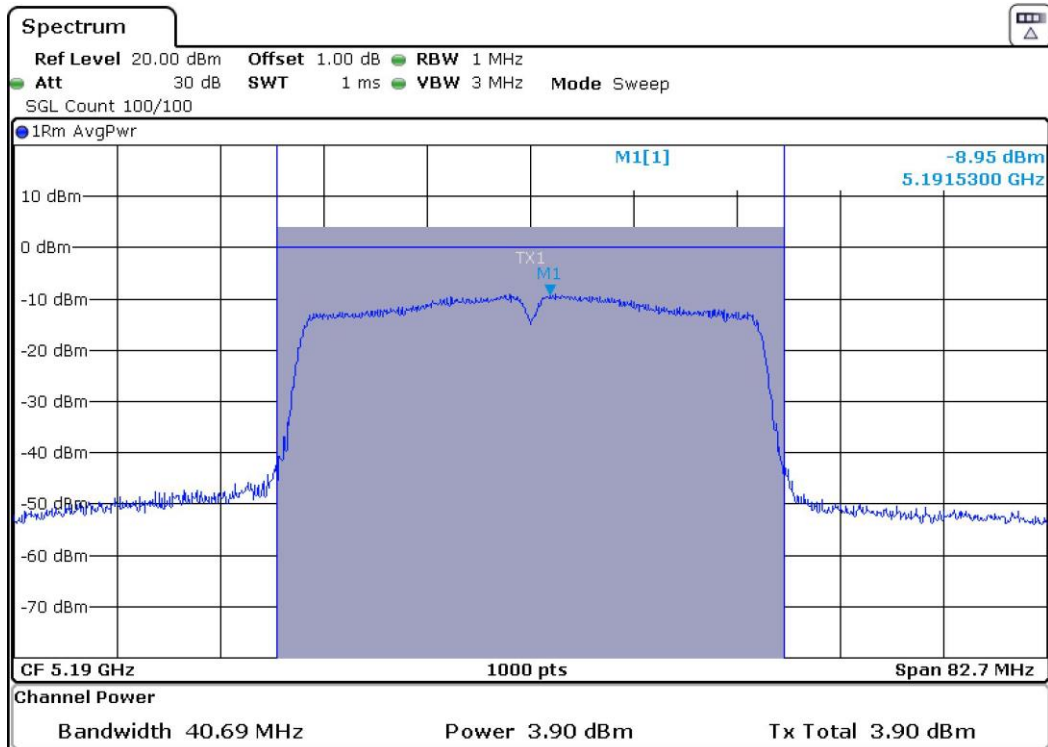
### Mode 802.11 n40 (HT40)

- Low Channel 38:

Port 1

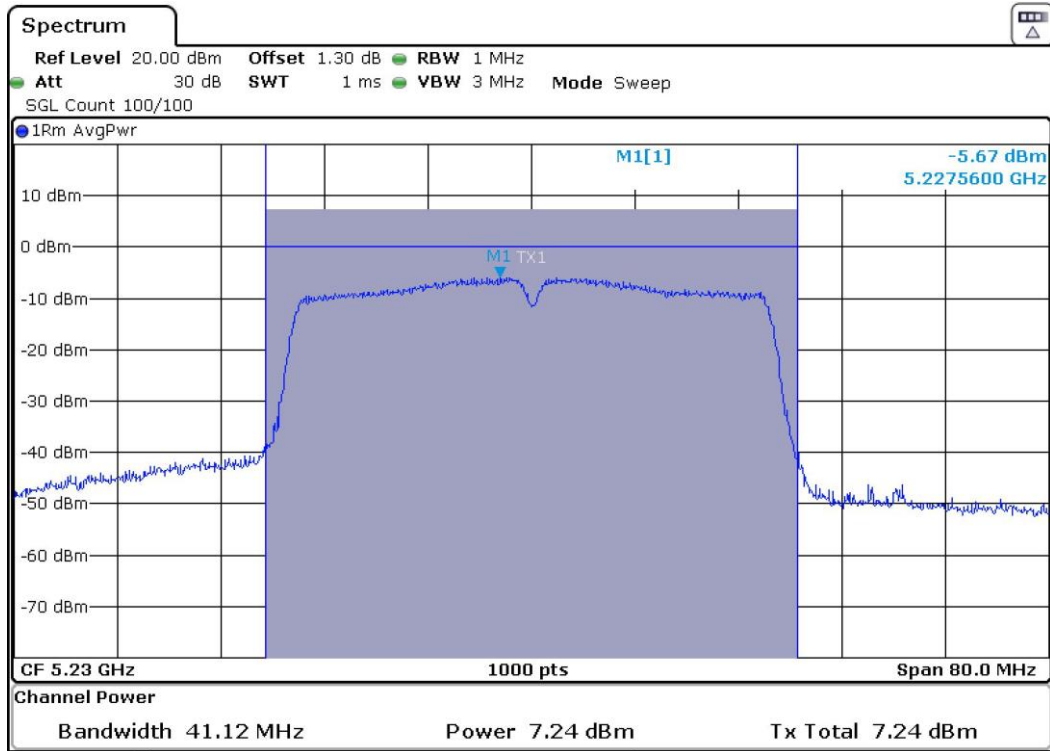


Port 4

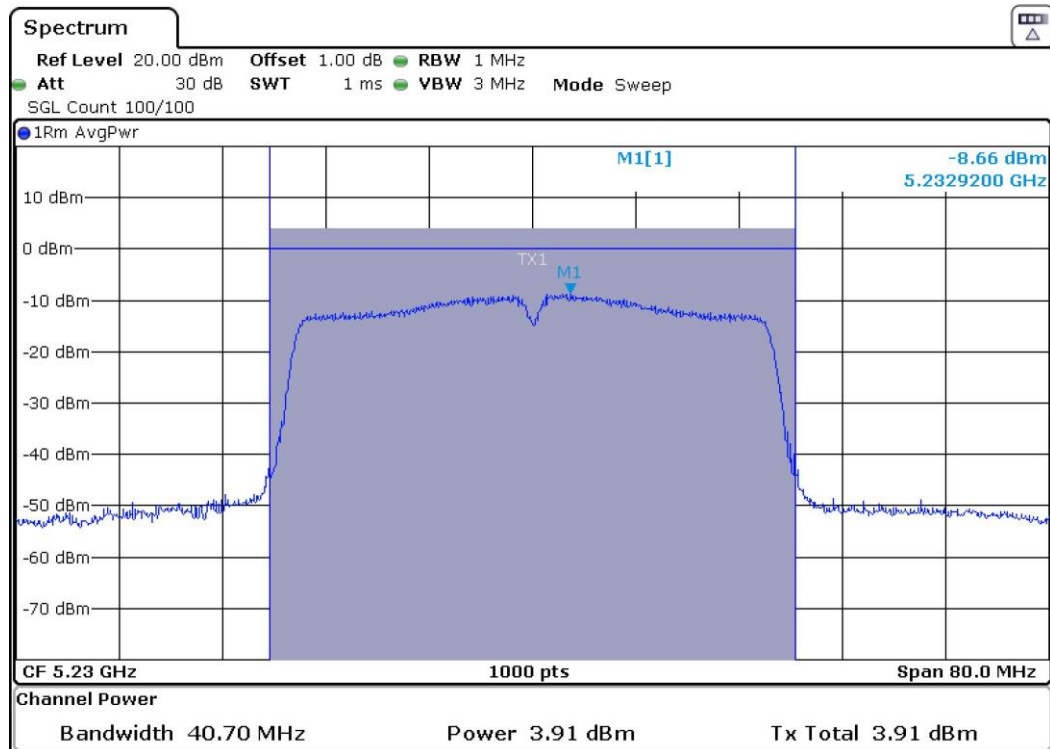


- High Channel 46:

Port 1



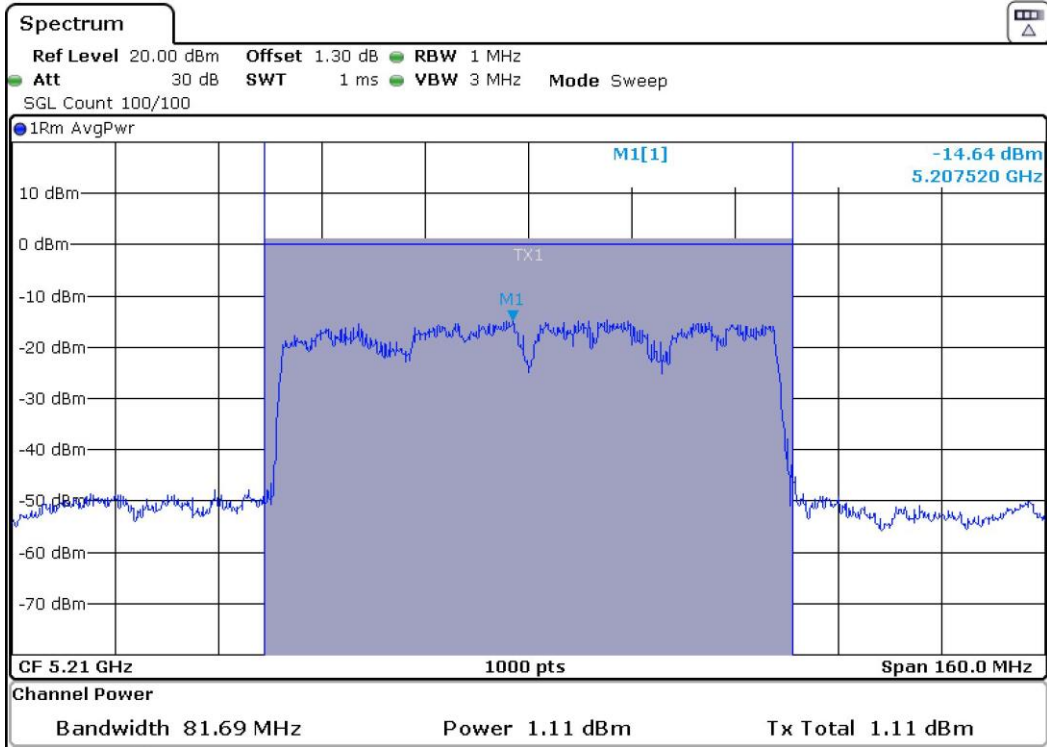
Port 4



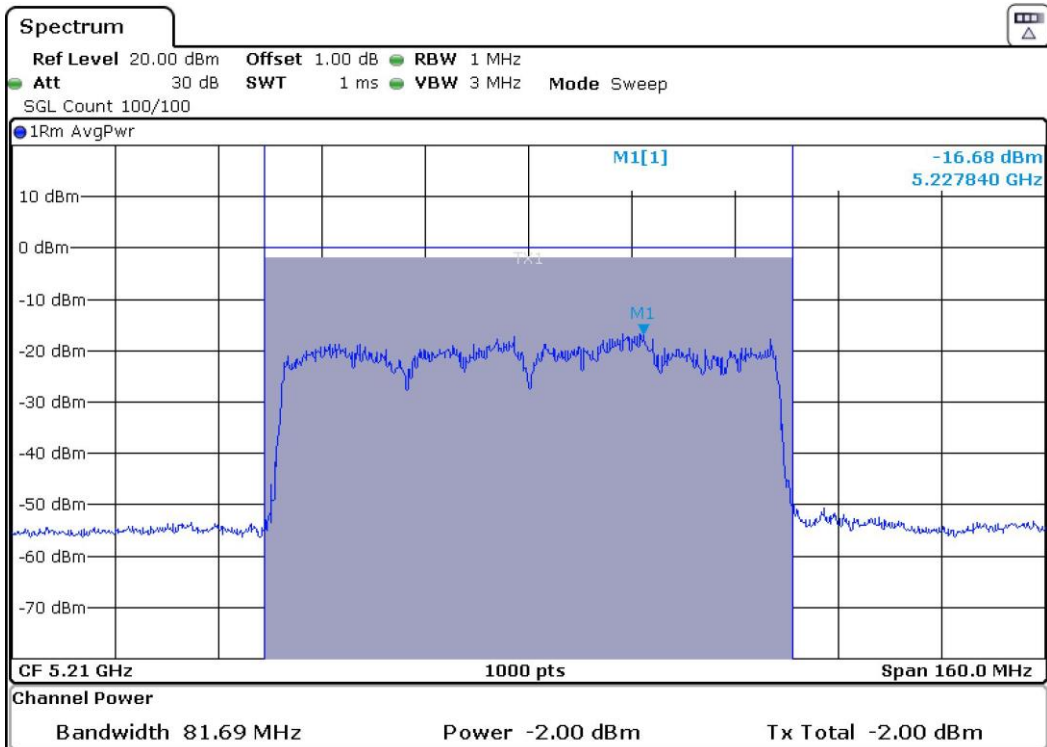
### Mode 802.11 ac80 (VHT80)

- Single Channel 42:

Port 1



Port 4



## FCC 15.407 (a)(1)(ii) Density / RSS-247 6.2.1.1. Maximum Power Spectral Density

### SPECIFICATION:

FCC 15.407: The maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, 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 10dBm 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).

Preliminary tests determined the SISO worst case is CORE-0\_Port3 Antenna.

Preliminary tests determined the MIMO worst case is CORE-MIMO\_Port1 & Port4 Antennas.

- SISO – CORE-0\_Port3 Antenna – Declared Maximum Antenna Gain: +2.5 dBi
- MIMO – CORE-MIMO\_Port1 & Port4 Antennas – Declared Maximum Antenna Gain:
  - Port4 – Declared Maximum Antenna Gain: +4.5 dBi
  - Port1 – Declared Maximum Antenna Gain: +4.5 dBi

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



**SISO – CORE-0\_Port3 – Antenna:**

**Mode 802.11 a20**

	Low Channel 36 (5180 MHz)	Middle Channel 40 (5200 MHz)	High Channel 48 (5240 MHz)
Maximum Average PSD (dBm/MHz)	1.04	0.38	0.28
Maximum EIRP PSD (dBm/MHz)	3.54	2.88	2.78
Duty Cycle Correction Factor (dB)	0.99		
Maximum Average PSD Corrected (dBm/MHz)	2.03	1.37	1.27
Maximum EIRP PSD Corrected (dBm/MHz)	4.53	3.87	3.77
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)	1.08	-0.2	0.008
Maximum EIRP PSD (dBm/MHz)	3.58	2.3	2.508
Duty Cycle Correction Factor (dB)	1.09		
Maximum Average PSD Corrected (dBm/MHz)	2.17	0.89	1.17
Maximum EIRP PSD Corrected (dBm/MHz)	4.67	3.39	3.67
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)	-4.46	-5.15
Maximum EIRP PSD (dBm/MHz)	-1.96	-2.65
Duty Cycle Correction Factor (dB)	2.08	
Maximum Average PSD Corrected (dBm/MHz)	-2.38	-3.07
Maximum EIRP PSD Corrected (dBm/MHz)	0.12	-0.57
Measurement uncertainty (dB)	<±1.20	

**Mode 802.11 ac80 (VHT80)**

	Low Channel 42 (5210 MHz)
Maximum Average PSD (dBm/MHz)	-7.91
Maximum EIRP PSD (dBm/MHz)	-5.41
Duty Cycle Correction Factor (dB)	3.57
Maximum Average PSD Corrected (dBm/MHz)	-4.34
Maximum EIRP PSD Corrected (dBm/MHz)	-1.84
Measurement uncertainty (dB)	<±1.20

Verdict: PASS

**MIMO – CORE-MIMO\_Port4 & Port1 Antennas:**

**Mode 802.11 n20 (HT20)**

	Low Channel MHz		Middle Channel MHz		High Channel MHz	
	CORE- MIMO _Port1	CORE- MIMO _Port4	CORE- MIMO _Port1	CORE- MIMO _Port4	CORE- MIMO _Port1	CORE- MIMO _Port4
Maximum Average Conducted Power Spectral Density (dBm/MHz)	-0.81	-4.66	-1.25	-5.43	-1.15	-6.18
Duty Cycle Correction Factor (dB)	1.88	1.84	1.88	1.84	1.88	1.84
Maximum PSD Corrected (dBm/MHz)	1.07	-2.82	0.63	-3.59	0.73	-4.34
Maximum PSD (dBm/MHz)	4.08	0.19	3.64	-0.58	3.74	-1.33
Maximum PSD E.I.R.P. (dBm/MHz)	8.58	4.69	8.14	3.92	8.24	3.17
Measurement uncertainty (dB)	<±1.56					

NOTE: The quantity  $10 \cdot \log 2$  (two antennas) is added to the spectrum peak value according to document 662911 D01.

**Mode 802.11 n40 (HT40)**

	Low Channel MHz		High Channel MHz	
	CORE- MIMO _Port1	CORE- MIMO _Port4	CORE- MIMO _Port1	CORE- MIMO _Port4
Maximum Average Conducted Power Spectral Density (dBm/MHz)	-5.35	-8.95	-5.67	-8.66
Duty Cycle Correction Factor (dB)	3.02	3.04	3.02	3.04
Maximum PSD Corrected (dBm/MHz)	-2.33	-5.91	-2.65	-5.62
Maximum PSD (dBm/MHz)	0.68	-2.90	0.36	-2.61
Maximum PSD E.I.R.P. (dBm/MHz)	5.18	1.60	4.86	1.89
Measurement uncertainty (dB)	<±1.56			

**Mode 802.11 ac80 (VHT80)**

	Single Channel MHz	
	CORE- MIMO _Port1	CORE- MIMO _Port4
Maximum Average Conducted Power Spectral Density (dBm/MHz)	-14.64	-16.68
Duty Cycle Correction Factor (dB)	9.67	9.67
Maximum PSD Corrected (dBm/MHz)	-4.97	-7.01
Maximum PSD (dBm/MHz)	-1.96	-4.00
Maximum PSD E.I.R.P. (dBm/MHz)	2.54	0.50
Measurement uncertainty (dB)	<±1.56	

Verdict: PASS

## FCC 15.407 (b)(1)(6) / RSS-247 6.2.1.2. 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 360° 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).

## SISO CORE-0\_Port3 Antenna:

### 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)
40.557	31.3	40	V	Peak	<±3.04
71.532	36.2	40	V	Peak	<±3.04
212.861	32.3	43.5	V	Peak	<±3.04
375.013	38.7	46	V	Peak	<±3.04
504.152	27.5	46	V	Peak	<±3.04
875.016	29.5	46	H	Peak	<±3.04

### 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 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)
1.2513	49.42	68.23	V	Peak	<±2.72
1.37483	49.07	68.23	V	Peak	<±2.72
8.50253	49.71	68.23	V	Peak	<±4.72
10.36138	67.16	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)
1.12494	47.09	68.23	V	Peak	<±2.72
1.37538	47.46	68.23	V	Peak	<±2.72
8.52843	50.71	68.23	V	Peak	<±4.72
10.40268	68.05	68.23	V	Peak	<±4.72

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

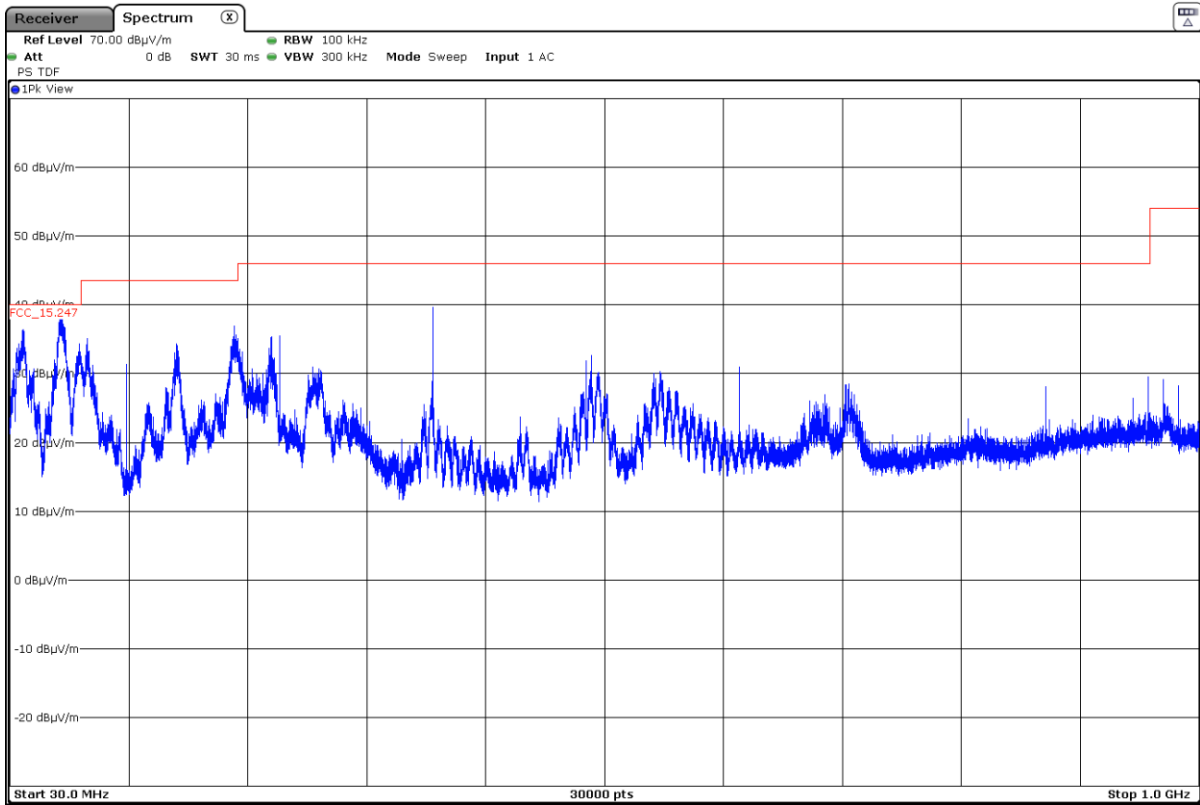
Spurious frequency (GHz)	Emission Level (dB $\mu$ V/m)	Limit (dB $\mu$ V/m)	Polarization	Detector	Measurement Uncertainty (dB)
1.12494	48.38	68.23	V	Peak	< $\pm$ 2.72
1.37501	49.57	68.23	V	Peak	< $\pm$ 2.72
6.99971	45.2	68.23	V	Peak	< $\pm$ 4.72
8.53018	49.37	68.23	V	Peak	< $\pm$ 4.72
10.47898	67.96	68.23	V	Peak	< $\pm$ 4.72

Verdict: PASS

### SISO CORE-0\_Port3 Antenna:

FREQUENCY RANGE 30 MHz - 1 GHz

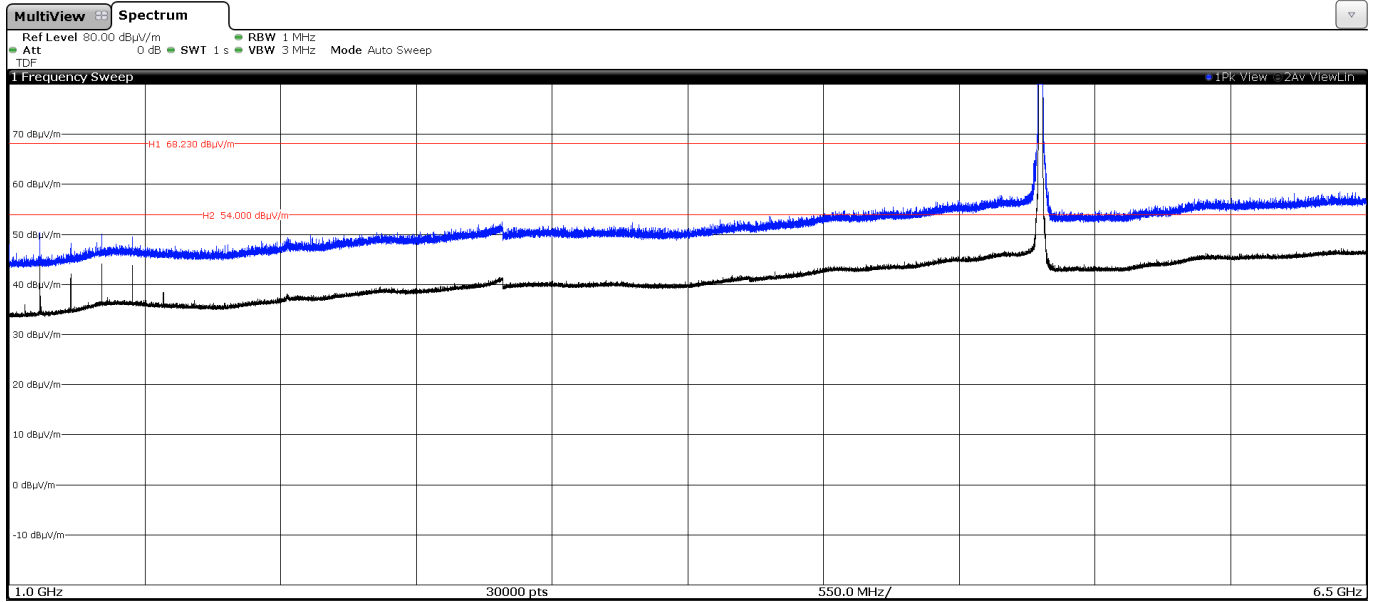
This plot is valid for the Low, Middle and High Channels and all the modulation modes.



- **Mode 802.11 a20.**

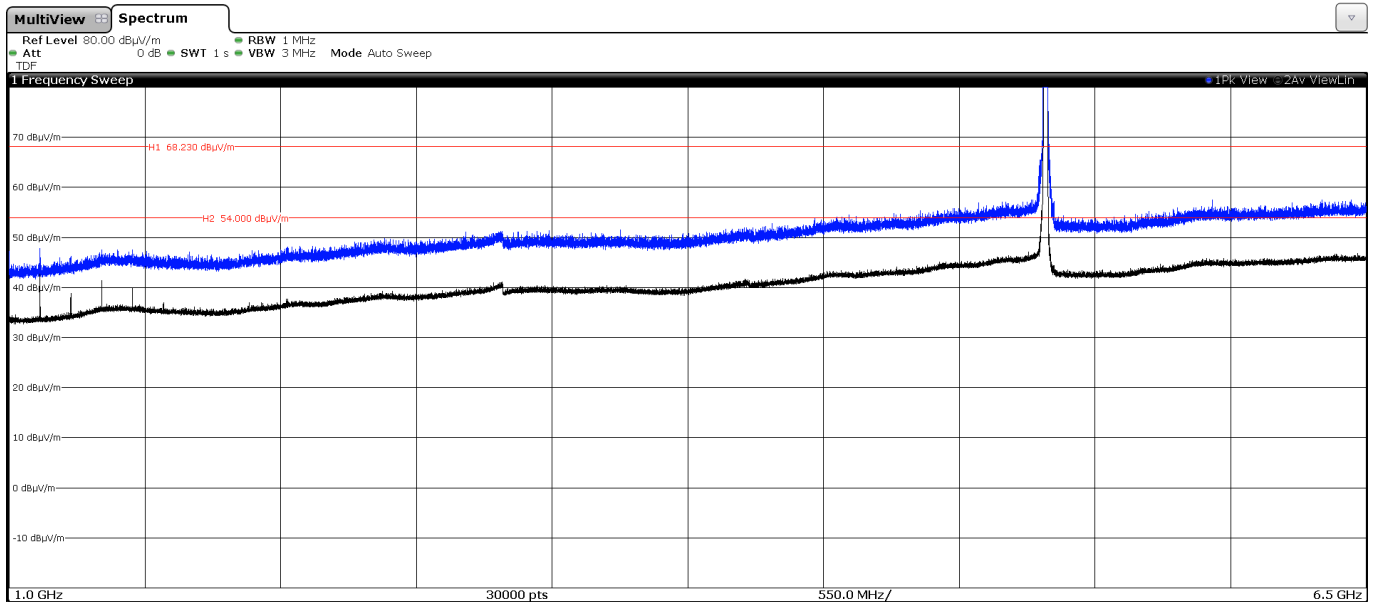
FREQUENCY RANGE 1 – 6.5 GHz (worst mode)

- Low Channel:



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

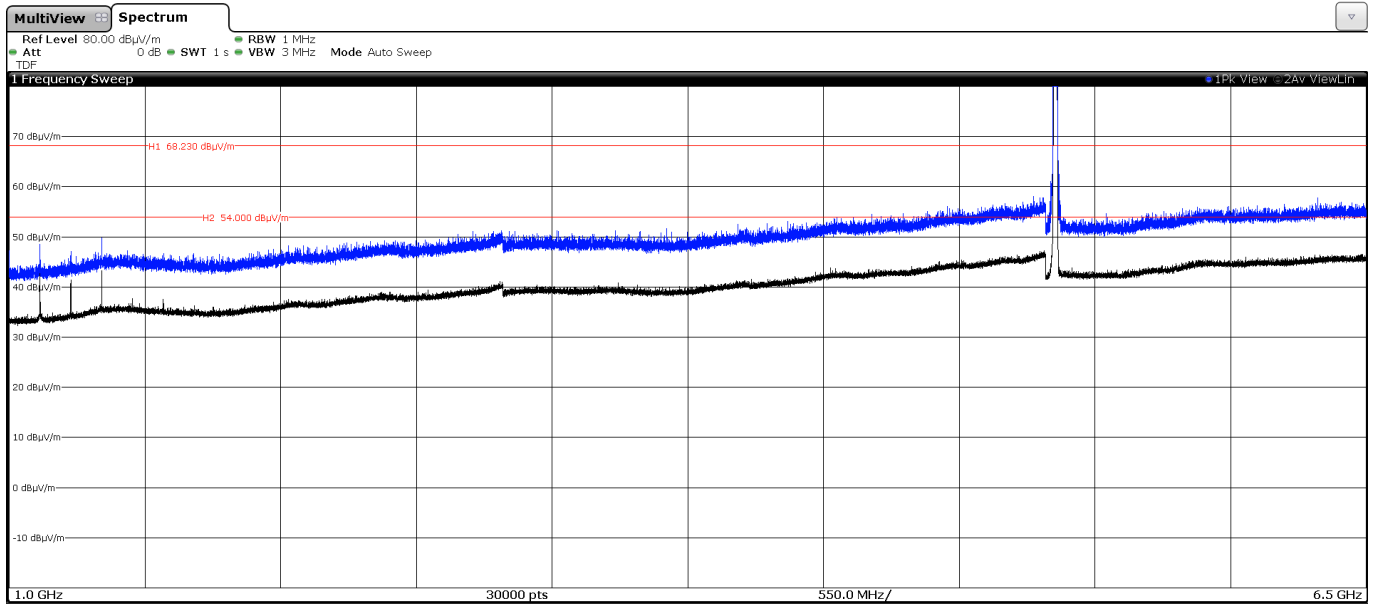
- Middle Channel:



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



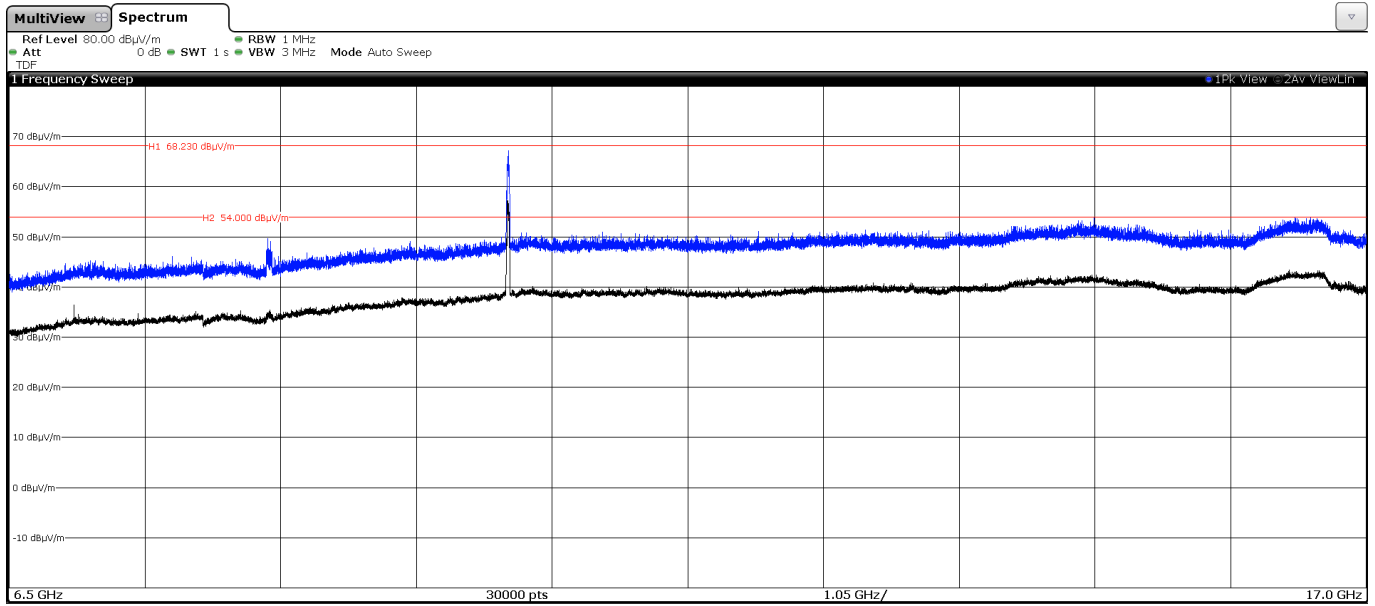
- High Channel:



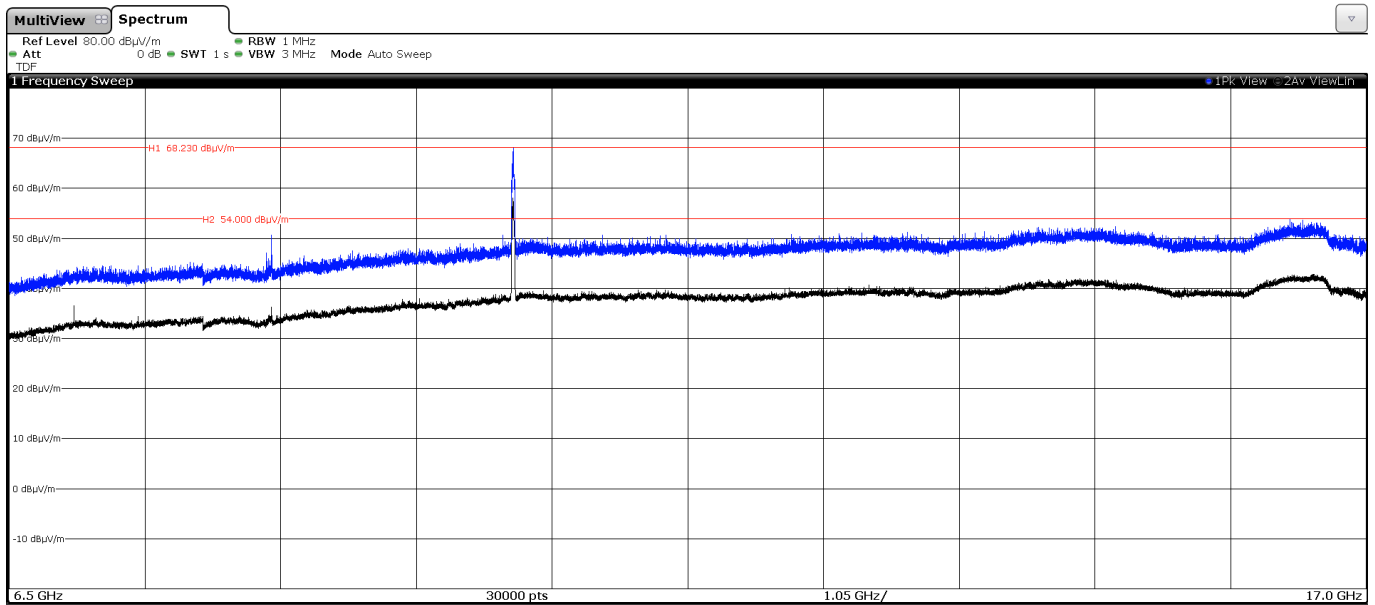
Note: The peak shown in the plot above the limit is the carrier frequency.

FREQUENCY RANGE 6.5 - 17 GHz. (worst mode)

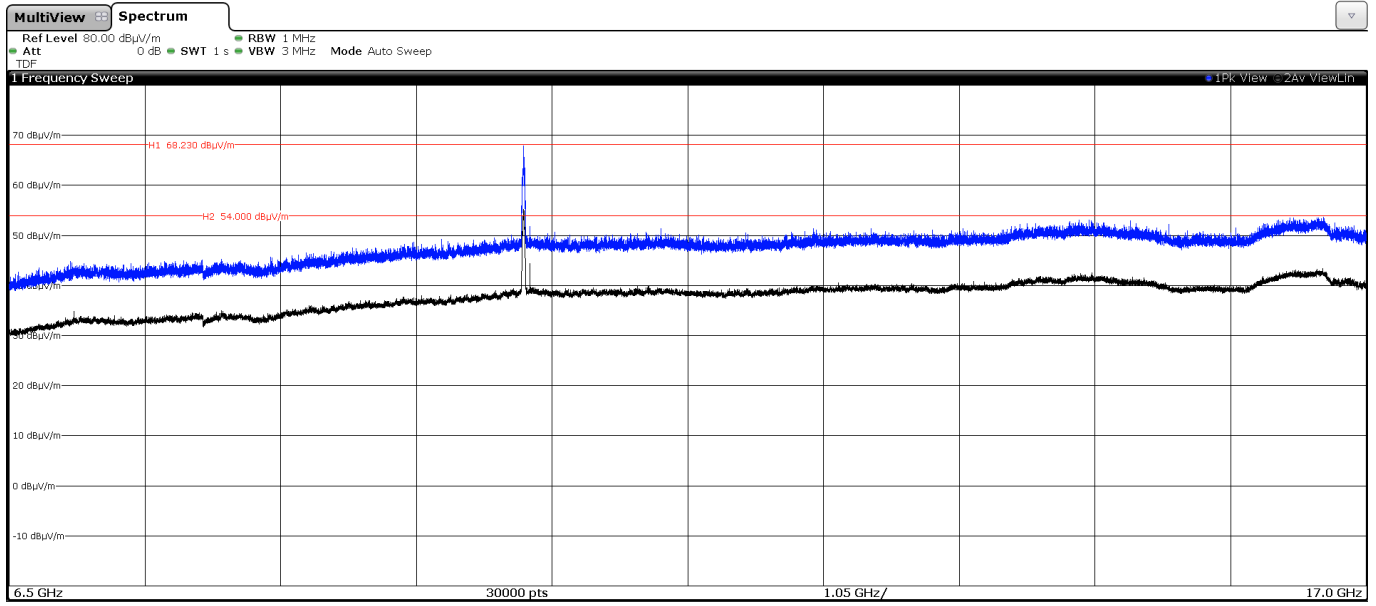
- Low Channel:



- Middle Channel:



- High Channel:



FREQUENCY RANGE 17 - 26 GHz

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

