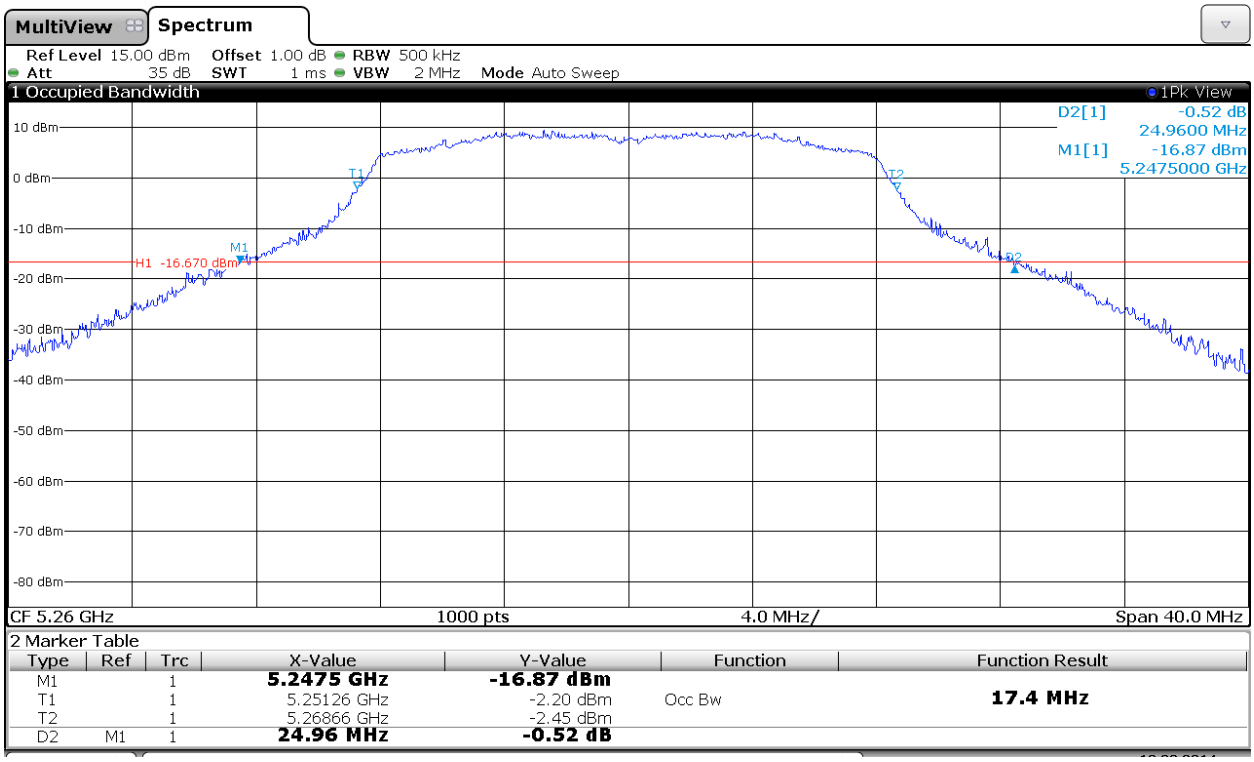
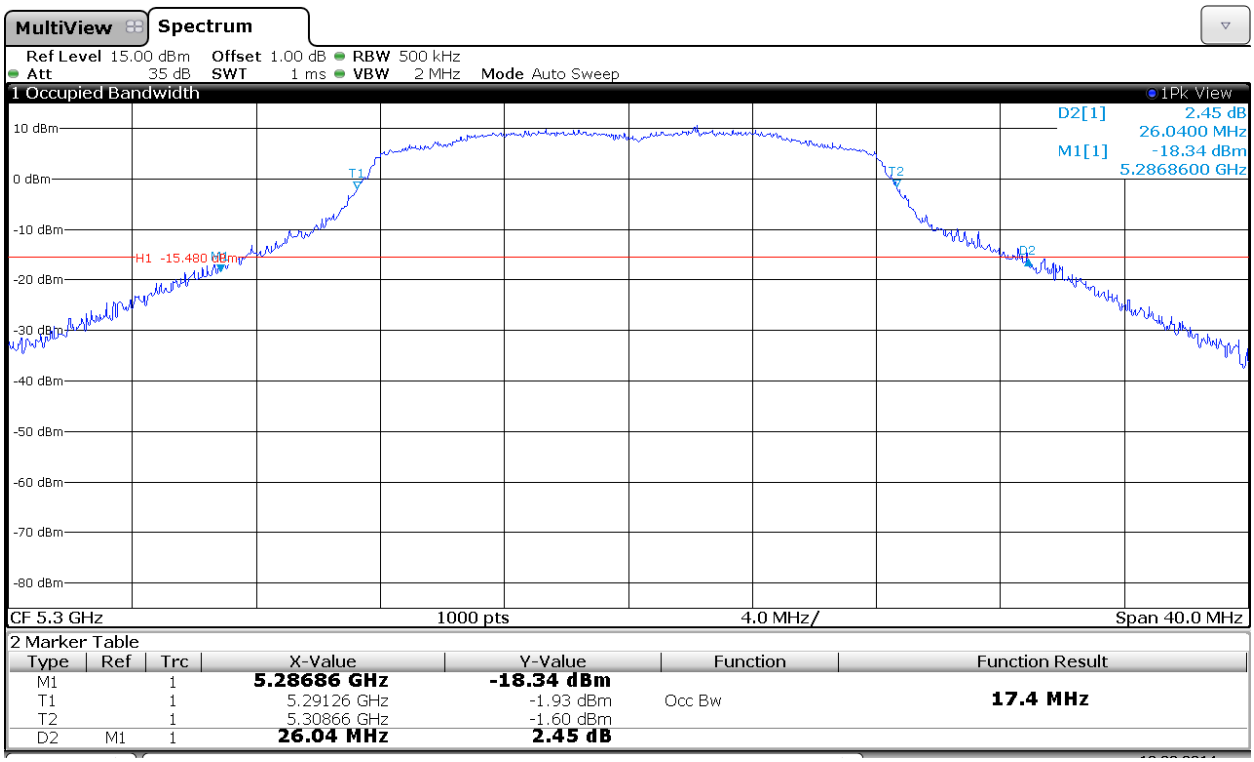
802.11a mode CHAIN A

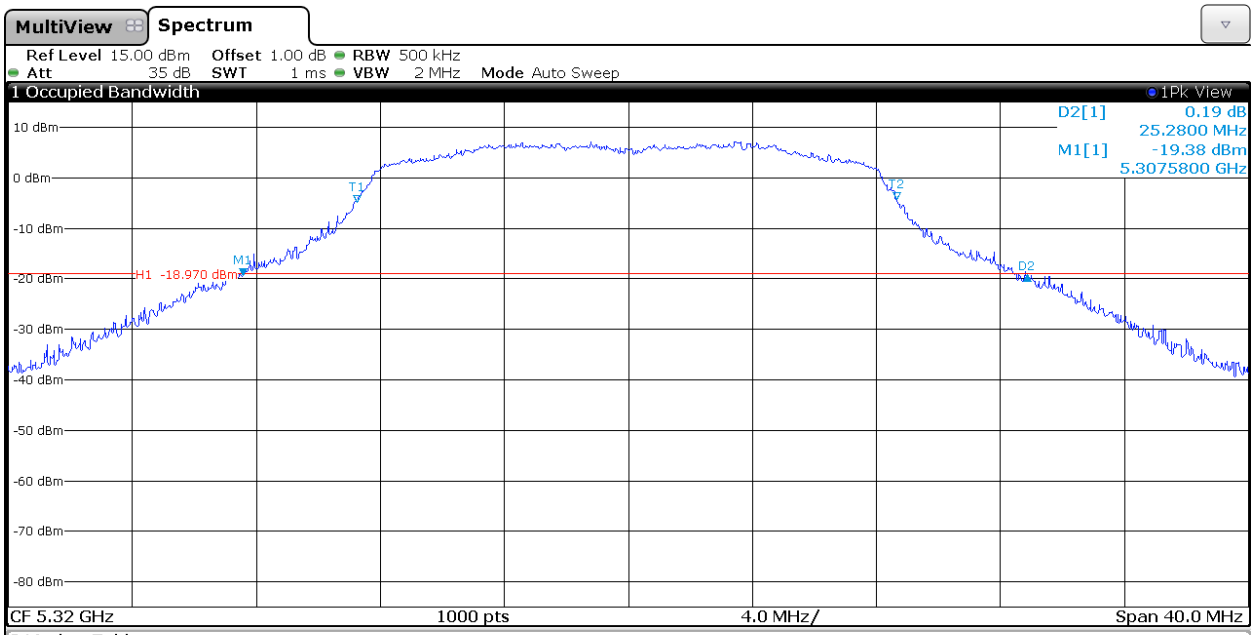
Lowest Channel



Middle Channel



Highest Channel

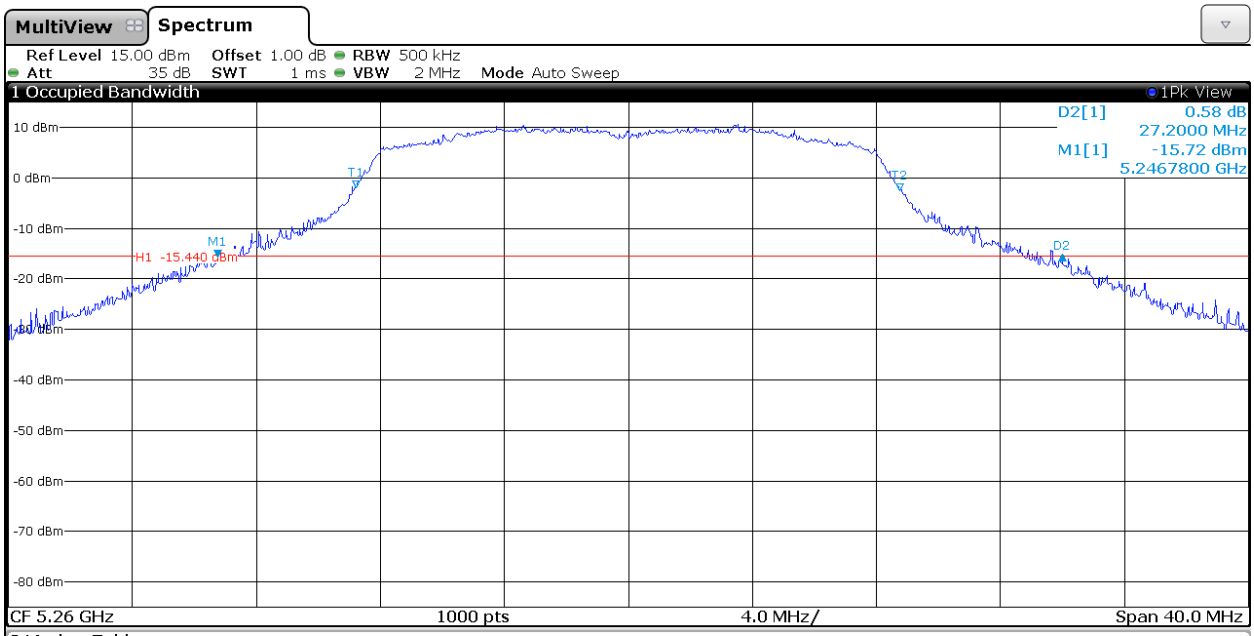


2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.30758 GHz**	**-19.38 dBm**		
T1		1	5.31126 GHz	-4.84 dBm	Occ Bw	**17.4 MHz**
T2		1	5.32866 GHz	-4.33 dBm		
D2	M1	1	**25.28 MHz**	**0.19 dB**		

802.11a mode CHAIN B

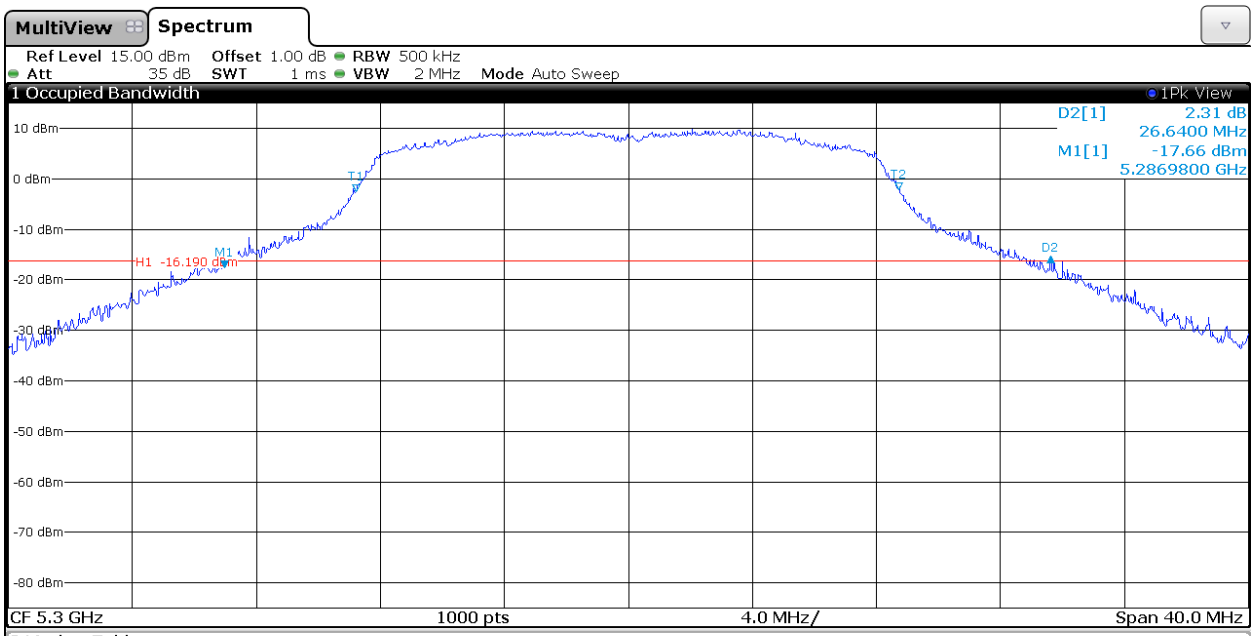
Lowest Channel



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.24678 GHz**	**-15.72 dBm**		
T1		1	5.25122 GHz	-1.96 dBm	Occ Bw	**17.52 MHz**
T2		1	5.26874 GHz	-2.55 dBm		
D2	M1	1	**27.2 MHz**	**0.58 dB**		

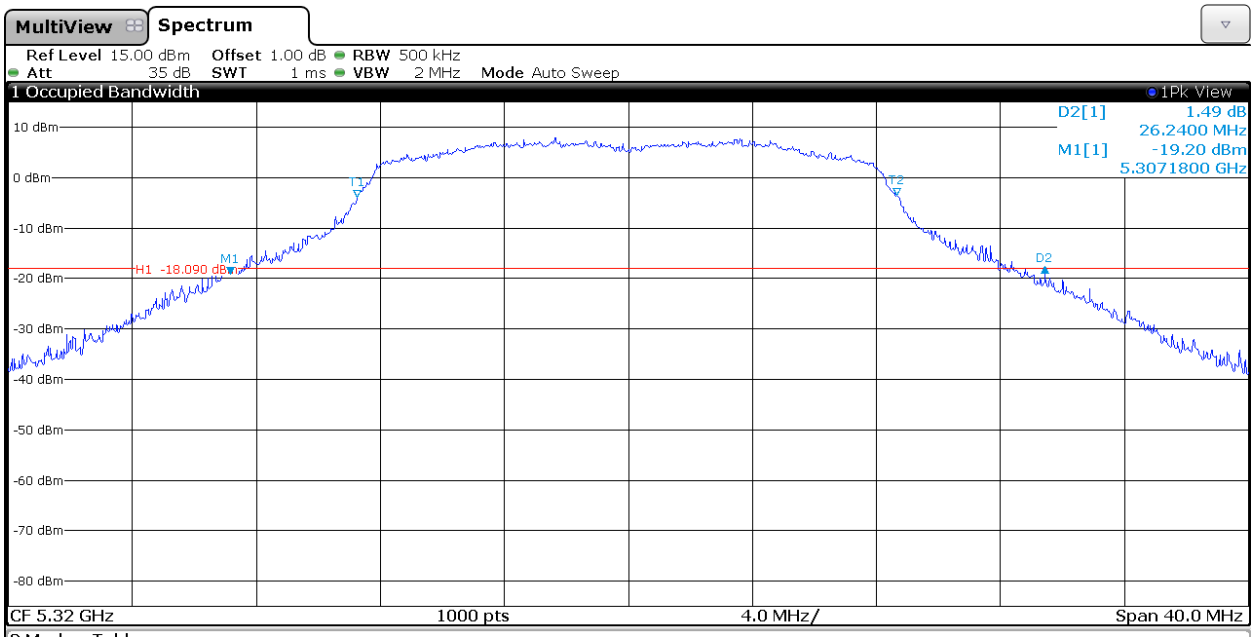
Middle Channel



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.28698 GHz**	**-17.66 dBm**		
T1		1	5.29122 GHz	-2.59 dBm	Occ Bw	**17.48 MHz**
T2		1	5.3087 GHz	-2.16 dBm		
D2	M1	1	**26.64 MHz**	**2.31 dB**		

Highest Channel

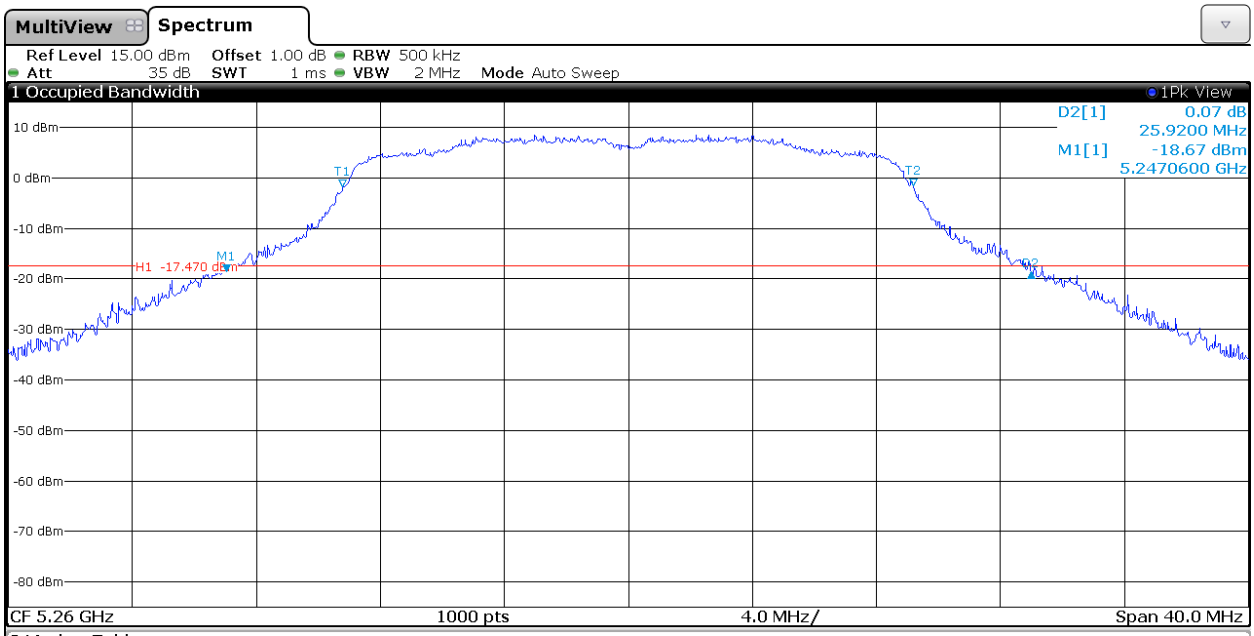


2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.30718 GHz**	**-19.20 dBm**		
T1		1	5.31126 GHz	-3.95 dBm	Occ Bw	**17.4 MHz**
T2		1	5.32866 GHz	-3.45 dBm		
D2	M1	1	**26.24 MHz**	**1.49 dB**		

802.11 n20 MHz and 802.11 ac 20 MHz modes CHAIN A

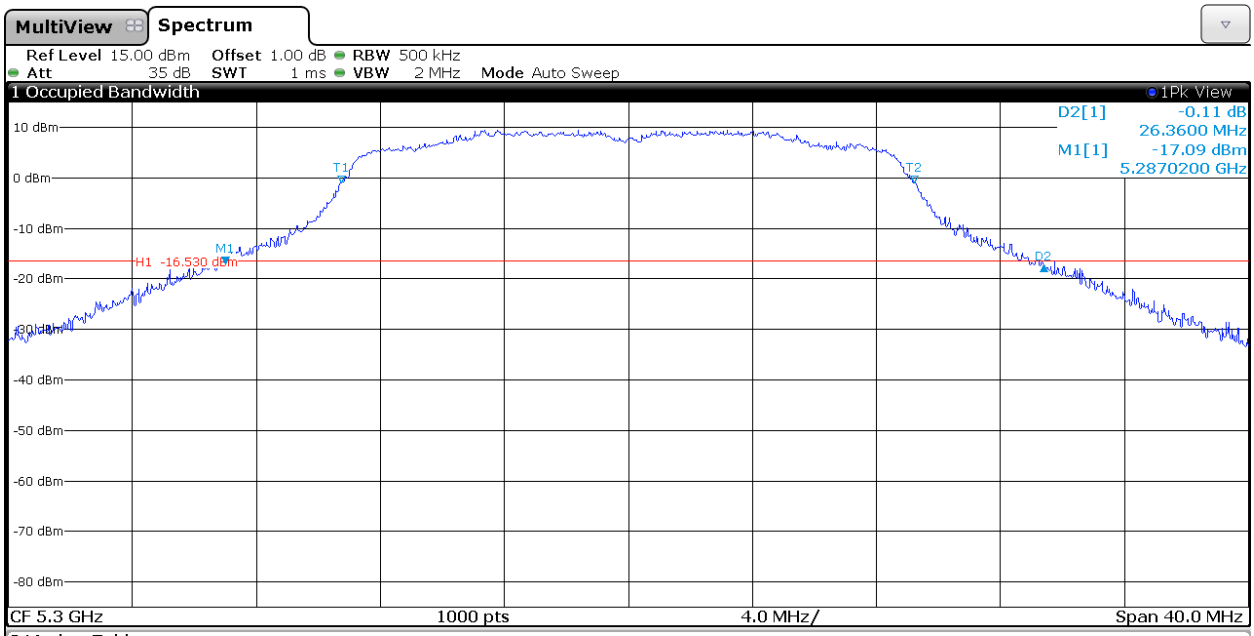
Lowest Channel



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.24706 GHz**	**-18.67 dBm**		
T1		1	5.25078 GHz	-1.70 dBm	Occ Bw	**18.4 MHz**
T2		1	5.26918 GHz	-1.52 dBm		
D2	M1	1	**25.92 MHz**	**0.07 dB**		

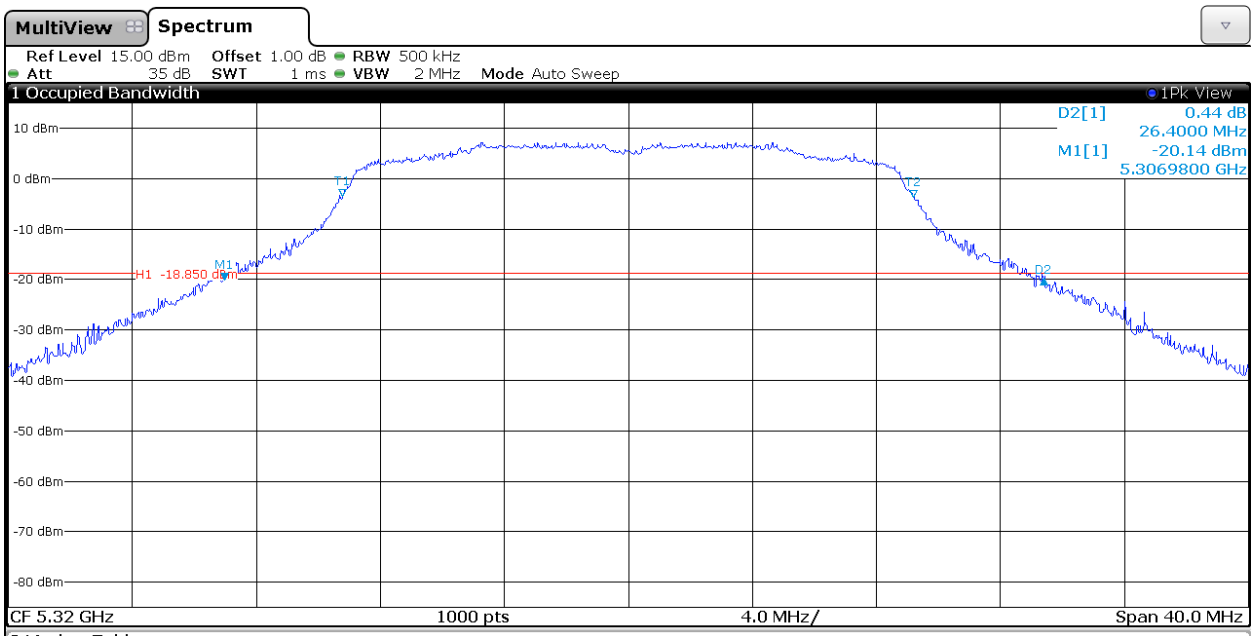
Middle Channel



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.28702 GHz**	**-17.09 dBm**		
T1		1	5.29074 GHz	-1.10 dBm	Occ Bw	**18.48 MHz**
T2		1	5.30922 GHz	-0.98 dBm		
D2	M1	1	**26.36 MHz**	**-0.11 dB**		

Highest Channel

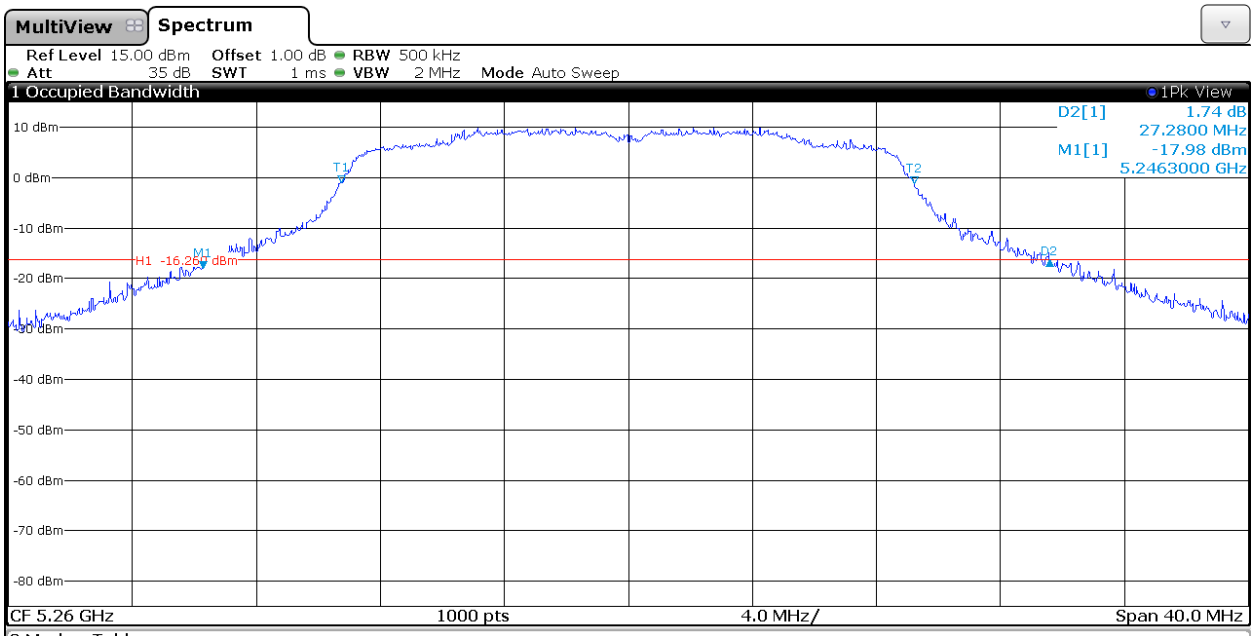


2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.30698 GHz**	**-20.14 dBm**		
T1		1	5.31078 GHz	-3.55 dBm	Occ Bw	**18.4 MHz**
T2		1	5.32918 GHz	-3.69 dBm		
D2	M1	1	**26.4 MHz**	**0.44 dB**		

802.11 n20 MHz and 802.11 ac 20 MHz modes CHAIN B

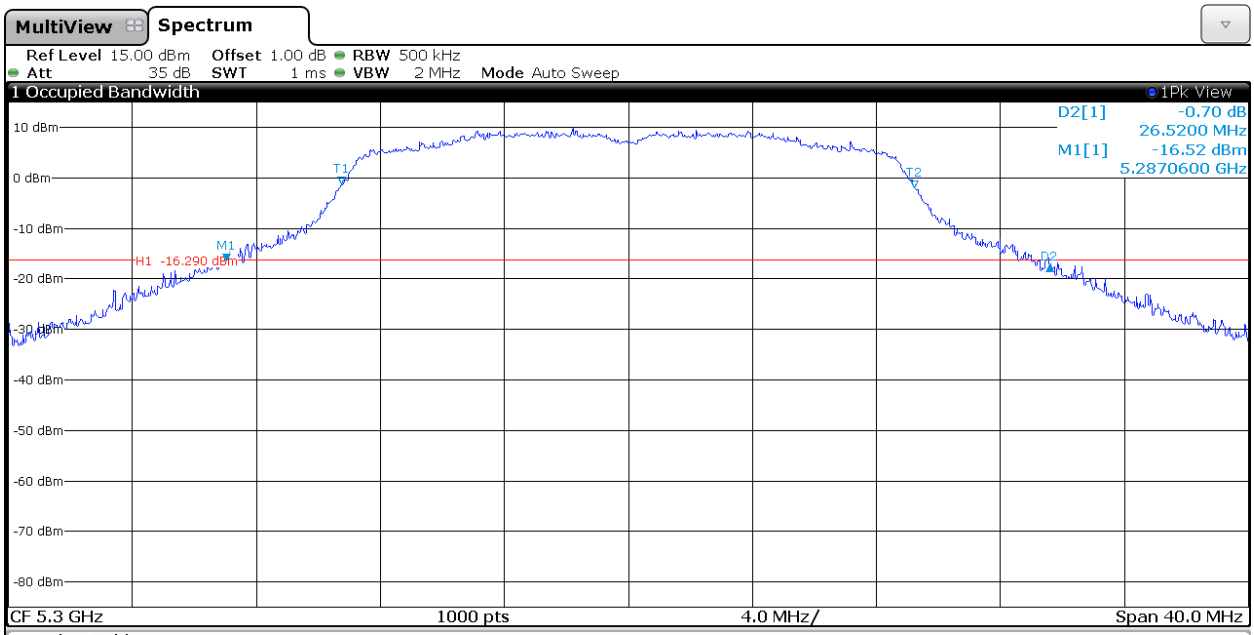
Lowest Channel



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.2463 GHz**	**-17.98 dBm**		
T1		1	5.25074 GHz	-1.04 dBm	Occ Bw	**18.48 MHz**
T2		1	5.26922 GHz	-1.26 dBm		
D2	M1	1	**27.28 MHz**	**1.74 dB**		

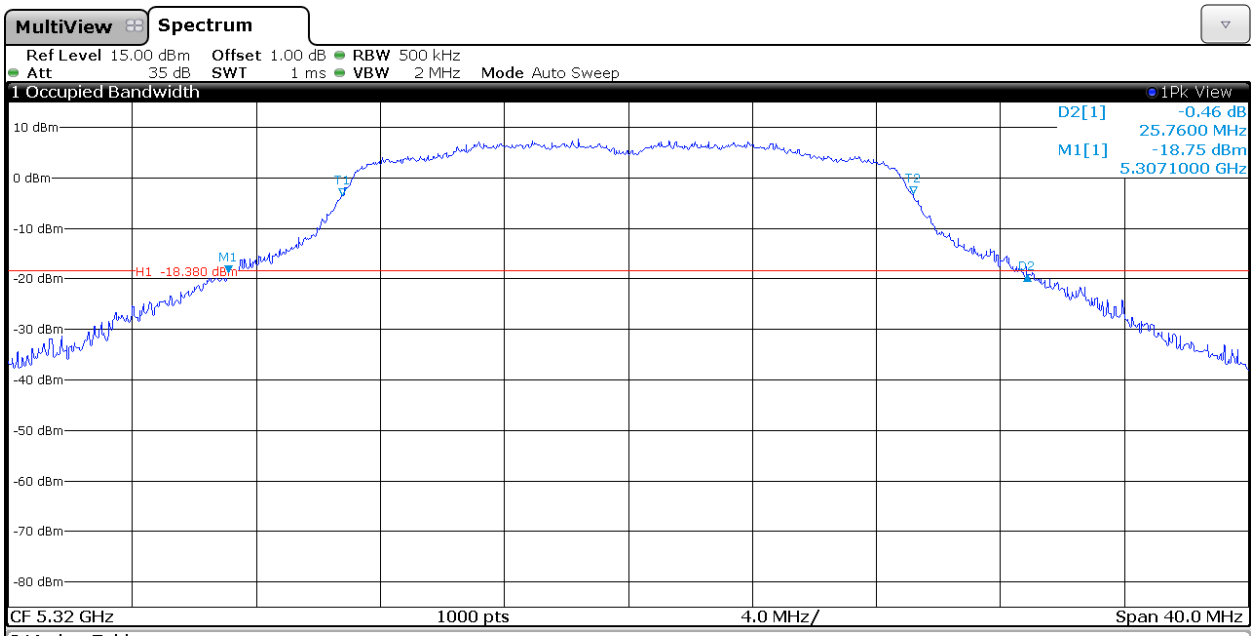
Middle Channel



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.28706 GHz**	**-16.52 dBm**		
T1		1	5.29074 GHz	-1.25 dBm	Occ Bw	**18.48 MHz**
T2		1	5.30922 GHz	-2.02 dBm		
D2	M1	1	**26.52 MHz**	**-0.70 dB**		

Highest Channel

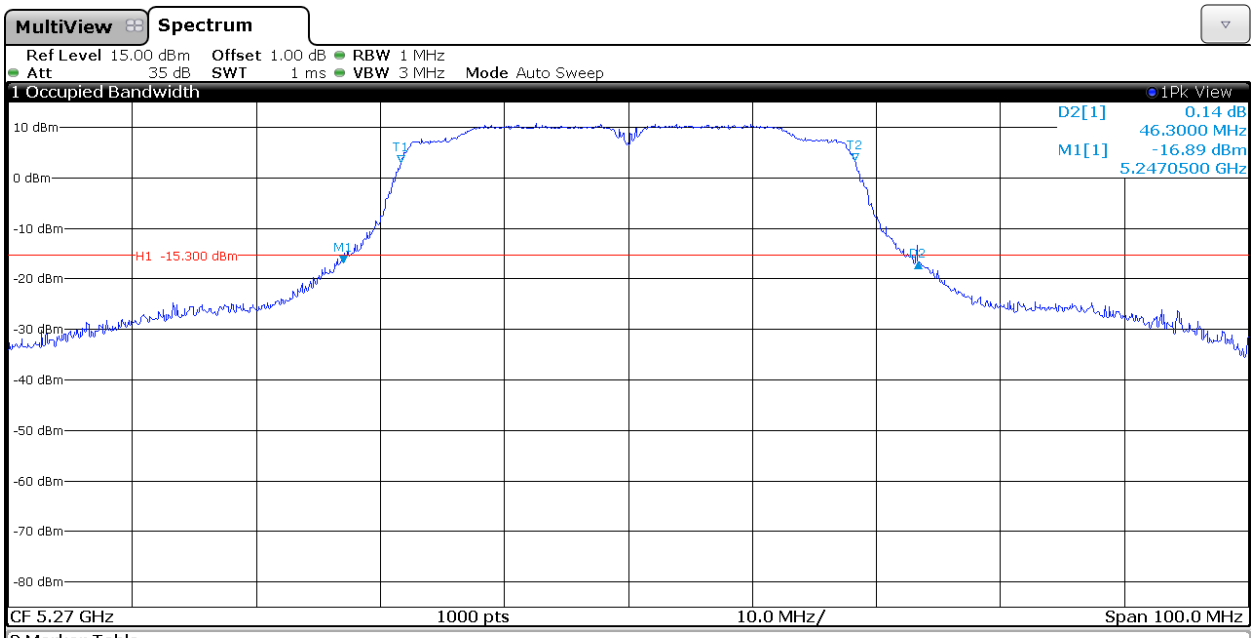


2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.3071 GHz**	**-18.75 dBm**		
T1		1	5.31078 GHz	-3.57 dBm	Occ Bw	**18.4 MHz**
T2		1	5.32918 GHz	-3.19 dBm		
D2	M1	1	**25.76 MHz**	**-0.46 dB**		

802.11 n40 MHz and 802.11 ac 40 MHz modes CHAIN A

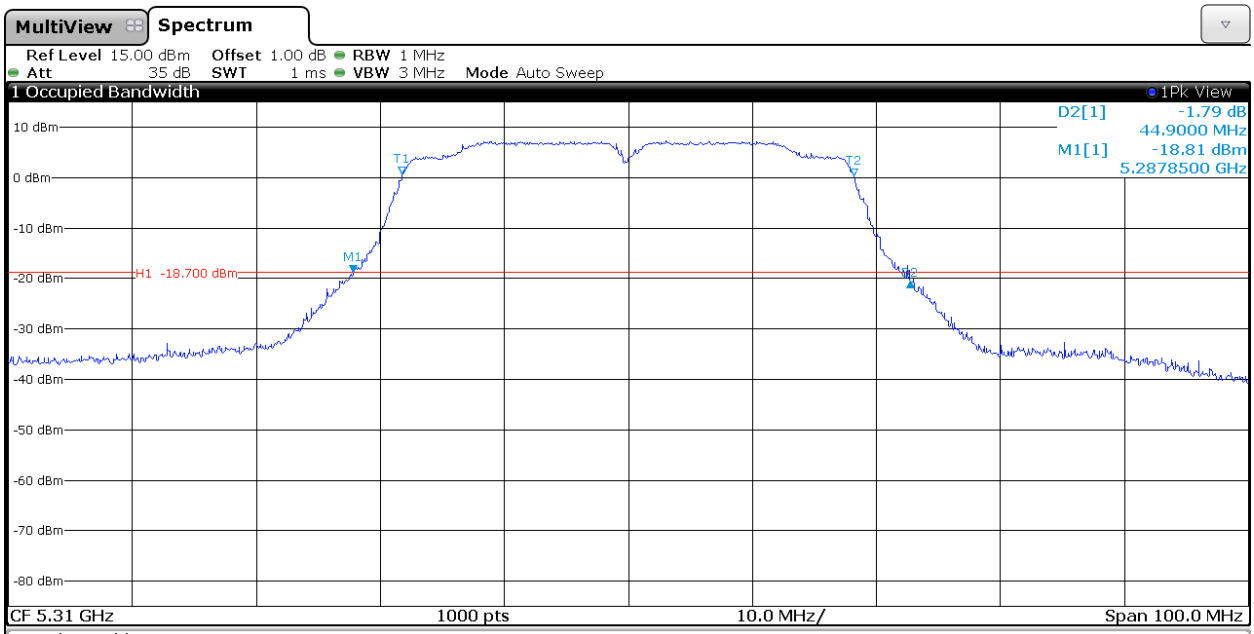
Lowest Channel



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.24705 GHz**	**-16.89 dBm**		
T1		1	5.25165 GHz	3.01 dBm	Occ Bw	**36.6 MHz**
T2		1	5.28825 GHz	3.48 dBm		
D2	M1	1	**46.3 MHz**	**0.14 dB**		

Highest Channel

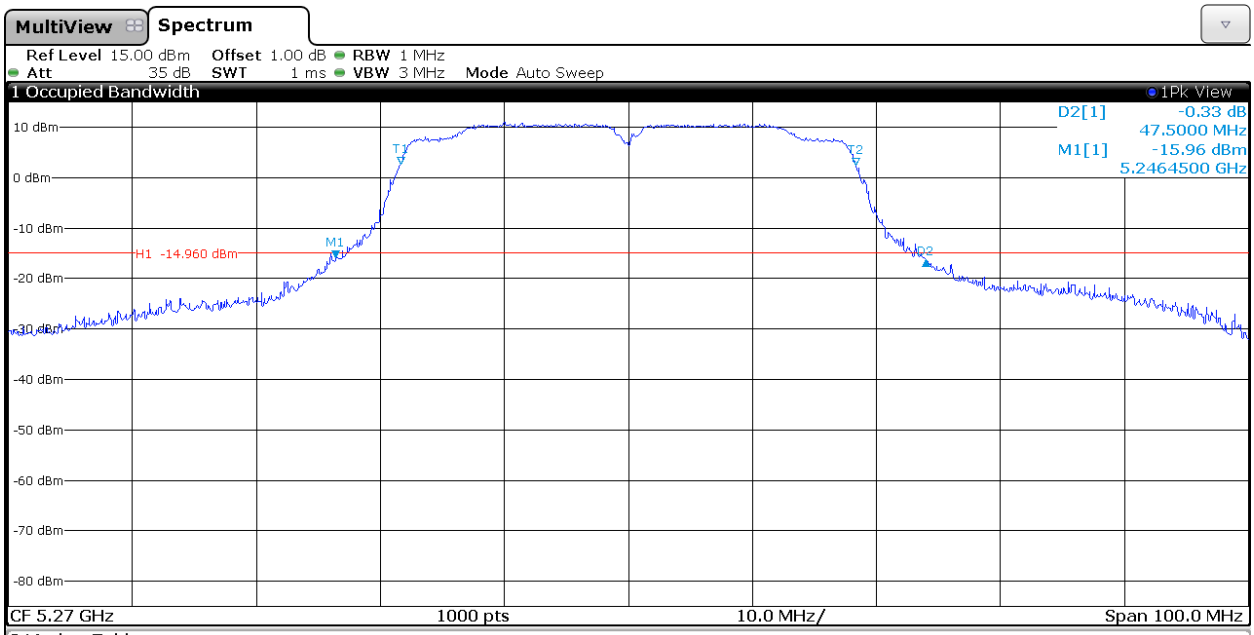


2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.28785 GHz**	**-18.81 dBm**		
T1		1	5.29175 GHz	0.74 dBm	Occ Bw	**36.4 MHz**
T2		1	5.32815 GHz	0.32 dBm		
D2	M1	1	**44.9 MHz**	**-1.79 dB**		

802.11 n40 MHz and 802.11 ac 40 MHz modes CHAIN B

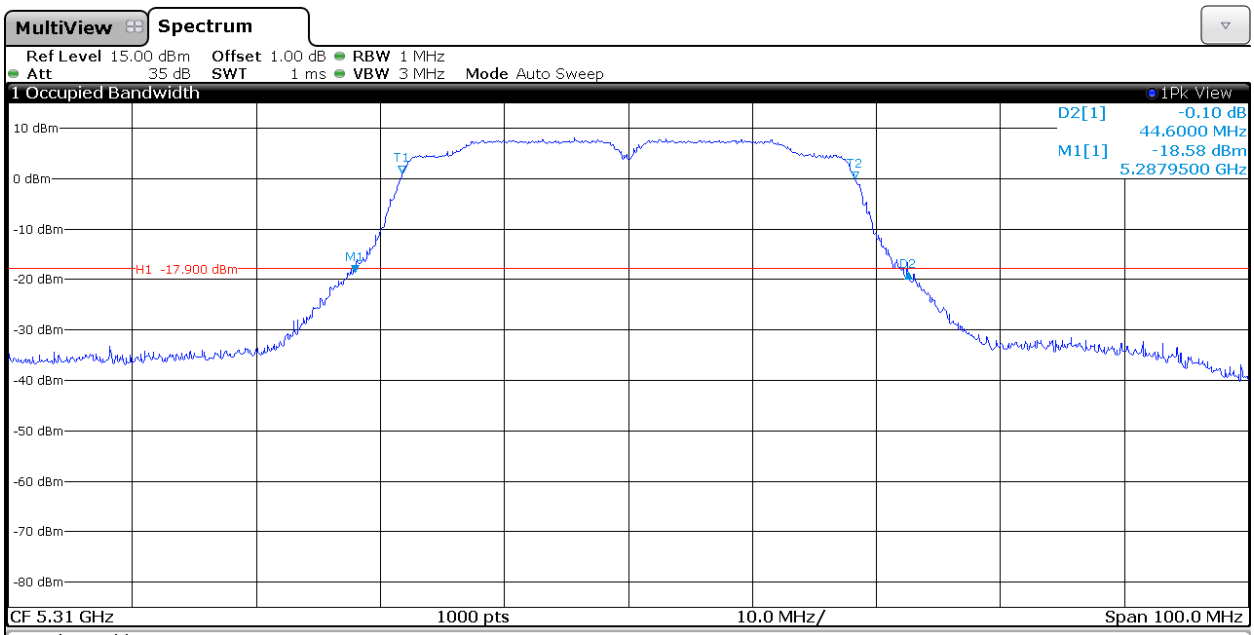
Lowest Channel



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.24645 GHz**	**-15.96 dBm**		
T1		1	5.25165 GHz	2.58 dBm	Occ Bw	**36.7 MHz**
T2		1	5.28835 GHz	2.40 dBm		
D2	M1	1	**47.5 MHz**	**-0.33 dB**		

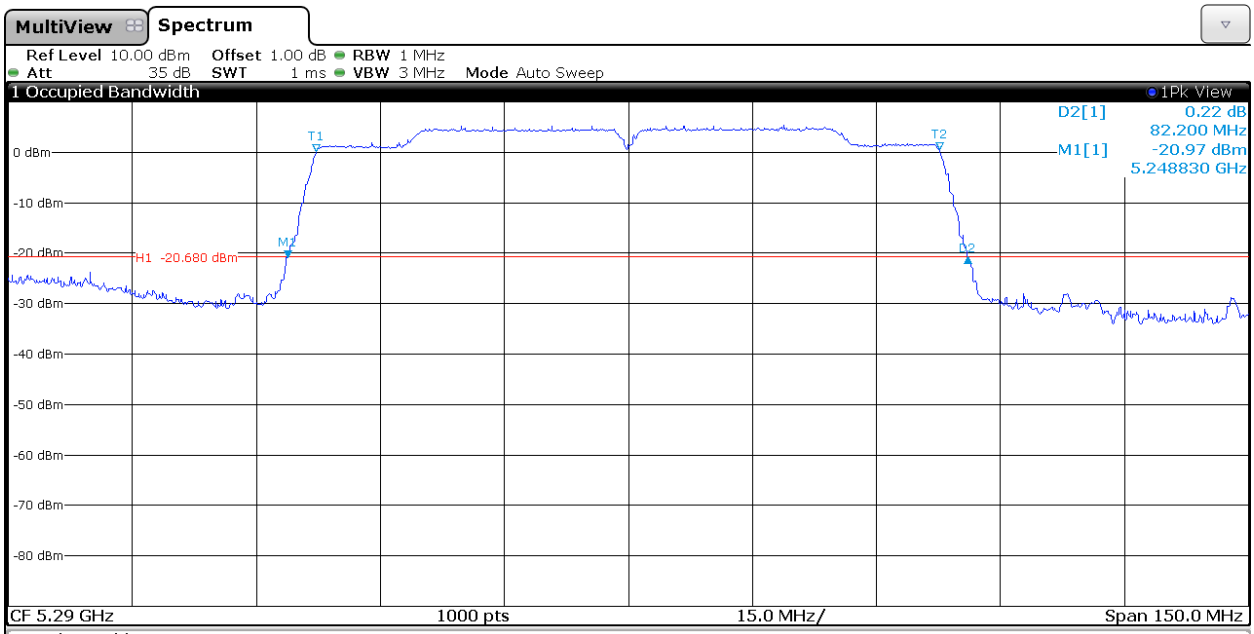
Highest Channel



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.28795 GHz**	**-18.58 dBm**		
T1		1	5.29175 GHz	1.02 dBm	Occ Bw	**36.5 MHz**
T2		1	5.32825 GHz	-0.15 dBm		
D2	M1	1	**44.6 MHz**	**-0.10 dB**		

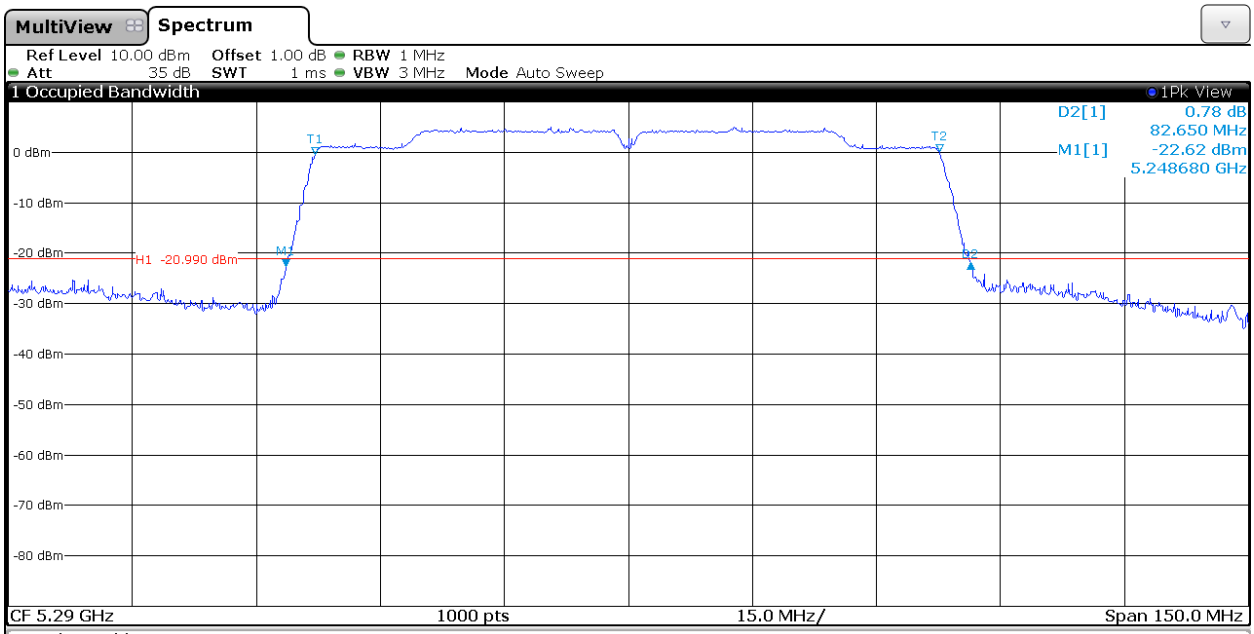
802.11 ac 80 MHz mode CHAIN A



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.24883 GHz**	**-20.97 dBm**		
T1		1	5.252275 GHz	0.10 dBm	Occ Bw	**75.3 MHz**
T2		1	5.327575 GHz	0.53 dBm		
D2	M1	1	**82.2 MHz**	**0.22 dB**		

802.11 ac 80 MHz mode CHAIN B



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.24868 GHz**	**-22.62 dBm**		
T1		1	5.252125 GHz	-0.37 dBm	Occ Bw	**75.45 MHz**
T2		1	5.327575 GHz	0.07 dBm		
D2	M1	1	**82.65 MHz**	**0.78 dB**		

Section 15.407 Subclause (a) (2) / RSS-210 A9.2. (2). Maximum output power, Peak power spectral density and antenna gain

SPECIFICATION

FCC 15.407: For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW (23.98 dBm) or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the peak power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS-210: The maximum conducted output power shall not exceed 250 mW (23.98 dBm) or 11 + 10 log10 B, dBm, whichever power is less. The power spectral density shall not exceed 11dBm in any 1.0 MHz band. The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10log B, dBm, whichever power is less. B is the 99% emission bandwidth in MHz.

Within the emission bandwidth, when the peak spectral density per MHz over any continuous transmission exceeds the average (10 log10 B) value by more than 3 dB, the permissible power spectral density shall be reduced by the excess amount.

RESULTS

The maximum conducted output power was measured using the channel power integration method according to point E) 2) b) (Method SA-1) of Guidance 789033 D01.

In the measure-and-sum approach for MIMO mode, the conducted emission level (*e.g.,* transmit power or power in specified bandwidth) is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in linear power units (mW—not dBm).

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

The peak power spectral density (PPSD) was measured using the method according to point F) (Method SA-1) of Guidance 789033 D01.

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

For MIMO mode, the Measure and add 10 log(NANT) dB, (where NANT is the number of outputs) technique was used according to the Guidance for Emission Testing of Transmitters with Multiple Outputs in the Same Band 662911 D01 Multiple Transmitter Output v02r01 dated 10/31/2013.
With this technique, spectrum measurements are performed at each output of the device, and the quantity 10 log(NANT) dB is added to each spectrum value before comparing to the emission limit. Number of outputs = 2.

The number of transmit antennas (N_{ANT}) are 2 and the number of spatial streams (Nss) are 2 and therefore the Array Gain is 0 dB.

1. 802.11a mode (see next plots).

CHAIN A Maximum declared antenna gain = 3.7 dBi

Frequency	Maximum conducted output power (dBm)	Maximum output power e.i.r.p. (dBm)	PPSD/MHz (dBm)	PPSD/MHz e.i.r.p. (dBm)
5260 MHz	15.49	19.19	5.18	8.88
5300 MHz	15.33	19.03	4.95	8.65
5320 MHz	13.18	16.88	2.81	6.51

CHAIN B Maximum declared antenna gain = 3.7 dBi

Frequency	Maximum conducted output power (dBm)	Maximum output power e.i.r.p. (dBm)	PPSD/MHz (dBm)	PPSD/MHz e.i.r.p. (dBm)
5260 MHz	15.90	19.60	5.50	9.20
5300 MHz	15.70	19.40	5.16	8.86
5320 MHz	13.21	16.91	2.76	6.46

Measurement uncertainty = ±1.2 dB

Verdict: PASS

2. 802.11 n20 MHz and 802.11 ac 20 MHz modes. (see next plots).

Note: the test was performed with 802.11 n20 MHz mode which is the same modulation scheme as 802.11 ac 20 MHz.

CHAIN A Maximum declared antenna gain = 3.7 dBi

Frequency	Maximum conducted output power (dBm)	Maximum output power e.i.r.p. (dBm)	PPSD/MHz (dBm)	PPSD/MHz e.i.r.p. (dBm)
5260 MHz	15.28	18.98	4.62	8.32
5300 MHz	15.67	19.37	5.23	8.93
5320 MHz	13.28	16.98	2.83	6.53

CHAIN B Maximum declared antenna gain = 3.7 dBi

Frequency	Maximum conducted output power (dBm)	Maximum output power e.i.r.p. (dBm)	PPSD/MHz (dBm)	PPSD/MHz e.i.r.p. (dBm)
5260 MHz	15.81	19.51	5.20	8.90
5300 MHz	15.81	19.51	5.26	8.96
5320 MHz	13.21	16.91	2.64	6.34

MIMO CHAIN A+B. MAXIMUM OUTPUT POWER

Maximum declared antenna gain = 3.7 dBi

Frequency	Maximum conducted output power Chain A (dBm)	Maximum conducted output power Chain B (dBm)	Total conducted output power (dBm) A+B	Total output power e.i.r.p. (dBm) A+B
5260 MHz	13.60	13.73	16.67	20.37
5300 MHz	13.70	13.69	16.70	20.40
5320 MHz	11.61	11.60	14.62	18.32

MIMO CHAIN A+B. PPSD/MHz

Maximum declared antenna gain = 3.7 dBi

Frequency	PPSD/MHz Chain A (dBm)	PPSD/MHz Chain B (dBm)	Total PPSD/MHz Chain A (dBm)[1]	Total PPSD/MHz Chain B (dBm)[1]	Total PPSD/MHz Chain A e.i.r.p. (dBm)	Total PPSD/MHz Chain B e.i.r.p. (dBm)
5260 MHz	3.15	3.27	6.16	6.28	9.86	9.98
5300 MHz	3.19	3.11	6.20	6.12	9.90	9.82
5320 MHz	1.22	1.05	4.23	4.06	7.93	7.76

Note 1: The quantity 10*log 2 (two antennas) is added to the spectrum peak value according to document 662911 D01.

Measurement uncertainty = ±1.2 dB

Verdict: Pass

3. 802.11 n40 MHz and 802.11 ac 40 MHz modes. (see next plots).

Note: the test was performed with 802.11 n40 MHz mode which is the same modulation scheme as 802.11 ac 40 MHz.

CHAIN A Maximum declared antenna gain = 3.7 dBi

Frequency	Maximum conducted output power (dBm)	Maximum output power e.i.r.p. (dBm)	PPSD/MHz (dBm)	PPSD/MHz e.i.r.p. (dBm)
5270 MHz	16.21	19.91	2.34	6.04
5310 MHz	13.21	16.91	-0.65	3.05

CHAIN B Maximum declared antenna gain = 3.7 dBi

Frequency	Maximum conducted output power (dBm)	Maximum output power e.i.r.p. (dBm)	PPSD/MHz (dBm)	PPSD/MHz e.i.r.p. (dBm)
5270 MHz	16.21	19.91	2.39	6.09
5310 MHz	13.15	16.85	-0.70	3.00

MIMO CHAIN A+B. MAXIMUM OUTPUT POWER

Maximum declared antenna gain = 3.7 dBi

Frequency	Maximum conducted output power Chain A (dBm)	Maximum conducted output power Chain B (dBm)	Total conducted output power (dBm) A+B	Total output power e.i.r.p. (dBm) A+B
5270 MHz	16.48	16.77	19.64	23.34
5310 MHz	11.62	11.51	14.58	18.28

Measurement uncertainty = ±1.2 dB

Verdict: Pass

MIMO CHAIN A+B. PPSD/MHz

Maximum declared antenna gain = 3.7 dBi

Frequency	PPSD/MHz Chain A (dBm)	PPSD/MHz Chain B (dBm)	Total PPSD/MHz Chain A (dBm)[1]	Total PPSD/MHz Chain B (dBm)[1]	Total PPSD/MHz Chain A e.i.r.p. (dBm)	Total PPSD/MHz Chain B e.i.r.p. (dBm)
5270 MHz	2.86	2.97	5.87	5.98	9.57	9.68
5310 MHz	-2.23	-2.12	0.78	0.89	4.48	4.59

Note 1: The quantity 10*log 2 (two antennas) is added to the spectrum peak value according to document 662911 D01.

Measurement uncertainty = ±1.2 dB

Verdict: Pass

4. 802.11 ac 80 MHz mode. (see next plots).

CHAIN A Maximum declared antenna gain = 3.7 dBi

Frequency	Maximum conducted output power (dBm)	Maximum output power e.i.r.p. (dBm)	PPSD/MHz (dBm)	PPSD/MHz e.i.r.p. (dBm)
5290 MHz	13.20	16.90	-3.47	0.23

CHAIN B Maximum declared antenna gain = 3.7 dBi

Frequency	Maximum conducted output power (dBm)	Maximum output power e.i.r.p. (dBm)	PPSD/MHz (dBm)	PPSD/MHz e.i.r.p. (dBm)
5290 MHz	13.32	17.02	-3.56	0.14

MIMO CHAIN A+B. MAXIMUM OUTPUT POWER

Maximum declared antenna gain = 3.7 dBi

Frequency	Maximum conducted output power Chain A (dBm)	Maximum conducted output power Chain B (dBm)	Total conducted output power (dBm)	Total output power e.i.r.p. (dBm)
5290 MHz	11.68	11.67	14.69	18.39

Measurement uncertainty = ±1.2 dB

Verdict: Pass

MIMO CHAIN A+B. PPSD/MHz

Maximum declared antenna gain = 3.7 dBi

Frequency	PPSD/MHz Chain A (dBm)	PPSD/MHz Chain B (dBm)	Total PPSD/MHz Chain A (dBm)[1]	Total PPSD/MHz Chain B (dBm)[1]	Total PPSD/MHz Chain A e.i.r.p. (dBm)	Total PPSD/MHz Chain B e.i.r.p. (dBm)
5290 MHz	-5.16	-5.24	-2.15	-2.23	1.55	1.47

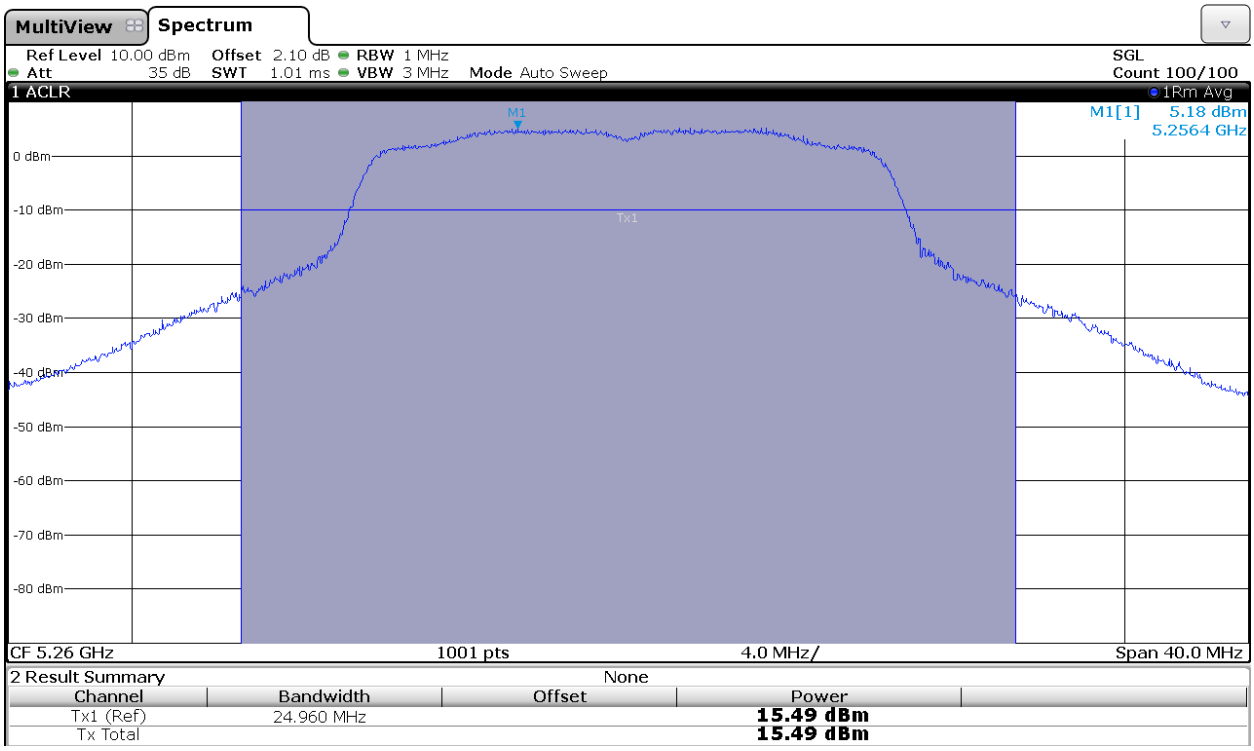
Note 1: The quantity 10*log 2 (two antennas) is added to the spectrum peak value according to document 662911 D01.

Measurement uncertainty = ±1.2 dB

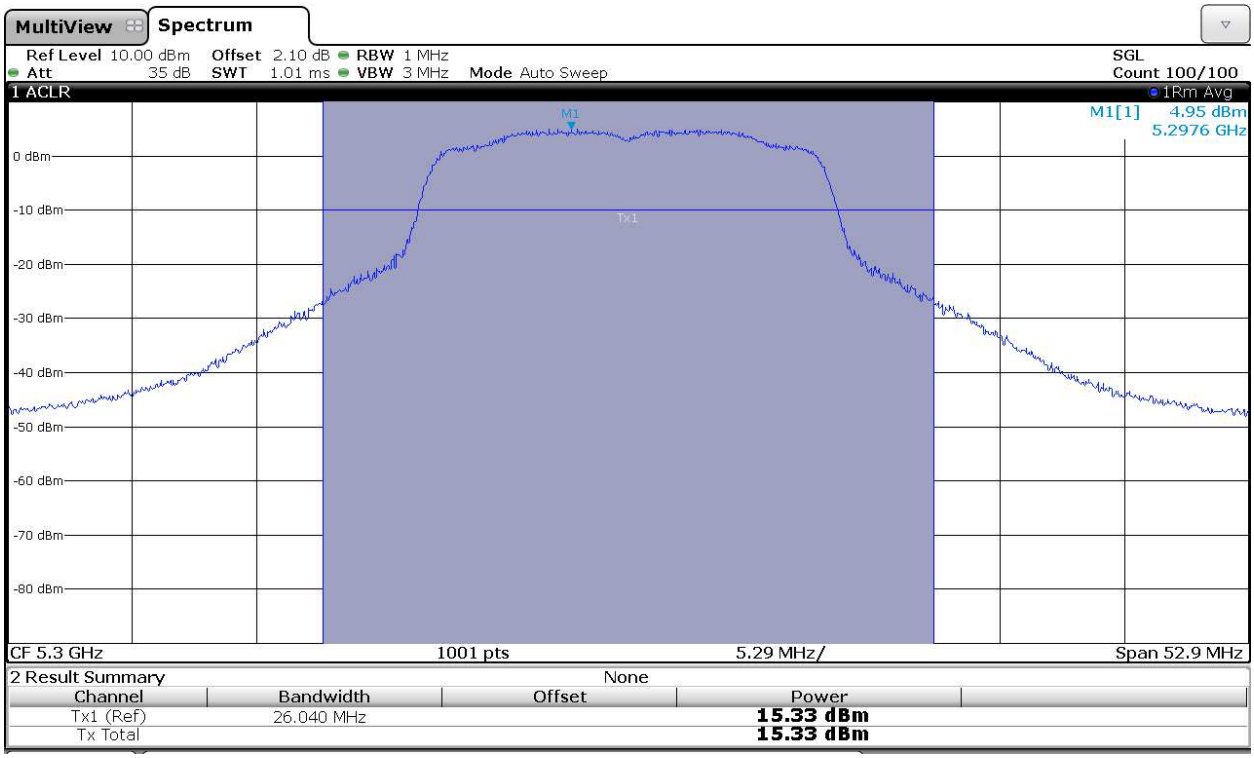
Verdict: Pass

802.11a mode CHAIN A

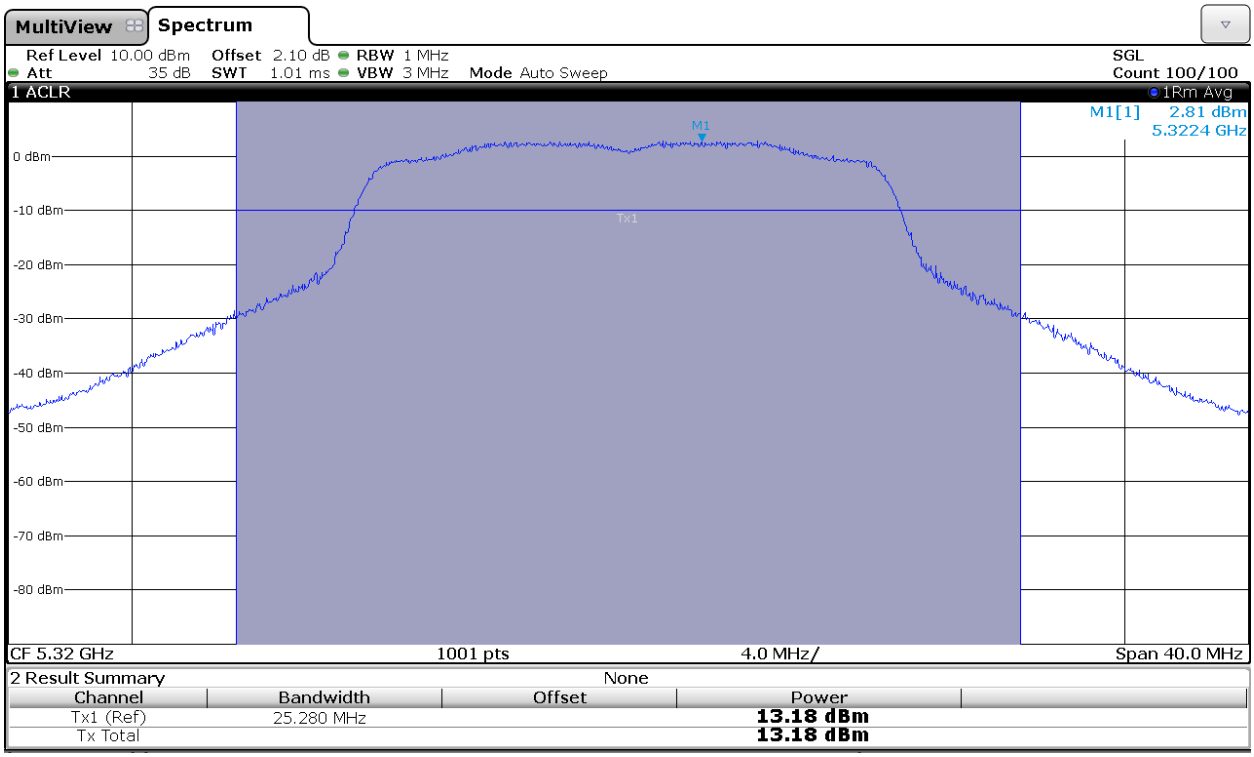
Lowest Channel



Middle Channel

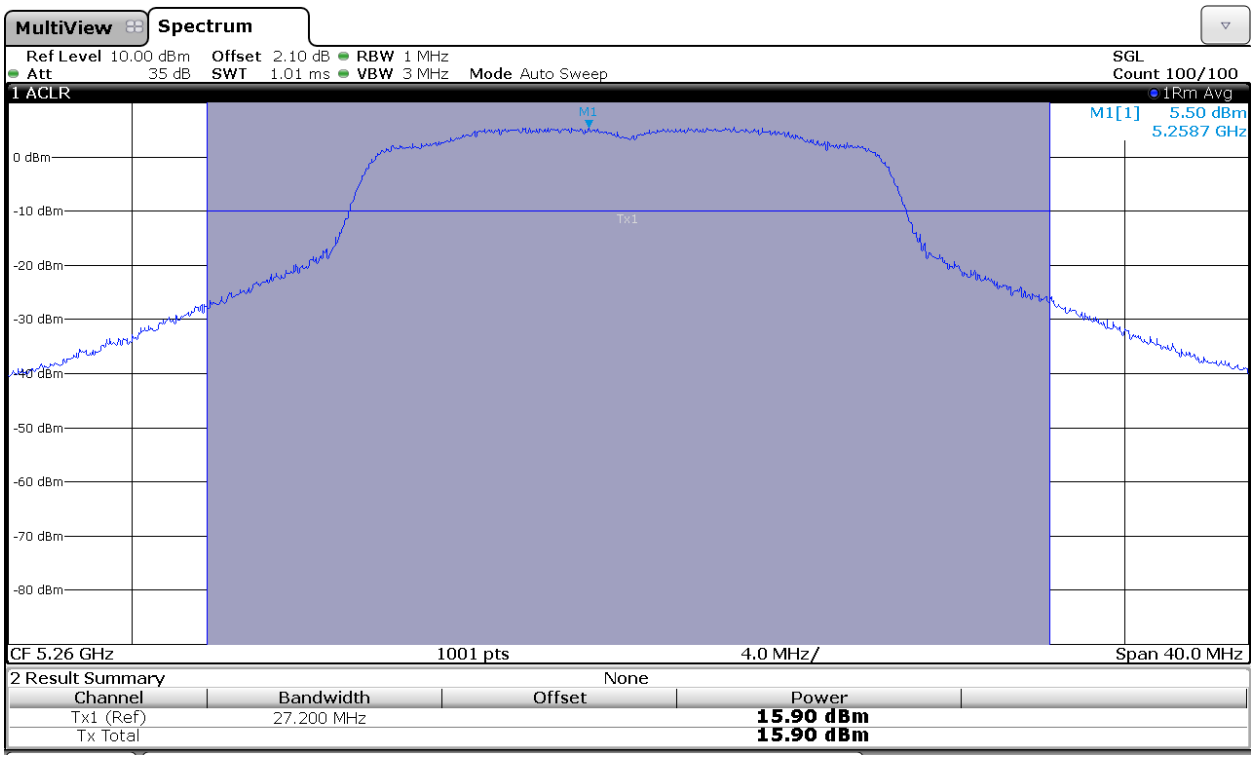


Highest Channel

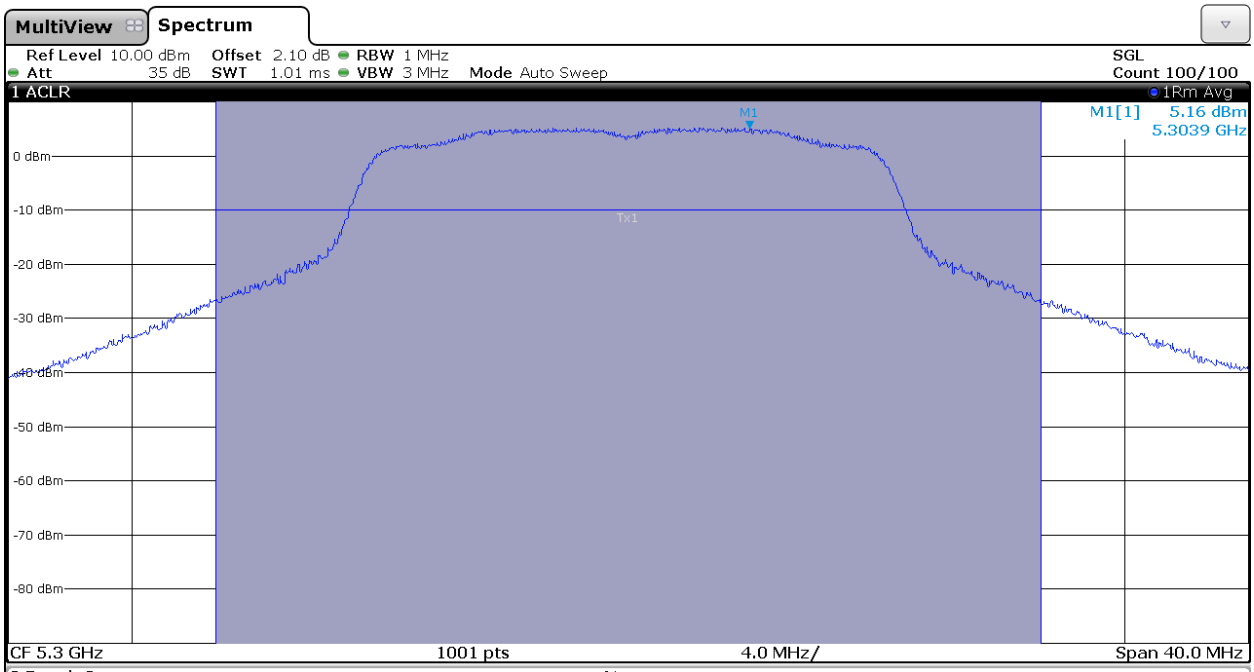


802.11a mode CHAIN B

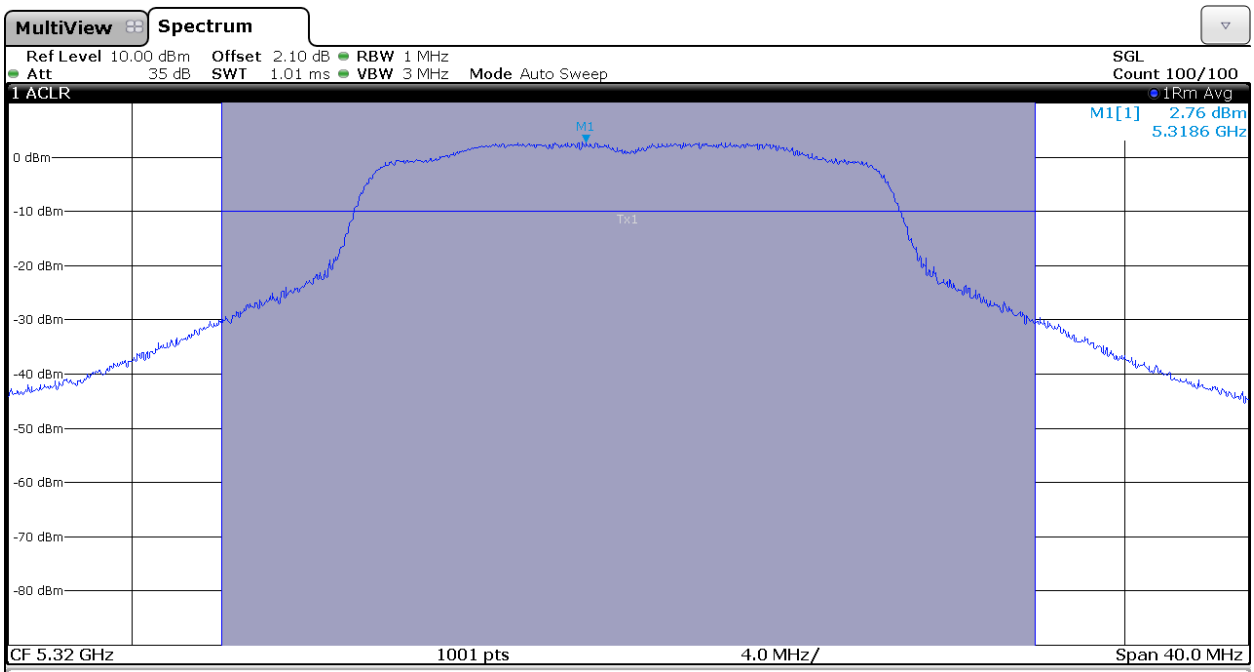
Lowest Channel



Middle Channel

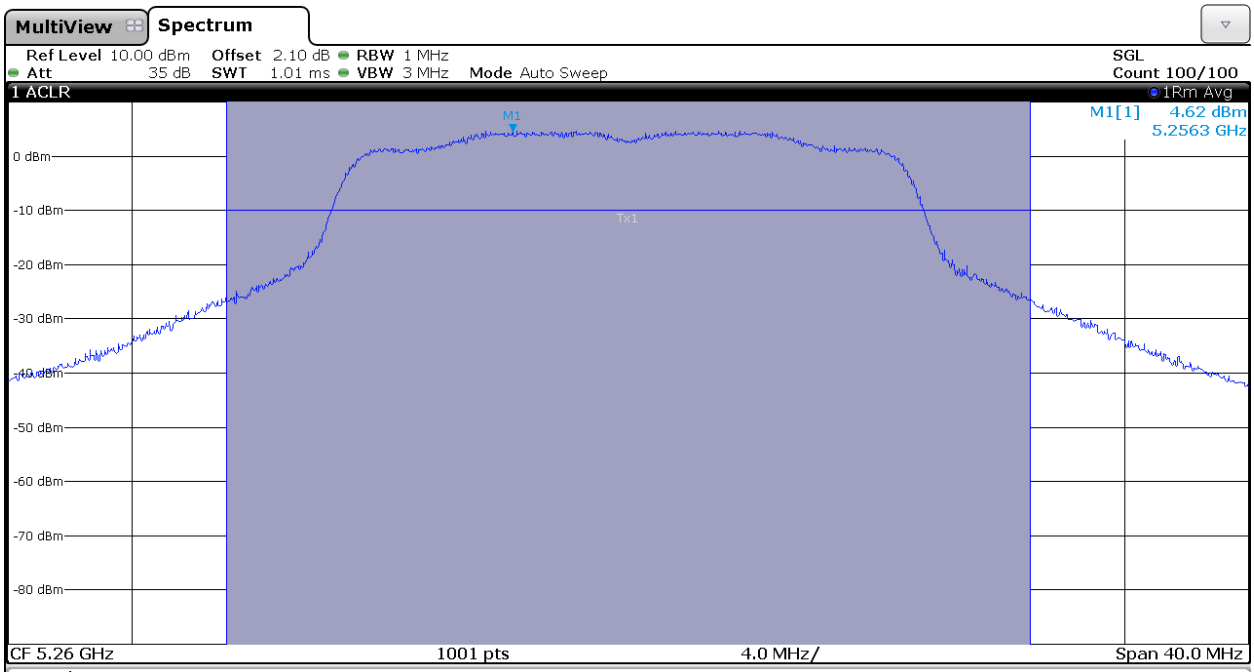


Highest Channel



802.11 n20 MHz and 802.11 ac 20 MHz modes CHAIN A

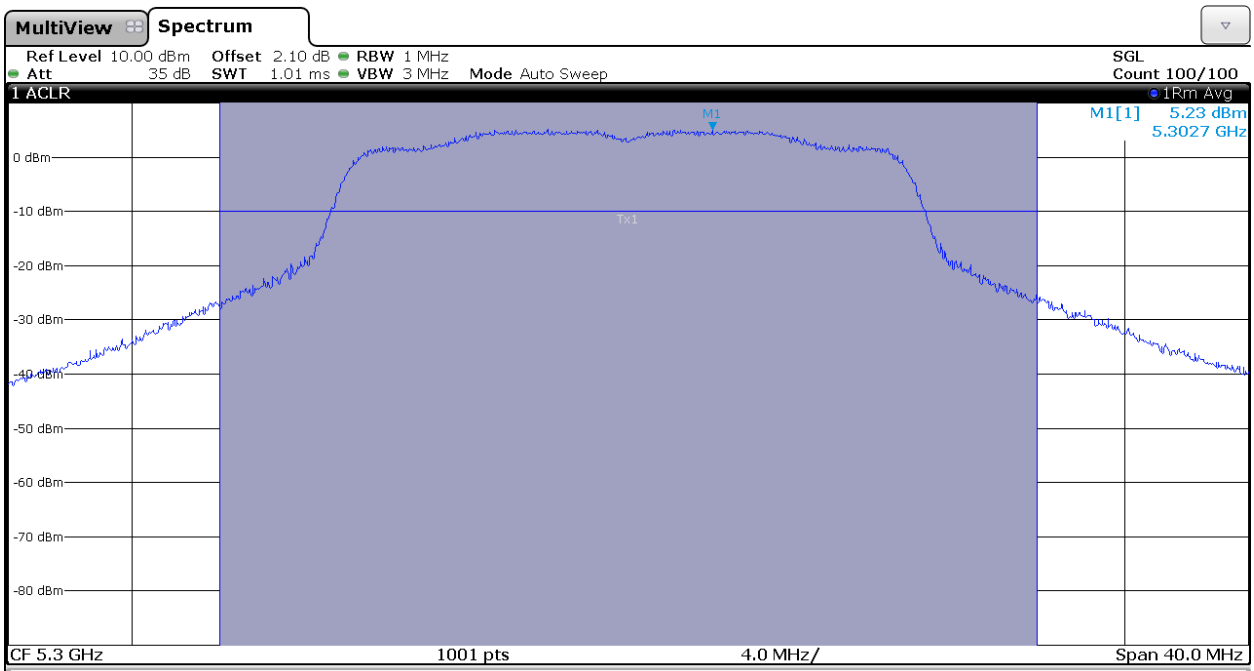
Lowest Channel



2 Result Summary None

Channel	Bandwidth	Offset	Power
Tx1 (Ref)	25.920 MHz		**15.28 dBm**
Tx Total			**15.28 dBm**

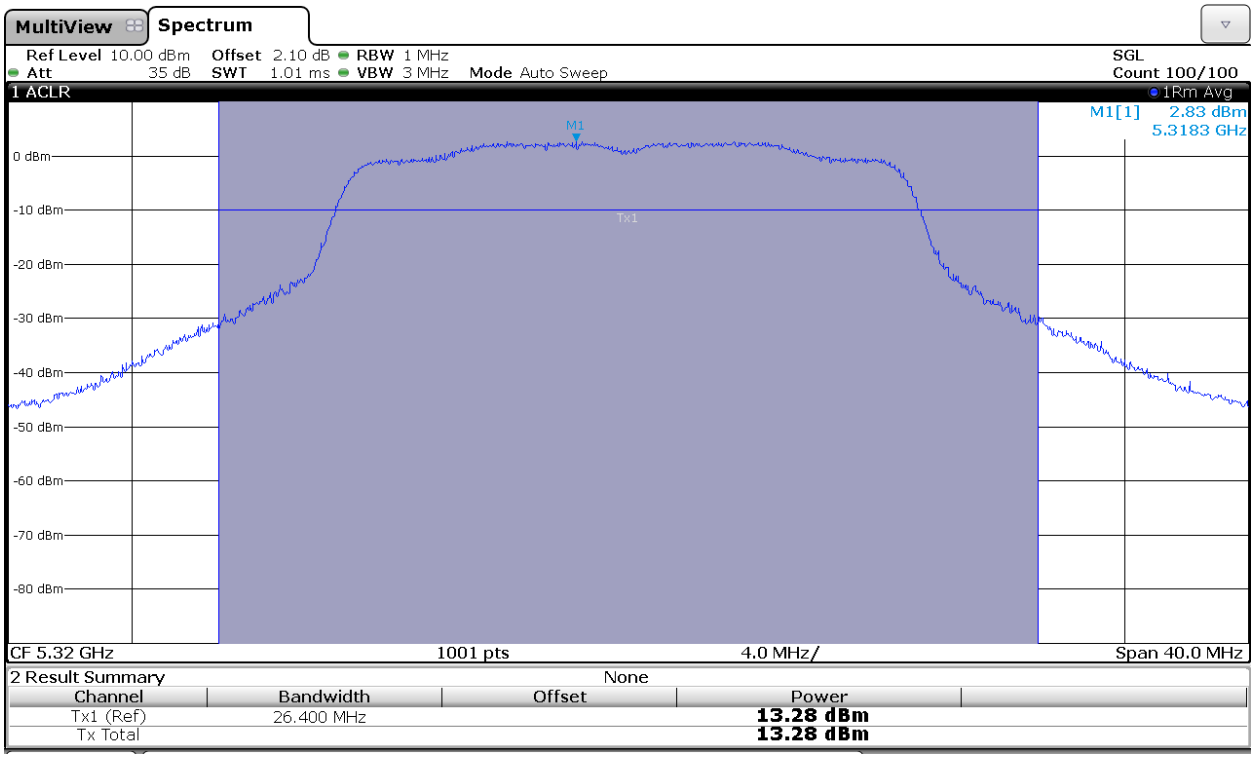
Middle Channel



2 Result Summary None

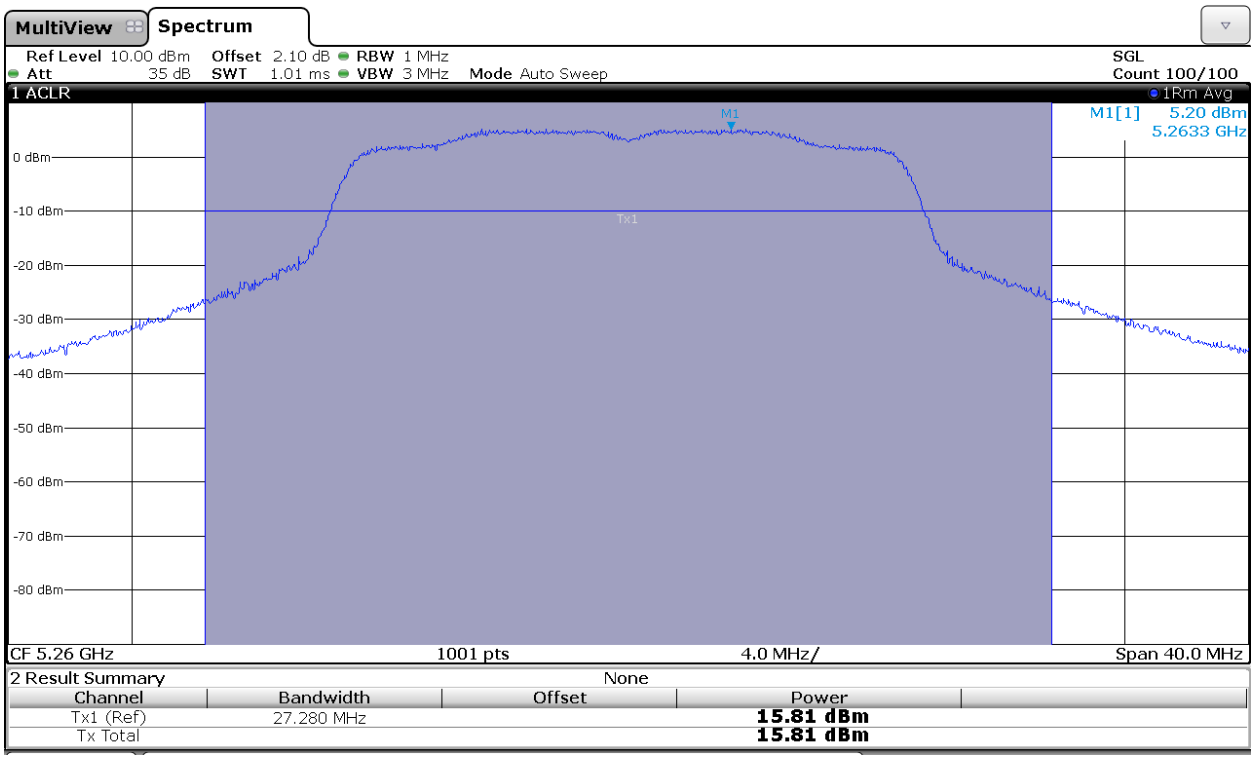
Channel	Bandwidth	Offset	Power
Tx1 (Ref)	26.360 MHz		**15.67 dBm**
Tx Total			**15.67 dBm**

Highest Channel

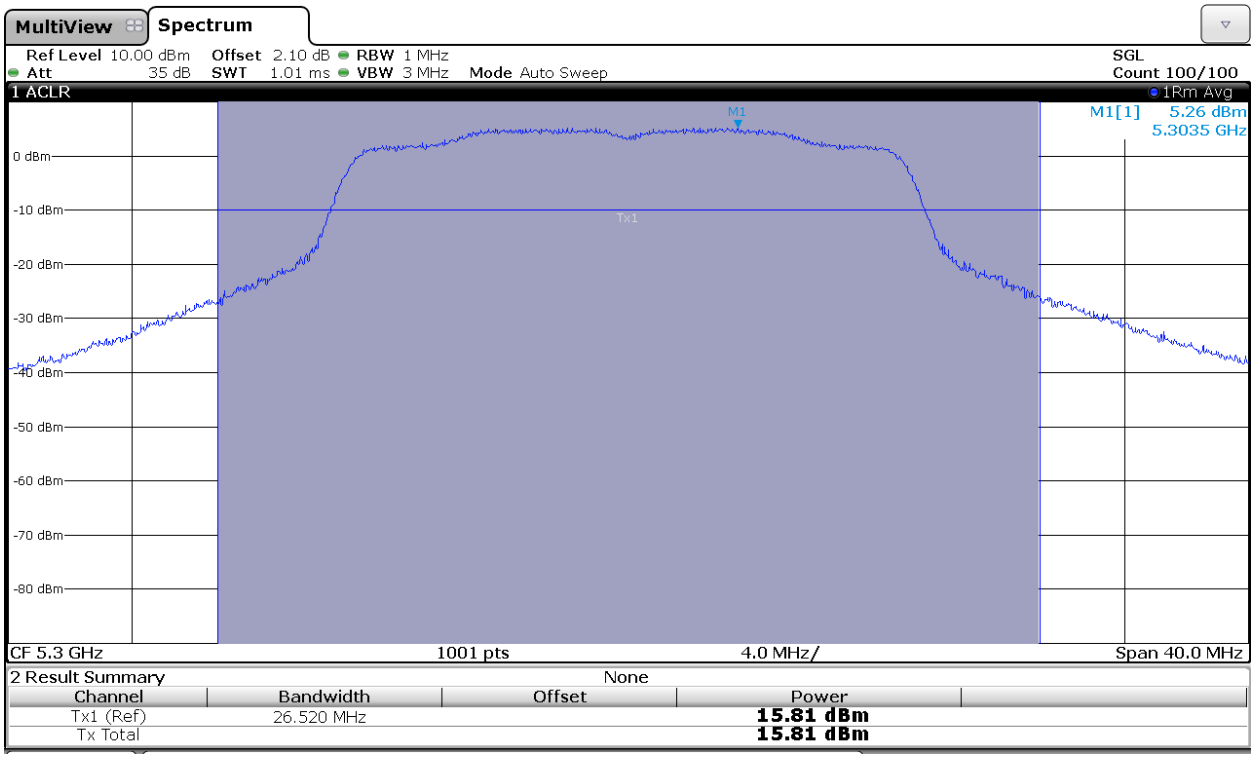


802.11 n20 MHz and 802.11 ac 20 MHz modes CHAIN B

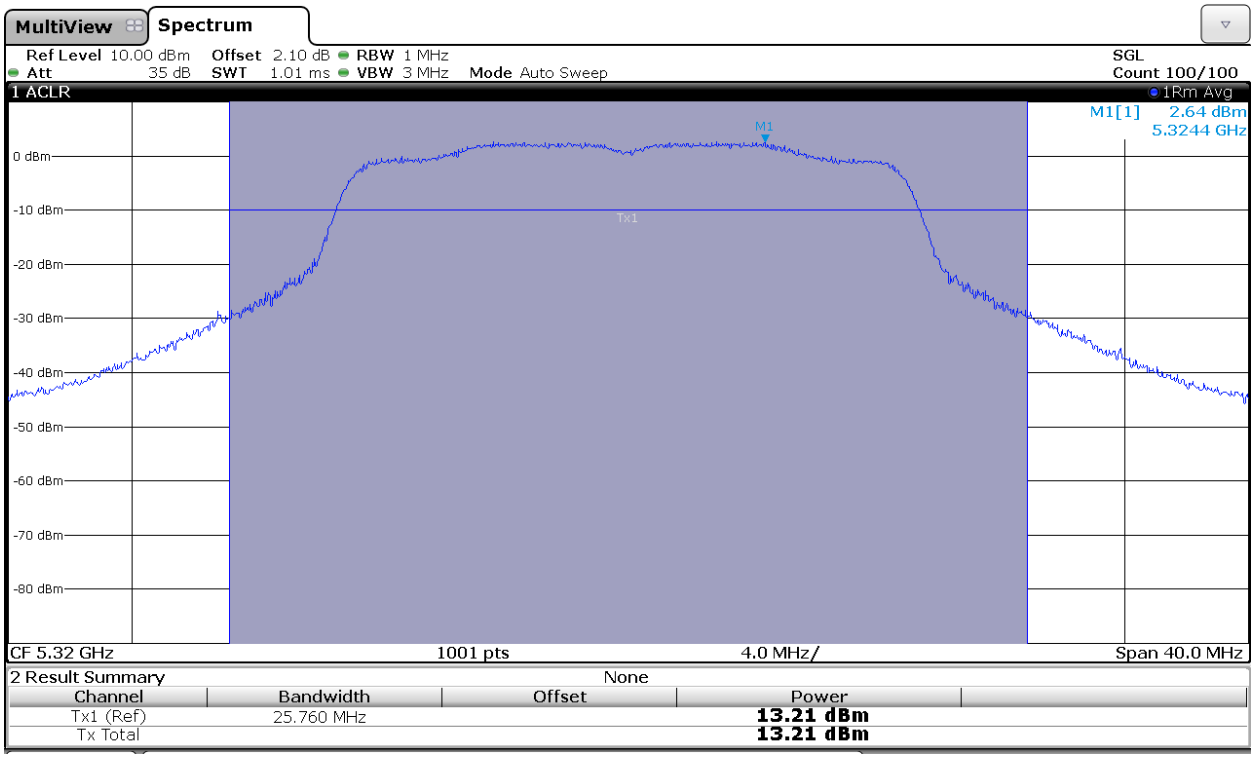
Lowest Channel



Middle Channel

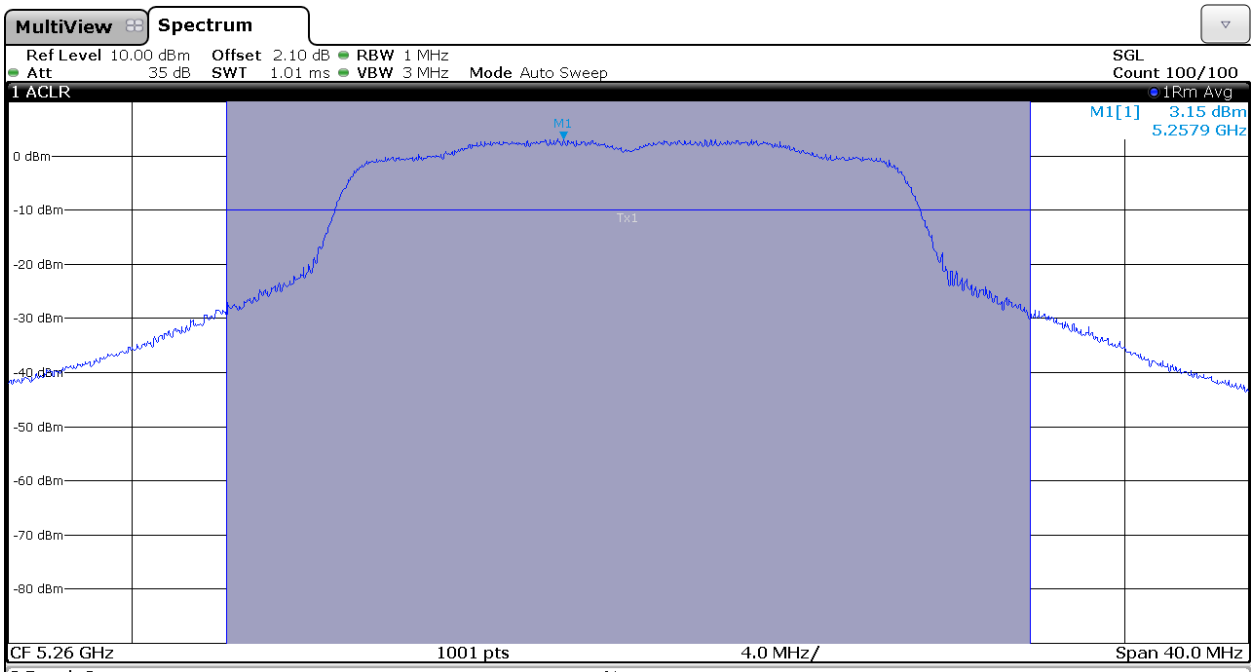


Highest Channel

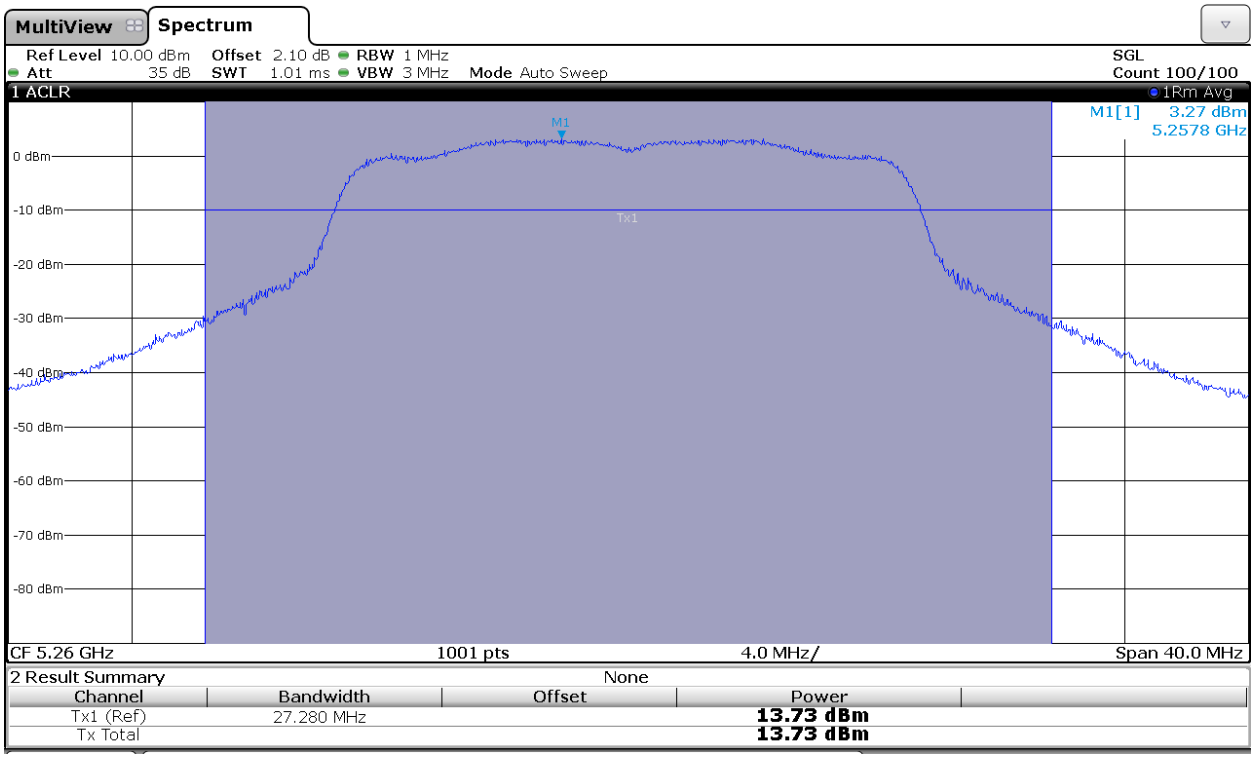


802.11 n20 MHz and 802.11 ac 20 MHz modes CHAIN A+B

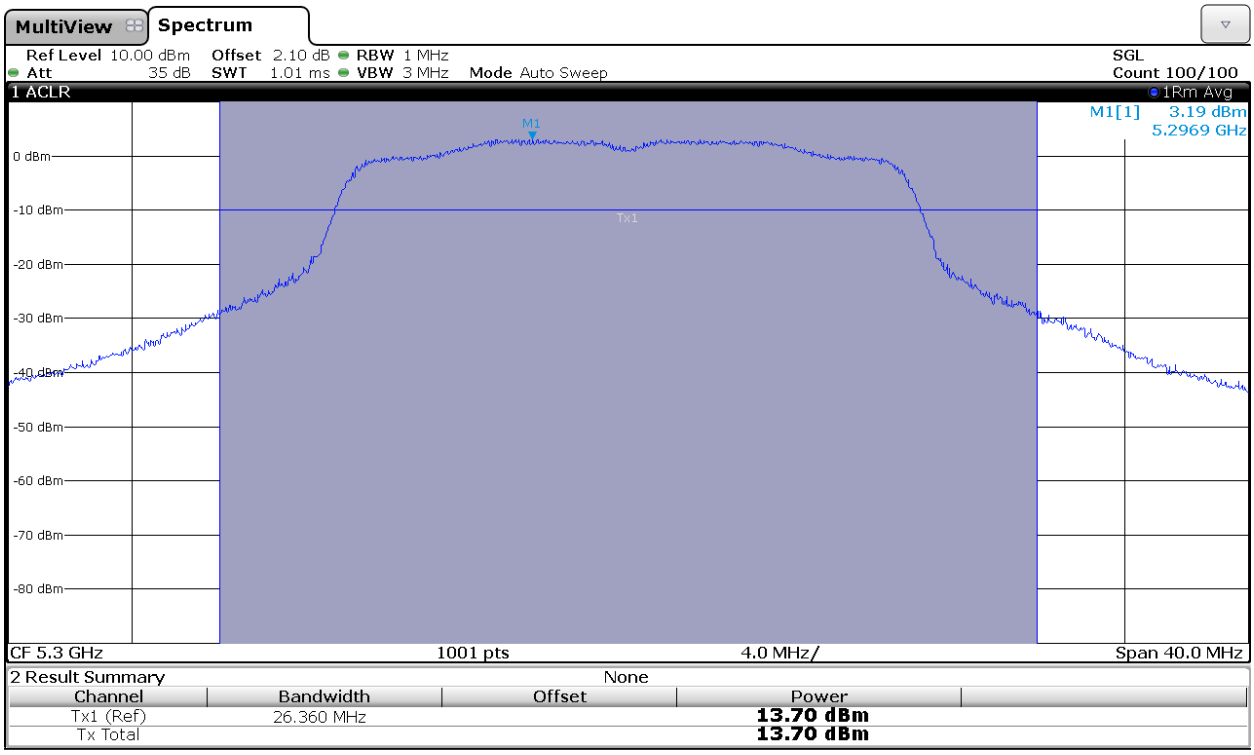
Lowest Channel. Chain A.



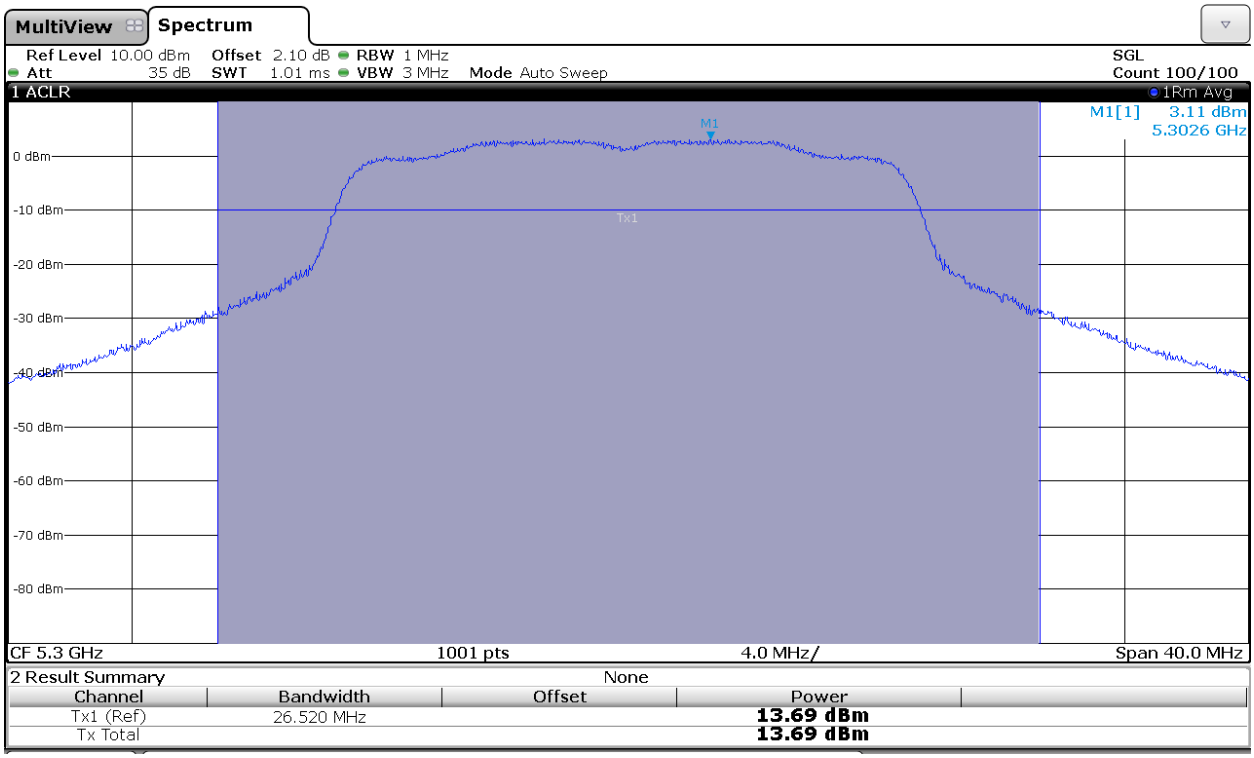
Lowest Channel. Chain B.



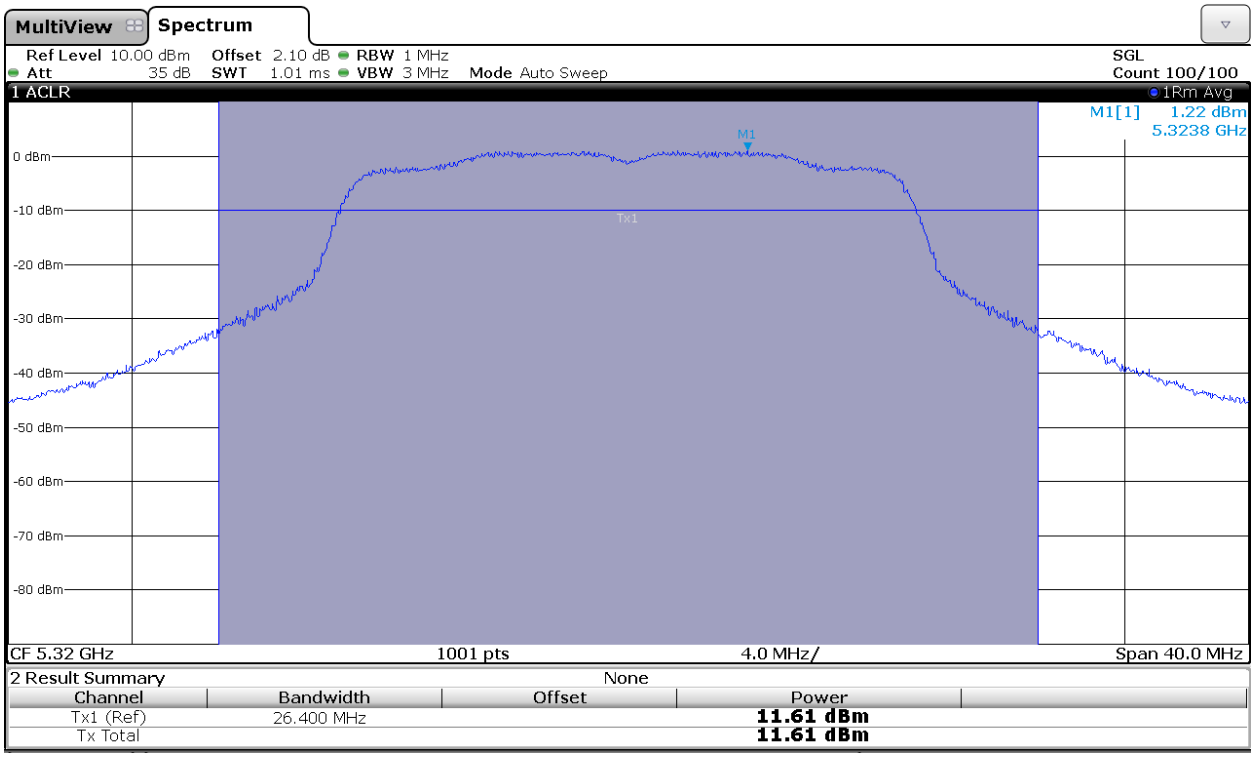
Middle Channel. Chain A.



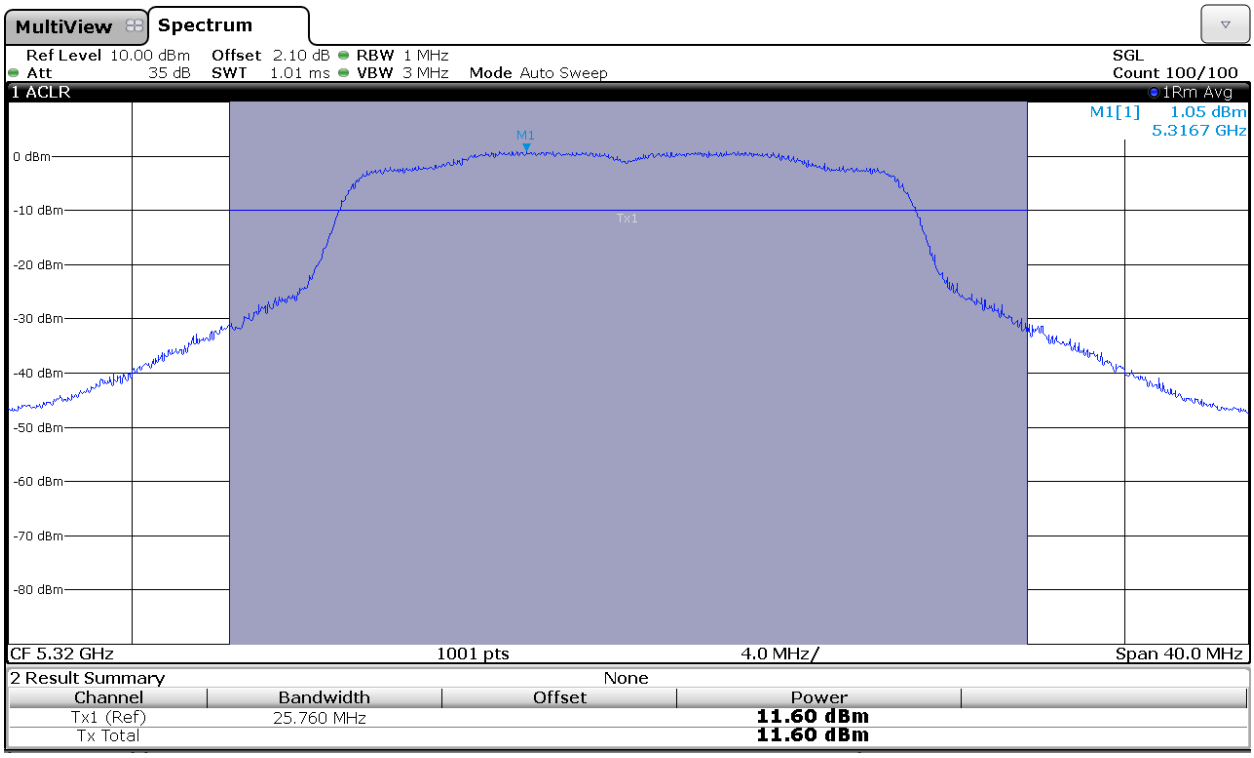
Middle Channel. Chain B.



Highest Channel. Chain A.

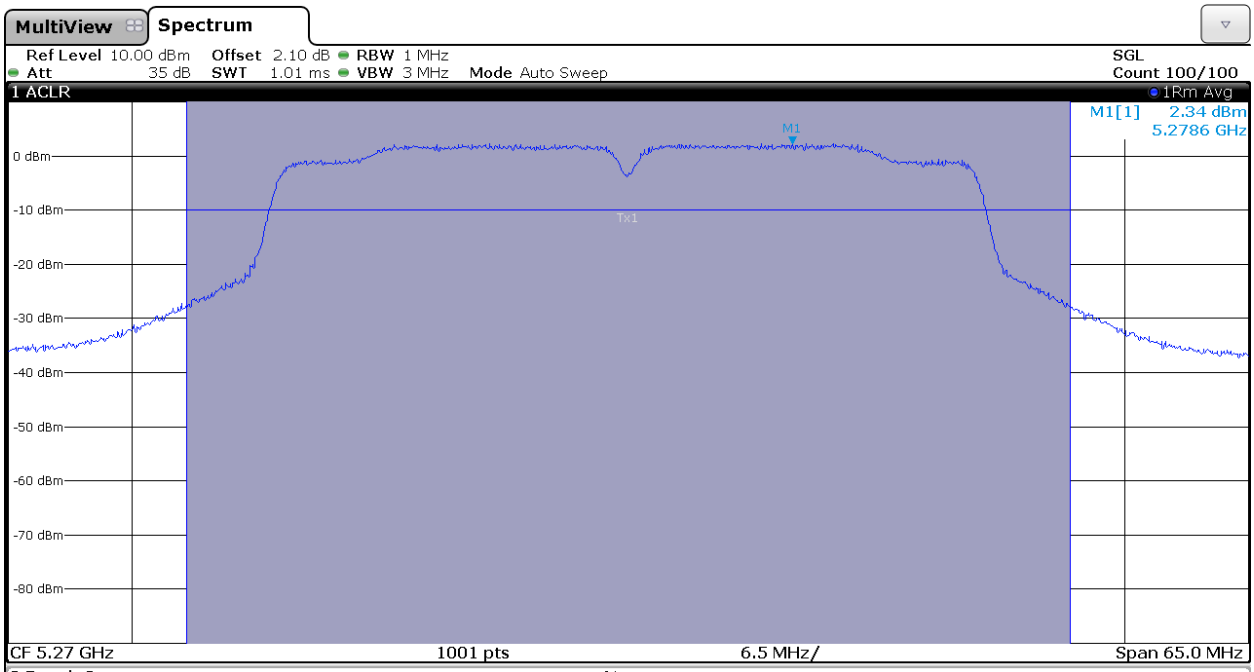


Highest Channel. Chain B.



802.11 n40 MHz and 802.11 ac 40 MHz modes CHAIN A

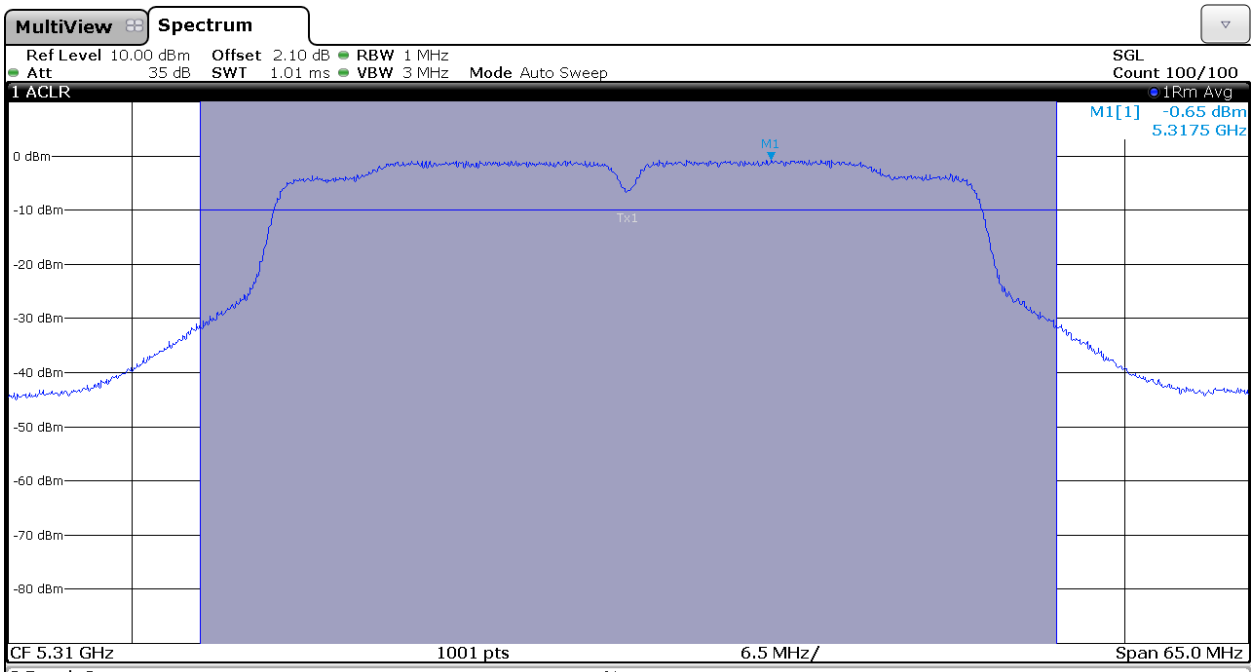
Lowest Channel



2 Result Summary None

Channel	Bandwidth	Offset	Power
Tx1 (Ref)	46.300 MHz		**16.21 dBm**
Tx Total			**16.21 dBm**

Highest Channel

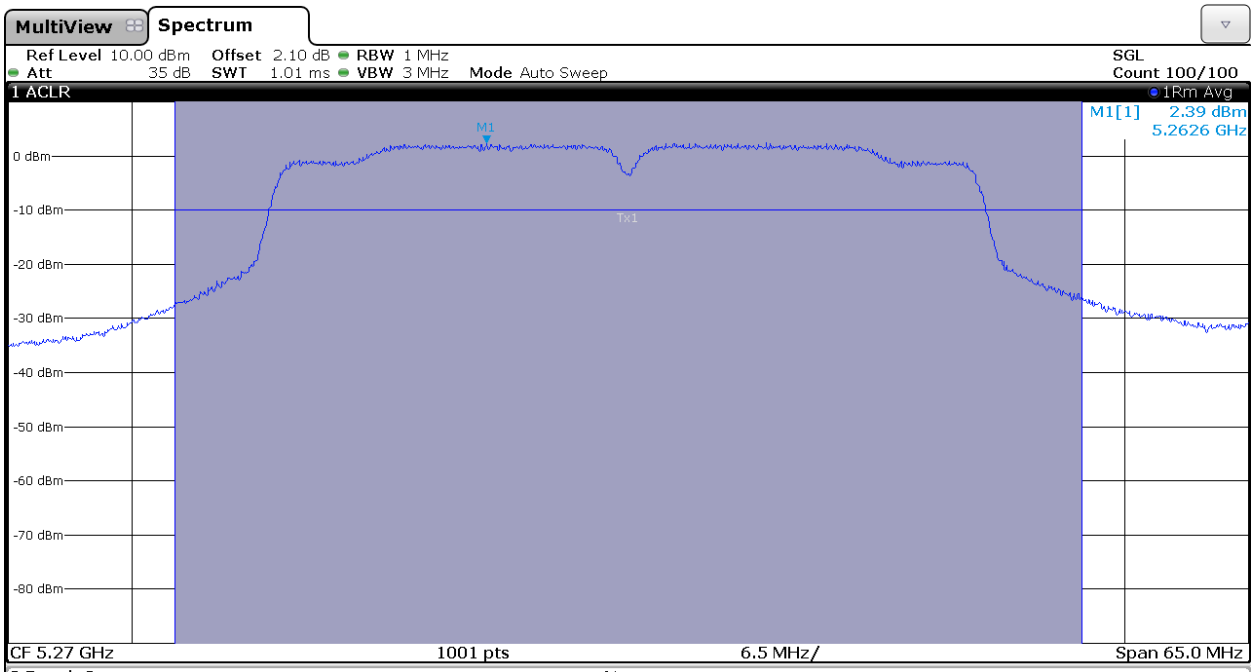


2 Result Summary None

Channel	Bandwidth	Offset	Power
Tx1 (Ref)	44.900 MHz		**13.21 dBm**
Tx Total			**13.21 dBm**

802.11 n40 MHz and 802.11 ac 40 MHz modes CHAIN B

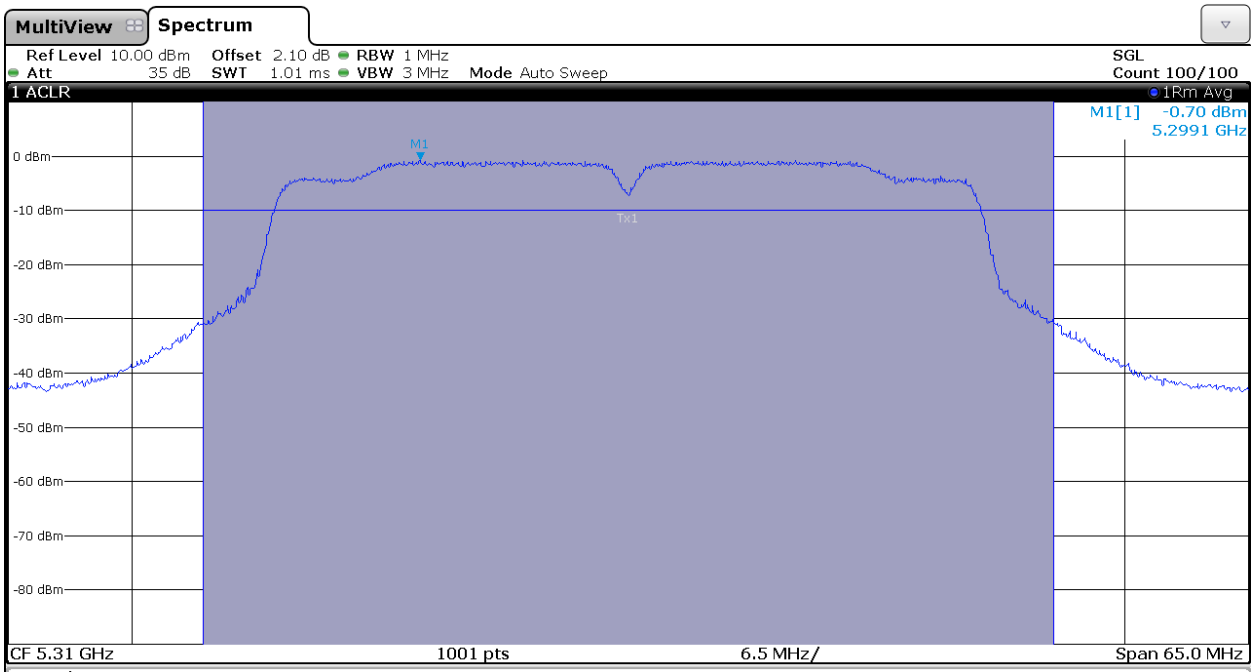
Lowest Channel



2 Result Summary None

Channel	Bandwidth	Offset	Power
Tx1 (Ref)	47.500 MHz		**16.21 dBm**
Tx Total			**16.21 dBm**

Highest Channel

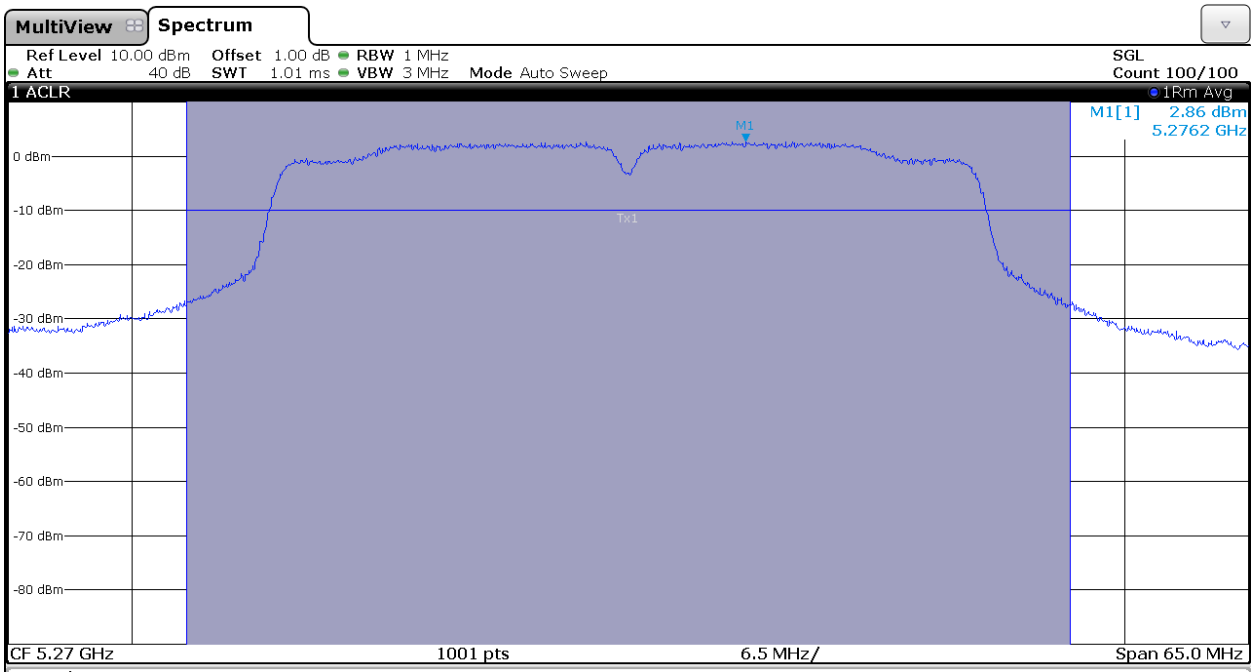


2 Result Summary None

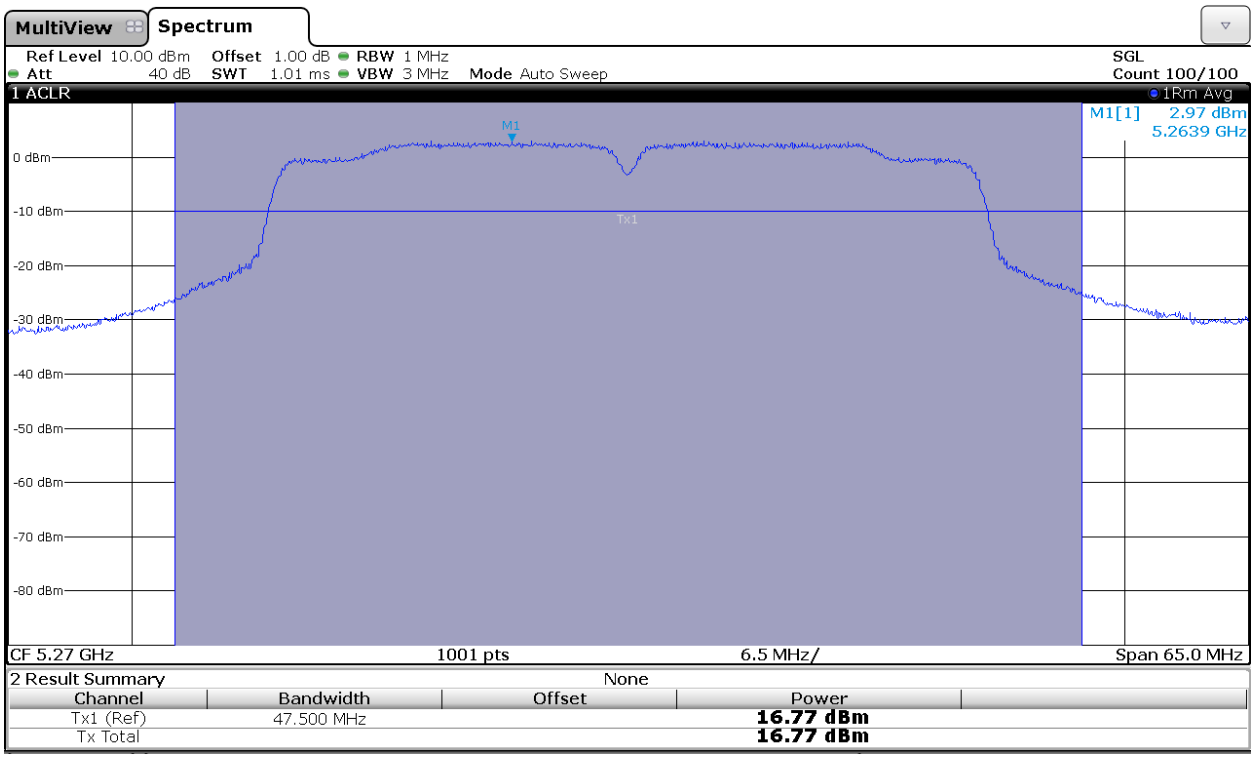
Channel	Bandwidth	Offset	Power
Tx1 (Ref)	44.600 MHz		**13.15 dBm**
Tx Total			**13.15 dBm**

802.11 n40 MHz and 802.11 ac 40 MHz modes CHAIN A+B

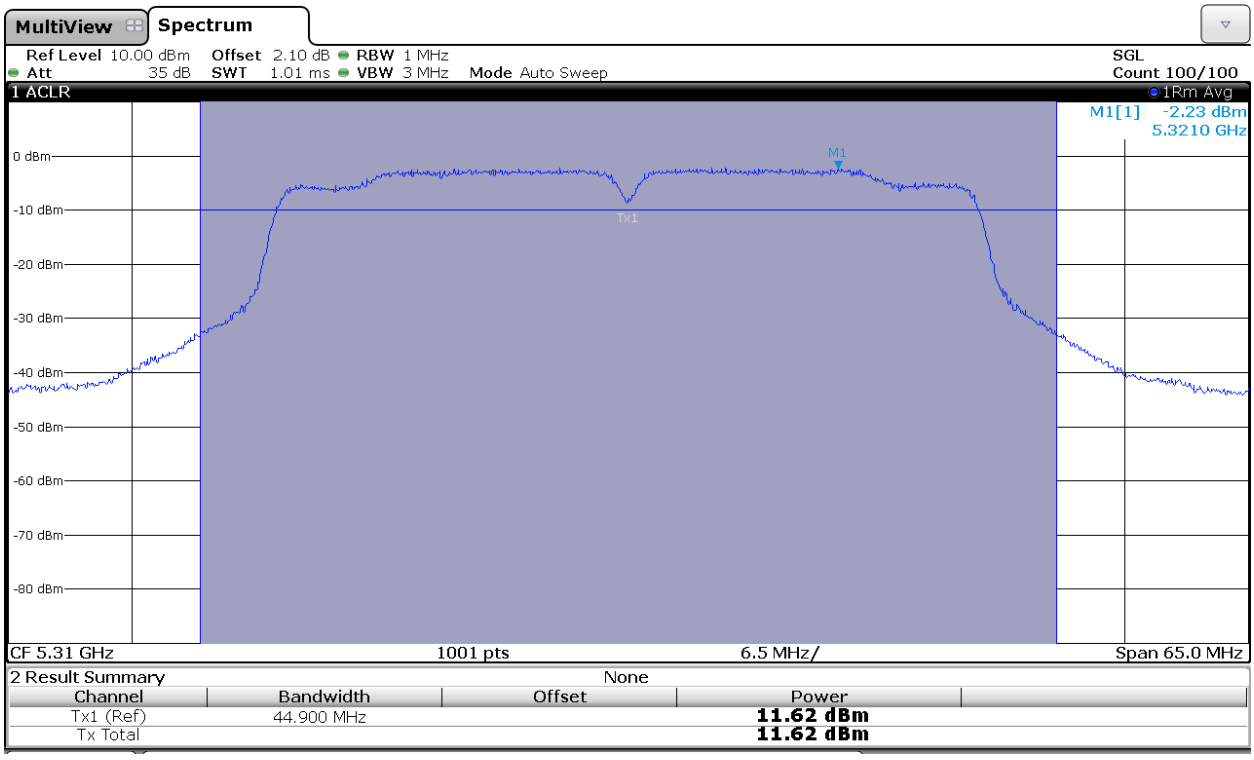
Lowest Channel. Chain A.



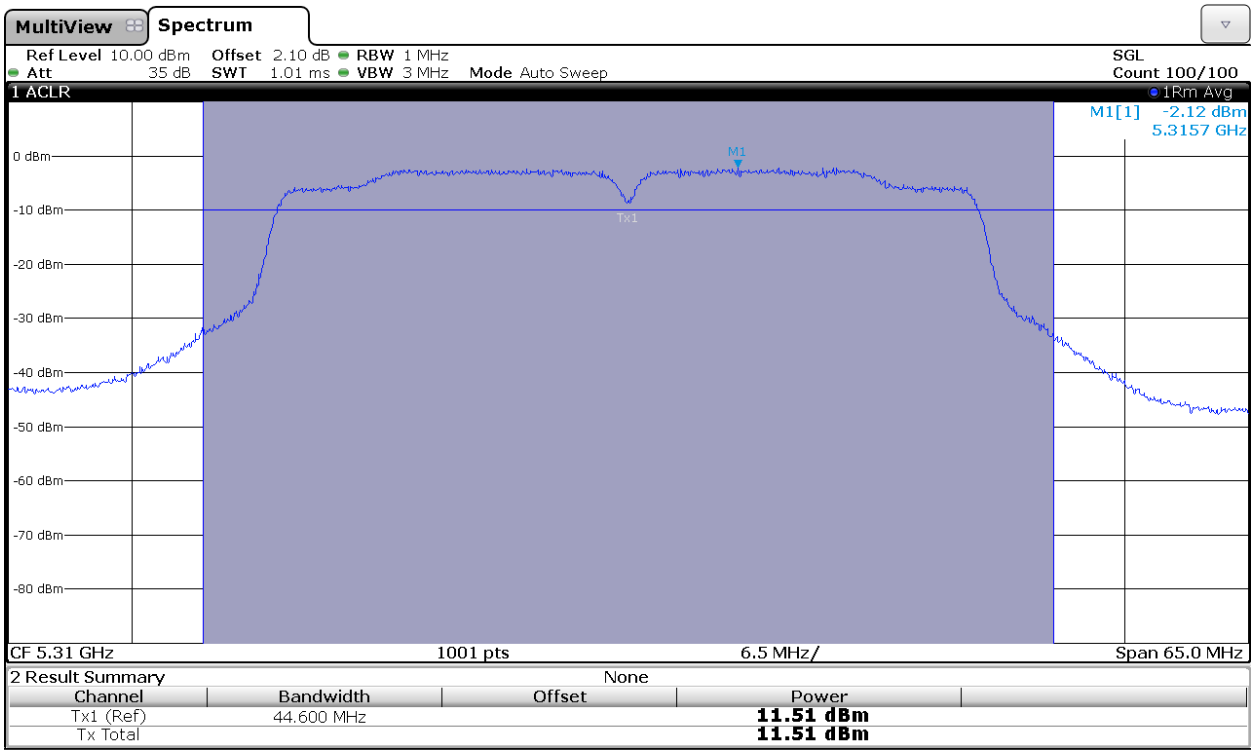
Lowest Channel. Chain B.



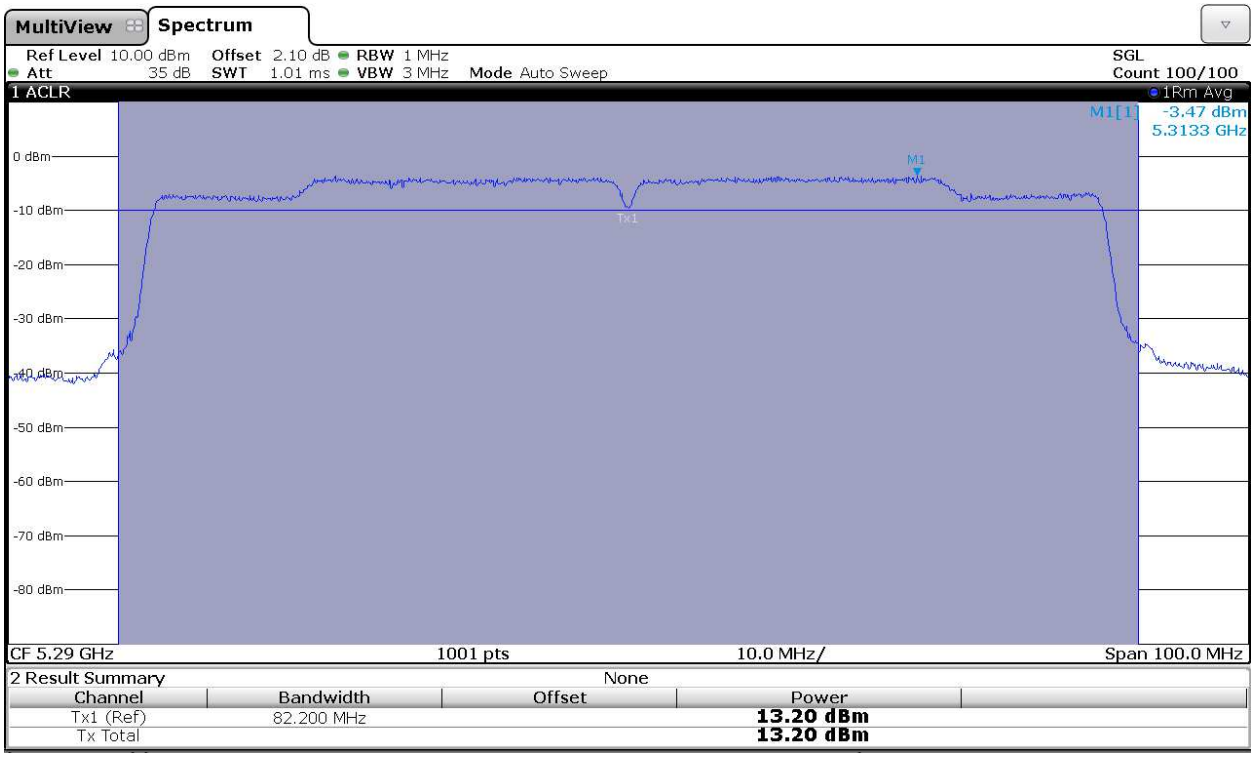
Highest Channel Chain A.



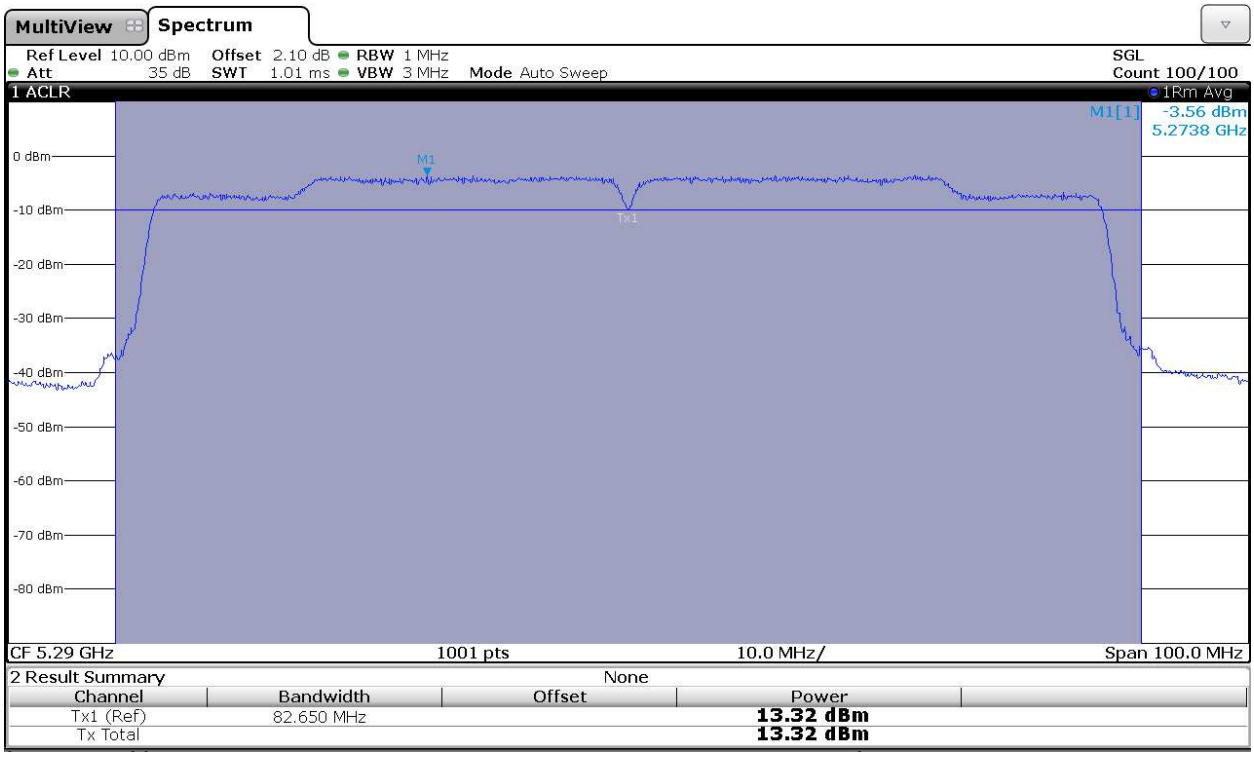
Highest Channel Chain B.



802.11 ac 80 MHz mode CHAIN A

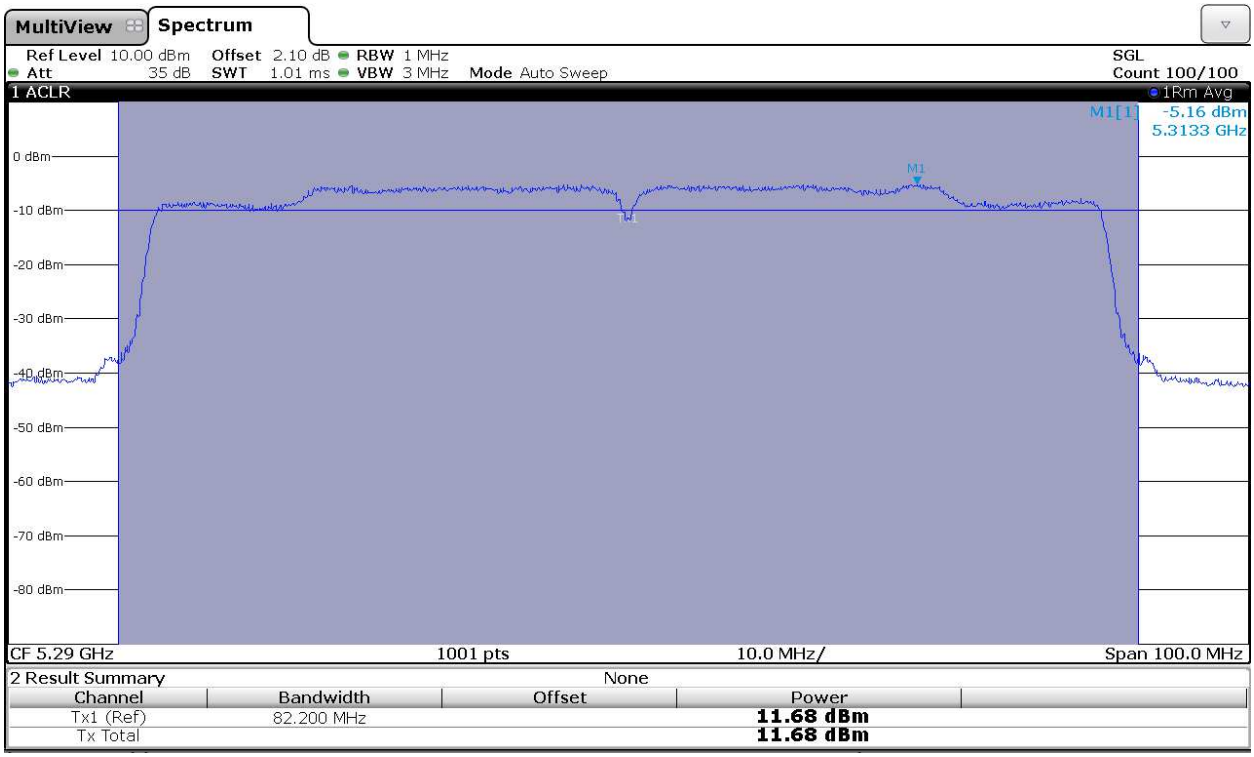


802.11 ac 80 MHz mode CHAIN B

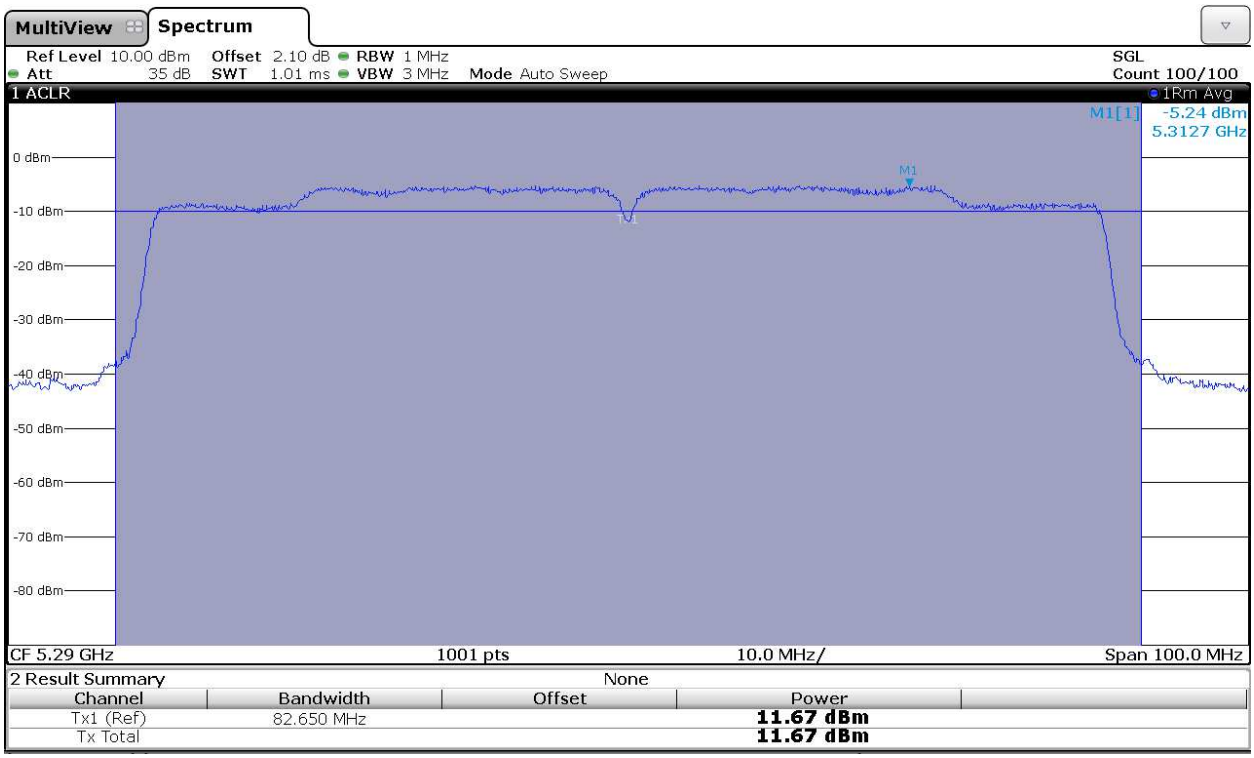


802.11 ac 80 MHz mode CHAIN A+B

Chain A.



Chain B.



SPECIFICATION

For transmitters operating in the 5.25-5.35 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). Devices operating in the 5.25-5.35 GHz band that generate emissions in the 5.15-5.25 GHz band must meet all applicable technical requirements for operation in the 5.15-5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of -27 dBm/MHz in the 5.15-5.25 GHz band.

Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)):

Frequency Range (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009-0.490	2400/F(kHz)	-	300
0.490-1.705	24000/F(kHz)	-	300
1.705 - 30.0	30	-	30
30 - 88	100	40	3
88 - 216	150	43.5	3
216 - 960	200	46	3
960 - 40000	500	54	3

The emission limits shown in the above table are based on measurements employing CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

For average radiated emission measurements above 1000 MHz, there is also a limit corresponding to 20 dB above the indicated values in the table is specified when measuring with peak detector function.

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º 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.

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.

The equipment transmits continuously in the selected channel so it is not necessary a duty cycle correction factor.

Frequency range 30 MHz-1 GHz

The spurious signals detected do not depend on either the operating channel or the modulation mode.

See test results in Appendix A for details.

Frequency range 1 GHz-40 GHz

The results in the next tables show the maximum measured levels in the 1-40 GHz range including the restricted band 5.35-5.46 GHz (see next plots).

For OFDM modulation modes (802.11a, 802.11n20, 802.11n40 and 802.11ac80), a preliminary measurement in the central channel in the range 1-18 GHz was performed to determine the worst case. The lowest and highest channels were measured for out-of-band emissions for the worst case (802.11a).

The field strength at the band edges was evaluated for each mode and on each chain individually on the lowest and highest channels at the rated power for the channel under test. Where the power at the edge channels was lower than the power at the center channels additional measurements were made at the adjacent channels. Single transmission at each chain and simultaneous transmission at both chains modes were fully evaluated.

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

1. WiFi 5GHz 802.11 a mode

Lowest frequency 5260 MHz. Out-of-band spurious emissions in the 1-40 GHz range.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
10.51971	V	Peak	50.83	± 4.00
15.78284	V	Peak	66.13	± 4.00
		Average	53.95	± 4.00
21.03950	V	Peak	53.58	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
15.77956	V	Peak	62.63	± 4.00
		Average	51.23	± 4.00
21.03950	V	Peak	53.96	± 4.00

Middle frequency 5300 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside restricted band 5.35-5.46 GHz.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.35821	V	Peak	51.09	± 4.00
10.59971	V	Peak	50.34	± 4.00
15.90073	V	Peak	65.23	± 4.00
		Average	53.73	± 4.00
21.19950	V	Peak	53.75	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.35873	V	Peak	51.15	± 4.00
15.90206	V	Peak	59.83	± 4.00
		Average	48.82	± 4.00
21.1995	V	Peak	54.98	± 4.00
		Average	48.50	± 4.00

Highest frequency 5320 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside restricted band 5.35-5.46 GHz.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.43581	V	Peak	50.94	± 4.00
15.96024	V	Peak	61.90	± 4.00
		Average	50.48	± 4.00
21.28050	V	Peak	53.92	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.35004	V	Peak	51.68	± 4.00
15.96079	V	Peak	56.17	± 4.00
		Average	44.67	± 4.00
21.27950	V	Peak	54.67	± 4.00
		Average	48.61	± 4.00

Verdict: PASS

2. WiFi 5GHz 802.11 n20 mode.

Middle frequency 5300MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside restricted band 5.35-5.46 GHz.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.35464	V	Peak	51.47	± 4.00
10.60004	V	Peak	50.37	± 4.00
15.89852	V	Peak	64.97	± 4.00
		Average	53.61	± 4.00
21.20050	V	Peak	53.81	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.35026	V	Peak	51.77	± 4.00
15.89567	V	Peak	59.38	± 4.00
		Average	48.24	± 4.00
21.20049	V	Peak	53.85	± 4.00

Chain A+B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.35076	V	Peak	51.55	± 4.00
10.59986	V	Peak	50.68	± 4.00
15.89910	V	Peak	62.77	± 4.00
		Average	52.37	± 4.00
21.19950	V	Peak	54.97	± 4.00
		Average	48.54	± 4.00

Highest frequency 5320 MHz. Spurious emissions inside restricted band 5.35-5.46 GHz.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.35235	V	Peak	51.78	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.35077	V	Peak	51.57	± 4.00

Chain A+B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.36531	V	Peak	51.32	± 4.00

Verdict: PASS

3. WiFi 5GHz 802.11 n40 mode

Lowest frequency 5270 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside restricted band 5.35-5.46 GHz.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.35172	V	Peak	52.53	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.35043	V	Peak	52.94	± 4.00

Chain A+B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.35128	V	Peak	56.30	± 4.00
		Average	44.34	± 4.00
10.53310	V	Peak	52.04	± 4.00
15.81030	V	Peak	62.49	± 4.00
		Average	52.23	± 4.00
21.08050	V	Peak	55.25	± 4.00
		Average	49.01	± 4.00

Verdict: PASS

Highest frequency 5310 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside restricted band 5.35-5.46 GHz.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.35035	V	Peak	51.75	± 4.00
15.92682	V	Peak	56.83	± 4.00
		Average	48.70	± 4.00
21.24050	V	Peak	53.39	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.35013	V	Peak	54.23	± 4.00
		Average	44.46	± 4.00
15.92518	V	Peak	51.52	± 4.00
21.24050	V	Peak	54.24	± 4.00
		Average	46.50	± 4.00

Chain A+B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.35043	V	Peak	52.88	± 4.00
15.92766	V	Peak	54.50	± 4.00
		Average	44.88	± 4.00
21.23950	V	Peak	53.59	± 4.00

Verdict: PASS

4. WiFi 5GHz 802.11 ac80 mode

Middle frequency 5290 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside restricted band 5.35-5.46 GHz.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.35014	V	Peak	56.69	± 4.00
		Average	46.12	± 4.00
15.85980	V	Peak	56.17	± 4.00
		Average	46.27	± 4.00
21.15950	V	Peak	53.60	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.35010	V	Peak	58.57	± 4.00
		Average	47.51	± 4.00
15.86940	V	Peak	52.92	± 4.00
21.15950	V	Peak	53.93	± 4.00

Chain A+B

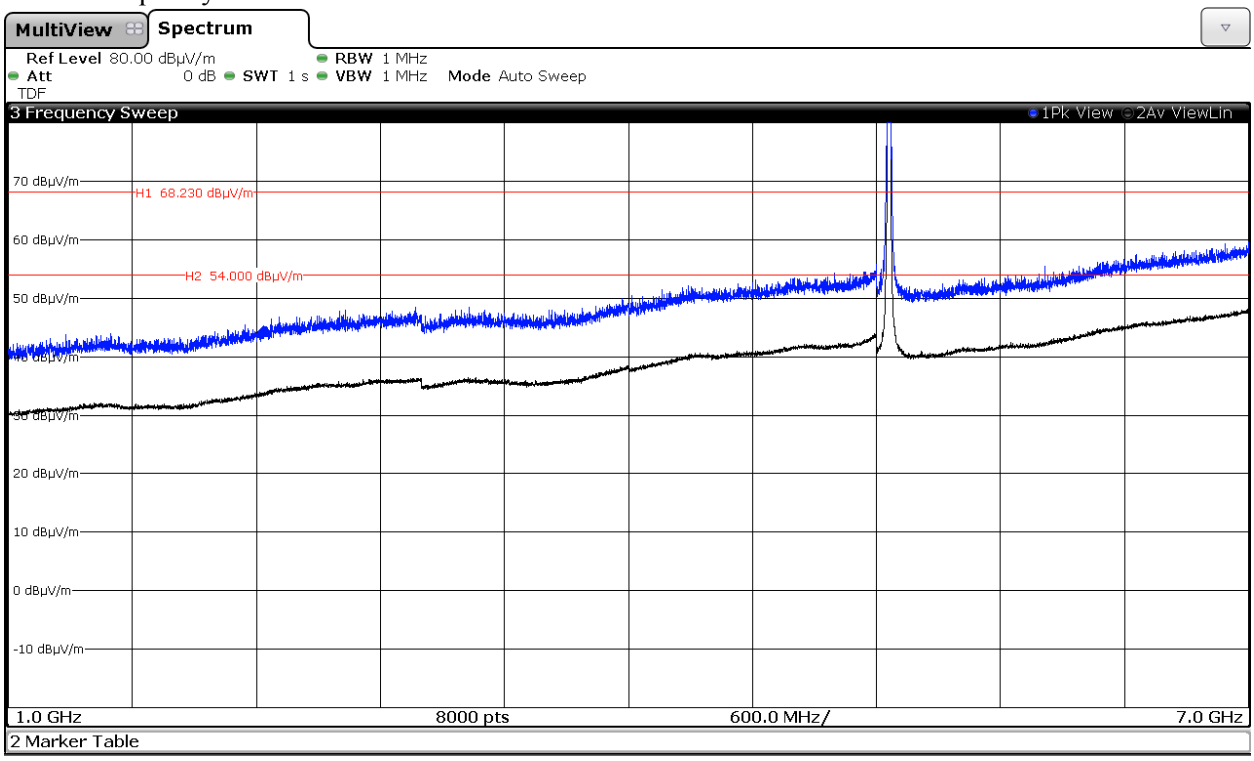
Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.35022	V	Peak	54.57	± 4.00
		Average	45.15	± 4.00
15.86540	V	Peak	54.28	± 4.00
		Average	43.24	± 4.00
21.15950	V	Peak	54.64	± 4.00
		Average	48.78	± 4.00

Verdict: PASS

FREQUENCY RANGE 1 GHz to 7 GHz.

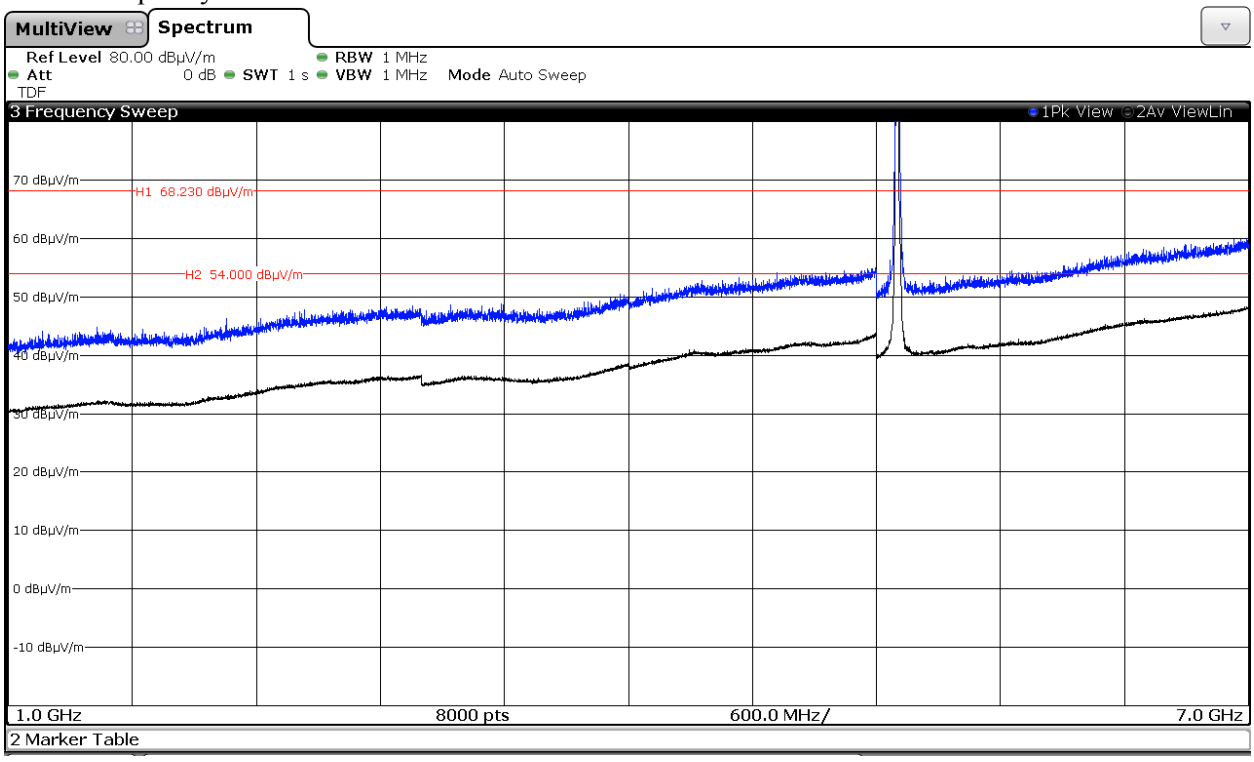
1. WiFi 5GHz 802.11 a mode

Lowest frequency 5260 MHz.



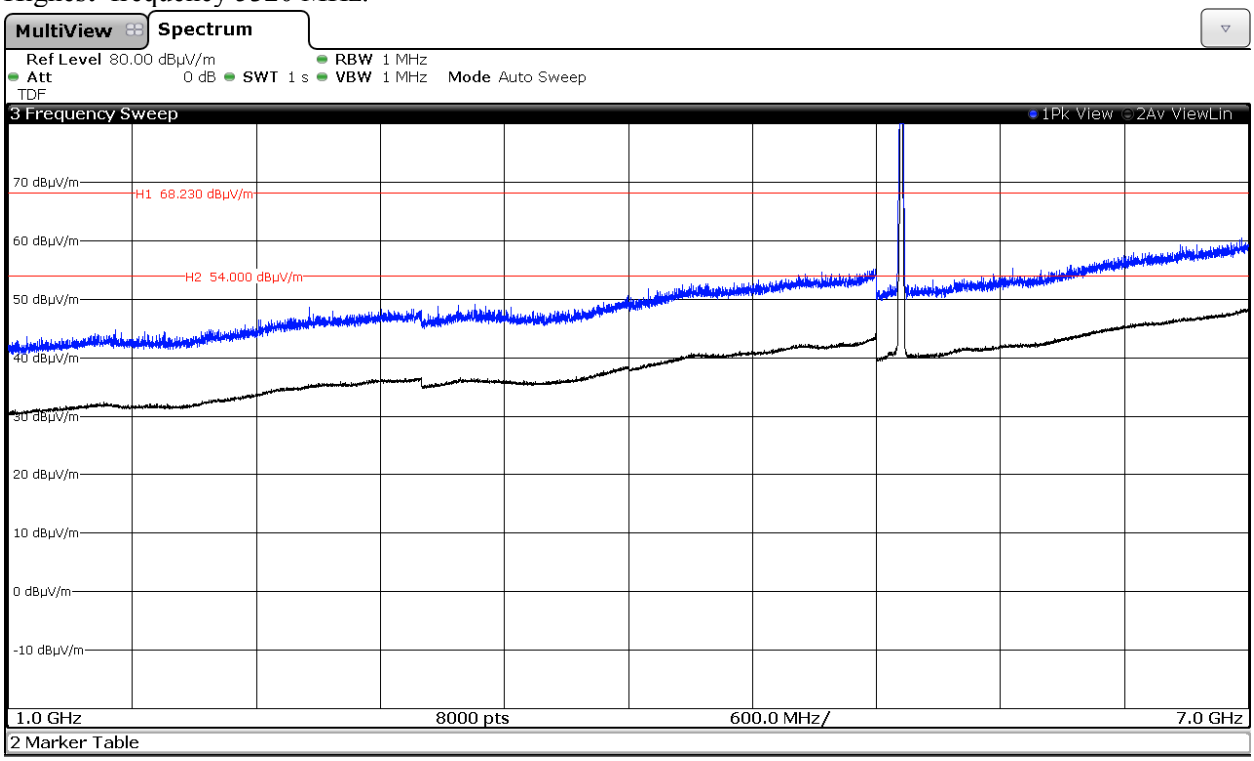
Note: The peak above the limit is the carrier frequency. This plot is valid for both Chain A and Chain B.

Middle frequency 5300 MHz.



Note: The peak above the limit is the carrier frequency. This plot is valid for both Chain A and Chain B.

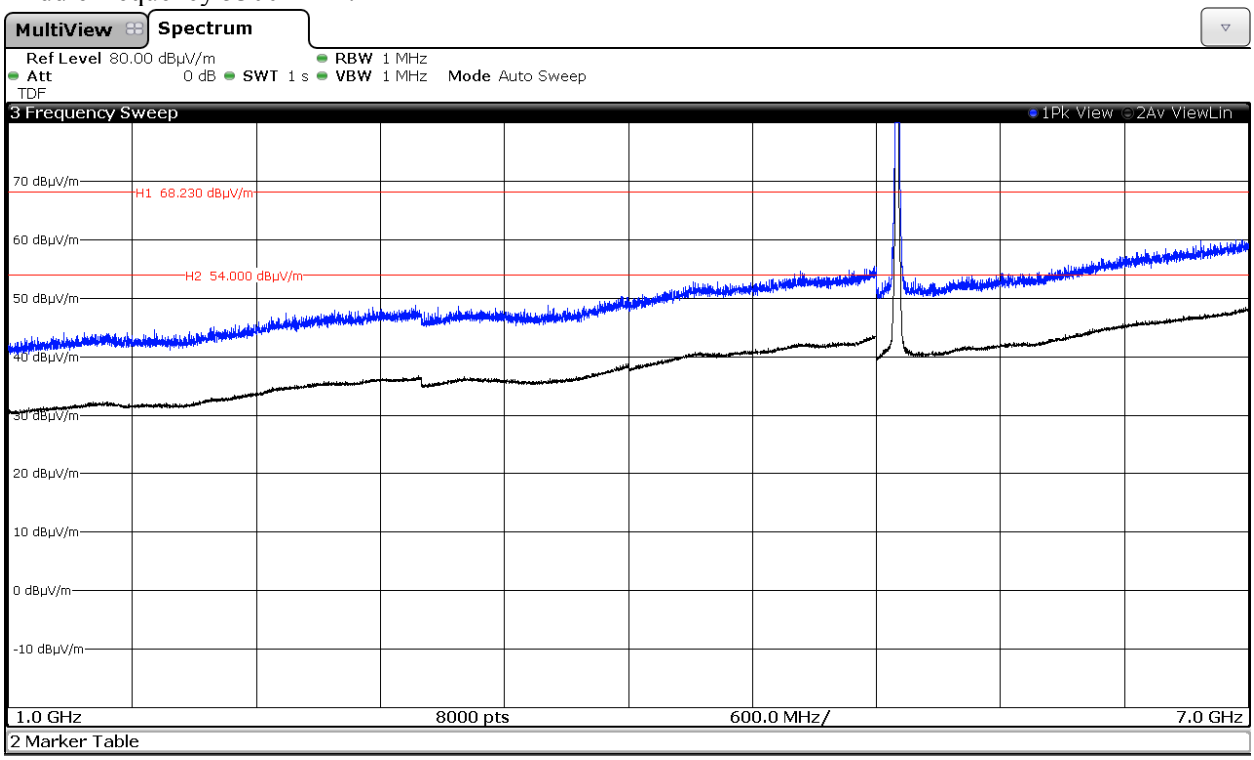
Highest frequency 5320 MHz.



Note: The peak above the limit is the carrier frequency. This plot is valid for both Chain A and Chain B.

2. WiFi 5GHz 802.11 n20 mode

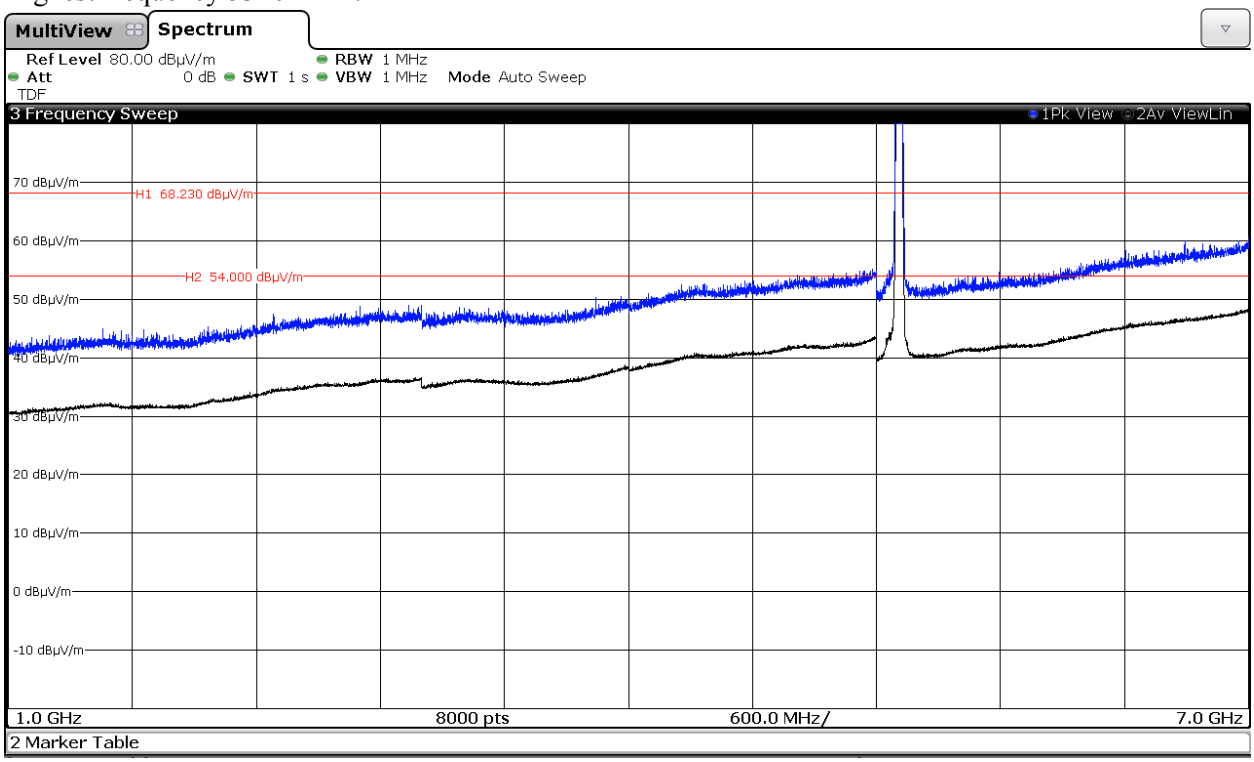
Middle frequency 5300 MHz.



Note: The peak above the limit is the carrier frequency. This plot is valid for Chain A, Chain B, Chain A+B.

3. WiFi 5GHz 802.11 n40 mode

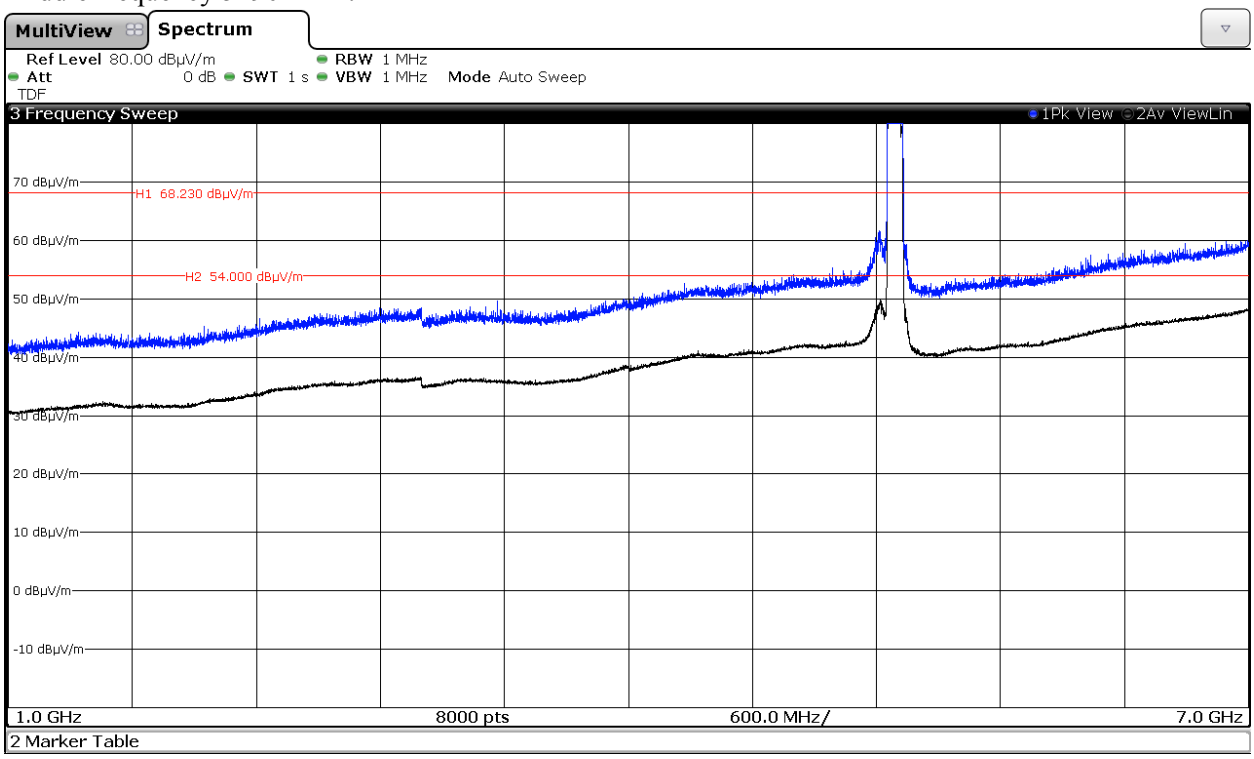
Highest frequency 5310 MHz.



Note: The peak above the limit is the carrier frequency. This plot is valid for Chain A, Chain B, Chain A+B.

4. WiFi 5GHz 802.11 ac80 mode

Middle frequency 5290 MHz.



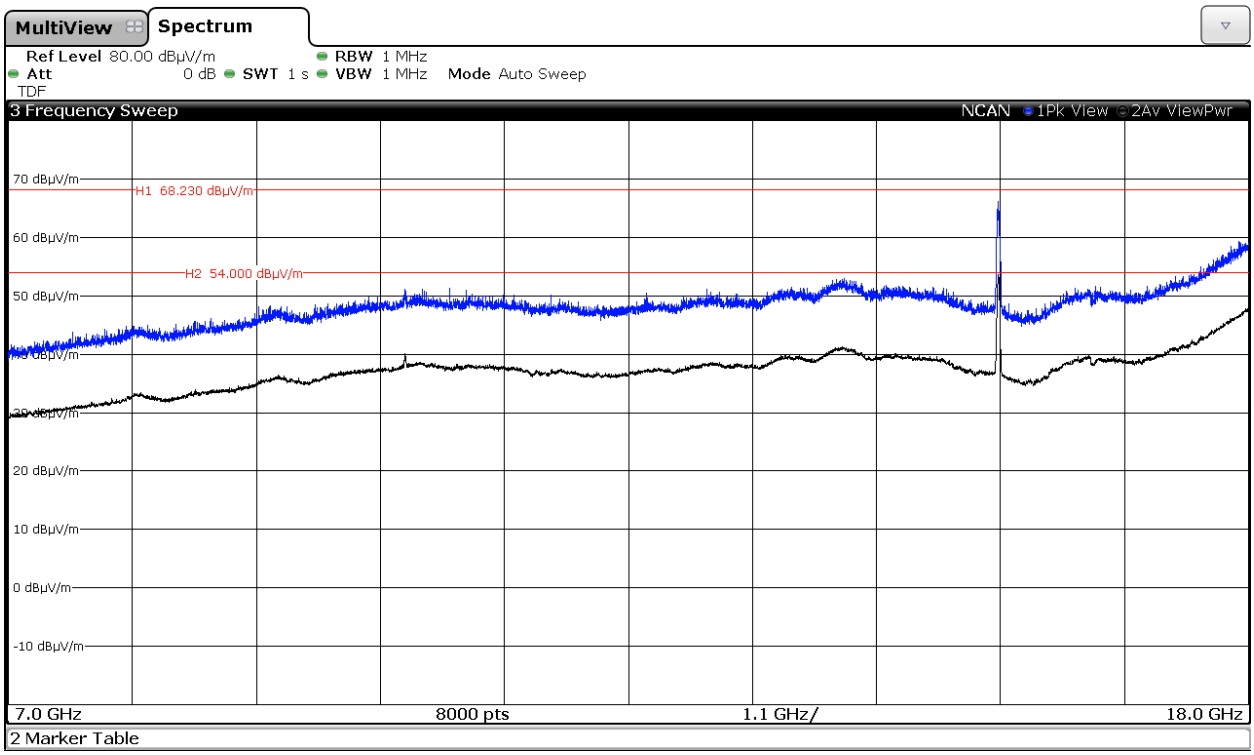
Note: The peak above the limit is the carrier frequency. This plot is valid for Chain A, Chain B, Chain A+B.

FREQUENCY RANGE 7 GHz to 18 GHz.

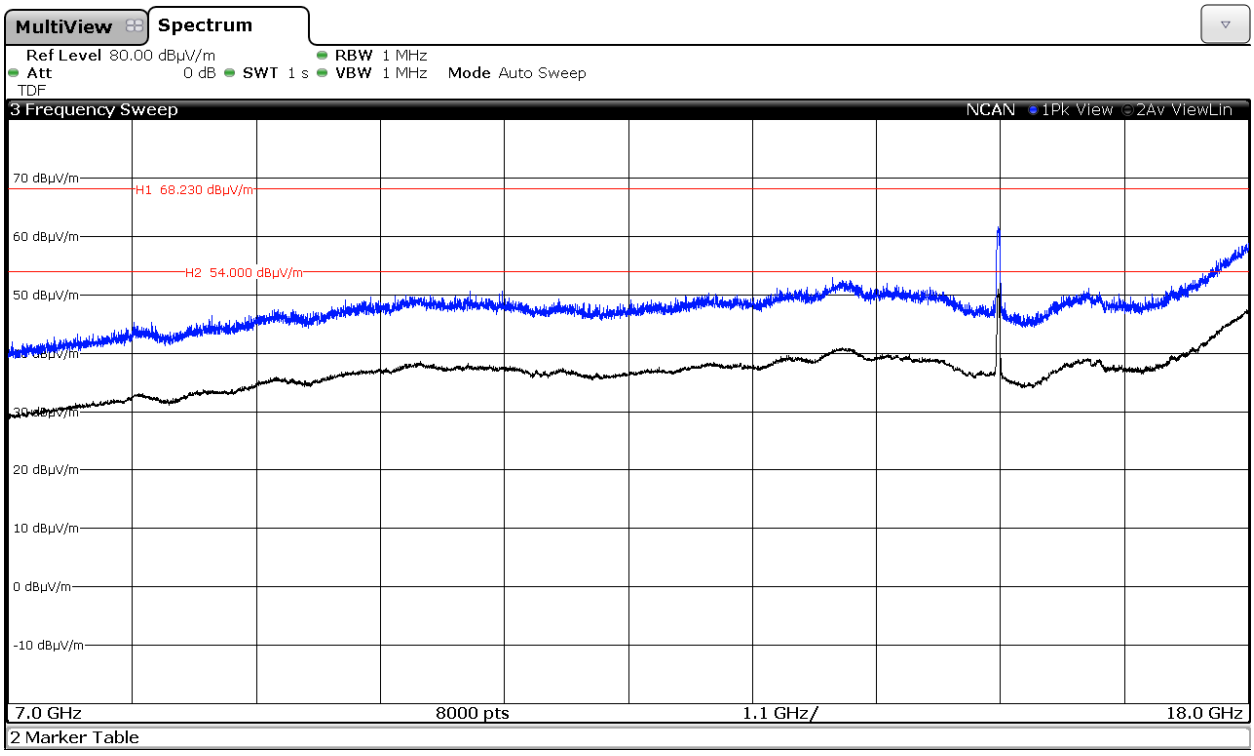
1. WiFi 5GHz 802.11 a mode

Lowest frequency 5260 MHz.

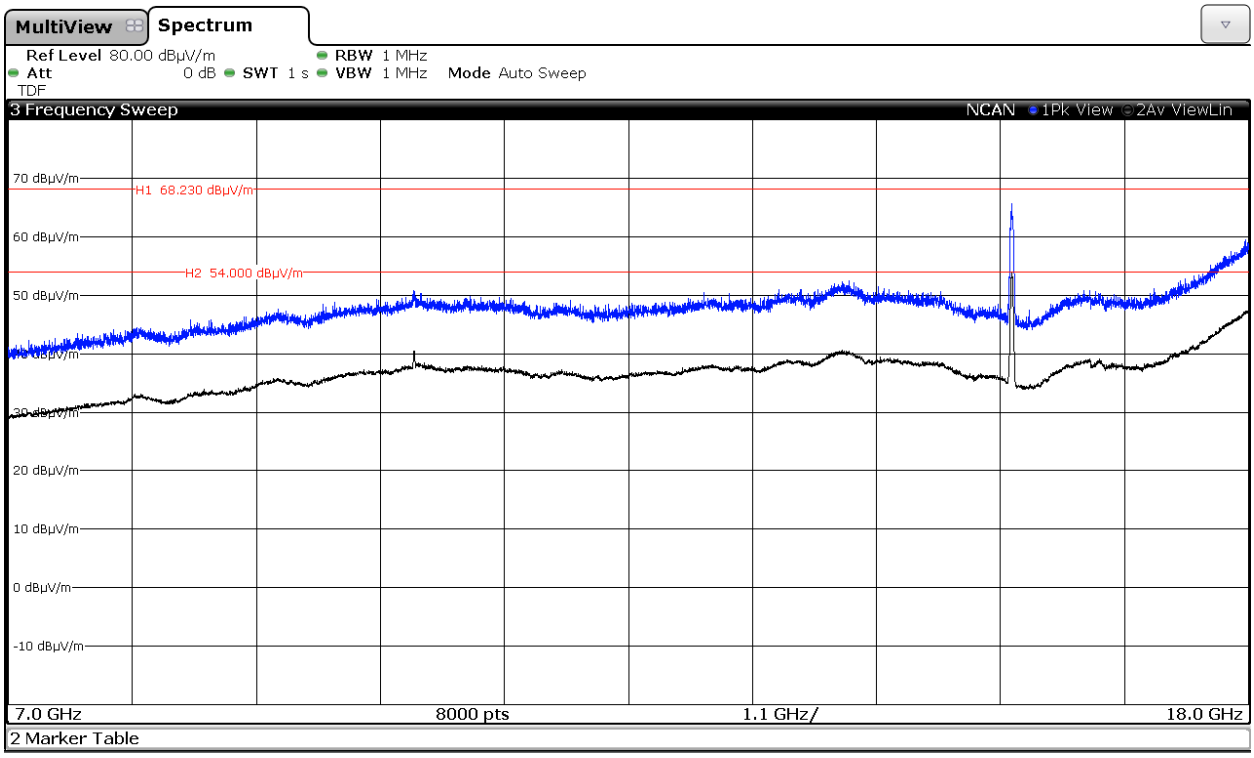
Chain A



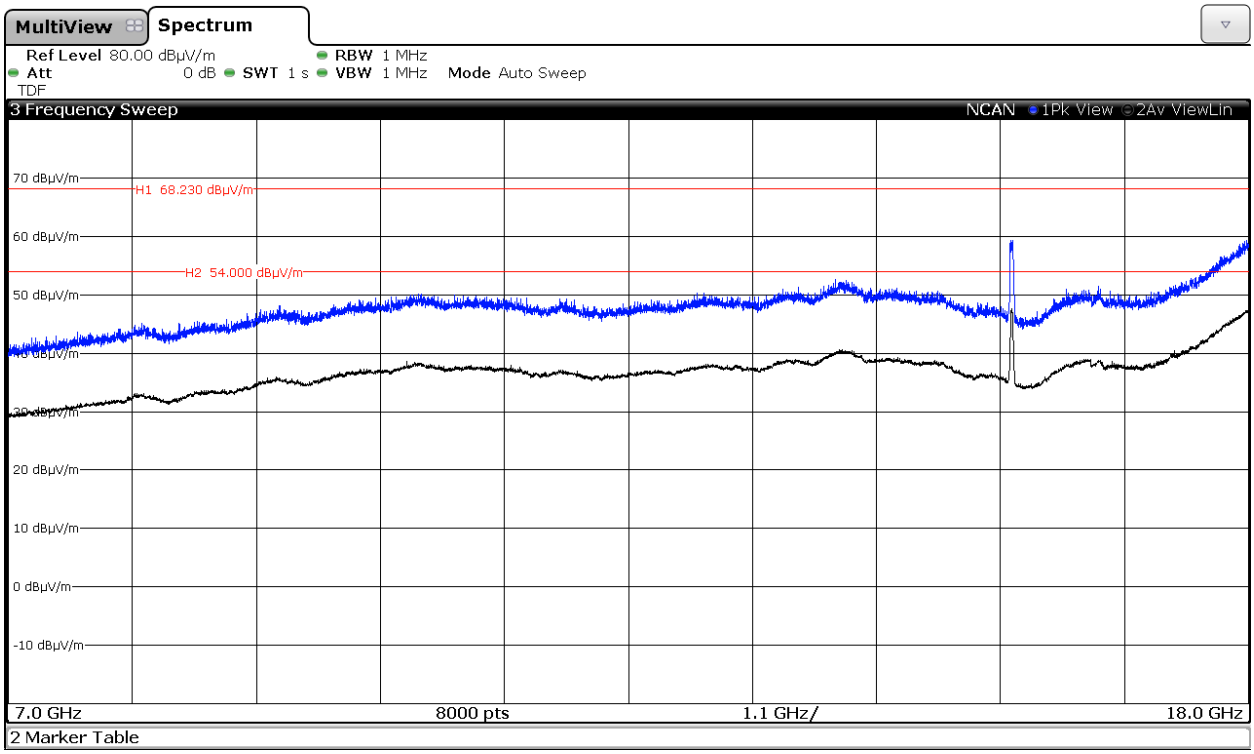
Chain B



Middle frequency 5300 MHz.
Chain A

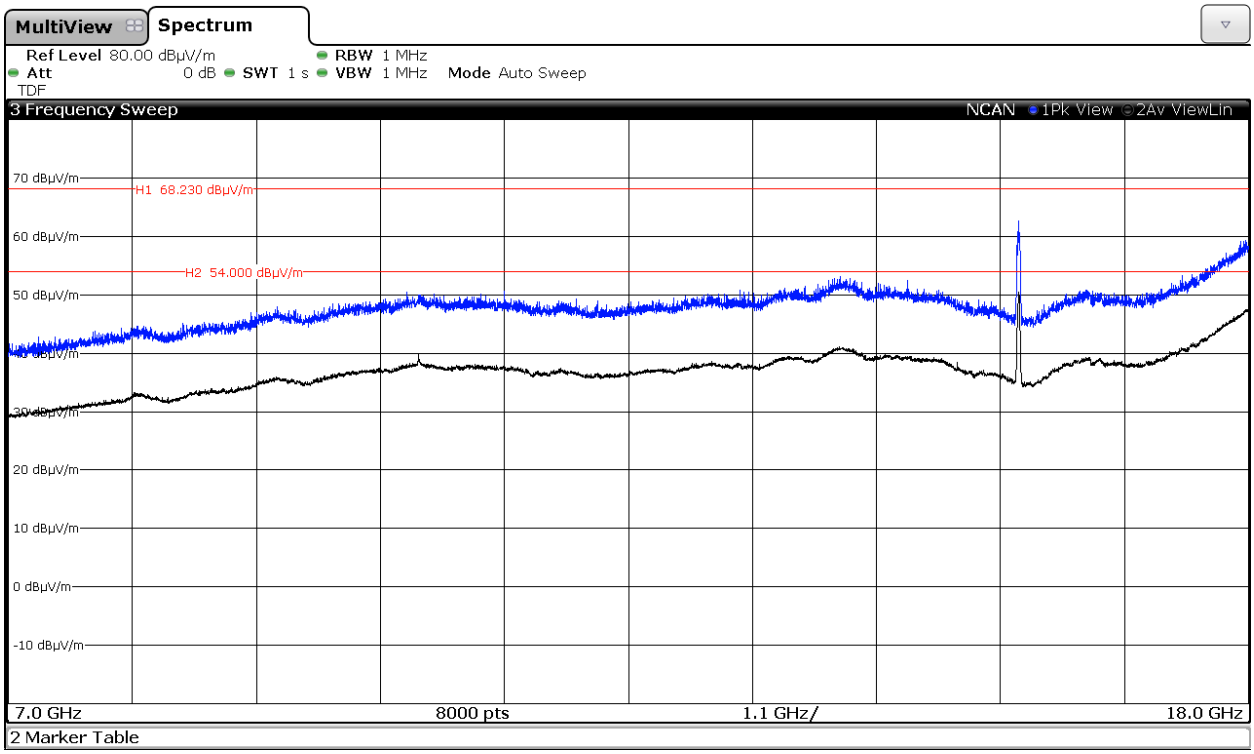


Chain B

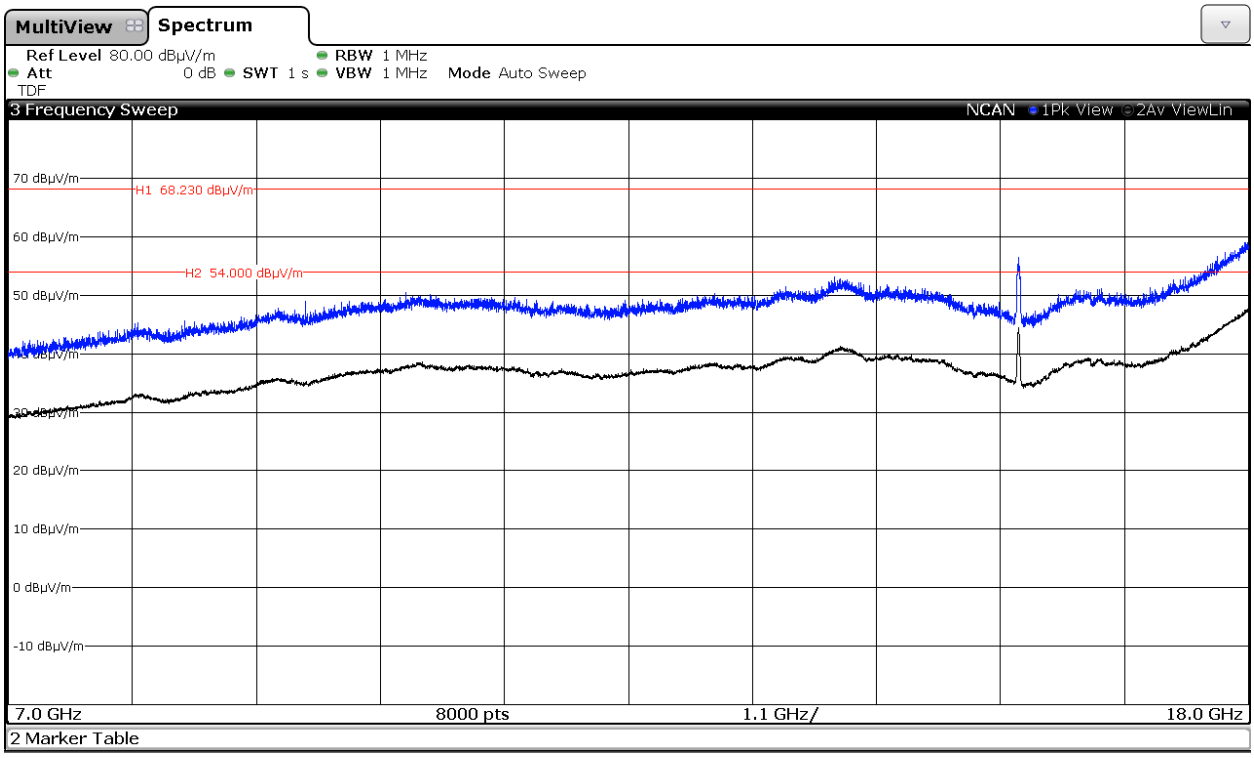


Highest frequency 5320 MHz.

Chain A

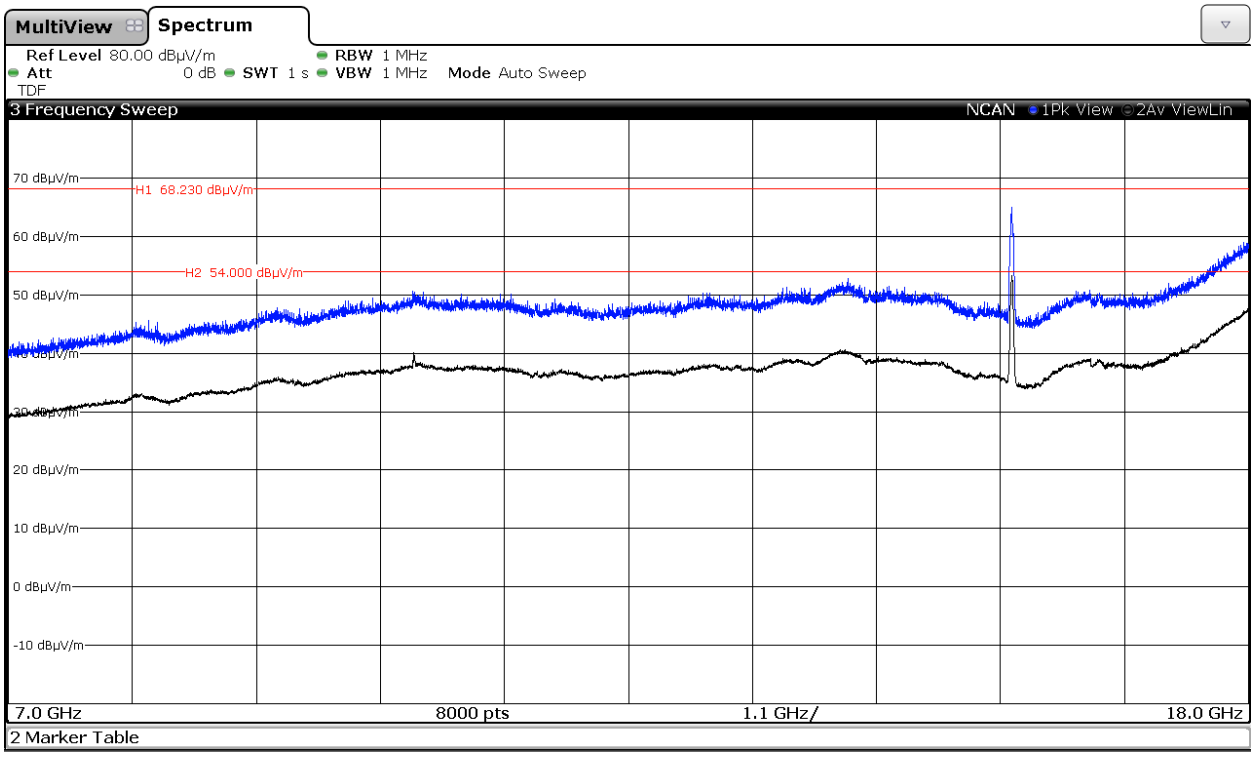


Chain B

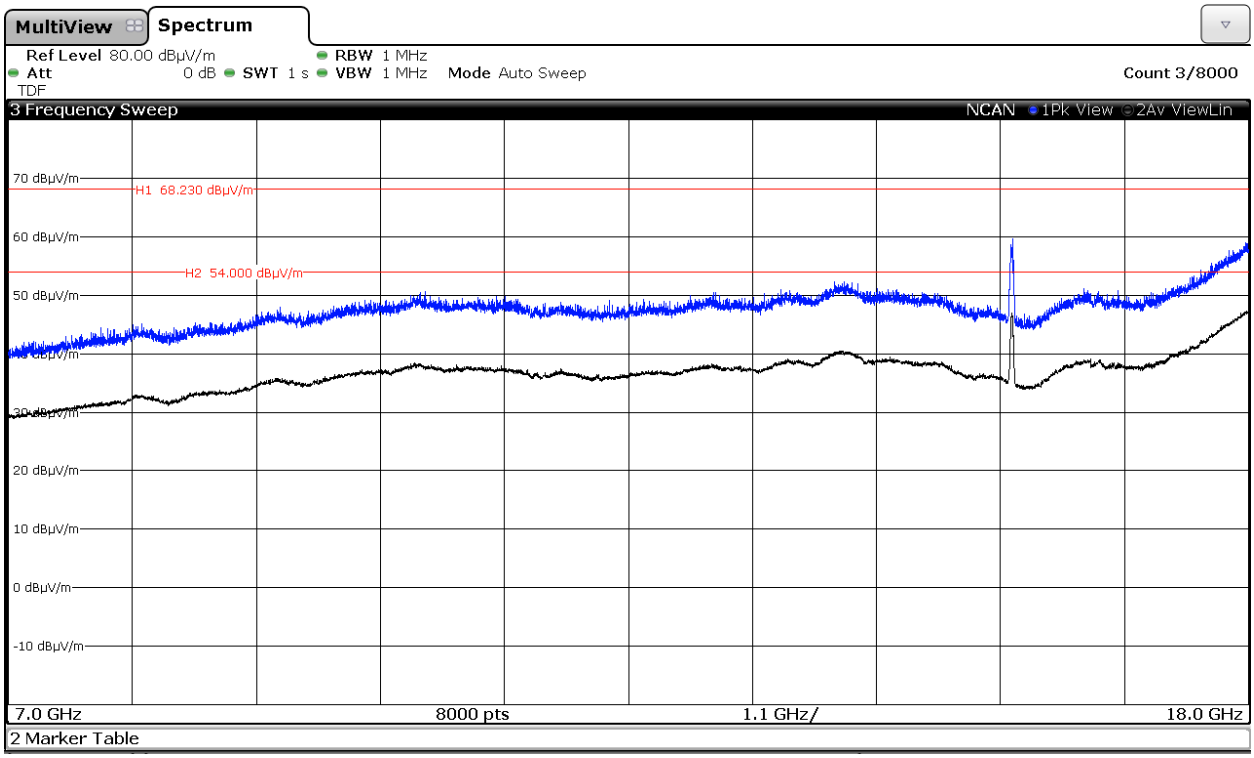


2. WiFi 5GHz 802.11 n20 mode

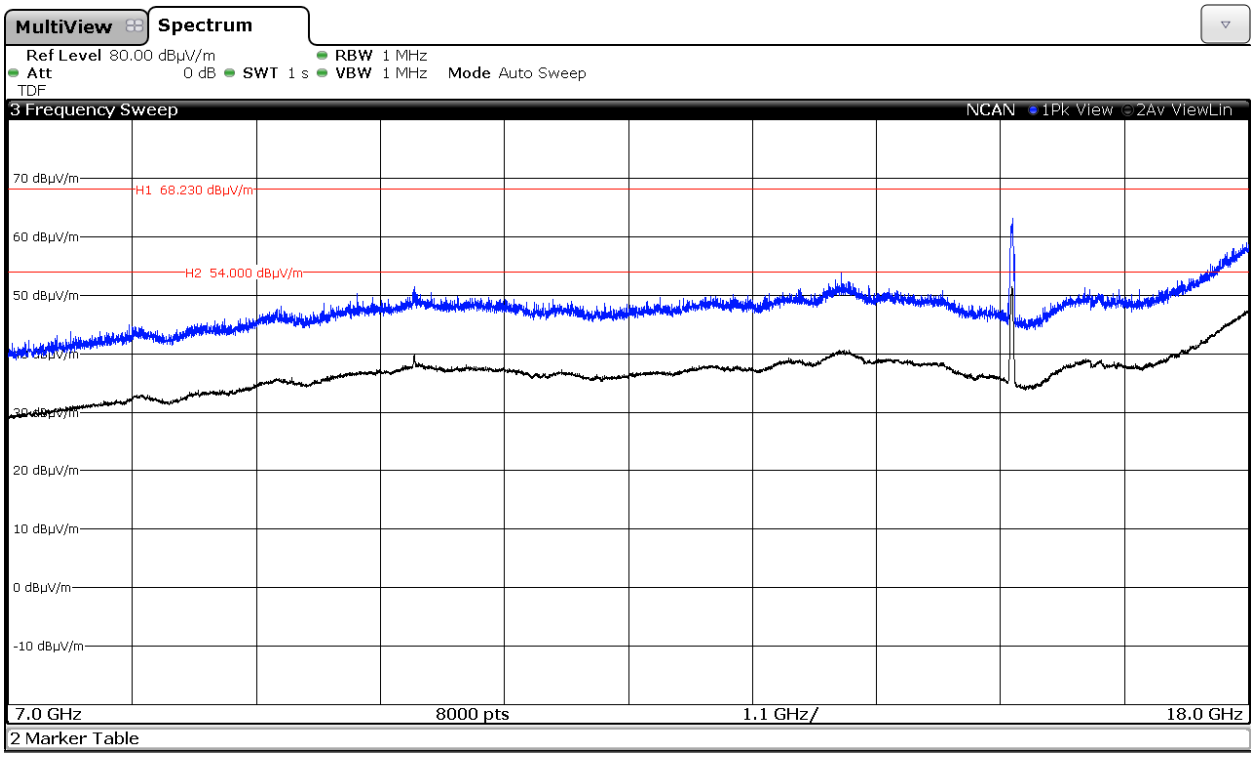
Middle frequency 5300 MHz.
Chain A



Chain B



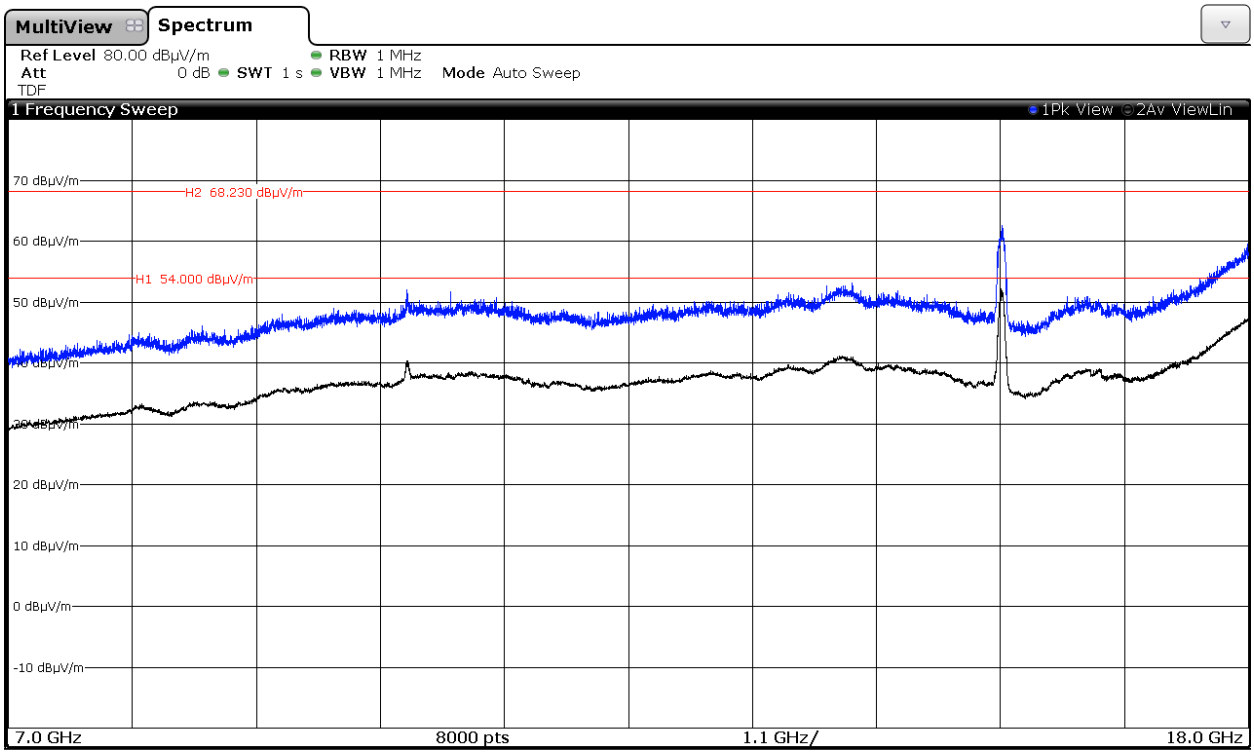
Chain A+B



3. WiFi 5GHz 802.11 n40 mode

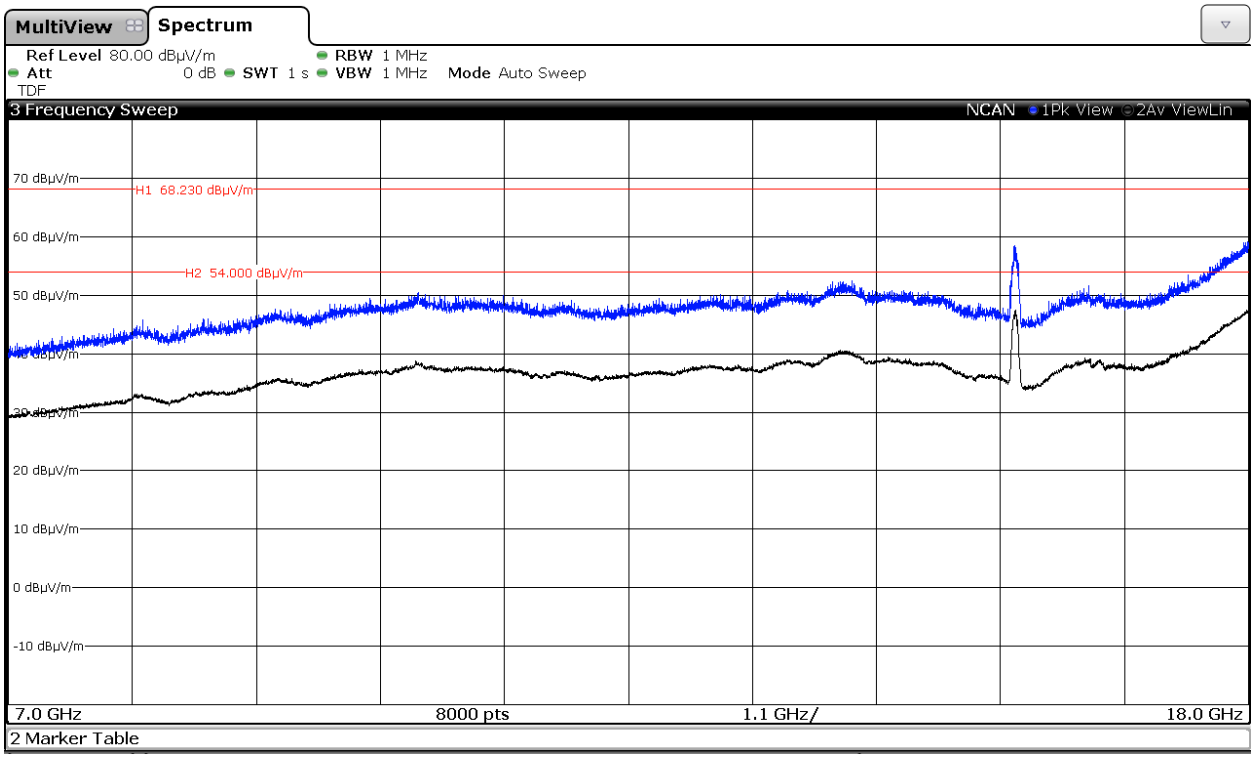
Lowest frequency 5270 MHz

Chain A+B

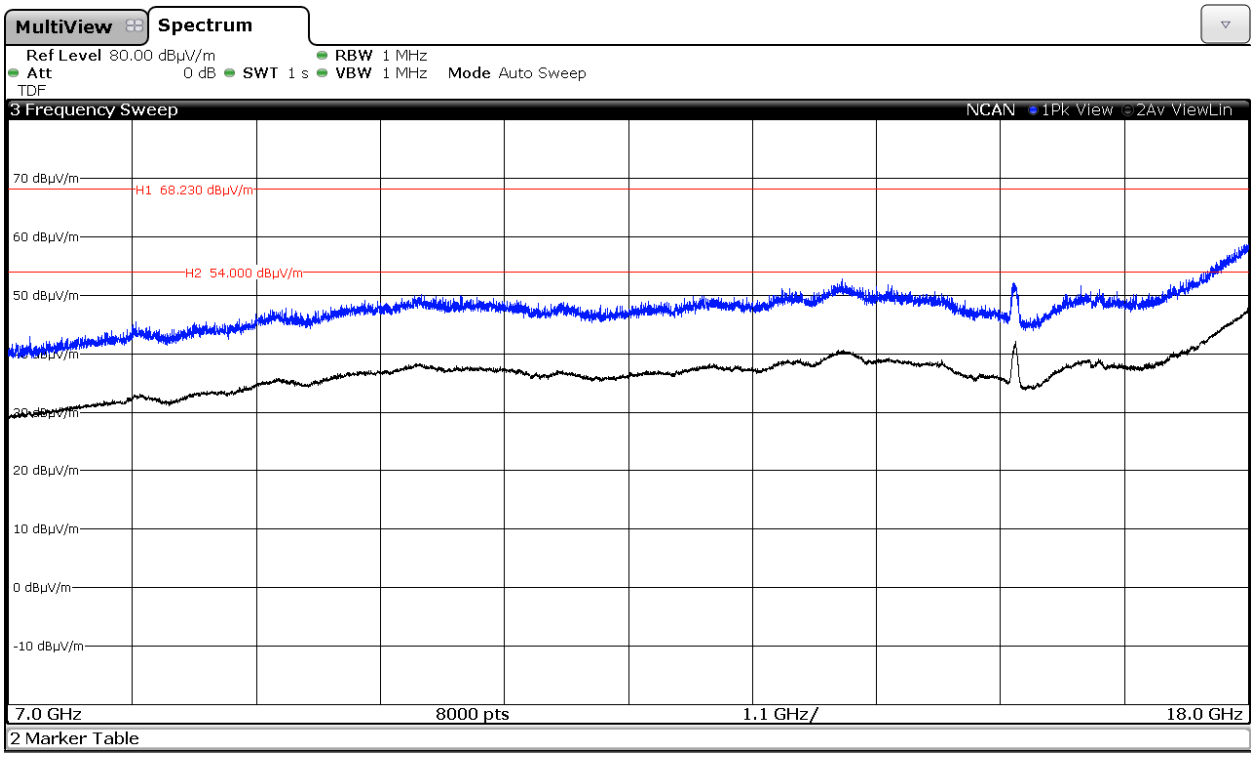


Highest frequency 5310 MHz.

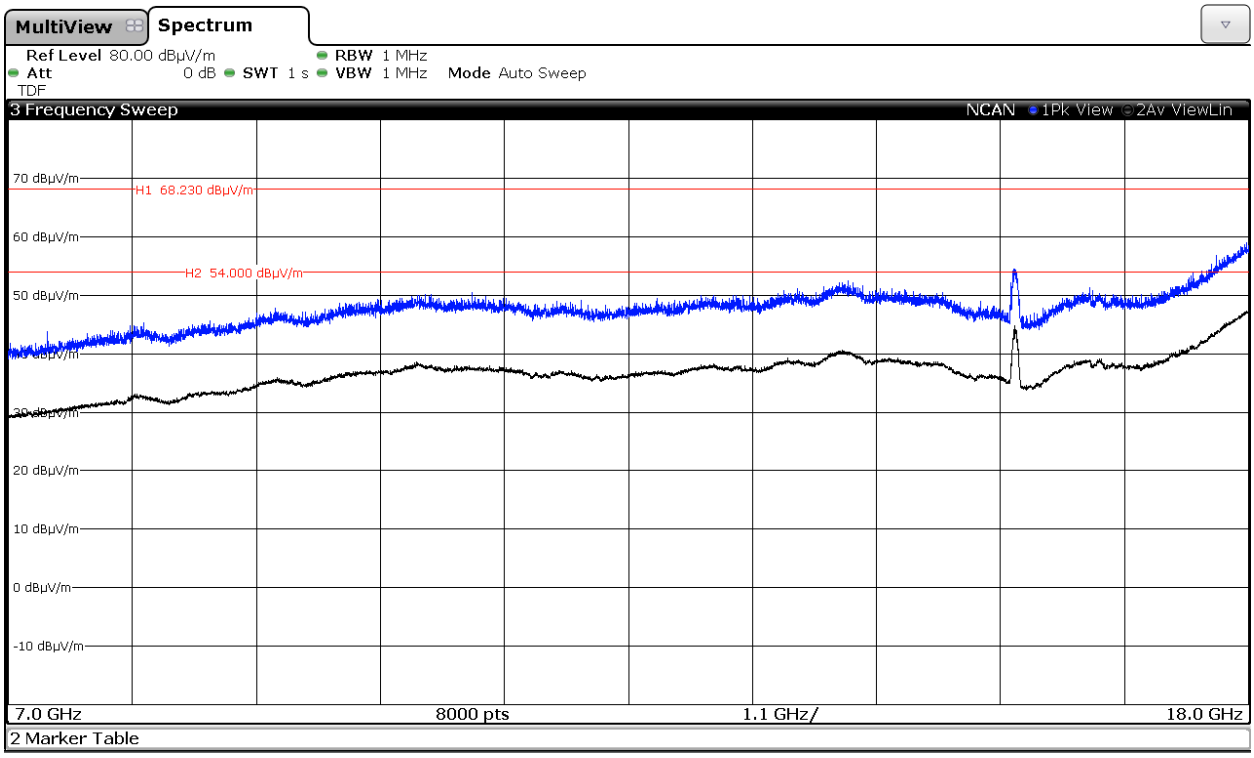
Chain A



Chain B

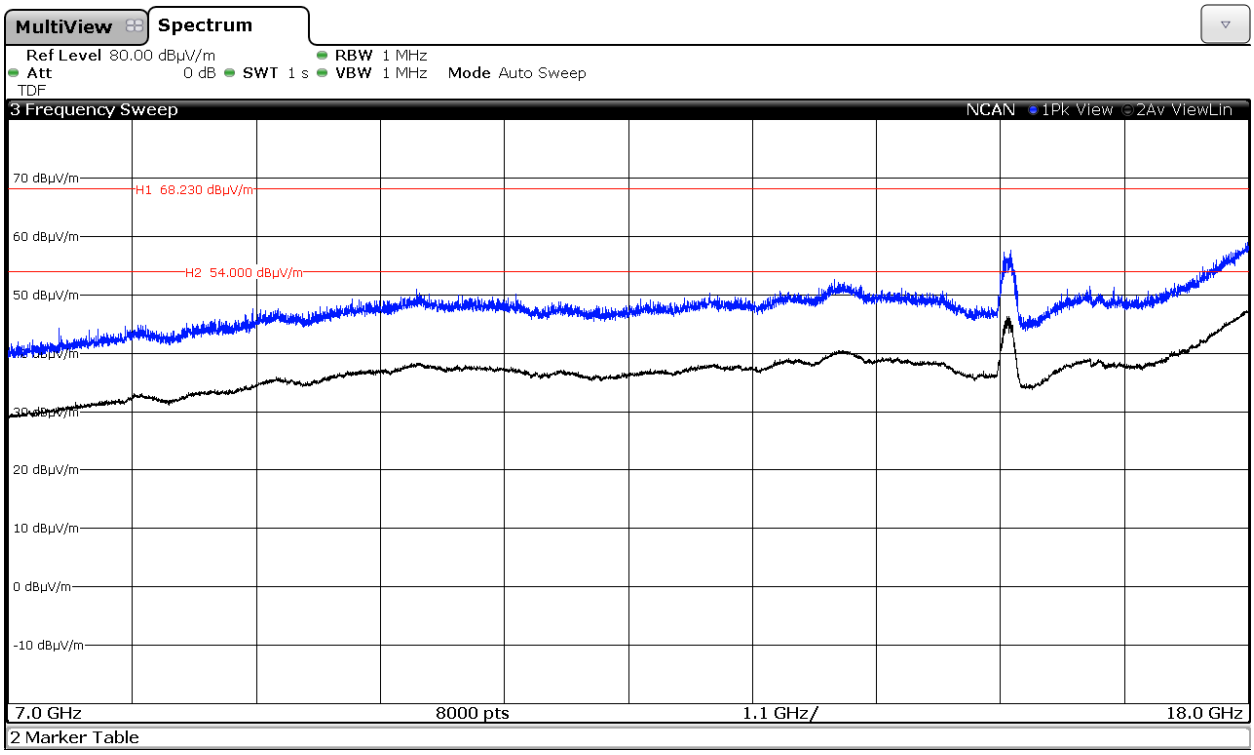


Chain A+B

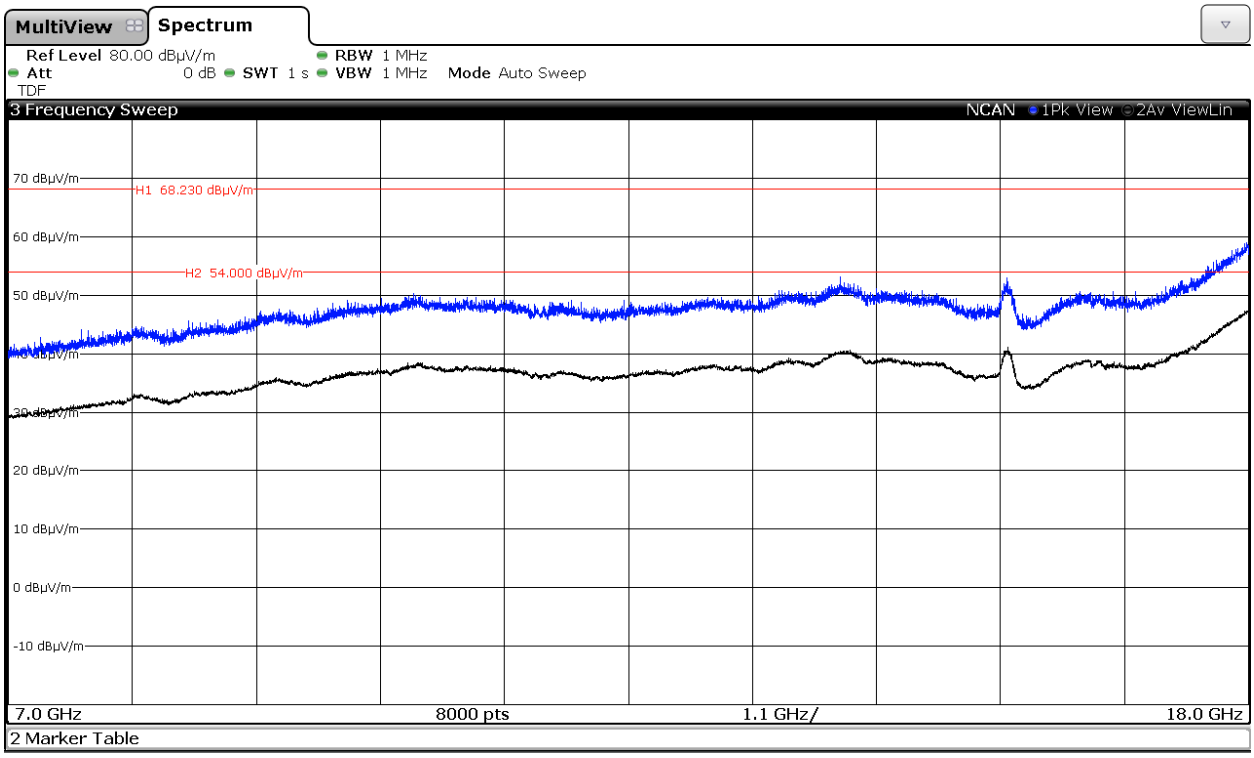


4. WiFi 5GHz 802.11 ac80 mode

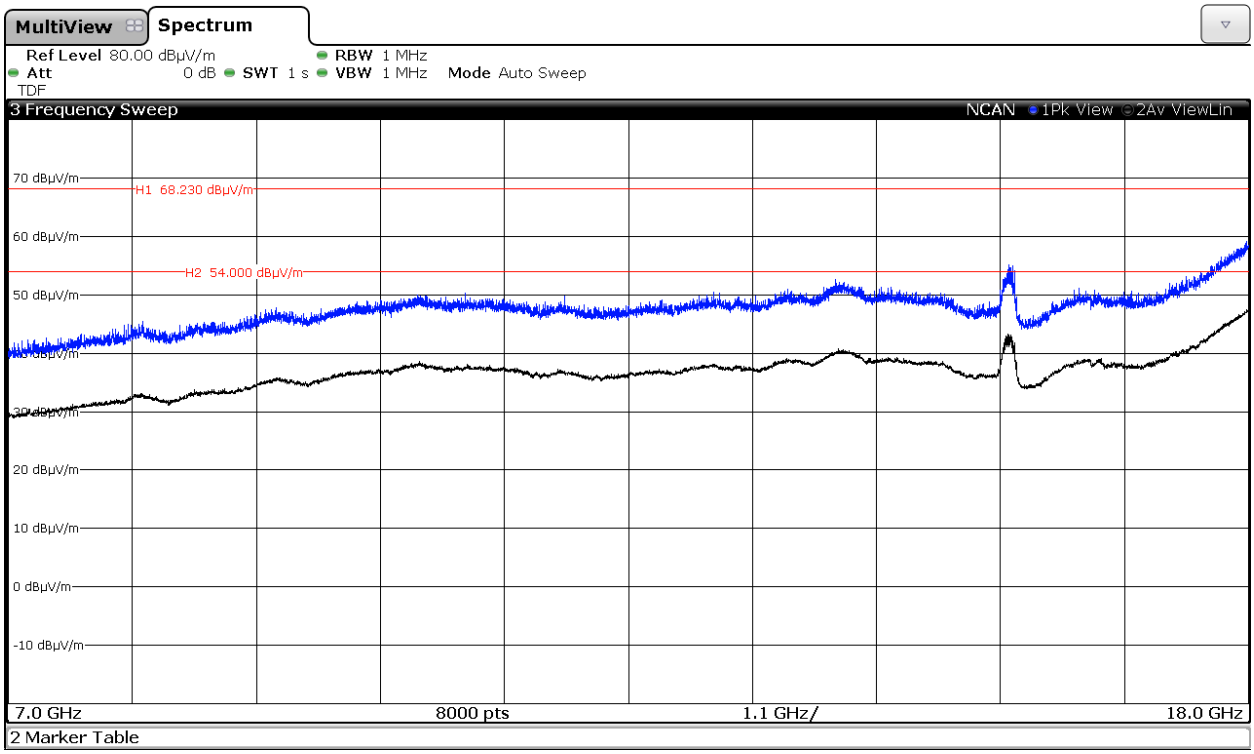
Chain A



Chain B



Chain A+B

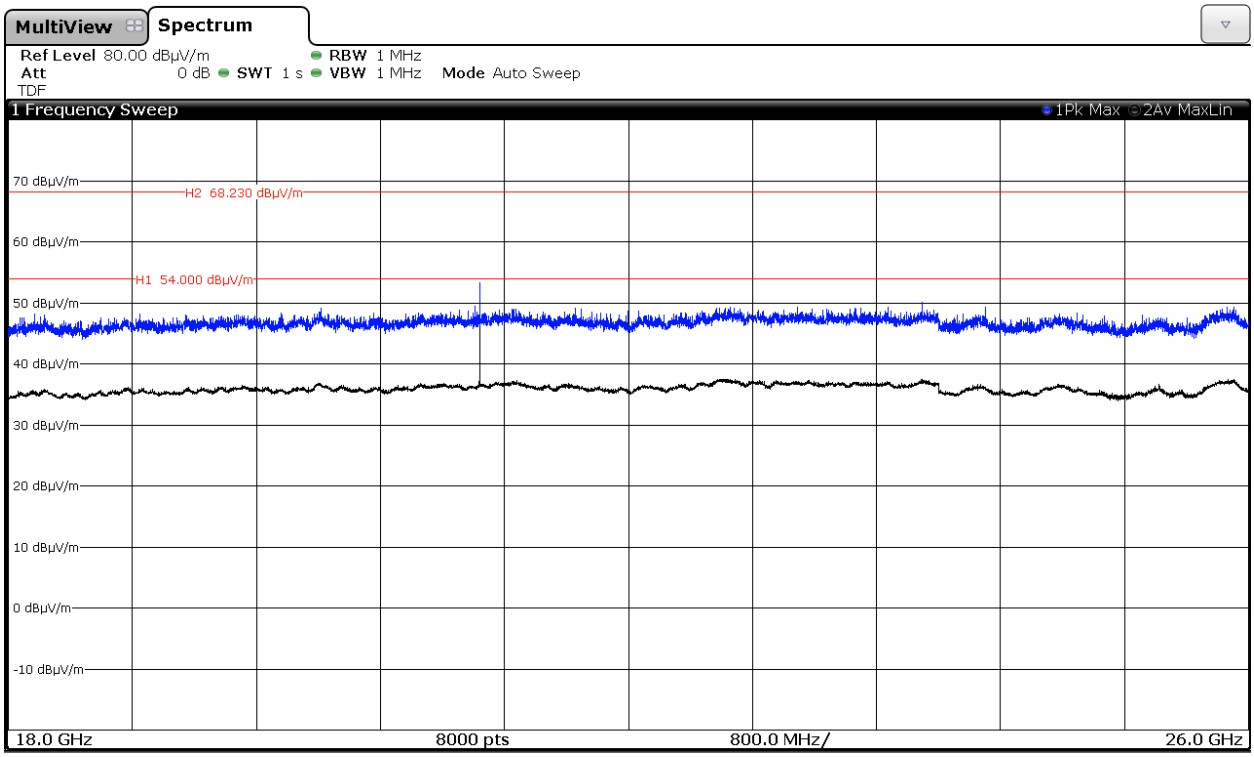


FREQUENCY RANGE 18 GHz to 26GHz.

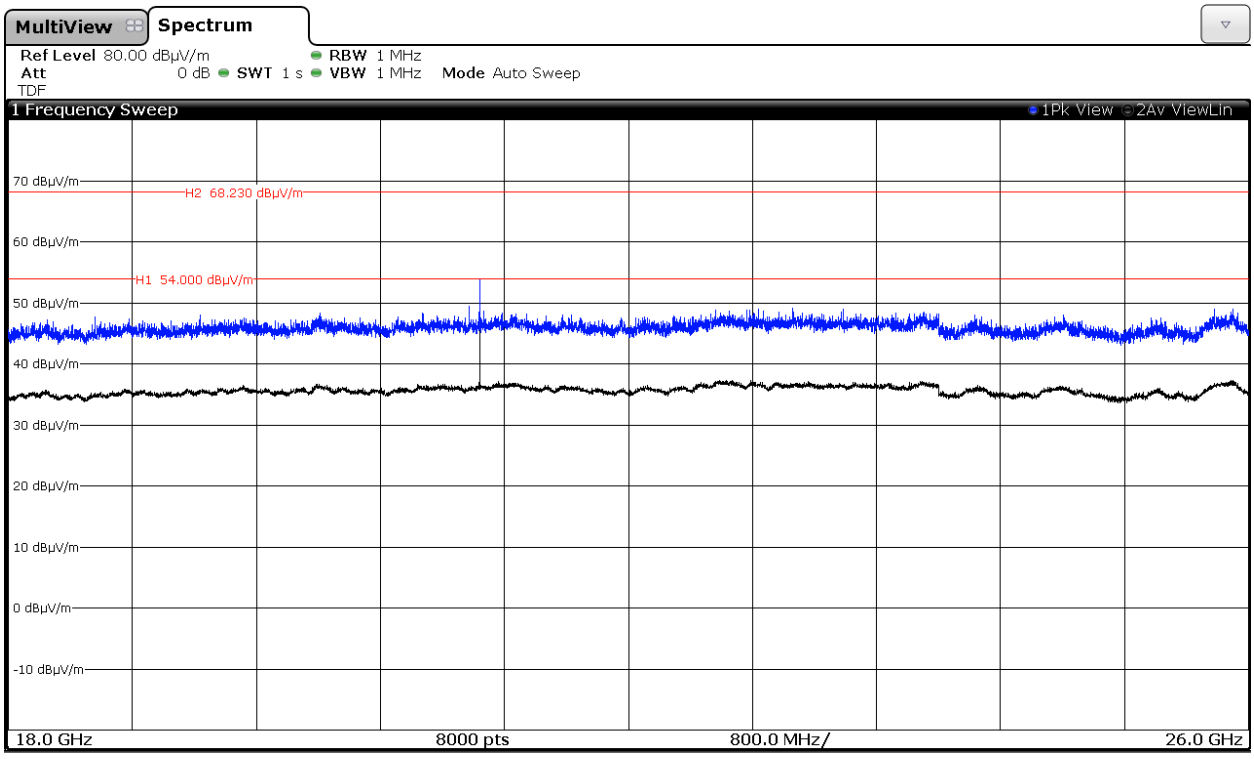
1. WiFi 5GHz 802.11 a mode

Lowest frequency 5260 MHz.

Chain A

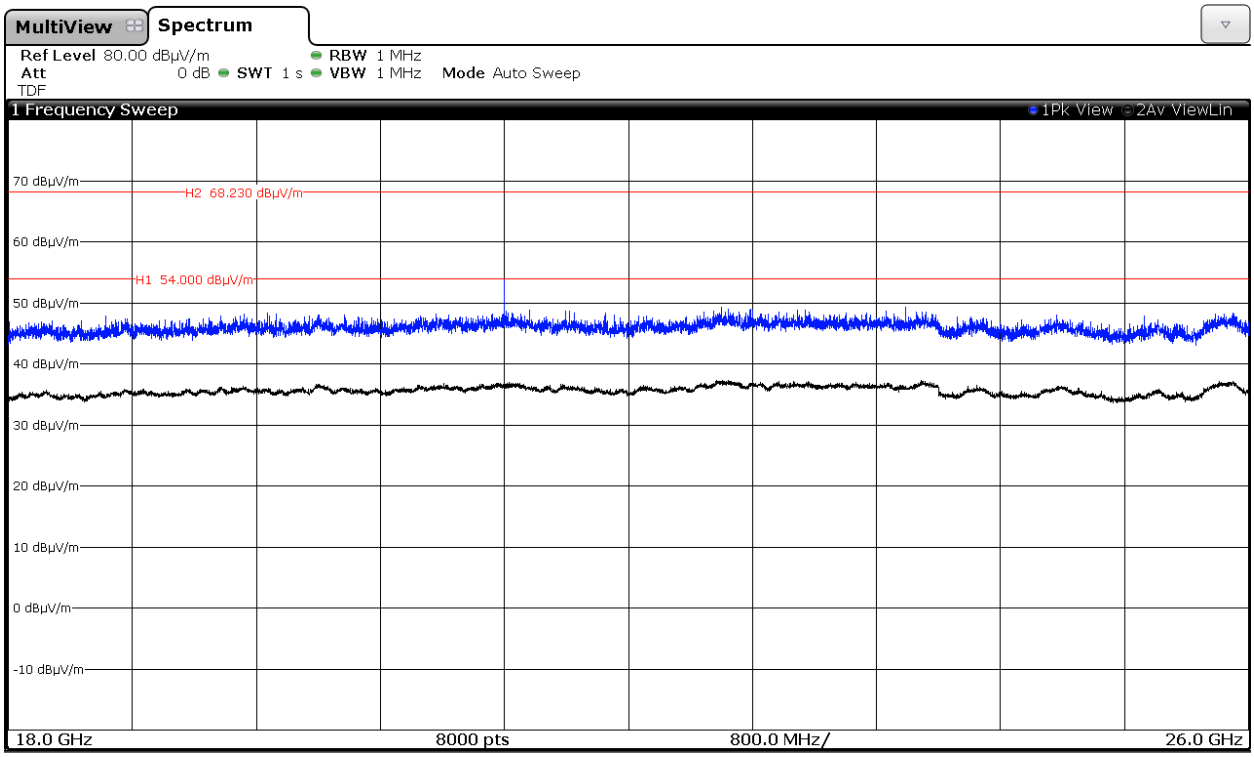


Chain B

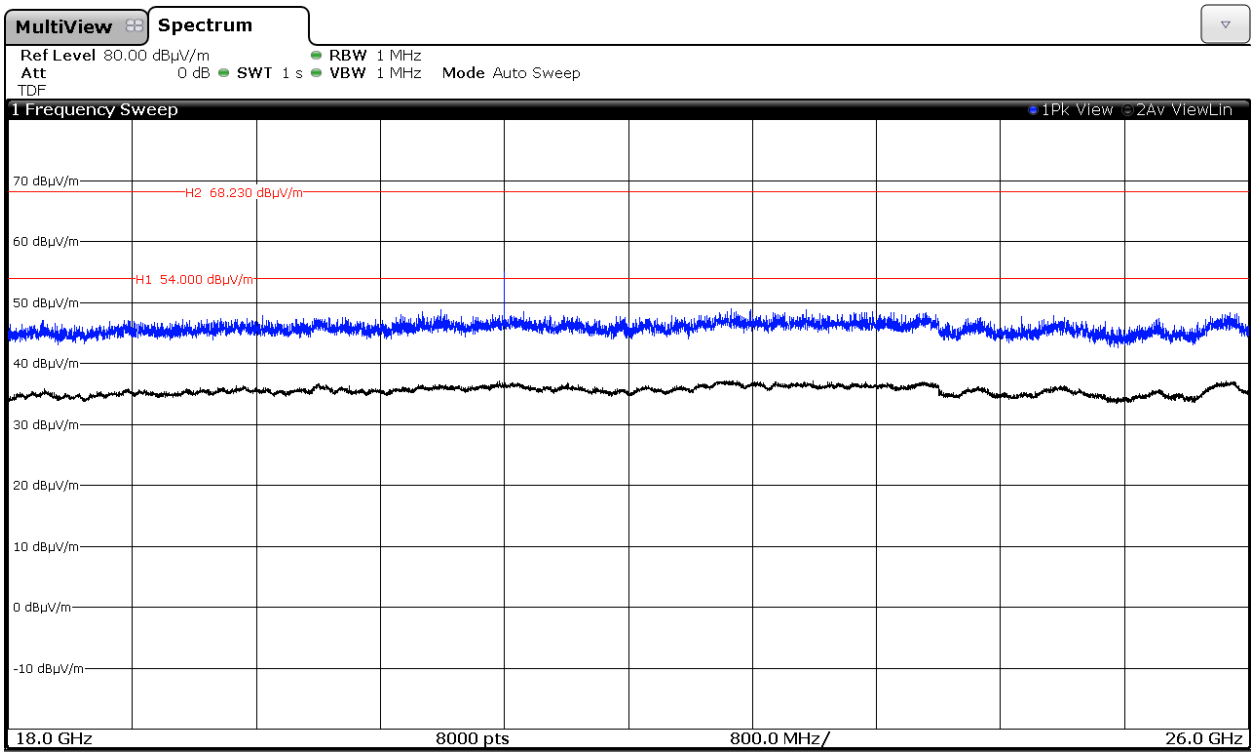


Middle frequency 5300 MHz.

Chain A

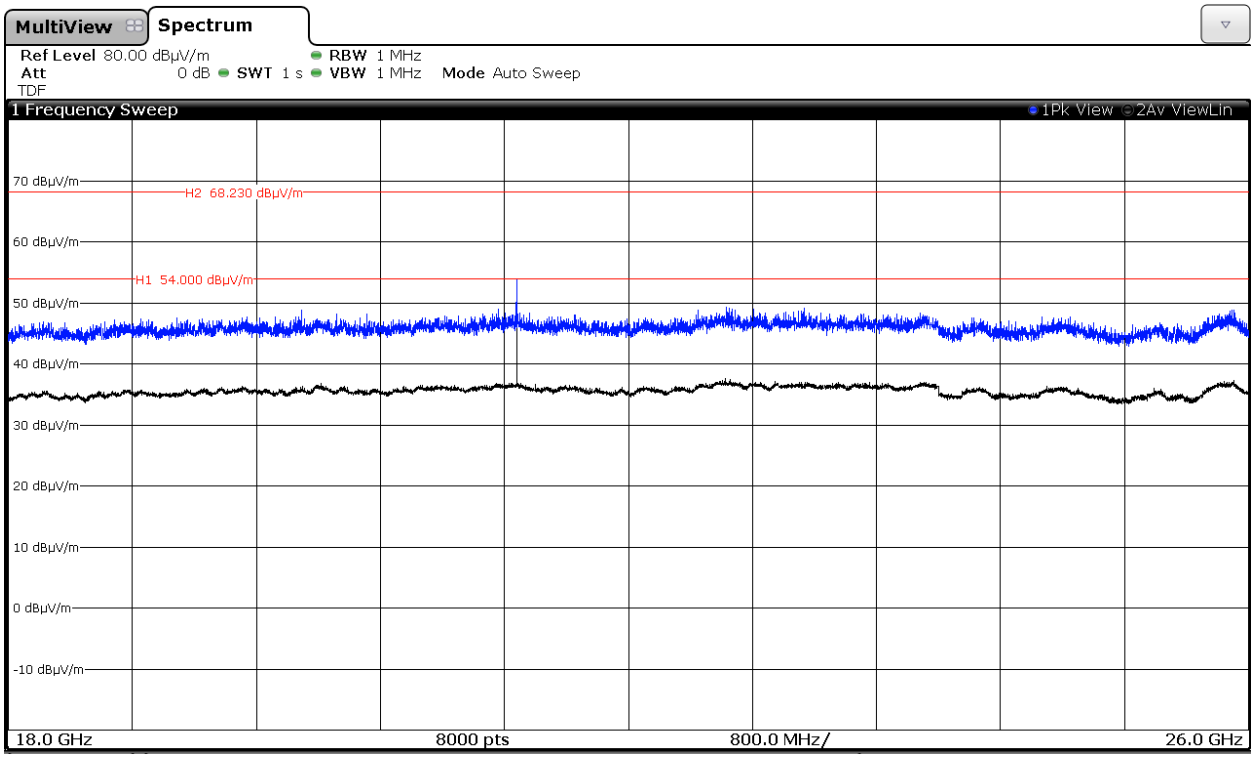


Chain B

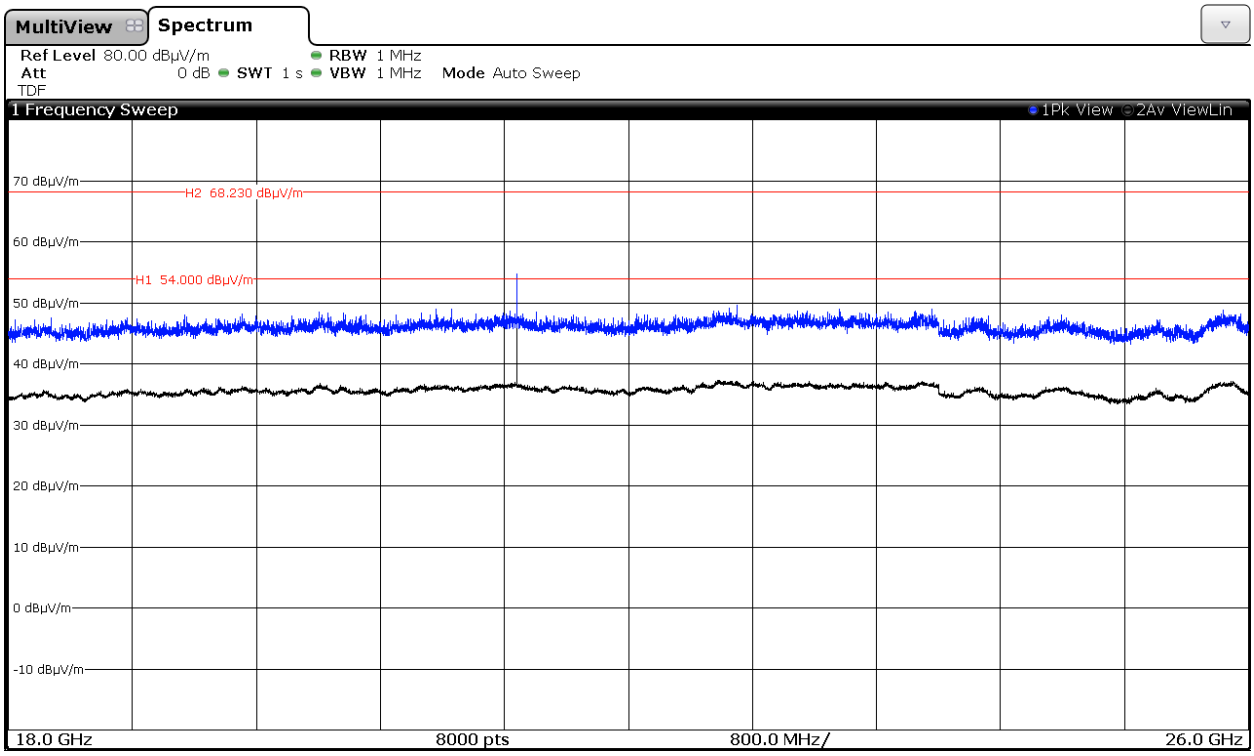


Highest frequency 5320 MHz.

Chain A

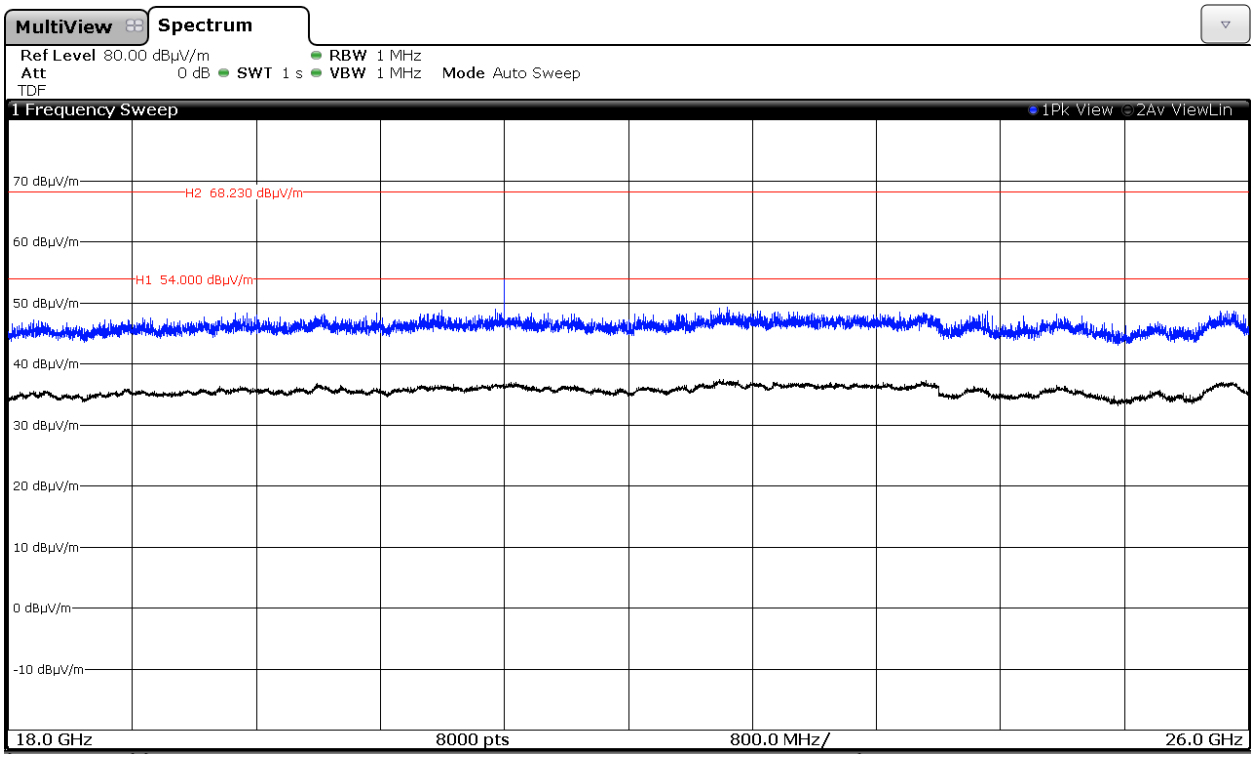


Chain B

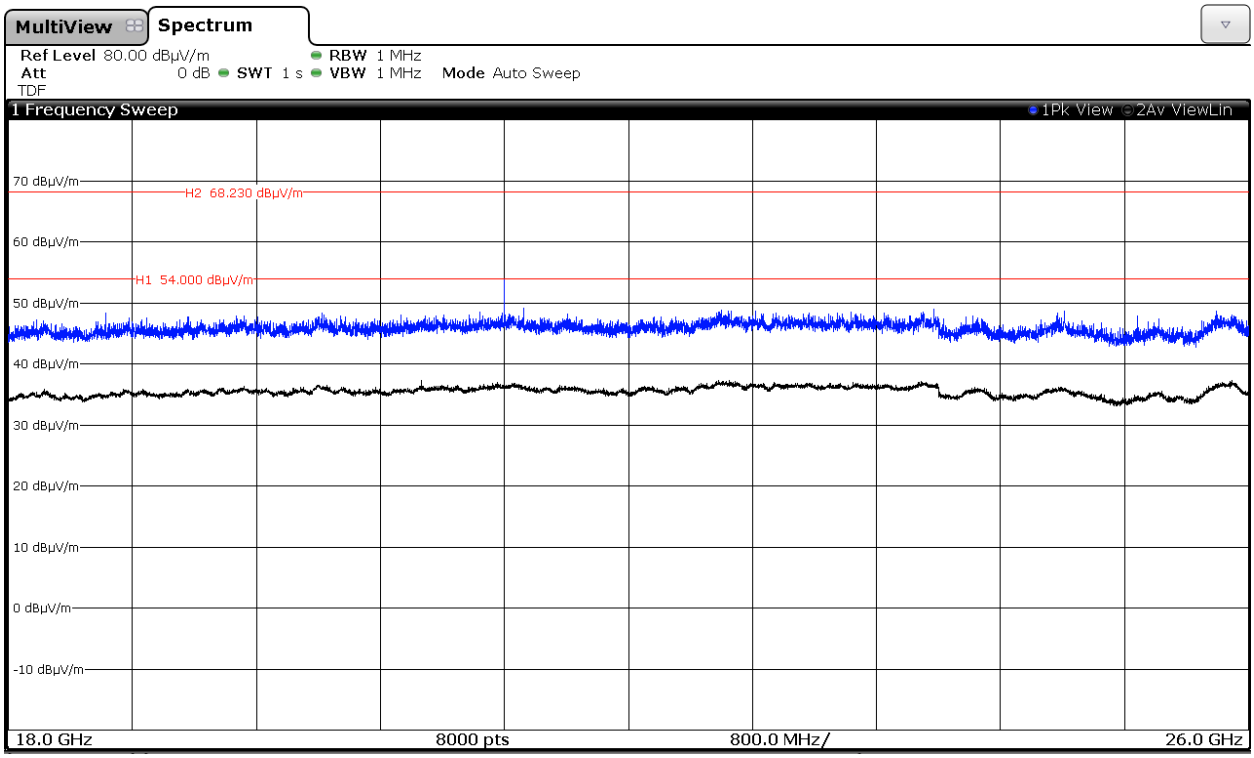


2. WiFi 5GHz 802.11 n20 mode

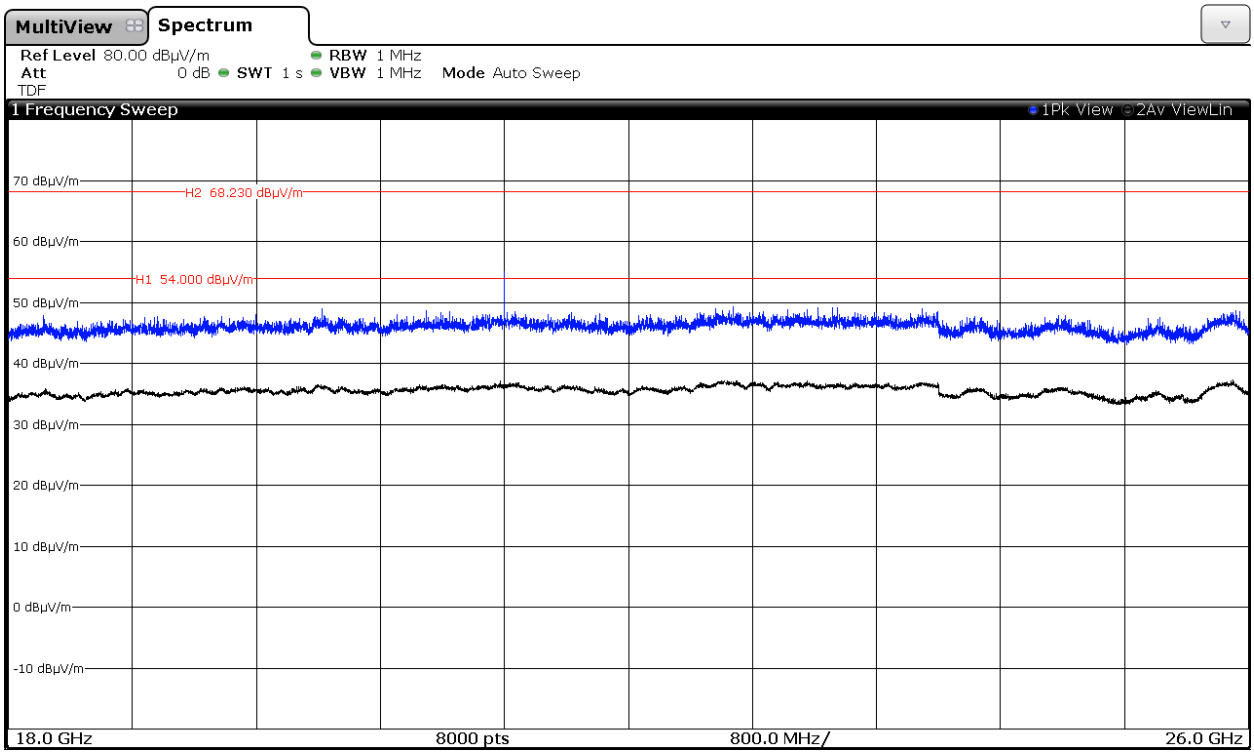
Middle frequency 5300 MHz.
Chain A



Chain B



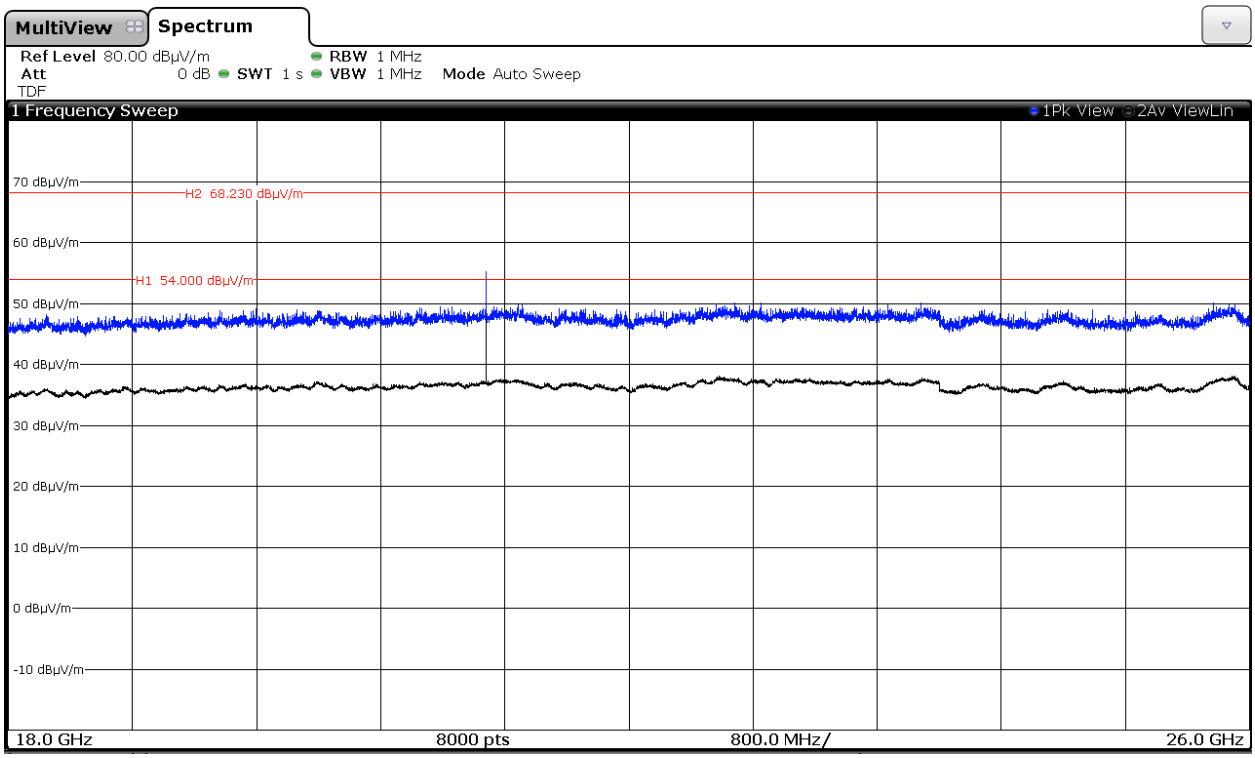
Chain A+B



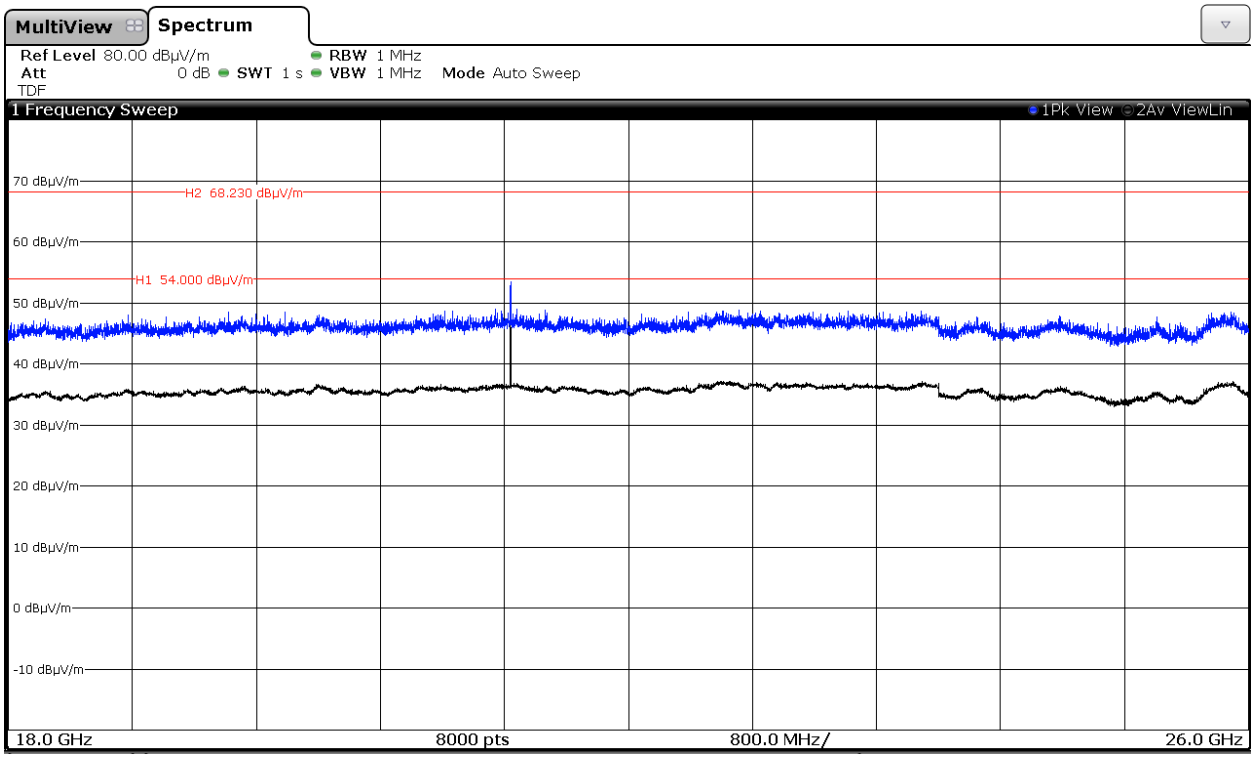
3. WiFi 5GHz 802.11 n40 mode

Lowest frequency 5270 MHz.

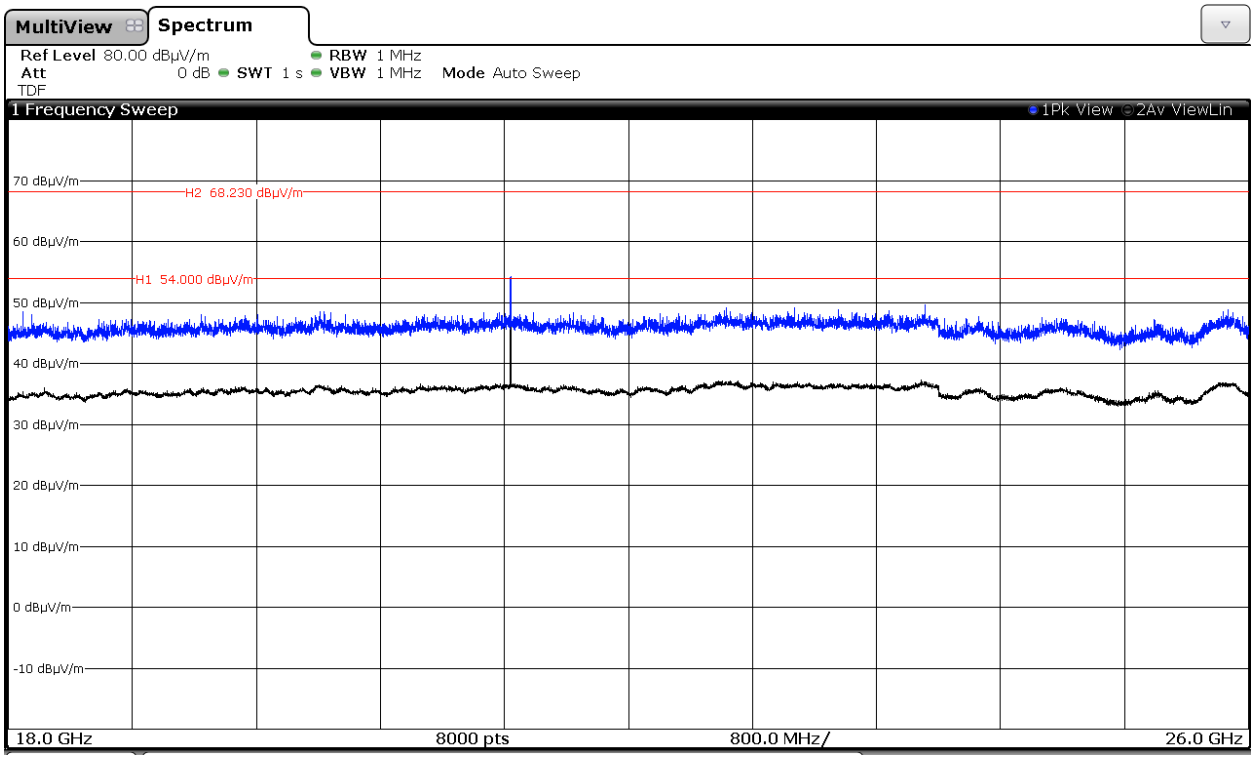
Chain A+B



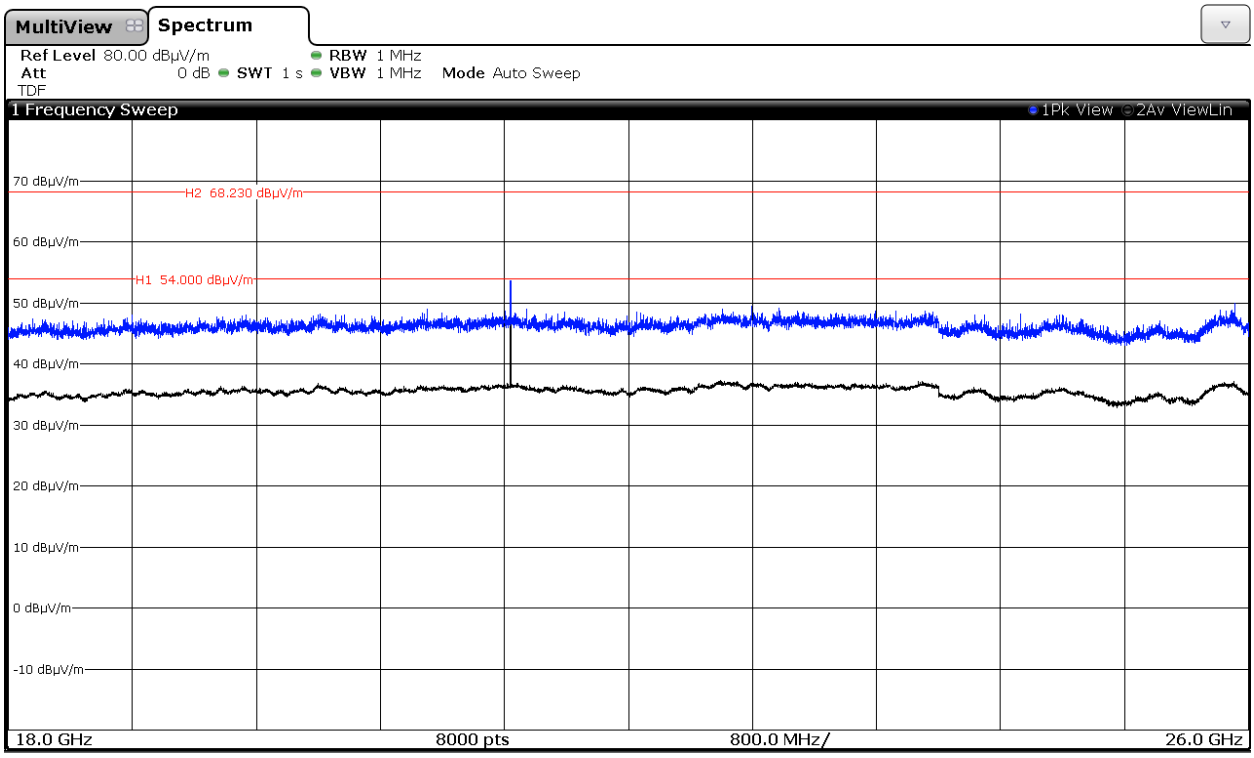
Highest frequency 5310 MHz.
Chain A



Chain B



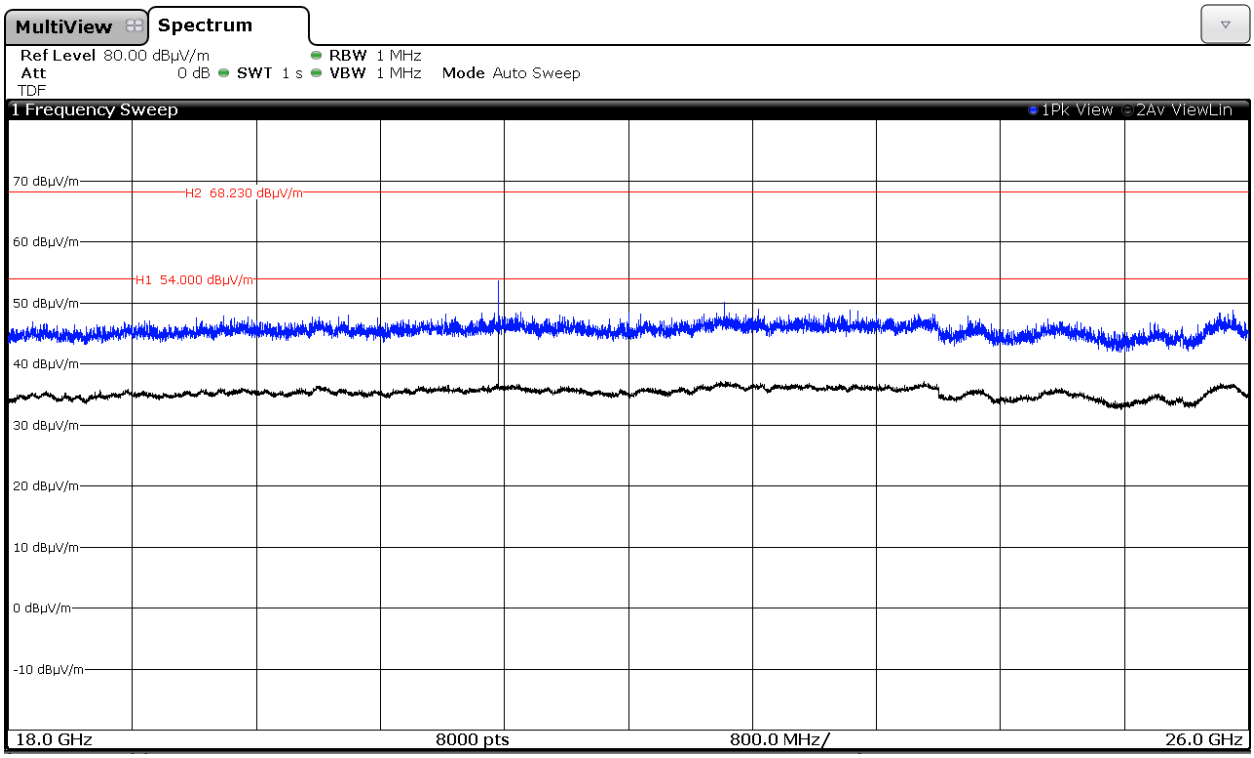
Chain A+B



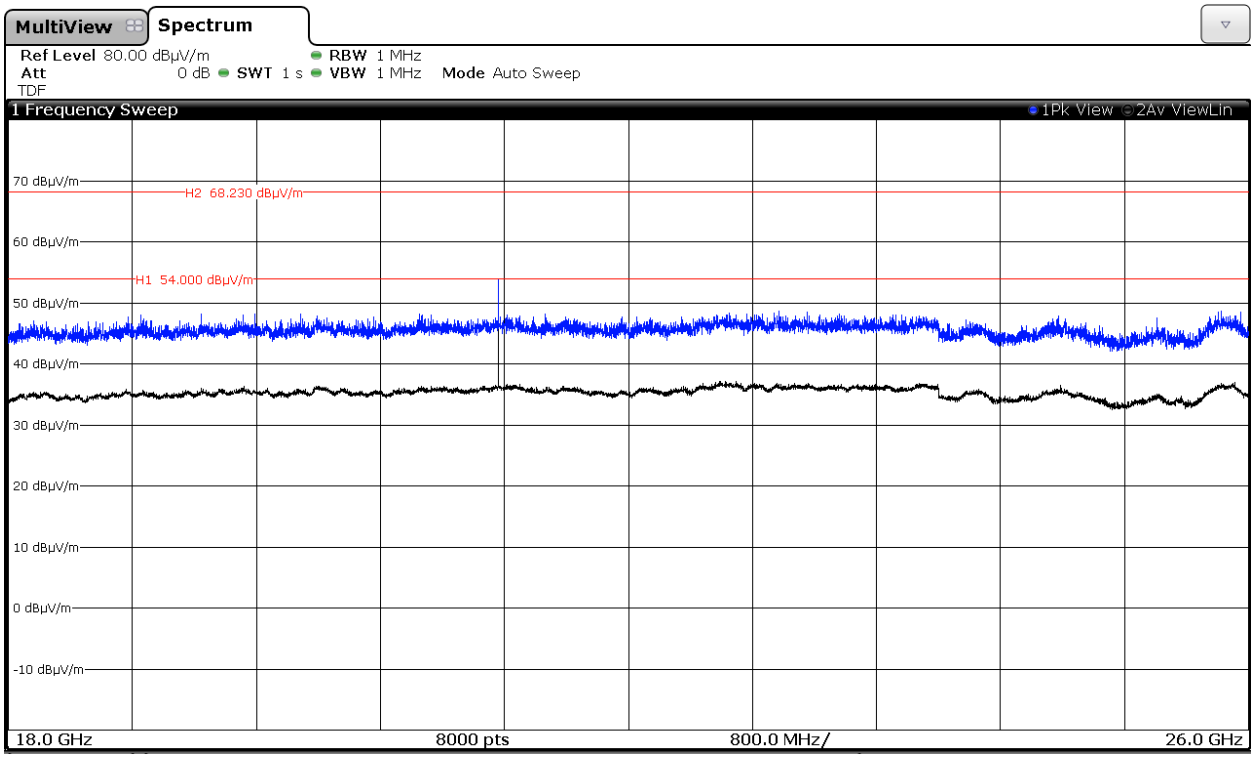
4. WiFi 5GHz 802.11 ac80 mode

Middle frequency 5290 MHz

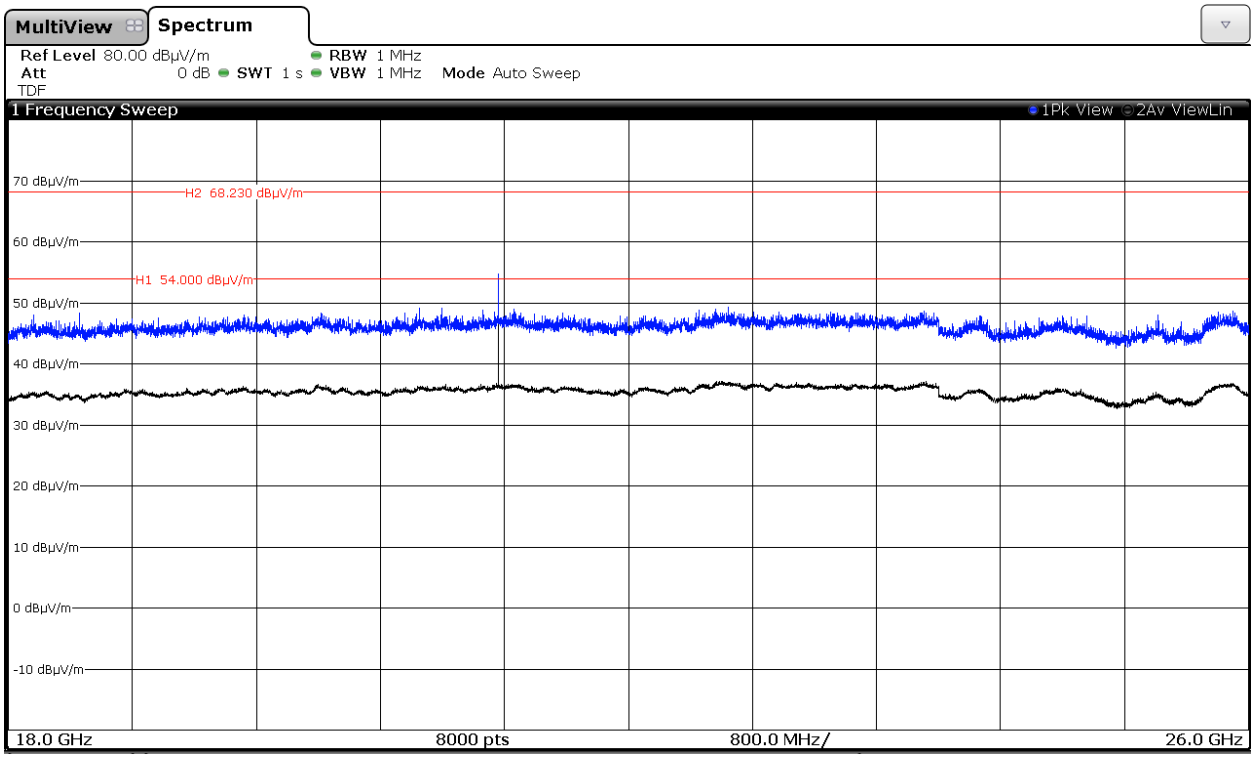
Chain A



Chain B

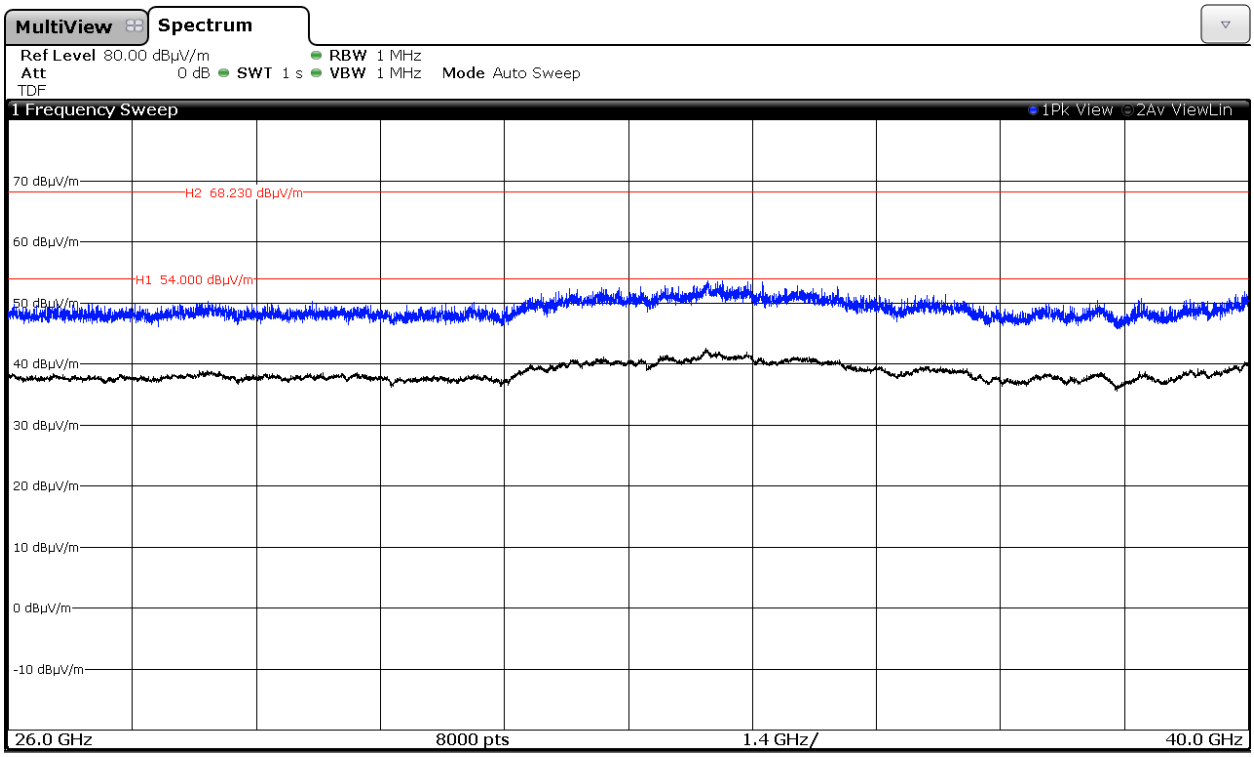


Chain A+B



FREQUENCY RANGE 26 GHz 40GHz.

No spurious signals were found in all modulations and channels tested.



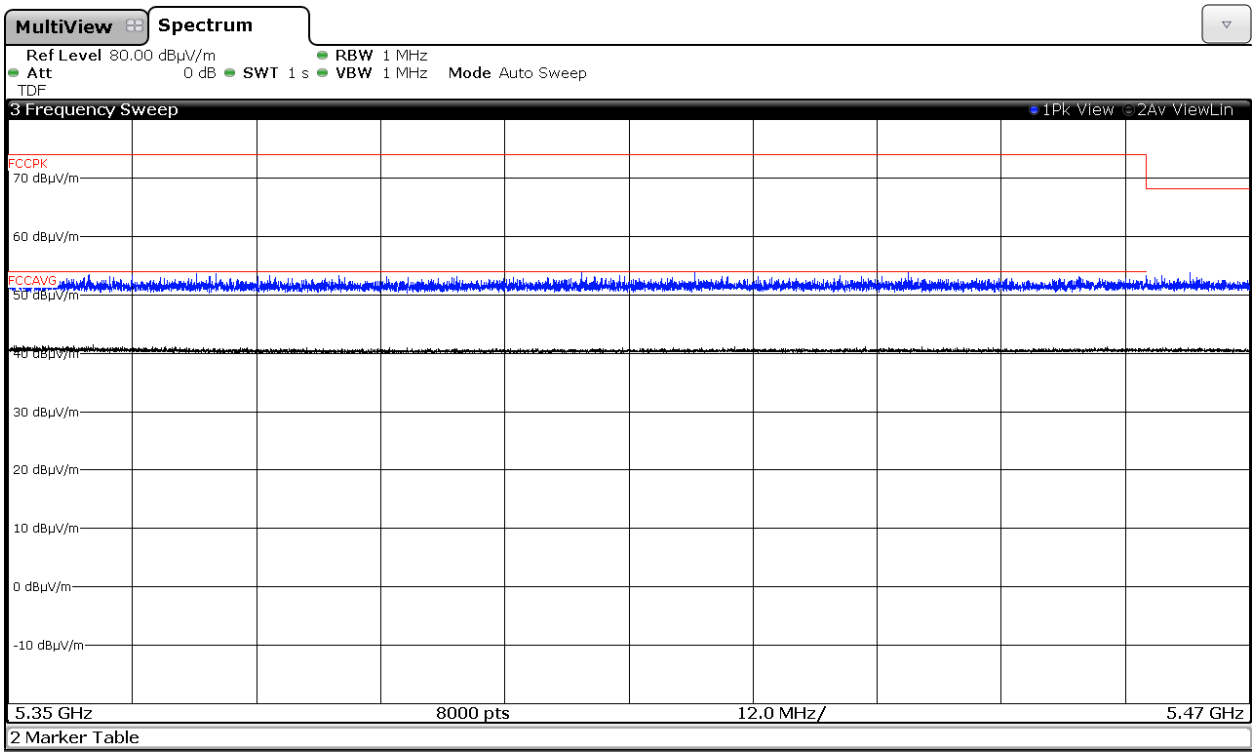
(This plot is valid for both SISO and MIMO).

Radiated spurious emissions at band-edges and inside restricted band 5.35 – 5.46 GHz.

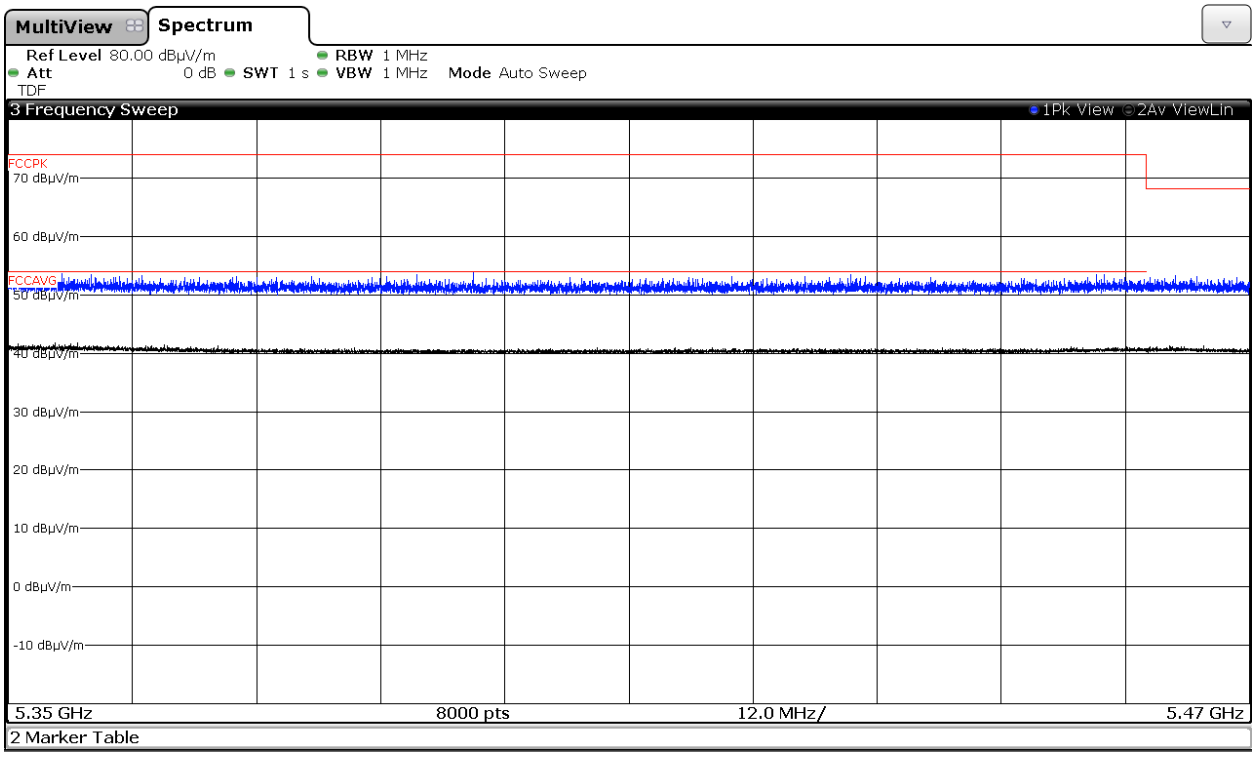
1. WiFi 5GHz 802.11 a mode

Middle frequency 5300 MHz.

Chain A

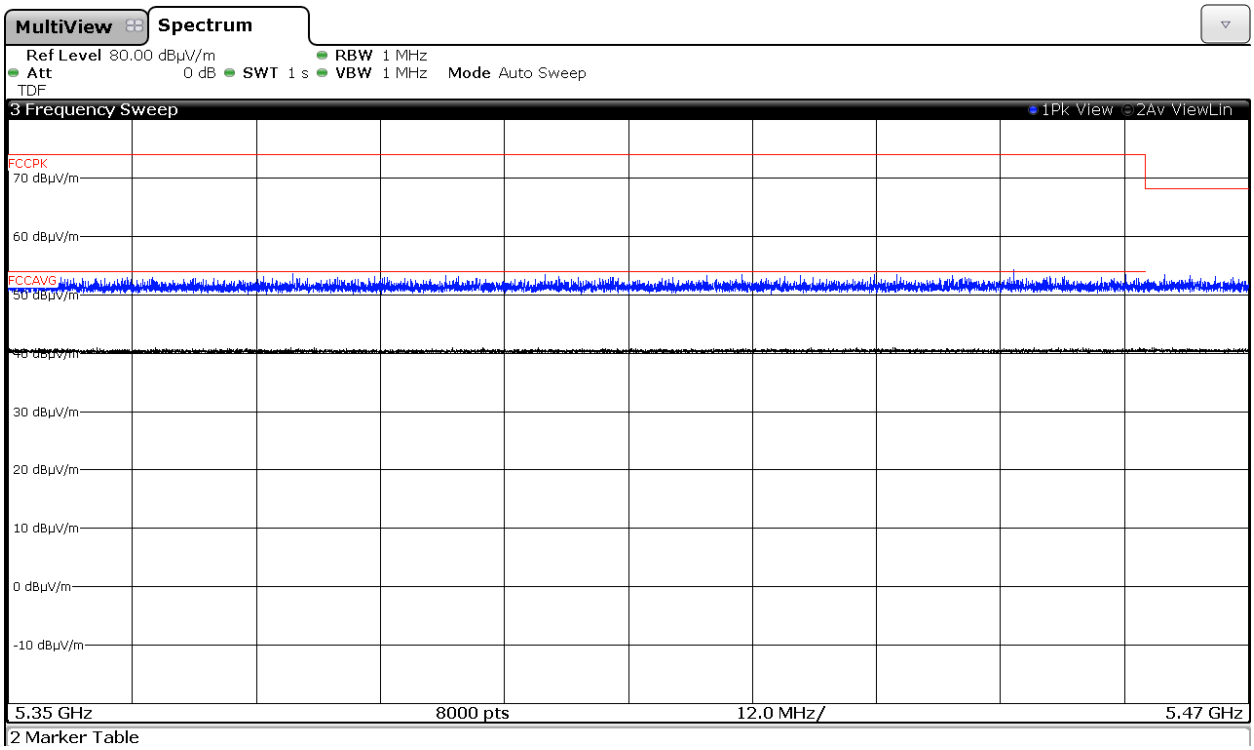


Chain B

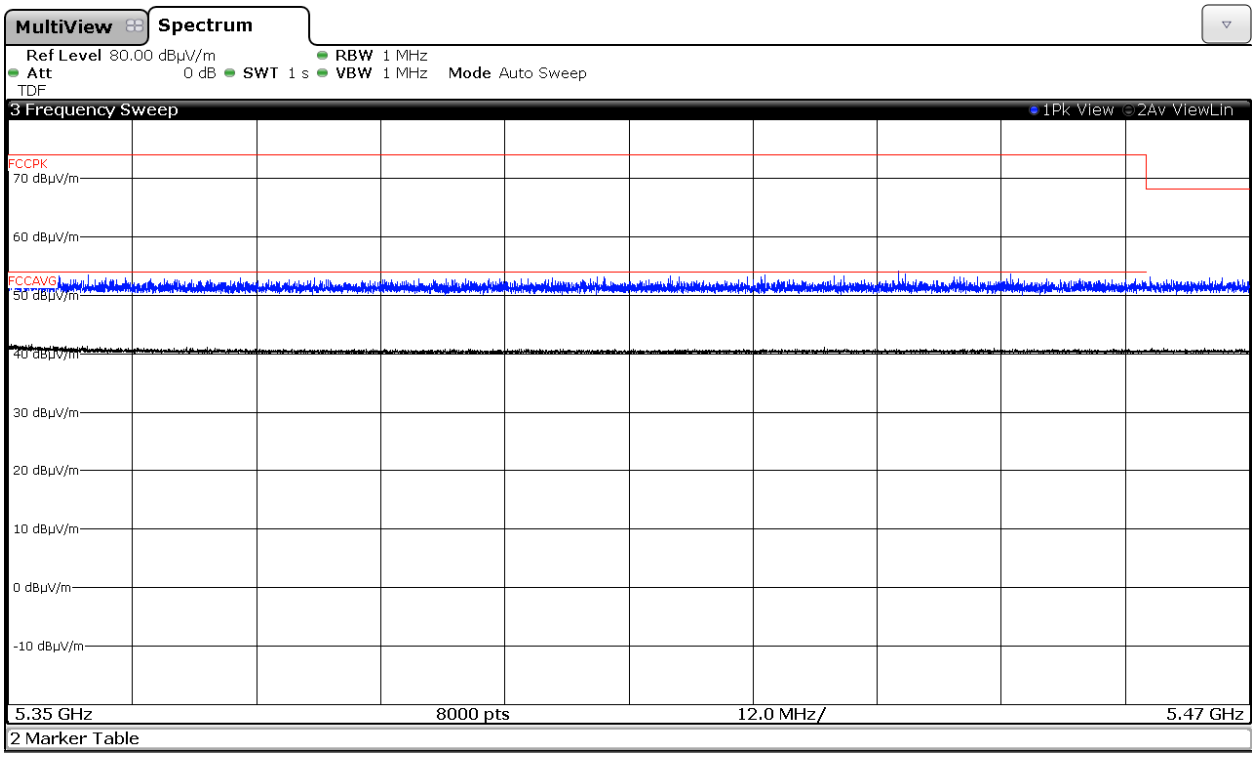


Highest frequency 5320 MHz.

Chain A



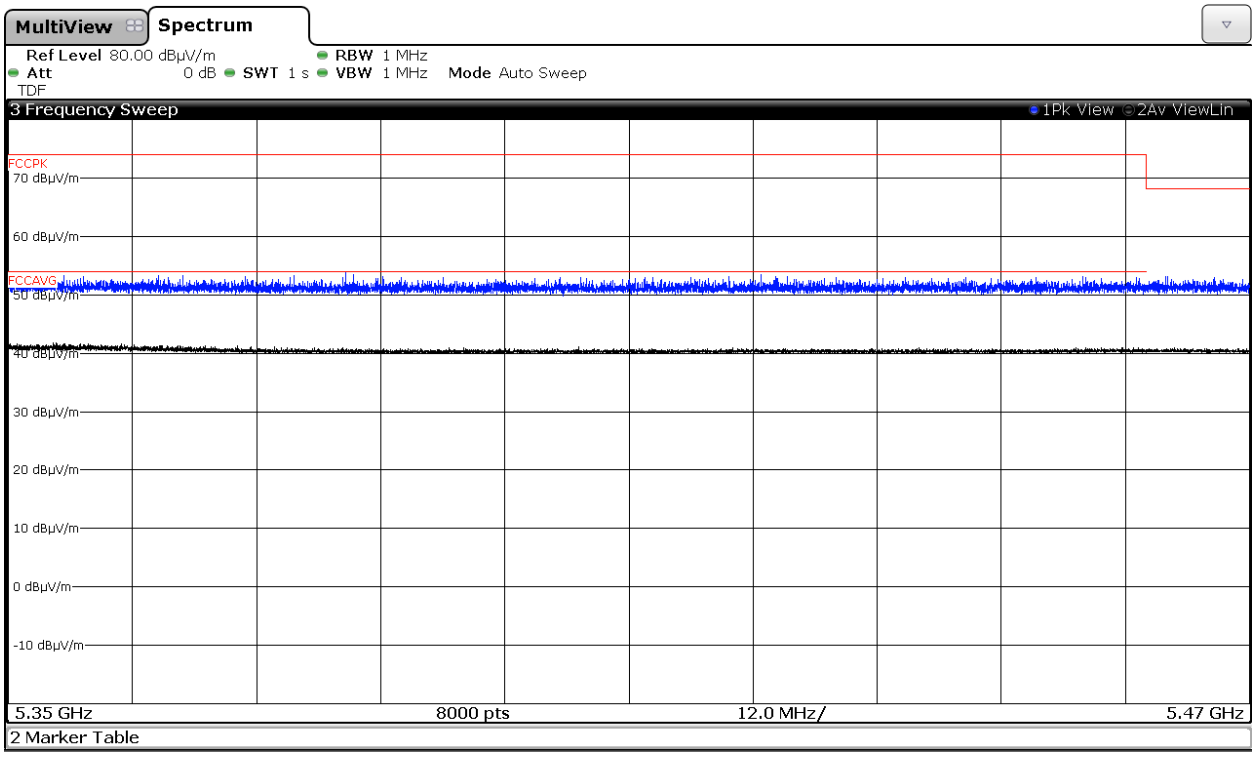
Chain B



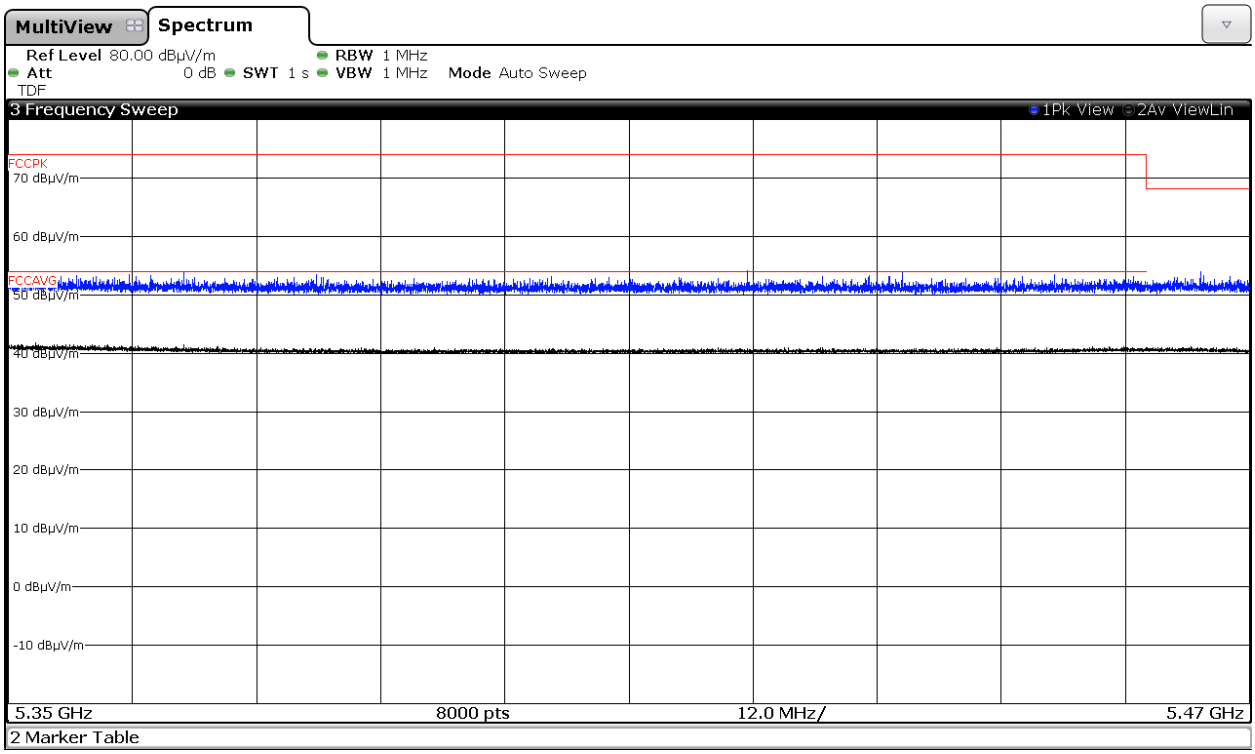
2. WiFi 5GHz 802.11 n20 mode

Middle frequency 5300 MHz.

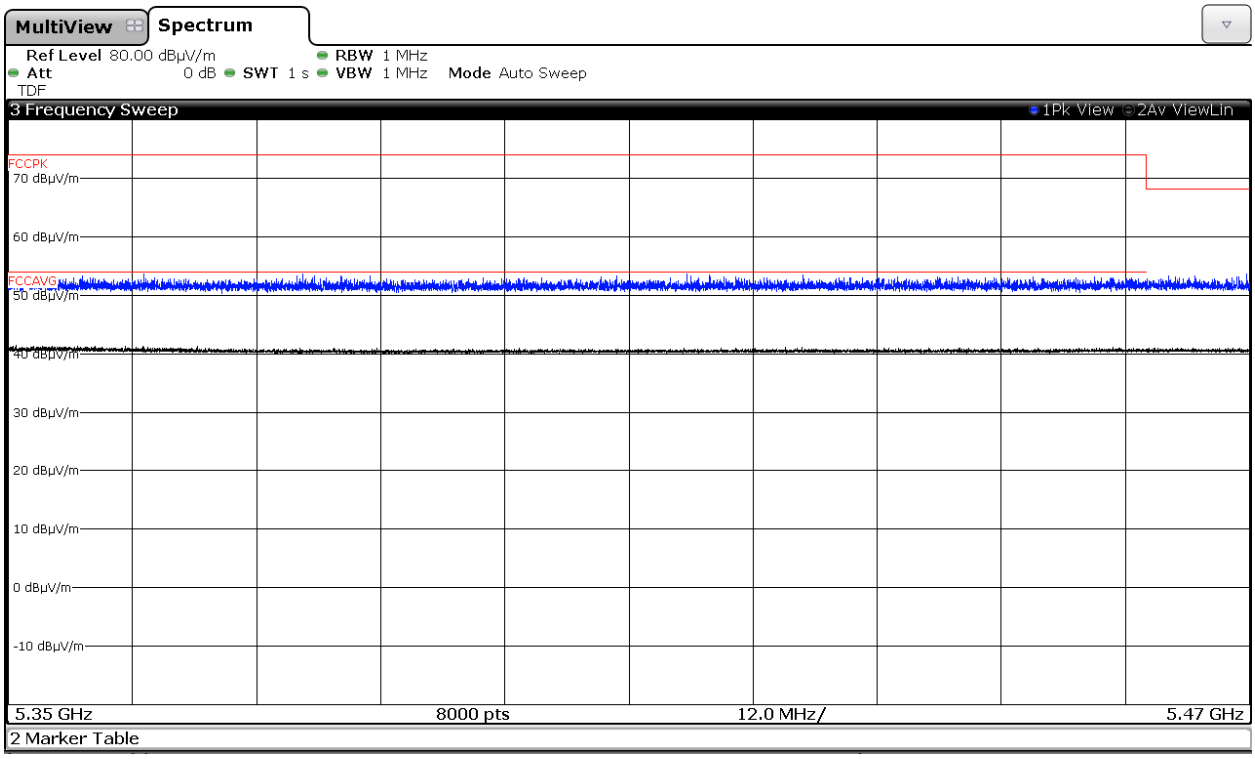
Chain A



Chain B

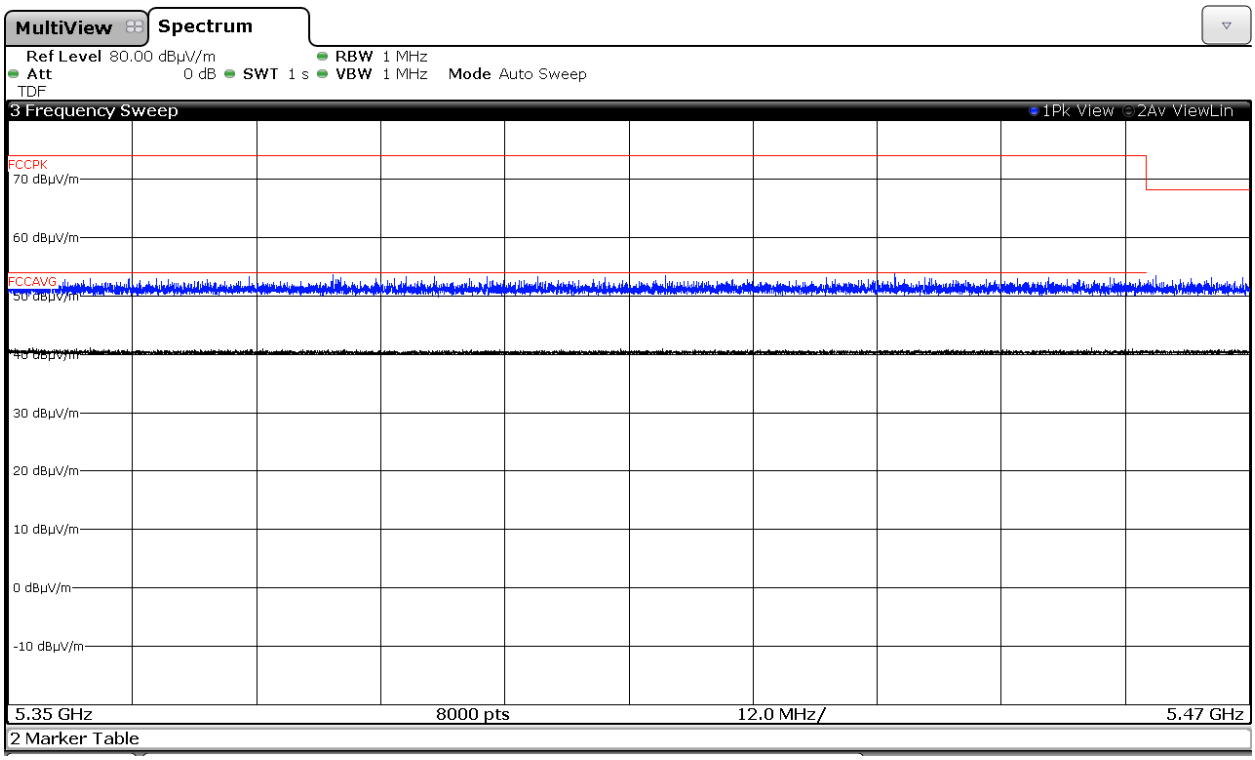


Chain A+B

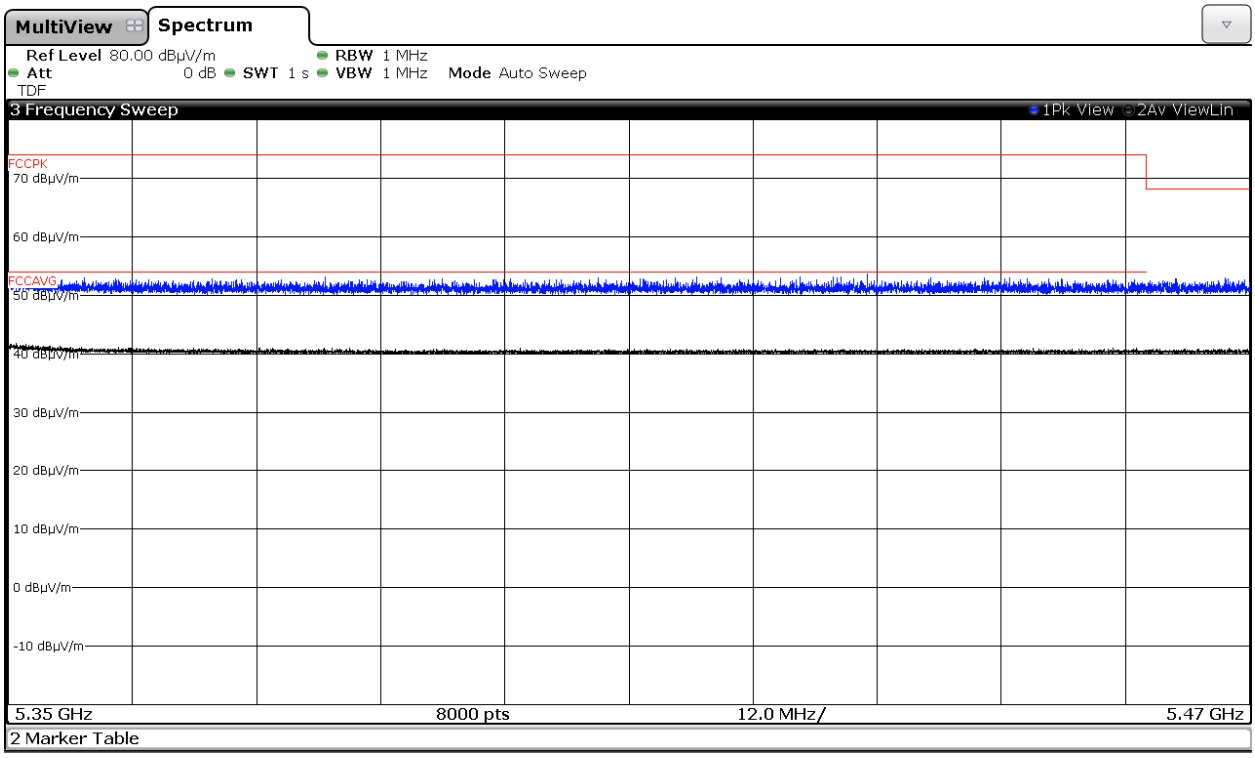


Highest frequency 5320 MHz.

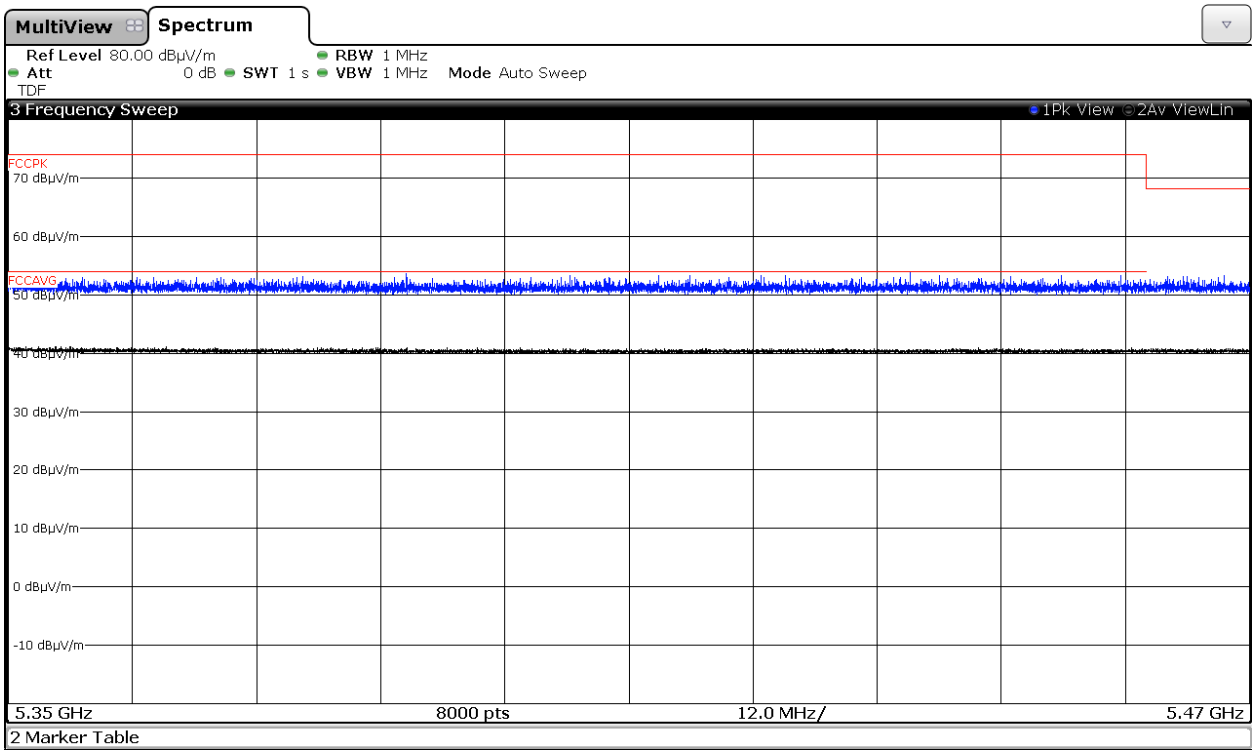
Chain A



Chain B



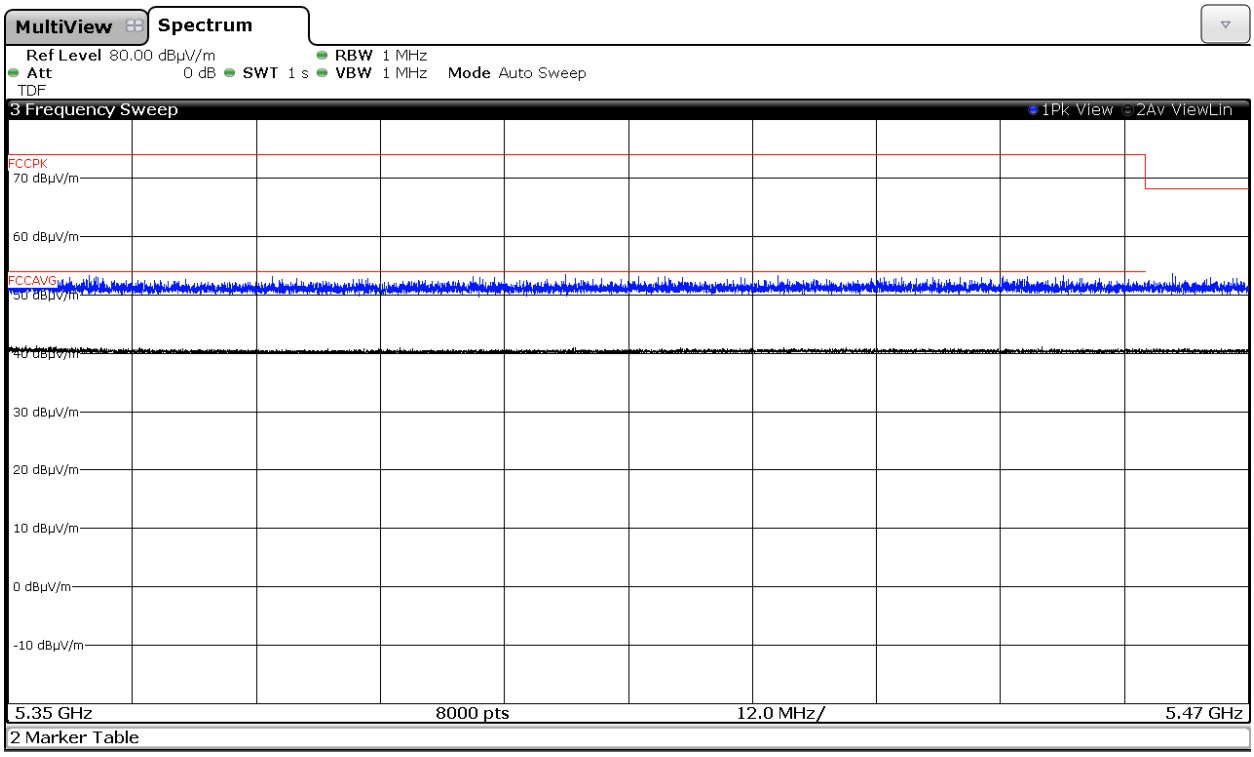
Chain A+B



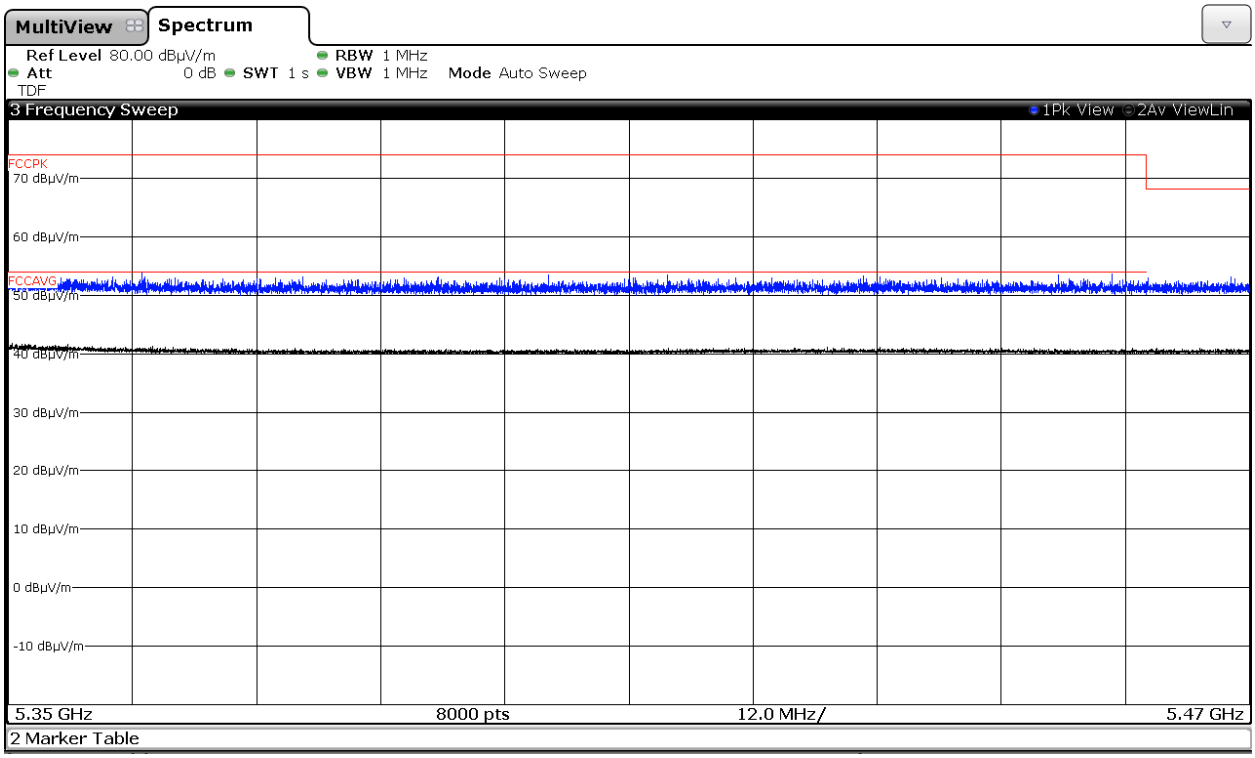
3. WiFi 5GHz 802.11 n40 mode

Lowest frequency 5270 MHz.

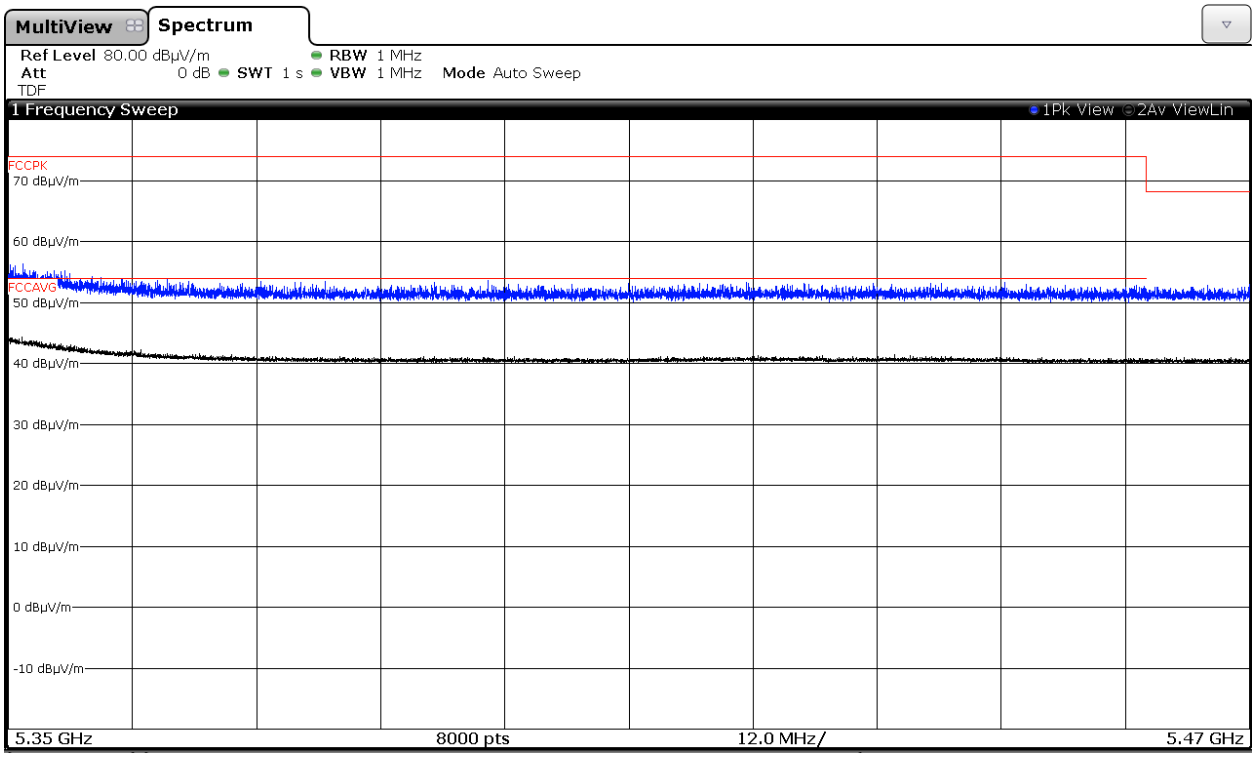
Chain A



Chain B

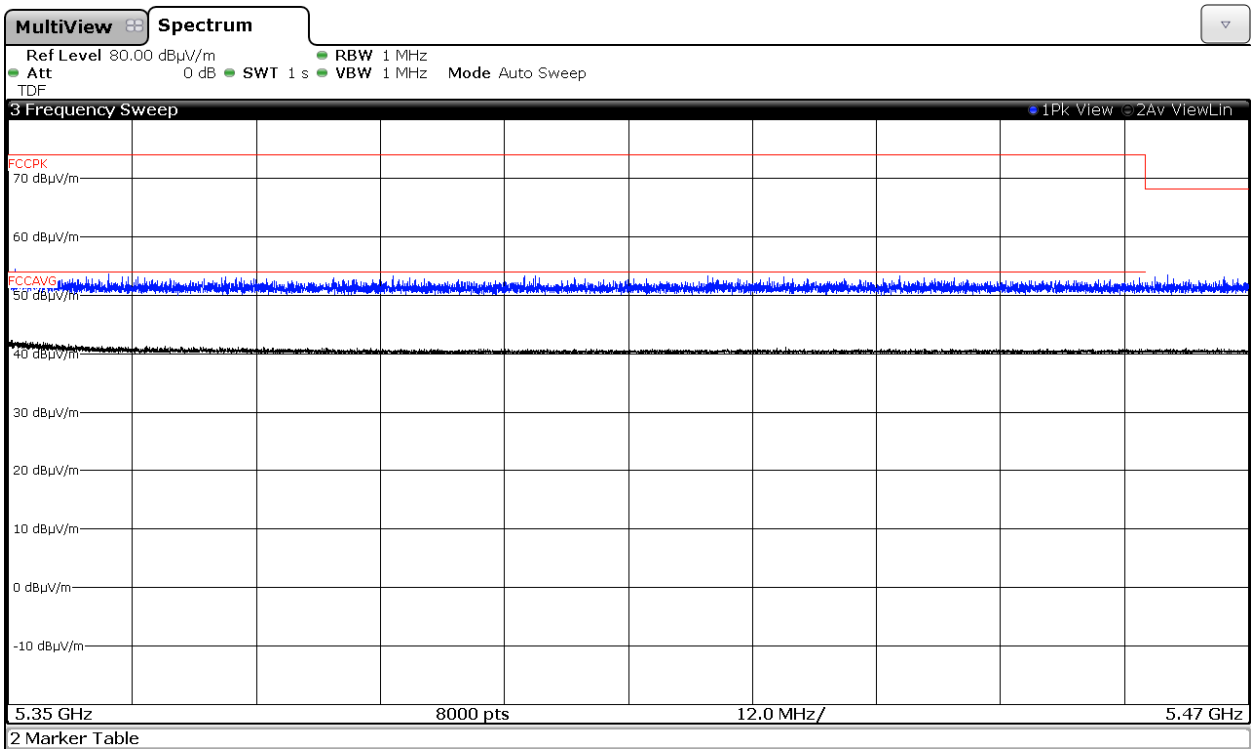


Chain A+B

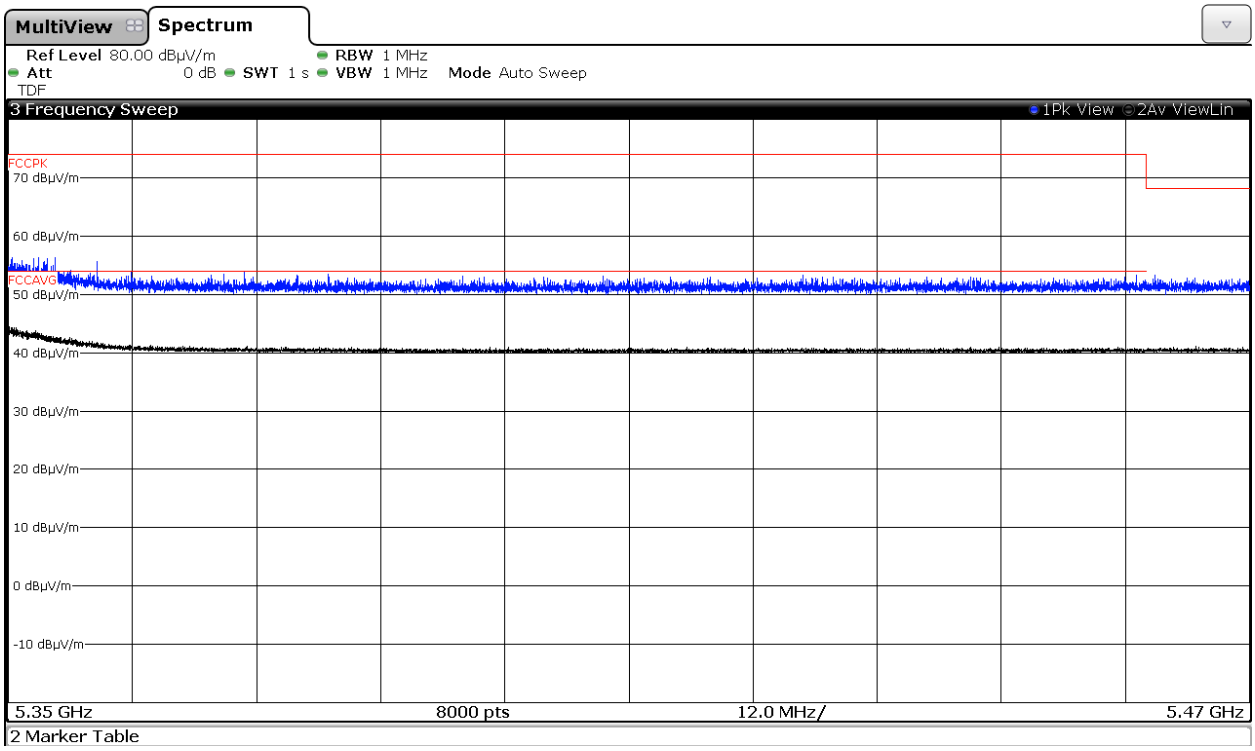


Highest frequency 5310 MHz.

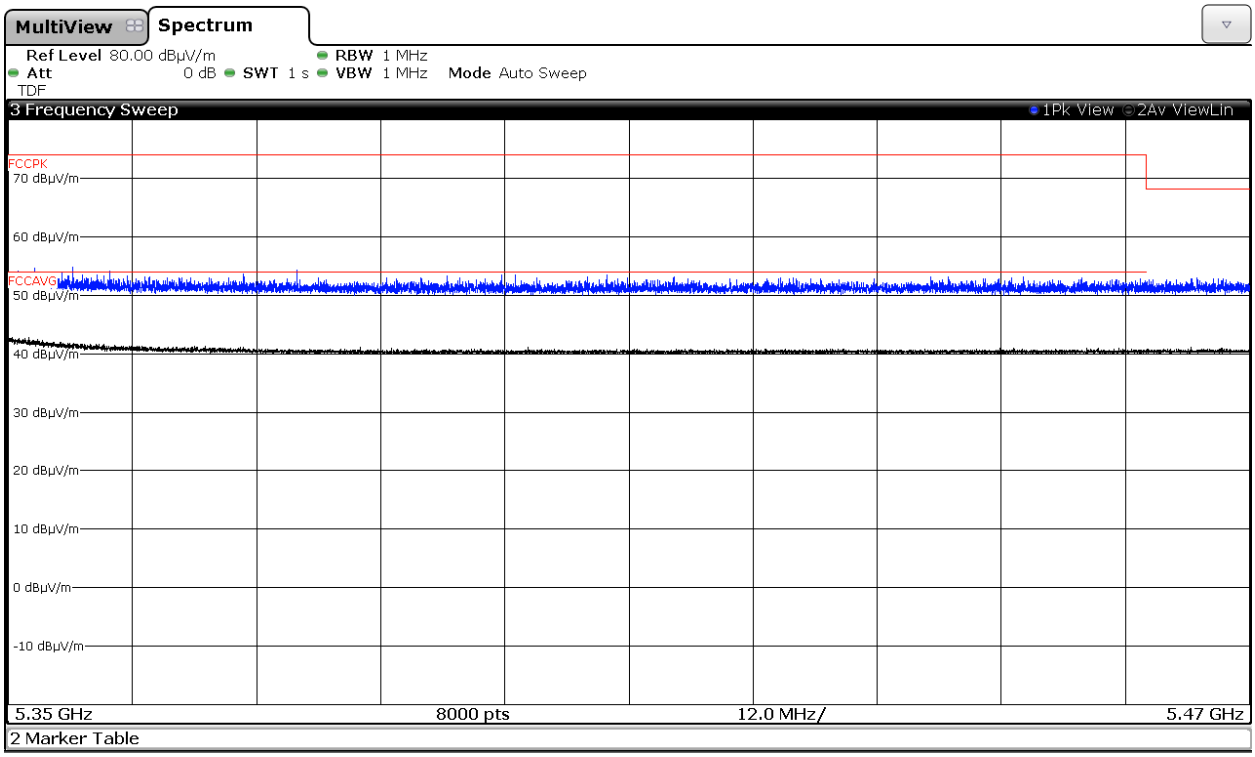
Chain A



Chain B



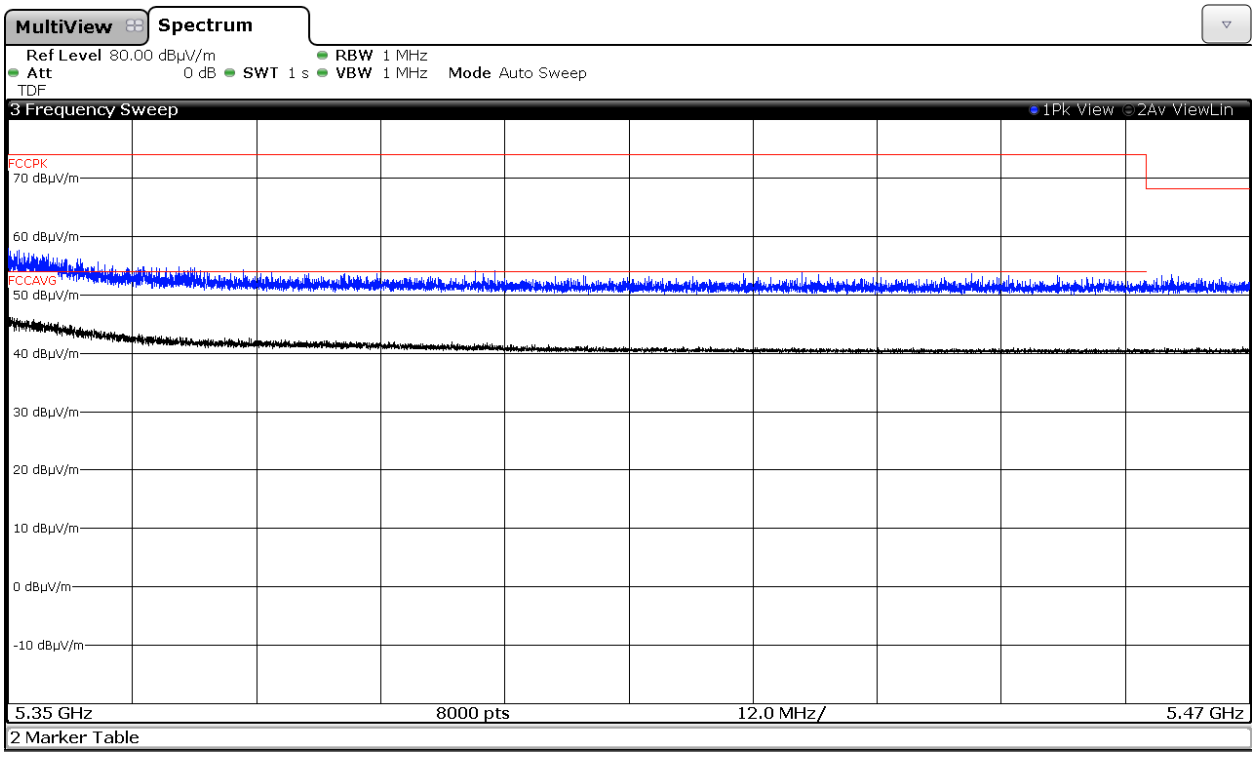
Chain A+B



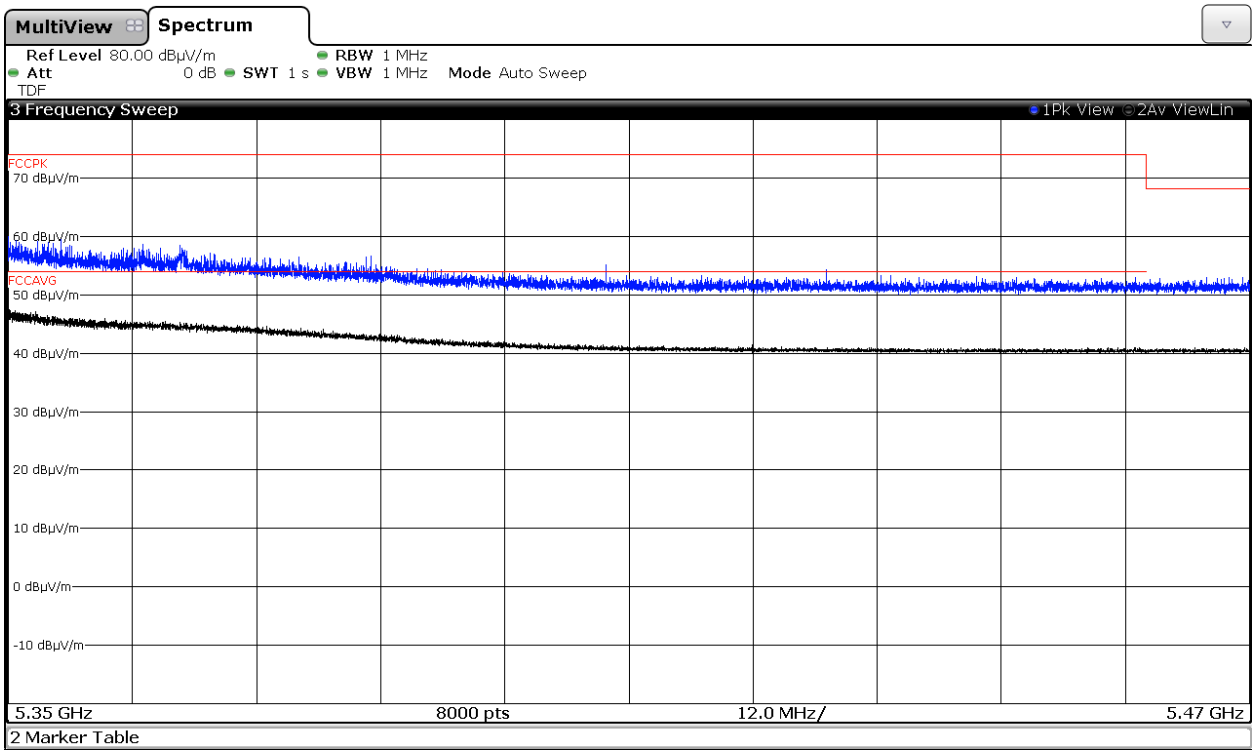
4. WiFi 5GHz 802.11 ac80 mode

Middle frequency 5290 MHz.

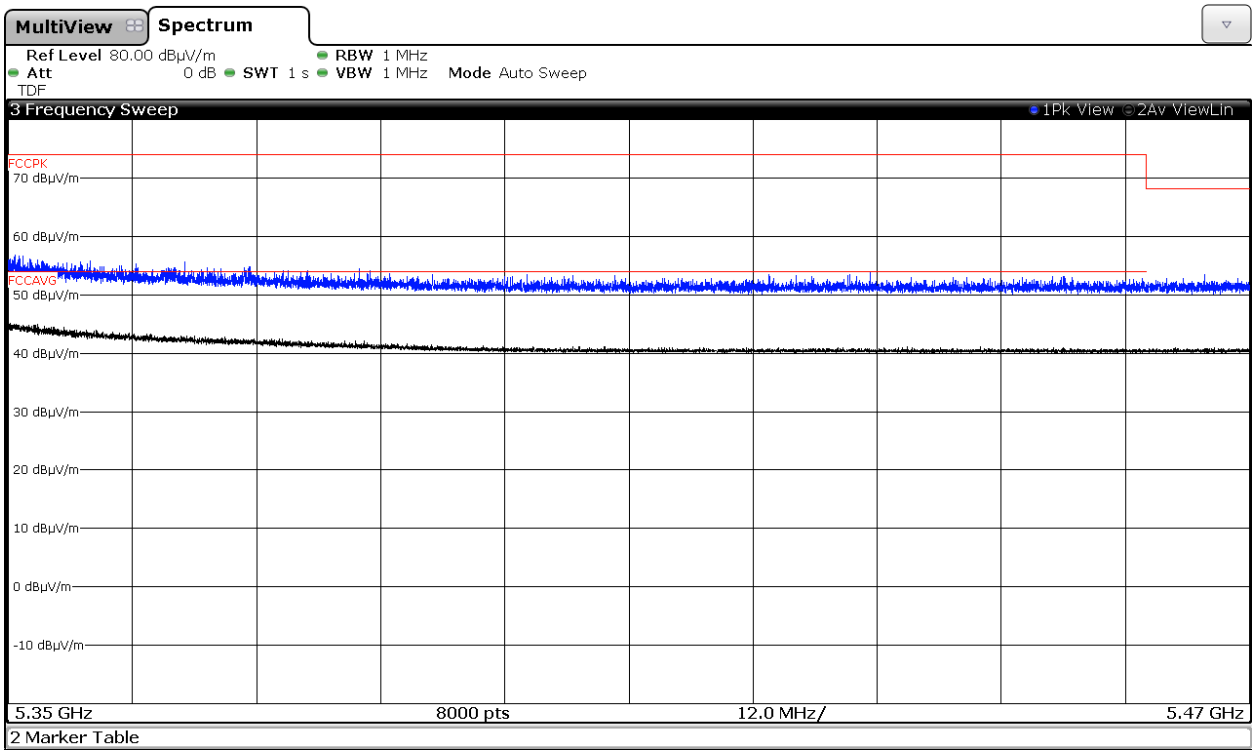
Chain A



Chain B



Chain A+B


MultiView
Spectrum
Ref Level 80.00 dBµV/m
RBW 1 MHz
Att 0 dB
SWT 1 s
VBW 1 MHz
Mode Auto Sweep
TDF
3 Frequency Sweep
1Pk View
2Av ViewLin
FCCPK
70 dBµV/m
60 dBµV/m
FCCAVG
50 dBµV/m
40 dBµV/m
30 dBµV/m
20 dBµV/m
10 dBµV/m
0 dBµV/m
-10 dBµV/m
5.35 GHz
8000 pts
12.0 MHz/
5.47 GHz
2 Marker Table

APPENDIX C: Test results for 5.47 GHz – 5.725 GHz band

INDEX

TEST CONDITIONS.....166
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Section 15.407 Subclause (b) (3) / RSS-210 A9.2. (3). Undesirable radiated emissions (Transmitter) 1 to 40 GHz.....232

TEST CONDITIONS

Power supply (V):

$V_{nominal}$ = 3.3 Vdc

Type of power supply = DC voltage from HMC/NGFC test board.

Type of antenna = External attachable PIFA antenna.

Declared Gain for antenna = 4.8 dBi

Operating frequencies in the sub-band 5.47-5.725 GHz.

-For IEEE 802.11a, the equipment uses channels 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140.

-For IEEE 802.11n, there are two bandwidths:

For 20 MHz bandwidth the equipment uses channels 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140.
For 40 MHz bandwidth the equipment uses channels 102, 110, 118, 126, 134.

-For IEEE 802.11ac, there are three bandwidths:

For 20 MHz bandwidth the equipment uses channels 100, 104, 108, 112, 116, 120, 124, 128, 132, 136, 140, 144.
For 40 MHz bandwidth the equipment uses channels 102, 110, 118, 126, 134,142.
For 80 MHz bandwidth the equipment uses channels 106, 122, 138.

TEST FREQUENCIES:

For WiFi a/n20/ac20:

Lowest channel (100): 5500 MHz

Middle channel (120): 5600 MHz

Highest channel (140) 5700 MHz for 802.11n20 and 5720 MHz (144) for 802.11ac20

For WiFi n40/ac40:

Lowest channel (102): 5510 MHz

Middle channel (118): 5590 MHz

Highest channel (134) 5670 MHz for 802.11n40 and 5710 MHz (142) for 802.11ac40

For WiFi ac80:

Lowest channel (106): 5530 MHz

Middle channel (122): 5610 MHz

Highest channel (138): 5690 MHz

The test set-up was made in accordance to the general provisions of ANSI C63.10: 2009 and FCC KDB 789033 D01 General UNII Test Procedures v01r03 and FCC KBD 662911 D01 Multiple Transmitter Output v02r01 dated 10/31/2013.

For 802.11a mode the EUT can transmit at both CHAIN A and CHAIN B RF outputs individually but not simultaneously.

For 802.11n/ac modes 802.11n20/ac20 (20 MHz channel bandwidth), 802.11n40/ac40 (40MHz channel bandwidth) and 802.11ac80 (80MHz channel bandwidth) mode the EUT can transmit at both CHAIN A and CHAIN B RF outputs individually and simultaneously.

For radio testing purposes the card was installed in a test fixture. The test fixture is connected to a laptop computer and dc power supplied. The laptop computer was used to configure the EUT to continuously transmit at a specified output power with different modes and modulation schemes.

The data rates of 6Mb/s for 802.11a, HT0 (SISO) for 802.11n20/ac20 and n40/ac40, and VHT0 (SISO) for 802.11 ac80 were selected based on preliminary testing that identified those rates corresponding to the worst cases for output power and spurious levels at the band edges.

The field strength at the band edges was evaluated for each mode and on each chain individually on the lowest and highest channels at the rated power for the channel under test. Where the power at the edge channels was lower than the power at the center channels additional measurements were made at the adjacent channels. Single transmission at each chain and simultaneous transmission at both chains modes were fully evaluated.

The PC was using the Intel test utility DRTU Version “DRTU 1.7.3-859”

During transmitter test the EUT was being controlled by the Intel DRTU tool to operate in a continuous transmit mode on the test channels as required and in each of the different modulation modes.

The conducted RF output power at each chain was adjusted according to the client’s supplied Target values (see following table) using the Intel DRTU tool and measuring the power by using a calibrated average power meter. Measured values for adjustment were within -0.2 dB/+0.3 dB respect to the Target values.

RF conducted output power target values

	Mode	BW (MHz)	Channel / Freq.	SISO Chain A (dBm)	SISO Chain B (dBm)	MIMO at both ports A and B (dBm)
5.47–5.725 GHz Band						
	802.11a	20	100 / 5500	13.5	13.5	n/a
			104 / 5520	15.5	16	n/a
			120 / 5600	15.5	16	n/a
			136 /5680	15.5	16	n/a
			140 / 5700	13	13	n/a
	802.11n	20	100 / 5500	13.5	13.5	10.50
			104 / 5520	15.5	16	14.50
			120 / 5600	15.5	16	14.50
			136 /5680	15.5	16	14.50
			140 / 5700	13	13	11.00
	802.11n*	40	102 / 5510	13.5	14	11.50
			110 / 5550	16.5	16.5	16.50
			118 / 5590	16.5	16.5	16.50
			134 / 5670	16.5	16.5	16.50
	802.11ac	20	144 / 5720	15.5	16	13.50
	802.11ac	40	142 /5710	16.5	16.5	16.50
	802.11ac	80	106 / 5530	13.5	13.5	11.50
			122 / 5610	16.5	16.5	16.50
			138 / 5690	16.5	16.5	16.50

CONDUCTED MEASUREMENTS

The equipment under test was set up in a shielded room and it is connected to the spectrum analyzer using low loss RF cables with sma type connectors. The reading in the spectrum analyzer is corrected taking into account the cable loss.

RADIATED MEASUREMENTS

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna is situated at a distance of 1m 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 equipment under test was set up on a non-conductive (wooden) platform one meter above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º.

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

99 % and 26 dB Bandwidth

RESULTS

1. 802.11a mode (see next plots).

CHAIN A

	Lowest frequency 5500 MHz	Middle frequency 5600 MHz	Highest frequency 5700 MHz
99% bandwidth (MHz)	17.32	17.44	17.45
26 dB bandwidth (MHz)	24.80	25.36	25.24
Measurement uncertainty (kHz)	±7		±21.7

CHAIN B

	Lowest frequency 5500 MHz	Middle frequency 5600 MHz	Highest frequency 5700 MHz
99% bandwidth (MHz)	17.36	17.44	17.55
26 dB bandwidth (MHz)	25.44	25.92	25.56
Measurement uncertainty (kHz)	±7		±21.7

2. 802.11 n20 MHz and 802.11 ac 20 MHz (except channel 144) modes. (see next plots).

CHAIN A

	Lowest frequency 5500 MHz	Middle frequency 5600 MHz	Highest frequency 5700 MHz
99% bandwidth (MHz)	18.36	18.44	18.44
26 dB bandwidth (MHz)	25.36	26.60	25.51
Measurement uncertainty (kHz)	±7		±21.7

CHAIN B

	Lowest frequency 5500 MHz	Middle frequency 5600 MHz	Highest frequency 5700 MHz
99% bandwidth (MHz)	18.32	18.40	17.60
26 dB bandwidth (MHz)	26.00	25.92	26.46
Measurement uncertainty (kHz)	±7		±21.7

Note: the test was performed with 802.11 n20 MHz mode which is the same modulation scheme as 802.11 ac 20 MHz.

802.11 ac 20MHz (channel 144):

CHAIN A

	Frequency 5720 MHz
99% bandwidth (MHz)	19.26
26 dB bandwidth (MHz)	17.93 in UNII_3, 8.61 in UNII_4 and 26.58 (Total)
Measurement uncertainty (kHz)	±21.7

CHAIN B

	Frequency 5720 MHz
99% bandwidth (MHz)	19.38
26 dB bandwidth (MHz)	18.06 in UNII_3, 8.96 in UNII_4 and 27.00 (Total)
Measurement uncertainty (kHz)	±21.7

3. 802.11 n40 MHz and 802.11 ac 40 MHz (except channel 142) modes. (see next plots).

CHAIN A

	Lowest frequency 5510 MHz	Middle frequency 5590 MHz	Highest frequency 5670 MHz
99% bandwidth (MHz)	36.40	36.60	36.60
26 dB bandwidth (MHz)	44.71	45.03	45.17
Measurement uncertainty (kHz)	±21.7		

CHAIN B

	Lowest frequency 5510 MHz	Middle frequency 5590 MHz	Highest frequency 5670 MHz
99% bandwidth (MHz)	36.40	36.60	36.60
26 dB bandwidth (MHz)	43.32	45.51	44.56
Measurement uncertainty (kHz)	±21.7		

Note: the test was performed with 802.11 n40 MHz mode which is the same modulation scheme as 802.11 ac 40 MHz.

802.11 ac 40MHz (channel 142):

CHAIN A

	Frequency 5710 MHz
99% bandwidth (MHz)	36.90
26 dB bandwidth (MHz)	38.45 in UNII_3, 8.18 in UNII_4 and 46.79 (Total)
Measurement uncertainty (kHz)	±21.7

CHAIN B

	Frequency 5710 MHz
99% bandwidth (MHz)	36.90
26 dB bandwidth (MHz)	38.94 in UNII_3, 7.69 in UNII_4 and 47.12 (Total)
Measurement uncertainty (kHz)	±21.7

4. 802.11 ac 80 MHz mode. (see next plots).

CHAIN A

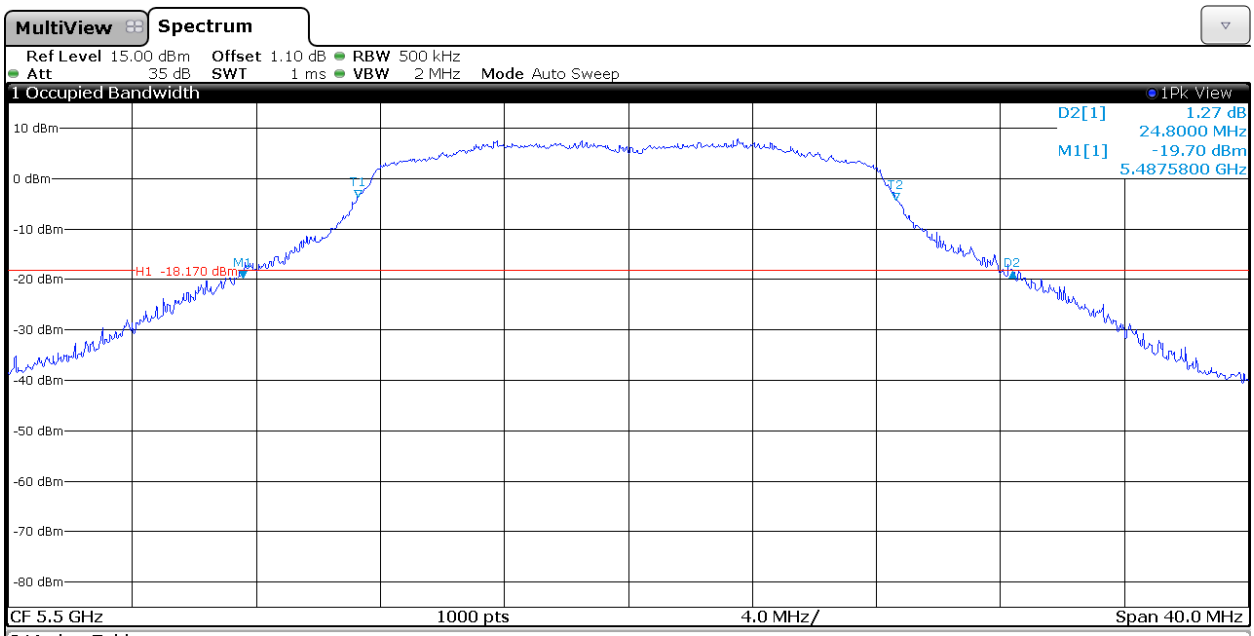
	Lowest frequency 5530 MHz	Highest frequency 5610 MHz	Highest frequency 5690 MHz
99% bandwidth (MHz)	75.60	75.45	75.45
26 dB bandwidth (MHz)	82.22	81.97	76.20 in UNII_3 + 6.01 in UNII_4 and 82.21 (Total)
Measurement uncertainty (kHz)	±21.7		

CHAIN B

	Lowest frequency 5530 MHz	Highest frequency 5610 MHz	Highest frequency 5690 MHz
99% bandwidth (MHz)	75.45	75.45	75.30
26 dB bandwidth (MHz)	82.05	82.21	76.20 in UNII_3 + 6.01 in UNII_4 and 82.21 (Total)
Measurement uncertainty (kHz)	±21.7		

802.11a mode CHAIN A

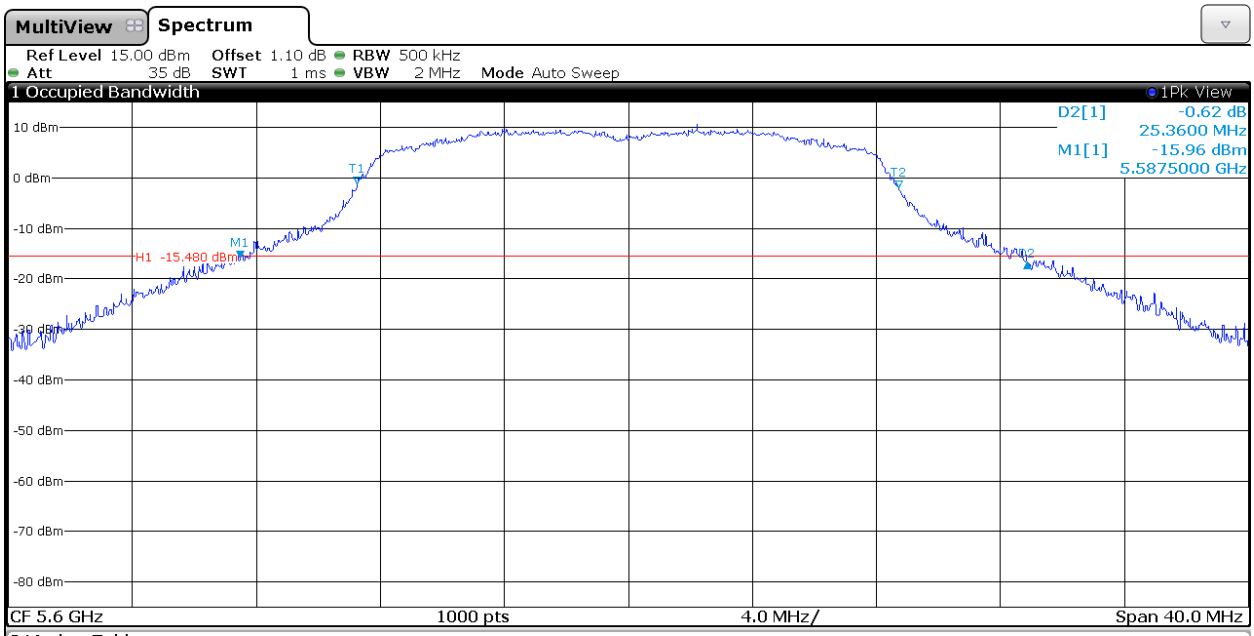
Lowest Channel



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.48758 GHz**	**-19.70 dBm**		
T1		1	5.4913 GHz	-3.71 dBm	Occ Bw	**17.32 MHz**
T2		1	5.50862 GHz	-4.29 dBm		
D2	M1	1	**24.8 MHz**	**1.27 dB**		

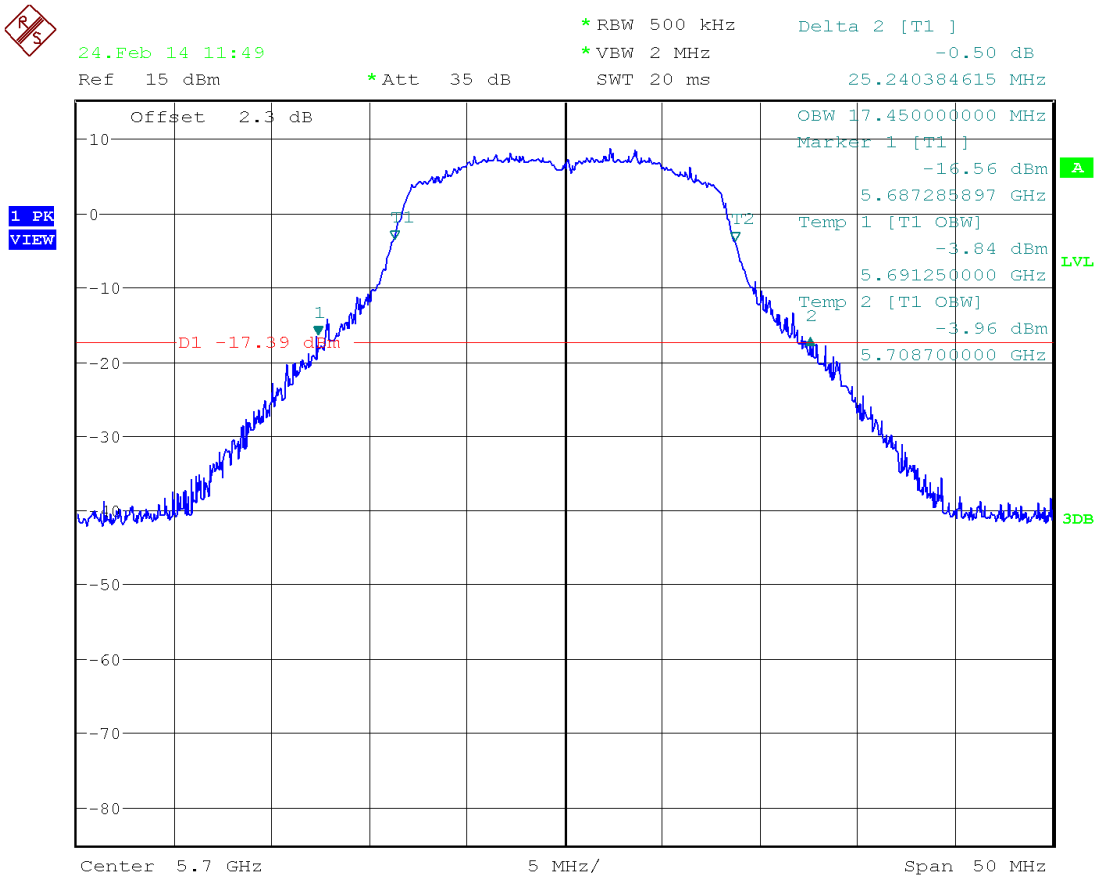
Middle Channel



2 Marker Table

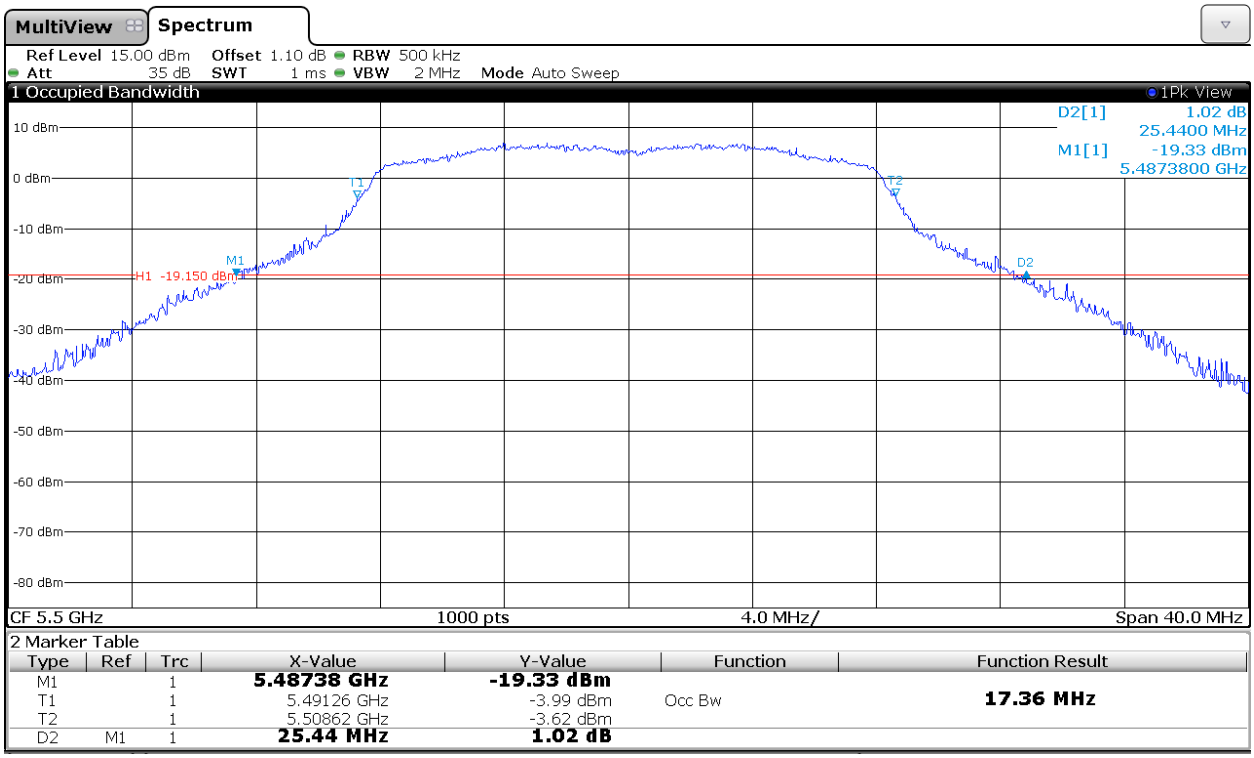
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.5875 GHz**	**-15.96 dBm**		
T1		1	5.59126 GHz	-1.27 dBm	Occ Bw	**17.44 MHz**
T2		1	5.6087 GHz	-2.06 dBm		
D2	M1	1	**25.36 MHz**	**-0.62 dB**		

Highest Channel

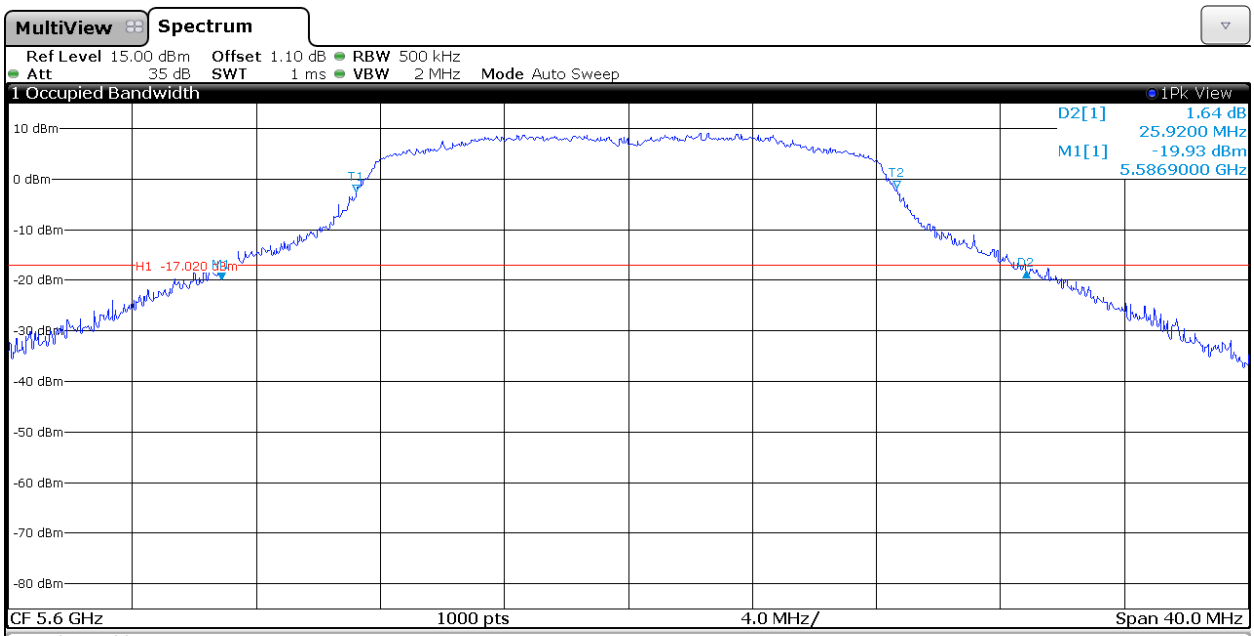


802.11a mode CHAIN B

Lowest Channel



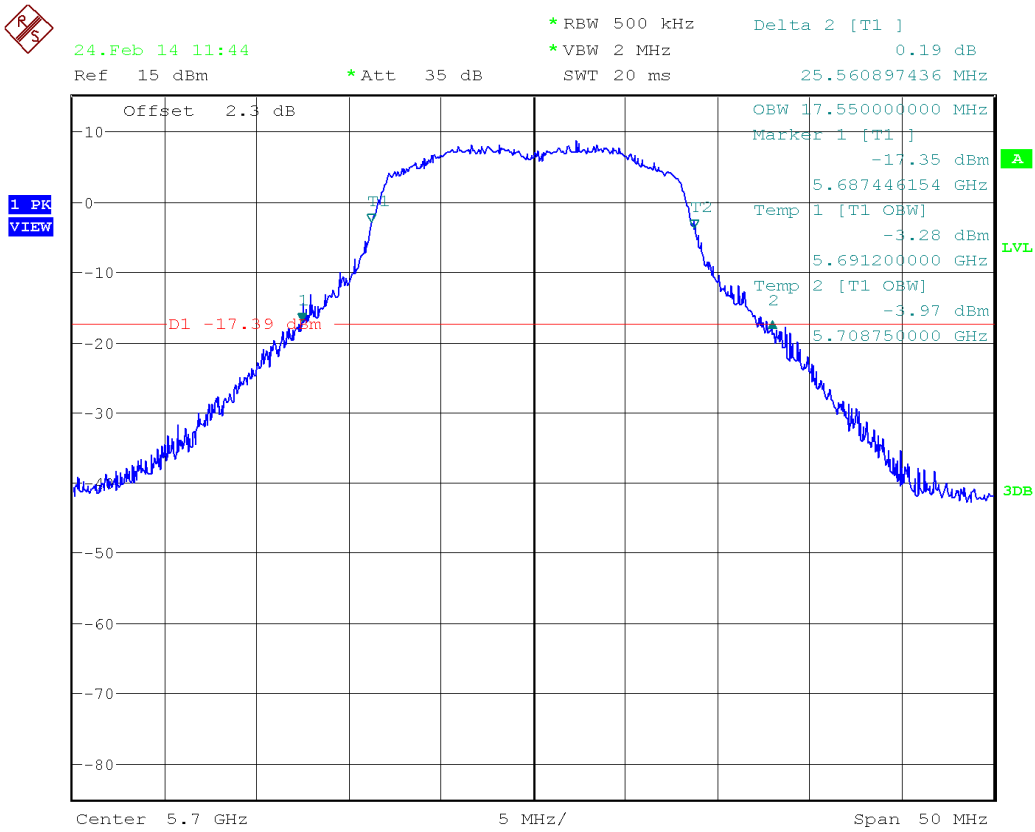
Middle Channel



2 Marker Table

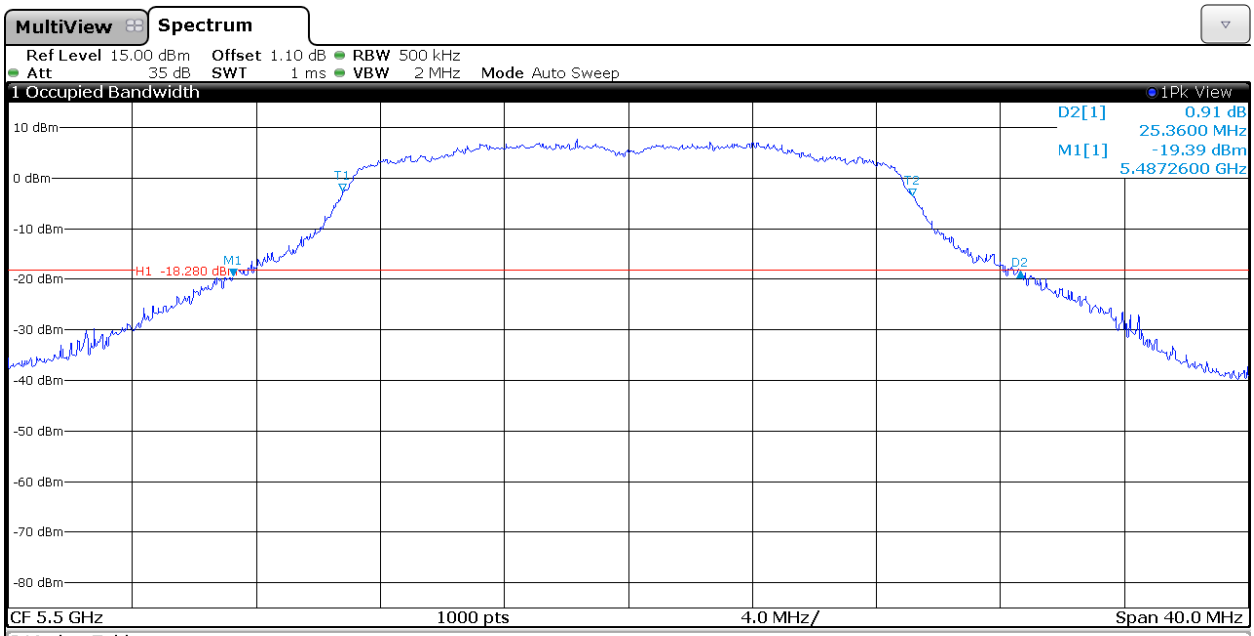
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.5869 GHz**	**-19.93 dBm**		
T1		1	5.59122 GHz	-2.57 dBm	Occ Bw	**17.44 MHz**
T2		1	5.60866 GHz	-1.71 dBm		
D2	M1	1	**25.92 MHz**	**1.64 dB**		

Highest Channel



802.11 n20 MHz and 802.11 ac 20 MHz modes (except channel 144) CHAIN A

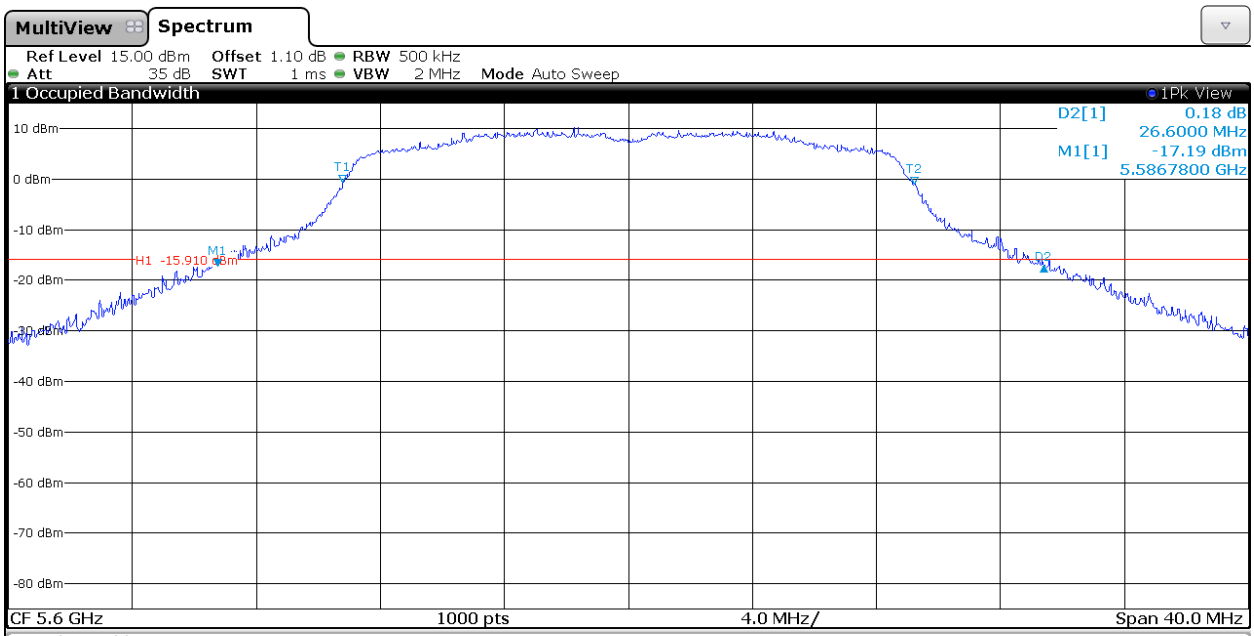
Lowest Channel



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.48726 GHz**	**-19.39 dBm**		
T1		1	5.49078 GHz	-2.58 dBm	Occ Bw	**18.36 MHz**
T2		1	5.50914 GHz	-3.57 dBm		
D2	M1	1	**25.36 MHz**	**0.91 dB**		

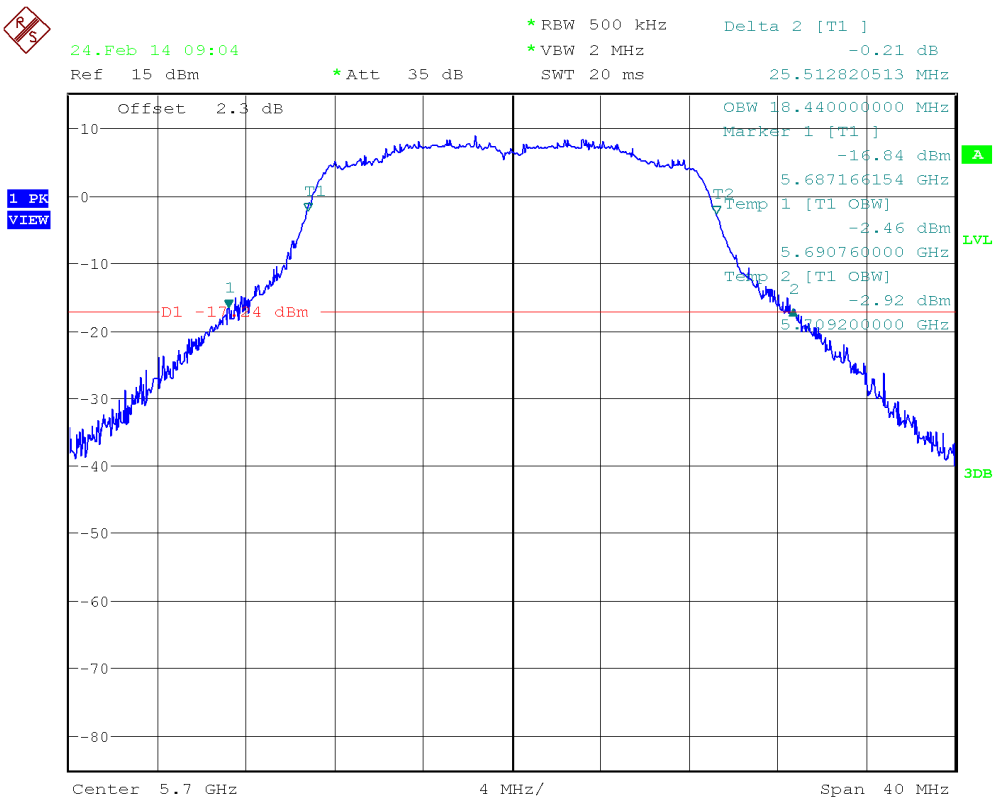
Middle Channel



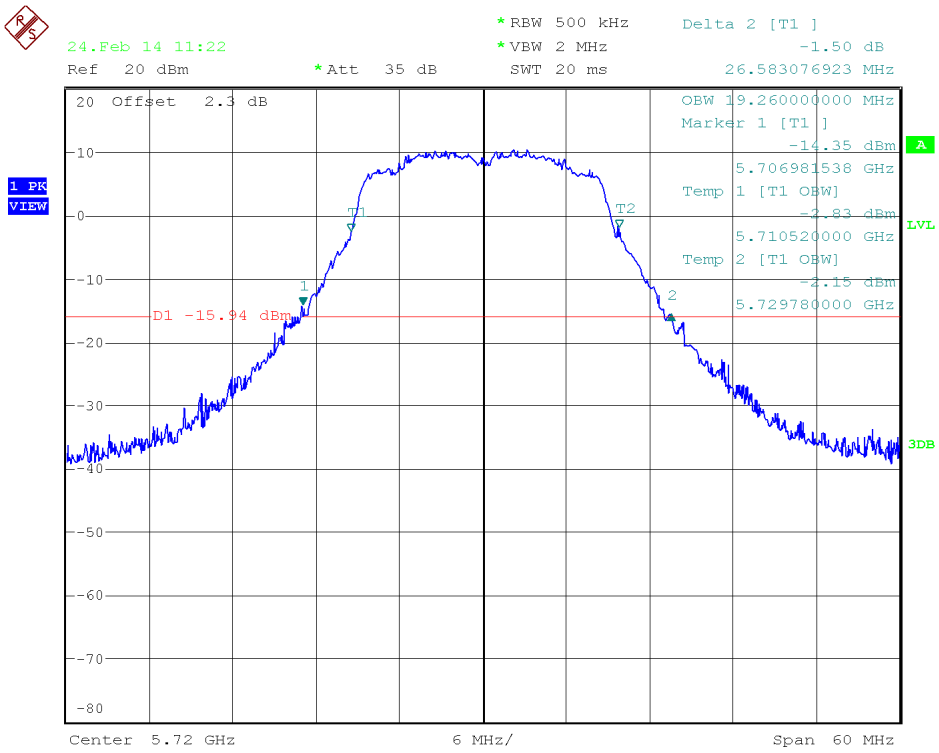
2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.58678 GHz**	**-17.19 dBm**		
T1		1	5.59078 GHz	-0.60 dBm	Occ Bw	**18.44 MHz**
T2		1	5.60922 GHz	-1.05 dBm		
D2	M1	1	**26.6 MHz**	**0.18 dB**		

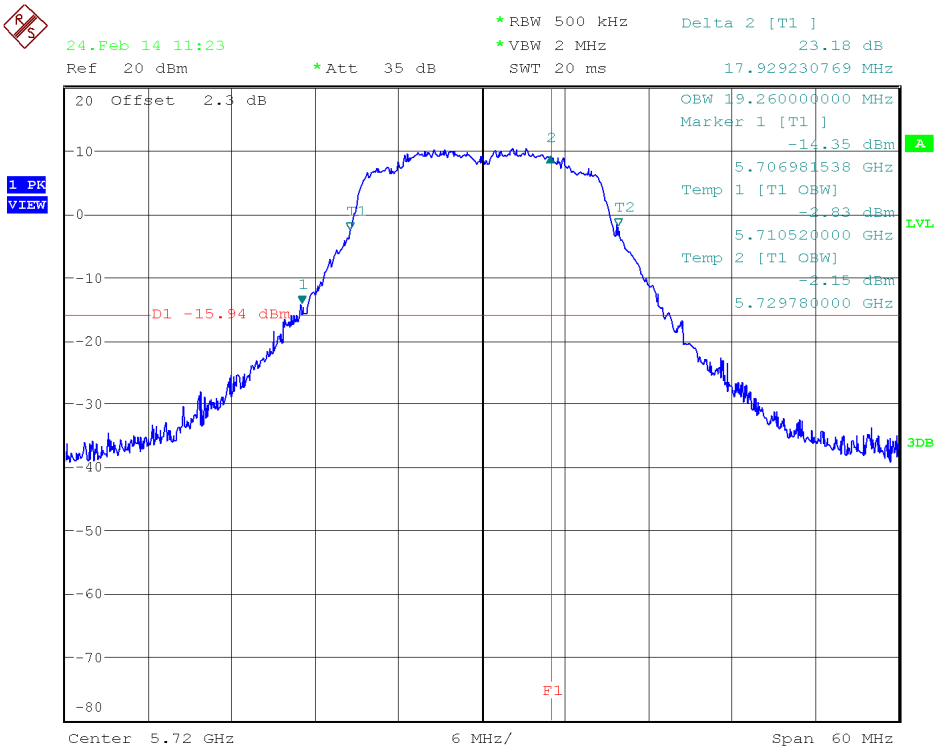
Highest Channel



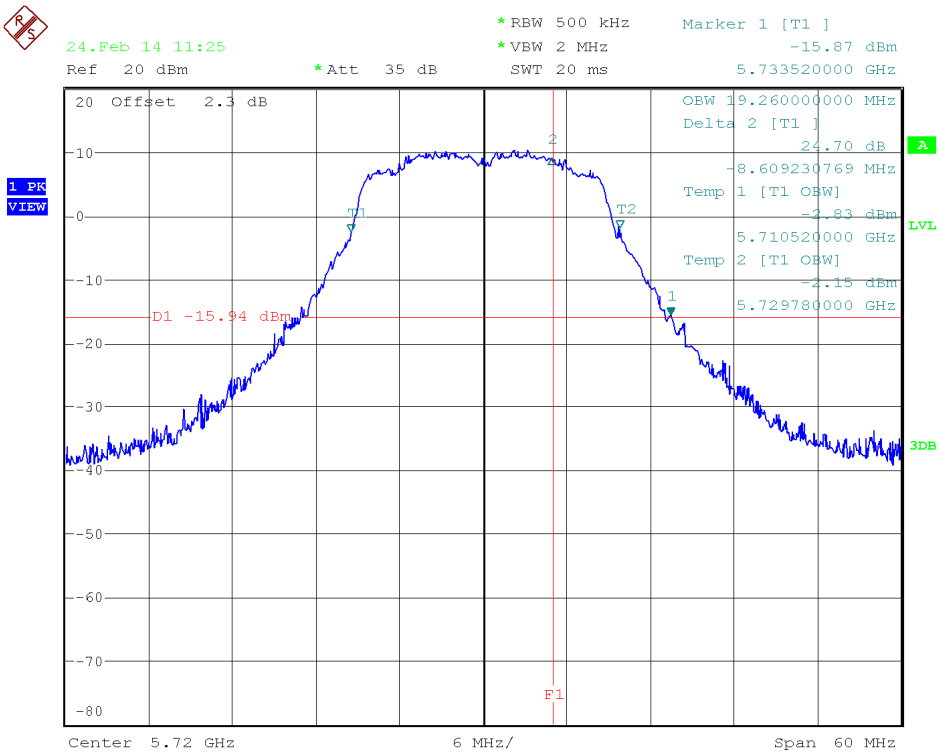
802.11 ac 20MHz: Channel 144. Total Bandwidth



26 dB BW inside UNII_3 sub-band:

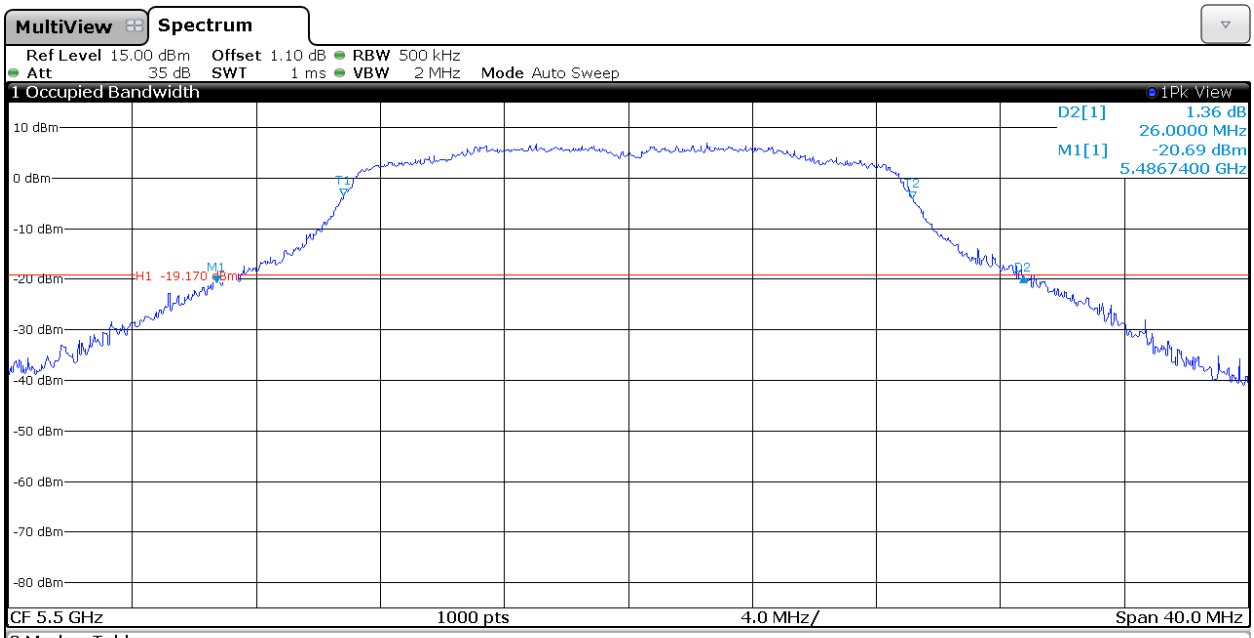


26 dB BW inside UNII_4 sub-band:



802.11 n20 MHz and 802.11 ac 20 MHz modes (except channel 144) CHAIN B

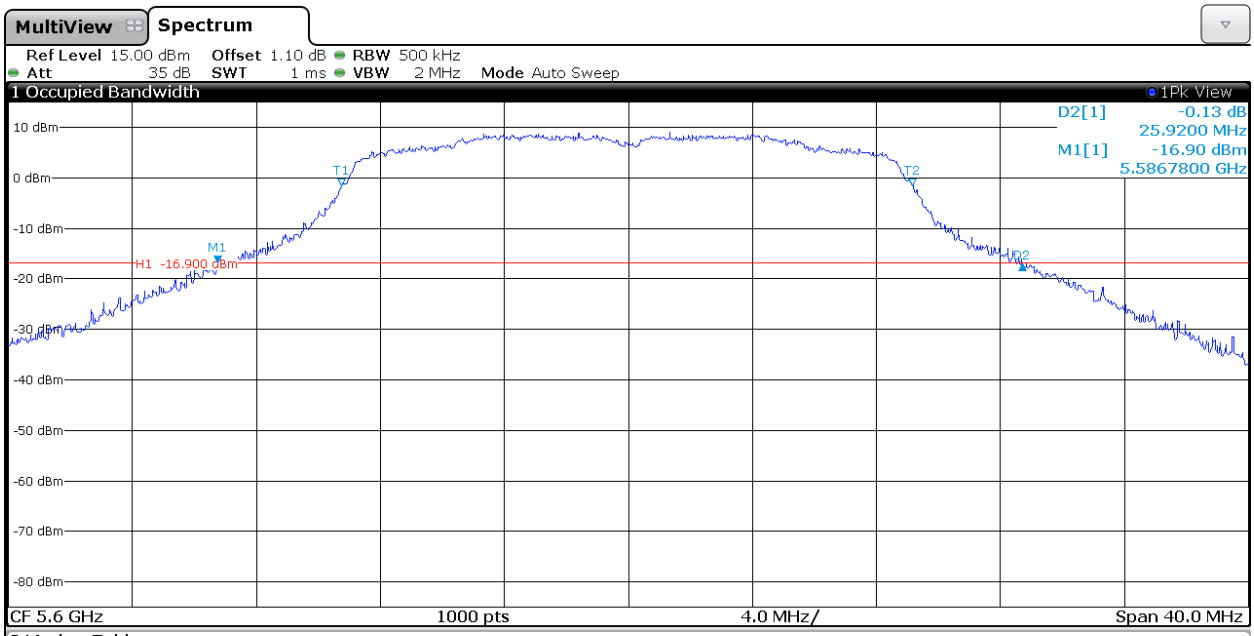
Lowest Channel



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.48674 GHz**	**-20.69 dBm**		
T1		1	5.49082 GHz	-3.46 dBm	Occ Bw	**18.32 MHz**
T2		1	5.50914 GHz	-4.03 dBm		
D2	M1	1	**26.0 MHz**	**1.36 dB**		

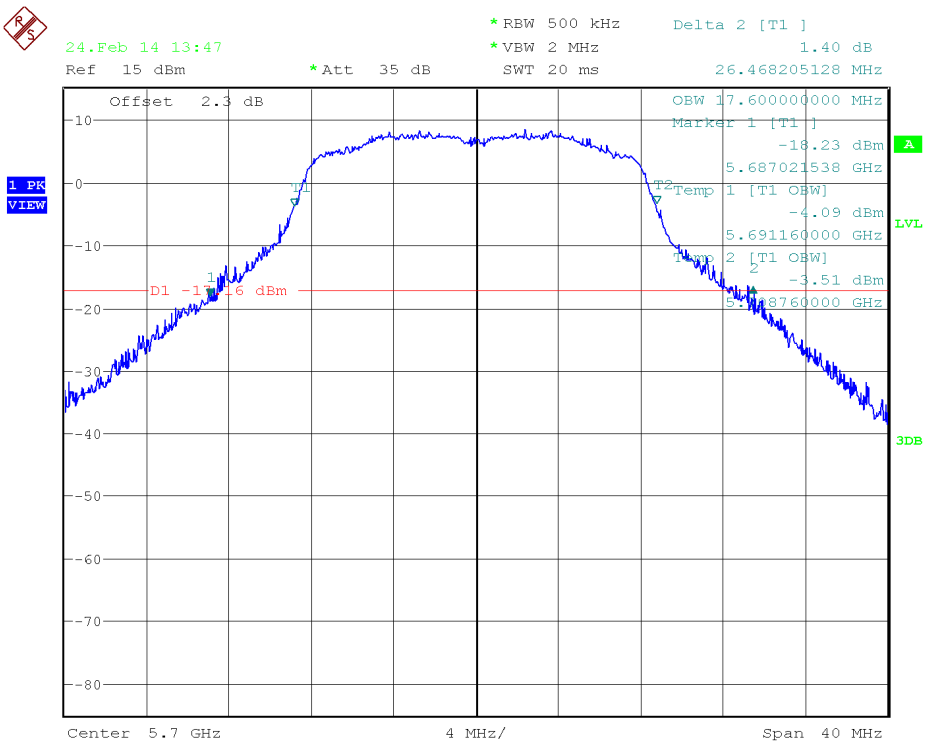
Middle Channel



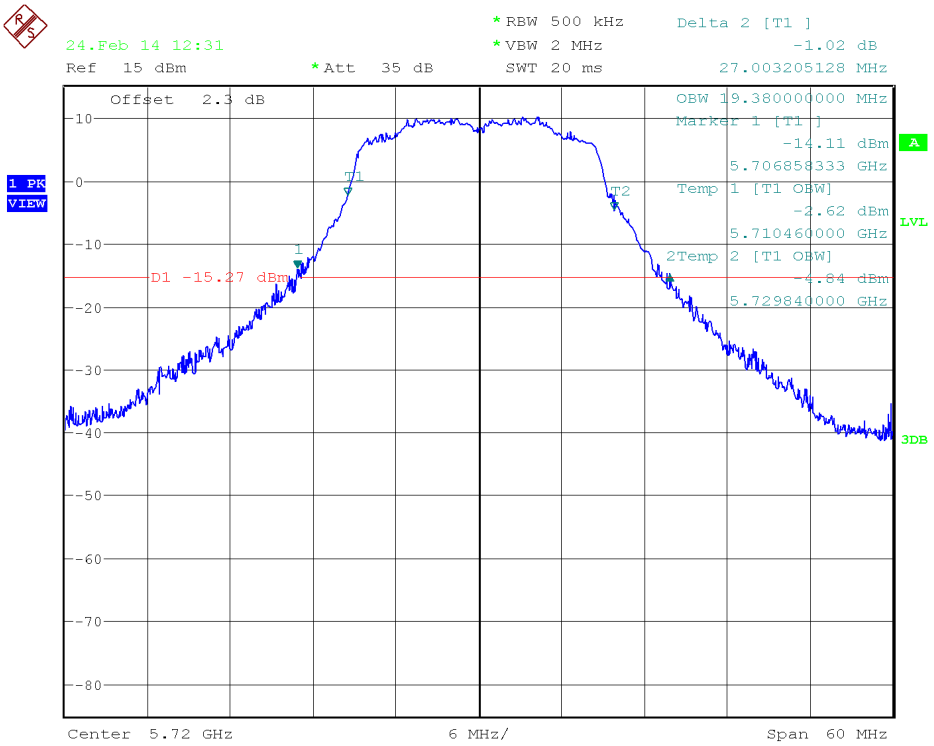
2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**5.58678 GHz**	**-16.90 dBm**		
T1		1	5.59074 GHz	-1.63 dBm	Occ Bw	**18.4 MHz**
T2		1	5.60914 GHz	-1.51 dBm		
D2	M1	1	**25.92 MHz**	**-0.13 dB**		

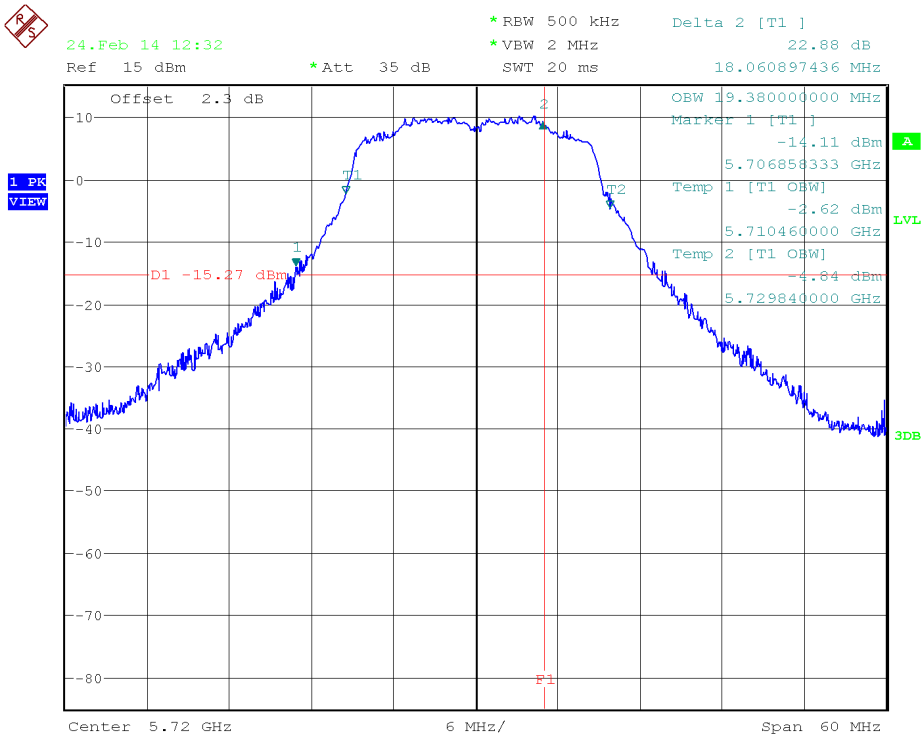
Highest Channel



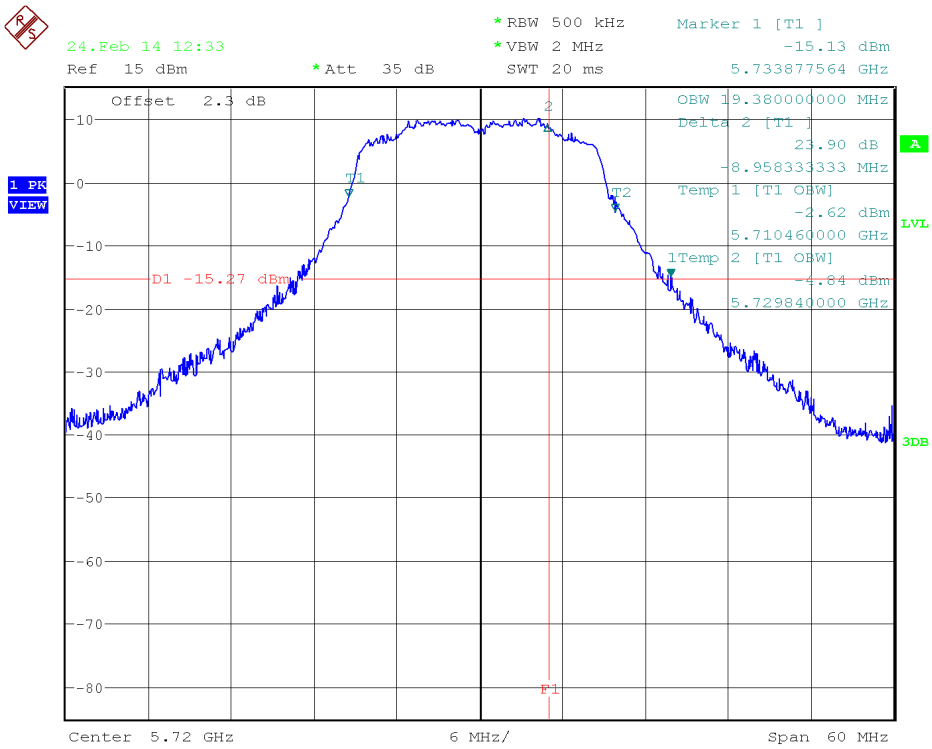
802.11 ac 20MHz: Channel 144. Total Bandwidth.



26 dB BW inside UNII_3 sub-band:

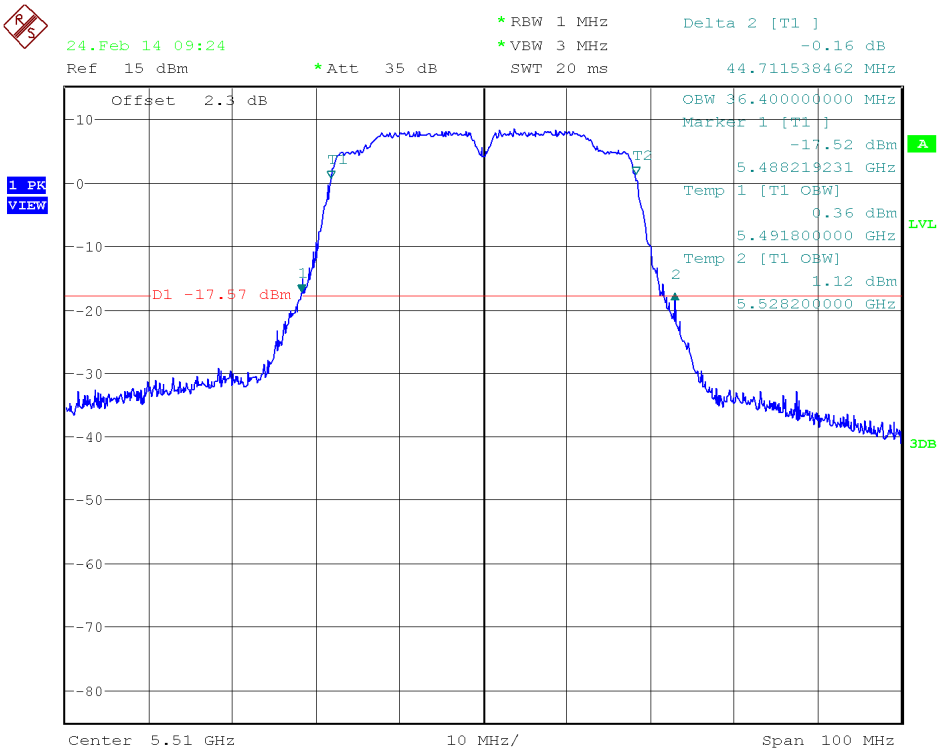


26 dB BW inside UNII_4 sub-band:

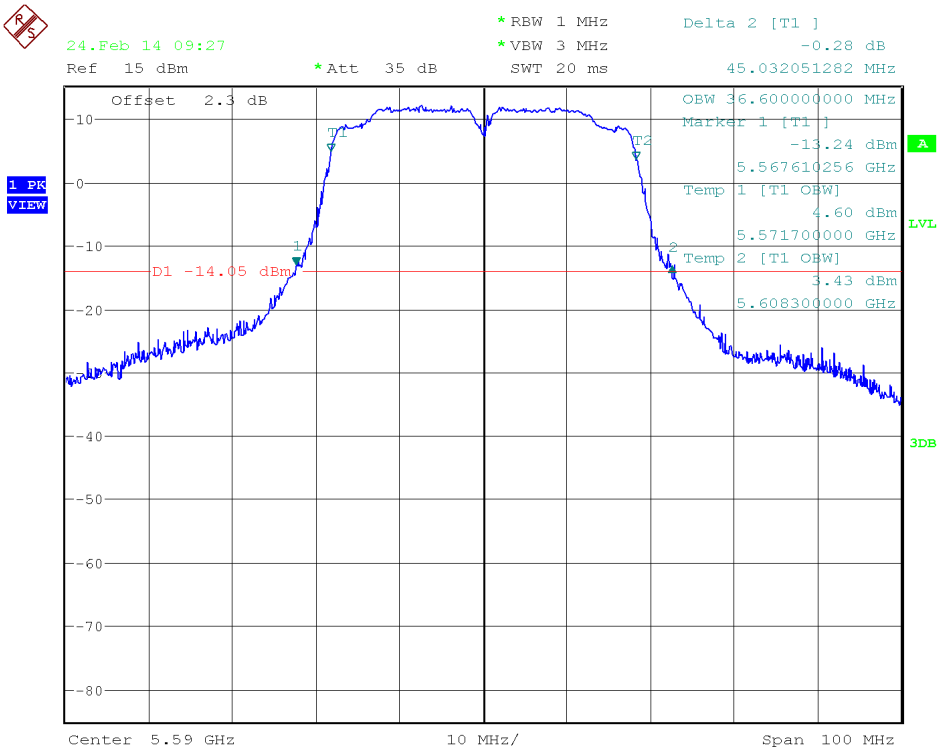


802.11 n40 MHz and 802.11 ac 40 MHz modes (except channel 142) CHAIN A

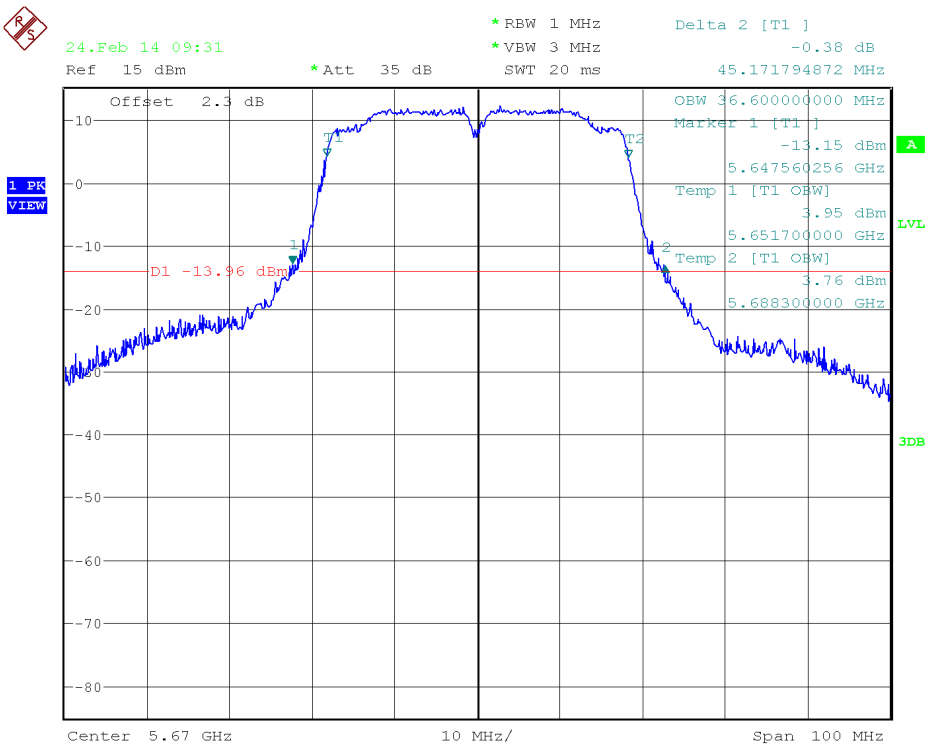
Lowest Channel



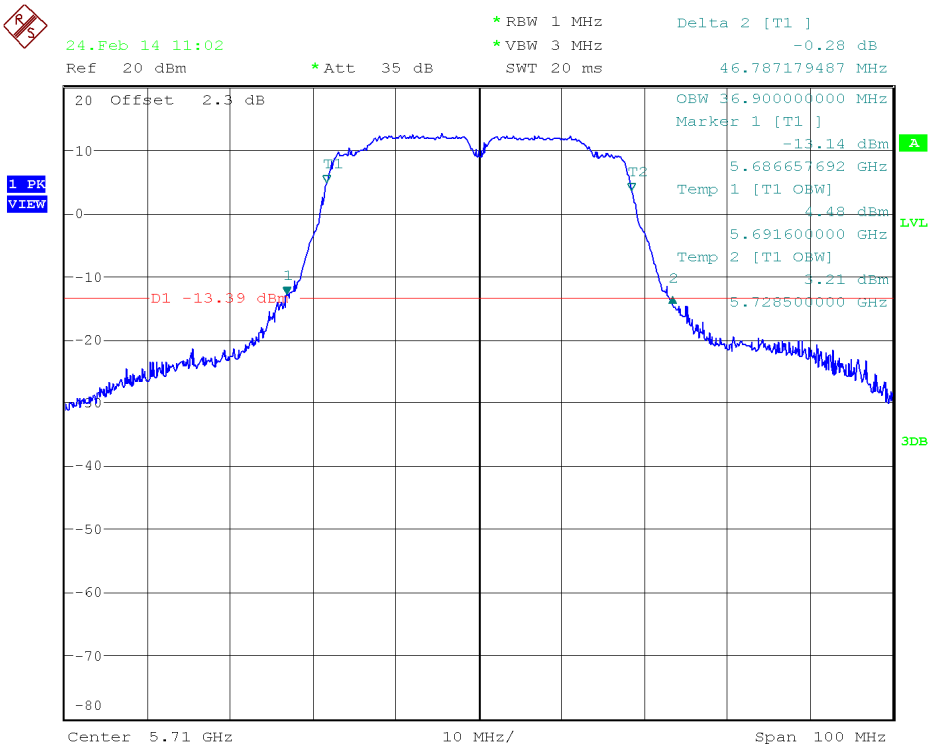
Middle Channel



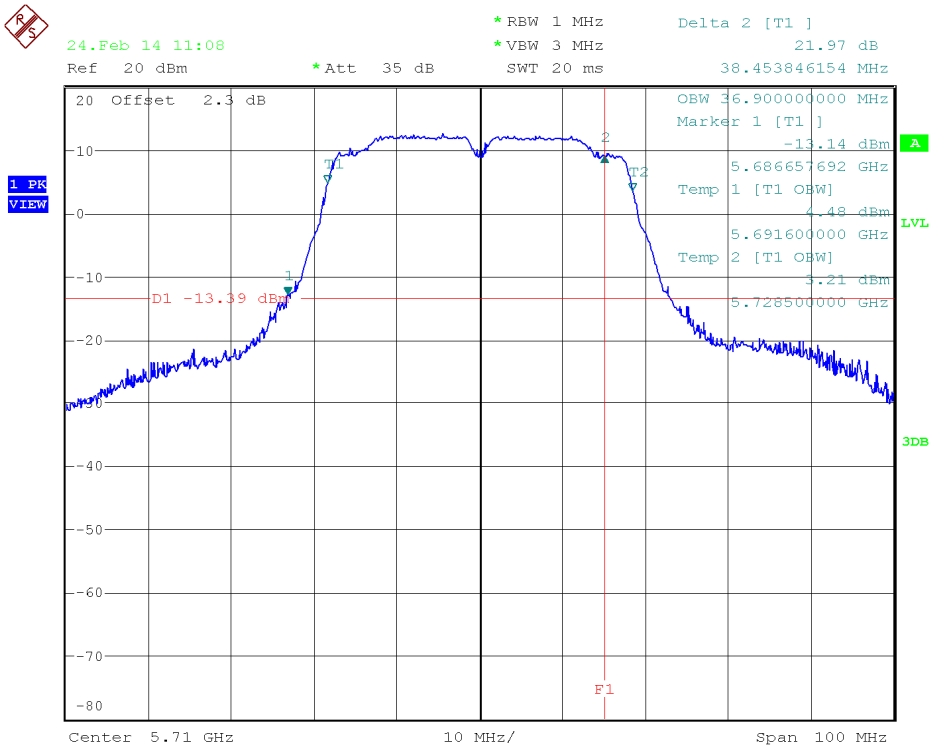
Highest Channel



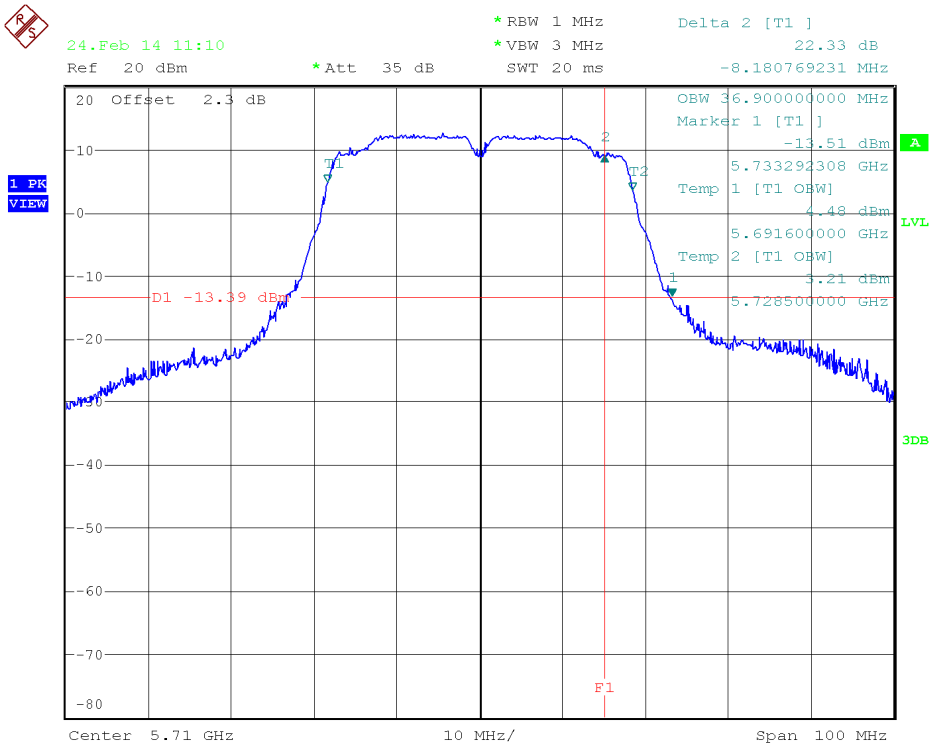
802.11 ac 40MHz: Channel 142. Total Bandwidth



26 dB BW inside UNII_3 sub-band:

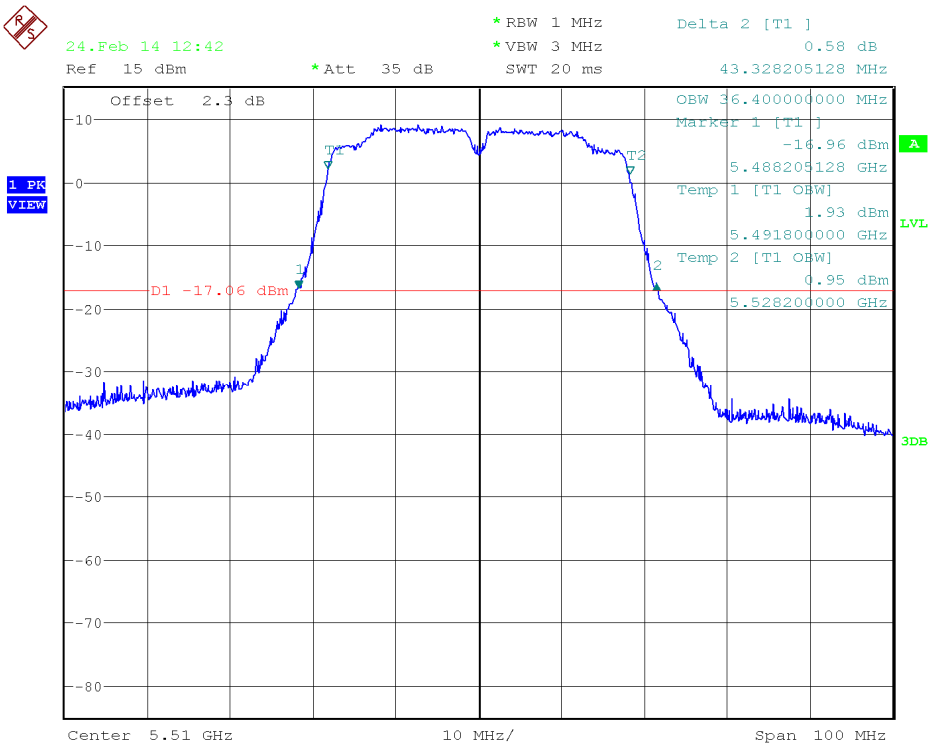


26 dB BW inside UNII_4 sub-band:

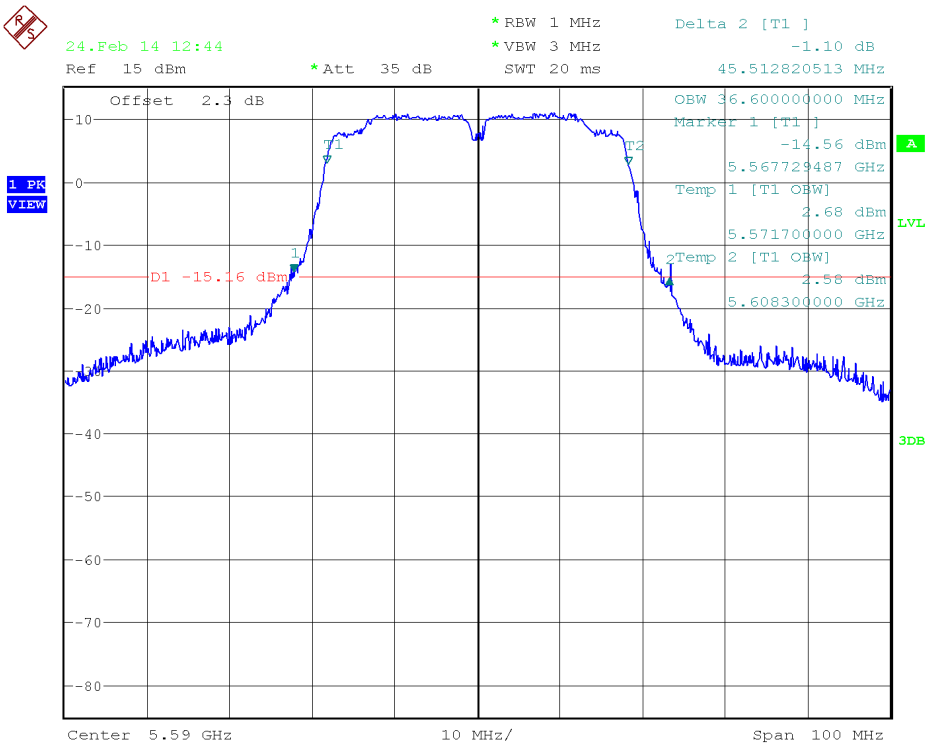


802.11 n40 MHz and 802.11 ac 40 MHz modes (except channel 142) CHAIN B

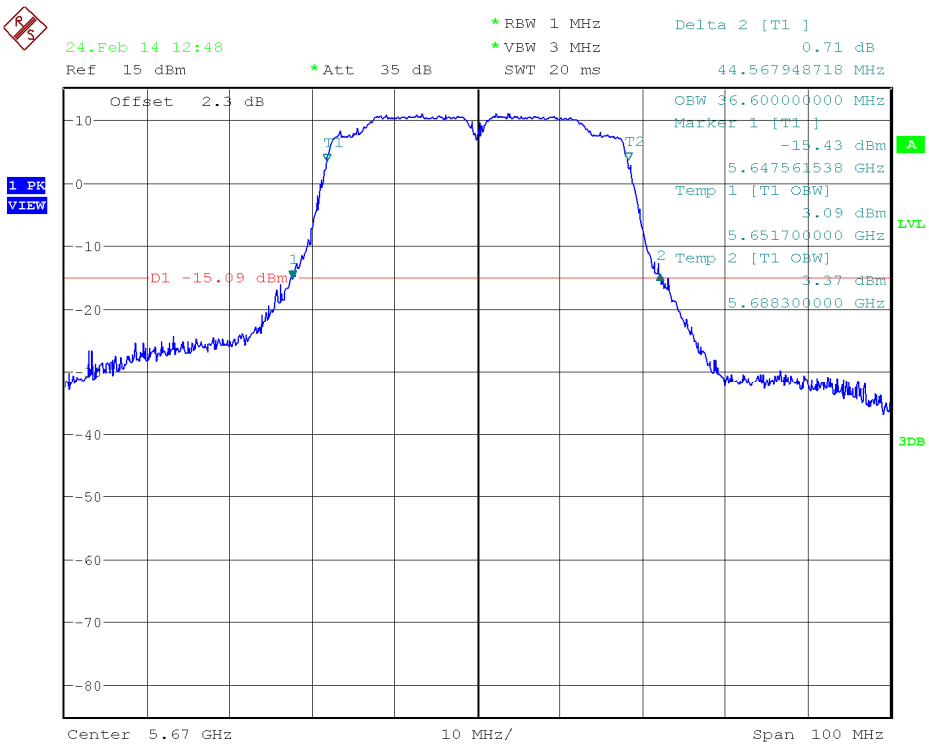
Lowest Channel



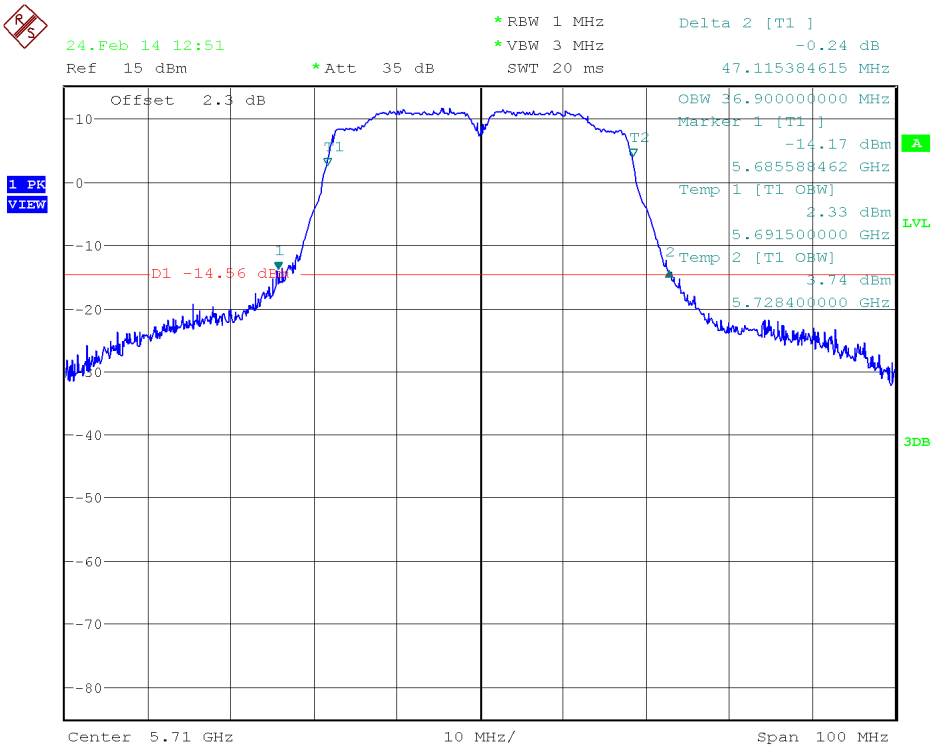
Middle Channel



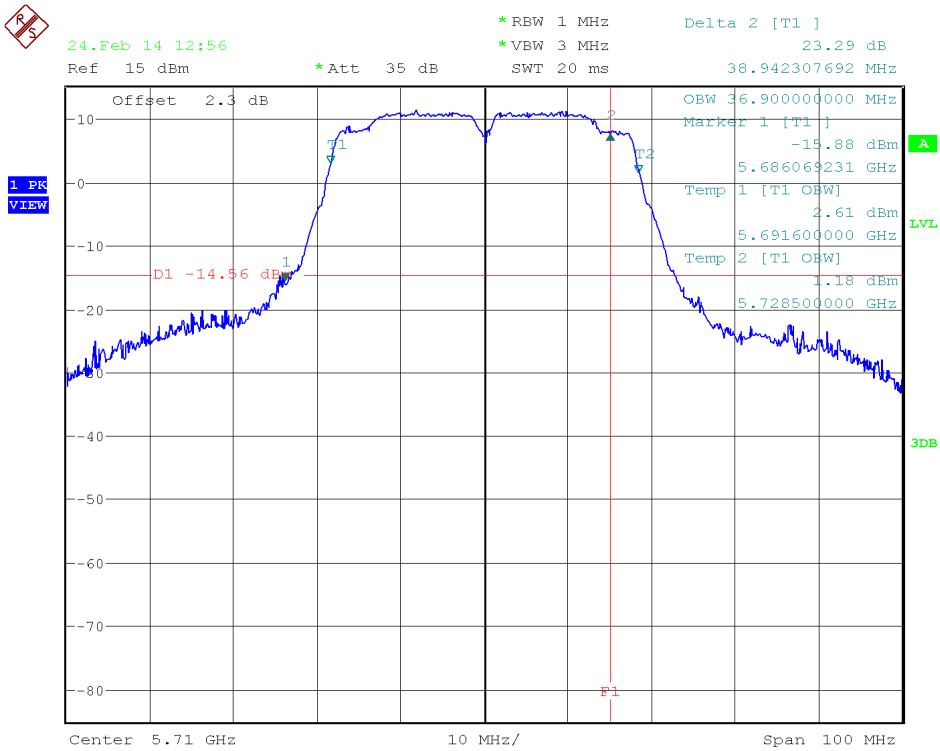
Highest Channel



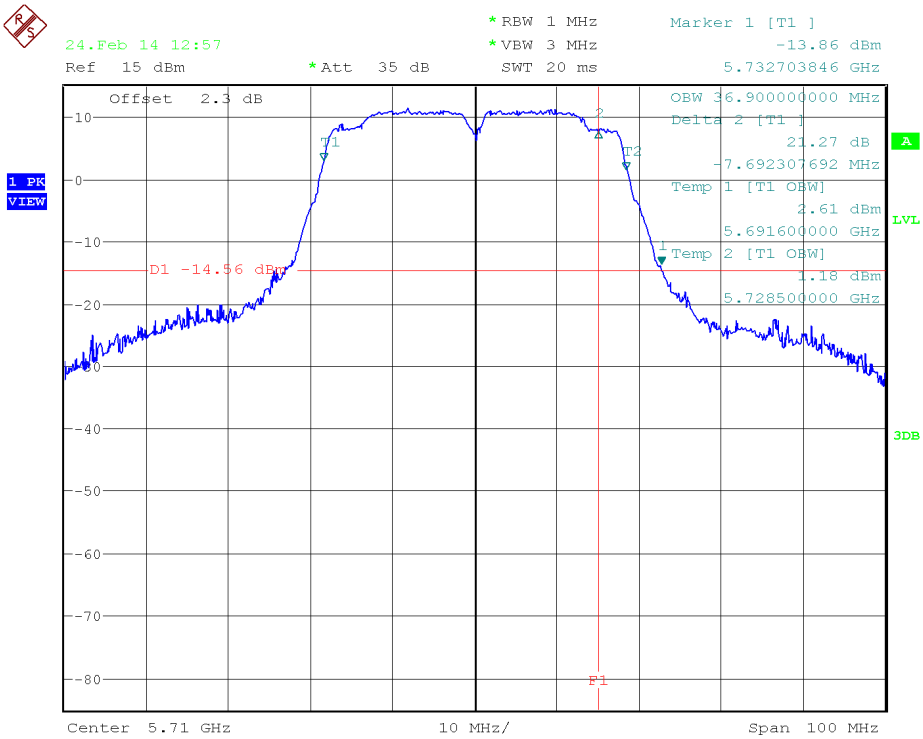
802.11 ac 40MHz: Channel 142. Total Bandwidth.



26 dB BW inside UNII_3 sub-band:

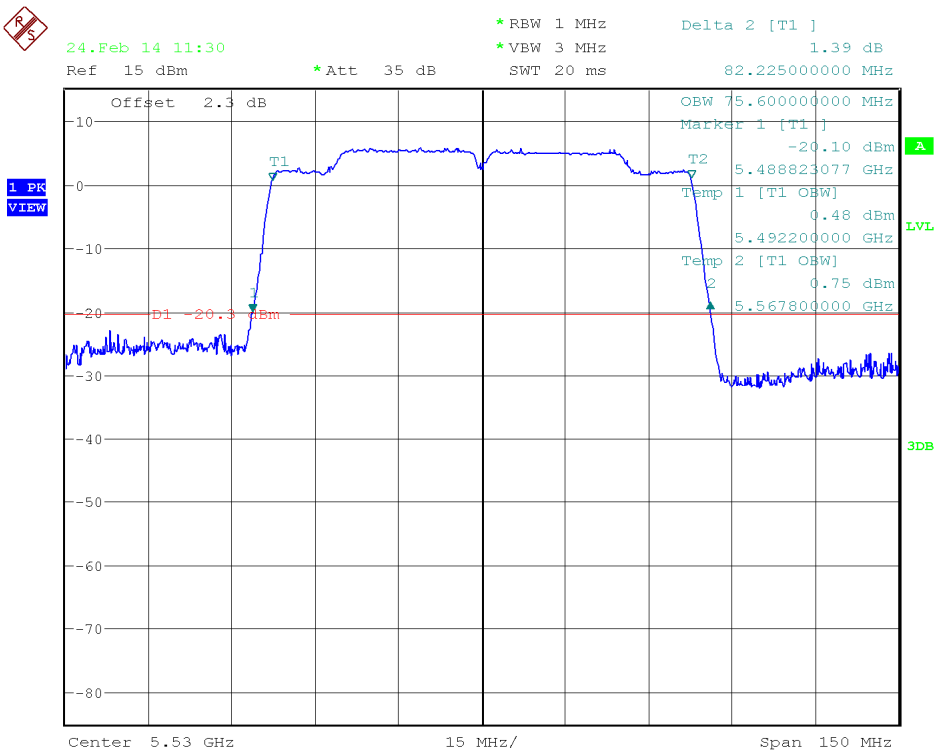


26 dB BW inside UNII_4 sub-band:

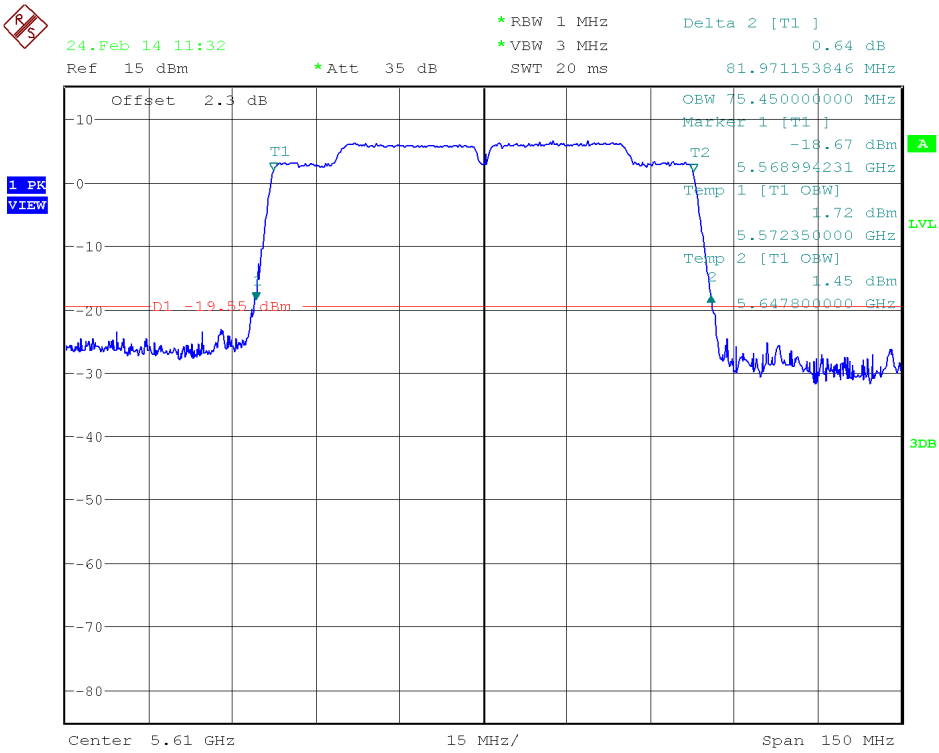


802.11 ac 80 MHz mode (except channel 138) CHAIN A

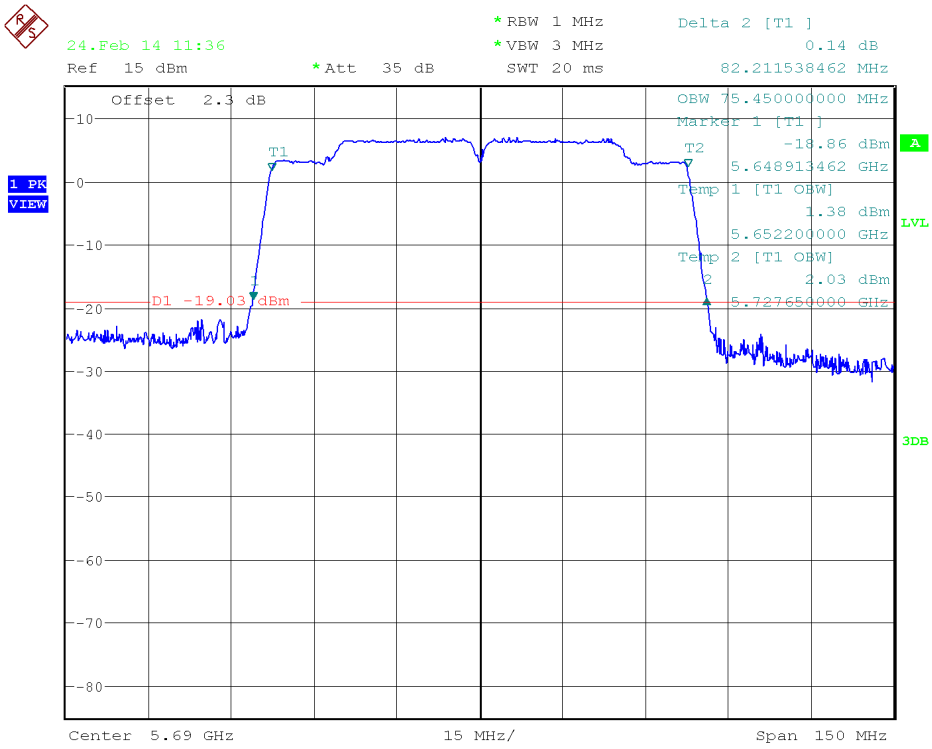
Lowest Channel



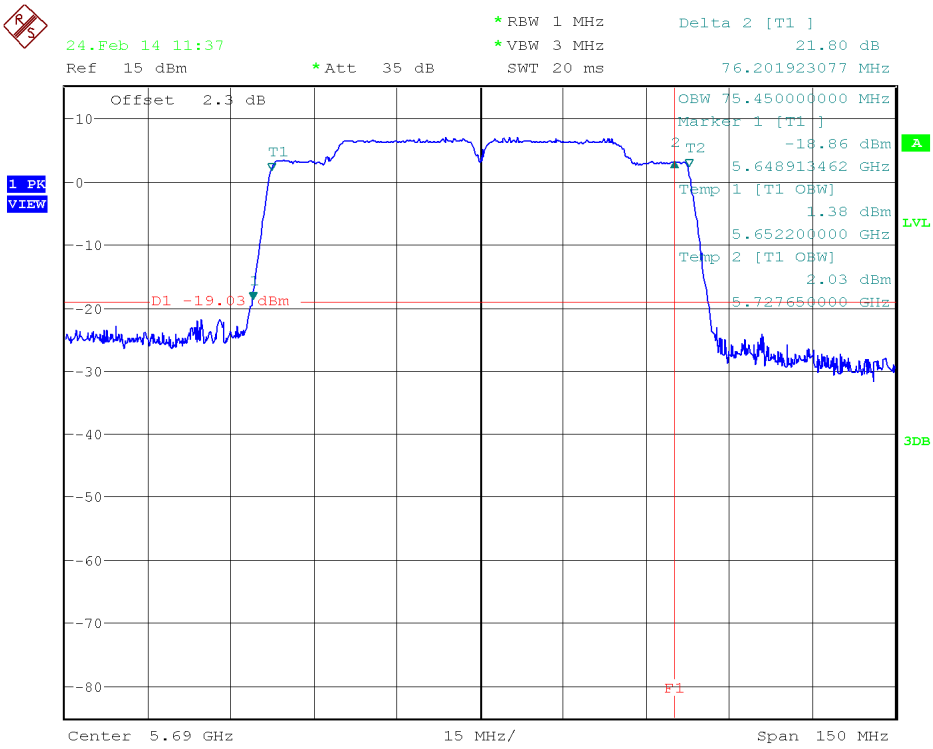
Middle Channel



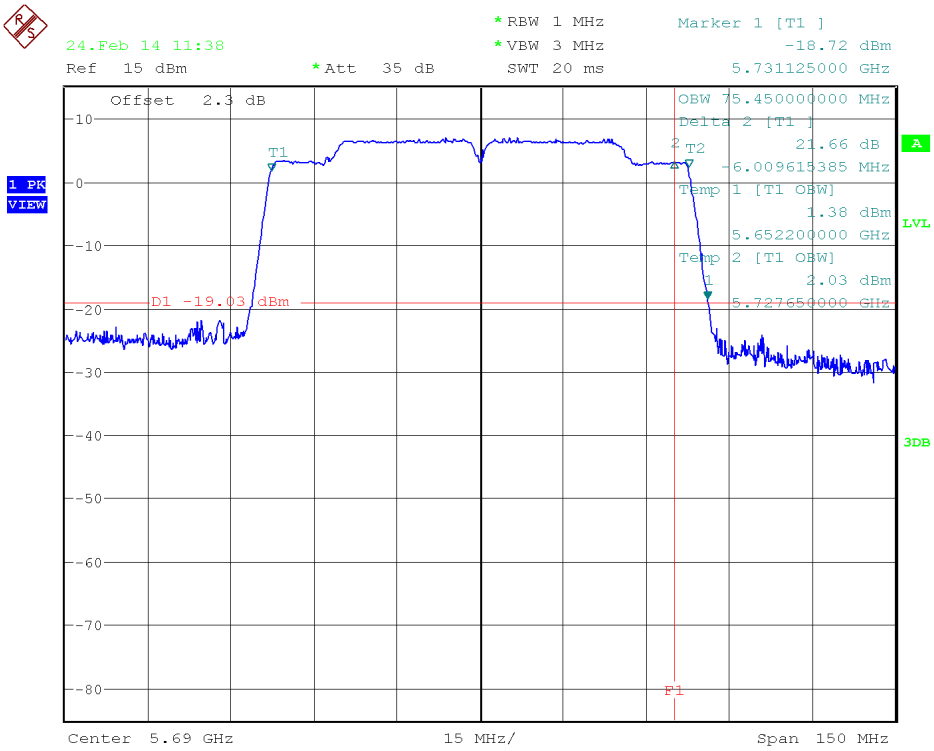
802.11 ac 80MHz: Channel 138. Total Bandwidth.



26 dB BW inside UNII_3 sub-band:

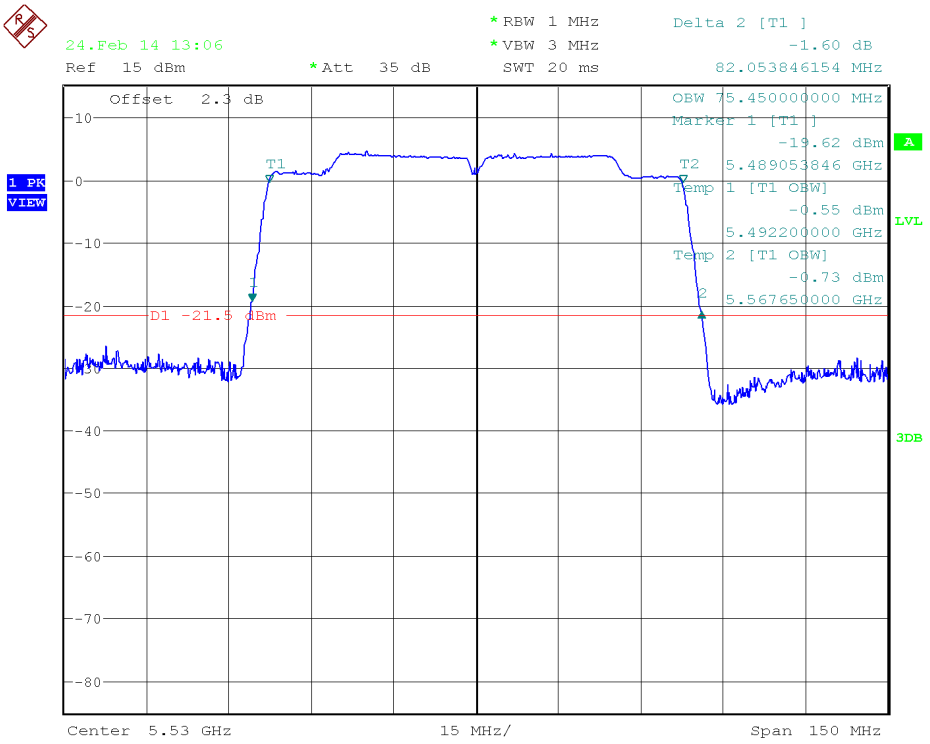


26 dB BW inside UNII_4 sub-band:

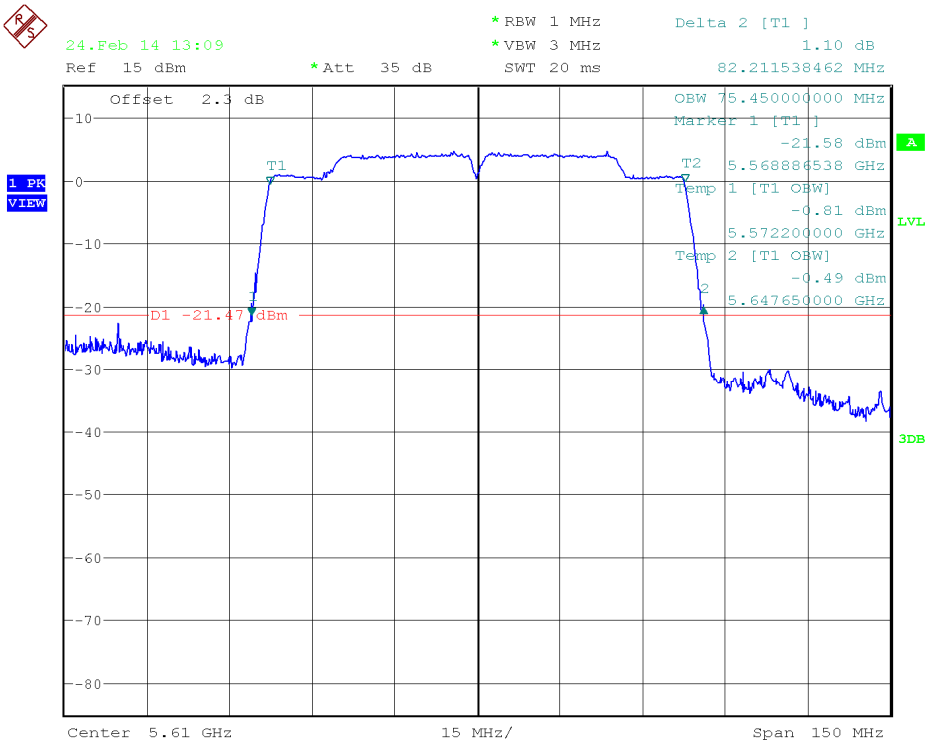


802.11 ac 80 MHz mode (except channel 138) CHAIN B

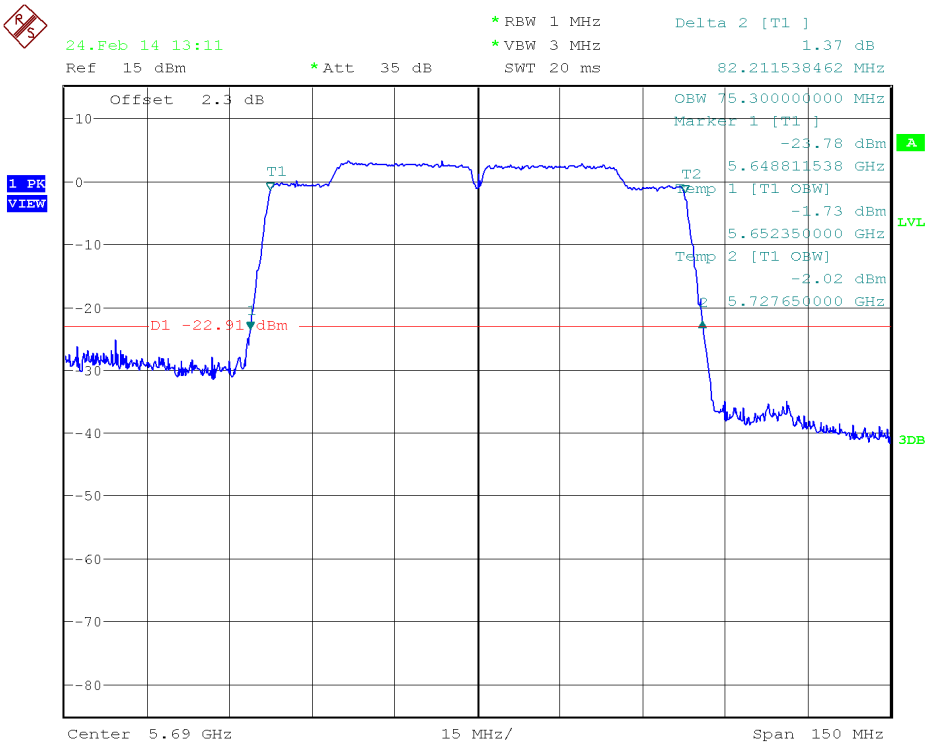
Lowest Channel



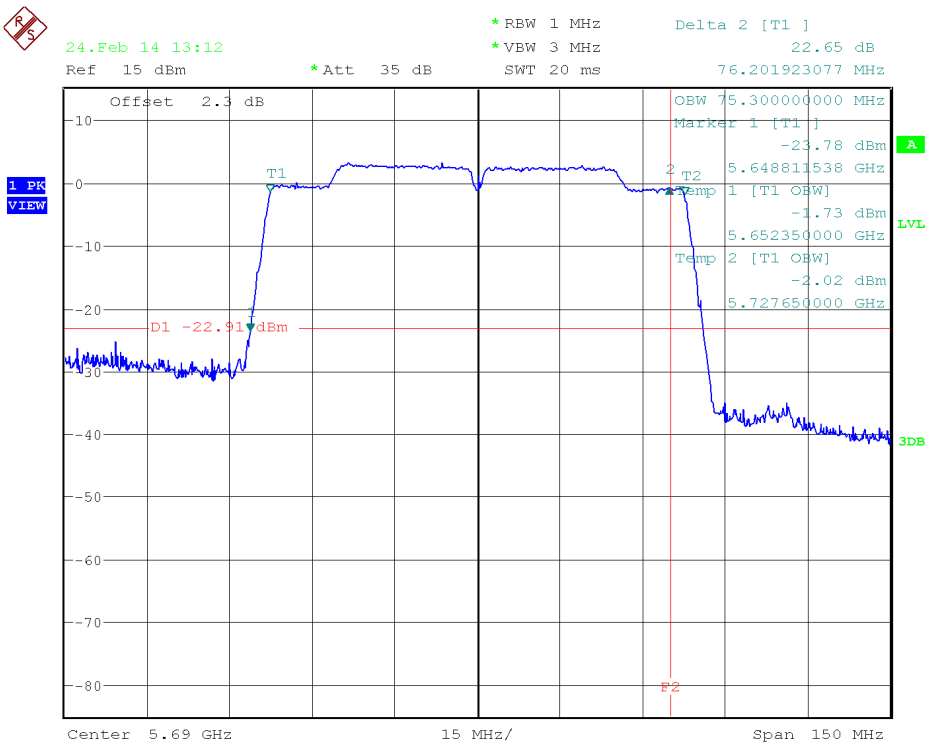
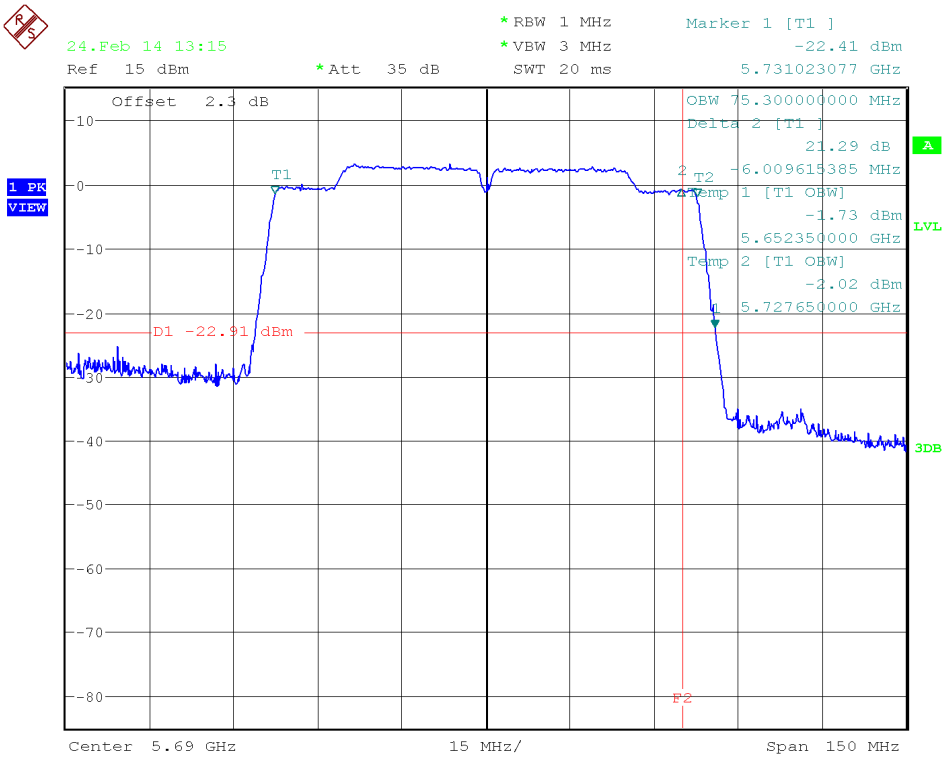
Middle Channel



802.11 ac 80MHz: Channel 138. Total Bandwidth.



26 dB BW inside UNII_3 sub-band:



26 dB BW inside UNII_4 sub-band: