Appendix D – Test result for 5.725 GHz – 5.85 GHz band

INDEX

TEST CONDITIONS

Power supply (V):

$V_{nominal}$ = 3.3 Vdc

Type of power supply = DC voltage from NGFC 30x30 test board.

Type of antenna = External attachable PIFA antenna.

Declared Gain for antenna = 5 dBi

Operating frequencies in the sub-band 5.725-5.85 GHz.

-For IEEE 802.11a, the equipment uses channels 149, 157, 165.

-For IEEE 802.11n, there are two bandwidths:

For 20 MHz bandwidth the equipment uses channels 149, 157, 165.
For 40 MHz bandwidth the equipment uses channels 151, 159.

-For IEEE 802.11ac, there are three bandwidths:

For 20 MHz bandwidth the equipment uses channels 149, 157, 165.
For 40 MHz bandwidth the equipment uses channels 151, 159.
For 80 MHz bandwidth the equipment uses channel 155.

TEST FREQUENCIES:

For WiFi a/n20/ac20:

Lowest channel (149): 5745 MHz

Middle channel (157): 5785 MHz

Highest channel (165): 5825 MHz

For WiFi n40/ac40:

Lowest channel (151): 5755 MHz

Highest channel (159): 5795 MHz

For WiFi ac80:

Middle channel (155): 5775 MHz

The test set-up was made in accordance to the general provisions of ANSI C63.10: 2009 and FCC KDB 789033 D02 General UNII Test Procedures New Rules v01 dated 06/06/2014 and FCC KBD 662911 D01 Multiple Transmitter Output v02r01 dated 10/31/2013.

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 (MHz).	SISO Chain A (dBm)	SISO Chain B (dBm)	MIMO at both ports A and B (dBm)
5.725-5.85GHz Band	802.11a	20	149 / 5745	16	15.5	n/a
			157 / 5785	15.5	15	n/a
			165 / 5825	16	15	n/a
	802.11n	20	149 / 5745	16	15.5	13.50
			157 / 5785	15.5	15.5	13.50
			165 / 5825	16	15	13.50
	802.11n*	40	151 / 5755	16.5	16.5	16.50
			159 / 5795	16.5	16.5	16.50
	802.11ac	80	155 / 5775	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 5745 MHz	Middle frequency 5785 MHz	Highest frequency 5825 MHz
99% bandwidth (MHz)	16.73	16.63	16.61
26 dB bandwidth (MHz)	25.06	22.59	23.56
Measurement uncertainty (kHz)	±21.7		

CHAIN B

	Lowest frequency 5745 MHz	Middle frequency 5785 MHz	Highest frequency 5825 MHz
99% bandwidth (MHz)	16.65	16.62	16.65
26 dB bandwidth (MHz)	23.41	23.52	23.04
Measurement uncertainty (kHz)	±21.7		

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

CHAIN A

	Lowest frequency 5745 MHz	Middle frequency 5785 MHz	Highest frequency 5825 MHz
99% bandwidth (MHz)	17.79	17.77	17.81
26 dB bandwidth (MHz)	24.35	23.96	24.67
Measurement uncertainty (kHz)	±21.7		

CHAIN B

	Lowest frequency 5745 MHz	Middle frequency 5785 MHz	Highest frequency 5825 MHz
99% bandwidth (MHz)	17.76	17.76	17.78
26 dB bandwidth (MHz)	23.81	24.11	24.72
Measurement uncertainty (kHz)	±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.

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

CHAIN A

	Lowest frequency 5755 MHz	Highest frequency 5795 MHz
99% bandwidth (MHz)	36.12	36.10
26 dB bandwidth (MHz)	44.10	44.12
Measurement uncertainty (kHz)	±21.7	

CHAIN B

	Lowest frequency 5755 MHz	Highest frequency 5795 MHz
99% bandwidth (MHz)	36.13	36.12
26 dB bandwidth (MHz)	44.48	43.78
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.

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

CHAIN A

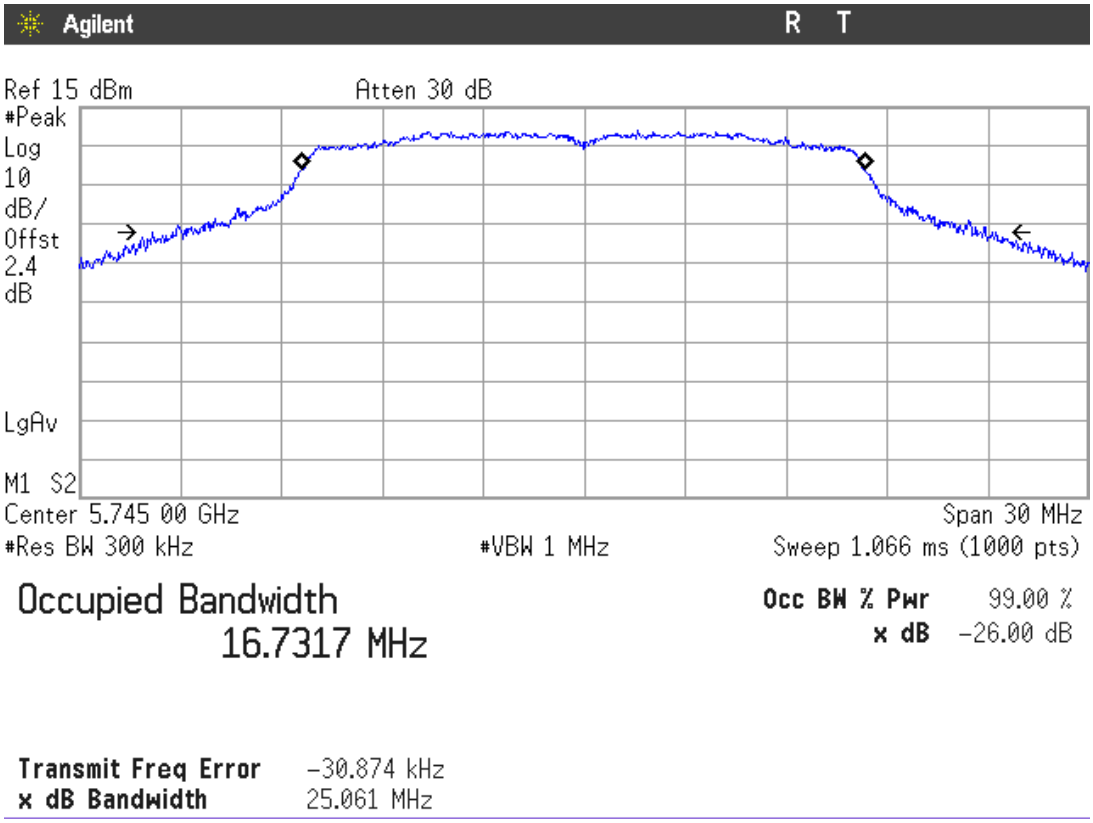
	Frequency 5775 MHz
99% bandwidth (MHz)	75.23
26 dB bandwidth (MHz)	89.84
Measurement uncertainty (kHz)	±21.7

CHAIN B

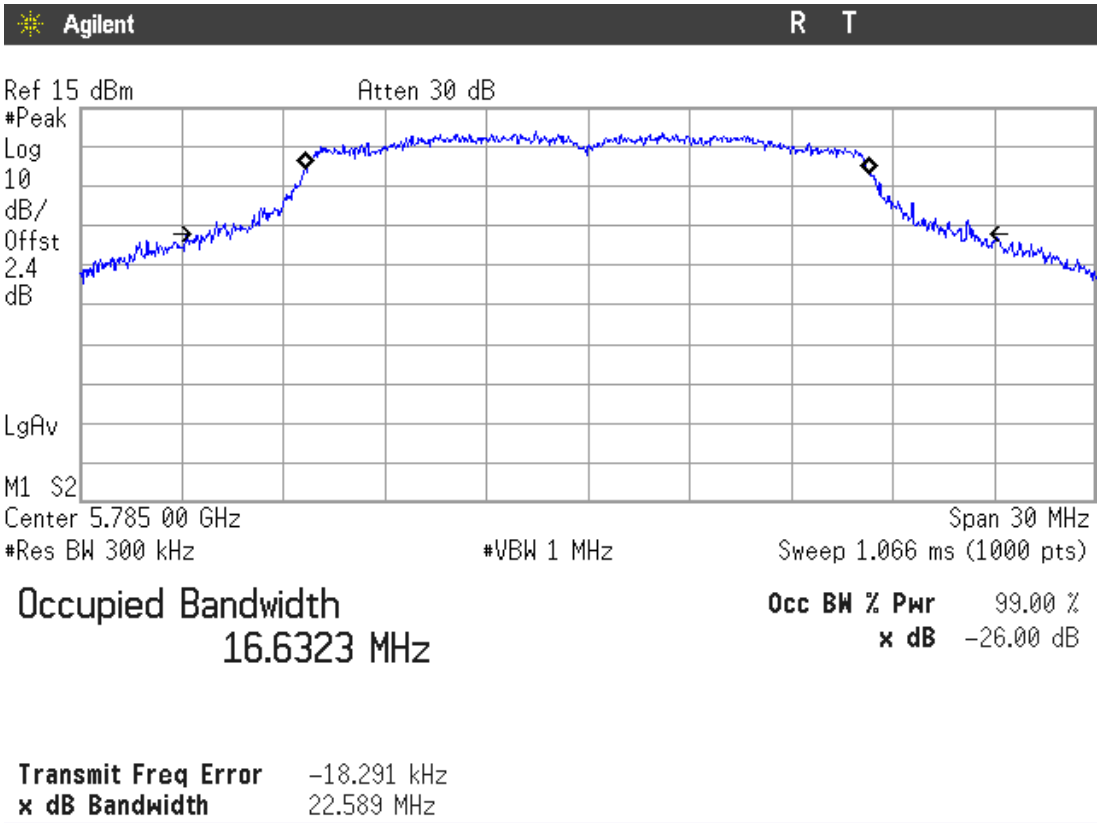
	Frequency 5775 MHz
99% bandwidth (MHz)	75.15
26 dB bandwidth (MHz)	88.45
Measurement uncertainty (kHz)	±21.7

802.11a mode CHAIN A

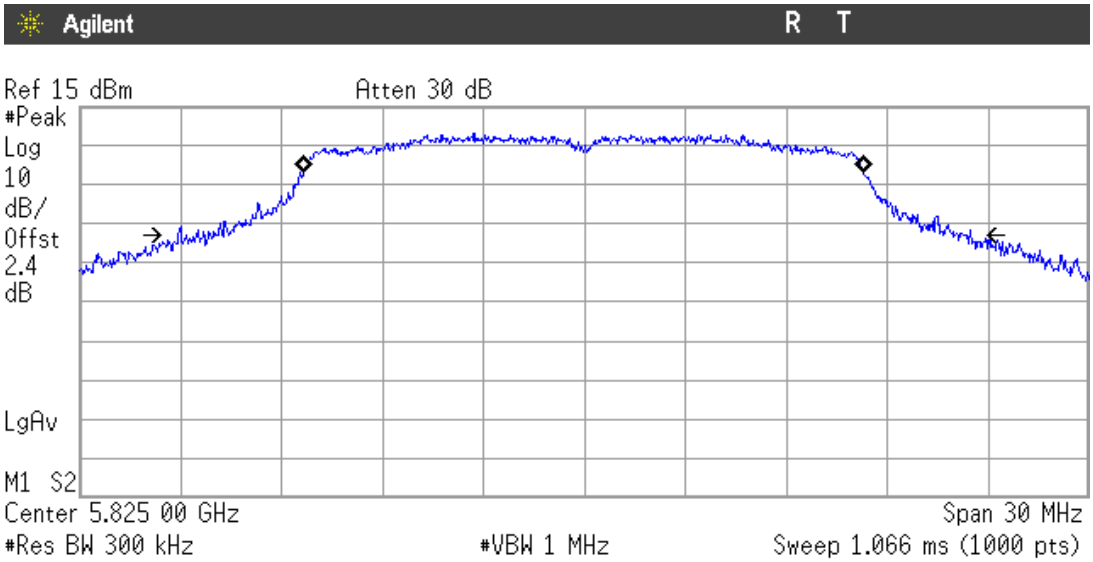
Lowest Channel



Middle Channel

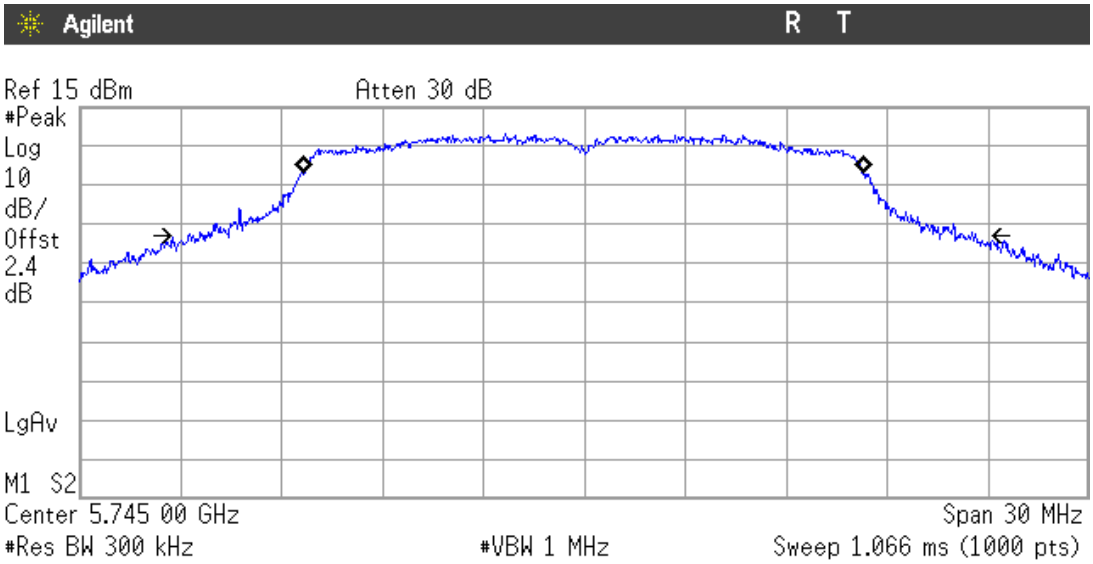


Highest Channel

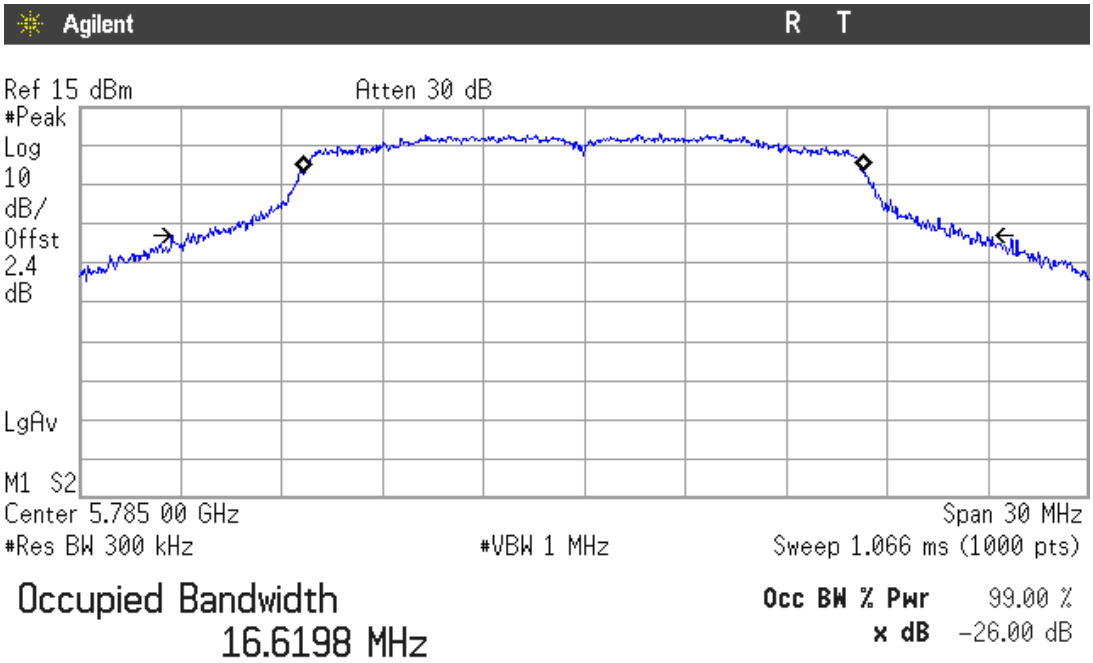


802.11a mode CHAIN B

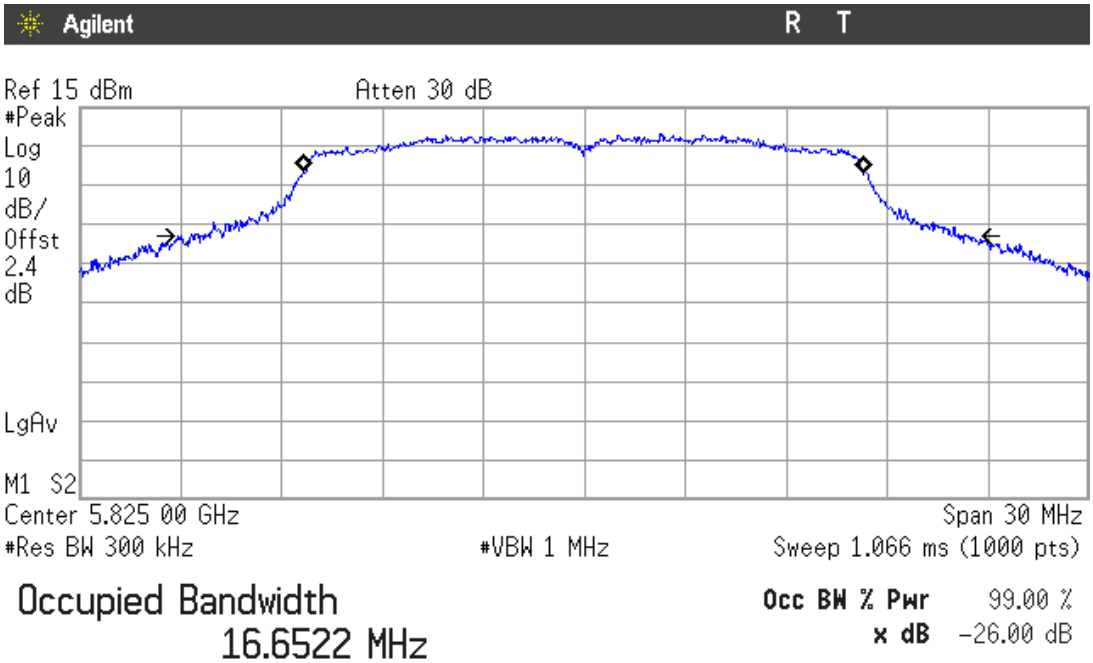
Lowest Channel



Middle Channel

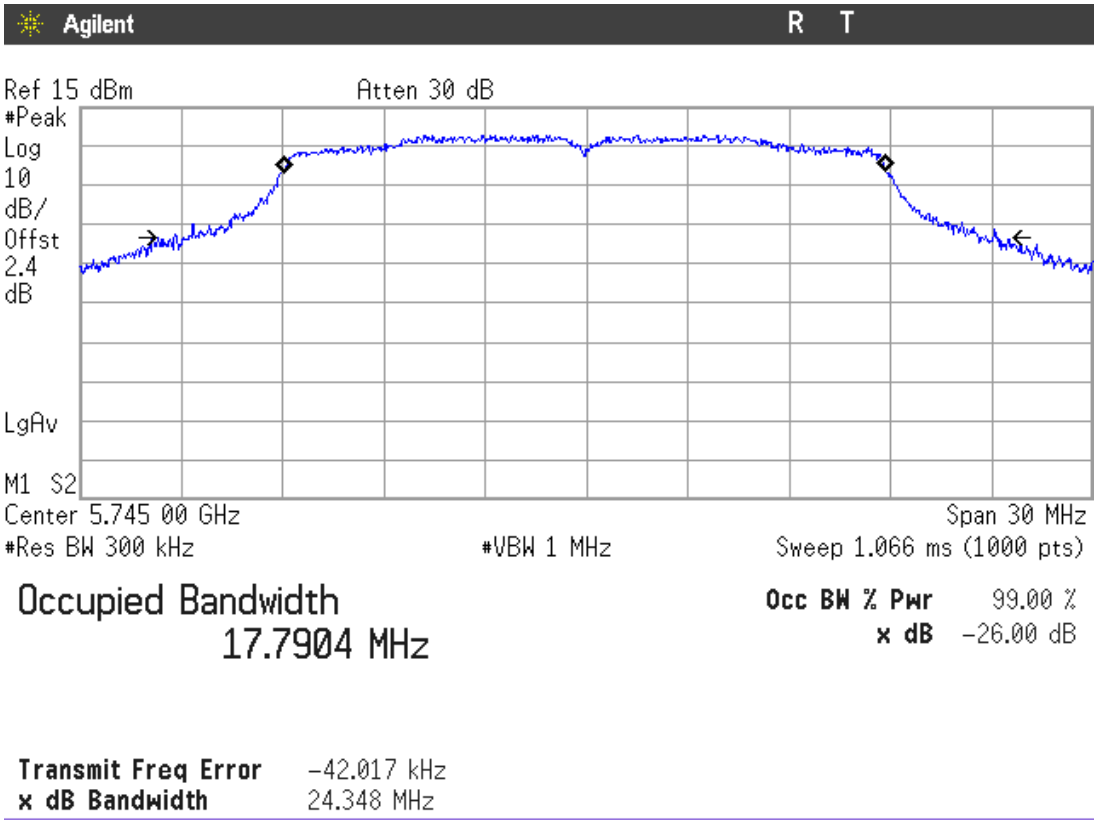


Highest Channel

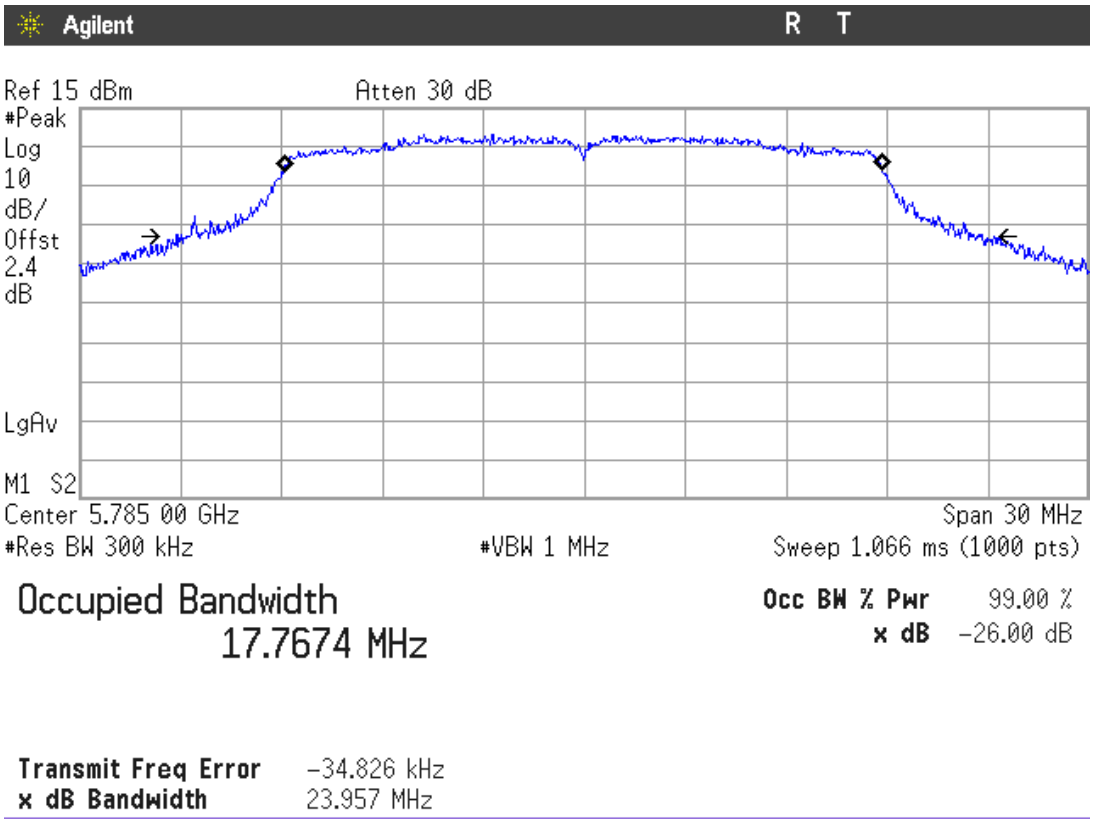


802.11 n20 MHz and 802.11 ac 20 MHz modes CHAIN A

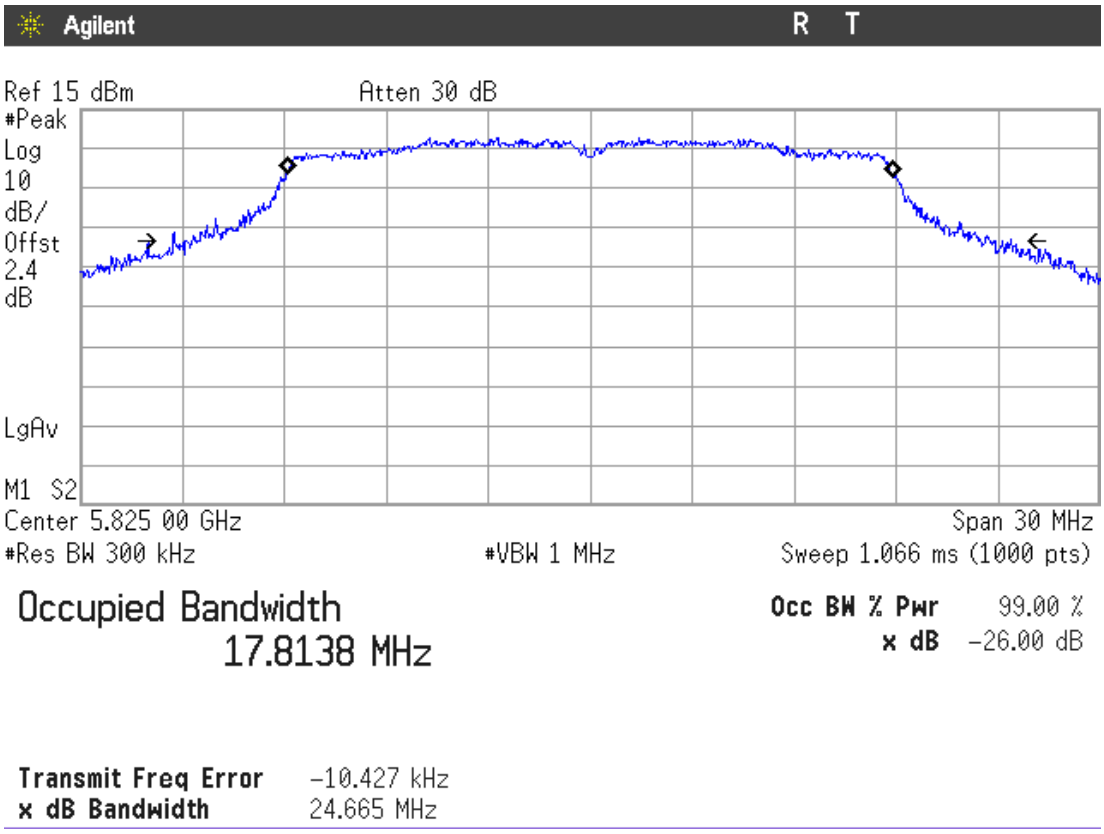
Lowest Channel



Middle Channel

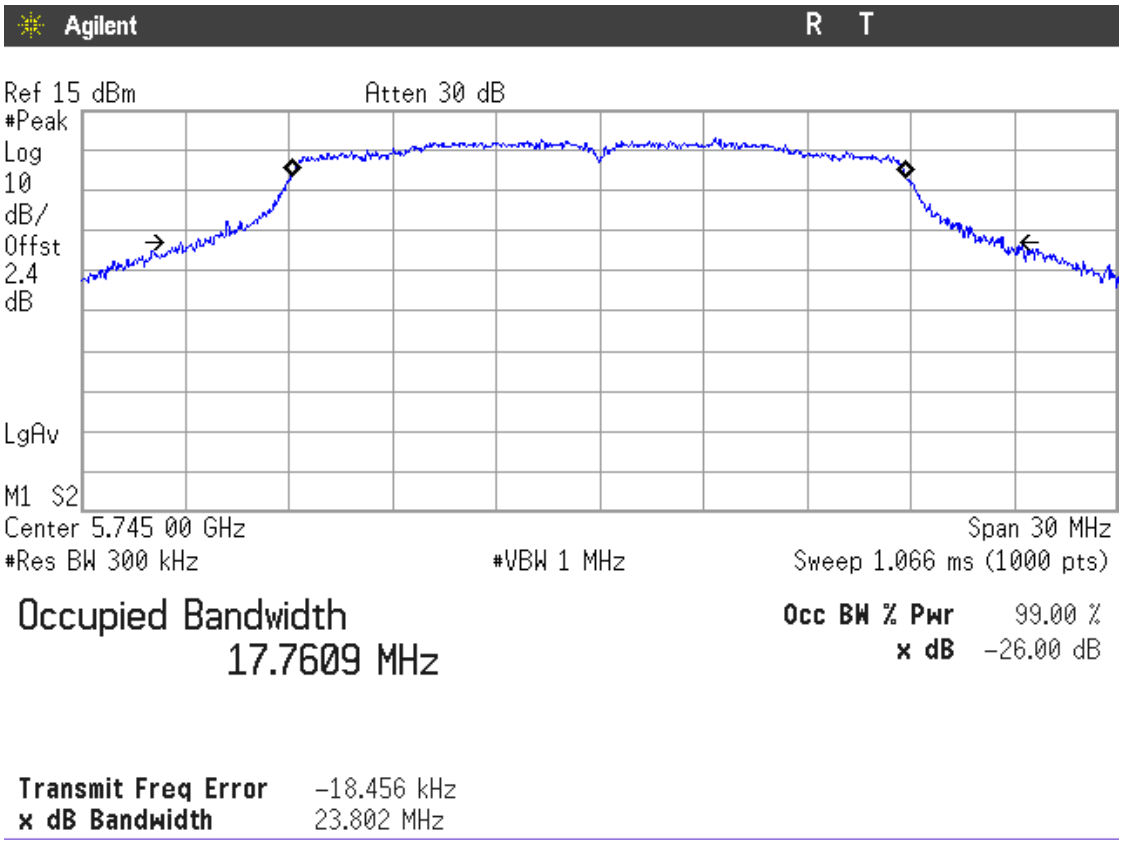


Highest Channel

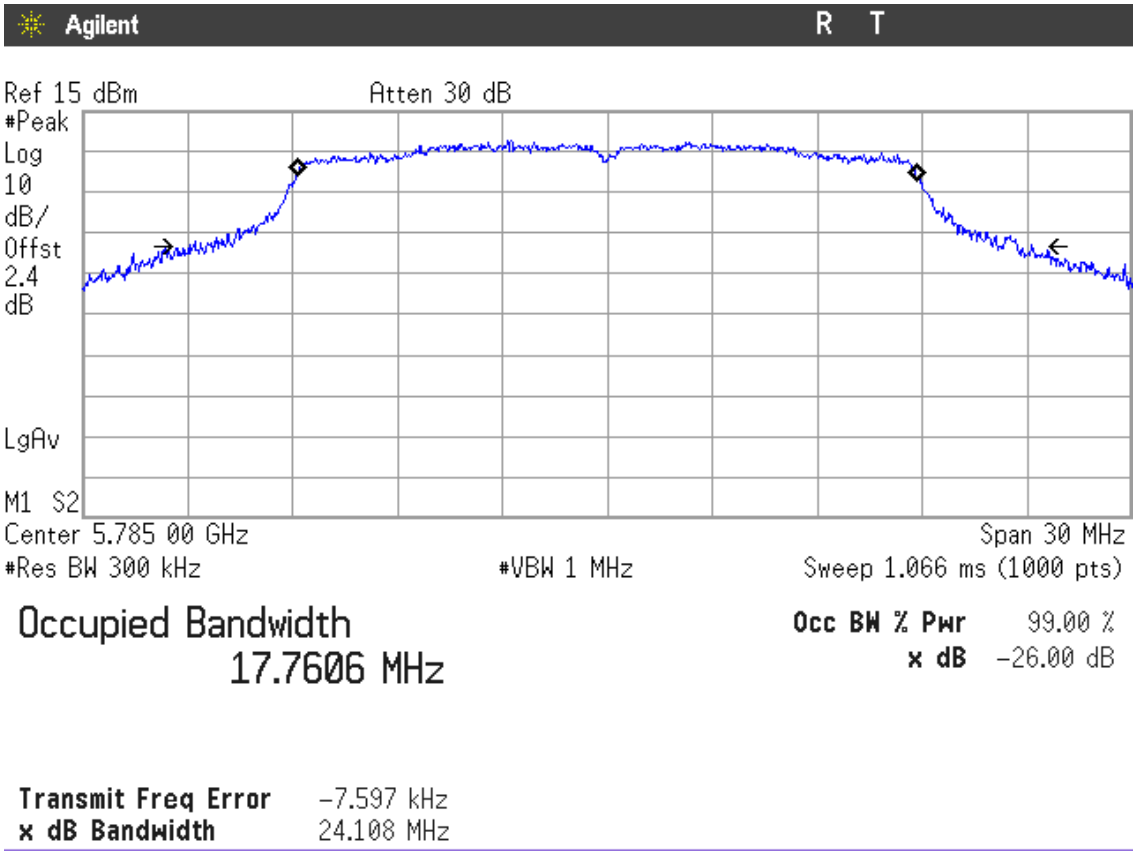


802.11 n20 MHz and 802.11 ac 20 MHz modes CHAIN B

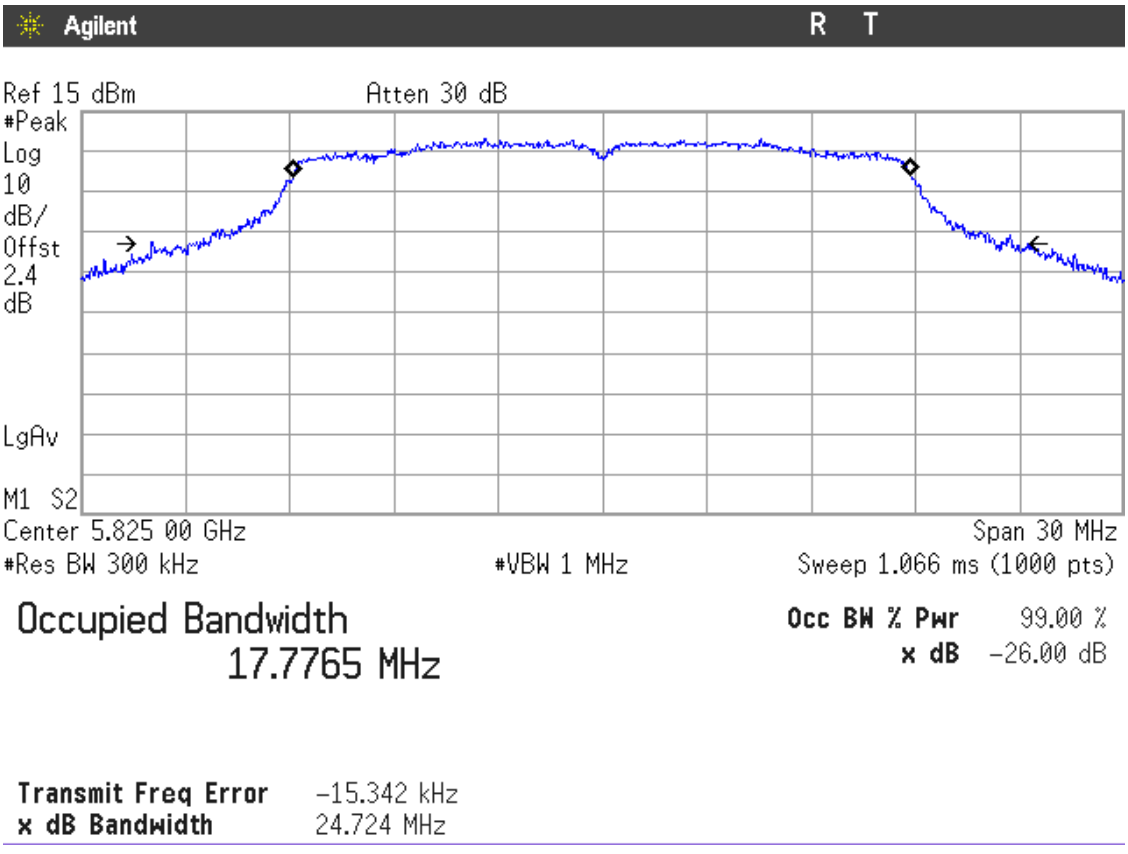
Lowest Channel



Middle Channel

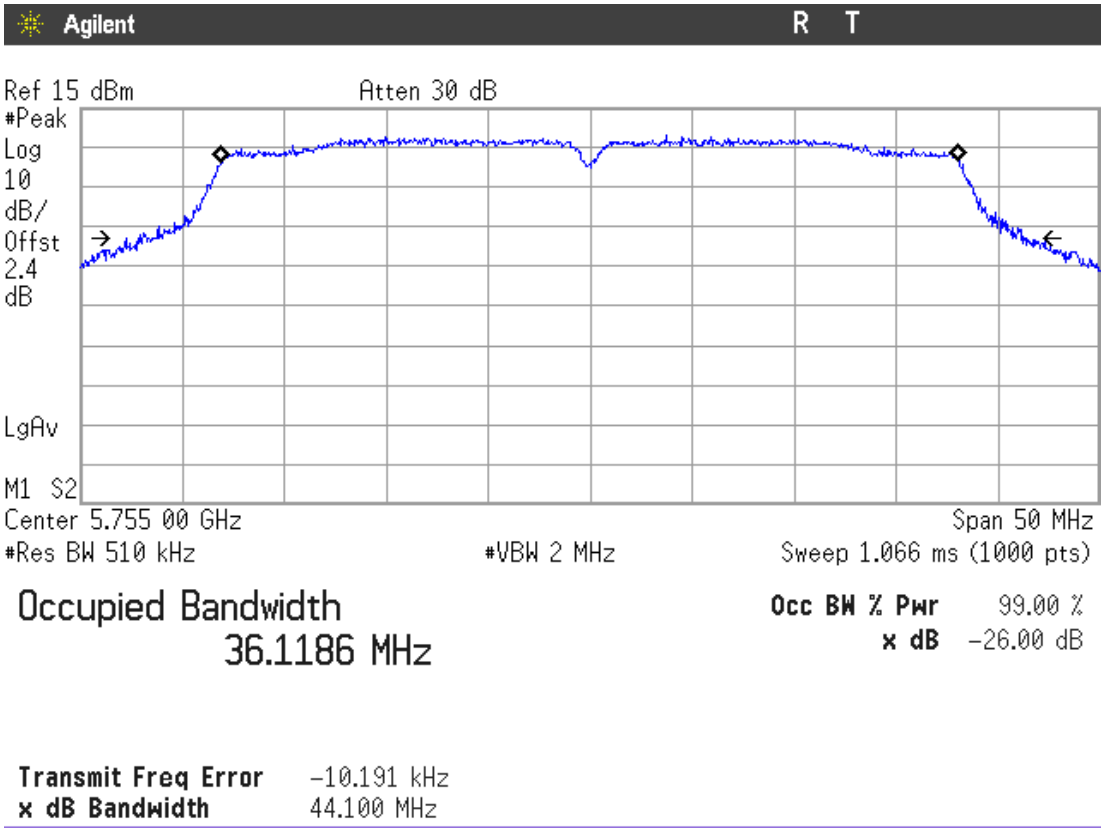


Highest Channel

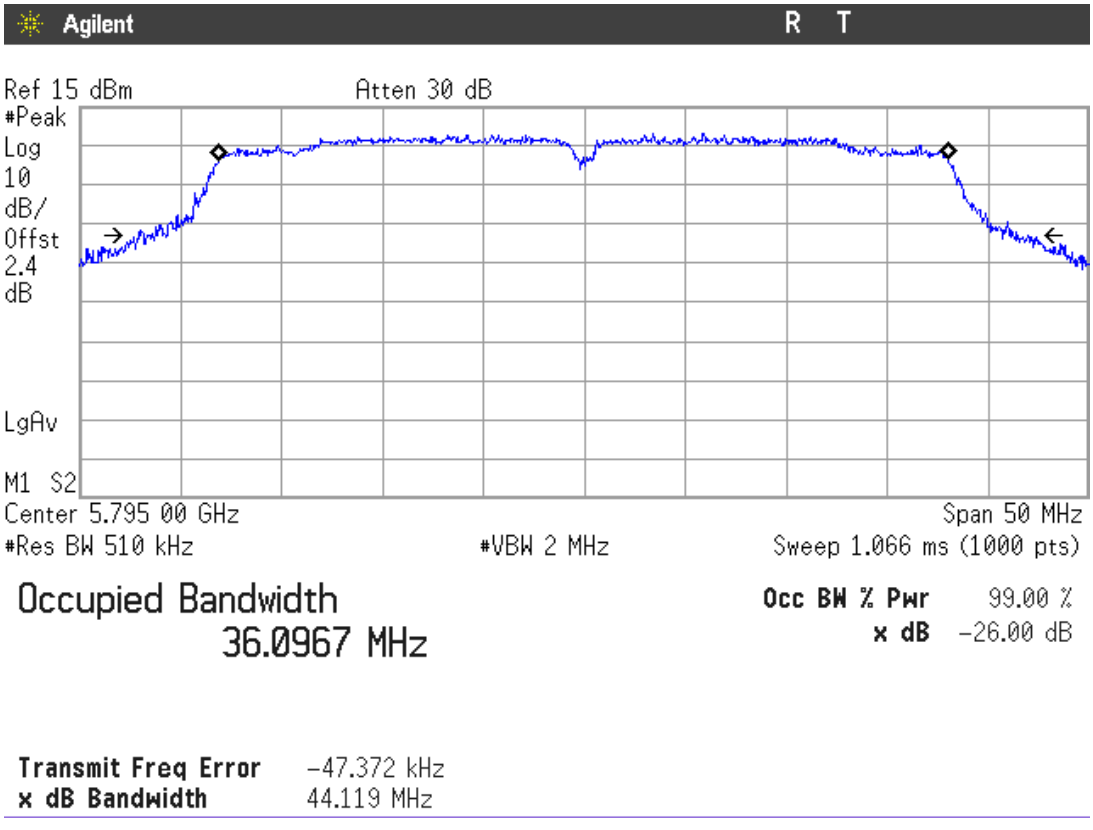


802.11 n40 MHz and 802.11 ac 40 MHz modes CHAIN A

Lowest Channel

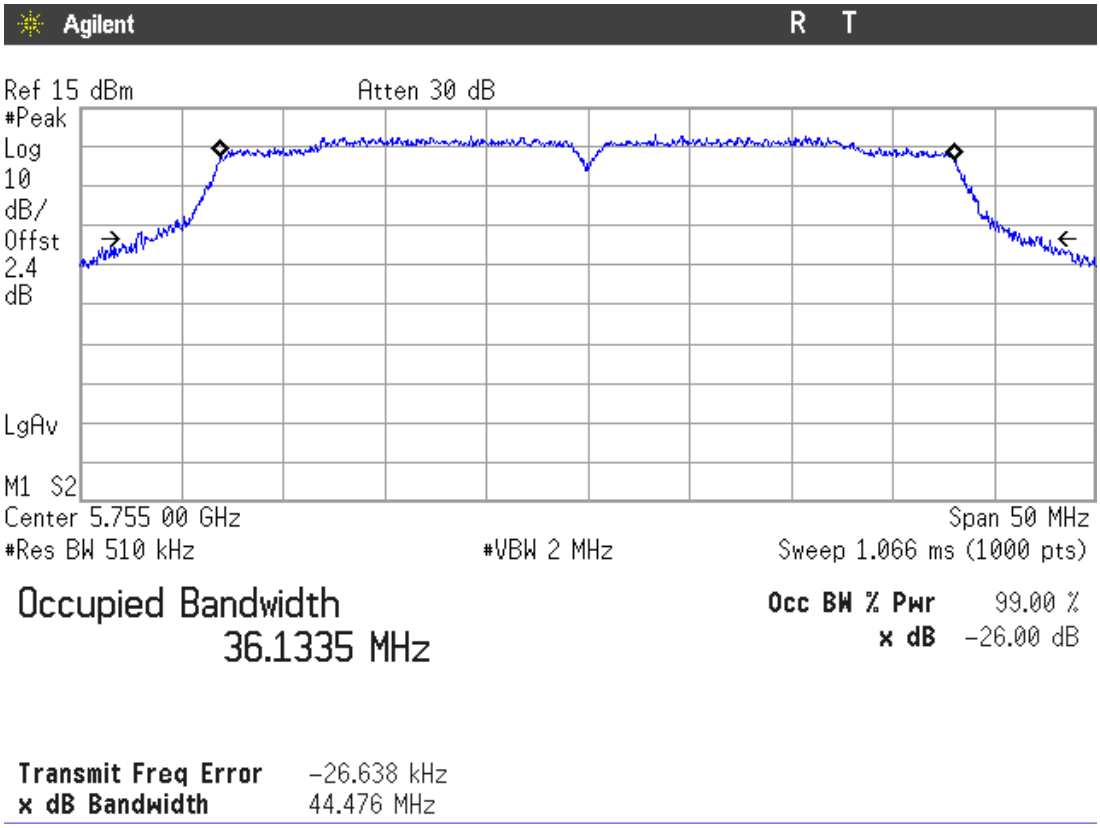


Highest Channel

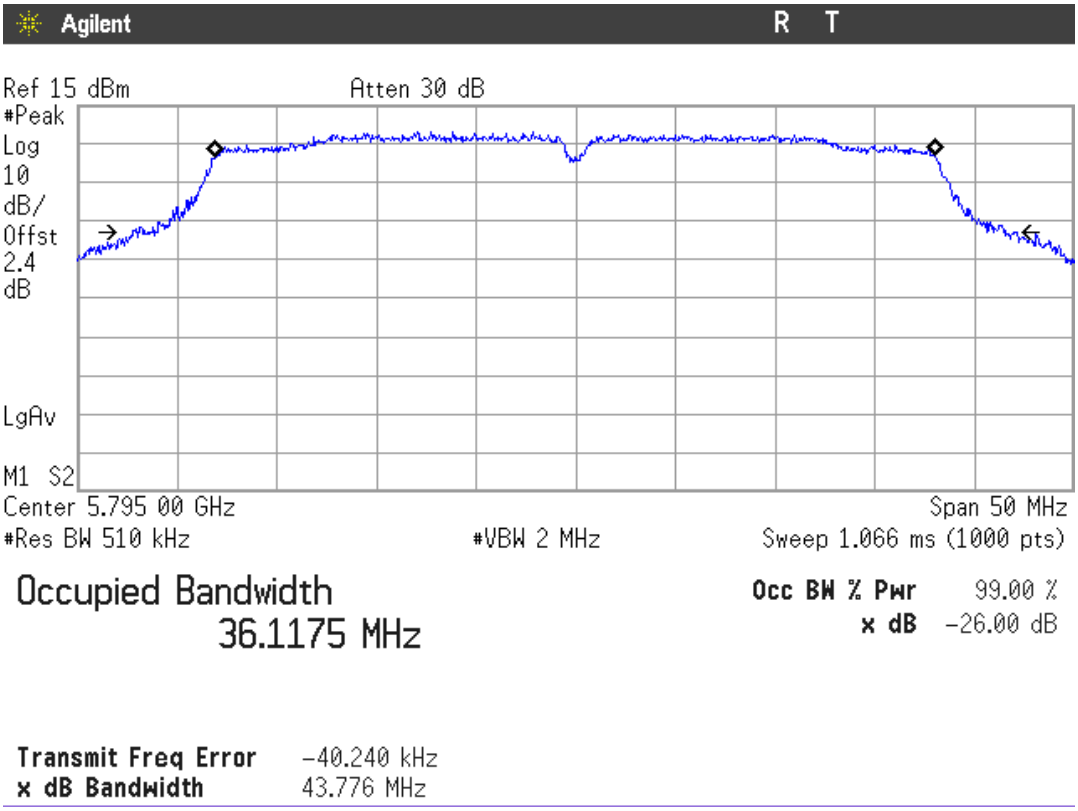


802.11 n40 MHz and 802.11 ac 40 MHz modes CHAIN B

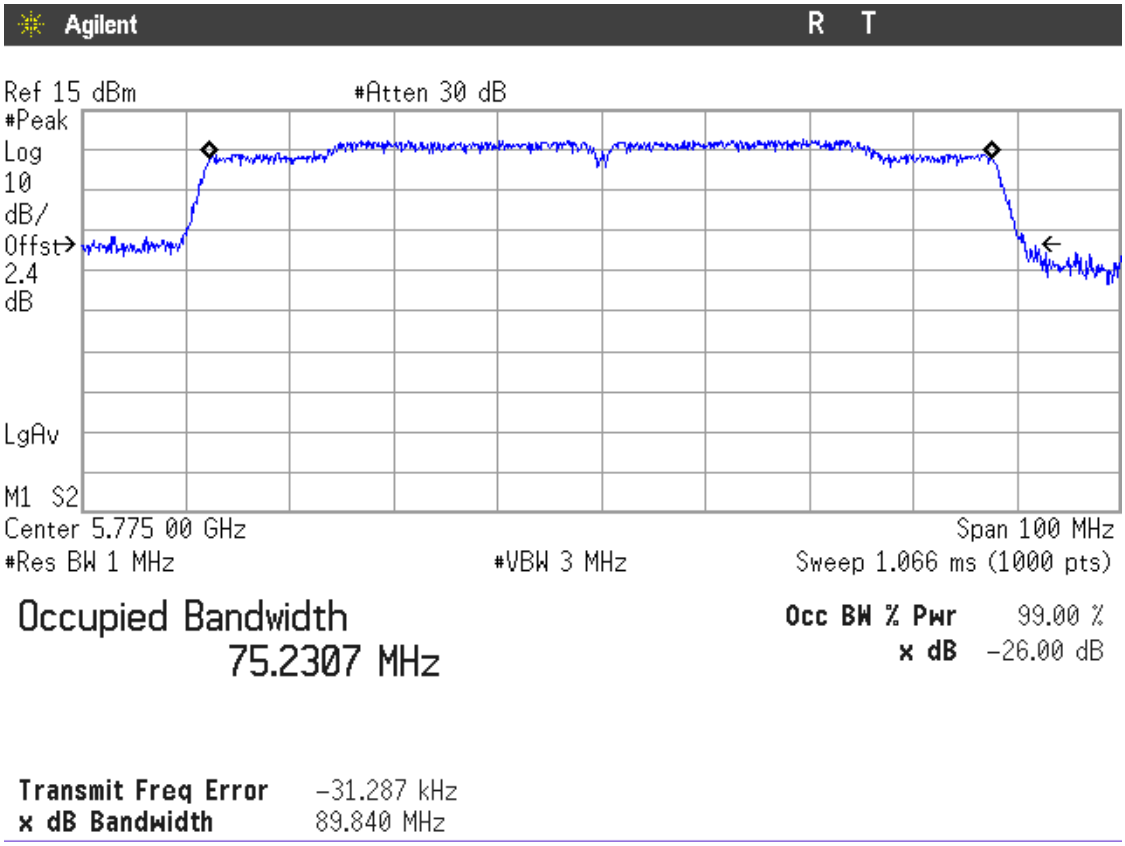
Lowest Channel



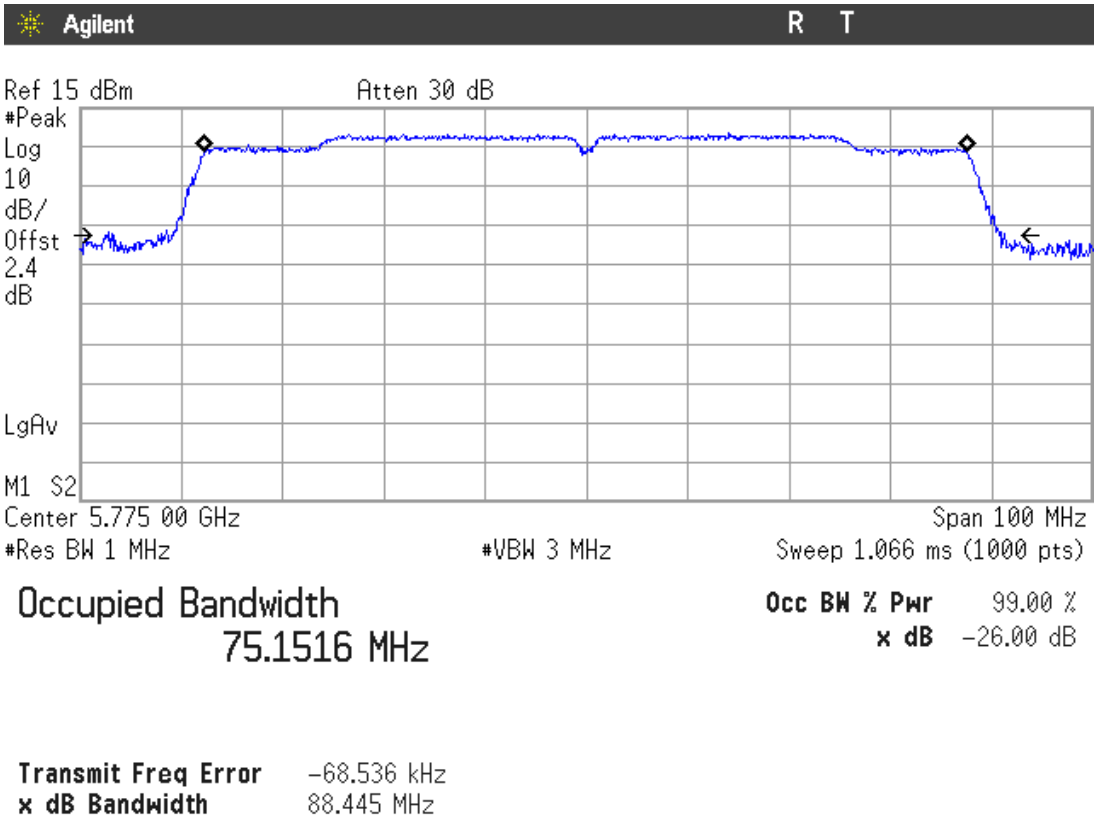
Highest Channel



802.11 ac 80 MHz mode CHAIN A



802.11 ac 80 MHz mode CHAIN B



Section 15.407 Subclause (e). 6 dB Bandwidth

SPECIFICATION

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

RESULTS

1. 802.11a mode (see next plots).

CHAIN A

	Lowest frequency 5745 MHz	Middle frequency 5785 MHz	Highest frequency 5825 MHz
6 dB bandwidth (MHz)	15.19	15.16	15.13
Measurement uncertainty (kHz)	±21.7		

CHAIN B

	Lowest frequency 5745 MHz	Middle frequency 5785 MHz	Highest frequency 5825 MHz
6 dB bandwidth (MHz)	15.13	15.16	15.16
Measurement uncertainty (kHz)	±21.7		

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

CHAIN A

	Lowest frequency 5745 MHz	Middle frequency 5785 MHz	Highest frequency 5825 MHz
6 dB bandwidth (MHz)	15.19	15.13	15.16
Measurement uncertainty (kHz)	±21.7		

CHAIN B

	Lowest frequency 5745 MHz	Middle frequency 5785 MHz	Highest frequency 5825 MHz
6 dB bandwidth (MHz)	15.13	15.19	15.19
Measurement uncertainty (kHz)	±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.

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

CHAIN A

	Lowest frequency 5755 MHz	Highest frequency 5795 MHz
6 dB bandwidth (MHz)	35.13	35.13
Measurement uncertainty (kHz)	±21.7	

CHAIN B

	Lowest frequency 5755 MHz	Highest frequency 5795 MHz
6 dB bandwidth (MHz)	35.13	35.13
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.

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

CHAIN A

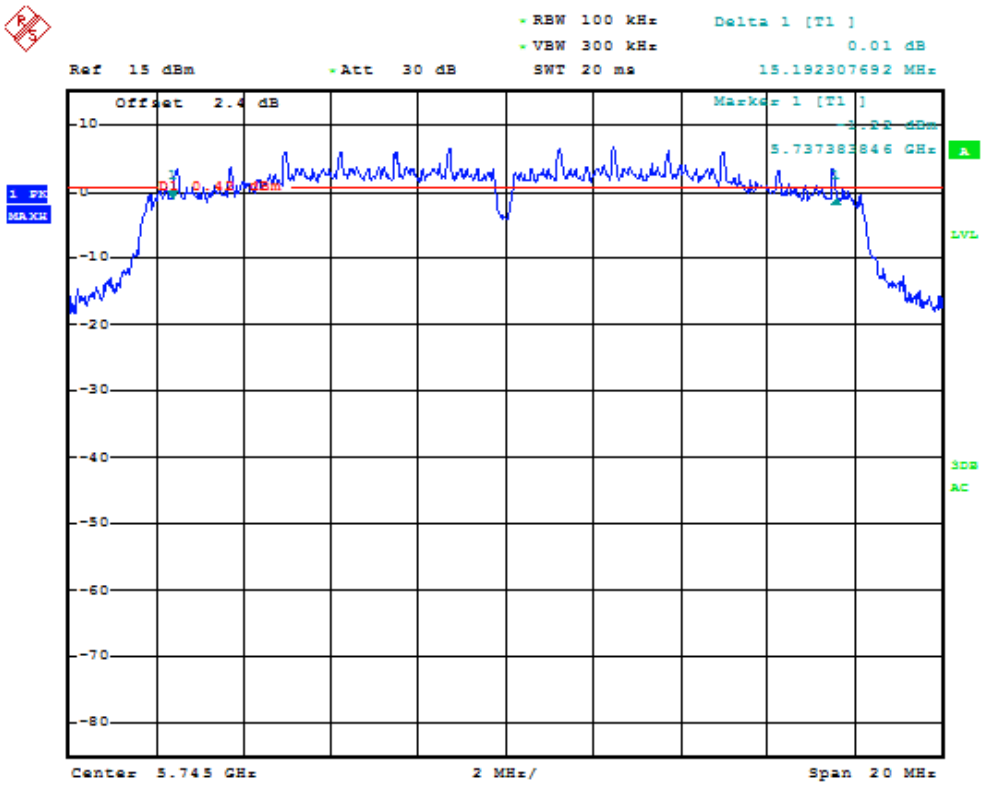
	Frequency 5775 MHz
6 dB bandwidth (MHz)	75.38
Measurement uncertainty (kHz)	±21.7

CHAIN B

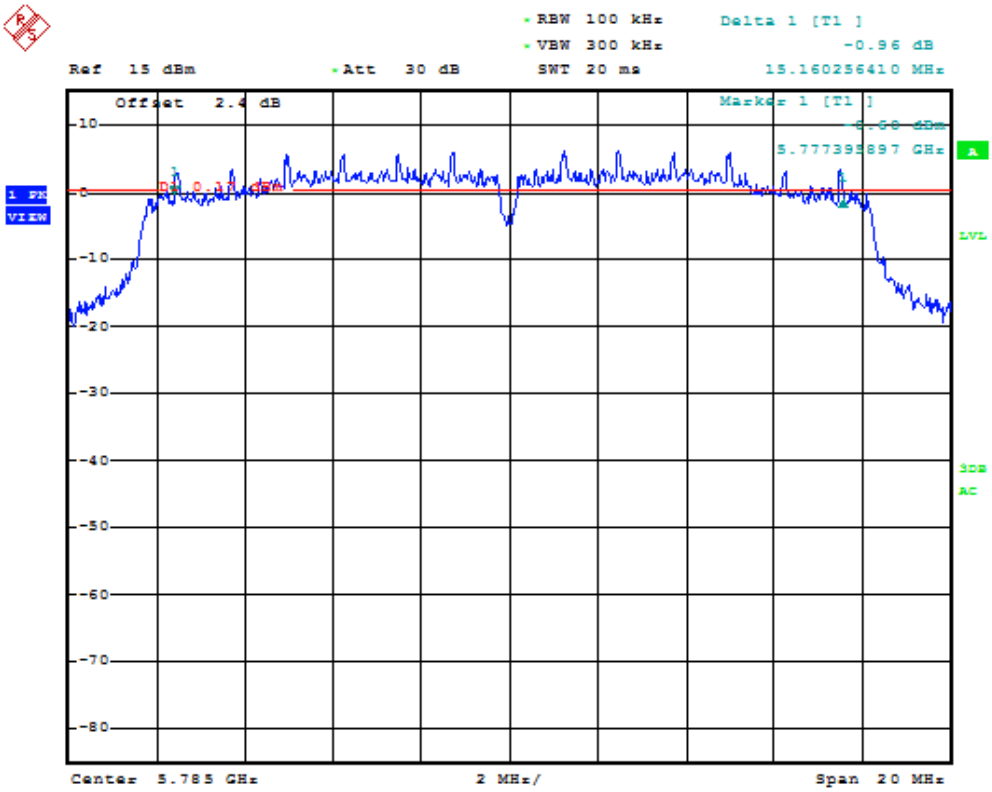
	Frequency 5775 MHz
6 dB bandwidth (MHz)	75.38
Measurement uncertainty (kHz)	±21.7

802.11a mode CHAIN A

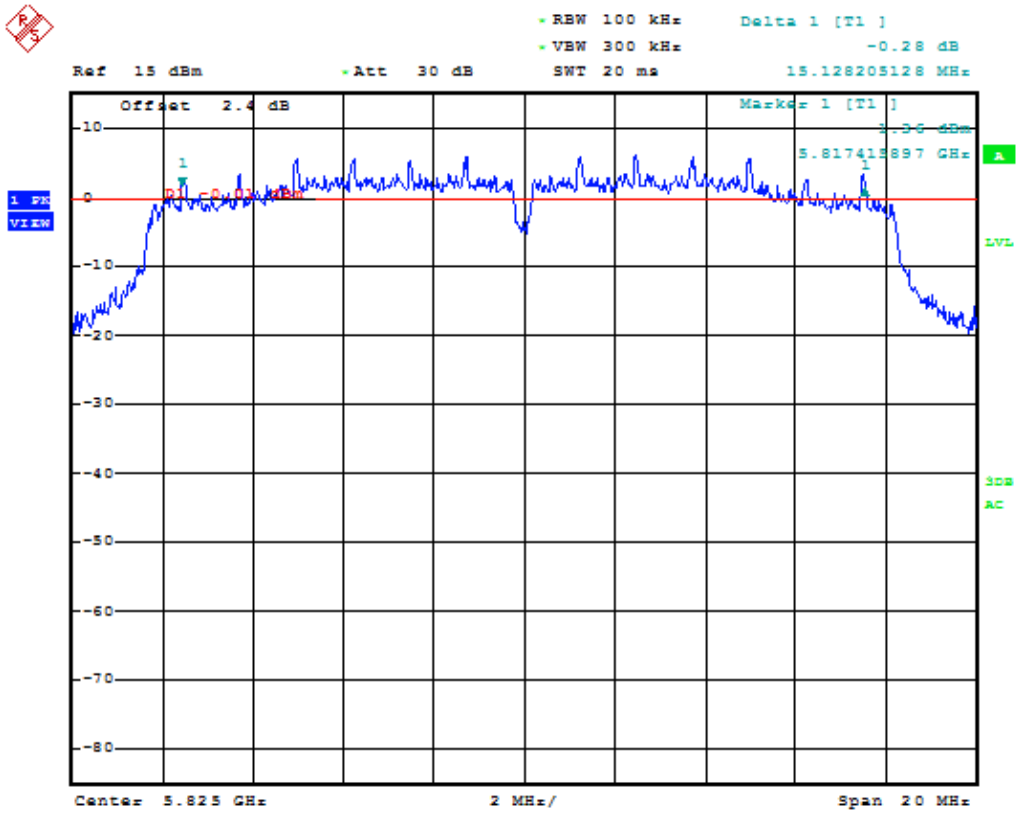
Lowest Channel



Middle Channel

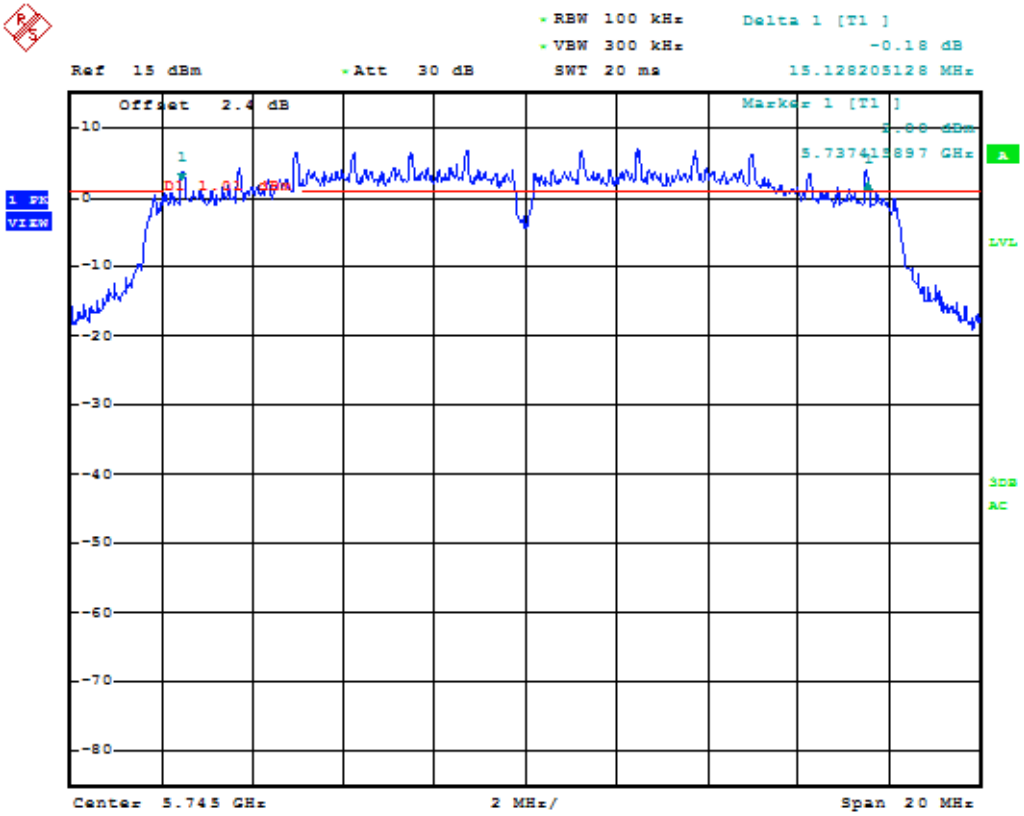


Highest Channel

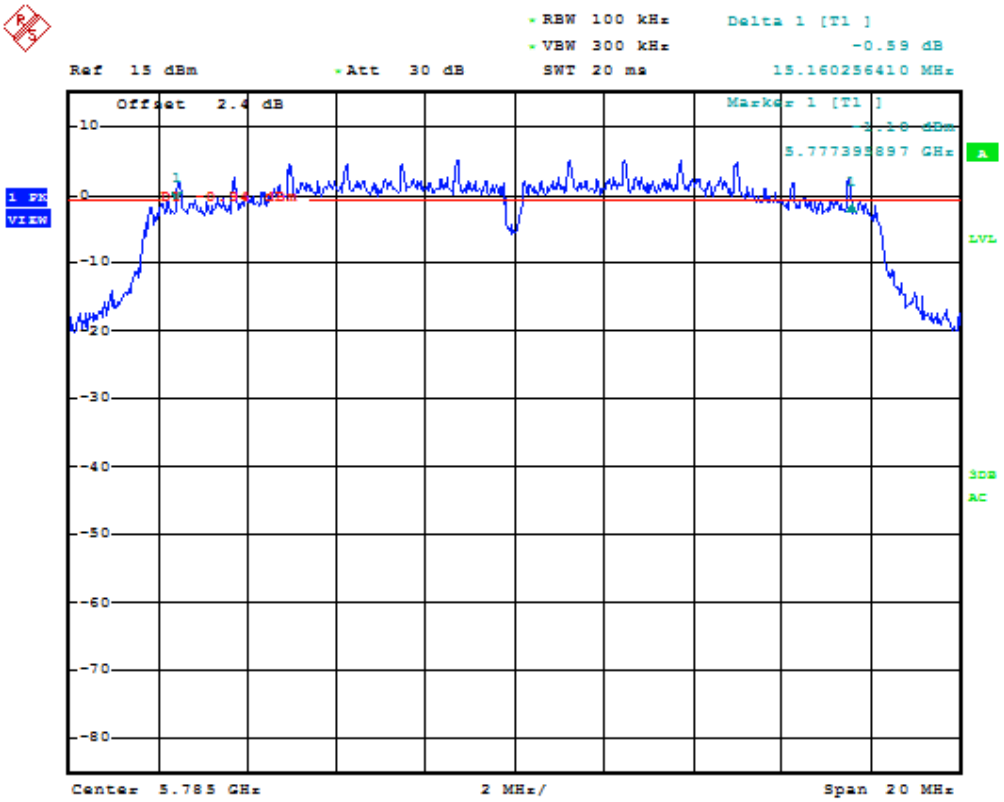


802.11a mode CHAIN B

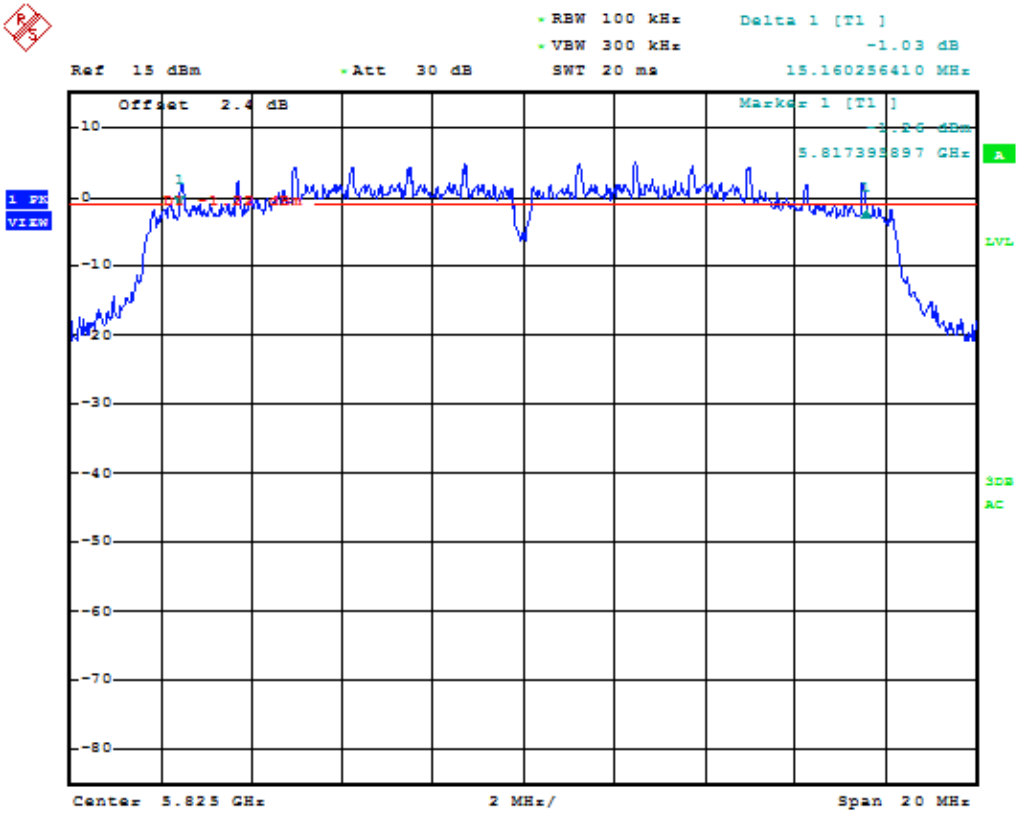
Lowest Channel



Middle Channel

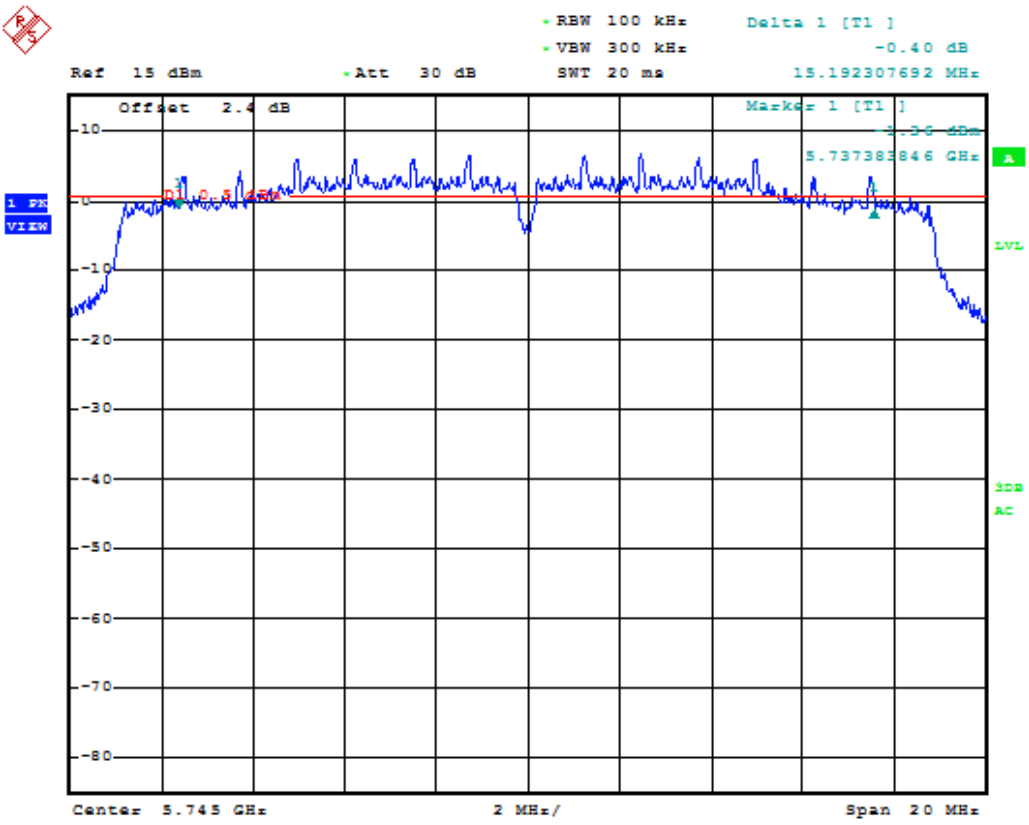


Highest Channel

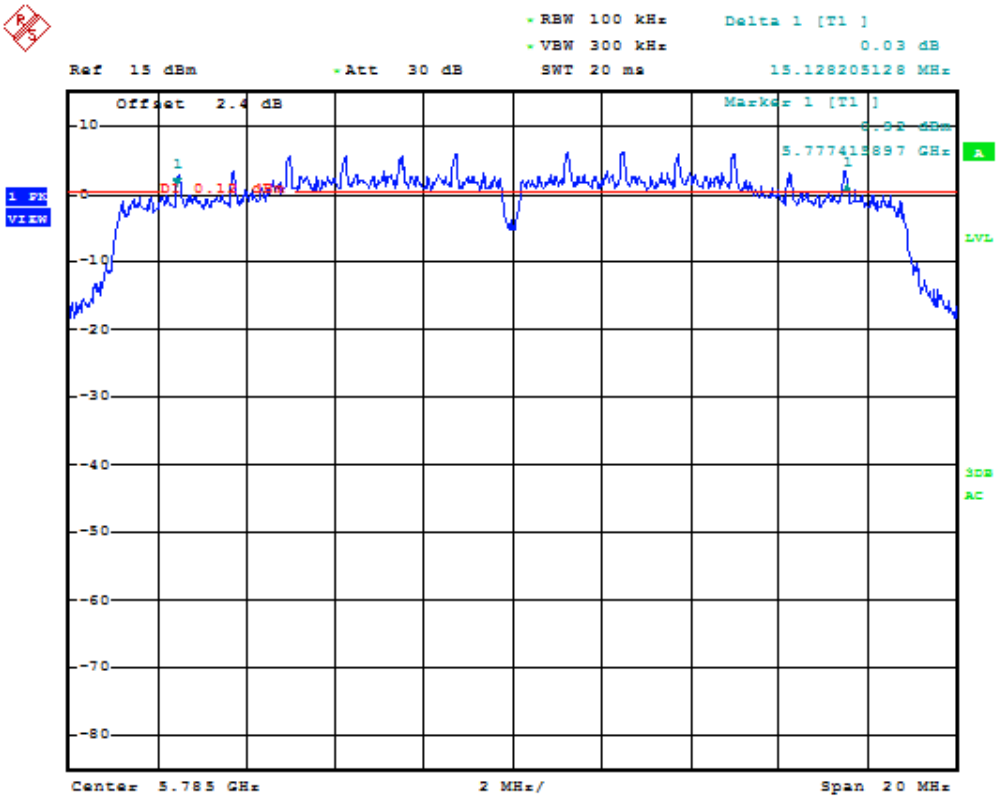


802.11 n20 MHz and 802.11 ac 20 MHz modes CHAIN A

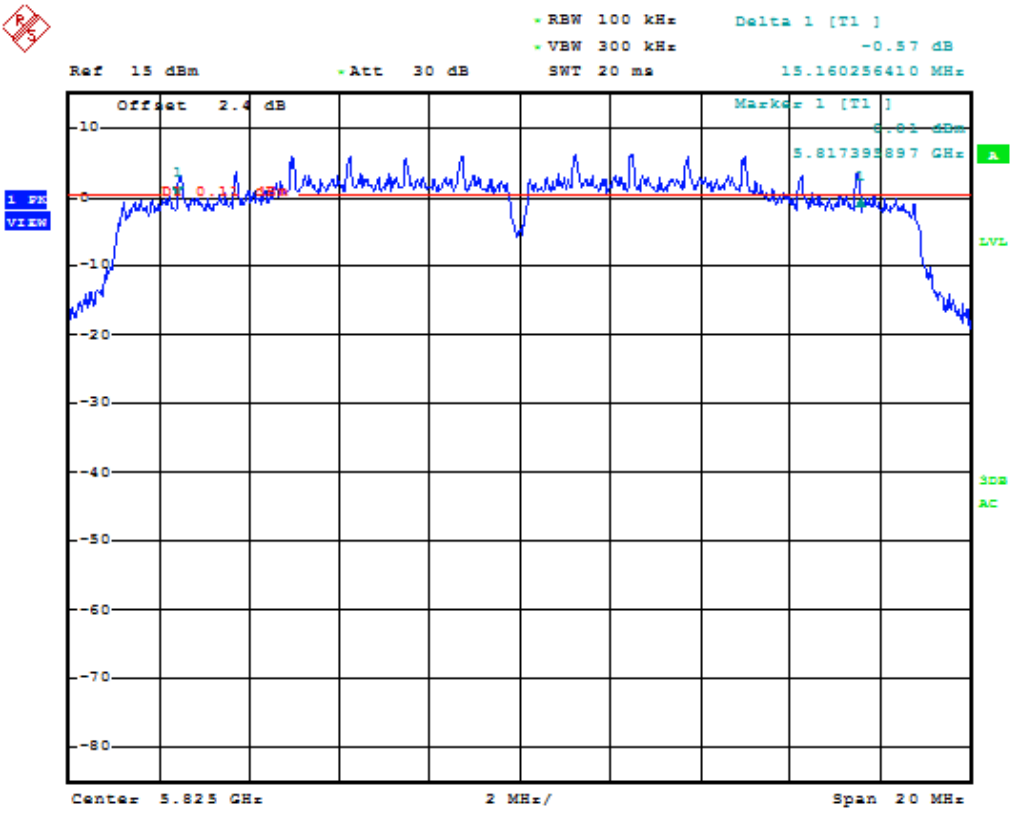
Lowest Channel



Middle Channel

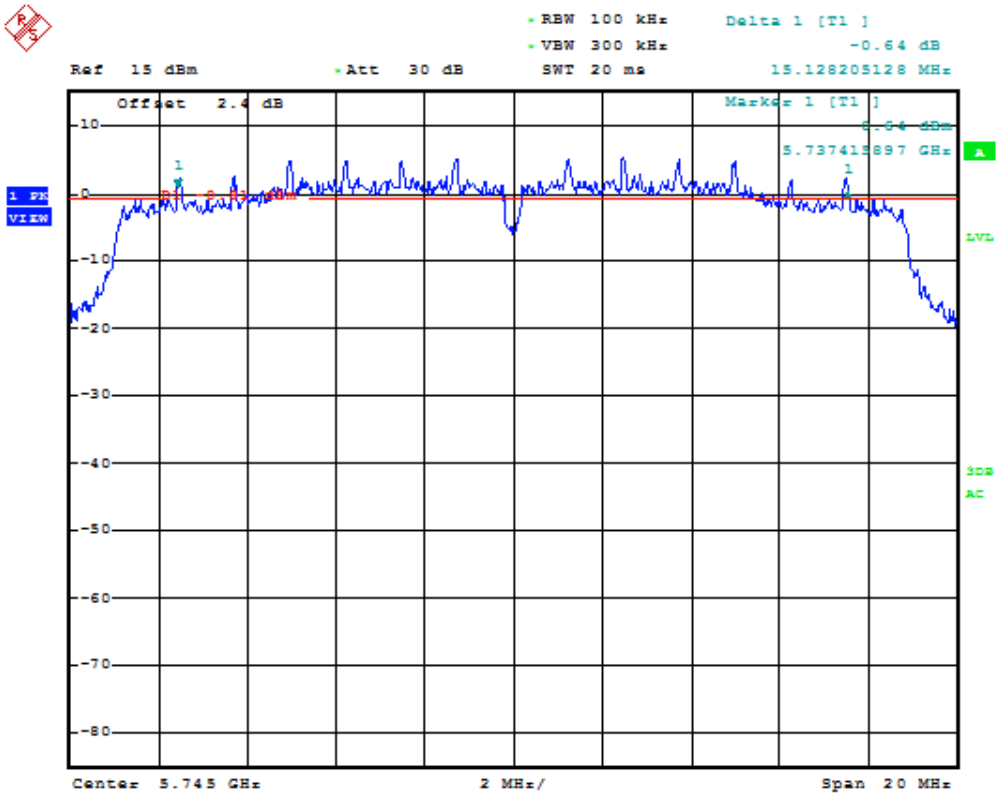


Highest Channel

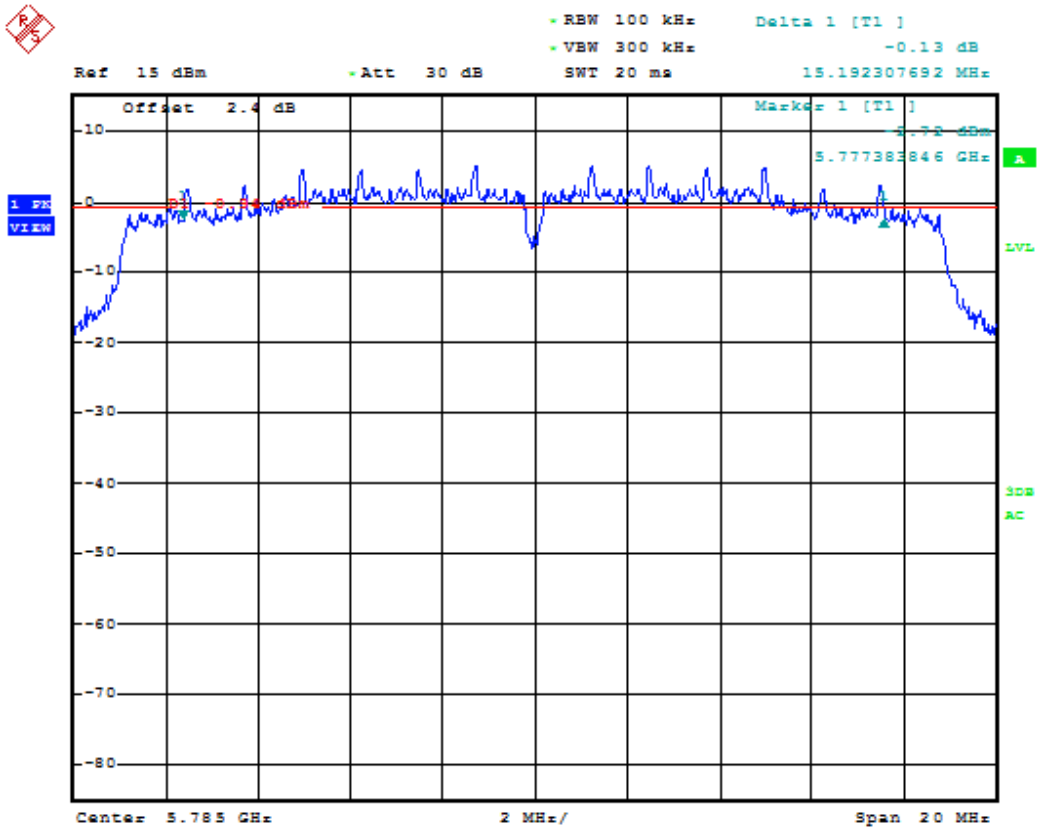


802.11 n20 MHz and 802.11 ac 20 MHz modes CHAIN B

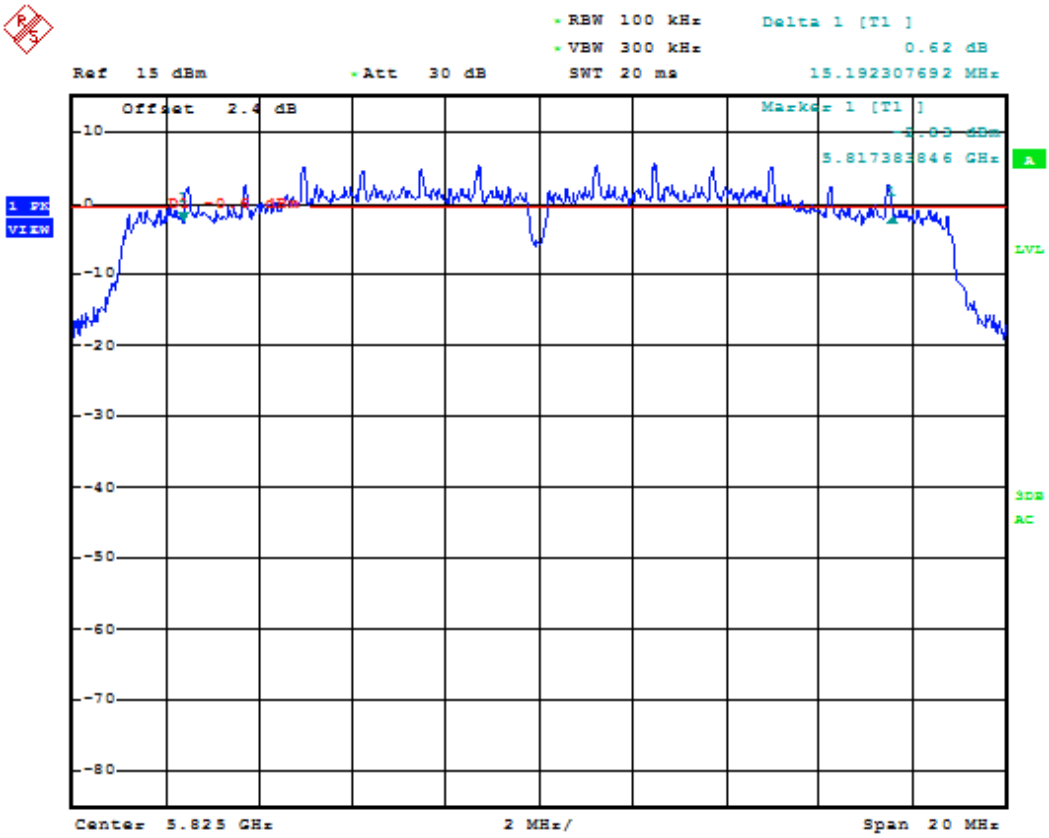
Lowest Channel



Middle Channel

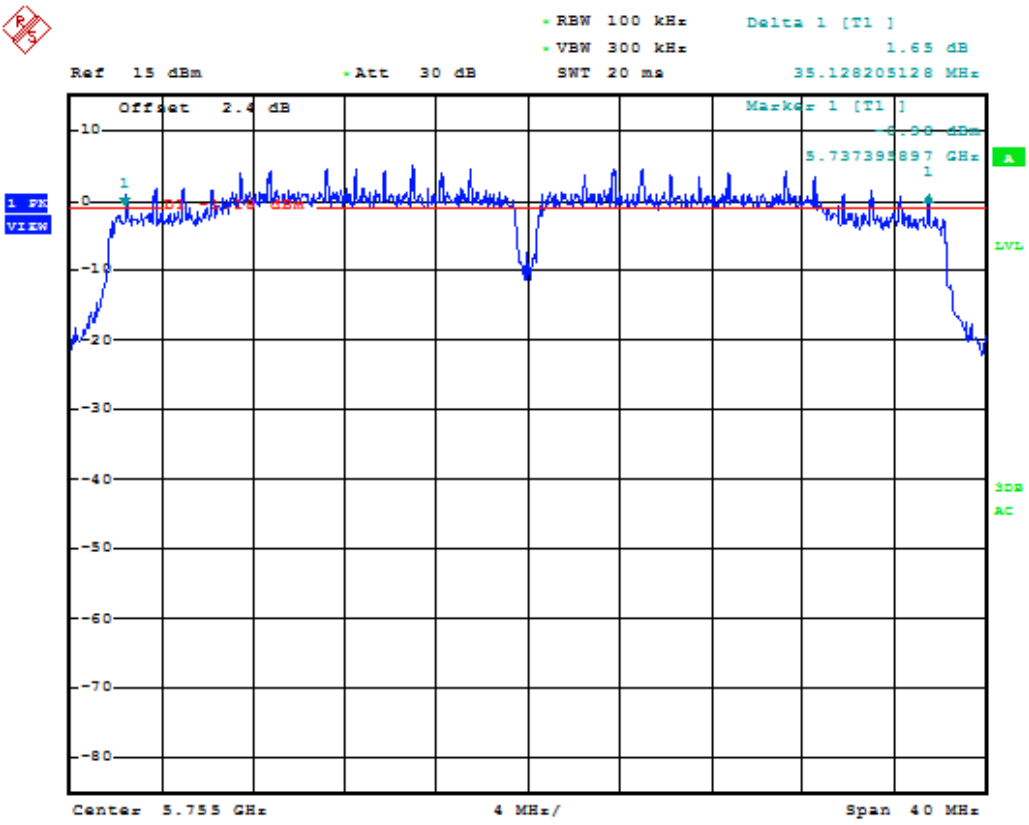


Highest Channel

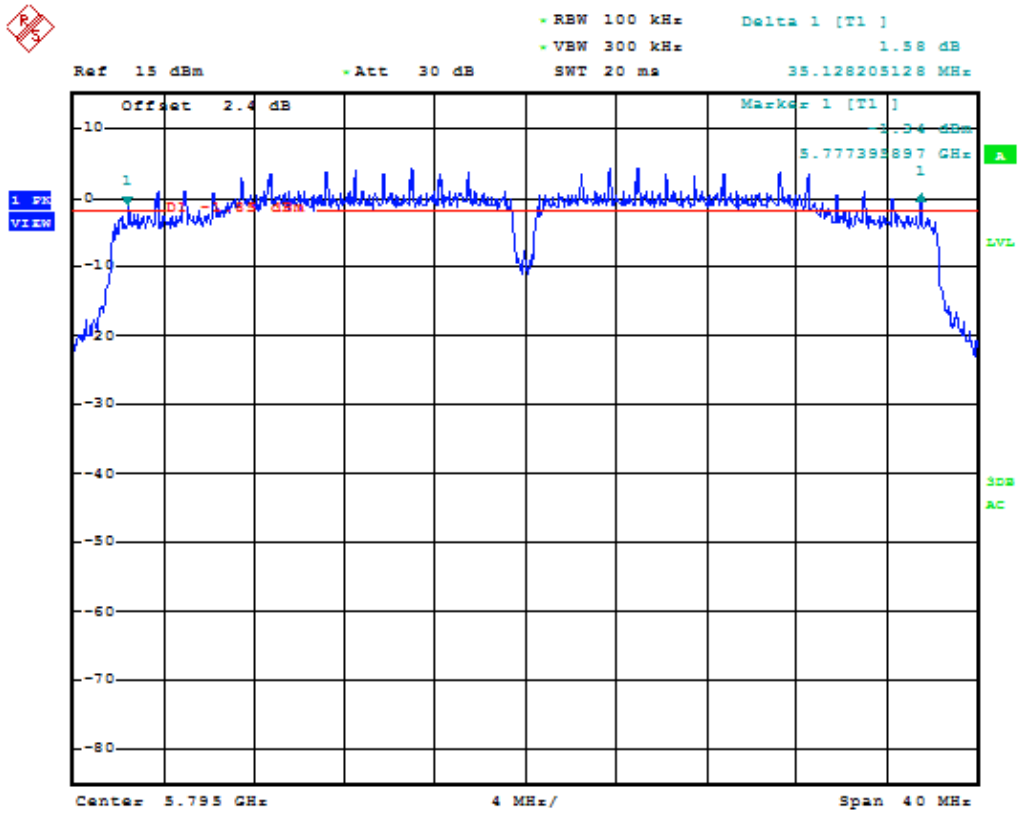


802.11 n40 MHz and 802.11 ac 40 MHz modes CHAIN A

Lowest Channel

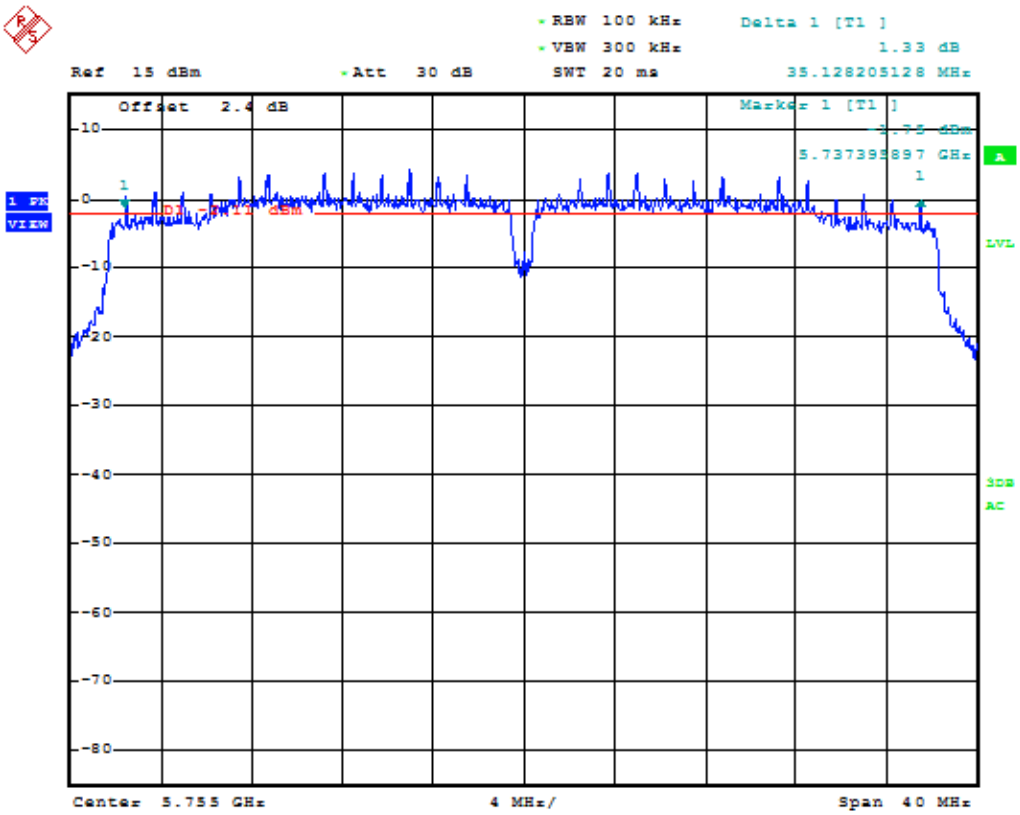


Highest Channel

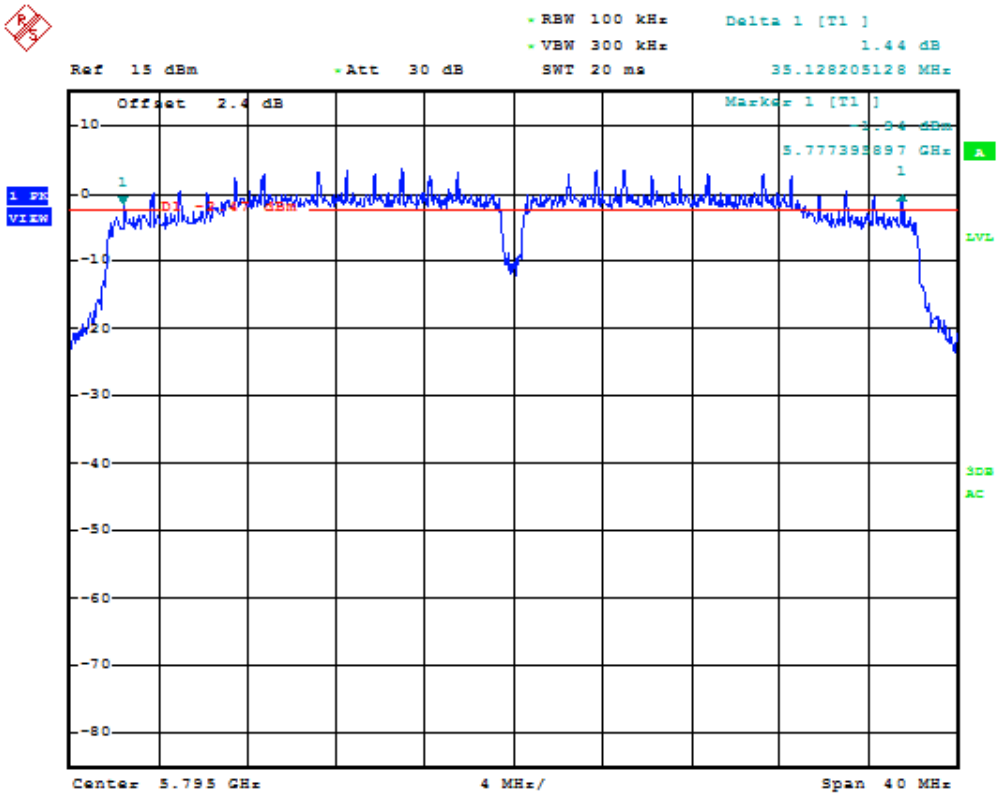


802.11 n40 MHz and 802.11 ac 40 MHz modes CHAIN B

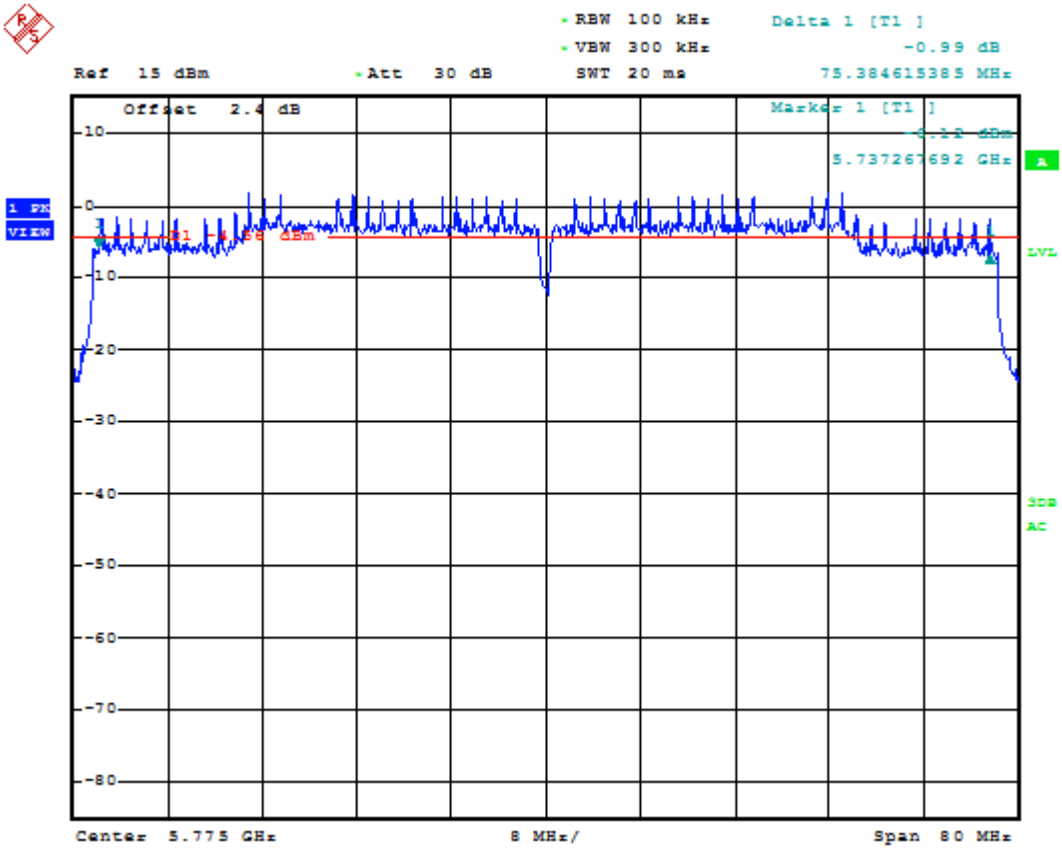
Lowest Channel



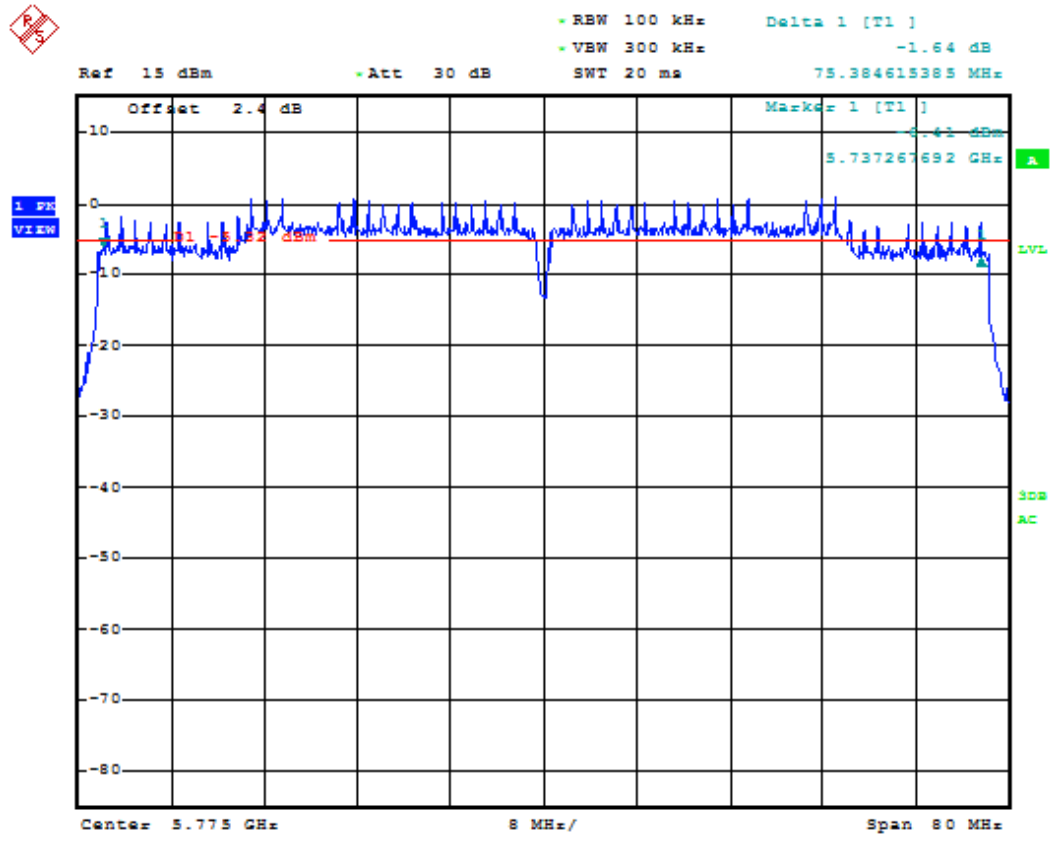
Highest Channel



802.11 ac 80 MHz mode CHAIN A



802.11 ac 80 MHz mode CHAIN B



Section 15.407 Subclause (a) (3) / RSS-210 A9.2. (4). Maximum output power, Maximum power spectral density and antenna gain

SPECIFICATION

FCC 15.407: For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W (30 dBm). In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

RSS-210: The maximum conducted output power shall not exceed 1.0 W (30 dBm) or 17 + 10 log10 B, dBm, whichever power is less. The power spectral density shall not exceed 17 dBm in any 1.0 MHz band. The maximum e.i.r.p. shall not exceed 4.0 W (36 dBm) or 23 + 10 log10 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 Guidance 789033 D02 v01.

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 maximum power spectral density (PSD) was measured using the method according to point F) (Method SA-1) of Guidance 789033 D02 v01, over 1 MHz and measured again over 500 kHz.

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 = 5 dBi

Frequency	Maximum conducted output power (dBm)	Maximum output power e.i.r.p. (dBm)	PSD/500 kHz (dBm)	PSD/500kHz e.i.r.p. (dBm)
5745 MHz	16.05	21.05	2.83	7.83
5785 MHz	15.62	20.62	2.31	7.31
5825 MHz	15.96	20.96	2.91	7.91

CHAIN B Maximum declared antenna gain = 5 dBi

Frequency	Maximum conducted output power (dBm)	Maximum output power e.i.r.p. (dBm)	PSD/500kHz (dBm)	PSD/500kHz e.i.r.p. (dBm)
5745 MHz	15.37	20.37	1.91	6.91
5785 MHz	14.92	19.92	1.74	6.74
5825 MHz	14.76	19.76	1.54	6.54

Maximum PSD Results for RSS-210 A9.2. (4).

Frequency	PSD/MHz Chain A (dBm)	PSD/MHz Chain B (dBm)	PSD/MHz Chain A e.i.r.p. (dBm)	PSD/MHz Chain B e.i.r.p. (dBm)
5745 MHz	5.68	5.01	10.68	10.01
5785 MHz	5.38	4.65	10.38	9.65
5825 MHz	5.72	4.54	10.72	9.54

Measurement uncertainty = ±1.5 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 = 5 dBi

Frequency	Maximum conducted output power (dBm)	Maximum output power e.i.r.p. (dBm)	PSD/500kHz (dBm)	PSD/500kHz e.i.r.p. (dBm)
5745 MHz	15.93	20.93	2.83	7.83
5785 MHz	15.60	20.60	2.22	7.22
5825 MHz	16.14	21.14	2.83	7.83

CHAIN B Maximum declared antenna gain = 5 dBi

Frequency	Maximum conducted output power (dBm)	Maximum output power e.i.r.p. (dBm)	PSD/500kHz (dBm)	PSD/500kHz e.i.r.p. (dBm)
5745 MHz	15.29	20.29	2.04	7.04
5785 MHz	15.42	20.42	1.97	6.97
5825 MHz	14.98	19.98	1.76	6.76

Maximum PSD Results for RSS-210 A9.2. (4).

Frequency	PSD/MHz Chain A (dBm)	PSD/MHz Chain B (dBm)	PSD/MHz Chain A e.i.r.p. (dBm)	PSD/MHz Chain B e.i.r.p. (dBm)
5745 MHz	5.48	4.81	10.48	9.81
5785 MHz	5.09	4.88	10.09	9.88
5825 MHz	5.61	4.49	10.61	9.49

MIMO CHAIN A+B. MAXIMUM OUTPUT POWER

Maximum declared antenna gain = 5 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
5745 MHz	13.67	13.33	16.51	21.51
5785 MHz	13.67	13.47	16.58	21.58
5825 MHz	13.62	13.53	16.59	21.59

MIMO CHAIN A+B. PSD/500kHz

Maximum declared antenna gain = 5 dBi

Frequency	PSD/500kHz Chain A (dBm)	PSD/500kHz Chain B (dBm)	Total PSD/500kHz Chain A (dBm)[1]	Total PSD/500kHz Chain B (dBm)[1]	Total PSD/500kHz Chain A e.i.r.p. (dBm)	Total PSD/500kHz Chain B e.i.r.p. (dBm)
5745 MHz	0.33	0.49	3.34	3.50	8.34	8.50
5785 MHz	0.05	0.33	3.06	3.34	8.06	8.34
5825 MHz	0.02	0.68	3.03	3.69	8.03	8.69

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

Maximum PSD Results for RSS-210 A9.2. (4). MIMO CHAIN A+B. PSD/MHz.

Frequency	PSD/MHz Chain A (dBm)	PSD/MHz Chain B (dBm)	Total PSD/MHz Chain A (dBm)[1]	Total PSD/MHz Chain B (dBm)[1]	Total PSD/MHz Chain A e.i.r.p. (dBm)	Total PSD/MHz Chain B e.i.r.p. (dBm)
5745 MHz	3.31	2.96	6.32	5.97	11.32	10.97
5785 MHz	3.32	3.16	6.33	6.17	11.33	11.17
5825 MHz	3.28	3.23	6.29	6.24	11.29	11.24

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

Measurement uncertainty = ±1.5 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 = 5 dBi

Frequency	Maximum conducted output power (dBm)	Maximum output power e.i.r.p. (dBm)	PSD/500kHz (dBm)	PSD/500kHz e.i.r.p. (dBm)
5755 MHz	16.61	21.61	0.06	5.06
5795 MHz	16.59	21.59	0.14	5.14

CHAIN B Maximum declared antenna gain = 5 dBi

Frequency	Maximum conducted output power (dBm)	Maximum output power e.i.r.p. (dBm)	PSD/500kHz (dBm)	PSD/500kHz e.i.r.p. (dBm)
5755 MHz	16.33	21.33	-0.17	4.83
5795 MHz	16.43	21.43	-0.12	4.88

Maximum PSD Results for RSS-210 A9.2. (4).

Frequency	PSD/MHz Chain A (dBm)	PSD/MHz Chain B (dBm)	PSD/MHz Chain A e.i.r.p. (dBm)	PSD/MHz Chain B e.i.r.p. (dBm)
5755 MHz	2.98	2.75	7.98	7.75
5795 MHz	3.00	2.86	8.00	7.86

MIMO CHAIN A+B. MAXIMUM OUTPUT POWER

Maximum declared antenna gain = 5 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
5755 MHz	16.65	16.45	19.56	24.56
5795 MHz	16.62	16.43	19.54	24.54

Measurement uncertainty = ±1.5 dB

Verdict: PASS

MIMO CHAIN A+B. PSD/500kHz

Maximum declared antenna gain = 5 dBi

Frequency	PSD/500kHz Chain A (dBm)	PSD/500kHz Chain B (dBm)	Total PSD/500kHz Chain A (dBm)[1]	Total PSD/500kHz Chain B (dBm)[1]	Total PSD/500kHz Chain A e.i.r.p. (dBm)	Total PSD/500kHz Chain B e.i.r.p. (dBm)
5755 MHz	1.27	0.49	4.28	3.50	9.28	8.50
5795 MHz	0.42	0.10	3.43	3.11	8.43	8.11

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

Maximum PSD Results for RSS-210 A9.2. (4). MIMO CHAIN A+B. PSD/MHz.

Frequency	PSD/MHz Chain A (dBm)	PSD/MHz Chain B (dBm)	Total PSD/MHz Chain A (dBm)[1]	Total PSD/MHz Chain B (dBm)[1]	Total PSD/MHz Chain A e.i.r.p. (dBm)	Total PSD/MHz Chain B e.i.r.p. (dBm)
5755 MHz	2.61	2.48	5.62	5.49	10.62	10.49
5795 MHz	2.54	2.39	5.55	5.40	10.55	10.40

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

Measurement uncertainty = ±1.5 dB

Verdict: PASS

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

CHAIN A Maximum declared antenna gain = 5 dBi

Frequency	Maximum conducted output power (dBm)	Maximum output power e.i.r.p. (dBm)	PSD/500kHz (dBm)	PSD/500kHz e.i.r.p. (dBm)
5775 MHz	16.57	21.57	-3.23	1.77

CHAIN B Maximum declared antenna gain = 5 dBi

Frequency	Maximum conducted output power (dBm)	Maximum output power e.i.r.p. (dBm)	PSD/500kHz (dBm)	PSD/500kHz e.i.r.p. (dBm)
5775 MHz	16.49	21.49	-3.27	1.73

Maximum PSD Results for RSS-210 A9.2. (4).

Frequency	PSD/MHz Chain A (dBm)	PSD/MHz Chain B (dBm)	PSD/MHz Chain A e.i.r.p. (dBm)	PSD/MHz Chain B e.i.r.p. (dBm)
5775 MHz	-0.48	-0.64	4.52	4.36

MIMO CHAIN A+B. MAXIMUM OUTPUT POWER

Maximum declared antenna gain = 5 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)
5775 MHz	16.62	16.49	19.57	24.57

Measurement uncertainty = ±1.5 dB

Verdict: PASS

MIMO CHAIN A+B. PSD/500kHz

Maximum declared antenna gain = 5 dBi

Frequency	PSD/500kHz Chain A (dBm)	PSD/500kHz Chain B (dBm)	Total PSD/500kHz Chain A (dBm)[1]	Total PSD/500kHz Chain B (dBm) [1]	Total PSD/500kHz Chain A e.i.r.p. (dBm)	Total PSD/500kHz Chain B e.i.r.p. (dBm)
5775 MHz	-3.11	-3.49	-0.10	-0.48	4.90	4.52

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

Maximum PSD Results for RSS-210 A9.2. (4). MIMO CHAIN A+B. PSD/MHz.

Frequency	PSD/MHz Chain A (dBm)	PSD/MHz Chain B (dBm)	Total PSD/MHz Chain A (dBm)[1]	Total PSD/MHz Chain B (dBm) [1]	Total PSD/MHz Chain A e.i.r.p. (dBm)	Total PSD/MHz Chain B e.i.r.p. (dBm)
5775 MHz	-0.22	-0.47	2.79	2.54	7.79	7.54

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

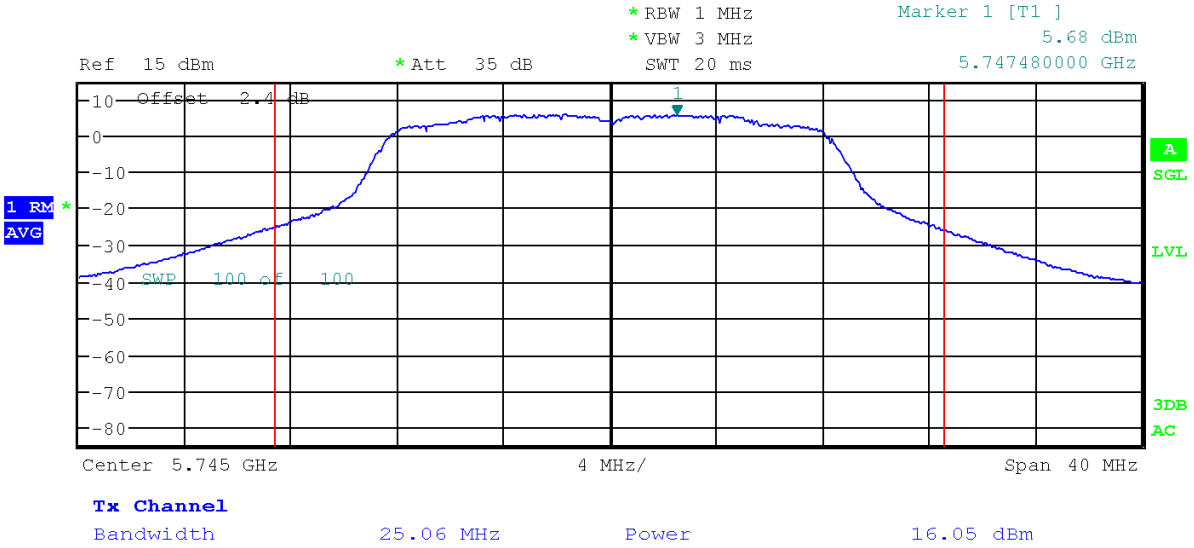
Measurement uncertainty = ±1.5 dB

Verdict: PASS

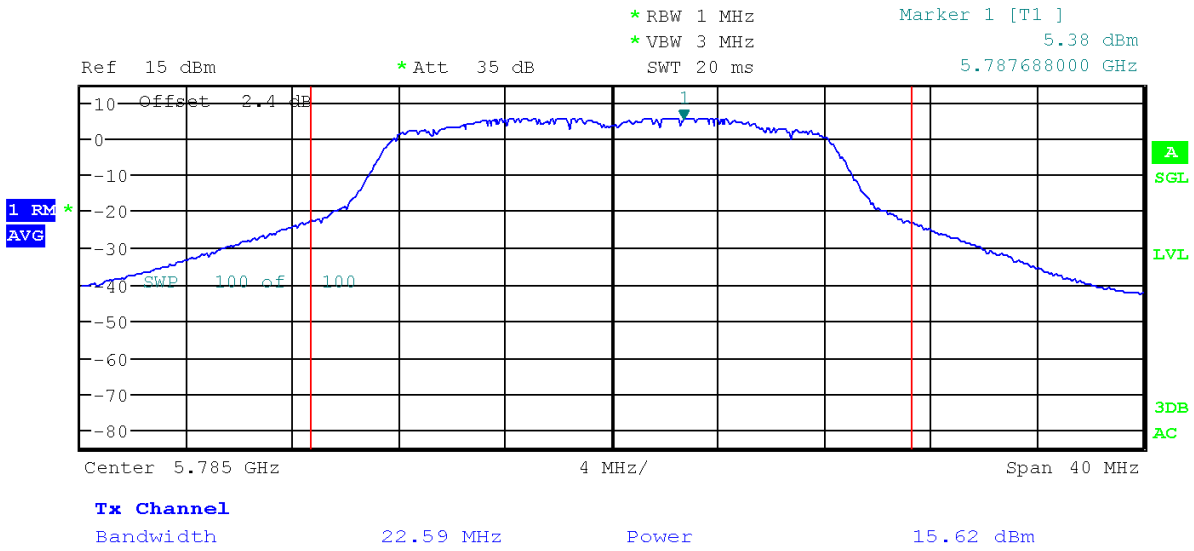
MAXIMUM OUTPUT POWER and MAXIMUM PSD/MHz

802.11a mode CHAIN A

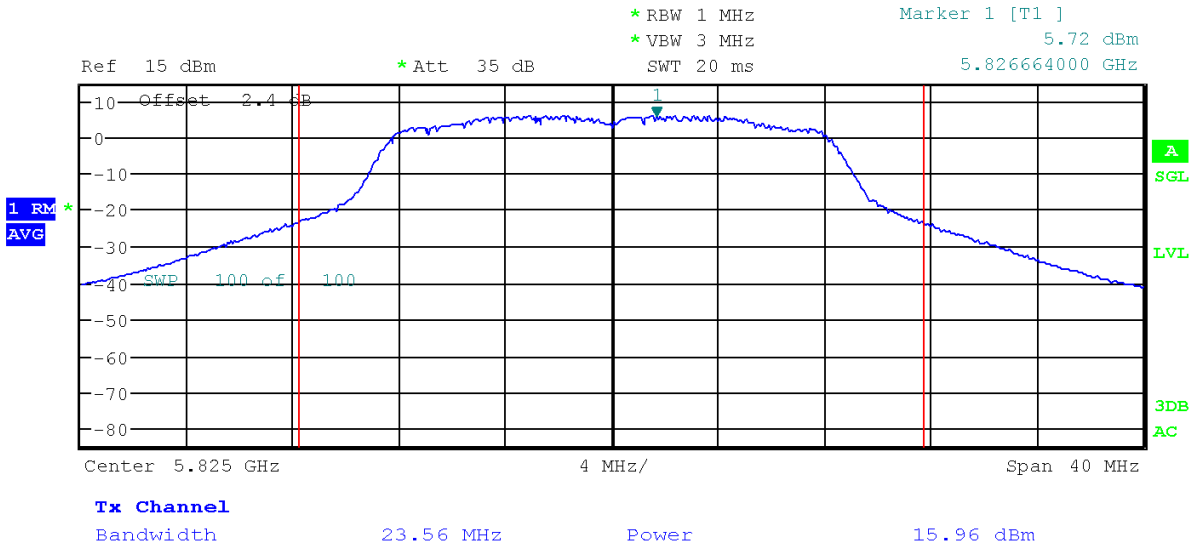
Lowest Channel



Middle Channel

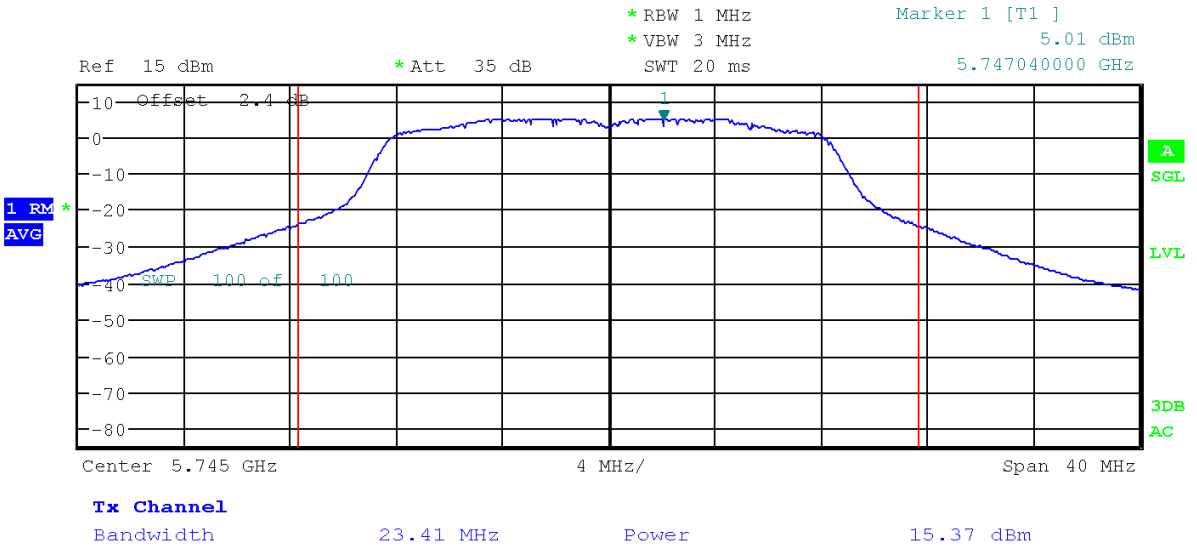


Highest Channel

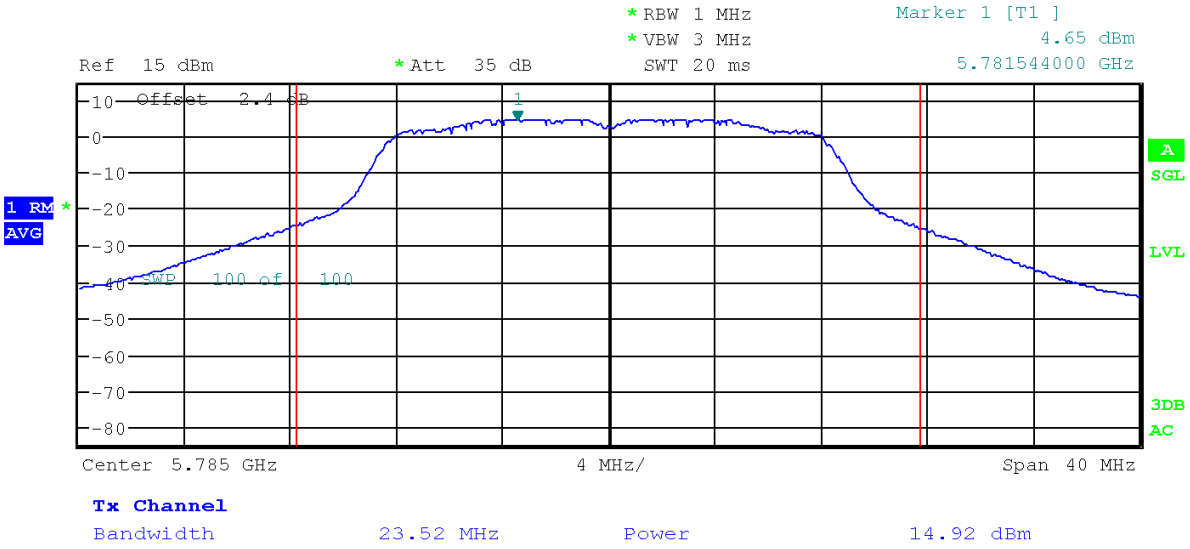


802.11a mode CHAIN B

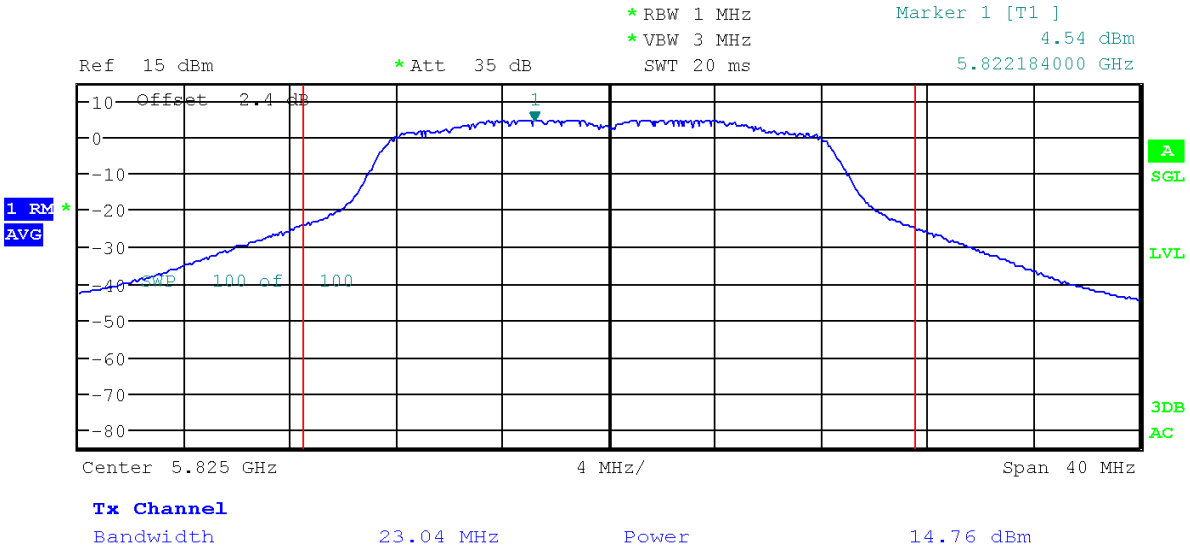
Lowest Channel



Middle Channel

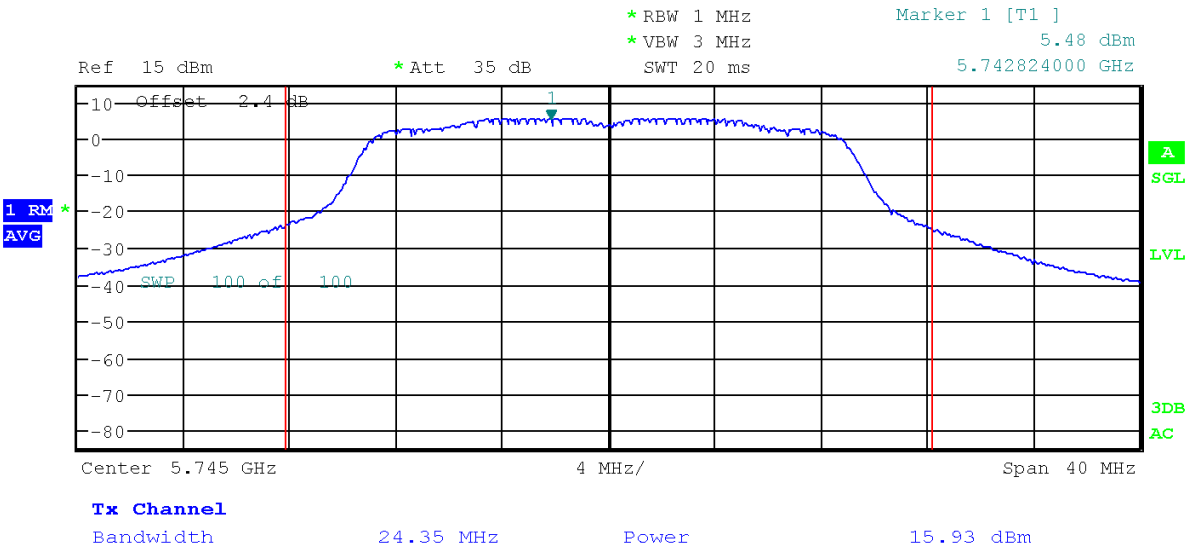


Highest Channel

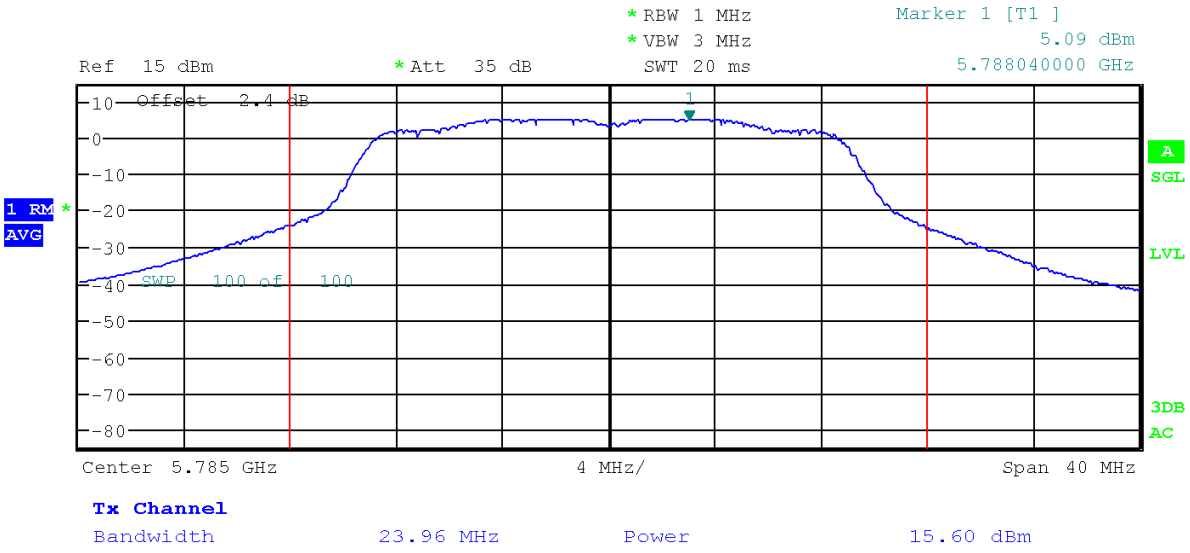


802.11 n20 MHz and 802.11 ac 20 MHz modes CHAIN A

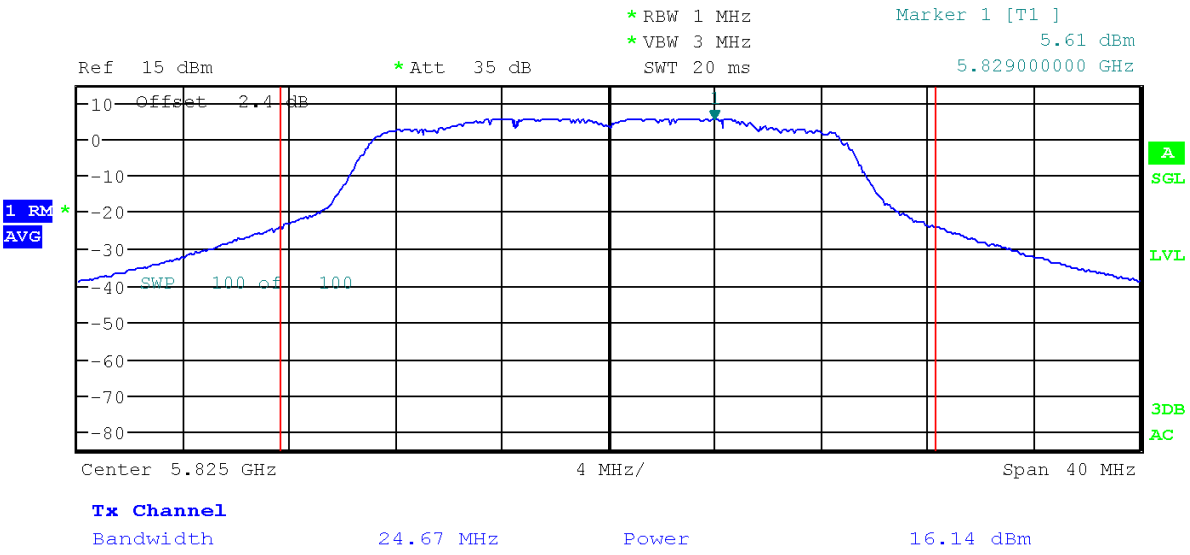
Lowest Channel



Middle Channel

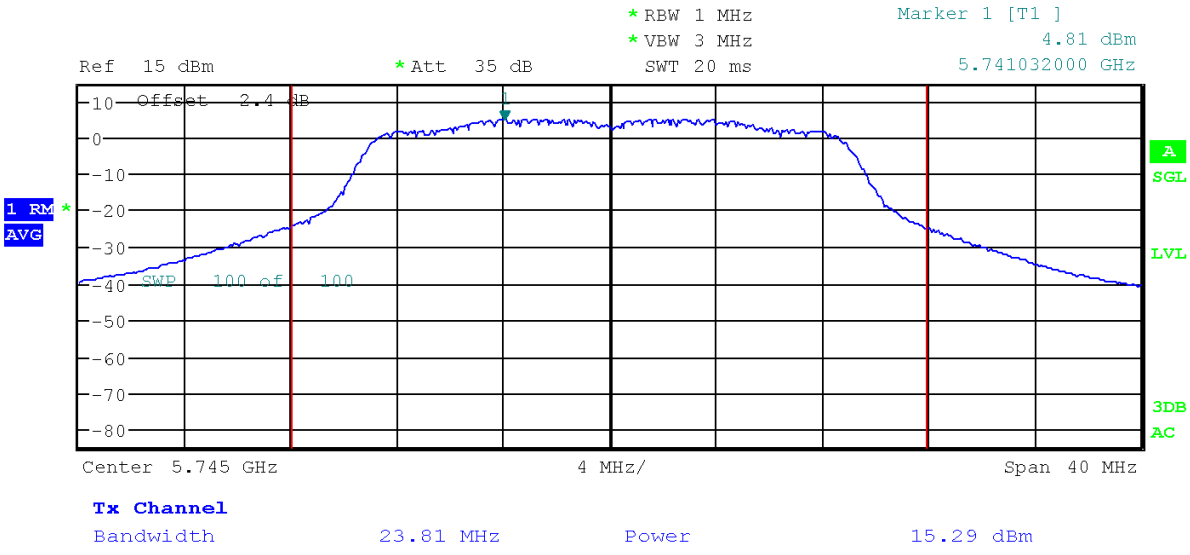


Highest Channel

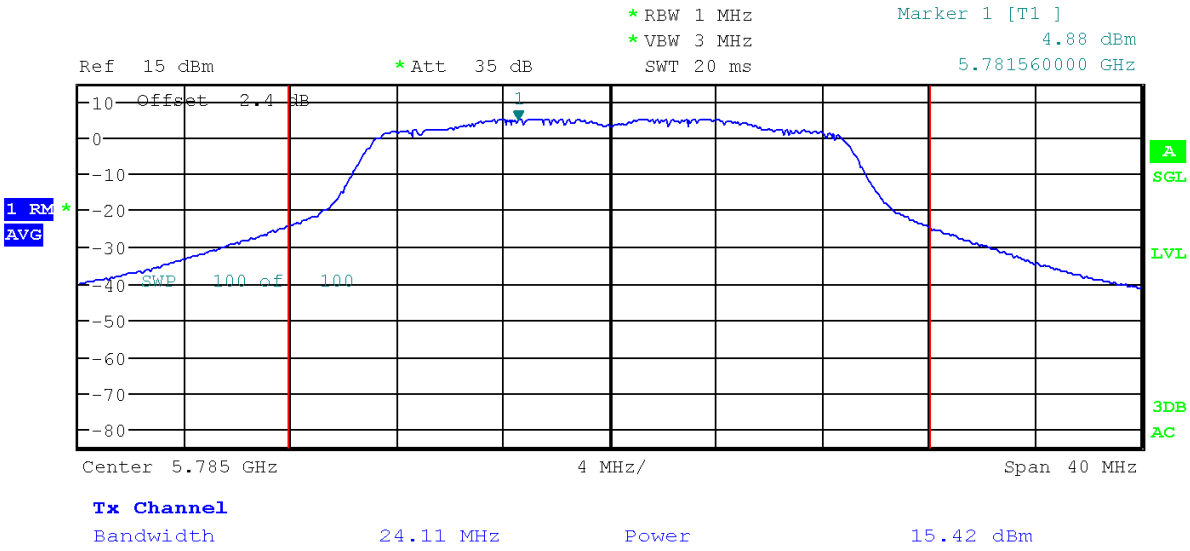


802.11 n20 MHz and 802.11 ac 20 MHz modes CHAIN B

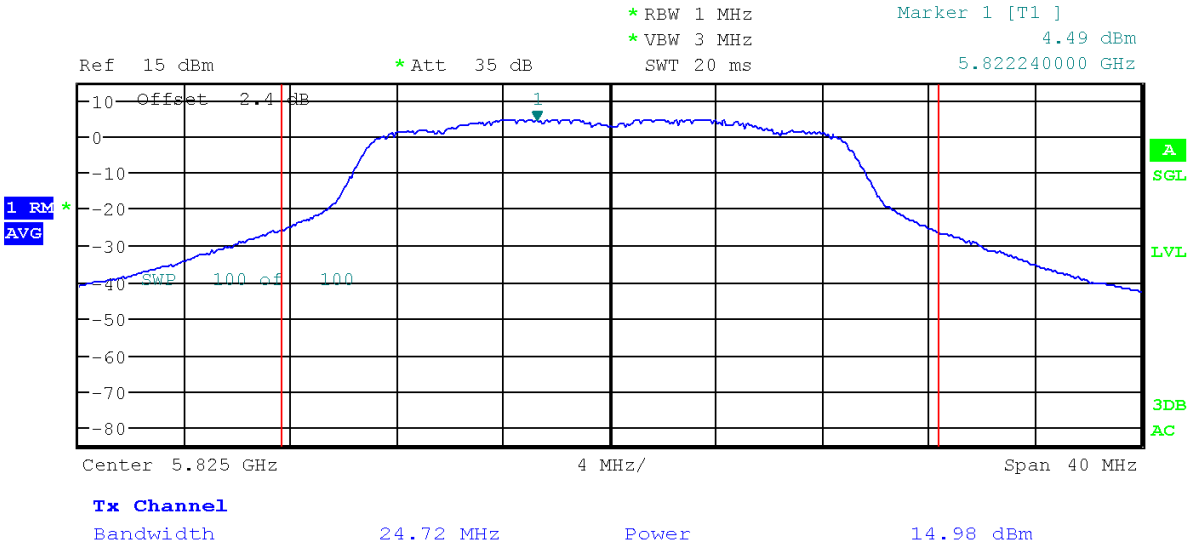
Lowest Channel



Middle Channel

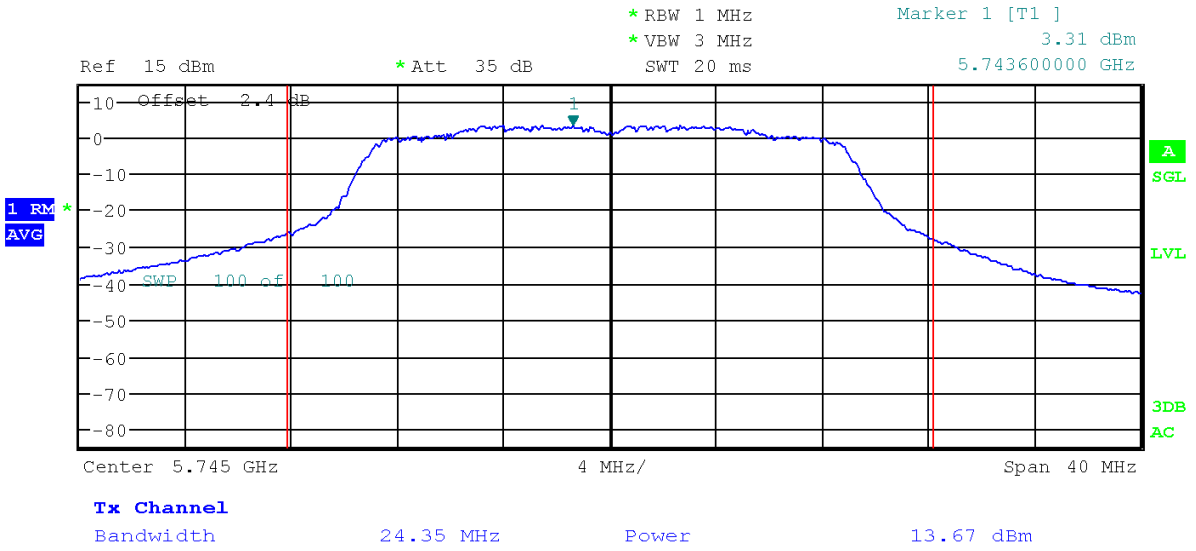


Highest Channel

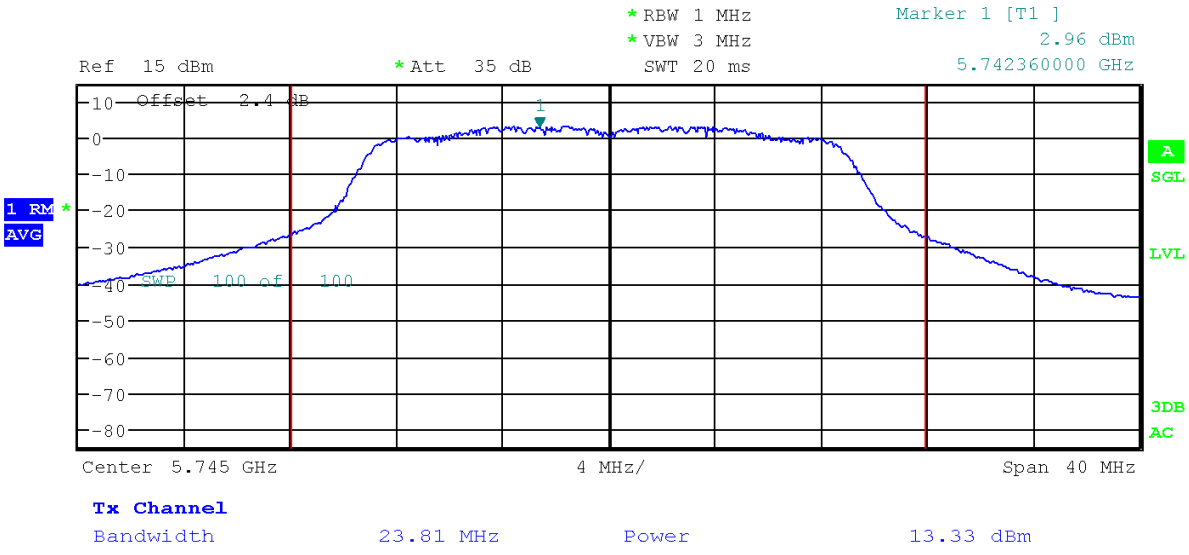


802.11 n20 MHz and 802.11 ac 20 MHz modes CHAIN A+B

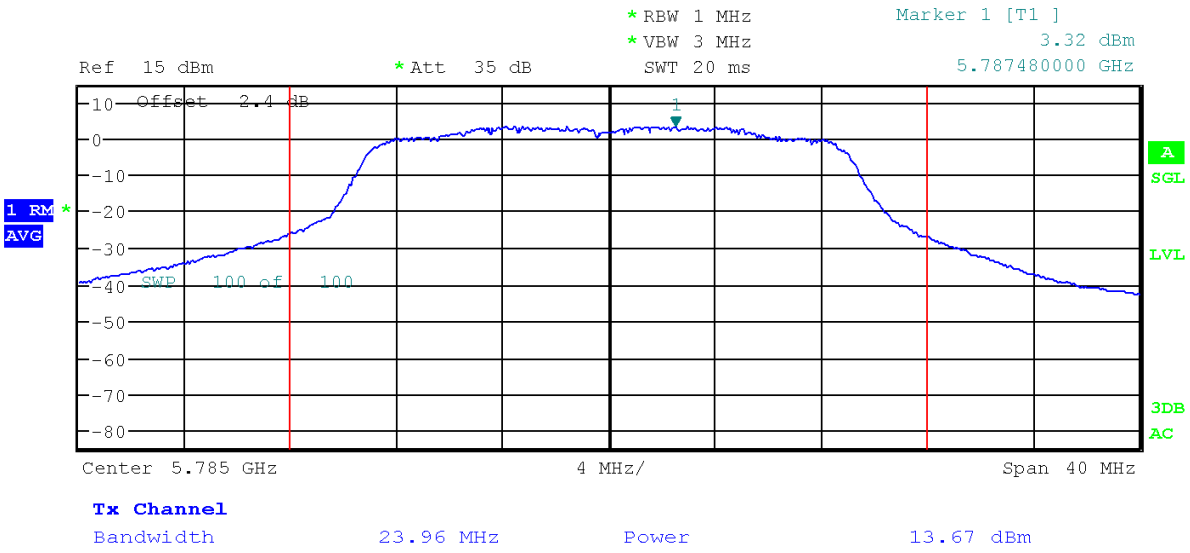
Lowest Channel. Chain A.



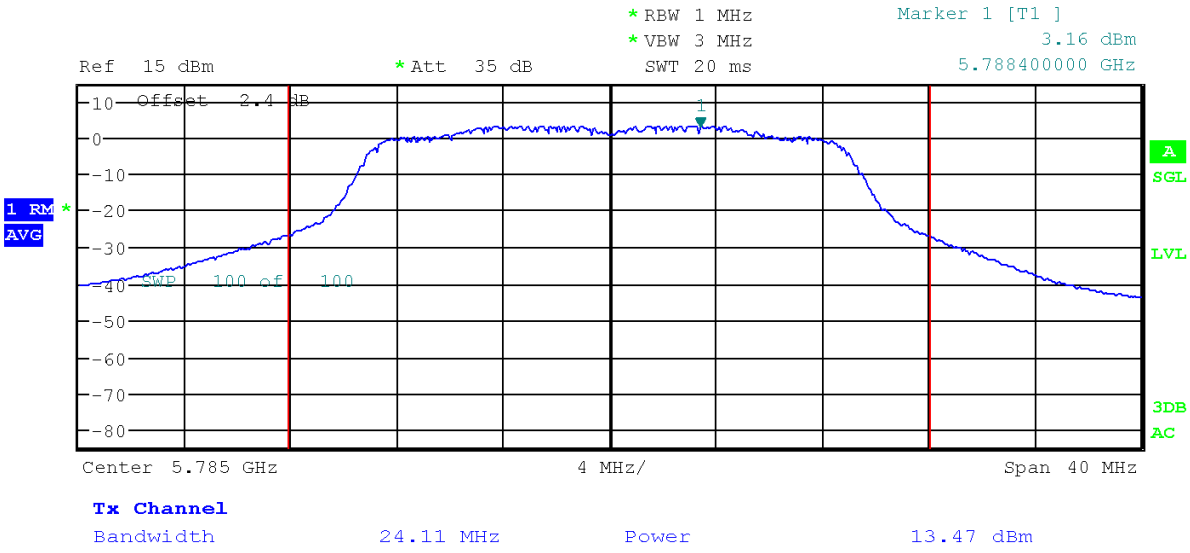
Lowest Channel. Chain B.



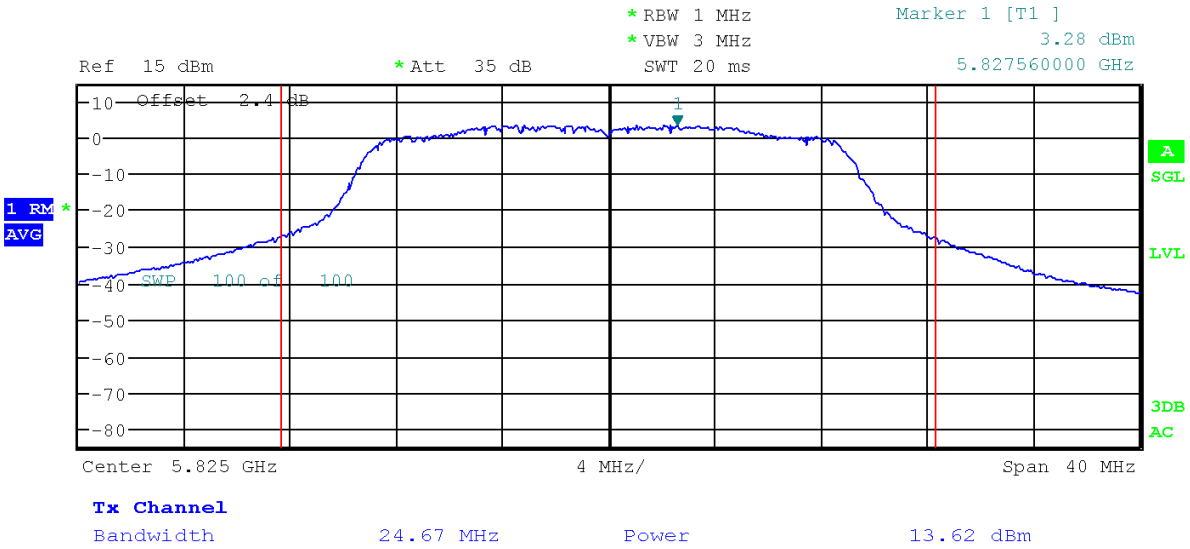
Middle Channel. Chain A.



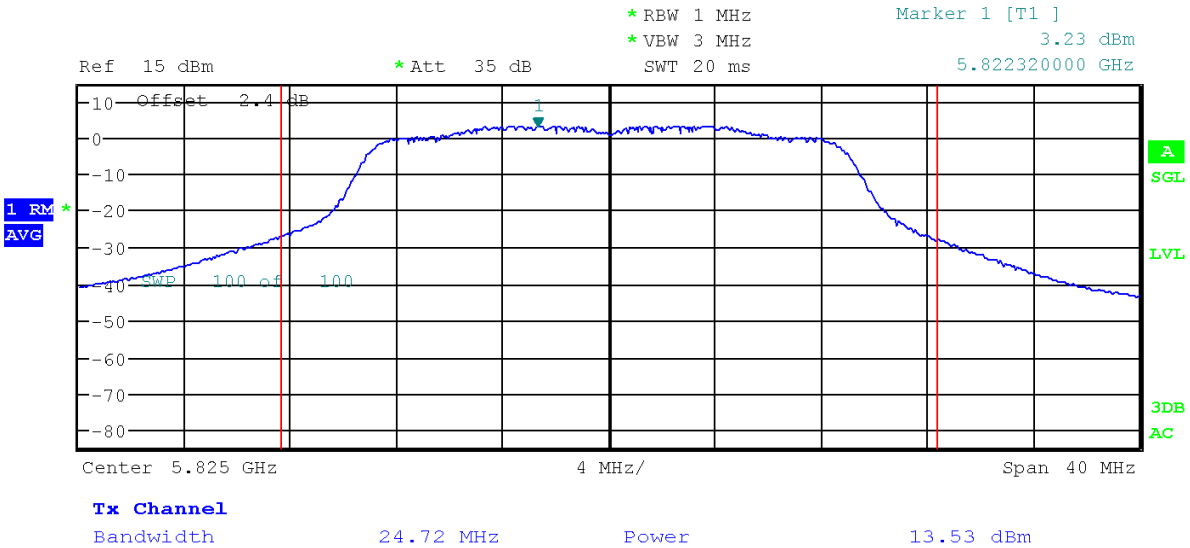
Middle Channel. Chain B.



Highest Channel. Chain A.

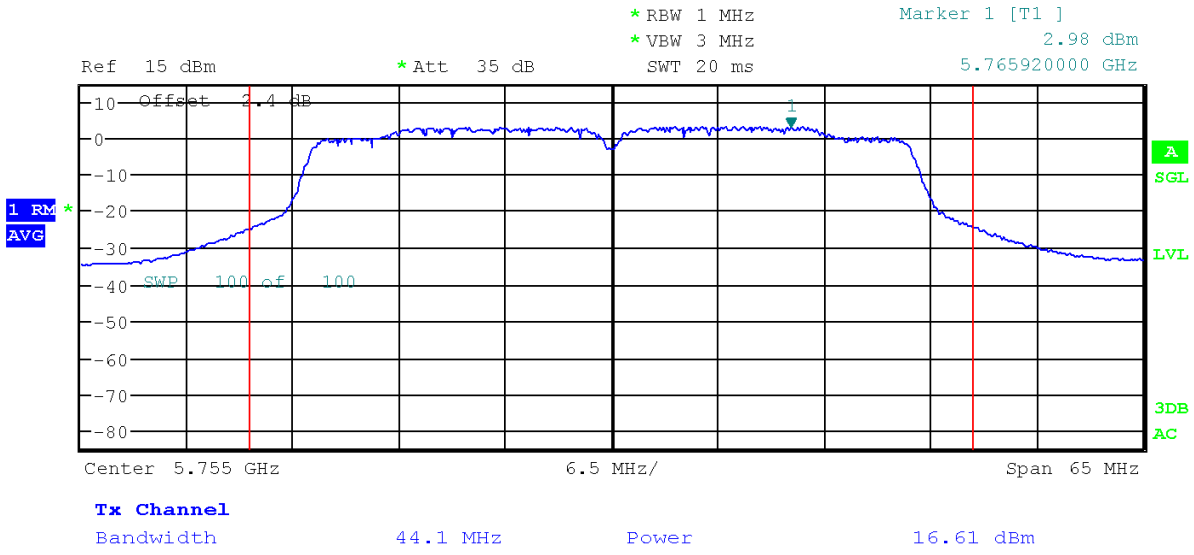


Highest Channel. Chain B.

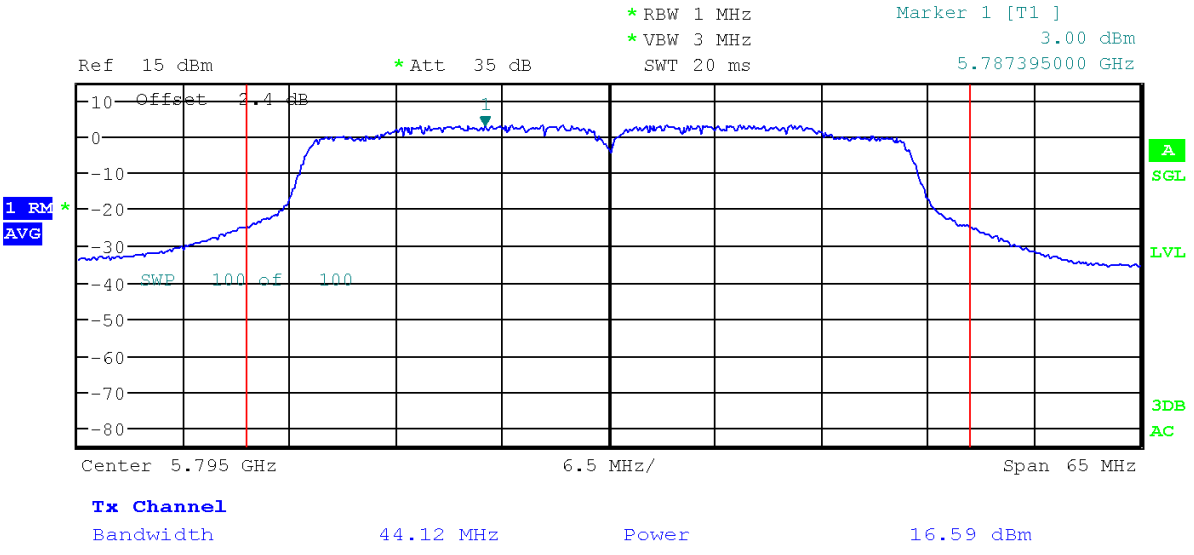


802.11 n40 MHz and 802.11 ac 40 MHz modes CHAIN A

Lowest Channel

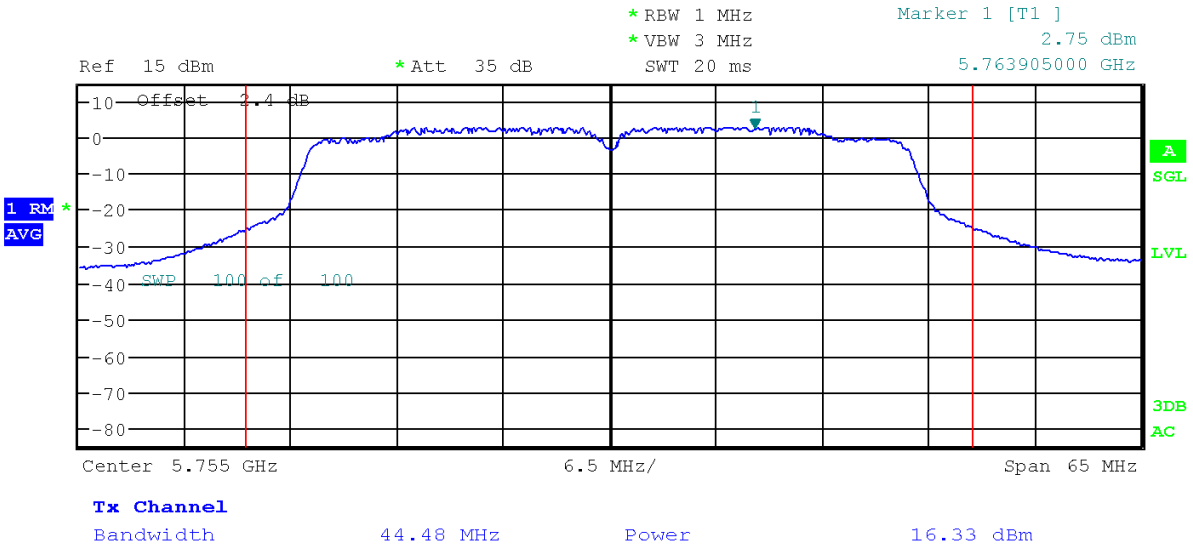


Highest Channel

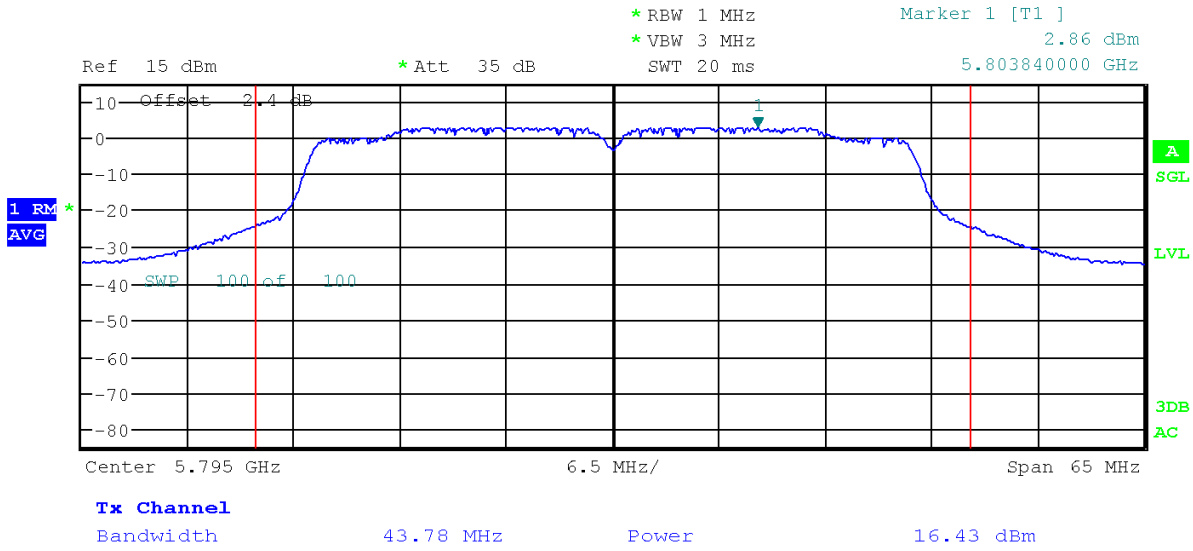


802.11 n40 MHz and 802.11 ac 40 MHz modes CHAIN B

Lowest Channel

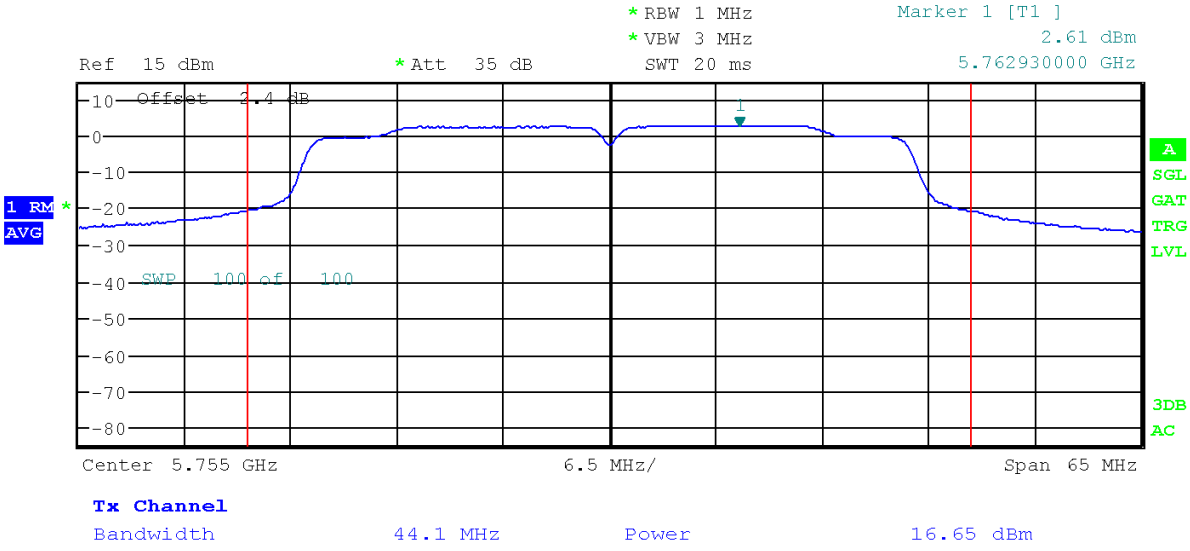


Highest Channel

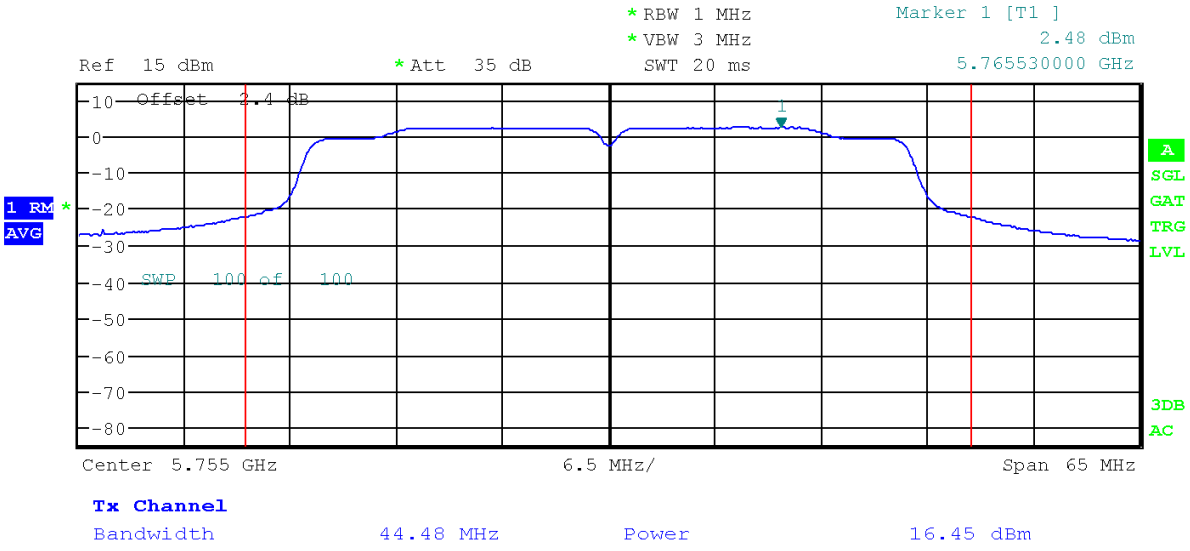


802.11 n40 MHz and 802.11 ac 40 MHz modes CHAIN A+B

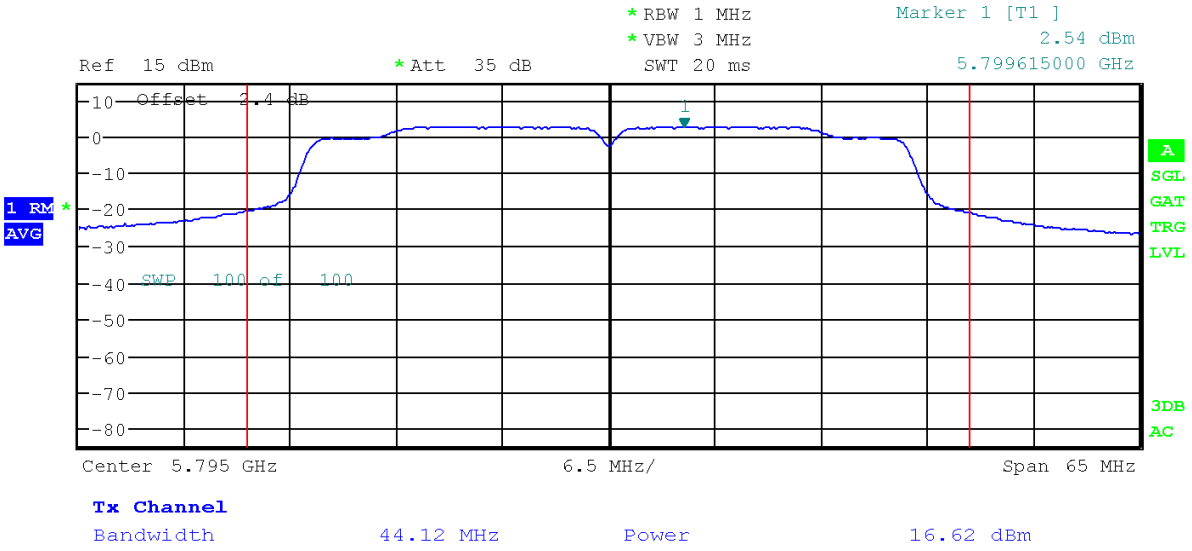
Lowest Channel. Chain A.



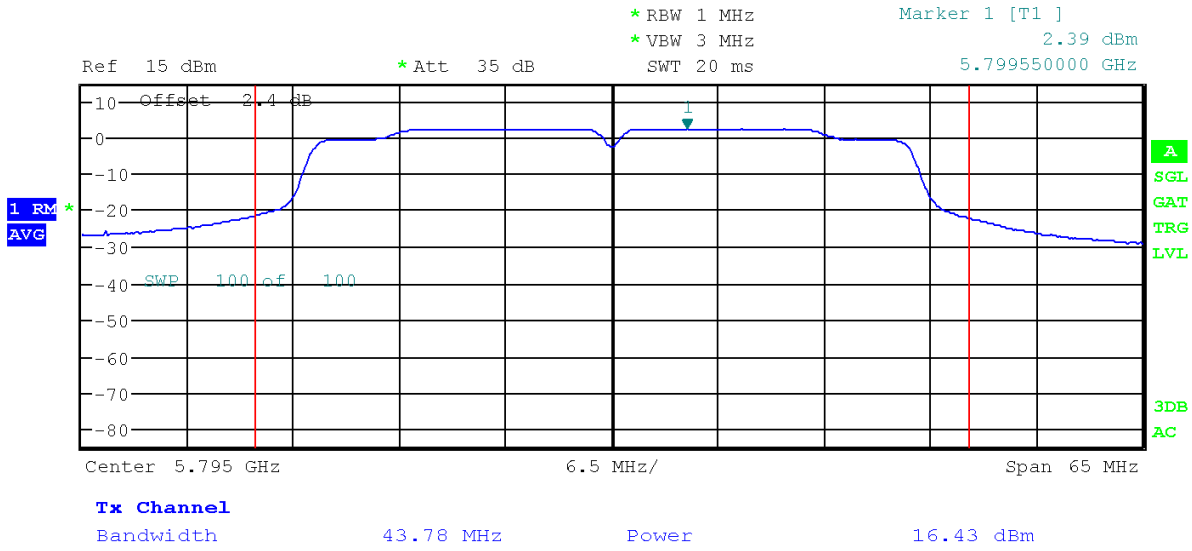
Lowest Channel. Chain B.



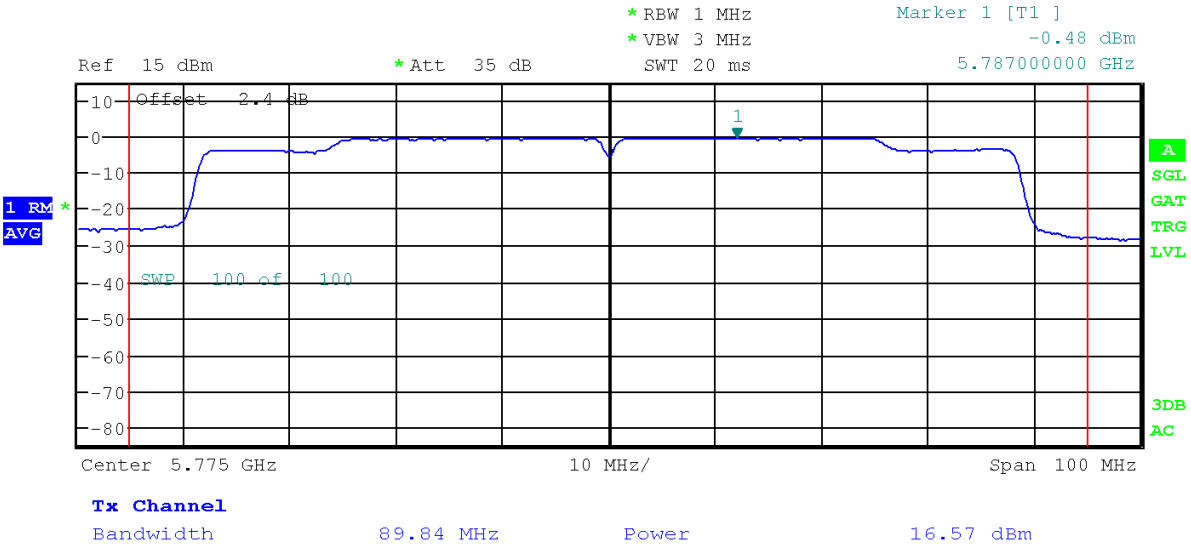
Highest Channel. Chain A.



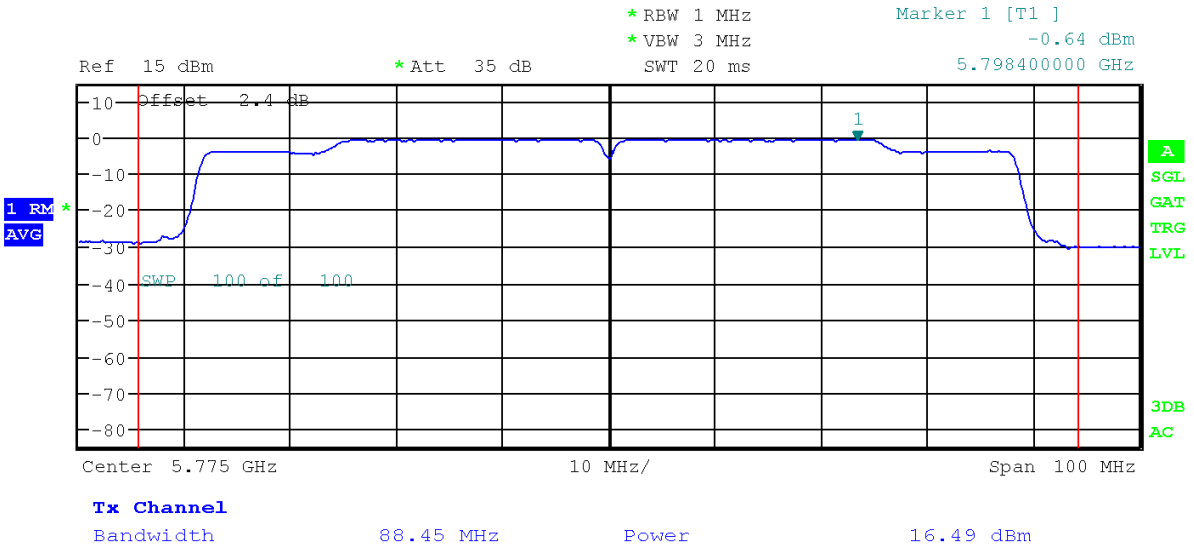
Highest Channel. Chain B.



802.11 ac 80 MHz mode. Middle channel. CHAIN A

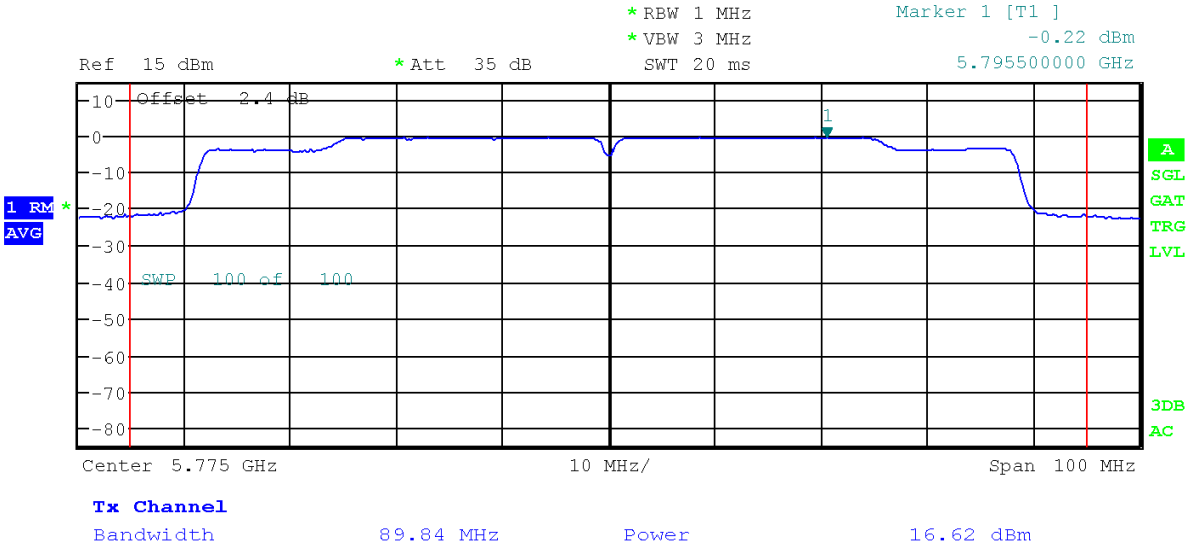


802.11 ac 80 MHz mode. Middle channel. CHAIN B

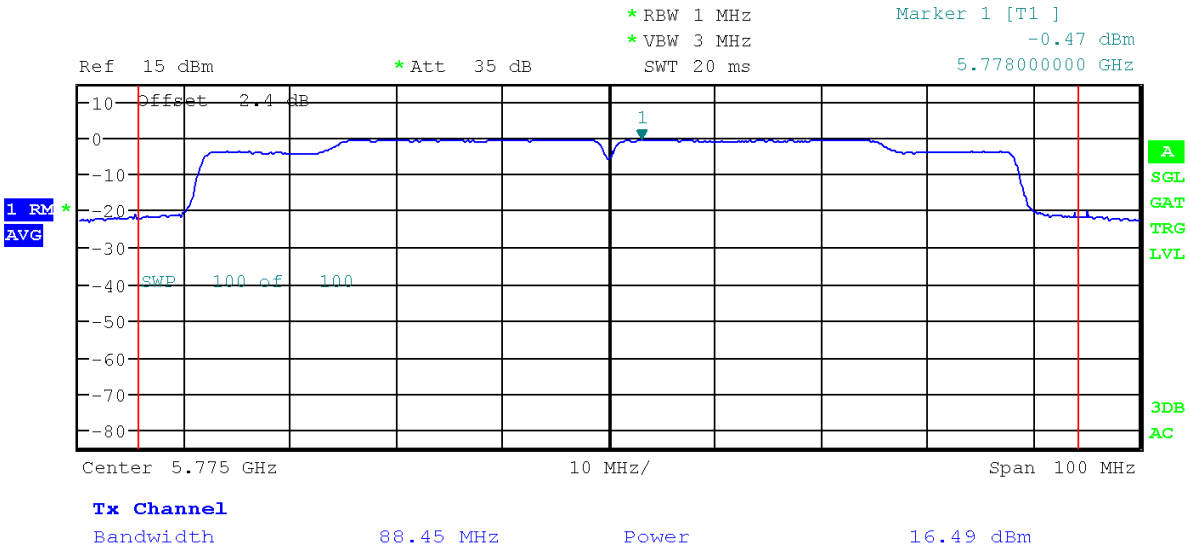


802.11 ac 80 MHz mode. Middle channel. CHAIN A+B

Chain A.



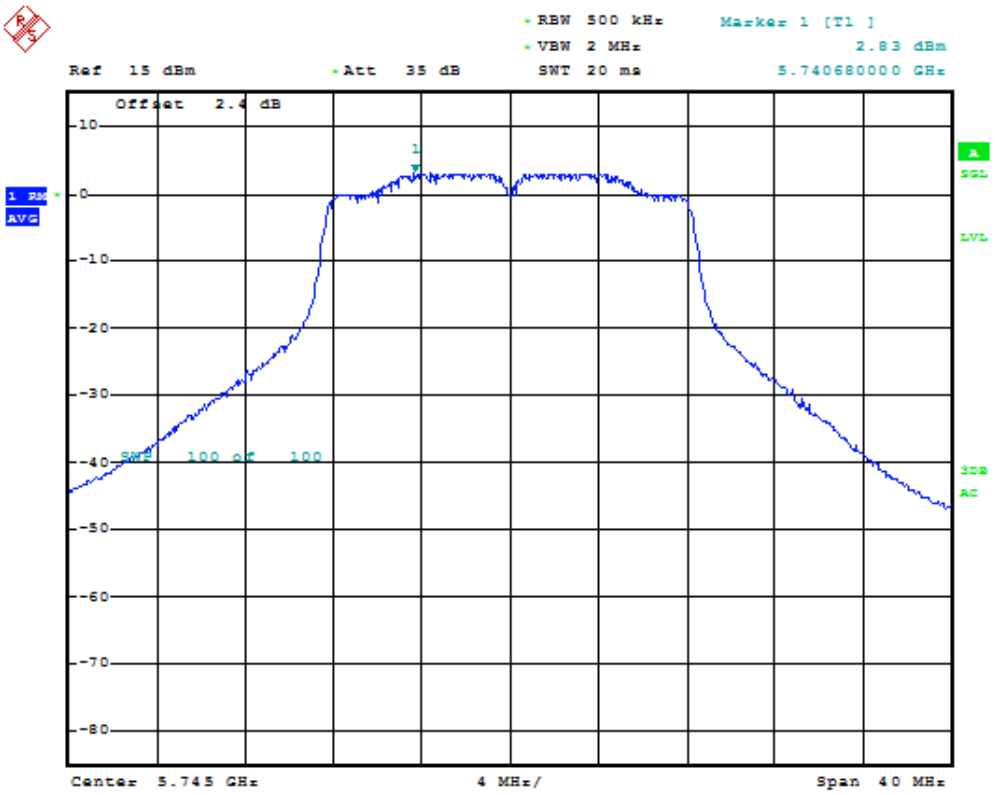
Chain B.



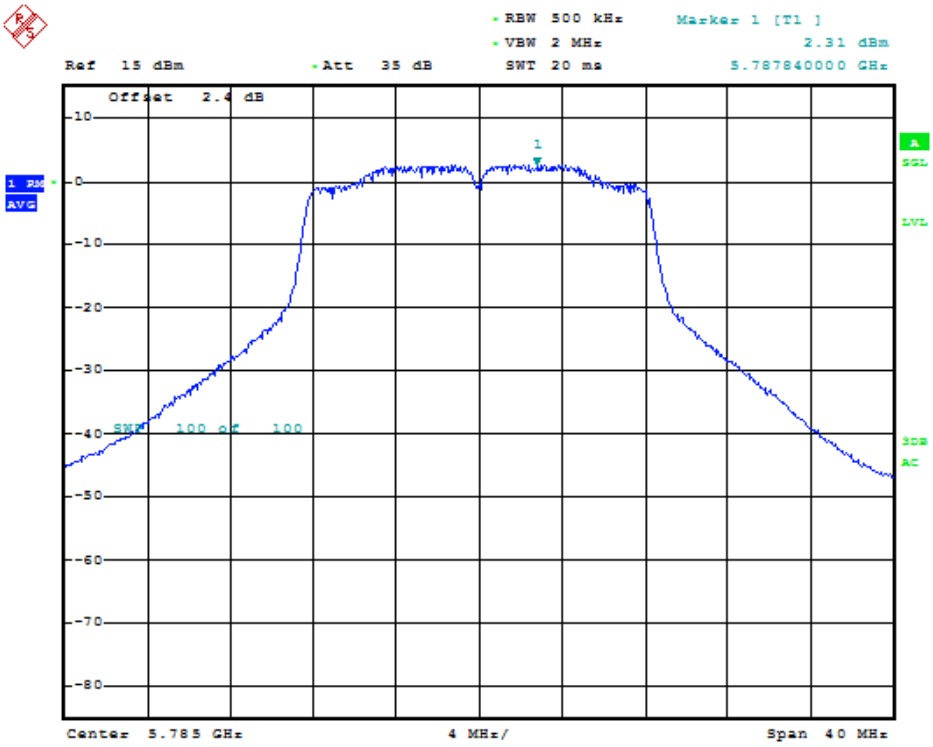
MAXIMUM POWER SPECTRAL DENSITY over 500 kHz

802.11a mode. CHAIN A

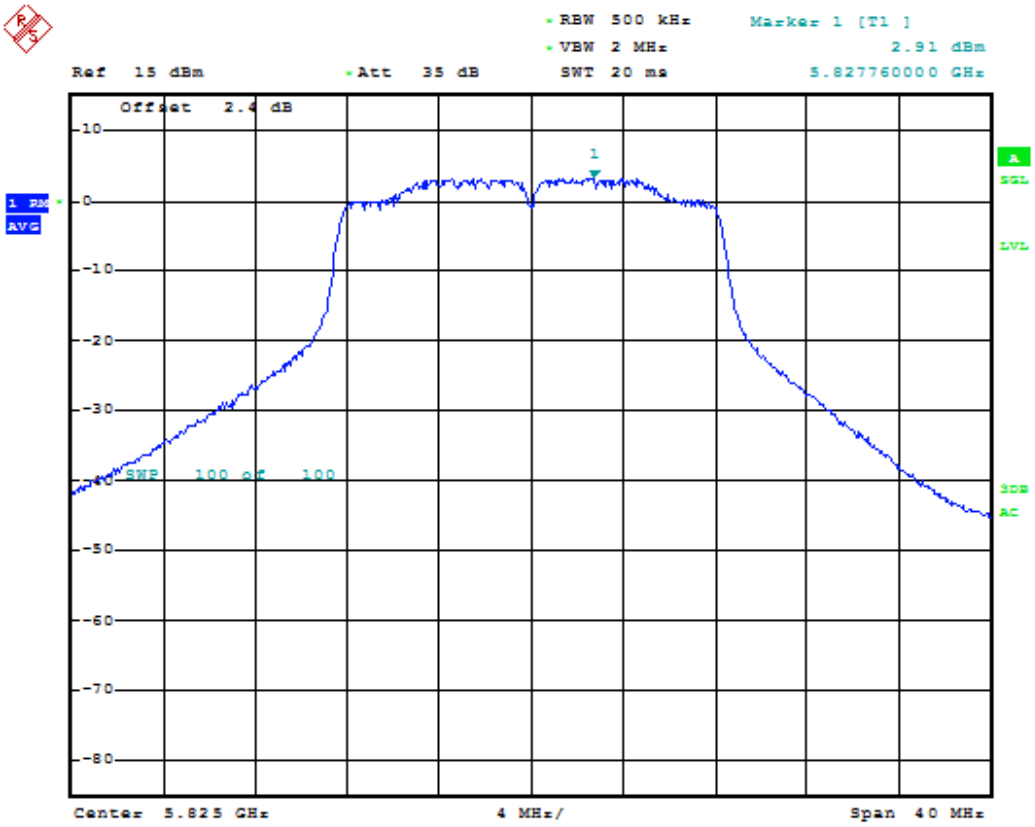
Lowest Channel



Middle Channel

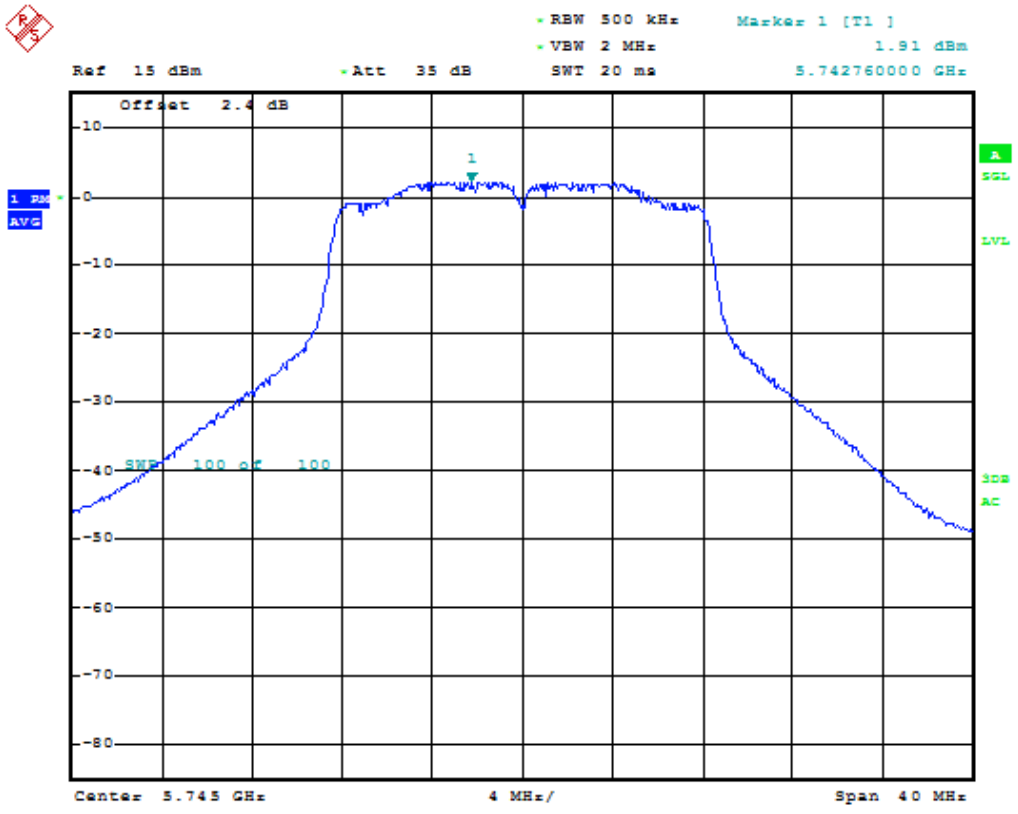


Highest Channel

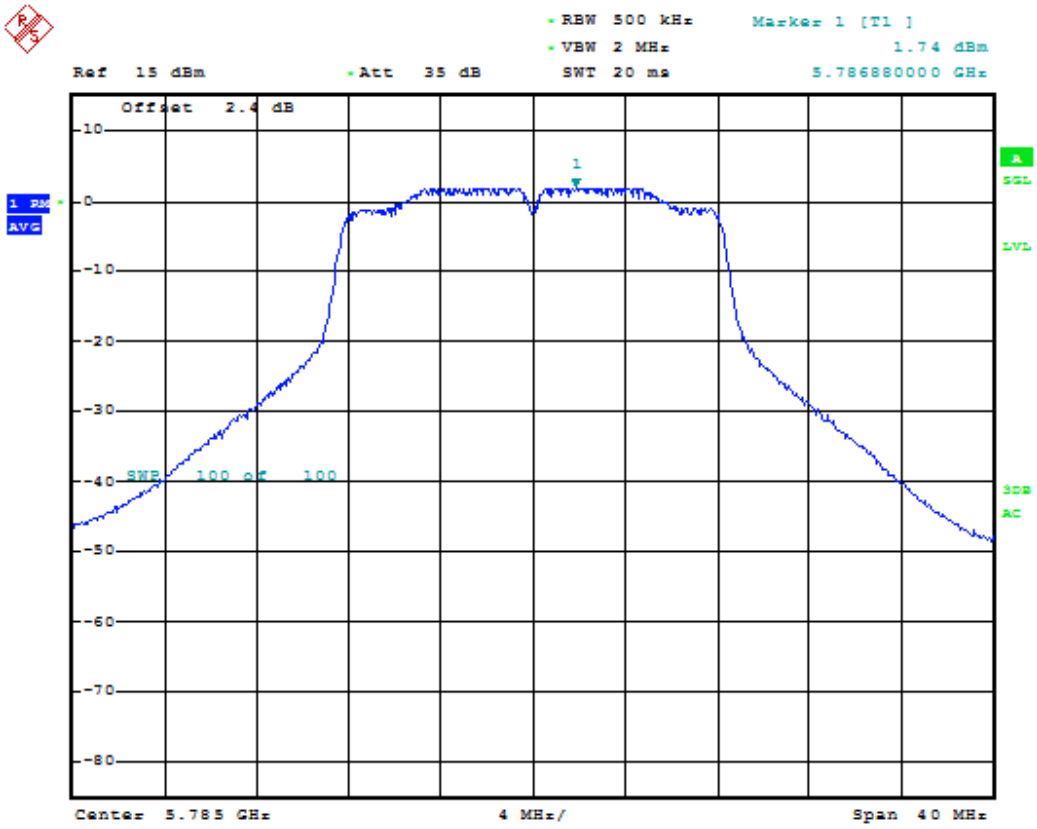


802.11a mode CHAIN B

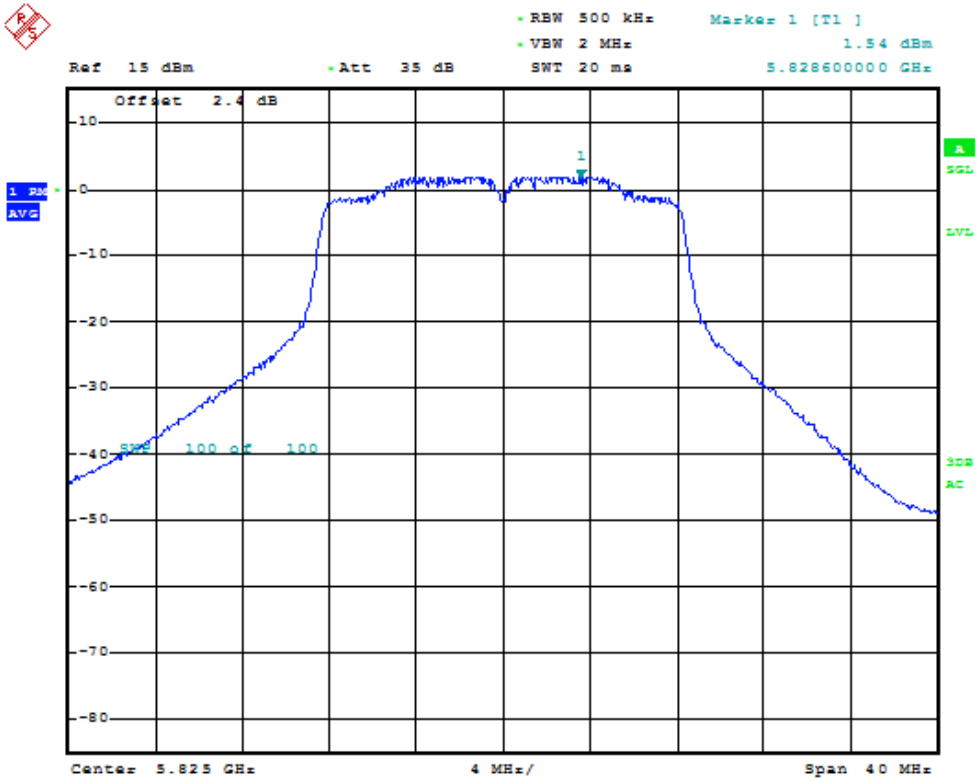
Lowest Channel



Middle Channel

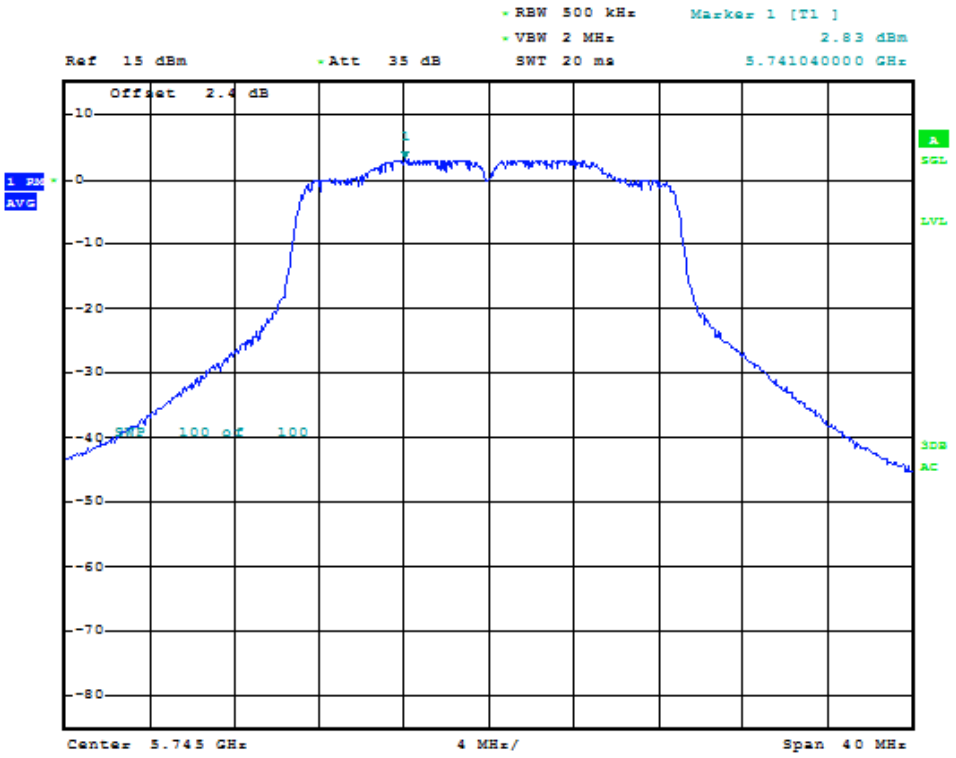


Highest Channel

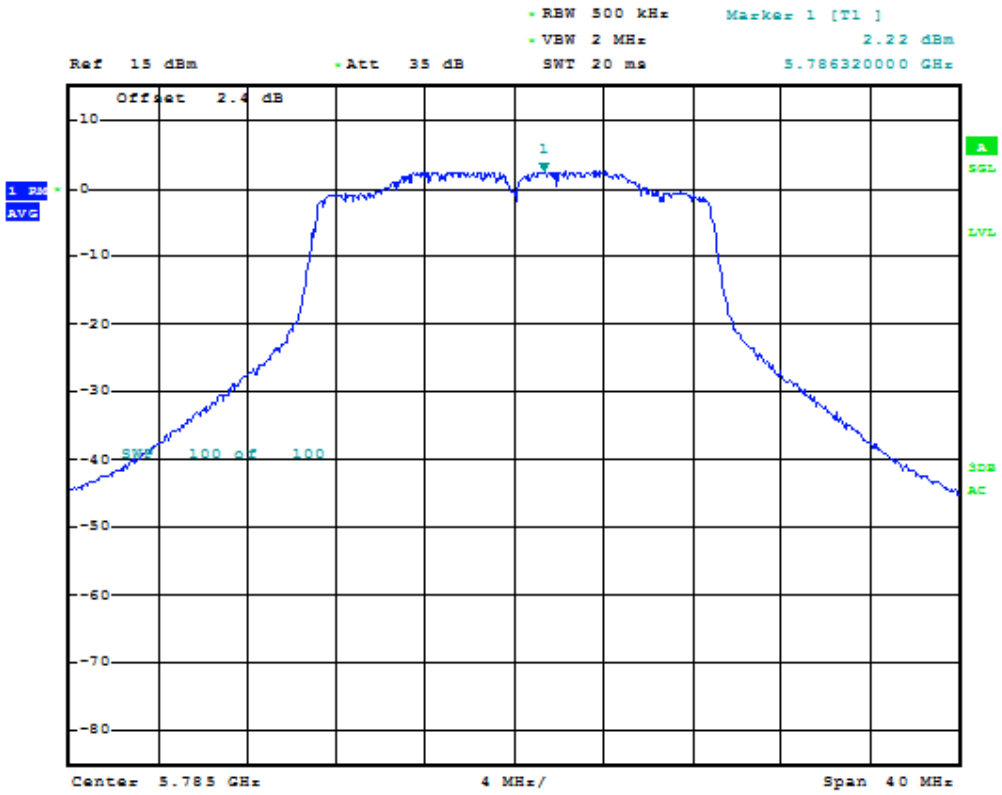


802.11 n20 MHz and 802.11 ac 20 MHz modes CHAIN A

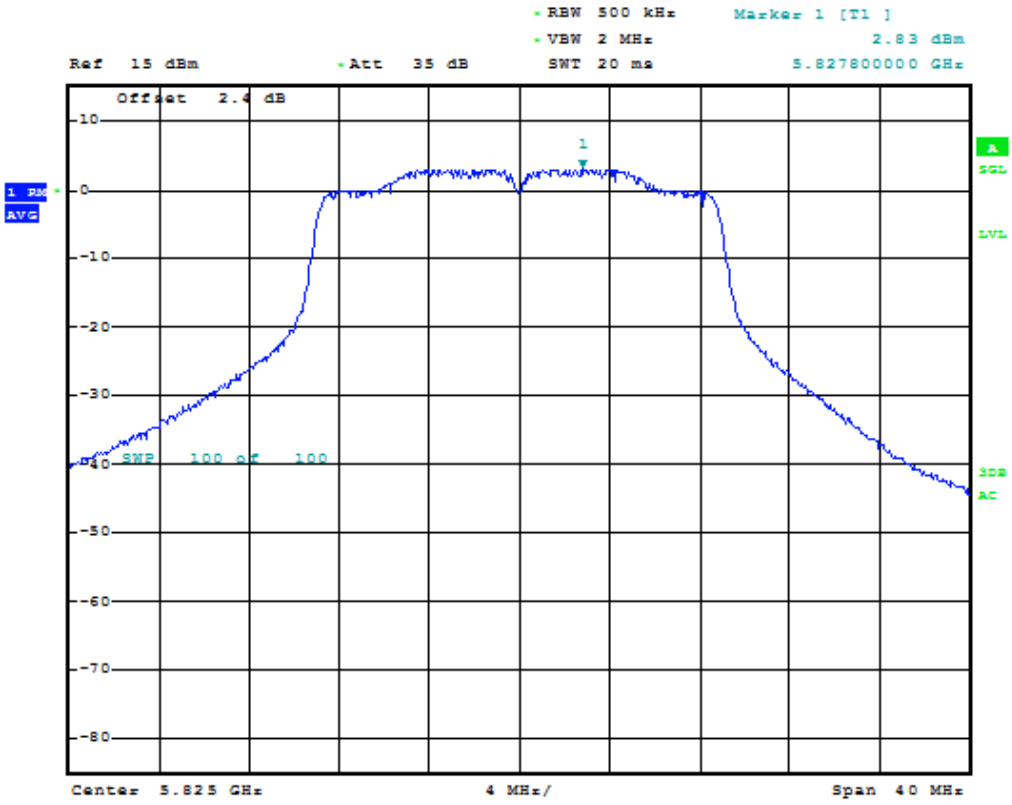
Lowest Channel



Middle Channel

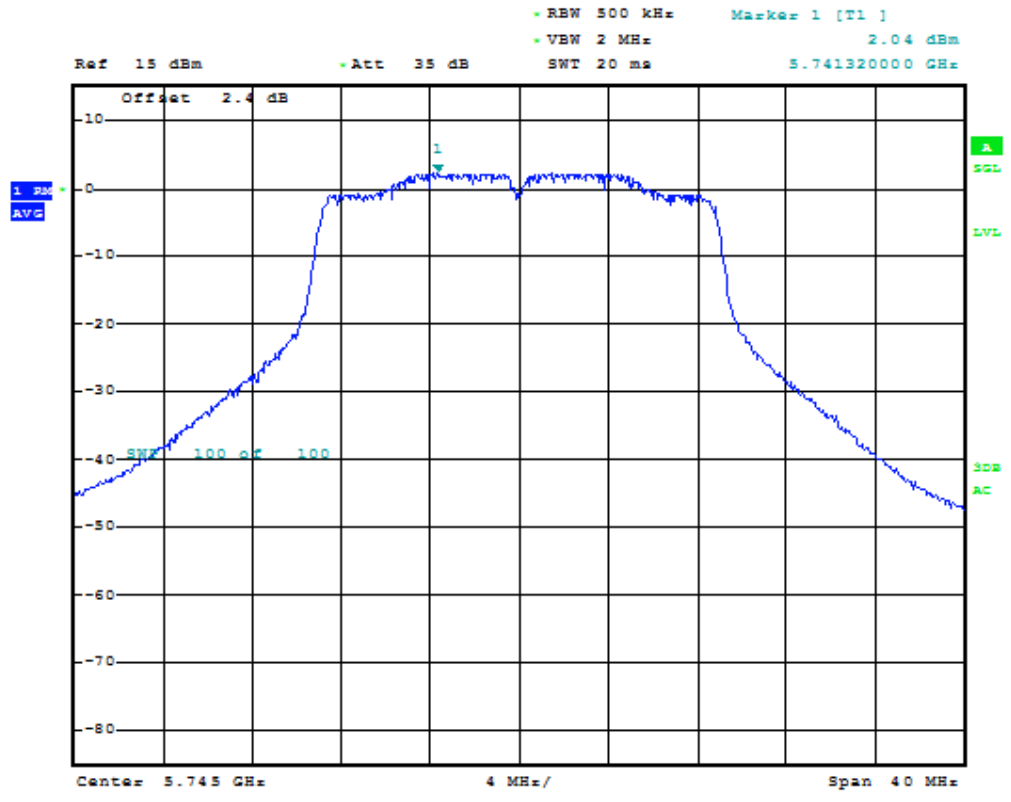


Highest Channel

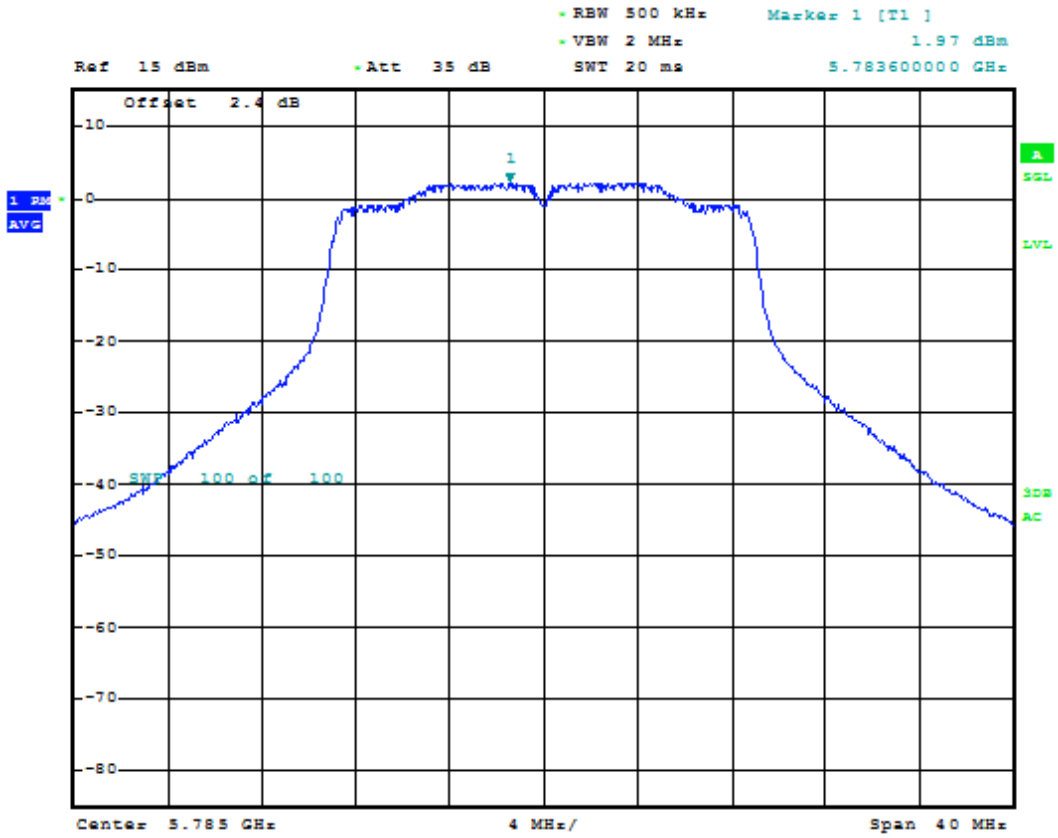


802.11 n20 MHz and 802.11 ac 20 MHz modes CHAIN B

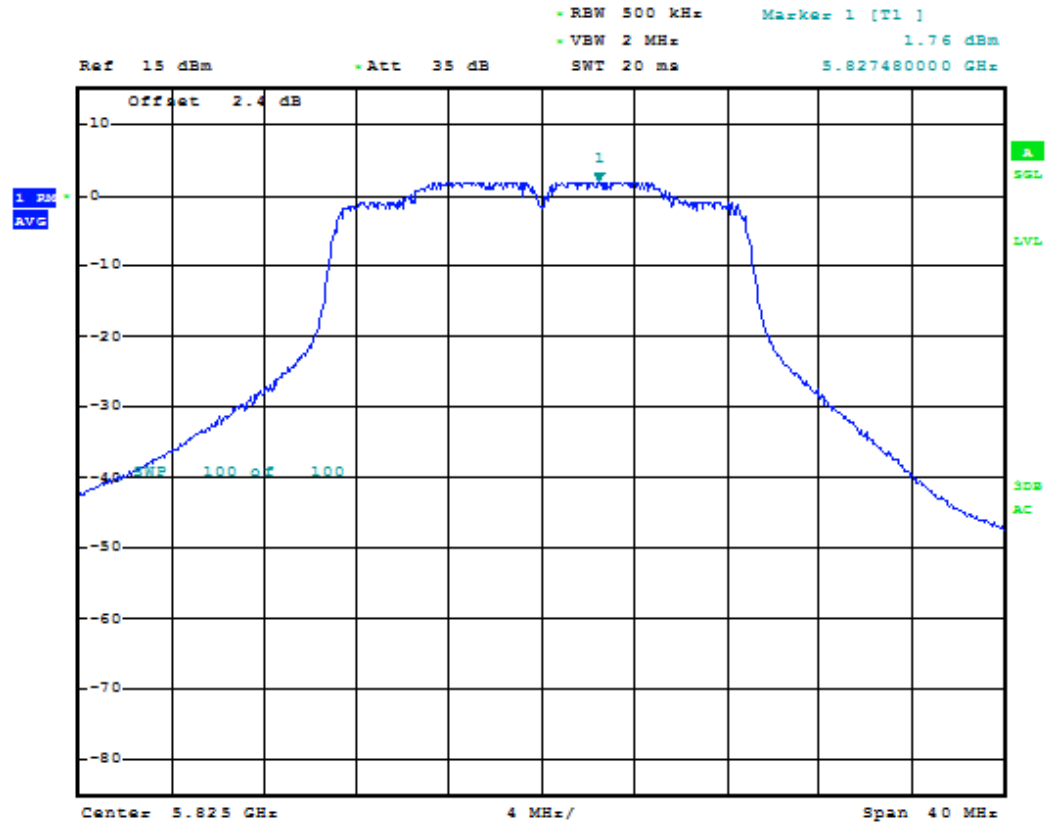
Lowest Channel



Middle Channel

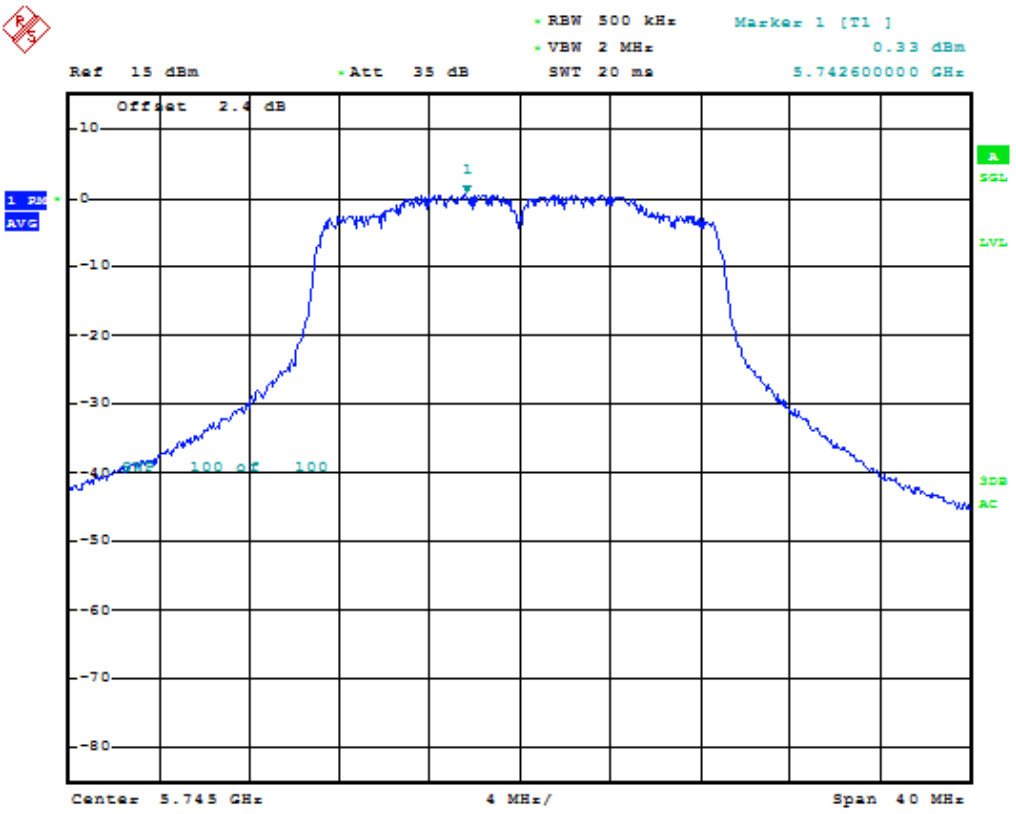


Highest Channel

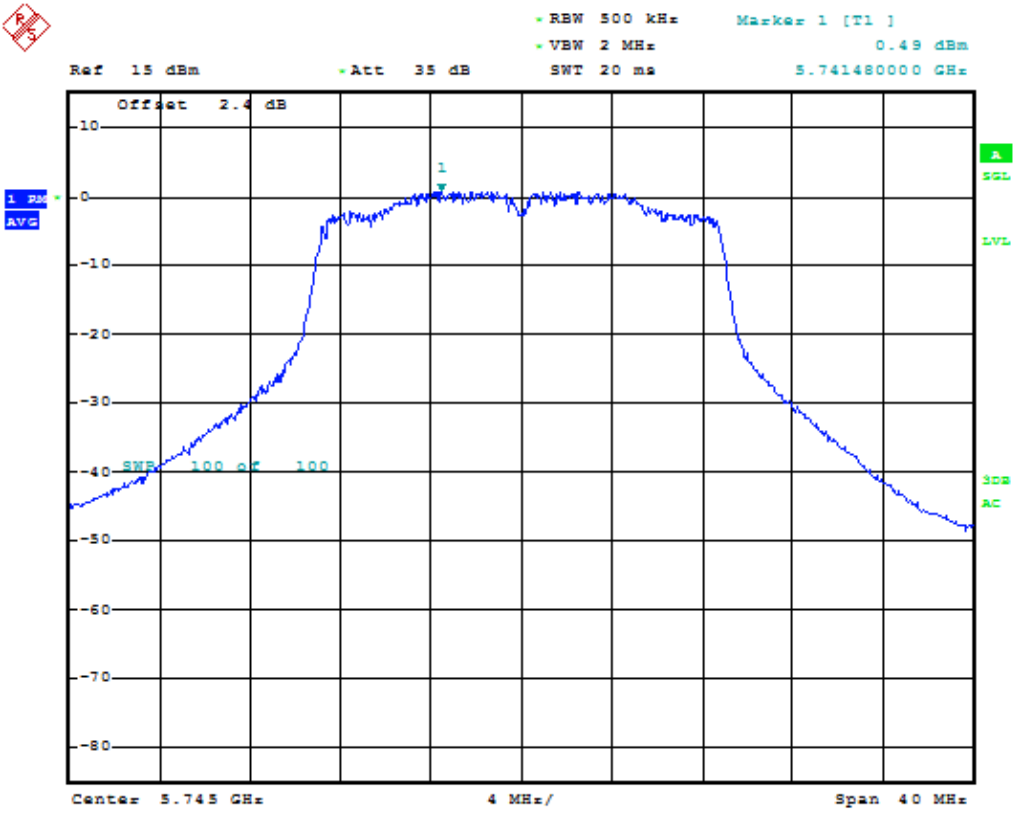


802.11 n20 MHz and 802.11 ac 20 MHz modes CHAIN A+B

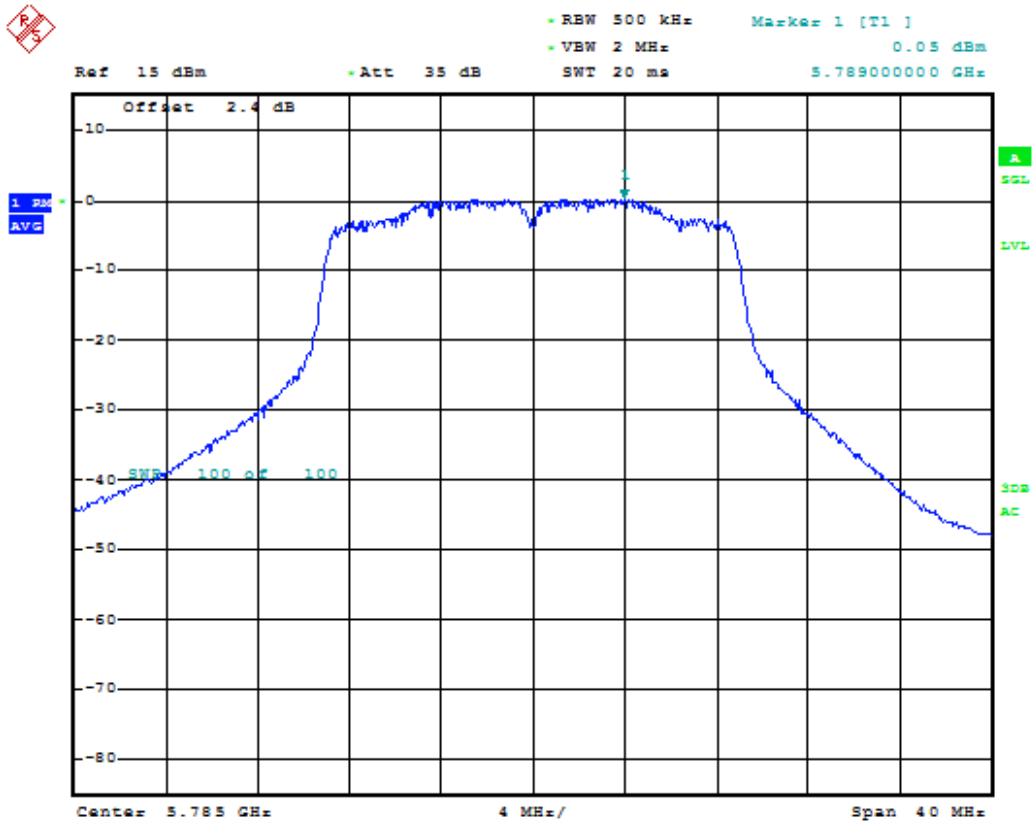
Lowest Channel. Chain A.



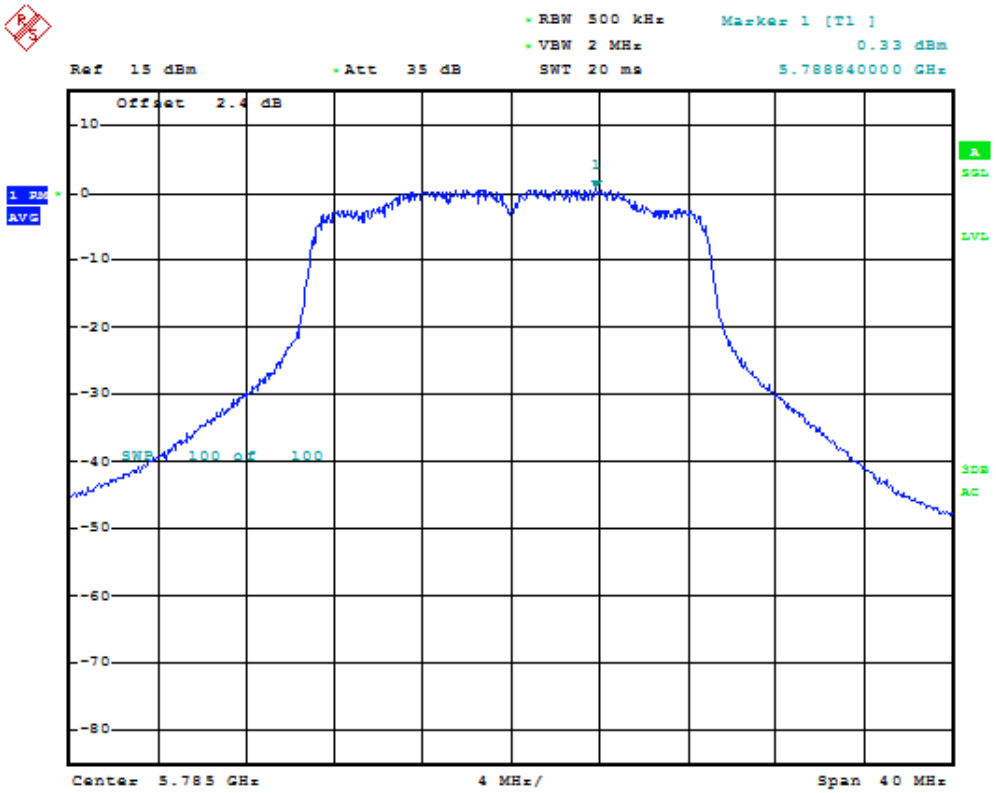
Lowest Channel. Chain B.



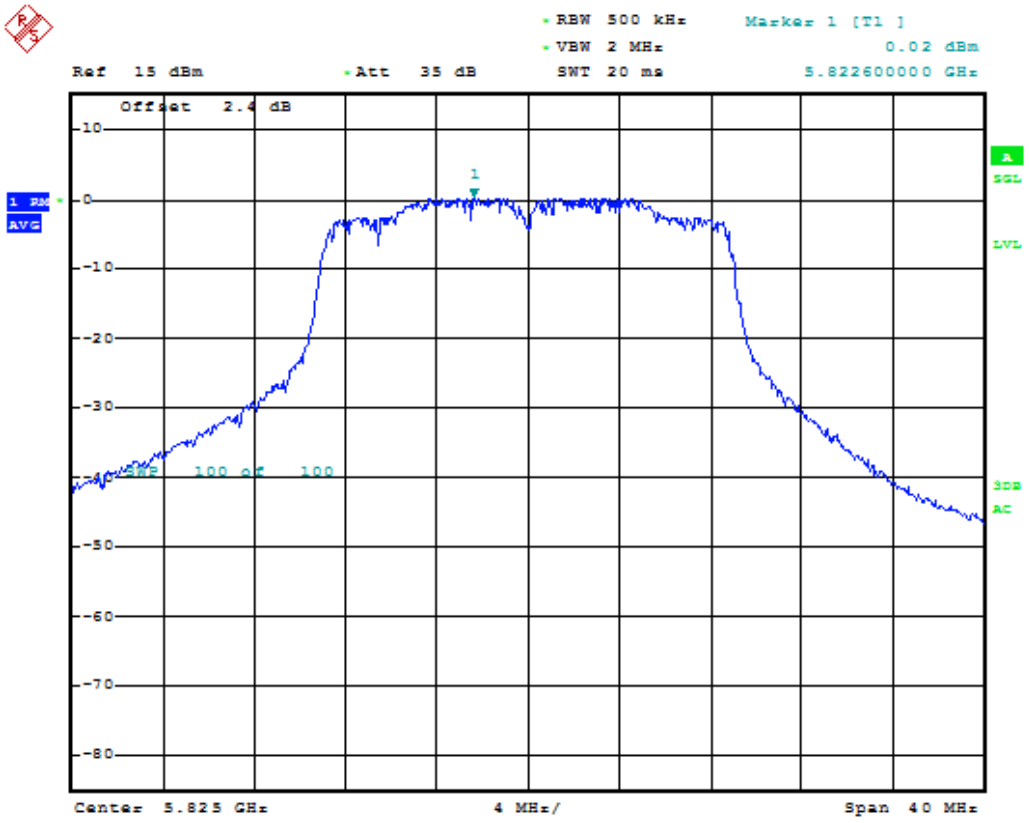
Middle Channel. Chain A.



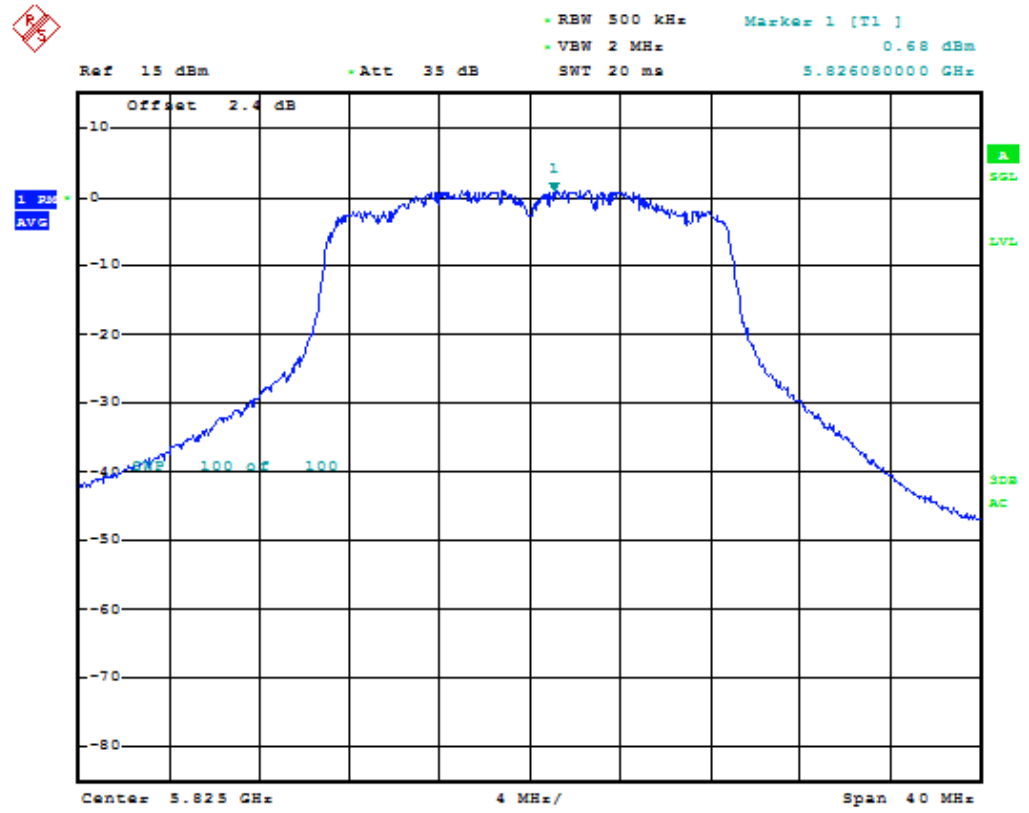
Middle Channel. Chain B.



Highest Channel. Chain A.

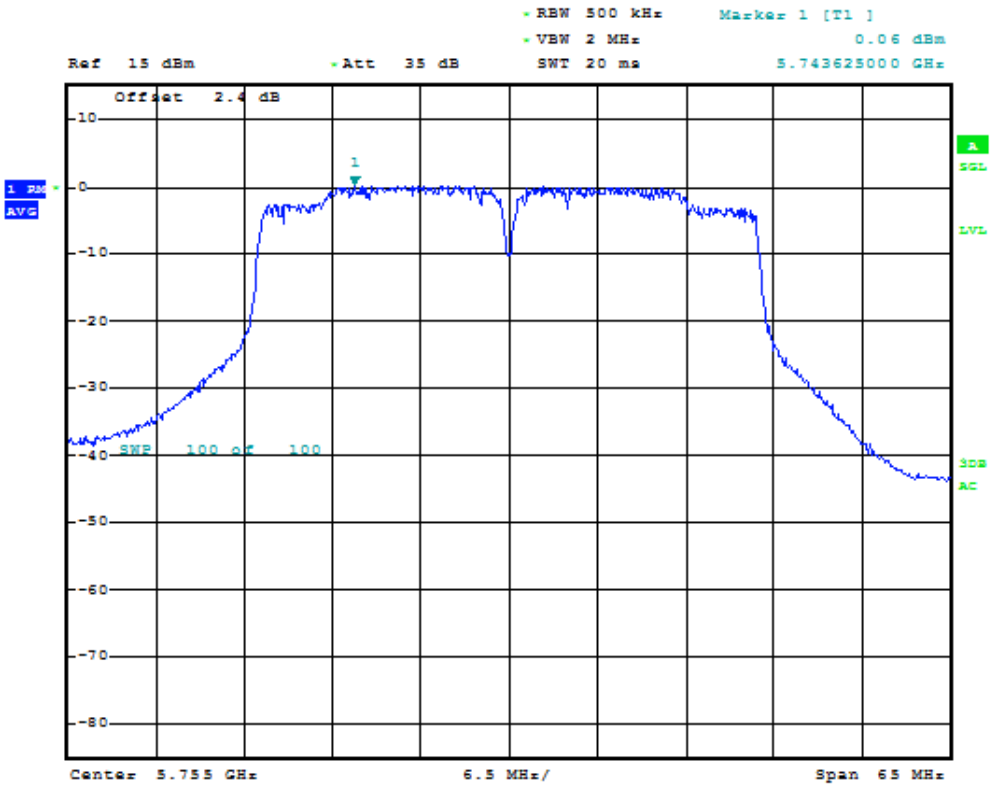


Highest Channel. Chain B.

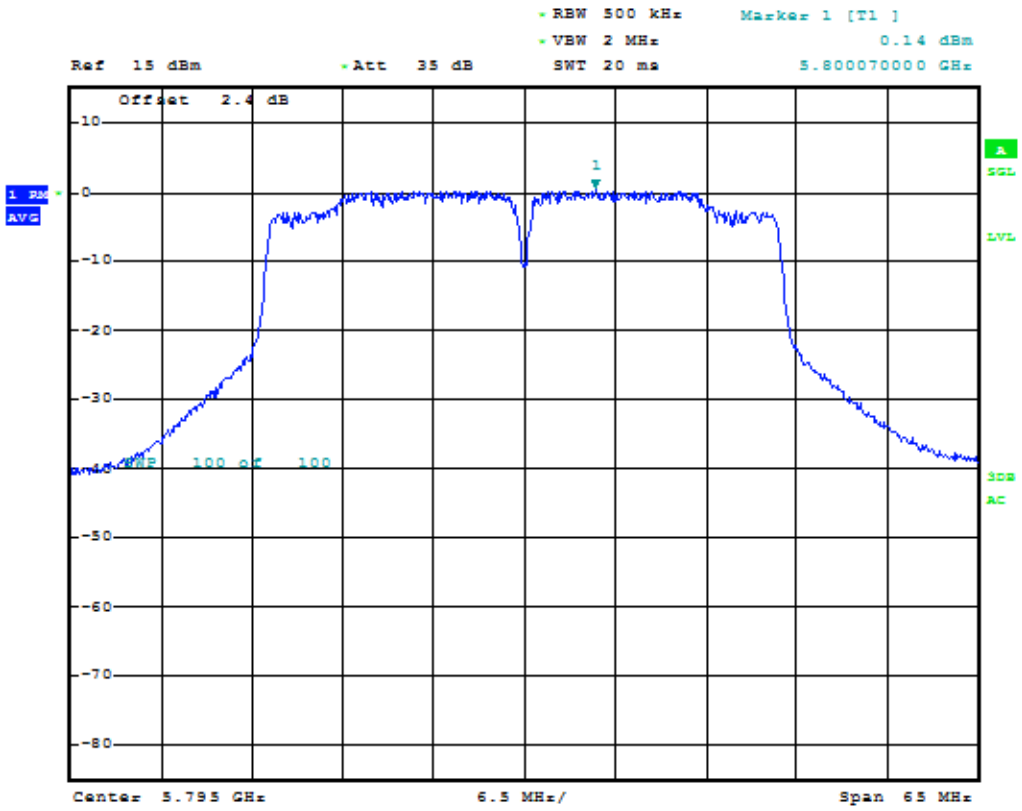


802.11 n40 MHz and 802.11 ac 40 MHz modes CHAIN A

Lowest Channel

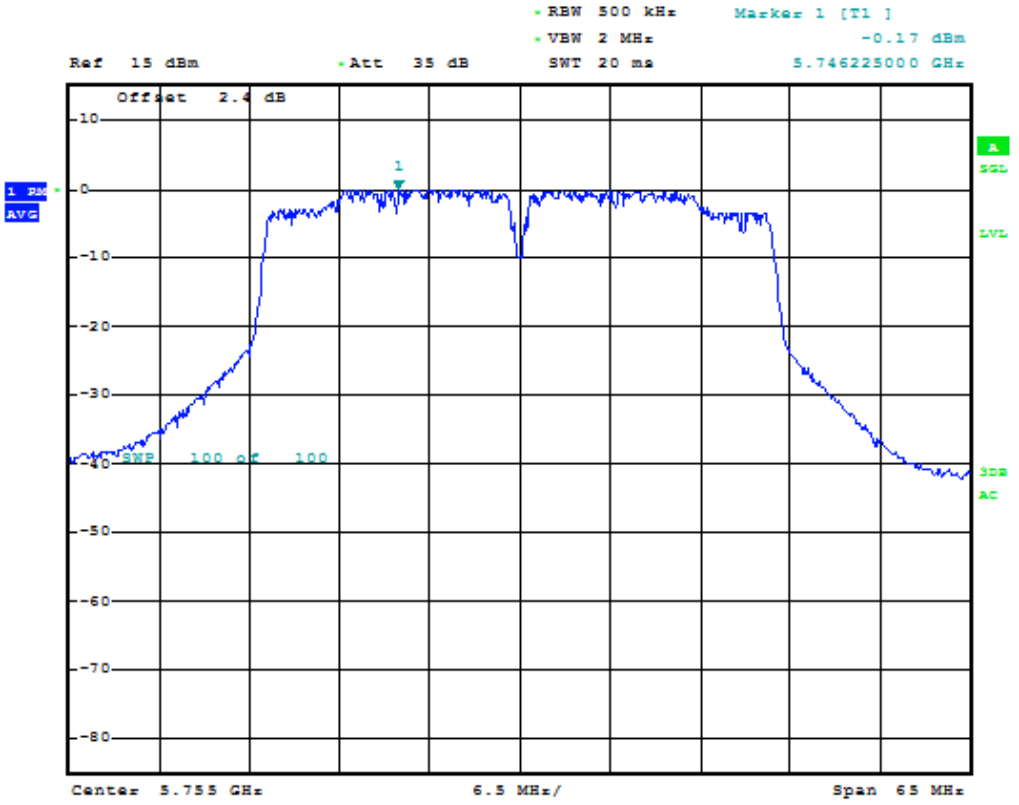


Highest Channel

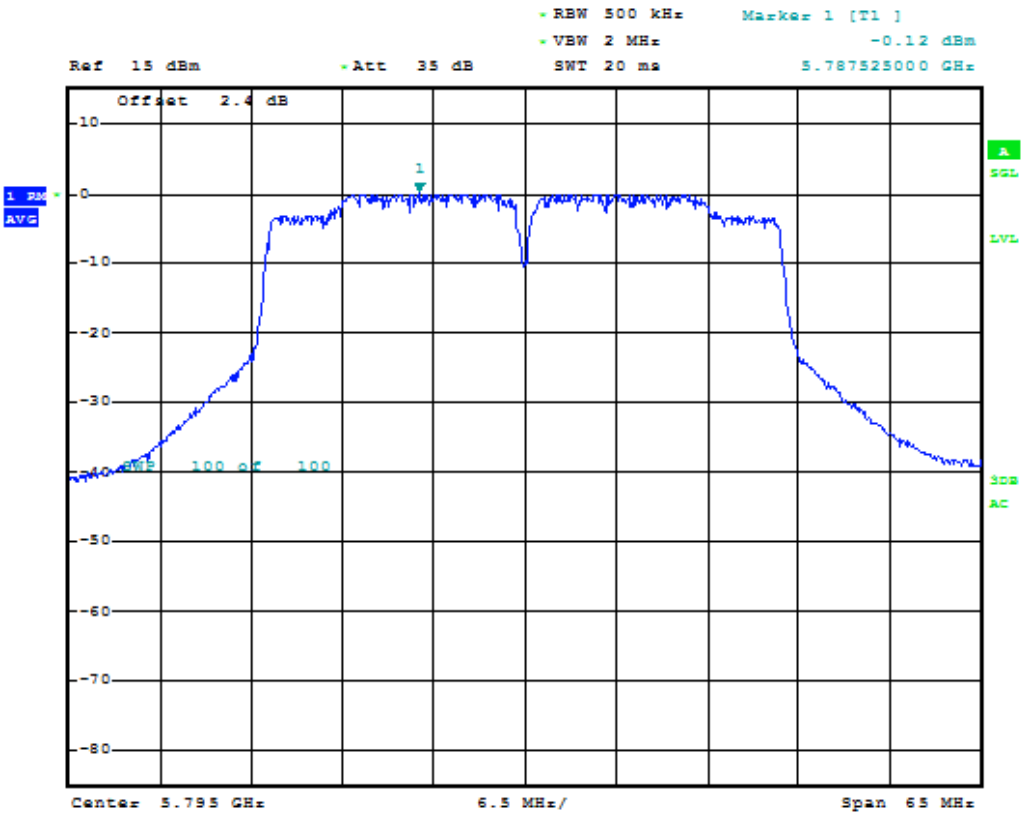


802.11 n40 MHz and 802.11 ac 40 MHz modes CHAIN B

Lowest Channel

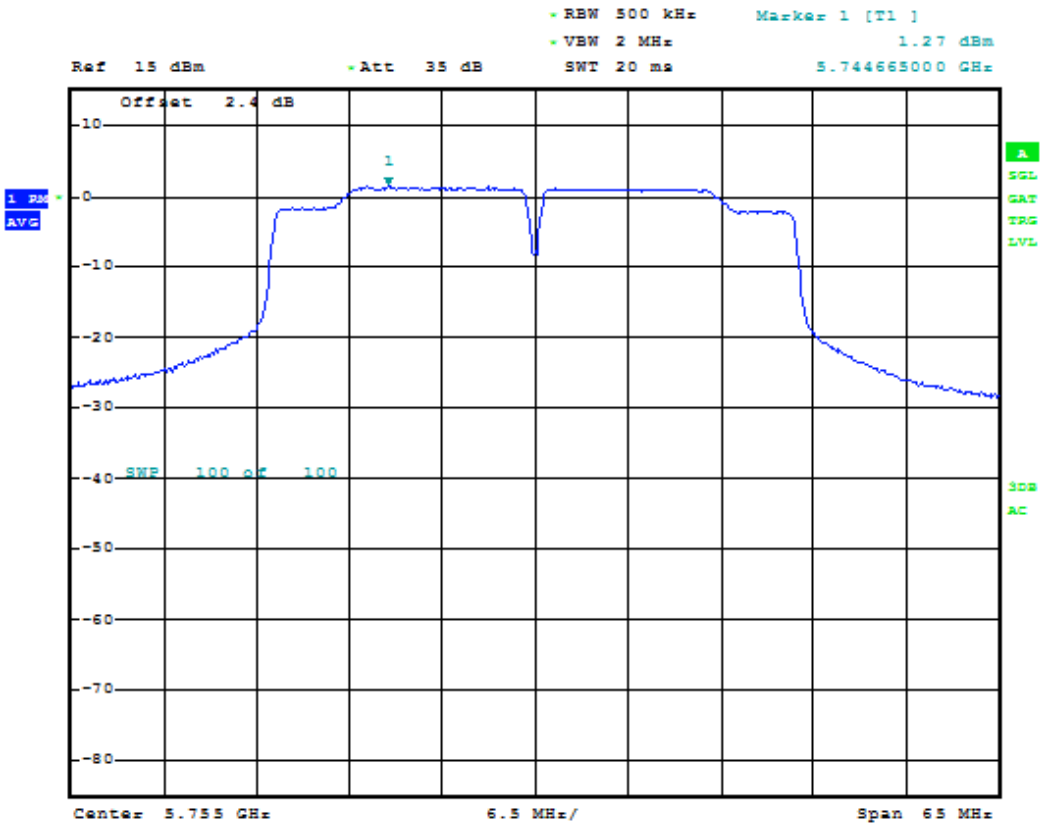


Highest Channel

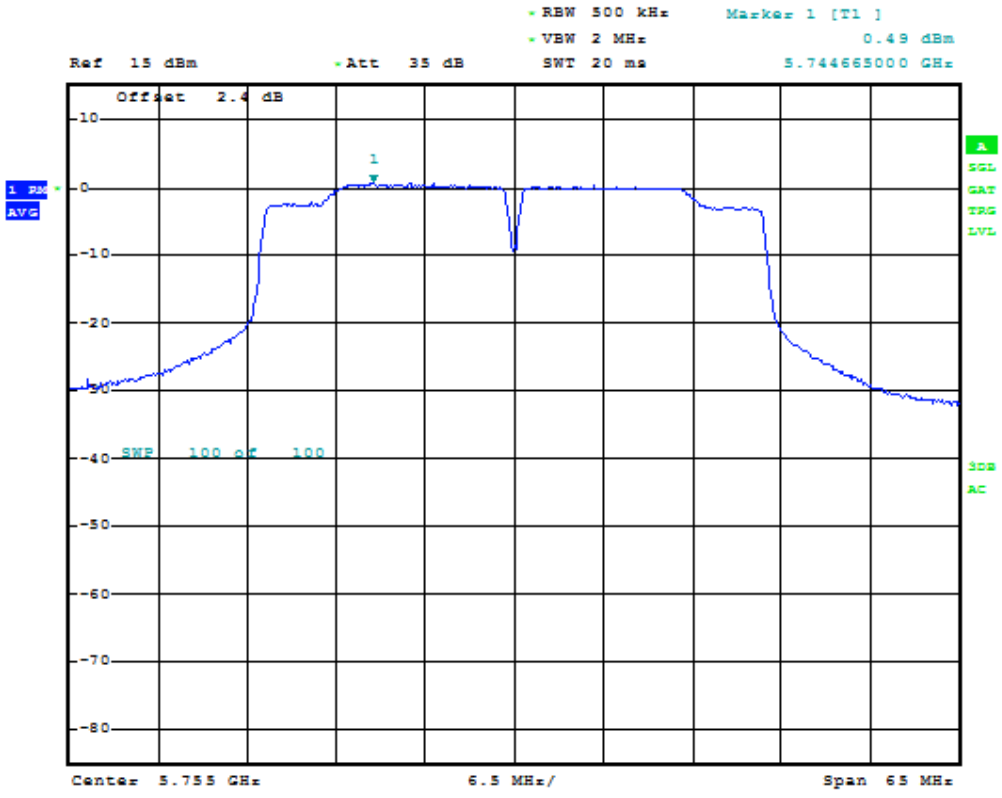


802.11 n40 MHz and 802.11 ac 40 MHz modes CHAIN A+B

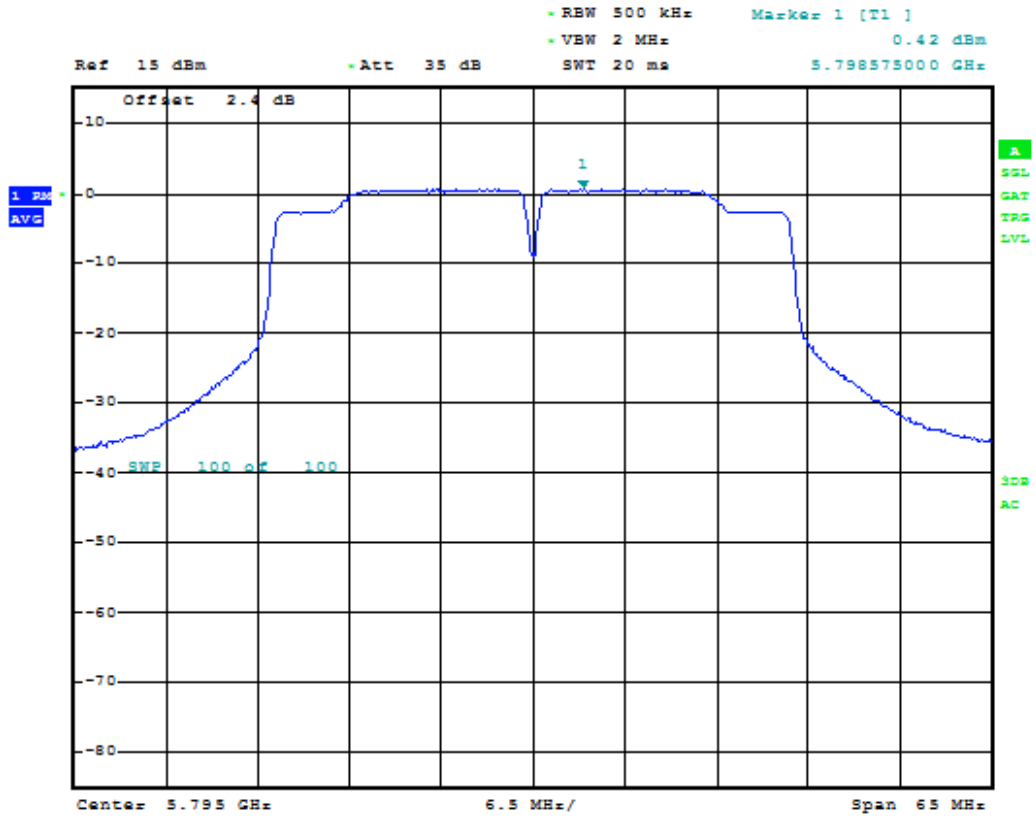
Lowest Channel. Chain A.



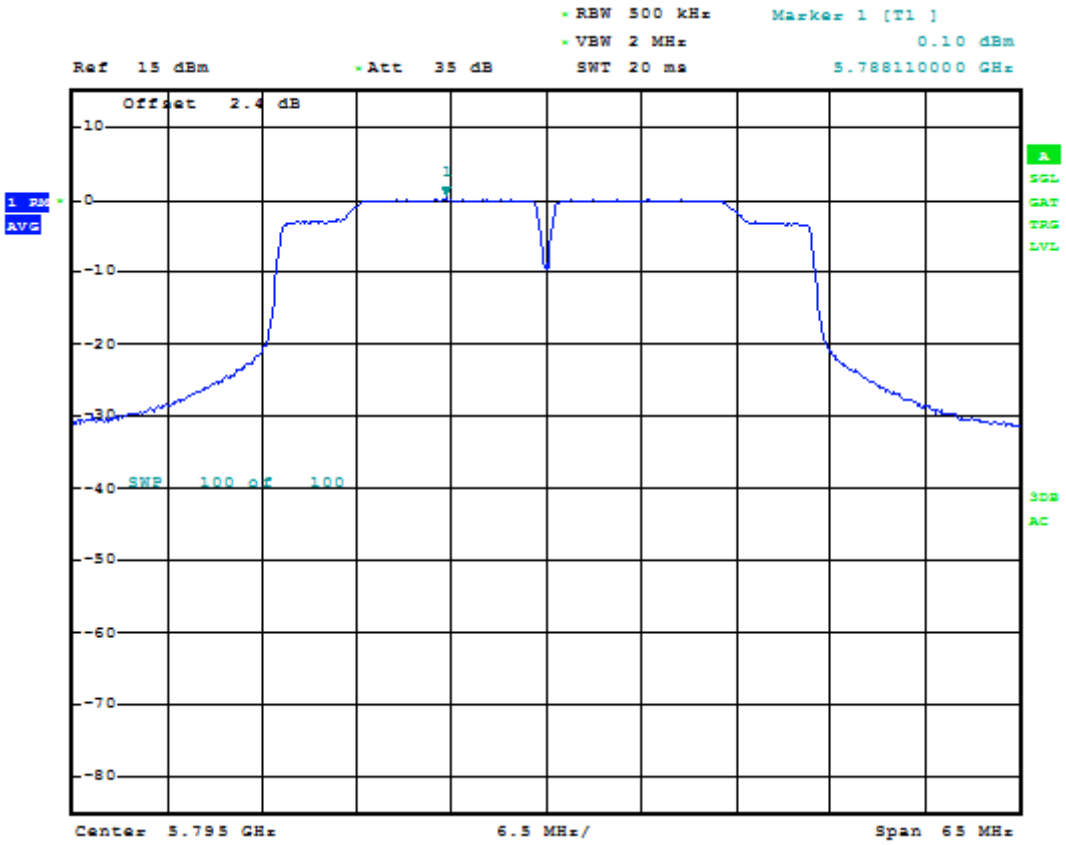
Lowest Channel. Chain B.



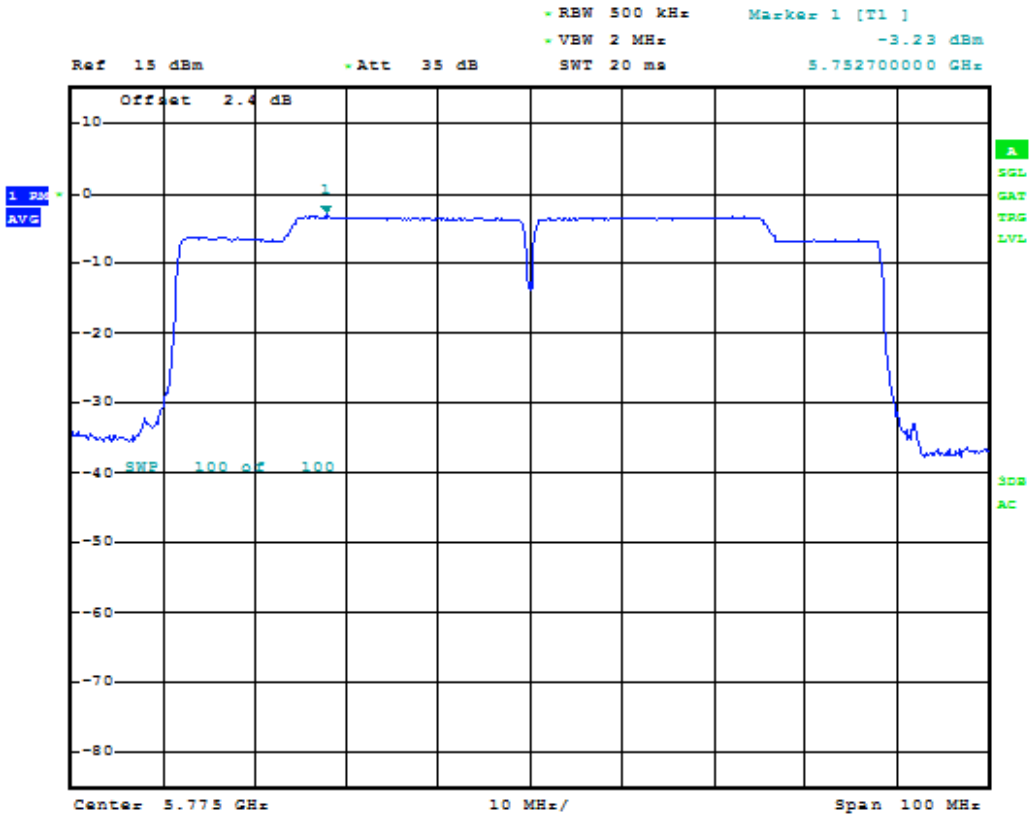
Highest Channel Chain A.



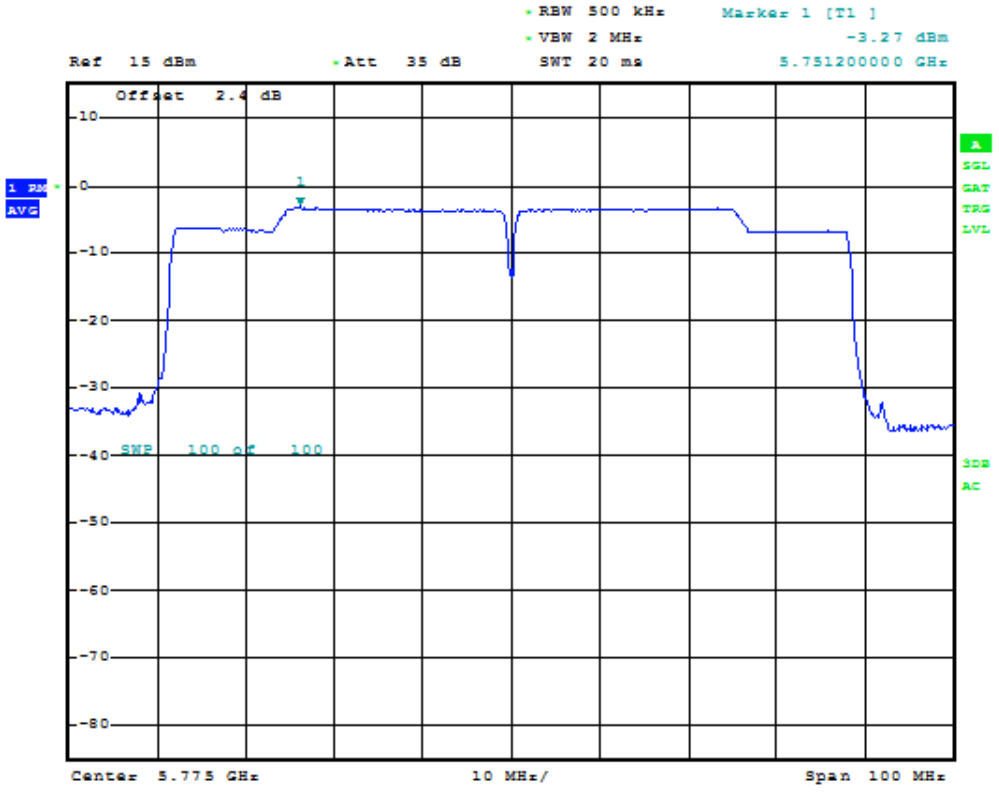
Highest Channel Chain B.



802.11 ac 80 MHz mode CHAIN A

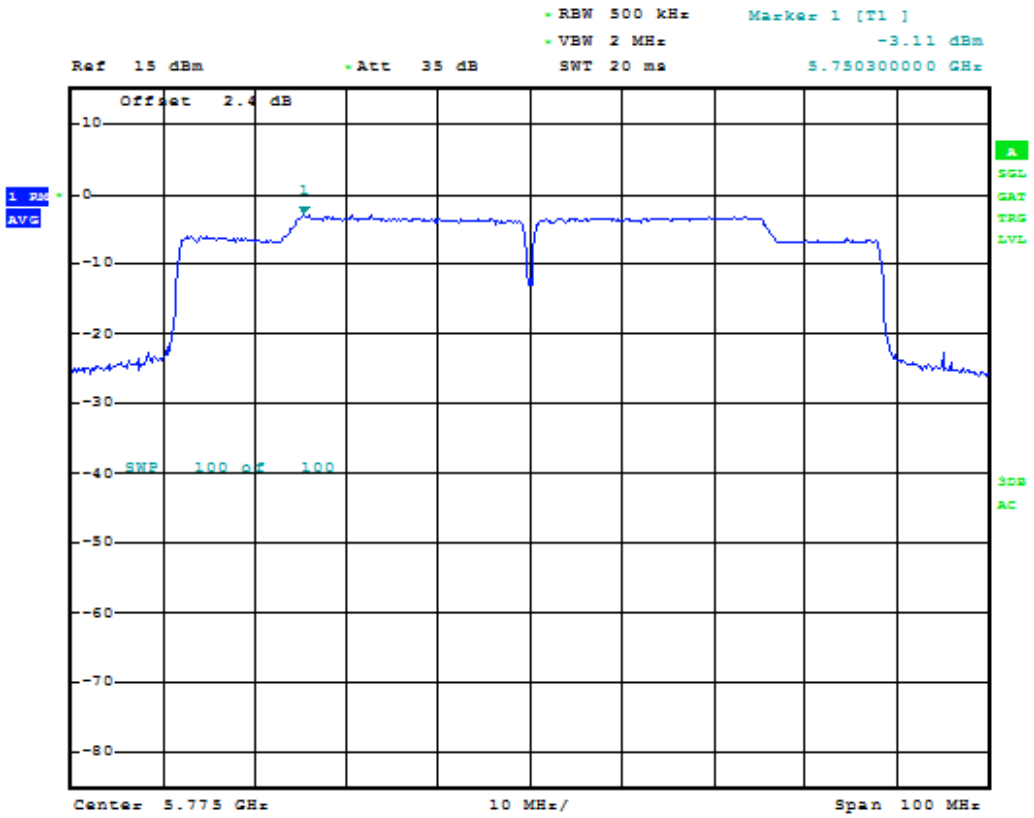


802.11 ac 80 MHz mode CHAIN B

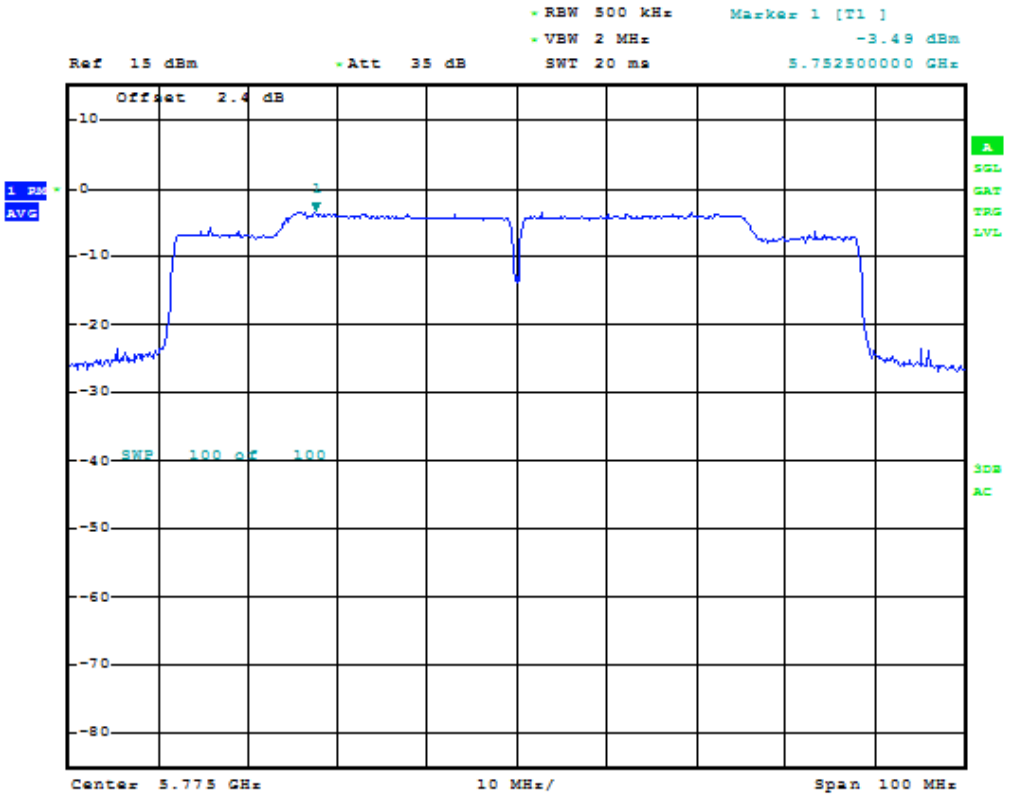


802.11 ac 80 MHz mode CHAIN A+B

Chain A.



Chain B.



Section 15.407 Subclause (b) (4) / RSS-210 A9.2. (4). Undesirable radiated emissions (Transmitter) 1 to 40 GHz

SPECIFICATION

For transmitters operating in the 5.725-5.85 GHz band: All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of −17 dBm/MHz (78.23 dBµV/m at 3 m distance).; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of −27 dBm/MHz (68.23 dBµV/m at 3 m distance).

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

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

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

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

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 360º 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 5.675-5.725 GHz and 5.85-5.90 GHz adjacent bands (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 (802.11n20).

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 an RMS average detector for checking compliance with the average limit.

1. WiFi 5GHz 802.11 a mode

Lowest frequency 5745 MHz. Out-of-band spurious emissions inside 5.675-5.725 GHz adjacent band.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.724392	V	Peak	67.83	± 4.00
		Average	50.02	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.723742	V	Peak	67.03	± 4.00
		Average	48.93	± 4.00

Middle frequency 5785 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside 5.675-5.725 GHz and 5.85-5.90 GHz adjacent bands.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.722492	V	Peak	55.21	± 4.00
		Average	42.44	± 4.00
5.876208	V	Peak	55.28	± 4.00
		Average	42.63	± 4.00
17.352926	V	Peak	64.10	± 4.00
		Average	53.75	± 4.00
23.13987	V	Peak	48.78	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.685825	V	Peak	54.55	± 4.00
		Average	41.95	± 4.00
5.882375	V	Peak	54.96	± 4.00
		Average	42.52	± 4.00
17.35668	V	Peak	62.62	± 4.00
		Average	53.04	± 4.00
23.14013	V	Peak	48.52	± 4.00

Highest frequency 5825 MHz. Out-of-band spurious emissions inside 5.85-5.90 GHz adjacent band.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.857908	V	Peak	55.40	± 4.00
		Average	43.15	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.866142	V	Peak	55.82	± 4.00
		Average	42.99	± 4.00

Verdict: PASS

2. WiFi 5GHz 802.11 n20 mode.

Lowest frequency 5745 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside 5.675-5.725 GHz adjacent band.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.724842	V	Peak	67.05	± 4.00
		Average	51.86	± 4.00
17.23495	V	Peak	62.40	± 4.00
		Average	53.45	± 4.00
22.97987	V	Peak	48.61	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.723942	V	Peak	67.05	± 4.00
		Average	49.86	± 4.00
17.23238	V	Peak	62.91	± 4.00
		Average	53.14	± 4.00
22.97987	V	Peak	47.83	± 4.00

Chain A+B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.724908	V	Peak	62.37	± 4.00
		Average	46.90	± 4.00
17.23202	V	Peak	61.02	± 4.00
		Average	51.10	± 4.00
22.97987	V	Peak	48.16	± 4.00

Middle frequency 5785 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside 5.675-5.725 GHz and 5.85-5.90 adjacent bands.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.681208	V	Peak	54.78	± 4.00
		Average	41.98	± 4.00
5.876292	V	Peak	55.31	± 4.00
		Average	42.66	± 4.00
17.35485	V	Peak	63.49	± 4.00
		Average	53.72	± 4.00
23.13987	V	Peak	48.01	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.719192	V	Peak	53.23	± 4.00
5.895492	V	Peak	55.61	± 4.00
		Average	42.87	± 4.00
17.353355	V	Peak	63.85	± 4.00
		Average	53.89	± 4.00
23.13960	V	Peak	48.05	± 4.00

Chain A+B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.722942	V	Peak	54.62	± 4.00
		Average	42.51	± 4.00
5.872675	V	Peak	55.21	± 4.00
		Average	42.78	± 4.00
17.35082	V	Peak	61.73	± 4.00
		Average	53.45	± 4.00
23.13987	V	Peak	48.09	± 4.00

Highest frequency 5825 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside 5.85-5.90 GHz adjacent band.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.851475	V	Peak	55.90	± 4.00
		Average	43.34	± 4.00
17.475635	V	Peak	65.10	± 4.00
		Average	53.77	± 4.00
23.29987	V	Peak	47.97	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.850275	V	Peak	56.41	± 4.00
		Average	43.64	± 4.00
17.47512	V	Peak	62.50	± 4.00
		Average	53.80	± 4.00
23.30013	V	Peak	48.38	± 4.00

Chain A+B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.854108	V	Peak	56.09	± 4.00
		Average	43.77	± 4.00
17.47475	V	Peak	62.68	± 4.00
		Average	53.36	± 4.00
23.29987	V	Peak	47.83	± 4.00

Verdict: PASS

3. WiFi 5GHz 802.11 n40 mode

Lowest frequency 5755 MHz. Spurious emissions inside 5.675-5.725 GHz adjacent band.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.724142	V	Peak	68.58	± 4.00
		Average	55.93	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.722292	V	Peak	68.91	± 4.00
		Average	56.52	± 4.00

Chain A+B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.724242	V	Peak	71.52	± 4.00
		Average	58.86	± 4.00

Verdict: PASS

Highest frequency 5795 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside 5.85-5.90 GHz adjacent band.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.855775	V	Peak	55.53	± 4.00
		Average	43.45	± 4.00
17.39592	V	Peak	61.34	± 4.00
		Average	52.88	± 4.00
23.18013	V	Peak	47.55	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.857808	V	Peak	55.41	± 4.00
		Average	43.33	± 4.00
17.39482	V	Peak	62.26	± 4.00
		Average	52.77	± 4.00
23.17960	V	Peak	48.11	± 4.00

Chain A+B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.852725	V	Peak	64.90	± 4.00
		Average	52.51	± 4.00
17.392239	V	Peak	62.62	± 4.00
		Average	52.37	± 4.00

Verdict: PASS

4. WiFi 5GHz 802.11 ac80 mode

Middle frequency 5775 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside 5.675-5.725 GHz and 5.85-5.90 adjacent bands.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.722625	V	Peak	72.60	± 4.00
		Average	55.85	± 4.00
5.855042	V	Peak	67.69	± 4.00
		Average	52.50	± 4.00
17.35778	V	Peak	59.11	± 4.00
		Average	51.94	± 4.00
23.09987	V	Peak	48.09	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.724892	V	Peak	68.06	± 4.00
		Average	53.99	± 4.00
5.853475	V	Peak	66.49	± 4.00
		Average	51.94	± 4.00
17.35742	V	Peak	60.67	± 4.00
		Average	51.60	± 4.00

Chain A+B

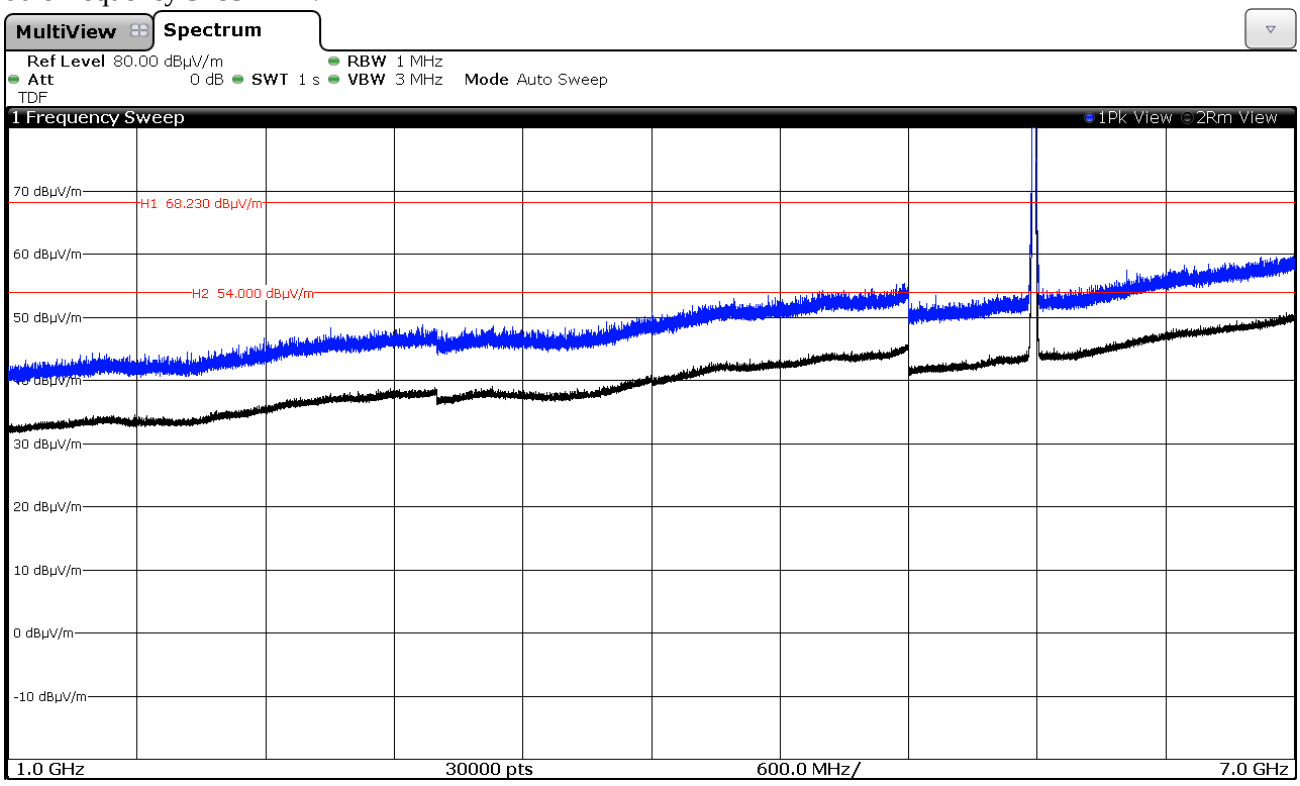
Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.721592	V	Peak	69.53	± 4.00
		Average	54.41	± 4.00
5.853892	V	Peak	69.96	± 4.00
		Average	56.46	± 4.00
17.35617	V	Peak	62.50	± 4.00
		Average	49.50	± 4.00

Verdict: PASS

FREQUENCY RANGE 1 GHz to 7 GHz.

1. WiFi 5GHz 802.11 a mode

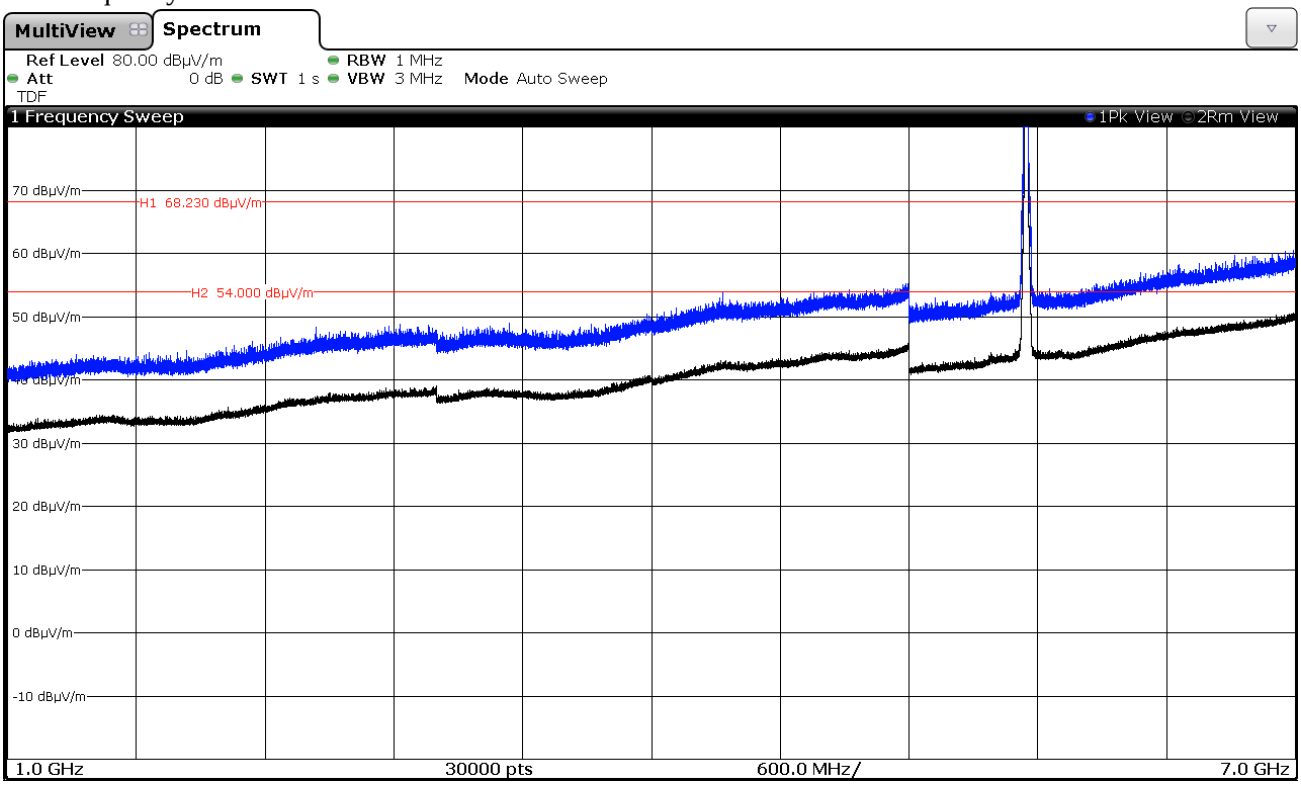
Middle frequency 5785 MHz.



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

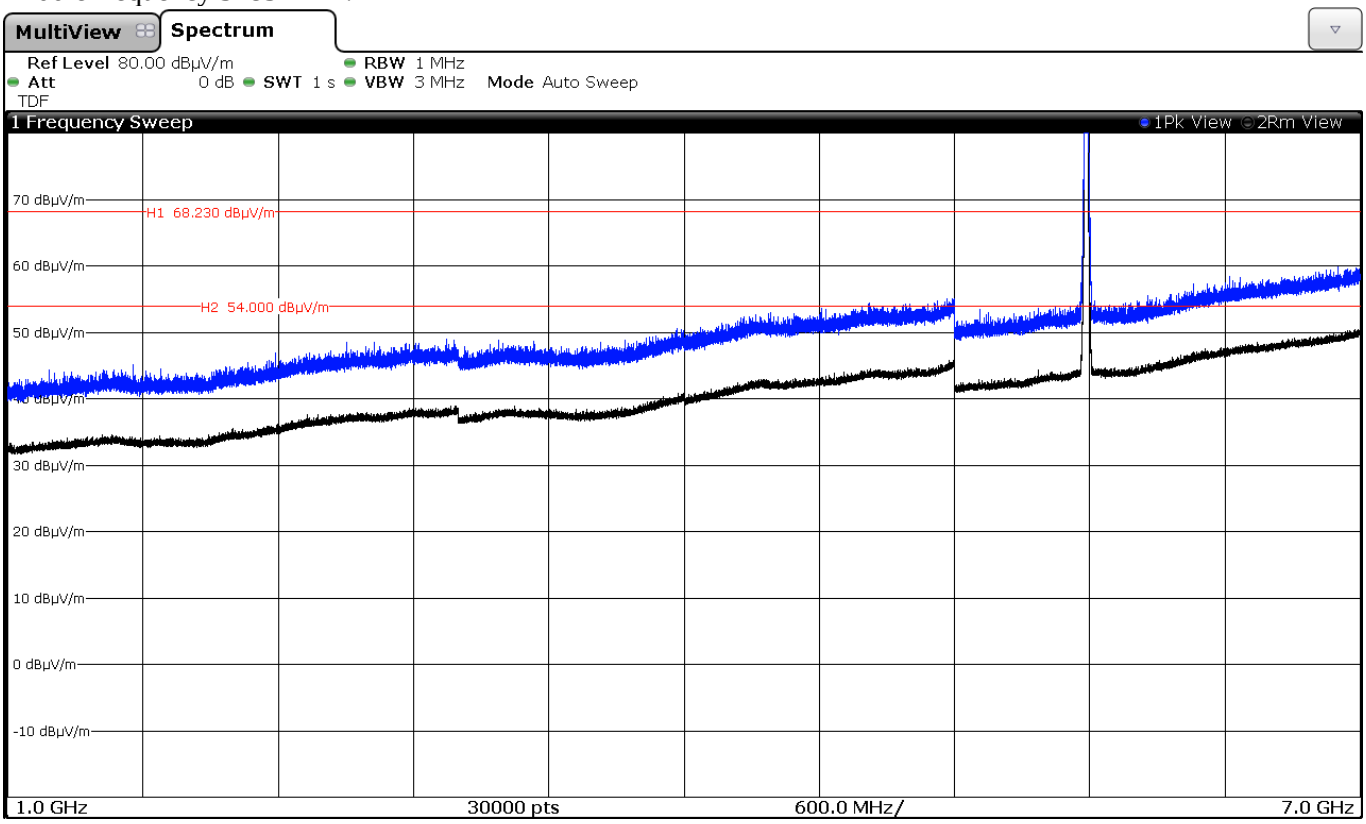
2. WiFi 5GHz 802.11 n20 mode

Lowest frequency 5745 MHz.



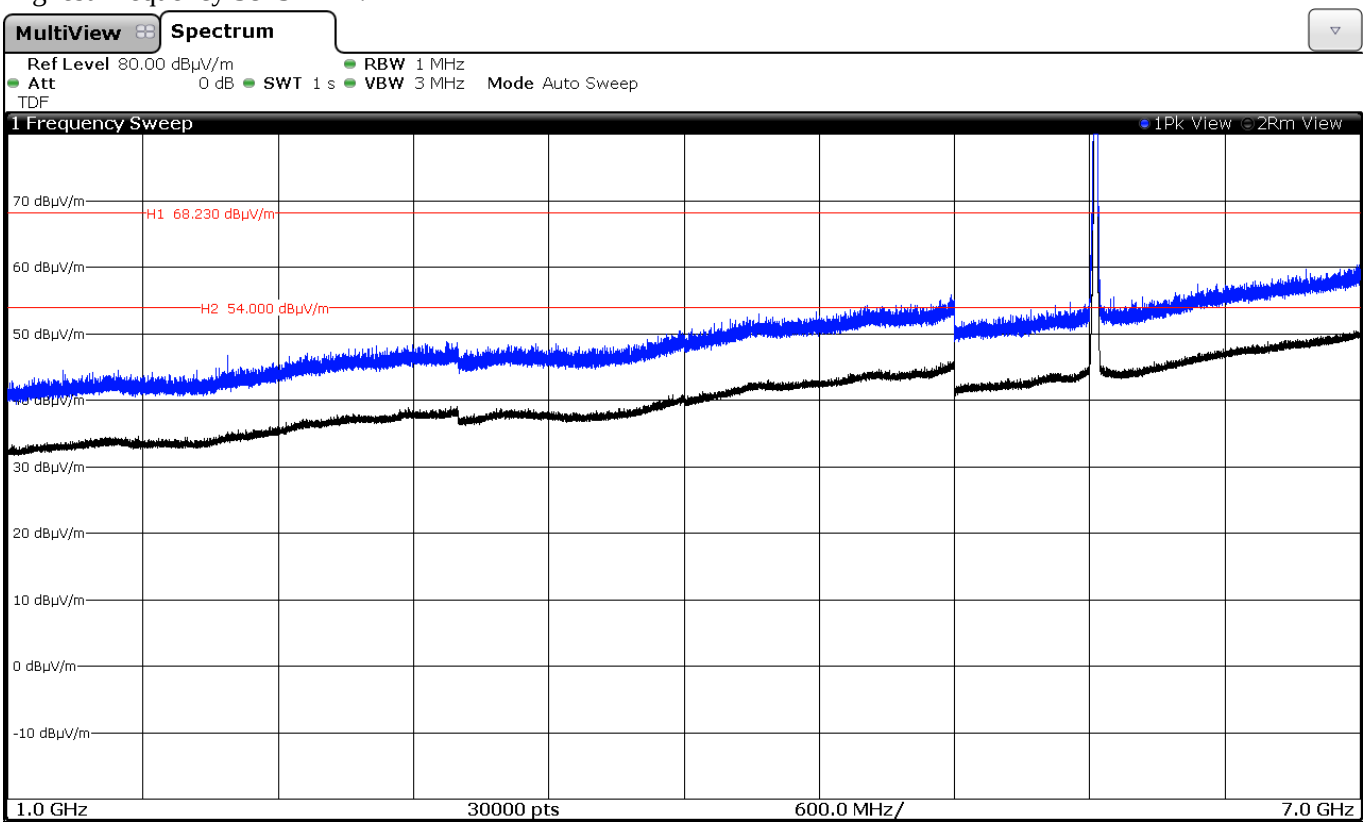
Note: The peak above the limit is the carrier frequency. This plot is valid for Chain A, Chain B and Chain A+B.

Middle frequency 5785 MHz.



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

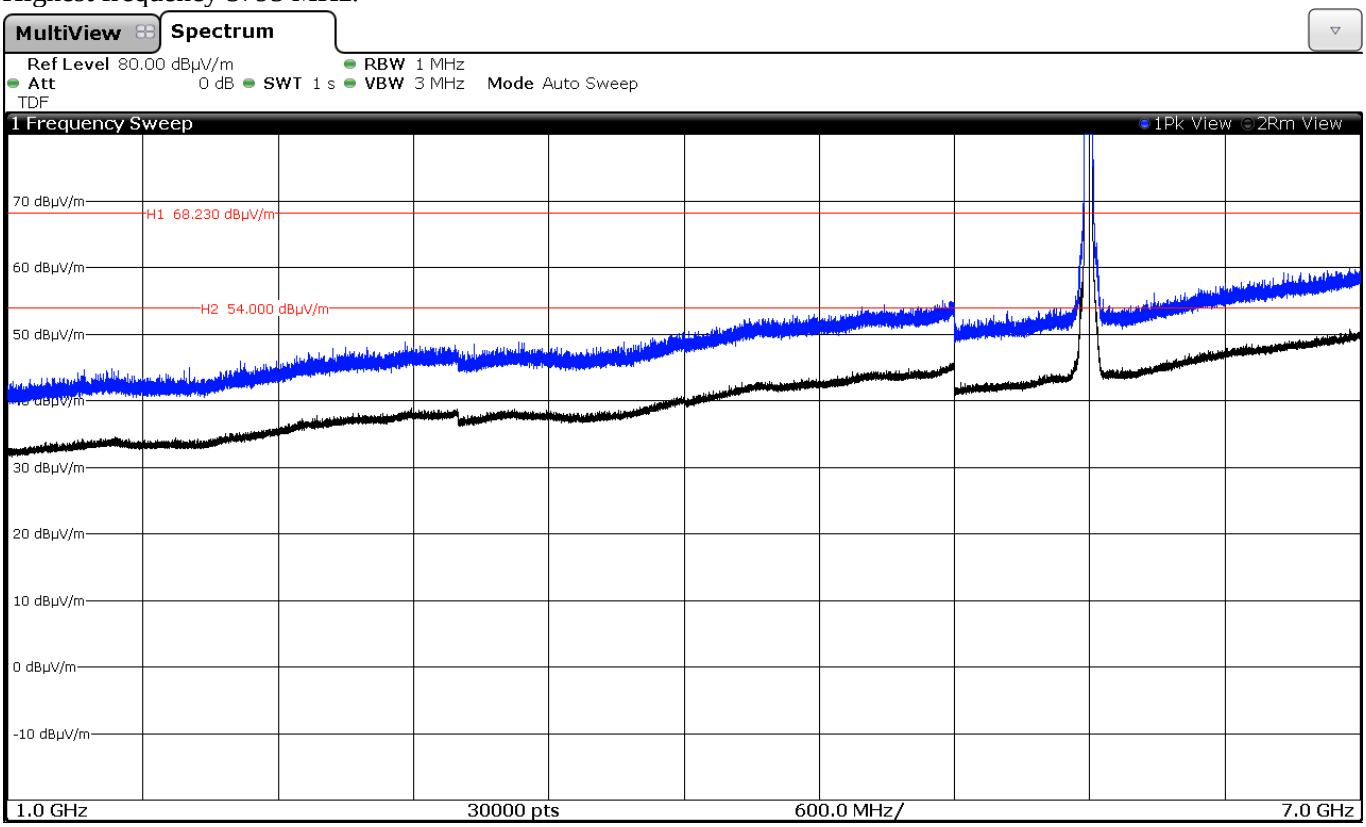
Highest frequency 5825 MHz.



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

3. WiFi 5GHz 802.11 n40 mode

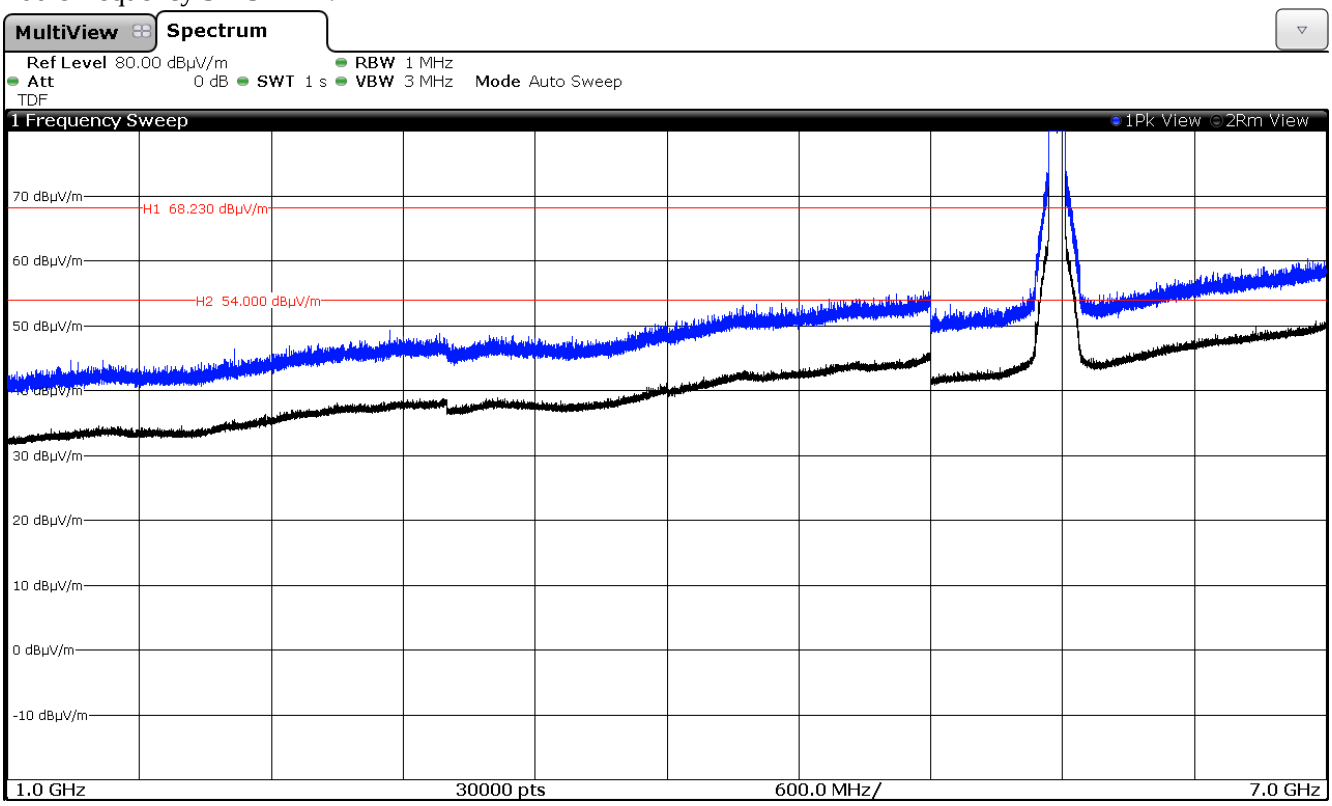
Highest frequency 5795 MHz.



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 5775 MHz.

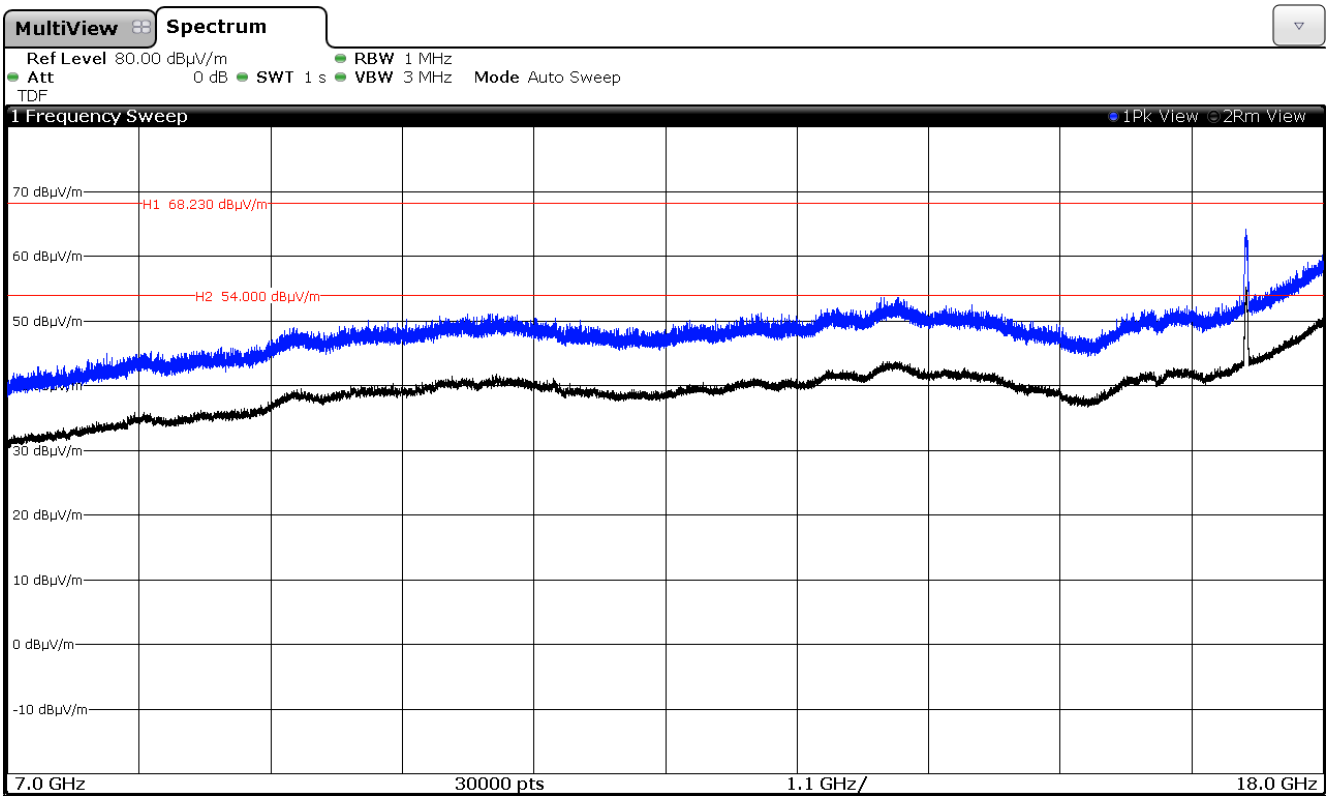


Note: The peak above the limit is the carrier frequency. This plot is valid for Chain A, Chain B, Chain A+B.

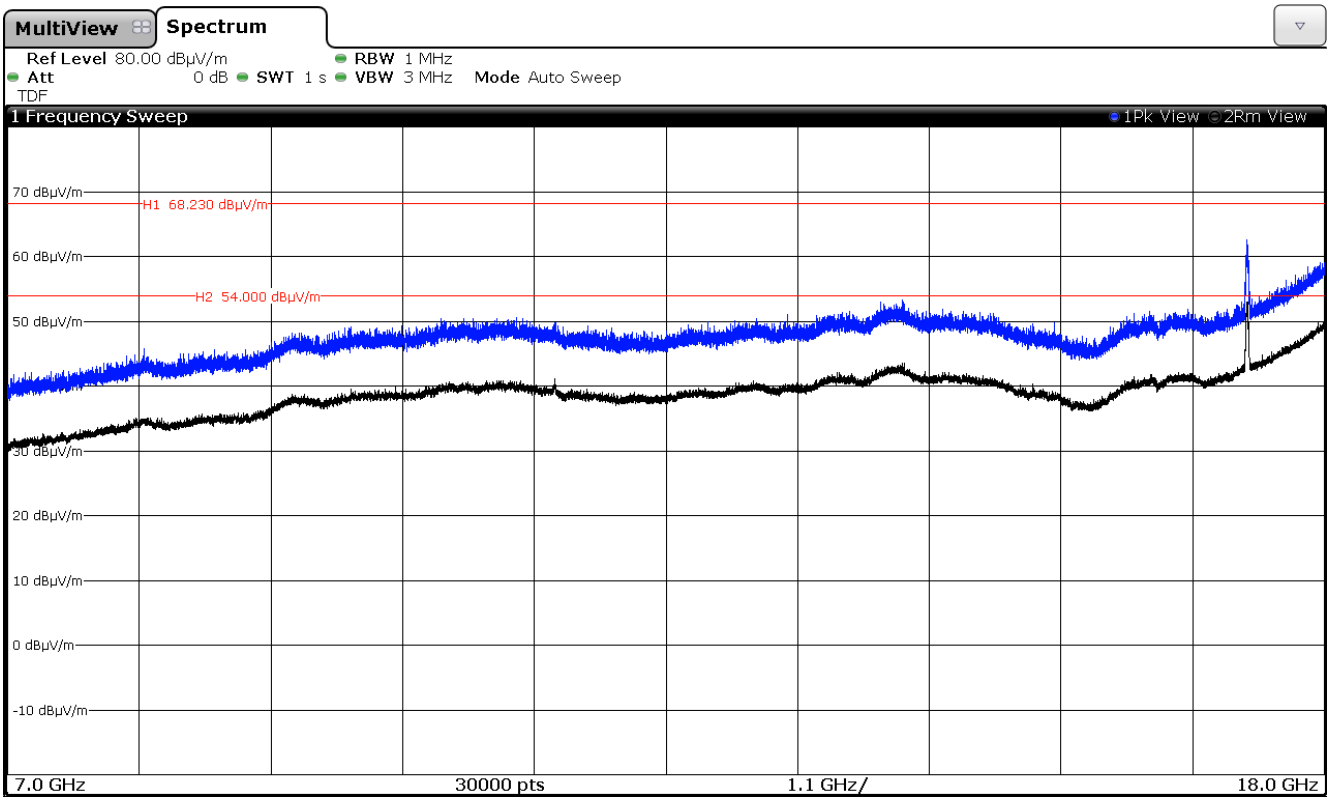
FREQUENCY RANGE 7 GHz to 18 GHz.

1. WiFi 5GHz 802.11 a mode

Middle frequency 5785 MHz.
Chain A

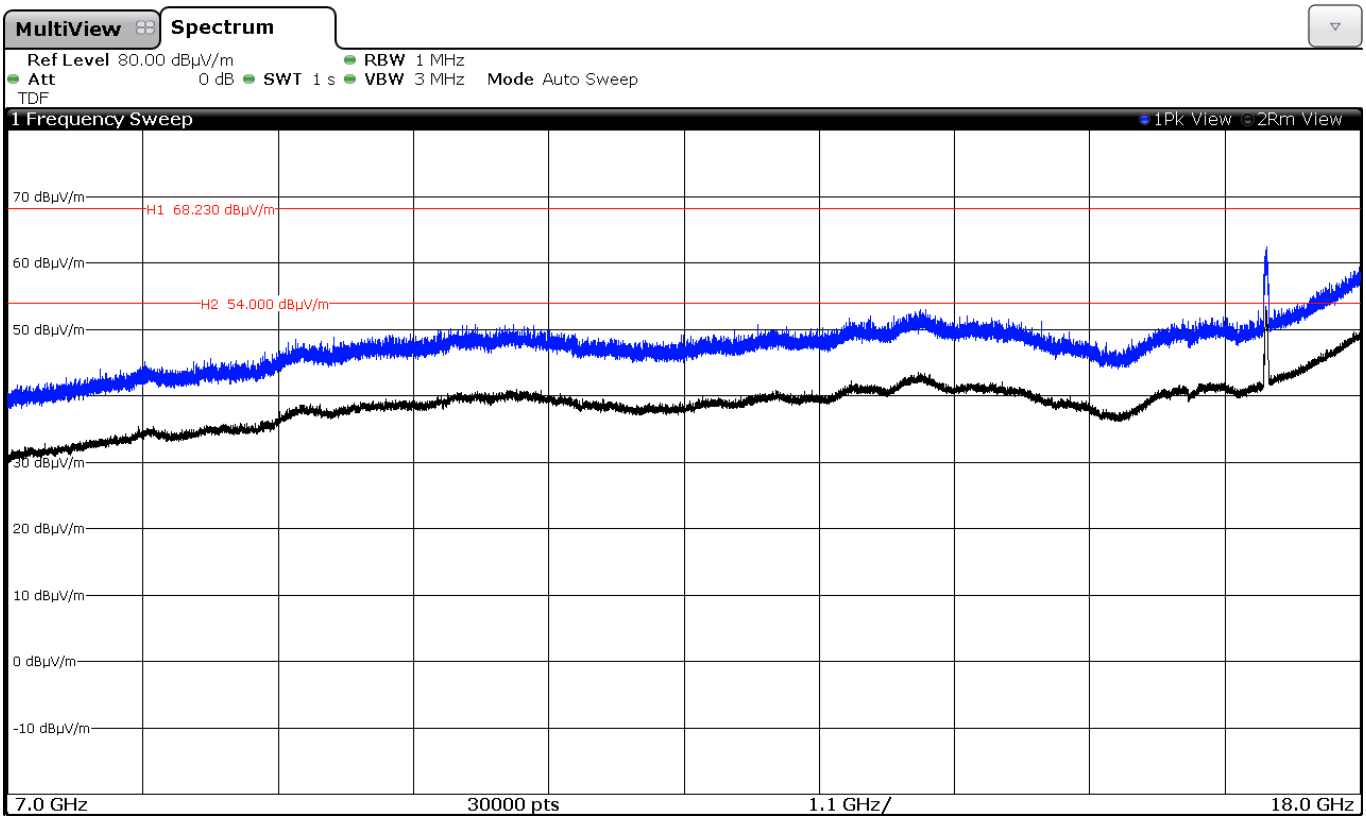


Chain B

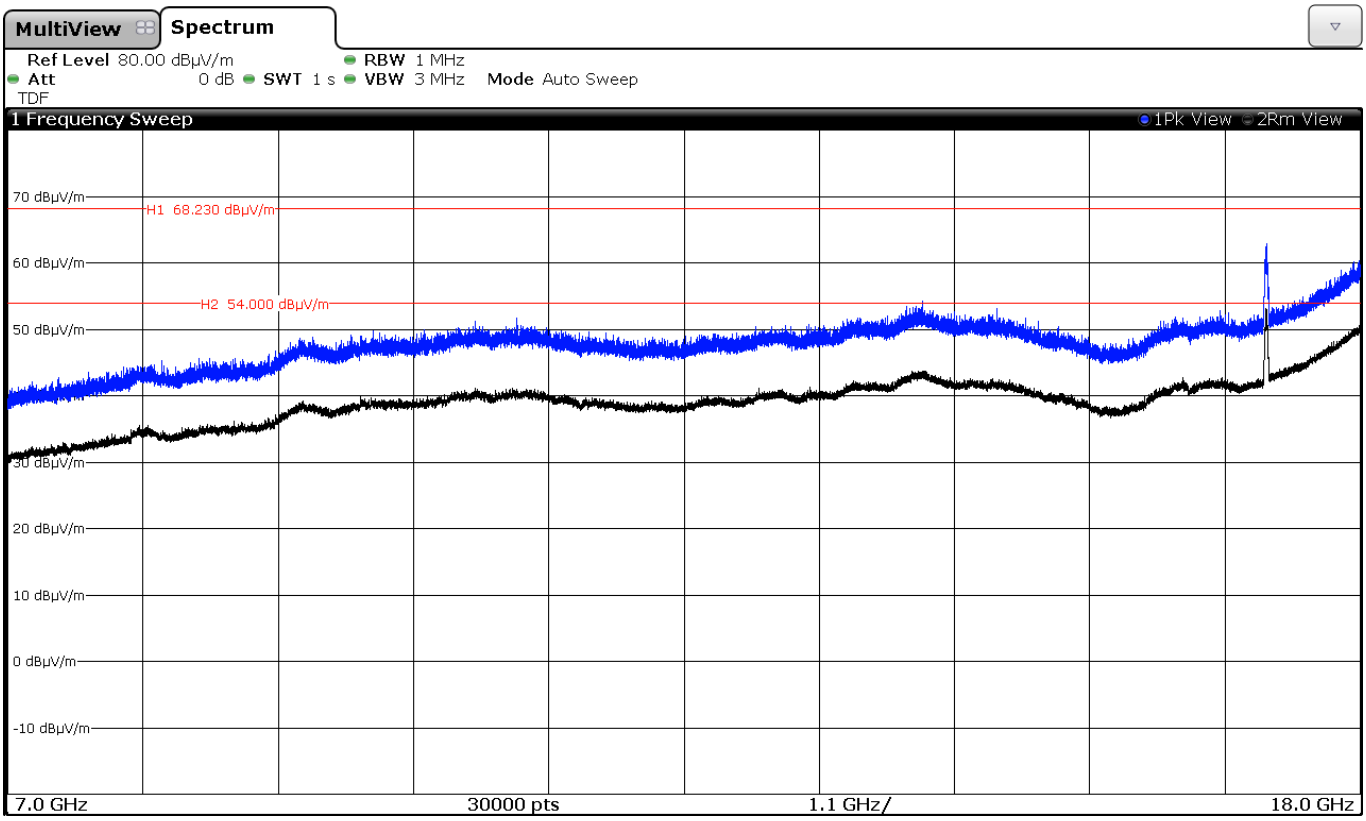


2. WiFi 5GHz 802.11 n20 mode

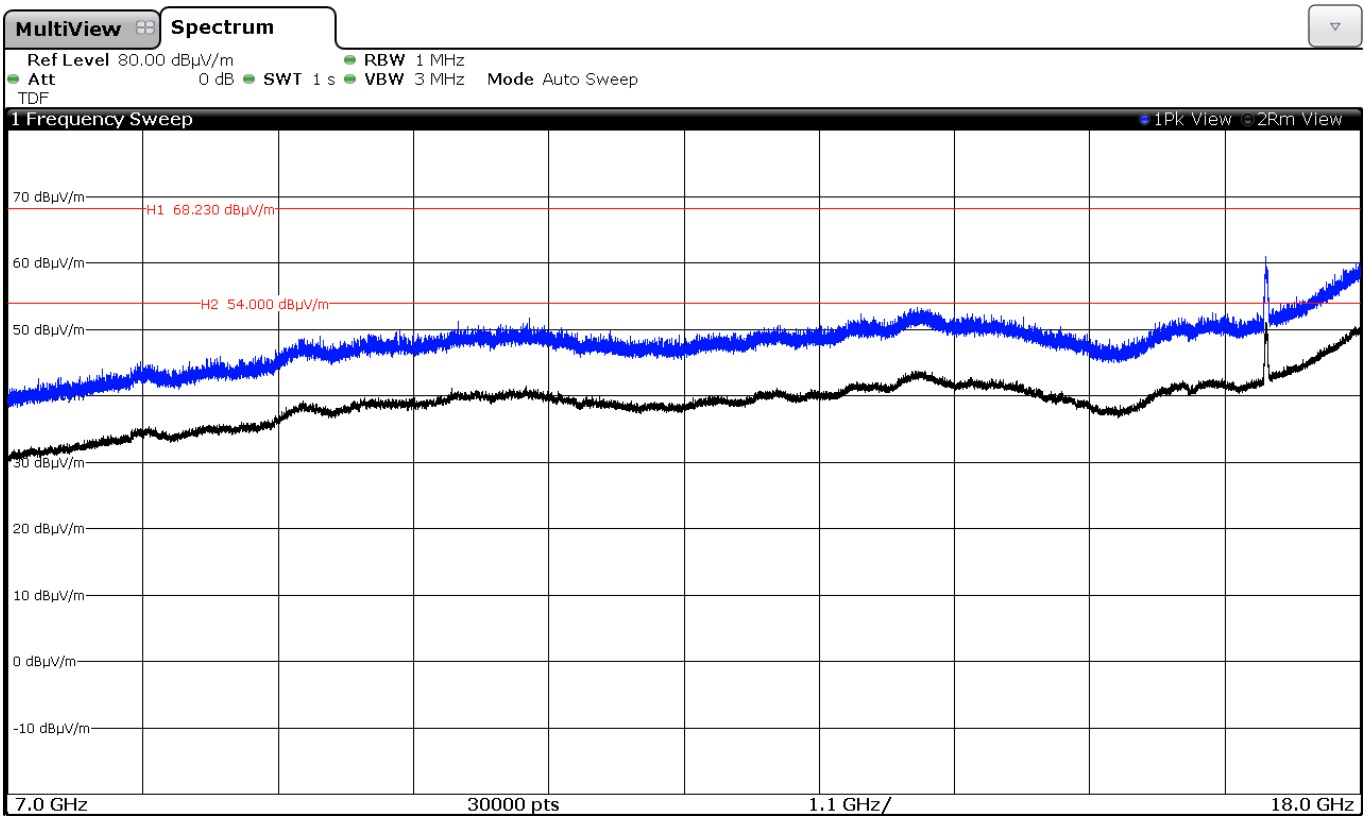
Lowest frequency 5745 MHz.
Chain A



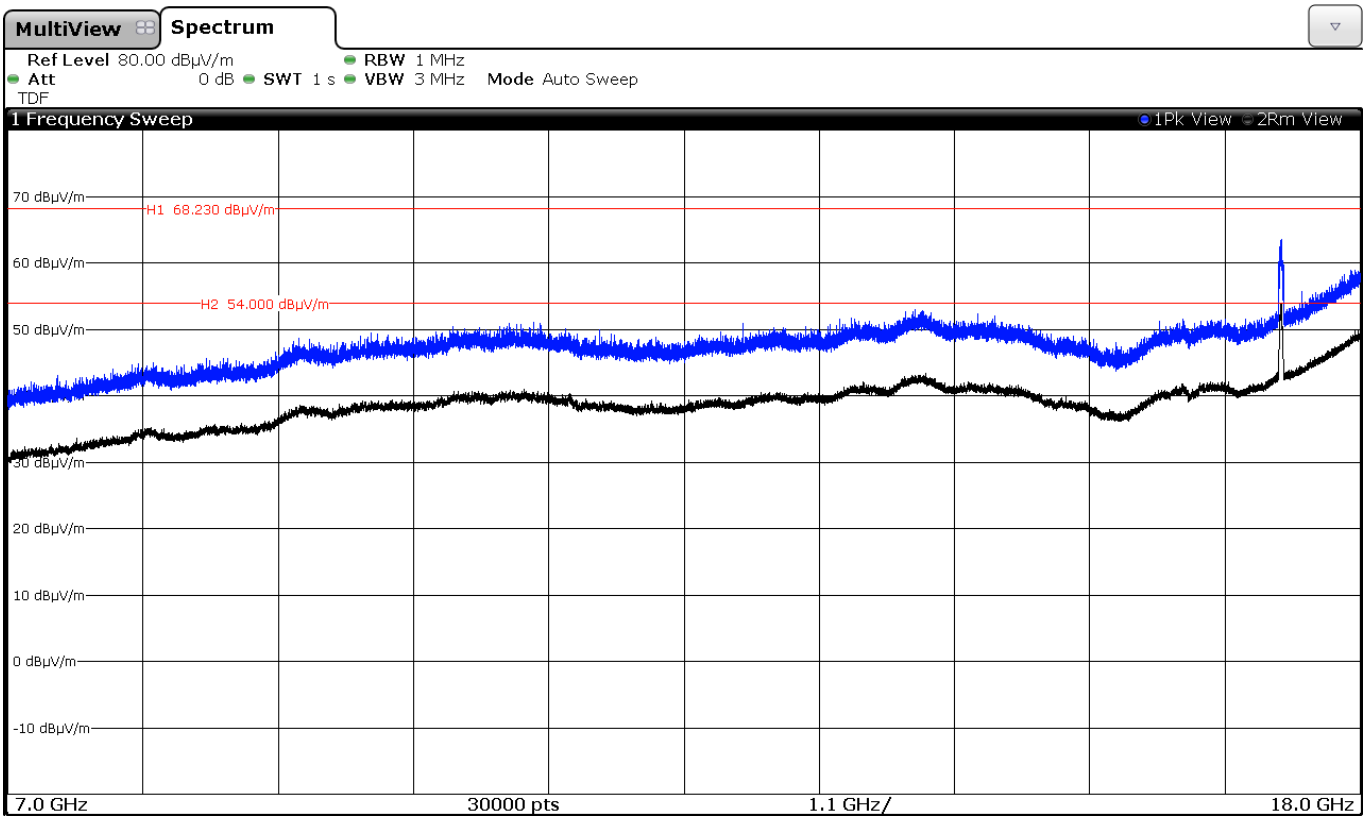
Chain B



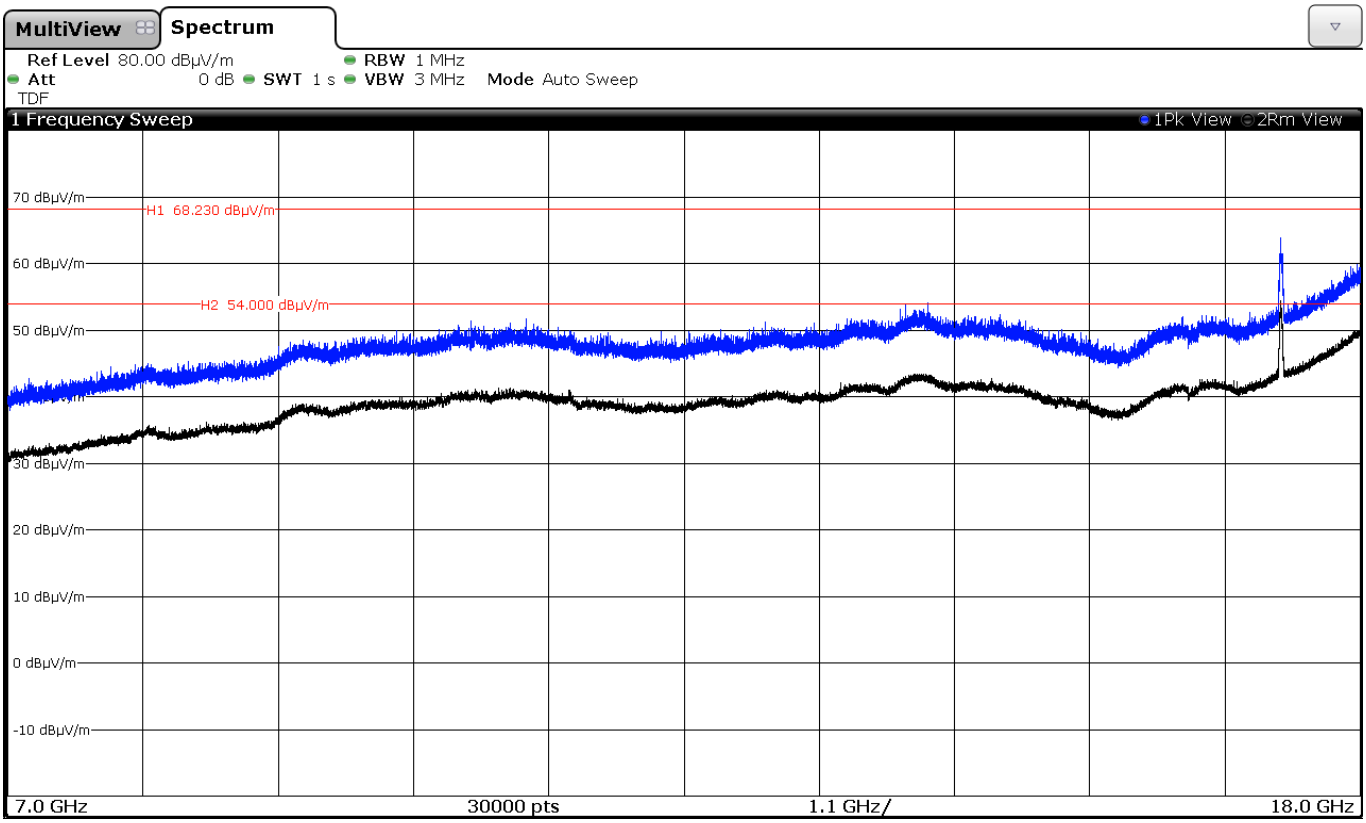
Chain A+B



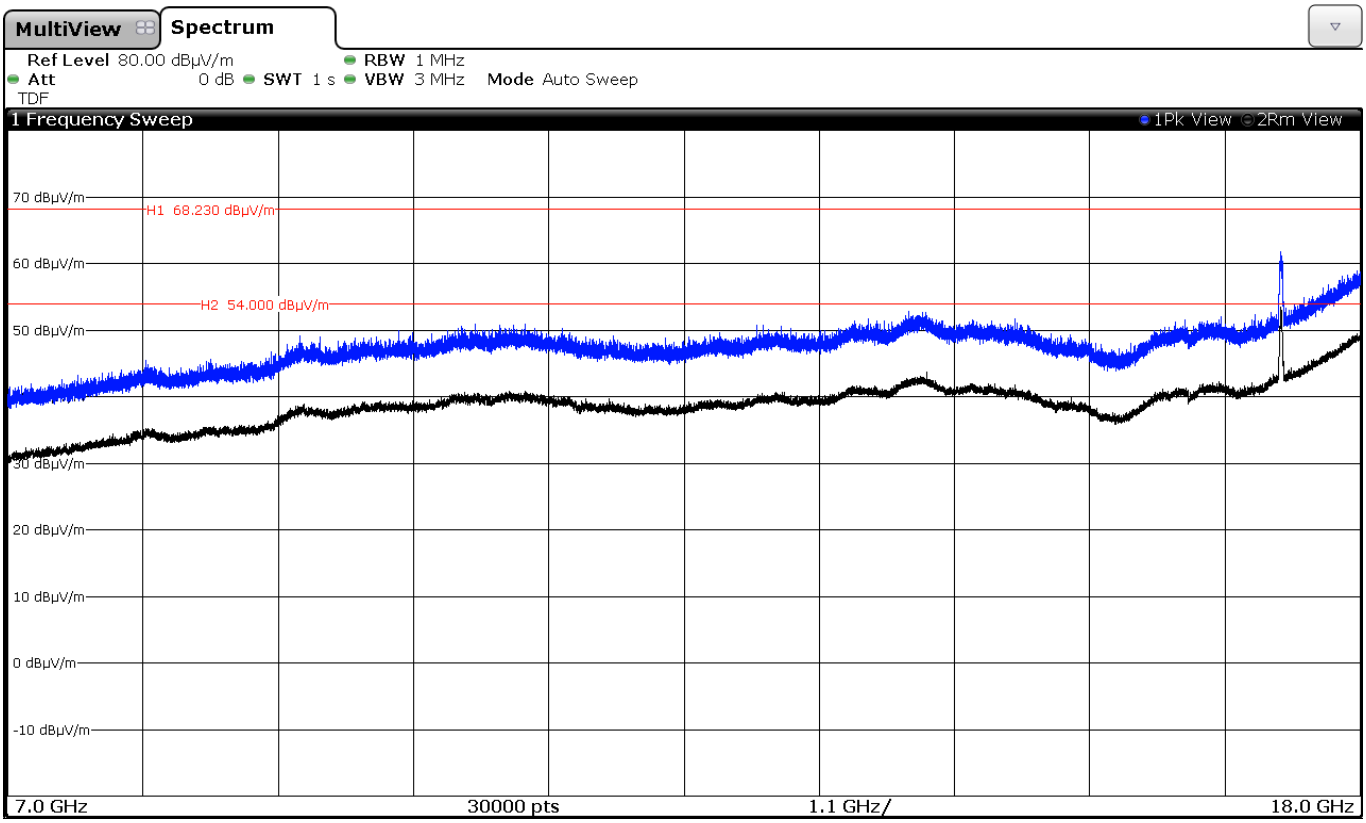
Middle frequency 5785 MHz.
Chain A



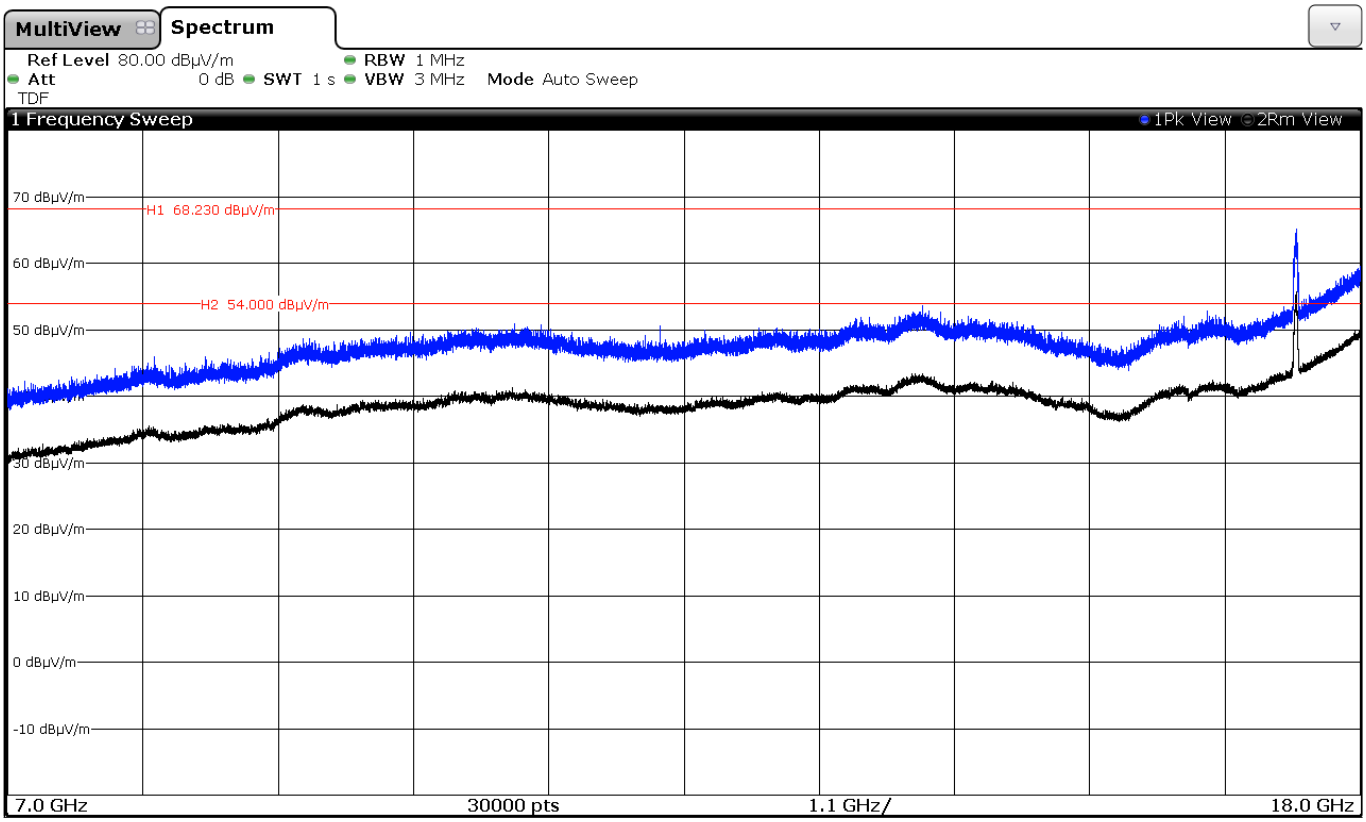
Chain B



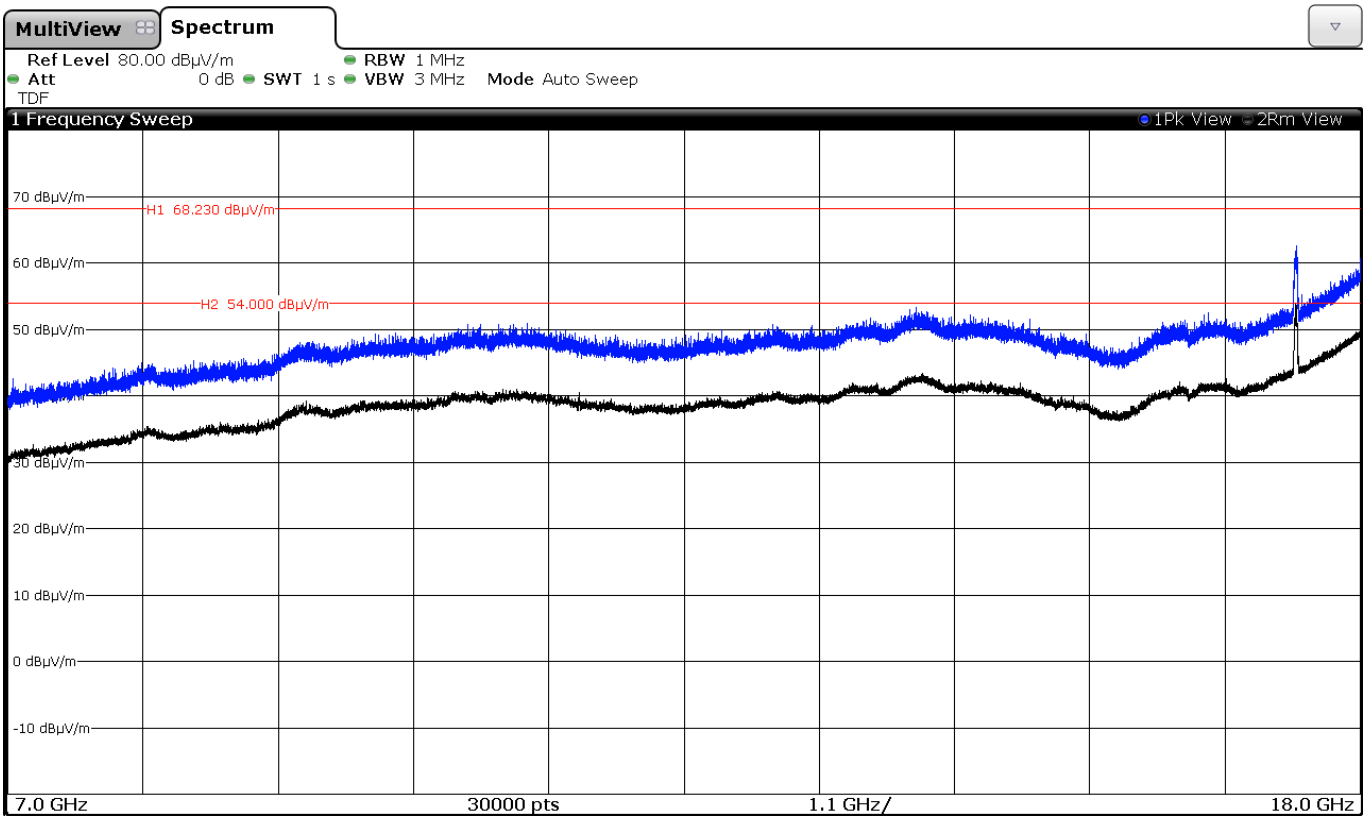
Chain A+B



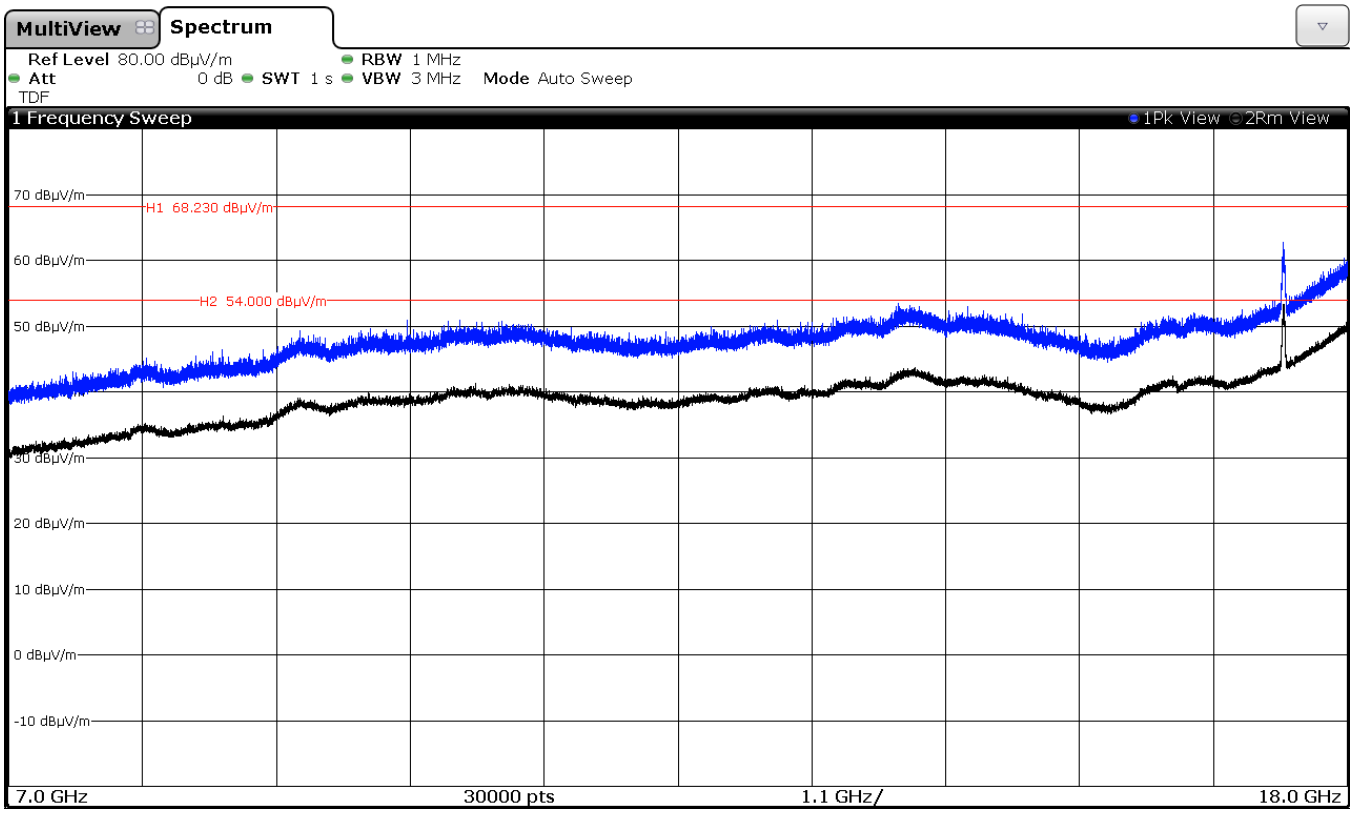
Highest frequency 5825 MHz.
Chain A



Chain B

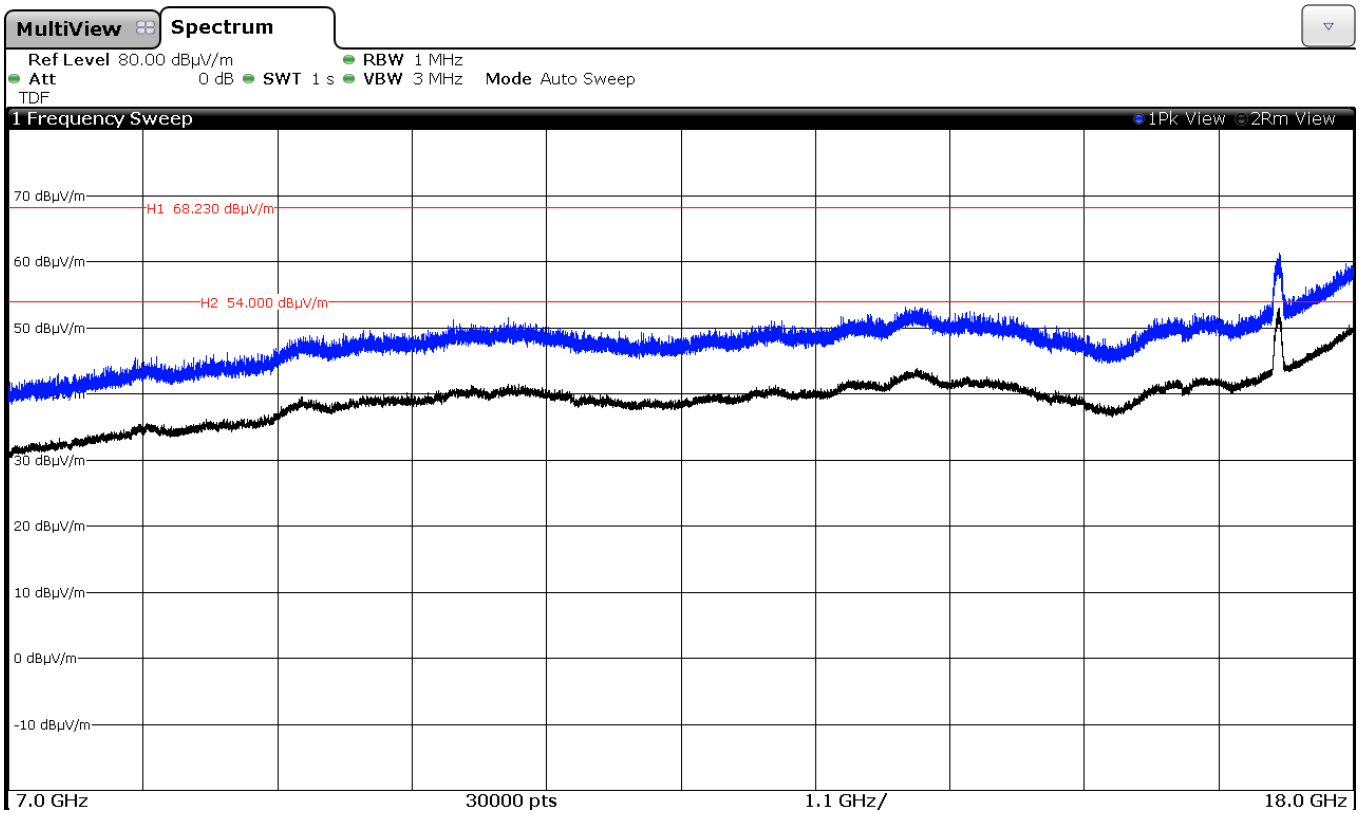


Chain A+B

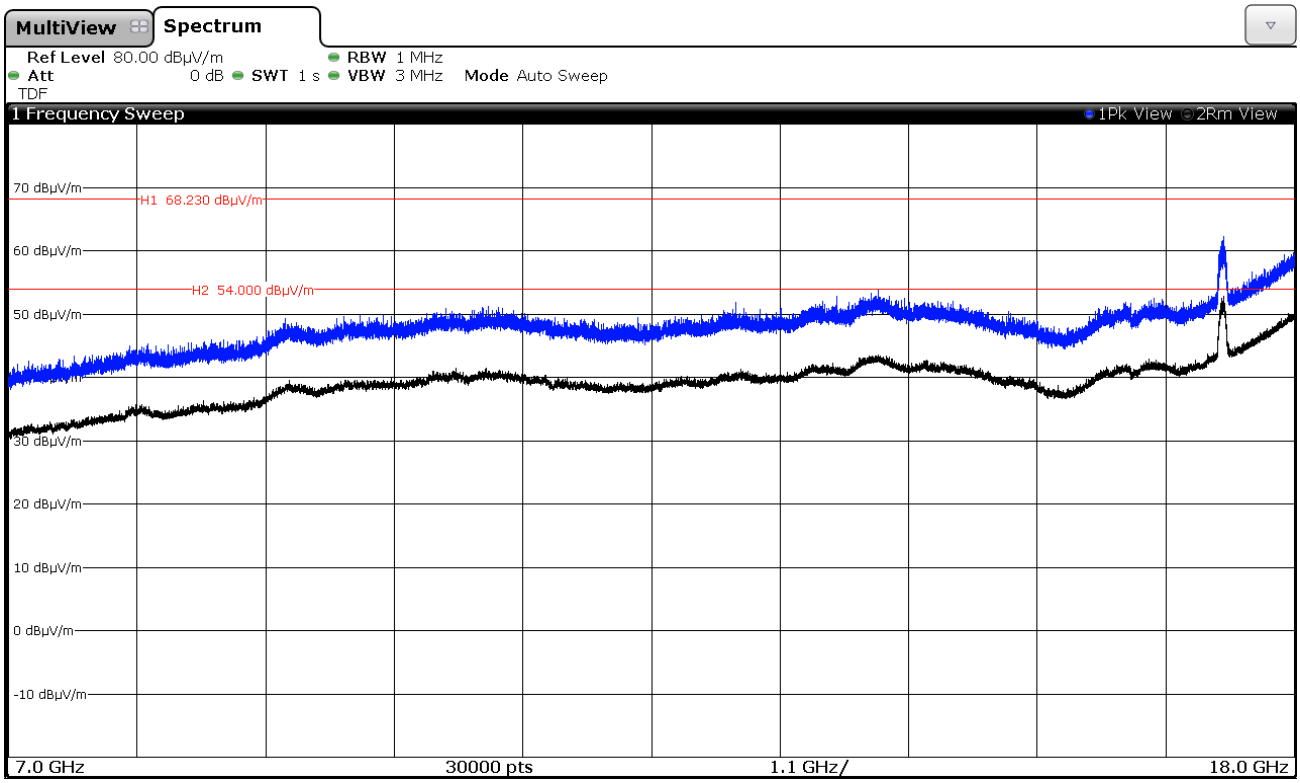


3. WiFi 5GHz 802.11 n40 mode

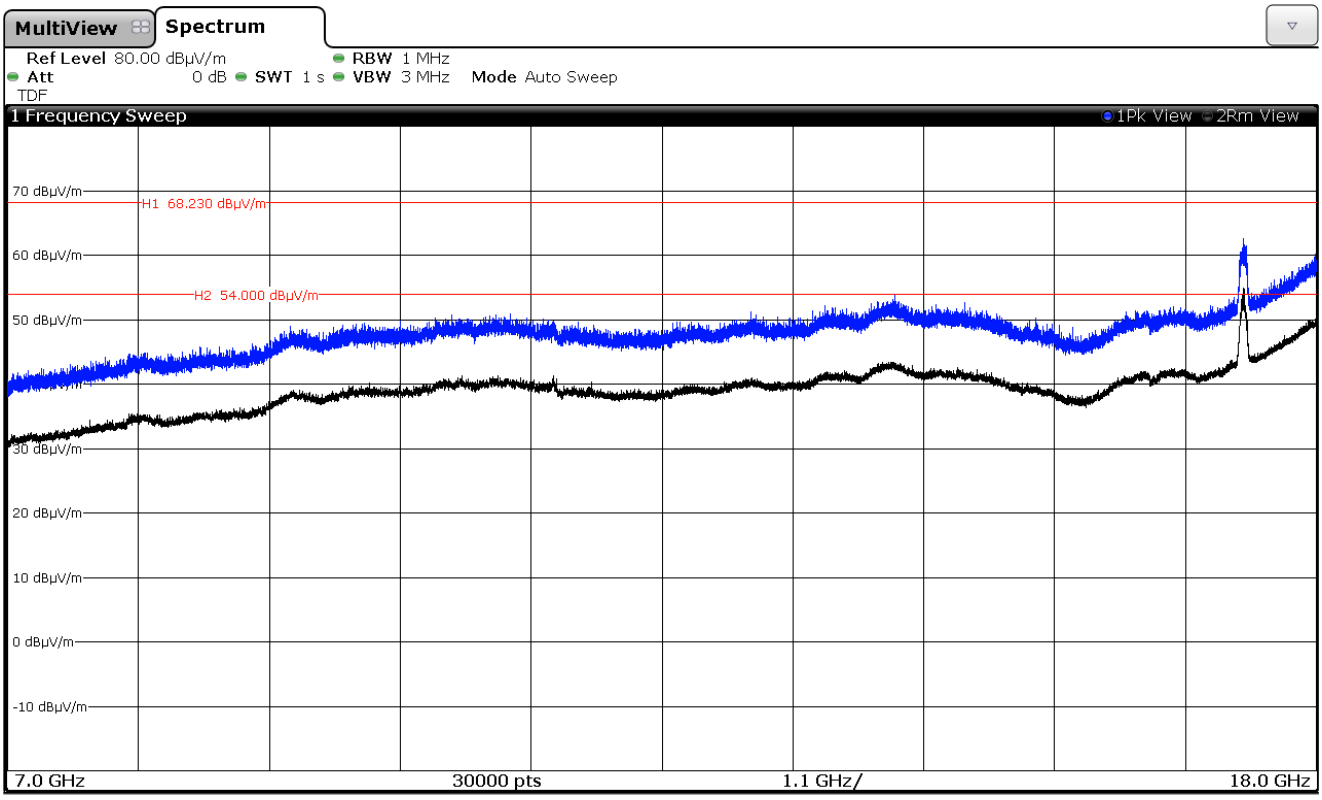
Highest frequency 5795 MHz.
Chain A



Chain B



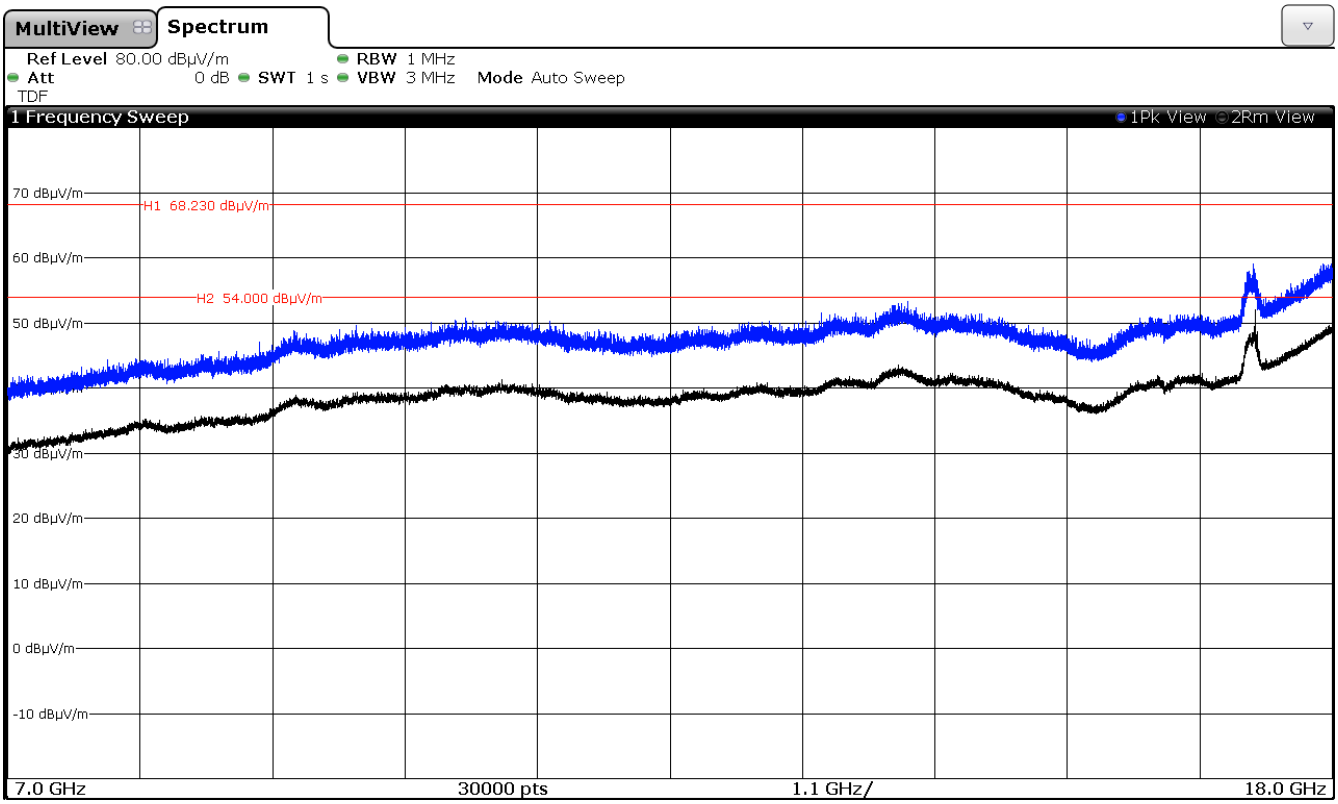
Chain A+B



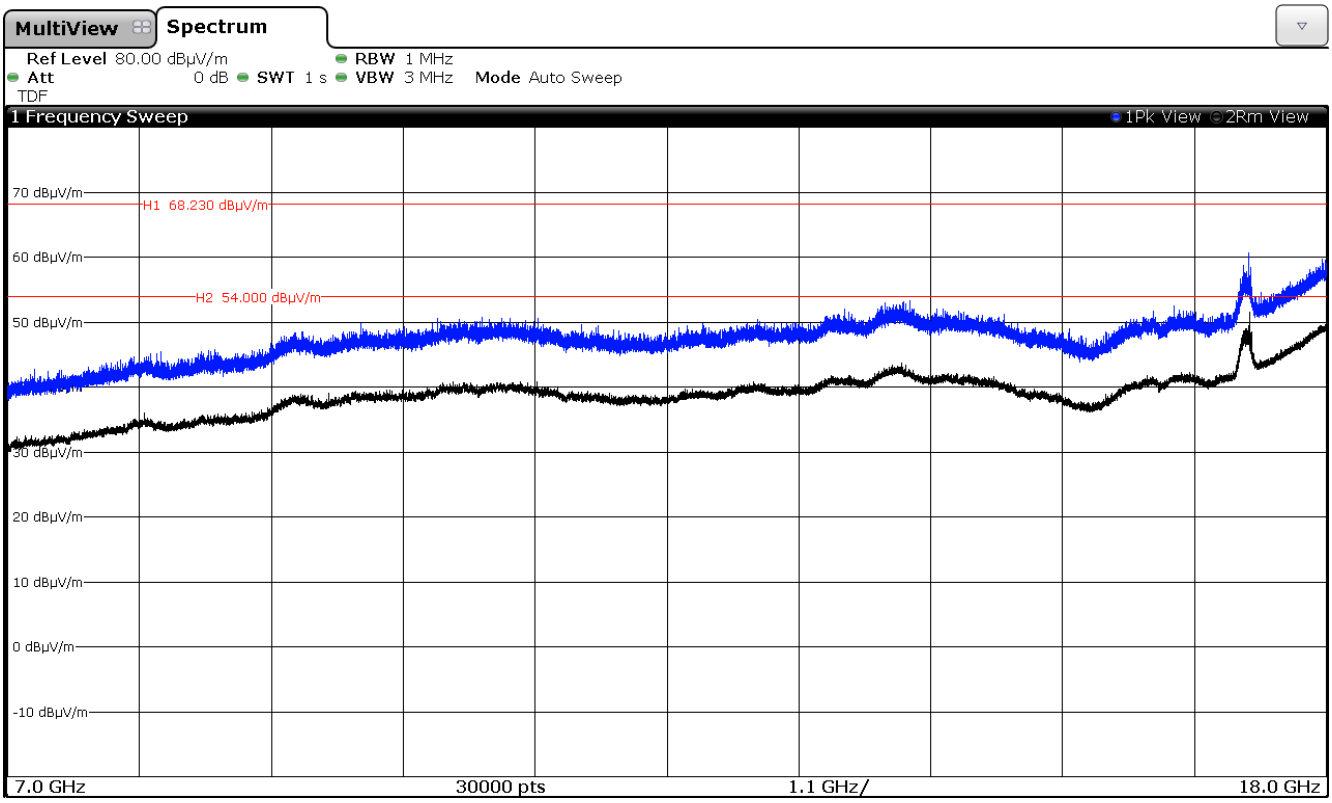
4. WiFi 5GHz 802.11 ac80 mode

Middle frequency 5775 MHz

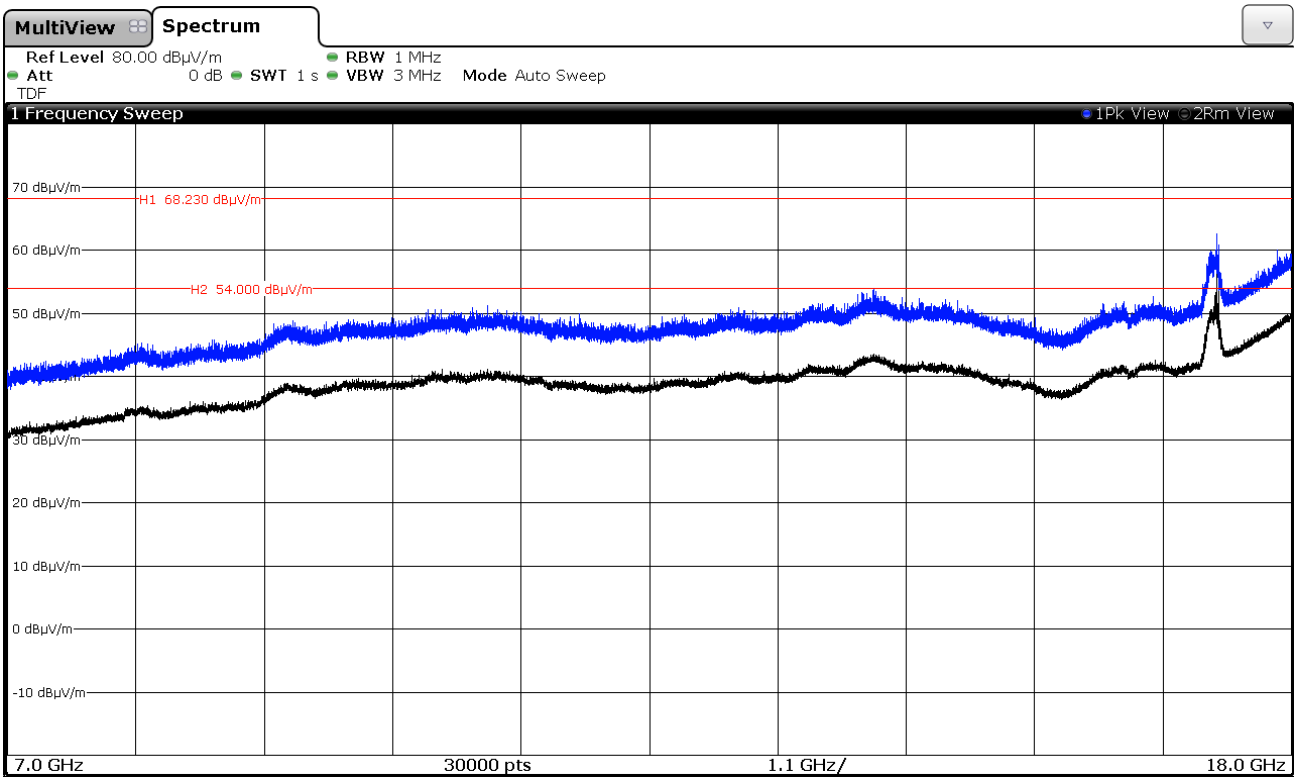
Chain A



Chain B



Chain A+B

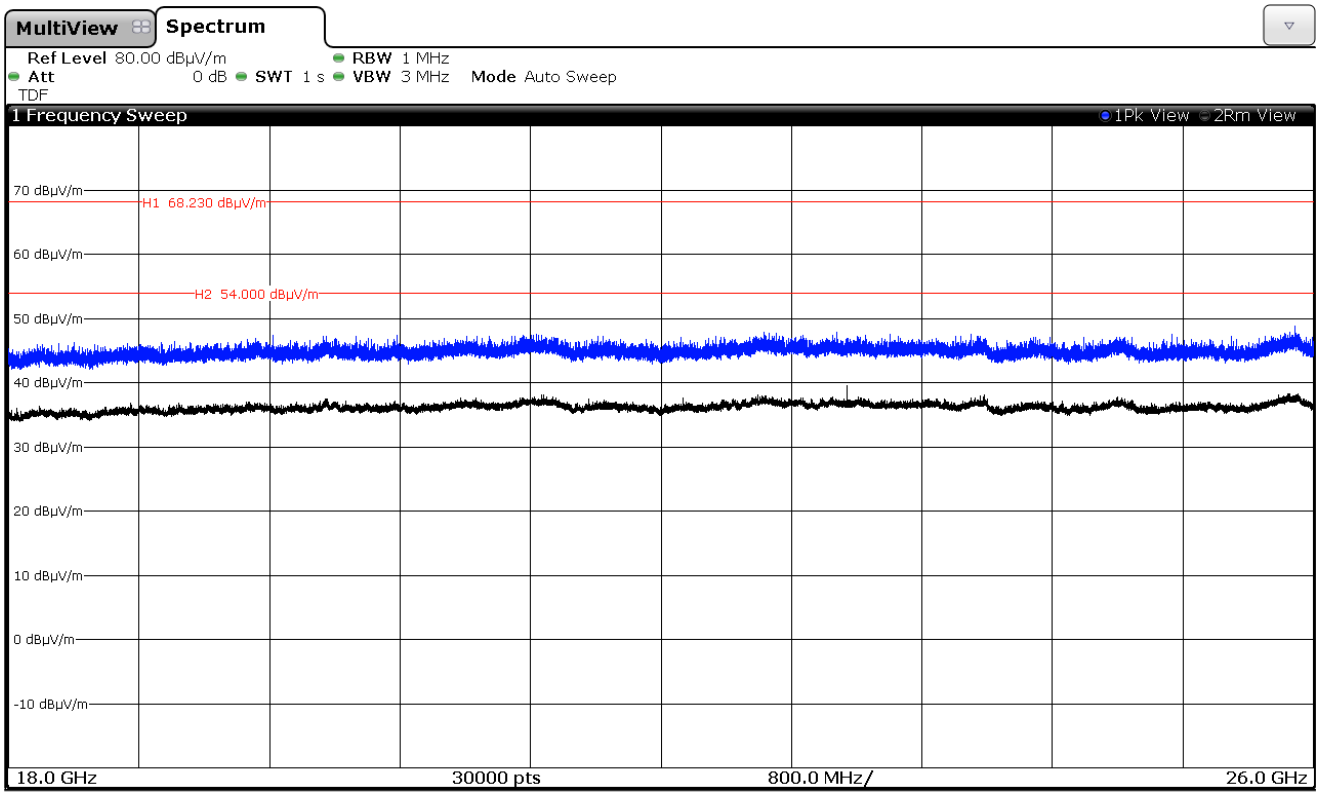


FREQUENCY RANGE 18 GHz to 26GHz.

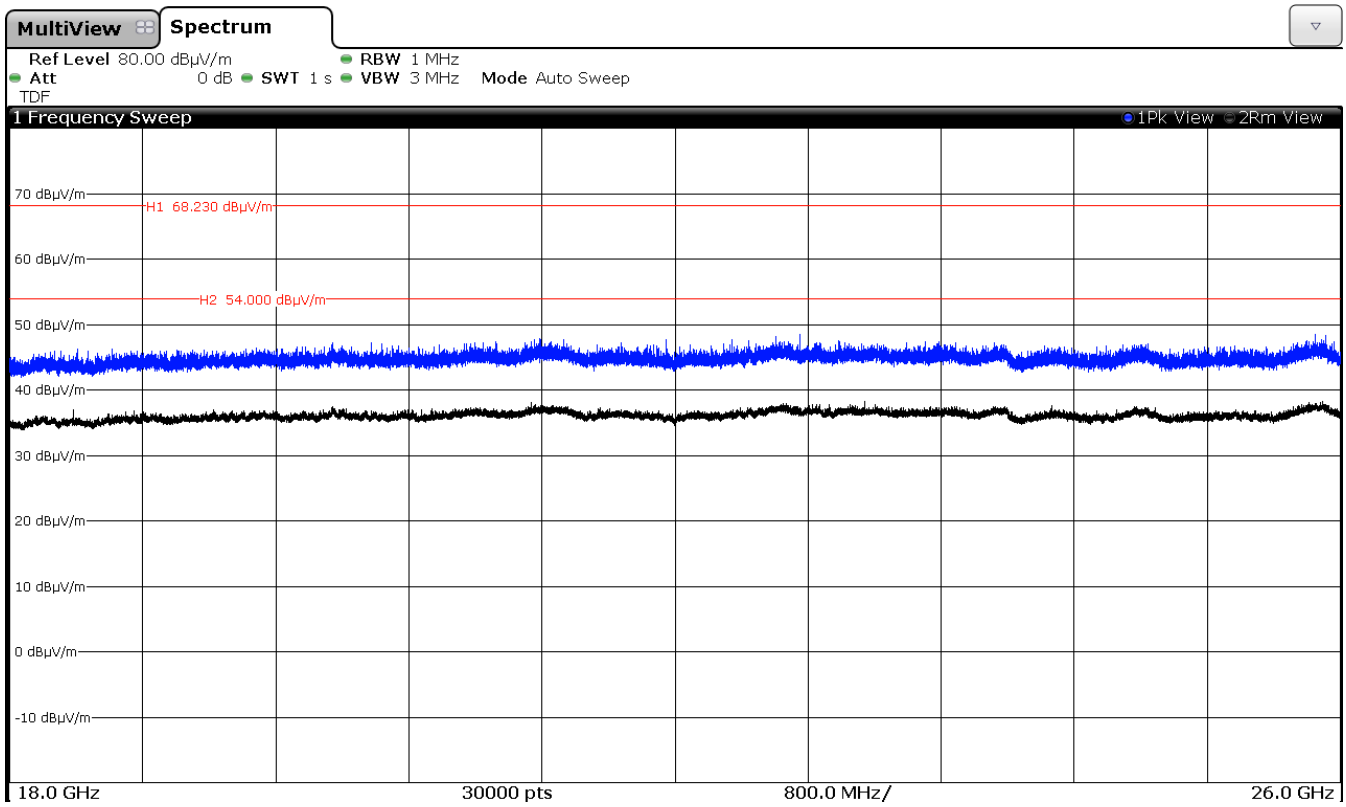
1. WiFi 5GHz 802.11 a mode

Middle frequency 5785 MHz.

Chain A

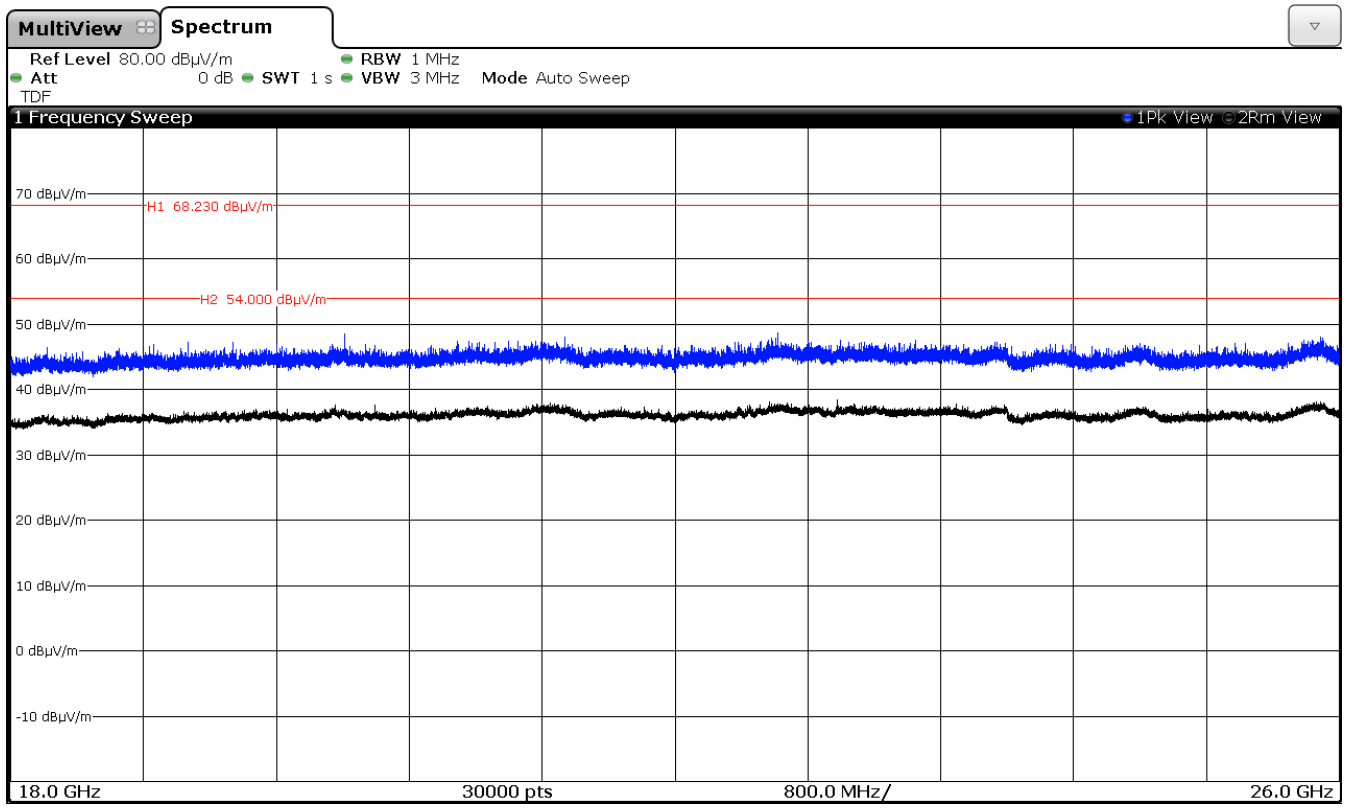


Chain B

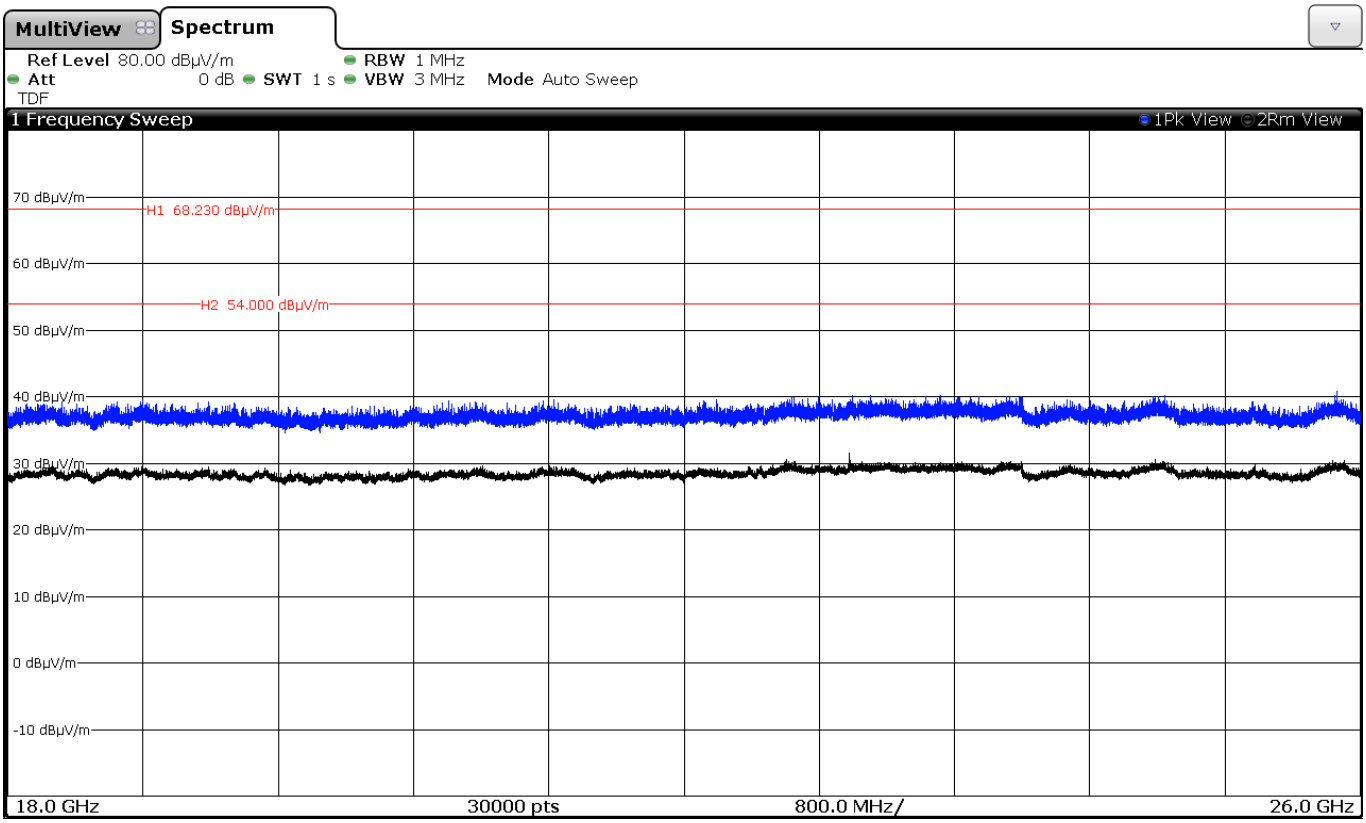


2. WiFi 5GHz 802.11 n20 mode

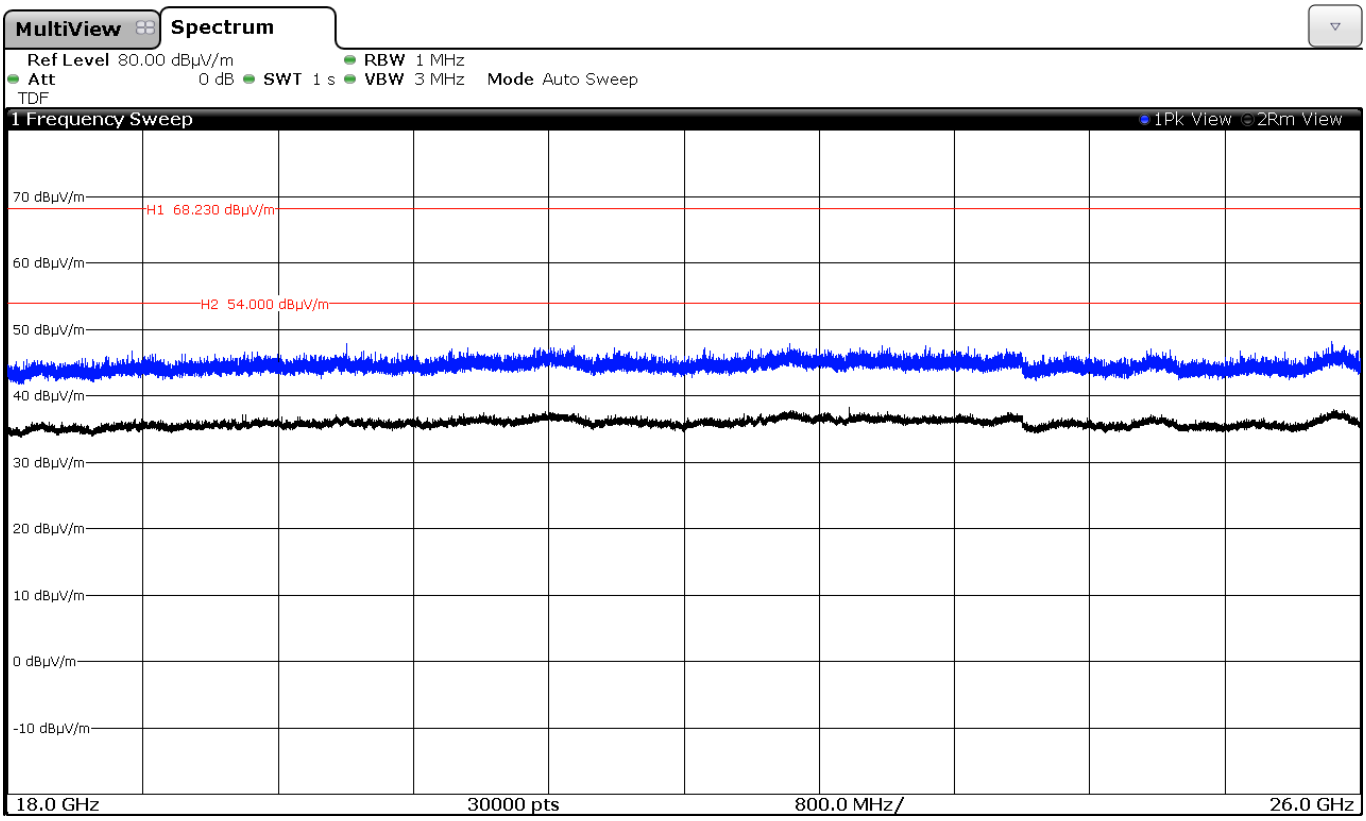
Lowest frequency 5745 MHz.
Chain A



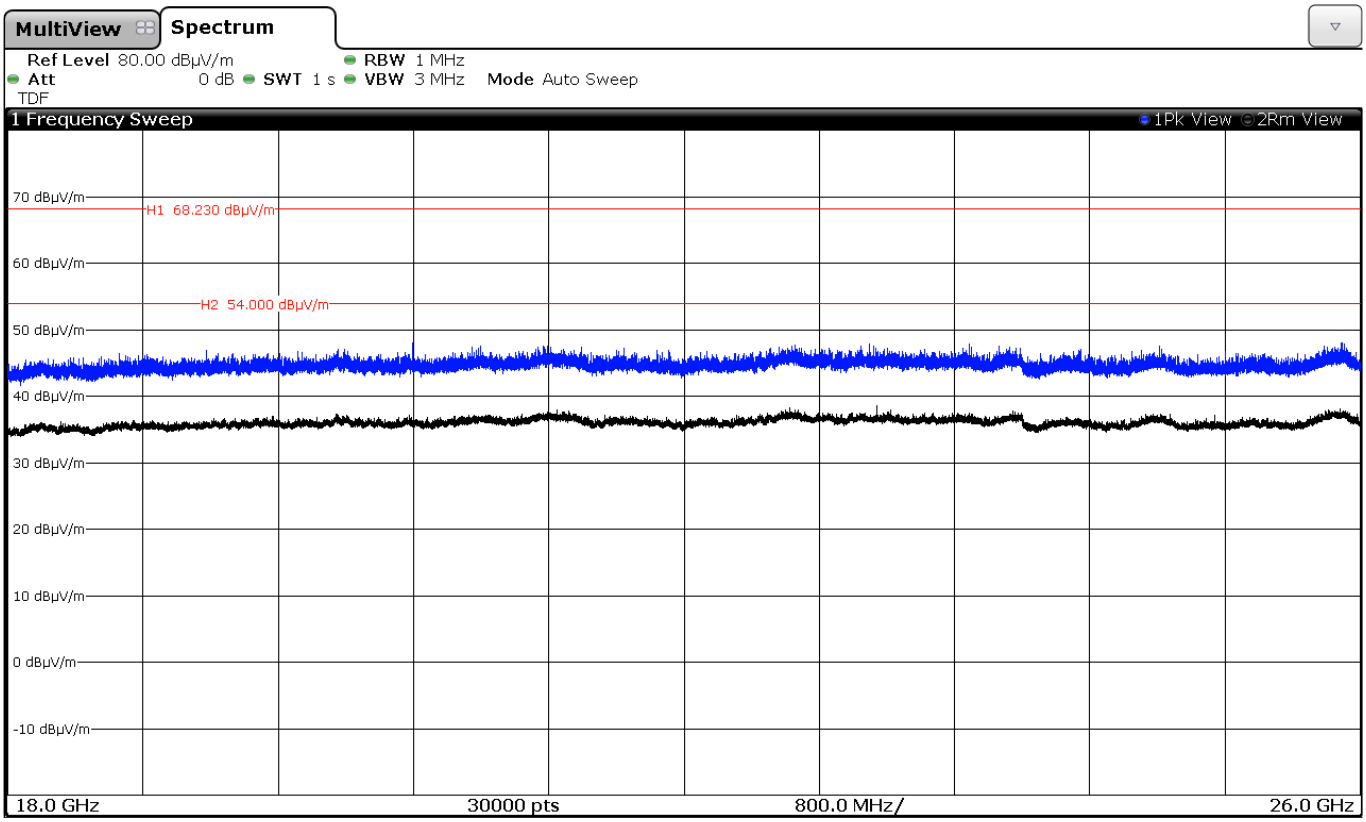
Chain B



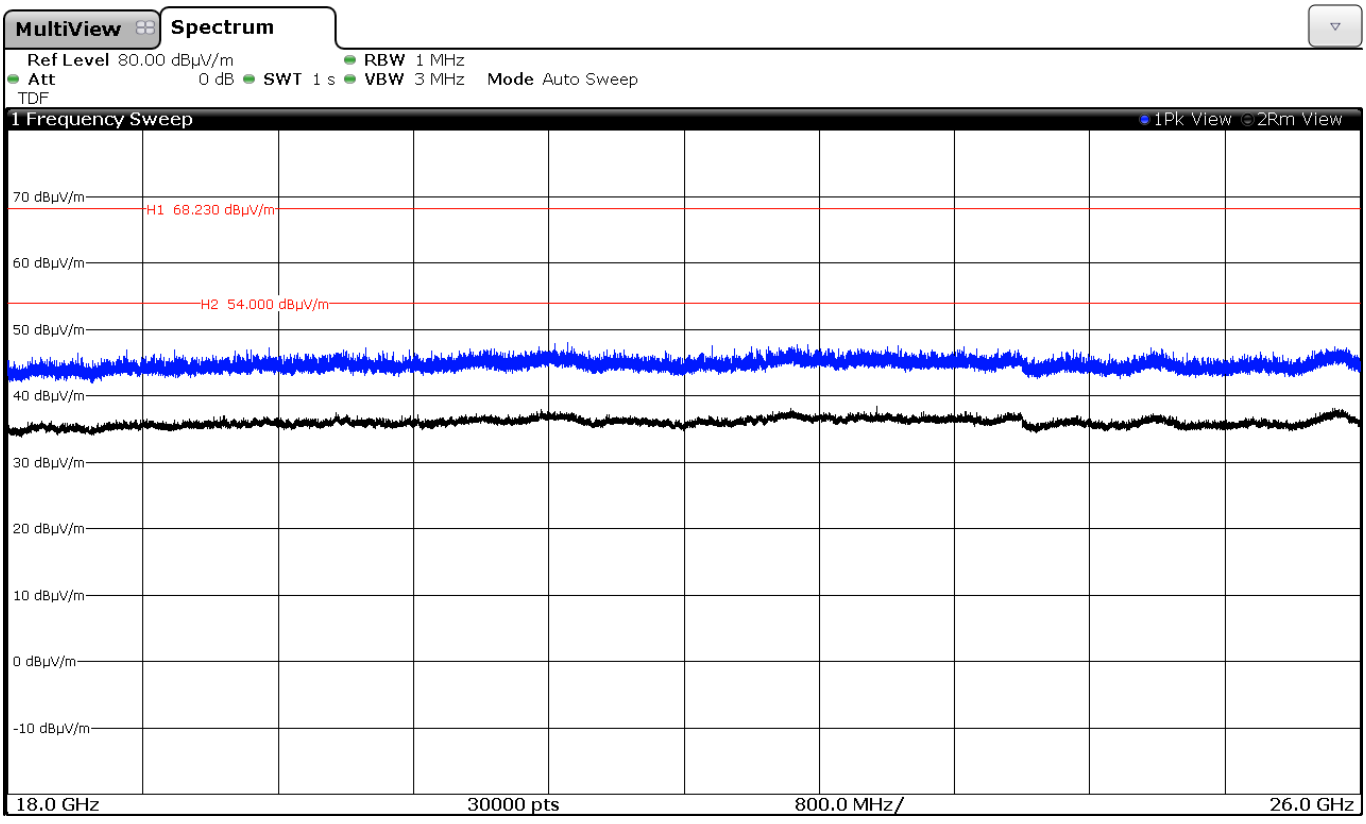
Chain A+B



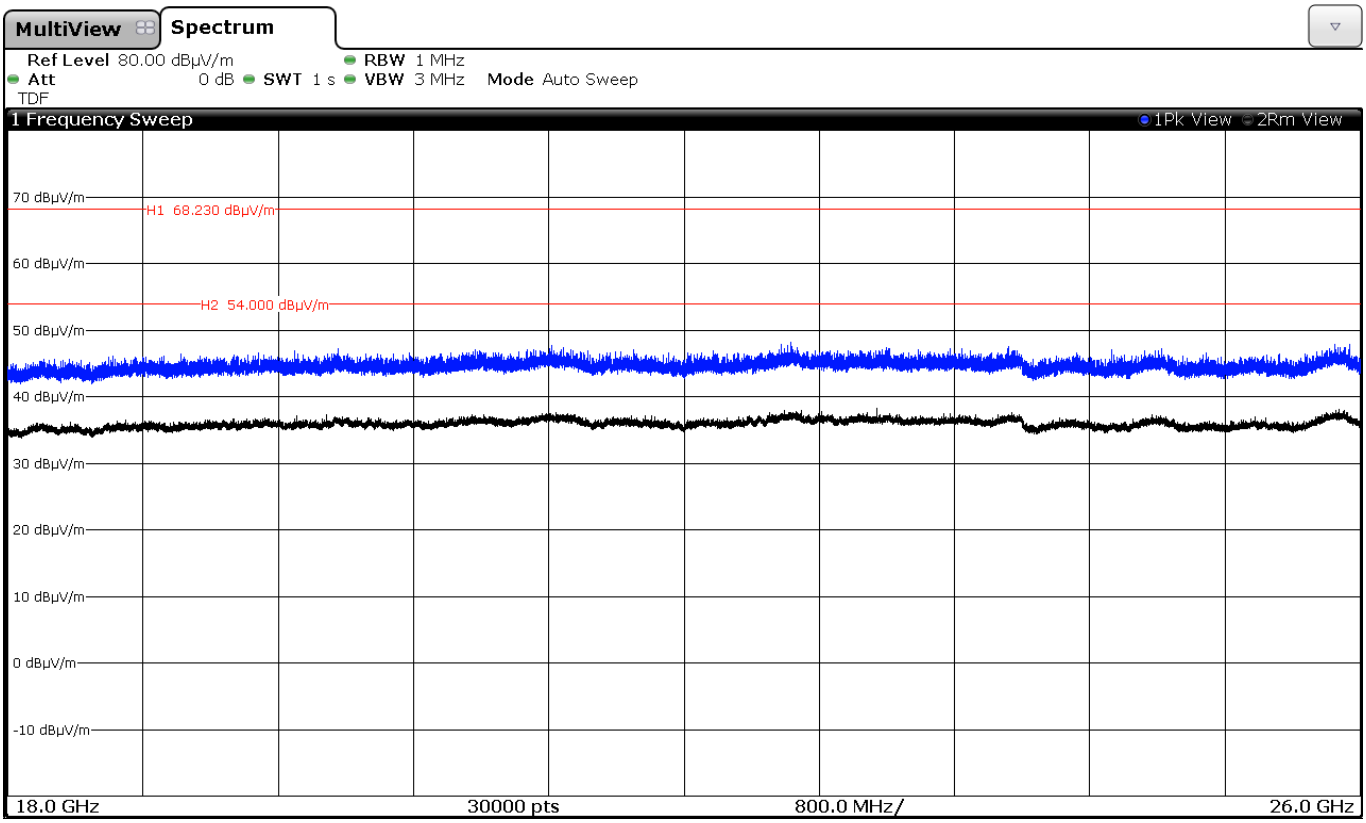
Middle frequency 5785 MHz.
Chain A



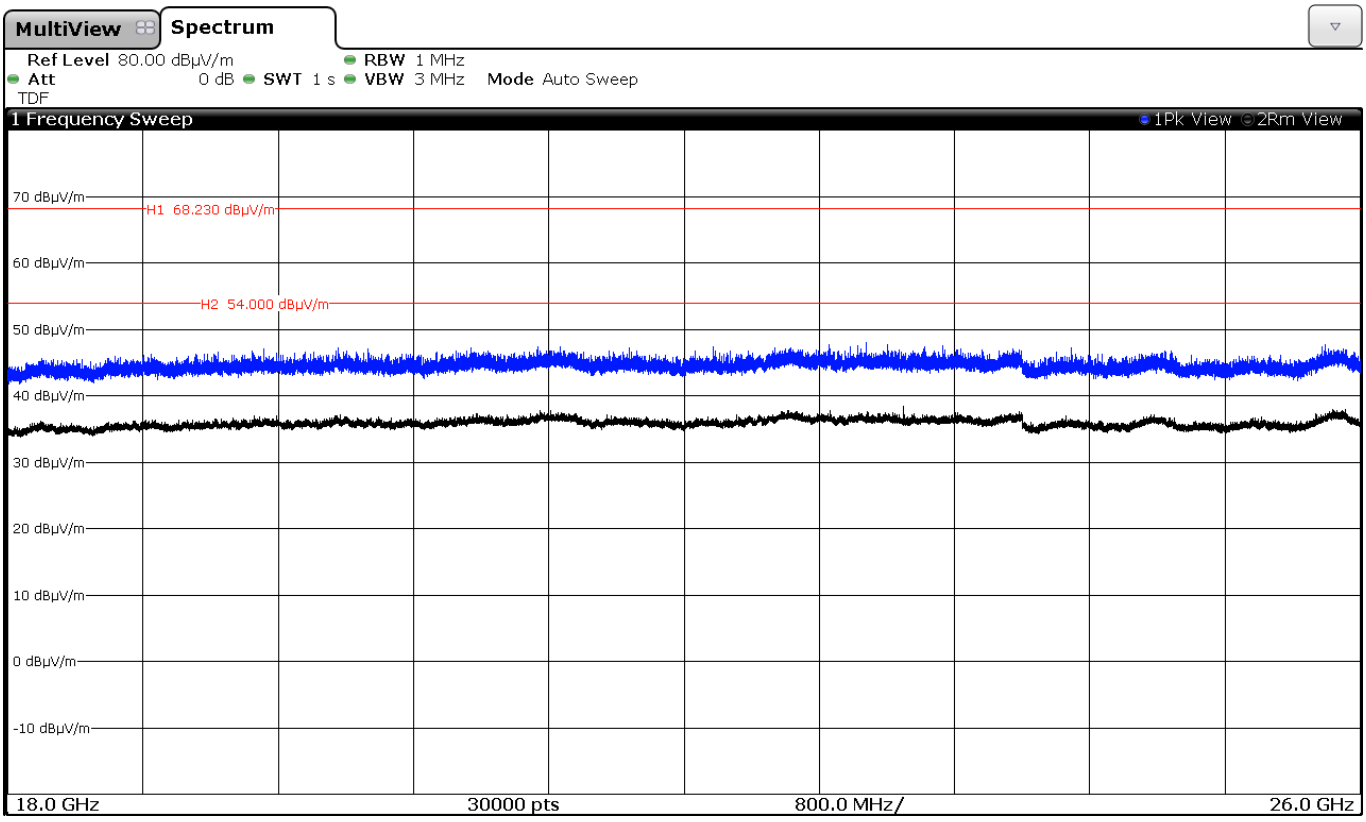
Chain B



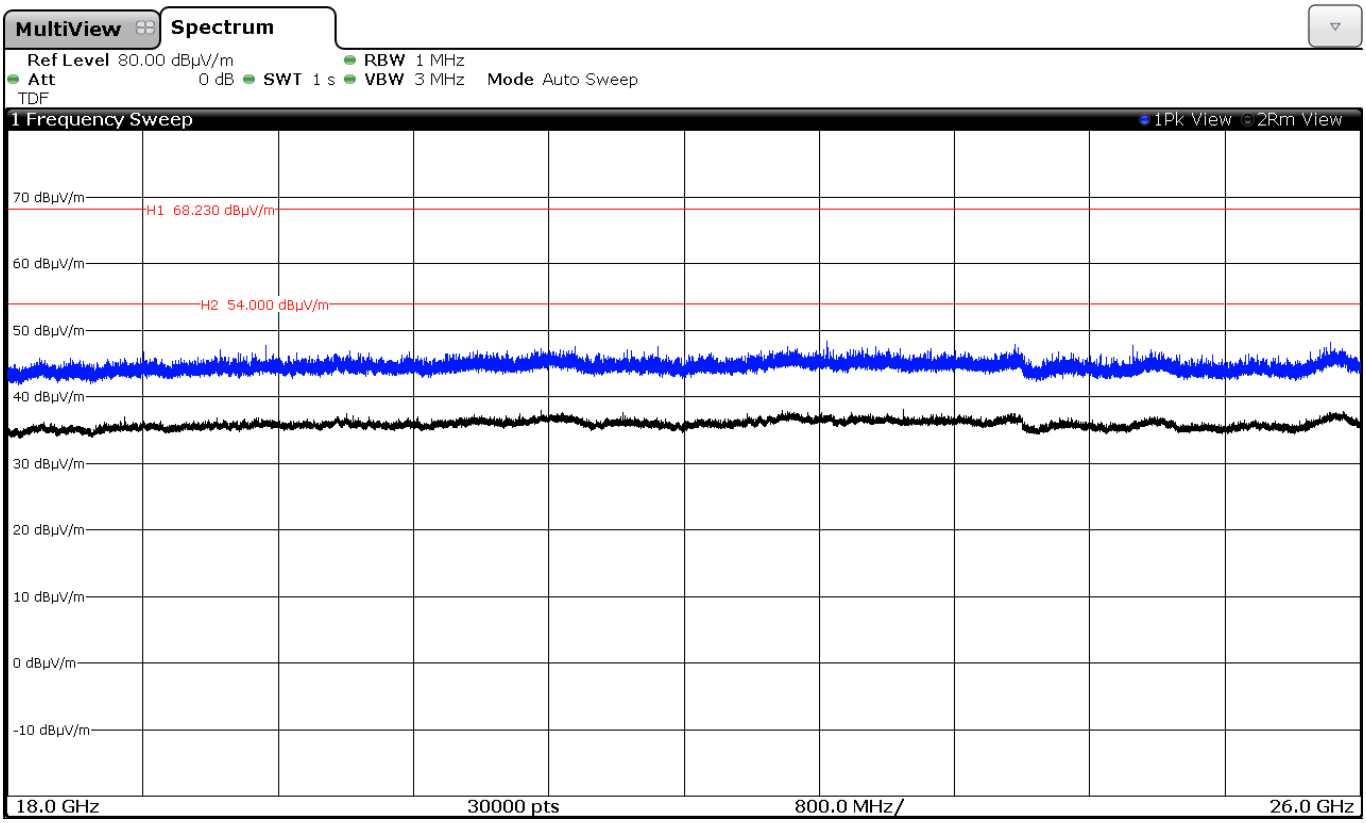
Chain A+B



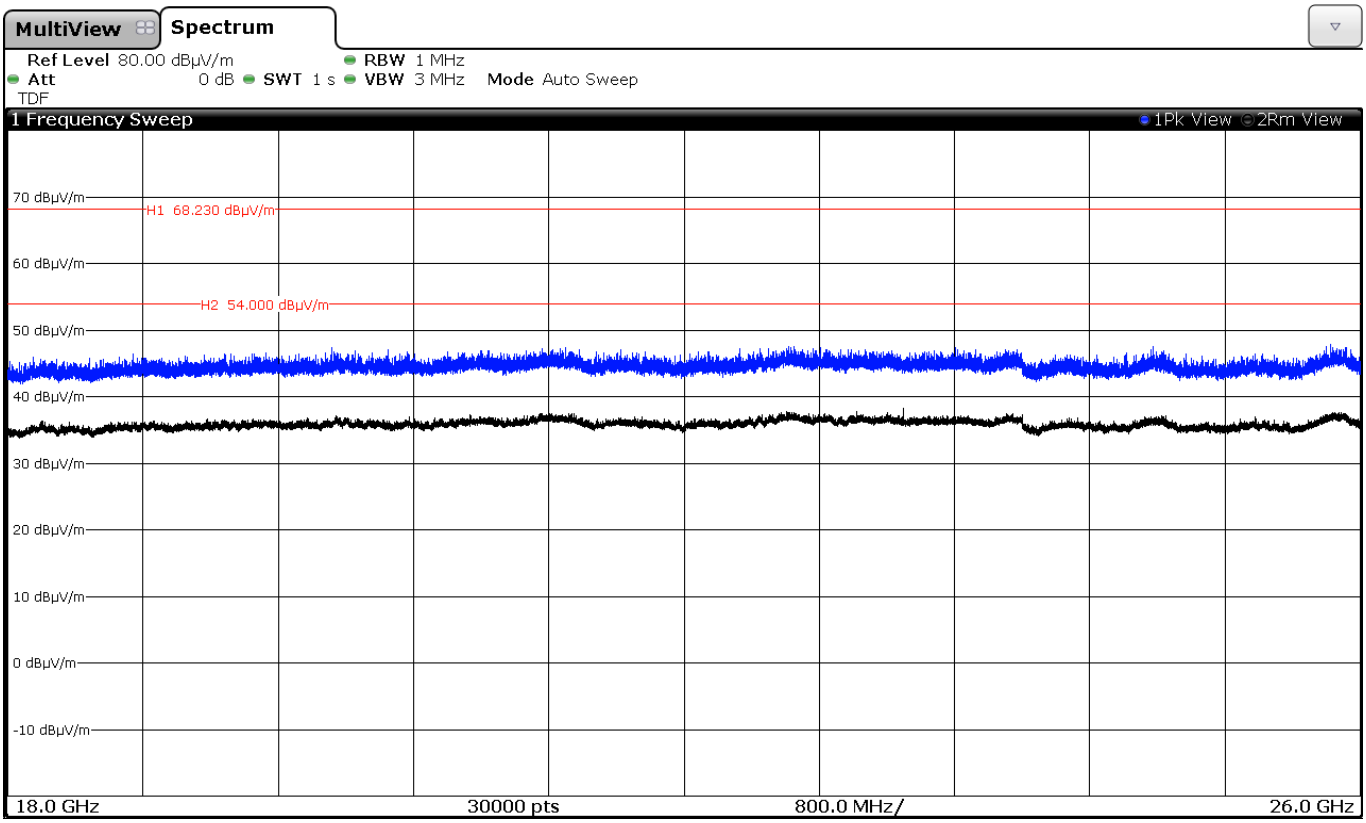
Highest frequency 5825 MHz.
Chain A



Chain B

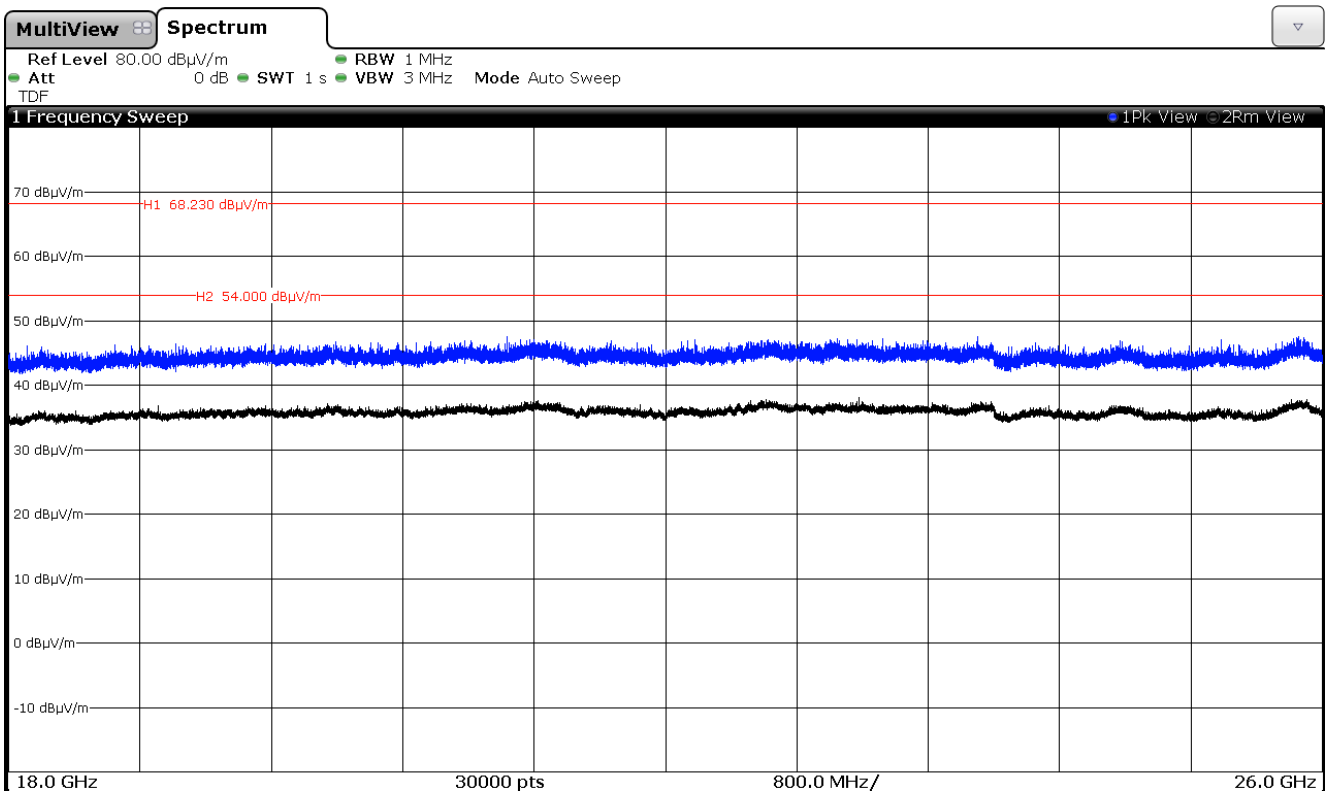


Chain A+B

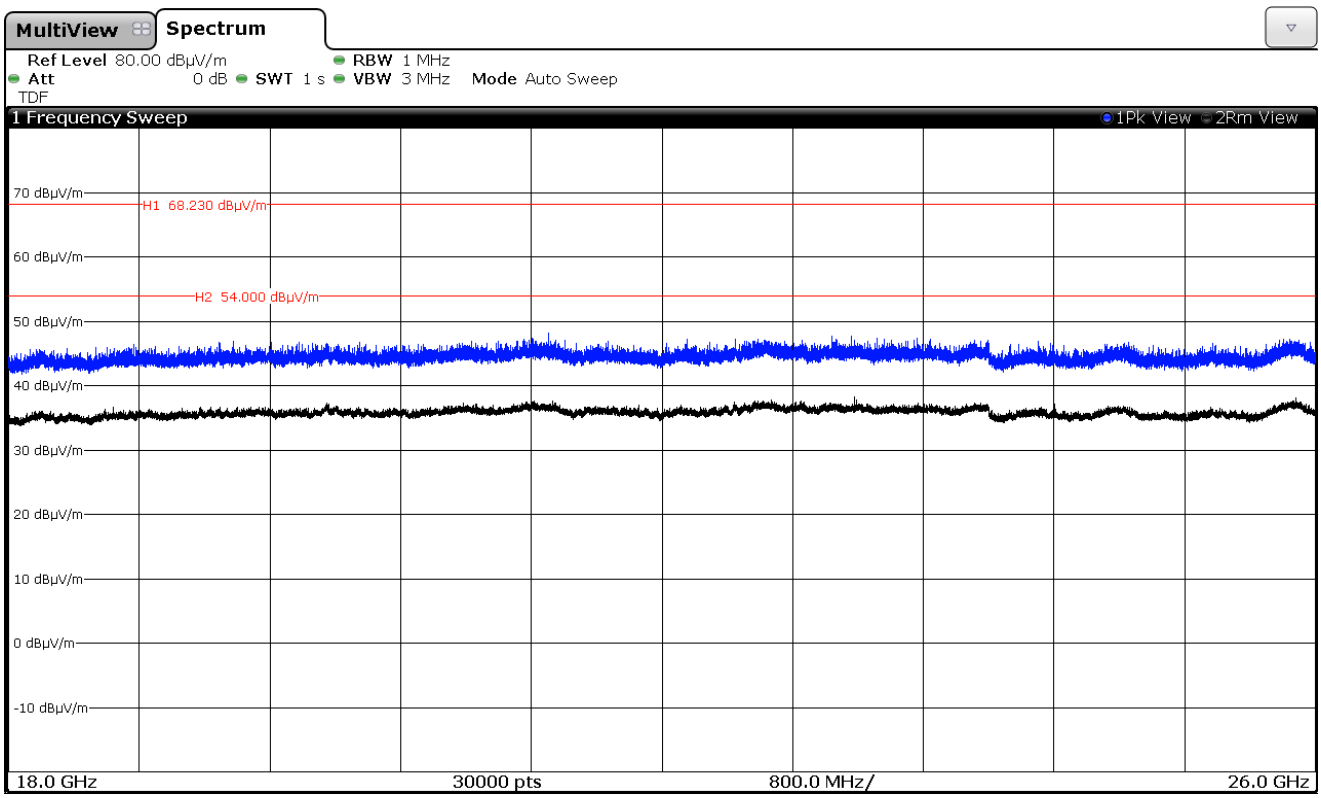


3. WiFi 5GHz 802.11 n40 mode

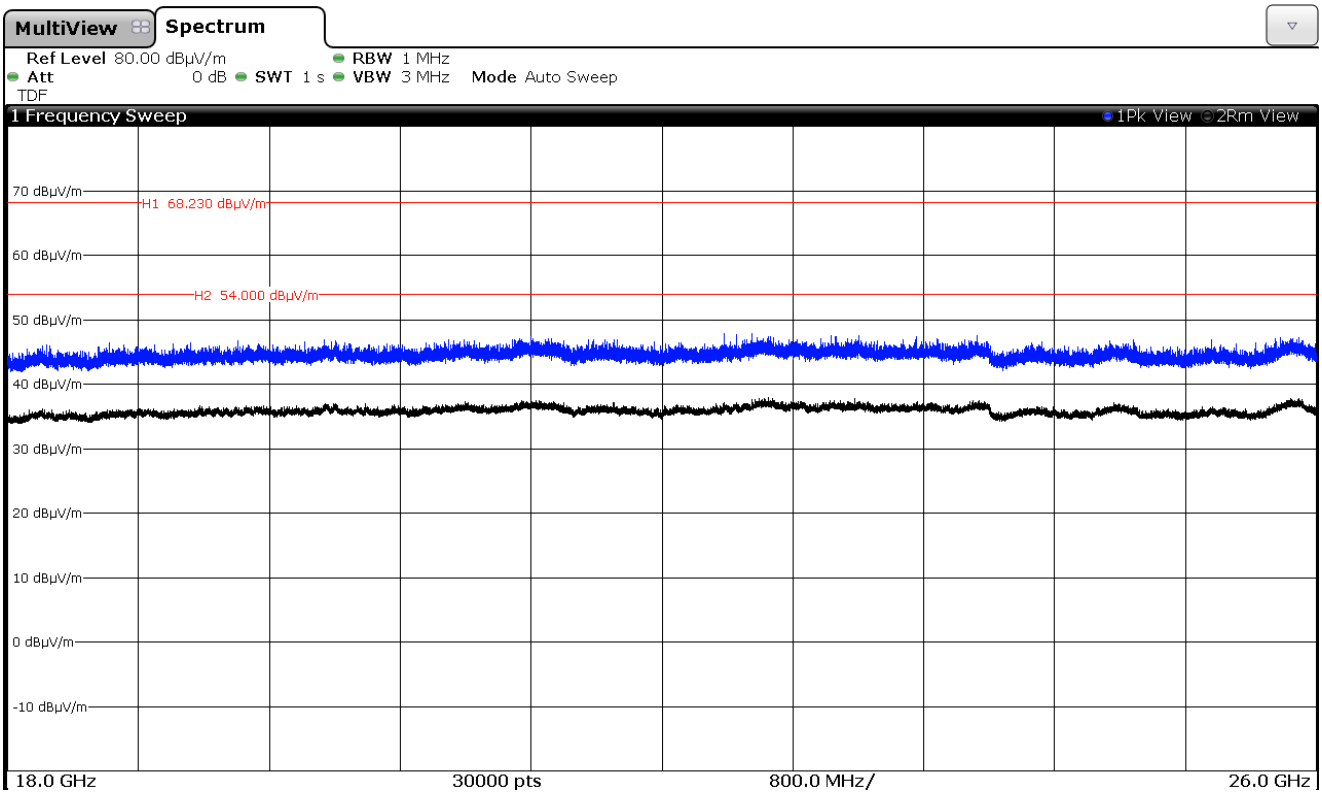
Highest frequency 5795 MHz.
Chain A



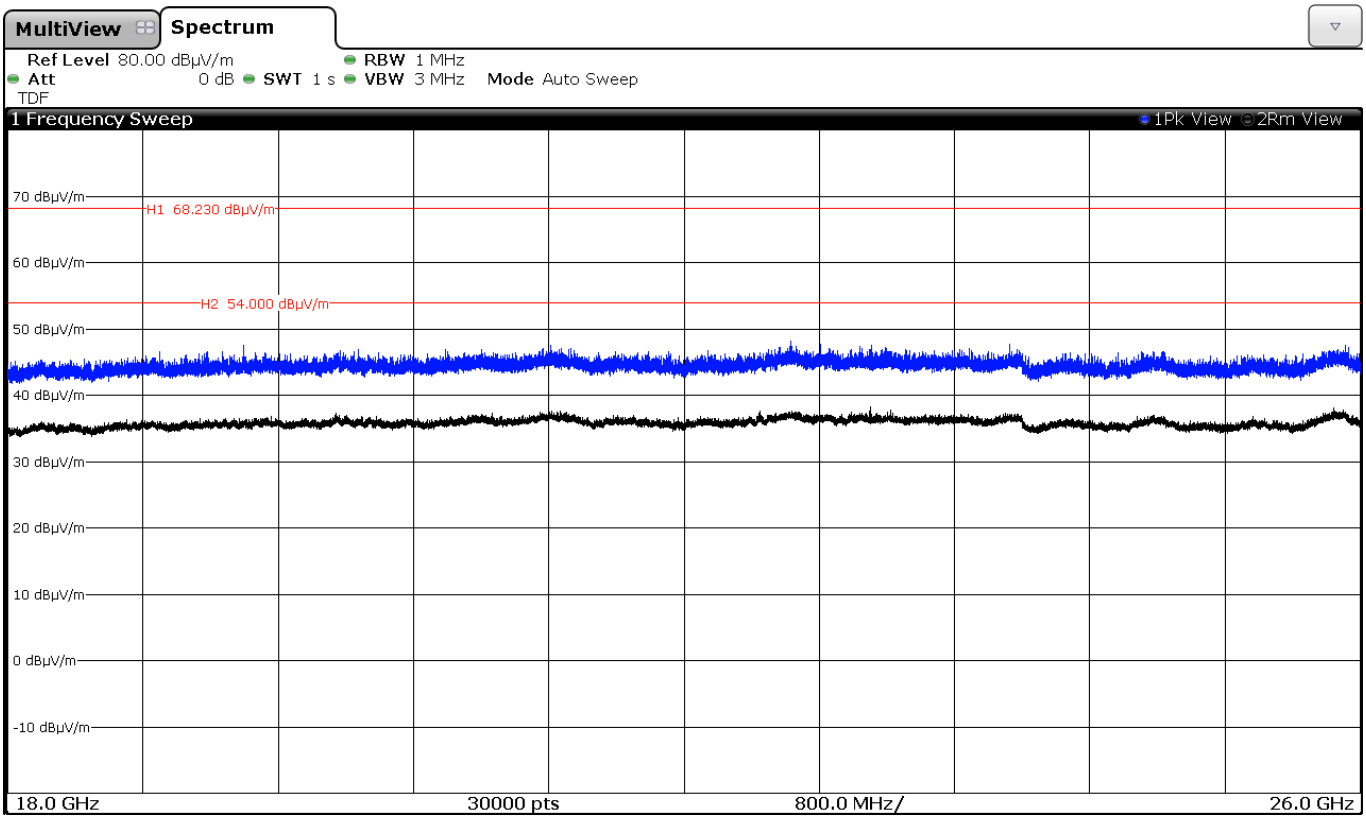
Chain B



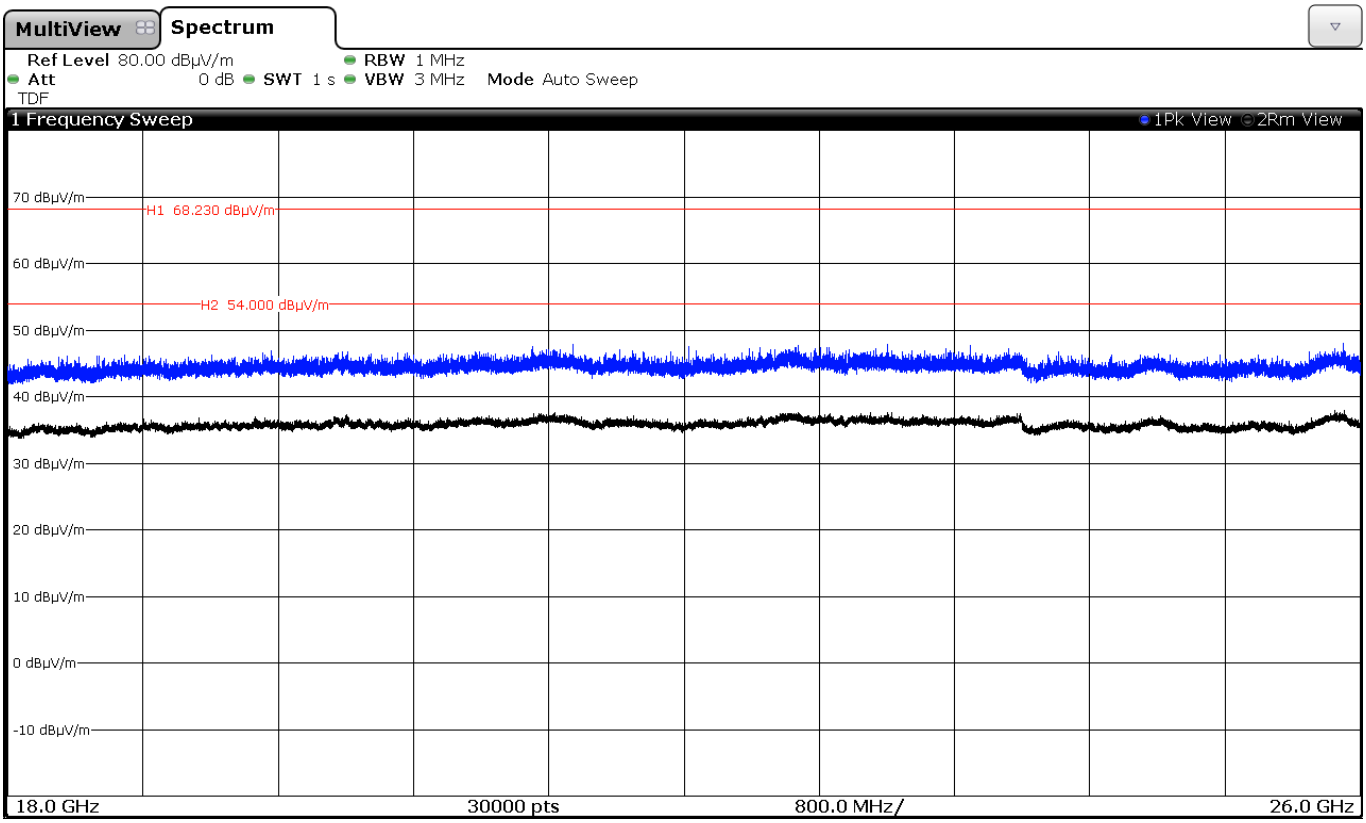
Chain A+B



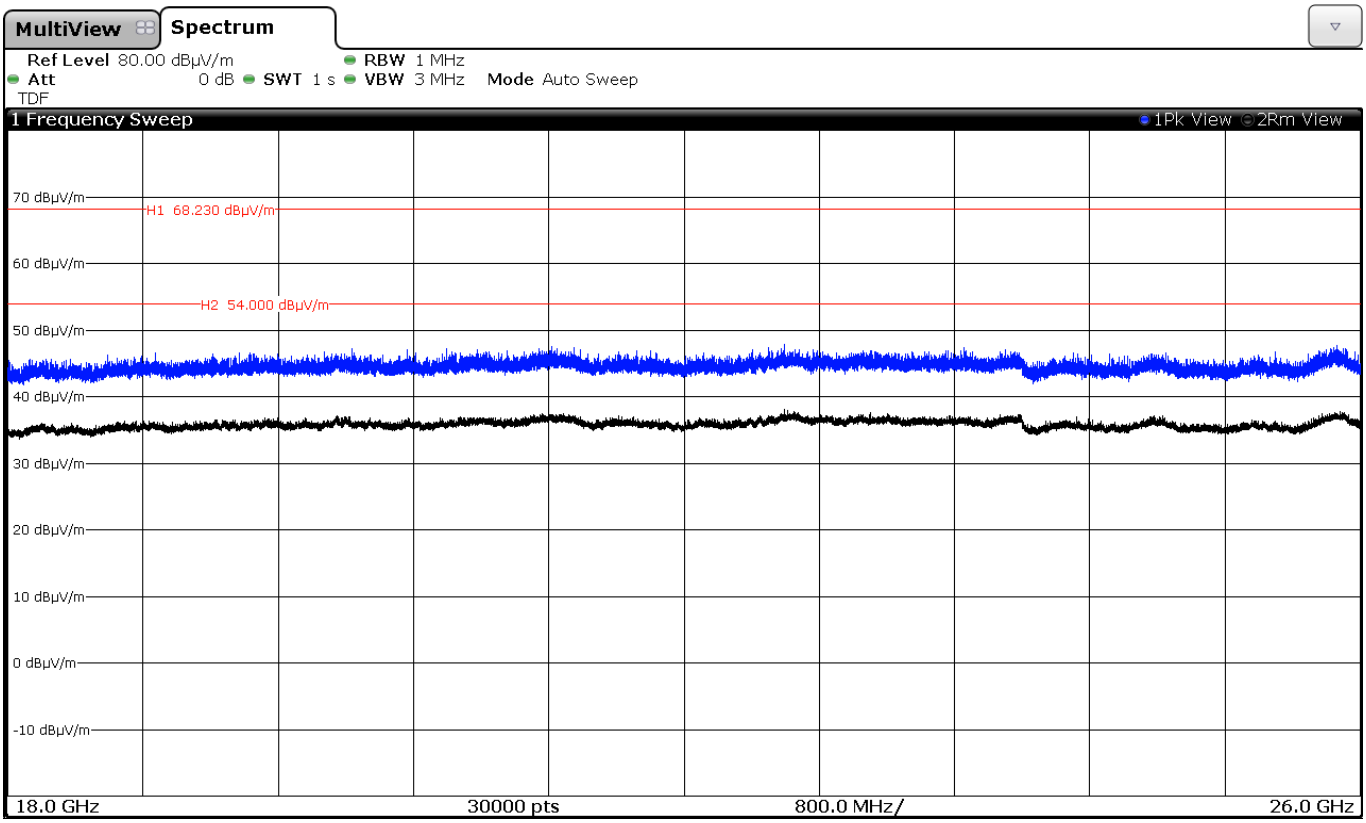
4. WiFi 5GHz 802.11 ac80 mode
Middle frequency 5775 MHz
Chain A



Chain B

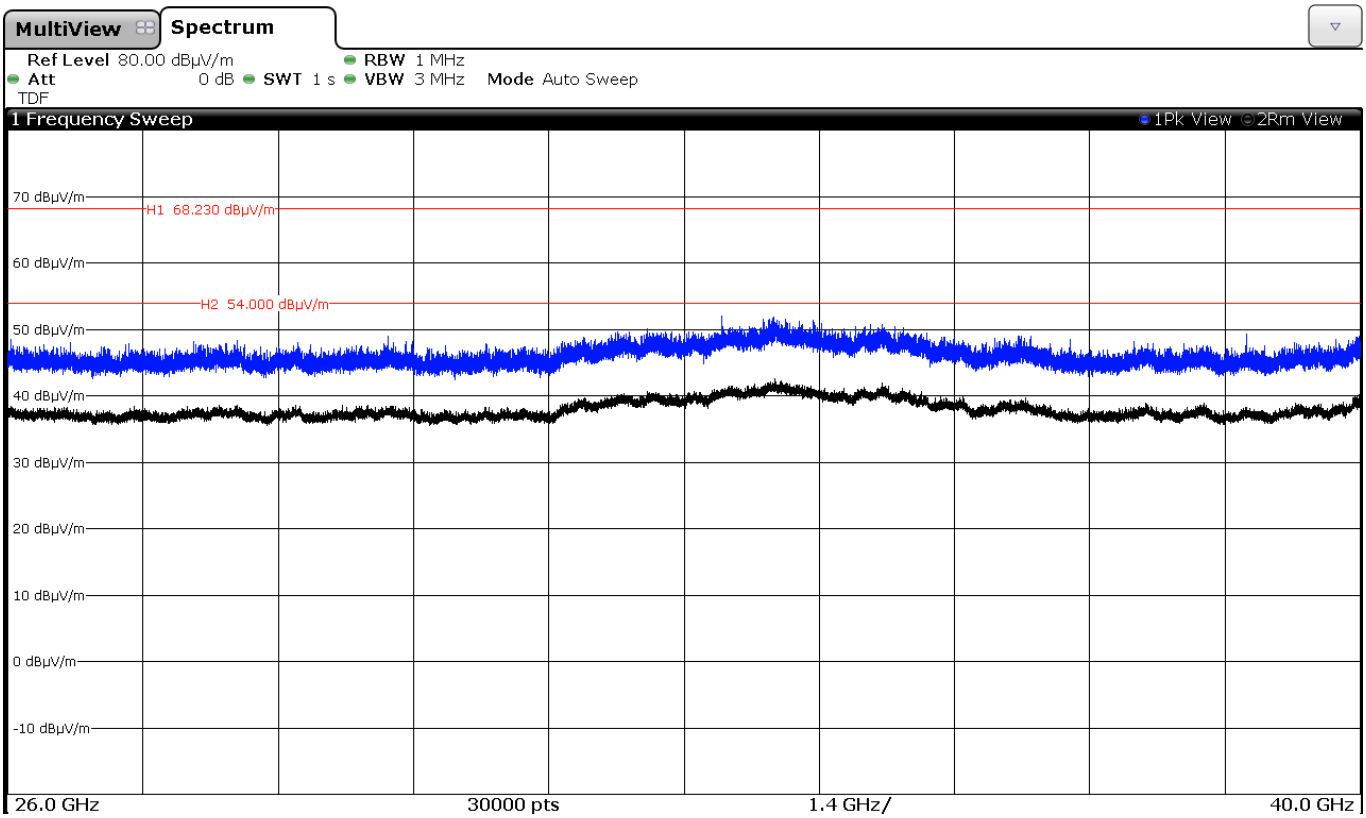


Chain A+B



FREQUENCY RANGE 26 GHz 40GHz.

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



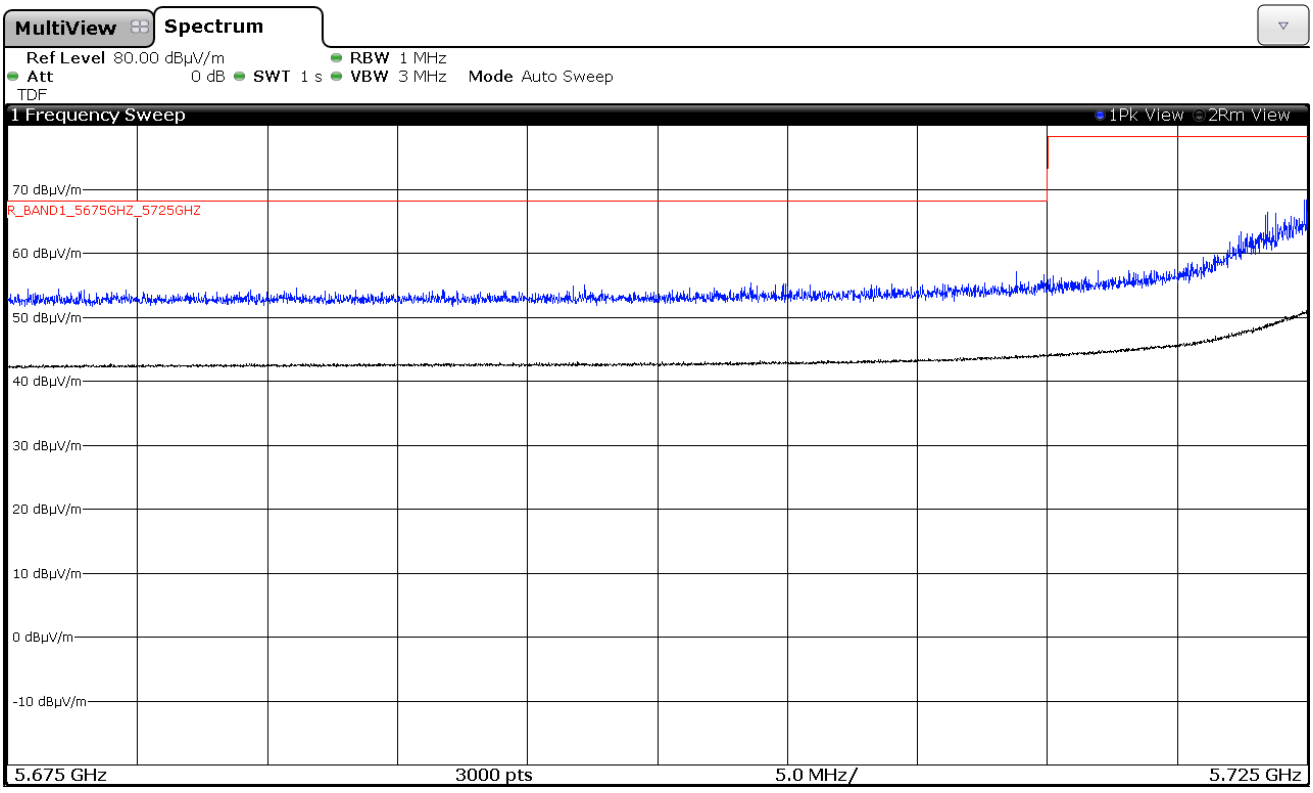
(This plot is valid for both SISO and MIMO).

Radiated spurious emissions at band-edges and inside adjacent band 5.675 – 5.725 GHz.

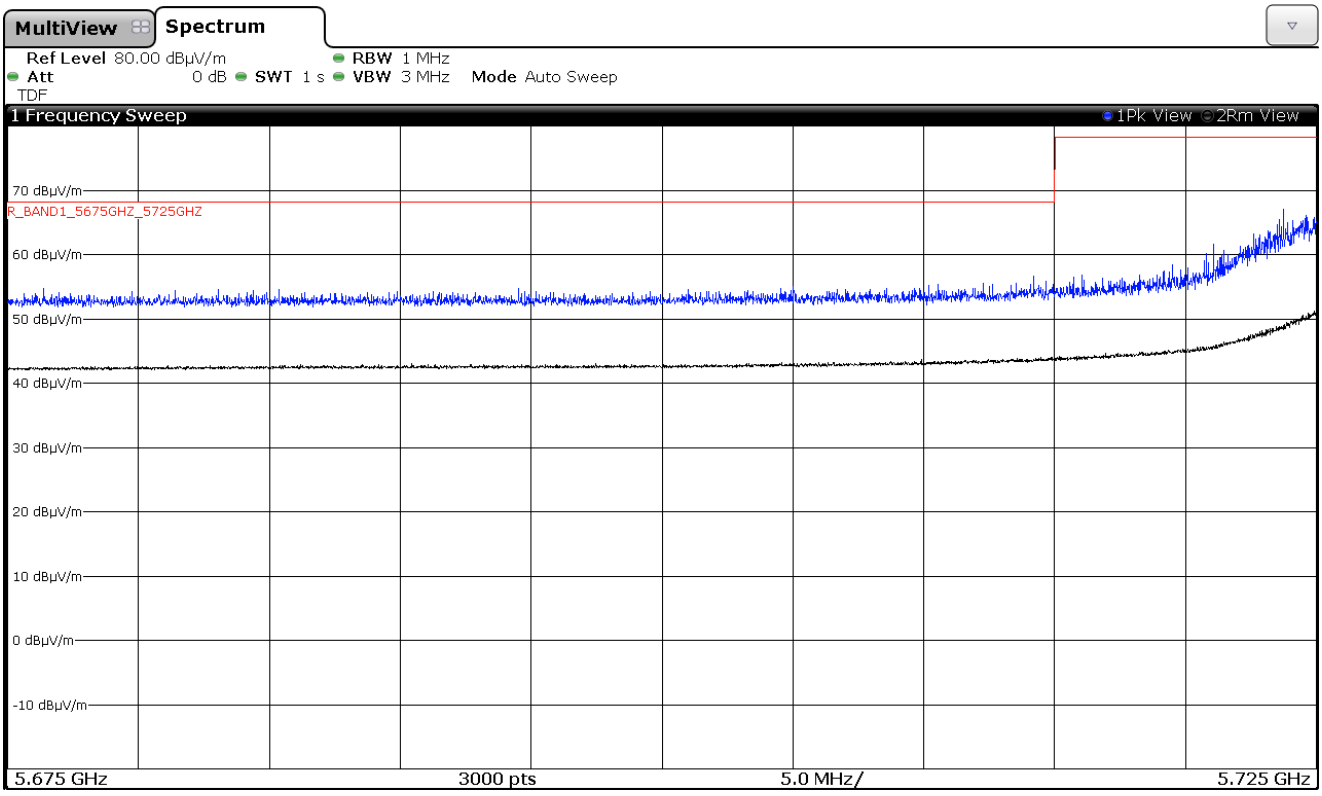
1. WiFi 5GHz 802.11 a mode

Lowest frequency 5745 MHz.

Chain A

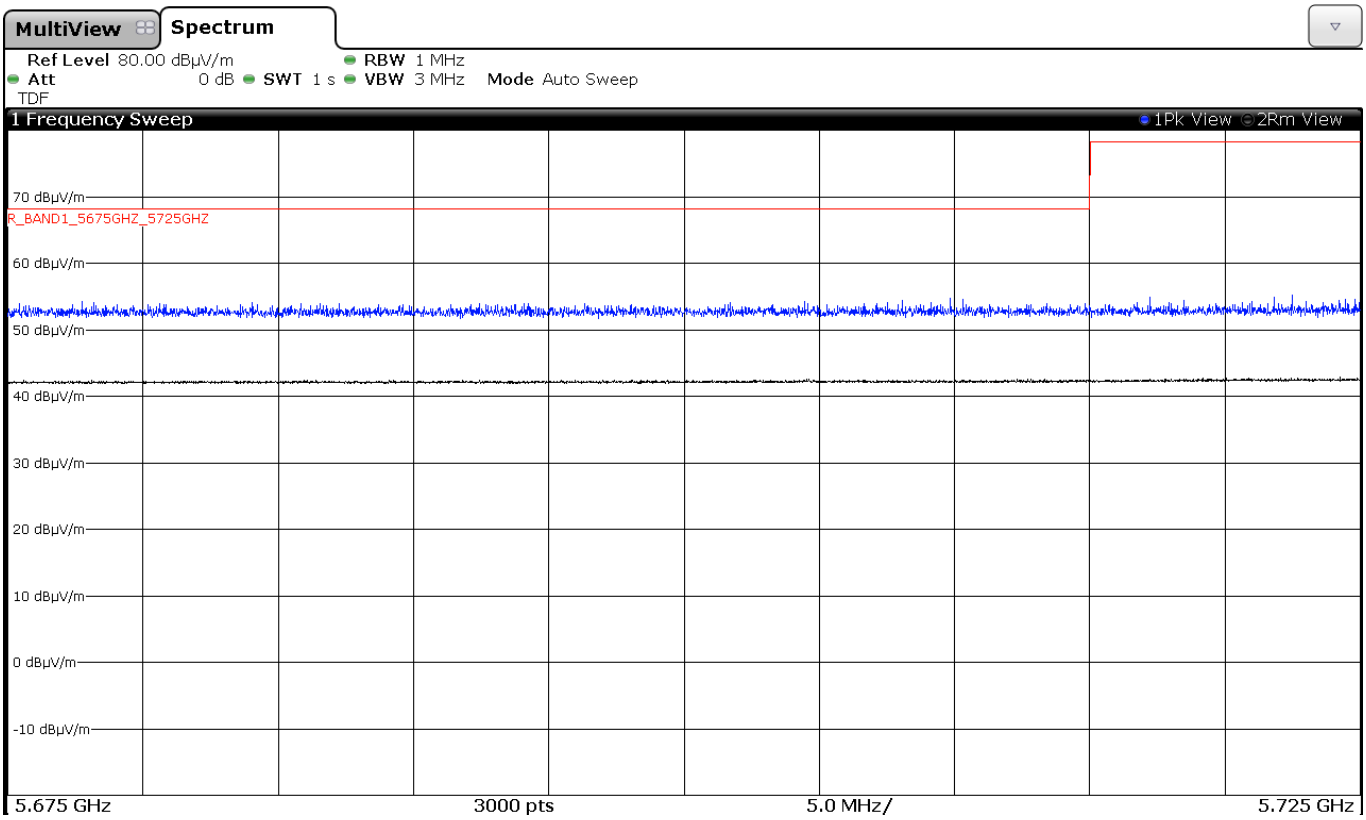


Chain B

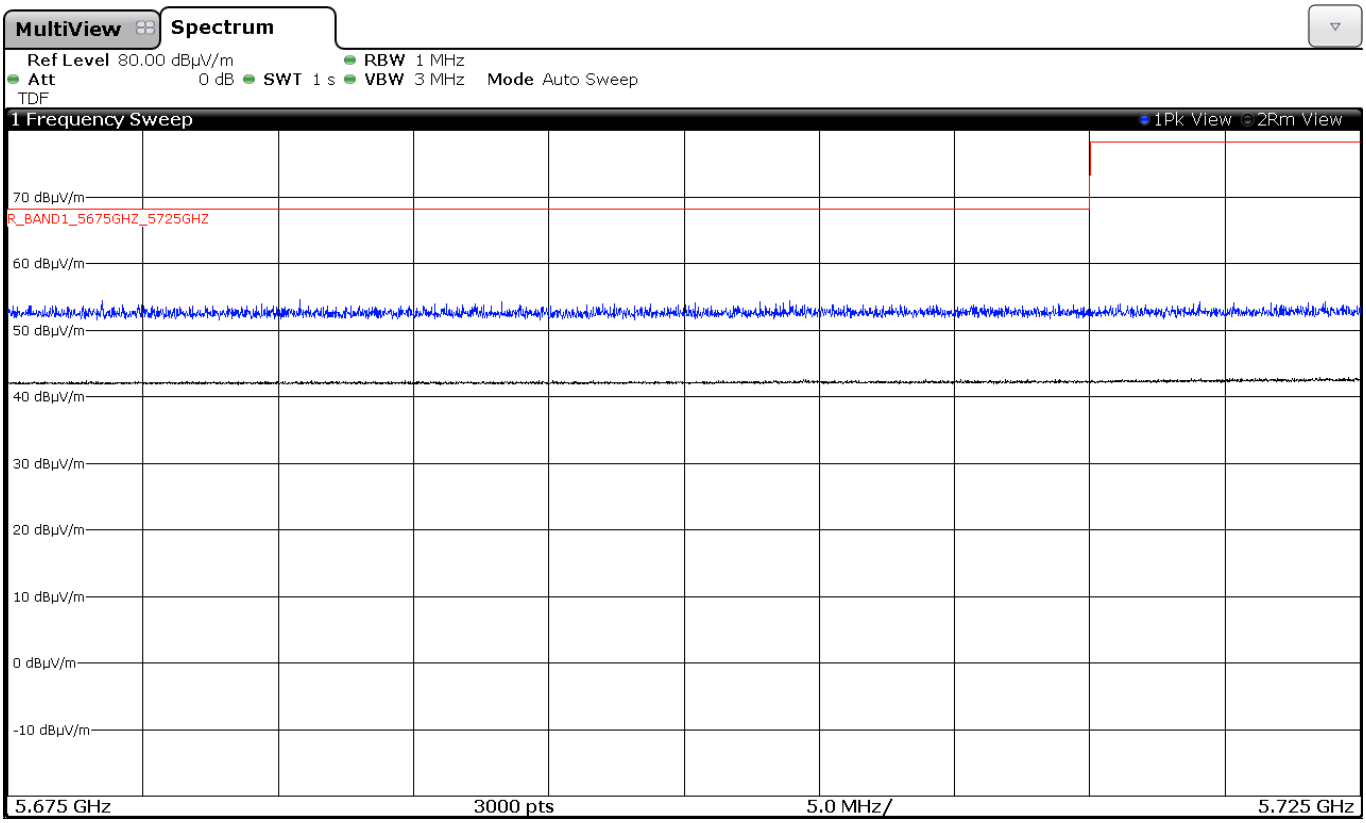


Middle frequency 5785 MHz.

Chain A



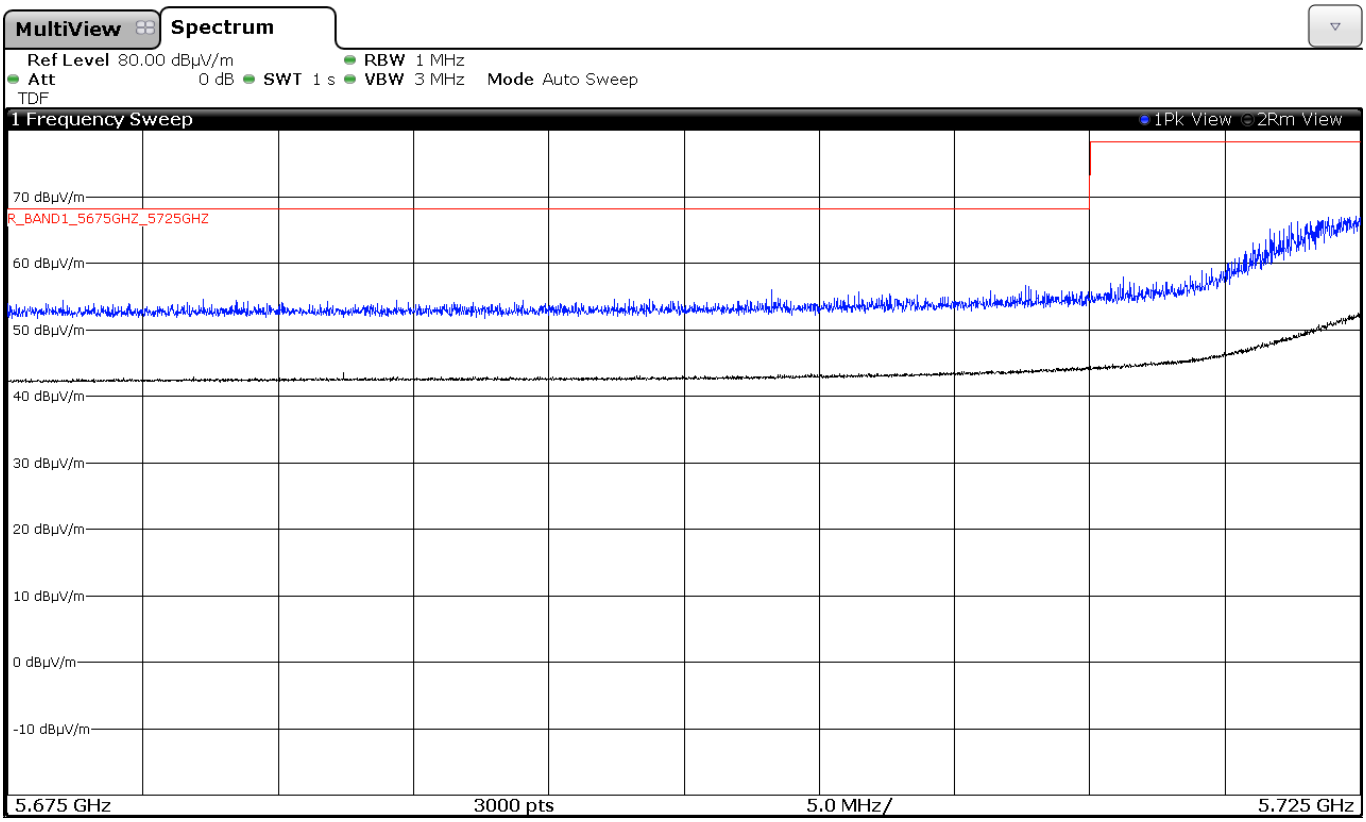
Chain B



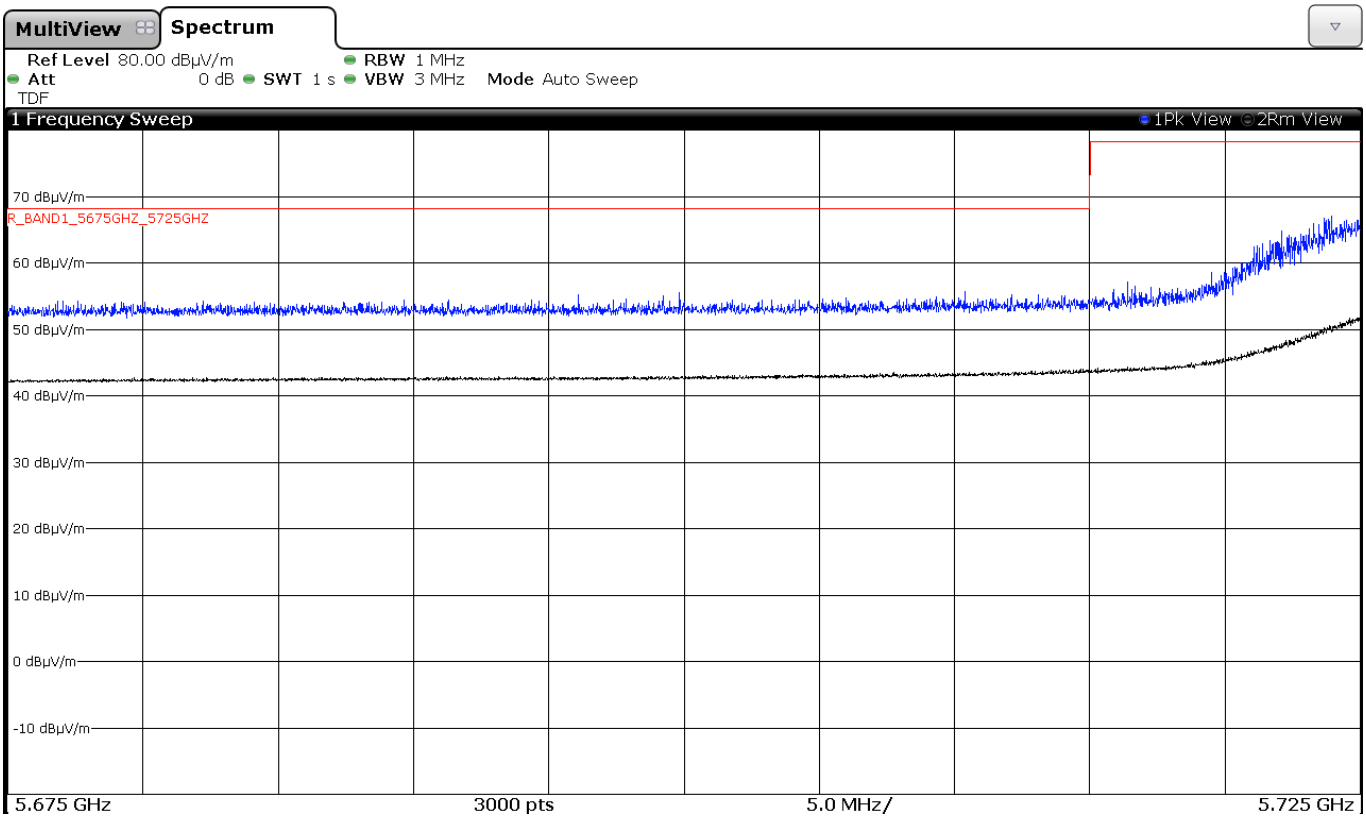
2. WiFi 5GHz 802.11 n20 mode

Lowest frequency 5745 MHz.

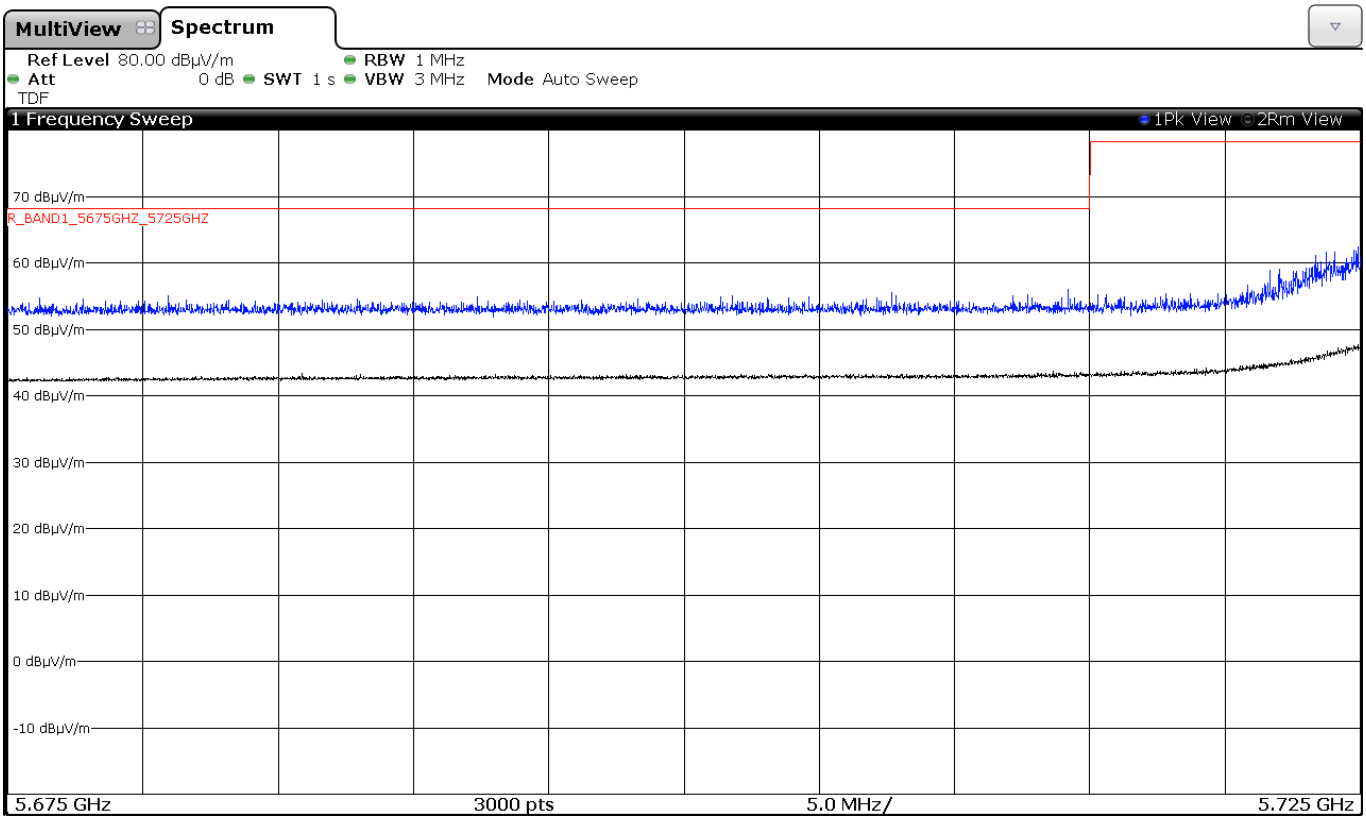
Chain A



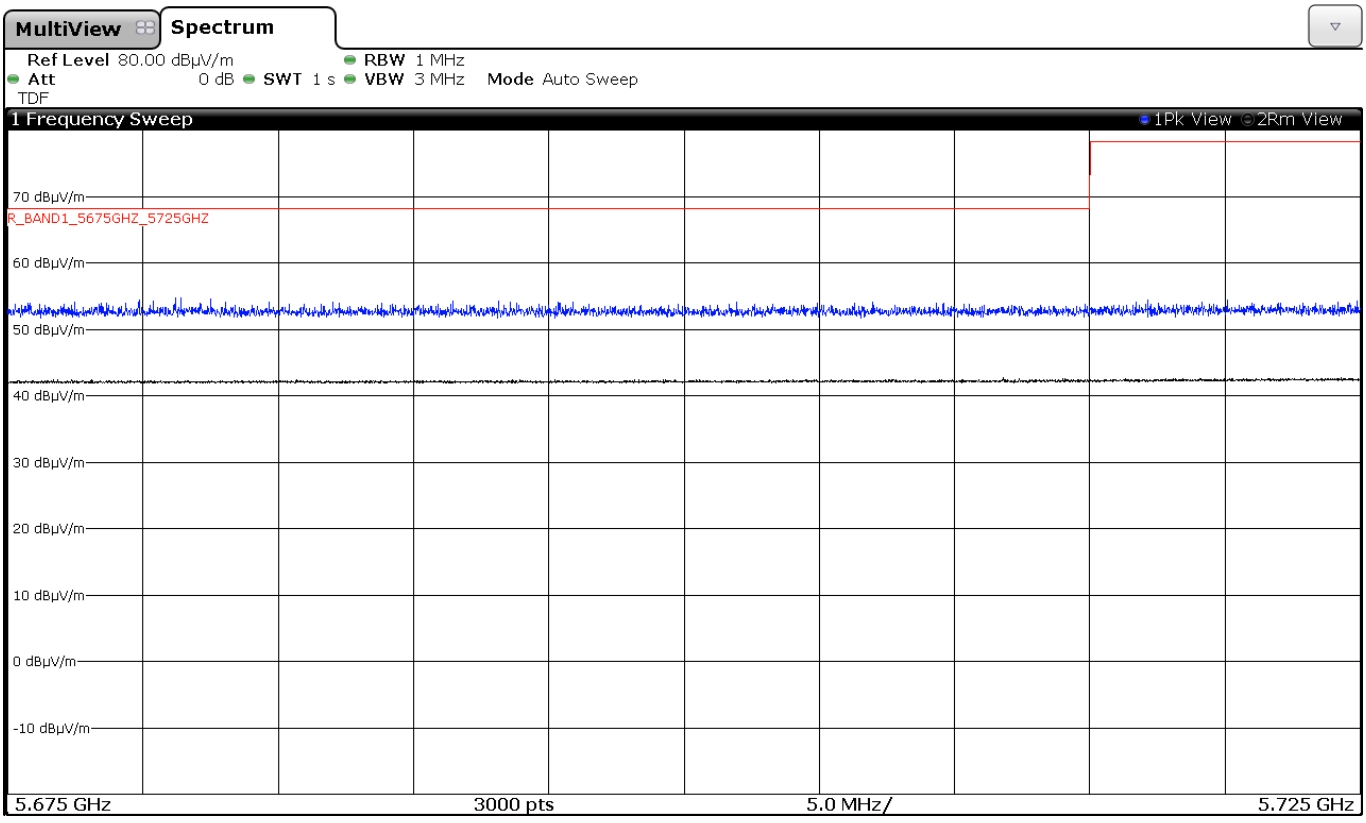
Chain B



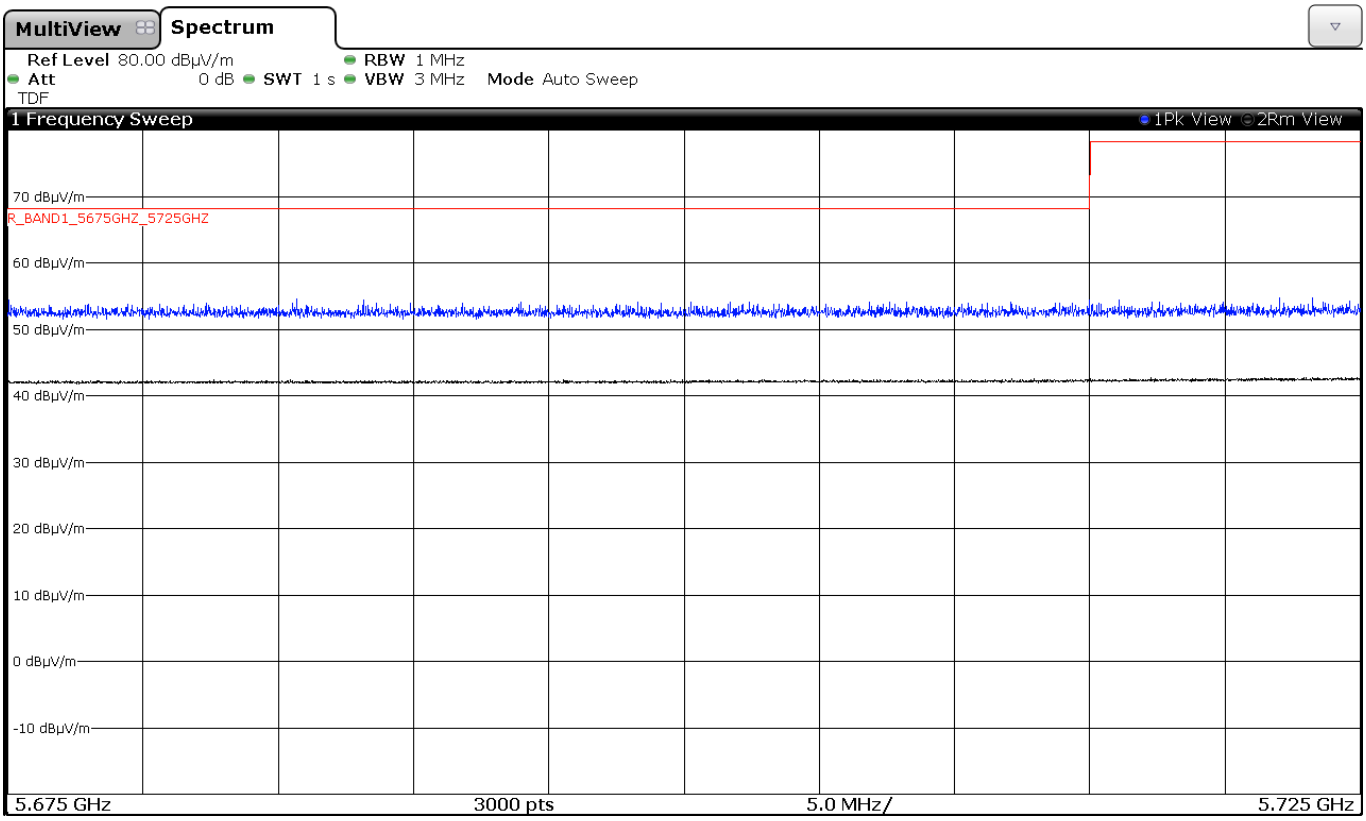
Chain A+B



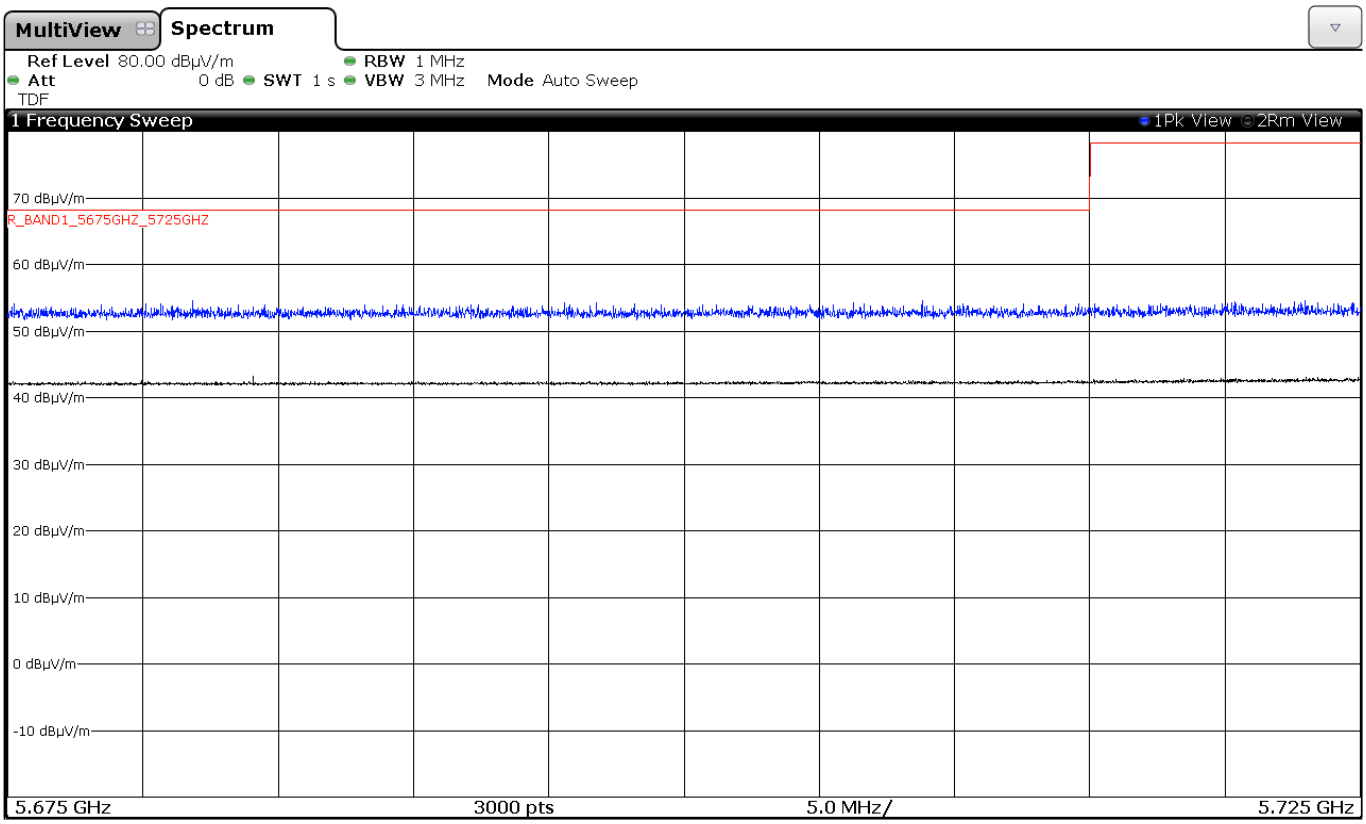
Middle frequency 5785 MHz.
Chain A



Chain B

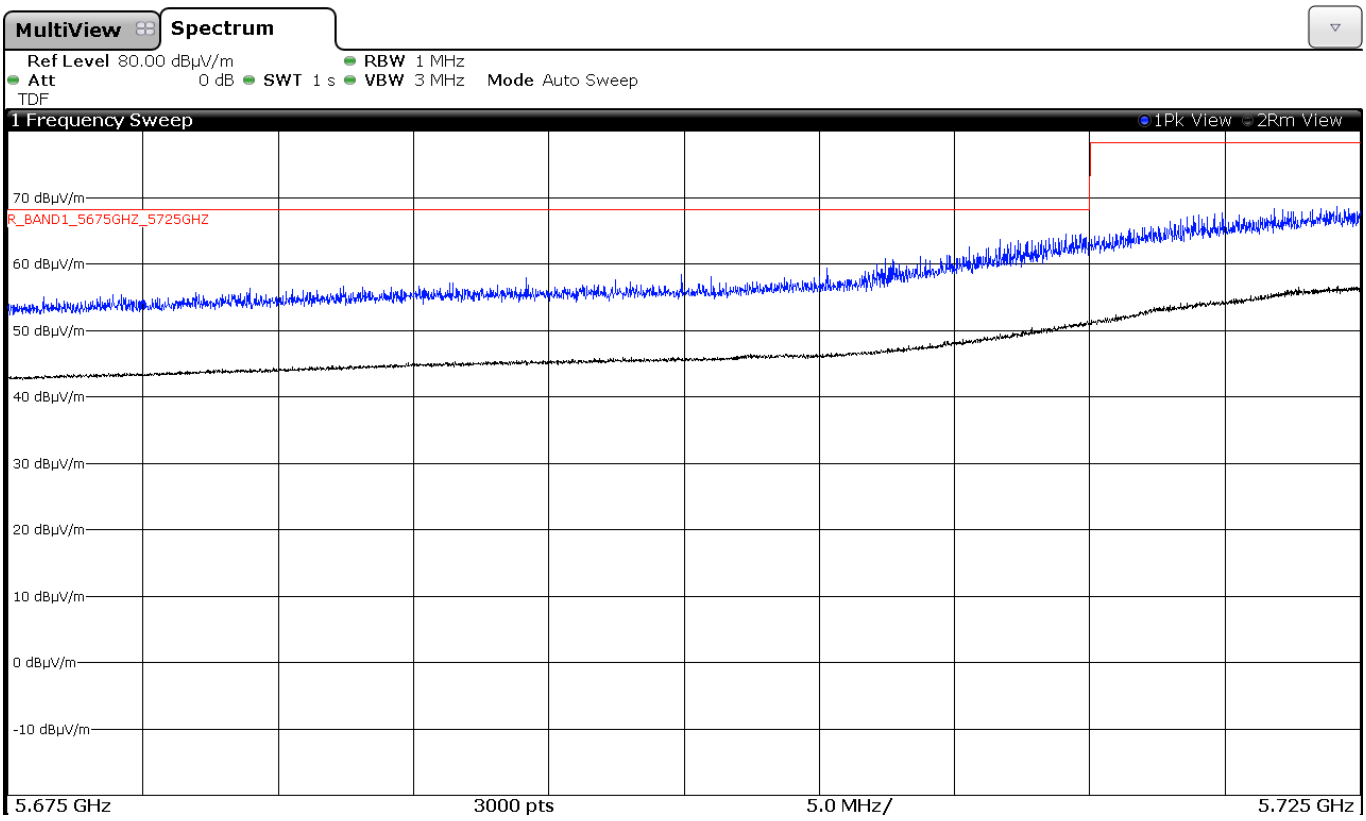


Chain A+B

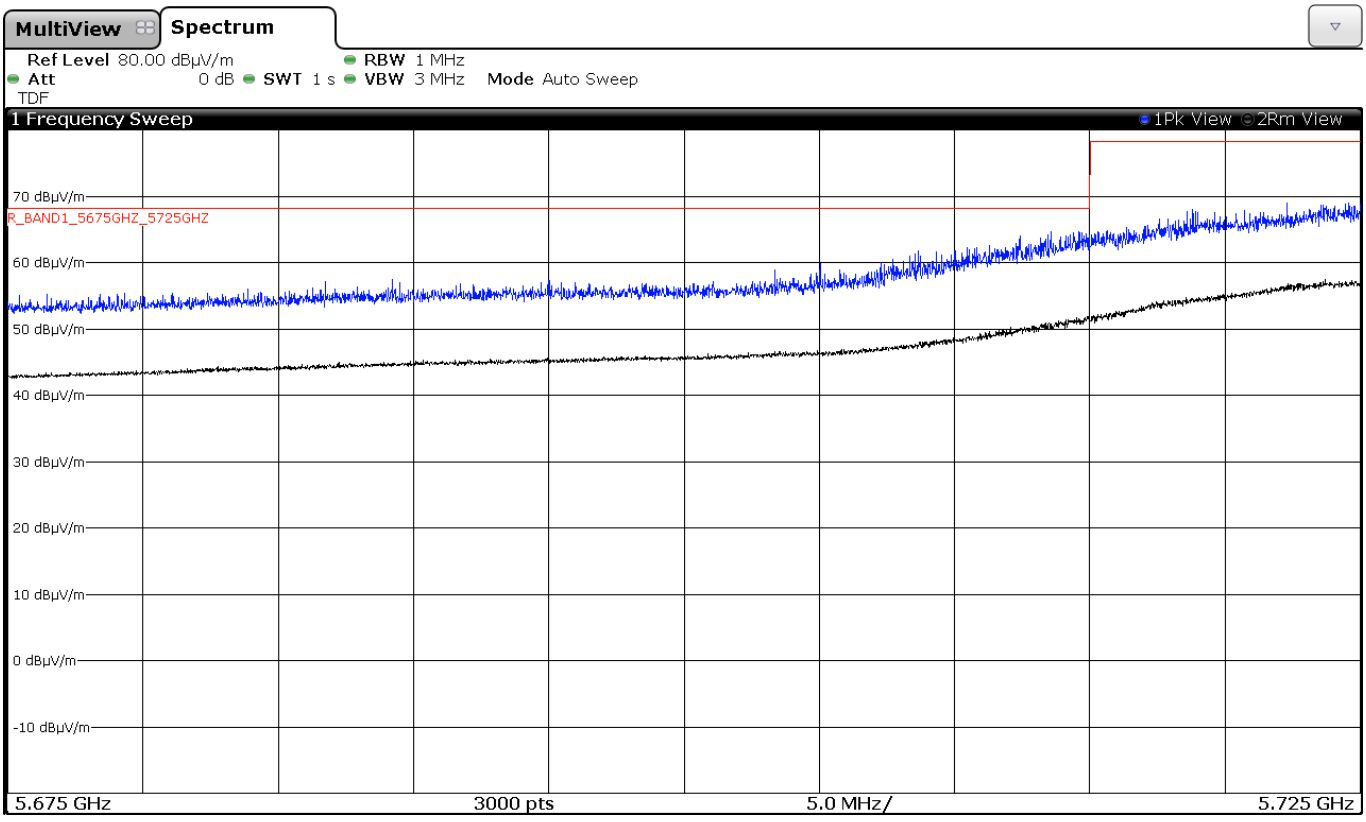


3. WiFi 5GHz 802.11 n40 mode

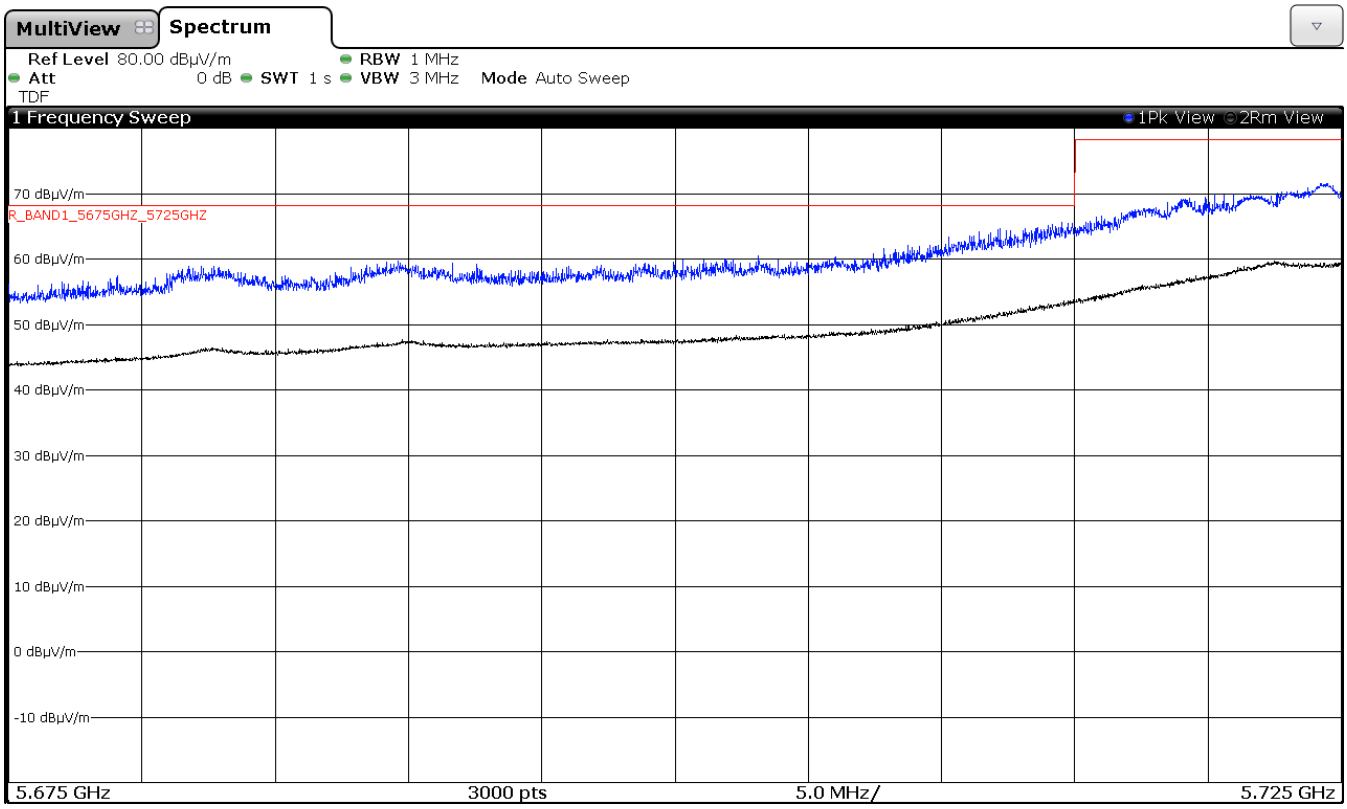
Lowest frequency 5755 MHz.
Chain A



Chain B

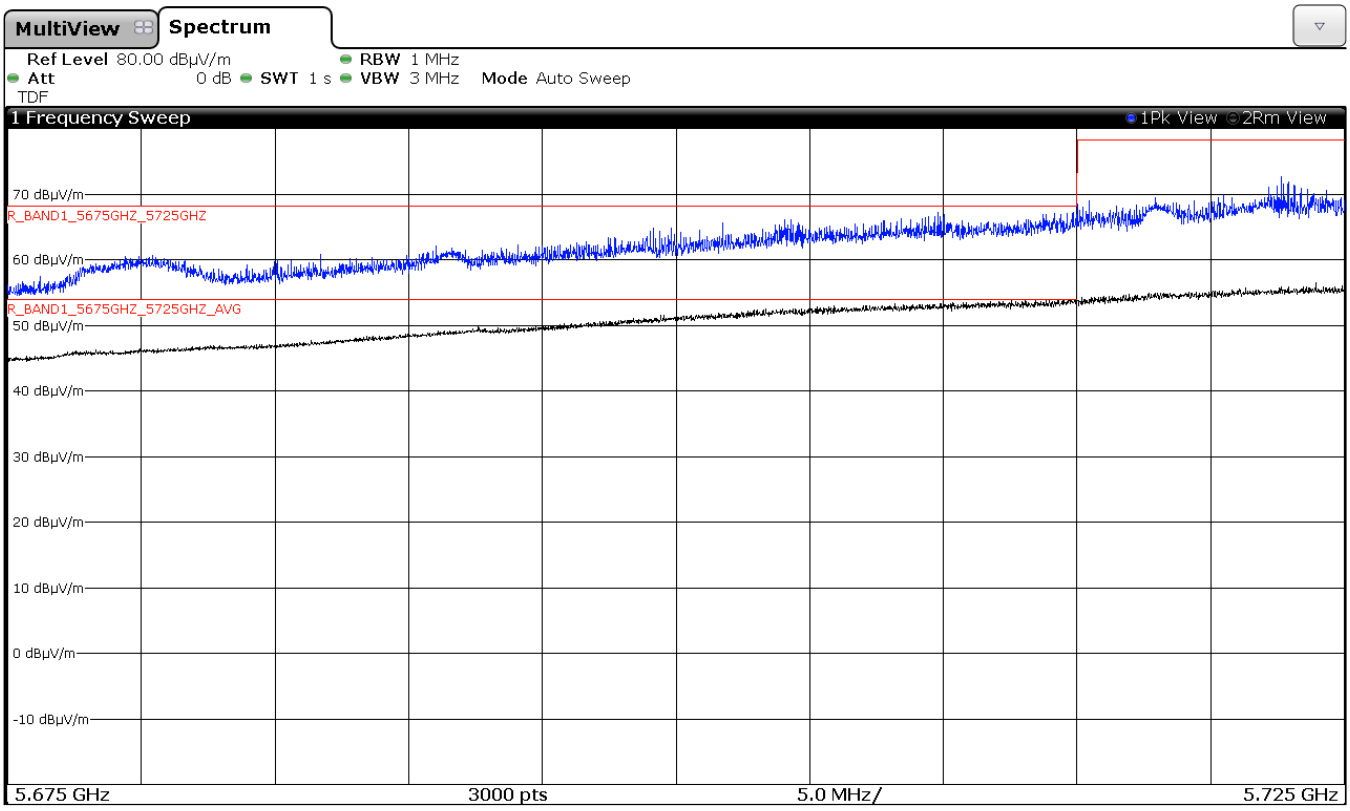


Chain A+B

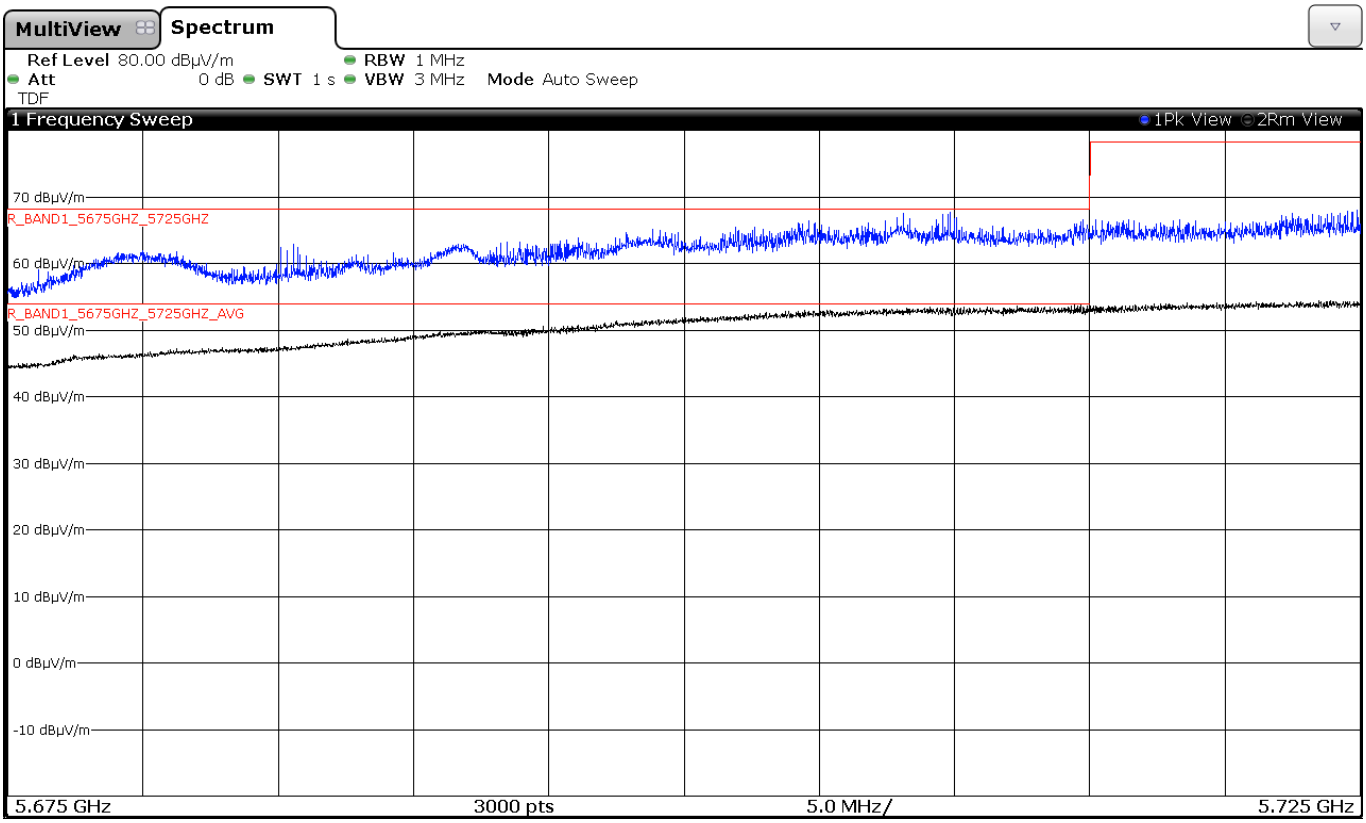


4. WiFi 5GHz 802.11 ac80 mode

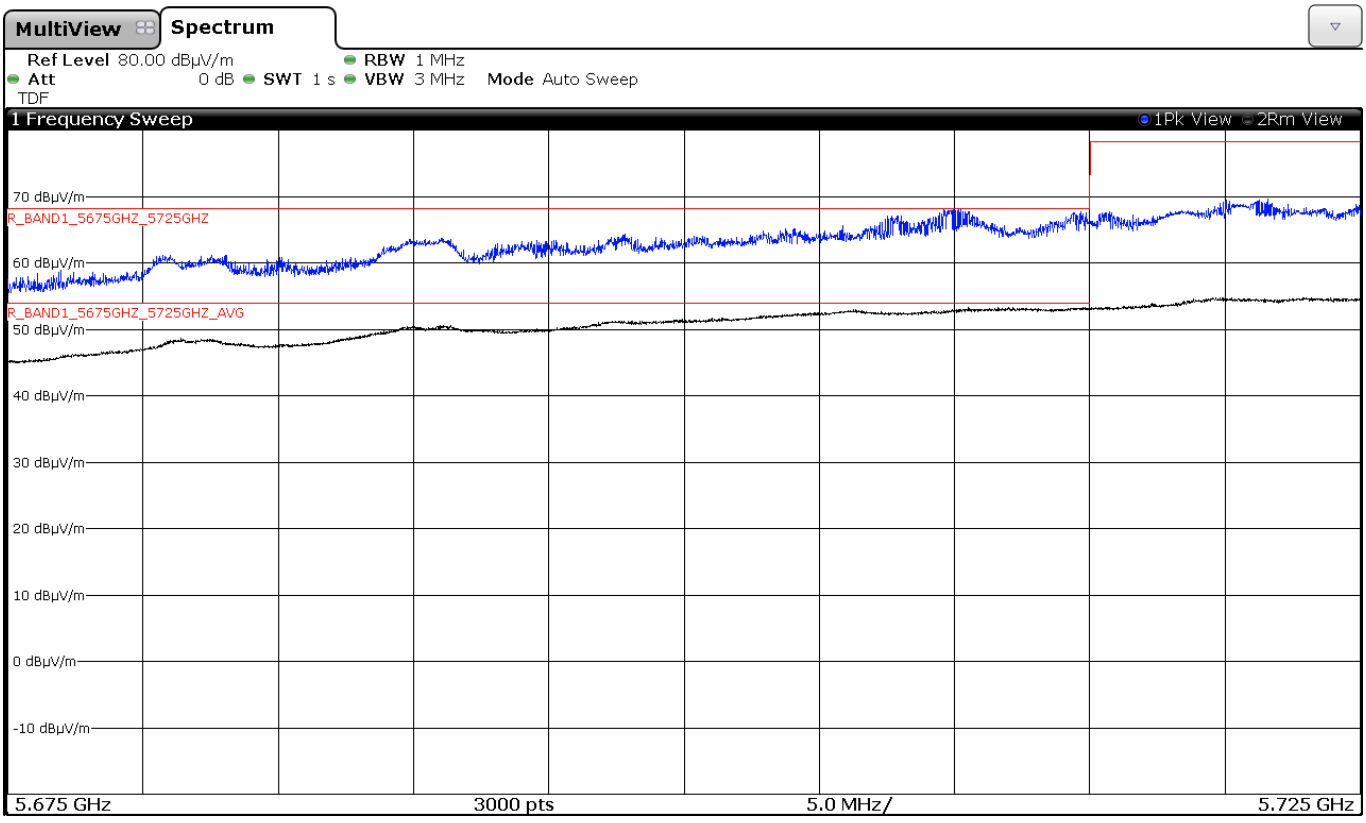
Middle frequency 5775 MHz.
Chain A



Chain B



Chain A+B

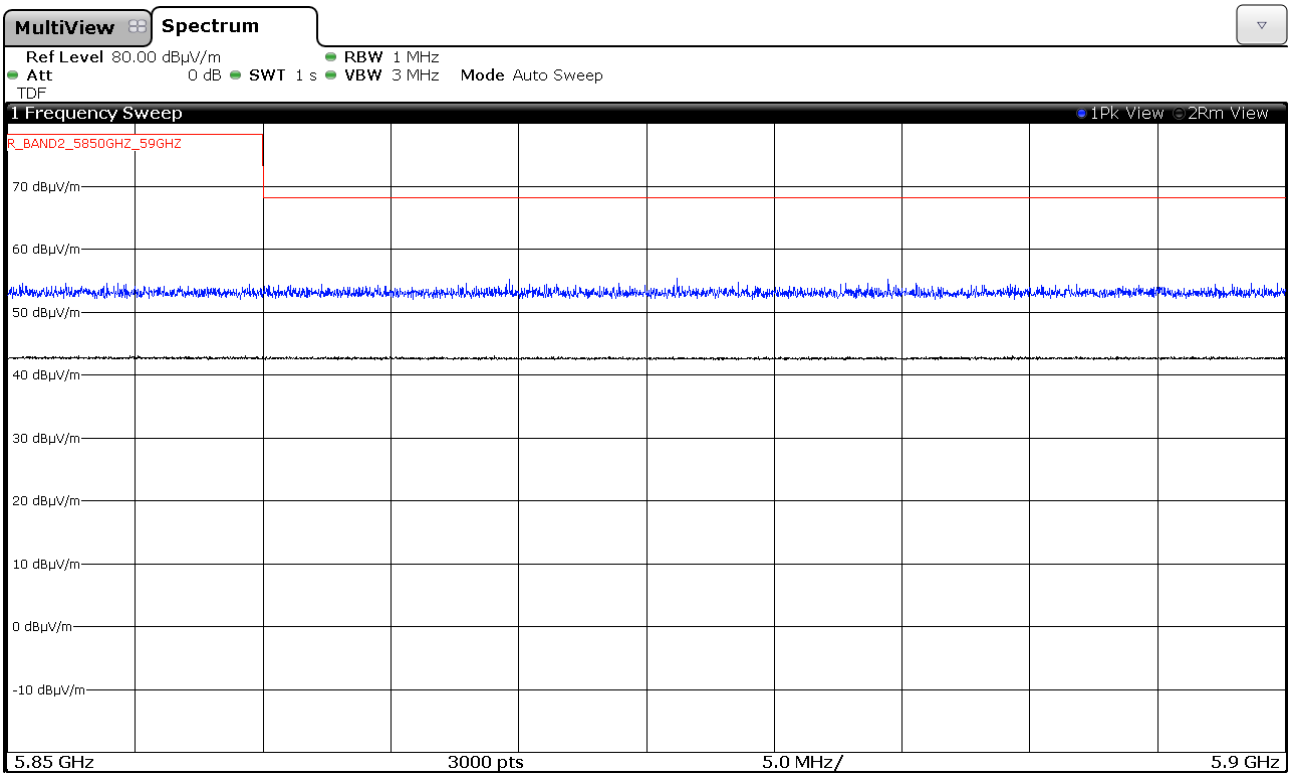


Radiated spurious emissions at band-edges and inside adjacent band 5.85 – 5.9 GHz.

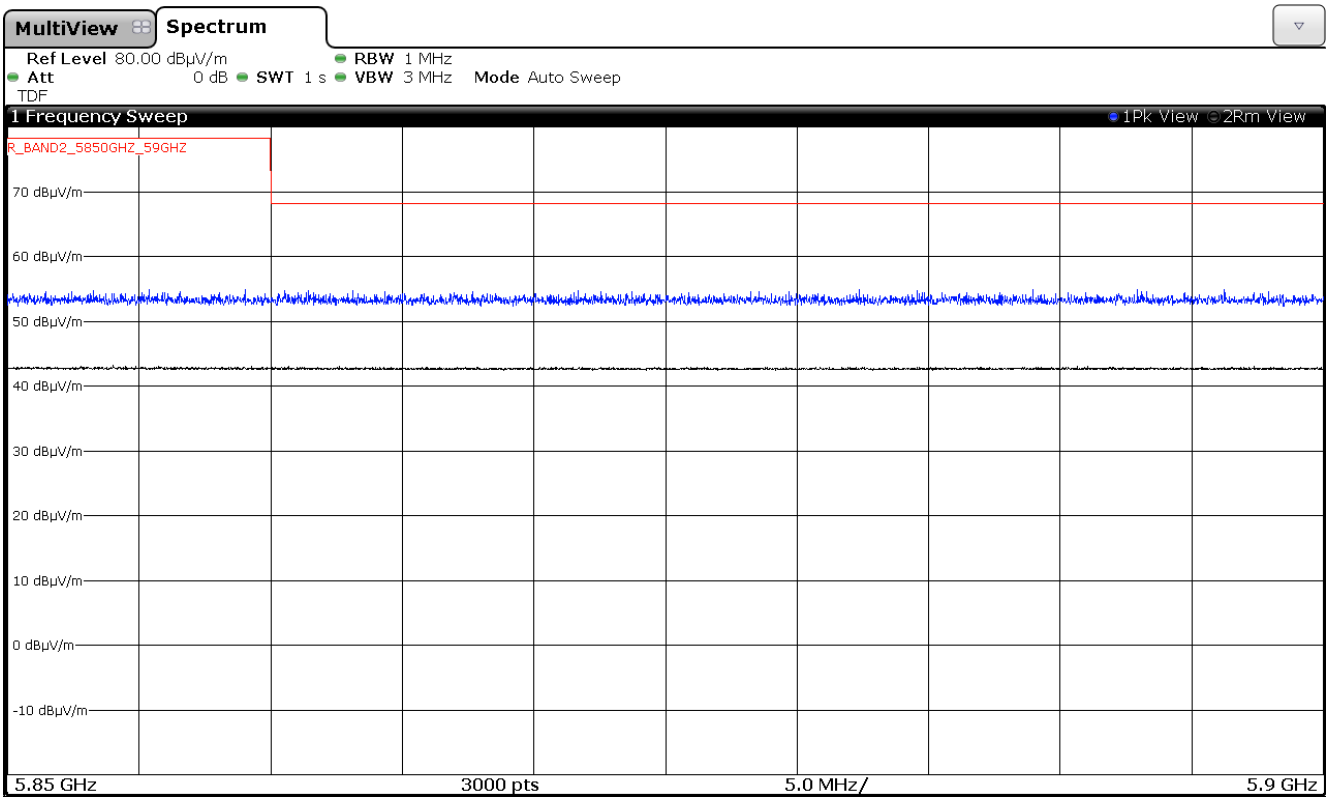
1. WiFi 5GHz 802.11 a mode

Middle frequency 5785 MHz.

Chain A

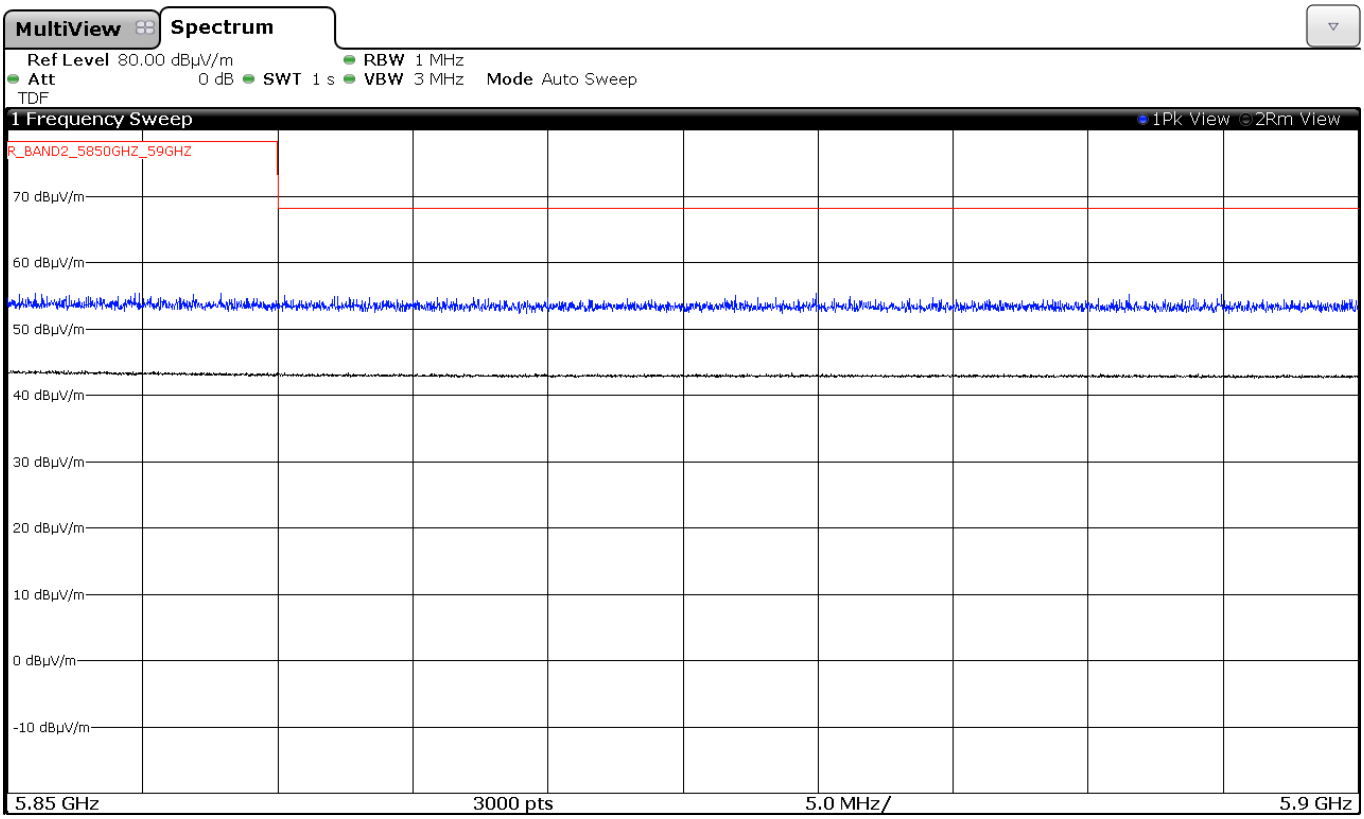


Chain B

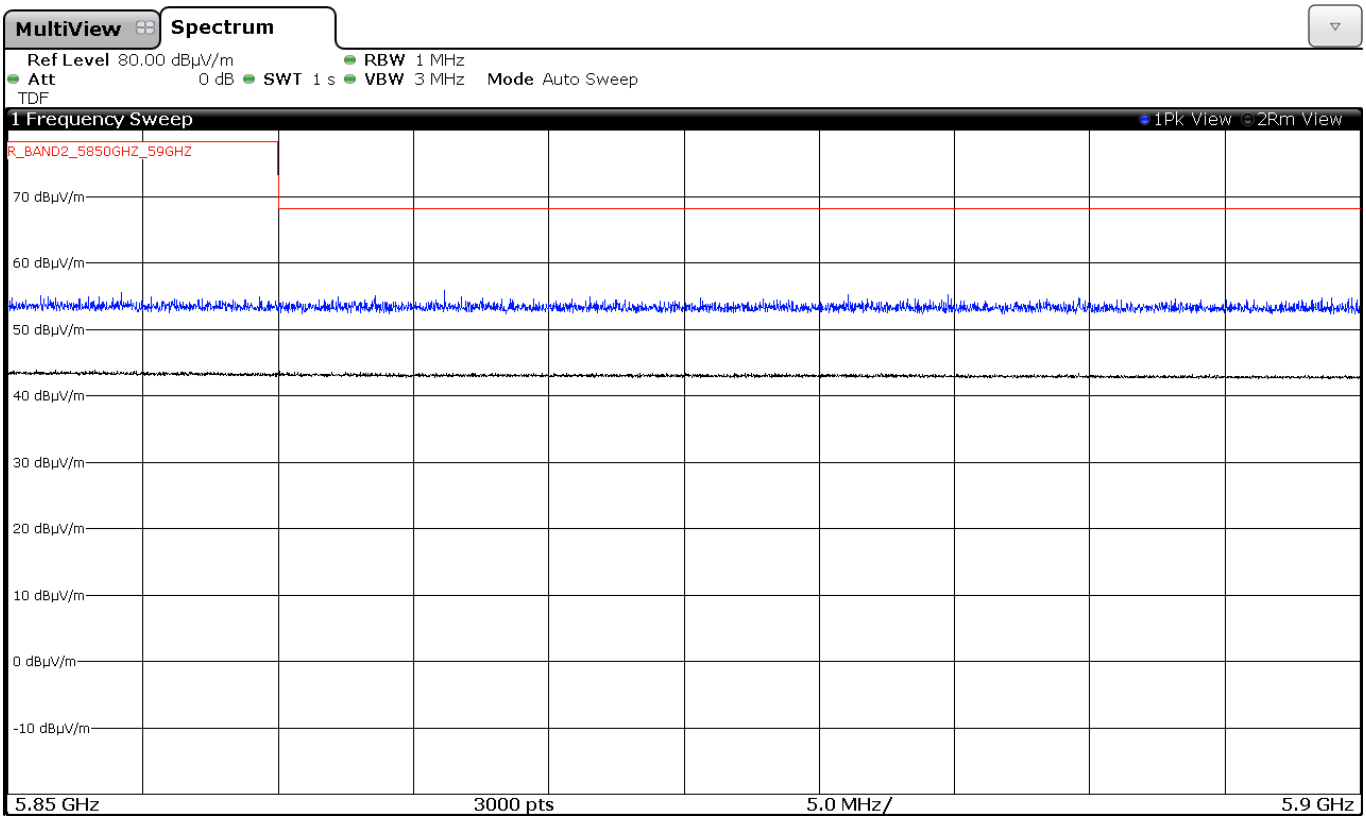


Highest frequency 5825 MHz.

Chain A



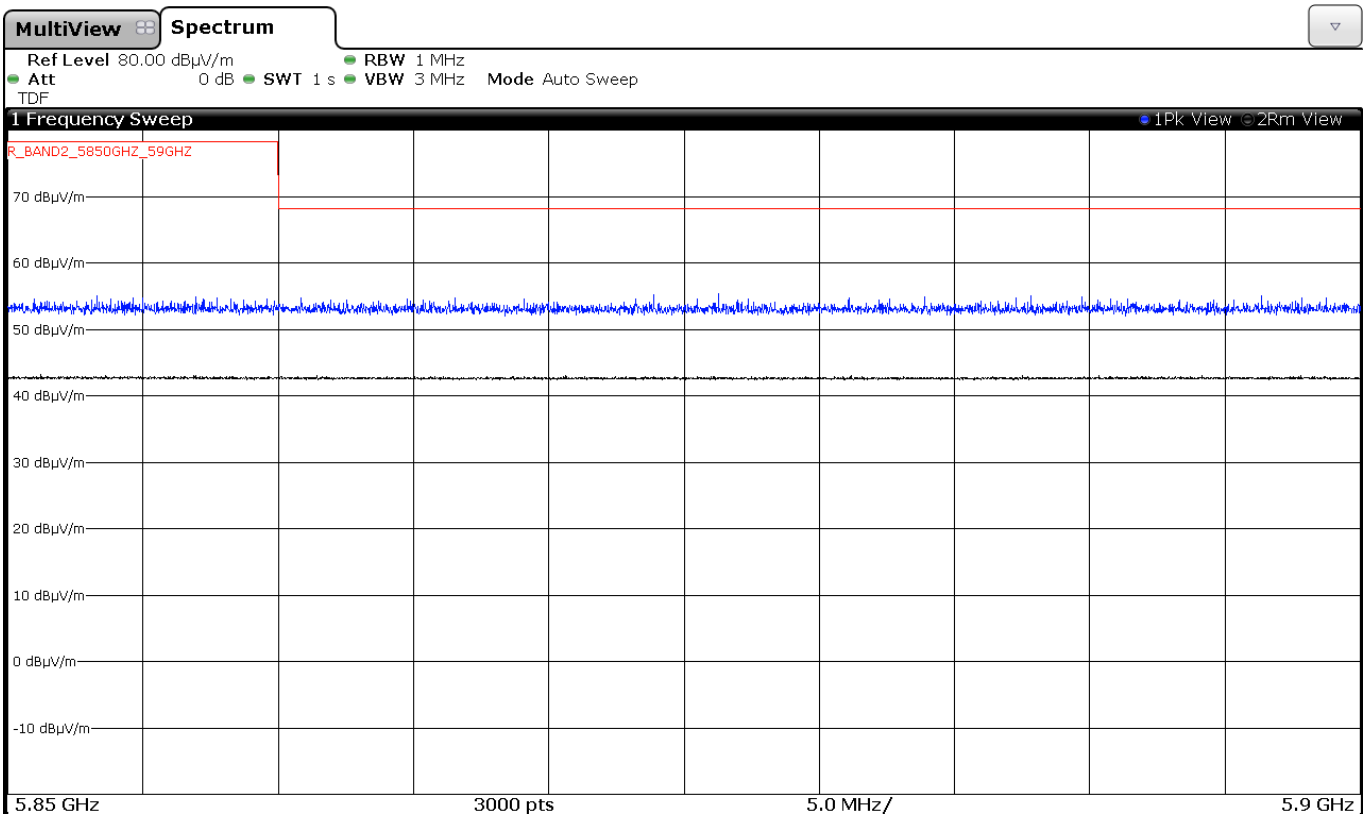
Chain B



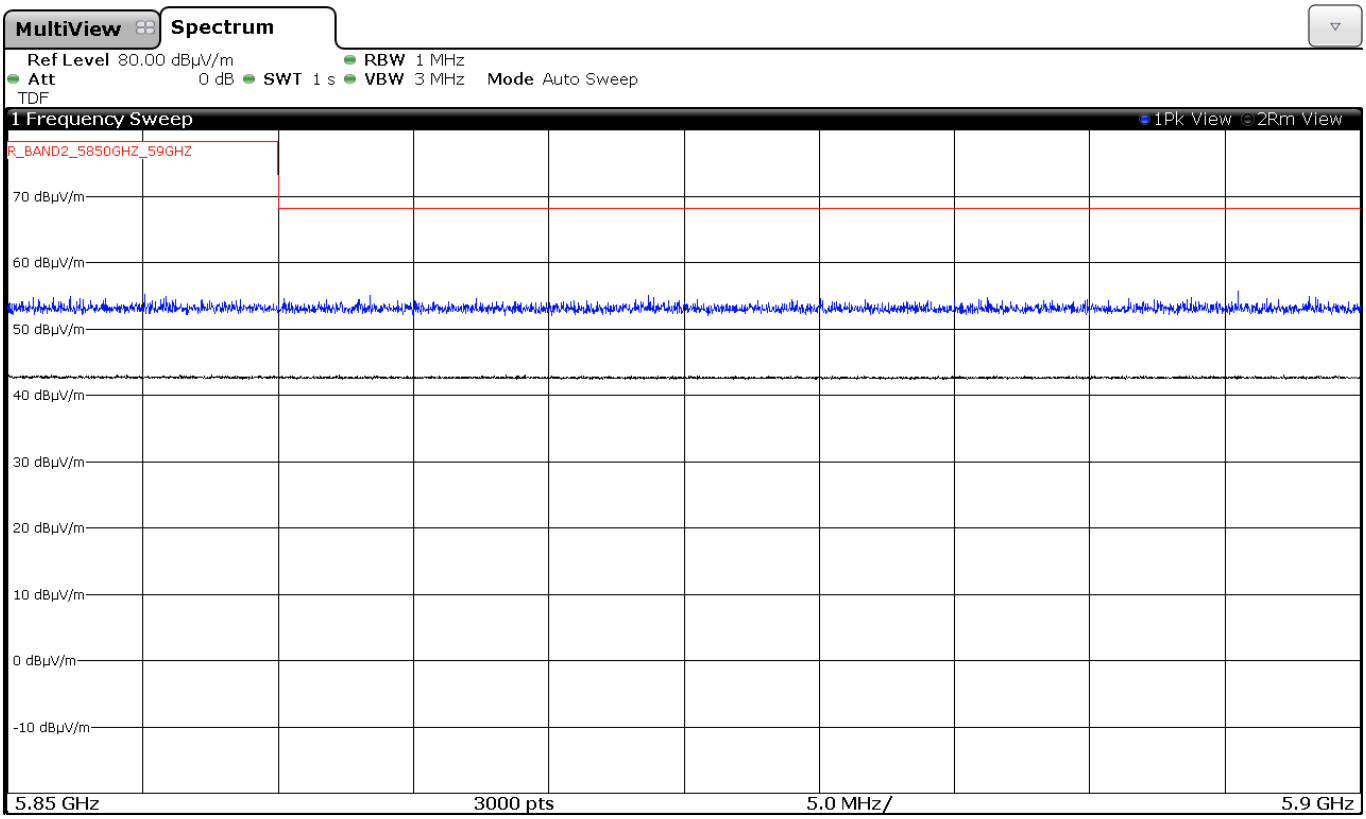
2. WiFi 5GHz 802.11 n20 mode

Middle frequency 5785 MHz.

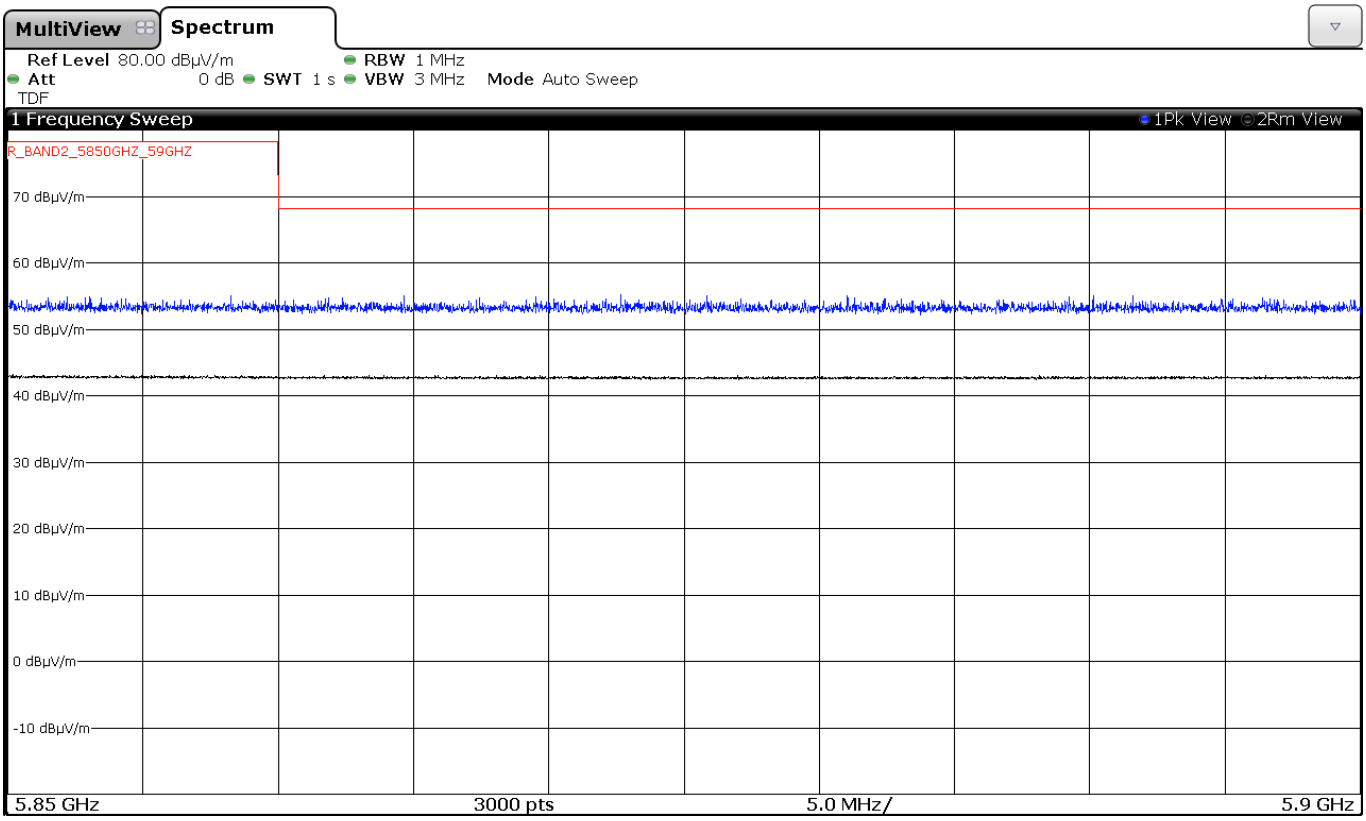
Chain A



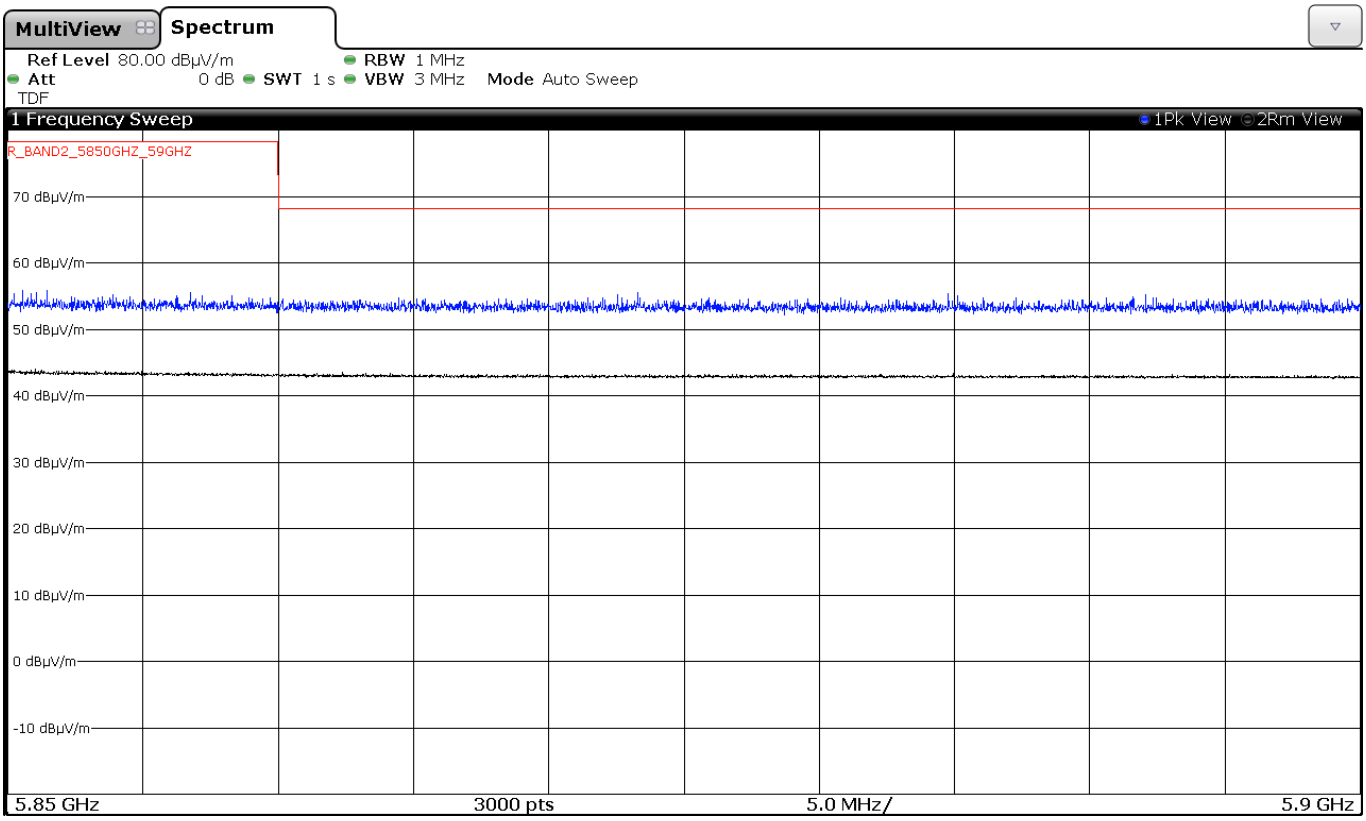
Chain B



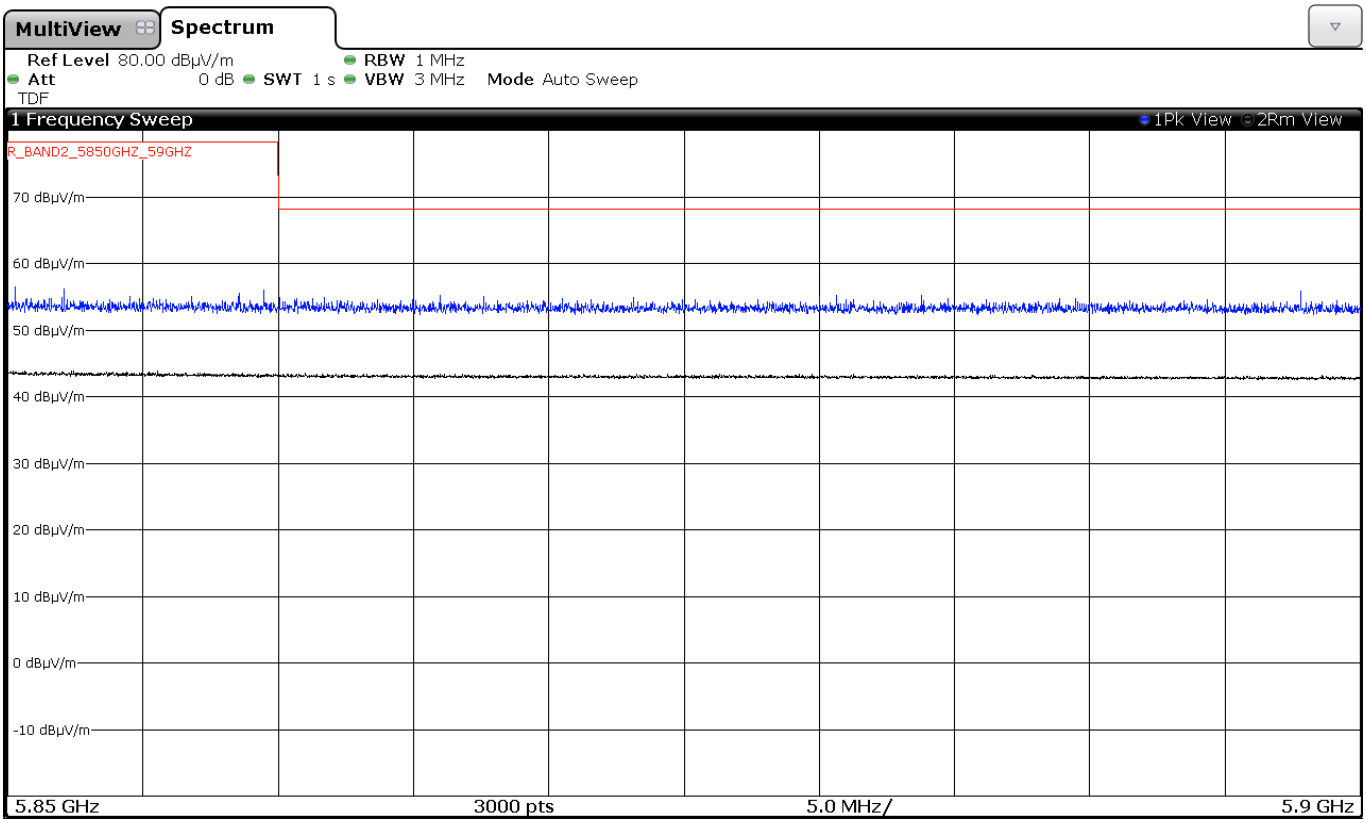
Chain A+B



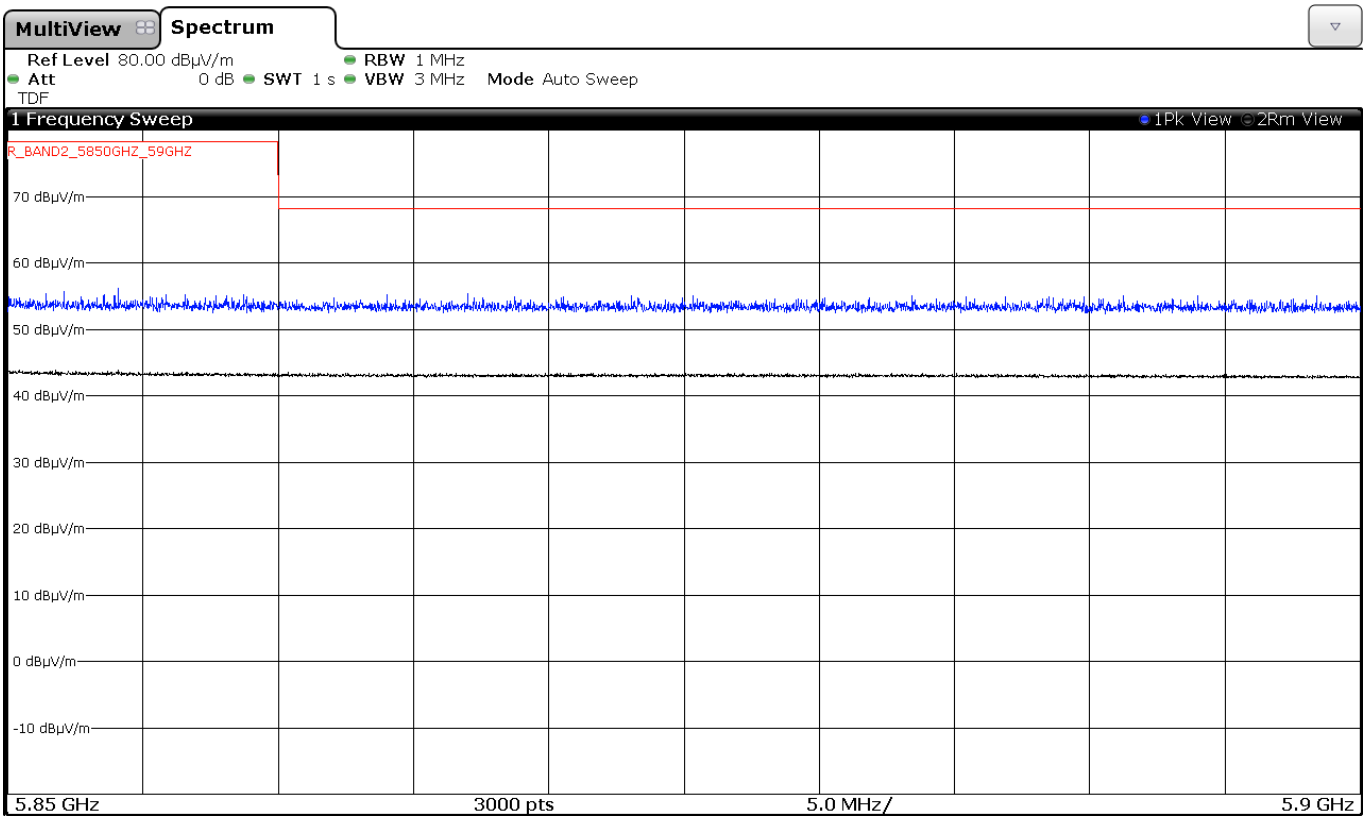
Highest frequency 5825 MHz.
Chain A



Chain B

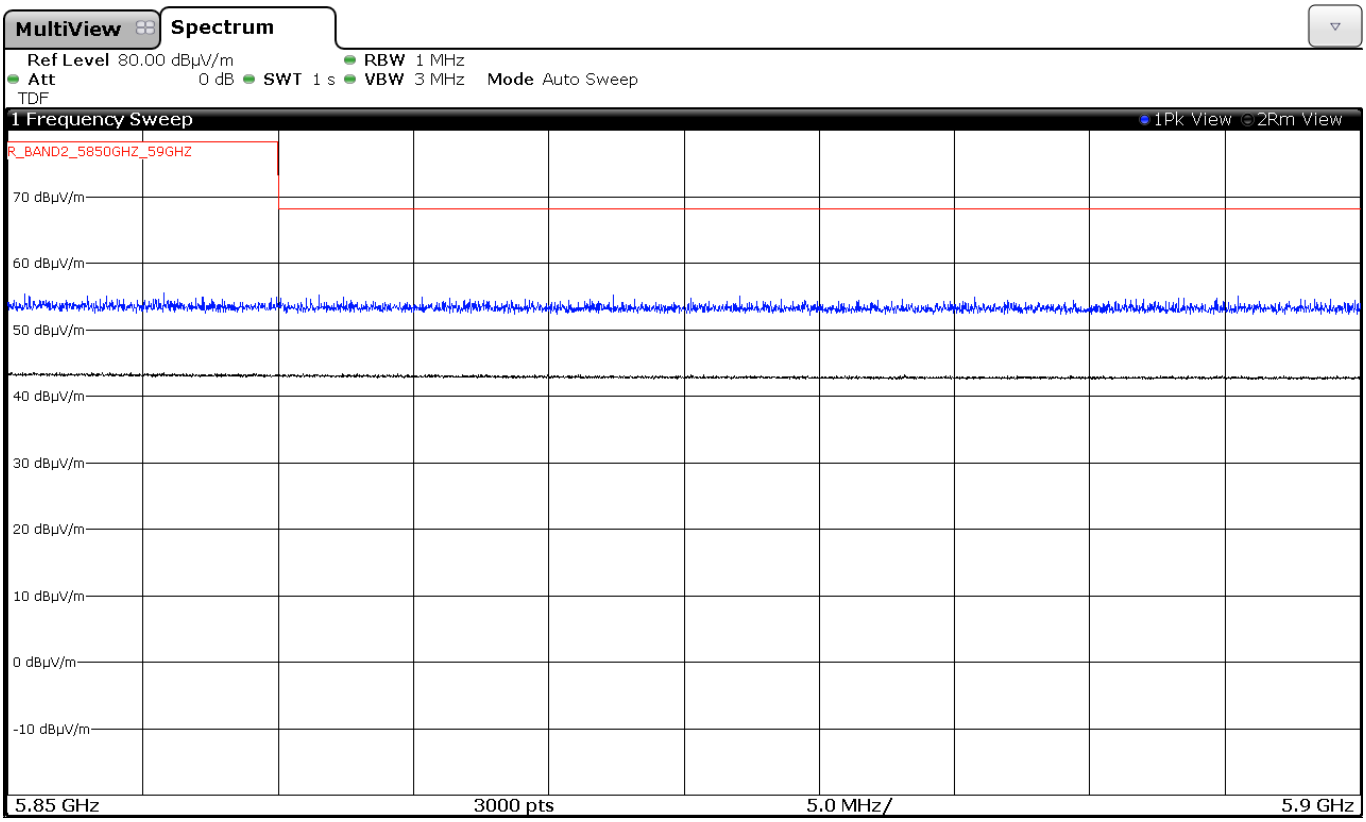


Chain A+B

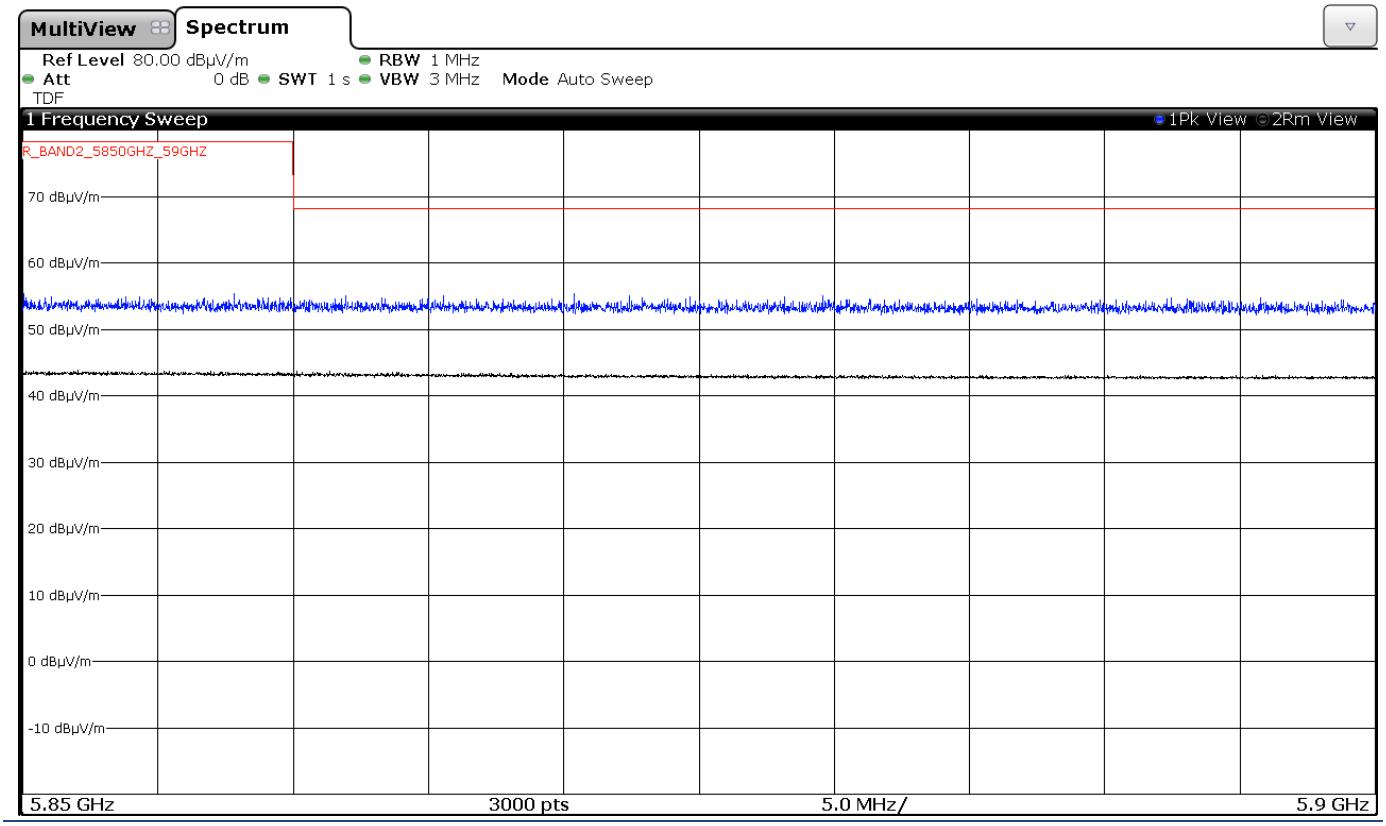


3. WiFi 5GHz 802.11 n40 mode

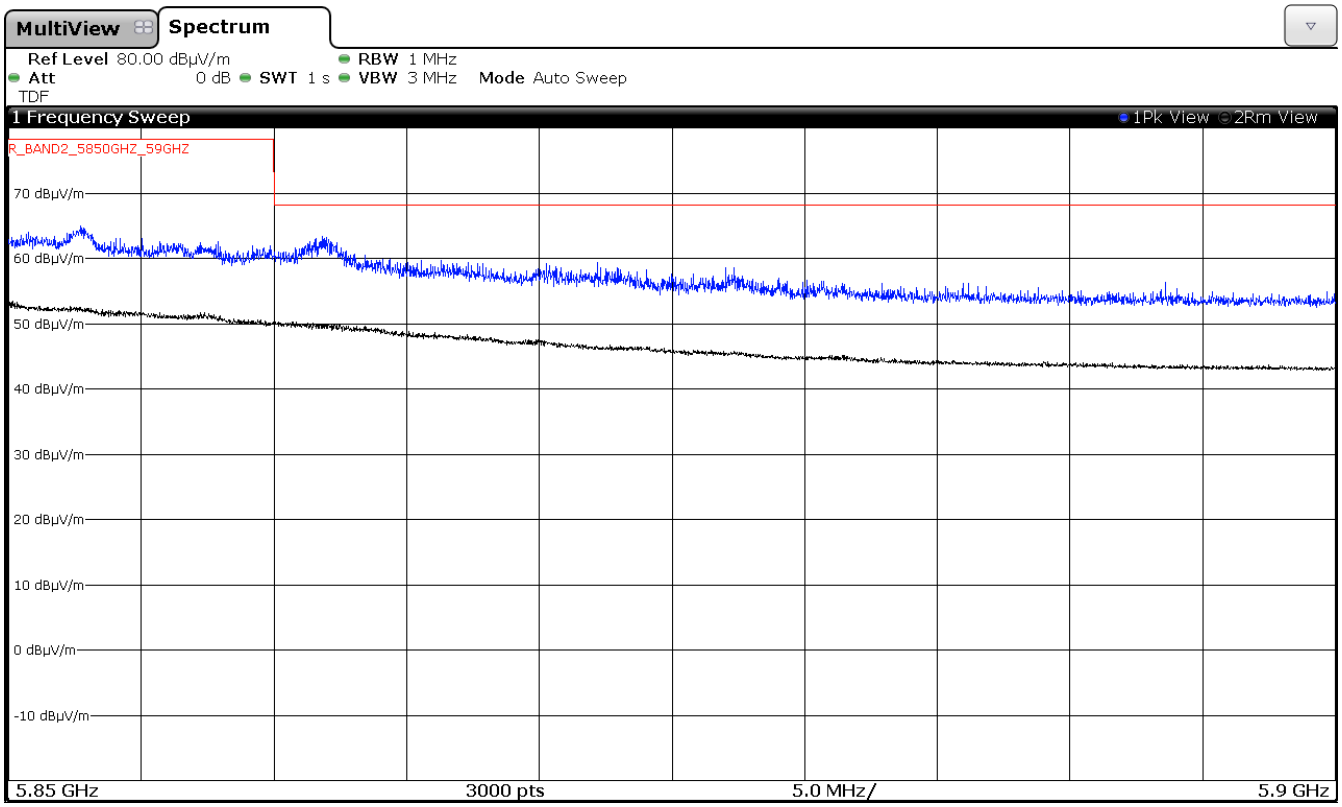
Highest frequency 5795 MHz.
Chain A



Chain B

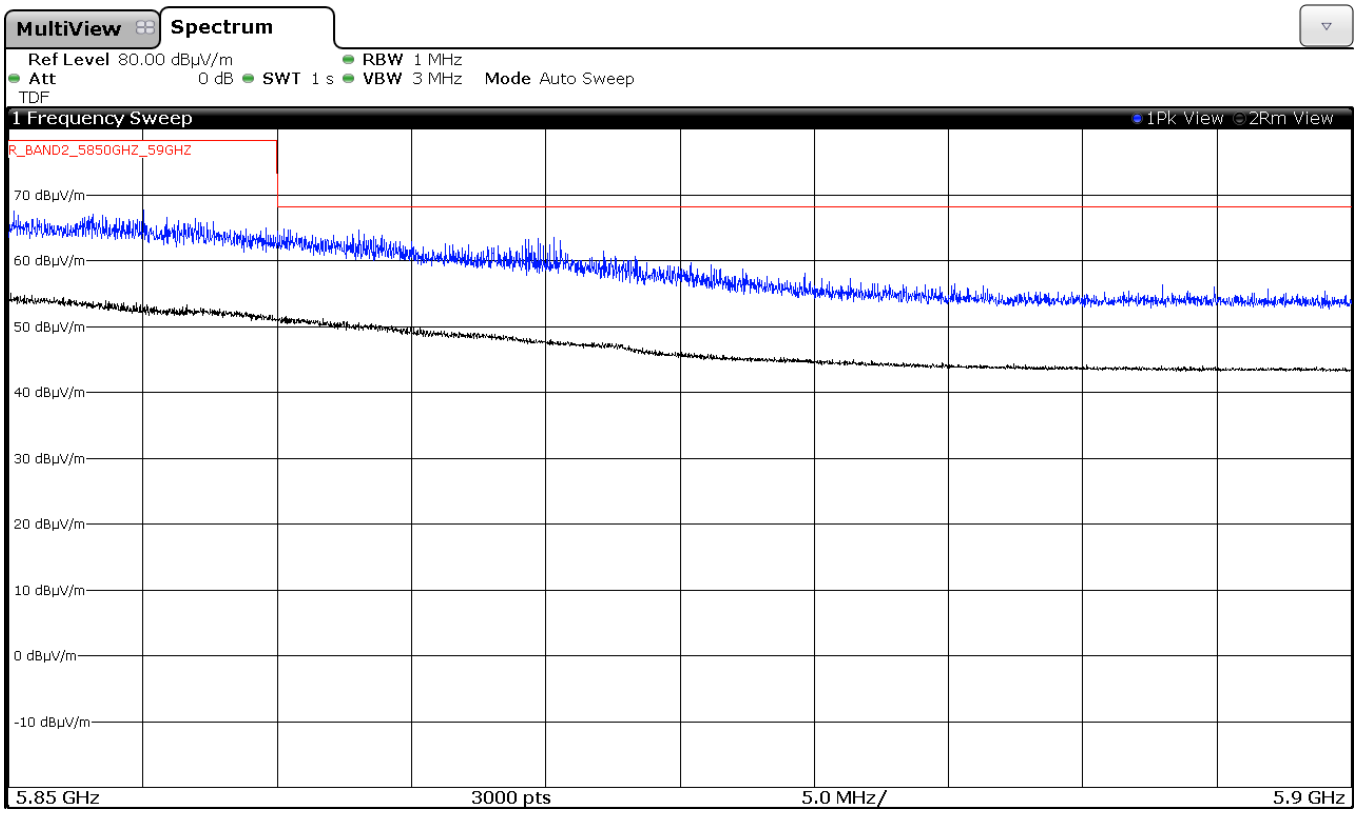


Chain A+B

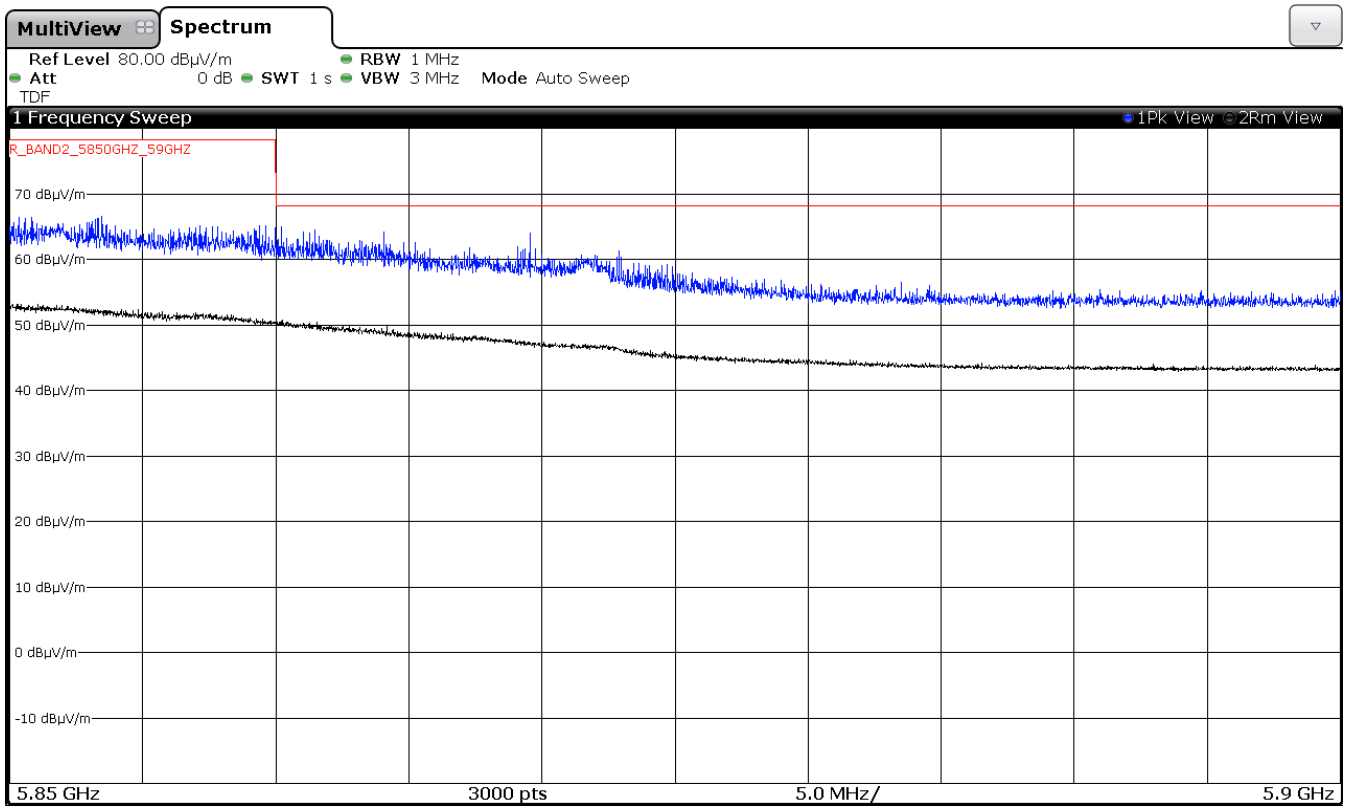


4. WiFi 5GHz 802.11 ac80 mode

Middle frequency 5775 MHz.
Chain A



Chain B



Chain A+B