Section 15.407 Subclause (a) (2) / RSS-210 A9.2. (3). 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 (23.97 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.

For the band 5.725–5.825 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 1 W (30 dBm) or 17 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. In addition, the peak power spectral density shall not exceed 17 dBm in any 1–MHz 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: For the band 5.47-5.725 GHz the maximum conducted output power shall not exceed 250 mW (23.97 dBm) or 10 + 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 (30 dBm) or 17 + 10log B, dBm, whichever power is less. B is the 99% emission bandwidth in MHz.

For the band 5.725–5.825 GHz 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 or 23 + 10 log10 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.

For channel 144 ac20MHz, channel 142 ac40 MHz and channel 138 ac80MHz the maximum conducted output power was measured using the method according to point H) 2) b) (ii) (Integration across the entire U-NII band) of the Guidance for IEEE 802.11ac and Pre-ac Device Emissions Testing “Guidance 644545 D01 for IEEE 802.11ac v01r02 dated 10/31/2013.

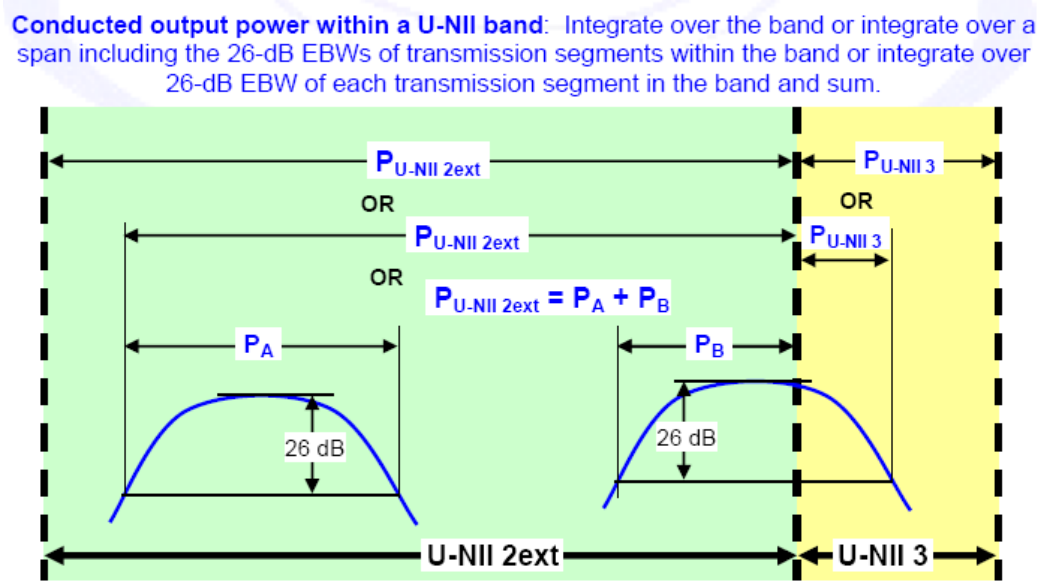


Figure 6. Conducted Output Power Measurement Examples

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 (NANT) 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 = 4.8 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)
5500 MHz	13.58	18.38	3.20	8.00
5600 MHz	15.44	20.24	5.10	9.90
5700 MHz	13.00	17.80	2.74	7.54

CHAIN B Maximum declared antenna gain = 4.8 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)
5500 MHz	13.18	17.98	2.99	7.79
5600 MHz	15.71	20.51	5.28	10.08
5700 MHz	13.14	17.94	2.79	7.59

Measurement uncertainty = ±1.2 dB

Verdict: Pass

2. 802.11 n20 MHz and 802.11 ac 20 MHz modes (except channel 144). (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 = 4.8 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)
5500 MHz	13.30	18.10	3.07	7.87
5600 MHz	15.44	20.24	4.92	9.72
5700 MHz	12.71	17.51	2.15	6.95

CHAIN B Maximum declared antenna gain = 4.8 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)
5500 MHz	13.29	18.09	2.79	7.59
5600 MHz	16.22	21.02	5.65	10.45
5700 MHz	12.82	17.62	2.21	7.01

MIMO CHAIN A+B. MAXIMUM OUTPUT POWER

Maximum declared antenna gain = 4.8 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
5500 MHz	10.67	10.34	13.52	18.32
5600 MHz	14.65	14.65	17.66	22.46
5700 MHz	11.19	11.07	14.14	18.94

MIMO CHAIN A+B. PPSD/MHz

Maximum declared antenna gain = 4.8 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)
5500 MHz	0.09	-0.21	3.10	2.80	7.90	7.60
5600 MHz	4.01	4.42	7.02	7.43	11.82	12.23
5700 MHz	0.71	0.45	3.72	3.46	8.52	8.26

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

802.11 ac 20MHz. Channel 144

CHAIN A Maximum declared antenna gain = 4.8 dBi

Frequency	PPSD/MHz (dBm) per sub-band		PPSD/MHz e.i.r.p. (dBm) per sub-band		Maximum conducted output power (dBm) per sub-band		Maximum output power e.i.r.p. (dBm) per sub-band	
	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4
5720 MHz	4.87	3.20	9.67	8.00	14.79	7.11	19.59	11.91

CHAIN B Maximum declared antenna gain = 4.8 dBi

Frequency	PPSD/MHz (dBm) per sub-band		PPSD/MHz e.i.r.p. (dBm) per sub-band		Maximum conducted output power (dBm) per sub-band		Maximum output power e.i.r.p. (dBm) per sub-band	
	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4
5720 MHz	5.70	3.77	10.50	8.57	15.75	7.63	20.55	12.43

MIMO CHAIN A+B. MAXIMUM OUTPUT POWER

Frequency	Maximum conducted output power per sub-band Chain A (dBm)		Maximum conducted output power per sub-band Chain B (dBm)		Total conducted output power (dBm)		Total output power e.i.r.p. (dBm)	
	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4
5720 MHz	12.70	4.88	12.96	4.15	15.84	7.54	20.64	12.34

Measurement uncertainty = ±1.2 dB

Verdict: PASS

MIMO CHAIN A+B. PPSD/MHz

Maximum declared antenna gain = 4.8 dBi

Freq.	PPSD/MHz per sub-band Chain A (dBm)		PPSD/MHz per sub-band Chain B (dBm)		Total PPSD/MHz per sub-band Chain A (dBm)[1]		Total PPSD/MHz per sub-band Chain B (dBm)[1]		Total PPSD/MHz per sub-band Chain A e.i.r.p. (dBm)		Total PPSD/MHz per sub-band Chain B e.i.r.p. (dBm)	
	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4
5720 MHz	2.67	1.03	2.84	0.24	5.68	4.04	5.85	3.25	10.48	8.84	10.65	8.05

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

3. 802.11 n40 MHz and 802.11 ac 40 MHz modes (except channel 142). (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 = 4.8 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)
5510 MHz	13.22	18.02	-0.61	4.19
5590 MHz	16.17	20.97	2.46	7.26
5670 MHz	16.22	21.02	2.29	7.09

CHAIN B Maximum declared antenna gain = 4.8 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)
5510 MHz	13.21	18.01	-0.62	4.18
5590 MHz	16.20	21.00	2.48	7.28
5670 MHz	16.73	21.53	2.93	7.73

MIMO CHAIN A+B. MAXIMUM OUTPUT POWER

Maximum declared antenna gain = 4.8 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
5510 MHz	11.29	11.57	14.44	19.24
5590 MHz	16.69	16.28	19.50	24.30
5670 MHz	16.70	16.31	19.51	24.31

Measurement uncertainty = ±1.2 dB

Verdict: PASS

MIMO CHAIN A+B. PPSD/MHz

Maximum declared antenna gain = 4.8 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)
5510 MHz	-2.18	-2.18	0.83	0.83	5.63	5.63
5590 MHz	2.92	2.53	5.93	5.54	10.73	10.34
5670 MHz	3.08	2.58	6.09	5.59	10.89	10.39

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

802.11 ac 40MHz. Channel 142.

CHAIN A Maximum declared antenna gain = 4.8 dBi

Frequency	Maximum conducted output power (dBm) per sub-band		Maximum output power e.i.r.p. (dBm) per sub-band		PPSD/MHz (dBm) per sub-band		PPSD/MHz e.i.r.p. (dBm) per sub-band	
	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4
5710 MHz	16.00	3.23	20.80	8.03	2.23	-1.15	7.03	3.65

CHAIN B Maximum declared antenna gain = 4.8 dBi

Frequency	Maximum conducted output power (dBm) per sub-band		Maximum output power e.i.r.p. (dBm) per sub-band		PPSD/MHz (dBm) per sub-band		PPSD/MHz e.i.r.p. (dBm) per sub-band	
	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4
5710 MHz	16.17	3.36	20.97	8.16	2.47	-1.13	7.27	3.67

MIMO CHAIN A+B. MAXIMUM OUTPUT POWER

Maximum declared antenna gain = 4.8 dBi

Frequency	Maximum conducted output power per sub-band Chain A (dBm)		Maximum conducted output power per sub-band Chain B (dBm)		Total conducted output power (dBm) per sub-band		Total output power e.i.r.p. (dBm) per sub-band	
	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4
5710 MHz	16.21	3.77	16.38	4.29	19.31	7.05	24.11	11.85

Measurement uncertainty = ±1.2 dB

Verdict: PASS

MIMO CHAIN A+B. PPSD/MHz

Maximum declared antenna gain = 4.8 dBi

Freq.	PPSD/MHz per sub-band Chain A (dBm)		PPSD/MHz per sub-band Chain B (dBm)		Total PPSD/MHz per sub-band Chain A (dBm)[1]		Total PPSD/MHz per sub-band Chain B (dBm)[1]		Total PPSD/MHz per sub-band Chain A e.i.r.p. (dBm)		Total PPSD/MHz Chain B e.i.r.p. per sub-band (dBm)	
	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4
5710 MHz	3.57	-0.96	2.39	-0.22	6.58	2.05	5.4	1.83	11.38	6.85	10.2	6.63

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 (except channel 138). (see next plots).

CHAIN A Maximum declared antenna gain = 4.8 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)
5530 MHz	13.52	18.32	-2.84	1.96
5610 MHz	16.50	21.30	0.70	5.50

CHAIN B Maximum declared antenna gain = 4.8 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)
5530 MHz	13.67	18.47	-2.07	2.73
5610 MHz	16.55	21.35	0.58	5.38

MIMO CHAIN A+B. MAXIMUM OUTPUT POWER

Maximum declared antenna gain = 4.8 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
5530 MHz	11.40	11.69	14.56	19.36
5610 MHz	16.75	16.38	19.58	24.38

Measurement uncertainty = ±1.2 dB

Verdict: PASS

MIMO CHAIN A+B. PPSD/MHz

Maximum declared antenna gain = 4.8 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)
5530 MHz	-4.84	-3.73	-1.83	-0.72	2.97	4.08
5610 MHz	1.35	1.33	4.36	4.34	9.16	9.14

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

802.11 ac 80MHz. Channel 138.

CHAIN A Maximum declared antenna gain = 4.8 dBi

Frequency	Maximum conducted output power (dBm) per sub-band		Maximum output power e.i.r.p. (dBm) per sub-band		PPSD/MHz (dBm) per sub-band		PPSD/MHz e.i.r.p. (dBm) per sub-band	
	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4
5690 MHz	16.30	0.49	21.1	5.29	0.69	-4.36	5.49	0.44

CHAIN B Maximum declared antenna gain = 4.8 dBi

Frequency	Maximum conducted output power (dBm) per sub-band		Maximum output power e.i.r.p. (dBm) per sub-band		PPSD/MHz (dBm) per sub-band		PPSD/MHz e.i.r.p. (dBm) per sub-band	
	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4
5690 MHz	16.33	-0.28	21.13	4.52	0.63	-5.06	5.43	-0.26

MIMO CHAIN A+B. MAXIMUM OUTPUT POWER

Maximum declared antenna gain = 4.8 dBi

Frequency	Maximum conducted output power per sub-band Chain A (dBm)		Maximum conducted output power per sub-band Chain B (dBm)		Total conducted output power (dBm) per sub-band		Total output power e.i.r.p. (dBm) per sub-band	
	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4
5690 MHz	16.28	1.02	16.37	0.51	19.33	3.78	24.13	8.58

Measurement uncertainty = ±1.2 dB

Verdict: PASS

MIMO CHAIN A+B. PPSD/MHz

Maximum declared antenna gain = 4.8 dBi

Freq.	PPSD/MHz per sub-band Chain A (dBm)		PPSD/MHz per sub-band Chain B (dBm)		Total PPSD/MHz per sub-band Chain A (dBm)[1]		Total PPSD/MHz per sub-band Chain B (dBm)[1]		Total PPSD/MHz per sub-band Chain A e.i.r.p. (dBm)		Total PPSD/MHz per sub-band Chain B e.i.r.p. (dBm)	
	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4	UNII_3	UNII_4
5690 MHz	-0.33	-3.85	-0.13	-4.43	2.68	-0.84	2.88	-1.42	7.48	3.96	7.68	3.38

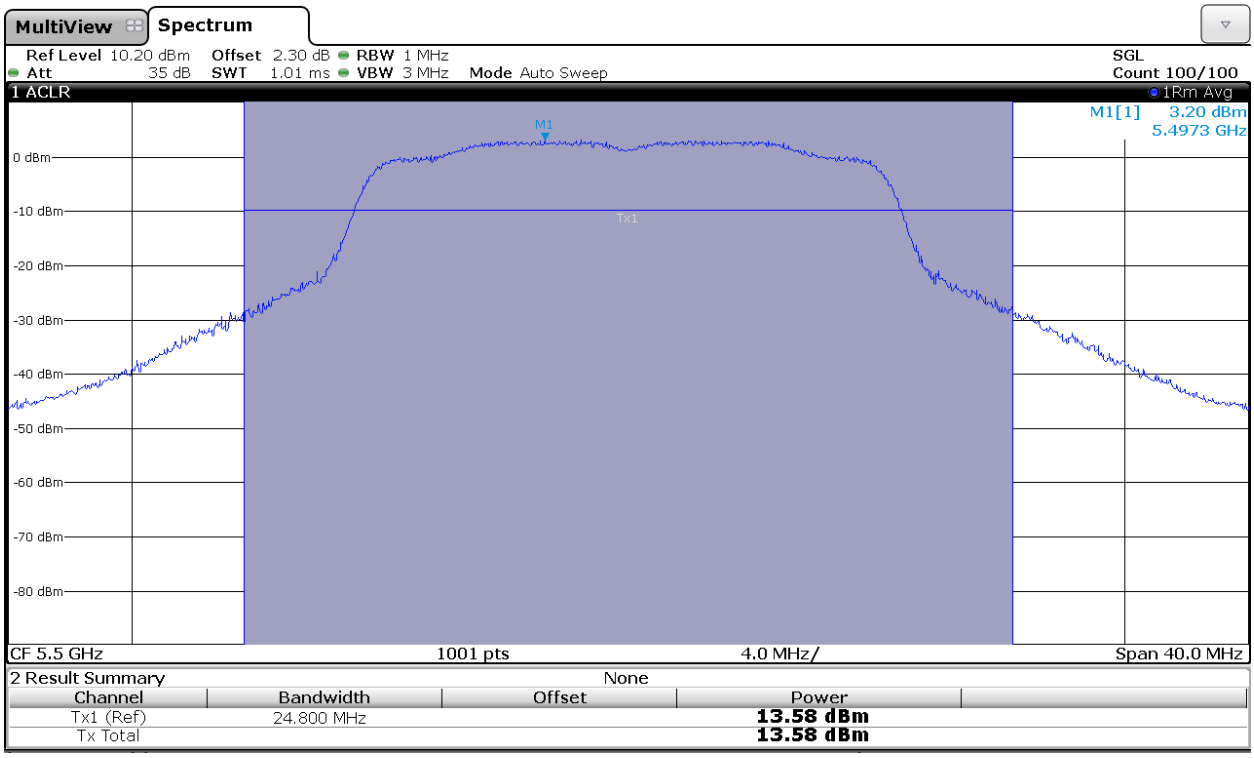
Note 1: The quantity 10*log 2 (two antennas) is added to the spectrum peak value according to document 662911 D01.

Measurement uncertainty = ±1.2 dB

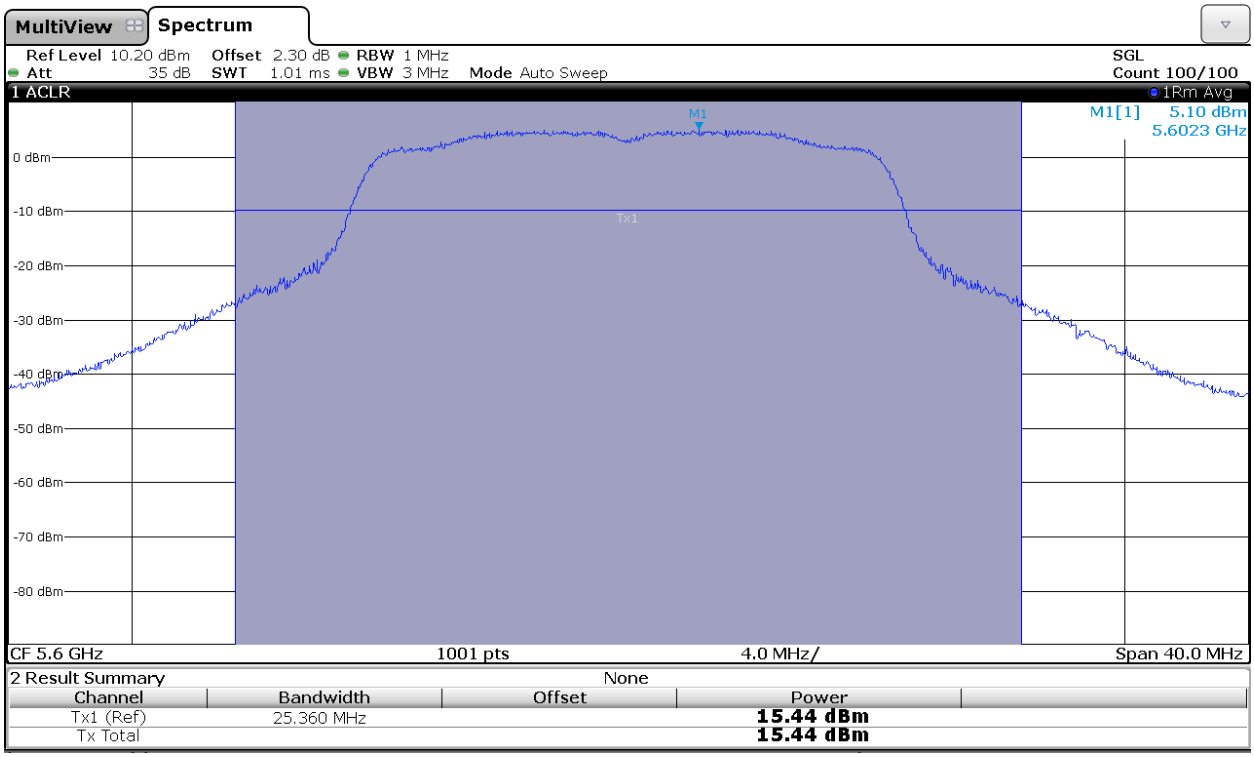
Verdict: PASS

802.11a mode CHAIN A

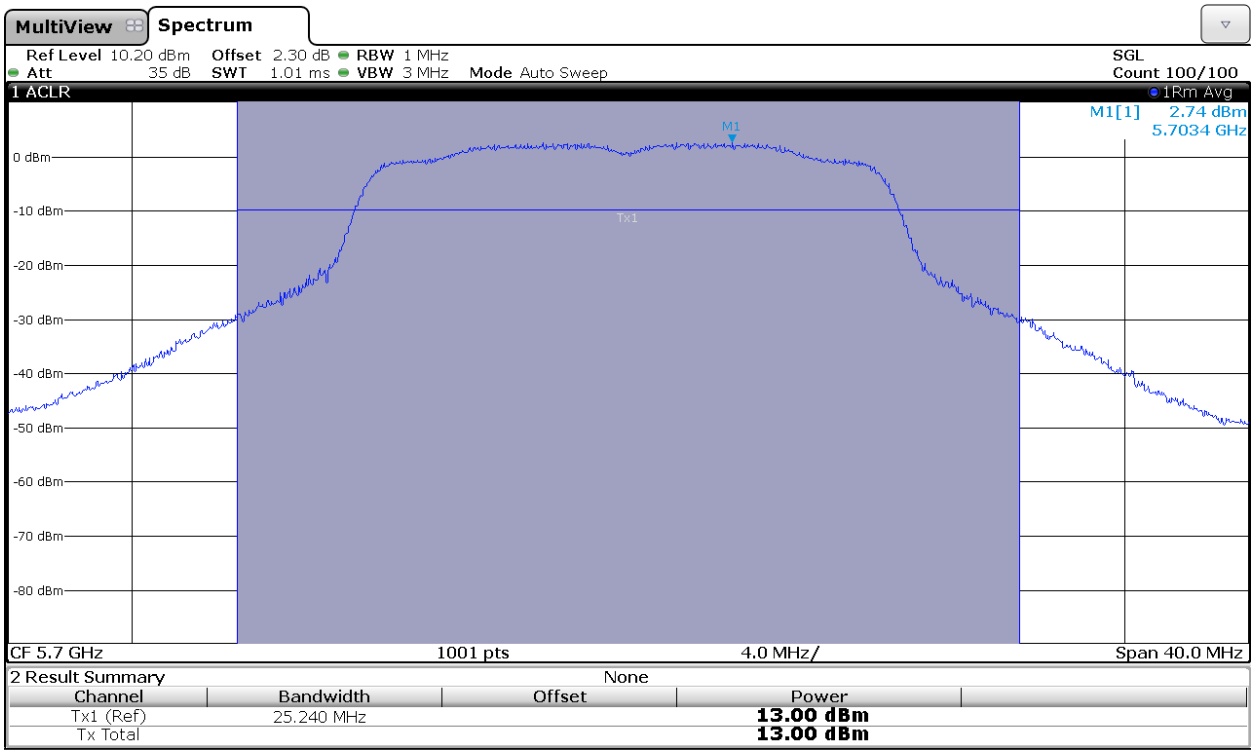
Lowest Channel



Middle Channel

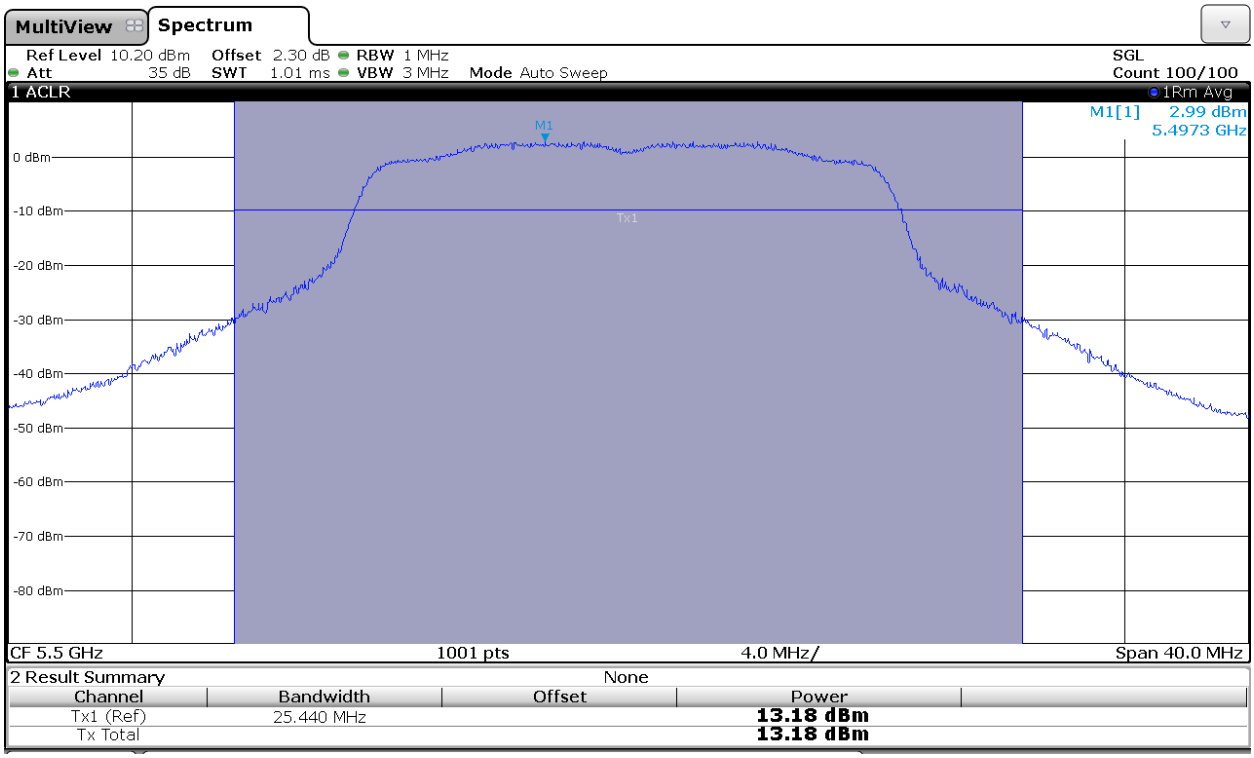


Highest Channel

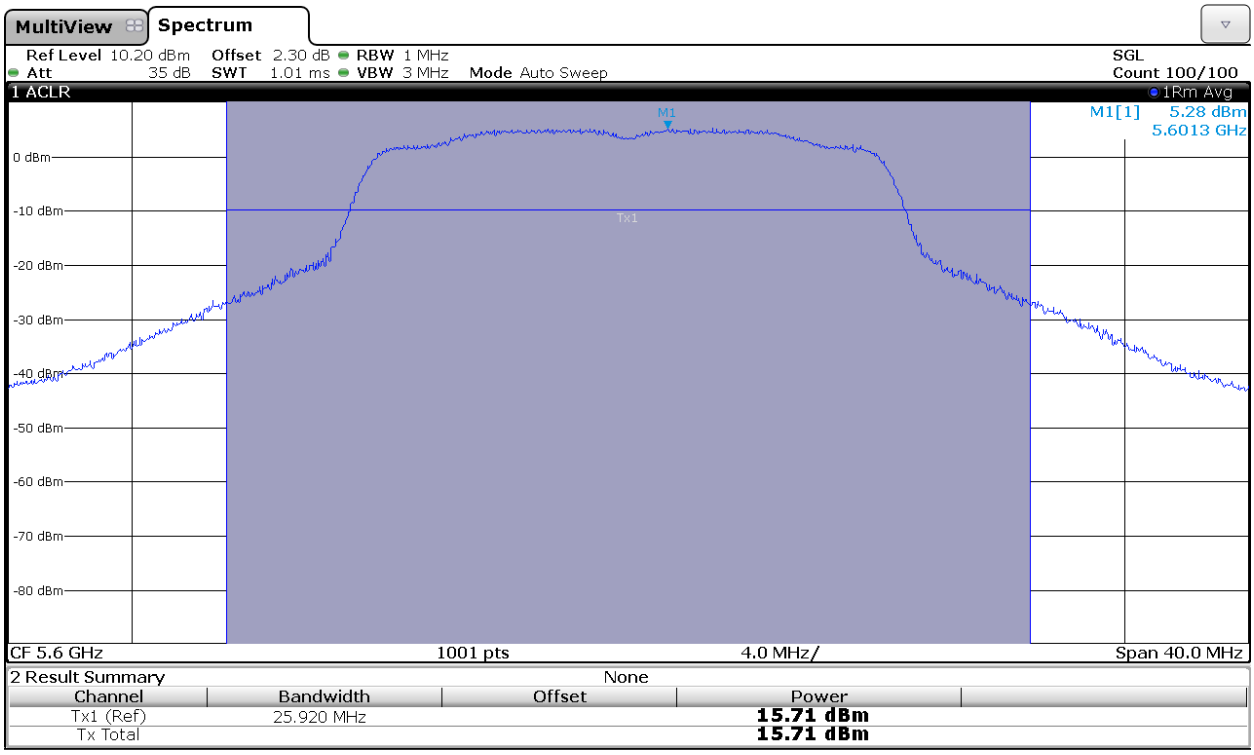


802.11a mode CHAIN B

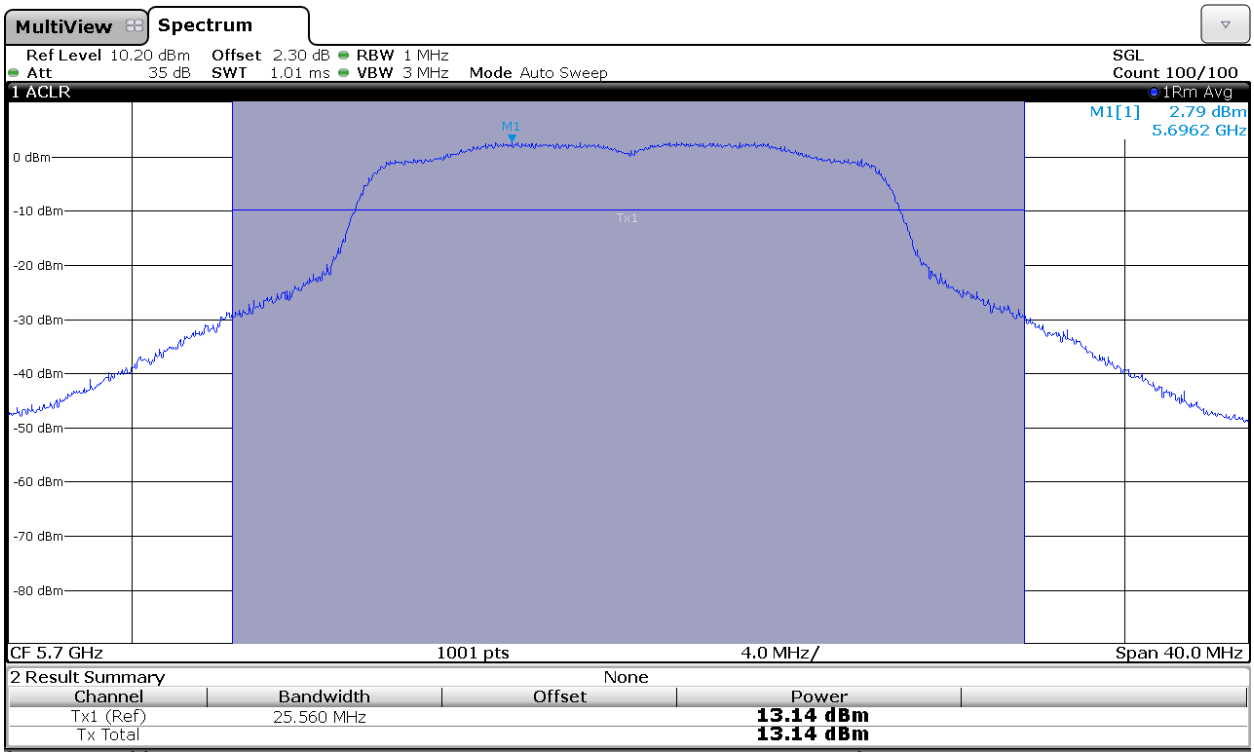
Lowest Channel



Middle Channel

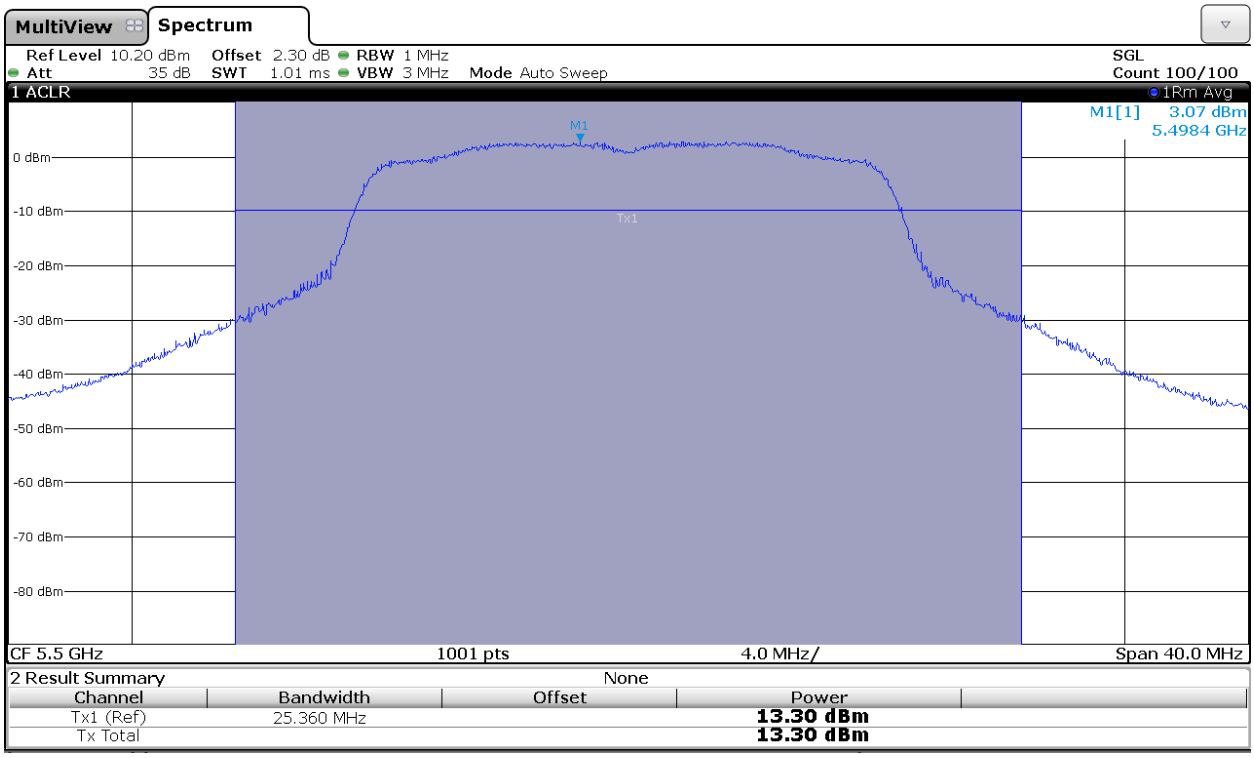


Highest Channel

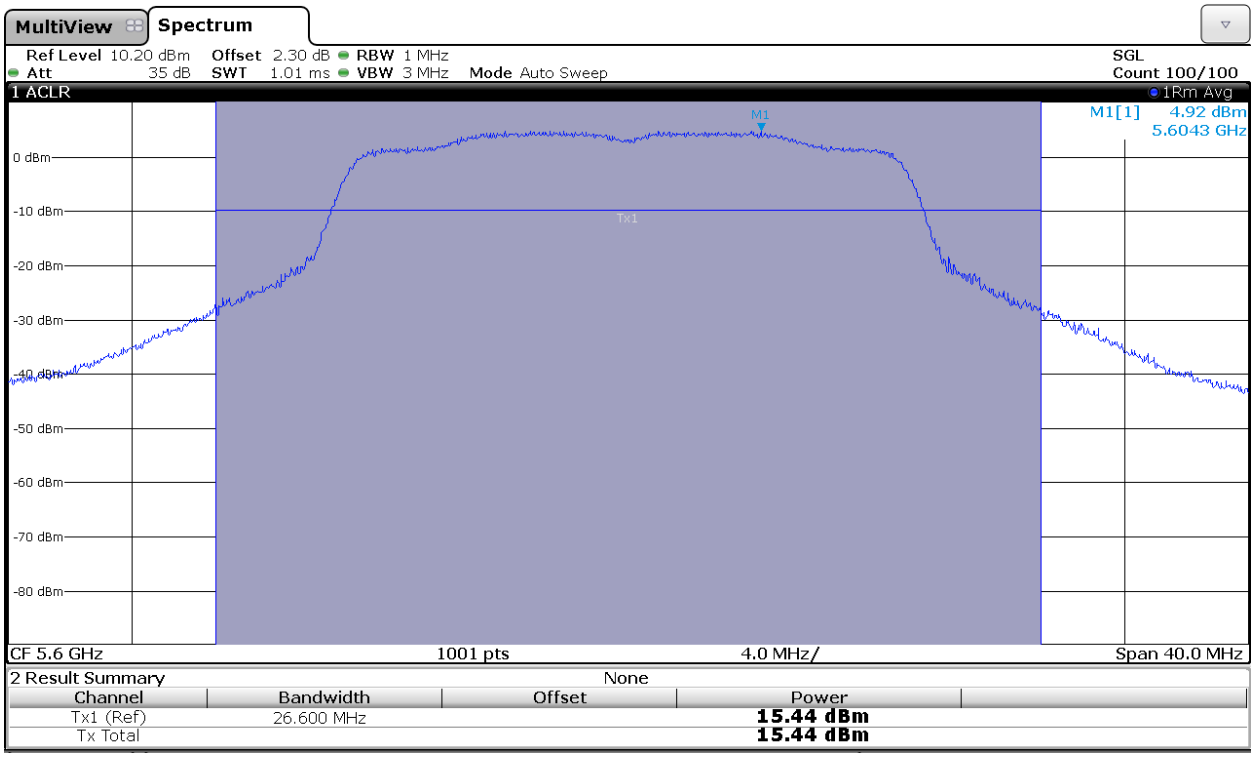


802.11 n20 MHz modes (except channel 144) CHAIN A

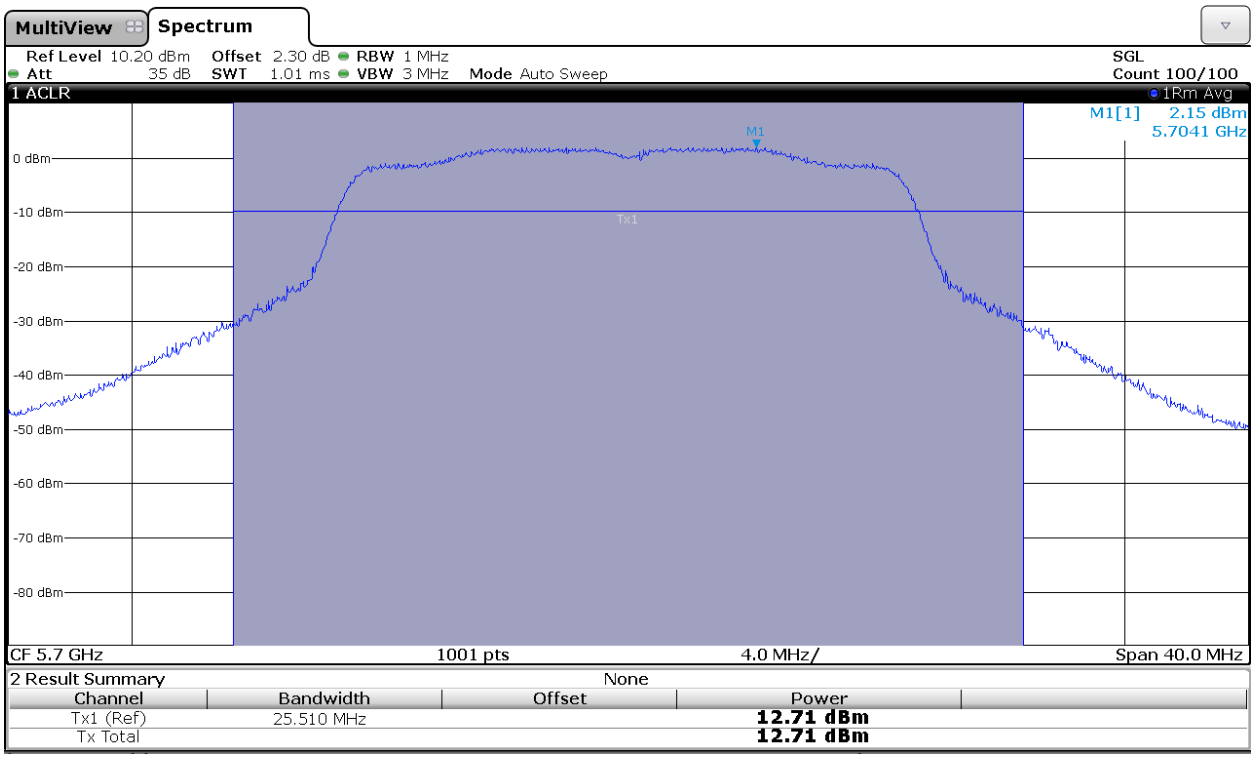
Lowest Channel



Middle Channel

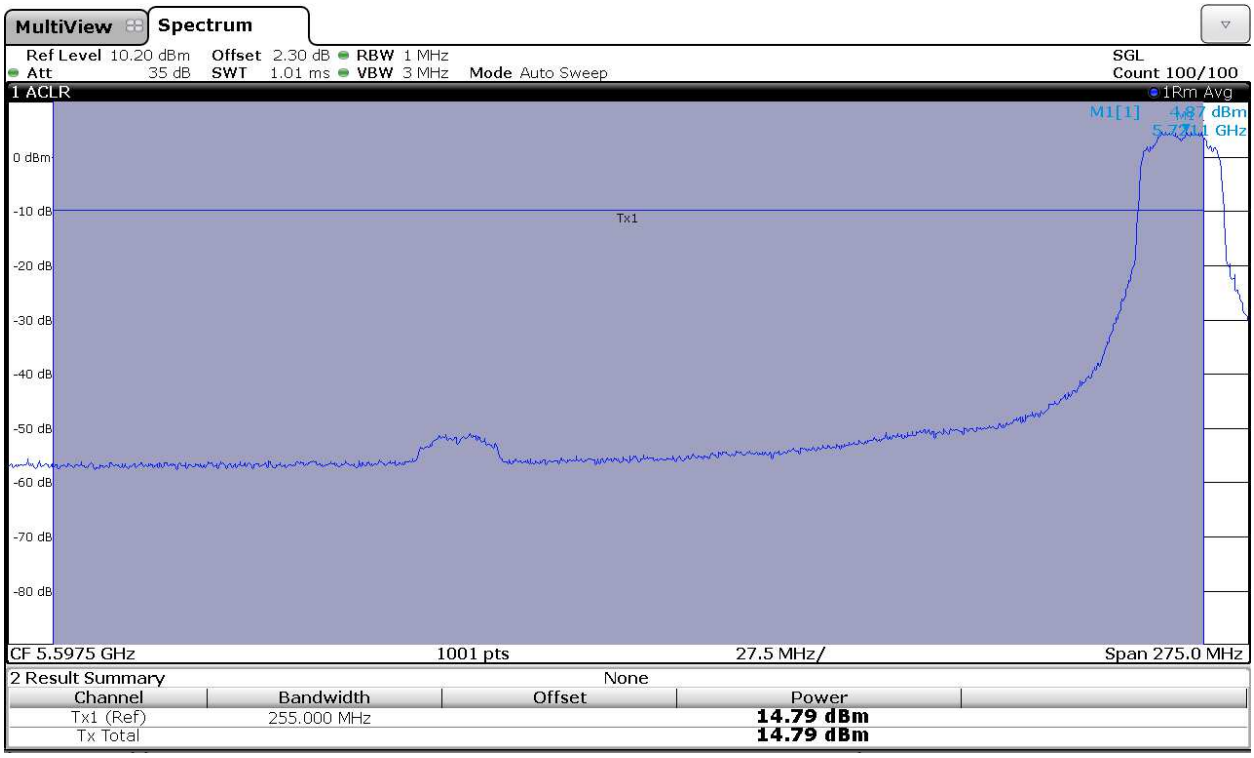


Highest Channel

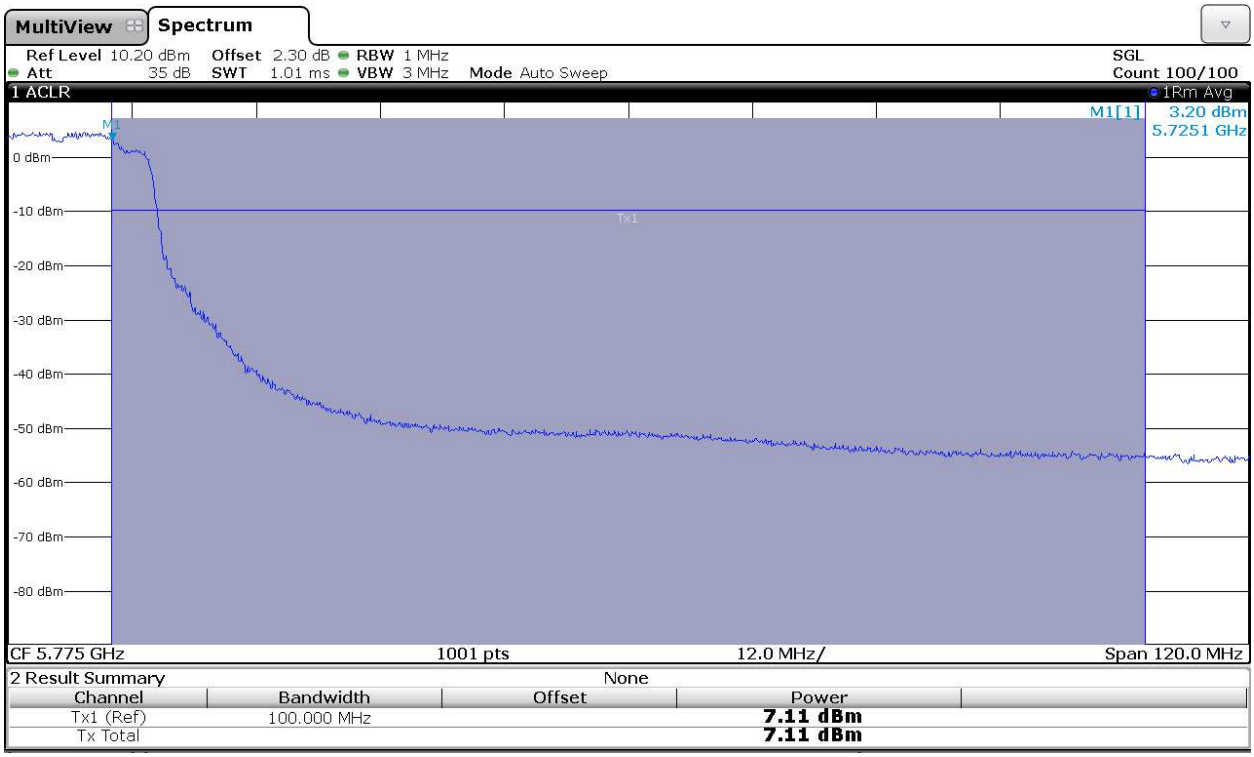


802.11 ac 20MHz : Channel 144

Power and PPSD in sub-band UNII_3:

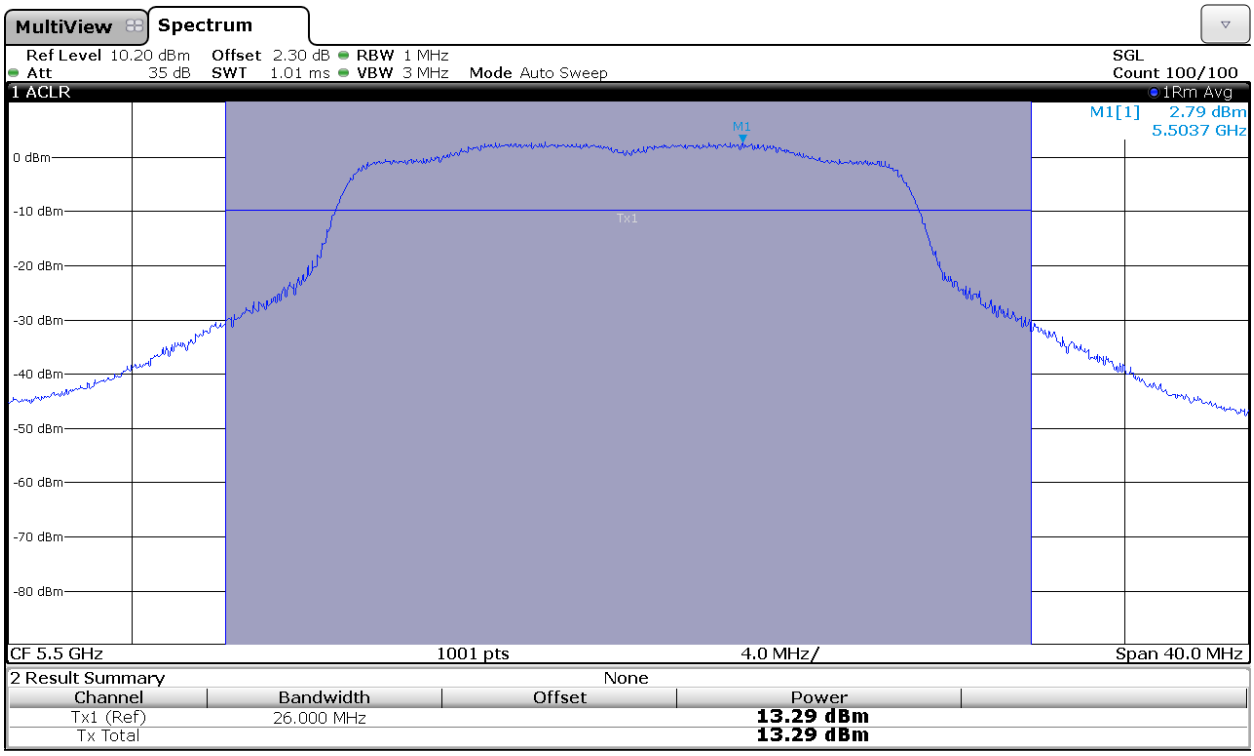


Power and PPSD in sub-band UNII_4:

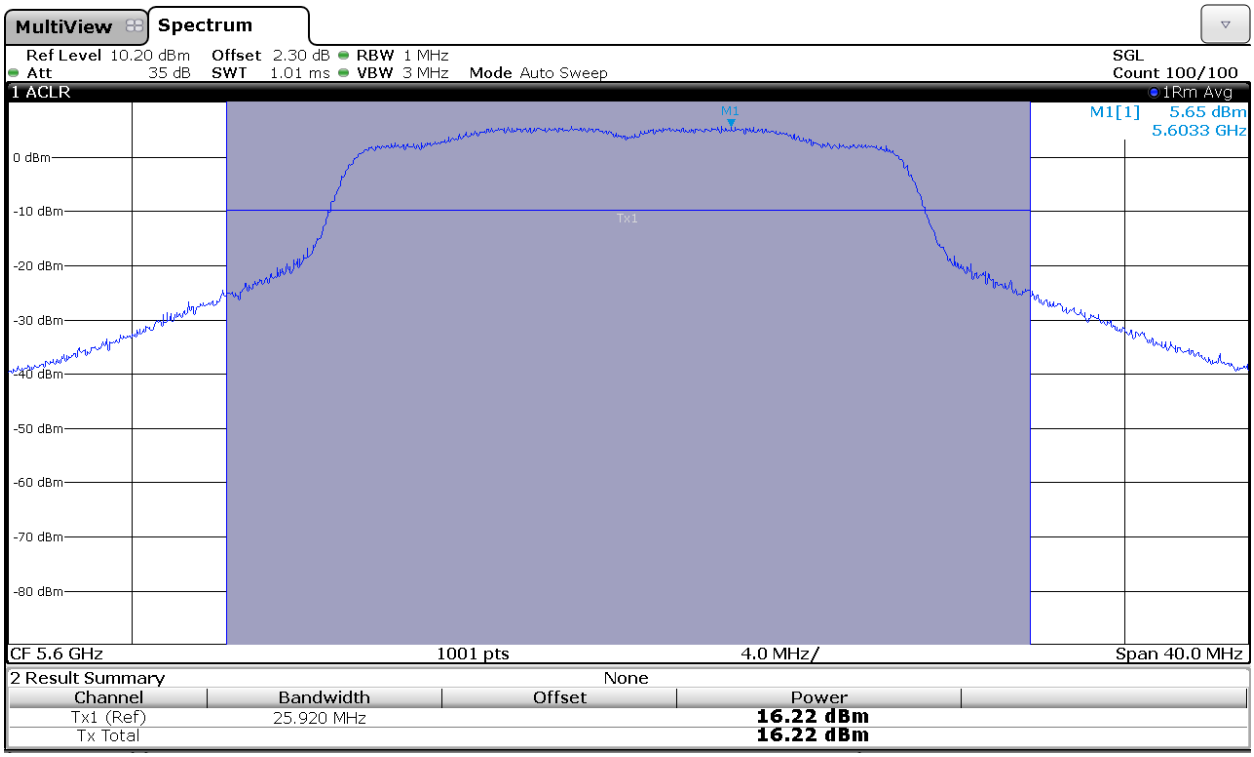


802.11 n20 MHz and 802.11 ac 20 MHz modes (except channel 144) CHAIN B

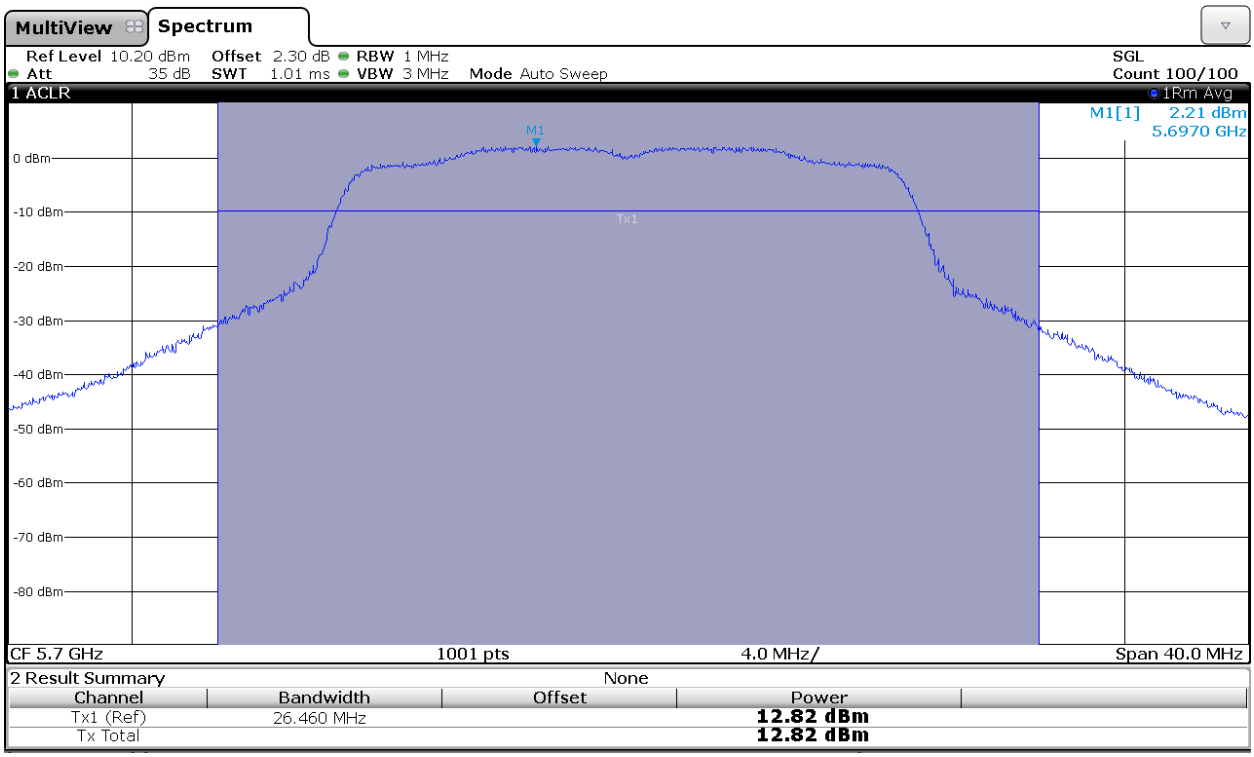
Lowest Channel



Middle Channel

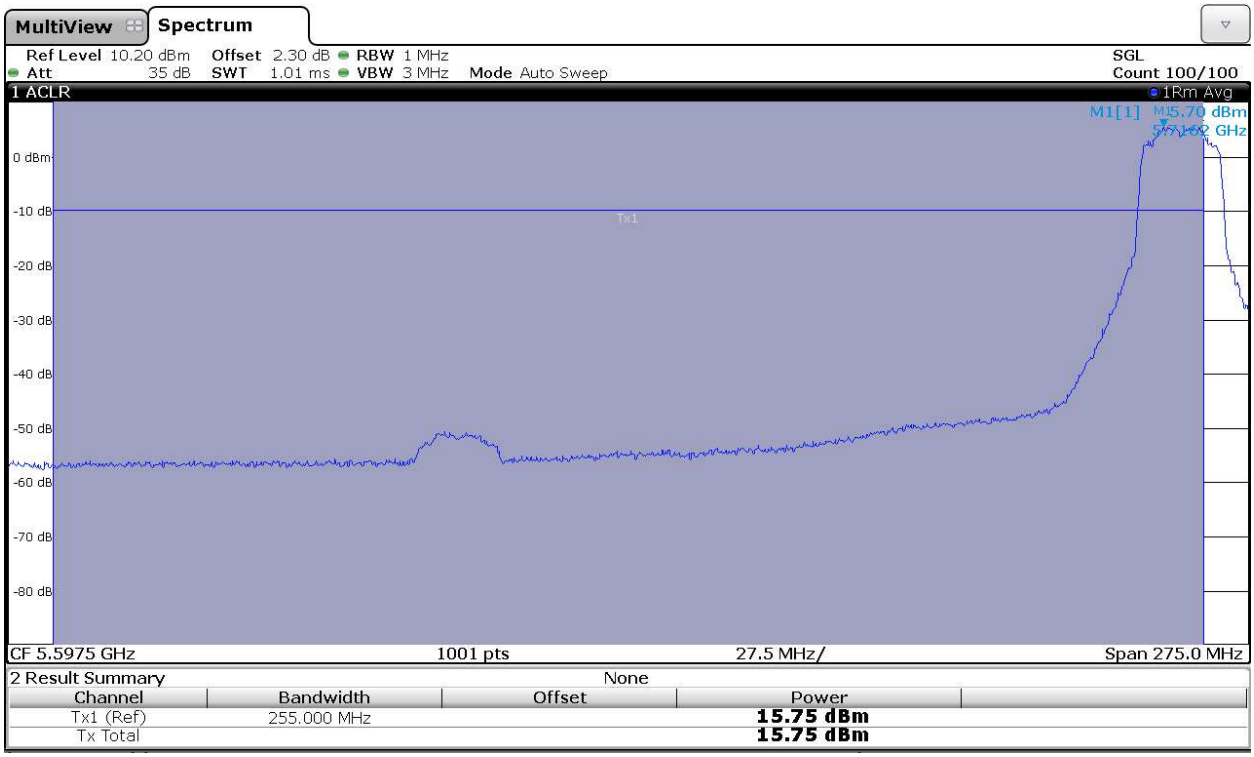


Highest Channel

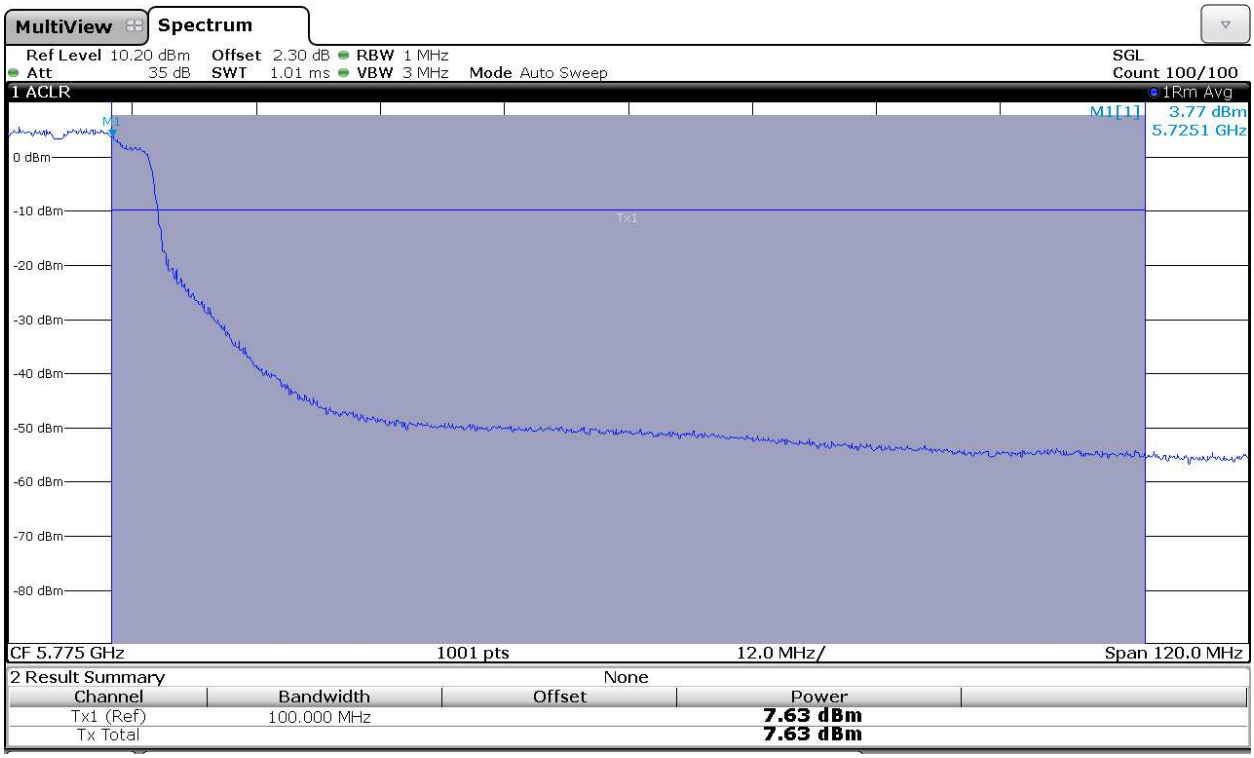


802.11 ac 20MHz : Channel 144

Power and PPSD in sub-band UNII_3:

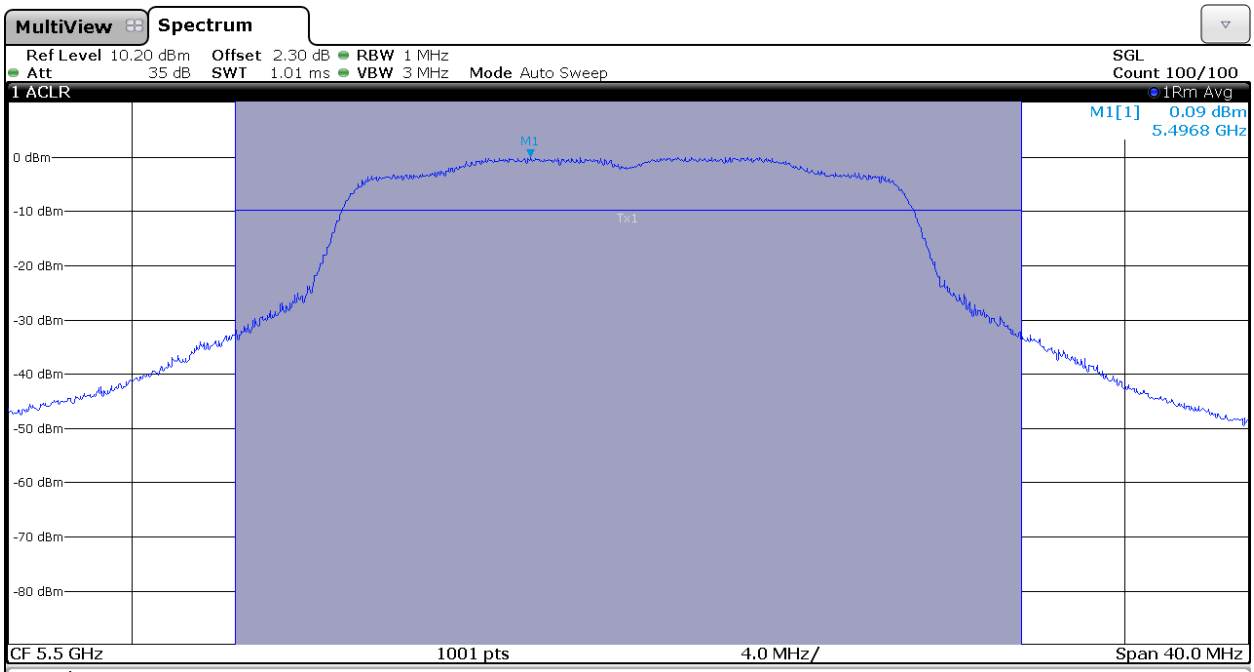


Power and PPSD in sub-band UNII_4:

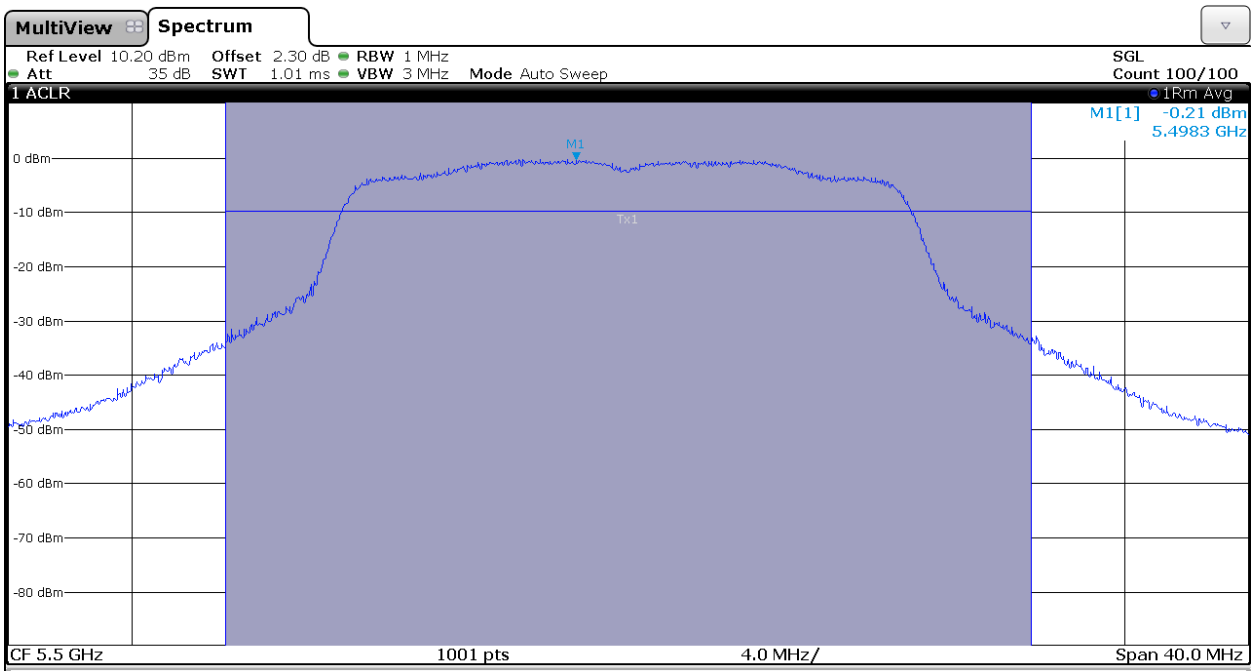


802.11 n20 MHz and 802.11 ac 20 MHz modes (except channel 144) MIMO CHAIN A+B

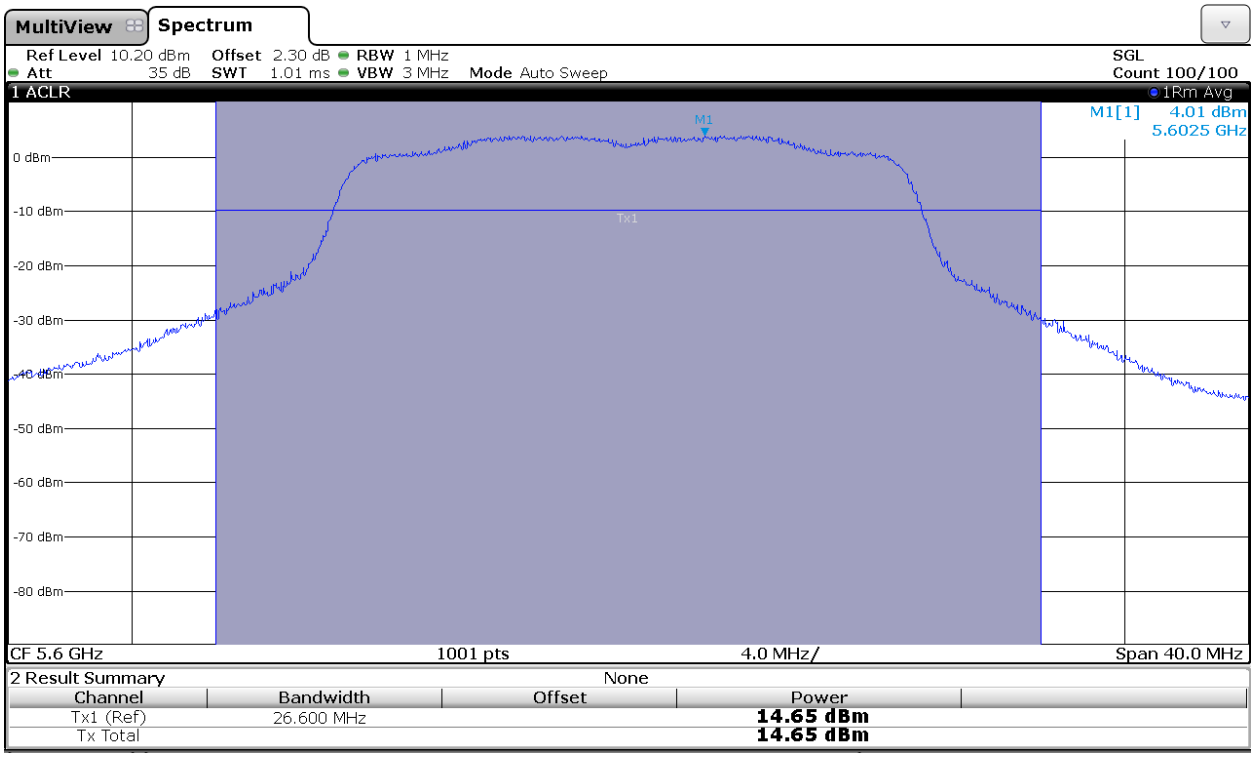
Lowest Channel. Chain A



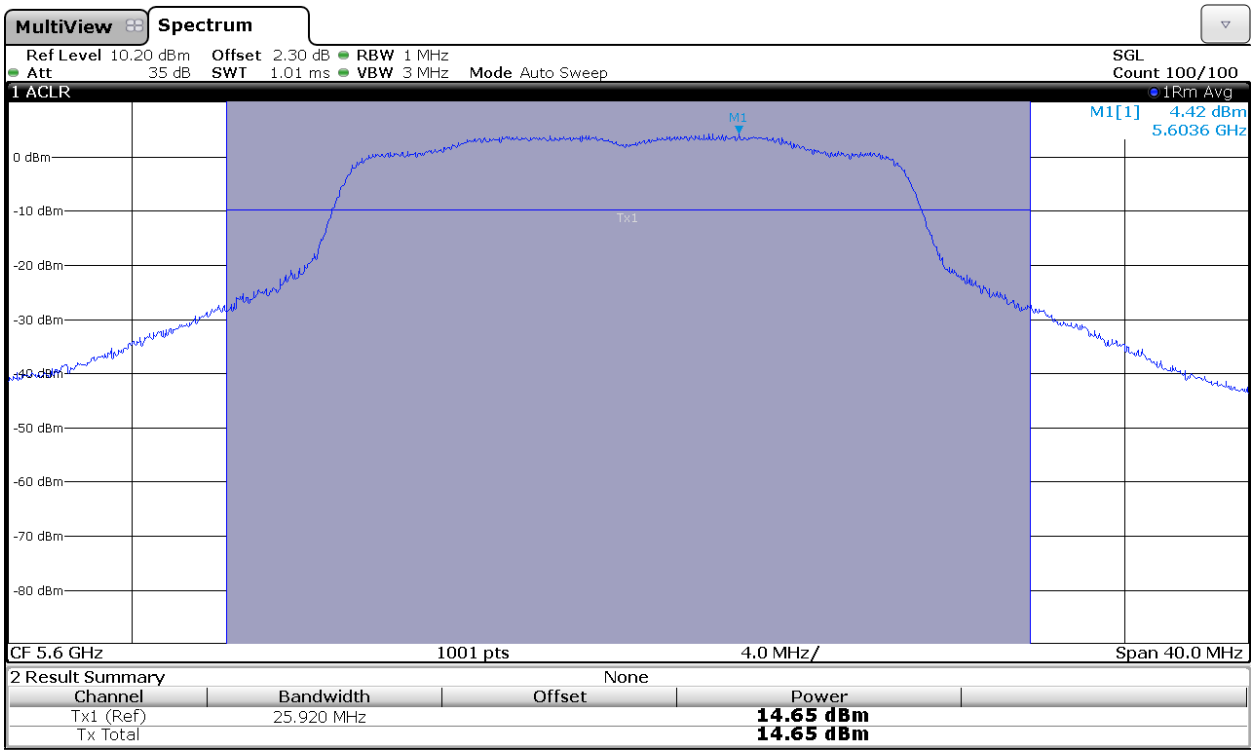
Lowest Channel. Chain B



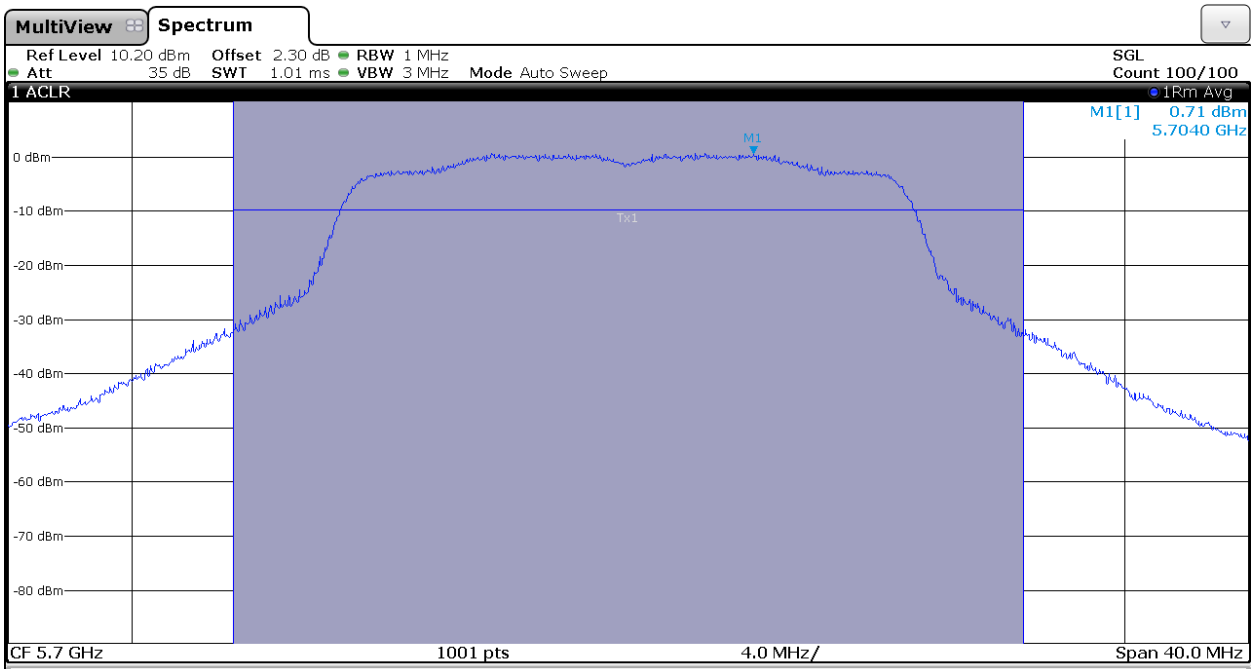
Middle Channel. Chain A



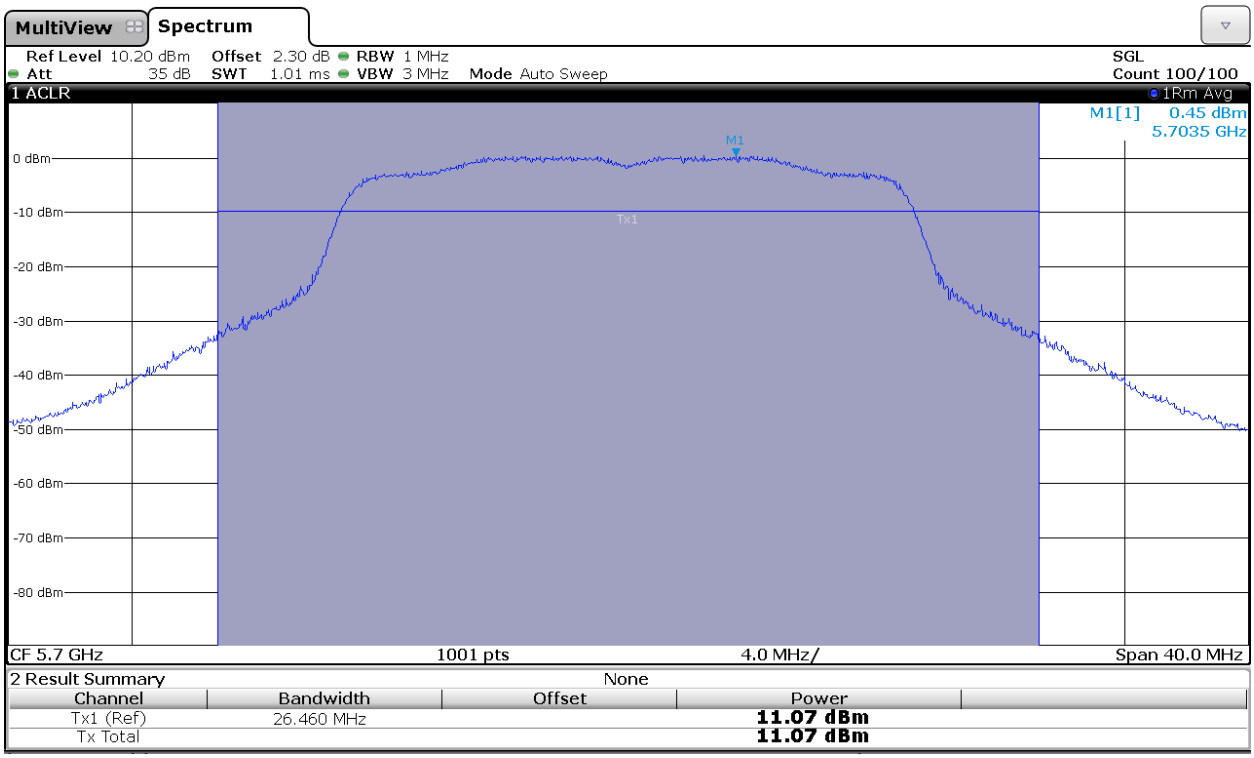
Middle Channel. Chain B



Highest Channel. Chain A

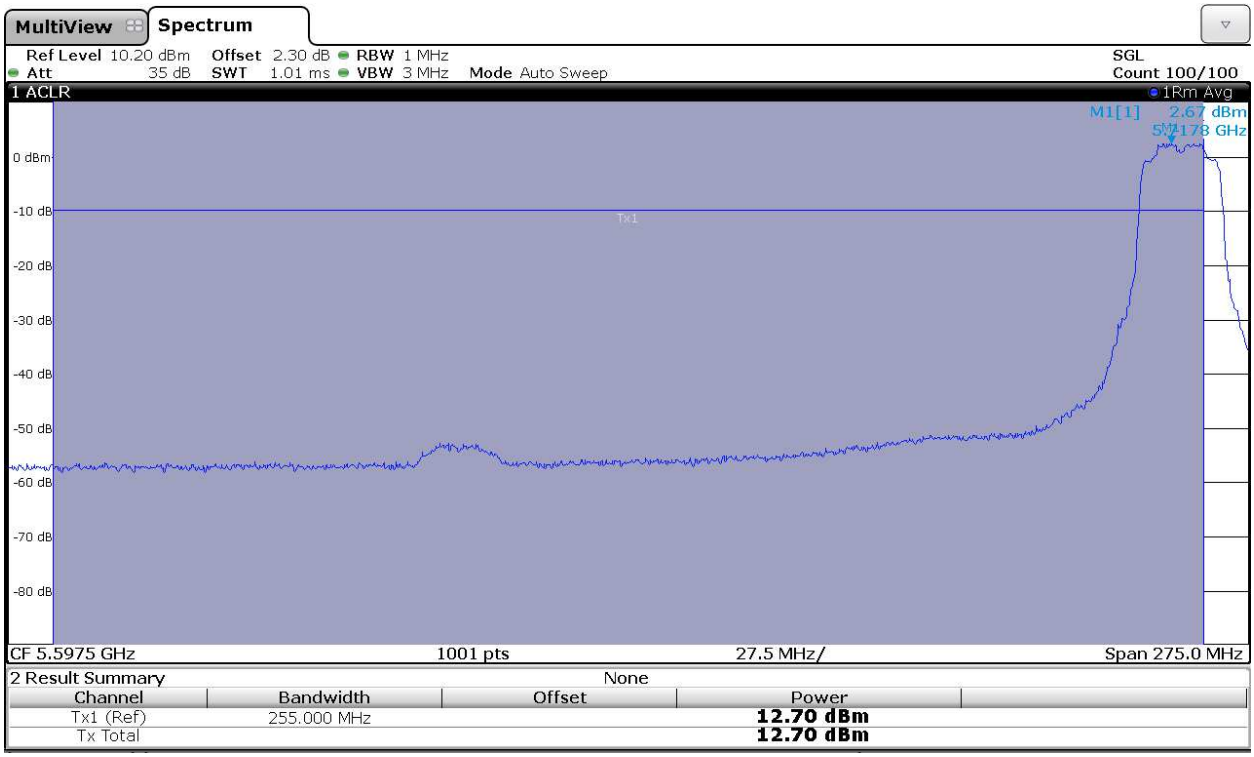


Highest Channel. Chain B

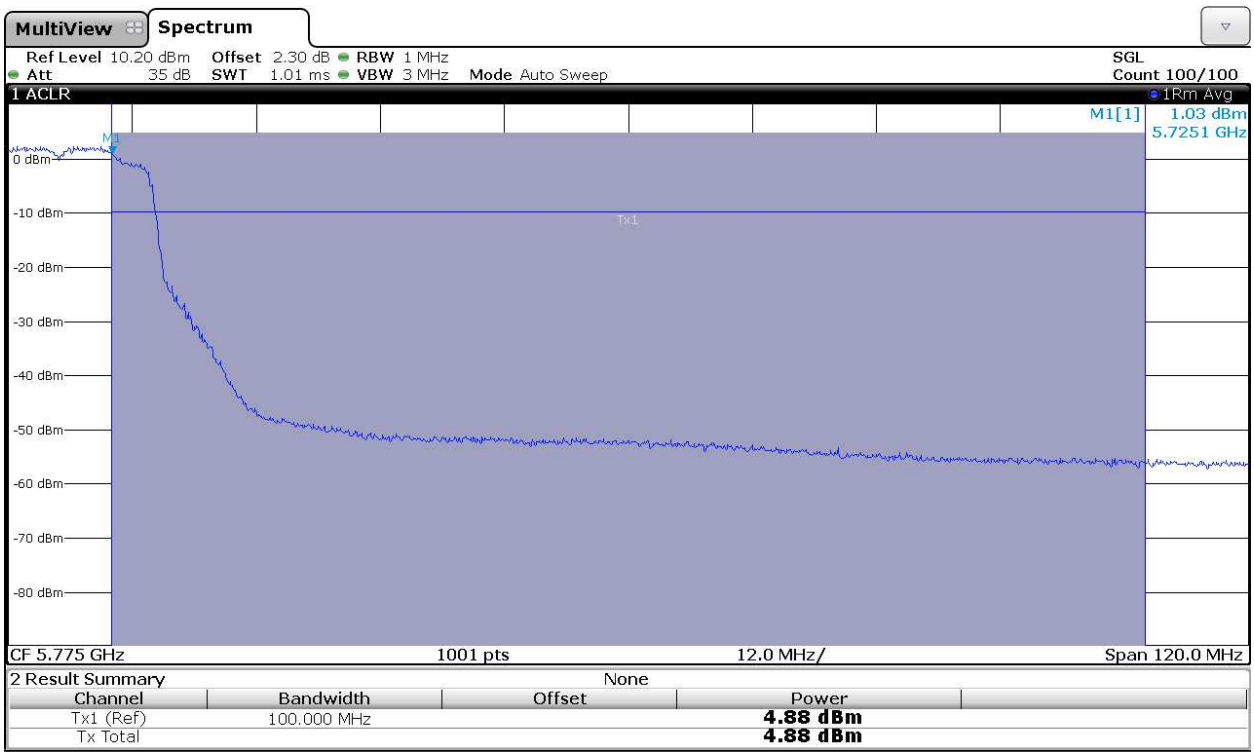


802.11 ac 20MHz : Channel 144

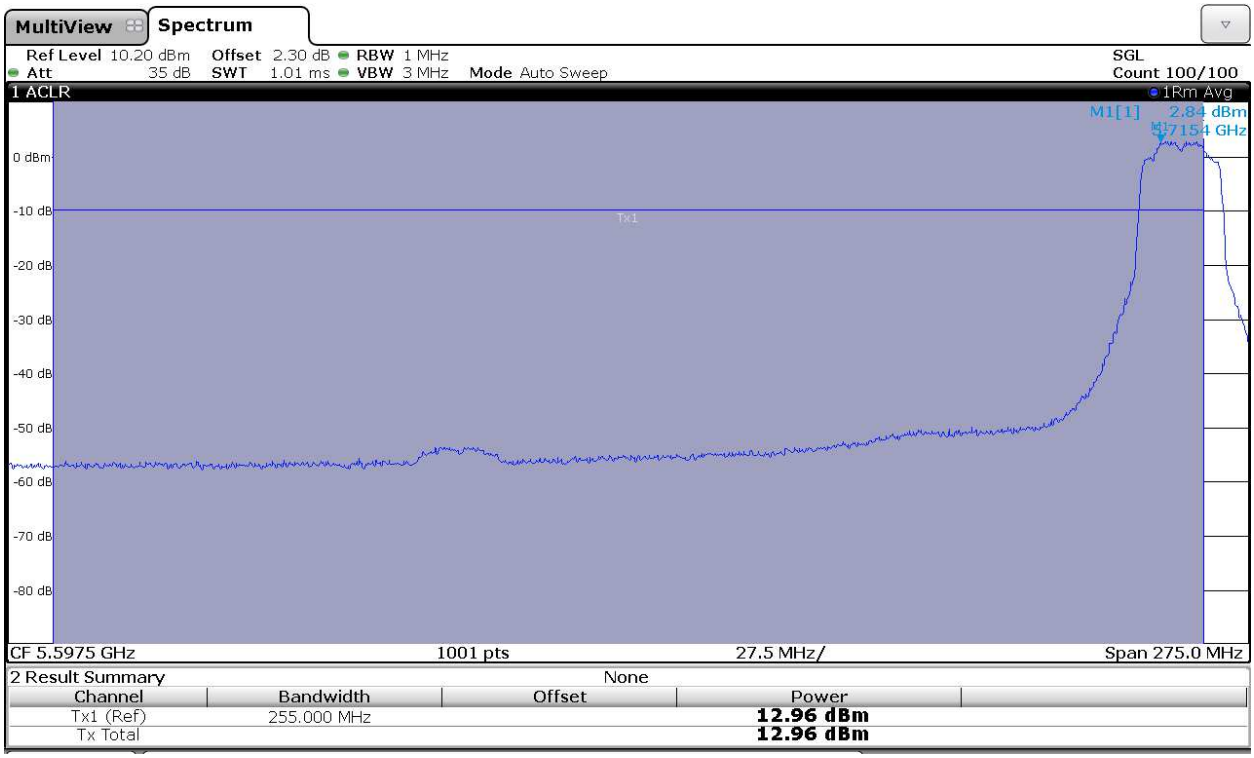
Power and PPSD in sub-band UNII_3: Chain A



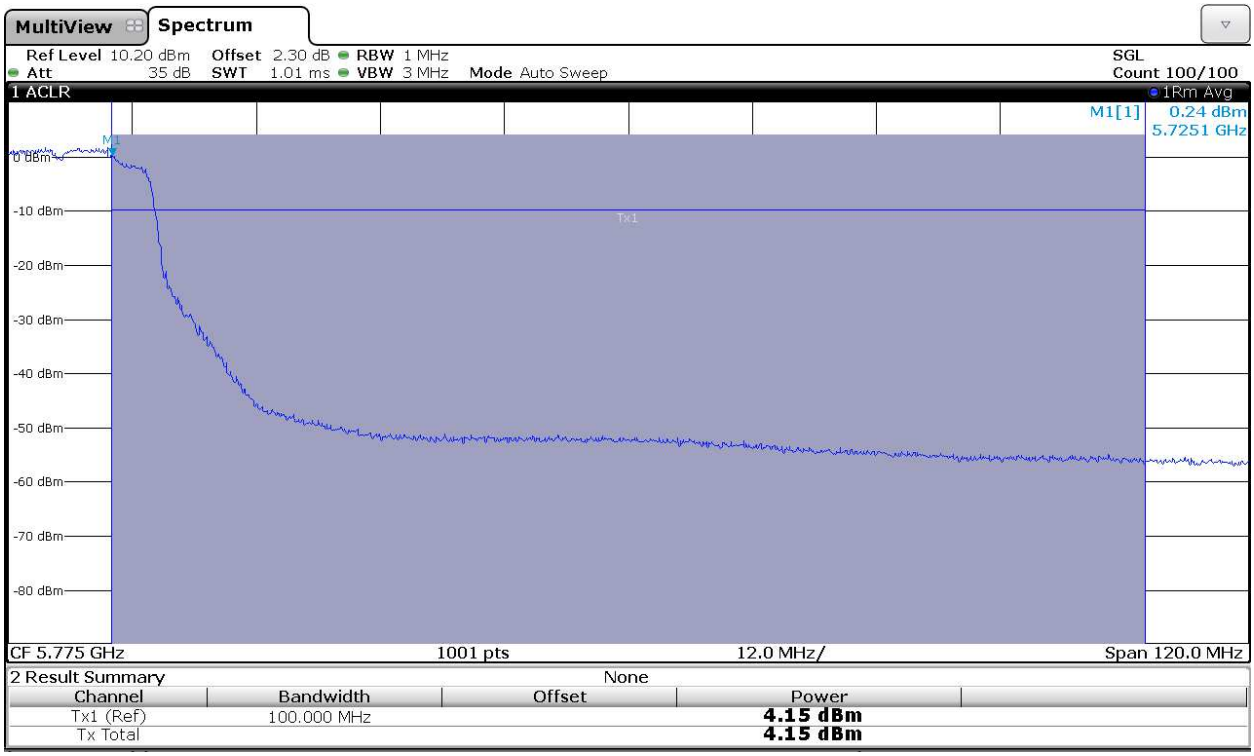
Power and PPSD in sub-band UNII_4: Chain A



Power and PPSD in sub-band UNII_3: Chain B

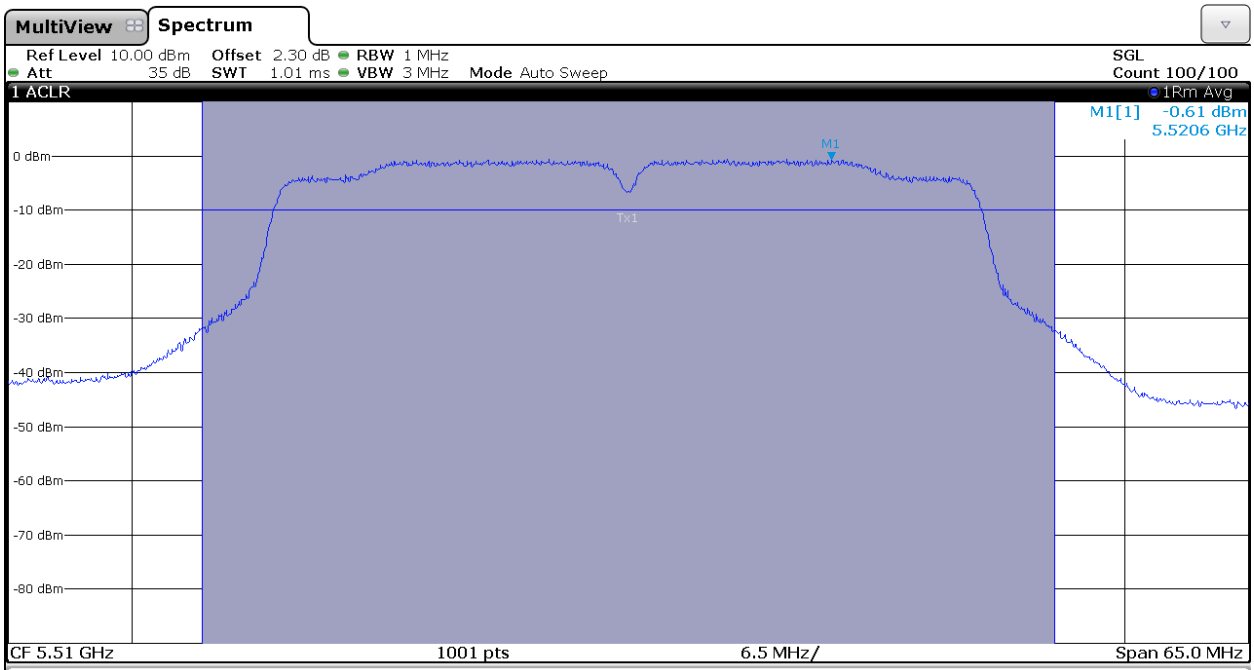


Power and PPSD in sub-band UNII_4: Chain B



802.11 n40 MHz modes (except channel 142) CHAIN A

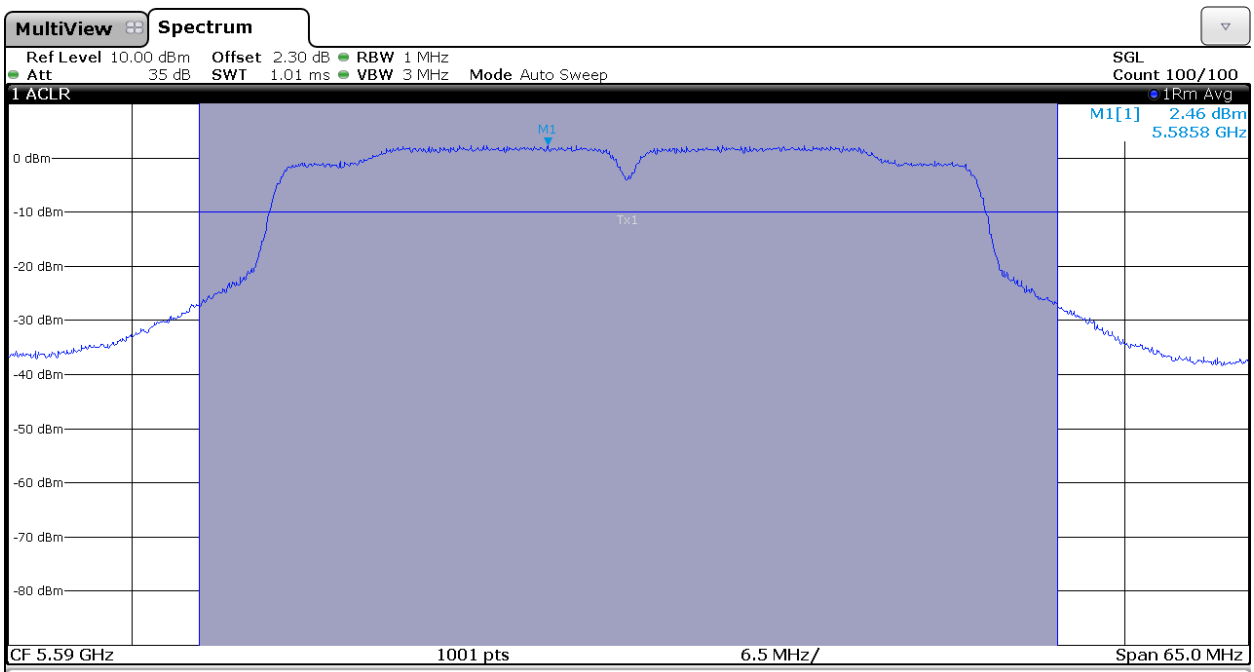
Lowest Channel



2 Result Summary None

Channel	Bandwidth	Offset	Power
Tx1 (Ref)	44.710 MHz		**13.22 dBm**
Tx Total			**13.22 dBm**

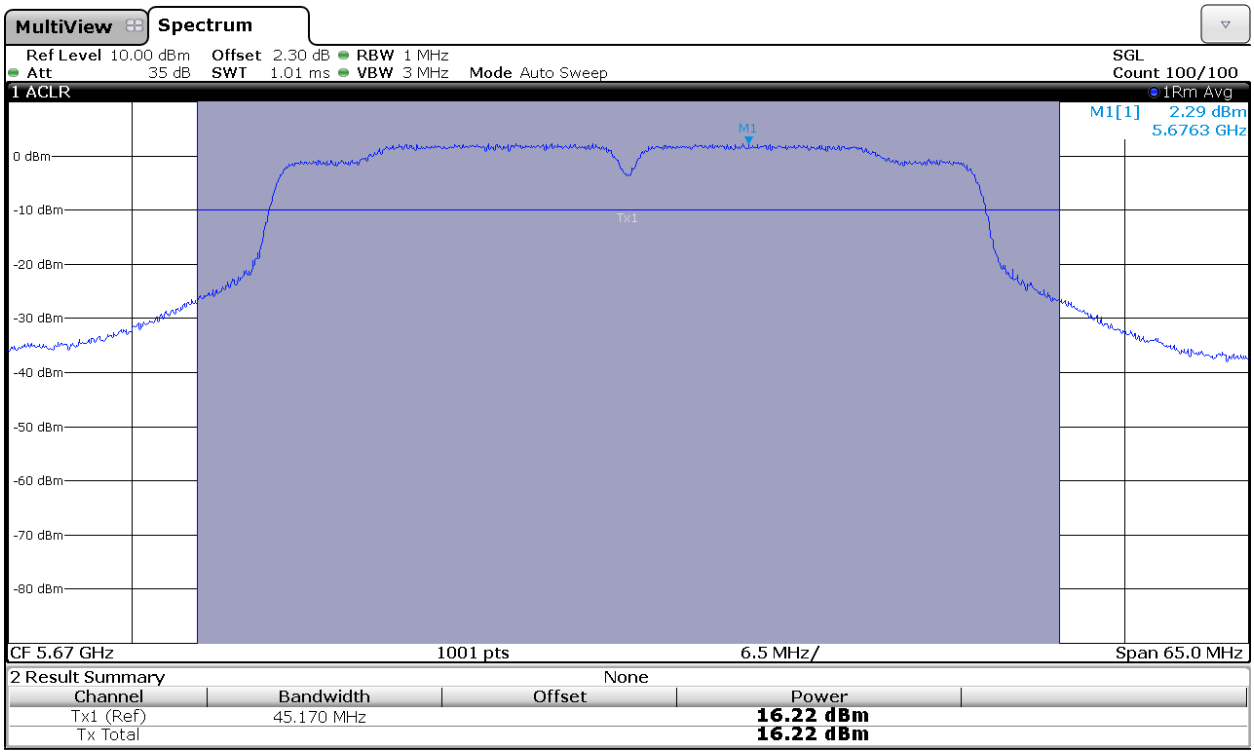
Middle Channel



2 Result Summary None

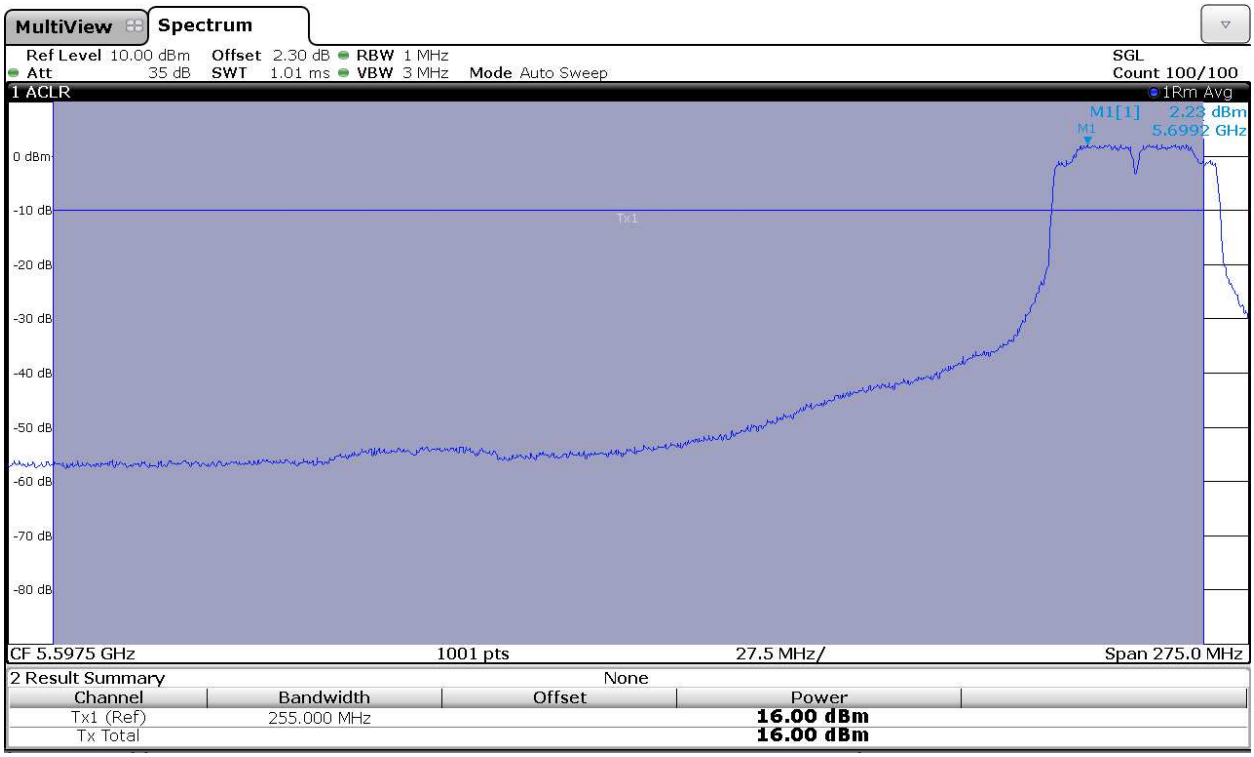
Channel	Bandwidth	Offset	Power
Tx1 (Ref)	45.030 MHz		**16.17 dBm**
Tx Total			**16.17 dBm**

Highest Channel

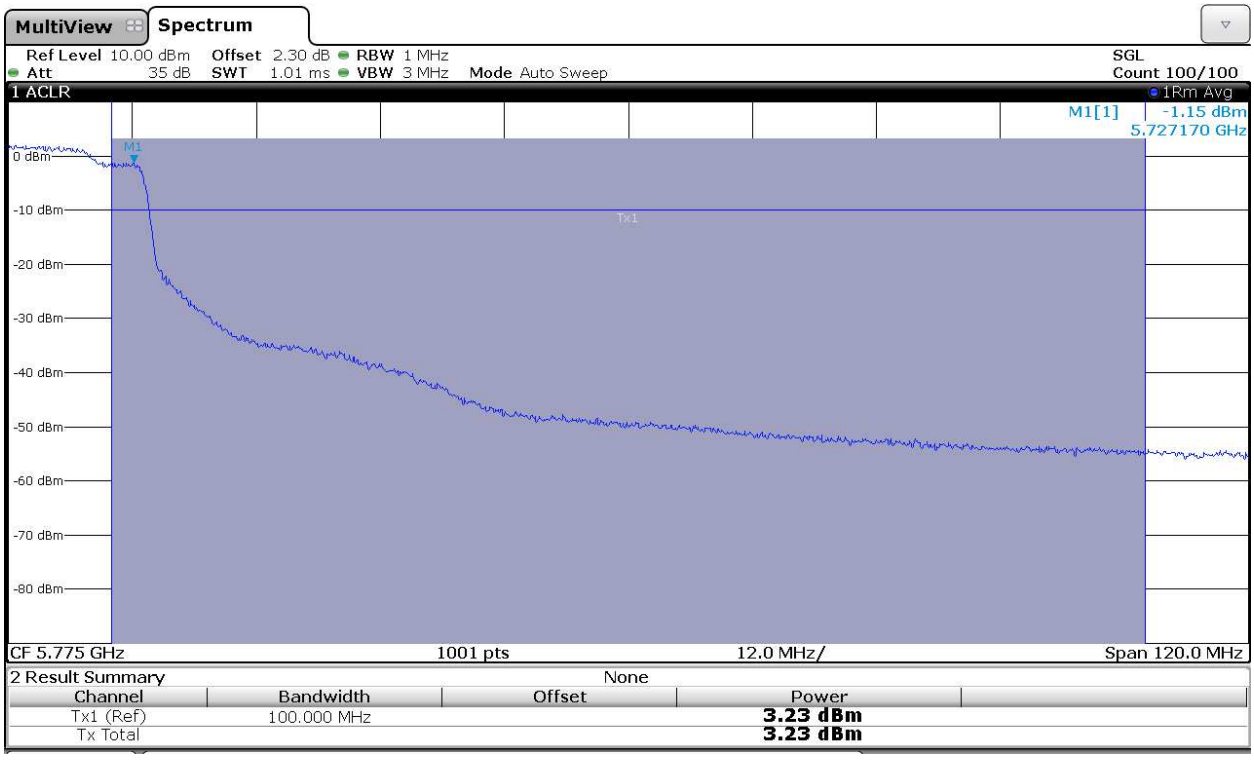


802.11 ac 40MHz : Channel 142

Power and PPSD in sub-band UNII_3:

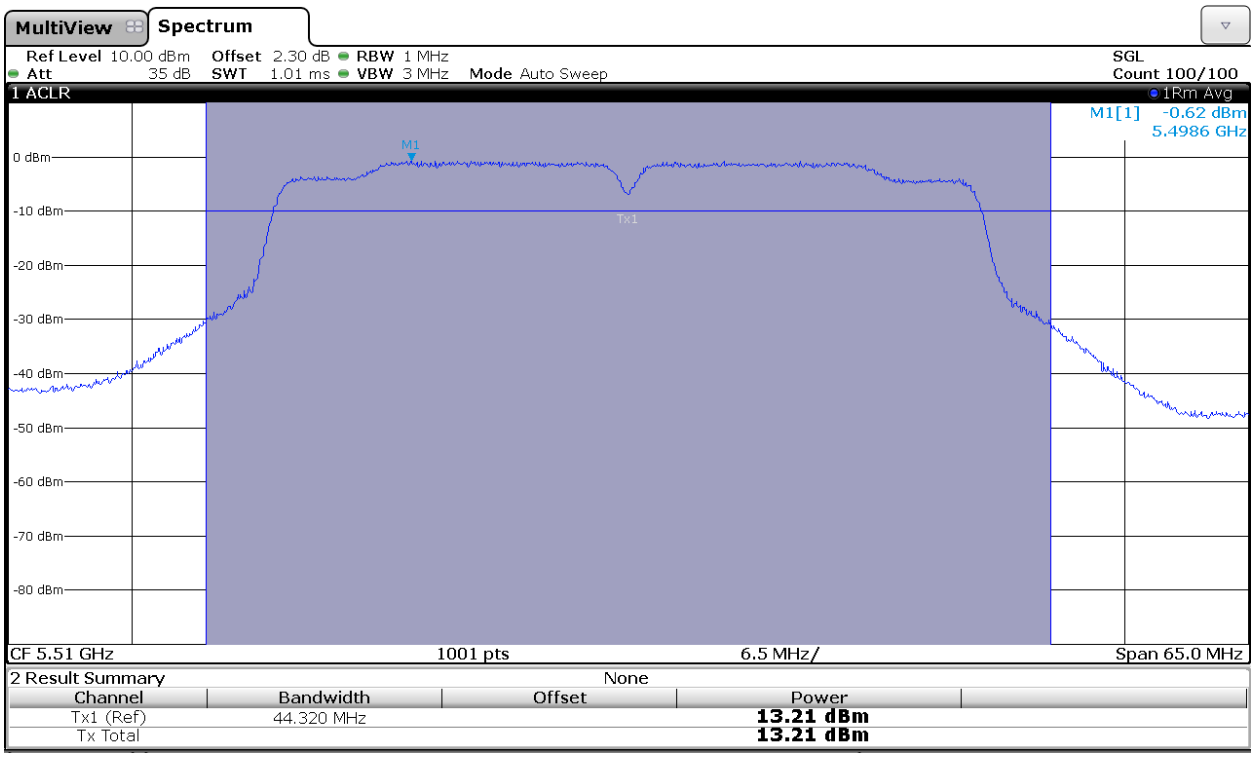


Power and PPSD in sub-band UNII_4:

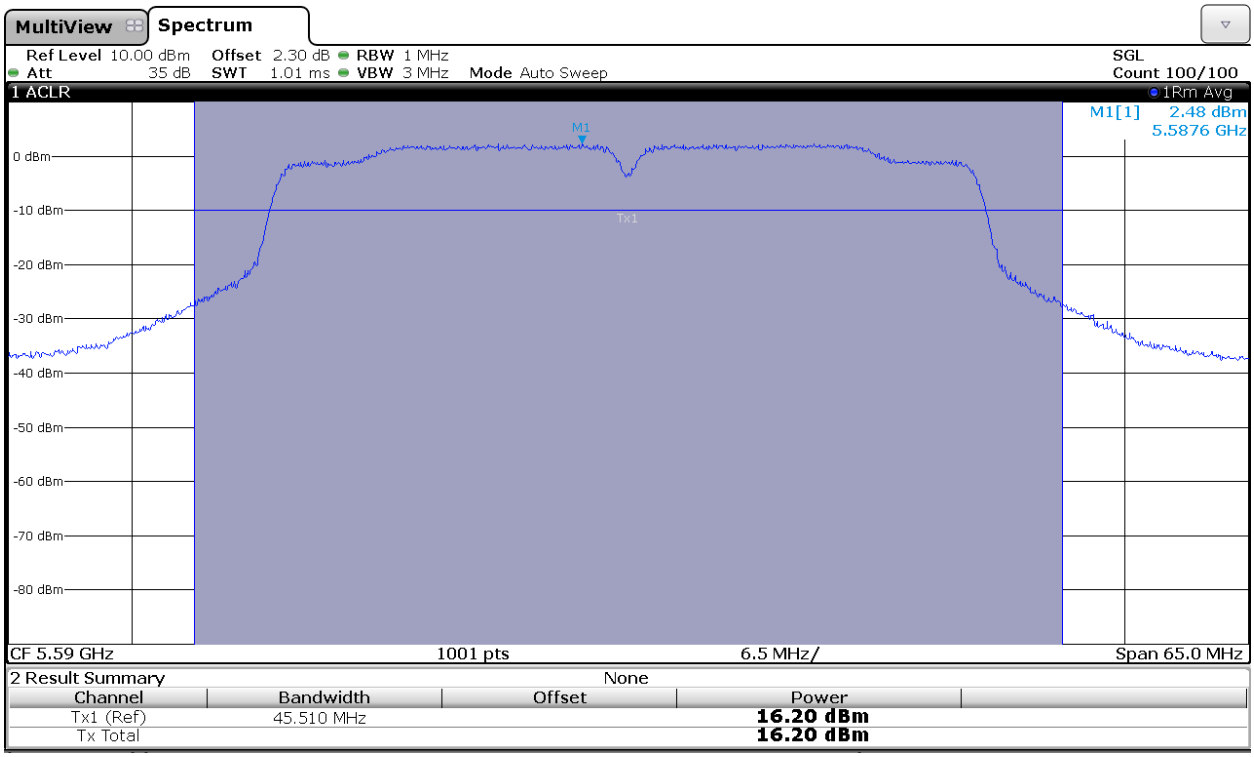


802.11 n40 MHz modes (except channel 142) CHAIN B

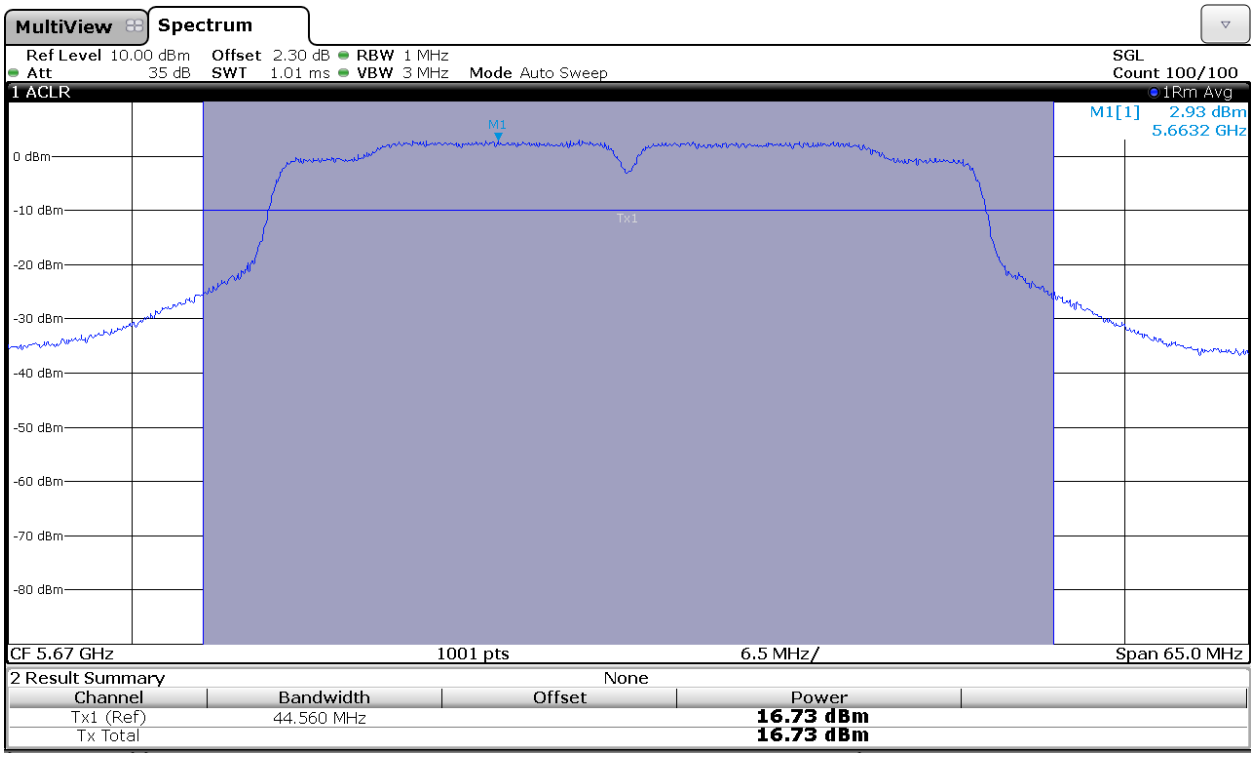
Lowest Channel



Middle Channel

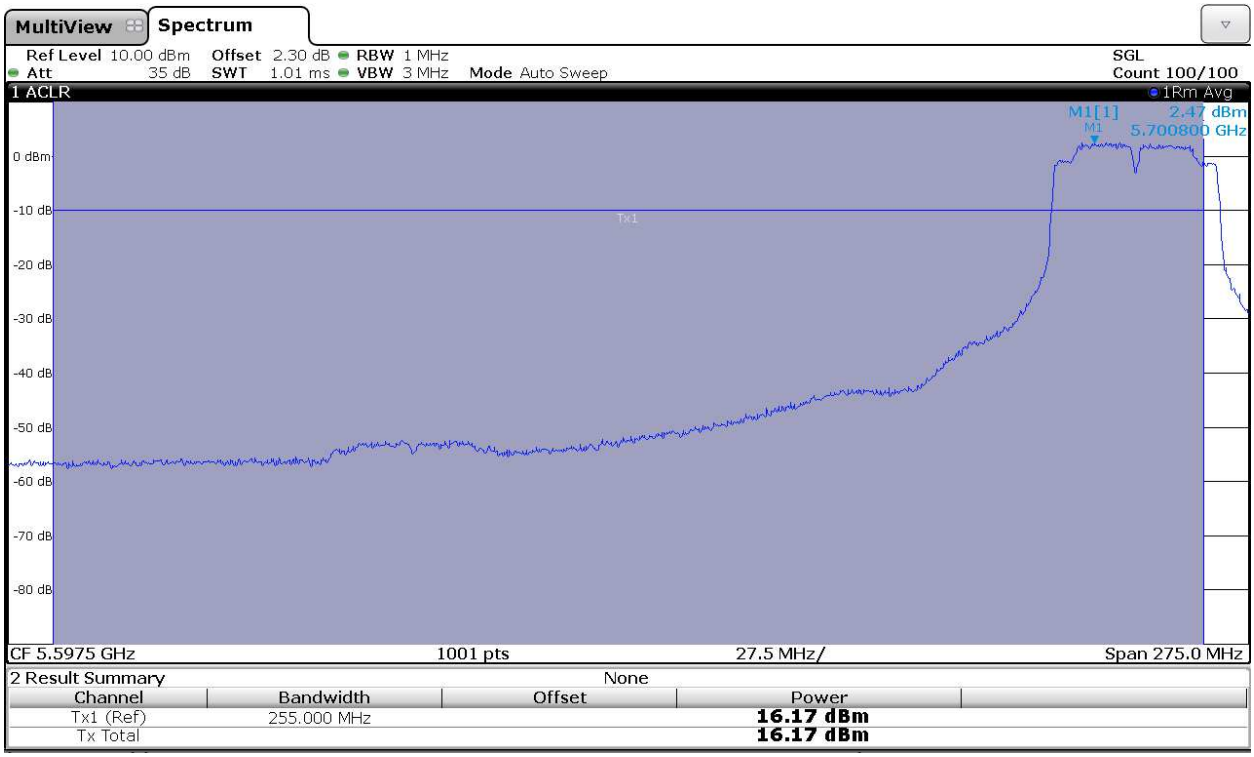


Highest Channel

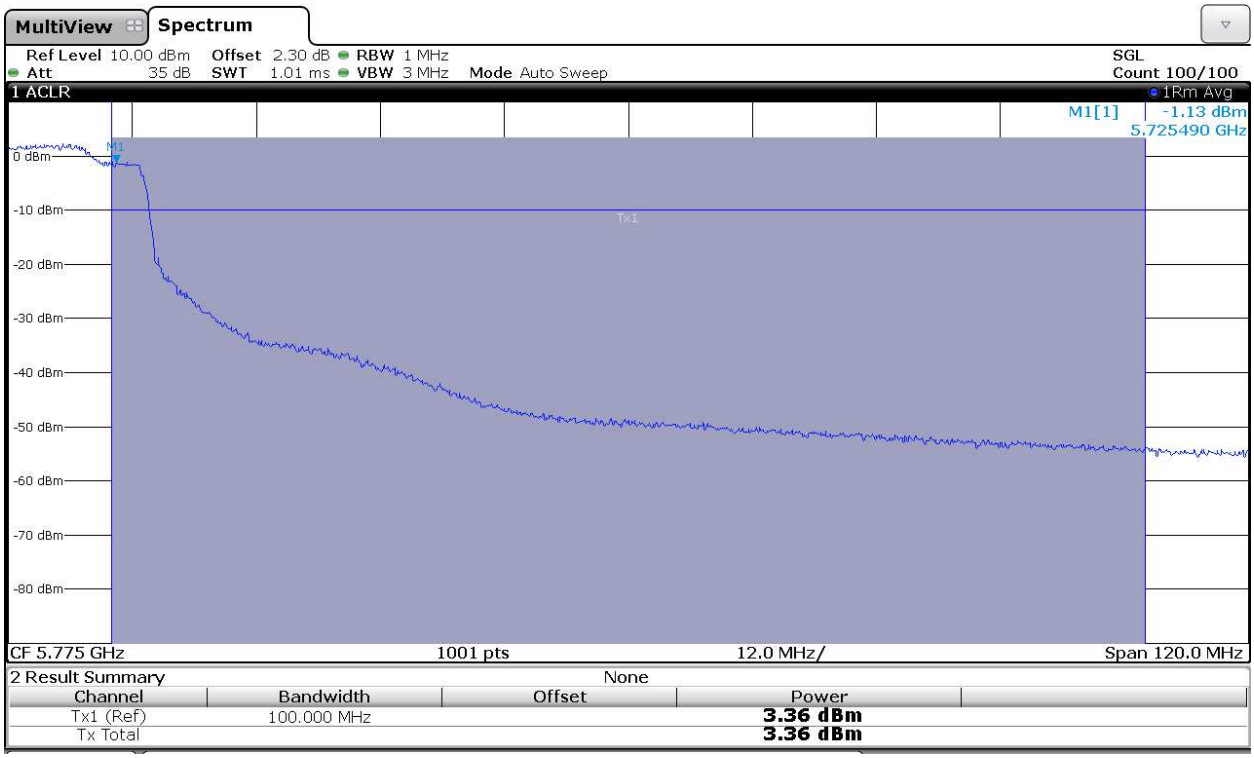


802.11 ac 40MHz : Channel 142

Power and PPSD in sub-band UNII_3:

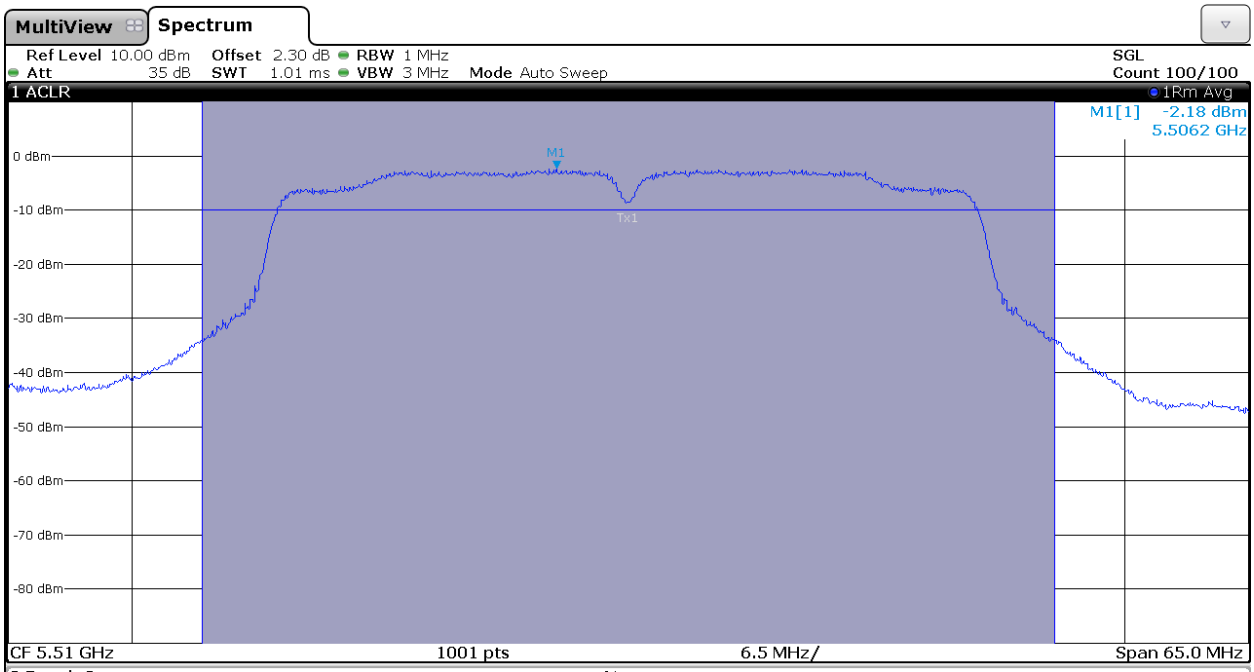


Power and PPSD in sub-band UNII_4:



802.11 n40 MHz modes (except channel 142) CHAIN A+B

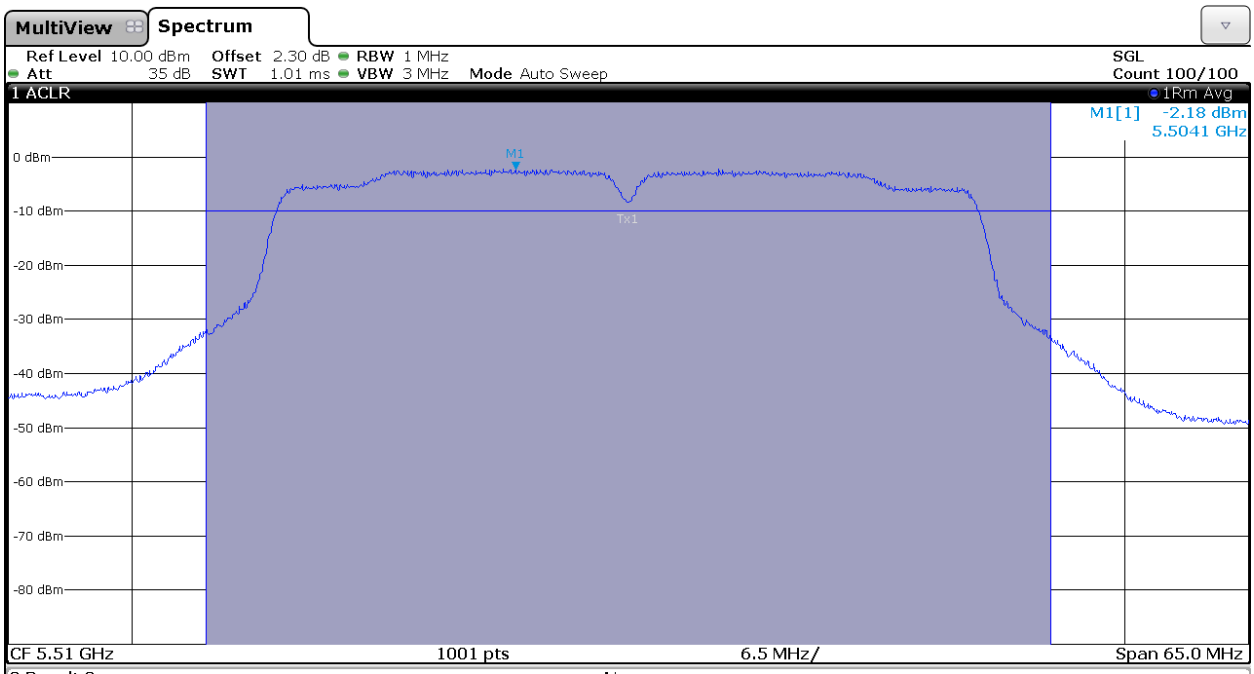
Lowest Channel. Chain A



2 Result Summary — None

Channel	Bandwidth	Offset	Power
Tx1 (Ref)	44.710 MHz		**11.29 dBm**
Tx Total			**11.29 dBm**

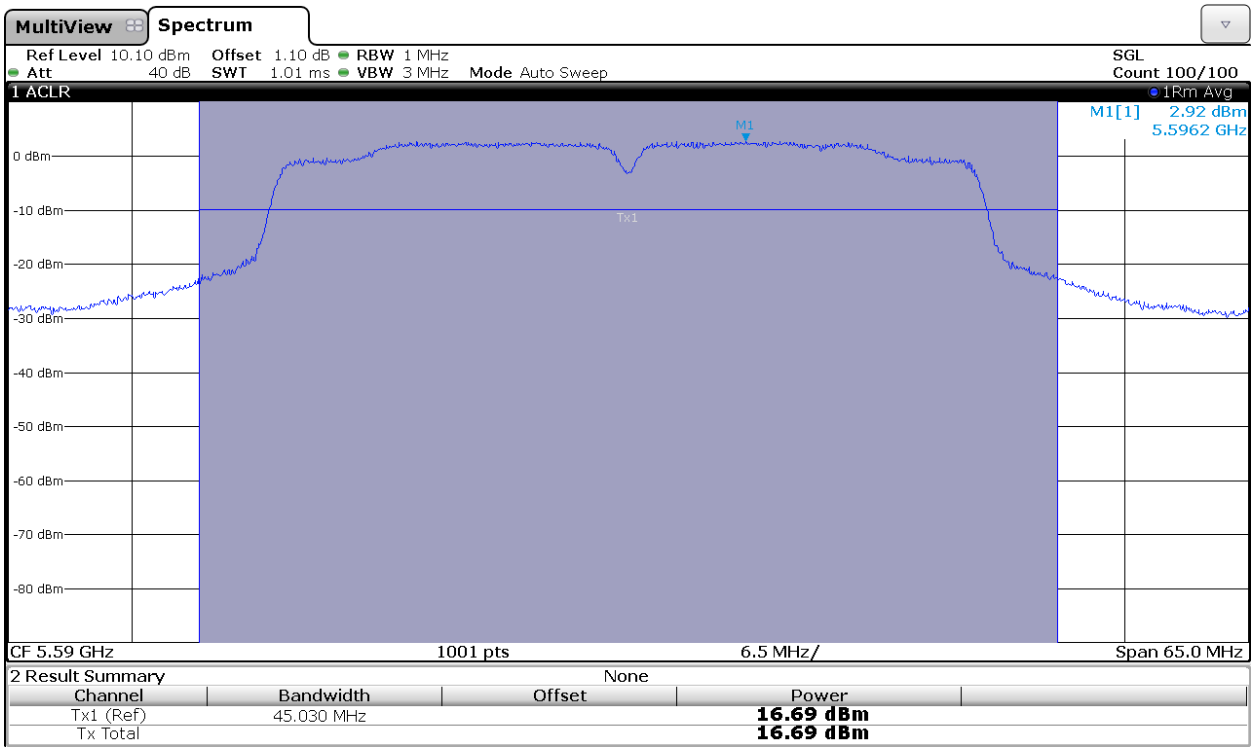
Lowest Channel. Chain B



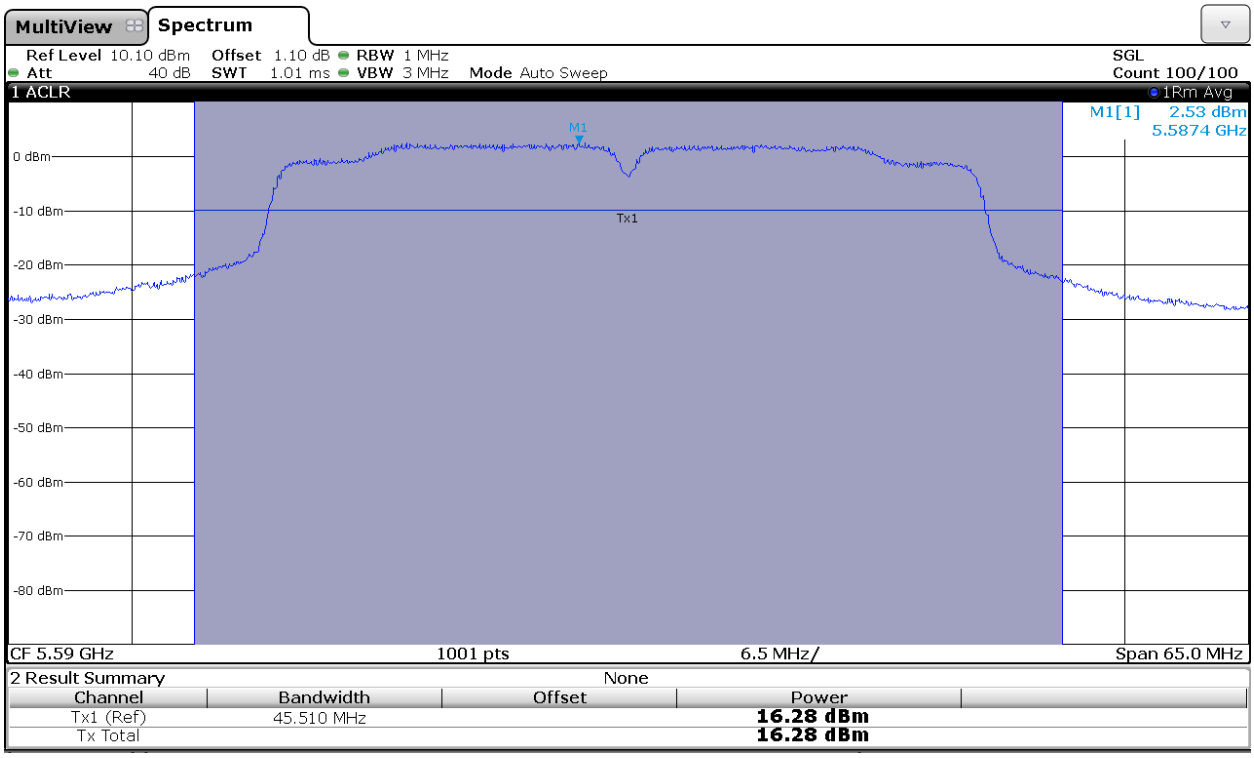
2 Result Summary — None

Channel	Bandwidth	Offset	Power
Tx1 (Ref)	44.320 MHz		**11.57 dBm**
Tx Total			**11.57 dBm**

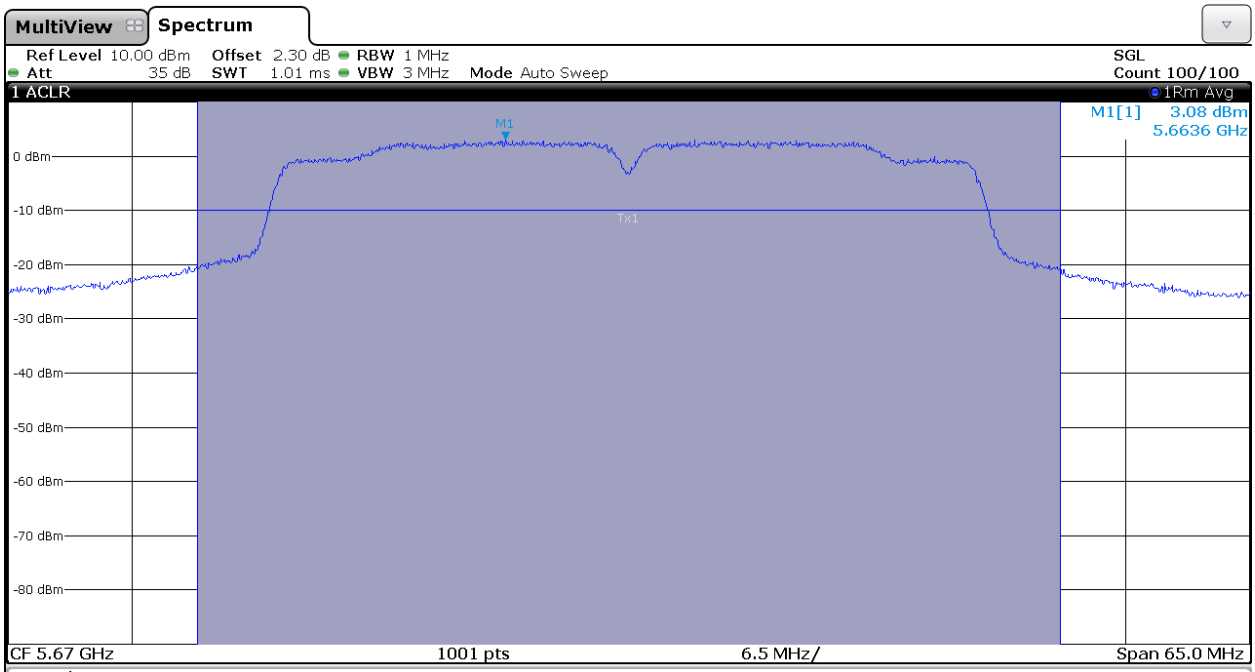
Middle Channel. Chain A



Middle Channel. Chain B



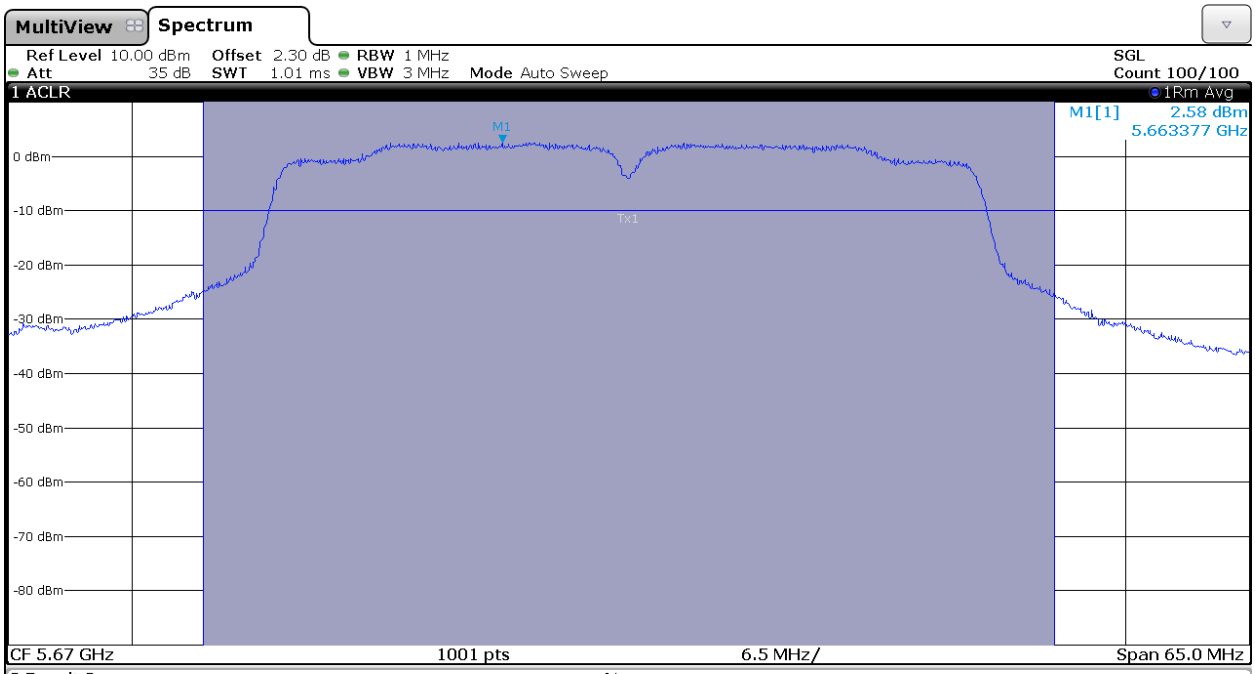
Highest Channel. Chain A



2 Result Summary — None

Channel	Bandwidth	Offset	Power
Tx1 (Ref)	45.170 MHz		**16.70 dBm**
Tx Total			**16.70 dBm**

Highest Channel. Chain B

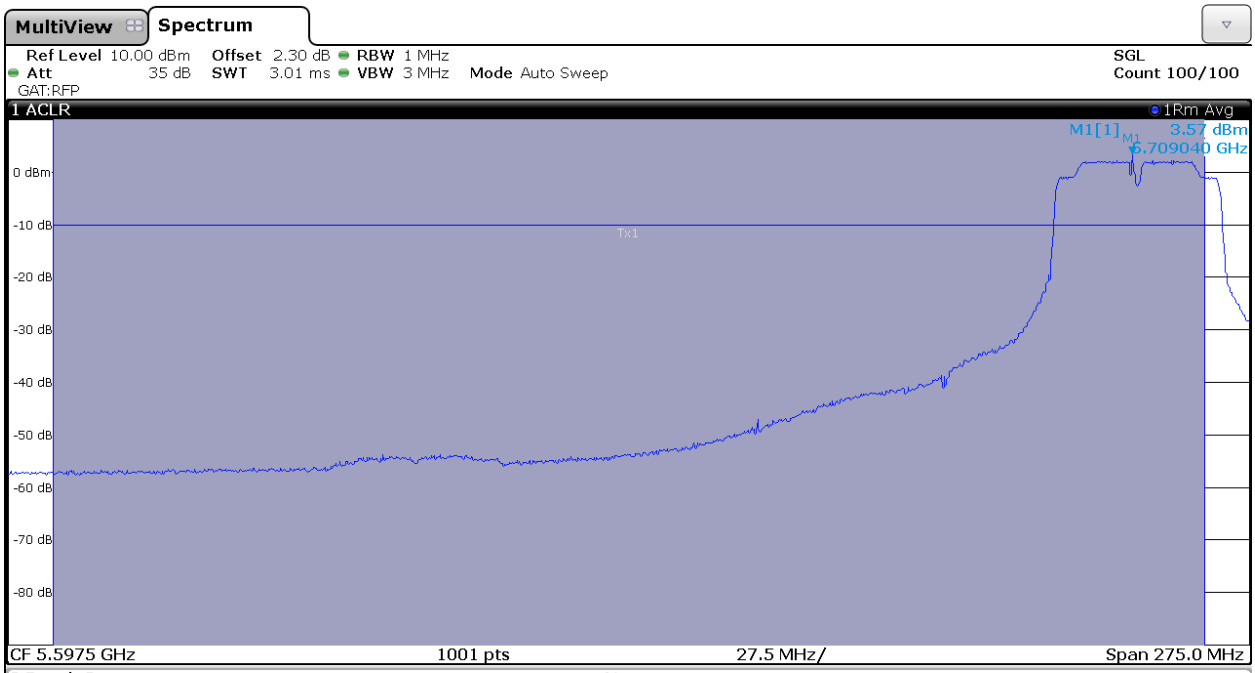


2 Result Summary — None

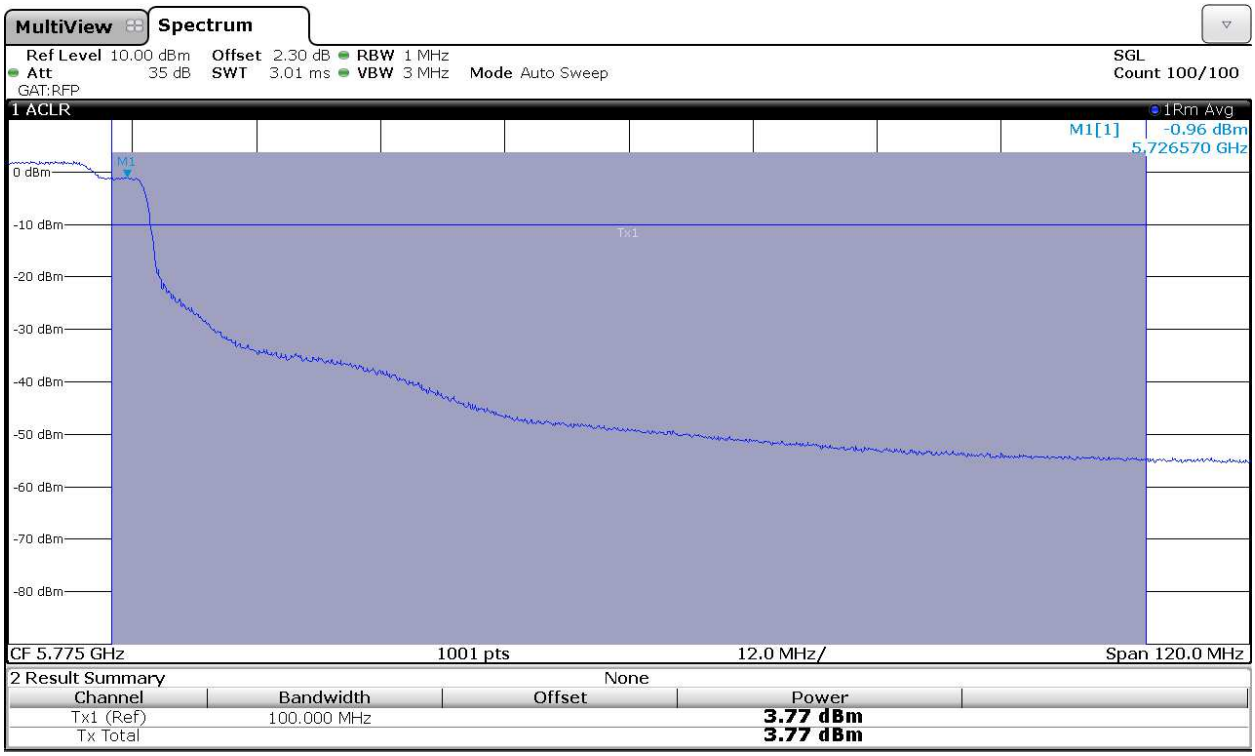
Channel	Bandwidth	Offset	Power
Tx1 (Ref)	44.560 MHz		**16.31 dBm**
Tx Total			**16.31 dBm**

802.11 ac40MHz : Channel 142

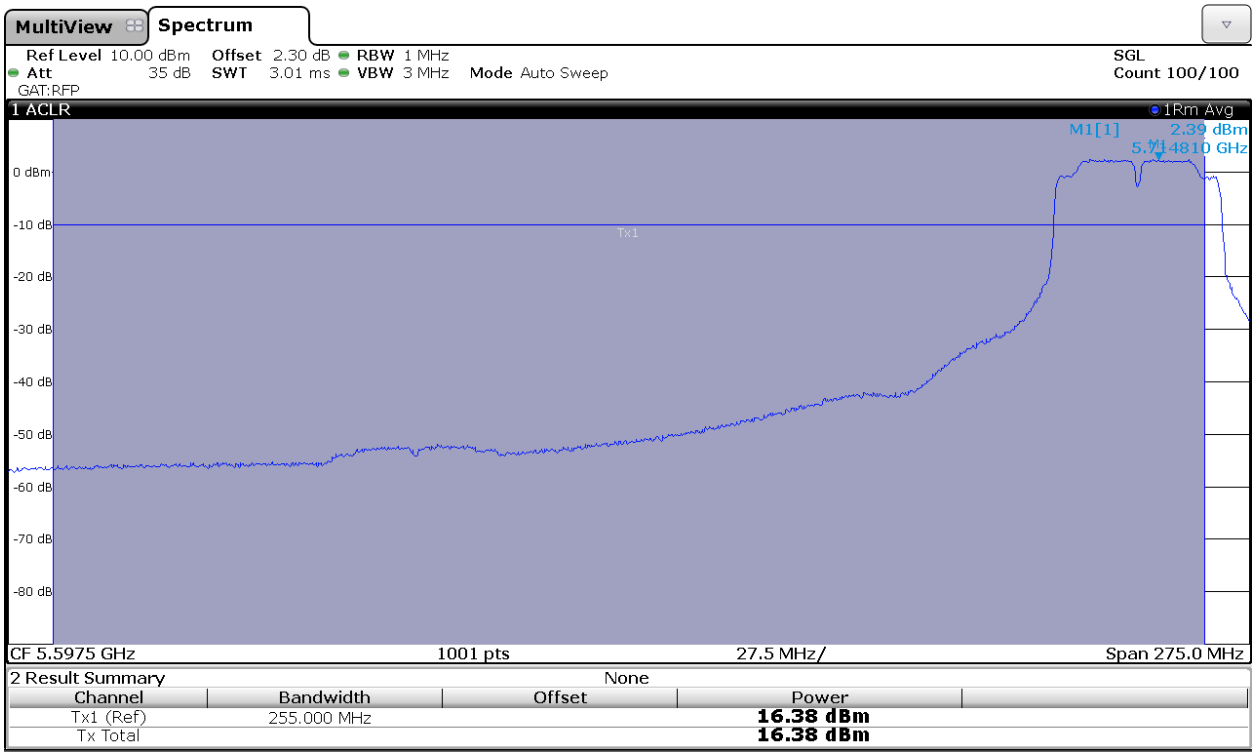
Power and PPSD in sub-band UNII_3: Chain A



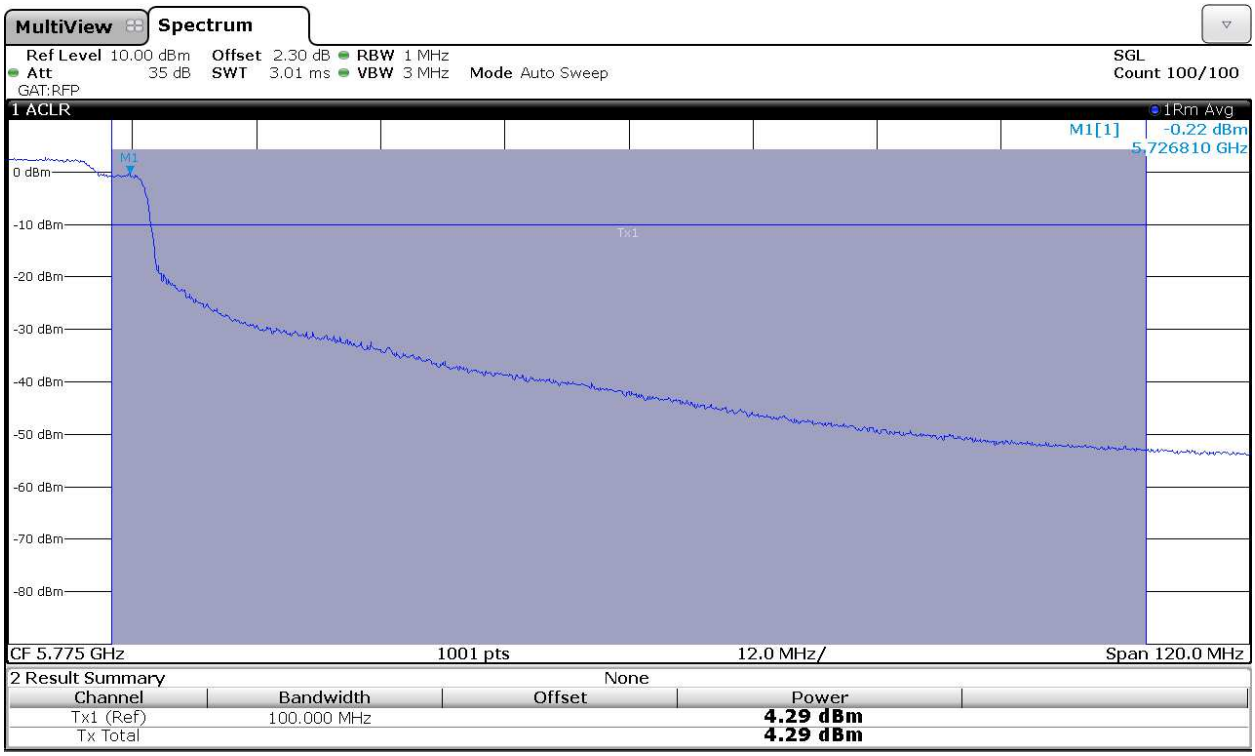
Power and PPSD in sub-band UNII_4: Chain A



Power and PPSD in sub-band UNII_3: Chain B

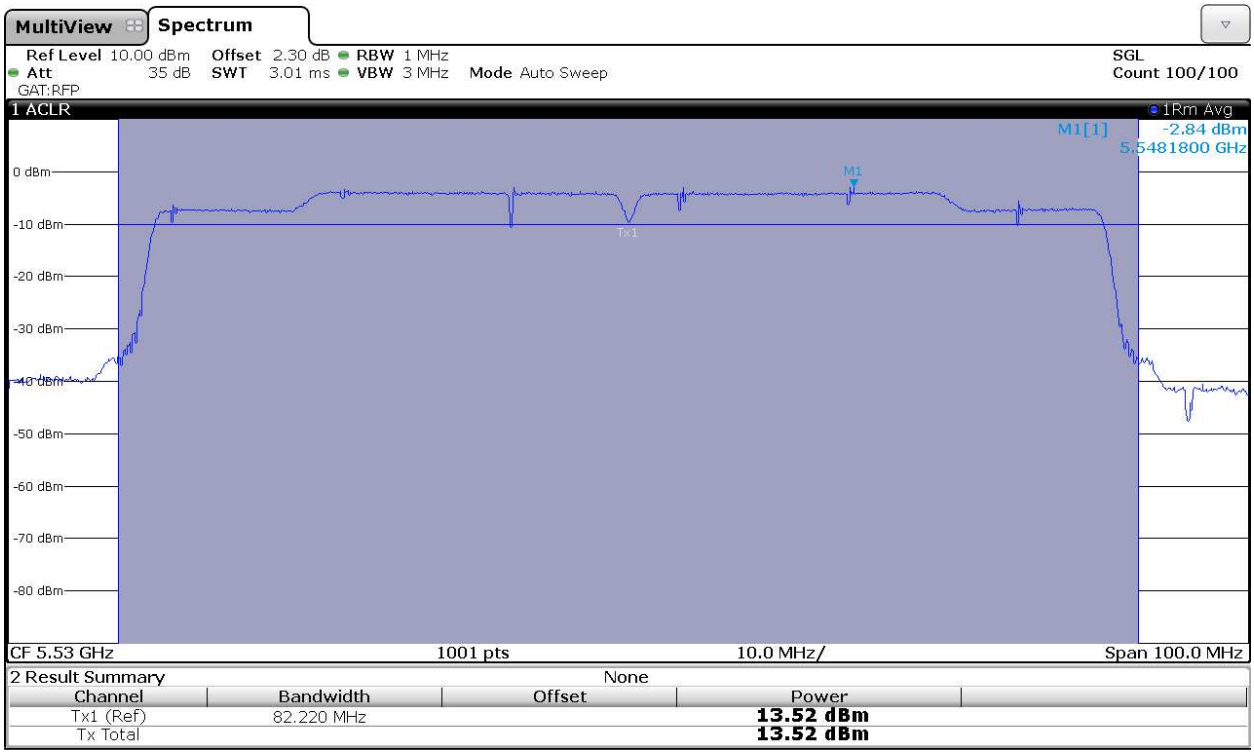


Power and PPSD in sub-band UNII_4: Chain B

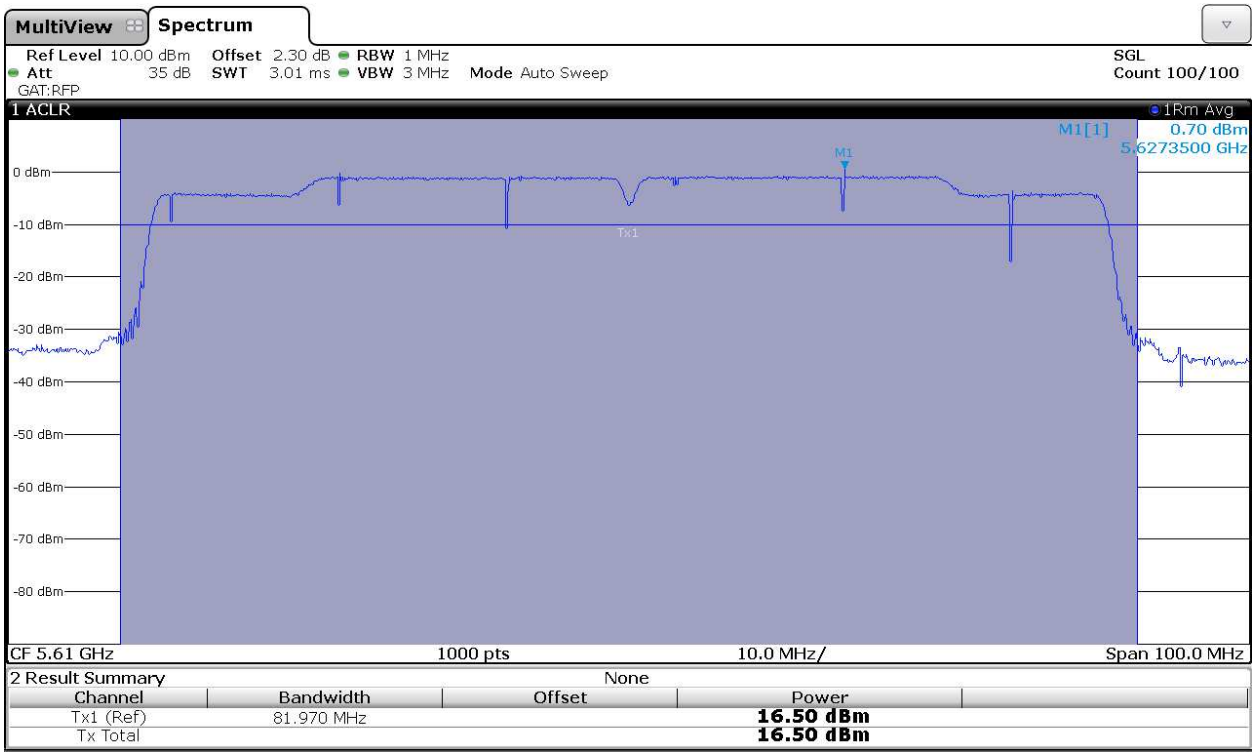


802.11 ac80 MHz modes (except channel 138) CHAIN A

Lowest Channel

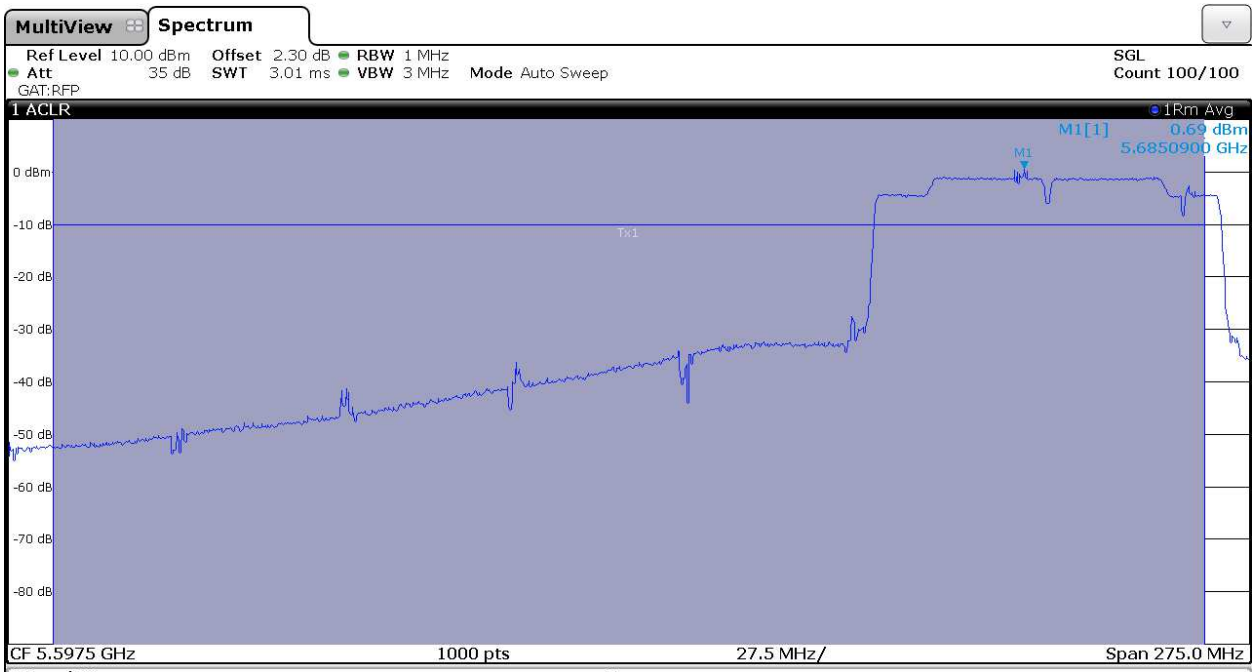


Middle Channel

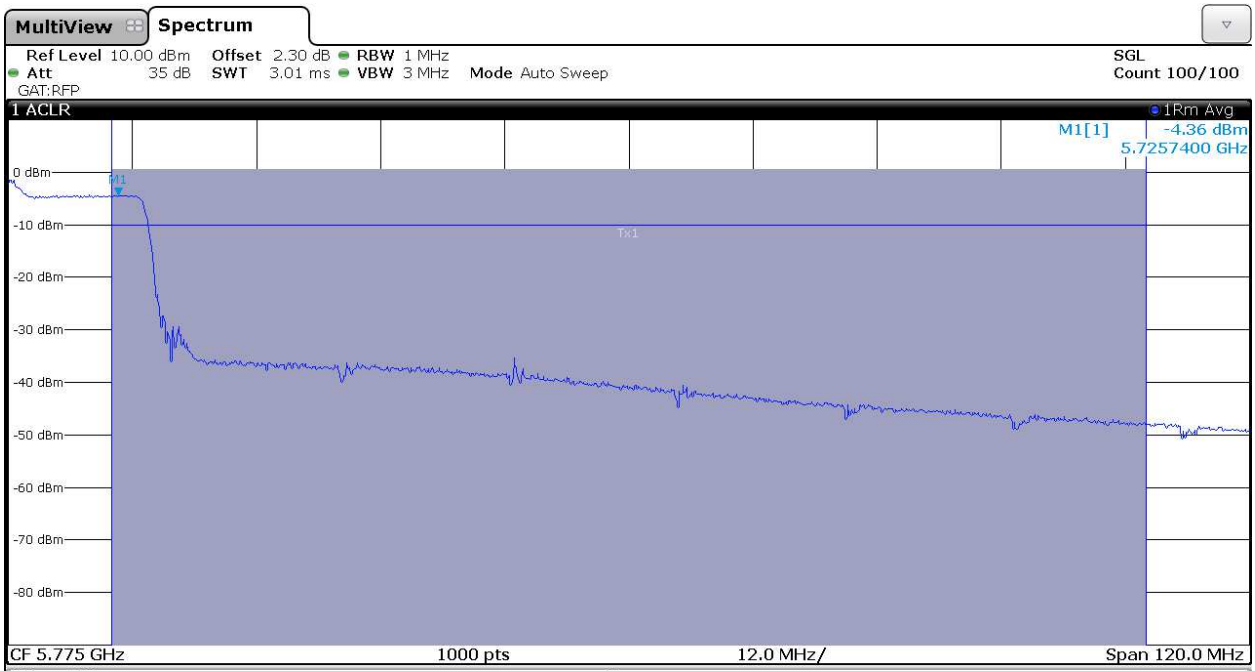


802.11 ac80MHz : Channel 138

Power and PPSD in sub-band UNII_3:

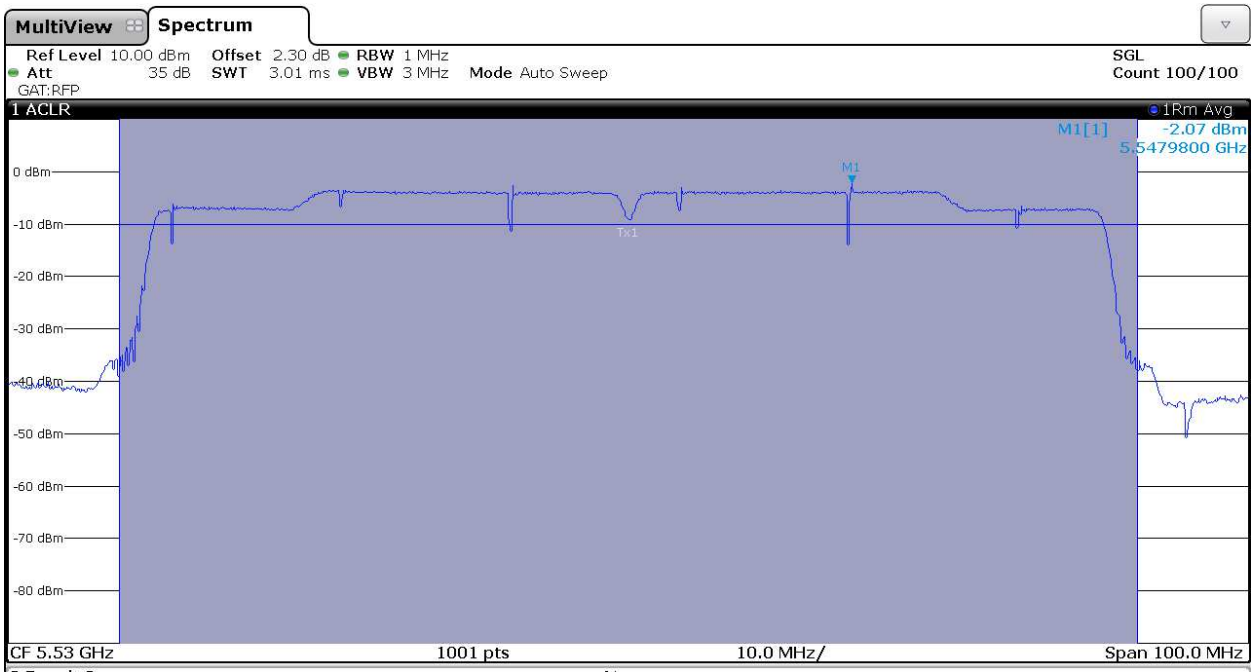


Power and PPSD in sub-band UNII_4:

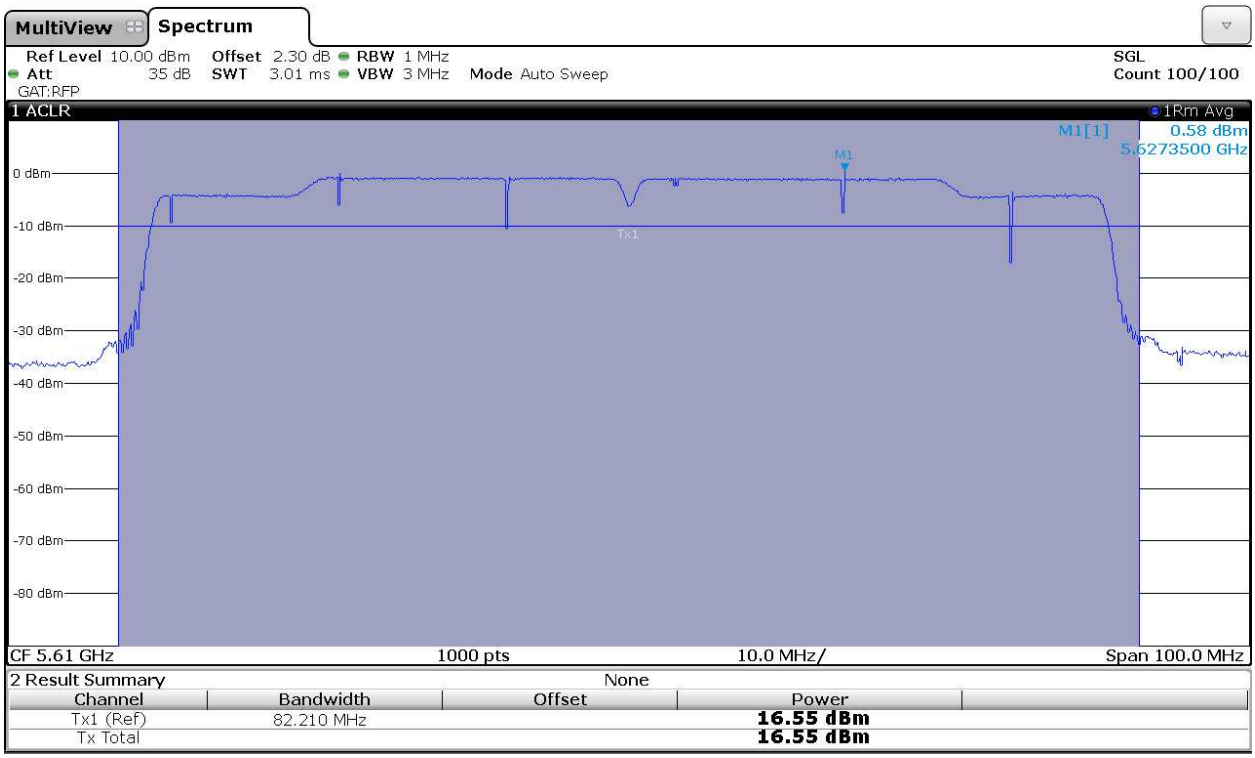


802.11 ac80 MHz modes (except channel 138) CHAIN B

Lowest Channel

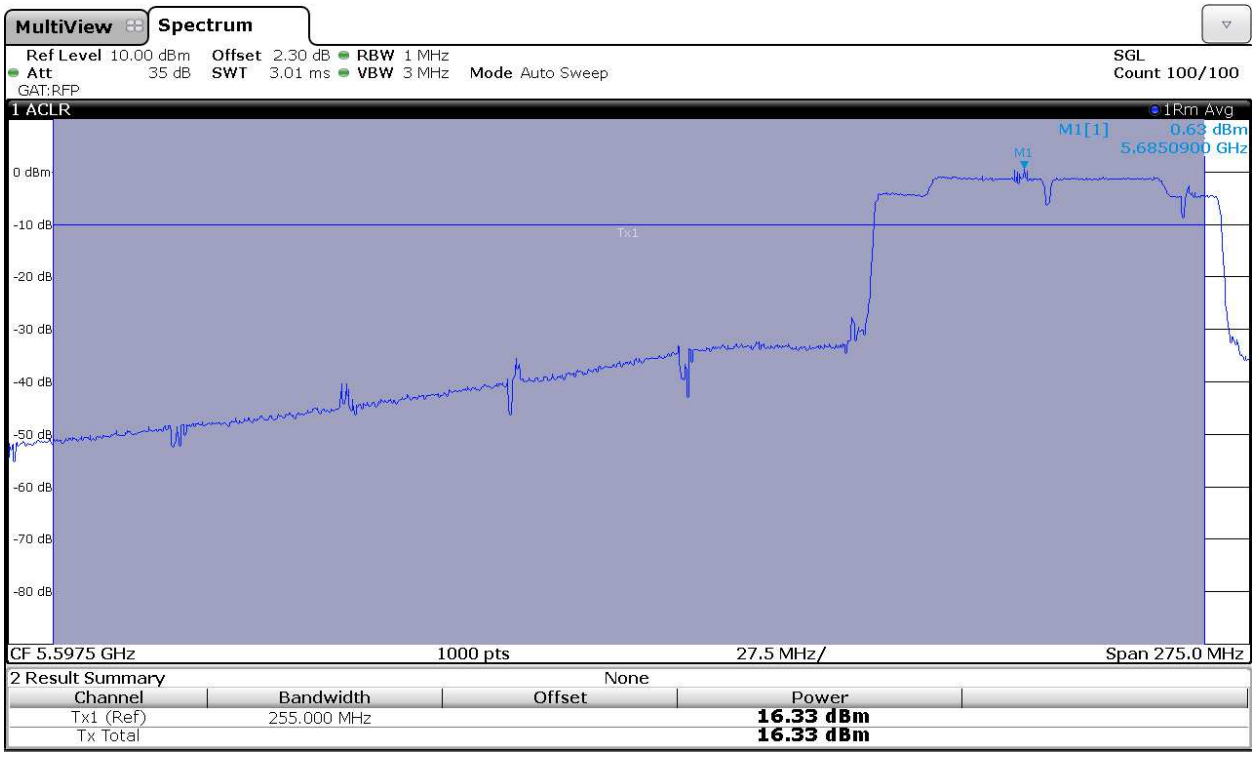


Middle Channel

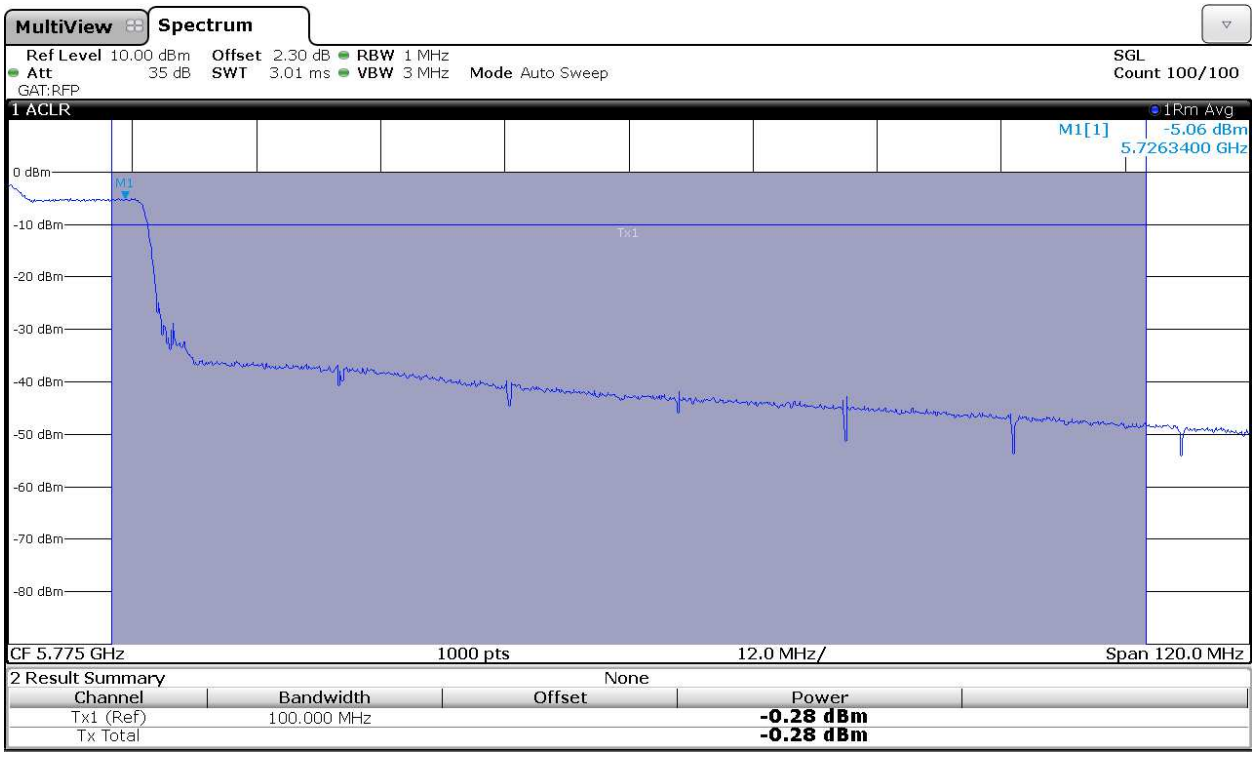


802.11 ac80MHz : Channel 138

Power and PPSD in sub-band UNII_3:

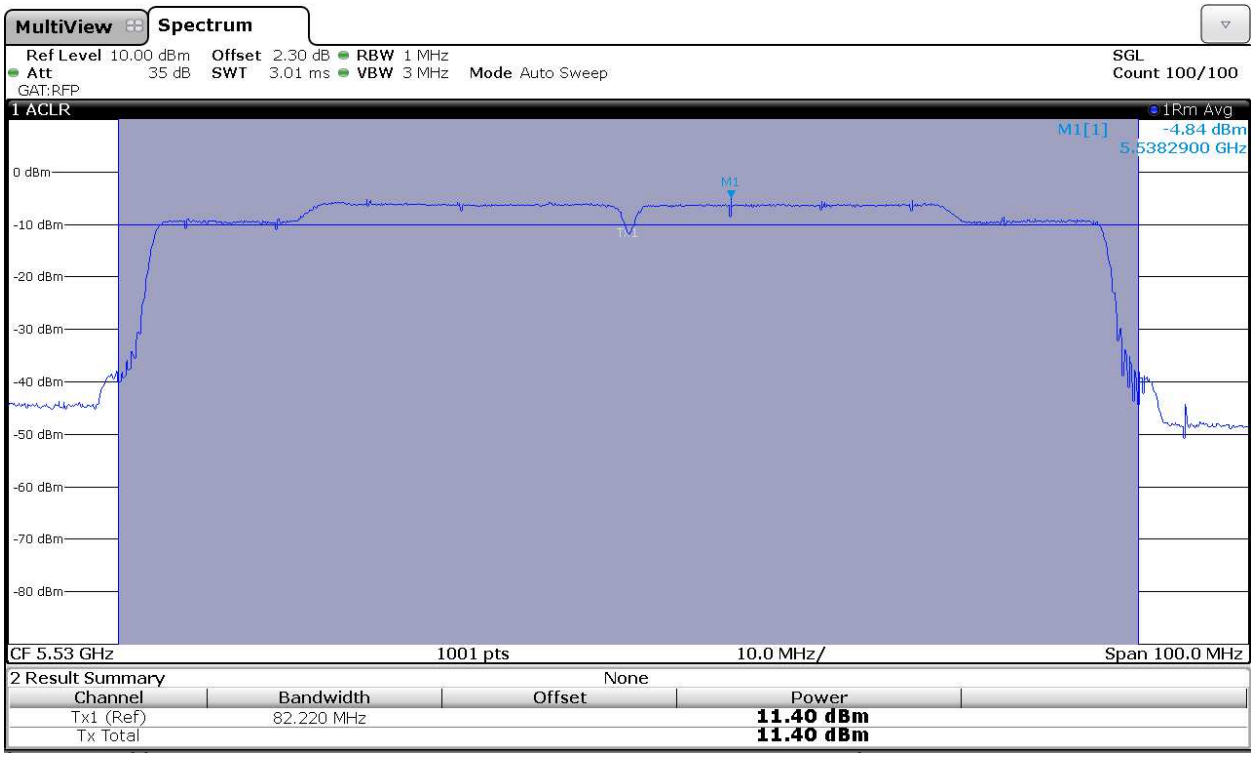


Power and PPSD in sub-band UNII_4:

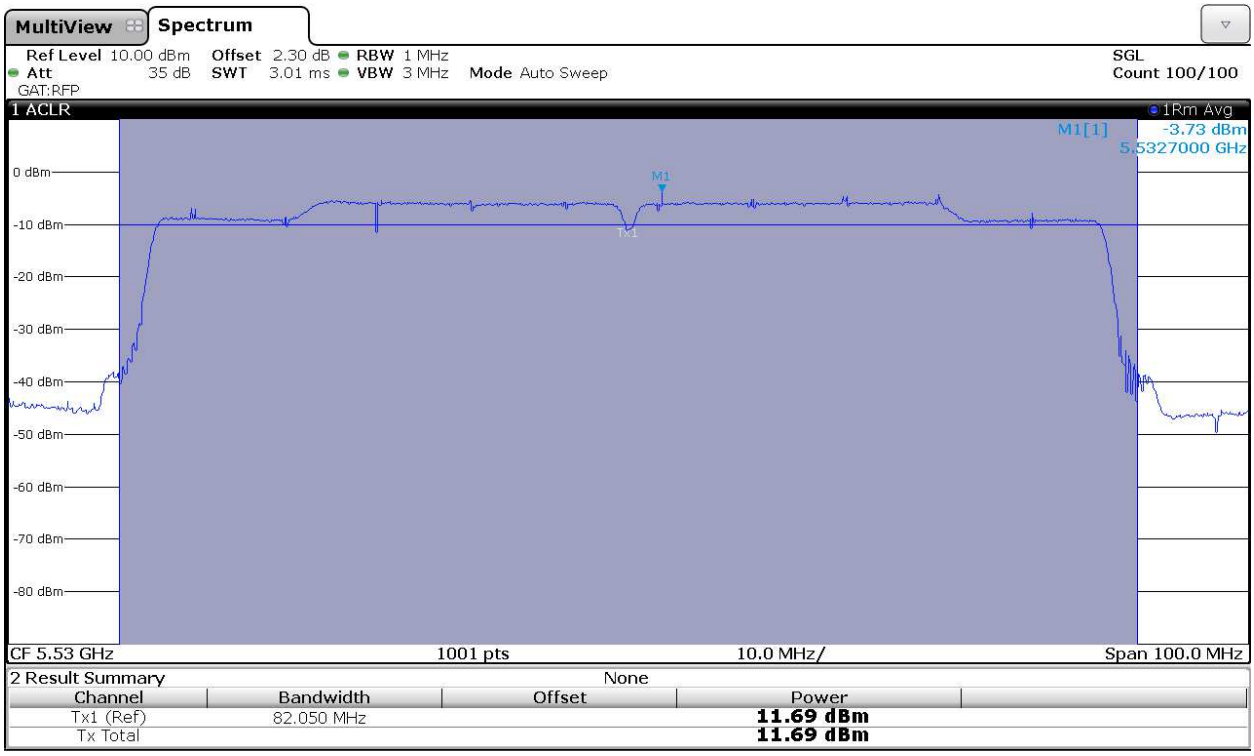


802.11 ac80 MHz modes (except channel 138) CHAIN A+B

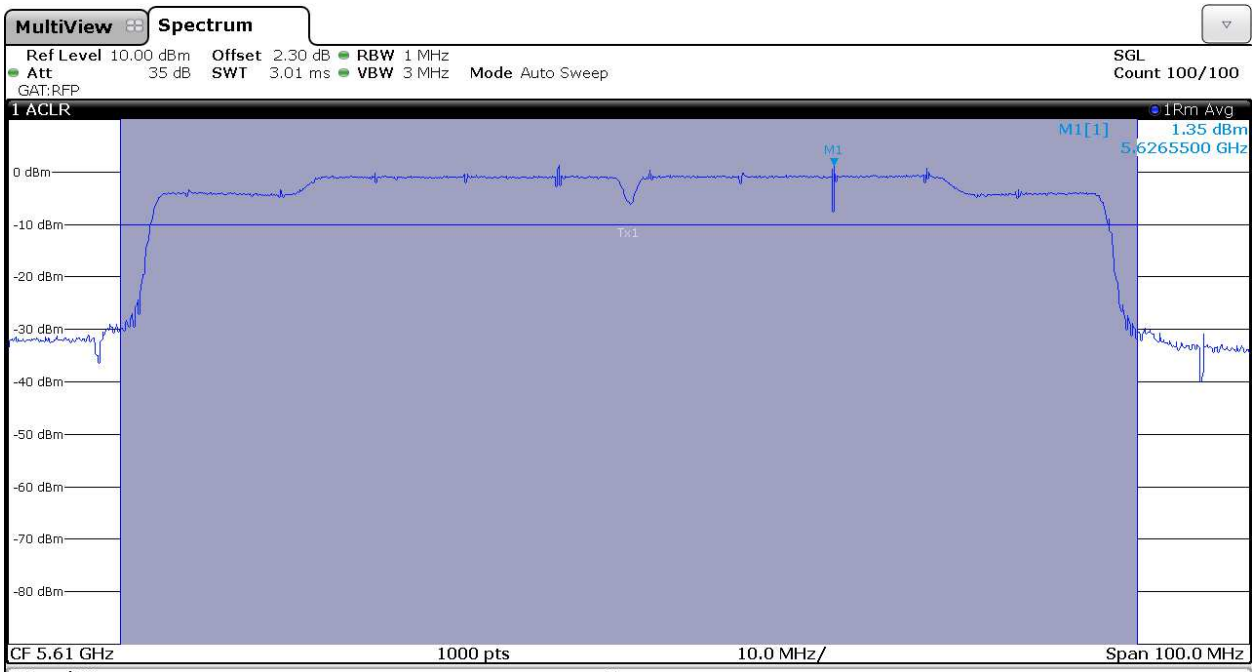
Lowest Channel. Chain A.



Lowest Channel. Chain B.



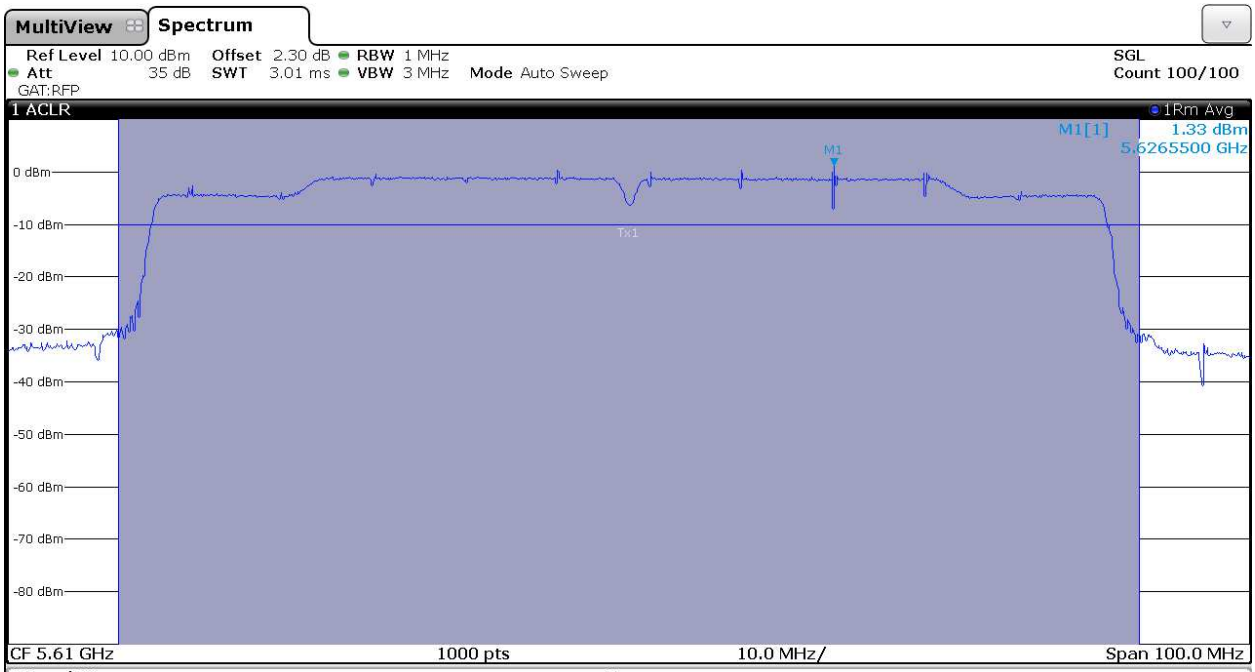
Middle Channel. Chain A.



2 Result Summary None

Channel	Bandwidth	Offset	Power
Tx1 (Ref)	81.970 MHz		**16.75 dBm**
Tx Total			**16.75 dBm**

Middle Channel. Chain B.

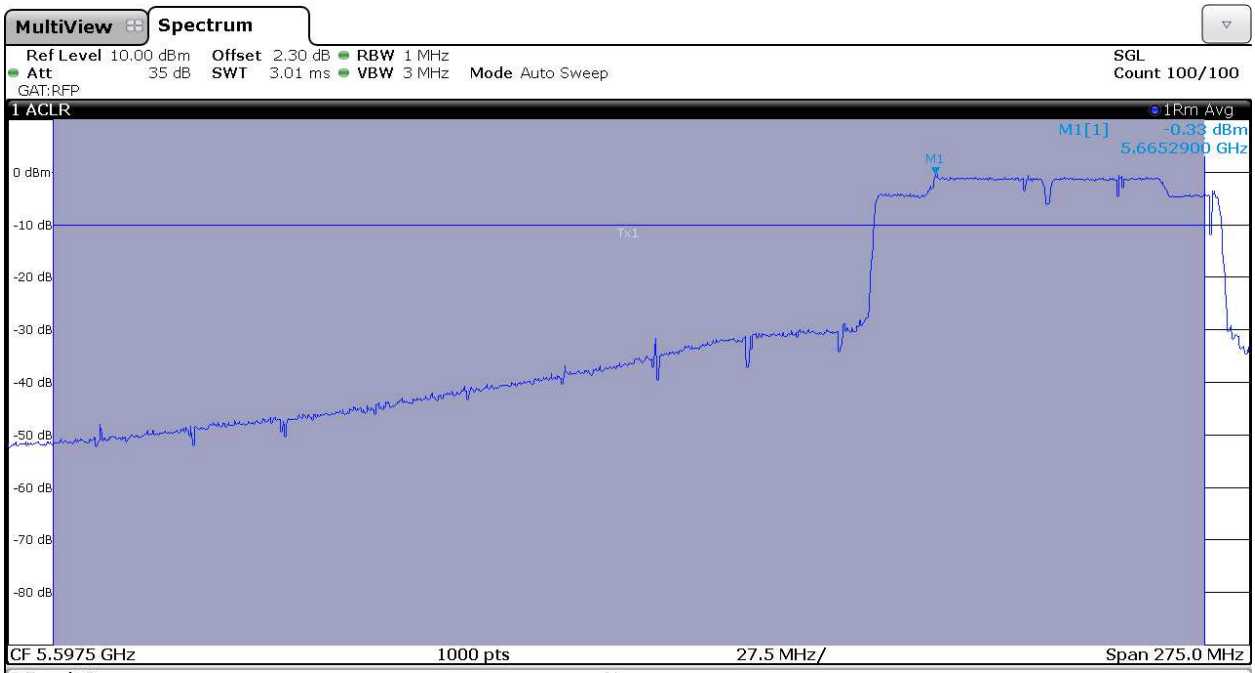


2 Result Summary None

Channel	Bandwidth	Offset	Power
Tx1 (Ref)	82.210 MHz		**16.38 dBm**
Tx Total			**16.38 dBm**

802.11 ac80MHz : Channel 138 CHAIN A+B

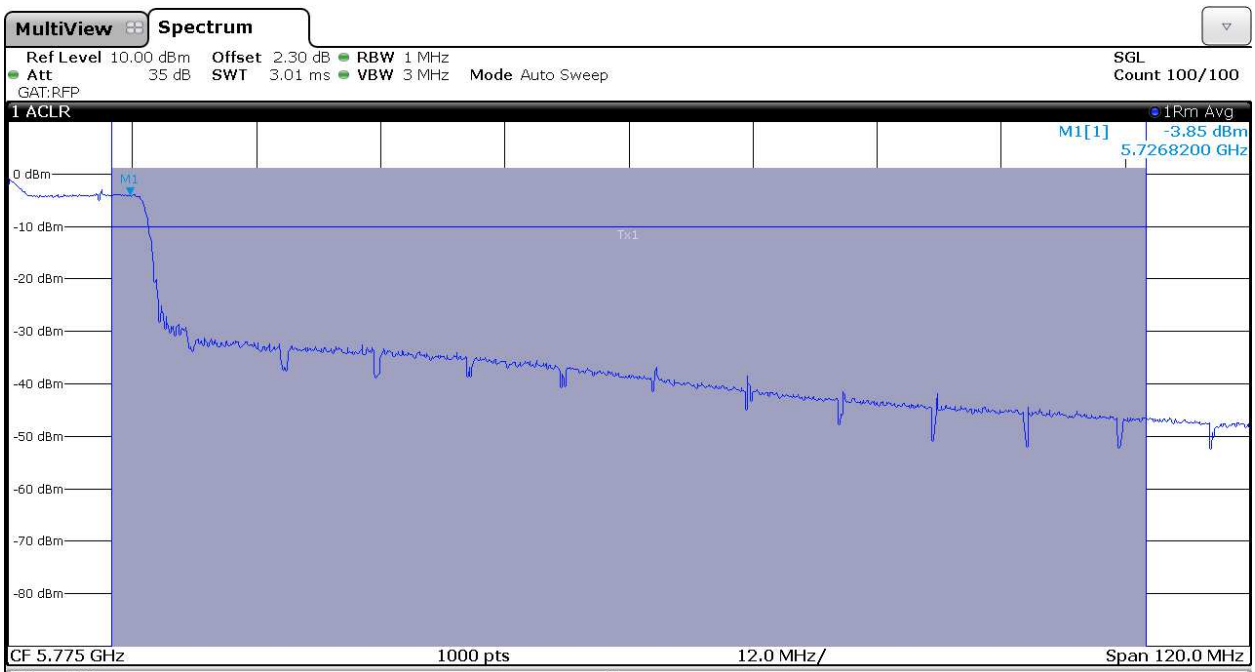
Power and PPSD in sub-band UNII_3: Chain A



2 Result Summary None

Channel	Bandwidth	Offset	Power
Tx1 (Ref)	255.000 MHz		**16.28 dBm**
Tx Total			**16.28 dBm**

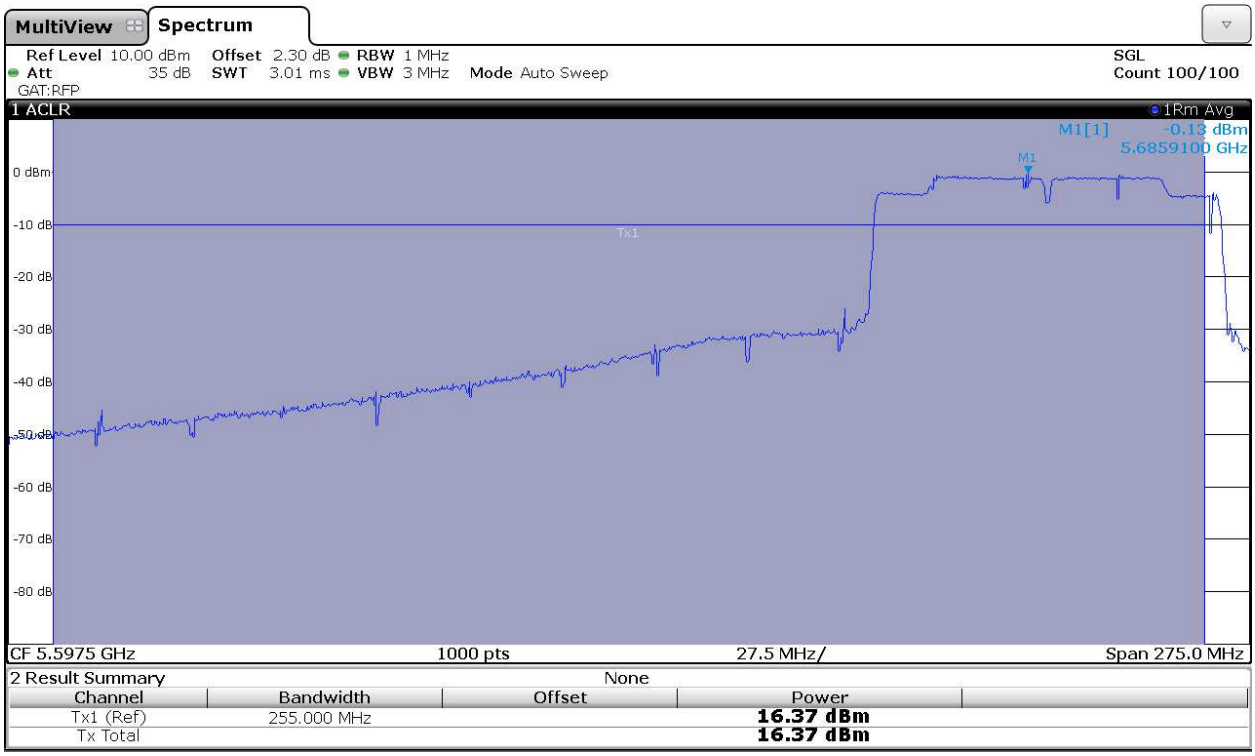
Power and PPSD in sub-band UNII_4: Chain A



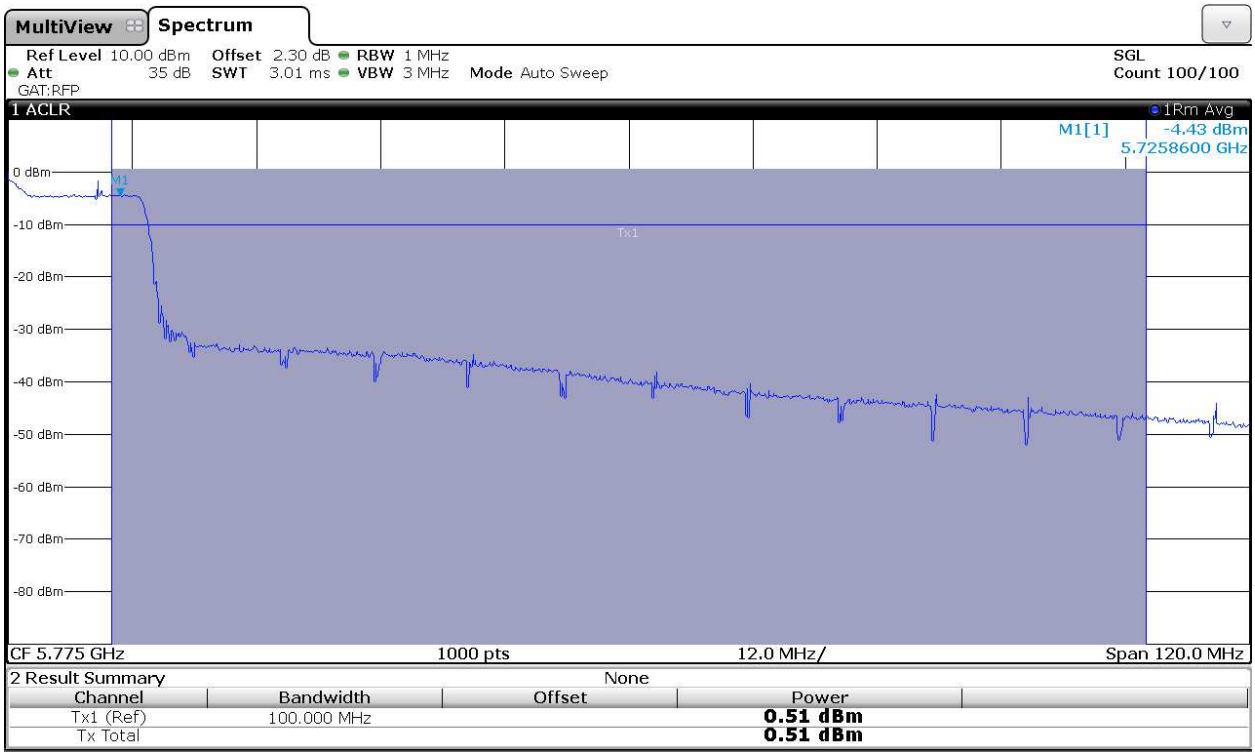
2 Result Summary None

Channel	Bandwidth	Offset	Power
Tx1 (Ref)	100.000 MHz		**1.02 dBm**
Tx Total			**1.02 dBm**

Power and PPSD in sub-band UNII_3: Chain B



Power and PPSD in sub-band UNII_4: Chain B



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

SPECIFICATION

For transmitters operating in the 5.47-5.725 GHz band: all emissions outside of the 5.47-5.725 GHz band shall not exceed an EIRP of −27 dBm/MHz (68.23 dBµV/m at 3 m distance).

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

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

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

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

RESULTS:

The situation and orientation was varied to find the maximum radiated emission. It was also rotated 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 and adjacent bands 5.46-5.47 GHz and 5.725-5.825 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 channel was measured for out-of-band emissions for the worst case (802.11a). The highest channel was measured for out-of-band emissions for channel 144 (ac20 mode 5720 MHz) since the adjusted transmit power is higher than channel 140 (802.11a mode 5700 MHz) in both SISO and MIMO modes.

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 (100) 5500 MHz. Out-of-band spurious in the 1-40 GHz range and inside restricted band 5.35-5.46 GHz and 5.46-5.47 adjacent band.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.46999	V	Peak	51.49	± 4.00
16.49993	V	Peak	65.06	± 4.00
		Average	53.15	± 4.00
21.99500	V	Peak	54.06	± 4.00
		Average	43.72	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.46938	V	Peak	51.73	± 4.00
16.50106	V	Peak	60.44	± 4.00
		Average	49.61	± 4.00
21.99950	V	Peak	53.72	± 4.00

Middle frequency (120) 5600 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)
11.19986	V	Peak	52.10	± 4.00
16.79848	V	Peak	64.51	± 4.00
		Average	53.81	± 4.00
22.40050	V	Peak	53.61	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
11.19981	V	Peak	53.27	± 4.00
16.80084	V	Peak	64.33	± 4.00
		Average	53.13	± 4.00
22.39950	V	Peak	53.90	± 4.00

Highest frequency (140) 5700 MHz. Out-of-band spurious emissions in the 1-40 GHz range and inside adjacent band 5.725-5.825 GHz.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.72509	V	Peak	53.89	± 4.00
17.09911	V	Peak	59.53	± 4.00
		Average	48.65	± 4.00
22.79950	V	Peak	53.03	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.82428	V	Peak	53.01	± 4.00
11.39947	V	Peak	51.34	± 4.00
17.10229	V	Peak	61.84	± 4.00
		Average	51.54	± 4.00
22.80050	V	Peak	52.88	± 4.00

Channel 104 (5520 MHz): Out-of-band spurious emissions inside restricted band 5.35-5.46 GHz and 5.46-5.47 adjacent band.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.46897	V	Peak	52.42	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.46894	V	Peak	55.11	± 4.00
		Average	44.81	± 4.00

Channel 136 (5680 MHz). Out-of-band spurious emissions inside adjacent band 5.725-5.825 GHz.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.72529	V	Peak	67.19	± 4.00
		Average	53.73	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.72686	V	Peak	59.09	± 4.00
		Average	46.05	± 4.00

Verdict: PASS

2. WiFi 5GHz 802.11 n20 mode

Lowest frequency (100) 5500 MHz. Out-of-band spurious emissions inside restricted band 5.35-5.46 GHz and 5.46-5.47 adjacent band.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.43195	V	Peak	50.80	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.46978	V	Peak	52.61	± 4.00

Chain A+B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.45676	V	Peak	51.41	± 4.00

Middle frequency (120) 5600MHz. 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)
11.19950	V	Peak	50.91	± 4.00
16.79552	V	Peak	63.61	± 4.00
		Average	53.25	± 4.00
22.39950	V	Peak	53.71	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
11.19930	V	Peak	52.36	± 4.00
16.79980	V	Peak	62.82	± 4.00
		Average	53.07	± 4.00
22.39950	V	Peak	53.63	± 4.00

Chain A+B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
11.19991	V	Peak	51.25	± 4.00
16.79734	V	Peak	65.48	± 4.00
		Average	51.48	± 4.00
22.39950	V	Peak	53.76	± 4.00

Highest frequency (140) 5700 MHz. Out-of-band spurious emissions inside adjacent band 5.725-5.825 GHz.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.72094	V	Peak	56.60	± 4.00
		Average	42.51	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.74842	V	Peak	54.93	± 4.00
		Average	41.49	± 4.00

Chain A+B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.76998	V	Peak	54.97	± 4.00
		Average	41.60	± 4.00

Channel 104 (5520 MHz): Out-of-band spurious emissions inside restricted band 5.35-5.46 GHz and 5.46-5.47 adjacent band.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.46845	V	Peak	52.24	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.46918	V	Peak	58.82	± 4.00
		Average	45.44	± 4.00

Chain A+B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.46624	V	Peak	51.22	± 4.00

Channel 136 (5680 MHz). Out-of-band spurious emissions inside adjacent band 5.725-5.825 GHz.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.72659	V	Peak	67.59	± 4.00
		Average	53.35	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.72809	V	Peak	60.08	± 4.00
		Average	45.31	± 4.00

Chain A+B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.81096	V	Peak	54.99	± 4.00
		Average	41.98	± 4.00

802.11 ac 20MHz:

Channel 144 (5720 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)
11.43985	V	Peak	51.71	± 4.00
17.16329	V	Peak	64.51	± 4.00
		Average	53.29	± 4.00
22.87950	V	Peak	52.46	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
11.44034	V	Peak	55.51	± 4.00
		Average	44.37	± 4.00
17.16348	V	Peak	67.73	± 4.00
		Average	53.70	± 4.00
22.88050	V	Peak	51.77	± 4.00

Chain A+B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
11.43953	V	Peak	52.37	± 4.09
17.16139	V	Peak	62.19	± 4.09
		Average	51.22	± 4.09
22.88050	V	Peak	51.73	± 4.09

Verdict: PASS

3. WiFi 5GHz 802.11 n40 mode

Lowest frequency (102) 5510MHz. Out-of-band spurious emissions inside restricted band 5.35-5.46 GHz and 5.46-5.47 adjacent band. Highest levels in bands.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.46962	V	Peak	57.80	± 4.00
		Average	45.92	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.46939	V	Peak	52.92	± 4.00

Chain A+B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.46971	V	Peak	56.53	± 4.00
		Average	44.21	± 4.00

Middle frequency (118) 5590 MHz. Out-of-band spurious emissions in the 1-40 GHz.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
11.16725	V	Peak	48.91	± 4.00
16.76230	V	Peak	61.74	± 4.00
		Average	52.69	± 4.00
22.35950	V	Peak	54.14	± 4.00
		Average	48.44	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
16.77269	V	Peak	59.97	± 4.00
		Average	50.47	± 4.00
22.35950	V	Peak	53.61	± 4.00

Chain A+B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
11.18620	V	Peak	50.36	± 4.00
16.77280	V	Peak	61.88	± 4.00
		Average	50.93	± 4.00
22.36050	V	Peak	53.74	± 4.00

Highest frequency (134) 5670MHz. Out-of-band spurious emissions inside adjacent band 5.725-5.825 GHz.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.72763	V	Peak	67.30	± 4.00
		Average	55.71	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.72716	V	Peak	56.21	± 4.00
		Average	45.33	± 4.00

Chain A+B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.72699	V	Peak	56.11	± 4.00
		Average	44.27	± 4.00

Channel 110 (5550 MHz). 5510MHz. Out-of-band spurious emissions inside restricted band 5.35-5.46 GHz and 5.46-5.47 adjacent band. Highest spurious levels in bands.

Chain A

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.46789	V	Peak	57.64	± 4.00
		Average	44.66	± 4.00

Chain B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.46830	V	Peak	56.11	± 4.00
		Average	42.83	± 4.00

Chain A+B

Spurious frequency (GHz)	Polarization	Detector	Emission Level (dBµV/m)	Measurement Uncertainty (dB)
5.46660	V	Peak	54.60	± 4.00
		Average	41.96	± 4.00