

ISED CABid: ES1909

Test Report No:
 NIE: 67442RRF.002

Test Report

USA FCC Part 15.247, 15.209

CANADA RSS-247, RSS-Gen

(*) Identification of item tested	Communications device
(*) Trademark	Ring LLC
(*) Model and /or type reference	5AT3T3
Other identification of the product	FCC ID: 2AEUPBHAXN001 IC: 20271-BHAXN001
(*) Features	--
Applicant	Ring LLC 1523 26th Street, Santa Monica, 90404, California, United States
Test method requested, standard	USA FCC Part 15.247 (10-1-20 Edition): Operation within the bands 902 - 928 MHz, 2400 -2483.5 MHz, and 5725 - 5850 MHz. USA FCC Part 15.209 (10-1-20 Edition): Radiated emission limits; general requirements. CANADA RSS-247 Issue 2 (February 2017). CANADA RSS-Gen Issue 5, Amendment 1, March 2019 Guidance for Performing Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid Systems Devices Operating Under Section 15.247 of the FCC Rules. 558074 D01 Meas Guidance v05r02 dated April 2, 2019. Guidance for Emission Testing of Transmitters with Multiple Outputs in the Same Band 662911 D01 Multiple Transmitter Output v02r01 dated 10/31/2013 ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	José Manuel Gómez Industrial & Automotive EMC Lab. Manager
Date of issue	2021-08-30
Report template No	FDT08_23 (* "Data provided by the client")

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DEKRA Testing and Certification S.A.U. is an FCC-recognized accredited testing laboratory with the appropriate scope of accreditation that covers the performed test in this report.

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Uncertainty

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

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").
2. The sample of the model number 5AT3T3 is a communications device.

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of result.

Usage of samples

Samples undergoing test have been selected by: The client.

- Sample S/01 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Reception
67442/036	Communications Device	5AT3T3	GCB1ES0011370003	2021/06/01

Auxiliary elements used with the Sample S/01:

Control Nº	Description	Model	Serial Nº	Reception
67442/037	AC/DC Power Adapter	DSA-36PDB FUS	GB51PR0110770SEX	2021/06/01

Sample S/01 has undergone the test(s): The tests indicated in the Appendix A.

Test sample description

Ports..... :	Port name and description	Cable					
		Specified max length [m]	Attached during test	Shielded	Coupled to patient ⁽³⁾		
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Supplementary information to the ports..... :							
Rated power supply	Voltage and Frequency		Reference poles				
			L1	L2	L3	N	PE
	<input type="checkbox"/>	AC:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input checked="" type="checkbox"/>	AC:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<input type="checkbox"/>	DC:					
<input type="checkbox"/>	DC:						
Rated Power							
Clock frequencies..... :							
Other parameters							
Software version	Rev 1.0						
Hardware version	Rev 1.3						
Dimensions in cm (W x H x D)							
Mounting position	<input checked="" type="checkbox"/>	Table top equipment					
	<input type="checkbox"/>	Wall/Ceiling mounted equipment					
	<input type="checkbox"/>	Floor standing equipment					
	<input type="checkbox"/>	Hand-held equipment					
	<input type="checkbox"/>	Other:					
Modules/parts..... :	Module/parts of test item		Type	Manufacturer			
Accessories (not part of the test item)	Description		Type	Manufacturer			
Documents as provided by the applicant	Description		File name	Issue date			

⁽³⁾ Only applicable to medical equipments.

Identification of the client

Ring LLC

1523 26th Street, Santa Monica, 90404, California, United States

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2021-05-04
Date (finish)	2021-06-18

Document history

Report number	Date	Description
67442RRF.002	2021-08-30	First release.

Environmental conditions

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

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

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

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

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

Temperature	Min. = 15 °C Max. = 35 °C
Relative humidity	Min. = 20 % Max. = 75 %

Remarks and comments

The tests have been performed by the technical personnel: Antonio Manuel Sánchez, Jaime Barranquero, Victoria Olmedo, Juan Manuel Pino and Humberto Pérez.

Used instrumentation:

Conducted Measurements:

	Last Calibration	Due Calibration
1. Spectrum Analyzer 9kHz-6GHz ROHDE AND SCHWARZ FSL6	2021/04	2023/04
2. Vector Signal Generator 100 KHz-6GHz ROHDE AND SCHWARZ SMU200A	2021/04	2023/04
3. Signal Generator 9 KHz-6 GHz, ROHDE AND SCHWARZ SMB100A	2019/10	2021/10
4. Open Switch and Control Platform ROHDE & SCHWARZ OSP-B157W8	2021/03	2023/03
5. EXTENSION FOR OPEN SWITCH UNIT UP TO 40GHz ROHDE & SCHWARZ OSP-B157Wx	2021/03	2023/03

Radiated Measurements:

	Last Calibration	Due Calibration
1. Semianechoic Absorber Lined Chamber ALBATROSS P29419	2020/01	2023/01
2. Ultralog Antenna 30MHz-6GHz, ROHDE AND SCHWARZ HL562E_UPG	2019/10	2022/10
3. EMI Test Receiver 2Hz-44GHz, ROHDE AND SCHWARZ ESW44	2019/10	2021/10
4. Shielded Room ETS LINDGREN S101	N/A	N/A
5. Horn Antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2019/11	2022/11
6. Horn Antenna 0,75-18GHz ETS LINDGREN 3115	2020/08	2023/08
7. Preamplifier, G>55dB 1-18GHz NARDA AMF-7D-01001800-22-10P	2021/02	2022/02
8. EMI Test Receiver 2 Hz - 44 GHz ROHDE AND SCHWARZ ESW44	2020/02	2022/02
9. Low Noise Amplifier G>30dB, 18 - 40 GHz BONN ELEKTRONIK BLMA 1840-3G	2019/11	2021/11
10. Broadband Horn Antenna 18 - 40 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9170	2017/12	2020/12

Testing verdicts

Not applicable:	N/A
Pass:	P
Fail:	F
Not measured:	N/M

Summary

A. 802.11 bgn2040he2040 2x2.

FCC PART 15 PARAGRAPH / RSS-247			
Requirement – Test case		Verdict	Remark
FCC 15.247 (a)(2) / RSS-247 5.2. (a)	6 dB Bandwidth	P	
FCC 15.247 (b) / RSS-247 5.4. (d)	Maximum output power and antenna gain	P	
FCC 15.247 (d) / RSS-247 5.5.	Band-edge emissions compliance (Transmitter)	P	
FCC 15.247 (e) / RSS-247 5.2. (b)	Power spectral density	P	
FCC 15.247 (d) / RSS-247 5.5.	Emission limitations radiated (Transmitter)	P	
<u>Supplementary information and remarks:</u>			
None.			

Appendix A: Test results. 802.11 bgn2040he2040

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TEST CONDITIONS

(*) Declared by the Client.

POWER SUPPLY (*):

Vnominal: 110 Vac
 Type of Power Supply: AC/DC Adapter.

ANTENNA 1 – WLAN1 (*):

Type of Antenna: Integral (stamped metal).
 Maximum Declared Antenna Gain: +4.6 dBi

ANTENNA 2 – WLAN2 (*):

Type of Antenna: Integral (stamped metal).
 Maximum Declared Antenna Gain: +3.8 dBi

Directional Antenna Gain Calculations for CDD MIMO:

- For 2Tx CDD MIMO modes, in accordance with KDB 662911 D01 v02r01 Section F)2)f)(ii), directional gain was calculated as (worst case):

$N_{SS} = 1$, $N_{ANT} = 2$, $G_{WLAN1} = 4.6$ dBi, $G_{WLAN2} = 3.8$ dBi

$$\begin{aligned} \text{Directional Gain} &= 10 \log \left[\frac{\sum_{j=1}^{N_{SS}} \left(\sum_{k=1}^{N_{ANT}} g_{j,k} \right)^2}{N_{ANT}} \right] = 10 \log \left[\frac{\sum_{j=1}^1 \left(\sum_{k=1}^2 g_{j,k} \right)^2}{2} \right] \\ &= 10 \log \left[\frac{(g_{1,1} + g_{1,2})^2}{2} \right] = 10 \log \left[\frac{\left(10^{\frac{4.6}{20}} + 10^{\frac{3.8}{20}} \right)^2}{2} \right] = 10 \log \left[\frac{\left(10^{\frac{4.6}{20}} + 10^{\frac{3.8}{20}} \right)^2}{2} \right] = 7.22 \text{ dBi} \end{aligned}$$

TEST FREQUENCIES for 20 MHz modes (*):

Low Channel (1): 2412 MHz
 Channel (2): 2417 MHz
 Middle Channel (6): 2437 MHz
 Channel (10): 2457 MHz
 High Channel (11): 2462 MHz

TEST FREQUENCIES for 40 MHz modes (*):

Low Channel (3): 2422 MHz
 Channel (4): 2427 MHz
 Middle Channel (6): 2437 MHz
 Channel (8): 2447 MHz
 High Channel (9): 2452 MHz

Transmit power setting:

Modes	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
802.11 b (WLAN1)	27.5 dBm	28 dBm	29 dBm	2 dBm	24.5 dBm
802.11 b (WLAN2)	26.5 dBm	27.5 dBm	29.5 dBm	25 dBm	dBm
802.11 b (WLAN1+2)	24 dBm	24 dBm	25.5 dBm	24.5 dBm	24.5 dBm
802.11 g (WLAN1)	24 dBm	25.5 dBm	29 dBm	25 dBm	22.5 dBm
802.11 g (WLAN2)	24 dBm	25 dBm	29 dBm	24 dBm	23.5 dBm
802.11 g (WLAN1+2)	23 dBm	24 dBm	26 dBm	24 dBm	22 dBm
802.11 n20 (WLAN1)	23.5 dBm	25 dBm	29 dBm	25 dBm	20 dBm
802.11 n20 (WLAN2)	24 dBm	25.5 dBm	28.5 dBm	24.5 dBm	24 dBm
802.11 n20 (WLAN1+2)	23.5 dBm	24.5 dBm	26 dBm	24 dBm	18.5 dBm
802.11 HE20 (WLAN1)	23 dBm	25 dBm	28.5 dBm	25 dBm	21 dBm
802.11 HE20 (WLAN2)	23.5 dBm	25 dBm	28.5 dBm	24.5 dBm	23.5 dBm
802.11 HE20 (WLAN1+2)	22.5 dBm	24.5dBm	26 dBm	23.5 dBm	18.5 dBm

Modes	Low Channel (3) 2422MHz	Channel (4) 2427MHz	Middle Channel (6) 2437MHz	Channel (8) 2447MHz	High Channel (9) 2452MHz
802.11 n40 (WLAN1)	22 dBm	22.5 dBm	24 dBm	19.5 dBm	16 dBm
802.11 n40 (WLAN2)	22 dBm	22.5 dBm	23.5 dBm	23.5 dBm	23 dBm
802.11 n40 (WLAN1+2)	20.5 dBm	21.5 dBm	23 dBm	18 dBm	15 dBm
802.11 HE40 (WLAN1)	22 dBm	22.5 dBm	24 dBm	18.5 dBm	16.5 dBm
802.11 HE40 (WLAN2)	22 dBm	22.5 dBm	24 dBm	23 dBm	23 dBm
802.11 HE40 (WLAN1+2)	20.5 dBm	21 dBm	20.5 dBm	18 dBm	15 dBm

The data rates of 1 Mbps for 802.11 b, 6.5 Mbps for 802.11 g, MCS0 for 802.11 n20,he20,n40 and he40 were selected based on preliminary testing that identified those rates corresponding to the worst cases for output power and band edge levels at restricted bands.

The sample was used to configure the EUT to continuously transmit at a specified output power in all channels with different modes and modulation schemes.

The field strength at the band edges was evaluated for each mode for the channel under test.

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

CONDUCTED MEASUREMENTS:

The equipment under test was set up in a shielded room and it is connected to the TS8997 system using a low loss RF cable. The reading of the spectrum analyser is corrected taking into account the cable loss.



RADIATED MEASUREMENTS:

All radiated tests were performed in a semi-anechoic chamber. The measurement antenna (Bilog antenna for the range between 30 MHz to 1000 MHz) and 1 GHz-18 GHz Double ridge horn antenna is situated at a distance of 3 m and a distance of 1 m for the frequency range 17 GHz-26 GHz (18 GHz-40 GHz horn antenna).

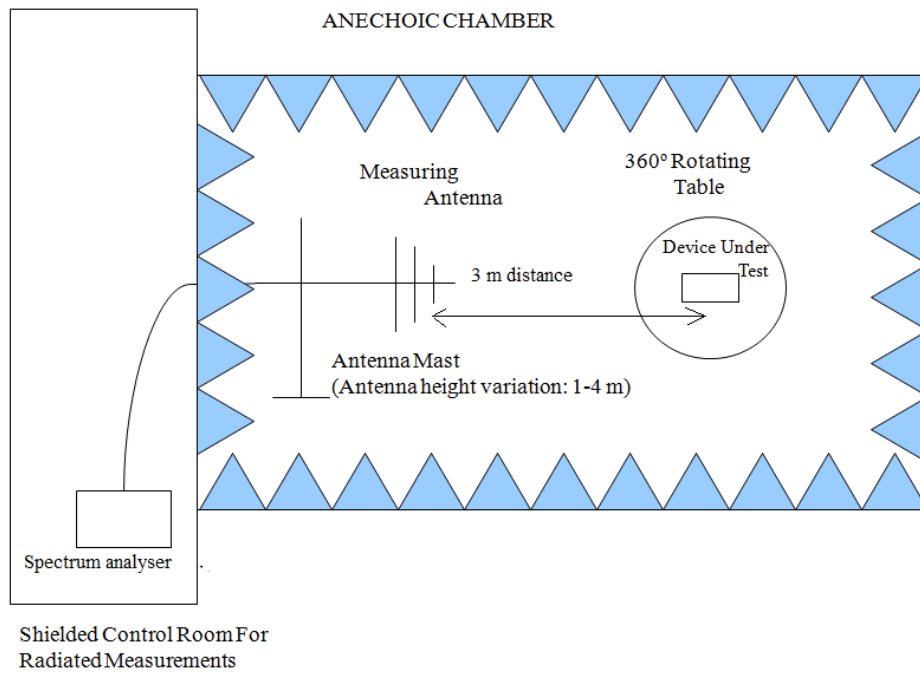
For radiated emissions in the range 17 GHz-26 GHz that is performed at a distance closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

The equipment under test was set up on a non-conductive platform above the ground plane and the situation and orientation was varied to find the maximum radiated emission. It was also rotated 360° and the antenna height (Bilog antenna and Double ridge horn antenna) was varied from 1 to 4 meters to find the maximum radiated emission.

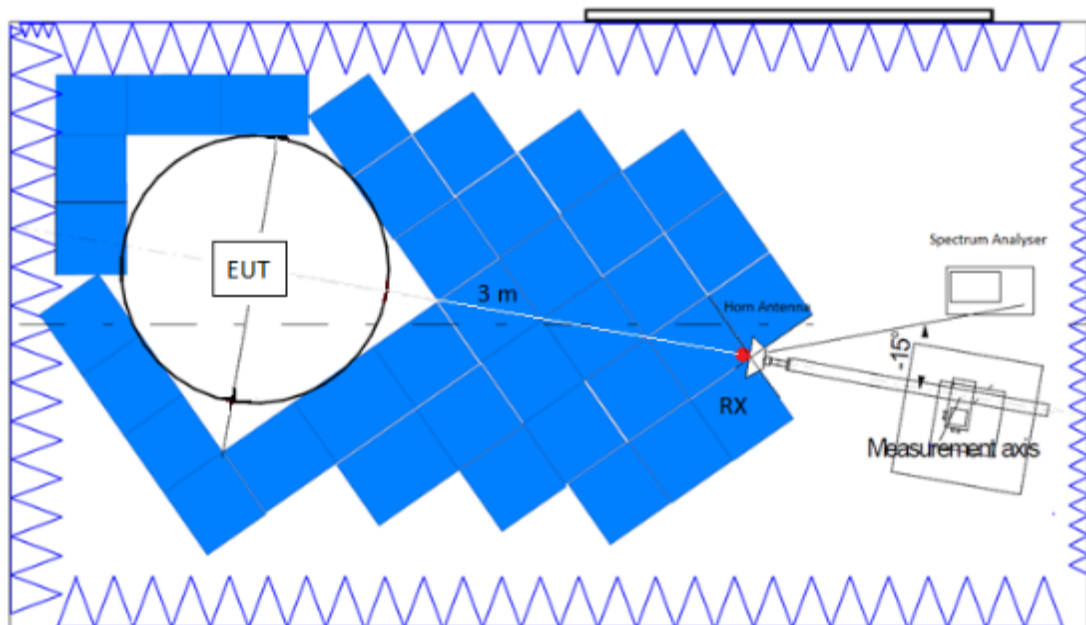
Measurements were made in both horizontal and vertical planes of polarization.

A resolution bandwidth / video bandwidth of 100 kHz / 300 kHz was used for frequencies below 1 GHz and 1 MHz / 3 MHz for frequencies above 1 GHz.

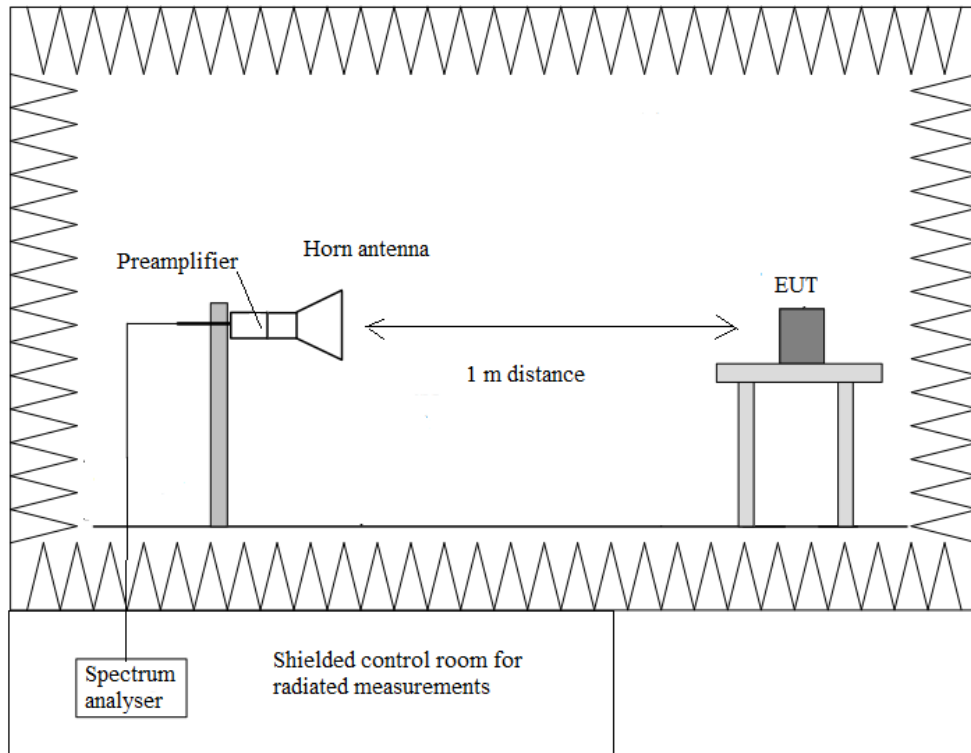
Radiated measurements setup from 30 MHz to 1 GHz:



Radiated measurements setup from 1 GHz to 17 GHz:



Radiated measurements setup $f > 17$ GHz:



Occupied Bandwidth

RESULTS:

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

- 802.11 b: 6 Mbit/s.
- 802.11 g: 6 Mbit/s.
- 802.11 n HT20: MCS0.
- 802.11 n HT40: MCS0.
- 802.11 ax HE20: MCS0.
- 802.11 ax HE40: MCS0.

- Preliminary tests determined the SISO worst case: WLAN1.

SISO worst case:

- **SISO 802.11 b:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
99% Bandwidth (MHz)	15.280899	16.629213	16.629213	13.483146	19.325843
Measurement uncertainty (%)	<± 1.40				

- **SISO 802.11 g:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
99% Bandwidth (MHz)	16.629213	16.928839	26.516854	16.779026	16.479400
Measurement uncertainty (%)	<± 1.40				

- **SISO 802.11 n20:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
99% Bandwidth (MHz)	17.677902	17.827715	26.367041	17.827715	17.677902
Measurement uncertainty (%)	<± 1.40				

- **SISO 802.11 he20:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
99% Bandwidth (MHz)	19.026217	19.176030	24.569288	19.026217	19.026217
Measurement uncertainty (%)	<± 1.40				

- **SISO 802.11 n40:**

	Low Channel (3) 2422MHz	Channel (4) 2427MHz	Middle Channel (6) 2437MHz	Channel (8) 2447MHz	High Channel (9) 2452MHz
99% Bandwidth (MHz)	36.500000	36.500000	37.000000	36.500000	36.500000
Measurement uncertainty (%)	<± 1.40				

- **SISO 802.11 he40:**

	Low Channel (3) 2422MHz	Channel (4) 2427MHz	Middle Channel (6) 2437MHz	Channel (8) 2447MHz	High Channel (9) 2452MHz
99% Bandwidth (MHz)	38.000000	38.500000	38.500000	38.000000	38.500000
Measurement uncertainty (%)	<± 1.40				

MIMO worst case:

- Preliminary tests determined the MIMO worst case: WLAN1 & WLAN2.

- **MIMO 802.11 b:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
99% Bandwidth (MHz)	18.726592	20.224719	13.183520	19.925093	20.823970
Measurement uncertainty (%)	<± 1.40				

- **MIMO 802.11 g:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
99% Bandwidth (MHz)	18.726592	17.827715	16.928839	18.127341	16.629213
Measurement uncertainty (%)	<± 1.40				

- **MIMO 802.11 n20:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
99% Bandwidth (MHz)	18.726592	18.426967	17.977528	18.426967	17.827715
Measurement uncertainty (%)	<± 1.40				

- **MIMO 802.11 he20:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
99% Bandwidth (MHz)	16.629213	16.928839	26.516854	16.779026	16.479400
Measurement uncertainty (%)	<± 1.40				

- **MIMO 802.11 n40:**

	Low Channel (3) 2422MHz	Channel (4) 2427MHz	Middle Channel (6) 2437MHz	Channel (8) 2447MHz	High Channel (9) 2452MHz
99% Bandwidth (MHz)	36.500000	36.500000	45.000000	37.000000	38.000000
Measurement uncertainty (%)	<± 1.40				

- **MIMO 802.11 he40:**

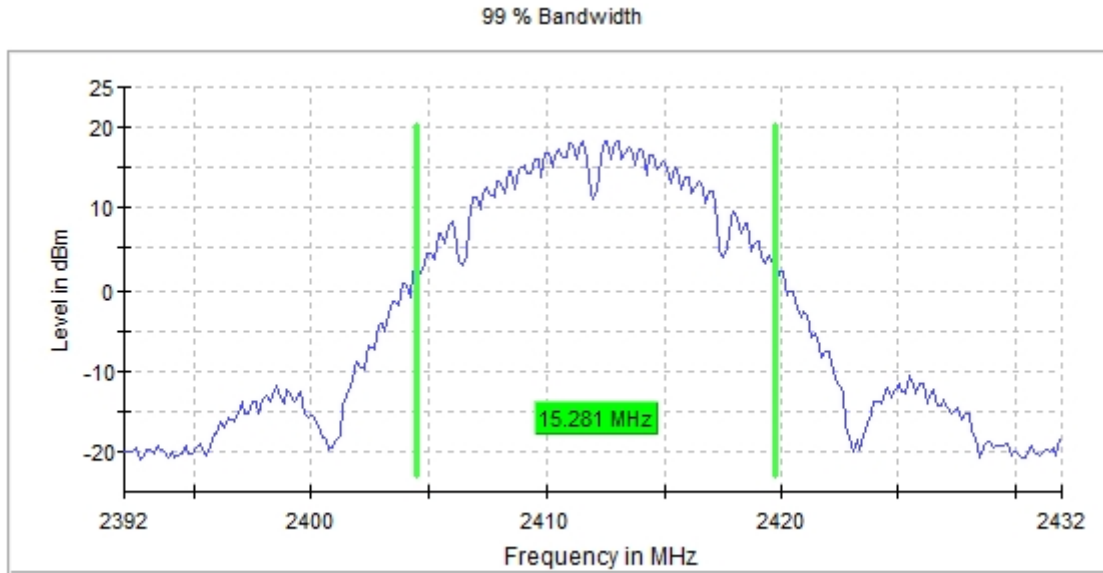
	Low Channel (3) 2422MHz	Channel (4) 2427MHz	Middle Channel (6) 2437MHz	Channel (8) 2447MHz	High Channel (9) 2452MHz
99% Bandwidth (MHz)	38.000000	38.500000	37.750000	38.500000	38.500000
Measurement uncertainty (%)	<± 1.40				

Verdict: PASS

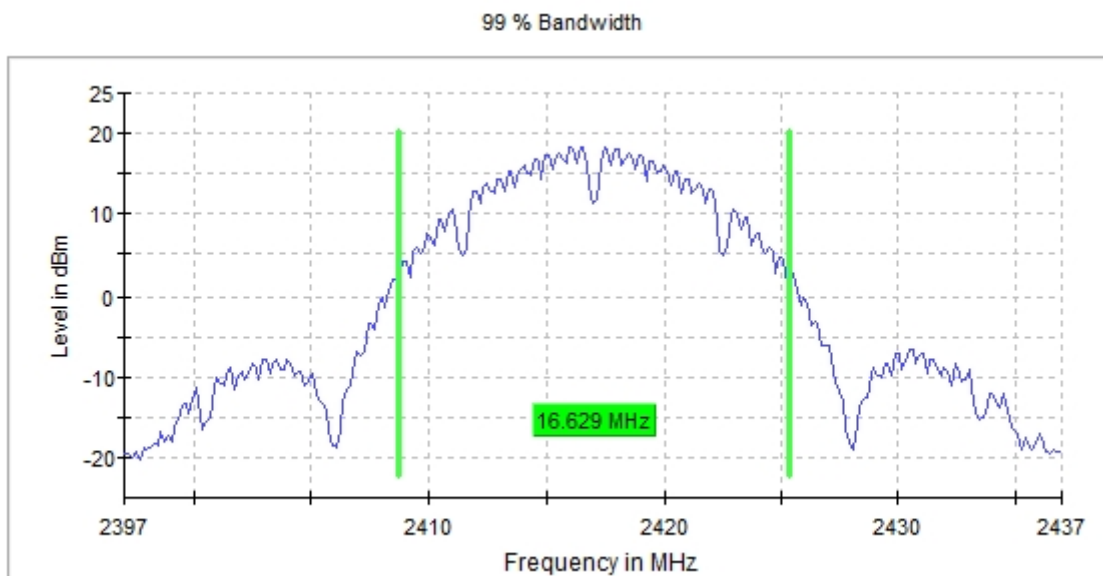
SISO worst case:

- **SISO 802.11 b – Occupied Bandwidth:**

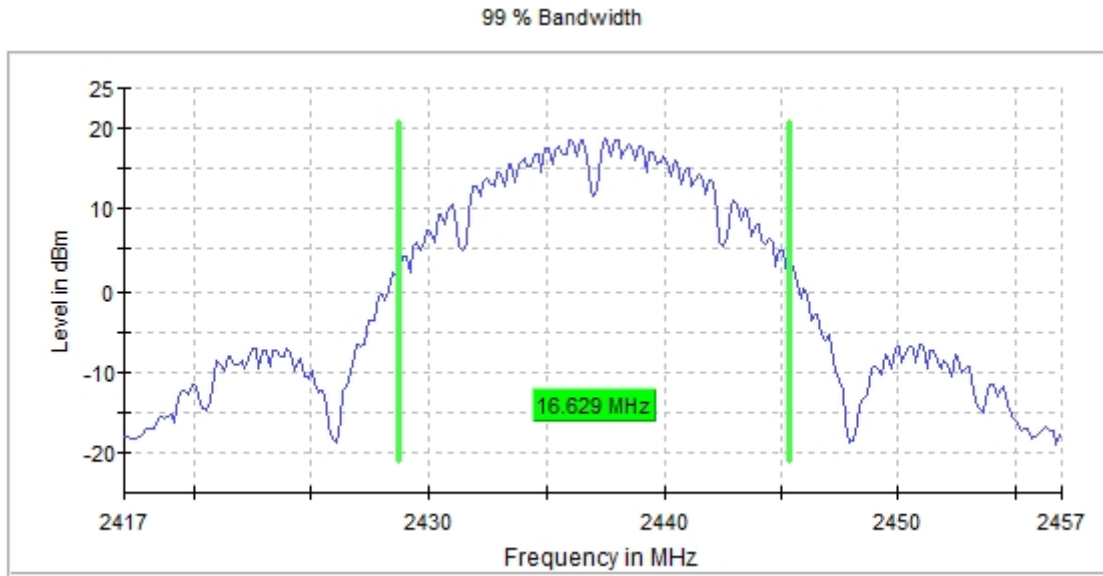
- Low Channel (1):



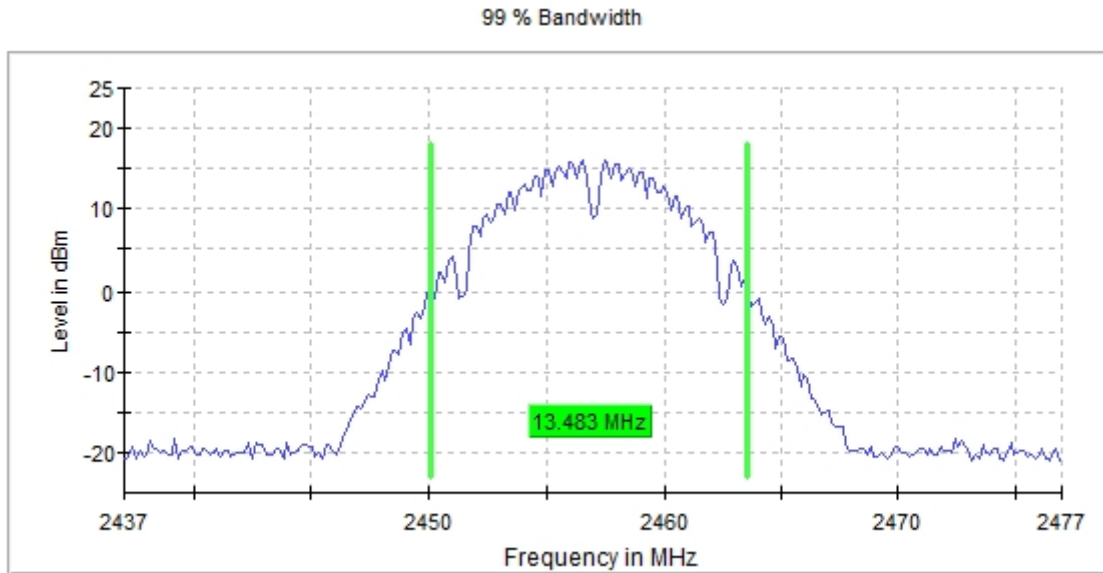
- Channel (2)::



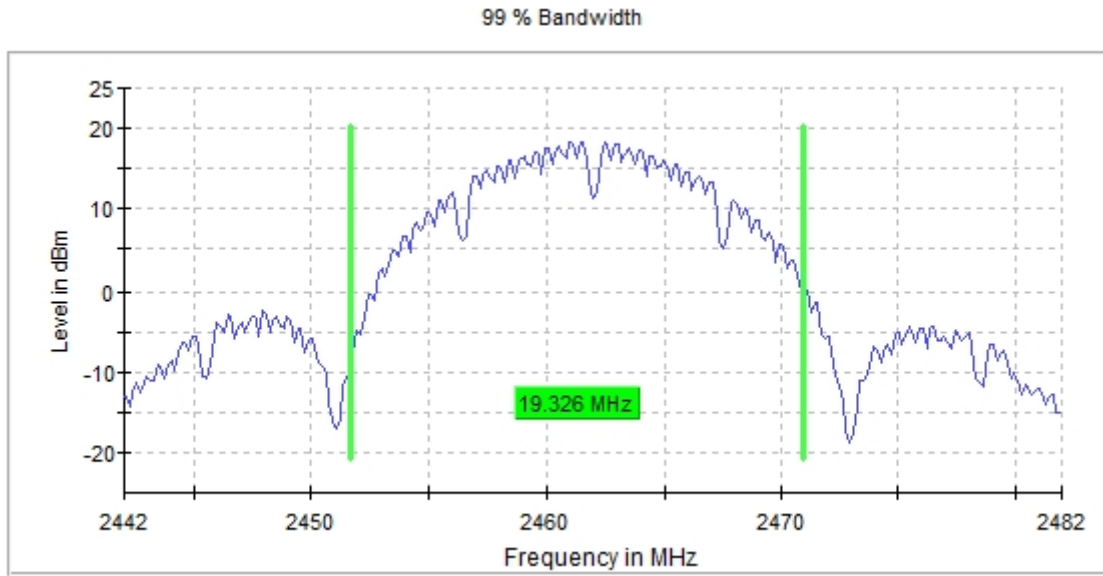
- Middle Channel (6):



- Channel (10):

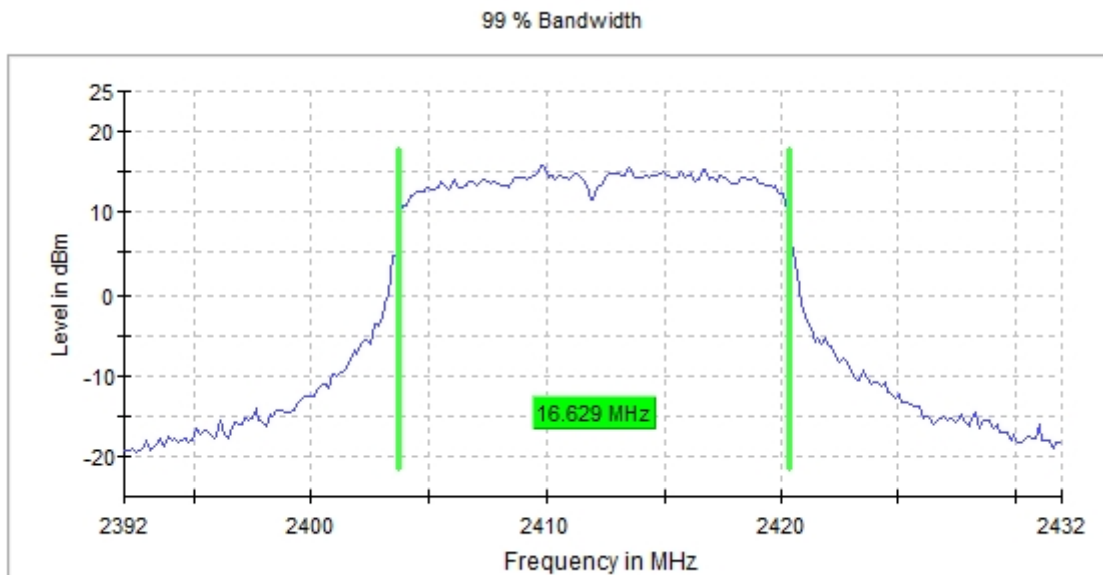


- High Channel (11):

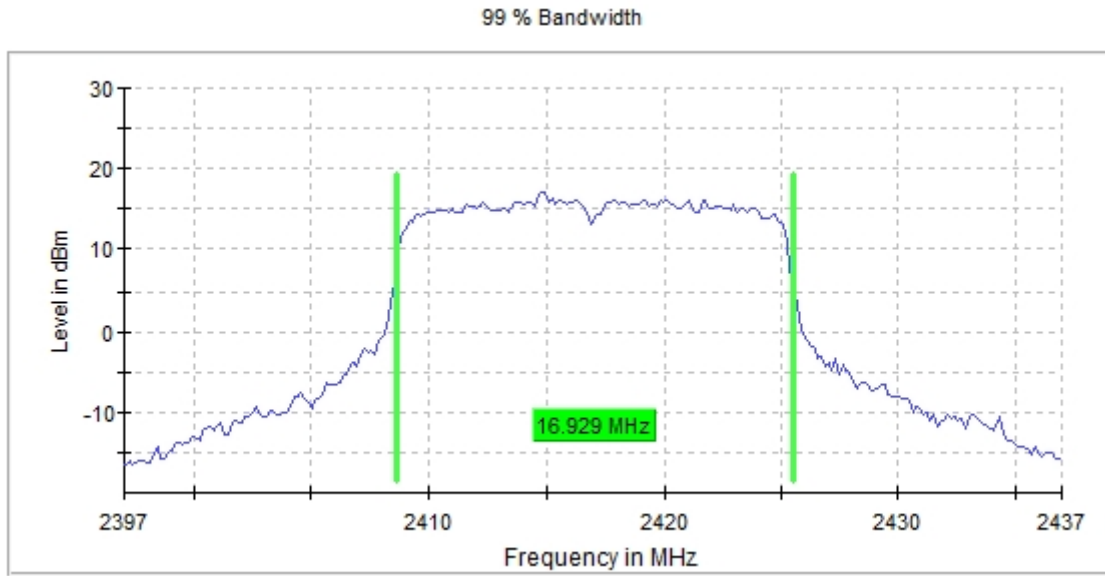


- **SISO 802.11 g – Occupied Bandwidth:**

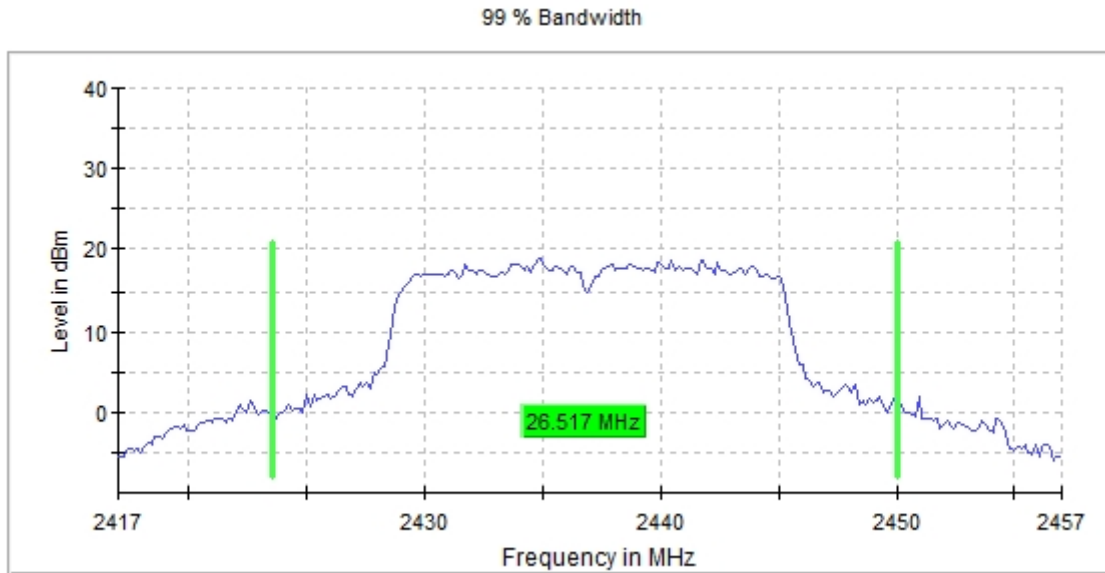
- Low Channel (1):



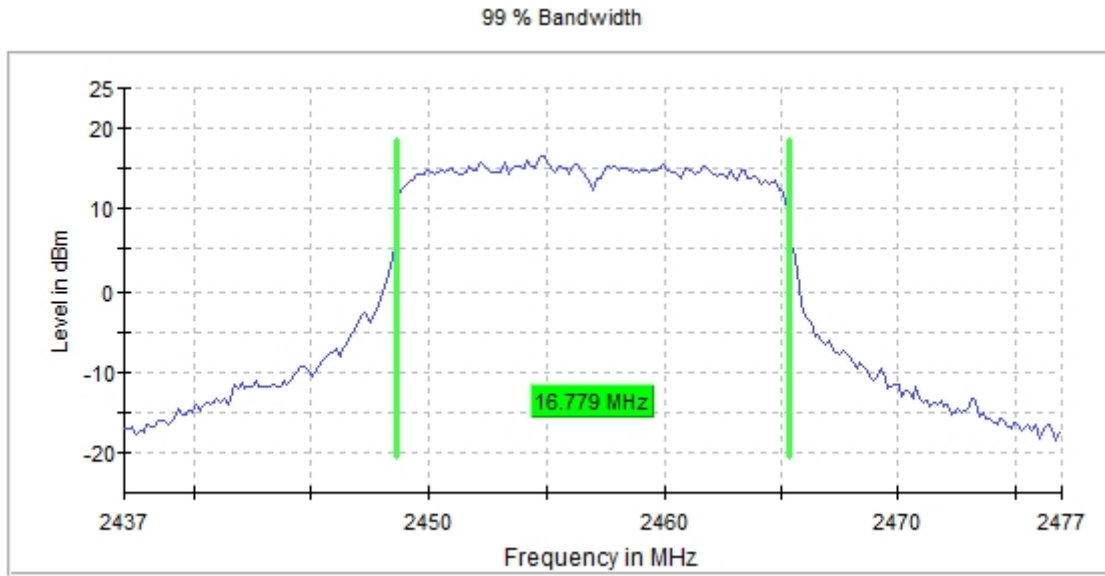
- Channel (2):



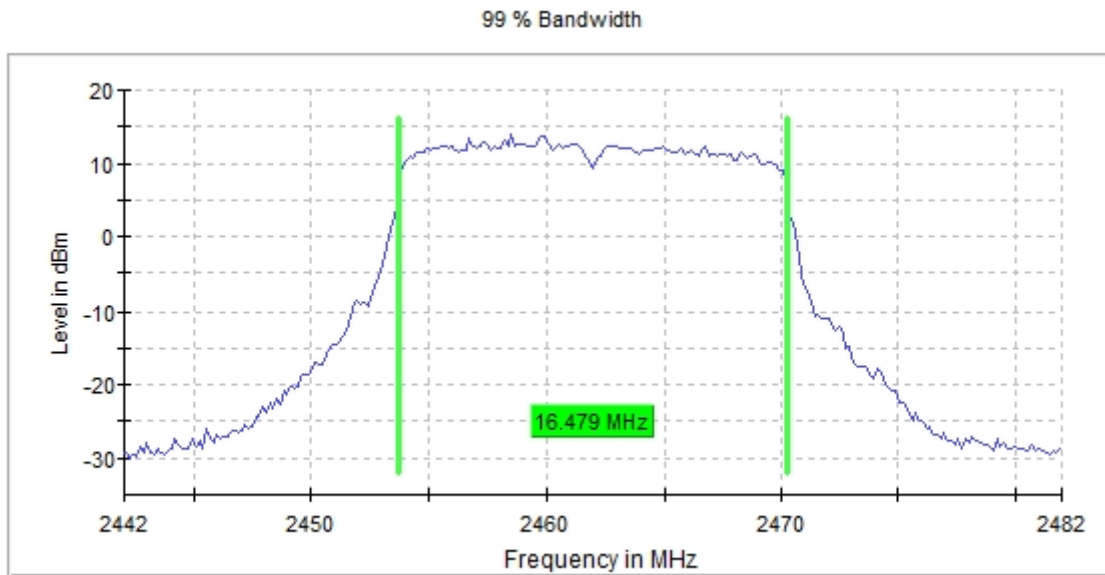
- Middle Channel (6):



- Channel (10):

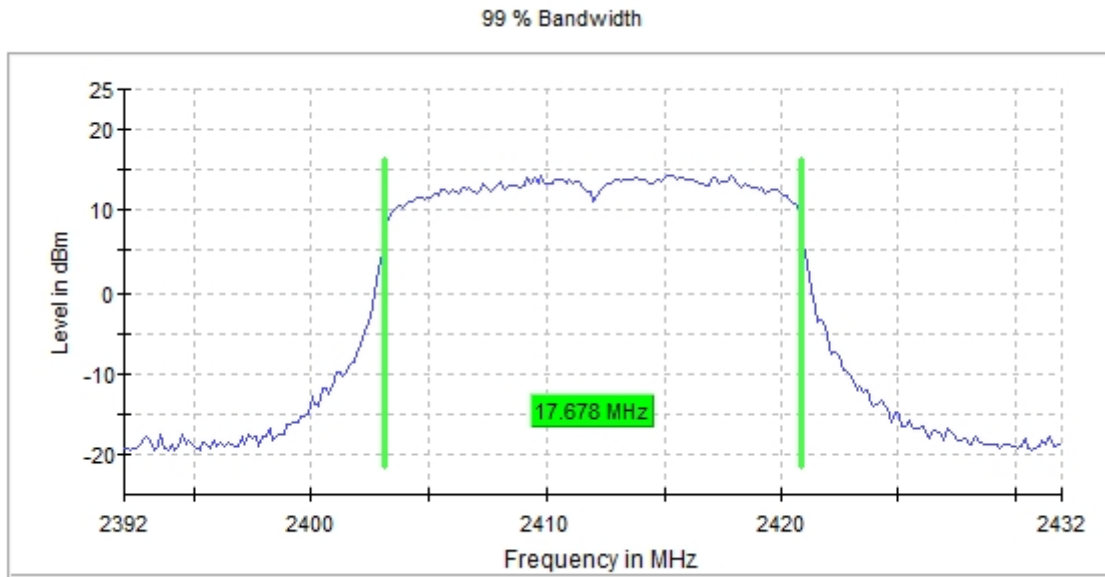


- High Channel (11):

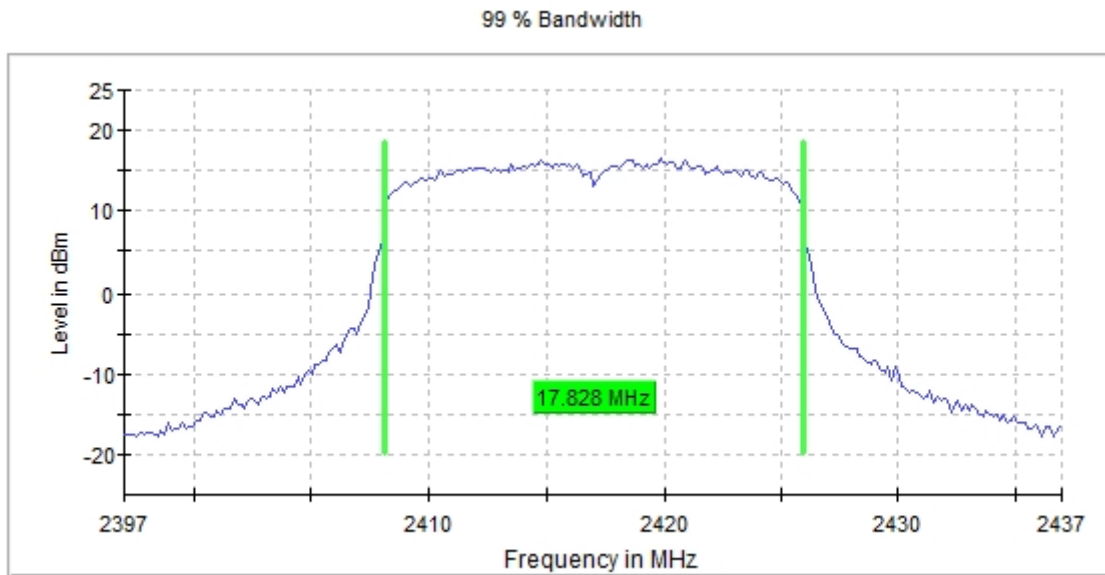


- **SISO 802.11 n20 – Occupied Bandwidth:**

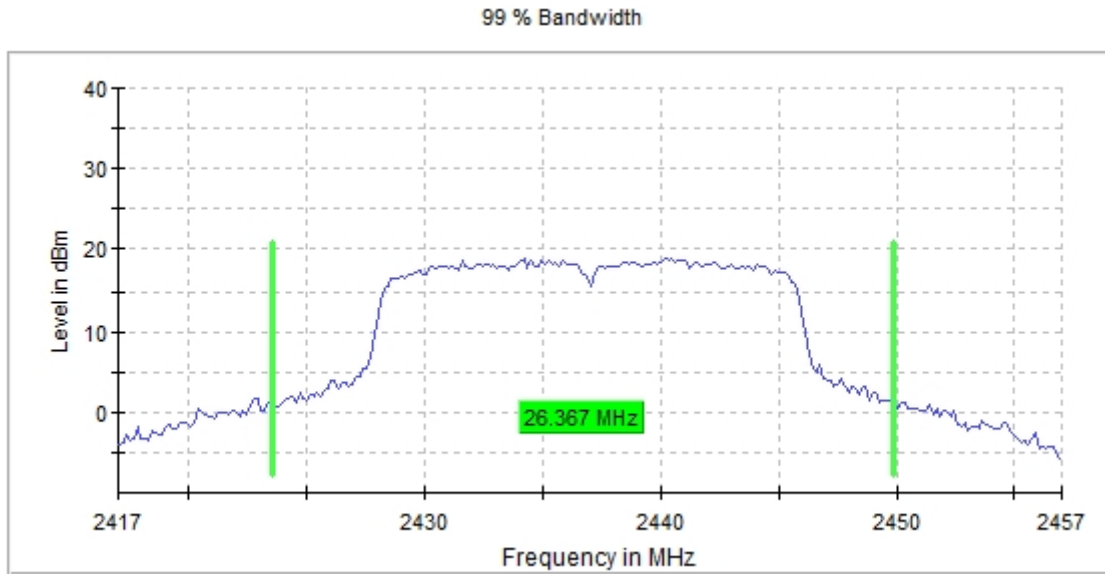
- Low Channel (1):



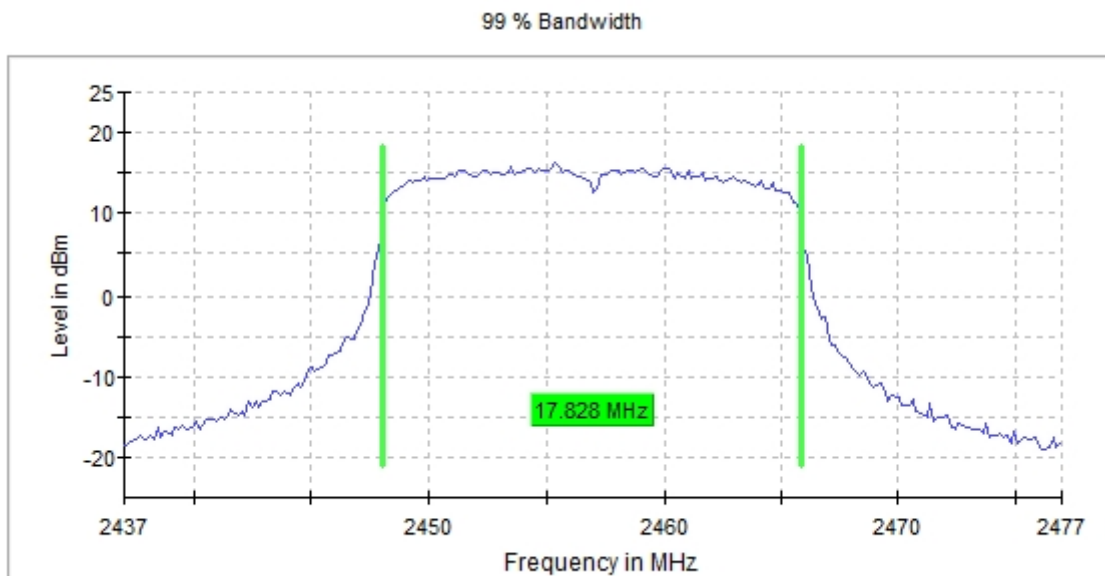
- Channel (2):



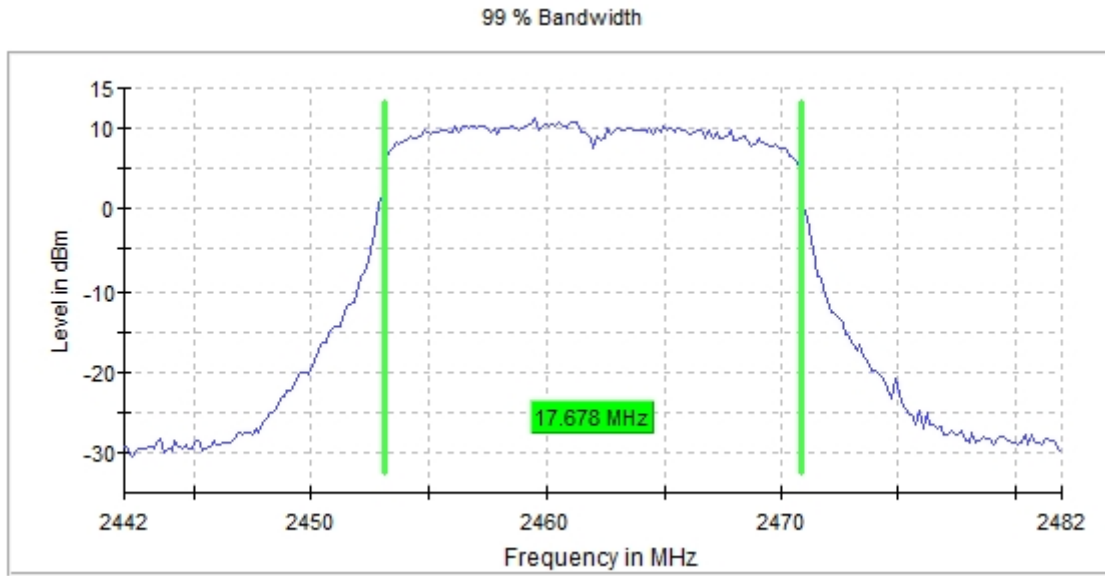
- Middle Channel (6):



- Channel (10):

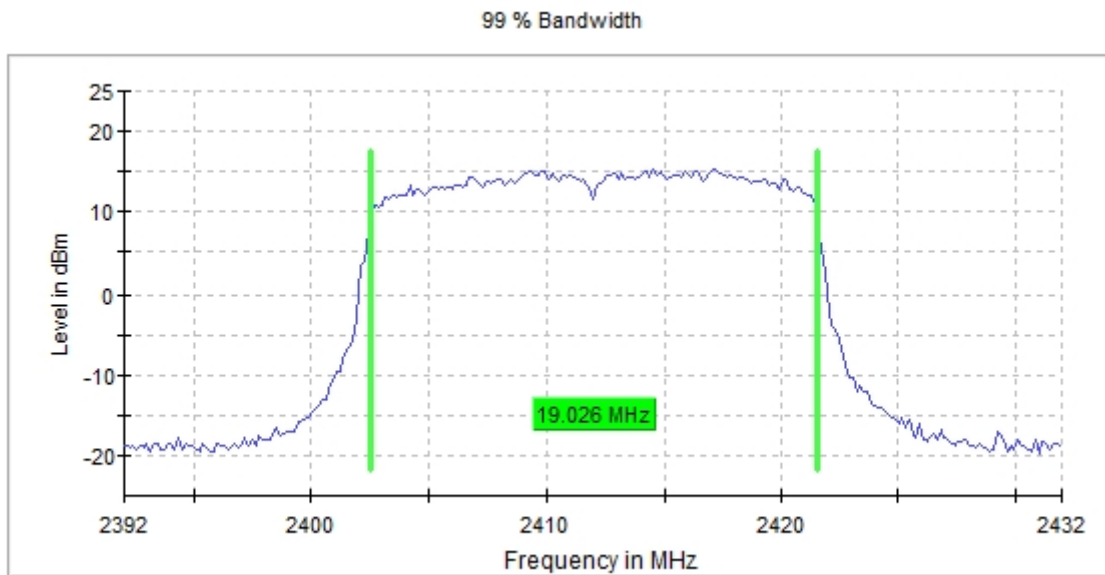


- High Channel (11):

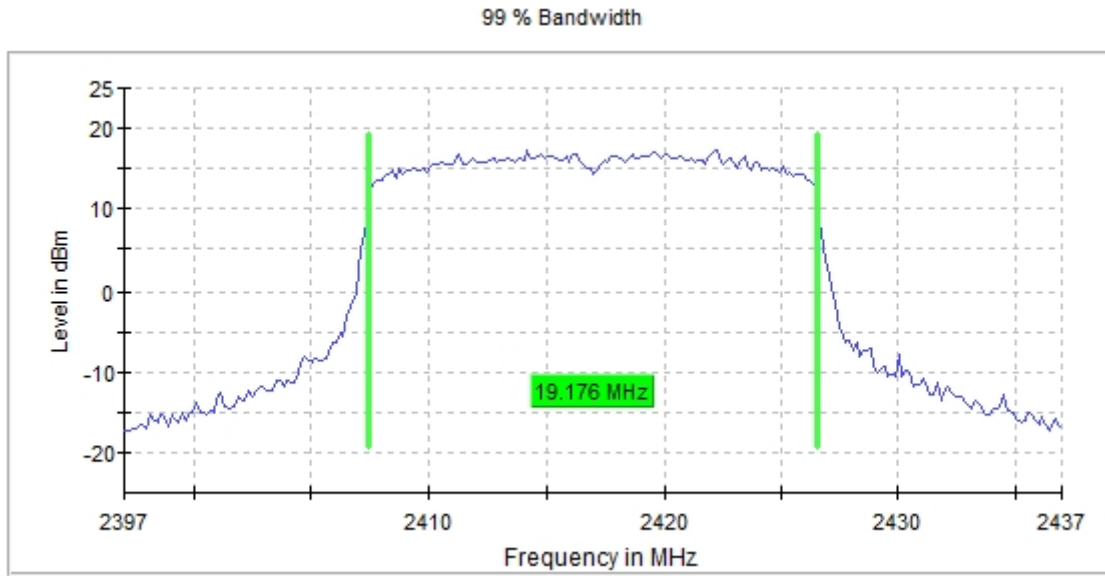


- SISO 802.11 he20 – Occupied Bandwidth:

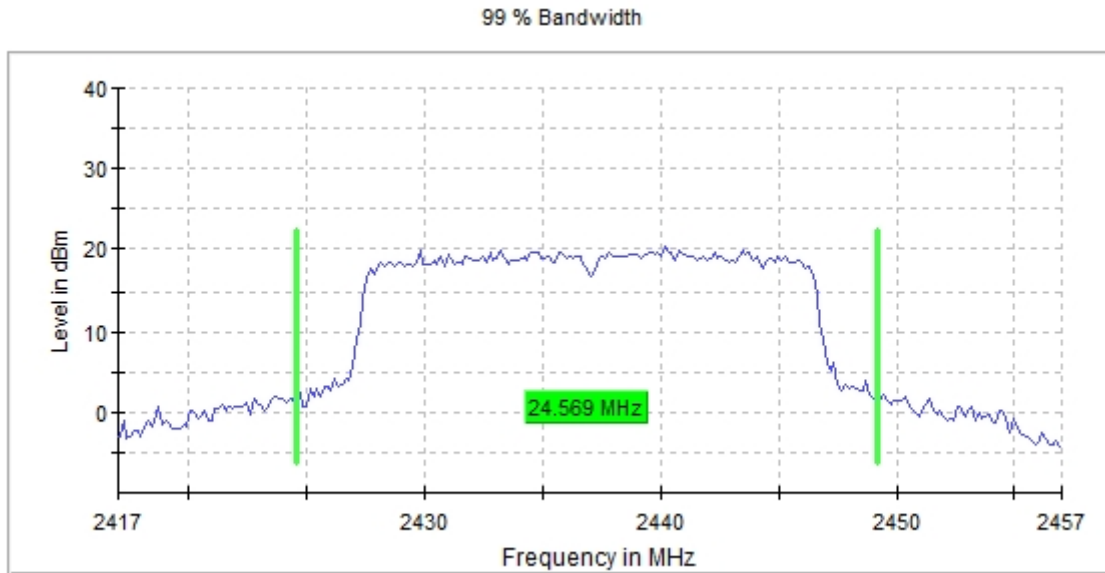
- Low Channel (1):



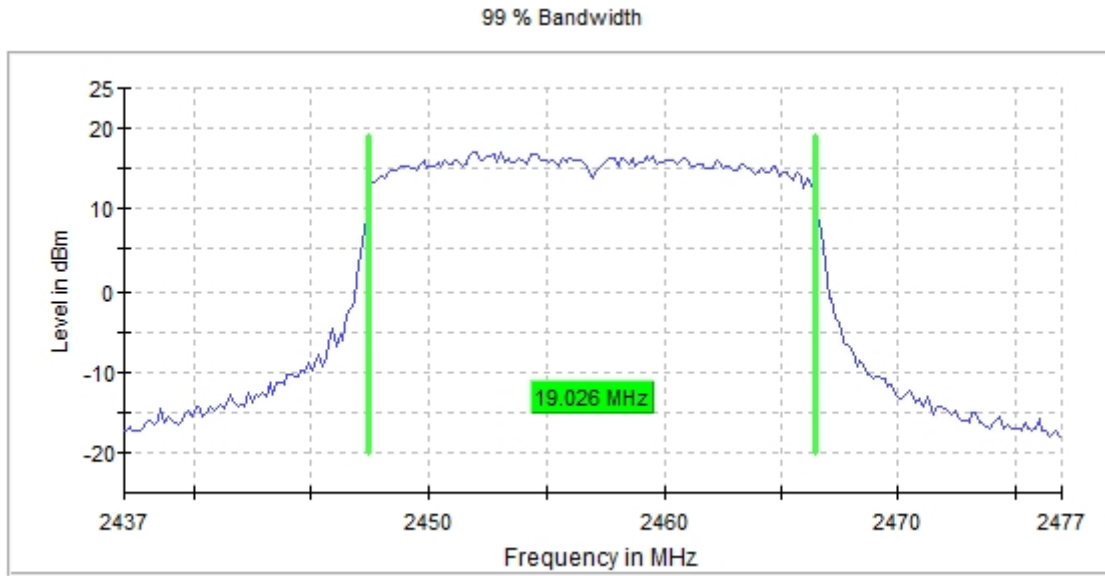
- Channel (2):



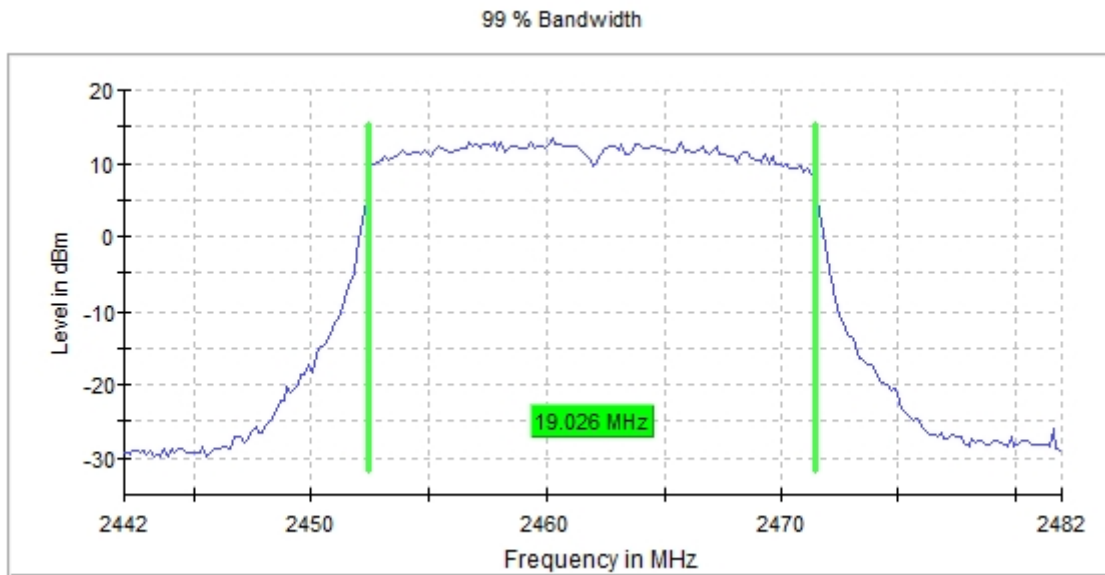
- Middle Channel (6):



- Channel (10):

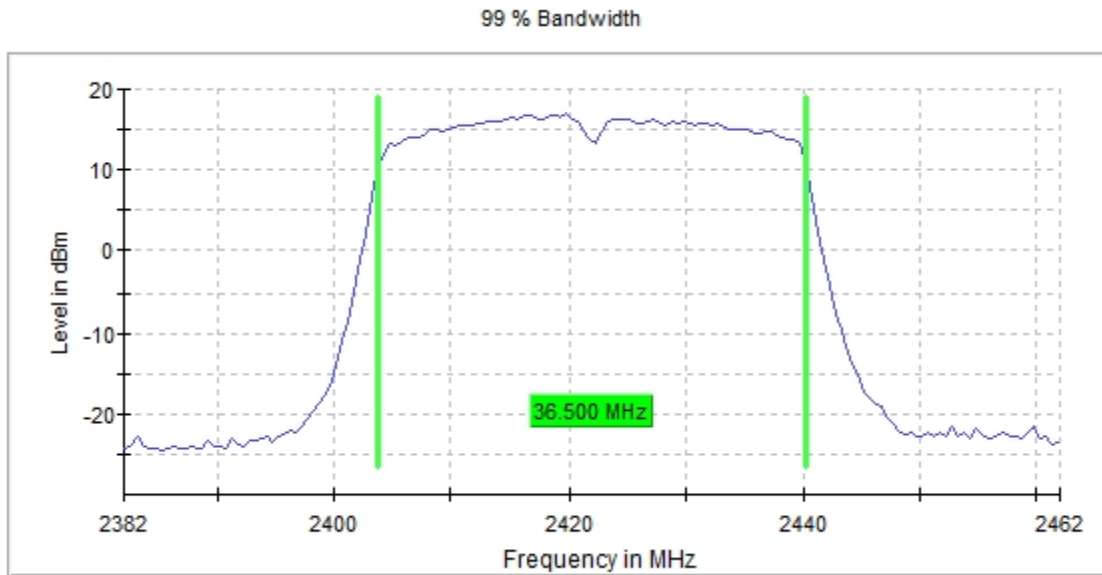


- High Channel (11):

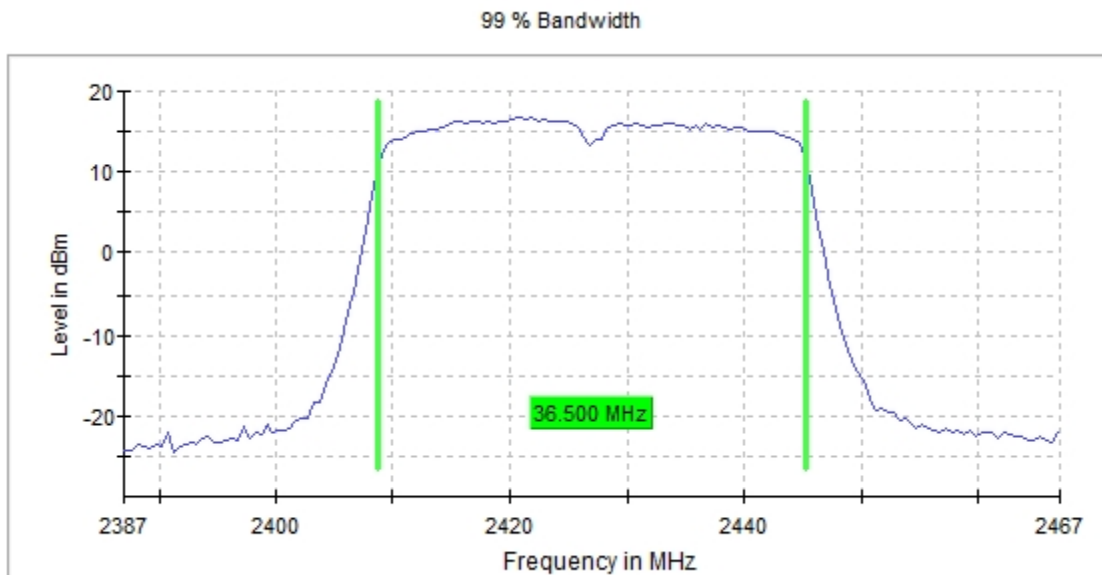


- **SISO 802.11 n40 – Occupied Bandwidth:**

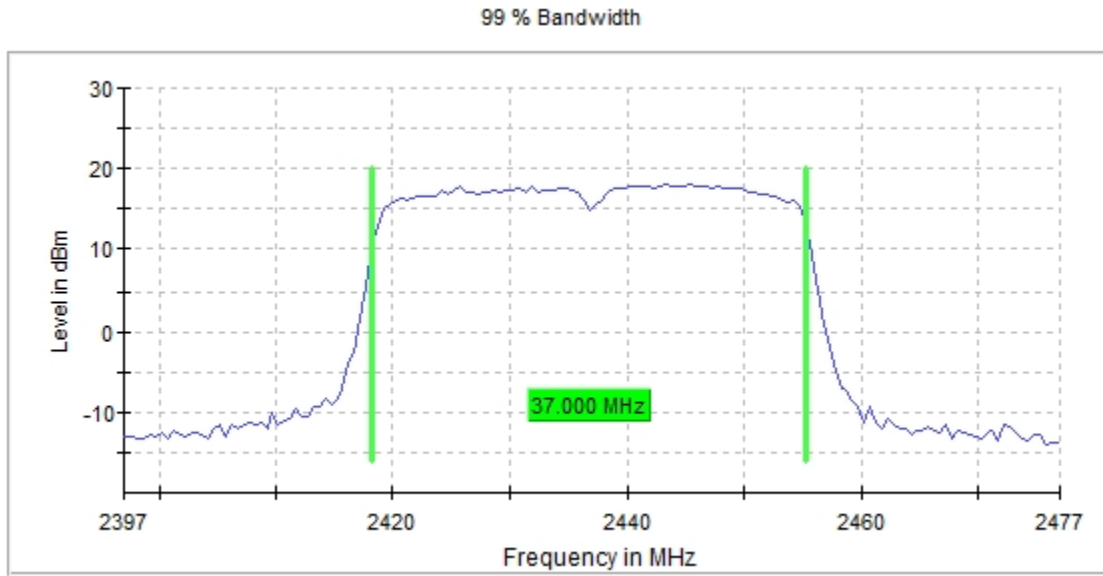
- Low Channel (3):



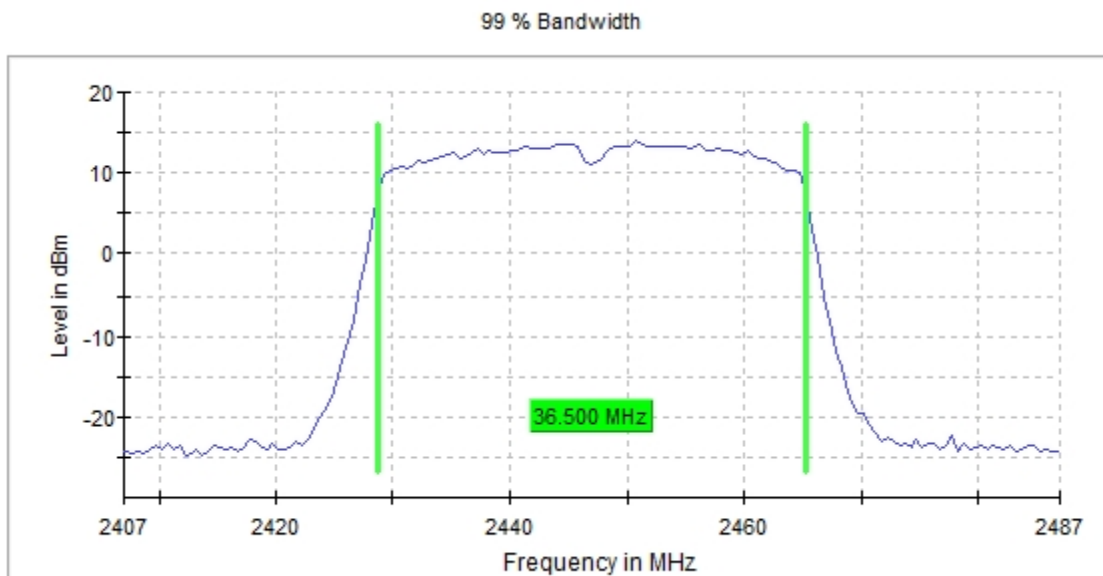
- Channel (4):



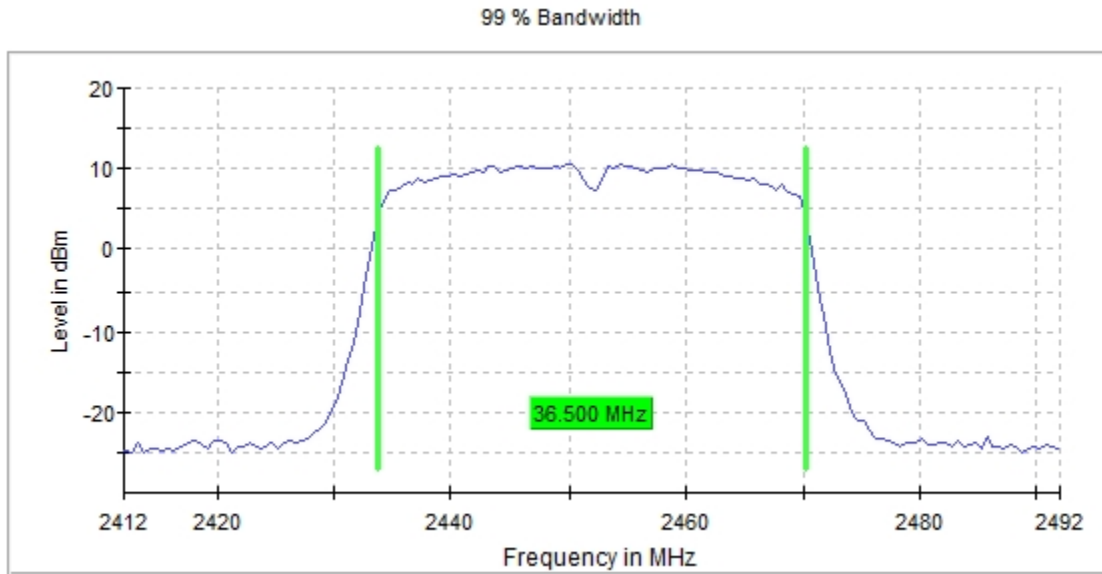
- Middle Channel (6):



- Channel (8):

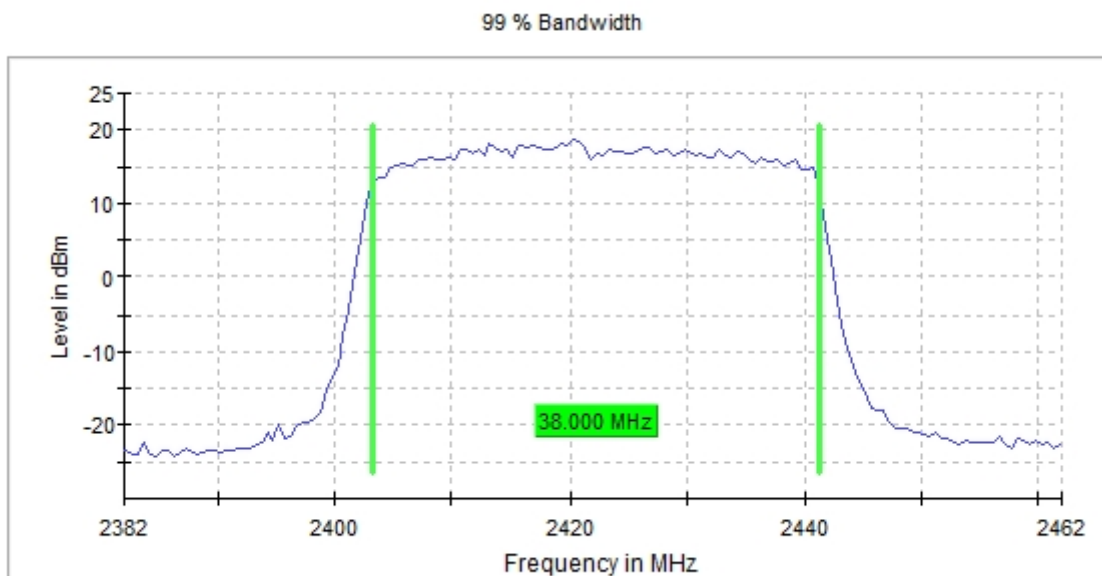


- High Channel (9):

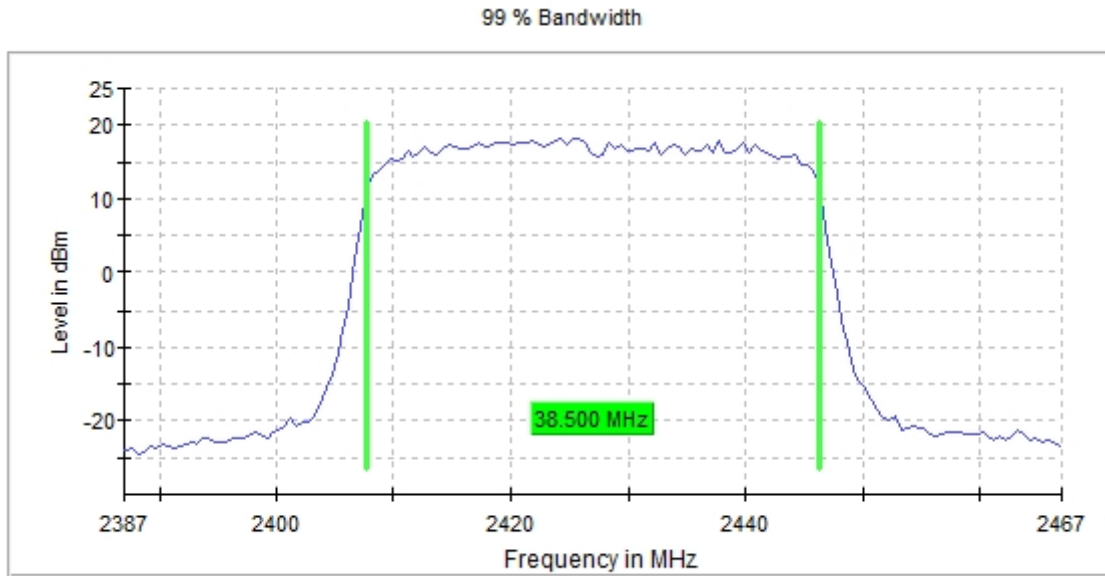


- **SISO 802.11 he40 – Occupied Bandwidth:**

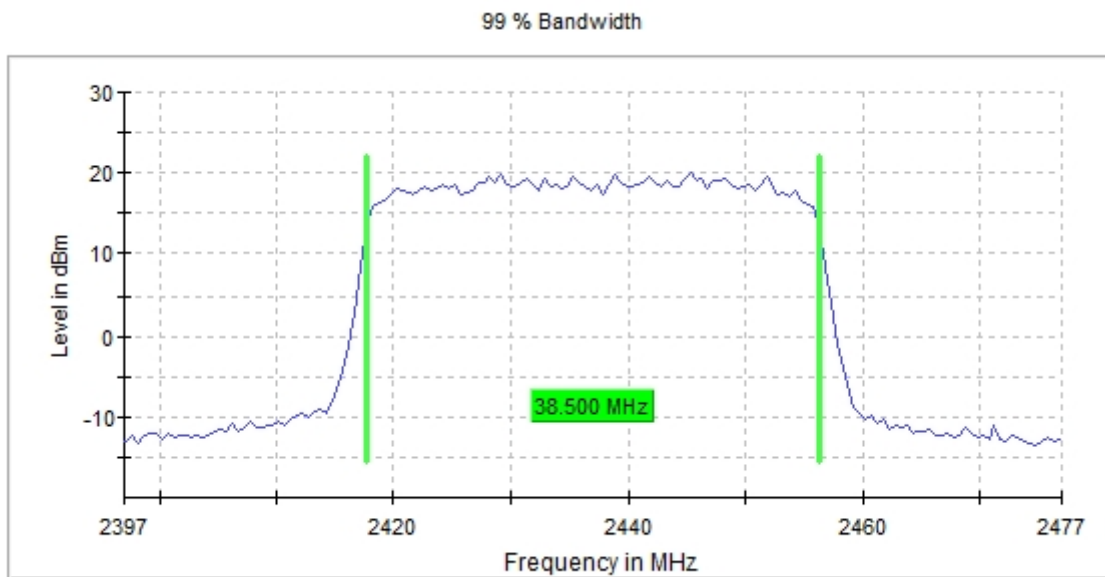
- Low Channel (3):



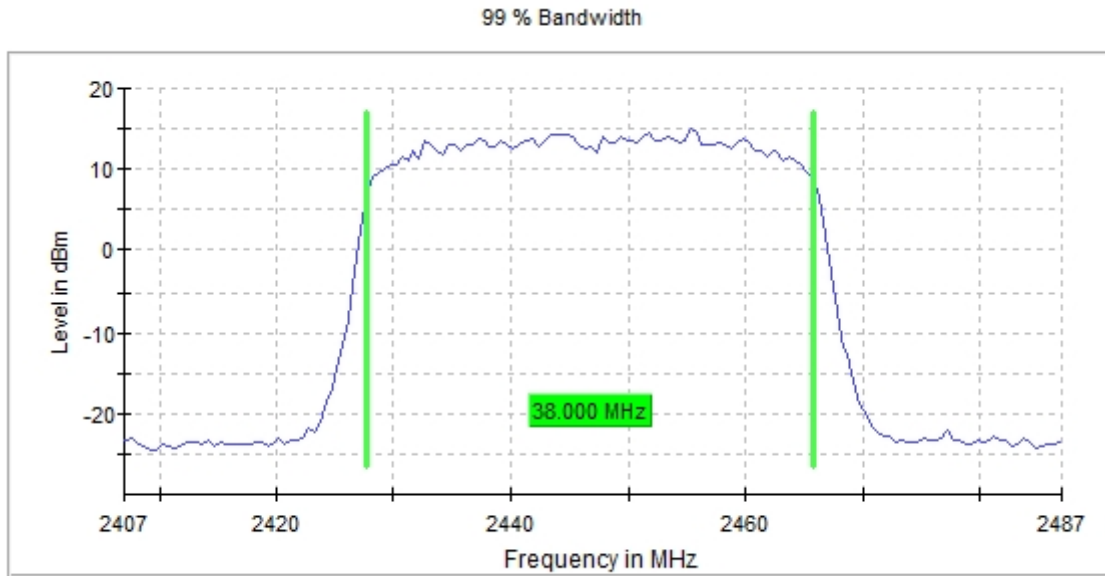
- Channel (4):



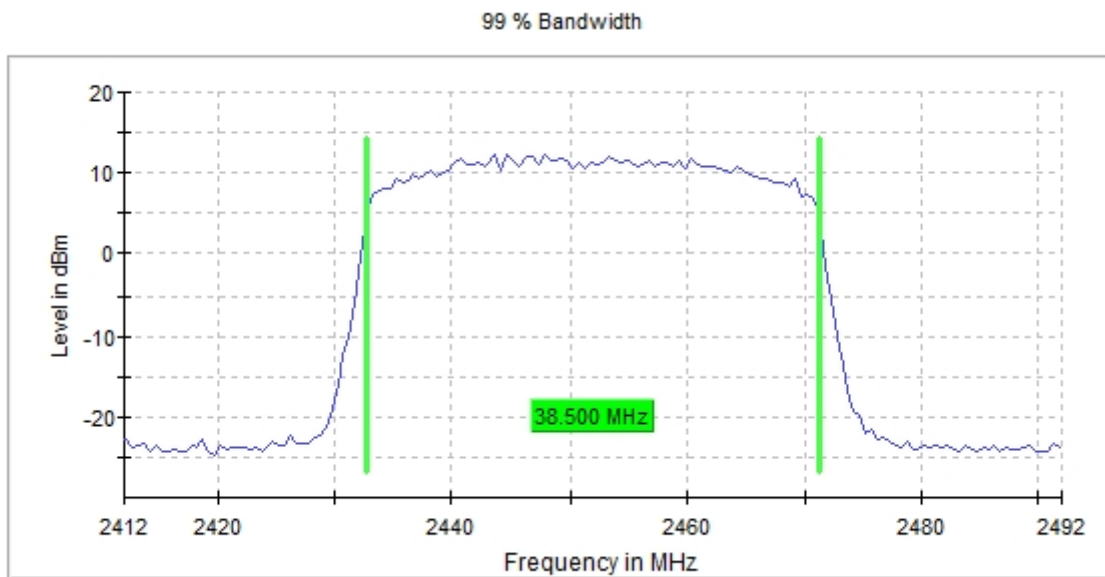
- Middle Channel (6):



- Channel (8):



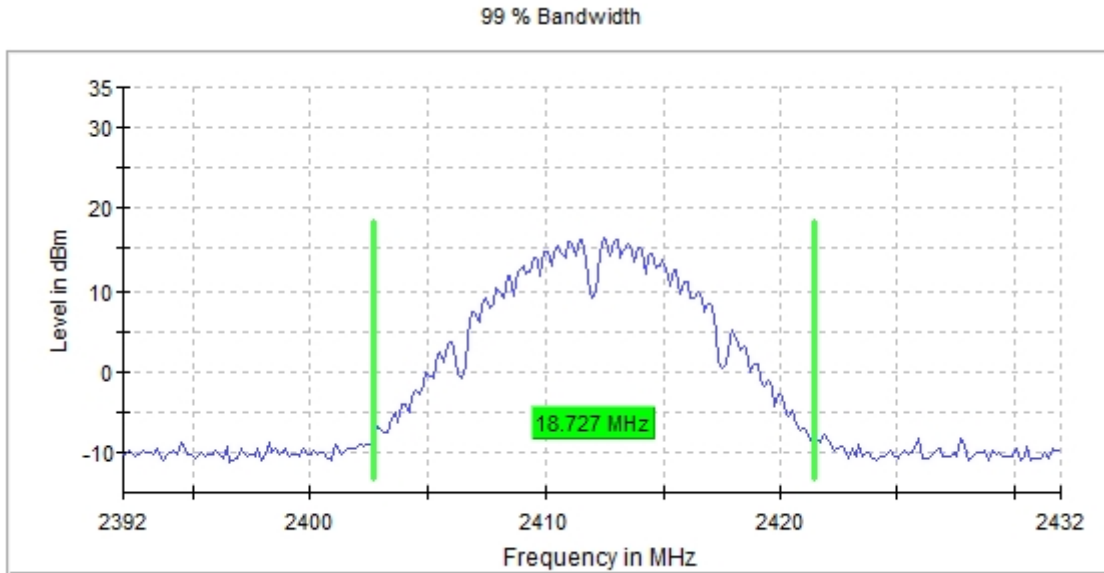
- High Channel (9):



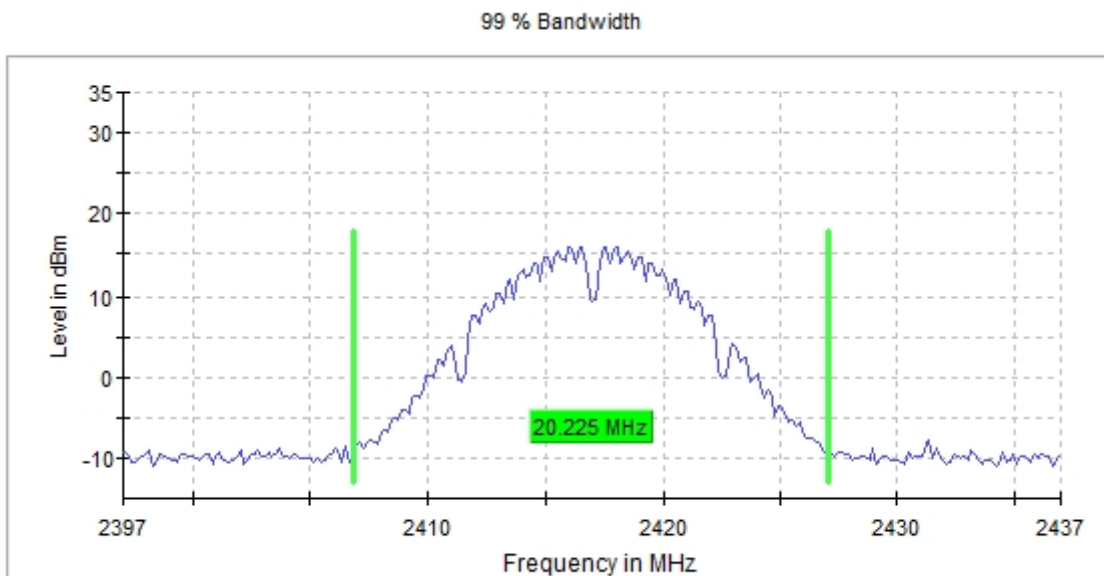
MIMO worst case:

- **MIMO 802.11 b – Occupied Bandwidth:**

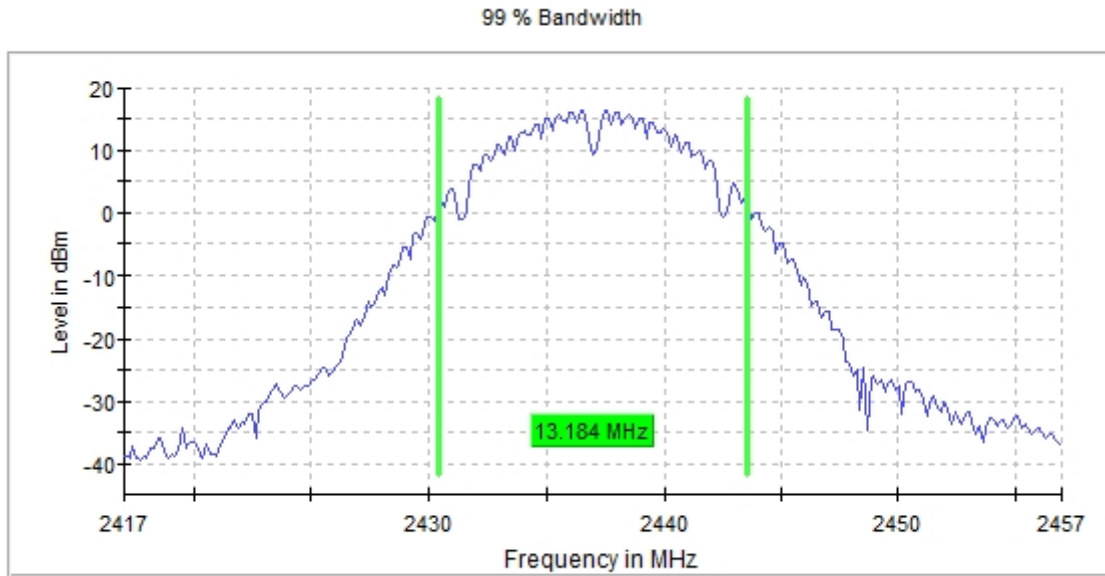
- Low Channel (1):



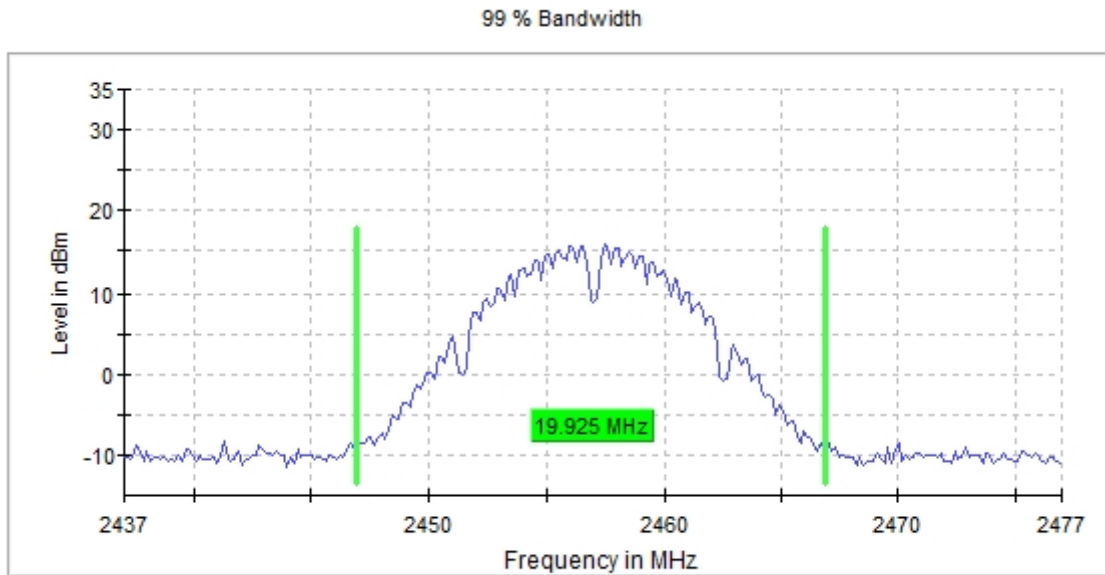
- Channel (2):



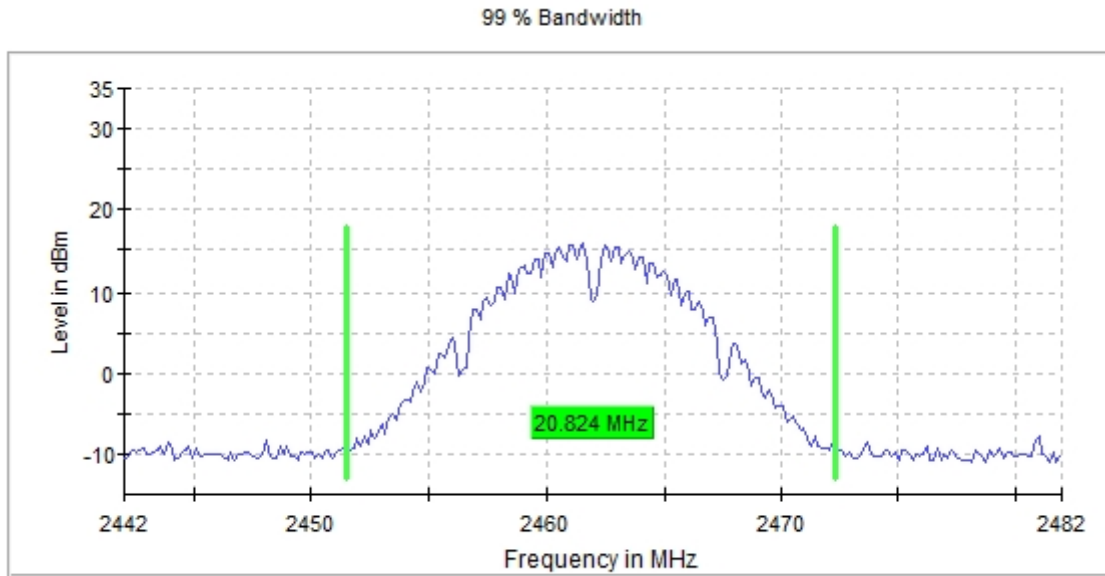
- Middle Channel (6):



- Channel (10):

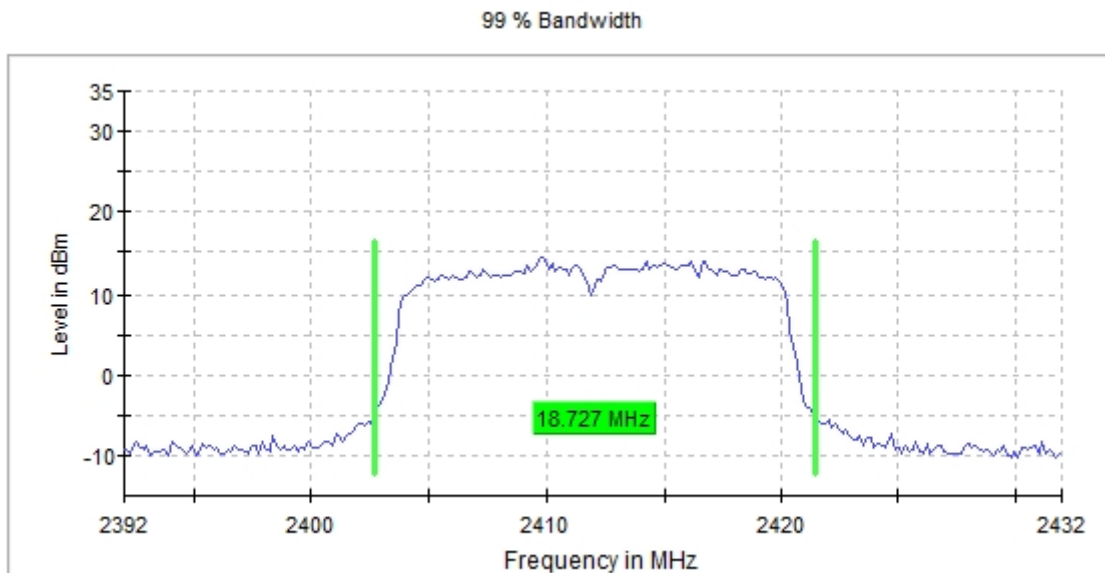


- High Channel (11):

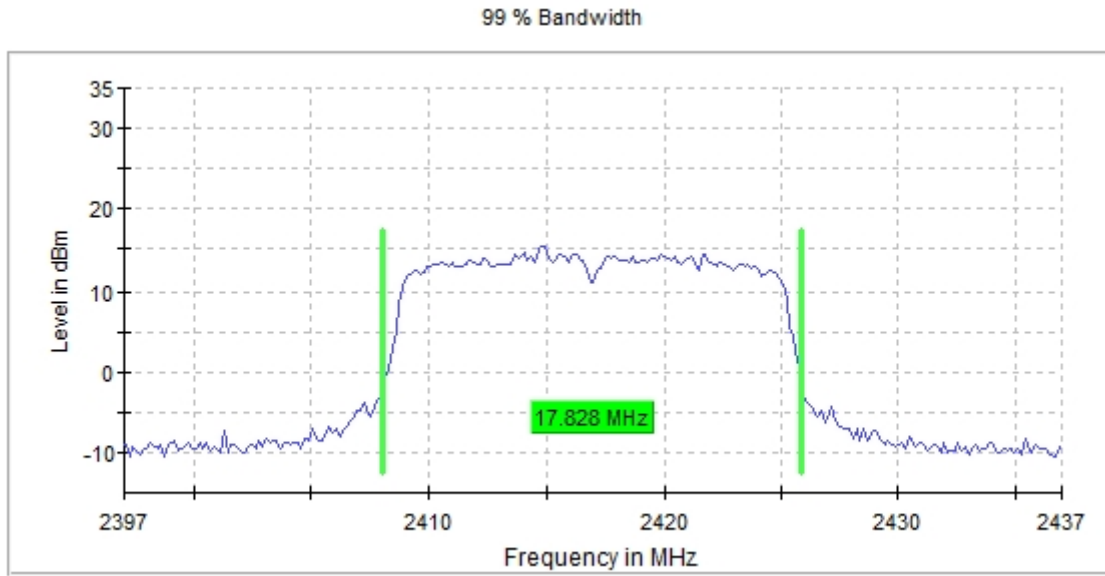


- **MIMO 802.11 g – Occupied Bandwidth:**

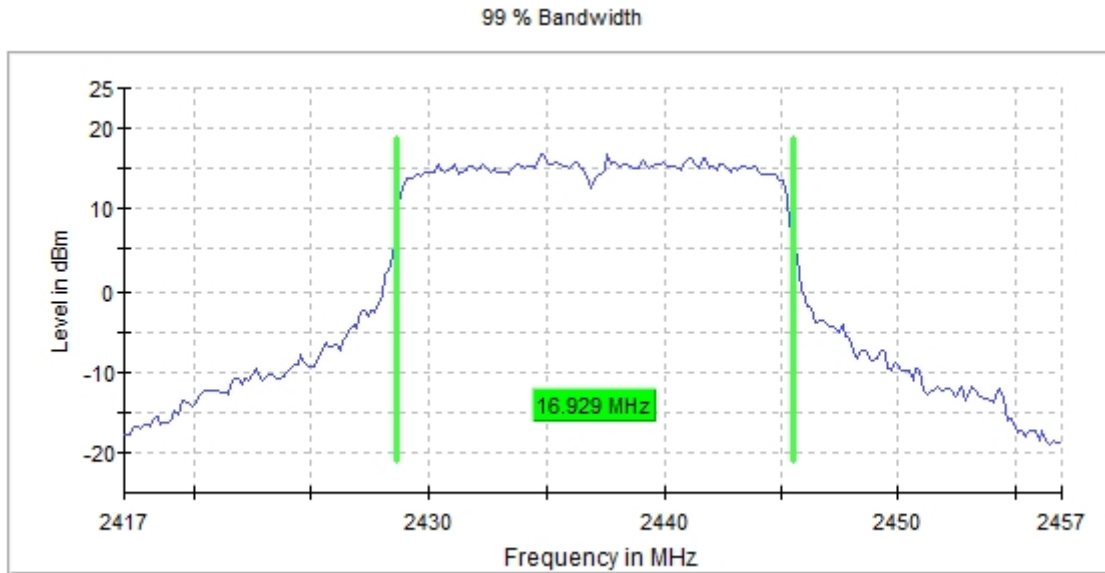
- Low Channel (1):



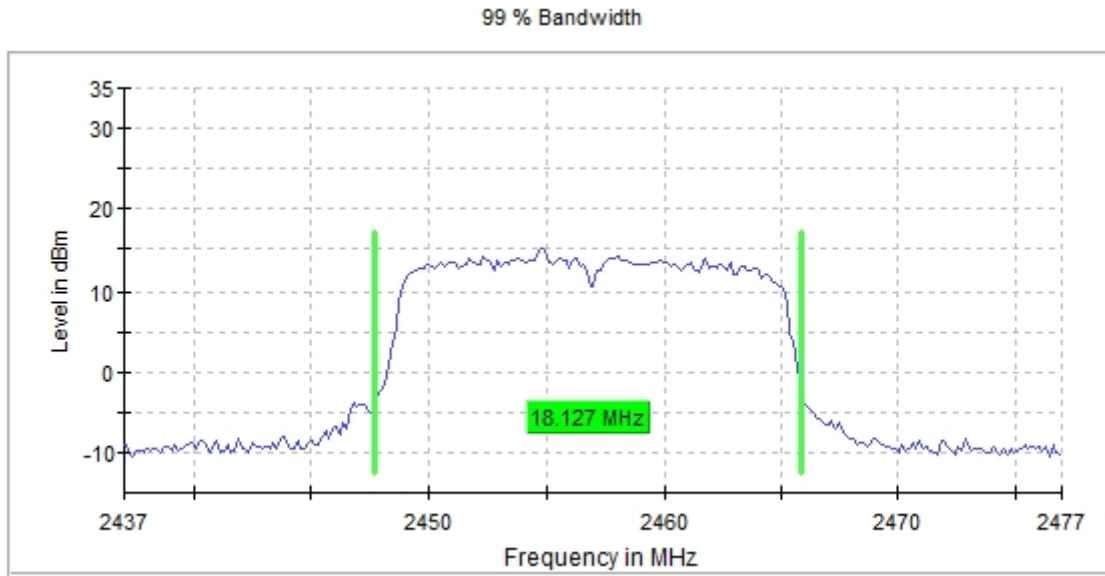
- Channel (2):



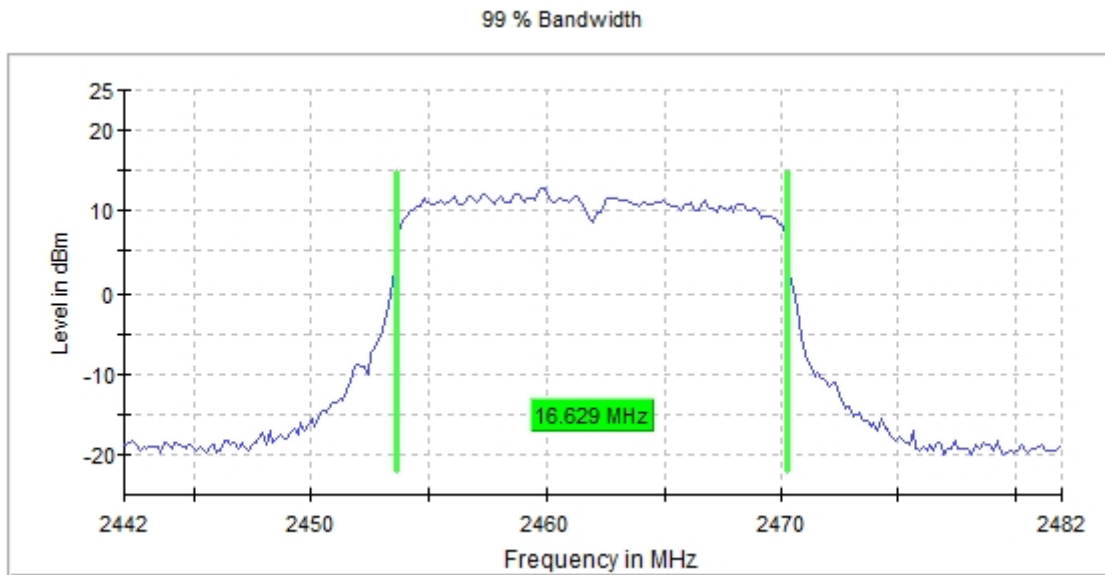
- Middle Channel (6):



- Channel (10):

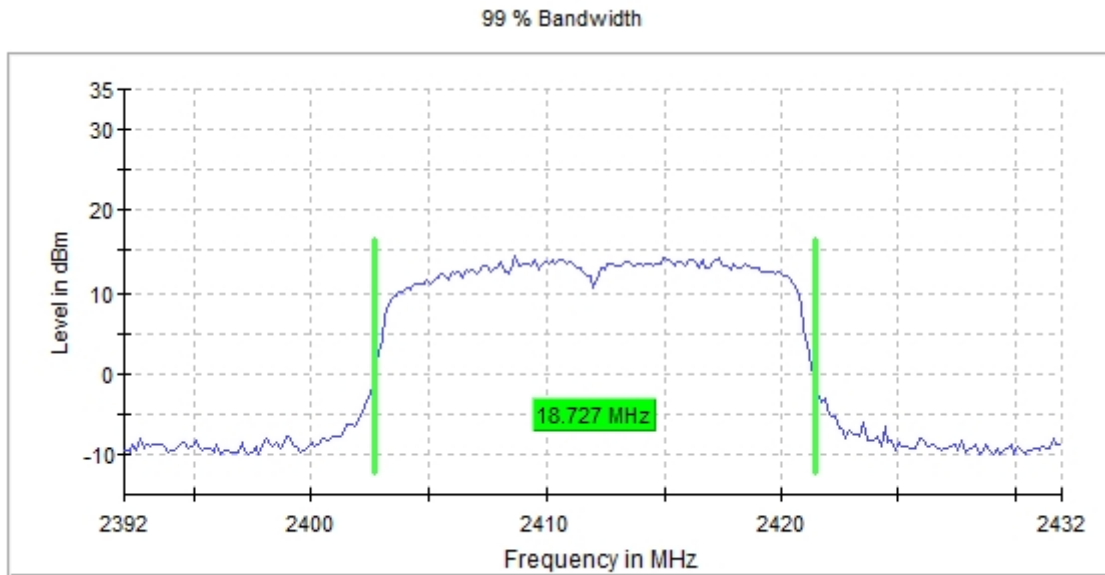


- High Channel (11):

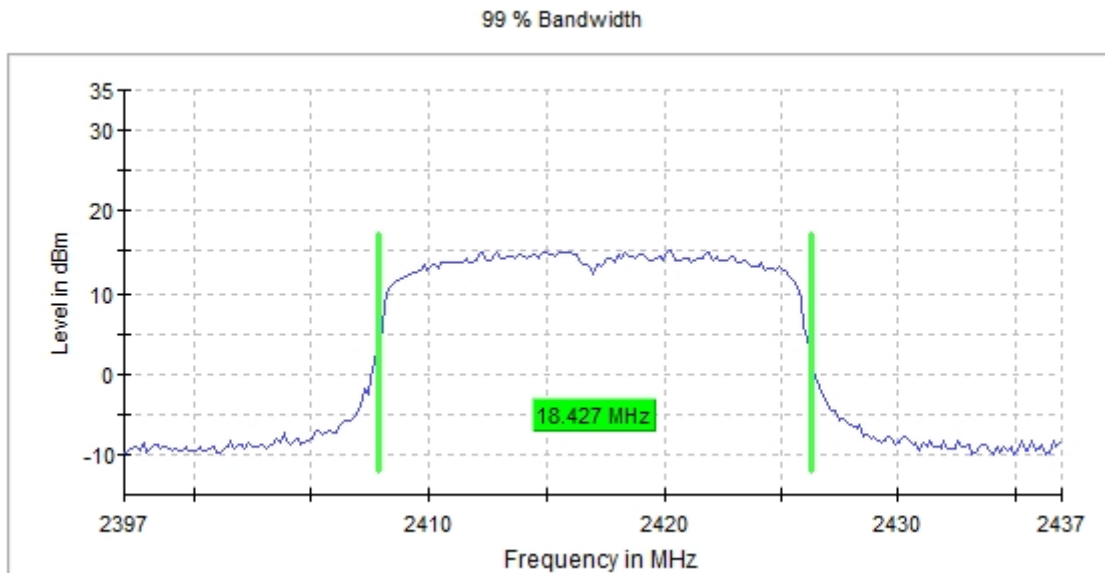


- **MIMO 802.11 n20 – Occupied Bandwidth:**

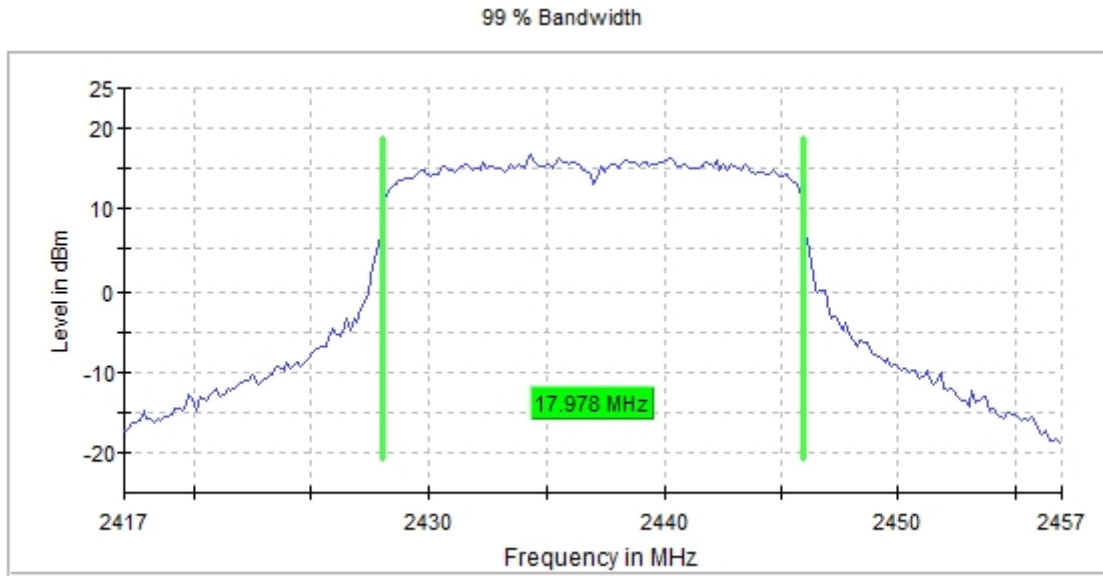
- Low Channel (1):



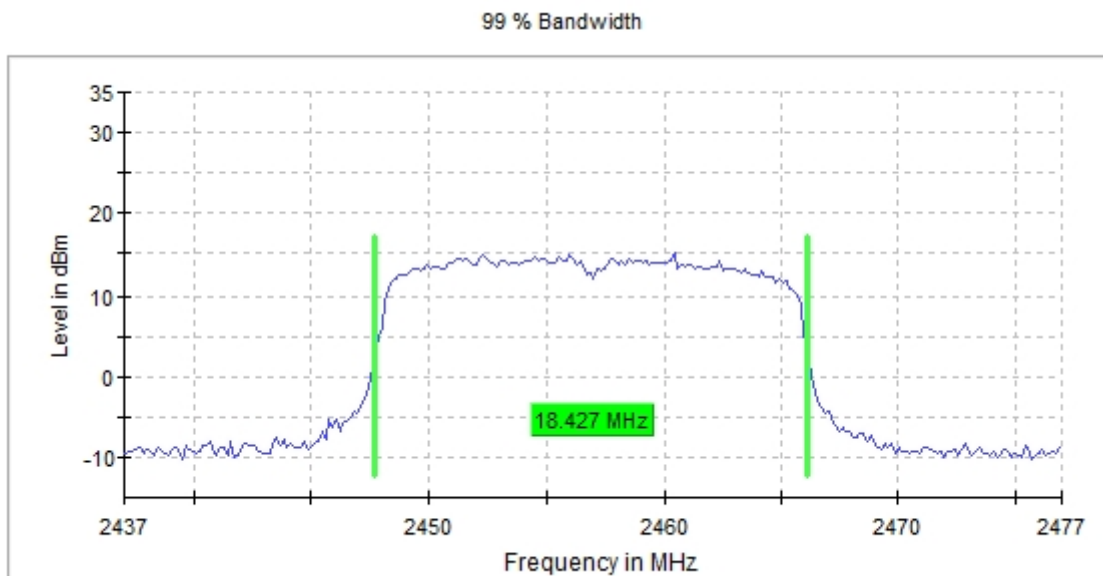
- Channel (2):



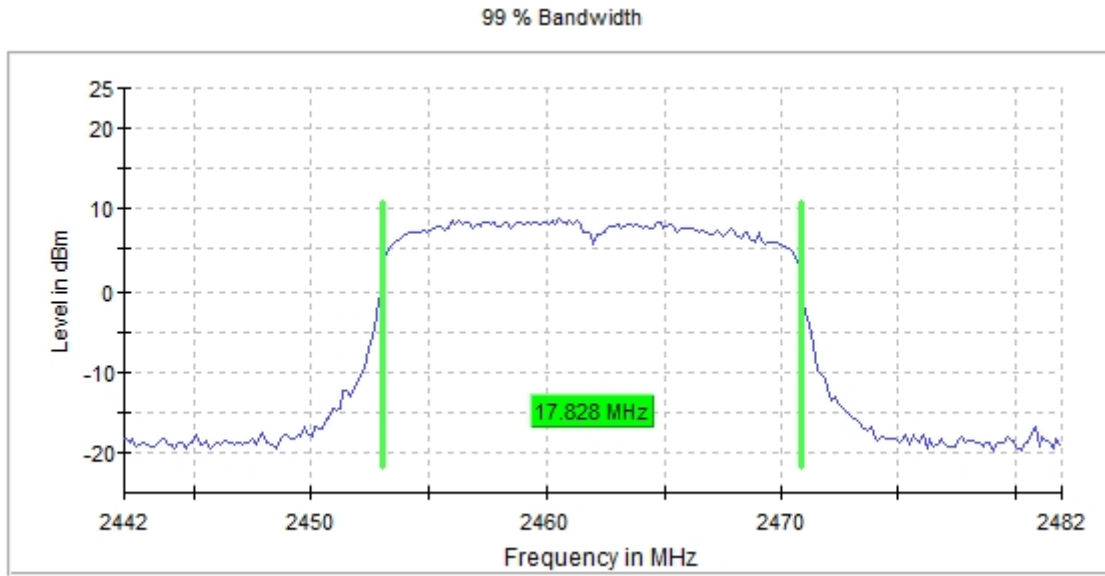
- Middle Channel (6):



- Channel (10):

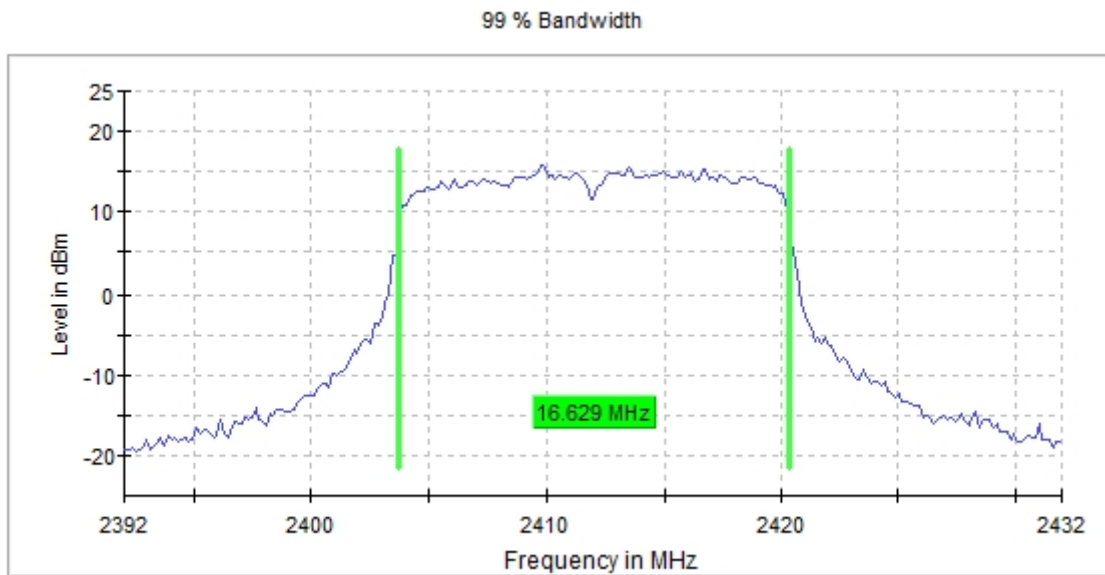


- High Channel (11):

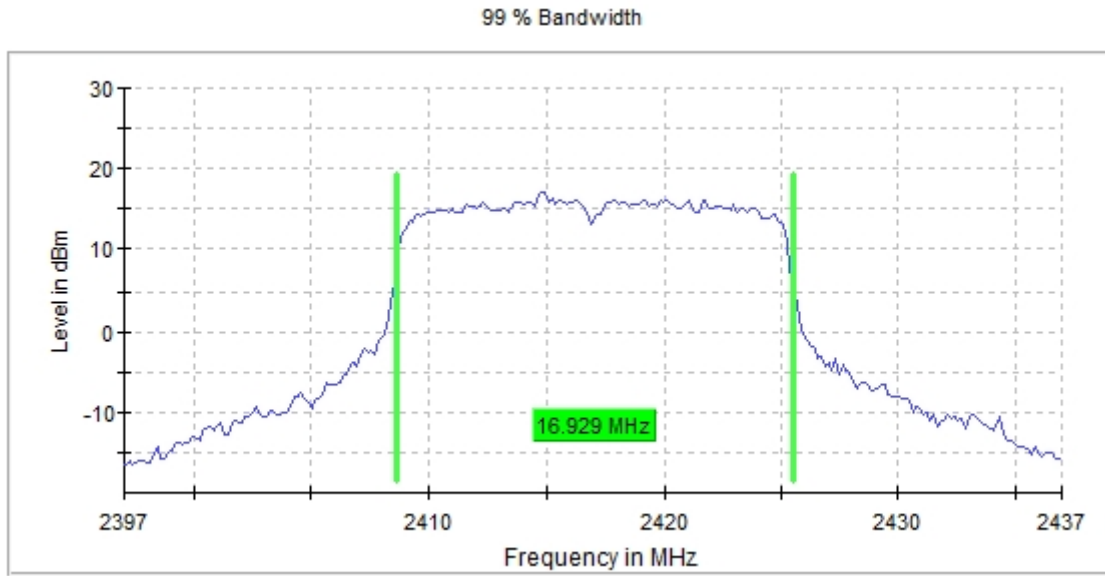


- **MIMO 802.11 he20 – Occupied Bandwidth:**

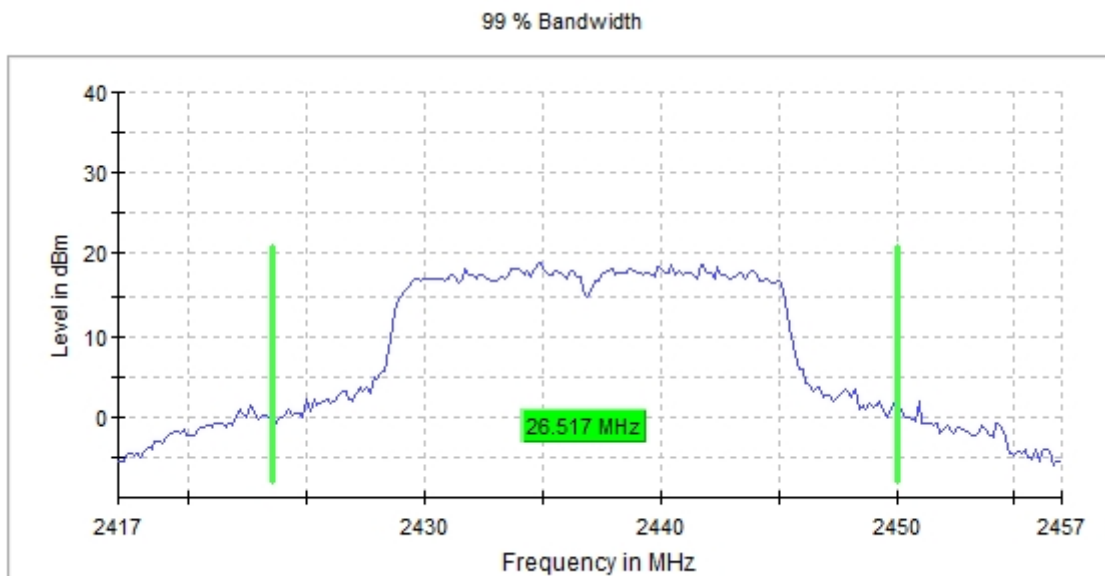
- Low Channel (1):



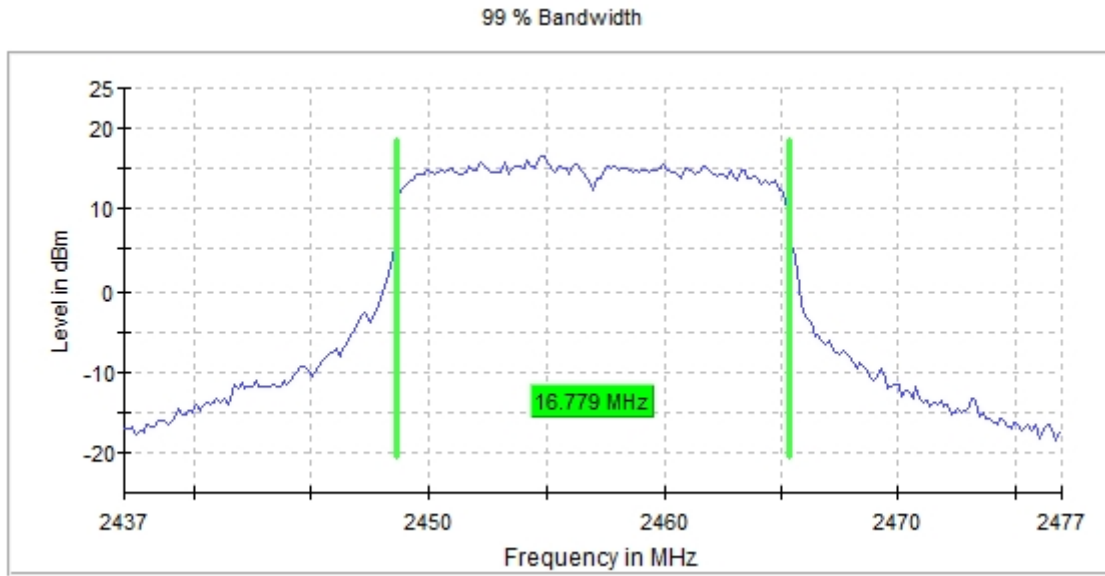
- Channel (2):



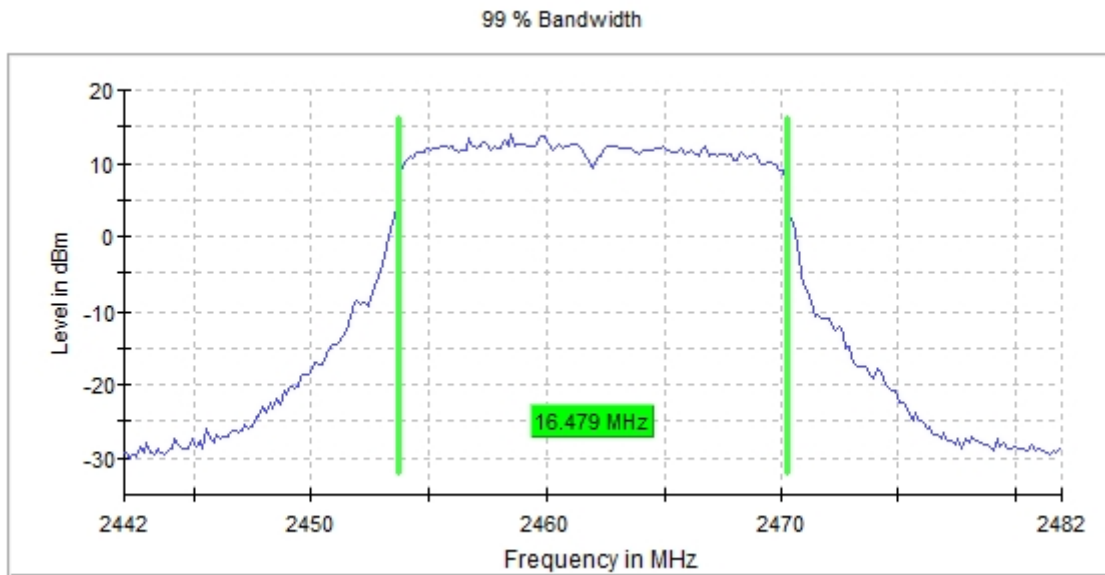
- Middle Channel (6):



- Channel (10):

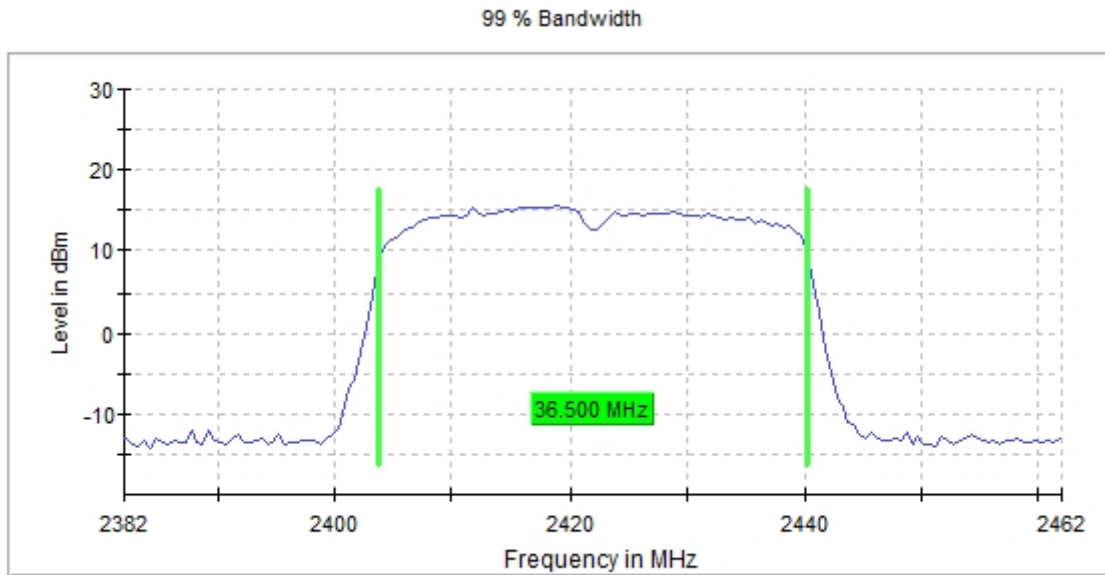


- High Channel (11):

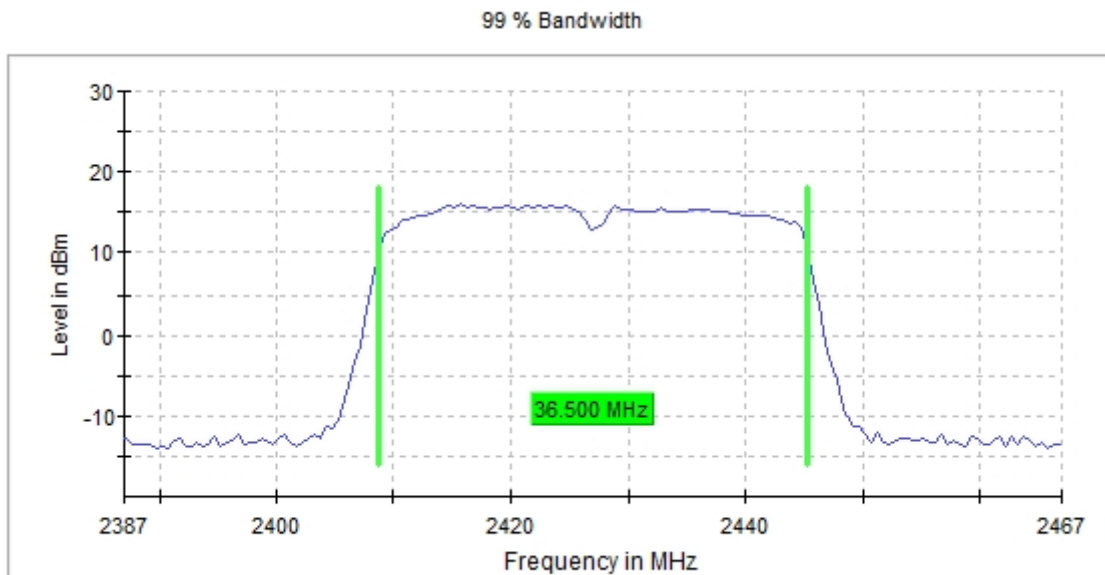


- **MIMO 802.11 n40 – Occupied Bandwidth:**

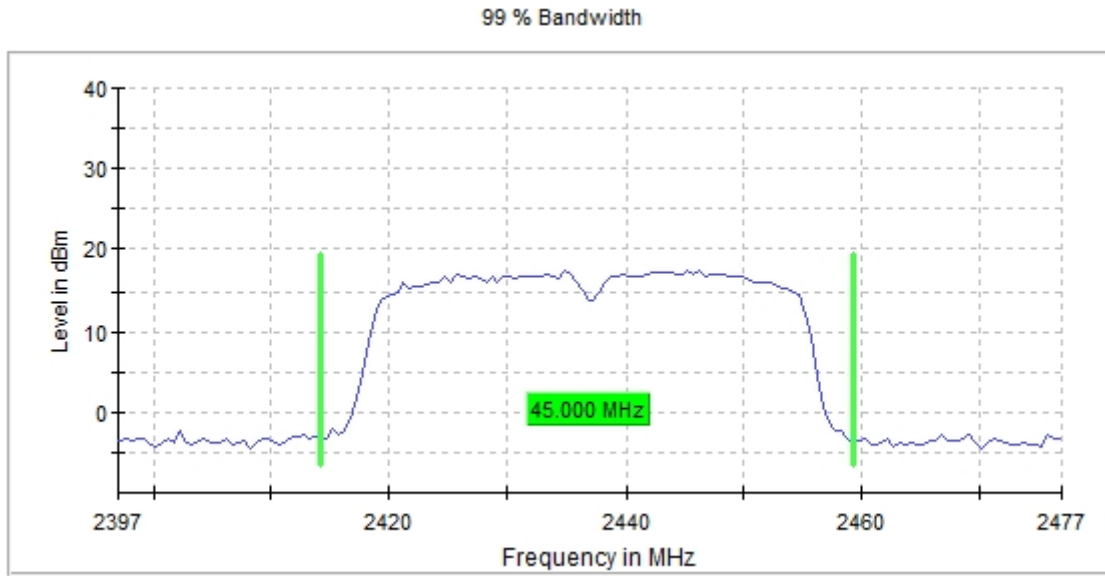
- Low Channel (3):



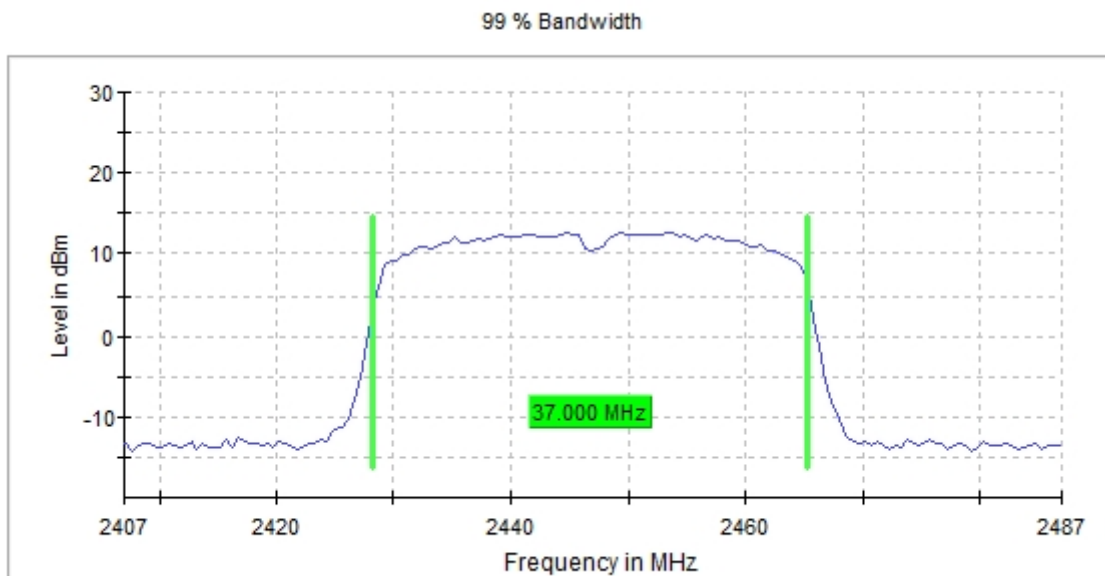
- Channel (4):



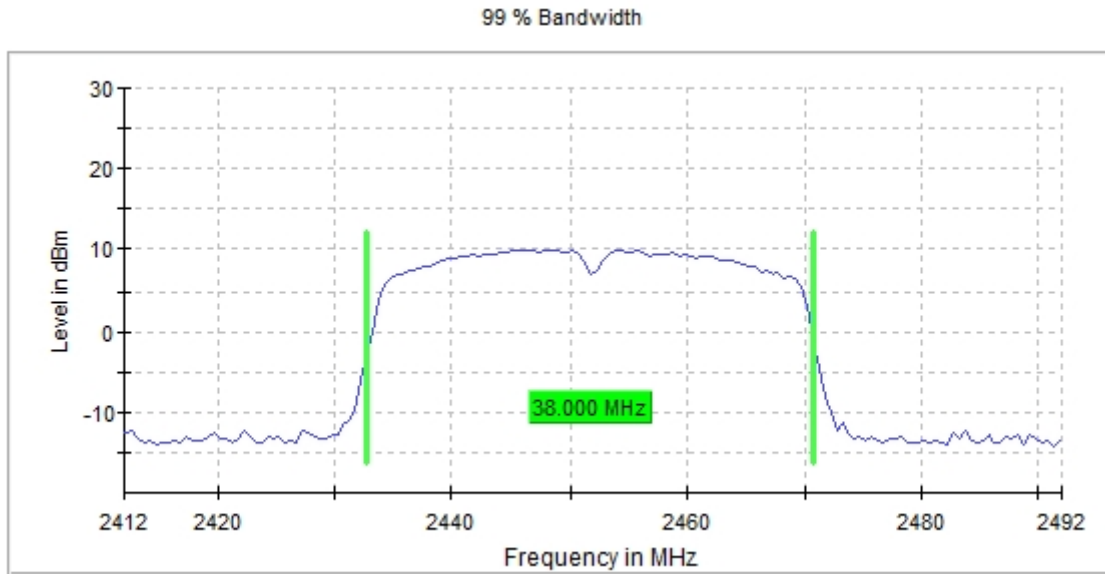
- Middle Channel (6):



- Channel (8):

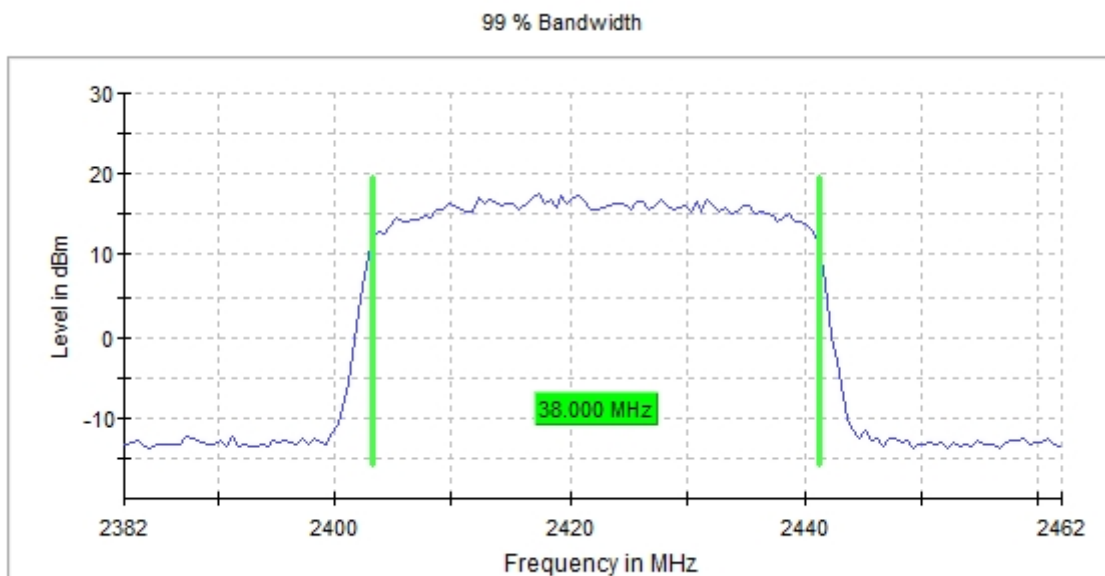


- High Channel (9):

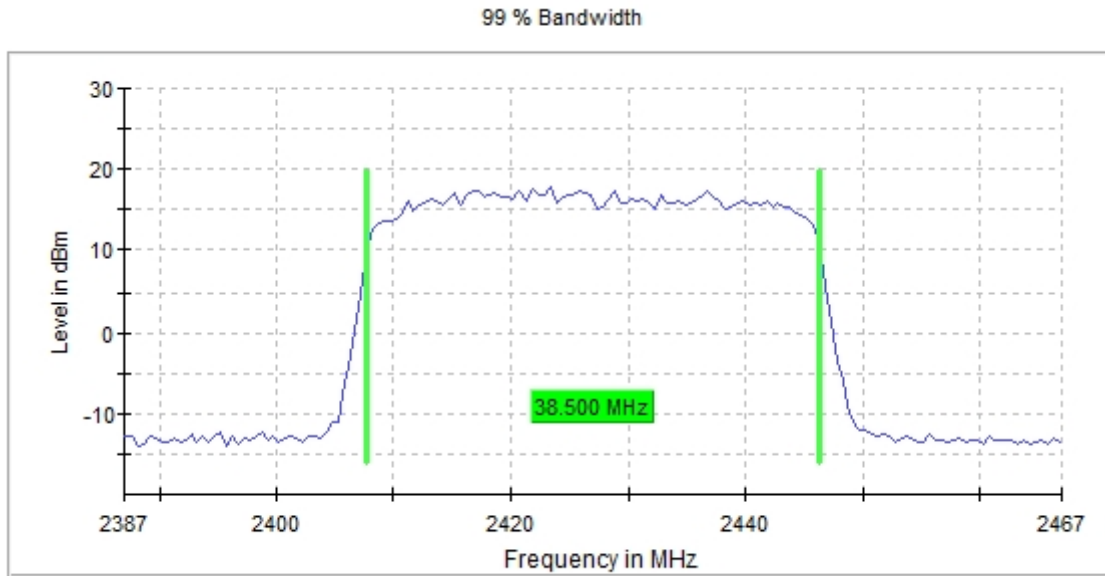


- **MIMO 802.11 he40 – Occupied Bandwidth:**

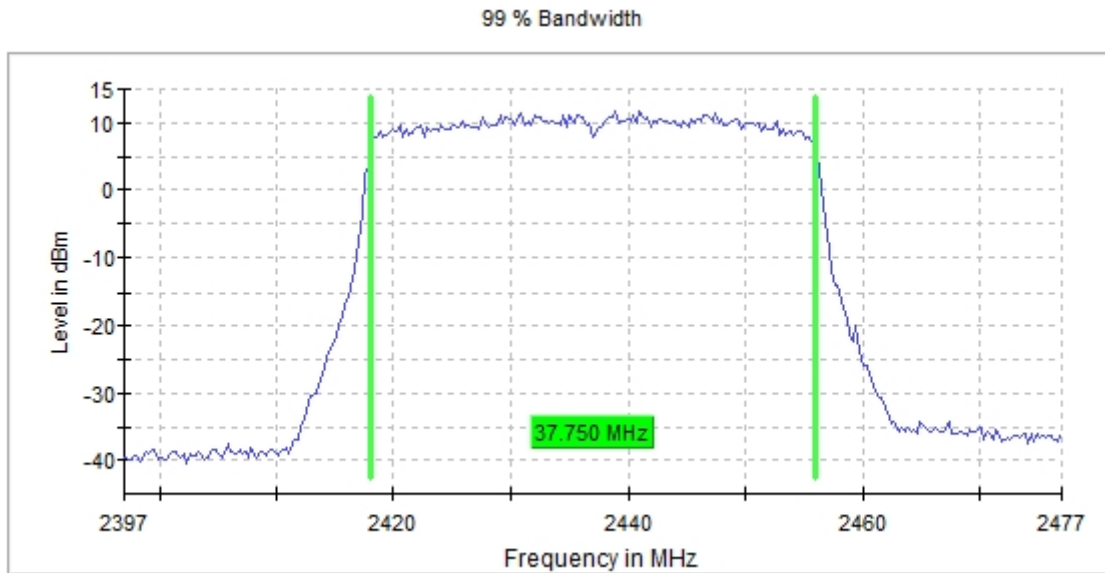
- Low Channel (3):



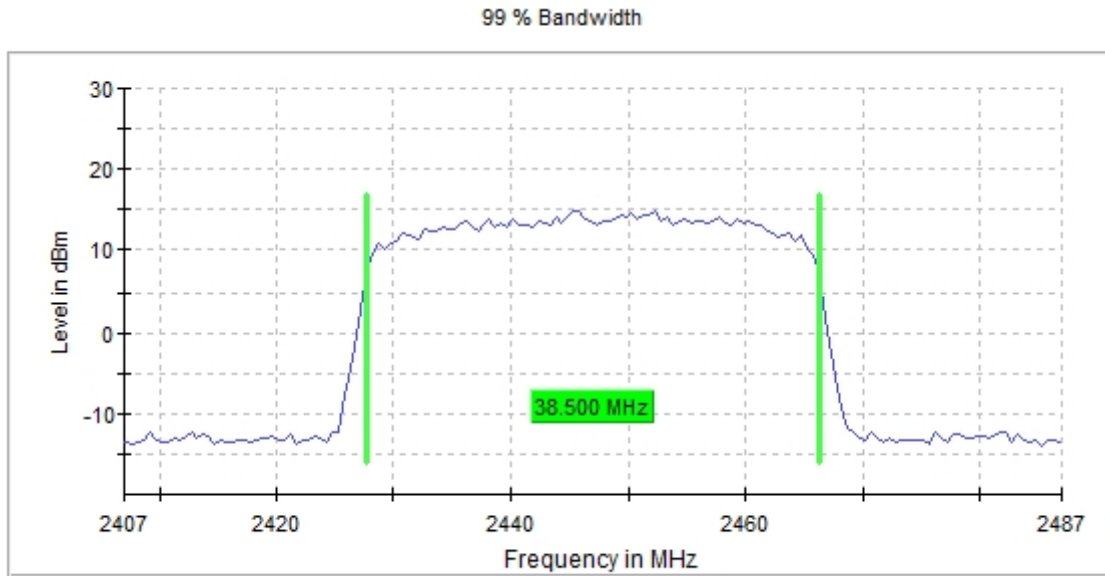
- Channel (4):



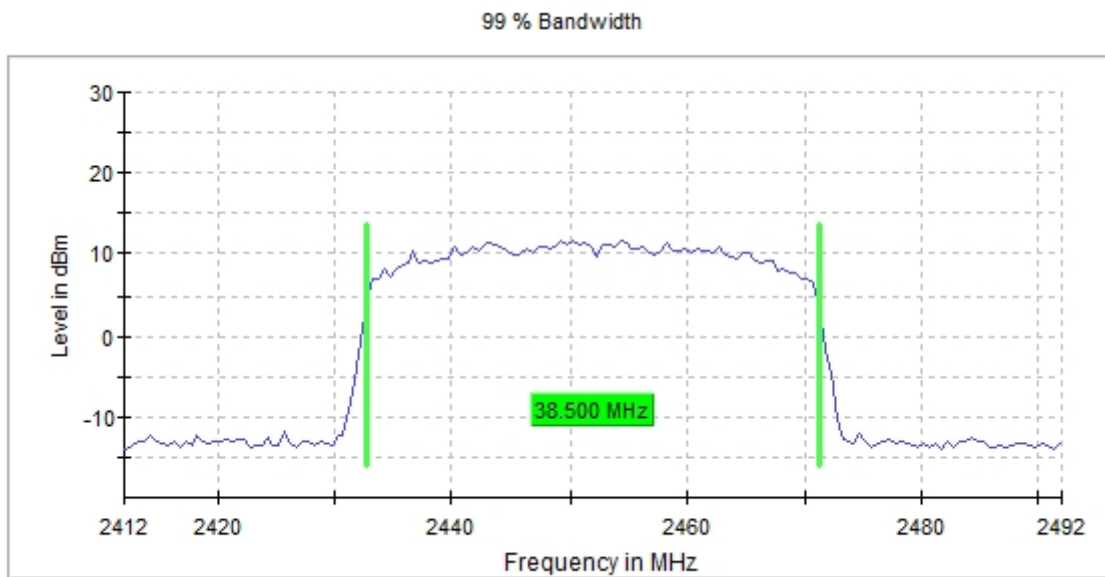
- Middle Channel (6):



- Channel (8):



- High Channel (9):



FCC 15.247 (a) (2) / RSS-247 5.2 (a) 6 dB Bandwidth

SPECIFICATION:

The minimum 6 dB bandwidth shall be at least 500 kHz.

RESULTS:

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

- 802.11 b: 6 Mbit/s.
- 802.11 g: 6 Mbit/s.
- 802.11 n HT20: MCS0.
- 802.11 n HT40: MCS0.
- 802.11 ax HE20: MCS0.
- 802.11 ax HE40: MCS0.

- Preliminary tests determined the SISO worst case: WLAN1.

SISO worst case:

- **SISO 802.11 b:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
6 dB Spectrum Bandwidth (MHz)	8.650000	10.150000	10.150000	8.050000	10.200000
Measurement uncertainty (%)	<± 2.84				

- **SISO 802.11 g:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
6 dB Spectrum Bandwidth (MHz)	15.550000	15.450000	16.350000	15.600000	15.850000
Measurement uncertainty (%)	<± 2.84				

- **SISO 802.11 n20:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
6 dB Spectrum Bandwidth (MHz)	16.000000	16.100000	17.650000	16.600000	16.350000
Measurement uncertainty (%)	<± 2.84				

- **SISO 802.11 he20:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
6 dB Spectrum Bandwidth (MHz)	17.200000	17.850000	18.750000	18.350000	18.300000
Measurement uncertainty (%)	<± 2.84				

- **SISO 802.11 n40:**

	Low Channel (3) 2422MHz	Channel (4) 2427MHz	Middle Channel (6) 2437MHz	Channel (8) 2447MHz	High Channel (9) 2452MHz
6 dB Spectrum Bandwidth (MHz)	35.500000	36.100000	35.900000	35.600000	35.600000
Measurement uncertainty (%)	<± 2.84				

- **SISO 802.11 he40:**

	Low Channel (3) 2422MHz	Channel (4) 2427MHz	Middle Channel (6) 2437MHz	Channel (8) 2447MHz	High Channel (9) 2452MHz
6 dB Spectrum Bandwidth (MHz)	37.400000	38.000000	37.900000	37.700000	37.650000
Measurement uncertainty (%)	<± 2.84				

Verdict: PASS

MIMO worst case:

- MIMO 802.11 b:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
6 dB Spectrum Bandwidth (MHz)	7.200000	8.150000	8.150000	8.150000	8.150000
Measurement uncertainty (%)	<± 2.84				

- MIMO 802.11 g:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
6 dB Spectrum Bandwidth (MHz)	15.800000	15.750000	16.100000	15.800000	15.850000
Measurement uncertainty (%)	<± 2.84				

- MIMO 802.11 n20:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
6 dB Spectrum Bandwidth (MHz)	16.000000	16.050000	16.950000	16.900000	16.450000
Measurement uncertainty (%)	<± 2.84				

- MIMO 802.11 he20:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
6 dB Spectrum Bandwidth (MHz)	15.550000	15.450000	16.350000	15.600000	15.850000
Measurement uncertainty (%)	<± 2.84				

- **MIMO 802.11 n40:**

	Low Channel (3) 2422MHz	Channel (4) 2427MHz	Middle Channel (6) 2437MHz	Channel (8) 2447MHz	High Channel (9) 2452MHz
6 dB Spectrum Bandwidth (MHz)	35.450000	35.950000	36.150000	35.400000	35.400000
Measurement uncertainty (%)	<± 2.84				

- **MIMO 802.11 he40:**

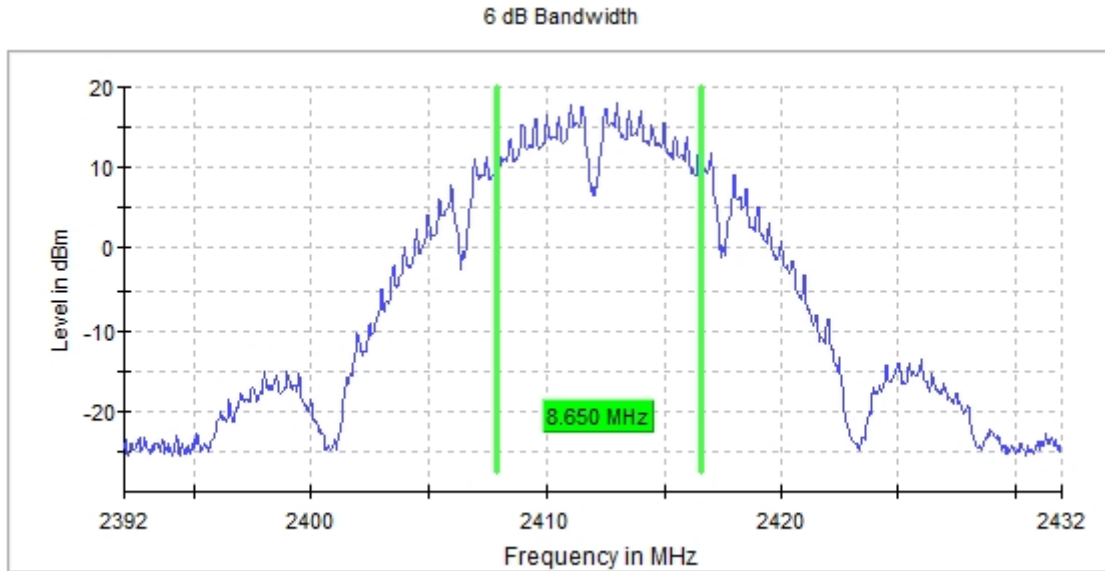
	Low Channel (3) 2422MHz	Channel (4) 2427MHz	Middle Channel (6) 2437MHz	Channel (8) 2447MHz	High Channel (9) 2452MHz
6 dB Spectrum Bandwidth (MHz)	37.100000	37.900000	37.900000	36.450000	37.650000
Measurement uncertainty (%)	<± 2.84				

Verdict: PASS

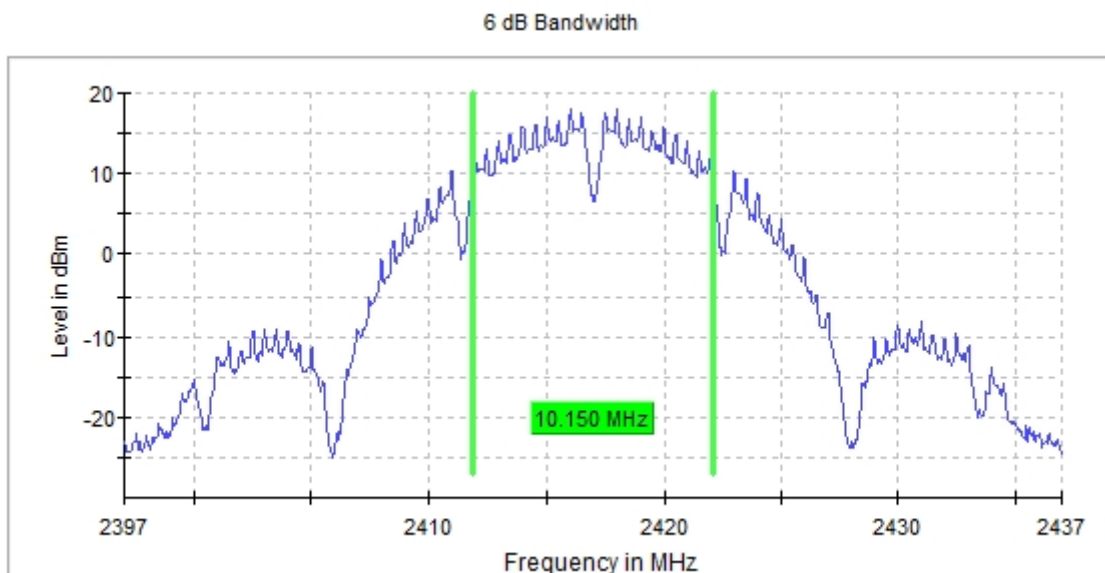
SISO worst case:

- **SISO 802.11 b – 6 dB Bandwidth:**

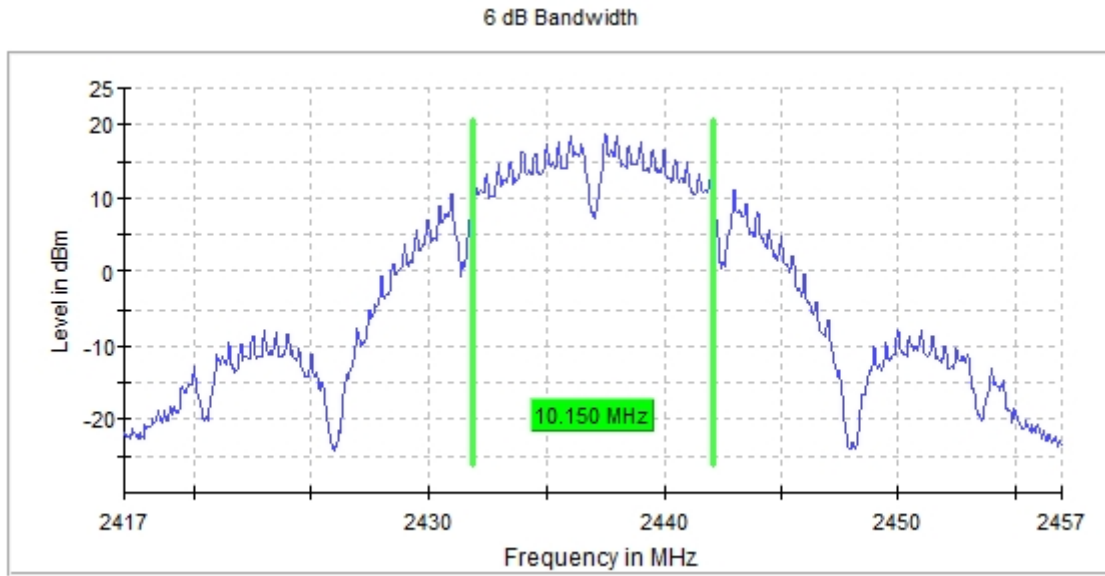
- Low Channel (1):



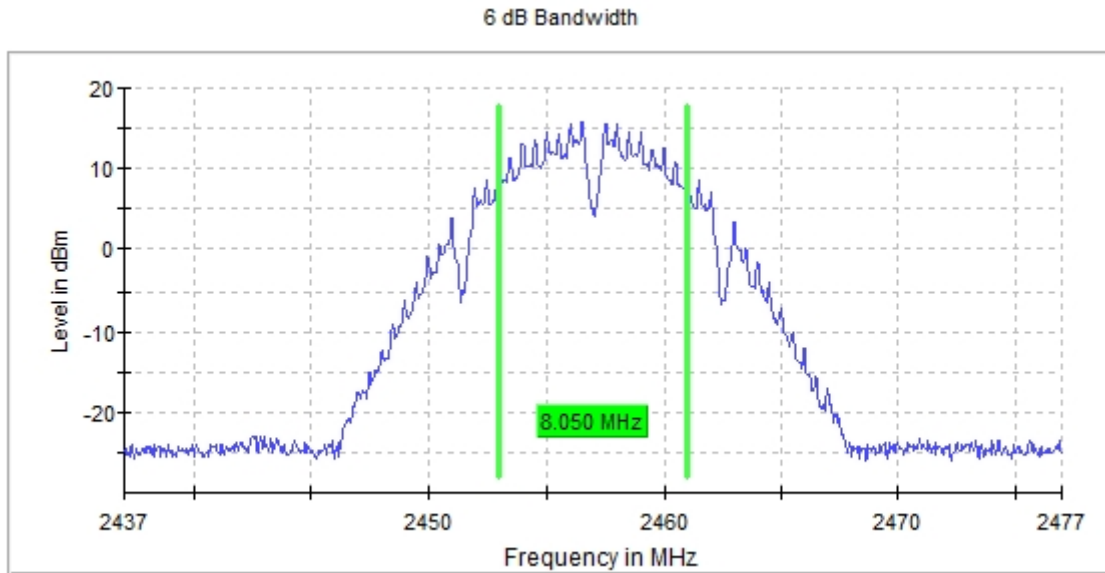
- Channel (2):



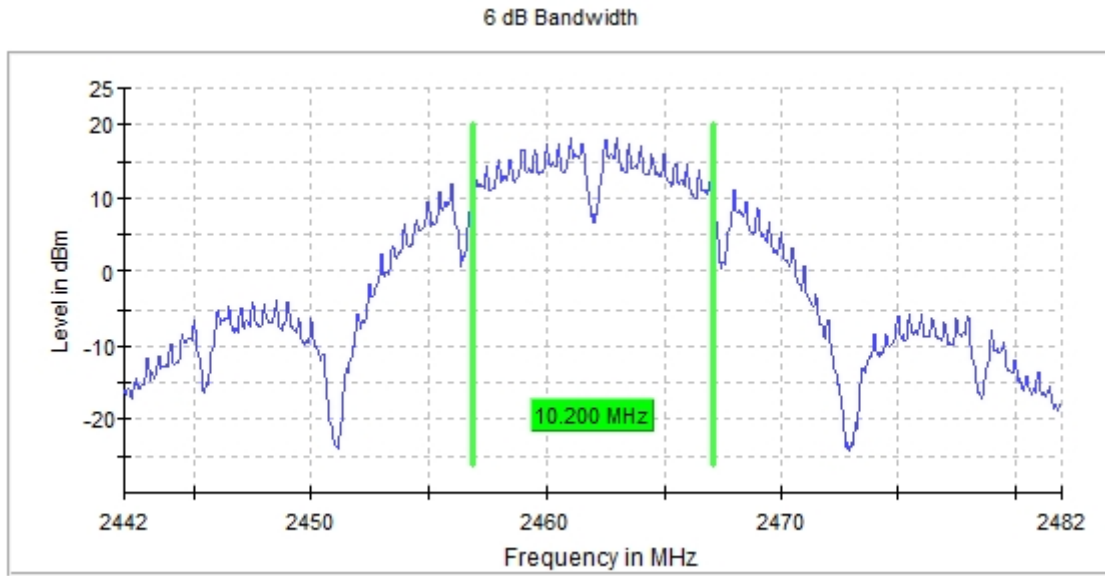
- Middle Channel (6):



- Channel (10):

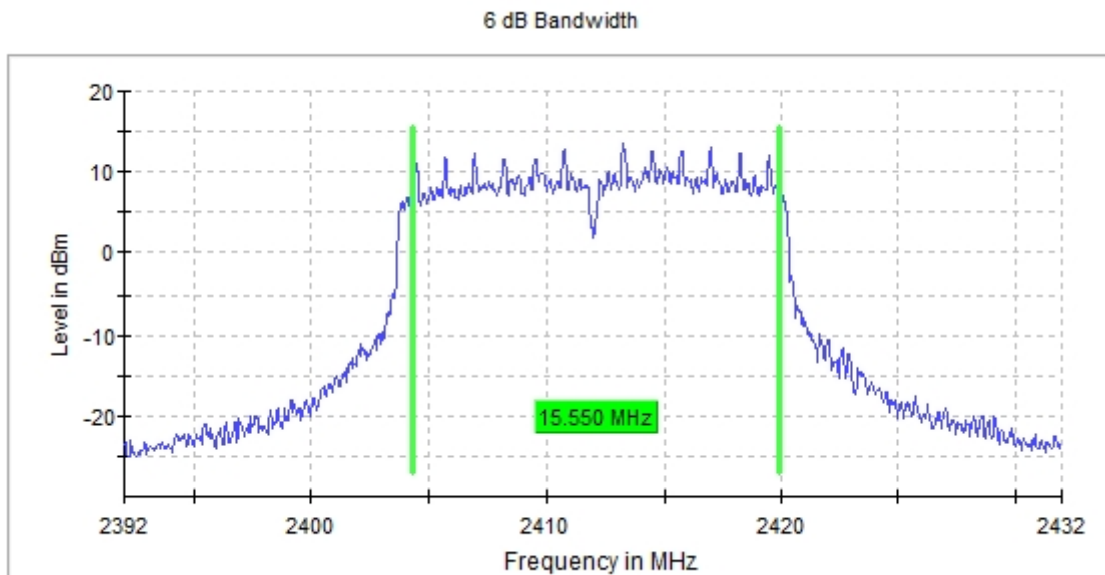


- High Channel (11):

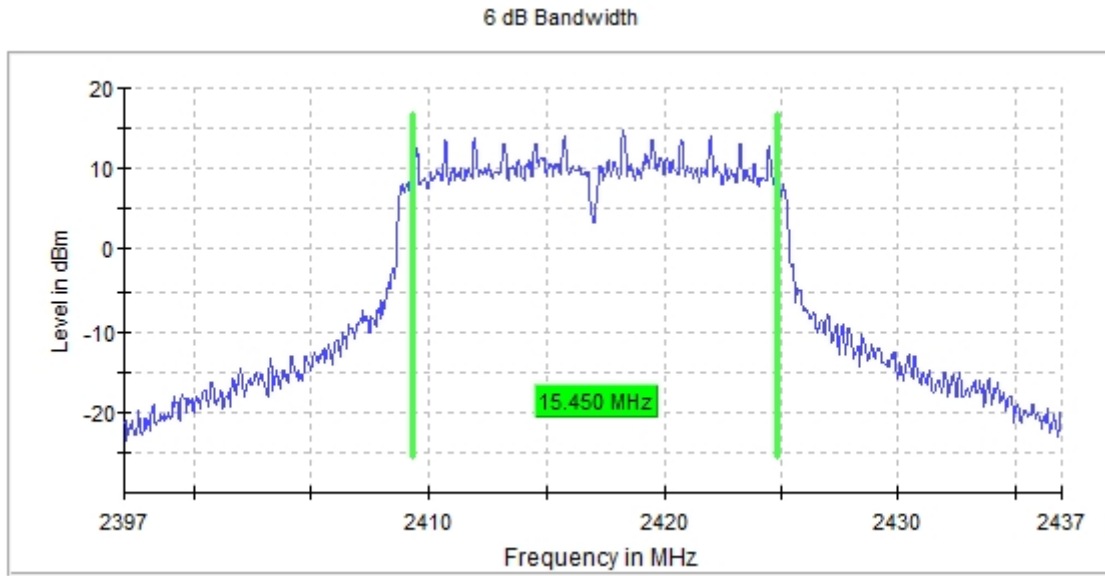


- SISO 802.11 g – 6 dB Bandwidth:

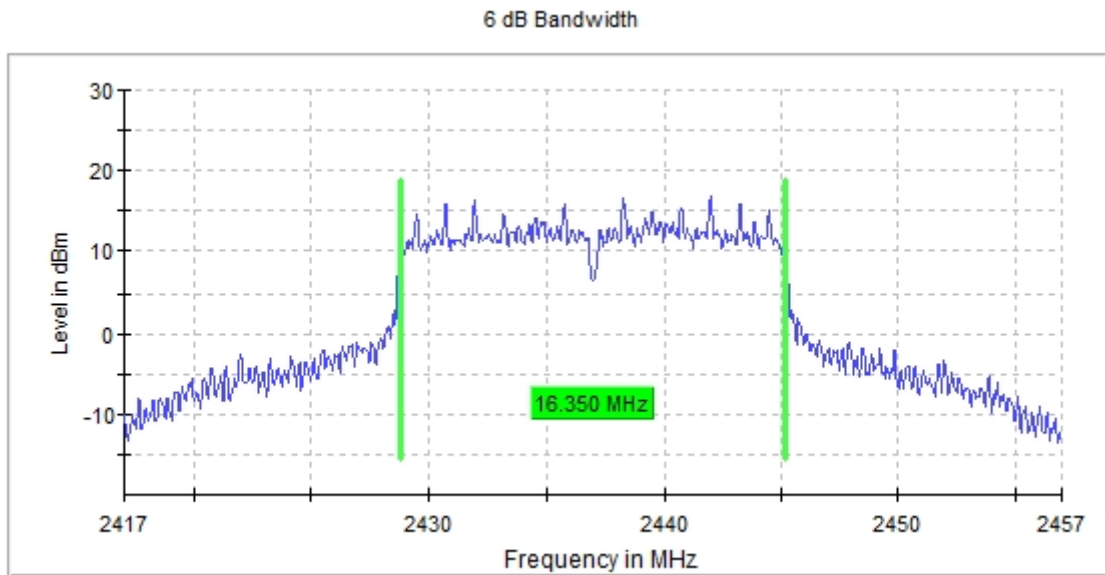
- Low Channel (1):



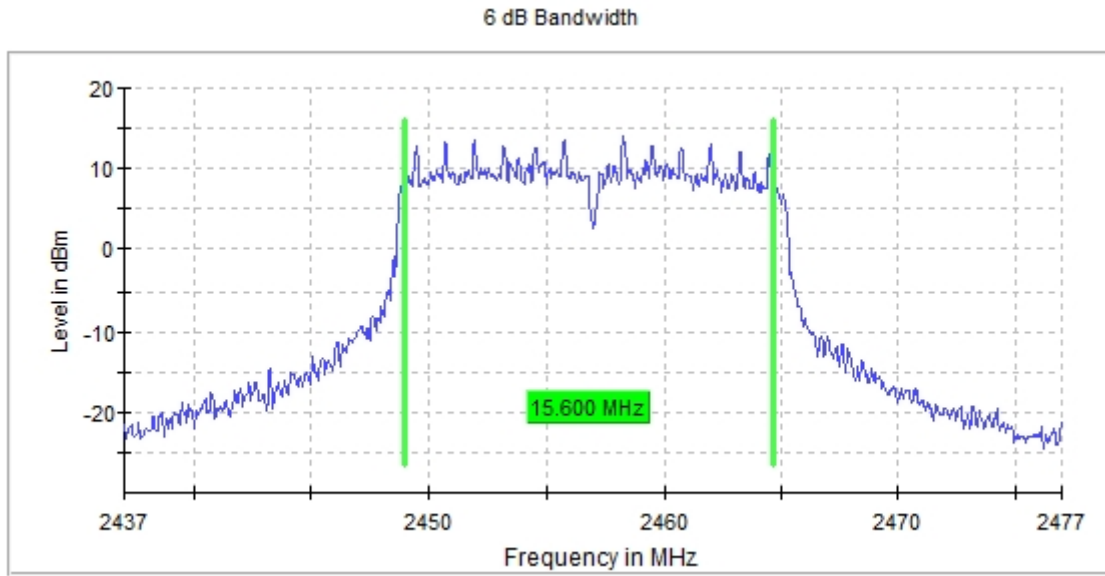
- Channel (2):



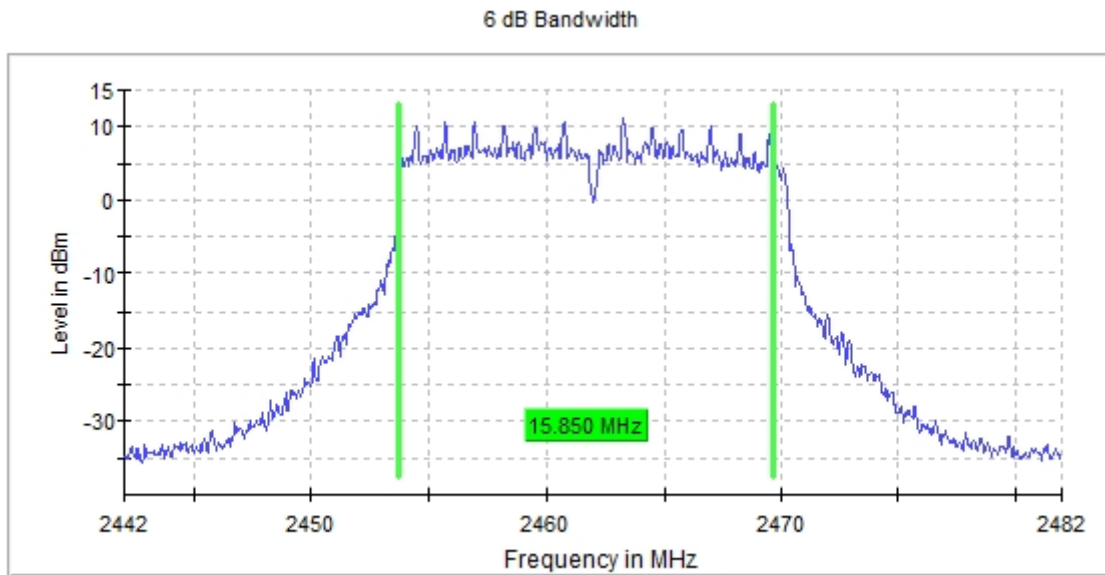
- Middle Channel (6):



- Channel (10):

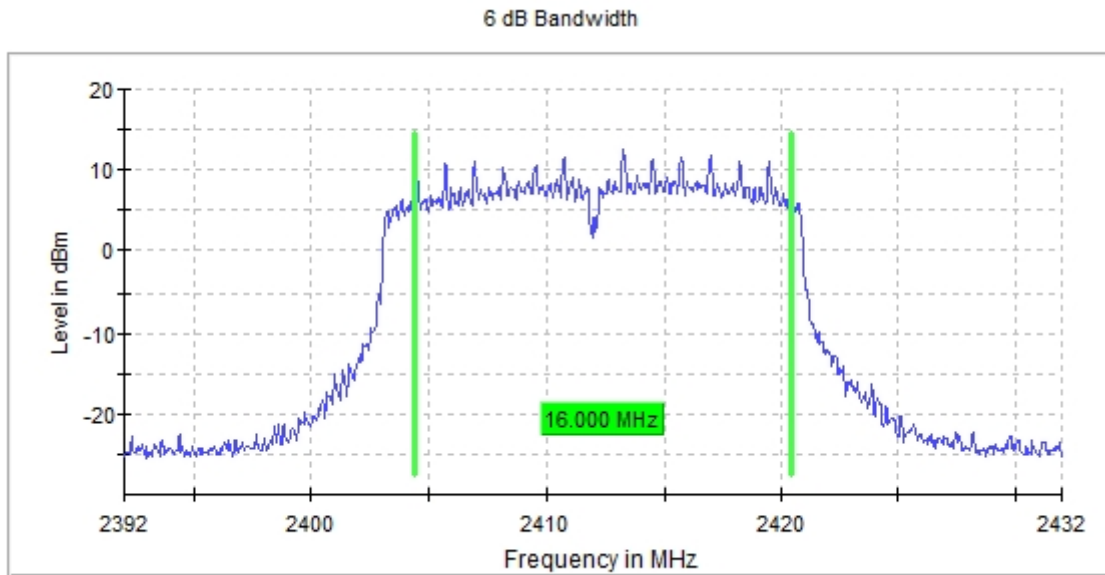


- High Channel (11):

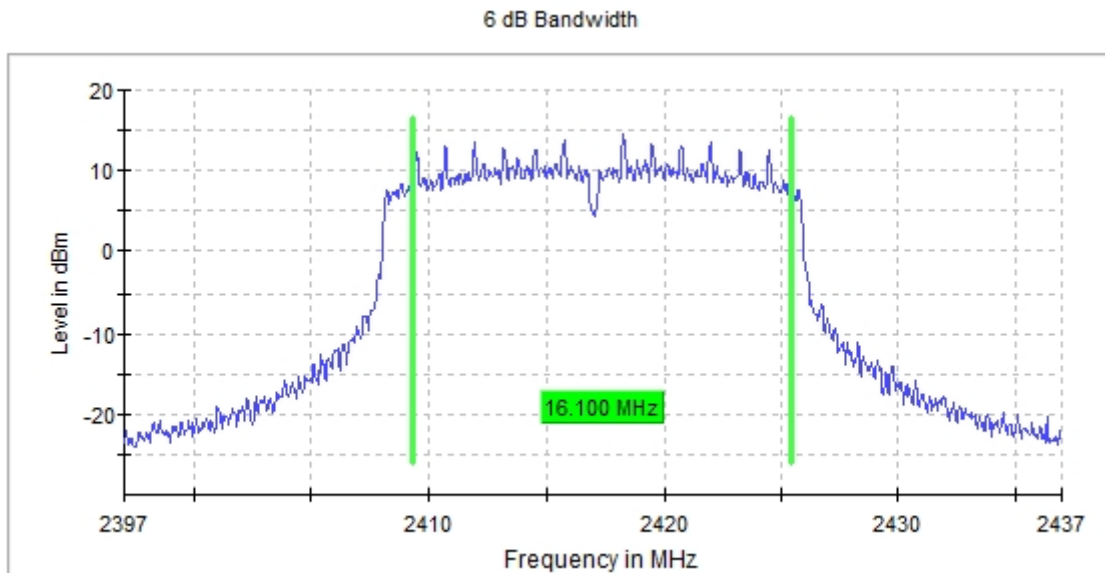


- **SISO 802.11 n20 – 6 dB Bandwidth:**

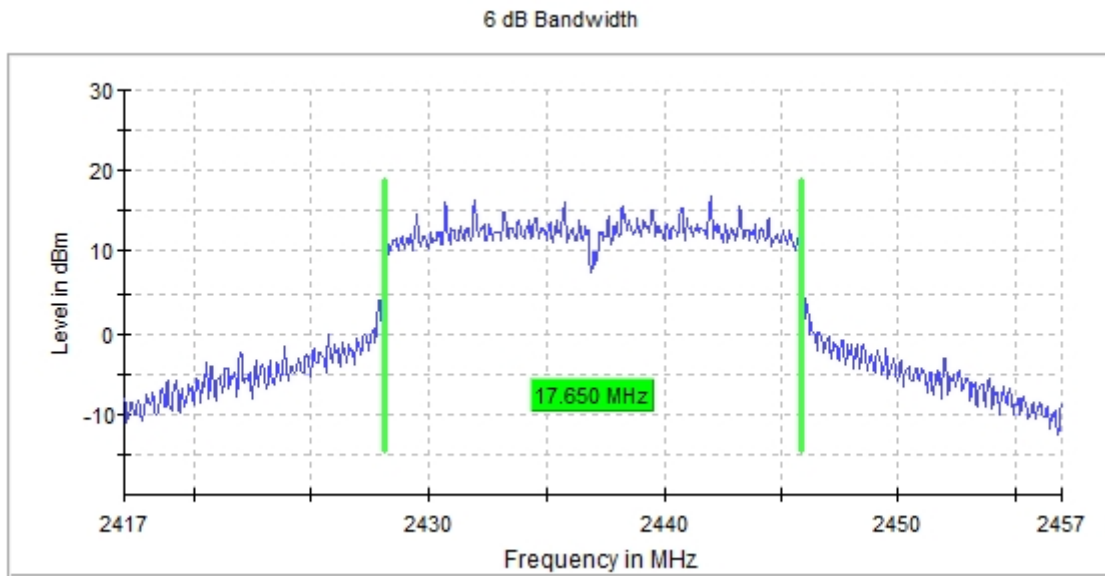
- Low Channel (1):



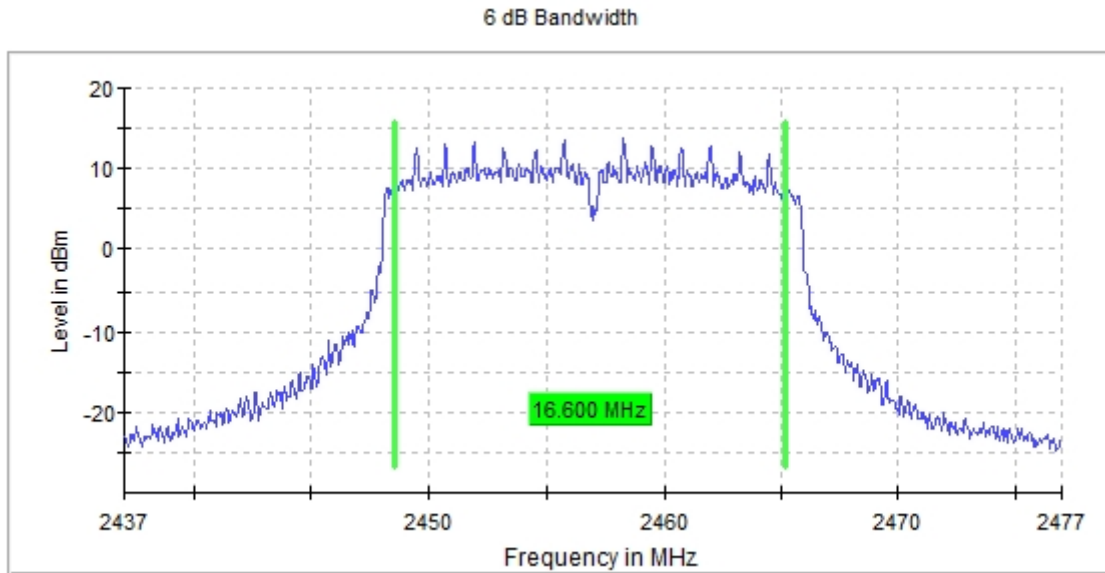
- Channel (2):



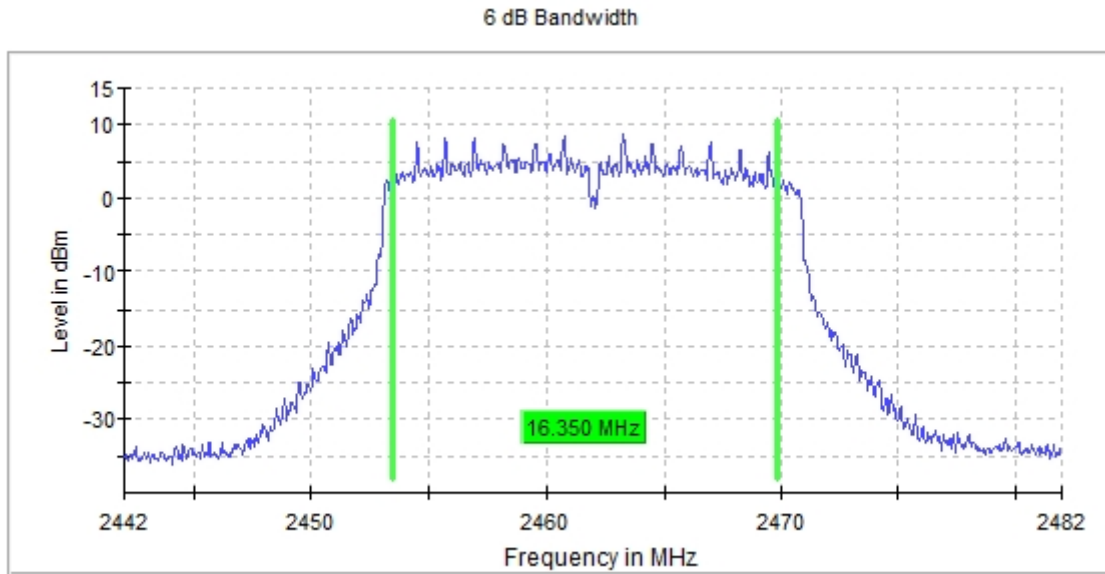
- Middle Channel (6):



- Channel (10):

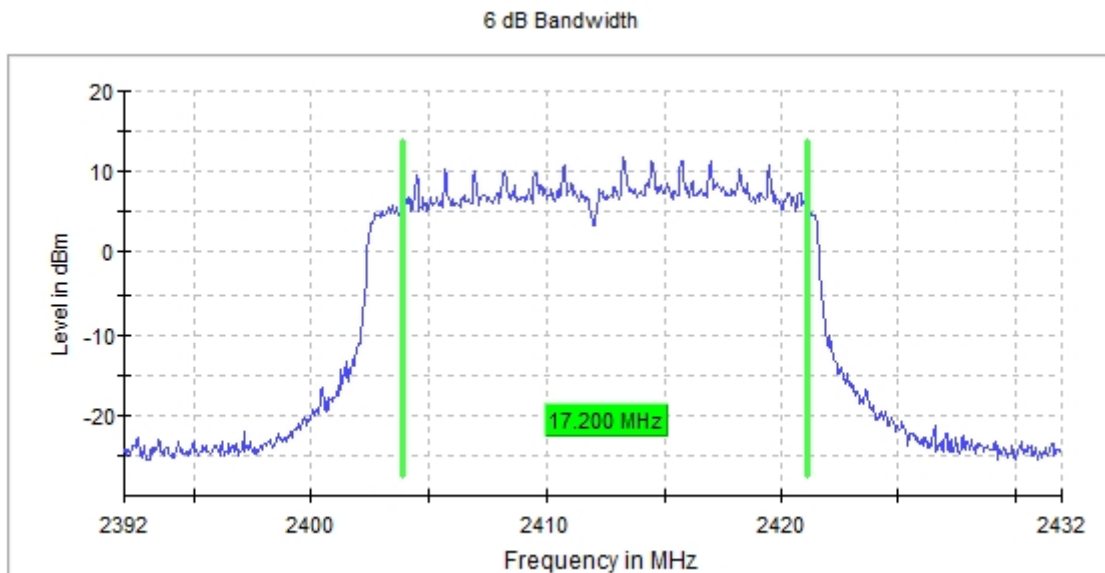


- High Channel (11):

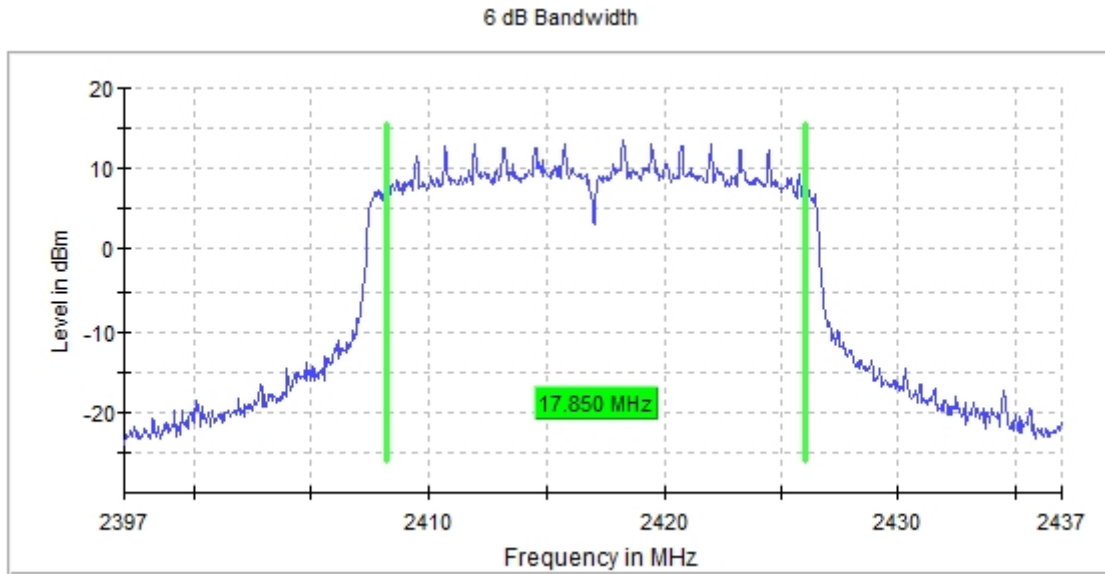


- SISO 802.11 he20 – 6 dB Bandwidth:

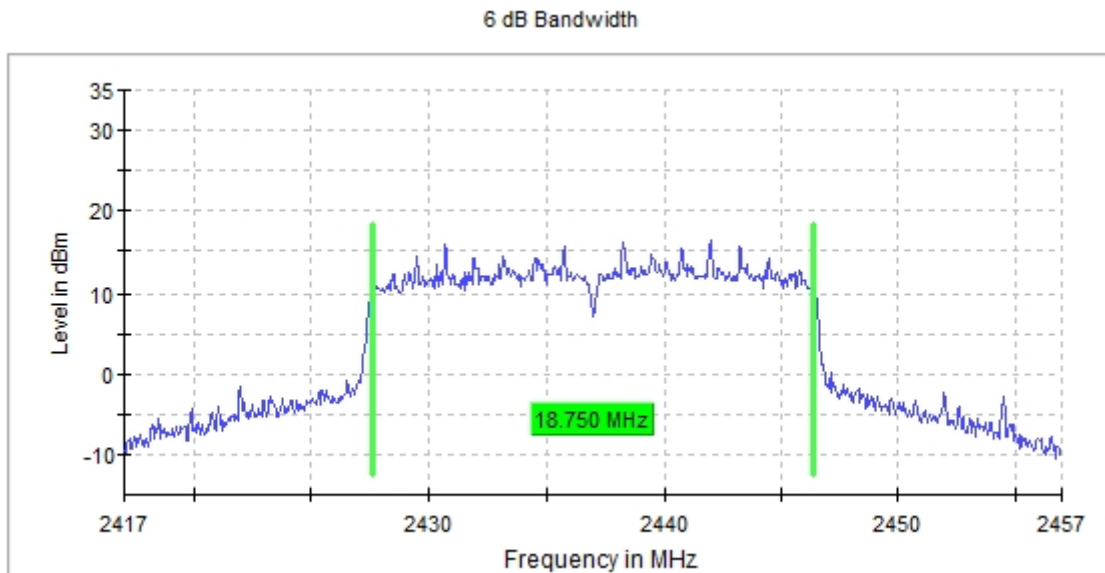
- Low Channel (1):



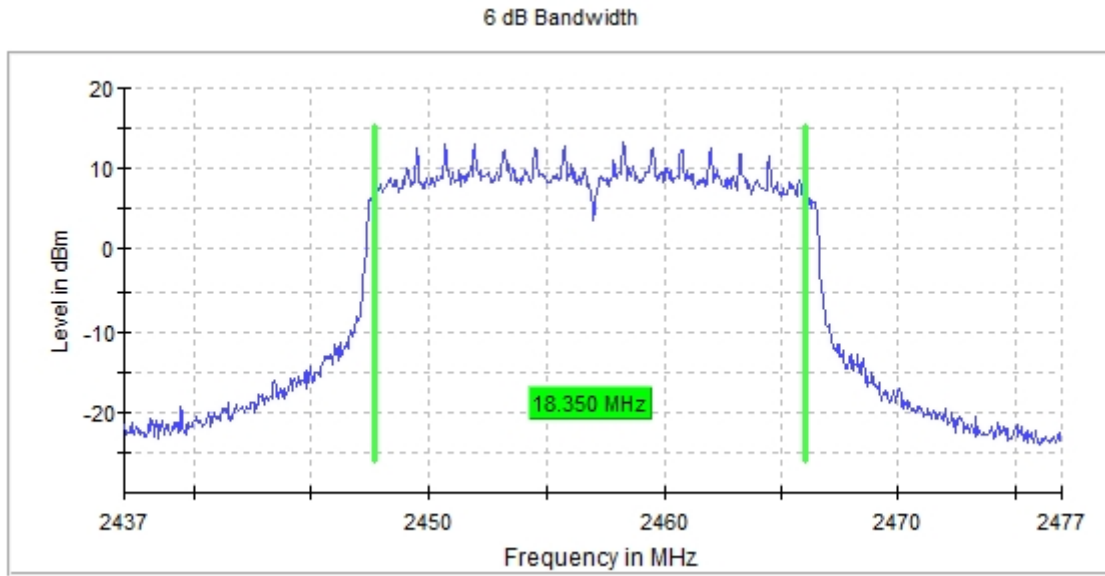
- Channel (2):



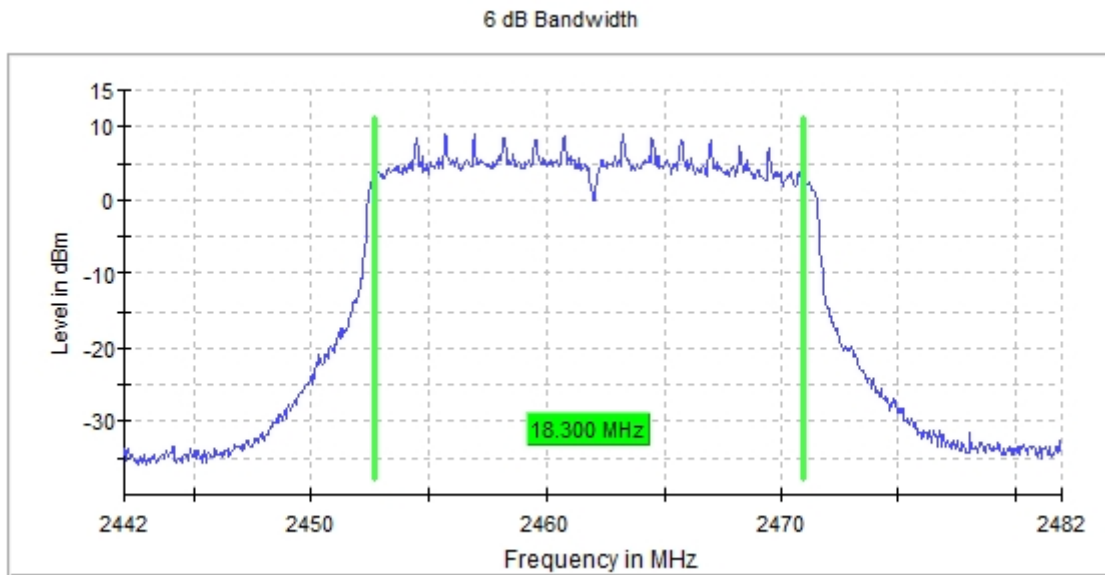
- Middle Channel (6):



- Channel (10):

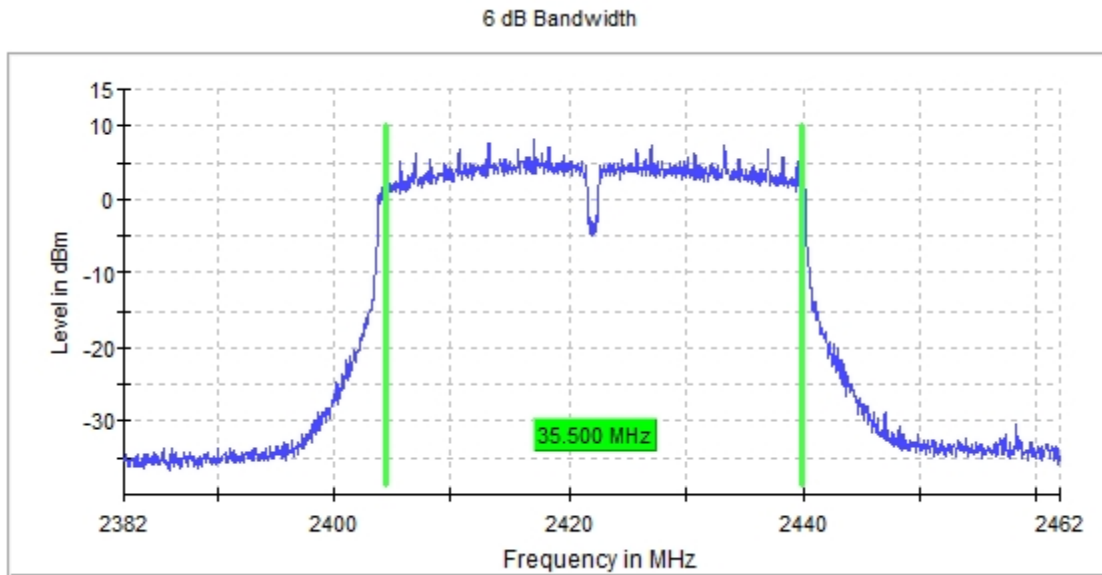


- High Channel (11):

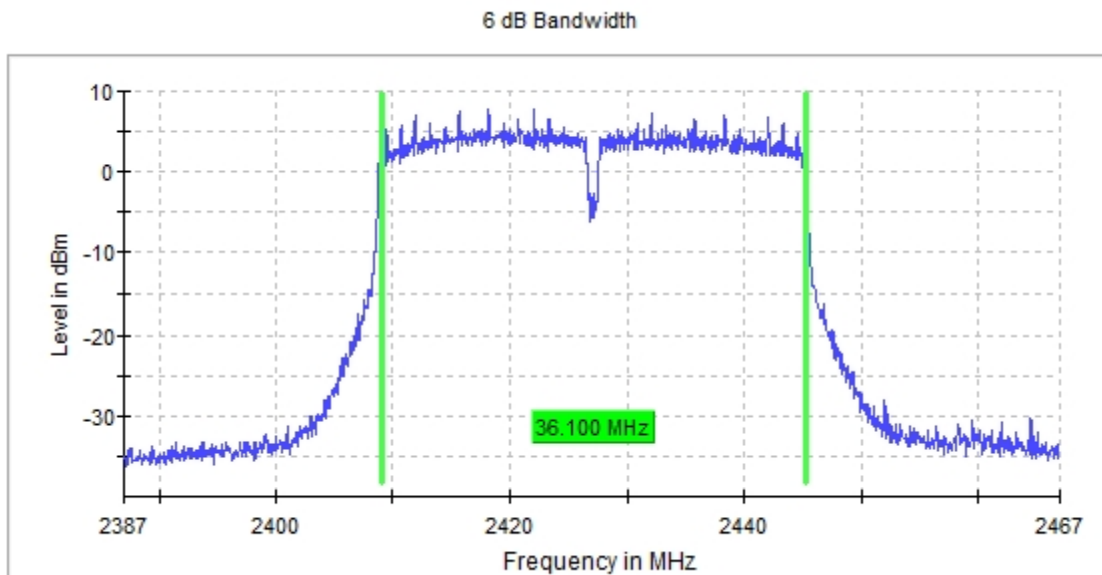


- **SISO 802.11 n40 – 6 dB Bandwidth:**

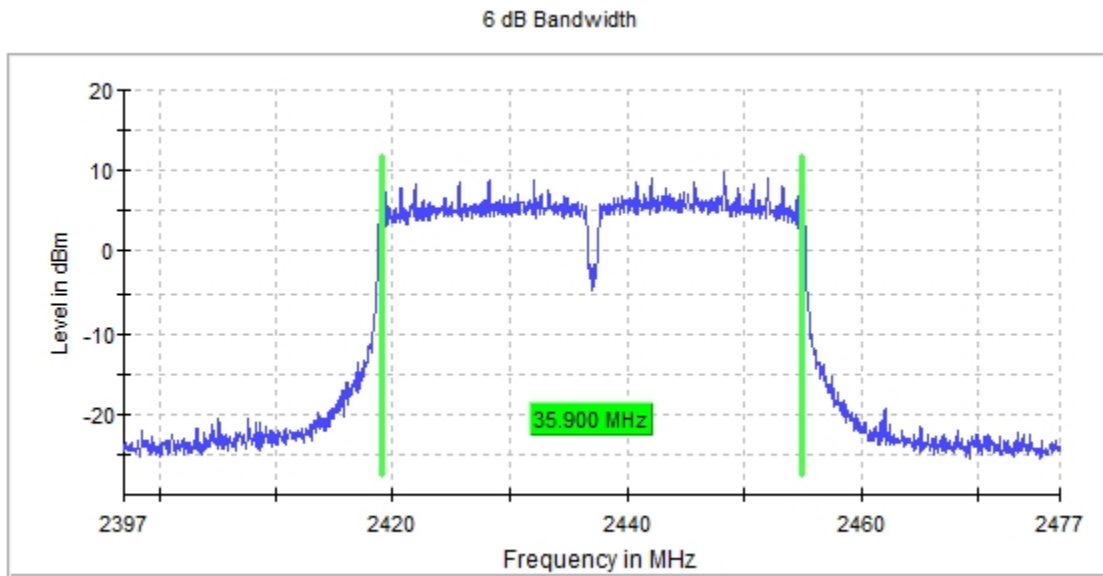
- Low Channel (3):



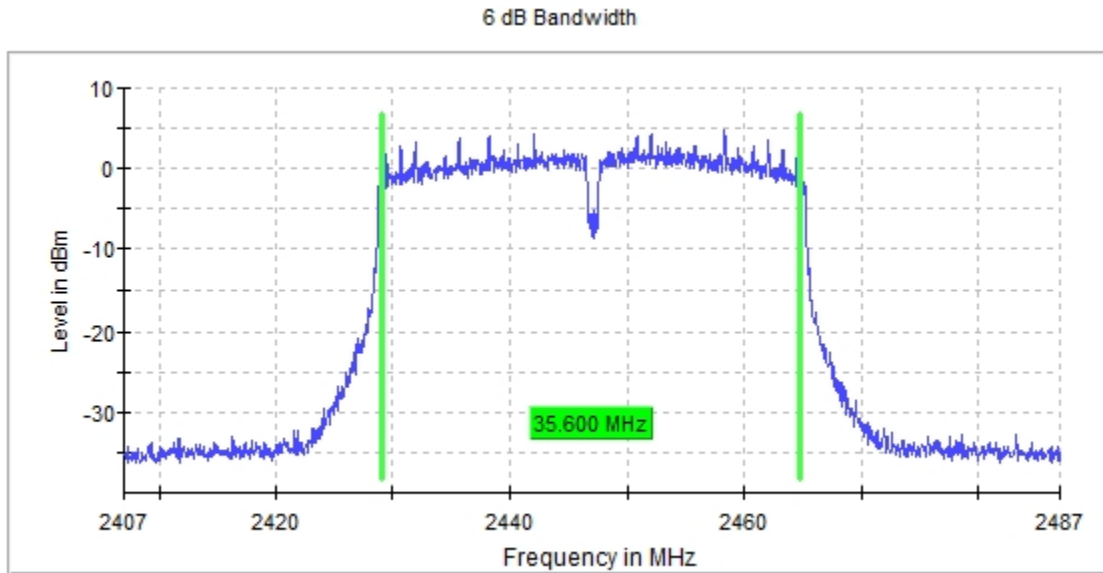
- Channel (4):



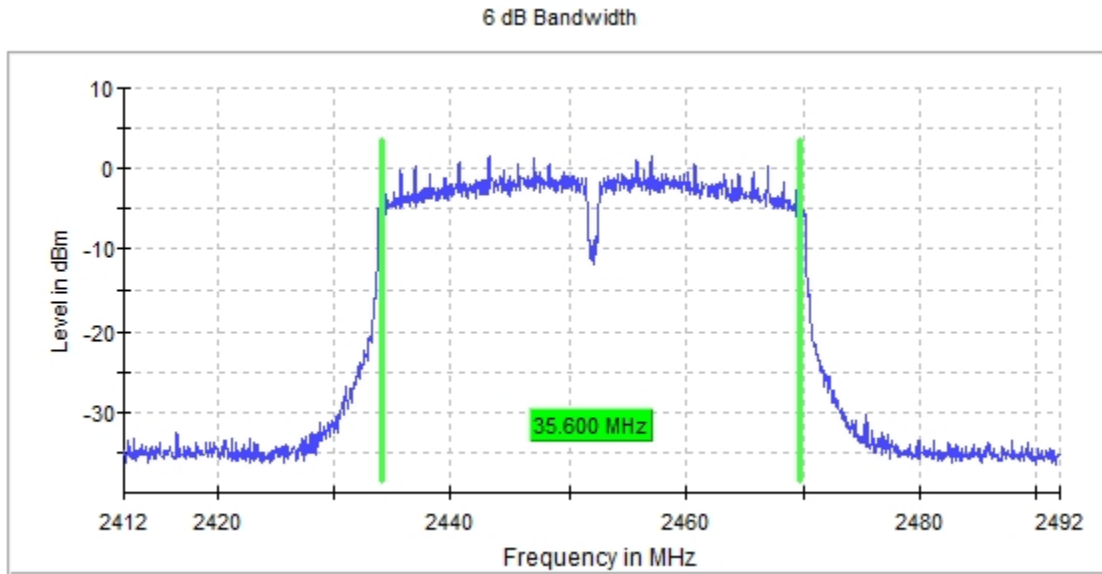
- Middle Channel (6):



- Channel (8):

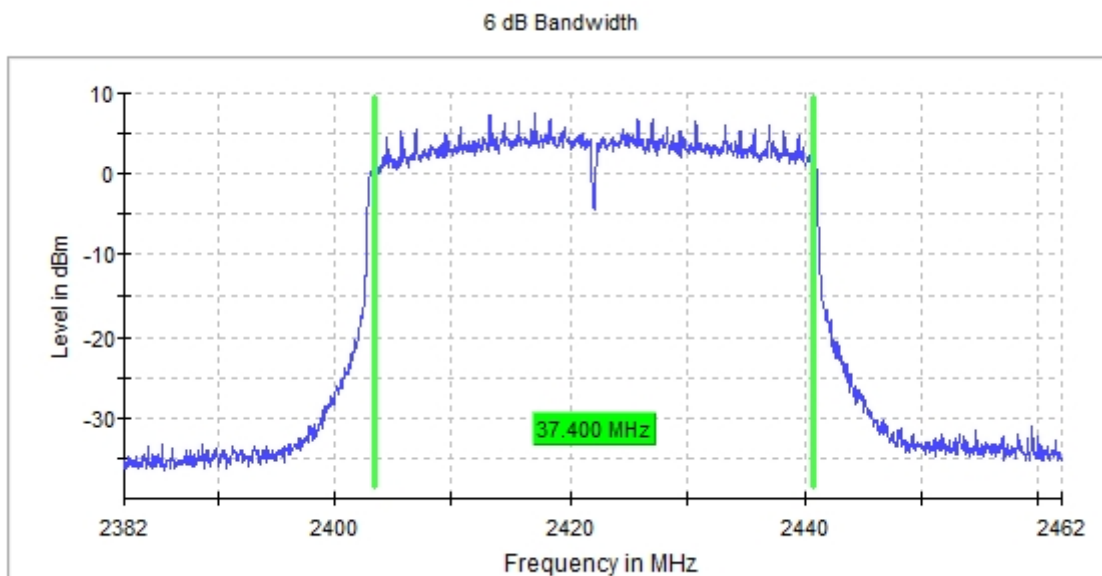


- High Channel (9):

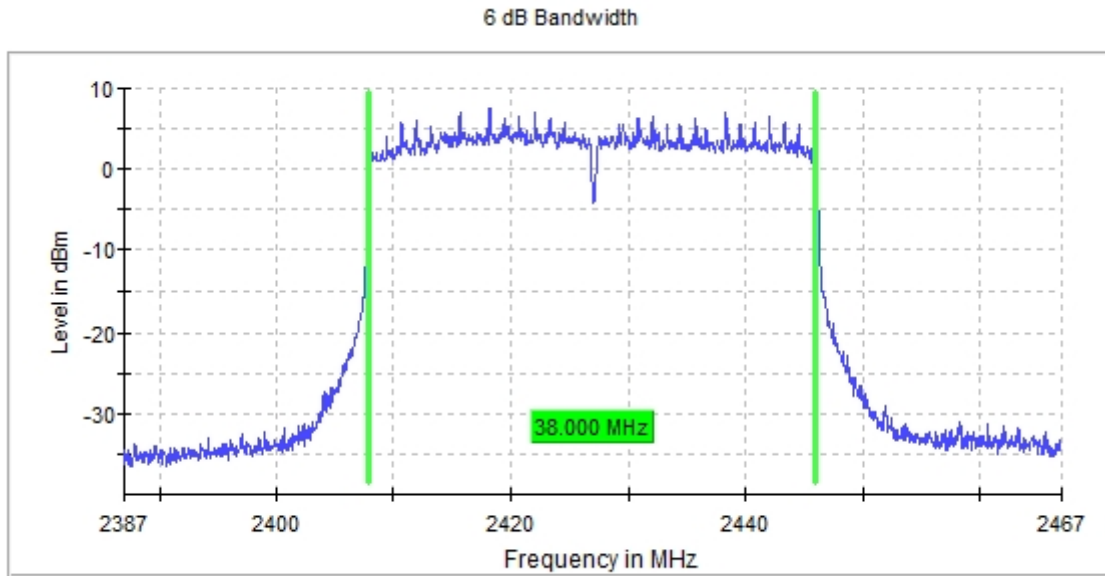


- SISO 802.11 he40 – 6 dB Bandwidth:

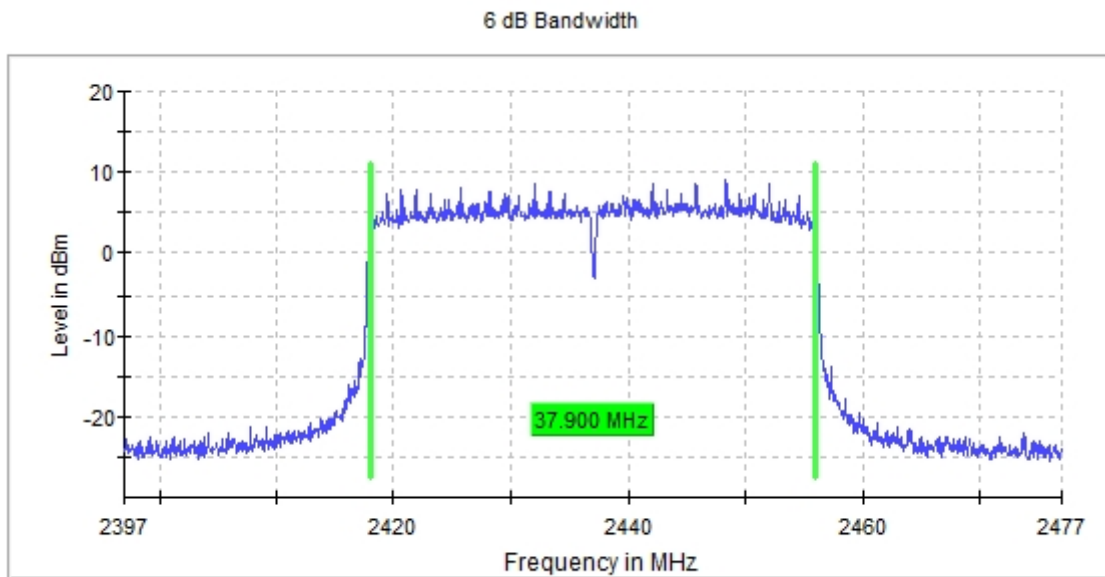
- Low Channel (3):



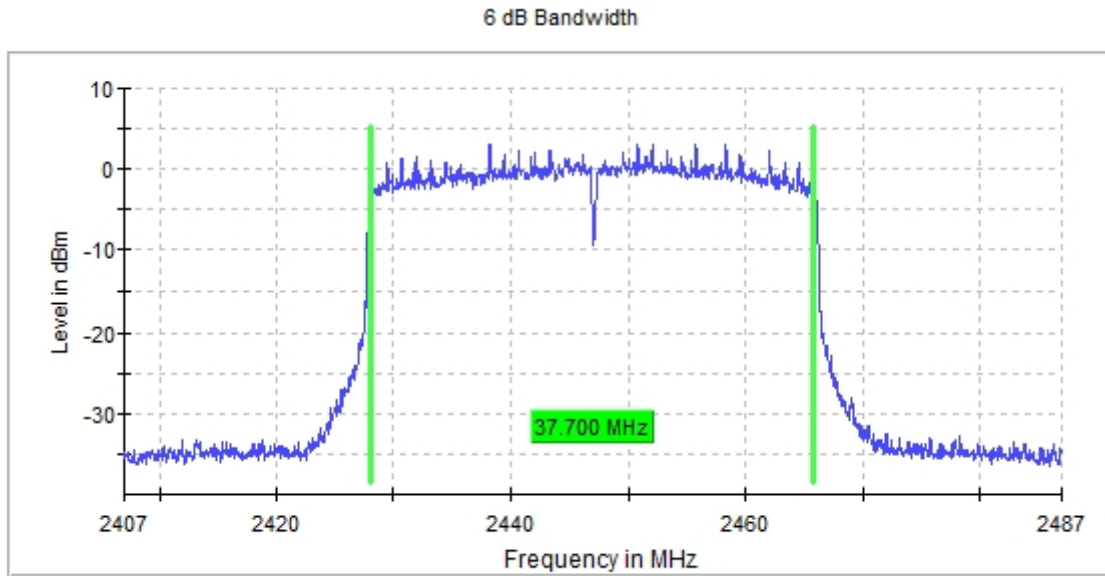
- Channel (4):



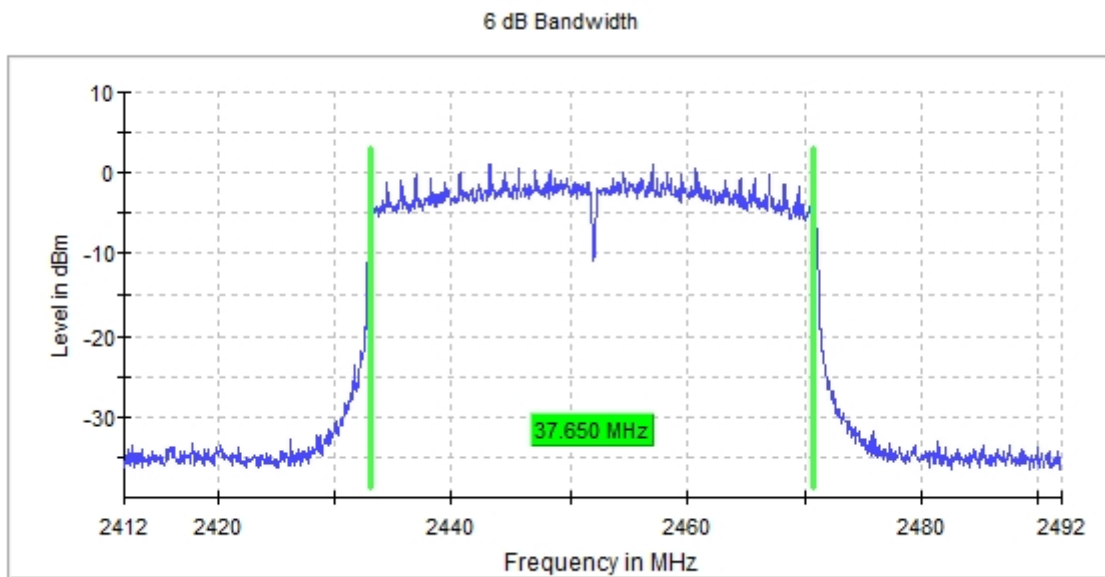
- Middle Channel (6):



- Channel (8):



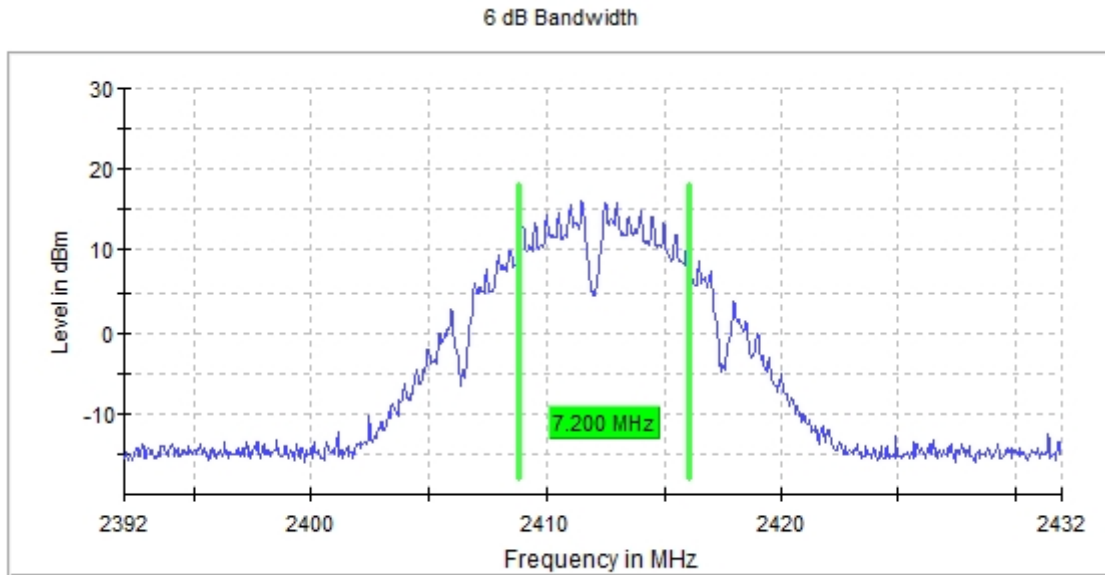
- High Channel (9):



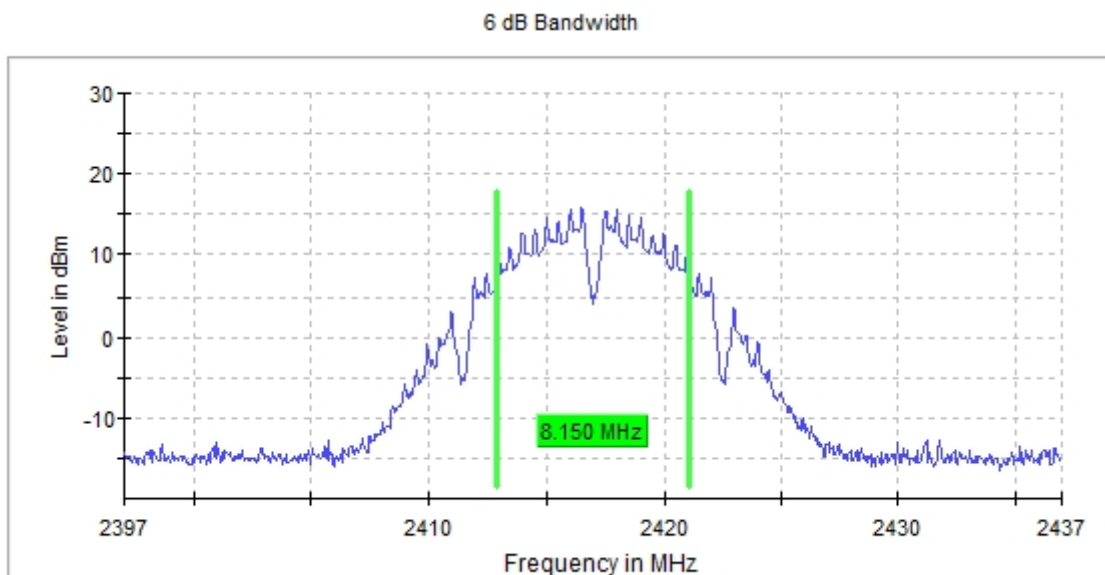
MIMO worst case:

- **MIMO 802.11 b – 6 dB Bandwidth:**

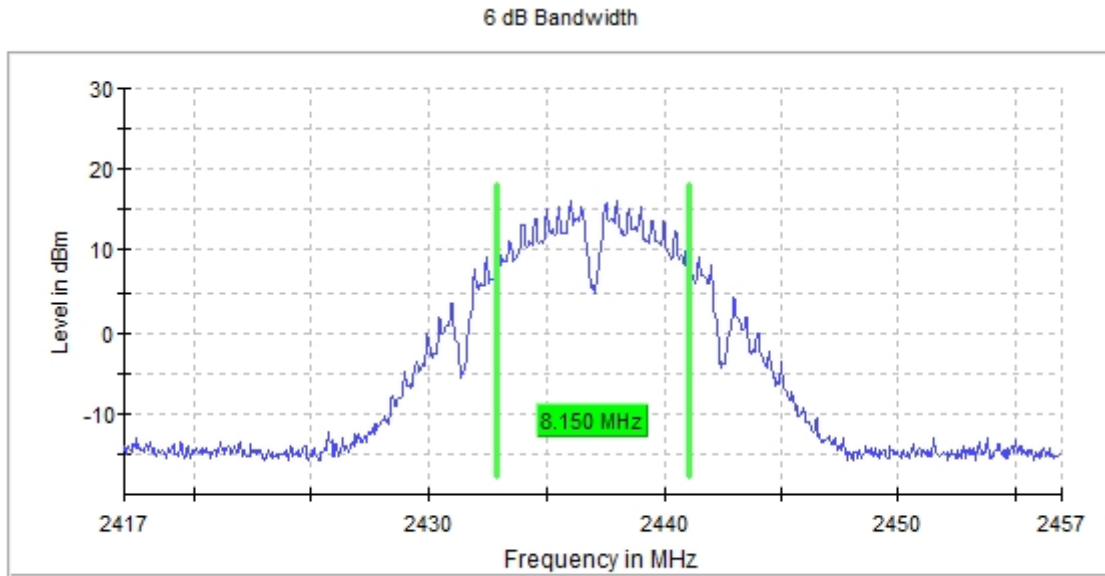
- Low Channel (1):



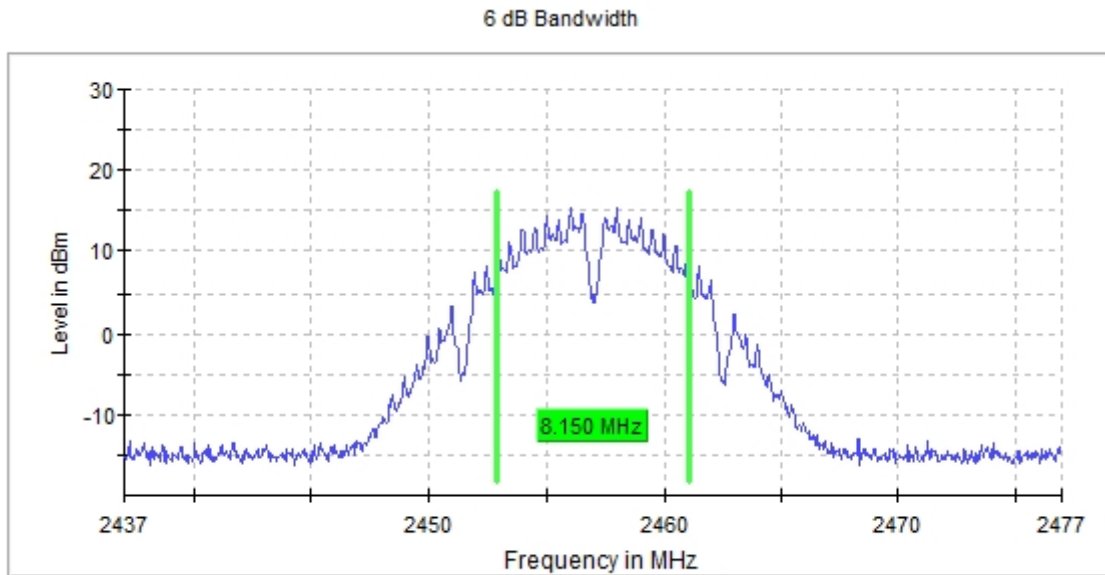
- Channel (2):



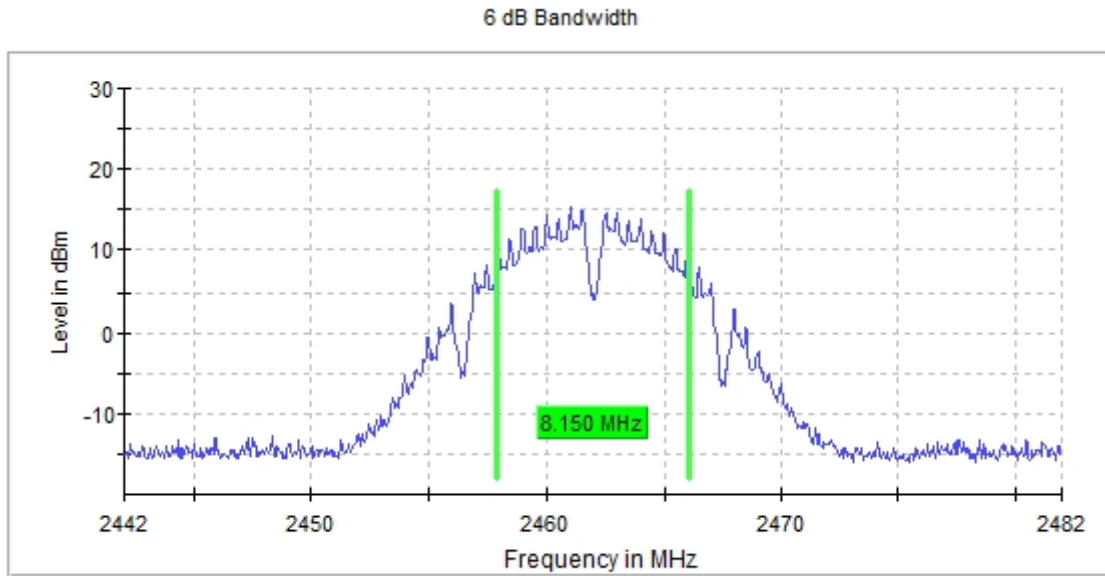
- Middle Channel (6):



- Channel (10):

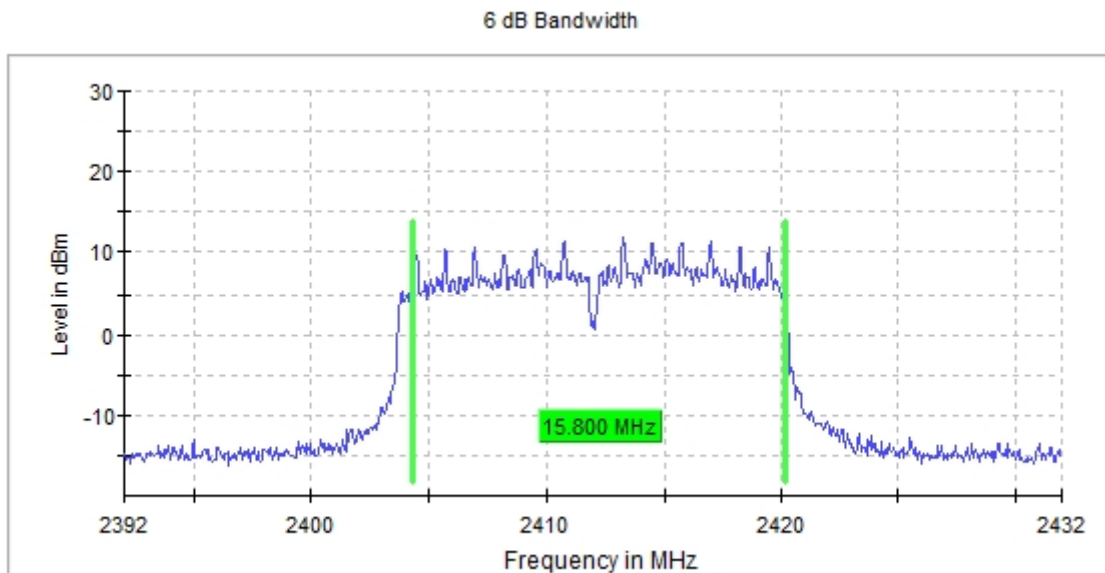


- High Channel (11):

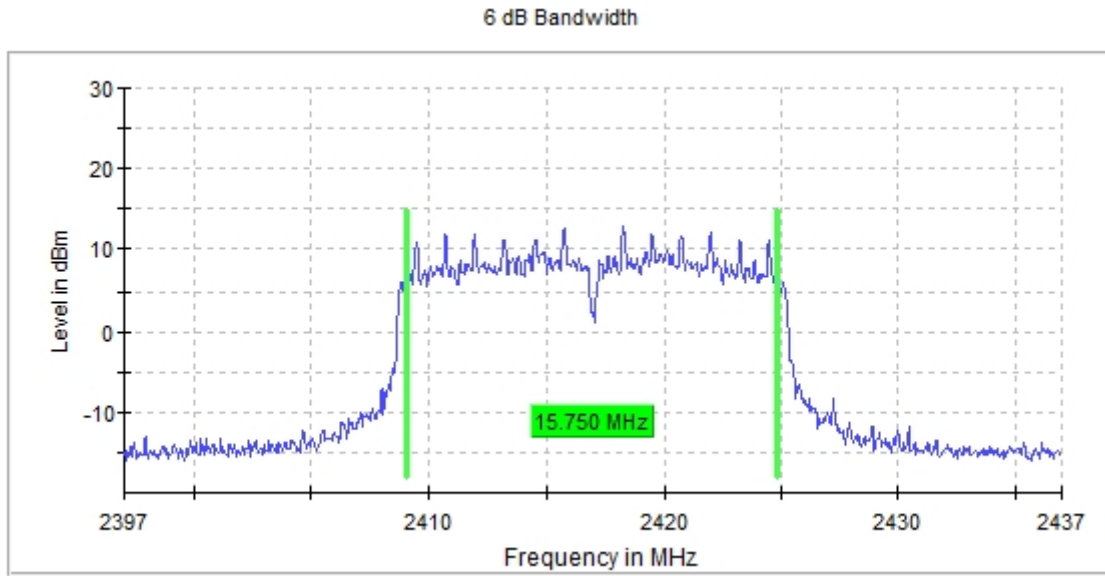


- **MIMO 802.11 g – 6 dB Bandwidth:**

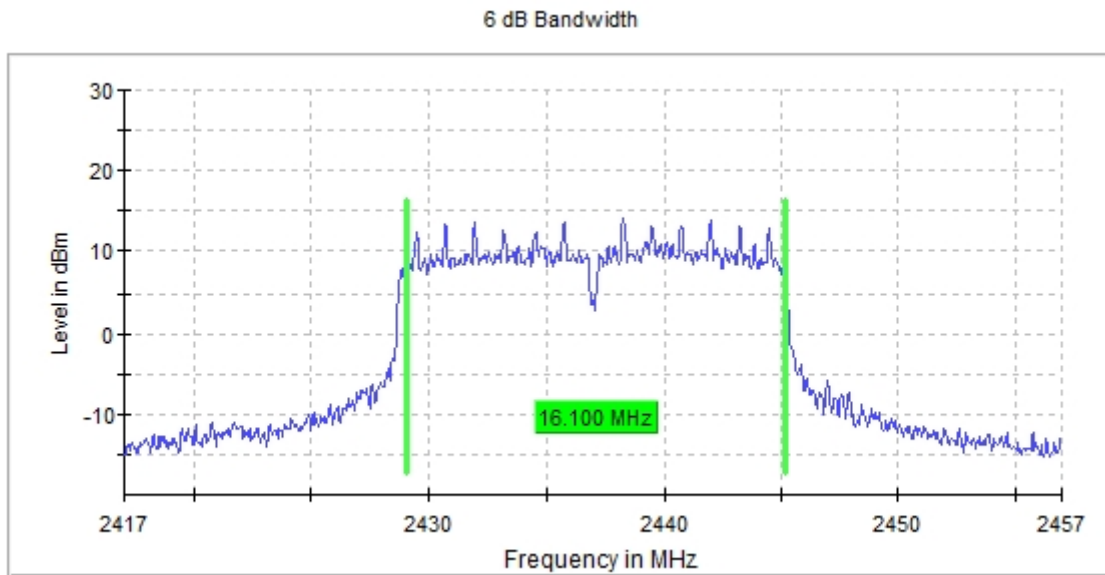
- Low Channel (1):



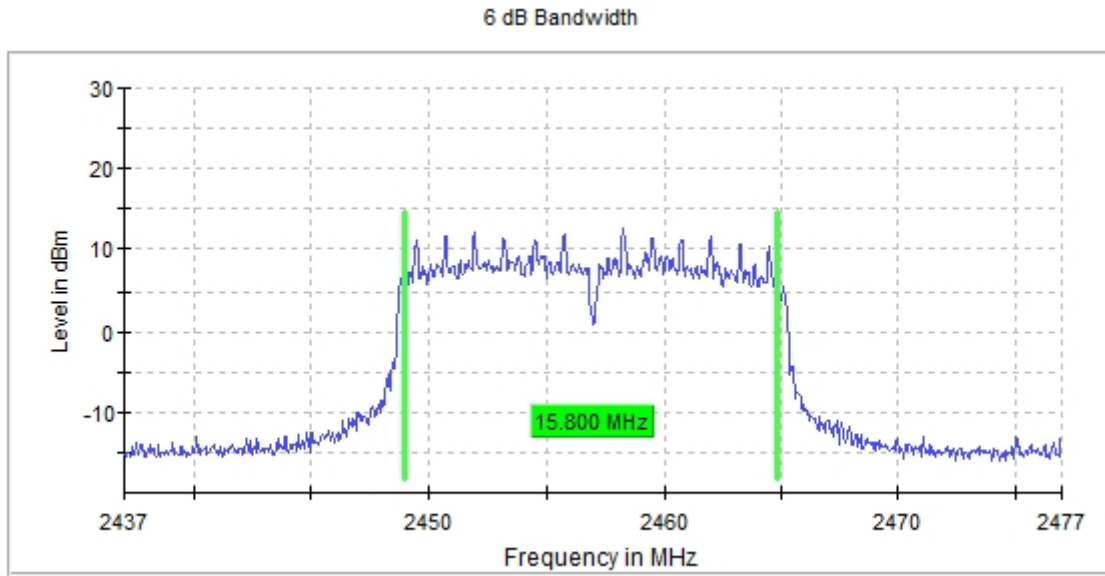
- Channel (2):



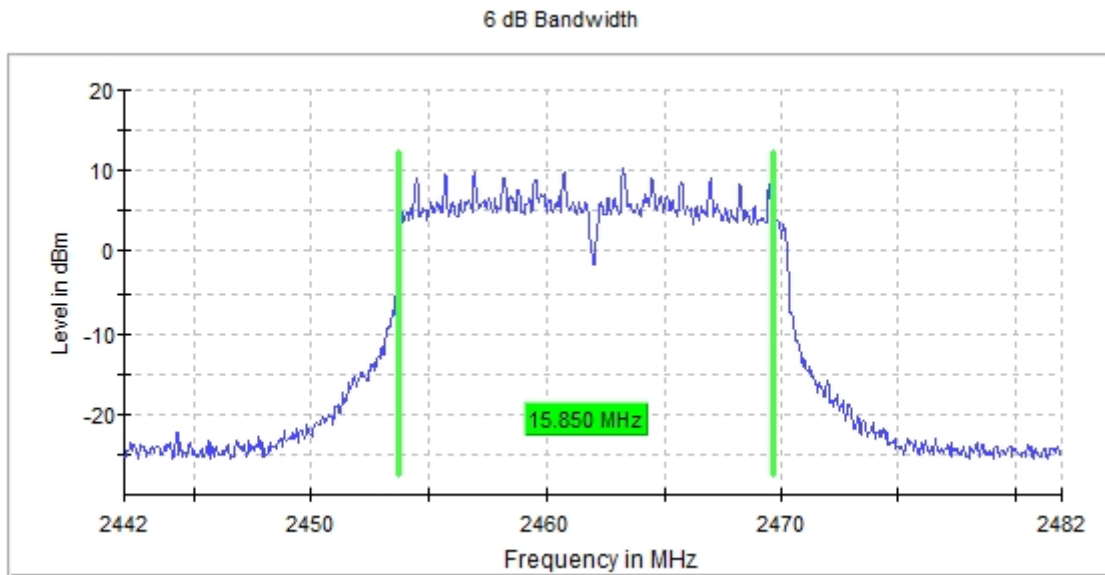
- Middle Channel (6):



- Channel (10):

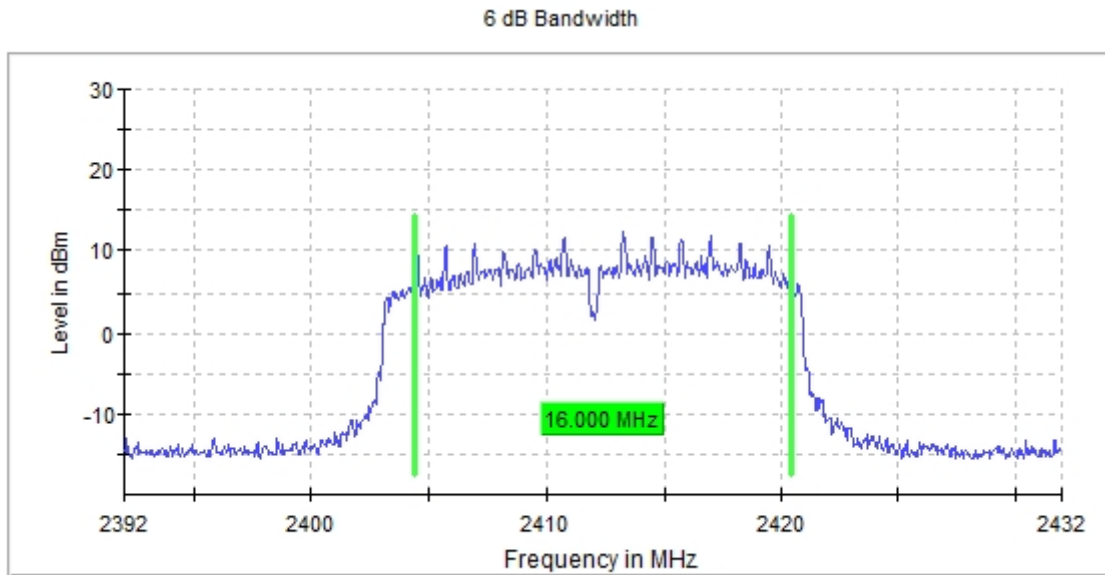


- High Channel (11):

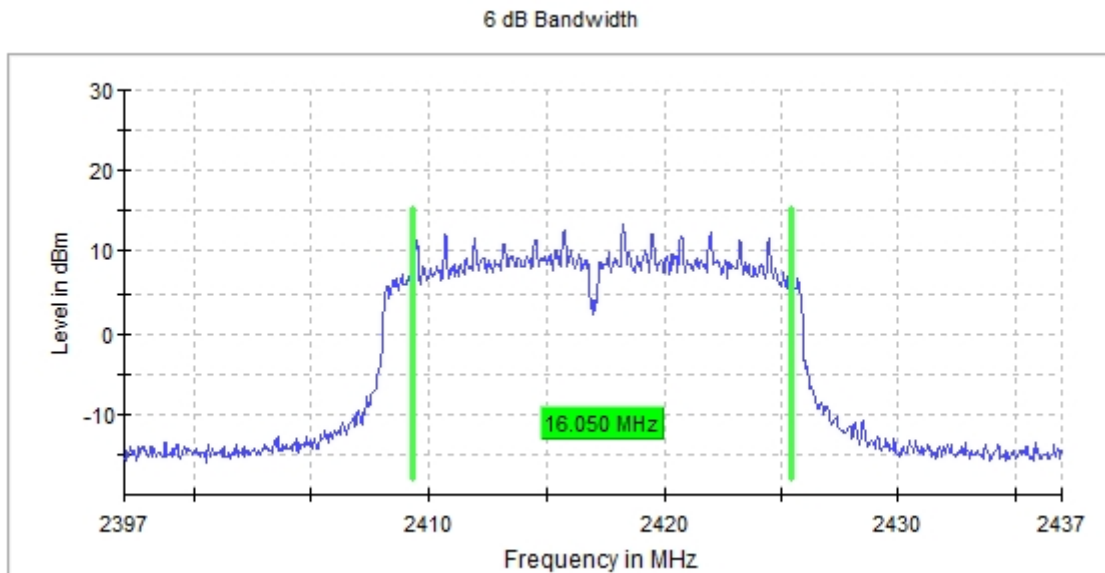


- **MIMO 802.11 n20 – 6 dB Bandwidth:**

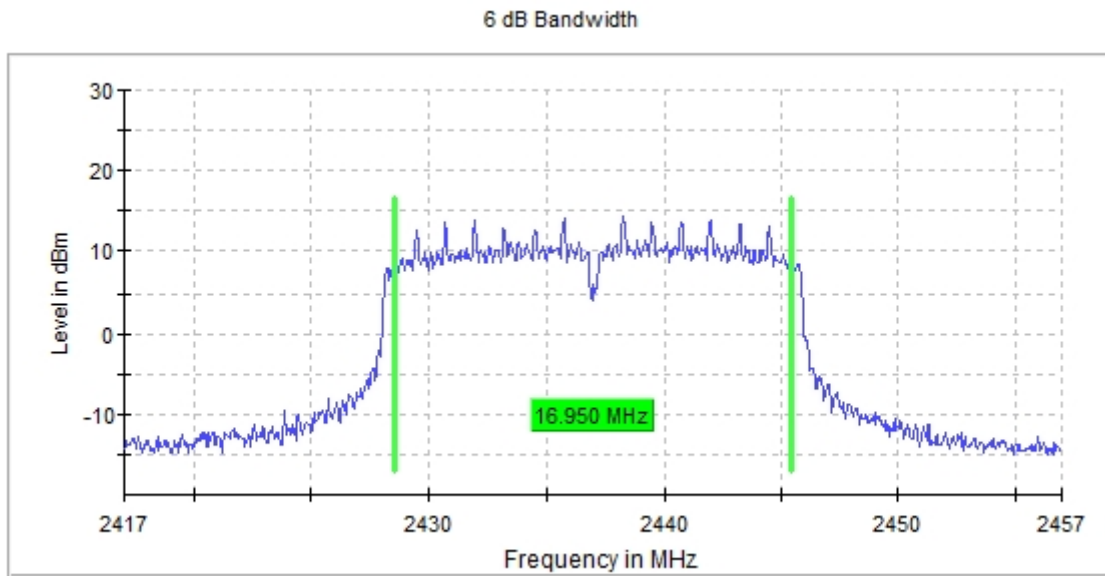
- Low Channel (1):



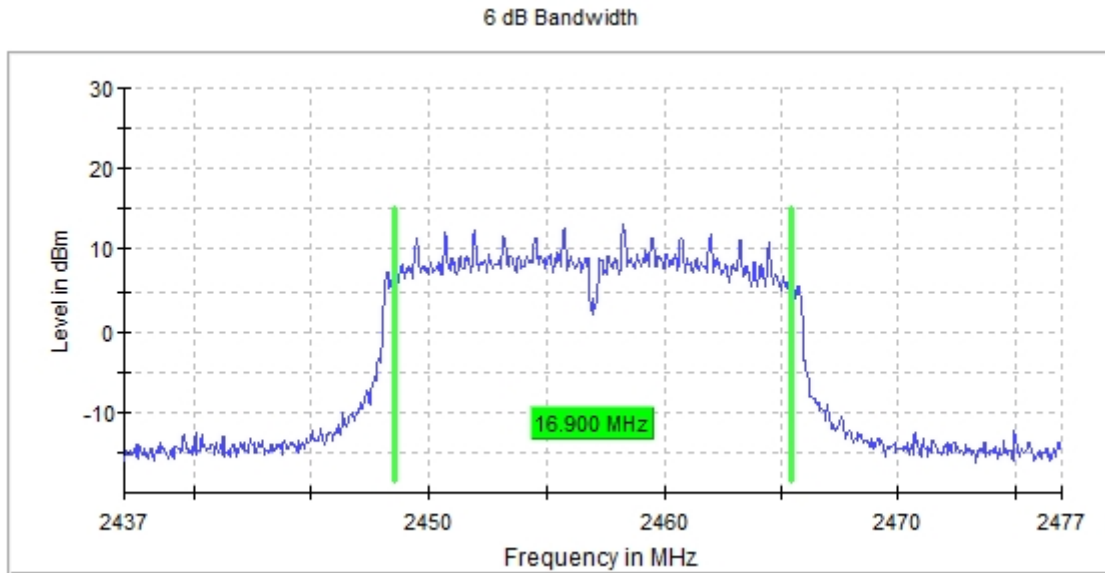
- Channel (2):



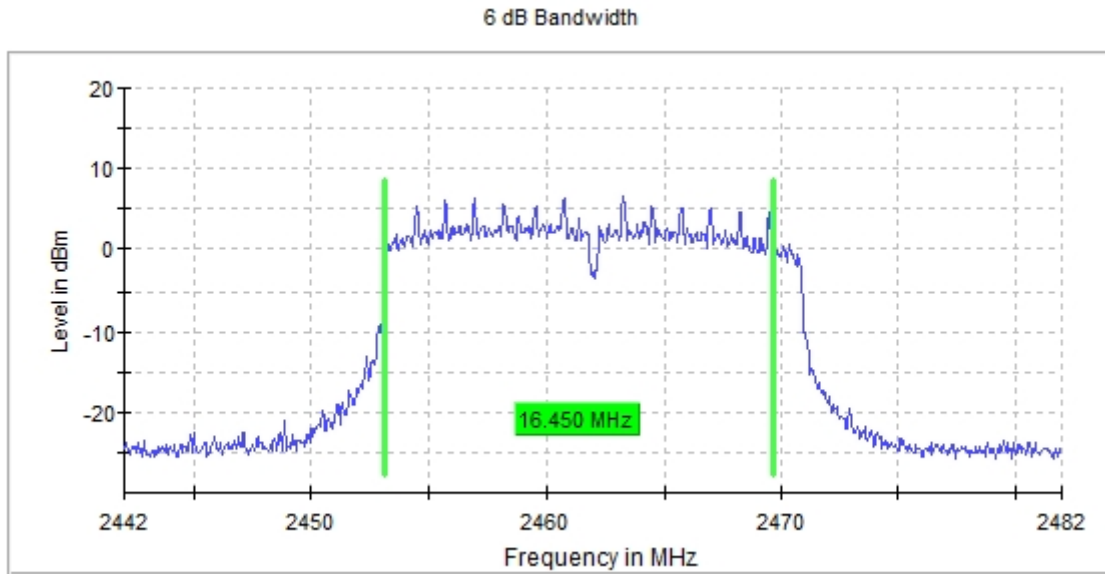
- Middle Channel (6):



- Channel (10):

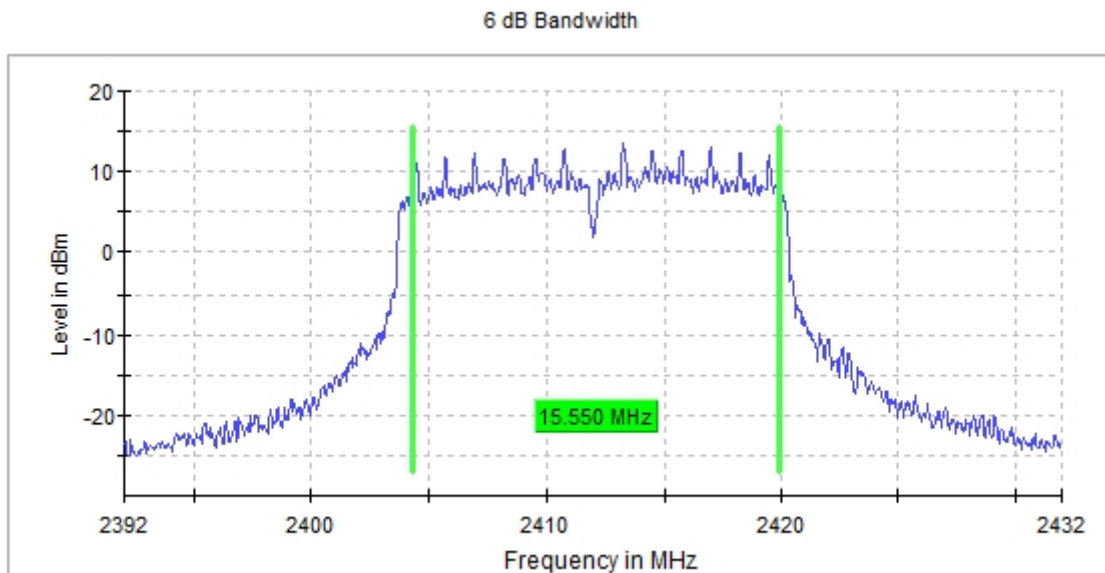


- High Channel (11):

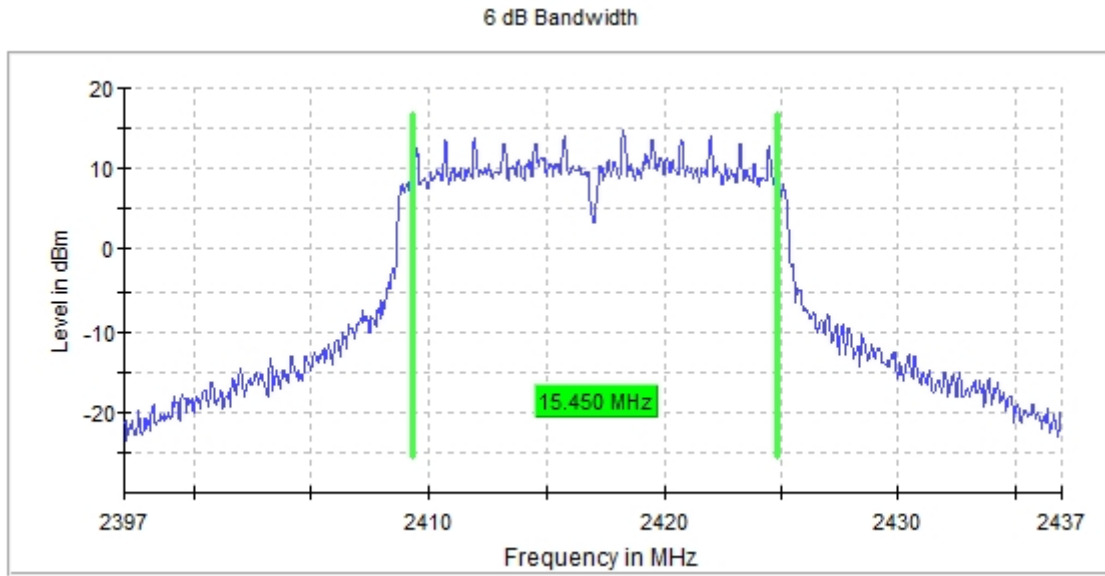


- **MIMO 802.11 he20 – 6 dB Bandwidth:**

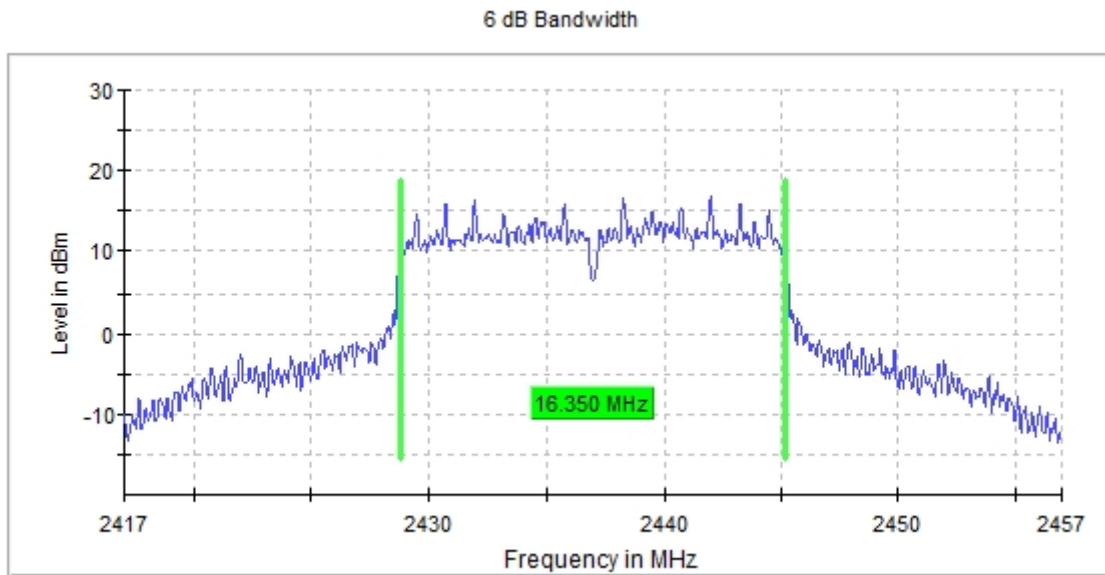
- Low Channel (1):



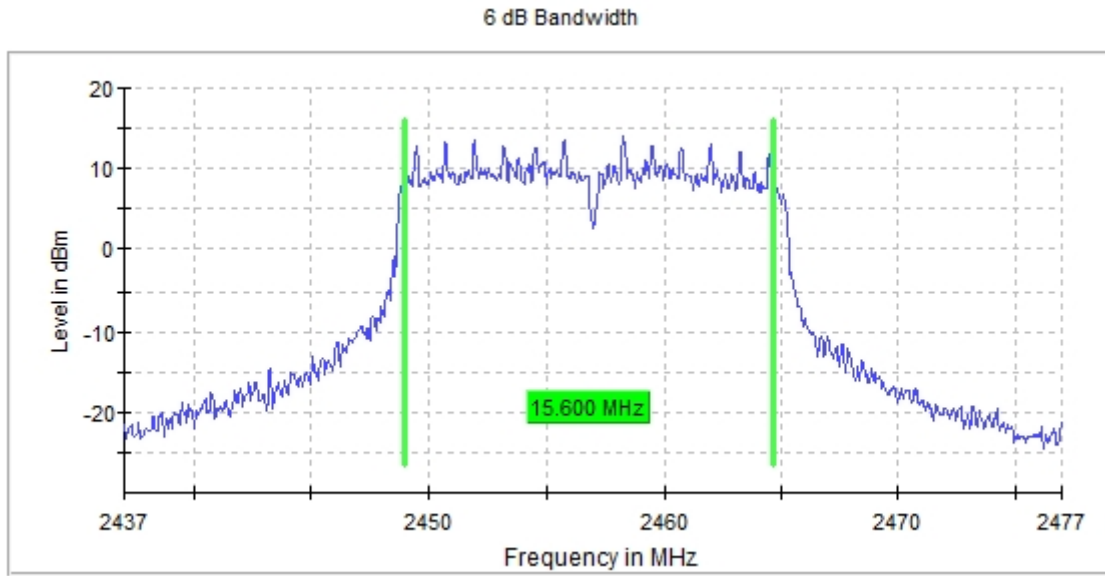
- Channel (2):



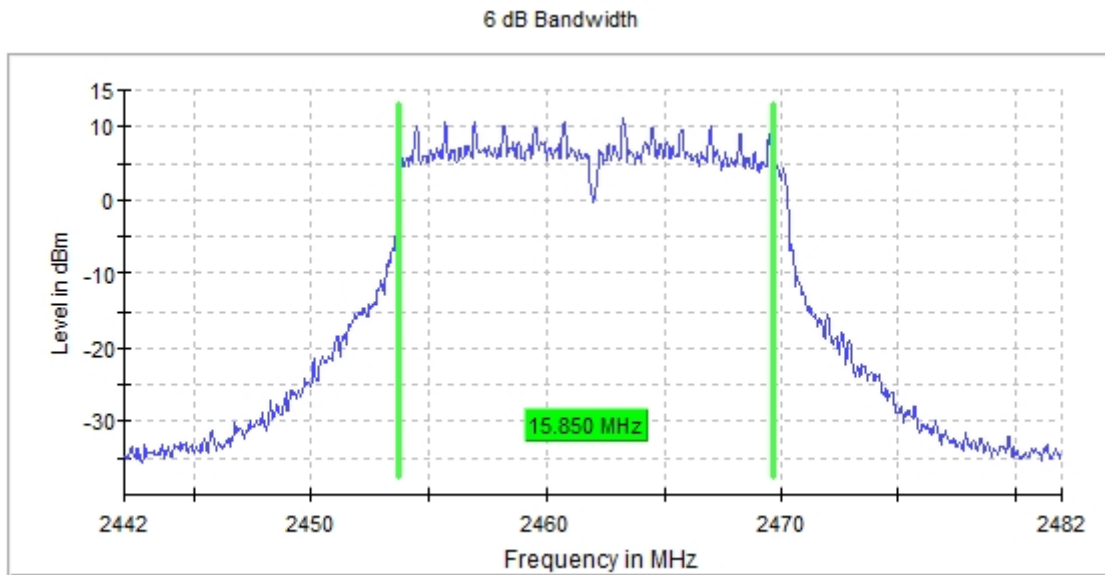
- Middle Channel (6):



- Channel (10):

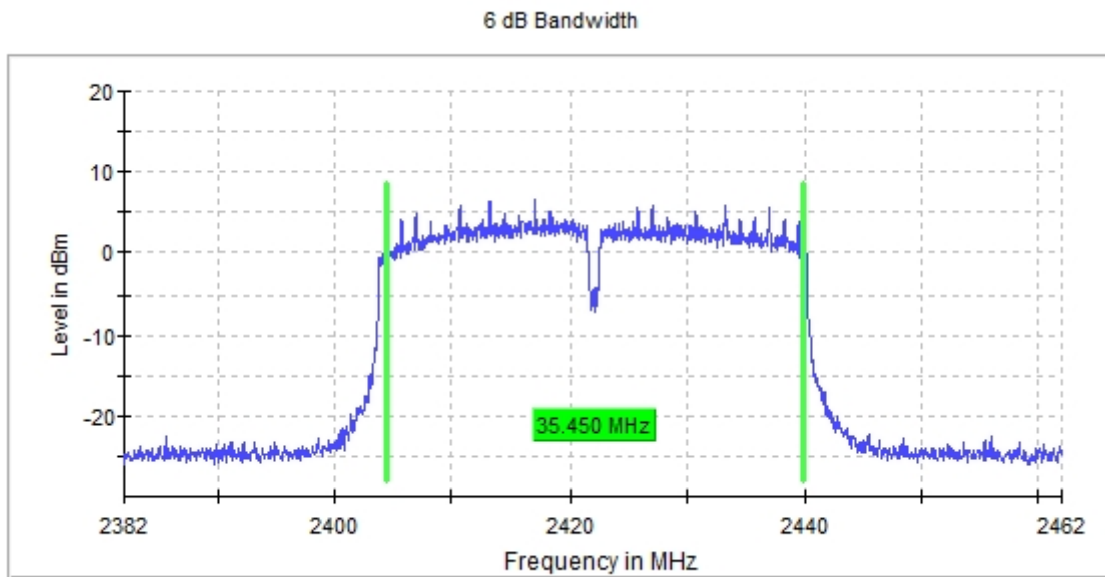


- High Channel (11):

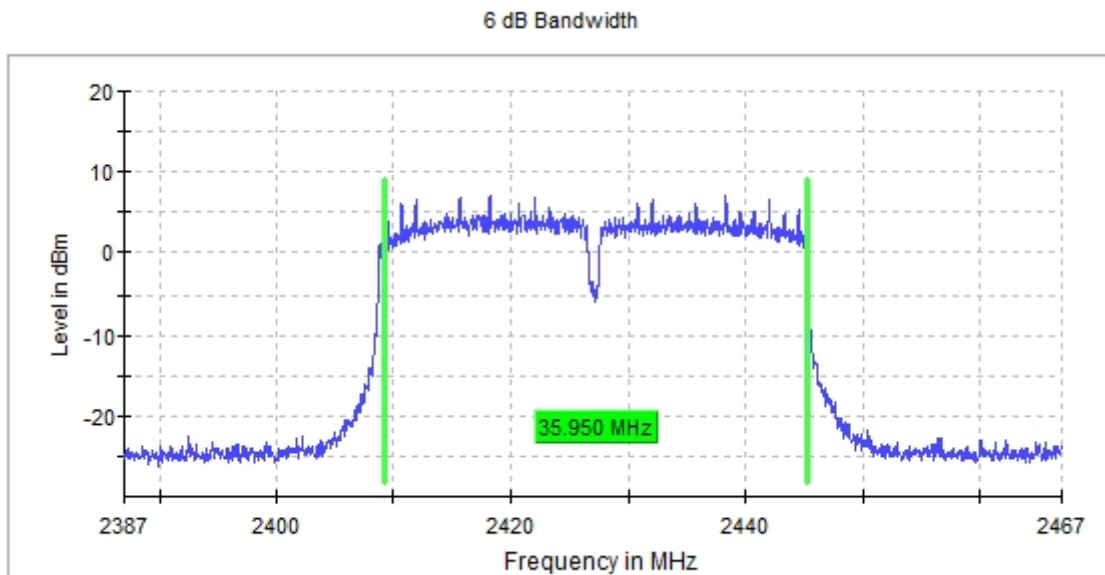


- **MIMO 802.11 n40 – 6 dB Bandwidth:**

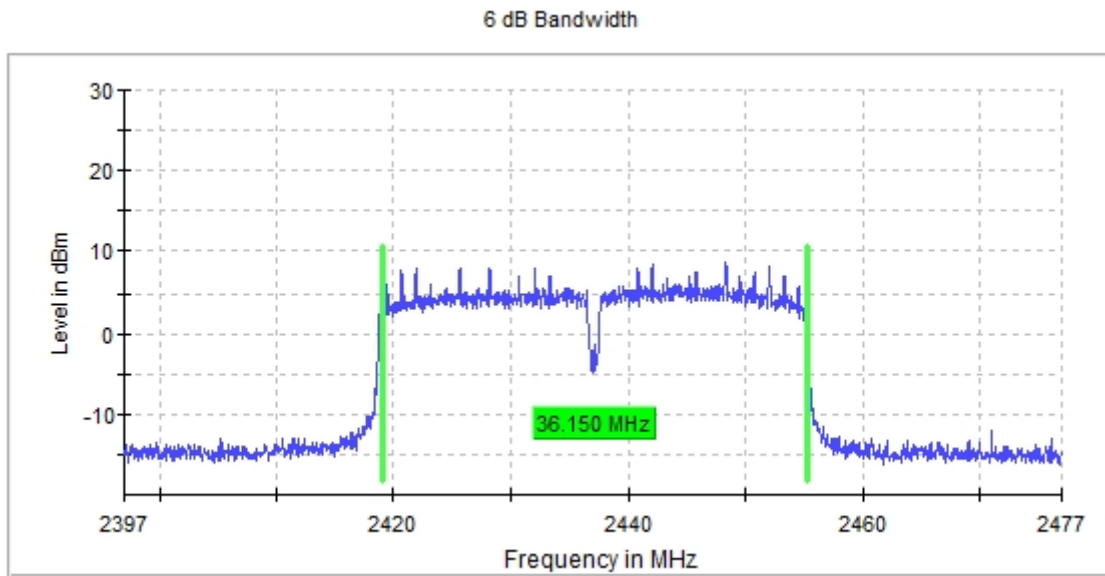
- Low Channel (3):



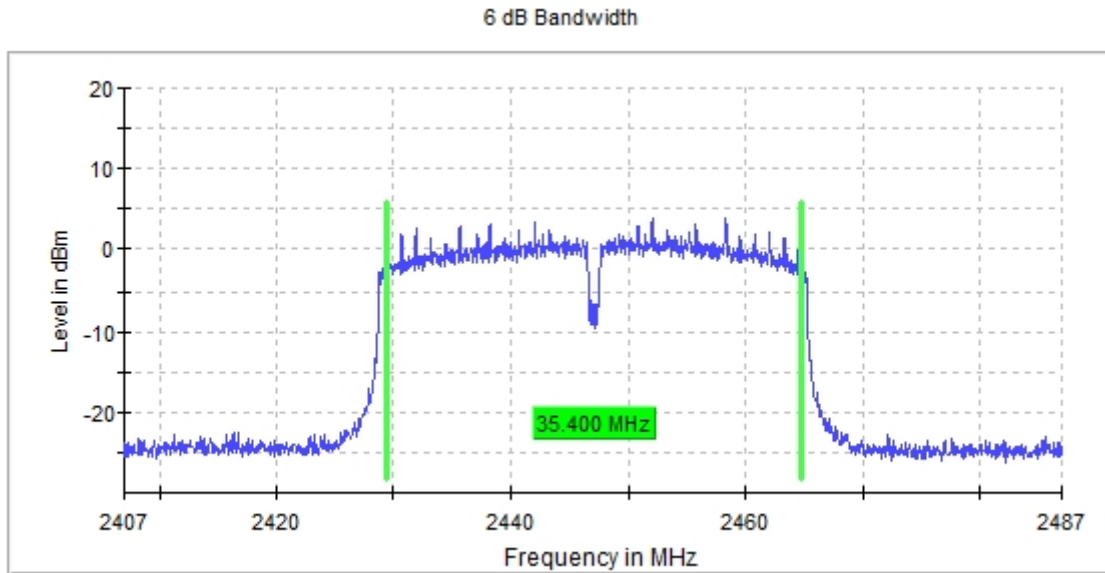
- Channel (4):



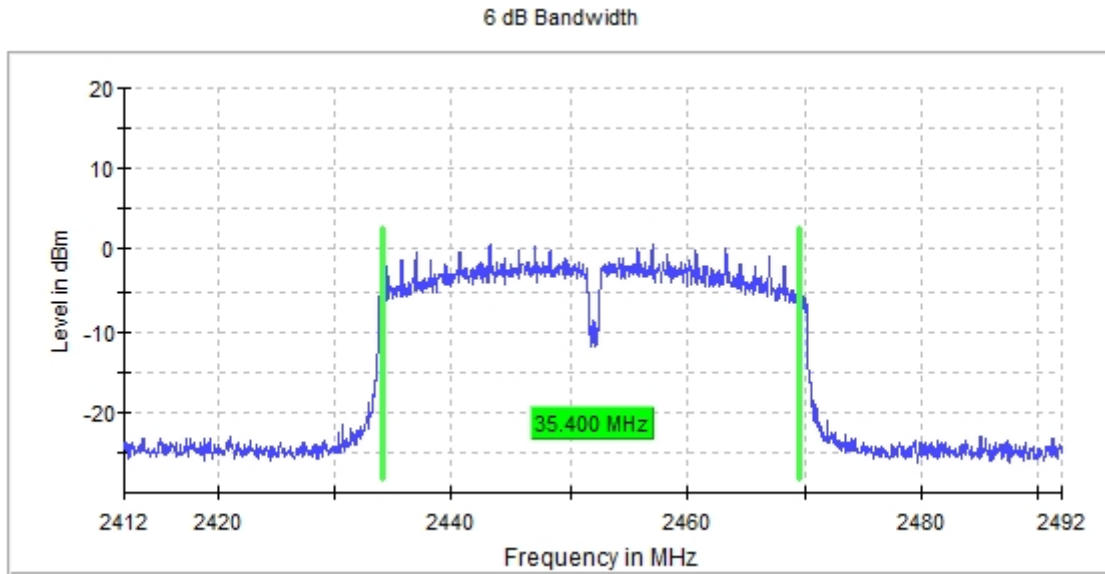
- Middle Channel (6):



- Channel (8):

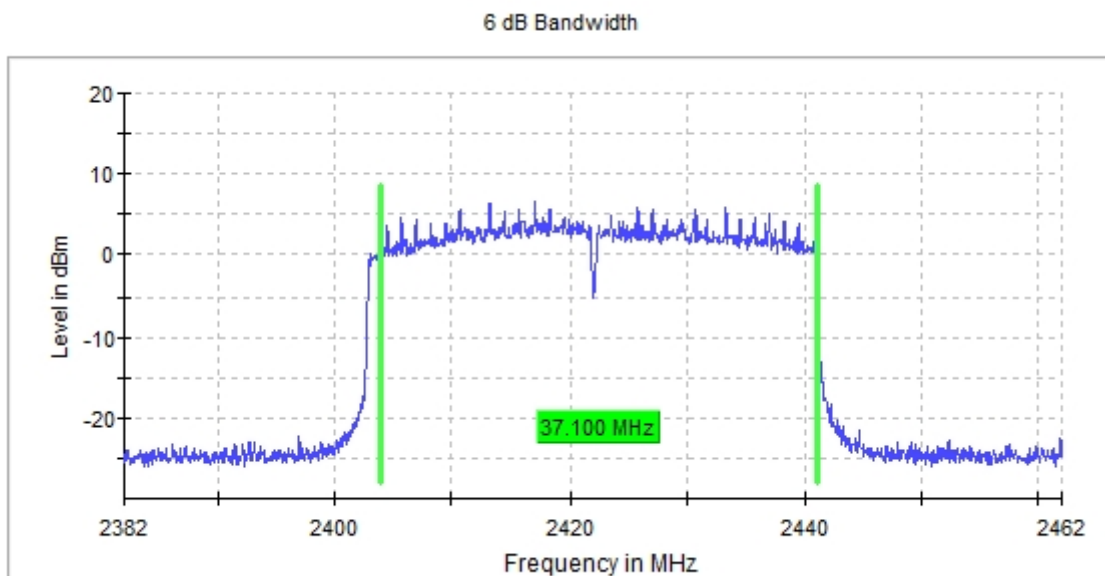


- High Channel (9):

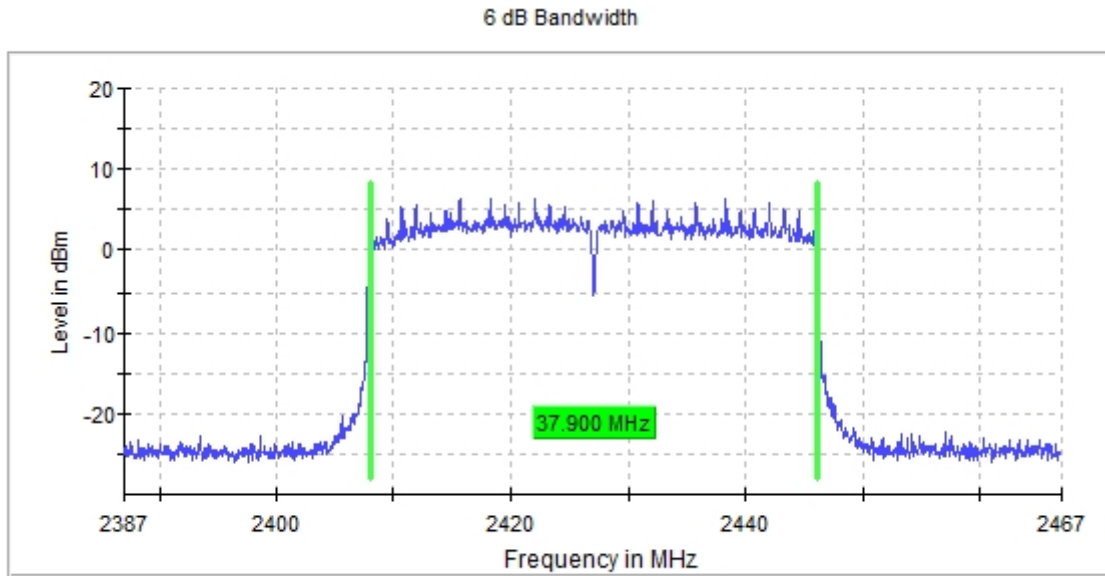


- **MIMO 802.11 he40 – 6 dB Bandwidth:**

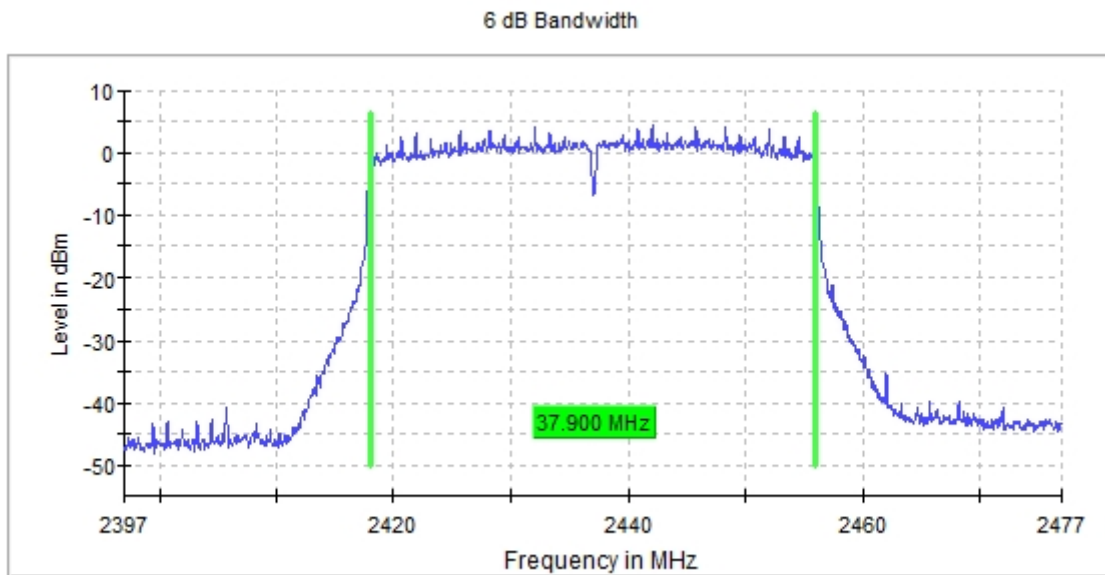
- Low Channel (3):



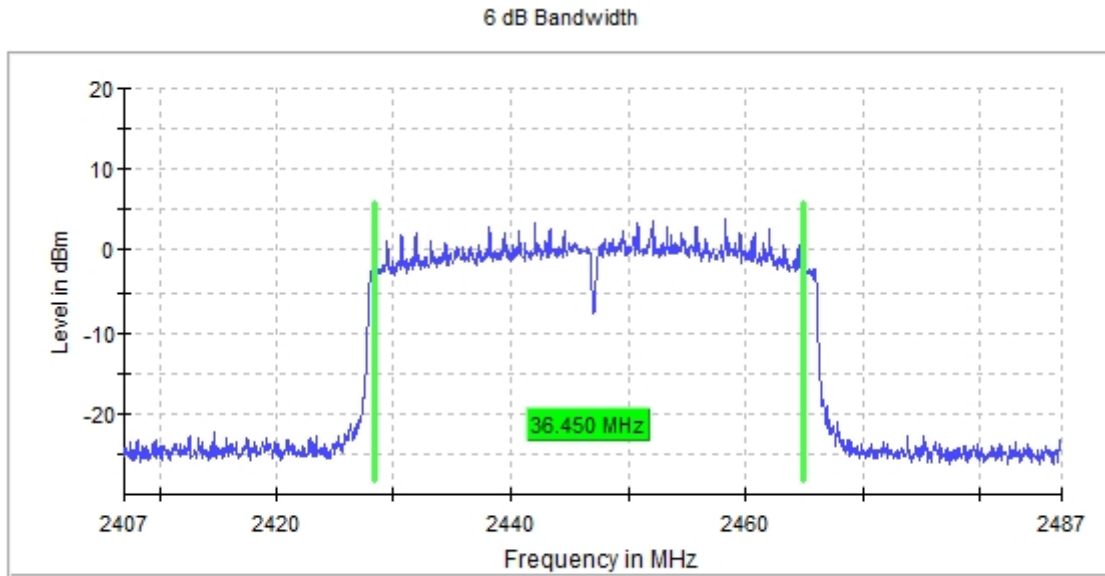
- Channel (4):



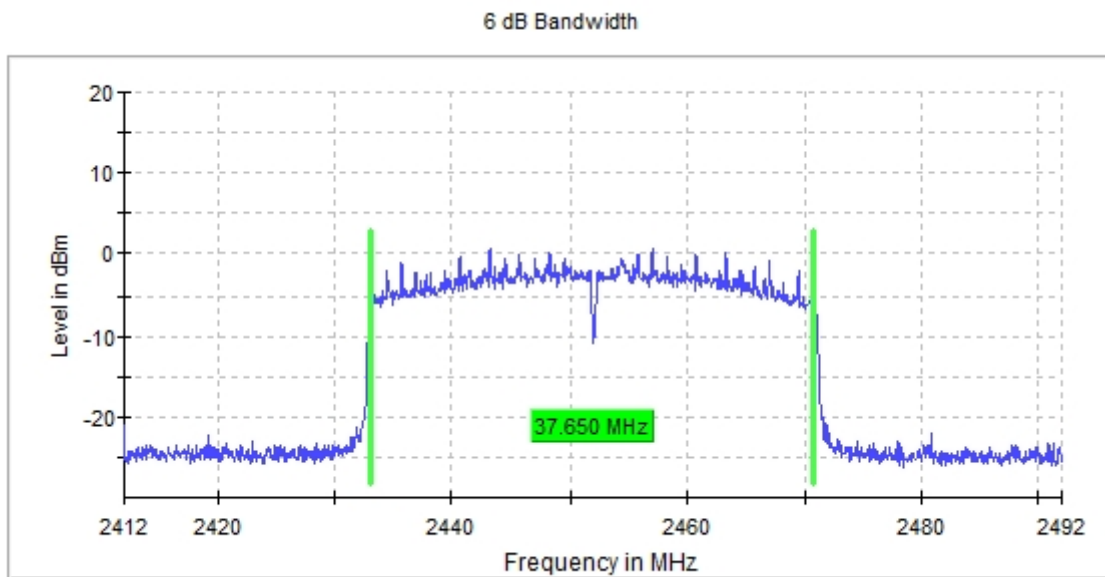
- Middle Channel (6):



- Channel (8):



- High Channel (9):



FCC 15.247 (b) / RSS-247 5.4 (d) Maximum output power and antenna gain

SPECIFICATION:

For systems using digital modulation in the 2400-2483.5 MHz band: 1 watt (30 dBm).
The e.i.r.p. shall not exceed 4 W (36 dBm) (Canada).

RESULTS:

The maximum conducted output power was measured using the method according to FCC title 47 part 15 §15.247(b), KDB 558074 D01 DTS Meas Guidance v05r02 and ANSI C63.10-2013 11.9.2.3.2.

The testing was performed in according with Method AVGPM-G.

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 EIRP power (dBm) is calculated by adding the declared maximum antenna gain to the measured conducted power.

As declared in the 15.247 (b) (4), the conducted output power is reduced by the amount in dB that the directional gain of the antenna exceeds 6dB. The applicable output power limit shall be calculated as follows:

$$P_{\text{Out}} = P_{\text{Limit}} - (G_{\text{Tx}} - 6)$$

Test performed on the following worst cases in all relevant tests channels:

- Preliminary tests determined the SISO worst case: WLAN1.
- Preliminary tests determined the MIMO worst case: WLAN1 & WLAN2.

Maximum Declared Antenna Gain:

- SISO Antenna – WLAN1: +4.6 dBi
- MIMO Antennas – WLAN1 & WLAN2:
 - WLAN1: +4.6 dBi
 - WLAN2: +3.8 dBi
 - TOTAL GAIN WLAN1+2: +7.22 dBi

SISO worst case:

- **SISO 802.11 b:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
Maximum Average Conducted Power (dBm)	27.7	28.1	28.5	25.1	28.6
Maximum EIRP Power (dBm)	32.3	32.7	33.1	29.7	33.2
Measurement uncertainty (dB)	<±0.80				

- **SISO 802.11 g:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
Maximum Average Conducted Power (dBm)	24.4	25.6	27.8	25.2	22.4
Maximum EIRP Power (dBm)	29.0	30.2	32.4	29.8	27.0
Measurement uncertainty (dB)	<±0.80				

- **SISO 802.11 n20:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
Maximum Average Conducted Power (dBm)	22.9	24.9	28.0	24.6	19.5
Maximum EIRP Power (dBm)	27.5	29.5	32.6	29.2	24.1
Measurement uncertainty (dB)	<±0.80				

- **SISO 802.11 he20:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
Maximum Average Conducted Power (dBm)	22.9	24.6	27.7	24.4	20.3
Maximum EIRP Power (dBm)	27.5	29.2	32.3	29.0	24.9
Measurement uncertainty (dB)	<±0.80				

- **SISO 802.11 n40:**

	Low Channel (3) 2422MHz	Channel (4) 2427MHz	Middle Channel (6) 2437MHz	Channel (8) 2447MHz	High Channel (9) 2452MHz
Maximum Average Conducted Power (dBm)	22.6	22.5	24.3	19.4	16.4
Maximum EIRP Power (dBm)	27.2	27.1	28.9	24.0	21.0
Measurement uncertainty (dB)	<±0.80				

- **SISO 802.11 he40:**

	Low Channel (3) 2422MHz	Channel (4) 2427MHz	Middle Channel (6) 2437MHz	Channel (8) 2447MHz	High Channel (9) 2452MHz
Maximum Average Conducted Power (dBm)	21.9	22.0	23.7	17.9	15.9
Maximum EIRP Power (dBm)	26.5	26.6	28.3	22.5	20.5
Measurement uncertainty (dB)	<±0.80				

Verdict: PASS

MIMO worst case:

- **MIMO 802.11 b:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
Maximum Average Conducted Power (dBm)	27.9	27.7	28.0	27.2	27.2
Maximum EIRP Power (dBm)	35.12	34.92	35.22	34.42	34.42
Measurement uncertainty (dB)	<±0.80				

- **MIMO 802.11 g:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
Maximum Average Conducted Power (dBm)	26.5	27.4	28.5	27.0	24.9
Maximum EIRP Power (dBm)	33.72	34.62	35.72	34.22	32.12
Measurement uncertainty (dB)	<±0.80				

- **MIMO 802.11 n20:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
Maximum Average Conducted Power (dBm)	26.3	27.2	28.3	26.8	20.7
Maximum EIRP Power (dBm)	33.52	34.42	35.52	34.02	27.92
Measurement uncertainty (dB)	<±0.80				

- **MIMO 802.11 he20:**

	Low Channel (1) 2412MHz	Channel (2) 2417MHz	Middle Channel (6) 2437MHz	Channel (10) 2457MHz	High Channel (11) 2462MHz
Maximum Average Conducted Power (dBm)	24.4	25.6	27.8	25.2	22.4
Maximum EIRP Power (dBm)	31.62	32.82	35.02	32.42	29.62
Measurement uncertainty (dB)	<±0.80				

- **MIMO 802.11 n40:**

	Low Channel (3) 2422MHz	Channel (4) 2427MHz	Middle Channel (6) 2437MHz	Channel (8) 2447MHz	High Channel (9) 2452MHz
Maximum Average Conducted Power (dBm)	24.4	25.3	26.1	22.5	20.6
Maximum EIRP Power (dBm)	31.62	32.52	33.32	29.72	27.82
Measurement uncertainty (dB)	<±0.80				

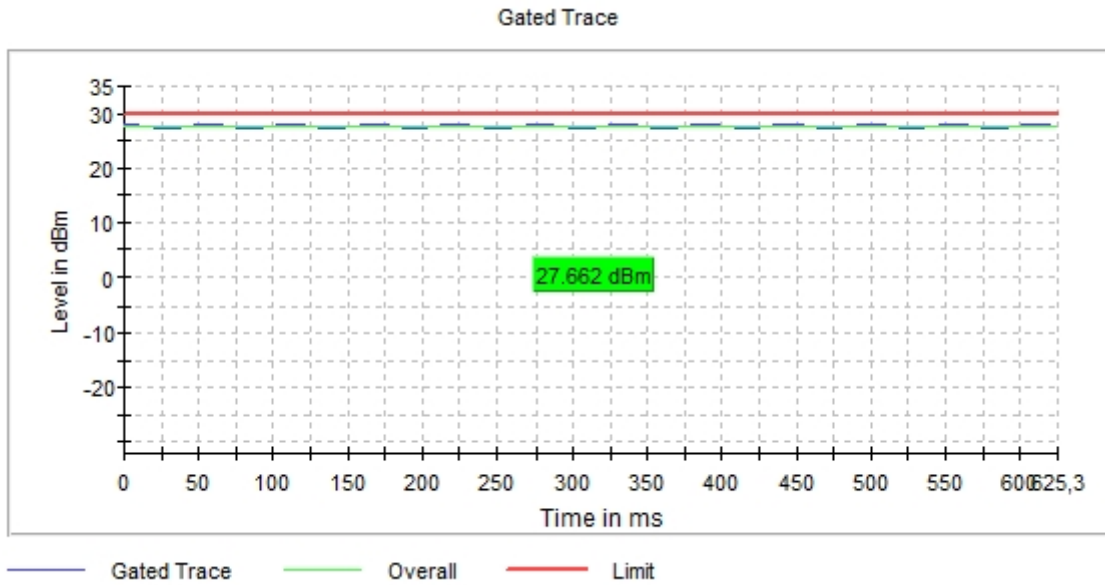
- **MIMO 802.11 he40:**

	Low Channel (3) 2422MHz	Channel (4) 2427MHz	Middle Channel (6) 2437MHz	Channel (8) 2447MHz	High Channel (9) 2452MHz
Maximum Average Conducted Power (dBm)	23.7	24.1	23.6	21.0	18.0
Maximum EIRP Power (dBm)	30.92	31.32	30.82	28.22	25.22
Measurement uncertainty (dB)	<±0.80				

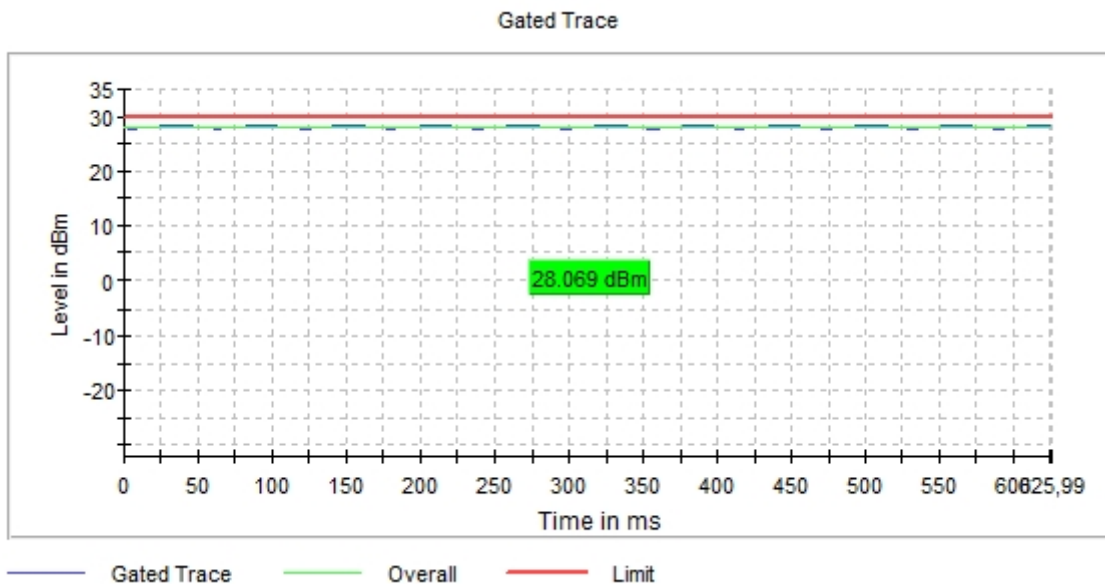
Verdict: PASS

SISO worst case:

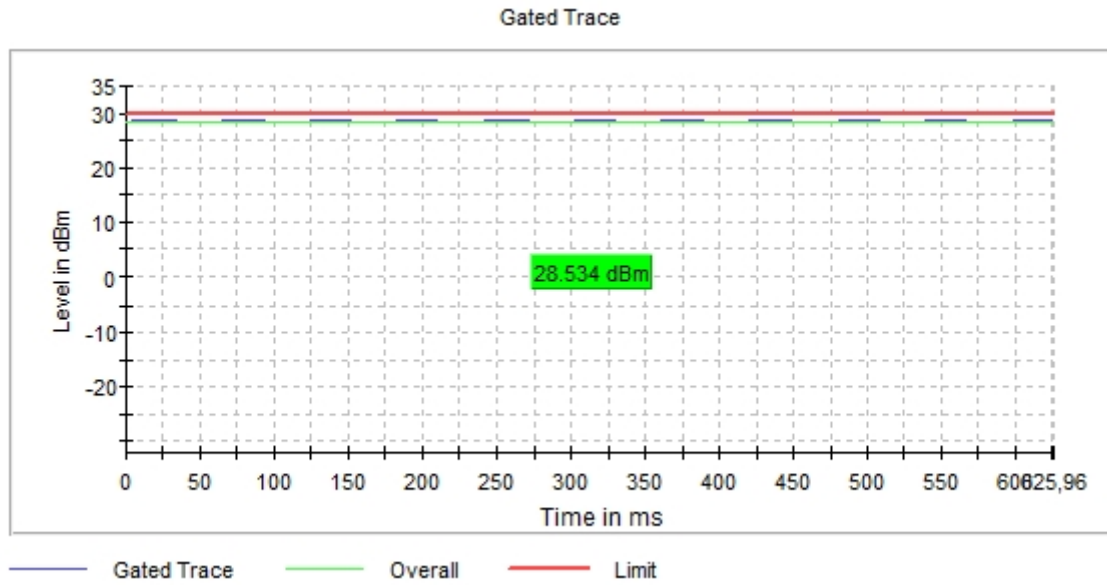
- **SISO 802.11 b – RF Output Power:**
 - Low Channel (1):



- Channel (2):



- Middle Channel (6):



- Channel (10):

