FCC REPORT
(UNII)

Applicant:	8Devices
Address of Applicant:	Gedimino 47, Kaunas, LT-44242, Lithuania

Equipment Under Test (EUT)

Product Name:	Habanero
Model No.:	Habanero
FCC ID:	Z9W-HAB
Applicable standards:	FCC CFR Title 47 Part 15 Subpart E Section 15.407
Date of sample receipt:	21 Apr., 2020
Date of Test:	22 Apr., to 29 Jun., 2020
Date of report issued:	01 Jul., 2020
Test Result:	PASS*

* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:

Bruce Zhang
Laboratory Manager

2 Version

Version No.	Date	Description
00	*01 Jul., 2020*	*Original*

Tested by: Mike.ou ***Date:*** *01 Jul., 2020*

Test Engineer

Reviewed by: Winner Zhang ***Date:*** *01 Jul., 2020*

Project Engineer

3 Contents

Page

4 Test Summary

Test Item	Section in CFR 47	Test Result
Antenna requirement	15.203 & 15.407 (a)	Pass
AC Power Line Conducted Emission	15.207	Pass
Conducted Peak Output Power	15.407 (a) (1) (iv) & (a) (3)	Pass
26dB Occupied Bandwidth	15.407 (a) (5)	Pass
6dB Emission Bandwidth	15.407(e)	Pass
Power Spectral Density	15.407 (a) (1) (iv) & (a) (3)	Pass
Band Edge	15.407(b)	Pass
Spurious Emission	15.407 (b) & 15.205 & 15.209	Pass
Frequency Stability	15.407(g)	Pass

Remark:

1. *Pass: The EUT complies with the essential requirements in the standard.*
2. *N/A: Not Applicable.*
3. *The cable insertion loss used by "RF Output Power" and other conduction measurement items is 0.5dB (provided by the customer).*

Test Method:	*ANSI C63.4-2014* *ANSI C63.10-2013* *KDB 789033 D02 General UNII Test Procedures New Rules v02r01*

5 General Information

5.1 Client Information

Applicant:	8Devices
Address:	Gedimino 47, Kaunas, LT-44242, Lithuania
Manufacturer/ Factory:	8Devices
Address:	Gedimino 47, Kaunas, LT-44242, Lithuania

5.2 General Description of E.U.T.

Product Name:	Habanero
Model No.:	Habanero
Operation Frequency:	Band 1: 5150MHz-5250MHz, Band 4: 5725MHz-5825MHz
HVIN:	HAB1003, HAB1004
Channel numbers:	Band 1: 802.11a/802.11n/ac20: 4, 802.11n/ac40: 2, 802.11ac80: 1 Band 4: 802.11a/802.11n/ac20: 5, 802.11n/ac40: 2, 802.11ac80: 1
Channel separation:	802.11a/802.11n/ac20: 20MHz, 802.11n/ac40: 40MHz, 802.11ac: 80MHz
Modulation technology (IEEE 802.11a):	BPSK, QPSK, 16-QAM, 64-QAM
Modulation technology (IEEE 802.11n):	BPSK, QPSK, 16-QAM, 64-QAM
Modulation technology (IEEE 802.11ac):	BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM
Data speed (IEEE 802.11a):	6Mbps, 9Mbps,12Mbps,18Mbps, 24Mbps, 36Mbps, 48Mbps, 54Mbps
Data speed (IEEE 802.11n20):	MCS0: 6.5Mbps, MCS1:13Mbps,MCS2:19.5Mbps, MCS3:26Mbps, MCS4:39Mbps, MCS5:52Mbps, MCS6:58.5Mbps, MCS7:65Mbps
Data speed (IEEE 802.11n40):	MCS0:15Mbps, MCS1:30Mbps, MCS2:45Mbps, MCS3:60Mbps, MCS4:90Mbps, MCS5:120Mbps, MCS6:135Mbps, MCS7:150Mbps
Data speed (IEEE 802.11ac):	Up to 433.3Mbps
Antenna Type:	Ceramic Antenna Whip Antenne Planare WLAN Antenne
Antenna gain:	Ceramic Antenna: Band 1 and Band 4: 4.32dBi Whip Antennel: Band 1: 4.5dBi Band 4: 5.0dBi Planare WLAN Antenne: Band 1: -3.6dBi Band 4: -5.5dBi
Power supply:	DC 3.3V
Remark:	Model No.: Habanero has two hardware version v03(HVIN:HAB1003) and v04(HVIN:HAB1004): v03 and v04 were identical inside, the electrical circuit design, layout, components used and internal wiring, with only difference being model version v03 and v04 and location of two capacitors C739, C740 which are on SFP interface datalines . v03 and v04 have Habanero -C, Habanero -I versions, with only difference being temperature grade of the components used, Habanero -C uses commercial temperature graded components and Habanero -I uses industrial temperature graded components(-I and -C, just different components which are graded for higher temperatures these are basically the same components but went with more robust testing and though industrial temperature grad) The hardware version v03(HVIN:HAB1003) was tested

Test Sample Condition:	The test samples were provided in good working order with no visible defects.

Operation Frequency each of channel					
Band 1					
802.11a/802.11n/ac-HT20		802.11n/ac-HT40		802.11ac-HT80	
Channel	Frequency	Channel	Frequency	Channel	Frequency
36	5180MHz	38	5190MHz	42	5210MHz
40	5200MHz	46	5230MHz		
44	5220MHz				
48	5240MHz				
Band 4					
802.11a/802.11n/ac-HT20		802.11n/ac-HT40		802.11ac-HT80	
Channel	Frequency	Channel	Frequency	Channel	Frequency
149	5745MHz	151	5755MHz	155	5775MHz
153	5765MHz	159	5795MHz		
157	5785MHz				
161	5805MHz				
165	5825MHz				

Note:
In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Band 1					
802.11a/802.11n/ac-HT20		802.11n/ac-HT40		802.11ac-HT80	
Channel	Frequency	Channel	Frequency	Channel	Frequency
Lowest	5180MHz	Lowest	5190MHz	Middle	5210MHz
Middle	5200MHz	Highest	5230MHz		
Highest	5240MHz				
Band 4					
802.11a/802.11n/ac-HT20		802.11n/ac-HT40		802.11ac-HT80	
Channel	Frequency	Channel	Frequency	Channel	Frequency
Lowest	5745MHz	Lowest	5755MHz	Middle	5775MHz
Middle	5785MHz	Highest	5795MHz		
Highest	5825MHz				

5.3 Test environment and test mode

Operating Environment:	
Temperature:	24.0 °C
Humidity:	54 % RH
Atmospheric Pressure:	1010 mbar
Test mode:	
Continuously transmitting mode	Keep the EUT in 100% duty cycle transmitting with modulation.
We have verified the construction and function in typical operation. All the test modes were carried out with the EUT in transmitting operation, which was shown in this test report and defined as follows:	
Per-scan all kind of data rate, and found the follow list were the worst case.	
Mode	Data rate
802.11a	6 Mbps
802.11n/ac20	6.5 Mbps
802.11n/ac40	13.5 Mbps
802.11ac80	29.3 Mbps

5.4 Description of Support Units

Manufacturer	Description	Model	Serial Number	FCC ID/DoC
LENOVO	Laptop	SL510	2847A65	DoC
Apple	Mobile phone	iPhone 11 Pro	MWDE2CH/A	Doc
Vonhk	AC ADAPTOR	KSAFE0900270W2US	/	/

5.5 Measurement Uncertainty

Parameters	Expanded Uncertainty
Conducted Emission (9kHz ~ 30MHz)	±1.60 dB (k=2)
Radiated Emission (9kHz ~ 30MHz)	±3.12 dB (k=2)
Radiated Emission (30MHz ~ 1000MHz)	±4.32 dB (k=2)
Radiated Emission (1GHz ~ 18GHz)	±5.16 dB (k=2)
Radiated Emission (18GHz ~ 40GHz)	±3.20 dB (k=2)

5.6 Additions to, deviations, or exclusions from the method

No

5.7 Related Submittal(s) / Grant (s)

This is an original grant, no related submittals and grants.

5.8 Laboratory Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **FCC - Designation No.: CN1211**

Shenzhen Zhongjian Nanfang Testing Co., Ltd. has been accredited as a testing laboratory by FCC(Federal Communications Commission). The test firm Registration No. is 727551.

- **ISED – CAB identifier.: CN0021**

The 3m Semi-anechoic chamber of Shenzhen Zhongjian Nanfang Testing Co., Ltd. has been Registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 10106A-1.

- **A2LA - Registration No.: 4346.01**

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories. The test scope can be found as below link: https://portal.a2la.org/scopepdf/4346-01.pdf

5.9 Laboratory Location

Shenzhen Zhongjian Nanfang Testing Co., Ltd.
Address: No.110~116, Building B, Jinyuan Business Building, Xixiang Road,
Bao'an District, Shenzhen, Guangdong, China
Tel: +86-755-23118282, Fax: +86-755-23116366
Email: info@ccis-cb.com, Website: http://www.ccis-cb.com

5.10 Test Instruments list

Test Equipment	Manufacturer	Model No.	Serial No.	Cal. Date (mm-dd-yy)	Cal. Due date (mm-dd-yy)
3m SAC	SAEMC	9m*6m*6m	966	07-22-2017	07-21-2020
BiConiLog Antenna	SCHWARZBECK	VULB9163	497	03-07-2020	03-06-2021
Biconical Antenna	SCHWARZBECK	VUBA9117	359	06-22-2017	06-21-2020
				06-22-2020	06-21-2021
Horn Antenna	SCHWARZBECK	BBHA9120D	916	03-07-2020	03-06-2021
Horn Antenna	SCHWARZBECK	BBHA9120D	1805	06-22-2017	06-21-2020
				06-22-2020	06-21-2021
Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170582	11-18-2019	11-17-2020
EMI Test Software	AUDIX	E3	Version: 6.110919b		
Pre-amplifier	HP	8447D	2944A09358	03-07-2020	03-06-2021
Pre-amplifier	CD	PAP-1G18	11804	03-07-2020	03-06-2021
Spectrum analyzer	Rohde & Schwarz	FSP30	101454	03-05-2020	03-04-2021
Spectrum analyzer	Rohde & Schwarz	FSP40	100363	11-18-2019	11-17-2020
EMI Test Receiver	Rohde & Schwarz	ESRP7	101070	03-05-2020	03-04-2021
Spectrum Analyzer	Agilent	N9020A	MY50510123	11-18-2019	11-17-2020
Signal Generator	Rohde & Schwarz	SMX	835454/016	03-05-2020	03-04-2021
Signal Generator	R&S	SMR20	1008100050	03-05-2020	03-04-2021
RF Switch Unit	MWRFTEST	MW200	N/A	N/A	N/A
Test Software	MWRFTEST	MTS8200	Version: 2.0.0.0		
Cable	ZDECL	Z108-NJ-NJ-81	1608458	03-07-2020	03-06-2021
Cable	MICRO-COAX	MFR64639	K10742-5	03-07-2020	03-06-2021
Cable	SUHNER	SUCOFLEX100	58193/4PE	03-07-2020	03-06-2021
DC Power Supply	XinNuoEr	WYK-10020K	1409050110020	09-25-2019	09-24-2020
Temperature Humidity Chamber	HengPu	HPGDS-500	20140828008	11-01-2019	10-31-2020
Simulated Station	Rohde & Schwarz	CMW500	140493	07-22-2019	07-21-2020

Conducted Emission:					
Test Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Cal. Date (mm-dd-yy)**	**Cal. Due date (mm-dd-yy)**
EMI Test Receiver	Rohde & Schwarz	ESCI	101189	03-05-2020	03-04-2021
Pulse Limiter	SCHWARZBECK	OSRAM 2306	9731	03-05-2020	03-04-2021
LISN	CHASE	MN2050D	1447	03-05-2020	03-04-2021
LISN	Rohde & Schwarz	ESH3-Z5	8438621/010	07-21-2017	07-20-2020
Cable	HP	10503A	N/A	03-05-2020	03-04-2021
EMI Test Software	AUDIX	E3	Version: 6.110919b		

6 Test results and Measurement Data

6.1 Antenna requirement

Standard requirement:	FCC Part15 E Section 15.203 /407(a)

15.203 requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

This requirement does not apply to carrier current devices or to devices operated under the provisions of §15.211, § 15.213, § 15.217, § 15.219, or § 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

E.U.T Antenna:	

The product is a professionally installed device which has three types of antennas for the application. The antennas information as below table:

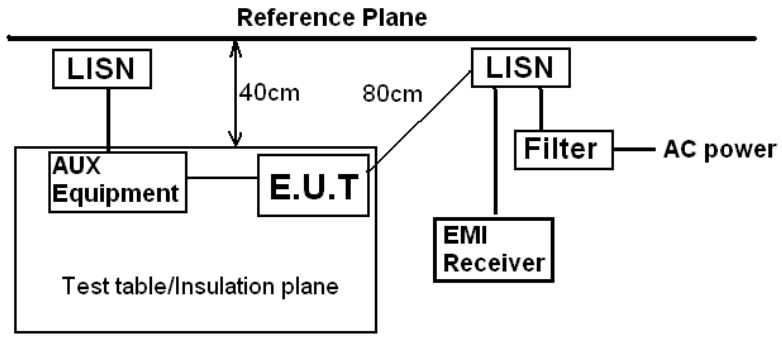
Antenna Type	Antenna Gain(dBi)	
	Band 1	Band 4
Chip Antenna	4.32	4.32
Whip Antenne	4.50	5.00
Planare WLAN Antenne	-3.60	-5.50

Ceramic Antenna

Planare WLAN Antenne

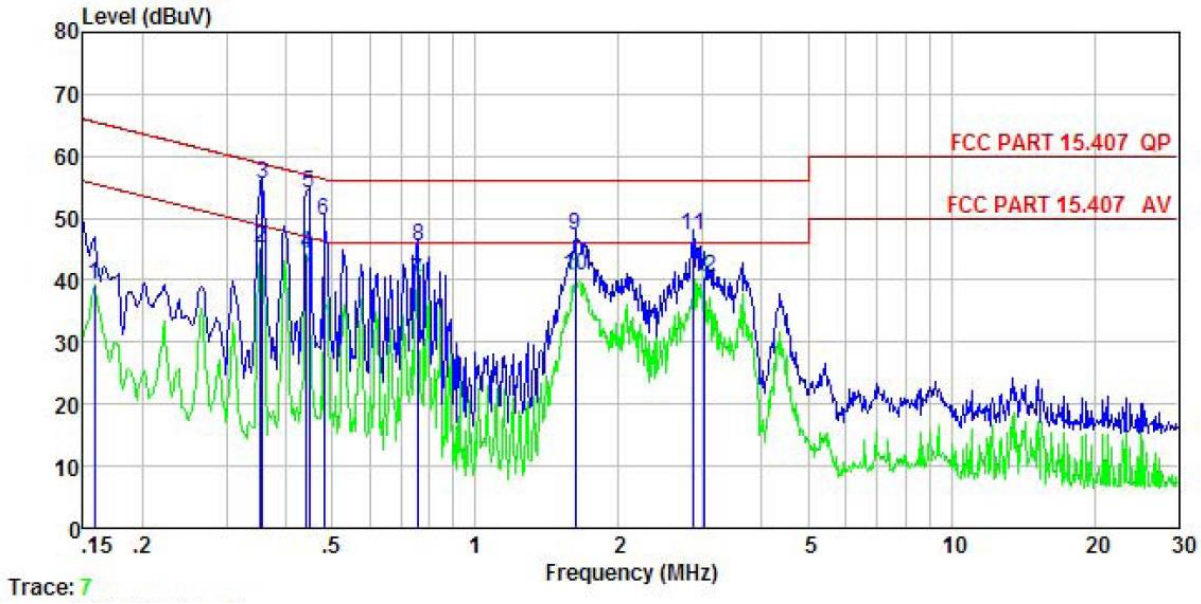
Whip Antenna

6.2 Conducted Emission

Test Requirement:	FCC Part15 C Section 15.207		
Test Frequency Range:	150kHz to 30MHz		
Class / Severity:	Class B		
Receiver setup:	RBW=9kHz, VBW=30kHz		
Limit:	Frequency range (MHz)	Limit (dBuV)	
		Quasi-peak	
	0.15-0.5	66 to 56*	0.15-0.5
	0.5-5	56	0.5-5
	5-30	60	5-30
	* Decreases with the logarithm of the frequency.		
Test procedure	1. The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). It provides a 50ohm/50uH coupling impedance for the measuring equipment. 2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). 3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10(latest version) on conducted measurement.		
Test setup:	 *Remark:* *E.U.T: Equipment Under Test* *LISN: Line Impedence Stabilization Network* *Test table height=0.8m*		
Test Instruments:	Refer to section 5.10 for details		
Test mode:	Refer to section 5.3 for details.		
Test results:	Passed		

Measurement Data:

Product name:	Habanero	Product model:	Habanero
Test by:	Mike	Test mode:	5G Wi-Fi Tx mode
Test frequency:	150 kHz ~ 30 MHz	Phase:	Line
Test voltage:	AC 120 V/60 Hz	Environment:	Temp: 22.5℃ Huni: 55%

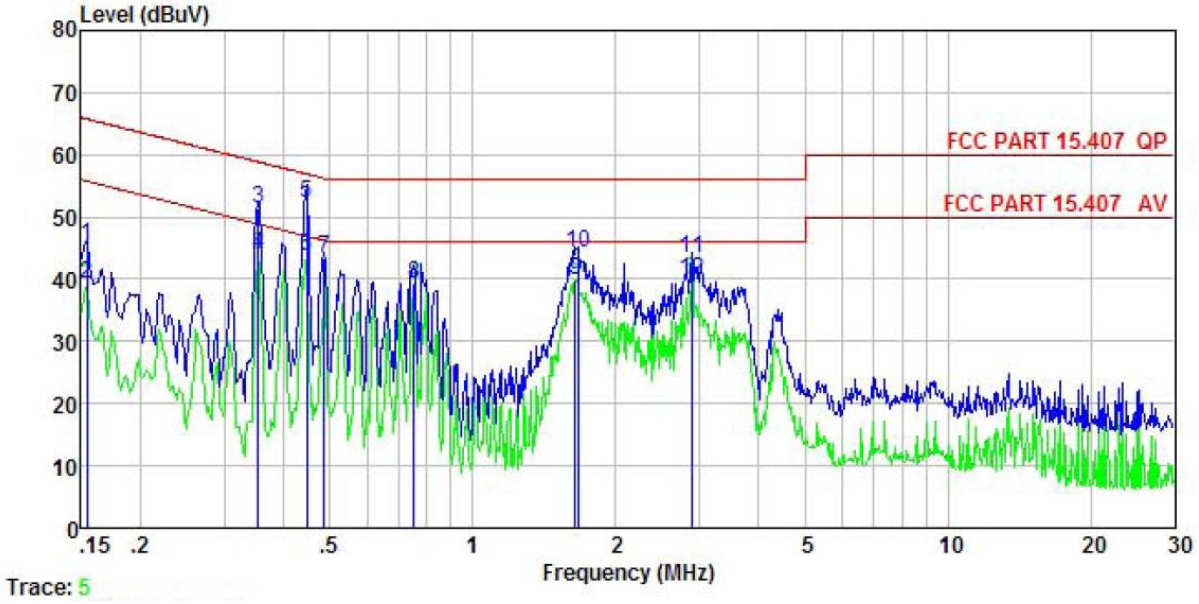


	Freq	Read Level	LISN Factor	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dB	dBuV	dBuV	dB	
1	0.158	28.97	-0.57	10.77	39.17	55.56	-16.39	Average
2	0.354	35.03	-0.51	10.73	45.25	48.87	-3.62	Average
3	0.358	45.35	-0.51	10.73	55.57	58.78	-3.21	QP
4	0.442	34.13	-0.46	10.74	44.41	47.02	-2.61	Average
5	0.447	43.61	-0.46	10.74	53.89	56.93	-3.04	QP
6	0.481	39.22	-0.44	10.75	49.53	56.32	-6.79	QP
7	0.755	29.53	-0.55	10.79	39.77	46.00	-6.23	Average
8	0.759	35.10	-0.55	10.80	45.35	56.00	-10.65	QP
9	1.619	36.70	-0.54	10.93	47.09	56.00	-8.91	QP
10	1.619	30.43	-0.54	10.93	40.82	46.00	-5.18	Average
11	2.869	36.65	-0.44	10.92	47.13	56.00	-8.87	QP
12	3.025	29.81	-0.43	10.92	40.30	46.00	-5.70	Average

Notes:

1. *An initial pre-scan was performed on the line and neutral lines with peak detector.*
2. *Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.*
3. *Final Level =Receiver Read level + LISN Factor + Aux Factor + Cable Loss.*

Product name:	Habanero	Product model:	Habanero
Test by:	Mike	Test mode:	5G Wi-Fi Tx mode
Test frequency:	150 kHz ~ 30 MHz	Phase:	Neutral
Test voltage:	AC 120 V/60 Hz	Environment:	Temp: 22.5℃ Huni: 55%

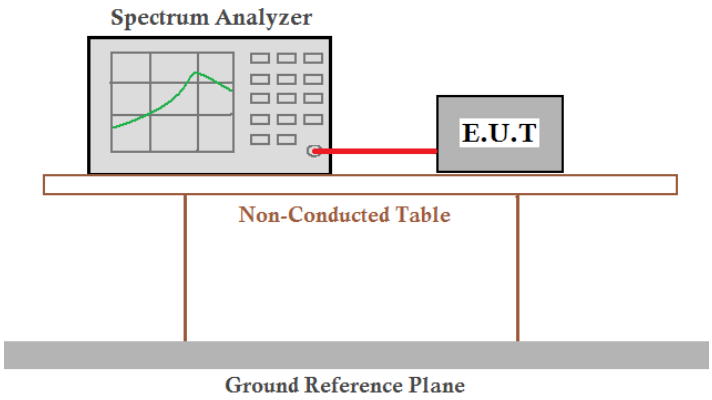


	Freq	Read Level	LISN Factor	Cable Loss	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dB	dBuV	dBuV	dB	
1	0.154	35.43	-0.69	10.78	45.52	65.78	-20.26	QP
2	0.154	29.11	-0.69	10.78	39.20	55.78	-16.58	Average
3	0.354	41.40	-0.65	10.73	51.48	58.87	-7.39	QP
4	0.354	33.90	-0.65	10.73	43.98	48.87	-4.89	Average
5	0.447	42.14	-0.64	10.74	52.24	56.93	-4.69	QP
6	0.447	33.64	-0.64	10.74	43.74	46.93	-3.19	Average
7	0.486	33.19	-0.65	10.76	43.30	56.23	-12.93	QP
8	0.751	29.27	-0.65	10.79	39.41	46.00	-6.59	Average
9	1.645	29.59	-0.70	10.93	39.82	46.00	-6.18	Average
10	1.662	34.03	-0.70	10.94	44.27	56.00	-11.73	QP
11	2.884	33.06	-0.66	10.92	43.32	56.00	-12.68	QP
12	2.884	29.62	-0.66	10.92	39.88	46.00	-6.12	Average

Notes:

1. *An initial pre-scan was performed on the line and neutral lines with peak detector.*
2. *Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.*
3. *Final Level =Receiver Read level + LISN Factor + Aux Factor + Cable Loss.*

6.3 Conducted Output Power

Test Requirement:	FCC Part15 E Section 15.407 (a) (1) (iv) & (a) (3)
Limit:	Band 1: 24dBm Band 4: 30dBm
Test setup:	
Test Instruments:	Refer to section 5.10 for details
Test mode:	Refer to section 5.3 for details
Test results:	Passed

Measurement Data:

Band 1						
Mode	Test CH	Ant. Port	Conducted Output power(dBm)	Total power (dBm)	Limit (dBm)	Result
802.11a	Lowest	ANT0	18.97	/	24.00	Pass
		ANT1	19.51			
	Middle	ANT0	18.92			
		ANT1	19.45			
	Highest	ANT0	18.55			
		ANT1	19.07			
802.11n20	Lowest	ANT0	17.50	20.52	*Ceramic Antenna:22.68 Planare WLAN Antenne24.00 Whip Antenna:22.50*	Pass
		ANT1	17.52			
	Middle	ANT0	17.44	20.51		
		ANT1	17.56			
	Highest	ANT0	17.31	20.49		
		ANT1	17.65			
802.11n40	Lowest	ANT0	15.66	18.96	*Ceramic Antenna:24 Planare WLAN Antenne24.00 Whip Antenna:23.0*	Pass
		ANT1	16.23			
	Highest	ANT0	17.78	21.03		
		ANT1	18.24			
802.11ac20	Lowest	ANT0	17.49	20.49	*Ceramic Antenna:22.68 Planare WLAN Antenne24.00 Whip Antenna:22.50*	Pass
		ANT1	17.47			
	Middle	ANT0	17.43	20.49		
		ANT1	17.53			
	Highest	ANT0	17.27	20.51		
		ANT1	17.71			
802.11ac40	Lowest	ANT0	15.65	18.97	*Ceramic Antenna:22.68 Planare WLAN Antenne22.25 Whip Antenna:22.50*	Pass
		ANT1	16.25			
	Highest	ANT0	17.75	21.00		
		ANT1	18.21			
802.11ac80	Lowest	ANT0	16.81	19.97	*Ceramic Antenna:22.68 Planare WLAN Antenne24.00 Whip Antenna:22.500*	Pass
		ANT1	17.10			

1. *Because transmit signals are correlated,* Directional gain = $G_{ANT} + 10\log(N_{ANT})$ dBi.
2. *So Ceramic Antenna: The Directional gain=4.32 + 10* $\log(2)$*=7.32dBi, The directional Gain of antenna is* greater *than 6 dBi, so the limit of power is 22.68dBm (for 802.11n/ac).*
   Planare WLAN Antenne The Directional gain=-3.6+ 10 $\log(2)$*=-0.6dBi, The directional Gain of antenna is less than 6 dBi, so the limit of power is 24 dBm (for 802.11n/ac).*
   Whip Antenna: The Directional gain=4.5 + 10 $\log(2)$*=7.5dBi, The directional Gain of antenna is* greater *than 6dBi, so the limit of power is 22.5 dBm (for 802.11n/ac).*

Band 4						
Mode	Test CH	Ant. Port	Conducted Output power(dBm)	Total power (dBm)	Limit (dBm)	Result
802.11a	Lowest	ANT0	18.91	/	30.00	Pass
		ANT1	18.89			
	Middle	ANT0	18.95			
		ANT1	18.67			
	Highest	ANT0	18.50			
		ANT1	18.34			
802.11n20	Lowest	ANT0	19.00	22.01	*Ceramic Antenna:28.68 Planare WLAN Antenne:30.0 Whip Antenna:28.0*	Pass
		ANT1	18.99			
	Middle	ANT0	19.01	21.88		
		ANT1	18.72			
	Highest	ANT0	18.60	21.51		
		ANT1	18.40			
802.11n40	Lowest	ANT0	18.35	21.32	*Ceramic Antenna:28.68 Planare WLAN Antenne28.25 Whip Antenna:28.0*	Pass
		ANT1	18.27			
	Highest	ANT0	18.28	21.16		
		ANT1	18.01			
802.11ac20	Lowest	ANT0	18.99	22.00	*Ceramic Antenna:28.68 Planare WLAN Antenne:30.0 Whip Antenna:28.0*	Pass
		ANT1	18.99			
	Middle	ANT0	19.02	21.89		
		ANT1	18.74			
	Highest	ANT0	18.59	21.52		
		ANT1	18.43			
802.11ac40	Lowest	ANT0	18.35	21.31	*Ceramic Antenna:28.68 Planare WLAN Antenne:30.0 Whip Antenna:28.0*	Pass
		ANT1	18.25			
	Highest	ANT0	18.24	21.14		
		ANT1	18.02			
802.11ac80	Lowest	ANT0	19.28	22.24	*Ceramic Antenna:28.68 Planare WLAN Antenne:30 Whip Antenna:28.0*	Pass
		ANT1	19.18			

1. *Because transmit signals are correlated,* Directional gain = $G_{ANT} + 10\log(N_{ANT})$ dBi.
2. *So Ceramic Antenna: The Directional gain=4.32 + 10* $\log(2)$*=7.32dBi, The directional Gain of antenna is greater than 6 dBi, so the limit of power is 28.68 dBm (for 802.11n/ac).*

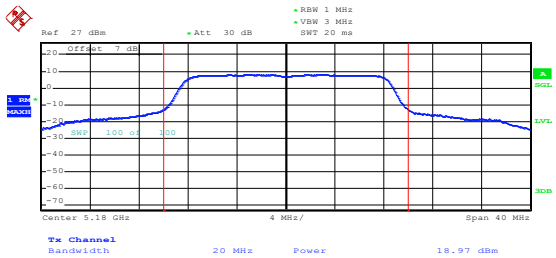
   Planare WLAN Antenne The Directional gain=-5.5+ 10 $\log(2)$*=-2.5dBi, The directional Gain of antenna is less than 6 dBi, so the limit of power is 30.0 dBm (for 802.11n/ac).*

   Whip Antenna: The Directional gain=5 + 10 $\log(2)$*=8.0dBi, The directional Gain of antenna is* greater *than 6dBi, so the limit of power is 28.0 dBm (for 802.11n/ac).*

Test plot as follows: ANT 0

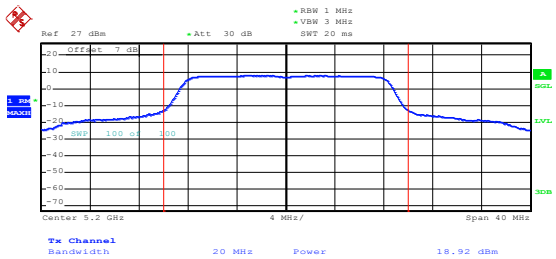
Band 1:

802.11a



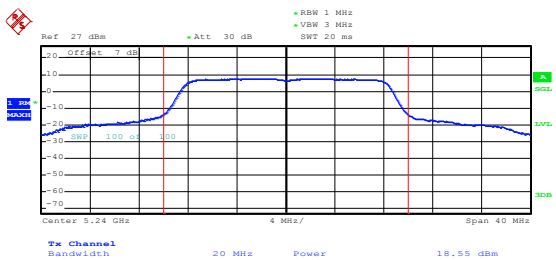
Date: 18.MAY.2020 14:28:00

Lowest channel



Date: 18.MAY.2020 14:28:26

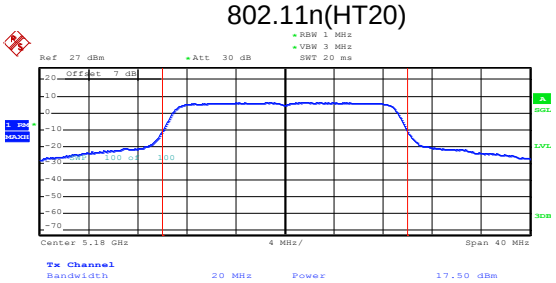
Middle channel



Date: 18.MAY.2020 14:28:46

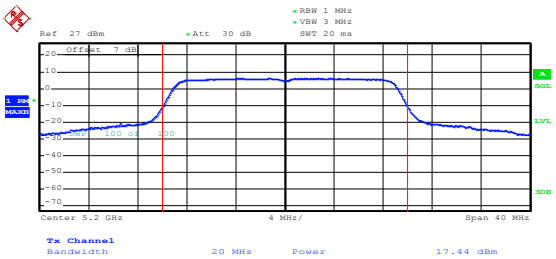
Highest channel

802.11n(HT20)



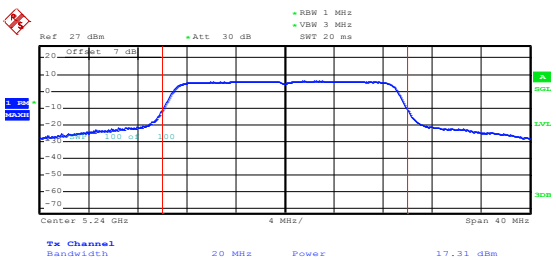
Date: 6.MAY.2020 14:36:20

Lowest channel



Date: 6.MAY.2020 14:36:50

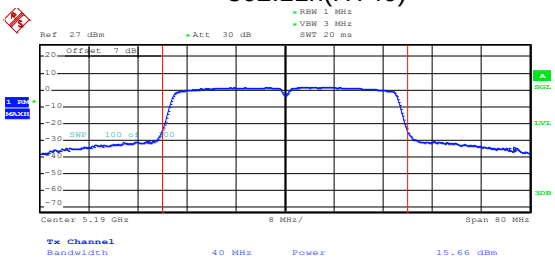
Middle channel



Date: 6.MAY.2020 14:37:37

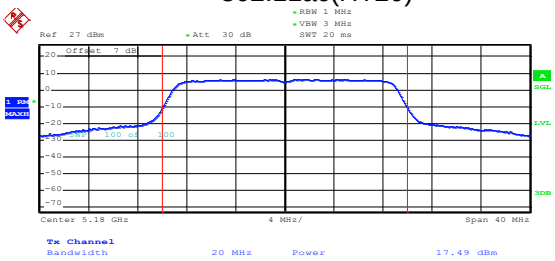
Highest channel

802.11n(HT40)



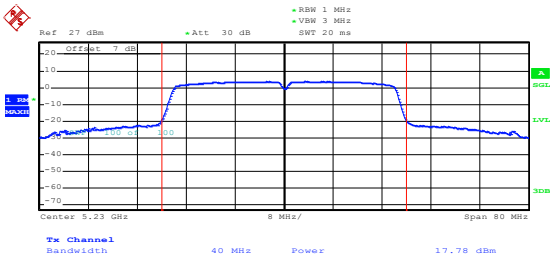
Date: 6.MAY.2020 14:32:25

802.11ac(HT20)



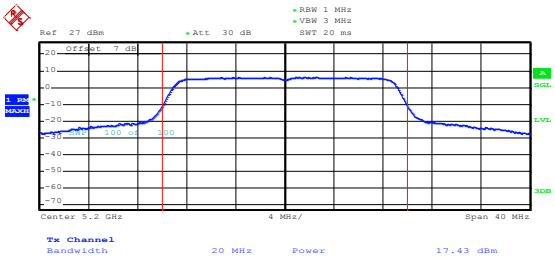
Date: 6.MAY.2020 14:39:05

Lowest channel



Date: 6.MAY.2020 10:16:19

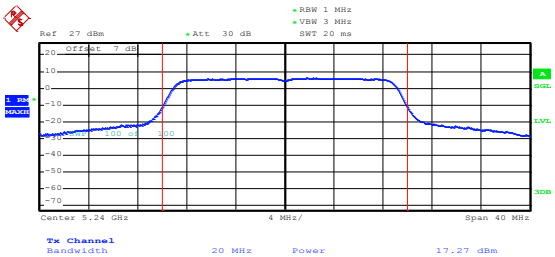
Lowest channel



Date: 6.MAY.2020 14:38:45

Highest channel

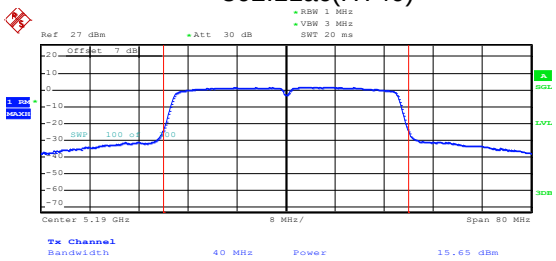
Middle channel



Date: 6.MAY.2020 14:38:19

Highest channel

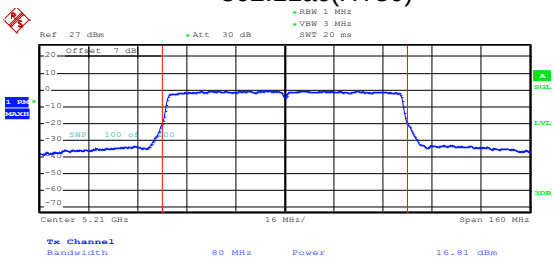
802.11ac(HT40)



Date: 6.MAY.2020 14:31:58

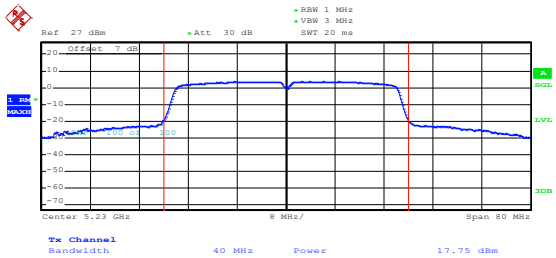
Lowest channel

802.11ac(HT80)



Date: 6.MAY.2020 14:33:28

Middle channel

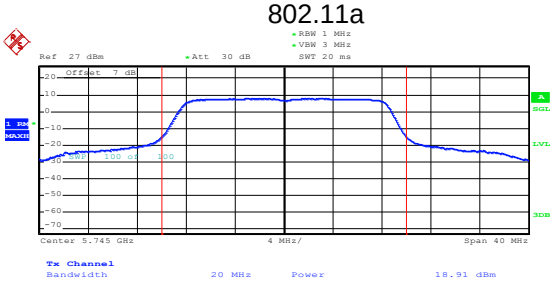


Date: 6.MAY.2020 10:16:01

Highest channel

Band 4:

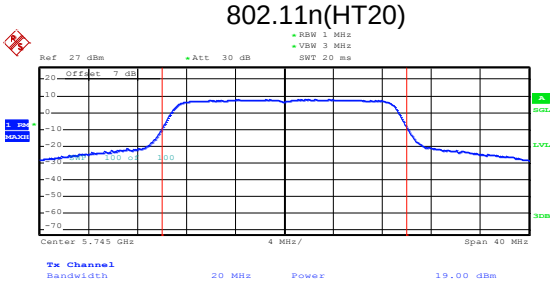
802.11a



Date: 13.APR.2020 15:30:22

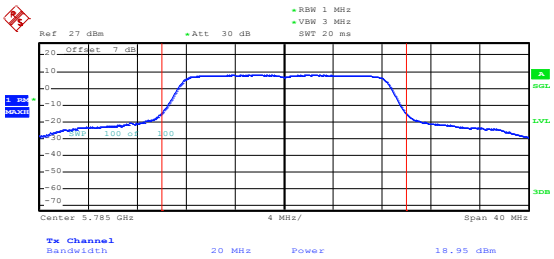
Lowest channel

802.11n(HT20)



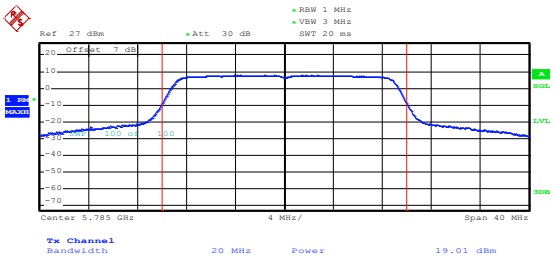
Date: 13.APR.2020 15:30:40

Lowest channel



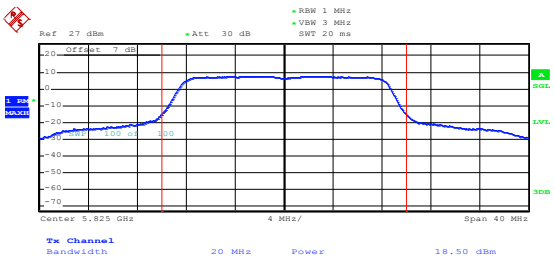
Date: 13.APR.2020 15:30:06

Middle channel



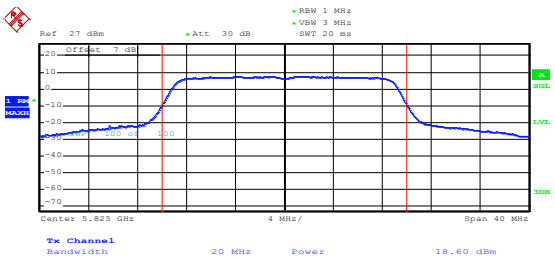
Date: 13.APR.2020 15:30:53

Middle channel



Date: 13.APR.2020 15:29:53

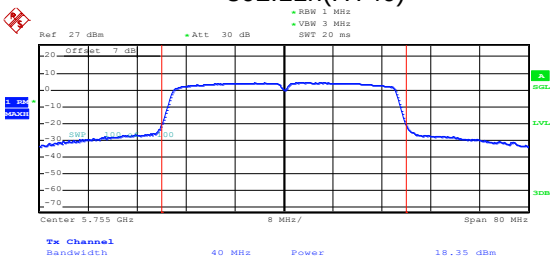
Highest channel



Date: 13.APR.2020 15:31:05

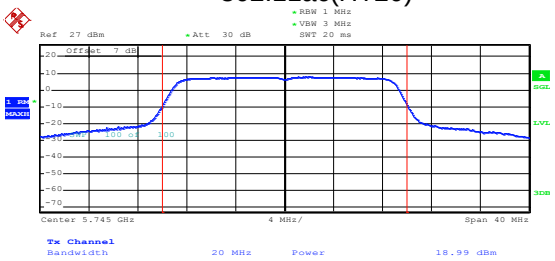
Highest channel

802.11n(HT40)



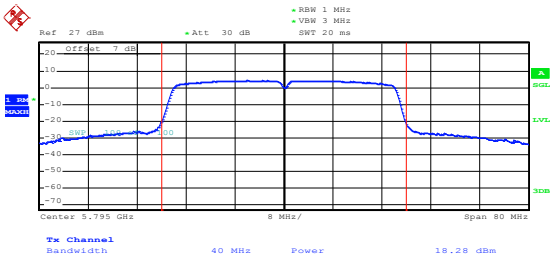
Date: 13.APR.2020 15:33:05

802.11ac(HT20)



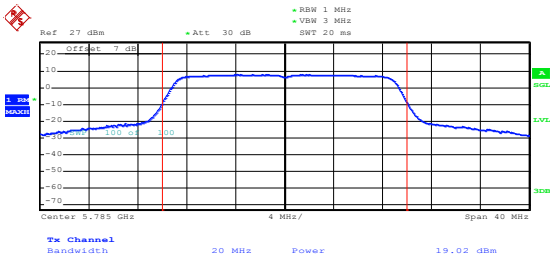
Date: 13.APR.2020 15:31:53

Lowest channel



Date: 13.APR.2020 15:32:50

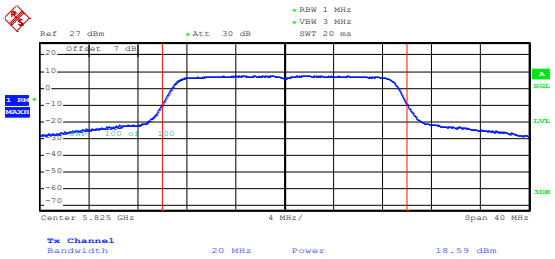
Lowest channel



Date: 13.APR.2020 15:31:38

Highest channel

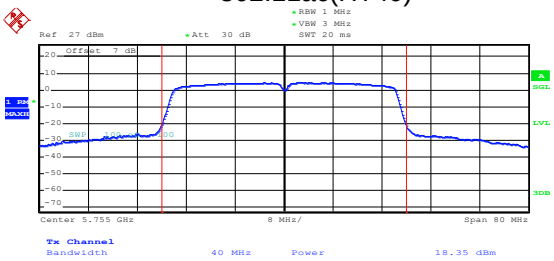
Middle channel



Date: 13.APR.2020 15:31:23

Highest channel

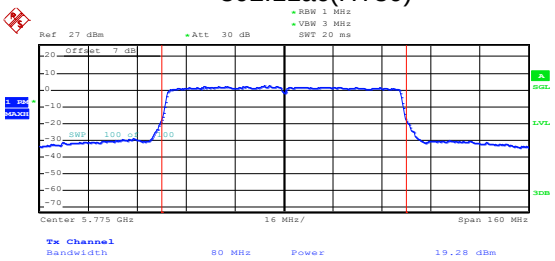
802.11ac(HT40)



Date: 13.APR.2020 15:32:18

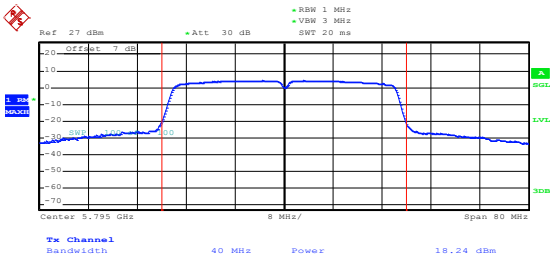
Lowest channel

802.11ac(HT80)



Date: 13.APR.2020 15:33:33

Middle channel



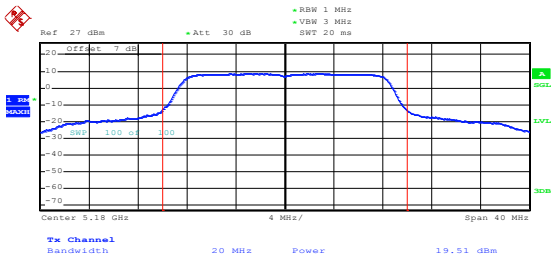
Date: 13.APR.2020 15:32:31

Highest channel

ANT 1

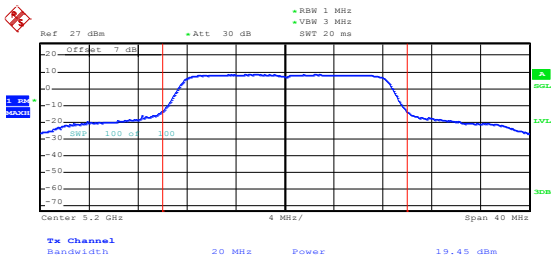
Band 1:

802.11a



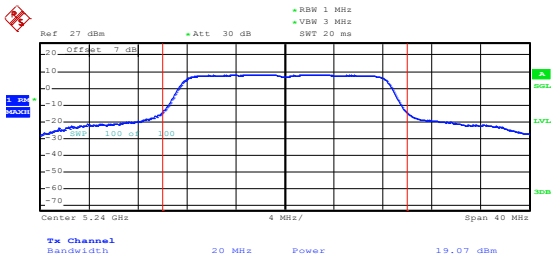
Date: 18.MAY.2020 14:23:17

Lowest channel



Date: 18.MAY.2020 14:24:00

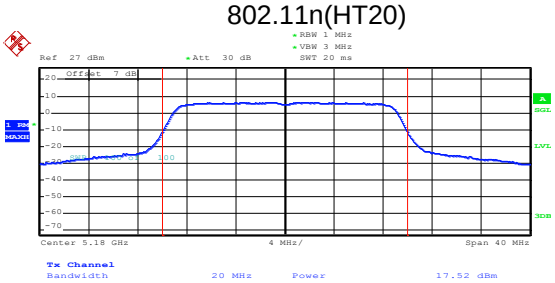
Middle channel



Date: 18.MAY.2020 14:24:21

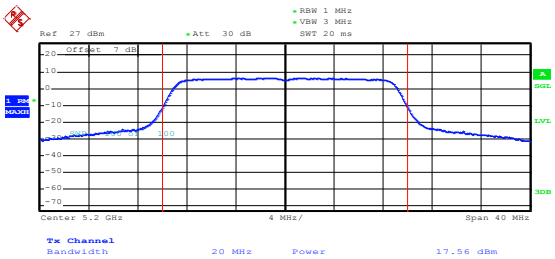
Highest channel

802.11n(HT20)



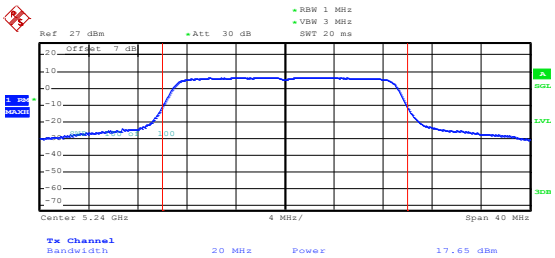
Date: 6.MAY.2020 14:45:14

Lowest channel



Date: 6.MAY.2020 14:45:32

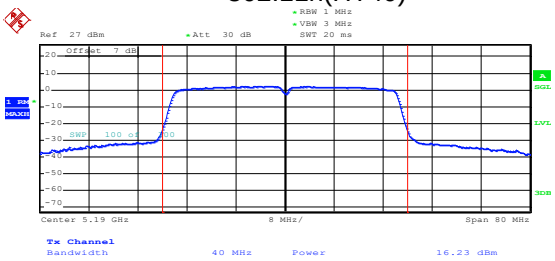
Middle channel



Date: 6.MAY.2020 14:45:59

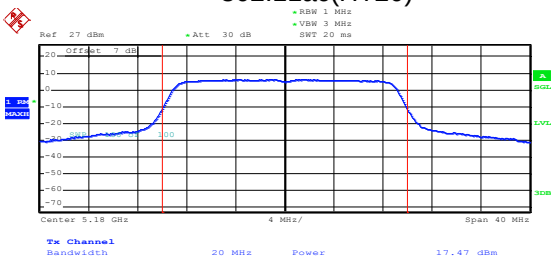
Highest channel

802.11n(HT40)



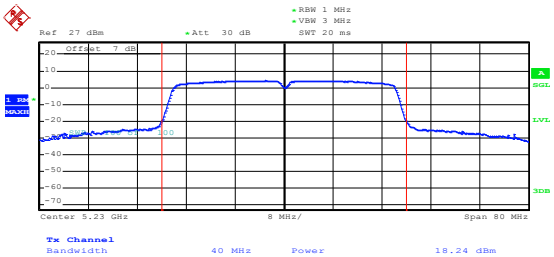
Date: 6.MAY.2020 14:48:19

802.11ac(HT20)



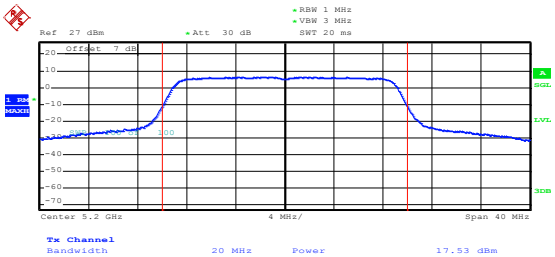
Date: 6.MAY.2020 14:47:22

Lowest channel



Date: 6.MAY.2020 10:19:23

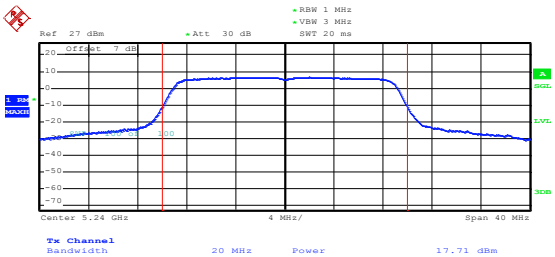
Lowest channel



Date: 6.MAY.2020 14:47:00

Highest channel

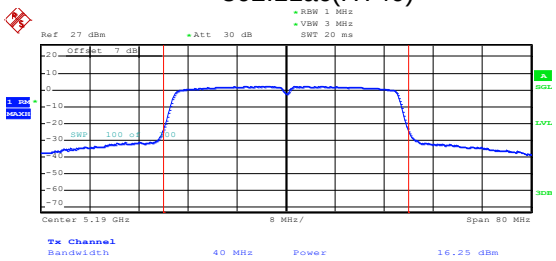
Middle channel



Date: 6.MAY.2020 14:46:34

Highest channel

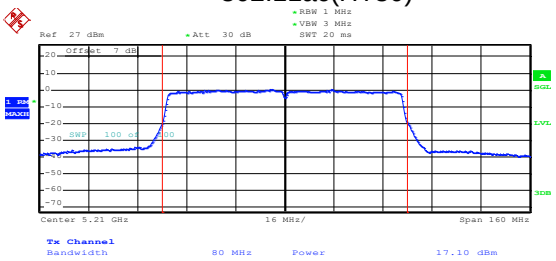
802.11ac(HT40)



Date: 6.MAY.2020 14:48:46

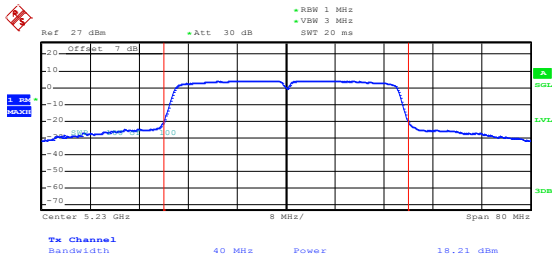
Lowest channel

802.11ac(HT80)



Date: 6.MAY.2020 14:50:33

Middle channel

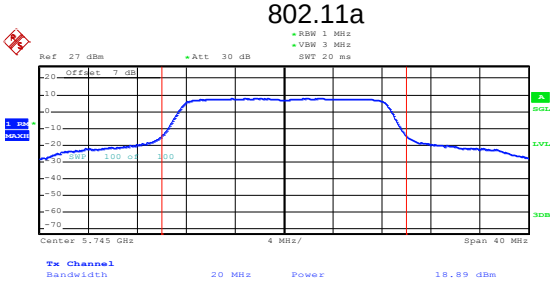


Date: 6.MAY.2020 10:19:05

Highest channel

Band 4:

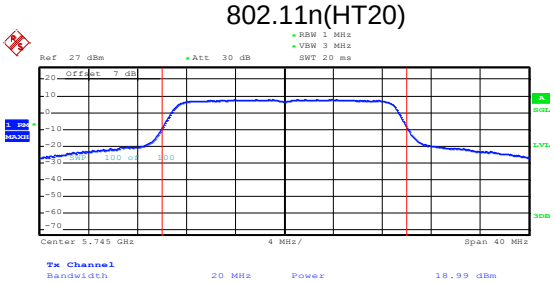
802.11a



Date: 13.APR.2020 15:29:09

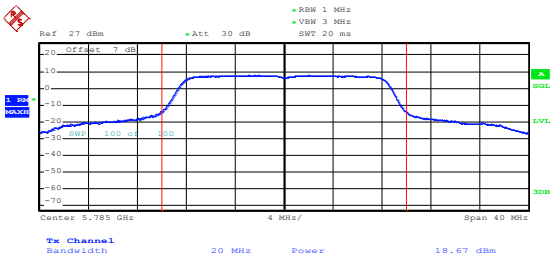
Lowest channel

802.11n(HT20)



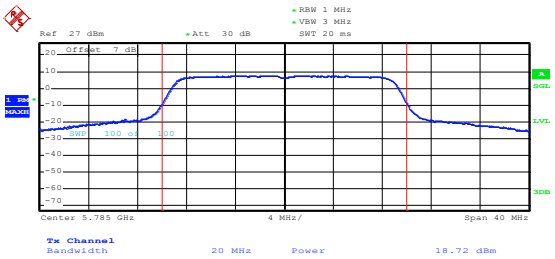
Date: 13.APR.2020 15:27:35

Lowest channel



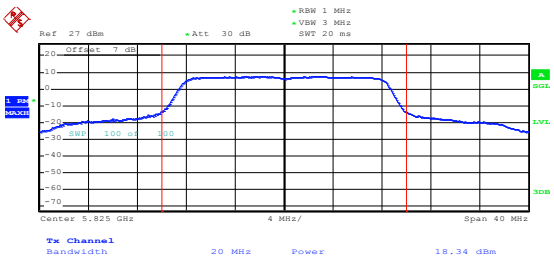
Date: 13.APR.2020 15:29:23

Middle channel



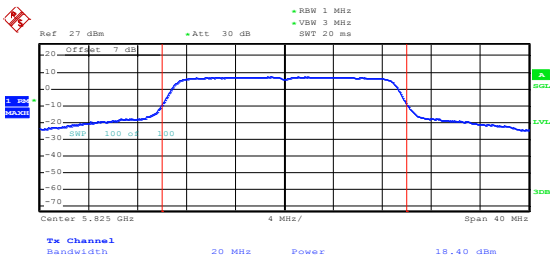
Date: 13.APR.2020 15:27:50

Middle channel



Date: 13.APR.2020 15:29:37

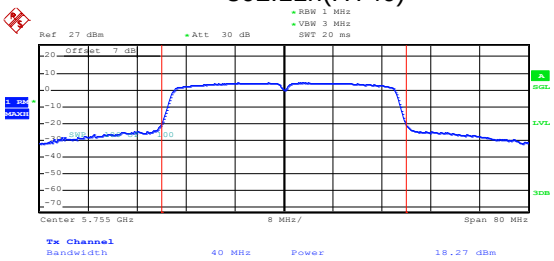
Highest channel



Date: 13.APR.2020 15:28:06

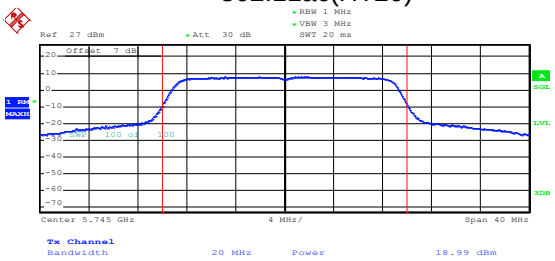
Highest channel

802.11n(HT40)



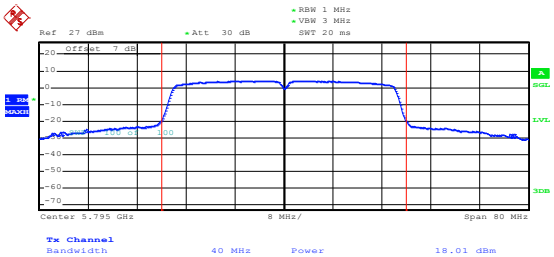
Date: 13.APR.2020 15:27:05

802.11ac(HT20)



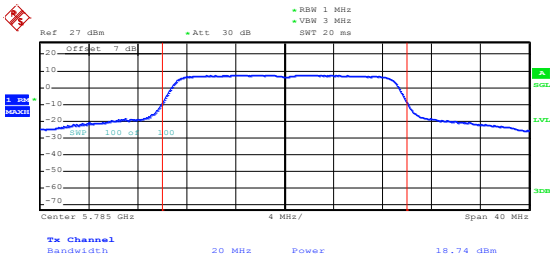
Date: 13.APR.2020 15:28:53

Lowest channel



Date: 13.APR.2020 15:26:49

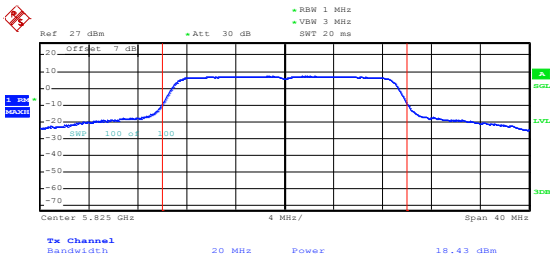
Lowest channel



Date: 13.APR.2020 15:28:40

Highest channel

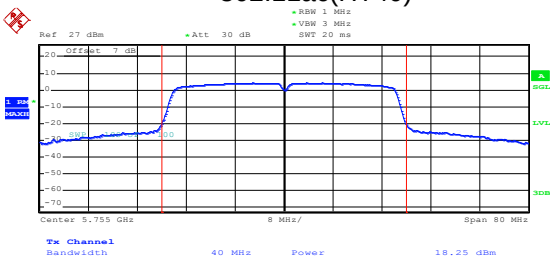
Middle channel



Date: 13.APR.2020 15:28:24

Highest channel

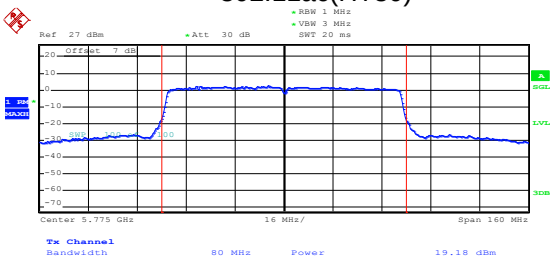
802.11ac(HT40)



Date: 13.APR.2020 15:25:59

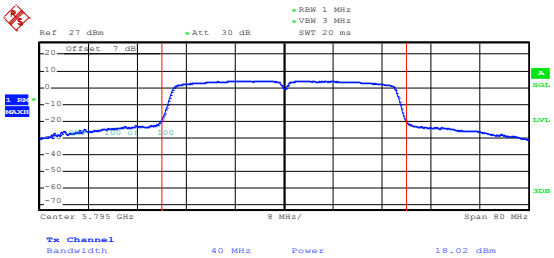
Lowest channel

802.11ac(HT80)



Date: 13.APR.2020 15:25:27

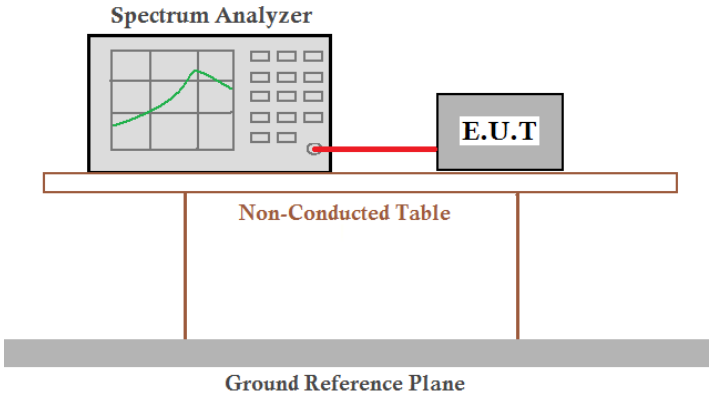
Middle channel



Date: 13.APR.2020 15:26:28

Highest channel

6.4 Occupy Bandwidth

Test Requirement:	FCC Part15 E Section 15.407 (a) (5) and Section 15.407 (e)
Limit:	Band 1/4: N/A (26dB Emission Bandwidth and 99% Occupy Bandwidth) Band 4: >500kHz (6dB Bandwidth)
Test setup:	
Test Instruments:	Refer to section 5.10 for details
Test mode:	Refer to section 5.3 for details
Test results:	Passed

Measurement Data:

ANT0

Band 1:

Test Channel	26dB Emission Bandwidth (MHz)						Limit	Result
	802.11a	802.11n (HT20)	802.11n (HT40)	802.11ac (HT20)	802.11ac (HT40)	802.11ac (HT80)		
Lowest	20.14	20.65	40.32	20.27	40.60	---	N/A	PASS
Middle	20.85	20.61	---	20.62	---	80.16		
Highest	19.25	19.95	40.24	19.88	39.98	---		
Test Channel	99% Occupy Bandwidth (MHz)						Limit	Result
	802.11a	802.11n (HT20)	802.11n (HT40)	802.11ac (HT20)	802.11ac (HT40)	802.11ac (HT80)		
Lowest	16.96	17.97	36.48	17.98	36.44	---	N/A	PASS
Middle	16.92	17.95	---	17.96	---	76.28		
Highest	16.84	17.86	36.44	17.89	36.44	---		

Band 4:

Test Channel	26dB Emission Bandwidth (MHz)						Limit	Result
	802.11a	802.11n (HT20)	802.11n (HT40)	802.11ac (HT20)	802.11ac (HT40)	802.11ac (HT80)		
Lowest	19.96	20.19	40.18	20.50	40.42	---	N/A	PASS
Middle	19.63	20.30	---	20.17	---	80.76		
Highest	20.91	20.29	40.14	20.33	40.24	---		
Test Channel	99% Occupy Bandwidth (MHz)						Limit	Result
	802.11a	802.11n (HT20)	802.11n (HT40)	802.11ac (HT20)	802.11ac (HT40)	802.11ac (HT80)		
Lowest	16.64	17.75	36.28	17.73	36.26	---	N/A	PASS
Middle	16.63	17.75	---	17.74	---	75.88		
Highest	16.66	17.74	36.24	17.75	36.24	---		
Test Channel	6dB Emission Bandwidth (MHz)						Limit	Result
	802.11a	802.11n (HT20)	802.11n (HT40)	802.11ac (HT20)	802.11ac (HT40)	802.11ac (HT80)		
Lowest	16.56	17.68	35.36	17.68	35.52	---	>500kHz	PASS
Middle	16.56	17.76	---	17.76	---	75.84		
Highest	16.56	17.76	35.52	17.76	35.52	---		

ANT1
Band 1:

Test Channel	26dB Emission Bandwidth (MHz)						Limit	Result
	802.11a	802.11n (HT20)	802.11n (HT40)	802.11ac (HT20)	802.11ac (HT40)	802.11ac (HT80)		
Lowest	19.95	20.67	40.68	20.30	40.38	---	N/A	PASS
Middle	20.57	20.42	---	20.65	---	79.96		
Highest	19.22	19.69	39.82	19.44	40.46	---		
Test Channel	99% Occupy Bandwidth (MHz)						Limit	Result
	802.11a	802.11n (HT20)	802.11n (HT40)	802.11ac (HT20)	802.11ac (HT40)	802.11ac (HT80)		
Lowest	16.70	17.79	36.30	17.79	36.28	---	N/A	PASS
Middle	16.69	17.76	---	17.76	---	75.92		
Highest	16.62	17.74	36.24	17.73	36.24	---		

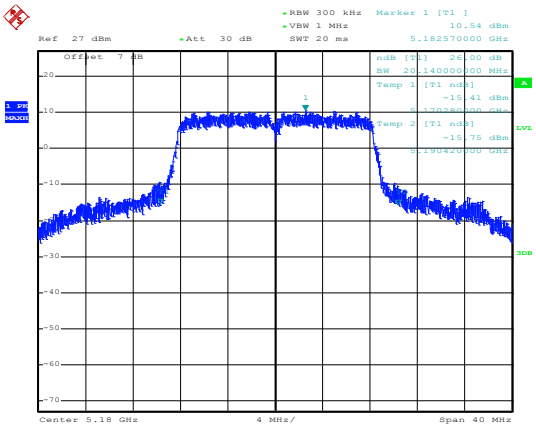
Band 4:

Test Channel	26dB Emission Bandwidth (MHz)						Limit	Result
	802.11a	802.11n (HT20)	802.11n (HT40)	802.11ac (HT20)	802.11ac (HT40)	802.11ac (HT80)		
Lowest	19.45	20.22	40.40	20.20	40.46	---	N/A	PASS
Middle	19.88	20.19	---	20.48	---	80.64		
Highest	20.43	20.45	40.44	20.21	40.44	---		
Test Channel	99% Occupy Bandwidth (MHz)						Limit	Result
	802.11a	802.11n (HT20)	802.11n (HT40)	802.11ac (HT20)	802.11ac (HT40)	802.11ac (HT80)		
Lowest	16.69	17.77	36.28	17.76	36.28	---	N/A	PASS
Middle	16.81	17.84	---	17.84	---	76.00		
Highest	16.94	17.96	36.40	17.97	36.40	---		
Test Channel	6dB Emission Bandwidth (MHz)						Limit	Result
	802.11a	802.11n (HT20)	802.11n (HT40)	802.11ac (HT20)	802.11ac (HT40)	802.11ac (HT80)		
Lowest	16.56	17.68	35.52	17.68	35.52	---	>500kHz	PASS
Middle	16.56	17.76	---	17.76	---	75.84		
Highest	16.56	17.76	35.52	17.76	35.52	---		

Test plot as follows: ANT0
Band 1:

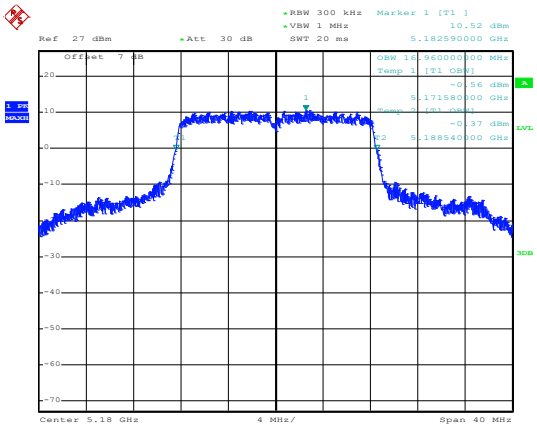
802.11a

26 dB EBW



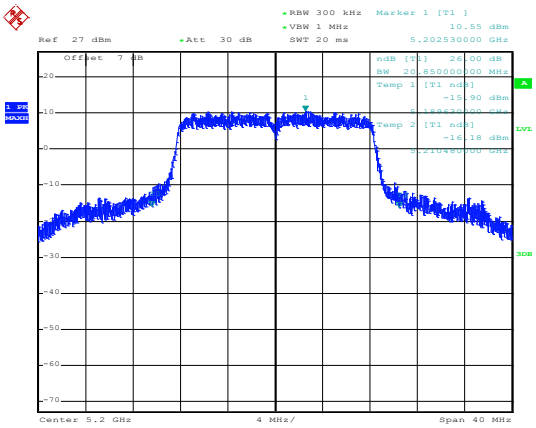
Date: 6.MAY.2020 09:53:51

99% OBW

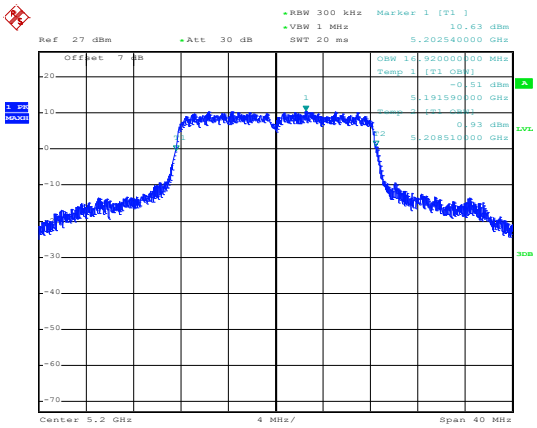


Date: 6.MAY.2020 09:54:29

Lowest channel

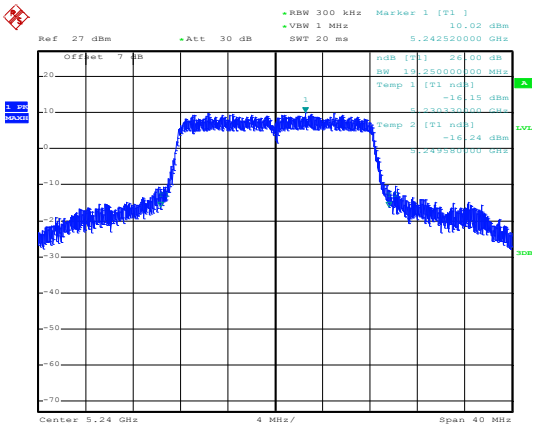


Date: 6.MAY.2020 09:42:35

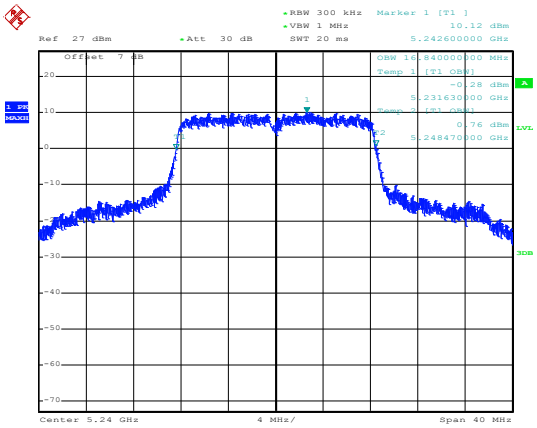


Date: 6.MAY.2020 09:42:47

Middle channel



Date: 6.MAY.2020 09:55:08

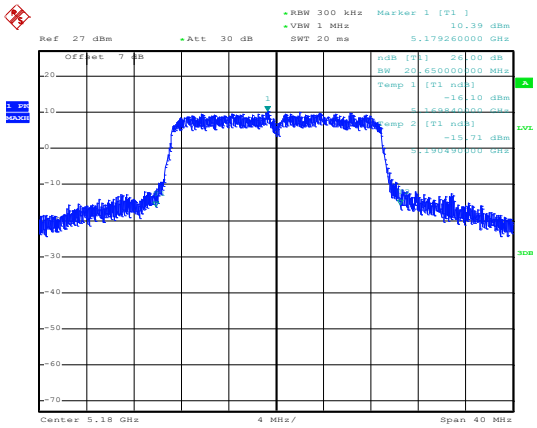


Date: 6.MAY.2020 09:54:41

Highest channel

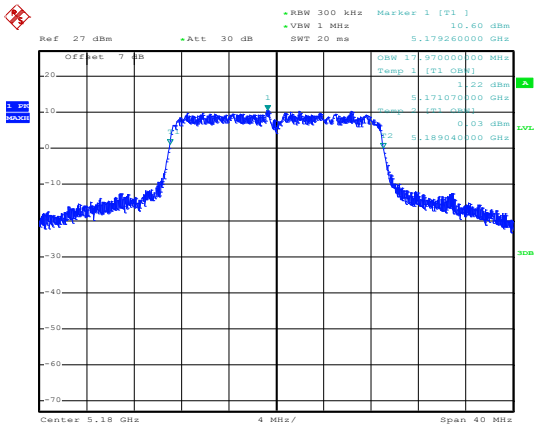
802.11n(HT20)

26 dB EBW



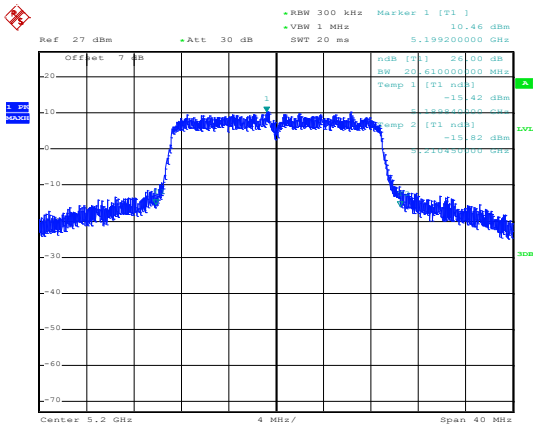
Date: 6.MAY.2020 09:52:35

99% OBW

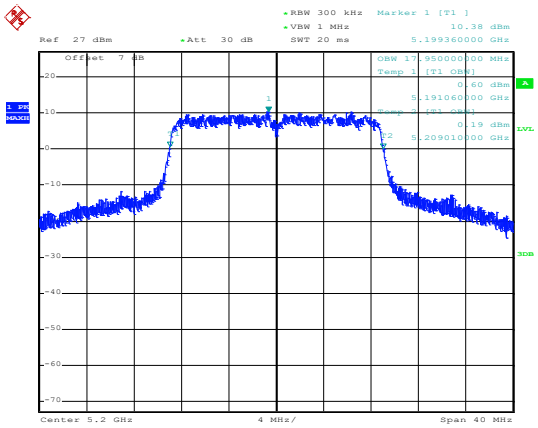


Date: 6.MAY.2020 09:52:46

Lowest channel

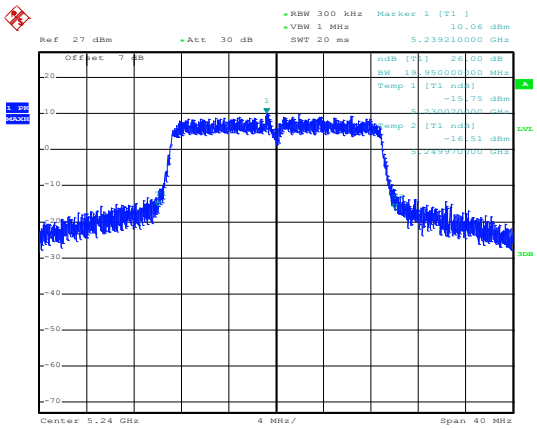


Date: 6.MAY.2020 09:52:15

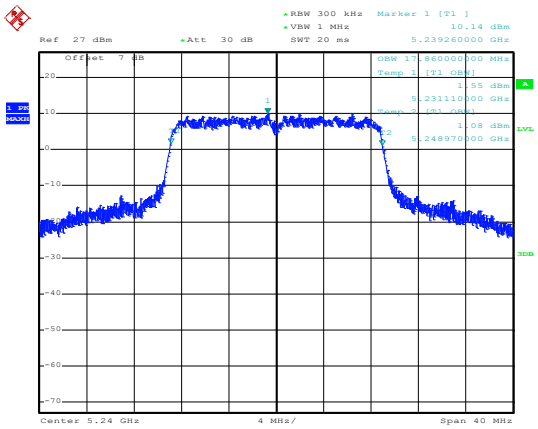


Date: 6.MAY.2020 09:52:00

Middle channel



Date: 6.MAY.2020 09:51:37

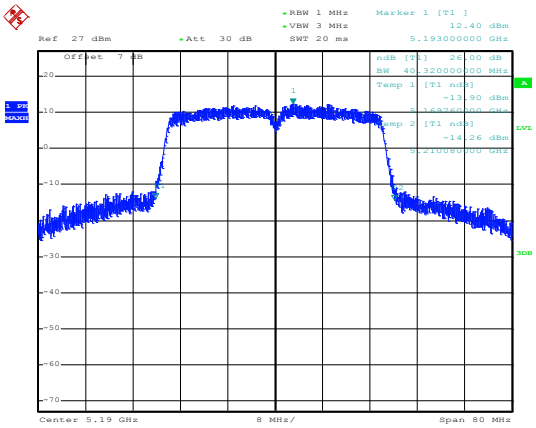


Date: 6.MAY.2020 09:51:47

Highest channel

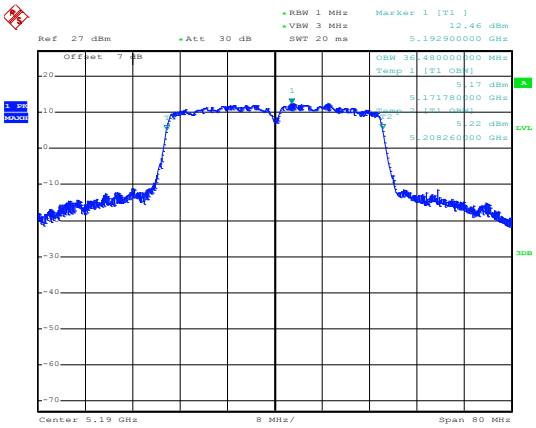
802.11n(HT40)

26 dB EBW



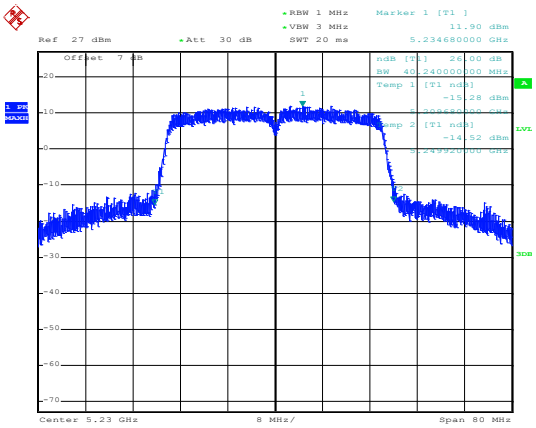
Date: 6.MAY.2020 09:59:09

99% OBW

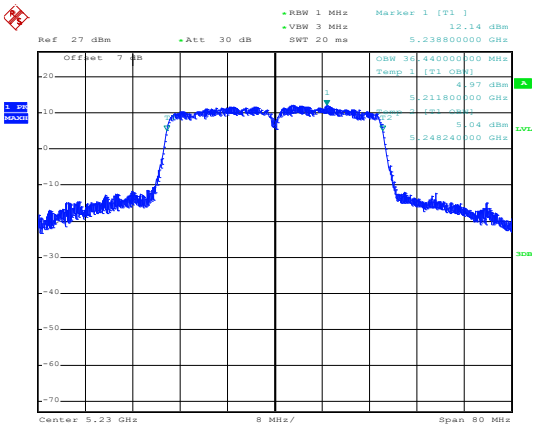


Date: 6.MAY.2020 09:58:47

Lowest channel



Date: 6.MAY.2020 09:59:33

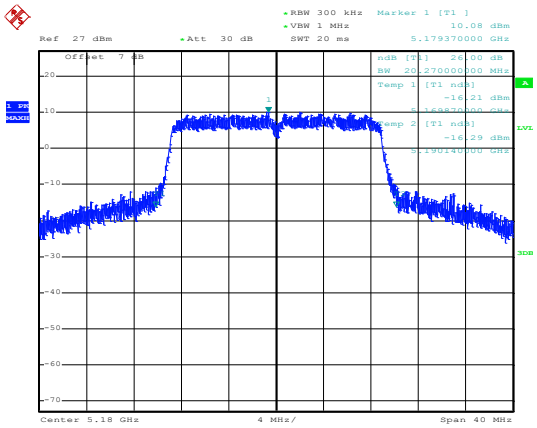


Date: 6.MAY.2020 09:59:43

Highest channel

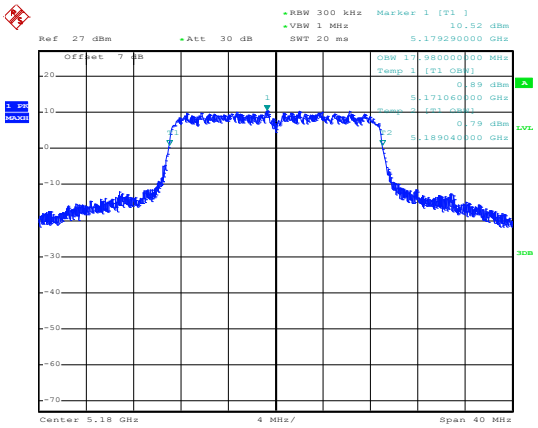
802.11ac(HT20)

26 dB EBW



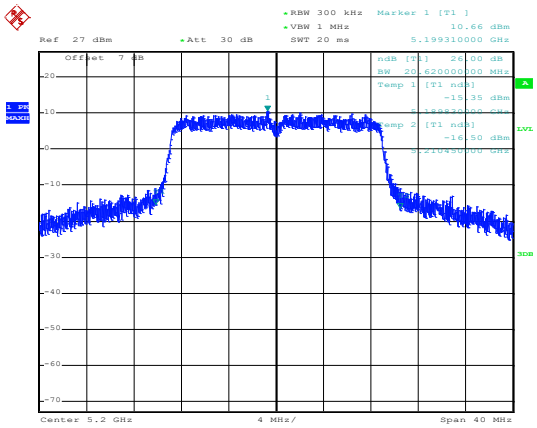
Date: 6.MAY.2020 09:49:42

99% OBW

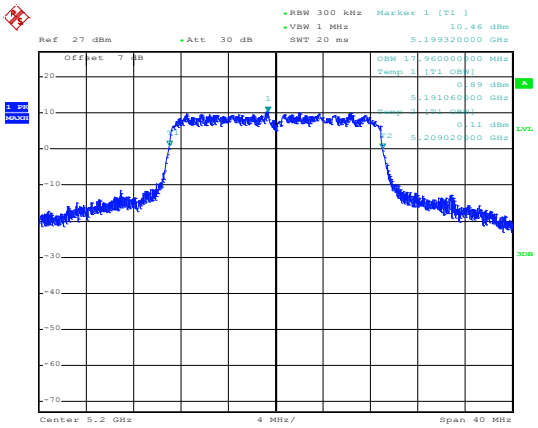


Date: 6.MAY.2020 09:49:23

Lowest channel

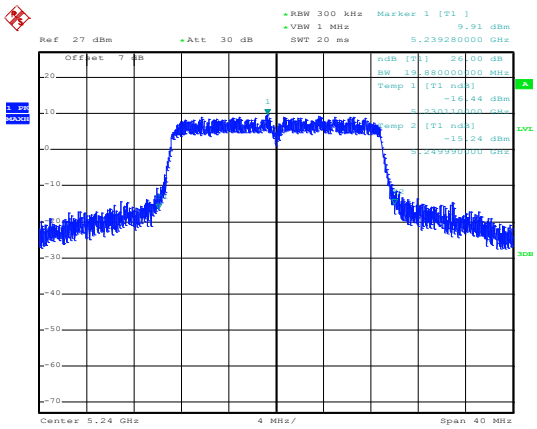


Date: 6.MAY.2020 09:50:14

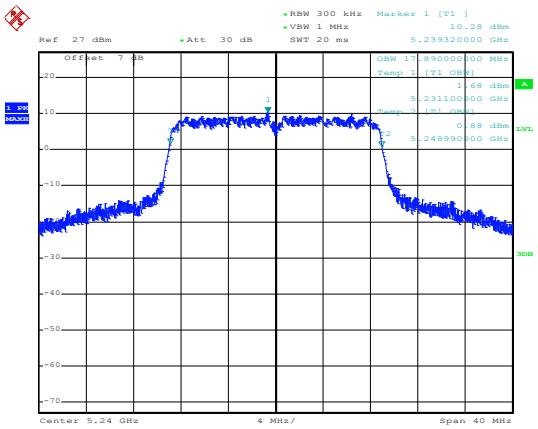


Date: 6.MAY.2020 09:50:26

Middle channel



Date: 6.MAY.2020 09:51:10

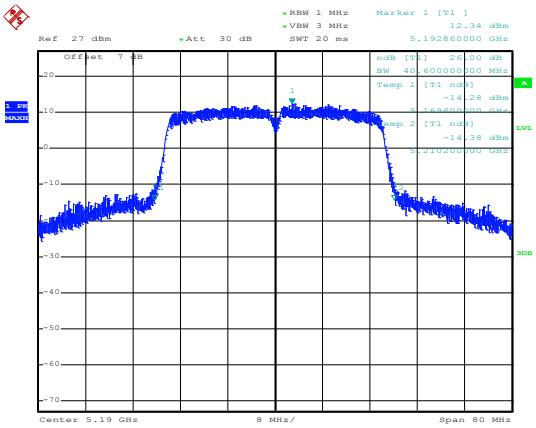


Date: 6.MAY.2020 09:50:41

Highest channel

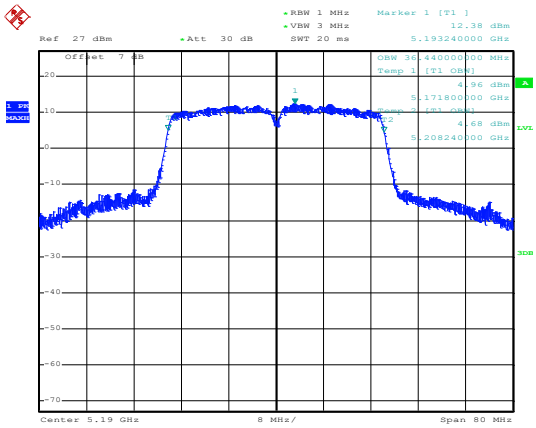
802.11ac(HT40)

26 dB EBW



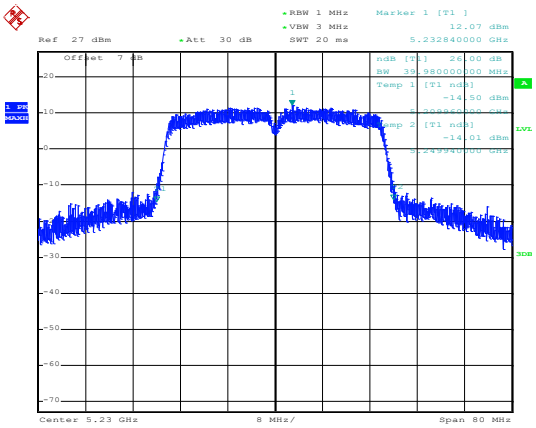
Date: 6.MAY.2020 10:01:11

99% OBW

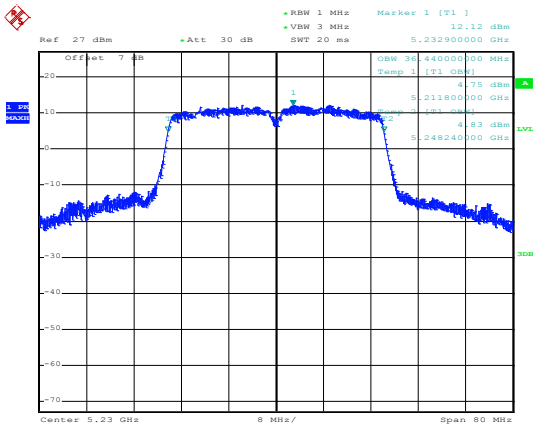


Date: 6.MAY.2020 10:01:22

Lowest channel



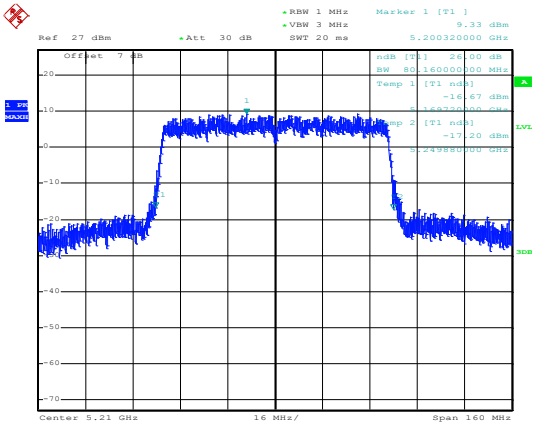
Date: 6.MAY.2020 10:00:44



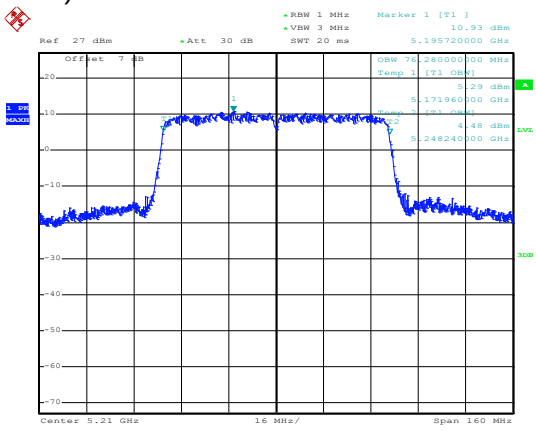
Date: 6.MAY.2020 10:00:03

Highest channel

802.11ac(HT80)



Date: 6.MAY.2020 10:05:42



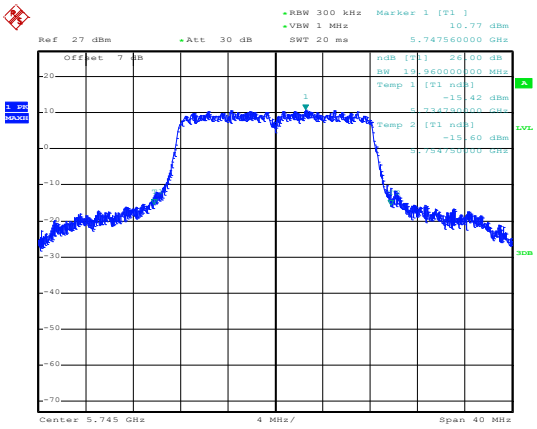
Date: 6.MAY.2020 10:02:20

Middle channel

Band 4:

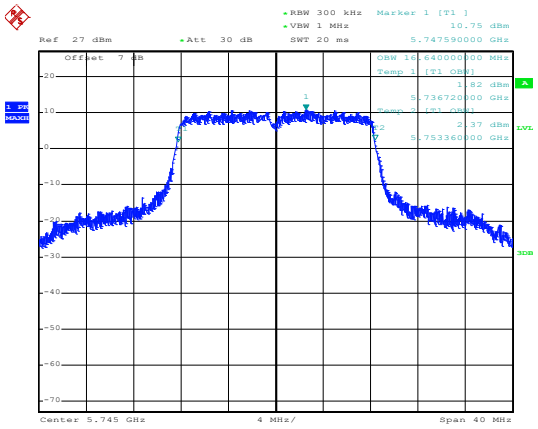
802.11a

26 dB EBW



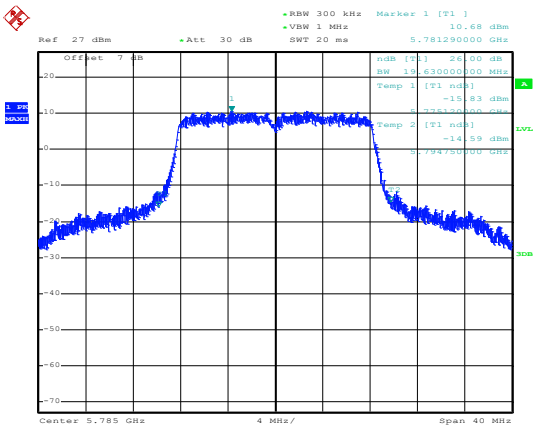
Date: 13.APR.2020 13:08:09

99% OBW

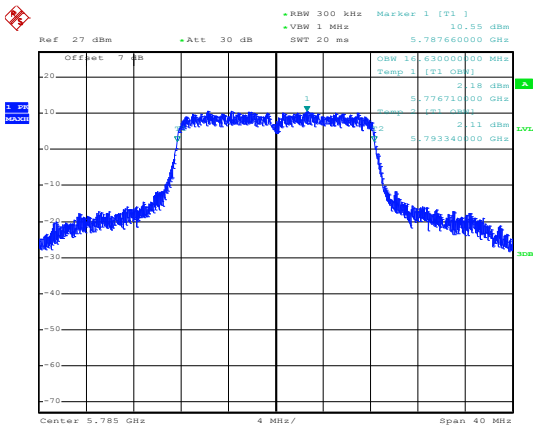


Date: 13.APR.2020 13:08:20

Lowest channel

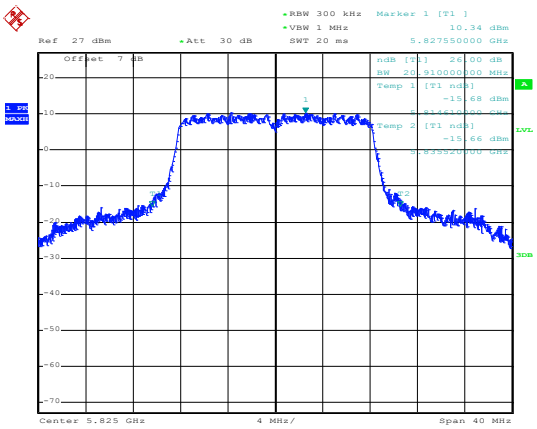


Date: 13.APR.2020 13:08:46

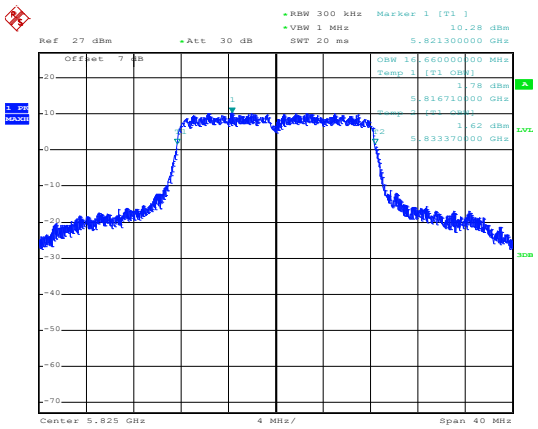


Date: 13.APR.2020 13:08:38

Middle channel



Date: 13.APR.2020 13:09:07

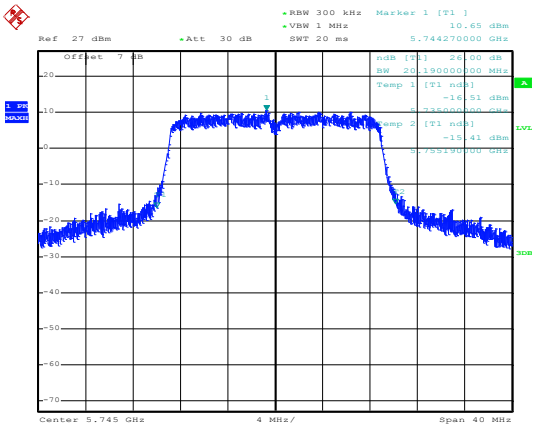


Date: 13.APR.2020 13:09:18

Highest channel

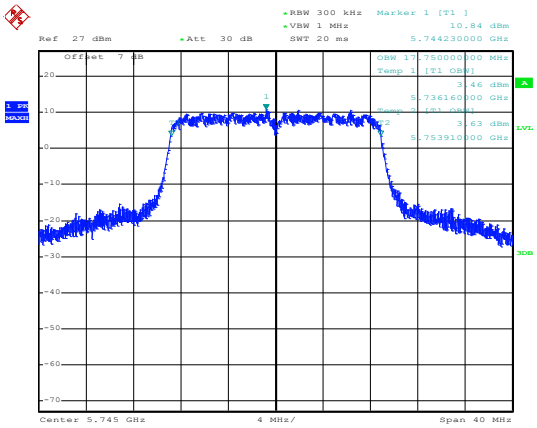
802.11n(HT20)

26 dB EBW



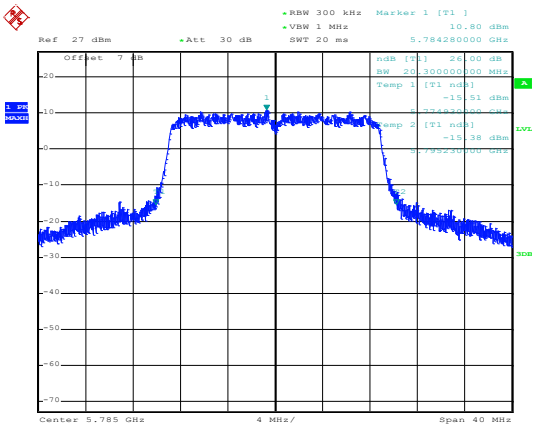
Date: 13.APR.2020 13:07:44

99% OBW

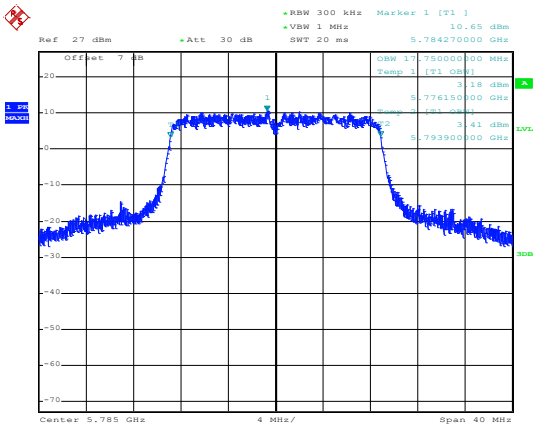


Date: 13.APR.2020 13:07:26

Lowest channel

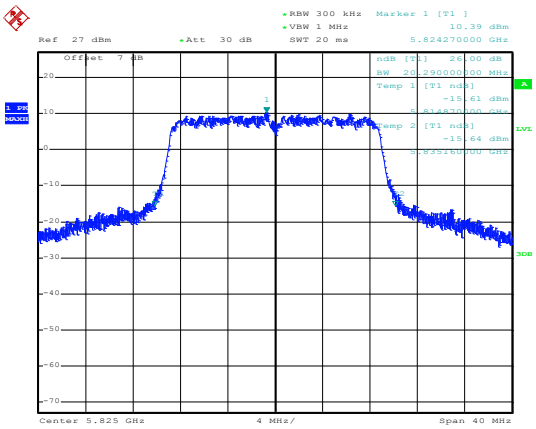


Date: 13.APR.2020 13:07:04

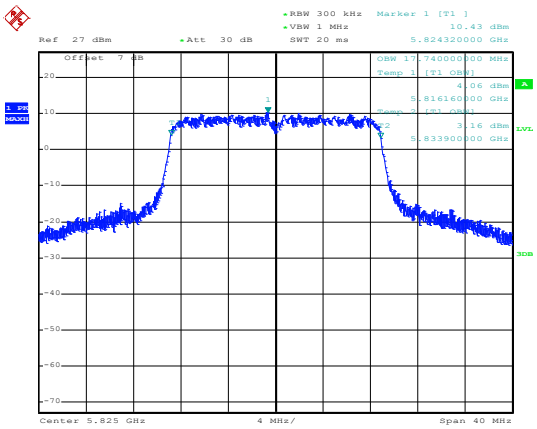


Date: 13.APR.2020 13:07:11

Middle channel



Date: 13.APR.2020 13:06:48

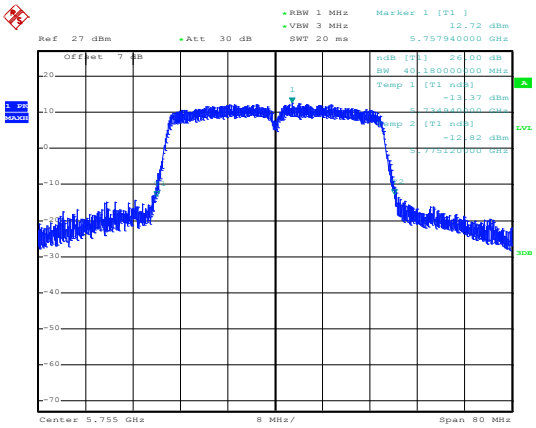


Date: 13.APR.2020 13:05:44

Highest channel

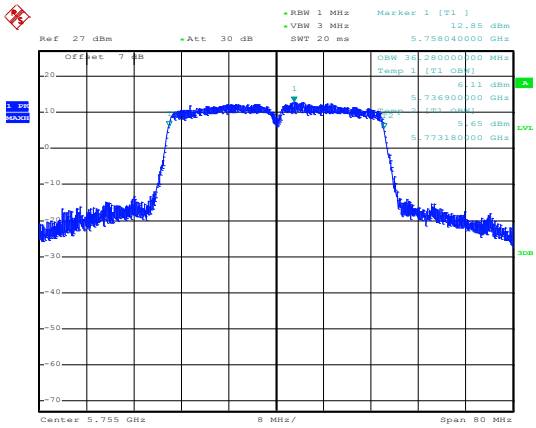
802.11n(HT40)

26 dB EBW



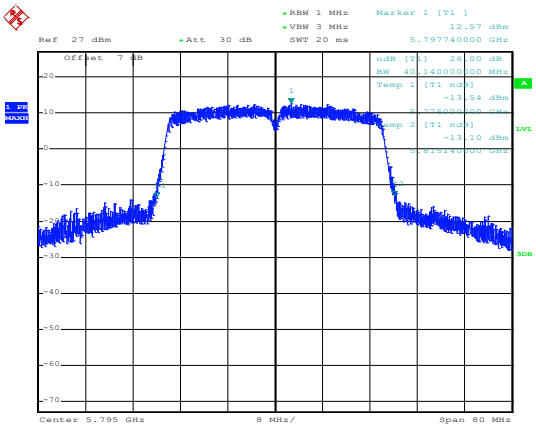
Date: 13.APR.2020 13:25:42

99% OBW

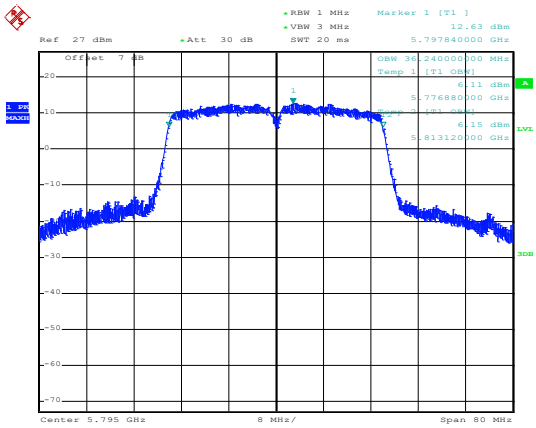


Date: 13.APR.2020 13:25:31

Lowest channel



Date: 13.APR.2020 13:25:12

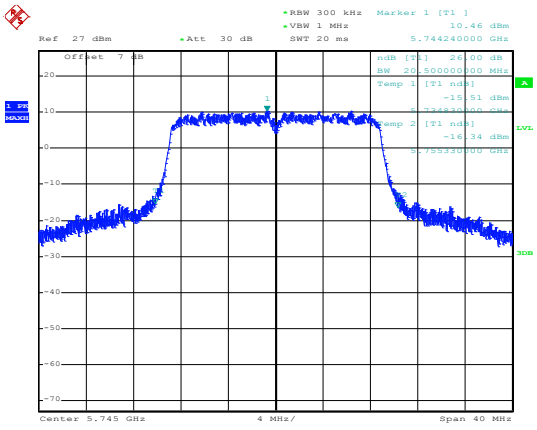


Date: 13.APR.2020 13:25:20

Highest channel

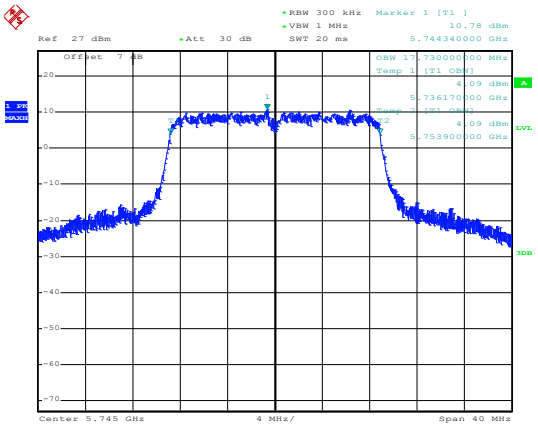
802.11ac(HT20)

26 dB EBW



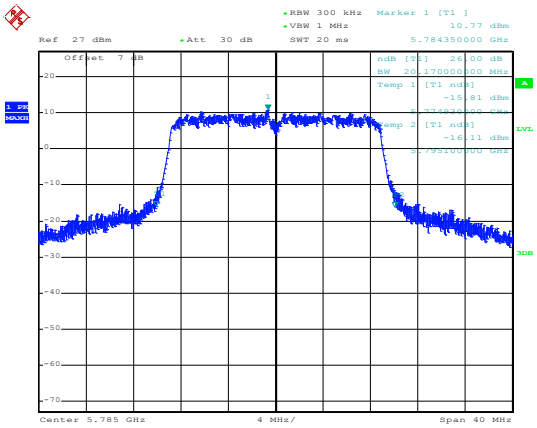
Date: 13.APR.2020 13:03:40

99% OBW

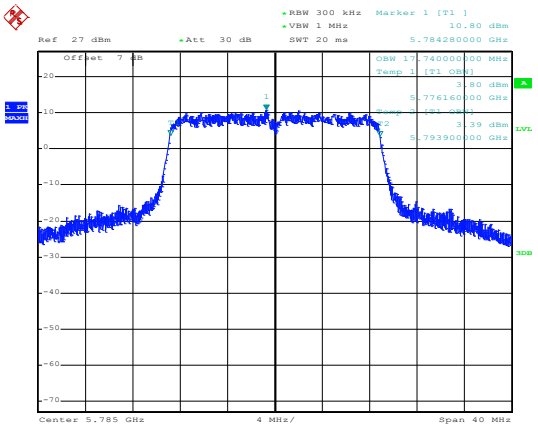


Date: 13.APR.2020 13:03:54

Lowest channel

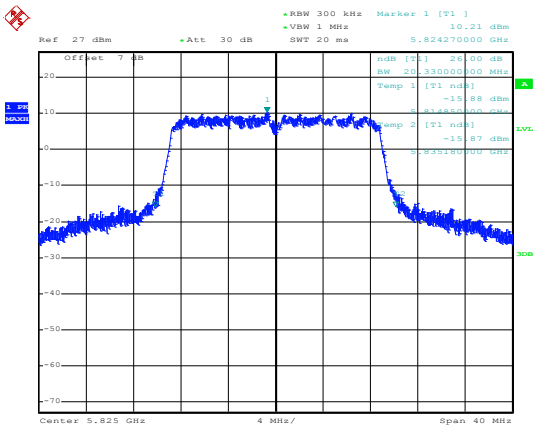


Date: 13.APR.2020 13:04:42

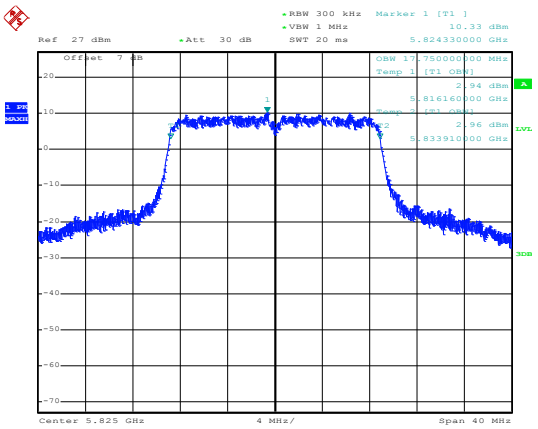


Date: 13.APR.2020 13:04:19

Middle channel



Date: 13.APR.2020 13:05:05

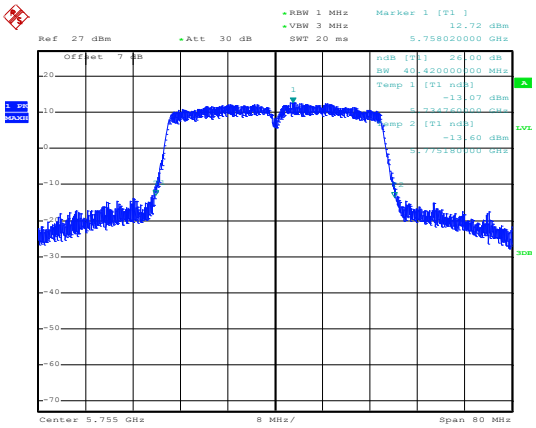


Date: 13.APR.2020 13:05:14

Highest channel

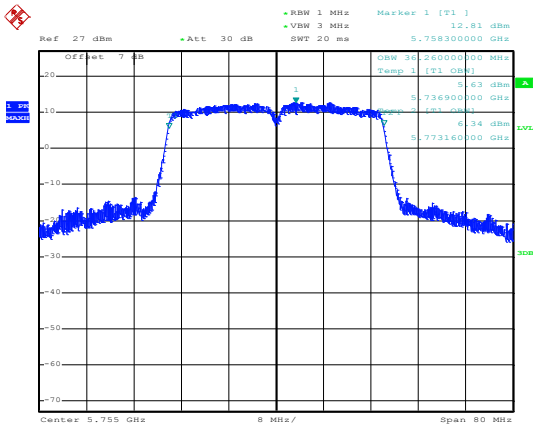
802.11ac(HT40)

26 dB EBW



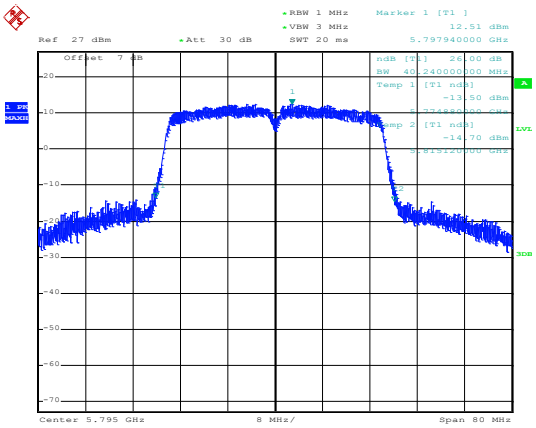
Date: 13.APR.2020 13:24:21

99% OBW

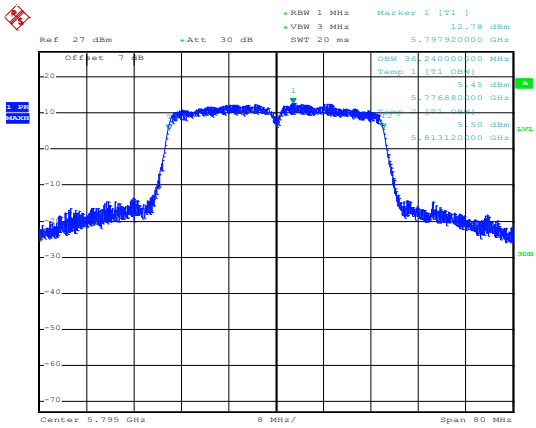


Date: 13.APR.2020 13:24:30

Lowest channel



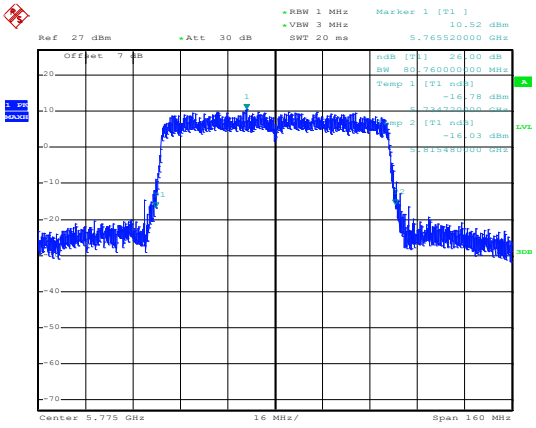
Date: 13.APR.2020 13:24:51



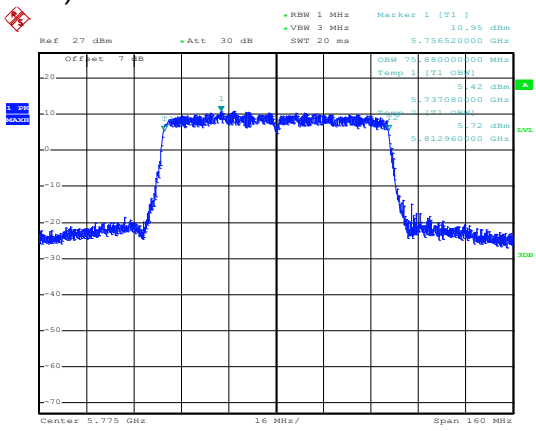
Date: 13.APR.2020 13:24:42

Highest channel

802.11ac(HT80)



Date: 13.APR.2020 13:23:52

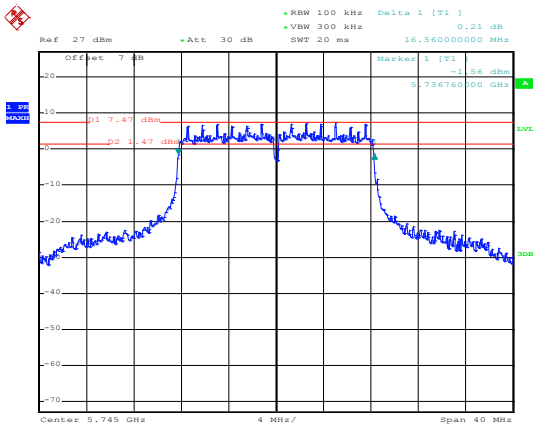


Date: 13.APR.2020 13:23:31

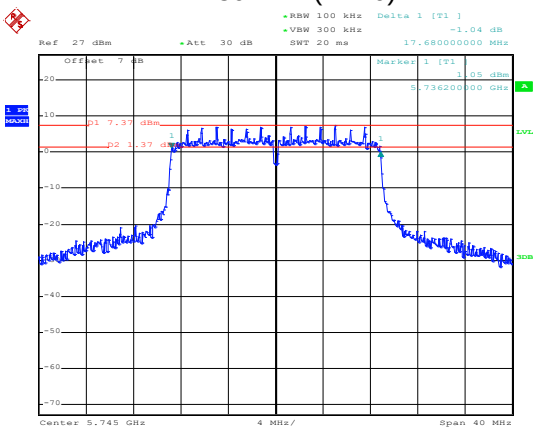
Middle channel

6dB BW

802.11a

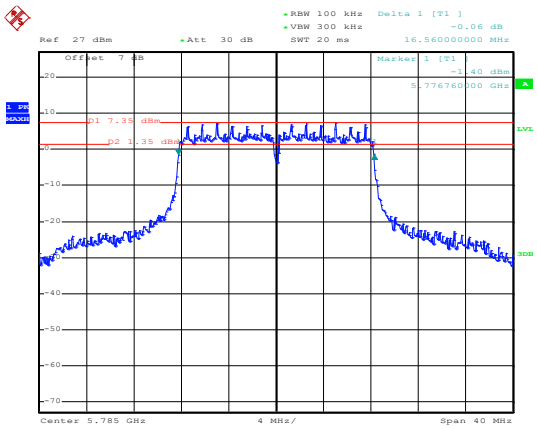


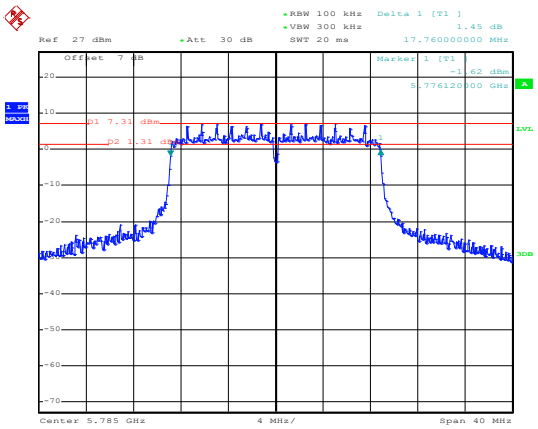
802.11n(HT20)



Lowest channel

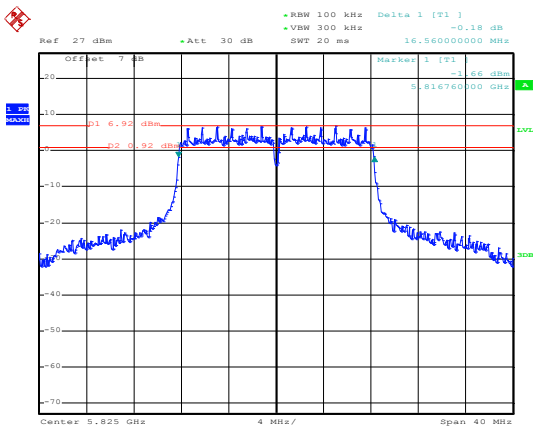
Lowest channel

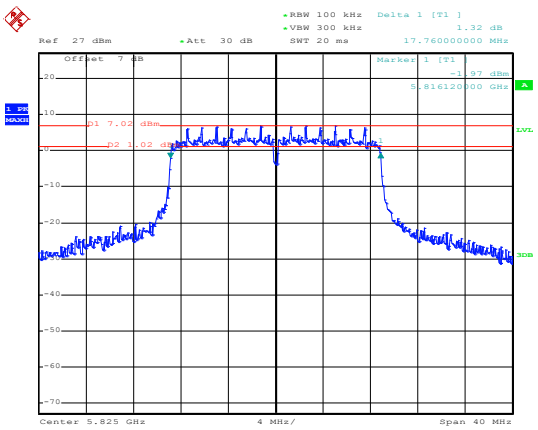




Middle channel

Middle channel

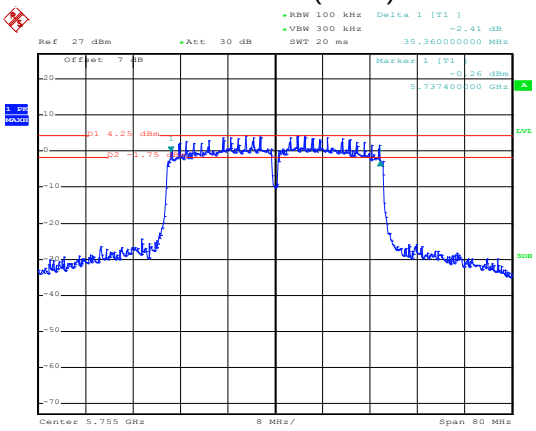




Highest channel

Highest channel

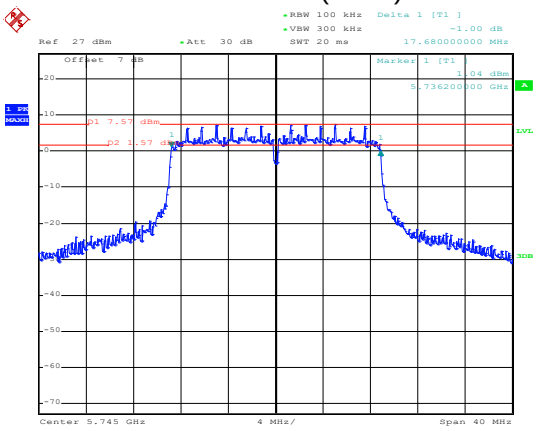
802.11n(HT40)



Date: 13.APR.2020 14:58:31

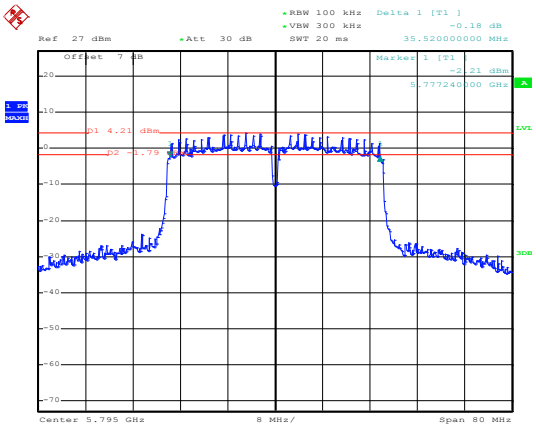
Lowest channel

802.11ac(HT20)



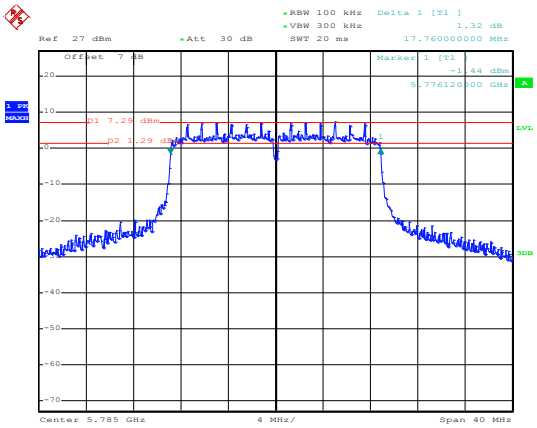
Date: 13.APR.2020 15:03:56

Lowest channel



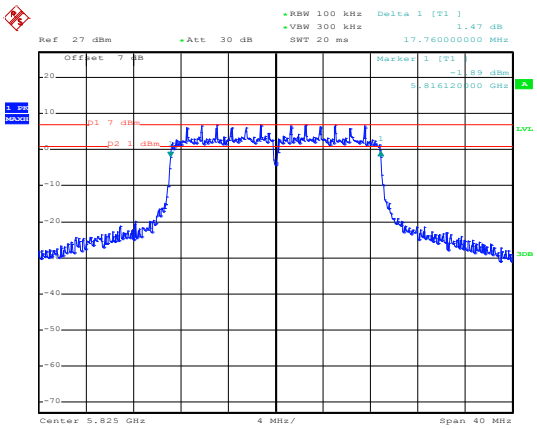
Date: 13.APR.2020 14:59:32

Highest channel



Date: 13.APR.2020 15:04:56

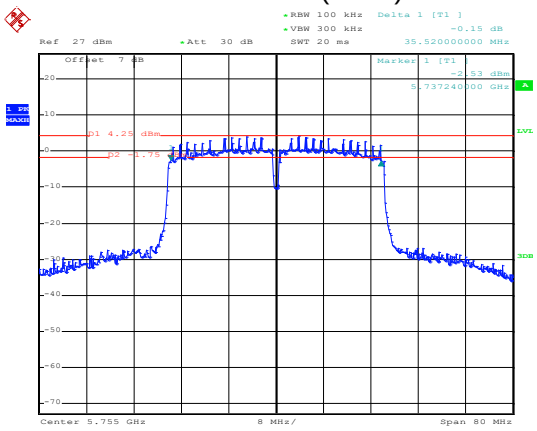
Middle channel



Date: 13.APR.2020 15:06:14

Highest channel

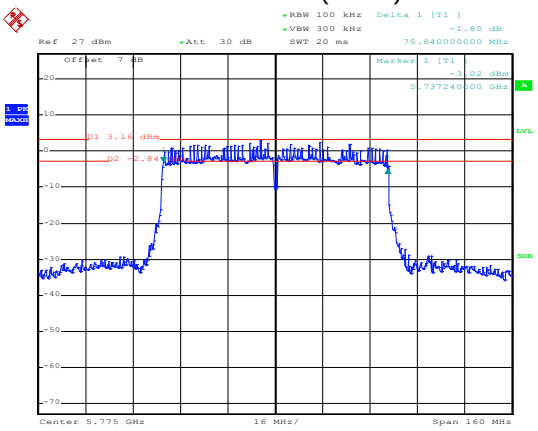
802.11ac(HT40)



Date: 13.APR.2020 15:01:32

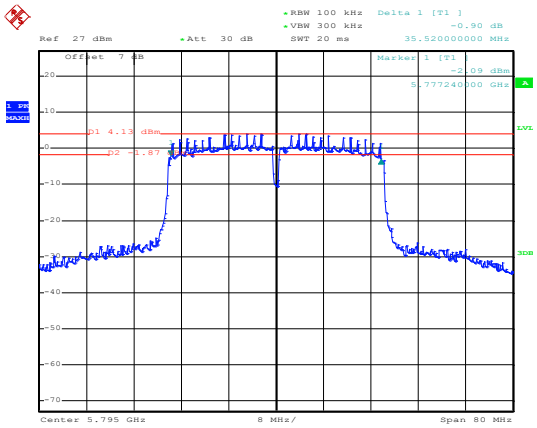
Lowest channel

802.11ac(HT80)



Date: 13.APR.2020 15:02:49

Middle channel



Date: 13.APR.2020 15:00:42

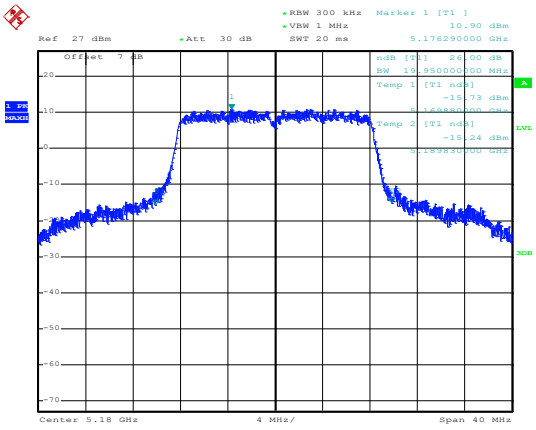
Highest channel

ANT1

Band 1:

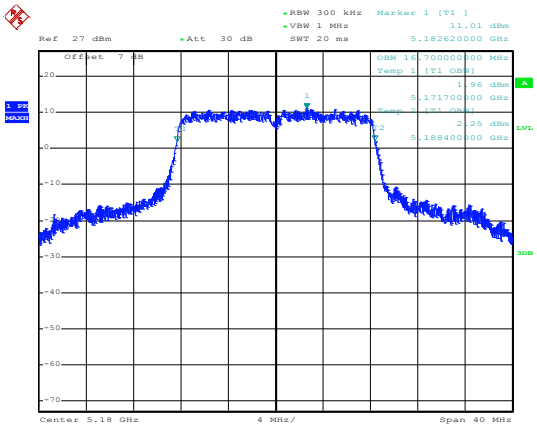
802.11a

26 dB EBW



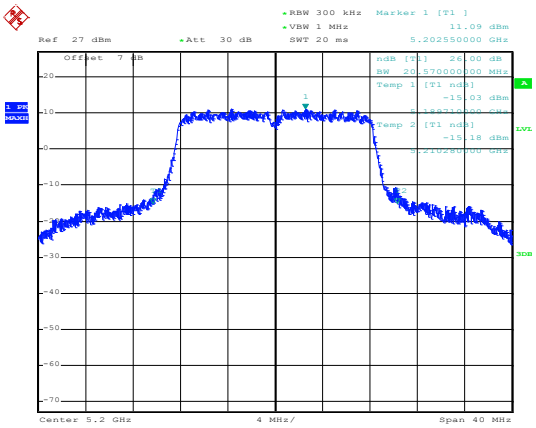
Date: 6.MAY.2020 10:27:38

99% OBW

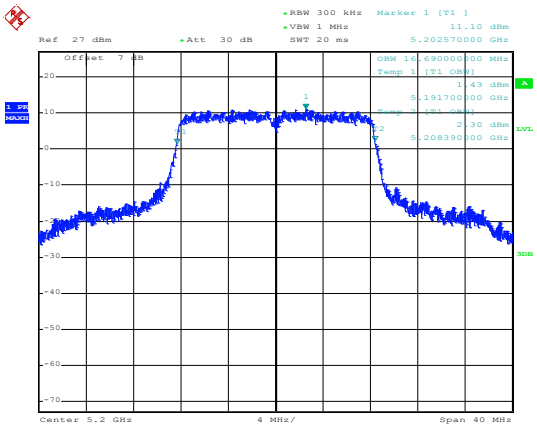


Date: 6.MAY.2020 10:27:49

Lowest channel

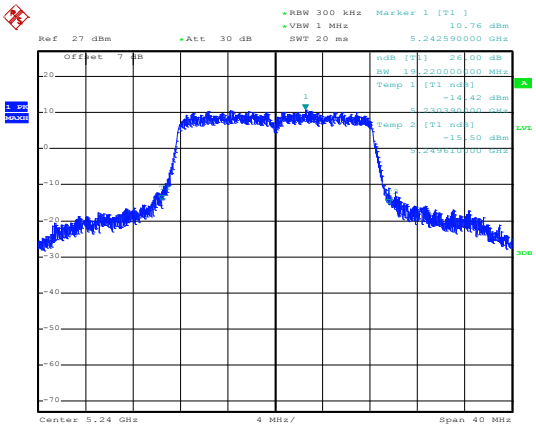


Date: 6.MAY.2020 10:27:23

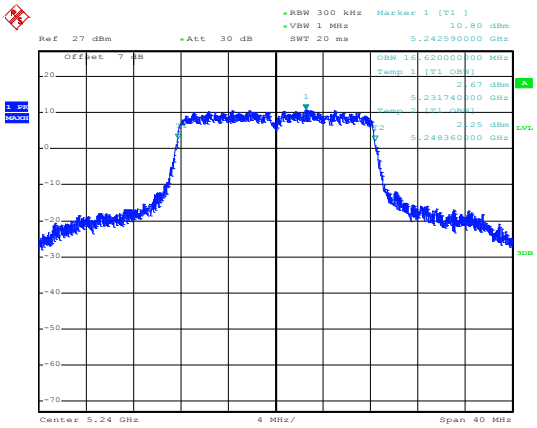


Date: 6.MAY.2020 10:27:08

Middle channel



Date: 6.MAY.2020 10:26:37

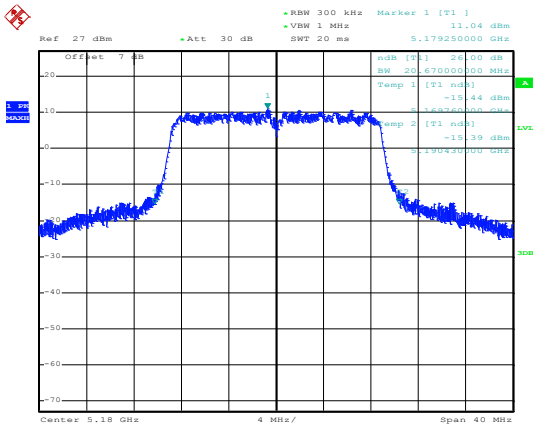


Date: 6.MAY.2020 10:26:48

Highest channel

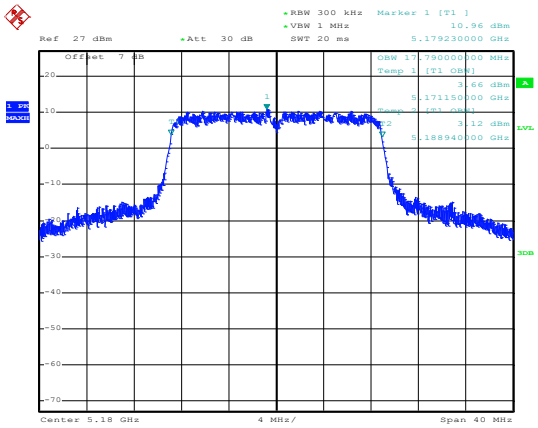
802.11n(HT20)

26 dB EBW



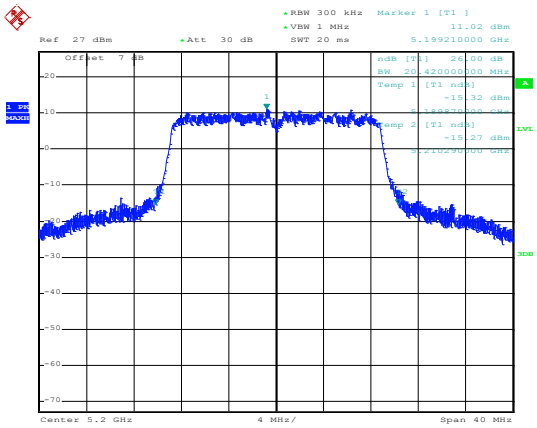
Date: 6.MAY.2020 10:28:13

99% OBW

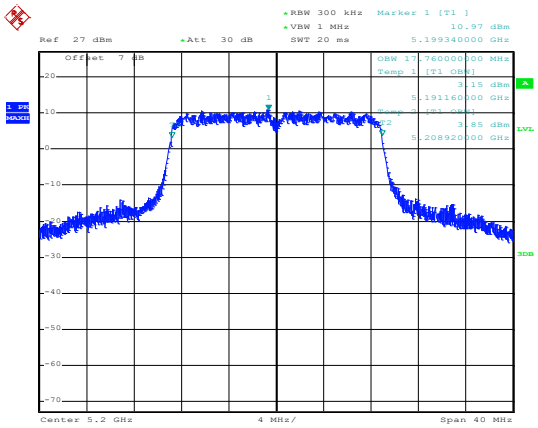


Date: 6.MAY.2020 10:28:04

Lowest channel

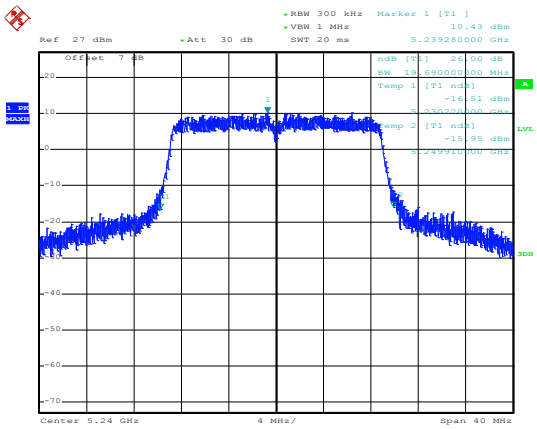


Date: 6.MAY.2020 10:28:27

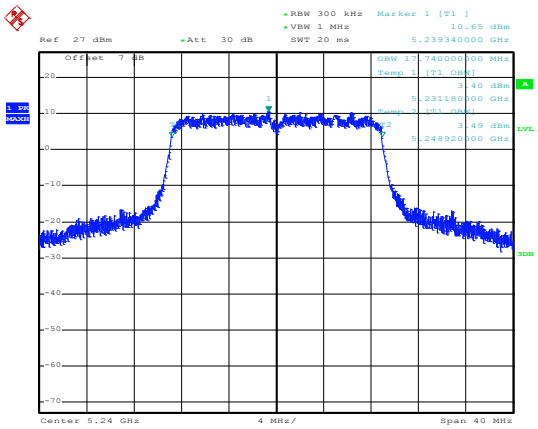


Date: 6.MAY.2020 10:28:34

Middle channel



Date: 6.MAY.2020 10:29:08

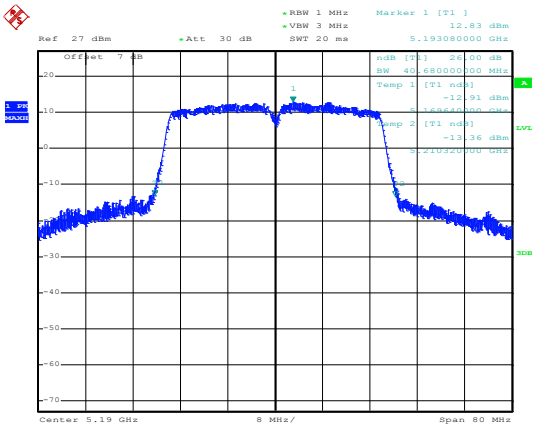


Date: 6.MAY.2020 10:28:46

Highest channel

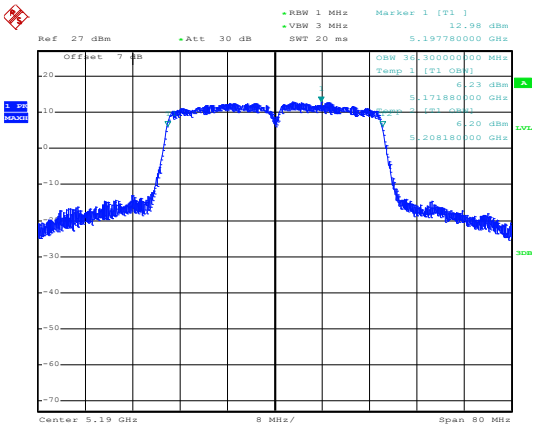
802.11n(HT40)

26 dB EBW



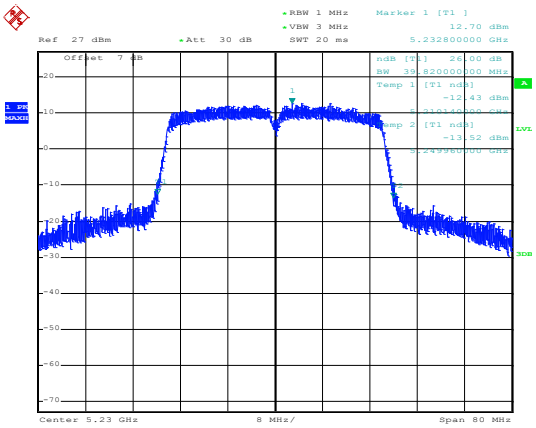
Date: 6.MAY.2020 10:32:43

99% OBW

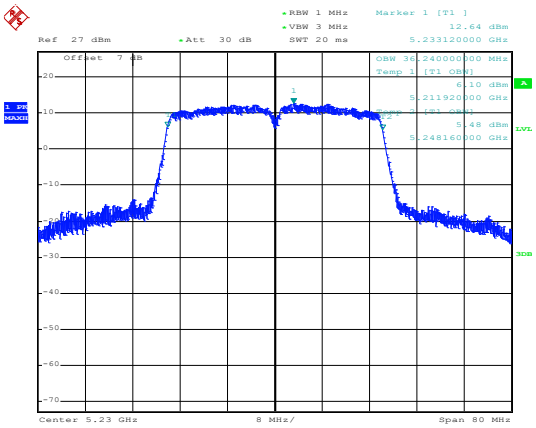


Date: 6.MAY.2020 10:32:51

Lowest channel



Date: 6.MAY.2020 10:32:28

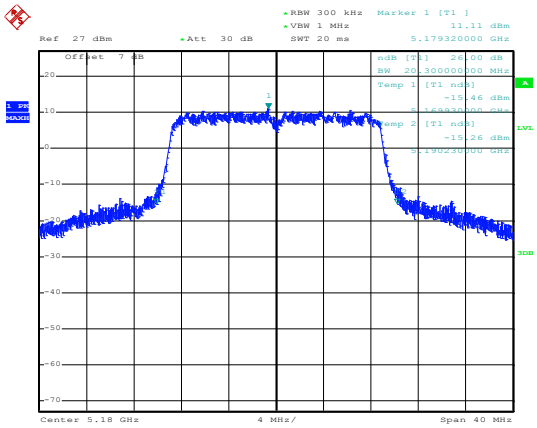


Date: 6.MAY.2020 10:32:11

Highest channel

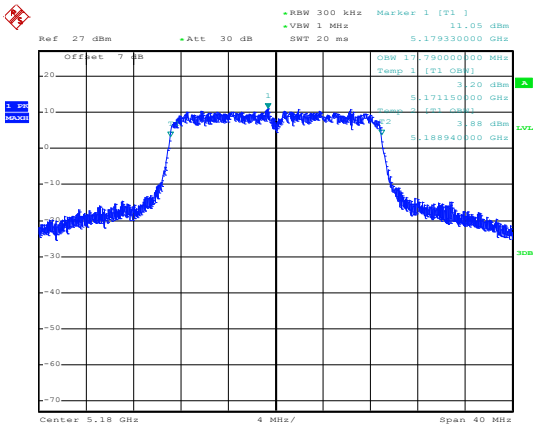
802.11ac(HT20)

26 dB EBW



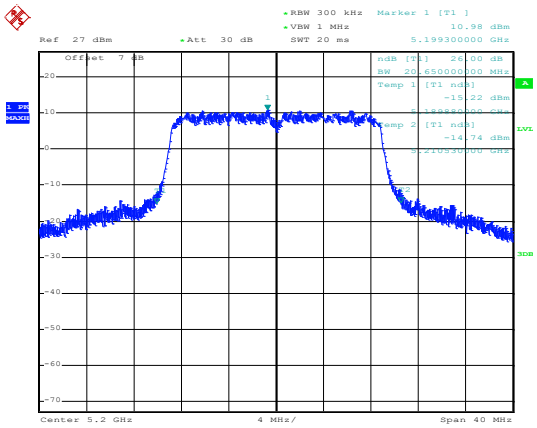
Date: 6.MAY.2020 10:30:18

99% OBW

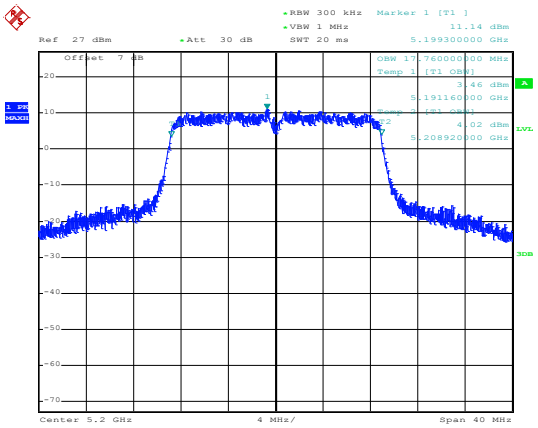


Date: 6.MAY.2020 10:30:27

Lowest channel

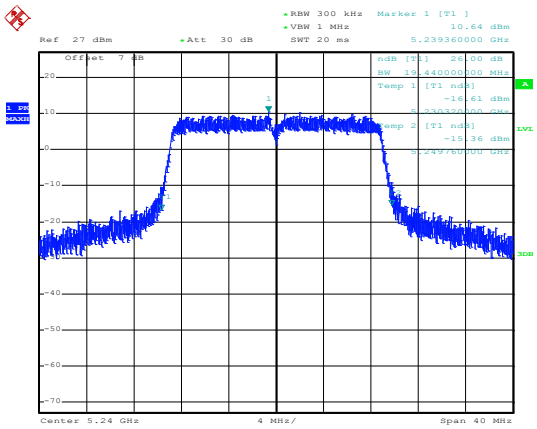


Date: 6.MAY.2020 10:30:02

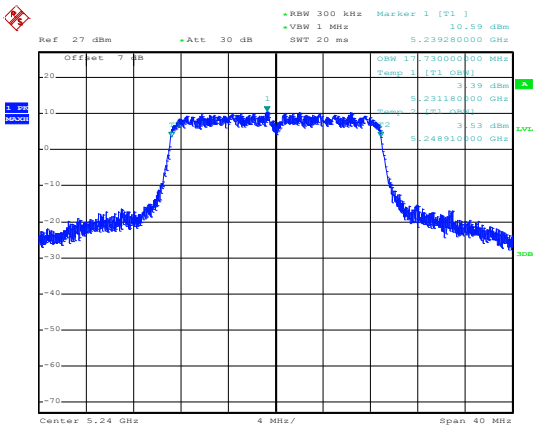


Date: 6.MAY.2020 10:29:54

Middle channel



Date: 6.MAY.2020 10:29:31

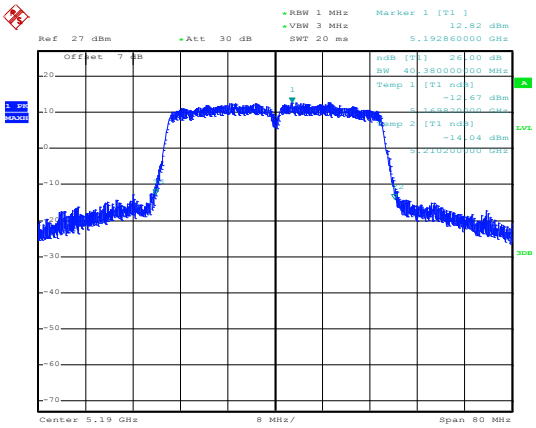


Date: 6.MAY.2020 10:29:39

Highest channel

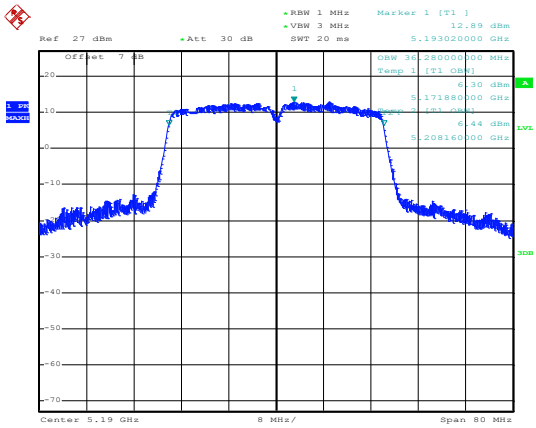
802.11ac(HT40)

26 dB EBW



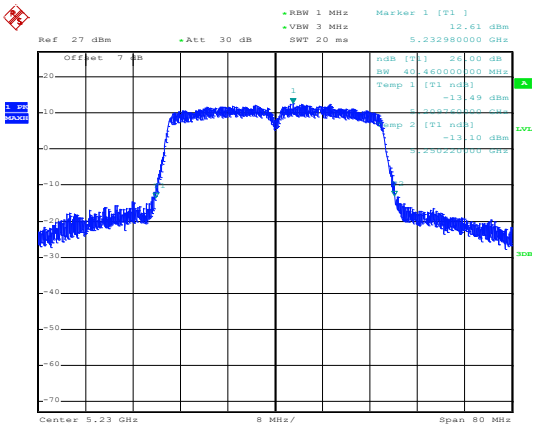
Date: 6.MAY.2020 10:31:20

99% OBW

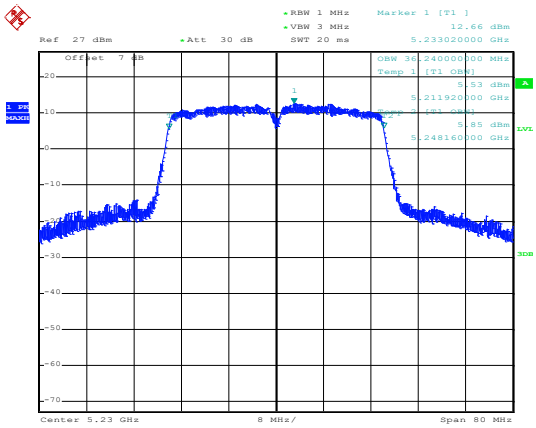


Date: 6.MAY.2020 10:30:53

Lowest channel



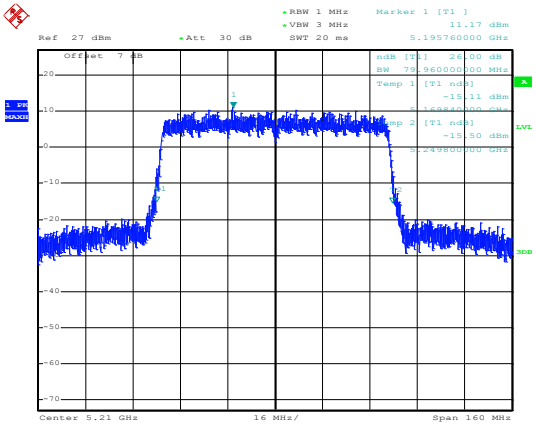
Date: 6.MAY.2020 10:31:41



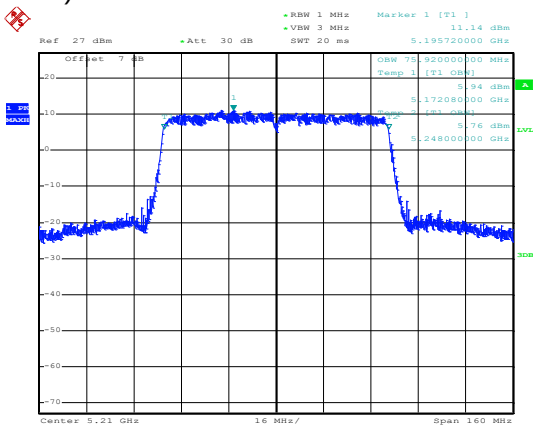
Date: 6.MAY.2020 10:31:49

Highest channel

802.11ac(HT80)



Date: 6.MAY.2020 10:33:54



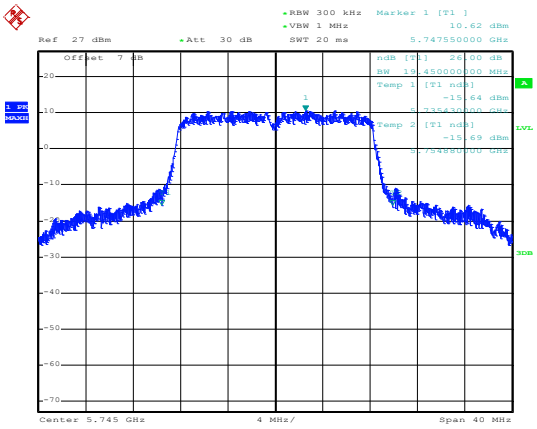
Date: 6.MAY.2020 10:33:15

Middle channel

Band 4:

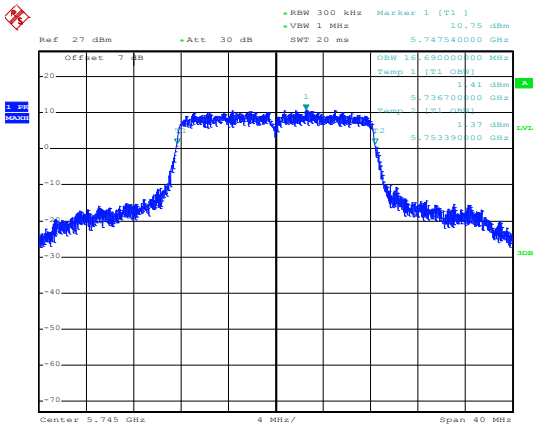
802.11a

26 dB EBW



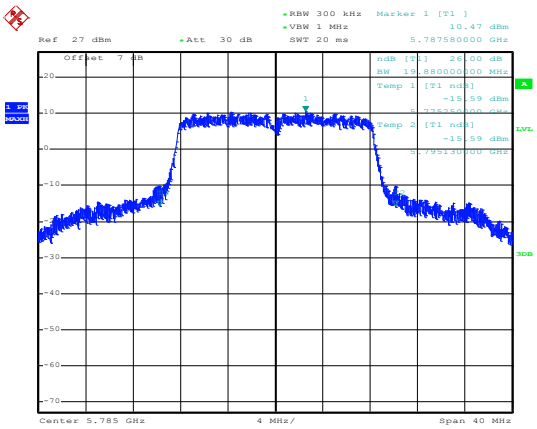
Date: 13.APR.2020 13:15:54

99% OBW

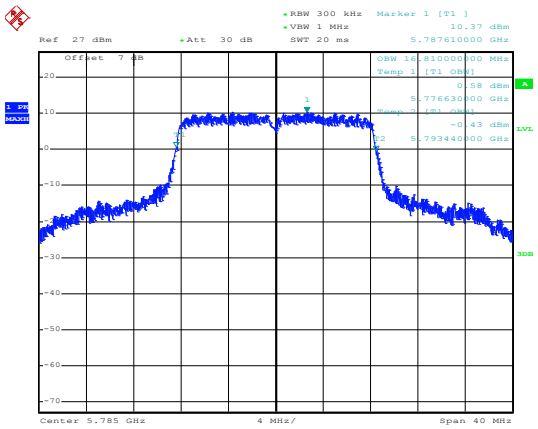


Date: 13.APR.2020 13:15:46

Lowest channel

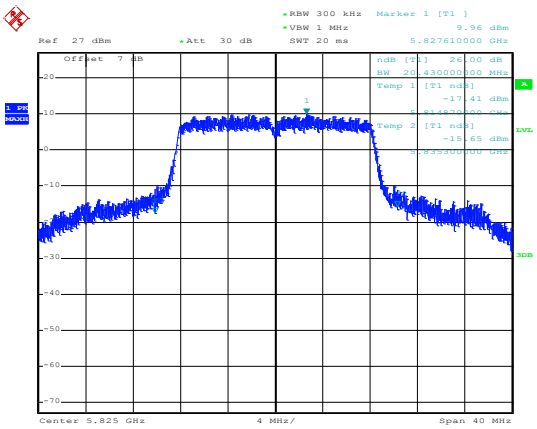


Date: 13.APR.2020 13:15:25

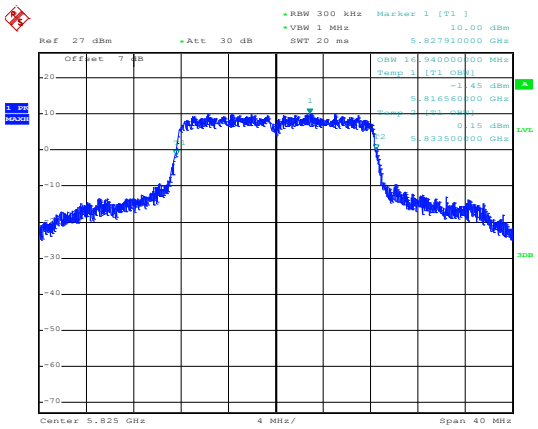


Date: 13.APR.2020 13:15:34

Middle channel



Date: 13.APR.2020 13:14:57

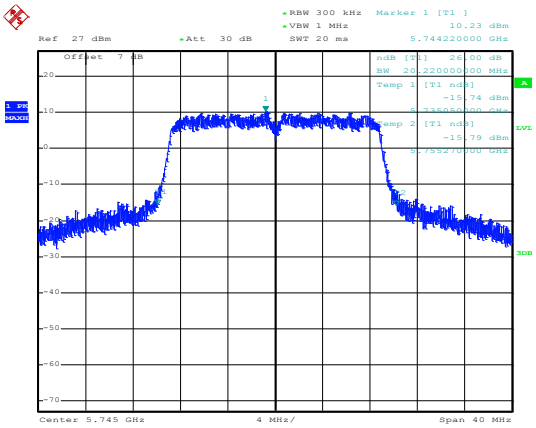


Date: 13.APR.2020 13:14:23

Highest channel

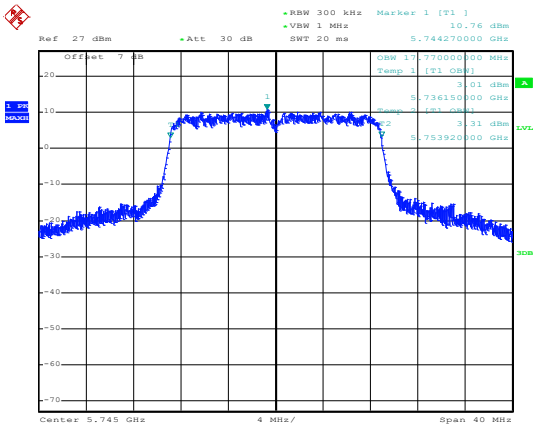
802.11n(HT20)

26 dB EBW



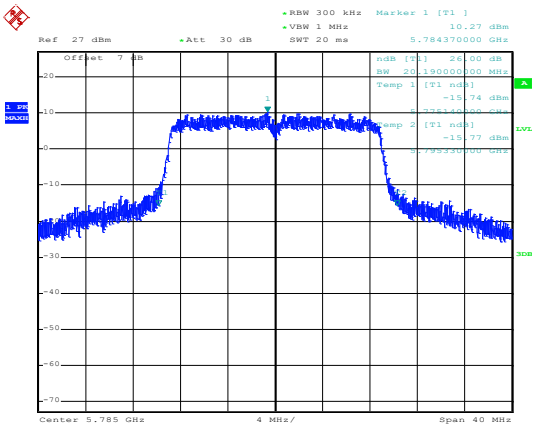
Date: 13.APR.2020 13:16:40

99% OBW

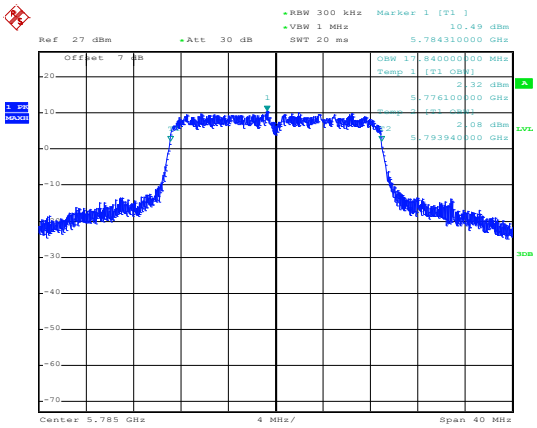


Date: 13.APR.2020 13:16:48

Lowest channel

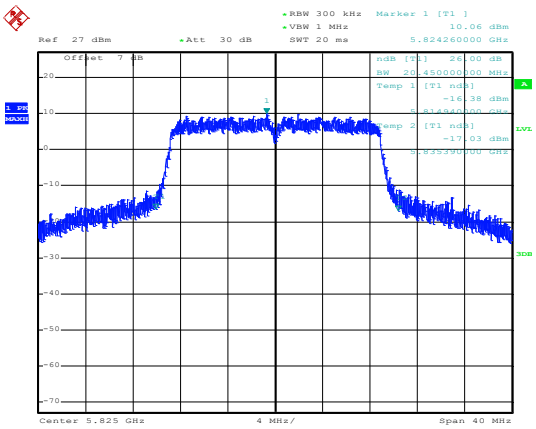


Date: 13.APR.2020 13:17:12

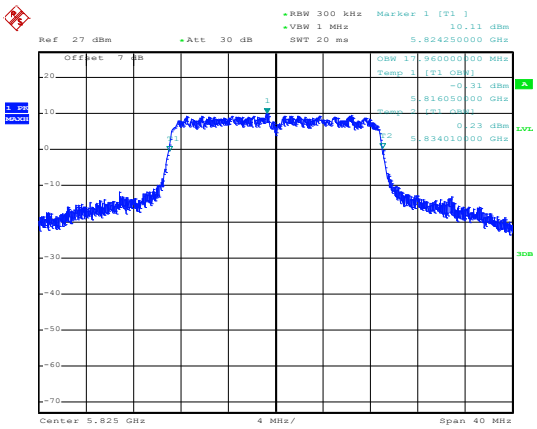


Date: 13.APR.2020 13:17:00

Middle channel



Date: 13.APR.2020 13:17:35

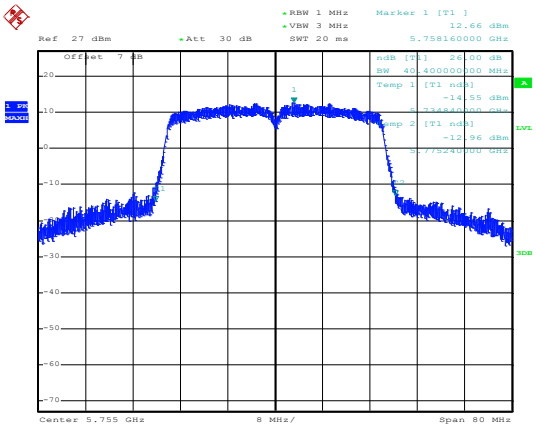


Date: 13.APR.2020 13:17:46

Highest channel

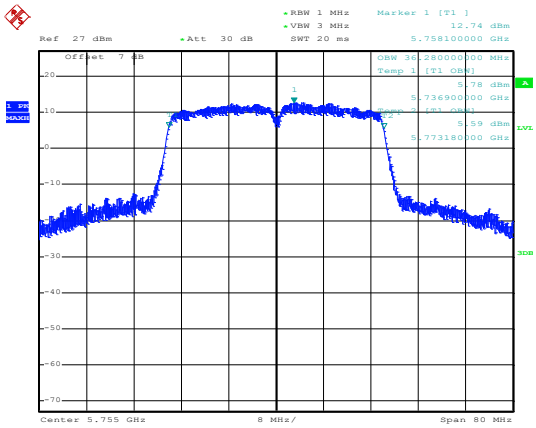
802.11n(HT40)

26 dB EBW



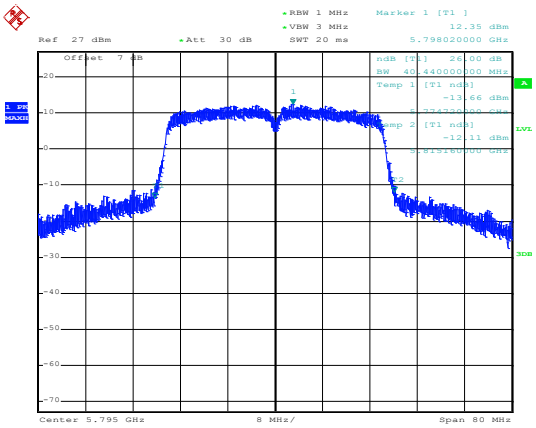
Date: 13.APR.2020 13:21:48

99% OBW

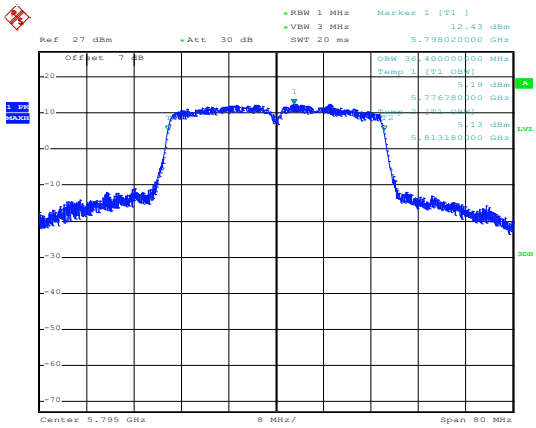


Date: 13.APR.2020 13:21:38

Lowest channel



Date: 13.APR.2020 13:21:07

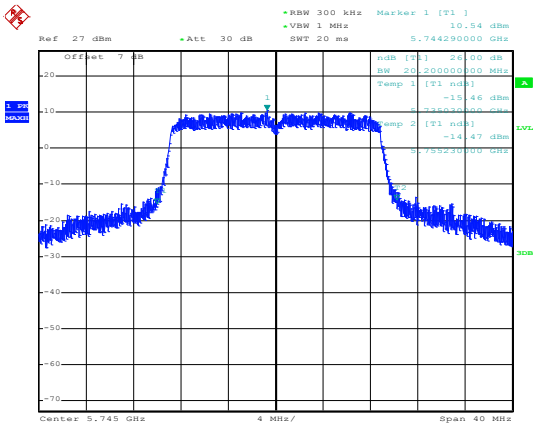


Date: 13.APR.2020 13:21:20

Highest channel

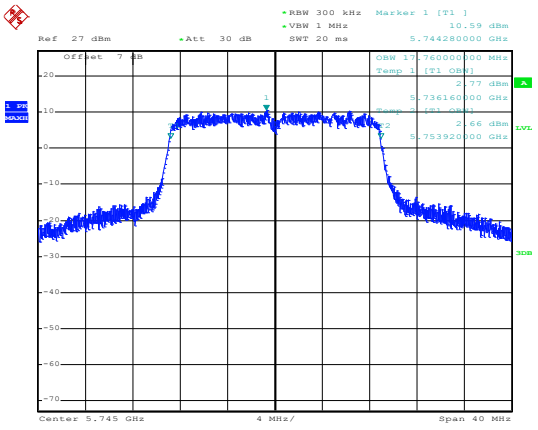
802.11ac(HT20)

26 dB EBW



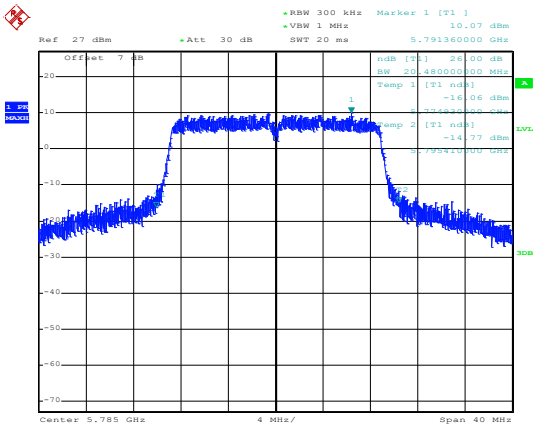
Date: 13.APR.2020 13:19:20

99% OBW

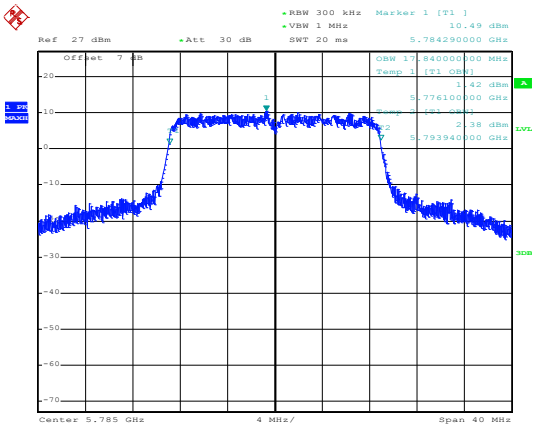


Date: 13.APR.2020 13:19:00

Lowest channel

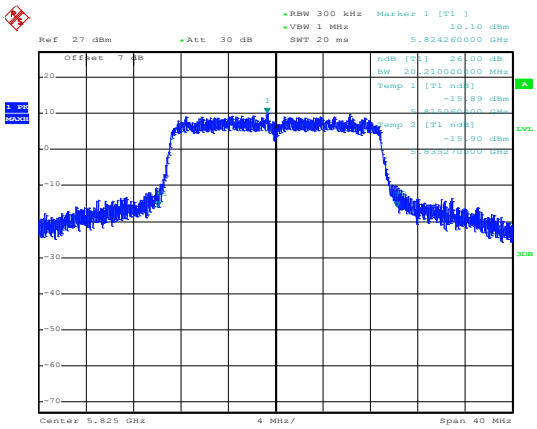


Date: 13.APR.2020 13:18:41

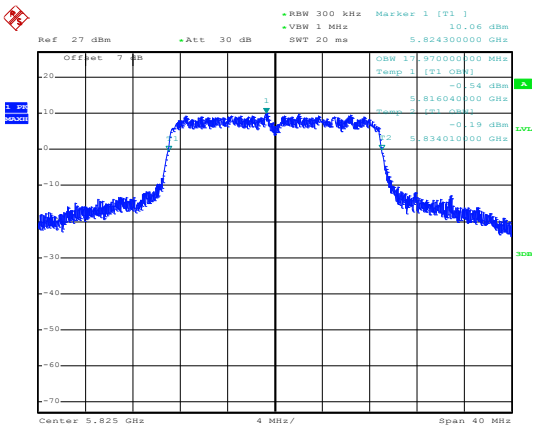


Date: 13.APR.2020 13:18:49

Middle channel



Date: 13.APR.2020 13:18:16

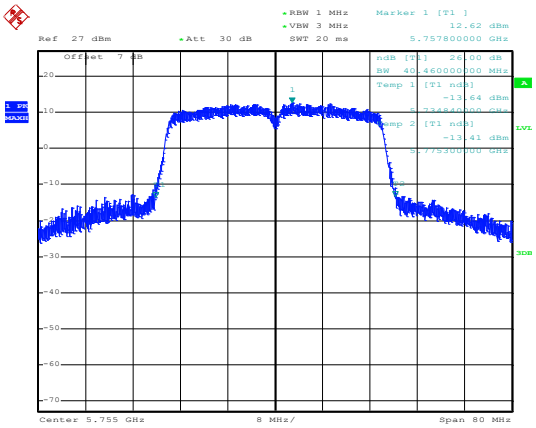


Date: 13.APR.2020 13:18:05

Highest channel

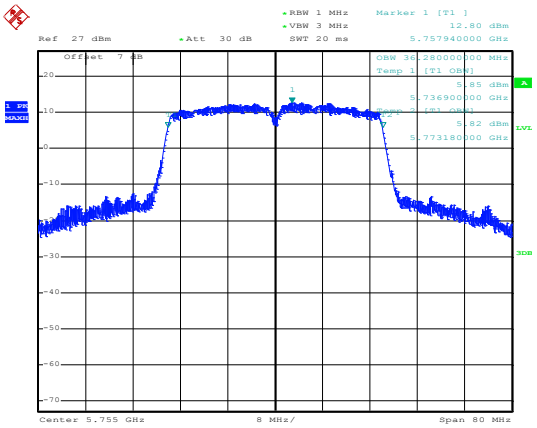
802.11ac(HT40)

26 dB EBW



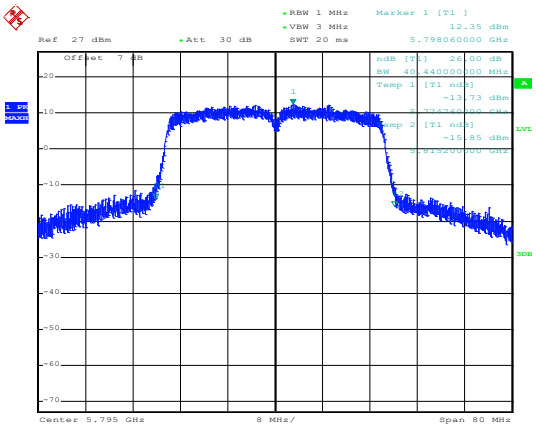
Date: 13.APR.2020 13:20:06

99% OBW

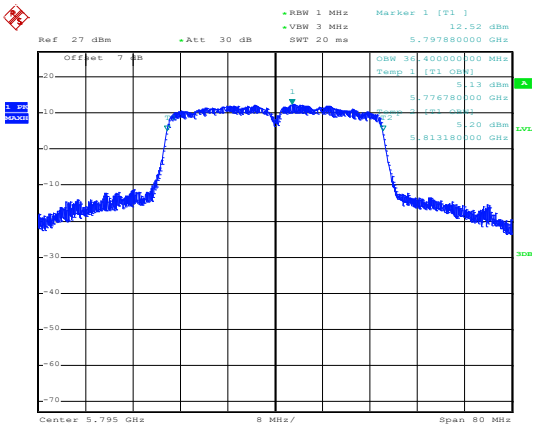


Date: 13.APR.2020 13:20:15

Lowest channel



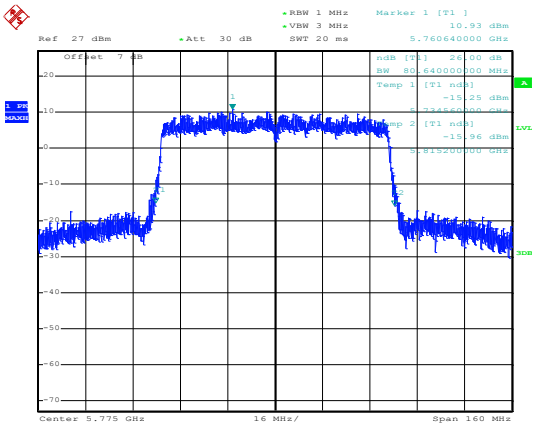
Date: 13.APR.2020 13:20:41



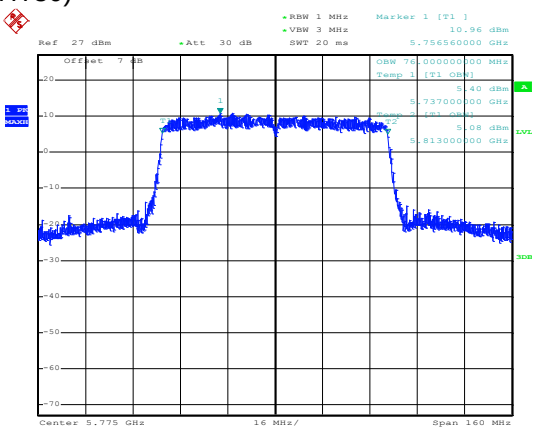
Date: 13.APR.2020 13:20:30

Highest channel

802.11ac(HT80)



Date: 13.APR.2020 13:23:01

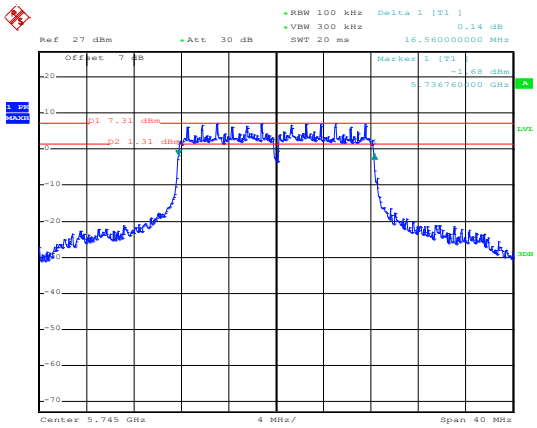


Date: 13.APR.2020 13:23:11

Middle channel

6dB BW

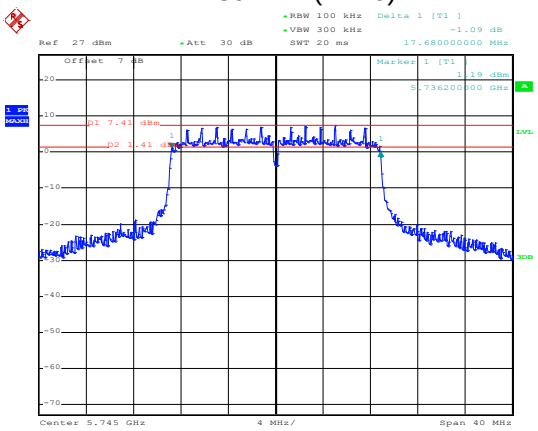
802.11a



Date: 13.APR.2020 15:14:01

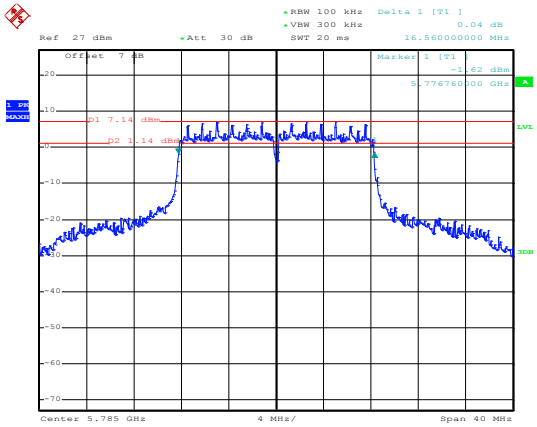
Lowest channel

802.11n(HT20)



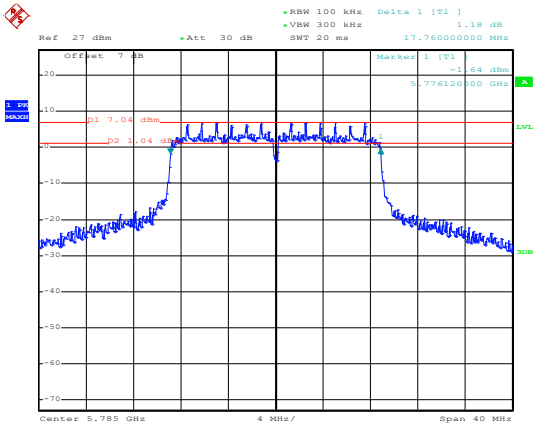
Date: 13.APR.2020 15:14:52

Lowest channel



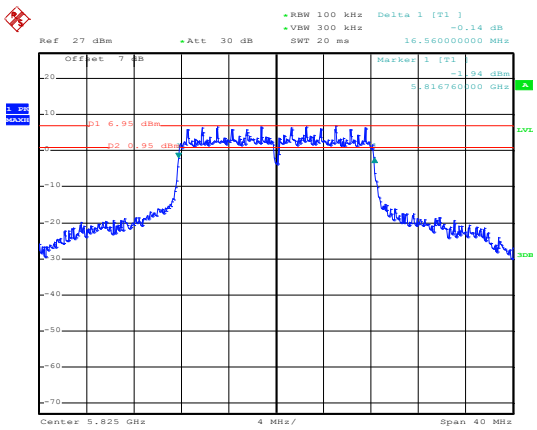
Date: 13.APR.2020 15:13:22

Middle channel



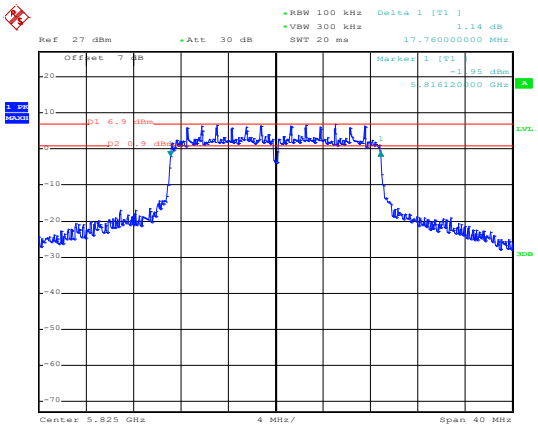
Date: 13.APR.2020 15:15:43

Middle channel



Date: 13.APR.2020 15:12:31

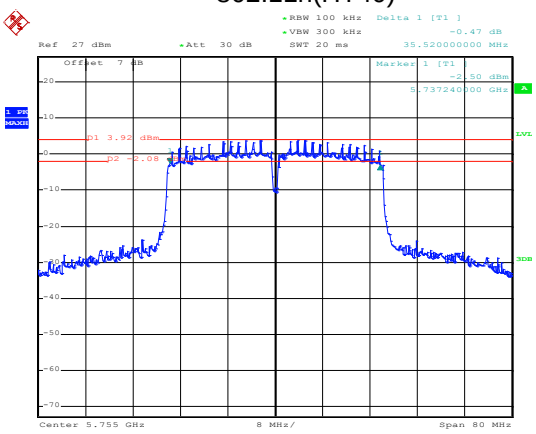
Highest channel



Date: 13.APR.2020 15:16:40

Highest channel

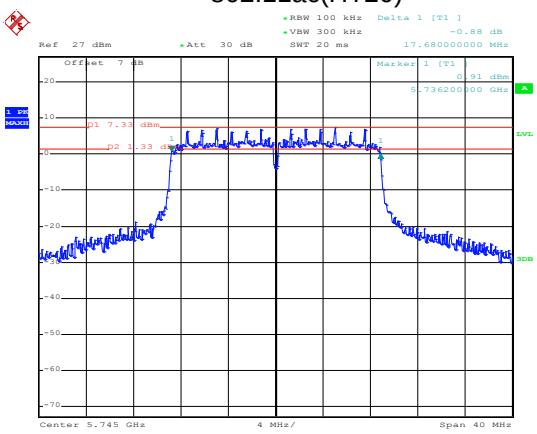
802.11n(HT40)



Date: 13.APR.2020 15:23:28

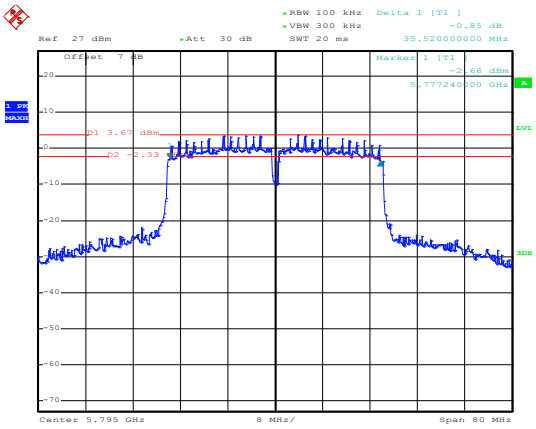
Lowest channel

802.11ac(HT20)



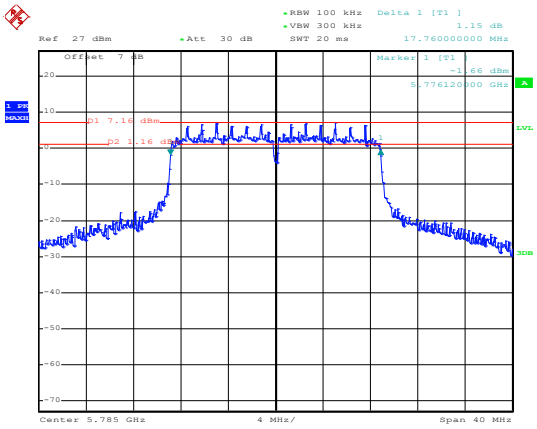
Date: 13.APR.2020 15:18:54

Lowest channel



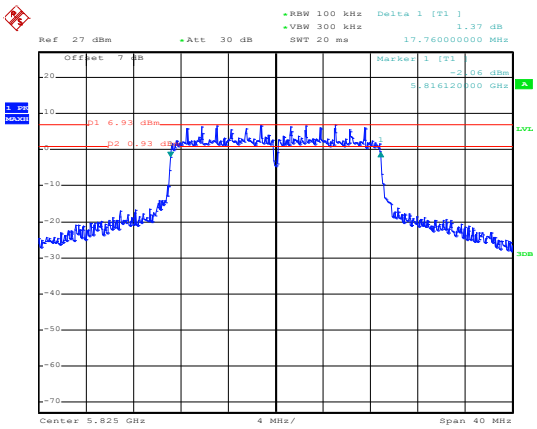
Date: 13.APR.2020 15:22:40

Highest channel



Date: 13.APR.2020 15:18:08

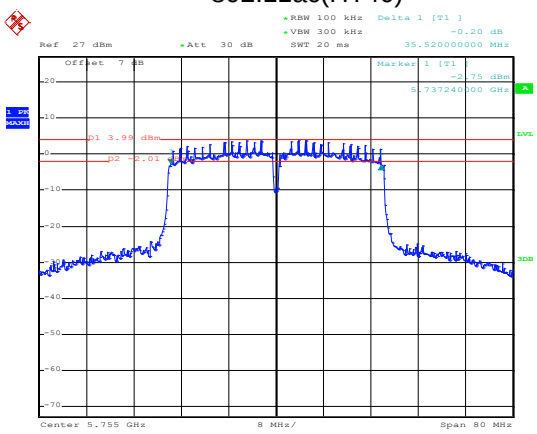
Middle channel



Date: 13.APR.2020 15:17:21

Highest channel

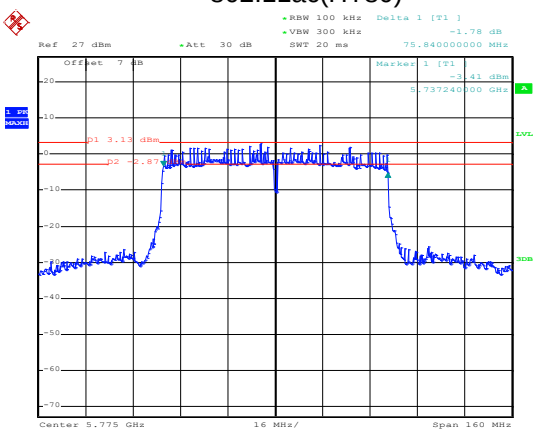
802.11ac(HT40)



Date: 13.APR.2020 15:20:16

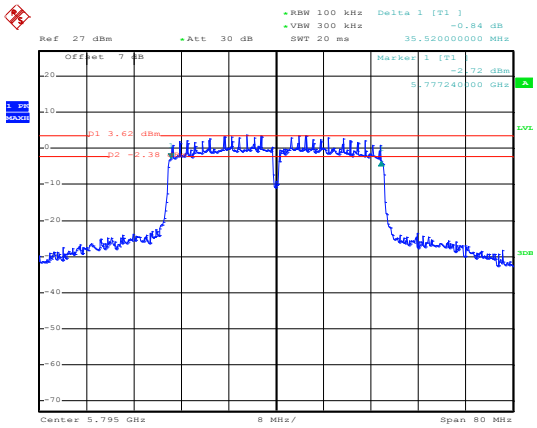
Lowest channel

802.11ac(HT80)



Date: 13.APR.2020 15:24:54

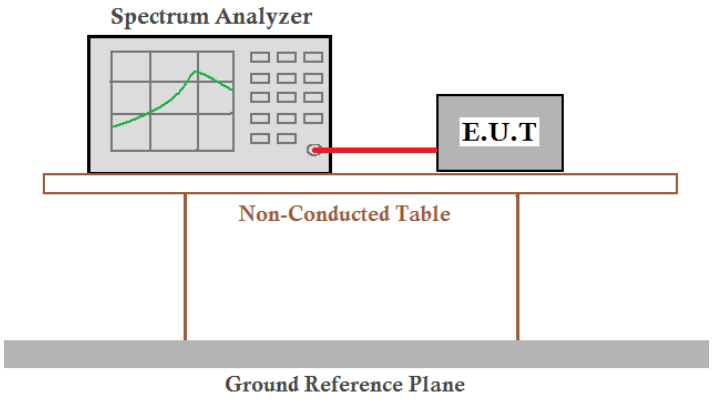
Middle channel



Date: 13.APR.2020 15:21:38

Highest channel

6.5 Power Spectral Density

Test Requirement:	FCC Part15 E Section 15.407 (a) (1) (iv) & (a)(3)
Limit:	Band 1: 11 dBm/MHz Band 4: 30 dBm/500kHz
Test setup:	
Test Instruments:	Refer to section 5.10 for details
Test mode:	Refer to section 5.3 for details
Test results:	Passed

Measurement Data:

Band 1						
Mode	Test CH	Ant. Port	Conducted P.S.D (dBm)	Total P.S.D (dBm)	Limit (dBm)	Result
802.11a	Lowest	ANT0	7.77	/	11.00	Pass
		ANT1	8.36			
	Middle	ANT0	7.90			
		ANT1	8.38			
	Highest	ANT0	7.44			
		ANT1	8.01			
802.11n20	Lowest	ANT0	6.36	9.38	*Ceramic Antenna:9.68 Planare WLAN Antenne:11.0 Whip Antenna:9.50*	Pass
		ANT1	6.37			
	Middle	ANT0	6.13	9.23		
		ANT1	6.30			
	Highest	ANT0	6.18	9.39		
		ANT1	6.58			
802.11n40	Lowest	ANT0	1.69	5.02	*Ceramic Antenna:9.68 Planare WLAN Antenne:11.0 Whip Antenna:9.50*	Pass
		ANT1	2.31			
	Highest	ANT0	3.99	7.21		
		ANT1	4.40			
802.11ac20	Lowest	ANT0	6.33	9.38	*Ceramic Antenna:9.68 Planare WLAN Antenne:11.0 Whip Antenna:9.50*	Pass
		ANT1	6.40			
	Middle	ANT0	6.20	9.29		
		ANT1	6.36			
	Highest	ANT0	6.02	9.29		
		ANT1	6.53			
802.11ac40	Lowest	ANT0	1.66	5.09	*Ceramic Antenna:9.68 Planare WLAN Antenne:11.0 Whip Antenna:9.50*	Pass
		ANT1	2.46			
	Highest	ANT0	3.73	7.08		
		ANT1	4.38			
802.11ac80	Lowest	ANT0	-0.18	3.11	*Ceramic Antenna:9.68 Planare WLAN Antenne:11.0 Whip Antenna:9.50*	Pass
		ANT1	0.36			

1. *Because transmit signals are correlated,* Directional gain = $G_{ANT} + 10\log(N_{ANT})$ dBi.
2. *So Ceramic Antenna: The Directional gain=4.32 + 10* $\log(2)$*=7.32dBi, The directional Gain of antenna is greater than 6 dBi, so the limit of P.S.D is 9.68 dBm (for 802.11n/ac).*

Planare WLAN Antenne The Directional gain=-3.6 + 10 $\log(2)$*=-0.6dBi, The directional Gain of antenna is less than 6 dBi, so the limit of P.S.D is 11.0 dBm (for 802.11n/ac).*

Whip Antenna: The Directional gain=4.5 + 10 $\log(2)$*=7.5dBi, The directional Gain of antenna is* greater *than 6dBi, so the limit of power is 9.50 dBm (for 802.11n/ac).*

Band 4						
Mode	Test CH	Ant. Port	Conducted P.S.D (dBm)	Total P.S.D (dBm)	Limit (dBm)	Result
802.11a	Lowest	ANT0	10.99	/	30.00	Pass
		ANT1	10.03			
	Middle	ANT0	10.03			
		ANT1	10.17			
	Highest	ANT0	10.21			
		ANT1	10.16			
802.11n20	Lowest	ANT0	9.48	12.53	*Ceramic Antenna:28.68 Planare WLAN Antenne28.25 Whip Antenna:28.00*	Pass
		ANT1	9.55			
	Middle	ANT0	9.58	12.62		
		ANT1	9.64			
	Highest	ANT0	10.09	12.73		
		ANT1	9.32			
802.11n40	Lowest	ANT0	5.64	8.50	*Ceramic Antenna:28.68 Planare WLAN Antenne28.25 Whip Antenna:28.0*	Pass
		ANT1	5.33			
	Highest	ANT0	5.44	8.59		
		ANT1	5.72			
802.11ac20	Lowest	ANT0	9.81	13.04	*Ceramic Antenna:28.68 Planare WLAN Antenne28.25 Whip Antenna:28.0*	Pass
		ANT1	10.24			
	Middle	ANT0	9.99	12.95		
		ANT1	9.88			
	Highest	ANT0	10.05	12.94		
		ANT1	9.80			
802.11ac40	Lowest	ANT0	5.32	8.52	*Ceramic Antenna:28.68 Planare WLAN Antenne28.25 Whip Antenna:28.00*	Pass
		ANT1	5.70			
	Highest	ANT0	5.44	8.41		
		ANT1	5.36			
802.11ac80	Lowest	ANT0	3.47	6.36	*Ceramic Antenna:28.68 Planare WLAN Antenne28.25 Whip Antenna:28.0*	Pass
		ANT1	3.23			

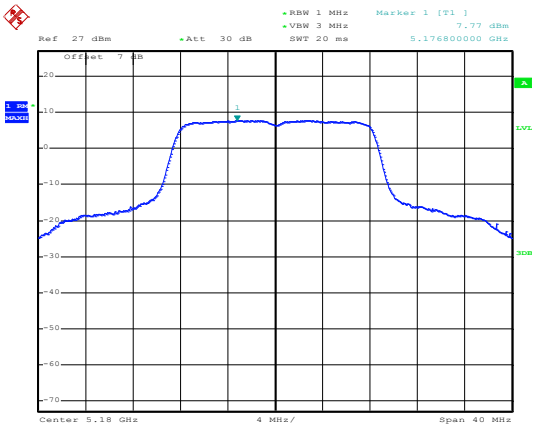
1. *Because transmit signals are correlated,* Directional gain = $G_{ANT} + 10\log(N_{ANT})$ dBi.
2. *So Ceramic Antenna: The Directional gain=4.32 + 10* $\log(2)$*=7.32dBi, The directional Gain of antenna is greater than 6 dBi, so the limit of P.S.D is 28.68 dBm (for 802.11n/ac).*
   Planare WLAN Antenne The Directional gain=4.75 + 10 $\log(2)$*=7.75dBi, The directional Gain of antenna is* greater *than 6 dBi, so the limit of P.S.D is 28.25 dBm (for 802.11n/ac).*
   Whip Antenna: The Directional gain=5 + 10 $\log(2)$*=8.0dBi, The directional Gain of antenna is* greater *than 6dBi, so the limit of P.S.D is 28.00 dBm (for 802.11n/ac).*

Test plot as follows:

ANT0

Band 1

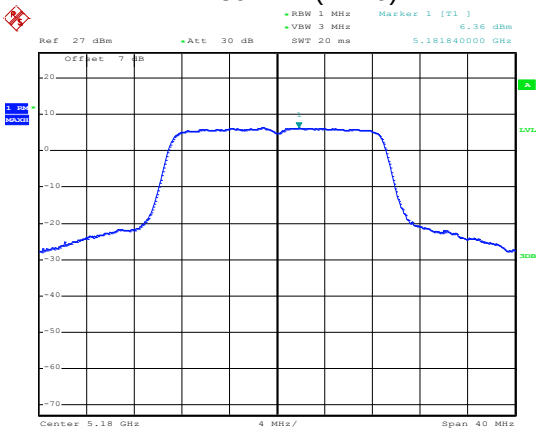
802.11a



Date: 6.MAY.2020 10:12:36

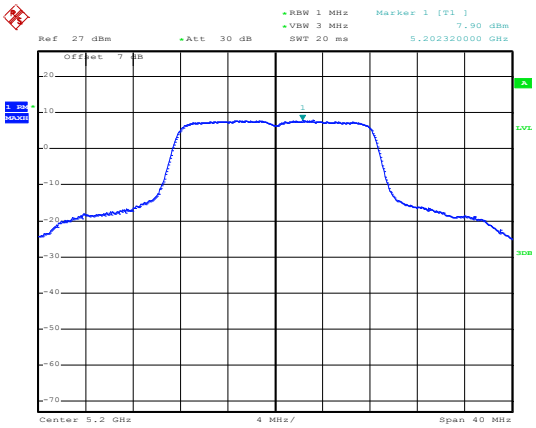
Lowest channel

802.11n(HT20)



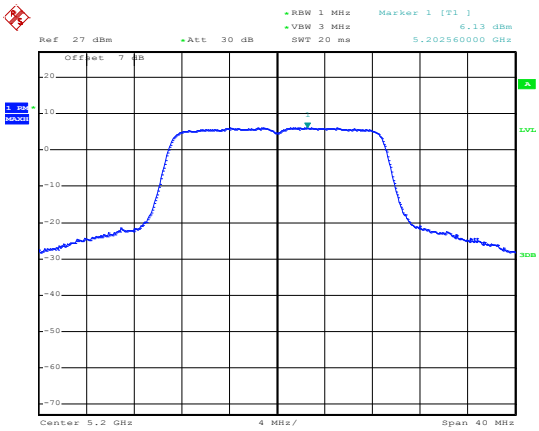
Date: 6.MAY.2020 14:13:46

Middle channel



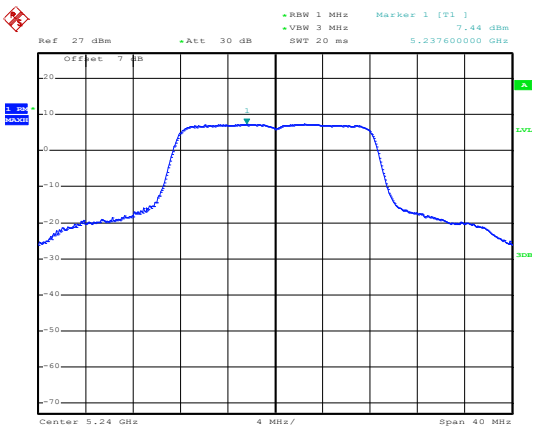
Date: 6.MAY.2020 10:12:48

Middle channel



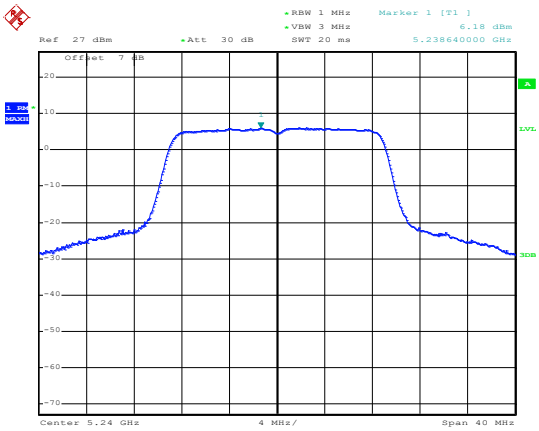
Date: 6.MAY.2020 14:14:29

Middle channel



Date: 6.MAY.2020 10:12:59

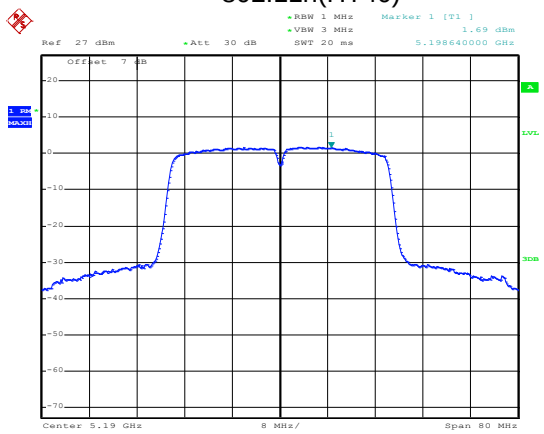
Highest channel



Date: 6.MAY.2020 14:14:47

Highest channel

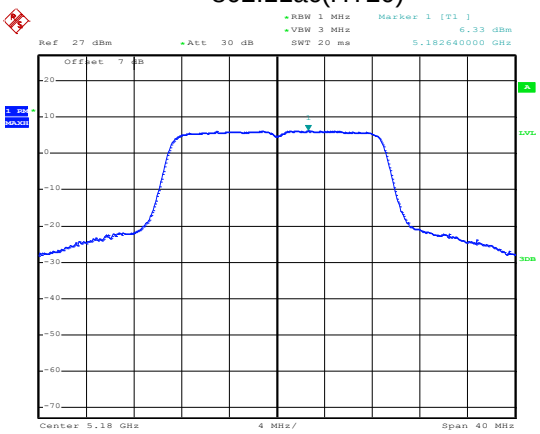
802.11n(HT40)



Date: 6.MAY.2020 14:34:50

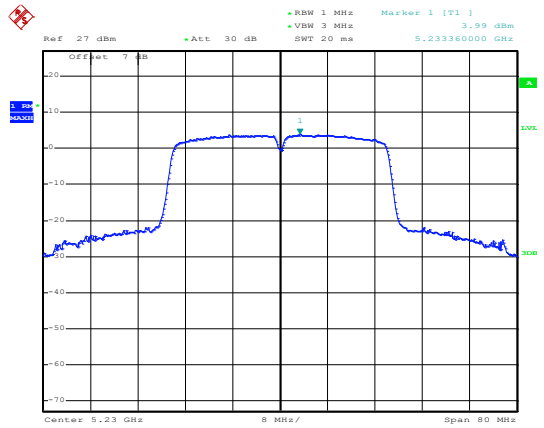
Lowest channel

802.11ac(HT20)



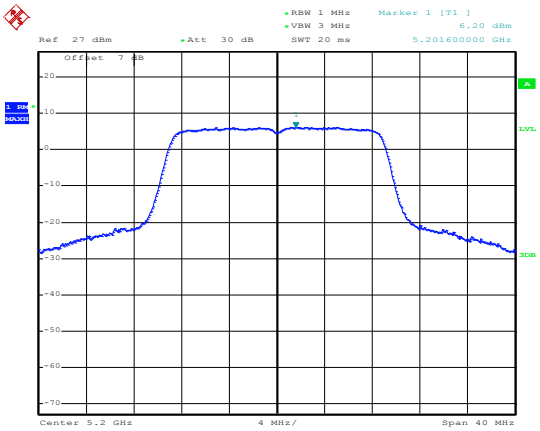
Date: 6.MAY.2020 14:15:33

Middle channel



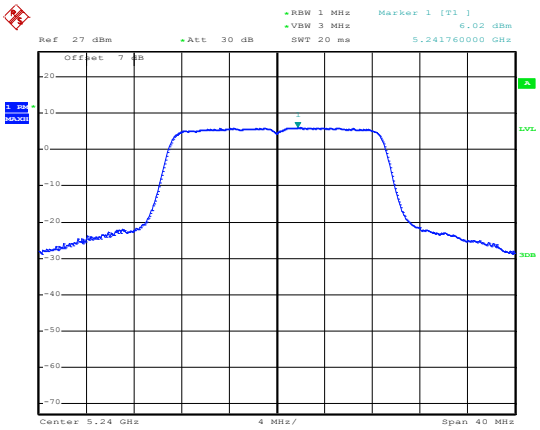
Date: 6.MAY.2020 10:11:35

Highest channel



Date: 6.MAY.2020 14:15:48

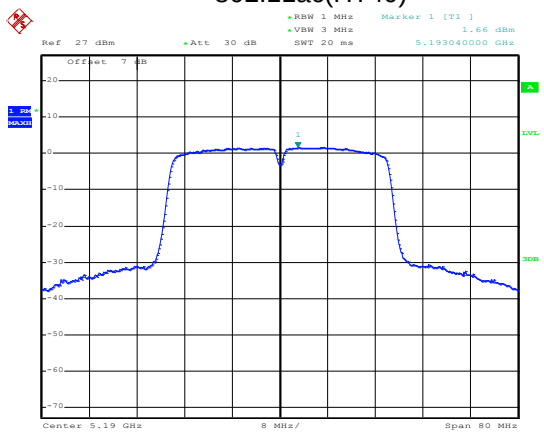
Middle channel



Date: 6.MAY.2020 14:16:07

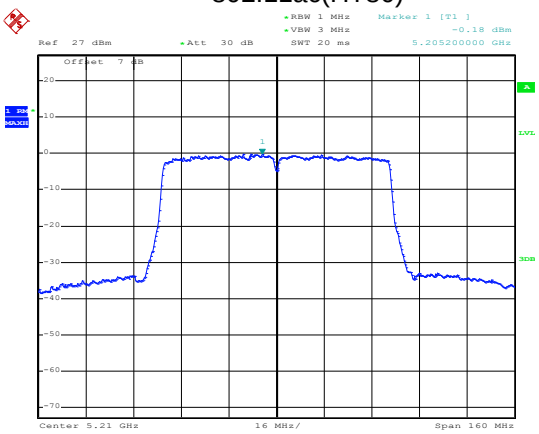
Highest channel

802.11ac(HT40)

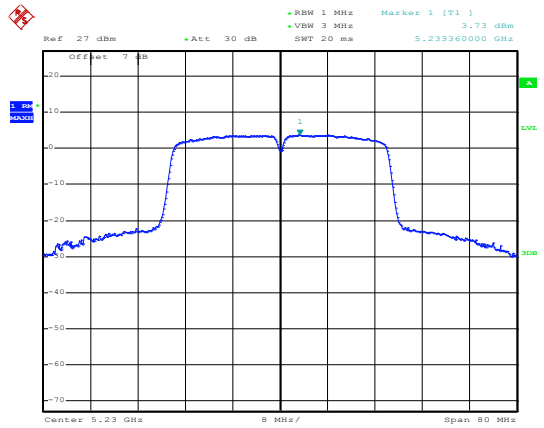


Lowest channel

802.11ac(HT80)



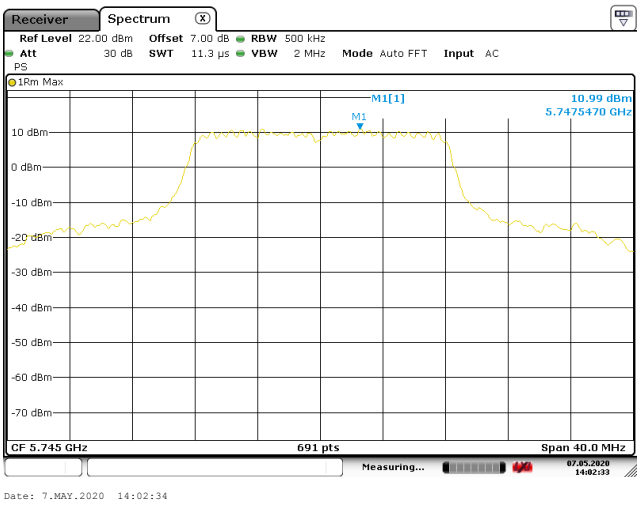
Middle channel



Highest channel

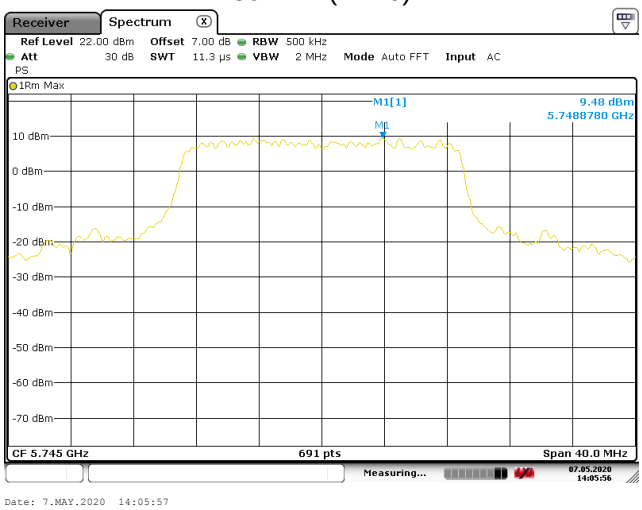
Band 4

802.11a

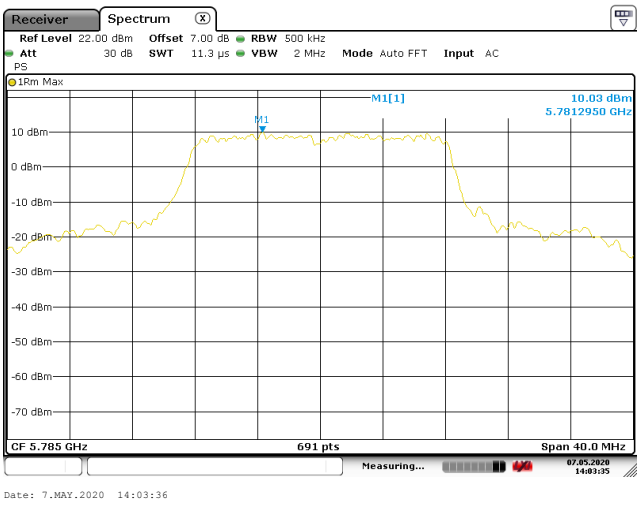


Lowest channel

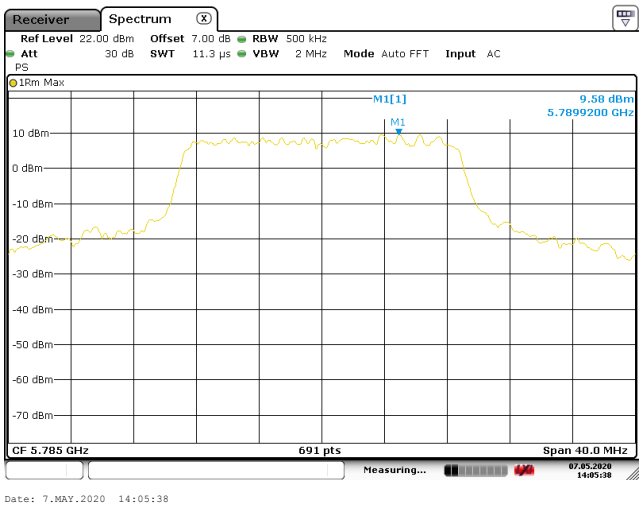
802.11n(HT20)



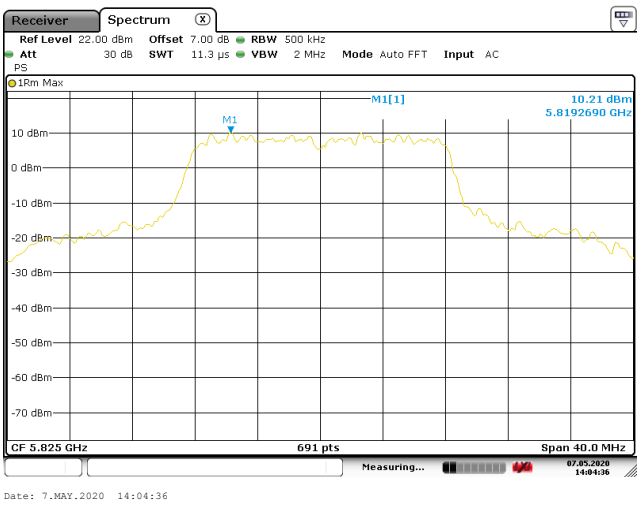
Middle channel



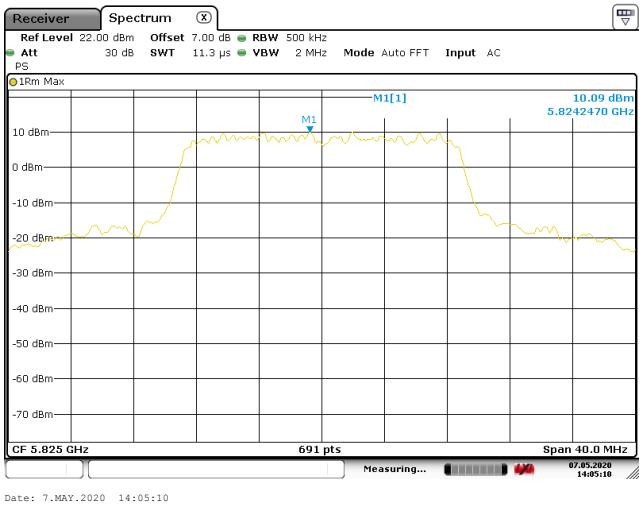
Middle channel



Middle channel



Highest channel



Highest channel