TESTING LABORATORY
CERTIFICATE #4820.01

FCC PART 15.407

TEST REPORT

For

Haverford Systems, Inc.

152 Robbins Road, Downingtown, Pennsylvania 19335, United States

FCC ID: 2ATNF20190701

Report Type:	**Product Name:**
Original Report	WirelessCable

Report Number: RDG190704004-00A

Report Date: 2019-07-19

Reviewed By: Jerry Zhang
EMC Manager

Jerry Zhang

Test Laboratory: Bay Area Compliance Laboratories Corp. (Dongguan)
No.69 Pulongcun, Puxinhu Industry Area,
Tangxia, Dongguan, Guangdong, China
Tel: +86-769-86858888
Fax: +86-769-86858891
www.baclcorp.com.cn

Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Dongguan). This report must not be used by the customer to claim product certification, approval, or endorsement by A2LA* or any agency of the Federal Government. * This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "*".

TABLE OF CONTENTS

GENERAL INFORMATION **4**
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT) 4
OBJECTIVE 4
RELATED SUBMITTAL(S)/GRANT(S) 4
TEST METHODOLOGY 4
MEASUREMENT UNCERTAINTY 5
TEST FACILITY 5
SYSTEM TEST CONFIGURATION **6**
DESCRIPTION OF TEST CONFIGURATION 6
EUT EXERCISE SOFTWARE 6
EQUIPMENT MODIFICATIONS 9
LOCAL SUPPORT EQUIPMENT LIST AND DETAILS 9
SUPPORT CABLE LIST AND DETAILS 9
BLOCK DIAGRAM OF TEST SETUP 10
SUMMARY OF TEST RESULTS **11**
FCC §15.407 (f) & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE) **12**
APPLICABLE STANDARD 12
FCC §15.203 – ANTENNA REQUIREMENT **13**
APPLICABLE STANDARD 13
ANTENNA CONNECTOR CONSTRUCTION 13
FCC §15.407 (b) (6) §15.207 (a) – CONDUCTED EMISSIONS **14**
APPLICABLE STANDARD 14
EUT SETUP 14
EMI TEST RECEIVER SETUP 14
CORRECTED AMPLITUDE & MARGIN CALCULATION 14
TEST EQUIPMENT LIST AND DETAILS 15
TEST PROCEDURE 15
TEST DATA 15
FCC §15.209, §15.205 & §15.407(b) –UNWANTED EMISSION **18**
APPLICABLE STANDARD 18
EUT SETUP 19
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP 20
TEST PROCEDURE 20
CORRECTED AMPLITUDE & MARGIN CALCULATION 21
TEST EQUIPMENT LIST AND DETAILS 22
TEST DATA 22
FCC §15.407(a)(e)–EMISSION BANDWIDTH AND OCCUPIED BANDWIDTH **34**
APPLICABLE STANDARD 34
TEST EQUIPMENT LIST AND DETAILS 34
TEST PROCEDURE 34
TEST DATA 34
FCC §15.407(a) –MAXIMUM CONDUCTED OUTPUT POWER **52**
APPLICABLE STANDARD 52
TEST EQUIPMENT LIST AND DETAILS 53

TEST PROCEDURE 53
TEST DATA 53

FCC §15.407(a) - POWER SPECTRAL DENSITY 55

APPLICABLE STANDARD 55
TEST PROCEDURE 56
TEST EQUIPMENT LIST AND DETAILS.....56
TEST DATA 56

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:		WirelessCable
EUT Model:		PT-WC-G1
Multiple Models:		PT-WC-PP-G1
Operation Frequency:		5180-5240(802.11a/n ht20) 5190-5230 MHz(802.11n ht40) 5745-5825(802.11a/n ht20) 5755-5795 MHz(802.11n ht40)
Maximum Output Power (Conducted):		5150-5250 MHz:16.46 dBm 5725-5850 MHz:17.03dBm
Modulation Type:		OFDM
Rated Input Voltage:		DC 12V from adapter
Adapter Information	**Model:**	GPE024C-120200-Z
	Input:	100-240V~50/60Hz 0.75A
	Output:	12V 2000mA 24W
External Dimension:		163mm(L)* 110mm(W)* 32mm(H)
Serial Number:		190704004
EUT Received Date:		2019-07-08

Note: Model PT-WC-G1 was selected for fully testing, the detailed information about the difference among PT-WC-PP-G1 and model PT-WC-G1can be referred to the declaration letter which was stated and guaranteed by the manufacturer.

Objective

This type approval report is prepared on behalf of ***Haverford Systems, Inc.*** in accordance with Part 2-Subpart J, Part 15-Subparts A, and E of the Federal Communications Commission's rules.

The tests were performed in order to determine compliance with FCC Rules Part 15, Subpart E, section 15.203, 15.205, 15.207, 15.209 and 15.407 rules.

Related Submittal(s)/Grant(s)

No Related Submittal(s)/Grant(s).

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices. And KDB 789033 D02 General U-NII Test Procedures New Rules v02r01.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan).

Measurement Uncertainty

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.61dB
Power Spectral Density, conducted	±0.61 dB
Unwanted Emissions, radiated	30M~200MHz: 4.55 dB,200M~1GHz: 5.92 dB,1G~6GHz: 4.98 dB, 6G~18GHz: 5.89 dB,18G~26.5G:5.47 dB,26.5G~40G:5.63 dB
Unwanted Emissions,conducted	±1.5 dB
Temperature	±1℃
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%
AC Power Lines Conducted Emission	3.12 dB (150 kHz to 30 MHz)

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 897218, the FCC Designation No. : CN1220.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0022.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The EUT was configured for testing in an engineering mode which was provided by the manufacturer.

The system only supports 802.11a/n ht20/n ht40 in 5.2G and 5.8 GHz band.

For 5150~5250 MHz band, 6 channels are provided:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
36	5180	44	5220
38	5190	46	5230
40	5200	48	5240

For 802.11a, 802.11n ht20 Channel 36, 40 and 48 was tested, for 802.11n ht40 Channel 38, 46 were tested.

For 5725~5850MHz band, 7 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
149	5745	159	5795
151	5755	161	5805
153	5765	165	5825
157	5785	/	/

For 802.11a, 802.11n ht20 Channel 149, 157 and 165 was tested, for 802.11n ht40 Channel 151, 159 were tested.

The device supports SISO and MIMO at 802.11n ht20/n ht40 mode, per pre-test, MIMO 4TX mode was the worst and reported.

EUT Exercise Software

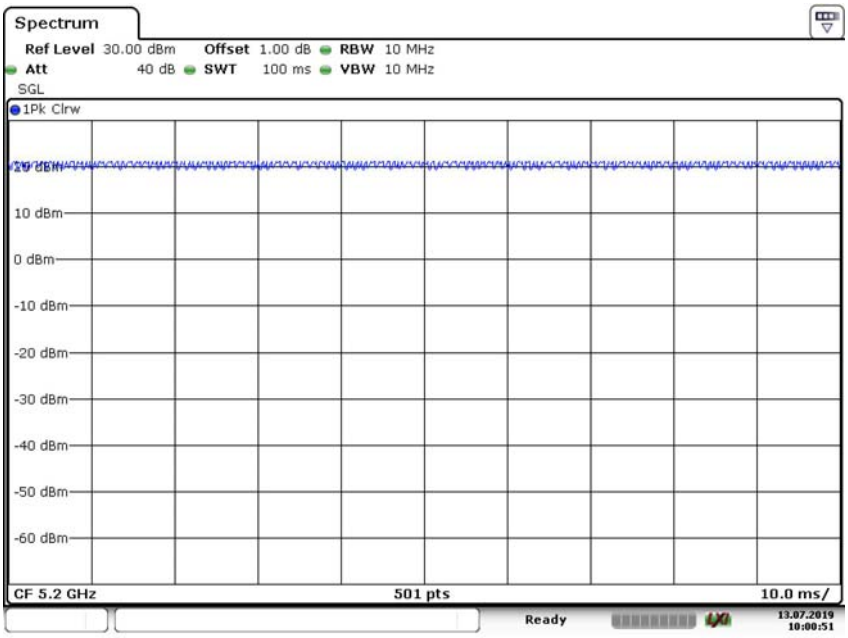
The software “CMD” was used for testing, the CMD command was provided by manufacturer. The worst-case data rates are determined to be as follows for each mode based upon investigations by measuring the average power and PSD across all data rates, bandwidths, and modulations. The maximum power was configured as below table, that provided by the manufacturer:

Band	Mode	Frequency (MHz)	Data Rate	Power level Setting			
				Chain 0	Chain 1	Chain 2	Chain 3
5.2G	802.11a	5180	6Mbps	16	16	16	15
		5200	6Mbps	16	16	16	15
		5240	6Mbps	16	16	16	15
	802.11n ht20	5180	MCS0	11	11	11	11
		5200	MCS0	11	11	11	11
		5240	MCS0	11	11	11	11
	802.11n ht 40	5190	MCS0	9	9	9	9
		5230	MCS0	12	12	12	12
5.8G	802.11a	5745	6Mbps	16	16	17	16
		5785	6Mbps	17	16	17	16
		5825	6Mbps	16	16	18	17
	802.11n ht20	5745	MCS0	11	11	11	11
		5785	MCS0	11	11	11	11
		5825	MCS0	11	11	11	11
	802.11n ht 40	5755	MCS0	11	11	11	11
		5795	MCS0	12	12	12	12

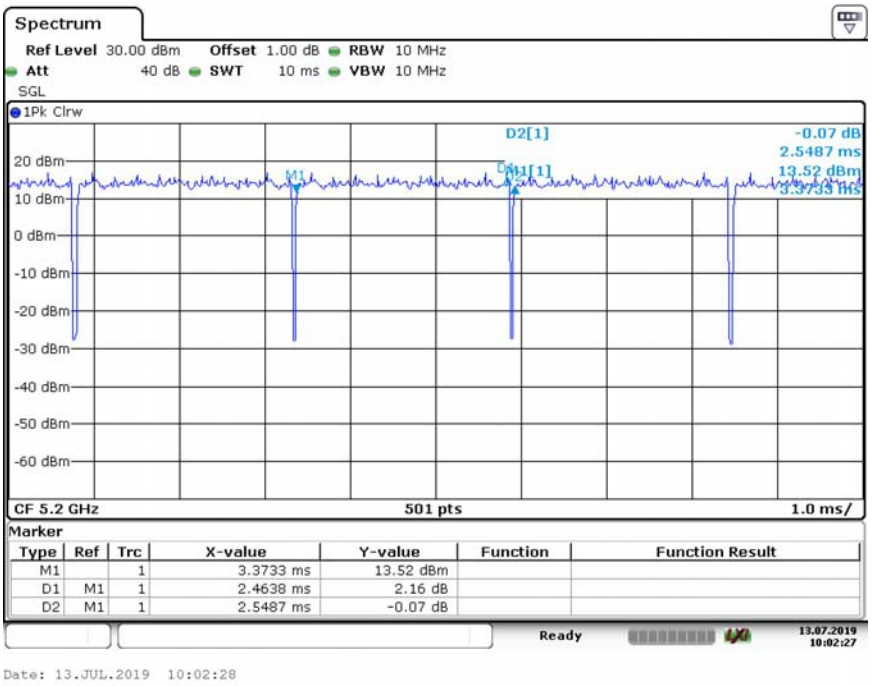
The duty cycle as below:

Mode	T_{on} (ms)	T_{on+off} (ms)	Duty Cycle(x) (%)	Ducycle Factor (10*log(1/x))
802.11 a	100	100	100	0
802.11n ht20	2.46	2.55	96.47	0.16
802.11n ht40	1.20	1.27	94.49	0.25

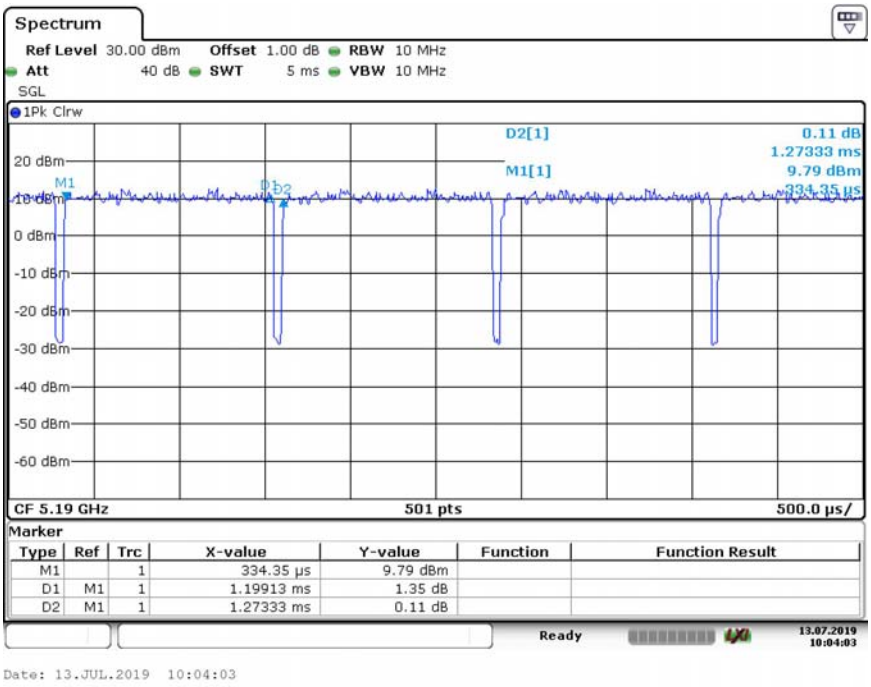
802.11a



802.11n ht20



802.11n ht40



Equipment Modifications

No modification was made to the EUT.

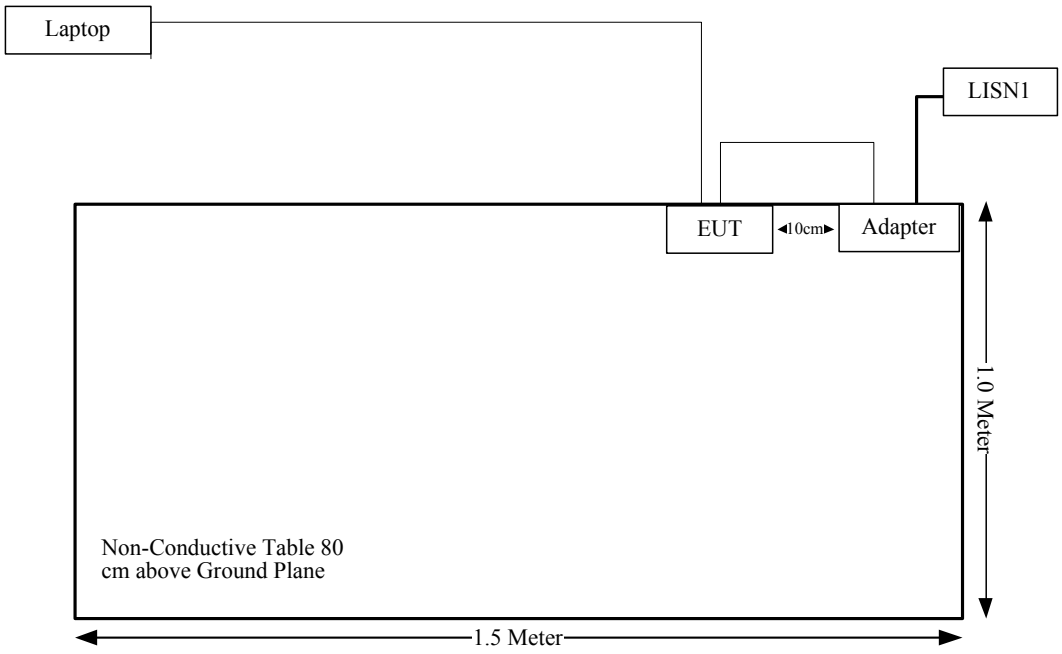
Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
DELL	Laptop	PP11L	QDS-BRCM1017

Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From	To
Power Cable	Yes	Yes	1.5	EUT	Adapter
RJ45 Cable	Yes	No	10	EUT	Laptop

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.407 (f) & §1.1310 & §2.1091	Maximum Permissable Exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.407(b)(6)& §15.207(a)	Conducted Emissions	Compliance
§15.205& §15.209 &§15.407(b)	Undesirable Emission& Restricted Bands	Compliance
§15.407(a)(e)	Emission Bandwidth	Compliance
§15.407(a)	Conducted Transmitter Output Power	Compliance
§15.407 (a)	Power Spectral Density	Compliance

FCC §15.407 (f) & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.407(f)and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (minutes)**
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f²)	30
30–300	27.5	0.073	0.2	30
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculation formula:

Prediction of power density at the distance of the applicable MPE limit
$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm^2);
P = power input to the antenna (in appropriate units, e.g., mW);
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

Calculated Data:

Frequency Range	**Antenna Gain**		**Max. Target Power including Tolerance**		**Evaluation Distance (cm)**	**Power Density (W/m^2)**	**MPE Limit (W/m^2)**
	(dBi)	**(numeric)**	**(dBm)**	**(mW)**			
5150-5250	5.5	3.55	17	50.12	20.00	0.04	1.0
5725-5850	5.5	3.55	17.5	56.23	20.00	0.04	1.0

Note 1: the Max. Target Power including Tolerance was declared by manufacturer.

Result: Compliance, The device meets MPE requirement for Devices Used by the General Public (Uncontrolled Environment) at distance ≥20 cm.

FCC §15.203 – ANTENNA REQUIREMENT

Applicable Standard

According to § 15.203, 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 shall be considered sufficient to comply with the provisions of this section. 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.

Antenna Connector Construction

The EUT has four external antennas, which uses a unique coupling to the intentional radiator, the antenna gains are 5.5 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

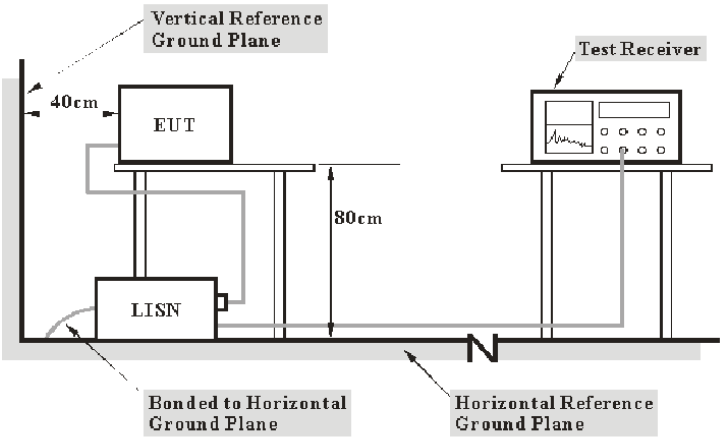
Result: Compliance.

FCC §15.407 (b) (6) §15.207 (a) – CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a), §15.407(b) (6)

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

The adapter was connected to the main lisn with a 120 V/60 Hz AC power source.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$V_C = V_R + A_C + VDF$
$C_f = A_C + VDF$

Herein,
V_C (cord. Reading): corrected voltage amplitude
V_R: reading voltage amplitude
A_c: attenuation caused by cable loss
VDF: voltage division factor of AMN
C_f: Correction Factor

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

Margin = Limit – Corrected Amplitude

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Unknown	Coaxial Cable	C-NJNJ-50	C-0200-01	2018-09-05	2019-09-05
R&S	Test Software	EMC32	Version8.53.0	N/A	N/A
R&S	Two-line V-network	ENV 216	101614	2018-12-10	2019-12-10
R&S	EMI Test Receiver	ESPI	100120	2019-05-09	2020-05-09

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

During the conducted emission test, the adapter was connected to the first LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

Test Data

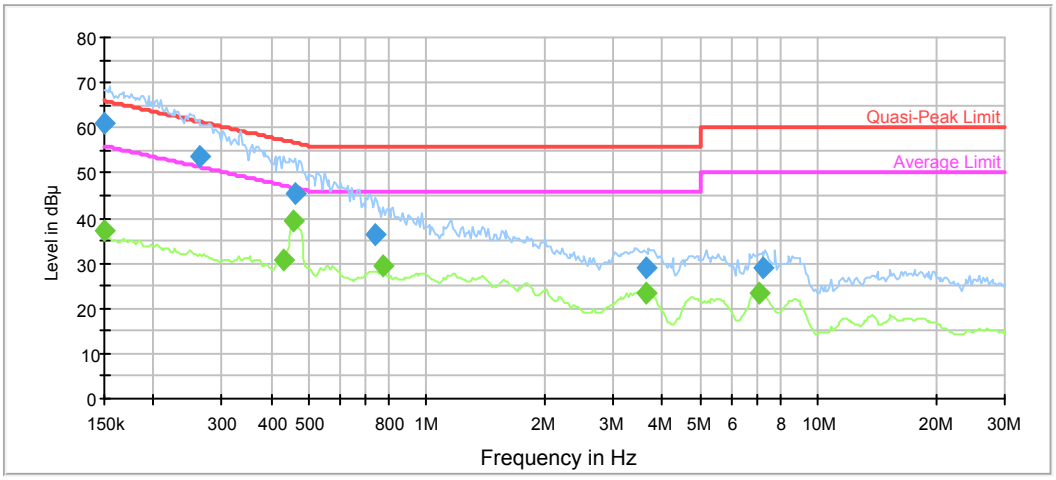
Environmental Conditions

Temperature:	29.2 °C
Relative Humidity:	63 %
ATM Pressure:	100.4 kPa

The testing was performed by Lily Xie on 2019-07-12.

Test Mode: Transmitting (802.11n ht20 5745MHz 4Tx was the worst)

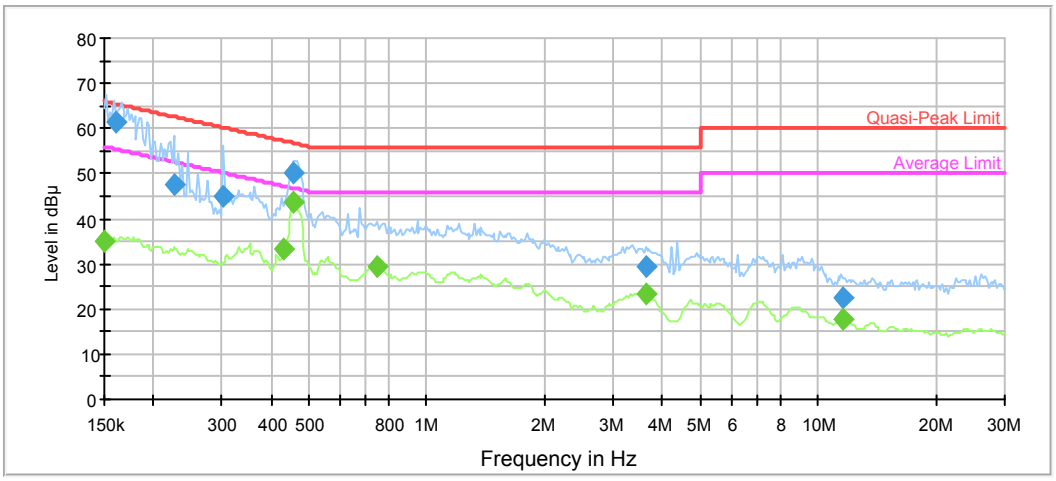
AC120 V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	61.1	9.000	L1	11.2	4.9	66.0
0.261872	53.7	9.000	L1	10.3	7.7	61.4
0.461750	45.5	9.000	L1	9.9	11.2	56.7
0.737074	36.4	9.000	L1	9.8	19.6	56.0
3.621856	29.0	9.000	L1	9.8	27.0	56.0
7.195742	29.1	9.000	L1	9.8	30.9	60.0

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	37.0	9.000	L1	11.2	19.0	56.0
0.430682	30.6	9.000	L1	9.9	16.6	47.2
0.457178	39.5	9.000	L1	9.9	7.2	46.7
0.774673	29.2	9.000	L1	9.8	16.8	46.0
3.621856	23.4	9.000	L1	9.8	22.6	46.0
7.054145	23.3	9.000	L1	9.8	26.7	50.0

AC120 V, 60 Hz, Neutral:



Frequency (MHz)	QuasiPeak (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.160000	61.3	9.000	N	11.2	4.1	65.4
0.225563	47.8	9.000	N	10.5	12.8	62.6
0.301015	45.1	9.000	N	10.1	15.1	60.2
0.457178	50.1	9.000	N	9.9	6.6	56.7
3.621856	29.3	9.000	N	9.8	26.7	56.0
11.601974	22.6	9.000	N	9.8	37.4	60.0

Frequency (MHz)	Average (dBµV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)
0.150000	35.2	9.000	N	11.2	20.8	56.0
0.430682	33.2	9.000	N	9.9	14.0	47.2
0.457178	43.7	9.000	N	9.9	3.0	46.7
0.744445	29.4	9.000	N	9.8	16.6	46.0
3.621856	23.5	9.000	N	9.8	22.5	46.0
11.601974	17.6	9.000	N	9.8	32.4	50.0

FCC §15.209, §15.205 & §15.407(b) –UNWANTED EMISSION

Applicable Standard

FCC §15.407; §15.209; §15.205;

(b) Undesirable emission limits. Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(1) For transmitters operating in the 5.15-5.25 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-5.725 GHz band shall not exceed an e.i.r.p. of −27 dBm/MHz.

(4) For transmitters operating in the 5.725-5.85 GHz band:

(i) All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

(ii) Devices certified before March 2, 2017 with antenna gain greater than 10 dBi may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease by March 2, 2018. Devices certified before March 2, 2018 with antenna gain of 10 dBi or less may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease before March 2, 2020.

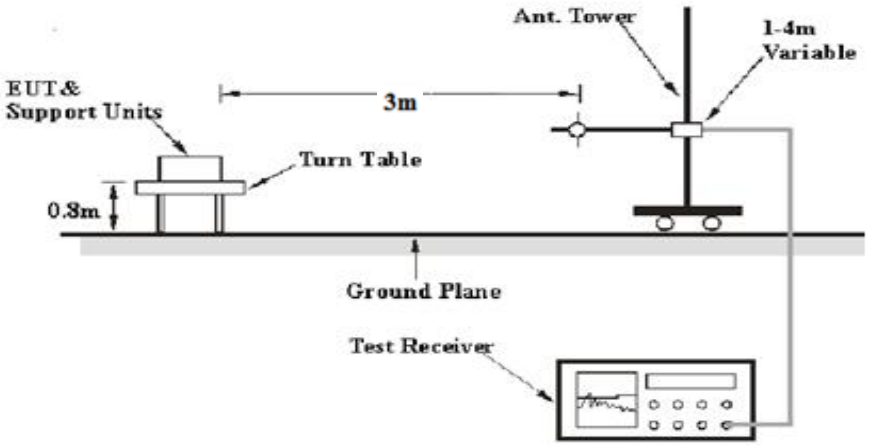
(5) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

(6) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

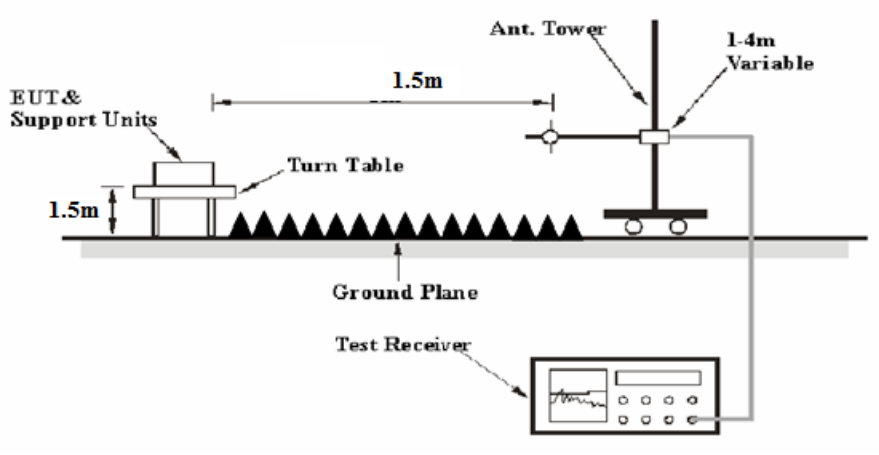
(7) The provisions of §15.205 apply to intentional radiators operating under this section.

EUT Setup

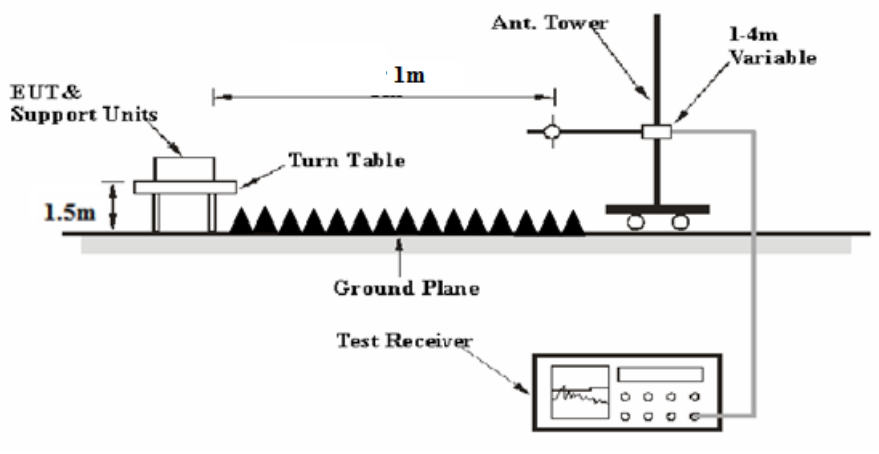
Below 1 GHz:



1-26.5 GHz:



26.5-40 GHz:



The radiated emission Below 1GHz tests were performed in the 10 meters chamber test site, above 1GHz tests were performed in the 3 meters chamber test site B, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.407 limits

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 40 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

30-1000MHz:

Measurement	RBW	Video B/W	IF B/W
QP	120 kHz	300 kHz	120kHz

1GHz- 40GHz:

Measurement	Duty cycle	RBW	Video B/W
PK	Any	1MHz	3 MHz
Ave.	>98%	1MHz	10 Hz
	<98%	1MHz	1/T

Note: T is minimum transmission duration

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

Test Procedure

During the radiated emission test, the adapter was connected to the first AC floor outlet.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1GHz, peak and Average detection modes for frequencies above 1GHz.

According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, emission shall be computed as: E [dBμV/m] = EIRP[dBm] + 95.2, for d = 3 meters.

According to C63.10, the above 1G test result shall be extrapolated to the specified distance using an extrapolation factor of 20dB/decade from 3m to 1.5m or 1m
Distance extrapolation factor =20 log (specific distance [3m]/test distance [1.5m]) dB= 6.02 dB
or
Distance extrapolation factor =20 log (specific distance [3m]/test distance [1m]) dB= 9.54 dB

All emissions under the average limit and under the noise floor have not recorded in the report.

Corrected Amplitude & Margin Calculation

For the range 30MHz-1GHz, the Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

Margin = Limit - Corrected Amplitude

For the range 1GHz-40GHz, Test performed at 1.5m or 1m, the Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading and the Distance extrapolation factor. The basic equation is as follows:

Corrected Amplitude
= Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain-Distance extrapolation factor

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

Margin = Limit- Corrected Amplitude

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESR3	102453	2019-06-26	2020-06-26
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2020-11-10
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2018-09-05	2019-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2018-09-05	2019-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-1400-01	2019-05-06	2020-05-06
HP	Amplifier	8447D	2727A05902	2018-09-05	2019-09-05
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2018-08-03	2019-08-03
R&S	Spectrum Analyzer	FSP 38	100478	2019-05-09	2020-05-09
TDK RF	Horn Antenna	HRN-0118	130 084	2018-10-12	2021-10-12
Ducommun Technolagies	Horn Antenna	ARH-4223-02	1007726-01 1304	2016-11-18	2019-11-18
Ducommun Technolagies	Horn Antenna	ARH-2823-02	1007726-01 1302	2016-11-18	2019-11-18
MICRO-COAX	Coaxial Cable	UFA147-1-2362-100100	64639 231029-001	2019-02-24	2020-02-24
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2018-09-05	2019-09-05
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2019-06-27	2020-06-27
Sinoscite	Bandstop Filters	BSF5150-5850MN-0899-003	0899003	2019-05-06	2020-05-06
Mini Circuits	High Pass Filter	VHF-6010+	31118	2019-06-16	2020-06-16

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

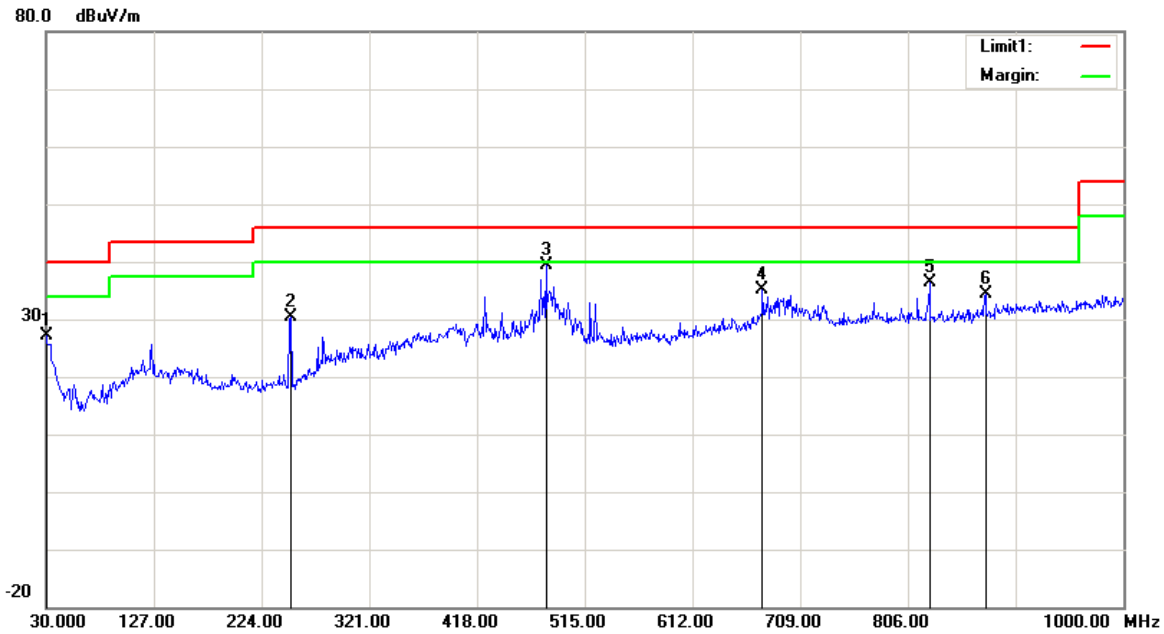
Environmental Conditions

Test Items	Radiation Below 1GHz	Radiation Above 1GHz
Temperature:	29.1 °C	29.1 °C
Relative Humidity:	54%	50 %
ATM Pressure:	100.4 kPa	100.1 kPa
Tester:	Vern Shen	Tyler Pan
Test Date:	2019-07-09	2019-07-16

Test Mode: Transmitting

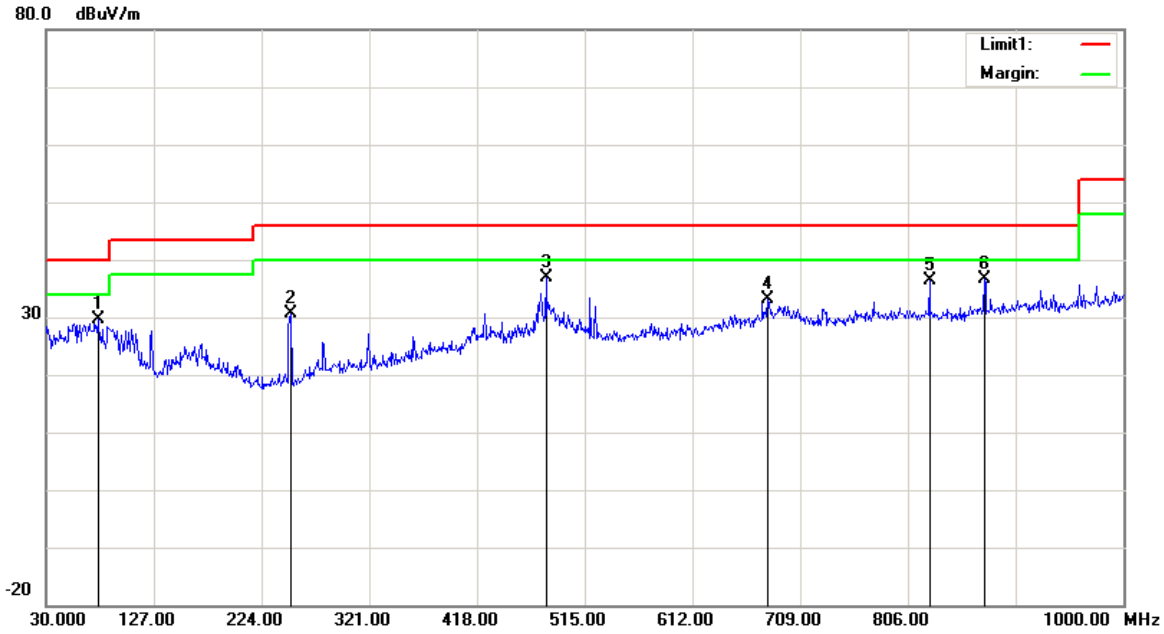
Below 1GHz (802.11n ht20, 5745 MHz 4Tx was the worst):

Horizontal



Frequency (MHz)	Receiver Reading (dBµV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBµV/m)	Limit (dBµV/m)	Margin (dB)
30.0000	25.36	peak	1.72	27.08	40.00	12.92
250.1900	36.47	peak	-6.03	30.44	46.00	15.56
480.0800	39.63	peak	-0.27	39.36	46.00	6.64
675.0500	32.57	peak	2.50	35.07	46.00	10.93
825.4000	31.41	peak	5.05	36.46	46.00	9.54
875.8400	28.77	peak	5.51	34.28	46.00	11.72

Vertical



Frequency (MHz)	Receiver Reading (dBµV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBµV/m)	Limit (dBµV/m)	Margin (dB)
76.5600	40.67	peak	-11.08	29.59	40.00	10.41
250.1900	36.66	peak	-6.03	30.63	46.00	15.37
480.0800	37.09	peak	-0.27	36.82	46.00	9.18
679.9000	30.56	peak	2.66	33.22	46.00	12.78
825.4000	31.34	peak	5.05	36.39	46.00	9.61
874.8700	31.05	peak	5.48	36.53	46.00	9.47

1GHz-40GHz:
5150-5250MHz
802.11a (Chain 0 was the worst)

Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBµV/m)	Extrapolation result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	Detector	Polar (H/V)	Factor (dB/m)						
Low Channel: 5180 MHz										
5180.00	68.25	PK	H	30.46	4.71	0.00	103.42	97.4	N/A	N/A
5180.00	58.76	AV	H	30.46	4.71	0.00	93.93	87.91	N/A	N/A
5180.00	82.94	PK	V	30.46	4.71	0.00	118.11	112.09	N/A	N/A
5180.00	73.39	AV	V	30.46	4.71	0.00	108.56	102.54	N/A	N/A
5150.00	23.66	PK	V	30.40	4.70	0.00	58.76	52.74	74.00	21.26
5150.00	21.35	AV	V	30.40	4.70	0.00	56.45	50.43	54.00	3.57
10360.00	46.58	PK	V	37.10	6.91	26.86	63.73	57.71	68.20	10.49
15540.00	40.35	PK	V	36.79	8.39	25.66	59.87	53.85	74.00	20.15
15540.00	27.77	AV	V	36.79	8.39	25.66	47.29	41.27	54.00	12.73
Middle Channel: 5200 MHz										
5200.00	68.36	PK	H	30.50	4.71	0.00	103.57	97.55	N/A	N/A
5200.00	58.70	AV	H	30.50	4.71	0.00	93.91	87.89	N/A	N/A
5200.00	82.59	PK	V	30.50	4.71	0.00	117.80	111.78	N/A	N/A
5200.00	73.10	AV	V	30.50	4.71	0.00	108.31	102.29	N/A	N/A
10400.00	45.67	PK	V	37.16	6.92	26.84	62.91	56.89	68.20	11.31
15600.00	40.51	PK	V	36.78	8.43	25.97	59.75	53.73	74.00	20.27
15600.00	28.15	AV	V	36.78	8.43	25.97	47.39	41.37	54.00	12.63
High Channel: 5240 MHz										
5240.00	67.71	PK	H	30.58	4.75	0.00	103.04	97.02	N/A	N/A
5240.00	57.33	AV	H	30.58	4.75	0.00	92.66	86.64	N/A	N/A
5240.00	82.93	PK	V	30.58	4.75	0.00	118.26	112.24	N/A	N/A
5240.00	73.65	AV	V	30.58	4.75	0.00	108.98	102.96	N/A	N/A
5350.00	31.63	PK	V	30.80	4.84	0.00	67.27	61.25	74.00	12.75
5350.00	16.66	AV	V	30.80	4.84	0.00	52.30	46.28	54.00	7.72
10480.00	47.10	PK	V	37.27	6.94	27.02	64.29	58.27	68.20	9.93
15720.00	40.99	PK	V	36.76	8.51	25.68	60.58	54.56	74.00	19.44
15720.00	28.46	AV	V	36.76	8.51	25.68	48.05	42.03	54.00	11.97

802.11n ht20(4Tx was the worst)

Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Extrapolation result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)						
Low Channel: 5180 MHz										
5180.00	70.36	PK	H	30.46	4.71	0.00	105.53	99.51	N/A	N/A
5180.00	60.77	AV	H	30.46	4.71	0.00	95.94	89.92	N/A	N/A
5180.00	84.76	PK	V	30.46	4.71	0.00	119.93	113.91	N/A	N/A
5180.00	75.16	AV	V	30.46	4.71	0.00	110.33	104.31	N/A	N/A
5150.00	34.65	PK	V	30.40	4.70	0.00	69.75	63.73	74.00	10.27
5150.00	20.98	AV	V	30.40	4.70	0.00	56.08	50.06	54.00	3.94
10360.00	44.34	PK	V	37.10	6.91	26.86	61.49	55.47	68.20	12.73
15540.00	40.64	PK	V	36.79	8.39	25.66	60.16	54.14	74.00	19.86
15540.00	28.13	AV	V	36.79	8.39	25.66	47.65	41.63	54.00	12.37
Middle Channel: 5200 MHz										
5200.00	69.88	PK	H	30.50	4.71	0.00	105.09	99.07	N/A	N/A
5200.00	60.21	AV	H	30.50	4.71	0.00	95.42	89.4	N/A	N/A
5200.00	84.69	PK	V	30.50	4.71	0.00	119.90	113.88	N/A	N/A
5200.00	75.03	AV	V	30.50	4.71	0.00	110.24	104.22	N/A	N/A
10400.00	44.96	PK	V	37.16	6.92	26.84	62.20	56.18	68.20	12.02
15600.00	40.13	PK	V	36.78	8.43	25.97	59.37	53.35	74.00	20.65
15600.00	27.78	AV	V	36.78	8.43	25.97	47.02	41	54.00	13.00
High Channel: 5240 MHz										
5240.00	69.83	PK	H	30.58	4.75	0.00	105.16	99.14	N/A	N/A
5240.00	60.32	AV	H	30.58	4.75	0.00	95.65	89.63	N/A	N/A
5240.00	84.68	PK	V	30.58	4.75	0.00	120.01	113.99	N/A	N/A
5240.00	74.71	AV	V	30.58	4.75	0.00	110.04	104.02	N/A	N/A
5350.00	32.47	PK	V	30.80	4.84	0.00	68.11	62.09	74.00	11.91
5350.00	18.04	AV	V	30.80	4.84	0.00	53.68	47.66	54.00	6.34
10480.00	44.87	PK	V	37.27	6.94	27.02	62.06	56.04	68.20	12.16
15720.00	40.87	PK	V	36.76	8.51	25.68	60.46	54.44	74.00	19.56
15720.00	28.45	AV	V	36.76	8.51	25.68	48.04	42.02	54.00	11.98

802.11n ht40(4Tx was the worst)

Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Extrapolation result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)						
Low Channel: 5190 MHz										
5190.00	64.60	PK	H	30.48	4.71	0.00	99.79	93.77	N/A	N/A
5190.00	54.59	AV	H	30.48	4.71	0.00	89.78	83.76	N/A	N/A
5190.00	80.25	PK	V	30.48	4.71	0.00	115.44	109.42	N/A	N/A
5190.00	69.73	AV	V	30.48	4.71	0.00	104.92	98.9	N/A	N/A
5150.00	35.93	PK	V	30.40	4.70	0.00	71.03	65.01	74.00	8.99
5150.00	22.87	AV	V	30.40	4.70	0.00	57.97	51.95	54.00	2.05
10380.00	43.17	PK	V	37.13	6.92	26.85	60.37	54.35	68.20	13.85
15570.00	40.86	PK	V	36.79	8.41	25.82	60.24	54.22	74.00	19.78
15570.00	28.36	AV	V	36.79	8.41	25.82	47.74	41.72	54.00	12.28
High Channel: 5230 MHz										
5230.00	66.91	PK	H	30.56	4.74	0.00	102.21	96.19	N/A	N/A
5230.00	57.38	AV	H	30.56	4.74	0.00	92.68	86.66	N/A	N/A
5230.00	83.09	PK	V	30.56	4.74	0.00	118.39	112.37	N/A	N/A
5230.00	73.34	AV	V	30.56	4.74	0.00	108.64	102.62	N/A	N/A
5350.00	33.10	PK	V	30.80	4.84	0.00	68.74	62.72	74.00	11.28
5350.00	17.13	AV	V	30.80	4.84	0.00	52.77	46.75	54.00	7.25
10460.00	45.87	PK	V	37.24	6.93	26.98	63.06	57.04	68.20	11.16
15690.00	40.56	PK	V	36.76	8.49	25.71	60.10	54.08	74.00	19.92
15690.00	27.77	AV	V	36.76	8.49	25.71	47.31	41.29	54.00	12.71

5725-5850MHz
802.11a (Chain 0 was the worst)

Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Extrapolation result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)						
Low Channel: 5745 MHz										
5745.00	66.55	PK	H	31.44	4.96	0.00	102.95	96.93	N/A	N/A
5745.00	56.35	AV	H	31.44	4.96	0.00	92.75	86.73	N/A	N/A
5745.00	83.54	PK	V	31.44	4.96	0.00	119.94	113.92	N/A	N/A
5745.00	73.10	AV	V	31.44	4.96	0.00	109.50	103.48	N/A	N/A
5725.00	52.18	PK	V	31.42	4.96	0.00	88.56	82.54	122.20	39.66
5720.00	45.04	PK	V	31.41	4.96	0.00	81.41	75.39	110.80	35.41
5700.00	35.05	PK	V	31.38	4.97	0.00	71.40	65.38	105.20	39.82
5650.00	32.97	PK	V	31.31	4.95	0.00	69.23	63.21	68.20	4.99
11490.00	39.13	PK	V	38.29	6.98	26.57	57.83	51.81	74.00	22.19
11490.00	26.84	AV	V	38.29	6.98	26.57	45.54	39.52	54.00	14.48
17235.00	41.63	PK	V	41.02	9.01	25.11	66.55	60.53	68.20	7.67
Middle Channel: 5785 MHz										
5785.00	66.19	PK	H	31.50	4.94	0.00	102.63	96.61	N/A	N/A
5785.00	56.32	AV	H	31.50	4.94	0.00	92.76	86.74	N/A	N/A
5785.00	83.69	PK	V	31.50	4.94	0.00	120.13	114.11	N/A	N/A
5785.00	73.45	AV	V	31.50	4.94	0.00	109.89	103.87	N/A	N/A
11570.00	38.96	PK	V	38.36	6.98	26.97	57.33	51.31	74.00	22.69
11570.00	26.78	AV	V	38.36	6.98	26.97	45.15	39.13	54.00	14.87
17355.00	41.34	PK	V	41.28	9.04	25.16	66.50	60.48	68.20	7.72
High Channel: 5825 MHz										
5825.00	67.18	PK	H	31.56	4.94	0.00	103.68	97.66	N/A	N/A
5825.00	57.43	AV	H	31.56	4.94	0.00	93.93	87.91	N/A	N/A
5825.00	85.25	PK	V	31.56	4.94	0.00	121.75	115.73	N/A	N/A
5825.00	75.61	AV	V	31.56	4.94	0.00	112.11	106.09	N/A	N/A
5850.00	38.36	PK	V	31.59	4.95	0.00	74.90	68.88	122.20	53.32
5855.00	38.64	PK	V	31.60	4.95	0.00	75.19	69.17	110.80	41.63
5875.00	34.92	PK	V	31.63	4.95	0.00	71.50	65.48	105.20	39.72
5925.00	32.16	PK	V	31.70	4.95	0.00	68.81	62.79	68.20	5.41
11650.00	39.06	PK	V	38.42	6.99	26.84	57.63	51.61	74.00	22.39
11650.00	26.78	AV	V	38.42	6.99	26.84	45.35	39.33	54.00	14.67
17475.00	41.64	PK	V	41.55	9.06	24.55	67.70	61.68	68.20	6.52

802.11n ht20(4Tx was the worst)

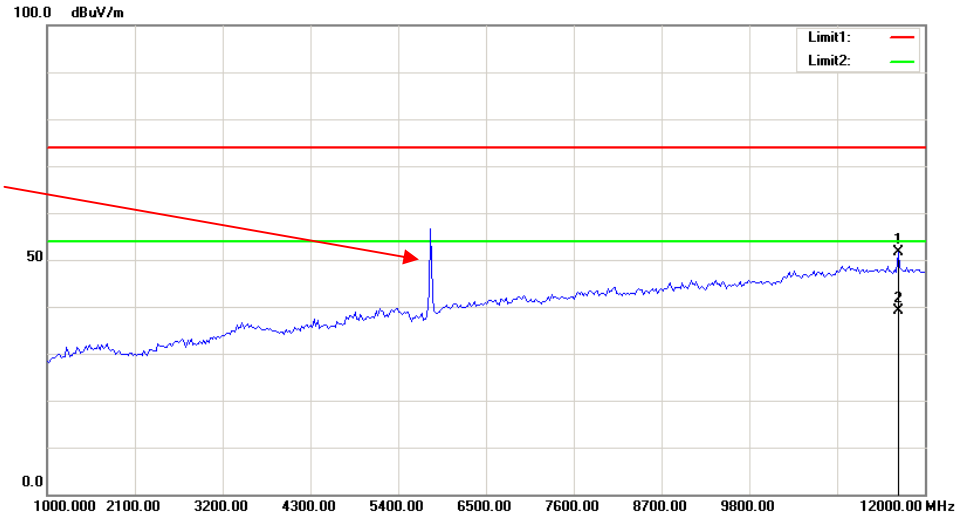
Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Extrapolation result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)						
Low Channel: 5745 MHz										
5745.00	67.27	PK	H	31.44	4.96	0.00	103.67	97.65	N/A	N/A
5745.00	57.54	AV	H	31.44	4.96	0.00	93.94	87.92	N/A	N/A
5745.00	84.78	PK	V	31.44	4.96	0.00	121.18	115.16	N/A	N/A
5745.00	75.22	AV	V	31.44	4.96	0.00	111.62	105.6	N/A	N/A
5725.00	52.35	PK	V	31.42	4.96	0.00	88.73	82.71	122.20	39.49
5720.00	41.77	PK	V	31.41	4.96	0.00	78.14	72.12	110.80	38.68
5700.00	33.54	PK	V	31.38	4.97	0.00	69.89	63.87	105.20	41.33
5650.00	32.50	PK	V	31.31	4.95	0.00	68.76	62.74	68.20	5.46
11490.00	38.78	PK	V	38.29	6.98	26.57	57.48	51.46	74.00	22.54
11490.00	26.34	AV	V	38.29	6.98	26.57	45.04	39.02	54.00	14.98
17235.00	41.63	PK	V	41.02	9.01	25.11	66.55	60.53	68.20	7.67
Middle Channel: 5785 MHz										
5785.00	67.56	PK	H	31.50	4.94	0.00	104.00	97.98	N/A	N/A
5785.00	58.03	AV	H	31.50	4.94	0.00	94.47	88.45	N/A	N/A
5785.00	84.74	PK	V	31.50	4.94	0.00	121.18	115.16	N/A	N/A
5785.00	75.13	AV	V	31.50	4.94	0.00	111.57	105.55	N/A	N/A
11570.00	38.99	PK	V	38.36	6.98	26.97	57.36	51.34	74.00	22.66
11570.00	26.68	AV	V	38.36	6.98	26.97	45.05	39.03	54.00	14.97
17355.00	40.87	PK	V	41.28	9.04	25.16	66.03	60.01	68.20	8.19
High Channel: 5825 MHz										
5825.00	67.14	PK	H	31.56	4.94	0.00	103.64	97.62	N/A	N/A
5825.00	57.41	AV	H	31.56	4.94	0.00	93.91	87.89	N/A	N/A
5825.00	84.81	PK	V	31.56	4.94	0.00	121.31	115.29	N/A	N/A
5825.00	75.23	AV	V	31.56	4.94	0.00	111.73	105.71	N/A	N/A
5850.00	38.87	PK	V	31.59	4.95	0.00	75.41	69.39	122.20	52.81
5855.00	38.26	PK	V	31.60	4.95	0.00	74.81	68.79	110.80	42.01
5875.00	36.01	PK	V	31.63	4.95	0.00	72.59	66.57	105.20	38.63
5925.00	33.50	PK	V	31.70	4.95	0.00	70.15	64.13	68.20	4.07
11650.00	39.15	PK	V	38.42	6.99	26.84	57.72	51.7	74.00	22.30
11650.00	26.57	AV	V	38.42	6.99	26.84	45.14	39.12	54.00	14.88
17475.00	40.73	PK	V	41.55	9.06	24.55	66.79	60.77	68.20	7.43

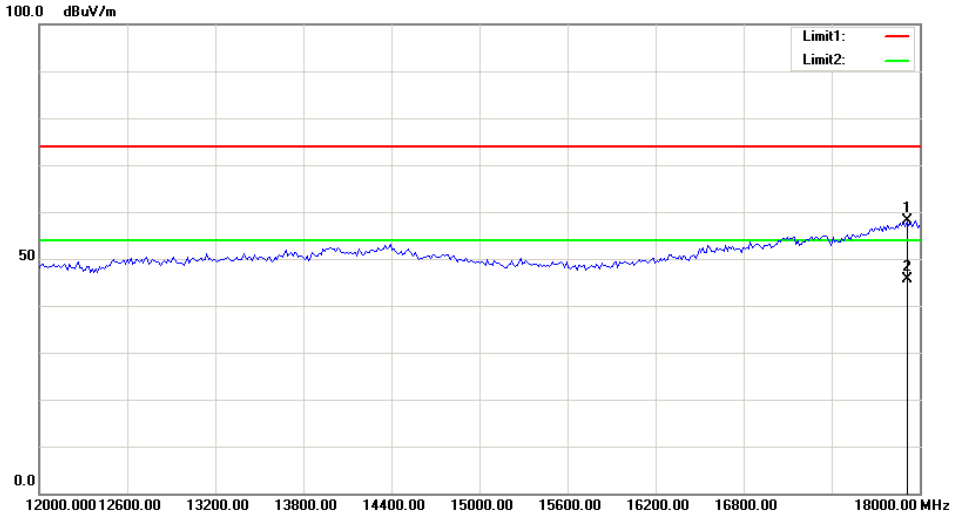
802.11n ht40(4Tx was the worst)

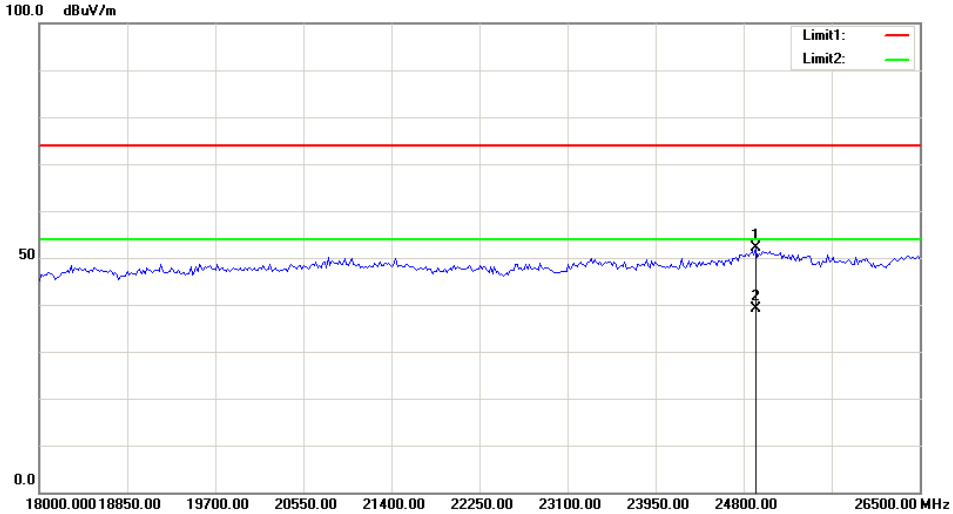
Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Extrapolation result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)						
Low Channel: 5755 MHz										
5755.00	67.41	PK	H	31.46	4.95	0.00	103.82	97.8	N/A	N/A
5755.00	57.69	AV	H	31.46	4.95	0.00	94.10	88.08	N/A	N/A
5755.00	83.41	PK	V	31.46	4.95	0.00	119.82	113.8	N/A	N/A
5755.00	73.87	AV	V	31.46	4.95	0.00	110.28	104.26	N/A	N/A
5725.00	41.76	PK	V	31.42	4.96	0.00	78.14	72.12	122.20	50.08
5720.00	51.51	PK	V	31.41	4.96	0.00	87.88	81.86	110.80	28.94
5700.00	33.71	PK	V	31.38	4.97	0.00	70.06	64.04	105.20	41.16
5650.00	33.58	PK	V	31.31	4.95	0.00	69.84	63.82	68.20	4.38
11510.00	38.78	PK	V	38.31	6.98	26.58	57.49	51.47	74.00	22.53
11510.00	26.35	AV	V	38.31	6.98	26.58	45.06	39.04	54.00	14.96
17265.00	40.65	PK	V	41.08	9.02	24.84	65.91	59.89	68.20	8.31
High Channel: 5795 MHz										
5795.00	67.12	PK	H	31.51	4.94	0.00	103.57	97.55	N/A	N/A
5795.00	55.99	AV	H	31.51	4.94	0.00	92.44	86.42	N/A	N/A
5795.00	84.44	PK	V	31.51	4.94	0.00	120.89	114.87	N/A	N/A
5795.00	74.28	AV	V	31.51	4.94	0.00	110.73	104.71	N/A	N/A
5850.00	35.12	PK	V	31.59	4.95	0.00	71.66	65.64	122.20	56.56
5855.00	32.69	PK	V	31.60	4.95	0.00	69.24	63.22	110.80	47.58
5875.00	32.01	PK	V	31.63	4.95	0.00	68.59	62.57	105.20	42.63
5925.00	31.29	PK	V	31.70	4.95	0.00	67.94	61.92	68.20	6.28
11590.00	39.15	PK	V	38.37	6.99	27.10	57.41	51.39	74.00	22.61
11590.00	26.87	AV	V	38.37	6.99	27.10	45.13	39.11	54.00	14.89
17385.00	41.13	PK	V	41.35	9.04	25.51	66.01	59.99	68.20	8.21

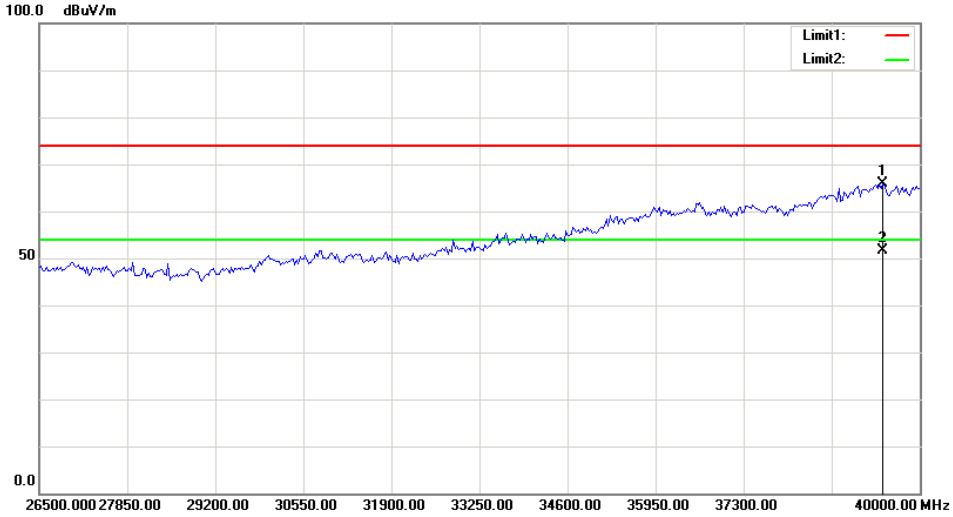
Test Plots(For worst mode 802.11a chain 0 5825MHz)
Horizontal

Fundamental Test with Band Rejection Filter



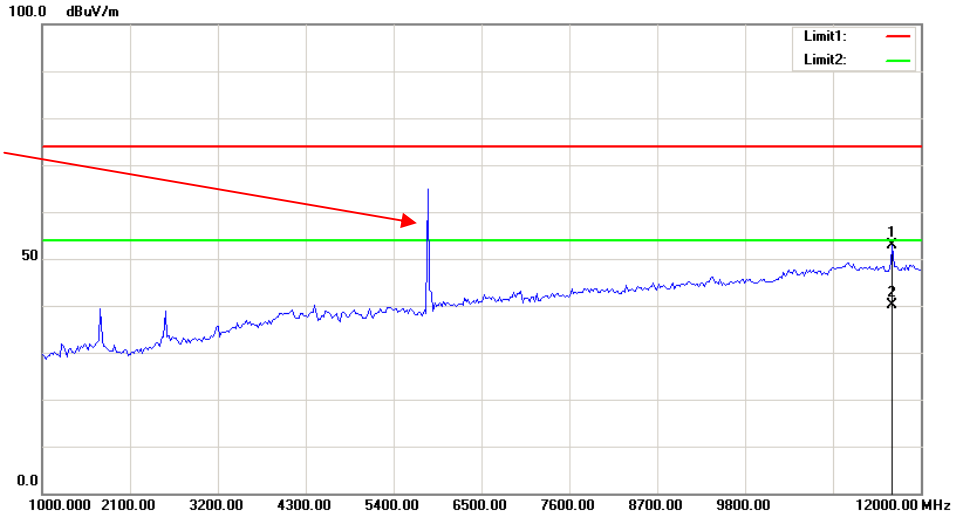


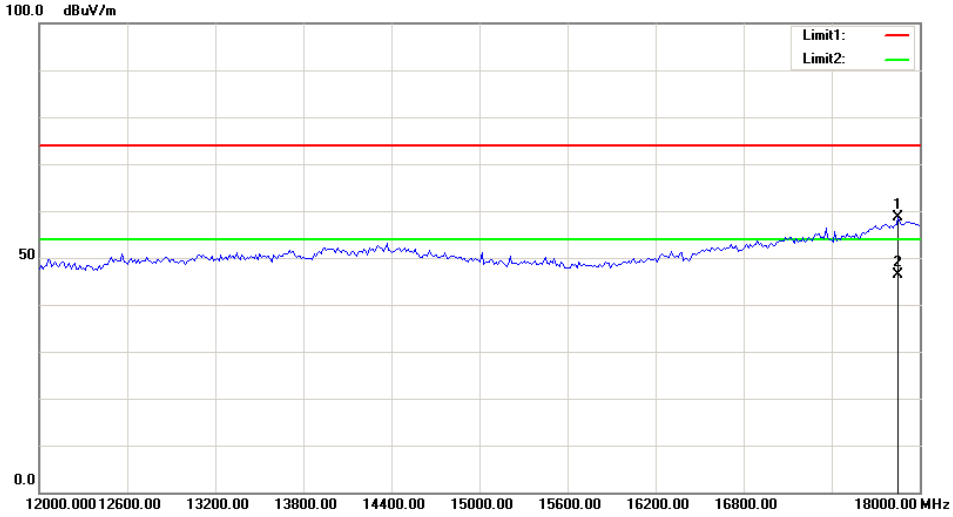


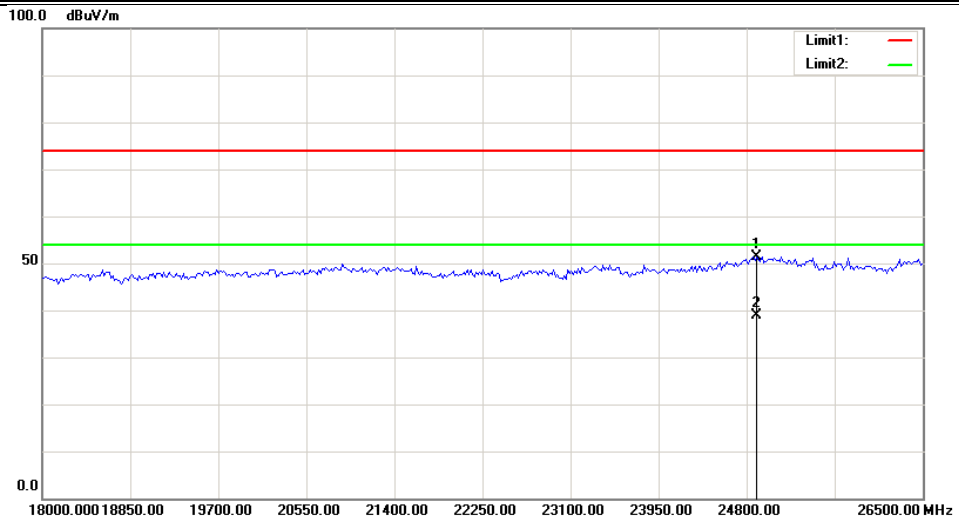


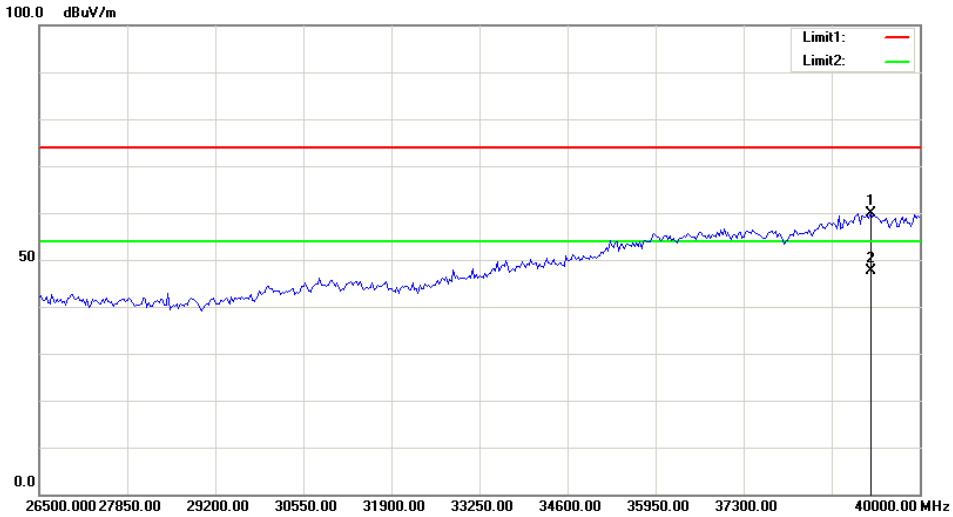
Vertical

Fundamental Test with Band Rejection Filter






100.0 dBuV/m
Limit1:
Limit2:
50
0.0
1
2
18000.000 18850.00 19700.00 20550.00 21400.00 22250.00 23100.00 23950.00 24800.00 26500.00 MHz


100.0 dBuV/m
Limit1:
Limit2:
50
0.0
1
2
26500.000 27850.00 29200.00 30550.00 31900.00 33250.00 34600.00 35950.00 37300.00 40000.00 MHz

FCC §15.407(a)(e)–EMISSION BANDWIDTH AND OCCUPIED BANDWIDTH

Applicable Standard

15.407(a) (e)

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101474	2019-01-09	2020-01-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/06	Each time	N/A

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01

Test Data

Environmental Conditions

Temperature:	27.8~27.9°C
Relative Humidity:	65~66 %
ATM Pressure:	100.1~100.4 kPa

The testing was performed by Carrie He from 2019-07-12 to 2019-07-13.

Test Result: Pass.

Please refer to the following tables and plots.

Test mode: Transmitting (test was only performed at chain 0)

5150-5250MHz:

Mode	Frequency (MHz)	26 dB Emission Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
802.11 a	5180	26.560	17.405
	5200	26.640	17.405
	5240	26.720	17.325
802.11n ht20	5180	24.720	18.363
	5200	25.040	18.363
	5240	24.960	18.363
802.11n ht40	5190	44.320	37.365
	5230	44.320	37.365

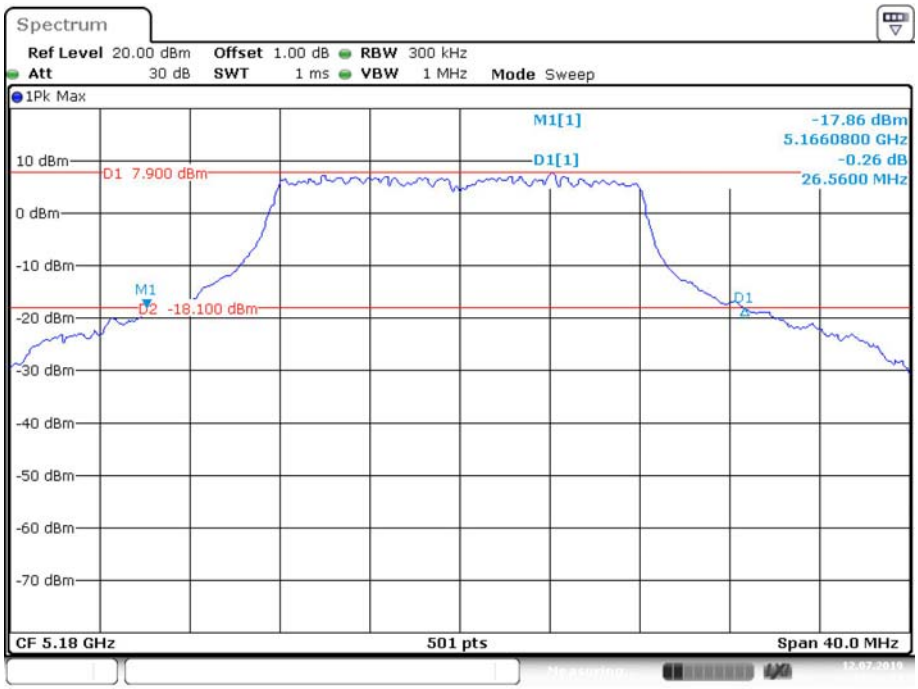
5725-5850MHz:

Mode	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
802.11 a	5745	16.480	17.325
	5785	16.400	17.405
	5825	16.400	17.405
802.11n ht20	5745	17.840	18.443
	5785	17.840	18.363
	5825	17.840	18.443
802.11n ht40	5755	36.480	37.206
	5795	36.480	37.365

Note: the 99% Occupied Bandwidth have not fall into the band 5150-5250MHz or 5470-5725MHz, please refer to the test plots of 99% Occupied Bandwidth.

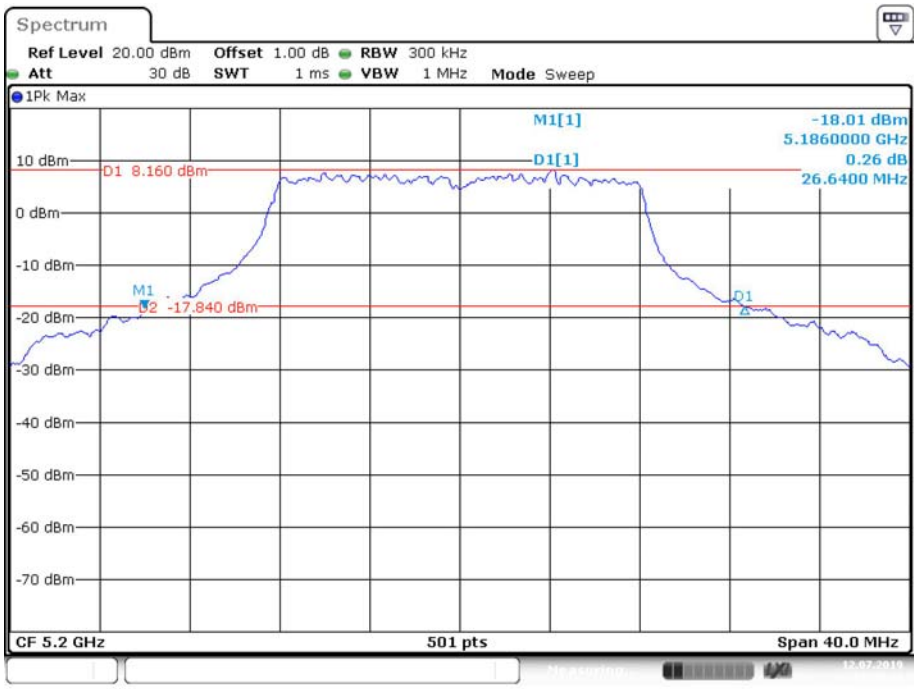
5150-5250MHz:
26dB Emission Bandwidth:

802.11a Low Channel



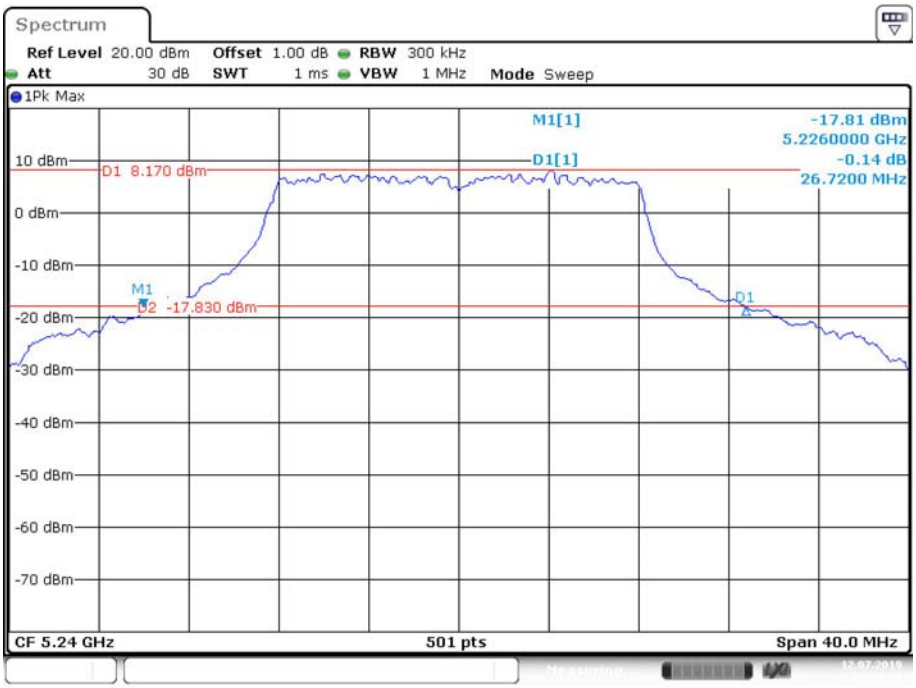
Date: 12.JUL.2019 15:56:50

802.11a Middle Channel



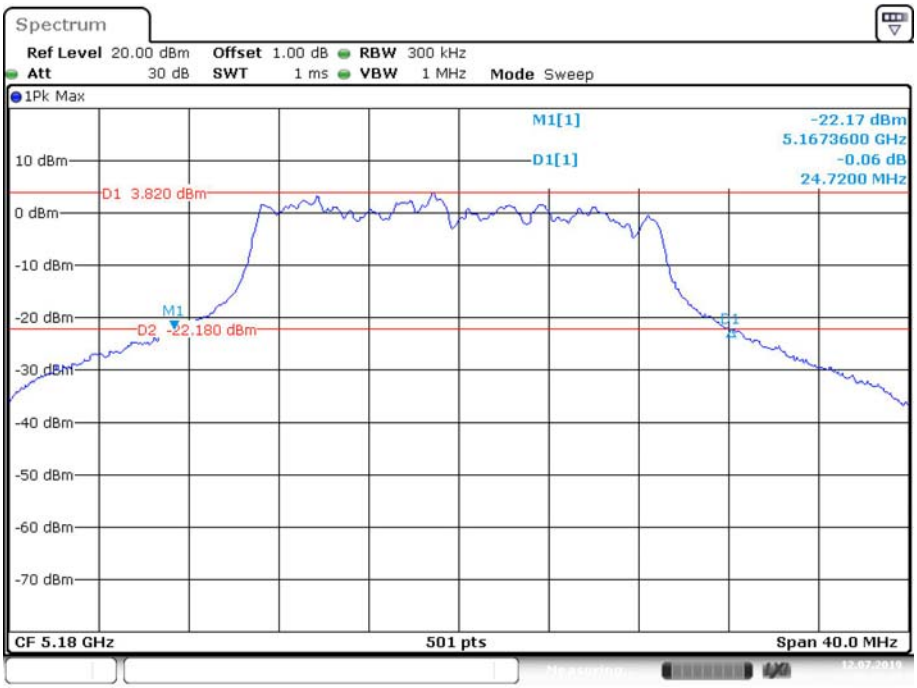
Date: 12.JUL.2019 15:58:25

802.11a High Channel



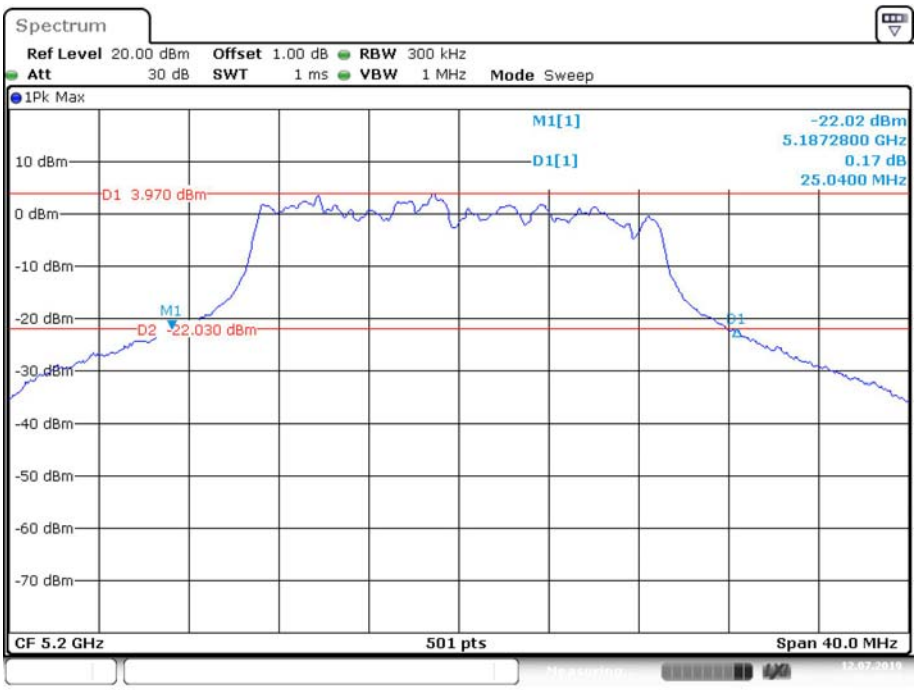
Date: 12.JUL.2019 15:59:25

802.11n ht20 Low Channel



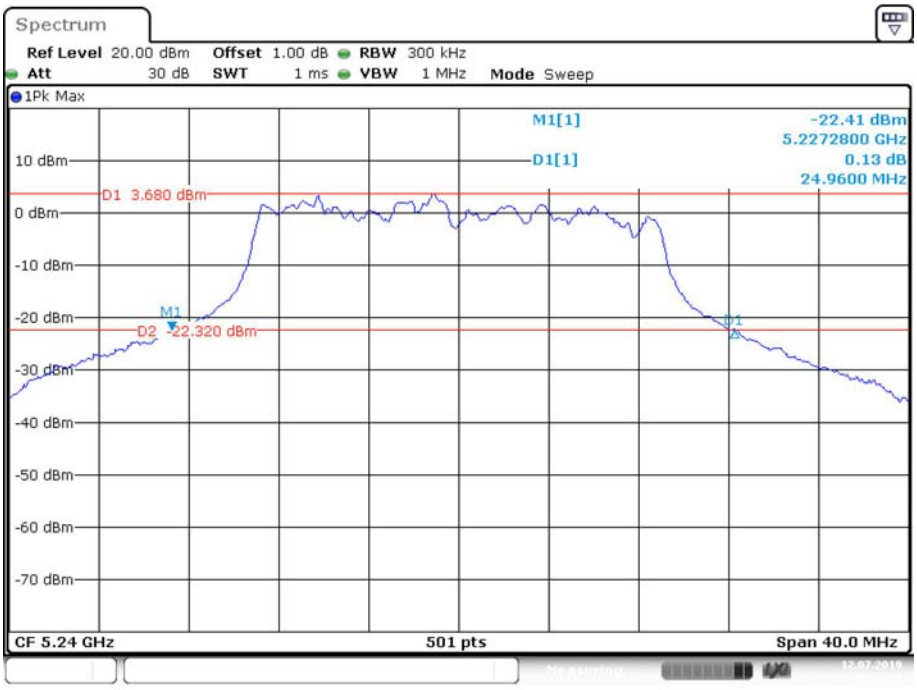
Date: 12.JUL.2019 16:13:39

802.11n ht20 Middle Channel



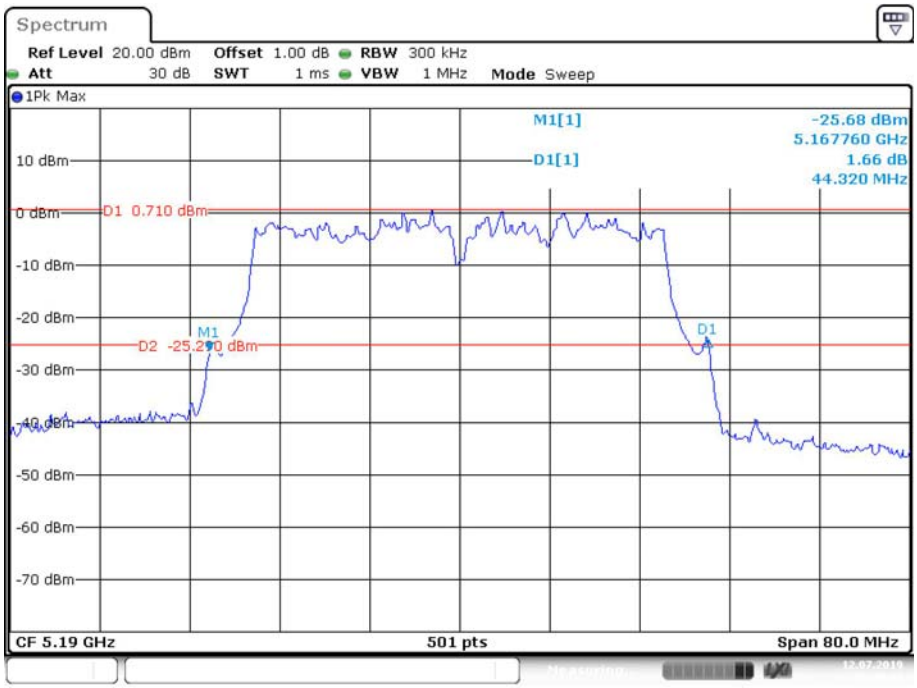
Date: 12.JUL.2019 16:25:27

802.11n ht20 High Channel



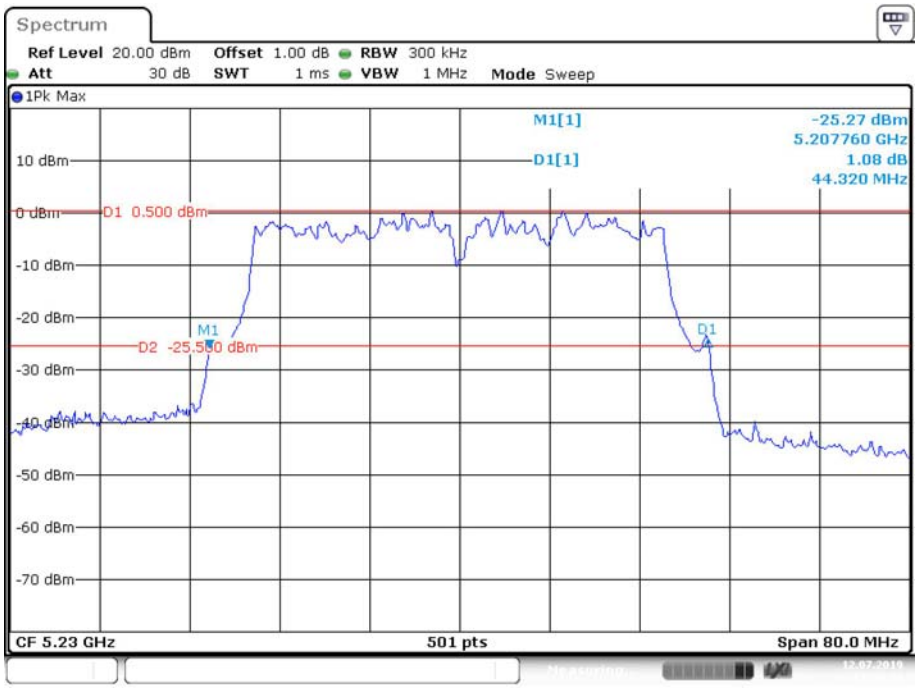
Date: 12.JUL.2019 16:26:20

802.11n ht40 Low Channel



Date: 12.JUL.2019 16:40:42

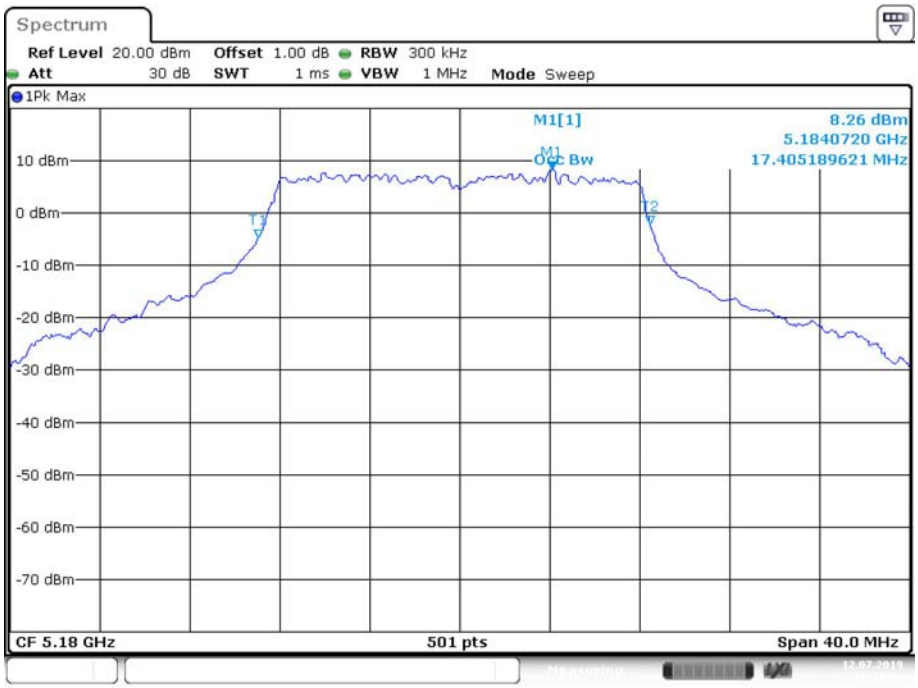
802.11n ht40 High Channel



Date: 12.JUL.2019 17:36:56

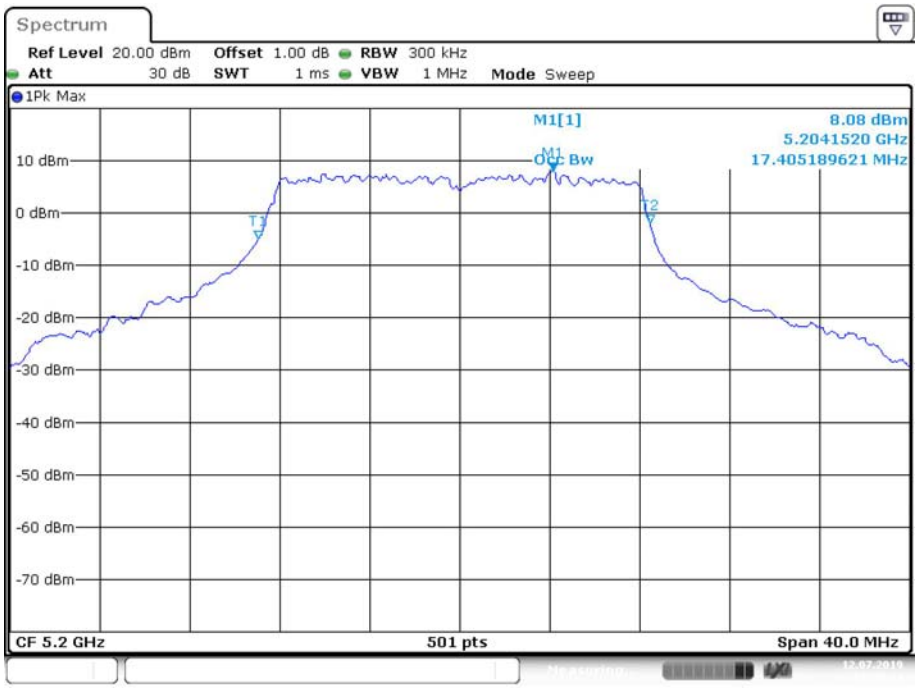
99% Occupied Bandwidth:

802.11a Low Channel



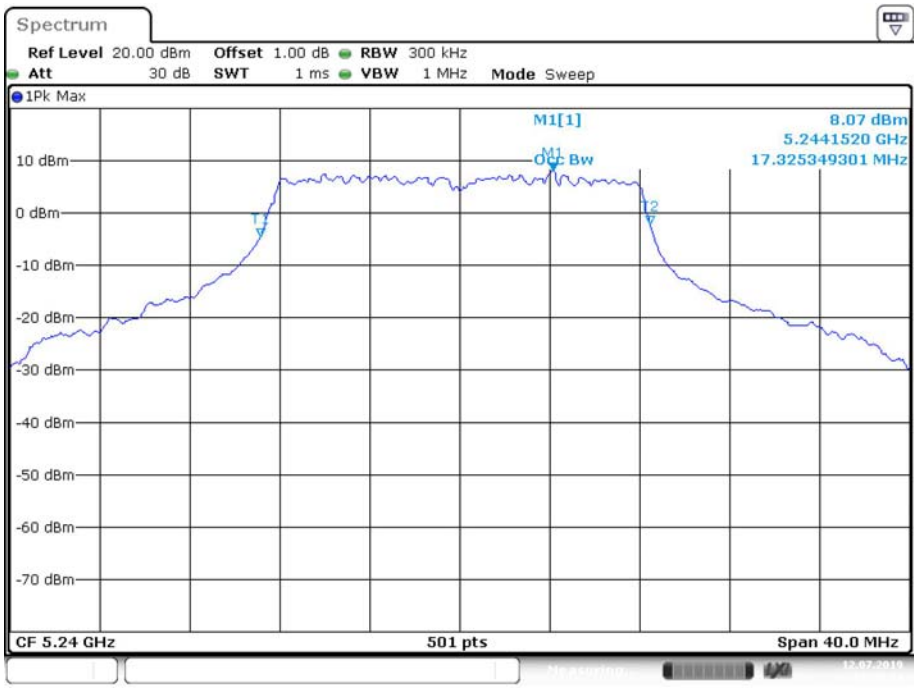
Date: 12.JUL.2019 15:57:02

802.11a Middle Channel



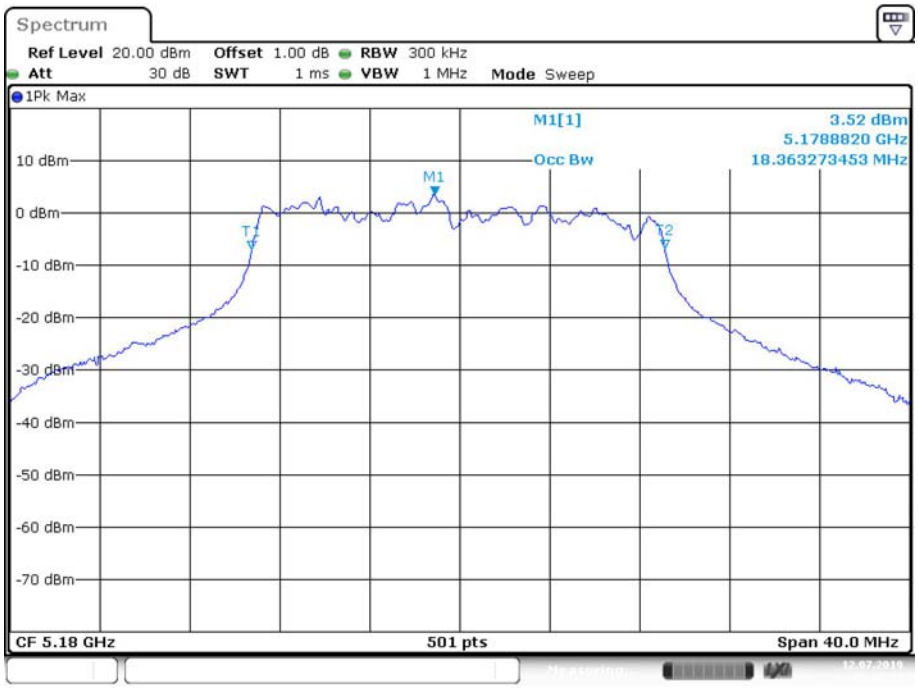
Date: 12.JUL.2019 15:58:34

802.11a High Channel



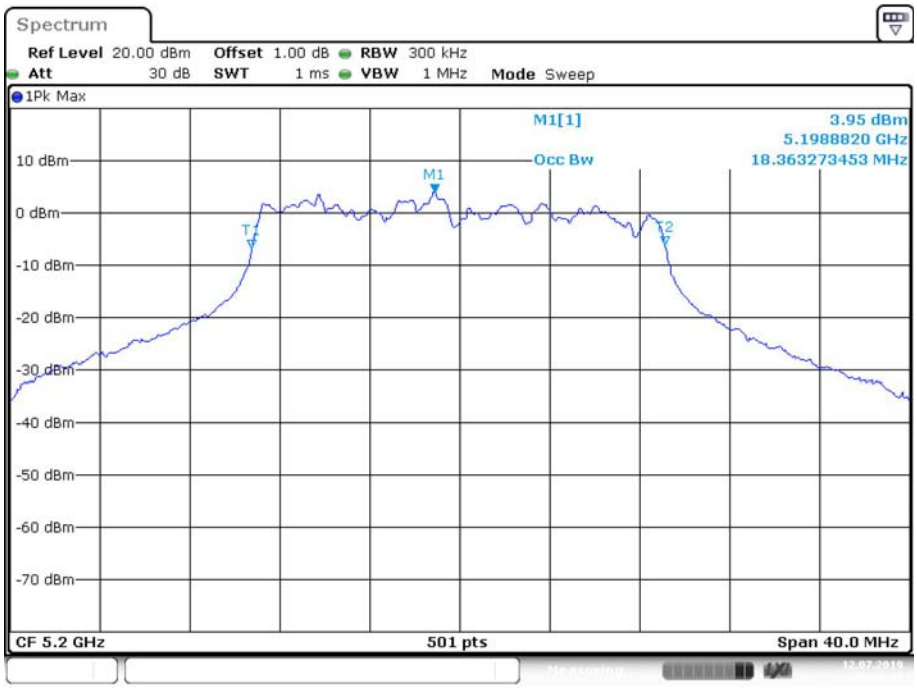
Date: 12.JUL.2019 15:59:34

802.11n ht20 Low Channel



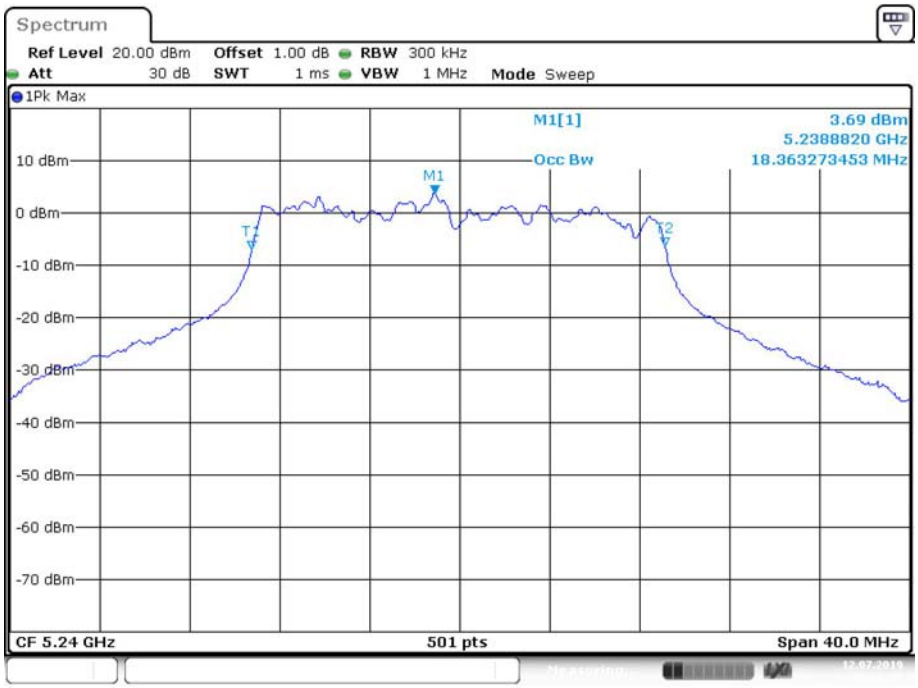
Date: 12.JUL.2019 16:12:21

802.11n ht20 Middle Channel



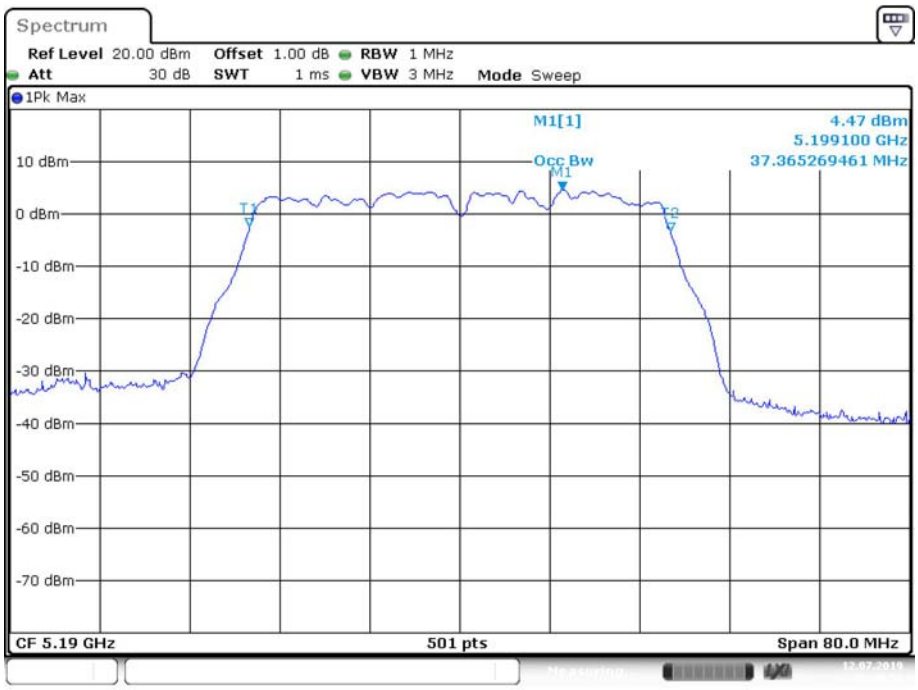
Date: 12.JUL.2019 16:24:42

802.11n ht20 High Channel



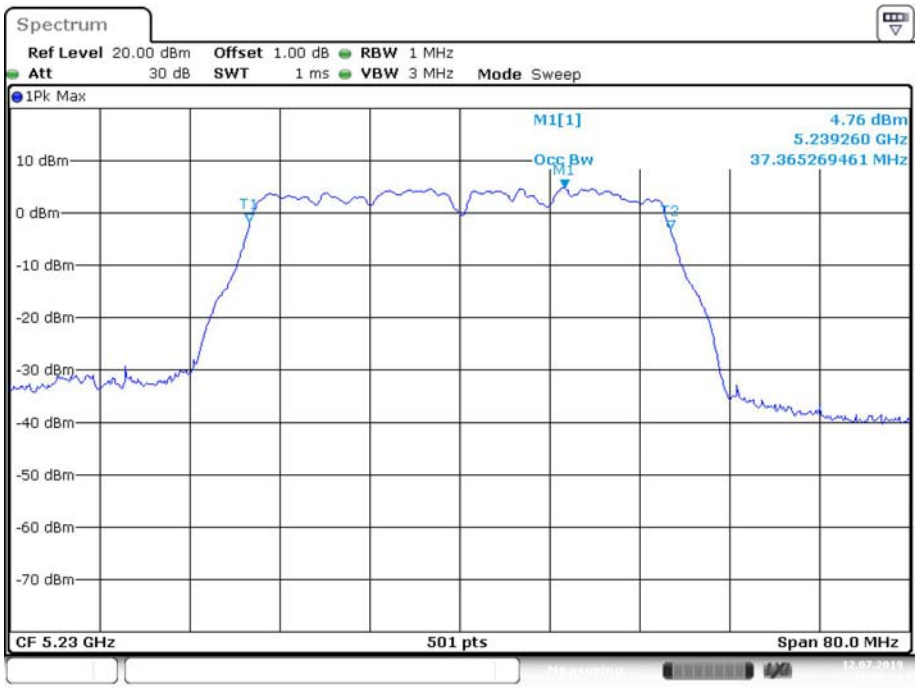
Date: 12.JUL.2019 16:26:39

802.11n ht40 Low Channel



Date: 12.JUL.2019 16:40:57

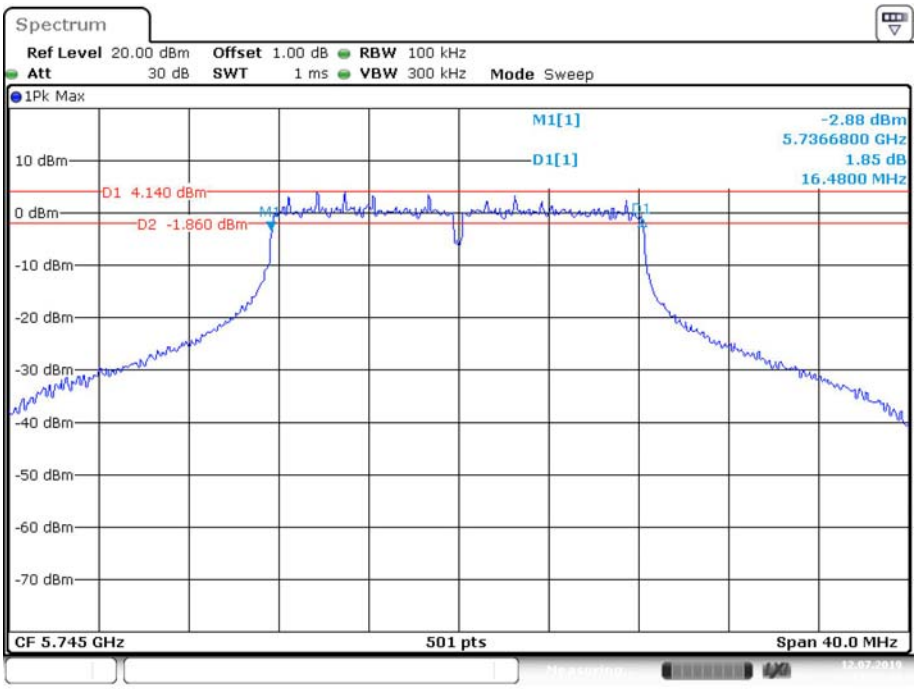
802.11n ht40 High Channel



Date: 12.JUL.2019 17:36:20

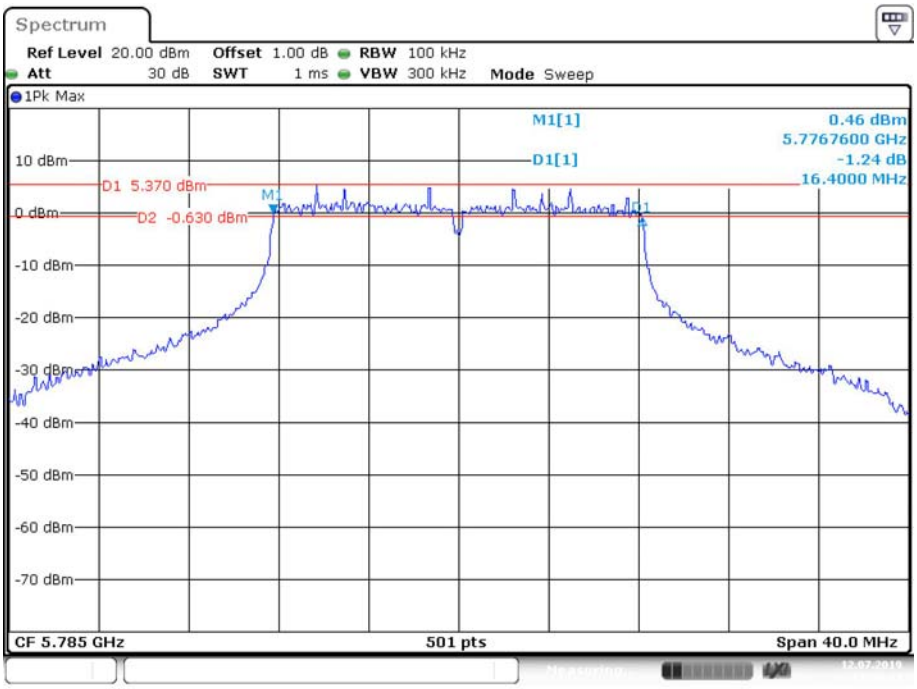
5725-5850MHz:
6dB Emission Bandwidth:

802.11a Low Channel



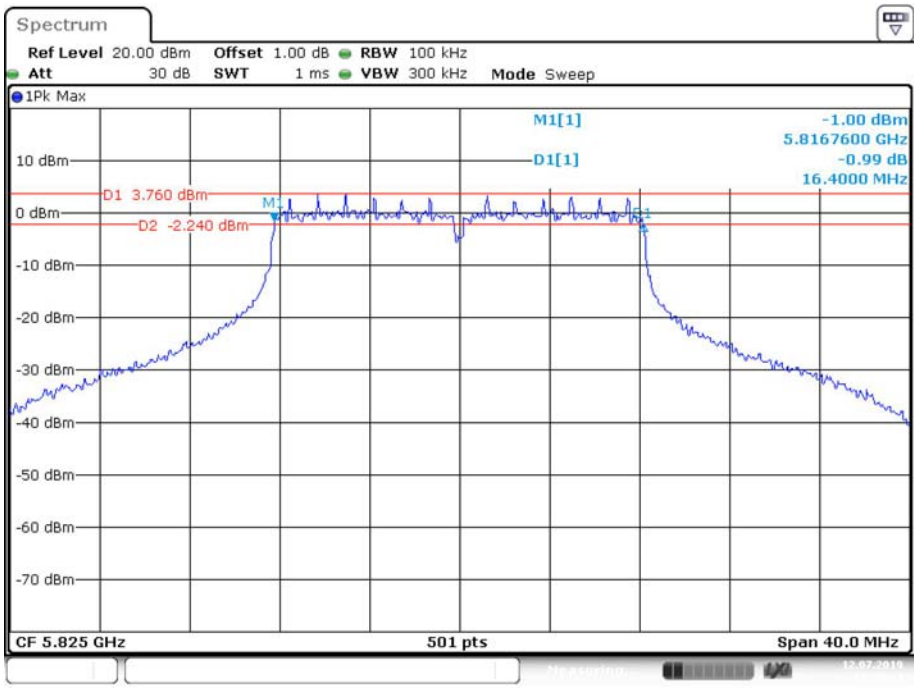
Date: 12.JUL.2019 17:52:42

802.11a Middle Channel



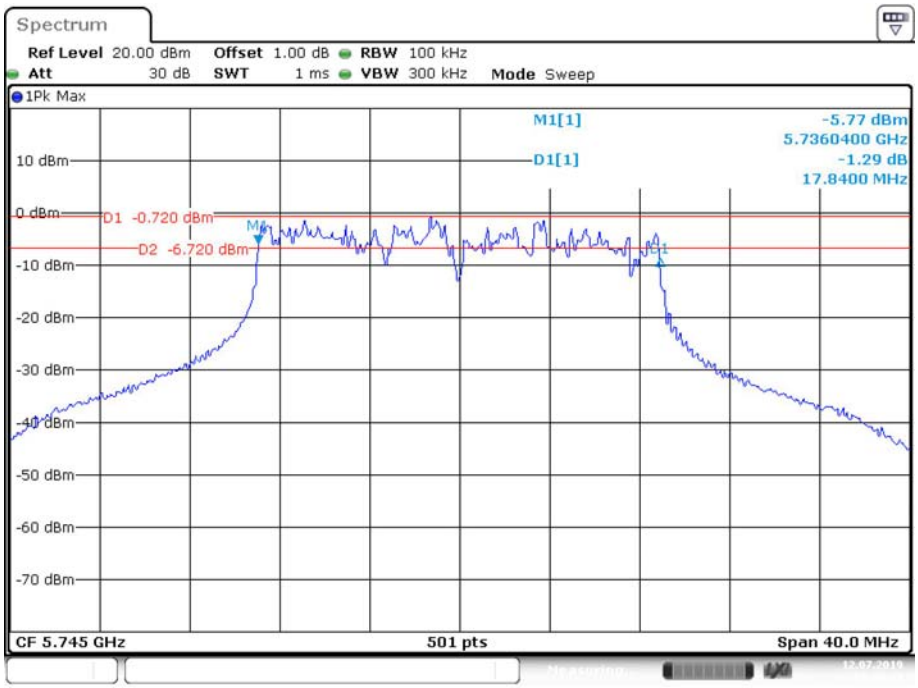
Date: 12.JUL.2019 17:54:11

802.11a High Channel



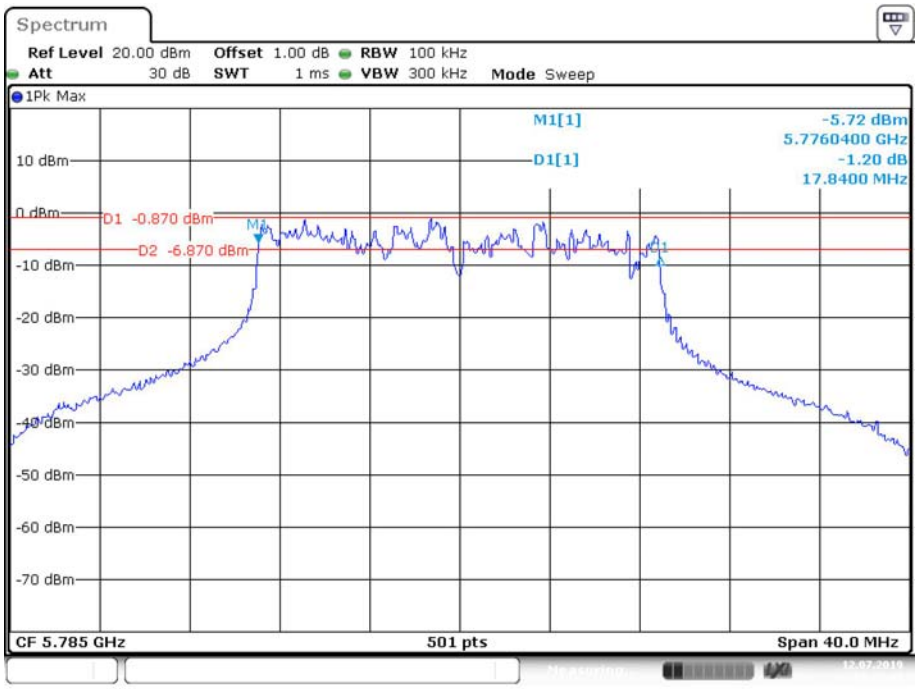
Date: 12.JUL.2019 17:55:16

802.11n ht20 Low Channel



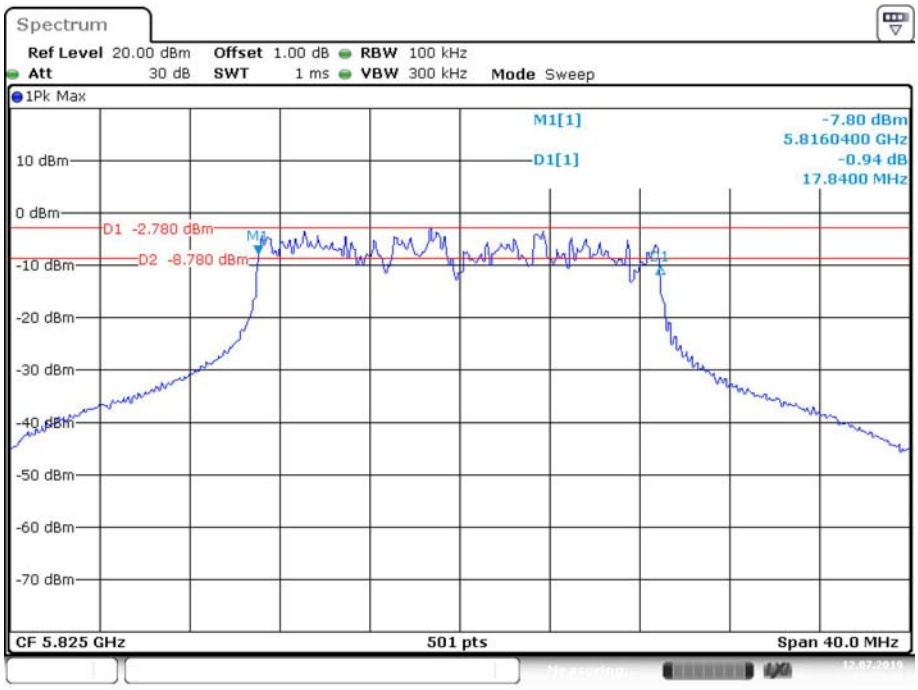
Date: 12.JUL.2019 18:14:15

802.11n ht20 Middle Channel



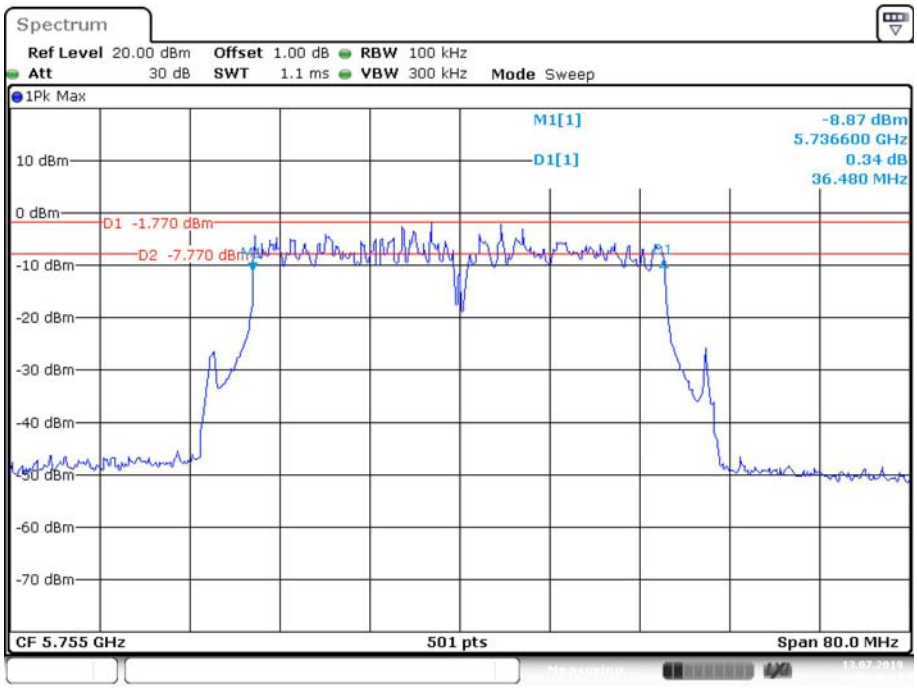
Date: 12.JUL.2019 18:15:42

802.11n ht20 High Channel



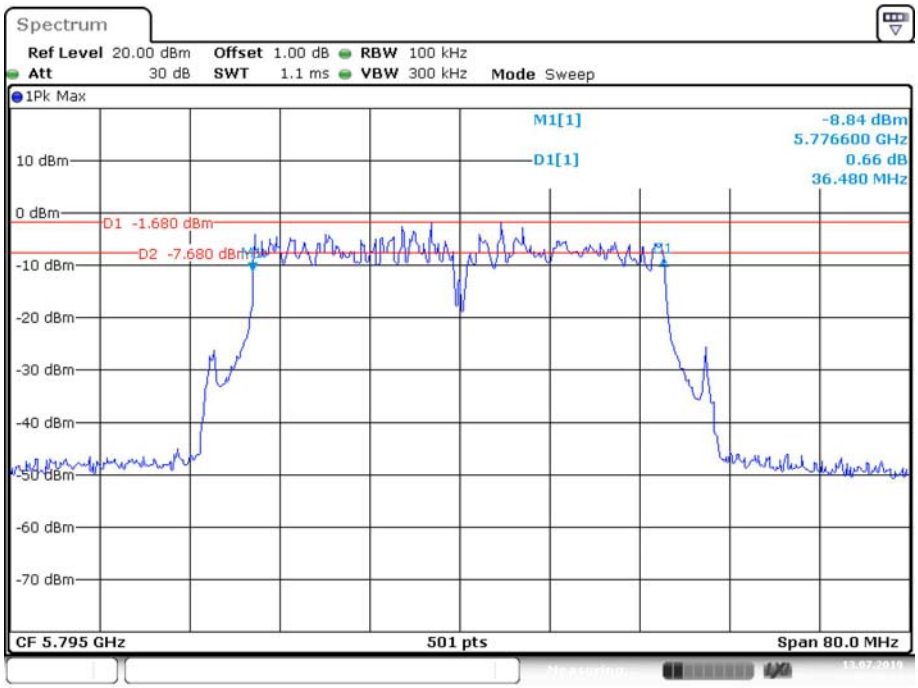
Date: 12.JUL.2019 18:22:47

802.11n ht40 Low Channel



Date: 13.JUL.2019 09:49:02

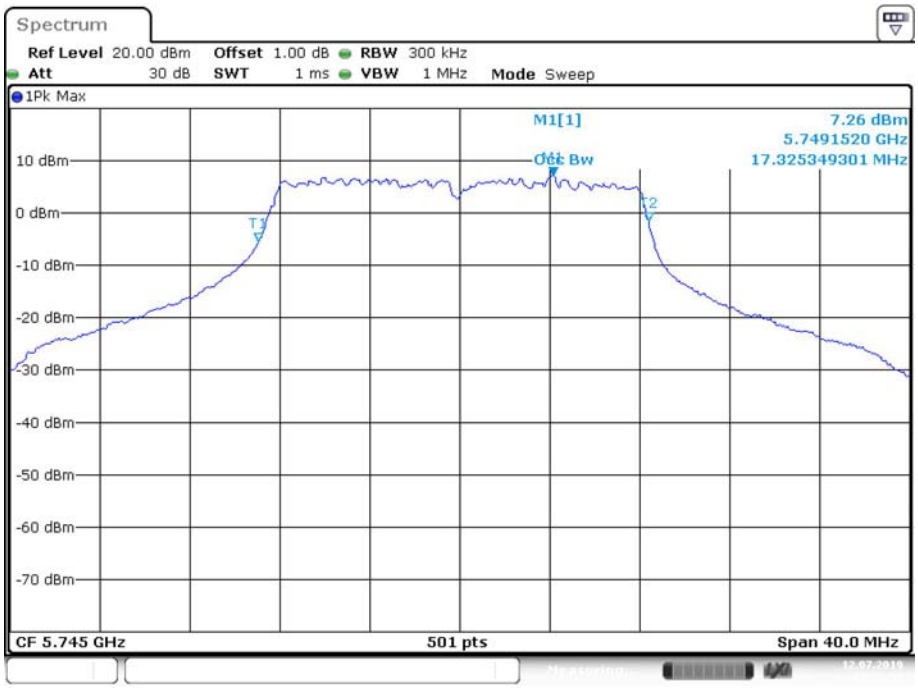
802.11n ht40 High Channel



Date: 13.JUL.2019 09:54:33

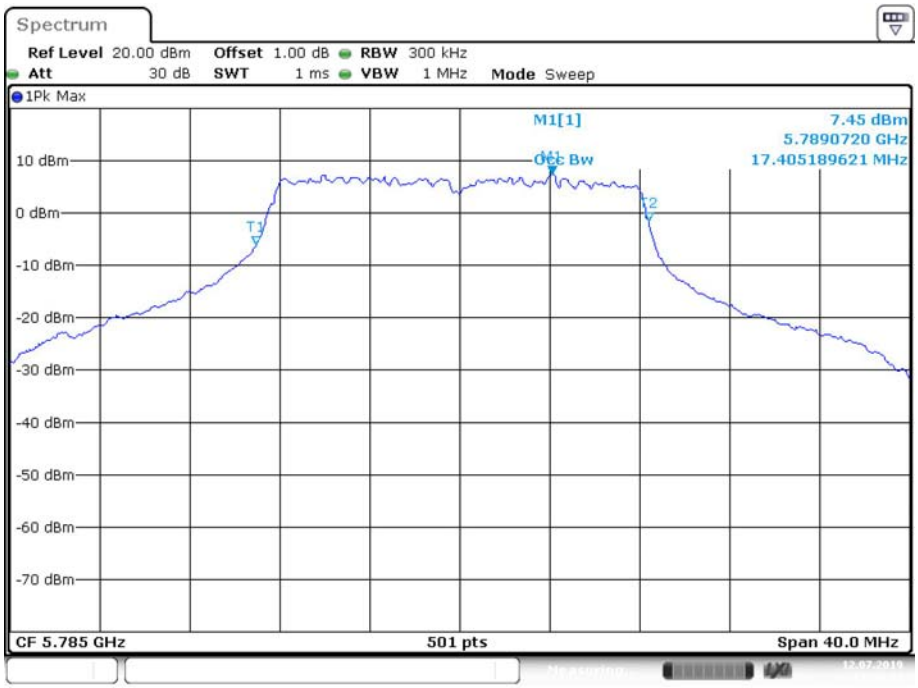
99% Occupied Bandwidth:

802.11a Low Channel



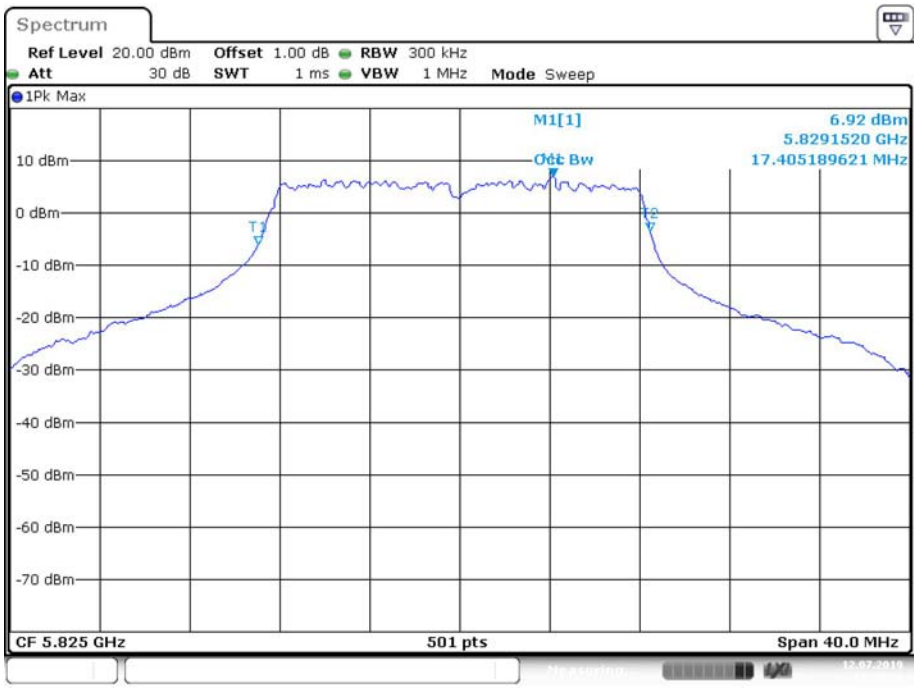
Date: 12.JUL.2019 17:52:51

802.11a Middle Channel



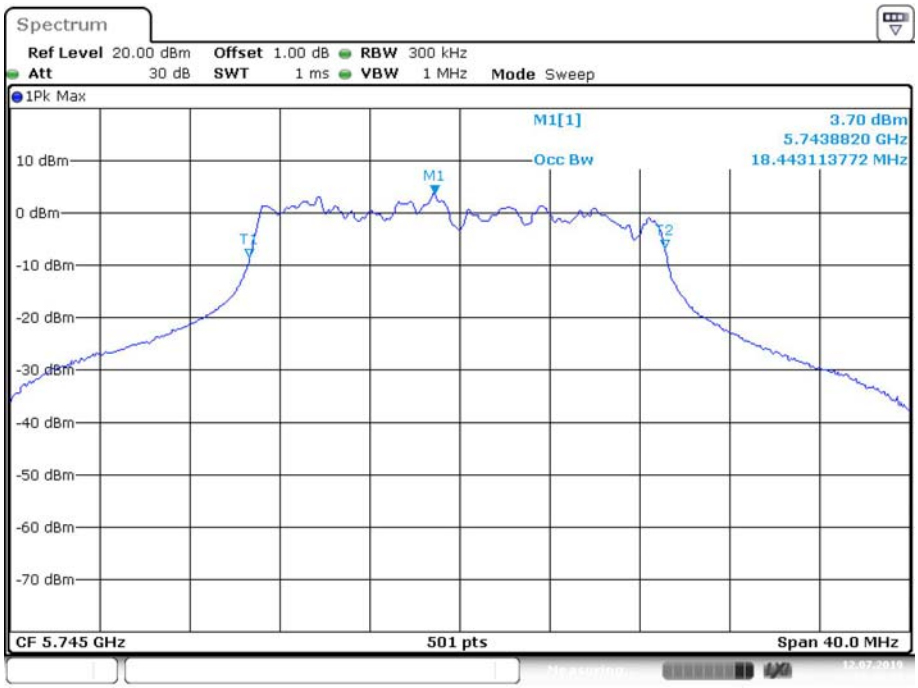
Date: 12.JUL.2019 17:54:21

802.11a High Channel



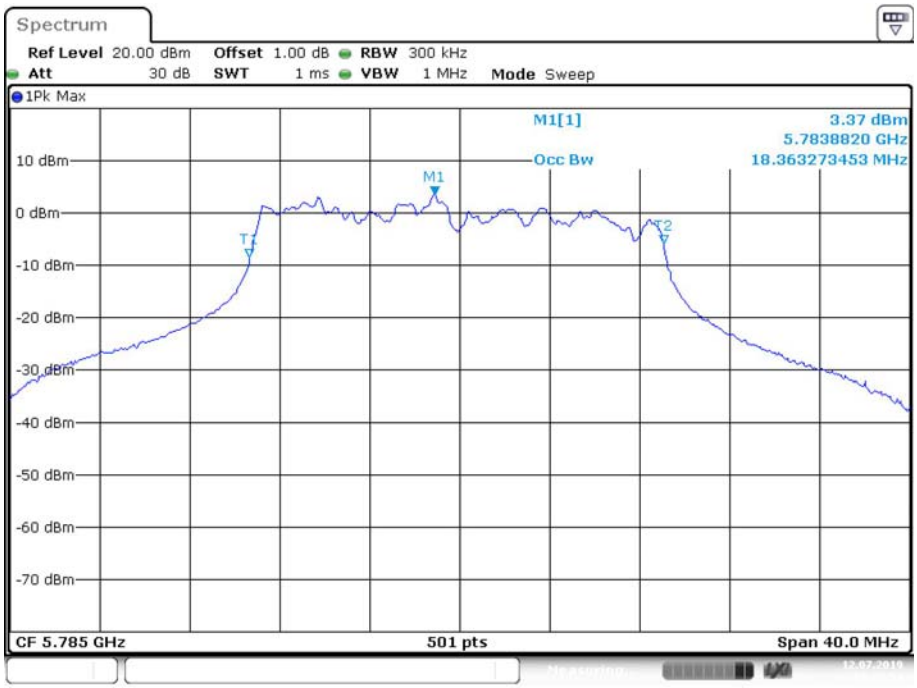
Date: 12.JUL.2019 17:55:28

802.11n ht20 Low Channel



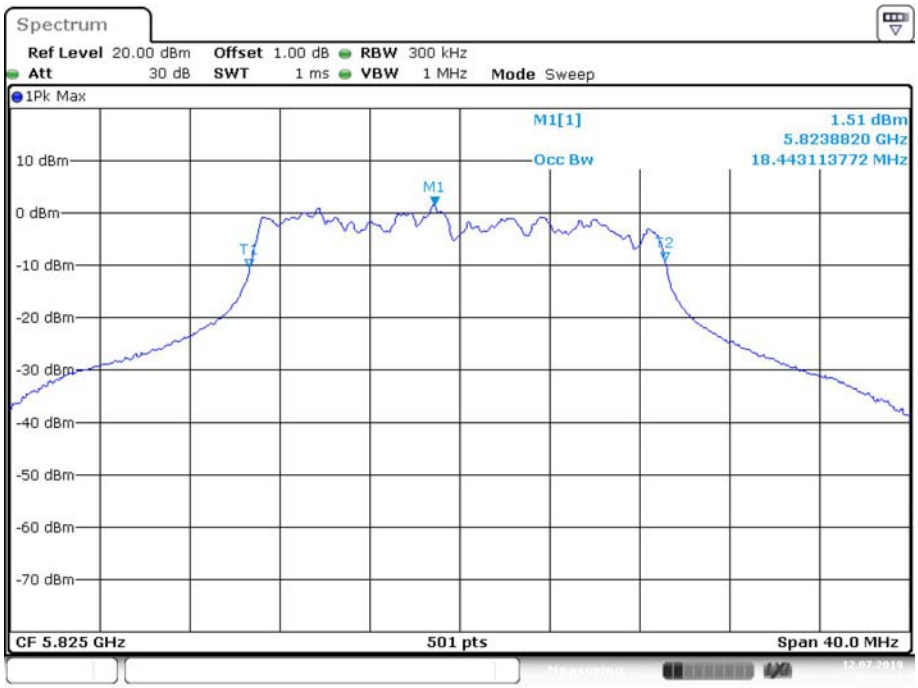
Date: 12.JUL.2019 18:14:27

802.11n ht20 Middle Channel



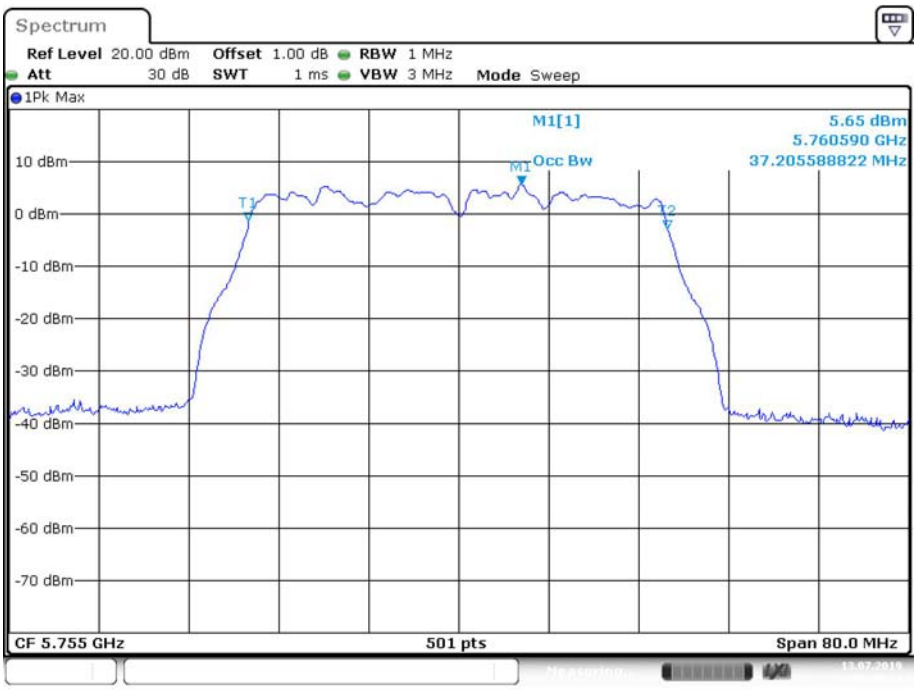
Date: 12.JUL.2019 18:15:54

802.11n ht20 High Channel



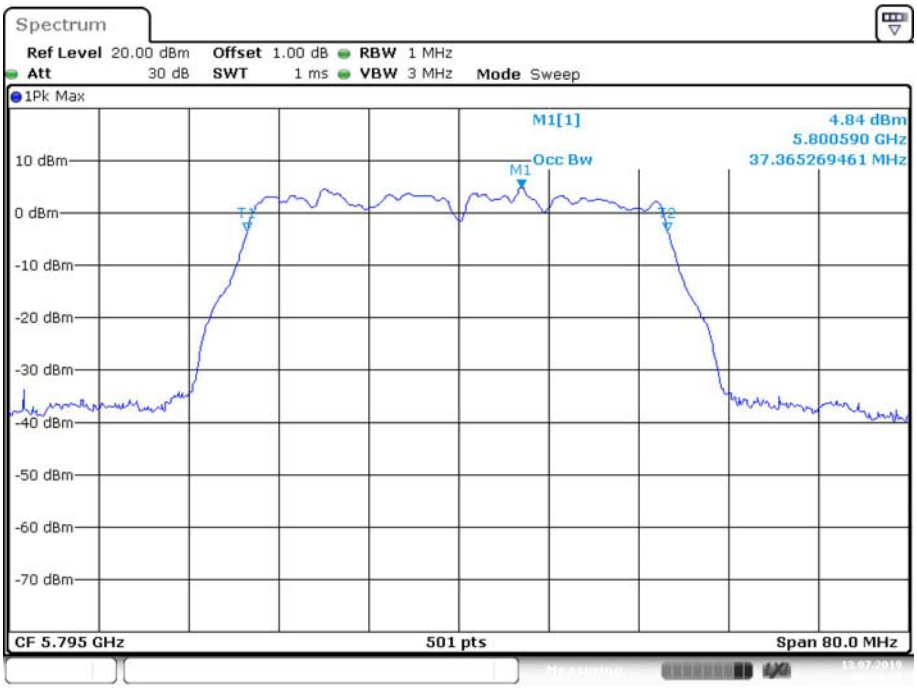
Date: 12.JUL.2019 18:23:02

802.11n ht40 Low Channel



Date: 13.JUL.2019 09:49:14

802.11n ht40 High Channel



Date: 13.JUL.2019 09:54:52

FCC §15.407(a) –MAXIMUM CONDUCTED OUTPUT POWER

Applicable Standard

(a) Power limits:

(1) For the band 5.15-5.25 GHz.

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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

(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(4) The maximum conducted output power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Agilent	USB Wideband Power Sensor	U2022XA	MY5417006	2018-12-10	2019-12-10
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01

Test Data

Environmental Conditions

Temperature:	27.8~27.9°C
Relative Humidity:	65~66 %
ATM Pressure:	100.1~100.4 kPa

The testing was performed by Carrie He from 2019-07-12 to 2019-07-23.

Test Mode: Transmitting

Band	Mode	Frequency (MHz)	Conducted Average Output Power(dBm)					Limit (dBm)
			Chain 0	Chain 1	Chain 2	Chain 3	Total	
5150 - 5250 MHz	802.11 a	5180	13.38	14.15	13.54	13.37	/	30
		5200	13.31	13.97	13.46	13.32	/	30
		5240	13.09	14.08	13.49	13.31	/	30
	802.11n ht20	5180	9.95	10.25	10.06	10.80	16.30	30
		5200	9.59	10.25	10.25	10.97	16.31	30
		5240	9.57	9.95	10.15	10.98	16.21	30
	802.11n ht40	5190	5.80	6.67	6.08	6.78	12.37	30
		5230	9.99	10.66	9.99	11.01	16.46	30
5725 - 5850 MHz	802.11 a	5745	16.13	16.85	16.70	16.92	/	30
		5785	16.34	16.40	16.27	16.36	/	30
		5825	16.37	16.10	16.84	16.80	/	30
	802.11n ht20	5745	10.34	11.44	10.33	11.26	16.89	30
		5785	10.10	11.02	10.17	10.87	16.58	30
		5825	10.05	11.15	10.11	11.01	16.63	30
	802.11n ht40	5755	10.46	10.79	9.82	10.99	16.56	30
		5795	9.39	11.82	10.70	11.71	17.03	30

Note:
The device is a master device.
The duty cycle factor has been calculated into the test data.
The maximum antenna gain is 5.5dBi in 5GHz band. The device employed Cyclic Delay Diversity (CDD) for 802.11 MIMO transmitting, per KDB 662911 D01 Multiple Transmitter Output v02r01, for power measurements on IEEE 802.11 devices:

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;

So:

Directional gain = G_{ANT} + Array Gain = 5.5dBi

FCC §15.407(a) - POWER SPECTRAL DENSITY

Applicable Standard

(a) Power limits:

(1) For the band 5.15-5.25 GHz.

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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

power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

Test Procedure

According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSV40	101474	2019-01-09	2020-01-09
Unknown	Coaxial Cable	C-SJ00-0010	C0010/06	Each time	N/A

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

Temperature:	27.8~27.9°C
Relative Humidity:	65~66 %
ATM Pressure:	100.1~100.4 kPa

The testing was performed by Carrie He from 2019-07-12 to 2019-07-23.

Test Mode: Transmitting

Test Result:Compliance.Please refer to the following table and plot.

5150-5250MHz

Mode	Frequency (MHz)	Reading (dBm/MHz)				Duty Cycle Factor (dB)	Maximum Power Spectral Density (dBm/MHz)					
		Chain 0	Chain 1	Chain 2	Chain 3		Chain 0	Chain 1	Chain 2	Chain 3	Total	Limit
802.11a	5180	7.70	8.01	7.54	7.32	0	7.7	8.01	7.54	7.32	/	17
	5200	7.69	7.60	7.63	7.04	0	7.69	7.6	7.63	7.04	/	17
	5240	7.30	7.87	8.23	7.81	0	7.3	7.87	8.23	7.81	/	17
802.11n ht20	5180	3.79	3.61	3.34	5.44	0.16	3.95	3.77	3.5	5.6	10.31	11.5
	5200	3.90	3.96	3.85	5.94	0.16	4.06	4.12	4.01	6.1	10.69	11.5
	5240	3.95	4.64	3.97	5.75	0.16	4.11	4.8	4.13	5.91	10.82	11.5
802.11n ht40	5190	-1.06	-0.67	2.18	2.77	0.25	-0.81	-0.42	2.43	3.02	7.39	11.5
	5230	1.67	2.75	2.02	3.47	0.25	1.92	3.00	2.27	3.72	8.80	11.5

5725-5850MHz

Mode	Frequency (MHz)	Reading (dBm/MHz)				Duty Cycle Factor (dB)	Maximum Power Spectral Density (dBm/MHz)					
		Chain 0	Chain 1	Chain 2	Chain 3		Chain 0	Chain 1	Chain 2	Chain 3	Total	Limit
802.11a	5745	6.14	6.41	5.63	6.82	0	8.36	8.63	7.85	9.04	/	30
	5785	6.57	6.52	5.23	6.12	0	8.79	8.74	7.45	8.34	/	30
	5825	5.96	6.15	5.67	6.85	0	8.18	8.37	7.89	9.07	/	30
802.11n ht20	5745	2.91	3.81	1.85	3.83	0.16	5.29	6.19	4.23	6.21	11.57	24.5
	5785	2.57	3.07	1.21	3.25	0.16	4.95	5.45	3.59	5.63	11.00	24.5
	5825	1.16	3.46	1.28	3.14	0.16	3.54	5.84	3.66	5.52	10.79	24.5
802.11n ht40	5755	0.49	0.25	-0.29	1.03	0.25	2.96	2.72	2.18	3.5	8.89	24.5
	5795	-0.31	1.02	-0.13	1.76	0.25	2.16	3.49	2.34	4.23	9.16	24.5

Note:
The device is an indoor master device.
The maximum antenna gain is 5.5 dBi in 5GHz band. The device employed Cyclic Delay Diversity (CDD) for 802.11 MIMO transmitting, per KDB 662911 D01 Multiple Transmitter Output v02r01, for power spectral density (PSD) measurements on the devices:

$$\text{Array Gain} = 10 \log(N_{ANT}/N_{SS}) \text{ dB.}$$

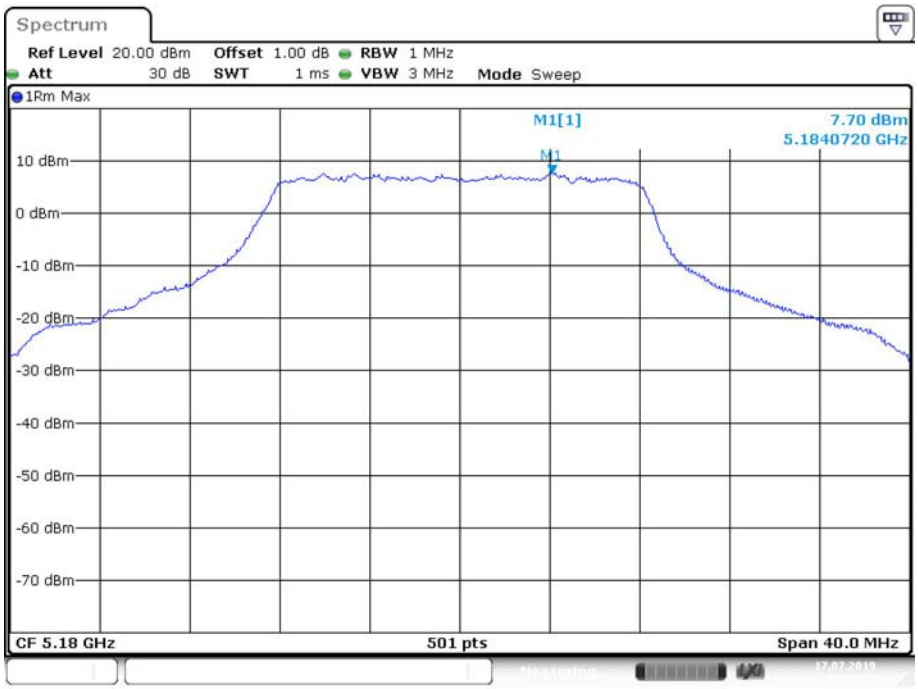
So:

$$\text{Directional gain} = G_{ANT} + \text{Array Gain} = 5.5\text{dBi}+10*\log(4/1)=11.5\text{dBi}$$

For 5.8GHz band, If measurement bandwidth of Maximum PSD is specified in 500 kHz, add 10log(500kHz/RBW) to the measured result, whereas RBW (< 500 KHz) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.

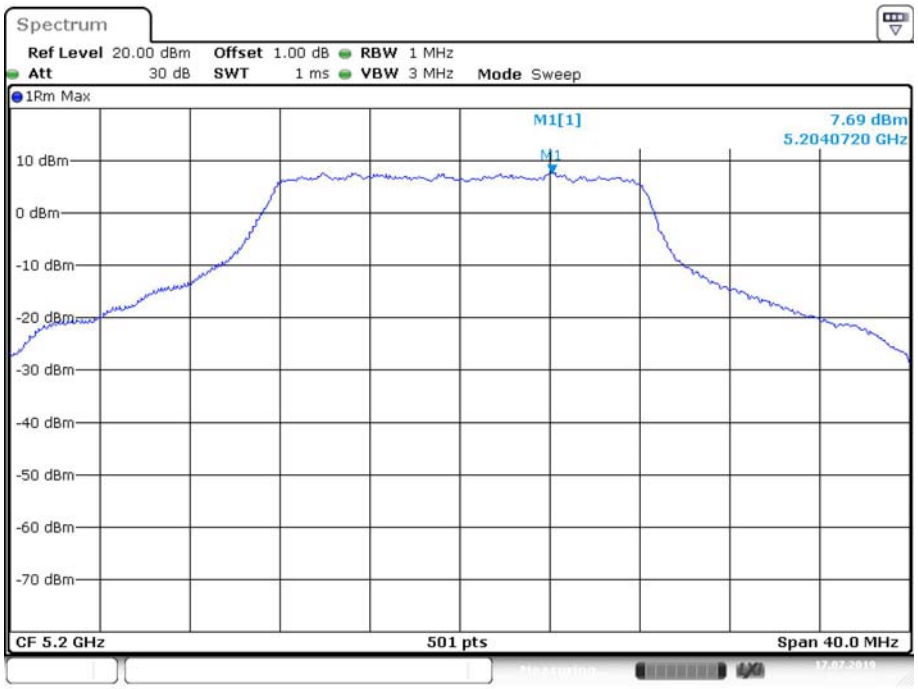
Chain 0:
5150-5250MHz

802.11a Low Channel



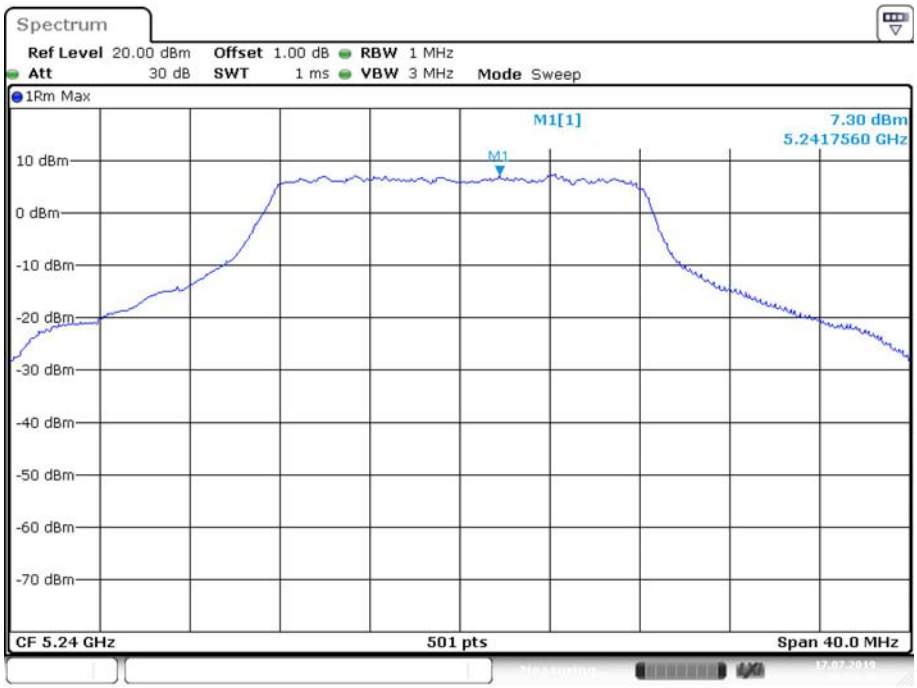
Date: 17.JUL.2019 19:52:53

802.11a Middle Channel



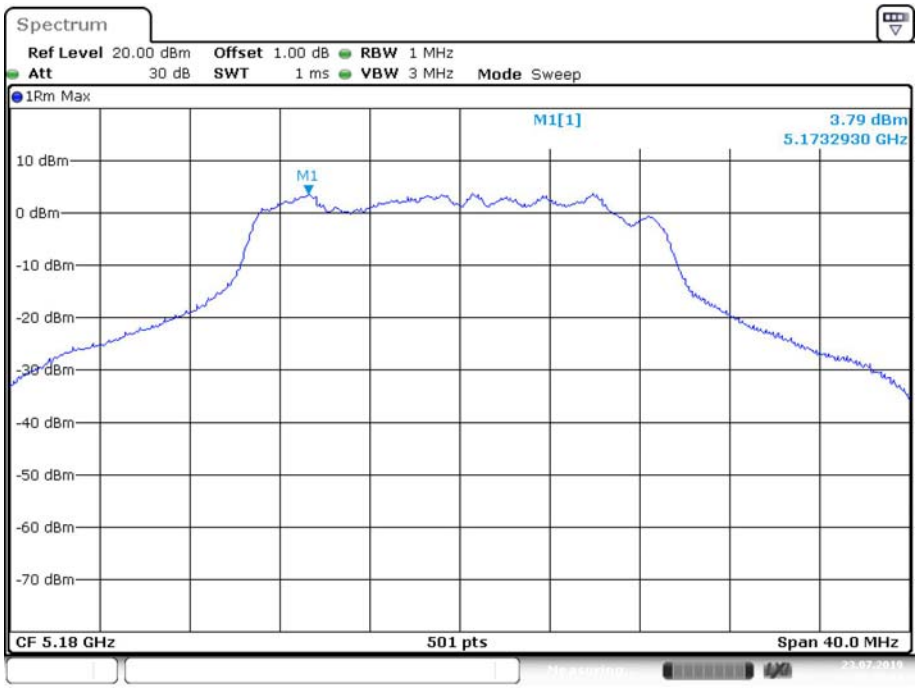
Date: 17.JUL.2019 19:53:22

802.11a High Channel



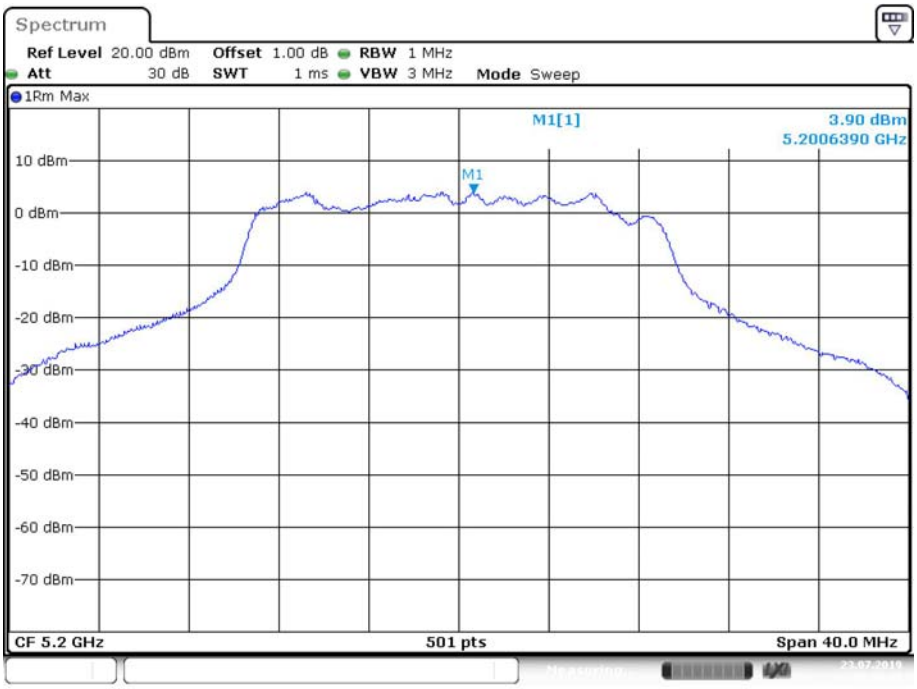
Date: 17.JUL.2019 19:53:48

802.11n ht20 Low Channel



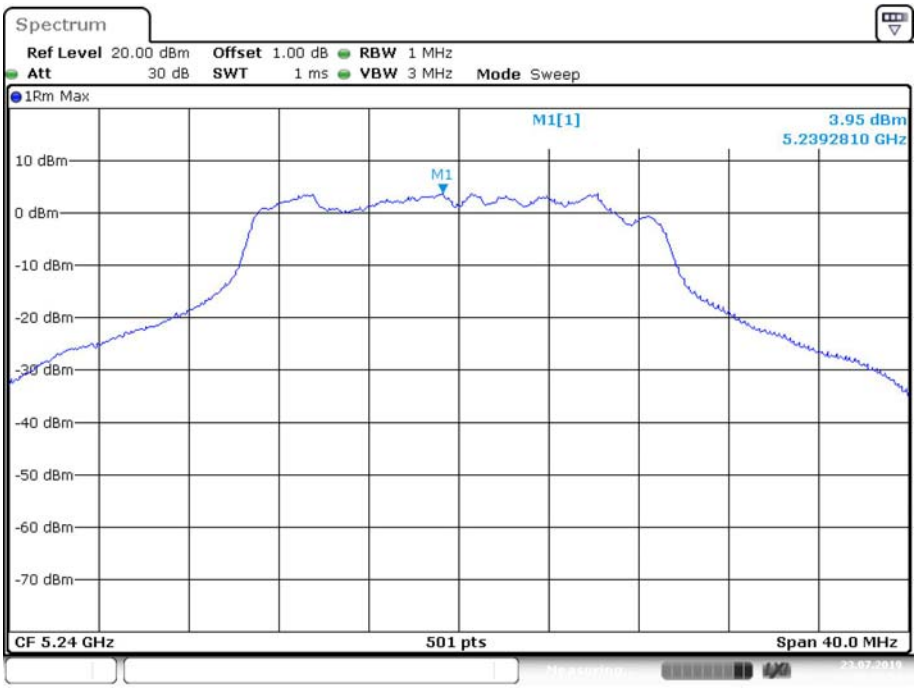
Date: 23.JUL.2019 10:18:05

802.11n ht20 Middle Channel



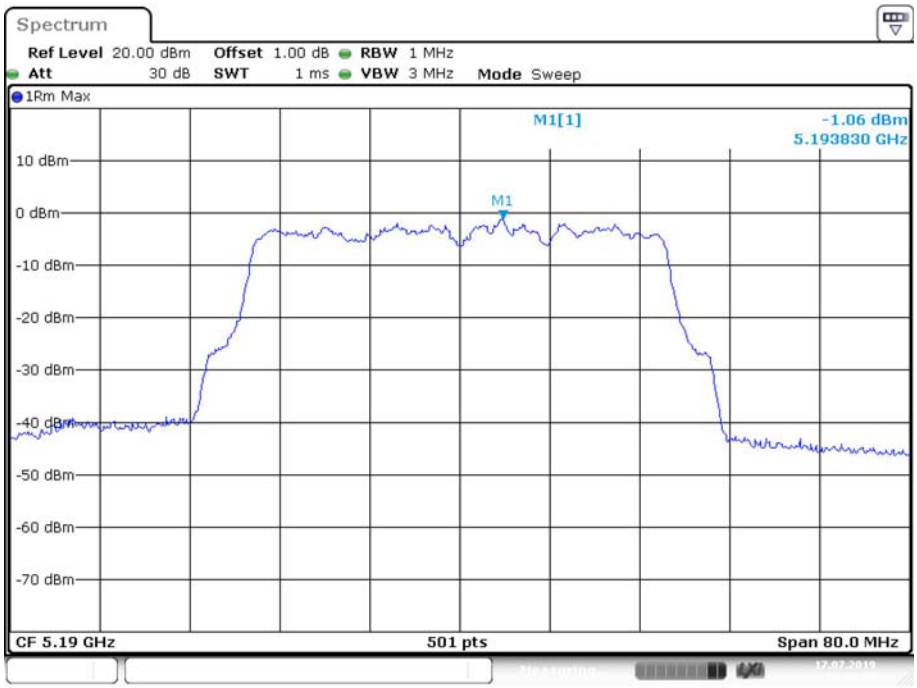
Date: 23.JUL.2019 10:14:33

802.11n ht20 High Channel



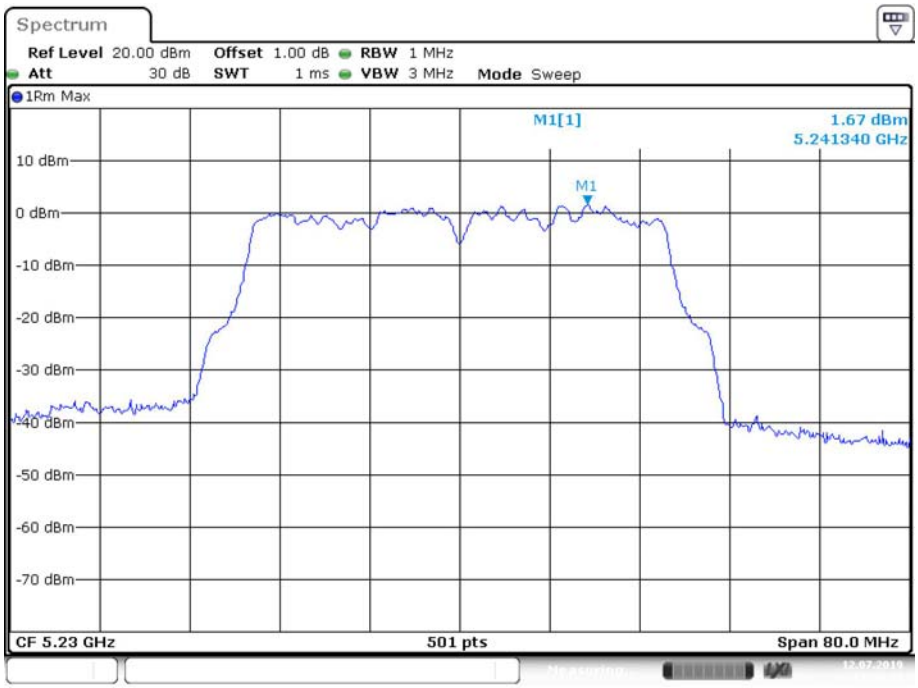
Date: 23.JUL.2019 10:13:54

802.11n ht40 Low Channel



Date: 17.JUL.2019 19:44:05

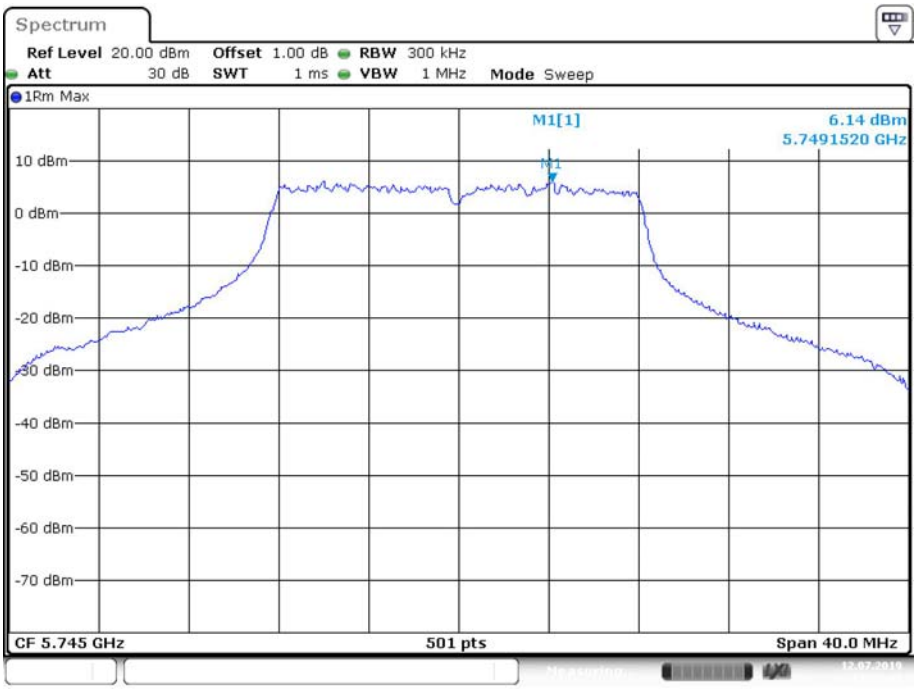
802.11n ht40 High Channel



Date: 12.JUL.2019 17:36:32

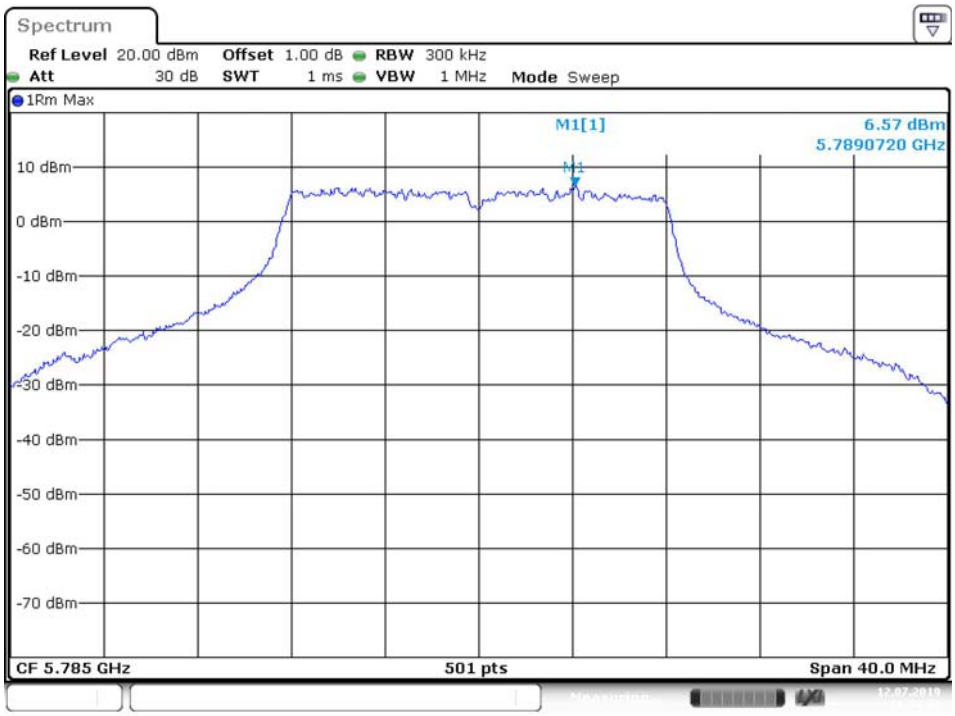
5725-5850MHz

802.11a Low Channel



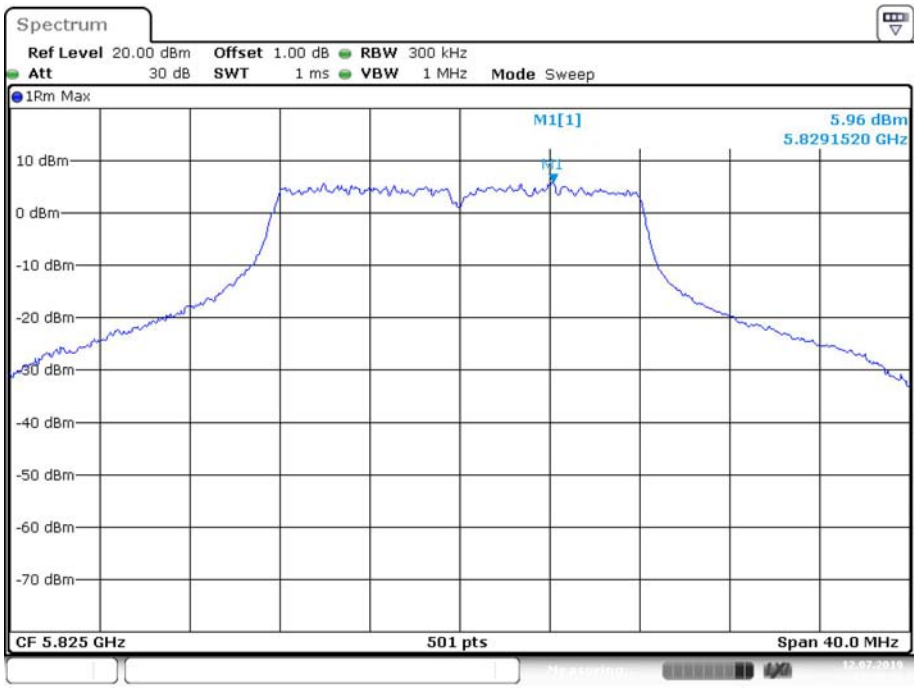
Date: 12.JUL.2019 17:53:02

802.11a Middle Channel



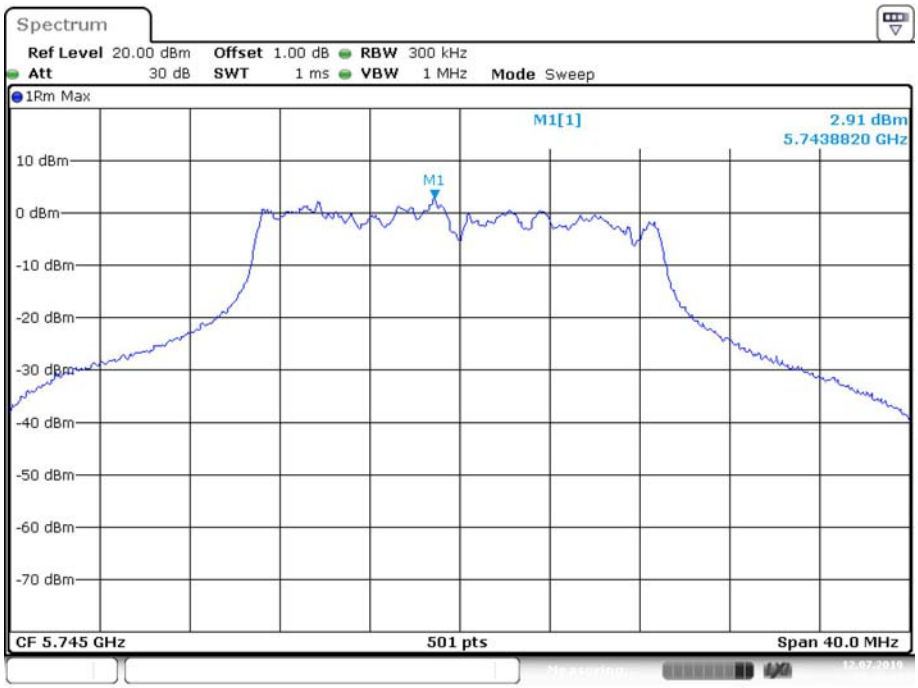
Date: 12.JUL.2019 17:54:32

802.11a High Channel



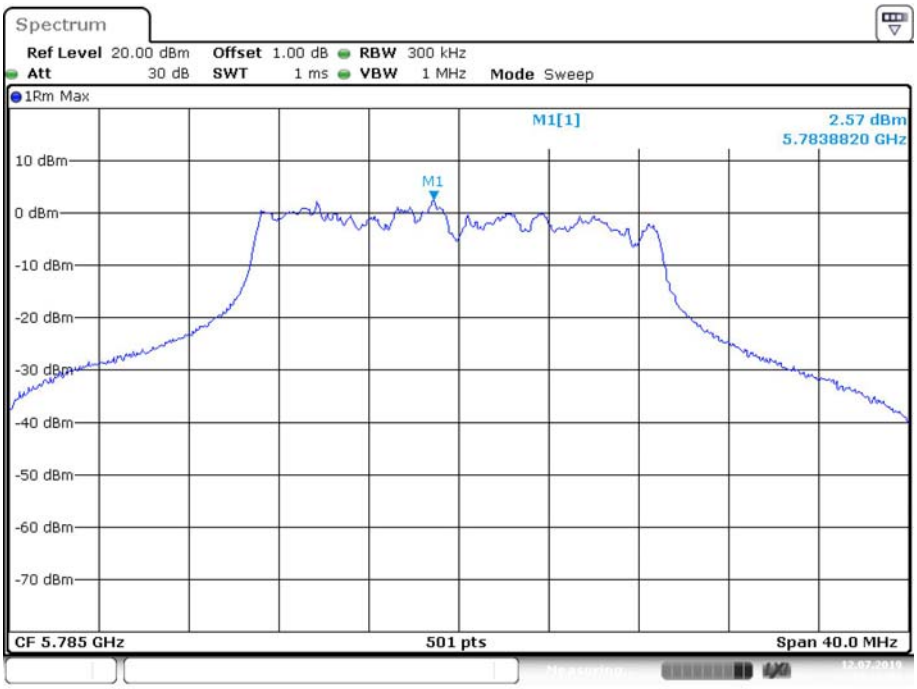
Date: 12.JUL.2019 17:55:36

802.11n ht20 Low Channel



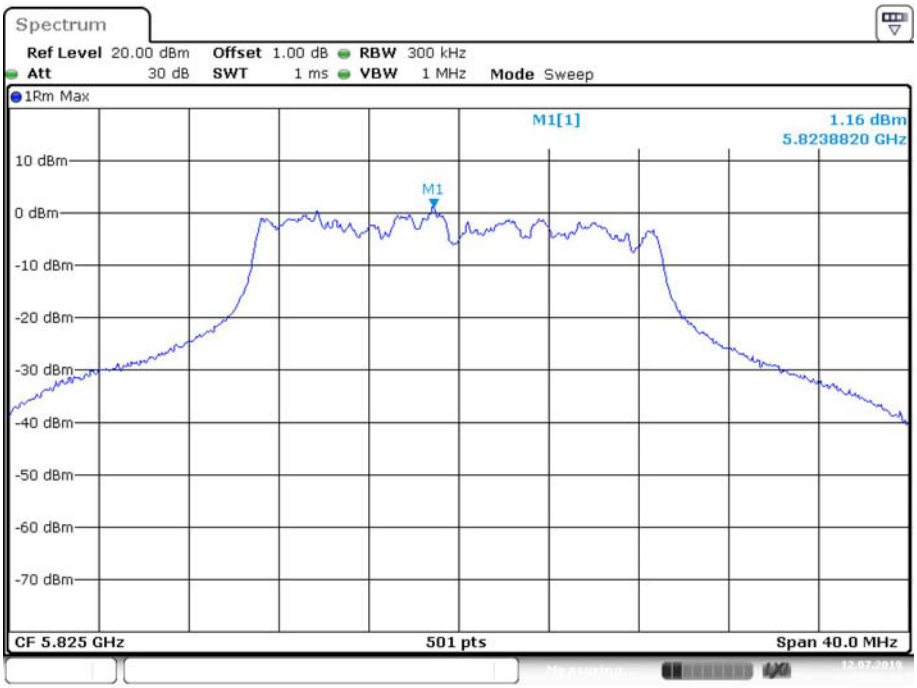
Date: 12.JUL.2019 18:14:41

802.11n ht20 Middle Channel



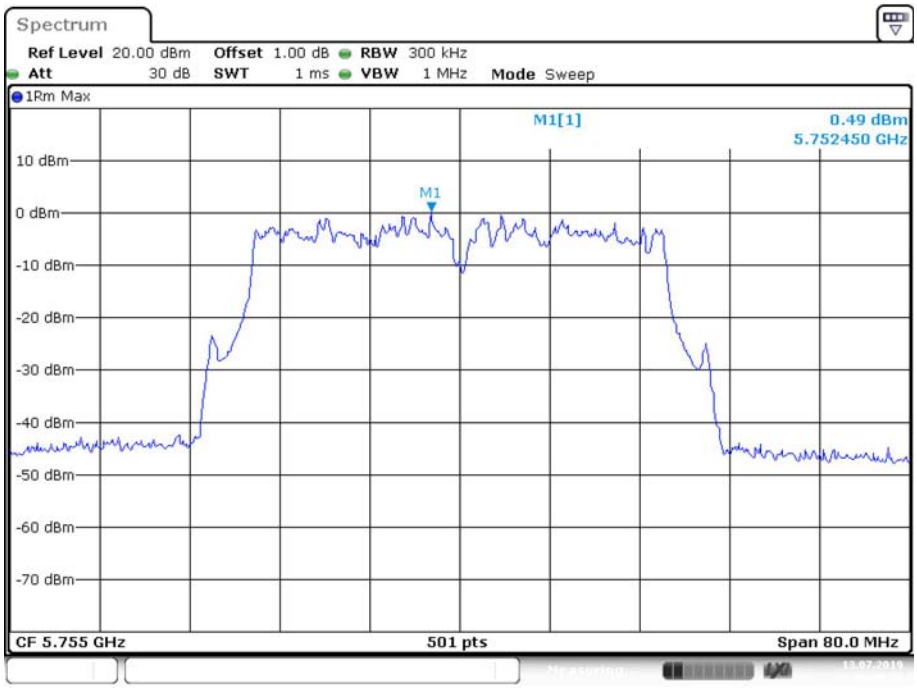
Date: 12.JUL.2019 18:16:08

802.11n ht20 High Channel



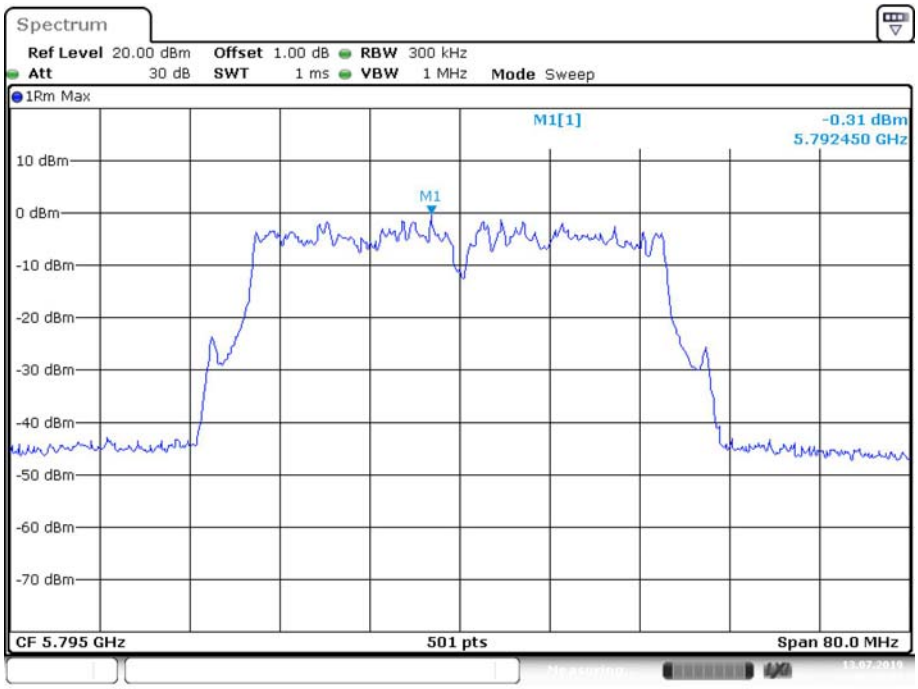
Date: 12.JUL.2019 18:23:16

802.11n ht40 Low Channel



Date: 13.JUL.2019 09:49:31

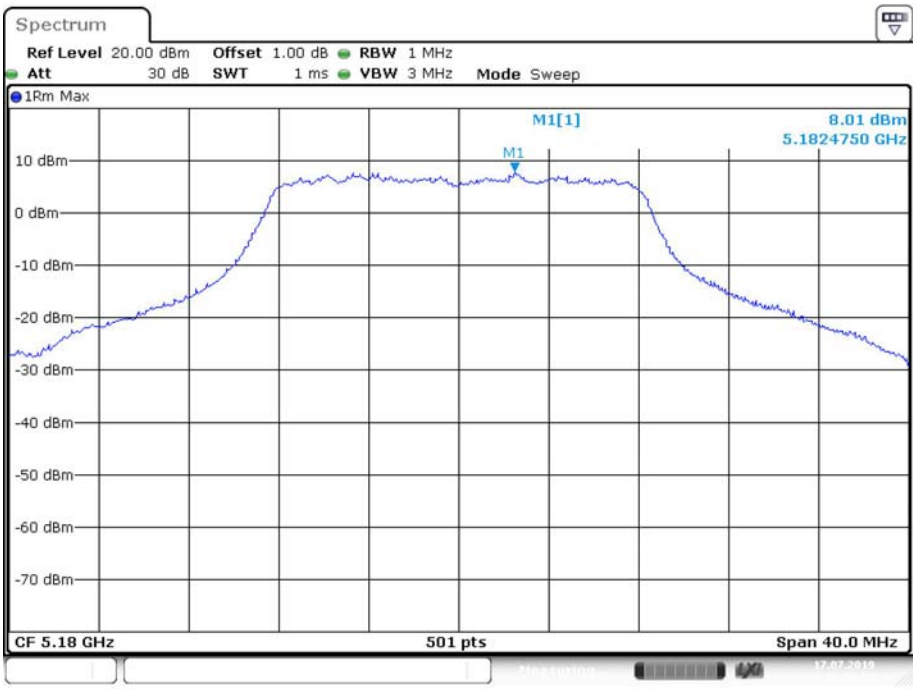
802.11n ht40 High Channel



Date: 13.JUL.2019 09:55:09

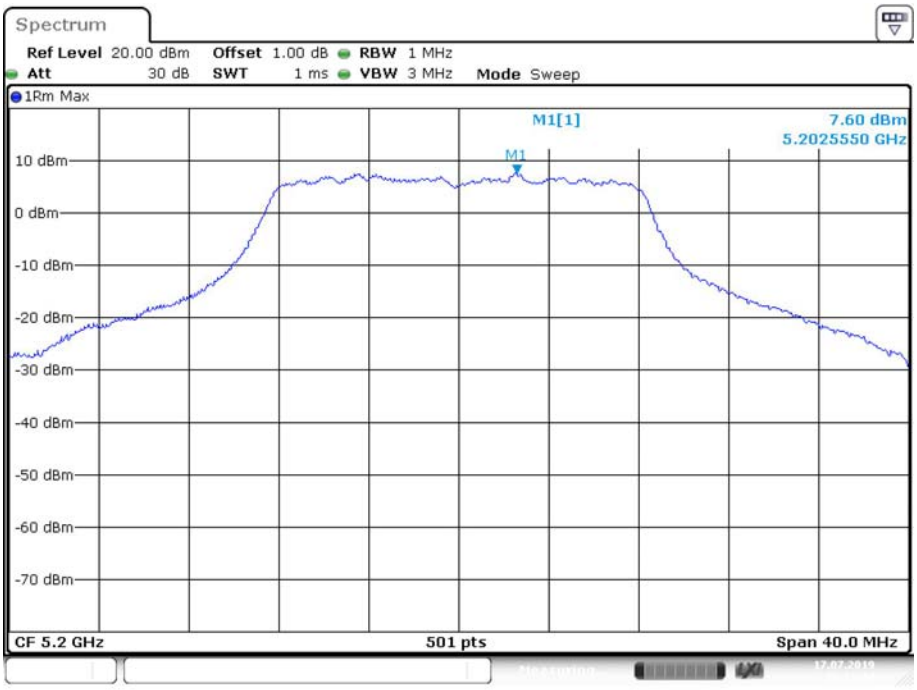
Chain 1:
5150-5250MHz

802.11a Low Channel



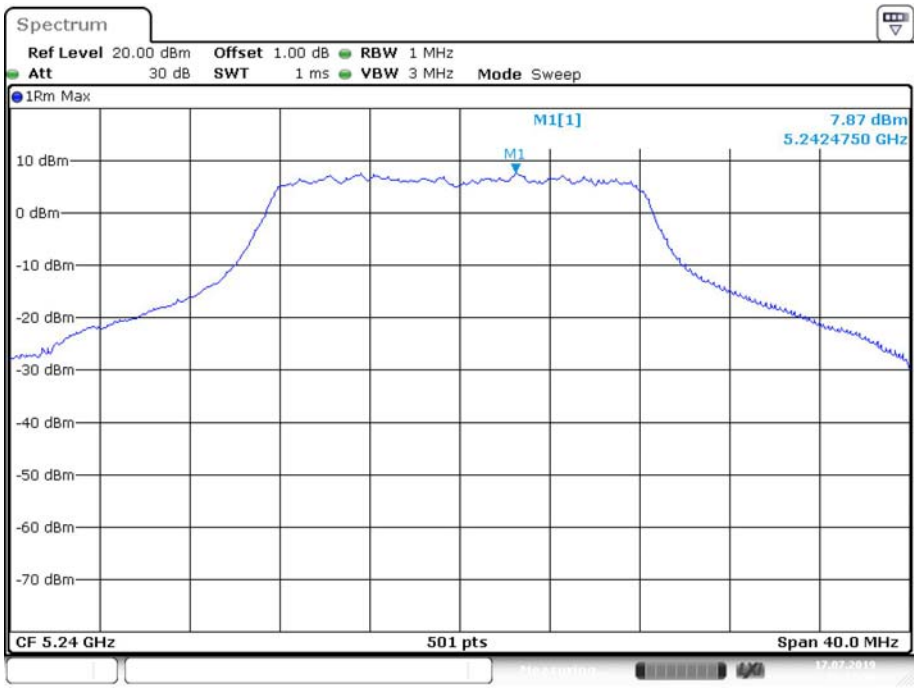
Date: 17.JUL.2019 19:50:52

802.11a Middle Channel



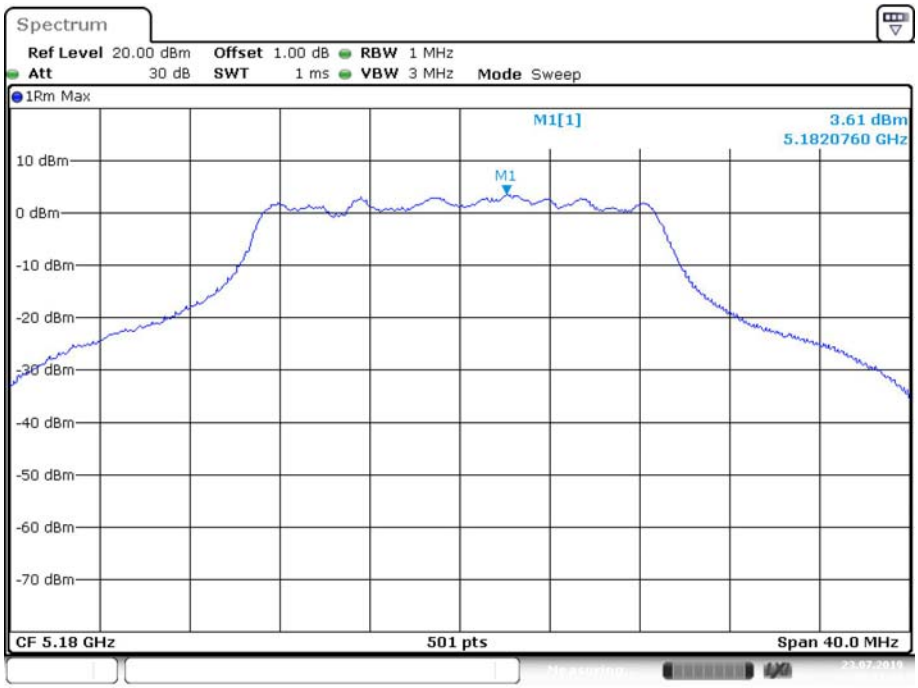
Date: 17.JUL.2019 19:51:24

802.11a High Channel



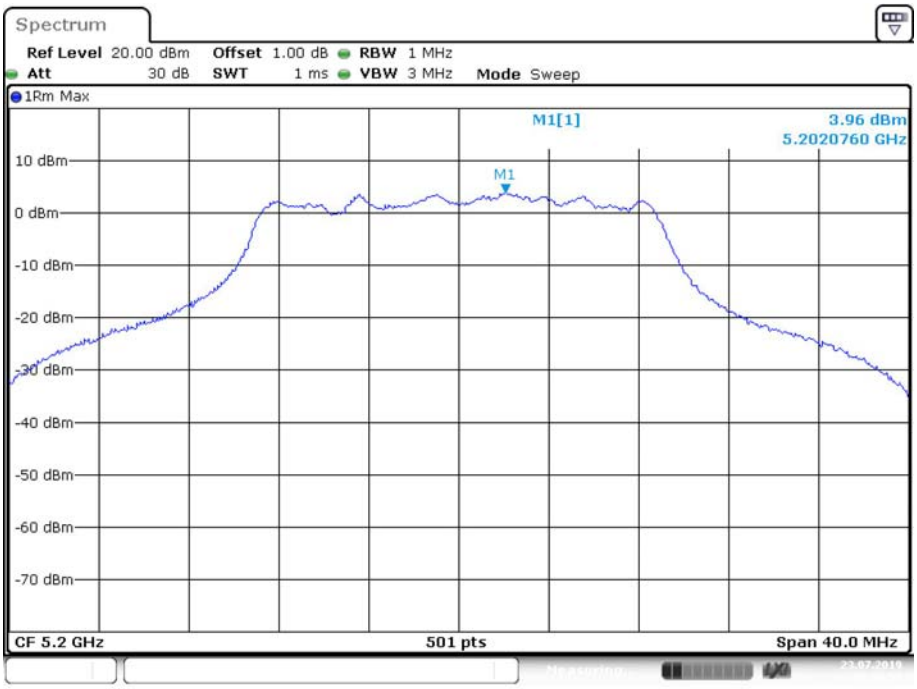
Date: 17.JUL.2019 19:51:56

802.11n ht20 Low Channel



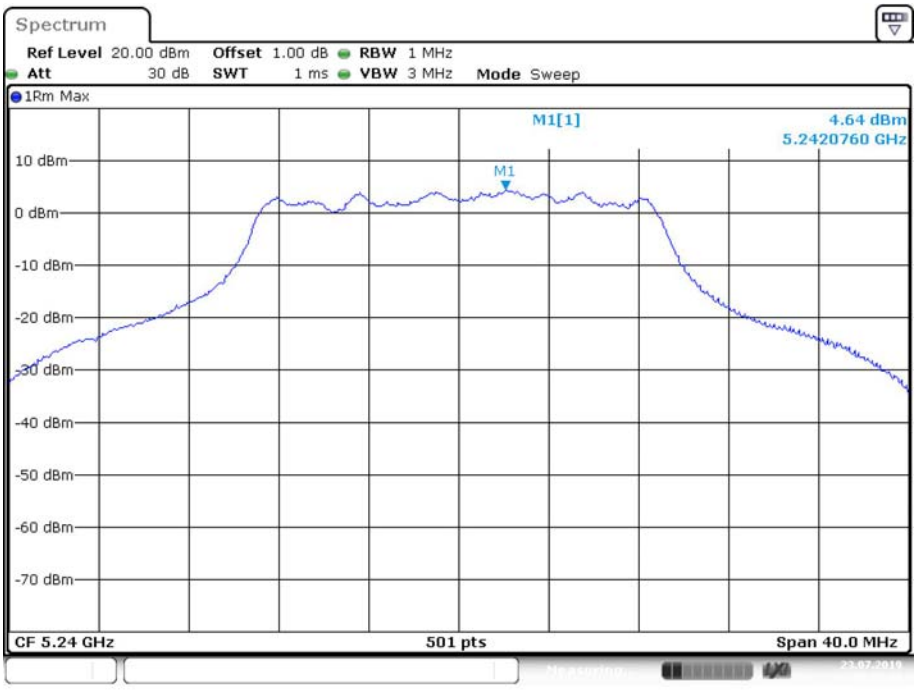
Date: 23.JUL.2019 10:17:37

802.11n ht20 Middle Channel



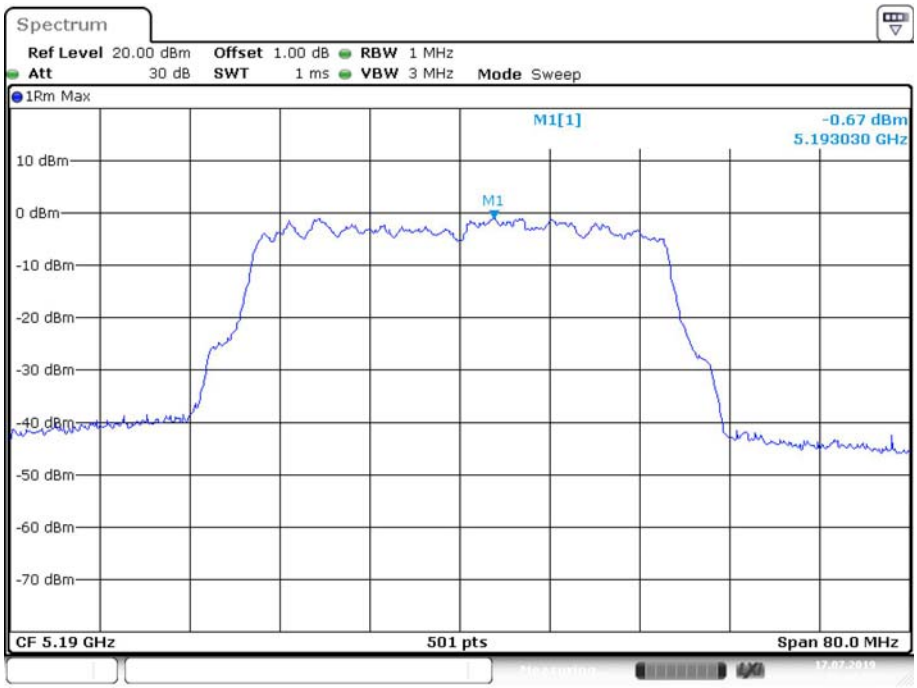
Date: 23.JUL.2019 10:14:59

802.11n ht20 High Channel



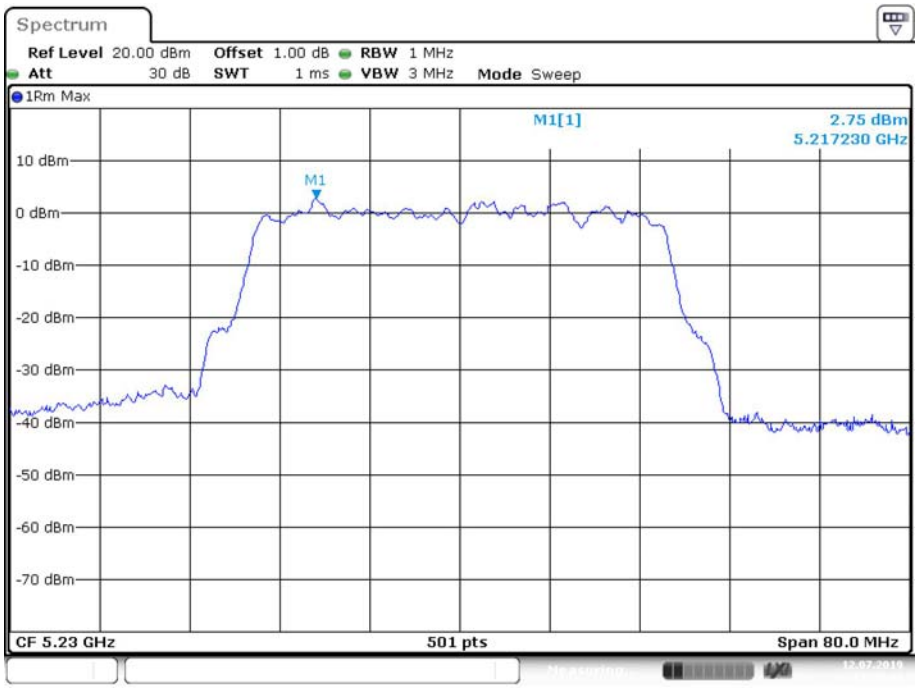
Date: 23.JUL.2019 10:13:29

802.11n ht40 Low Channel



Date: 17.JUL.2019 19:44:51

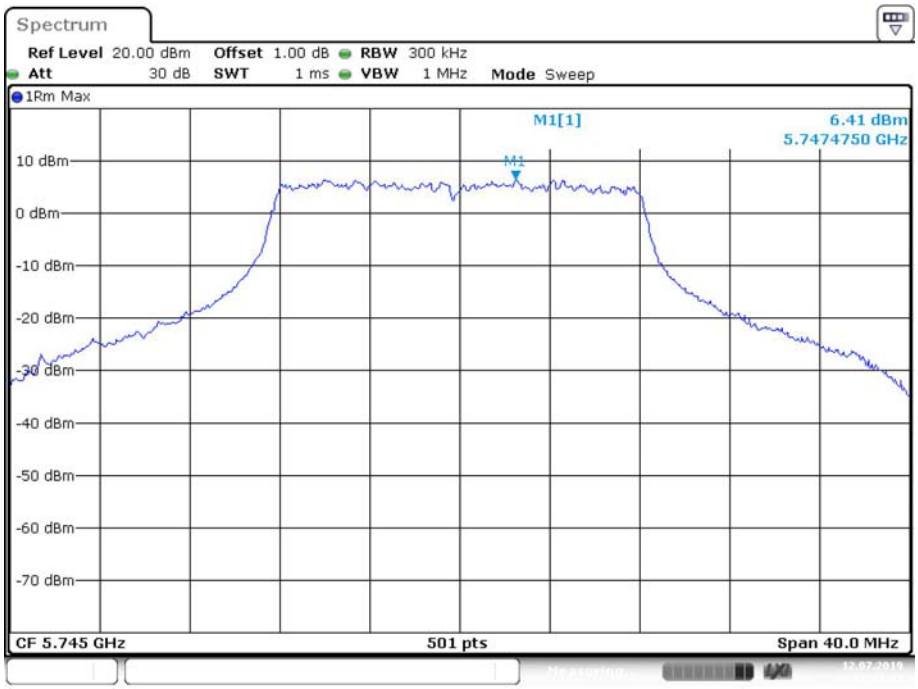
802.11n ht40 High Channel



Date: 12.JUL.2019 17:38:05

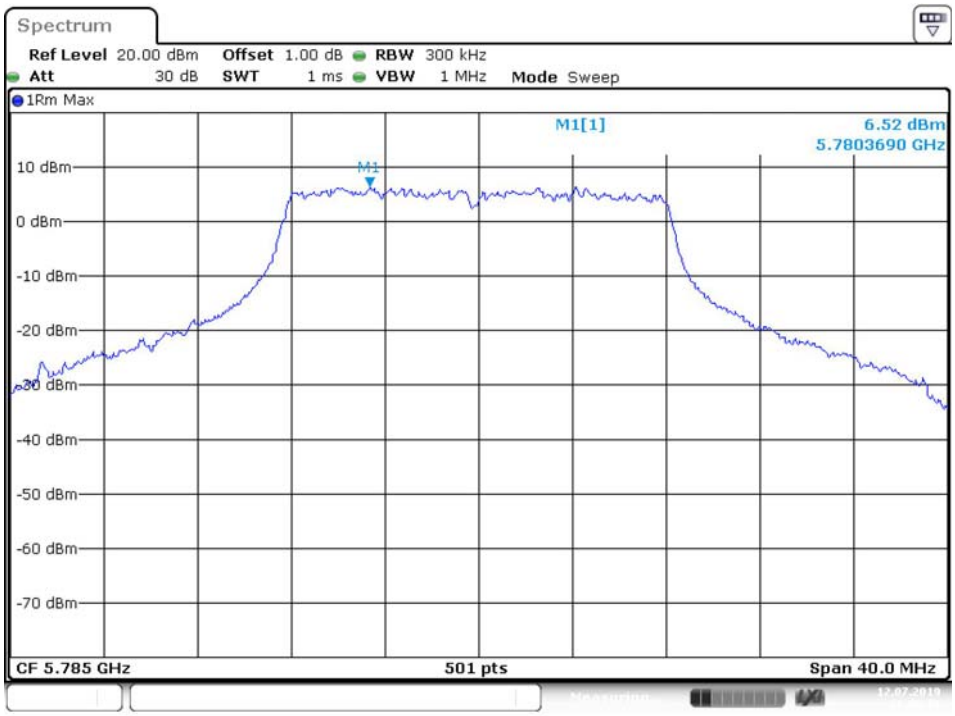
5725-5850MHz

802.11a Low Channel



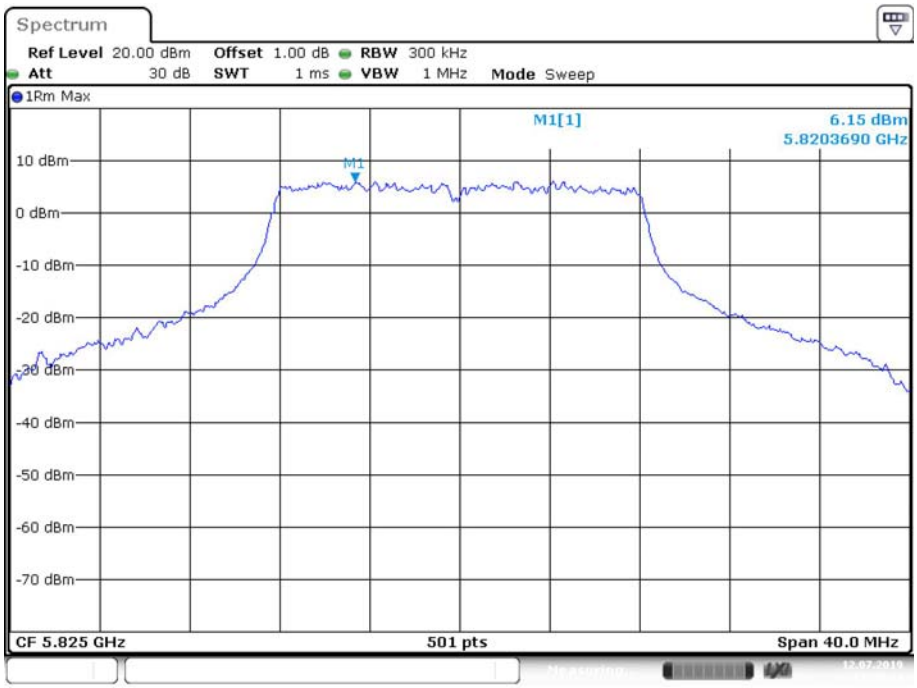
Date: 12.JUL.2019 17:57:17

802.11a Middle Channel



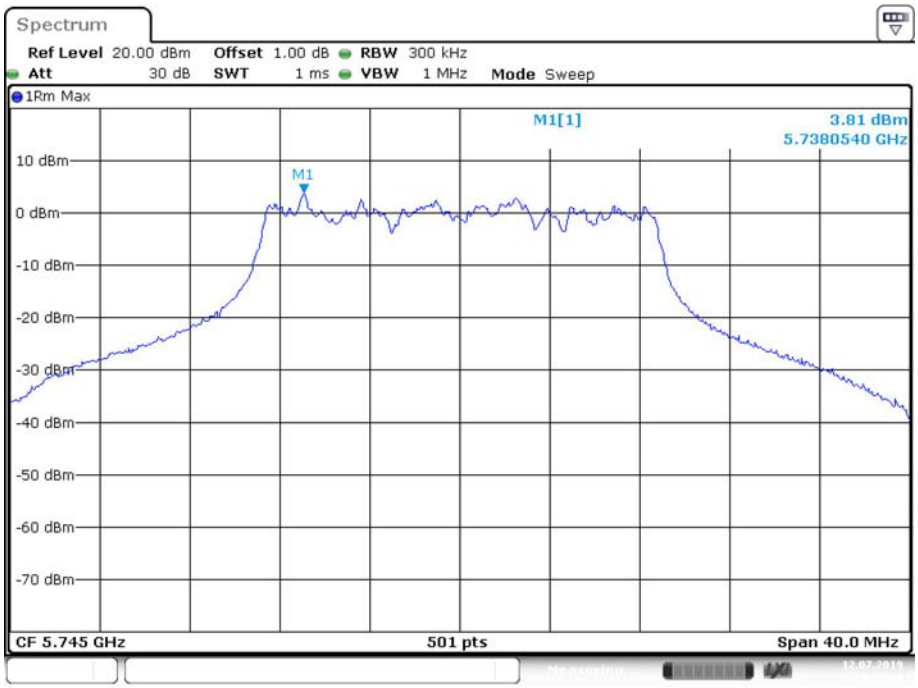
Date: 12.JUL.2019 17:58:17

802.11a High Channel



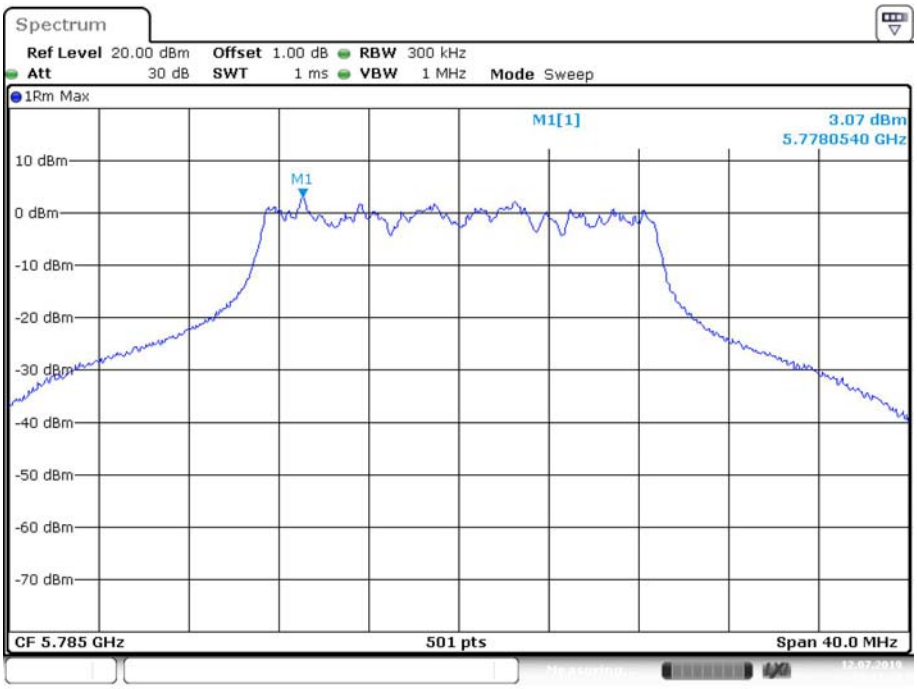
Date: 12.JUL.2019 17:59:14

802.11n ht20 Low Channel



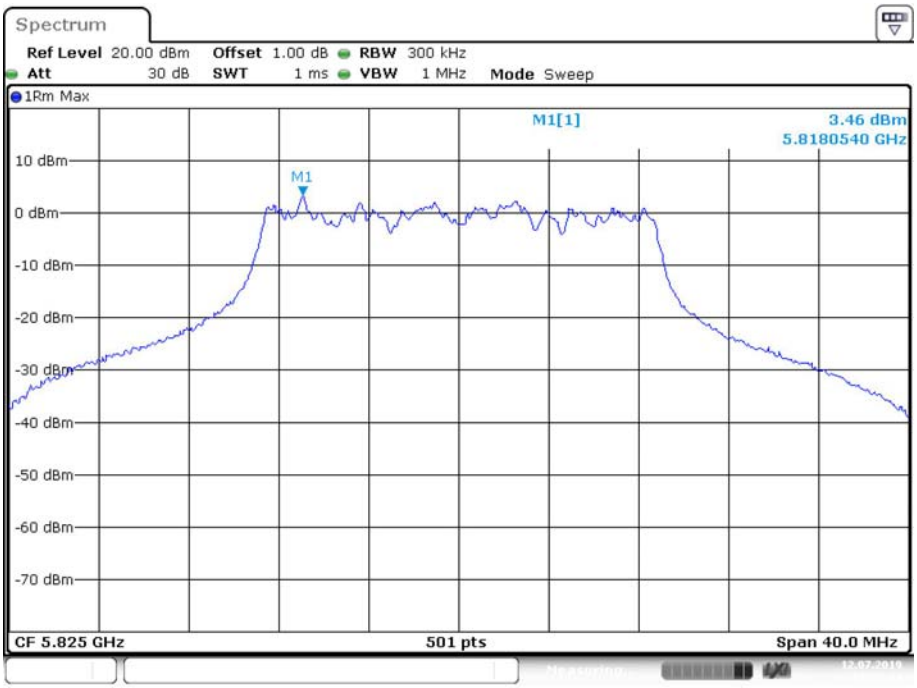
Date: 12.JUL.2019 18:13:30

802.11n ht20 Middle Channel



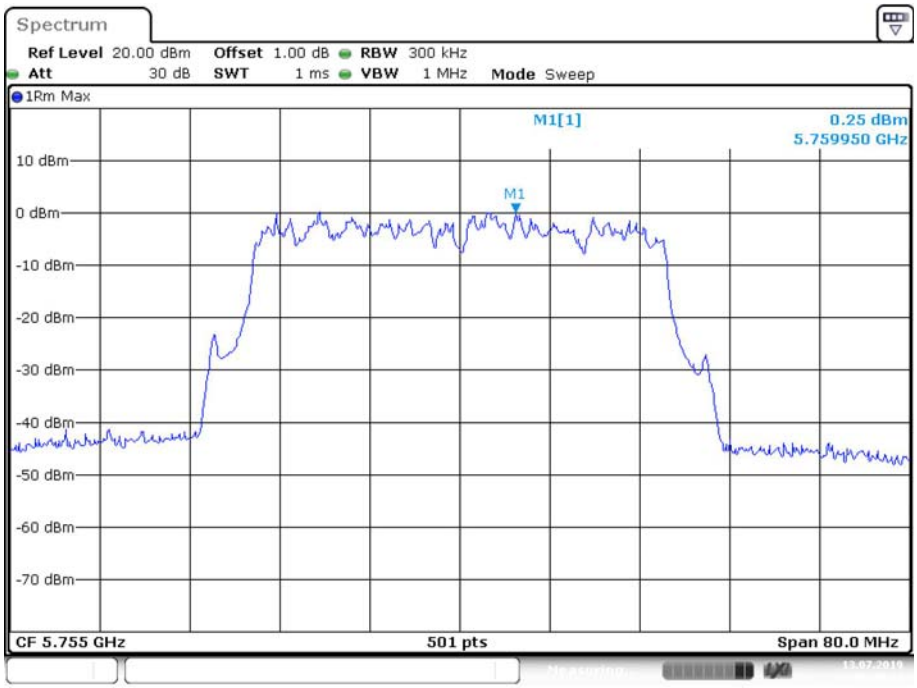
Date: 12.JUL.2019 18:17:15

802.11n ht20 High Channel



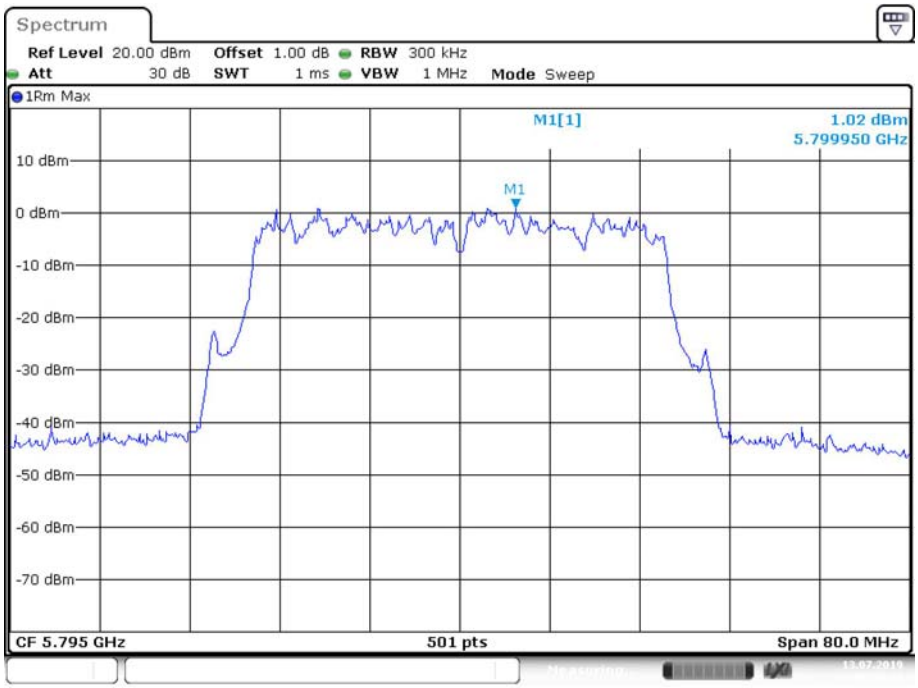
Date: 12.JUL.2019 18:22:13

802.11n ht40 Low Channel



Date: 13.JUL.2019 09:48:24

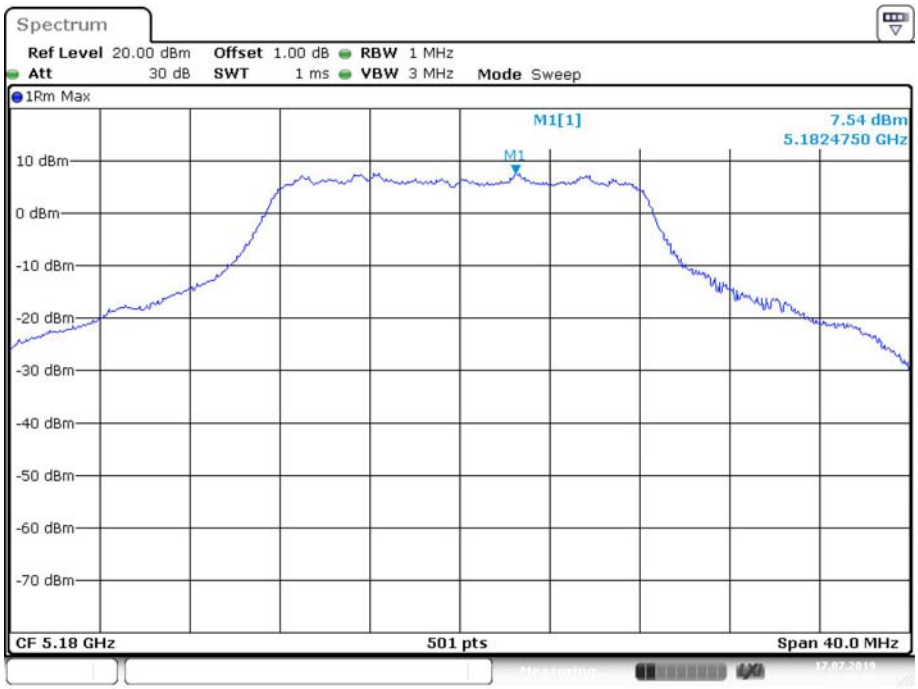
802.11n ht40 High Channel



Date: 13.JUL.2019 09:54:09

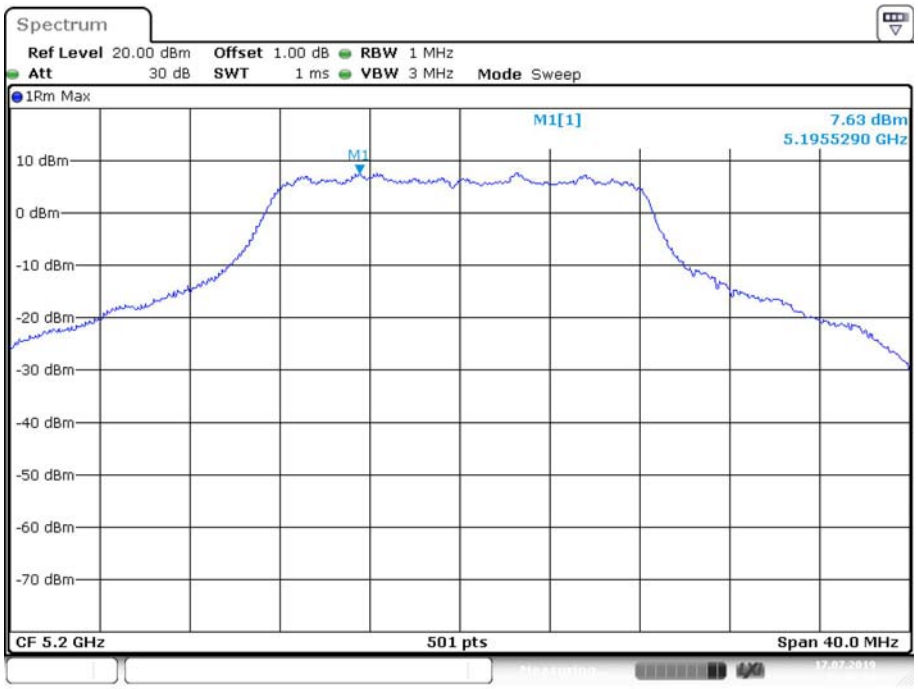
Chain 2:
5150-5250MHz

802.11a Low Channel



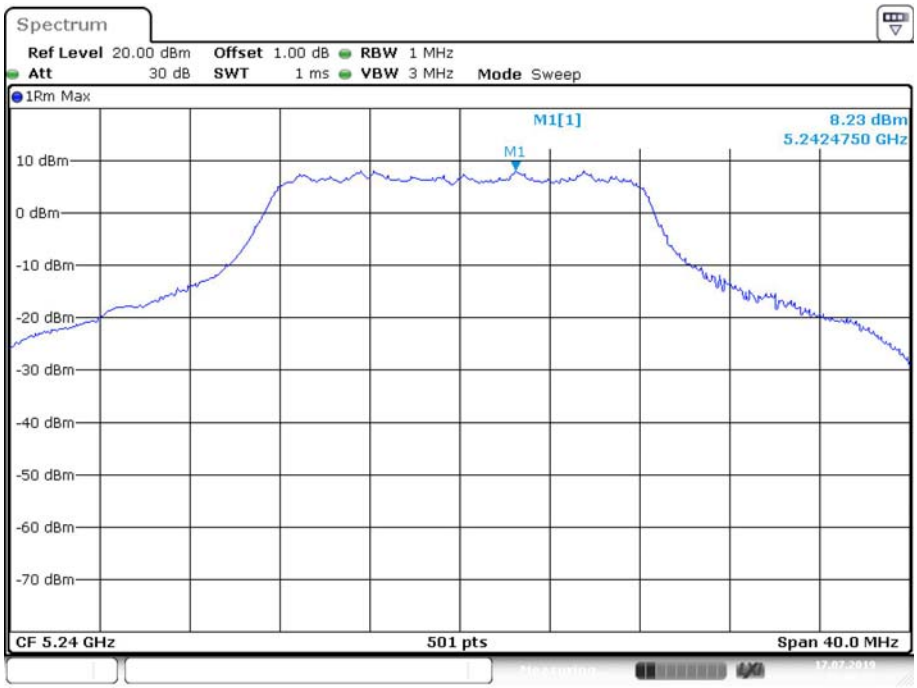
Date: 17.JUL.2019 19:50:08

802.11a Middle Channel



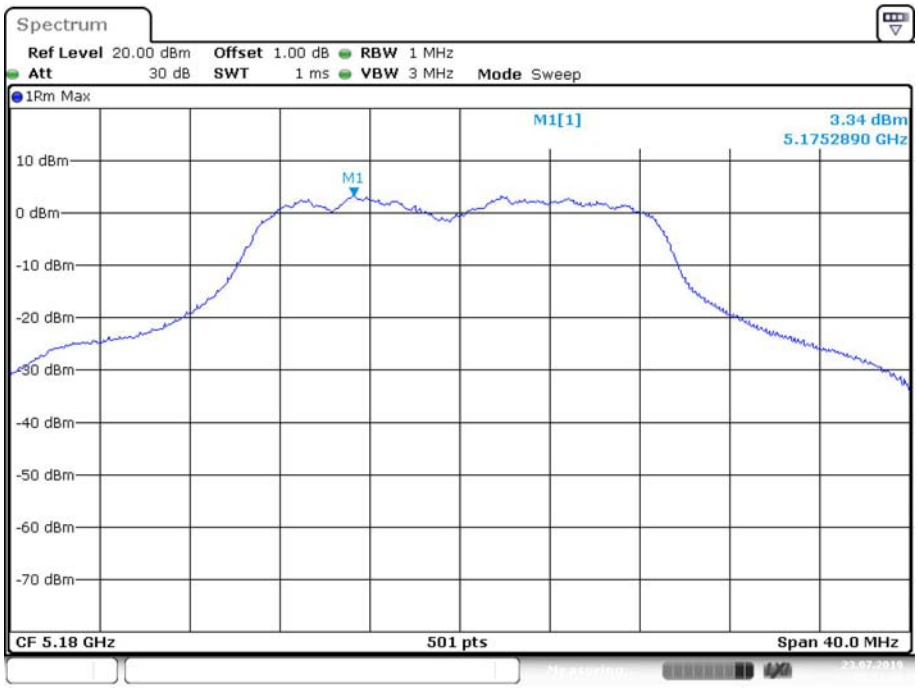
Date: 17.JUL.2019 19:49:34

802.11a High Channel



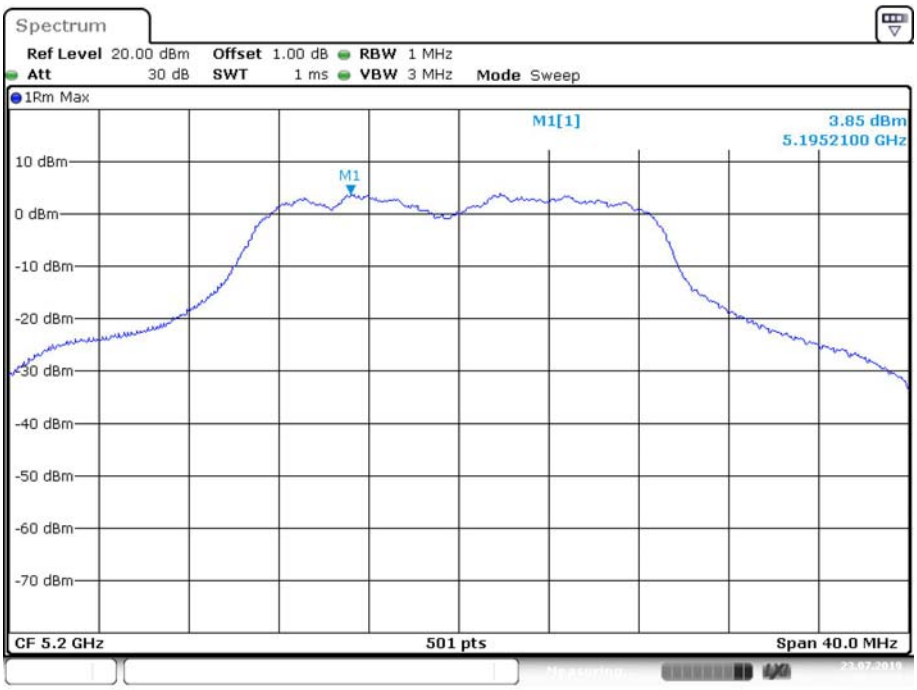
Date: 17.JUL.2019 19:49:02

802.11n ht20 Low Channel



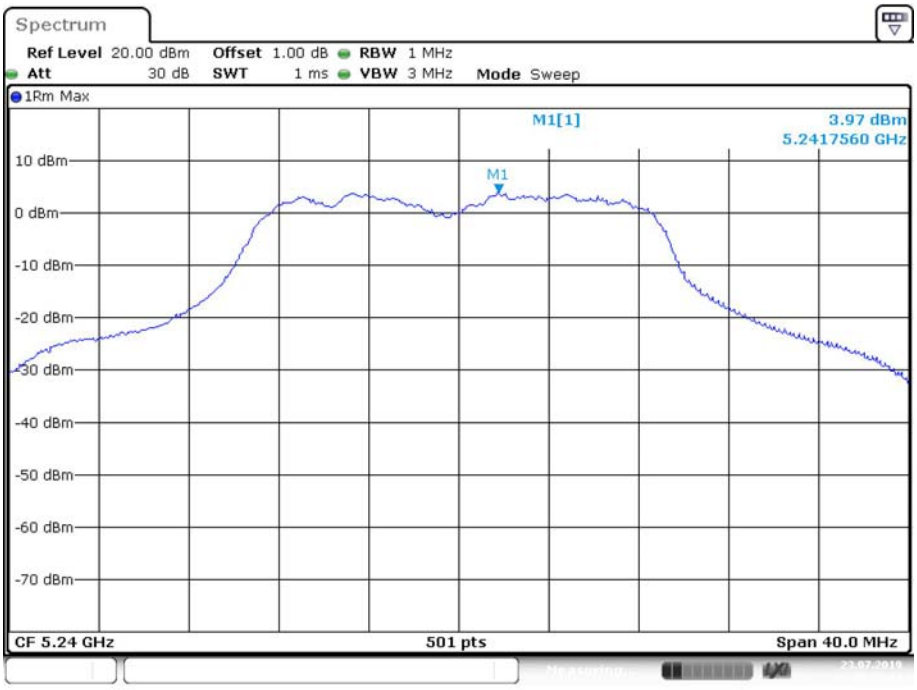
Date: 23.JUL.2019 10:17:11

802.11n ht20 Middle Channel



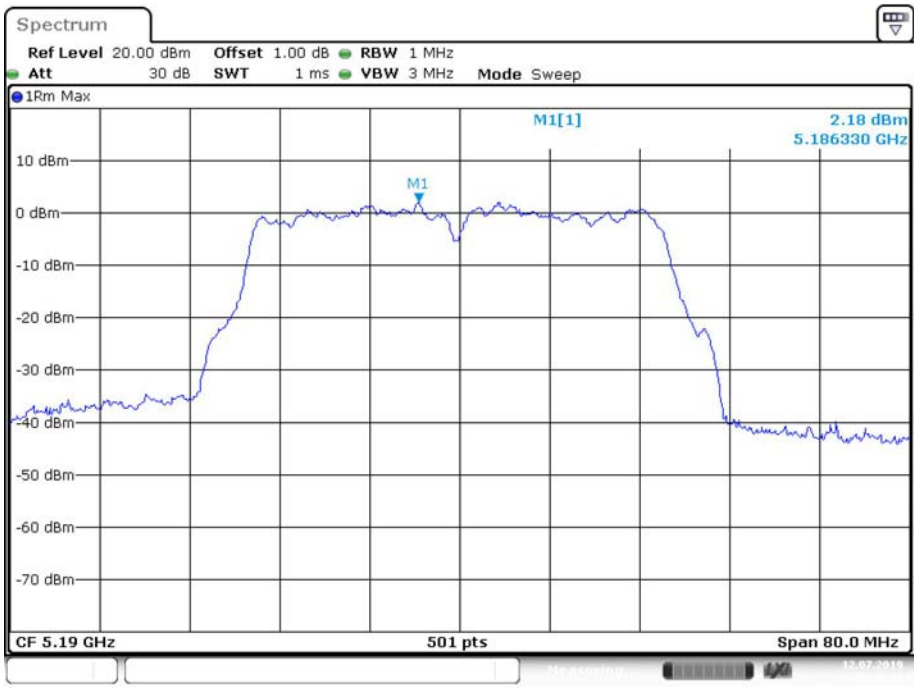
Date: 23.JUL.2019 10:15:28

802.11n ht20 High Channel



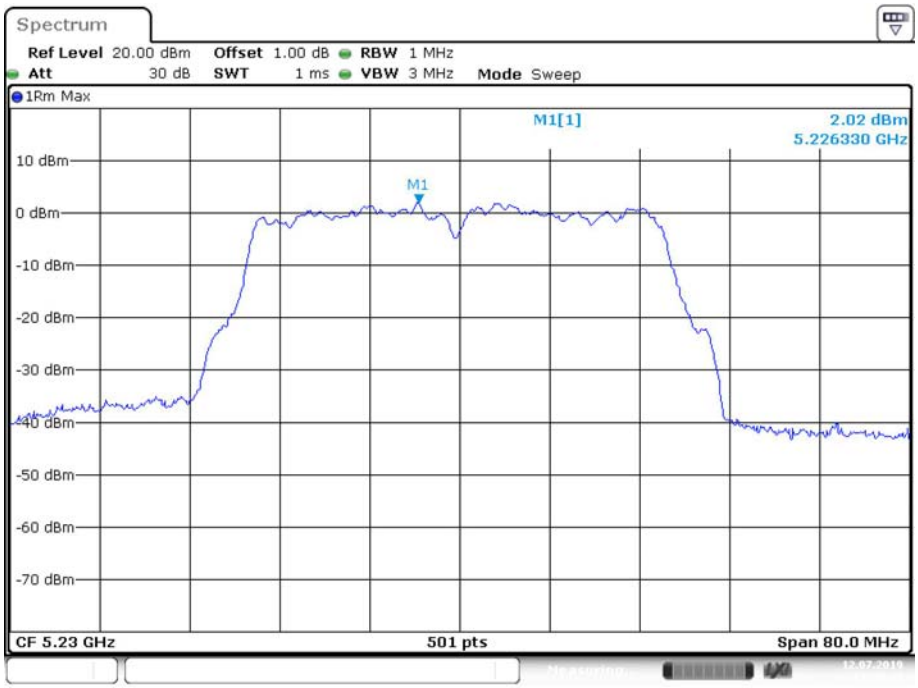
Date: 23.JUL.2019 10:13:05

802.11n ht40 Low Channel



Date: 12.JUL.2019 16:39:09

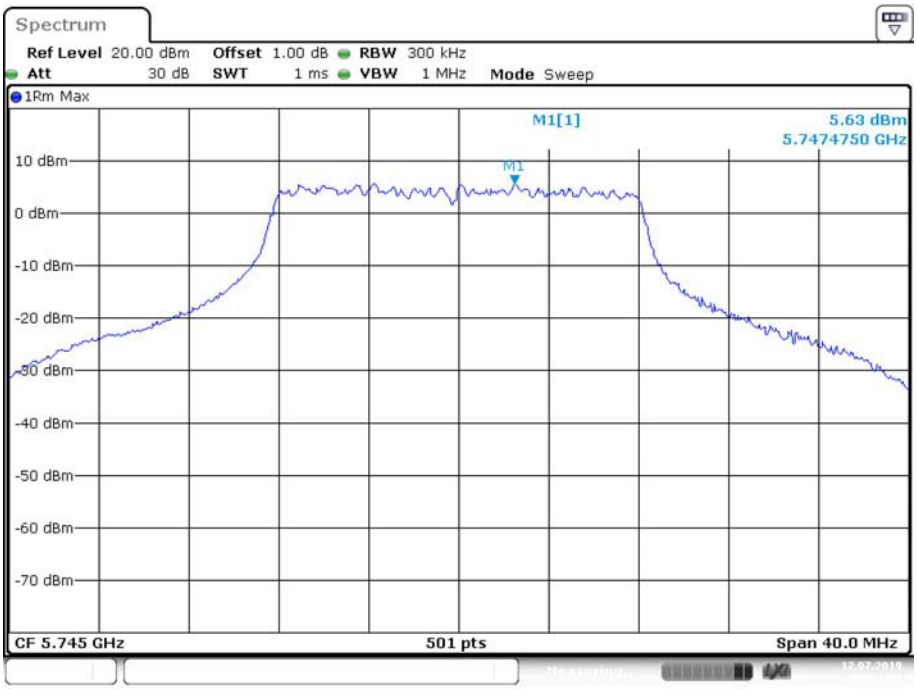
802.11n ht40 High Channel



Date: 12.JUL.2019 17:39:07

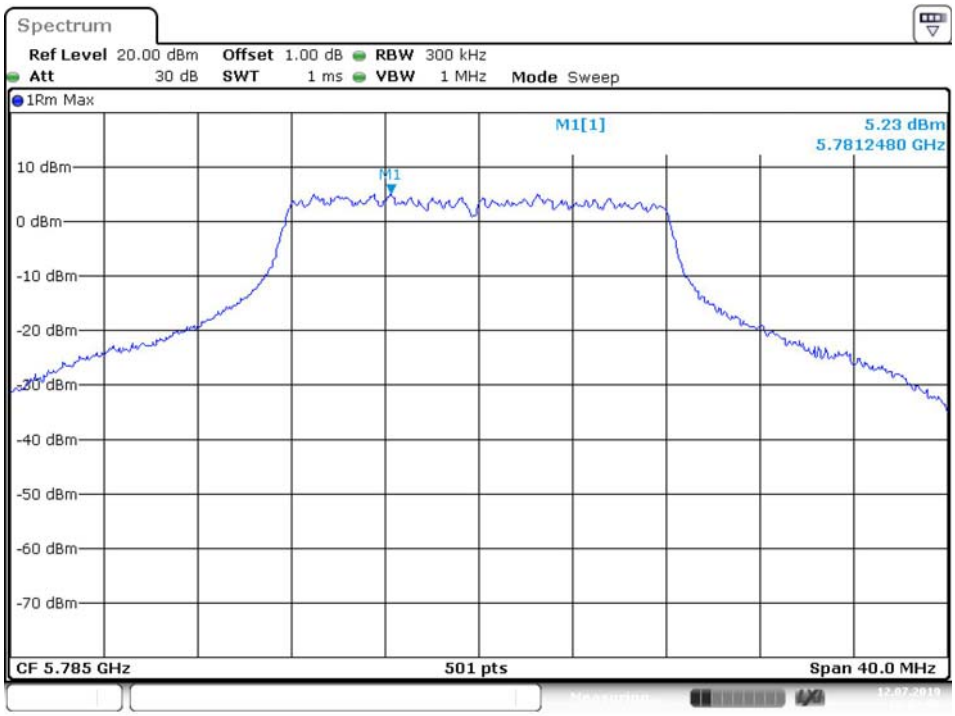
5725-5850MHz

802.11a Low Channel



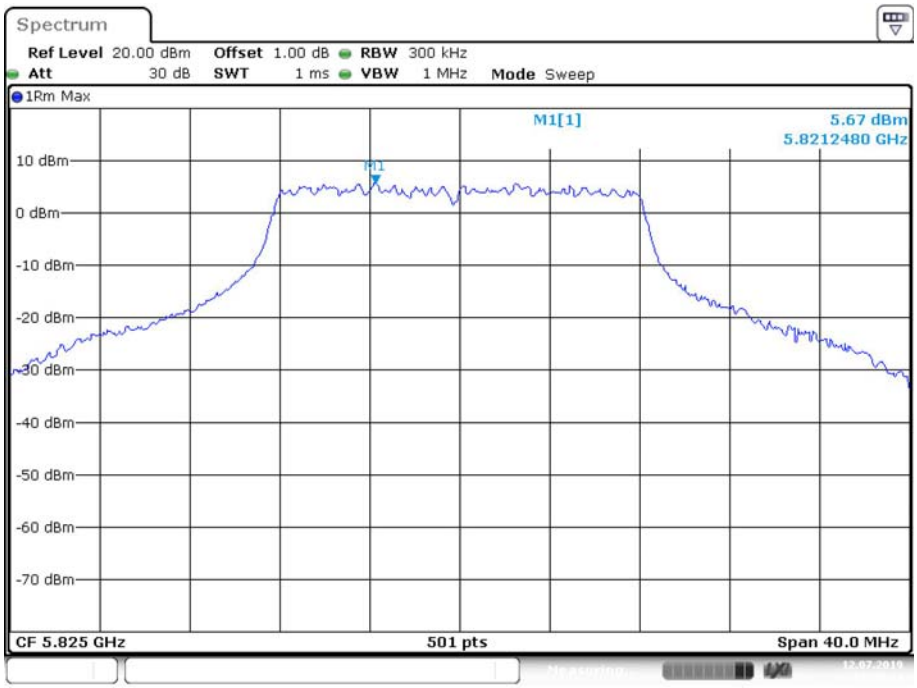
Date: 12.JUL.2019 18:01:00

802.11a Middle Channel



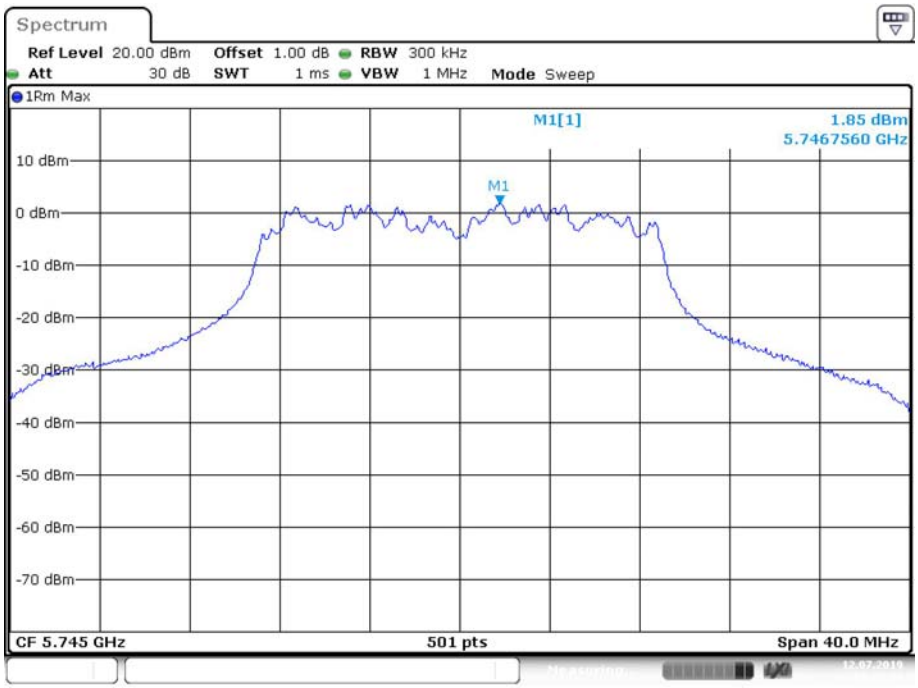
Date: 12.JUL.2019 18:02:06

802.11a High Channel



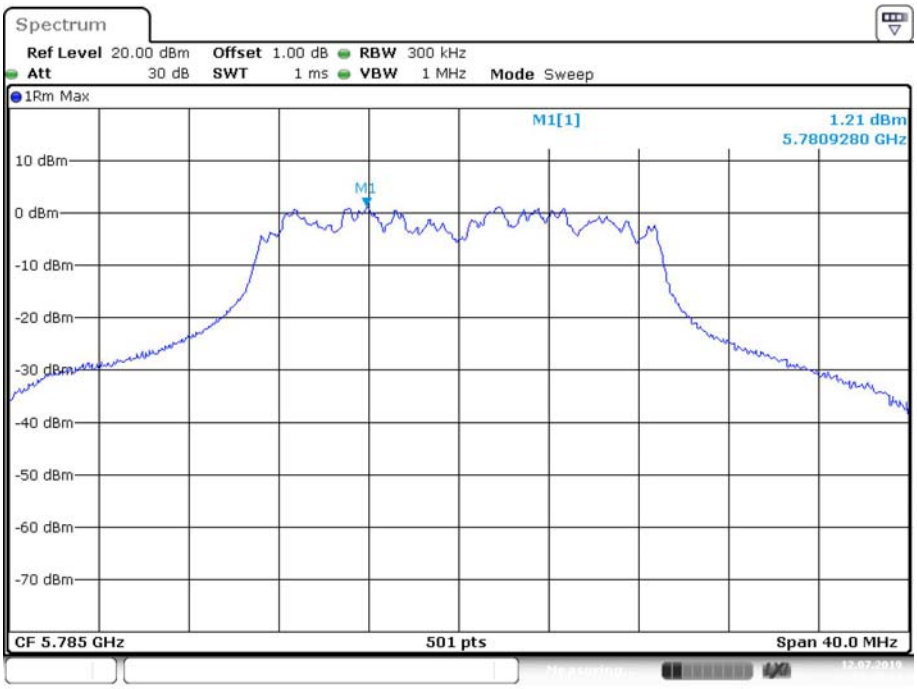
Date: 12.JUL.2019 18:03:13

802.11n ht20 Low Channel



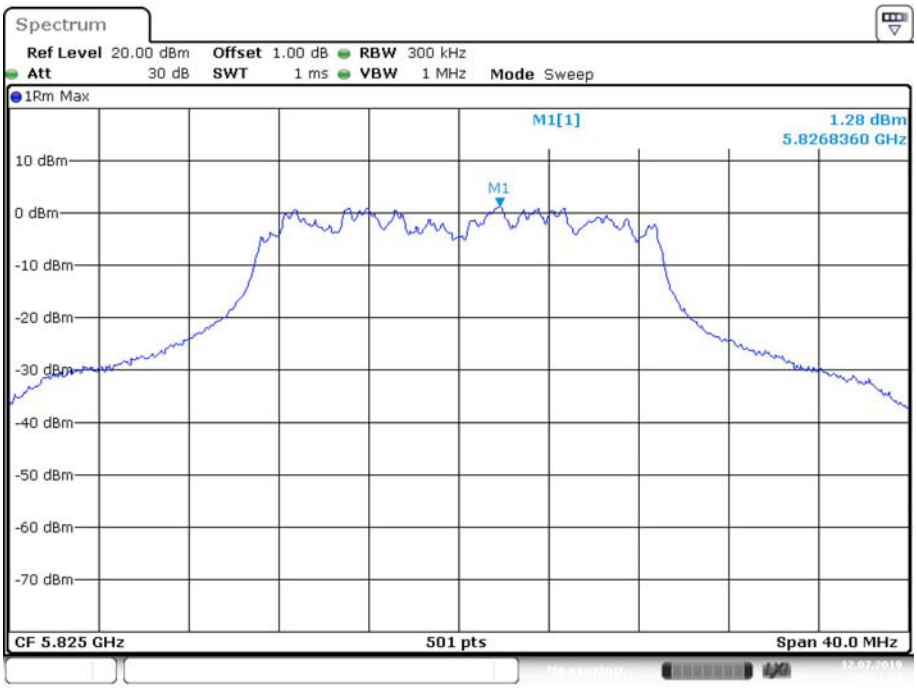
Date: 12.JUL.2019 18:12:29

802.11n ht20 Middle Channel



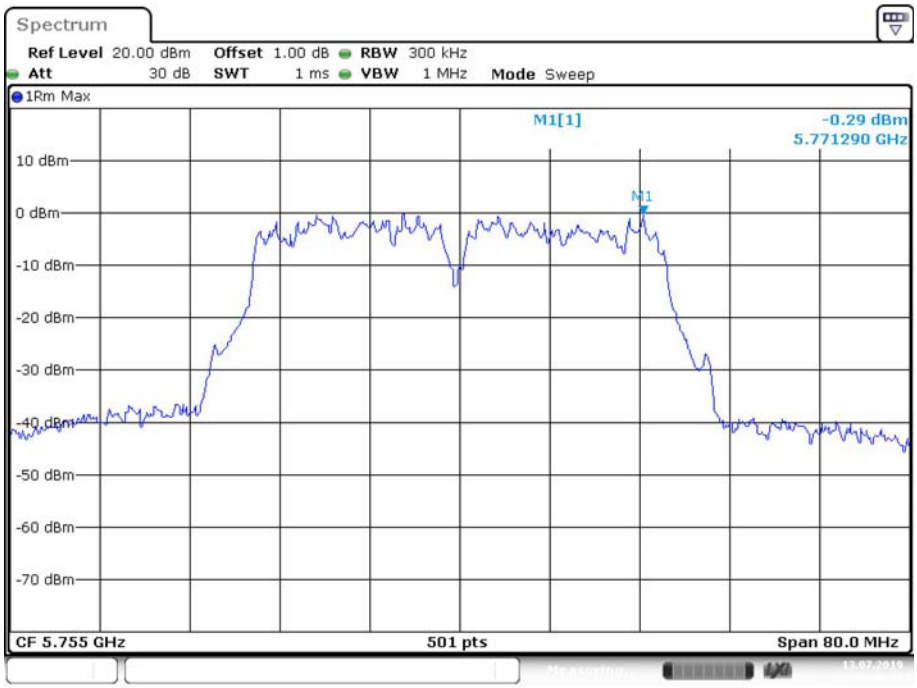
Date: 12.JUL.2019 18:18:13

802.11n ht20 High Channel



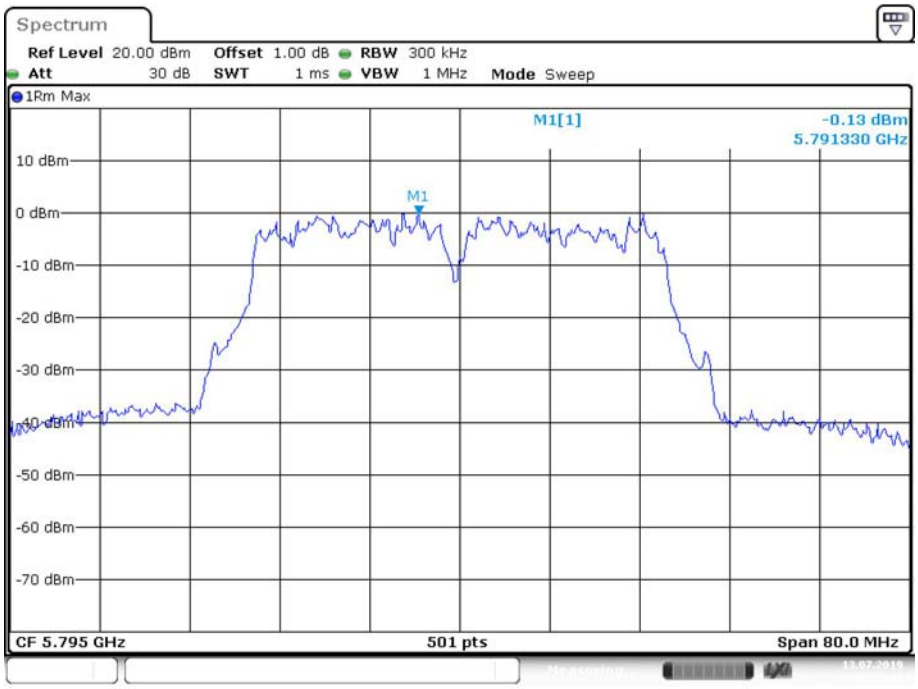
Date: 12.JUL.2019 18:21:24

802.11n ht40 Low Channel



Date: 13.JUL.2019 09:46:45

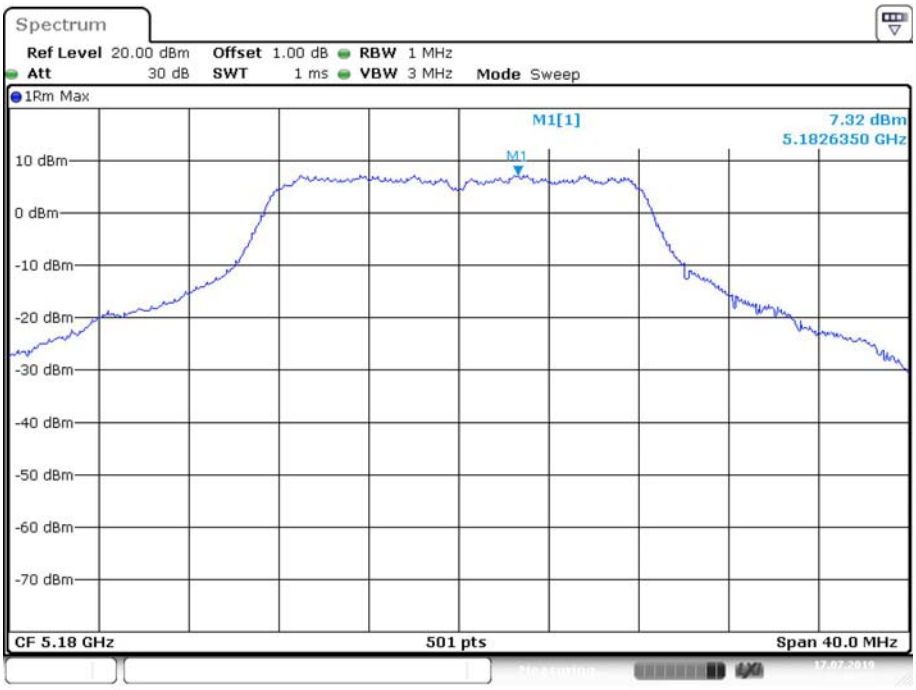
802.11n ht40 High Channel



Date: 13.JUL.2019 09:53:06

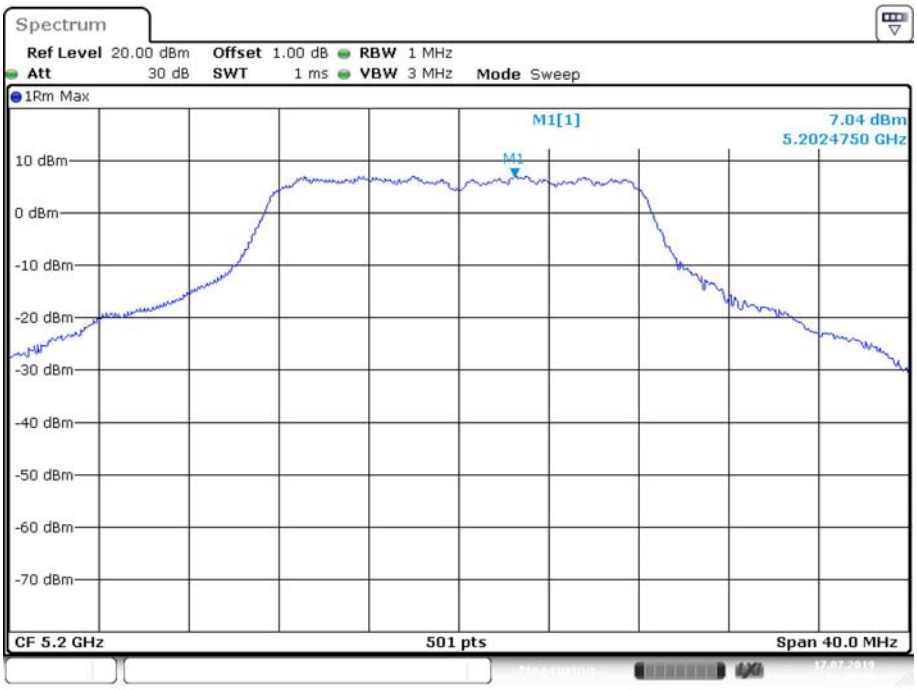
Chain 3:
5150-5250MHz

802.11a Low Channel



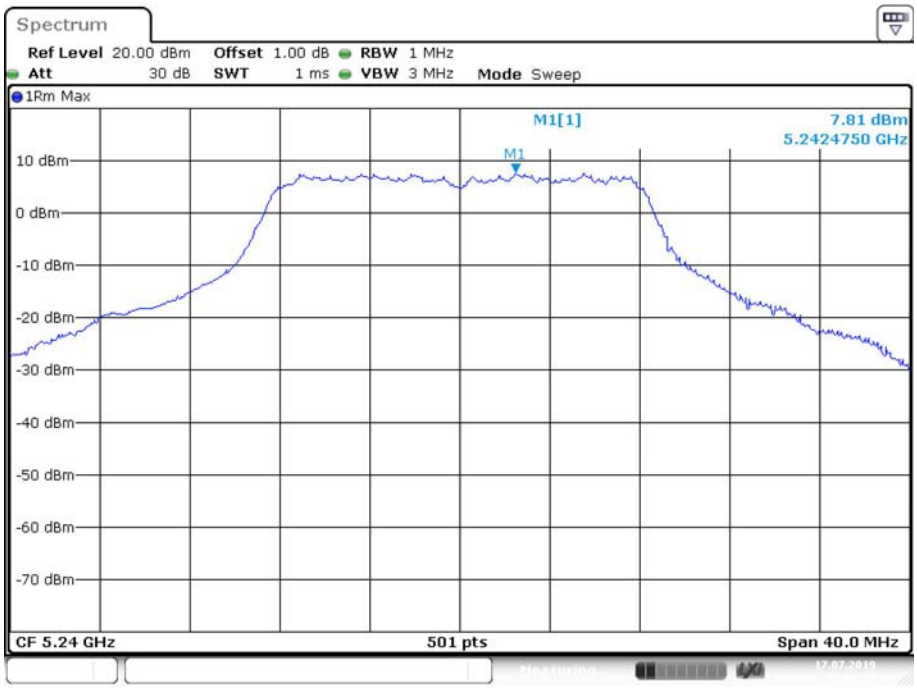
Date: 17.JUL.2019 19:46:52

802.11a Middle Channel



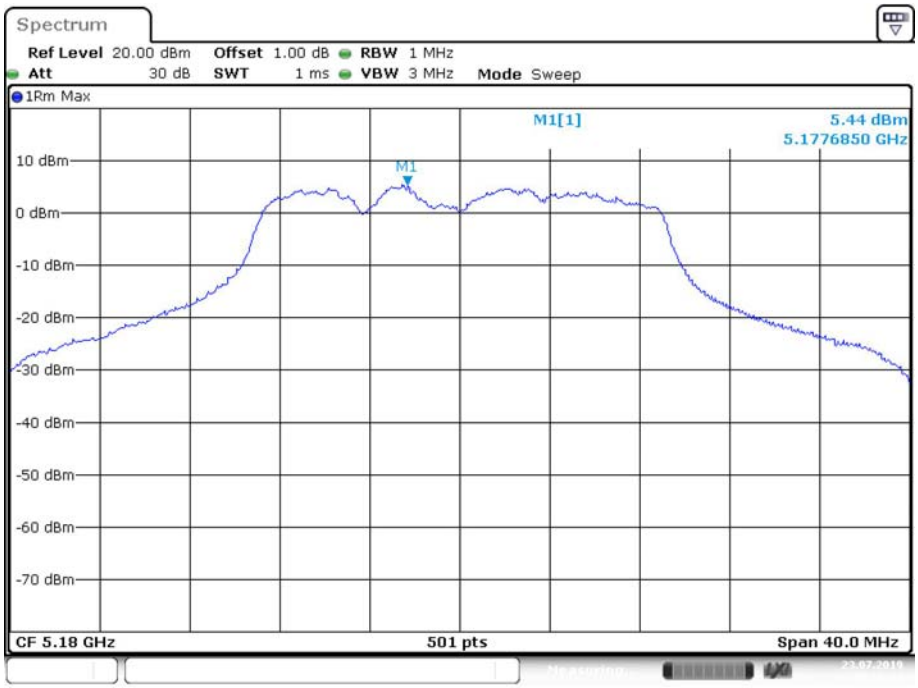
Date: 17.JUL.2019 19:47:28

802.11a High Channel



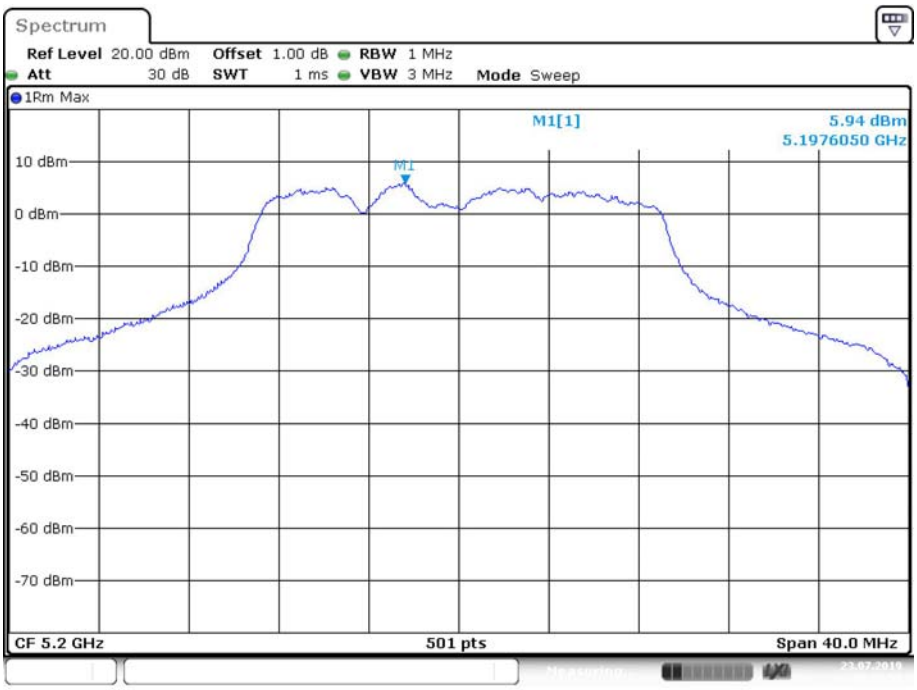
Date: 17.JUL.2019 19:48:03

802.11n ht20 Low Channel



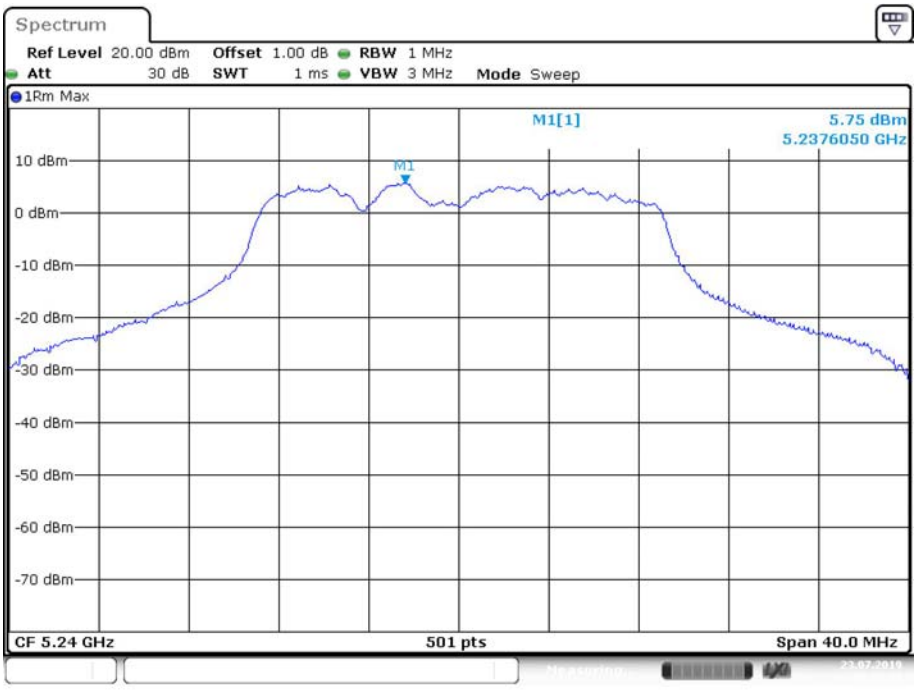
Date: 23.JUL.2019 10:16:45

802.11n ht20 Middle Channel



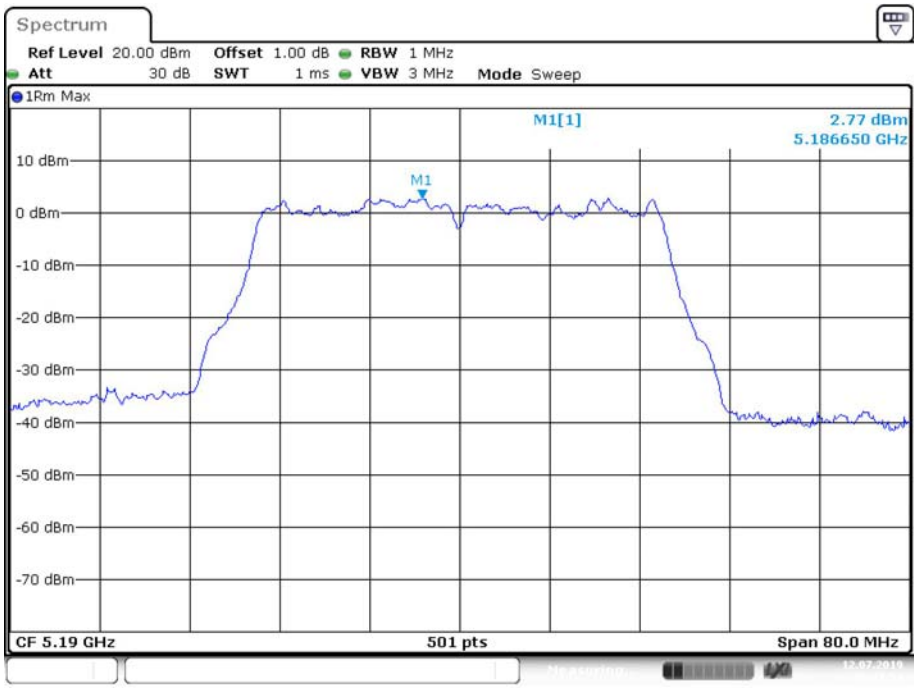
Date: 23.JUL.2019 10:15:53

802.11n ht20 High Channel



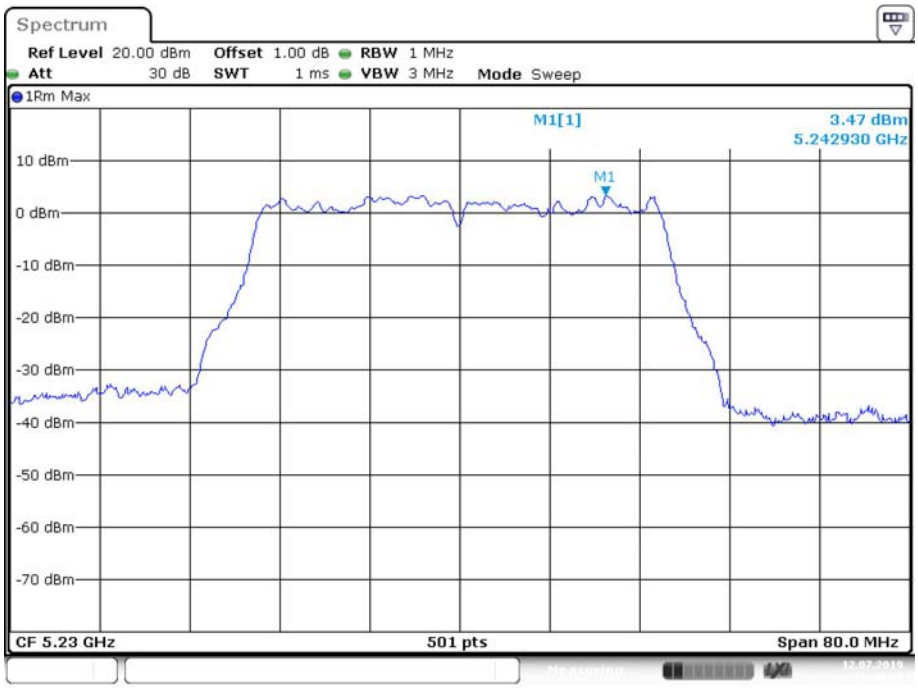
Date: 23.JUL.2019 10:12:32

802.11n ht40 Low Channel



Date: 12.JUL.2019 16:37:54

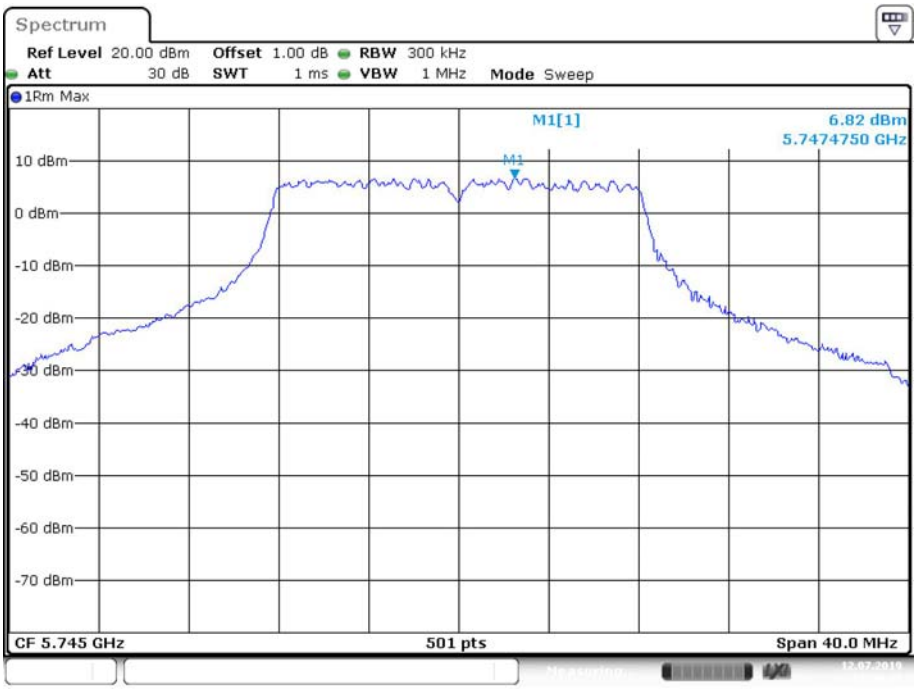
802.11n ht40 High Channel



Date: 12.JUL.2019 17:40:15

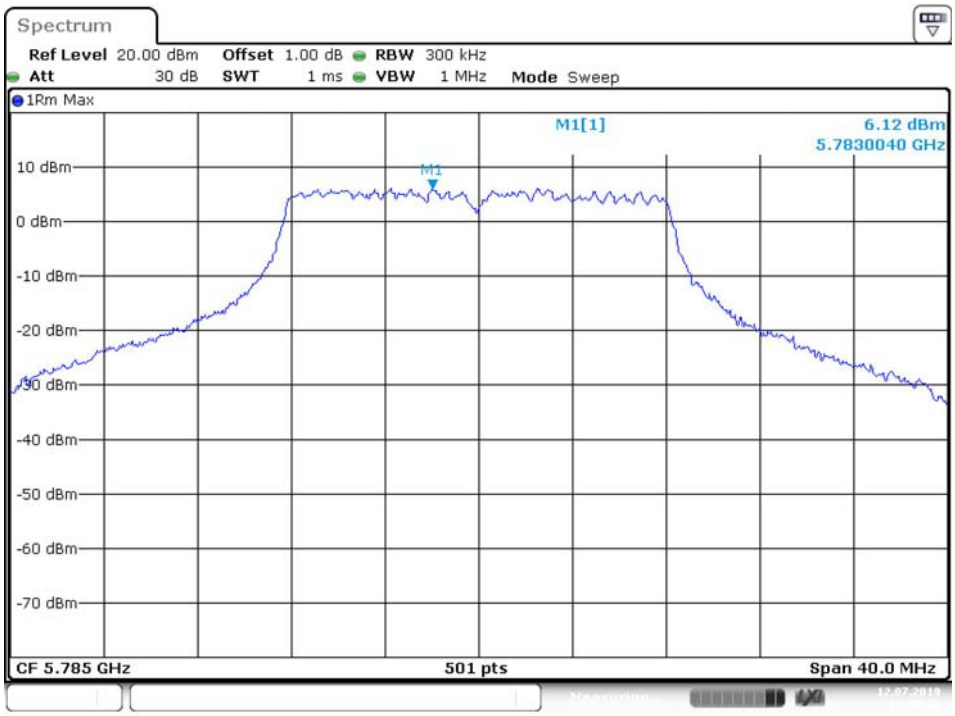
5725-5850MHz

802.11a Low Channel



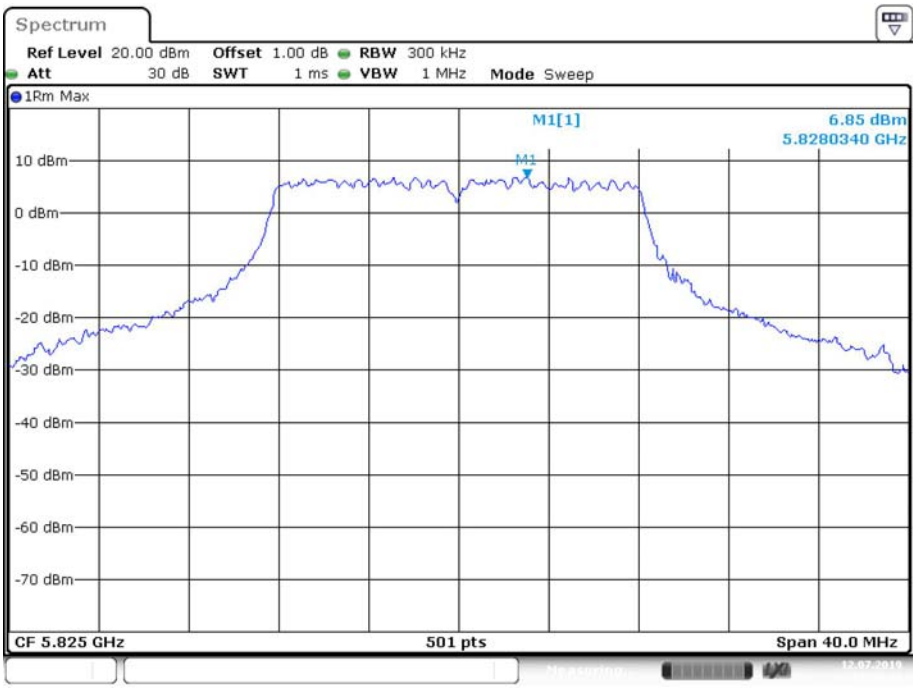
Date: 12.JUL.2019 18:04:39

802.11a Middle Channel



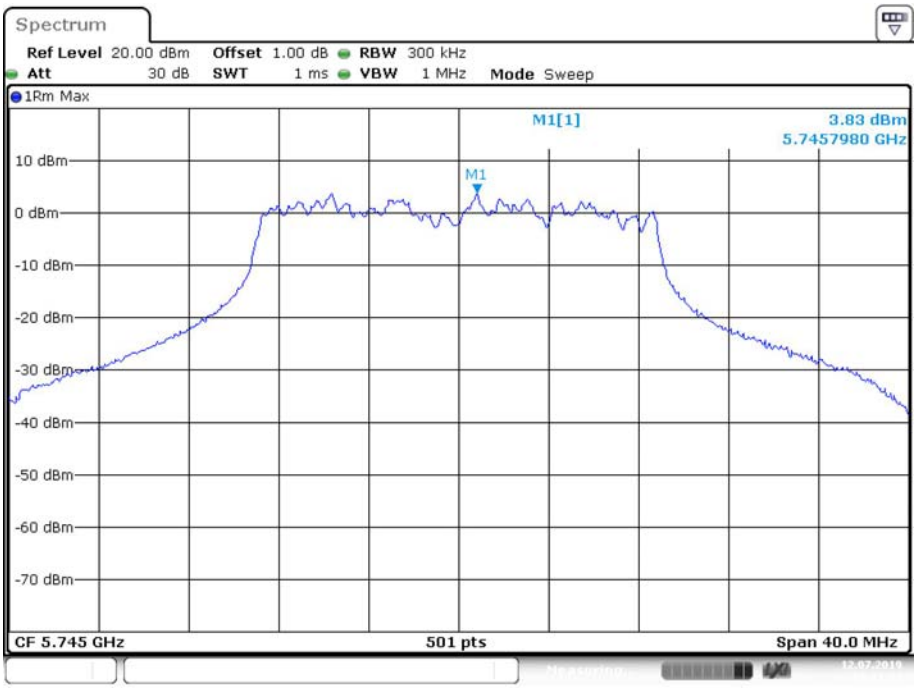
Date: 12.JUL.2019 18:05:48

802.11a High Channel



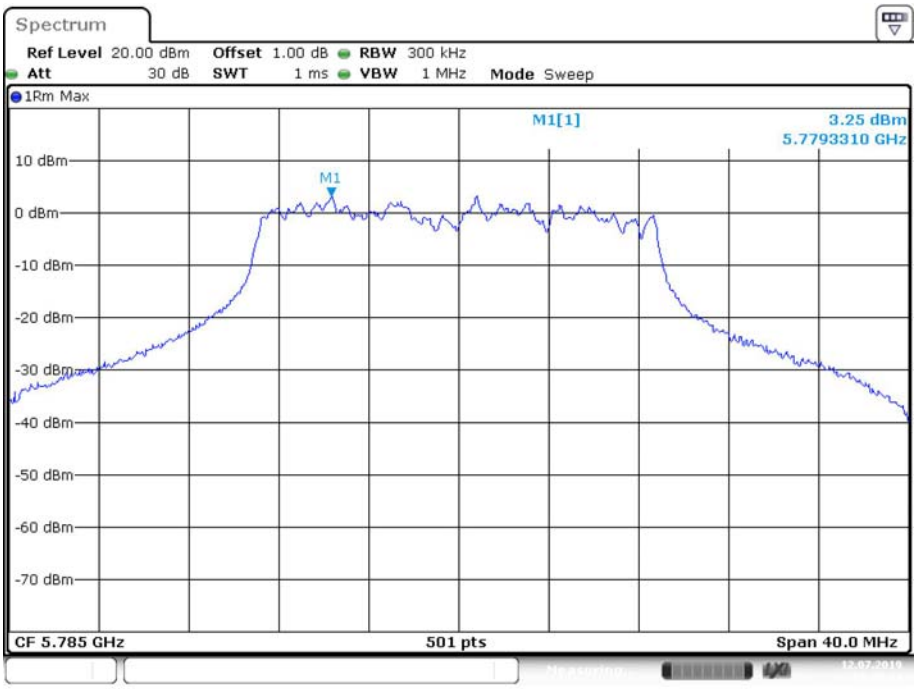
Date: 12.JUL.2019 18:06:43

802.11n ht20 Low Channel



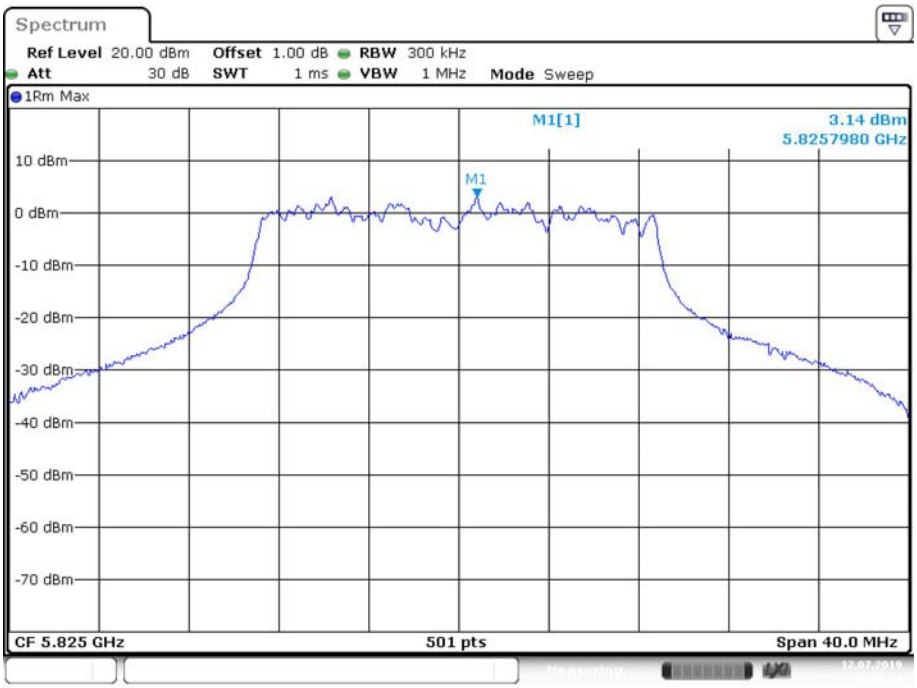
Date: 12.JUL.2019 18:11:21

802.11n ht20 Middle Channel



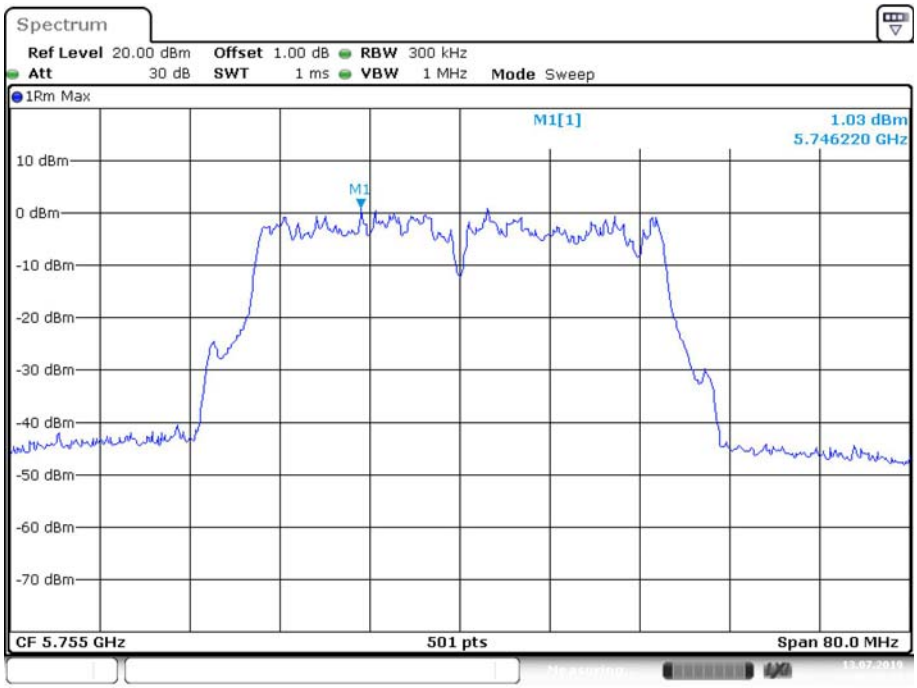
Date: 12.JUL.2019 18:19:13

802.11n ht20 High Channel



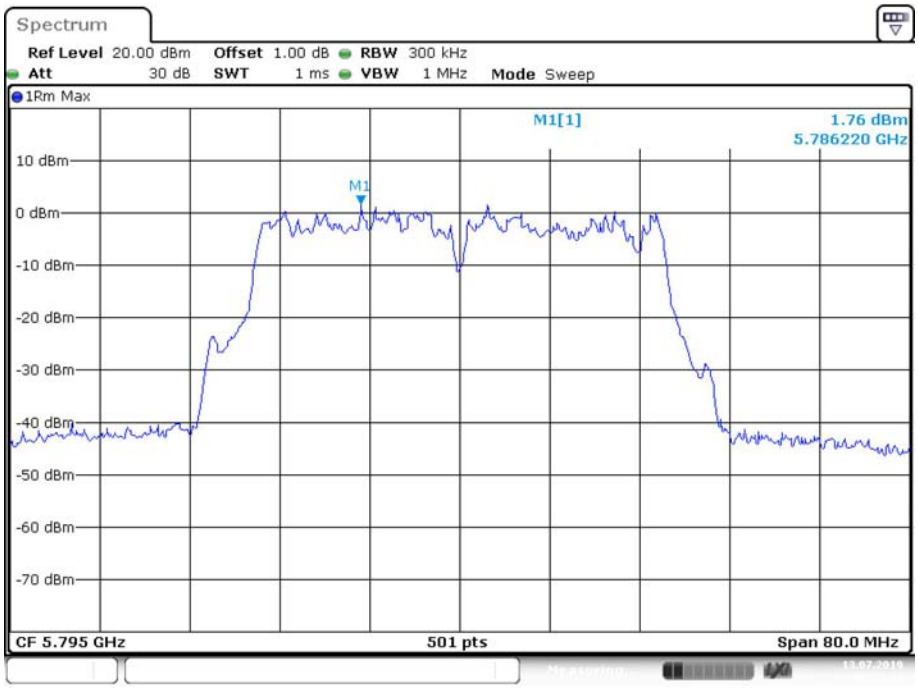
Date: 12.JUL.2019 18:20:26

802.11n ht40 Low Channel



Date: 13.JUL.2019 09:50:33

802.11n ht40 High Channel



Date: 13.JUL.2019 09:52:03

***** END OF REPORT *****