FCC PART 15.407

TEST REPORT

For

Roku, Inc.

1155 Coleman Ave,
San Jose, CA 95110, USA

FCC ID: TC2-R1036

Report Type:	Model:
Original Report	4800X

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Report Number:	R2006012-NII
Report Date:	2020-08-25
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ACCREDITED
CERTIFICATE #3297.02

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2006012-NII	Original Report	2020-08-25

1 General Description

1.1 Product Description for Equipment under Test (EUT)

This test report was prepared on behalf of *Roku, Inc.*, and their product model: *4800X*, FCC ID: TC2-R1036, or the "EUT" as referred to in this report. It is a Set-top-box.

1.2 Objective

This report was prepared on behalf of Roku, Inc in accordance with FCC CFR47 §15.407 Issue 2, February2017.

The objective was to determine compliance with FCC Part 15.407 rules for Output Power, Antenna Requirements, AC Line Conducted Emissions, Emission Bandwidth, Power spectral density, Conducted and Radiated Spurious Emissions.

1.3 Related Submittal(s)/Grant(s)

FCC Part 15, Subpart C, Equipment DSS with FCC IDTC2-R1036
FCC Part 15, Subpart C, Equipment DTS with FCC ID: TC2-R1036

1.4 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2013, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz, and FCC KDB 789033 D02 General UNII Test Procedure New Rules v02r01.

1.5 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Parameter	Measurement uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.57 dB
Power Spectral Density, conducted	±1.48dB
Unwanted Emissions, conducted	±1.57dB
All emissions, radiated	±4.0 dB
AC power line Conducted Emission	±2.0 dB
Temperature	±2 º C
Humidity	±5 %
DC and low frequency voltages	±1.0 %
Time	±2 %
Duty Cycle	±3 %

1.6 Test Facility Registrations

BACLs test facilities that are used to perform Radiated and Conducted Emissions tests are currently recognized by the Federal Communications Commission as Accredited with NIST Designation Number US1129.

BACL's test facilities that are used to perform Radiated and Conducted Emissions tests are currently registered with Industry Canada under Registration Numbers: 3062A-1, 3062A-2, and 3062A-3.

BACL is a Chinese Taipei Bureau of Standards Metrology and Inspection (BSMI) validated Conformity Assessment Body (CAB), under Appendix B, Phase I Procedures of the APEC Mutual Recognition Arrangement (MRA). BACL's BSMI Lab Code Number is: SL2-IN-E-1002R

BACL's test facilities that are used to perform AC Line Conducted Emissions, Telecommunications Line Conducted Emissions, Radiated Emissions from 30 MHz to 1 GHz, and Radiated Emissions from 1 GHz to 6 GHz are currently recognized as Accredited in accordance with the Voluntary Control Council for Interference [VCCI] Article 15 procedures under Registration Number A-0027.

1.7 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- ***An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2005 by A2LA (Test Laboratory Accreditation Certificate Number 3297.02)*****,** in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2005 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report..

BACL's ISO/IEC 17025:2005 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices,

Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment; Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

B- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.03)*** to certify

- For the USA (Federal Communications Commission):
  - 1- All Unlicensed radio frequency devices within FCC Scopes A1, A2, A3, and A4;
  - 2- All Licensed radio frequency devices within FCC Scopes B1, B2, B3, and B4;
  - 3- All Telephone Terminal Equipment within FCC Scope C.
- For the Canada (Industry Canada):
  - 1 All Scope 1-Licence-Exempt Radio Frequency Devices;
  - 2 All Scope 2-Licensed Personal Mobile Radio Services;
  - 3 All Scope 3-Licensed General Mobile & Fixed Radio Services;
  - 4 All Scope 4-Licensed Maritime & Aviation Radio Services;
  - 5 All Scope 5-Licensed Fixed Microwave Radio Services
  - 6 All Broadcasting Technical Standards (BETS) in the Category I Equipment Standards List.
- For Singapore (Info-Communications Development Authority (IDA)):
  - 1 All Line Terminal Equipment: All Technical Specifications for Line Terminal Equipment – Table 1 of IDA MRA Recognition Scheme: 2011, Annex 2
  - 2. All Radio-Communication Equipment: All Technical Specifications for Radio-Communication Equipment – Table 2 of IDA MRA Recognition Scheme: 2011, Annex 2
- For the Hong Kong Special Administrative Region:
  - 1 All Radio Equipment, per KHCA 10XX-series Specifications;
  - 2 All GMDSS Marine Radio Equipment, per HKCA 12XX-series Specifications;
  - 3 All Fixed Network Equipment, per HKCA 20XX-series Specifications.
- For Japan:
  - 1 MIC Telecommunication Business Law (Terminal Equipment):
    - All Scope A1 - Terminal Equipment for the Purpose of Calls;
    - All Scope A2 - Other Terminal Equipment
  - 2 Radio Law (Radio Equipment):
    - All Scope B1 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 1 of the Radio Law
    - All Scope B2 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 2 of the Radio Law
    - All Scope B3 - Specified Radio Equipment specified in Article 38-2-2, paragraph 1, item 3 of the Radio Law

C- ***A Product Certification Body accredited to ISO/IEC 17065:2012 by A2LA (Product Certification Body Accreditation Certificate Number 3297.01)*** to certify Products to USA's Environmental Protection Agency (EPA) ENERGY STAR Product Specifications for:

1 Electronics and Office Equipment:
- for Telephony (ver. 3.0)
- for Audio/Video (ver. 3.0)
- for Battery Charging Systems (ver. 1.1)
- for Set-top Boxes & Cable Boxes (ver. 4.1)
- for Televisions (ver. 6.1)
- for Computers (ver. 6.0)
- for Displays (ver. 6.0)
- for Imaging Equipment (ver. 2.0)
- for Computer Servers (ver. 2.0)

2 Commercial Food Service Equipment
- for Commercial Dishwashers (ver. 2.0)
- for Commercial Ice Machines (ver. 2.0)
- for Commercial Ovens (ver. 2.1)
- for Commercial Refrigerators and Freezers

3 Lighting Products
- For Decorative Light Strings (ver. 1.5)
- For Luminaires (including sub-components) and Lamps (ver. 1.2)
- For Compact Fluorescent Lamps (CFLs) (ver. 4.3)
- For Integral LED Lamps (ver. 1.4)

4 Heating, Ventilation, and AC Products
- for Residential Ceiling Fans (ver. 3.0)
- for Residential Ventilating Fans (ver. 3.2)

5 Other
- For Water Coolers (ver. 3.0)

D- ***A NIST Designated Phase-I and Phase-II Conformity Assessment Body (CAB) for the following economies and regulatory authorities under the terms of the stated MRAs/Treaties:***

- Australia: ACMA (Australian Communication and Media Authority) – APEC Tel MRA -Phase I;
- Canada: (Innovation, Science and Economic development Canada - ISEDC) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
  - BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
  - NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
  - EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
  - Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
  - Low Voltage Directive (LVD) 2014/35/EU
- Hong Kong Special Administrative Region: (Office of the Telecommunications Authority – OFTA) APEC Tel MRA -Phase I & Phase II
- Israel – US-Israel MRA Phase I
- Republic of Korea (Ministry of Communications - Radio Research Laboratory) APEC Tel MRA -Phase I
- Singapore: (Infocomm Media Development Authority - IMDA) APEC Tel MRA -Phase I & Phase II;
- Japan: VCCI - Voluntary Control Council for Interference US-Japan Telecom Treaty VCCI Side Letter-
- USA:
  - ENERGY STAR Recognized Test Laboratory – US EPA
  - Telecommunications Certification Body (TCB) – US FCC;
  - Nationally Recognized Test Laboratory (NRTL) – US OSHA
- Vietnam: APEC Tel MRA -Phase I;

2 EUT Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.10-2013 and FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

The worst-case data rates are determined by measuring the average power, peak power and PPSD across all data rates bandwidths, and modulations.

2.2 EUT Exercise Software

The test software used was PuTTy. The software is compliant with the standard requirements being tested against.

Please refer to the following power setting table.

FCC:

Modulation	Frequency (MHz)	Power Setting	
		Ant A	Ant B
802.11a	5180	83	76
	5220	104	100
	5240	103	95
	5745	88	118
	5785	93	107
	5825	95	105
802.11n20	5180	75	75
	5220	86	86
	5240	84	84
	5745	80	80
	5785	85	85
	5825	85	85
802.11ac20	5180	76	76
	5220	87	87
	5240	84	84
	5745	76	76
	5785	80	80
	5825	83	83

*Data rates tested:
802.11a mode: 6Mbps
802.11n HT20: MCS0
802.11ac VHT20: MCS0

2.3 Duty Cycle Correction Factor

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

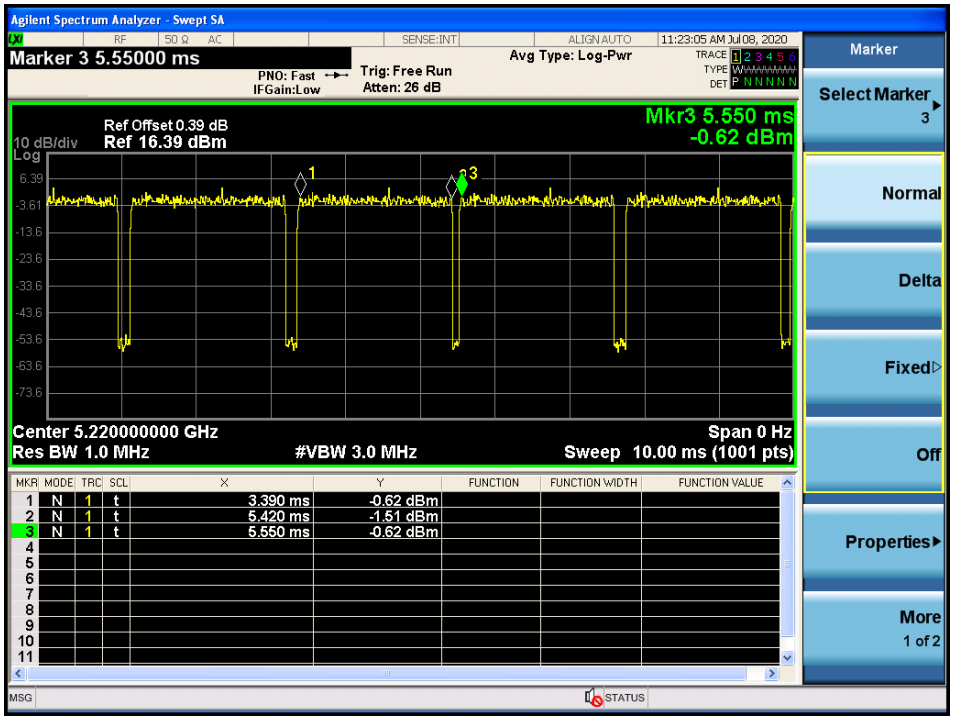
All measurements are to be performed with the EUT transmitting at 100% duty cycle at its maximum power control level; however, if 100% duty cycle cannot be achieved, measurements of duty cycle, x, and maximum-power transmission duration, T, are required for each tested mode of operation.

Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11a	1.85	2.16	85.65	0.67
802.11n20	1.89	2.12	89.15	0.50
802.11ac20	1.91	2.15	88.84	0.51

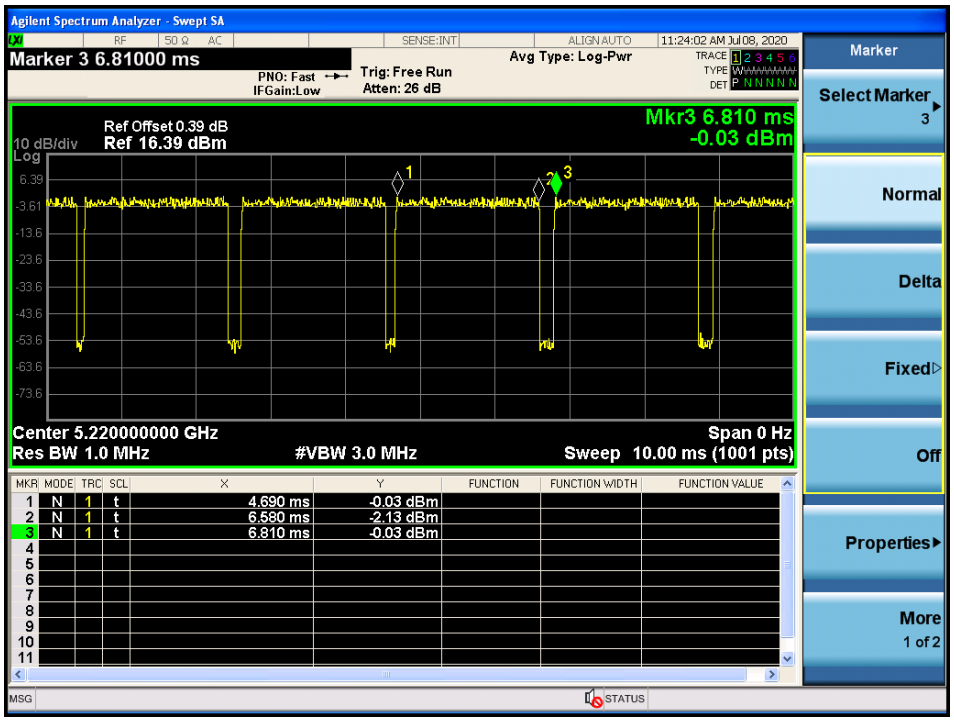
Note: Duty Cycle Correction Factor = 10*log(1/duty cycle)

Please refer to the following plots.

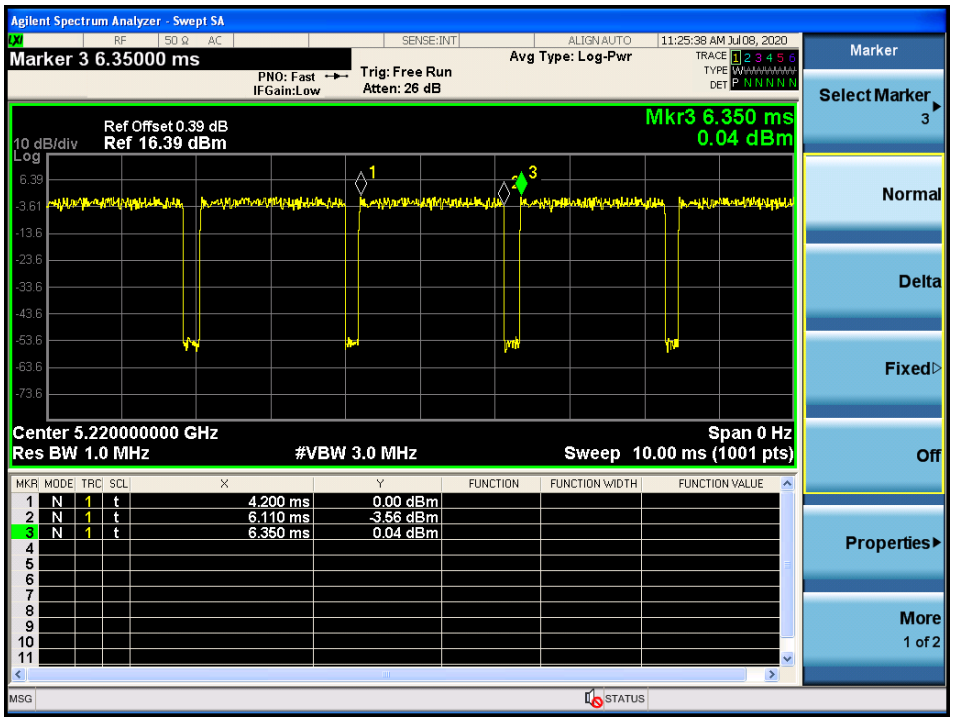
802.11a mode



802.11ac20 mode



802.11n20 mode



2.4 Equipment Modifications

N/A

2.5 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E6410

2.6 Support Equipment

Manufacturer	Description	Model
Roku, Inc.	Debug Board	-

2.7 Interface Ports and Cabling

Cable Description	Length (m)	To	From
USB Cable	< 1 m	Laptop	EUT
RF Cable	< 1 m	EUT	PSA

3 Summary of Test Results

FCC Rules	Description of Test	Result
FCC §2.1091, §15.407(f)	RF Exposure	Compliant[1]
FCC §15.203	Antenna Requirement	Compliant
FCC §15.207	AC Power Line Conducted Emissions	Compliant
FCC §2.1053, §15.205, §15.209, 15.407(b)	Spurious Radiated Emissions	Compliant
FCC §15.407(e)	Emission Bandwidth	Compliant
FCC §407(a)	Output Power	Compliant
FCC §2.1051, §15.407(b)	Band Edges	Compliant
FCC §15.407(a)	Power Spectral Density	Compliant
FCC §2.1051, §15.407(b)	Spurious Emissions at Antenna Terminals	Compliant

4 FCC §2.1091, §15.407(f) - RF Exposure

4.1 Applicable Standards

According to FCC §15.247(i) and §1.1307(b)(1), 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.

According to KDB 447 498 Section (7.2), "simultaneous transmission of MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on calculated or measured field strengths or power density, is ≤ 1.0. The MPE ratio of each antenna is determined at the minimum *test separation distance* required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency.

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)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	* (100)	30
1.34-30	824/f	2.19/f	* ($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

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

Before equipment certification is granted, the procedure of IC RSS-102 must be followed concerning the exposure of humans to RF field.

4.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2$$

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

4.3 MPE Results

5GHz WiFi

Worst Case: 802.11n20, 5785 MHz

Maximum peak output power at antenna input terminal (dBm):	22.60
Maximum peak output power at antenna input terminal (mW):	181.97
Prediction distance (cm):	20
Prediction frequency (MHz):	5785
Maximum Directional Antenna Gain, typical (dBi):	7.61
Maximum Antenna Gain (numeric):	5.768
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.2088
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.2088 mW/cm^2. Limit is 1.0 mW/cm^2.

Radio Co-location

2.4 GHz Wi-Fi and 5 GHz Wi-Fi simultaneous transmission is not supported.

Worst case colocation 5 GHz Wi-Fi and 2.4 GHz Classic Bluetooth:

Frequency Band	Max Conducted Power(dBm)	Evaluated Distance (cm)	Worst-Case MPE (mW/cm^2)	MPE Limit (mW/cm^2)	Worst-Case MPE Ratios	Sum of MPE Ratios	Limit
Worst Case							
5 GHz Wi-Fi	22.60	20	0.2088	1.0	20.88%	21.98%	1
2.4 GHz Classic BT	14.58	20	0.011	1.0	1.1%		

5 FCC §15.203 - Antenna Requirements

5.1 Applicable Standards

According to FCC §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.

And according to FCC §15.247 (b) (4), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.2 Antenna List

The antennas used by the EUT are permanent attached antennas.

Antenna usage	Frequency Range (MHz)	Maximum Antenna Gain (dBi)
Bluetooth Metal Antenna	2400-2483.5	2.7
2.4GHz Wi-Fi Metal Antenna (Ant A)	2400-2483.5	2.4
2.4GHz Wi-Fi PCB Antenna (Ant B)	2400-2483.5	3.9
5GHz Wi-Fi Metal Antenna (Ant A)	5150-5850	4.7
5GHz Wi-Fi PCB Antenna (Ant B)	5150-5850	4.5

6 FCC §15.207 - AC Power Line Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 Note1	56 to 46 Note2
0.5-5	56	46
5-30	60	50

Note1: Decreases with the logarithm of the frequency.
Note2: A linear average detector is required

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.10-2013 measurement procedure. The specification used was FCC §15.207 limits.

External I/O cables were draped along the edge of the test table and bundle when necessary.
The AC/DC power adapter of the EUT was connected with LISN-1 which provided 120 V / 60 Hz AC power.

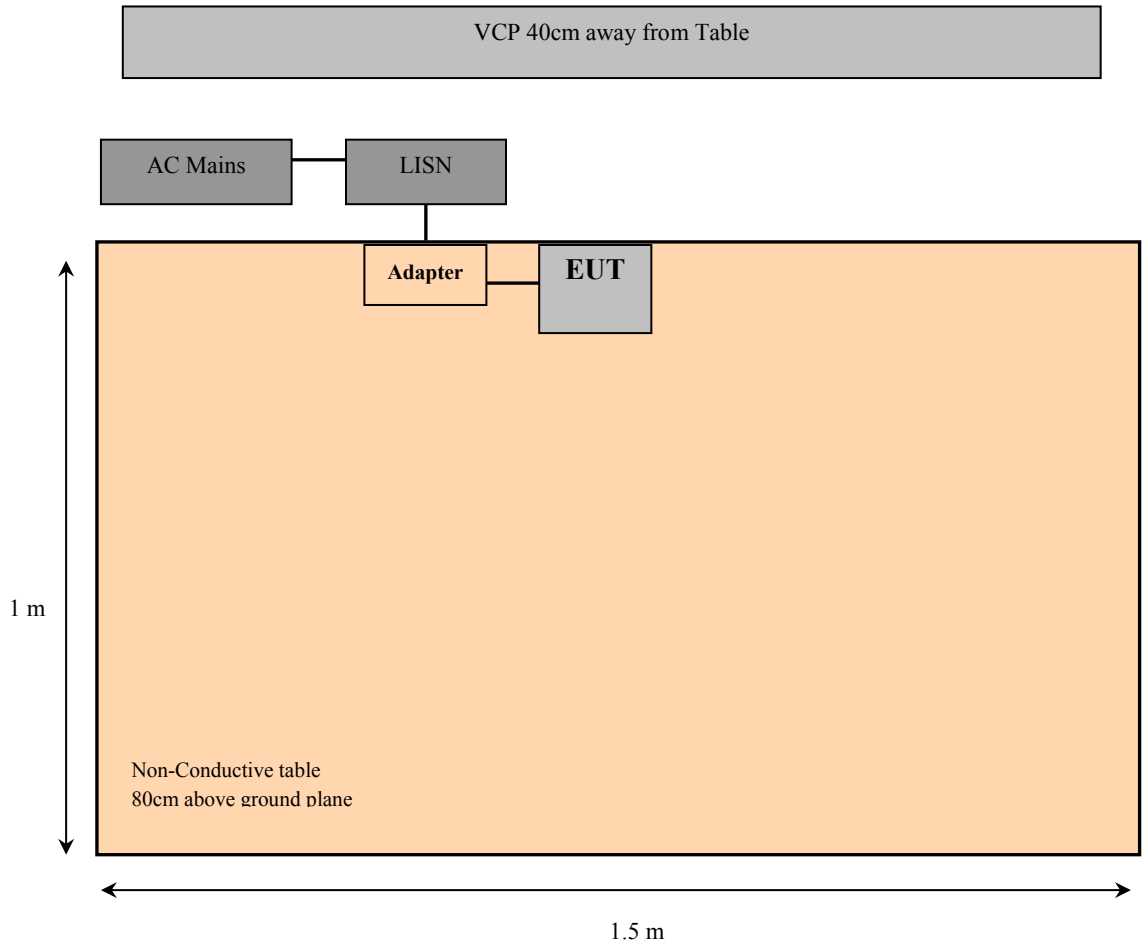
6.3 Test Procedure

During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-1 and the power cords of support equipment were connected to LISN-2.

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

All data was recorded in the peak, quasi-peak, and average detection mode. Quasi-Peak readings are distinguished with a “QP.” Average readings are distinguished with an “Ave”.

6.4 Test Setup Block Diagram



6.5 Corrected Amplitude and Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Cable Loss (CL), the Attenuator Factor (Atten) to indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + CL + Atten

For example, a corrected amplitude of 46.2 dBuV = Indicated Reading (32.5 dBuV) + Cable Loss (3.7 dB) + Attenuator (10 dB)

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

Margin = Corrected Amplitude - Limit

6.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde and Schwarz	Receiver, EMI Test	ESCI 1166.5950.03	100338	2018-07-05	2 years
Rohde and Schwarz	Impulse Limiter	ESH3-Z2	101964	2019-07-31	1 year
Solar Electronics Company	High Pass Filter	Type 7930-100	7930150202	2020-02-27	1 year
Suirong	30 ft conductive emission cable	LMR 400	-	N/R	N/A
FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160129	2019-07-11	14 months
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 02 October 2018) "A2LA Policy on Metrological Traceability".*

6.7 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	101.31 kPa

The testing was performed by Matthew Riego de Dios on 2020-06-30 in the Ground Plane test site.

6.8 Summary of Test Results

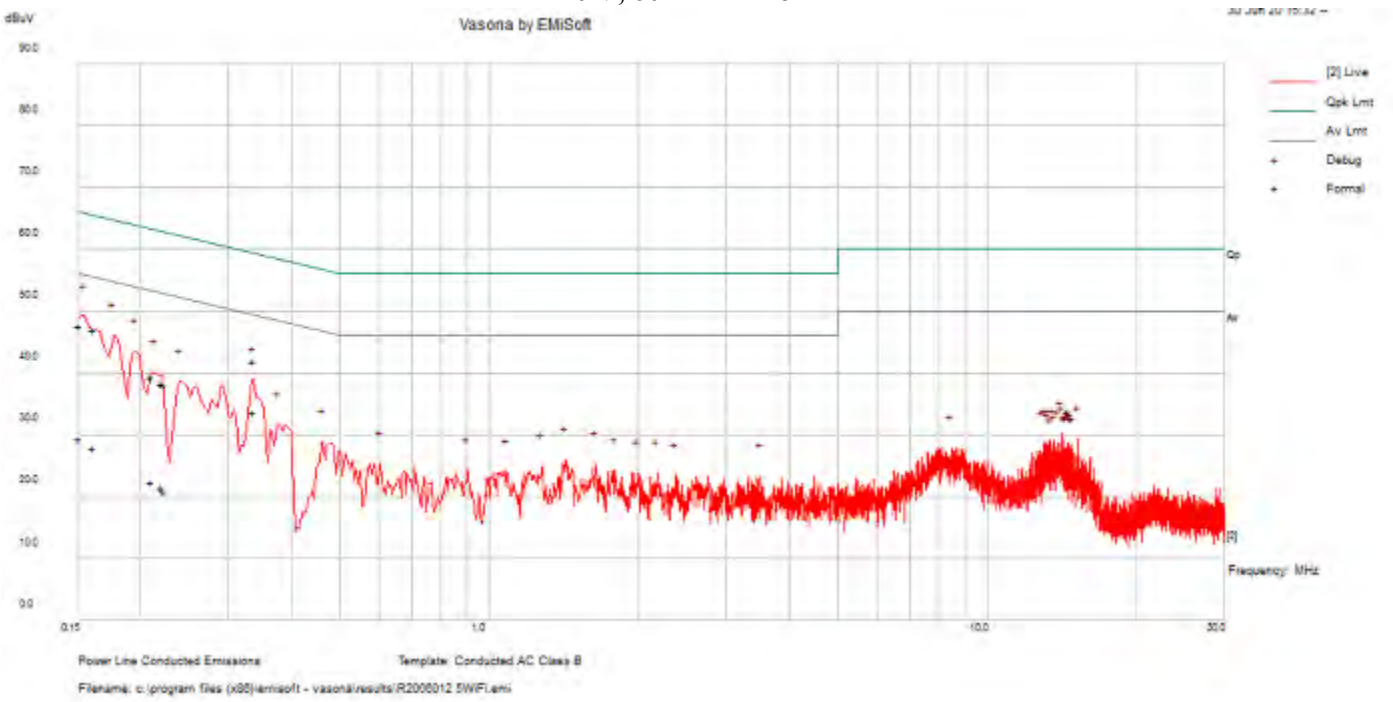
According to the recorded data in following table, the EUT complied with the FCC Part 15 and RSS-Gen standards' conducted emissions limits, with the margin reading of:

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-15.57	0.336827	Line	0.15-30

6.9 Conducted Emissions Test Plots and Data

Worst Case: 802.11n20 mode – 5785MHz

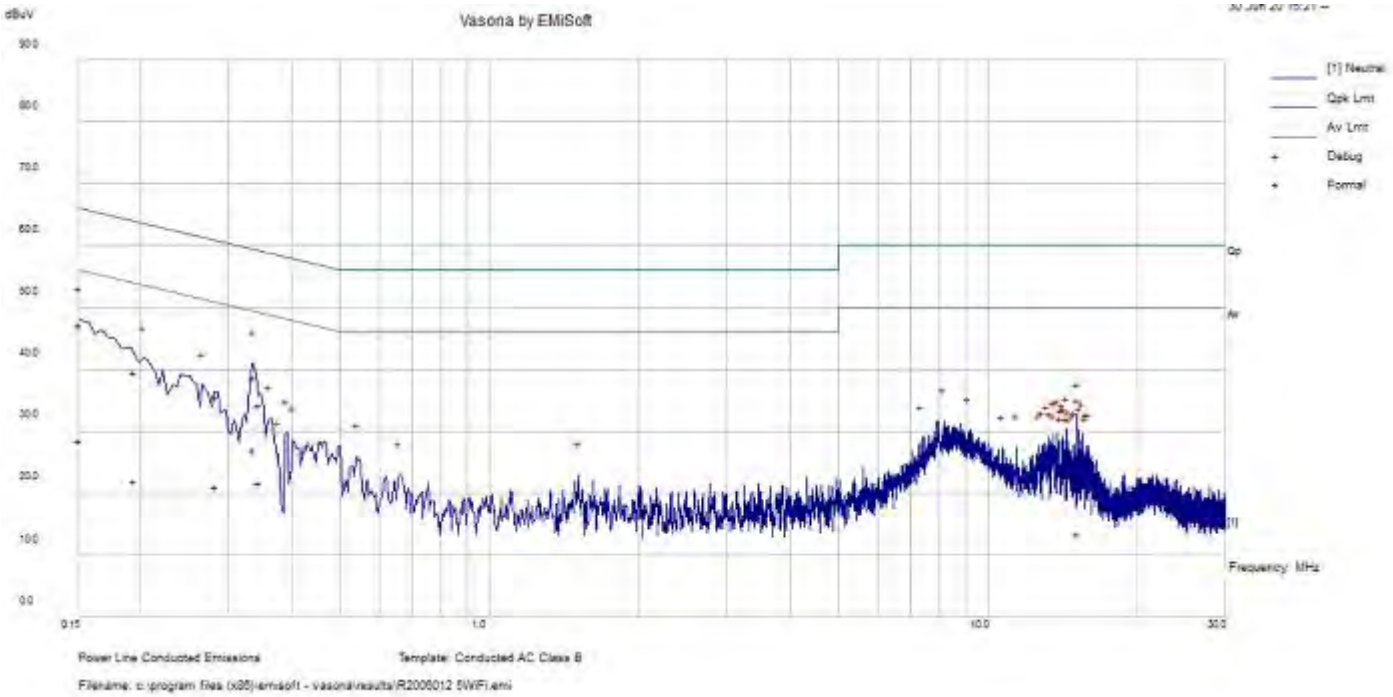
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.150078	47.71	Line	66	-18.28	QP
0.160929	46.96	Line	65.42	-18.46	QP
0.336827	41.96	Line	59.28	-17.32	QP
0.210348	39.28	Line	63.19	-23.91	QP
0.219574	38.37	Line	62.84	-24.47	QP
0.223446	38.02	Line	62.69	-24.67	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.150078	29.26	Line	56	-26.73	Ave.
0.160929	27.83	Line	55.42	-27.58	Ave.
0.336827	33.71	Line	49.28	-15.57	Ave.
0.210348	22.27	Line	53.19	-30.92	Ave.
0.219574	21.44	Line	52.84	-31.39	Ave.
0.223446	20.82	Line	52.69	-31.87	Ave.

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.150268	47.17	Neutral	65.99	-18.81	QP
0.335729	38.74	Neutral	59.31	-20.57	QP
0.193673	39.55	Neutral	63.88	-24.32	QP
0.282075	35.43	Neutral	60.75	-25.33	QP
0.344876	34.15	Neutral	59.08	-24.93	QP
15.120894	22.28	Neutral	60	-37.72	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.150268	28.4	Neutral	55.99	-27.58	Ave.
0.335729	26.98	Neutral	49.31	-22.33	Ave.
0.193673	21.96	Neutral	53.88	-31.92	Ave.
0.282075	21	Neutral	50.75	-29.75	Ave.
0.344876	21.73	Neutral	49.08	-27.35	Ave.
15.120894	13.32	Neutral	50	-36.68	Ave.

7 FCC §15.209, §15.407(b) - Spurious Radiated Emissions

7.1 Applicable Standard

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	960 – 1240	4. 5 – 5. 15
0.495 – 0.505	16.69475 – 16.69525	1300 – 1427	5. 35 – 5. 46
2.1735 – 2.1905	25.5 – 25.67	1435 – 1626.5	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1645.5 – 1646.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1660 – 1710	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1718.8 – 1722.2	9.3 – 9.5
6.215 – 6.218	108 – 121.94	2200 – 2300	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2310 – 2390	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2483.5 – 2500	14.47 – 14.5
8.291 – 8.294	156.52475 – 156.52525	2690 – 2900	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	3260 – 3267	17.7 – 21.4
8.37625 – 8.38675	162.0125 –167.17	3.332 – 3.339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3 3458 – 3 358	23.6 – 24.0
12.29 – 12.293	240 – 285	3.600 – 4.400	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4		36.43 – 36.5
12.57675 – 12.57725	399.9 – 410		Above 38.6
13.36 – 13.41	608 – 614		

As per FCC §15.209: The emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100 Note 1	3
88 - 216	150 Note 1	3
216 - 960	200 Note 1	3
Above 960	500	3

Note 1: Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As per FCC Part 15.407 (b)

(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 5.47-5725 GHz band shall not exceed an ei.r.p. of -27 dBm/MHz.

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

(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.

7.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.10-2013. The specification used was the FCC 15.407 limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

7.3 Test Procedure

For the radiated emissions test, the EUT host, and all support equipment power cords were connected to the AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT is set 3 meter away from the testing antenna, which is varied from 1-4 meter, and the EUT is placed on a turntable, which is 0.8 meter or 1.5 meter above ground plane, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

(1) Peak: RBW = 1MHz / VBW = 3MHz / Sweep = 100ms
(2) Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

7.4 Corrected Amplitude and Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + AF + CL + Atten – Ga

For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

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

Margin = Corrected Amplitude - Limit

7.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2019-07-26	1 year
Rhode & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100044	2018-10-26	2 years
BACL	5m3 Sensitivity Box	1	2	2019-10-02	1 year
Sunol Sciences	System Controller	SC99V	011003-1	N/R	N/A
Sunol Sciences	Biconilog Antenna	JB3	A020106-2	2019-11-20	2 years
ETS Lindgren	Horn Antenna	3117	00218973	2019-02-13	2 years
Wisewave	Antenna, Horn	ARH-4223-02	10555-02	2020-02-05	2 years
Wisewave	Antenna, Horn	ARH-2823-02	10555-01	2020-02-05	2 years
-	SMA cable	-	-	Each time[1]	N/A
IW Microwave	150 Series 2.92mm Cable	KPS1501AN-3780-KPS	DC 1925	2019-09-11	1 year
IW Microwave	157 Series Cable Armored with 2.92mm Male Plugs on Both Sides	KPS-1571AN-2400	DC 1922	2020-06-06	1 year
MDP Digital	Times Microwave LMR 400 UltraFex Coaxial Cable 35\'	LMR400UF	BACL1904161	2020-05-20	1 year
AH Systems	Preamplifier	PAM 1840 VH	170	2019-09-24	1 year
Agilent	Preamplifier	8449B	3147A00400	2020-02-27	1 year
HP	Pre Amplifier	8447D	2443A04374	2019-08-13	1 year
Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

Note[1]: cables and attenuators included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 02 October 2018) "A2LA Policy on Metrological Traceability".*

7.6 Test Environmental Conditions

Temperature:	22-24 ºC
Relative Humidity:	40-41 %
ATM Pressure:	103.1-104.1 kPa

The testing was performed by Christian McCaig and Matthew Riego de Dios from 2020-06-09 to 2020-07-13 in 5m chamber 3..

7.7 Summary of Test Results

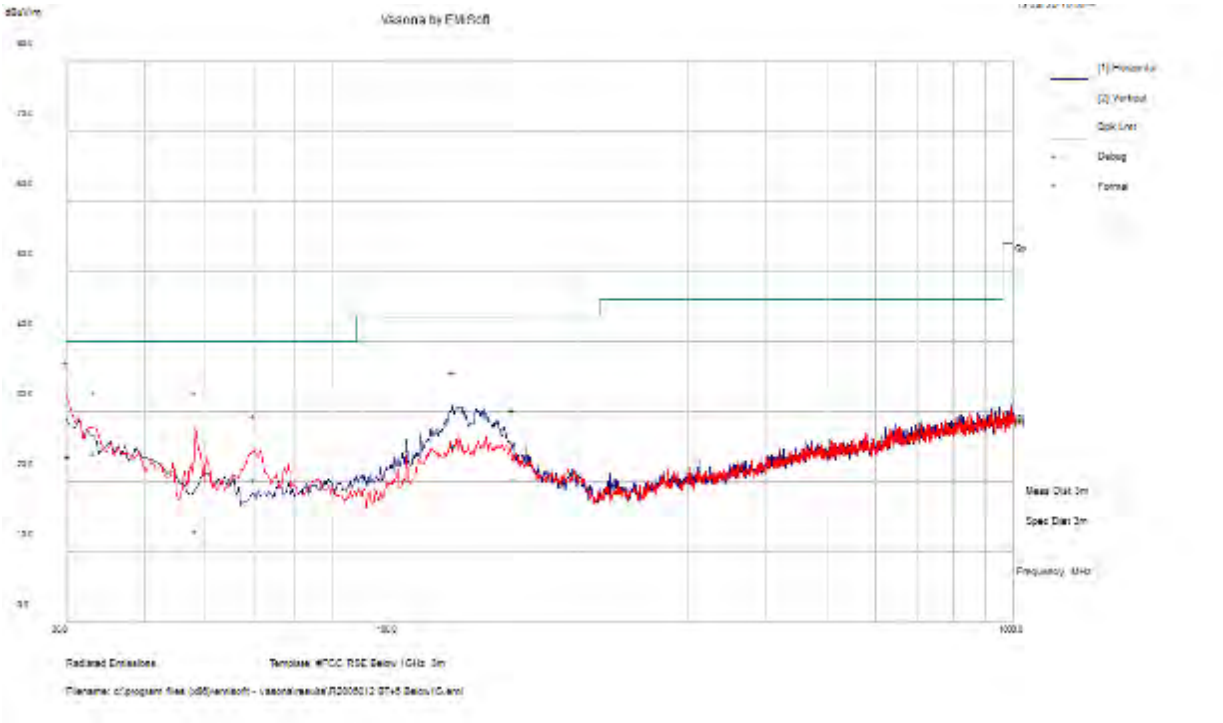
According to the data hereinafter, the EUT complied with the FCC Part 15.407 and RSS-247 standards' radiated emissions limits, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, Channel**
-0.50	15720	Horizontal	802.11a mode, Antenna A, 5240 MHz

7.8 Radiated Emissions Test Result Data

1) 30 MHz – 1 GHz at 3 meters

Worst Case Colocation: n20 mode, 5785MHz + GFSK , 2441MHz



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
30.245134	23.62	252	H	132	40	-16.38	QP
33.1965	24.15	229	V	283	40	-15.85	QP
48.35325	13.05	99	H	300	40	-26.95	QP
125.6805	25.23	230	H	102	43.5	-18.27	QP
60.12825	20.36	130	V	330	40	-19.64	QP
156.7695	20.45	297	H	224	43.5	-23.05	QP

2) 1–40 GHz Band Edges measured at 3 meters, Harmonics measured at 1 meter

5150 - 5250 MHz

802.11a mode Antenna A

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5180 MHz											
5150	55.59	305	235	V	35.50	9.77	35.20	65.66	74	-8.35	Peak
5150	58.02	50	150	H	35.50	9.77	35.20	68.09	74	-5.91	Peak
5150	41.47	305	235	V	35.50	9.77	35.20	51.53	54	-2.47	Ave
5150	42.81	50	150	H	35.50	9.77	35.20	52.88	54	-1.12	Ave
10360	47.12	245	130	V	38.10	13.25	35.49	62.98	78	-15.02	Peak
10360	45.48	0	100	H	38.10	13.25	35.49	61.34	78	-16.66	Peak
15540	46.36	0	100	V	40.7	19.053	33.87	72.243	84	-11.757	Peak
15540	45.37	0	100	H	40.7	19.053	33.87	71.253	84	-12.747	Peak
15540	32.95	0	100	V	40.7	19.053	33.87	58.833	64	-5.167	Ave
15540	33.11	0	100	H	40.7	19.053	33.87	58.993	64	-5.007	Ave
Middle Channel 5220 MHz											
10440	49.74	245	130	V	38.10	13.25	35.49	65.60	78	-12.40	Peak
10440	45.75	90	130	H	38.10	13.25	35.49	61.61	78	-16.39	Peak
15660	44.96	162	130	V	40.70	19.05	33.87	70.84	84	-13.16	Peak
15660	45.61	100	130	H	40.70	19.05	33.87	71.49	84	-12.51	Peak
15660	35.41	162	130	V	40.70	19.05	33.87	61.30	64	-2.70	Ave
15660	35.78	100	130	H	40.70	19.05	33.87	61.66	64	-2.34	Ave
High Channel 5240 MHz											
10480	48.59	341	132	V	38.20	13.25	35.49	64.55	78	-13.45	Peak
10480	46.09	0	100	H	38.20	13.25	35.49	62.05	78	-15.95	Peak
15720	47.16	160	130	V	40.70	19.09	33.87	73.08	84	-10.92	Peak
15720	47.93	308	130	H	40.70	19.09	33.87	73.85	84	-10.15	Peak
15720	36.56	160	130	V	40.70	19.09	33.87	62.48	64	-1.52	Ave
15720	37.58	308	130	H	40.70	19.09	33.87	63.50	64	-0.50	Ave

5150 - 5250 MHz

802.11a mode Antenna B

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5180 MHz											
5150	54.45	345	300	V	35.50	9.77	35.20	64.52	74	-9.49	Peak
5150	56.37	315	120	H	35.50	9.77	35.20	66.44	74	-7.57	Peak
5150	41.67	345	300	V	35.50	9.77	35.20	51.74	54	-2.26	Ave
5150	43.00	315	120	H	35.50	9.77	35.20	53.06	54	-0.94	Ave
10360	46.34	0	100	V	38.10	13.25	35.74	61.95	78	-16.05	Peak
10360	45.8	0	100	H	38.10	13.25	35.74	61.41	78	-16.59	Peak
15540	44.25	290	140	V	40.70	19.05	33.87	70.13	84	-13.87	Peak
15540	43.01	300	140	H	40.70	19.05	33.87	68.89	84	-15.11	Peak
15540	34.00	290	140	V	40.70	19.05	33.87	59.89	64	-4.11	Ave
15540	33.77	300	140	H	40.70	19.05	33.87	59.65	64	-4.35	Ave
Middle Channel 5220 MHz											
10440	47.05	68	124	V	38.1	13.25	35.49	62.91	78	-15.09	Peak
10440	47.42	0	200	H	38.1	13.25	35.49	63.28	78	-14.72	Peak
15660	47.33	290	140	V	40.70	19.05	33.87	73.21	84	-10.79	Peak
15660	44.23	300	140	H	40.70	19.05	33.87	70.11	84	-13.89	Peak
15660	37.61	290	140	V	40.70	19.05	33.87	63.49	64	-0.51	Ave
15660	34.56	300	140	H	40.70	19.05	33.87	60.44	64	-3.56	Ave
High Channel 5240 MHz											
10480	47.59	352	121	V	38.2	13.25	35.49	63.552	78	-14.448	Peak
10480	48.36	30	246	H	38.2	13.25	35.49	64.322	78	-13.678	Peak
15720	47.90	290	140	V	40.70	19.09	33.87	73.82	84	-10.18	Peak
15720	44.16	300	140	H	40.70	19.09	33.87	70.08	84	-13.92	Peak
15720	37.44	290	140	V	40.70	19.09	33.87	63.36	64	-0.64	Ave
15720	34.61	300	140	H	40.70	19.09	33.87	60.53	64	-3.47	Ave

5150 - 5250 MHz

802.11n20 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5180 MHz											
5150	53.13	325	110	V	35.50	9.77	35.20	63.20	74	-10.81	Peak
5150	58.98	310	110	H	35.50	9.77	35.20	69.05	74	-4.96	Peak
5150	38.65	325	110	V	35.50	9.77	35.20	48.72	54	-5.28	Ave
5150	43.08	310	110	H	35.50	9.77	35.20	53.15	54	-0.85	Ave
10360	46.89	71	100	V	38.10	13.25	35.74	62.50	78	-15.50	Peak
10360	46.11	0	100	H	38.10	13.25	35.74	61.72	78	-16.28	Peak
15540	44.64	162	130	V	40.70	19.05	33.87	70.52	84	-13.48	Peak
15540	44.85	100	130	H	40.70	19.05	33.87	70.73	84	-13.27	Peak
15540	34.88	162	130	V	40.70	19.05	33.87	60.76	64	-3.24	Ave
15540	34.99	100	130	H	40.70	19.05	33.87	60.87	64	-3.13	Ave
Middle Channel 5220 MHz											
10440	47.22	71	100	V	38.10	13.25	35.49	63.08	78	-14.92	Peak
10440	46.27	109	100	H	38.10	13.25	35.49	62.13	78	-15.87	Peak
15660	45.29	180	190	V	40.70	19.05	33.87	71.17	84	-12.83	Peak
15660	45.96	310	185	H	40.70	19.05	33.87	71.84	84	-12.16	Peak
15660	35.19	180	190	V	40.70	19.05	33.87	61.08	64	-2.92	Ave
15660	35.46	310	185	H	40.70	19.05	33.87	61.35	64	-2.65	Ave
High Channel 5240 MHz											
10480	47.02	344	124	V	38.20	13.25	35.49	62.98	78	-15.02	Peak
10480	47.32	113	100	H	38.20	13.25	35.49	63.28	78	-14.72	Peak
15720	47.26	180	190	V	40.70	19.09	33.87	73.18	84	-10.82	Peak
15720	48.34	310	185	H	40.70	19.09	33.87	74.26	84	-9.74	Peak
15720	35.95	180	190	V	40.70	19.09	33.87	61.87	64	-2.13	Ave
15720	36.84	310	185	H	40.70	19.09	33.87	62.76	64	-1.24	Ave

5150 - 5250 MHz

802.11ac20 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5180 MHz											
5150	55.02	325	130	V	35.50	9.77	35.20	65.09	74	-8.91	Peak
5150	58.86	325	280	H	35.50	9.77	35.20	68.93	74	-5.08	Peak
5150	39.68	325	130	V	35.50	9.77	35.20	49.75	54	-4.25	Ave
5150	42.96	325	280	H	35.50	9.77	35.20	53.02	54	-0.98	Ave
10360	45.76	0	100	V	38.10	13.25	35.74	61.37	78	-16.63	Peak
10360	46.34	0	100	H	38.10	13.25	35.74	61.95	78	-16.05	Peak
15540	43.51	292	135	V	40.50	19.05	33.70	69.36	84	-14.64	Peak
15540	44.34	325	135	H	40.50	19.05	33.70	70.19	84	-13.81	Peak
15540	33.91	292	135	V	40.50	19.05	33.70	59.77	64	-4.23	Ave
15540	34.12	325	135	H	40.50	19.05	33.70	59.97	64	-4.03	Ave
Middle Channel 5220 MHz											
10440	47.62	60	100	V	38.10	13.25	35.49	63.48	78	-14.52	Peak
10440	46.3	318	240	H	38.10	13.25	35.49	62.16	78	-15.84	Peak
15660	46.11	292	135	V	40.70	19.05	33.87	71.99	84	-12.01	Peak
15660	46.06	325	135	H	40.70	19.05	33.87	71.94	84	-12.06	Peak
15660	35.02	292	135	V	40.70	19.05	33.87	60.91	64	-3.09	Ave
15660	35.07	325	135	H	40.70	19.05	33.87	60.95	64	-3.05	Ave
High Channel 5240 MHz											
10480	47.21	339	128	V	38.20	13.25	35.49	63.17	78	-14.83	Peak
10480	47.33	19	195	H	38.20	13.25	35.49	63.29	78	-14.71	Peak
15720	47.30	292	135	V	40.70	19.09	33.87	73.22	84	-10.78	Peak
15720	47.89	325	135	H	40.70	19.09	33.87	73.81	84	-10.19	Peak
15720	36.28	292	135	V	40.70	19.09	33.87	62.20	64	-1.80	Ave
15720	36.27	325	135	H	40.70	19.09	33.87	62.19	64	-1.81	Ave

5745 - 5825 MHz

802.11a mode Antenna A

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5745 MHz											
5625-5650	28.66	66	100	V	35.40	9.14	0.00	73.20	78.20	-5.00	Peak
5650-5700	33.5	66	100	V	35.40	9.14	0.00	78.04	115.10	-37.06	Peak
5700-5720	43.33	66	100	V	35.40	9.14	0.00	87.87	120.70	-32.83	Peak
5720-5725	53.75	66	100	V	35.40	9.14	0.00	98.29	131.48	-33.19	Peak
5625-5650	29.6	104	100	H	35.40	9.14	0.00	74.14	78.20	-4.06	Peak
5650-5700	36.36	104	100	H	35.40	9.14	0.00	80.90	115.23	-34.33	Peak
5700-5720	45.68	104	100	H	35.40	9.14	0.00	90.22	120.63	-30.41	Peak
5720-5725	55.4	104	100	H	35.40	9.14	0.00	99.94	128.70	-28.75	Peak
11490	44.99	0	100	V	38.70	13.68	34.47	62.90	84.00	-21.10	Peak
11490	44.98	0	100	H	38.70	13.68	34.47	62.89	84.00	-21.11	Peak
11490	33.06	0	100	V	38.70	13.68	34.47	50.97	64.00	-13.03	Ave
11490	33.31	0	100	H	38.70	13.68	34.47	51.22	64.00	-12.78	Ave
17235	46.54	220	130	V	41.80	16.35	32.84	71.85	78.00	-6.15	Peak
17235	51.95	317	135	H	41.80	16.35	32.84	77.26	78.00	-0.74	Peak
Middle Channel 5785 MHz											
11570	46.23	0	100	V	38.90	13.77	34.47	64.43	84.00	-19.57	Peak
11570	44.44	0	100	H	38.90	13.77	34.47	62.64	84.00	-21.36	Peak
11570	33.46	0	100	V	38.90	13.77	34.47	51.66	64.00	-12.34	Ave
11570	33.40	0	100	H	38.90	13.77	34.47	51.60	64.00	-12.40	Ave
17355	46.01	220	130	V	41.90	17.83	32.84	72.90	78.00	-5.10	Peak
17355	49.95	317	135	H	41.90	17.83	32.84	76.84	78.00	-1.16	Peak
High Channel 5825 MHz											
5850-5855	48.52	68	127	V	35.60	9.14	0.00	93.26	130.11	-36.85	Peak
5855-5875	41.78	68	127	V	35.60	9.14	0.00	86.52	120.79	-34.27	Peak
5875-5925	32.04	68	127	V	35.60	9.14	0.00	76.78	192.13	-115.35	Peak
5925-5950	29.31	68	127	V	35.60	9.14	0.00	74.05	78.20	-4.15	Peak
5850-5855	50.25	108	100	H	35.60	9.14	0.00	94.99	130.57	-35.57	Peak
5855-5875	42.78	108	100	H	35.60	9.14	0.00	87.52	120.77	-33.24	Peak
5875-5925	34.63	108	100	H	35.60	9.14	0.00	79.37	110.61	-31.23	Peak
5925-5950	29.8	108	100	H	35.60	9.14	0.00	74.54	78.20	-3.66	Peak
11650	45.37	0	100	V	39.00	13.69	34.49	63.57	84.00	-20.43	Peak
11650	45.97	0	100	H	39.00	13.69	34.49	64.17	84.00	-19.83	Peak
11650	33.91	0	100	V	39.00	13.69	34.49	52.11	64.00	-11.89	Ave
11650	34.05	0	100	H	39.00	13.69	34.49	52.25	64.00	-11.75	Ave
17475	44.91	220	130	V	41.80	16.70	32.73	70.68	78.00	-7.32	Peak
17475	51.47	317	135	H	41.80	16.70	32.73	77.24	78.00	-0.76	Peak

5745 - 5825 MHz

802.11a mode Antenna B

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5745 MHz											
5625-5650	29.91	60	100	V	35.40	9.14	0.00	74.45	78.20	-3.75	Peak
5650-5700	45.11	60	100	V	35.40	9.14	0.00	89.65	111.90	-22.25	Peak
5700-5720	57.71	60	100	V	35.40	9.14	0.00	102.25	120.45	-18.20	Peak
5720-5725	64.53	60	100	V	35.40	9.14	0.00	109.07	130.20	-21.13	Peak
5625-5650	32.49	16	124	H	35.40	9.14	0.00	77.03	78.20	-1.17	Peak
5650-5700	52.44	16	124	H	35.40	9.14	0.00	96.98	112.33	-15.35	Peak
5700-5720	63.9	16	124	H	35.40	9.14	0.00	108.44	120.47	-12.02	Peak
5720-5725	70.71	16	124	H	35.40	9.14	0.00	115.25	130.41	-15.15	Peak
11490	47.06	247	127	V	38.70	13.68	34.47	64.97	84.00	-19.03	Peak
11490	48.69	7	136	H	38.70	13.68	34.47	66.60	84.00	-17.40	Peak
11490	36.28	247	127	V	38.70	13.68	34.47	54.19	64.00	-9.81	Ave
11490	37.58	7	136	H	38.70	13.68	34.47	55.49	64.00	-8.51	Ave
17235	51.83	152	115	V	41.80	16.35	32.84	77.14	78.00	-0.86	Peak
17235	50.55	318	128	H	41.80	16.35	32.84	75.86	78.00	-2.14	Peak
Middle Channel 5785 MHz											
11570	47.15	245	122	V	38.90	13.77	34.47	65.35	84.00	-18.65	Peak
11570	48.02	11	135	H	38.90	13.77	34.47	66.22	84.00	-17.78	Peak
11570	35.81	245	122	V	38.90	13.77	34.47	54.01	64.00	-9.99	Ave
11570	37.17	11	135	H	38.90	13.77	34.47	55.37	64.00	-8.63	Ave
17355	50.13	152	115	V	41.90	17.83	32.84	77.02	78.00	-0.98	Peak
17355	49.24	318	128	H	41.90	17.83	32.84	76.13	78.00	-1.87	Peak
High Channel 5825 MHz											
5850-5855	49.12	75	100	V	35.60	9.14	0.00	93.86	126.48	-32.62	Peak
5855-5875	45.02	75	100	V	35.60	9.14	0.00	89.76	120.83	-31.07	Peak
5875-5925	31.31	75	100	V	35.60	9.14	0.00	76.05	114.62	-38.56	Peak
5925-5950	29.46	75	100	V	35.60	9.14	0.00	74.20	78.20	-4.00	Peak
5850-5855	55.45	20	125	H	35.60	9.14	0.00	100.19	126.28	-26.09	Peak
5855-5875	51.55	20	125	H	35.60	9.14	0.00	96.29	120.83	-24.54	Peak
5875-5925	38.77	20	125	H	35.60	9.14	0.00	83.51	113.94	-30.42	Peak
5925-5950	29.91	20	125	H	35.60	9.14	0.00	74.65	78.20	-3.55	Peak
11650	45.32	0	100	V	39.00	13.69	34.49	63.52	84.00	-20.48	Peak
11650	45.72	0	100	H	39.00	13.69	34.49	63.92	84.00	-20.08	Peak
11650	32.72	0	100	V	39.00	13.69	34.49	50.92	64.00	-13.08	Ave
11650	32.87	0	100	H	39.00	13.69	34.49	51.07	64.00	-12.93	Ave
17475	51.70	152	115	V	41.80	16.70	32.73	77.47	78.00	-0.53	Peak
17475	50.45	318	128	H	41.80	16.70	32.73	76.22	78.00	-1.78	Peak

5745 - 5825 MHz

802.11n20 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5745 MHz											
5625-5650	28.54	71	100	V	35.40	9.14	0.00	73.08	78.20	-5.12	Peak
5650-5700	33.02	71	100	V	35.40	9.14	0.00	77.56	114.31	-36.74	Peak
5700-5720	45.78	71	100	V	35.40	9.14	0.00	90.32	120.81	-30.49	Peak
5720-5725	53.69	71	100	V	35.40	9.14	0.00	98.23	130.70	-32.47	Peak
5625-5650	29.23	346	117	H	35.40	9.14	0.00	73.77	78.20	-4.43	Peak
5650-5700	35.6	346	117	H	35.40	9.14	0.00	80.14	115.23	-35.09	Peak
5700-5720	47.81	346	117	H	35.40	9.14	0.00	92.35	120.80	-28.45	Peak
5720-5725	56.46	346	117	H	35.40	9.14	0.00	101.00	130.52	-29.52	Peak
11490	45.24	16	125	V	38.70	13.68	34.47	63.15	84.00	-20.85	Peak
11490	46.21	0	180	H	38.70	13.68	34.47	64.12	84.00	-19.88	Peak
11490	33.43	16	125	V	38.70	13.68	34.47	51.34	64.00	-12.66	Ave
11490	34.64	0	180	H	38.70	13.68	34.47	52.55	64.00	-11.45	Ave
17235	50.94	240	128	V	41.80	16.35	32.84	76.25	78.00	-1.75	Peak
17235	51.49	317	135	H	41.80	16.35	32.84	76.80	78.00	-1.20	Peak
Middle Channel 5785 MHz											
11570	47.27	37	122	V	38.90	13.77	34.47	65.47	84.00	-18.53	Peak
11570	47.60	0	185	H	38.90	13.77	34.47	65.80	84.00	-18.20	Peak
11570	35.39	37	122	V	38.90	13.77	34.47	53.59	64.00	-10.41	Ave
11570	35.41	0	185	H	38.90	13.77	34.47	53.61	64.00	-10.39	Ave
17355	49.18	240	128	V	41.90	17.83	32.84	76.07	78.00	-1.93	Peak
17355	50.20	317	135	H	41.90	17.83	32.84	77.09	78.00	-0.91	Peak
High Channel 5825 MHz											
5850-5855	45.02	71	100	V	35.60	9.14	0.00	89.76	132.23	-42.47	55.08
5855-5875	39.17	71	100	V	35.60	9.14	0.00	83.91	120.72	-36.81	51.96
5875-5925	31.07	71	100	V	35.60	9.14	0.00	75.81	97.47	-21.66	34.51
5925-5950	29.62	71	100	V	35.60	9.14	0.00	74.36	78.20	-3.84	29.69
5850-5855	46.12	351	102	H	35.60	9.14	0.00	90.86	132.23	-41.37	52.57
5855-5875	39.17	351	102	H	35.60	9.14	0.00	83.91	120.82	-36.91	51.01
5875-5925	30.17	351	102	H	35.60	9.14	0.00	74.91	96.42	-21.51	33.55
5925-5950	29.97	351	102	H	35.60	9.14	0.00	74.71	78.20	-3.49	29.81
11650	46.69	33	128	V	39.00	13.69	34.49	64.89	84.00	-19.11	47.82
11650	45.87	0	137	H	39.00	13.69	34.49	64.07	84.00	-19.93	49.24
11650	35.25	33	128	V	39.00	13.69	34.49	53.45	64.00	-10.55	38.5
11650	34.29	0	137	H	39.00	13.69	34.49	52.49	64.00	-11.51	39.4
17475	50.26	240	128	V	41.80	16.70	32.73	76.03	78.00	-1.97	51.74
17475	51.55	317	135	H	41.80	16.70	32.73	77.32	78.00	-0.68	51.47

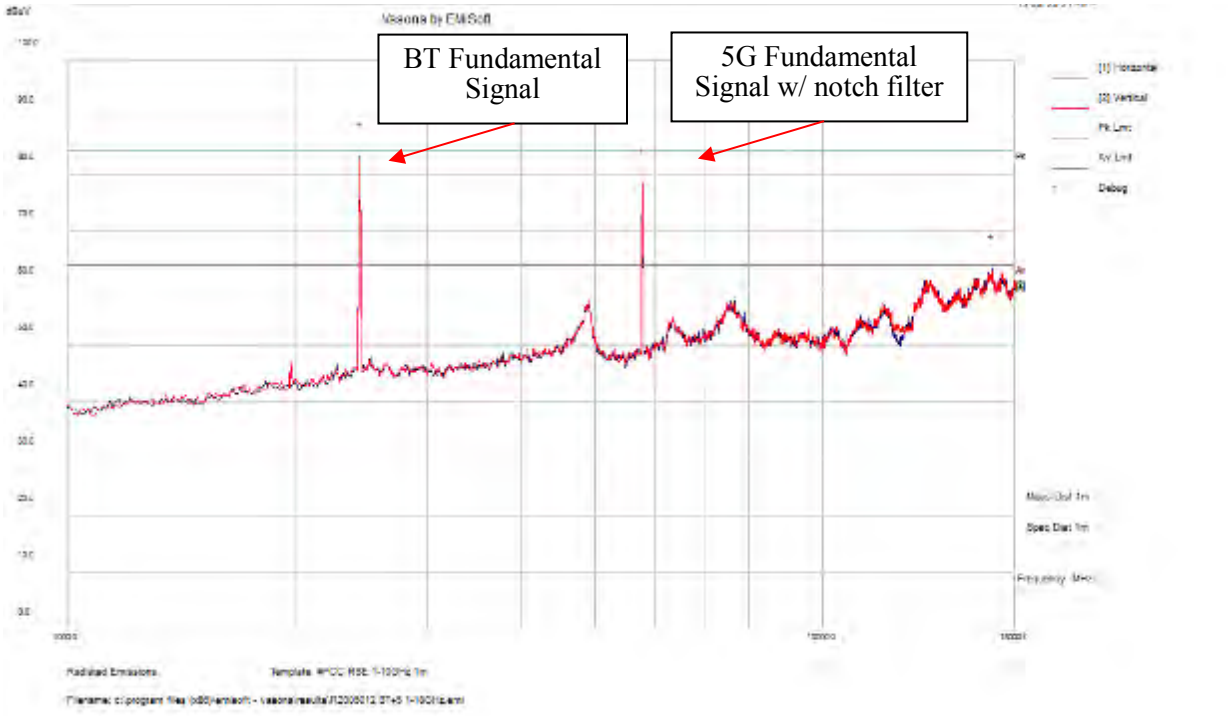
5745 - 5825 MHz

802.11ac20 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5745 MHz											
5625-5650	28.95	71	100	V	35.40	9.14	0.00	73.49	78.20	-4.71	Peak
5650-5700	31.48	71	100	V	35.40	9.14	0.00	76.02	114.06	-38.04	Peak
5700-5720	43.07	71	100	V	35.40	9.14	0.00	87.61	120.73	-33.12	Peak
5720-5725	49.93	71	100	V	35.40	9.14	0.00	94.47	132.21	-37.74	Peak
5625-5650	28.7	347	112	H	35.40	9.14	0.00	73.24	78.20	-4.96	Peak
5650-5700	33.71	347	112	H	35.40	9.14	0.00	78.25	113.62	-35.37	Peak
5700-5720	44.4	347	112	H	35.40	9.14	0.00	88.94	120.69	-31.75	Peak
5720-5725	52.62	347	112	H	35.40	9.14	0.00	97.16	132.07	-34.91	Peak
11490	45.16	266	145	V	38.70	13.68	34.47	63.07	84.00	-20.93	Peak
11490	46.14	0	196	H	38.70	13.68	34.47	64.05	84.00	-19.95	Peak
11490	33.69	266	145	V	38.70	13.68	34.47	51.60	64.00	-12.40	Ave
11490	34.45	0	196	H	38.70	13.68	34.47	52.36	64.00	-11.64	Ave
17235	51.42	282	120	V	41.80	16.35	32.84	76.73	78.00	-1.27	Peak
17235	52.07	125	185	H	41.80	16.35	32.84	77.38	78.00	-0.62	Peak
Middle Channel 5785 MHz											
11570	46.96	34	105	V	38.90	13.77	34.47	65.16	84.00	-18.84	Peak
11570	46.75	0	220	H	38.90	13.77	34.47	64.95	84.00	-19.05	Peak
11570	35.25	34	105	V	38.90	13.77	34.47	53.45	64.00	-10.55	Ave
11570	35.12	0	220	H	38.90	13.77	34.47	53.32	64.00	-10.68	Ave
17355	48.86	280	122	V	41.90	17.83	32.84	75.75	78.00	-2.25	Peak
17355	49.98	318	125	H	41.90	17.83	32.84	76.87	78.00	-1.13	Peak
High Channel 5825 MHz											
5850-5855	43.52	71	100	V	35.60	9.14	0.00	88.26	132.12	-43.85	Peak
5855-5875	38.65	71	100	V	35.60	9.14	0.00	83.39	120.66	-37.27	Peak
5875-5925	30.64	71	100	V	35.60	9.14	0.00	75.38	97.04	-21.66	Peak
5925-5950	29.49	71	100	V	35.60	9.14	0.00	74.23	78.20	-3.97	Peak
5850-5855	44.62	349	110	H	35.60	9.14	0.00	89.36	131.82	-42.46	Peak
5855-5875	39.97	349	110	H	35.60	9.14	0.00	84.71	120.70	-35.99	Peak
5875-5925	30.37	349	110	H	35.60	9.14	0.00	75.11	96.49	-21.37	Peak
5925-5950	30.19	349	110	H	35.60	9.14	0.00	74.93	78.20	-3.27	Peak
11650	47.14	37	135	V	39.00	13.69	34.49	65.34	84.00	-18.66	Peak
11650	45.96	0	205	H	39.00	13.69	34.49	64.16	84.00	-19.84	Peak
11650	35.16	37	135	V	39.00	13.69	34.49	53.36	64.00	-10.64	Ave
11650	34.4	0	205	H	39.00	13.69	34.49	52.60	64.00	-11.40	Ave
17475	48.76	280	120	V	41.80	16.70	32.73	74.53	78.00	-3.47	Peak
17475	51.14	315	125	H	41.80	16.70	32.73	76.91	78.00	-1.09	Peak

1 GHz – 18 GHz Worst Case Scan at 1 Meter

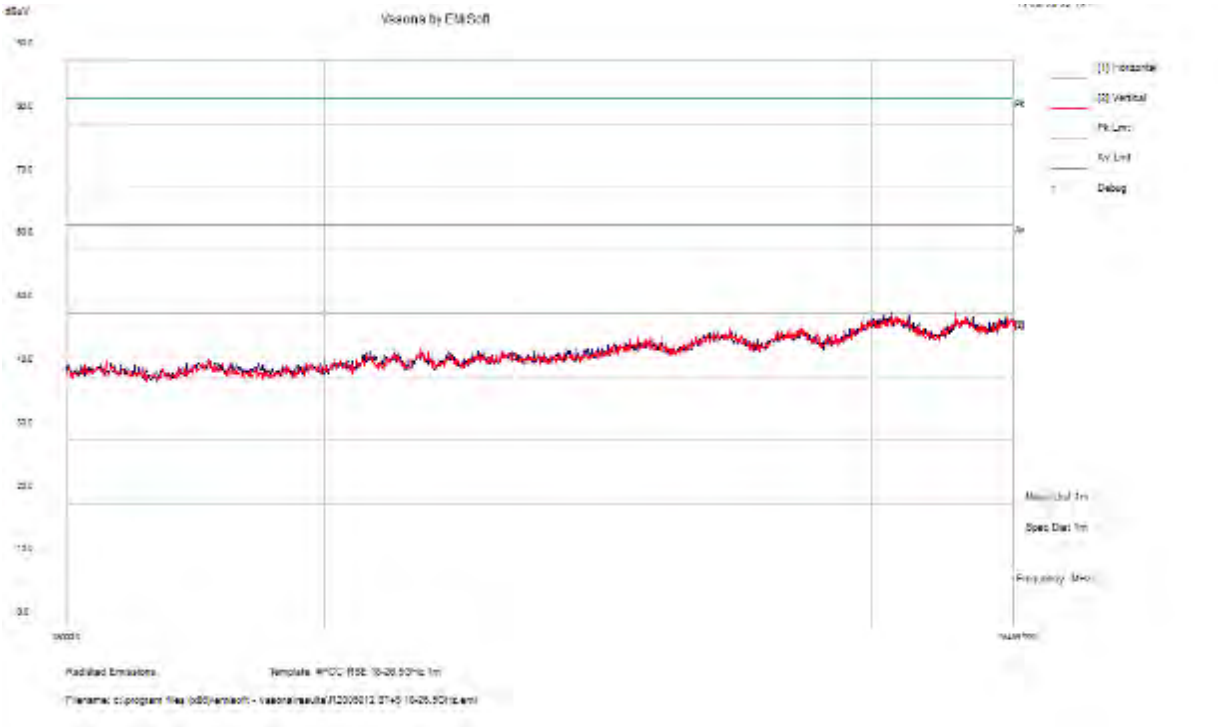
Worst Case Colocation: n20 mode, 5785MHz + GFSK , 2441 MHz



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
16799.375	63.43	100	H	0	64	-0.57	Peak

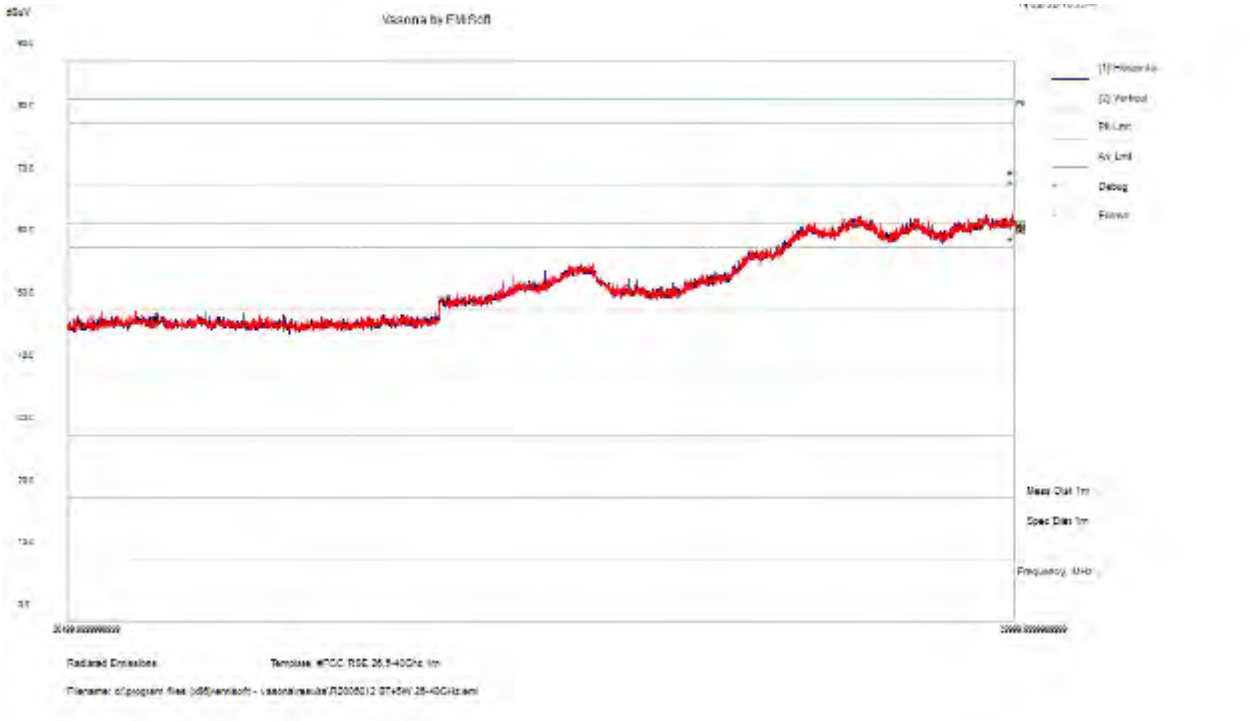
18 GHz – 26.5 GHz Worst Case Scan at 1 Meter

Worst Case Colocation: n20 mode, 5785MHz + GFSK , 2441 MHz



26.5 GHz – 40 GHz Worst Case Scan at 1 Meter

Worst Case Colocation: n20 mode, 5785MHz + GFSK , 2441 MHz



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
39947.735	72.35	113	V	38	84	-11.65	Peak
39947.735	61.5	160	H	127	64	-2.5	Average

8 FCC §15.407(e) - 6 dB, 26 dB, & 99% - Occupied Bandwidth

8.1 Applicable Standards

As per FCC §15.407(e): for equipment operating in the band 5725 – 5850 MHz, the minimum 6 dB bandwidth of U-NII devices shall be 500 kHz.

8.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 or 26 dB from the reference level. Record the frequency difference as the minimum emission or emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2019-06-26	18 Months
Agilent	Spectrum Analyzer	N9010A	MY48030852	2020-02-10	1 Year
-	RF cable	-	-	Each time[1]	N/A
-	20 dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 02 October 2018) "A2LA Policy on Metrological Traceability".*

8.4 Test Environmental Conditions

Temperature:	22-24 ºC
Relative Humidity:	40-41 %
ATM Pressure:	103.1-104.1 kPa

The testing was performed by Christian McCaig on 2020-06-29, 2020-06-30 and 2020-07-09 in RF site.

8.5 Test Results

Please refer to the following tables and plots.

FCC:

5150 - 5250 MHz

Ant A

Channel	Frequency (MHz)	99% OBW (MHz)	26 dB OBW (MHz)
802.11a mode			
36	5180	16.3185	18.77
44	5220	17.664	33.876
48	5240	17.4767	34.244
802.11n20 mode			
36	5180	17.4715	19.465
44	5220	17.4646	19.596
48	5240	17.4691	19.411
802.11ac20 mode			
36	5180	17.4623	19.338
44	5220	17.4667	19.382
48	5240	17.472	19.483

Ant B

Channel	Frequency (MHz)	99% OBW (MHz)	26 dB OBW (MHz)
802.11a mode			
36	5180	16.303	18.735
44	5220	17.6736	34.931
48	5240	17.8729	34.48
802.11n20 mode			
36	5180	17.4708	19.455
44	5220	17.545	19.49
48	5240	17.559	19.37
802.11ac20 mode			
36	5180	17.4684	19.366
44	5220	17.4919	19.563
48	5240	17.4909	19.57

FCC:

5725 - 5850 MHz

Ant A

Channel	Frequency (MHz)	99% OBW (MHz)	6 dB OBW (MHz)	6 dB OBW limit (kHz)
802.11a mode				
149	5745	16.429	16.37	≥500
157	5785	21.21	16.36	≥500
165	5825	19.162	16.35	≥500
802.11n20 mode				
149	5745	17.585	17.61	≥500
157	5785	17.837	17.59	≥500
165	5825	17.667	17.1	≥500
802.11ac20 mode				
149	5745	17.711	17.53	≥500
157	5785	17.643	17.59	≥500
165	5825	17.637	17.26	≥500

Ant B

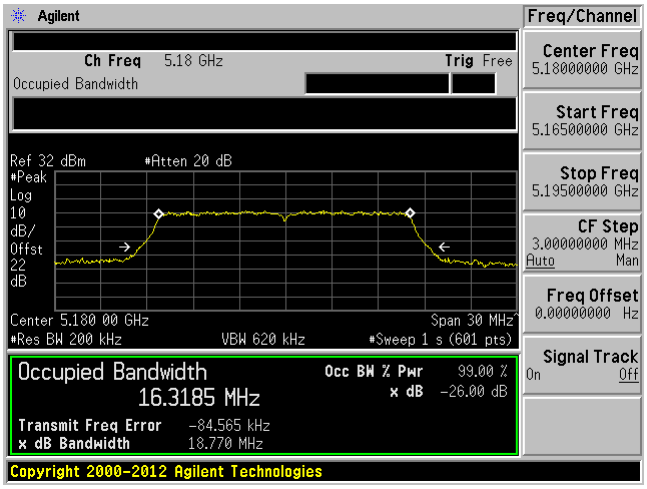
Channel	Frequency (MHz)	99% OBW (MHz)	6 dB OBW (MHz)	6 dB OBW limit (kHz)
802.11a mode				
149	5745	32.74	16.37	≥500
157	5785	24.634	16.32	≥500
165	5825	20.997	16.07	≥500
802.11n20 mode				
149	5745	17.564	16.97	≥500
157	5785	17.672	17.59	≥500
165	5825	17.62	17.34	≥500
802.11ac20 mode				
149	5745	17.617	17.58	≥500
157	5785	17.602	17.59	≥500
165	5825	17.583	17.58	≥500

Please refer to the following plots:

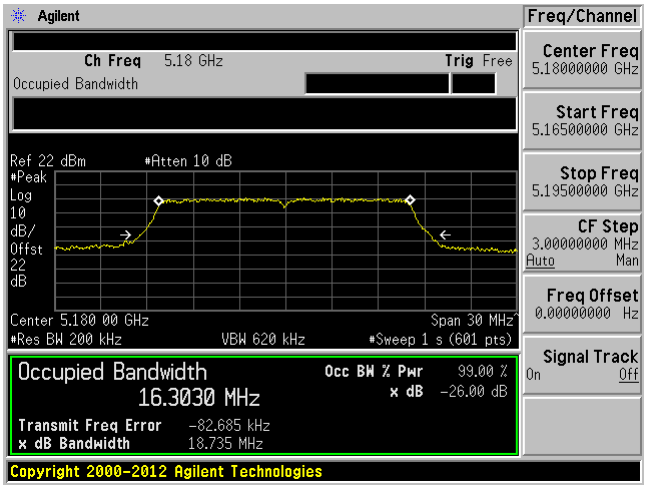
FCC:

5150 - 5250 MHz
99% and 26dB OBW
802.11a Mode

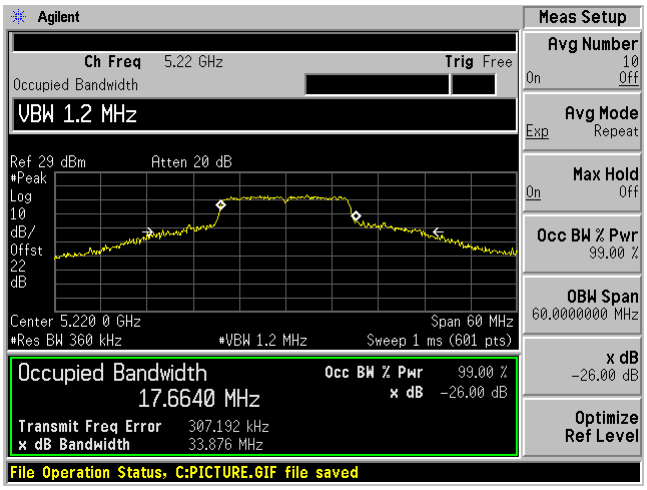
Low Channel ANT A



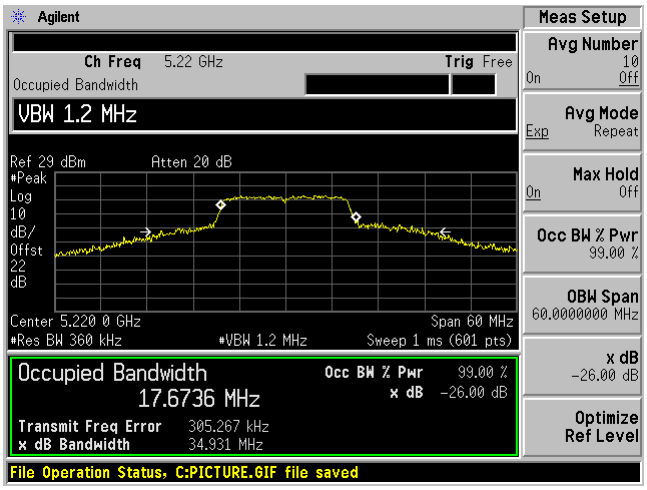
Low Channel ANT B



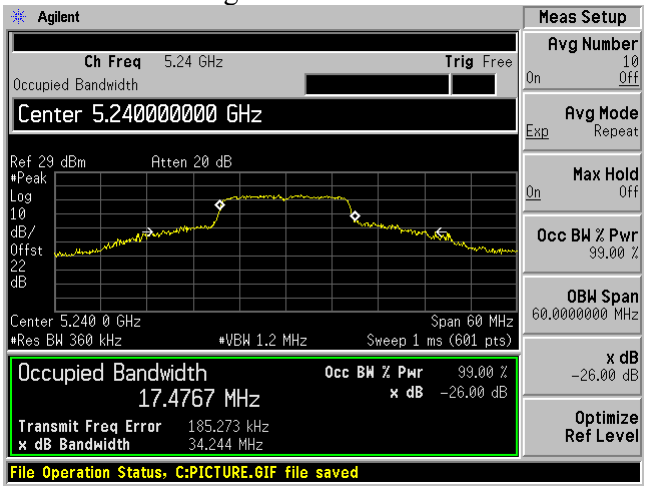
Mid Channel ANT A



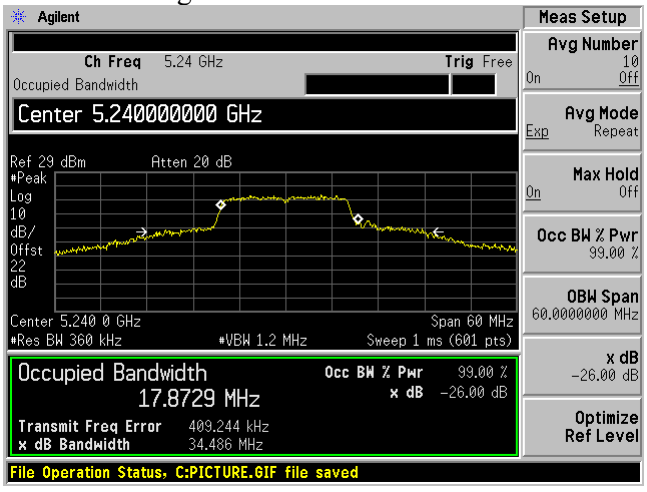
Mid Channel ANT B



High Channel ANT A

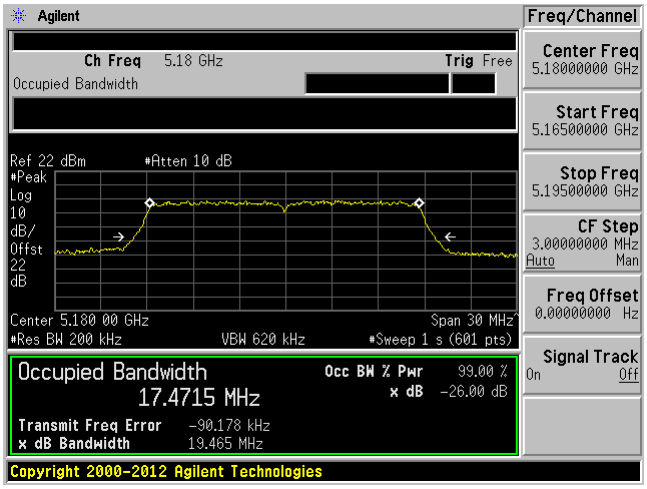


High Channel ANT B

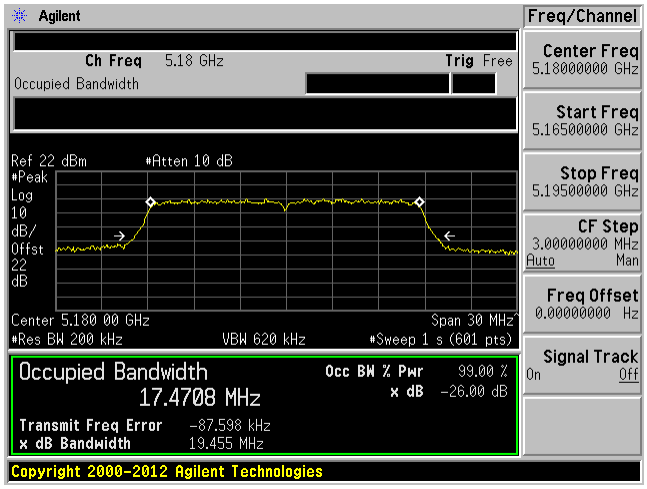


802.11n20 Mode

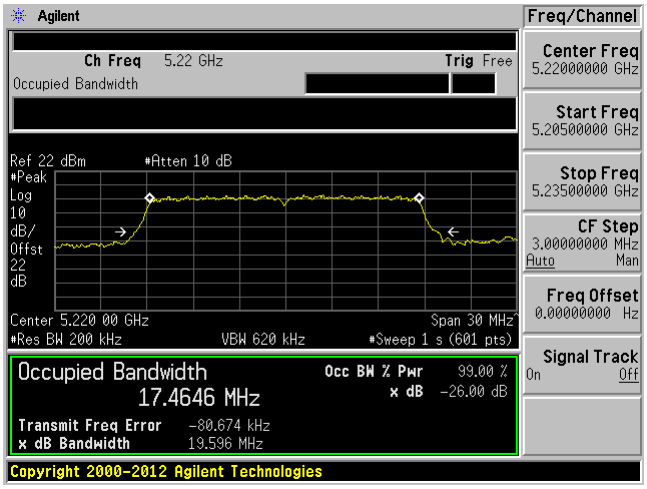
Low Channel ANT A



Low Channel ANT B

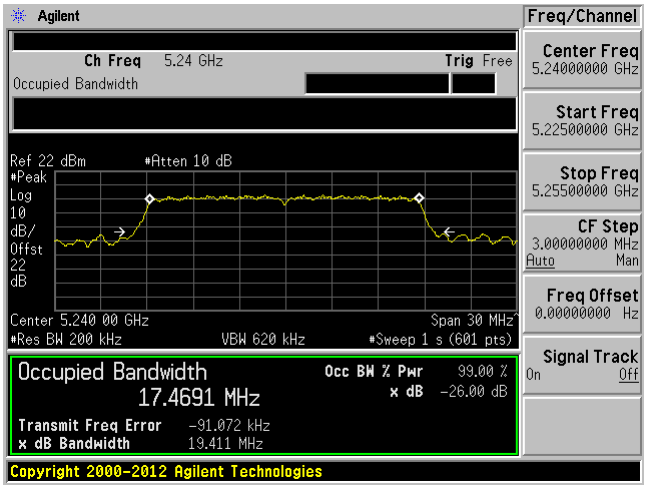


Mid Channel ANT A

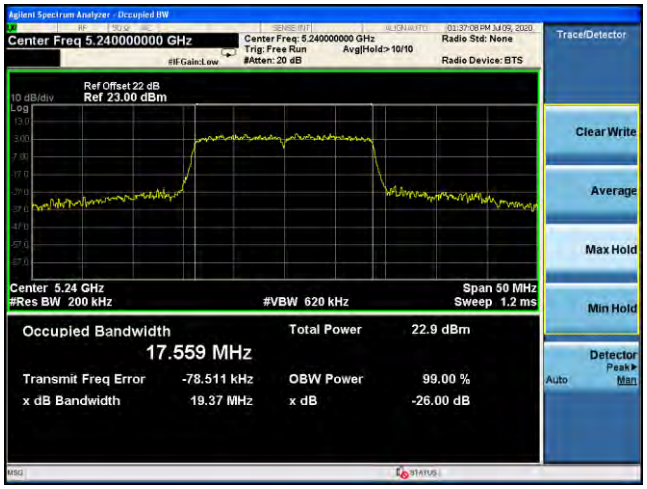


Mid Channel ANT B

High Channel ANT A

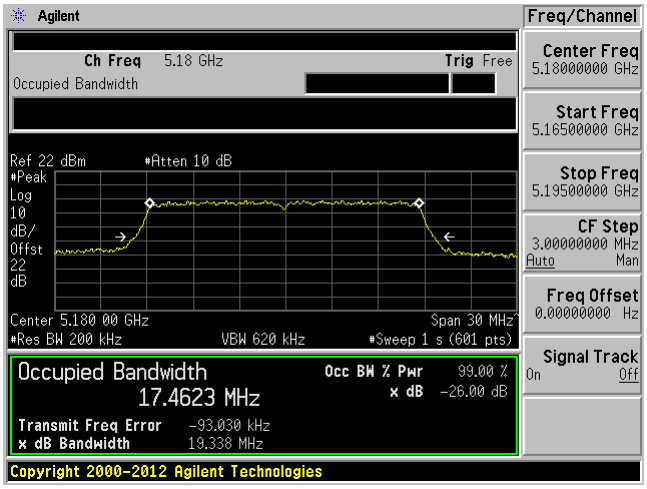


High Channel ANT B

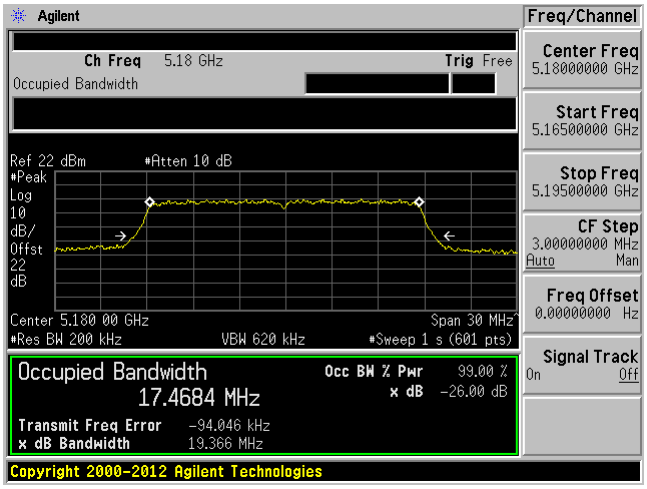


802.11ac20 Mode

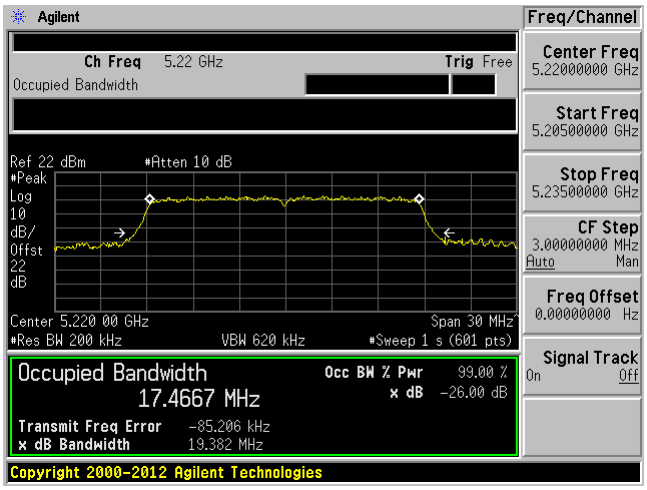
Low Channel ANT A



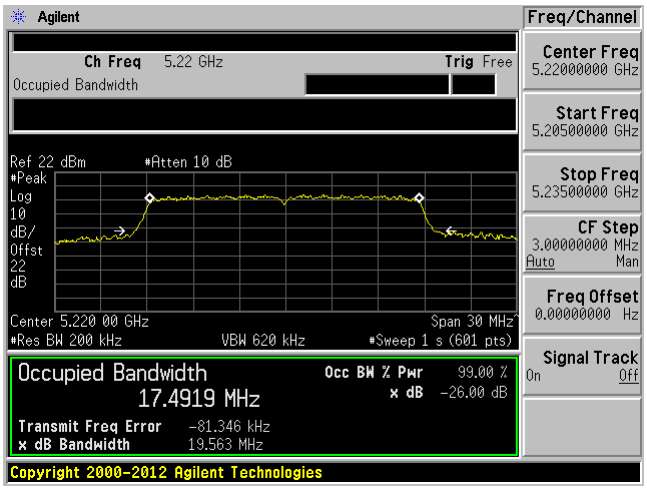
Low Channel ANT B



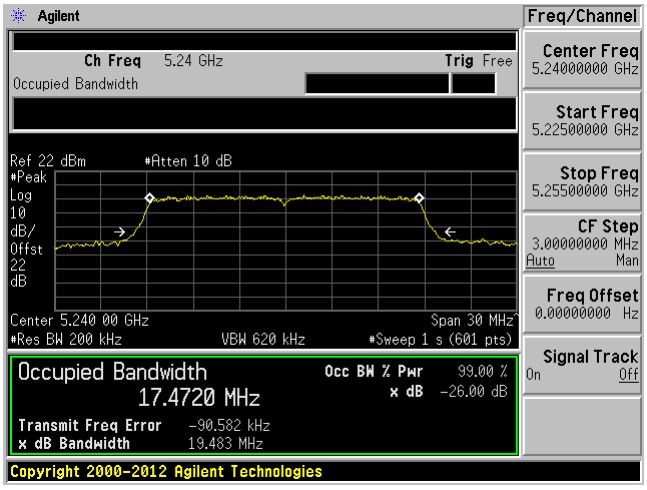
Mid Channel ANT A



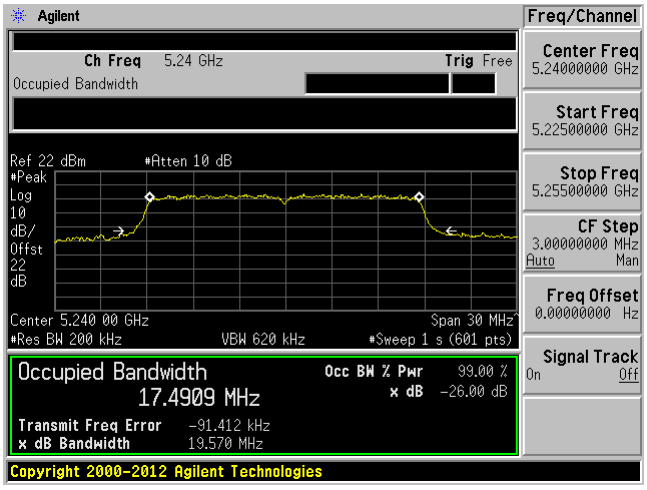
Mid Channel ANT B



High Channel ANT A



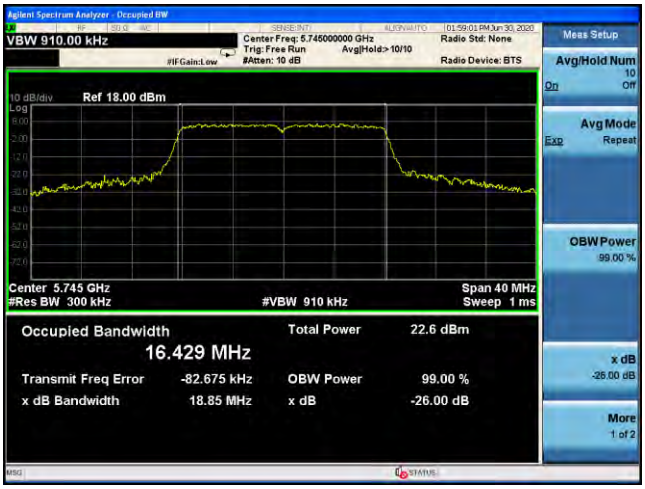
High Channel ANT B



FCC:

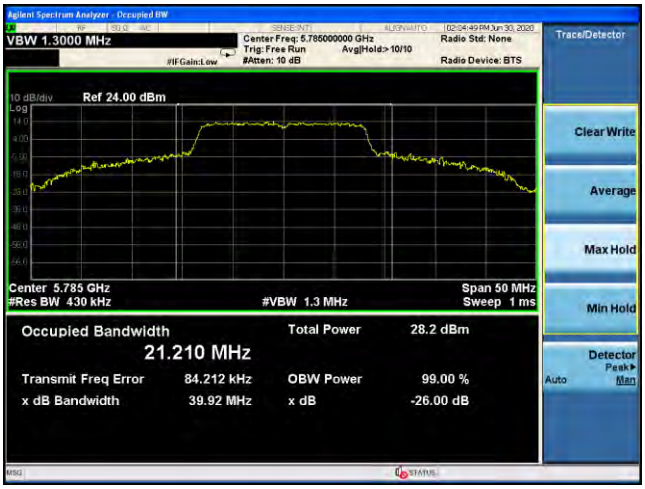
99% OBW
5725 - 5850 MHz
802.11a Mode

Low Channel ANT A



Low Channel ANT B

Mid Channel ANT A



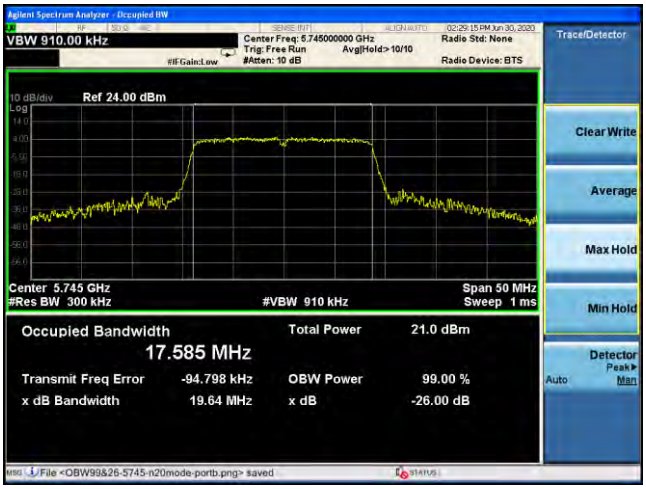
Mid Channel ANT B

High Channel ANT A

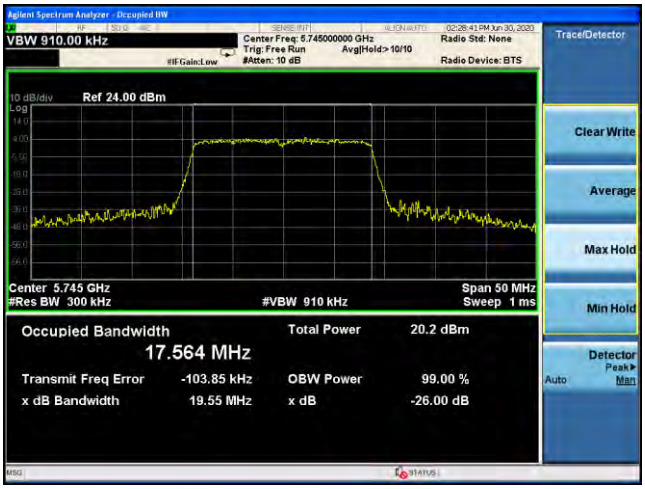
High Channel ANT B

802.11n20 Mode

Low Channel ANT A

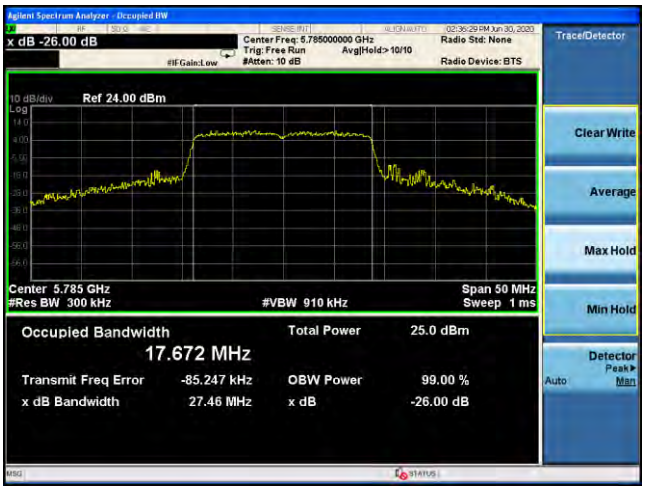


Low Channel ANT B

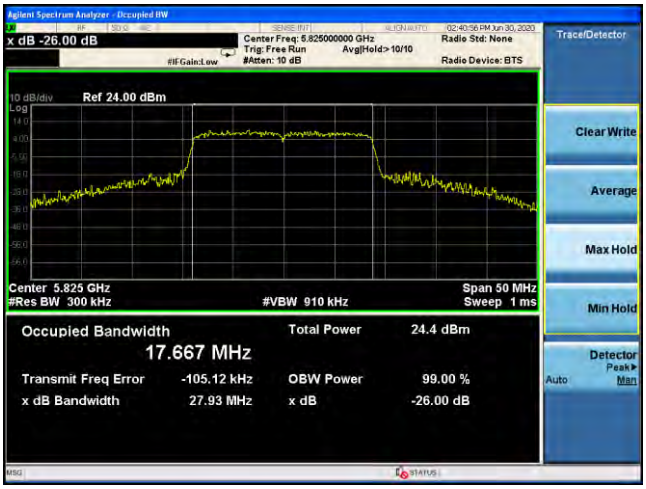


Mid Channel ANT A

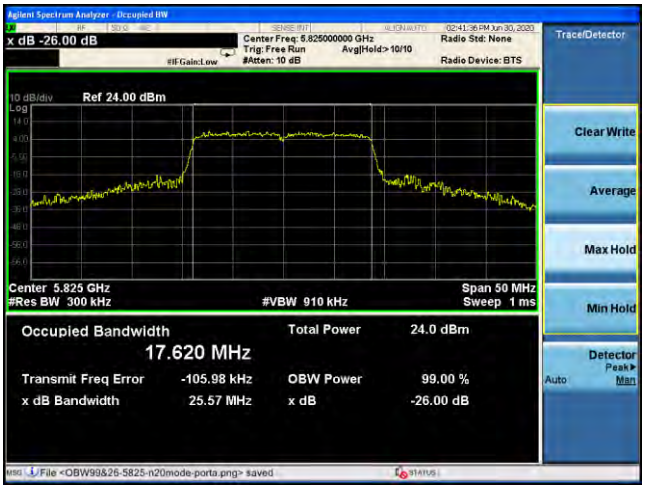
Mid Channel ANT B



High Channel ANT A

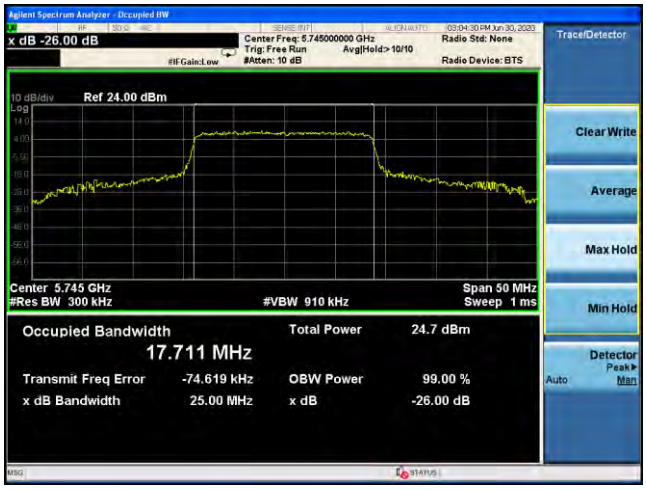


High Channel ANT B

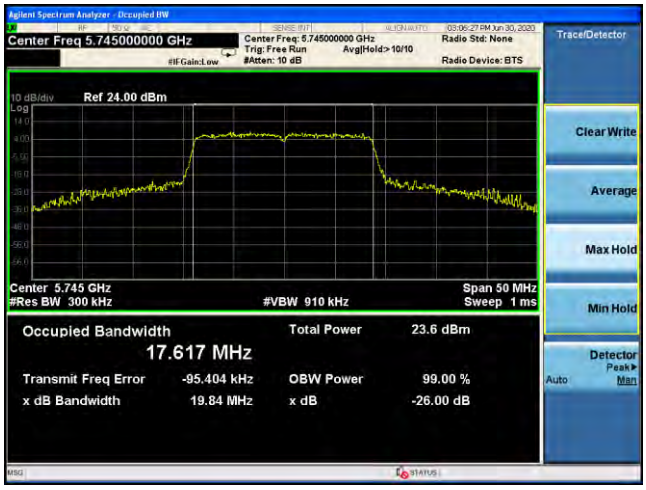


802.11ac20 Mode

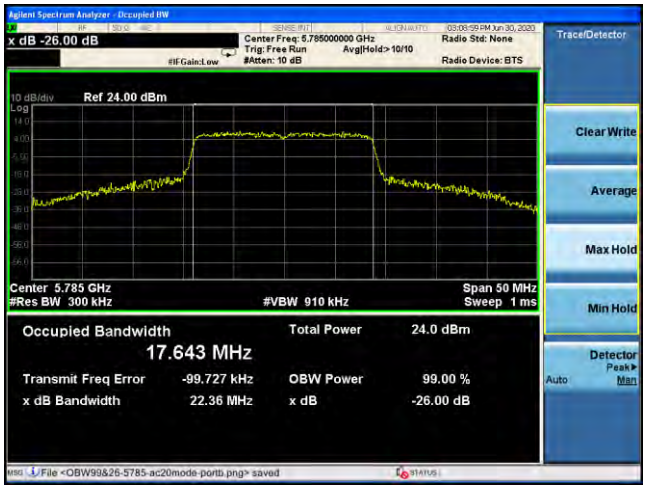
Low Channel ANT A



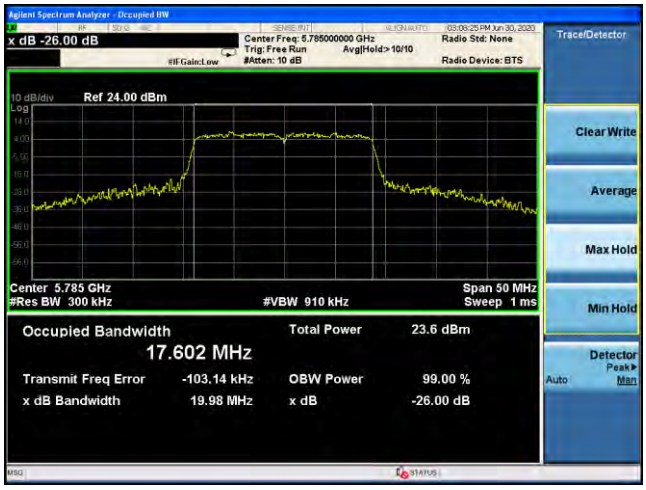
Low Channel ANT B



Mid Channel ANT A

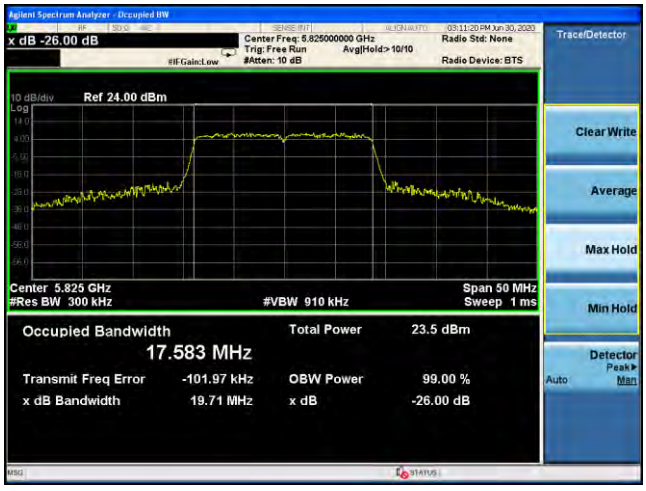


Mid Channel ANT B



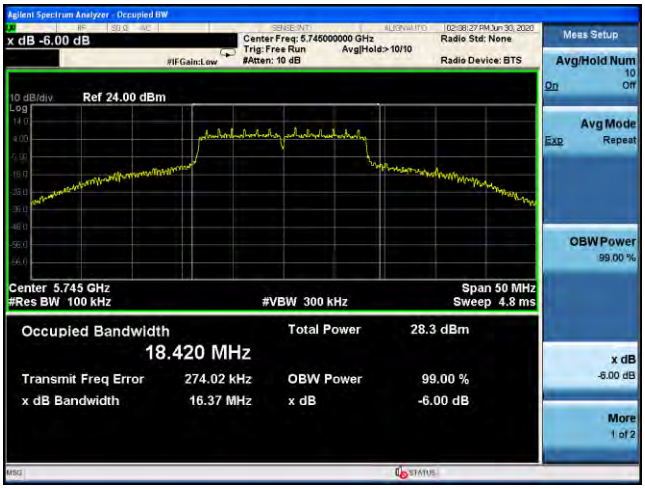
High Channel ANT A

High Channel ANT B

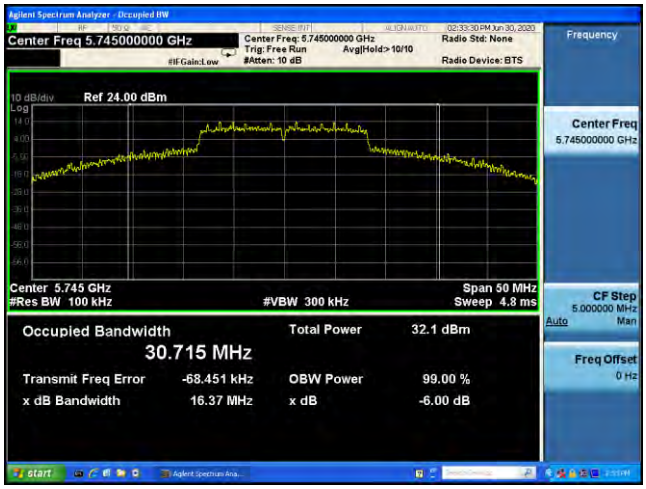


6dB OBW
5725 - 5850 MHz
802.11a Mode

Low Channel ANT A

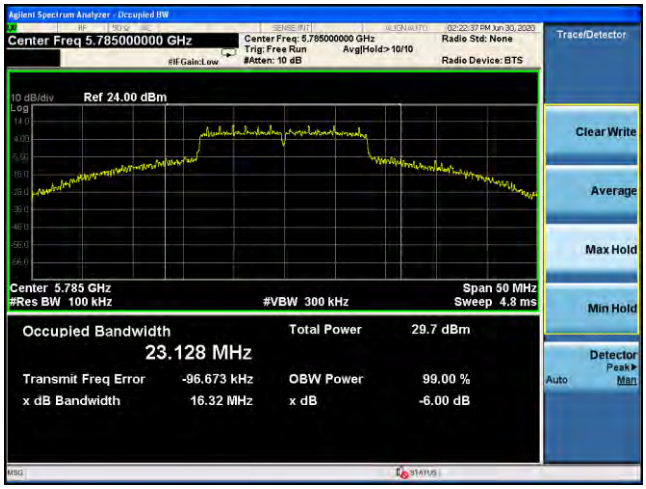


Low Channel ANT B



Mid Channel ANT A

Mid Channel ANT B



High Channel ANT A

High Channel ANT B

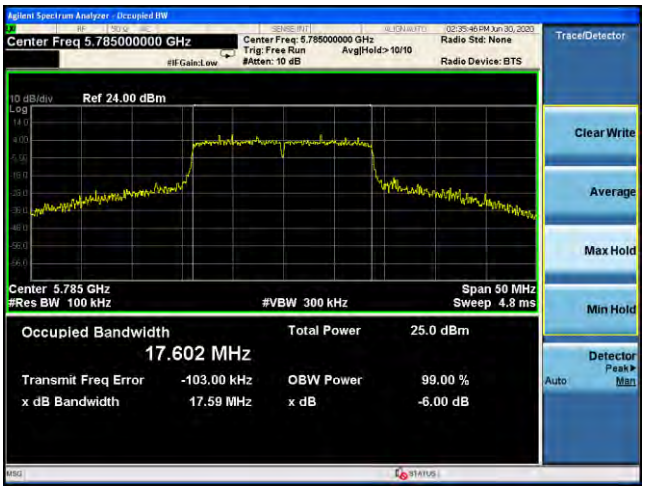
802.11n20 Mode

Low Channel ANT A

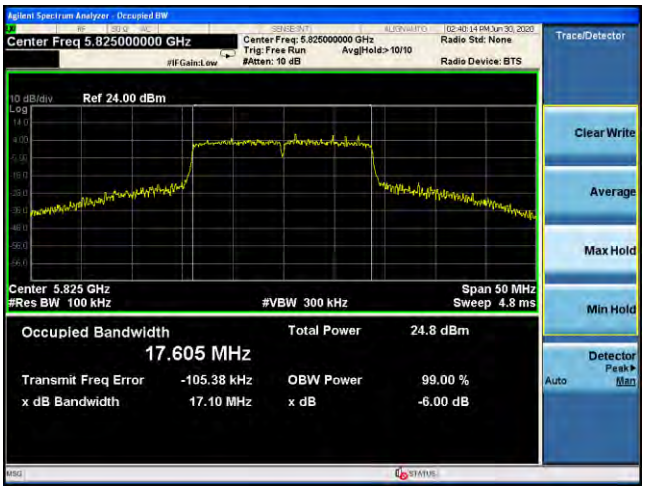
Low Channel ANT B

Mid Channel ANT A

Mid Channel ANT B



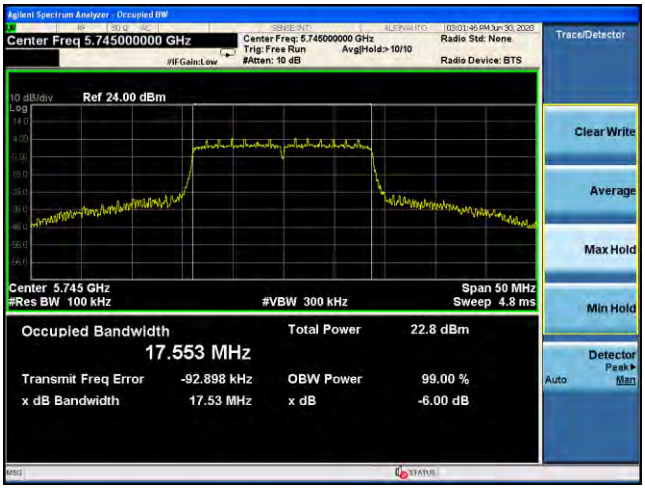
High Channel ANT A



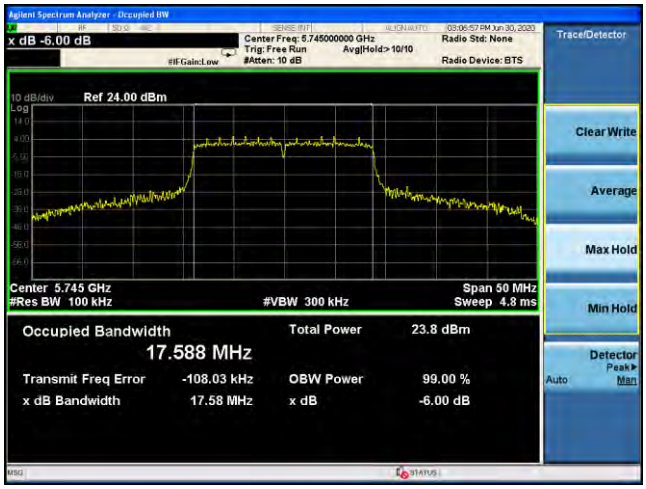
High Channel ANT B

802.11ac20 Mode

Low Channel ANT A

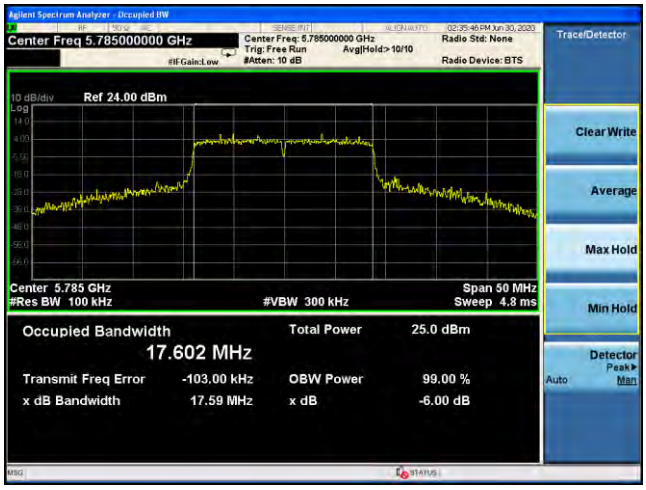


Low Channel ANT B

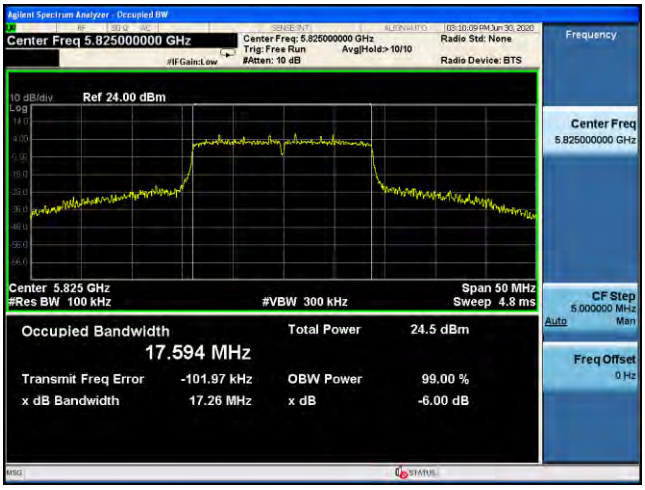


Mid Channel ANT A

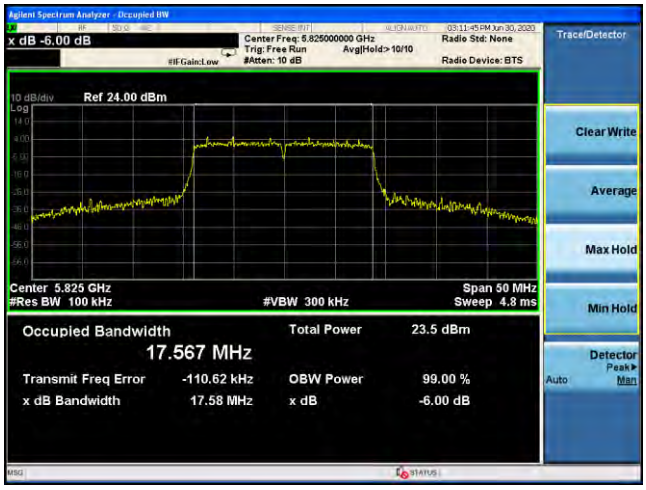
Mid Channel ANT B



High Channel ANT A



High Channel ANT B



9 FCC §407(a) - Output Power

9.1 Applicable Standards

According to FCC §15.407(a):

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.

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.

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.

9.2 Measurement Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to a power meter.

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
-	RF cable	-	-	Each time[1]	N/A
-	20 dB attenuator	-	-	Each time[1]	N/A
ETS- Lingerin	Power Sensor	7002-006	160097	2018-12-31	2 years

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 02 October 2018) "A2LA Policy on Metrological Traceability".*

9.4 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	42 %
ATM Pressure:	102.7 KPa

The testing was performed by Christopher Casteel from 2020-06-19 in RF site.

9.5 Test Results

FCC Results

5150 - 5250 MHz

Channel	Frequency (MHz)	Conducted Output Power (dBm)		Total (dBm)	FCC Limit (dBm)
		ANT A	ANT B		
802.11a mode					
Low	5180	16.11	14.4	-	24.00
Middle	5220	20.74	20.75	-	24.00
High	5240	20.64	19.9	-	24.00
802.11n20 mode					
Low	5180	13.32	14.01	16.69	22.39
Middle	5220	15.83	16.8	19.35	22.39
High	5240	15.48	16.72	19.15	22.39
802.11ac20 mode					
Low	5180	12.99	14.68	16.93	22.39
Middle	5220	15.74	17.36	19.64	22.39
High	5240	15.84	16.76	19.33	22.39

FCC Results:

5745 - 5825 MHz

Channel	Frequency (MHz)	Conducted Output Power (dBm)		Total (dBm)	FCC Limit (dBm)
		ANT A	ANT B		
802.11a mode					
Low	5745	21.31	24.25	-	30
Middle	5785	21.94	23.05	-	30
High	5825	21.99	22.56	-	30
802.11n20 mode					
Low	5745	18.68	18.75	21.73	28.39
Middle	5785	19.78	19.4	22.60	28.39
High	5825	19.5	19.59	22.56	28.39
802.11ac20 mode					
Low	5745	18.47	17.97	21.24	28.39
Middle	5785	19.07	18.47	21.79	28.39
High	5825	19.21	18.65	21.95	28.39

Note: When the directional gain is greater than 6dBi, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The directional antenna gain for 802.11n20/ac20 mode is 7.61 dBi calculated based on method specified in KDB 662911 D01.

Note: Duty cycle correction factor has already been added to the measurements.

10 FCC §15.407(a) - Power Spectral Density

10.1 Applicable Standards

According to FCC §15.407(a):

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.

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.

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.

10.2 Measurement Procedure

(i) Set span to encompass the entire emission bandwidth (EBW) of the signal.
(ii) Set RBW = 1 MHz.
(iii) Set VBW ≥ 3 MHz.
(iv) Number of points in sweep ≥ 2 Span / RBW. (This ensures that bin-to-bin spacing is ≤ RBW/2, so that narrowband signals are not lost between frequency bins.)
(v) Sweep time = auto.
(vi) Detector = RMS (i.e., power averaging), if available. Otherwise, use sample detector mode.
(vii) If transmit duty cycle < 98 percent, use a video trigger with the trigger level set to enable triggering only on full power pulses. Transmitter must operate at maximum power control level for the entire duration of every sweep. If the EUT transmits continuously (i.e., with no off intervals) or at duty cycle ≥ 98 percent, and if each transmission is entirely at the maximum power control level, then the trigger shall be set to "free run".
(viii) Trace average at least 100 traces in power averaging (i.e., RMS) mode.
(ix) Compute power by integrating the spectrum across the 26 dB EBW of the signal using the spectrum analyzer's band power measurement function with band limits set equal to the EBW band edges. If the spectrum analyzer does not have a band power function, sum the spectrum levels (in power units) at 1 MHz intervals extending across the 26 dB EBW of the spectrum.

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2019-06-26	18 Months
Agilent	Spectrum Analyzer	N9010A	MY48030852	2020-02-10	1 Year
-	RF cable	-	-	Each time[1]	N/A
-	20 dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 02 October 2018) "A2LA Policy on Metrological Traceability".*

10.4 Test Environmental Conditions

Temperature:	22-24 ºC
Relative Humidity:	40-41 %
ATM Pressure:	103.1-104.1 kPa

The testing was performed by Christian McCaig on 2020-06-26 and 2020-06-29 in RF site.

10.5 Test Results

FCC:

5150 - 5250 MHz

Channel	Frequency (MHz)	PSD (dBm/MHz)		Corrected Total (dBm/MHz)		FCC Limit (dBm/MHz)
		ANT A	ANT B	ANT A	ANT B	
801.11a mode						
Low	5180	2.212	1.566	2.882	2.236	11.00
Middle	5220	8.061	8.267	8.731	8.937	11.00
High	5240	8.268	7.901	8.938	8.571	11.00
801.11n20 mode						
Low	5180	-0.503	0.438	3.503		9.39
Middle	5220	2.793	3.583	6.716		9.39
High	5240	3.268	3.615	6.955		9.39
801.11ac20 mode						
Low	5180	-0.737	0.134	3.241		9.39
Middle	5220	2.964	3.92	6.979		9.39
High	5240	3.107	3.771	6.962		9.39

Corrected Total PSD (dBm/MHz) = PSD (dBm/MHz) + Duty Cycle Correction (dB)

Note: When the directional gain is greater than 6dBi, the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The directional antenna gain for 802.11n20/ac20 mode is 7.61 dBi calculated based on method specified in KDB 662911 D01.

FCC:

5745 - 5825 MHz

Channel	Frequency (MHz)	PSD (dBm/100 kHz)		Corrected PSD (dBm/100 kHz)		Corrected PSD (dBm/500 kHz)		FCC Limit (dBm/500 kHz)
		ANT A	ANT B	ANT A	ANT B	ANT A	ANT B	
801.11a mode								
Low	5745	10.651	14.161	11.321	14.831	18.311	21.821	30
Middle	5785	10.705	12.311	11.375	12.981	18.365	19.971	30
High	5825	11.026	12.033	11.696	12.703	18.686	19.693	30
801.11n20 mode								
Low	5745	2.07	4.61	11.444		18.434		28.39
Middle	5785	2.33	4.85	11.200		18.189		28.39
High	5825	1.64	4.15	10.744		17.733		28.39
801.11ac20 mode								
Low	5745	2.32	4.51	10.316		17.306		28.39
Middle	5785	2.35	4.72	10.610		17.599		28.39
High	5825	1.75	3.96	10.371		17.361		28.39

Correct PSD (dBm/500 kHz) = PSD (dBm/100 kHz) + Duty Cycle Correction (dB) + 10*log(500 kHz/100 kHz)

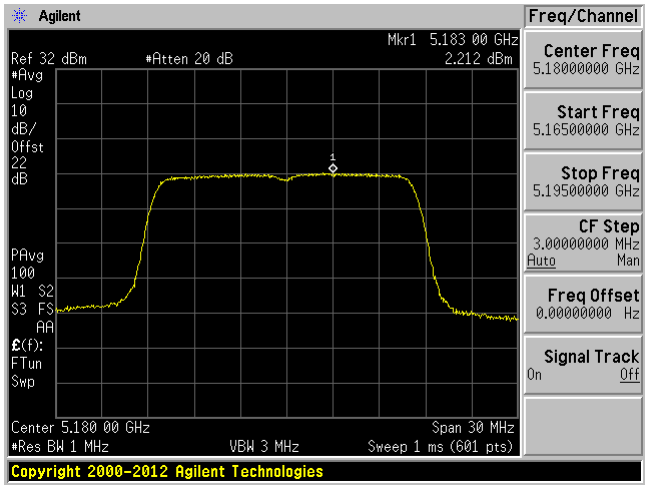
Note: When the directional gain is greater than 6dBi, the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The directional antenna gain for 802.11n20/ac20 mode is 7.61 dBi calculated based on method specified in KDB 662911 D01.

Please refer to the following plots.

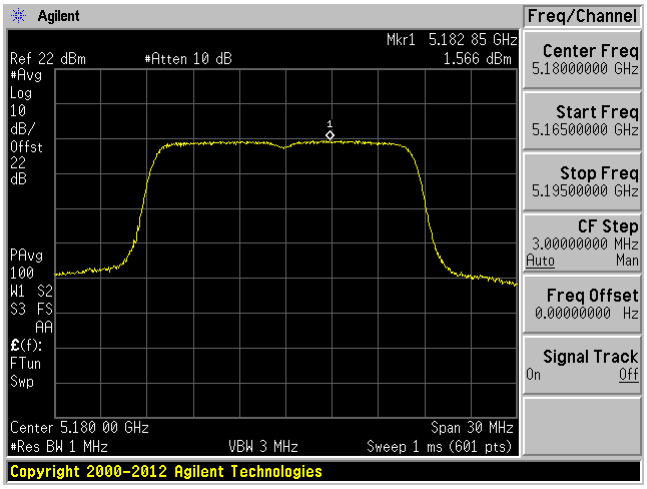
FCC:

5150 - 5250 MHz
802.11a Mode

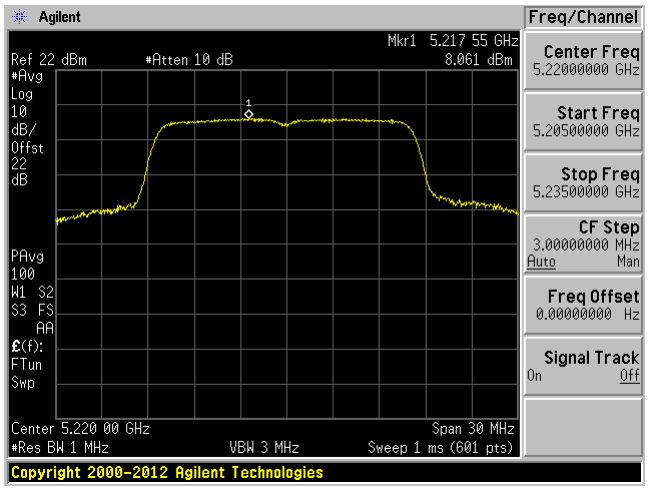
Low Channel ANT A



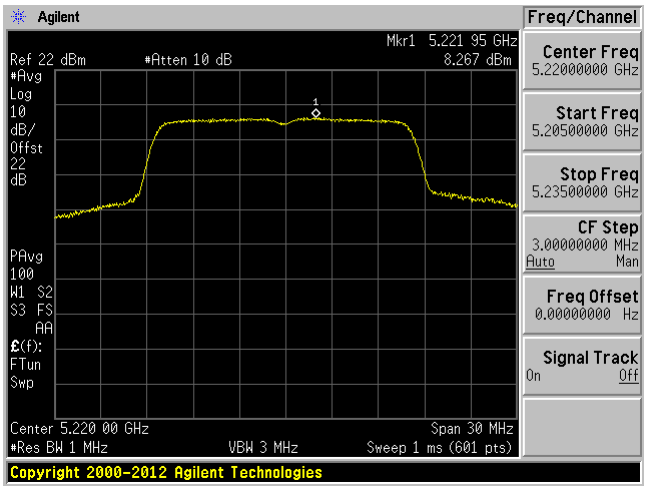
Low Channel ANT B



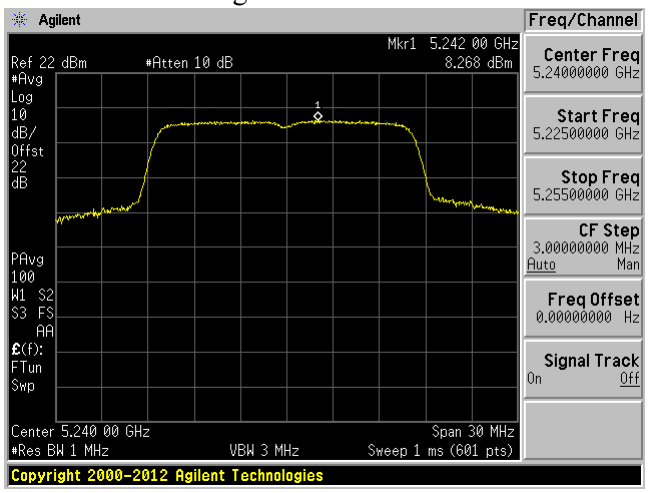
Mid Channel ANT A



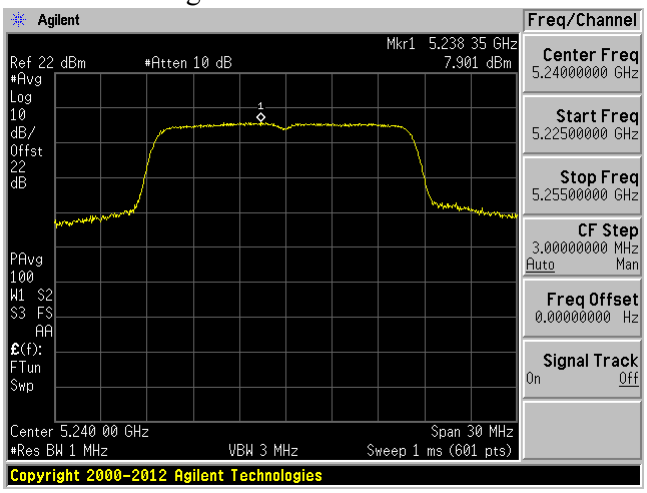
Mid Channel ANT B



High Channel ANT A

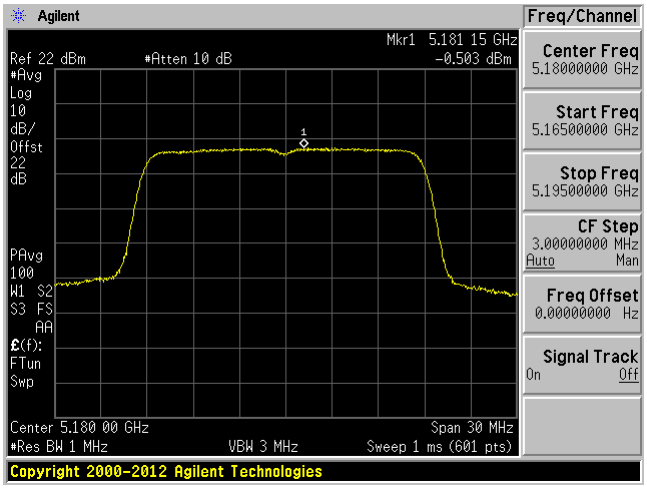


High Channel ANT B

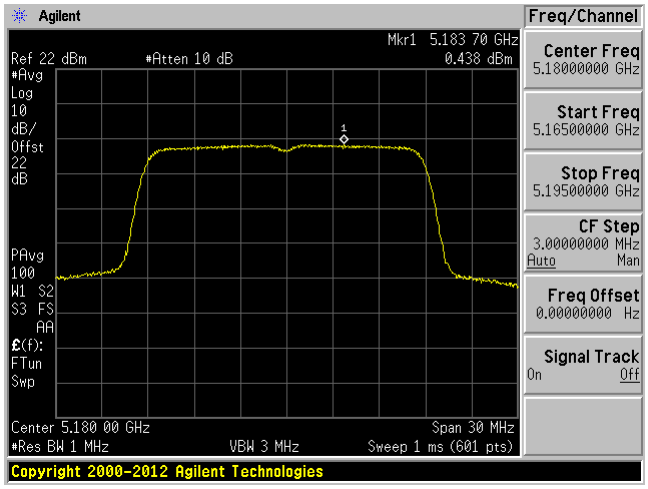


802.11n20 Mode

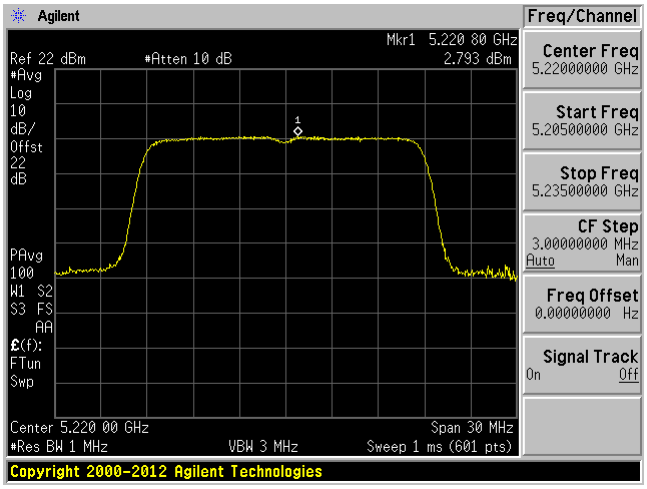
Low Channel ANT A



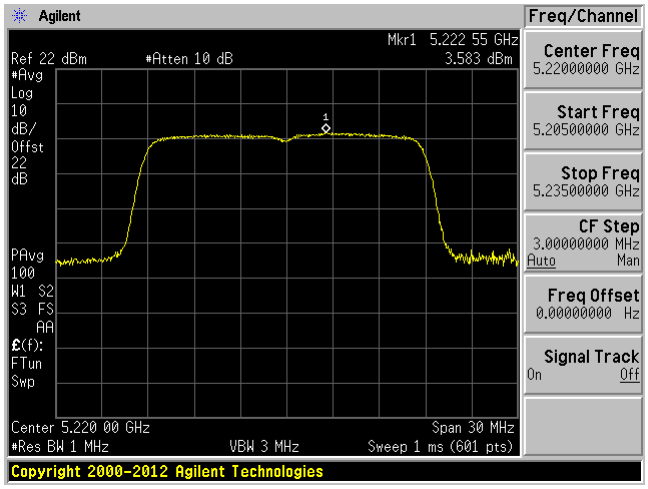
Low Channel ANT B



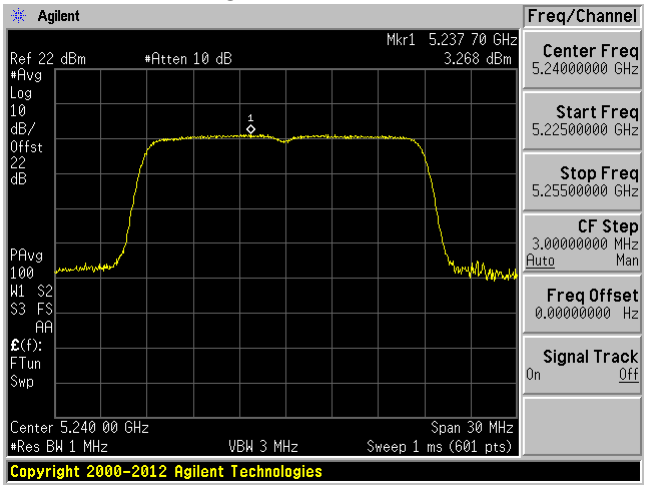
Mid Channel ANT A



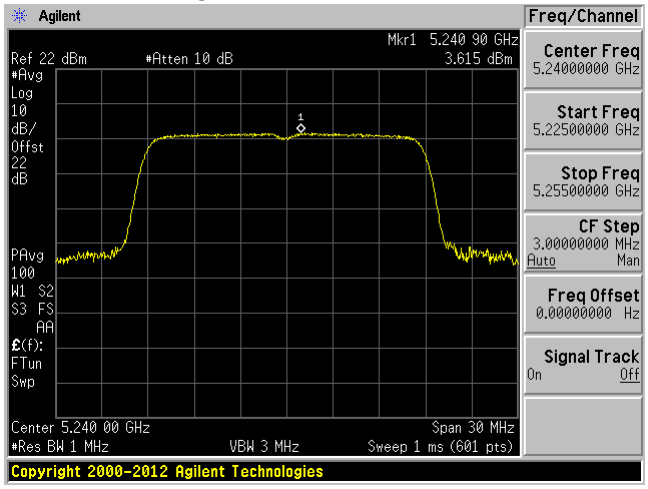
Mid Channel ANT B



High Channel ANT A

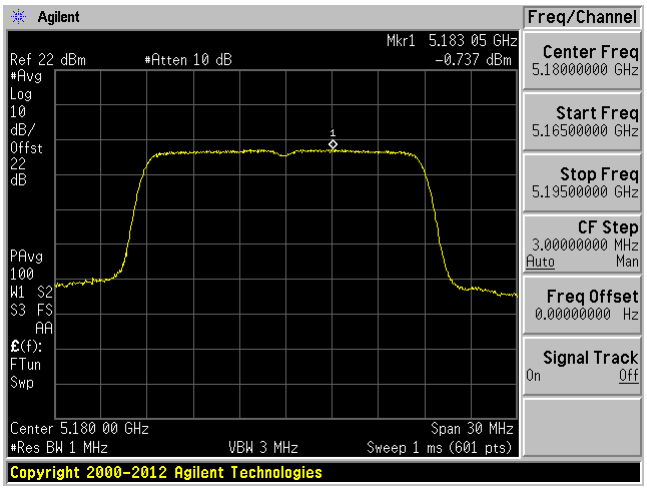


High Channel ANT B

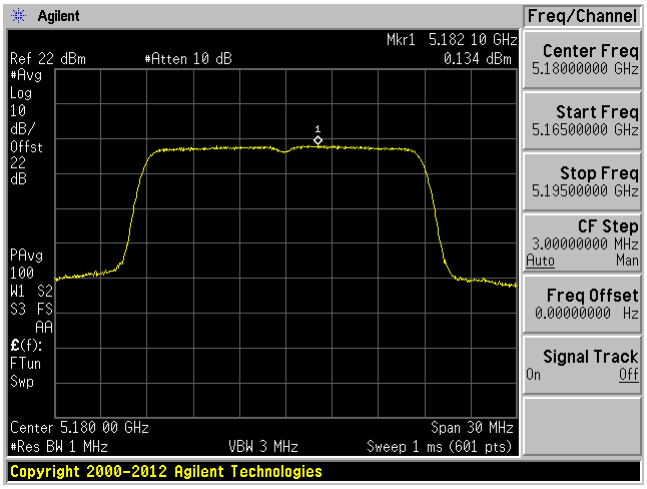


802.11ac20 Mode

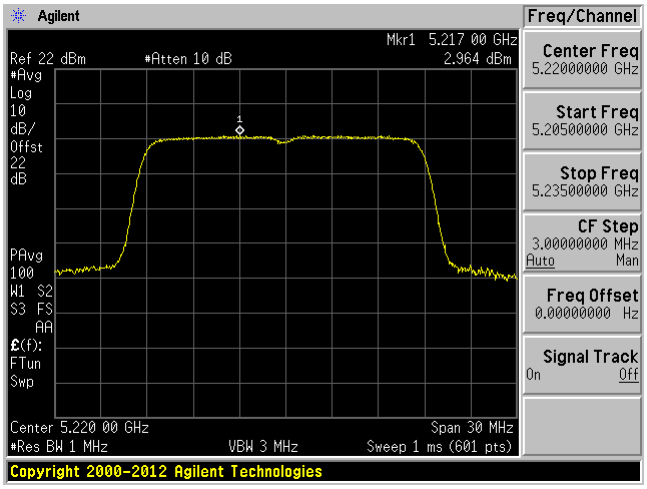
Low Channel ANT A



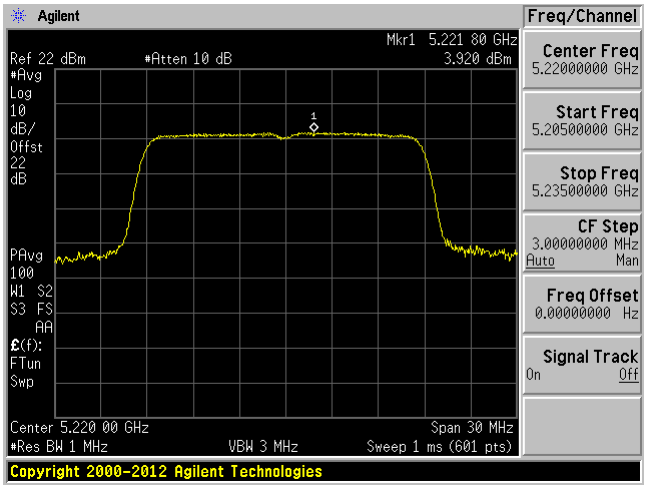
Low Channel ANT B



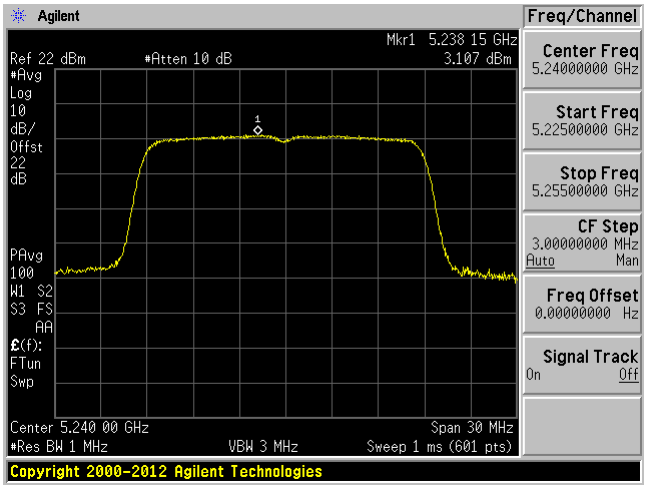
Mid Channel ANT A



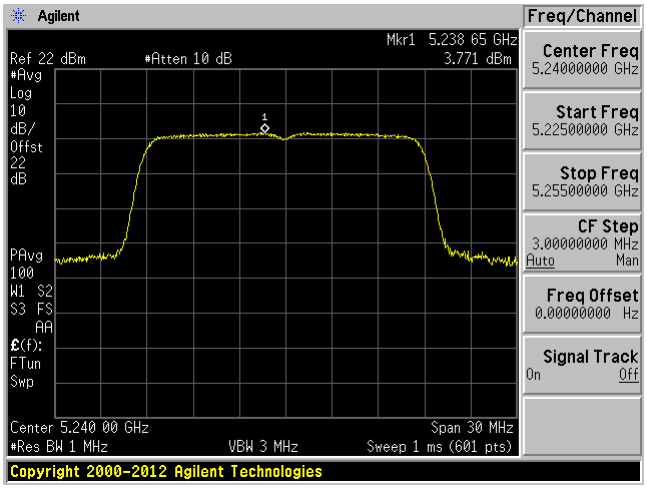
Mid Channel ANT B



High Channel ANT A



High Channel ANT B



FCC:

5745 - 5825 MHz
802.11a Mode

Low Channel ANT A

Low Channel ANT B

Mid Channel ANT A

Mid Channel ANT B

High Channel ANT A

High Channel ANT B

802.11n20 Mode

Low Channel ANT A

Low Channel ANT B

Mid Channel ANT A

Mid Channel ANT B

High Channel ANT A

High Channel ANT B

802.11ac20 Mode

Low Channel ANT A

Low Channel ANT B

Mid Channel ANT A

Mid Channel ANT B

High Channel ANT A

High Channel ANT B

11 FCC §15.407(b) - Out of Band Emissions

11.1 Applicable Standards

According to FCC §15.407(b):

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.

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.

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.

For transmitters operating in the 5.725-5.85 GHz band: 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.

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.

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

11.2 Measurement Procedure

Add a correction factor (antenna gain+ Attenuator loss+cable loss) to the offset of the spectrum analyzer.

Unwanted Emission Measurement:

Maximum emission levels are measured by setting the analyzer as follows:

i. RBW = 1 MHz
ii. VBW ≥ 3 MHz
iii. Detector = Peak
iv. Sweep time = auto
v. Trace mode = max hold

Integration Method:

1. For peak emissions measurements, follow the procedures described in section H)5), “Procedures for Peak Unwanted Emissions Measurements above 1000 MHz”, except for the following changes:

- Set RBW = 100 kHz
- Set VBW = 3RBW
- Perform a band-power integration across the 1 MHz bandwidth in which the band-edge emission level is to be measured. CAUTION: You must ensure that the spectrum analyzer or EMI receiver is set for peak-detection and max-hold for this measurement.

2. For average emissions measurements, follow the procedures described in section H)6), “Procedures for Average Unwanted Emissions Measurements above 1000 MHz”, except for the following changes:

- Set RBW = 100 kHz

- Set VBW = 3RBW
- Perform a band-power integration across the 1 MHz bandwidth in which the band-edge emission level is to be measured.

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2019-06-26	18 Months
Agilent	Spectrum Analyzer	N9010A	MY48030852	2020-02-10	1 Year
Rohde & Schwarz	Spectrum Analyzer	FSQ26	200749	2019-11-07	2 Years
-	RF cable	-	-	Each time[1]	N/A
-	10 dB attenuator	-	-	Each time[1]	N/A

Note[1]: cable and attenuator included in the test set-up will be checked each time before testing.
Statement of Traceability: BACL Corp. *attests that all of the calibrations on the equipment items listed above were traceable to NIST or to another internationally recognized National Metrology Institute (NMI), and were compliant with A2LA Policy P102 (dated 02 October 2018) "A2LA Policy on Metrological Traceability".*

11.4 Test Environmental Conditions

Temperature:	22-24º C
Relative Humidity:	40-41 %
ATM Pressure:	103.1-104.1 kPa

The testing was performed by Christian McCaig from 2020-06-29 to 2020-07-02 in RF site.

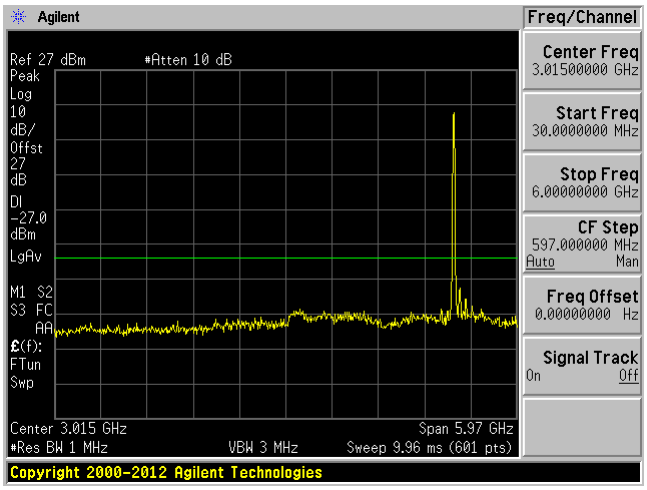
11.5 Test Results

Please refer to the following plots

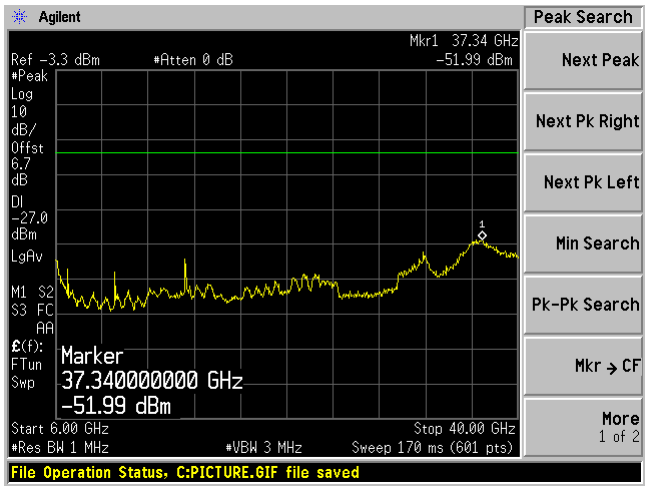
Spurious Emissions:
FCC:

5150 - 5250 MHz, 802.11a Mode, ANTENNA A

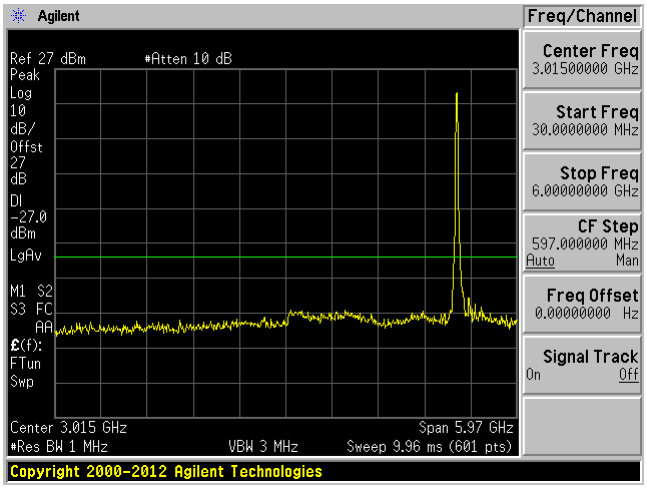
Low Channel 5180 MHz , 30MHz – 6GHz



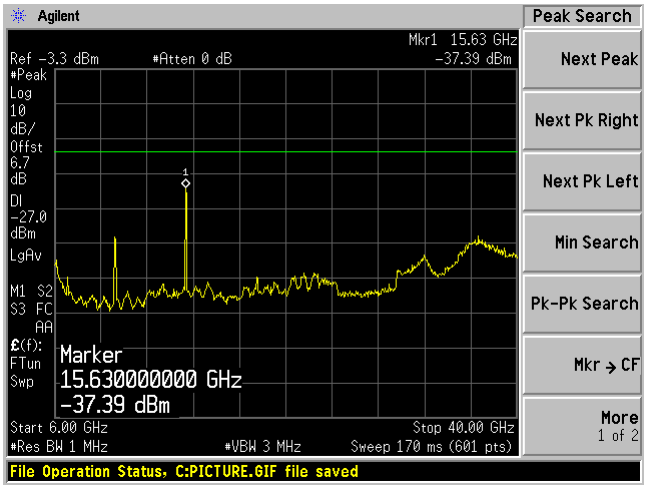
Low Channel 5180 MHz, 6GHz – 40GHz



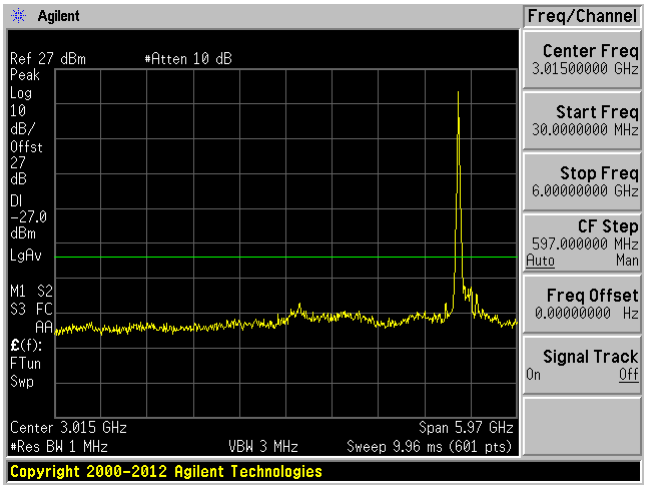
Mid Channel 5220 MHz , 30MHz – 6GHz



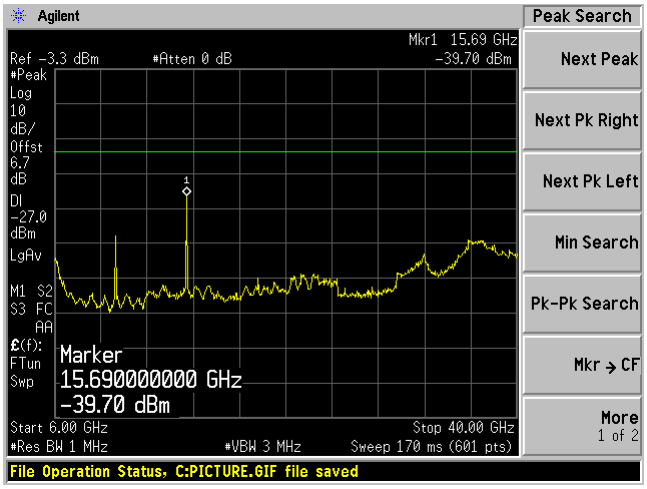
Mid Channel 5220 MHz, 6GHz – 40GHz



High Channel 5240 MHz , 30MHz – 6GHz

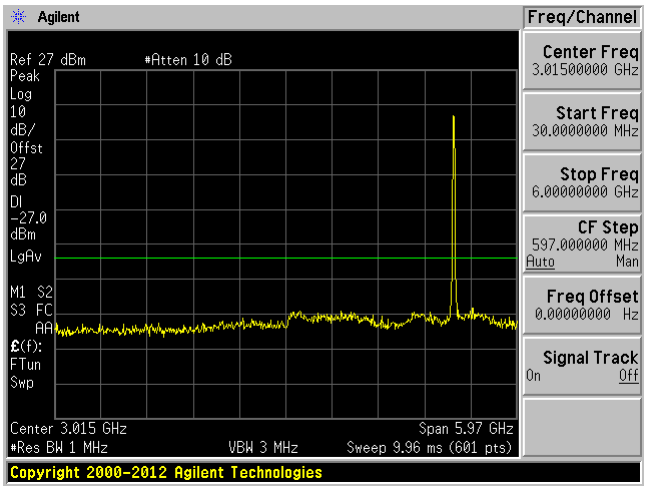


High Channel 5240 MHz, 6GHz – 40GHz

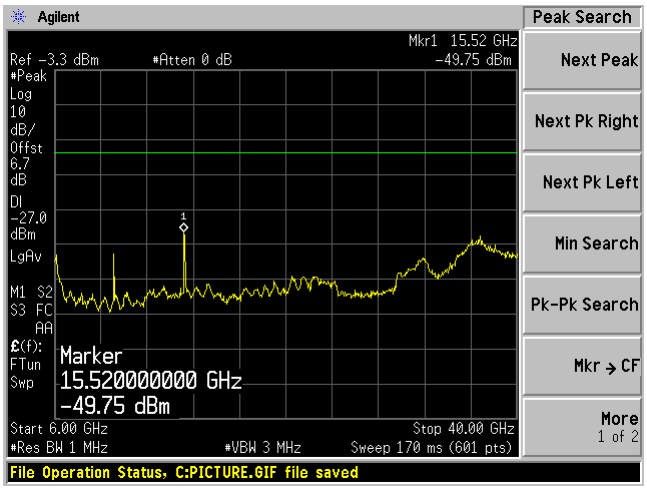


5150 - 5250 MHz, 802.11a Mode, ANTENNA B

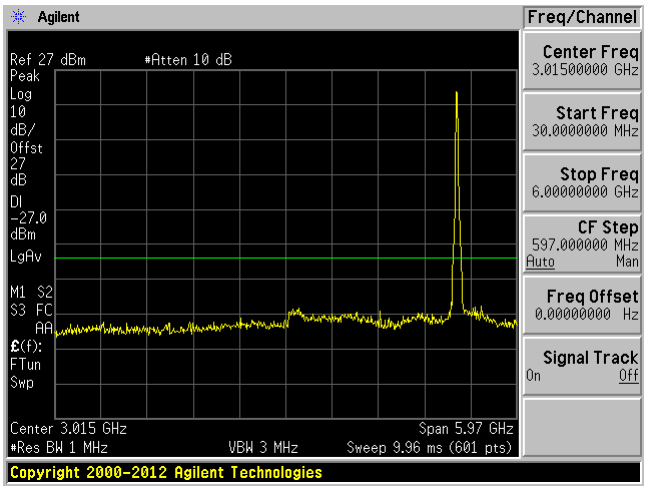
Low Channel 5180 MHz , 30MHz – 6GHz



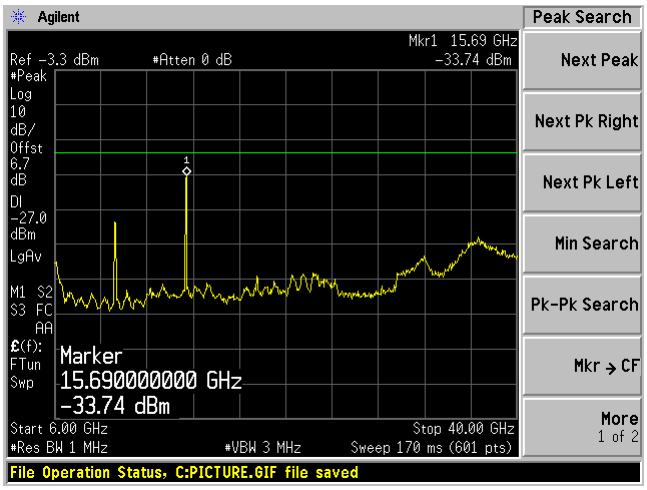
Low Channel 5180 MHz, 6GHz – 40GHz



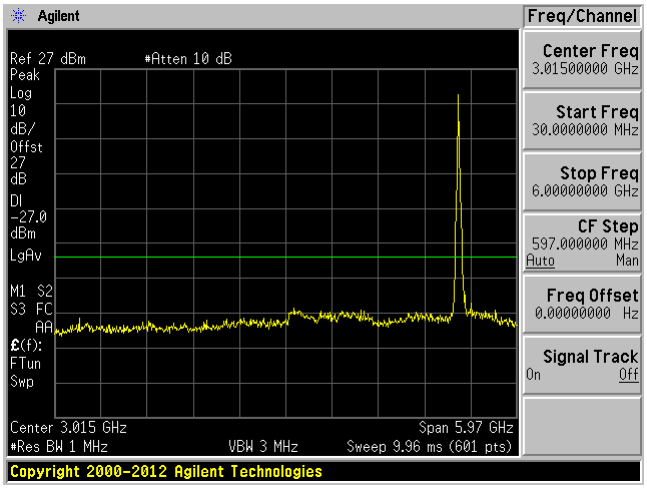
Mid Channel 5220 MHz , 30MHz – 6GHz



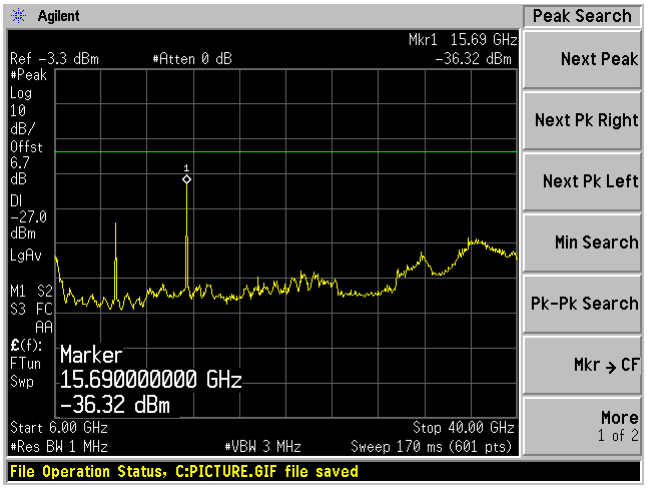
Mid Channel 5220 MHz, 6GHz – 40GHz



High Channel 5240 MHz , 30MHz – 6GHz

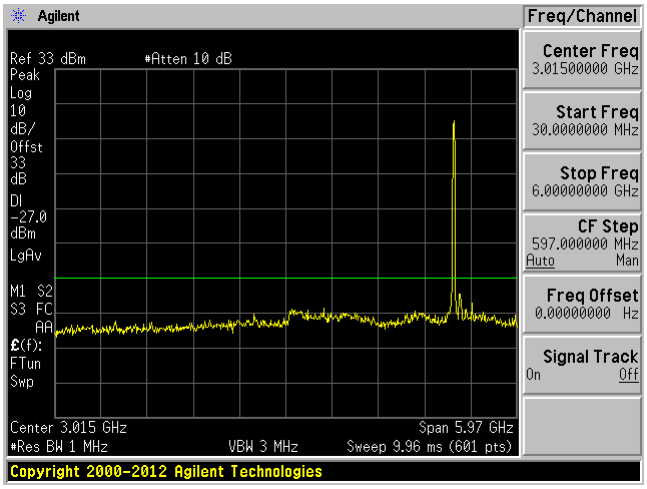


High Channel 5240 MHz, 6GHz – 40GHz

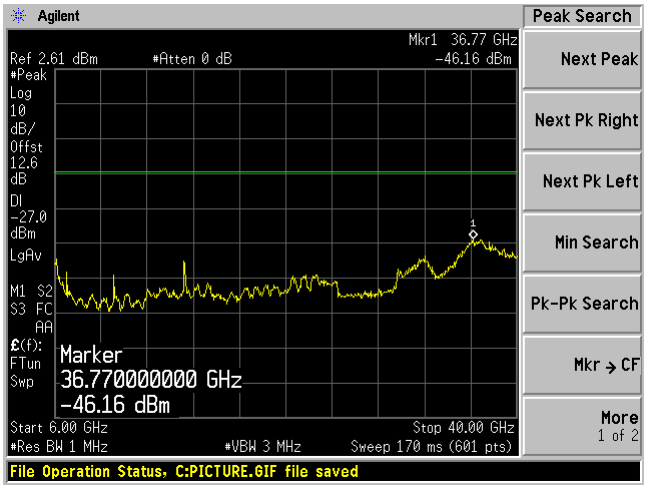


5150 - 5250 MHz, 802.11n20 Mode, ANTENNA A

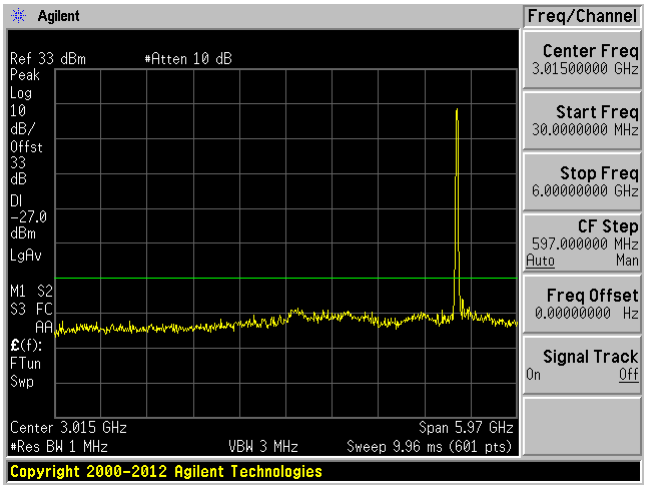
Low Channel 5180 MHz , 30MHz – 6GHz



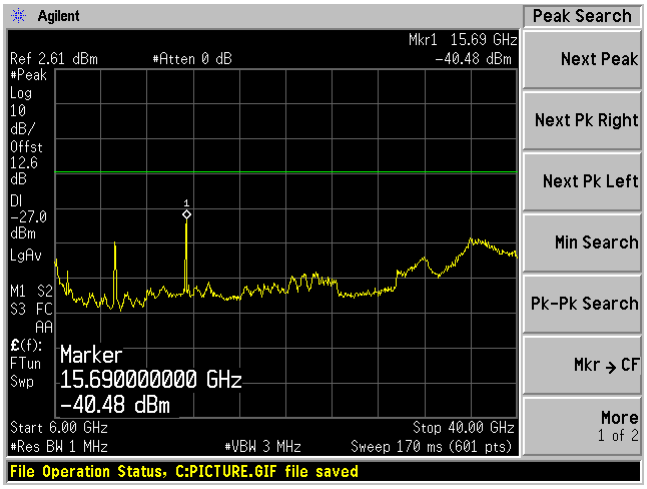
Low Channel 5180 MHz, 6GHz – 40GHz



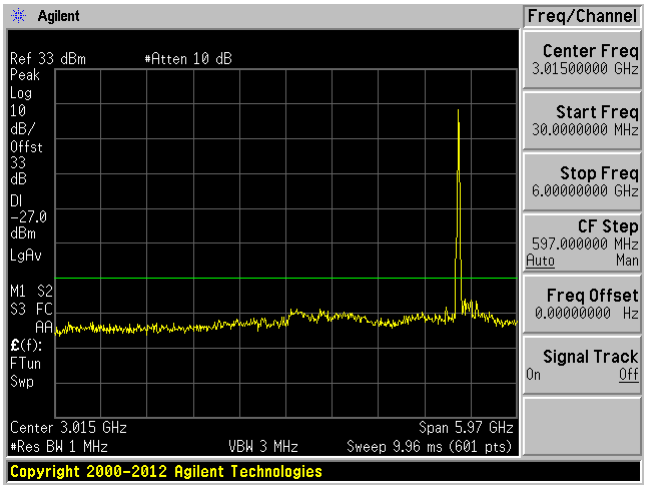
Mid Channel 5220 MHz , 30MHz – 6GHz



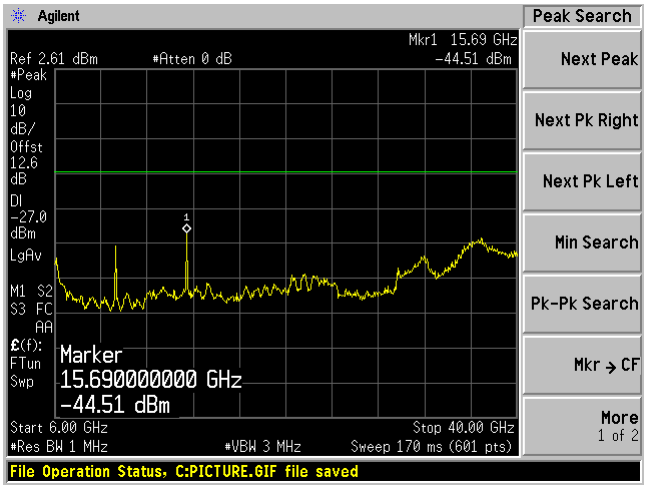
Mid Channel 5220 MHz, 6GHz – 40GHz



High Channel 5240 MHz , 30MHz – 6GHz

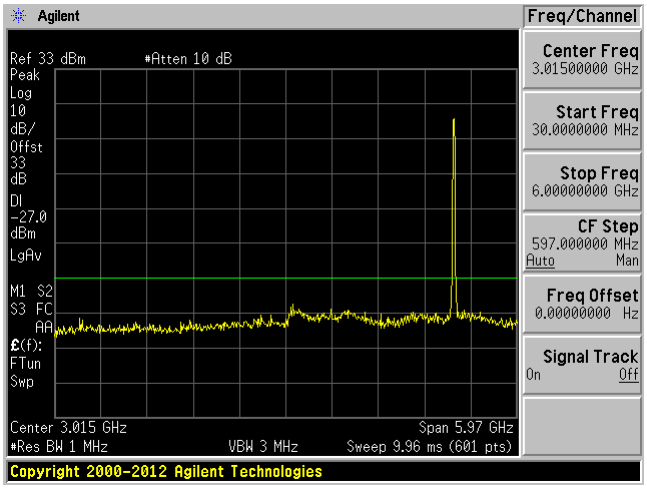


High Channel 5240 MHz, 6GHz – 40GHz

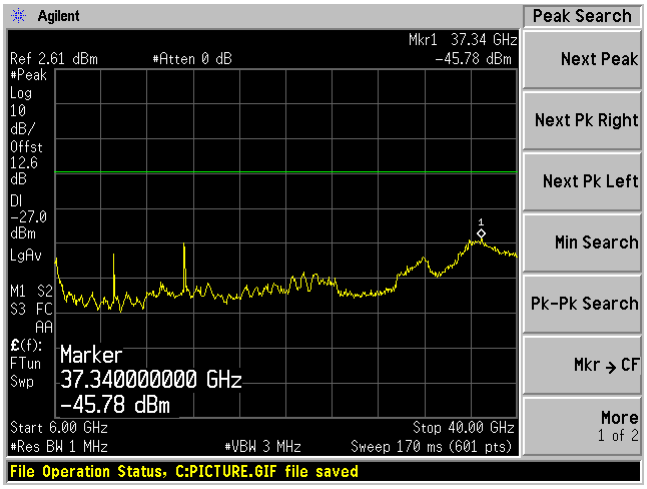


5150 - 5250 MHz, 802.11n20 Mode, ANTENNA B

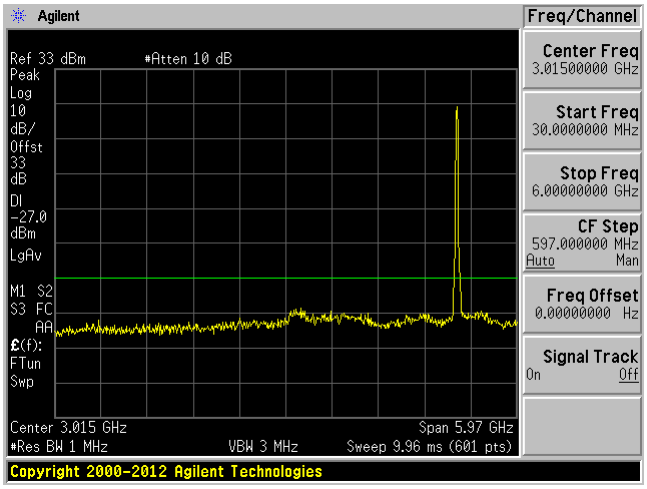
Low Channel 5180 MHz , 30MHz – 6GHz



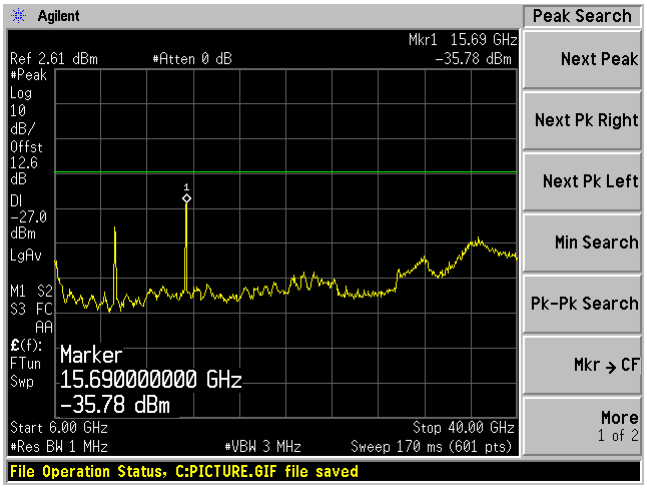
Low Channel 5180 MHz, 6GHz – 40GHz



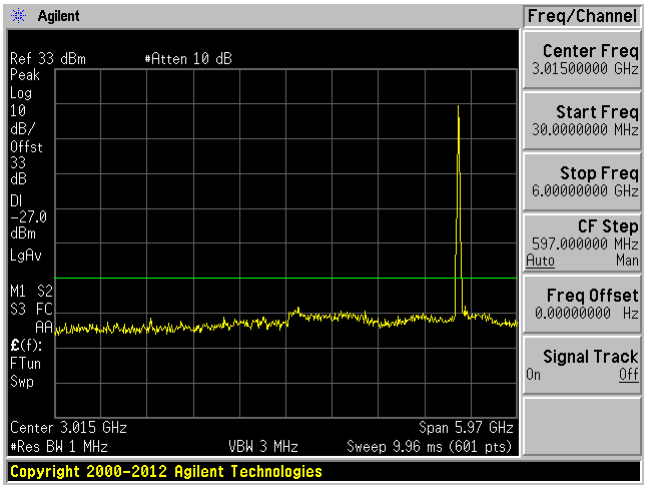
Mid Channel 5220 MHz , 30MHz – 6GHz



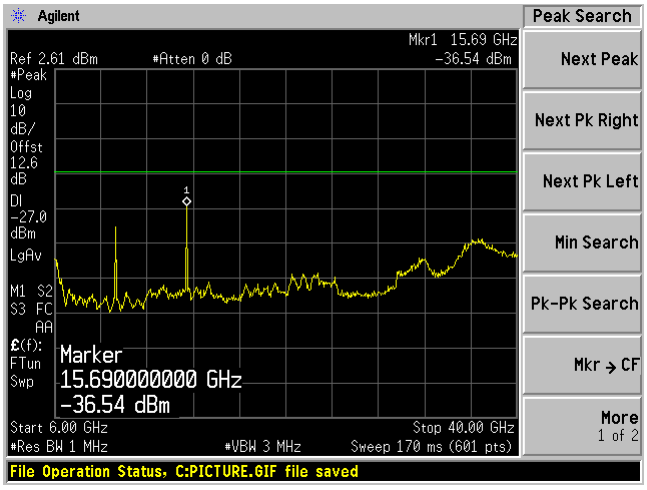
Mid Channel 5220 MHz, 6GHz – 40GHz



High Channel 5240 MHz , 30MHz – 6GHz

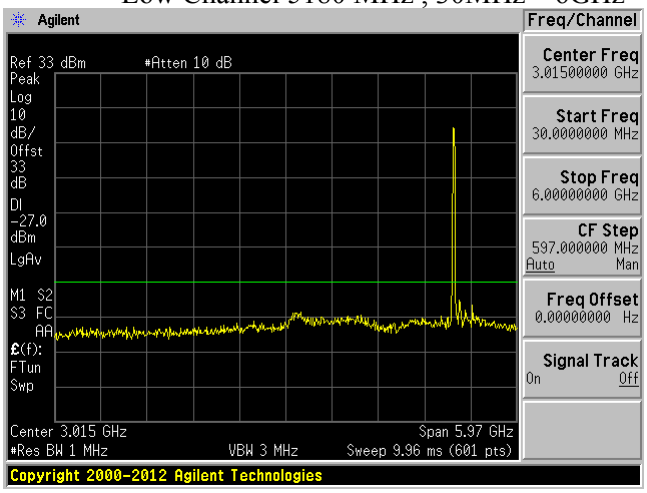


High Channel 5240 MHz, 6GHz – 40GHz

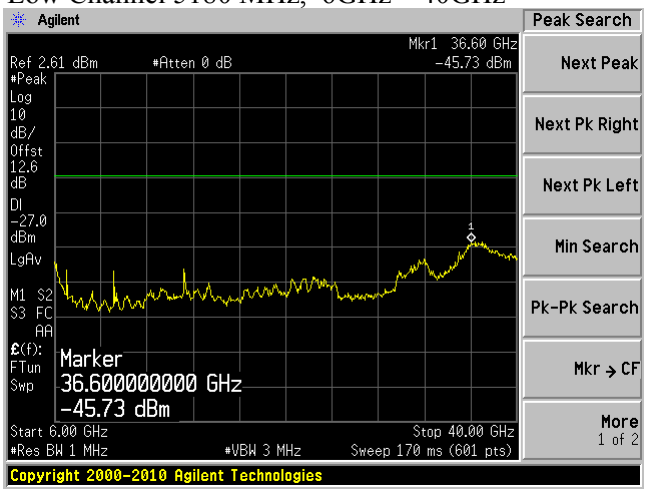


5150 - 5250 MHz, 802.11ac20 Mode, ANTENNA A

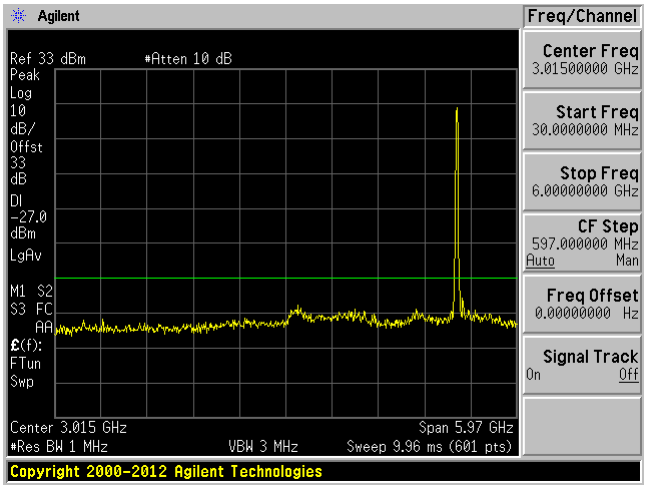
Low Channel 5180 MHz , 30MHz – 6GHz



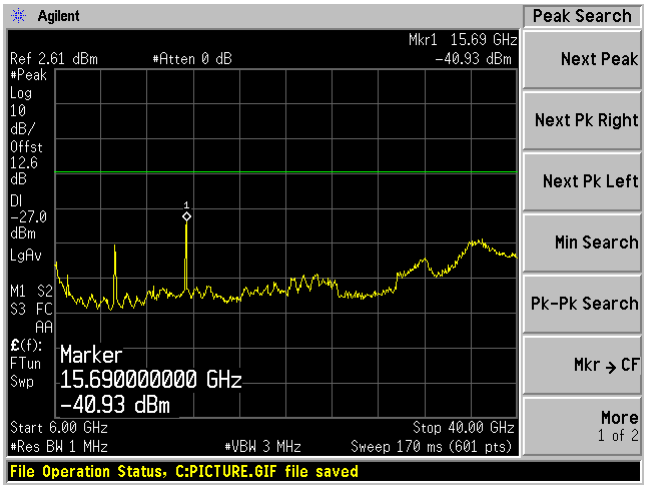
Low Channel 5180 MHz, 6GHz – 40GHz



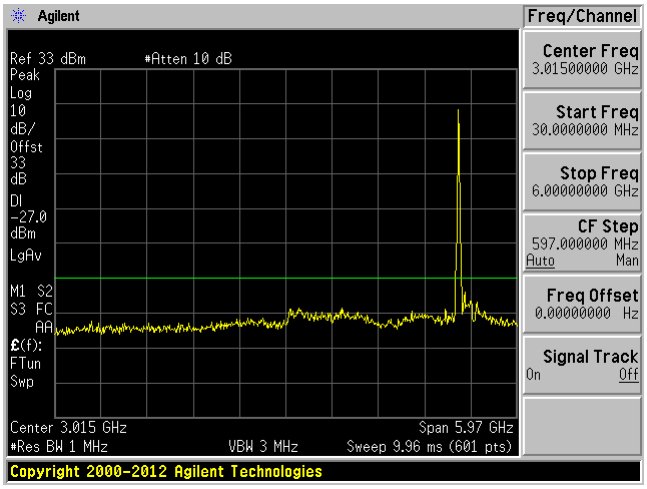
Mid Channel 5220 MHz , 30MHz – 6GHz



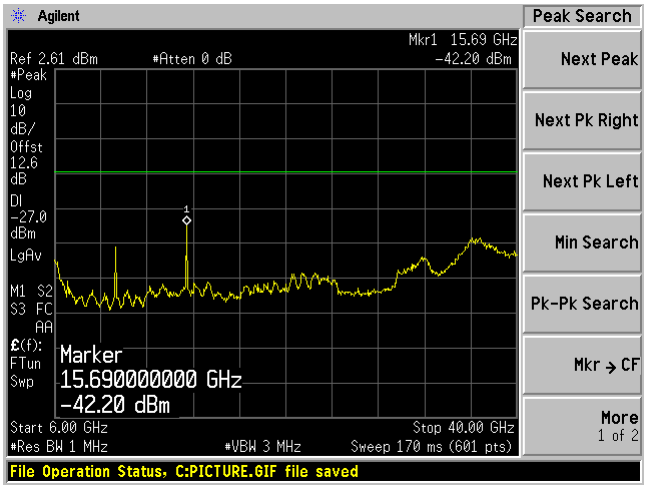
Mid Channel 5220 MHz, 6GHz – 40GHz



High Channel 5240 MHz , 30MHz – 6GHz

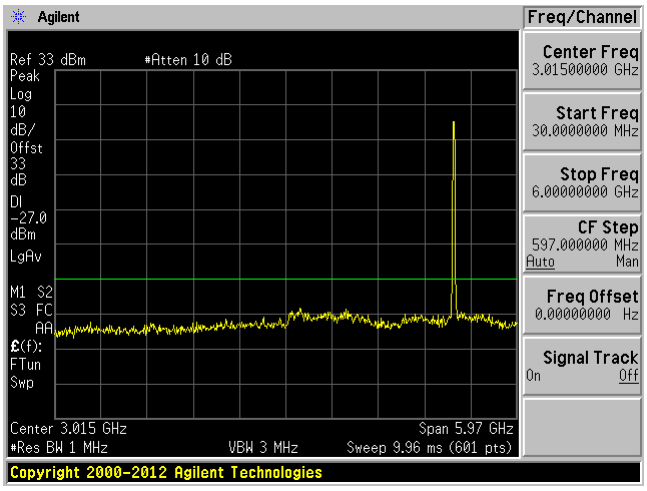


High Channel 5240 MHz, 6GHz – 40GHz

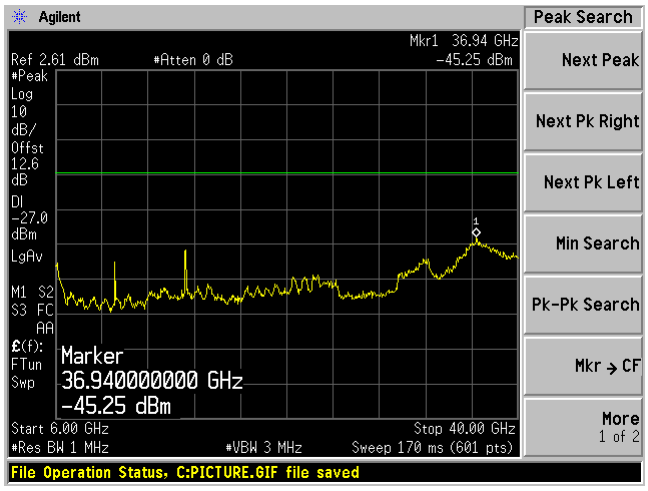


5150 - 5250 MHz, 802.11ac20 Mode, ANTENNA B

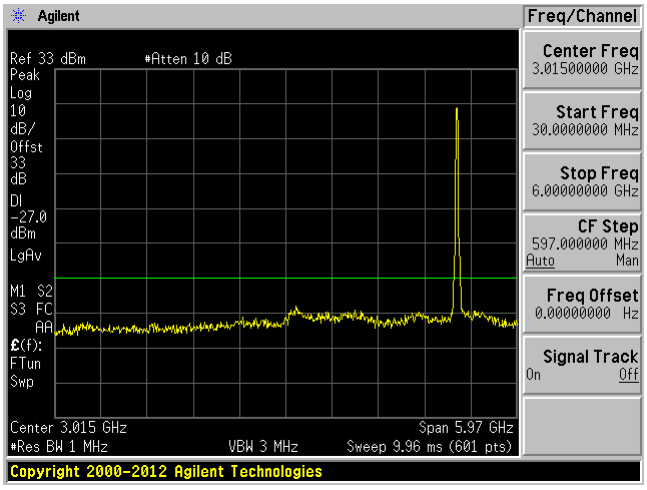
Low Channel 5180 MHz , 30MHz – 6GHz



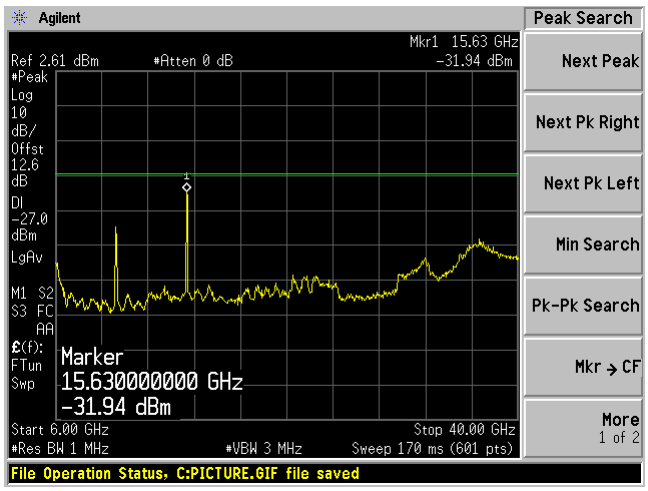
Low Channel 5180 MHz, 6GHz – 40GHz



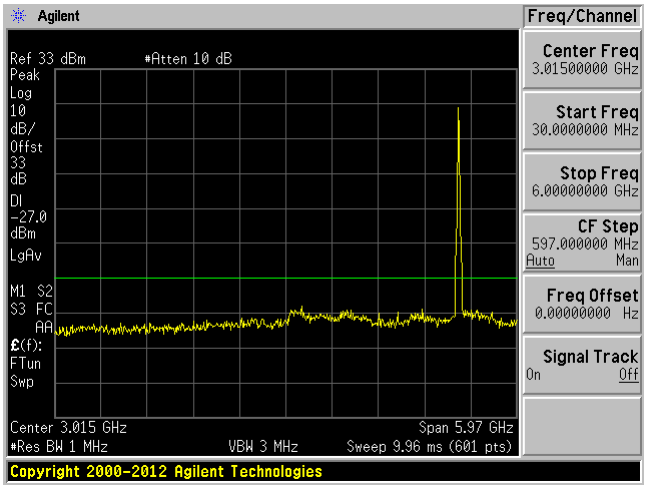
Mid Channel 5220 MHz , 30MHz – 6GHz



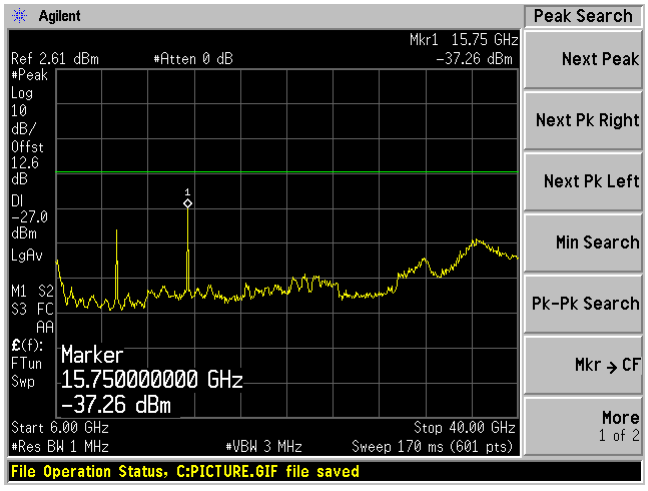
Mid Channel 5220 MHz, 6GHz – 40GHz



High Channel 5240 MHz , 30MHz – 6GHz



High Channel 5240 MHz, 6GHz – 40GHz

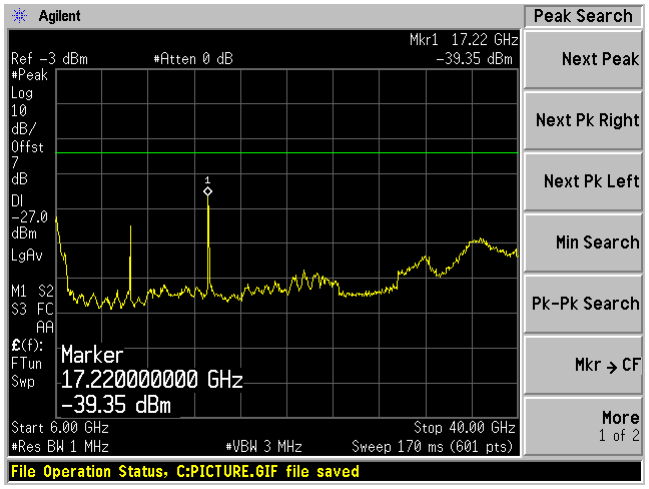


FCC:

5725 - 5850 MHz, 802.11a Mode, ANTENNA A

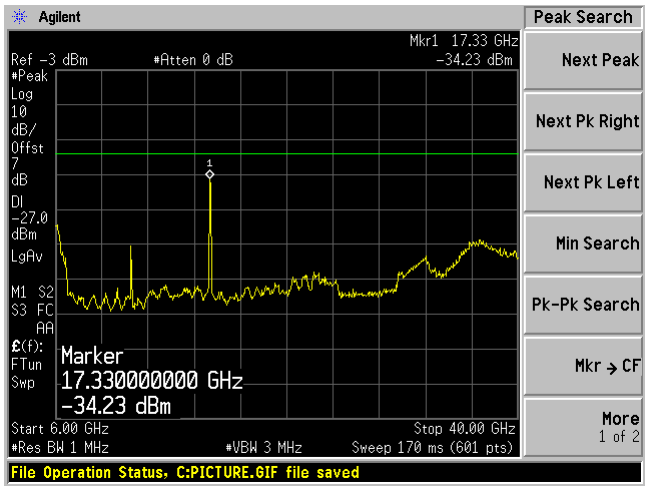
Low Channel 5745 MHz , 30MHz – 6GHz

Low Channel 5745 MHz, 6GHz – 40GHz



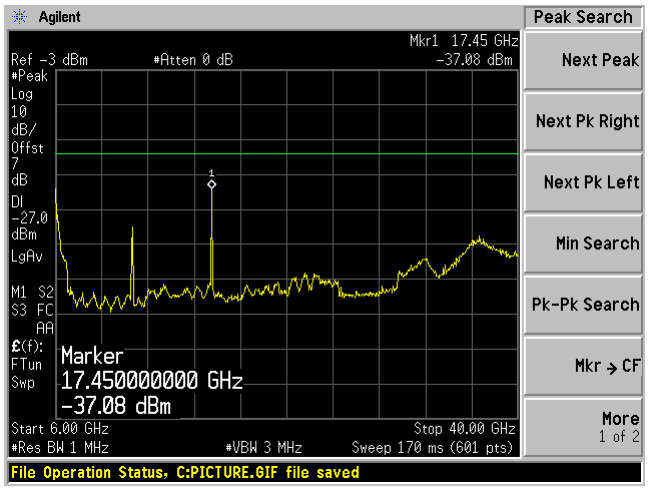
Mid Channel 5785 MHz , 30MHz – 6GHz

Mid Channel 5785 MHz, 6GHz – 40GHz



High Channel 5825 MHz , 30MHz – 6GHz

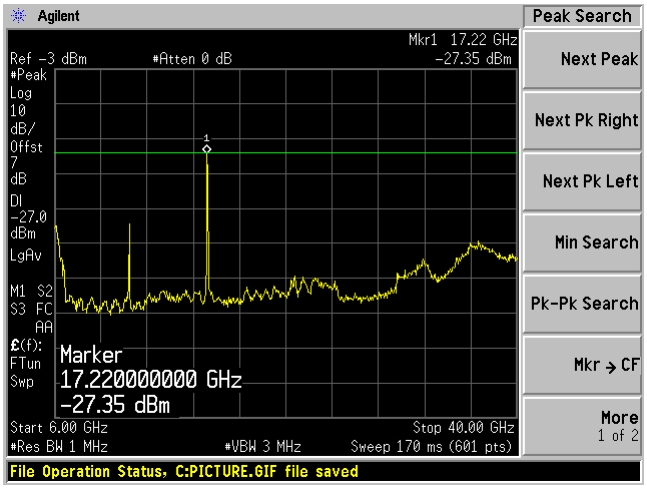
High Channel 5825 MHz, 6GHz – 40GHz



5725 - 5850 MHz, 802.11a Mode, ANTENNA B

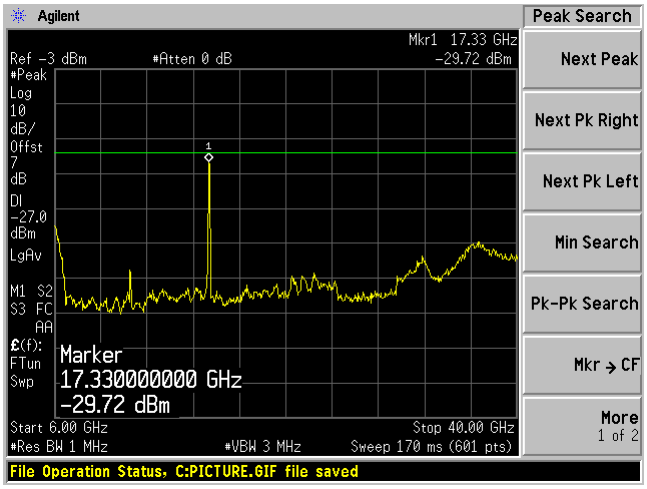
Low Channel 5745 MHz , 30MHz – 6GHz

Low Channel 5745 MHz, 6GHz – 40GHz



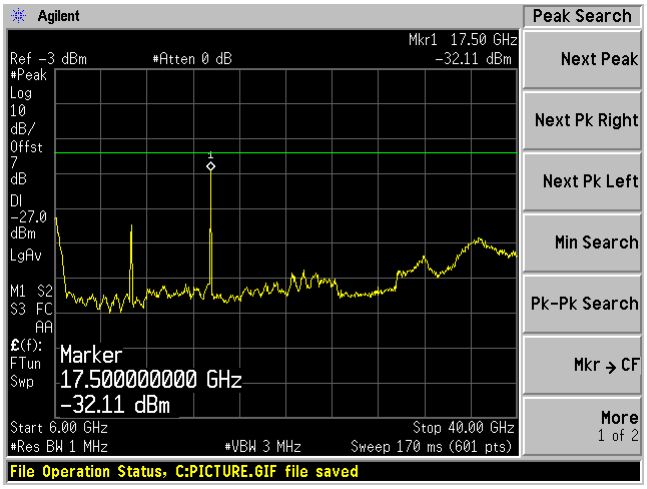
Mid Channel 5785 MHz , 30MHz – 6GHz

Mid Channel 5785 MHz, 6GHz – 40GHz



High Channel 5825 MHz , 30MHz – 6GHz

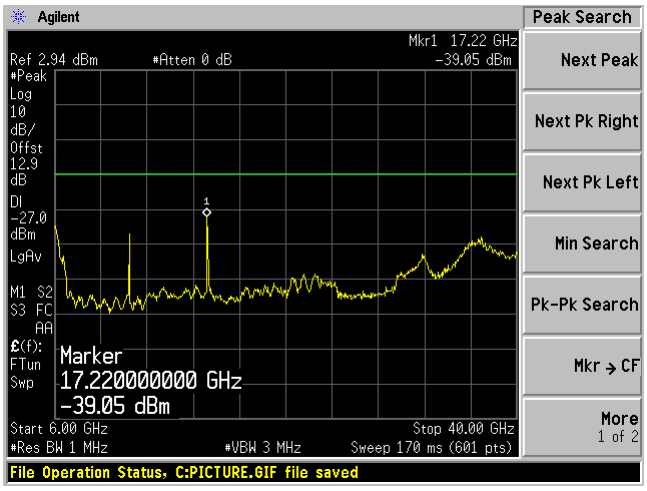
High Channel 5825 MHz, 6GHz – 40GHz



5725 – 5850 MHz, 802.11n20 Mode, ANTENNA A

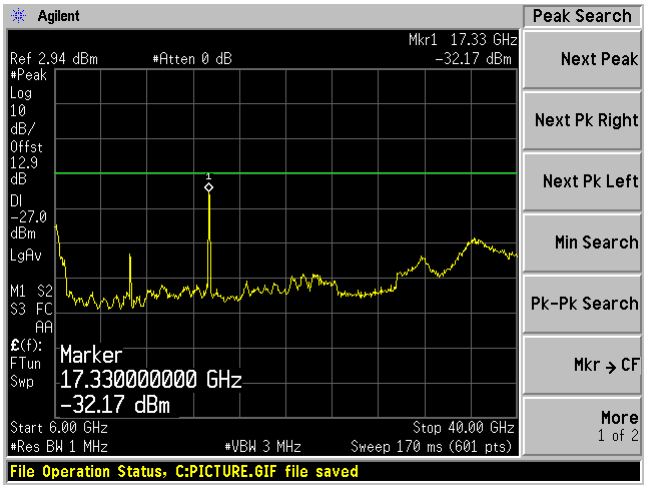
Low Channel 5745 MHz , 30MHz – 6GHz

Low Channel 5745 MHz, 6GHz – 40GHz



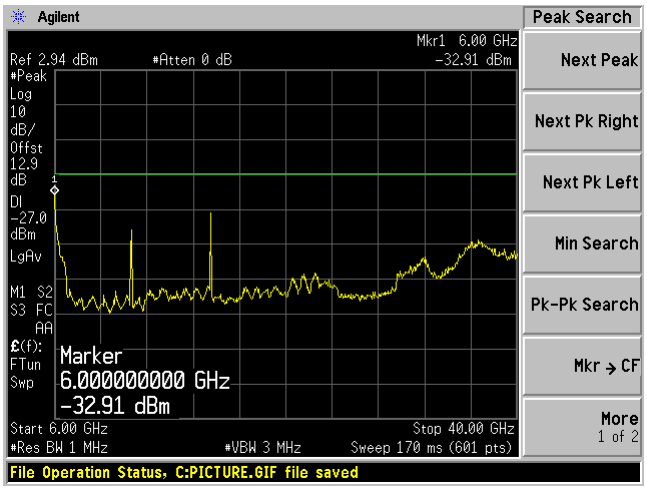
Mid Channel 5785 MHz , 30MHz – 6GHz

Mid Channel 5785 MHz, 6GHz – 40GHz



High Channel 5825 MHz , 30MHz – 6GHz

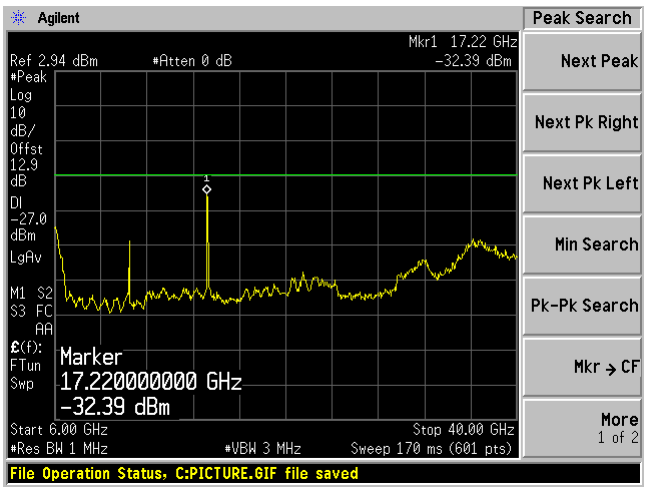
High Channel 5825 MHz, 6GHz – 40GHz



5725 – 5850 MHz, 802.11n20 Mode, ANTENNA B

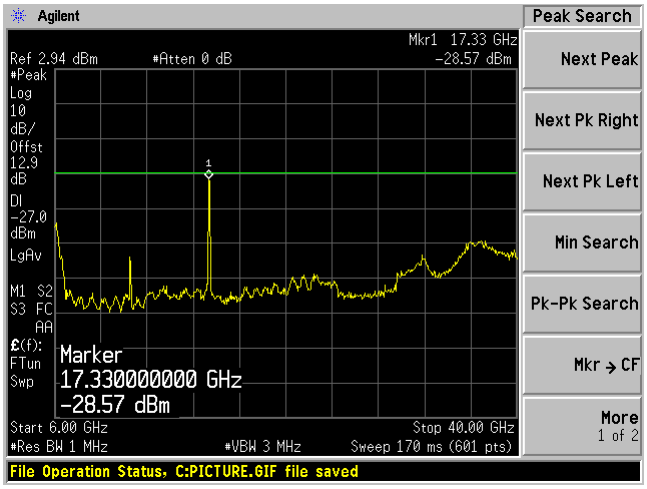
Low Channel 5745 MHz , 30MHz – 6GHz

Low Channel 5745 MHz, 6GHz – 40GHz



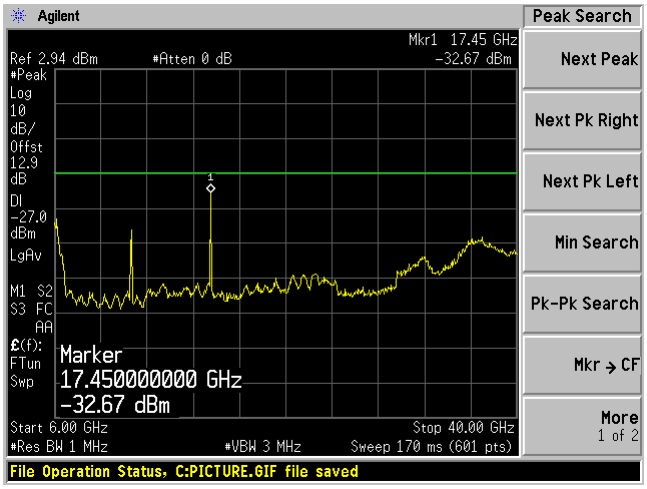
Mid Channel 5785 MHz , 30MHz – 6GHz

Mid Channel 5785 MHz, 6GHz – 40GHz



High Channel 5825 MHz , 30MHz – 6GHz

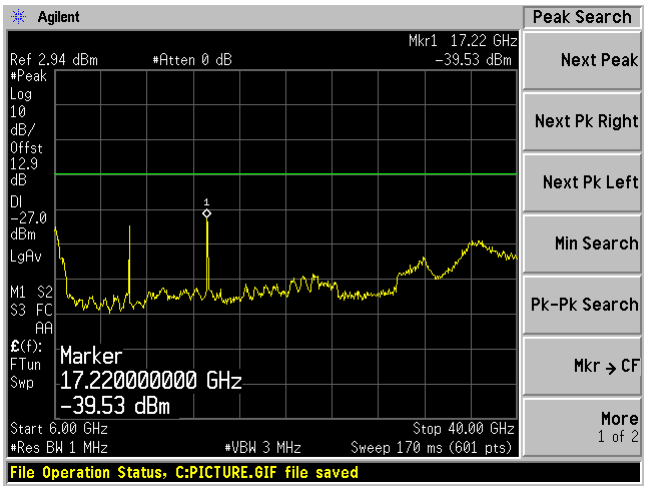
High Channel 5825 MHz, 6GHz – 40GHz



5725 – 5850 MHz, 802.11ac20 Mode, ANTENNA A

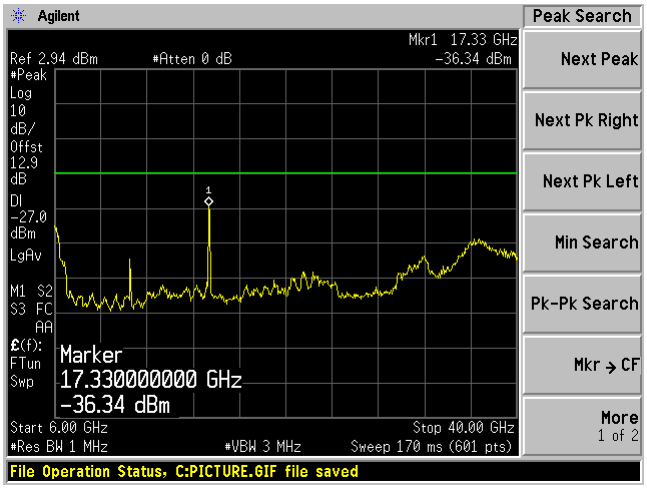
Low Channel 5745 MHz , 30MHz – 6GHz

Low Channel 5745 MHz, 6GHz – 40GHz



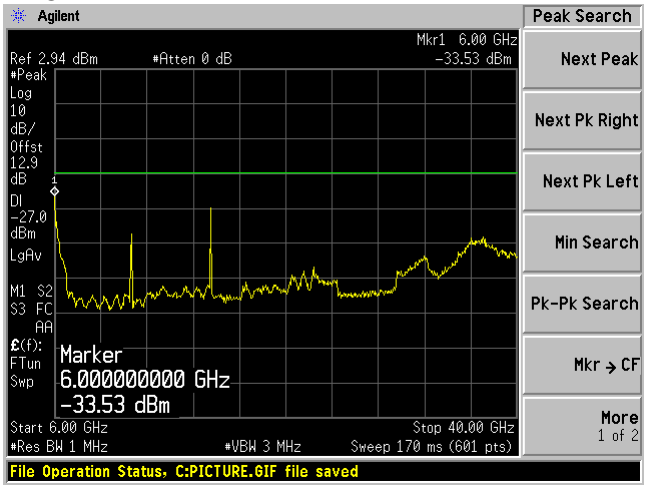
Mid Channel 5785 MHz , 30MHz – 6GHz

Mid Channel 5785 MHz, 6GHz – 40GHz



High Channel 5825 MHz , 30MHz – 6GHz

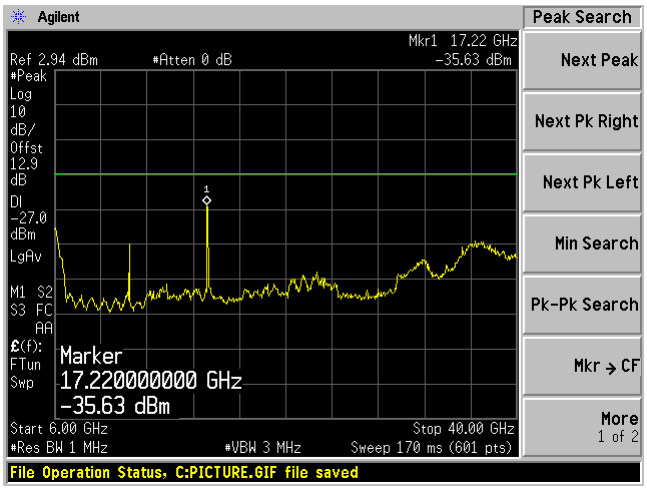
High Channel 5825 MHz, 6GHz – 40GHz



5725 – 5850 MHz, 802.11ac20 Mode, ANTENNA B

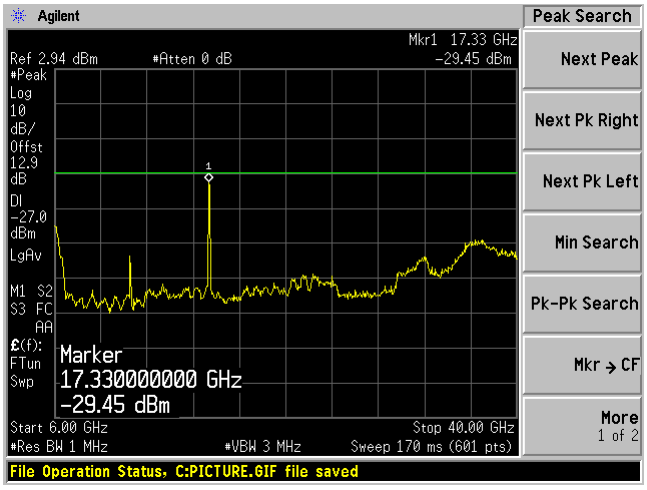
Low Channel 5745 MHz , 30MHz – 6GHz

Low Channel 5745 MHz, 6GHz – 40GHz



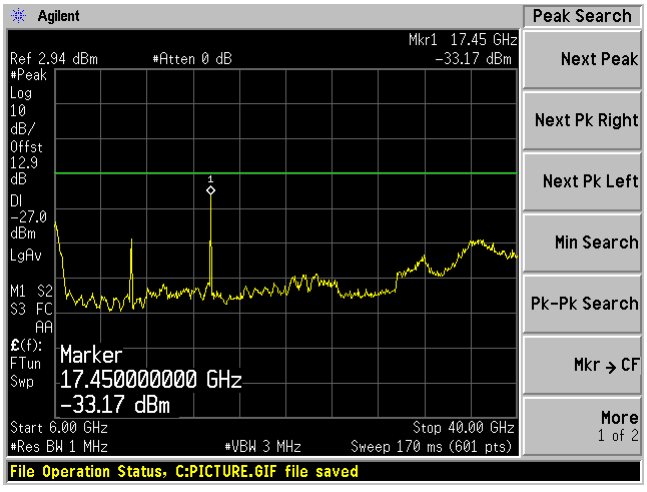
Mid Channel 5785 MHz , 30MHz – 6GHz

Mid Channel 5785 MHz, 6GHz – 40GHz



High Channel 5825 MHz , 30MHz – 6GHz

High Channel 5825 MHz, 6GHz – 40GHz

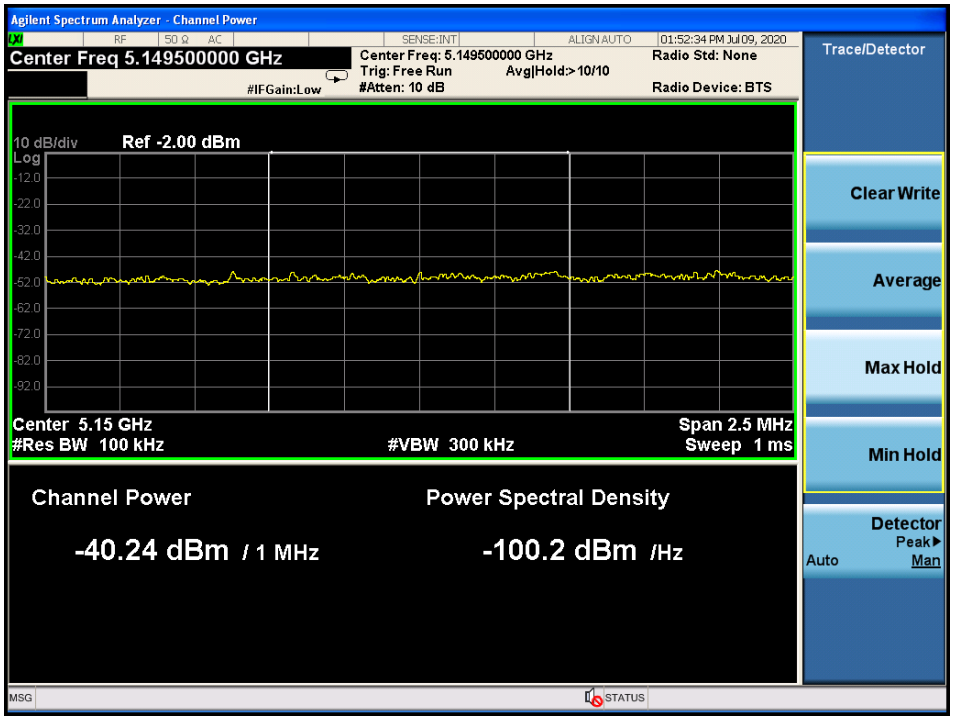


Band Edge Emissions

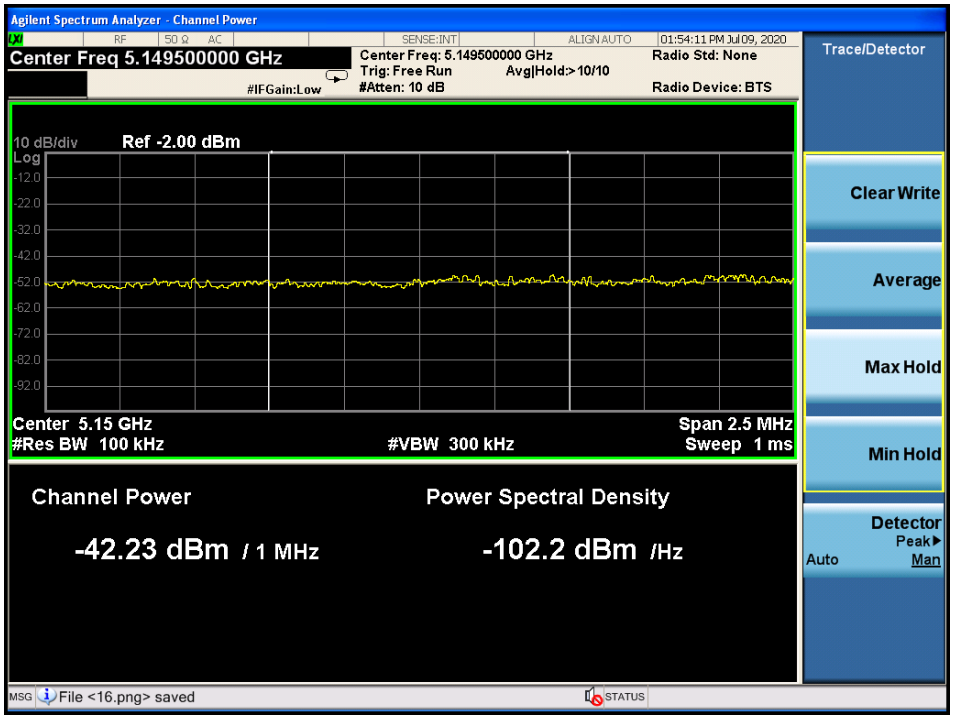
FCC:

5150 - 5250 MHz, 802.11a Mode

Ant A, Low Channel

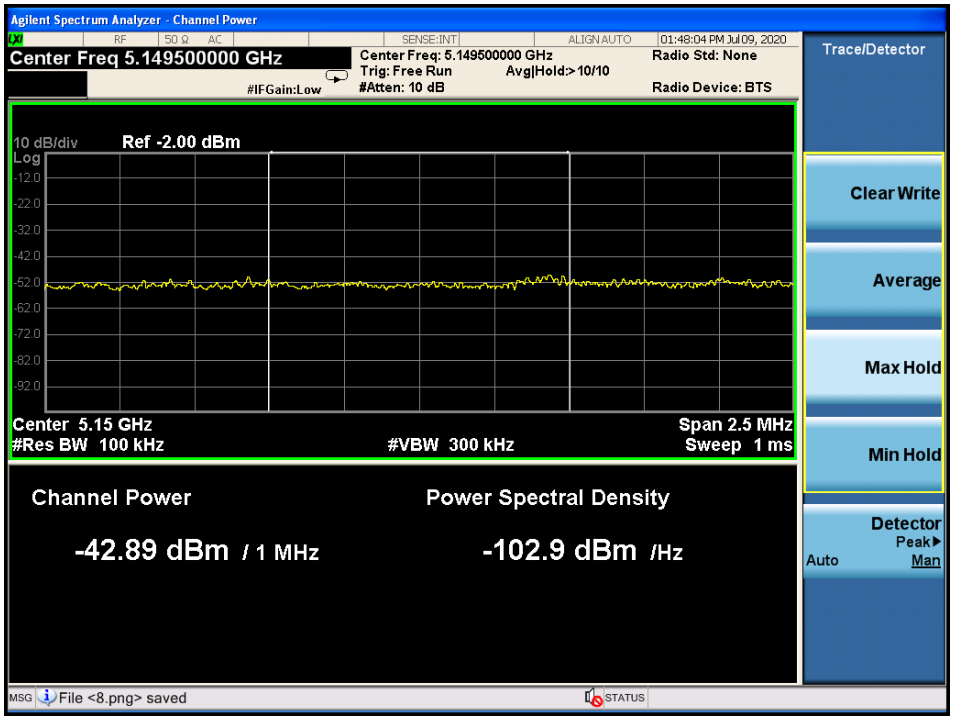


Ant B, Low Channel

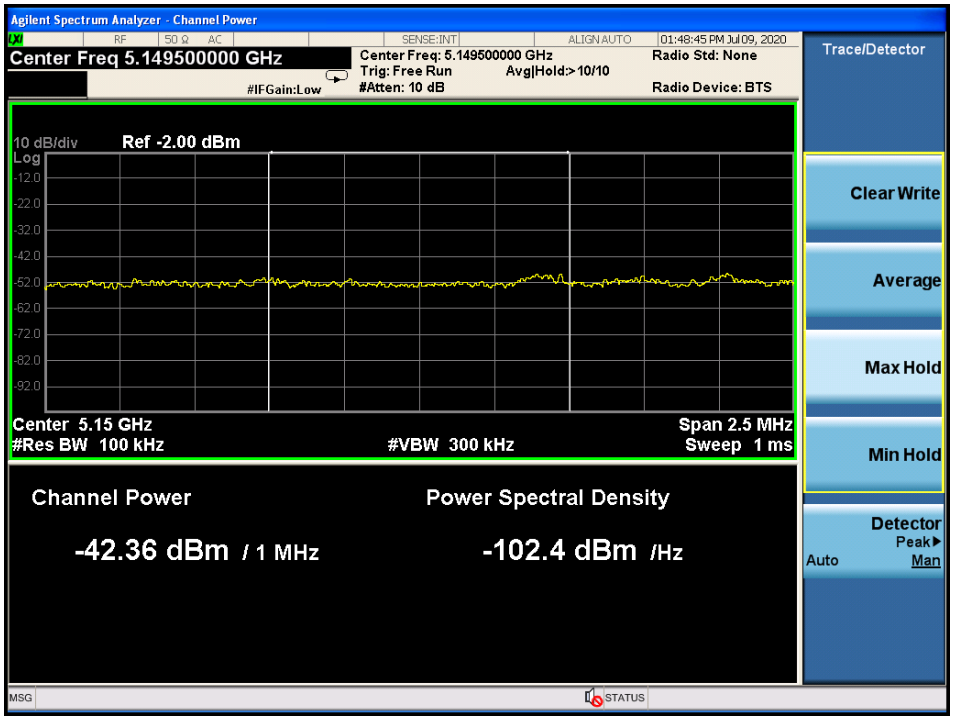


5150 - 5250 MHz, 802.11n20 Mode

Ant A, Low Channel

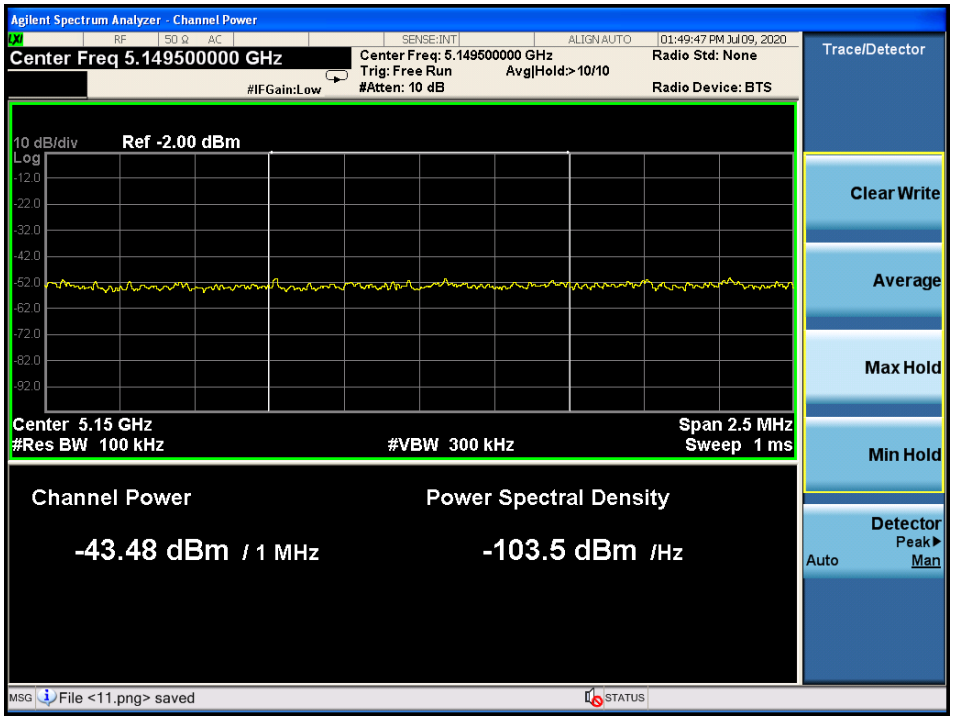


Ant B, Low Channel

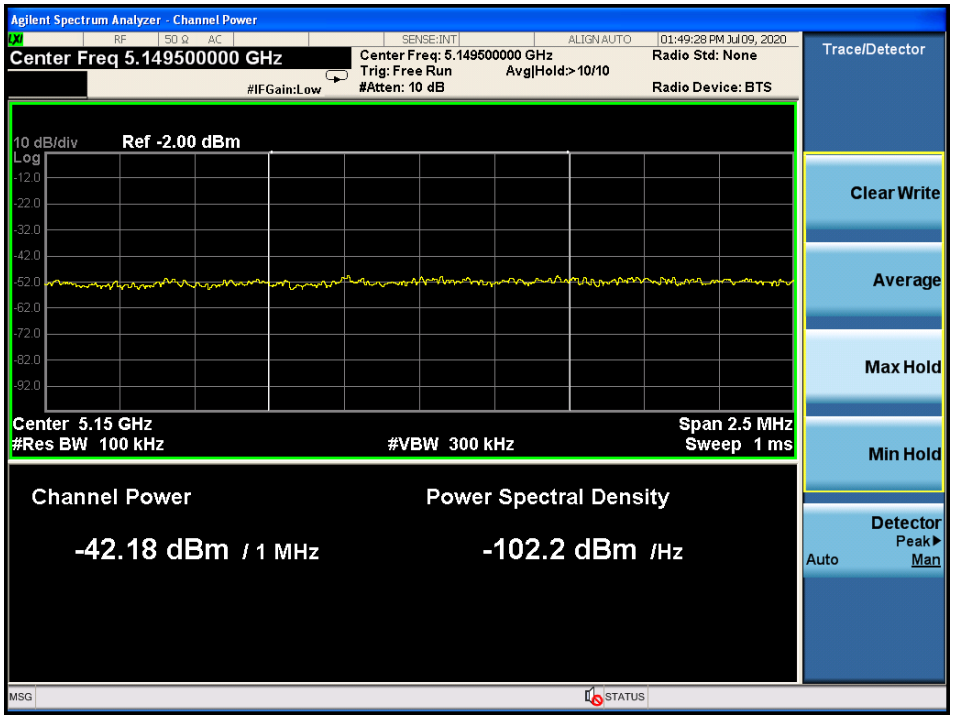


5150 - 5250 MHz, 802.11ac20 Mode

Ant A, Low Channel



Ant B, Low Channel

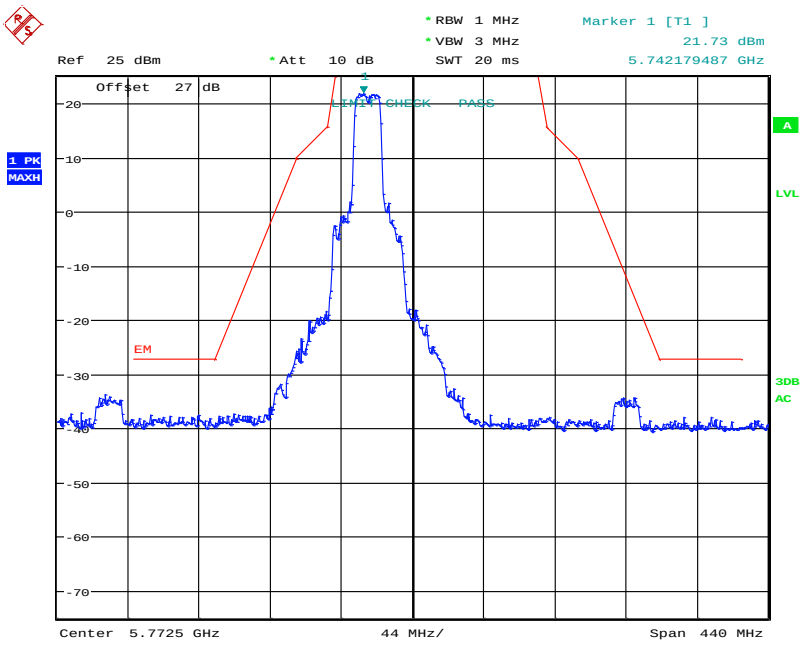


Emission Mask

FCC:

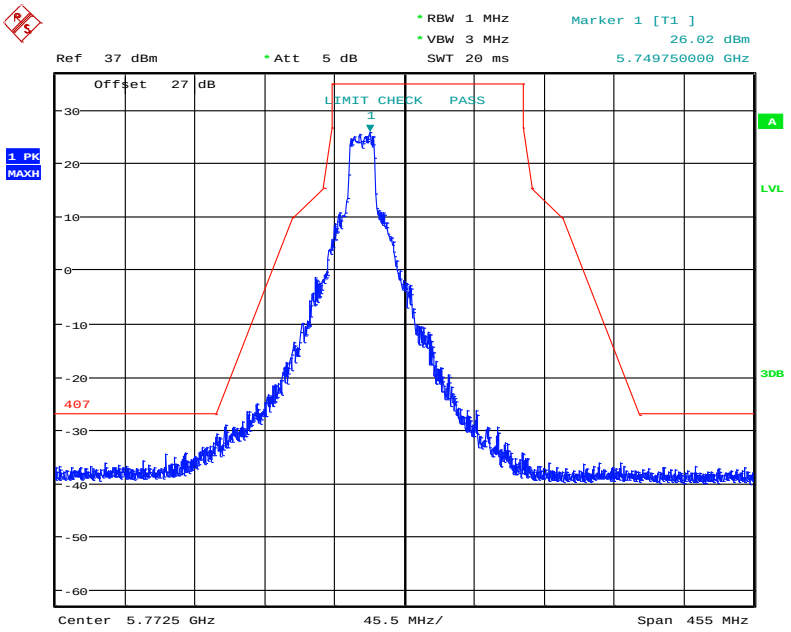
5725 - 5850 MHz, 802.11a Mode

Low Channel ANT A



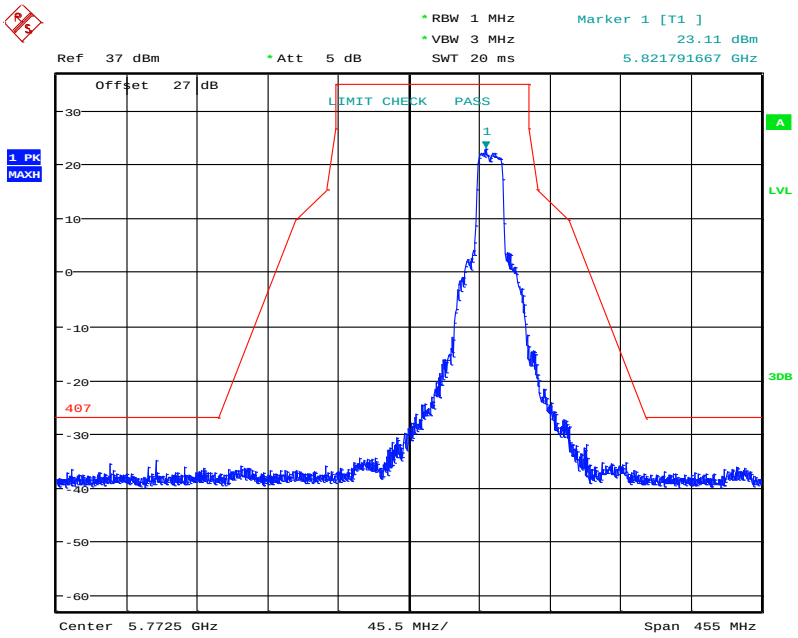
Date: 10.JUL.2020 01:48:42

Low Channel ANT B



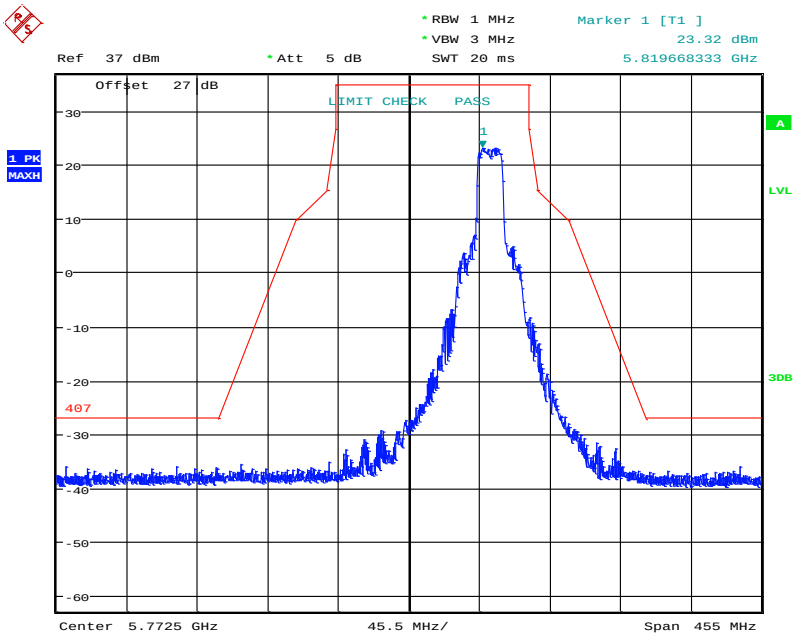
Date: 5.JAN.2003 04:38:04

High Channel ANT A



Date: 5.JAN.2003 04:35:03

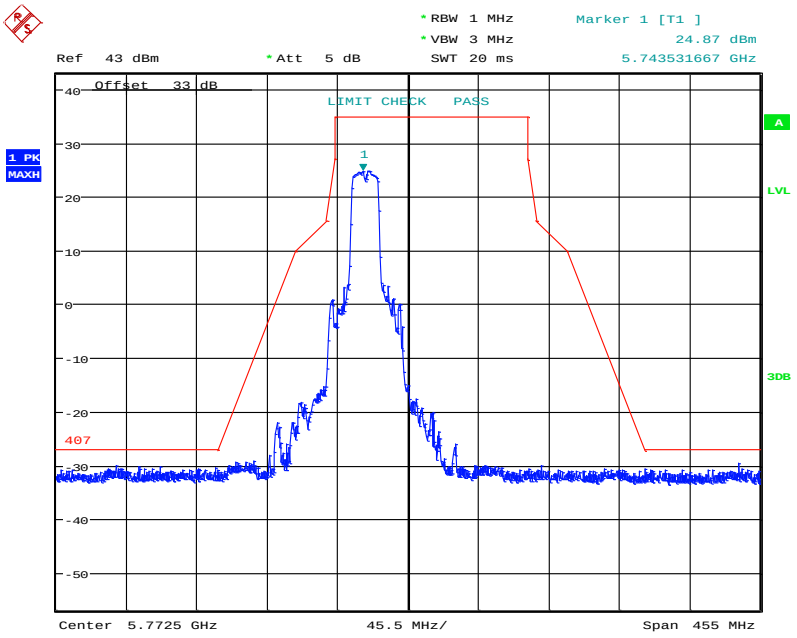
High Channel ANT B



Date: 5.JAN.2003 04:36:53

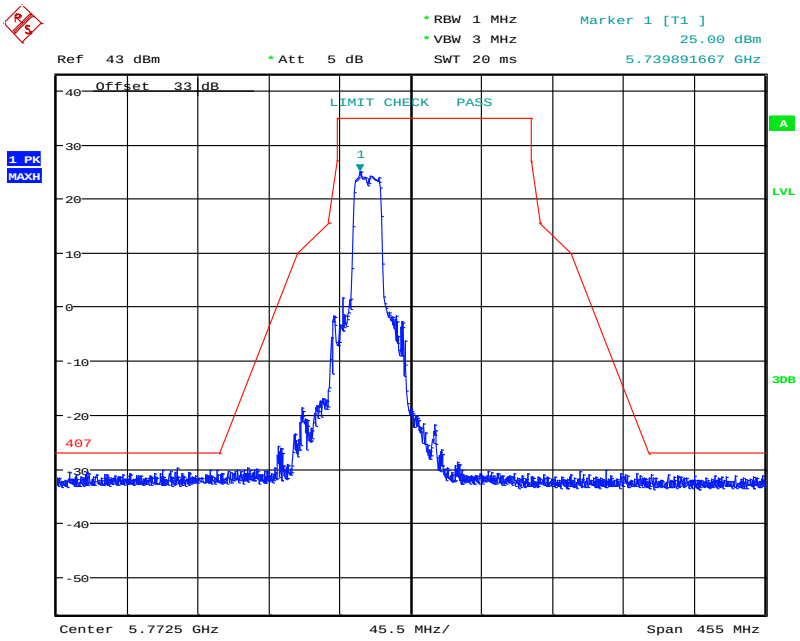
5725 - 5850 MHz, 802.11n20 Mode

Low Channel ANT A



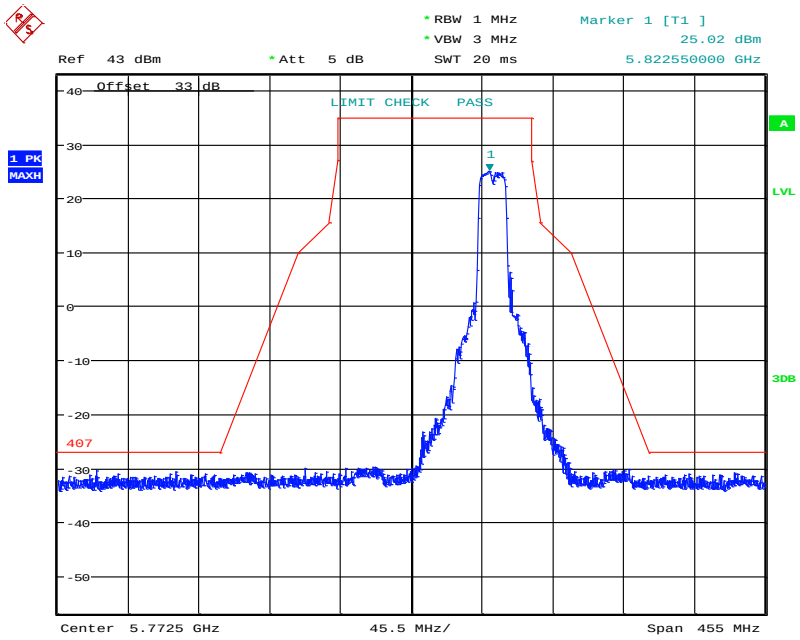
Date: 5.JAN.2003 04:18:21

Low Channel ANT B



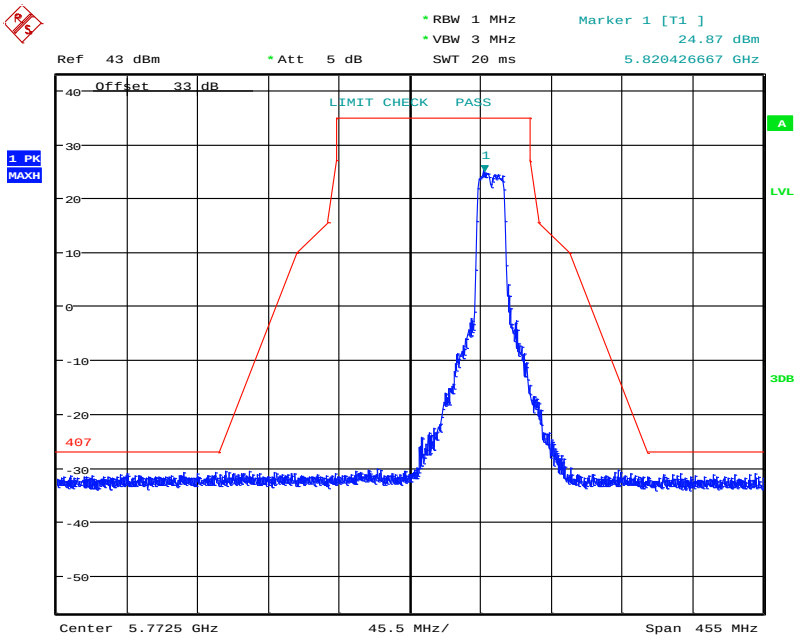
Date: 5.JAN.2003 04:20:25

High Channel ANT A



Date: 5.JAN.2003 04:22:47

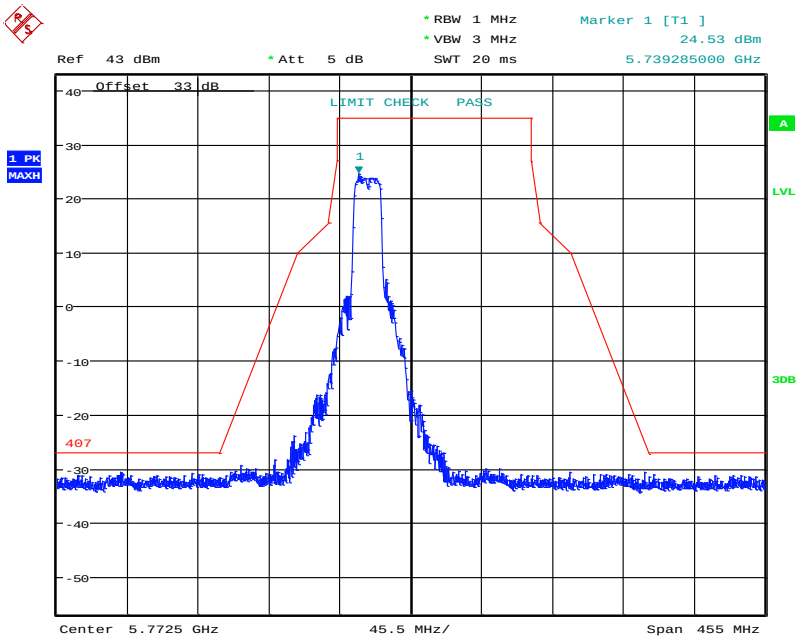
High Channel ANT B



Date: 5.JAN.2003 04:21:54

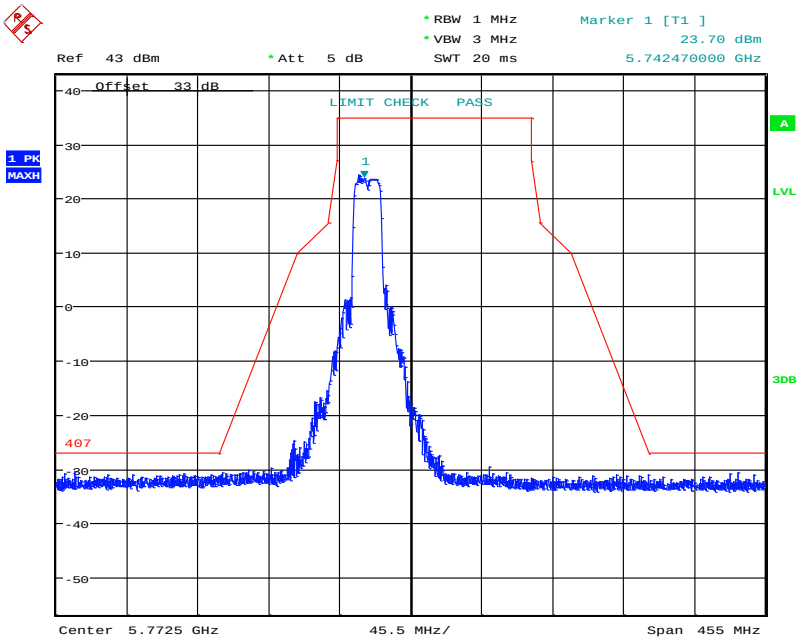
5725 - 5850 MHz, 802.11ac20 Mode

Low Channel ANT A



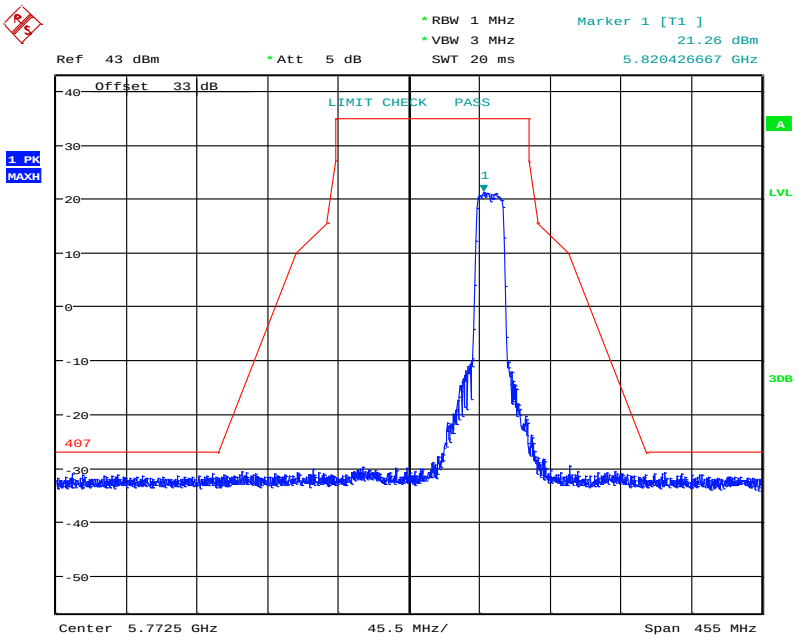
Date: 5.JAN.2003 04:30:59

Low Channel ANT B



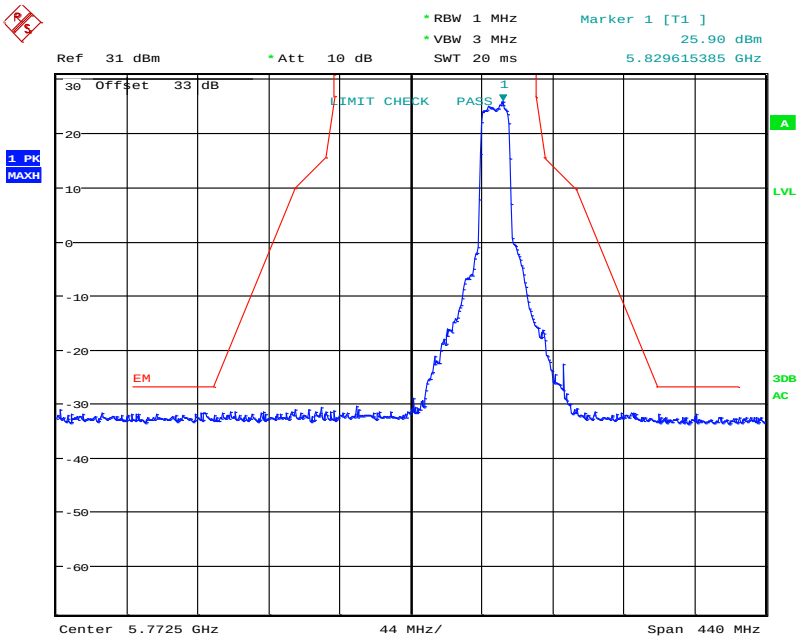
Date: 5.JAN.2003 04:28:15

High Channel ANT A



Date: 5.JAN.2003 04:26:15

High Channel ANT B



Date: 10.JUL.2020 01:46:47

12 Annex A (Normative) – EUT Test Setup Photographs

Please refer to the attachment.

13 Annex B (Normative) – EUT External Photographs

Please refer to the attachment.

14 Annex C (Normative) – EUT Internal Photographs

Please refer to the attachment.

15 Annex D (Normative) - A2LA Electrical Testing Certificate

Accredited Laboratory

A2LA has accredited

BAY AREA COMPLIANCE LABORATORIES CORP.

Sunnyvale, CA

for technical competence in the field of

Electrical Testing

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*. This laboratory also meets A2LA R222 - *Specific Requirements EPA ENERGY STAR Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 2nd day of October 2018.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2020
Revised June 5, 2019

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

Please follow the web link below for a full ISO 17025 scope

https://www.a2la.org/scopepdf/3297-02.pdf

--- END OF REPORT ---