FCC PART 15.407
ISEDC RSS-247, ISSUE 2, FEBRUARY 2017

TEST REPORT

For

Roku, Inc.

1155 Coleman Ave., San Jose, CA 95110, USA

FCC ID: TC2-R1048
IC: 5959A-R1044

Report Type:	**Model:**
Original Report	3960X

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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	R2203165-407	Original Report	2022-09-01

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: *3960X*, FCC ID: TC2-R1048, IC: 5959A-R1044 or the "EUT" as referred to in this report. It is a Set-Top-Box Device.

1.2 Objective

This report was prepared on behalf of Roku, Inc in accordance with FCC CFR47 §15.407 and ISEDC RSS-247 Issue 2, February2017.

The objective was to determine compliance with FCC Part 15.407 and ISEDC RSS-247 rules for Output Power, Antenna Requirements, AC Line Conducted Emissions, Emission Bandwidth, Power spectral density, Dynamic Frequency Selection, Conducted and Radiated Spurious Emissions.

1.3 Related Submittal(s)/Grant(s)

FCC Part 15, Subpart E, Equipment DTS with FCC ID: TC2-R1048, IC: 5959A-R1044

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 ° 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 17025:2017 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 17025:2017 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 17025:2017 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.

Modulation	Frequency (MHz)	Power Setting
802.11a	5180	117
	5200	117
	5240	117
	5260	127
	5280	127
	5320	110
	5500	118
	5580	127
	5700	95
	5745	127
	5785	127
	5825	127
802.11n/ac20	5180	114
	5200	114
	5240	114
	5260	127
	5280	127
	5320	107
	5500	118
	5580	127
	5700	95
	5745	127
	5785	127
	5825	127
802.11n/ac40	5190	108
	5230	124
	5270	127
	5310	99
	5510	100
	5590	127
	5670	100
	5755	127
	5795	127

*Data rates tested:
802.11a mode: 6Mbps
802.11n/ac V/HT20: MCS0
802.11n/ac V/HT40: MCS0

2.3 Duty Cycle Correction Factor

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

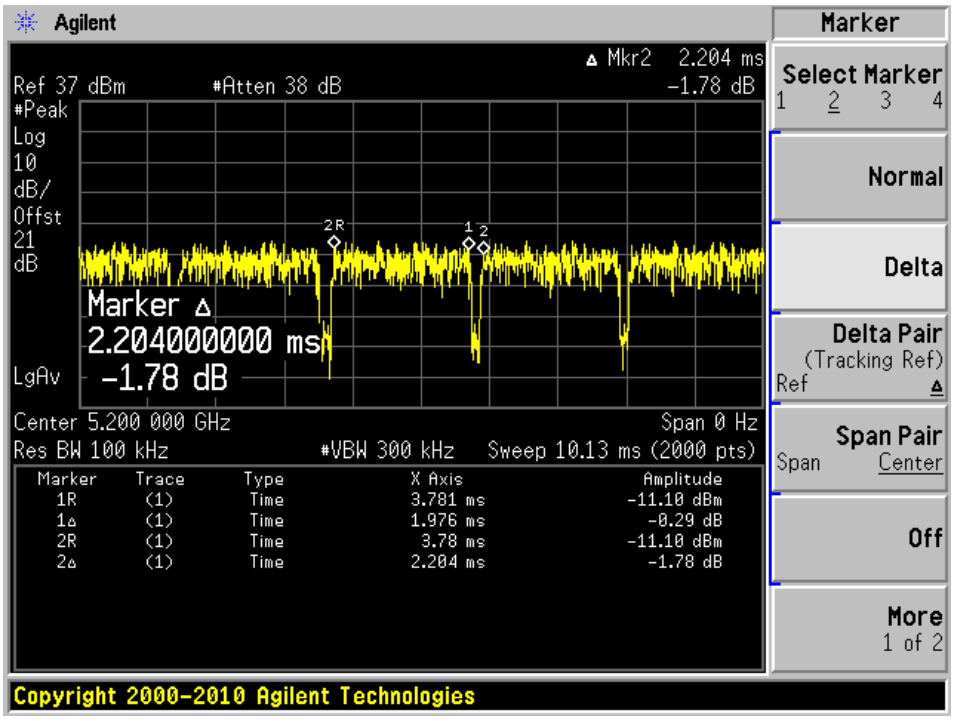
All measurements are to be performed with the EUT transmitting at 100% duty cycle at its maximum power control level; however, if 100% duty cycle cannot be achieved, measurements of duty cycle, x, and maximum-power transmission duration, T, are required for each tested mode of operation.

Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11a	1.976	2.204	89.65	0.47
802.11n/ac20	1.783	2.042	87.31	0.59
802.11n/ac40	0.823	1.125	73.15	1.36

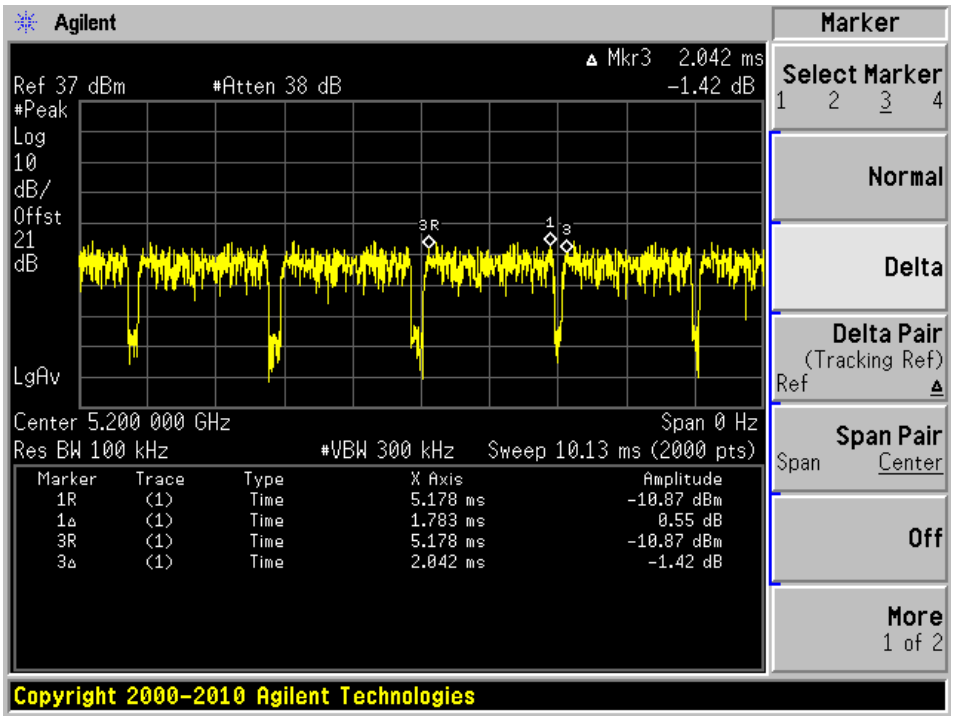
Note: Duty Cycle Correction Factor = 10*log(1/duty cycle)

Please refer to the following plots.

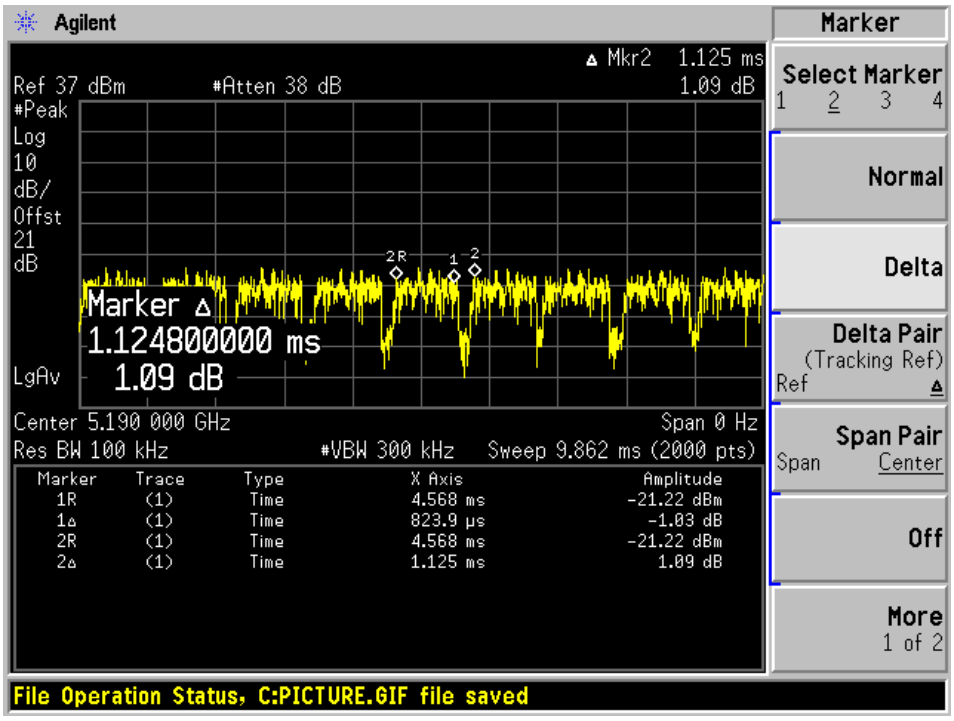
802.11a mode



802.11n/ac20 mode



802.11n/ac40 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 and ISEDC Rules	Description of Test	Result
FCC §2.1091, §15.407(f), ISEDC RSS-102	RF Exposure	Compliant
FCC §15.203 ISEDC RSS-Gen §6.8	Antenna Requirement	Compliant
FCC §15.207 ISEDC RSS-Gen §8.8	AC Power Line Conducted Emissions	Compliant
FCC §2.1053, §15.205, §15.209, 15.407(b) ISEDC RSS-247 §6.2	Spurious Radiated Emissions	Compliant
FCC §15.407(h) & ISEDC RSS-247 §6.3	Dynamic Frequency Selection	Compliant
FCC §15.407(e) ISEDC RSS-Gen §6.2	Emission Bandwidth	Compliant
FCC §407(a) ISEDC RSS-247 §6.2	Output Power	Compliant
FCC §2.1051, §15.407(b) ISEDC RSS-247 §6.2	Band Edges	Compliant
FCC §15.407(a) ISEDC RSS-247 §6.2	Power Spectral Density	Compliant
FCC §2.1051, §15.407(b) ISEDC RSS-247 §6.2	Spurious Emissions at Antenna Terminals	Compliant

BACL is responsible for all the information provided in this report, except when information is provided by the customer as identified in this report. Information provided by the customer, e.g., antenna gain, can affect the validity of results.

4 FCC §2.1091, §15.407(f) & ISEDC RSS-102 - RF Exposure

4.1 Applicable Standards

According to FCC KDB 447498 D04 Interim General RF Exposure Guidance v01, Section 2.1 RF Exposure Test Exemptions for Single Source,

2.1.1 General RF Exposure Test Exemption Considerations

RF exposure test exemptions provide means to obtain certification without the need of showing data (measurements, or analytical/numerical modeling) to demonstrate compliance. Hereafter, in this context, an RF source is referred to as "*exempt RF device*" in the sense that it is not required to show data demonstrating compliance to RF exposure limits.

Test exemptions apply for devices used in general population/uncontrolled exposure environments, according to the SAR-based, or MPE-based exemption thresholds.[8] However, it is always possible, especially when the potential for exposure cannot be easily determined, that an RF exposure evaluation may become required according §§ 1.1307(c) and (d).

As detailed in Section 2.1.2, the 1 mW and SAR-based test exemption conditions are in terms of source-based available maximum time-averaged (matched conducted) output power for all operating configurations, adjusted for tune-up tolerance, and at the minimum *test separation distance* required for the particular RF exposure scenario under consideration. This minimum *test separation distance* is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander. To qualify for SAR test exemption, the *test separation distances* applied must be fully explained and justified (typically in the SAR measurement, or SAR analysis report, according to KDB Pub. 865664) by showing the actual operating configurations and exposure conditions of the transmitter, and applicable host platform requirements (e.g., KDB Pubs. 648474, 616217, 941225)

When no other RF exposure testing or reporting is required, a statement of justification and compliance must be included in the equipment approval, in lieu of the SAR report, to qualify for SAR test exemption.

If RF exposure testing requirements for a specific device are covered in a KDB Publication, those requirements must be satisfied before applying any SAR test exemption provisions. For example, this is the case for handheld PTT two-way radios, handsets, laptops, and tablets, etc.[9]

Finally, when 10-g extremity SAR applies, SAR test exemption may be considered by applying a factor of 2.5 to the SAR-based exemption thresholds.

2.1.2 1-mW Test Exemption

Per §1.1307(b)(3)(i)(A), a single RF source is *exempt RF device* (from the requirement to show data demonstrating compliance to RF exposure limits, as previously mentioned) if the available maximum time-averaged power is no more than 1 mW, regardless of separation distance.

This exemption applies to all operating configurations and exposure conditions, for the frequency range 100 kHz to 100 GHz, regardless of fixed, mobile, or portable device exposure conditions. This is a standalone exemption, and it cannot be applied in conjunction with any other test exemption.

2.1.3 SAR-Based Exemption

A more comprehensive exemption, considering a variable power threshold that depends on both the *separation distance* and power, is provided in §1.1307(b)(3)(ii)(B). This exemption is applicable to the frequency range between 300 MHz and 6 GHz, with *test separation distances* between 0.5 cm and 40 cm, and for all RF sources in fixed, mobile, and portable device exposure conditions.

Accordingly, a RF source is considered an *RF exempt device* if its available maximum time-averaged (matched conducted) power or its effective radiated power (ERP), whichever is greater, are below a specified threshold. This exemption threshold was derived based on general population 1-g SAR requirements and is detailed in Appendix C.

2.1.4 MPE-Based Exemption

An alternative to the SAR-based exemption is provided in §1.1307(b)(3)(ii)(C), for a much wider frequency range, from 300 kHz to 100 GHz, applicable for separation distances greater or equal to $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. The MPE-based test exemption condition is in terms of ERP, defined as the

[8] Specific test exemption thresholds for operations under occupational/controlled limits are not established.
[9] When SAR evaluation is required by the hotspot mode or UMPC mini-tablet procedures, that is, where an antenna is ≤ 2.5 cm from a surface or edge, the *test separation distance* from the phantom to the antenna or device enclosure, as appropriate, should be applied to determine SAR test exemption for such configurations, according to the criteria in this document. For that case, the *test separation distance* cannot be determined from the distance of the antenna to the device surface or edge.

According to ISED RSS-102 Issue 5 Section 2.5.1 Exemption Limits for Routine Evaluation-SAR Evaluation:

SAR evaluation is required if the separation distance between the user and/or bystander and the antenna and/or radiating element of the device is less than or equal to 20 cm, except when the device operates at or below the applicable output power level (adjusted for tune-up tolerance) for the specified separation distance defined in table below,

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of ≤5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤300	71	101	132	162	193
450	52	70	88	106	123
835	17	30	42	55	67
1900	7	10	18	34	60
2450	4	7	15	30	52
3500	2	6	16	32	55
5800	1	6	15	27	41

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of ≥50 mm
≤300	223	254	284	315	345
450	141	159	177	195	213
835	80	92	105	117	130
1900	99	153	225	316	431
2450	83	123	173	235	309
3500	86	124	170	225	290
5800	56	71	85	97	106

4.2 FCC RF Exposure Exemption Evaluation Procedures

According to FCC KDB 447498 D04 Interim General RF Exposure Guidance v01, Annex B Exemptions for Single Source,

B.1 General

This appendix provides the exemption criteria and summarizes relevant parameters and usage considerations based on descriptions in FCC 19-126.

B.2 Blanket 1 mW Blanket Exemption

The 1 mW Blanket Exemption of § 1.1307(b)(3)(i)(A) applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power of no more than 1 mW, regardless of separation distance. The 1 mW blanket exemption applies at separation distances less than 0.5 cm, including where there is no separation. This exemption shall not be used in conjunction with other exemption criteria other than those for multiple RF sources in paragraph § 1.1307(b)(3)(ii)(A). The 1 mW exemption is independent of service type and covers the full range of 100 kHz to 100 GHz, but it shall not be used in conjunction with other exemption criteria or in devices with higher-power transmitters operating in the same time-averaging period. Exposure from such higher-power transmitters would invalidate the underlying assumption that exposure from the lower-power transmitter is the only contributor to SAR in the relevant volume of tissue.

B.3 MPE-based Exemption

General frequency and separation-distance dependent MPE-based effective radiated power (ERP) thresholds are in Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] to support an exemption from further evaluation from 300 kHz through 100 GHz.

Table B.1 – THRESHOLD FOR SINGLE RF SOURCE SUBJECT TO ROUTINE ENVIRONMENTAL EVALUATION

RF Source			Minimum Distance			Threshold ERP
f_L MHz		f_H MHz	$\lambda_L/2\pi$		$\lambda_H/2\pi$	W
0.3	-	1.34	159 m	-	35.6 m	1,920 R^2
1.34	-	30	35.6 m	-	1.6 m	3,450 R^2/f^2
30	-	300	1.6 m	-	159 mm	3.83 R^2
300	-	1,500	159 mm	-	31.8 mm	0.0128 $R^2 f$
1,500	-	100,000	31.8 mm	-	0.5 mm	19.2 R^2
Subscripts L and H are low and high; λ is wavelength. From § 1.1307(b)(3)(i)(C), modified by adding Minimum Distance columns.						

The table applies to any RF source (i.e., single fixed, mobile, and portable transmitters) and specifies power and distance criteria for each of the five frequency ranges used for the MPE limits. These criteria apply at separation distances from any part of the radiating structure of at least $\lambda/2\pi$. The thresholds are based on the general population MPE limits with a single perfect reflection, outside of the reactive near-field, and in the main beam of the radiator.

For mobile devices that are not exempt per Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] at distances from 20 cm to 40 cm and in 0.3 GHz to 6 GHz, evaluation of compliance with the exposure limits in § 1.1310 is necessary if the ERP of the device is greater than ERP20cm in Formula (B.1) [repeated from § 2.1091(c)(1) and § 1.1307(b)(1)(i)(B)].

$$P_{th}\,(\text{mW}) = ERP_{20\,\text{cm}}\,(\text{mW}) = 2040f \quad 0.3\ \text{GHz} \le f < 1.5\ \text{GHz}$$
$$P_{th}\,(\text{mW}) = ERP_{20\,\text{cm}}\,(\text{mW}) = 3060 \quad 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \qquad \text{(B.1)}$$

If the ERP is not easily obtained, then the available maximum time-averaged power may be used (i.e., without consideration of ERP only if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole.

SAR-based exemptions are constant at separation distances between 20 cm and 40 cm to avoid discontinuities in the threshold when transitioning between SAR-based and MPE-based exemption criteria at 40 cm, considering the importance of reflections.

B.4 SAR-based Exemption

SAR-based thresholds are derived based on frequency, power, and separation distance of the RF source. The formula defines the thresholds in general for either available maximum time-averaged power or maximum time-averaged ERP, whichever is greater.

If the ERP of a device is not easily determined, such as for a portable device with a small form factor, the applicant may use the available maximum time-averaged power exclusively if the device antenna or radiating structure does not exceed an electrical length of $\lambda/4$.

As for devices with antennas of length greater than λ/4 where the gain is not well defined, but always less than that of a half-wave dipole (length λ/2), the available maximum time-averaged power generated by the device may be used in place of the maximum time-averaged ERP, where that value is not known.

The separation distance is the smallest distance from any part of the antenna or radiating structure for all persons, during operation at the applicable ERP. In the case of mobile or portable devices, the separation distance is from the outer housing of the device where it is closest to the antenna.

The SAR-based exemption formula of § 1.1307(b)(3)(i)(B), repeated here as Formula (B.2), applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power or effective radiated power (ERP), whichever is greater, of less than or equal to the threshold P_{th} (mW).

This method shall only be used at separation distances from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by Formula (B.2).

$$P_{th}\ (\text{mW}) = ERP_{20\ \text{cm}}\,(d/20\ \text{cm})^{x} \quad d \leq 20\ \text{cm}$$
$$P_{th}\ (\text{mW}) = ERP_{20\ \text{cm}} \quad 20\ \text{cm} < d \leq 40\ \text{cm} \qquad \text{(B.2)}$$

Where

$$x = -\log_{10}\,(60/(ERP_{20\ \text{cm}}\sqrt{f}))$$

and f is in GHz, d is the separation distance (cm), and EPR20cm is per Formula (B.1).

The example values shown in Table B.2 are for illustration only.

Table B.2 – Example Power Thresholds (mW)

Frequency (MHz)	Distance (mm)										
		5	10	15	20	25	30	35	40	45	50
	300	39	65	88	110	129	148	166	184	201	217
	450	22	44	67	89	112	135	158	180	203	226
	835	9	25	44	66	90	116	145	175	207	240
	1900	3	12	26	44	66	92	122	157	195	236
	2450	3	10	22	38	59	83	111	143	179	219
	3600	2	8	18	32	49	71	96	125	158	195
	5800	1	6	14	25	40	58	80	106	136	169

4.3 RF exposure evaluation exemption for FCC

Prediction frequency (GHz)			5.825	
Maximum output power (dBm)			22.29	
Maximum ERP (dBm)			22.64	
Maximum ERP (mW)			183.66	
Prediction distance (cm)			20	
Maximum antenna gain (dBi)			2.50	
0.3 GHz ≤ f < 1.5 GHz	$ERP_{20\,cm}$ (mW)	x	SAR-based Exemption Threshold	
	-	-	$d \leq 20$ cm	P_{th} (mW)
				-
			20 cm < $d \leq 40$ cm	P_{th} (mW)
				-
1.5 GHz ≤ f ≤ 6 GHz	$ERP_{20\,cm}$ (mW)	x	SAR-based Exemption Threshold	
	3060	-	$d \leq 20$ cm	P_{th} (mW)
				-
			20 cm < $d \leq 40$ cm	P_{th} (mW)
				3060

As shown in the table above, the EUT's Max ERP is lower than the SAR-based Exemption Threshold. SAR testing for this device is exempted.

4.4 RF exposure evaluation exemption for IC

Maximum EIRP = 22.29 dBm + 2.50dBi = 24.79 dBm (0.301 W), which is less $1.31\times10^{-2}f^{0.6834}$ = 4.90 W = 36.9 dBm. Therefore, ISED SAR testing is not required.

5 FCC §15.203 & ISEDC RSS-Gen §6.8 - 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.

According to ISEDC RSS-Gen §6.8: Transmitter Antenna

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

5.2 Antenna List

The antennas used by the EUT are permanent attached antennas.

Radio	Frequency Range (MHz)	Maximum Antenna Gain (dBi)	Antenna Type
Wi-Fi 2.4 GHz	2400-2500	3.11	Chip
Wi-Fi 5 GHz	5150-5850	2.50	

Note: Antenna gain provided by customer

6 FCC §15.207 & ISEDC RSS-Gen §8.8 - AC Power Line Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207 and ISEDC RSS GEN §8.8

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 and and ISEDC RSS GEN §8.8.

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.

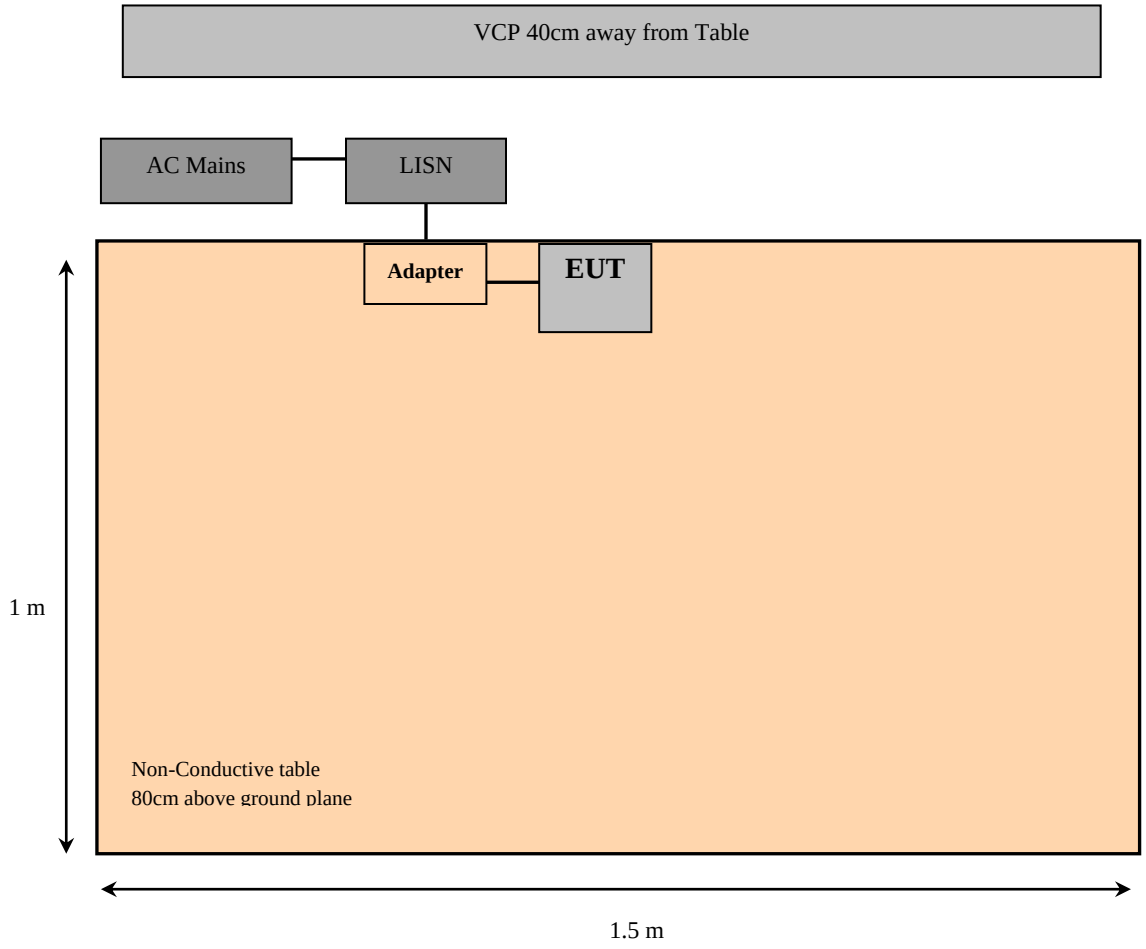
6.3 Test Procedure

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

BACL No.	Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
124	Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100044	2021-05-14	2 years
681	Rohde & Schwarz	Impulse Limiter	ESH3-Z2	101962	2021-11-30	1 year
725	Solar Electronics Company	High Pass Filter	Type 7930-100	7930150203	2022-03-18	1 year
732	FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160129	2021-11-24	1 year
1187	Fairview Microwave	Coaxial Cable	PE3C2220-1250CM	1	2021-09-08	1 year
-	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 the latest version of A2LA policy P102 "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 Weishan Zhang on 2022-07-08 in the Ground Plane test site.

6.8 Summary of Test Results

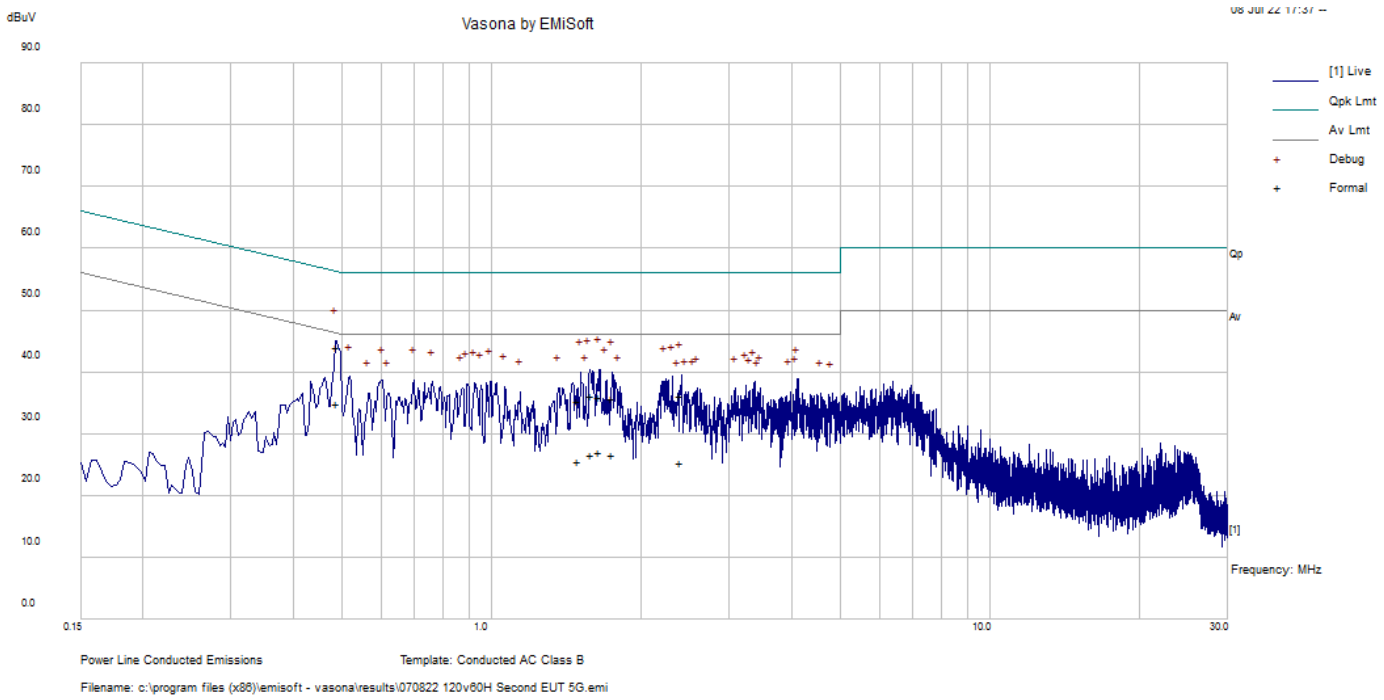
According to the recorded data in following table, the EUT complied with the FCC Part 15 and RSS-Gen standards' conducted emissions limits, with the margin reading of:

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Live/Neutral)**	**Range (MHz)**
-7.33	0.489783	Neutral	0.15-30

6.9 Conducted Emissions Test Plots and Data

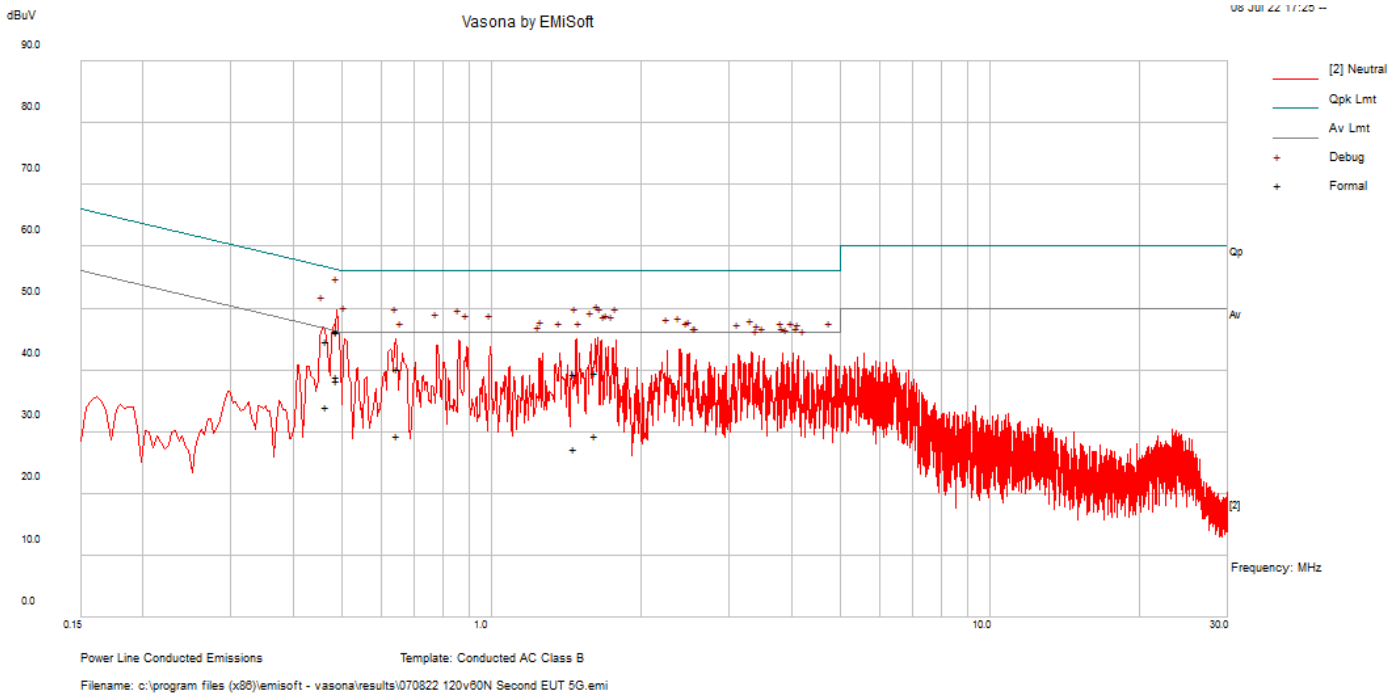
Worst Case: a mode, 5825 MHz

120 V, 60 Hz – Line



Frequency (MHz)	Ai. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBµV)	Limit (dBµV)	Margin (dB)	Detector
0.491235	34.06	9.9	43.96	56.15	-12.19	QP
1.645779	25.94	9.99	35.93	56	-20.07	QP
1.587308	26.11	10	36.11	56	-19.89	QP
1.747748	25.69	10	35.69	56	-20.31	QP
1.494172	25.26	9.99	35.25	56	-20.75	QP
2.396482	26.02	10.04	36.06	56	-19.94	QP
0.491235	24.88	9.91	34.79	46.15	-11.36	Ave
1.645779	17.02	9.99	27.01	46	-18.99	Ave
1.587308	16.63	9.99	26.62	46	-19.38	Ave
1.747748	16.5	10.01	26.51	46	-19.49	Ave
1.494172	15.62	9.99	25.61	46	-20.39	Ave
2.396482	15.29	10.04	25.33	46	-20.67	Ave

120 V, 60 Hz – Neutral



Frequency (MHz)	Ai. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBµV)	Limit (dBµV)	Margin (dB)	Detector
0.489783	36.55	9.9	46.45	56.17	-9.72	QP
0.465709	34.69	9.9	44.59	56.59	-12	QP
1.617227	29.47	9.99	39.46	56	-16.54	QP
0.490458	36.17	9.9	46.07	56.16	-10.09	QP
1.47053	29.28	9.99	39.27	56	-16.73	QP
0.647148	30.24	9.93	40.17	56	-15.83	QP
0.489783	28.94	9.91	38.85	46.17	-7.33	Ave
0.465709	24.16	9.91	34.07	46.59	-12.52	Ave
1.617227	19.47	9.99	29.46	46	-16.54	Ave
0.490458	28.37	9.9	38.27	46.16	-7.89	Ave
1.47053	17.25	9.99	27.24	46	-18.76	Ave
0.647148	19.45	9.92	29.37	46	-16.63	Ave

7 FCC §15.209, §15.407(b) & ISEDC RSS-247 §6.2 - 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.

As per ISEDC RSS-247 §6.2

For transmitters operating in the band 5150-5250 MHz, all emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. However, any unwanted emissions that fall into the band 5250- 5350 MHz must be 26 dBc, when measured using a resolution bandwidth between 1 and 5% of the occupied bandwidth, above 5.25 GHz. Otherwise, the transmission is considered as intentional and the devices shall implement dynamic frequency selection (DFS) and transmitter power control (TPC) as per the requirements for the band 5250-5350 MHz

For devices with both operating frequencies and channel bandwidths contained within the band 5250-5350 MHz, the device shall comply with the following:

1. All emissions outside the band 5250-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. if the equipment is intended for outdoor use; or
2. All emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. and any emissions within the band 5150-5250 MHz shall meet the power spectral density limits of Section 6.2.1. The device shall be labelled “for indoor use only.”

For devices with operating frequencies in the band 5250-5350 MHz but having a channel bandwidth that overlaps the band 5150-5250 MHz, the devices’ unwanted emission shall not exceed -27 dBm/MHz e.i.r.p. outside the band 5150-5350 MHz and its power shall comply with the spectral power density for operation within the band 5150-5250 MHz. The device shall be labelled “for indoor use only.”

For transmitters operating in the band 5470-5725 MHz, emissions outside the band shall not exceed -27 dBm/MHz e.i.r.p.

For the band 5725-5850 MHz, emissions at frequencies from the band edges to 10 MHz above or below the band edges shall not exceed -17 dBm/MHz e.i.r.p. For emissions at frequencies more than 10 MHz above or below the band edges, the emissions power shall not exceed -27 dBm/MHz.

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 and ISEDC RSS-247 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

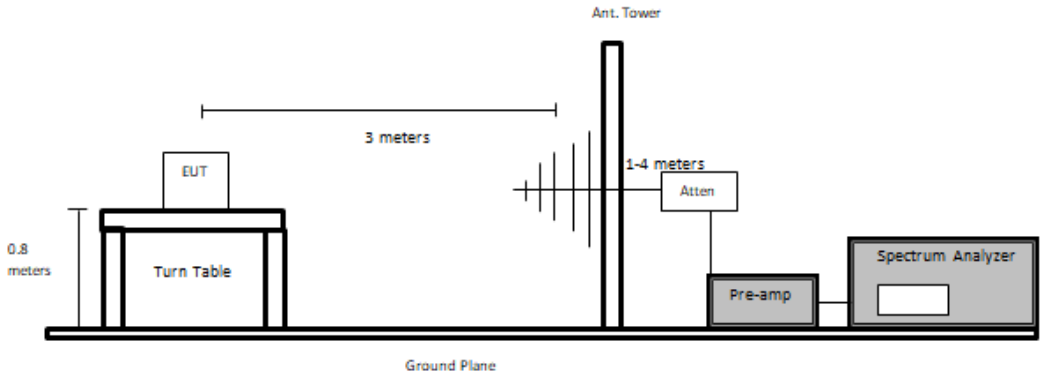
For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

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

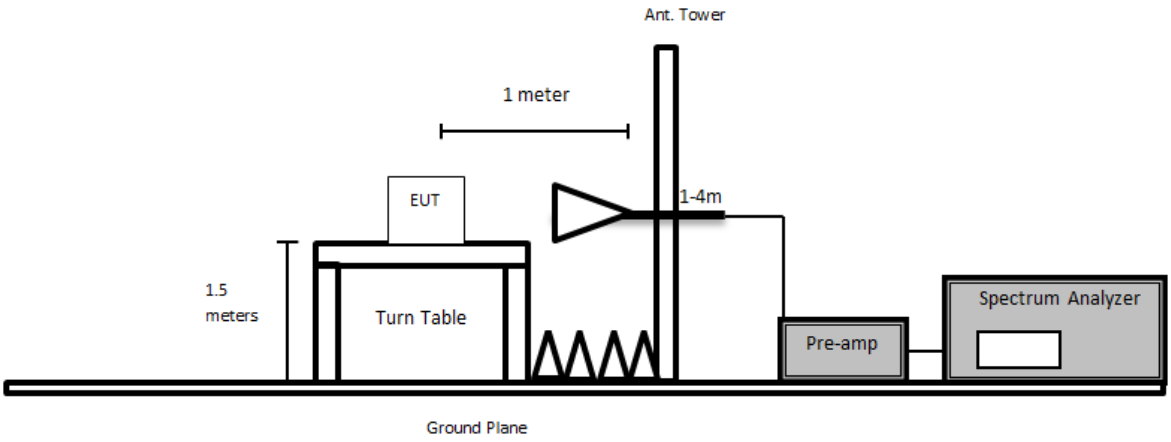
7.5 Test Setup Block Diagram

Below 1GHz:

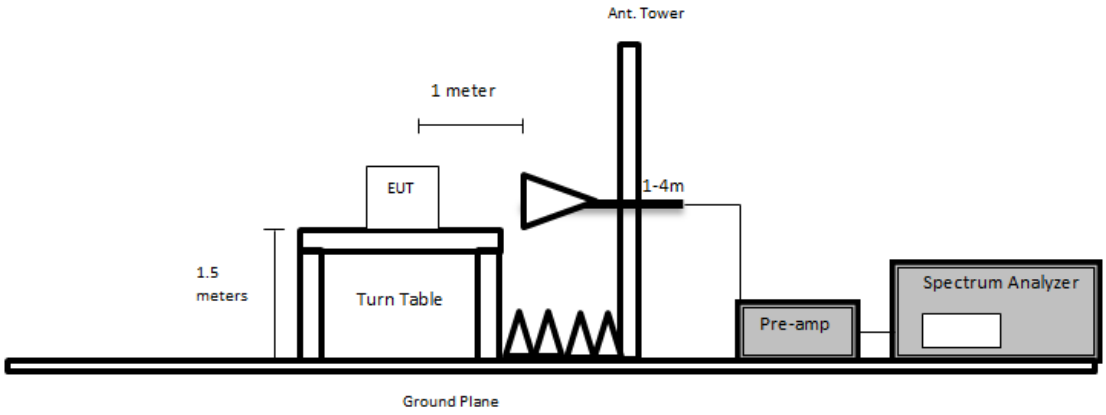


Above 1GHz:

Using Asset #1192



Using Asset #91, #92



7.6 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
912	Rhode & Schwarz	Signal Analyzer	FSV40	101203	2022-05-05	1 year
287	Agilent	Spectrum Analyzer	E4446A	US44300386	2022-05-05	1 year
124	Rhode & Schwarz	EMI Test Receiver	ESCI 1166.5950 K03	100044	2021-05-14	2 years
-	Sunol Sciences	System Controller	SC99V	011003-1	N/R	N/A
321	Sunol Sciences	Biconilog Antenna	JB3	A020106-2	2021-11-22	2 years
1192	ETS Lindgren	Horn Antenna	3117	00218973	2021-09-14	2 years
91	Wisewave	Antenna, Horn	ARH-4223-02	10555-02	2022-03-08	2 years
92	Wisewave	Antenna, Horn	ARH-2823-02	10555-01	2022-03-17	2 years
-	-	SMA cable	-	-	Each time[1]	N/A
-	-	Notch Filter	-	-	Each time[1]	N/A
1228	Pasternack	Coaxial Cable, RG213	PE3496-800CM	2111301	2021-11-30	1 year
1077	Insulted Wire Corp.	157 Series 2.92 SM (x2) Armored 33 ft. Cable	KPS-1571AN-3960-KPS	DC 1917	2022-03-30	1 year
827	AH Systems	Preamplifier	PAM 1840 VH	170	2021-08-03	1 year
658	Agilent	Pre-Amplifier	8449B	3008A01103	2022-05-05	1 year
459	HP	Pre Amplifier	8447D	2443A04374	2021-11-02	1 year
-	Vasona	Test software	V6.0 build 11	10400213	N/R	N/R

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 the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

7.7 Test Environmental Conditions

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

The testing was performed by Deepak Mishra from 2022-06-02 to 2022-07-06 in 5m chamber 3.

7.8 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:

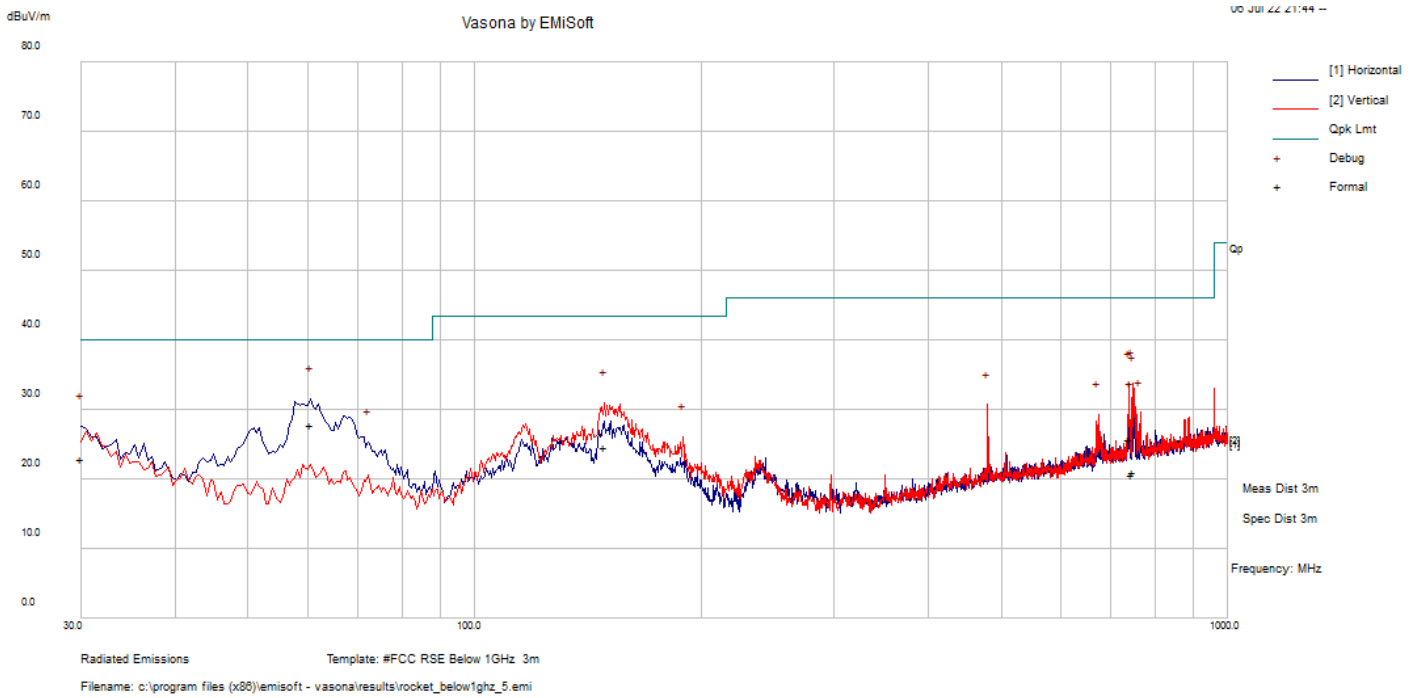
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, Channel**
-2.54	17479.375	Vertical	802.11a mode, 5825 MHz

7.9 Radiated Emissions Test Result Data

Note: Pre-scan was performed in order to determine worst-case orientation of device with respect to measurement antenna. Plots/data shown represent measurements made in worst-case orientation.

1) 30 MHz – 1 GHz at 3 meters

Worst Case: a mode, 5825 MHz



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
60.6765	39.53	-11.71	27.82	216	H	82	40	-12.18	Pass
746.861	17.83	2.73	20.56	289	V	353	46	-25.44	Pass
738.8625	22.95	2.68	25.63	237	V	121	46	-20.37	Pass
30.003438	20.84	1.98	22.82	276	H	66	40	-17.18	Pass
149.04375	30.97	-6.34	24.63	233	V	319	43.5	-18.87	Pass
749.058	18.18	2.74	20.92	155	V	7	46	-25.08	Pass

FCC/IC Limits for 1 GHz to 40 GHz				
Applicablity	**(dBm)**	**(uV/m at 3meters)**	**(dBuV/m at 3meters)**	**(dBuV/m at 1meter)[2]**
Restricted Band Average Limit	-	500	54	64
Restricted Band Peak Limit[1]	-	-	74	84
FCC §15.407(b) & ISEDC RSS-247 §6.2 Defined Unwanted Emissions Limit	-27	-	68	78

Note[1]: Restricted Band Peak Limit is defined to be 20dB higher than Average Limit.
Note[2]: Limits at 1 meter are determined by applying a Distance correction factor accounts for extrapolation from 1 meters to 3 meters. Formula used is as follows: 20*log(3meters/1meter) = 9.54 (According to ANSI C63.10-2013 Section 9.4)
Note[3]: Where Restricted Band Peak Limit is replaced with stricter 78 dBµV/m at 1 meter, compliance is being shown for unwmated emissions per FCC §15.407(b) & ISEDC RSS-247 §6.2

2) 1-40 GHz measured at 1 meter

5150 - 5250 MHz

802.11a mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5180 MHz											
10360	52.100	351	150	H	38.15	12.88	36.58	66.55	78	-11.45	Peak
10360	42.127	351	150	H	38.15	12.88	36.58	56.58	64	-7.42	Peak
Middle Channel 5220 MHz											
10440	51.380	190	150	H	38.15	12.79	36.58	65.74	78	-12.26	Peak
10440	39.750	190	150	H	38.15	12.79	36.58	54.11	64	-9.89	Peak
High Channel 5240 MHz											
10480	49.860	360	150	H	38.15	12.92	36.47	64.46	78	-13.54	Peak
10480	39.289	360	150	H	38.15	12.92	36.47	53.89	64	-10.11	Peak

802.11n/ac20 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5180 MHz											
10360	51.120	360	128	H	38.15	12.88	36.58	65.57	78	-12.43	Peak
10360	39.726	360	128	H	38.15	12.88	36.58	54.17	64	-9.83	Peak
Middle Channel 5220 MHz											
10440	52.314	0	150	H	38.15	12.79	36.58	66.68	78	-11.33	Peak
10440	40.822	0	150	H	38.15	12.79	36.58	55.18	64	-8.82	Peak
High Channel 5240 MHz											
10480	51.345	354	150	H	38.15	12.92	36.47	65.94	78	-12.06	Peak
10480	41.322	354	150	H	38.15	12.92	36.47	55.92	64	-8.08	Peak

802.11n/ac40 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5190 MHz											
10380	50.340	360	150	H	38.15	12.79	36.58	64.71	78	-13.29	Peak
10380	37.708	360	150	H	38.15	15.85	36.58	55.13	64	-8.87	Peak
High Channel 5230 MHz											
10460	48.220	360	150	H	38.15	13.01	36.36	63.01	78	-14.99	Peak
10460	38.058	360	150	H	38.15	13.01	36.36	52.85	64	-11.15	Peak

5250-5350 MHz

802.11a mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5260 MHz											
10520	49.770	360	150	H	38.19	12.93	36.47	64.43	78	-13.57	Peak
10520	38.863	360	150	H	38.19	12.93	36.47	53.52	64	-10.48	Peak
Middle Channel 5280 MHz											
10560	51.460	360	150	H	38.19	13.07	36.36	66.36	78	-11.64	Peak
10560	39.063	360	150	H	38.19	13.07	36.36	53.96	64	-10.04	Peak
High Channel 5320 MHz											
10640	51.490	236	150	H	38.19	13.14	36.36	66.46	84	-17.54	Peak
10640	39.358	236	150	H	38.19	13.14	36.36	54.33	64	-9.67	Peak

802.11n/ac20 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5260 MHz											
10520	51.390	360	150	H	38.19	12.93	36.47	66.05	78	-11.95	Peak
10520	39.184	360	150	H	38.19	12.93	36.47	53.84	64	-10.16	Peak
Middle Channel 5280 MHz											
10560	48.920	360	150	H	38.19	13.07	36.36	63.82	78	-14.18	Peak
10560	38.335	360	150	H	38.19	13.07	36.36	53.23	64	-10.77	Peak
High Channel 5320 MHz											
10640	48.420	360	150	H	38.19	13.14	36.36	63.39	84	-20.61	Peak
10640	37.570	360	150	H	38.19	13.14	36.36	52.54	64	-11.46	Peak

802.11n/ac40 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5270 MHz											
10380	49.890	360	150	H	38.19	12.99	36.47	64.60	78	-13.40	Peak
10380	38.278	360	150	H	38.19	12.99	36.47	52.99	64	-11.01	Peak
High Channel 5310 MHz											
10460	47.600	195	150	H	38.19	13.17	36.36	62.60	84	-21.40	Peak
10460	36.261	195	150	H	38.19	13.17	36.36	51.26	64	-12.74	Peak

5470-5725 MHz

802.11a mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5500 MHz											
11000	49.320	360	150	H	38.63	13.53	36.15	65.33	84	-18.67	Peak
11000	37.429	360	150	H	38.63	13.53	36.15	53.44	64	-10.56	Peak
Middle Channel 5580 MHz											
11160	49.640	360	150	H	38.63	13.37	36.10	65.54	84	-18.46	Peak
11160	37.529	360	150	H	38.63	13.37	36.10	53.43	64	-10.57	Peak
High Channel 5700 MHz											
11400	49.160	360	150	H	38.63	13.75	36.04	65.51	84	-18.49	Peak
11400	38.972	360	150	H	38.63	13.75	36.04	55.32	64	-8.68	Peak

802.11n/ac20 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5500 MHz											
11000	49.030	360	150	H	38.63	13.53	36.15	65.04	84	-18.96	Peak
11000	42.810	360	150	H	38.63	13.53	36.15	58.82	64	-5.18	Peak
Middle Channel 5580 MHz											
11160	49.820	360	150	H	38.63	13.37	36.10	65.72	84	-18.28	Peak
11160	41.174	360	150	H	38.63	13.37	36.10	57.07	64	-6.93	Peak
High Channel 5700 MHz											
11400	49.130	360	150	H	38.63	13.75	36.04	65.48	84	-18.52	Peak
11400	37.723	360	150	H	38.63	13.75	36.04	54.07	64	-9.93	Peak

802.11n/ac40 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5510 MHz											
11020	49.050	360	150	H	38.63	13.46	36.15	64.99	84	-19.01	Peak
11020	38.246	360	150	H	38.63	13.46	36.15	54.19	64	-9.81	Peak
Middle Channel 5590 MHz											
11180	48.720	360	150	H	38.63	13.38	36.10	64.63	84	-19.37	Peak
11180	38.022	360	150	H	38.63	13.38	36.10	53.93	64	-10.07	Peak
High Channel 5670 MHz											
11340	50.590	360	150	H	38.63	13.45	36.07	66.60	84	-17.40	Peak
11340	38.713	360	150	H	38.63	13.45	36.07	54.73	64	-9.27	Peak

5745 - 5825 MHz

802.11a mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5745 MHz											
11490	49.560	360	150	H	38.86	13.76	36.03	66.15	84	-17.85	Peak
11490	37.801	360	150	H	38.86	13.76	36.03	54.39	64	-9.61	Peak
Middle Channel 5785 MHz											
11570	51.530	360	150	H	38.86	13.98	36.05	68.33	84	-15.68	Peak
11570	40.593	360	150	H	38.86	13.98	36.05	57.39	64	-6.61	Peak
High Channel 5825 MHz											
11650	51.370	360	150	H	38.86	14.10	36.09	68.24	84	-15.76	Peak
11650	39.403	360	150	H	38.86	14.10	36.09	56.28	64	-7.72	Peak

802.11n/ac20 mode

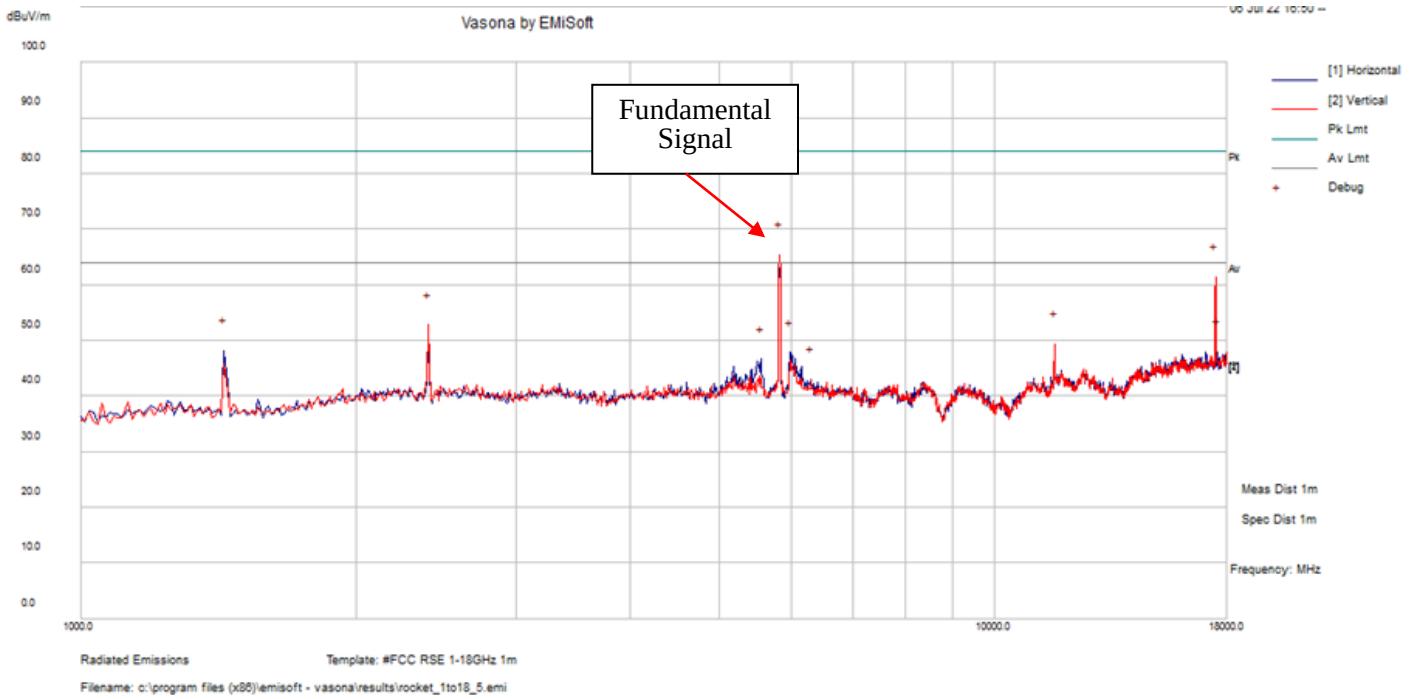
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5745 MHz											
11490	49.620	360	150	H	38.86	13.76	36.03	66.21	84	-17.79	Peak
11490	39.851	360	150	H	38.86	13.76	36.03	56.44	64	-7.56	Peak
Middle Channel 5785 MHz											
11570	52.040	360	150	H	38.86	13.98	36.05	68.84	84	-15.17	Peak
11570	38.420	360	150	H	38.86	13.98	36.05	55.21	64	-8.79	Peak
High Channel 5825 MHz											
11650	52.030	360	150	H	38.86	14.10	36.09	68.90	84	-15.10	Peak
11650	40.445	360	50	H	38.86	14.10	36.09	57.32	64	-6.68	Peak

802.11n/ac40 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/ISEDC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 5755 MHz											
11020	51.070	360	150	H	38.86	13.83	36.03	67.73	84	-16.27	Peak
11020	38.729	360	150	H	38.86	13.83	36.03	55.39	64	-8.61	Peak
High Channel 5795 MHz											
11340	48.880	360	150	H	38.86	13.91	36.05	65.60	84	-18.40	Peak
11340	38.439	360	150	H	38.86	13.91	36.05	55.16	64	-8.84	Peak

3) 1 GHz – 18 GHz Worst Case Scan at 1 Meter

Worst Case: a mode, 5825 MHz

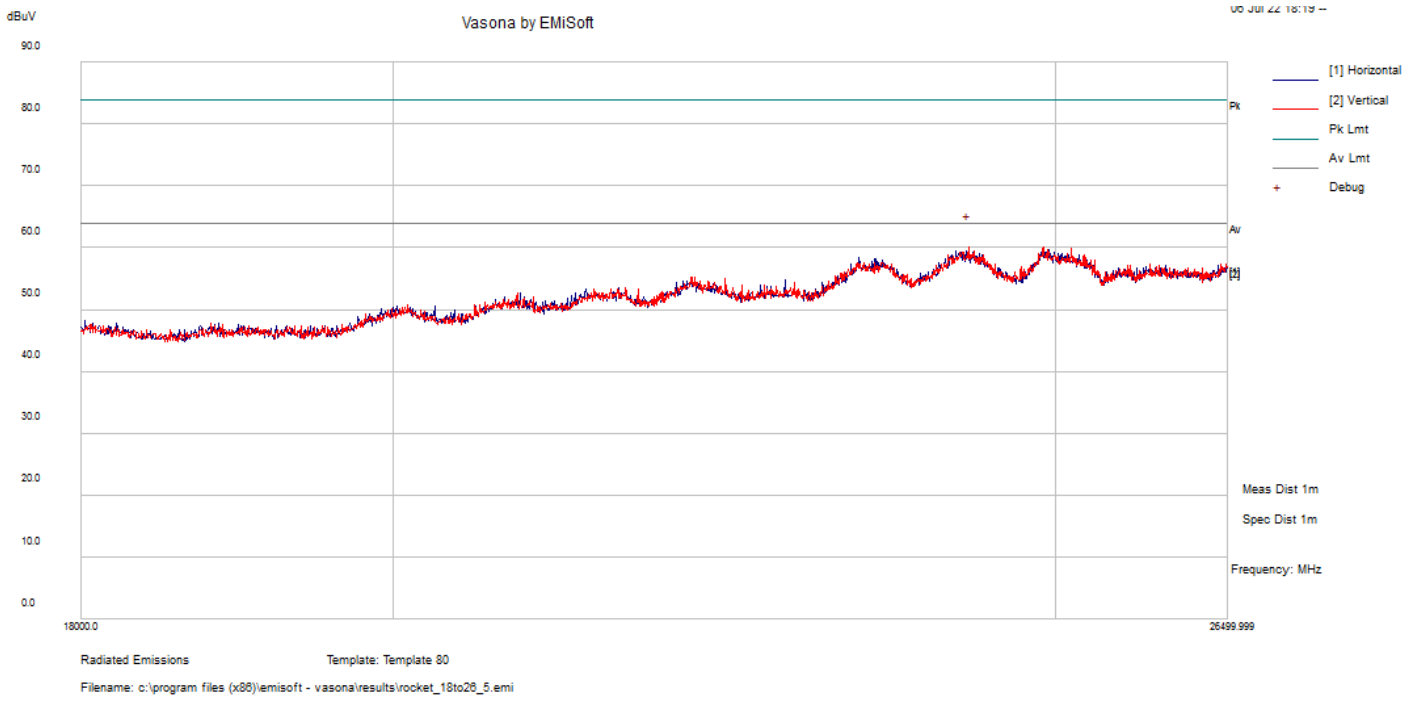


Frequency (MHz)	S.A. Reading (dBµV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
17479.375	63.08	-5.87	61.46	200	V	0	64	-2.54	Peak

Note: Max Peak emission compared to average limit to show compliance.

4) 18 GHz – 26.5 GHz Worst Case Scan at 1 Meter

Worst Case: a mode, 5825 MHz

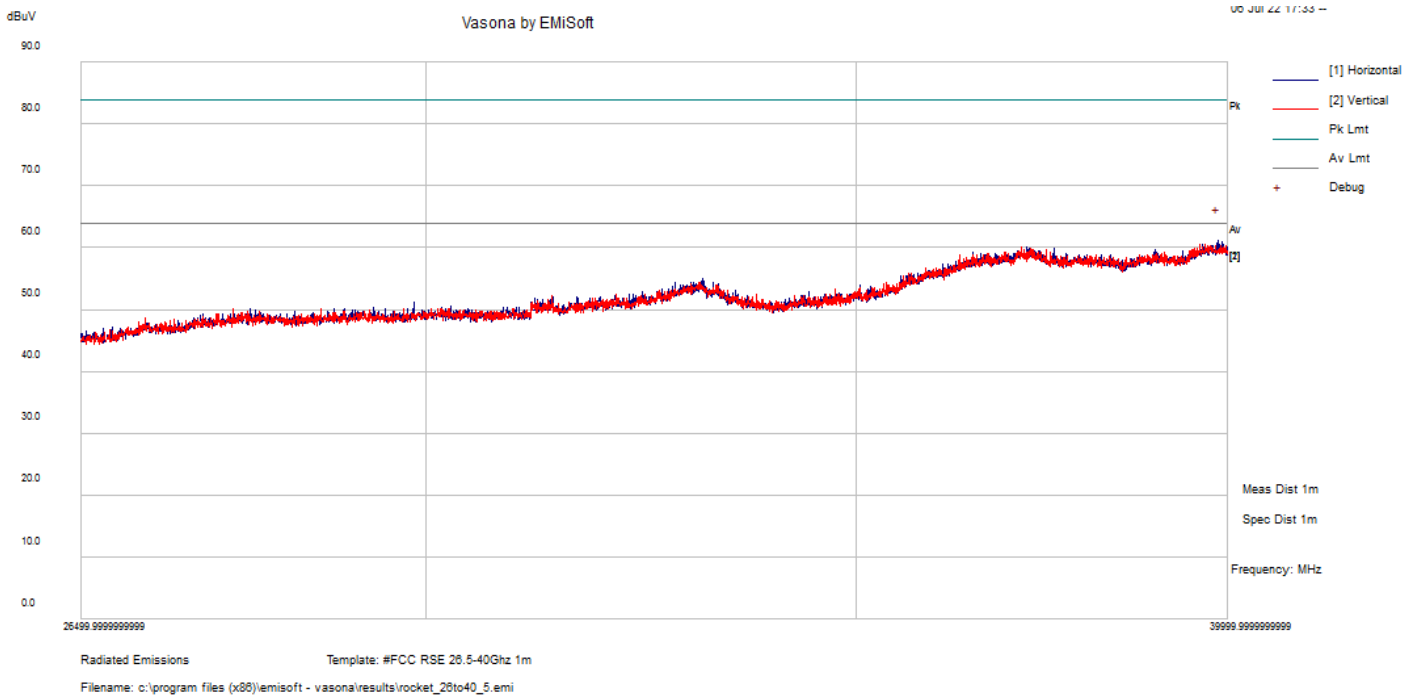


Frequency (MHz)	S.A. Reading (dBµV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
24279.37	38.56	21.6	60.16	300	V	0	64	-3.84	Peak

Note: Max Peak emission compared to average limit to show compliance.

5) 26.5 GHz – 40 GHz Worst Case Scan at 1 Meter

Worst Case: a mode, 5825 MHz



Frequency (MHz)	S.A. Reading (dBµV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
39852.34	45.2	15.97	61.17	100	H	0	64	-2.83	Peak

Note: Max Peak emission compared to average limit to show compliance.

8 FCC §15.407(e) & ISEDC RSS-247 §6.2 - Occupied Bandwidth

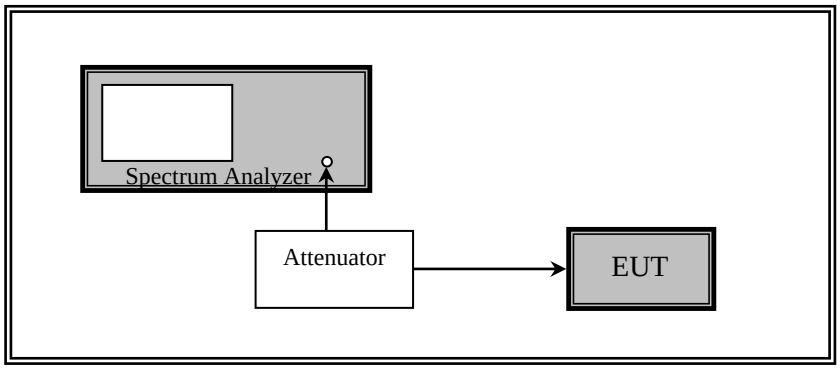
8.1 Applicable Standards

As per FCC §15.407(e) and ISEDC RSS-247 6.2.4(1): 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 Setup Block Diagram



8.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
287	Agilent	Spectrum Analyzer	E4446A	US443 00386	2022-05-05	1 year
-	-	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 the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

8.5 Test Environmental Conditions

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

The testing was performed by Marc Jean from 2022-06-29 in RF site.

8.6 Test Results

Please refer to the following tables and plots.

5.2GHz

Channel	Frequency (MHz)	99% OBW (MHz)	26 dB OBW (MHz)
802.11a mode			
36	5180	16.841	17.314
40	5200	16.643	17.208
48	5240	16.663	17.045
802.11n/ac20 mode			
36	5180	17.819	18.353
40	5200	17.776	18.278
48	5240	17.776	18.146
802.11n/ac40 mode			
36	5180	36.507	35.920
48	5240	36.249	40.437

5.3GHz

Channel	Frequency (MHz)	99% OBW (MHz)	26 dB OBW (MHz)
802.11a mode			
52	5260	17.906	24.094
56	5280	17.453	21.151
64	5320	16.998	17.165
802.11n/ac20 mode			
52	5260	18.262	18.255
56	5280	18.162	18.401
64	5320	17.609	18.040
802.11n/ac40 mode			
54	5270	39.830	46.394
62	5310	35.828	46.097

5.6GHz

Channel	Frequency (MHz)	99% OBW (MHz)	26 dB OBW (MHz)
802.11a mode			
100	5500	18.218	22.789
116	5580	19.346	25.790
140	5700	31.754	17.344
802.11n/ac20 mode			
100	5500	19.182	22.279
116	5580	18.961	28.539
140	5700	33.491	18.284
802.11n/ac40 mode			
102	5510	37.855	35.935
118	5590	60.143	59.956
134	5670	62.424	37.068

5.8GHz

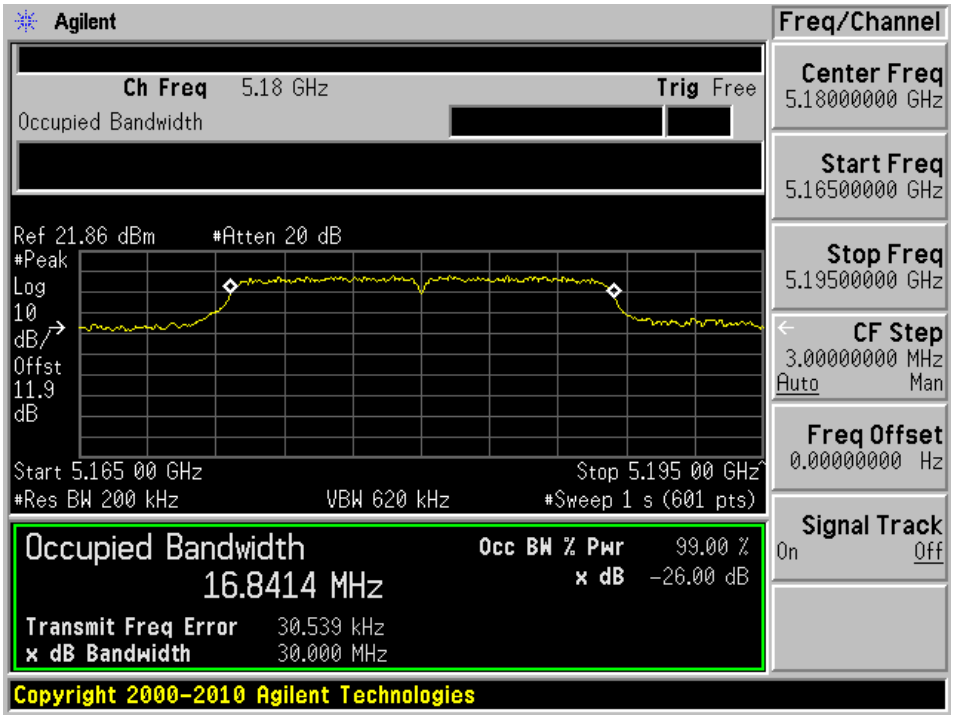
Channel	Frequency (MHz)	99% OBW (MHz)	6 dB OBW (MHz)
802.11a mode			
149	5745	32.548	21.544
157	5785	32.340	23.875
165	5825	32.340	22.975
802.11n/ac20 mode			
149	5745	35.677	23.116
157	5785	33.821	22.409
165	5825	35.466	22.315
802.11n/ac40 mode			
151	5755	45.842	45.842
159	5795	44.038	44.038

99% OBW

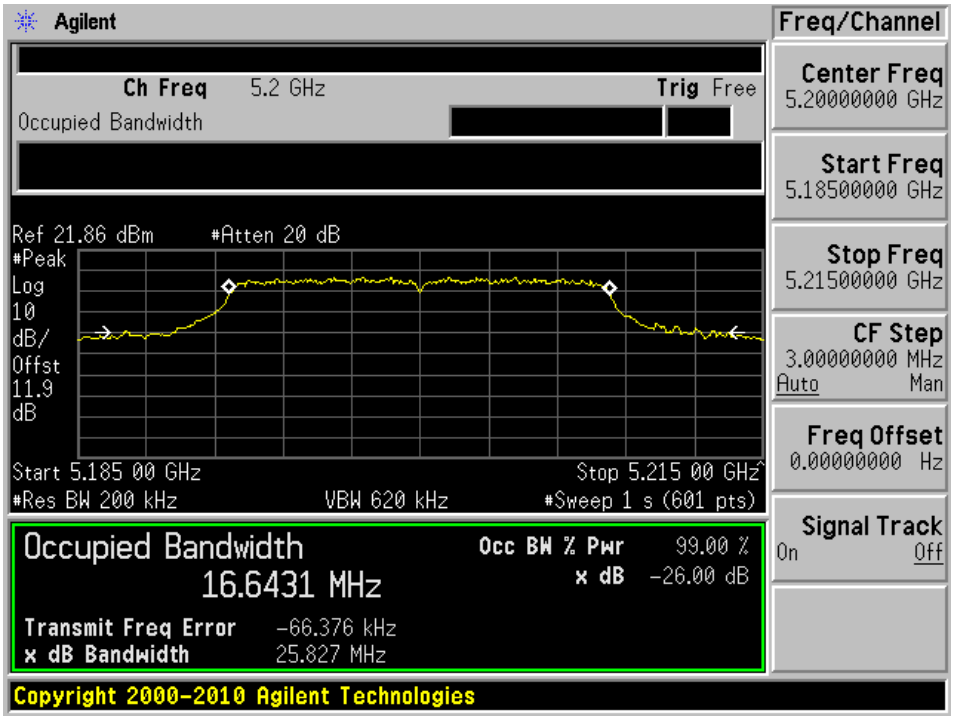
5150 - 5250 MHz

802.11a Mode

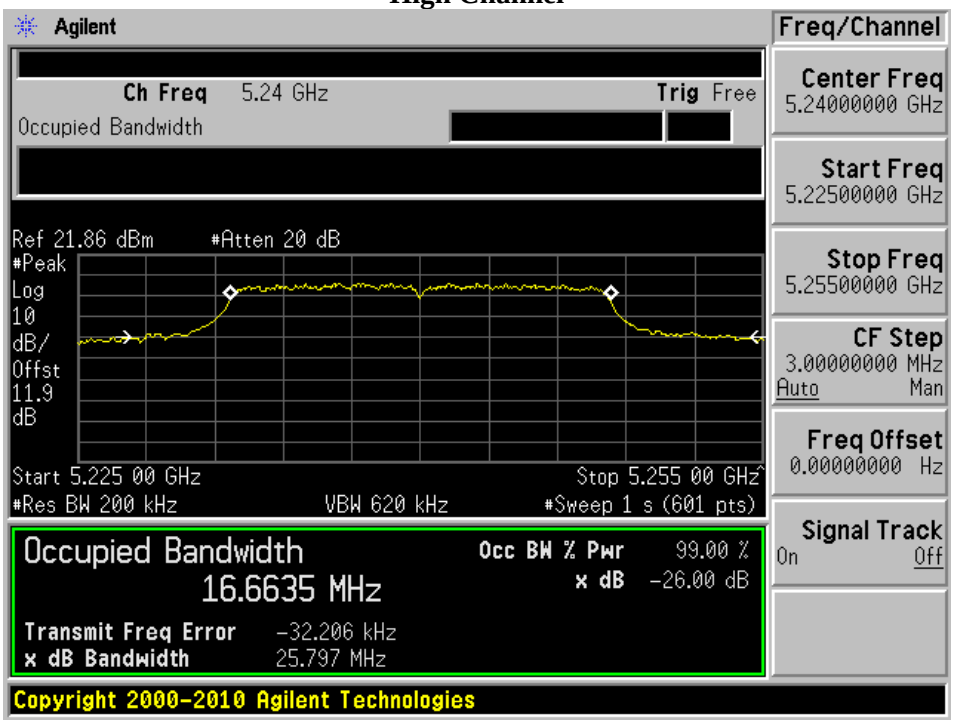
Low Channel



Mid Channel

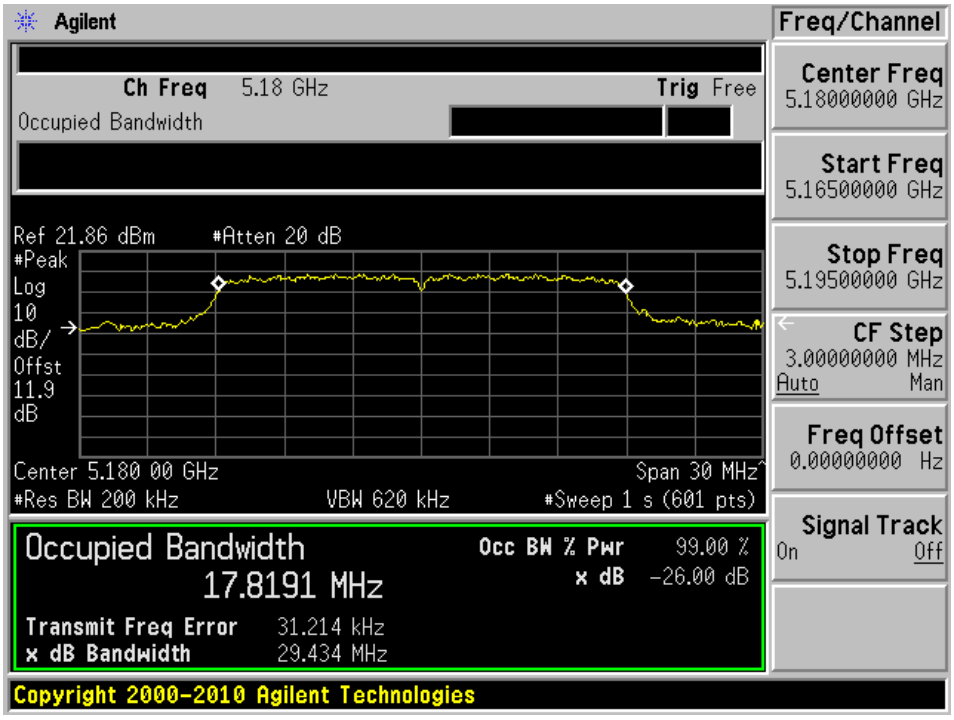


High Channel

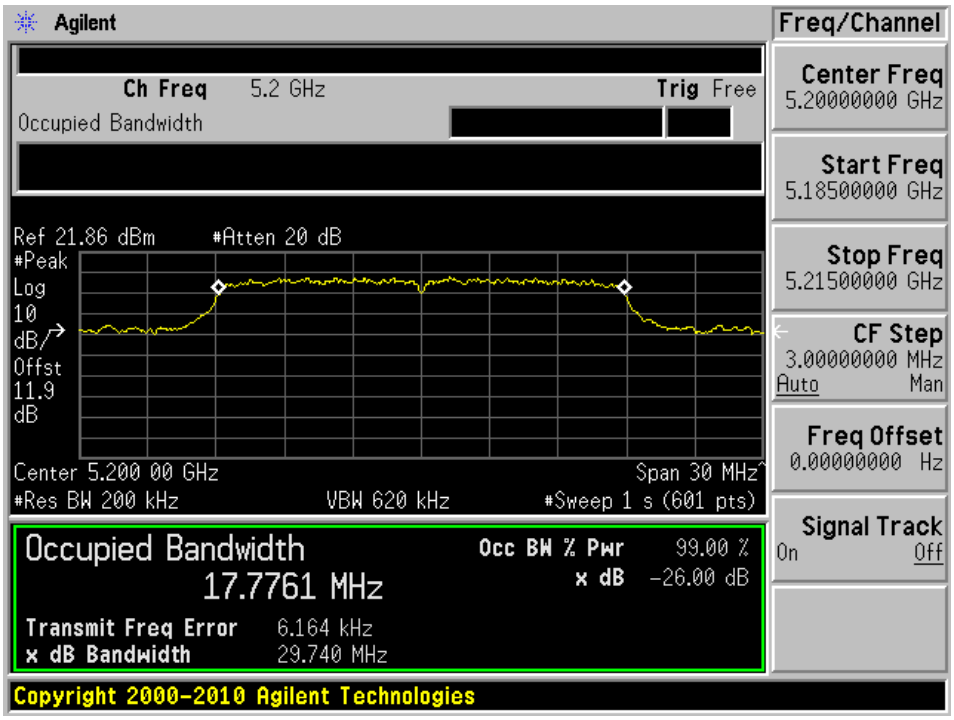


802.11n/ac20 Mode

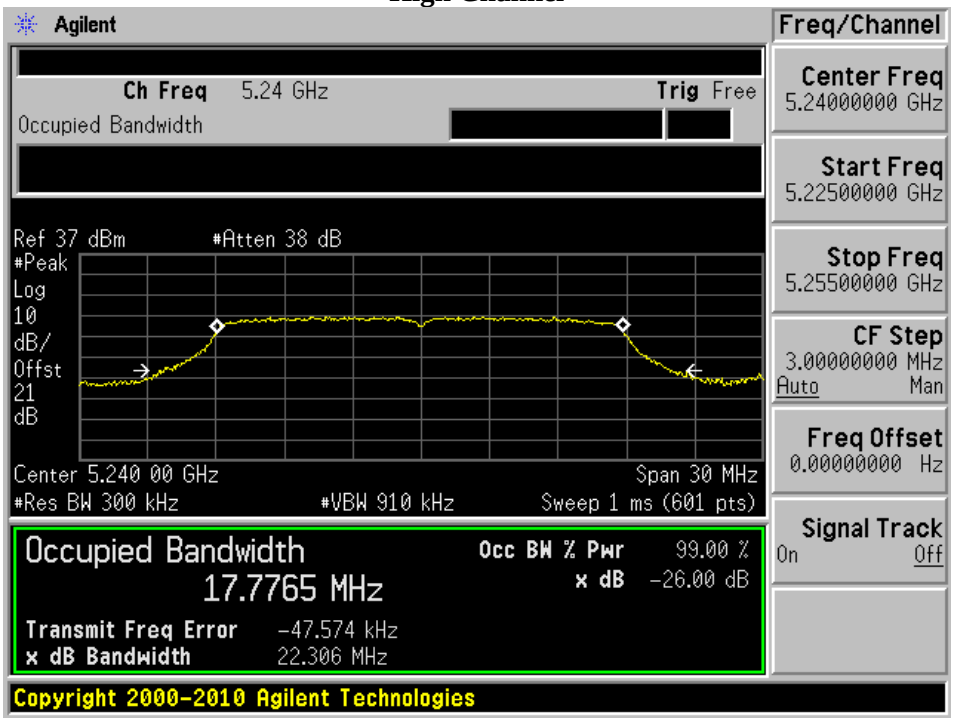
Low Channel



Mid Channel

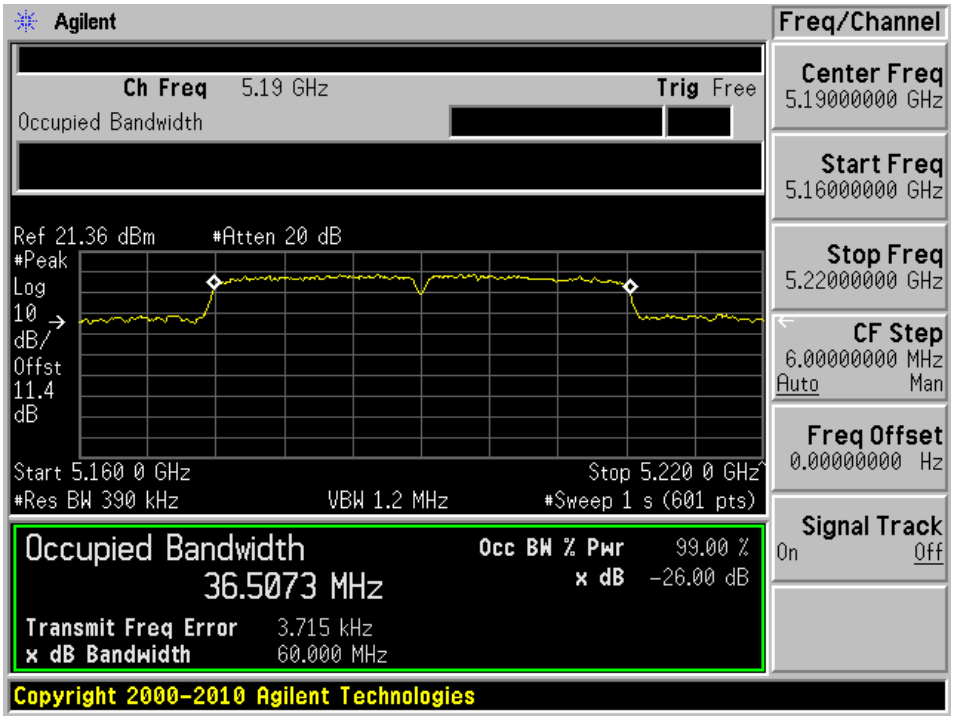


High Channel

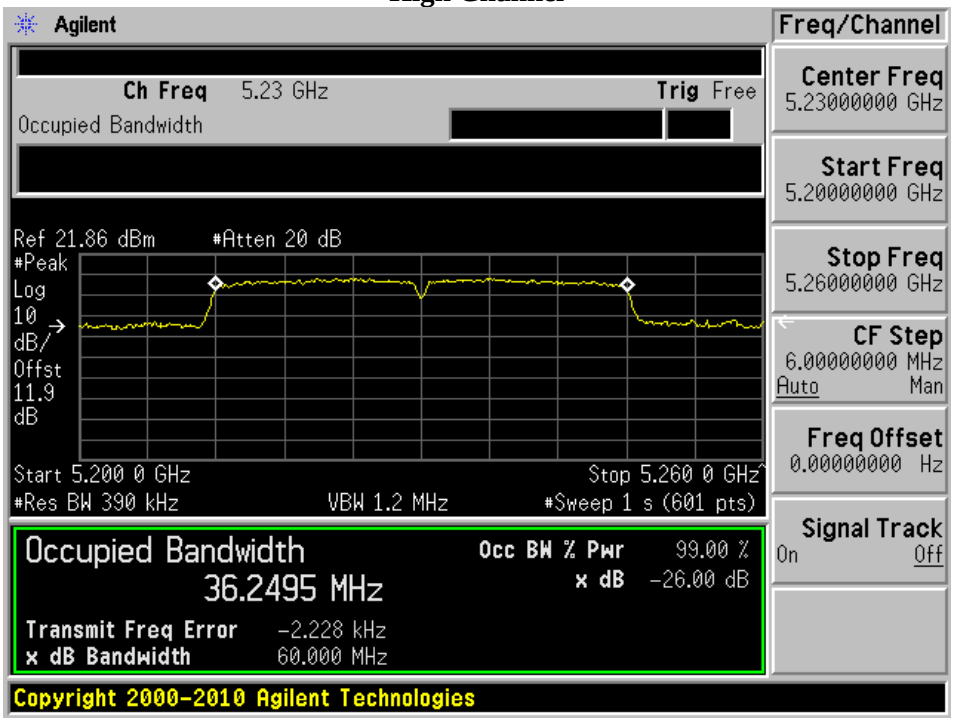


802.11n/ac40 Mode

Low Channel



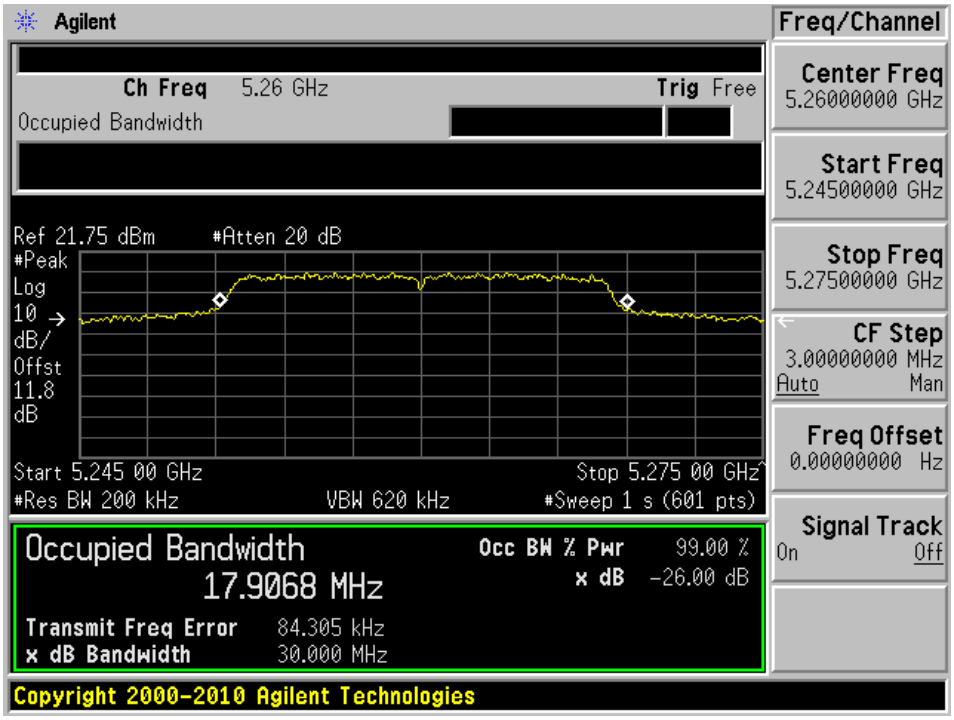
High Channel



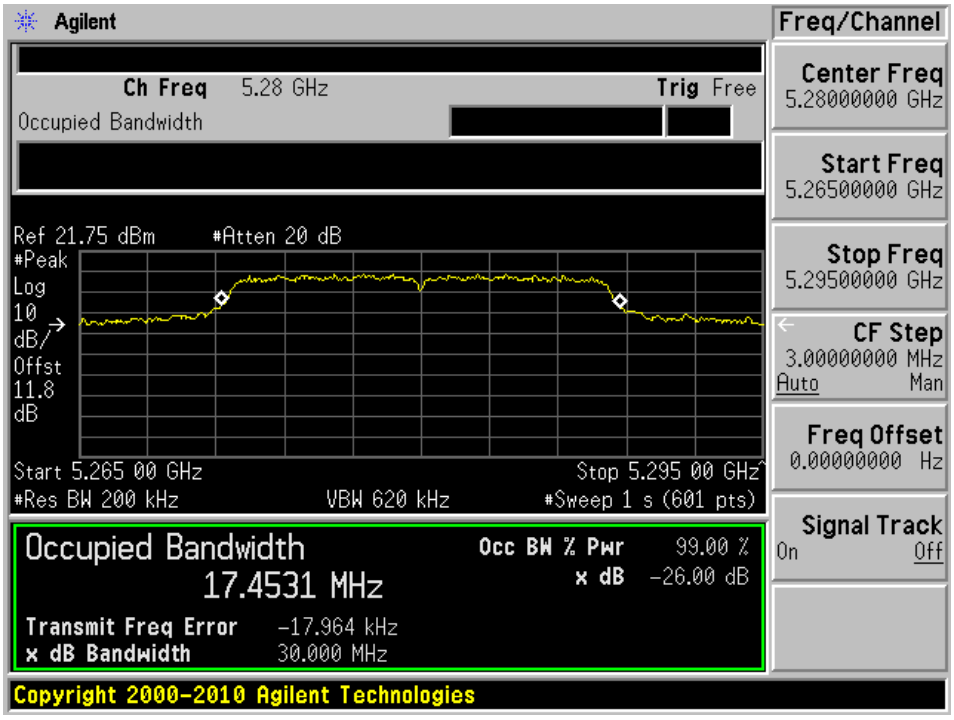
5.25-5.35 GHz

802.11a Mode

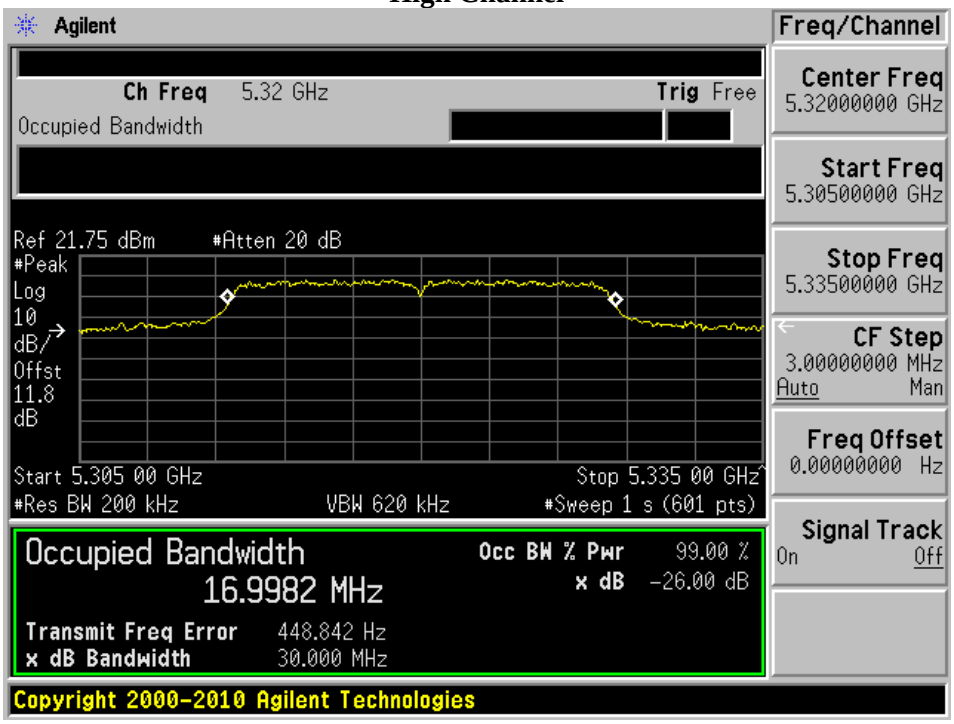
Low Channel



Middle Channel

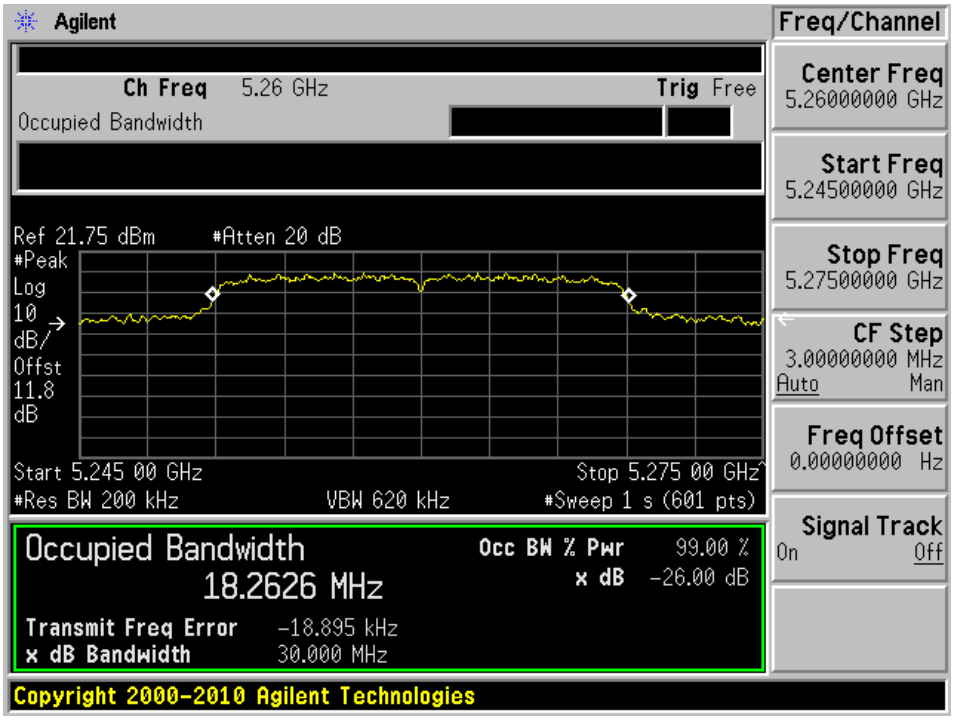


High Channel

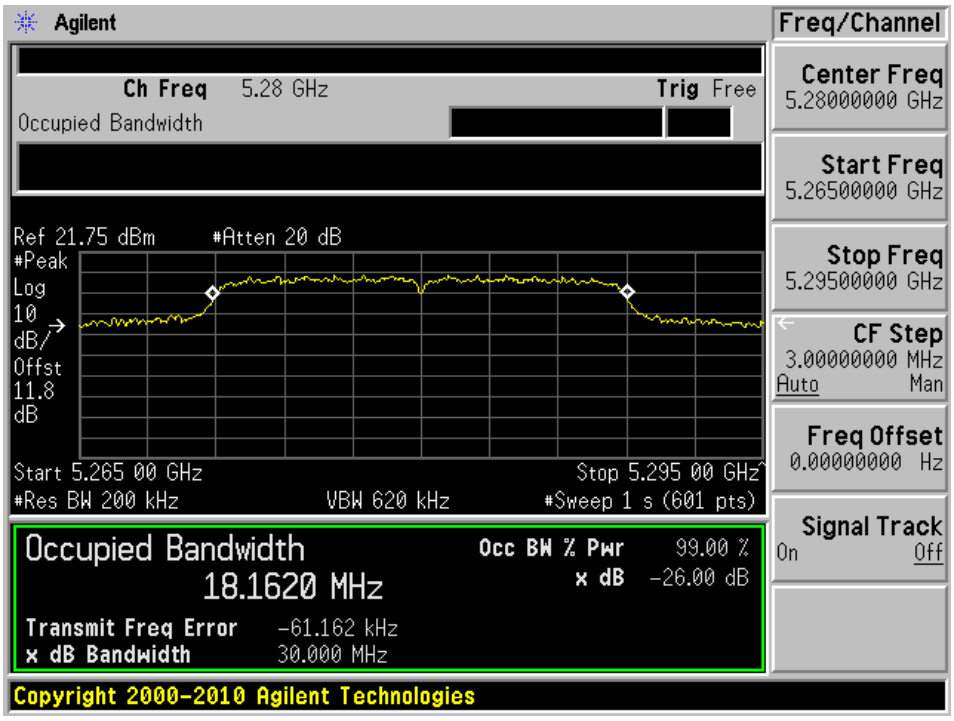


802.11n/ac20 Mode

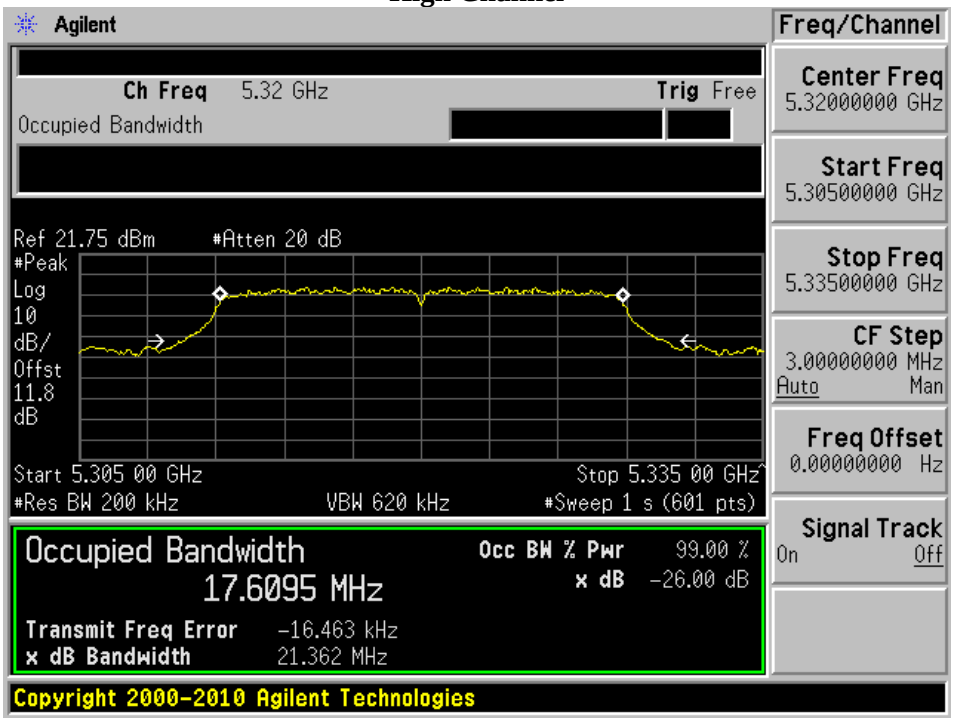
Low Channel



Mid Channel

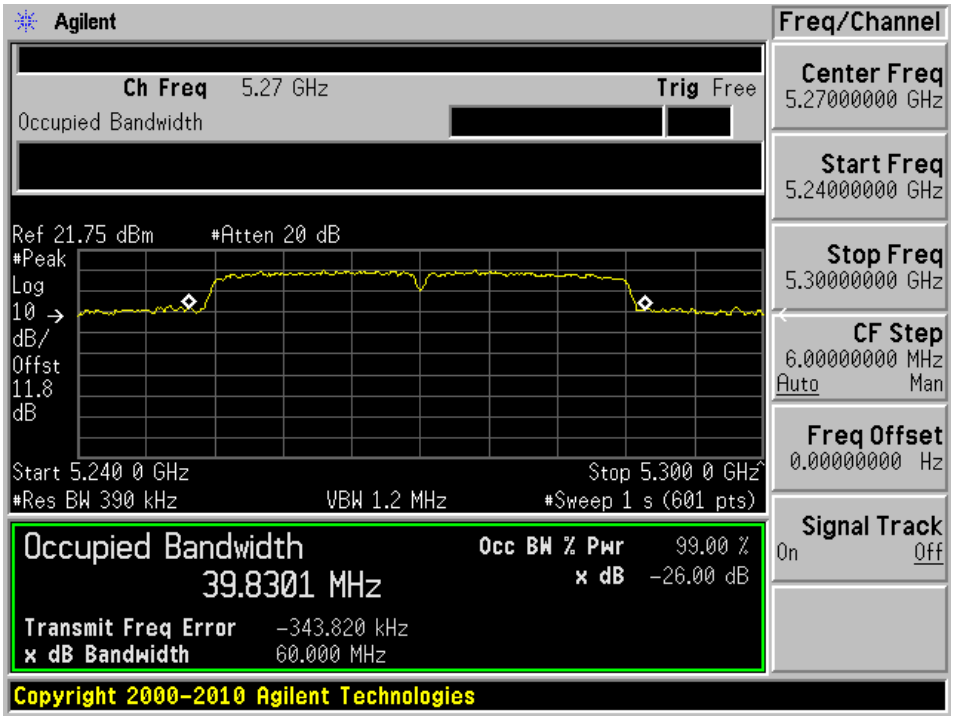


High Channel

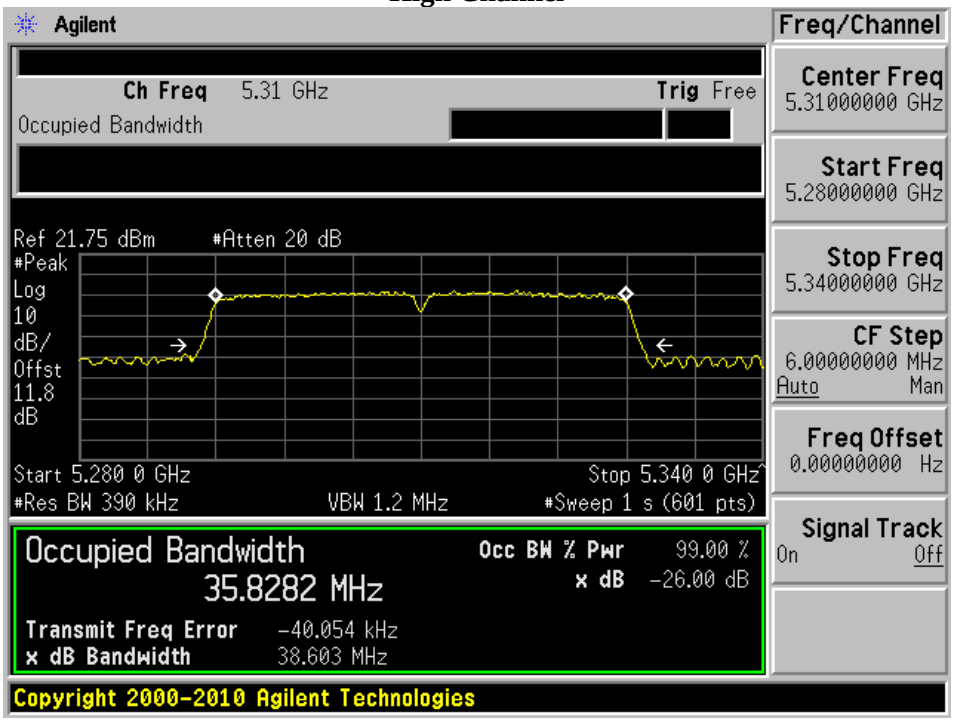


802.11n/ac40 Mode

Low Channel



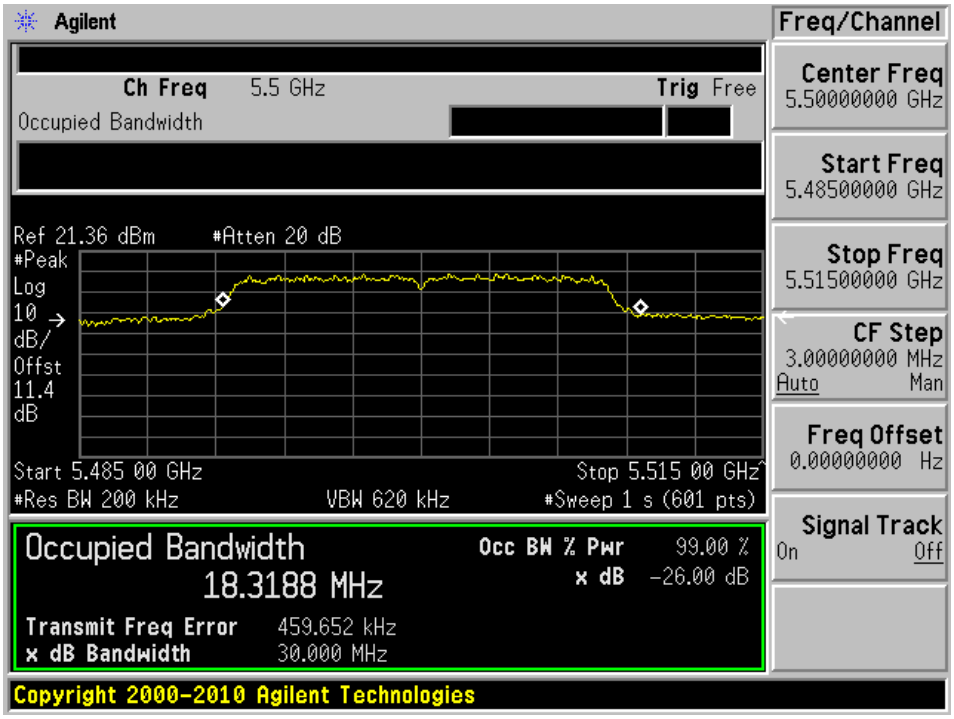
High Channel



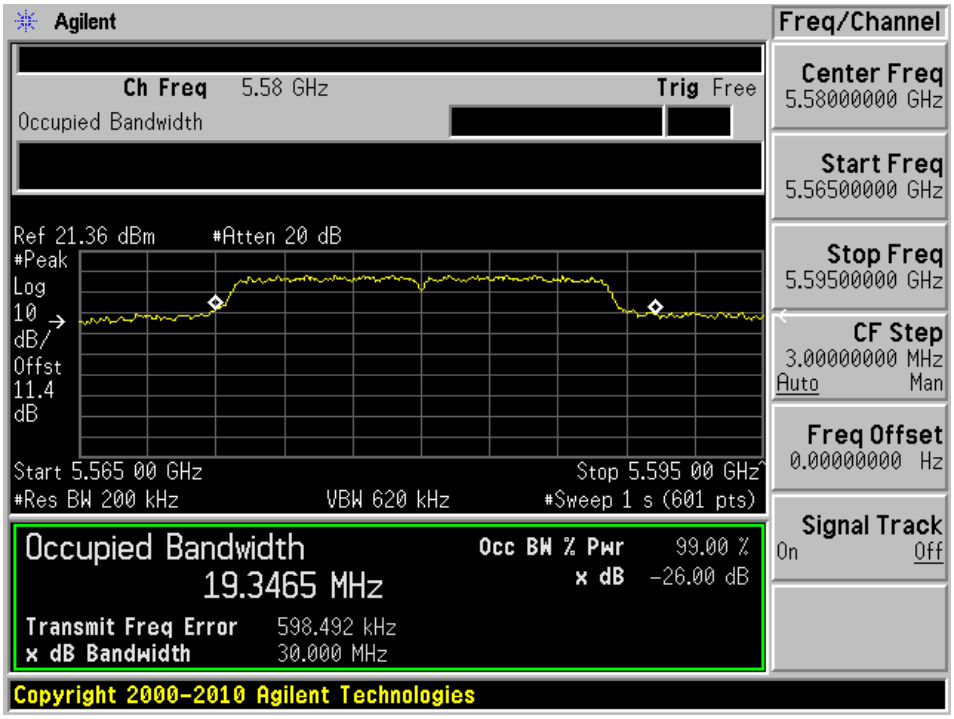
5.47-5.725 GHz

802.11a Mode

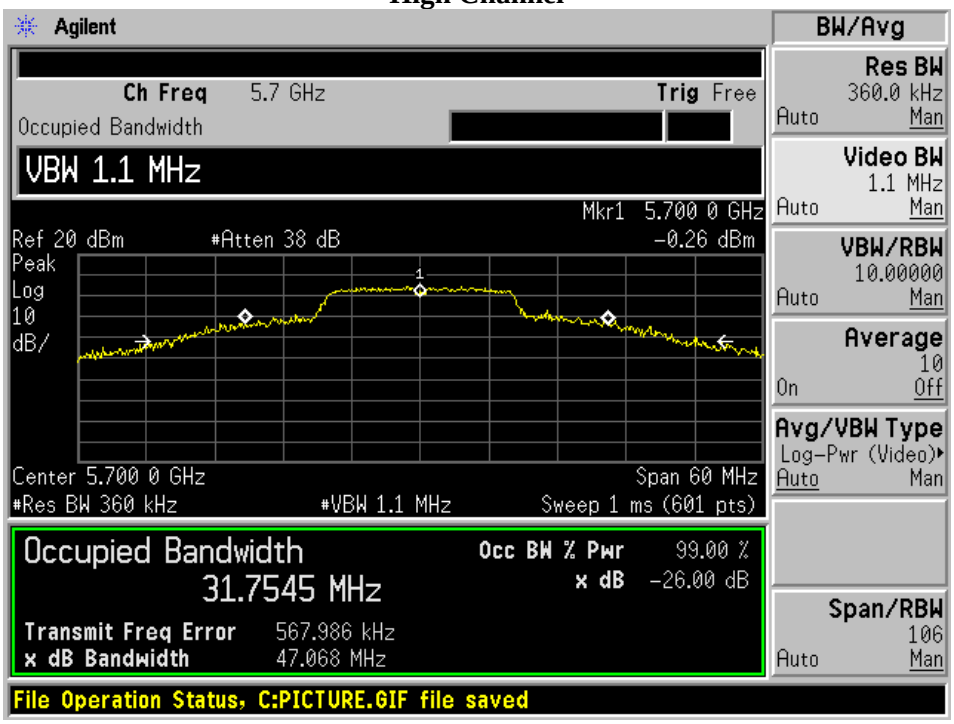
Low Channel



Mid Channel

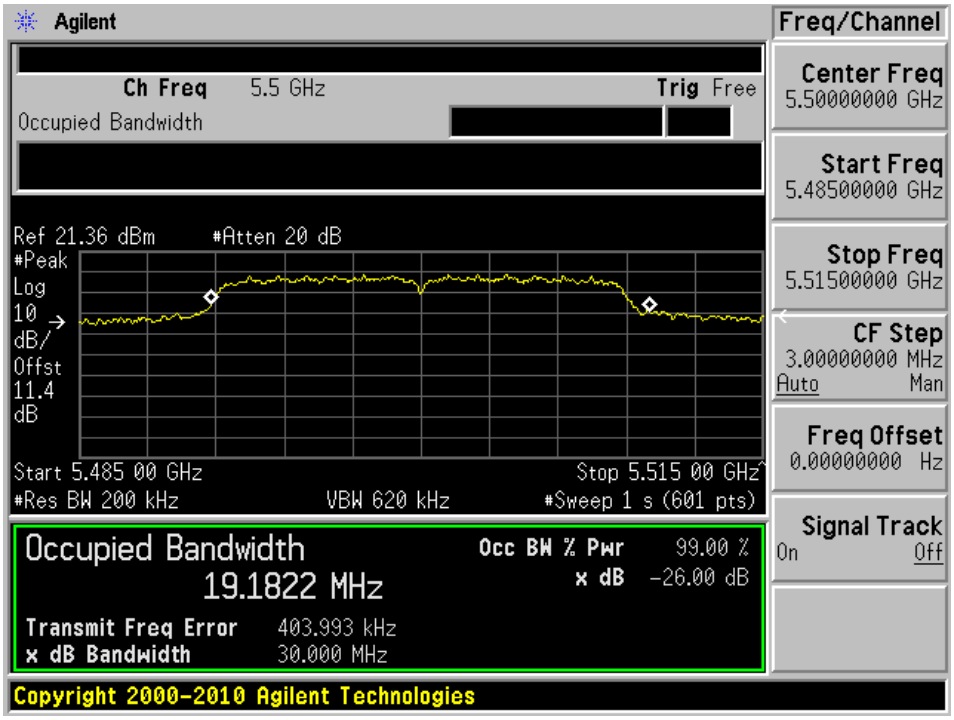


High Channel

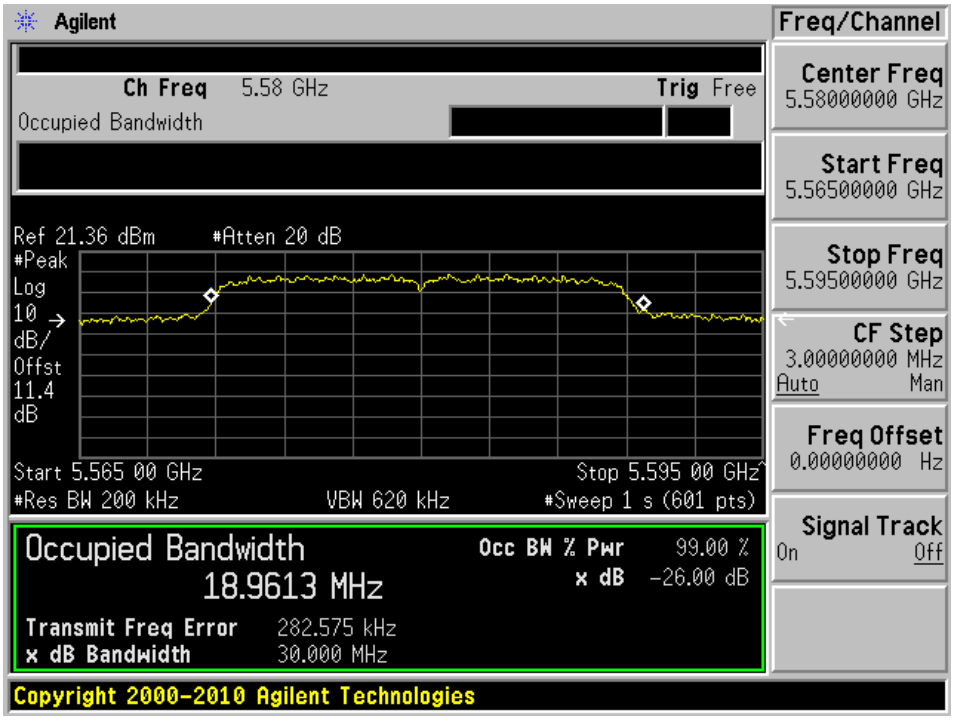


802.11n/ac20 Mode

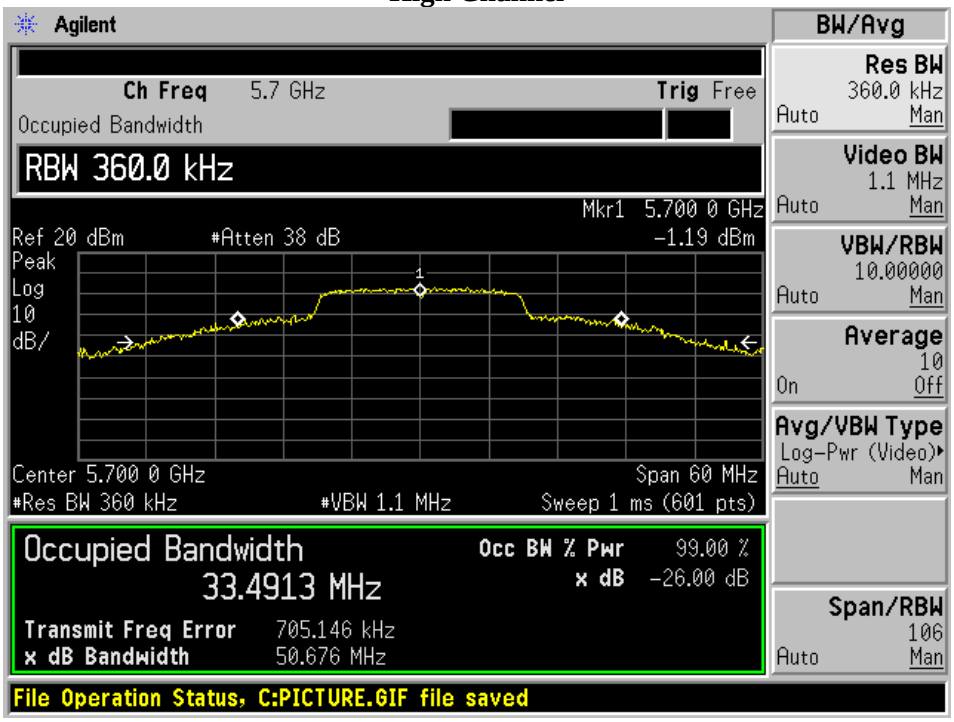
Low Channel



Mid Channel

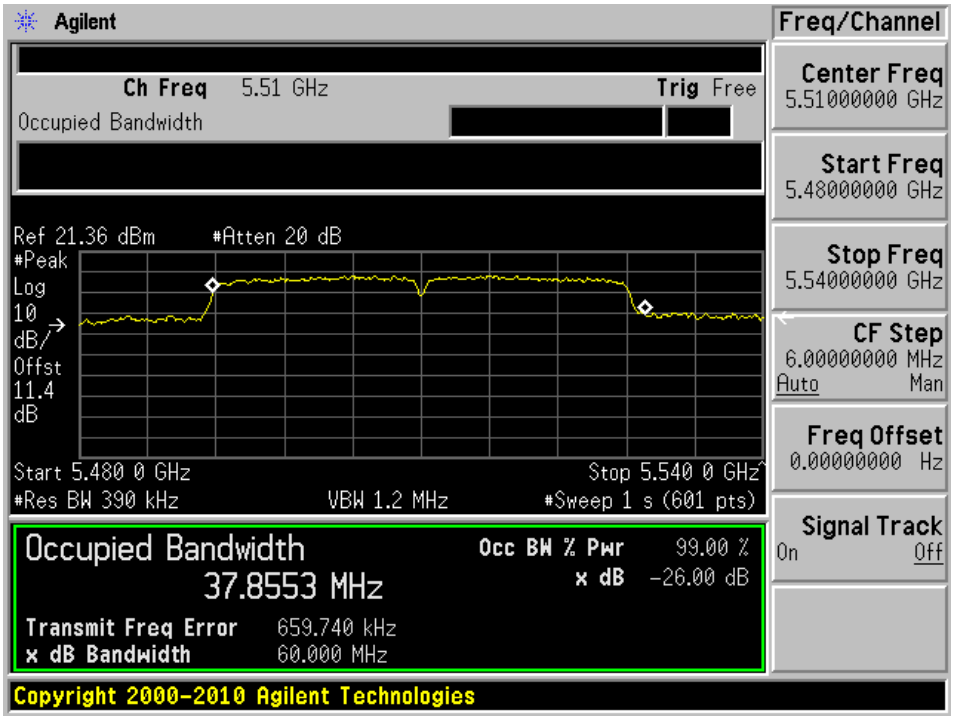


High Channel

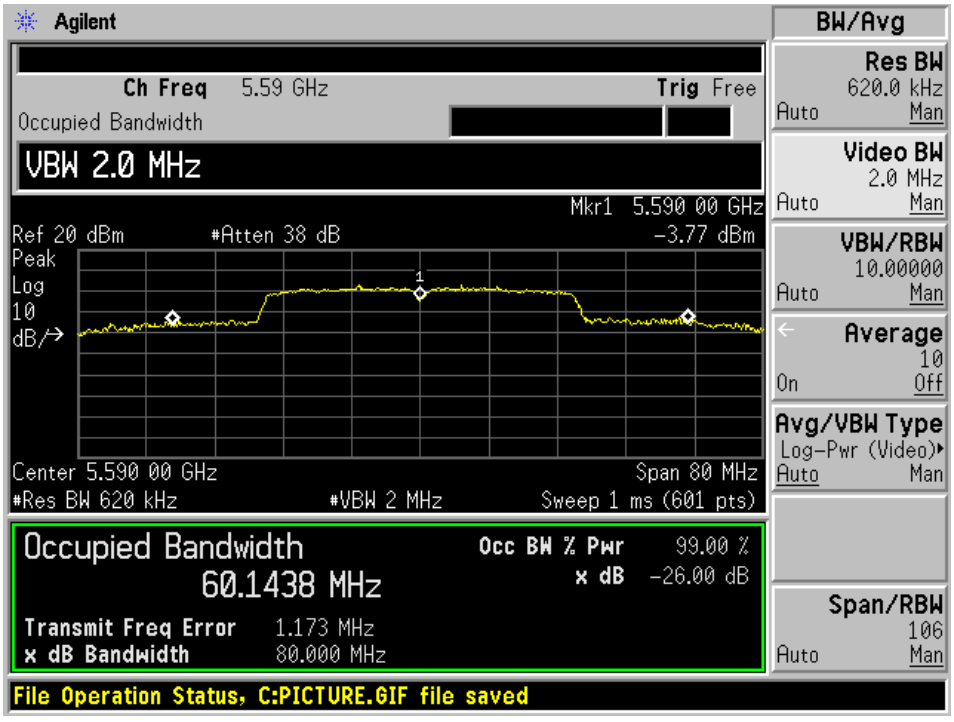


802.11n/ac40 Mode

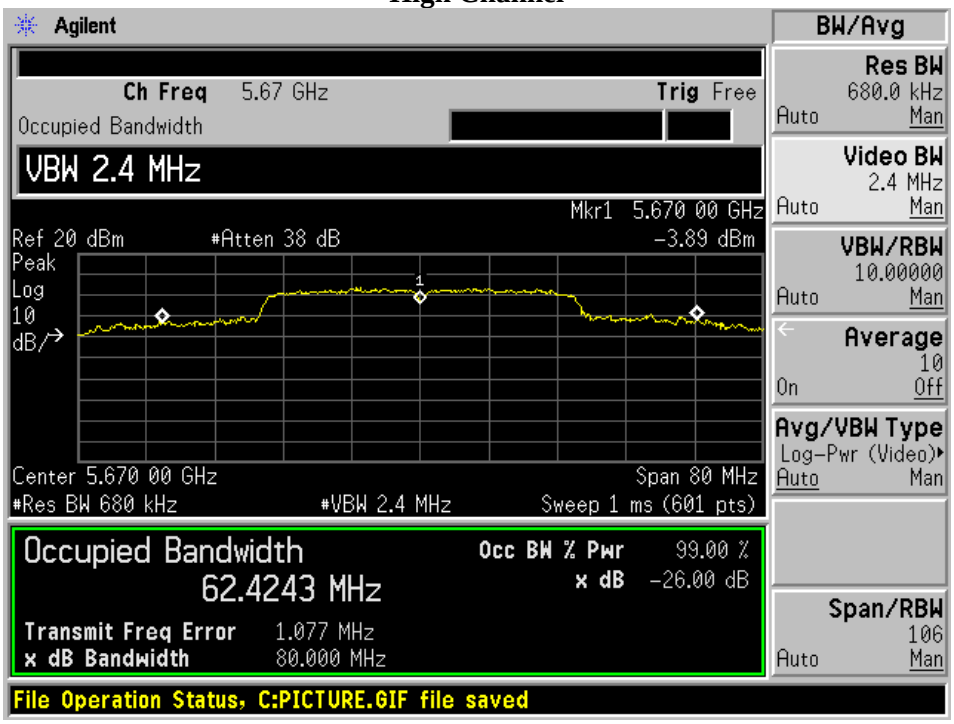
Low Channel



Mid Channel



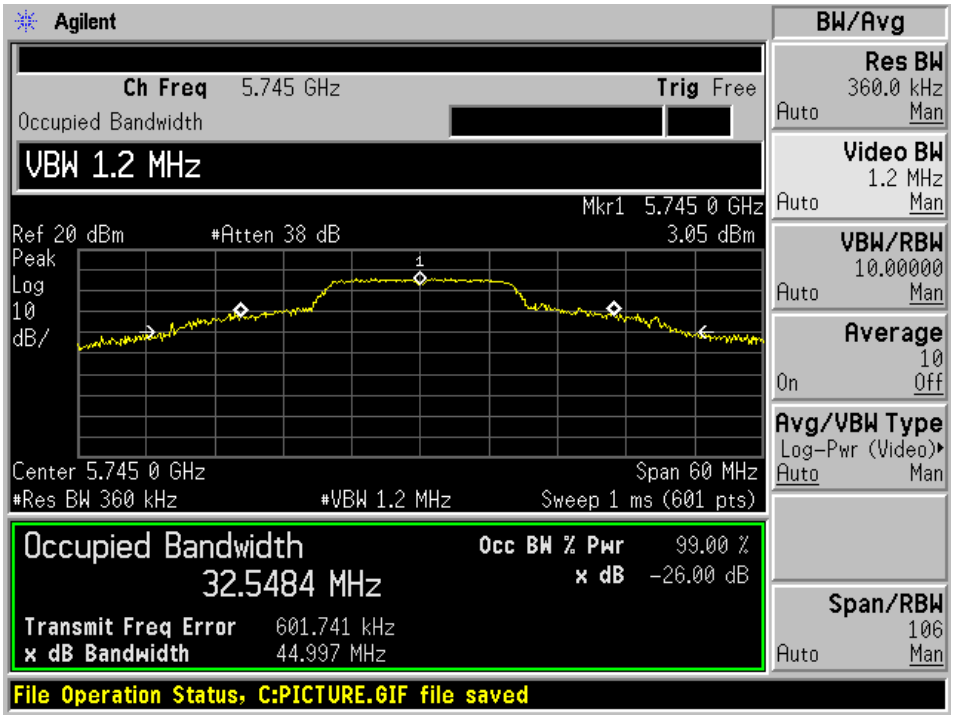
High Channel



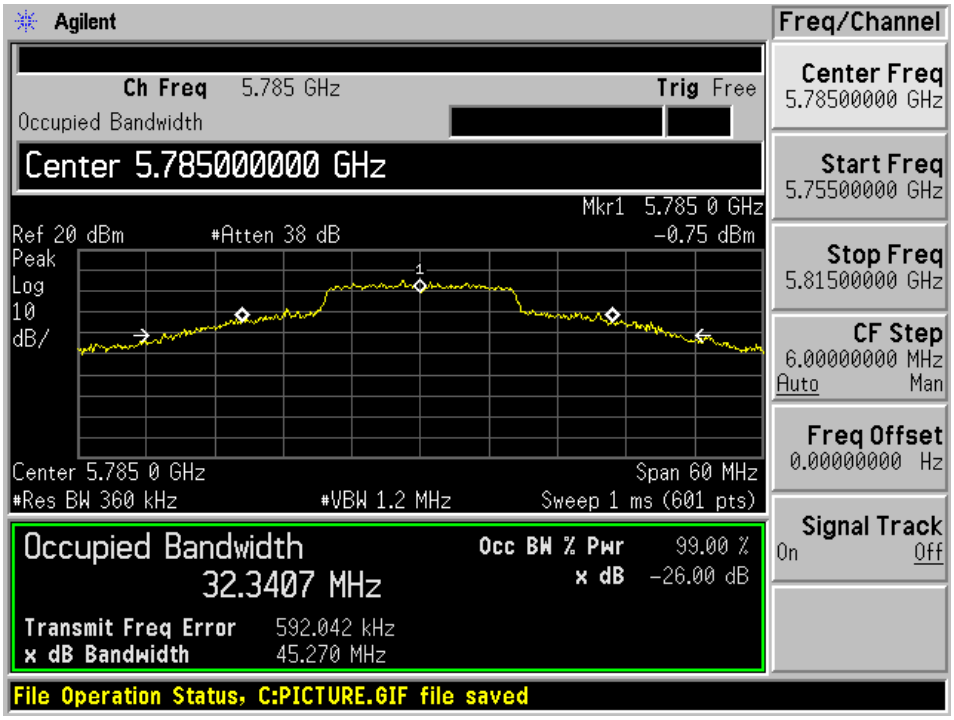
5745 - 5825 MHz

802.11a Mode

Low Channel



Mid Channel



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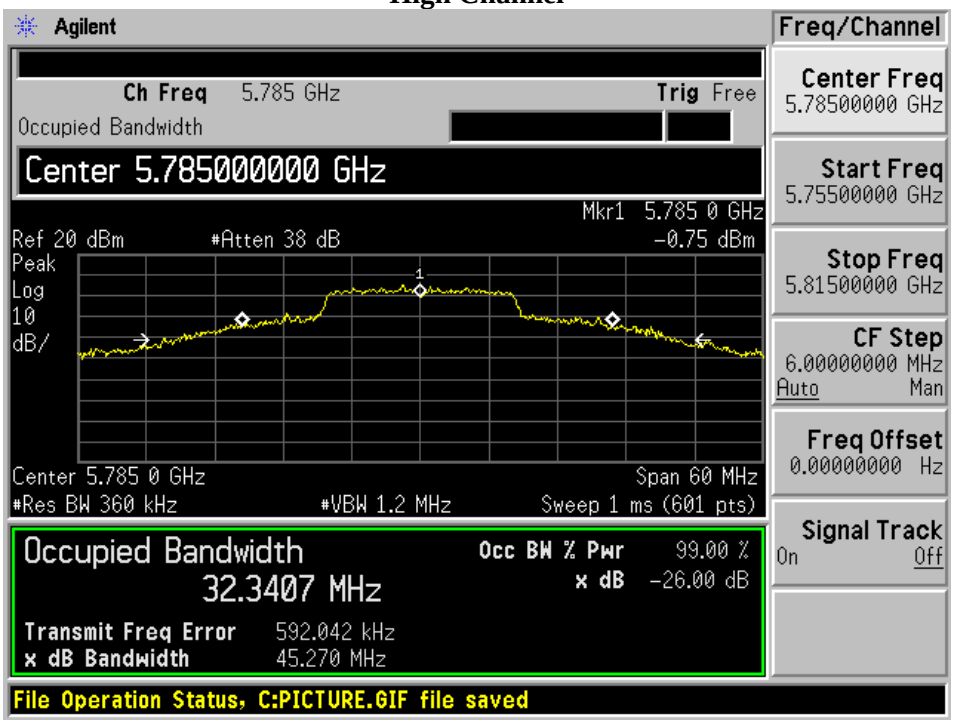
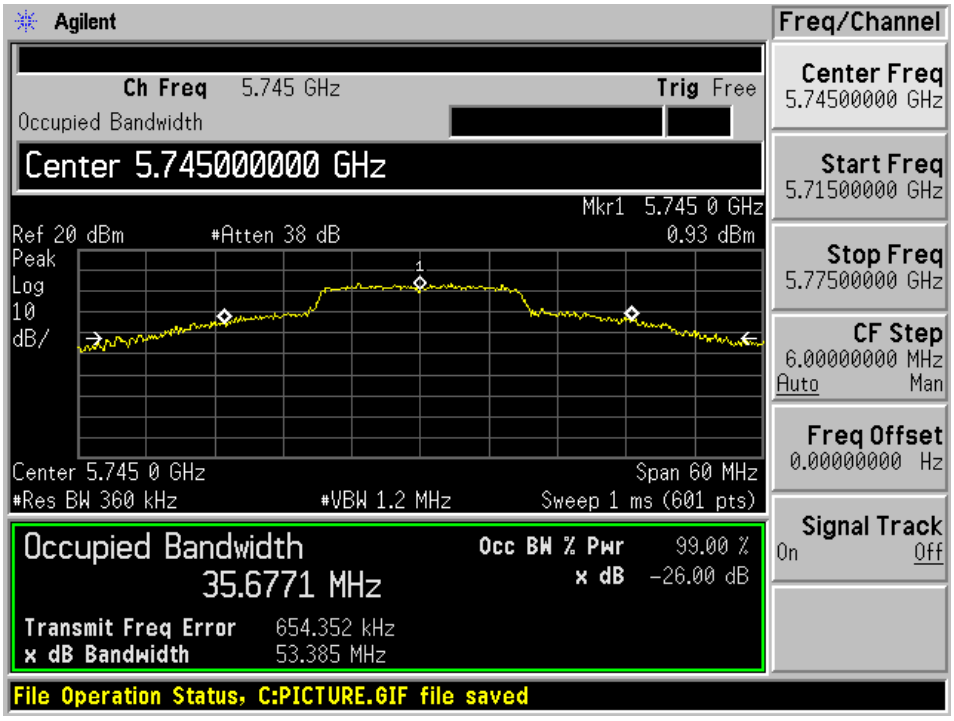
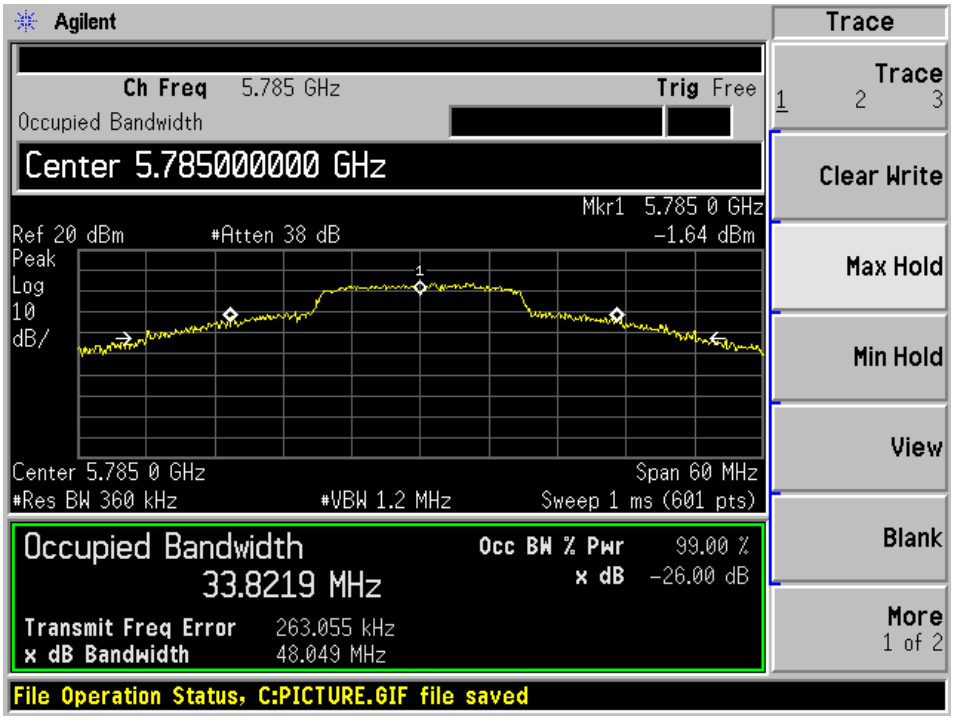


802.11n/ac20 Mode

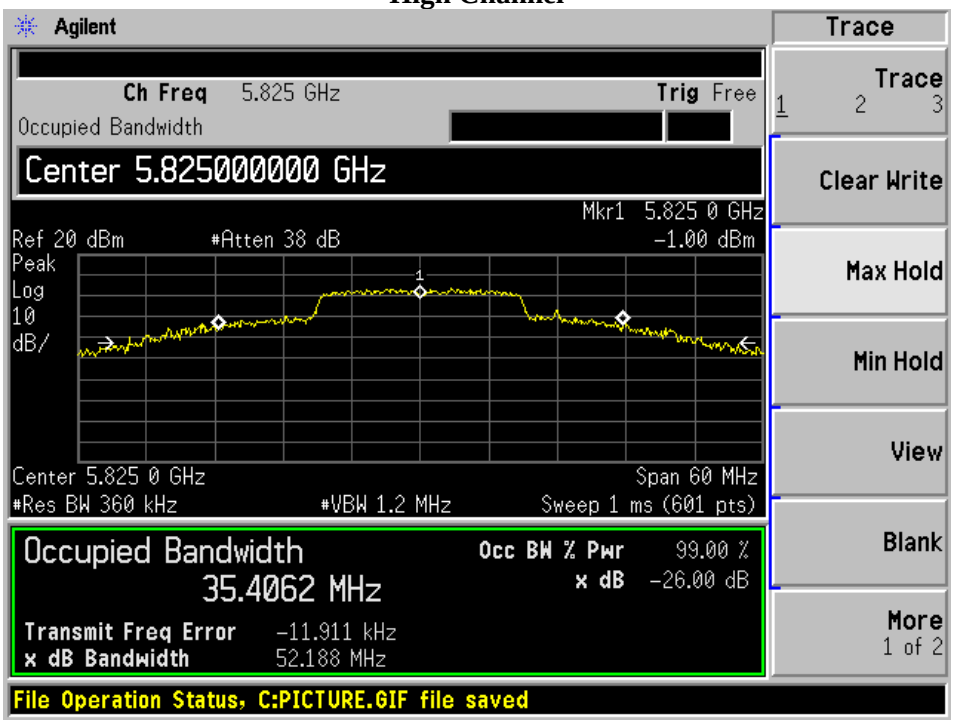
Low Channel



Mid Channel

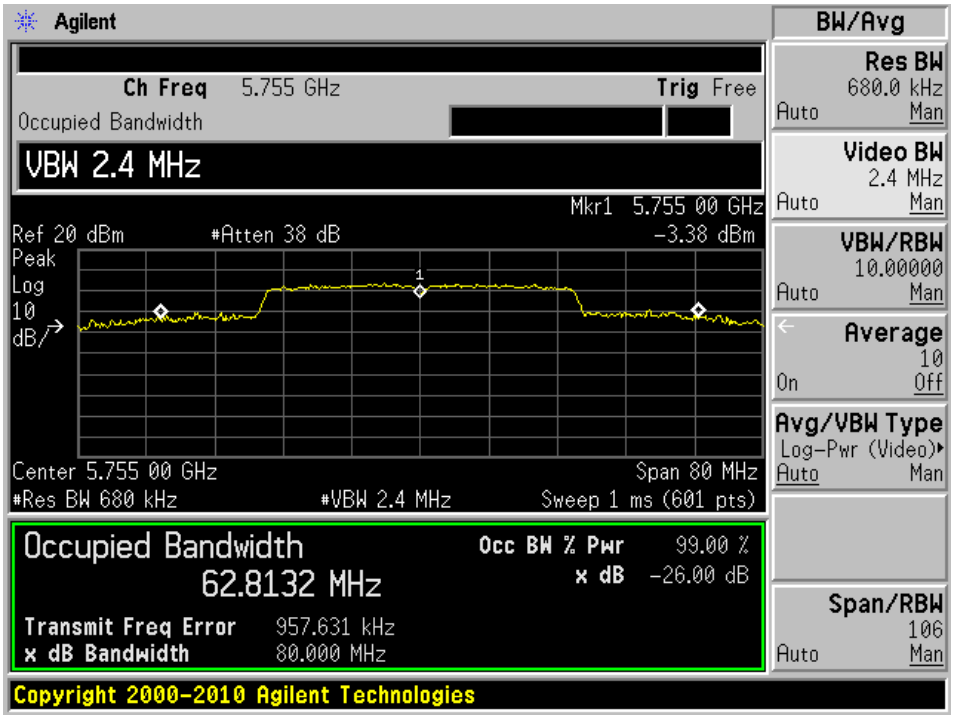


High Channel

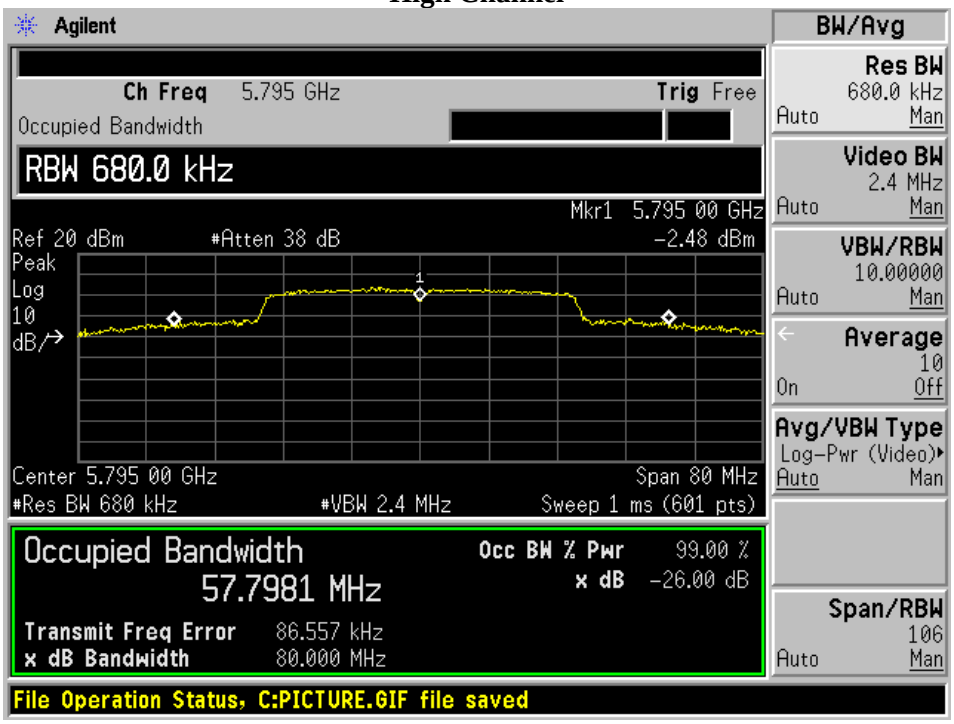


802.11n/ac40 Mode

Low Channel



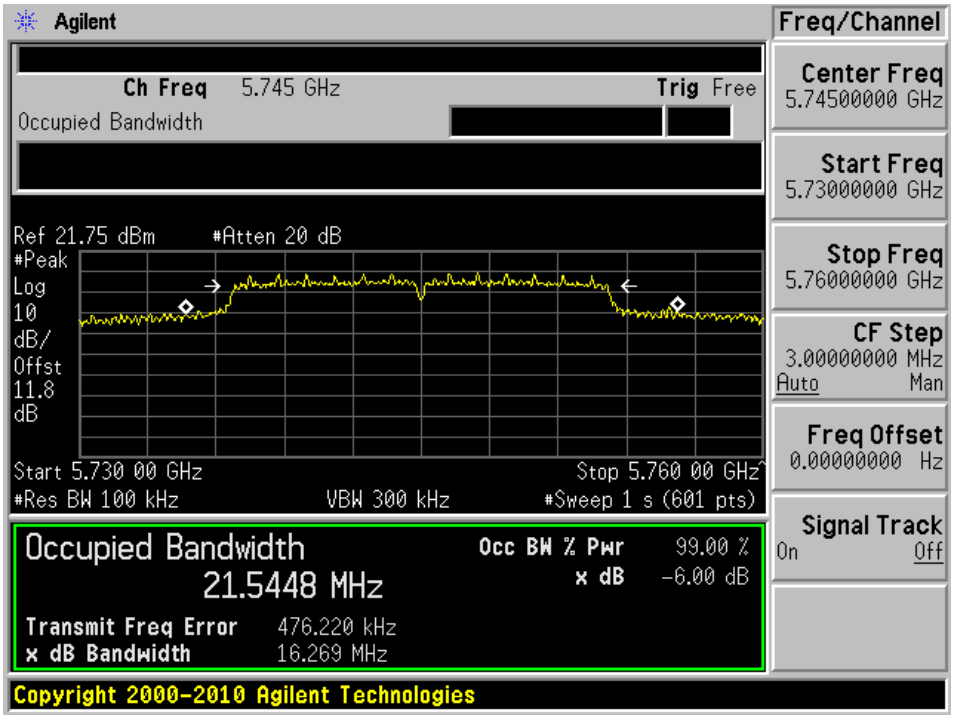
High Channel



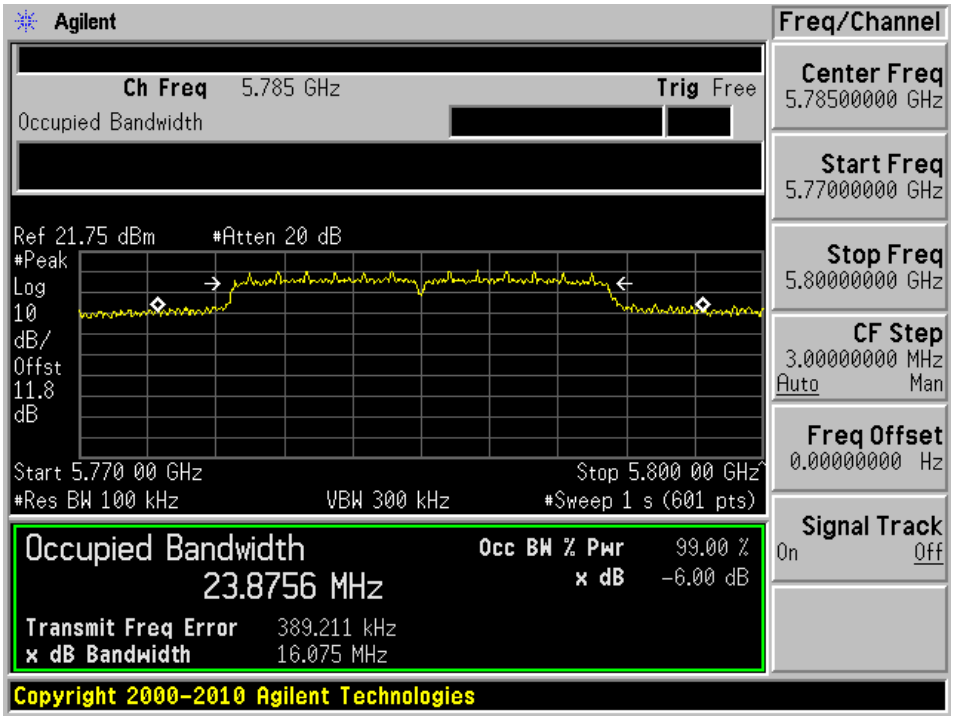
5.8GHz 6 dB OBW

802.11a

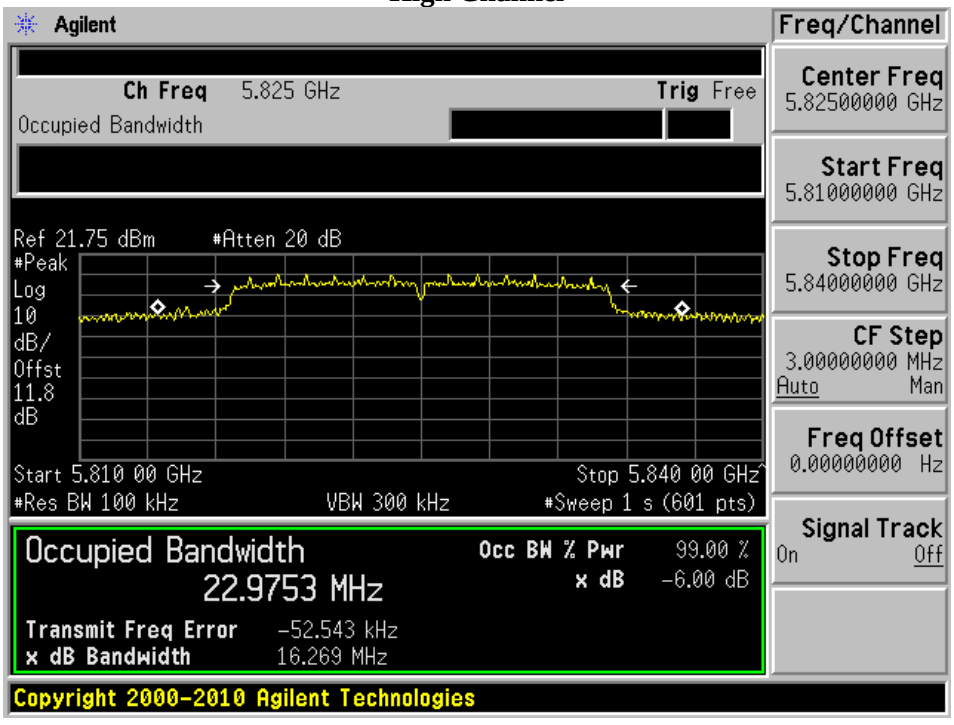
Low Channel



Middle Channel

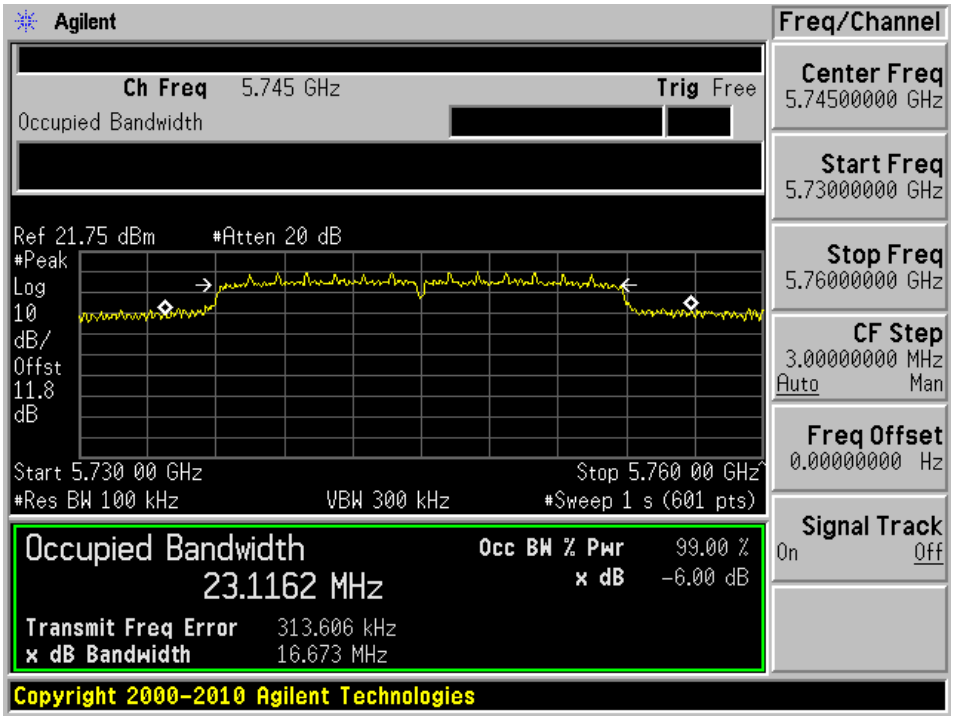


High Channel

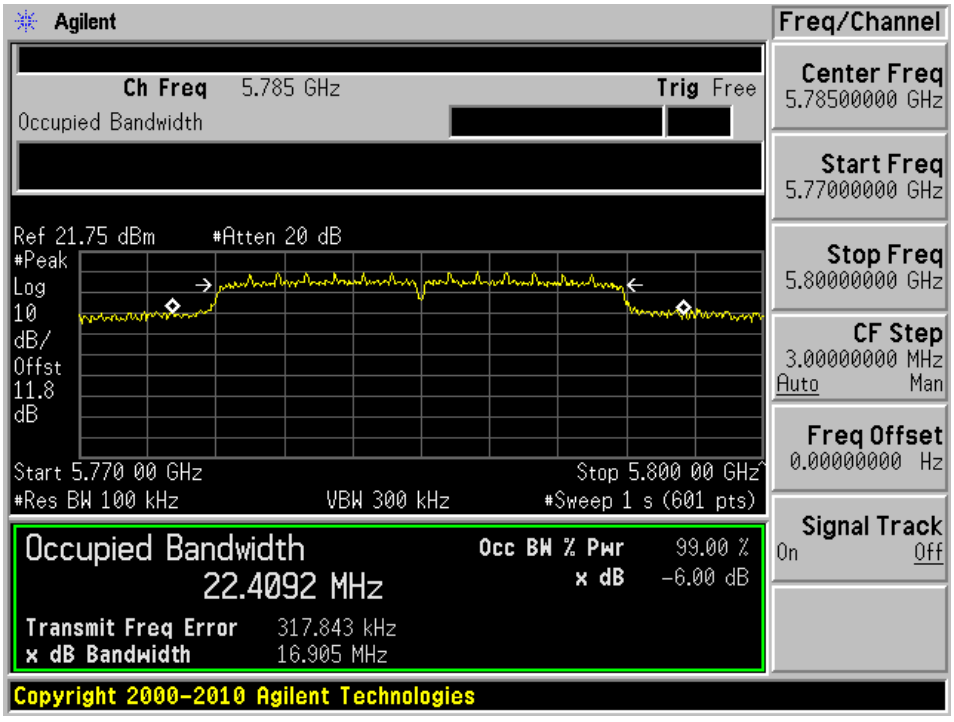


802.11n/ac20

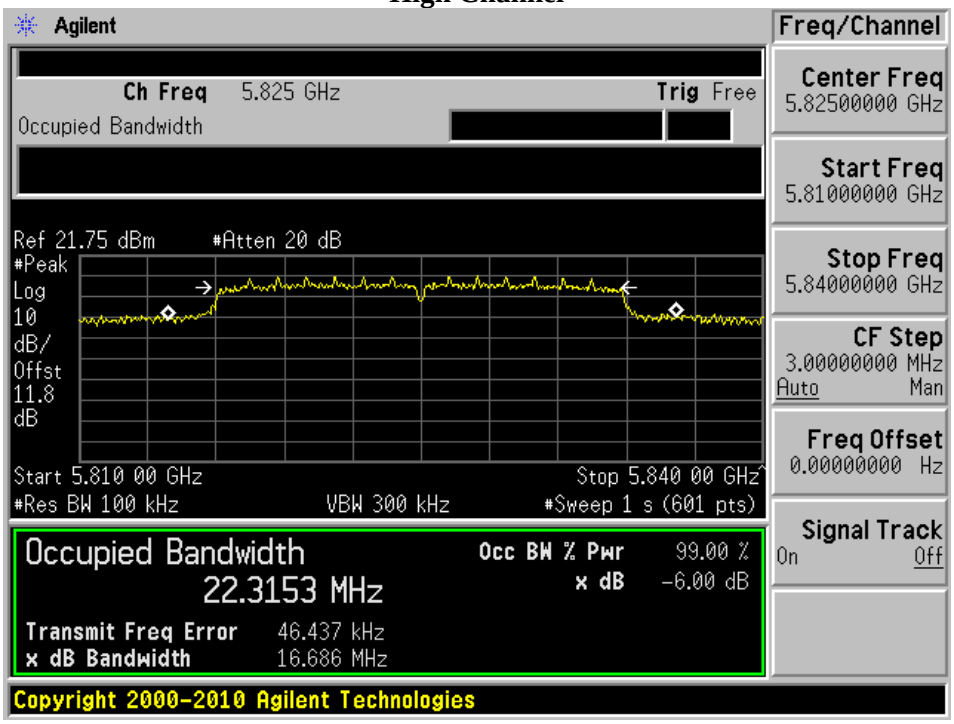
Low Channel



Mid Channel

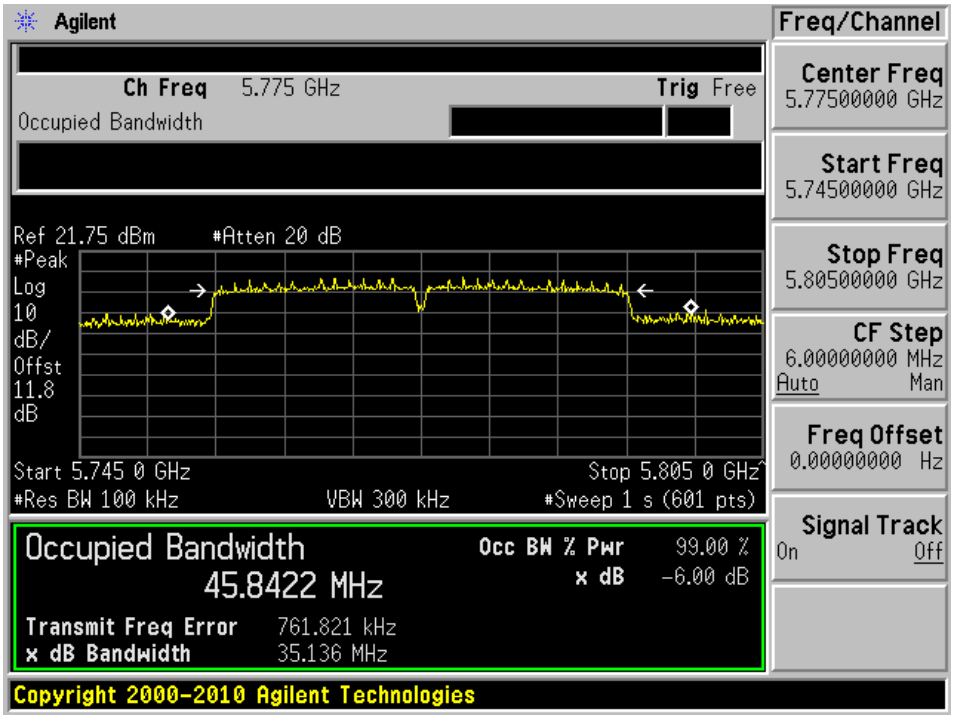


High Channel

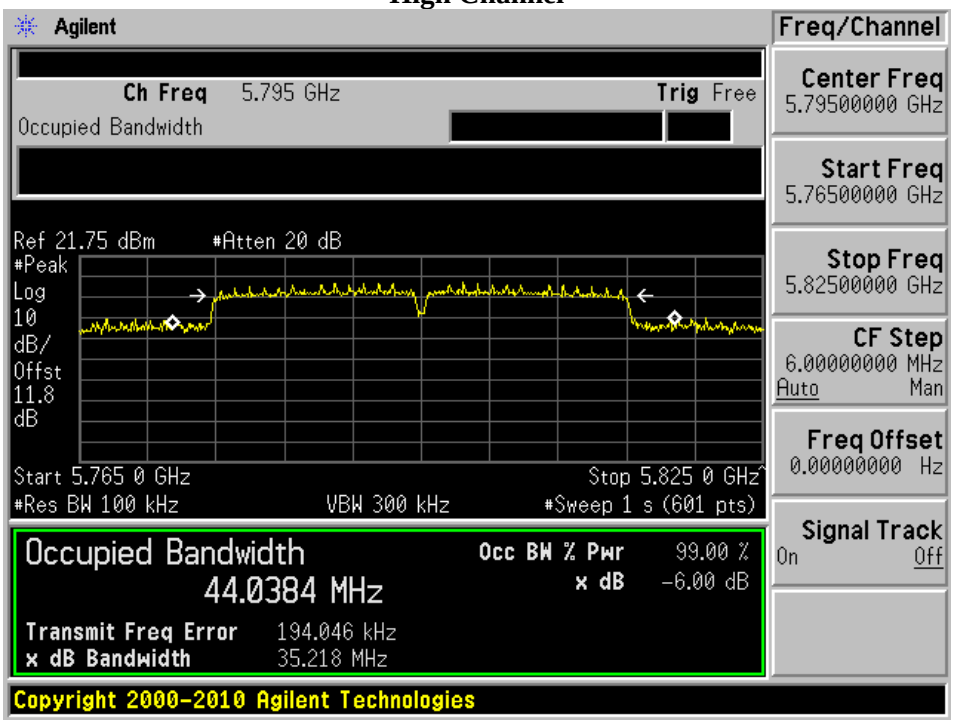


802.11n/ac40

Low Channel



High Channel

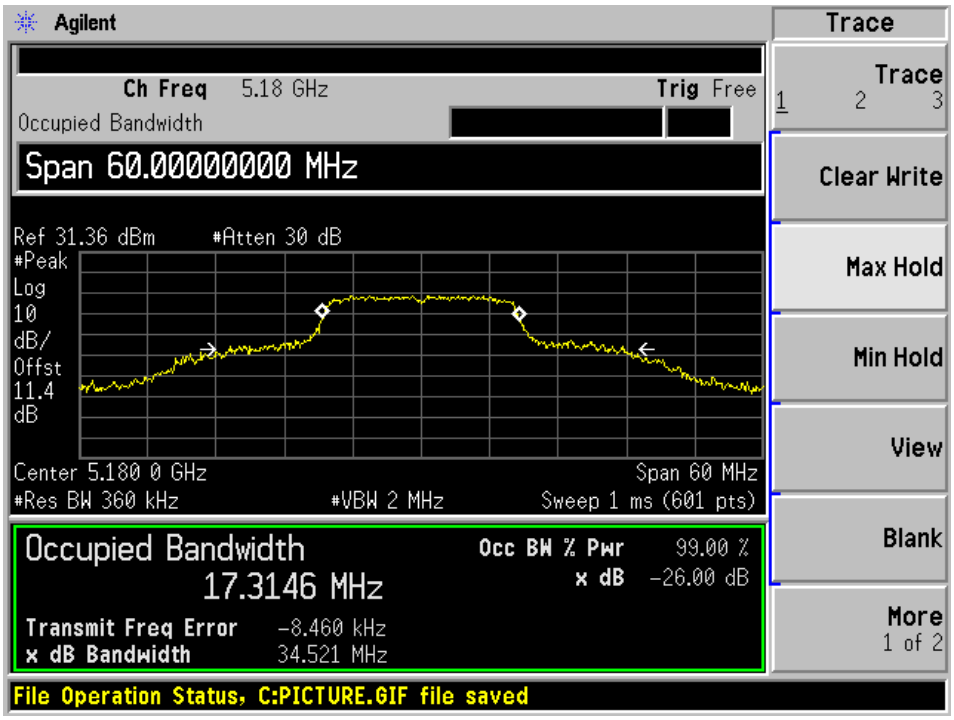


26 dB OBW

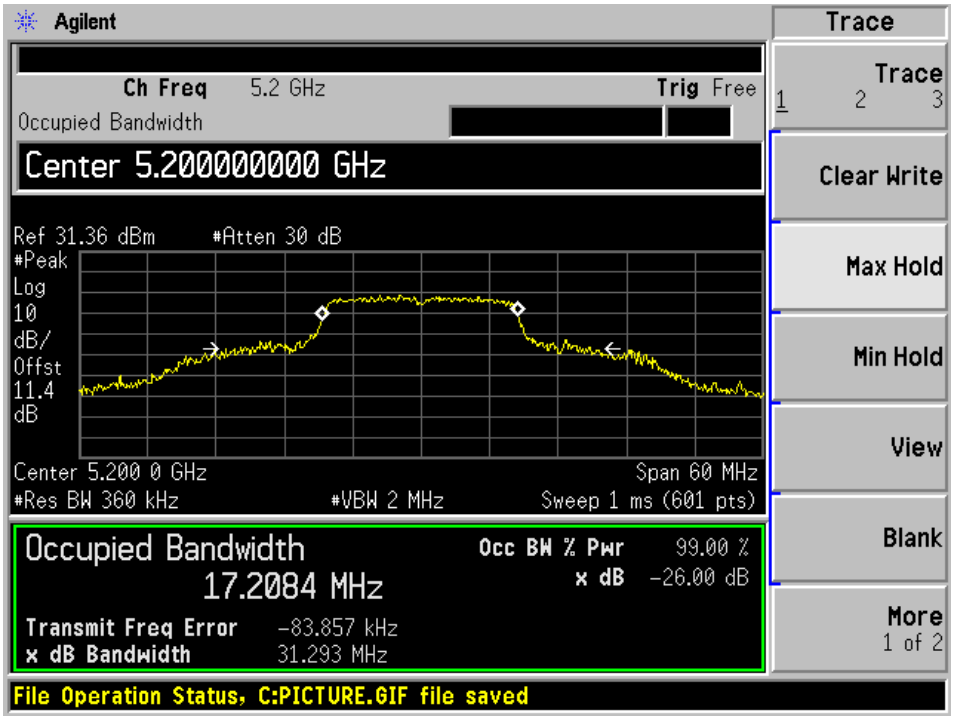
5150 - 5250 MHz

802.11a Mode

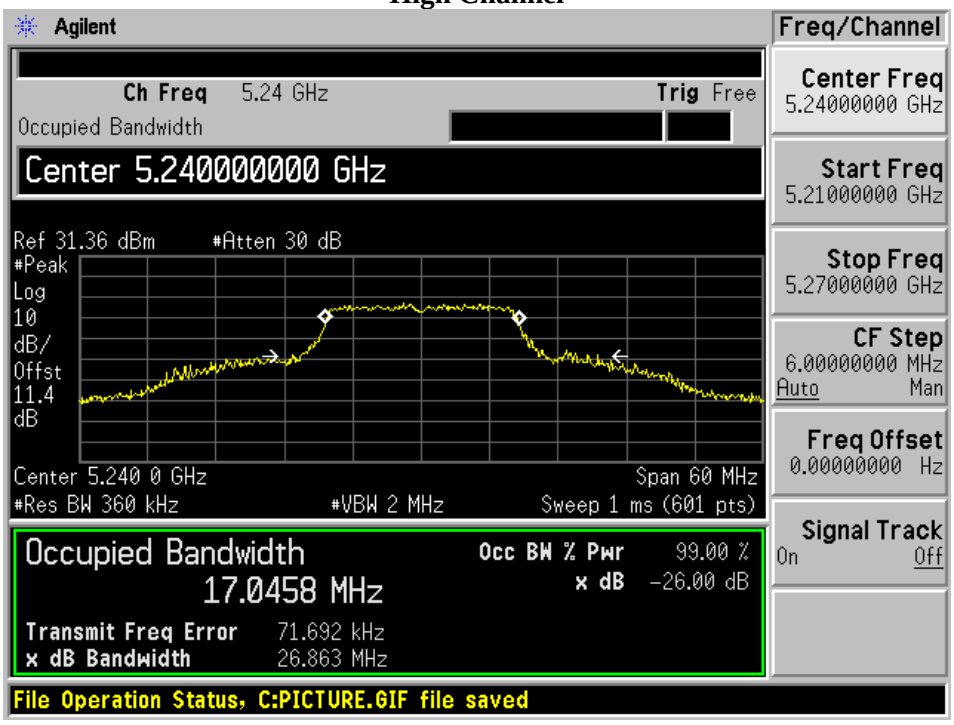
Low Channel



Mid Channel

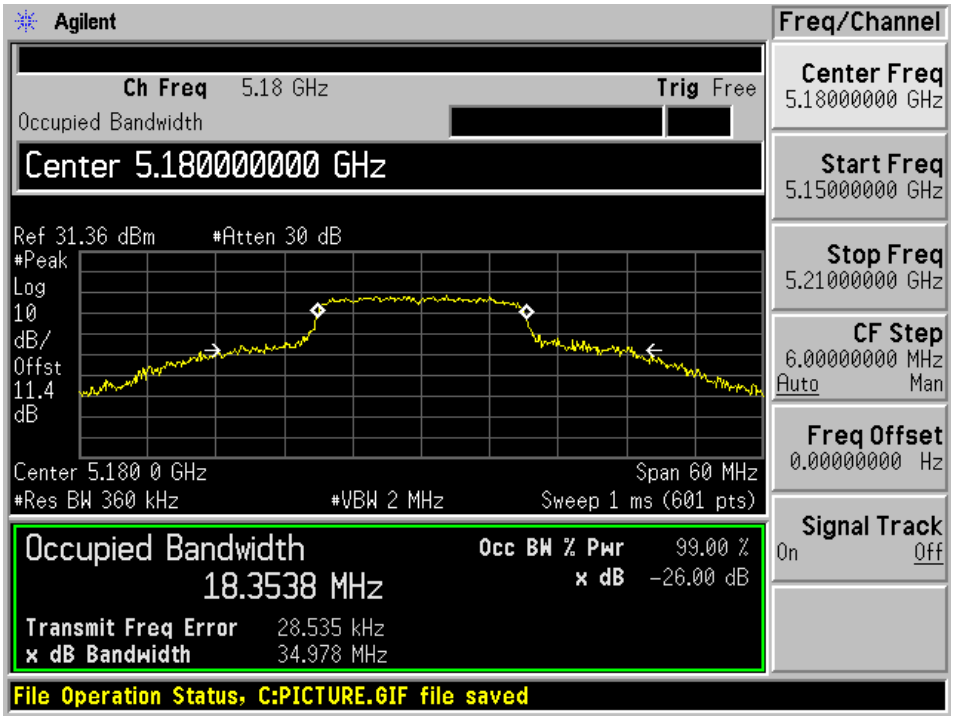


High Channel

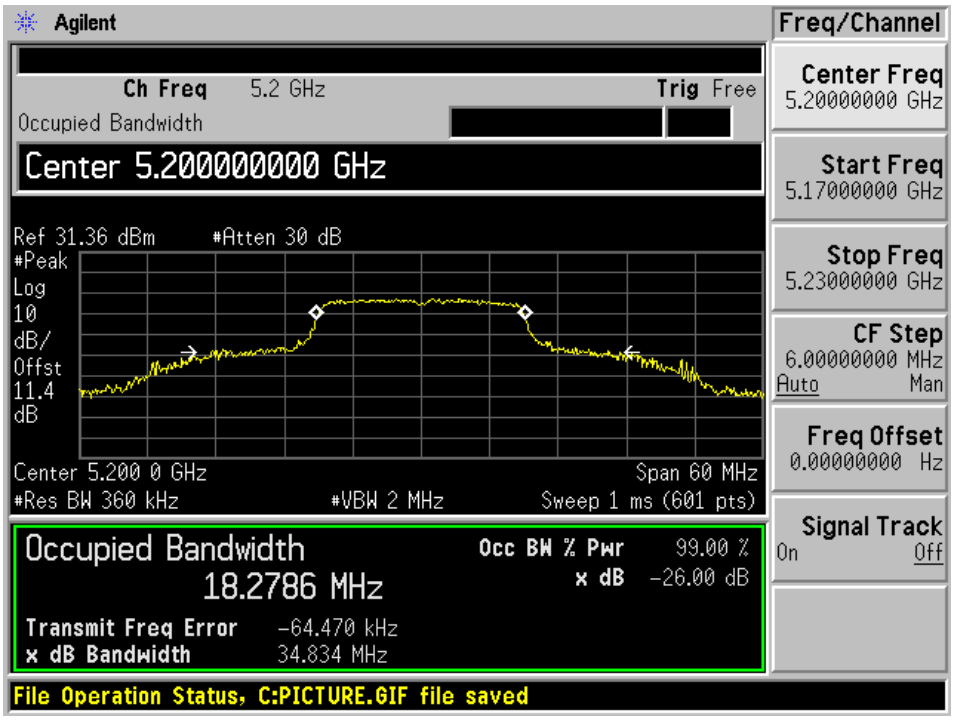


802.11n/ac20 Mode

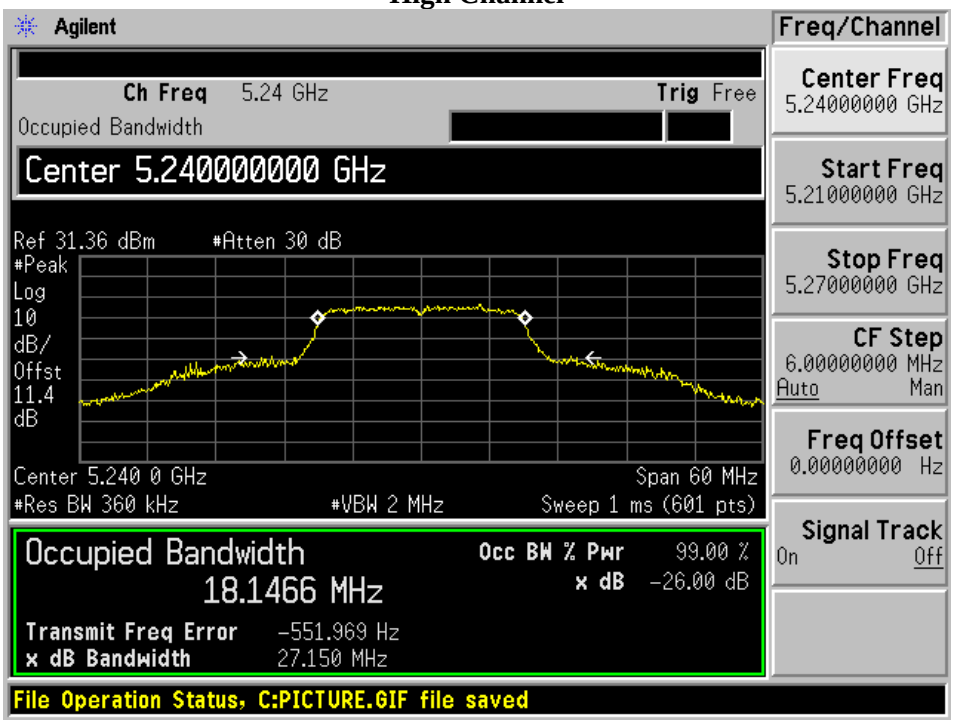
Low Channel



Middle Channel

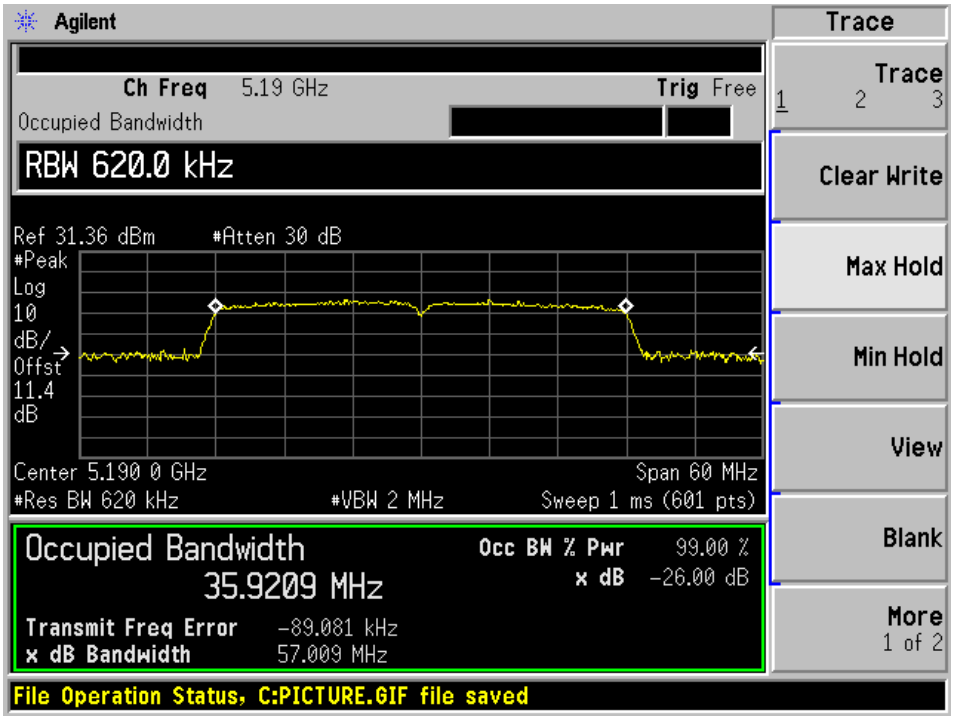


High Channel

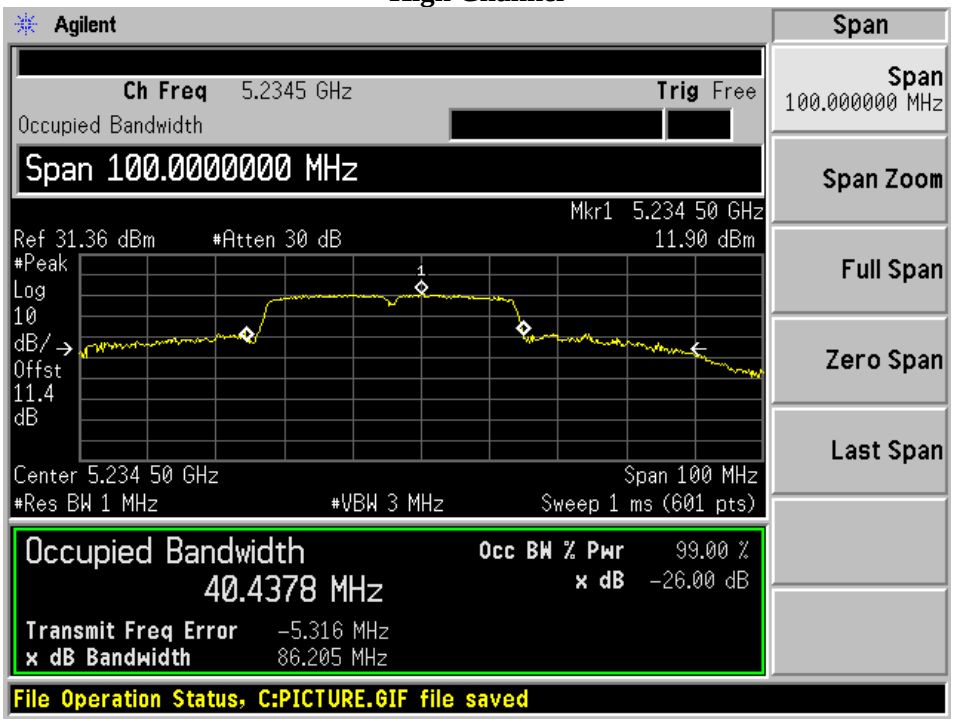


802.11n/ac40 Mode

Low Channel



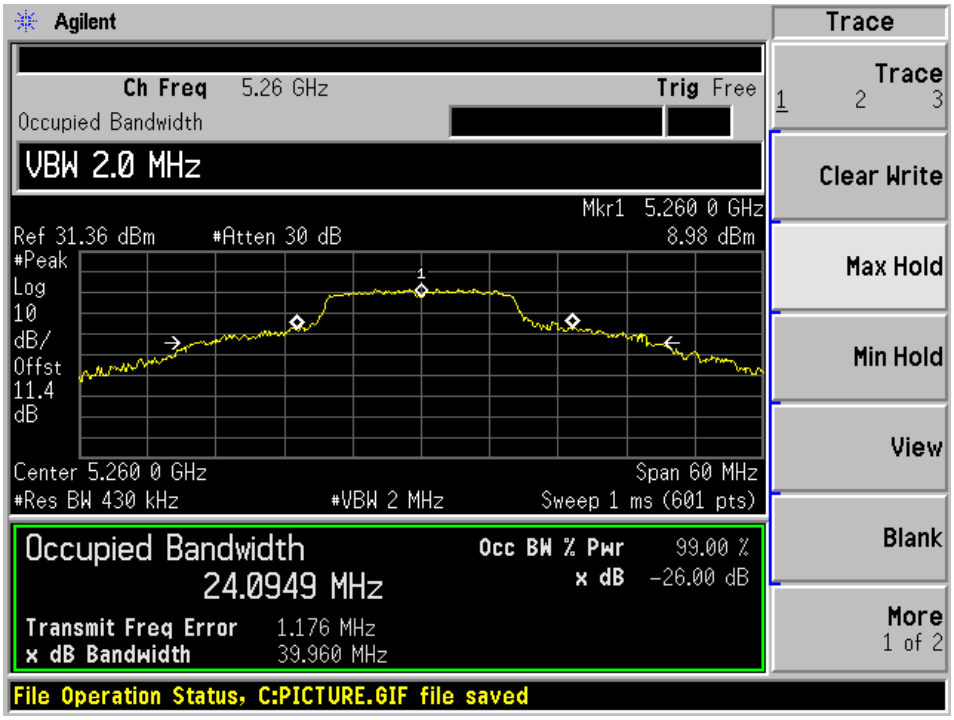
High Channel



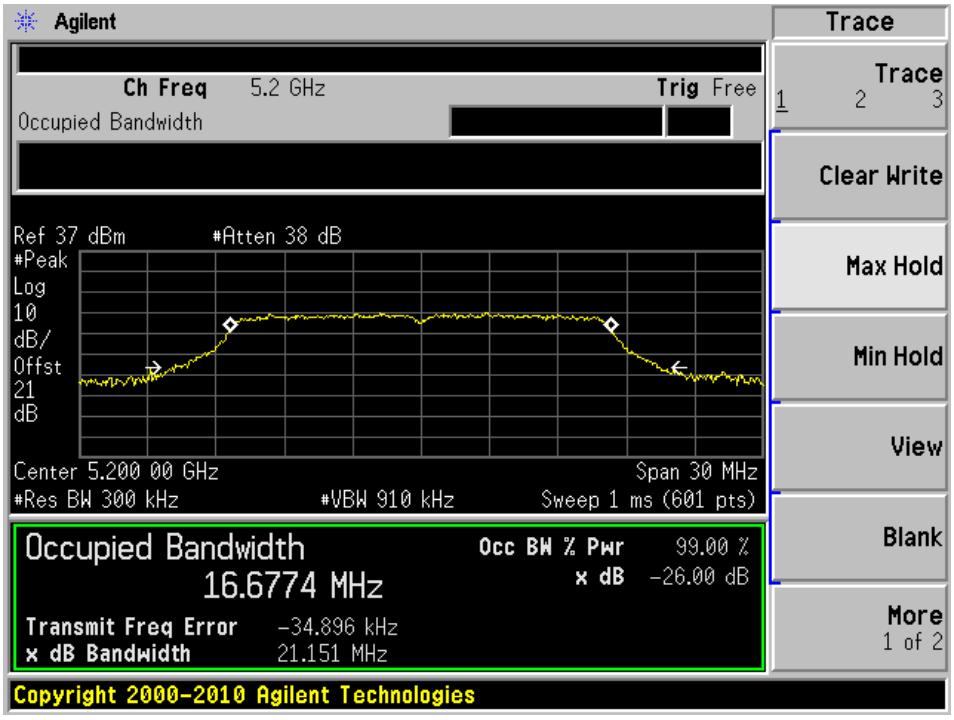
5.25-5.35 GHz

802.11a Mode

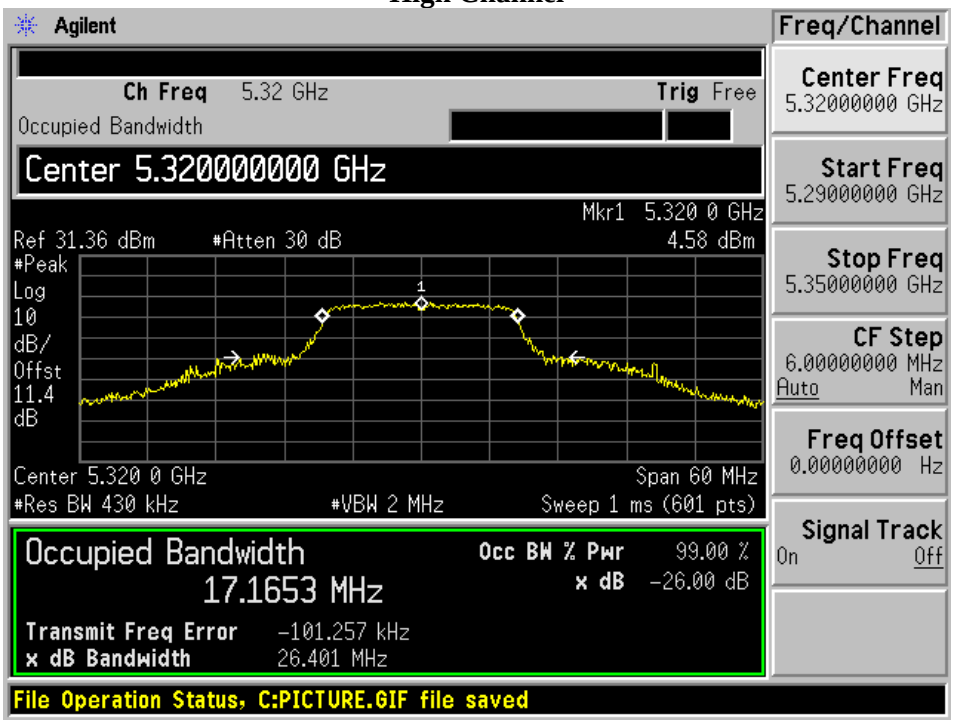
Low Channel



Mid Channel

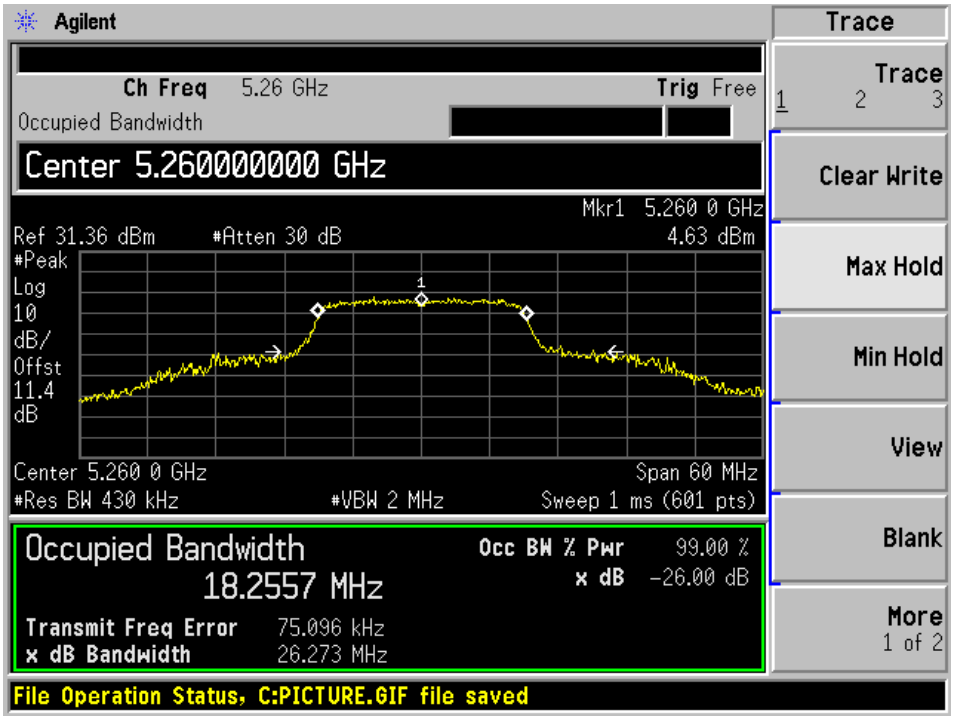


High Channel

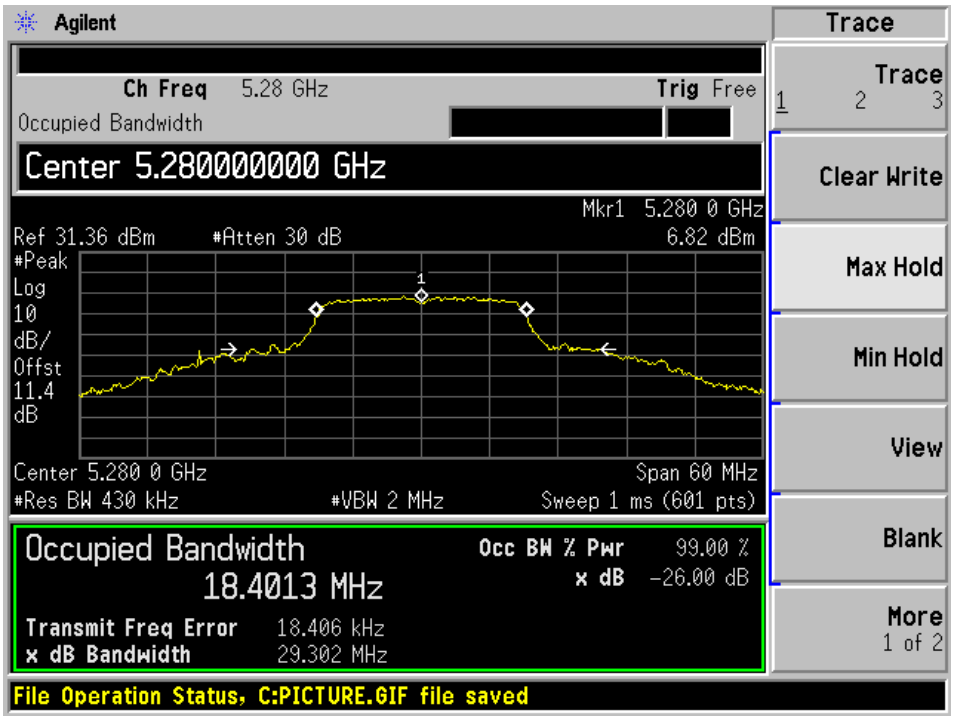


802.11n/ac20 Mode

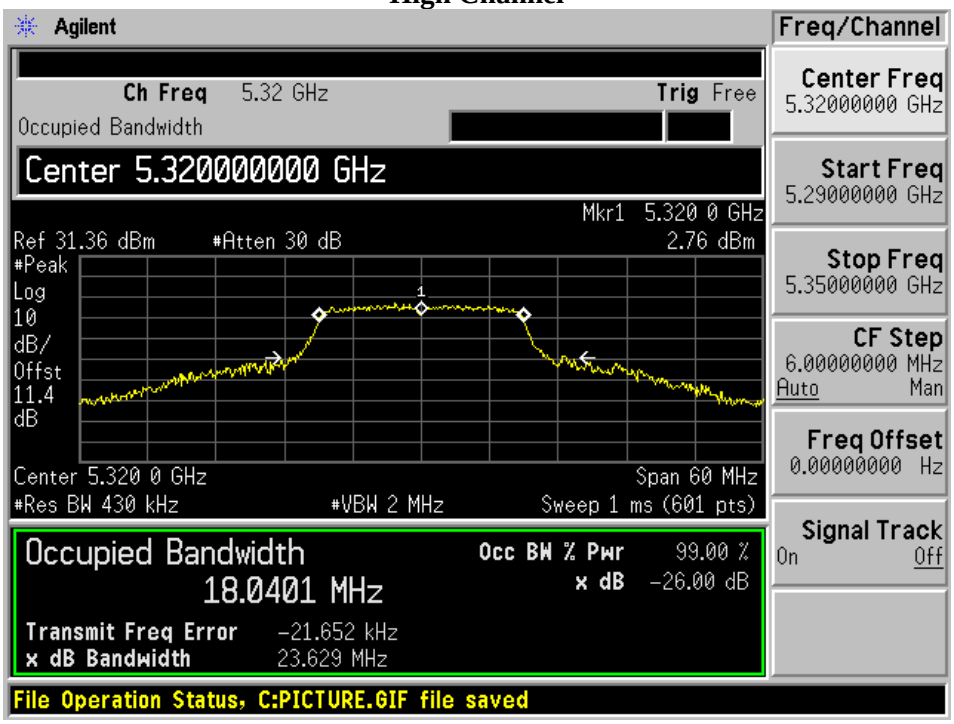
Low Channel



Mid Channel

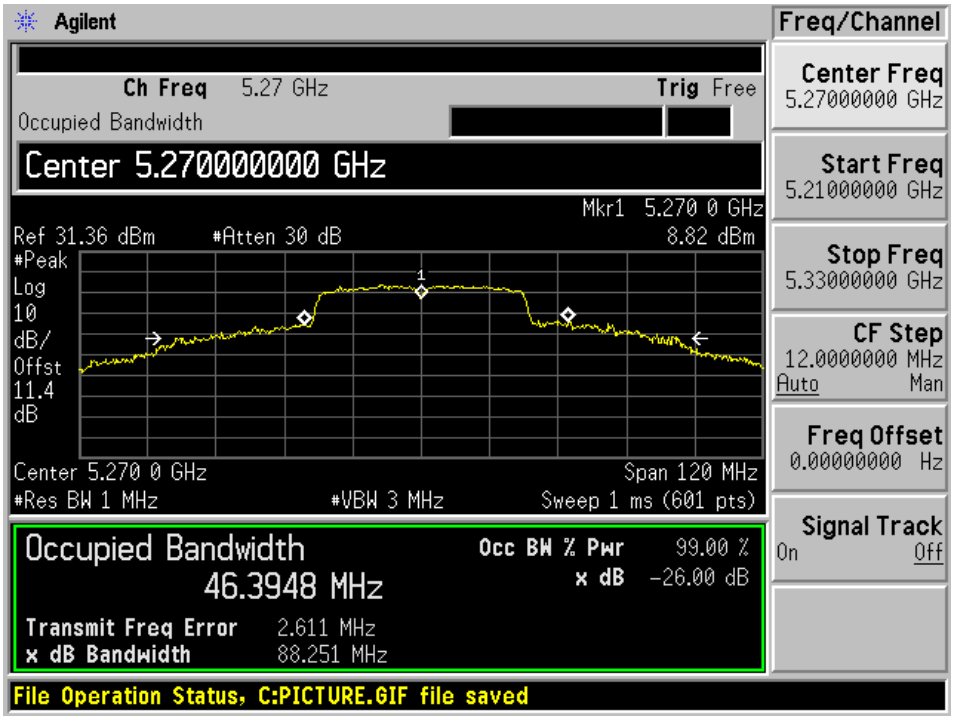


High Channel

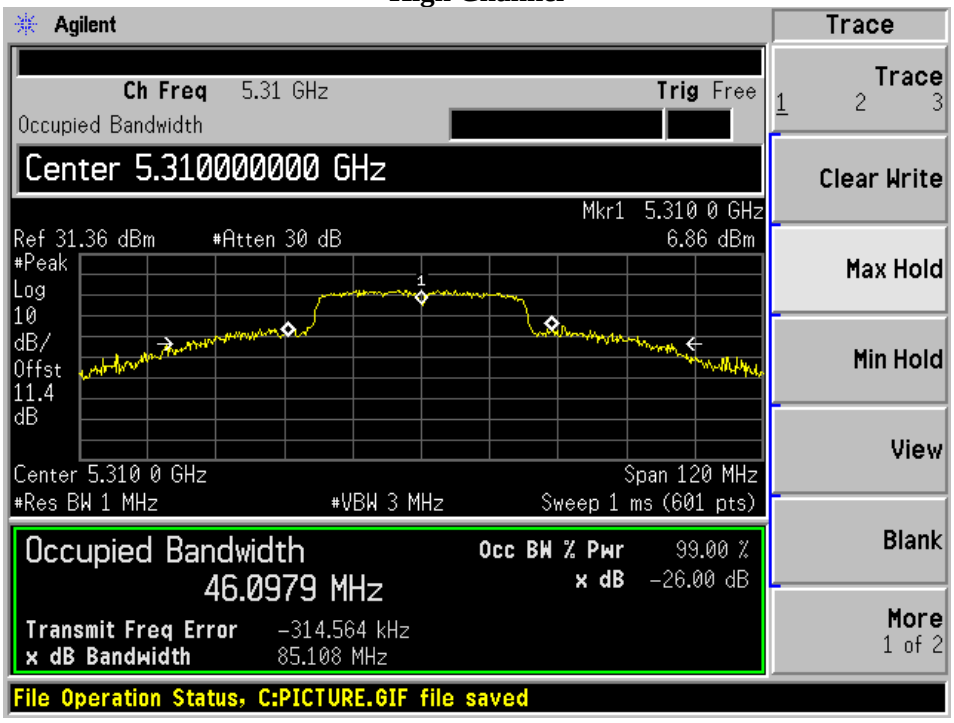


802.11n/ac40 Mode

Low Channel



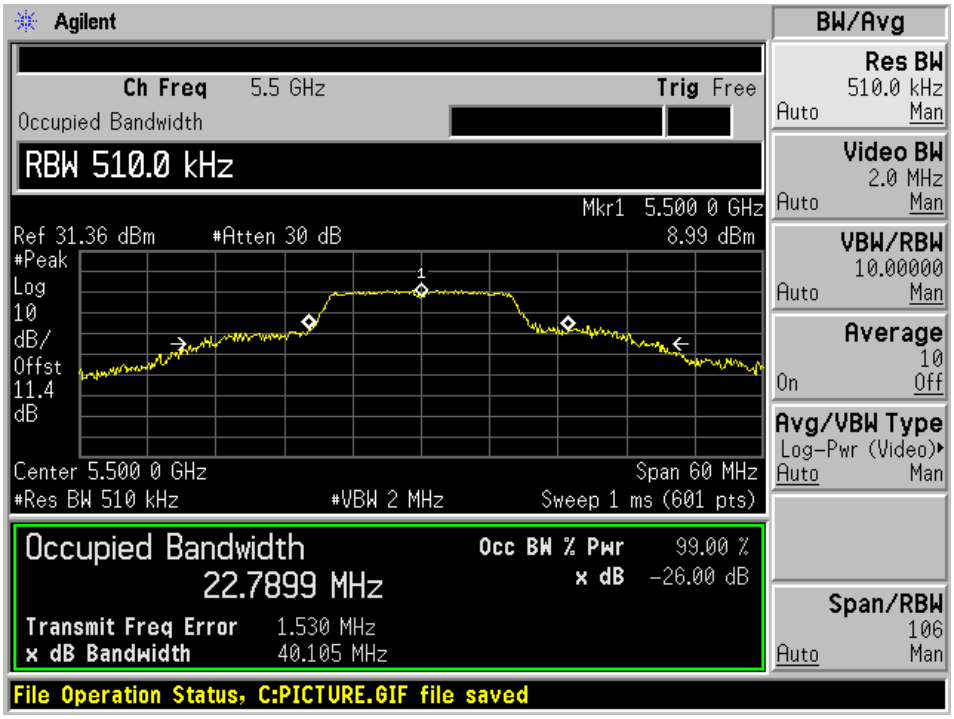
High Channel



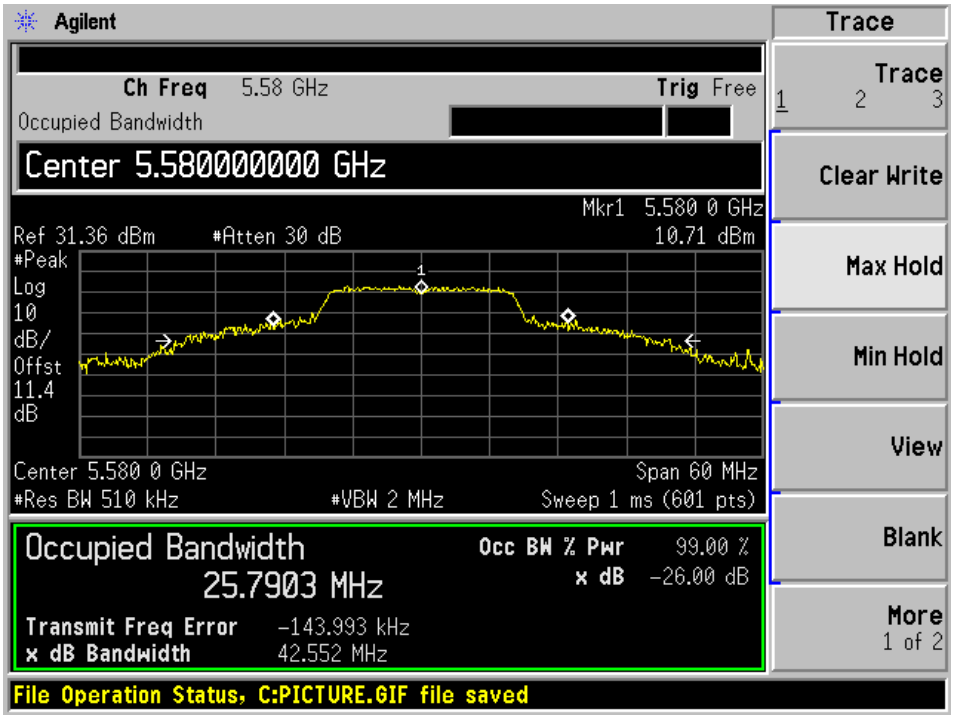
5.47-5.725 GHz

802.11a Mode

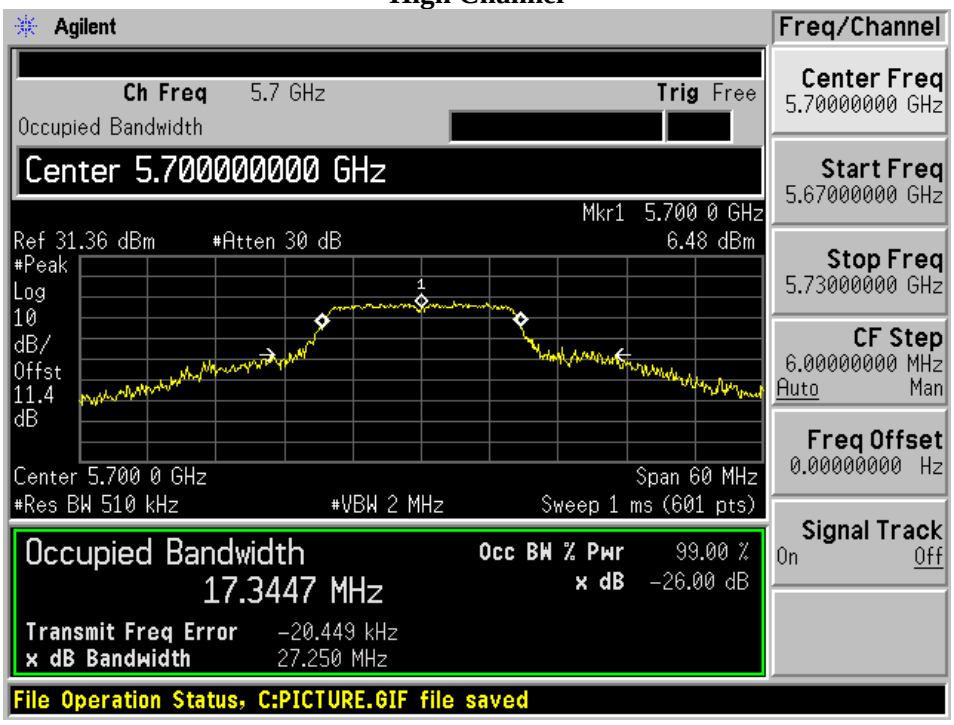
Low Channel



Mid Channel

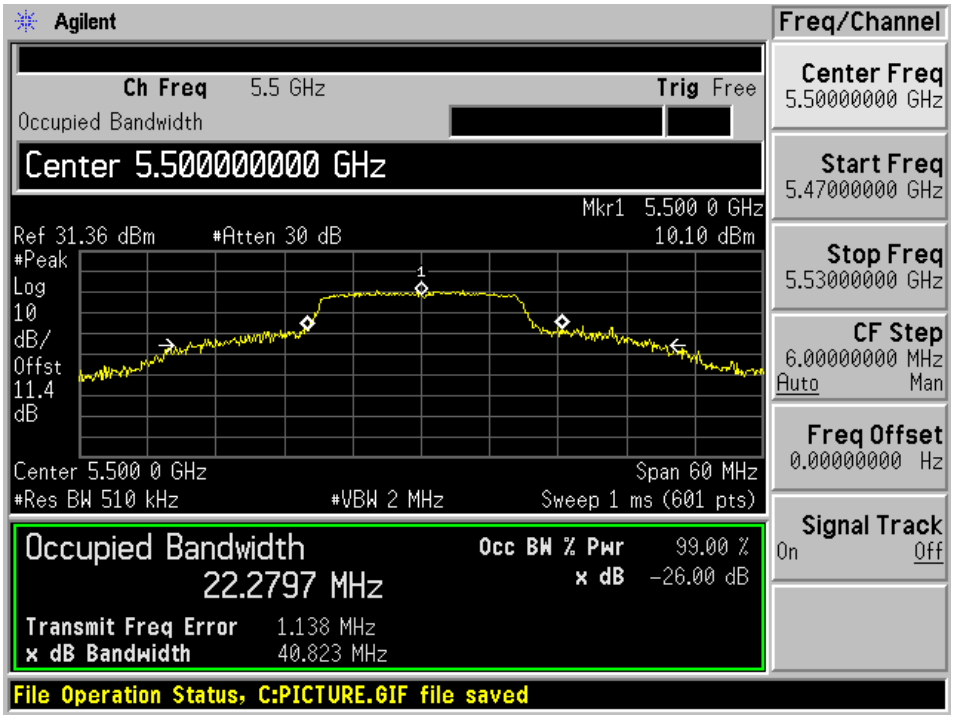


High Channel

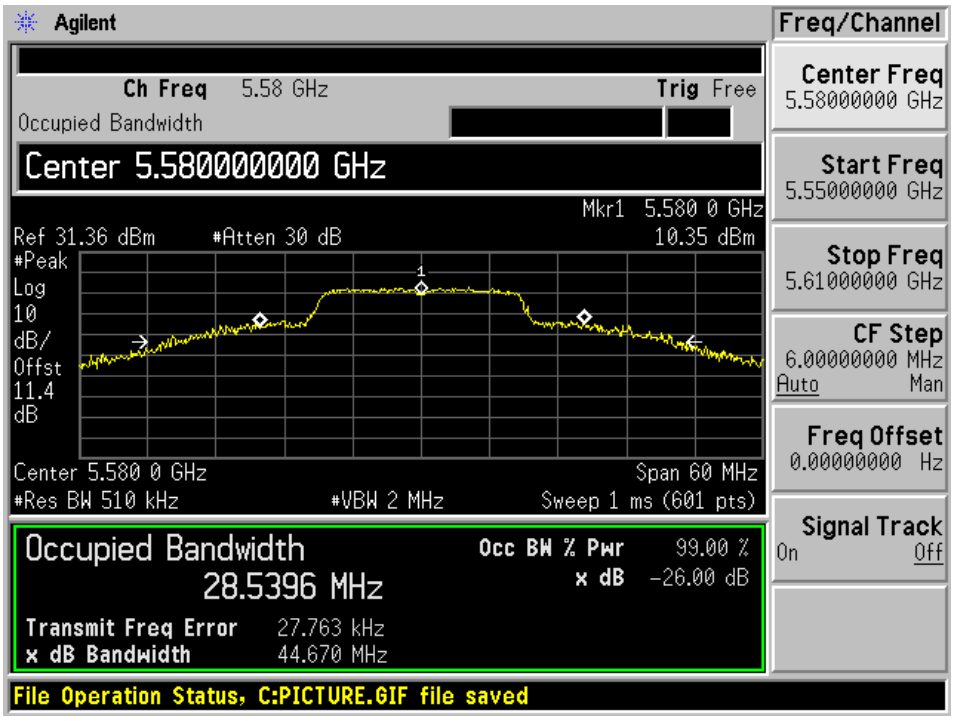


802.11n/ac20 Mode

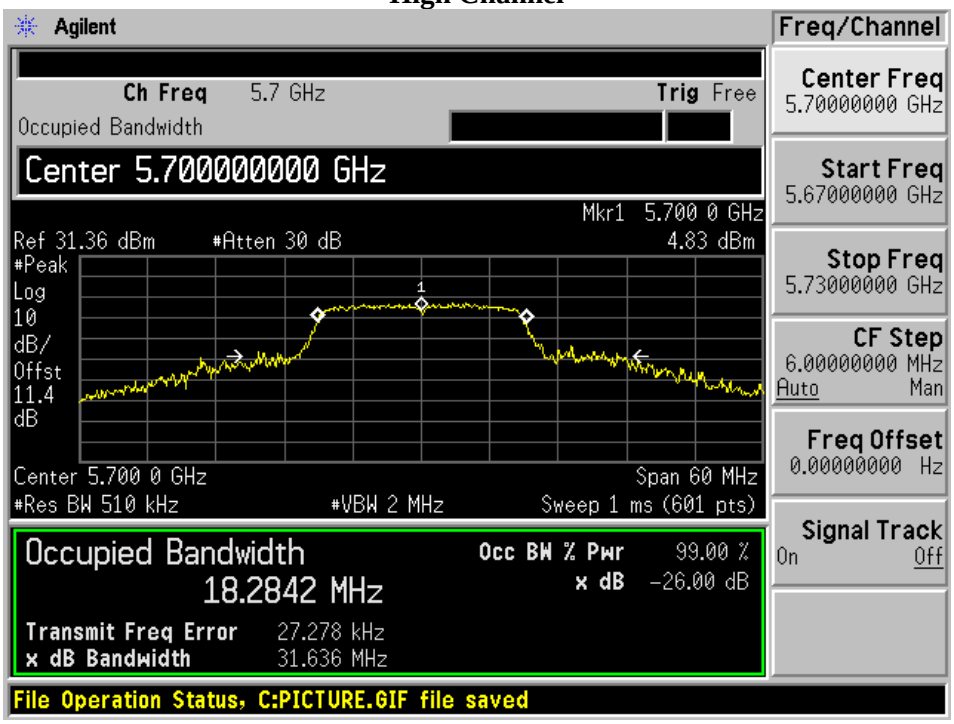
Low Channel



Mid Channel

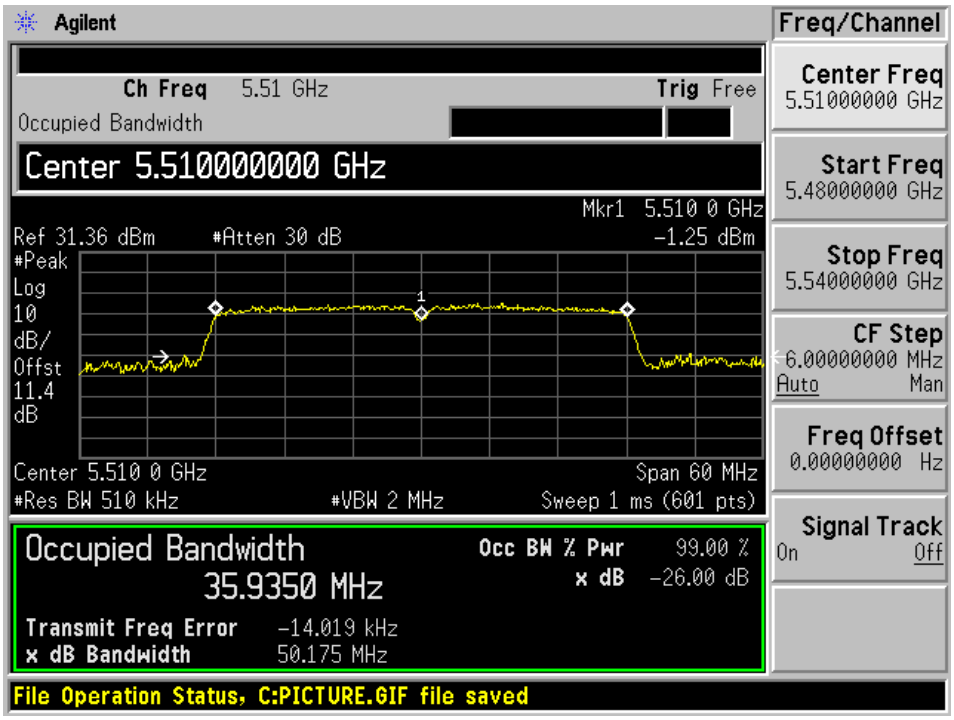


High Channel

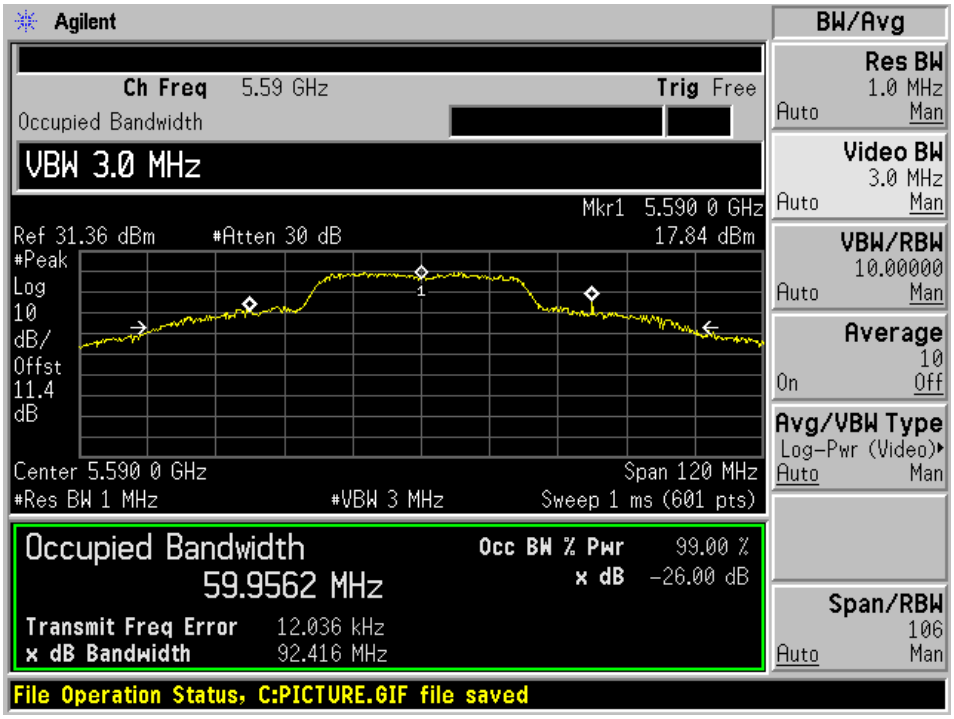


802.11n/ac40 Mode

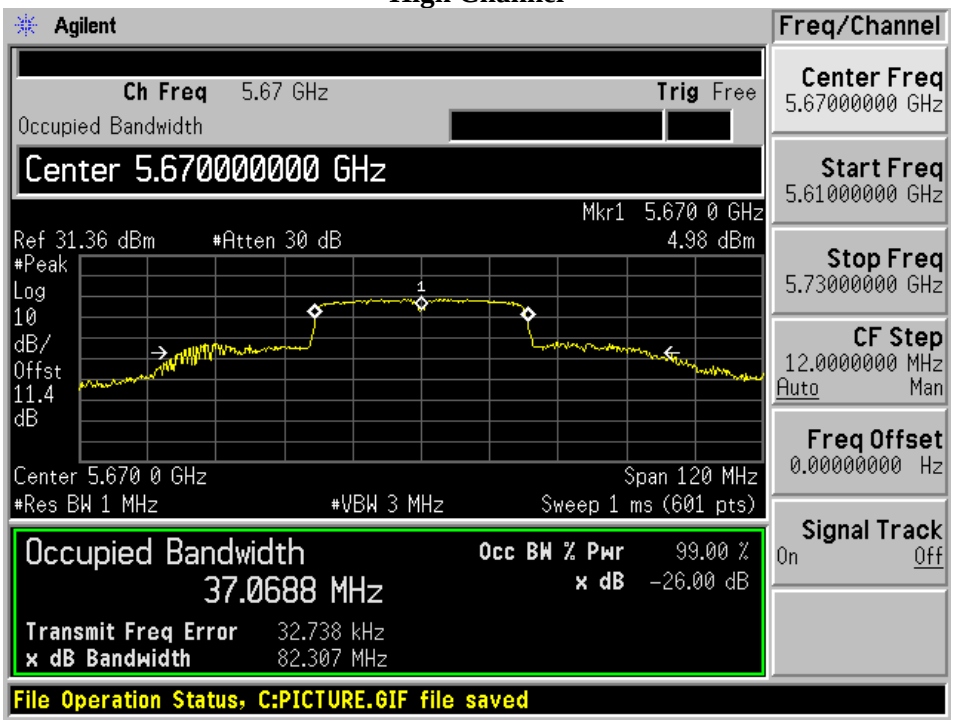
Low Channel



Mid Channel



High Channel



9 FCC §407(a) & ISEDC RSS-247 §6.2 - Output Power

9.1 Applicable Standards

According to FCC §15.407(a):

For 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.

According to ISEDC RSS-247 §6.2.1 for frequency band 5150-5250 MHz:

The maximum e.i.r.p. shall not exceed 200 mW or $10 + 10 \log_{10}B$, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

According to ISEDC RSS-247 §6.2.2 for frequency band 5250-5350 MHz:

The maximum conducted output power shall not exceed 250 mW or $11 + 10 \log_{10}B$, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

The maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log_{10}B$, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

According to ISEDC RSS-247 §6.2.3 for frequency band 5470-5600 MHz and 5650-5725 MHz:

The maximum conducted output power shall not exceed 250 mW or $11 + 10 \log_{10}B$, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.
The maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log_{10}B$, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

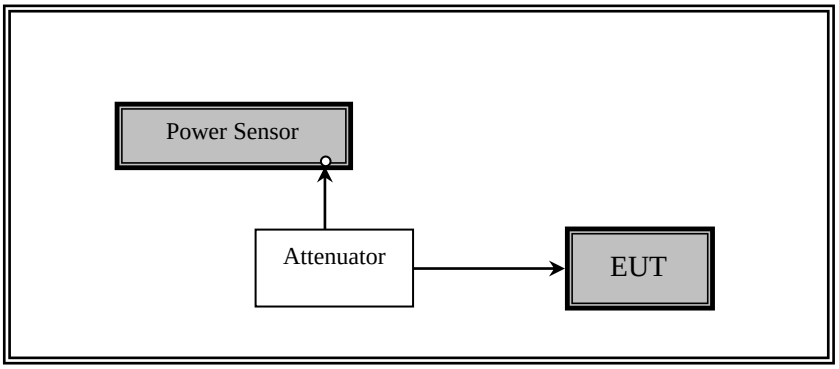
According to ISEDC RSS-247 §6.2.4 for frequency band 5725-5850 MHz:

The maximum conducted output power shall not exceed 1 W. The 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 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 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.

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 Setup Block Diagram



9.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
-	-	RF cable	-	-	Each time[1]	N/A
-	-	10 dB attenuator	-	-	Each time[1]	N/A
697	ETS- Lingerin	Power Sensor	7002-006	160097	2021-02-21	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 the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

9.5 Test Environmental Conditions

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

The testing was performed by Marc Jean from 2022-06-29 in RF site.

9.6 Test Results

5.2GHz

Channel	Frequency (MHz)	Output Power (dBm)	FCC Limit (dBm)
801.11a mode			
Low	5180	19.19	23
Middle	5220	19.53	23
High	5240	19.28	23
801.11n/ac20 mode			
Low	5180	17.92	23
Middle	5220	17.68	23
High	5240	17.54	23
802.11n/ac40 mode			
Low	5190	17.33	23
High	5230	20.28	23

5.2GHz

Channel	Frequency (MHz)	Output Power (dBm)	EIRP (dBm)	IC Limit (dBm)
801.11a mode				
Low	5180	19.19	21.65	22
Middle	5220	19.53	21.99	22
High	5240	19.28	21.74	22
801.11n/ac20 mode				
Low	5180	17.92	20.38	22
Middle	5220	17.68	20.14	22
High	5240	17.54	20	22
802.11n/ac40 mode				
Low	5190	17.33	19.79	23
High	5230	20.28	22.74	23

Note: IC limit is determined by formula: 10 + 10 log10B, dBm, where. B is the 99% emission bandwidth in megahertz. In this instance B was chosen to be the lowest measured BW rounded down to represent the worst case limit.

Note: EIRP (dBm) = Output Power (dBm) + antenna gain (dBi)

5.3GHz

Channel	Frequency (MHz)	Output Power (dBm)	FCC/IC Limit (dBm)
801.11a mode			
Low	5260	21.45	23
Middle	5280	20.63	23
High	5320	17.05	23
801.11n/ac20 mode			
Low	5260	21.24	23
Middle	5280	20.84	23
High	5320	16.38	23
802.11n/ac40 mode			
Low	5270	21.4	24
High	5310	14.33	24

Note: IC limit is determined by formula: 11 + 10 log10B, dBm, where. B is the 99% emission bandwidth for IC and 26dB bandwidth for FCC in megahertz. In this instance B was chosen to be the lowest measured BW rounded down to represent the worst case limit.

5.6GHz

Channel	Frequency (MHz)	Output Power (dBm)	FCC/IC Limit (dBm)
801.11a mode			
Low	5500	19.13	23
Middle	5580	20.25	23
High	5700	15.48	23
801.11n/ac20 mode			
Low	5500	19.32	23
Middle	5580	20.25	23
High	5700	15.51	23
802.11n/ac40 mode			
Low	5510	16.22	24
Middle	5590	20.43	24
High	5670	16.31	24

Note: IC limit is determined by formula: 11 + 10 log10B, dBm, where. B is the 99% emission bandwidth for IC and 26dB bandwidth for FCC in megahertz. In this instance B was chosen to be the lowest measured BW rounded down to represent the worst case limit.

5.8GHz

Channel	Frequency (MHz)	Output Power (dBm)	FCC/IC Limit (dBm)
801.11a mode			
Low	5745	22.04	30
Middle	5785	21.84	30
High	5825	22.29	30
801.11n/ac20 mode			
Low	5745	21.74	30
Middle	5785	21.73	30
High	5825	22.15	30
802.11n/ac40			
Low	5755	21.88	30
High	5795	21.94	30

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

10 FCC §15.407(a) & ISEDC RSS-247 §6.2 - 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.

According to ISEDC RSS-247 §6.2.1 for frequency band 5150-5250 MHz:

The maximum e.i.r.p. shall not exceed 200 mW or 10 + 10 log10B, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

According to ISEDC RSS-247 §6.2.2 for frequency band 5250-5350 MHz:

The maximum conducted output power shall not exceed 250 mW or 11 + 10 $\log_{10}$B, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 $\log_{10}$B, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

According to ISEDC RSS-247 §6.2.3 for frequency band 5470-5600 MHz and 5650-5725 MHz:

The maximum conducted output power shall not exceed 250 mW or 11 + 10 $\log_{10}$B, dBm, whichever is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band.

The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 $\log_{10}$B, dBm, whichever is less. B is the 99% emission bandwidth in megahertz. Note that devices with a maximum e.i.r.p. greater than 500 mW shall implement TPC in order to have the capability to operate at least 6 dB below the maximum permitted e.i.r.p. of 1 W.

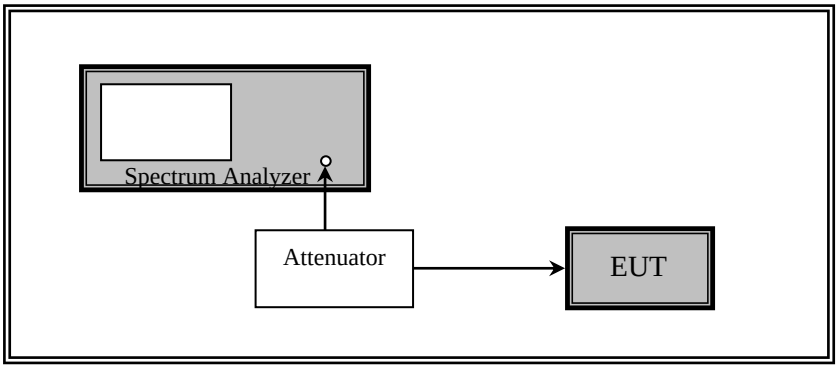
According to ISEDC RSS-247 §6.2.4 for frequency band 5725-5850 MHz:

The maximum conducted output power shall not exceed 1 W. The 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 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 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.

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 Setup Block Diagram



10.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
287	Agilent	Spectrum Analyzer	E4446A	US443 00386	2022-05-05	1 year
-	-	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 the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

10.5 Test Environmental Conditions

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

The testing was performed by Marc Jean from 2022-06-29 in RF site.

10.6 Test Results

5.2GHz

Channel	Frequency (MHz)	PSD (dBm/MHz)	FCC Limit (dBm/MHz)
801.11a mode			
Low	5180	7.006	11
Middle	5220	7.065	11
High	5240	6.745	11
801.11n/ac20 mode			
Low	5180	7.305	11
Middle	5220	7.072	11
High	5240	7.357	11
802.11n/ac40 mode			
Low	5190	5.351	11
High	5230	5.476	11

5.2GHz

Channel	Frequency (MHz)	PSD (dBm/MHz)	EIRP PSD (dBm/MHz)	IC Limit (dBm/MHz)
801.11a mode				
Low	5180	7.006	9.466	10
Middle	5220	7.065	9.525	10
High	5240	6.745	9.205	10
801.11n/ac20 mode				
Low	5180	7.305	9.765	10
Middle	5220	7.072	9.532	10
High	5240	7.357	9.817	10
802.11n/ac40 mode				
Low	5190	5.351	7.811	10
High	5230	5.476	7.936	10

Note: EIRP PSD (dBm/MHz) = PSD (dBm/MHz) + antenna gain (dBi)

5.3GHz

Channel	Frequency (MHz)	PSD (dBm/MHz)	FCC/IC Limit (dBm/MHz)
801.11a mode			
Low	5260	9.587	11
Middle	5280	9.095	11
High	5320	8.313	11
801.11n/ac20 mode			
Low	5260	9.131	11
Middle	5280	8.631	11
High	5320	3.721	11
802.11n/ac40 mode			
Low	5270	5.529	11
High	5310	-0.676	11

5.6GHz

Channel	Frequency (MHz)	PSD (dBm/MHz)	FCC/IC Limit (dBm/MHz)
801.11a mode			
Low	5500	7.981	11
Middle	5580	8.106	11
High	5700	9.861	11
801.11n/ac20 mode			
Low	5500	7.965	11
Middle	5580	7.792	11
High	5700	9.559	11
802.11n/ac40 mode			
Low	5510	4.772	11
Middle	5590	4.912	11
High	5670	6.266	11

5.8GHz

Channel	Frequency (MHz)	PSD (dBm/100kHz)	PSD (dBm/500kHz)	FCC/IC Limit (dBm/500kHz)
801.11a mode				
Low	5745	0.959	7.949	30
Middle	5785	2.076	9.066	30
High	5825	2.019	9.009	30
801.11n/ac20 mode				
Low	5745	1.040	8.03	30
Middle	5785	1.844	8.834	30
High	5825	1.819	8.809	30
802.11n/ac40				
Low	5755	-1.937	5.053	30
High	5795	-1.976	5.014	30

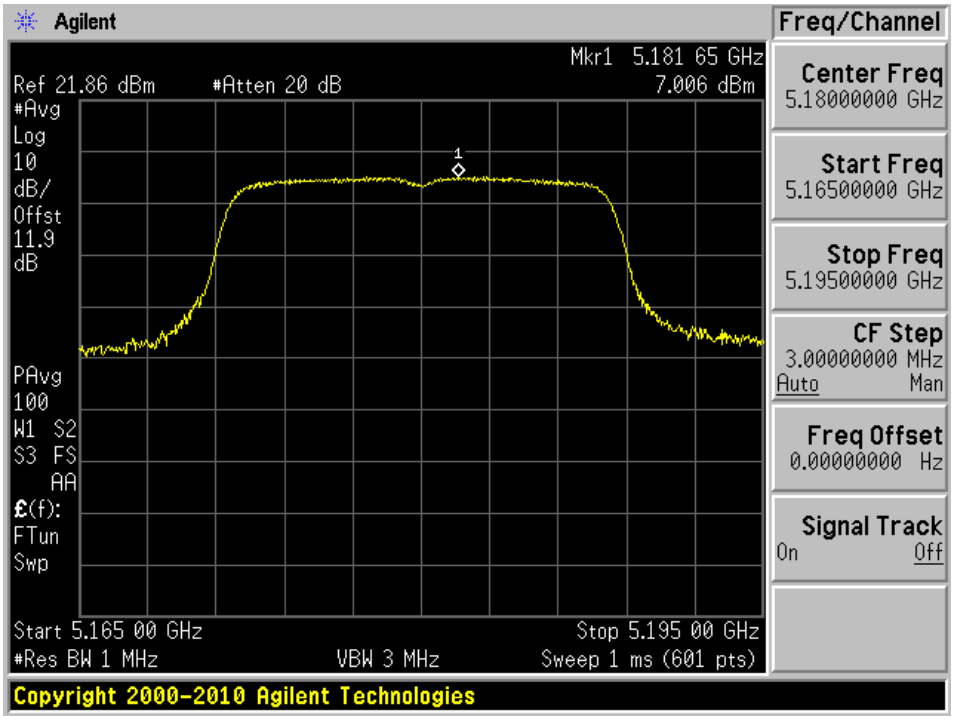
Note: PSD measurements have duty cycle correction factor already considered
Note: PSD (dBm/500 kHz) = PSD (dBm/100 kHz) + 10*log(500 kHz/100 kHz)

Please refer to the following plots.

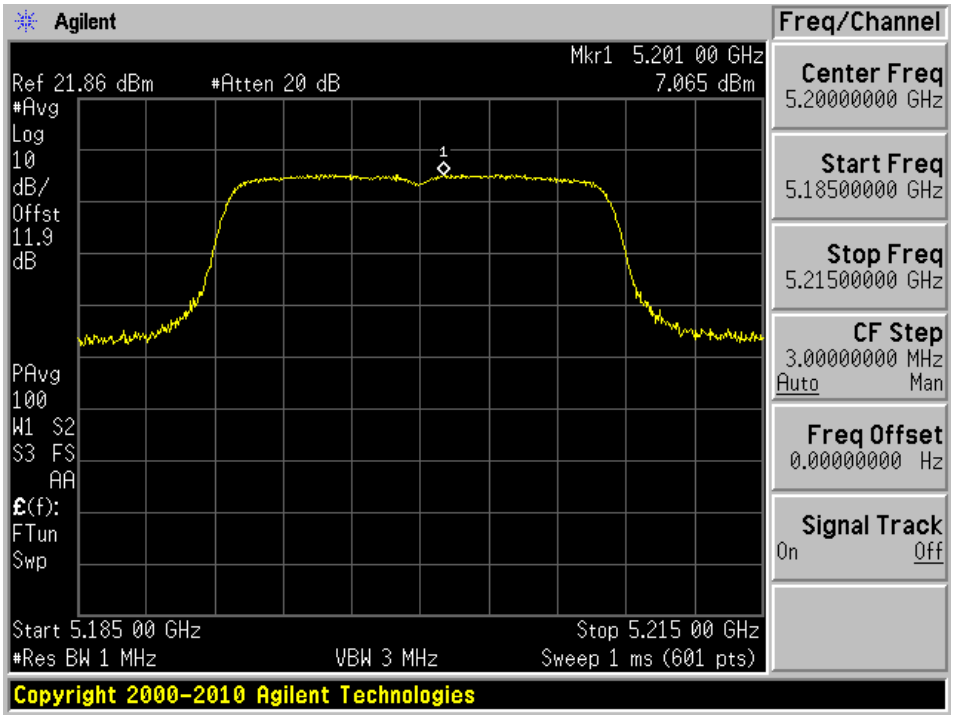
5.2 GHz

802.11a Mode

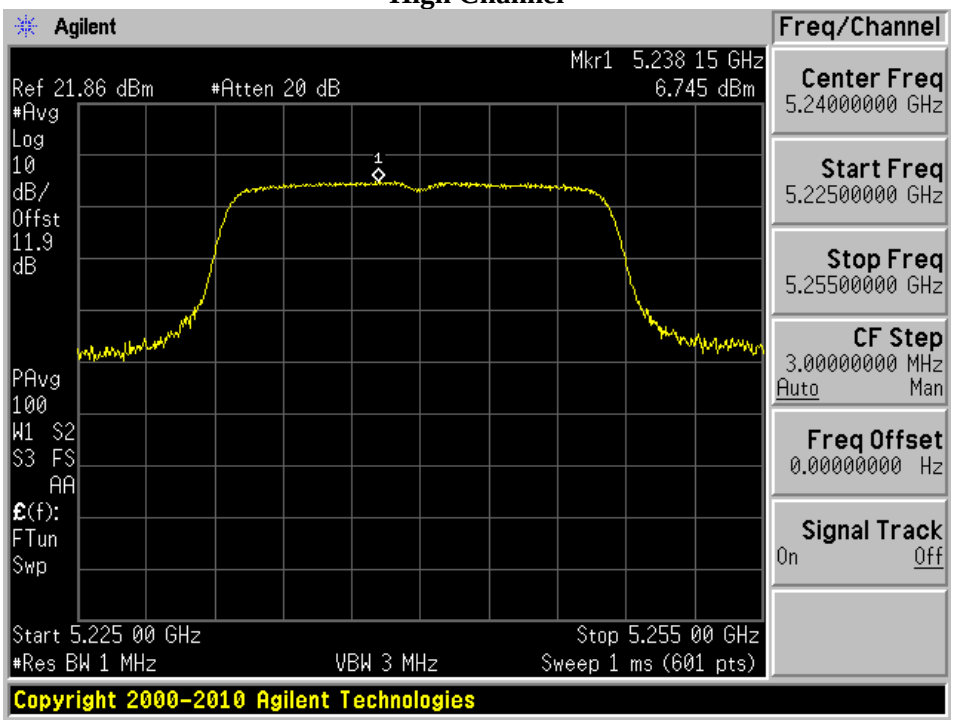
Low Channel



Mid Channel

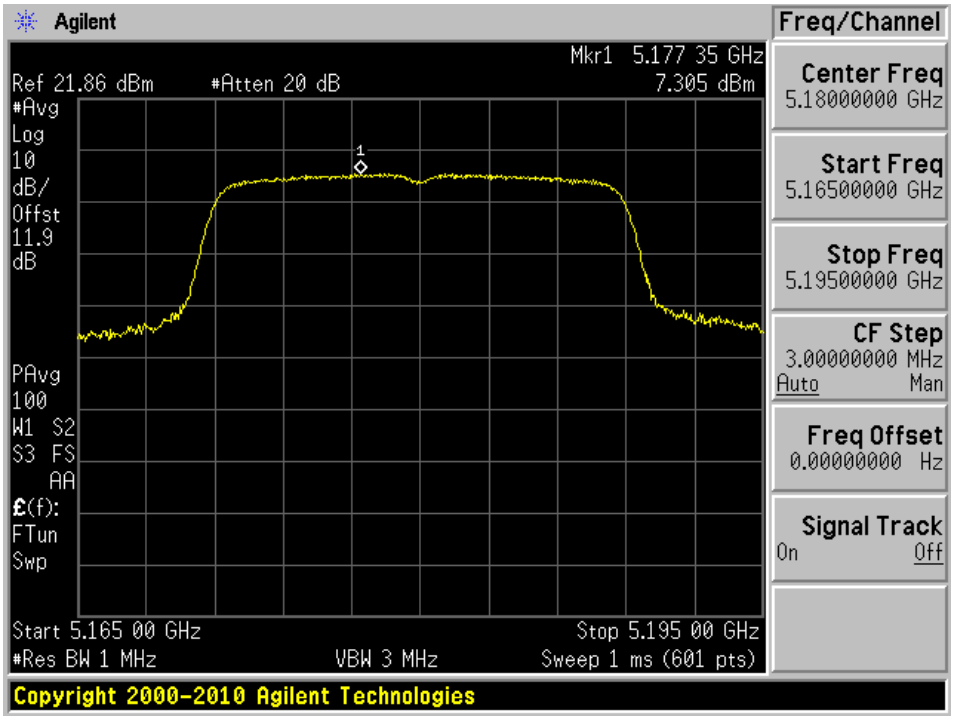


High Channel

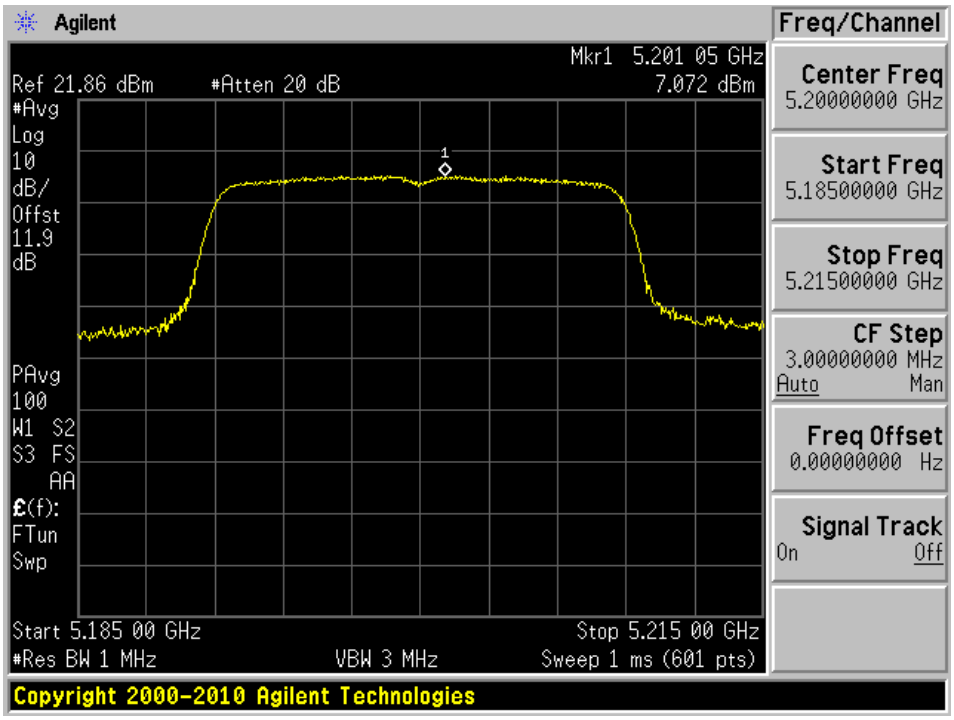


802.11n/ac20 Mode

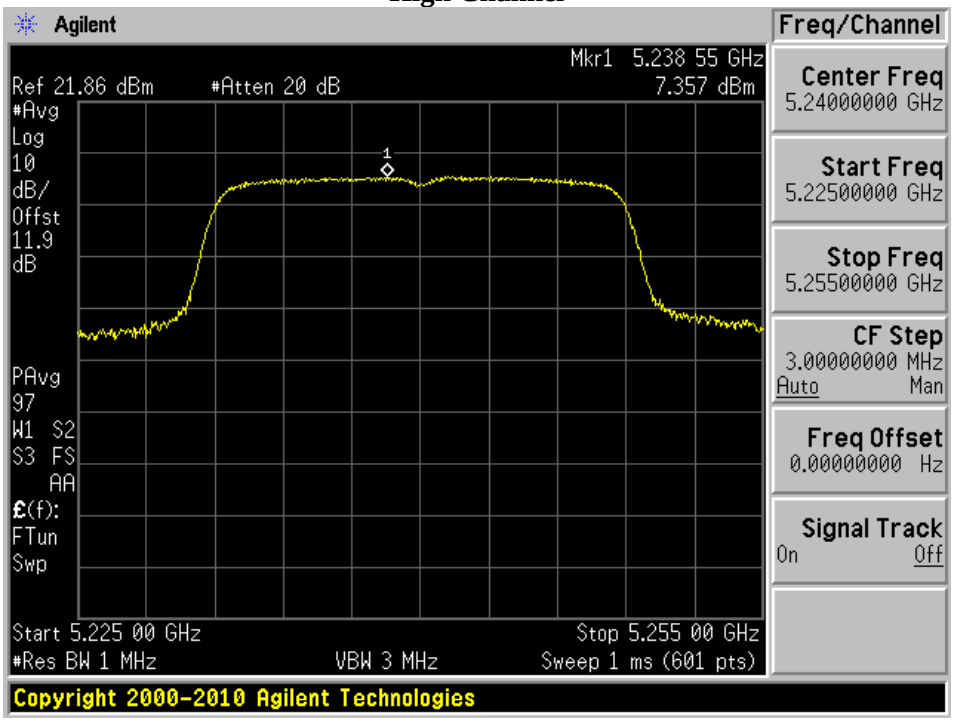
Low Channel



Mid Channel

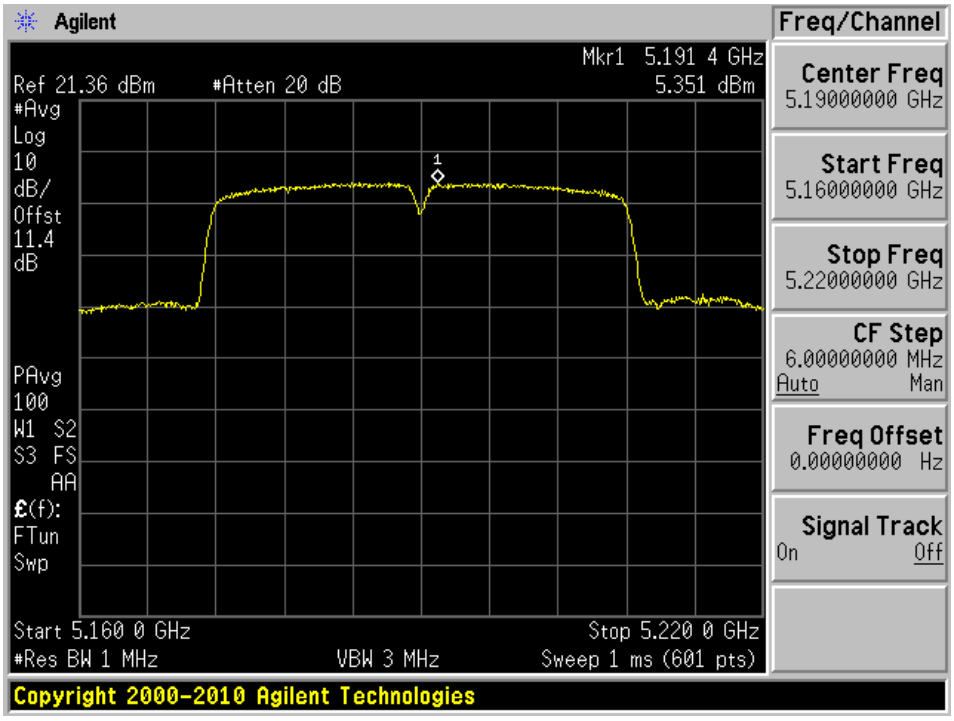


High Channel

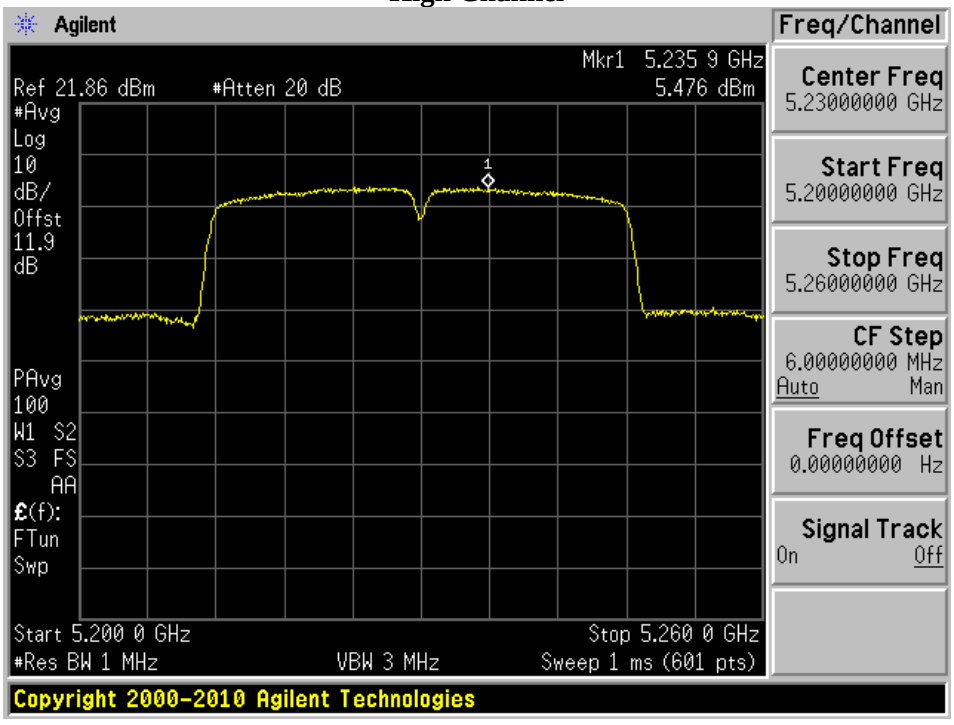


802.11n/ac40 Mode

Low Channel



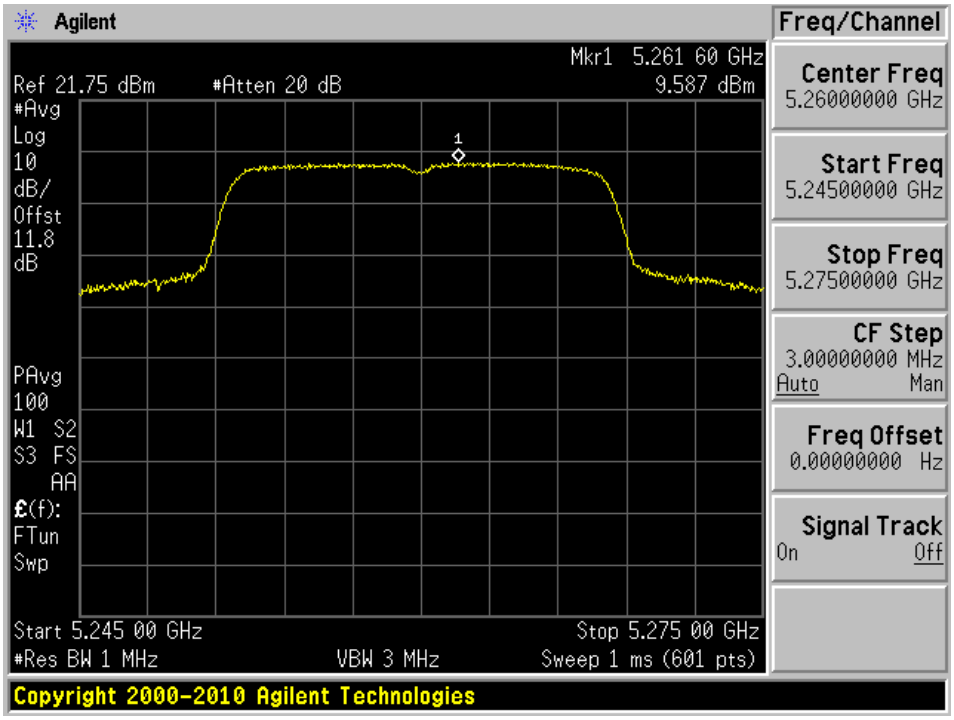
High Channel



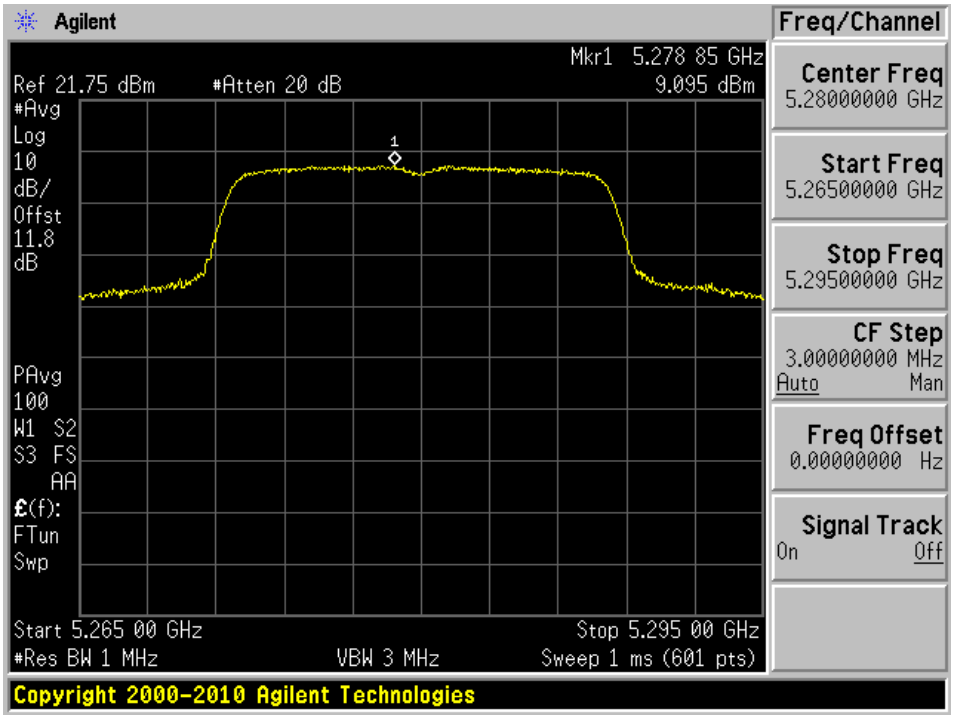
5.3 GHz

802.11a Mode

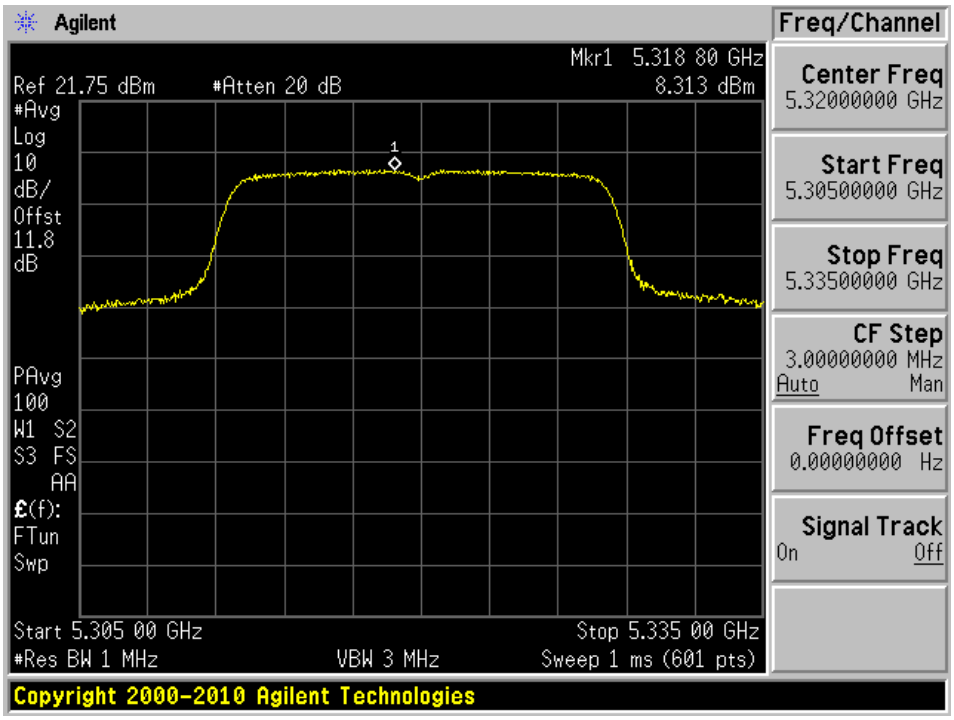
Low Channel



Mid Channel

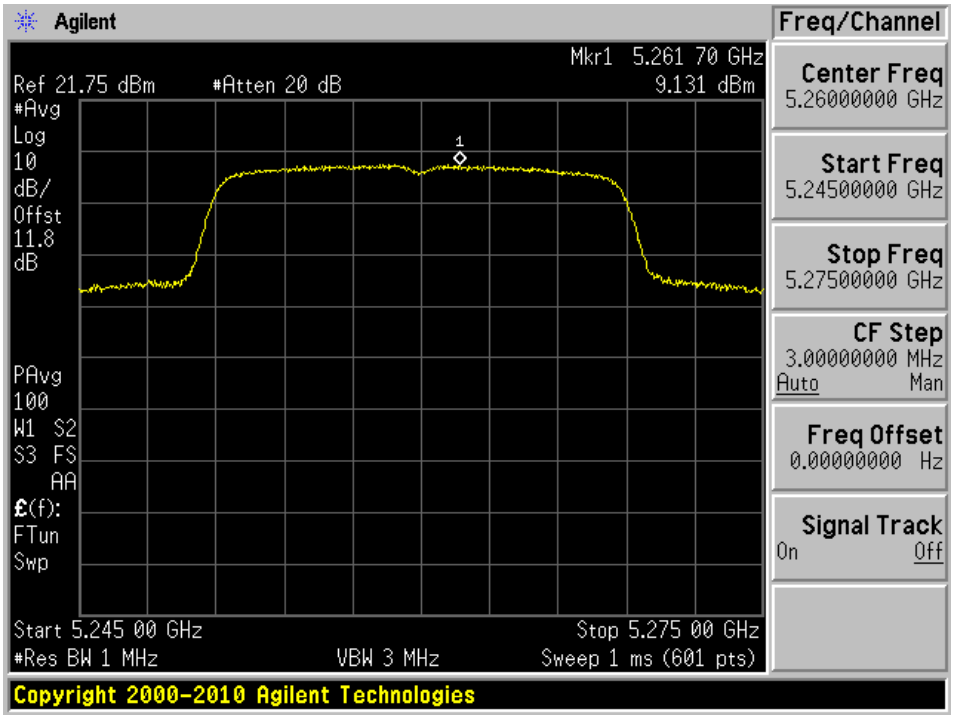


High Channel

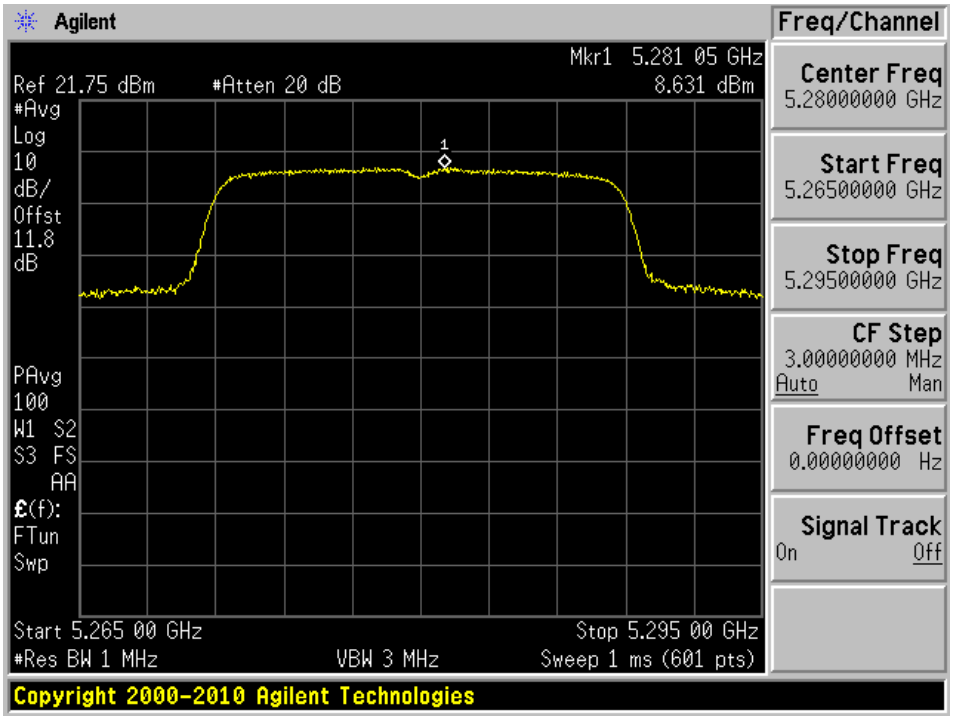


802.11n/ac20 Mode

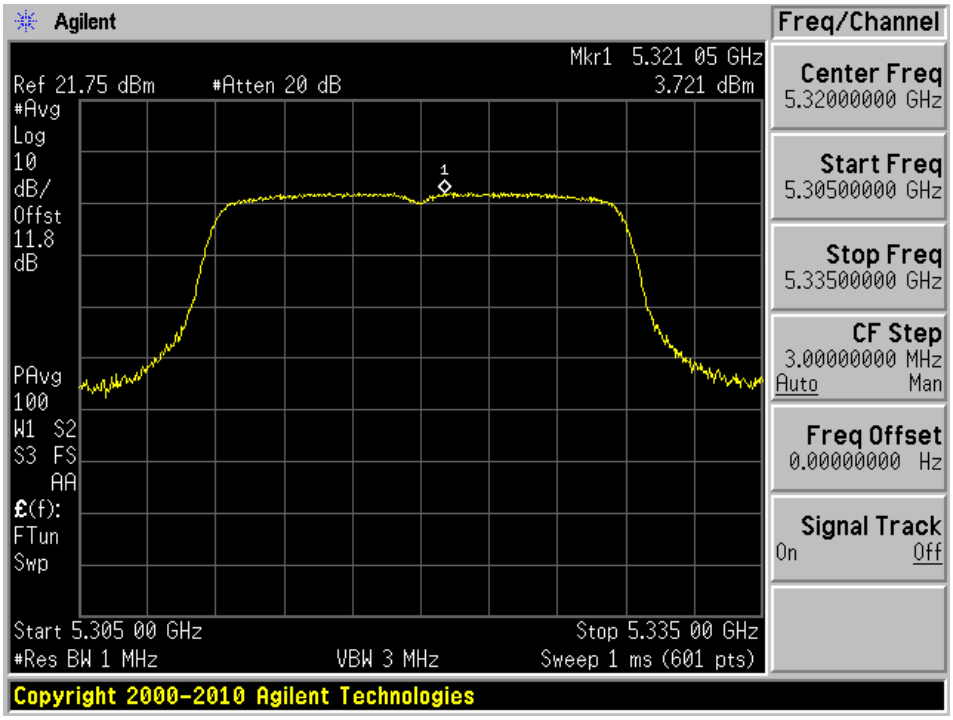
Low Channel



Mid Channel

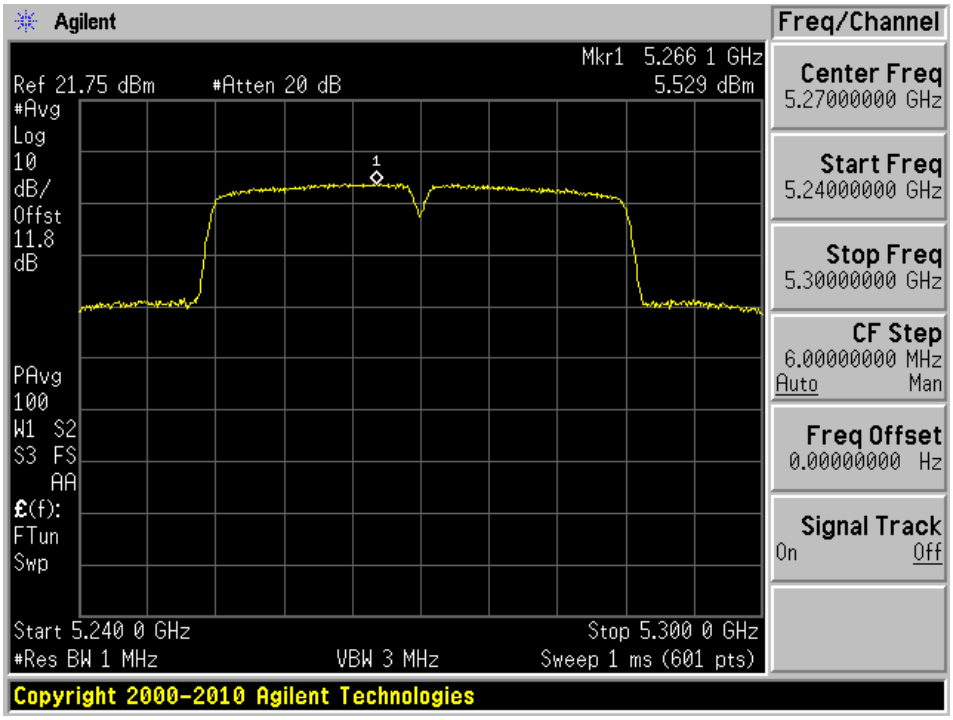


High Channel

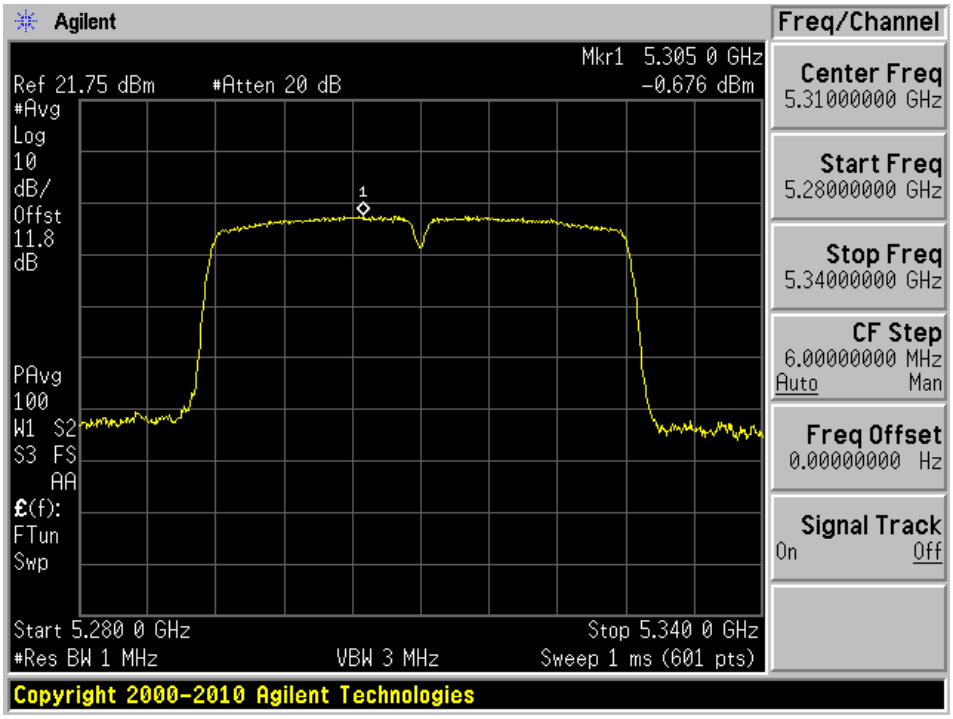


802.11n/ac40 Mode

Low Channel



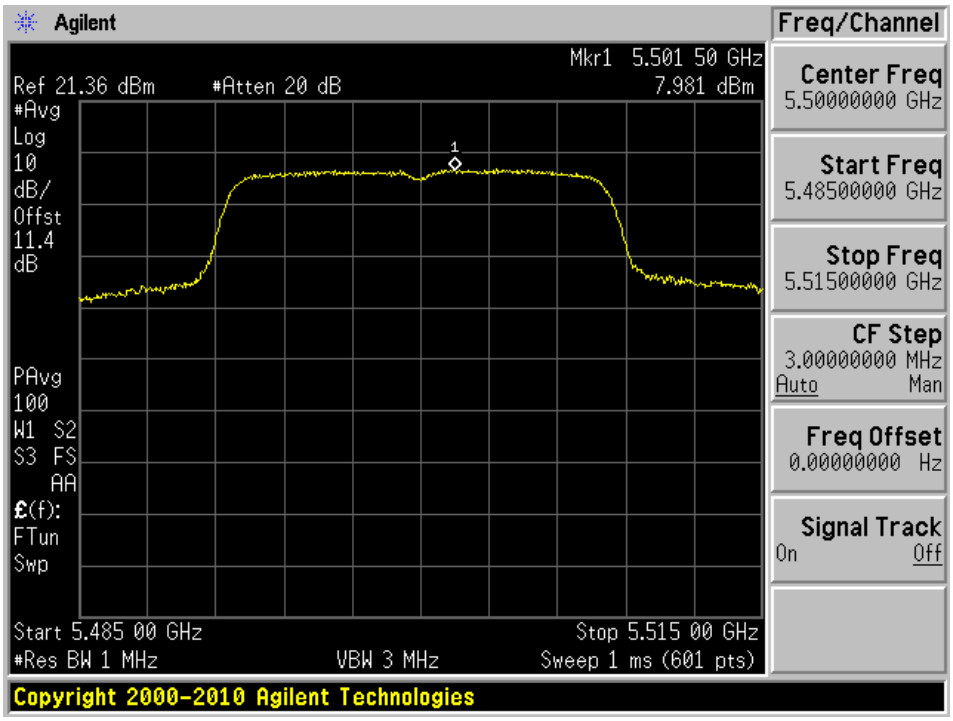
High Channel



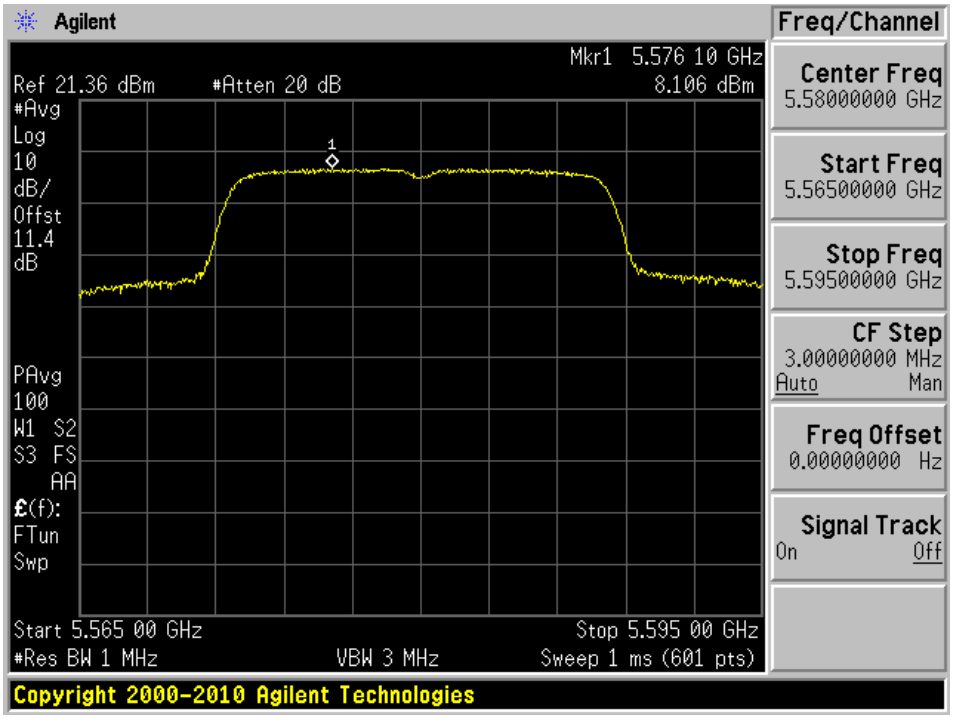
5.6 GHz

802.11a Mode

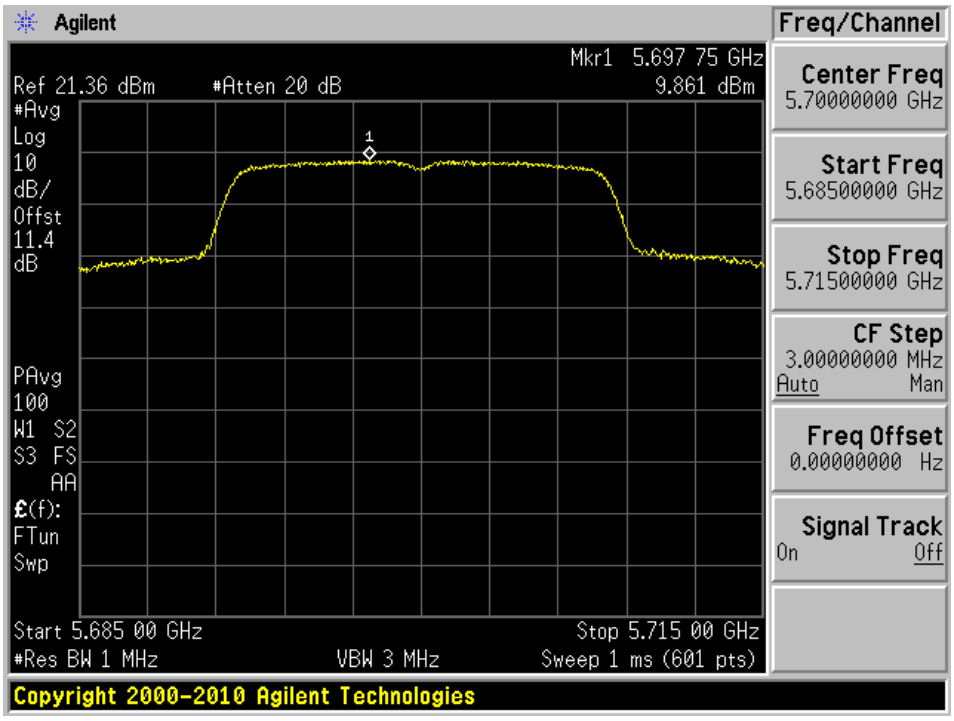
Low Channel



Mid Channel

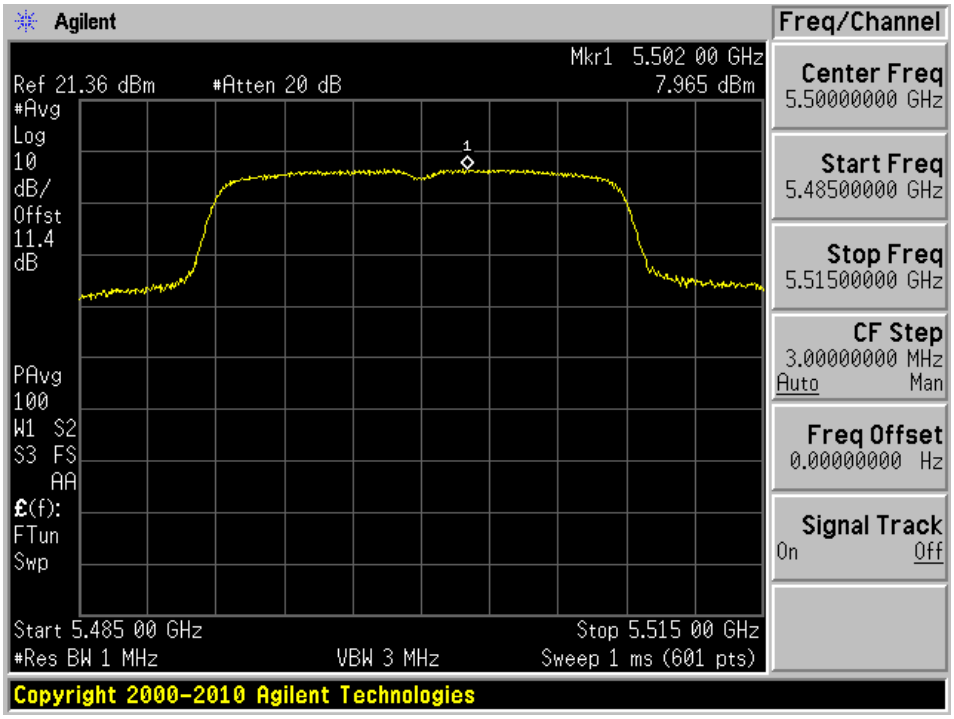


High Channel

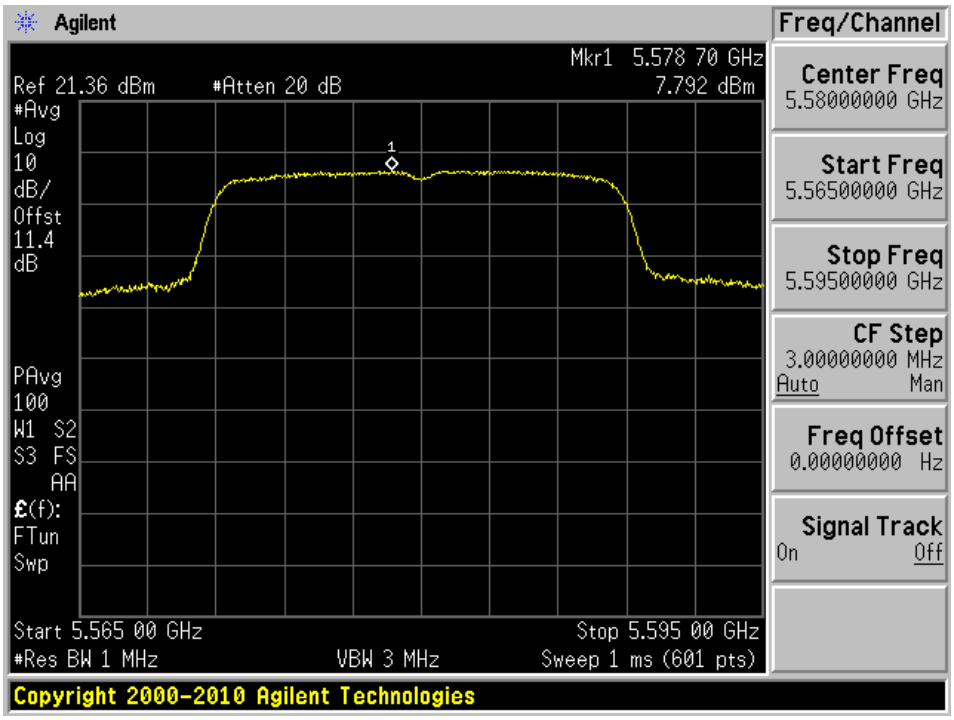


802.11n/ac20 Mode

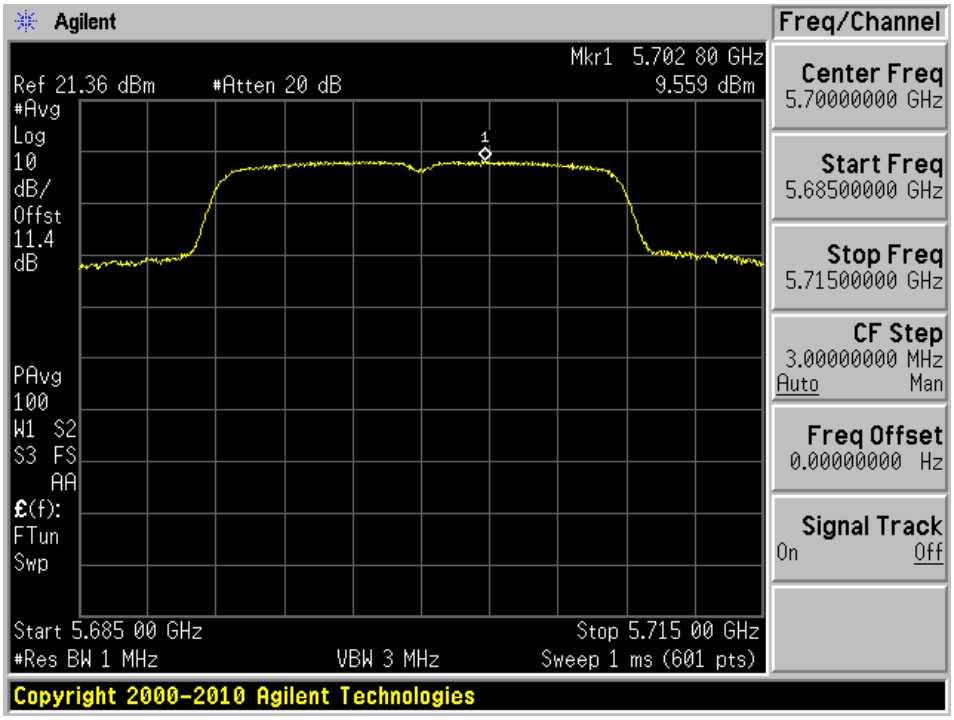
Low Channel



Mid Channel

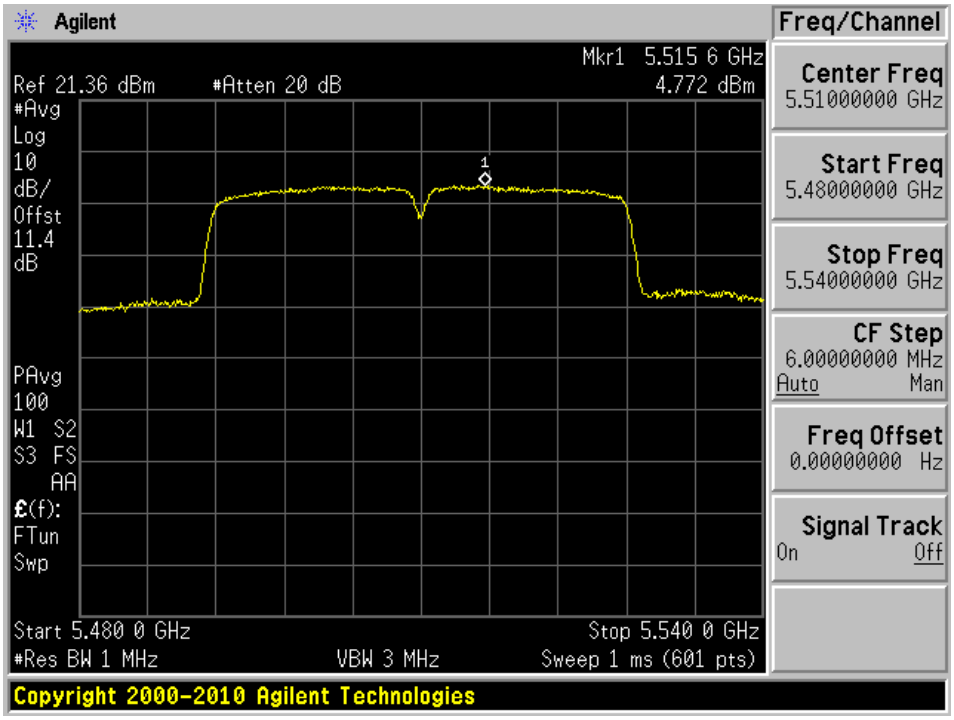


High Channel

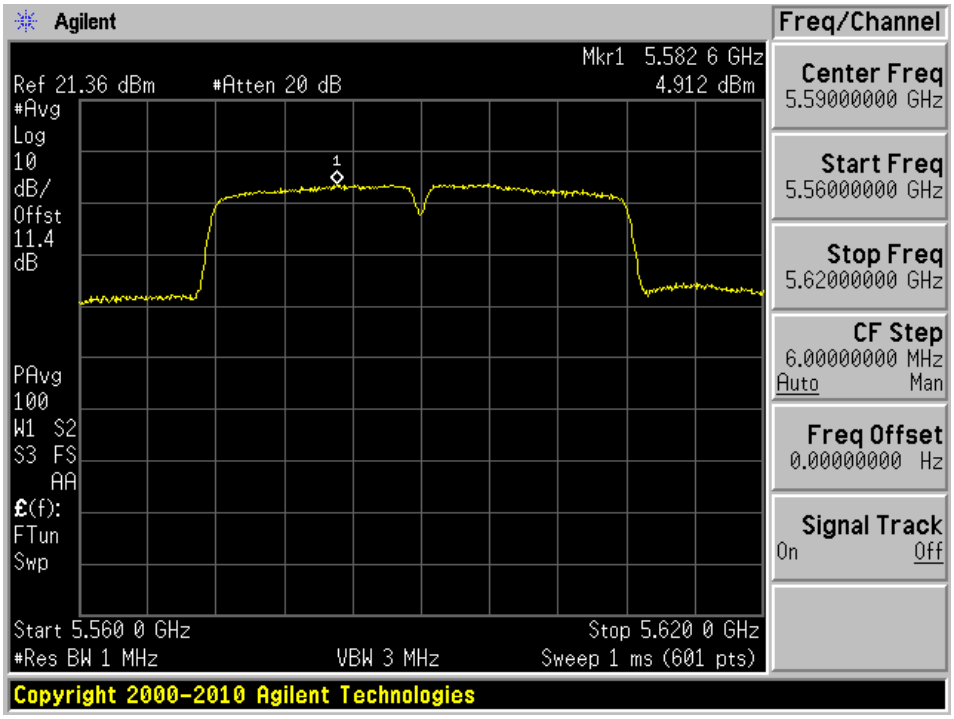


802.11n/ac40 Mode

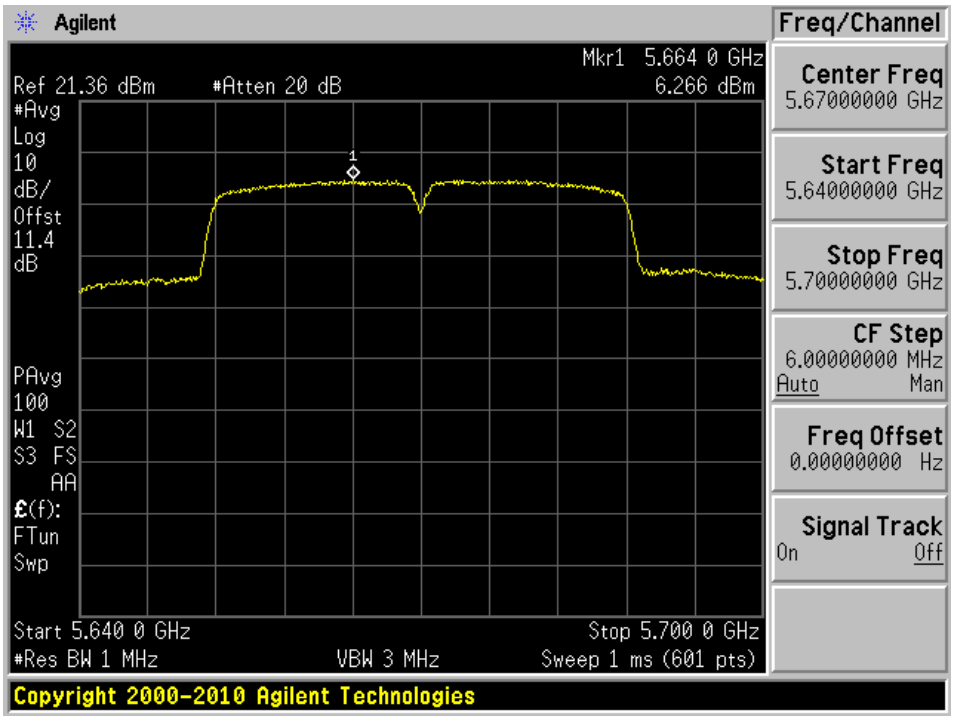
Low Channel



Mid Channel



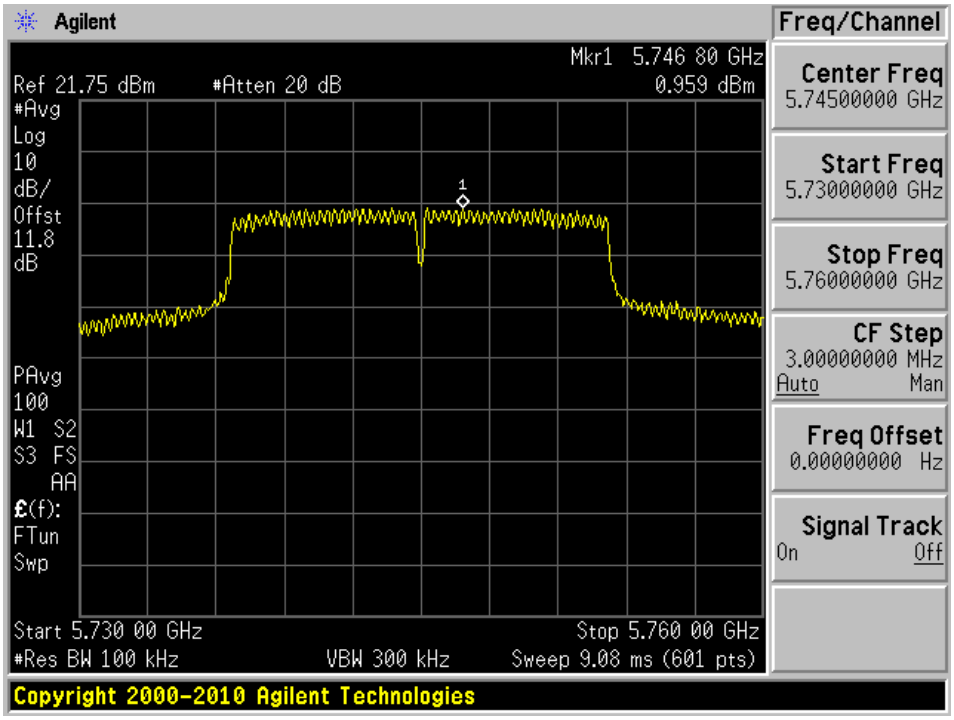
High Channel



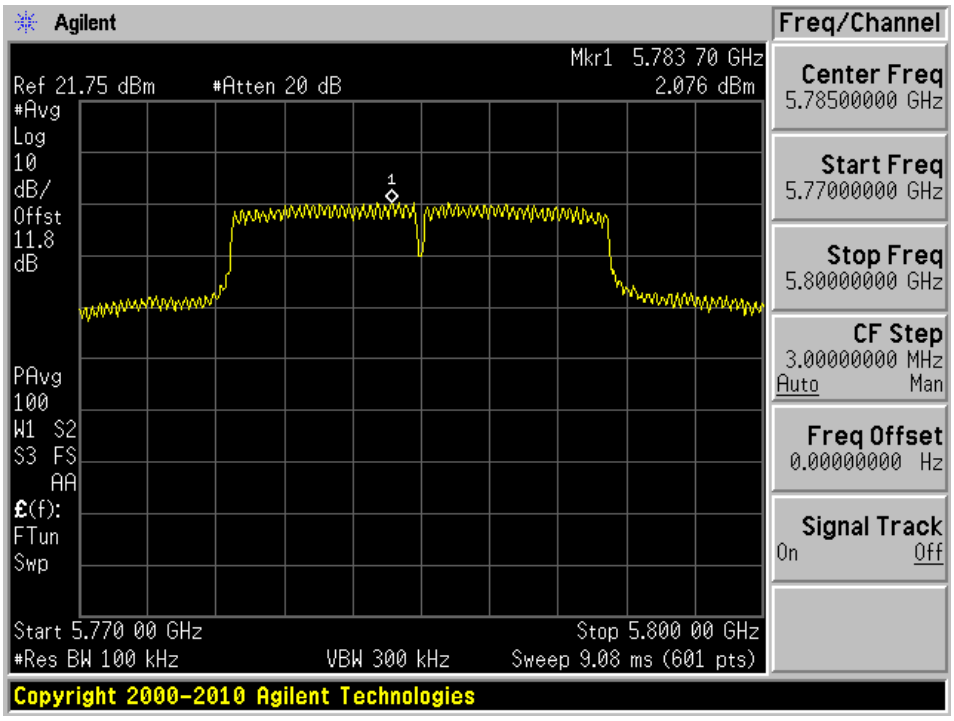
5.8 GHz

802.11a Mode

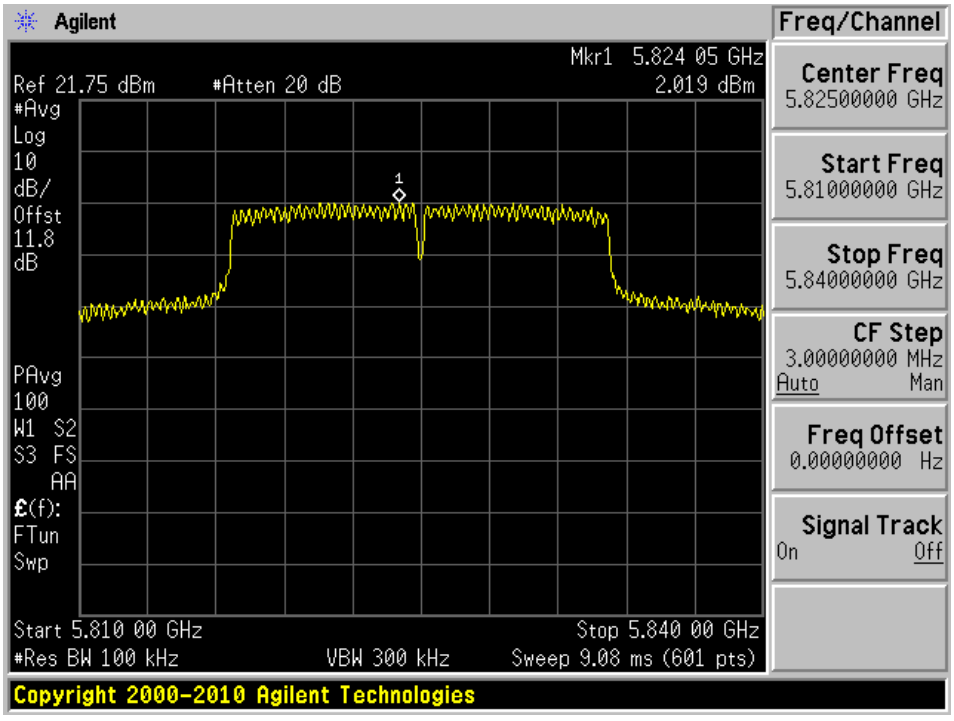
Low Channel



Mid Channel

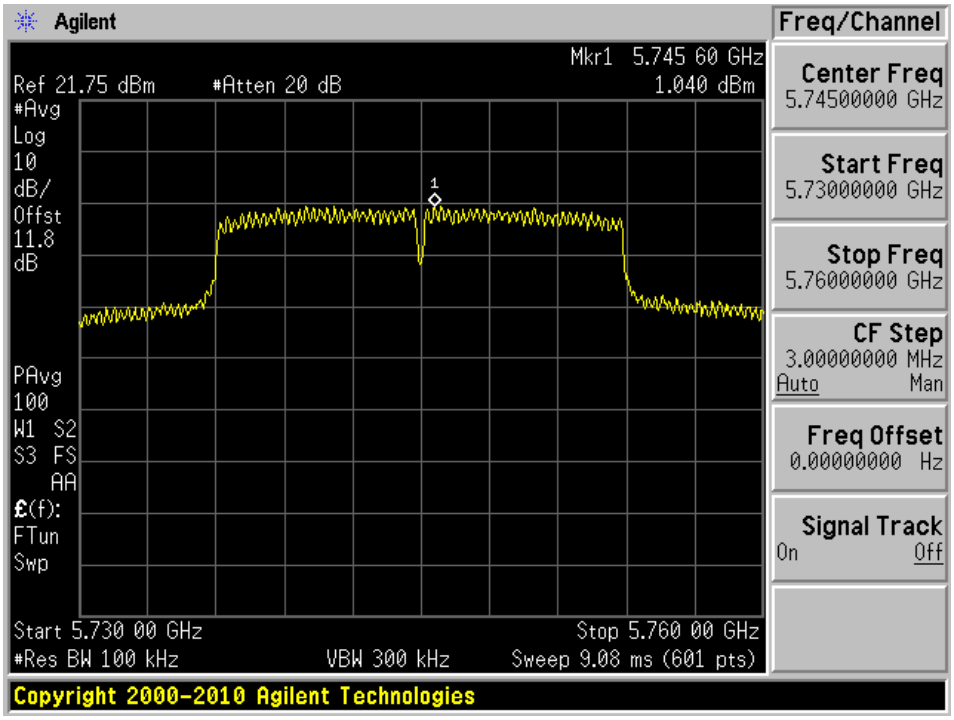


High Channel

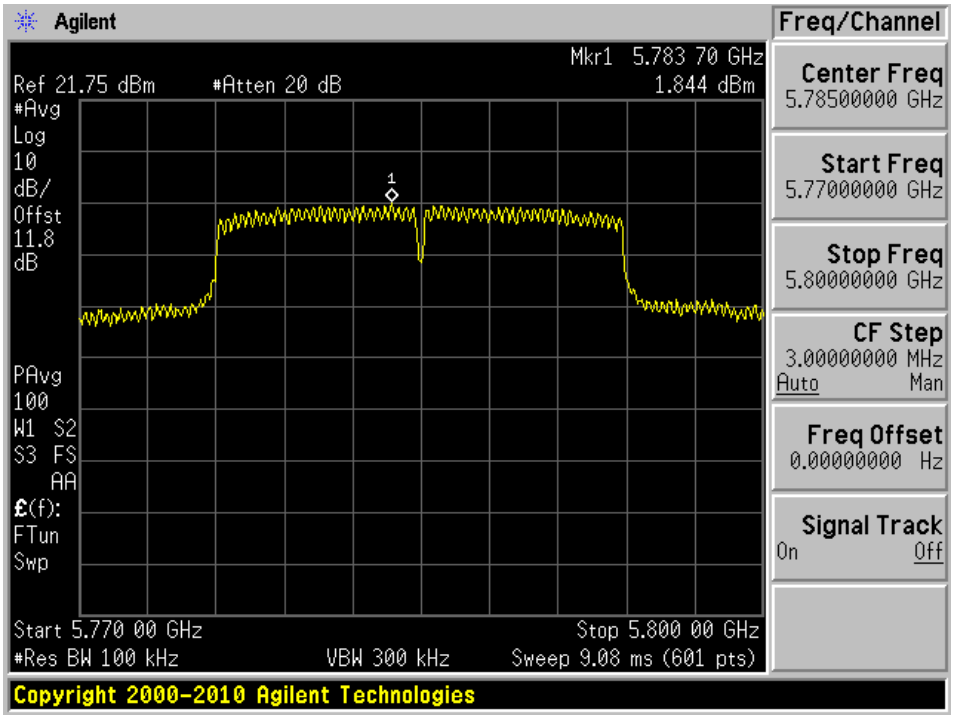


802.11n/ac20 Mode

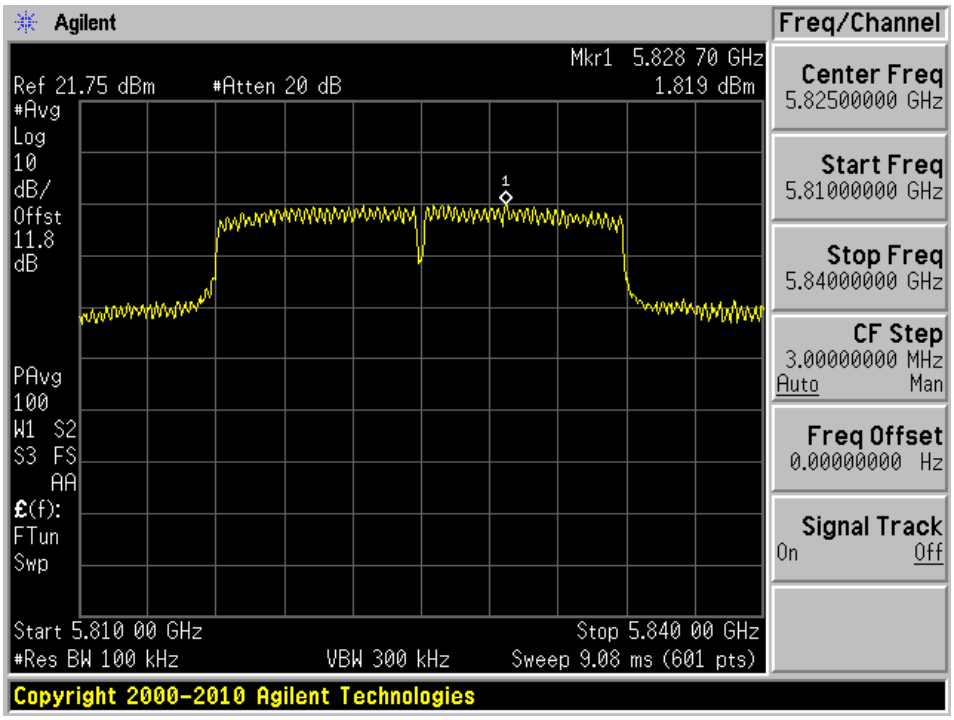
Low Channel



Mid Channel

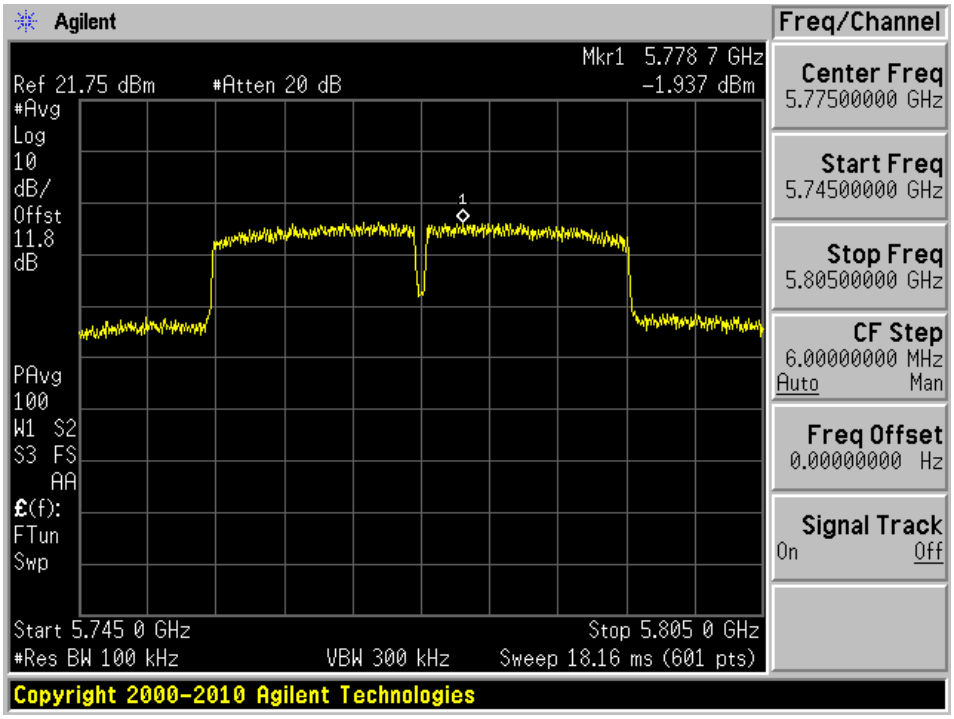


High Channel

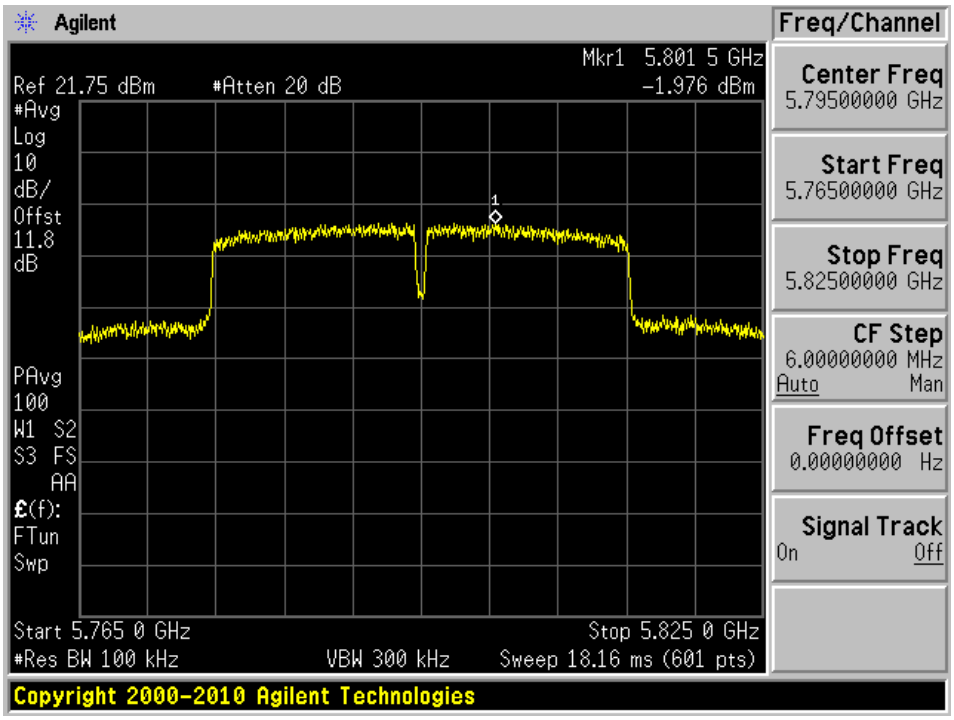


802.11n/ac40 Mode

Low Channel



High Channel



11 FCC §15.407(b) & ISEDC RSS-247 §6.2 - 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.

According to ISEDC RSS-247 §6.2.1 for devices operatinging in the frequency band 5150-5250 MHz:

For transmitters operating in the band 5150-5250 MHz, all emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. However, any unwanted emissions that fall into the band 5250-5350 MHz must be 26 dBc, when measured using a resolution bandwidth between 1 and 5% of the occupied bandwidth, above 5.25 GHz. Otherwise, the transmission is considered as intentional and the devices shall implement dynamic frequency selection (DFS) and transmitter power control (TPC) as per the requirements for the band 5250-5350 MHz.

According to ISEDC RSS-247 §6.2.2 for devices operatinging in the frequency band 5250-5350 MHz:

For devices with both operating frequencies and channel bandwidths contained within the band 5250-5350 MHz, the device shall comply with the following:

1. All emissions outside the band 5250-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. if the equipment is intended for outdoor use; or
2. All emissions outside the band 5150-5350 MHz shall not exceed -27 dBm/MHz e.i.r.p. and any emissions within the band 5150-5250 MHz shall meet the power spectral density limits of Section 6.2.1. The device shall be labelled “for indoor use only.”

For devices with operating frequencies in the band 5250-5350 MHz but having a channel bandwidth that overlaps the band 5150-5250 MHz, the devices’ unwanted emission shall not exceed -27 dBm/MHz e.i.r.p. outside the band 5150-5350 MHz and its power shall comply with the spectral power density for operation within the band 5150-5250 MHz. The device shall be labelled “for indoor use only.”
According to ISEDC RSS-247 §6.2.3 for devices operatinging in the frequency band 5470-5600 MHz and 5650-5725 MHz. Emissions outside the band 5470-5725 MHz shall not exceed -27 dBm/MHz e.i.r.p.

According to ISEDC RSS-247 §6.2.4 for devices operatinging in the frequency band 5725-5850 MHz:
For the band 5725-5850 MHz, emissions at frequencies from the band edges to 10 MHz above or below the band edges shall not exceed -17 dBm/MHz e.i.r.p.
For emissions at frequencies more than 10 MHz above or below the band edges, the emissions power shall not exceed -27 dBm/MHz.

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:

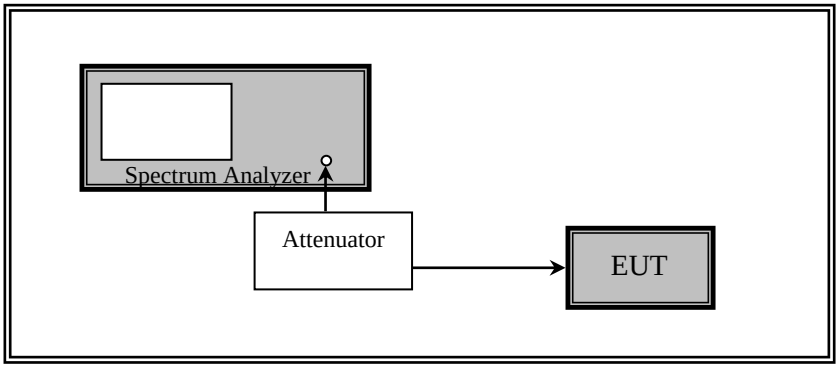
1. For peak emissions measurements, follow the procedures described in section H)5), "Procedures for Peak Unwanted Emissions Measurements above 1000 MHz", except for the following changes:

- 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 Setup Block Diagram



11.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
287	Agilent	Spectrum Analyzer	E4446A	US44300386	2022-05-05	1 year
912	Signal Analyzer	Signal Analyzer	FSV40	1321.3008k39-101203-UW	2022-05-05	1 year
-	-	RF cable	-	-	Each time[1]	N/A
-	-	10 dB attenuator			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 the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

11.5 Test Environmental Conditions

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

The testing was performed by Marc Jean from 2022-06-29 to 2022-07-22 in RF site.

11.6 Test Results

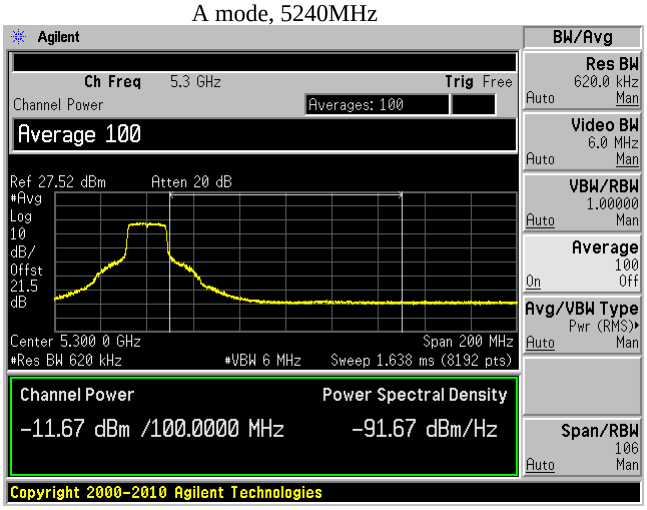
Please refer to the following plots

ISEDC Emission falling into 5250 – 5350 MHz

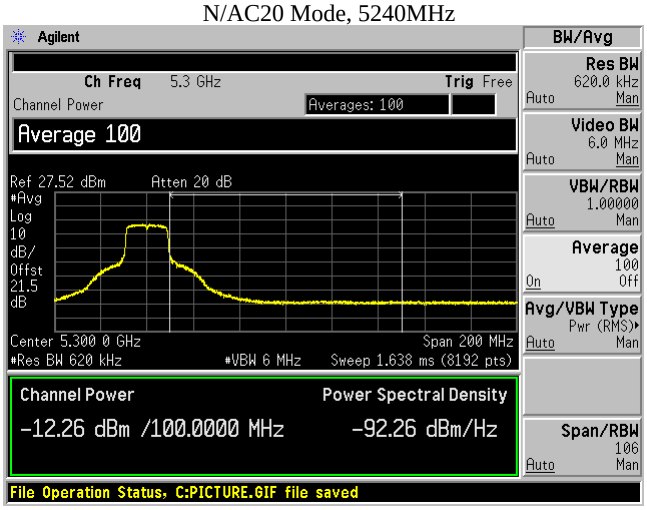
Channel	Frequency (MHz)	Channel Power (dBm)	Unwanted Emission Power (dBm)	Delta (dB)	Limit (dB)
802.11a					
48	5240	19.28	-11.67	30.95	>26
802.11n/ac20					
48	5240	17.54	-12.26	29.8	>26
802.11n/ac40					
46	5230	20.28	-6.94	27.22	>26

Note: please refer to section 9.5 for the output power result.

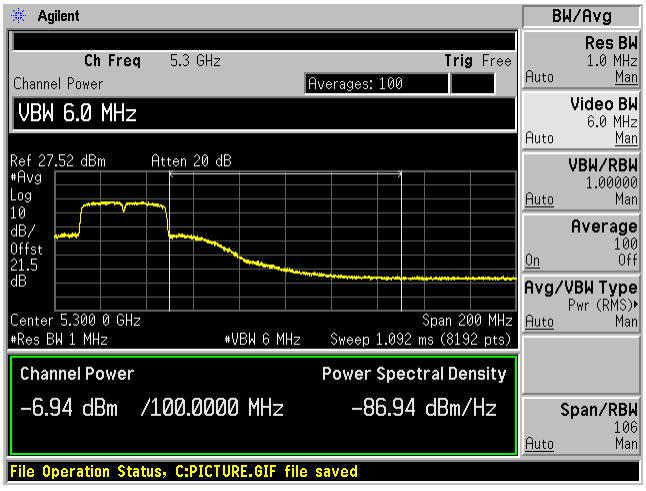
A mode, 5240MHz



N/AC20 Mode, 5240MHz



N/AC40 mode, 5230MHz

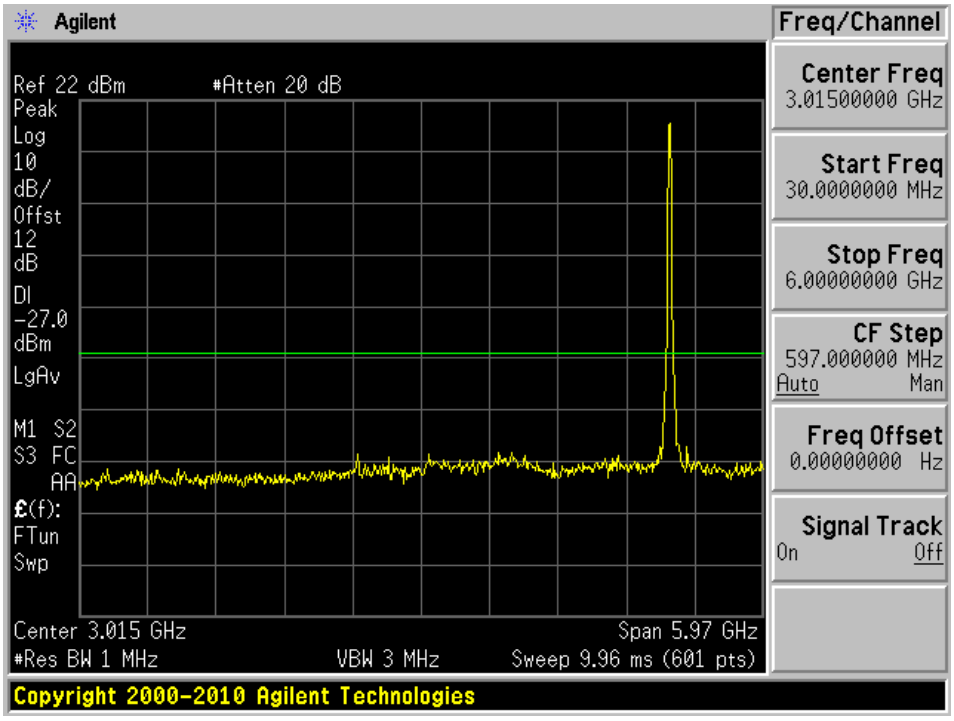


Spurious Emissions

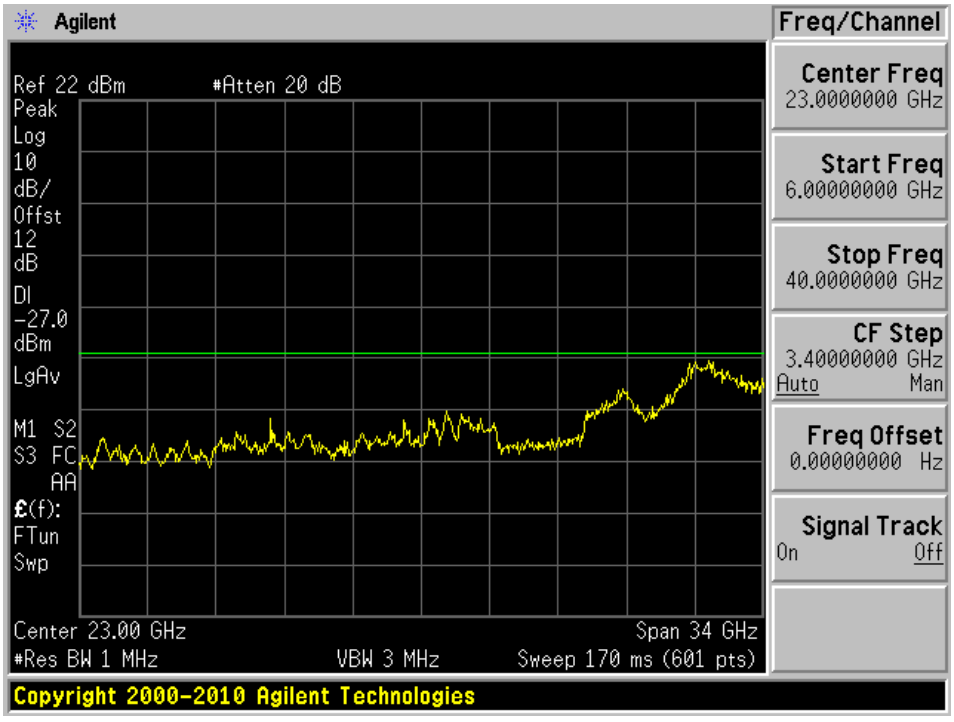
5.2 GHz 802.11a

Low Channel

30MHz – 6GHz

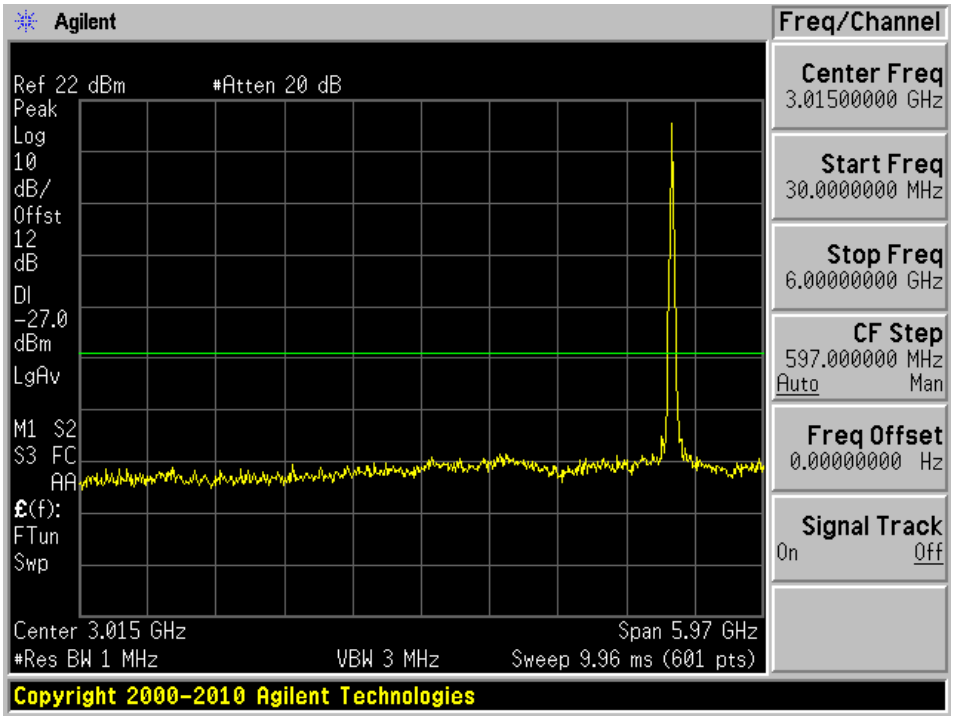


6GHz – 40GHz

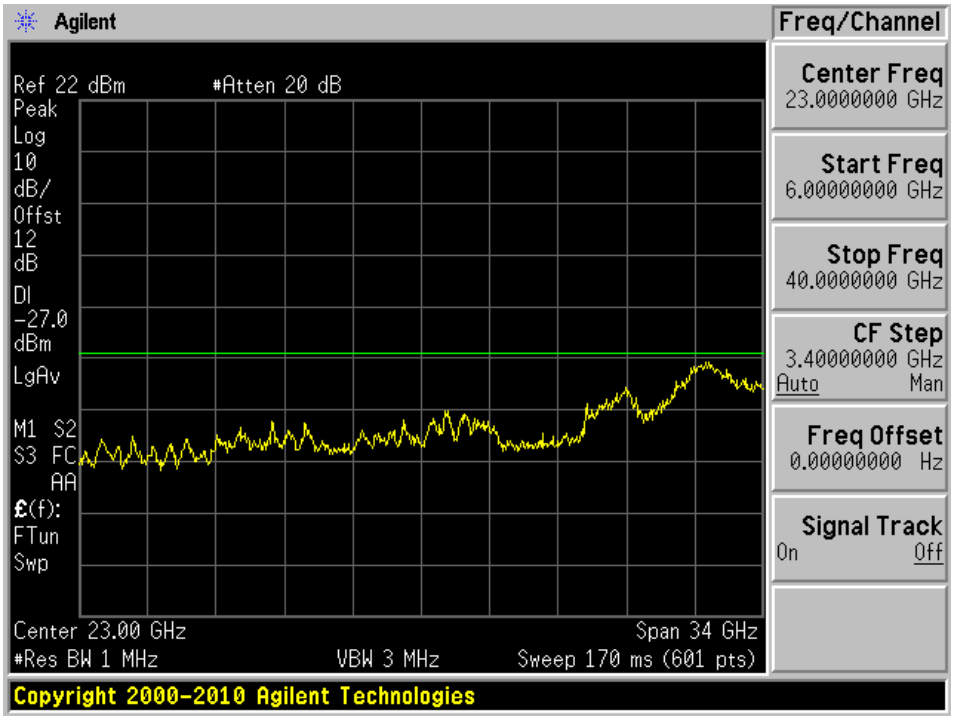


Mid Channel

30MHz – 6GHz

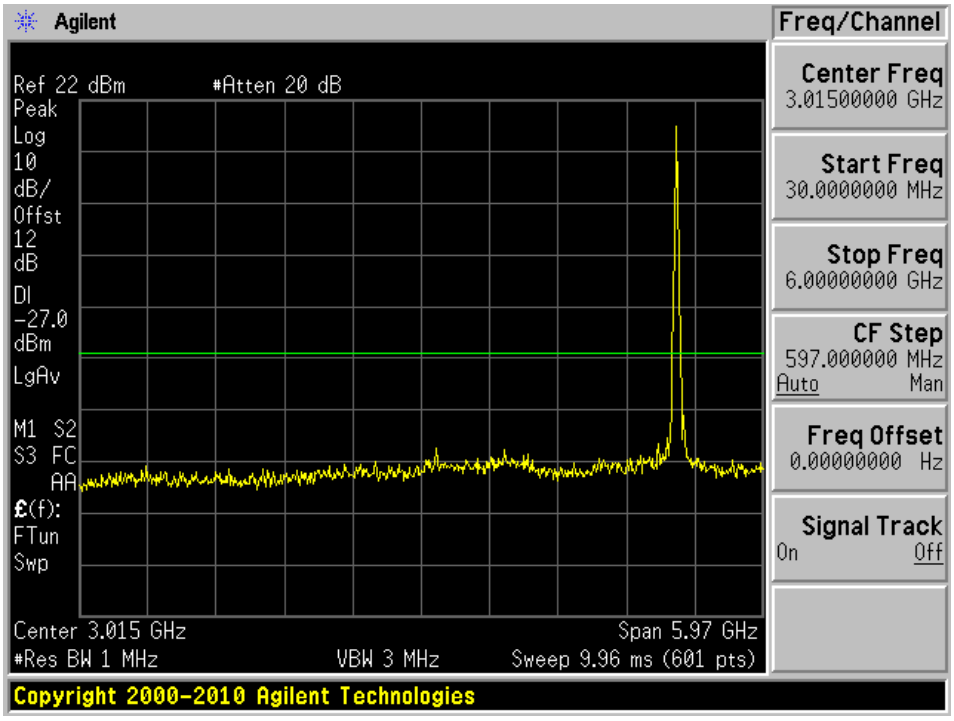


6GHz – 40GHz

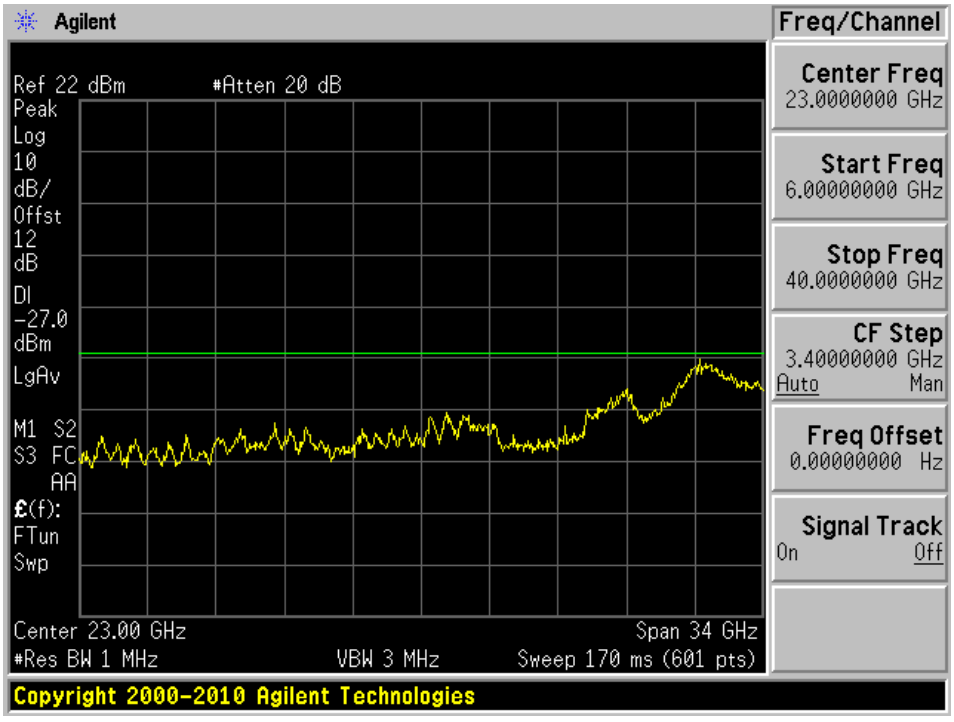


High Channel

30MHz – 6GHz



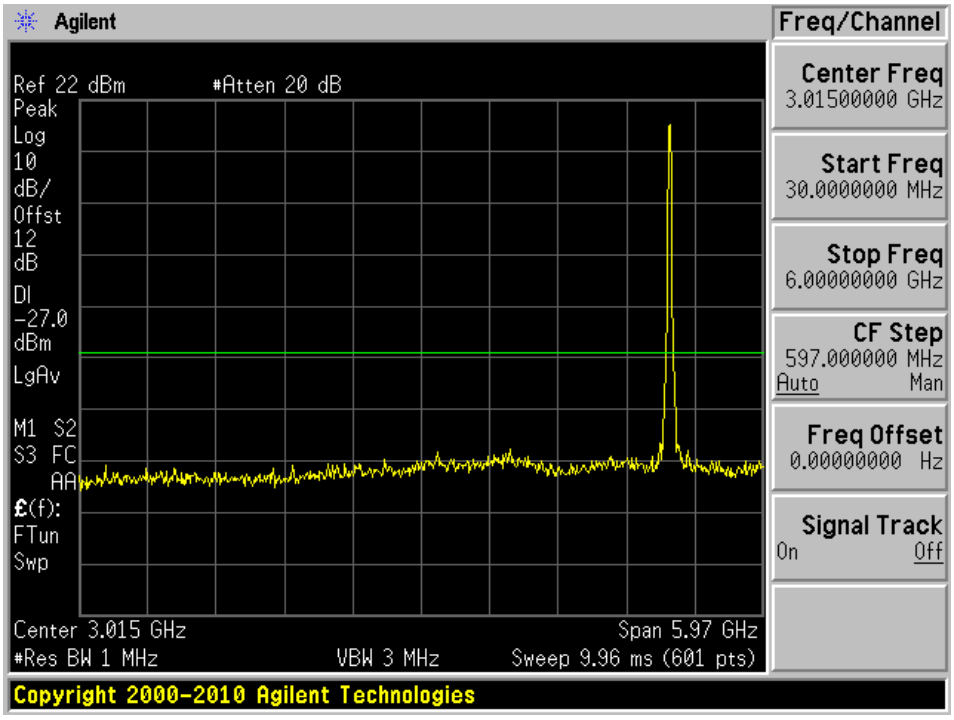
6GHz – 40GHz



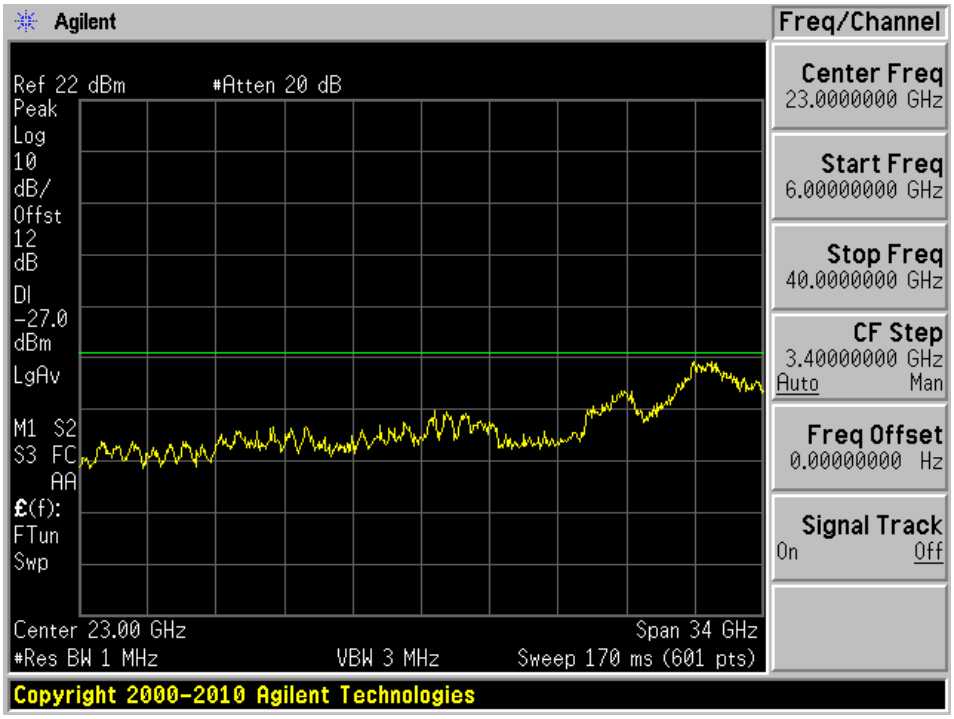
5.2 GHz 802.11n/ac20

Low Channel

30MHz – 6GHz

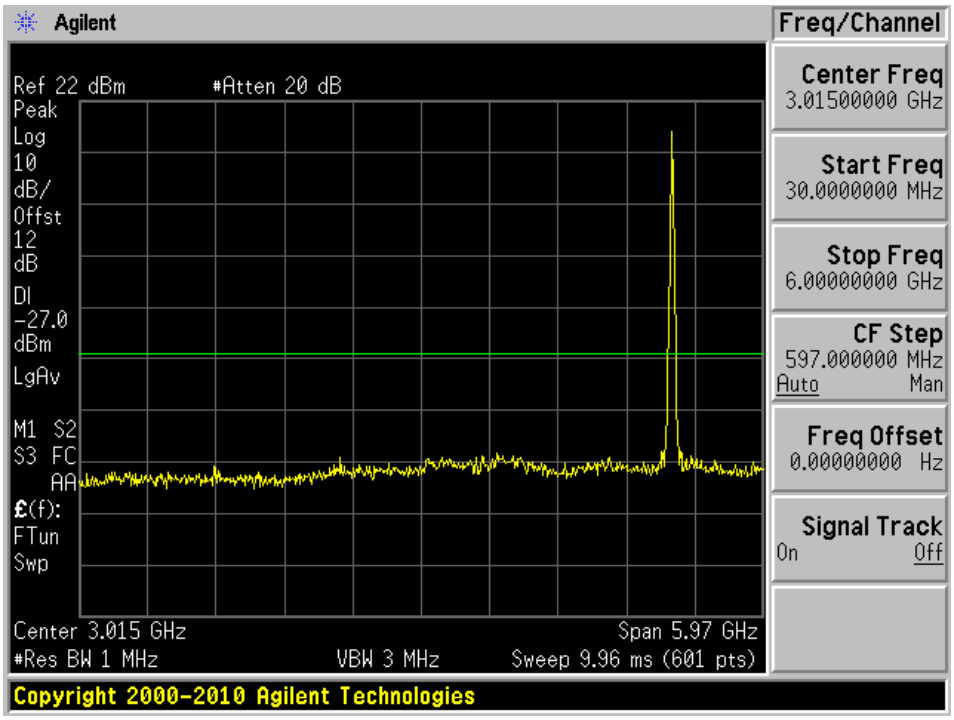


6GHz – 40GHz

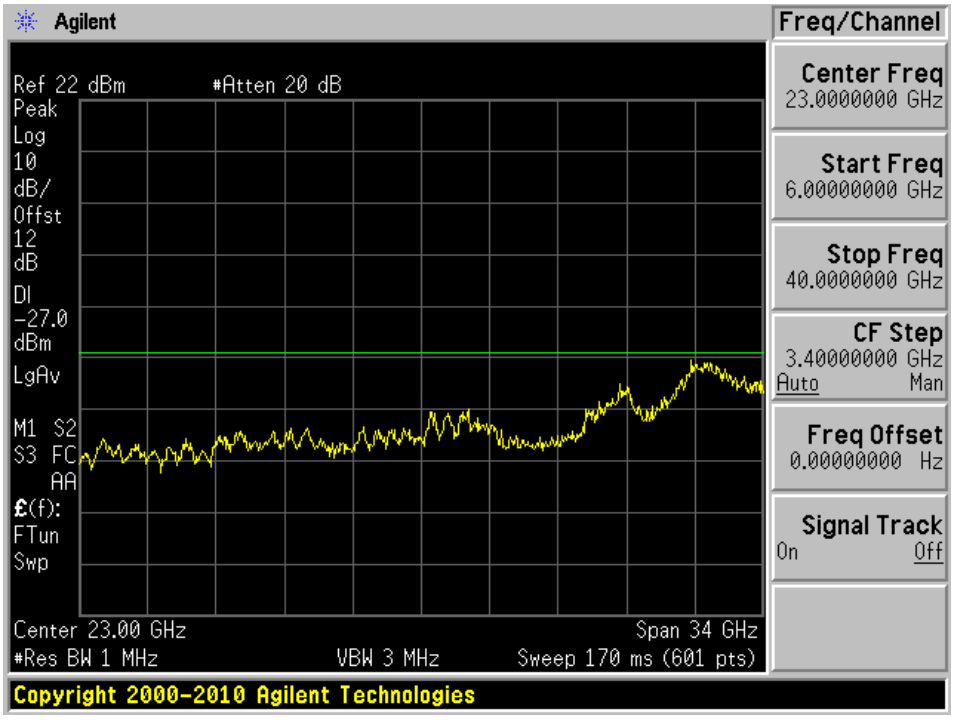


Mid Channel

30MHz – 6GHz

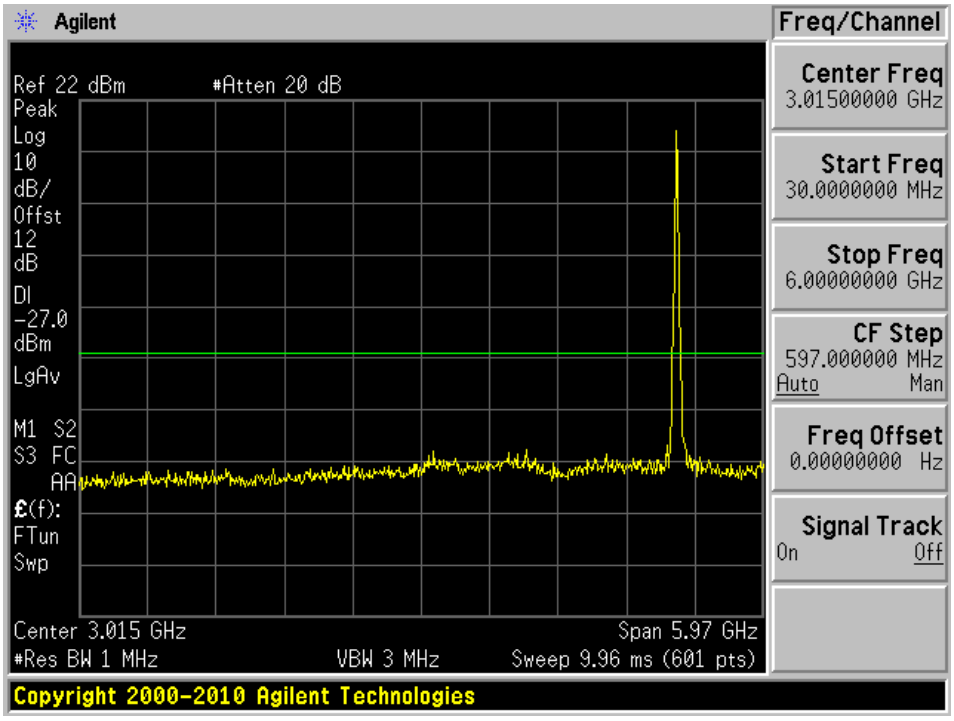


6GHz – 40GHz

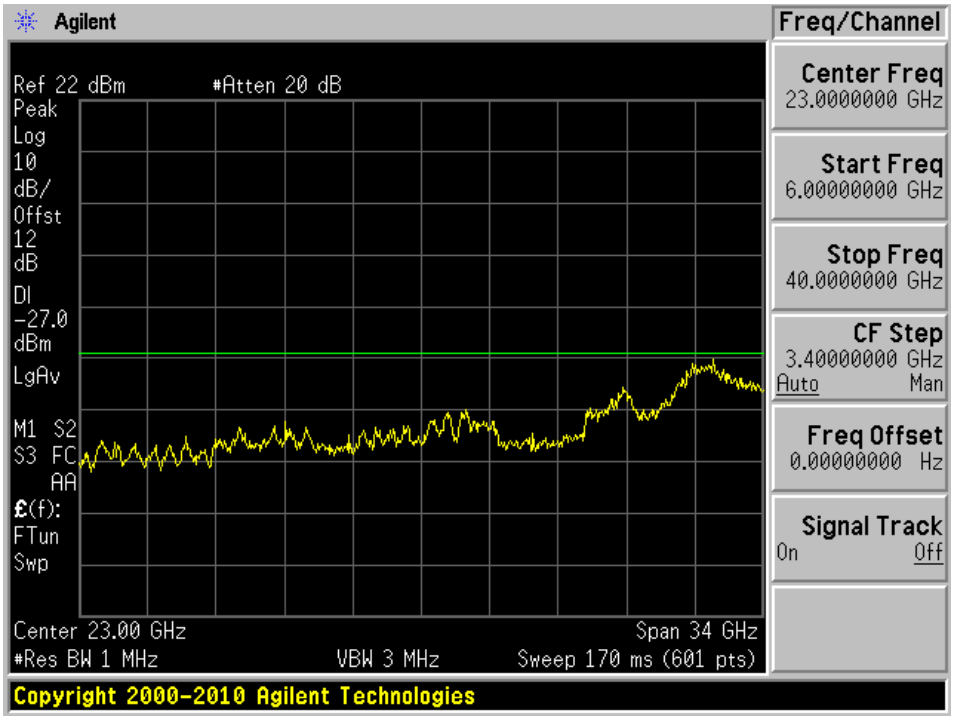


High Channel

30MHz – 6GHz



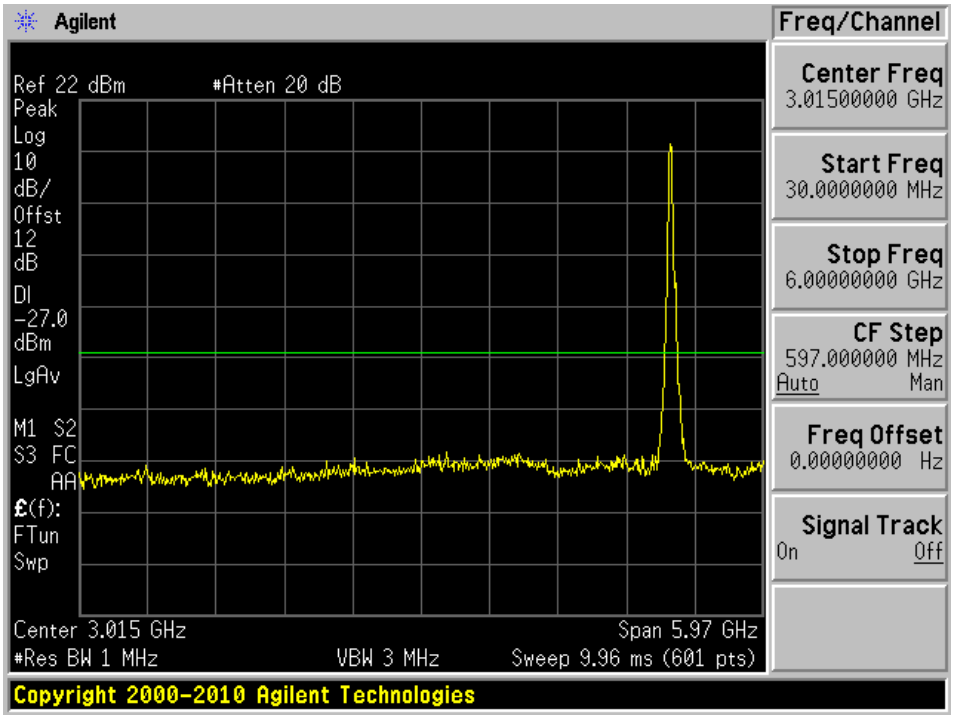
6GHz – 40GHz



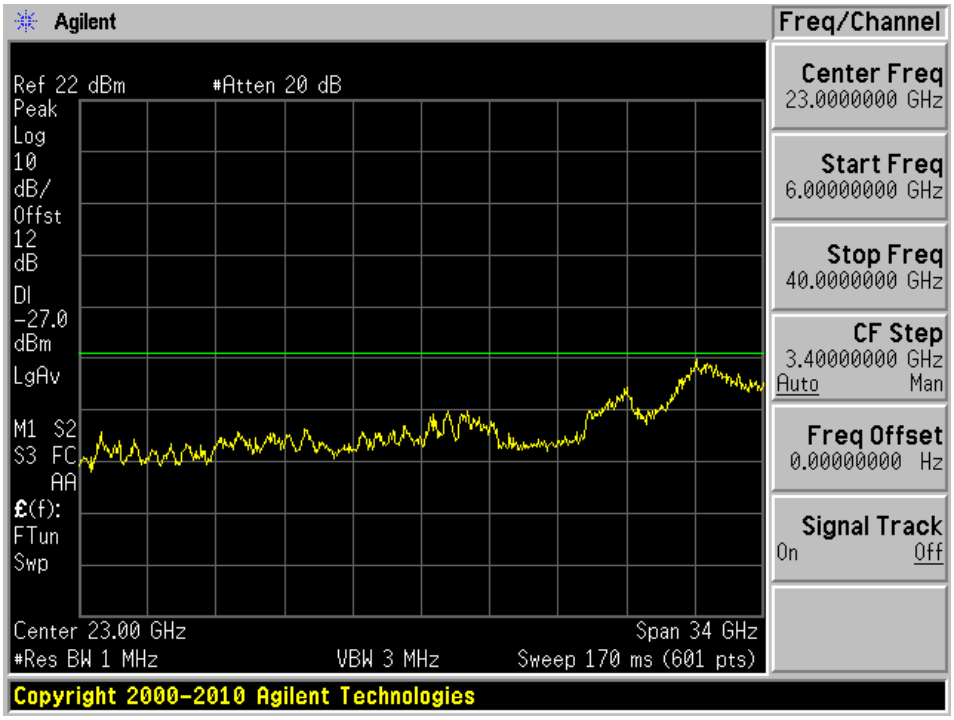
5.2 GHz 802.11n/ac40

Low Channel

30MHz – 6GHz

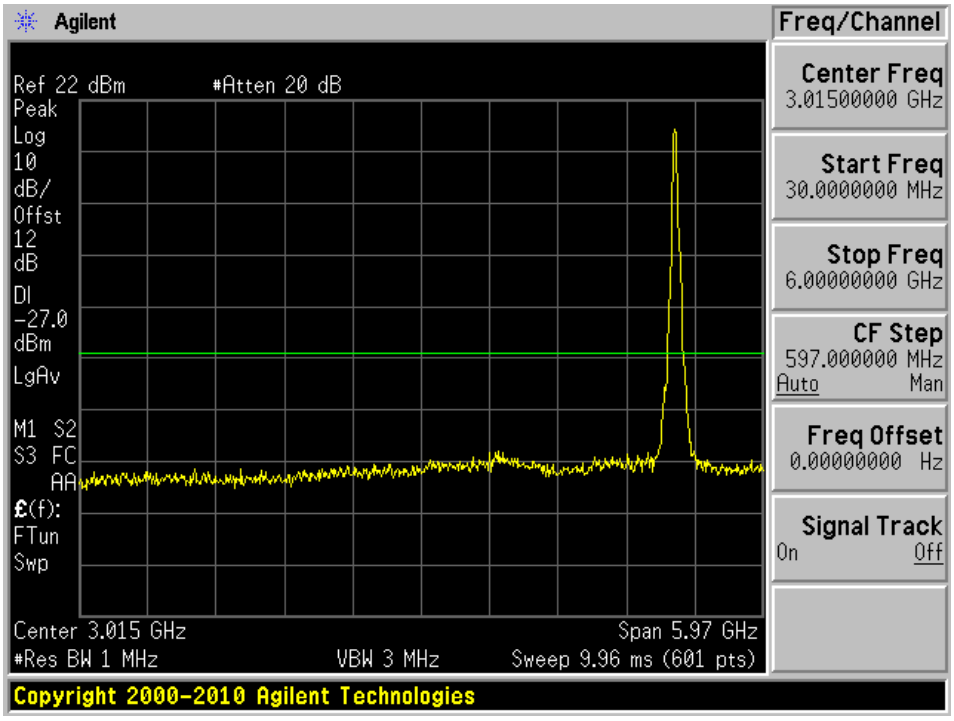


6GHz – 40GHz

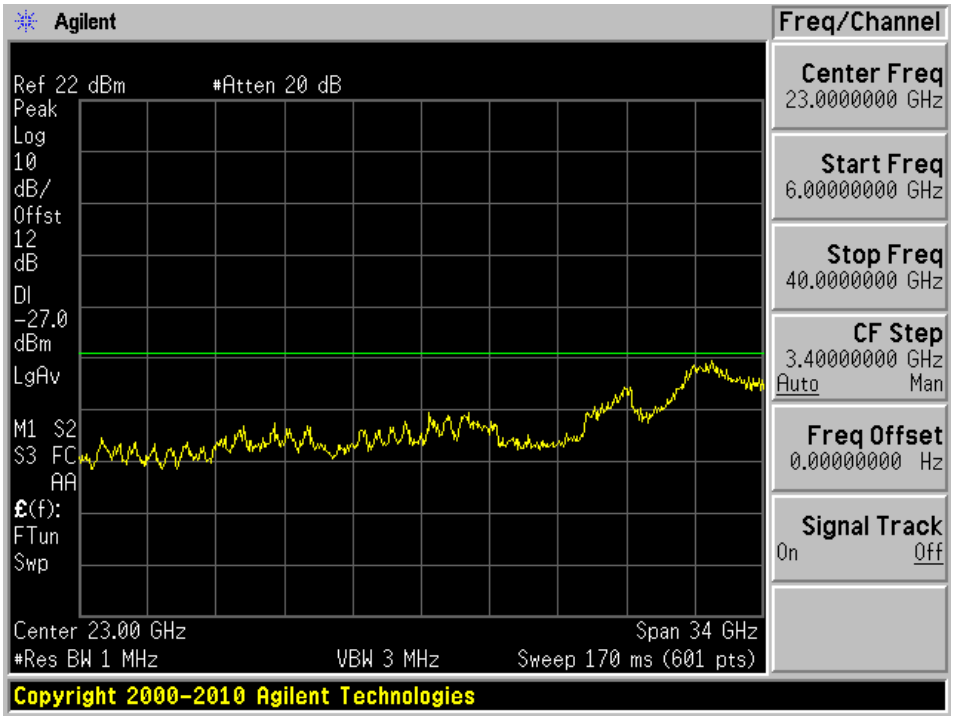


High Channel

30MHz – 6GHz



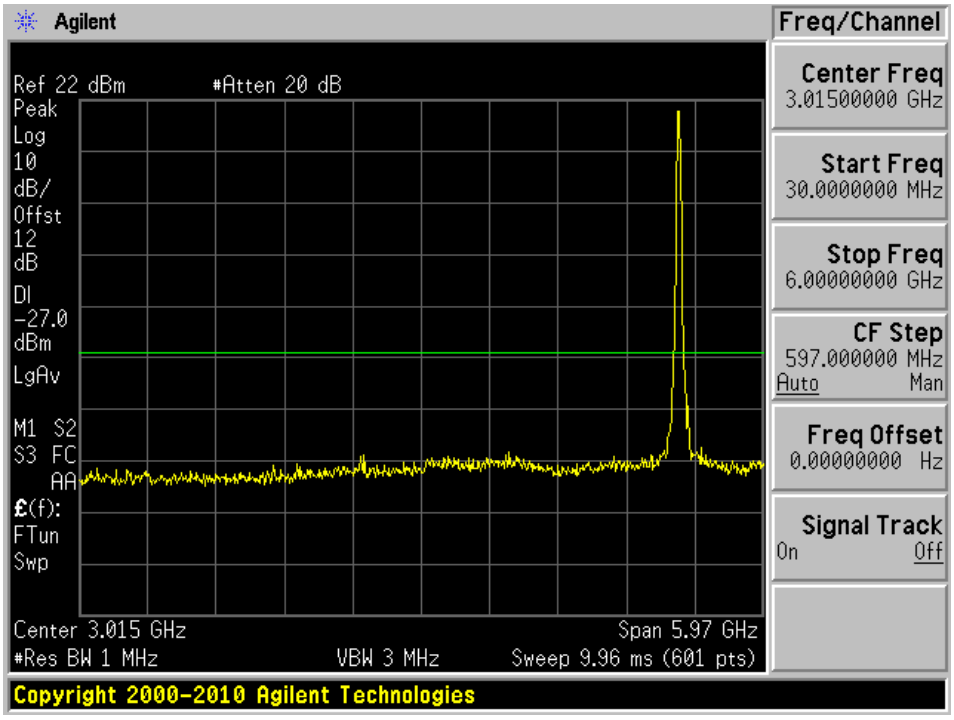
6GHz – 40GHz



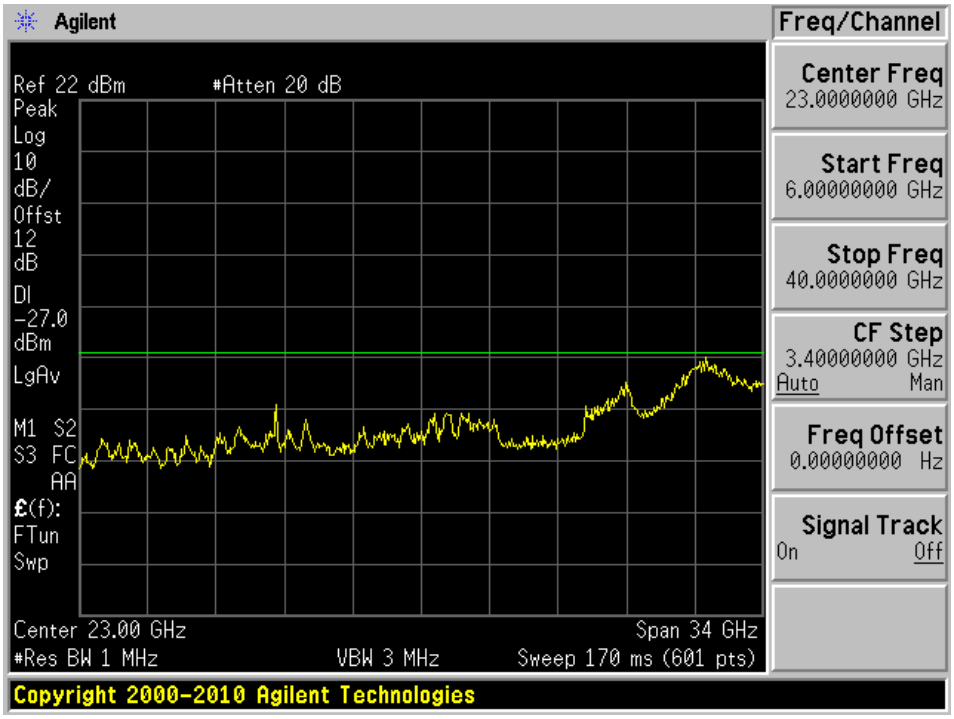
5.3 GHz 802.11a

Low Channel

30MHz - 6GHz

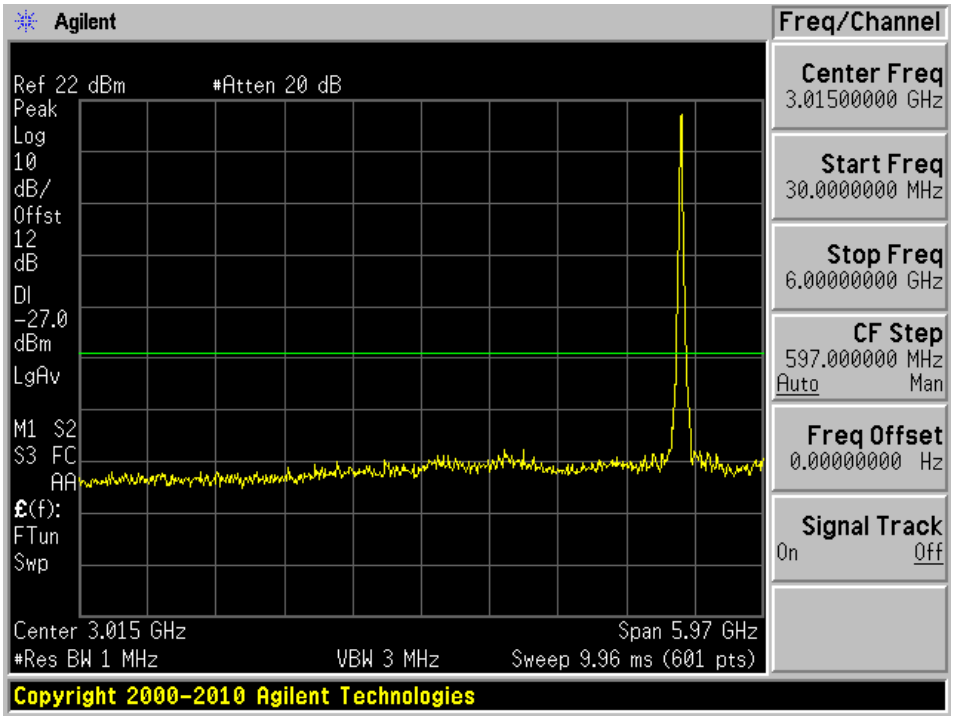


6GHz – 40GHz

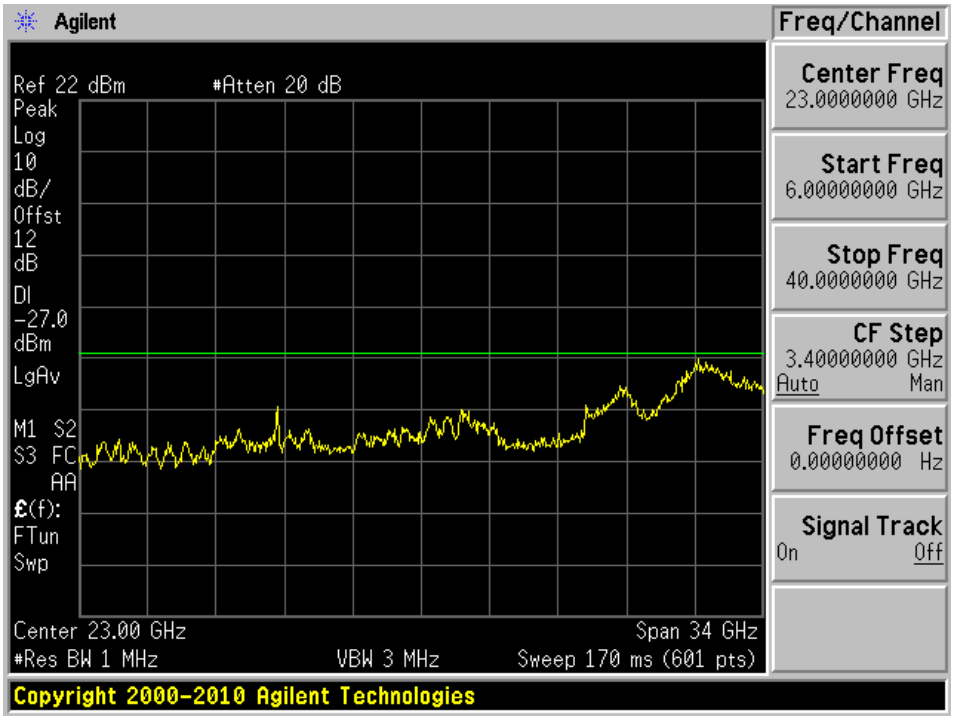


Mid Channel

30MHz - 6GHz

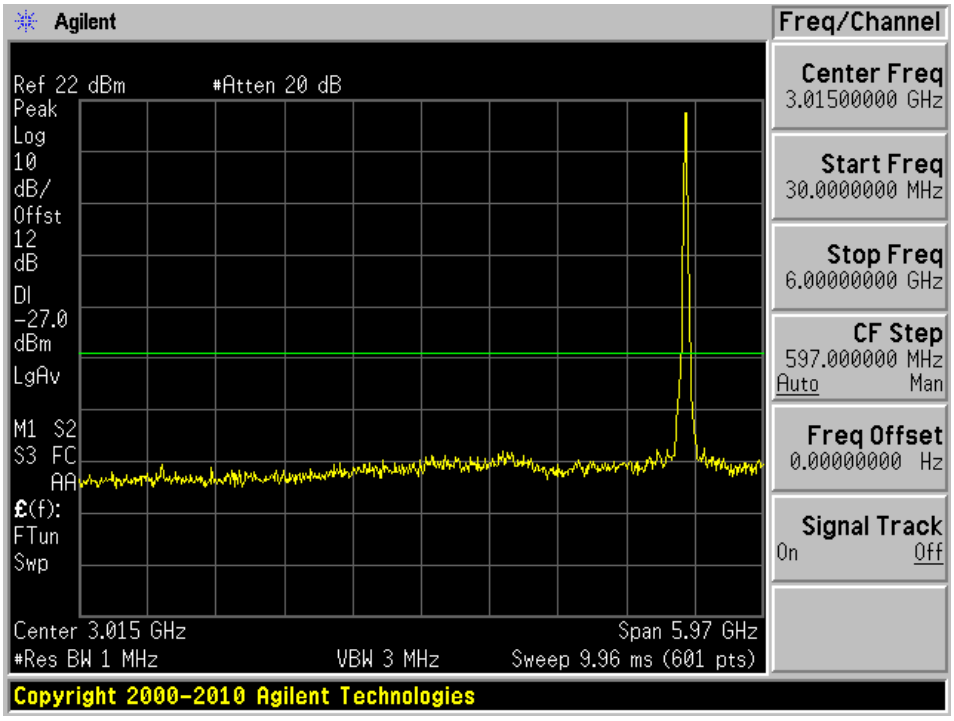


6GHz – 40GHz

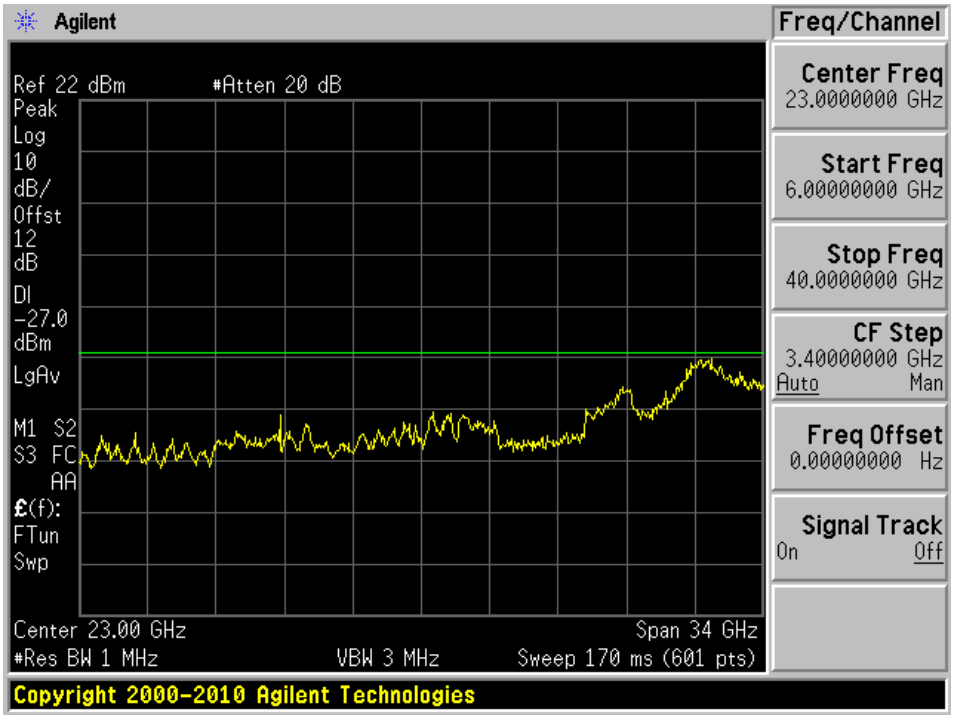


High Channel

30MHz – 6GHz



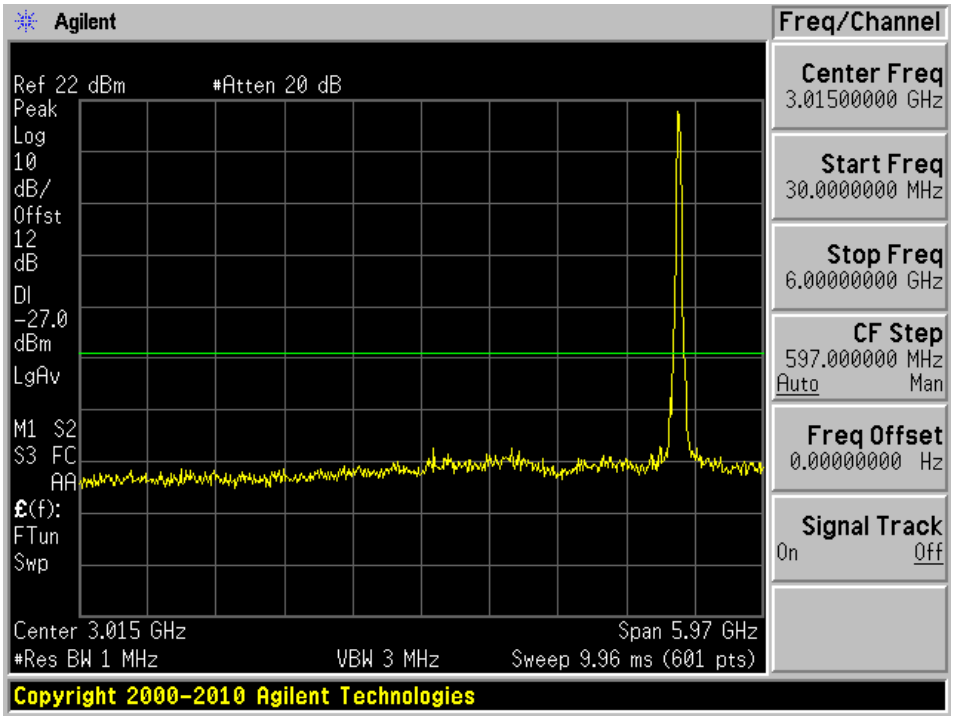
6GHz – 40GHz



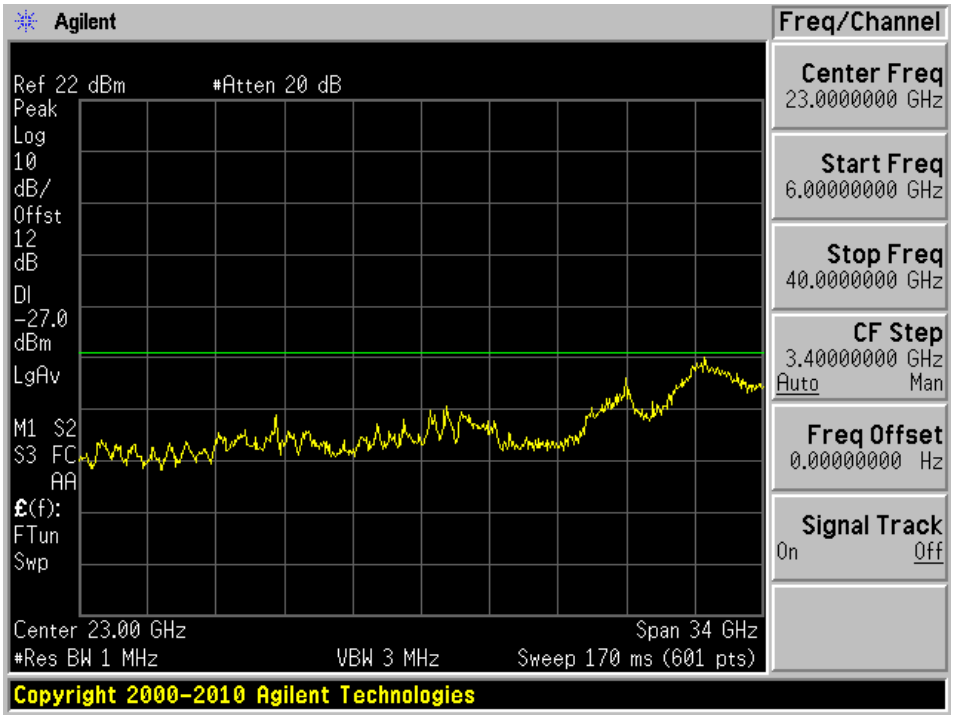
5.3 GHz 802.11n/ac20

Low Channel

30MHz - 6GHz

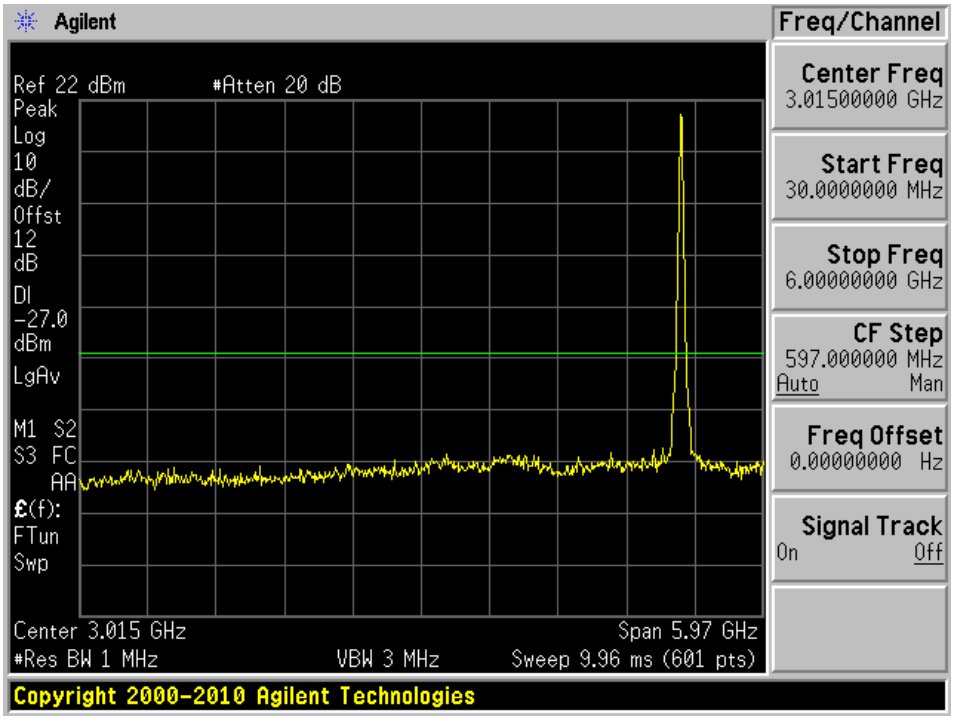


6GHz – 40GHz

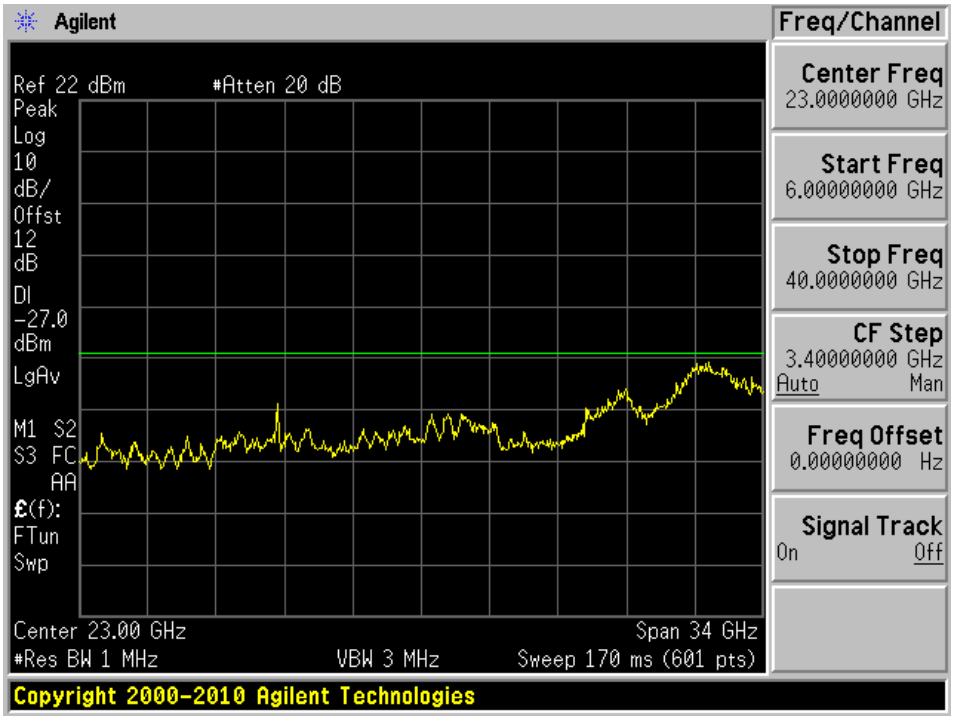


Mid Channel

30MHz – 6GHz

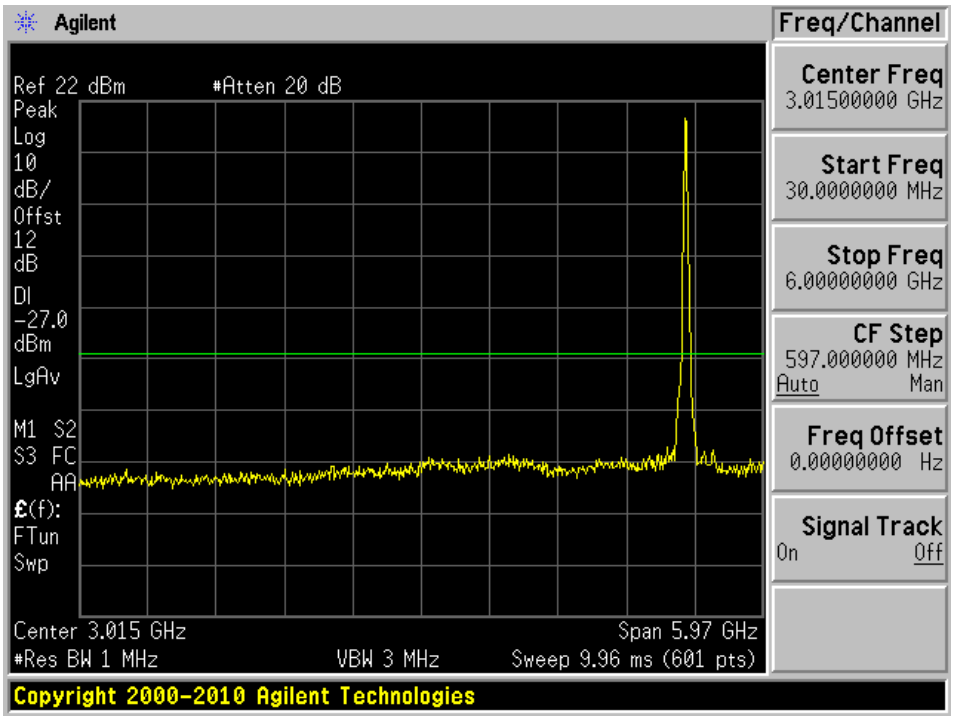


6GHz – 40GHz

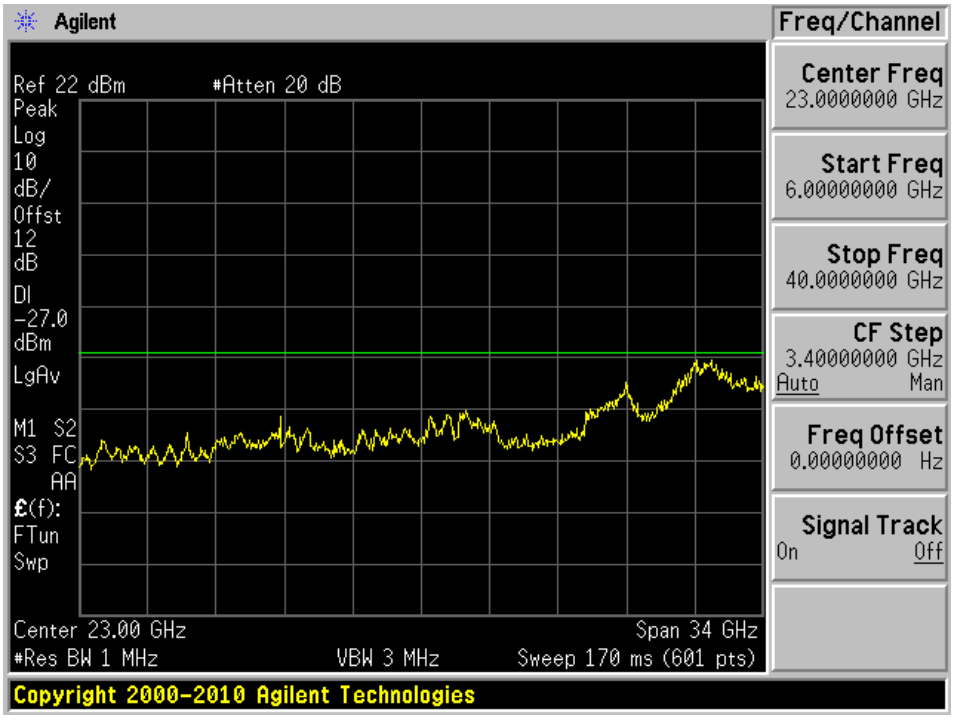


High Channel

30MHz – 6GHz



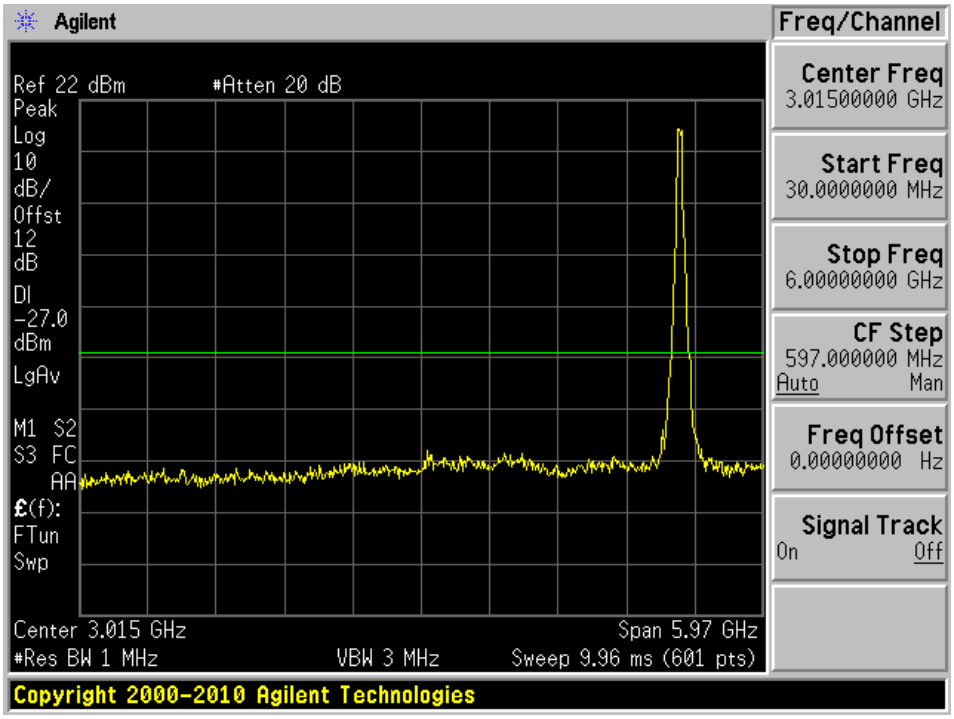
6GHz – 40GHz



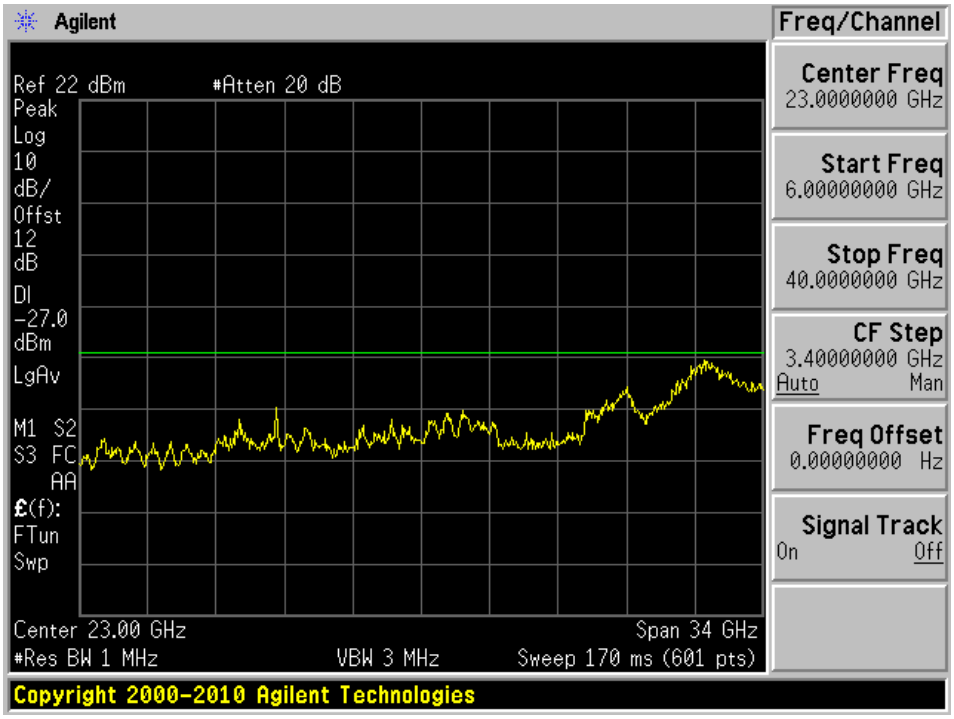
5.3 GHz 802.11n/ac40

Low Channel

30MHz – 6GHz

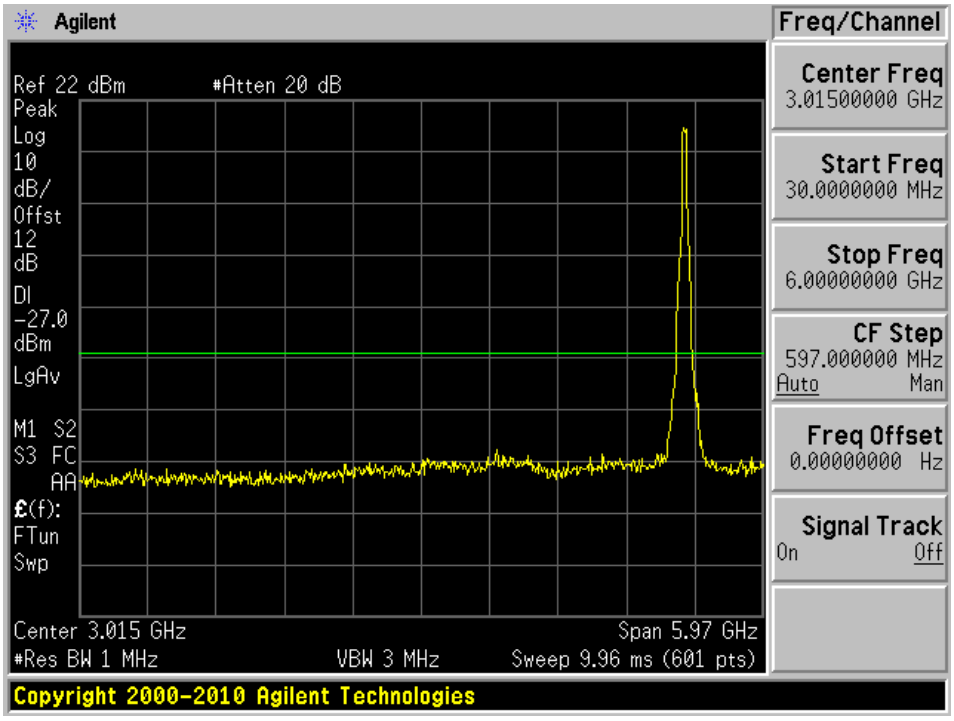


6GHz – 40GHz

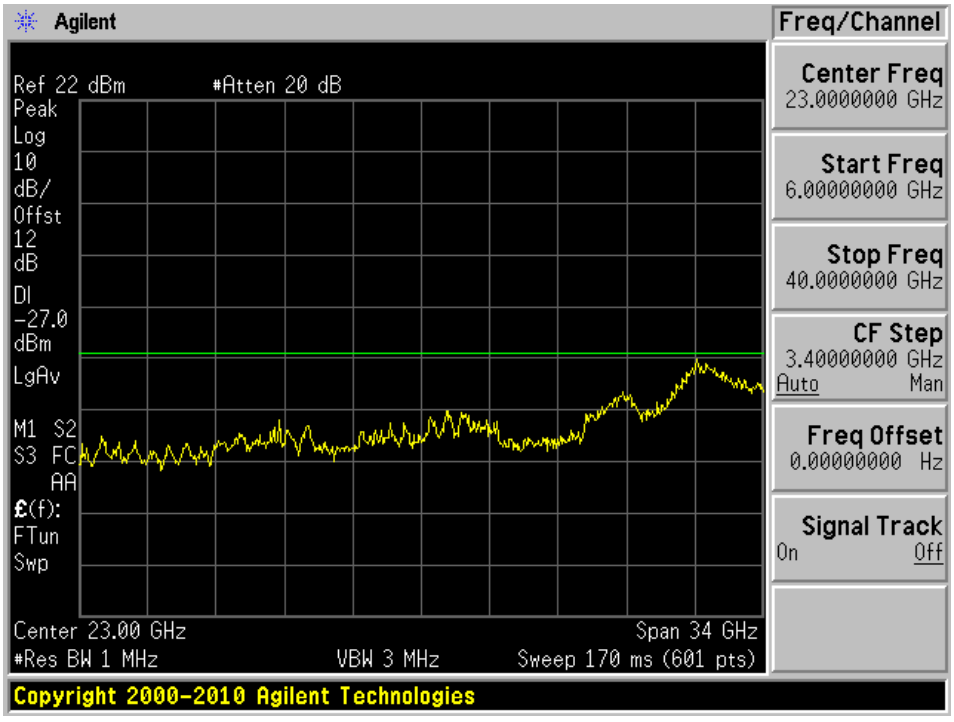


High Channel

30MHz – 6GHz



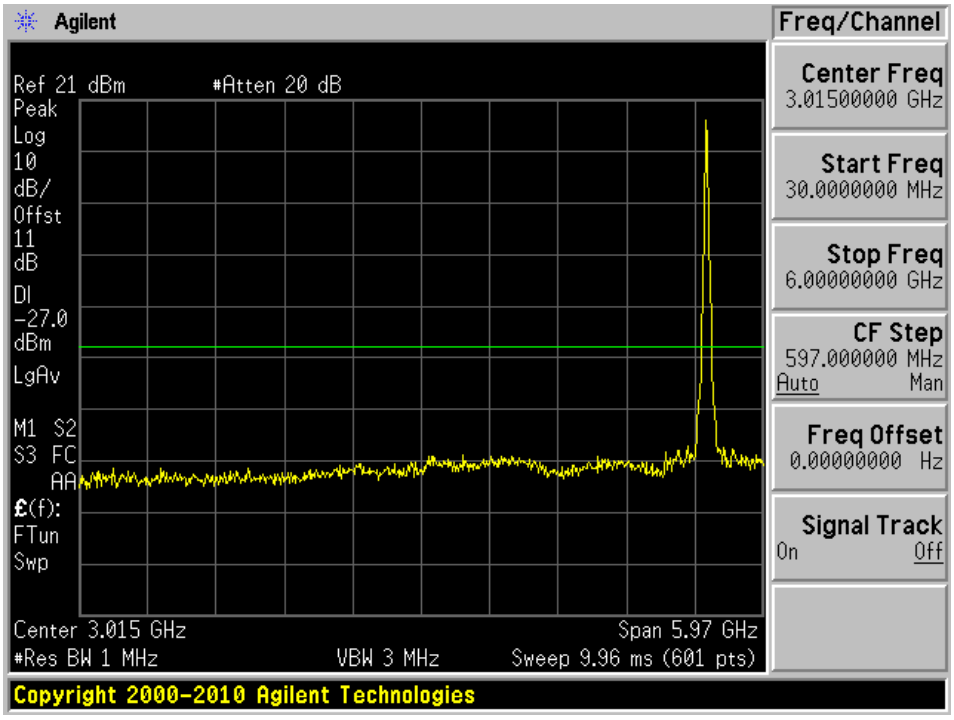
6GHz – 40GHz



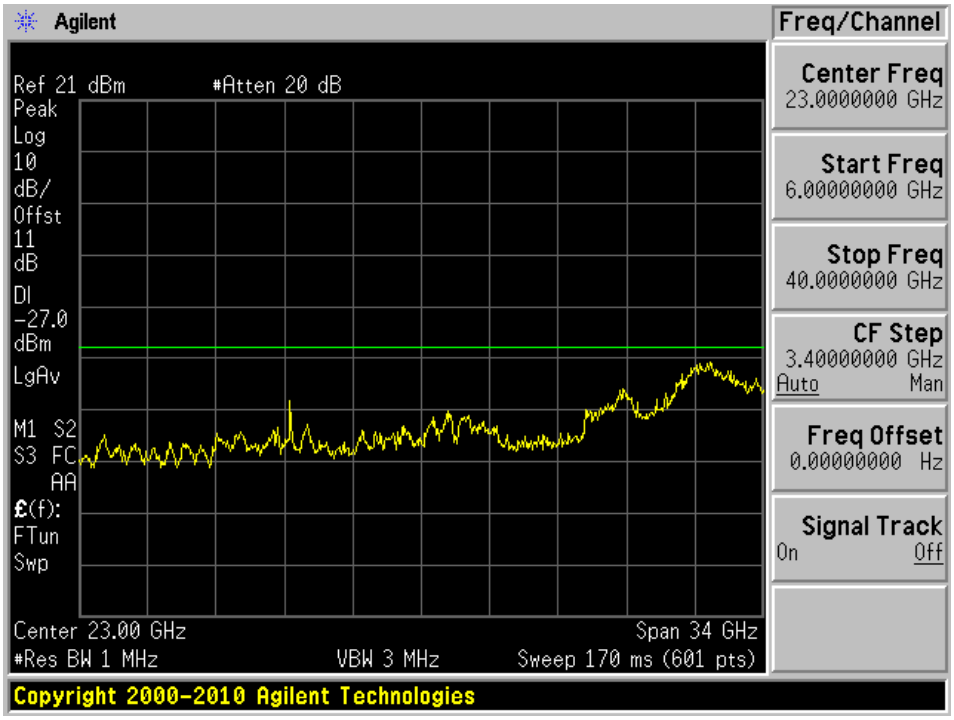
5.6 GHz 802.11a

Low Channel

30MHz – 6GHz

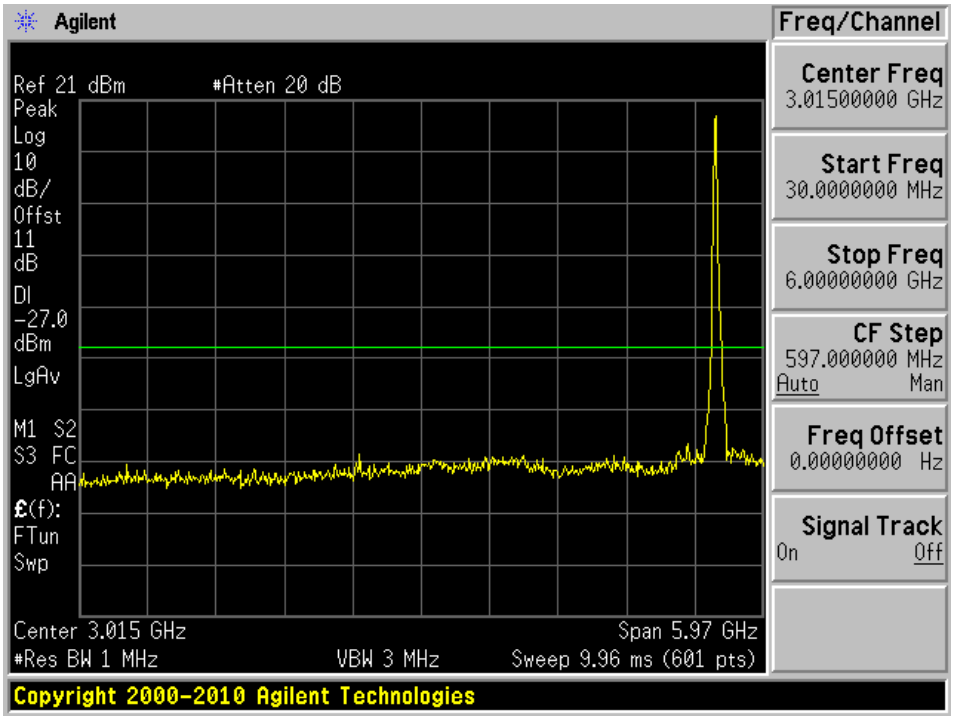


6GHz – 40GHz

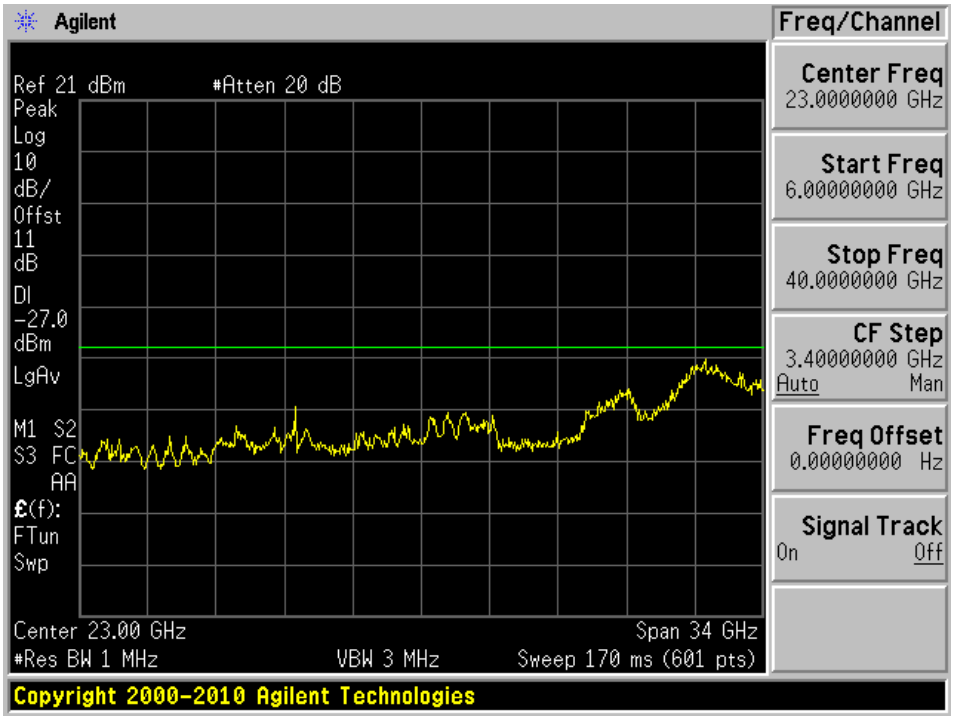


Middle Channel

30MHz – 6GHz

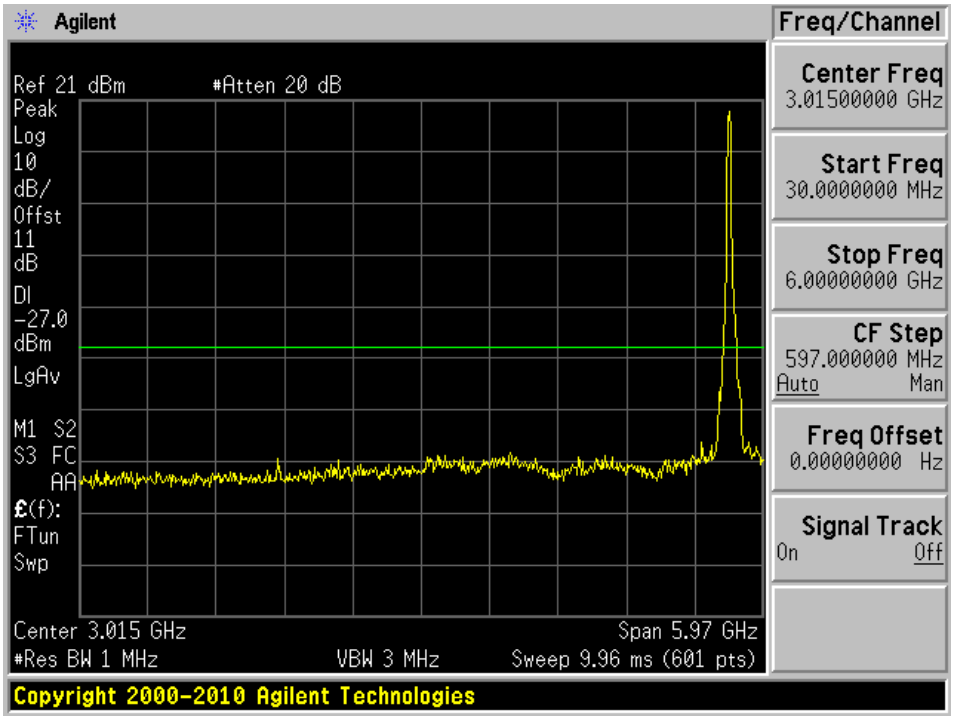


6GHz – 40GHz

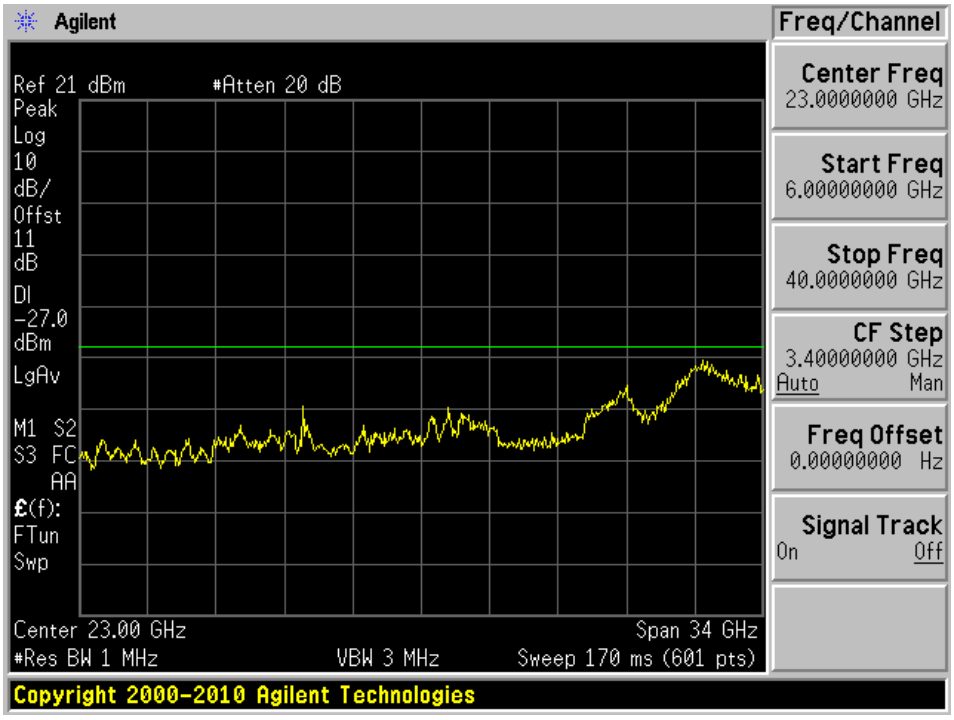


High Channel

30MHz – 6GHz



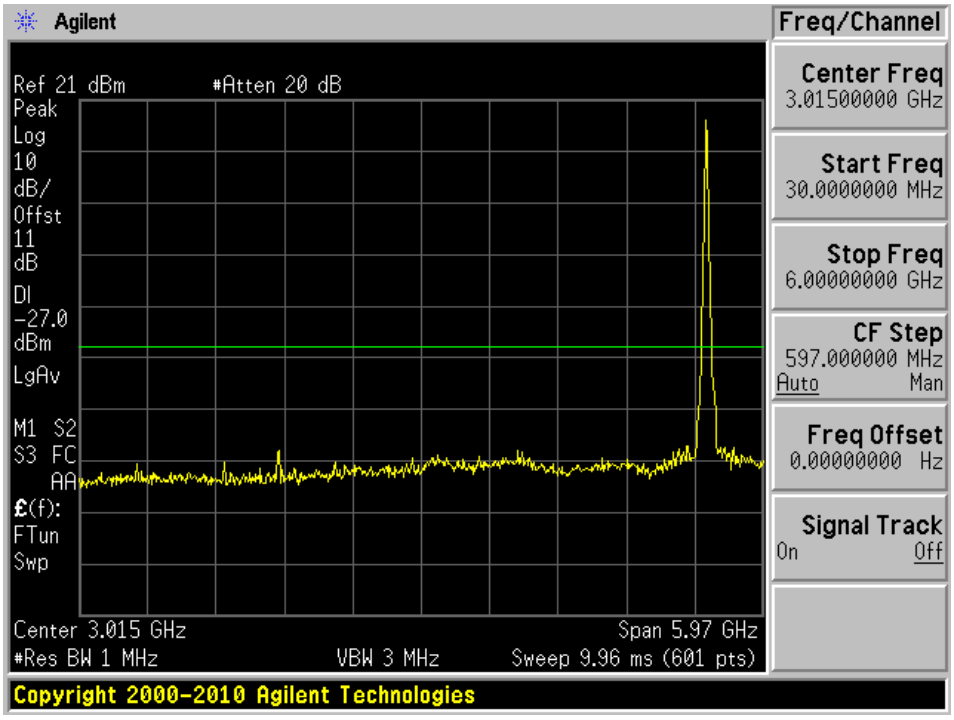
6GHz – 40GHz



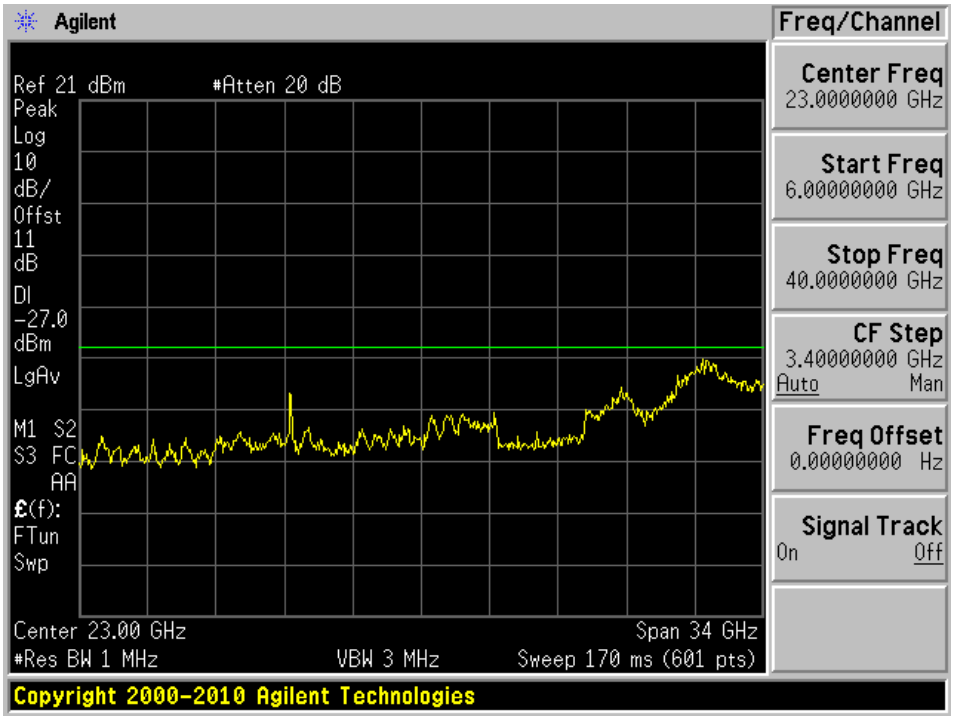
5.6 GHz 802.11n/ac20

Low Channel

30MHz – 6GHz

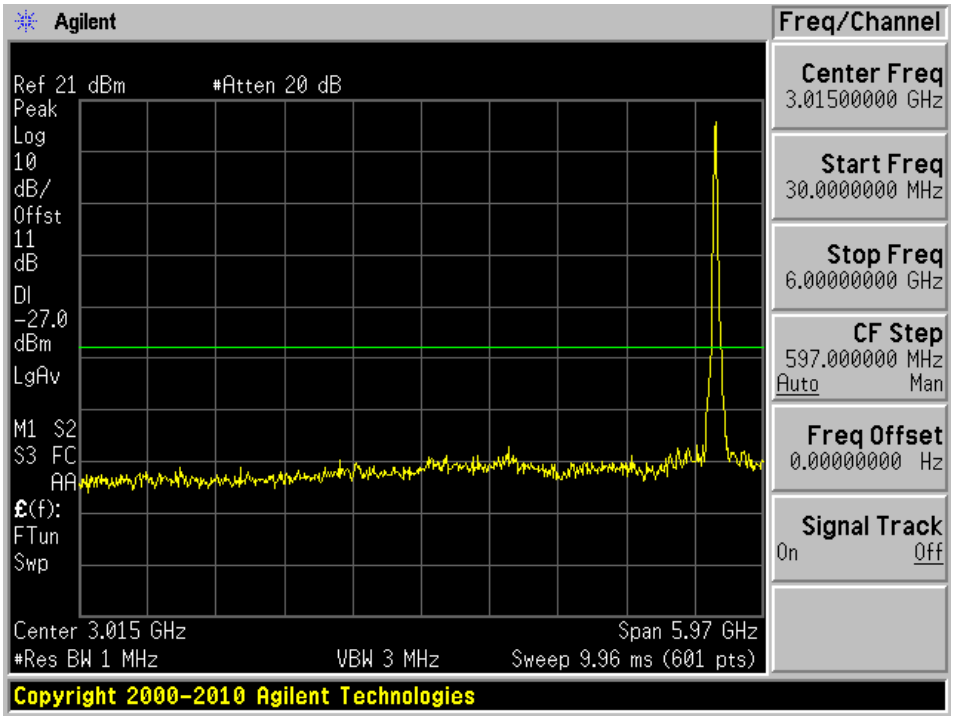


6GHz – 40GHz

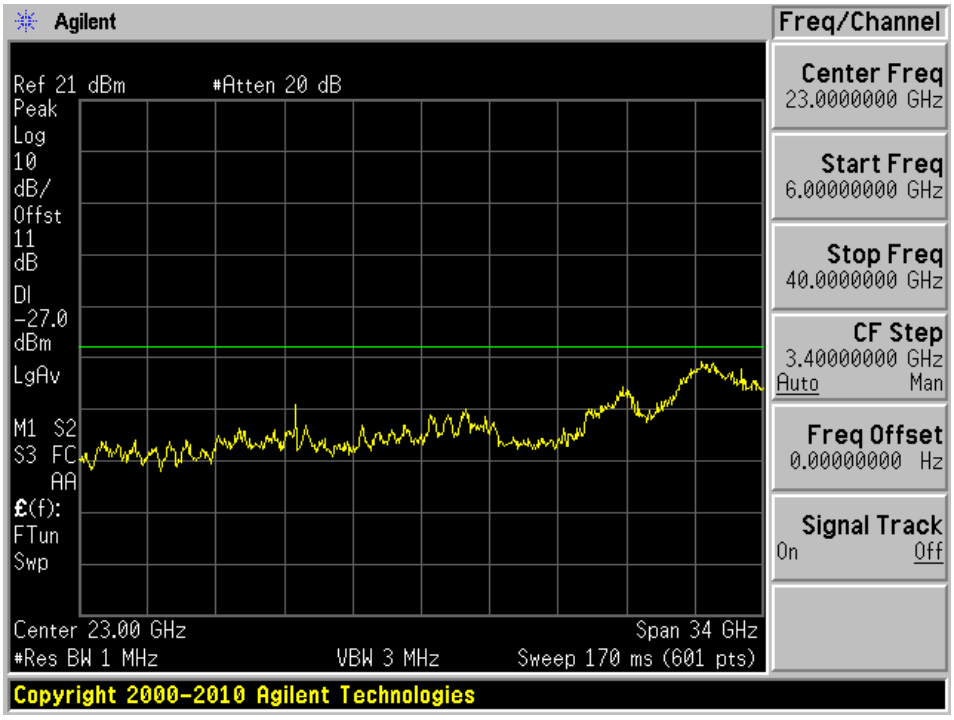


Mid Channel

30MHz – 6GHz

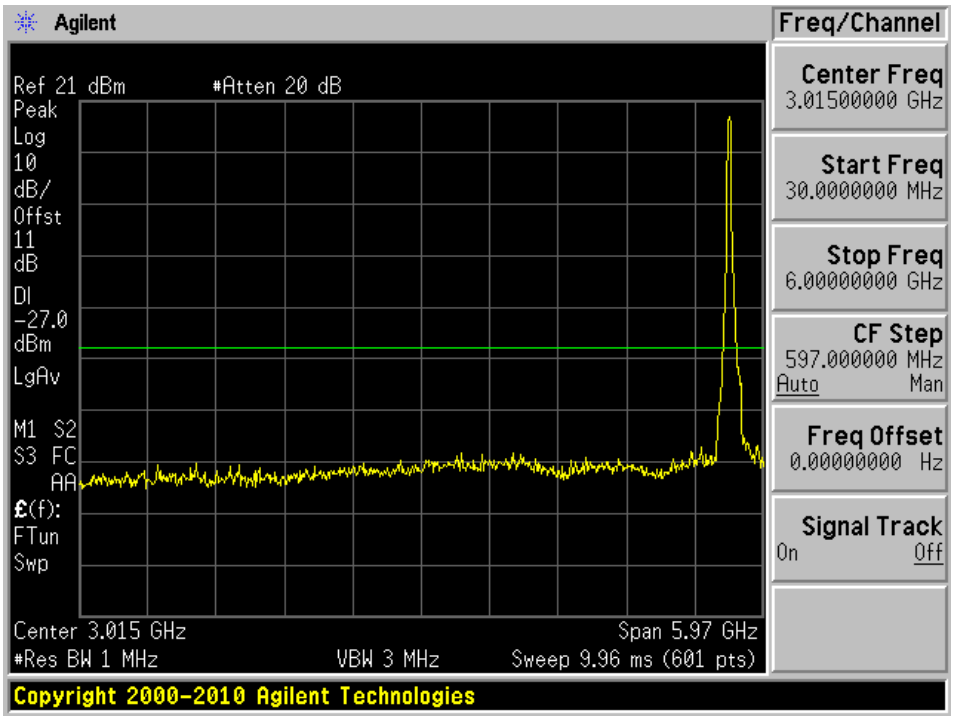


6GHz – 40GHz

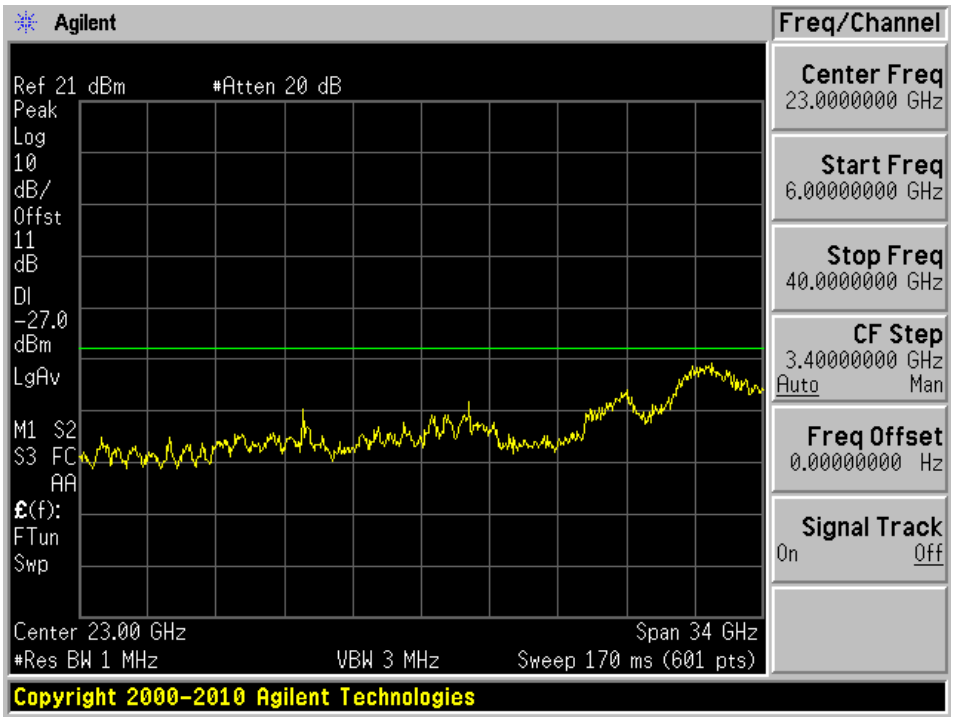


High Channel

30MHz – 6GHz



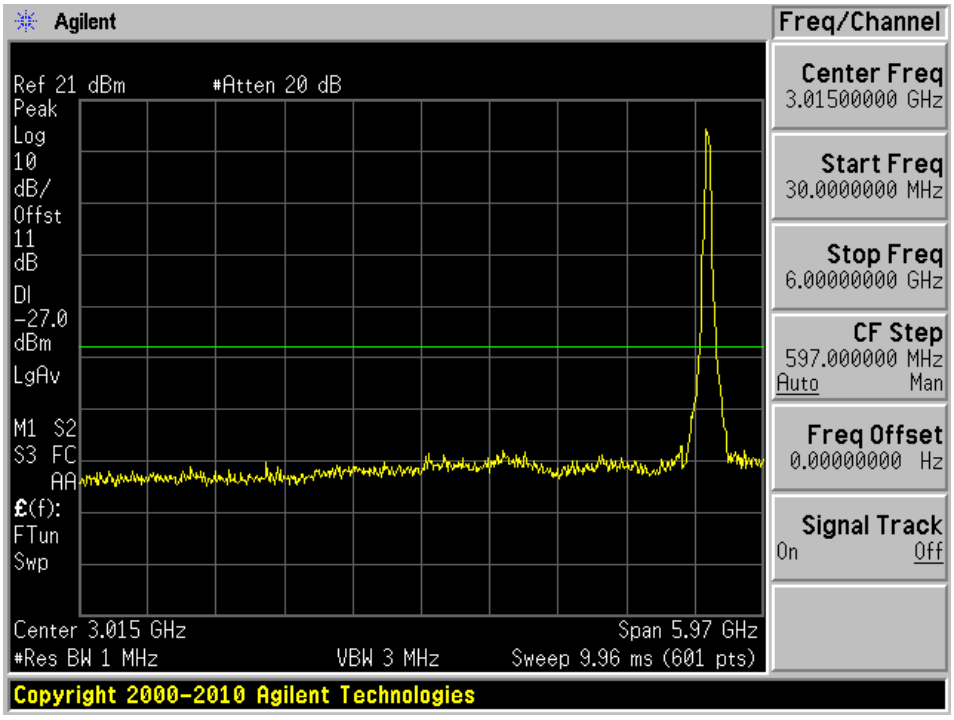
6GHz – 40GHz



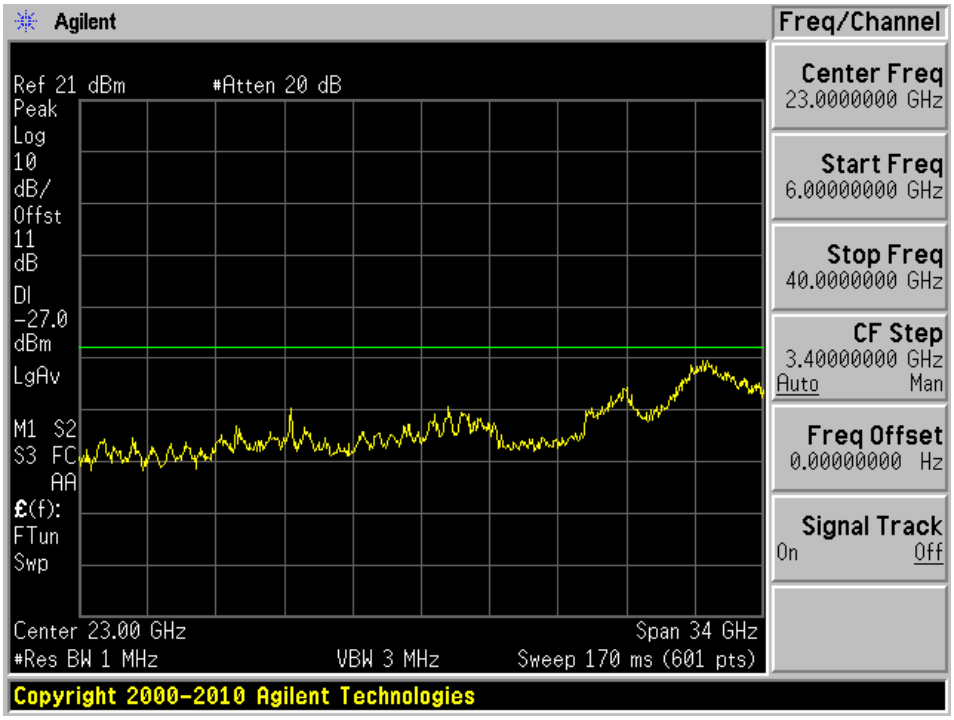
5.6 GHz 802.11n/ac40

Low Channel

30MHz – 6GHz

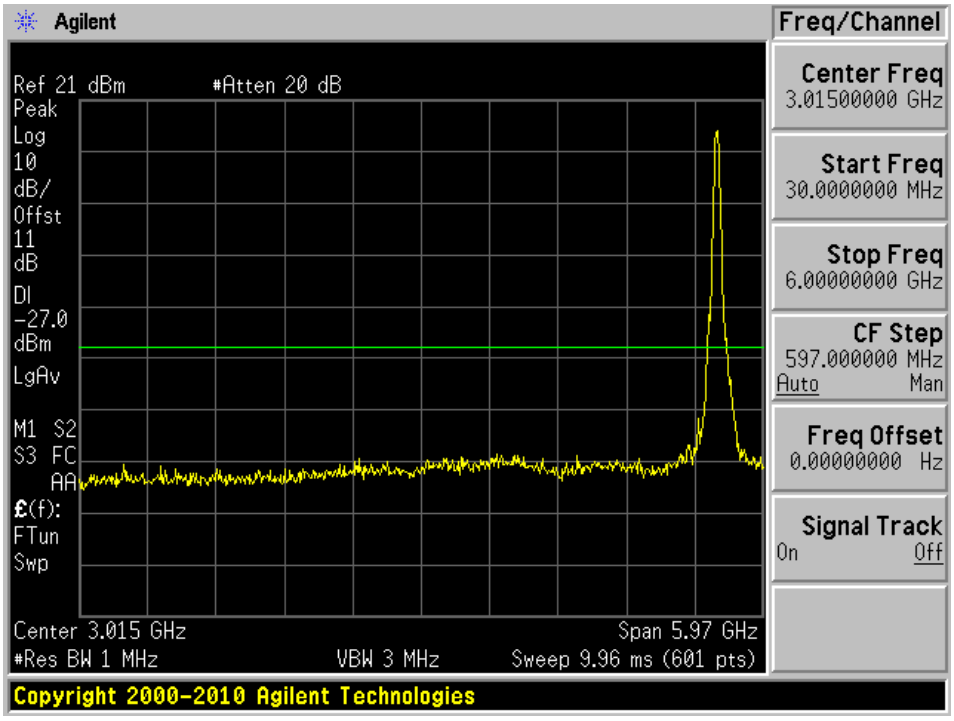


6GHz – 40GHz

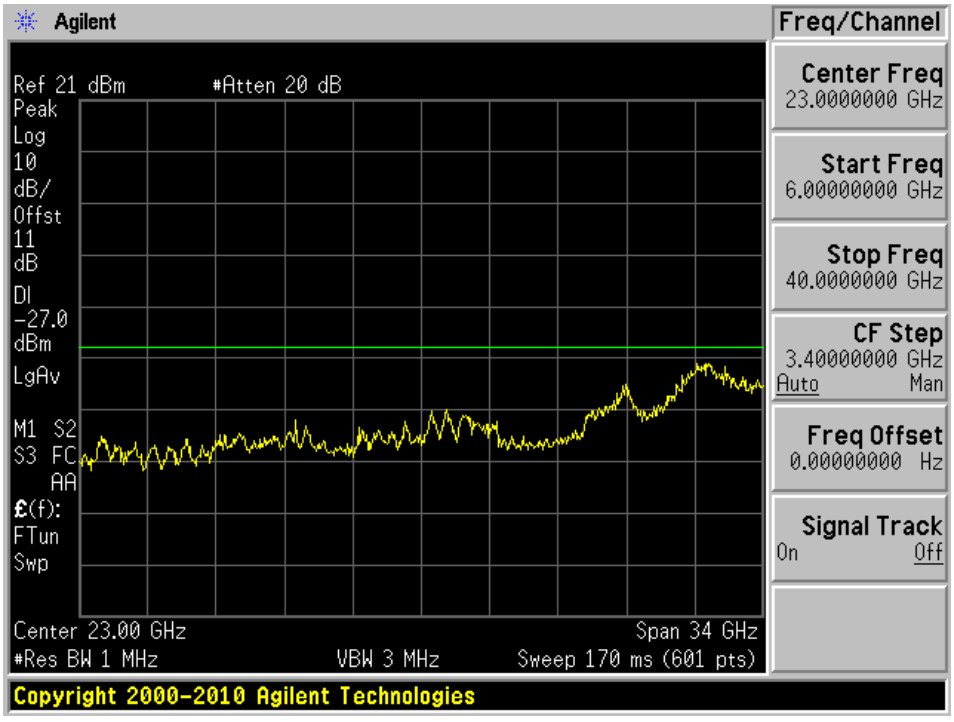


Mid Channel

30MHz – 6GHz

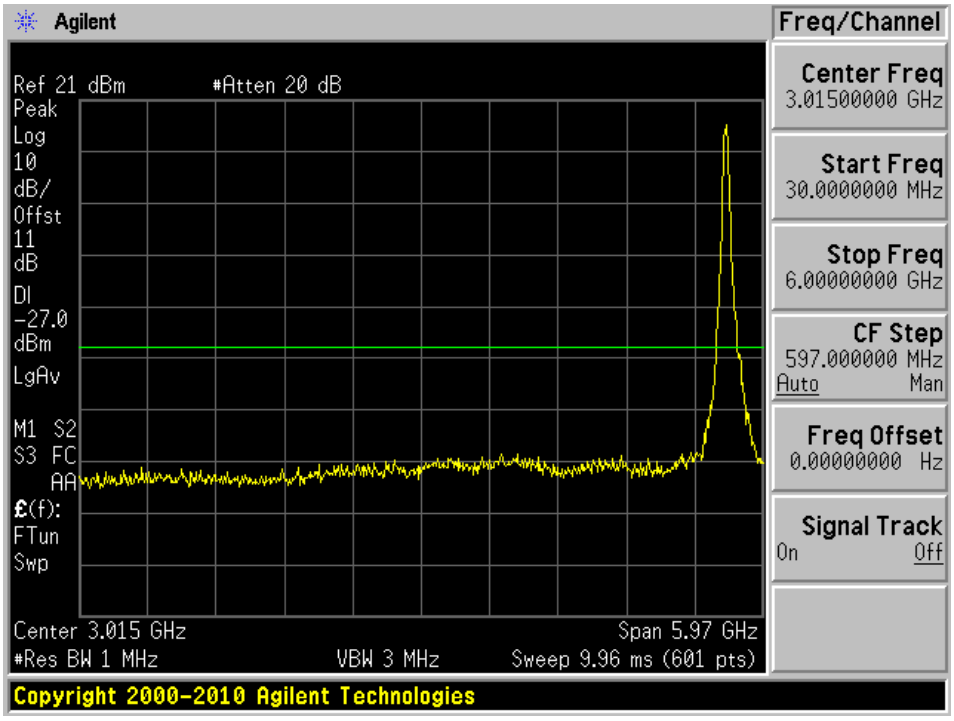


6GHz – 40GHz

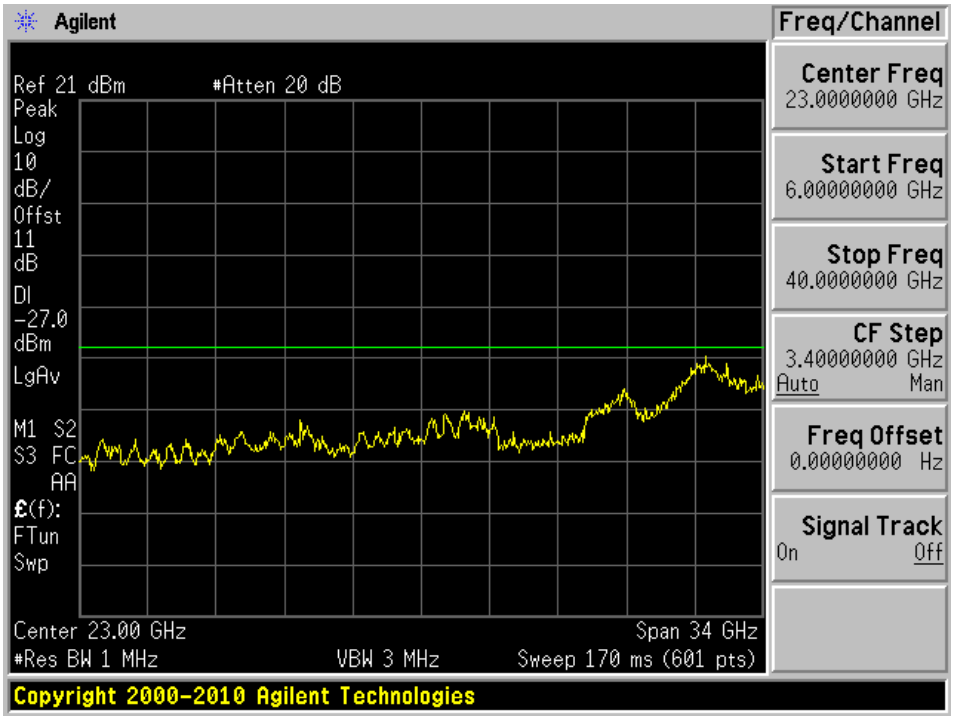


High Channel

30MHz – 6GHz



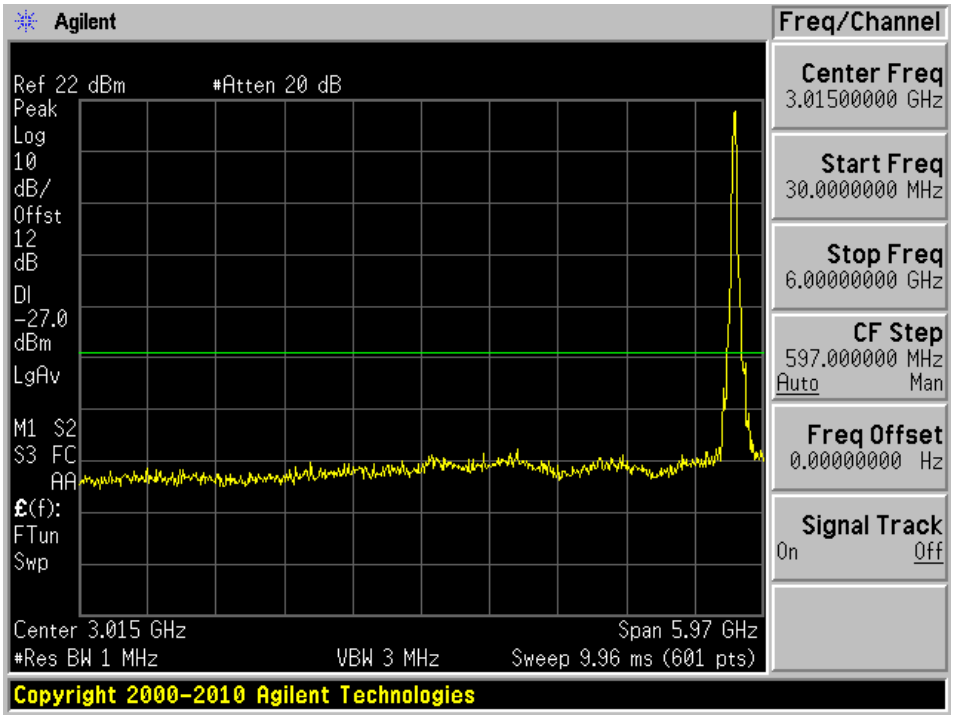
6GHz – 40GHz



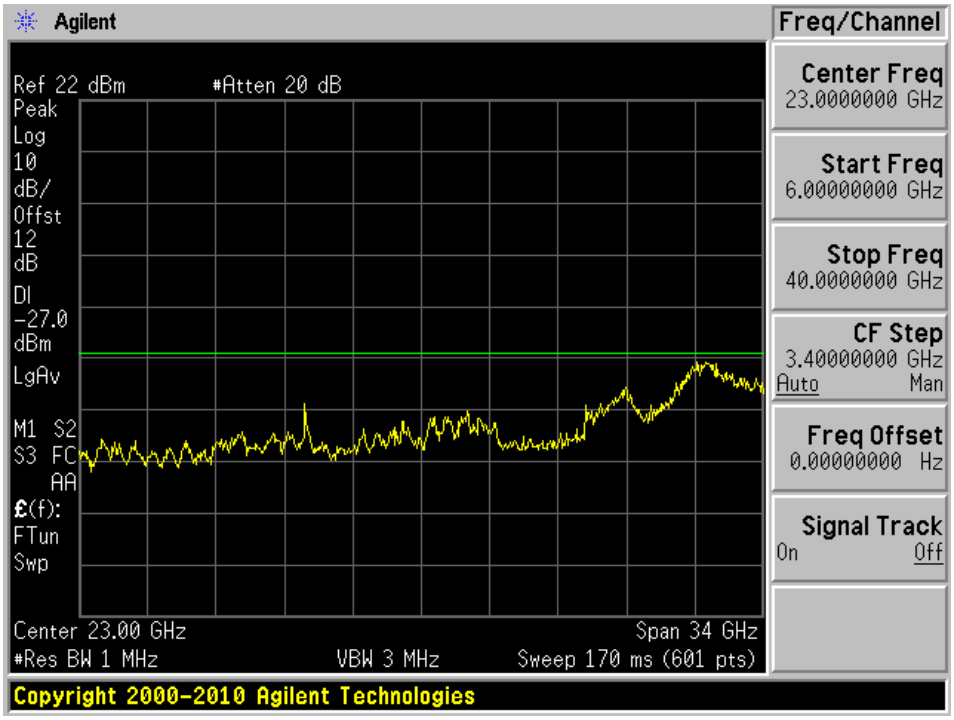
5.8 GHz 802.11a

Low Channel

30MHz – 6GHz

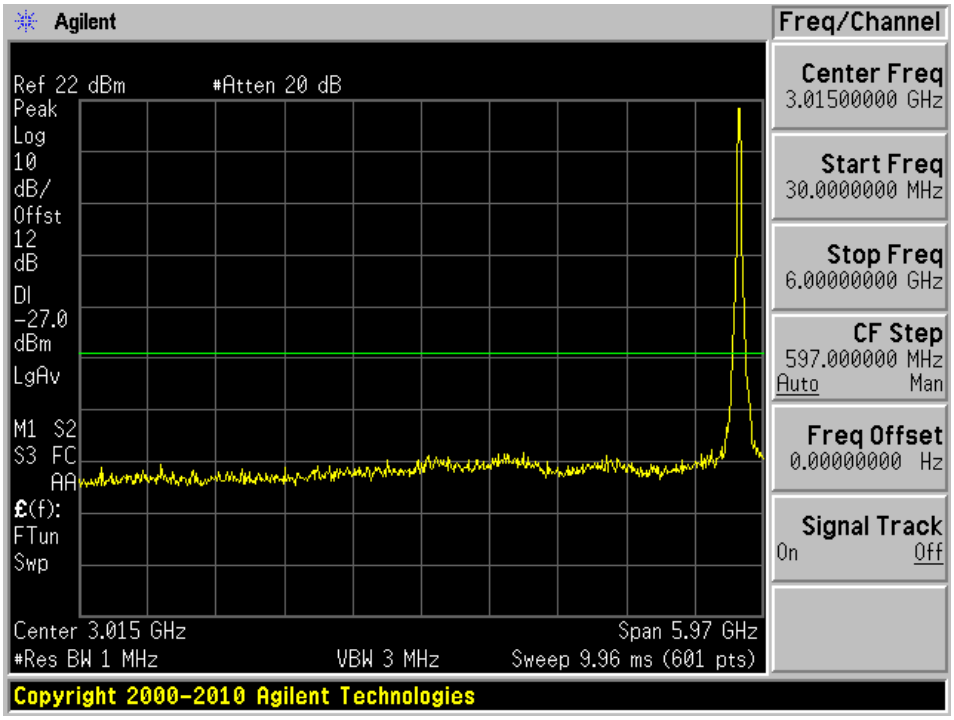


6GHz – 40GHz

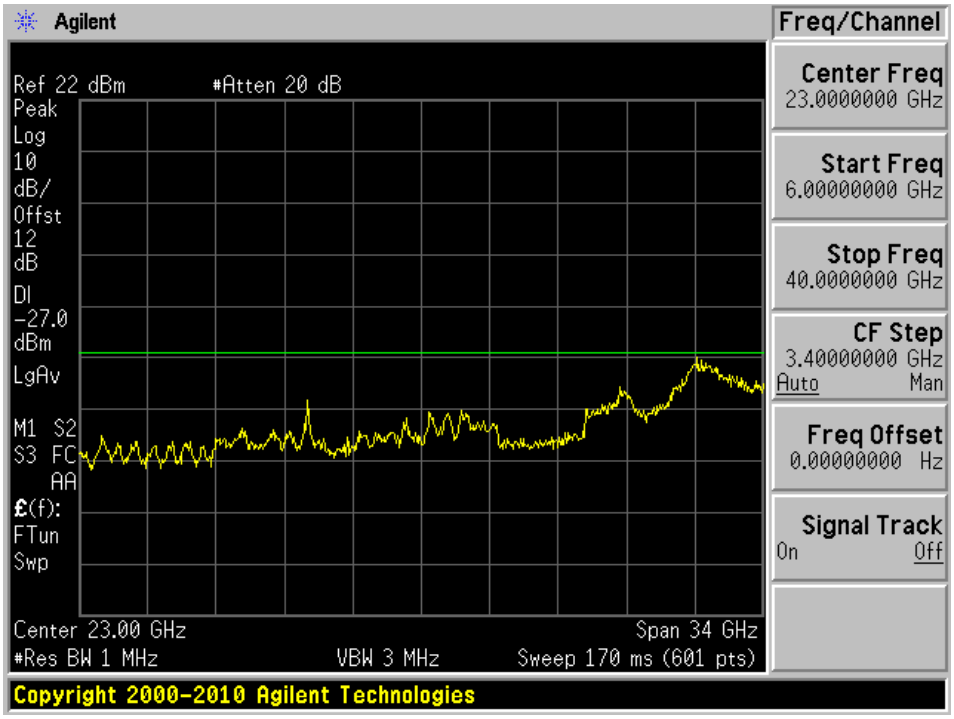


Mid Channel

30MHz – 6GHz

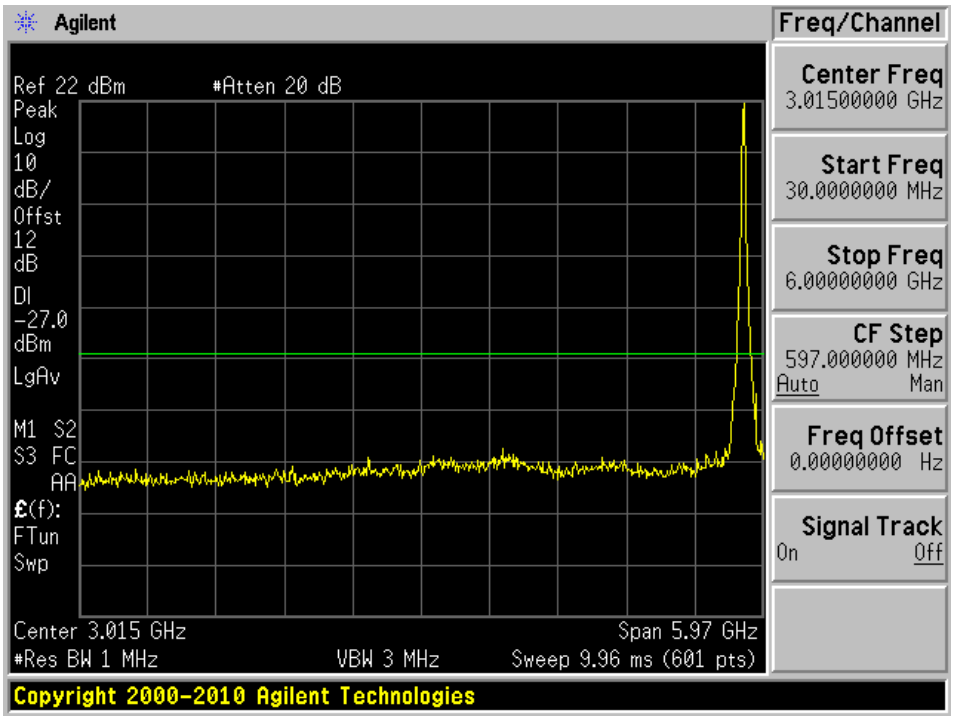


6GHz – 40GHz

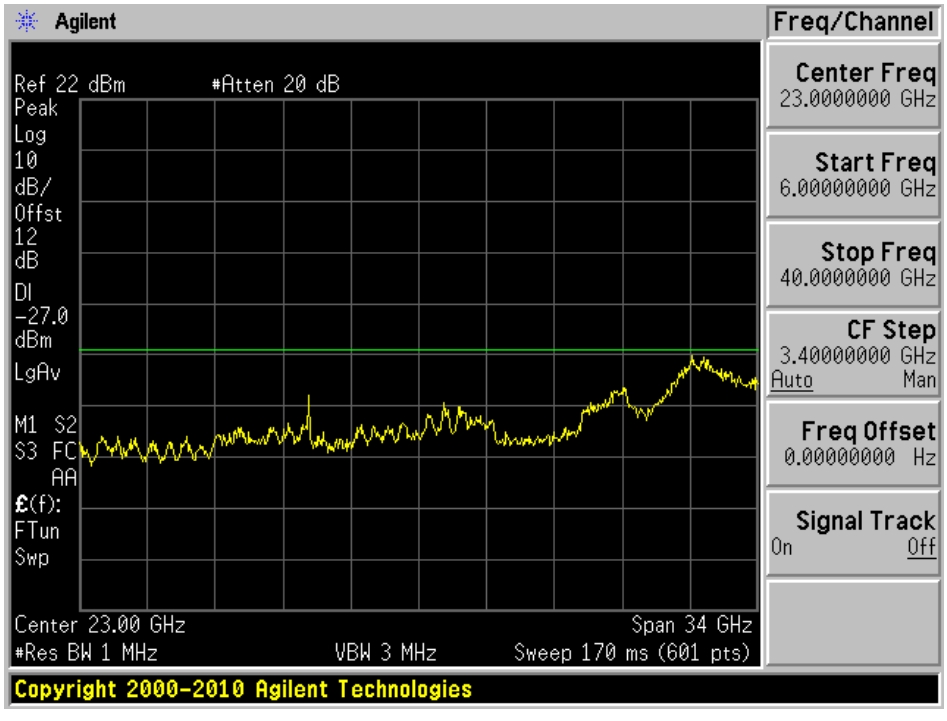


High Channel

30MHz – 6GHz



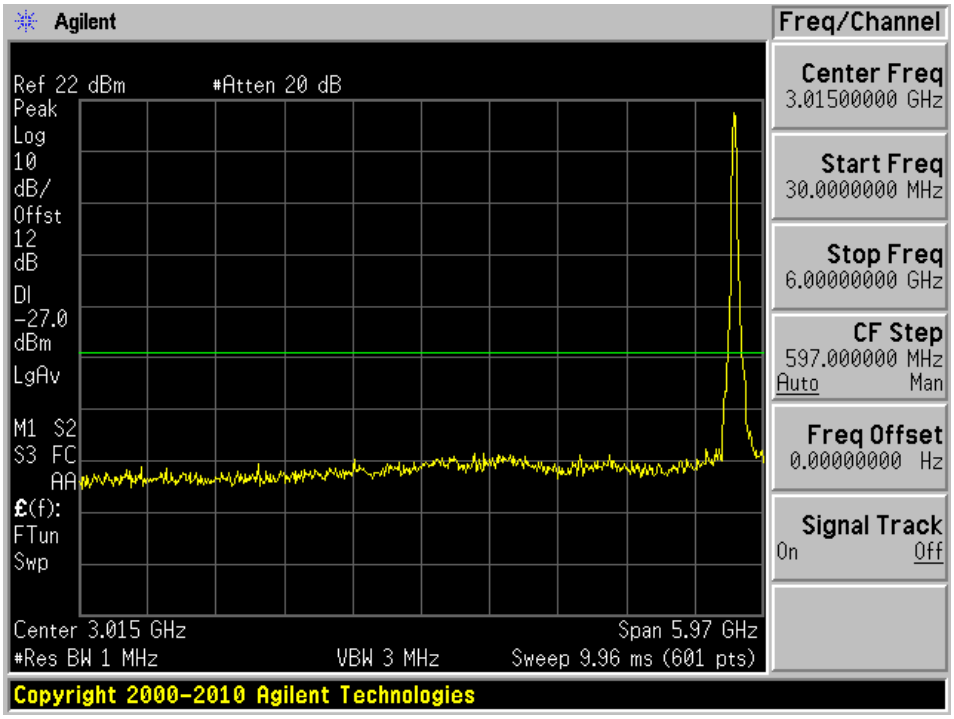
6GHz – 40GHz



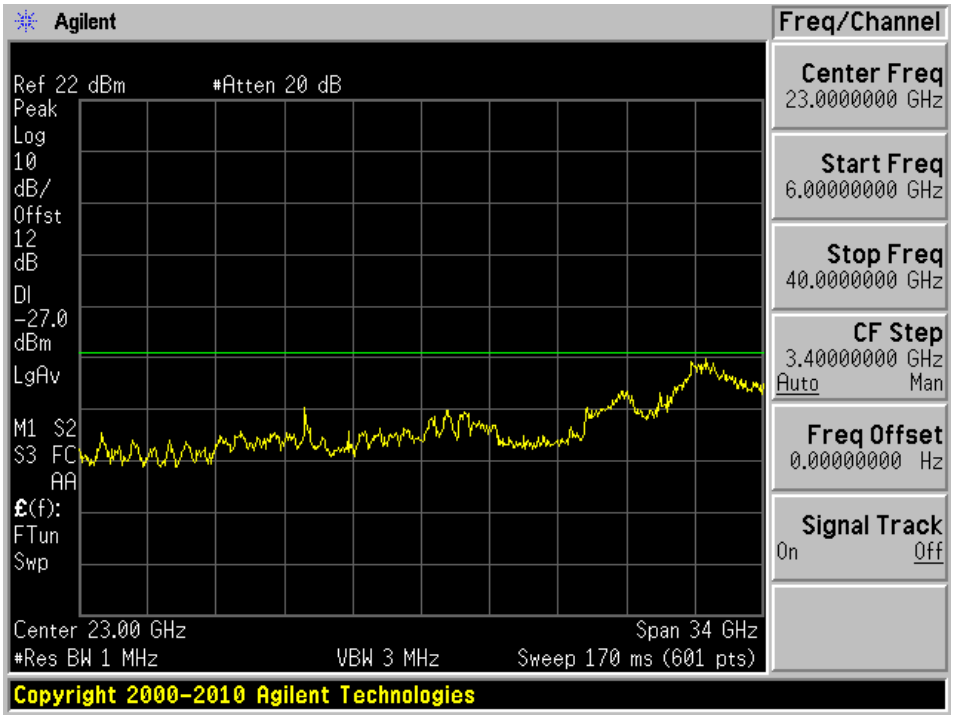
5.8 GHz 802.11n/ac20

Low Channel

30MHz – 6GHz

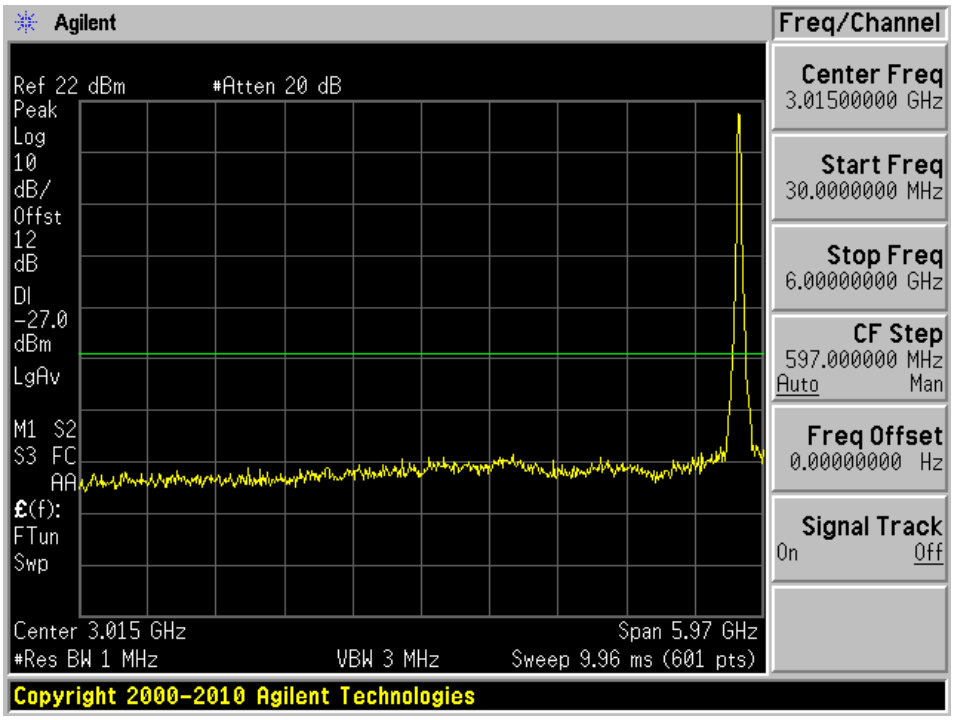


6GHz – 40GHz

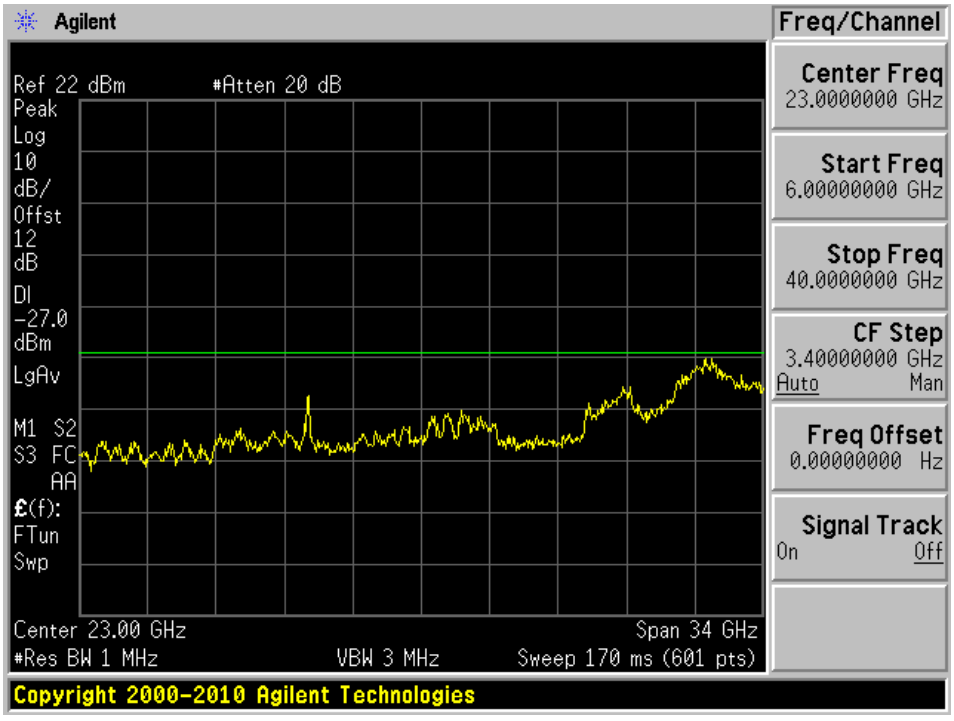


Mid Channel

30MHz – 6GHz

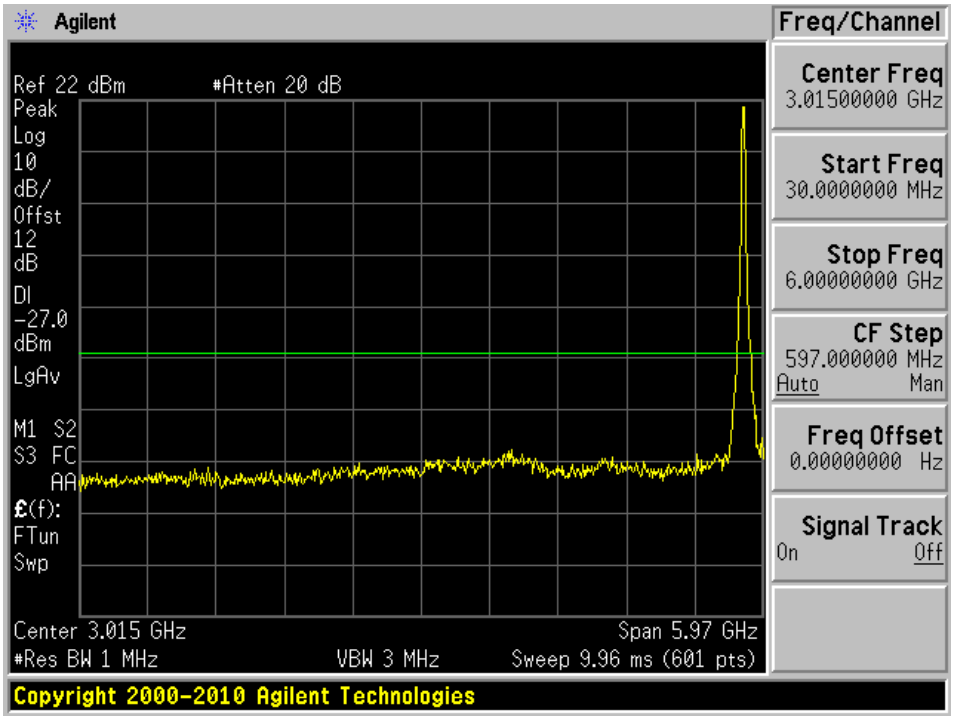


6GHz – 40GHz

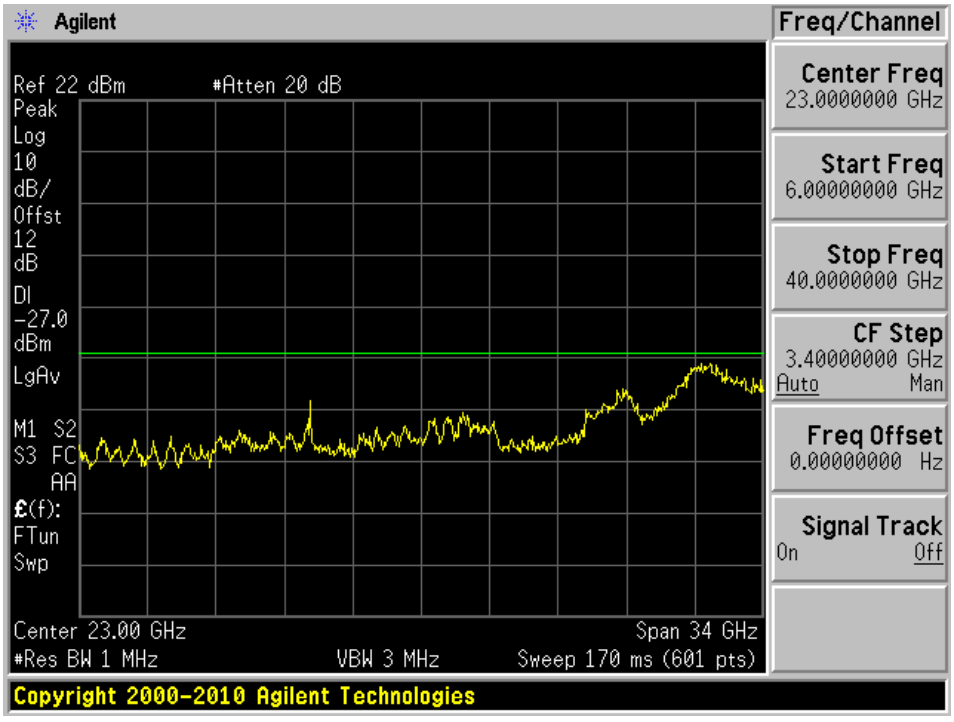


High Channel

30MHz – 6GHz



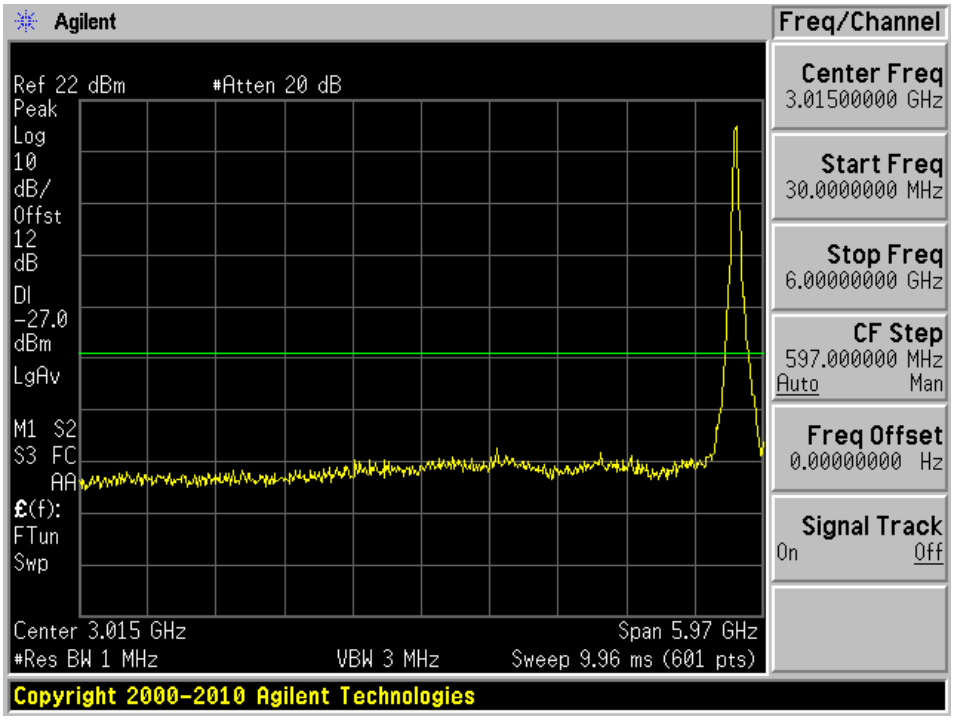
6GHz – 40GHz



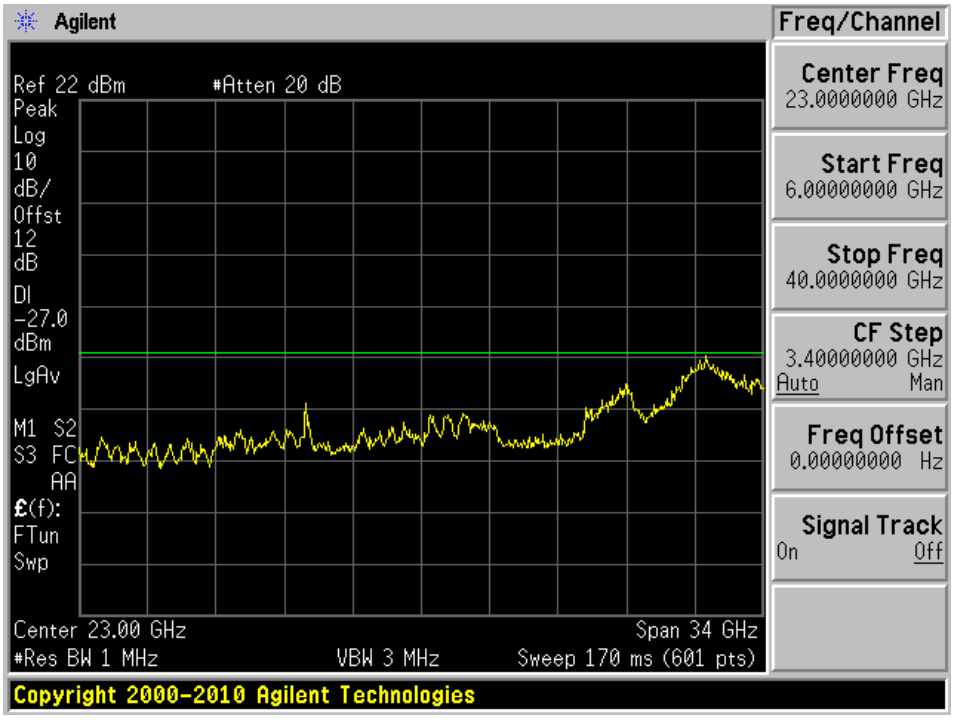
5.8 GHz 802.11n/ac40

Low Channel

30MHz – 6GHz

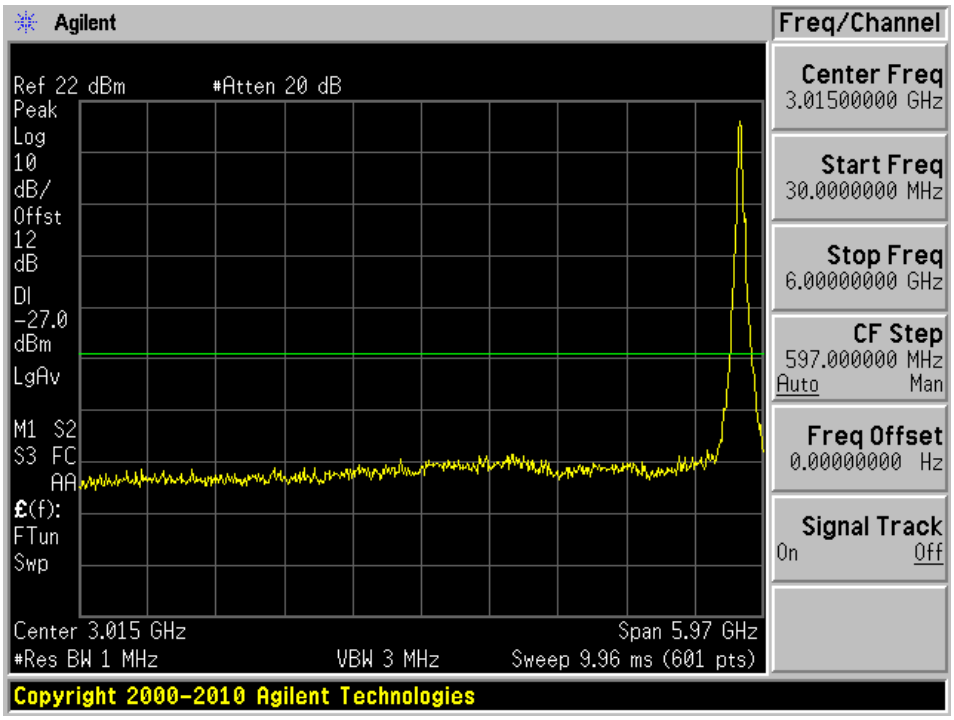


6GHz – 40GHz

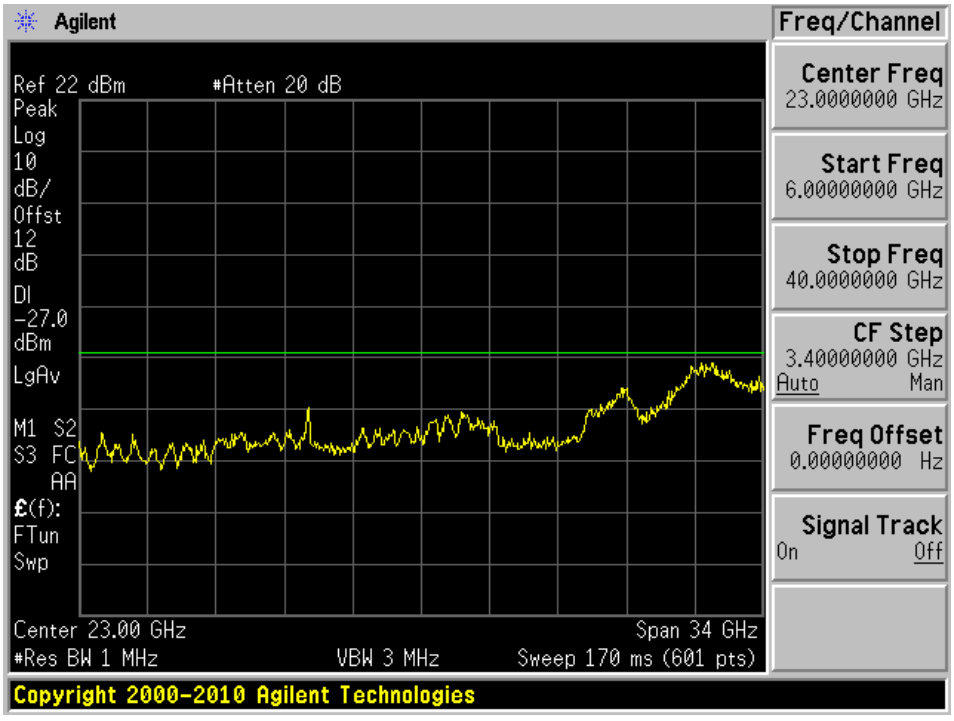


High Channel

30MHz – 6GHz



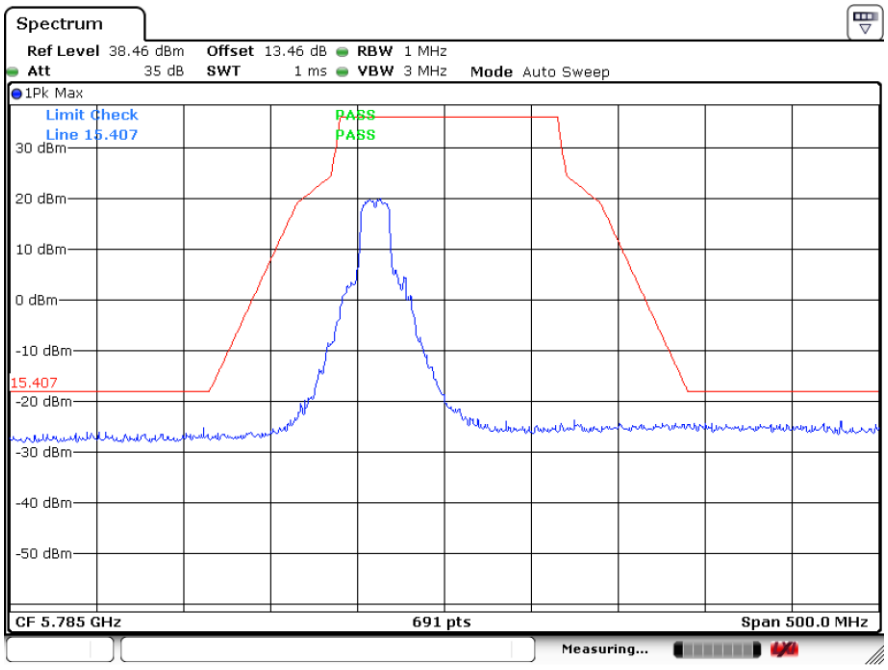
6GHz – 40GHz



5.8 GHz Emissions Mask

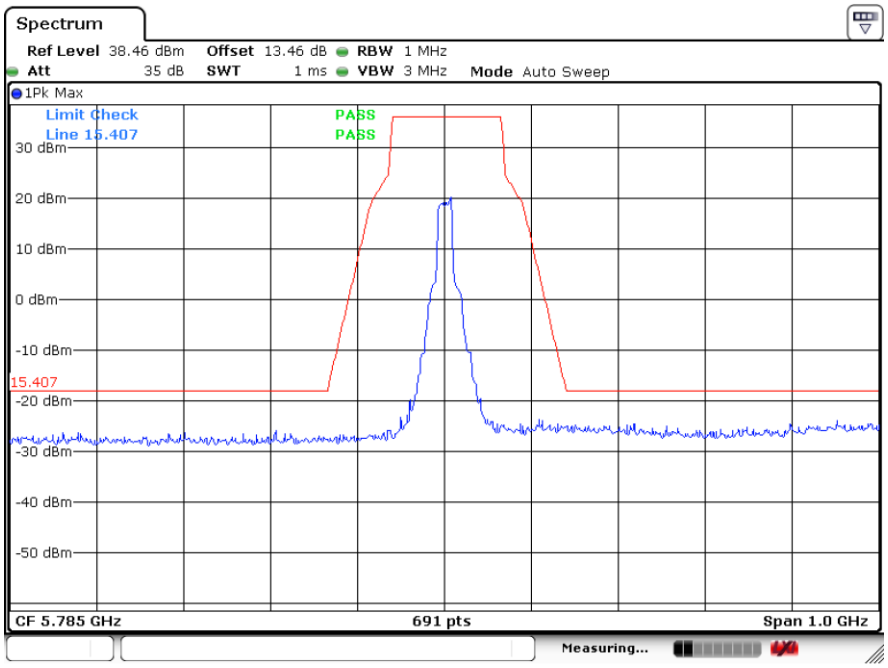
802.11a Mode

Low Channel



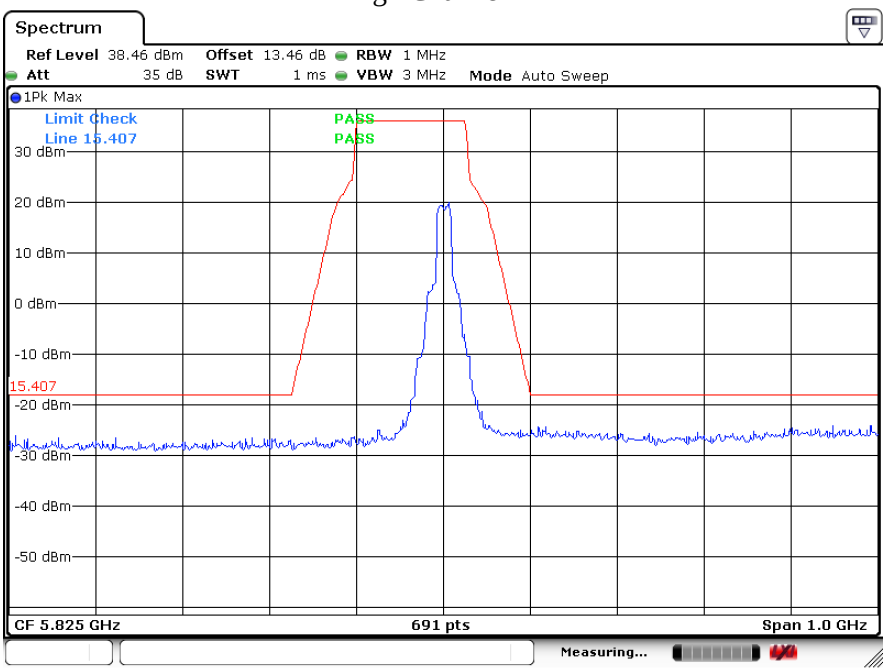
Date: 8.JUL.2022 15:39:01

Mid Channel



Date: 8.JUL.2022 15:43:45

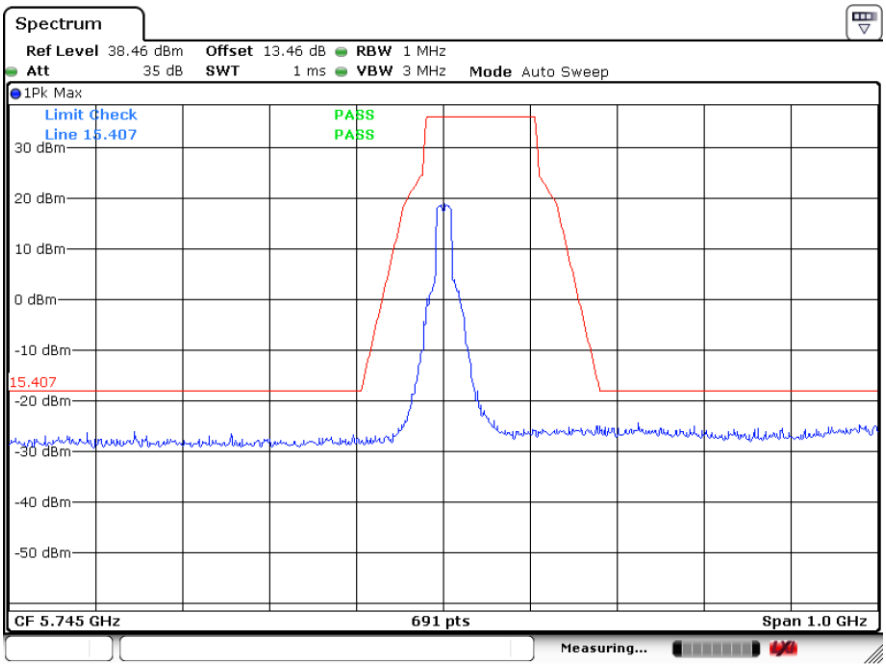
High Channel



Date: 8.JUL.2022 15:44:43

802.11n/ac20 Mode

Low Channel



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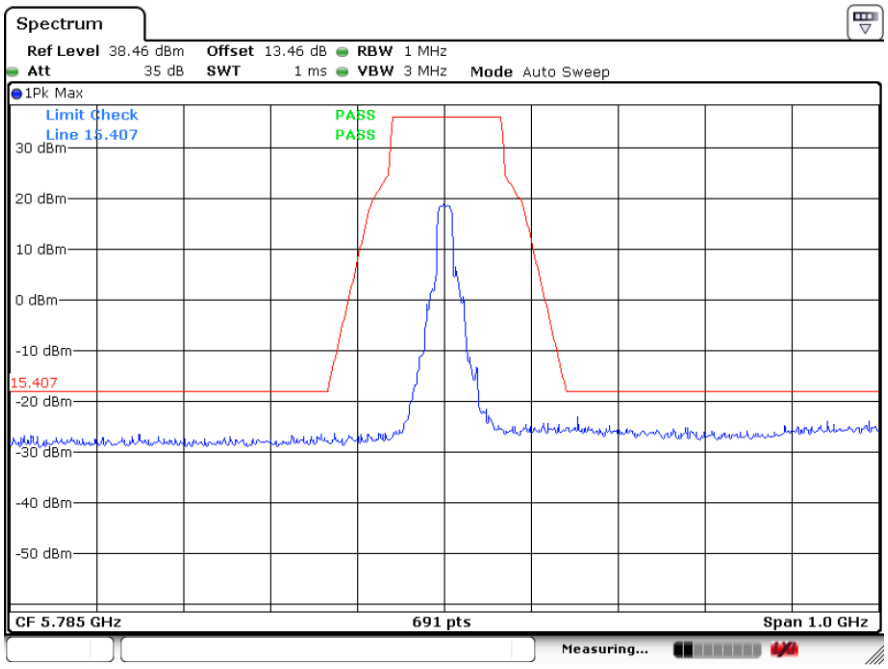
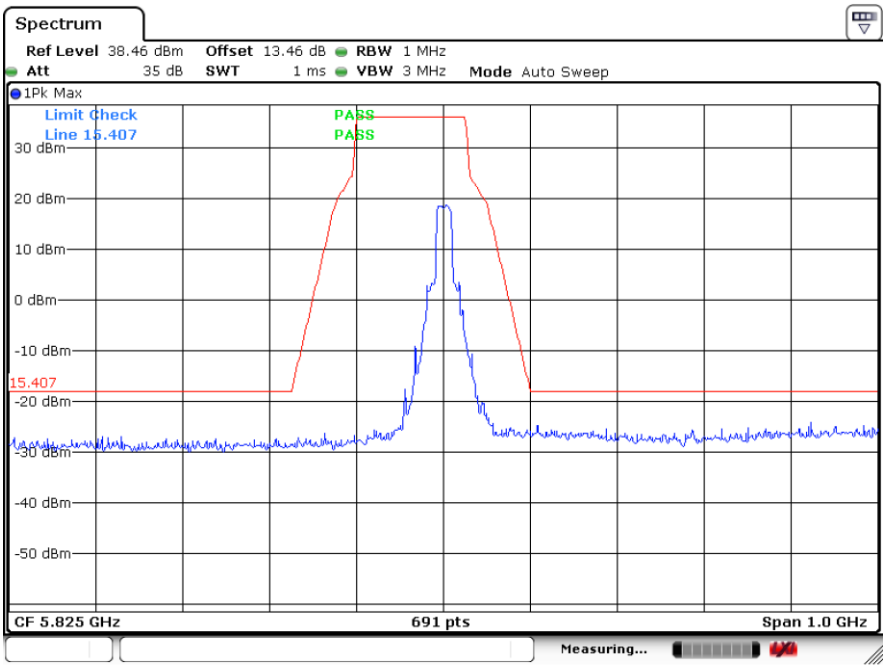
Mid Channel



Date: 8.JUL.2022 15:46:49

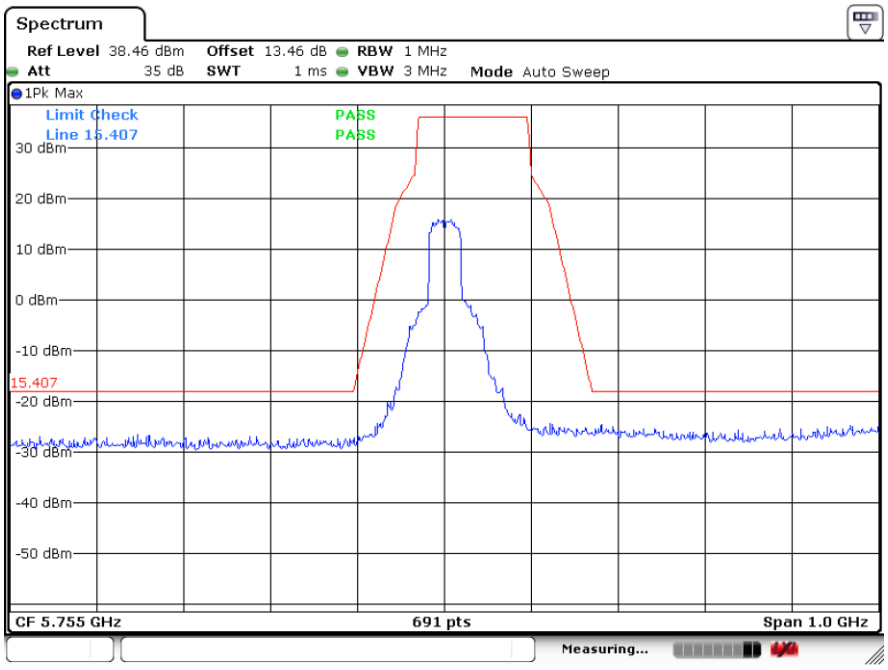
High Channel



Date: 8.JUL.2022 15:47:29

802.11n/ac40 Mode

Low Channel



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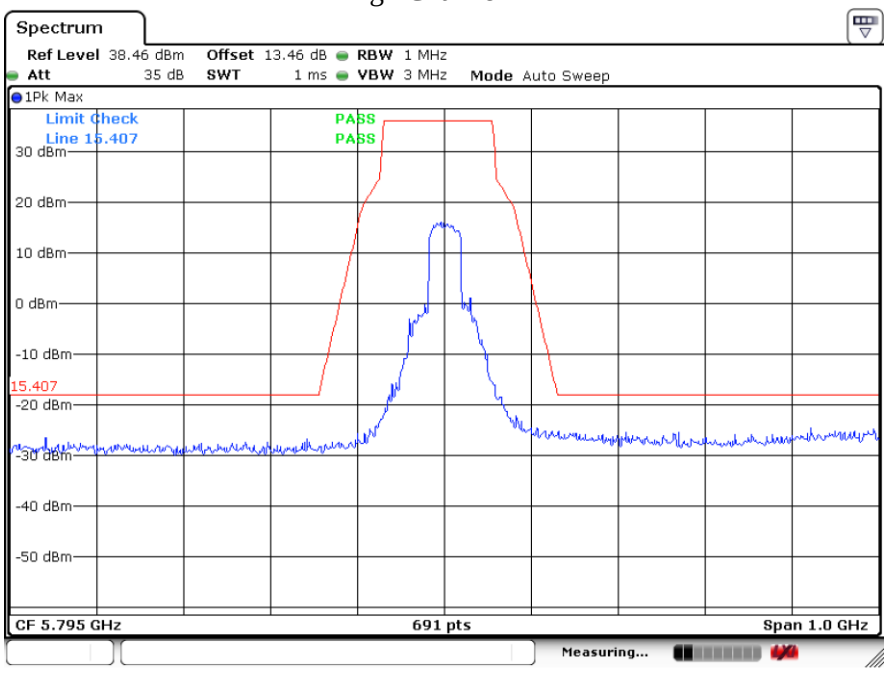
High Channel

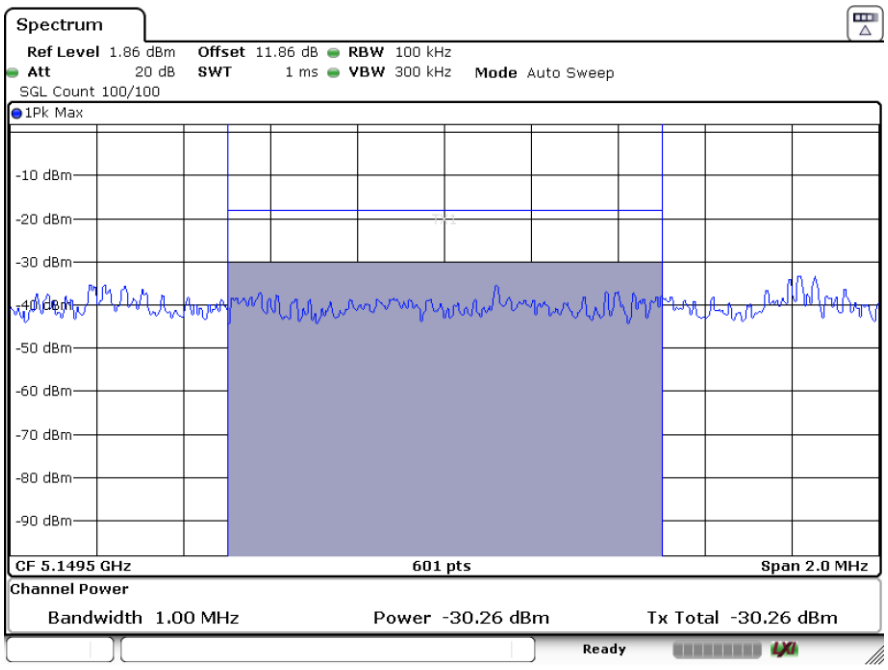


Date: 8.JUL.2022 15:51:26

Band Edge Emissions

802.11a Mode

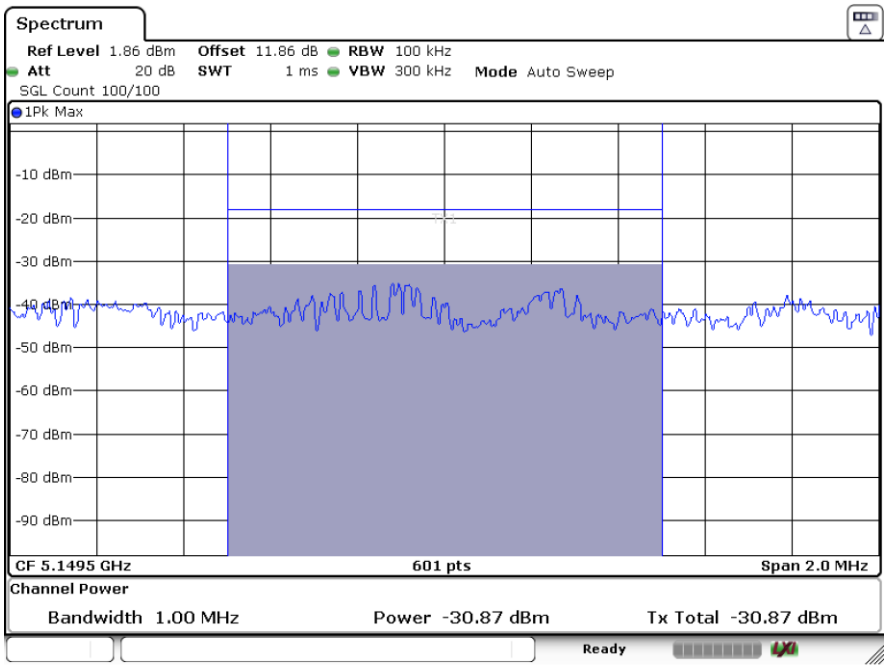
5.15-5.25 GHz



Date: 22.JUN.2022 15:03:07

802.11n/ac20 Mode

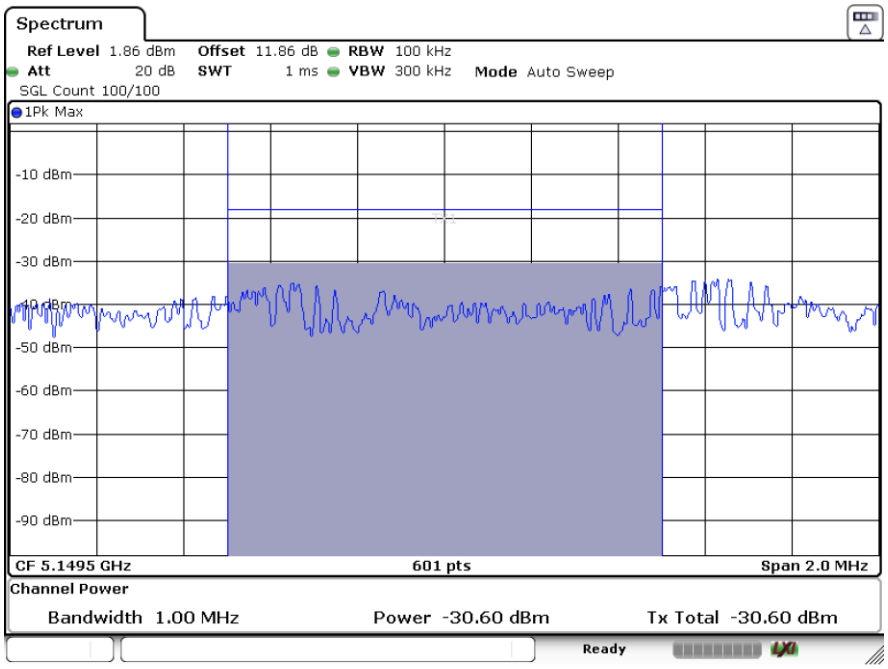
5.15-5.25 GHz



Date: 22.JUN.2022 15:05:10

802.11n/ac40 Mode

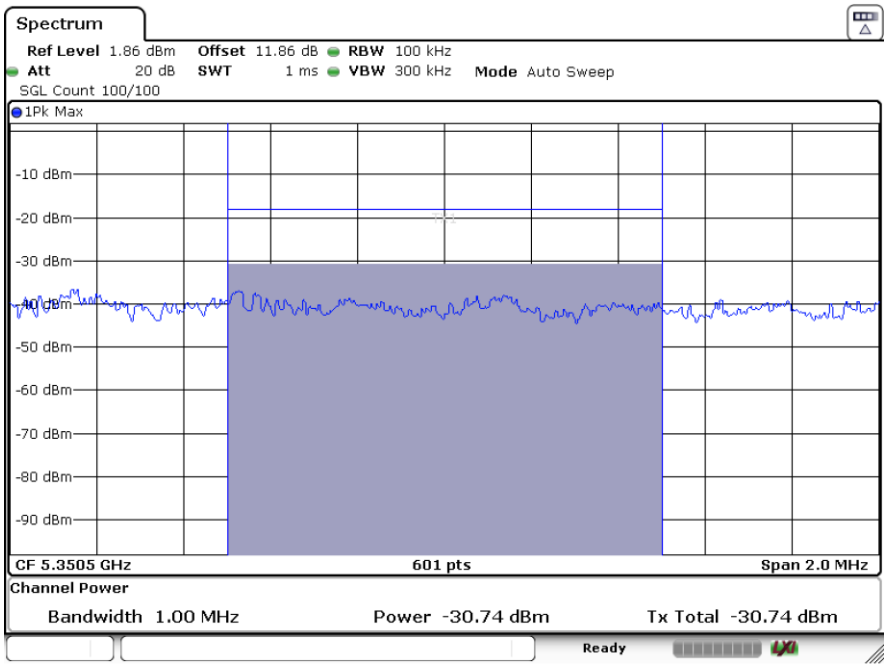
5.15-5.25 GHz



Date: 22.JUN.2022 15:09:15

802.11a Mode

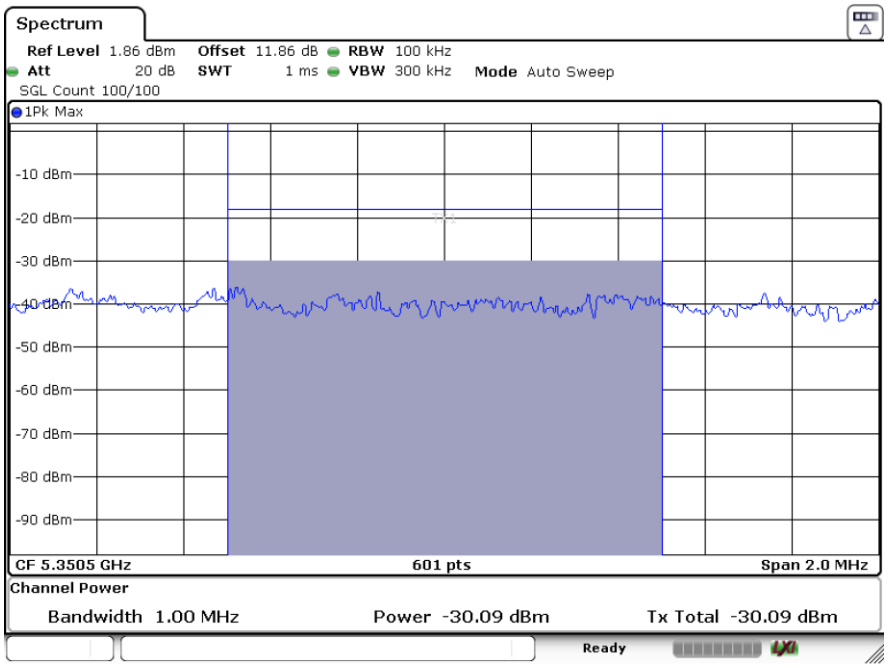
5.25-5.35 GHz



Date: 22.JUN.2022 15:12:55

802.11n/ac20 Mode

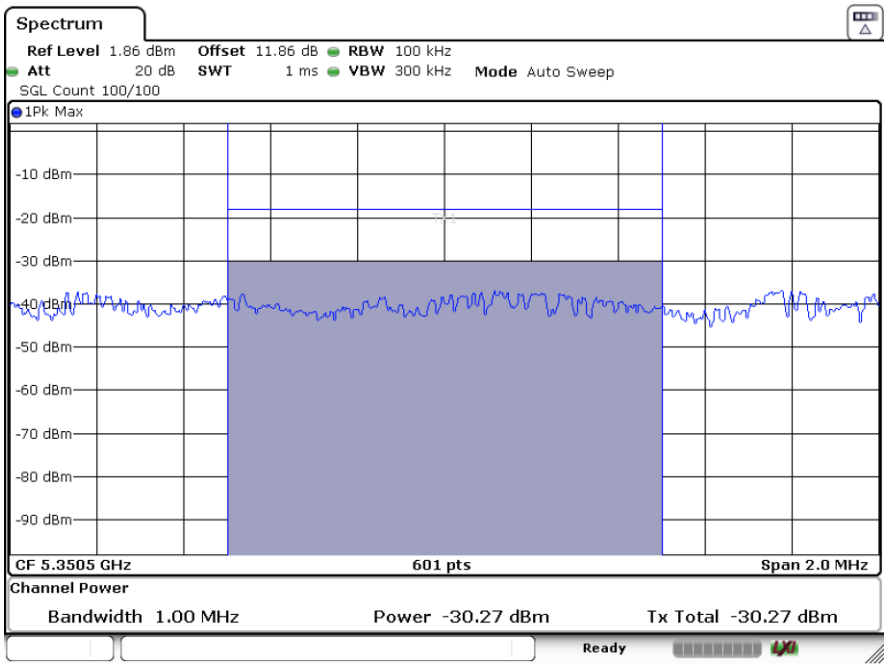
5.25-5.35 GHz



Date: 22.JUN.2022 15:14:12

802.11n/ac40 Mode

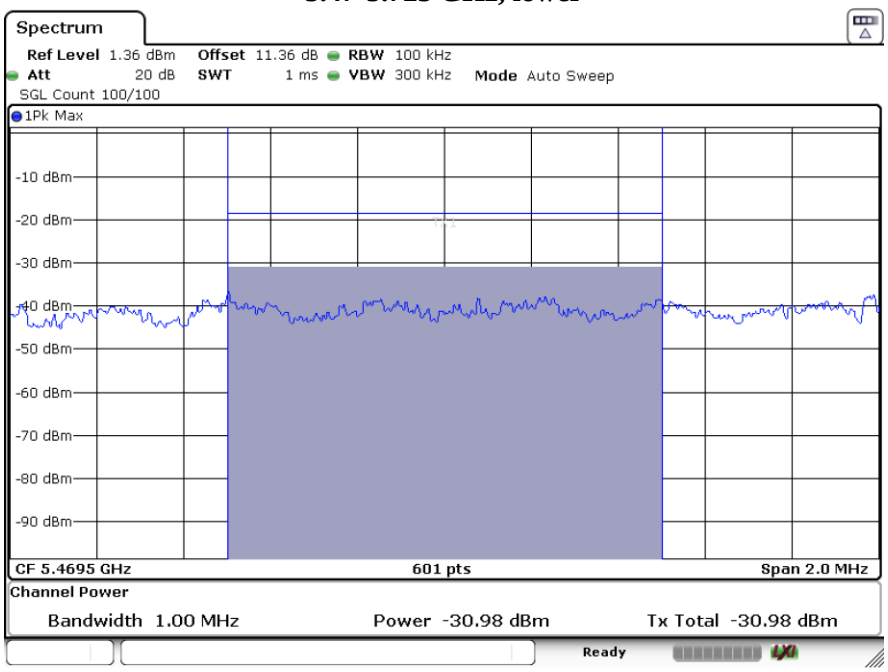
5.25-5.35 GHz



Date: 22.JUN.2022 15:16:06

802.11a Mode

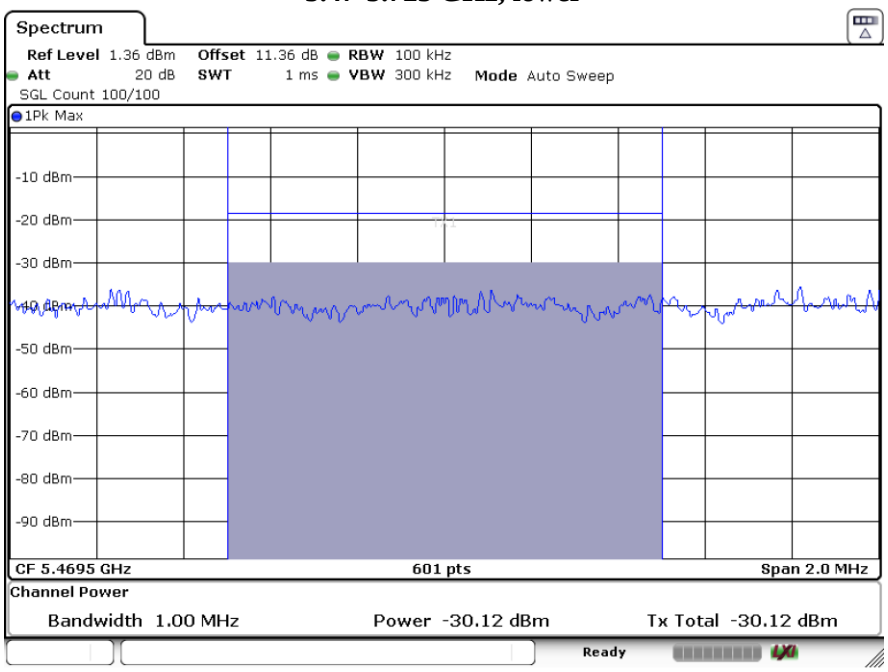
5.47-5.725 GHz, lower



Date: 22.JUN.2022 15:20:56

802.11n/ac20 Mode

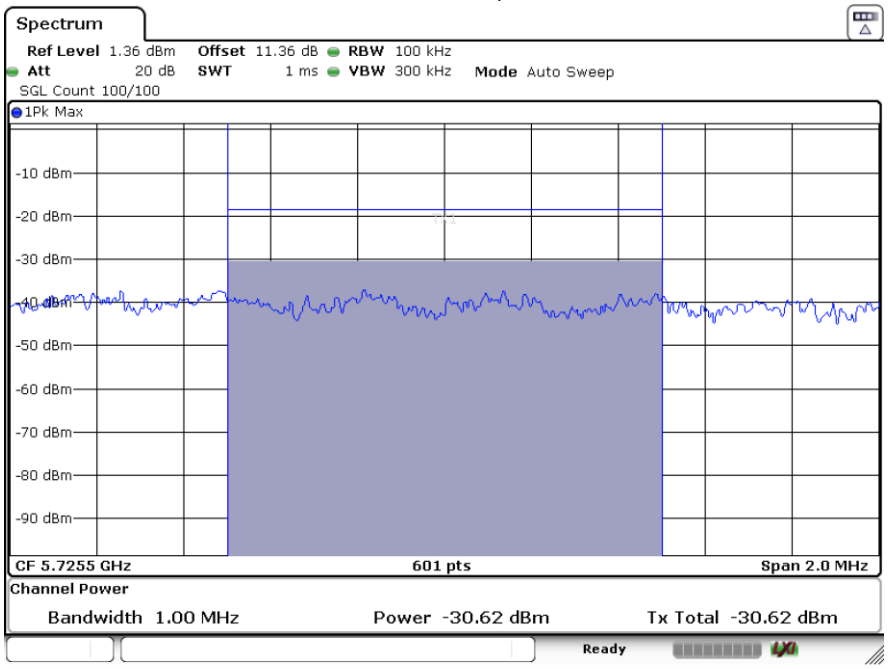
5.47-5.725 GHz, lower



Date: 22.JUN.2022 15:22:18

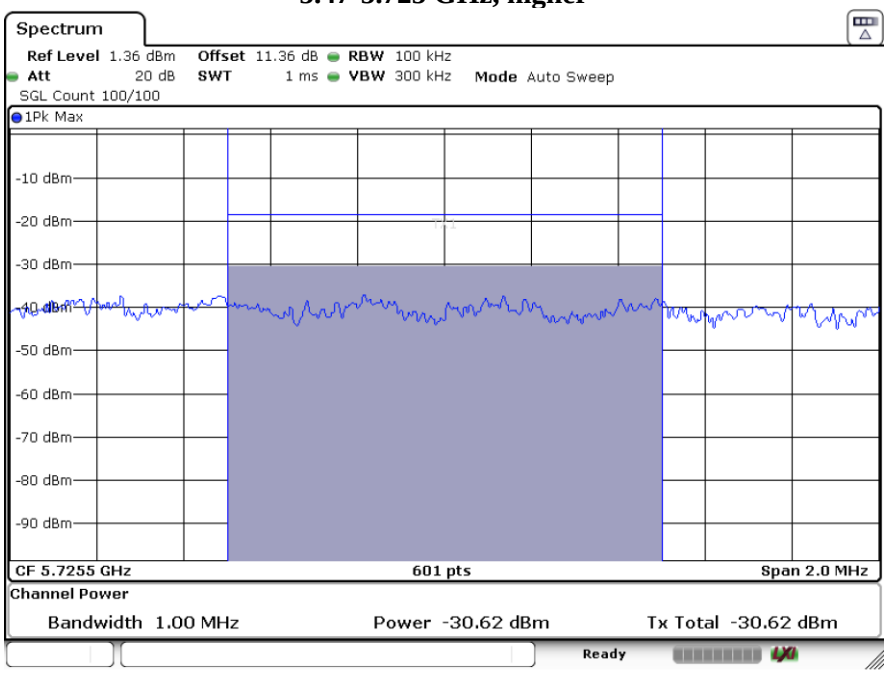
802.11n/ac40 Mode

5.47-5.725 GHz, lower



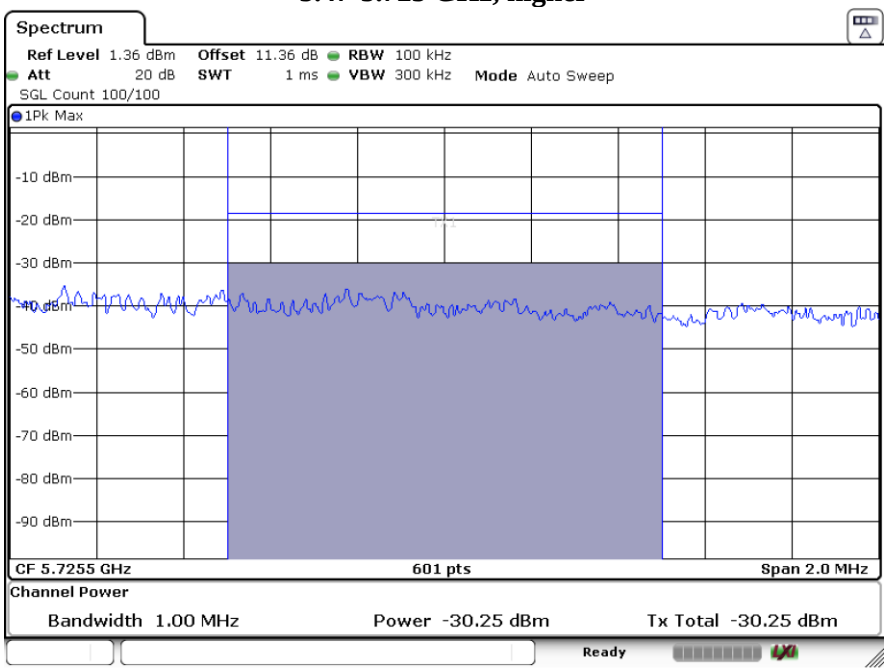
802.11a Mode

5.47-5.725 GHz, higher



802.11n/ac20 Mode

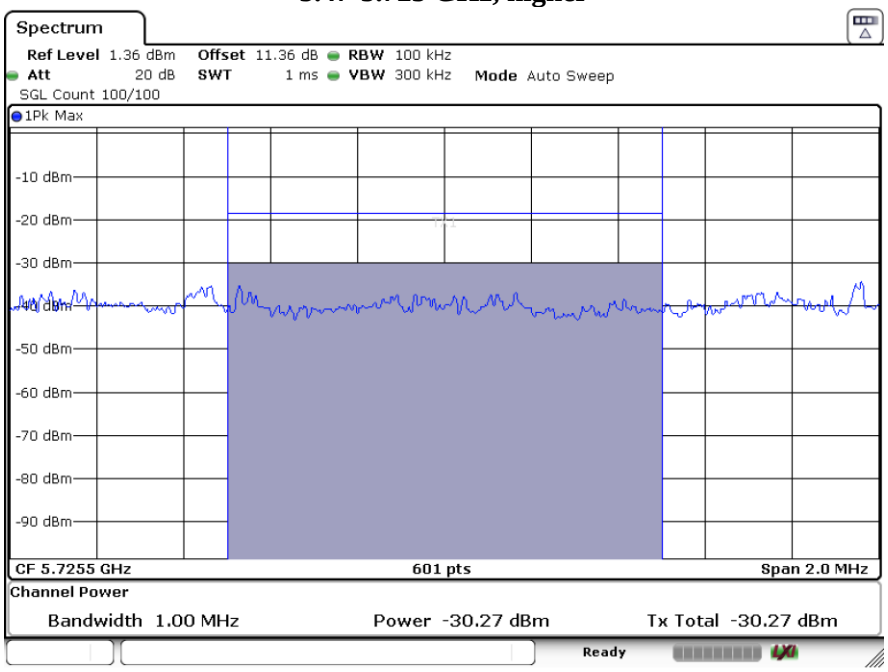
5.47-5.725 GHz, higher



Date: 22.JUN.2022 15:26:22

802.11n/ac40 Mode

5.47-5.725 GHz, higher



Date: 22.JUN.2022 15:30:46

Note: Antenna Gain is considered into offset.

12 FCC §15.407(h) & ISEDC RSS-247 §6.3 – Dynamic Frequency Selection

12.1 Applicable Standards

FCC CFR47 §15.407 (h), RSS-247 Issue 2 and KDB: 905462 D02 UNII DFS Compliance Procedures New Rules v02.

Table 1: Applicability of DFS requirements prior to use of a channel

Requirement	Operational Mode		
	Master	Client (Without radar detection)	Client (With radar detection)
Non-Occupancy Period	Yes	Not Required	Yes
DFS Detection Threshold	Yes	Not Required	Yes
Channel Availability Check Time	Yes	Not Required	Not Required
U-NII Detection Bandwidth	Yes	Not Required	Yes

Table 2: Applicability of DFS requirements during normal operation

Requirement	Operational Mode	
	Master Device or Client with Radar Detection	Client Without Radar Detection
DFS Detection Threshold	Yes	Not Required
Channel Closing Transmission Time	Yes	Yes
Channel Move Time	Yes	Yes
U-NII Detection Bandwidth	Yes	Not Required

Additional requirements for devices with multiple bandwidth modes	Master Device or Client with Radar Detection	Client Without Radar Detection
U-NII Detection Bandwidth and Statistical Performance Check	All BW modes must be tested	Not required
Channel Move Time and Channel Closing Transmission Time	Test using widest BW mode available	Test using the widest BW mode available for the link
All other tests	Any single BW mode	Not required
Note: Frequencies selected for statistical performance check (Section 7.8.4) should include several frequencies within the radar detection bandwidth and frequencies near the edge of the radar detection bandwidth. For 802.11 devices it is suggested to select frequencies in each of the bonded 20 MHz channels and the channel center frequency.		

Table 3: Interference Threshold for Master and Client with Radar Detection

Maximum Transmit Power	Value (See Notes 1, 2 and 3)
EIRP≥ 200 milliwatt	-64 dBm
EIRP< 200 milliwatt and power spectral density < 10dBm/MHz	-62 dBm
EIRP< 200 milliwatt that do not meet the power spectral density requirement	-64 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna. **Note 2:** Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response. **Note3**: EIRP is based on the highest antenna gain. For MIMO devices refer to KDB Publication 662911 D01.	

Table 4: DFS Response Requirement Values

Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds ***See Note 1***.
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. ***See Notes 1 and 2***.
U-NII Detection Bandwidth	Minimum 100% of the UNII 99% transmission power bandwidth. ***See Note 3***.

Note 1: Channel Move Time and the Channel Closing Transmission Time should be performed with Radar Type 0. The measurement timing begins at the end of the Radar Type 0 burst.

Note 2: The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus any additional intermittent control signals required to facilitate a Channel move (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.

Note 3: During the U-NII Detection Bandwidth detection test, radar type 0 should be used. For each frequency step the minimum percentage of detection is 90 percent. Measurements are performed with no data traffic.

Table 5: Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (Microseconds)	PRI (Microseconds)	Pulses	Minimum Percentage of Successful Detection	Minimum Number of Trials
0	1	1428	18	See Note 1	See Note 1
1	1	Test A: 15 unique PRI values randomly selected from the list of 23 PRI values in Table 5a Test B: 15 unique PRI values randomly selected within the range of 518-3066 μsec, with a minimum increment of 1 μsec, excluding PRI values selected in Test A	$\text{Roundup}\left\{\left(\frac{1}{360}\right)\cdot\left(\frac{19\cdot 10^6}{PRI_{\mu sec}}\right)\right\}$	60%	30
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120
Note 1: Short Pulse Radar Type 0 should be used for the detection bandwidth test, channel move time, and channel closing time tests.					

Table 6: Long Pulse Radar Test Signal

Radar Type	Bursts	Chirp Width (MHz)	PRI (usec)	Number of Pulses per Burst	Number of Bursts	Minimum Percentage of Successful Detection	Minimum Number of Trials
5	50-100	5-20	1000-2000	1-3	8-20	80%	30

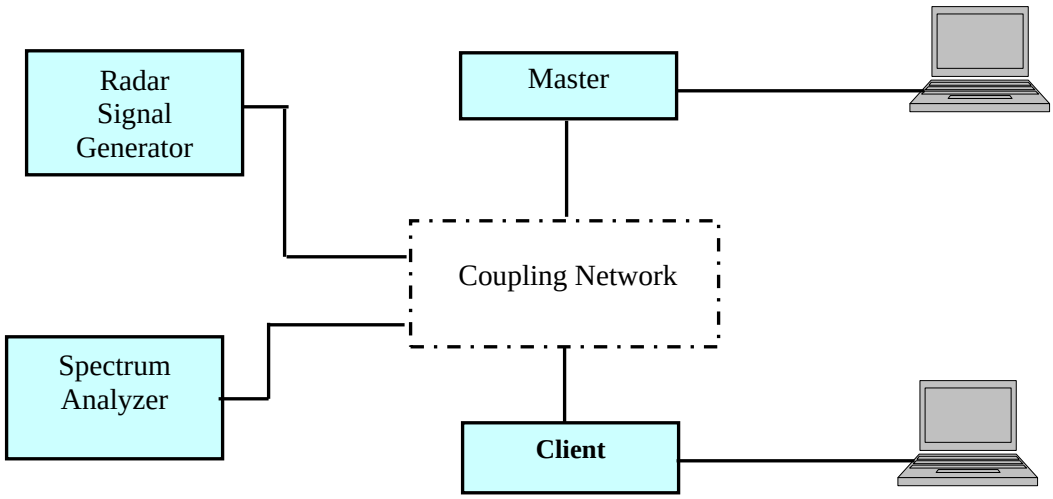
Table 7: Frequency Hopping Radar Test Signal

Radar Type	Pulse Width (usec)	PRI (usec)	Pulses per Hop	Hopping Rate (kHz)	Hopping Sequence Length (msec)	Minimum Percentage of Successful Detection	Minimum Number of Trials
6	1	333	9	0.333	300	70%	30

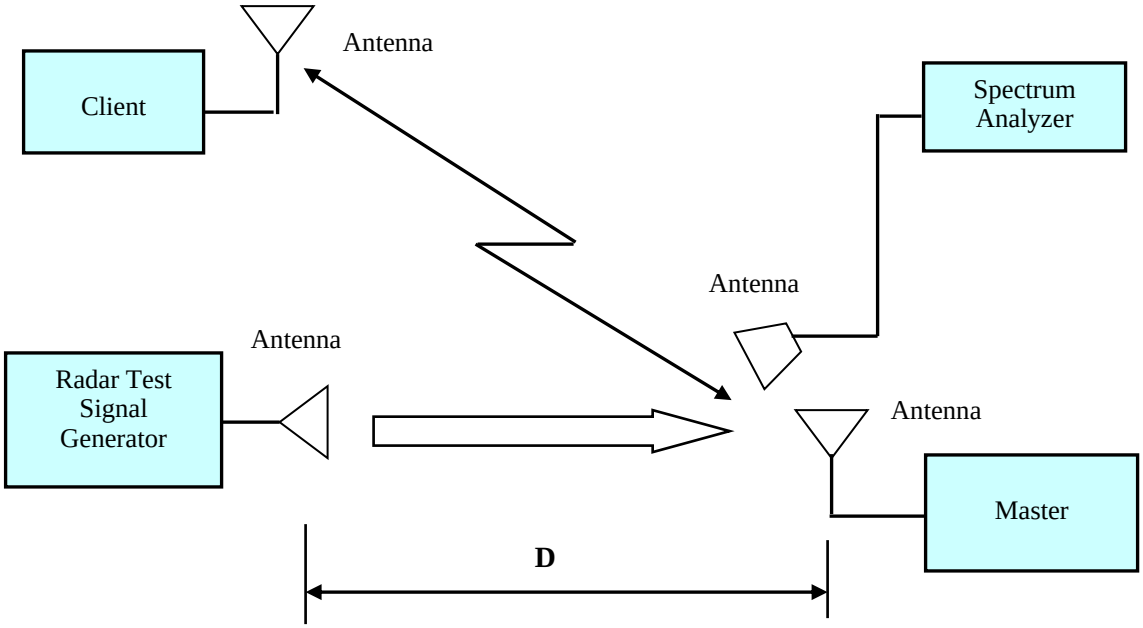
12.2 DFS Measurement System

BACL DFS measurement system consists of two subsystems: (1) The radar signal generating subsystem and (2) the traffic monitoring subsystem.

12.3 System Block Diagram



12.4 Radiated Method



12.5 Test Procedure

The EUT was connected to a certified master device (FCC ID: S9GH350, IC: 5912A-H350). A spectrum analyzer was used as a monitor that verifies the EUT's status, which includes the Channel Closing Transmission Time and the Channel Move Time.

BACL use type 0 radar signal to test the channel move time and channel closing transmission time.

The aggregate channel closing transmission time is calculated as follows:

Aggregate Transmission Time = N * Dwell Time

N is the number of spectrum analyzer bins showing a device transmission
Dwell Time is the dwell time per bin (i.e. Dwell Time = S/B, S is the sweep time and B is the number of bin, i.e. 8192)

12.6 Test Equipment List and Details

Bacl No.	Manufacturer	Equipment Description	Model	S/N	Calibration Date	Calibration Interval
547	National Instruments	NI PXI-1042 8-Slot chassis	PXI-1042	V08X01EE1	N/A	N/A
-	National Instruments	Arbitrary Waveform Generator	PXI-5421	N/A	N/A	N/A
-	National Instruments	RF Upconverter	PXI-5610	N/A	N/A	N/A
-	ASCOR	Upconverter	AS-7206	N/A	N/A	N/A
424	Agilent	Analyzer, Spectrum	E4440A	US45303156	2021-12-06	1 year
187	A.R.A	Horn Antenna	DRG-118/A	1132	2022-03-17	2 years
473	EMCO	Horn Antenna	3115	9511-4627	2020-10-12	2 years
-	-	RF Cable	-	-	Each Time	Each Time

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 the latest version of A2LA policy P102 "A2LA Policy on Metrological Traceability".*

12.7 Test Environmental Conditions

Temperature:	22° C
Relative Humidity:	43 %
ATM Pressure:	101.9 kPa

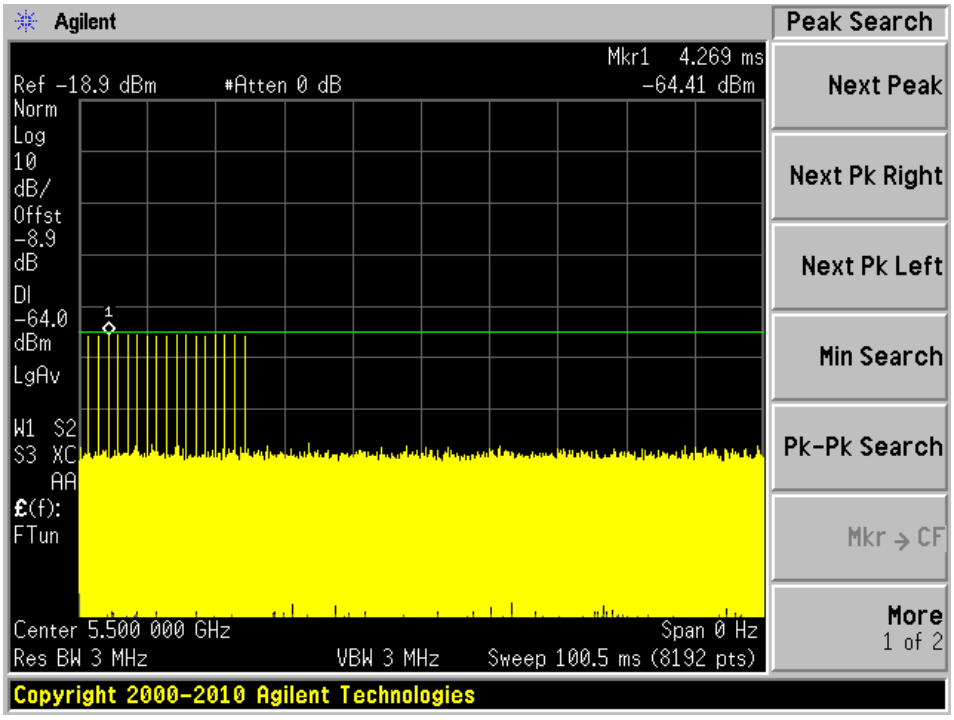
Testing was performed by Simon Ma on 2022-06-20 at the DFS testing site.

12.8 Test Results

Plots of Radar Waveforms

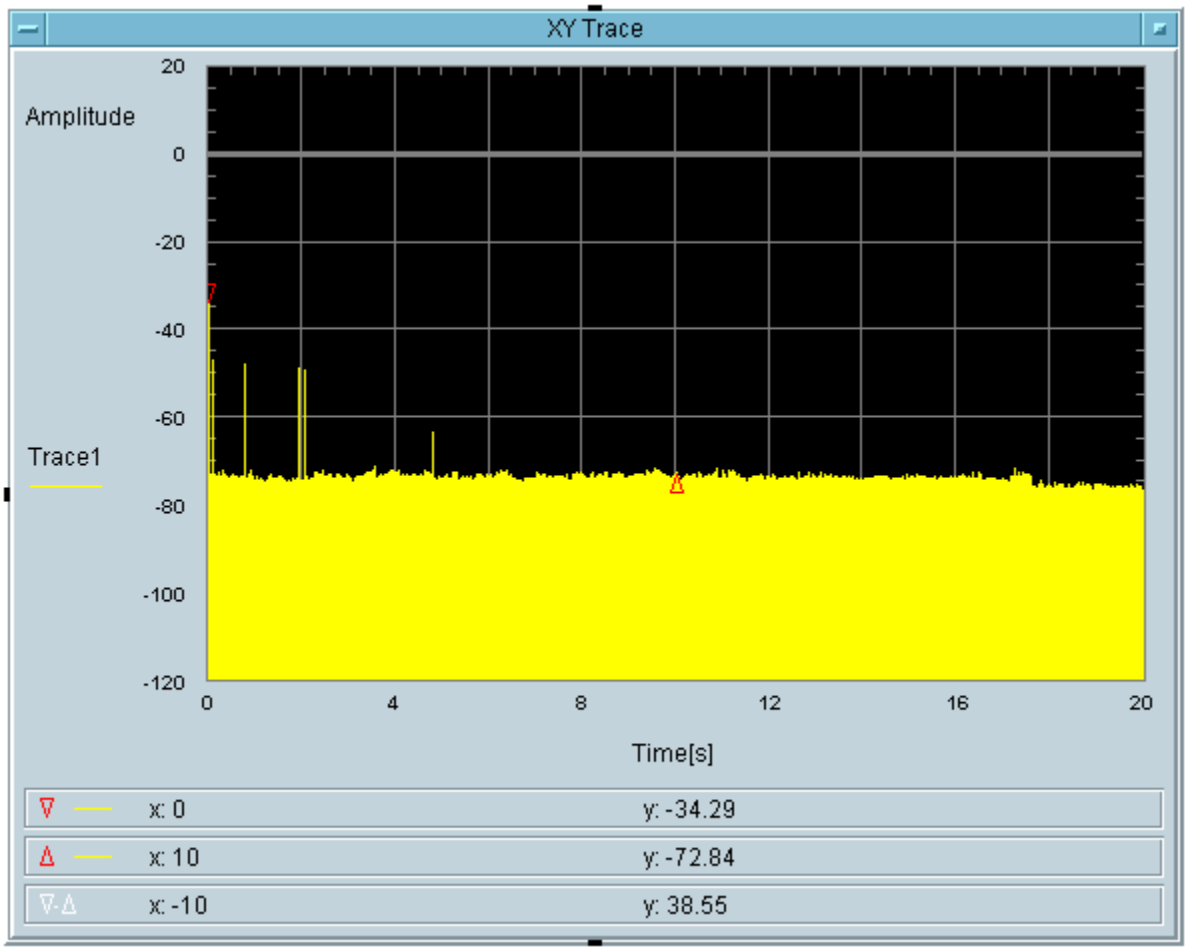
Radar Type 0

5500 MHz



Frequency (MHz)	Bandwidth (MHz)	Radar Type	Results
5500	20	Type 0	Compliant

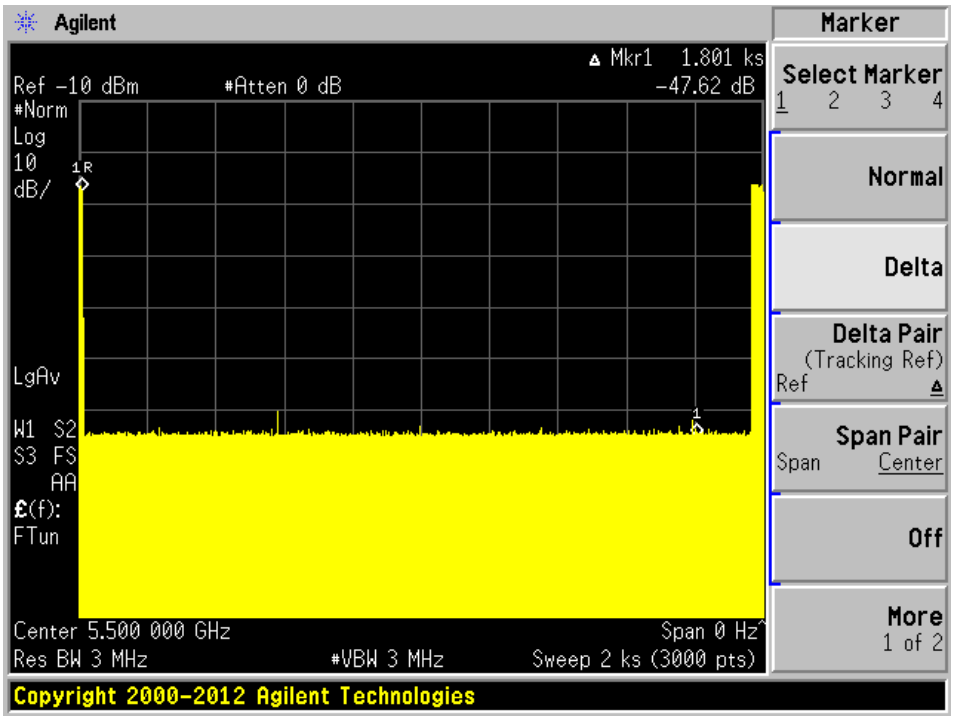
Type 0 radar channel move time less than 10s result:



Type 0 radar channel closing transmission time result:

Channel closing transmitting time (ms)	Limit (ms)	Result
40+26.67	200	Pass

Non-occupancy Time



13 Annex A (Normative) – EUT Test Setup Photographs

Please refer to the attachment.

14 Annex B (Normative) – EUT External Photographs

Please refer to the attachment.

15 Annex C (Normative) – EUT Internal Photographs

Please refer to the attachment.

16 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 17025:2017 *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 10th day of March 2021.

Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3297.02
Valid to September 30, 2022

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 ---