



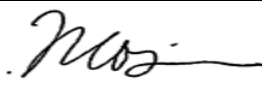
FCC PART 15, SUBPART E
ISED C RSS-247, ISSUE 2, FEBRUARY 2017
TEST REPORT

For

Roku, Inc.

1155 Coleman Avenue, San Jose, CA 95110, USA

FCC ID: TC2-R1046
IC: 5959A-R1042

Report Type: Original Report	Model: 9203X
Prepared By: Marc Jean Test Technician	
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Reviewed By: Christian McCaig RF Lead Engineer	
Bay Area Compliance Laboratories Corp. 1274 Anvilwood Avenue, Sunnyvale, CA 94089, USA Tel: +1 (408) 732-9162, Fax: +1 (408) 732-9164	



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* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "*" (Rev.2)

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2205318-407	Original Report	2022-08-31

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: 9203X, *FCC ID: TC2-R1046*, *IC: 5959A-R1042*, or the “EUT” as referred to in this report. The EUT has 2.4 GHz/5 GHz Wi-Fi capabilities.

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, February 2017.

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, Conducted and Radiated Spurious Emissions.

1.3 Related Submittal(s)/Grant(s)

Equipment Class: DTS, FCC ID: TC2-R1046, IC: 5959A-R1042

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 17025:2017Scope 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 - ISED) Foreign Certification Body – FCB – APEC Tel MRA -Phase I & Phase II;
- Chinese Taipei (Republic of China – Taiwan):
 - o BSMI (Bureau of Standards, Metrology and Inspection) APEC Tel MRA -Phase I;
 - o NCC (National Communications Commission) APEC Tel MRA -Phase I;
- European Union:
 - o EMC Directive 2014/30/EU US-EU EMC & Telecom MRA CAB (NB)
 - o Radio Equipment (RE) Directive 2014/53/EU US-EU EMC & Telecom MRA CAB (NB)
 - o 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:
 - o ENERGY STAR Recognized Test Laboratory – US EPA
 - o Telecommunications Certification Body (TCB) – US FCC;
 - o 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 TeraTerm. The software is compliant with the standard requirements being tested against.

Please refer to the following power setting table.

Modulation	Frequency (MHz)	Power Setting	
		Ant A	Ant B
802.11a	5180	100	100
	5200	104	104
	5240	105	105
802.11n/ac20	5180	76	76
	5200	78	78
	5240	76	76

Modulation	Frequency (MHz)	Power Setting	
		Ant A	Ant B
802.11a	5745	127	127
	5785	127	127
	5825	127	127
802.11n/ac20	5745	127	127
	5785	127	127
	5825	127	127

*Data rates tested:

802.11a mode: 6 Mbps

802.11n/ac20 HT20/VHT20: MCS0

2.3 Duty Cycle Correction Factor

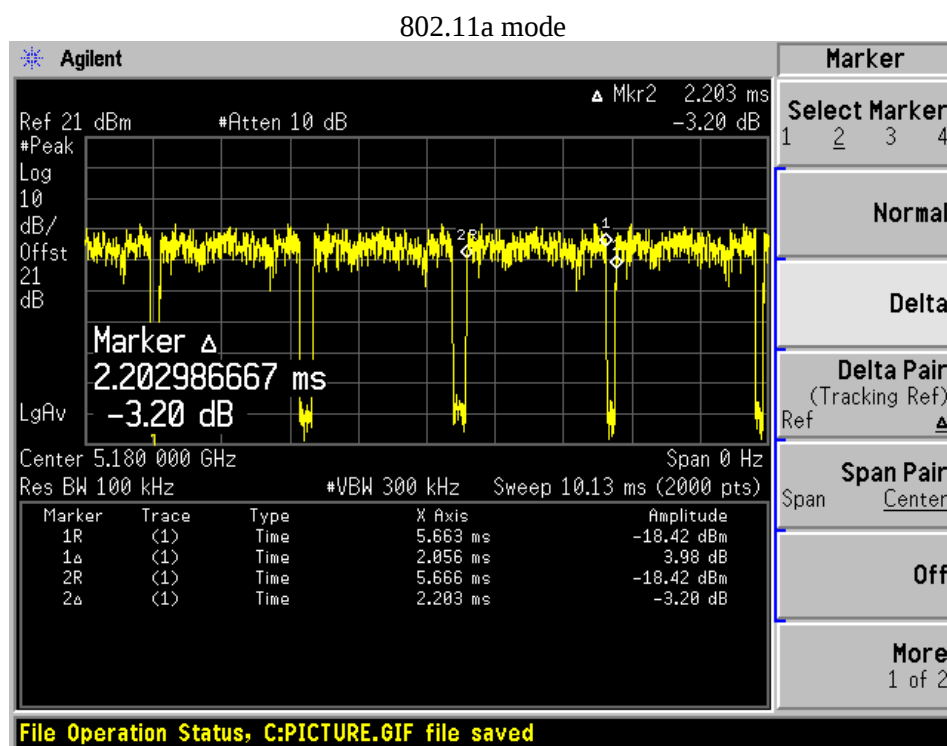
According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01 section B:

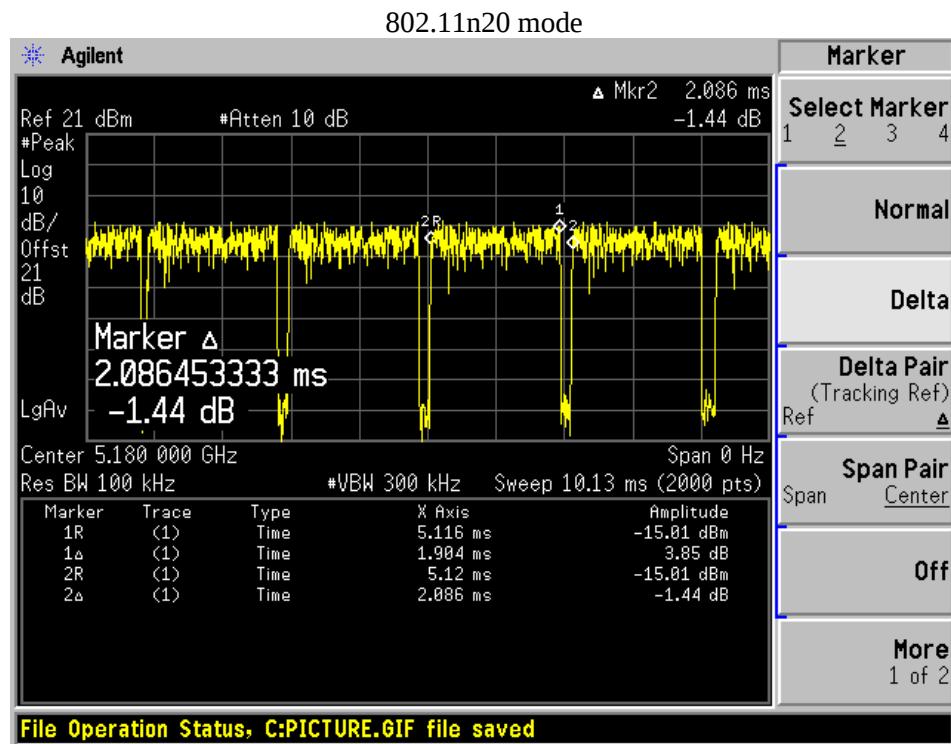
All measurements are to be performed with the EUT transmitting at 100% duty cycle at its maximum power control level; however, if 100% duty cycle cannot be achieved, measurements of duty cycle, x, and maximum-power transmission duration, T, are required for each tested mode of operation.

Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11a	2.056	2.203	93.3	0.30
802.11n/ac20	1.904	2.086	91.3	0.40

Note: Duty Cycle Correction Factor = $10 \cdot \log(1/\text{duty cycle})$

Please refer to the following plots.





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/ISED Rules	Description of Test	Result
FCC §2.1091, §15.407(f), ISED RSS-102	RF Exposure	Compliant
FCC §15.203 ISED RSS-Gen §6.8	Antenna Requirement	Compliant
FCC §15.207 ISED RSS-Gen §8.8	AC Power Line Conducted Emissions	Compliant
FCC §2.1053, §15.205, §15.209, 15.407(b) ISED RSS-247 §6.2	Spurious Radiated Emissions	Compliant
FCC §15.407(e) ISED RSS-Gen §6.2	Emission Bandwidth	Compliant
FCC §407(a) ISED RSS-247 §6.2	Output Power	Compliant
FCC §2.1051, §15.407(b) ISED RSS-247 §6.2	Band Edges	Compliant
FCC §15.407(a) ISED RSS-247 §6.2	Power Spectral Density	Compliant

4 FCC §2.1091, §15.407(f) & ISED 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

1.1 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 ERP_{20cm} in Formula (B.1) [repeated from § 2.1091(c)(1) and § 1.1307(b)(1)(i)(B)].

$$P_{th} \text{ (mW)} = ERP_{20 \text{ cm}} \text{ (mW)} = 2040f \quad 0.3 \text{ GHz} \leq f < 1.5 \text{ GHz}$$

$$P_{th} \text{ (mW)} = ERP_{20 \text{ cm}} \text{ (mW)} = 3060 \quad 1.5 \text{ GHz} \leq f \leq 6 \text{ GHz}$$
(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 $\lambda/4$ where the gain is not well defined, but always less than that of a half-wave dipole (length $\lambda/2$), 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).

$$P_{th} \text{ (mW)} = ERP_{20 \text{ cm}} (d/20 \text{ cm})^x \quad d \leq 20 \text{ cm}$$

$$P_{th} \text{ (mW)} = ERP_{20 \text{ cm}} \quad 20 \text{ cm} < d \leq 40 \text{ cm}$$
(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 $EPR_{20\text{cm}}$ 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	

1.2 RF exposure evaluation exemption for FCC

Prediction frequency (GHz)			5.825	
Maximum output power (dBm)			24.77	
Maximum ERP (dBm)			27.8	
Maximum ERP (mW)			602.56	
Prediction distance (cm)			20	
Maximum antenna gain (dBi)			5.18	
$0.3 \text{ GHz} \leq f < 1.5 \text{ GHz}$	$ERP_{20 \text{ cm}}$ (mW)	x	SAR-based Exemption Threshold	
	-	-	$d \leq 20 \text{ cm}$	P_{th} (mW)
				-
			$20 \text{ cm} < d \leq 40 \text{ cm}$	P_{th} (mW)
				-
$1.5 \text{ GHz} \leq f \leq 6 \text{ GHz}$	$ERP_{20 \text{ cm}}$ (mW)	x	SAR-based Exemption Threshold	
	3060	-	$d \leq 20 \text{ cm}$	P_{th} (mW)
				-
			$20 \text{ cm} < d \leq 40 \text{ cm}$	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.

1.3 RF exposure evaluation exemption for IC

Maximum EIRP = 24.77 dBm + 5.18dBi = 29.95 dBm (0.989 W), which is less $1.31 \times 10^{-2} f^{0.6834} = 4.9 \text{ W} = 36.9 \text{ dBm}$. Therefore, ISED SAR testing is not required.

Note: The directional antenna gain for 802.11n/ac20 mode is 5.18 dBi. Calculated based on method specified in KDB 662911 D01.

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

Antenna usage	Frequency Range (MHz)	Maximum Antenna Gain (dBi)	Antenna Type
5 GHz Wi-Fi Ant A	5150-5250	2.56	PCB
	5725-5850	2.47	
5 GHz Wi-Fi Ant B	5150-5250	2.42	
	5725-5850	1.91	

Note: The antennas used by the EUT are permanent attached antennas.

Note: Antenna info is information 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 μ H/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.

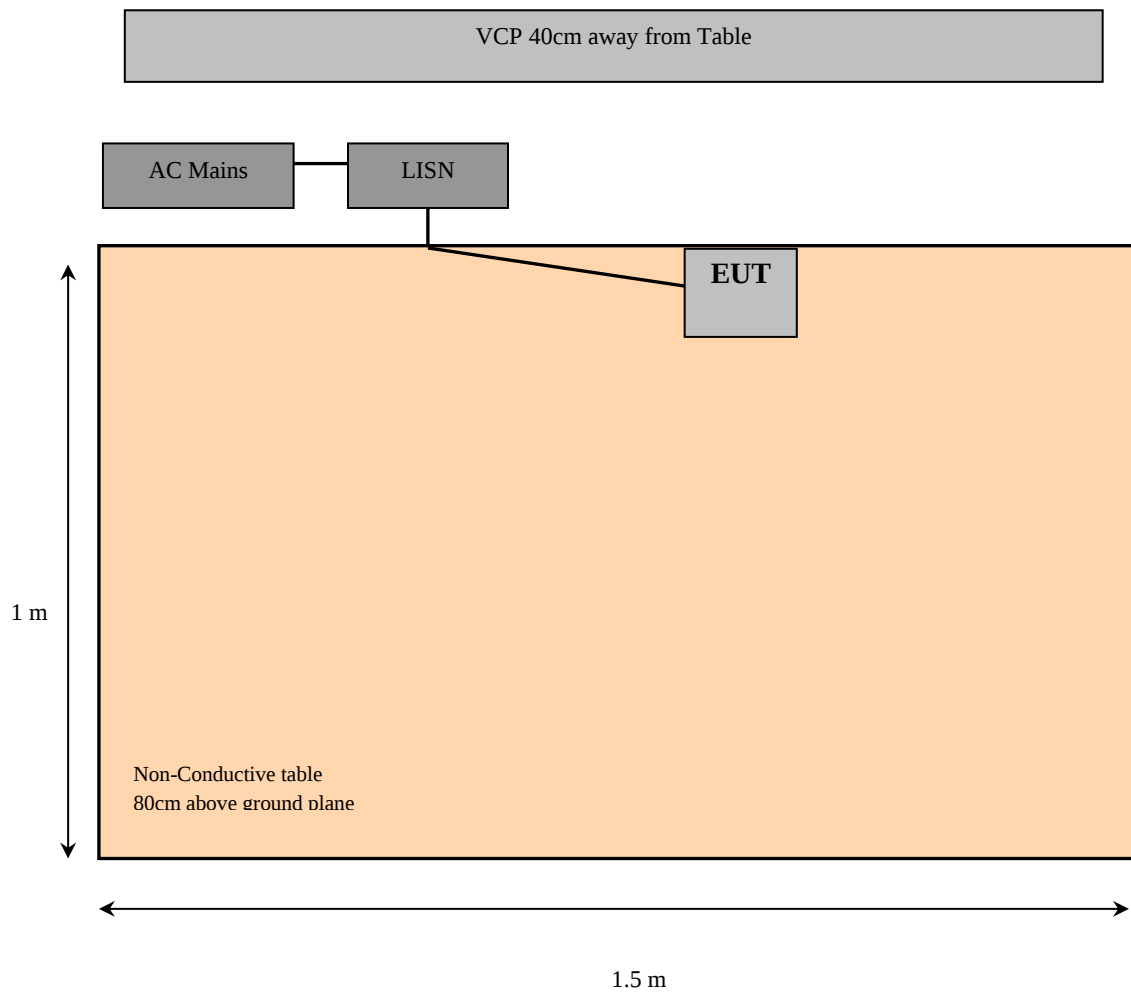
6.3 Test Procedure

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 Correction Factor (CF) to indicated Amplitude (Ai) reading. The basic equation is as follows:

$$CA = A_i + CF$$

For example, a corrected amplitude of 46.2 dBuV = Indicated Reading (32.5 dBuV) + Correction Factor (13.7 dB)

The Correction Factor is calculated by adding Cable loss (CL), LISN calibration factor, and attenuation of the impulse limiter and the high pass filter. The basic equation is as follows:

$$CF = CL + \text{LISN calibration factor} + \text{Attenuation}$$

For example, a corrected amplitude of 46.2 dBuV = Indicated Reading (32.5 dBuV) + Cable Loss (3.5 dB) + LISN calibration factor (0.2 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:

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

6.6 Test Equipment List and Details

BACL #	Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
124	Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100044	2021-05-14	2 years
680	Rohde & Schwarz	Impulse Limiter	ESH3-Z2	101964	2021-07-07	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:	20° C
Relative Humidity:	55 %
ATM Pressure:	102.1 kPa

The testing was performed by Weishan Zhang on 2022-07-08 in the Ground Plane test site.

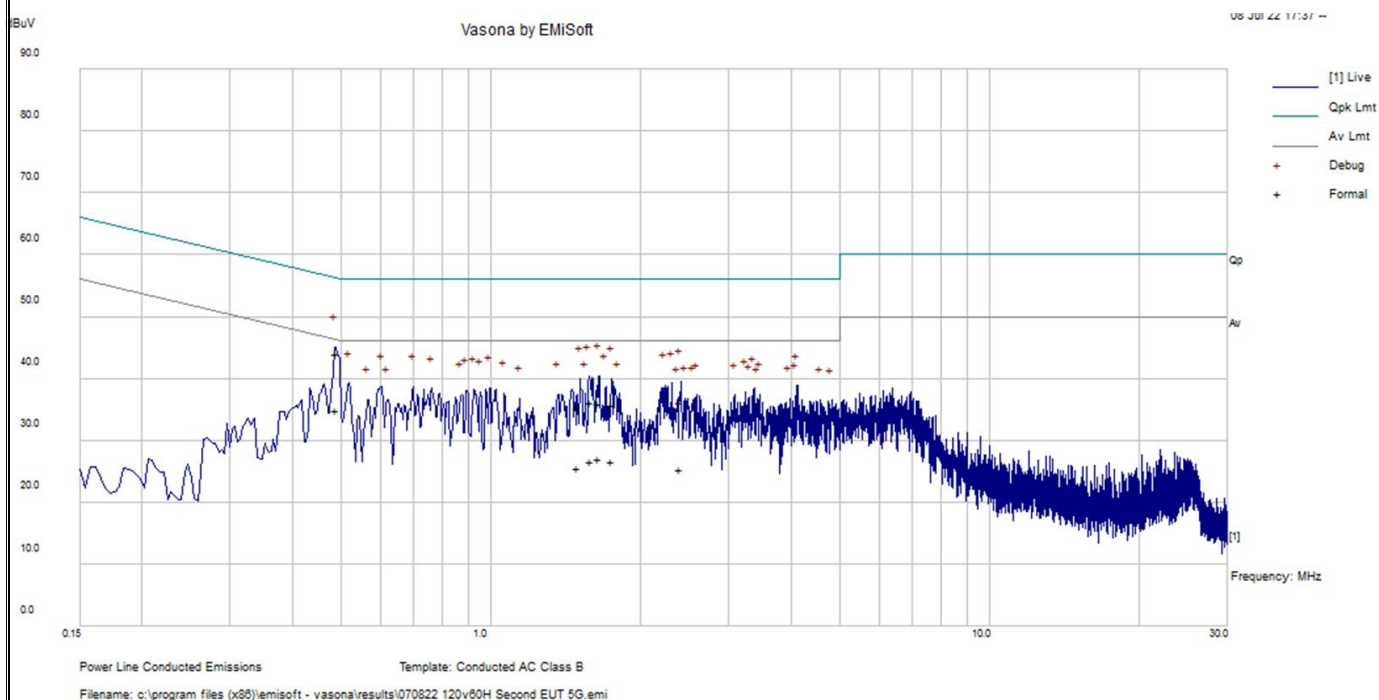
6.8 Summary of Test Results

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 (Line/Neutral)	Range (MHz)
-7.33	0.489783	Neutral	0.15-30

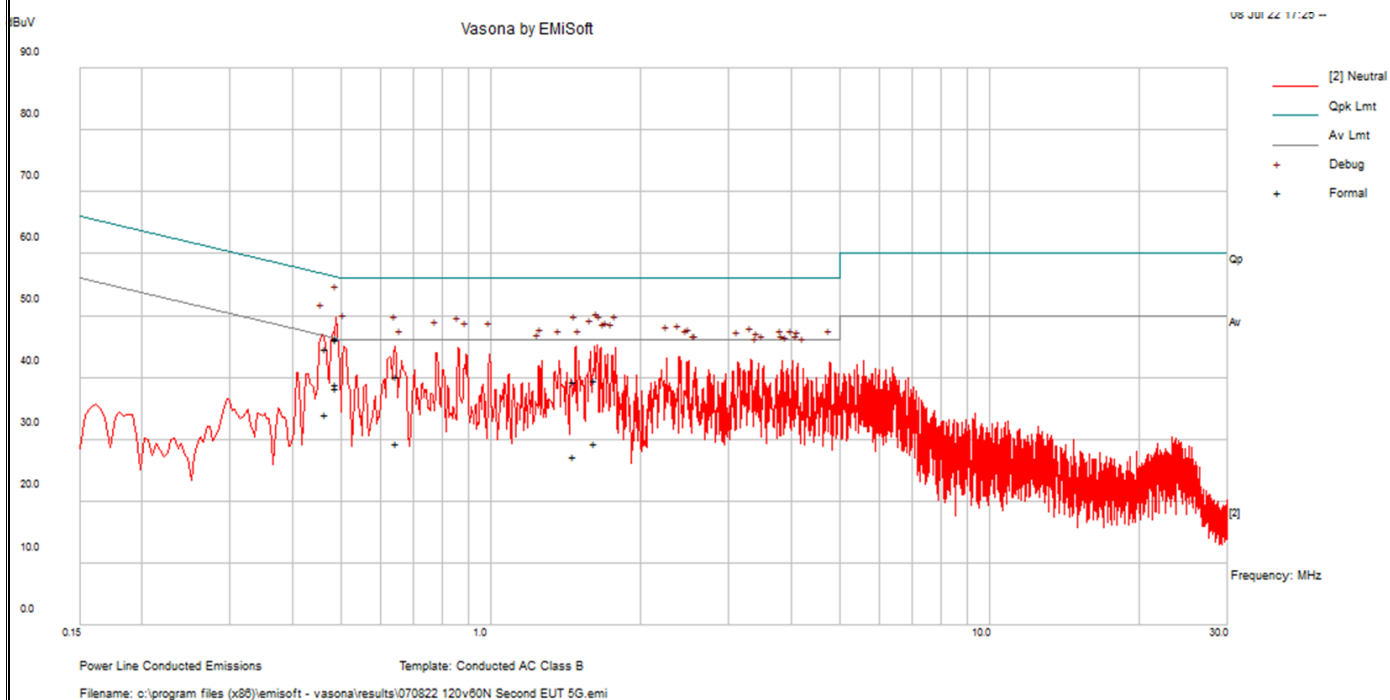
6.9 Conducted Emissions Test Plots and Data

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 e.i.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 not 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 ISSED 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:

$$\text{RBW} = 100 \text{ kHz} / \text{VBW} = 300 \text{ kHz} / \text{Sweep} = \text{Auto}$$

Above 1000 MHz:

$$(1) \text{ Peak: RBW} = 1\text{MHz} / \text{VBW} = 3\text{MHz} / \text{Sweep} = 100\text{ms}$$

$$(2) \text{ Average: RBW} = 1\text{MHz} / \text{VBW} = 10\text{Hz} / \text{Sweep} = \text{Auto}$$

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:

$$\text{CA} = \text{Ai} + \text{AF} + \text{CL} + \text{Atten} - \text{Ga}$$

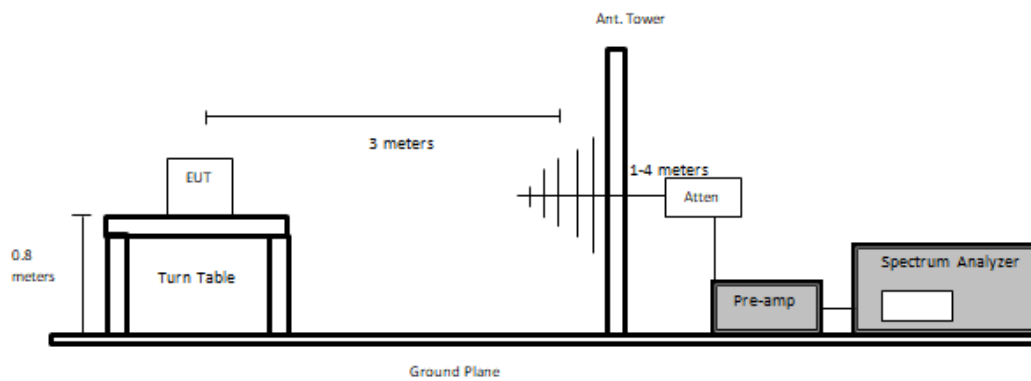
For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

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:

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

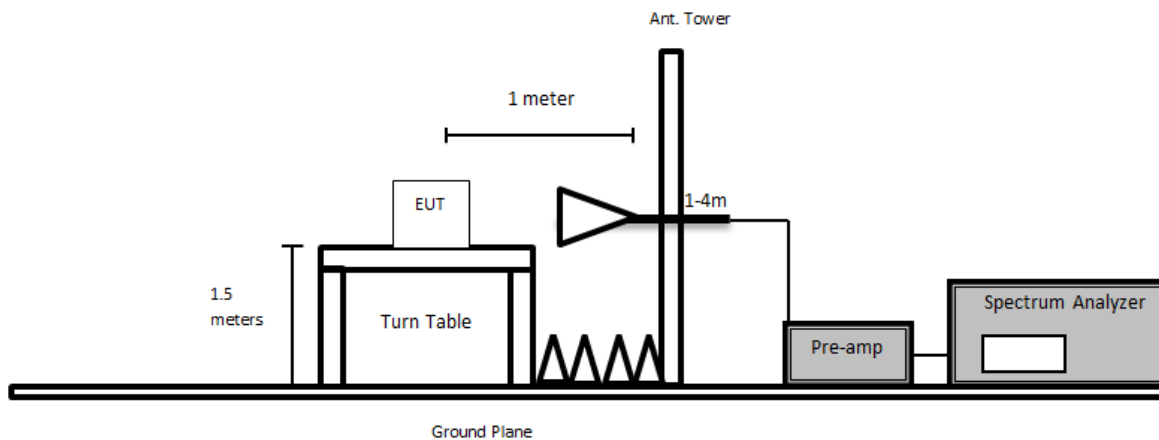
7.5 Test Setup Block Diagram

Below 1GHz:

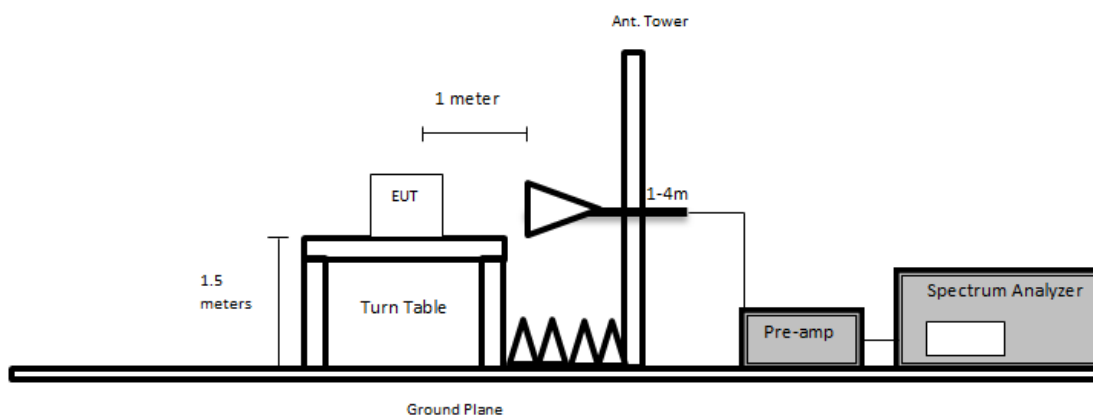


Above 1GHz:

At 1 meter:
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	Insulated 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

Note¹: cables and attenuators included in the test set-up will be checked each time before testing.

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

7.7 Test Environmental Conditions

Temperature:	21-02 °C
Relative Humidity:	42-47 %
ATM Pressure:	101.7 kPa

The testing was performed by Deepak Mishra from 2022-06-08 to 2022-06-28 in 5m chamber 3.

7.8 Summary of Test Results

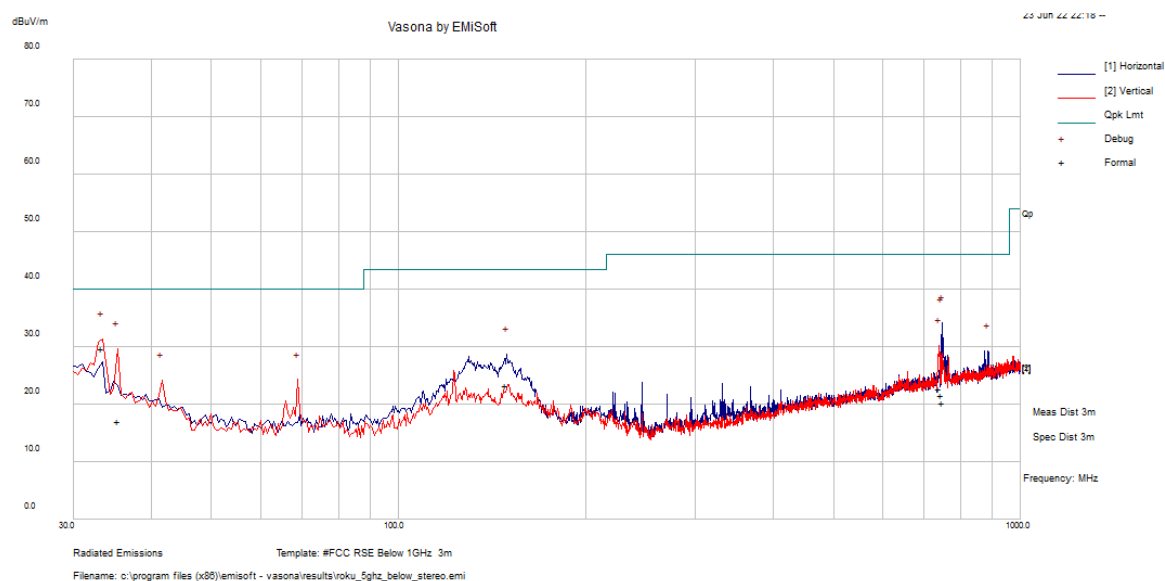
According to the data hereinafter, the EUT complied with the FCC Part 15.407 and RSS-247 standards' radiated emissions limits, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Mode, Channel
-5.84	39715.777	Horizontal	802.11n/ac20 mode, Antenna A+B, 5825 MHz

7.9 Radiated Emissions Test Result Data

1) 30 MHz – 1 GHz at 3 meters

Worst Case: 802.11n/ac20, 5825MHz



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBuV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBuV/m)	Margin (dB)	Comment
33.317	30.25	-0.61	29.65	105	V	63	40	-10.35	Pass
35.35375	19.05	-2.11	16.95	126	V	170	40	-23.05	Pass
749.03225	17.52	2.74	20.26	248	H	99	46	-25.74	Pass
746.8295	18.78	2.73	21.51	224	H	82	46	-24.49	Pass
149.1075	29.61	-6.35	23.25	195	H	91	43.5	-20.25	Pass
739.41775	19.99	2.7	22.68	132	V	139	46	-23.32	Pass

FCC/IC Limits for 1 GHz to 40 GHz				
Applicability	(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) & ISED RSS-247 §6.2 Defined Unwanted Emissions Limit	-27	-	68	78

Note¹: Restricted Band Peak Limit is defined to be 20dB higher than Average Limit.

Note²: 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: $20 \cdot \log(3\text{meters}/1\text{meter}) = 9.54$ (According to ANSI C63.10-2013 Section 9.4)

Note³: Where Restricted Band Peak Limit is replaced with stricter 78 dBuV/m at 1 meter, compliance is being shown for unwanted emissions per FCC §15.407(b) & ISED RSS-247 §6.2

2) 1 – 18 GHz, Harmonics & Emission Masks measured at 1 meter

5150 - 5250 MHz

802.11a mode Antenna A

Frequency (MHz)	S.A. Reading (dBμV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre- Amp. (dB)	Cord. Reading (dBμV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
Low Channel: 5180 MHz											
10360	48.450	250	150	H	38.15	12.88	36.58	62.90	78	-15.10	Peak
10360	36.951	250	150	H	38.15	12.88	36.58	51.40	64	-12.60	Ave
Middle Channel: 5200 MHz											
10400	49.630	223	150	H	38.15	12.79	36.58	63.99	78	-14.01	Peak
10400	38.190	223	150	H	38.15	12.79	36.58	52.55	64	-11.45	Ave
High Channel: 5240 MHz											
10480	48.710	315	178	H	38.15	12.92	36.47	63.31	78	-14.69	Peak
10480	39.174	315	178	H	38.15	12.92	36.47	53.77	64	-10.23	Ave

5150 - 5250 MHz

802.11a mode Antenna B

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre- Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel: 5180 MHz											
10360	50.460	227	100	H	38.15	12.88	36.58	64.91	78	-13.09	Peak
10360	39.073	227	100	H	38.15	12.88	36.58	53.52	64	-10.48	Ave
Middle Channel: 5200 MHz											
10400	48.730	250	150	H	38.15	12.79	36.58	63.09	78	-14.91	Peak
10400	37.293	250	150	H	38.15	12.79	36.58	51.65	64	-12.35	Ave
High Channel: 5240 MHz											
10480	48.380	360	150	H	38.15	12.92	36.47	62.98	78	-15.02	Peak
10480	37.192	360	150	H	38.15	12.92	36.47	51.79	64	-12.21	Ave

5150 - 5250 MHz

802.11ac20/n20 mode Antenna A+B

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre- Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel: 5180 MHz											
10360	45.600	278	150	H	38.15	12.88	36.58	60.05	78	-17.95	Peak
10360	35.359	278	150	H	38.15	12.88	36.58	49.81	64	-14.19	Ave
Middle Channel: 5200 MHz											
10400	45.350	306	150	H	38.15	12.79	36.58	59.71	78	-18.29	Peak
10400	35.962	306	150	H	38.15	12.79	36.58	50.32	64	-13.68	Ave
High Channel: 5240 MHz											
10480	45.91	286	150	H	38.15	12.92	36.47	60.51	78	-17.49	Peak
10480	36.37	286	150	H	38.15	12.92	36.47	50.97	64	-13.03	Ave

5725 - 5850 MHz**802.11a mode Antenna A**

Frequency (MHz)	S.A. Reading (dBμV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre- Amp. (dB)	Cord. Reading (dBμV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
Low Channel: 5745 MHz											
11490	45.320	107	183	H	38.86	13.76	36.03	61.91	84.00	-22.09	Peak
11490	35.808	107	183	H	38.86	13.76	36.03	52.40	64.00	-11.60	Ave
Middle Channel: 5785 MHz											
11570	46.140	127	160	H	38.86	13.98	36.05	62.94	84.00	-21.07	Peak
11570	36.767	127	160	H	38.86	13.98	36.05	53.56	64.00	-10.44	Ave
High Channel: 5825 MHz											
11650	46.390	102	150	H	38.86	14.10	36.09	63.26	84.00	-20.74	Peak
11650	37.049	102	150	H	38.86	14.10	36.09	53.92	64.00	-10.08	Ave

5725 - 5850 MHz**802.11a mode Antenna B**

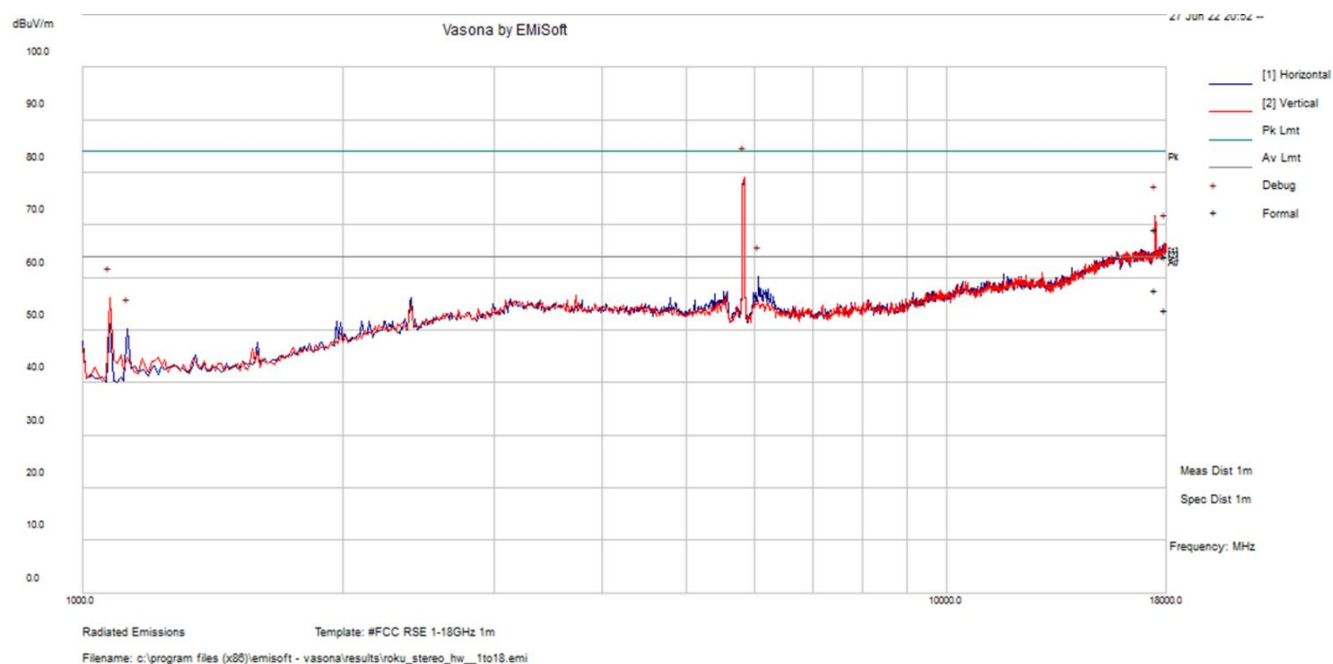
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre- Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel: 5745 MHz											
11490	45.470	235	138	H	38.86	13.76	36.03	62.06	84.00	-21.94	Peak
11490	35.992	235	138	H	38.86	13.76	36.03	52.58	64.00	-11.42	Ave
Middle Channel: 5785 MHz											
11570	47.100	105	110	H	38.86	13.98	36.05	63.90	84.00	-20.11	Peak
11570	36.774	105	110	H	38.86	13.98	36.05	53.57	64.00	-10.43	Ave
High Channel: 5825 MHz											
11650	46.300	108	102	H	38.86	14.10	36.09	63.17	84.00	-20.83	Peak
11650	36.970	108	102	H	38.86	14.10	36.09	53.84	64.00	-10.16	Ave

5725 - 5850 MHz

802.11ac20/n20 mode Antenna A+B

Frequency (MHz)	S.A. Reading (dBμV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre- Amp. (dB)	Cord. Reading (dBμV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	
Low Channel: 5745 MHz											
11490	45.830	103	265	H	38.86	13.76	36.03	62.42	84.00	-21.58	Peak
11490	36.229	103	265	H	38.86	13.76	36.03	52.82	64.00	-11.18	Ave
Middle Channel: 5785 MHz											
11570	46.580	107	270	H	38.86	13.98	36.05	63.38	84.00	-20.63	Peak
11570	37.143	107	270	H	38.86	13.98	36.05	53.94	64.00	-10.06	Ave
High Channel: 5825 MHz											
11650	46.850	102	134	H	38.86	14.10	36.09	63.72	84.00	-20.28	Peak
11650	37.072	102	134	H	38.86	14.10	36.09	53.95	64.00	-10.05	Ave

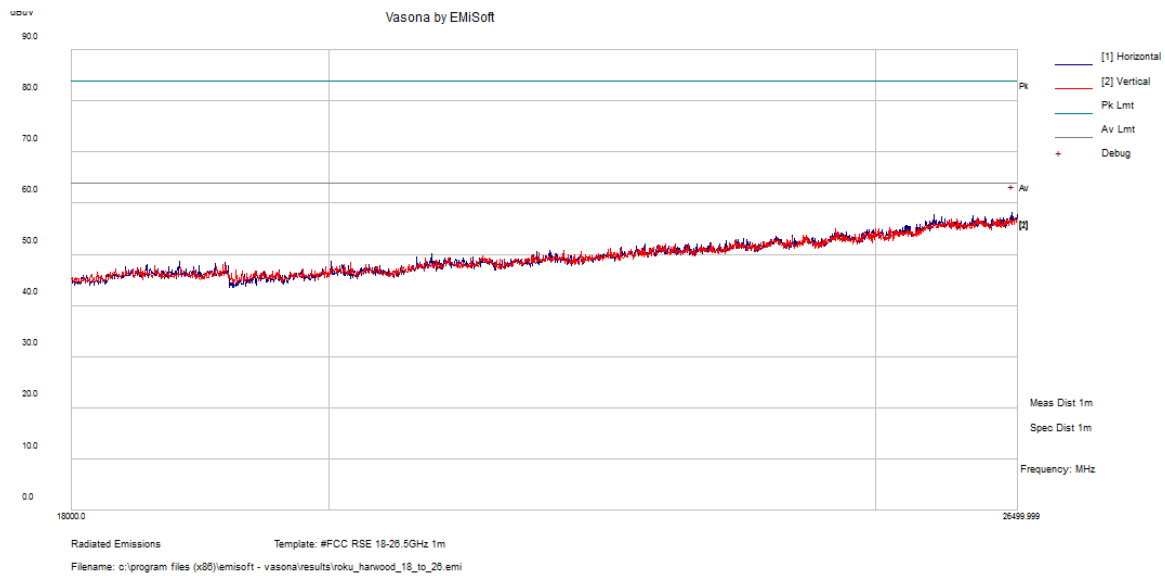
3) **1 to 18 GHz Vasona scan at 1 meter**
Worst Case: 802.11n/ac20, 5825MHz



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
17469.72	50.77	18.33	69.11	213	H	78	84	-14.89	Peak
17938.103	44.98	19.09	64.07	138	H	139	84	-19.93	Peak
17469.72	39.34	18.33	57.67	213	H	78	64	-6.33	Average
17938.103	34.82	19.09	53.91	138	H	139	64	-10.09	Average

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

Worst Case: 802.11n/ac20, 5825MHz

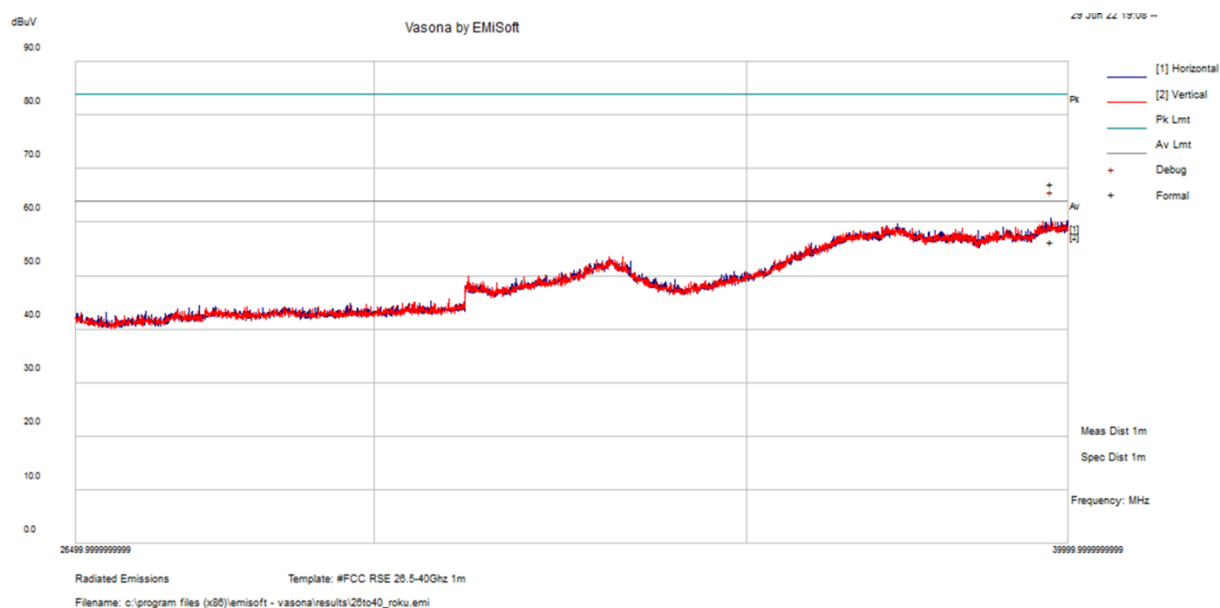


Frequency (MHz)	S.A. Reading (dBμV)	Correction Factor (dB/m)	Corrected Amplitude (dBμV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBμV/m)	Margin (dB)	Comment
26441.562	35.1	23.06	58.16	300	H	0	64	-5.84	Peak

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

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

Worst Case: 802.11n/ac20, 5825MHz



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
39715.777	51.66	15.6	67.25	171	H	138	84	-16.75	Pass
39715.777	40.79	15.6	56.38	171	H	138	64	-7.62	Pass

8 FCC §15.407(e) & ISEDC RSS-247 §6.2 - 6 dB, 26 dB, & 99% - Occupied Bandwidth

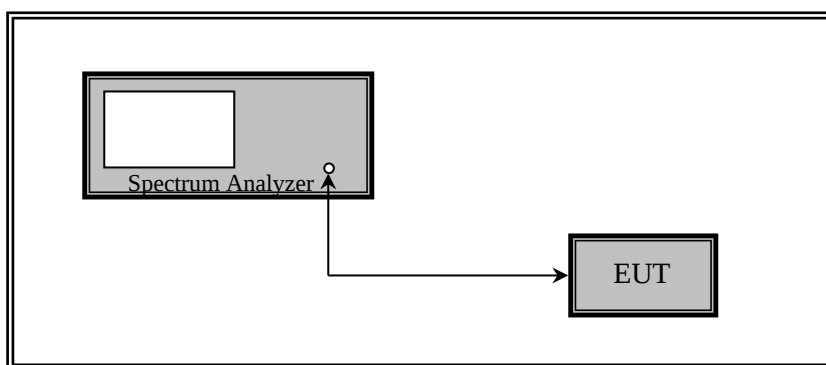
8.1 Applicable Standards

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

Note¹: 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 °C
Relative Humidity:	40-41 %
ATM Pressure:	103.1-104.1 kPa

The testing was performed by Marc Jean from 2022-06-17 to 2022-06-23 in RF site.

8.6 Test Results

Please refer to the following tables and plots.

5150 - 5250 MHz

Ant A

Channel	Frequency (MHz)	99% OBW (MHz)	26 dB OBW (MHz)
802.11a mode			
36	5180	16.328	28.583
40	5200	16.361	18.607
48	5240	16.422	18.553
802.11n/ac20 mode			
36	5180	17.437	19.539
40	5200	17.464	19.640
48	5240	17.459	19.459

Ant B

Channel	Frequency (MHz)	99% OBW (MHz)	26 dB OBW (MHz)
802.11a mode			
36	5180	16.358	24.179
44	5200	16.331	18.426
48	5240	16.340	18.503
802.11n/ac20 mode			
36	5180	17.451	19.564
44	5200	17.456	19.787
48	5240	21.096	19.592

5725 - 5850 MHz**Ant A**

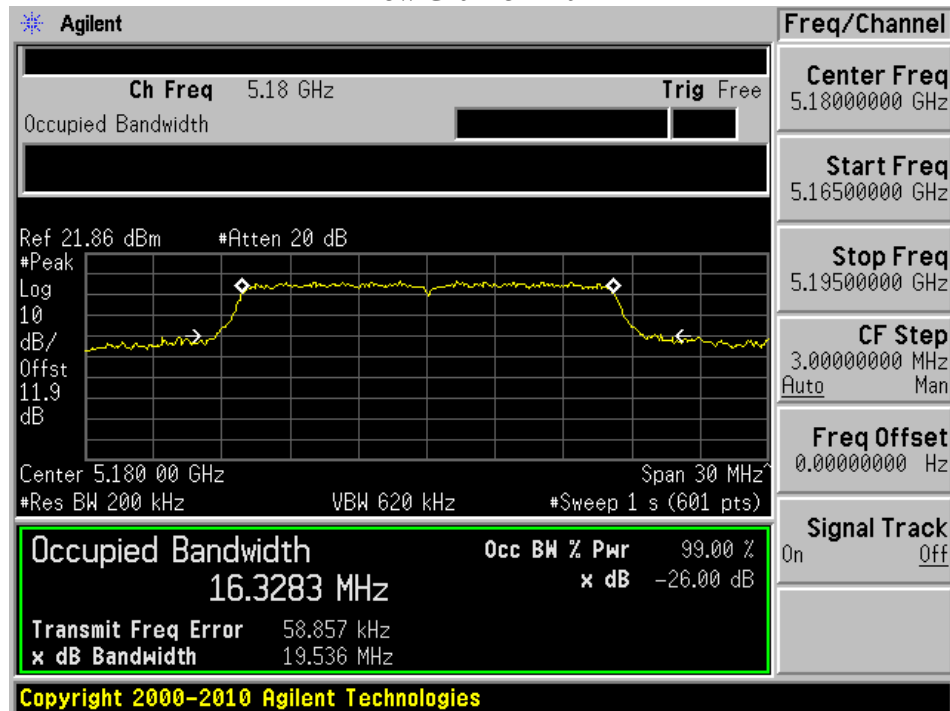
Channel	Frequency (MHz)	99% OBW (MHz)	6 dB OBW (MHz)	Limit (≥500kHz)
802.11a mode				
149	5745	29.502	16.307	Pass
157	5785	31.284	16.317	Pass
165	5825	16.587	16.312	Pass
802.11n/ac20 mode				
149	5745	32.689	17.178	Pass
157	5785	33.114	17.315	Pass
165	5825	31.772	17.278	Pass

Ant B

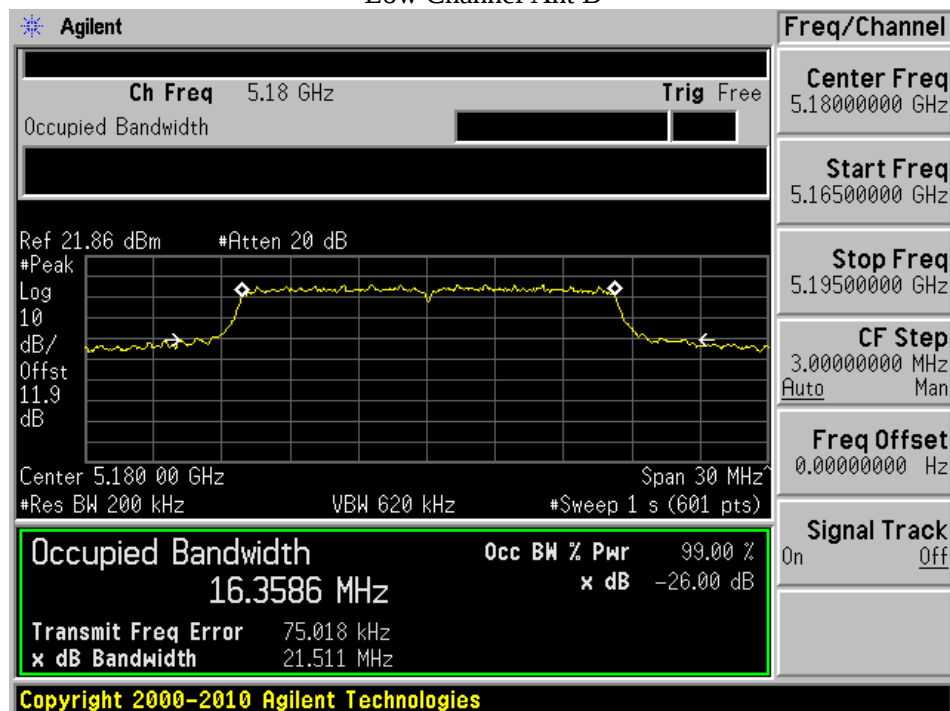
Channel	Frequency (MHz)	99% OBW (MHz)	6 dB OBW (MHz)	Limit (≥500kHz)
802.11a mode				
149	5745	30.535	16.323	Pass
157	5785	30.017	16.338	Pass
165	5825	31.299	16.335	Pass
802.11n/ac20 mode				
149	5745	32.289	17.295	Pass
157	5785	32.190	16.774	Pass
165	5825	17.777	16/836	Pass

99% Occupied Band Width**5150 - 5250 MHz 802.11a OBW**

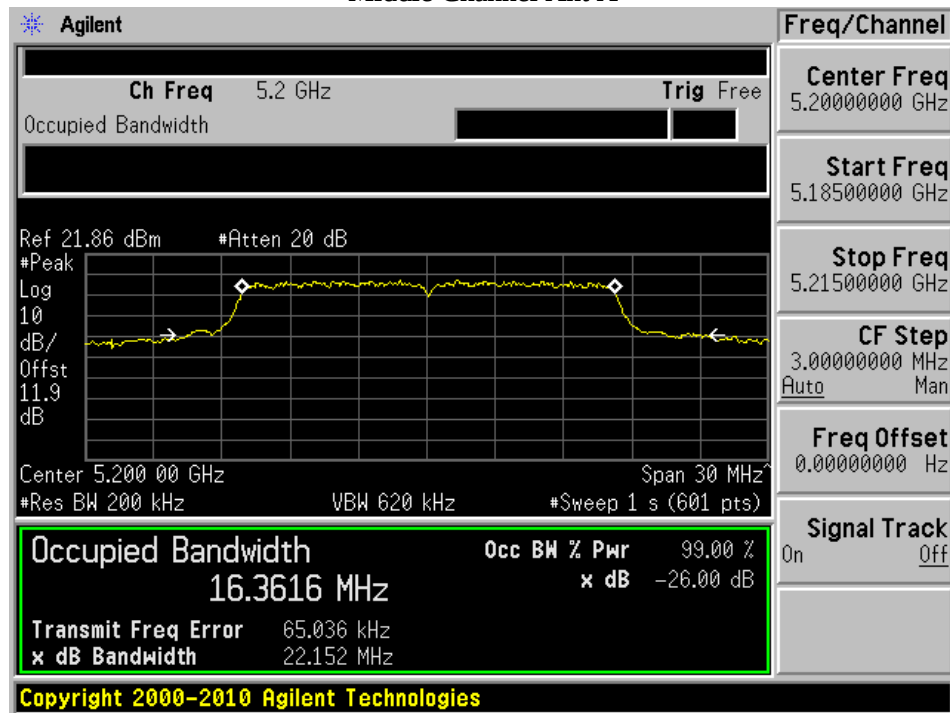
Low Channel Ant A



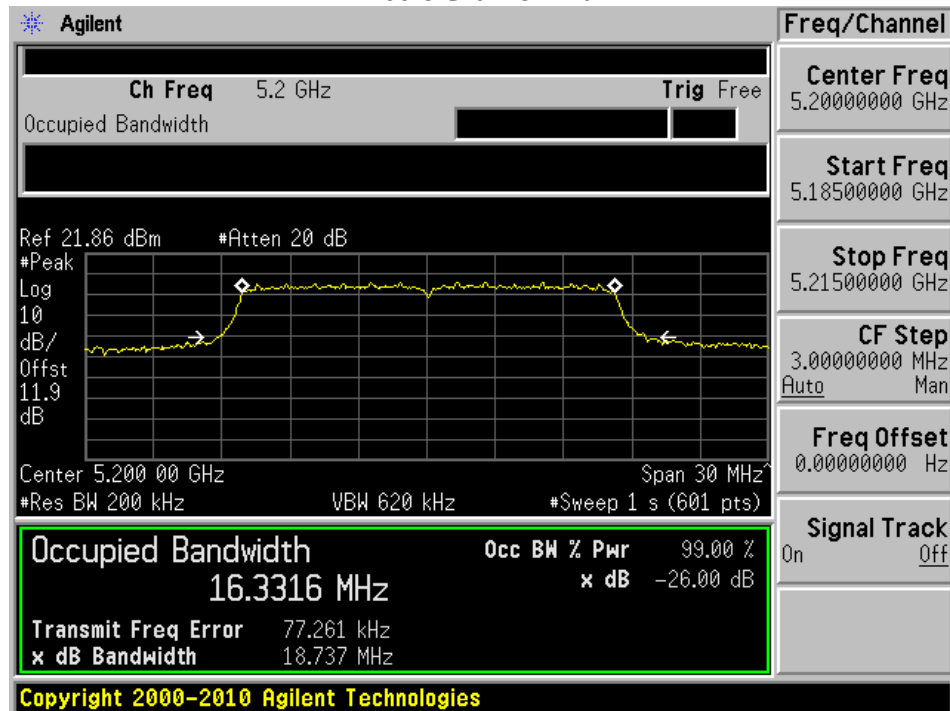
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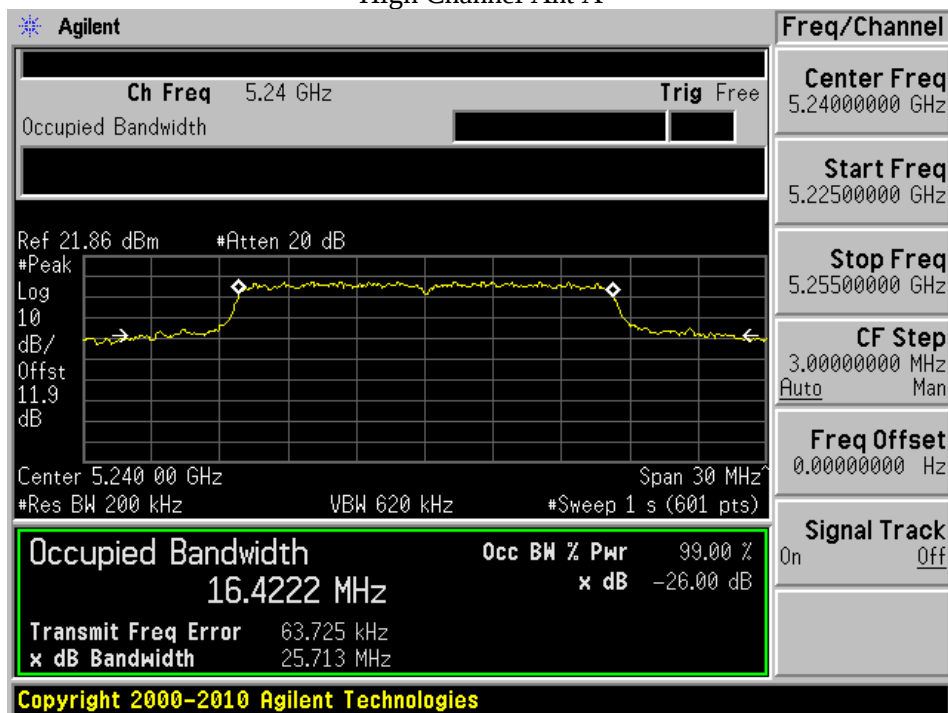
Middle Channel Ant A



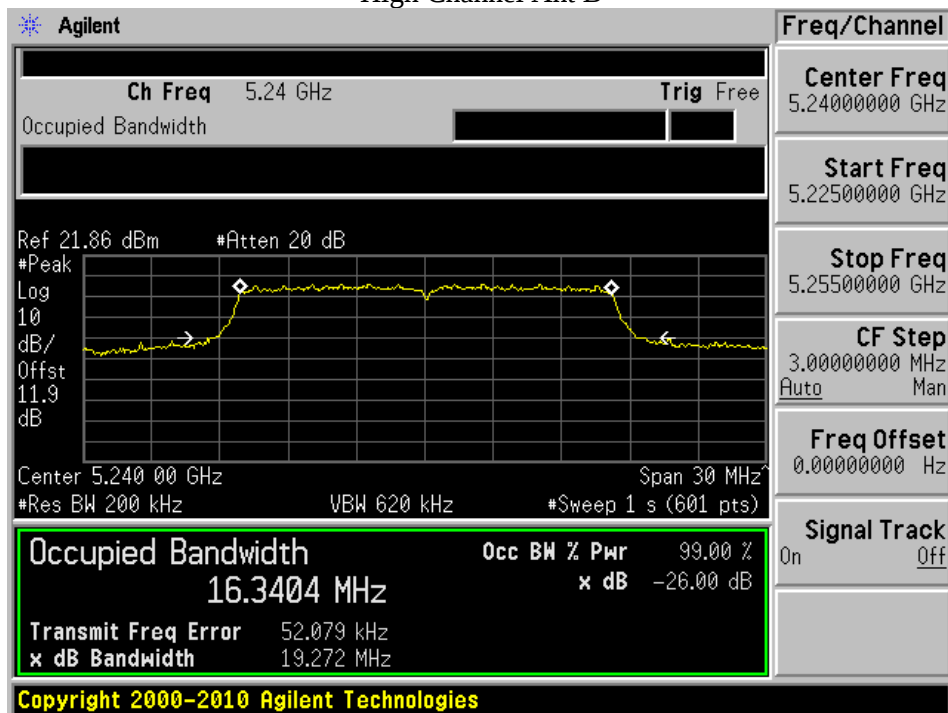
Middle Channel Ant B



High Channel Ant A

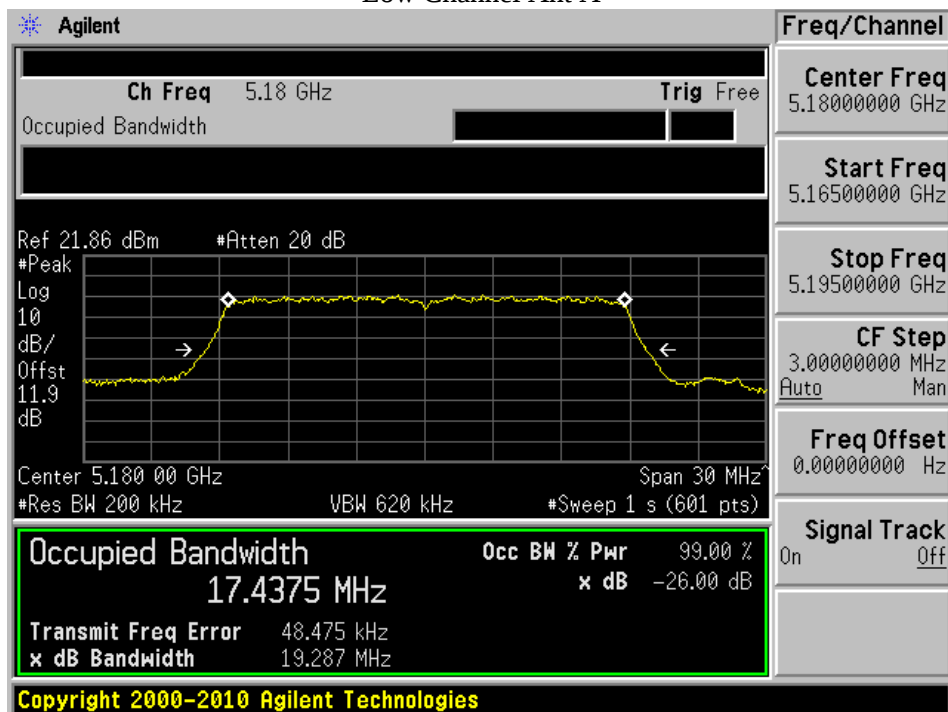


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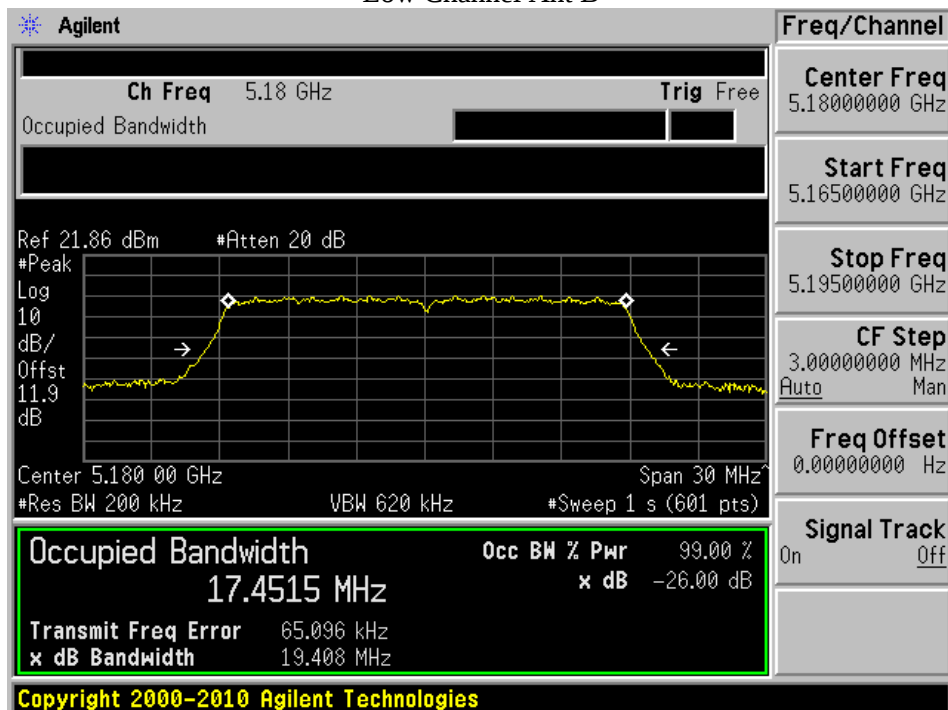


5150 - 5250 MHz 802.11n20 OBW

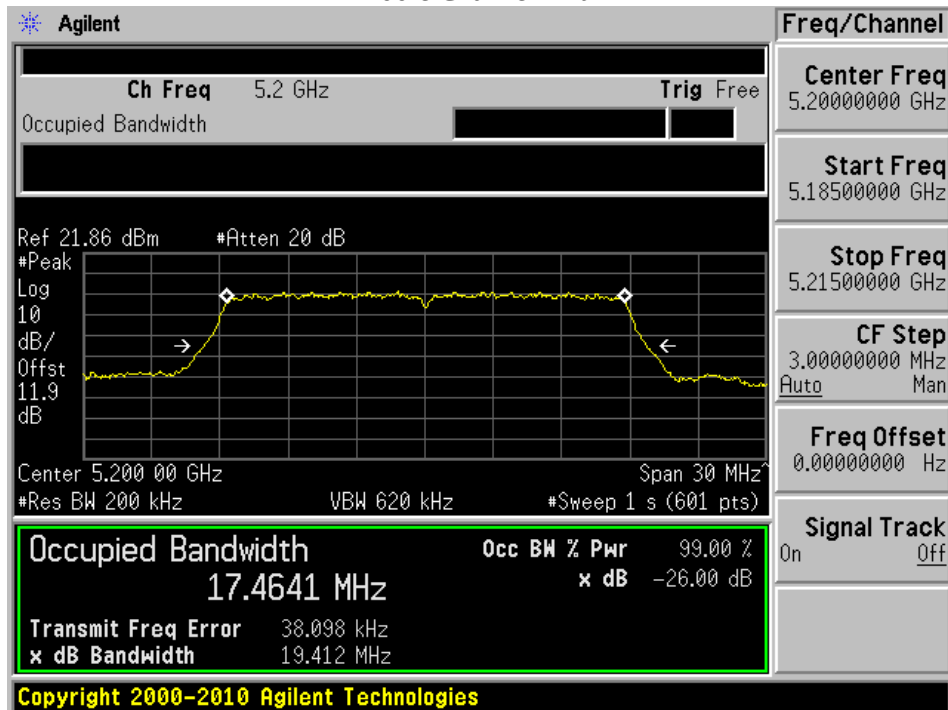
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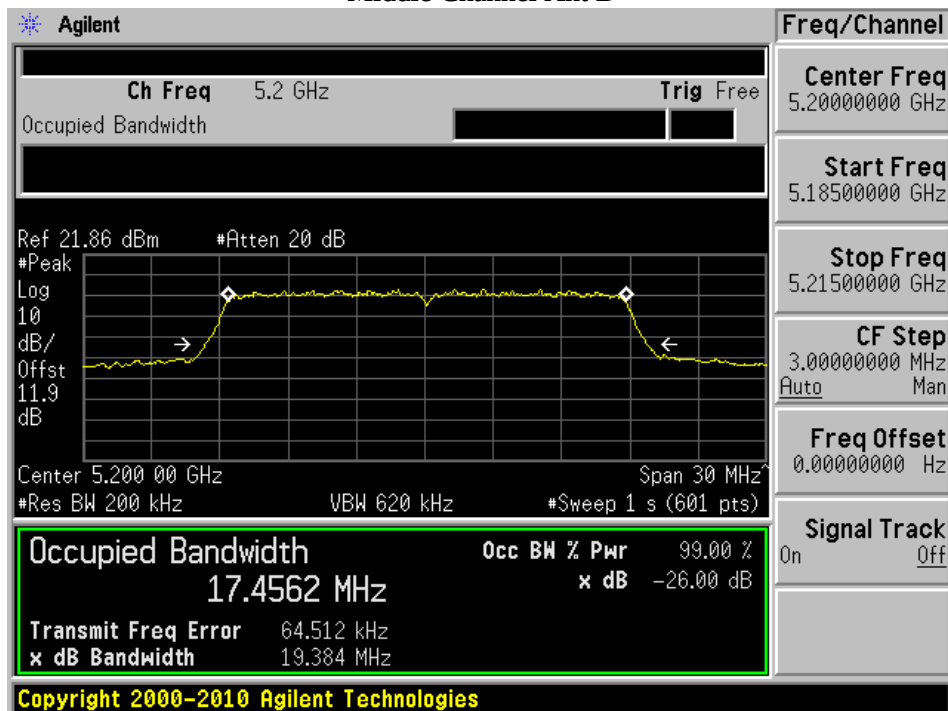
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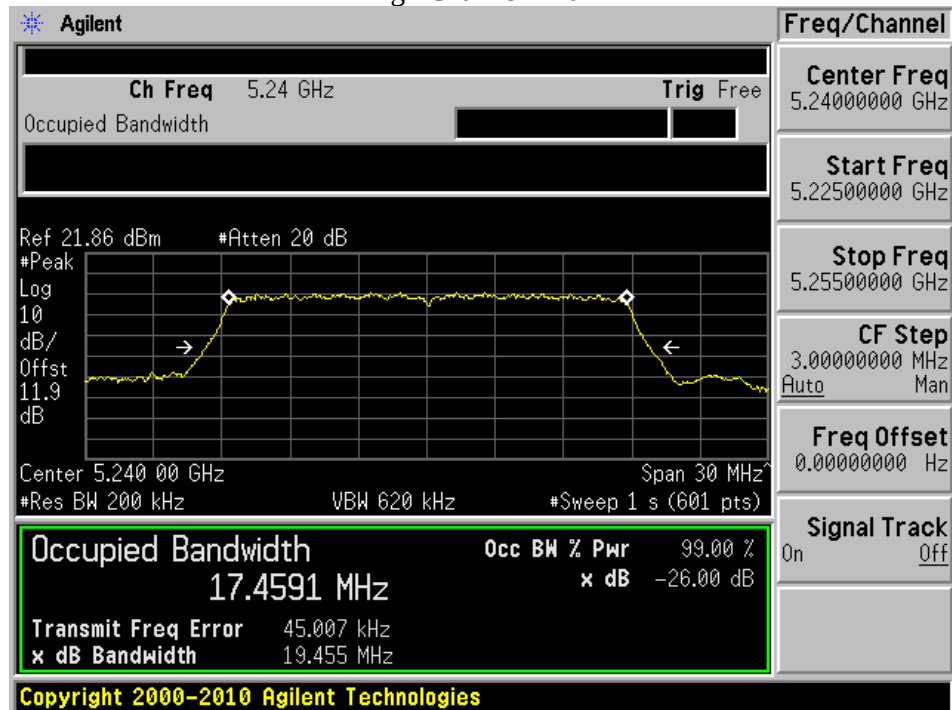
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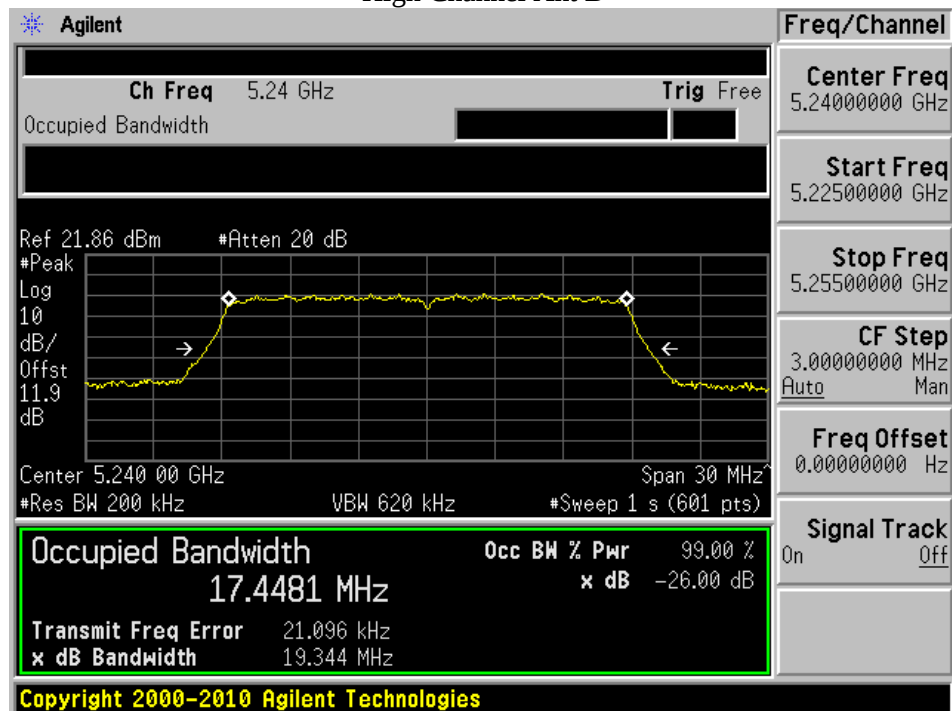
Middle Channel Ant B



High Channel Ant A

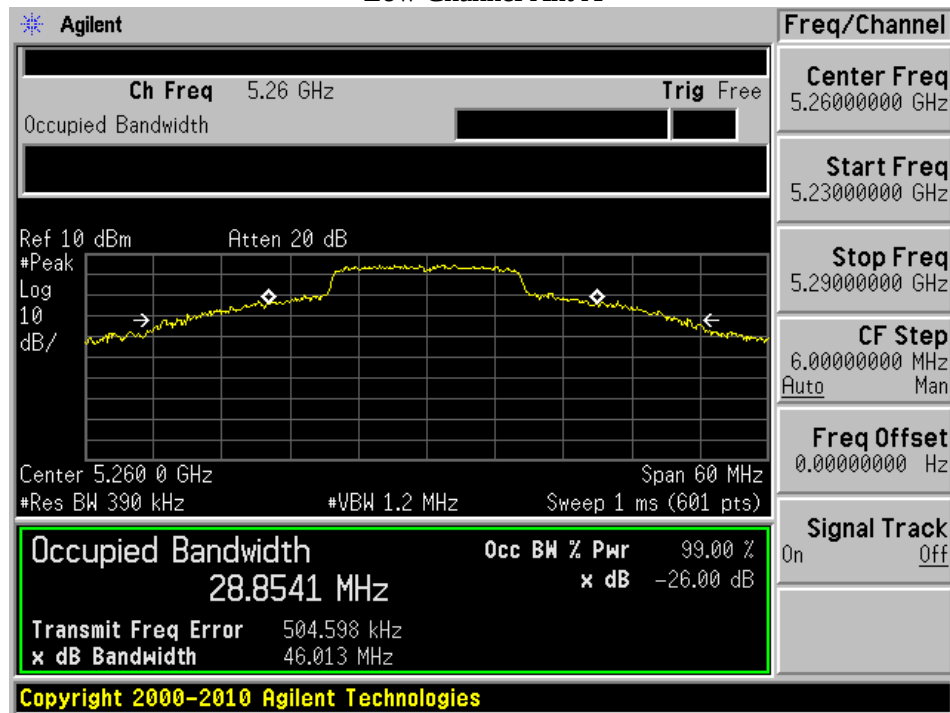


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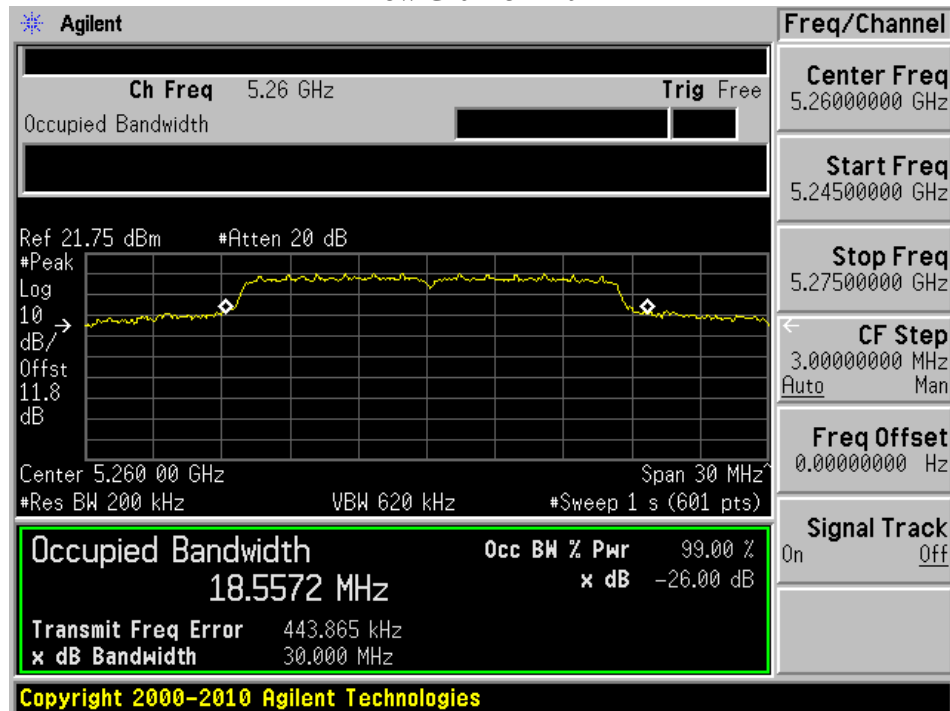


5250 - 5350 MHz 802.11a

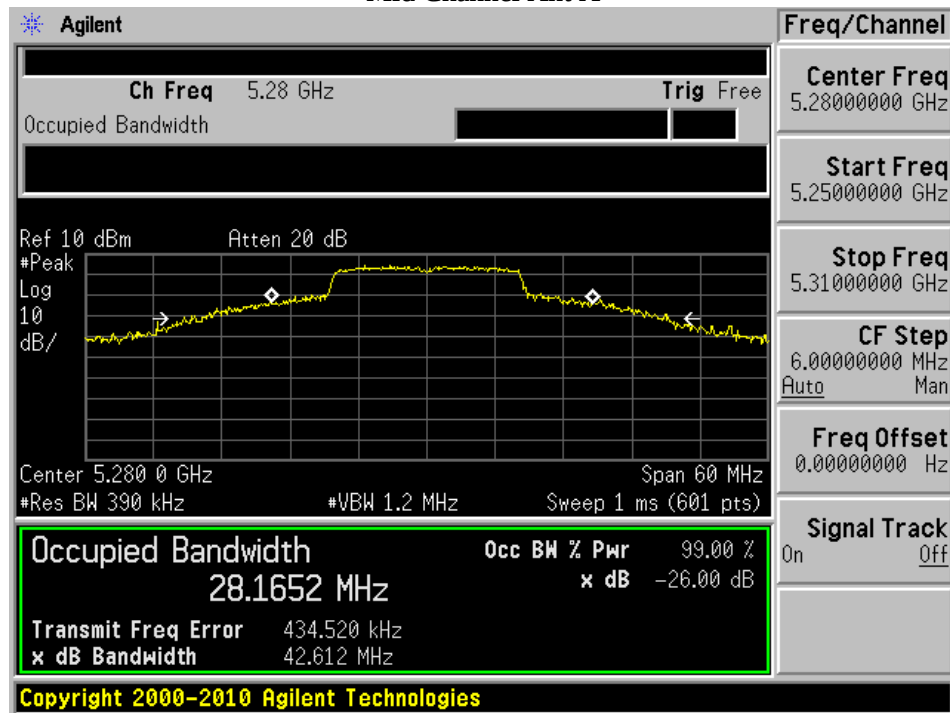
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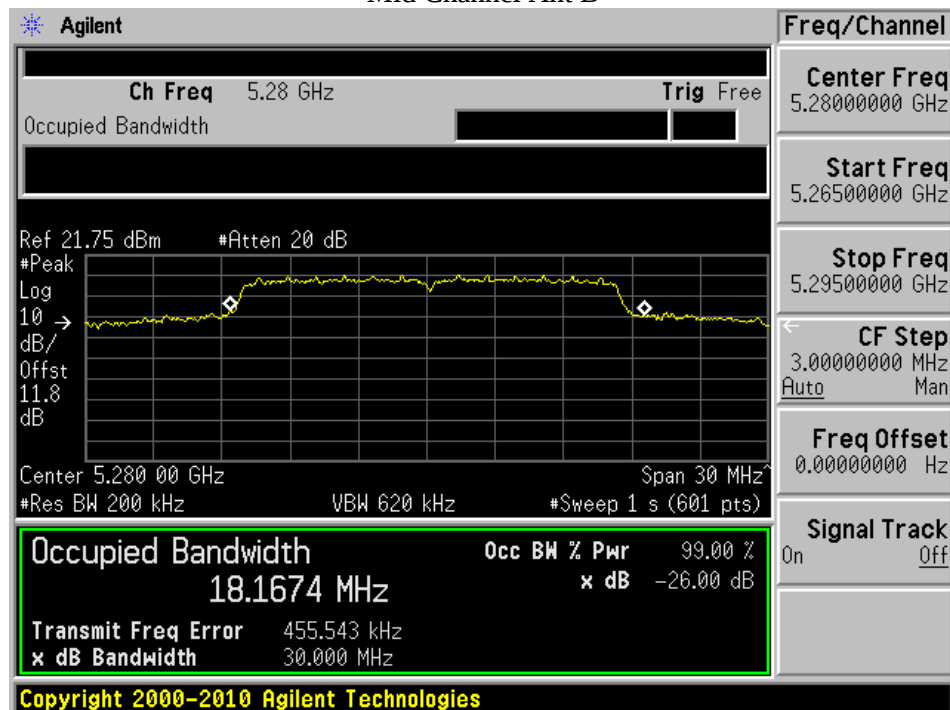
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Mid Channel Ant A



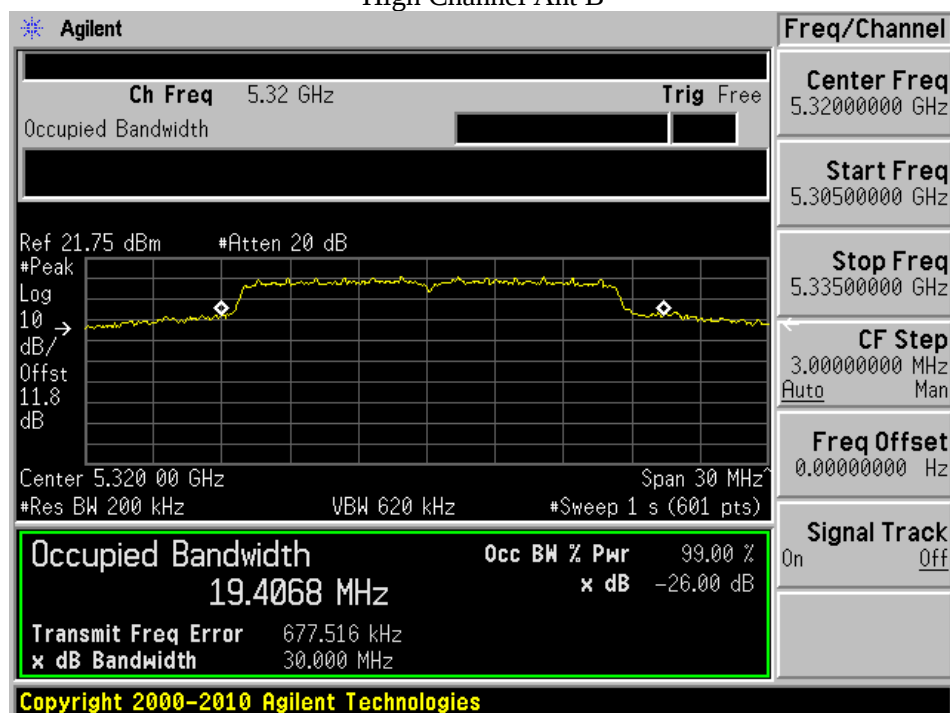
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High Channel Ant A

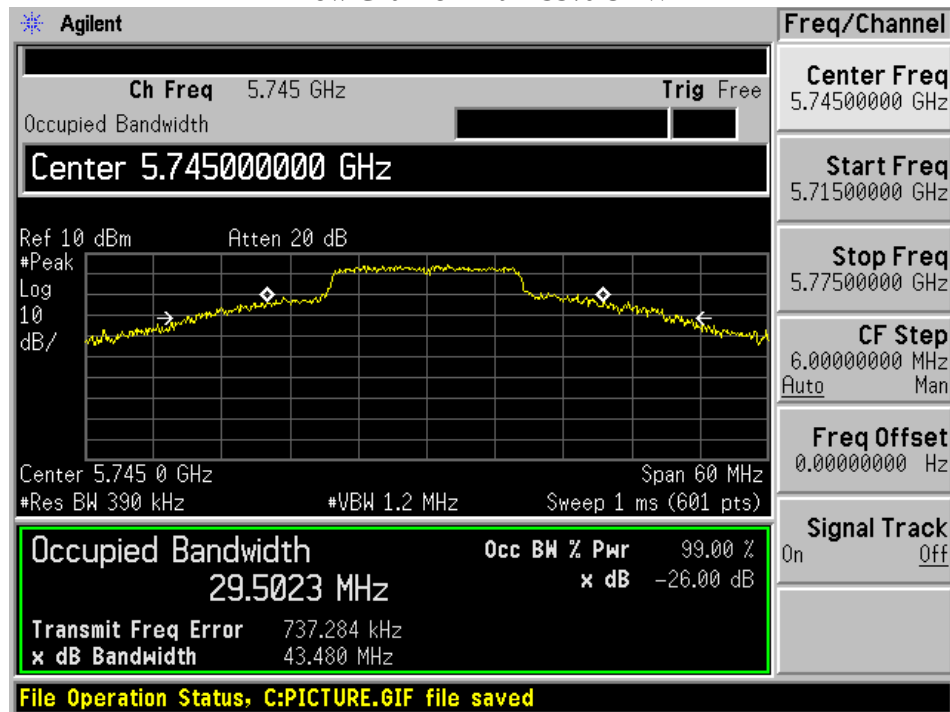


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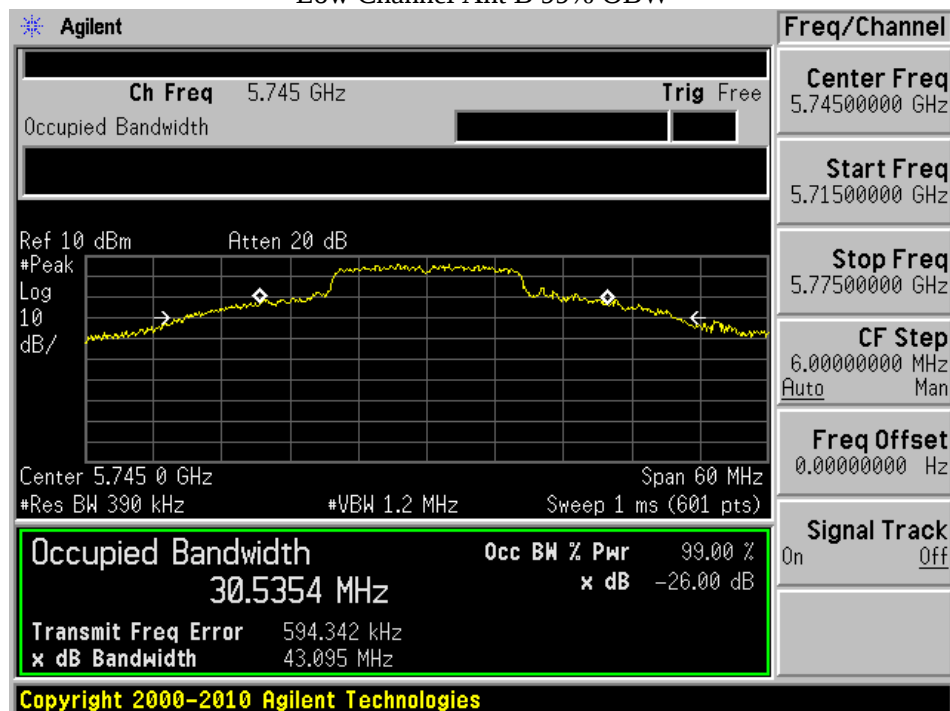


5725 - 5850 MHz 802.11a

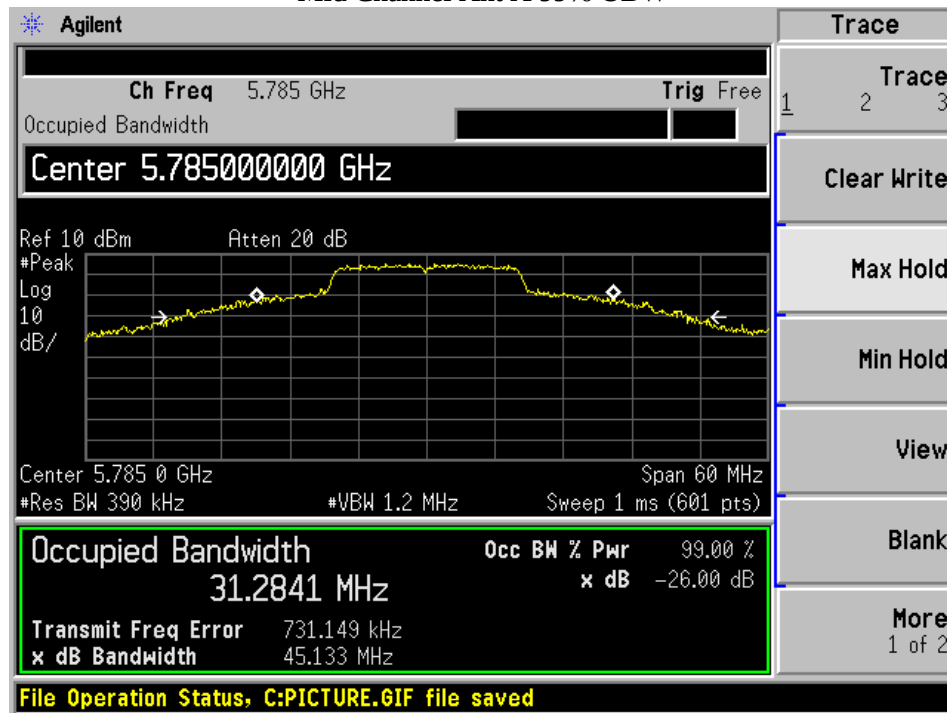
Low Channel Ant A 99% OBW



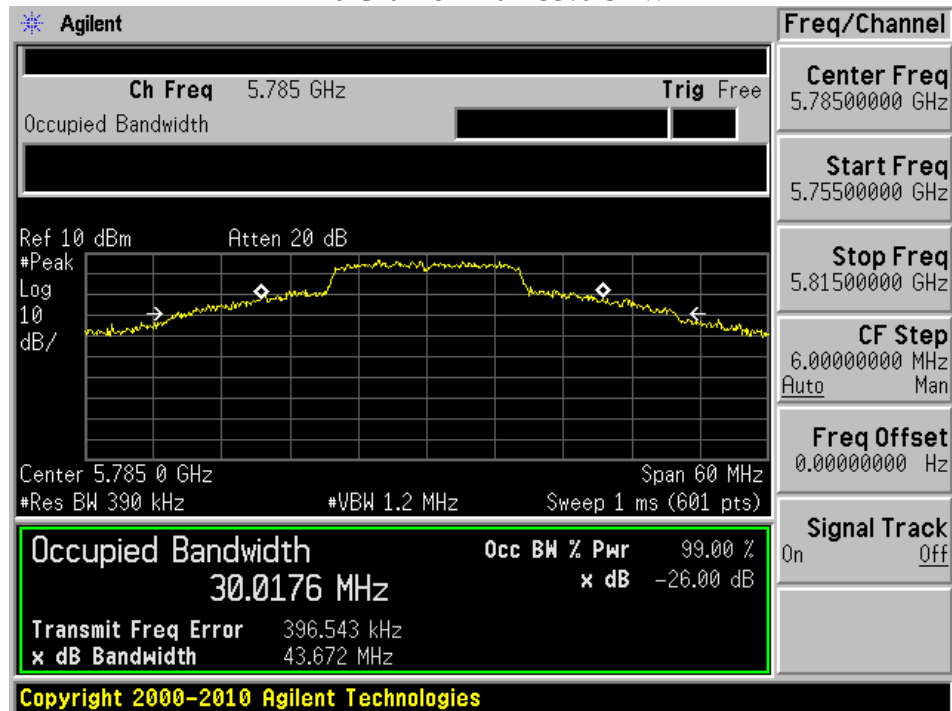
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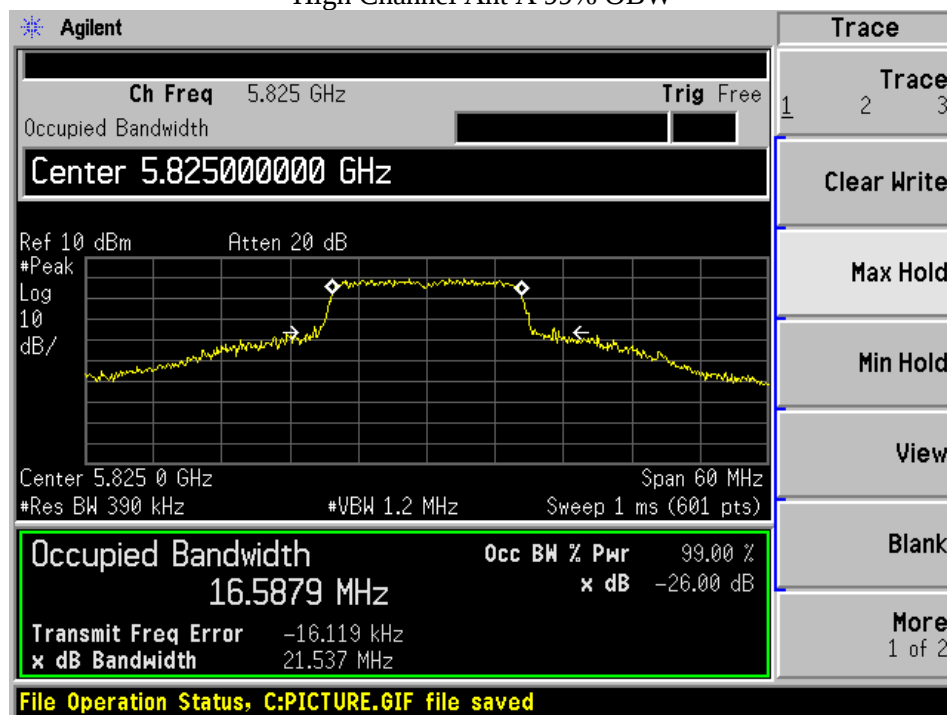
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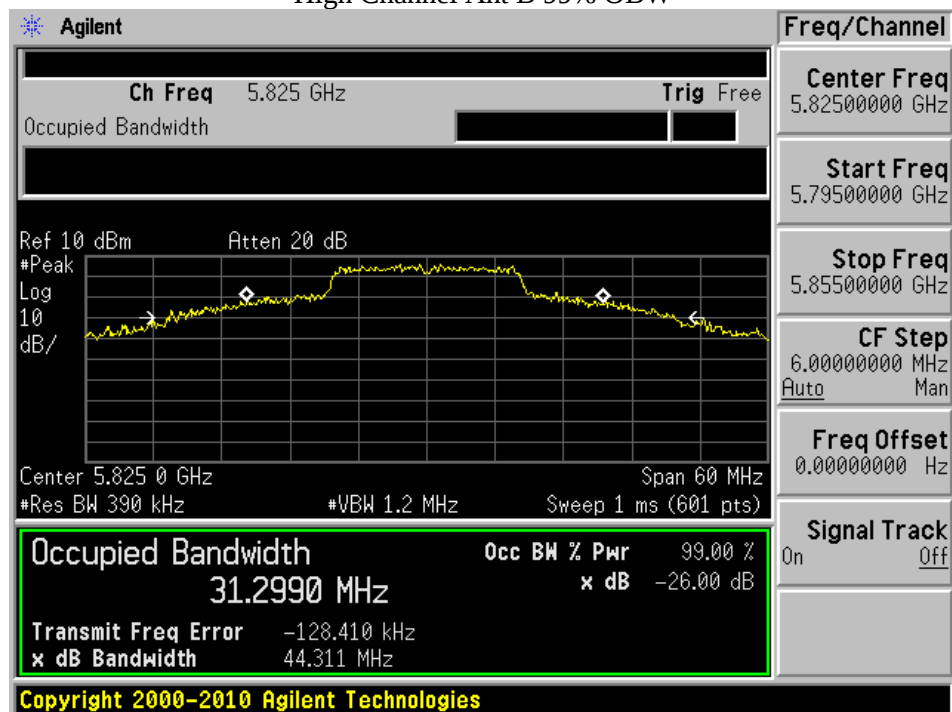
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High Channel Ant A 99% OBW

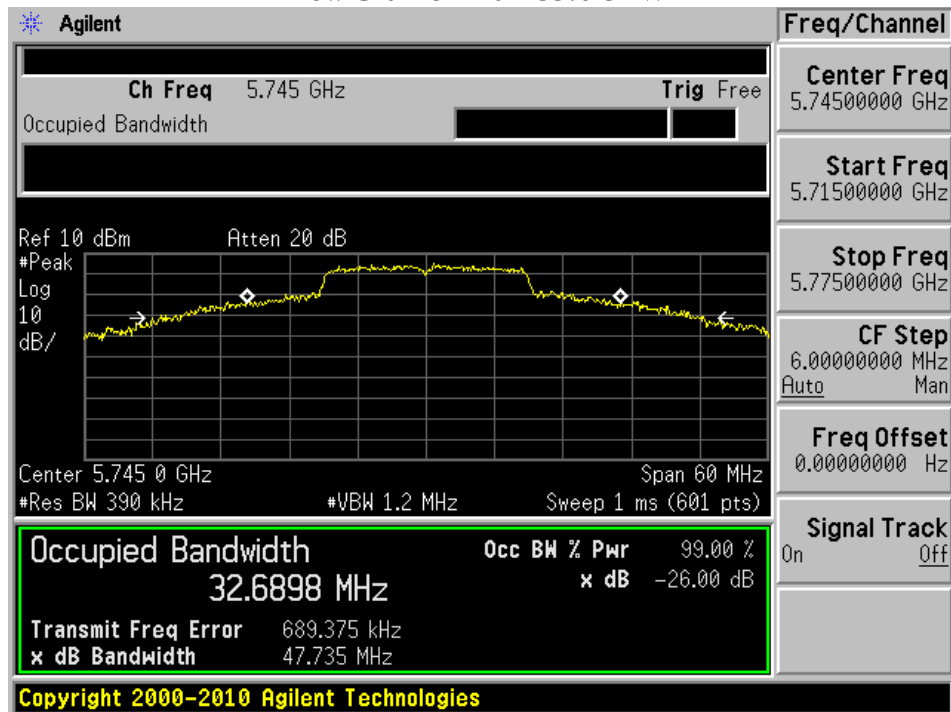


High Channel Ant B 99% OBW

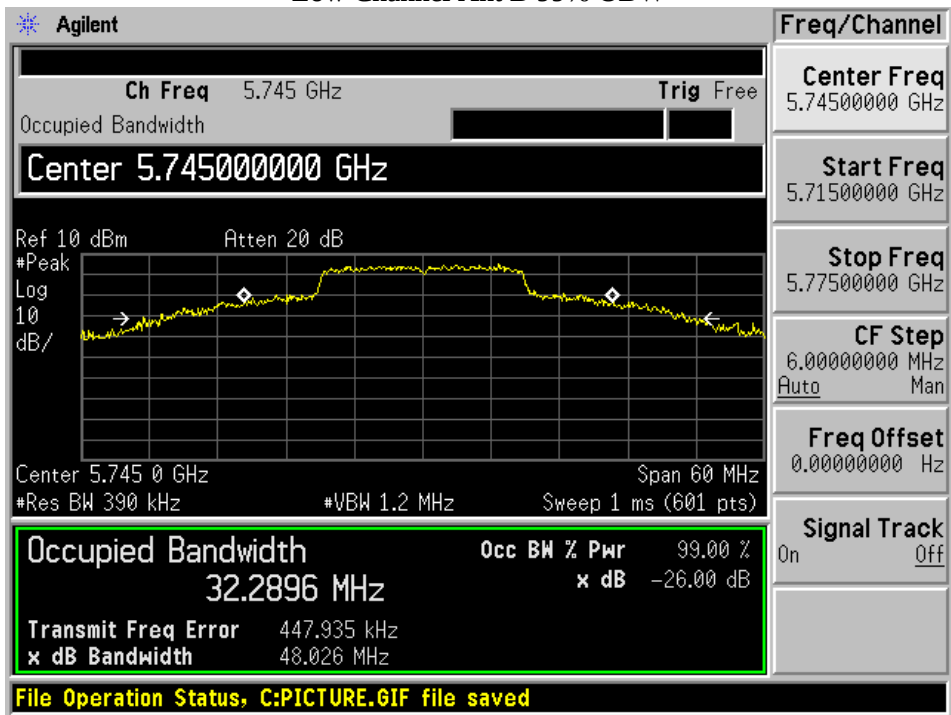


5725 - 5850 MHz 802.11n20

Low Channel Ant A 99% OBW



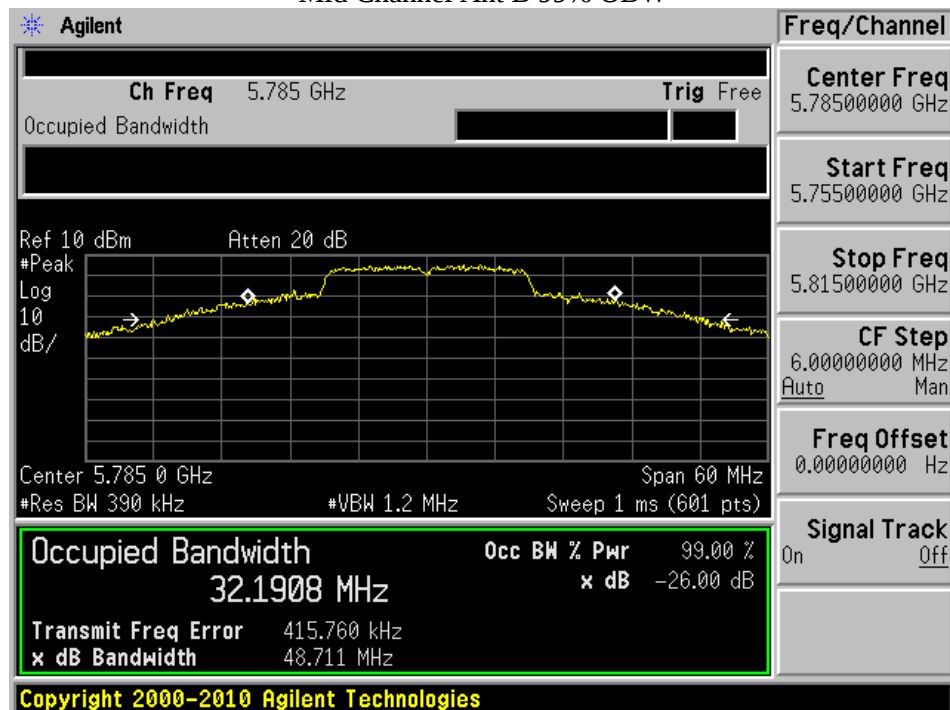
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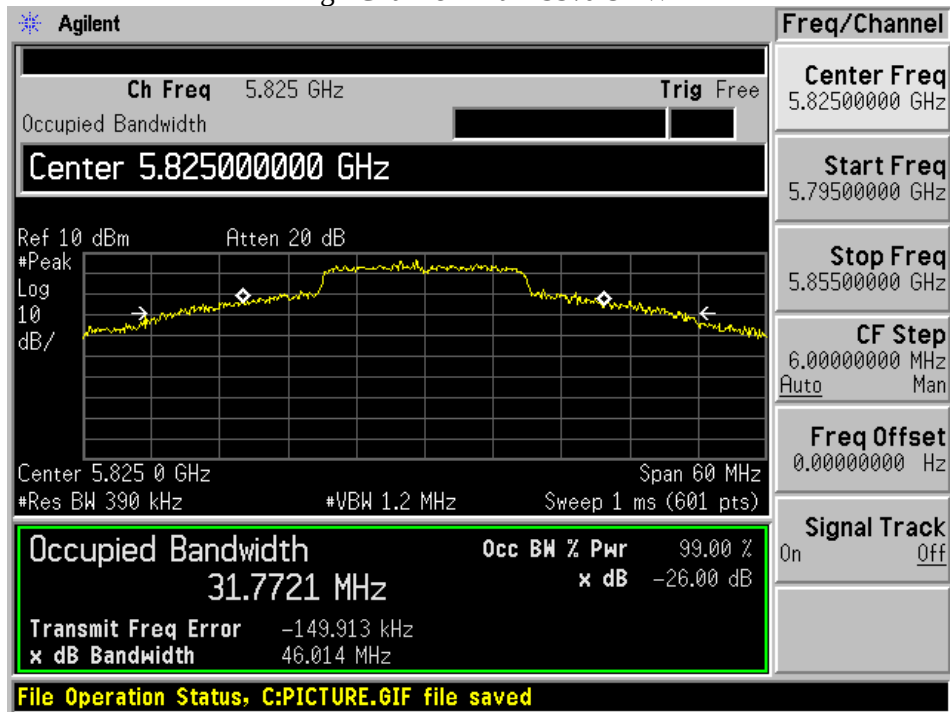
Mid Channel Ant A 99% OBW



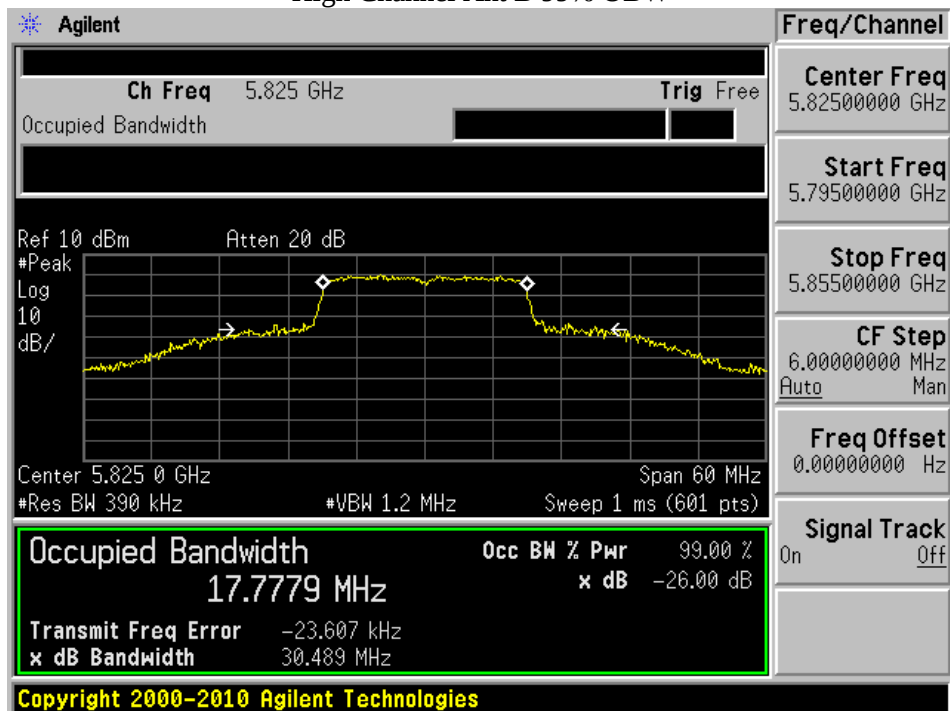
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High Channel Ant A 99% OBW



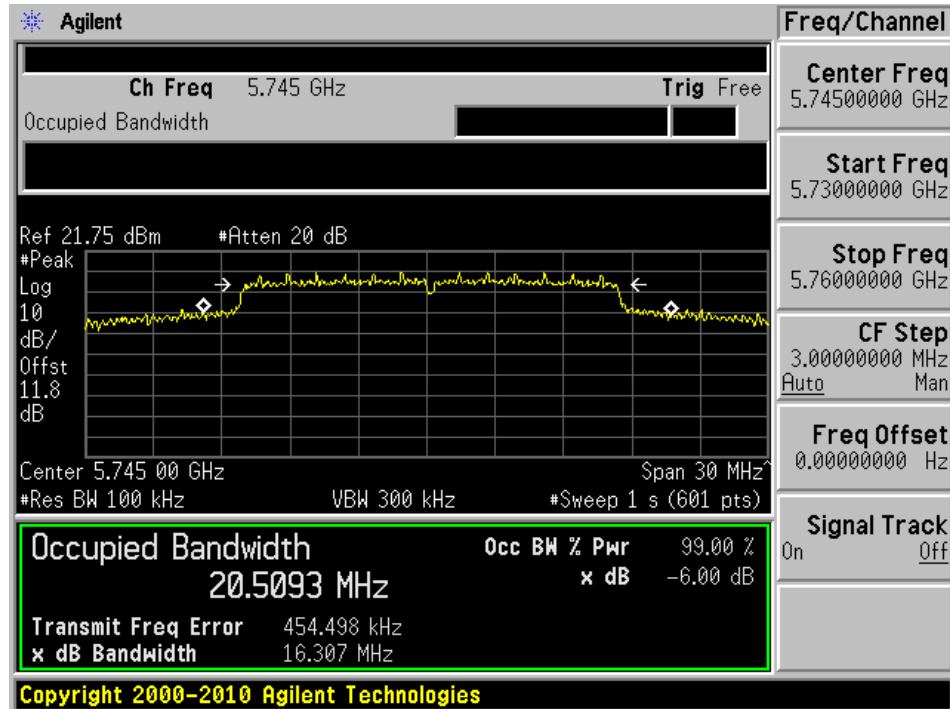
High Channel Ant B 99% OBW



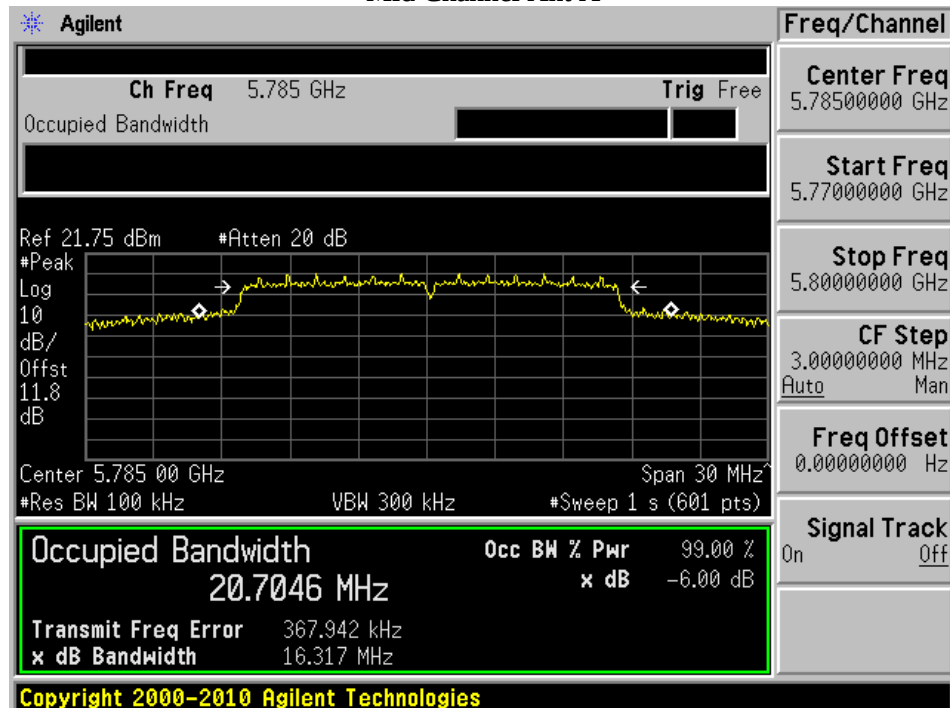
5 GHz 6 dB Occupied Band Width

5725 - 5850 MHz 802.11a

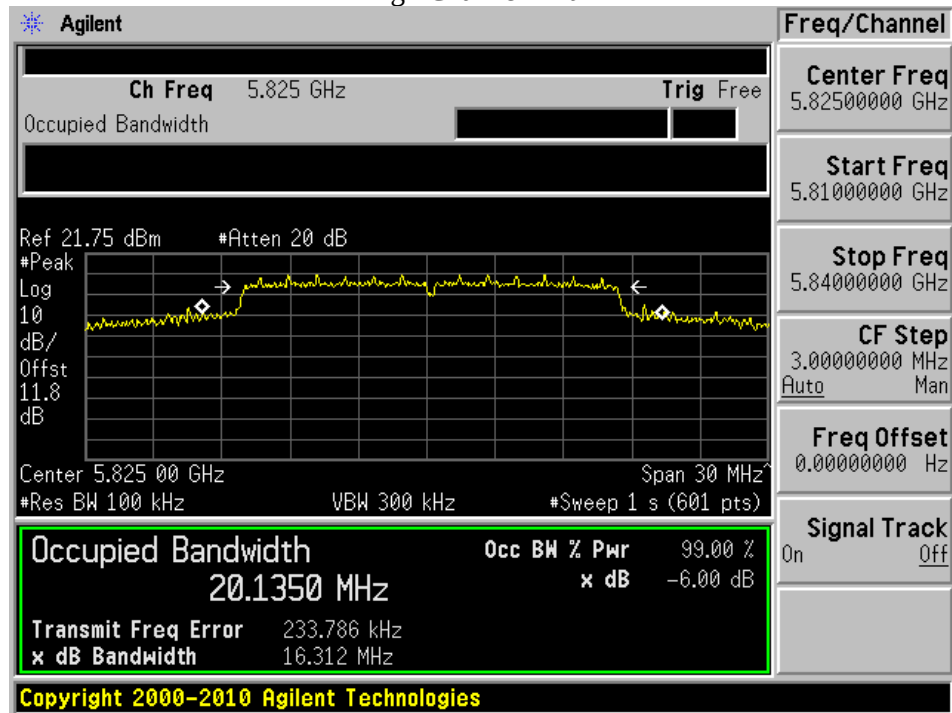
Low Channel Ant A



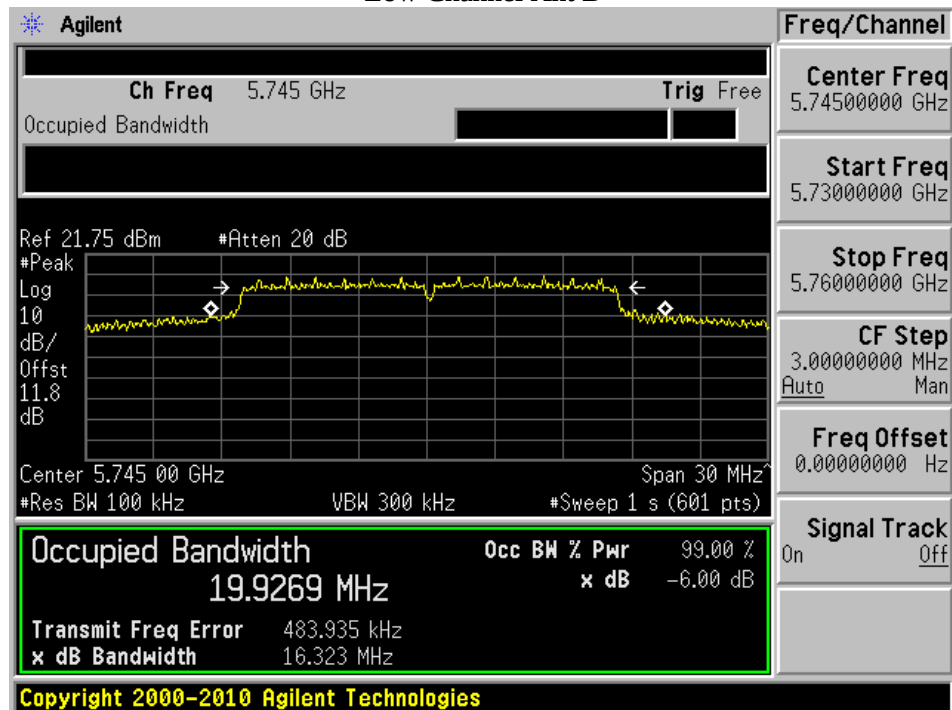
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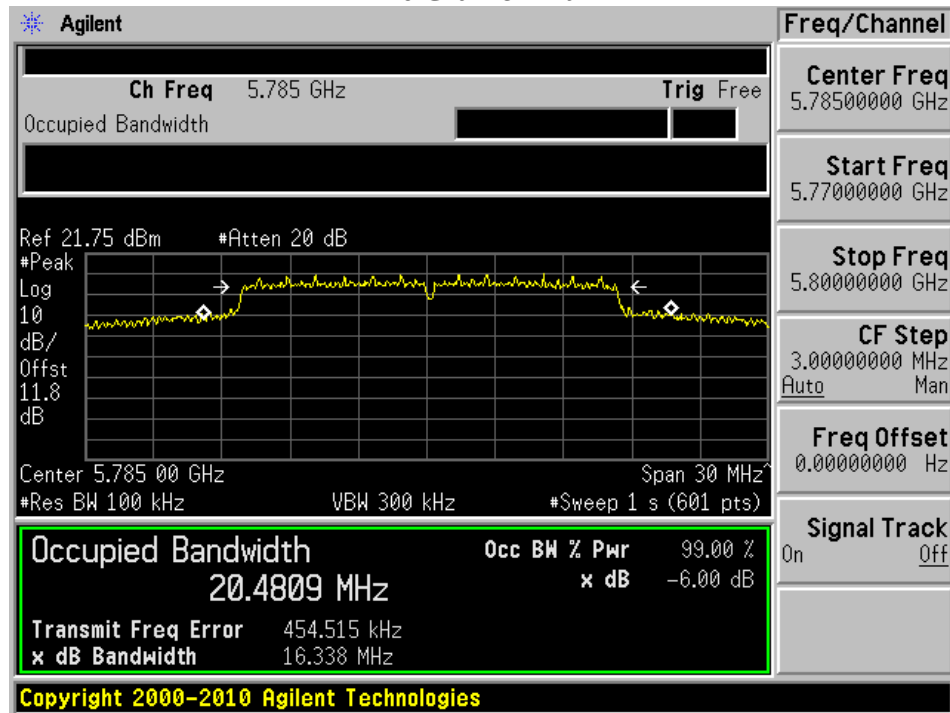
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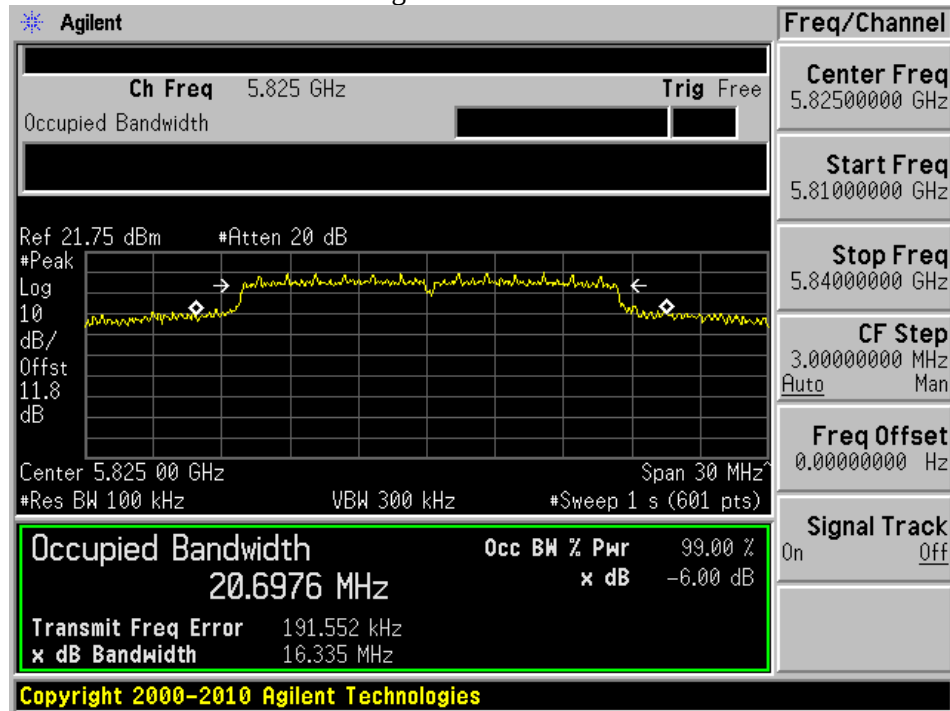
Low Channel Ant B



Mid Channel Ant B

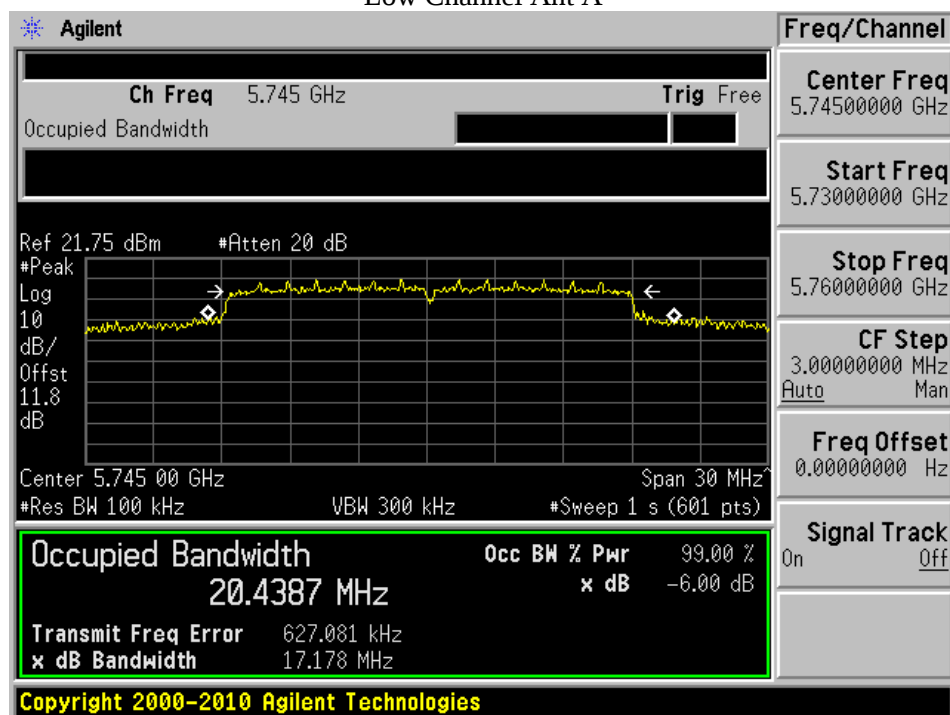


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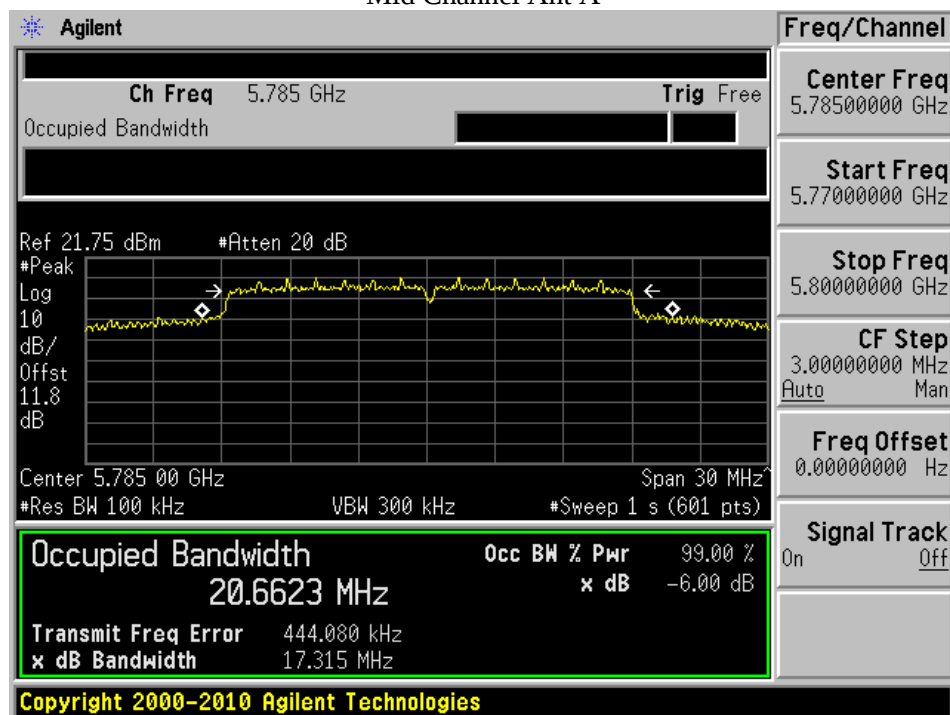


5725 - 5850 MHz 802.11n20

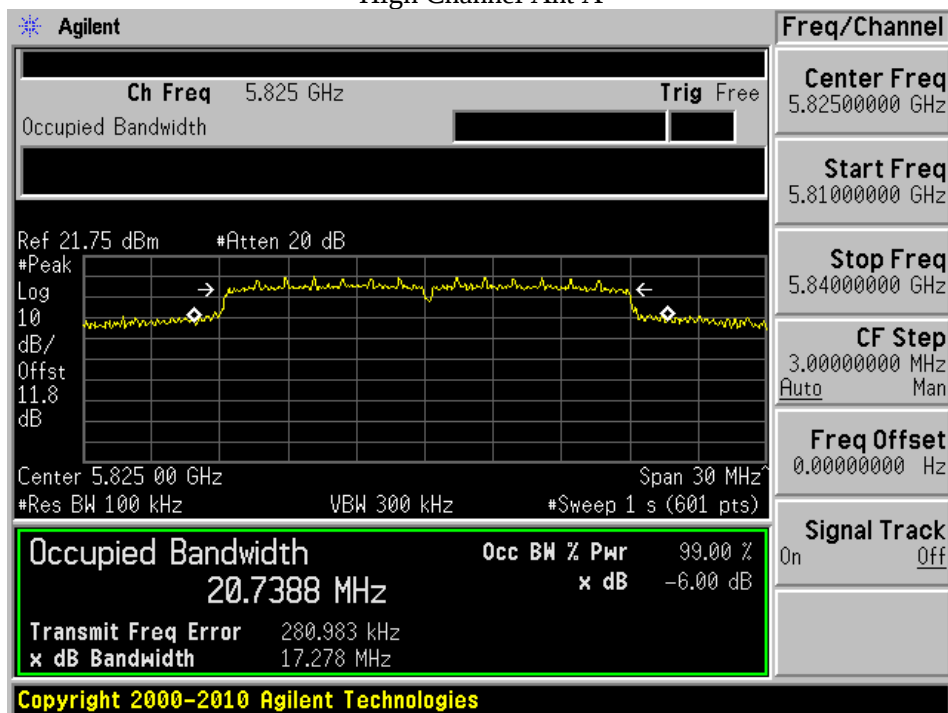
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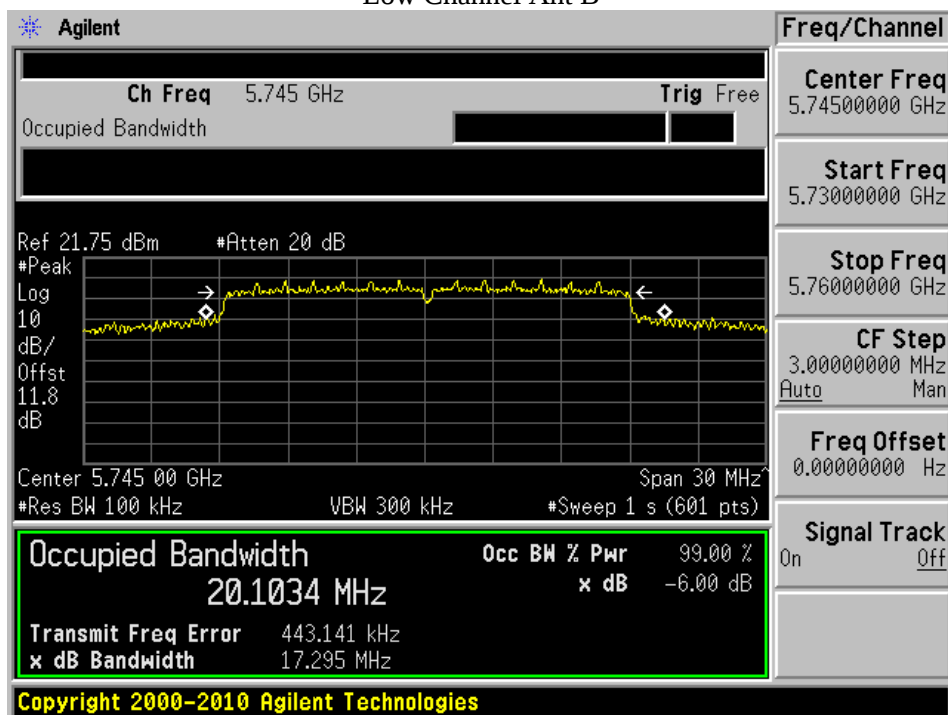
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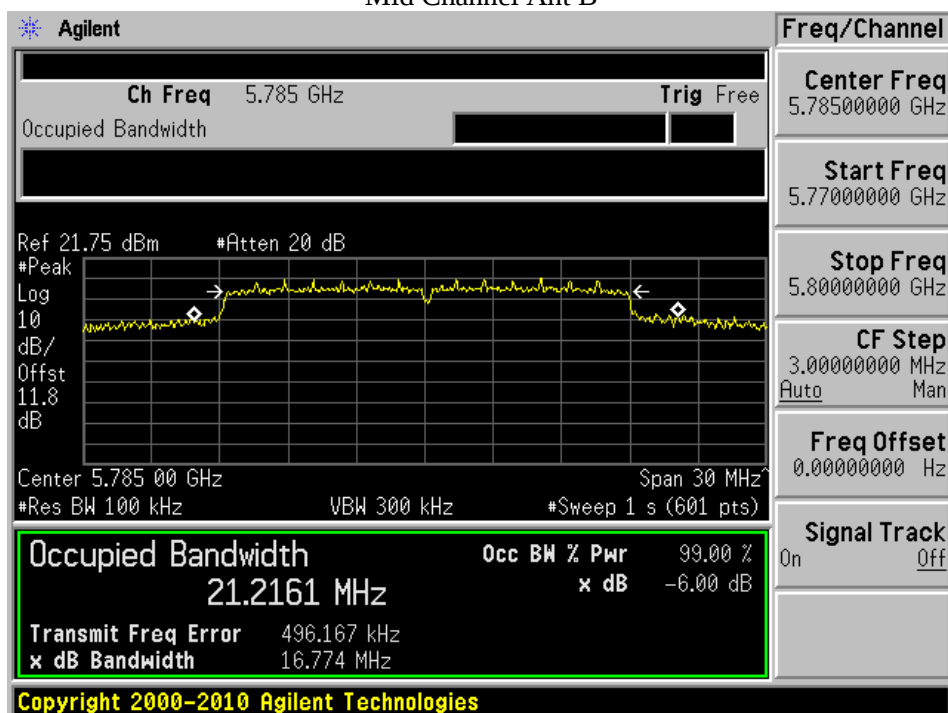
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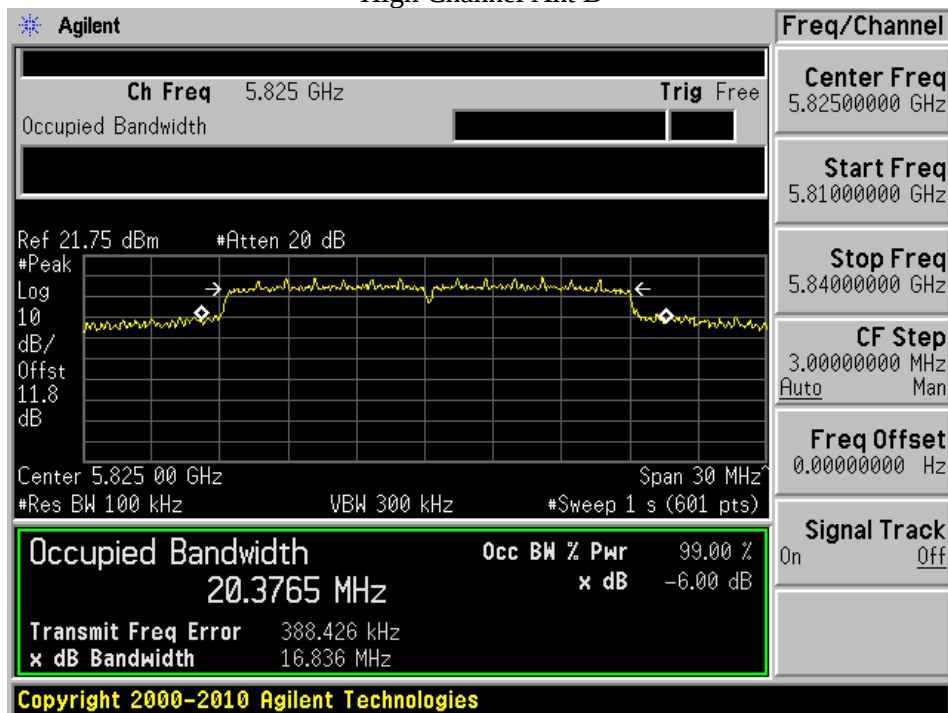
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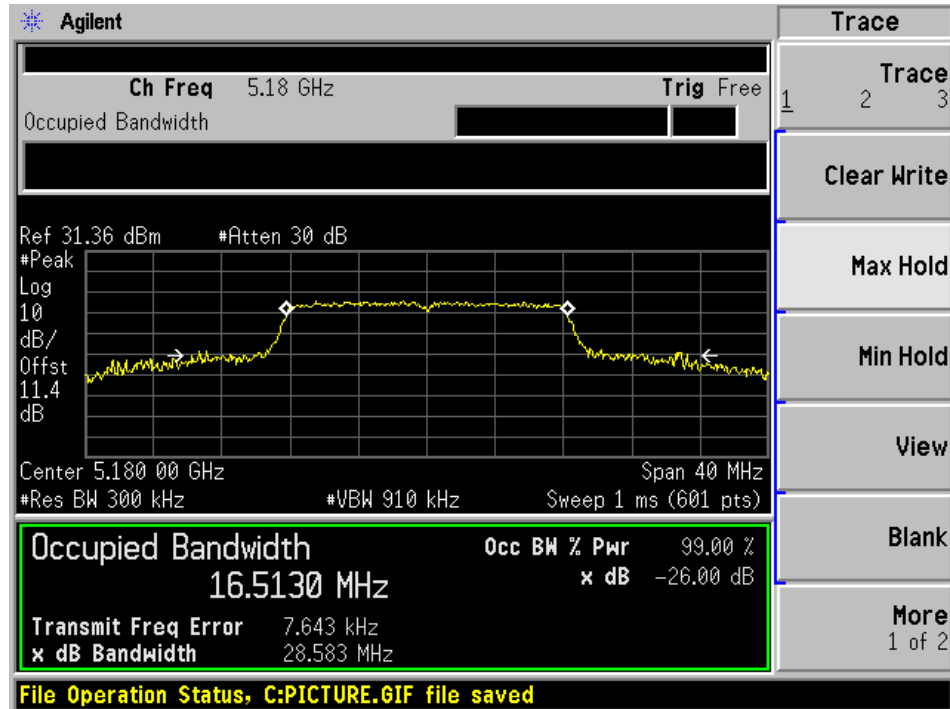
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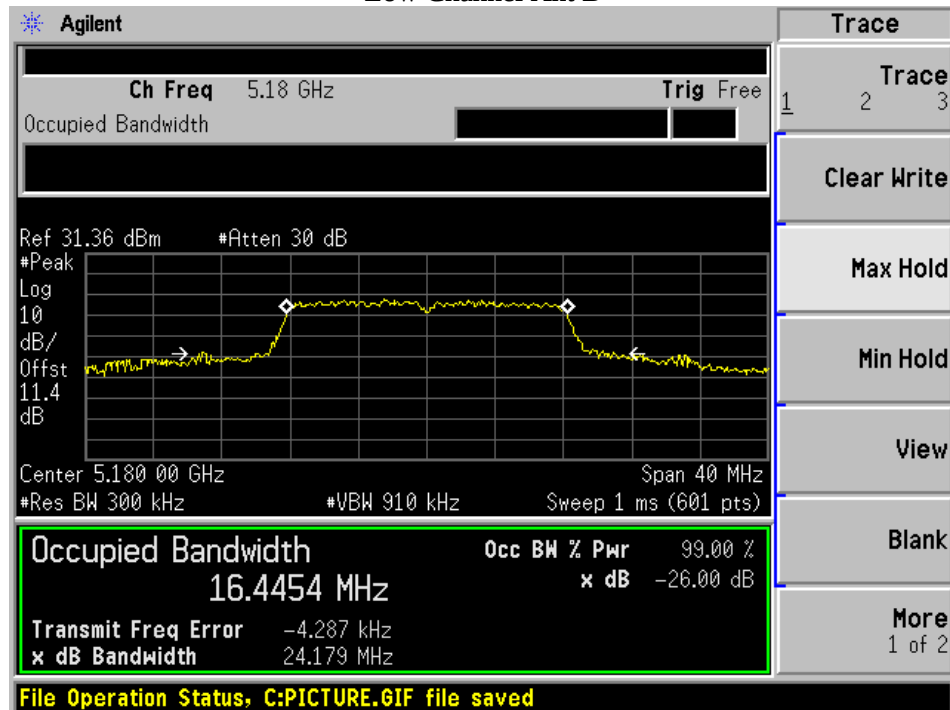
26 dB Occupied Band Width

5150 - 5250 MHz 802.11a

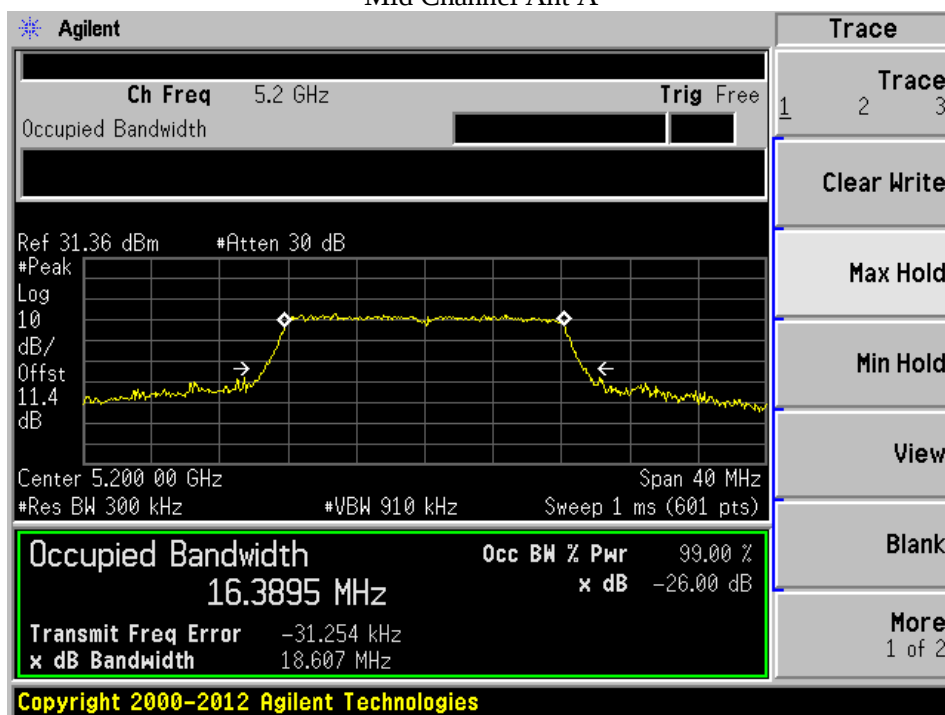
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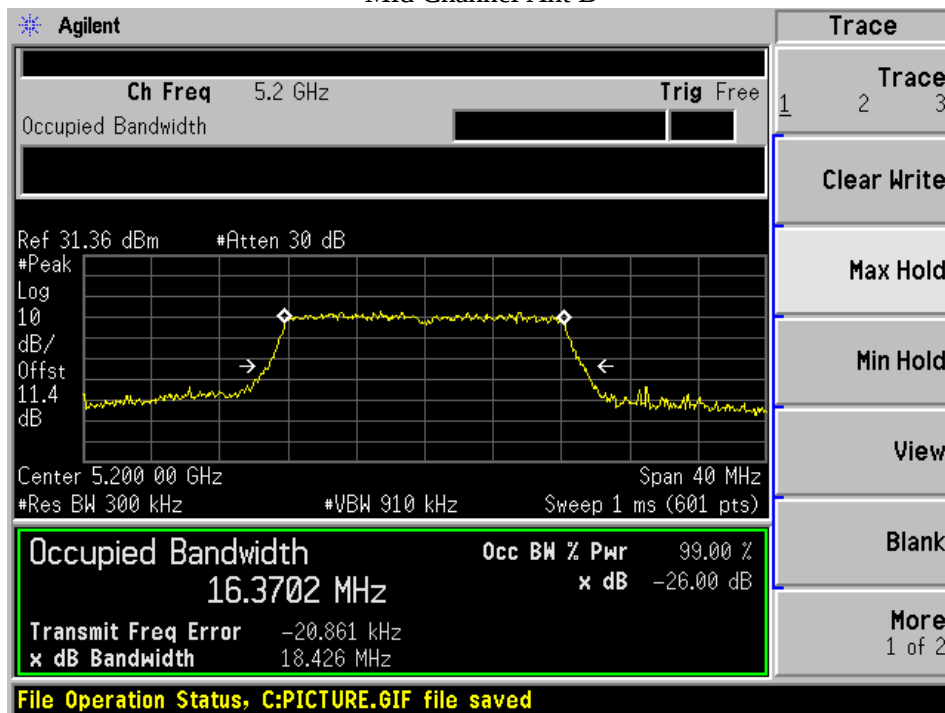
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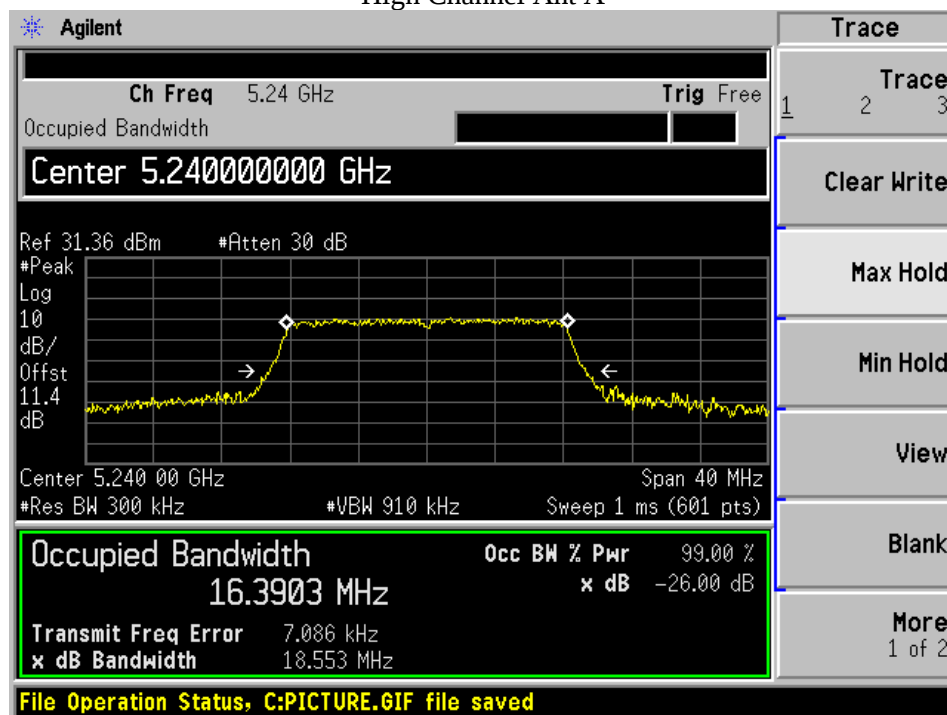
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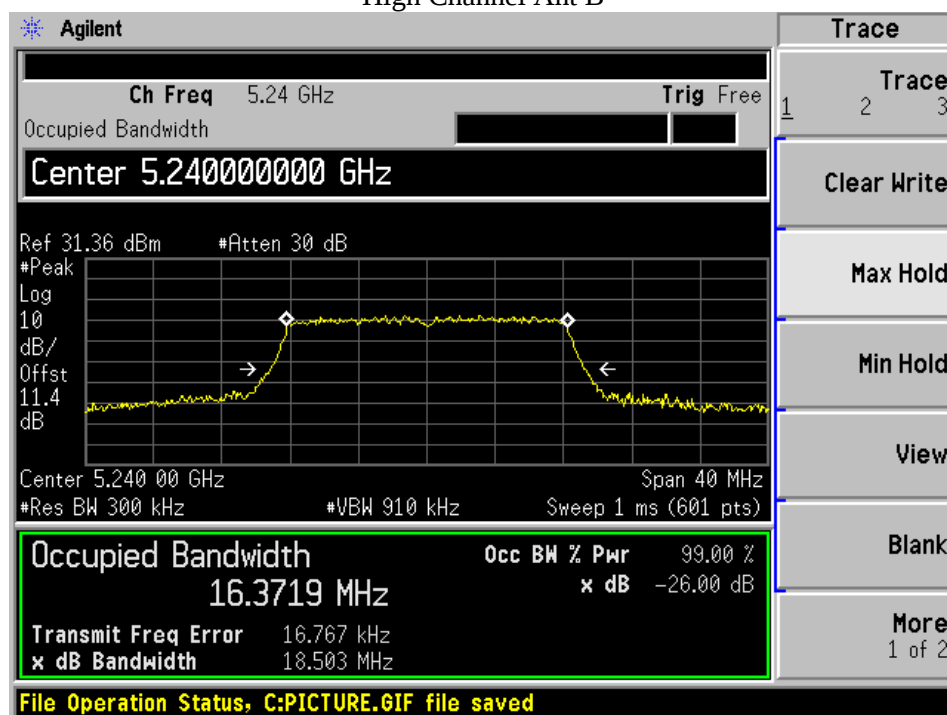
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High Channel Ant A

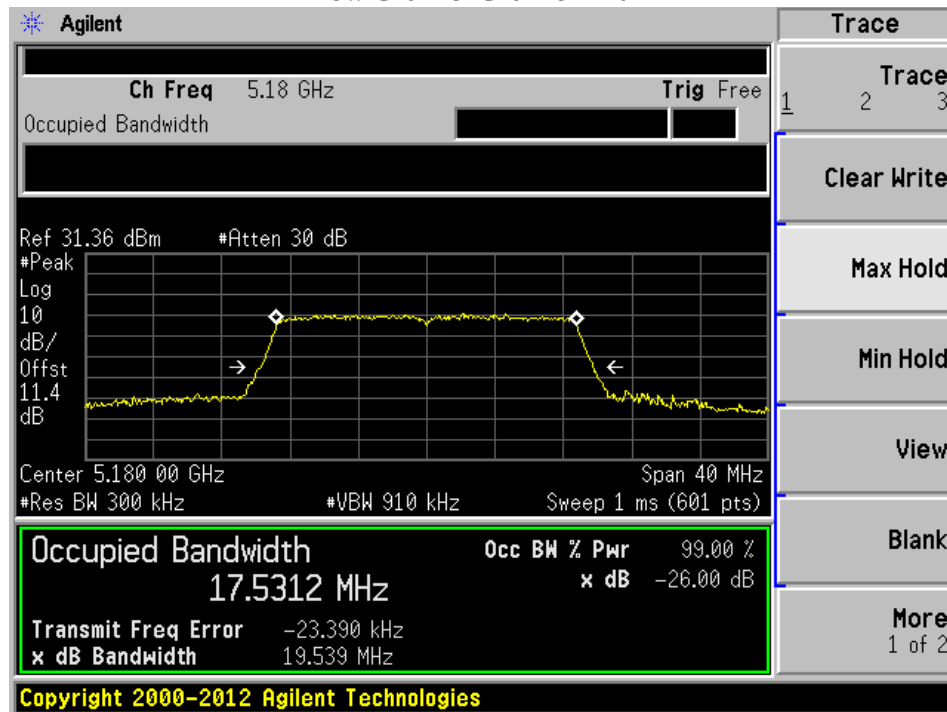


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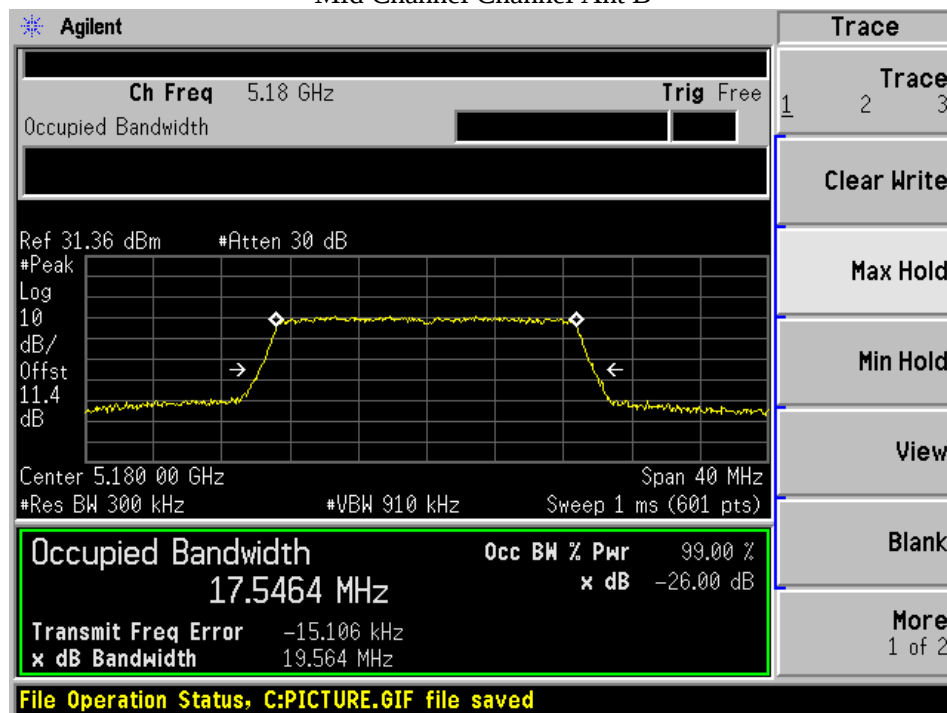


5150 - 5250 MHz 802.11n20

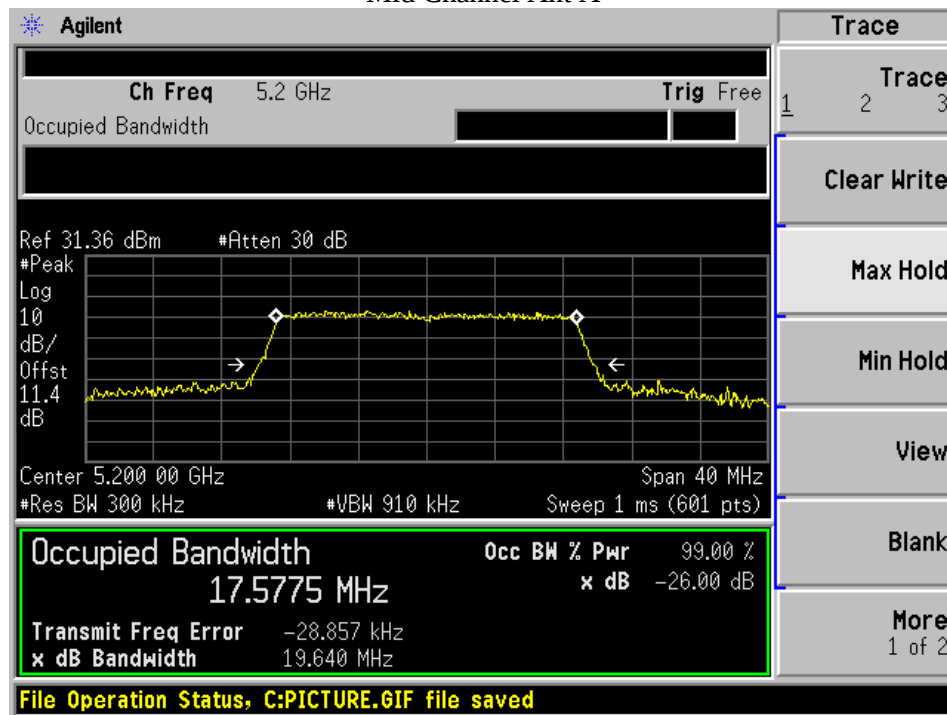
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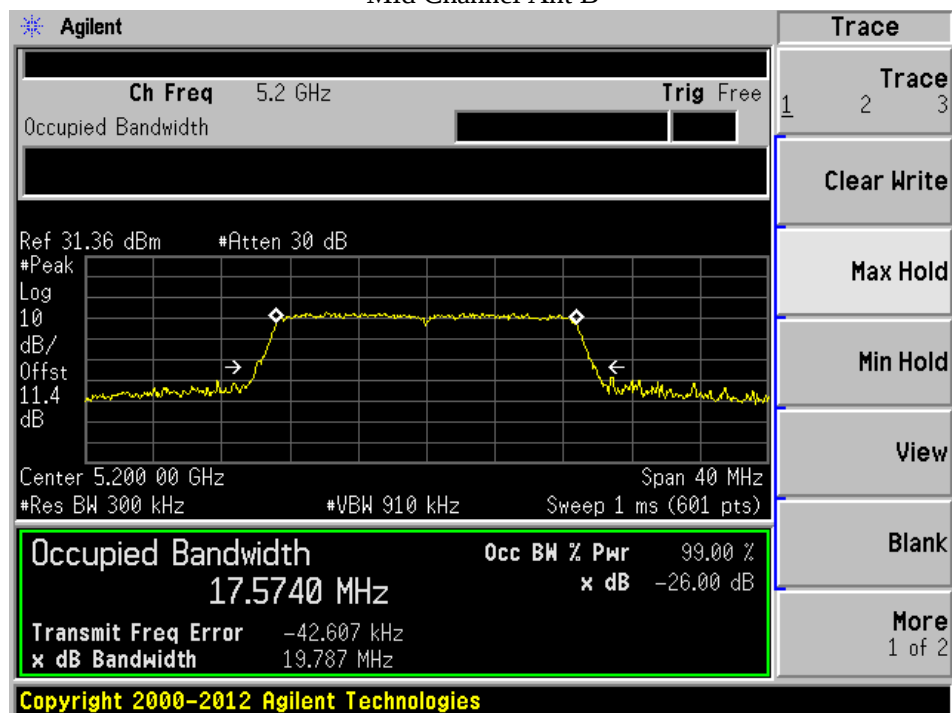
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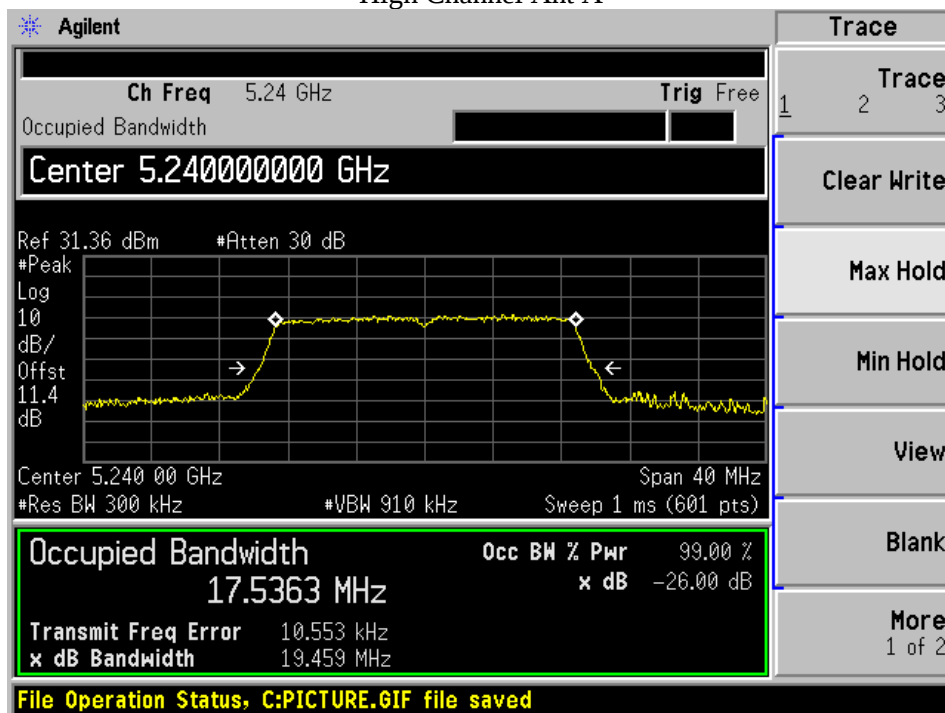
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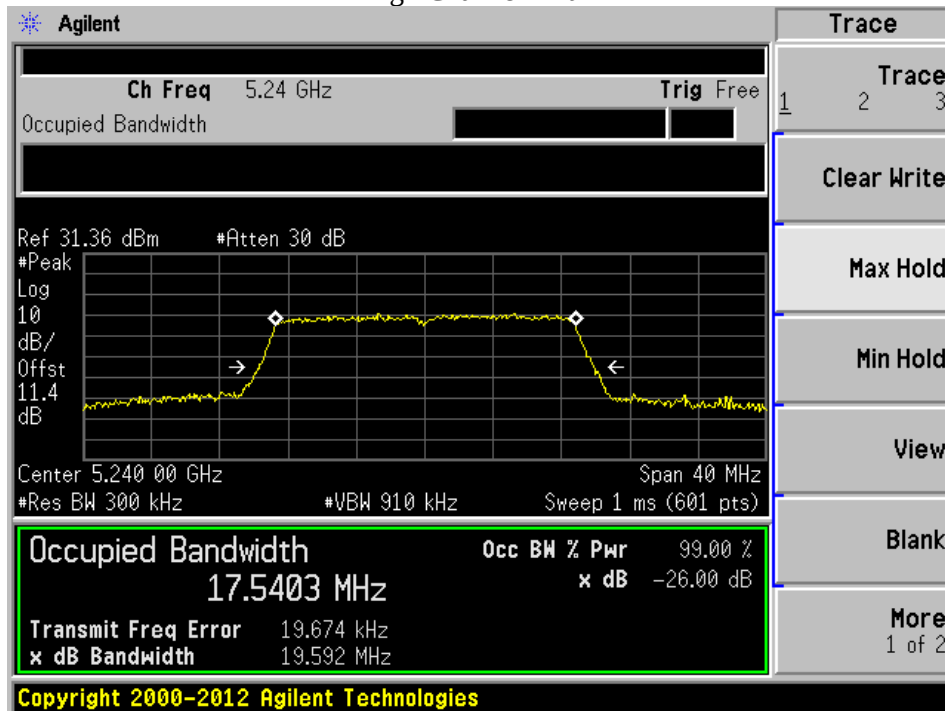
Mid Channel Ant B



High Channel Ant A



High Channel Ant B



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 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.

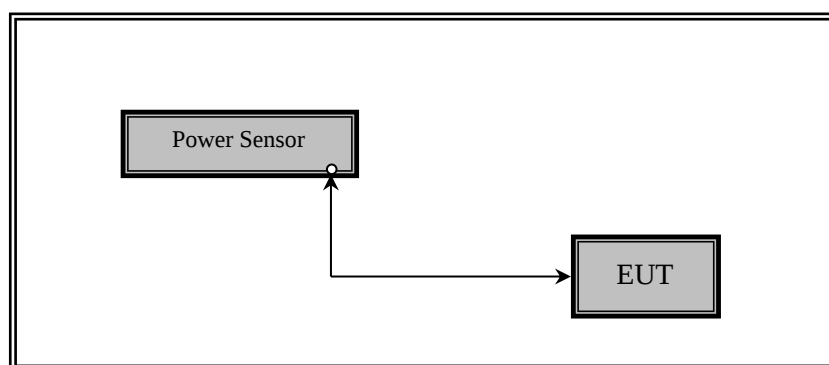
According to ISED RSS-247 §6.2.4 for frequency band 5725-5850 MHz:

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

Note¹: 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:	23° C
Relative Humidity:	55 %
ATM Pressure:	102.2 KPa

The testing was performed by Marc Jean from 2022-06-17 to 2022-06-23 in RF site.

9.6 Test Results

5150 - 5250 MHz

FCC Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)		Total Power (dBm)	FCC Limit (dBm)
		ANT A	ANT B		
802.11a mode					
36	5180	18.54	18.24	-	24
44	5200	18.61	18.28	-	24
48	5240	18.89	18.9	-	24
802.11n/ac20 mode					
36	5180	12.33	12.38	15.37	24
44	5200	12.51	12.59	15.56	24
48	5240	12.46	12.73	15.61	24

IC Results

Channel	Frequency (MHz)	EIRP (dBm)		IC Limit (dBm)
		ANT A	ANT B	
802.11a mode				
36	5180	21.1	20.71	22
44	5200	21.17	20.75	22
48	5240	21.45	21.37	22

Channel	Frequency (MHz)	Conducted Output Power (dBm)		Total EIRP (dBm)	IC Limit (dBm)
		ANT A	ANT B		
802.11n/ac20 mode					
36	5180	12.33	12.38	20.90	22
44	5200	12.51	12.59	21.09	22
48	5240	12.46	12.73	21.14	22

Note: Total EIRP (dBm) = $10 \cdot \log(\text{Ant A(mw)} + \text{Ant B(mw)}) + \text{Directional Antenna Gain (dBi)}$

Note: Directional antenna gain (dBi) = 5.53 dBi. Calculated based on method specified in KDB 662911 D01. Individual antenna gain was provided by customer.

Note: IC limit is determined by formula: $10 + 10 \log_{10} B$, 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.

FCC/IC Results**5725 - 5850 MHz**

Channel	Frequency (MHz)	Conducted Output Power (dBm)		Total Power (dBm)	FCC/IC Limit (dBm)
		ANT A	ANT B		
802.11a mode					
149	5745	21.45	20.73	-	30
157	5785	22.04	21.8	-	30
165	5825	21.68	21.75	-	30
802.11n/ac20 mode					
149	5745	21.92	21.56	24.75	30
157	5785	21.58	21.45	24.53	30
165	5825	21.83	21.68	24.77	30

Note: Total power (dBm) = $10 \cdot \log(\text{Ant A(mw)} + \text{Ant B(mw)})$

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

FCC §15.407(a) & ISEDC RSS-247 §6.2 - Power Spectral Density

9.7 Applicable Standards

According to FCC §15.407(a):

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

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 $11 \text{ dBm} + 10 \log B$, 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.

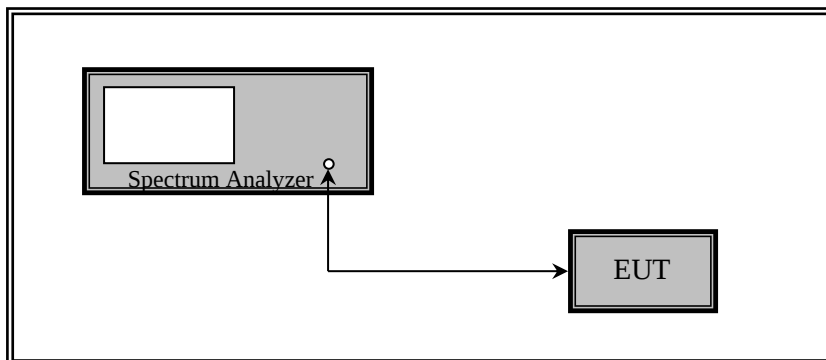
According to ISEDC RSS-247 §6.2.4 for frequency band 5725-5850 MHz:

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.

9.8 Measurement Procedure

- (i) Set span to encompass the entire emission bandwidth (EBW) of the signal.
- (ii) Set RBW = 1 MHz.
- (iii) Set VBW $\geq$ 3 MHz.
- (iv) Number of points in sweep $\geq$ 2 Span / RBW. (This ensures that bin-to-bin spacing is $\leq$ 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 $\geq$ 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.

9.9 Test Setup Block Diagram



9.10 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

Note¹: 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".*

9.11 Test Environmental Conditions

Temperature:	22-24 °C
Relative Humidity:	50-55 %
ATM Pressure:	102.1-102.7 kPa

The testing was performed by Marc Jean from 2022-06-17 to 2022-06-23 in RF site.

9.12 Test Results

5150 - 5250 MHz**FCC:**

Channel	Frequency (MHz)	PSD (dBm/MHz)		Total PSD (dBm/MHz)	FCC Limit (dBm/MHz)
		ANT A	ANT B		
802.11a mode					
36	5180	6.585	6.297	-	17
44	5200	7.127	6.270	-	
48	5240	6.902	6.508	-	
802.11n/ac20 mode					
36	5180	-1.03	-0.19	1.75	17
44	5200	0.771	0.611	2.35	
48	5240	1.006	0.812	2.47	

IC:

Channel	Frequency (MHz)	EIRP PSD (dBm/MHz)		Total EIRP PSD (dBm/MHz)	IC Limit (dBm/MHz)
		ANT A	ANT B		
802.11a mode					
36	5180	9.145	8.767	-	10
44	5200	9.687	8.74	-	
48	5240	9.462	8.978	-	
802.11n/ac20 mode					
36	5180	1.53	2.28	7.95	10
44	5200	3.331	3.081	9.23	
48	5240	3.566	3.282	9.45	

Note: Total EIRP PSD (dBm) = 10 * Log (Ant A(mw) + Ant B(mw)) + Directional Antenna Gain (dBi)

Note: Directional antenna gain (dBi) = 5.53 dBi. Calculated based on method specified in KDB 662911 D01. Individual antenna gain was provided by customer.

FCC/IC:

5725 - 5850 MHz

Channel	Frequency (MHz)	PSD (dBm/500kHz)		Total PSD (dBm/MHz)	FCC/IC Limit (dBm/MHz)
		ANT A	ANT B		
802.11a mode					
36	5180	8.296	7.705	-	
44	5200	8.715	8.354	-	
48	5240	8.379	8.112	-	
802.11n/ac20 mode					
36	5180	7.939	7.361	10.67	30
44	5200	8.491	8.261	11.39	
48	5240	8.161	7.895	11.04	

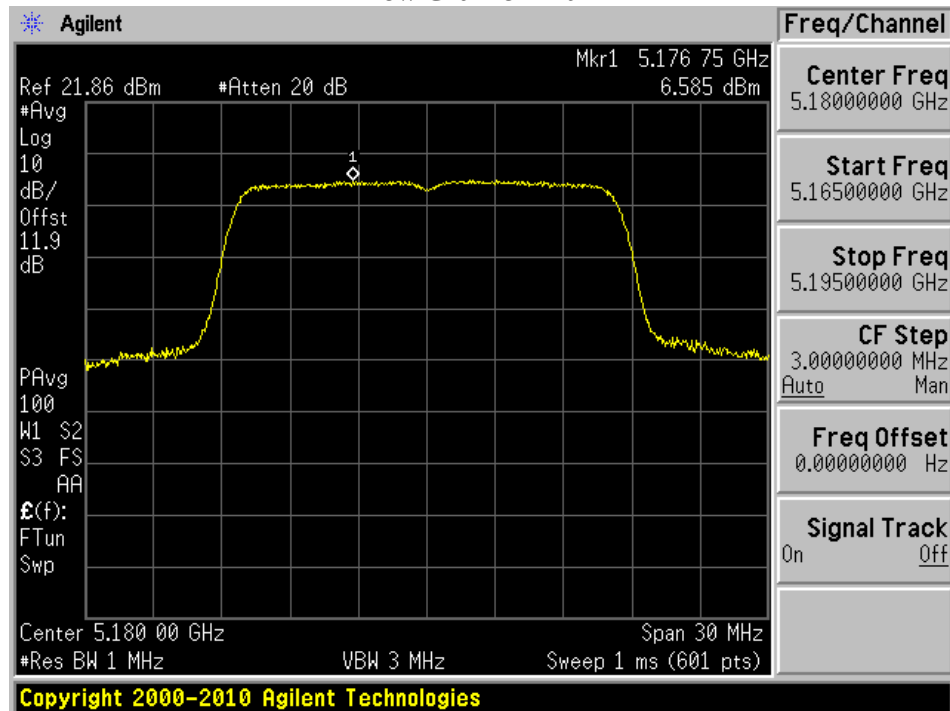
Note: PSD (dBm/500 kHz) = PSD (dBm/100 kHz) + 10*log(500 kHz/100 kHz)

Note: Total power (dBm) = 10*Log(Ant A(mw)+Ant B(mw))

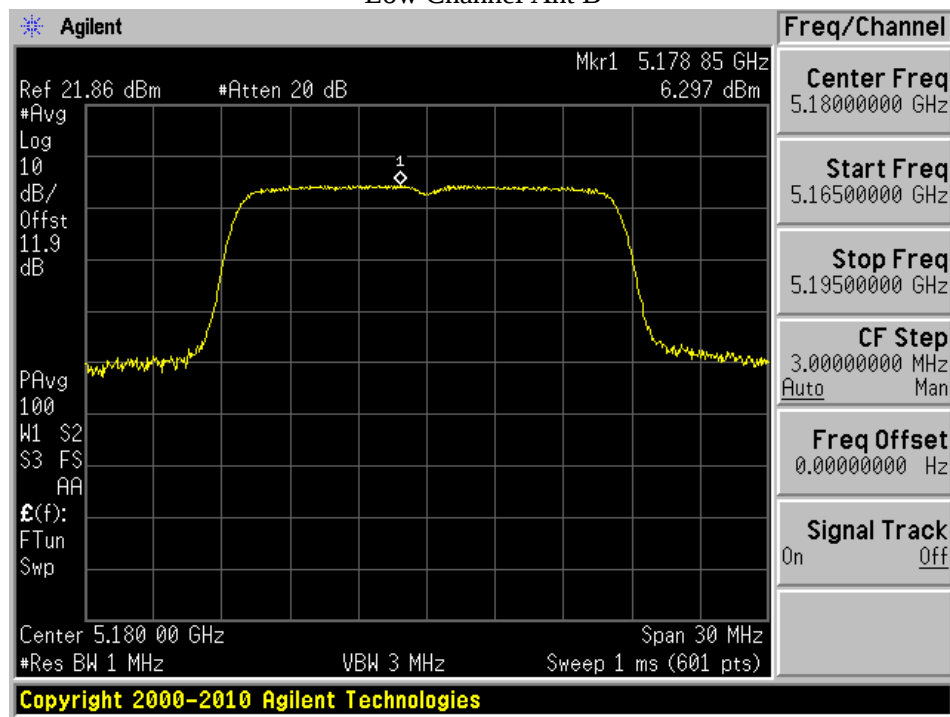
Note: Duty cycle correction factor has already been added to the measurements

5150 - 5250 MHz 802.11a

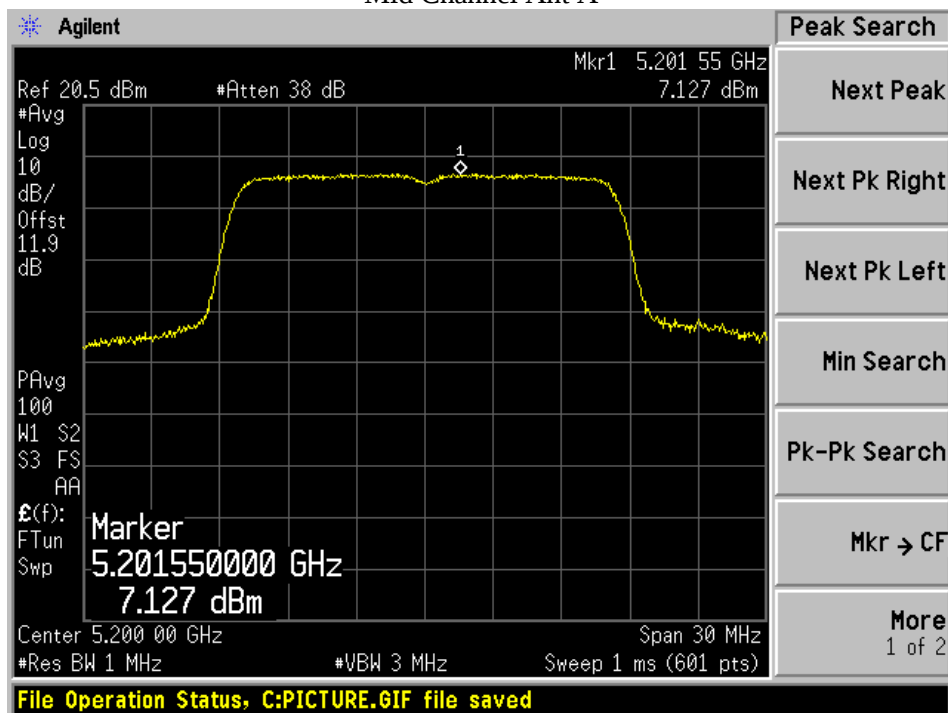
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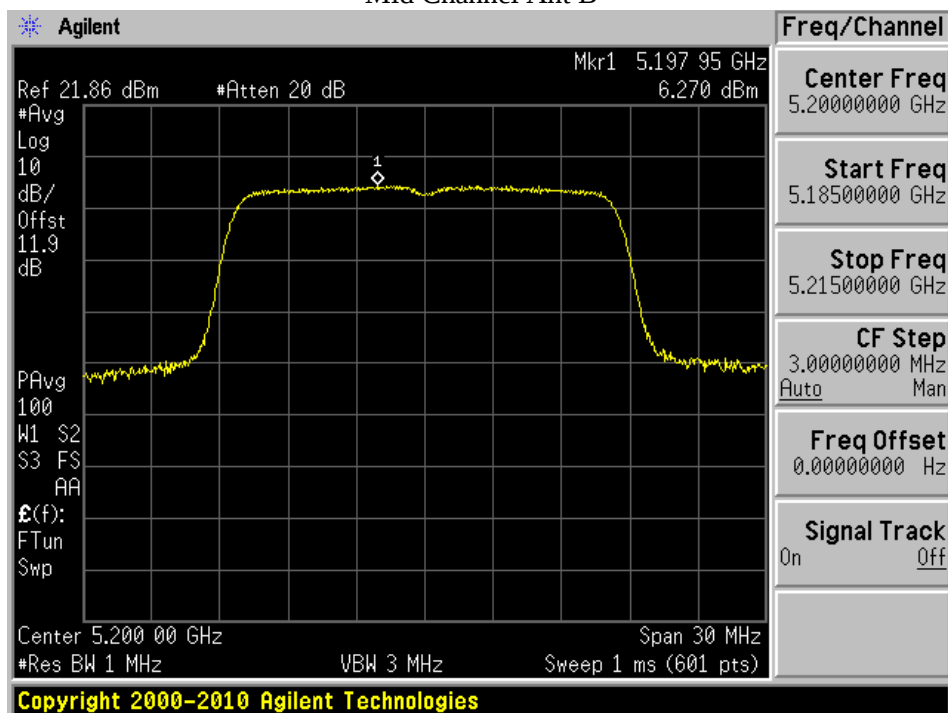
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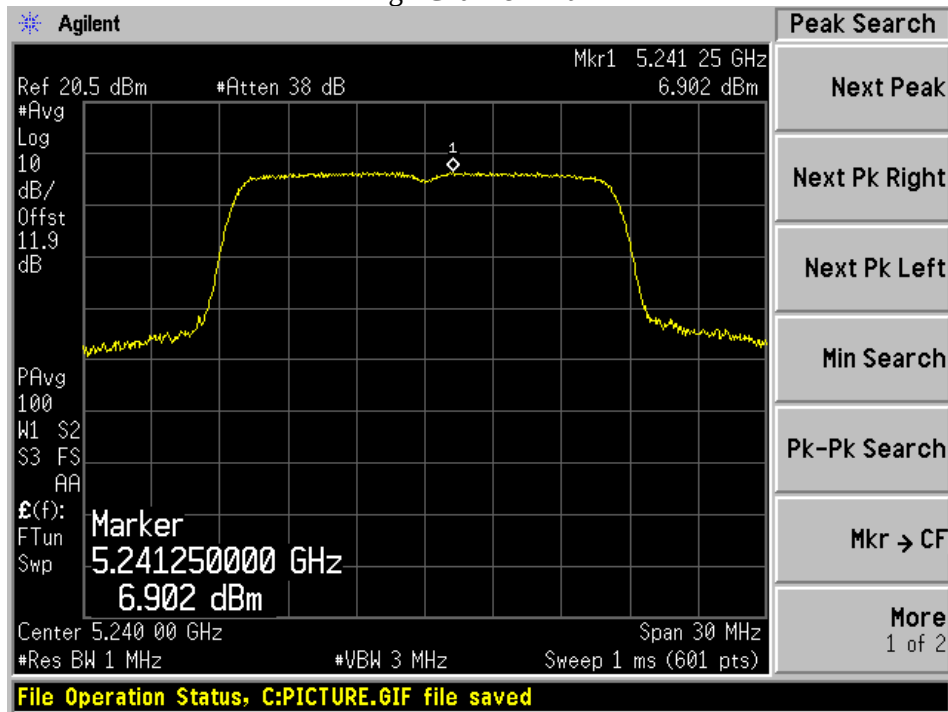
Mid Channel Ant A



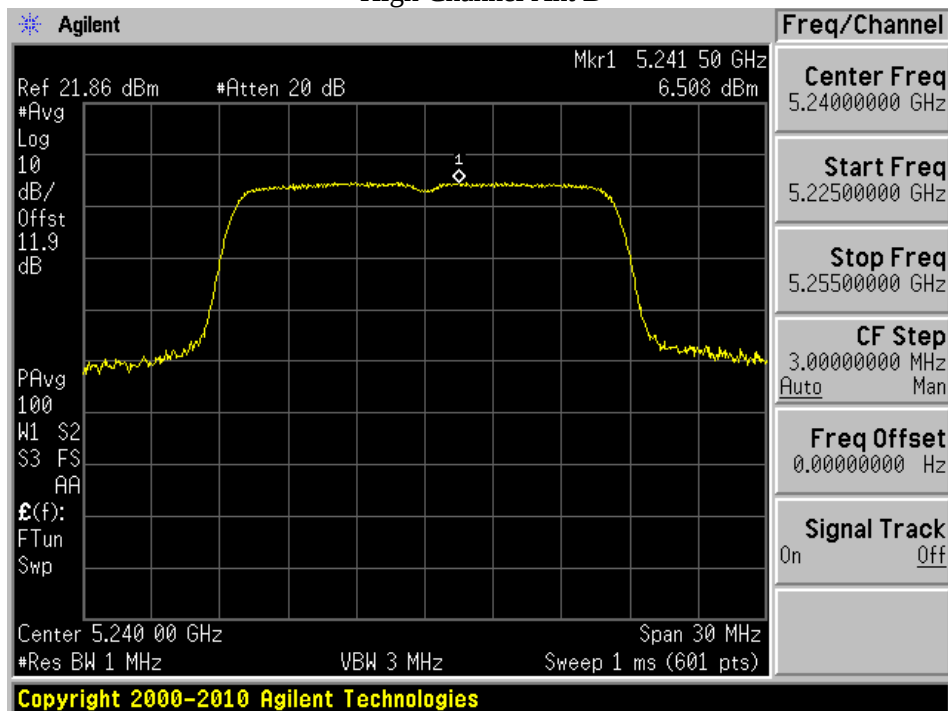
Mid Channel Ant B



High Channel Ant A

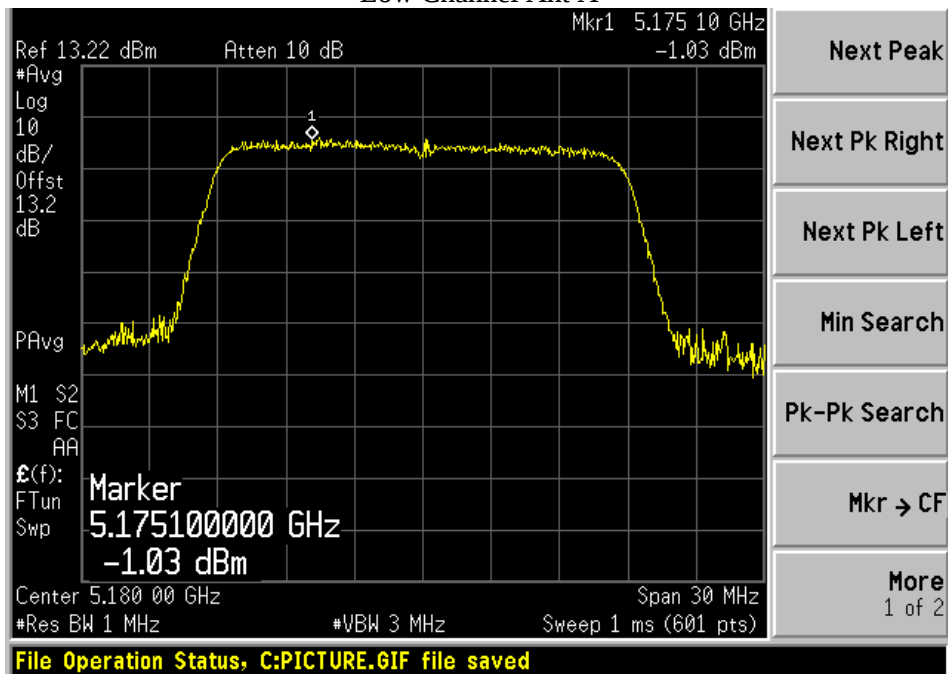


High Channel Ant B

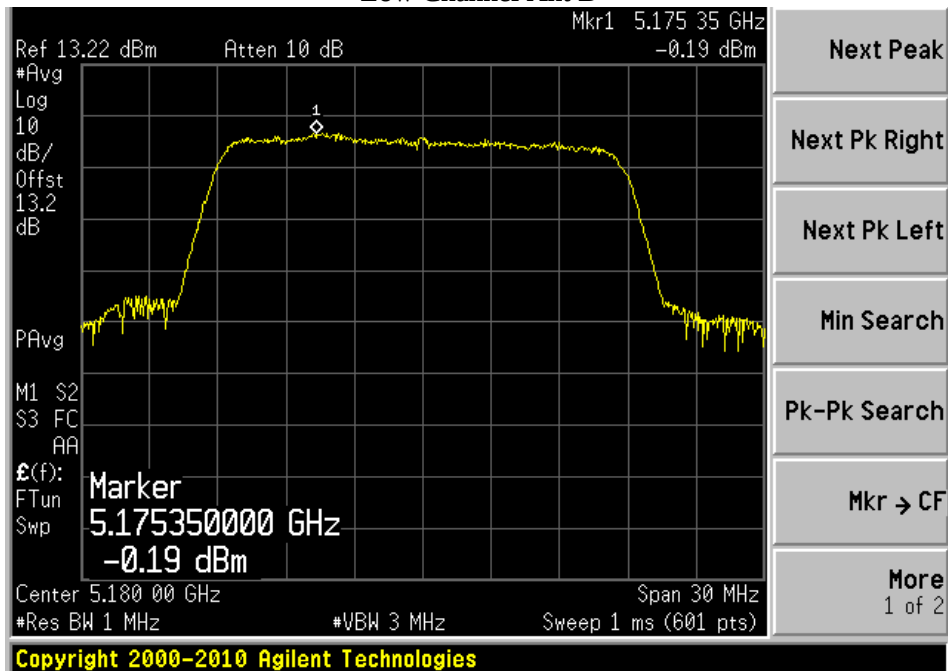


5150 - 5250 MHz 802.11n20

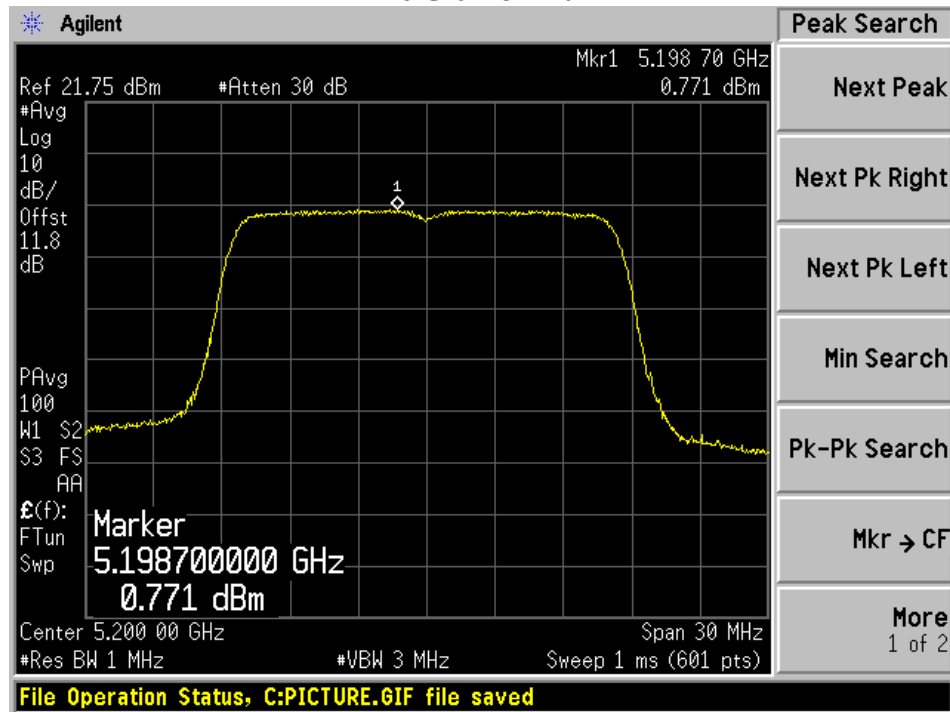
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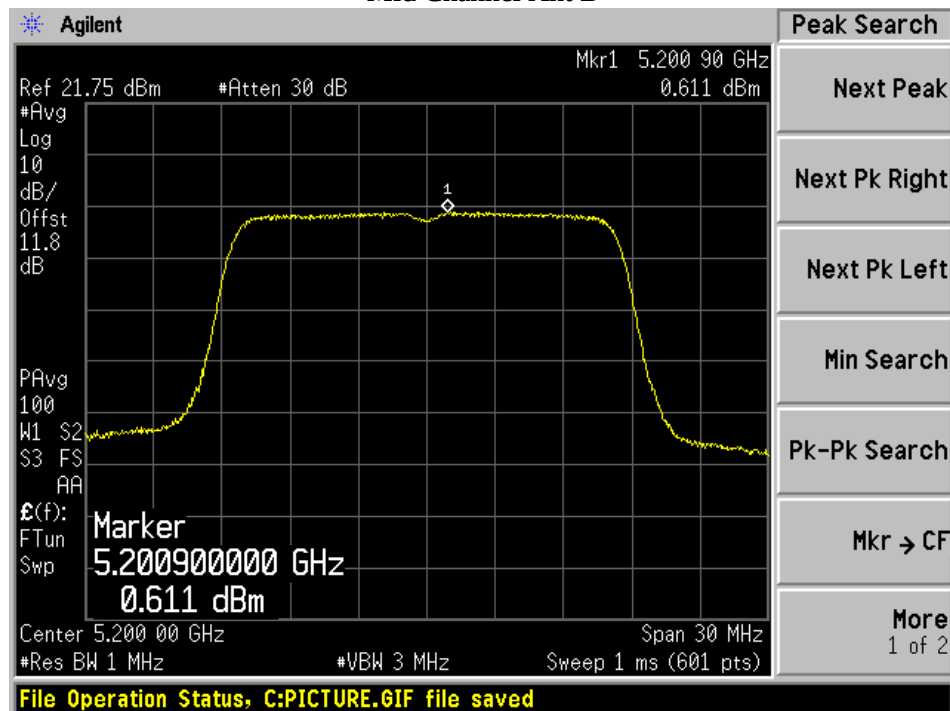
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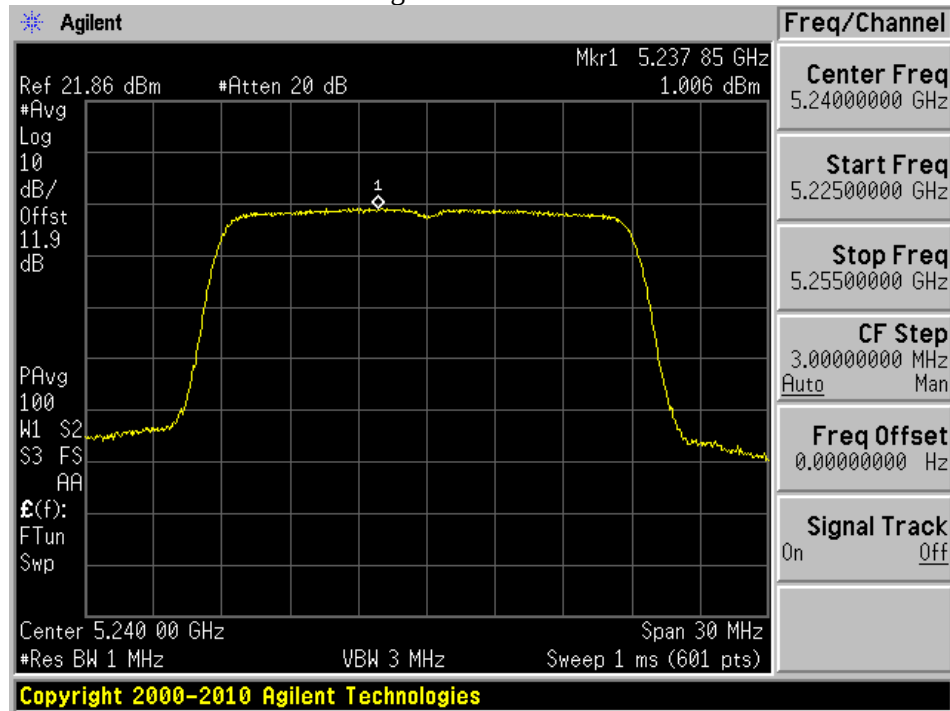
Mid Channel Ant A



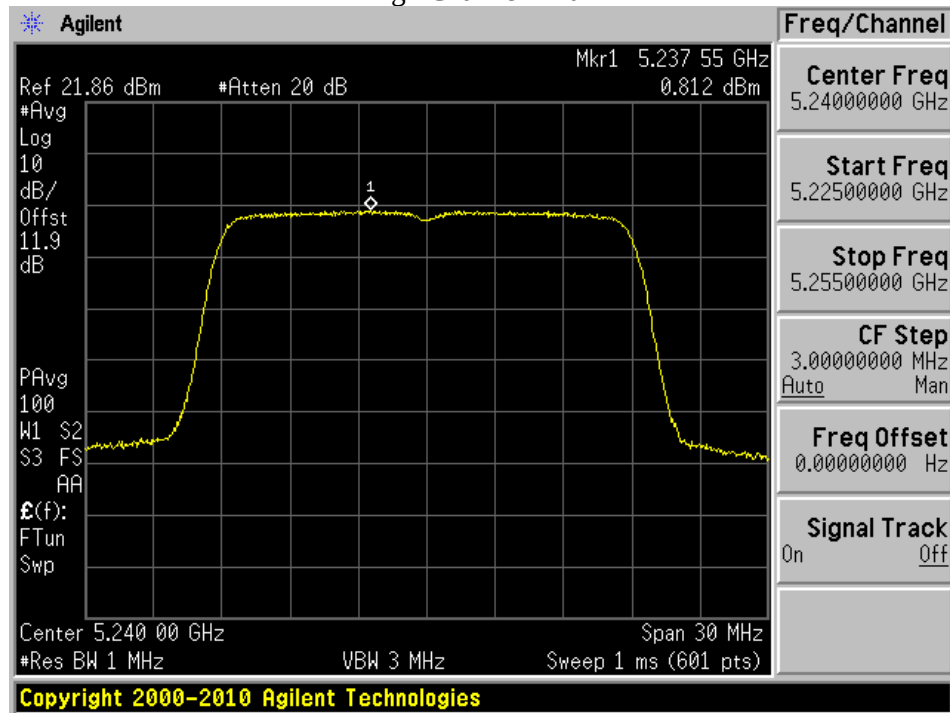
Mid Channel Ant B



High Channel Ant A

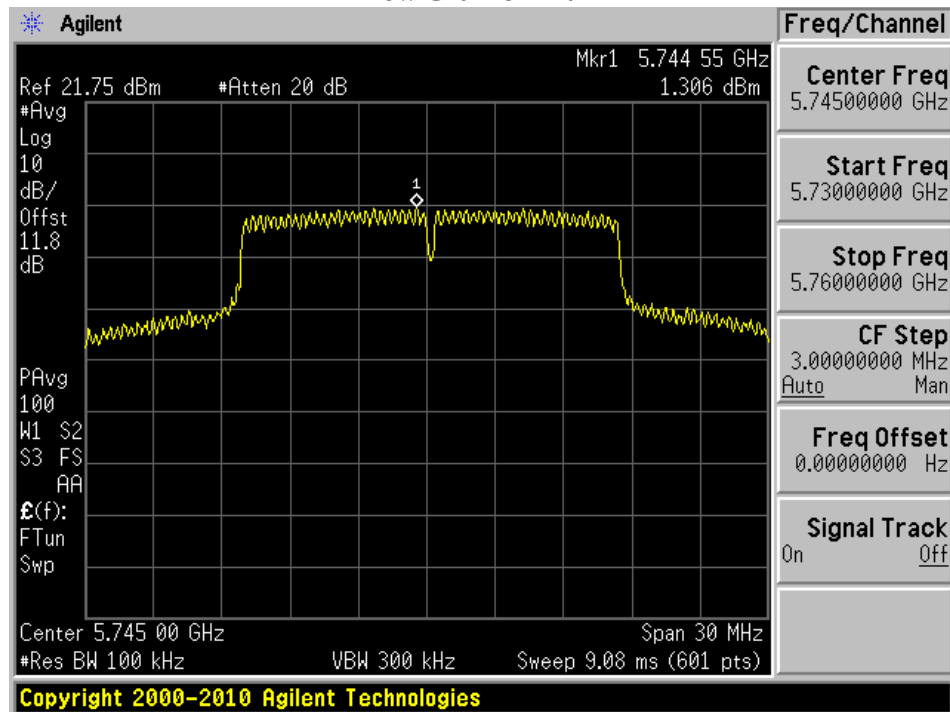


High Channel Ant B

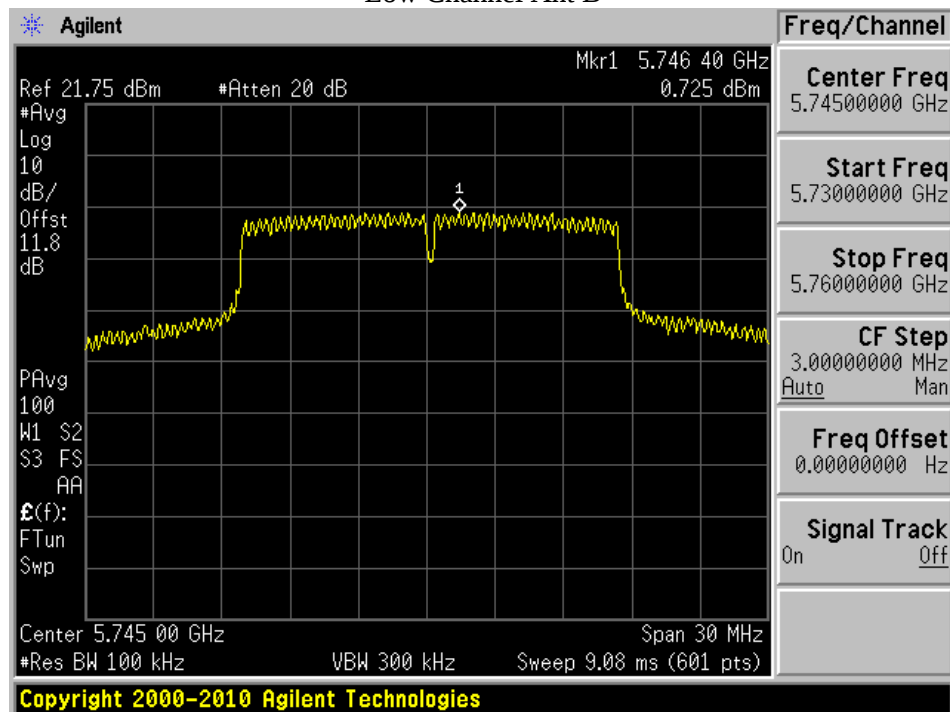


5725 - 5850 MHz 802.11a

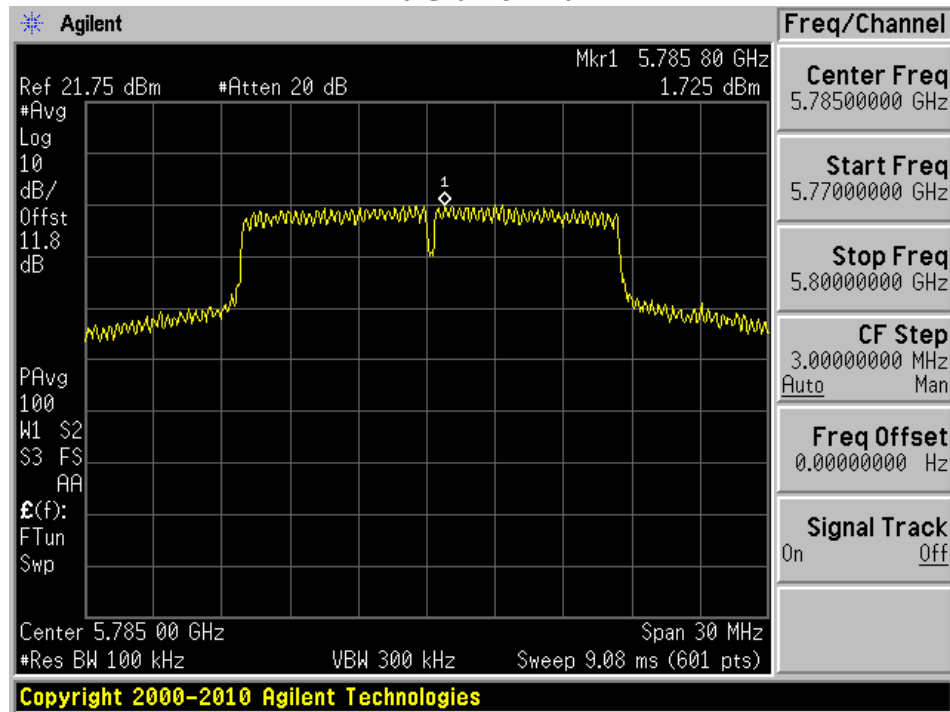
Low Channel Ant A



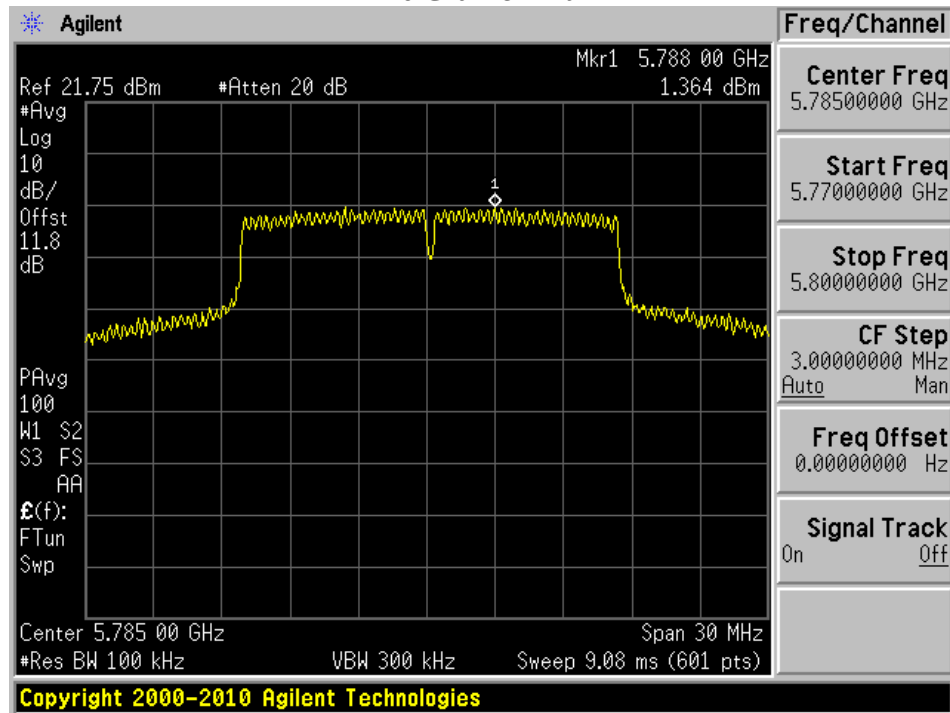
Low Channel Ant B



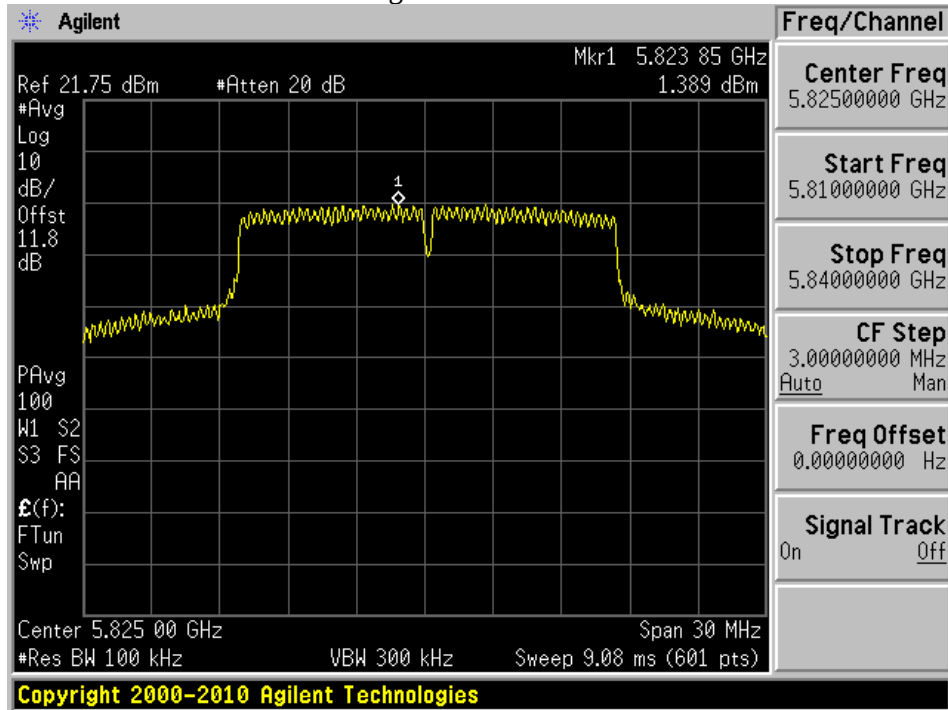
Mid Channel Ant A



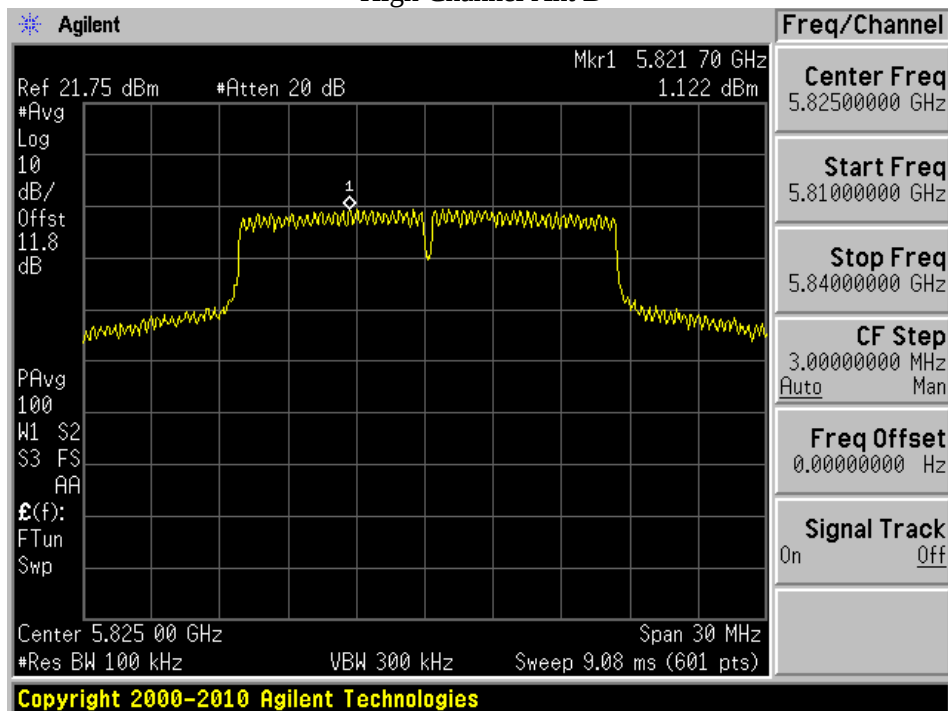
Mid Channel Ant B



High Channel Ant A

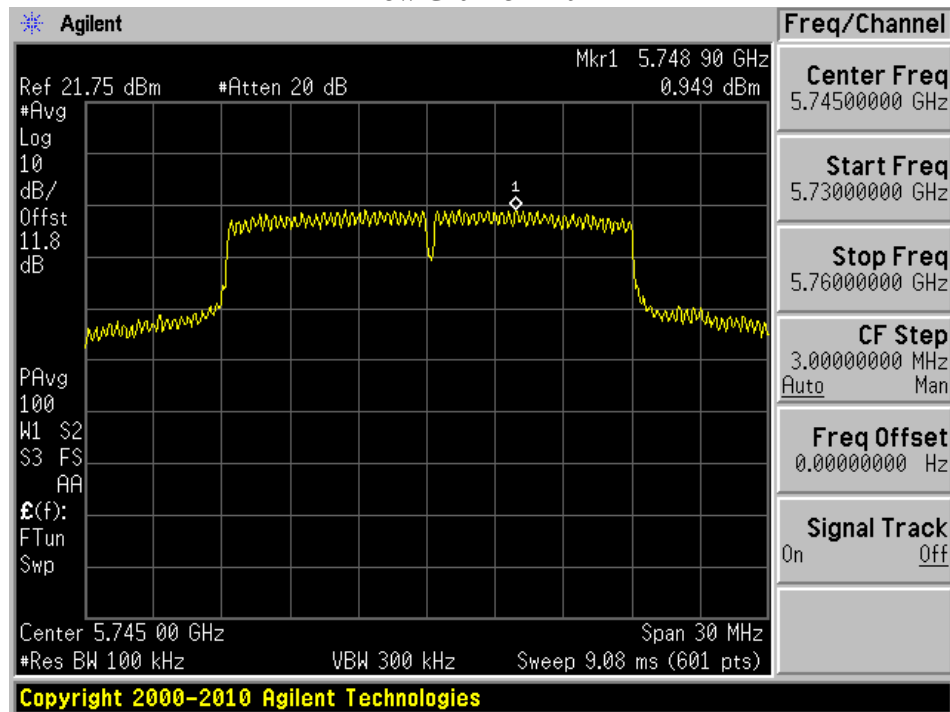


High Channel Ant B

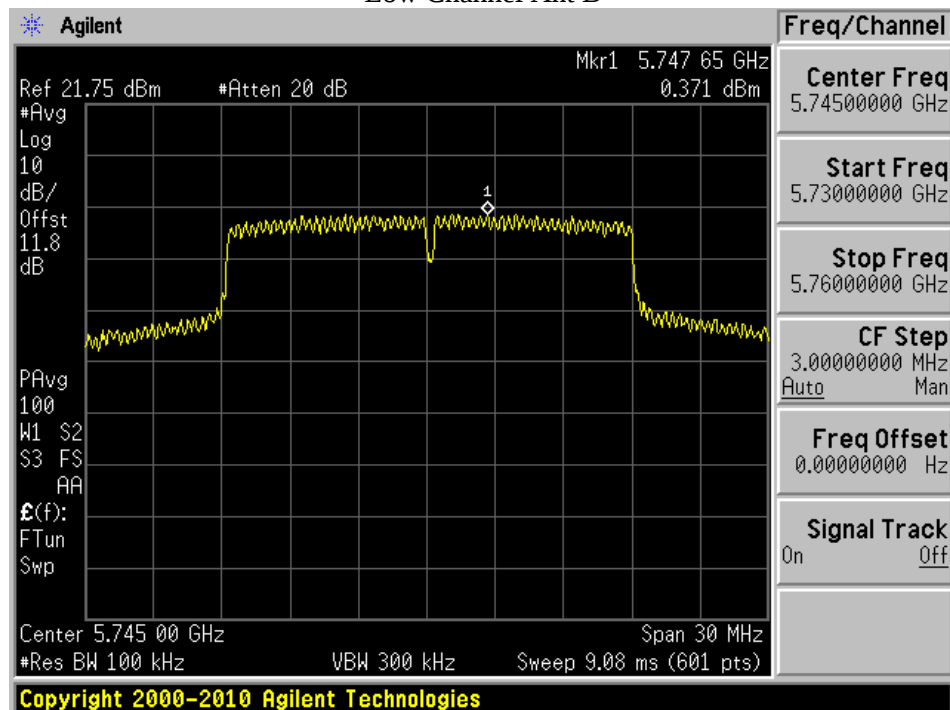


5725 - 5850 MHz 802.11n20

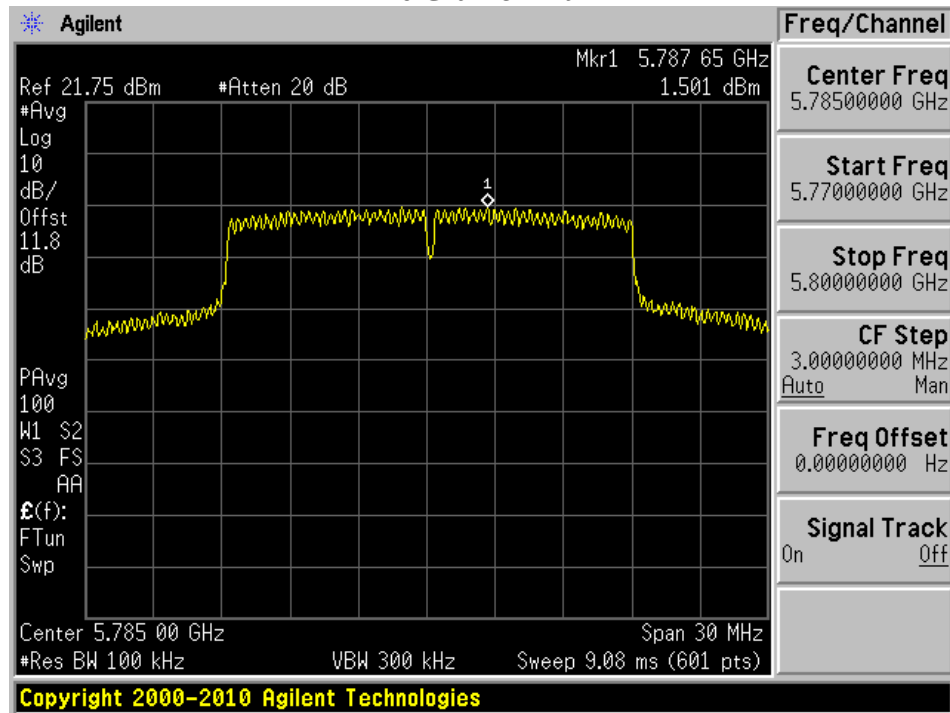
Low Channel Ant A



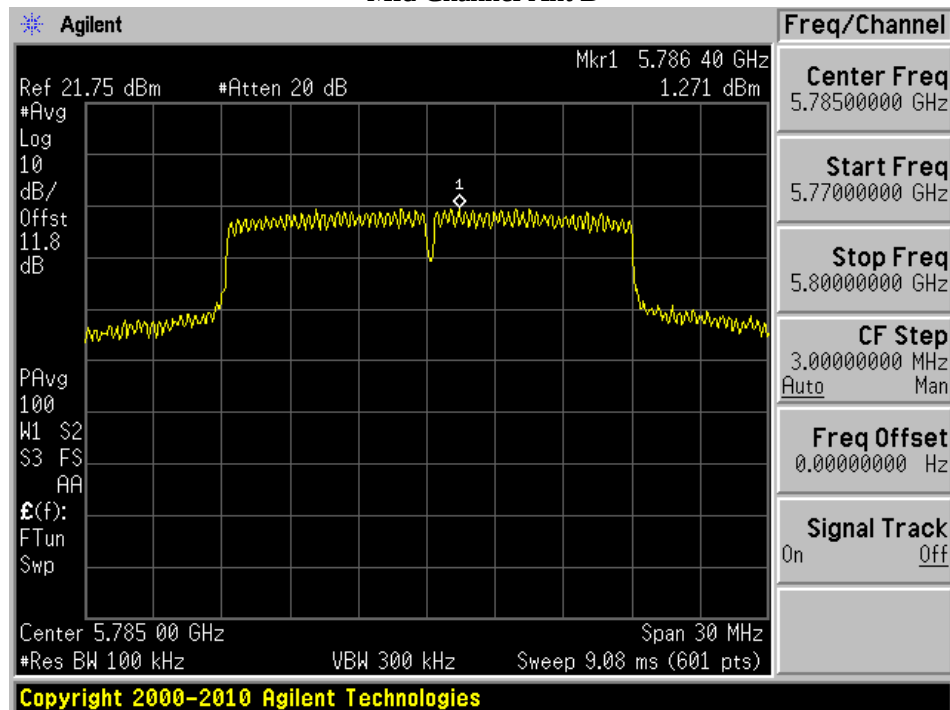
Low Channel Ant B



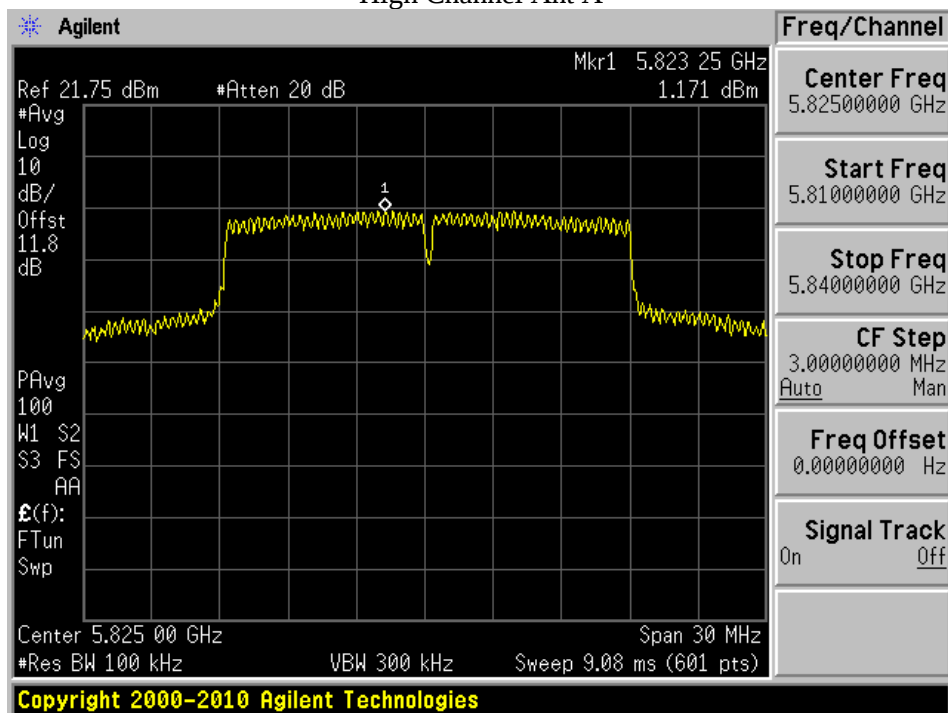
Mid Channel Ant A



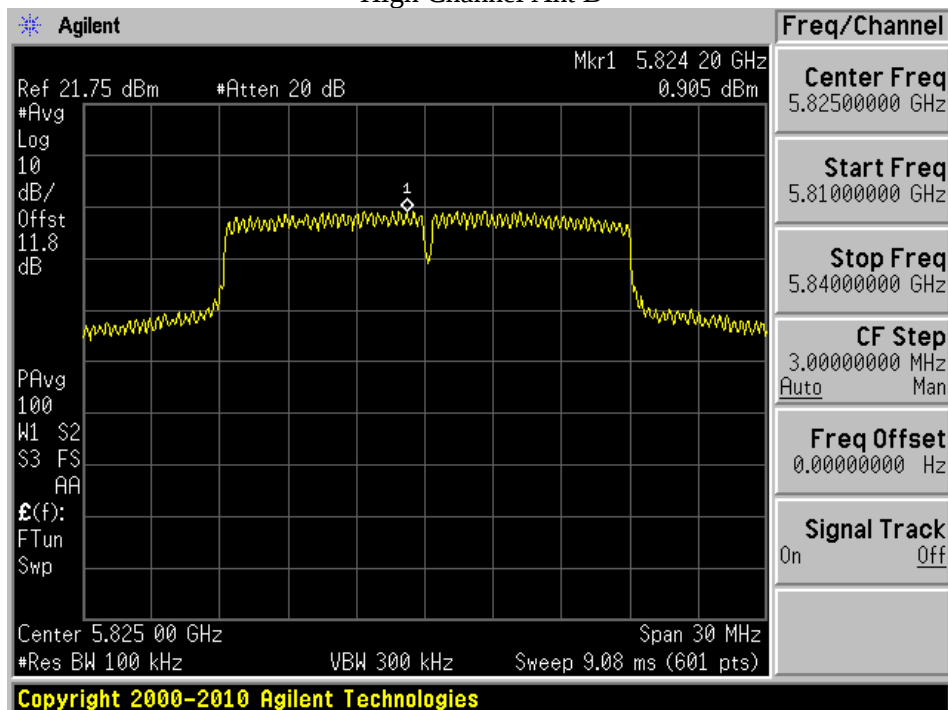
Mid Channel Ant B



High Channel Ant A



High Channel Ant B



10 FCC §15.407(b) & RSS-247 §6.2 - Out of Band Emissions

10.1 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.

As per ISSED 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.

10.2 Measurement Procedure

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

Unwanted Emission Measurement:

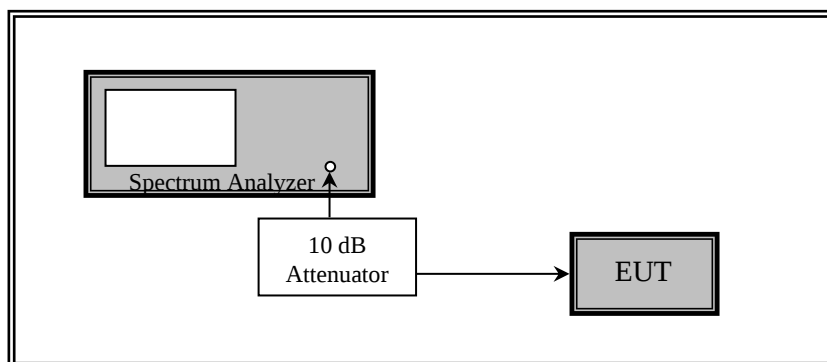
Maximum emission levels are measured by setting the analyzer as follows:

- i. RBW = 1 MHz
- ii. VBW $\geq$ 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.

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	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

Note¹: 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° C
Relative Humidity:	40-41 %
ATM Pressure:	103.1-104.1 kPa

The testing was performed by Marc Jean from 2022-06-17 to 2022-06-23 in RF site.

10.6 Test Results

Please refer to the following plots

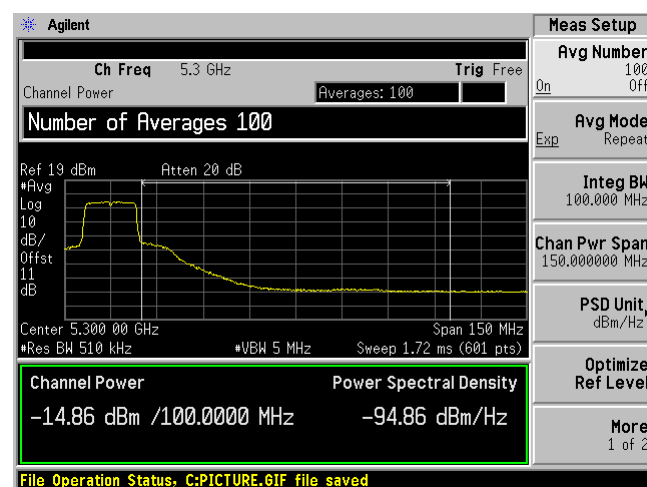
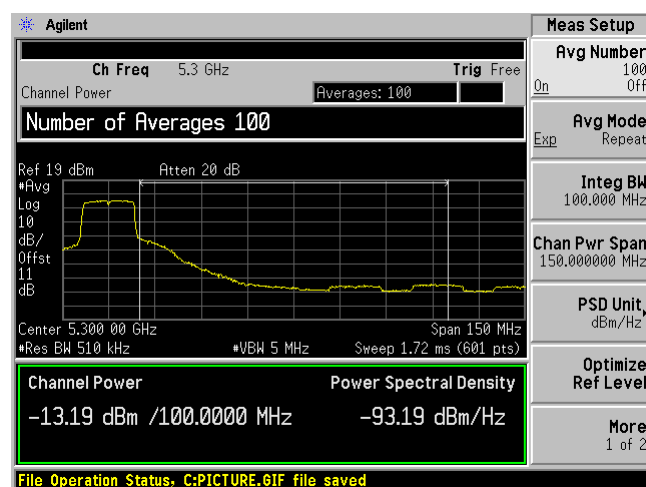
ISED Emission falling into 5250 – 5350 MHz

Channel, Port	Frequency (MHz)	Channel Power (dBm)	Conducted Emission Power (dBm)	Delta (dB)	Limit (dB)
802.11a					
48, Port A	5240	18.89	-13.19	32.08	>26
48, Port B	5240	18.9	-14.86	33.76	>26
802.11n20					
48, Port A	5240	12.46	-31.30	43.76	>26
48, Port B	5240	12.73	-32.11	44.84	>26

Note: please refer to section 9.6 for the output power result.

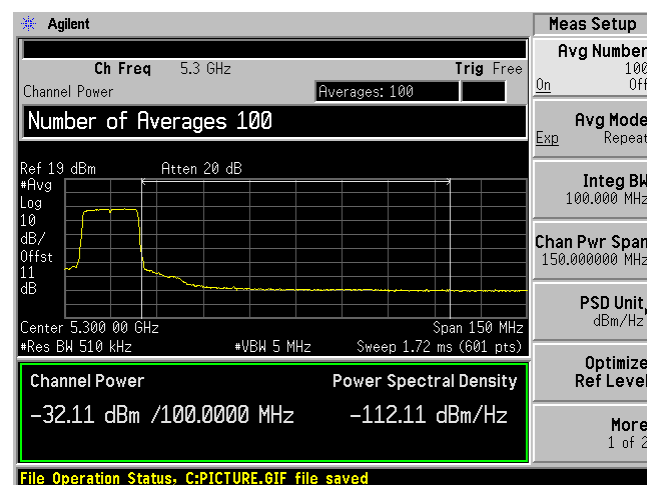
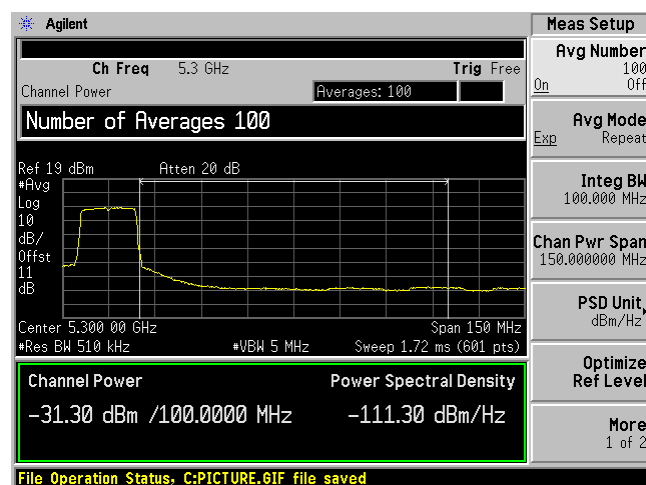
A mode, 5230MHz, Conducted Emission Power, Port A

A Mode, 5230MHz, Conducted Emission Power, Port B



N/AC20 mode, 5230MHz, Conducted Emission Power, Port A

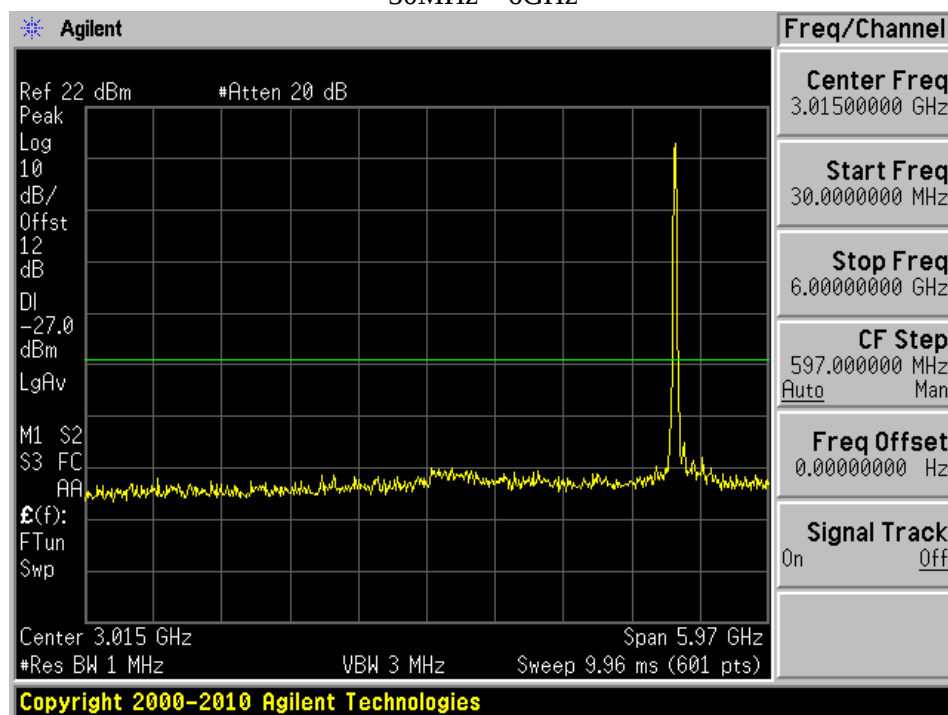
N/AC20Mode, 5230MHz, Conducted Emission Power, Port B



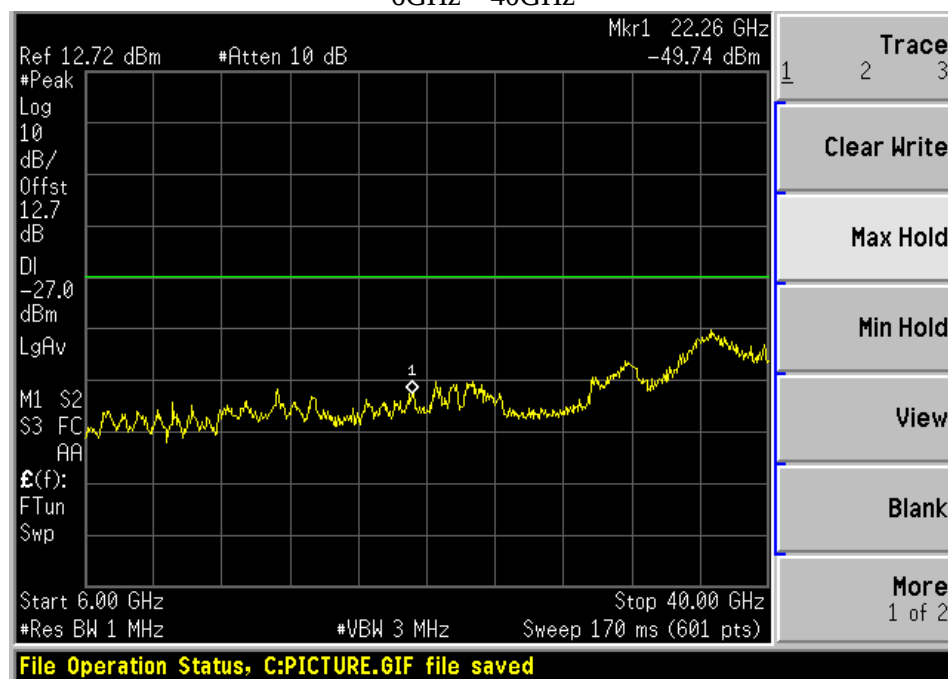
Spurious Emissions**5150 - 5250 MHz 802.11a**

Low Channel Ant A

30MHz – 6GHz

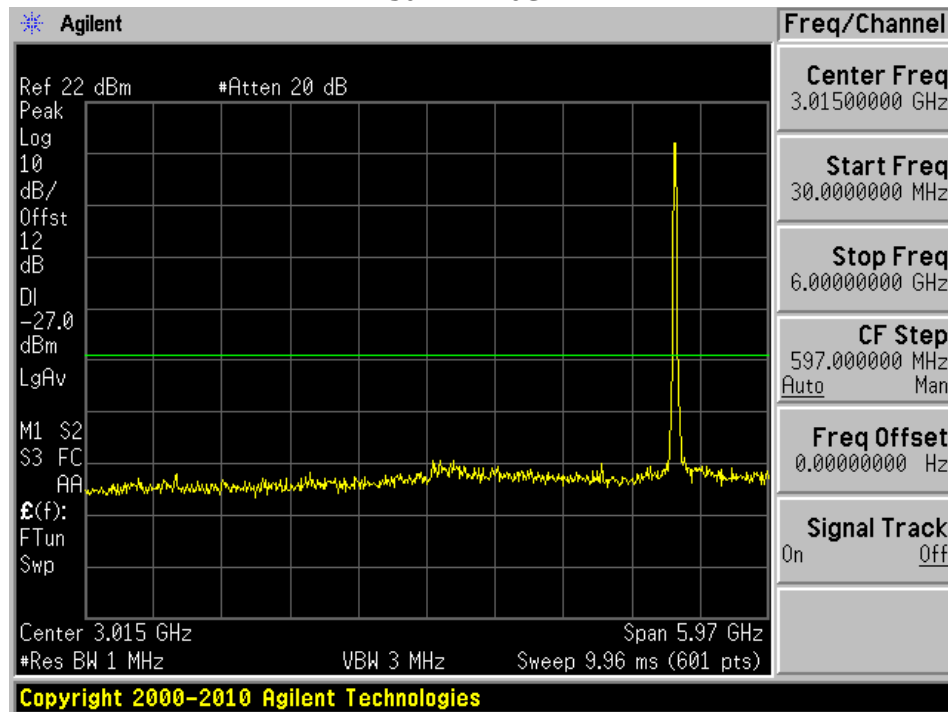


6GHz – 40GHz



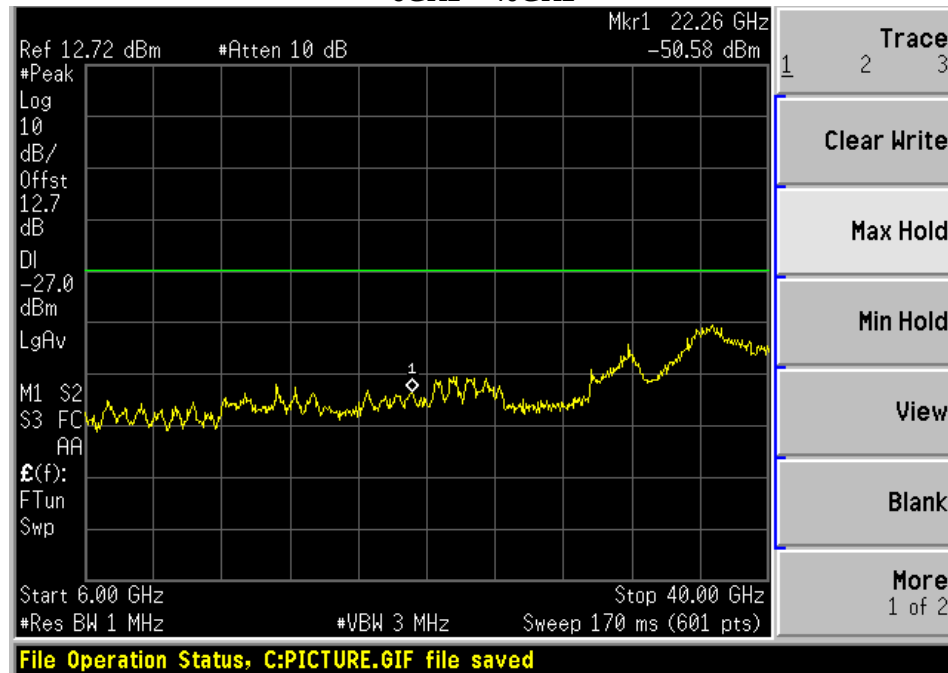
Low Channel Ant B

30MHz – 6GHz



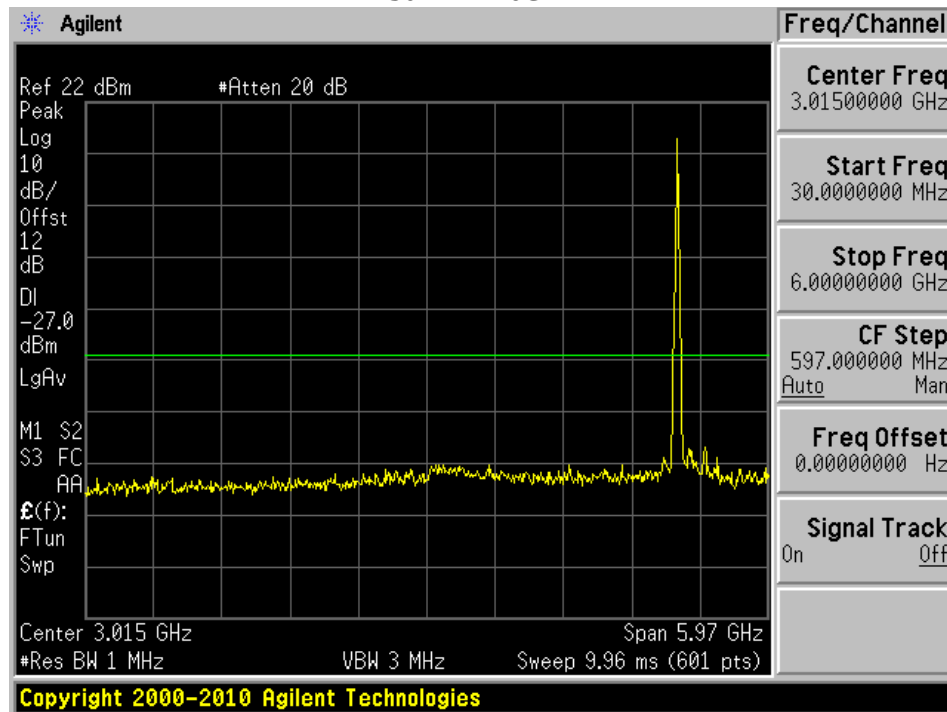
Low Channel Ant B

6GHz – 40GHz



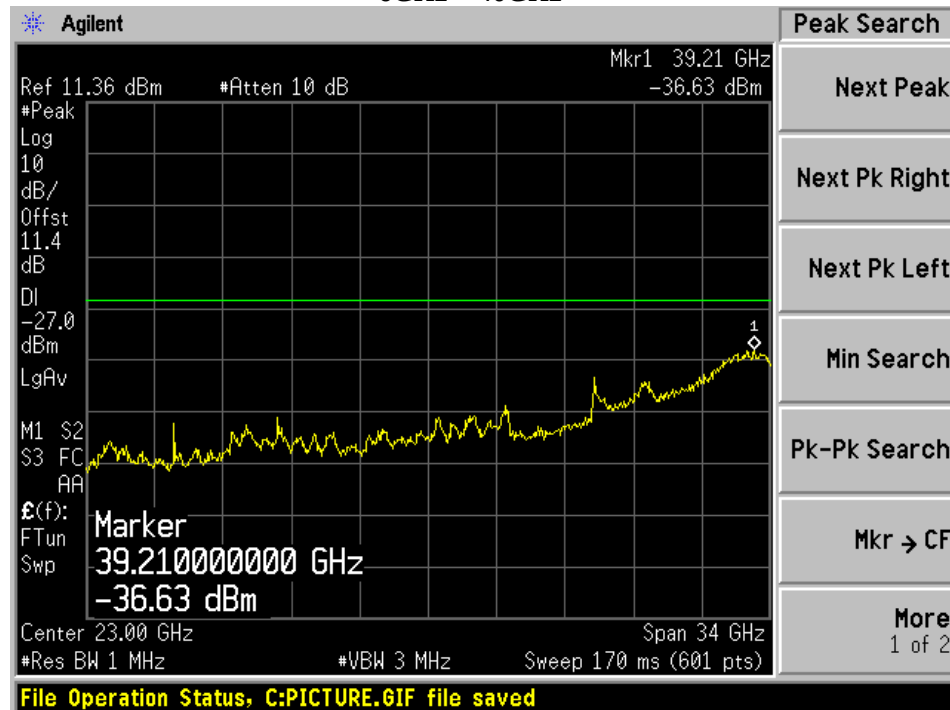
Mid Channel Ant A

30MHz – 6GHz



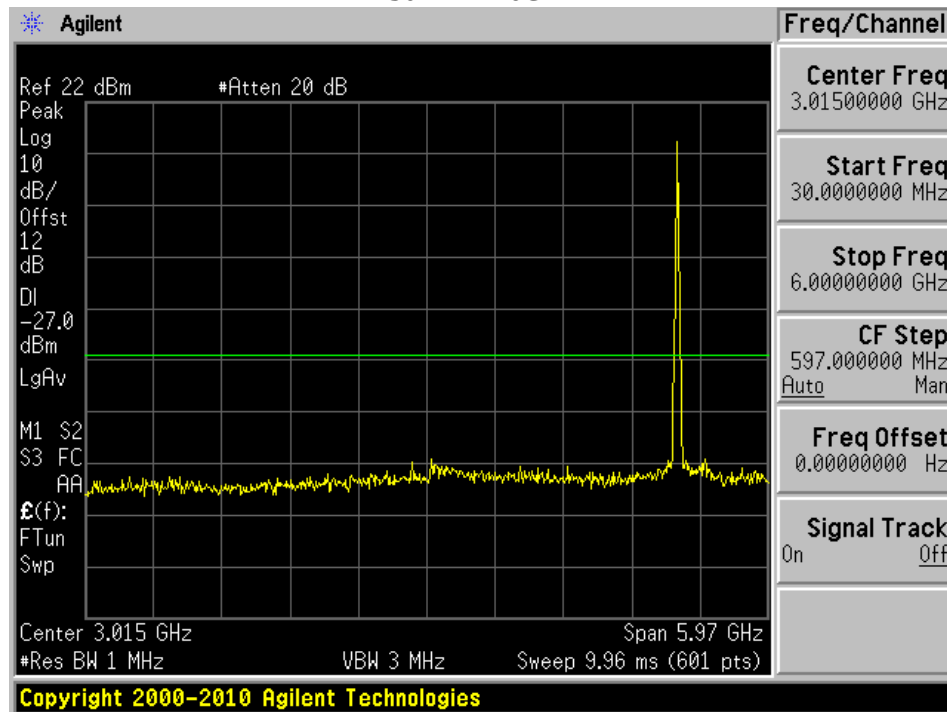
Mid Channel Ant A

6GHz – 40GHz



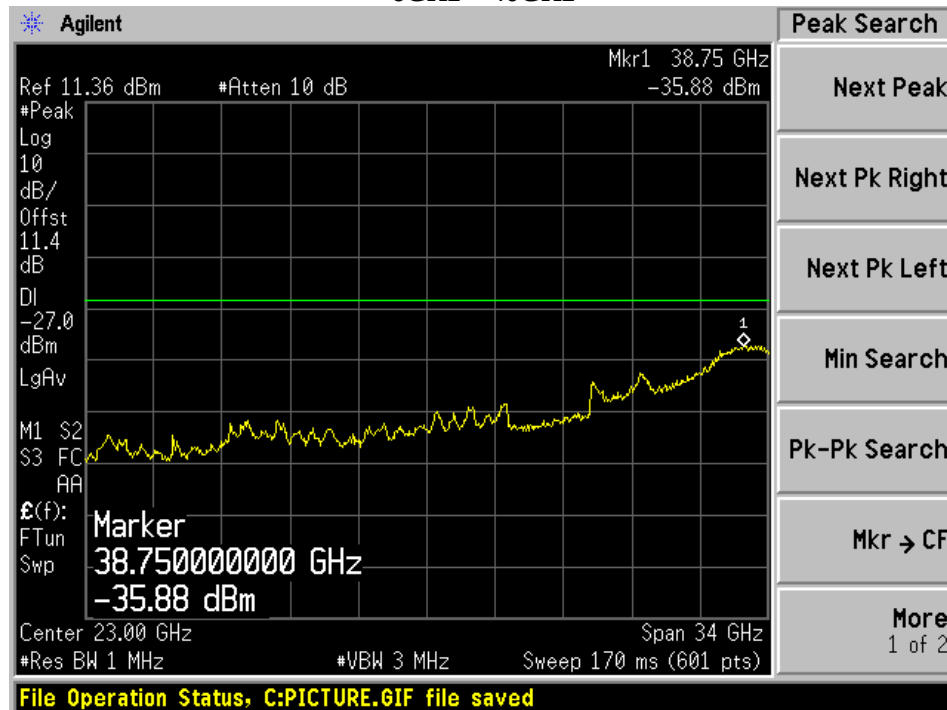
Mid Channel Ant B

30MHz – 6GHz



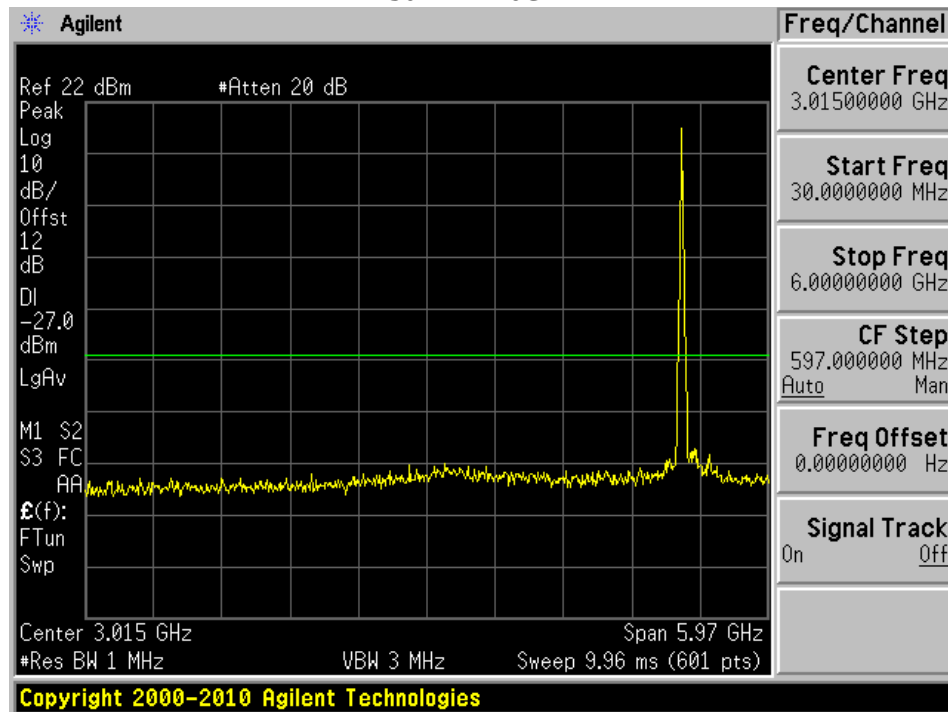
Mid Channel Ant B

6GHz – 40GHz



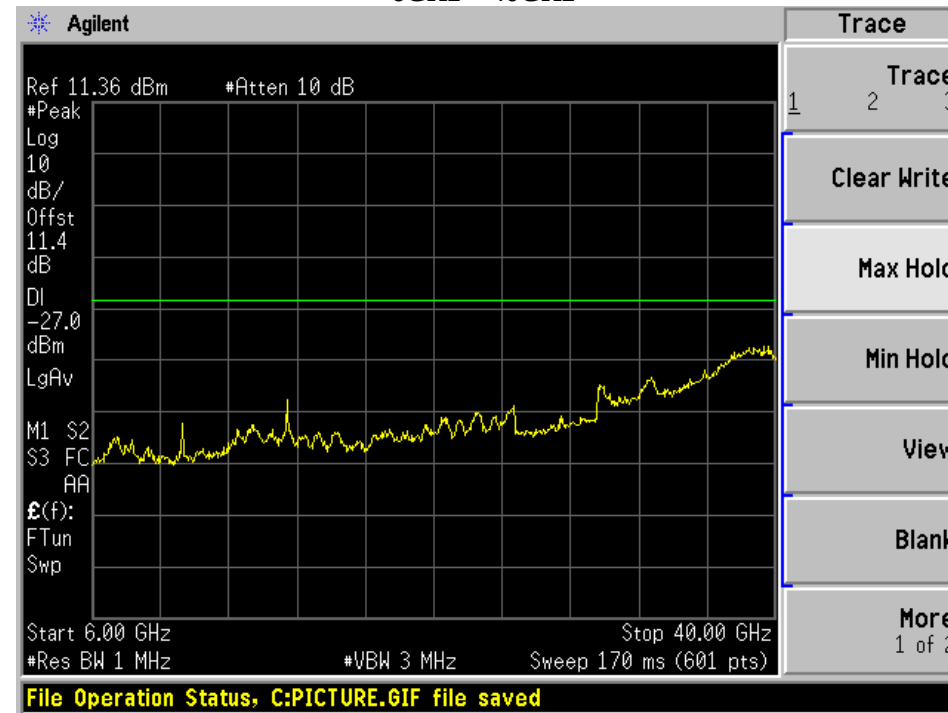
High Channel Ant A

30MHz – 6GHz



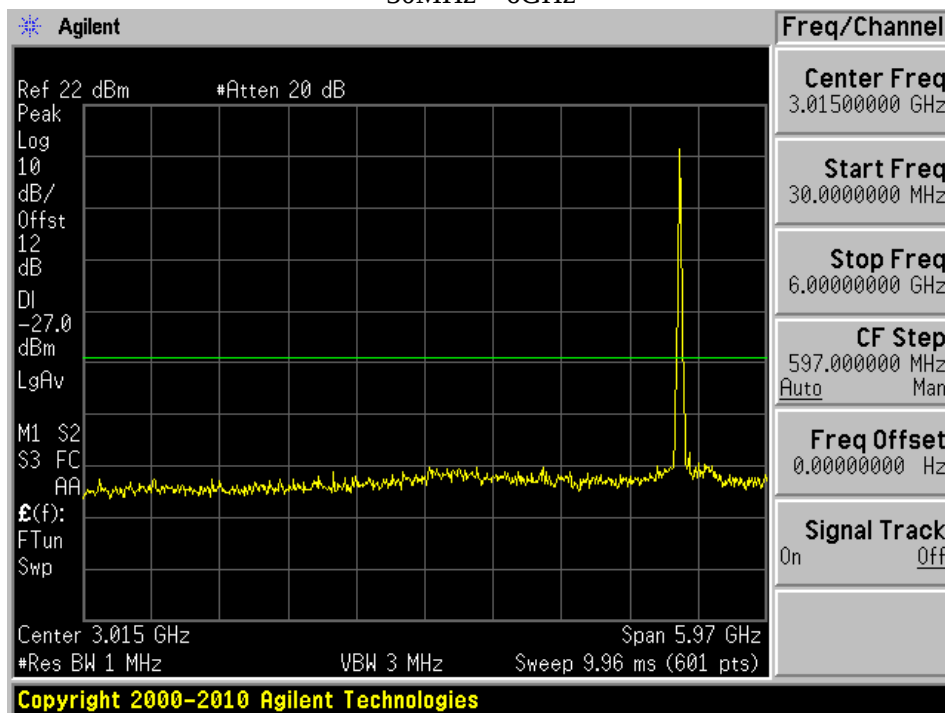
High Channel Ant A

6GHz – 40GHz



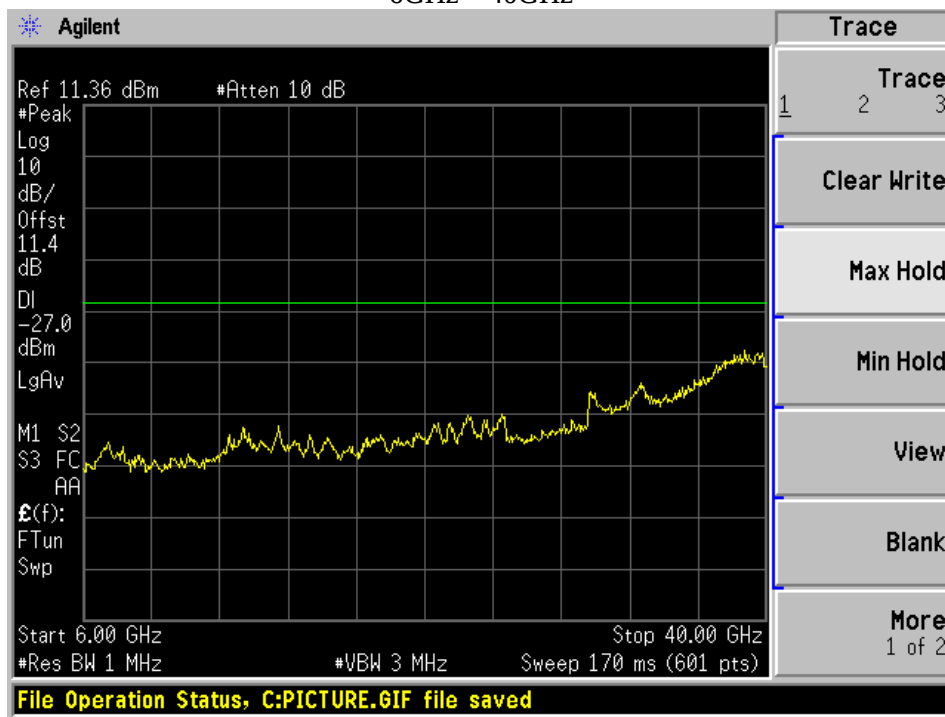
High Channel Ant B

30MHz – 6GHz



High Channel Ant B

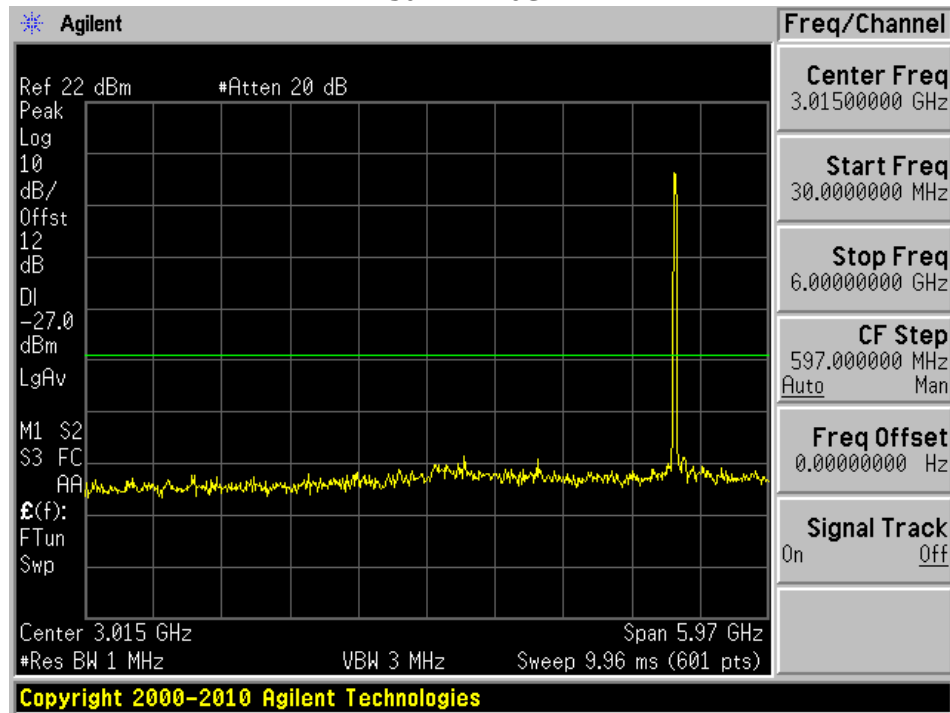
6GHz – 40GHz



5150 - 5250 MHz 802.11n20

Low Channel Ant A

30MHz – 6GHz



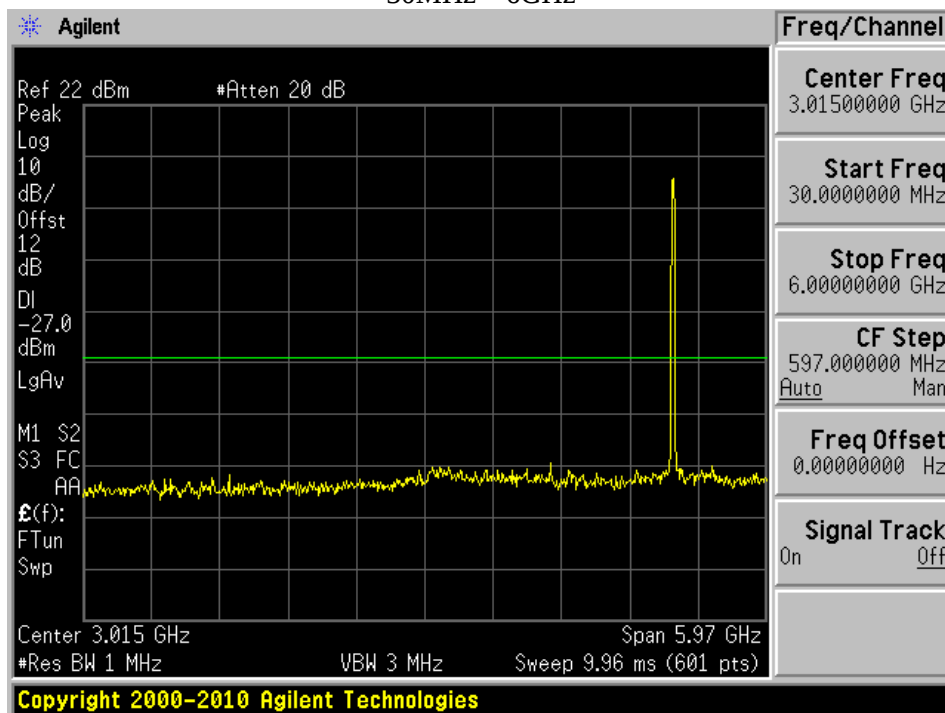
Low Channel Ant A

6GHz – 40GHz



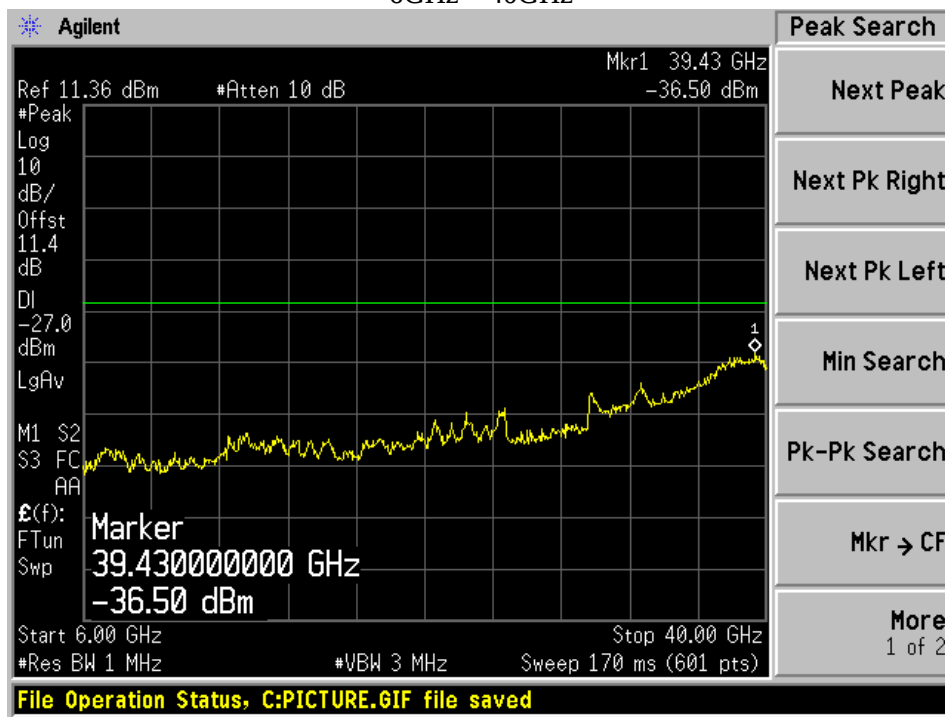
Low Channel Ant B

30MHz – 6GHz



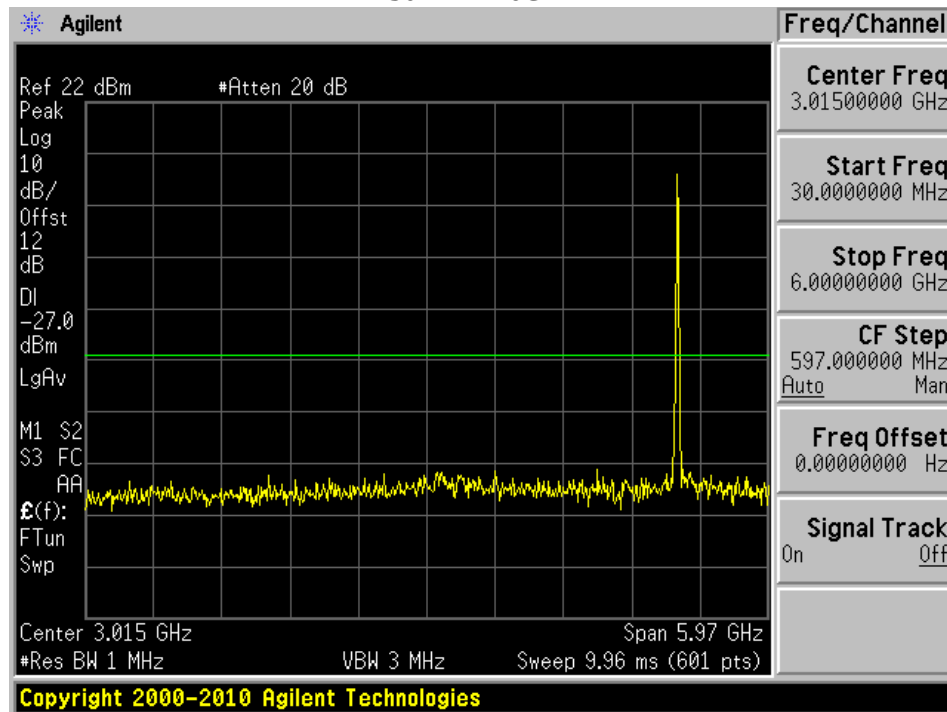
Low Channel Ant B

6GHz – 40GHz



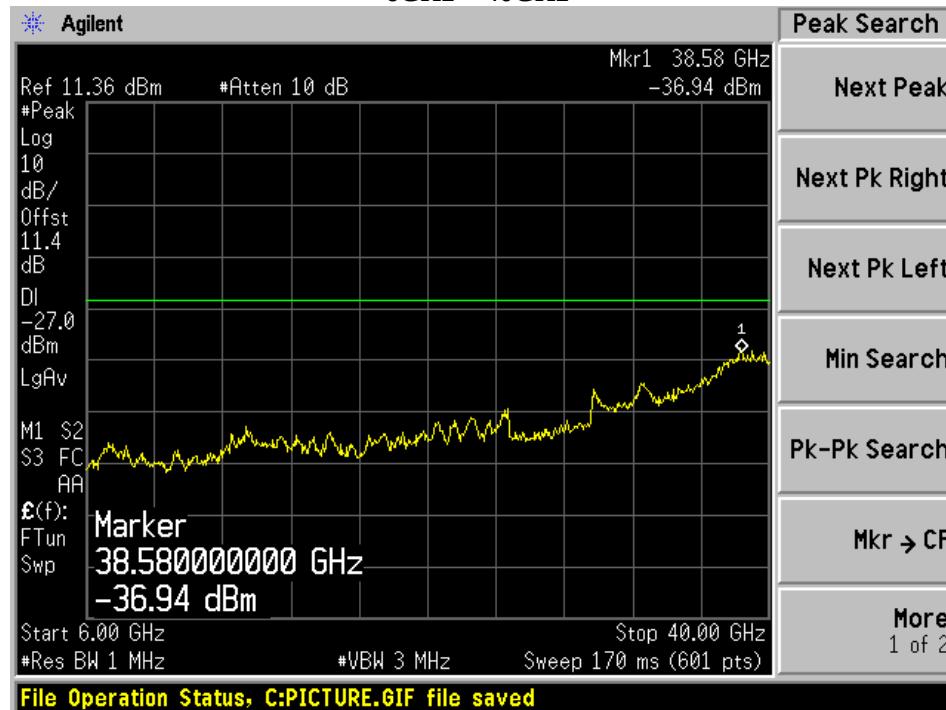
Mid Channel Ant A

30MHz – 6GHz



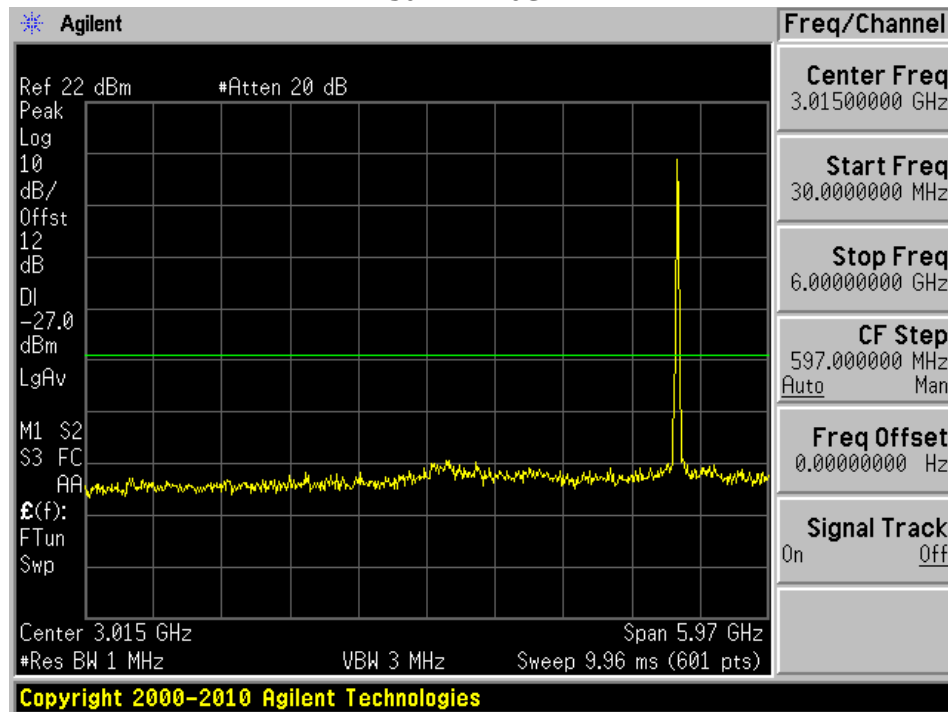
Mid Channel Ant A

6GHz – 40GHz



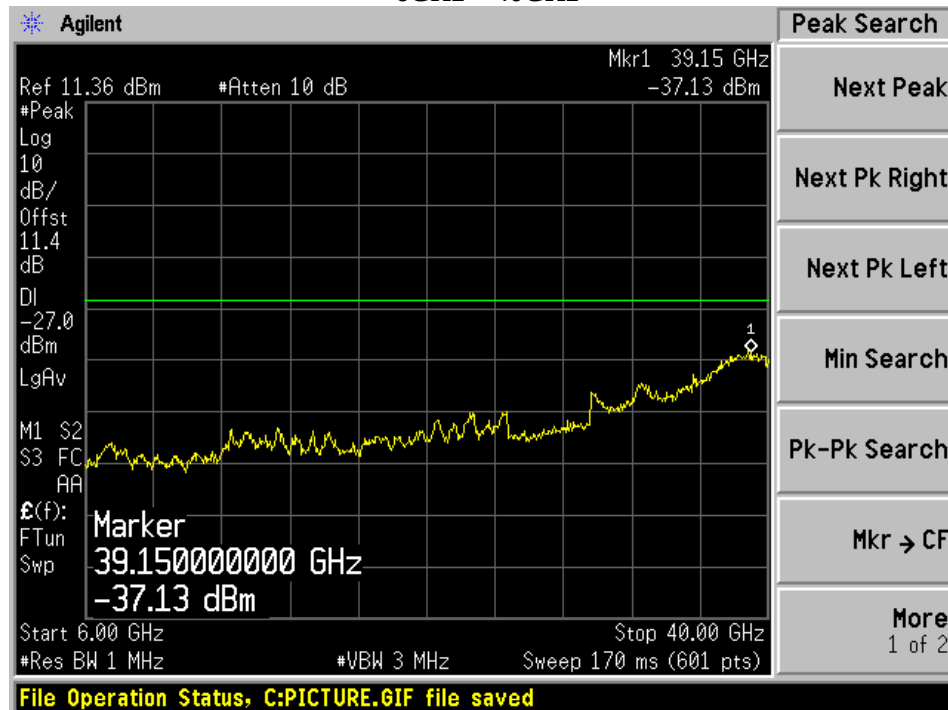
Mid Channel Ant B

30MHz – 6GHz



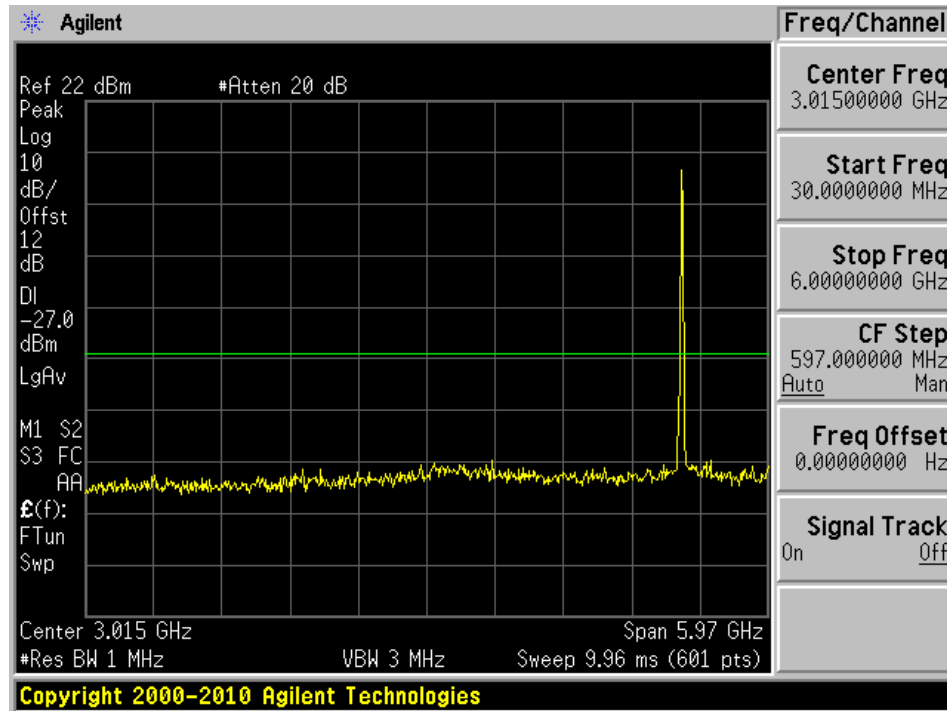
Mid Channel Ant B

6GHz – 40GHz



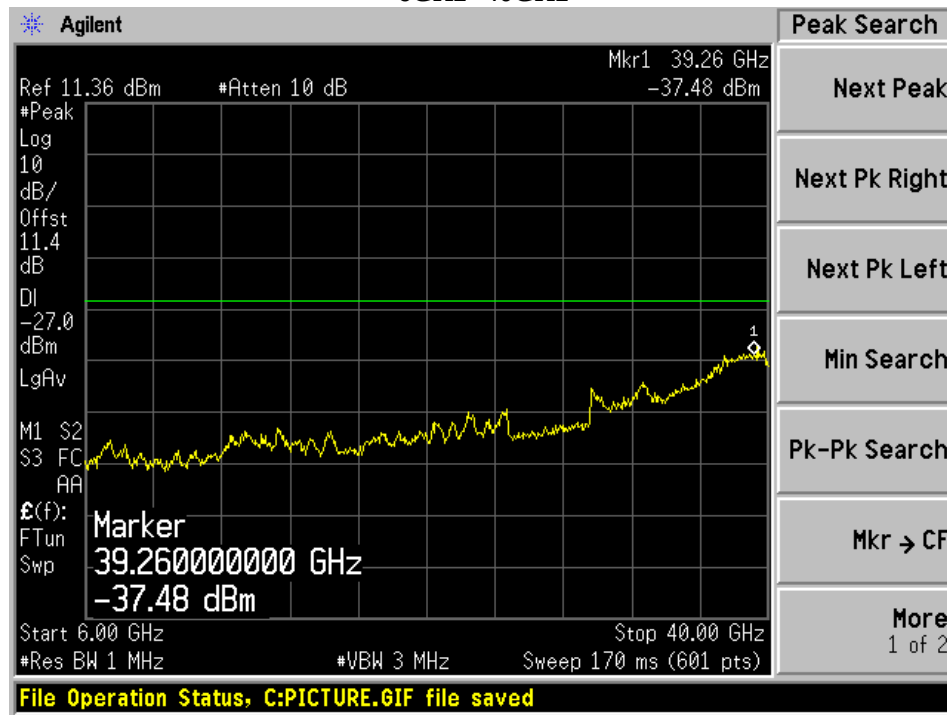
High Channel Ant A

30MHz – 6GHz



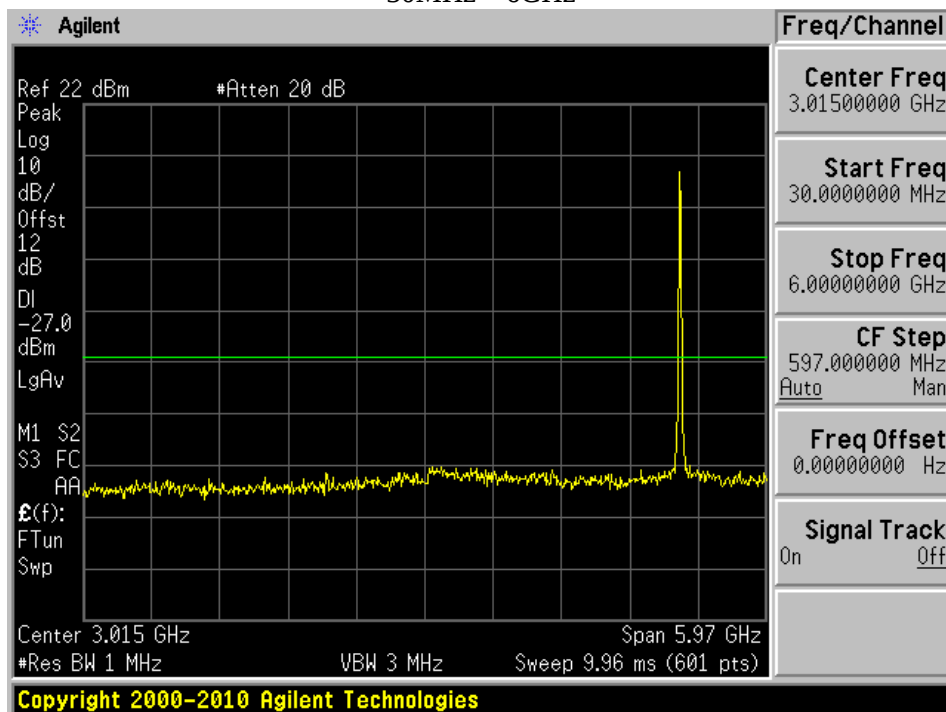
High Channel Ant A

6GHz- 40GHz



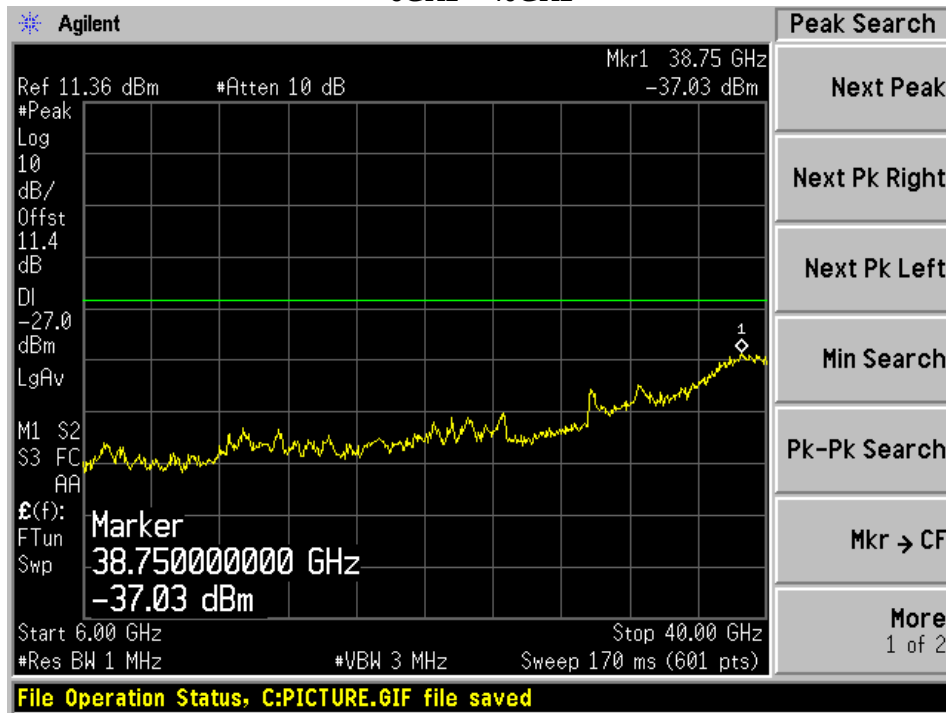
High Channel Ant B

30MHz – 6GHz



High Channel Ant B

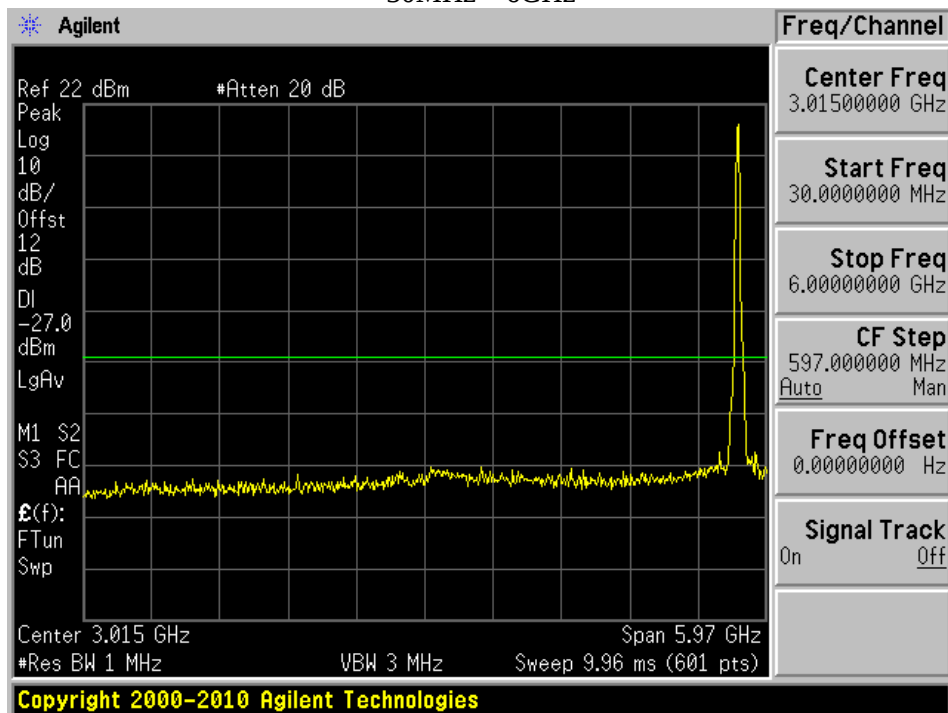
6GHz – 40GHz



5725 - 5850 MHz 802.11a

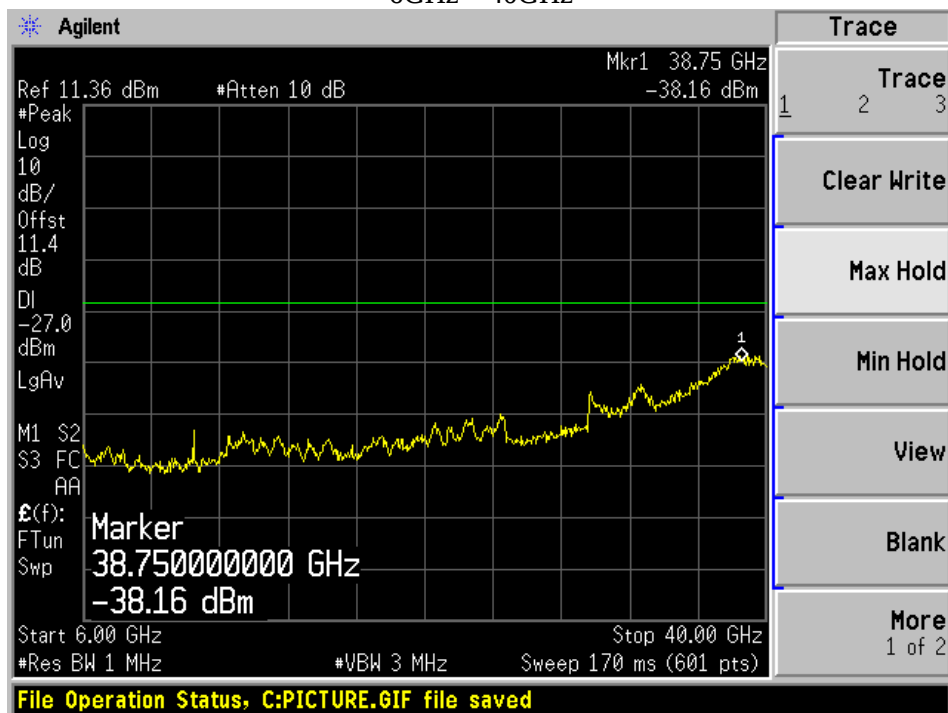
Low Channel Ant A

30MHz – 6GHz



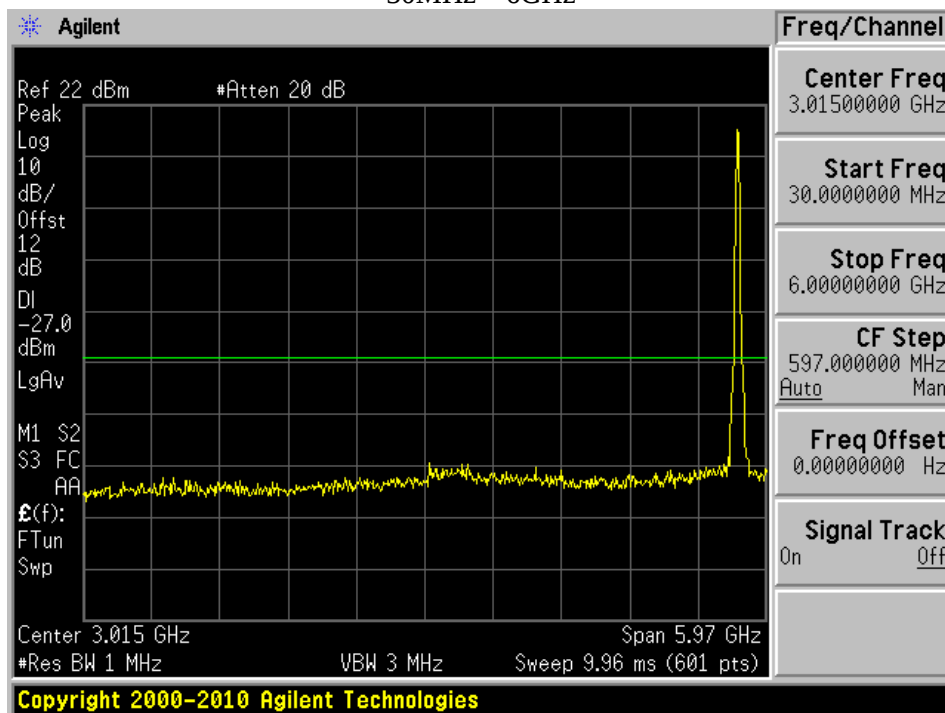
Low Channel Ant A

6GHz – 40GHz



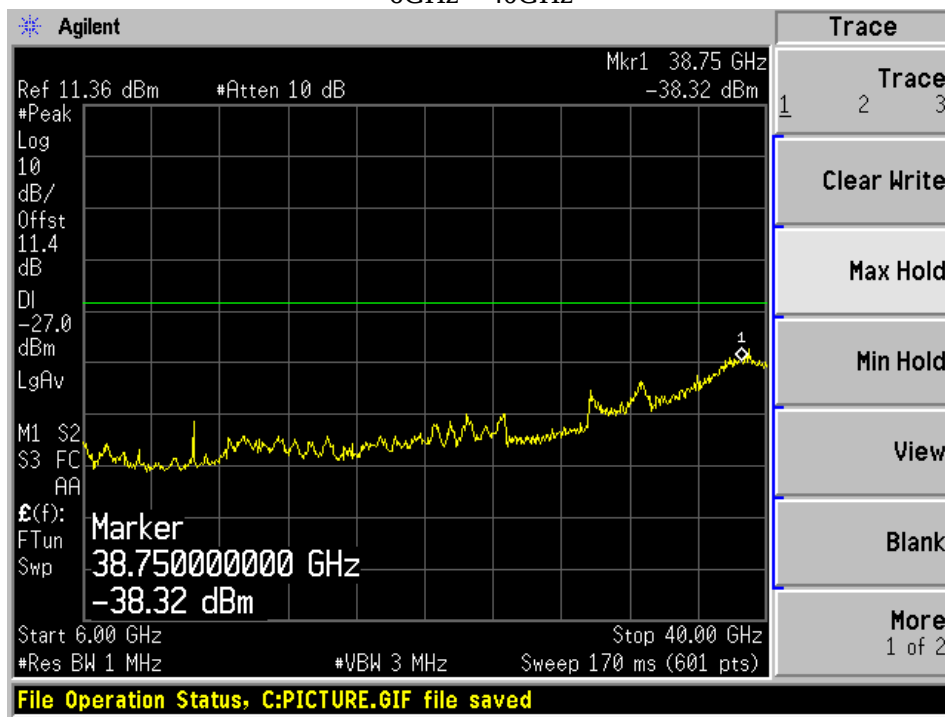
Low Channel Ant B

30MHz – 6GHz



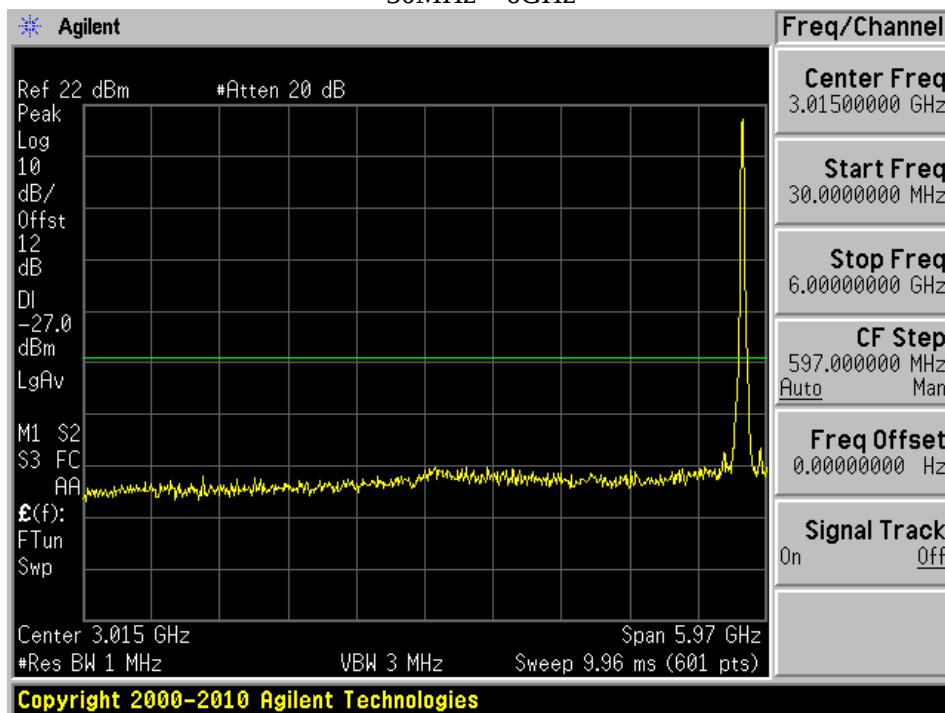
Low Channel Ant B

6GHz – 40GHz



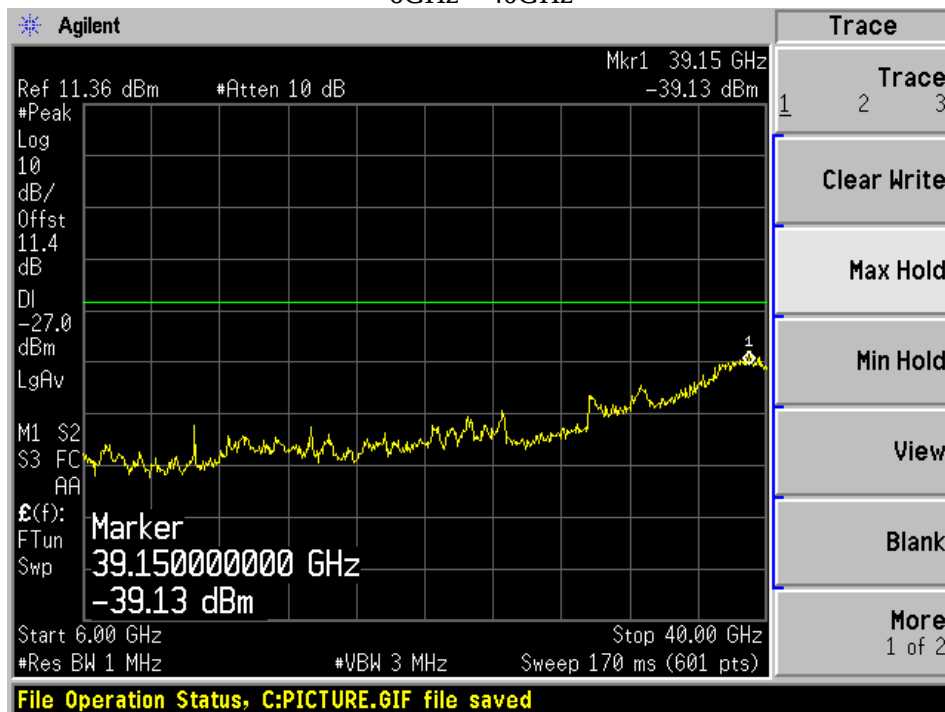
Mid Channel Ant A

30MHz – 6GHz



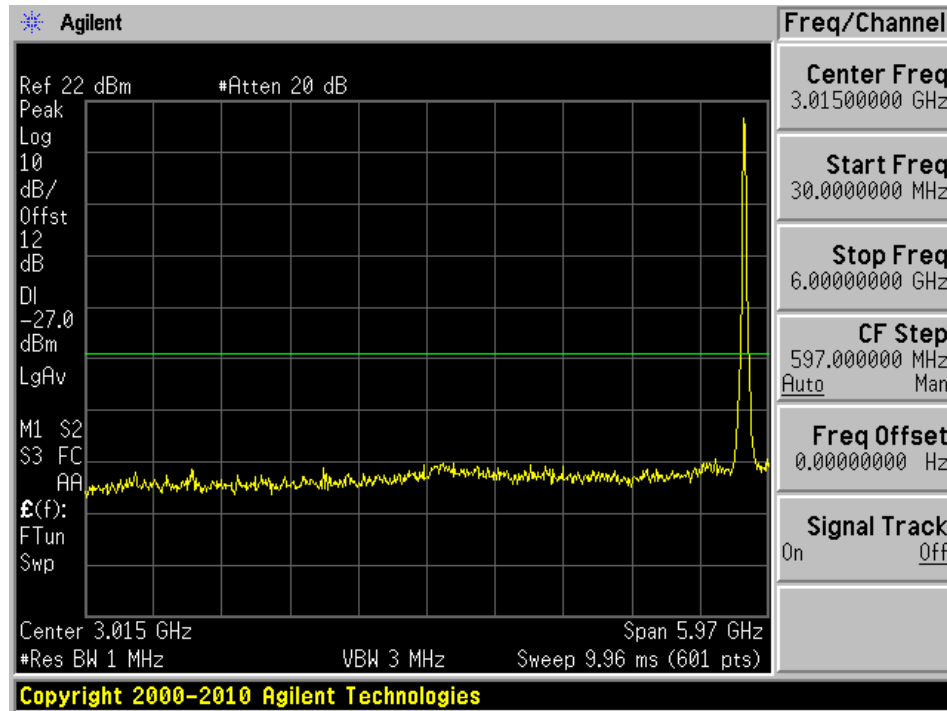
Mid Channel Ant A

6GHz – 40GHz



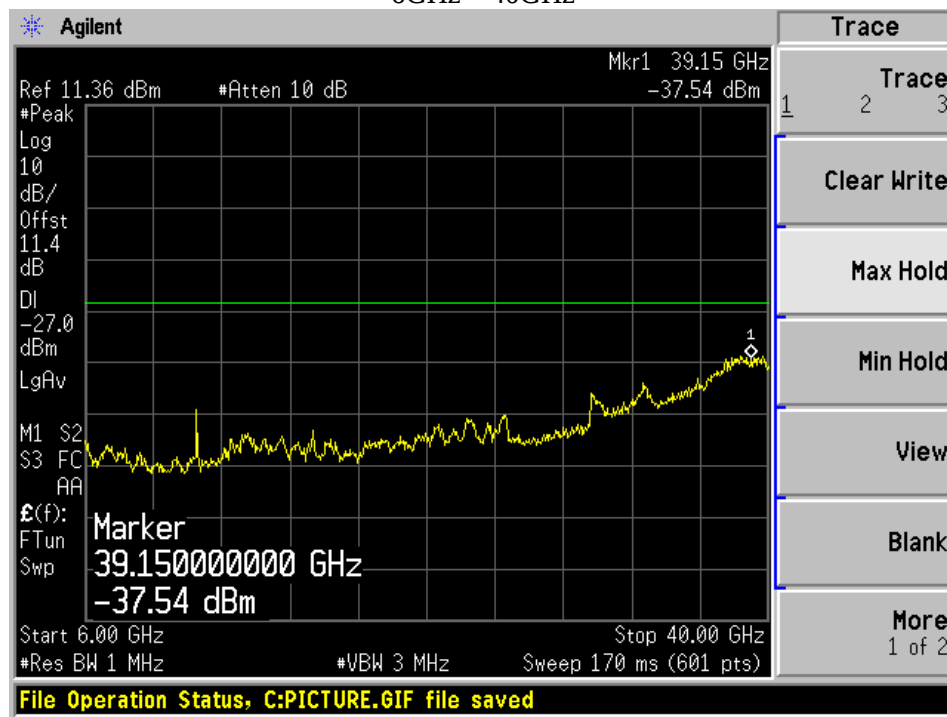
Mid Channel Ant B

30MHz – 6GHz



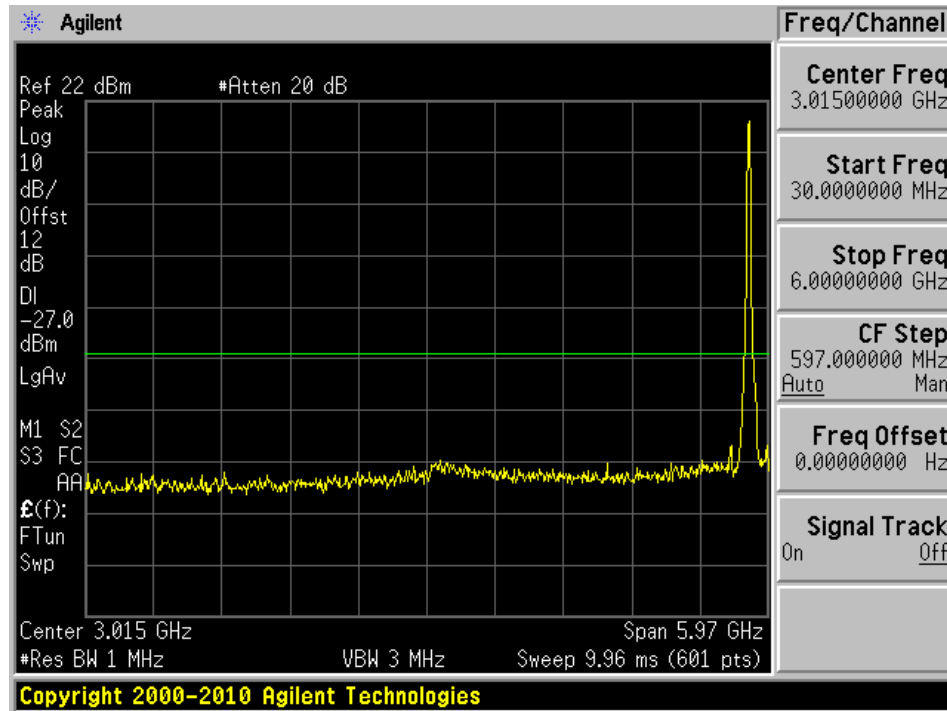
Mid Channel Ant B

6GHz – 40GHz



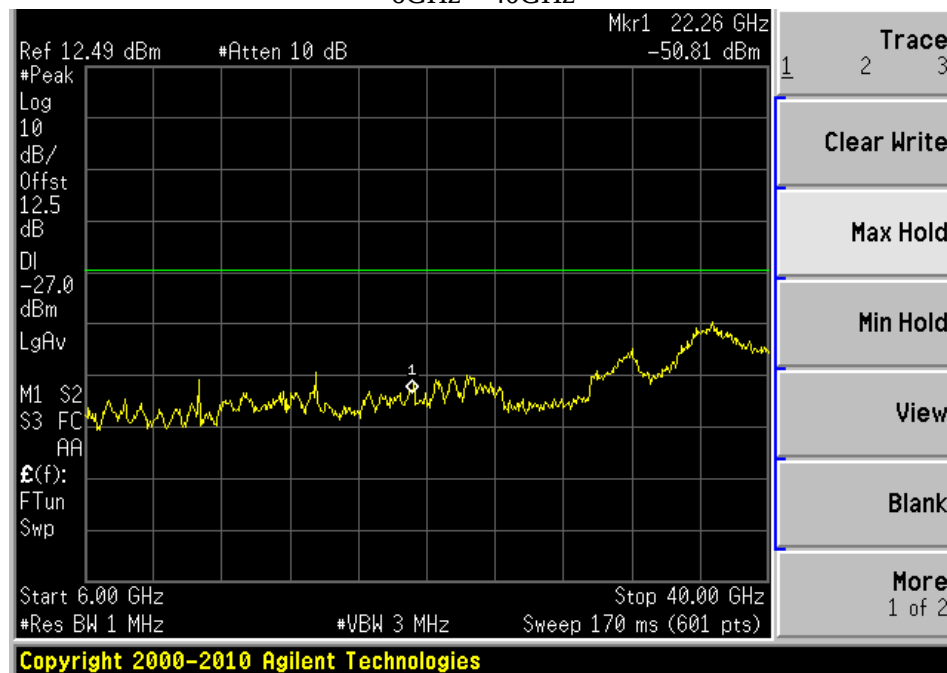
High Channel Ant A

30MHz – 6GHz



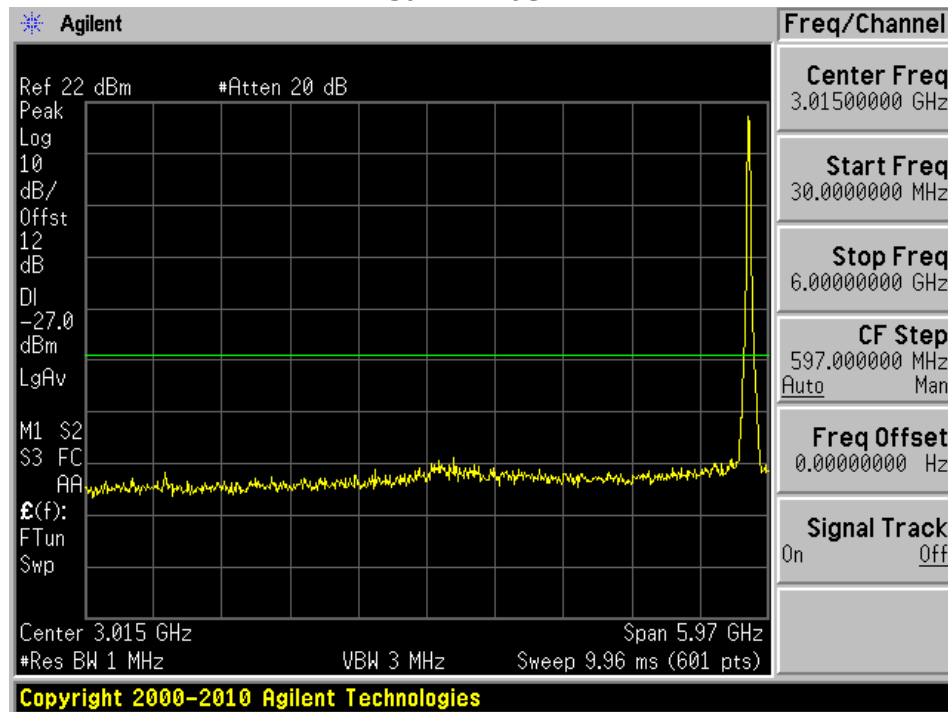
High Channel Ant A

6GHz – 40GHz



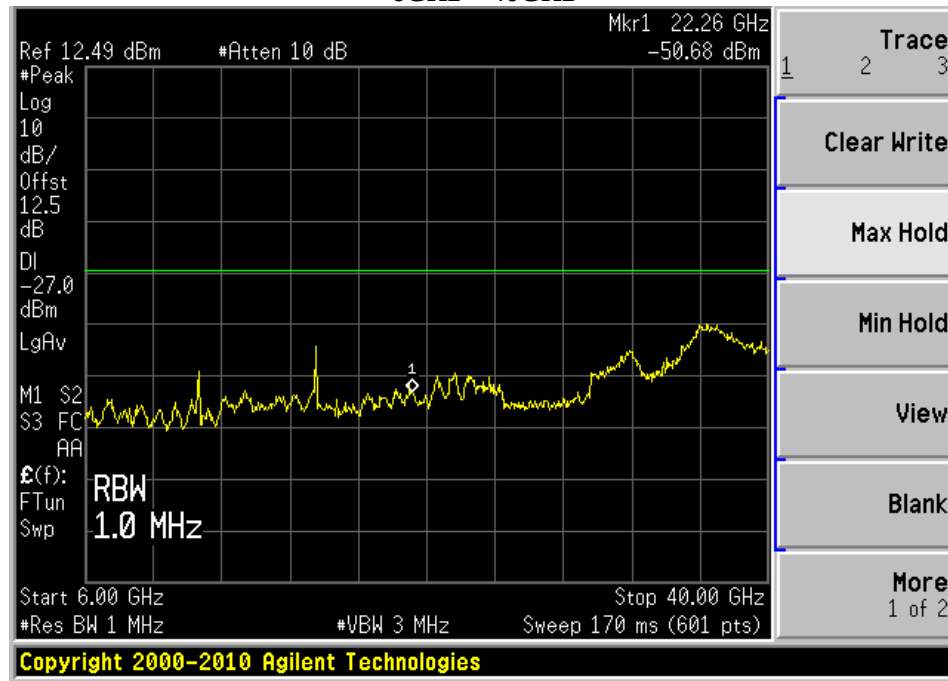
High Channel Ant B

30MHz – 6GHz



High Channel Ant B

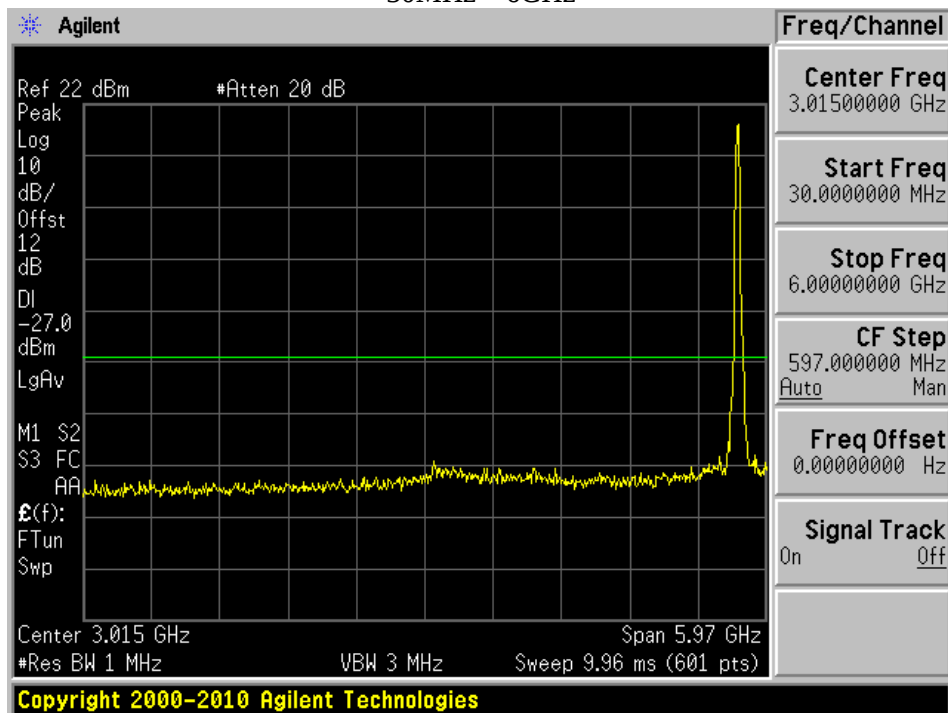
6GHz – 40GHz



5725 - 5850 MHz 802.11n20

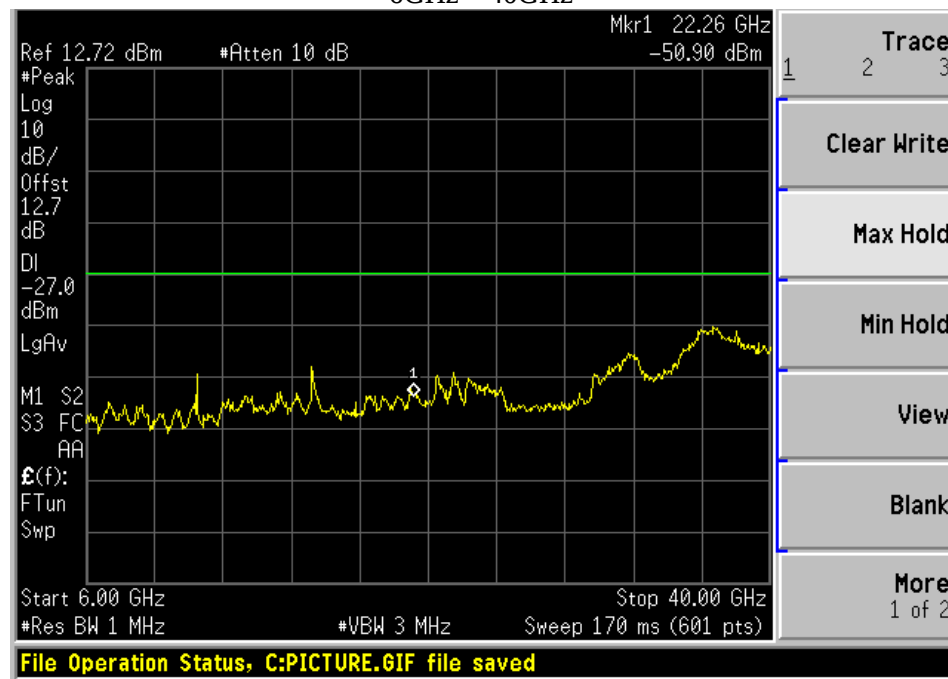
Low Channel Ant A

30MHz – 6GHz

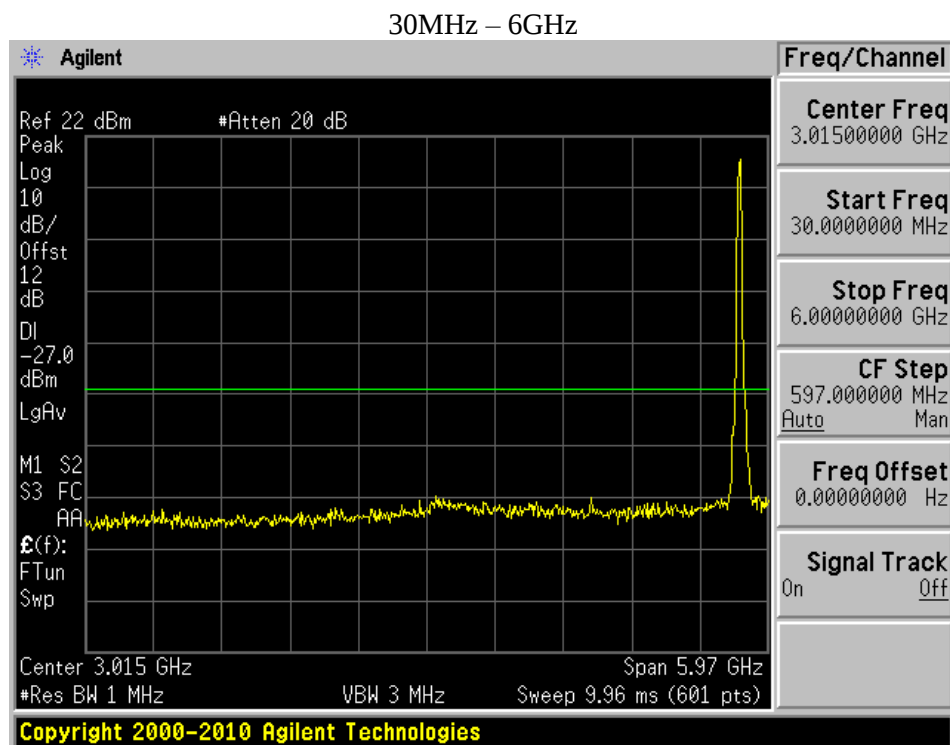


Low Channel Ant A

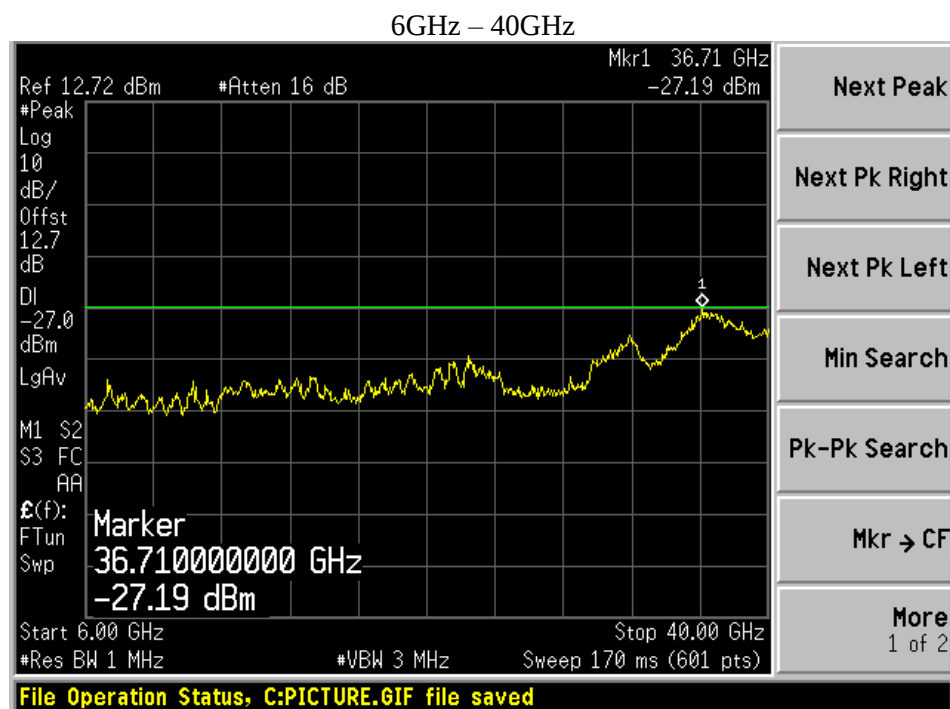
6GHz – 40GHz



Low Channel Ant B

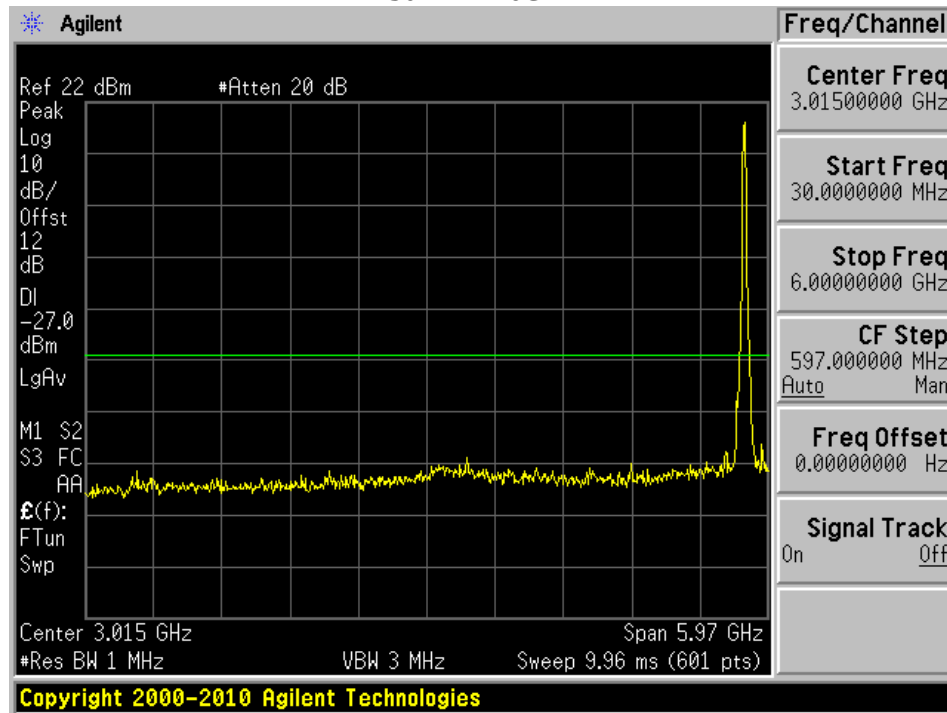


Low Channel Ant B



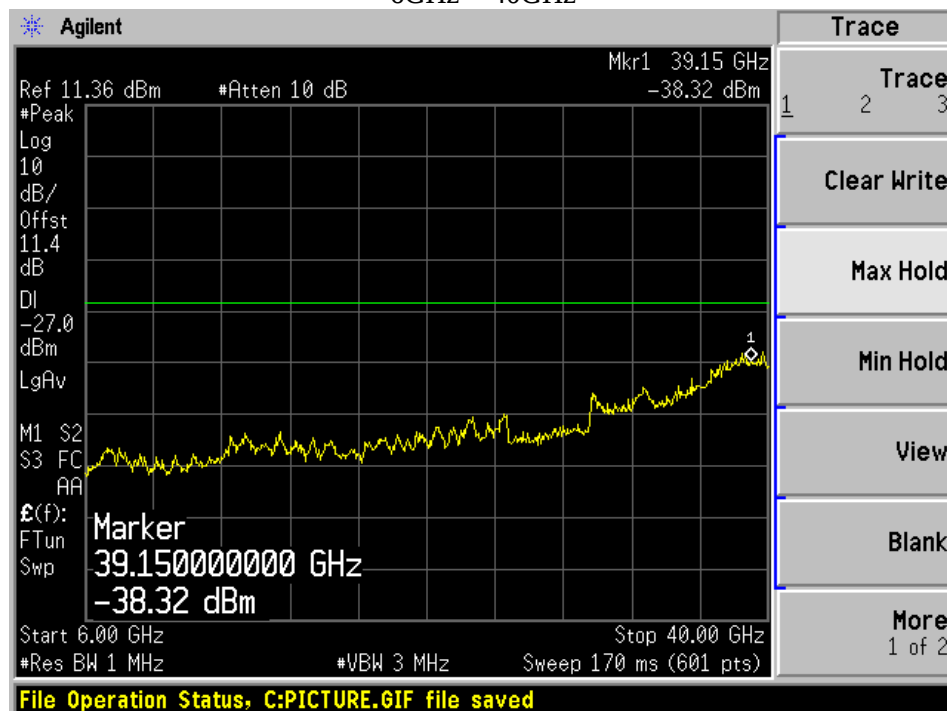
Mid Channel Ant A

30MHz – 6GHz



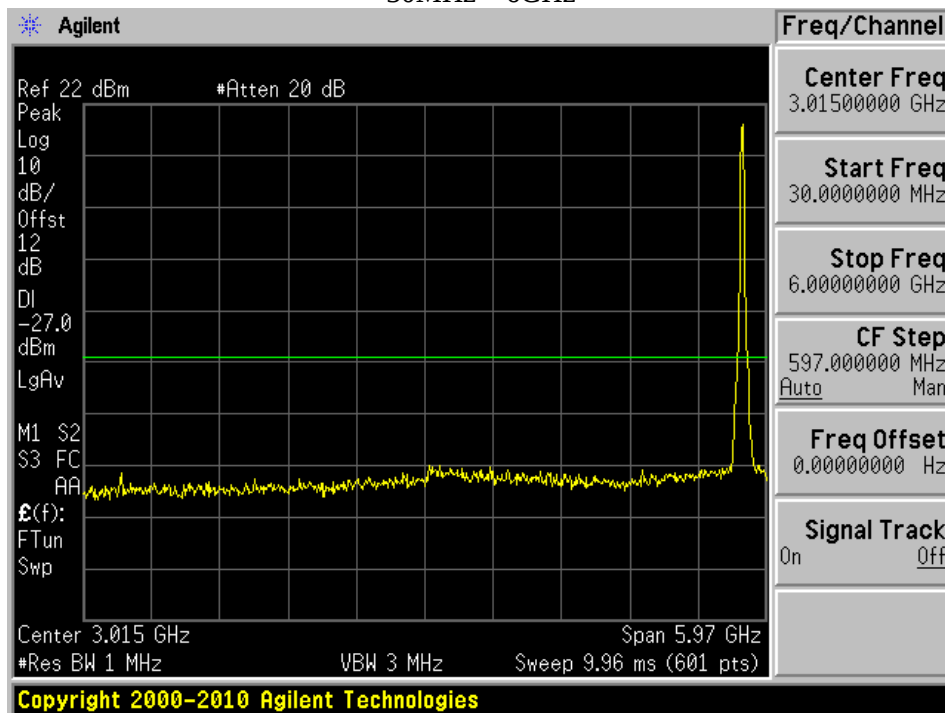
Mid Channel Ant A

6GHz - 40GHz



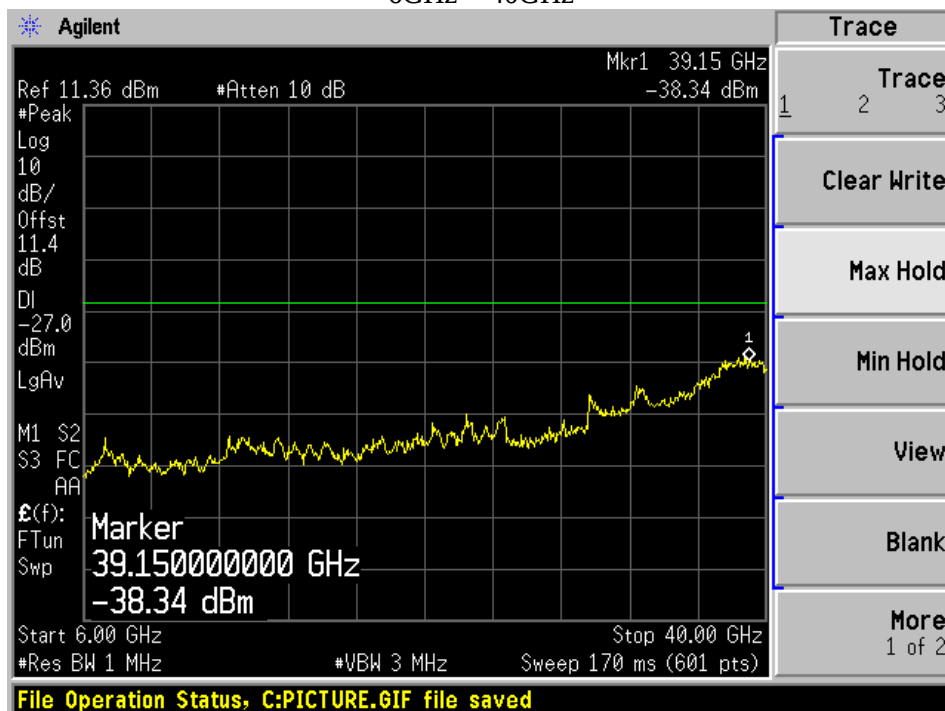
Mid Channel Ant B

30MHz – 6GHz



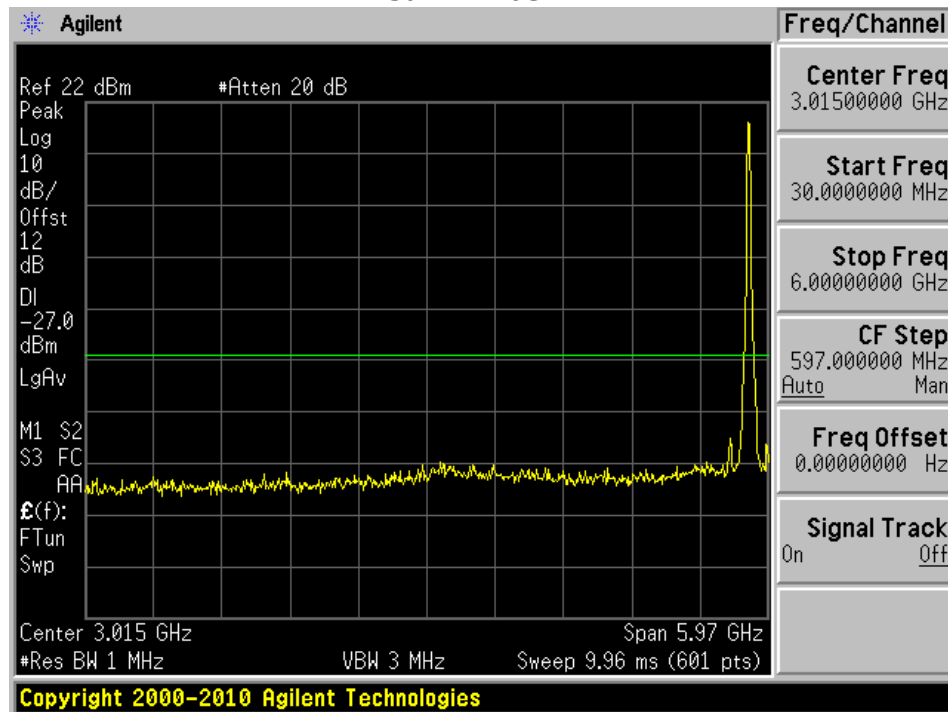
Mid Channel Ant B

6GHz - 40GHz



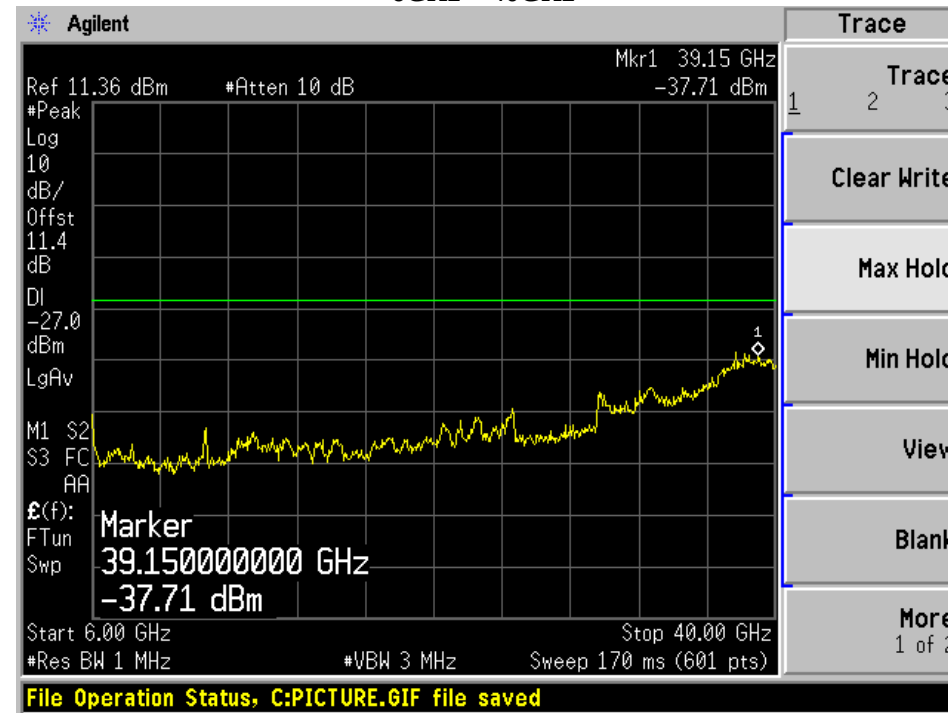
High Channel Ant A

30MHz – 6GHz



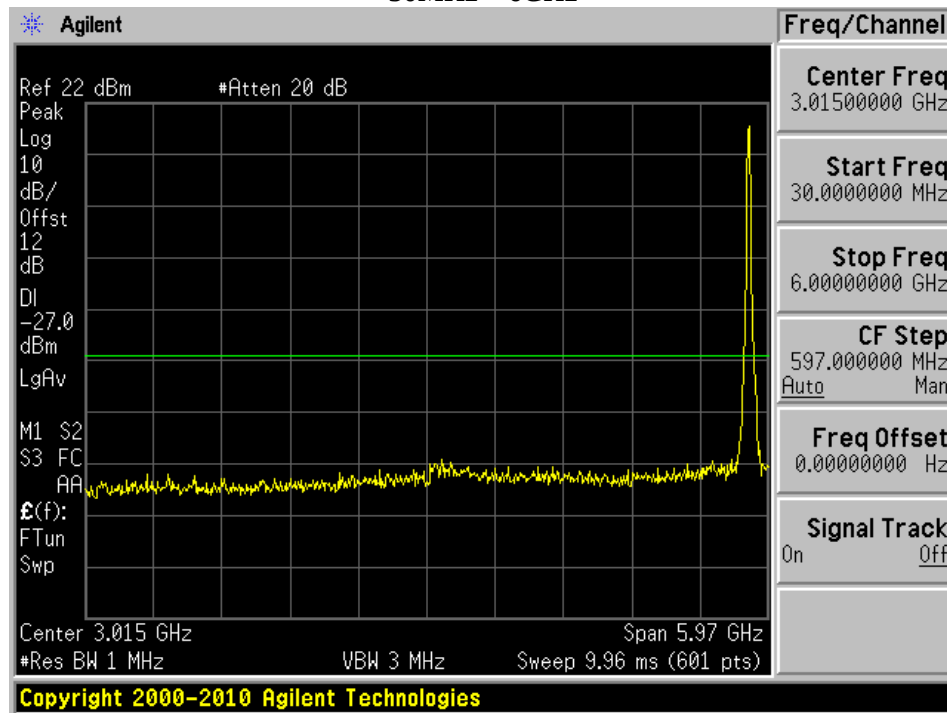
High Channel Ant A

6GHz – 40GHz



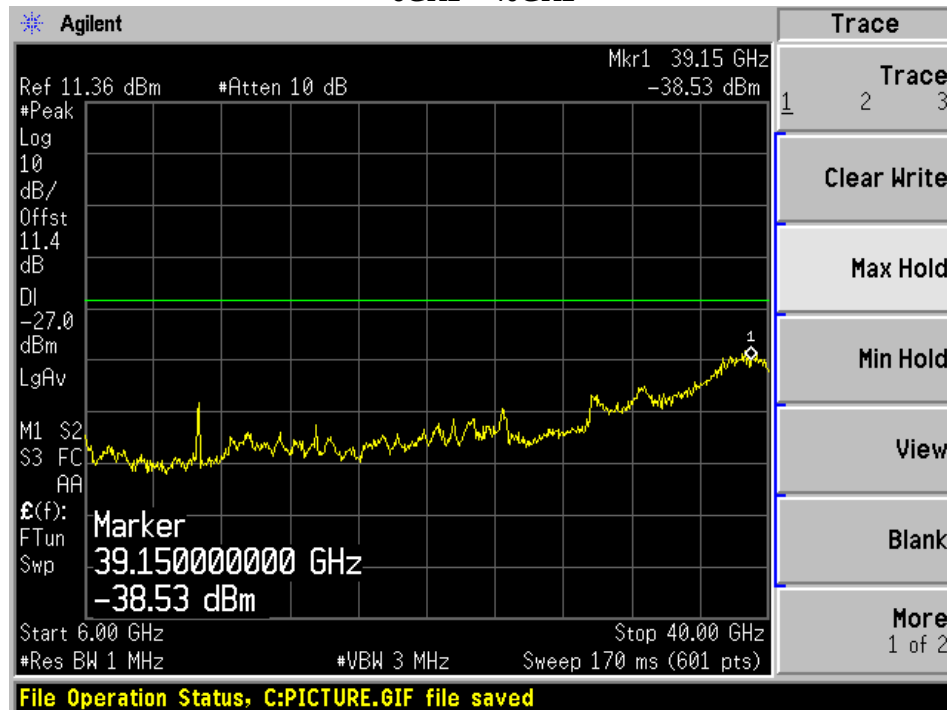
High Channel Ant B

30MHz – 6GHz



High Channel Ant B

6GHz – 40GHz

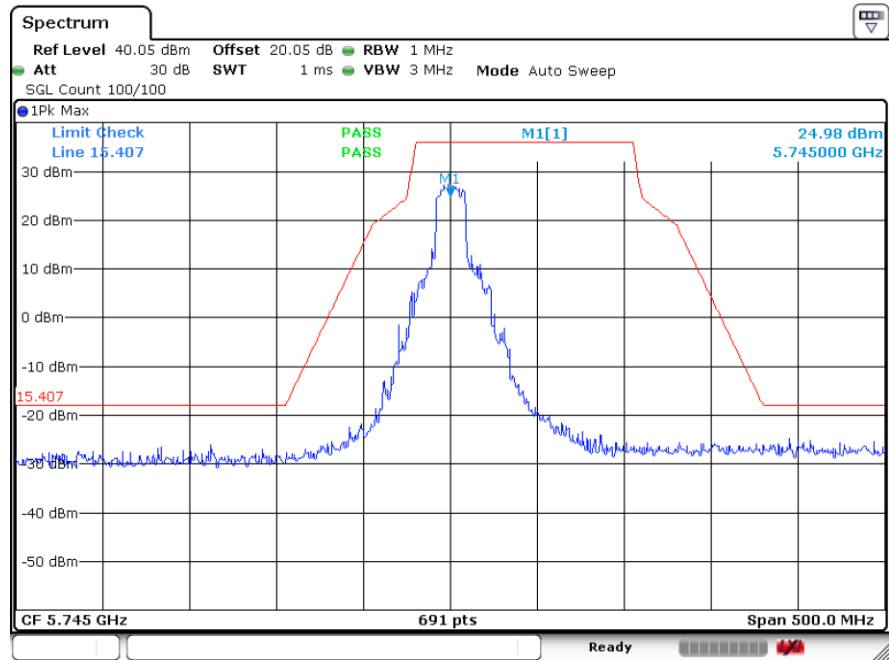


Note: Emission above limit line is fundamental

5.8 GHz Masked Emissions

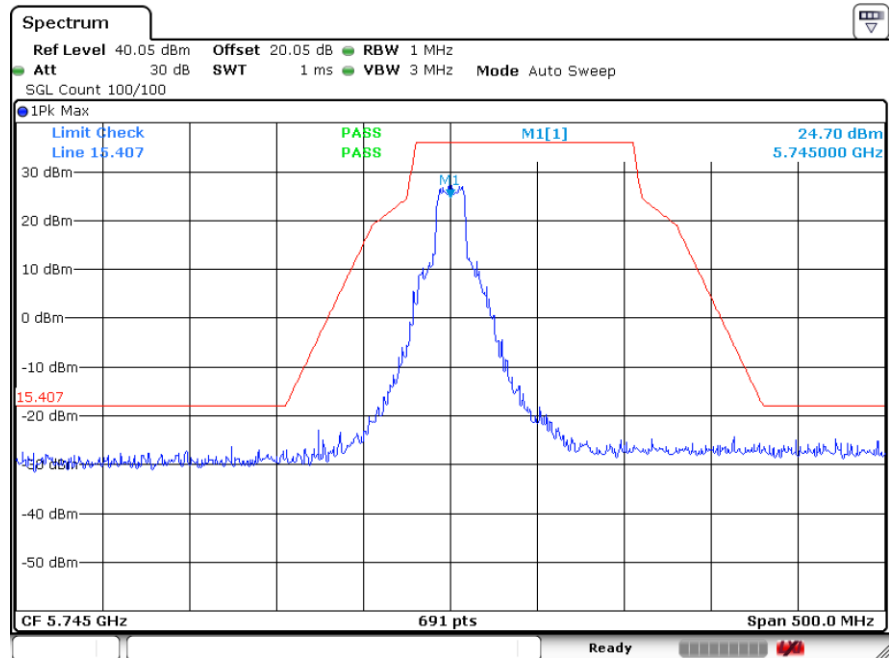
802.11a

Low Channel Ant A



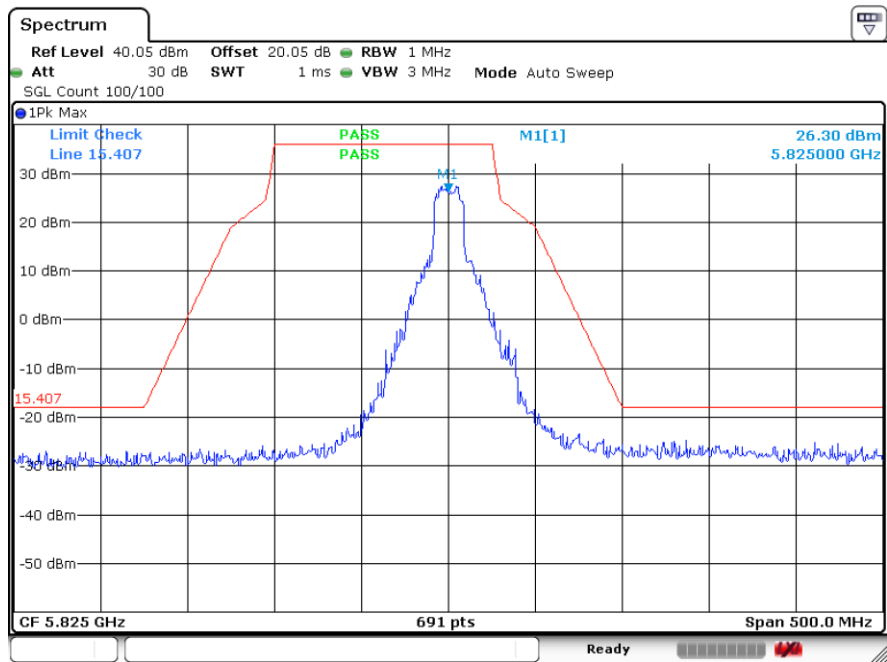
Date: 23 JUN 2022 10:05:49

Low Channel Ant B



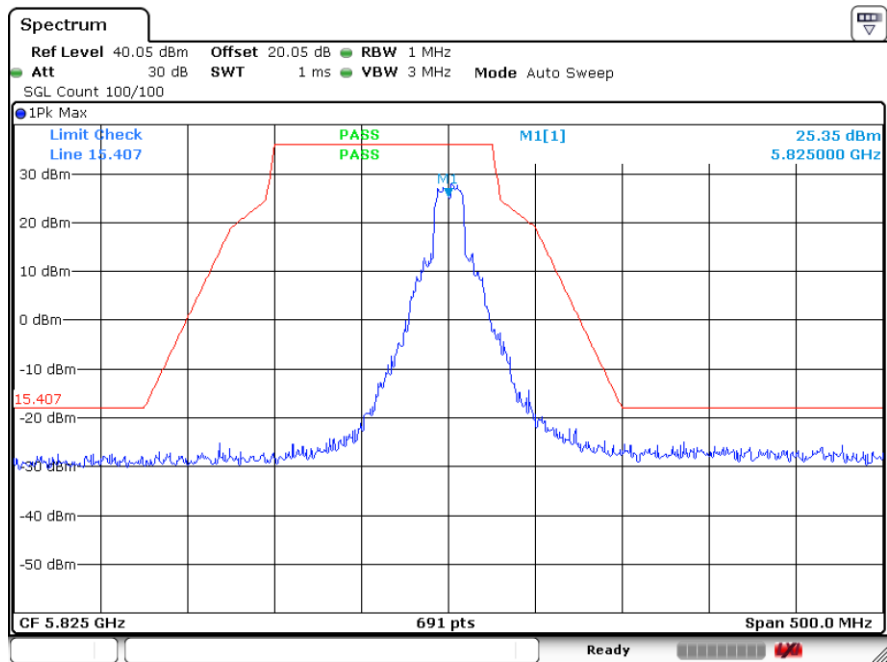
Date: 23 JUN 2022 10:06:47

High Channel Ant A



Date: 23 JUN 2022 10:14:37

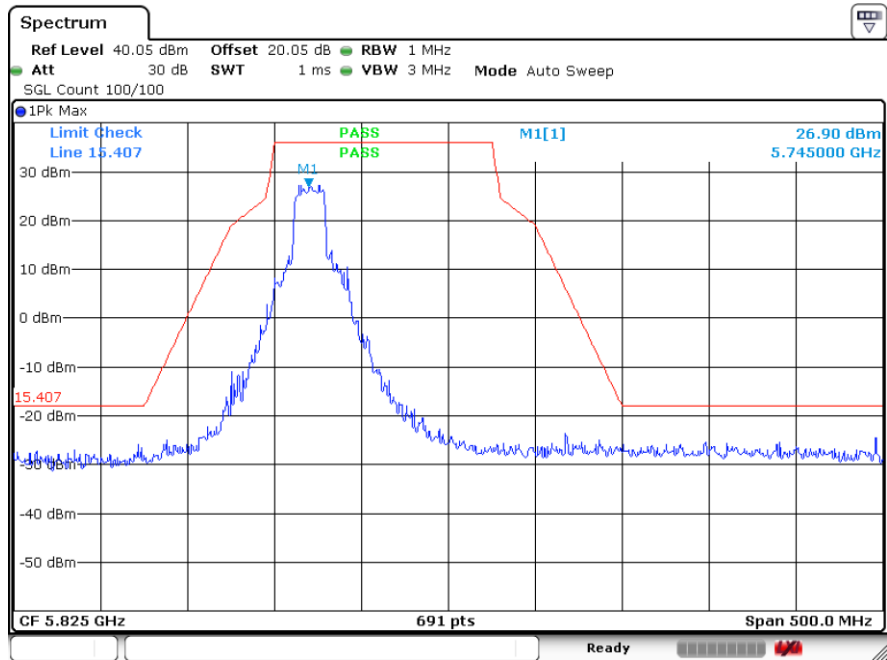
High Channel Ant B



Date: 23 JUN 2022 10:15:38

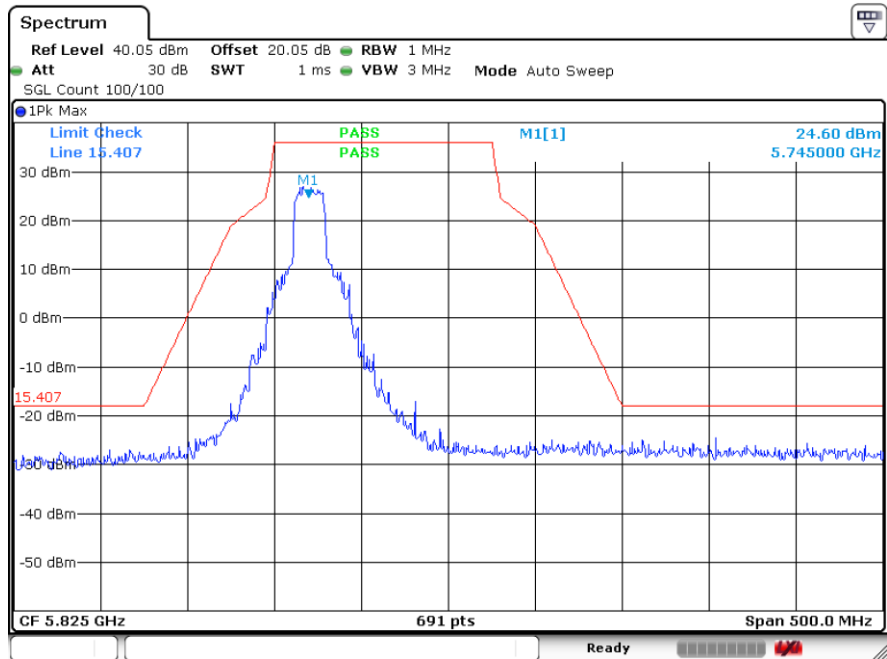
802.11n20

Low Channel Ant A



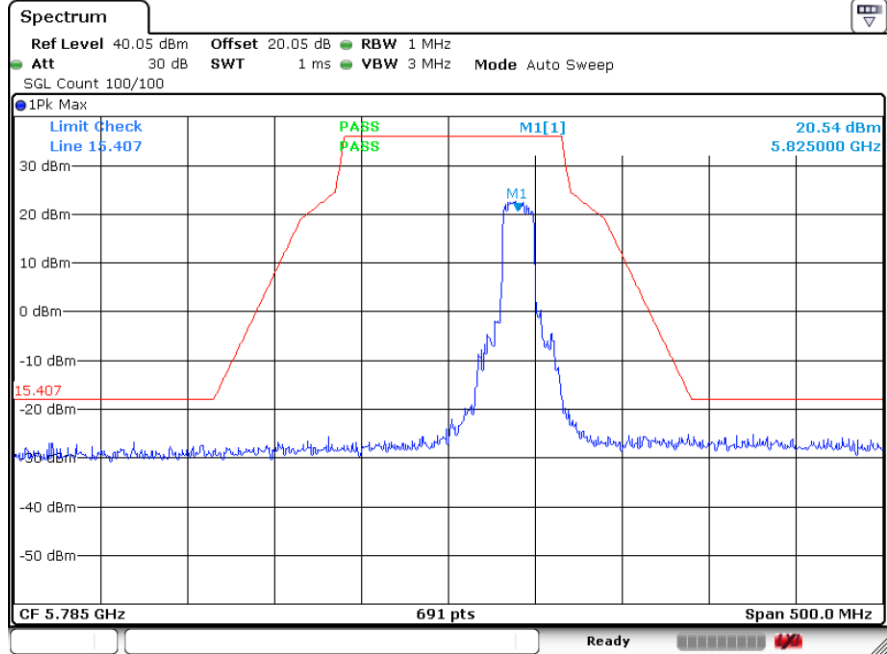
Date: 23 JUN.2022 10:21:10

Low Channel Ant B



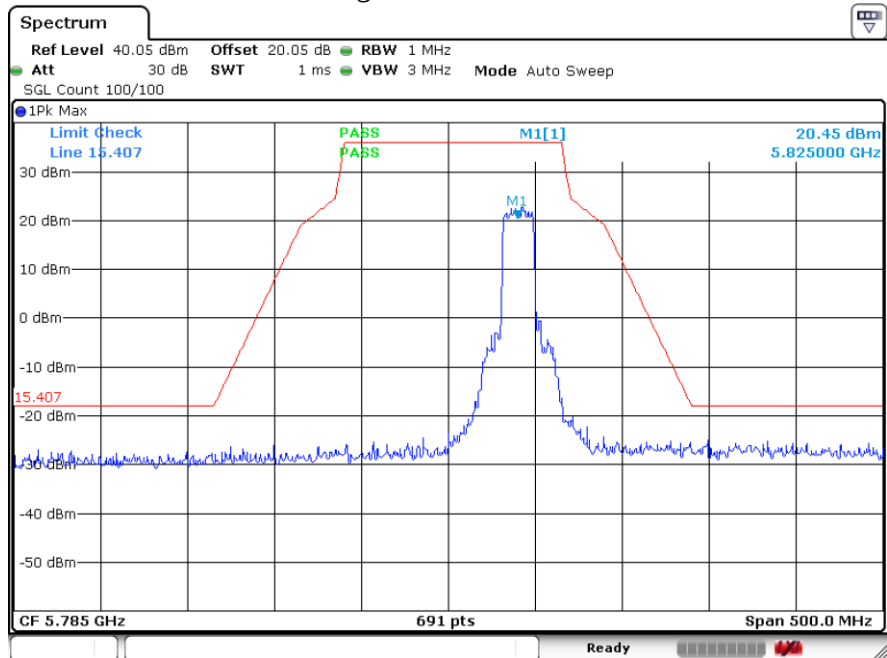
Date: 23 JUN.2022 10:22:23

High Channel Ant A



Date: 23 JUN 2022 10:26:32

High Channel Ant B

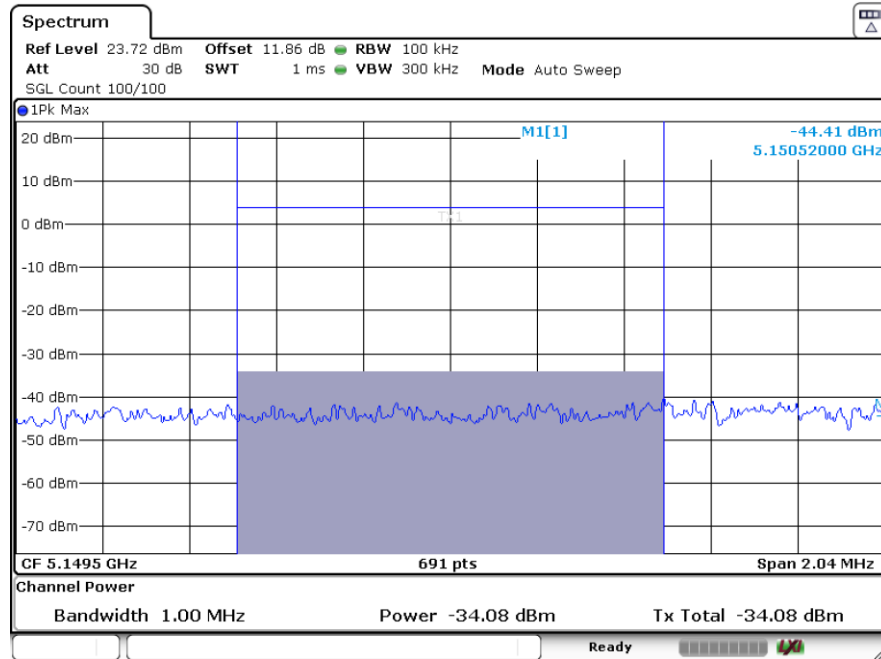


Date: 23 JUN 2022 10:27:25

Band Edges

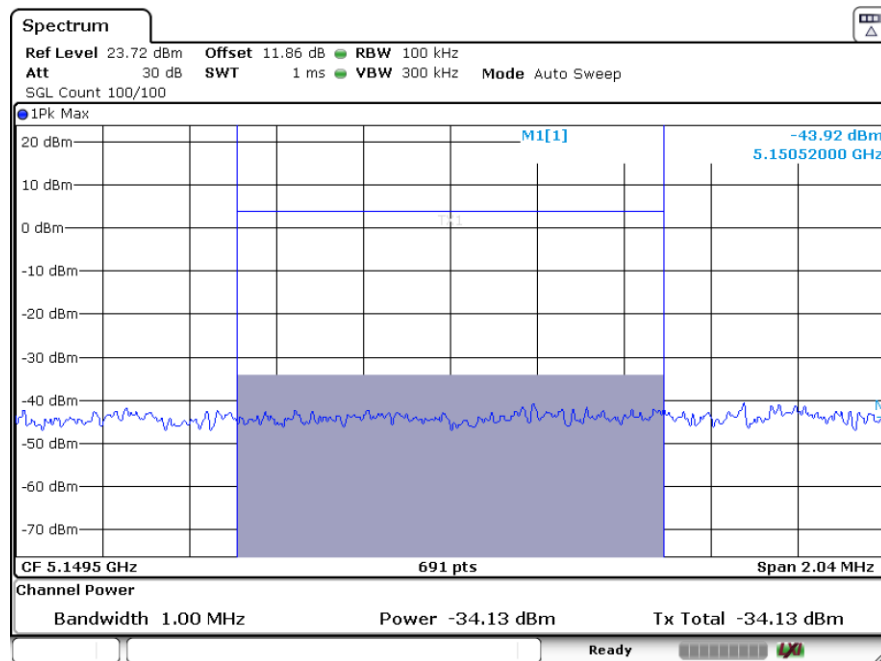
5150 - 5250 MHz 802.11a

Low Channel Ant A



Date: 22 JUN 2022 16:32:54

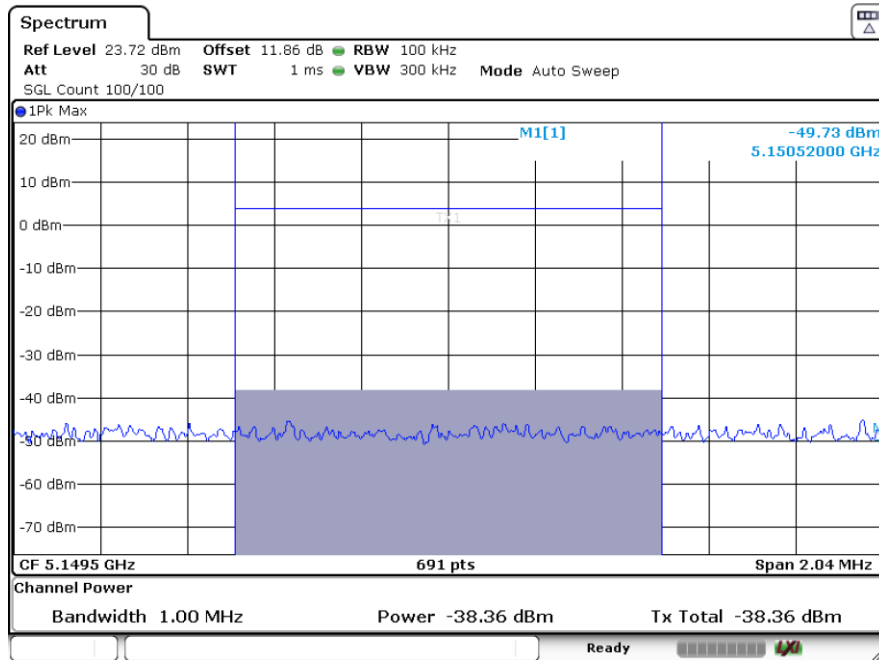
Low Channel Ant B



Date: 22 JUN 2022 16:33:46

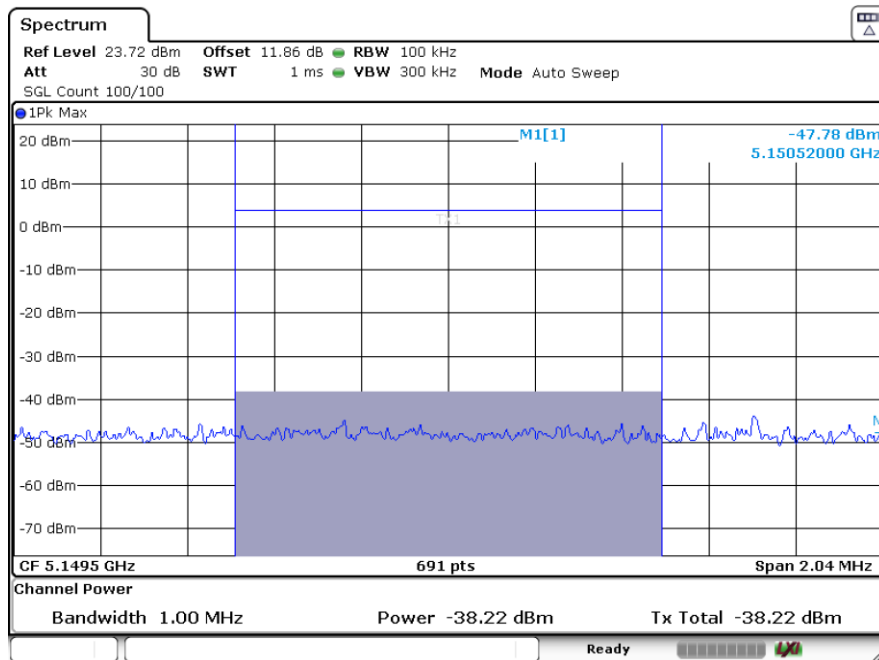
5150 - 5250 MHz 802.11n20

Low Channel Ant A



Date: 22 JUN 2022 16:31:02

Low Channel Ant B



Date: 22 JUN 2022 16:29:50

Note: Antenna Gain is considered into offset.

11 Annex A (Normative) – EUT Test Setup Photographs

Please refer to the attachment.

12 Annex B (Normative) – EUT External Photographs

Please refer to the attachment.

13 Annex C (Normative) – EUT Internal Photographs

Please refer to the attachment.

14 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.

A blue ink signature of Trace McInturff.

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 ---