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

TEST REPORT

For

Roku, Inc.

1155 Coleman Avenue,
San Jose, CA 95110, USA

FCC ID: TC2-R1016
IC: 5959A-R1016

Report Type:	**Product Type:**
Class II Permissive Change Report	IP-STB

Prepared By:	Christian McCaig RF Lead Engineer
Report Number:	R2111301-407
Report Date:	2022-02-18
Reviewed By:	Zhao Zhao RF Project Engineer

Bay Area Compliance Laboratories Corp.
1274 Anvilwood Avenue,
Sunnyvale, CA 94089, USA
Tel: +1 (408) 732-9162
Fax: +1 (408) 732-9164

ACCREDITED
CERTIFICATE #3297.02

TABLE OF CONTENTS

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2111301-407	CIIPC Report	2022-02-18

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: *4670X*, *FCC ID: TC2-R1016*, *IC: 5959A-R1016*, or the "EUT" as referred to in this report. The EUT has 2.4 GHz/5 GHz Wi-Fi capabilities. The previous model: 4660X and the updated tested model: 4670X were declared to be electrically identical. Please refer to the manufacturer declaration of similarity letter in Annex D of this report.

1.2 Mechanical Description of EUT

4670X measures approximately 12.4 cm (Length), 12.4 cm (Width), and 1.9 cm (Height) and weighs approximately 0.2 kg.

The data gathered are from a production sample provided by Roku, Inc. with BACL assigned serial numbers: KWA036914655 & KWA034762617.

1.3 Objective

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

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

This report was for a Permissive Change II submission for the purpose of enabling 40MHz and 80MHz bandwidth capabilities and adding additional memory.

1.4 Related Submittal(s)/Grant(s)

Equipment Class: DTS, FCC ID: TC2-R1016, IC: 5959A-R1016

1.5 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.

1.6 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 %

1.7 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.

1.8 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

A- ***An independent, 3rd-Party, Commercial Test Laboratory accredited to ISO/IEC 17025:2017 by A2LA (Test Laboratory Accreditation Certificate Number 3297.02),*** in the fields of: Electromagnetic Compatibility and Telecommunications. Unless noted by an Asterisk (*) in the Compliance Matrix (See Section 3 of this Test Report), BACL's ISO/IEC 17025:2017 Scope of Accreditation includes all of the Test Method Standards and/or the Product Family Standards detailed in this Test Report..

BACL's ISO/IEC 17025:2017 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices,

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

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

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

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

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

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

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

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

5 Other
- For Water Coolers (ver. 3.0)

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

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

2 EUT Test Configuration

2.1 Justification

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

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
802.11n/ac40	5190	44	44
	5230	55	55
	5755	62	62
	5795	62	62
802.11ac80	5210	44	44
	5775	56	56

*Data rates tested:

802.11n/ac40 HT40/VHT40: MCS0
802.11ac80 VHT80: MCS0

2.3 Duty Cycle Correction Factor

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

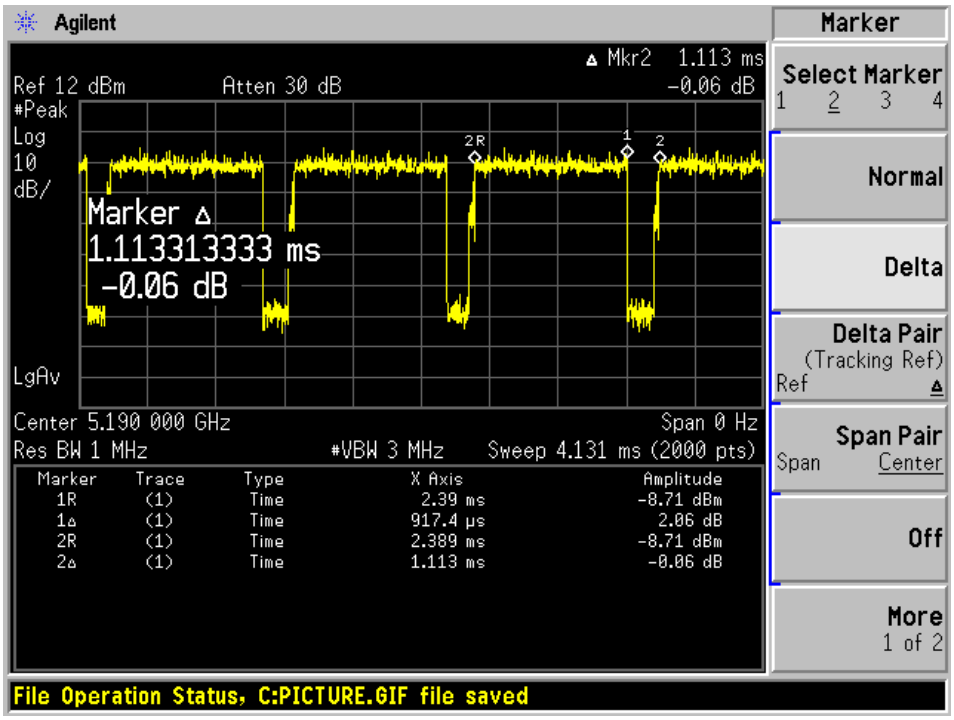
All measurements are to be performed with the EUT transmitting at 100% duty cycle at its maximum power control level; however, if 100% duty cycle cannot be achieved, measurements of duty cycle, x, and maximum-power transmission duration, T, are required for each tested mode of operation.

Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11n/ac40	0.9174	1.113	82.43	0.84
802.11ac80	0.4248	0.5947	71.43	1.46

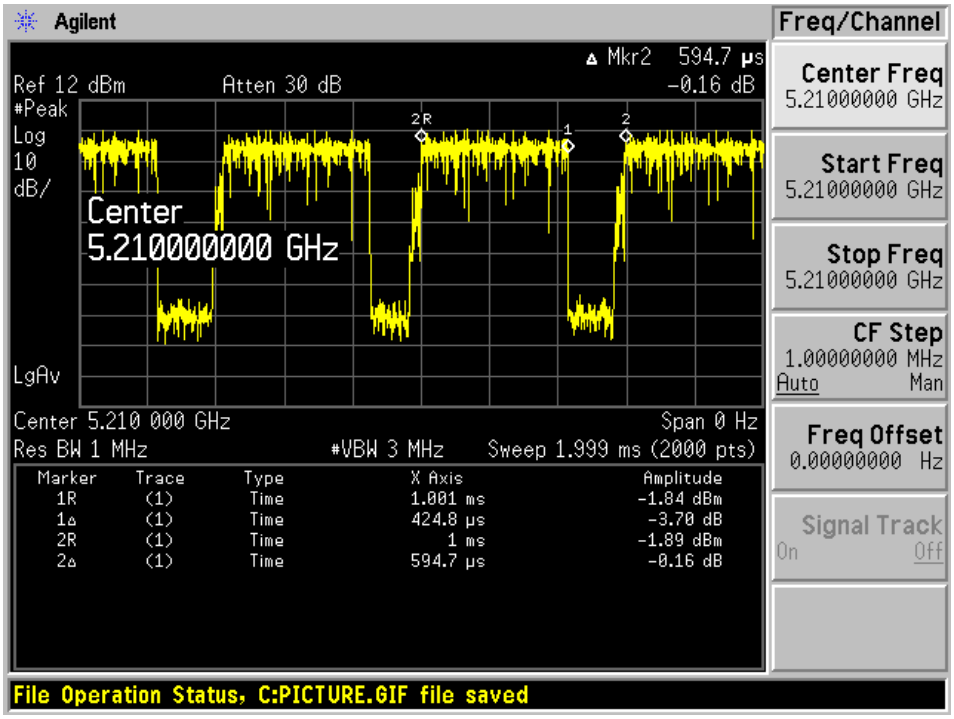
Note: Duty Cycle Correction Factor = 10*log(1/duty cycle)

Please refer to the following plots.

802.11n/ac40 mode



802.11ac80 mode



2.4 Equipment Modifications

N/A

2.5 Local Support Equipment

Manufacturer	Description	Model
Dell	Laptop	Latitude E6410

2.6 Support Equipment

Manufacturer	Description	Model
Roku, Inc.	Debug Board	-

2.7 Interface Ports and Cabling

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

3 Summary of Test Results

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

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

4.1 Applicable Standards

According to FCC §15.407(f) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

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

Limits for General Population/Uncontrolled Exposure

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

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

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

According to ISED RSS-102 Issue 5:

2.5.2 Exemption Limits for Routine Evaluation – RF Exposure Evaluation

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz[6] and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

4.2 MPE Prediction

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

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

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

Note: According to MIMOFCC KDB 662911 D02 MIMO with Cross Polarized Antenna v01, Where an FCC rule specifies limits in radiated terms such as EIRP or ERP; the limits apply to the maximum emission that would be observed by a linearly polarized measurement antenna. Therefore, the highest output power from single antenna power was selected to calculate in this section.

4.3 MPE Results

Radio Standalone RF Exposure Configuration

5 GHz Wi-Fi: 802.11n/ac40 mode, 5795 MHz

Maximum output power at antenna input terminal (dBm):	19.63
Maximum output power at antenna input terminal (mW):	91.83
Prediction distance (cm):	20
Prediction frequency (MHz):	5795
Maximum Antenna Gain, typical (dBi):	5.4
Maximum Antenna Gain (numeric):	3.47
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0634
FCC MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

The device is compliant with the requirement FCC MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0634 mW/cm^2. Limit is 1.0 mW/cm^2.

Note: Maximum Antenna Gain used is based on Combined Antenna Gain calculation for MIMO transmitting usage (i.e. Combined Antenna Gain (dBi) = Single Antenna Gain (dBi) + 10*log(Number of Antennas)). In this case the Combined Antenna Gain is 5.4 dBi = 2.4 dBi +10*log(2).

Radio Co-location: 2.4 GHz Wi-Fi and 5 GHz Wi-Fi simultaneous transmission is not supported.

4.4 RF exposure evaluation exemption for IC

5 GHz Wi-Fi: 802.11n/ac40 mode, 5795 MHz

Maximum EIRP power = 19.63 dBm + 5.4 dBi = 25.03 dBm which is less than $1.31\times10^{-2}f^{0.6834}$ = 4.89 W = 36.89 dBm

Therefore the RF exposure Evaluation is not required.

Note: Maximum Antenna Gain used is based on Combined Antenna Gain calculation for MIMO transmitting usage (i.e. Combined Antenna Gain (dBi) = Single Antenna Gain (dBi) + 10*log(Number of Antennas)). In this case the Combined Antenna Gain is 5.4 dBi = 2.4 dBi +10*log(2).

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)
5 GHz Wi-Fi Metal Antenna (2 Antennas)	5150-5250	1.1
5 GHz Wi-Fi Metal Antenna (2 Antennas)	5725-5850	2.4

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 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

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

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

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.10-2013 measurement procedure. The specification used was FCC §15.207 limits and and ISEDC RSS GEN §8.8.

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

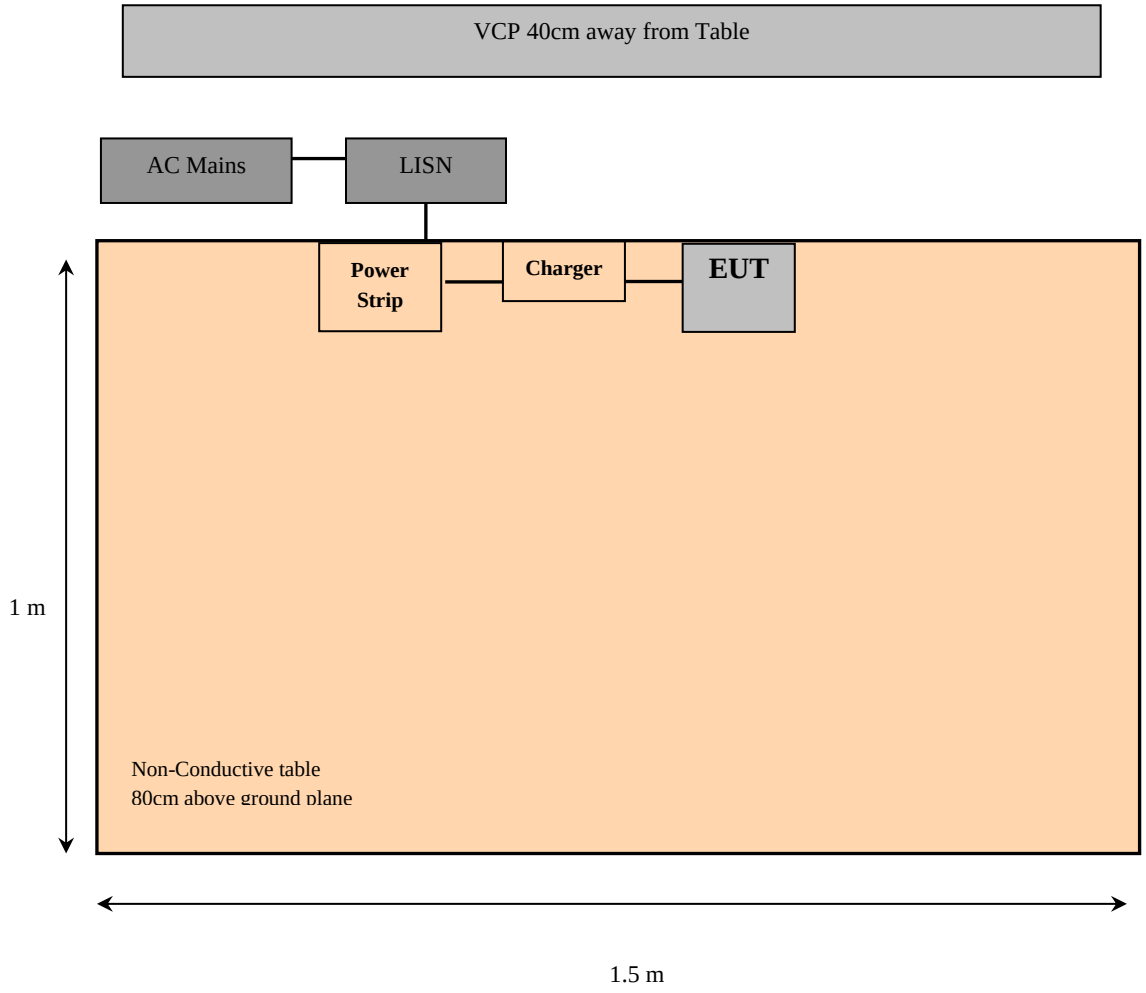
6.3 Test Procedure

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

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

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

6.4 Test Setup Block Diagram



6.5 Corrected Amplitude and Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Correction Factor (CF) to indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + 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 + LISN calibration factor + 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:

Margin = Corrected Amplitude - Limit

6.6 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
831	Rohde & Schwarz	EMI Test Receiver	ESU-40	100433	2021-09-20	1 year
679	Rohde and Schwarz	Impulse Limiter	ESH3-Z2	101964	2021-07-07	1 year
725	Solar Electronics Company	High Pass Filter	Type 7930-100	7930150202	2021-03-02	1 year
1226	Suirong	30 ft conductive emission cable	LMR 400	-	N/R	N/A
733	FCC	LISN	FCC-LISN-50-25-2-10-CISPR16	160130	2021-11-24	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:	20º C
Relative Humidity:	55 %
ATM Pressure:	102.1 kPa

The testing was performed by Christian McCaig on 2022-01-11 in the Ground Plane test site.

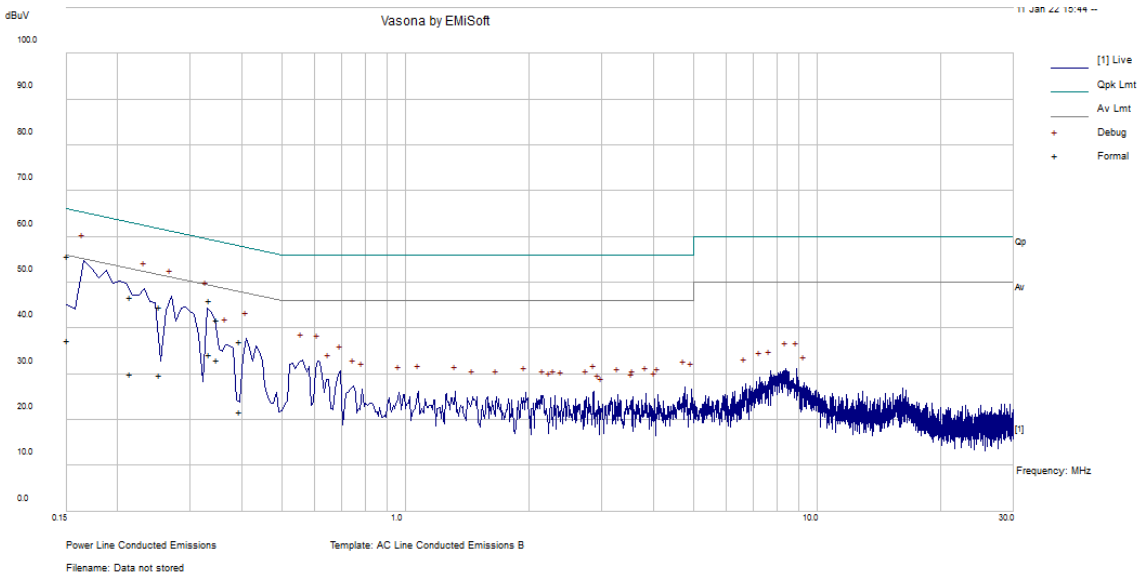
6.8 Summary of Test Results

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)**
-10.08	0.151155	Live	0.15-30

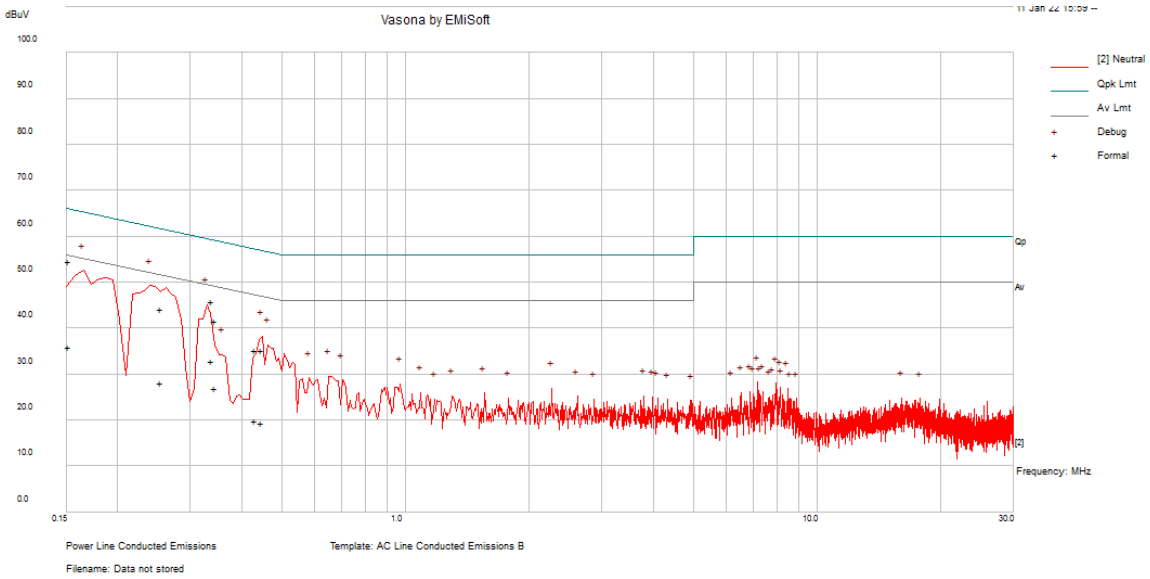
6.9 Conducted Emissions Test Plots and Data

120 V, 60 Hz – Line



Frequency (MHz)	Ai. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBµV)	Limit (dBµV)	Margin (dB)	Detector
0.151155	**45.1**	**10.75**	**55.85**	**65.94**	**-10.08**	**QP**
0.215564	36.02	10.66	46.68	62.99	-16.31	QP
0.253002	33.99	10.6	44.59	61.66	-17.07	QP
0.334644	35.56	10.49	46.05	59.34	-13.28	QP
0.395168	26.68	10.42	37.1	57.95	-20.86	QP
0.348953	31.41	10.47	41.88	58.99	-17.11	QP
0.151155	26.6	10.75	37.35	55.94	-18.59	Ave
0.215564	19.46	10.67	30.13	52.99	-22.86	Ave
0.253002	19.16	10.59	29.75	51.66	-21.9	Ave
0.334644	23.8	10.48	34.28	49.34	-15.05	Ave
0.395168	11.45	10.41	21.86	47.95	-26.09	Ave
0.348953	22.69	10.47	33.16	48.99	-15.83	Ave

120 V, 60 Hz – Neutral



Frequency (MHz)	Ai. Reading (dBuV)	Correction Factor (dB)	Corrected Amplitude (dBµV)	Limit (dBµV)	Margin (dB)	Detector
0.151983	43.82	10.75	54.57	65.89	-11.32	QP
0.254616	33.65	10.59	44.24	61.61	-17.36	QP
0.337956	35.46	10.49	45.95	59.25	-13.31	QP
0.431508	24.94	10.38	35.32	57.22	-21.91	QP
0.448593	24.74	10.36	35.1	56.9	-21.8	QP
0.34509	31.06	10.47	41.53	59.08	-17.55	QP
0.151983	25.1	10.74	35.84	55.89	-20.05	Ave
0.254616	17.62	10.6	28.22	51.61	-23.39	Ave
0.337956	22.42	10.48	32.9	49.25	-16.35	Ave
0.431508	9.55	10.38	19.93	47.22	-27.29	Ave
0.448593	9.13	10.36	19.49	46.9	-27.41	Ave
0.34509	16.47	10.47	26.94	49.08	-22.14	Ave

7 FCC §15.209, §15.407(b) & ISEDC RSS-247 §6.2 - Spurious Radiated Emissions

7.1 Applicable Standard

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

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

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

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

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

As per FCC Part 15.407 (b)

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

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

(3) For transmitters operating in the 5.47 -5.725 GHz band: All emissions outside of the 5.47-5725 GHz band shall not exceed an ei.r.p. of -27 dBm/MHz.

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

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

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

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

As per ISEDC RSS-247 §6.2

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

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

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

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

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

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

7.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.10-2013. The specification used was the FCC 15.407 and ISEDC RSS-247 limits.

The spacing between the peripherals was 10 centimeters.

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

7.3 Test Procedure

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

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

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

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

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

Above 1000 MHz:

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

7.4 Corrected Amplitude and Margin Calculation

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

CA = Ai + AF + CL + Atten – Ga

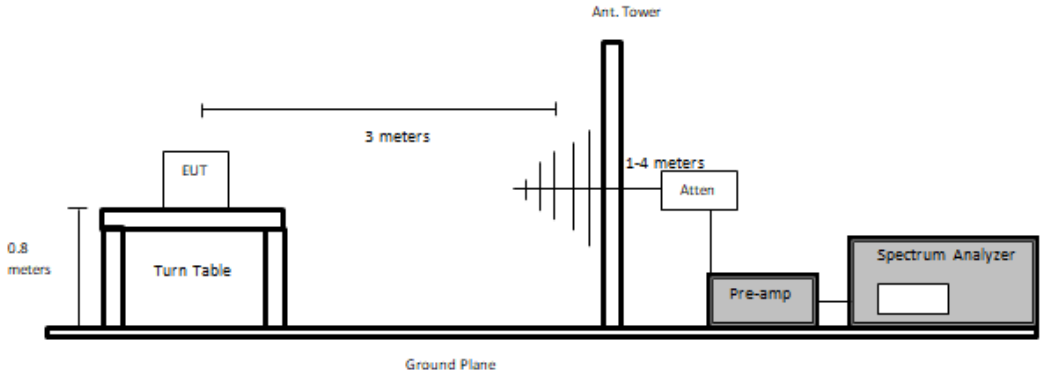
For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

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

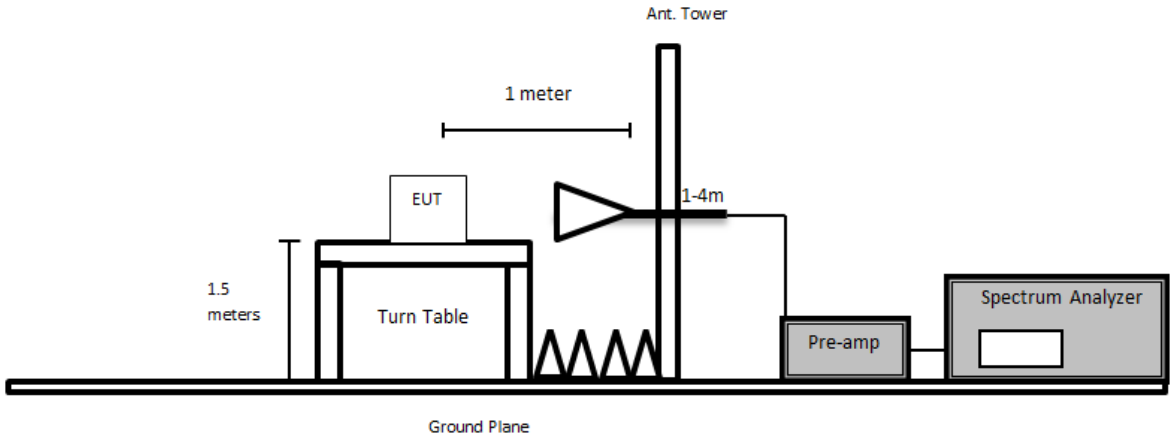
Margin = Corrected Amplitude – Limit

7.5 Test Setup Block Diagram

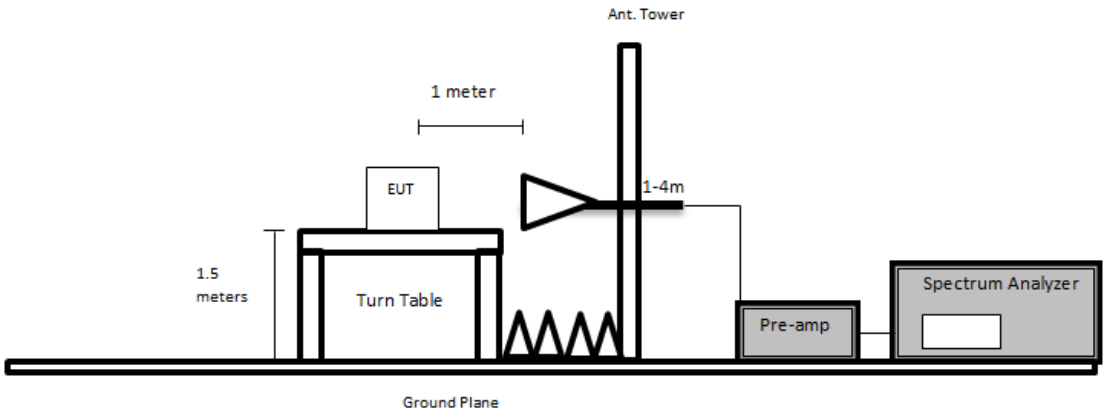
Below 1GHz:



1 GHz to 18 GHz (Asset #1192 Antenna used):



18 GHz to 40 GHz (Asset #91 and #92 Antennas used):



7.6 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
831	Rohde & Schwarz	EMI Test Receiver	ESU-40	100433	2021-09-20	1 year
287	Agilent	Spectrum Analyzer	E4446A	US44300386	2021-04-27	1 year
-	Sunol Science Corp	System Controller	SC110V	122303-1	N/R	N/A
459	HP	Pre-Amplifier	8447D	2443A04374	2021-11-02	1 year
658	HP	Pre-Amplifier	8449B OPT HO2	3008A0113	2021-05-06	1 year
91	Wisewave	Horn Antenna	ARH-4223-02	10555-02	2020-02-05	2 years
92	Wisewave	Antenna, Horn	ARH-2823-02	10555-01	2020-02-05	2 years
827	AH Systems	Preamplifier	PAM 1840 VH	170	2021-08-03	1 year
1192	ETS Lindgren	Horn Antenna	3117	00218973	2021-09-14	2 years
321	Sunol Sciences	Biconilog Antenna	JB3	A020106-2	2021-11-22	2 years
-	-	RF cable	-	-	Each time[1]	N/A
-	-	Notch Filter	-	-	Each time[1]	N/A
1077	Insulted Wire Corp.	157 Series 2.92 SM (x2) Armored 33 ft. Cable	KPS-1571AN-3960-KPS	DC 1917	2021-03-03	1 year
1081	MDP Digital	Times Microwave LMR 400 UltraFex Coaxial Cable 35\'	LMR400UF	BACL1904161	2021-06-18	1 year
1101	IW Microwave	157 Series Cable Armored with 2.92mm Male Plugs	KPS-1571AN-2400	DC 1922	2021-07-06	1 year

Note[1]: equipment 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:	16.7 ºC
Relative Humidity:	50 %
ATM Pressure:	102.7 kPa

The testing was performed by Deepak Mishra and Christian McCaig from 2021-12-09 to 2022-01-24 in 5m chamber 3.

7.8 Summary of Test Results

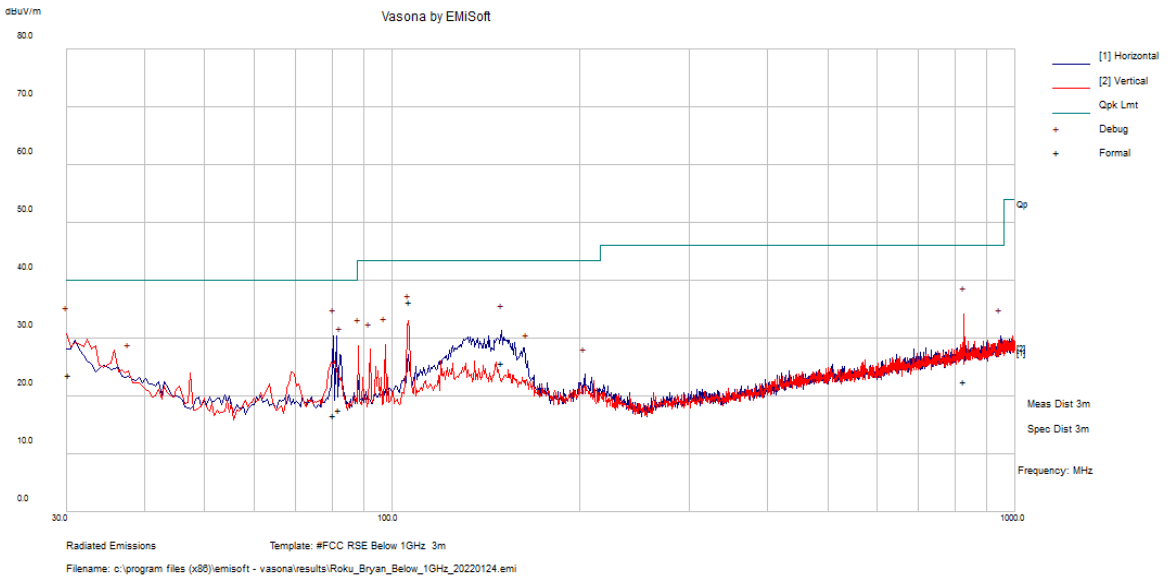
According to the data hereinafter, the EUT complied with the FCC Part 15.407 and RSS-247 standards' radiated emissions limits, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, Channel**
-0.55	5150	Vertical	802.11n/ac40, 5795 MHz, Antenna A+B

7.9 Radiated Emissions Test Result Data

1) 30 MHz – 1 GHz at 3 meters

Worst Case: 802.11n/ac40, 5795 MHz, Antenna A+B



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
30.234738	21.33	2.29	23.62	277	H	46	40	-16.38	Pass
80.4215	27.56	-10.9	16.66	102	V	28	40	-23.34	Pass
106.482	42.38	-6.16	36.22	237	V	41	43.5	-7.28	Pass
827.45325	18.19	4.34	22.53	165	V	27	46	-23.47	Pass
150.03	31.62	-5.82	25.8	287	H	57	43.5	-17.7	Pass
82.33625	28.63	-11.04	17.59	282	V	15	40	-22.41	Pass

2) 1 – 18 GHz, measured at 1 meter

802.11n/ac40 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 5190 MHz											
5150	69.86	8	150	H	35.532	8.336	38.142	75.59	78.20	-2.41	Peak
5150	71.72	300	115	V	35.532	8.336	38.142	77.45	78.20	-0.55	Peak
5150	57.10	8	150	H	35.532	8.336	38.142	62.83	64.00	-1.17	Ave
5150	56.89	300	115	V	35.532	8.336	38.142	62.62	64.00	-1.39	Ave
10380	50.28	360	150	H	37.959	13.353	38.364	63.23	78.20	-14.77	Peak
10380	52.76	70	150	V	37.959	13.353	38.364	65.71	78.20	-12.29	Peak
High Channel: 5230 MHz											
10460	56.74	230	127	H	38.194	13.353	38.05	70.24	78.20	-7.76	Peak
10460	56.75	65	150	V	38.194	13.353	38.05	70.25	78.20	-7.75	Peak
Low Channel 5755 MHz											
5625-5650	64.49	215	150	V	35.24	9.47	37.90	71.30	78.20	-6.90	Peak
5650-5700	75.5	304	137	V	35.24	9.47	37.90	82.31	112.86	-30.55	Peak
5700-5720	89.78	230	127	V	35.24	9.47	37.90	96.59	121.25	-24.66	Peak
5720-5725	90.59	32	137	V	35.24	9.47	37.90	97.40	125.16	-27.76	Peak
11510	45.58	196	150	H	38.757	13.88	37.781	60.44	84.00	-23.56	Peak
11510	49.48	43	135	V	38.757	13.88	37.781	64.34	84.00	-19.66	Peak
11510	36.18	196	150	H	38.757	13.88	37.781	51.04	64.00	-12.96	Ave
11510	39.94	43	135	V	38.757	13.88	37.781	54.79	64.00	-9.21	Ave
High Channel 5795 MHz											
5850-5855	63.68	329	150	V	35.53	9.47	37.95	70.73	130.86	-60.13	Peak
5855-5875	60.83	332	134	V	35.53	9.47	37.95	67.88	120.41	-52.53	Peak
5875-5925	59.97	171	150	V	35.53	9.47	37.95	67.02	109.98	-42.95	Peak
5925-5950	60.36	0	150	V	35.53	9.47	37.95	67.41	78.20	-10.79	Peak
11590	47.72	258	150	H	38.822	13.88	37.781	62.64	84.00	-21.36	Peak
11590	50.45	215	139	V	38.822	13.88	37.781	65.37	84.00	-18.63	Peak
11590	37.024	258	150	H	38.822	13.88	37.781	51.95	64.00	-12.06	Ave
11590	40.338	215	139	V	38.822	13.88	37.781	55.26	64.00	-8.74	Ave

Note: For harmonics outside of restricted bands, only 15.407(b) spurious emission limit was applied (i.e. -27 dBm [78.20dBµV/m at 1meter]).
Note: For 5.2 GHz band edge, stricter 15.407(b) spurious emission limit (i.e. -27 dBm [78.20dBµV/m at 1meter]) was used for peak measurement to show compliance.

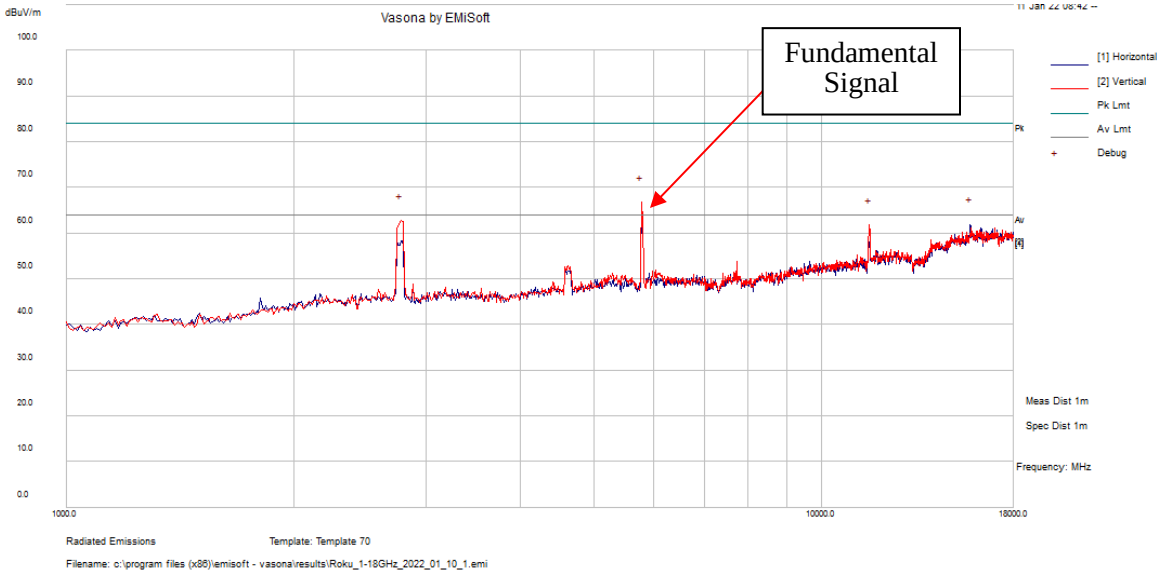
802.11ac80 mode, Antenna A+B

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)	
5210 MHz											
5150	67.52	180	150	H	35.532	8.336	38.142	73.25	78.20	-4.75	Peak
5150	68.34	235	150	V	35.532	8.336	38.142	74.07	78.20	-3.93	Peak
5150	55.16	180	150	H	35.532	8.336	38.142	60.89	64.00	-3.11	Ave
5150	56.35	235	150	V	35.532	8.336	38.142	62.07	64.00	-1.93	Ave
10360	48.14	151	150	H	37.959	13.353	38.364	61.09	78.20	-16.91	Peak
10360	48.77	62	150	V	37.959	13.353	38.364	61.72	78.20	-16.28	Peak
5775 MHz											
5625-5650	69.54	42	150	V	35.24	9.47	37.90	76.35	78.20	-1.85	Peak
5650-5700	80.97	313	137	V	35.24	9.47	37.90	87.78	111.60	-23.83	Peak
5700-5720	81.09	32	150	V	35.24	9.47	37.90	87.90	122.15	-34.25	Peak
5720-5725	82.70	311	135	V	35.24	9.47	37.90	89.51	131.32	-41.81	Peak
5850-5855	84.69	318	150	V	35.53	9.47	37.95	91.74	105.23	-13.49	Peak
5855-5875	82.29	322	137	V	35.53	9.47	37.95	89.34	94.51	-5.17	Peak
5875-5925	76.57	311	150	V	35.53	9.47	37.95	83.62	111.53	-27.91	Peak
5925-5950	65.57	309	142	V	35.53	9.47	37.95	72.62	78.20	-5.58	Peak
11550	47.32	58	238	H	38.757	13.88	37.781	62.18	84.00	-21.82	Peak
11550	46.75	35	142	V	38.757	13.88	37.781	61.61	84.00	-22.39	Peak
11550	35.943	58	238	H	38.757	13.88	37.781	50.80	64.00	-13.20	Ave
11550	35.907	35	142	V	38.757	13.88	37.781	50.76	64.00	-13.24	Ave

Note: For harmonics outside of restricted bands, only 15.407(b) spurious emission limit was applied (i.e. -27 dBm [78.20dBµV/m at 1meter]).
Note: For 5.2 GHz band edge, stricter 15.407(b) spurious emission limit (i.e. -27 dBm [78.20dBµV/m at 1meter]) was used for peak measurement to show compliance.

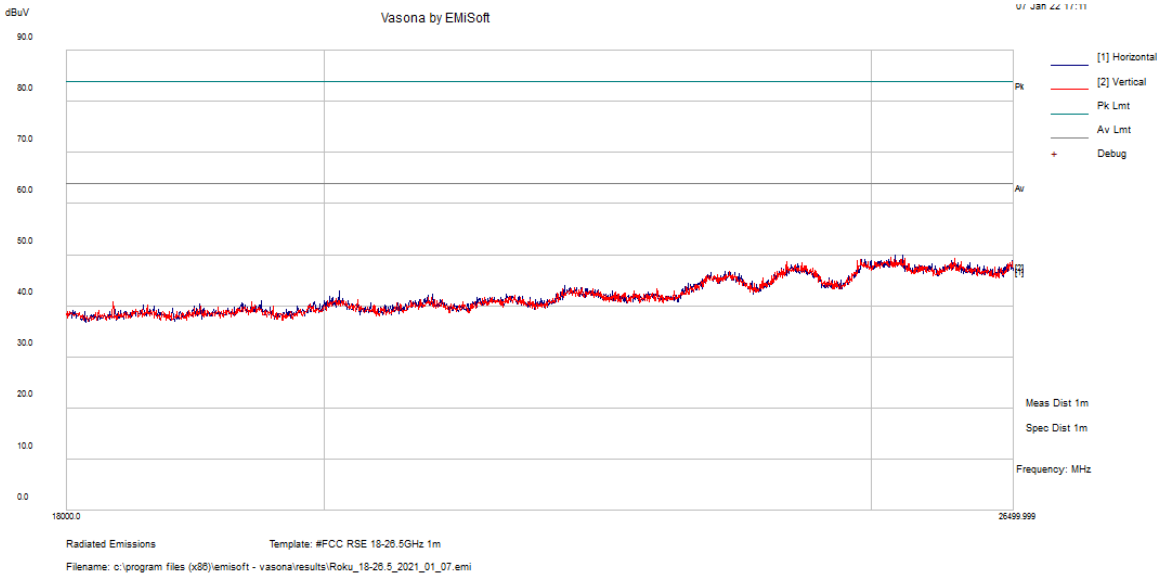
3) to 18 GHz Vasona scan at 1 meter

Worst Case: 802.11n/ac40, 5795 MHz, Antenna A+B



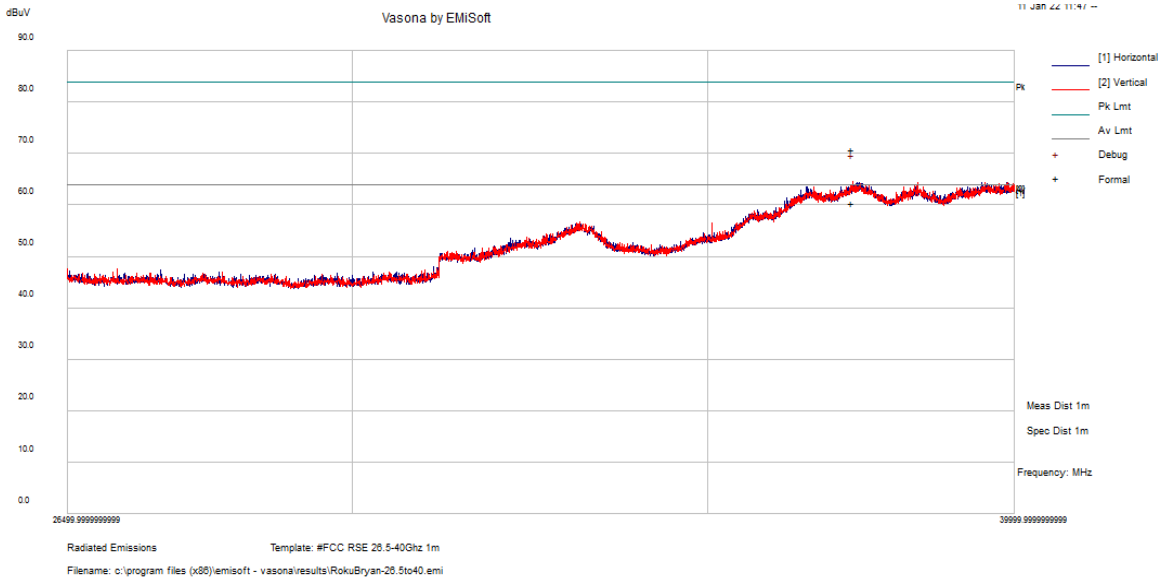
4) 18 – 26.5 GHz Worst Case Scan at 1 Meter

Worst Case: 802.11n/ac40, 5795 MHz, Antenna A+B



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

Worst Case: 802.11n/ac40, 5795 MHz, Antenna A+B



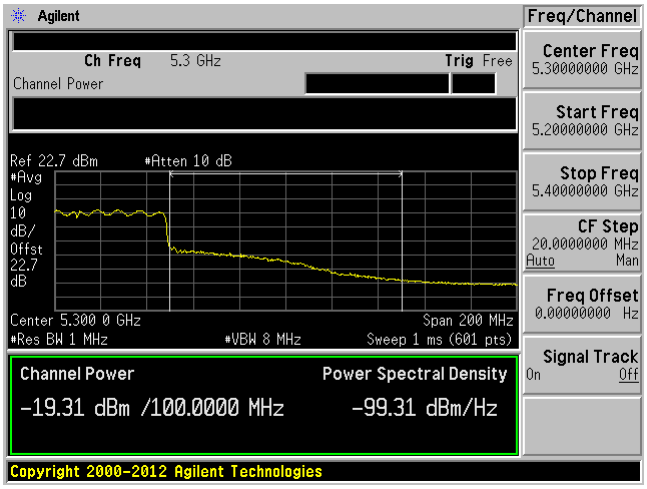
Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
37275.538	54.53	16.24	70.77	105	V	129	84	-13.23	Peak
37275.538	44.15	16.24	60.39	105	V	129	64	-3.61	Ave

ISEDC Emission falling into 5250 – 5350 MHz

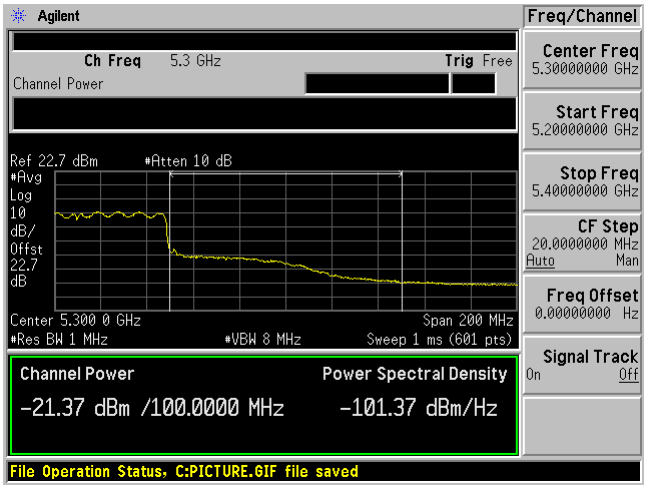
Channel	Frequency (MHz)	Conducted Output Power (dBm)		Conducted Emission Power (dBm)		Delta (dB)		Limit (dB)
		ANT A	ANT A	ANT A	ANT B	ANT A	ANT B	
802.11n/ac40								
46	5230	16.49	14.8	-11.83	-17.13	28.32	31.93	>26
802.11ac80								
42	5210	12.03	10.85	-19.31	-21.37	31.34	32.22	>26

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

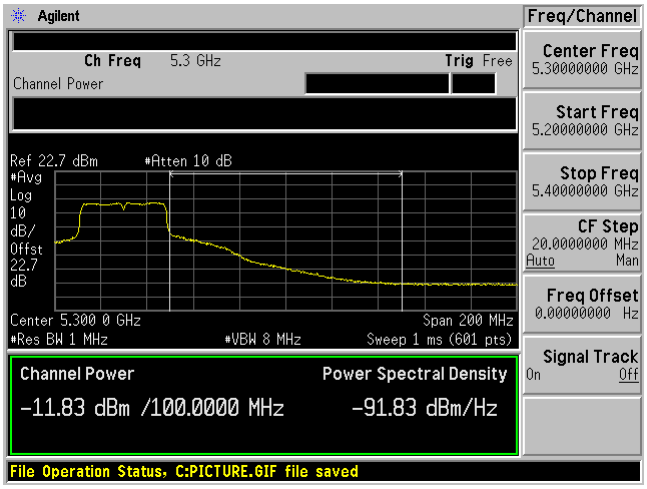
5230MHz Antenna A



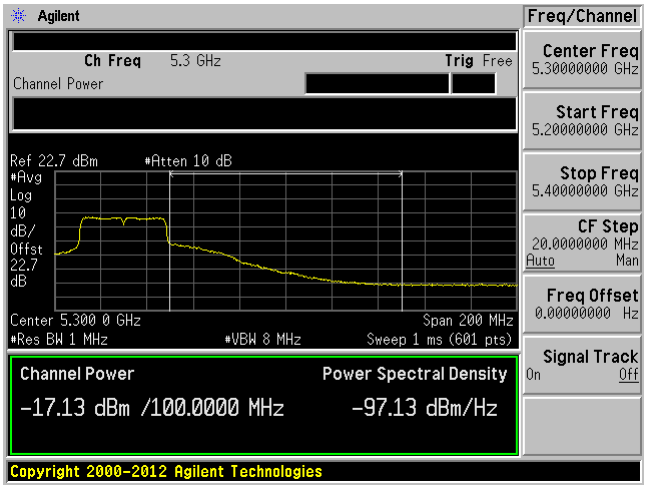
5230MHz Antenna B



5210MHz Antenna A



5210MHz Antenna B



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

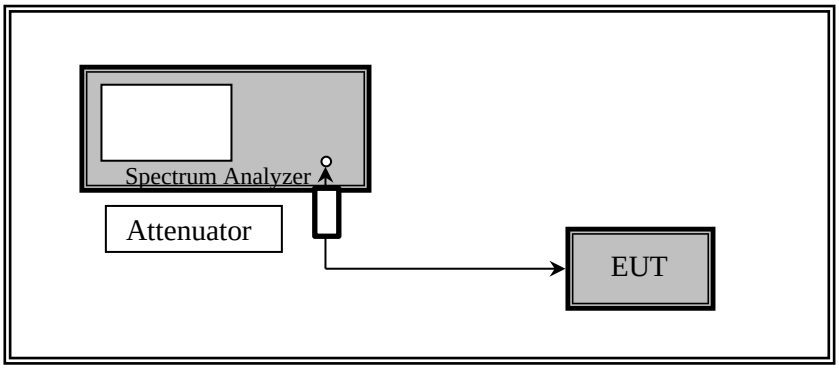
8.1 Applicable Standards

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	US44300386	2021-04-27	1 year
-	-	RF cable	-	-	Each time[1]	N/A
-	-	20 dB attenuator	-	-	Each time[1]	N/A

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

8.5 Test Environmental Conditions

Temperature:	16.7 ºC
Relative Humidity:	50 %
ATM Pressure:	102.7 kPa

The testing was performed by Christian McCaig on 2022-01-05 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)
802.11n/ac40 mode			
38	5190	36.427	44.539
46	5230	36.8045	81.101
802.11ac80 mode			
42	5210	75.7796	104.848

ANT B

Channel	Frequency (MHz)	99% OBW (MHz)	26 dB OBW (MHz)
802.11n/ac40 mode			
38	5190	36.3766	43.787
46	5230	36.7017	78.393
802.11ac80 mode			
42	5210	75.7527	84.028

5725 – 5850 MHz

ANT A

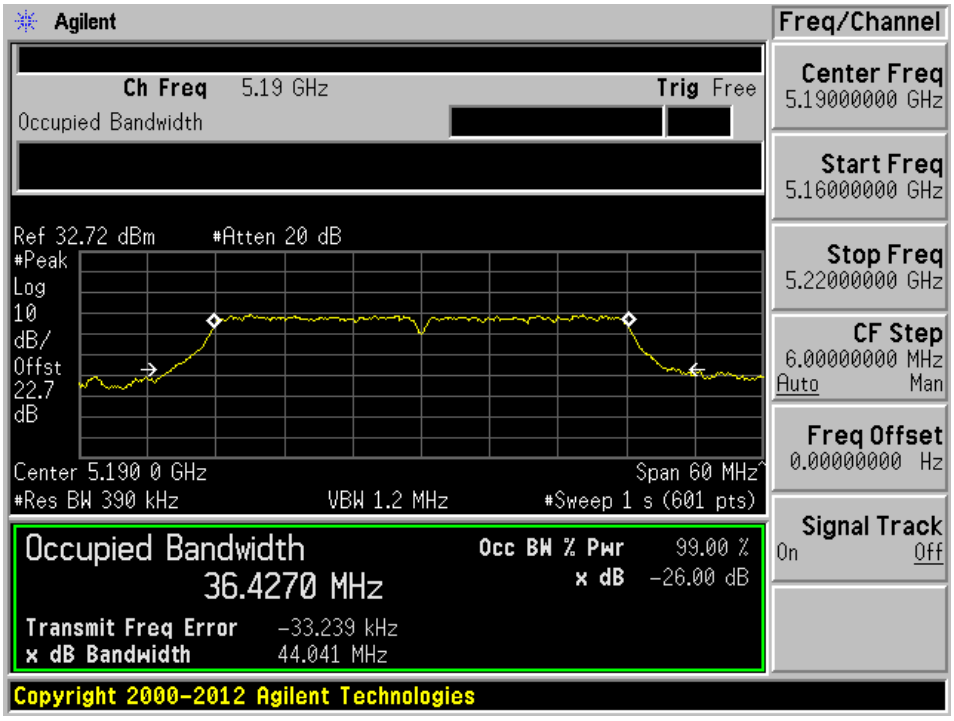
Channel	Frequency (MHz)	99% OBW (MHz)	6 dB OBW (MHz)	Limit (≥500kHz)
802.11n/ac40 mode				
151	5755	46.3739	36.542	Pass
159	5795	46.6223	36.548	Pass
802.11ac80 mode				
155	5775	82.4489	76.559	Pass

ANT B

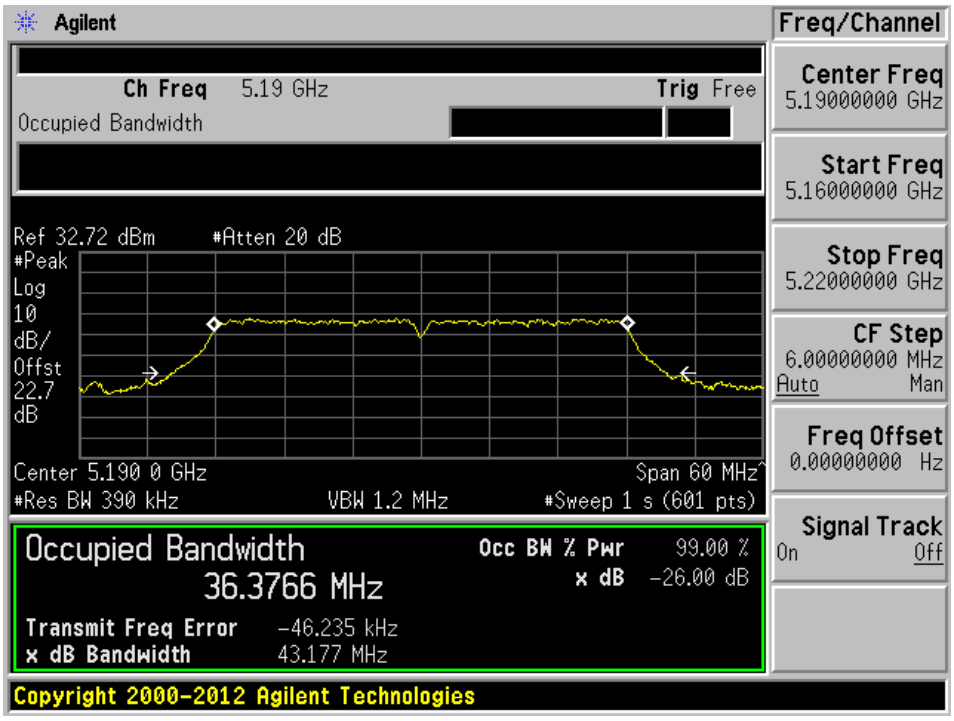
Channel	Frequency (MHz)	99% OBW (MHz)	6 dB OBW (MHz)	Limit (≥500kHz)
802.11n/ac40 mode				
151	5755	36.8020	36.536	Pass
159	5795	36.7718	36.548	Pass
802.11ac80 mode				
155	5775	75.9558	76.494	Pass

5150 - 5250 MHz, 802.11n/ac40 Mode, 99% OBW

Low Channel ANT A

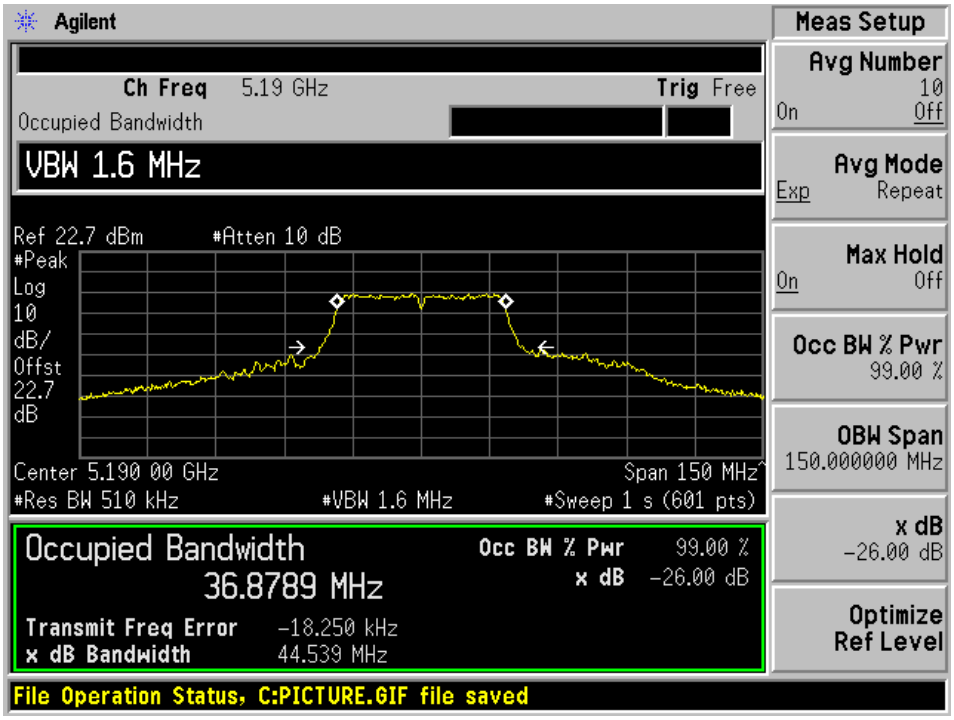


Low Channel ANT B

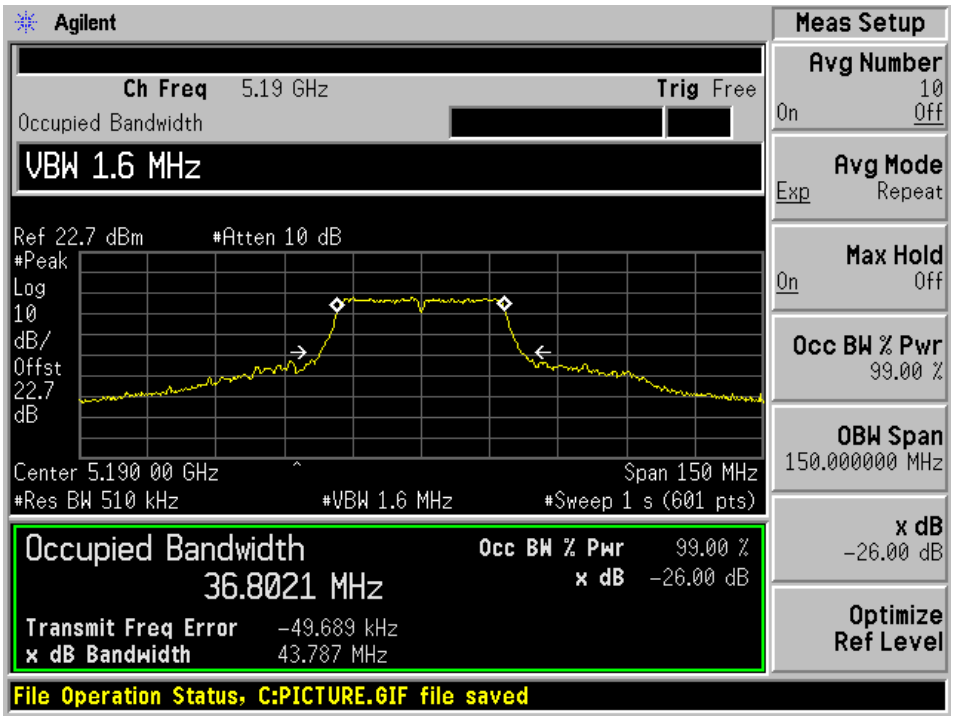


5150 - 5250 MHz, 802.11n/ac40 Mode, 26 dB OBW

Low Channel ANT A

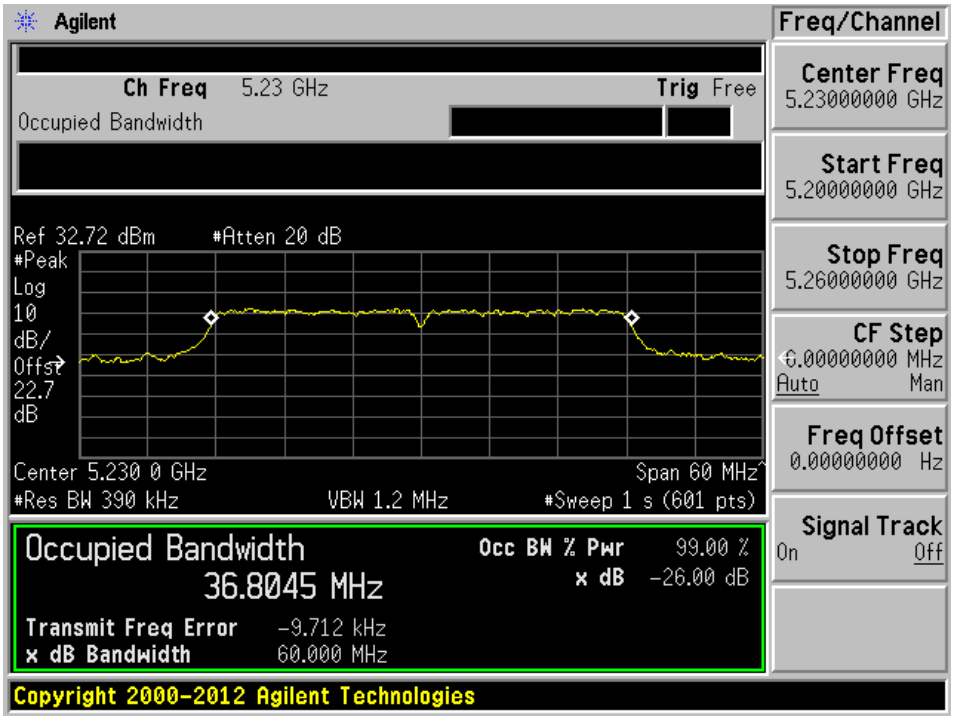


Low Channel ANT B

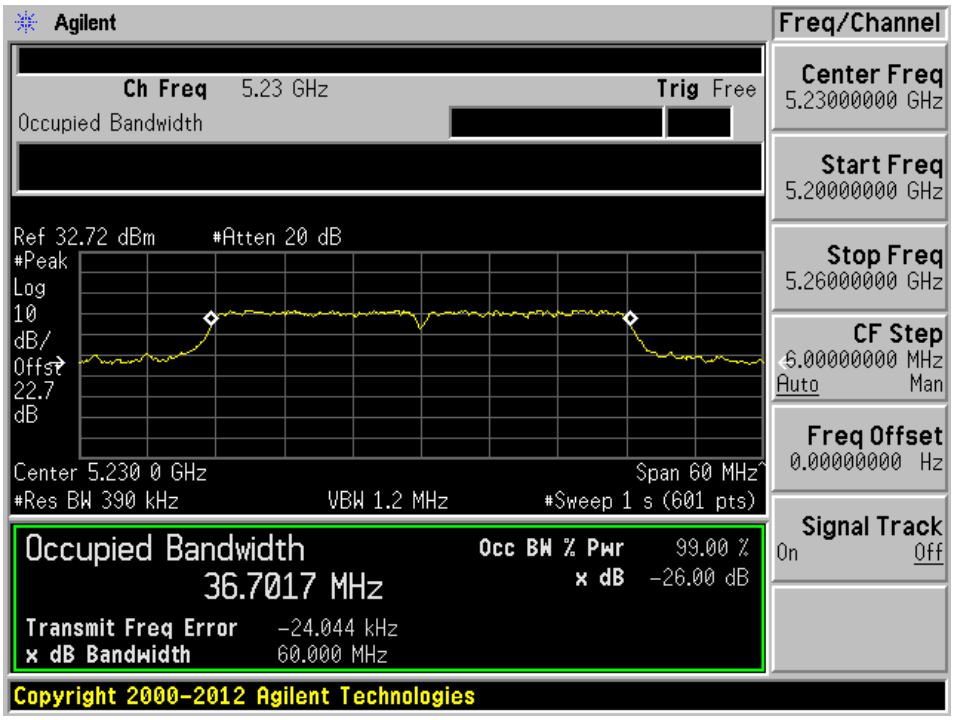


5150 - 5250 MHz, 802.11n/ac40 Mode, 99% OBW

High Channel ANT A

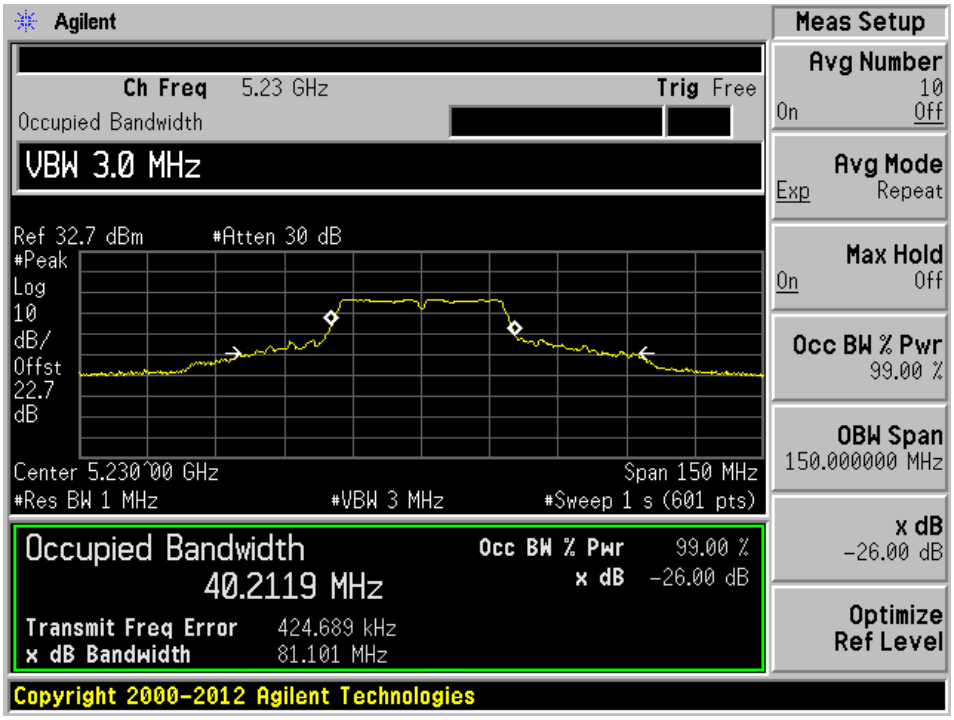


High Channel ANT B

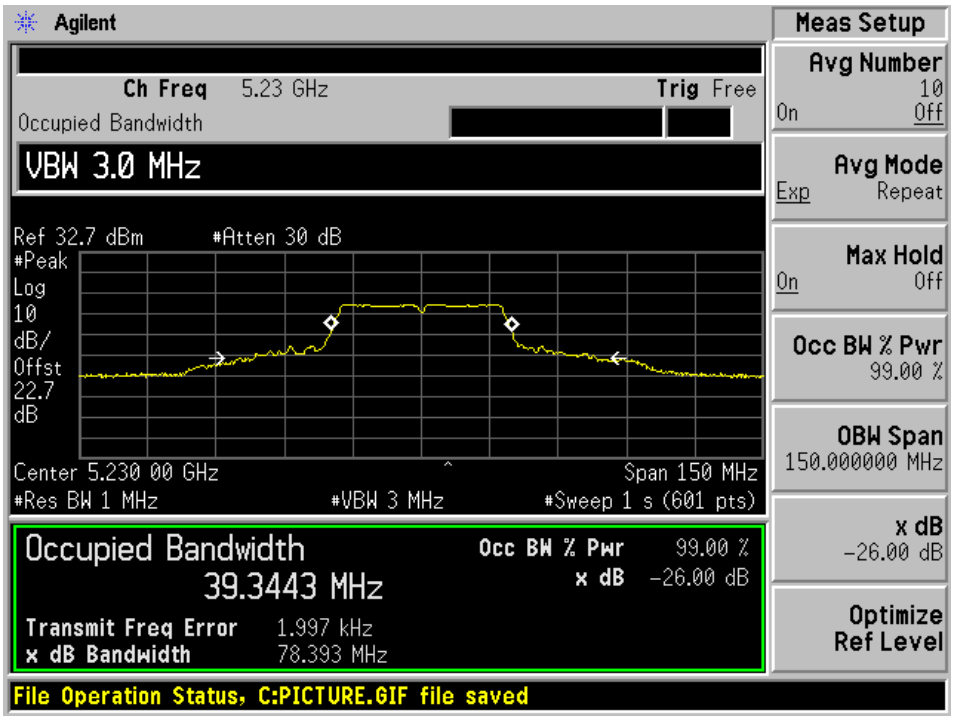


5150 - 5250 MHz, 802.11n/ac40 Mode, 26dB OBW

High Channel ANT A

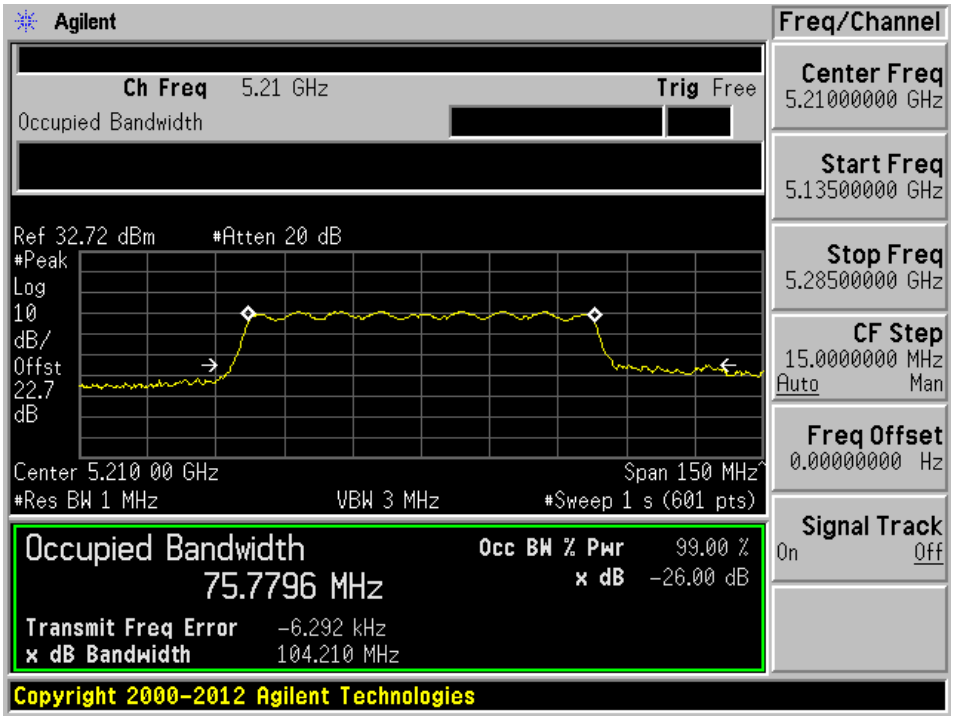


High Channel ANT B

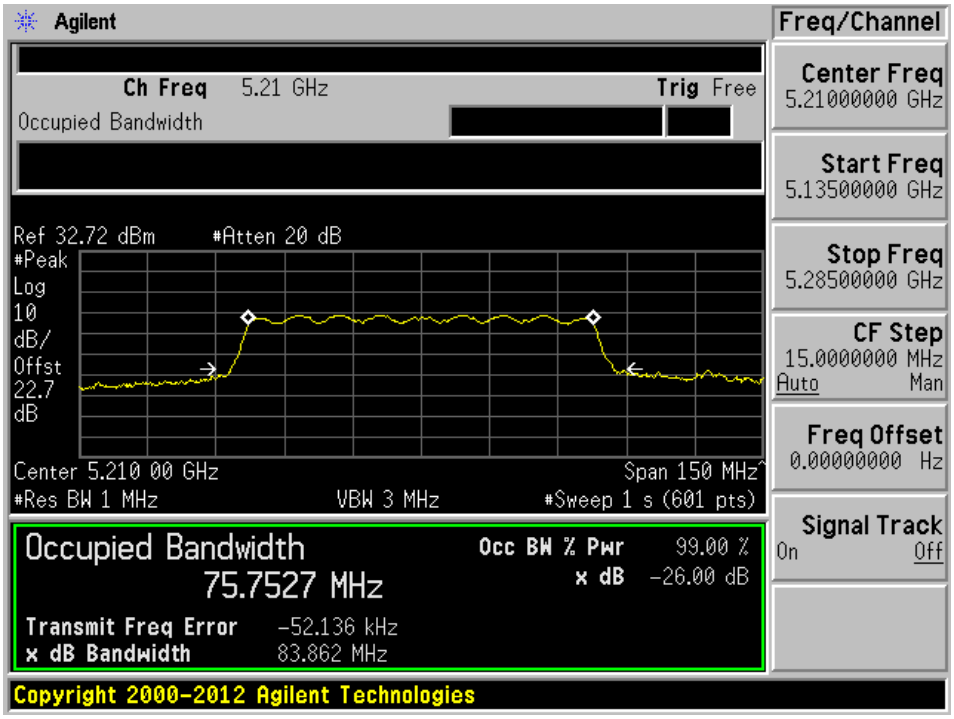


5150 - 5250 MHz, 802.11 ac80 Mode, 99% OBW

ANT A

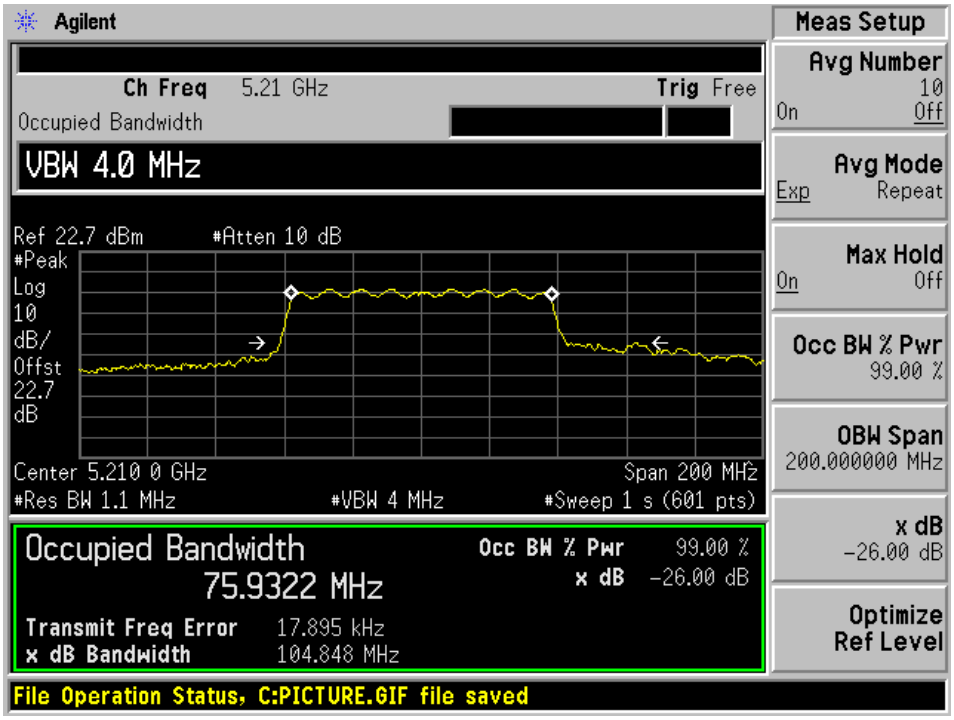


ANT B

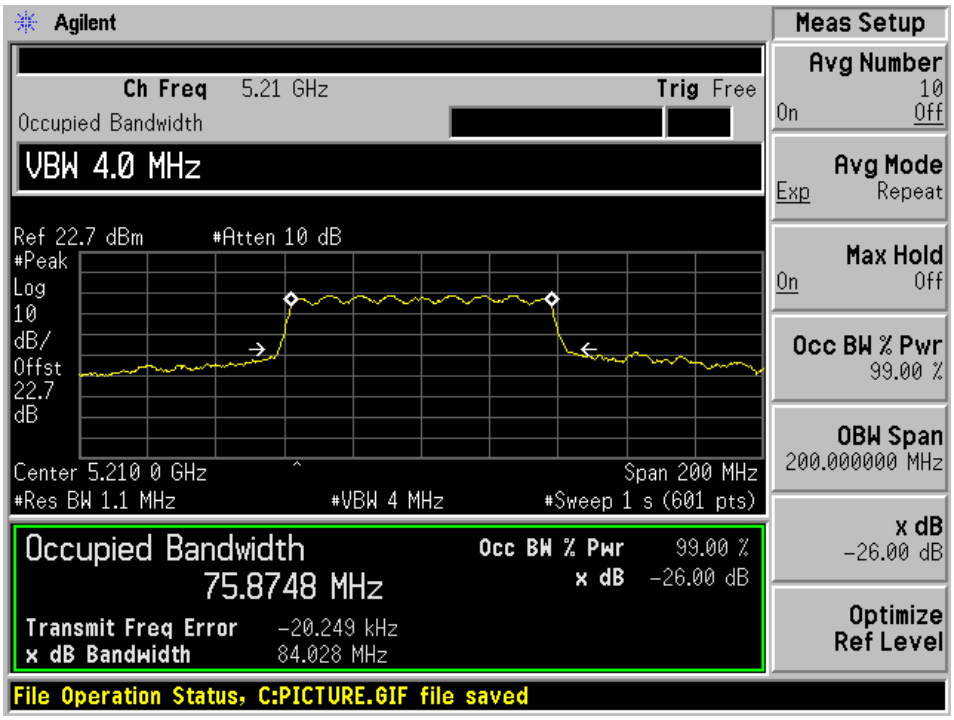


5150 - 5250 MHz, 802.11 ac80 Mode, 26 dB OBW

ANT A

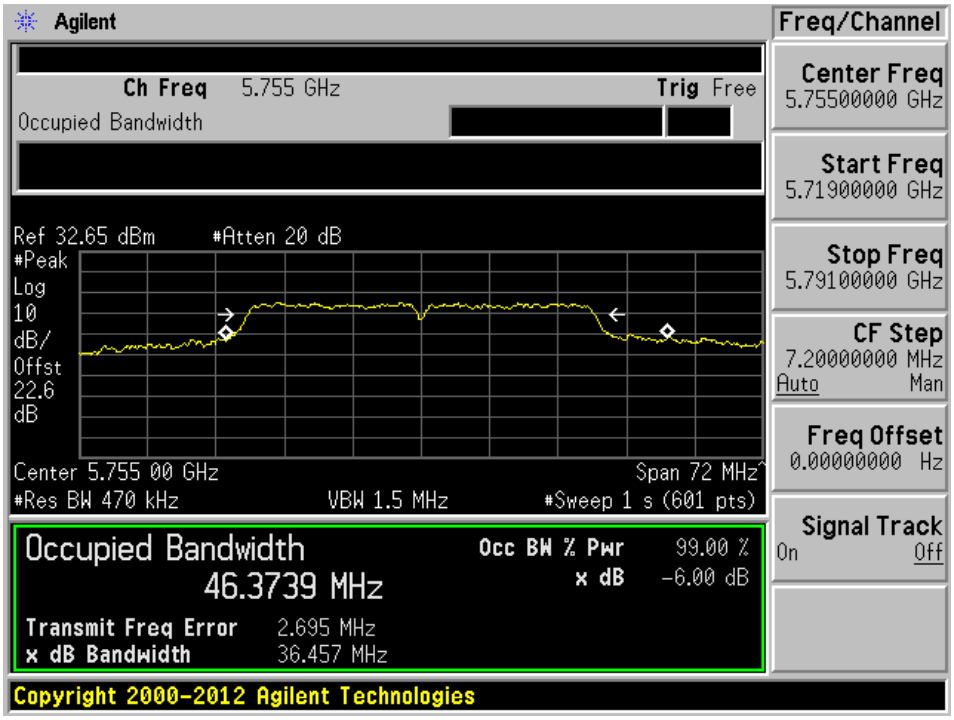


ANT B

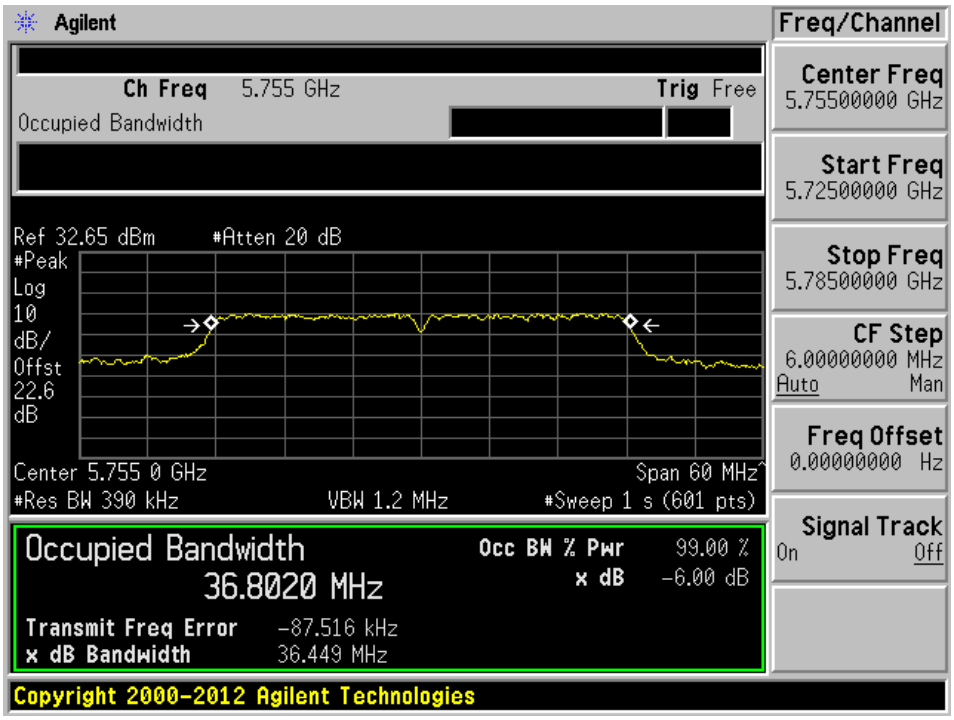


5725 - 5850 MHz, 802.11 n/ac40 Mode, 99% OBW

Low Channel ANT A

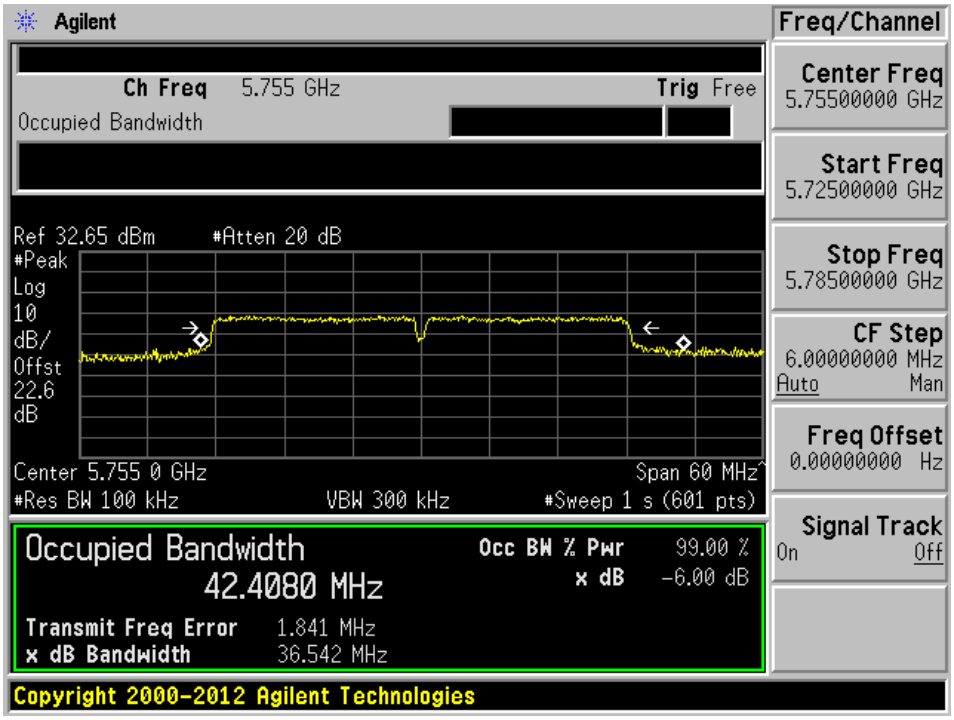


Low Channel ANT B

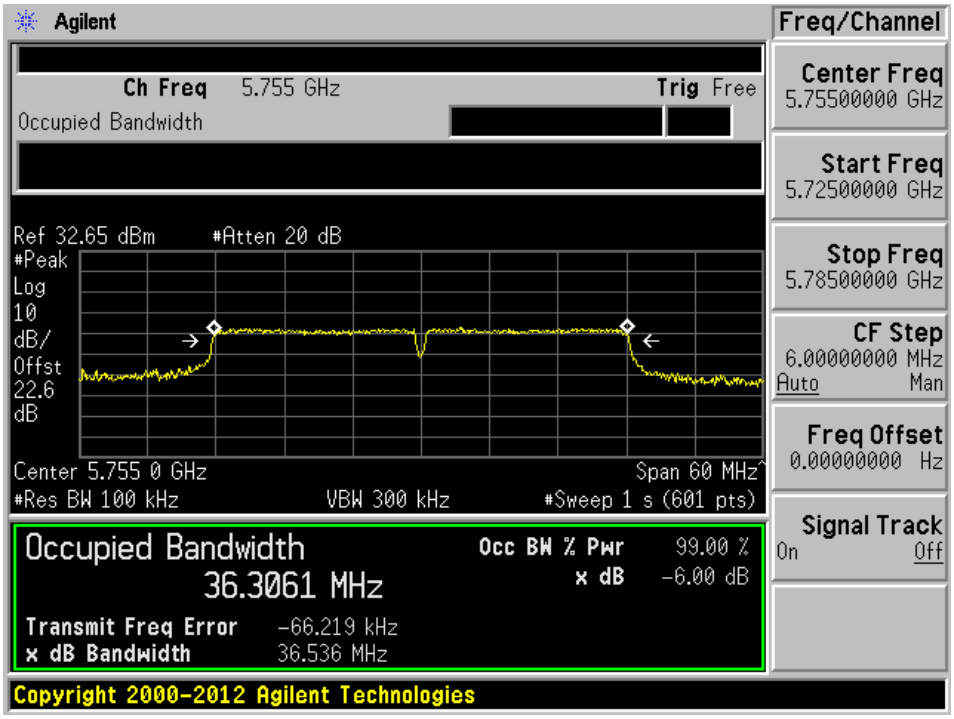


5725 - 5850 MHz, 802.11 n/ac40 Mode, 6 dB OBW

Low Channel ANT A

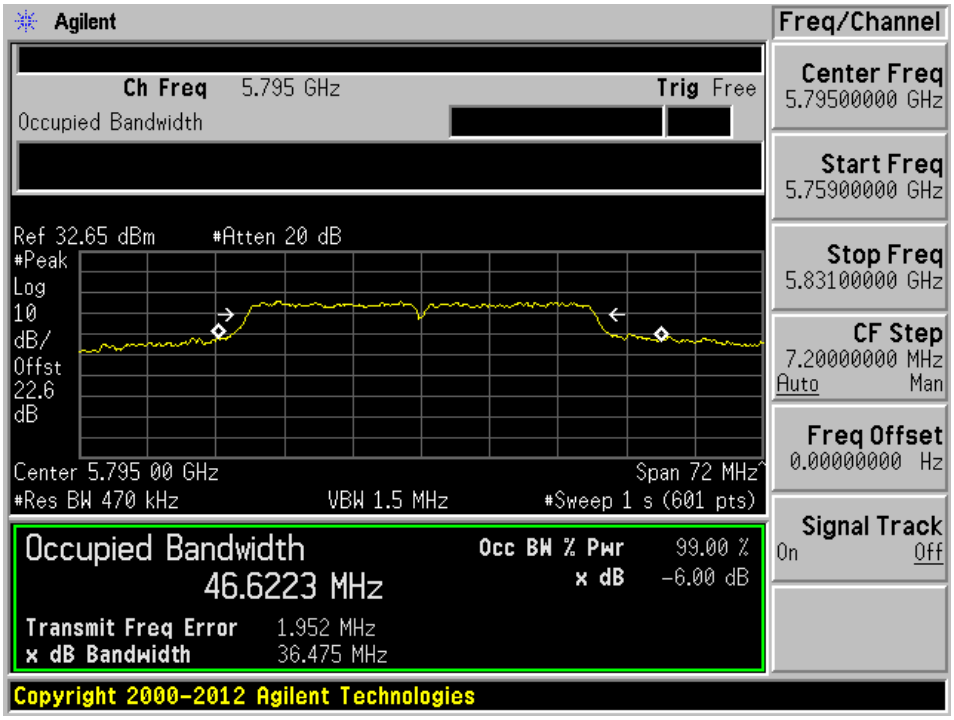


Low Channel ANT B

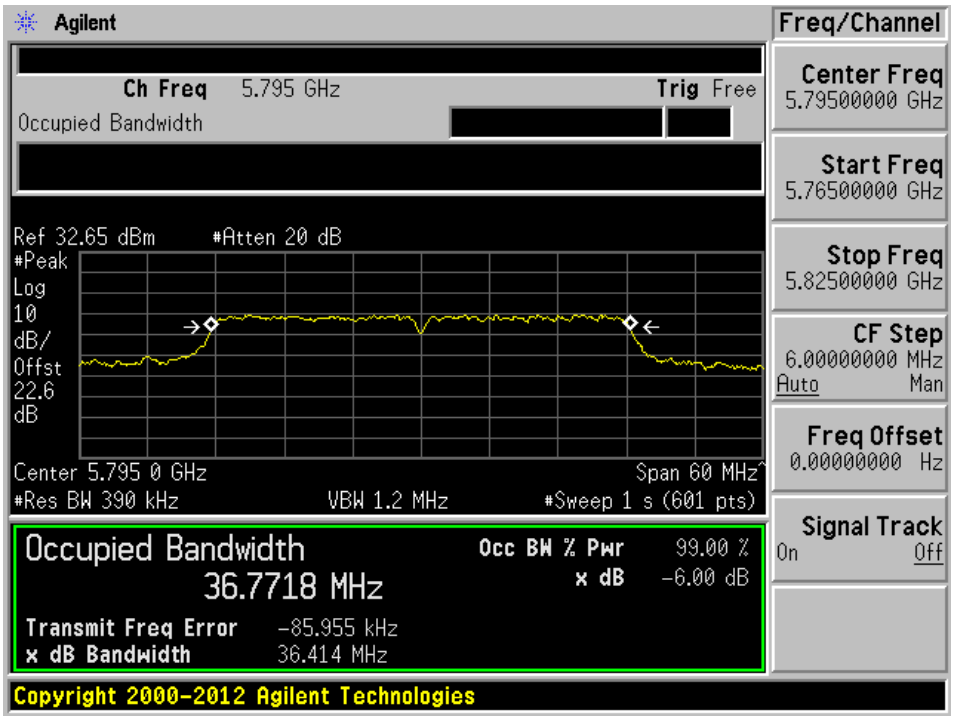


5725 - 5850 MHz, 802.11 n/ac40 Mode, 99% OBW

High Channel ANT A

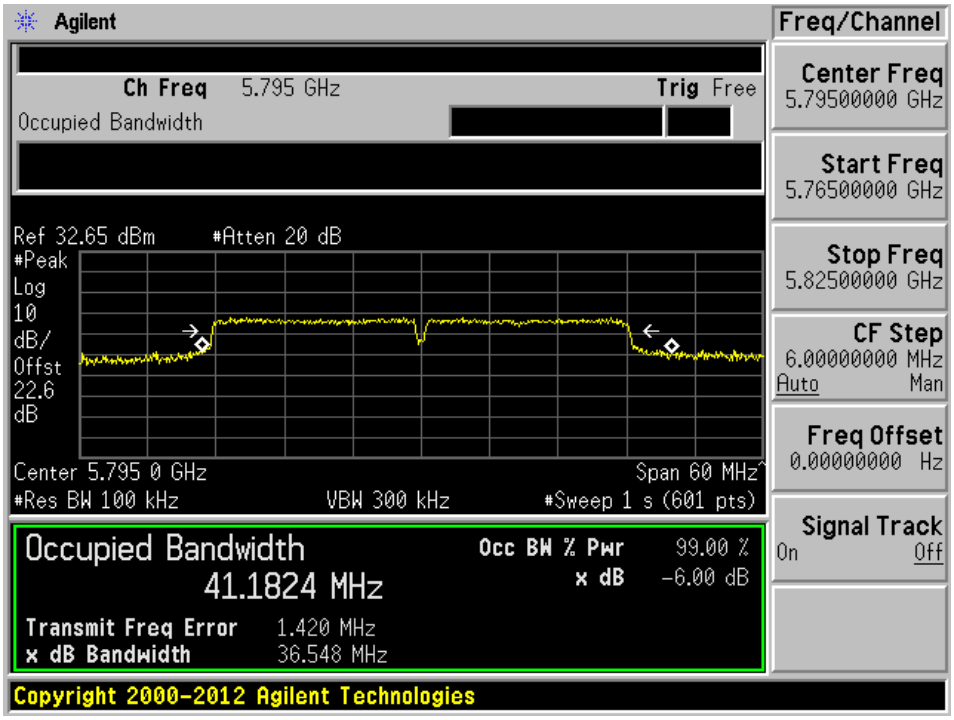


High Channel ANT B

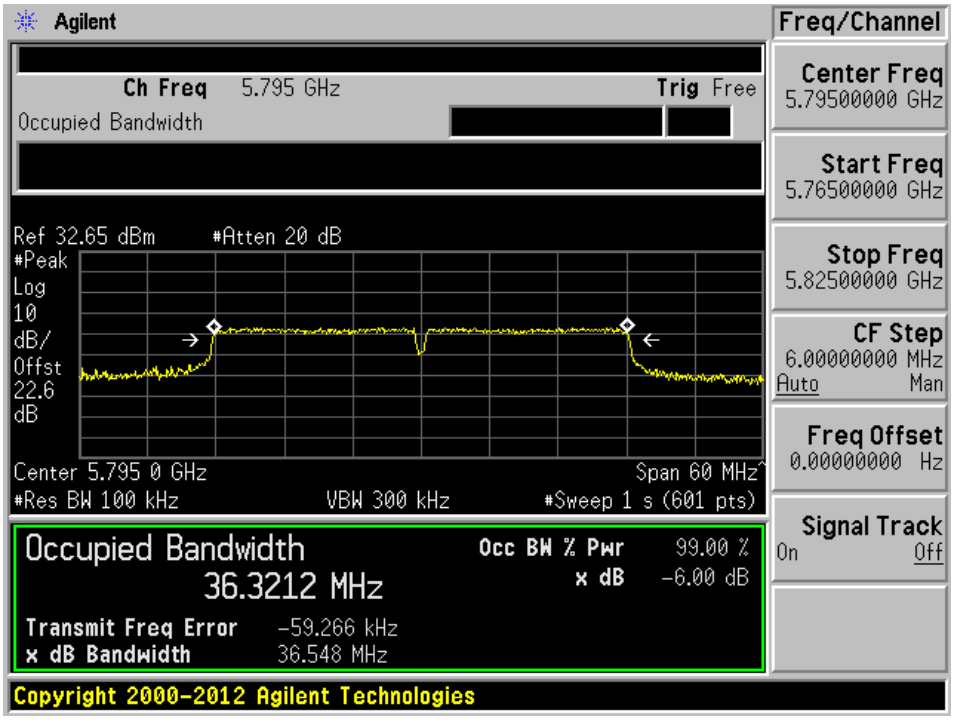


5725 - 5850 MHz, 802.11 n/ac40 Mode, 6 dB OBW

High Channel ANT A

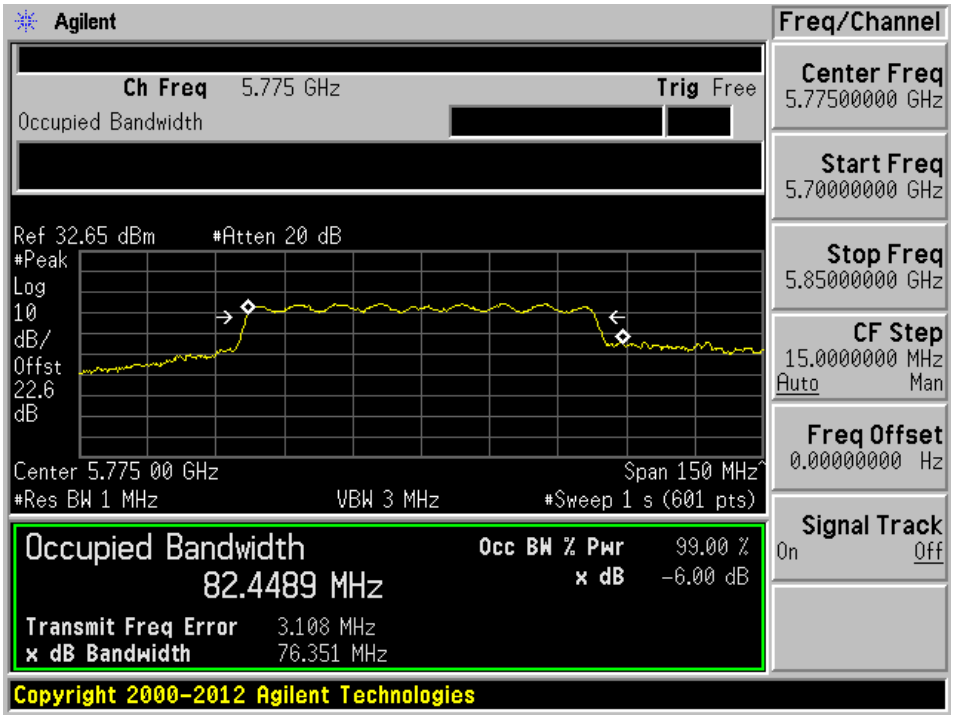


High Channel ANT B

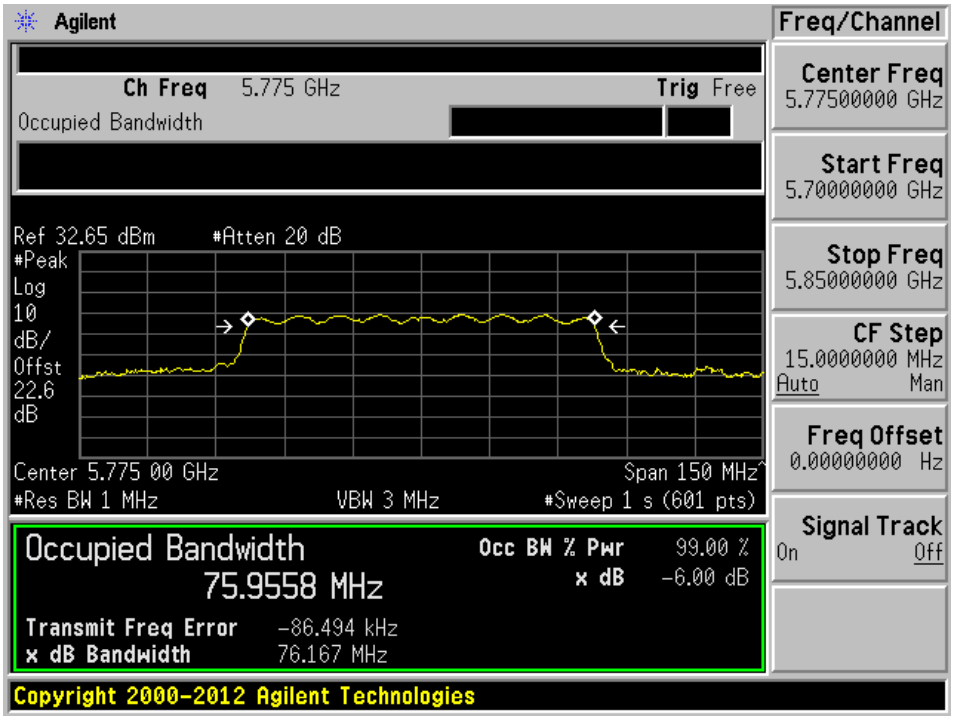


5725 - 5850 MHz, 802.11 ac80 Mode, 99% OBW

ANT A

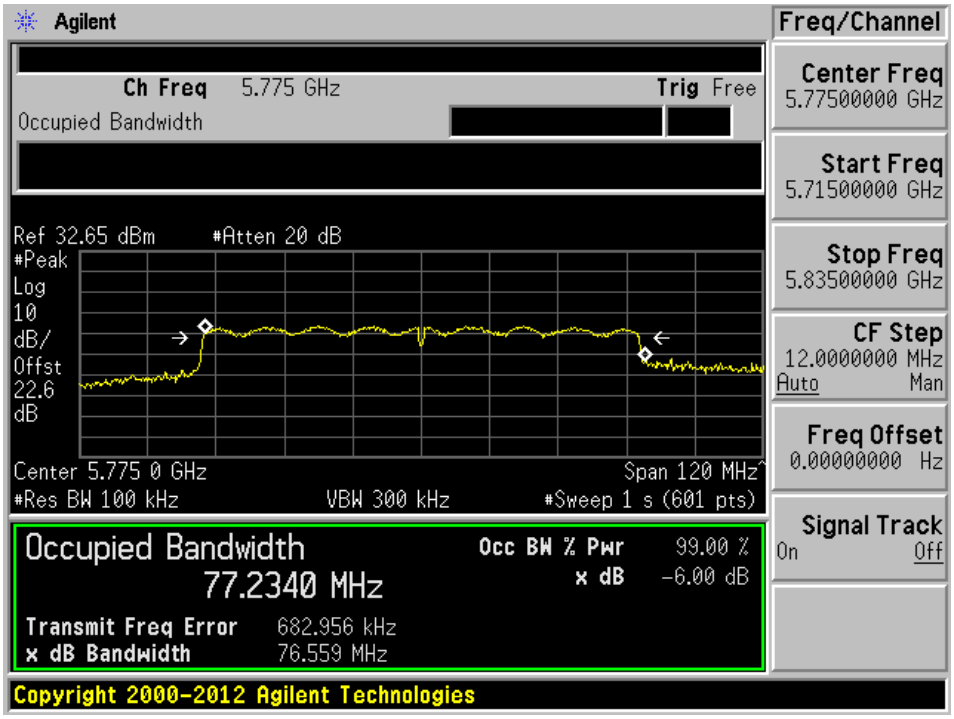


ANT B

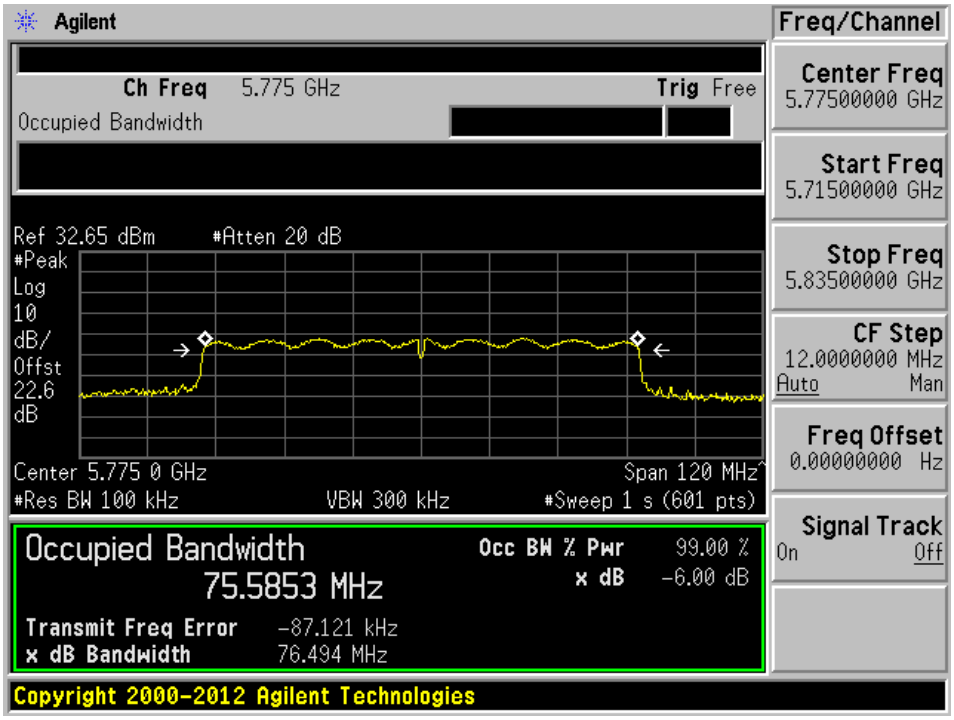


5725 - 5850 MHz, 802.11 ac80 Mode, 6 dB OBW

ANT A



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.

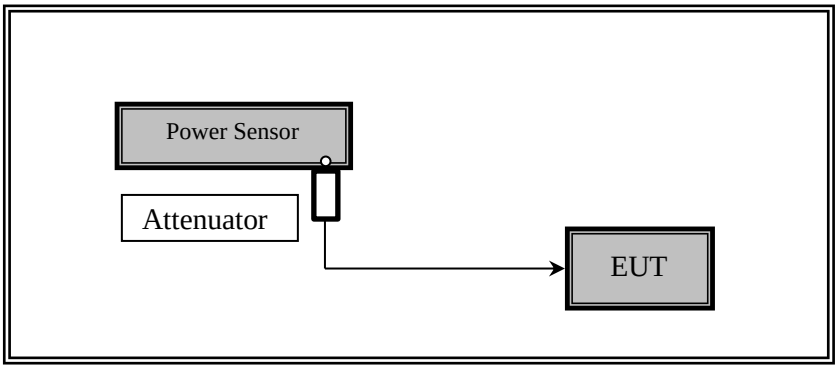
According to ISEDC RSS-247 §6.2.4 for frequency band 5725-5850 MHz:

The maximum conducted output power shall not exceed 1 W. The power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

9.2 Measurement Procedure

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

9.3 Test Setup Block Diagram



9.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
697	ETS-LINDGREN	Power Sensor	7002-006	160097	2021-02-23	1 year
-	-	RF cable	-	-	Each time[1]	N/A
-	-	20 dB attenuator	-	-	Each time[1]	N/A

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

9.5 Test Environmental Conditions

Temperature:	23º C
Relative Humidity:	55 %
ATM Pressure:	102.2 KPa

The testing was performed by Deepak Mishra on 2021-12-16 in RF site.

9.6 Test Results

FCC results

5150 - 5250 MHz

Channel	Frequency (MHz)	Conducted Output Power (dBm)		Total Power (dBm)	Limit (dBm)
		ANT A	ANT B		
802.11n/ac40 mode					
38	5190	13.1	11.3	15.30	< 24
46	5230	16.49	14.8	18.74	< 24
802.11ac80 mode					
42	5210	12.03	10.85	14.49	< 24

Note: Total power (dBm) =10*Log(10^(Ant A[dBm])+10^(Ant B[dBm]))
Note: Duty cycle correction factor has already been added to the measurements
Note: Where applicable, limits are reduced (in dB) by amount that antenna gain exceeds 6dBi. Individual antenna gain = 1.1 dBi @ 5.2 GHz. Directional antenna gain (dBi) = 1.1 dBi + 10*log(2) = 4.1 dBi. Individual antenna gain was provided by customer.

IC results

5150 - 5250 MHz

Channel	Frequency (MHz)	Conducted Power (dBm)			EIRP (dBm)			IC Limit (dBm)
		ANT A	ANT B	Total	ANT A	ANT B	Total	
802.11n/ac40 mode								
38	5190	13.1	11.3	15.30	-	-	19.40	< 23.00
46	5230	16.49	14.8	18.74	-	-	22.84	< 23.00
802.11ac80 mode								
42	5210	12.03	10.85	14.49	-	-	18.59	< 23.00

Note: Total power (dBm) =10*Log(10^(Ant A[dBm])+10^(Ant B[dBm]))
Note: Total EIRP (dBm) = Total power (dBm) + Directional antenna gain (dBi)
Note: Duty cycle correction factor has already been added to the measurements
Note: For 5.2 GHz IC Limit, the maximum e.i.r.p. shall not exceed 200 mW or 10 + 10 $\log_{10}$B, dBm, where B is 99% OBW. [Limit is the lower value of the two]
Note: Individual antenna gain = 1.1 dBi @ 5.2 GHz. Directional antenna gain (dBi) = 1.1 dBi + 10*log(2) = 4.1 dBi. Individual antenna gain was provided by customer.

5725-5850 MHz

FCC/IC results

Channel	Frequency (MHz)	Conducted Output Power (dBm)		Total Power (dBm)	FCC/IC Limit (dBm)
		ANT A	ANT B		
802.11n/ac40 mode					
151	5755	17.92	13.8	19.34	< 30
159	5795	18.15	14.22	19.63	< 30
802.11ac80 mode					
155	5775	16.94	12.3	18.22	< 30

Note: Total power (dBm) =10*Log(10^(Ant A[dBm])+10^(Ant B[dBm]))
Note: Duty cycle correction factor has already been added to the measurements
Note: Where applicable, limits are reduced (in dB) by amount that antenna gain exceeds 6dBi. Individual antenna gain = 2.4 dBi @ 5.8 GHz. Directional antenna gain (dBi) = 2.4 dBi + 10*log(2) = 5.4 dBi. Individual antenna gain was provided by customer.

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

10.1 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 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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

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

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

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

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

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

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

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

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

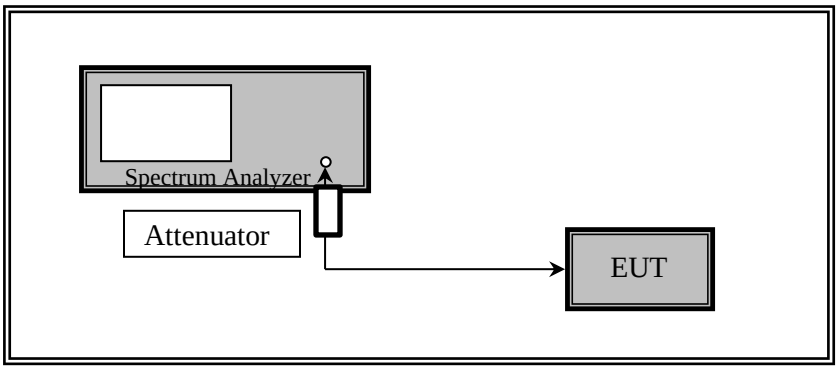
According to ISEDC RSS-247 §6.2.4 for frequency band 5725-5850 MHz:

The maximum conducted output power shall not exceed 1 W. The power spectral density shall not exceed 30 dBm in any 500 kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications and multiple collocated transmitters transmitting the same information.

10.2 Measurement Procedure

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

10.3 Test Setup Block Diagram



10.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
287	Agilent	Spectrum Analyzer	E4446A	US44300386	2021-04-27	1 year
-	-	RF cable	-	-	Each time[1]	N/A
-	-	20 dB attenuator	-	-	Each time[1]	N/A

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

10.5 Test Environmental Conditions

Temperature:	16.7 ºC
Relative Humidity:	50 %
ATM Pressure:	102.7 kPa

The testing was performed by Deepak Mishra on 2022-01-05 in RF site.

10.6 Test Results

5150 - 5250 MHz

FCC:

Channel	Frequency (MHz)	PSD (dBm/MHz)		DCCF (dB)	Total Corrected PSD (dBm/MHz)	FCC Limit (dBm/MHz)
		ANT A	ANT B			
802.11n/ac40 mode						
38	5190	-2.001	-3.307	0.84	1.245	< 11
46	5230	1.113	0.680	0.84	4.752	< 11
802.11ac80 mode						
42	5210	-4.636	-6.254	1.46	-0.900	< 11

Note: Total Corrected PSD (dBm/MHz) = 10*Log(10^(Ant A[dBm/MHz])+10^(Ant B[dBm/MHz])) + DCCF (dB)
Note: Where applicable, limits are reduced (in dB) by amount that antenna gain exceeds 6dBi.
Note: Individual antenna gain = 1.1 dBi @ 5.2 GHz. Directional antenna gain (dBi) = 1.1 dBi + 10*log(2) = 4.1 dBi. Individual antenna gain was provided by customer.

IC:

Channel	Frequency (MHz)	PSD (dBm/MHz)		DCCF (dB)	Total E.I.R.P Corrected PSD (dBm/MHz)	IC Limit (dBm/MHz)
		ANT A	ANT B			
802.11n/ac40 mode						
38	5190	-2.001	-3.307	0.84	5.35	< 10
46	5230	1.113	0.680	0.84	8.85	< 10
802.11ac80 mode						
42	5210	-4.636	-6.254	1.46	3.20	< 10

Note: Total E.I.R.P corrected PSD (dBm/MHz) = 10*Log(10^(Ant A[dBm/MHz])+10^(Ant B[dBm/MHz])) + DCCF (dB) + Directional Gain(dBi)
Note: Individual antenna gain = 1.1 dBi @ 5.2 GHz. Directional antenna gain (dBi) = 1.1 dBi + 10*log(2) = 4.1 dBi. Individual antenna gain was provided by customer.

5725– 5850 MHz

FCC/IC:

Channel	Frequency (MHz)	Conducted PSD (dBm/500kHz)		DCCF (dB)	Total Corrected PSD (dBm/500kHz)	FCC/IC Limit (dBm/500KHz)
		ANT A	ANT B			
802.11n/ac40 mode						
151	5755	1.6337	-4.0743	0.84	3.51	< 30
159	5795	0.8407	-3.7463	0.84	2.98	< 30
802.11ac80 mode						
155	5775	-4.5763	-8.5183	1.46	-1.64	< 30

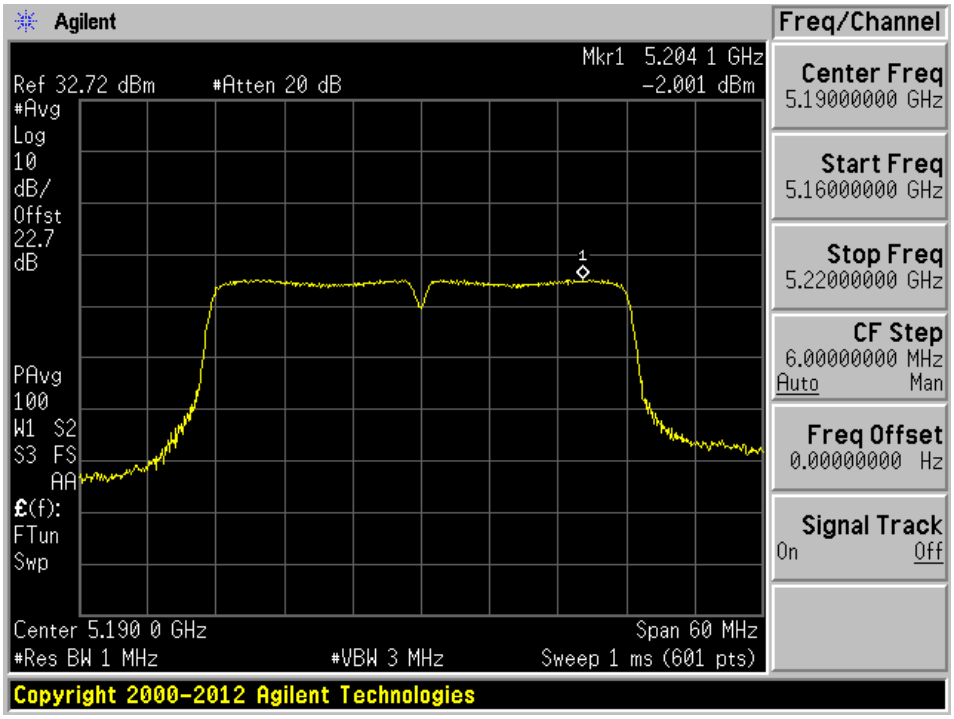
Note: Conducted PSD (dBm/500kHz)= PSD (dBm/100kHz) + 10 * log(500kHz/100kHz)
Note: Note: Total Corrected (dBm/500kHz) =10*Log(10^(Ant A[dBm/500kHz])+10^(Ant B[dBm/500kHz])) + DCCF (dB)
Note: Where applicable, limits are reduced (in dB) by amount that antenna gain exceeds 6dBi.
Note: Individual antenna gain = 2.4 dBi @ 5.8 GHz. Directional antenna gain (dBi) = 2.4 dBi + 10*log(2) = 5.4 dBi. Individual antenna gain was provided by customer.

Please refer to the following plots.

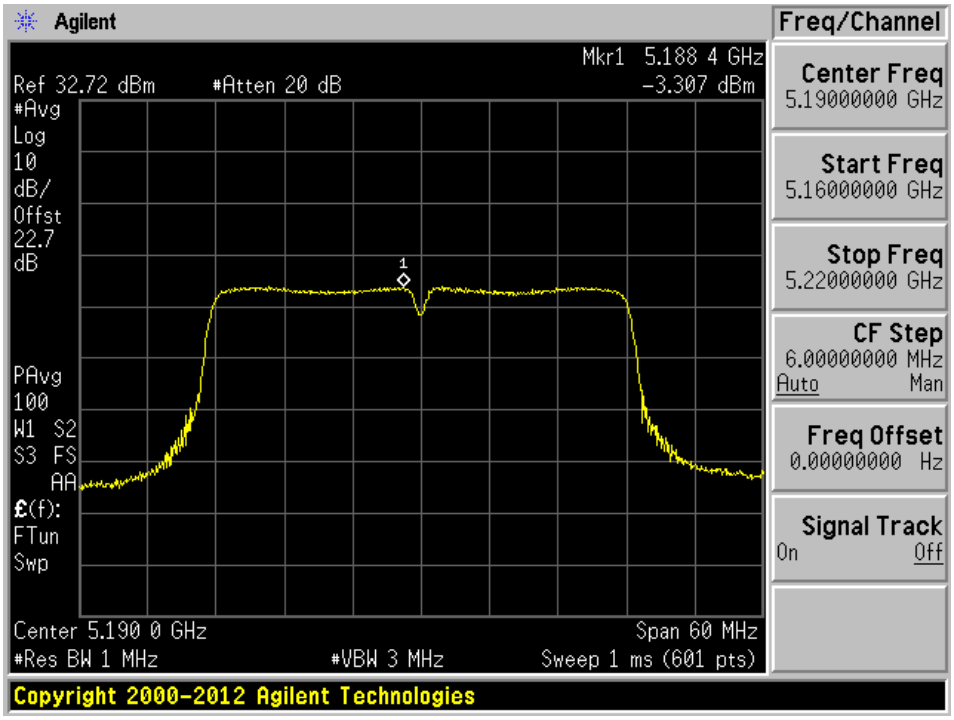
FCC 5150 - 5250 MHz

802.11n/ac40 Mode

ANT A Low Channel

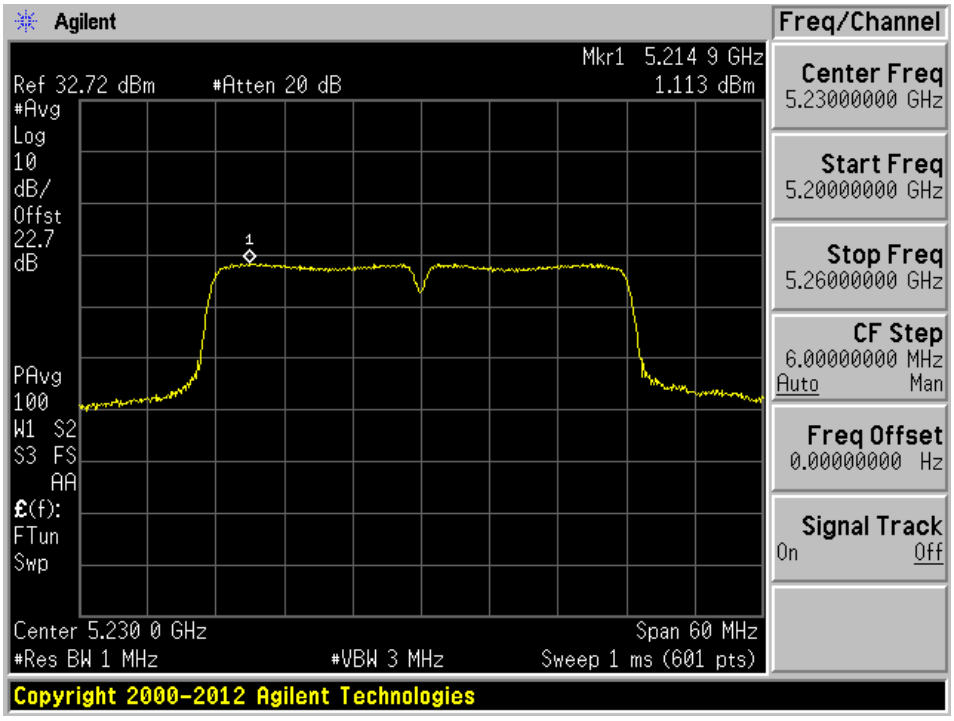


ANT B Low Channel

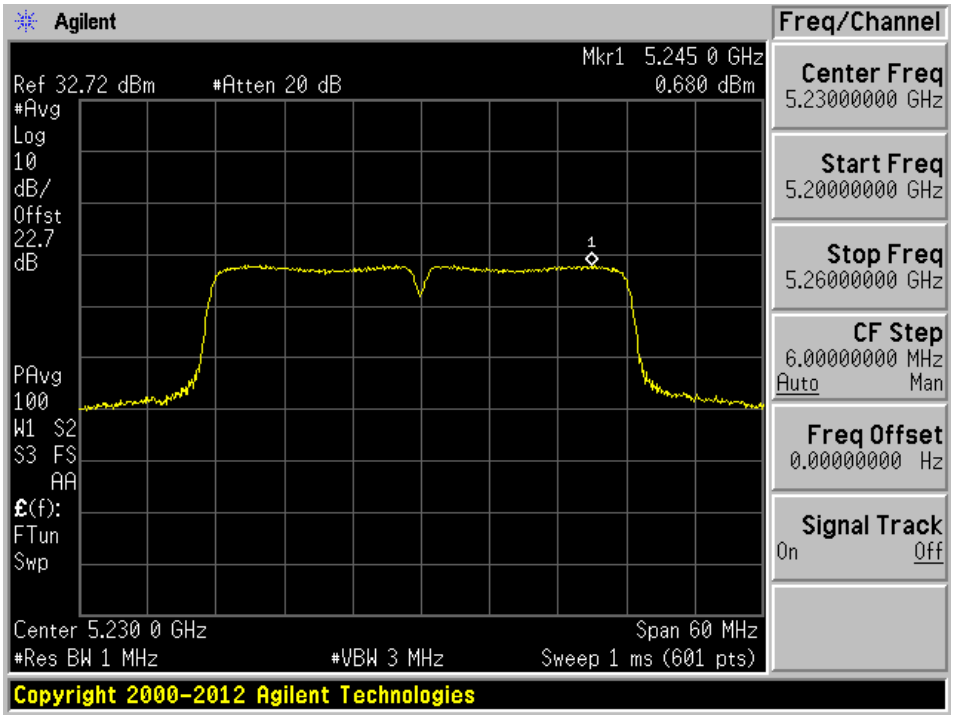


802.11n/ac40 Mode

ANT A High Channel

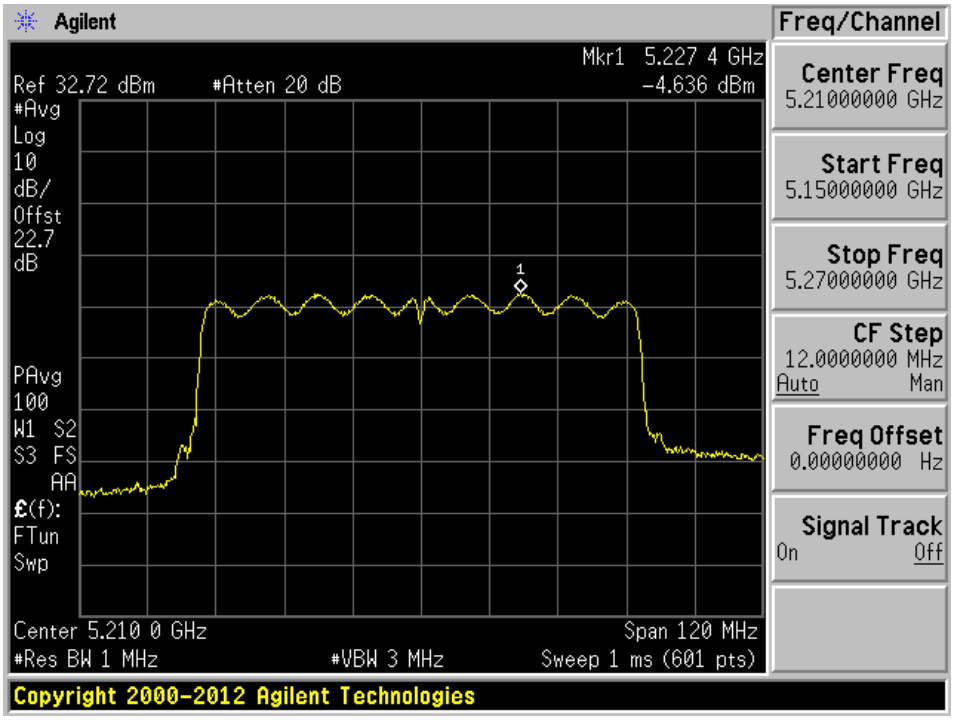


ANT B High Channel

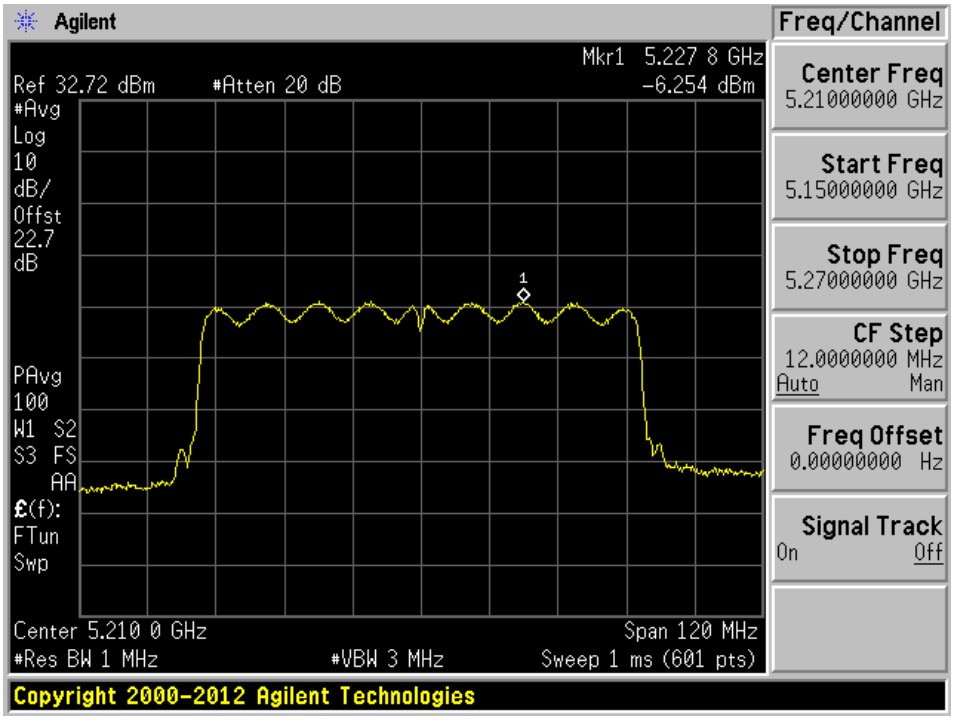


802.11 ac80 Mode

ANT A



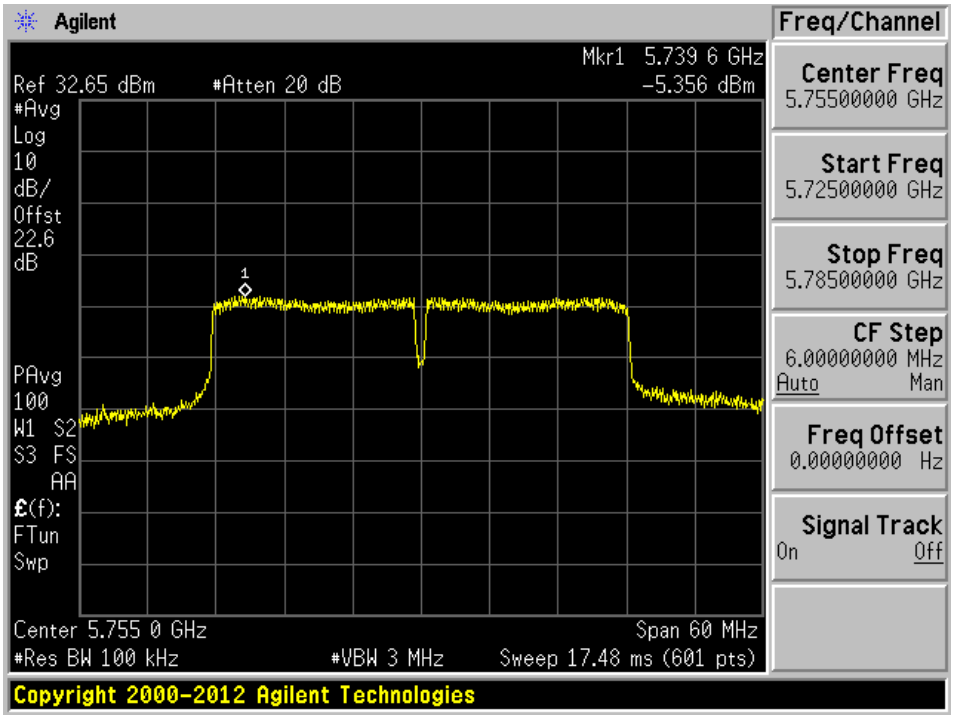
ANT B



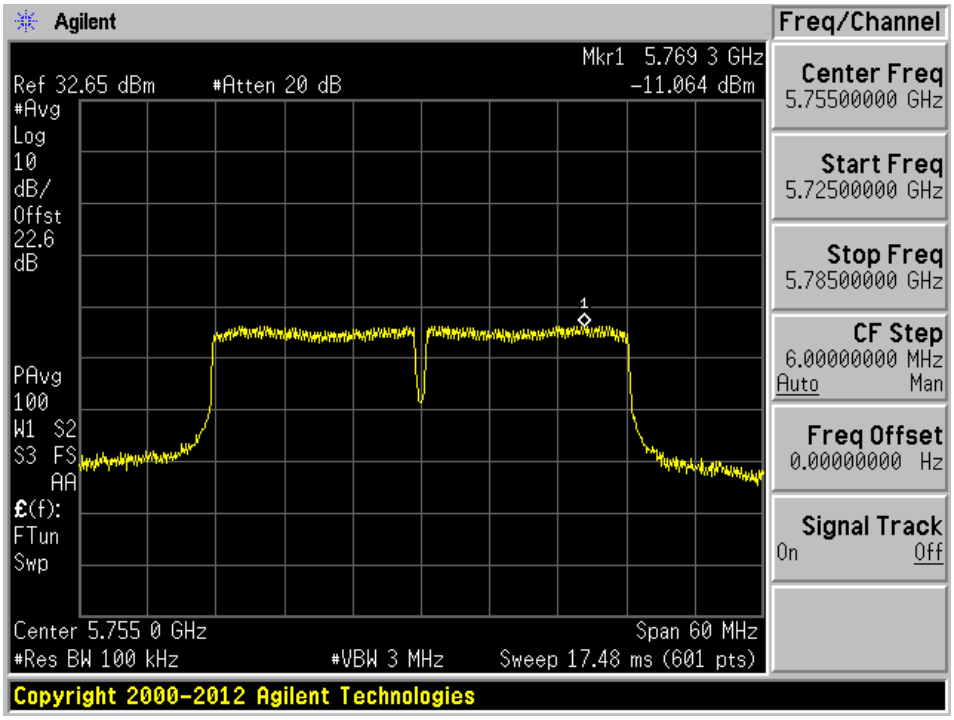
5725 - 5850MHz

802.11n/ac40 Mode

ANT A Low Channel

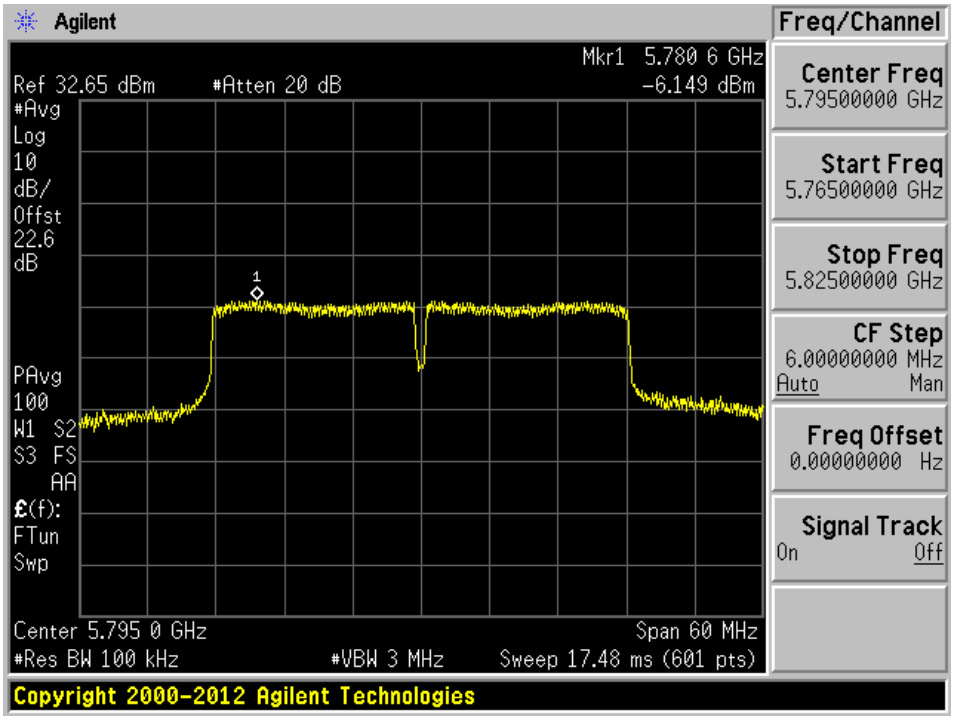


ANT B Low Channel

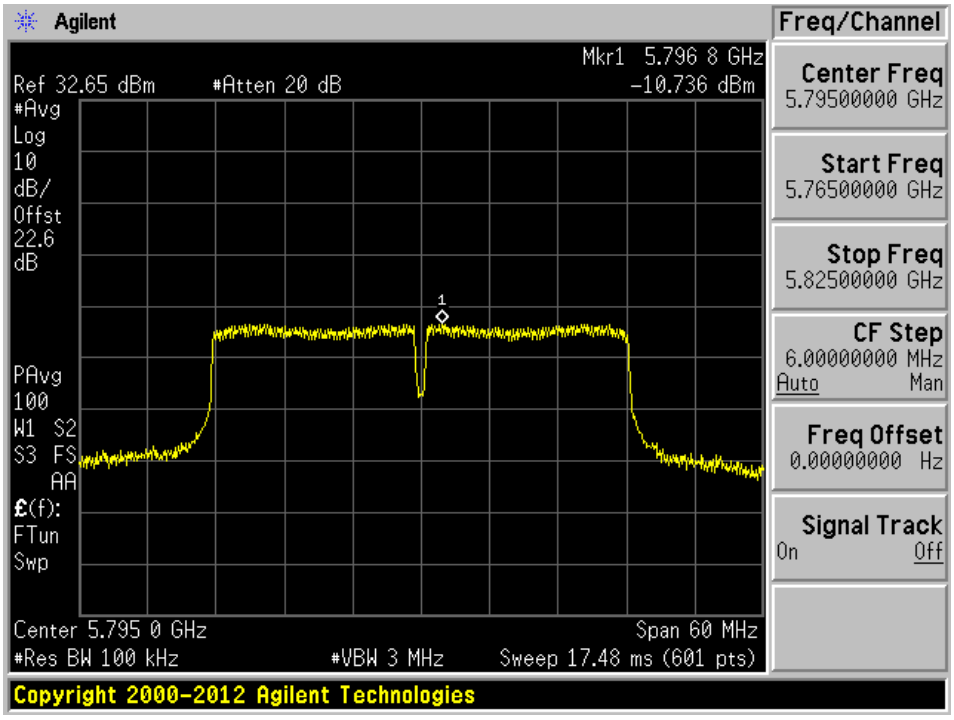


802.11n/ac40 Mode

ANT A High Channel

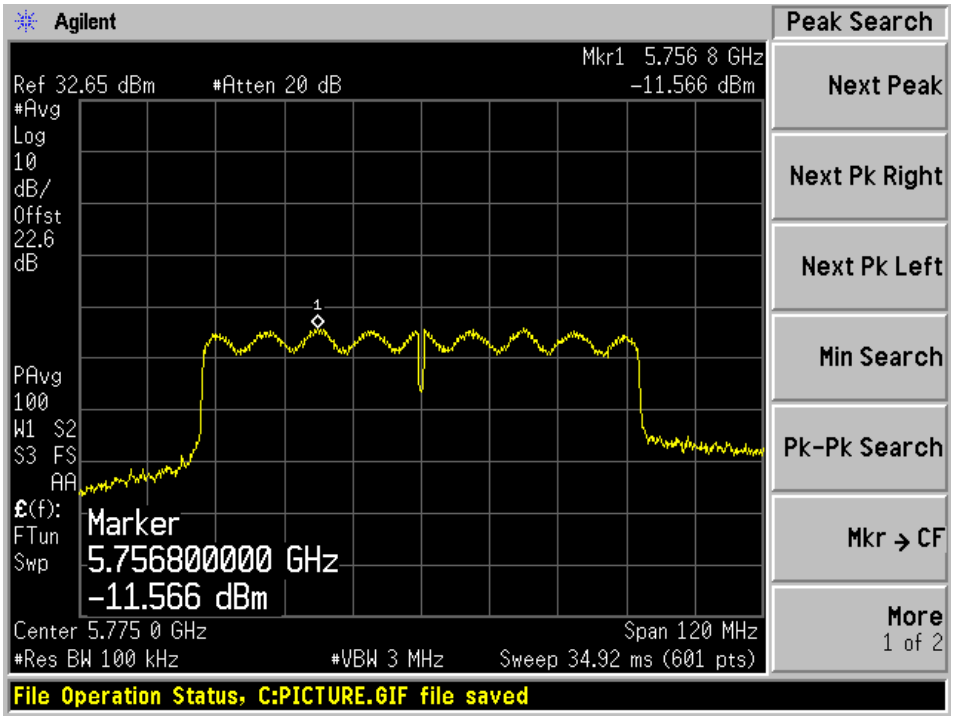


ANT B High Channel

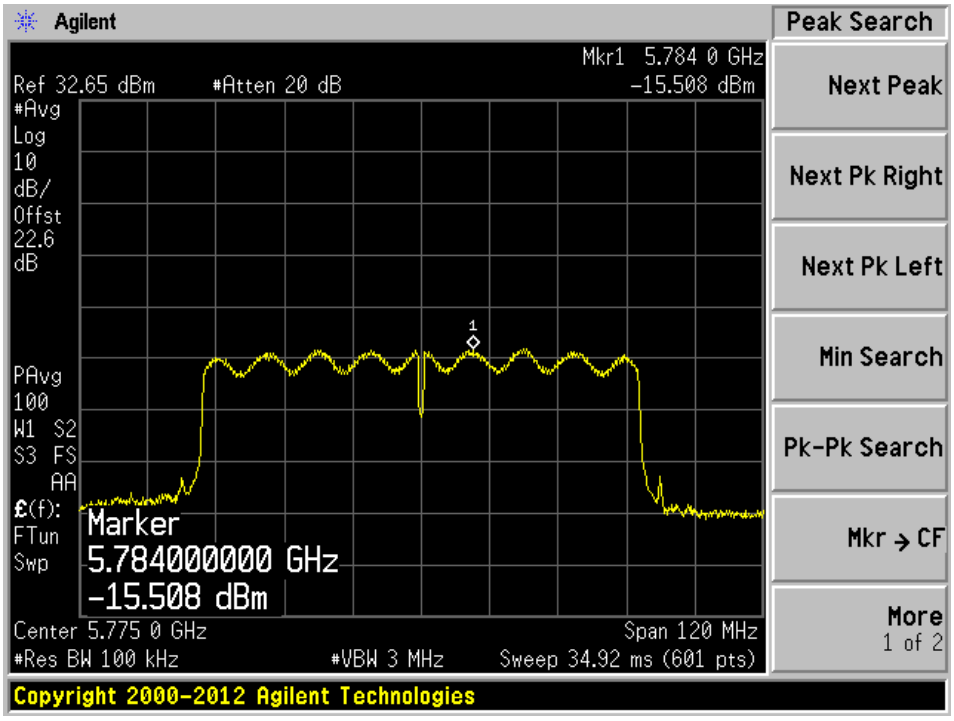


802.11 ac80 Mode

ANT A



ANT B



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

11.1 Applicable Standards

According to FCC §15.407(b):

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

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

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

For transmitters operating in the 5.725-5.85 GHz band: All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

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

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

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

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

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

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

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

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

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

11.2 Measurement Procedure

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

Unwanted Emission Measurement:

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

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

Integration Method:

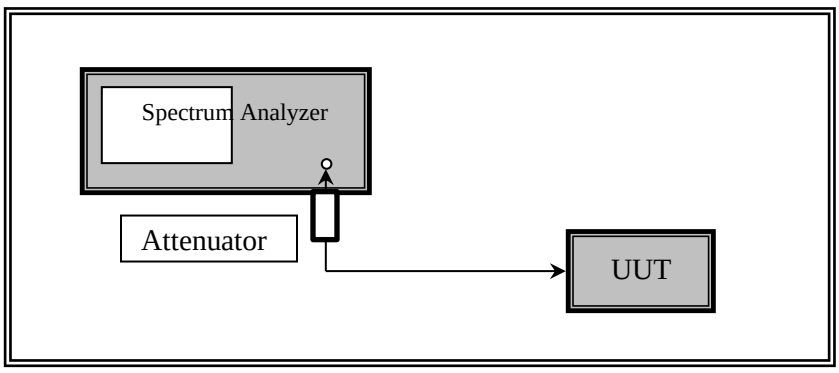
1. For peak emissions measurements, follow the procedures described in section H)5), "Procedures for Peak Unwanted Emissions Measurements above 1000 MHz", except for the following changes:

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

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

- Set RBW = 100 kHz
- Set VBW = 3RBW
- Perform a band-power integration across the 1 MHz bandwidth in which the band-edge emission level is to be measured.

11.3 Test Setup Block Diagram



11.4 Test Equipment List and Details

BACL No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
287	Agilent	Spectrum Analyzer	E4446A	US44300386	2021-04-27	1 year
912	Rhode & Schwarz	Signal Analyzer	FSV40	101203	2021-04-26	1 year
-	-	RF cable	-	-	Each time[1]	N/A
-	-	20 dB attenuator	-	-	Each time[1]	N/A

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

11.5 Test Environmental Conditions

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

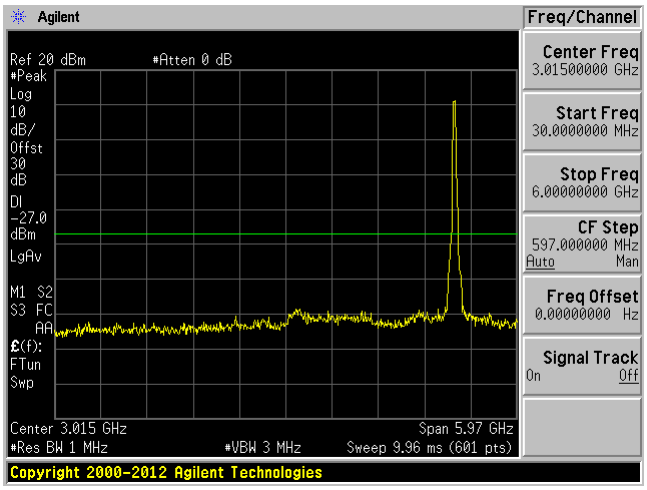
The testing was performed by Christian McCaig on 2022-01-05 in RF site.

11.6 Test Results

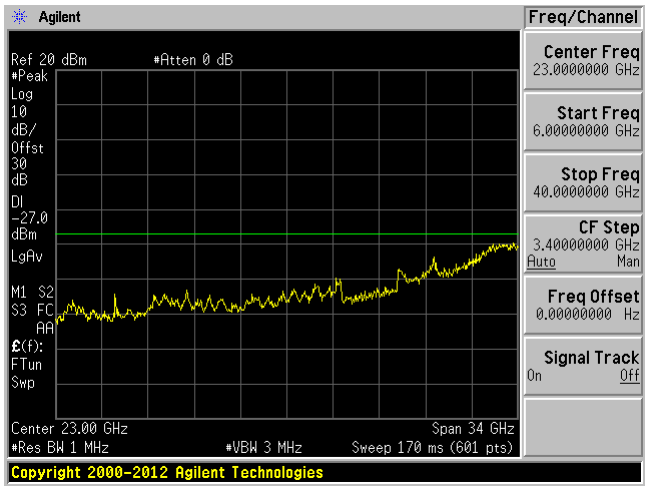
Spurious Emissions

5150 - 5250 MHz, 802.11n/ac40 Mode, ANT A

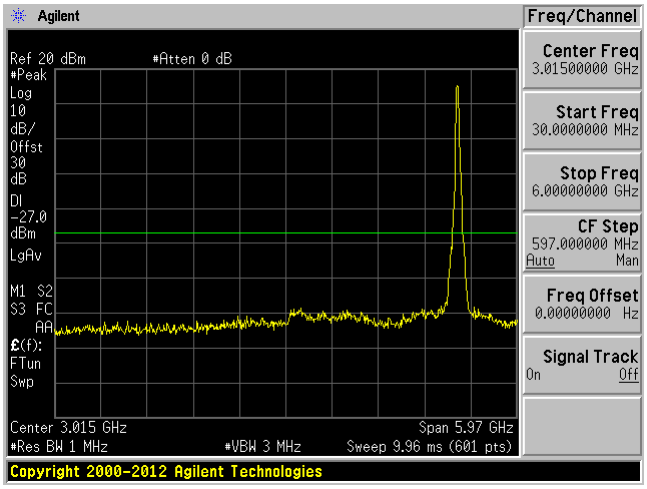
Low Channel 5190 MHz, 30MHz – 6GHz



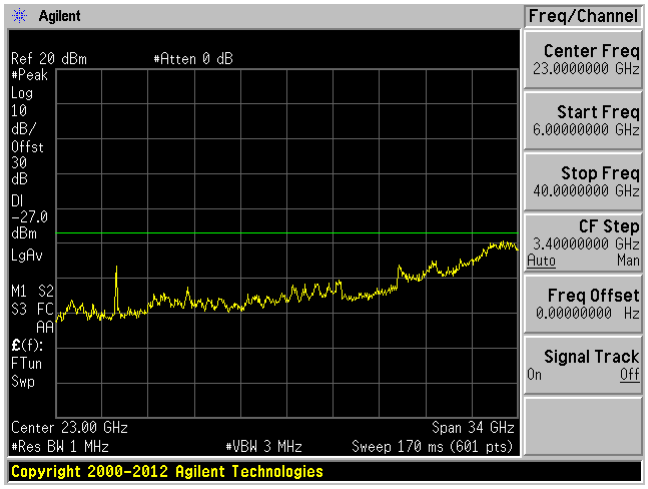
Low Channel 5190 MHz, 6GHz – 40GHz



High Channel 5230 MHz, 30MHz – 6GHz

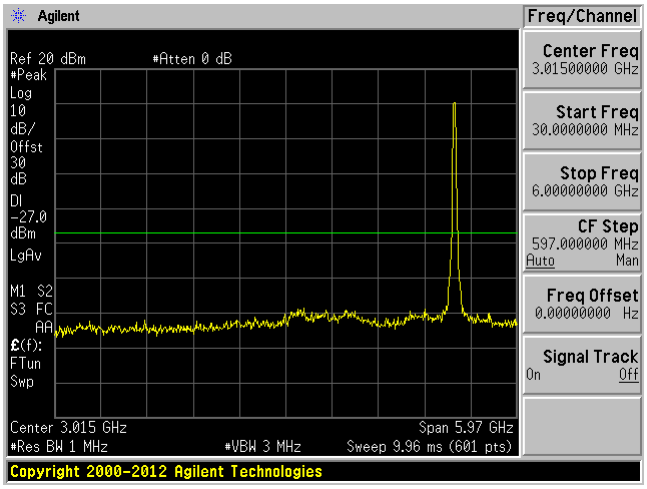


High Channel 5230 MHz, 6GHz – 40GHz

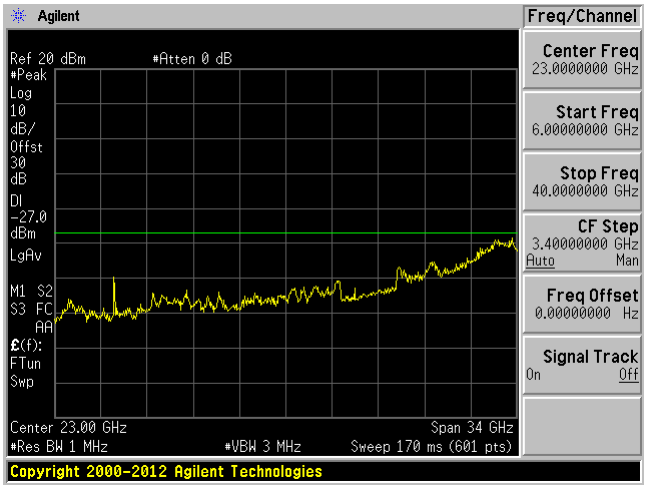


5150 - 5250 MHz, 802.11n/ac40 Mode, ANT B

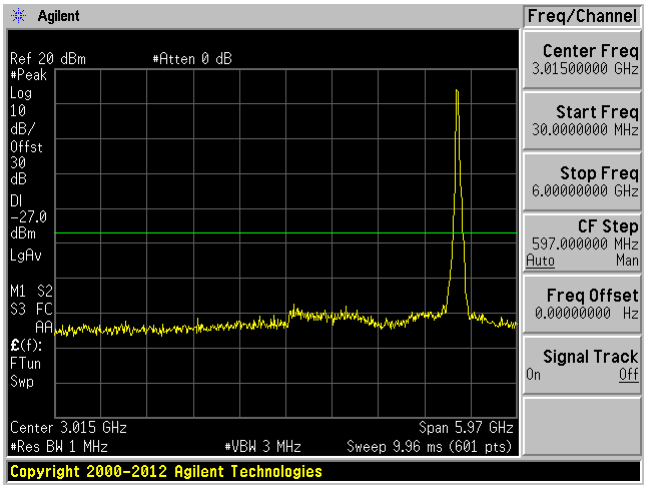
Low Channel 5190 MHz, 30MHz – 6GHz



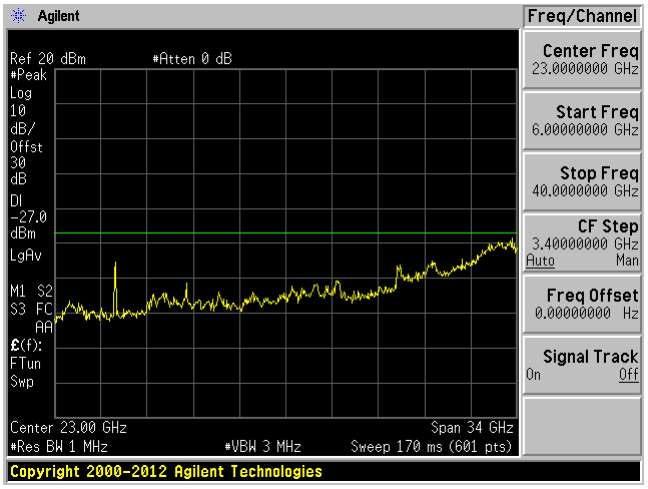
Low Channel 5190 MHz, 6GHz – 40GHz



High Channel 5230 MHz, 30MHz – 6GHz

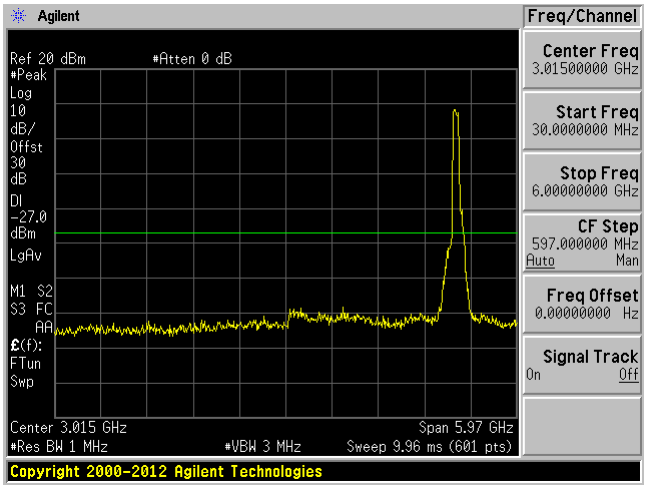


High Channel 5230 MHz, 6GHz – 40GHz

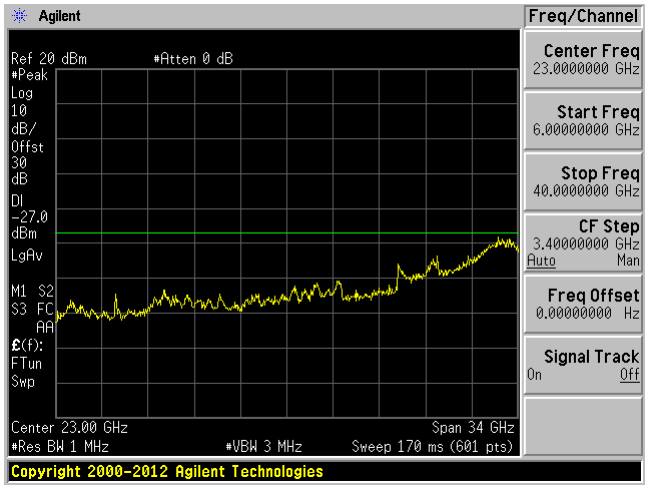


5150 - 5250 MHz, 802.11ac80 Mode, ANT A

5210 MHz, 30MHz – 6GHz

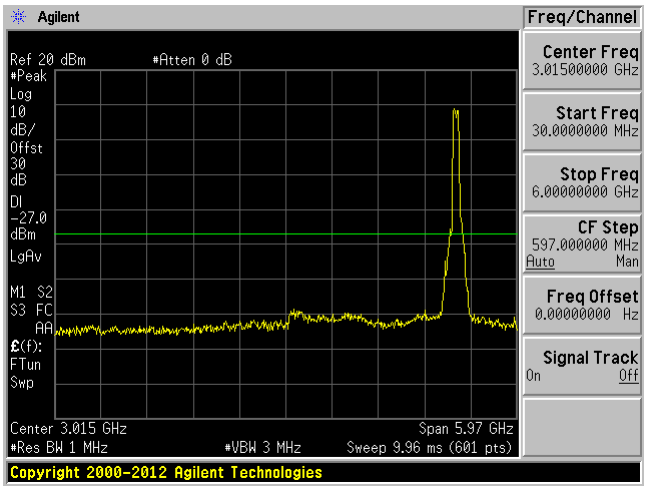


5210 MHz, 6GHz – 40GHz

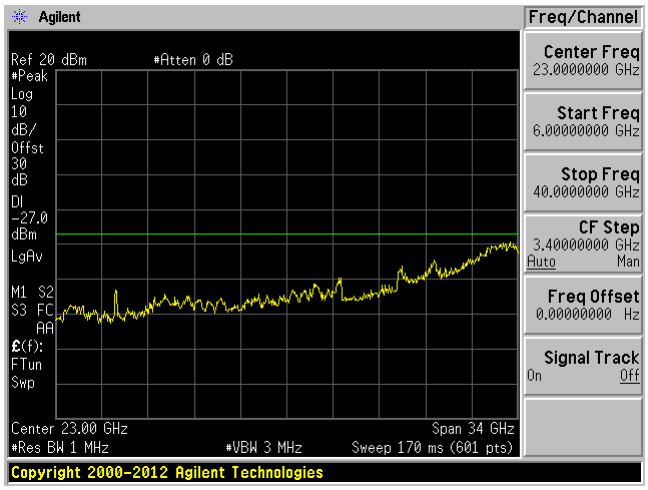


5150 - 5250 MHz, 802.11ac80 Mode, ANT B

5210 MHz, 30MHz – 6GHz

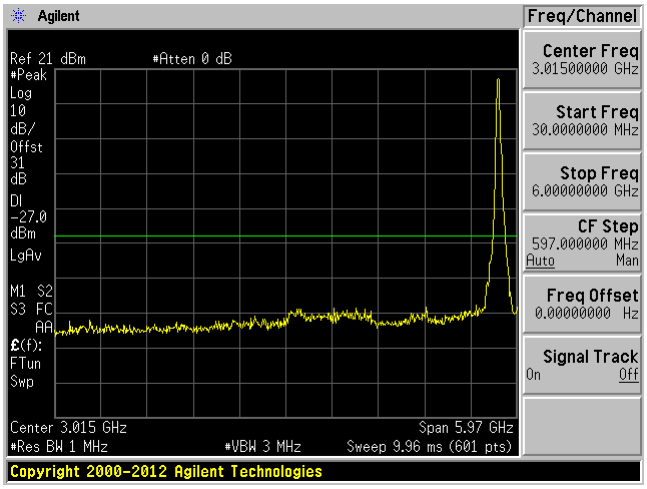


5210 MHz, 6GHz – 40GHz

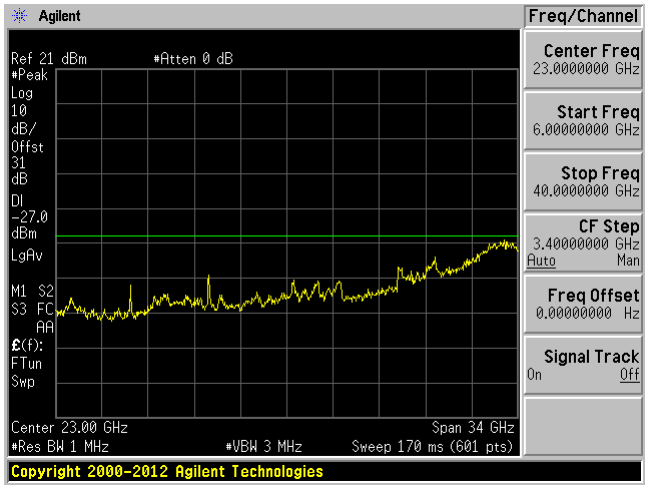


5725 - 5850 MHz, 802.11n/ac40, ANT A

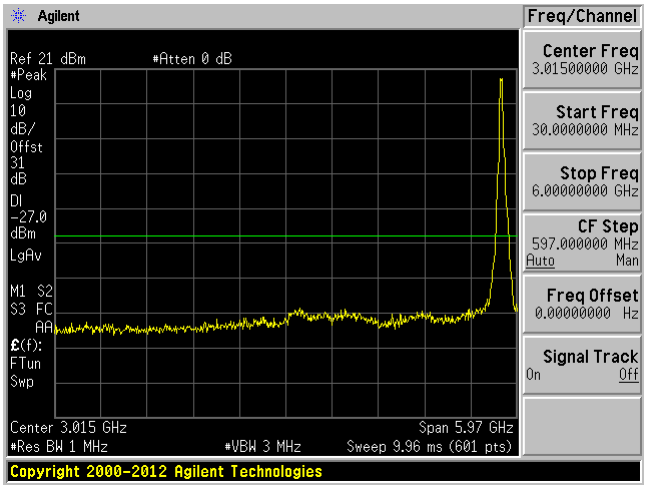
Low Channel 5755 MHz, 30MHz – 6GHz



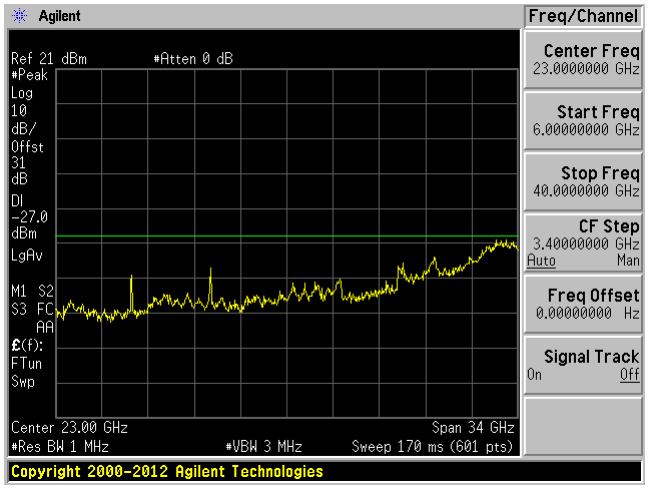
Low Channel 5755 MHz, 6GHz – 40GHz



High Channel 5795 MHz, 30MHz –6GHz

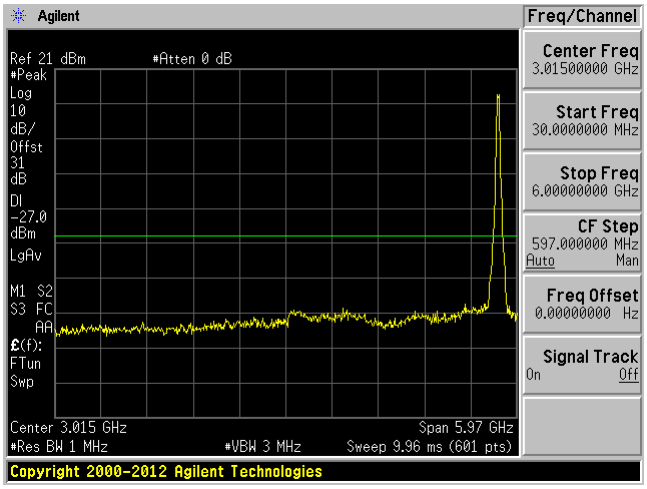


High Channel 5795 MHz, 6GHz – 40GHz

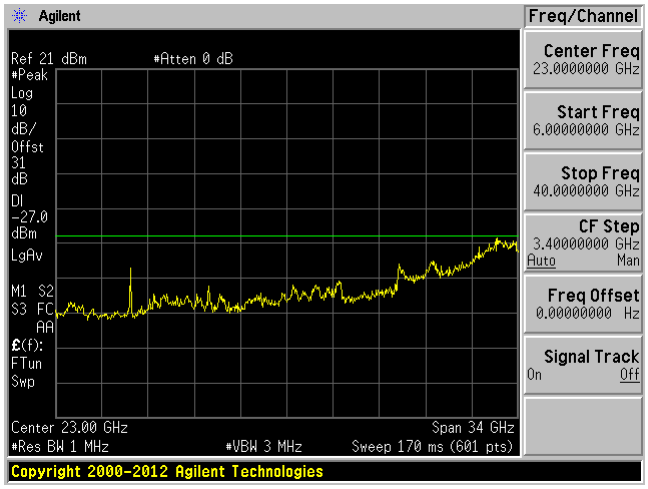


5725 - 5850 MHz, 802.11n/ac40, ANT B

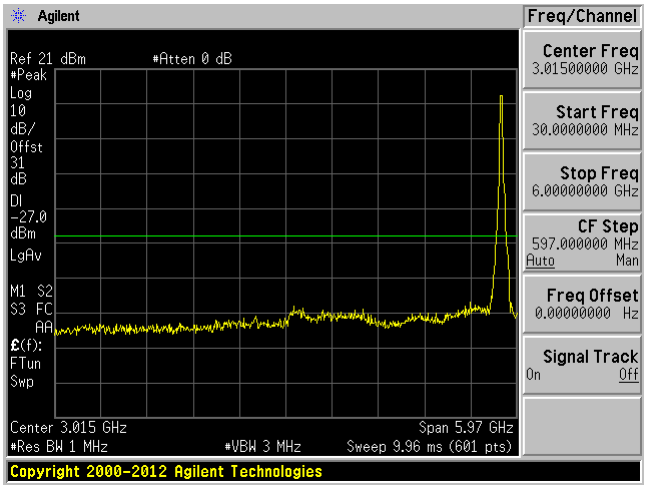
Low Channel 5755 MHz, 30MHz – 6GHz



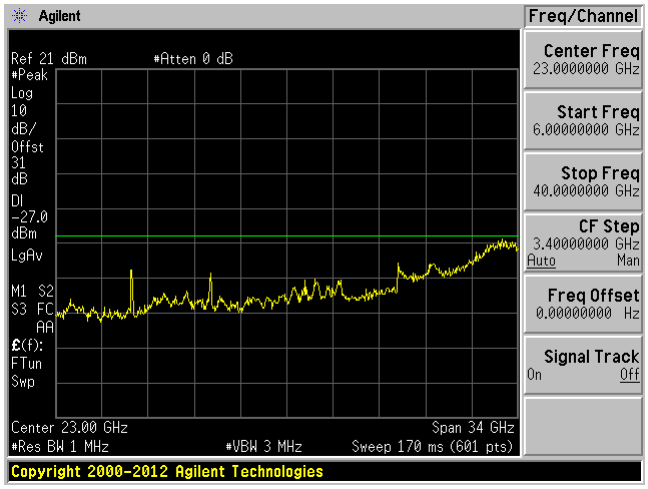
Low Channel 5755 MHz, 6GHz – 40GHz



High Channel 5795 MHz, 30MHz –6GHz

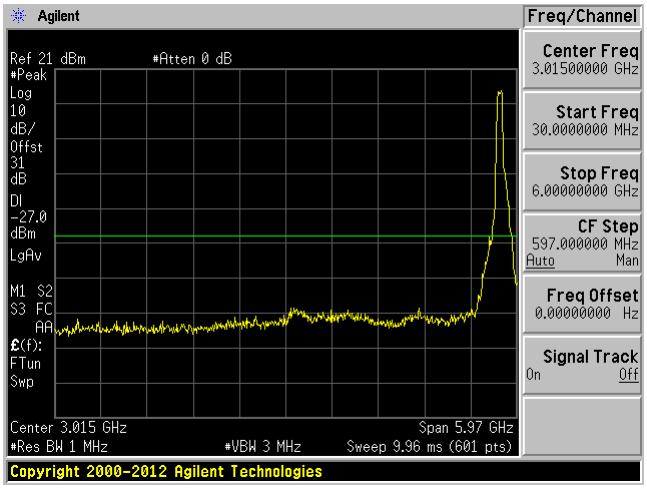


High Channel 5795 MHz, 6GHz – 40GHz

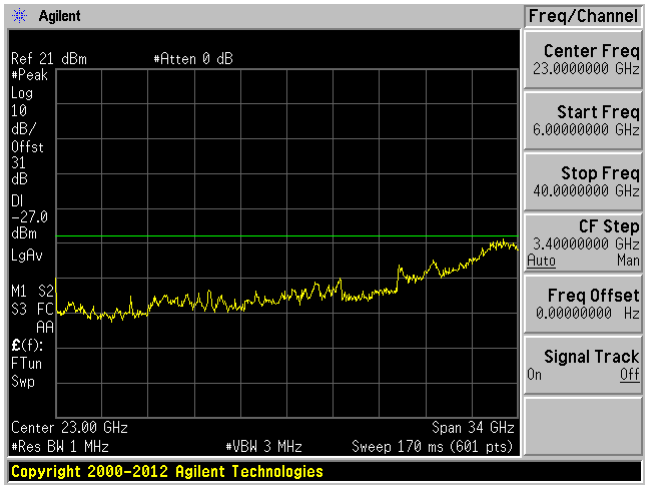


5725 - 5850 MHz, 802.11ac80, ANT A

5775 MHz, 30MHz – 6GHz

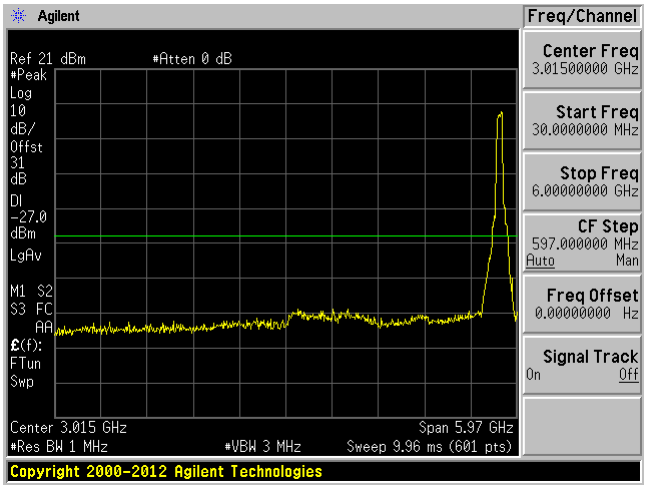


5755 MHz, 6GHz – 40GHz

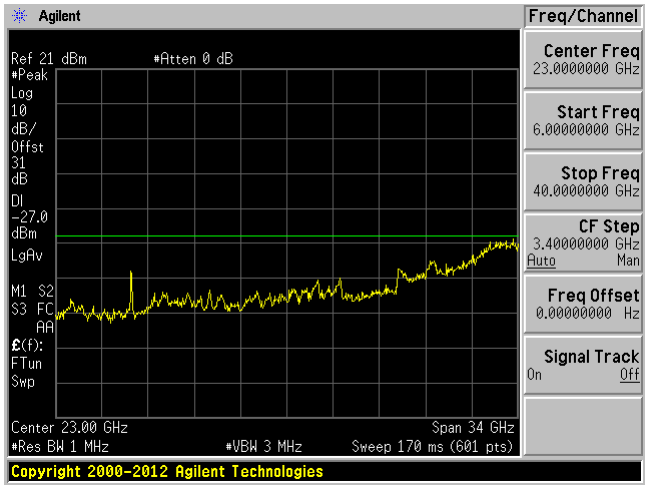


5725 - 5850 MHz, 802.11ac80, ANT B

5775 MHz, 30MHz – 6GHz



5755 MHz, 6GHz – 40GHz

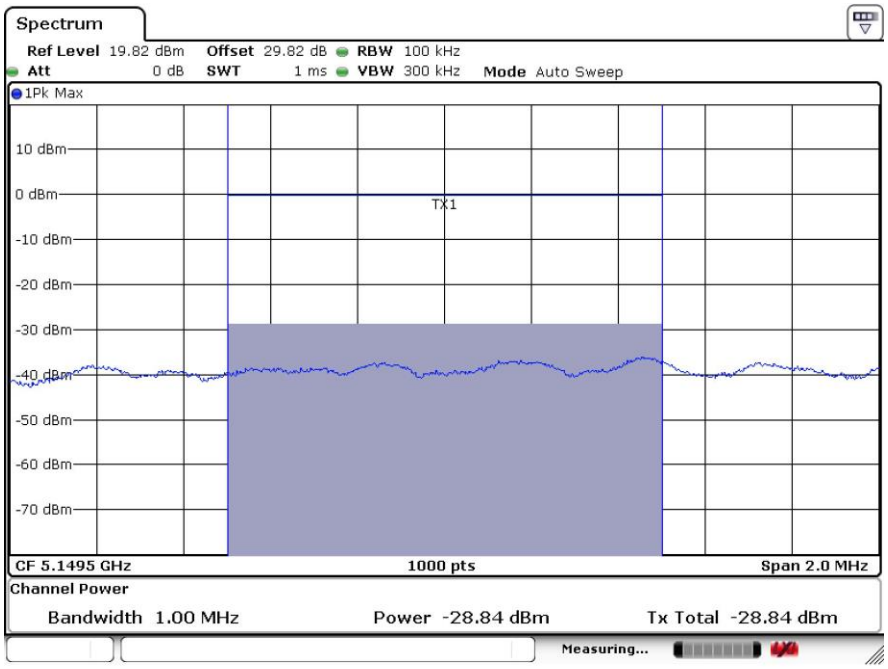


Note: In addition to path loss, offset includes the Directional antenna gain as well as a Combining factor (i.e. Offset (dB) = Path loss (dB) + Directional antenna gain (dbi) + Combining factor (dB)).
Note: Individual antenna gain = 1.1 dBi @ 5.2 GHz. Directional antenna gain (dBi) = 1.1 dBi + 10*log (2) = 4.1 dBi. Individual antenna gain was provided by customer.
Note: Individual antenna gain = 2.4 dBi @ 5.8 GHz. Directional antenna gain (dBi) = 2.4 dBi + 10*log (2) = 5.4 dBi. Individual antenna gain was provided by customer.
Note: Combining factor (dB) = 10 * log (number of antennas) = 10 * log (2) = 3dB.

Band Edge Emissions:

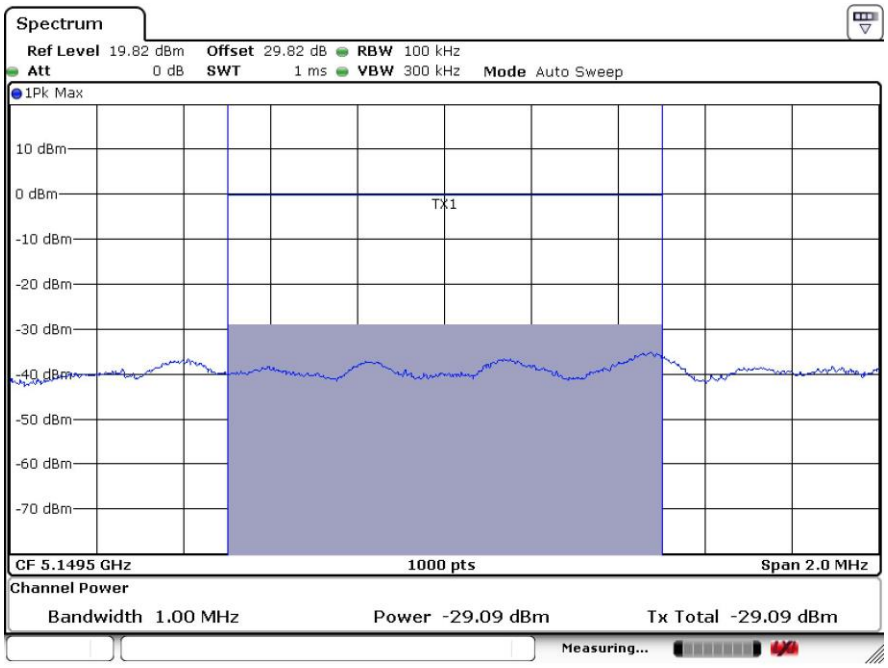
5150 - 5250 MHz

802.11n/ac40 Mode, 5190 MHz, ANTA



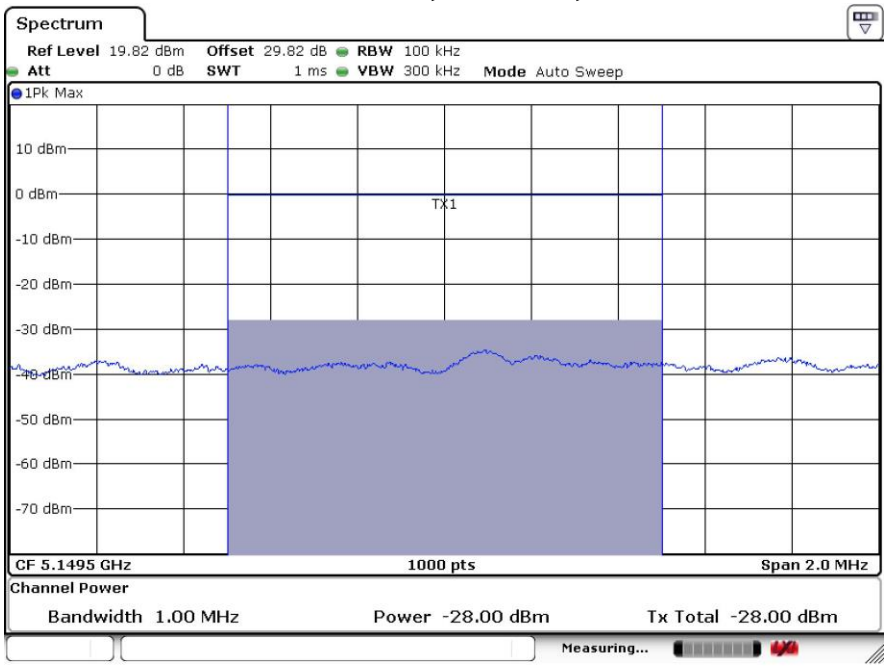
Date: 5.JAN.2022 11:25:43

802. 11n/ac40 Mode, 5190 MHz, ANTB



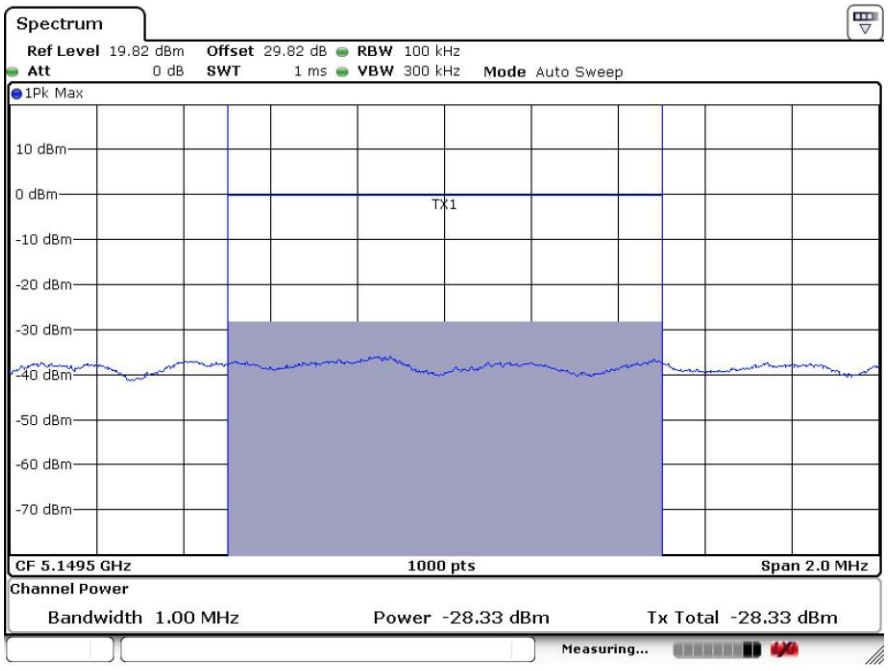
Date: 5.JAN.2022 11:24:55

802.11ac80 Mode, 5210 MHz, ANTA



Date: 5.JAN.2022 11:21:44

802. 11ac80 Mode, 5210 MHz, ANTB

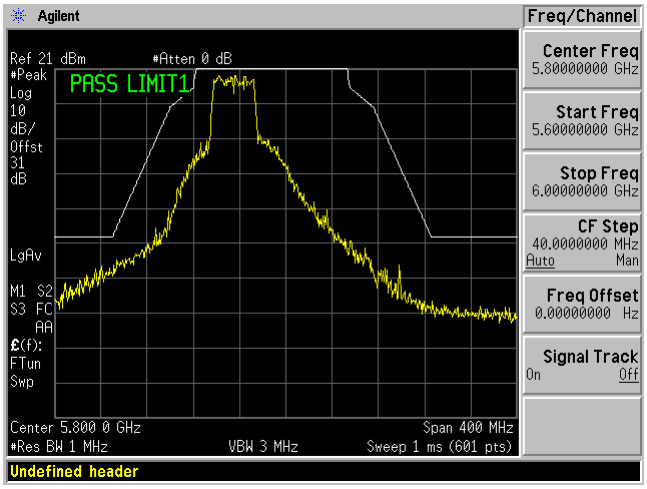


Date: 5.JAN.2022 11:22:31

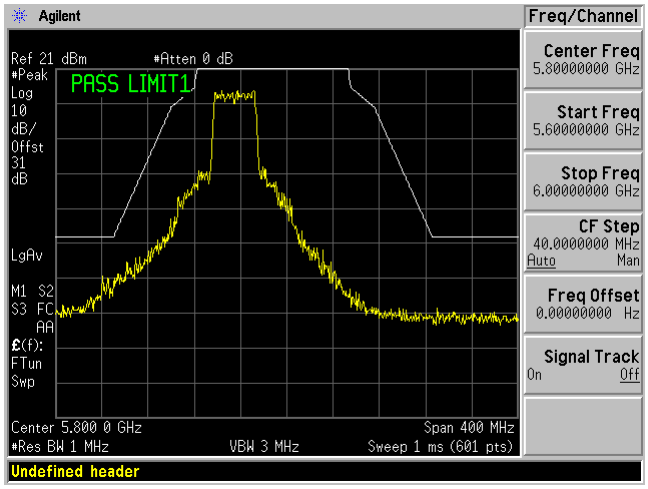
5725 MHz – 5850 MHz

802.11n/ac40 mode

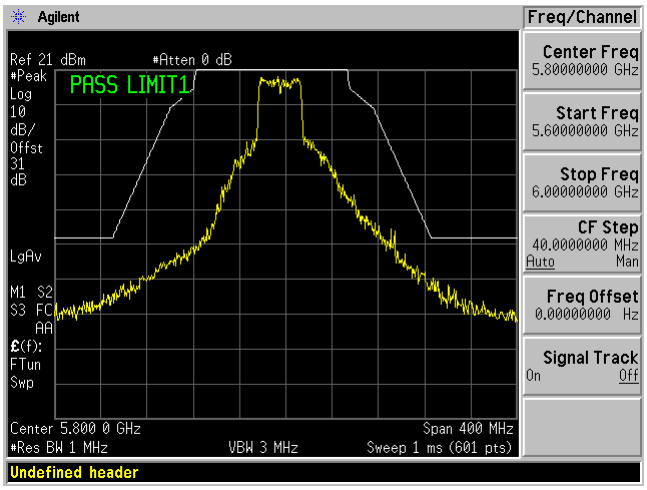
Low Channel, 5755 MHz, ANT A



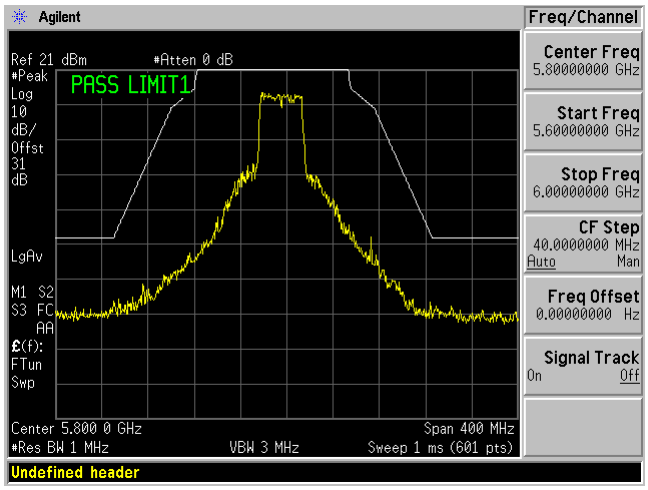
Low Channel, 5755 MHz, ANT B



High Channel, 5795 MHz, ANT A

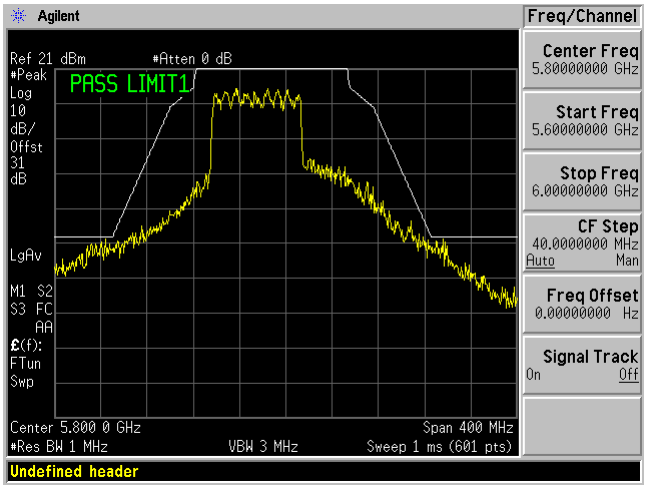


High Channel, 5795 MHz, ANT B

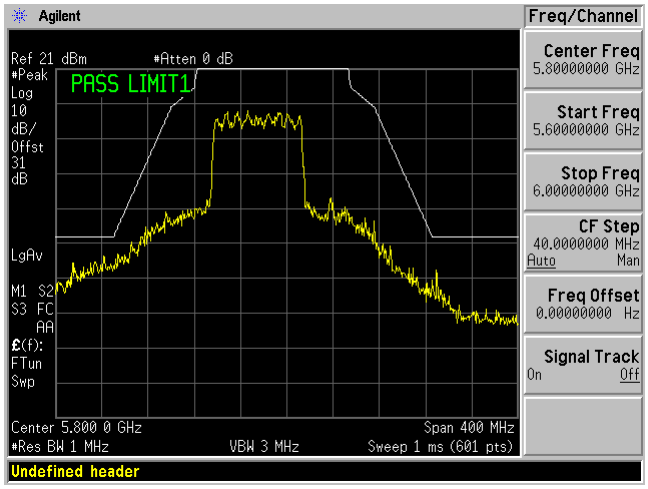


802.11ac80 mode

5775 MHz, ANT A



5775 MHz, ANT B



Note: In addition to path loss, offset includes the Directional antenna gain as well as a Combining factor (i.e. Offset (dB) = Path loss (dB) + Directional antenna gain (dbi) + Combining factor (dB)).
Note: Individual antenna gain = 1.1 dBi @ 5.2 GHz. Directional antenna gain (dBi) = 1.1 dBi + 10*log (2) = 4.1 dBi. Individual antenna gain was provided by customer.
Note: Individual antenna gain = 2.4 dBi @ 5.8 GHz. Directional antenna gain (dBi) = 2.4 dBi + 10*log (2) = 5.4 dBi. Individual antenna gain was provided by customer.
Note: Combining factor (dB) = 10 * log (number of antennas) = 10 * log (2) = 3dB.

12 Annex A (Normative) – EUT Test Setup Photographs

Please refer to the attachment.

13 Annex B (Normative) – EUT External Photographs

Please refer to the attachment.

14 Annex C (Normative) – EUT Internal Photographs

Please refer to the attachment.

15 Annex D (Normative) – Declaration of Similarity

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

DECLARATION OF SIMILARITY

February 14, 2022

To:

FEDERAL COMMUNICATIONS COMMISSIONS
Authorization and Evaluation Division
7435 Oakland Mills Road
Columbia, MD 21046

Dear Sir or Madam:

We *Roku, Inc.* hereby declare that the products below are electrically identical with the same electromagnetic emissions and electromagnetic compatibility characteristics as model: 4670X as tested by BACL, the results of which are featured in BACL Project: R2111301. The differences are also described:

Product Type: IP-STB		
	Model	**Differences**
Original Model	4660X2	
Tested Model	4670X	Different memory configuration

Please contact me should there be need for any additional clarification or information.

Best Regards,

Robert Curtis

Robert Curtis/ Sr. Director SW Engineering
Roku, Inc.
1155 Coleman Ave, San Jose, CA 95110

16 Annex E (Normative) - A2LA Electrical Testing Certificate

Accredited Laboratory

A2LA has accredited

BAY AREA COMPLIANCE LABORATORIES CORP.

Sunnyvale, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets A2LA *R222 - Specific Requirements EPA ENERGY STAR Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 10th day of March 2021.

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

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

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

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

--- END OF REPORT ---