FCC PART 15, SUBPART E
ISEDC RSS-247, ISSUE 2, FEBRUARY 2017

TEST REPORT

For

Roku, Inc.

1155 Coleman Avenue,
San Jose, CA 95110, USA

FCC ID: TC2-R1047
IC: 5959A-R1043

Report Type:	**Product Type:**
Original Report	WiFi Remote Control

Prepared By	Deepak Mishra Test Technician	
Report Number	R2204071-407	
Report Date	2022-05-31	
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R2204071-407	Original Report	2022-05-31

1 General Description

1.1 Product Description for Equipment under Test (EUT)

This test report was prepared on behalf of *Roku, Inc.,* and their product models: *RC-GZ1 and RC-GZ5, FCC ID: TC2-R1047 IC: 5959A-R1043* or the "EUT" as referred to in this report. The EUT has 2.4 GHz/5 GHz Wi-Fi capabilities.

RC-GZ1 and RC-GZ5 have been declared by manufacturer to be electrically identical and RC-GZ1 was selected for testing. Please refer to the manufacturer declaration of similarity letter in Annex D of this report

1.2 Objective

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

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

1.3 Related Submittal(s)/Grant(s)

Equipment Class: DTS, FCC ID: TC2-R1047 IC: 5959A-R1043

1.4 Test Methodology

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

1.5 Measurement Uncertainty

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

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

1.6 Test Facility Registrations

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

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

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

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

1.7 Test Facility Accreditations

Bay Area Compliance Laboratories Corp. (BACL) is:

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

BACL's ISO/IEC 17025:2017 Scope of Accreditation includes a comprehensive suite of EMC Emissions, EMC Immunity, Radio, RF Exposure, Safety and wireline Telecommunications test methods applicable to a wide range of product categories. These product categories include Central Office Telecommunications Equipment [including NEBS - Network Equipment Building Systems], Unlicensed and Licensed Wireless and RF devices, Information Technology Equipment (ITE); Telecommunications Terminal Equipment (TTE); Medical Electrical Equipment; Industrial, Scientific and Medical Test Equipment; Professional Audio and Video Equipment;

Industrial and Scientific Instruments and Laboratory Apparatus; Cable Distribution Systems, and Energy Efficient Lighting.

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

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

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

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

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

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

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

5 Other
- For Water Coolers (ver. 3.0)

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

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

2 EUT Test Configuration

2.1 Justification

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

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

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

2.2 EUT Exercise Software

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

Please refer to the following power setting table.

Standard	Modulation	Frequency (MHz)	Power Setting
FCC 15.407/RSS-247	802.11a	5180	102
		5200	127
		5240	127
		5260	127
		5280	127
		5320	92
		5500	92
		5580	127
		5700	92
		5745	127
		5785	127
		5825	127
	802.11n/ac20	5180	97
		5200	127
		5240	127
		5260	127
		5280	127
		5320	88
		5500	92
		5580	127
		5700	92
		5745	127
		5785	127
		5825	127

*Data rates tested:
802.11a mode: 6 Mbps
802.11n/ac20 HT20/VHT20: MCS0

2.3 Duty Cycle Correction Factor

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

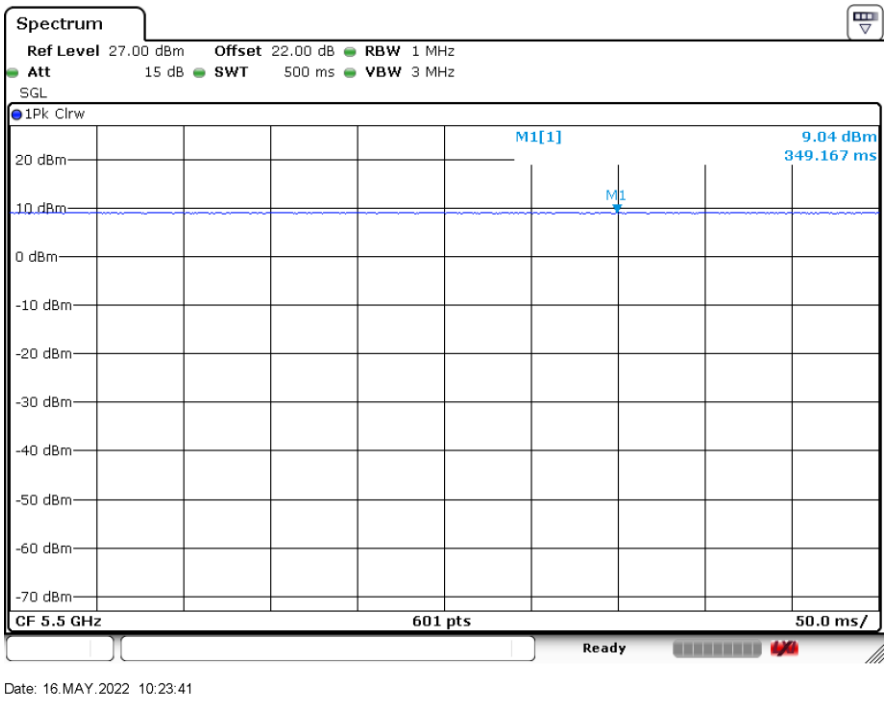
All measurements are to be performed with the EUT transmitting at 100% duty cycle at its maximum power control level; however, if 100% duty cycle cannot be achieved, measurements of duty cycle, x, and maximum-power transmission duration, T, are required for each tested mode of operation.

Radio Mode	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
802.11a	1	1	100%	0
802.11n/ac20	1	1	100%	0

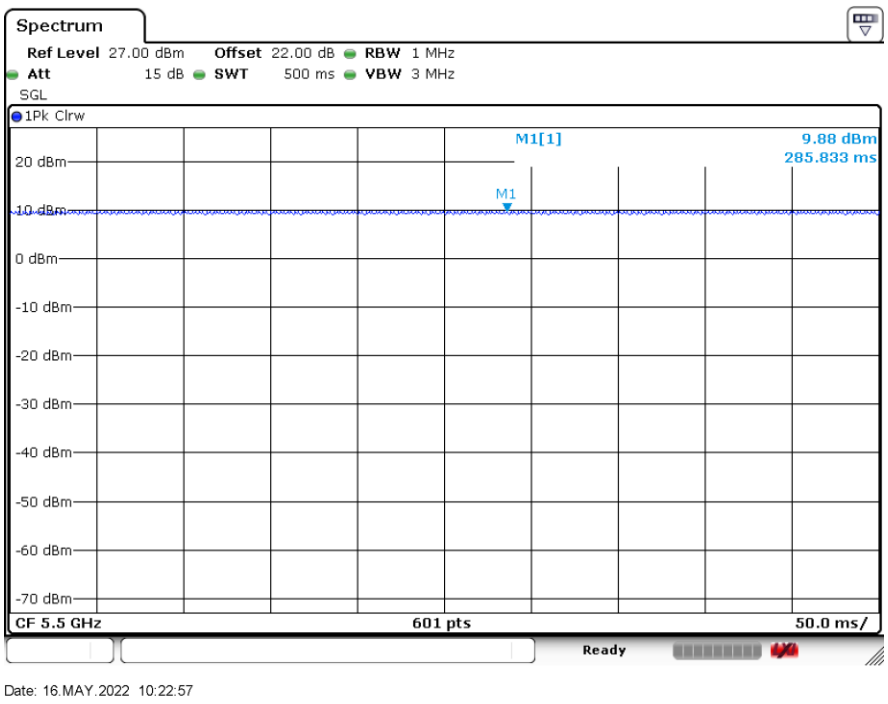
Note: Duty Cycle Correction Factor = 10*log(1/duty cycle)

Please refer to the following plots.

802.11a mode



802.11ac20 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[1]
FCC §15.207 ISEDC RSS-Gen §8.8	AC Line Conducted Emissions	N/A[2]
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

Note[1]: Please refer to Report Number *SAR.20220501* and issued by RF Exposure Lab, LLC for results.
Note[2]: Device is battery powered.

4 FCC §15.203 & ISEDC RSS-Gen §6.8 - Antenna Requirements

4.1 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.

4.2 Antenna List

Antenna usage	Frequency Range (MHz)	Maximum Antenna Gain (dBi)	Antenna Type
5 GHz Wi-Fi	5150-5825	-0.7	PCB Trace

Note: The antenna used by the EUT is permanent attached antenna.
Note: Antenna info is information provided by customer.

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

5.1 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.

5.2 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.

5.3 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

5.4 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

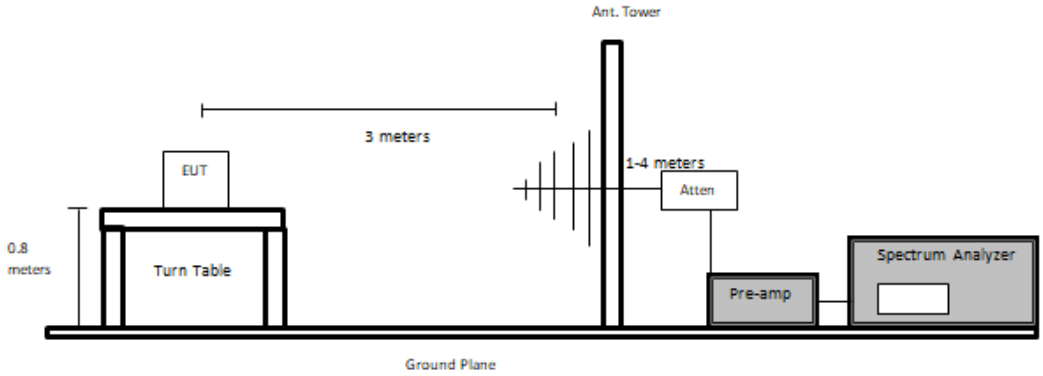
For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (29.4 dB)

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

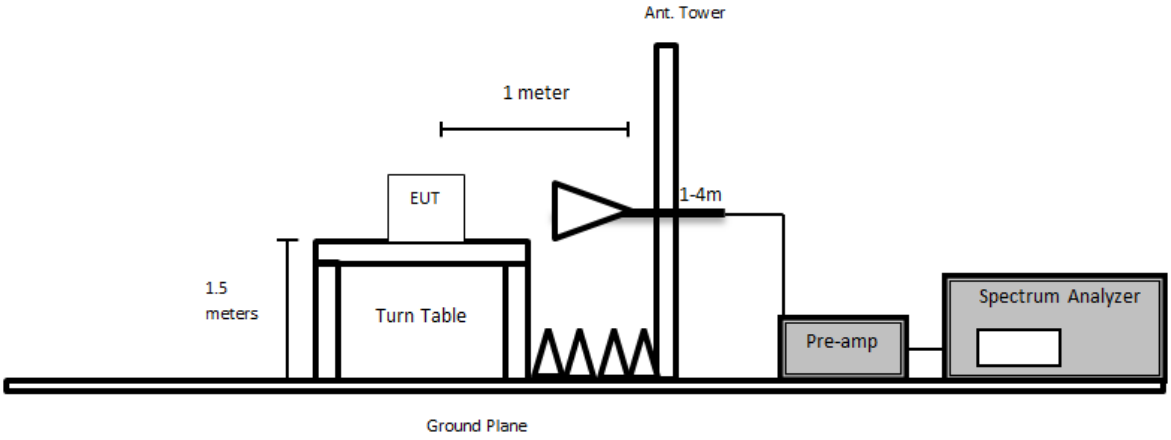
5.5 Test Setup Block Diagram

Below 1GHz:

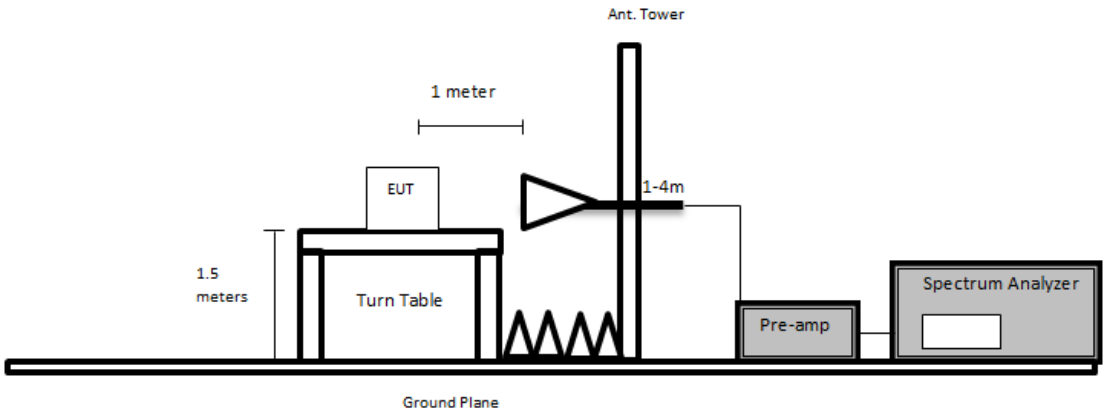


Above 1GHz:

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



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



5.6 Test Equipment List and Details

BACL No	Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Interval
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	2021-06-23	1 year
310	Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950.03	100338	2021-11-18	1 year
-	Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/A
321	Sunol Sciences	Biconilog Antenna	JB3	A020106-2	2021-11-22	2 years
1101	IW Microwave	157 Series Cable Armored with 2.92mm Male Plugs on Both Sides	KPS-1571AN-2400	DC 1922	2021-07-06	1 year
91	Wisewave	Antenna, Horn	ARH-4223-02	10555-02	2022-03-08	2 years
92	Wisewave	Antenna, Horn	ARH-2823-02	10555-01	2022-03-17	2 years
827	AH Systems	Preamplifier	PAM 1840 VH	170	2021-08-03	1 year
1077	Insulted Wire Corp	157 Series 2.92 SM (x2) Armored 33 ft. Cable	KPS-1571AN-3960-KPS	DC 1917	2021-03-03	15 months
1228	Pasternack	Coaxial Cable, RG213	PE3496-800CM	2111301	2021-11-30	1 year
459	HP	Amplifier, Pre	8447D	2443A04374	2021-11-02	1 year
658	Agilent	Pre-Amplifier	8449B	3008A0113	2021-05-06	13 months
1192	ETS Lindgren	Antenna, Horn	3117	00218973	2021-09-14	2 years
-	-	Notch filter	-	-	Each time[1]	N/A
-	-	SMA cable	-	-	Each time[1]	N/A

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

5.7 Test Environmental Conditions

Temperature:	20-22 ºC
Relative Humidity:	42-50 %
ATM Pressure:	102.7 kPa

The testing was performed by Deepak Mishra from 2022-04-29 to 2022-05-05 in 5m chamber 3.

5.8 Summary of Test Results

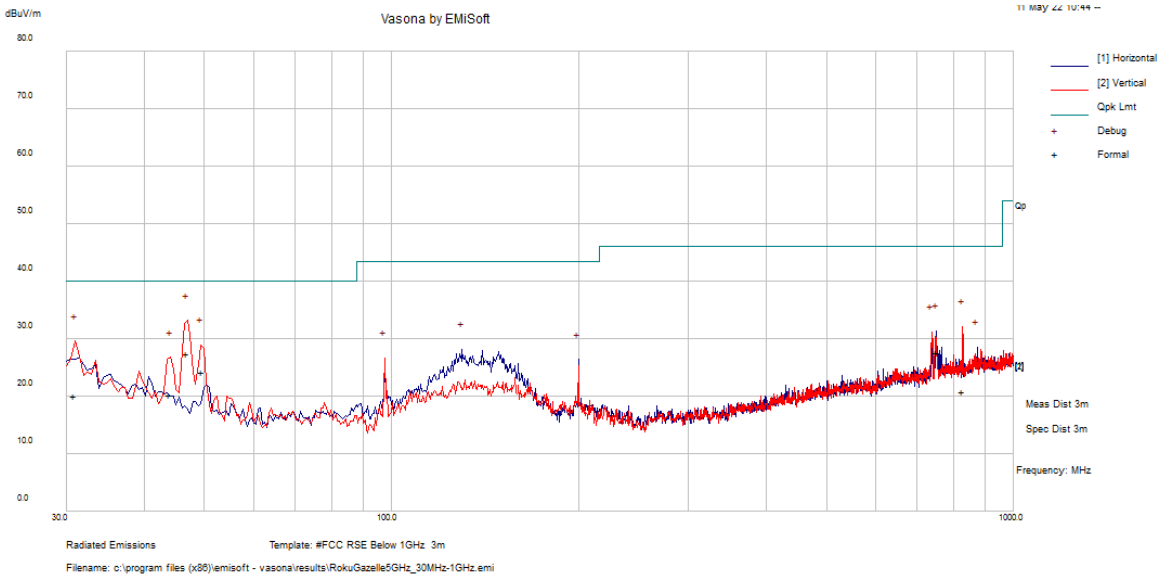
According to the data hereinafter, the EUT complied with the FCC Part 15.407 and RSS-247 standards' radiated emissions limits, and had the worst margin of:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, Channel**
-0.31	11160	Horizontal	802.11ac20/n20 mode, 5580MHz

5.9 Radiated Emissions Test Result Data

1) 30 MHz – 1 GHz Scan at 3 meters

Worst Case: 802.11a, 5825 MHz



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
46.935	37.58	-10.18	27.4	276	H	94	40	-12.6	Pass
30.9215	18.74	1.33	20.08	166	V	184	40	-19.92	Pass
49.65	35.41	-11.21	24.21	286	V	243	40	-15.79	Pass
44.0075	28.72	-8.52	20.21	149	H	343	40	-19.79	Pass
828.176	17.03	3.82	20.86	198	H	27	46	-25.14	Pass
751.2428	24.79	2.75	27.55	126	H	80	46	-18.45	Pass

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

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

2) 1 – 18 GHz, Band Edges, Emission Masks and Harmonics measured at 1 meter

5150 - 5250 MHz

802.11a mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel: 5180 MHz											
5150	60.93	15	150	V	35.53	9.69	38.14	68.01	78	-9.99	Peak
5150	63.86	192	150	H	35.53	9.69	38.14	70.94	78	-7.06	Peak
5150	51.33	15	150	V	35.53	9.69	38.14	58.41	64	-5.59	Ave
5150	55.55	200	150	H	35.53	9.69	38.14	62.63	64	-1.37	Ave
10360	54.01	282	150	V	38.15	15.85	38.36	69.65	78	-8.35	Peak
10360	52.64	294	150	H	38.15	15.85	38.36	68.28	78	-9.72	Peak
Middle Channel: 5200 MHz											
10400	50.06	0	150	V	38.15	15.85	38.24	65.82	78	-12.18	Peak
10400	49.19	71	150	H	38.15	15.85	38.24	64.95	78	-13.05	Peak
15600	49.11	0	150	V	41.07	15.03	37.92	67.29	84	-16.71	Peak
High Channel: 5240 MHz											
10480	50.48	235	230	V	38.15	15.85	38.24	66.24	78	-11.76	Peak
10480	50.10	229	150	H	38.15	15.85	38.24	65.86	78	-12.14	Peak

5150 - 5250 MHz

802.11ac20/n20 mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel: 5180 MHz											
5150	57.93	152	150	V	35.53	9.69	38.14	65.01	78	-12.99	Peak
5150	61.34	209	150	H	35.53	9.69	38.14	68.42	78	-9.58	Peak
5150	46.14	152	150	V	35.53	9.69	38.14	53.21	64	-10.79	Ave
5150	55.26	209	150	H	35.53	9.69	38.14	62.34	64	-1.66	Ave
10360	54.38	191	100	V	38.15	15.85	38.36	70.02	78	-7.98	Peak
10360	50.57	229	118	H	38.15	15.85	38.36	66.21	78	-11.79	Peak
Middle Channel: 5200 MHz											
10400	59.75	187	113	V	38.15	15.85	38.24	75.51	78	-2.49	Peak
10400	57.47	219	110	H	38.15	15.85	38.24	73.23	78	-4.77	Peak
High Channel: 5240 MHz											
10480	47.81	6	150	V	38.15	15.85	38.24	63.57	78	-14.43	Peak
10480	47.60	68	150	H	38.15	15.85	38.24	63.36	78	-14.64	Peak

5250 - 5350 MHz

802.11a mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel: 5260 MHz											
10520	61.41	285	176	V	38.19	15.85	38.24	77.22	78	-0.78	Peak
10520	58.75	192	138	H	38.19	15.85	38.24	74.56	78	-3.44	Peak
Middle Channel: 5280 MHz											
10560	60.55	284	187	V	38.19	15.85	38.24	76.36	78	-1.64	Peak
10560	58.41	343	204	H	38.19	15.85	38.24	74.22	78	-3.78	Peak
High Channel: 5320 MHz											
5350	64.15	0	100	V	35.242	9.949	38.142	71.199	84	-12.801	Peak
5350	75.02	208	150	H	35.242	9.949	38.142	82.069	84	-1.931	Peak
5350	49.02	0	150	V	35.242	9.949	38.142	56.069	64	-7.931	Ave
5350	55.488	208	150	H	35.242	9.949	38.142	62.537	64	-1.463	Ave
10640	52.25	293	150	V	38.19	15.85	38.24	68.06	84	-15.94	Peak
10640	51.26	285	150	H	38.19	15.85	38.24	67.07	84	-16.93	Peak
10640	39.865	293	150	V	38.19	15.85	38.24	55.68	64	-8.33	Ave
10640	38.341	285	150	H	38.19	15.85	38.24	54.15	64	-9.85	Ave

5250 - 5350 MHz

802.11ac20/n20 mode

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: 5260 MHz											
10520	61.24	285	150	V	38.19	15.85	38.24	77.05	78	-0.95	Peak
10520	58.40	219	142	H	38.19	15.85	38.24	74.21	78	-3.79	Peak
Middle Channel: 5280 MHz											
10560	60.51	275	172	V	38.19	15.85	38.24	76.32	78	-1.68	Peak
10560	58.32	50	150	H	38.19	15.85	38.24	74.13	78	-3.87	Peak
High Channel: 5320 MHz											
5350	61.39	340	150	V	35.242	9.949	38.142	68.439	84	-15.561	Peak
5350	74.94	200	150	H	35.242	9.949	38.142	81.989	84	-2.011	Peak
5350	47.483	340	150	V	35.242	9.949	38.142	54.532	64	-9.468	Ave
5350	55.211	200	150	H	35.242	9.949	38.142	62.26	64	-1.74	Ave
10640	52.46	353	132	V	38.19	15.85	38.24	68.27	84	-15.73	Peak
10640	51.79	292	150	H	38.19	15.85	38.24	67.60	84	-16.40	Peak
10640	40.403	353	132	V	38.19	15.85	38.24	56.21	64	-7.79	Ave
10640	39.979	292	150	H	38.19	15.85	38.24	55.79	64	-8.21	Ave

5470 - 5725 MHz

802.11a mode

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel: 5500 MHz											
5470	62.47	170	193	V	35.21	10.20	37.94	69.95	78	-8.06	Peak
5470	65.13	187	150	H	35.21	10.20	37.94	72.61	78	-5.40	Peak
5470	54.56	198	150	V	35.21	10.20	37.94	62.04	64	-1.97	Ave
5470	53.71	187	150	H	35.21	10.20	37.94	61.18	64	-2.82	Ave
11000	51.91	185	163	V	38.63	16.38	37.92	69.00	84	-15.00	Peak
11000	50.08	353	150	H	38.63	16.38	37.92	67.17	84	-16.83	Peak
11000	40.56	185	163	V	38.63	16.38	37.92	57.65	64	-6.35	Ave
11000	38.79	353	150	H	38.63	16.38	37.92	55.88	64	-8.12	Ave
Middle Channel: 5580 MHz											
11160	60.11	184	150	V	38.63	16.38	37.92	77.20	84	-6.80	Peak
11160	59.6	351	187	H	38.63	16.38	37.92	76.69	84	-7.31	Peak
11160	44.971	184	150	V	38.63	16.38	37.92	62.06	64	-1.94	Ave
11160	44.464	351	187	H	38.63	16.38	37.92	61.56	64	-2.44	Ave
High Channel: 5700 MHz											
5725	46.76	260	178	V	35.242	10.769	37.903	54.868	78	-23.132	Peak
5725	46.17	230	100	H	35.242	10.769	37.903	54.278	78	-23.722	Peak
5725	35.319	260	178	V	35.242	10.769	37.903	43.427	64	-20.573	Ave
5725	54.565	230	100	H	35.242	10.769	37.903	62.673	64	-1.327	Ave
11400	50.53	186	150	V	38.63	16.38	37.92	67.62	84	-16.38	Peak
11400	47.02	331	150	H	38.63	16.38	37.92	64.11	84	-19.89	Peak
11400	39.637	186	150	V	38.63	16.38	37.92	56.73	64	-7.27	Ave
11400	36.467	331	150	H	38.63	16.38	37.92	53.56	64	-10.44	Ave

5470 - 5725 MHz

802.11ac20/n20 mode

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: 5500 MHz											
5470	61.74	165	148	V	35.21	10.20	37.94	69.22	78	-8.79	Peak
5470	69.81	205	150	H	35.21	10.20	37.94	77.29	78	-0.72	Peak
5470	49.79	165	148	V	35.21	10.20	37.94	57.27	64	-6.74	Ave
5470	55.21	205	150	H	35.21	10.20	37.94	62.69	64	-1.31	Ave
11000	50.85	185	163	V	38.63	16.38	37.92	67.94	84	-16.06	Peak
11000	50.22	353	150	H	38.63	16.38	37.92	67.31	84	-16.69	Peak
11000	40.16	185	163	V	38.63	16.38	37.92	57.25	64	-6.75	Ave
11000	39.02	353	150	H	38.63	16.38	37.92	56.11	64	-7.89	Ave
Middle Channel: 5580 MHz											
11160	52.65	190	150	V	38.63	16.38	37.92	69.74	84	-14.26	Peak
11160	57.58	360	196	H	38.63	16.38	37.92	74.67	84	-9.33	Peak
11160	40.185	190	150	V	38.63	16.38	37.92	57.28	64	-6.72	Ave
11160	46.598	360	196	H	38.63	16.38	37.92	63.69	64	-0.31	Ave
High Channel: 5700 MHz											
5725	62.9	54	150	V	35.242	10.769	37.903	71.008	78	-6.992	Peak
5725	68.78	230	100	H	35.242	10.769	37.903	76.888	78	-1.112	Peak
5725	47.022	54	150	V	35.242	10.769	37.903	55.13	64	-8.87	Ave
5725	54.237	230	100	H	35.242	10.769	37.903	62.345	64	-1.655	Ave
11400	48.74	183	145	V	38.63	16.38	37.92	65.83	84	-18.17	Peak
11400	46.97	259	116	H	38.63	16.38	37.92	64.06	84	-19.94	Peak
11400	38.285	183	145	V	38.63	16.38	37.92	55.38	64	-8.62	Ave
11400	36.775	259	116	H	38.63	16.38	37.92	53.87	64	-10.13	Ave

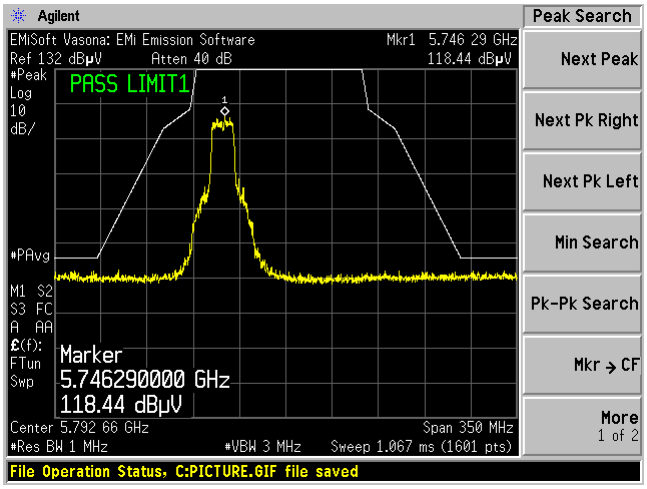
5725 - 5850 MHz

802.11a mode

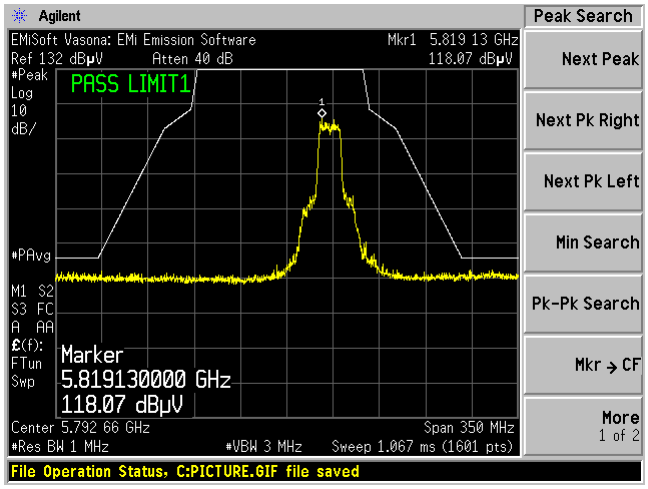
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel: 5745 MHz											
11490	59.28	189	150	V	38.86	16.38	37.78	76.74	84	-7.26	Peak
11490	53.31	360	191	H	38.86	16.38	37.78	70.77	84	-13.23	Peak
11490	44.437	189	150	V	38.86	16.38	37.78	61.90	64	-2.10	Ave
11490	43.717	360	191	H	38.86	16.38	37.78	61.18	64	-2.82	Ave
Middle Channel: 5785 MHz											
11570	58.14	190	150	V	38.86	16.38	37.78	75.60	84	-8.40	Peak
11570	54.59	360	190	H	38.86	16.38	37.78	72.05	84	-11.95	Peak
11570	44.348	190	150	V	38.86	16.38	37.78	61.81	64	-2.19	Ave
11570	43.974	360	190	H	38.86	16.38	37.78	61.43	64	-2.57	Ave
High Channel: 5825 MHz											
11650	59.05	190	150	V	38.86	16.38	37.78	76.51	84	-7.49	Peak
11650	57.64	360	190	H	38.86	16.38	37.78	75.10	84	-8.90	Peak
11650	44.064	190	150	V	38.86	16.38	37.78	61.52	64	-2.48	Ave
11650	43.864	360	190	H	38.86	16.38	37.78	61.32	64	-2.68	Ave

5725 - 5850 MHz Emission Mask

802.11a mode, Low Channel



802.11a mode, High Channel



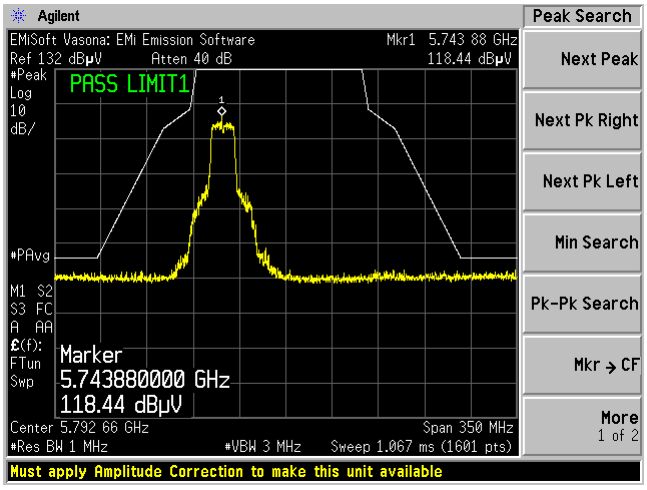
5725 - 5850 MHz

802.11ac20/n20 mode

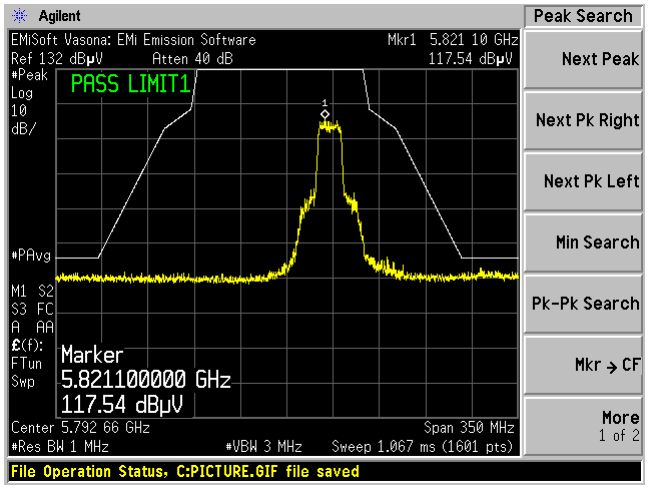
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel: 5745 MHz											
11490	55.96	189	150	V	38.86	16.38	37.78	73.42	84	-10.58	Peak
11490	53.52	360	191	H	38.86	16.38	37.78	70.98	84	-13.02	Peak
11490	44.86	189	150	V	38.86	16.38	37.78	62.32	64	-1.68	Ave
11490	41.923	360	191	H	38.86	16.38	37.78	59.38	64	-4.62	Ave
Middle Channel: 5785 MHz											
11570	54.88	190	150	V	38.86	16.38	37.78	72.34	84	-11.66	Peak
11570	53.12	360	190	H	38.86	16.38	37.78	70.58	84	-13.42	Peak
11570	45.05	190	150	V	38.86	16.38	37.78	62.51	64	-1.49	Ave
11570	40.84	360	190	H	38.86	16.38	37.78	58.30	64	-5.70	Ave
High Channel: 5825 MHz											
11650	55.067	190	150	V	38.86	16.38	37.78	72.53	84	-11.47	Peak
11650	54.678	360	190	H	38.86	16.38	37.78	72.14	84	-11.86	Peak
11650	43.648	190	150	V	38.86	16.38	37.78	61.11	64	-2.89	Ave
11650	41.547	360	190	H	38.86	16.38	37.78	59.01	64	-4.99	Ave

5725 - 5850 MHz Emission Mask

802.11n/ac20 mode, Low Channel

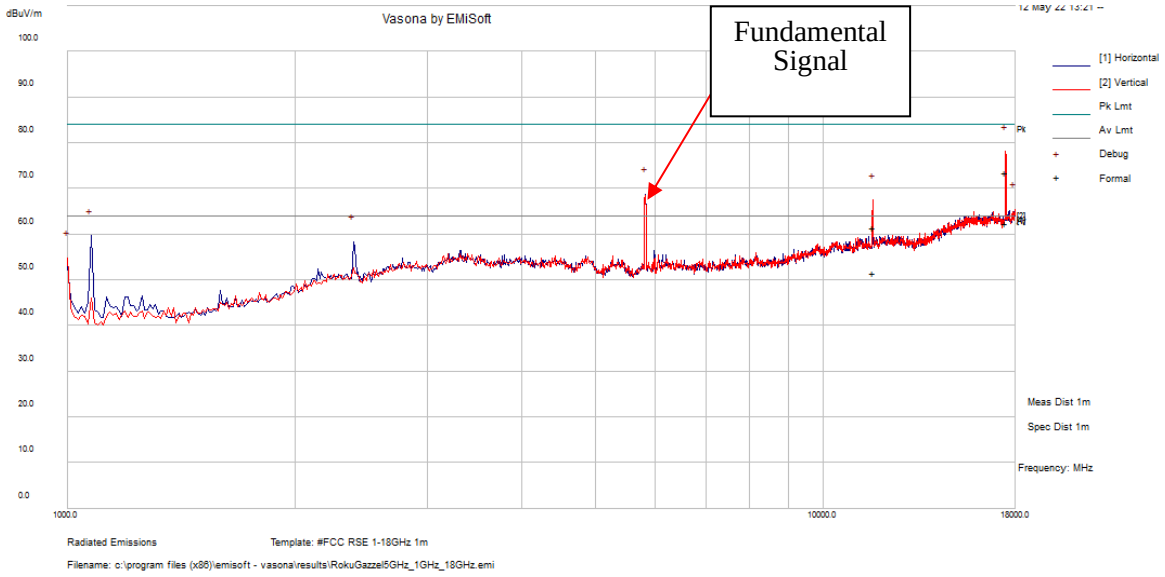


802.11n/ac20 mode, High Channel



3) 1 to 18 GHz scan at 1 meter

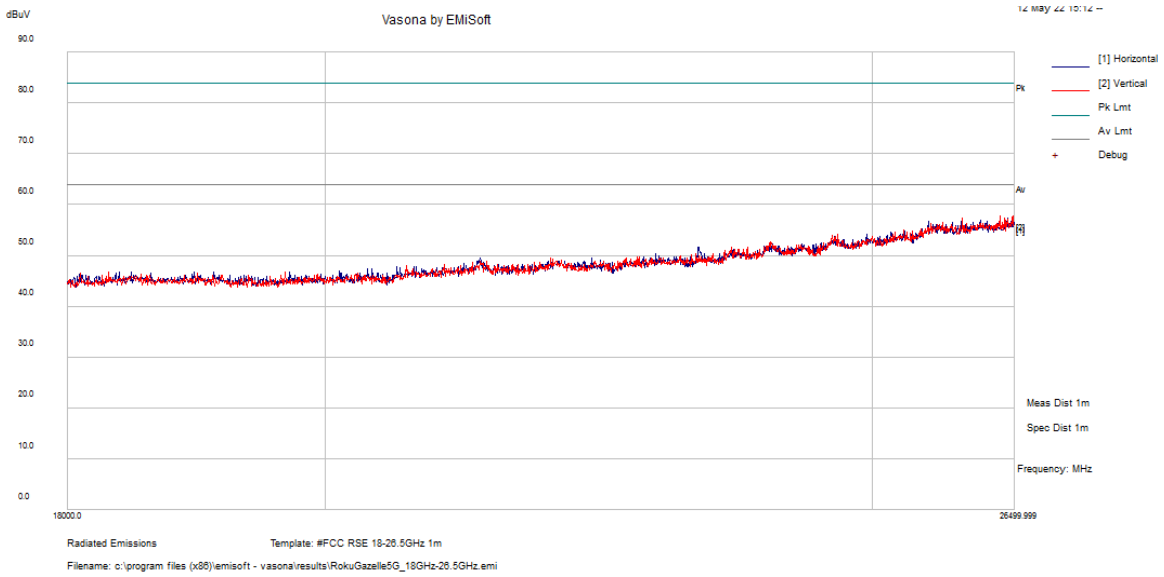
Worst Case: 802.11a, 5825 MHz



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
17466.87	55.12	18.34	73.45	106	V	275	84	-10.55	Peak
11656.52	49.09	12.42	61.51	101	V	242	84	-22.49	Peak
17466.87	44	18.34	62.33	106	V	275	64	-1.67	Average
11656.52	39.16	12.42	51.58	101	V	242	64	-12.42	Average

4) 18 – 26.5 GHz Scan at 1 Meter

Worst Case: 802.11a, 5825 MHz

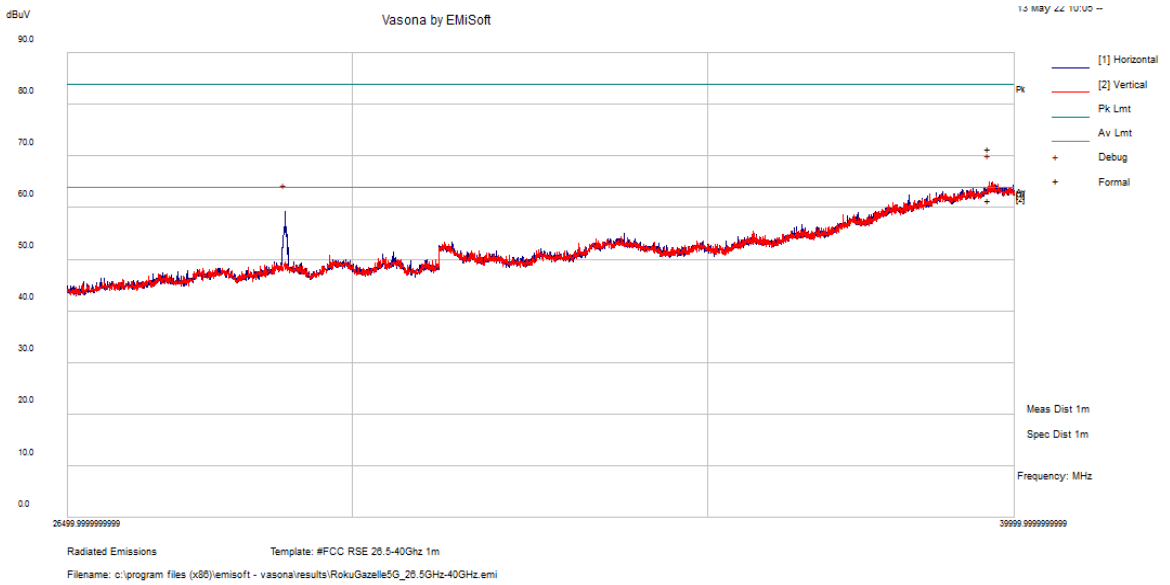


Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
26474.388	26474.388	23.16	55.73	150	H	0	64	-8.27	Peak

Note: Peak measurement made on worst-case emission and compared to average limit to show compliance.

5) 26.5 – 40 GHz Scan at 1 Meter

Worst Case: 802.11a, 5825 MHz



Frequency (MHz)	S.A. Reading (dBuV)	Correction Factor (dB/m)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment
39596.468	57.45	15.4	72.85	200	H	177	84	-11.15	Peak
39596.468	46.26	15.4	61.66	271	V	65	64	-2.34	Average

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

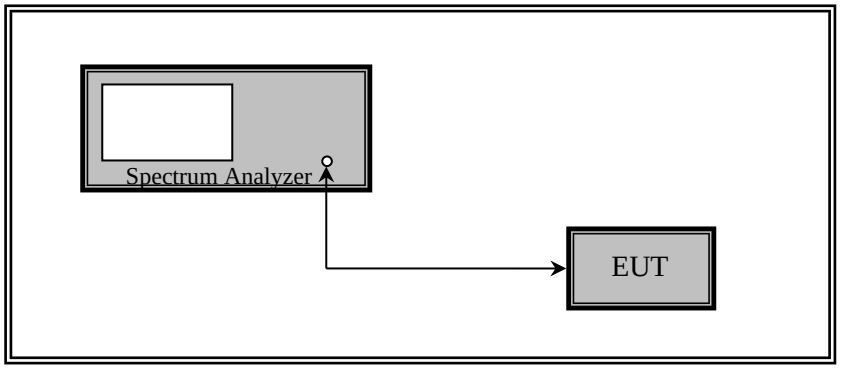
6.1 Applicable Standards

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.

6.2 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.

6.3 Test Setup Block Diagram



6.4 Test Equipment List and Details

Bacl No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	2021-06-23	1 year
-	-	RF cable	-	-	Each time[1]	N/A
-	-	10 dB attenuator	-	-	Each time[1]	N/A

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

6.5 Test Environmental Conditions

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

The testing was performed by Deepak Mishra on 2022-04-21 in RF site.

6.6 Test Results

Please refer to the following tables and plots.

5150 – 5250 MHz, 5250 – 5350 MHz, 5470 – 5725 MHz

Channel	Frequency (MHz)	99% OBW (MHz)	26 dB OBW (MHz)
802.11a mode			
36	5180	17.1349	21.936
40	5200	21.0544	37.701
48	5240	22.9576	38.543
52	5260	23.9387	38.679
56	5280	23.8647	38.631
64	5320	17.1719	22.084
100	5500	17.0484	22.157
116	5580	17.6523	33.444
140	5700	17.1570	22.164
802.11n/ac20 mode			
36	5180	18.0881	22.940
40	5200	25.6999	43.595
48	5240	27.7283	44.775
52	5260	28.5010	44.967
56	5280	28.9013	45.047
64	5320	18.3377	23.353
100	5500	18.2326	22.886
116	5580	20.0328	41.091
140	5700	18.4048	23.376

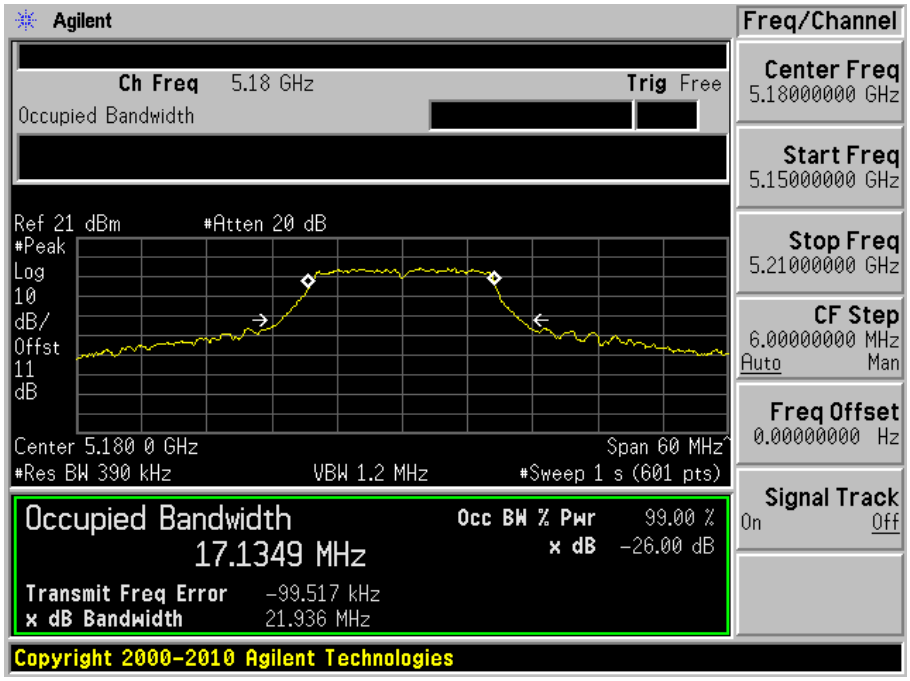
5725 - 5850 MHz

Channel	Frequency (MHz)	99% OBW (MHz)	6 dB OBW (MHz)
802.11a mode			
149	5745	16.8944	16.573
157	5785	16.8612	16.572
165	5825	17.1277	16.578
802.11n/ac20 mode			
149	5745	18.1314	17.8517
157	5785	18.0509	17.755
165	5825	18.3590	17.816

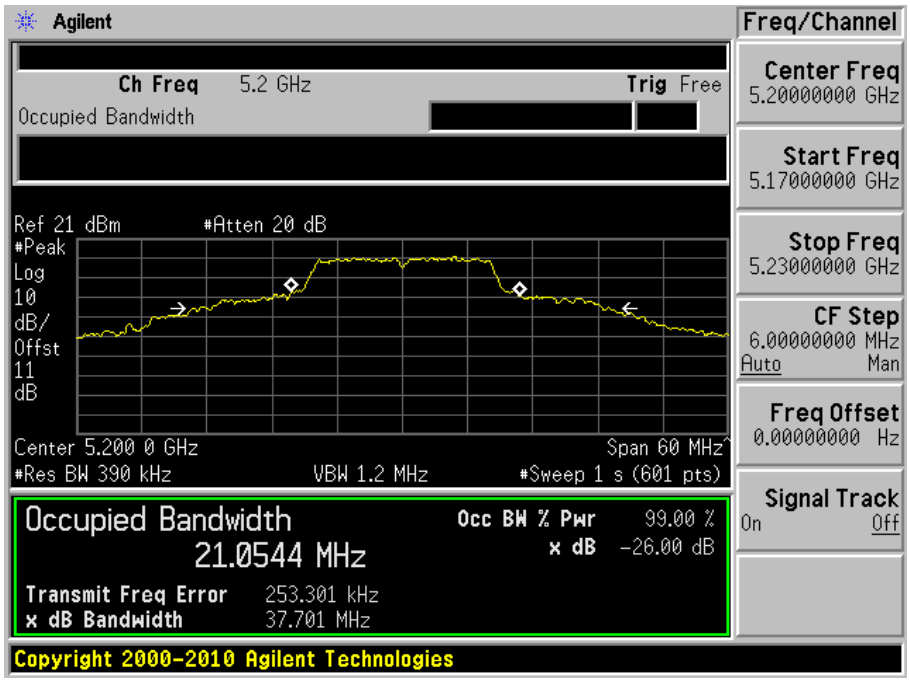
99% & 26dB BW

5150 – 5250 MHz

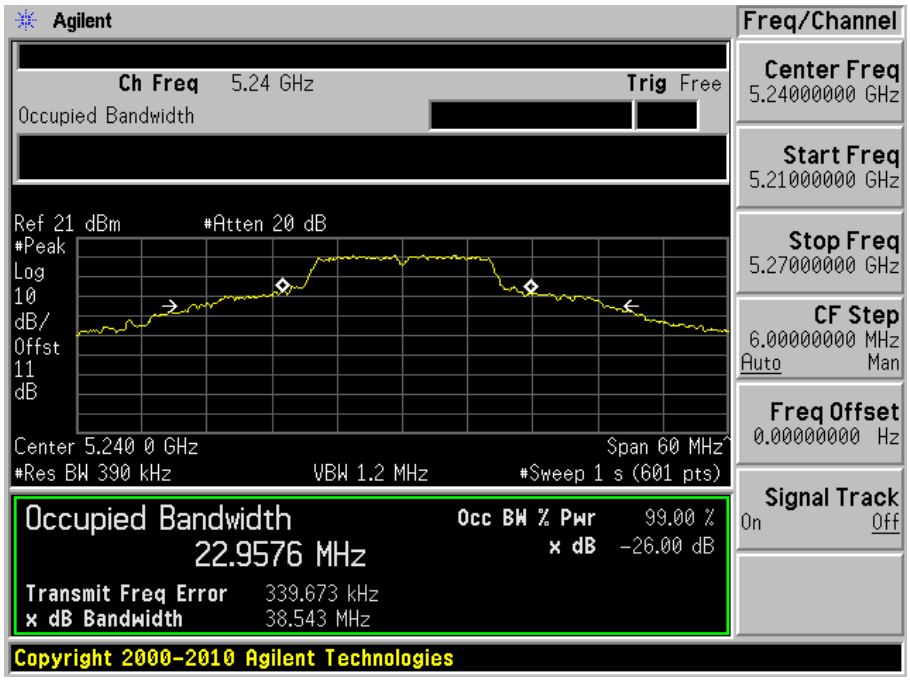
a Mode 5180 MHz Low Channel OBW



a Mode 5200 MHz Mid Channel OBW

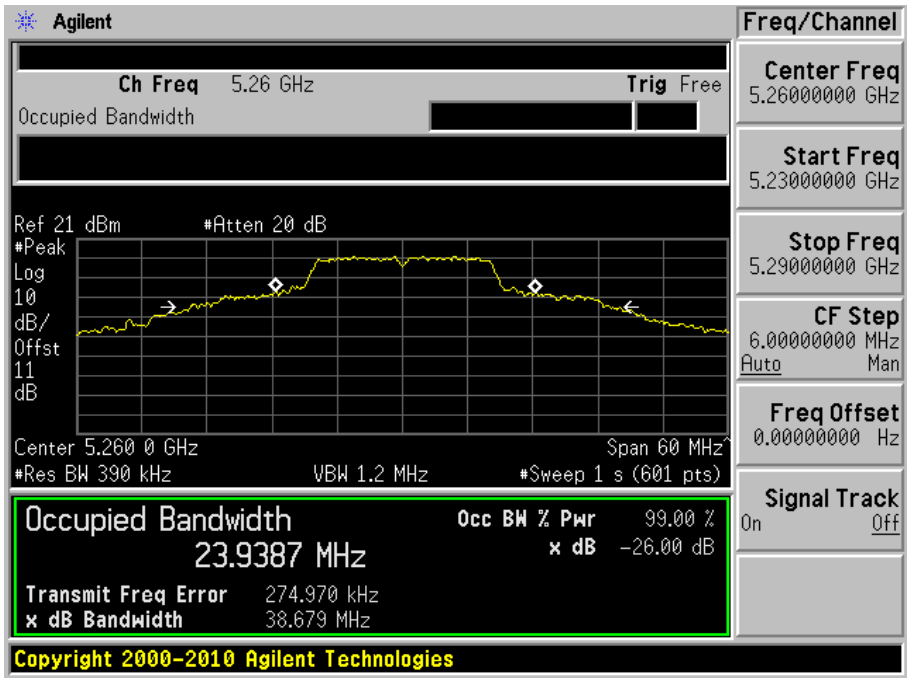


a Mode 5240 MHz High Channel OBW

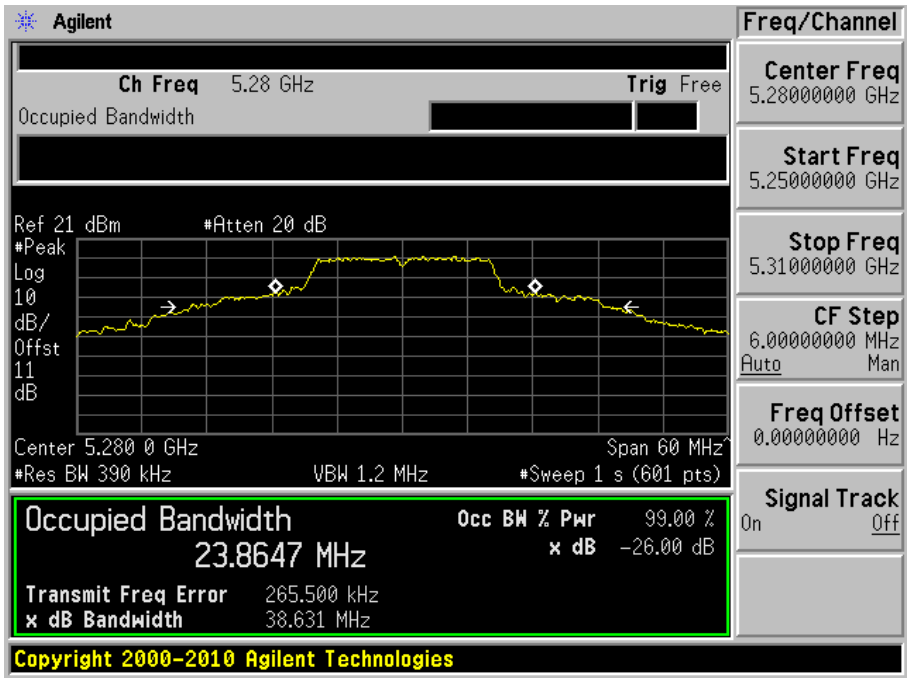


5250 – 5350 MHz

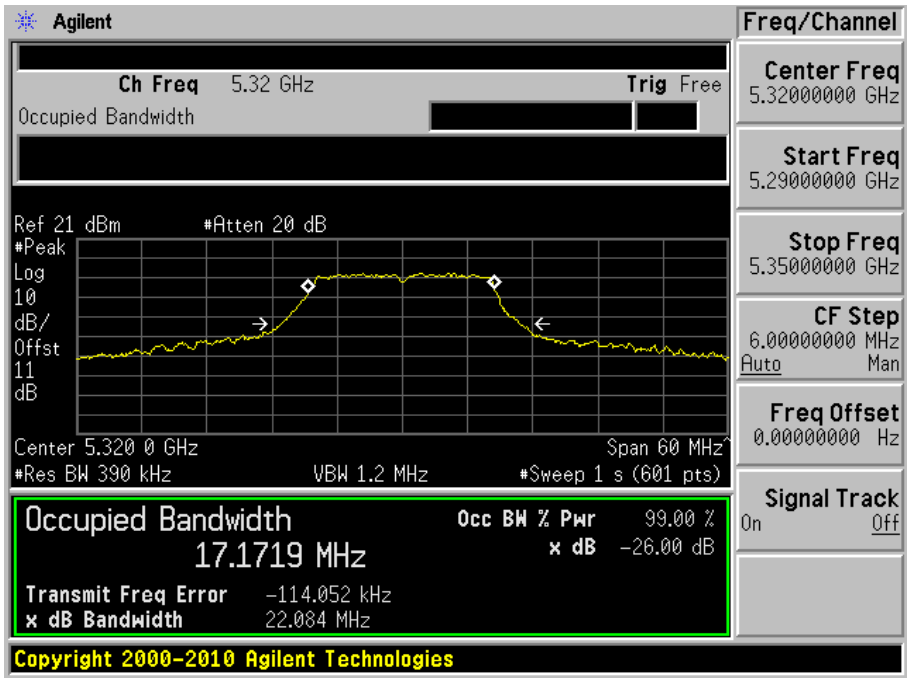
a Mode 5260 MHz Low Channel OBW



a Mode 5280 MHz Mid Channel OBW

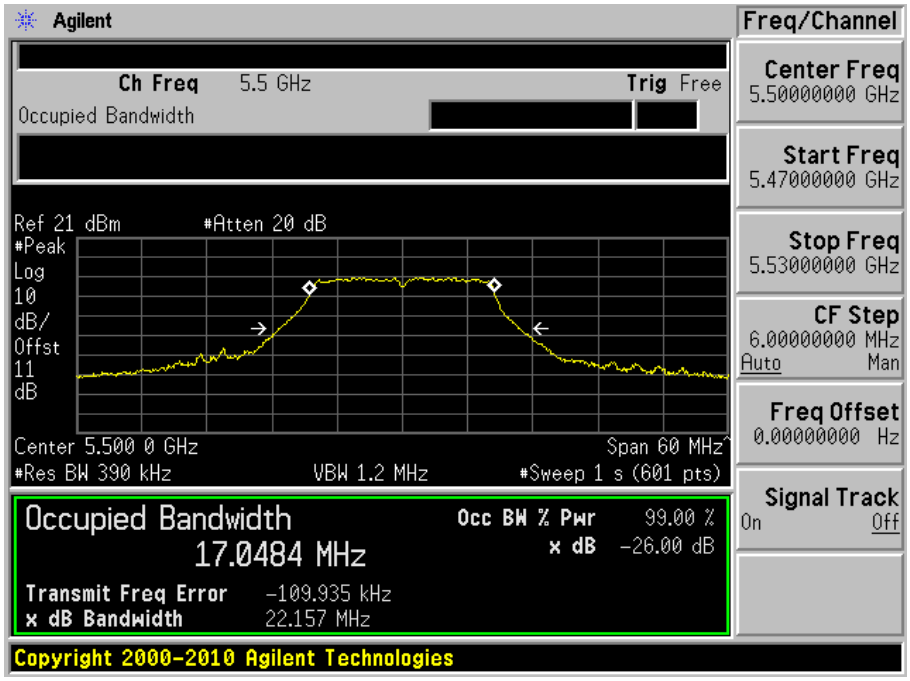


a Mode 5320 MHz High Channel OBW

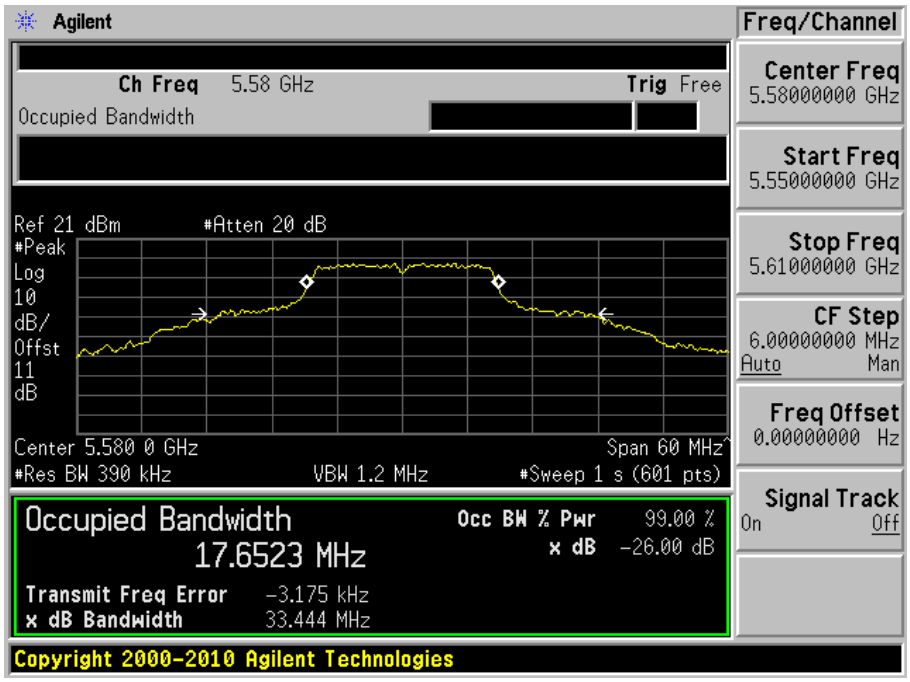


5470 – 5725 MHz

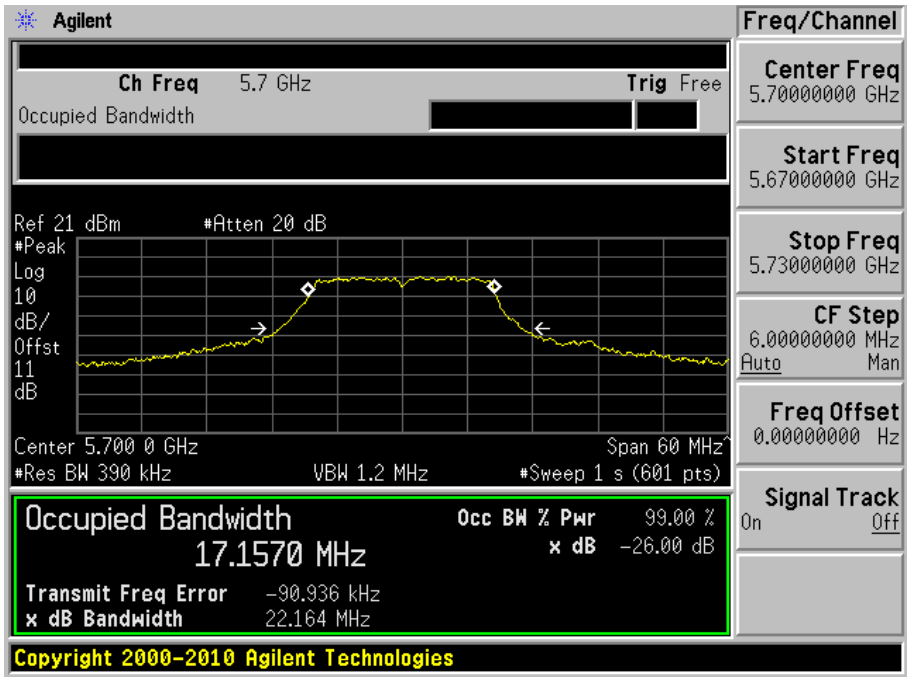
a Mode 5500 MHz Low Channel OBW



a Mode 5580 MHz Mid Channel OBW

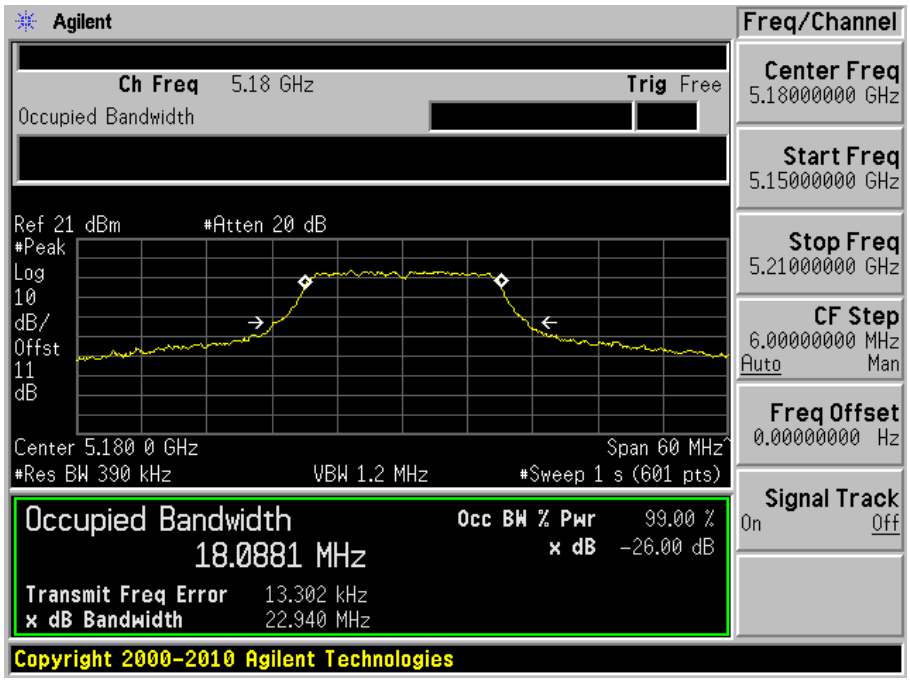


a Mode 5700 MHz High Channel OBW

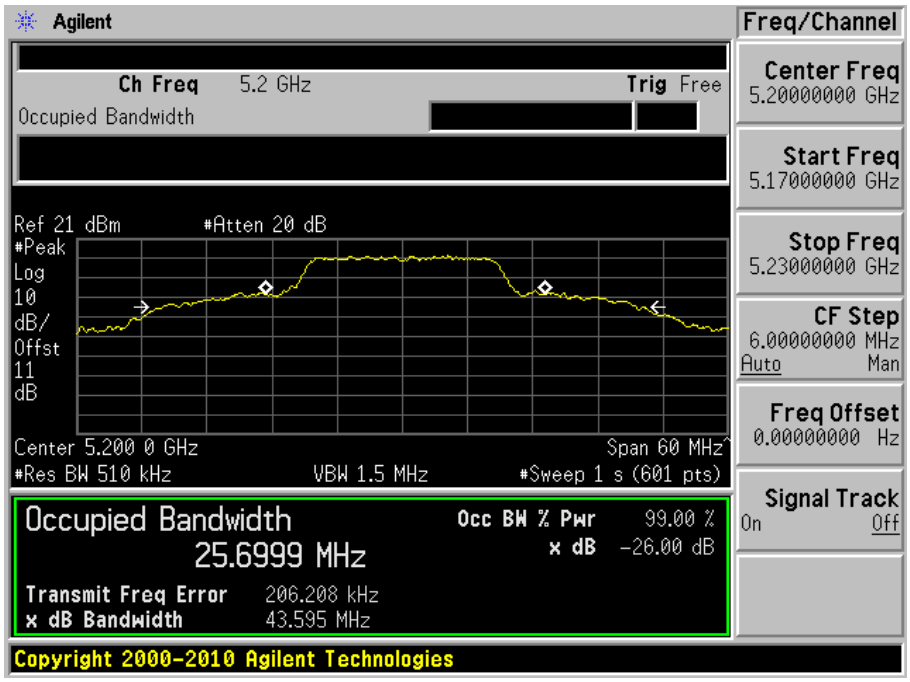


5150 – 5250 MHz

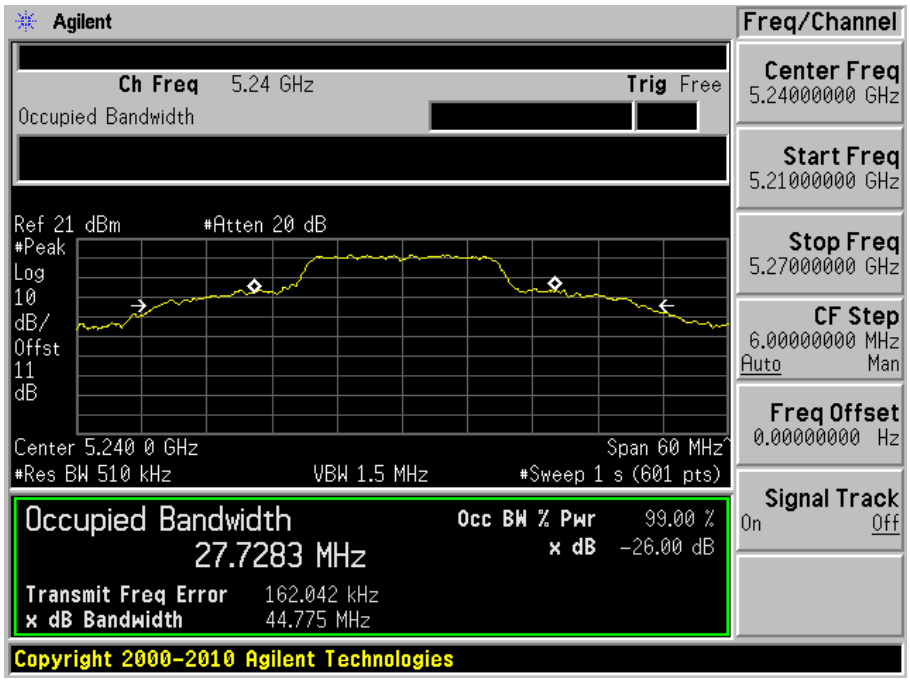
N/AC20 Mode 5180 MHz Low Channel OBW



N/AC20 Mode 5200 MHz Mid Channel OBW

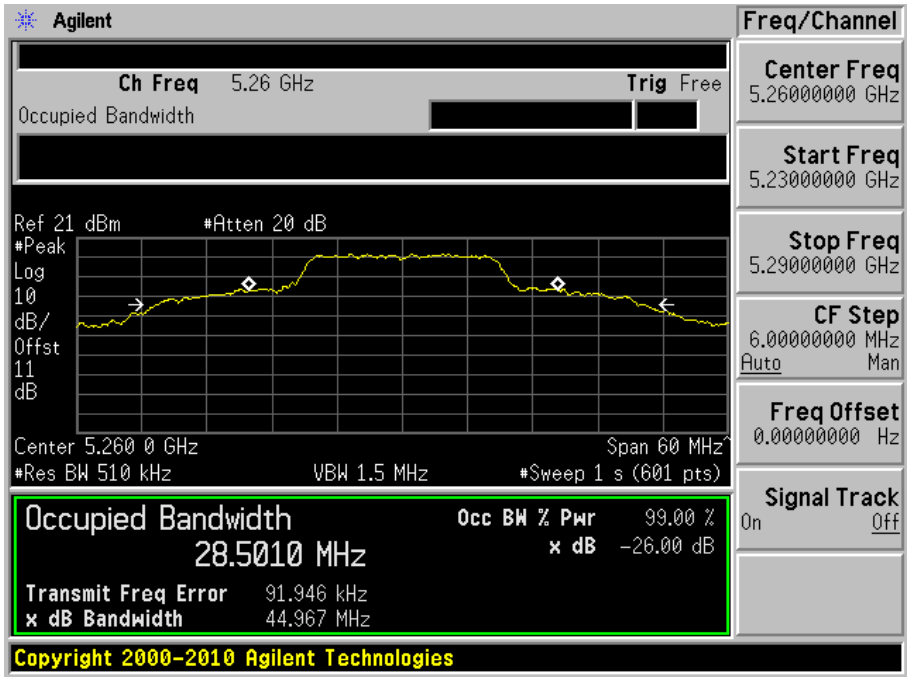


N/AC20 Mode 5240 MHz High Channel OBW

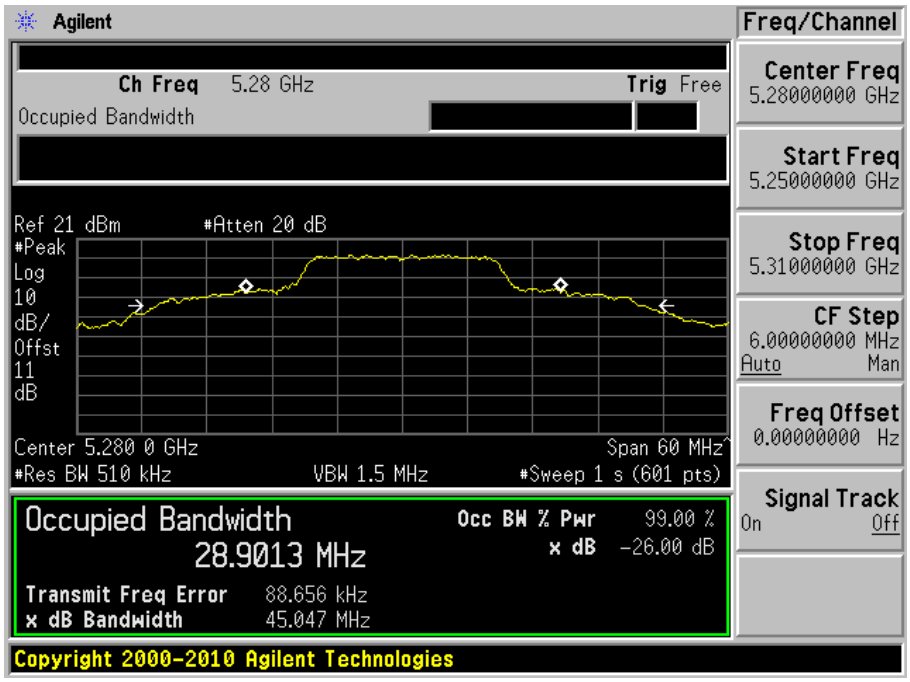


5250 – 5350 MHz

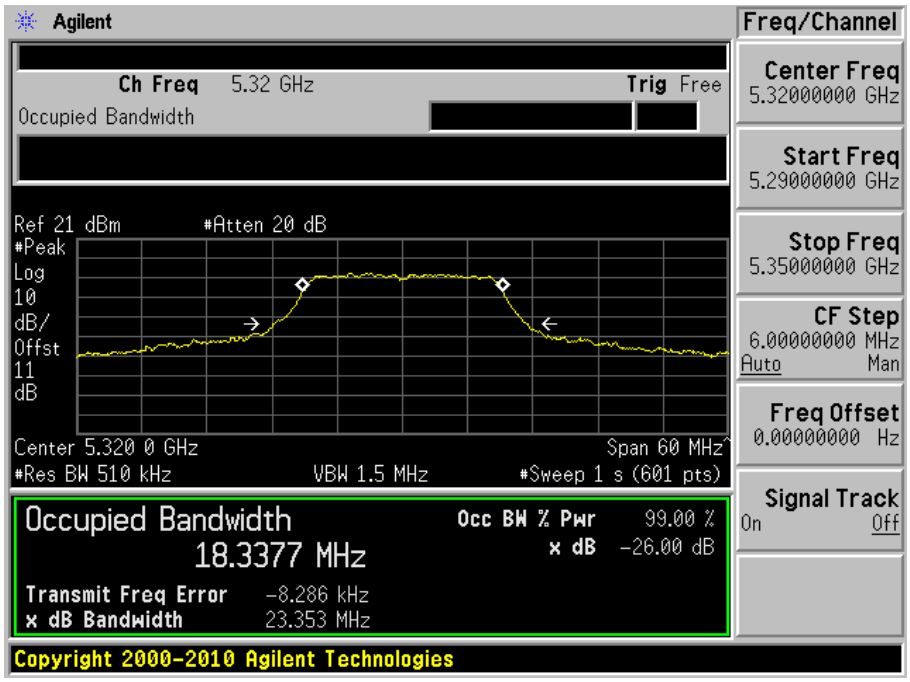
N/AC20 Mode 5260 MHz Low Channel OBW



N/AC20 Mode 5280 MHz Mid Channel OBW

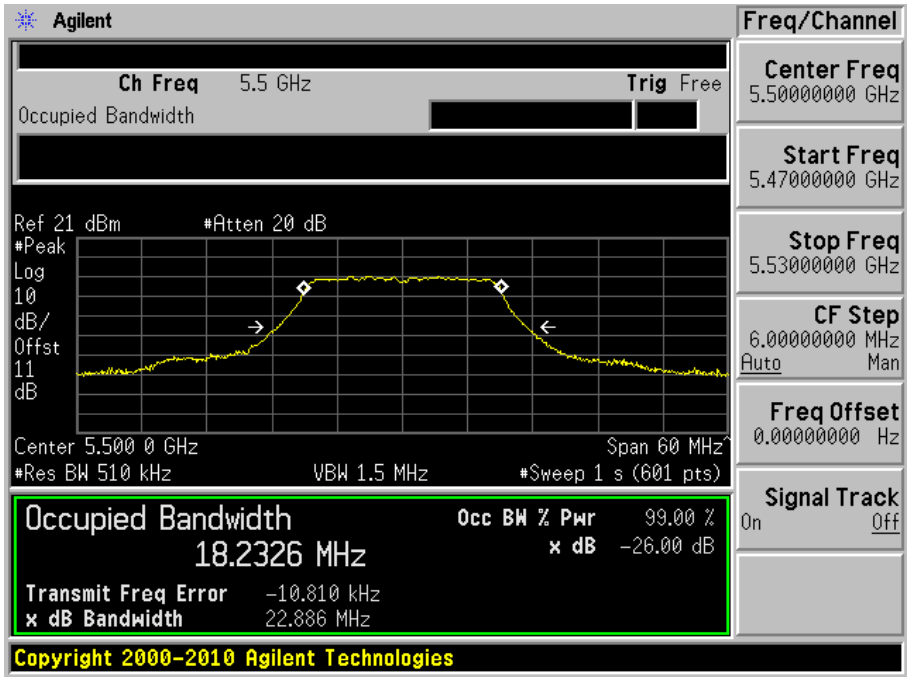


N/AC20 Mode 5320 MHz High Channel OBW

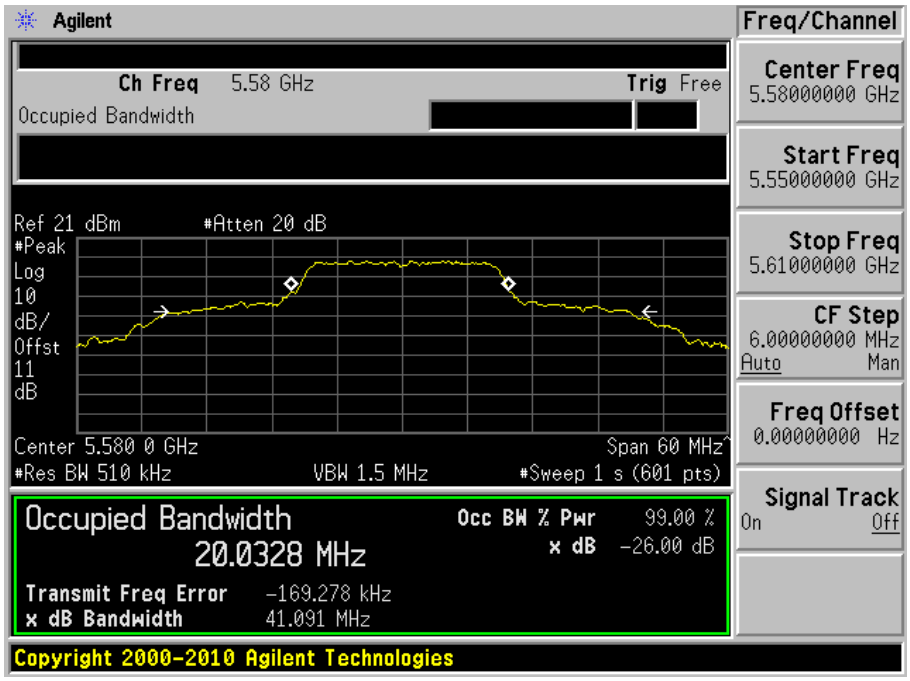


5470 – 5725 MHz

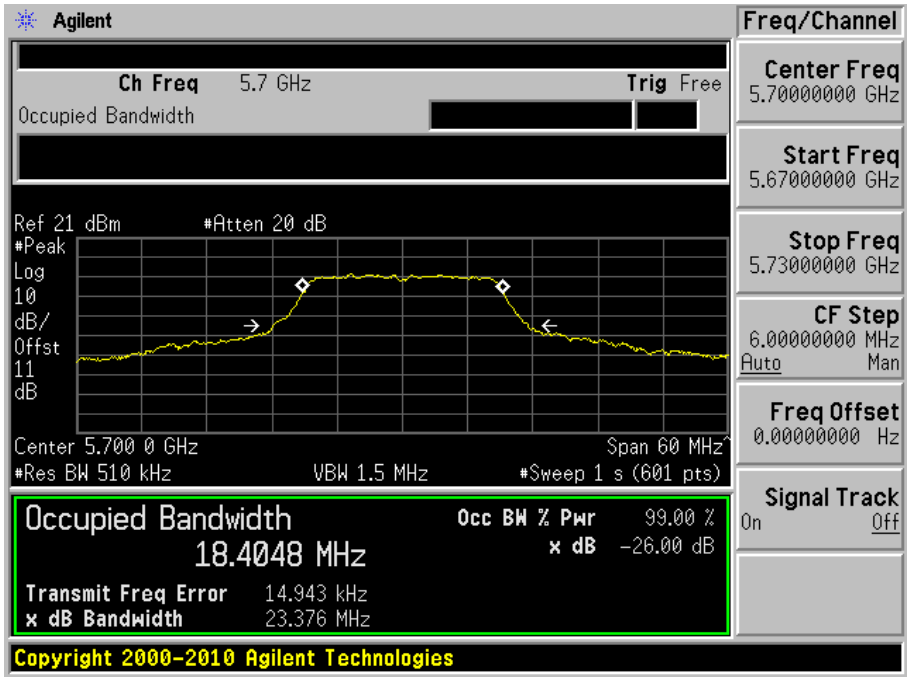
N/AC20 Mode 5500 MHz Low Channel OBW



N/AC20 Mode 5580 MHz Mid Channel OBW



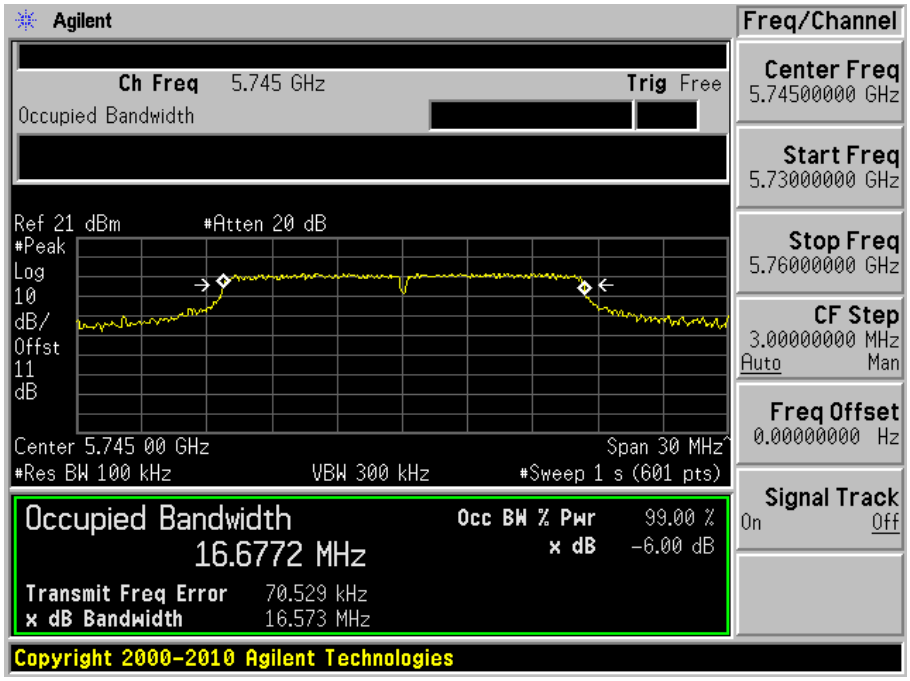
N/AC20 Mode 5700 MHz High Channel OBW



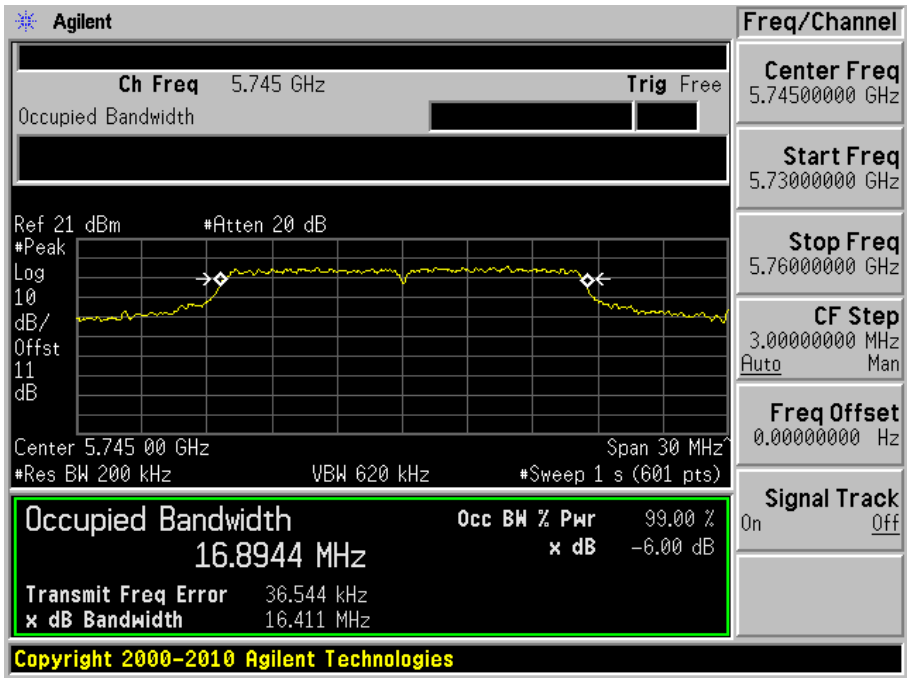
99% & 6dB BW

5725 – 5850 MHz

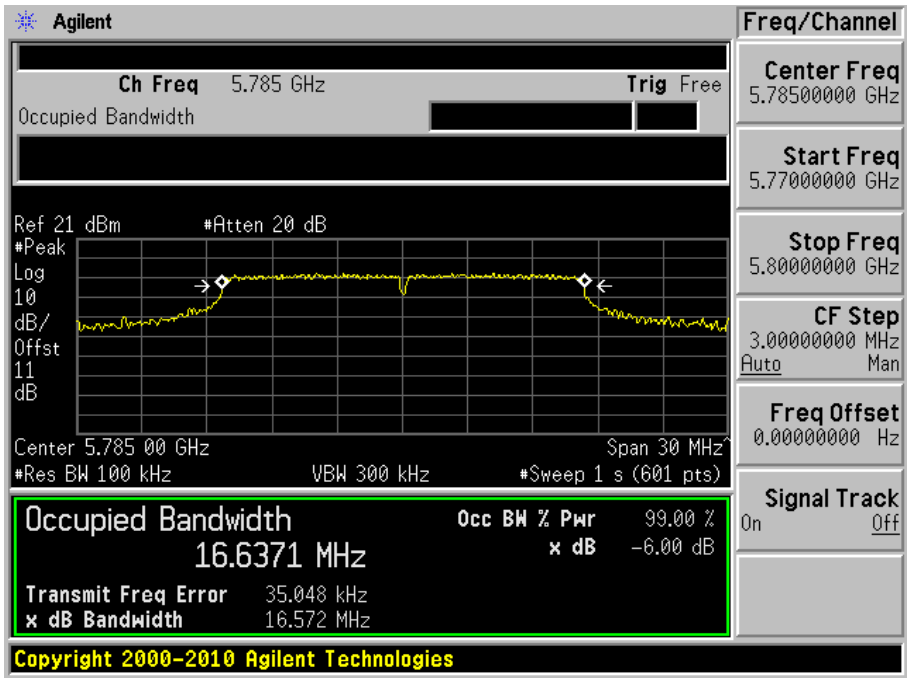
a Mode 5745 MHz Low Channel 6 dB BW



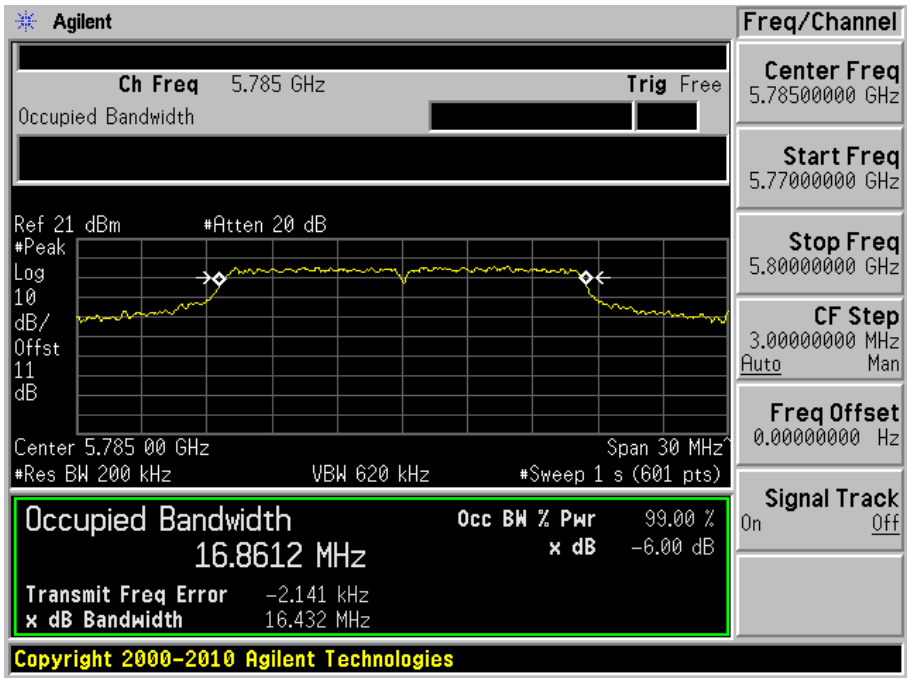
a Mode 5745 MHz Low Channel 99 BW



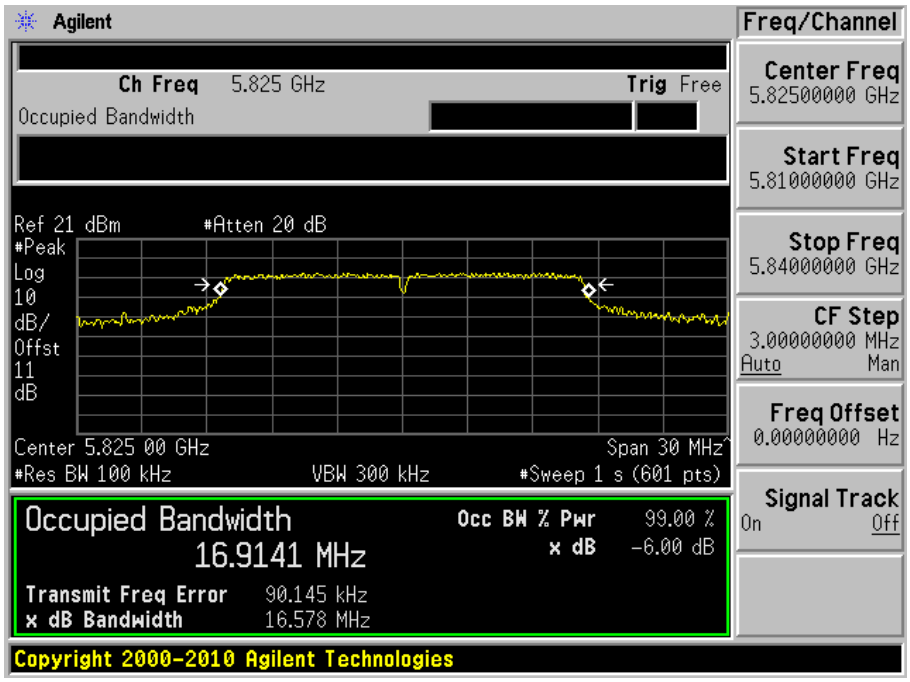
a Mode 5785 MHz Mid Channel 6 dB BW



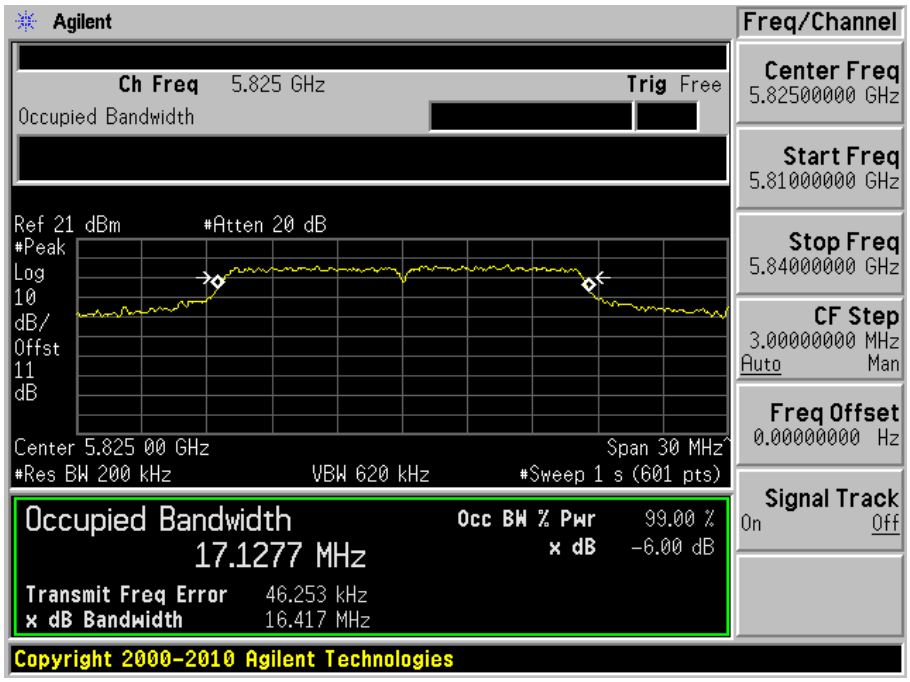
a Mode 5785 MHz Mid Channel 99 BW



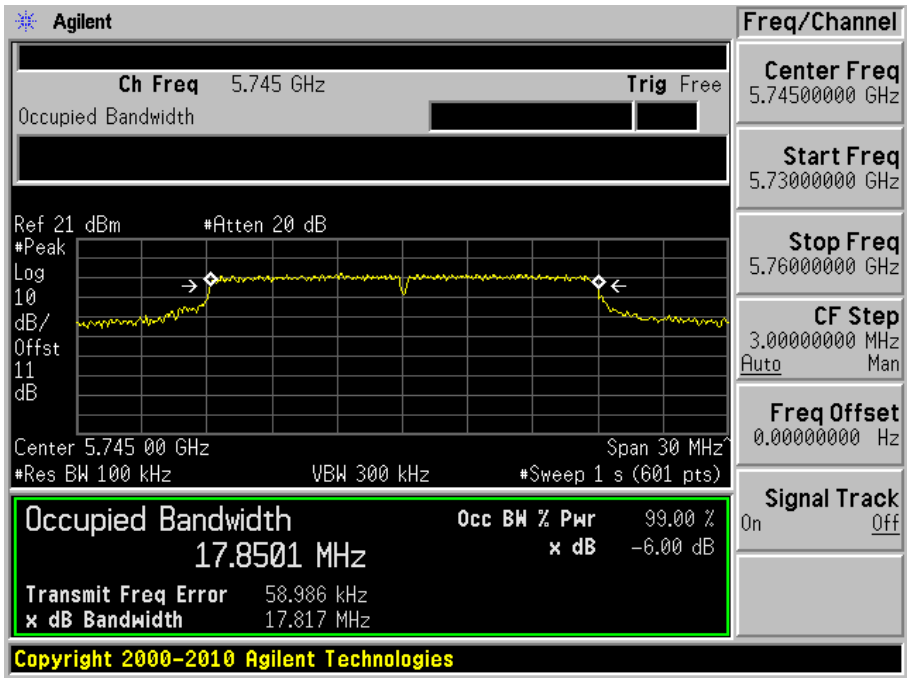
a Mode 5825 MHz High Channel 6 dB BW



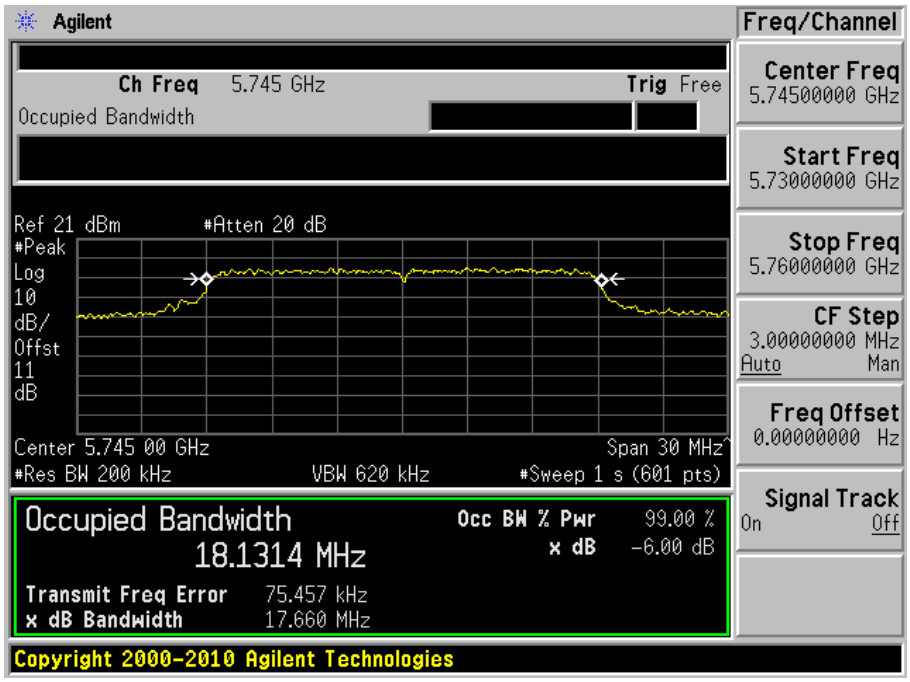
a Mode 5825 MHz High Channel 99 BW



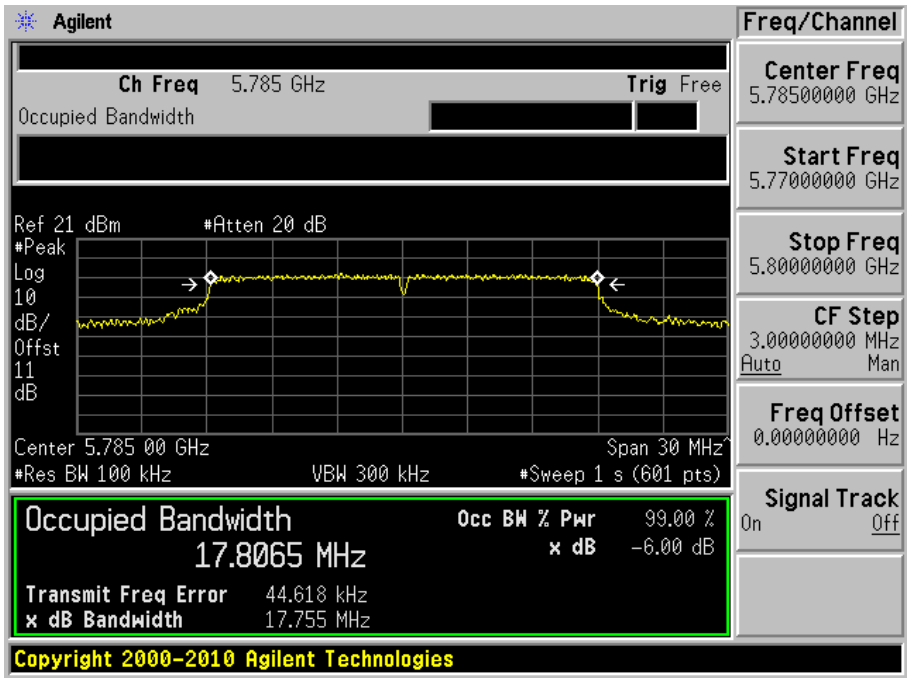
N/AC20 Mode 5745 MHz Low Channel 6 dB BW



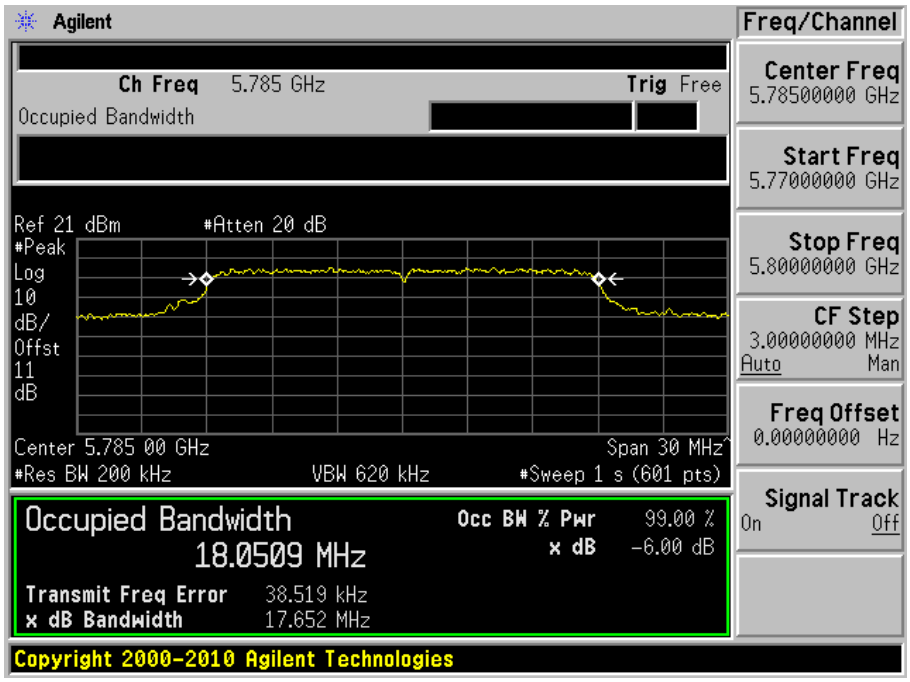
N/AC20 Mode 5745 MHz Low Channel 99 BW



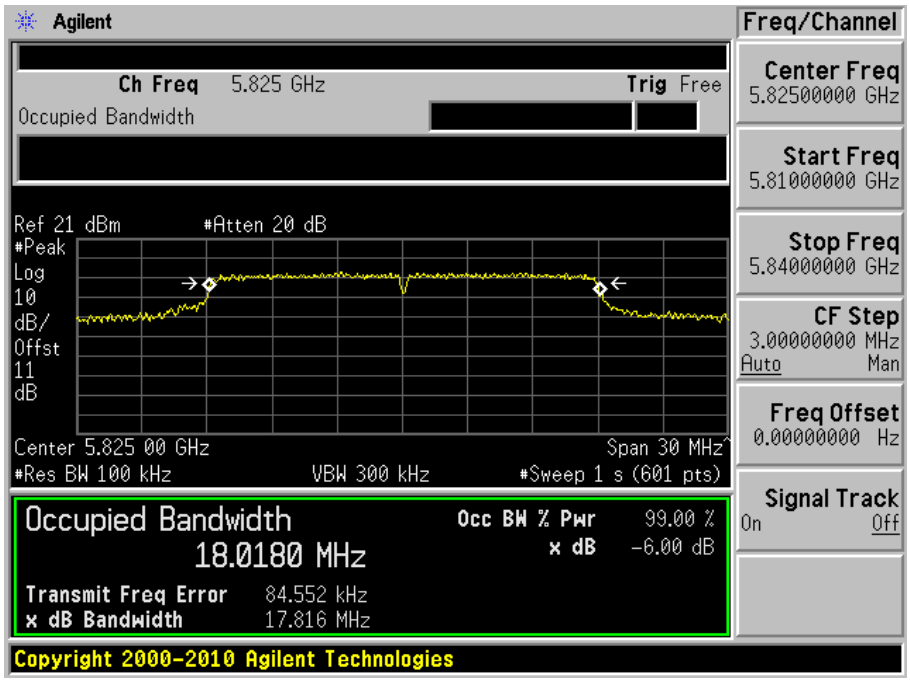
N/AC20 Mode 5785 MHz Mid Channel 6 dB BW



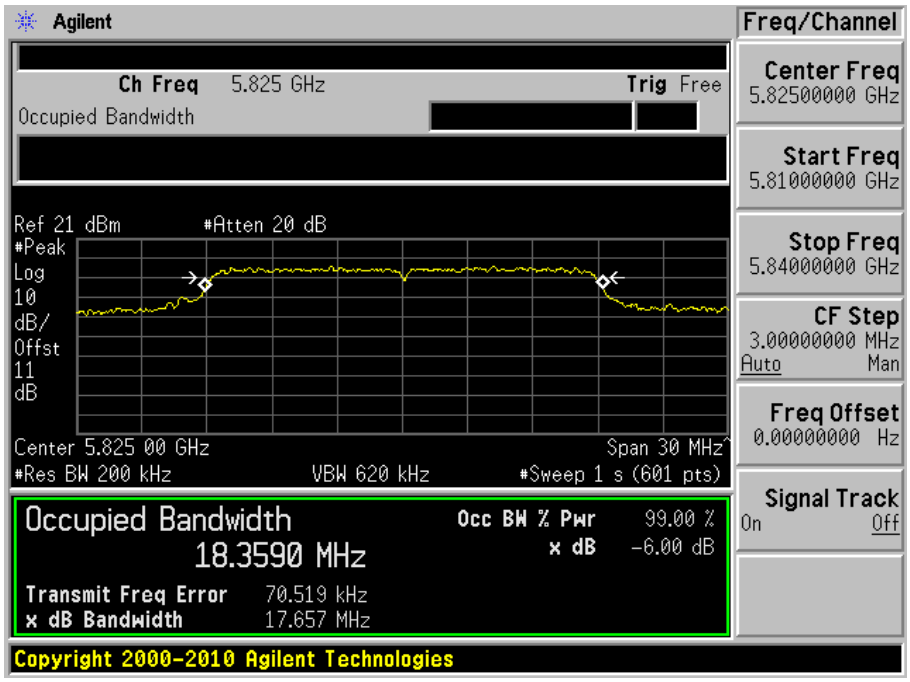
N/AC20 Mode 5785 MHz Mid Channel 99 BW



N/AC20 Mode 5825 MHz High Channel 6 dB BW



N/AC20 Mode 5825 MHz High Channel 99 BW



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

7.1 Applicable Standards

According to FCC §15.407(a):

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

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

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

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

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

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

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

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

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

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

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

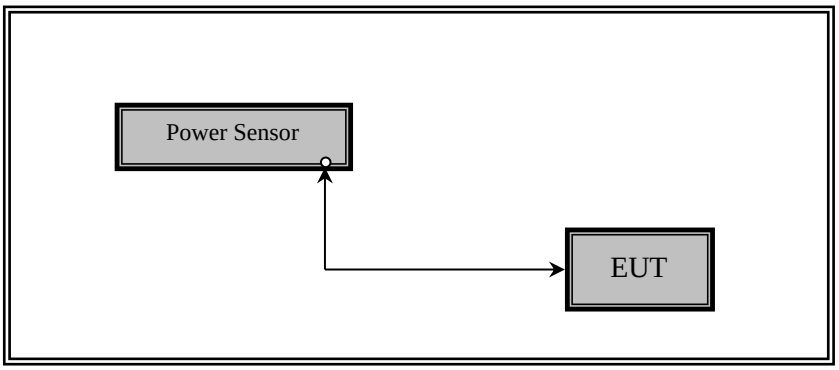
According to ISEDC RSS-247 §6.2.4 for frequency band 5725-5850 MHz:

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

7.2 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.

7.3 Test Setup Block Diagram



7.4 Test Equipment List and Details

Bacl No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
697	ETS- Lingerin	Power Sensor	7002-006	160097	2021-02-21	2 years
-	-	RF cable	-	-	Each time[1]	N/A
-	-	10 dB attenuator	-	-	Each time[1]	N/A

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

7.5 Test Environmental Conditions

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

The testing was performed by Deepak Mishra on 2022-04-20 in RF site.

7.6 Test Results

5150 - 5250 MHz

FCC Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)	FCC Limit (dBm)
802.11a mode			
36	5180	8.6	24
40	5200	15.15	24
48	5240	15.1	24
802.11n/ac20 mode			
36	5180	6.55	24
40	5200	15.15	24
48	5240	15.01	24

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

IC Results

Channel	Frequency (MHz)	Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	IC Limit (dBm)
802.11a mode					
36	5180	8.6	-0.7	7.9	22.3
40	5200	15.15	-0.7	14.45	22.3
48	5240	15.1	-0.7	14.4	22.3
802.11n/ac20 mode					
36	5180	6.55	-0.7	5.85	22.3
40	5200	15.15	-0.7	14.45	22.3
48	5240	15.01	-0.7	14.31	22.3

Note: Total EIRP (dBm) = Conducted Output Power + Antenna Gain (dBi)
Note: Duty cycle correction factor has already been added to the measurements
Note: IC limit is determined by formula: 10 + 10 log10B, dBm, where. B is the 99% emission bandwidth in megahertz. In this instance B was chosen to be the lowest measured BW rounded down to represent the worst case limit.

5250 - 5850 MHz

FCC/IC results

Channel	Frequency (MHz)	Conducted Output Power (dBm)	FCC Limit (dBm)	IC Limit (dBm)
802.11a mode				
52	5260	16.19	24	23.3
56	5280	16.2	24	23.3
64	5320	7.25	24	23.3
100	5500	4.44	24	23.3
116	5580	13.35	24	23.3
140	5700	4.42	24	23.3
149	5745	16.01	30	30
157	5785	16.5	30	30
165	5825	17.19	30	30
802.11n/ac20 mode				
52	5260	16.21	24	23.3
56	5280	16.24	24	23.3
64	5320	7.1	24	23.3
100	5500	4.96	24	23.3
116	5580	13.25	24	23.3
140	5700	4.53	24	23.3
149	5745	15.93	30	30
157	5785	16.6	30	30
165	5825	17.09	30	30

Note: Duty cycle correction factor has already been added to the measurements
Note: For 5250MHz-5725MHz for FCC: the maximum conducted output power shall not exceed 250 mW or 11 + 10 log10B, dBm, whichever is less. Here B is the 26dB bandwidth in megahertz. In this instance B was chosen to be the lowest measured BW rounded down to represent the worst case limit.
Note: For 5250MHz-5725MHz for IC: the maximum conducted output power shall not exceed 250 mW or 11 + 10 log10B, dBm, whichever is less. Here B is the 99% emission bandwidth in megahertz. In this instance B was chosen to be the lowest measured BW rounded down to represent the worst case limit.

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

8.1 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.

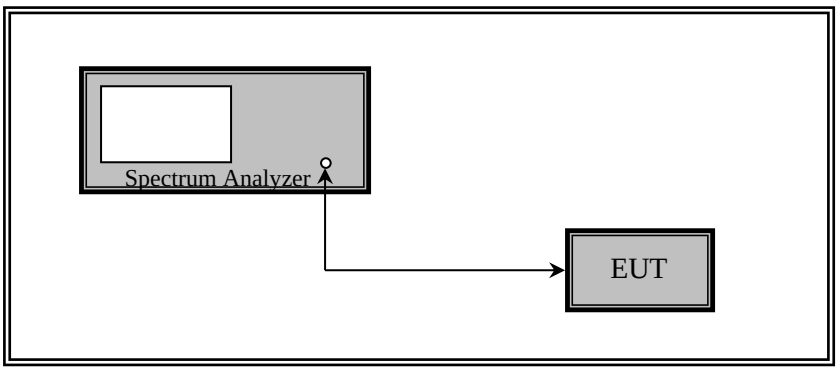
According to ISEDC RSS-247 §6.2.4 for frequency band 5725-5850 MHz:

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.

8.2 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.

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
624	Agilent	Spectrum Analyzer	E4446A	MY48250 238	2021-06-23	1 year
-	-	RF cable	-	-	Each time[1]	N/A
-	-	10 dB attenuator	-	-	Each time[1]	N/A

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

8.5 Test Environmental Conditions

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

The testing was performed by Deepak Mishra on 2022-04-21 in RF site.

8.6 Test Results

5150 - 5250 MHz

FCC Results

Channel	Frequency (MHz)	PSD (dBm/MHz)	FCC Limit (dBm)
802.11a mode			
36	5180	2.461	11
40	5200	7.925	11
48	5240	8.044	11
802.11n/ac20 mode			
36	5180	1.109	11
40	5200	8.8016	11
48	5240	8.8026	11

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

IC Results

Channel	Frequency (MHz)	Conducted PSD (dBm/MHz)	Antenna Gain (dBi)	EIRP PSD (dBm/MHz)	IC Limit (dBm)
802.11a mode					
36	5180	2.461	-0.7	1.761	10
40	5200	7.925	-0.7	7.225	10
48	5240	8.044	-0.7	7.344	10
802.11n/ac20 mode					
36	5180	1.109	-0.7	0.409	10
40	5200	8.8016	-0.7	8.1016	10
48	5240	8.8026	-0.7	8.1026	10

Note: Total EIRP PSD (dBm/MHz) = Conducted PSD (dBm/MHz) + Antenna Gain (dBi)
Note: Duty cycle correction factor has already been added to the measurements

5250 - 5850 MHz

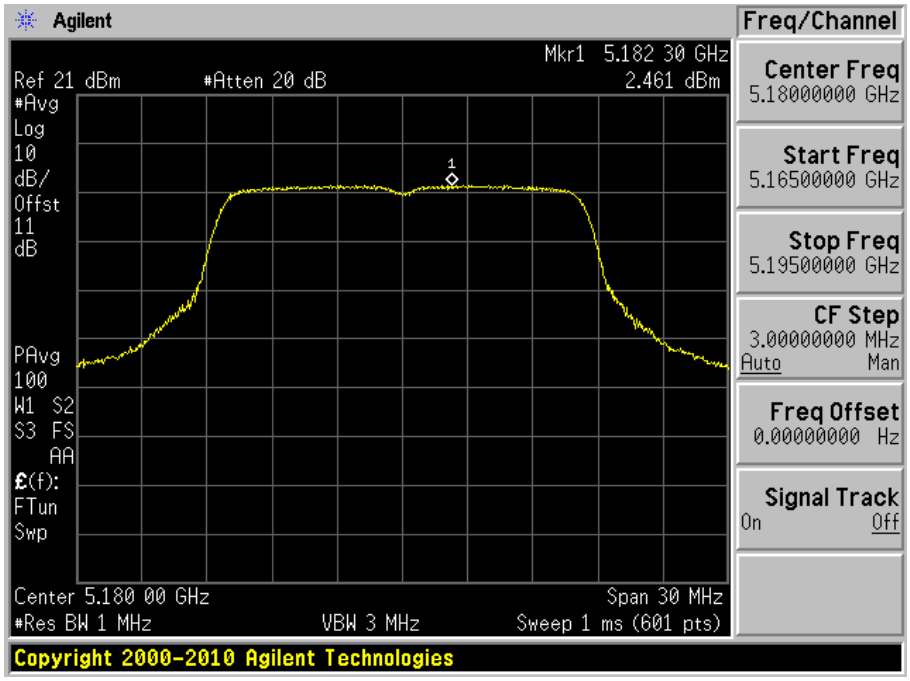
Channel	Frequency (MHz)	PSD	FCC/IC Limit
802.11a mode			
52	5260	7.939 dBm/MHz	11 dBm/MHz
56	5280	8.035 dBm/MHz	11 dBm/MHz
64	5320	-0.256 dBm/MHz	11 dBm/MHz
100	5500	-3.413 dBm/MHz	11 dBm/MHz
116	5580	4.473 dBm/MHz	11 dBm/MHz
140	5700	-2.762 dBm/MHz	11 dBm/MHz
149	5745	-1.272 dBm/500kHz	30 dBm/500kHz
157	5785	-0.698 dBm/500kHz	30 dBm/500kHz
165	5825	-0.392 dBm/500kHz	30 dBm/500kHz
802.11n/ac20 mode			
52	5260	8.168 dBm/MHz	11 dBm/MHz
56	5280	7.724 dBm/MHz	11 dBm/MHz
64	5320	-1.581 dBm/MHz	11 dBm/MHz
100	5500	-2.903 dBm/MHz	11 dBm/MHz
116	5580	4.210 dBm/MHz	11 dBm/MHz
140	5700	-2.627 dBm/MHz	11 dBm/MHz
149	5745	-1.185 dBm/500kHz	30 dBm/500kHz
157	5785	-1.087 dBm/500kHz	30 dBm/500kHz
165	5825	-0.509 dBm/500kHz	30 dBm/500kHz

Note: Duty cycle correction factor has already been added to the measurements
Note: PSD (dBm/500 kHz) = PSD (dBm/300 kHz) + 10*log(500 kHz/300 kHz)

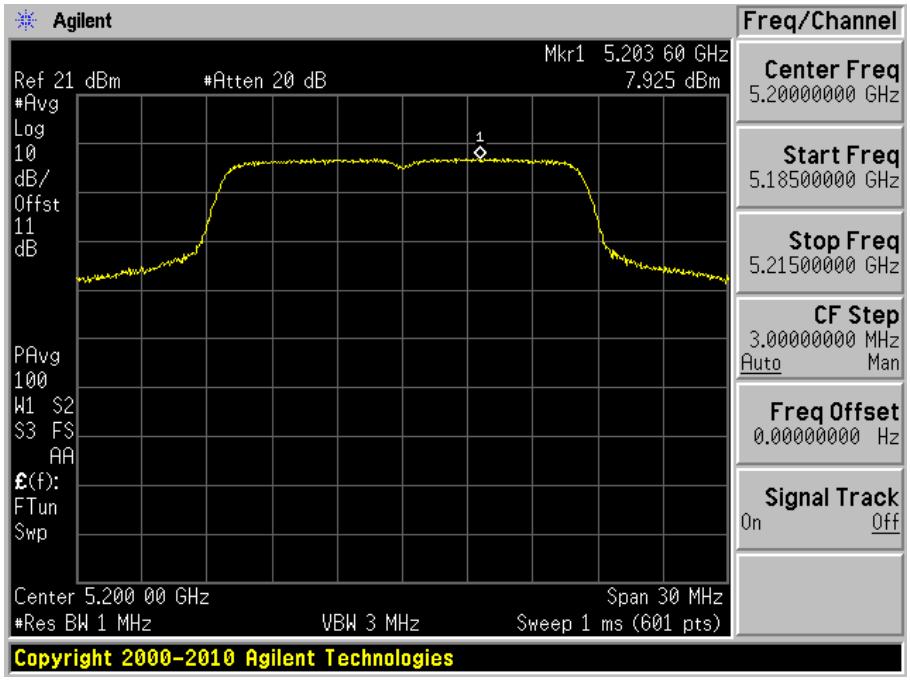
Please refer to the following plots.

5150 - 5250 MHz

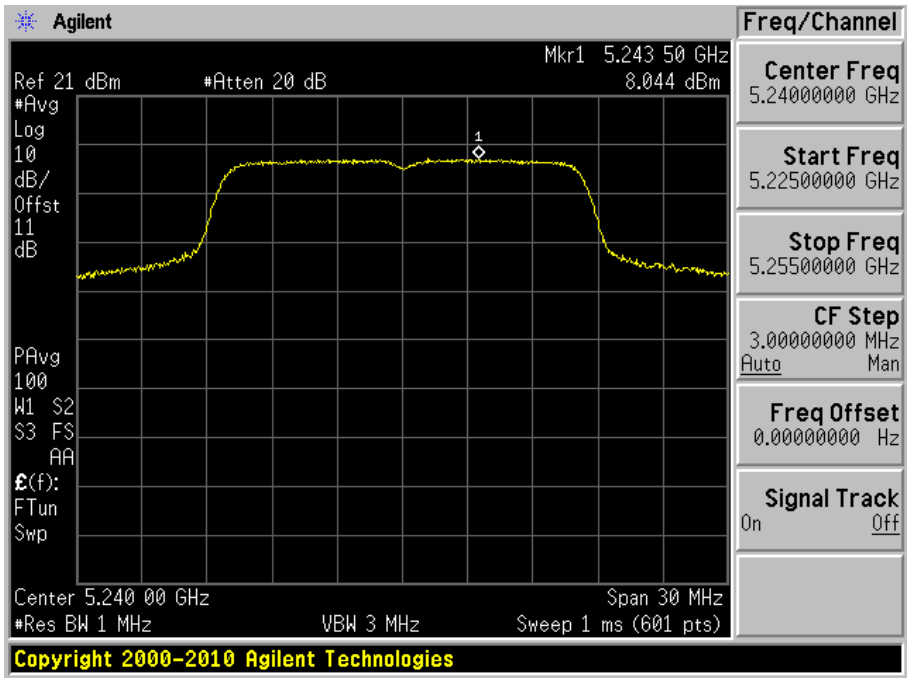
a Mode 5180 MHz Low Channel PSD



a Mode 5200 MHz Mid Channel PSD

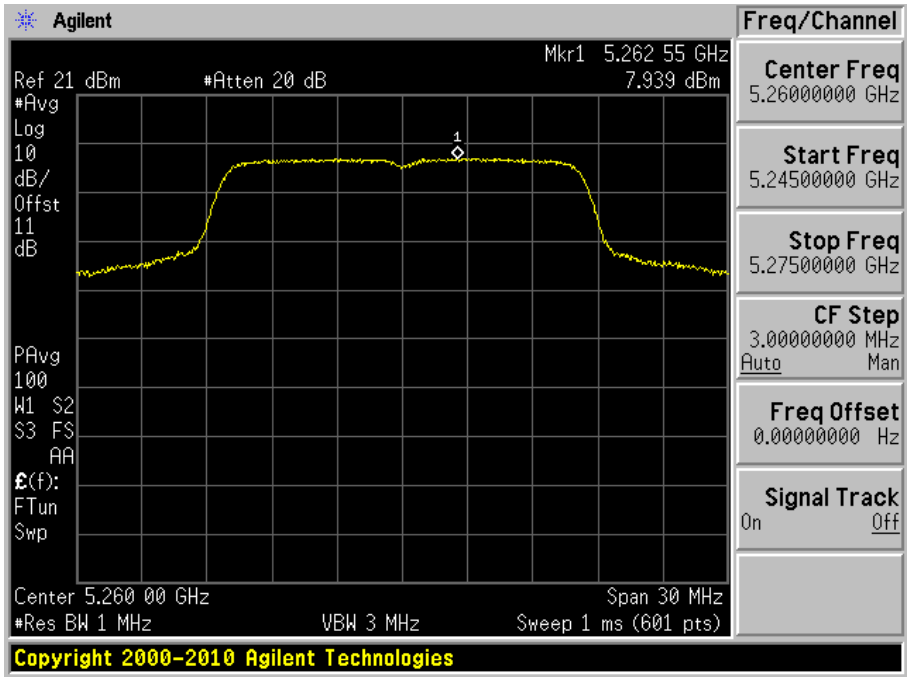


a Mode 5240 MHz High Channel PSD

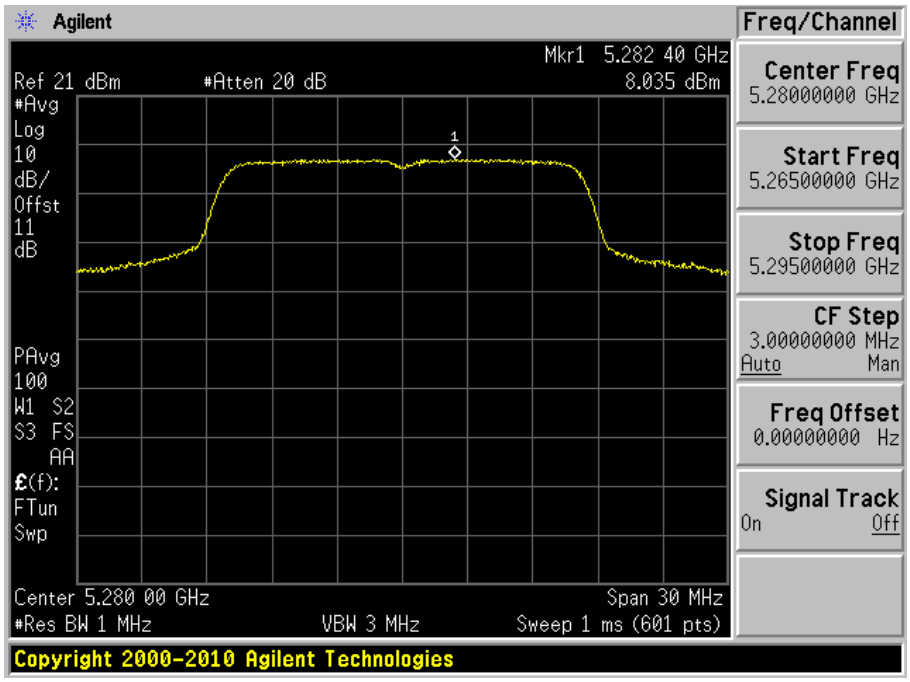


5250 - 5350 MHz

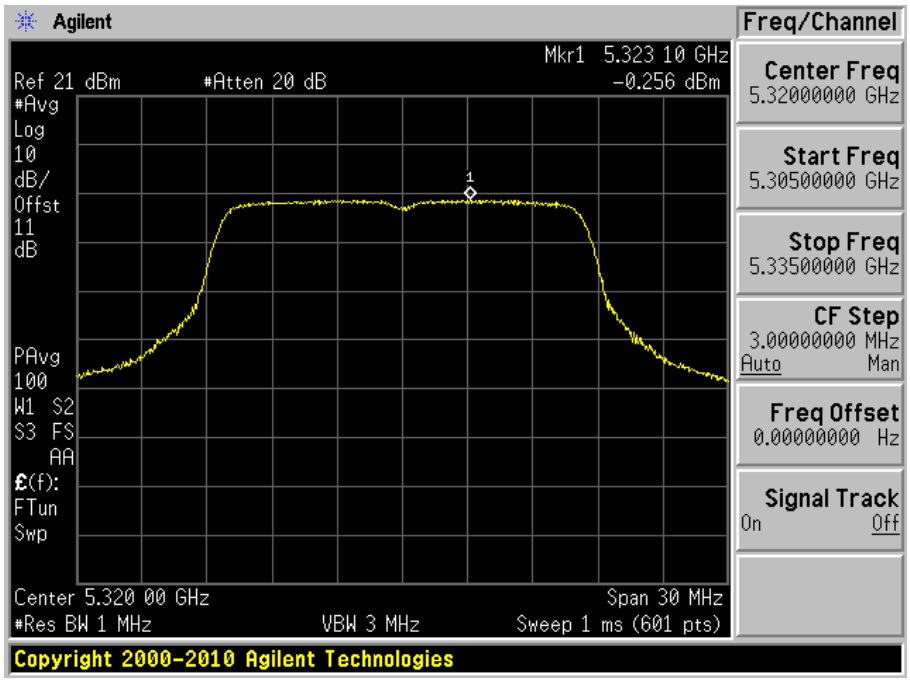
a Mode 5260 MHz Low Channel PSD



a Mode 5280 MHz Mid Channel PSD

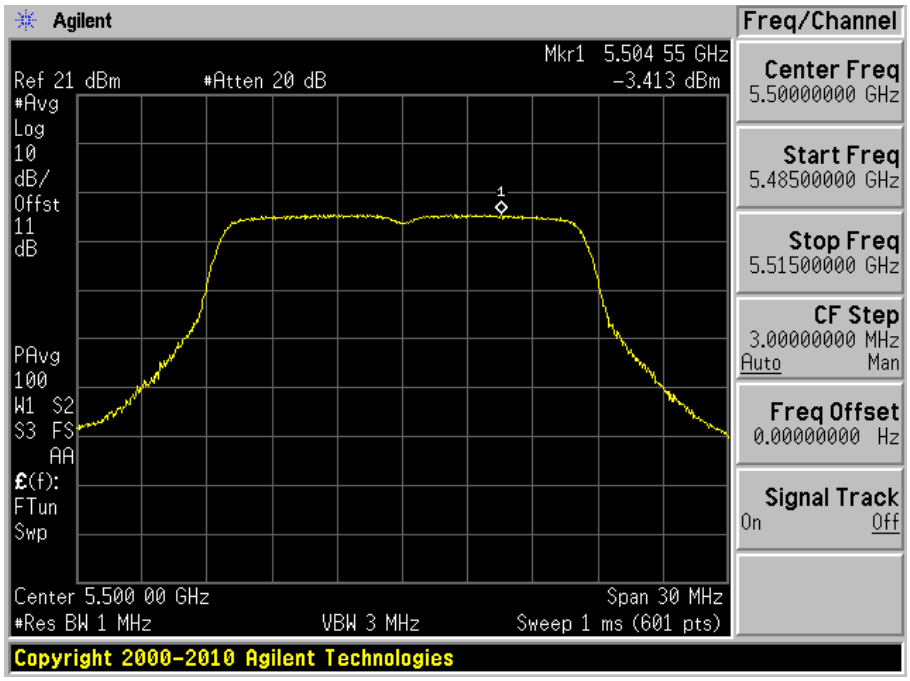


a Mode 5320 MHz High Channel PSD

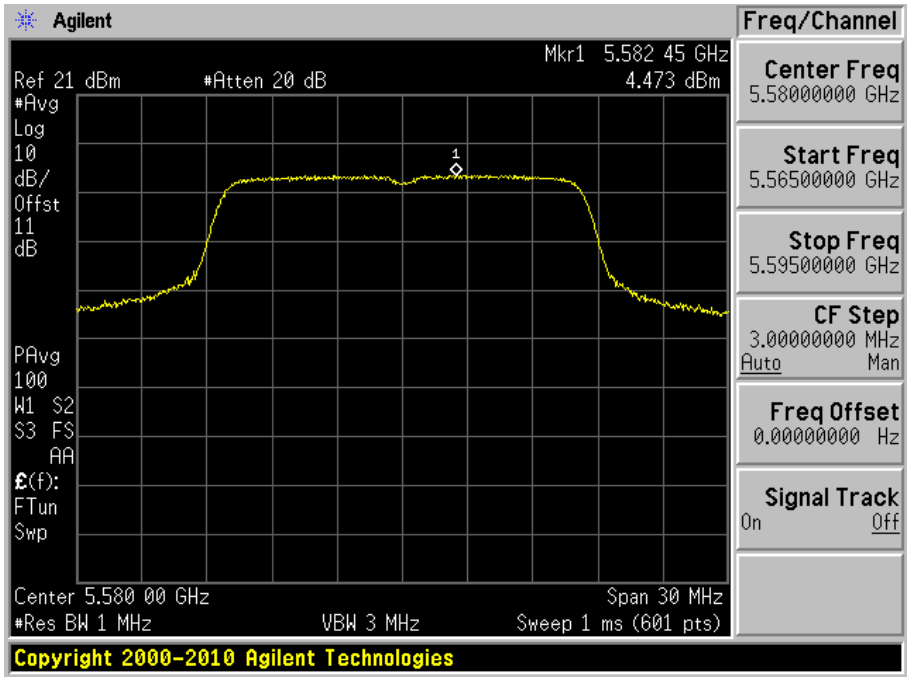


5470 - 5725 MHz

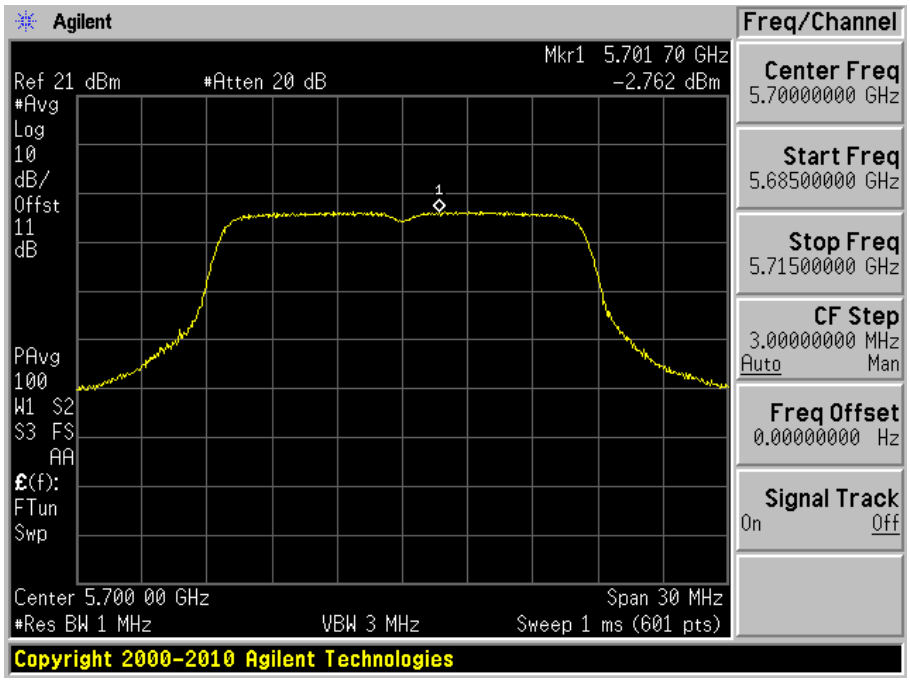
a Mode 5500 MHz Low Channel PSD



a Mode 5580 MHz Mid Channel PSD

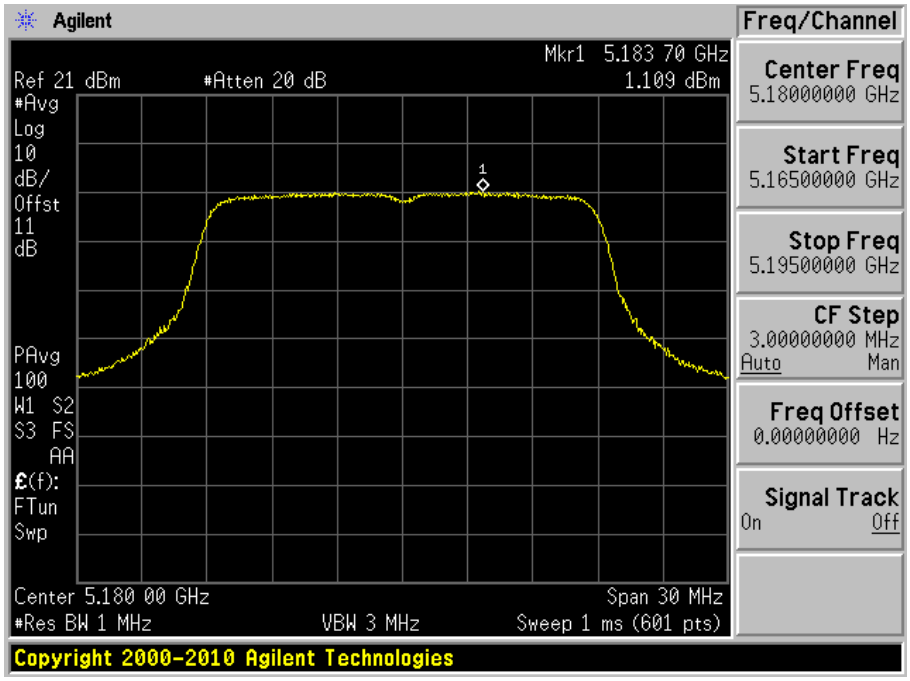


a Mode 5700 MHz High Channel PSD

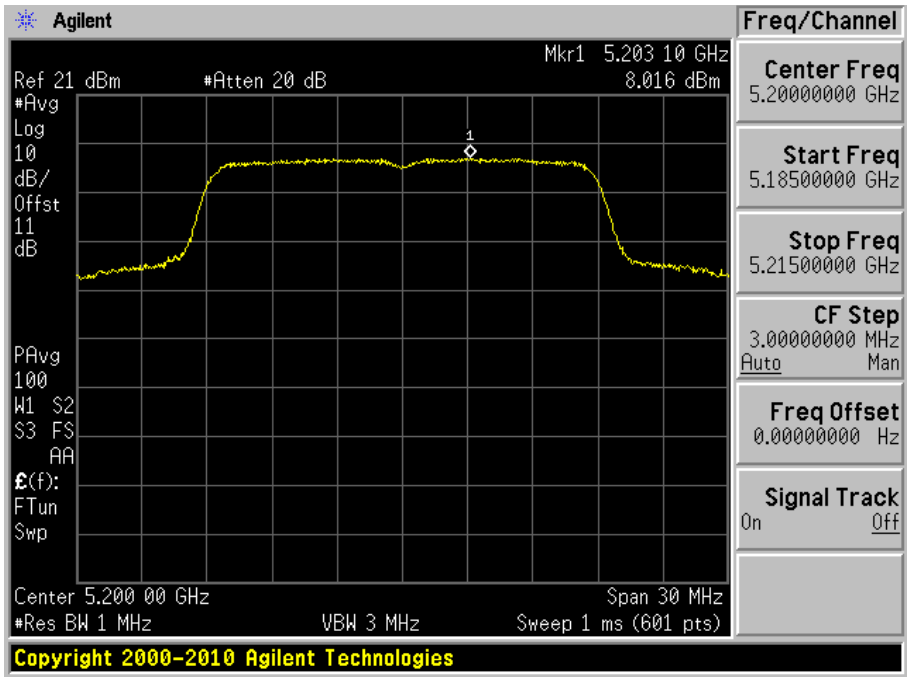


5150 - 5250 MHz

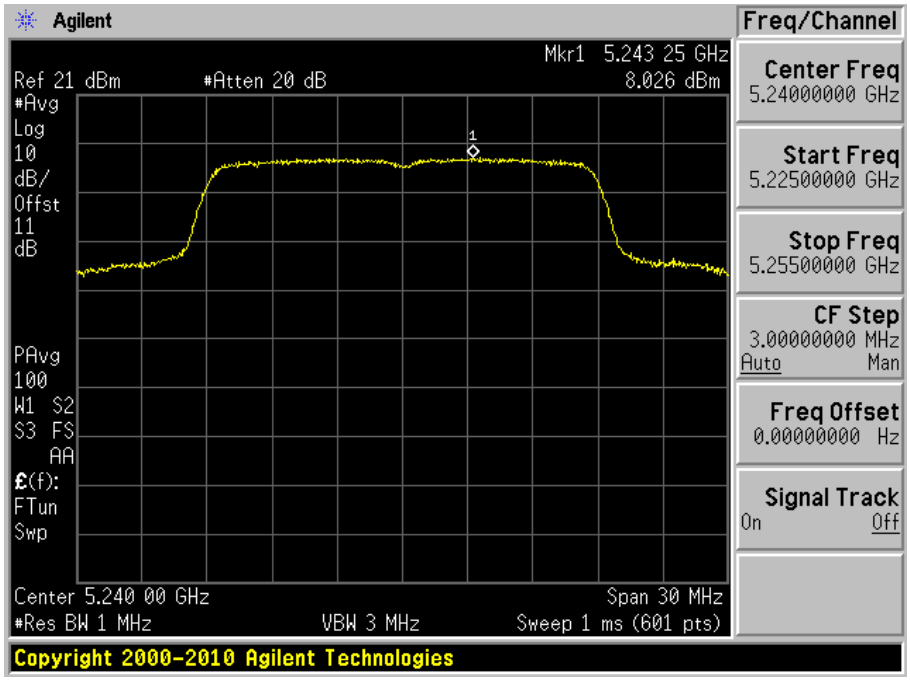
N/AC20 Mode 5180 MHz Low Channel PSD



N/AC20 Mode 5200 MHz Mid Channel PSD

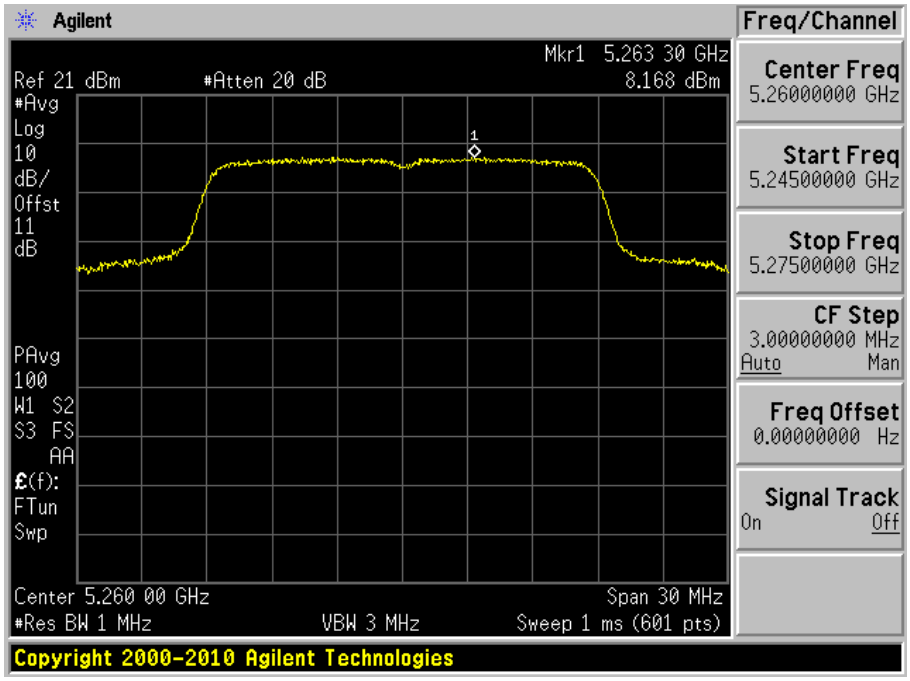


N/AC20 Mode 5240 MHz High Channel PSD

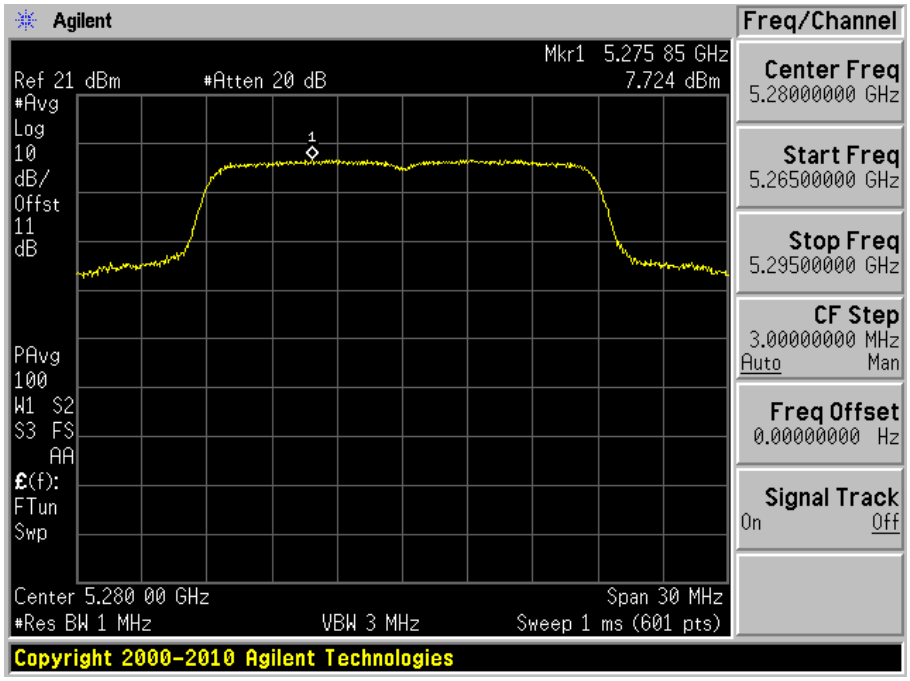


5250 - 5350 MHz

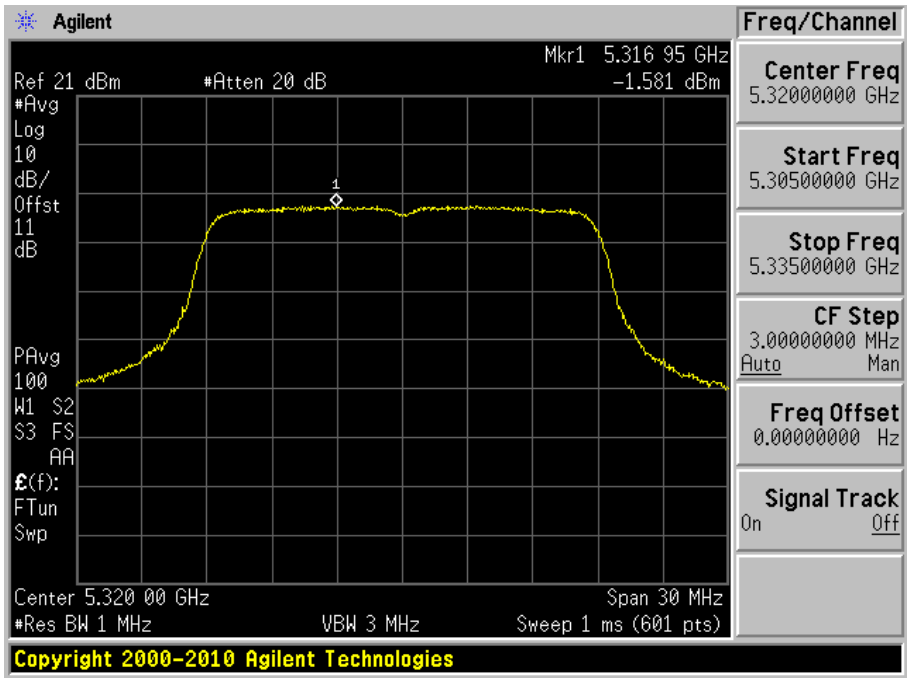
N/AC20 Mode 5260 MHz Low Channel PSD



N/AC20 Mode 5280 MHz Mid Channel PSD

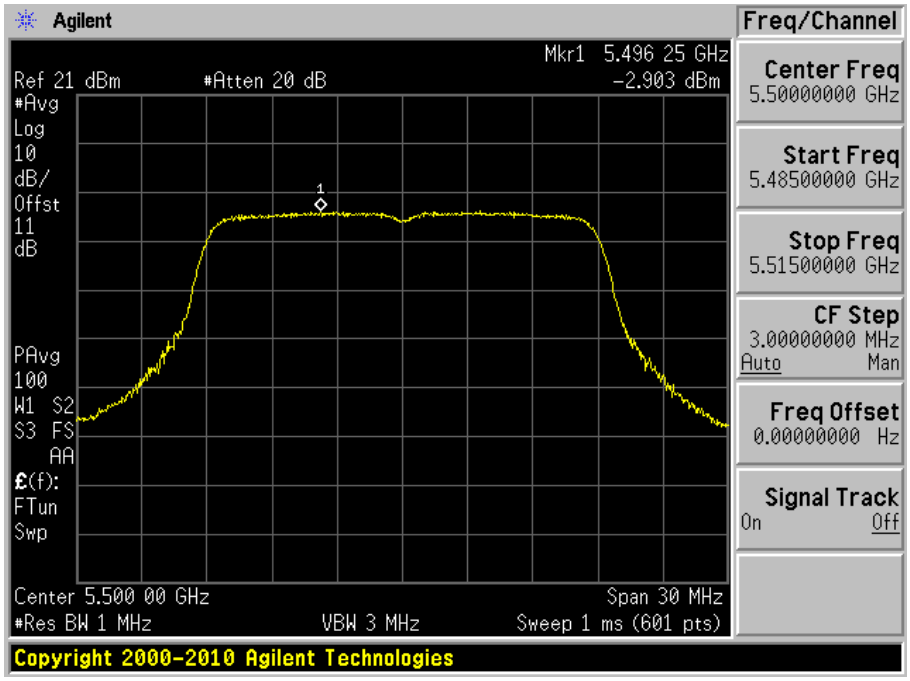


N/AC20 Mode 5320 MHz High Channel PSD

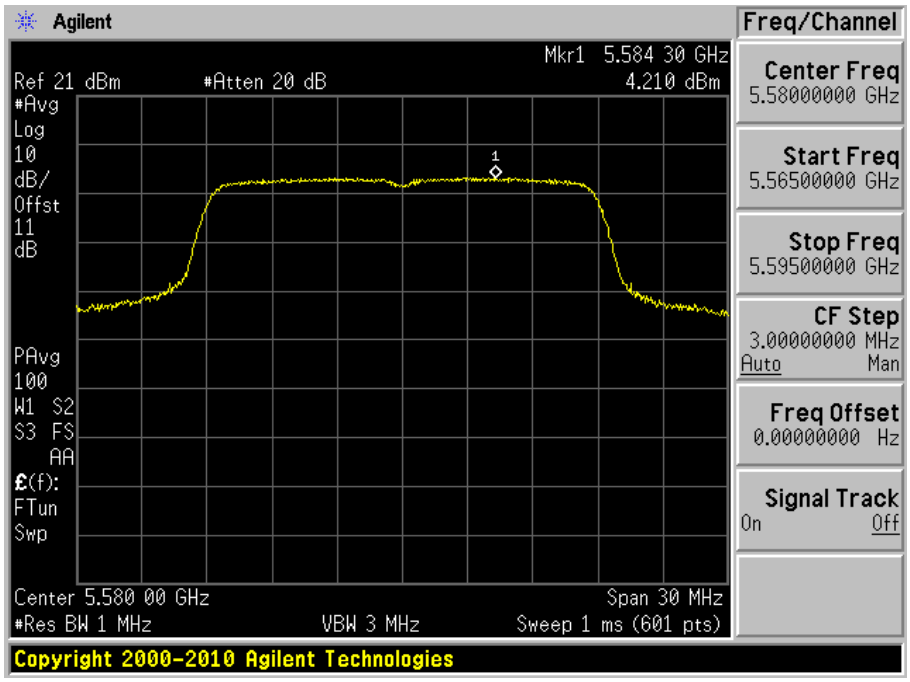


5470 - 5725 MHz

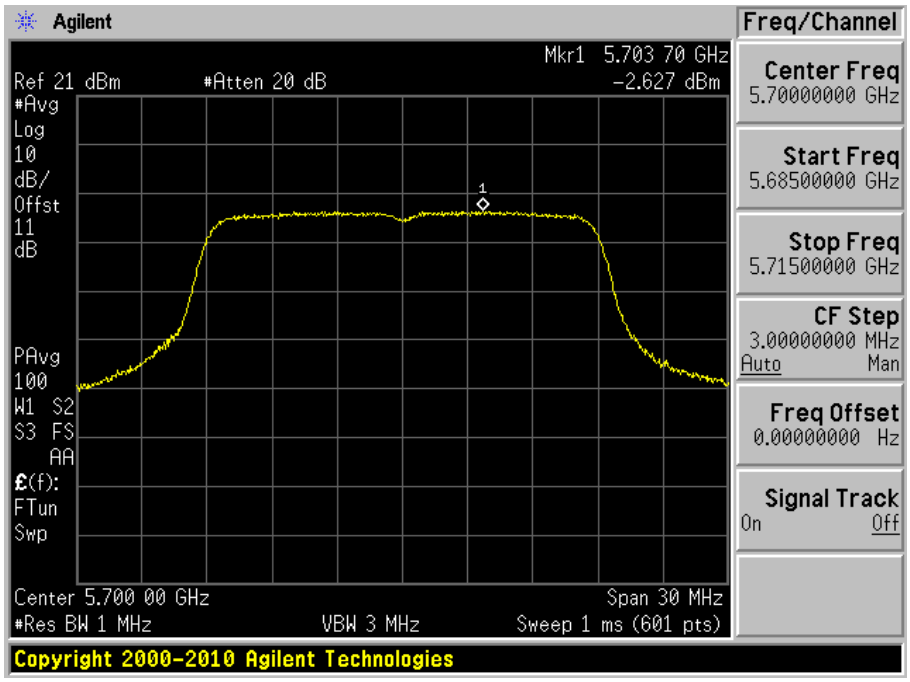
N/AC20 Mode 5500 MHz Low Channel PSD



N/AC20 Mode 5580 MHz Mid Channel PSD

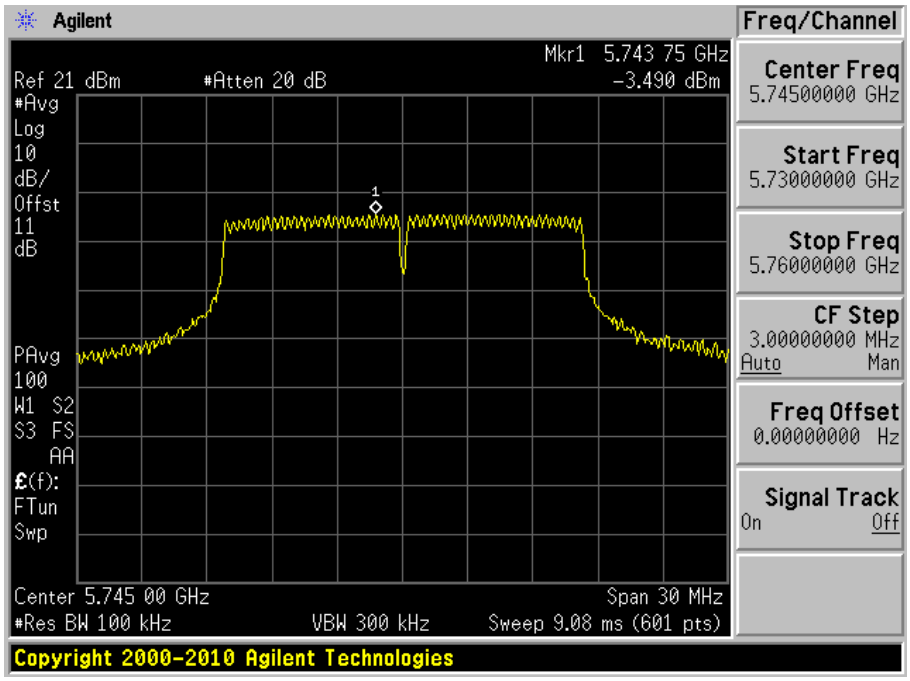


N/AC20 Mode 5700 MHz High Channel PSD

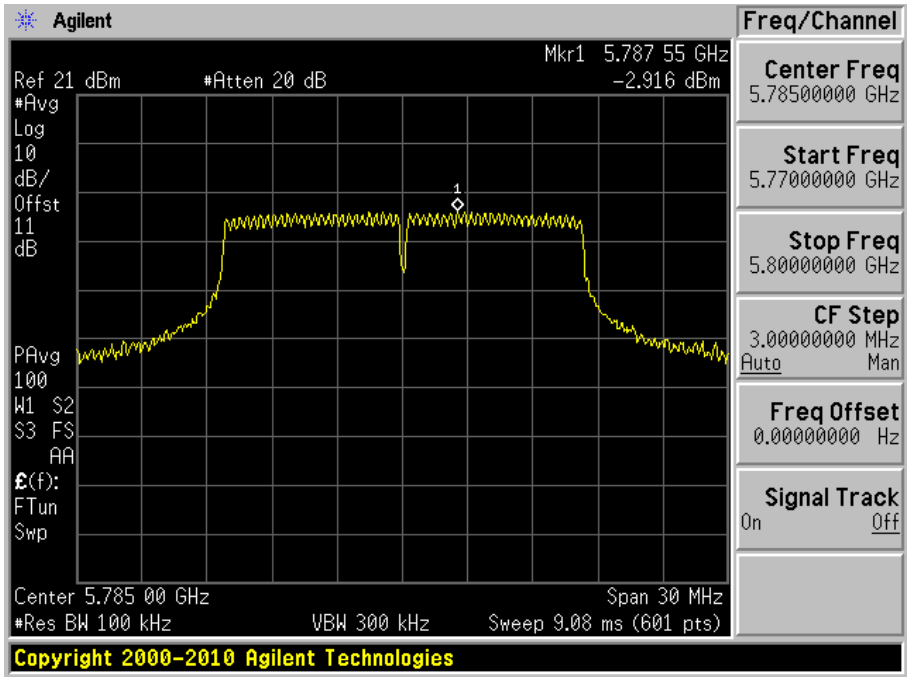


5725 - 5850 MHz

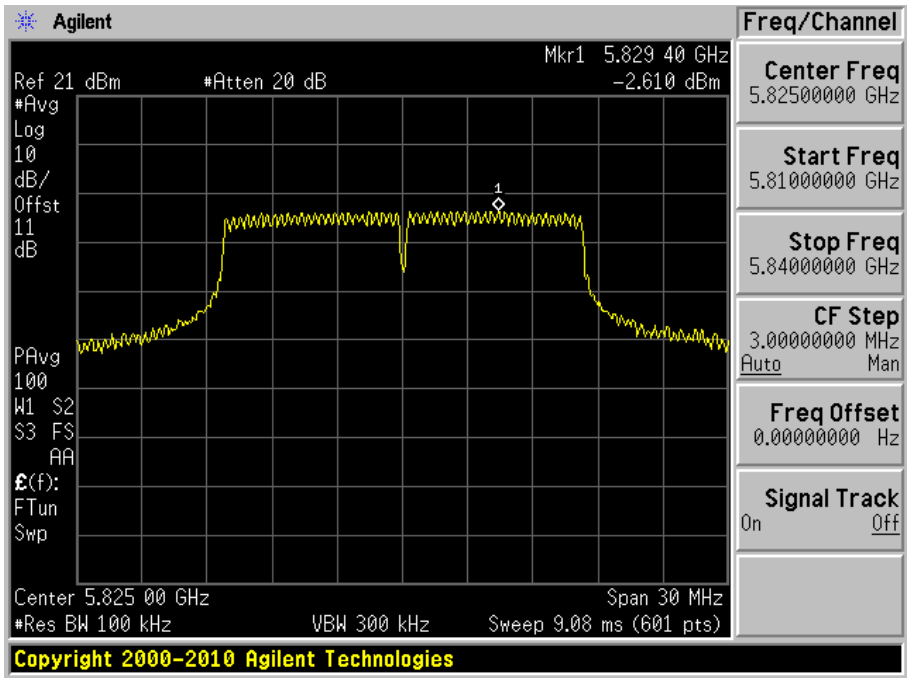
a Mode 5745 MHz Low Channel PSD



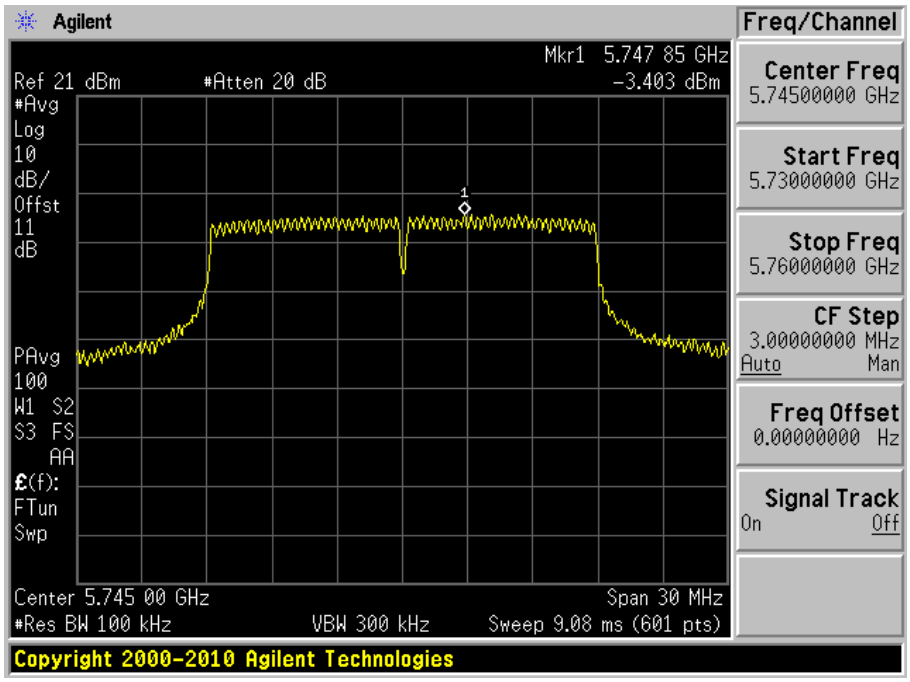
a Mode 5785 MHz Mid Channel PSD



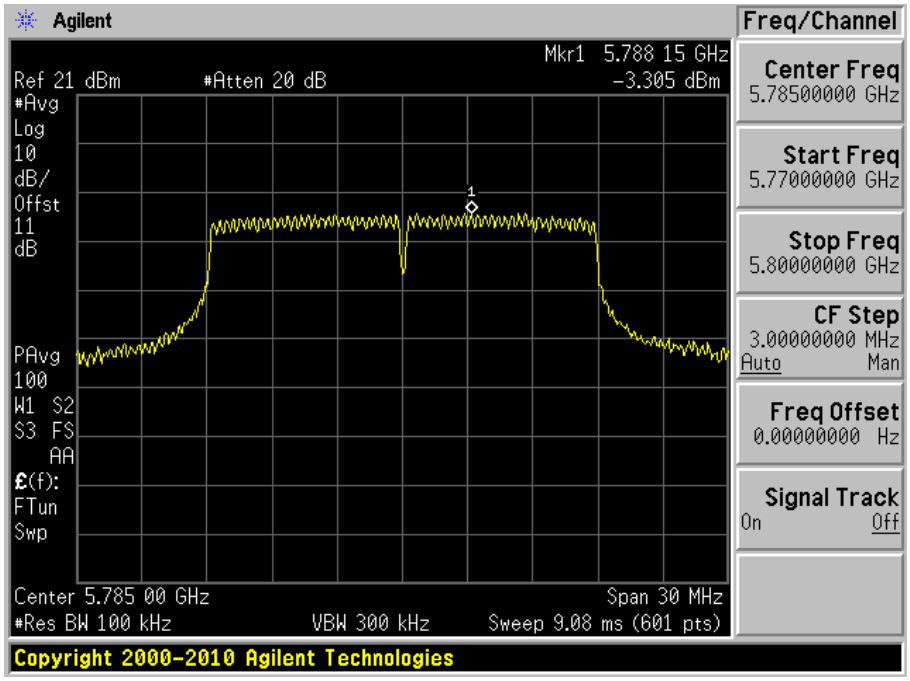
a Mode 5825 MHz High Channel PSD



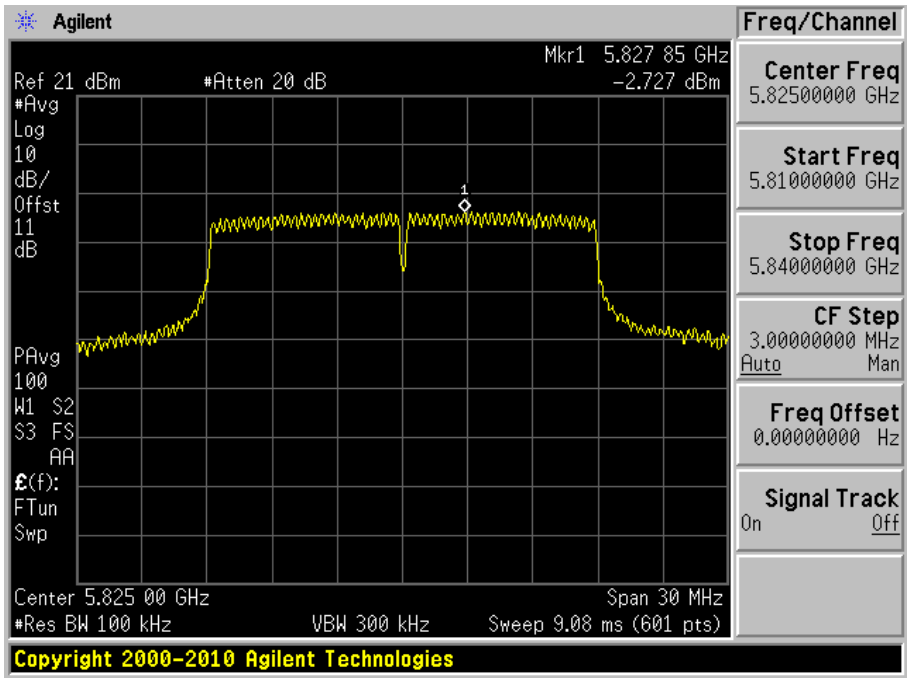
N/AC20 Mode 5745 MHz Low Channel PSD



N/AC20 Mode 5785 MHz Mid Channel PSD



N/AC20 Mode 5825 MHz High Channel PSD



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

9.1 Applicable Standards

According to FCC §15.407(b):

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

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

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

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

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

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

As per 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.

9.2 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.

9.3 Test Equipment List and Details

Bacl No.	Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
624	Agilent	Spectrum Analyzer	E4446A	MY48250238	2021-06-23	1 year
912	Rhode & Schwarz	Signal Analyzer	FSV40	1321.3008k39-101203-UW	2022-05-05	1 year
-	-	RF cable	-	-	Each time[1]	N/A
-	-	10 dB attenuator	-	-	Each time[1]	N/A

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

9.4 Test Environmental Conditions

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

The testing was performed by Deepak Mishra on 2022-04-22 in RF site.

9.5 Test Results

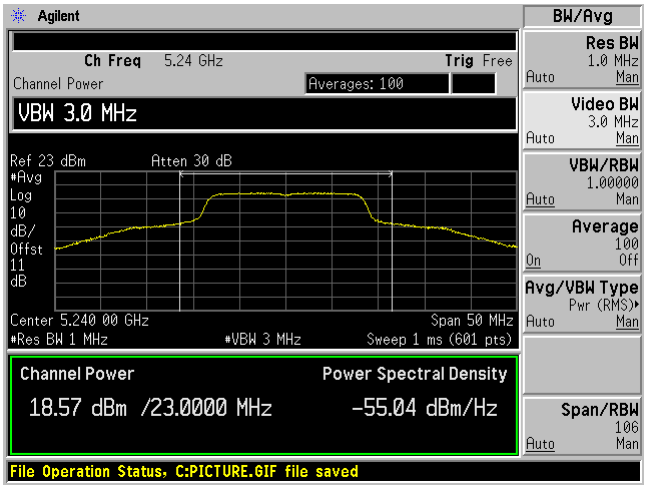
Please refer to the following plots

ISEDC Emission falling into 5250 – 5350 MHz

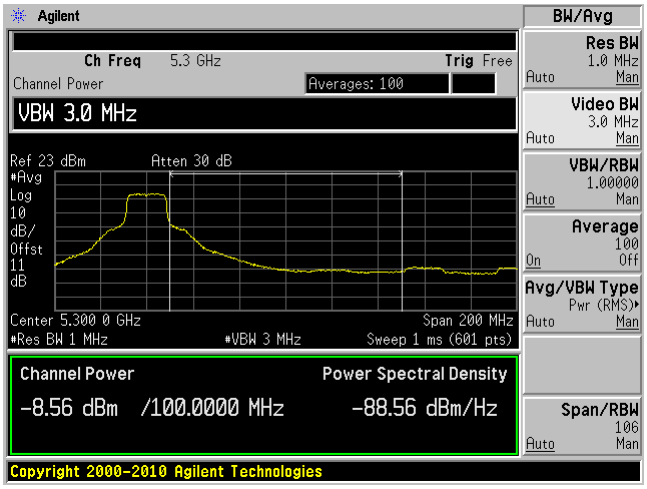
Channel	Frequency (MHz)	Channel Power (dBm)	Conducted Emission Power (dBm)	Delta (dB)	Limit (dB)
802.11a					
46	5230	18.57	-8.56	27.13	>26
802.11n20					
46	5230	18.51	-8.93	27.44	>26

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

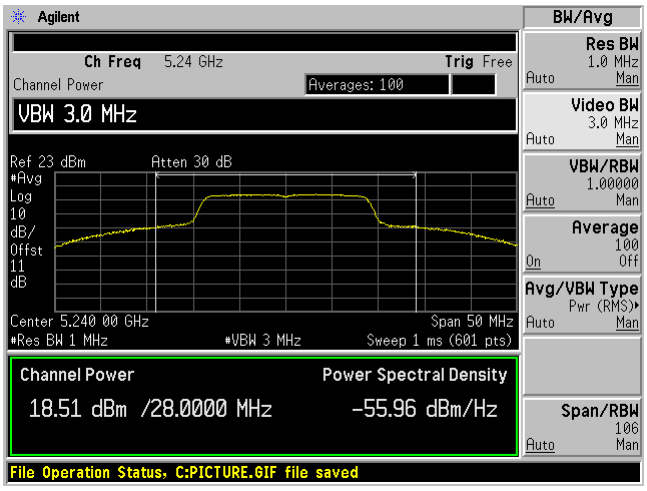
A mode, 5230MHz, Channel Power



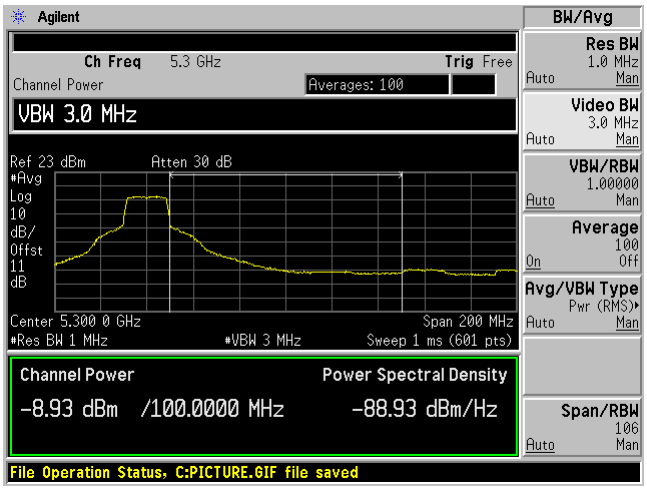
A mode, 5230MHz, Conducted Emission Power



HT20 mode, 5230MHz, Channel Power

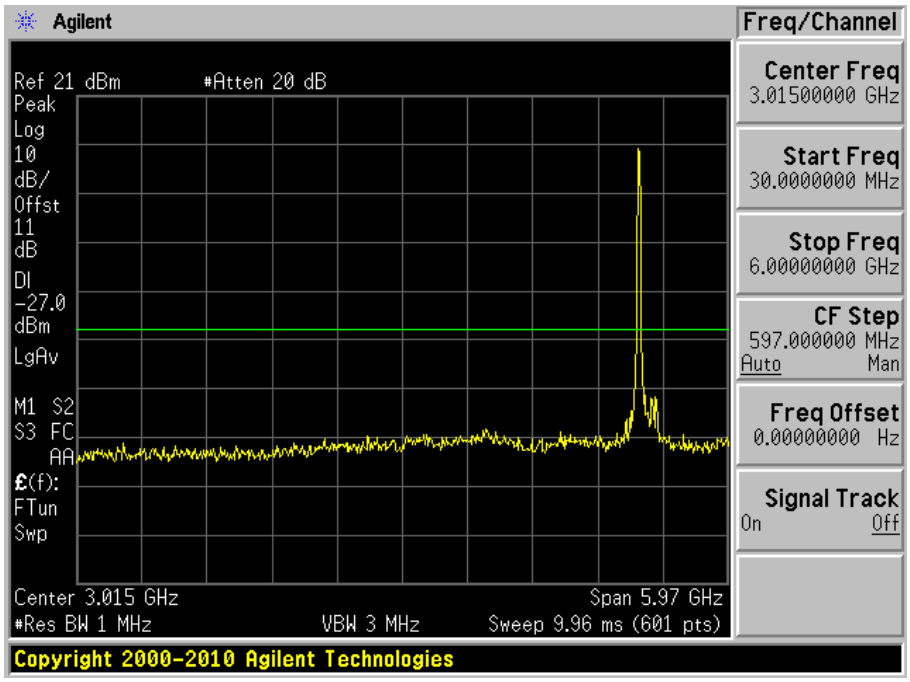


HT20 mode, 5230MHz, Conducted Emission Power

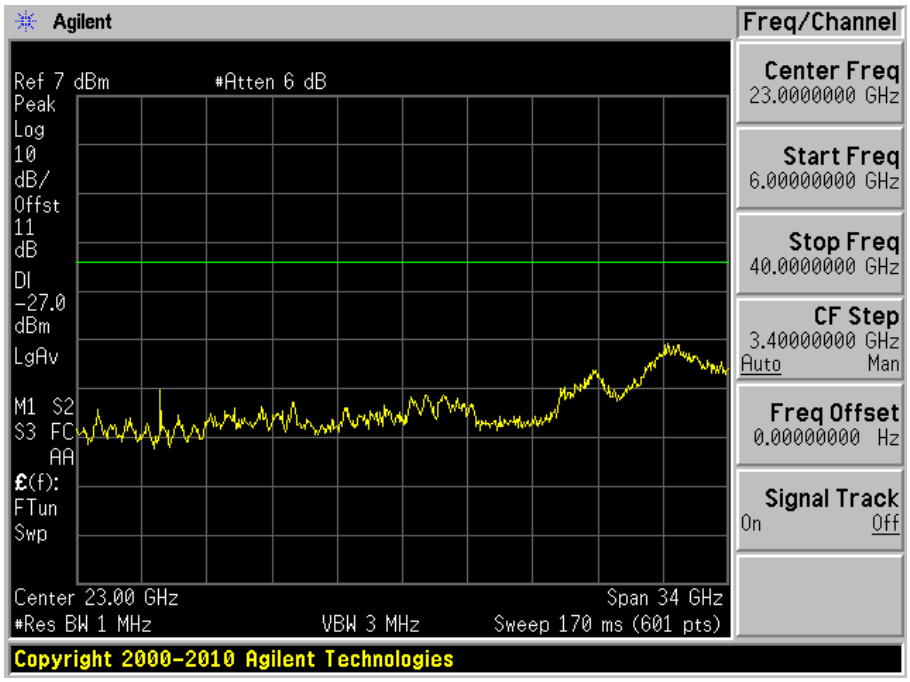


Spurious Emissions:

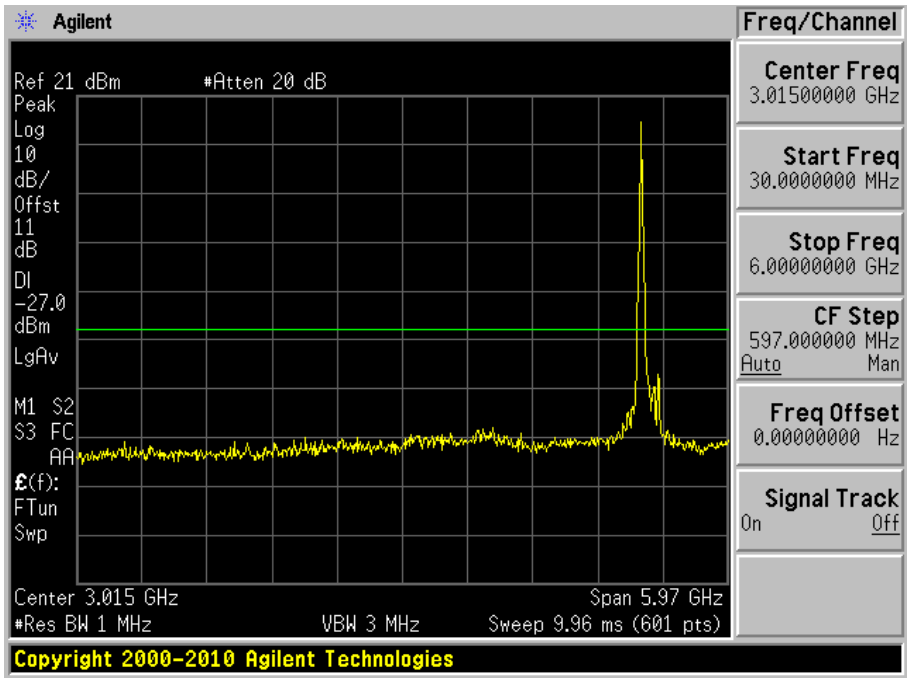
a Mode 5180 MHz Low Channel Spurious Emission_1



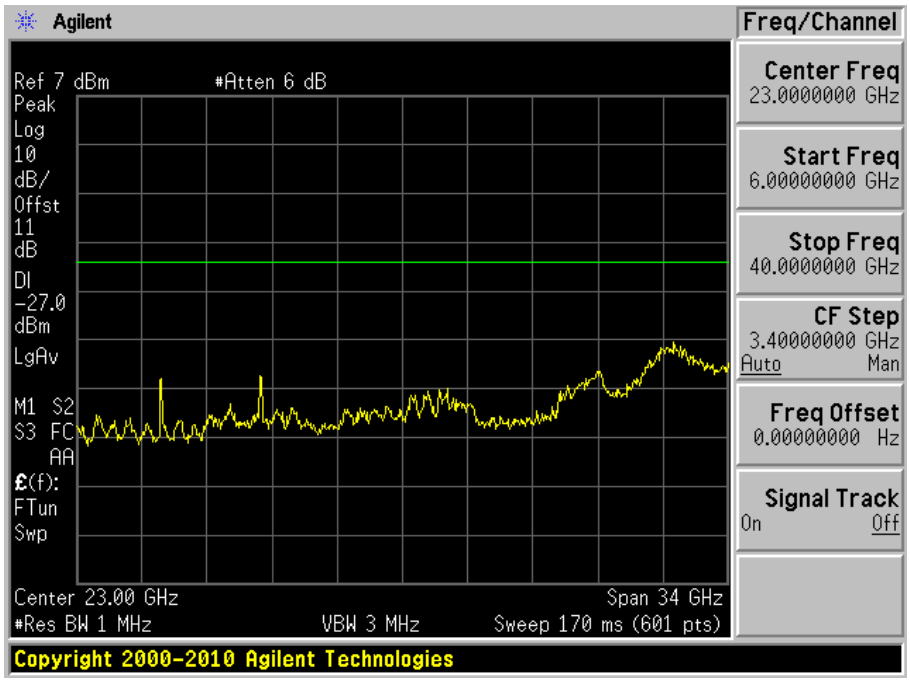
a Mode 5180 MHz Low Channel Spurious Emission_2



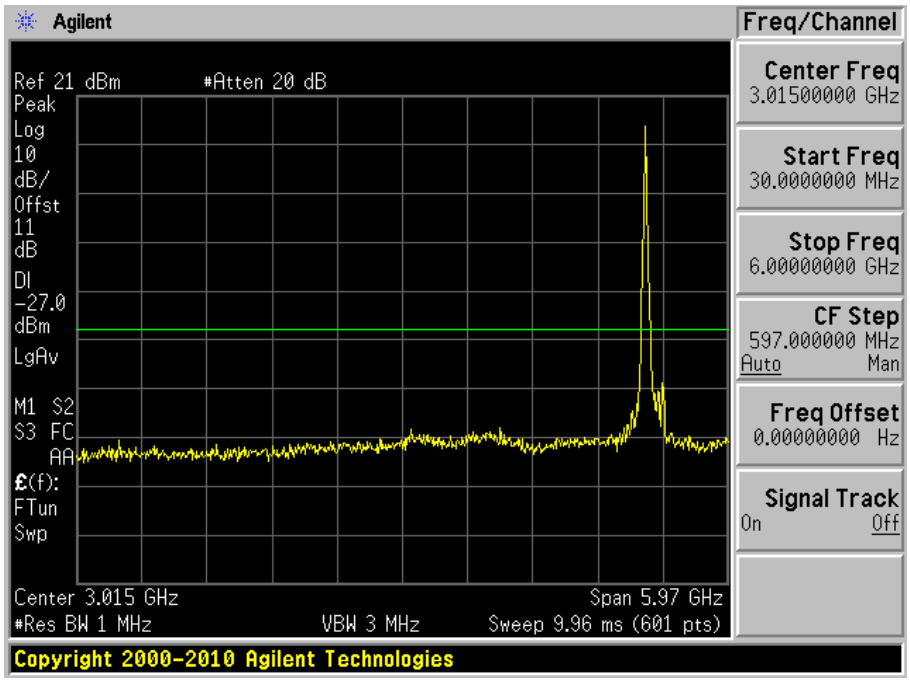
a Mode 5200 MHz Mid Channel Spurious Emission_1



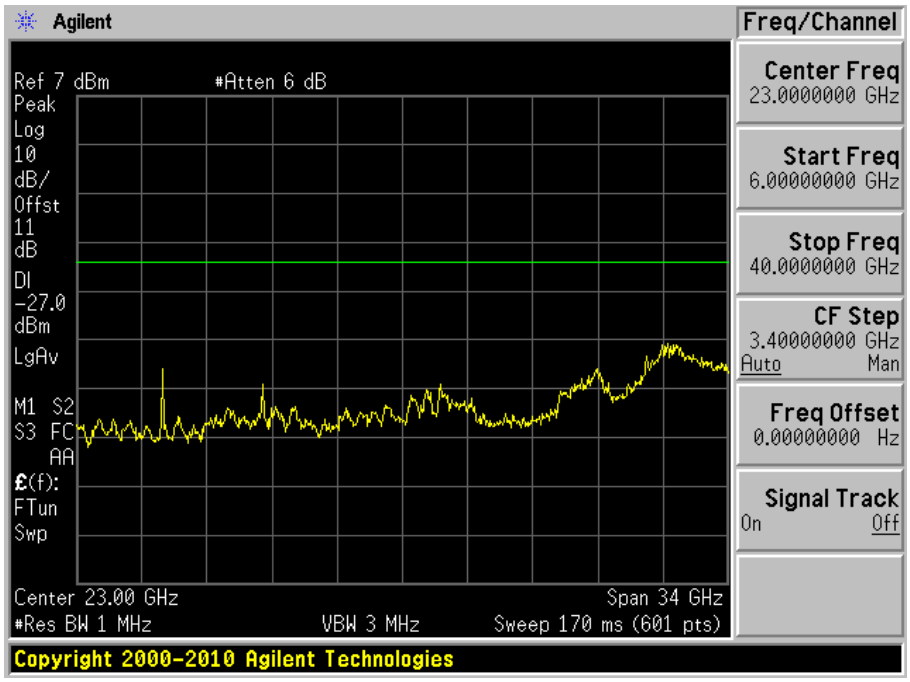
a Mode 5200 MHz Mid Channel Spurious Emission_2



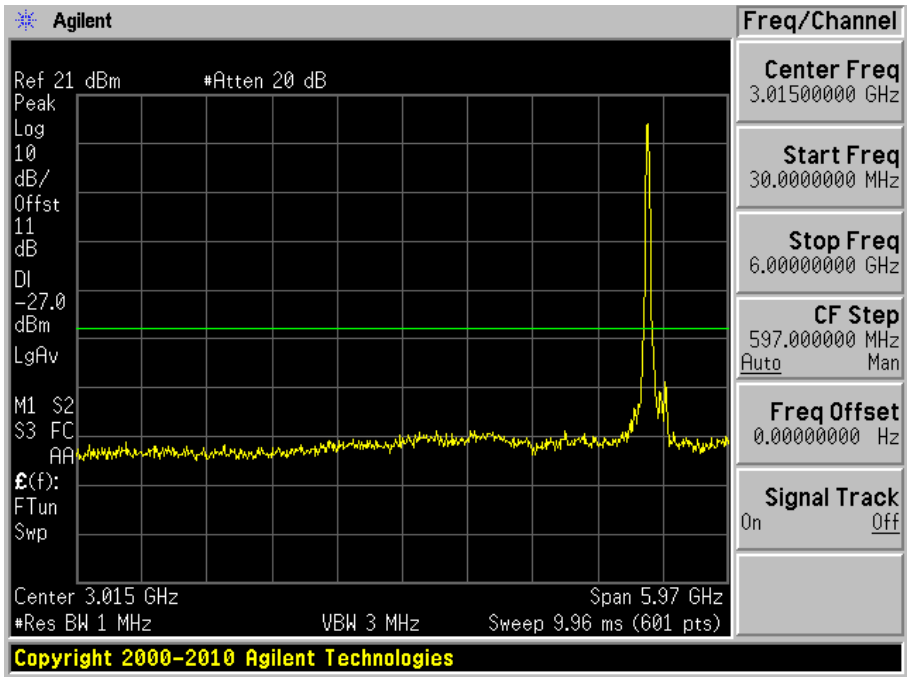
a Mode 5240 MHz High Channel Spurious Emission_1



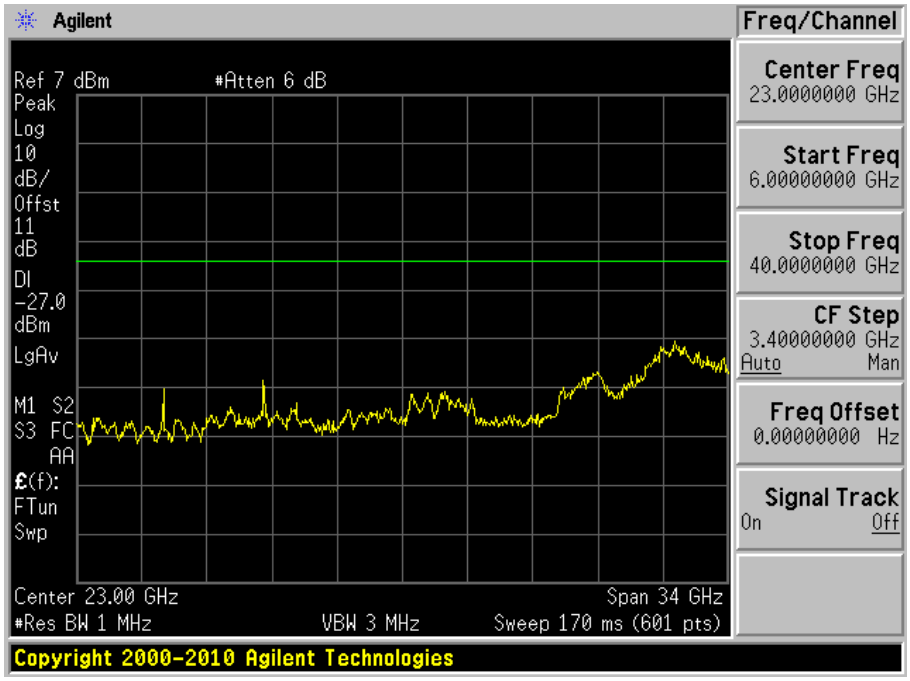
a Mode 5240 MHz High Channel Spurious Emission_2



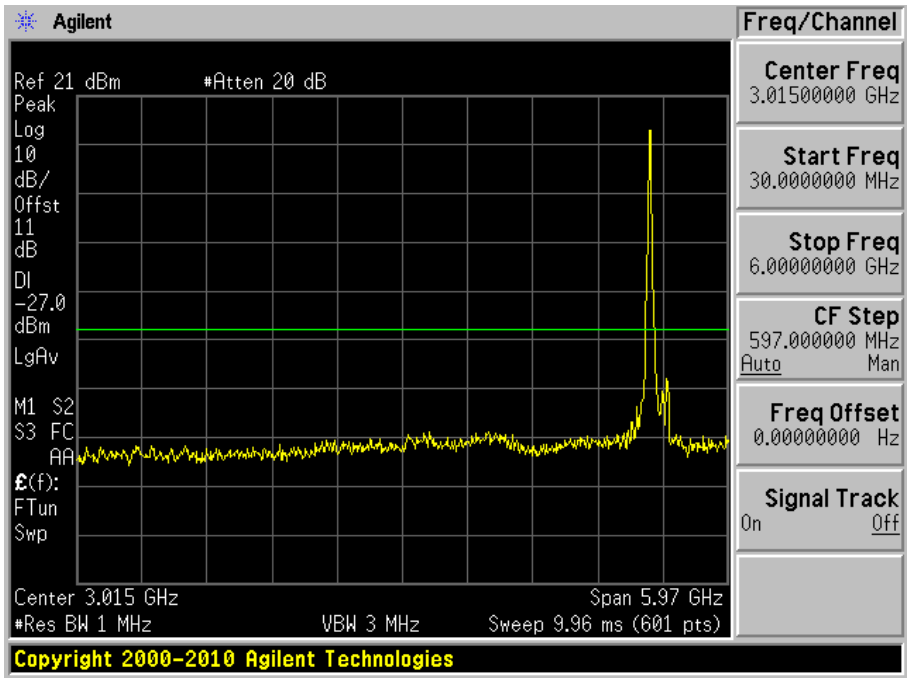
a Mode 5260 MHz Low Channel Spurious Emission_1



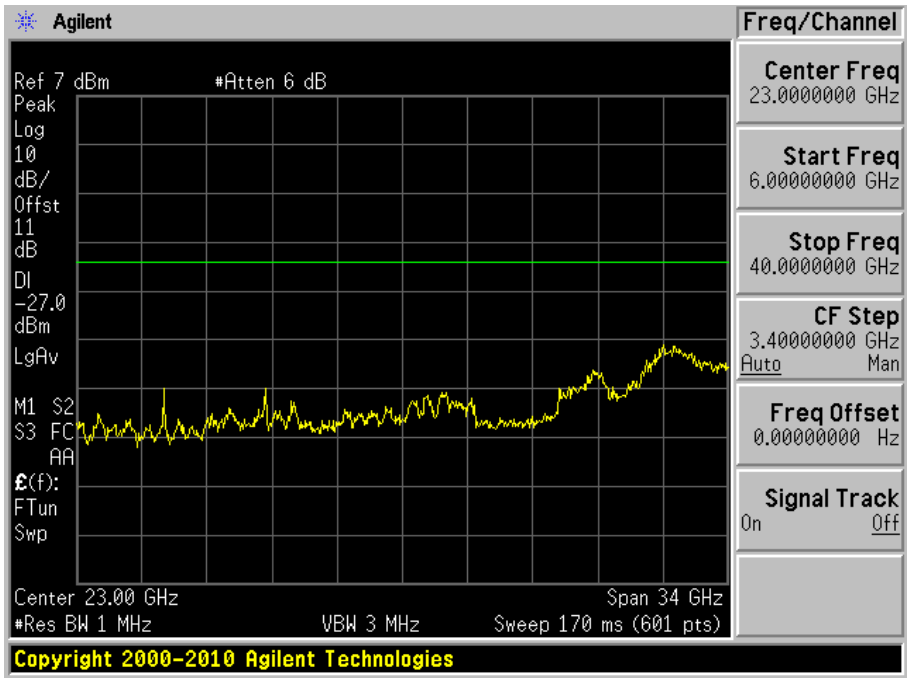
a Mode 5260 MHz Low Channel Spurious Emission_2



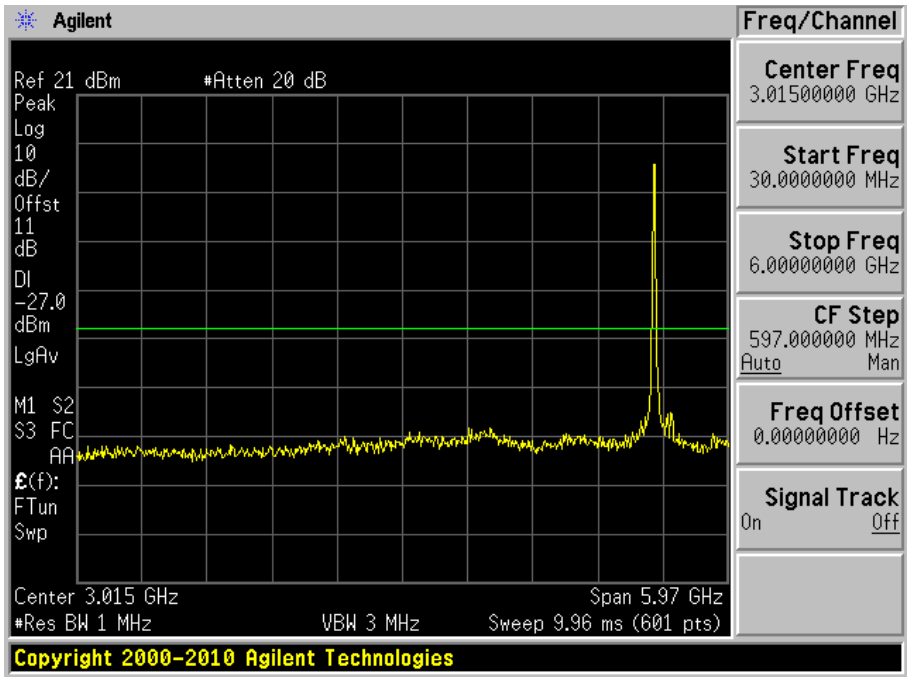
a Mode 5280 MHz Mid Channel Spurious Emission_1



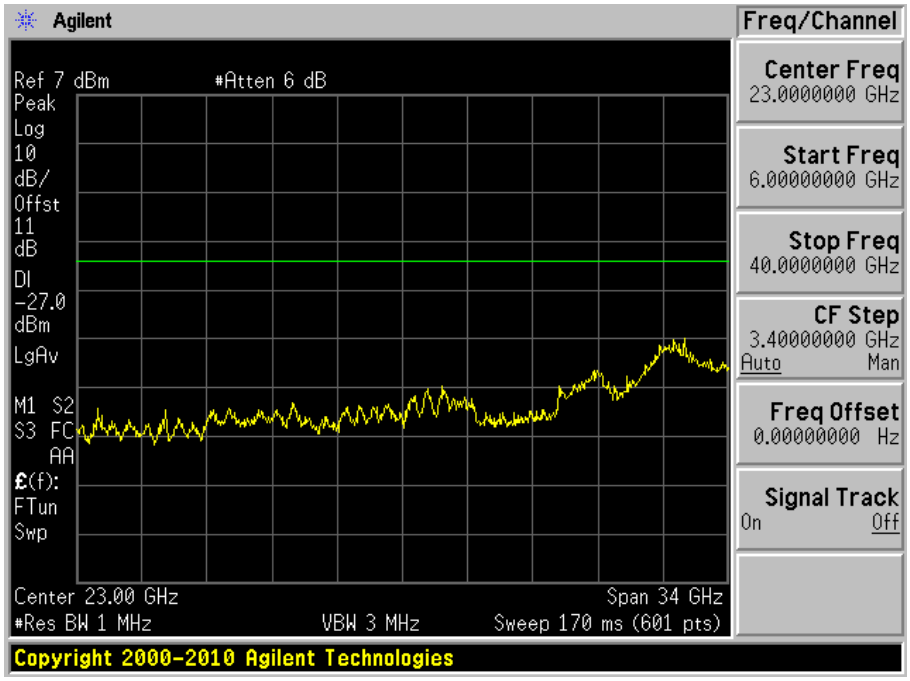
a Mode 5280 MHz Mid Channel Spurious Emission_2



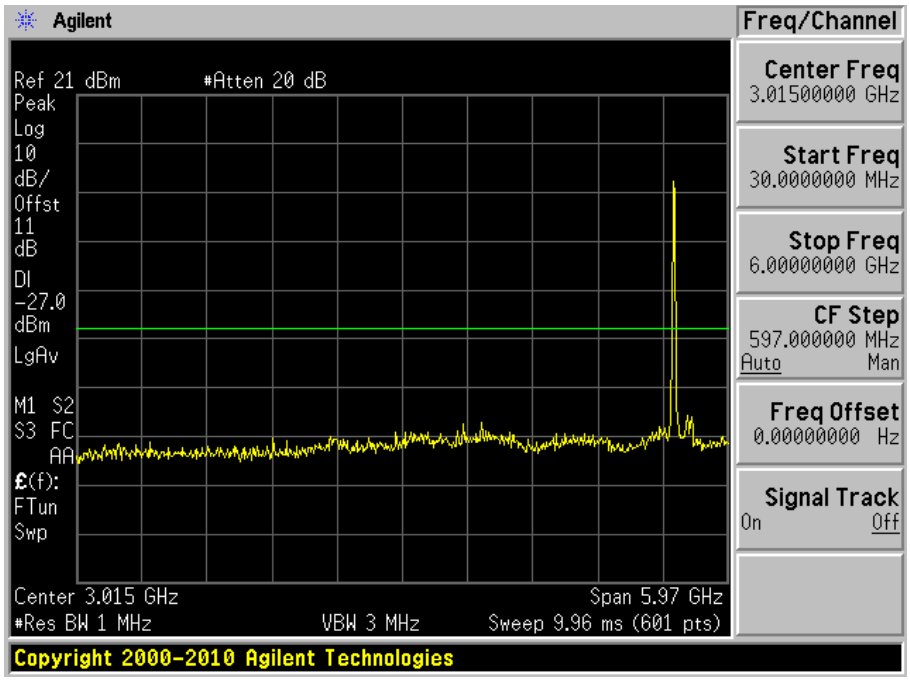
a Mode 5320 MHz High Channel Spurious Emission_1



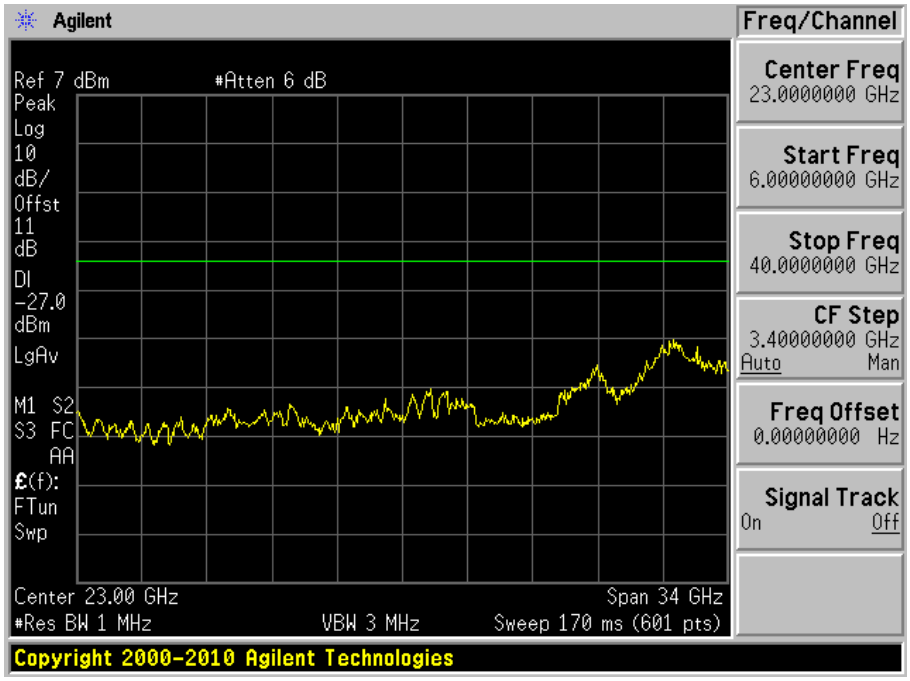
a Mode 5320 MHz High Channel Spurious Emission_2



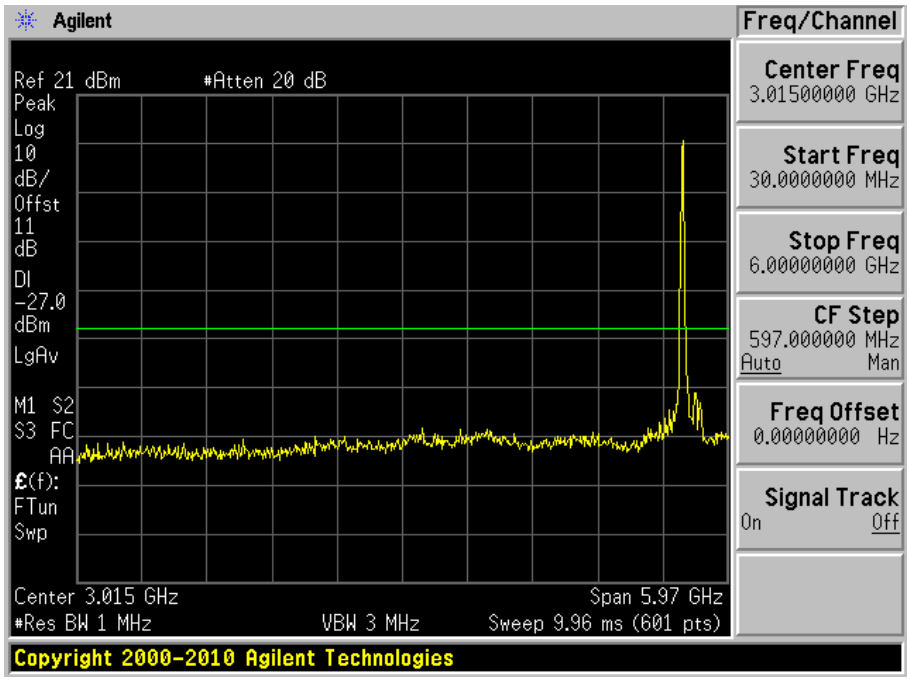
a Mode 5500 MHz Low Channel Spurious Emission_1



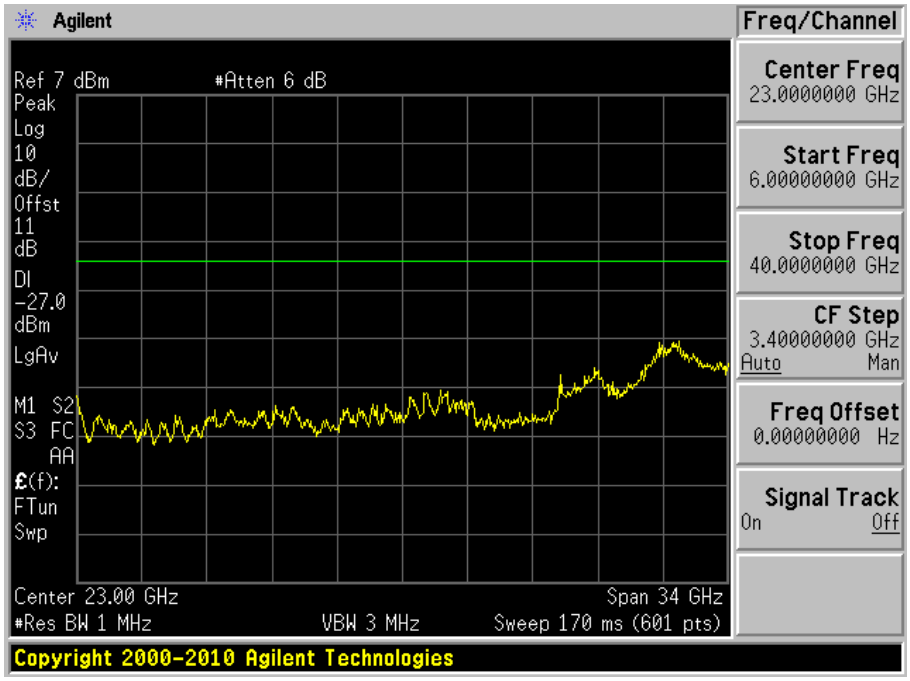
a Mode 5500 MHz Low Channel Spurious Emission_2



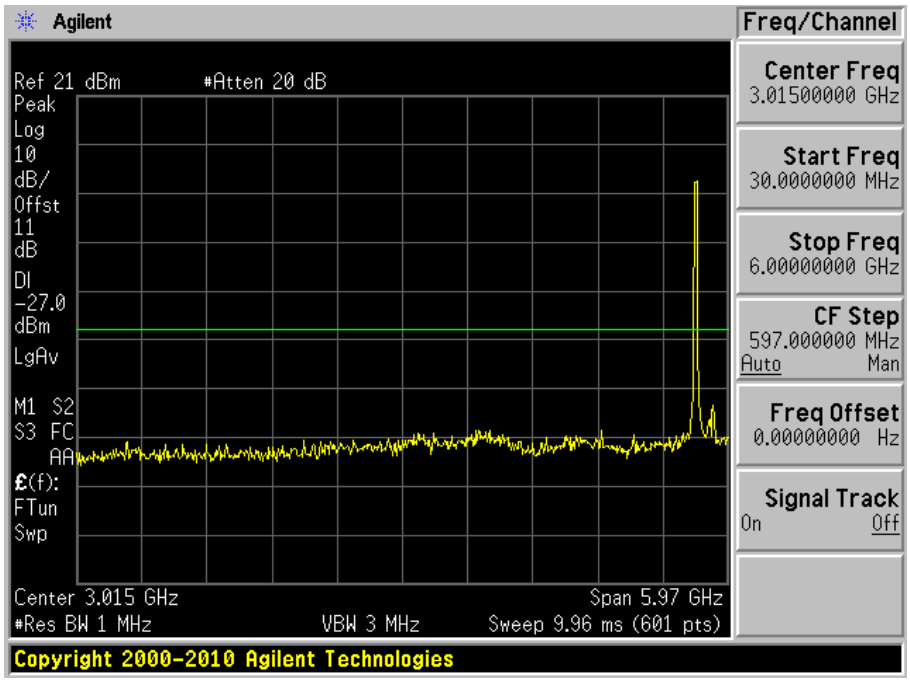
a Mode 5580 MHz Mid Channel Spurious Emission_1



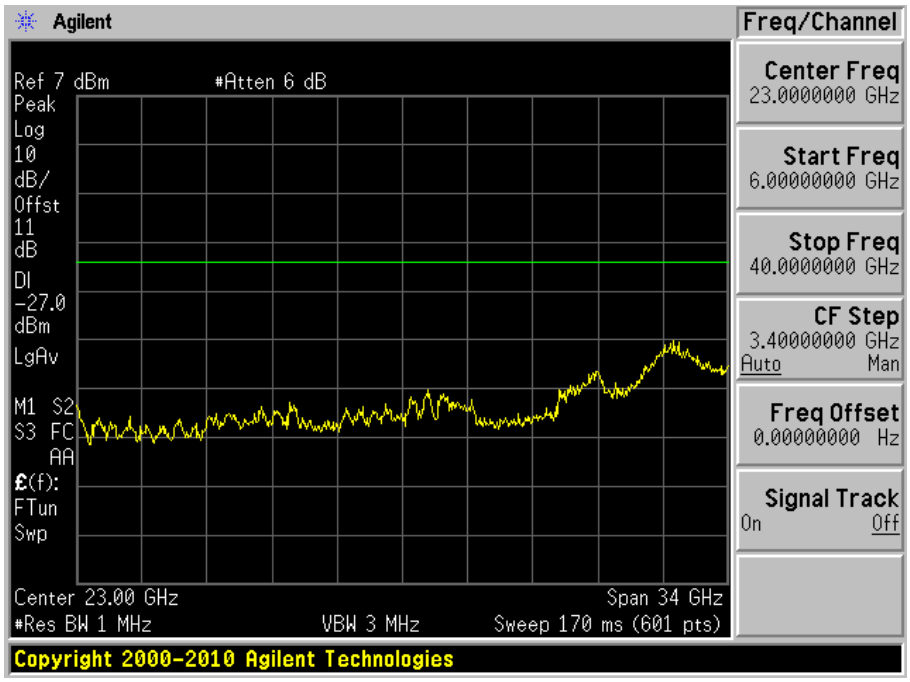
a Mode 5580 MHz Mid Channel Spurious Emission_2



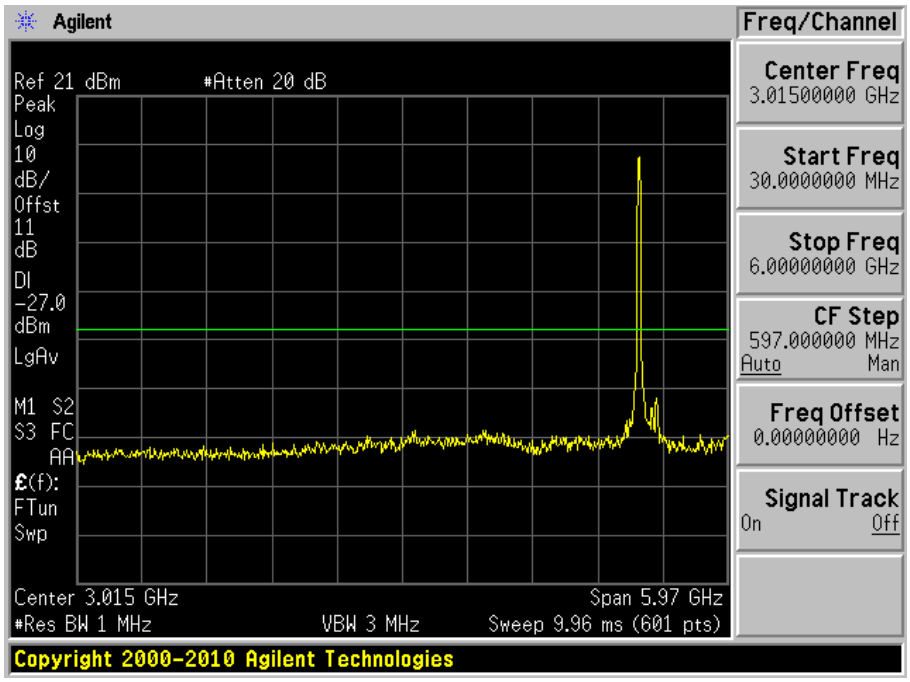
a Mode 5700 MHz High Channel Spurious Emission_1



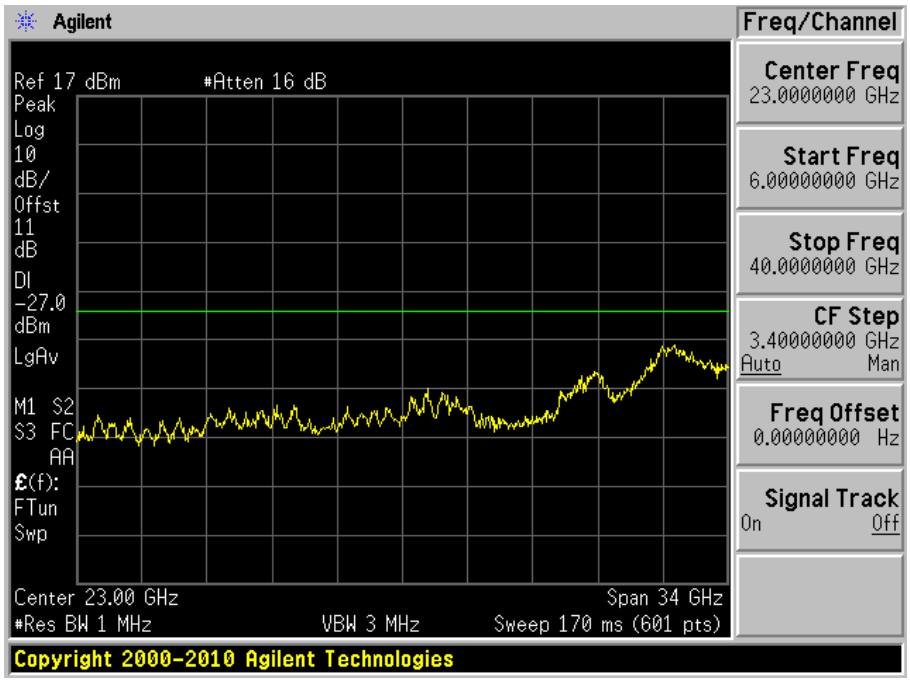
a Mode 5700 MHz High Channel Spurious Emission_2



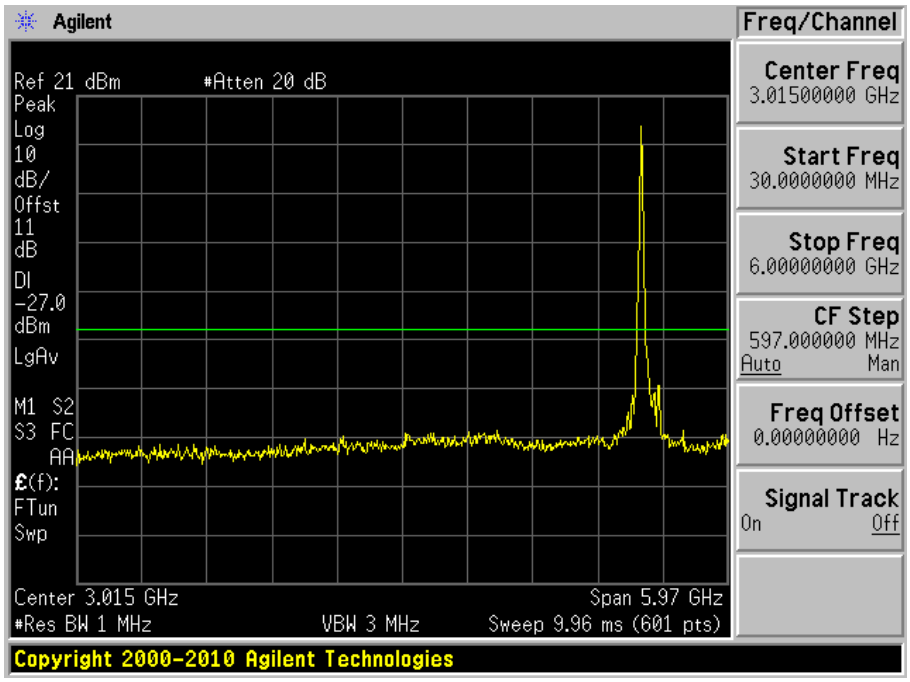
HT20 Mode 5180 MHz Low Channel Spurious Emission_1



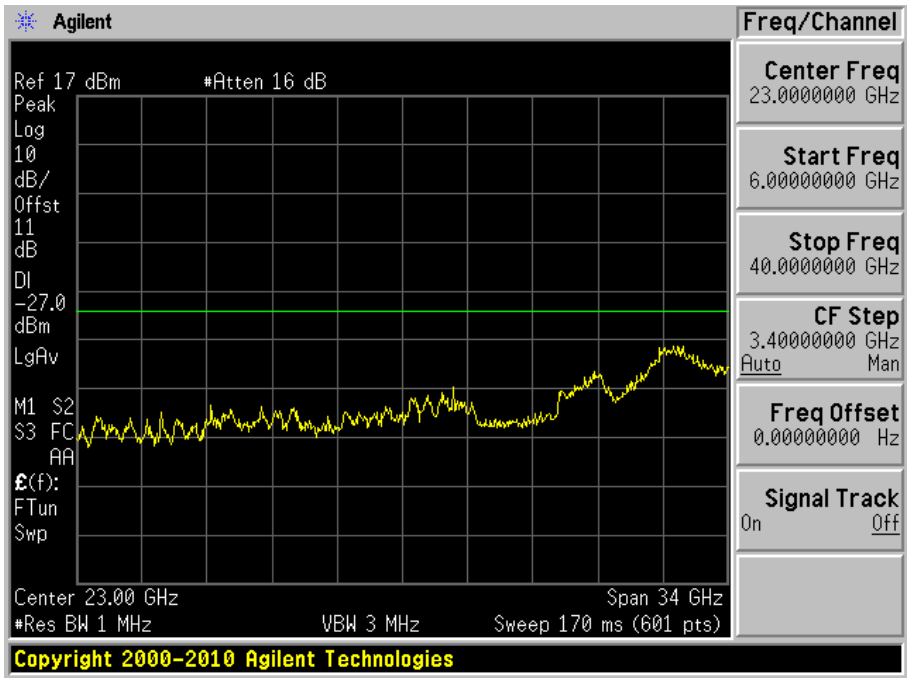
HT20 Mode 5180 MHz Low Channel Spurious Emission_2



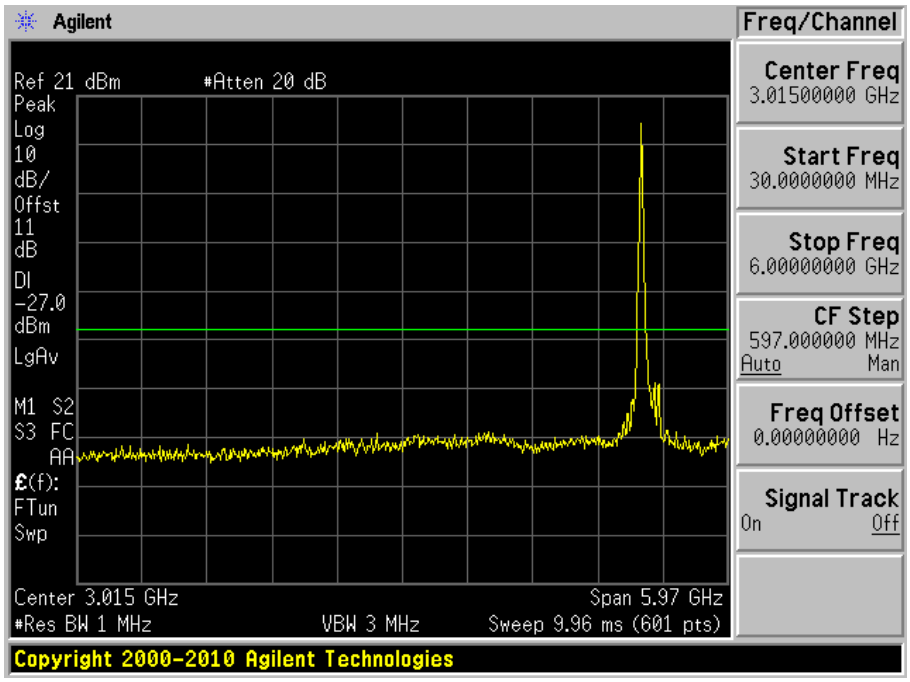
HT20 Mode 5200 MHz Low Channel Spurious Emission_1



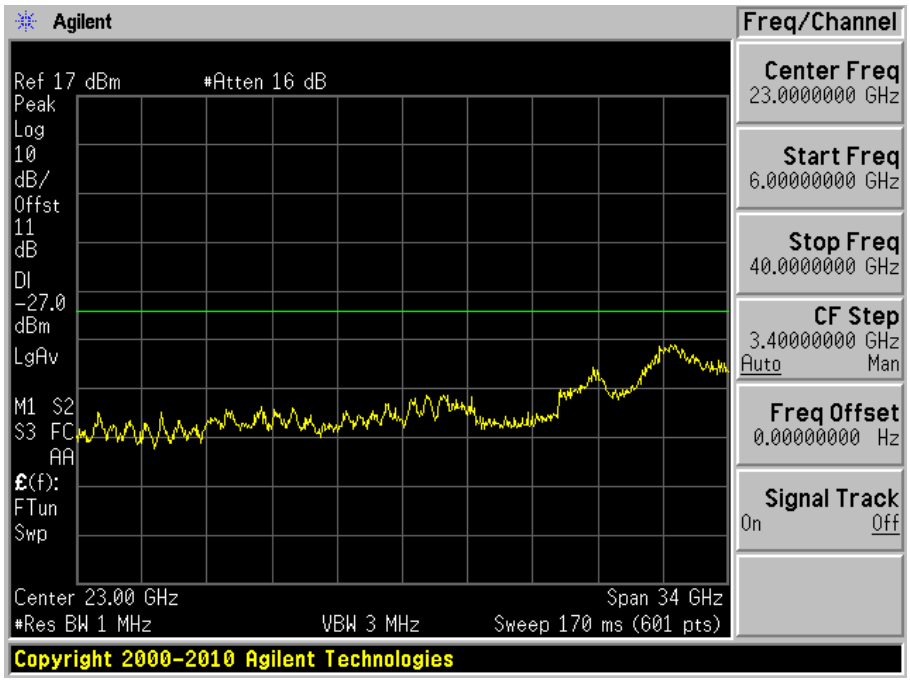
HT20 Mode 5200 MHz Low Channel Spurious Emission_2



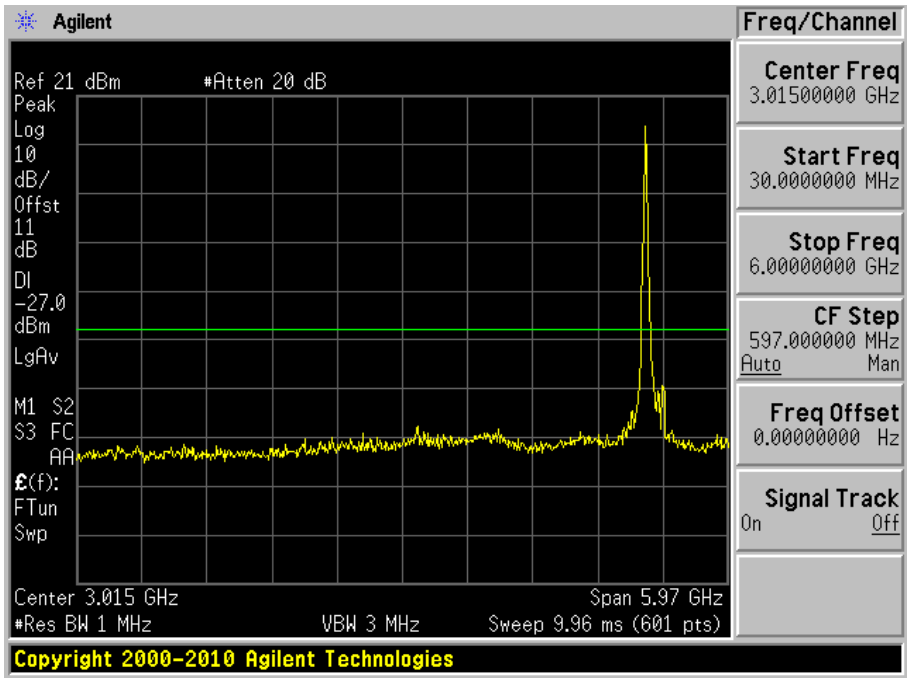
HT20 Mode 5200 MHz Mid Channel Spurious Emission_1



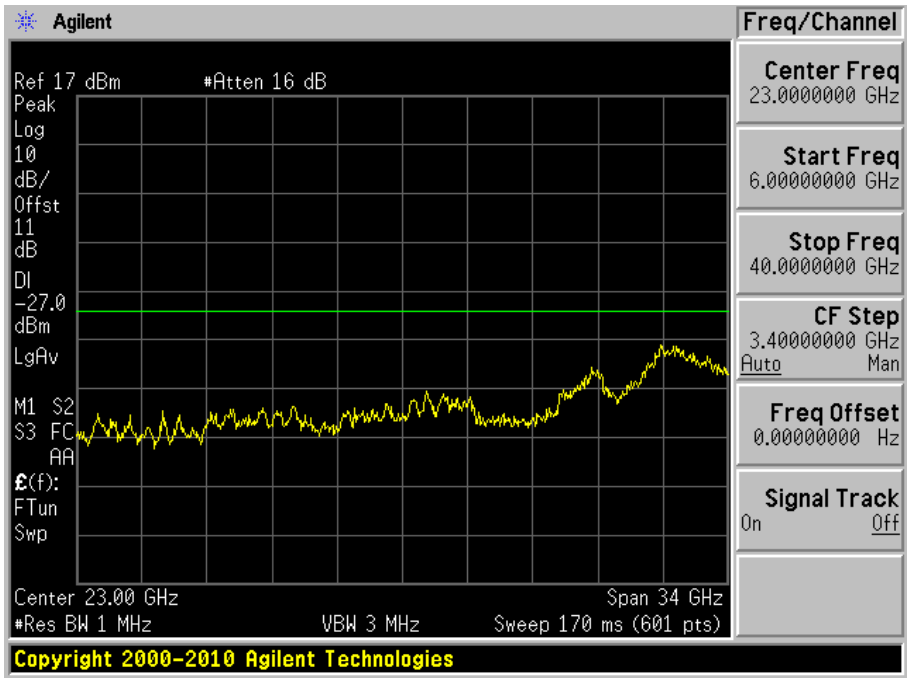
HT20 Mode 5200 MHz Mid Channel Spurious Emission_2



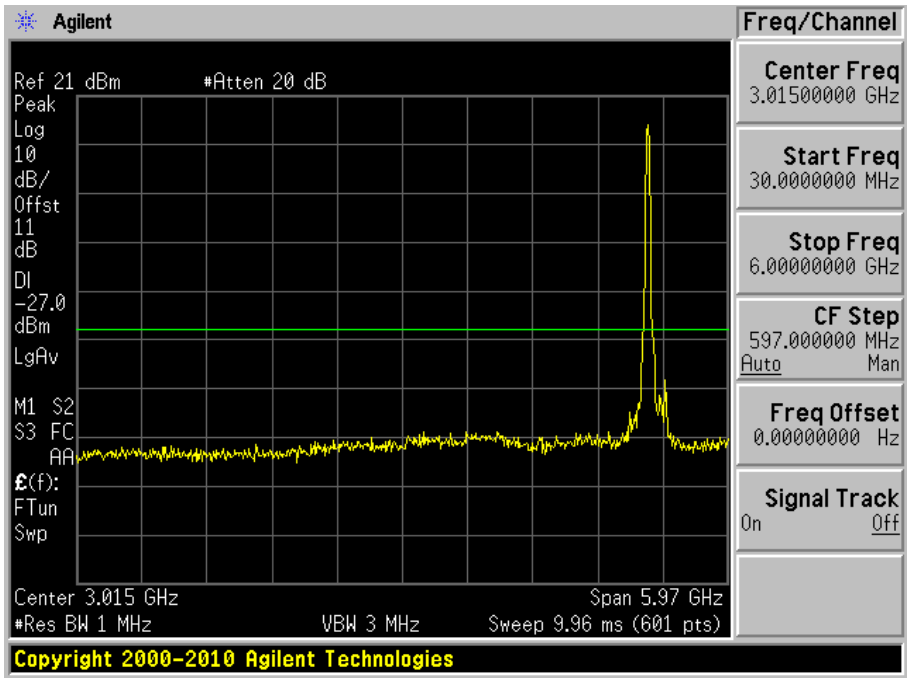
HT20 Mode 5240 MHz High Channel Spurious Emission_1



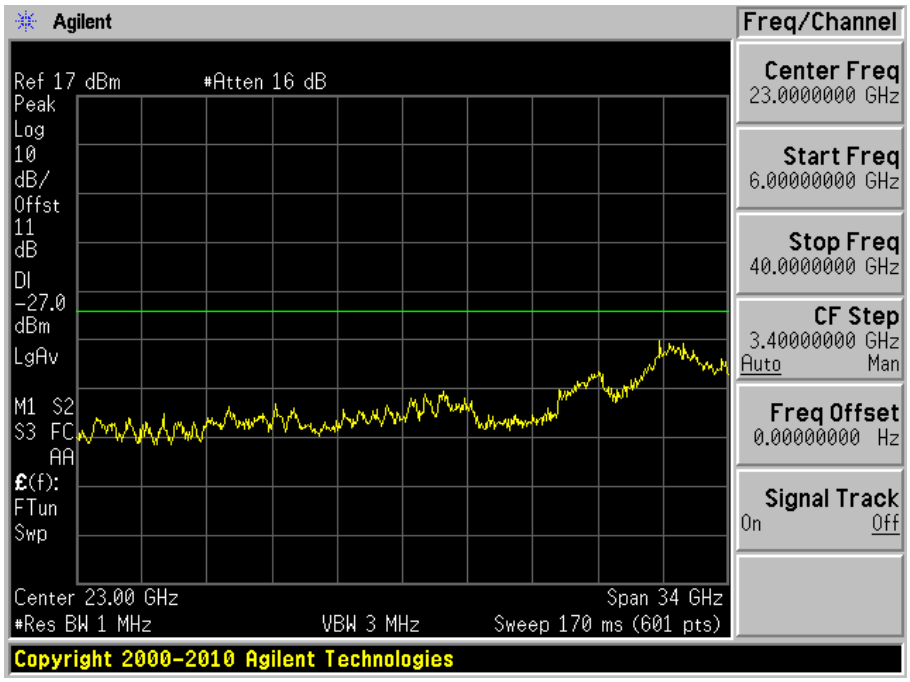
HT20 Mode 5240 MHz High Channel Spurious Emission_2



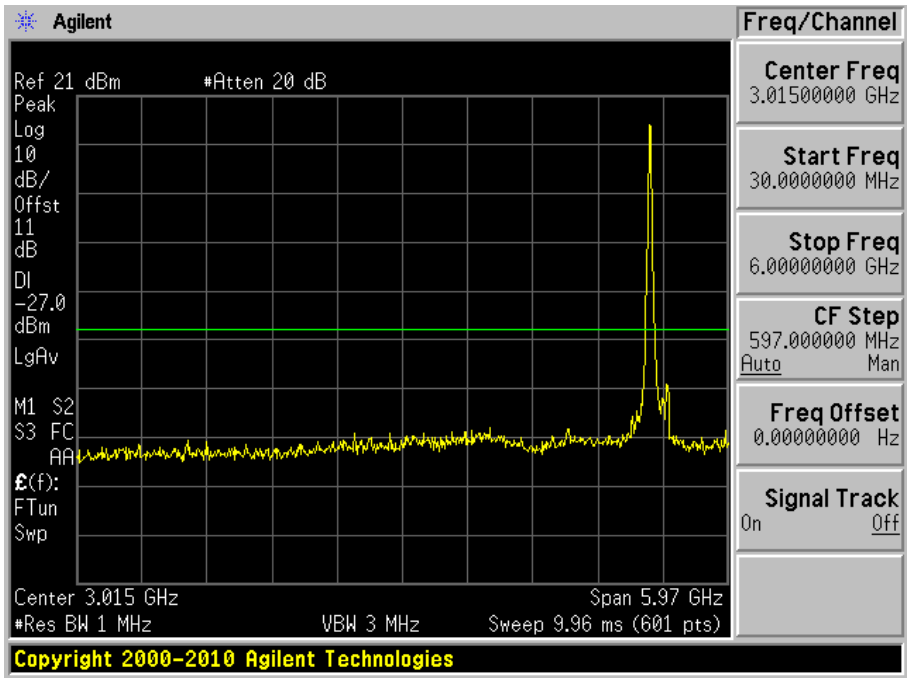
HT20 Mode 5260 MHz Low Channel Spurious Emission_1



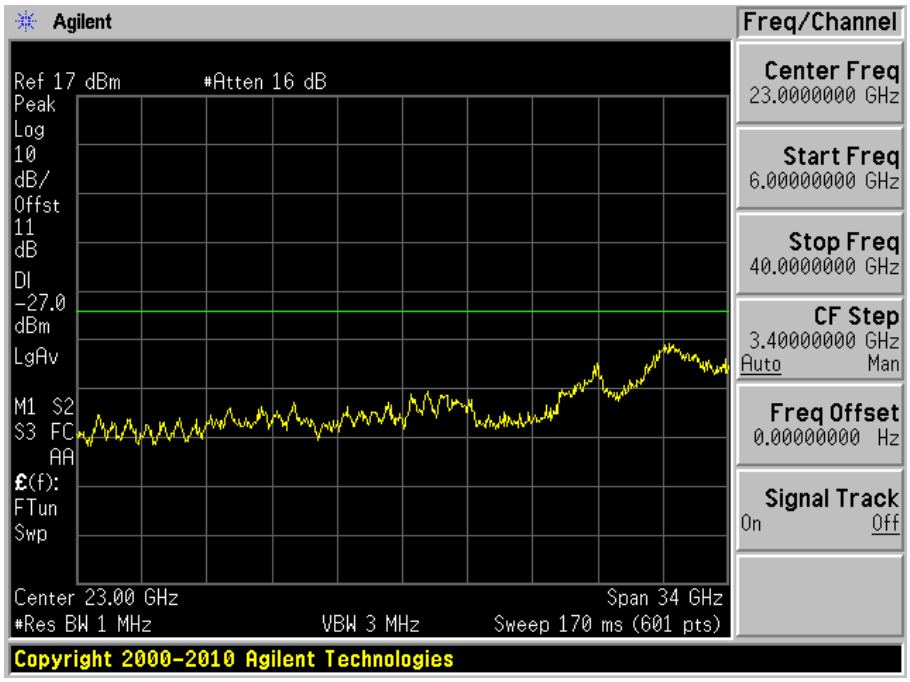
HT20 Mode 5260 MHz Low Channel Spurious Emission_2



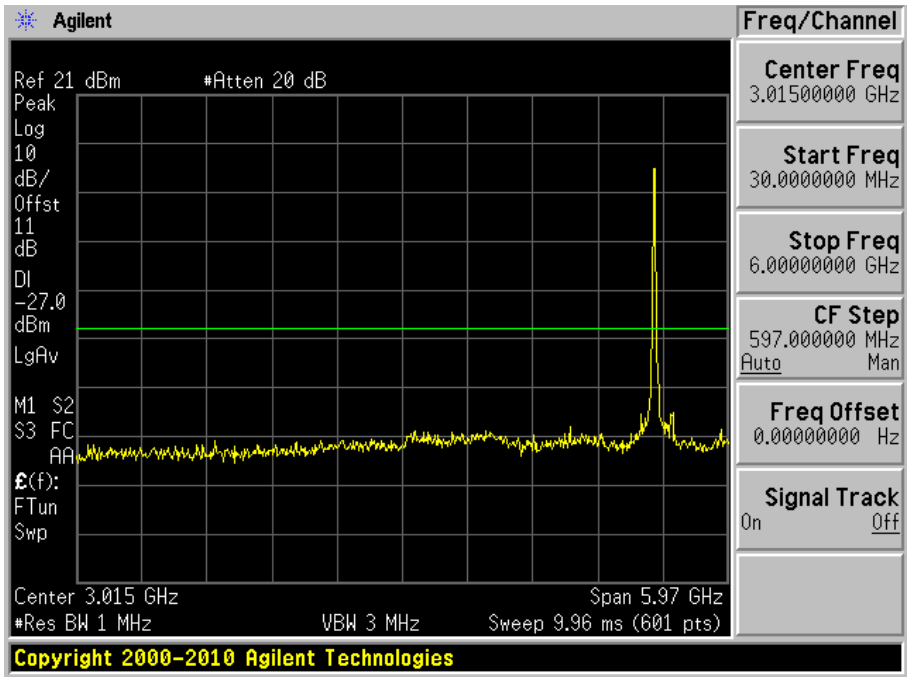
HT20 Mode 5280 MHz Mid Channel Spurious Emission_1



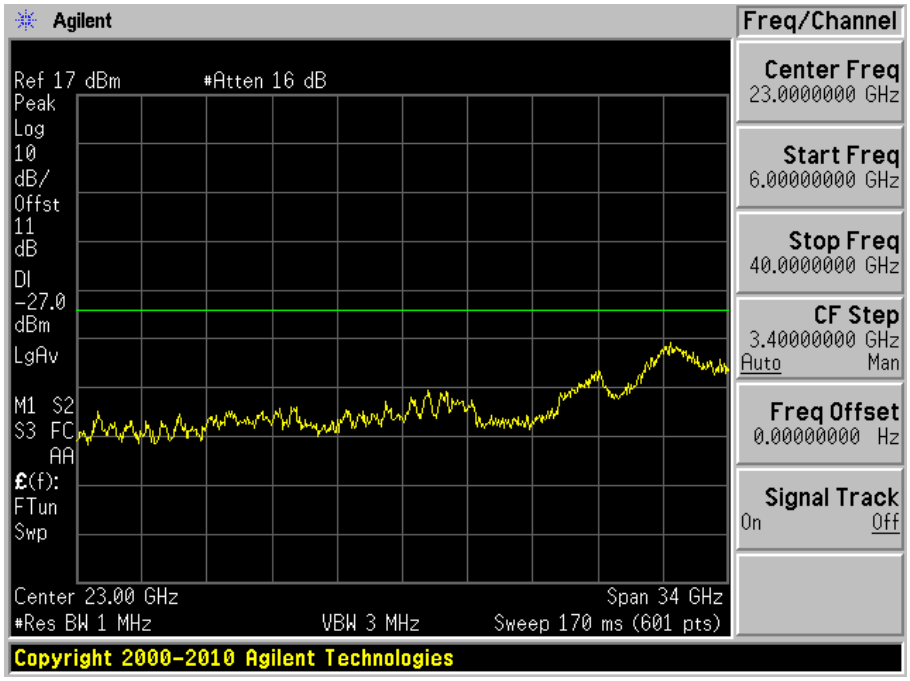
HT20 Mode 5280 MHz Mid Channel Spurious Emission_2



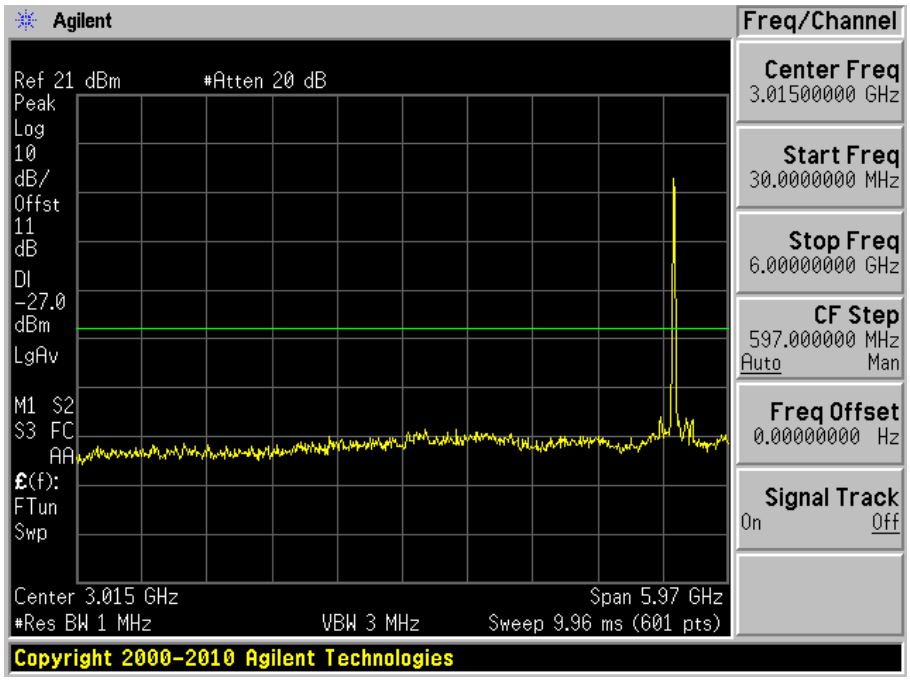
HT20 Mode 5320 MHz High Channel Spurious Emission_1



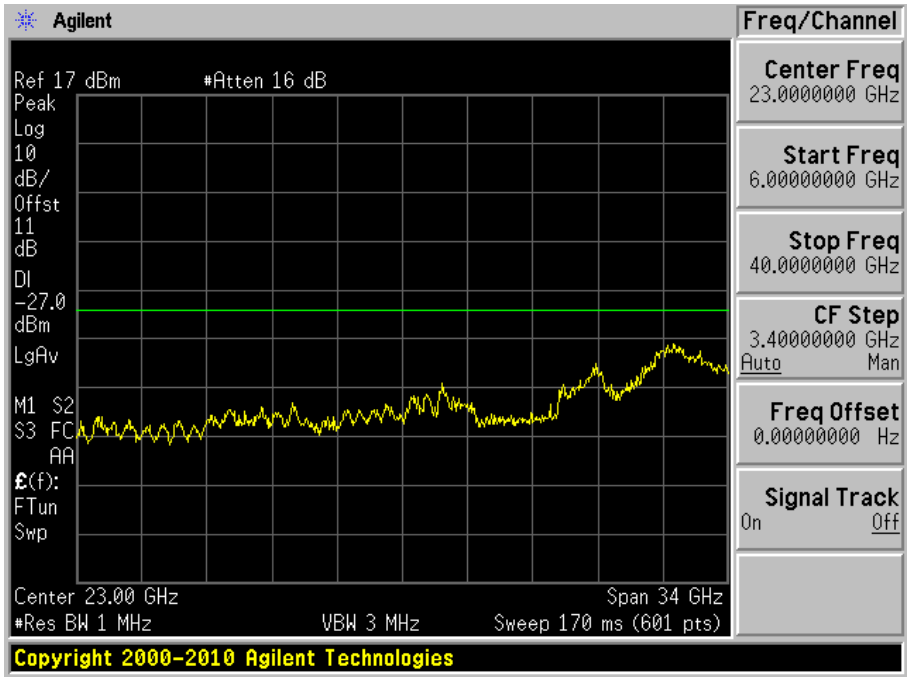
HT20 Mode 5320 MHz High Channel Spurious Emission_2



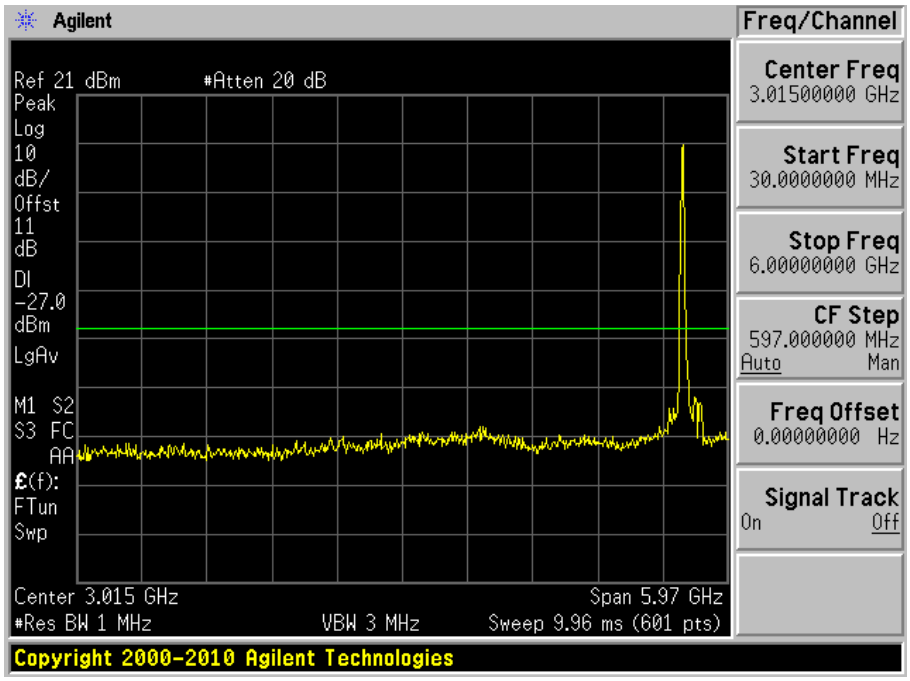
HT20 Mode 5500 MHz Low Channel Spurious Emission_1



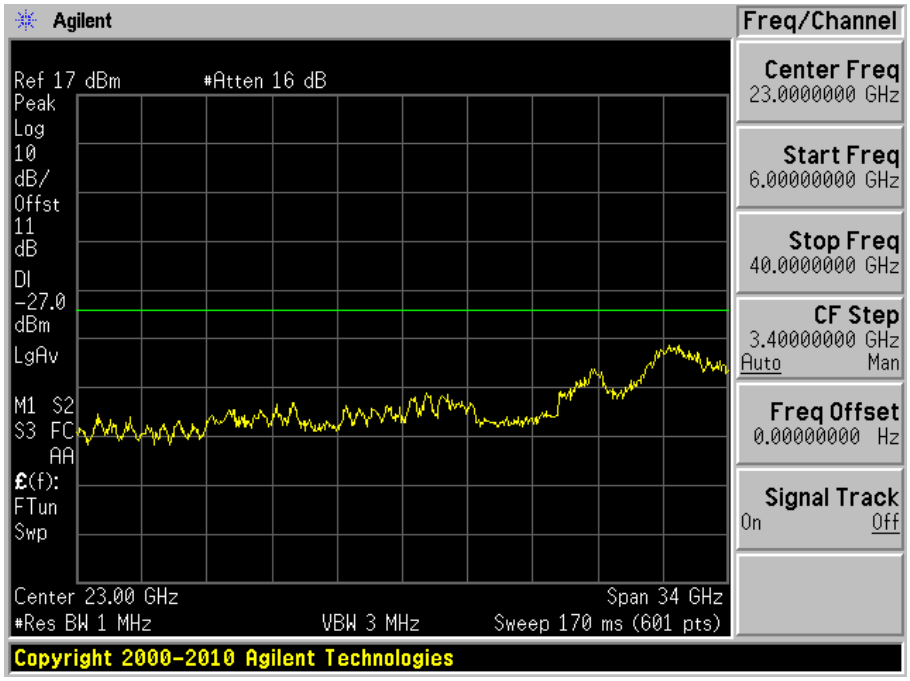
HT20 Mode 5500 MHz Low Channel Spurious Emission_2



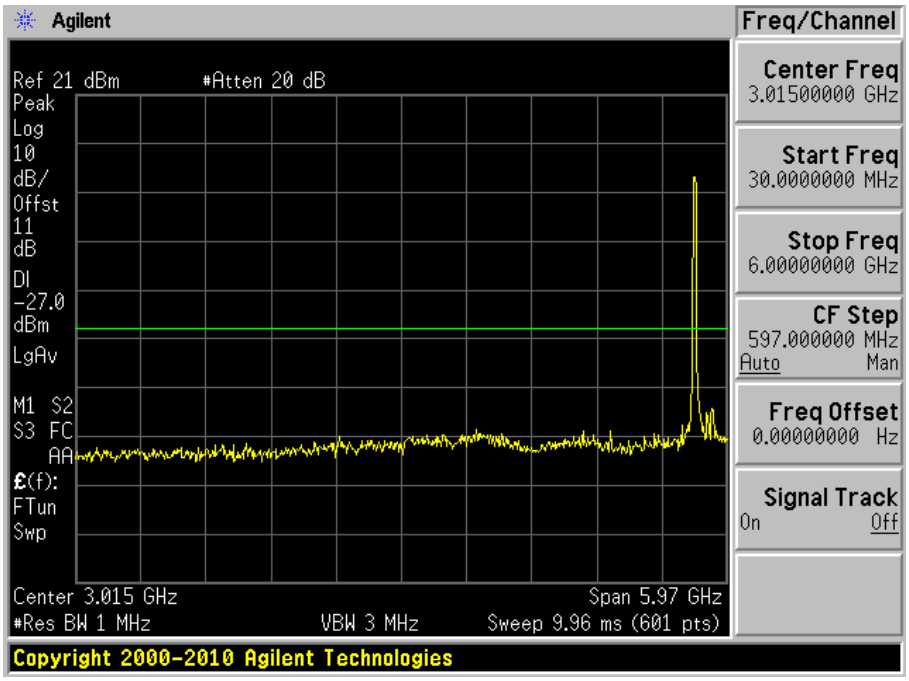
HT20 Mode 5580 MHz Mid Channel Spurious Emission_1



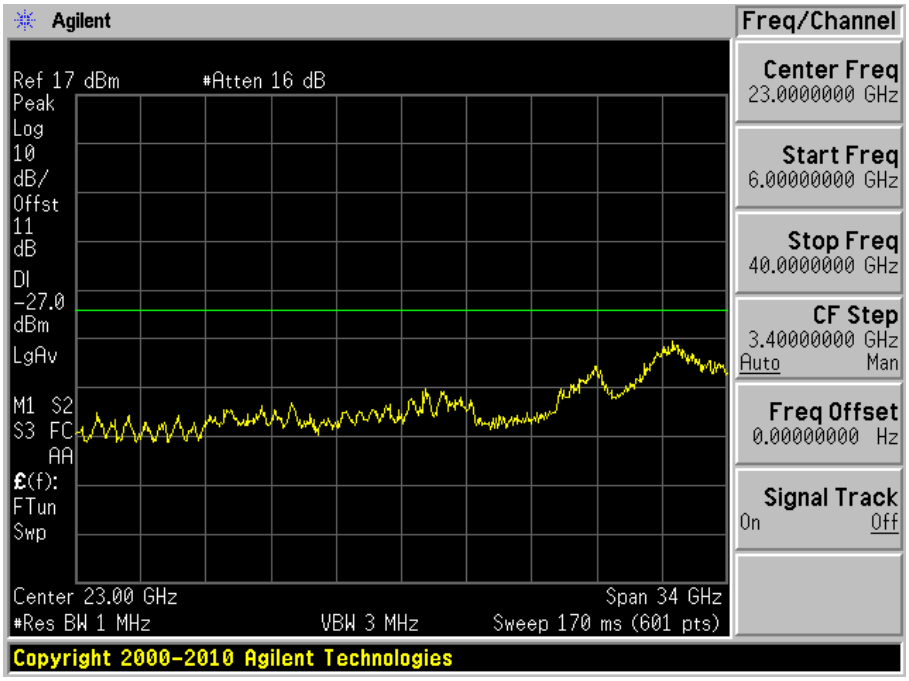
HT20 Mode 5580 MHz Mid Channel Spurious Emission_2



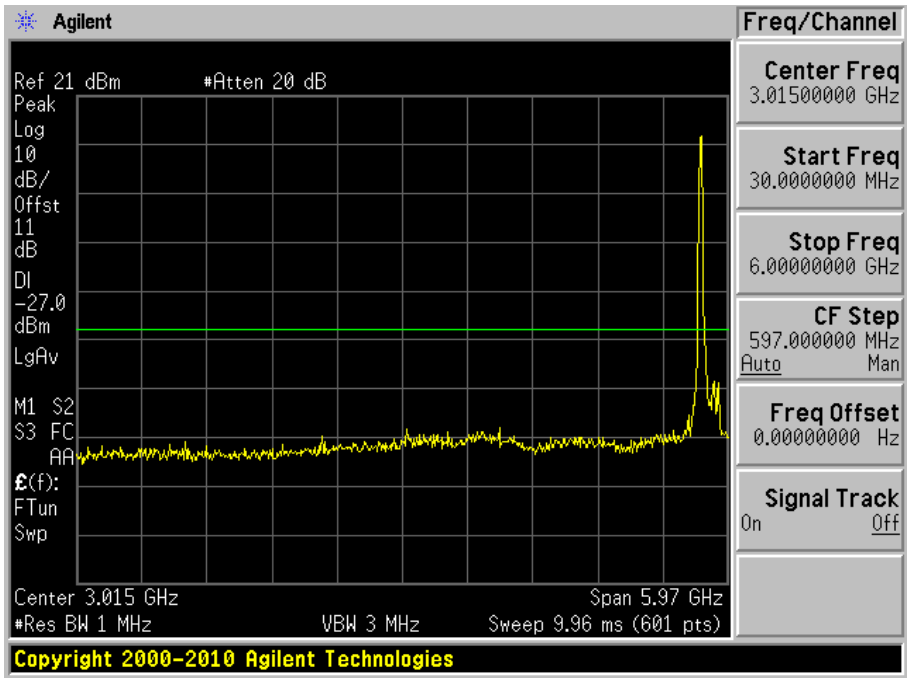
HT20 Mode 5700 MHz High Channel Spurious Emission_1



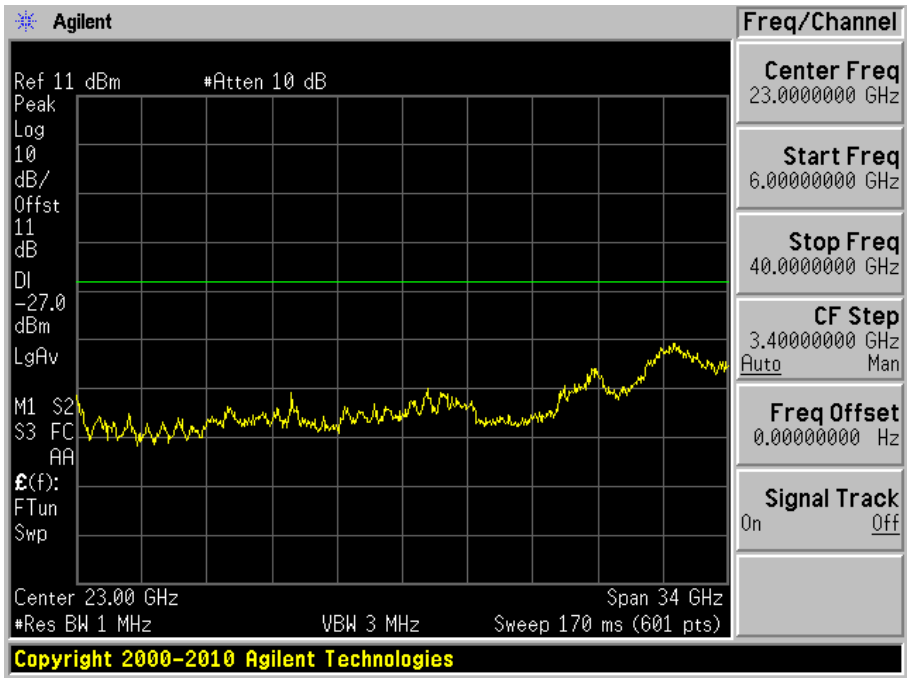
HT20 Mode 5700 MHz High Channel Spurious Emission_2



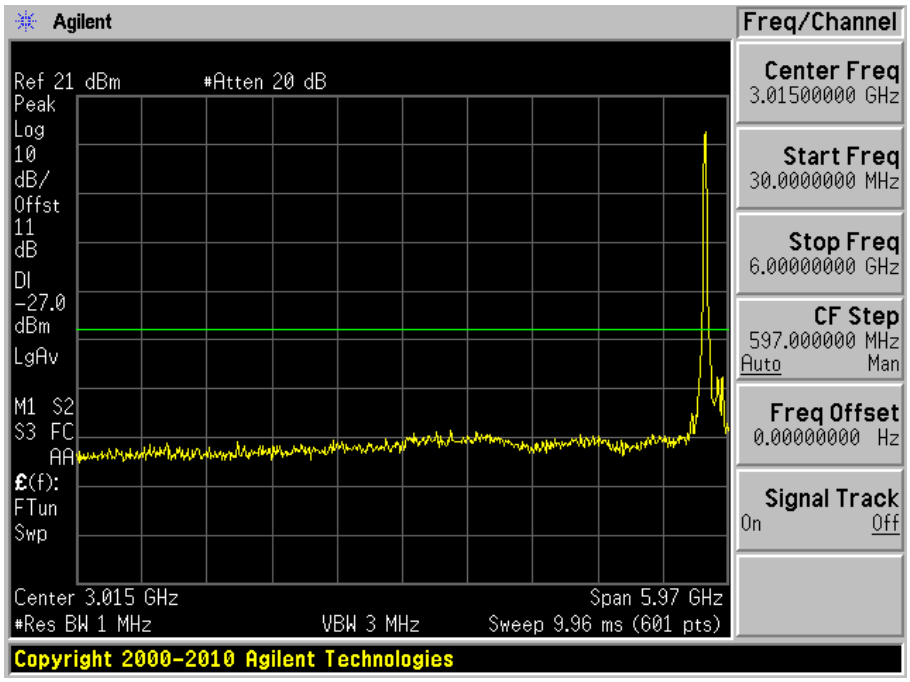
a Mode 5745 MHz Low Channel Spurious Emission_1



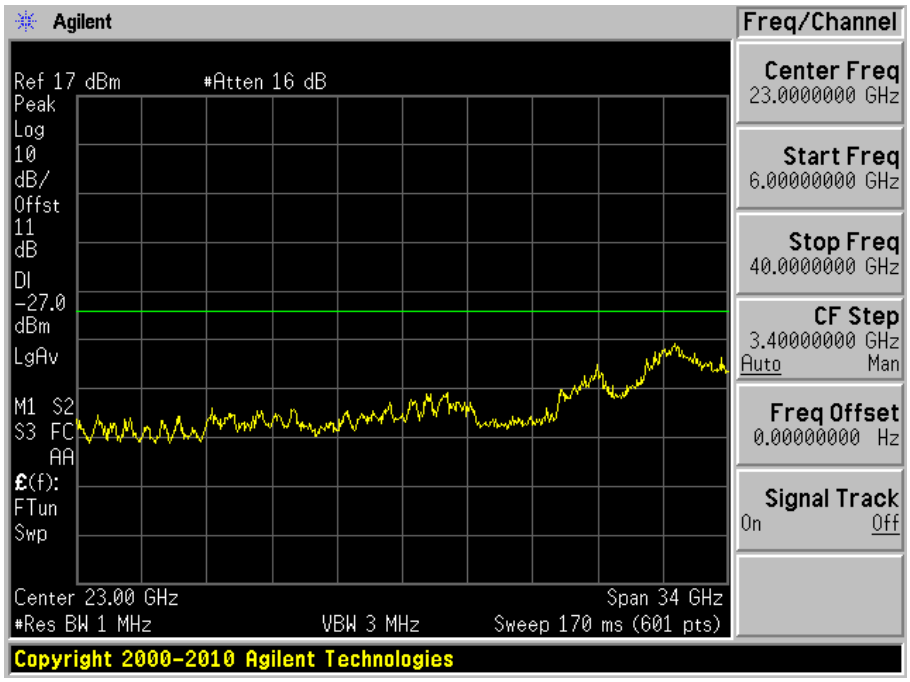
a Mode 5745 MHz Low Channel Spurious Emission_2



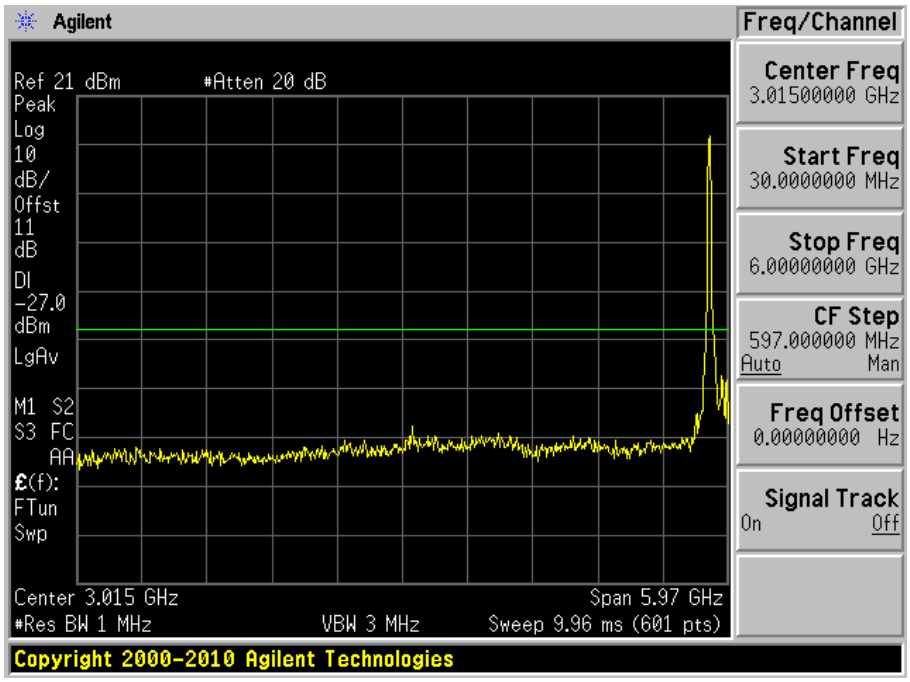
a Mode 5785 MHz Mid Channel Spurious Emission_1



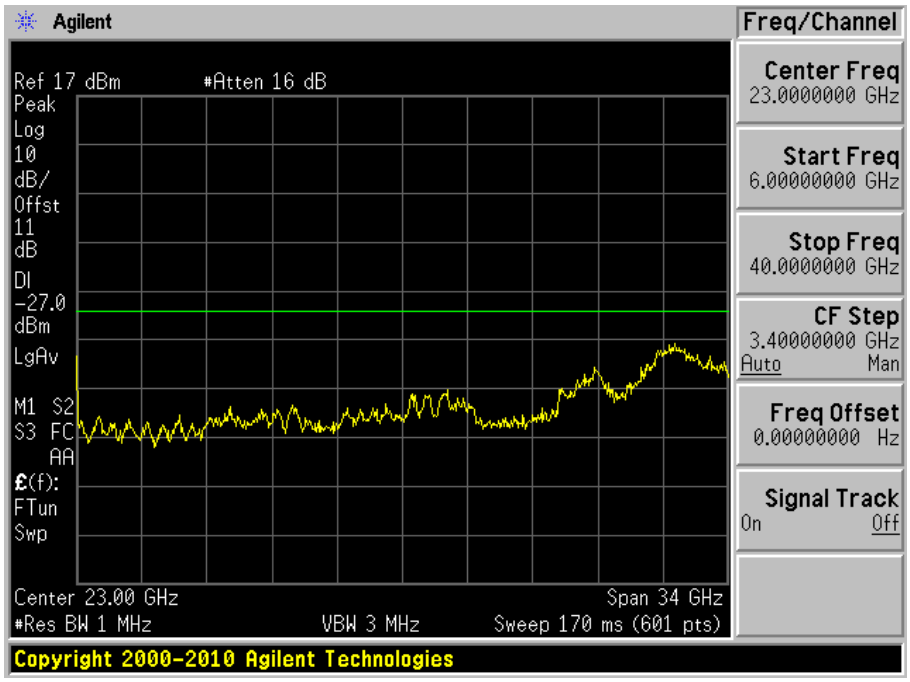
a Mode 5785 MHz Mid Channel Spurious Emission_2



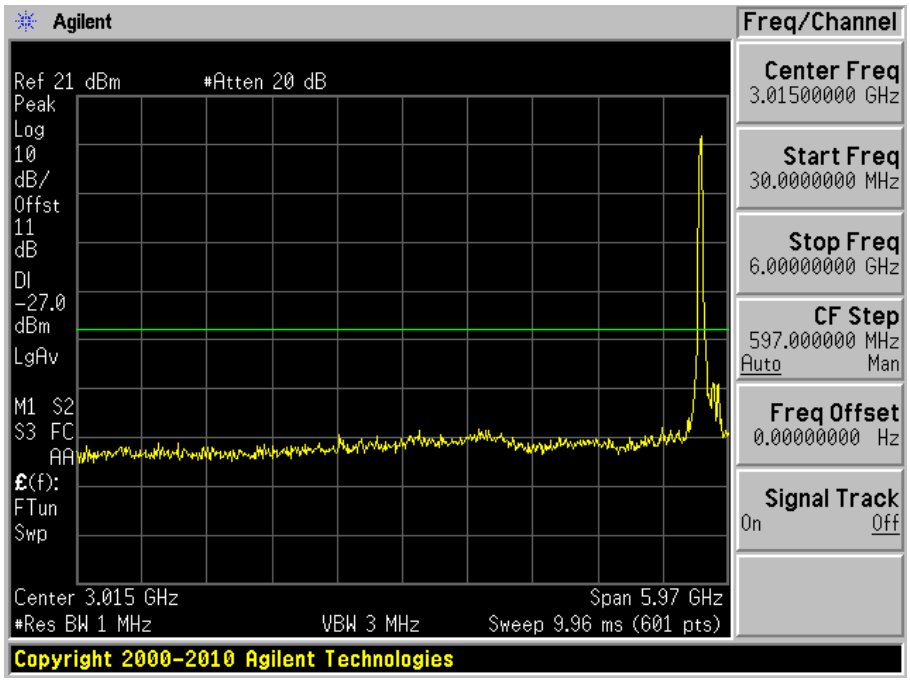
a Mode 5825 MHz High Channel Spurious Emission_1



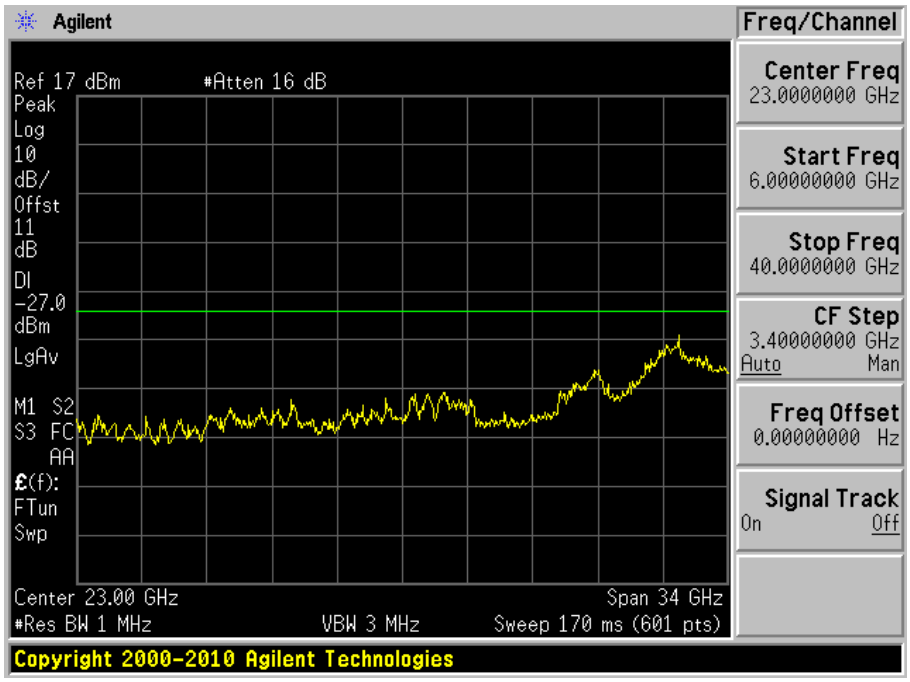
a Mode 5825 MHz High Channel Spurious Emission_2



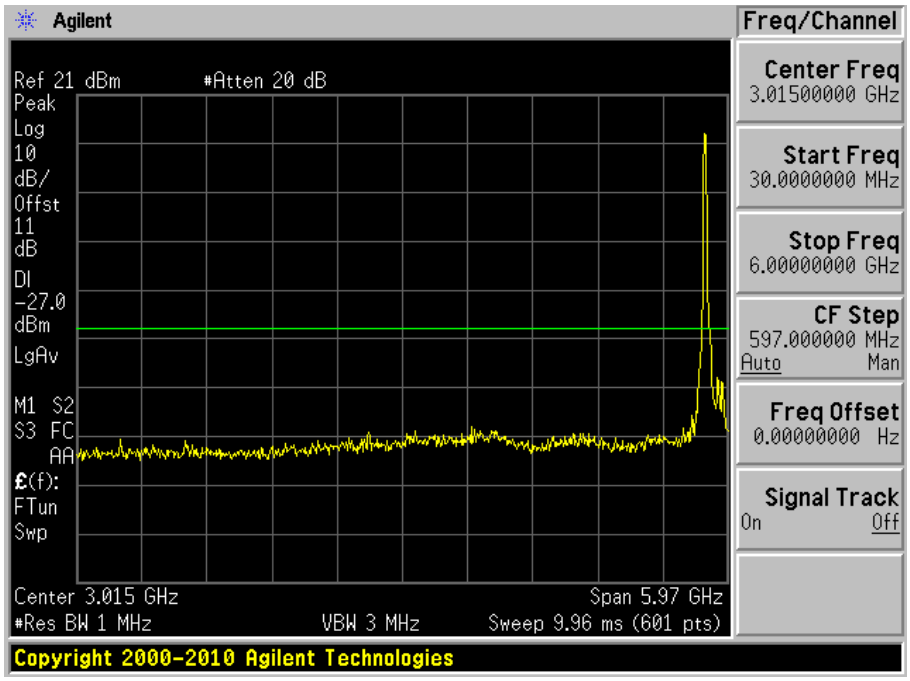
HT20 Mode 5745 MHz Low Channel Spurious Emission_1



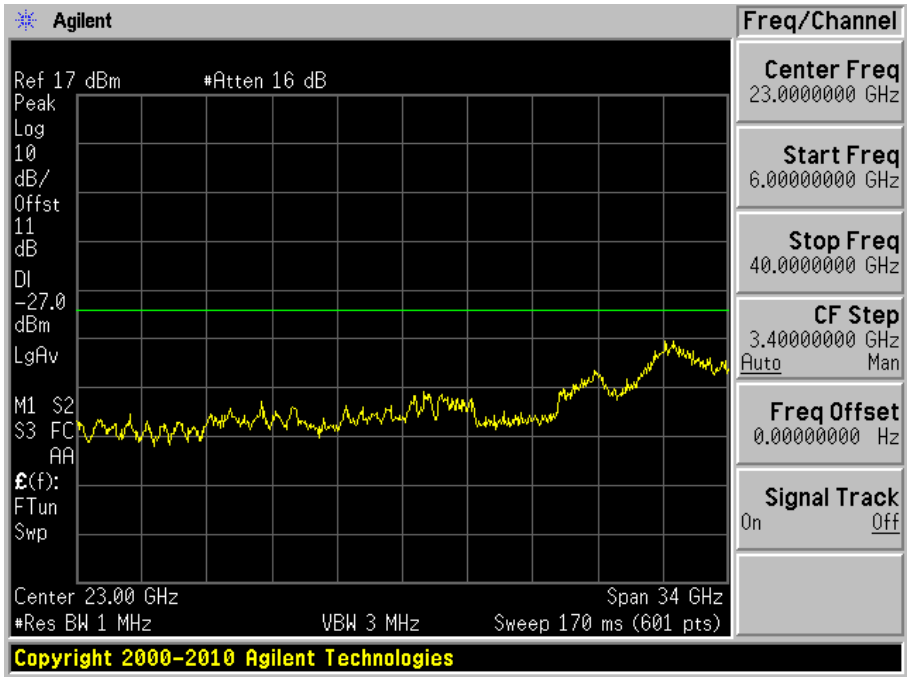
HT20 Mode 5745 MHz Low Channel Spurious Emission_2



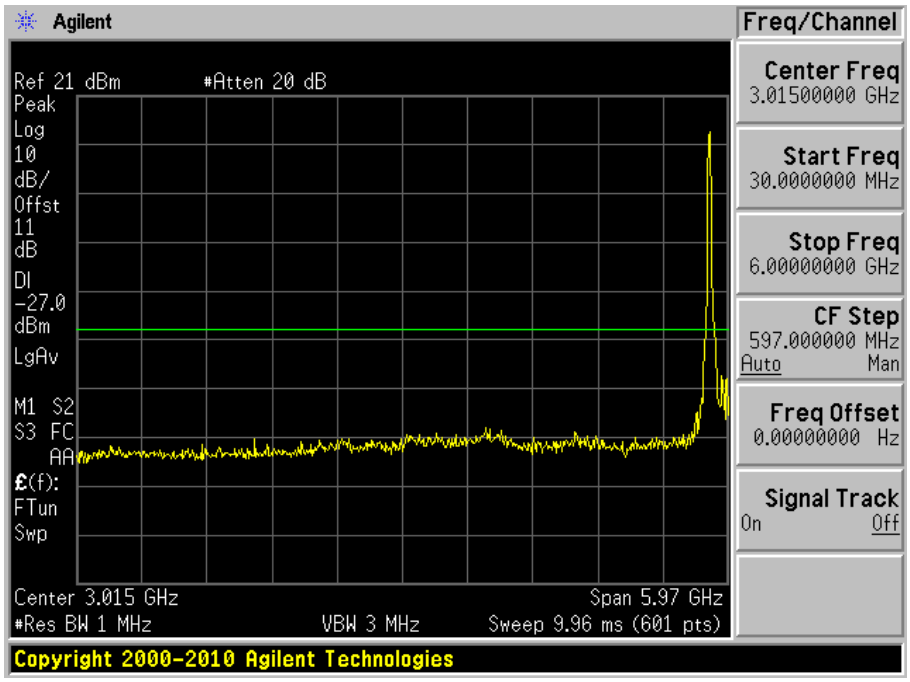
HT20 Mode 5785 MHz Mid Channel Spurious Emission_1



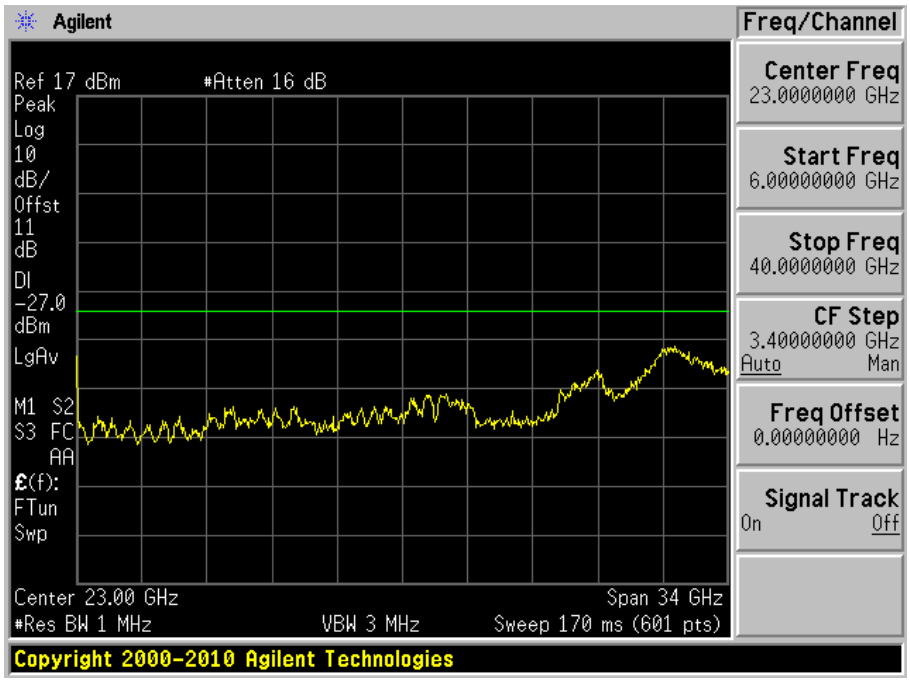
HT20 Mode 5785 MHz Mid Channel Spurious Emission_2



HT20 Mode 5825 MHz High Channel Spurious Emission_1



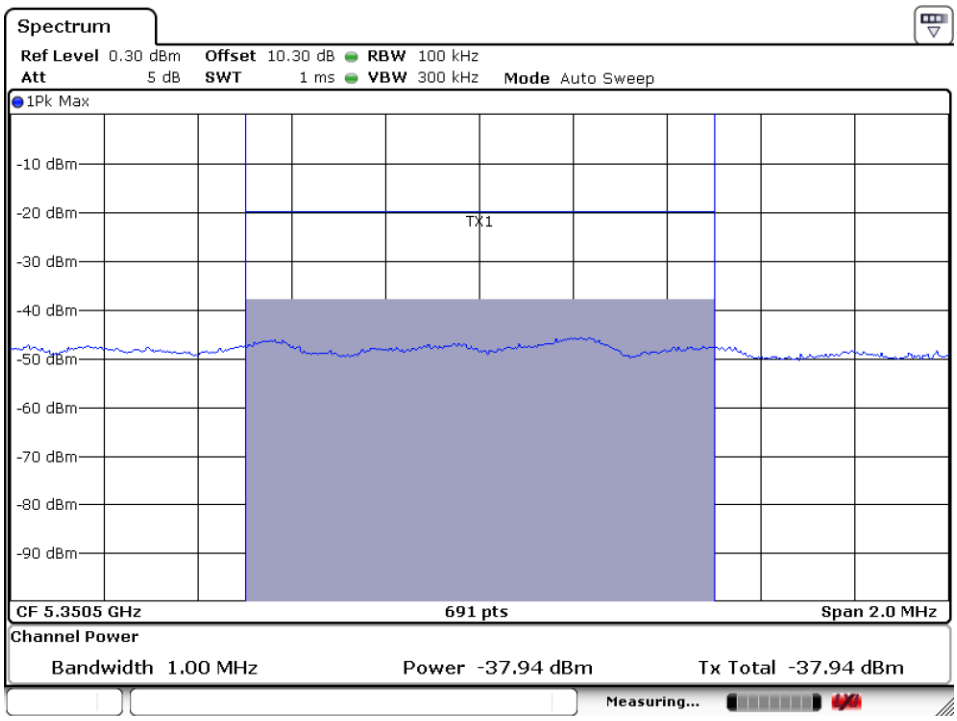
HT20 Mode 5825 MHz High Channel Spurious Emission_2



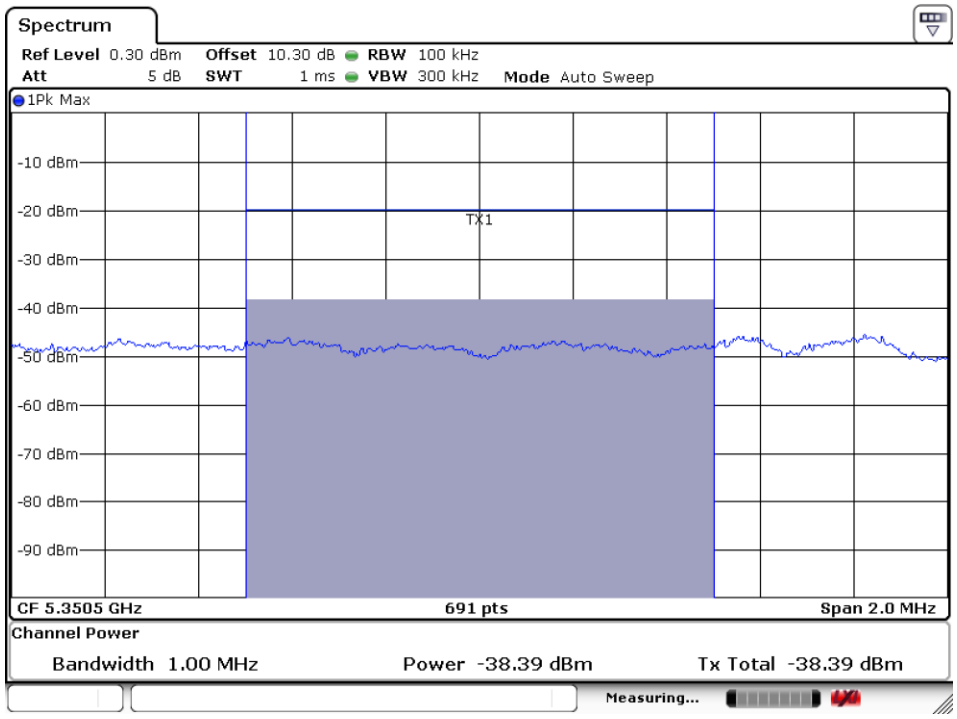
Note: Emission above limit line is fundamental

Bandedge:

a Mode 5320 MHz High Channel Bandedge



HT20 Mode 5320 MHz High Channel Bandedge



Note: Antenna Gain is considered into offset.
Note: Bandedges for 5.2, 5.6 and 5.8 bands are covered in section 5.9.

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

10.1 Applicable Standards

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

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

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

Table 2: Applicability of DFS requirements during normal operation

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

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

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

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

Table 4: DFS Response Requirement Values

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

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

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

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

Table 5: Short Pulse Radar Test Waveforms

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

Table 6: Long Pulse Radar Test Signal

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

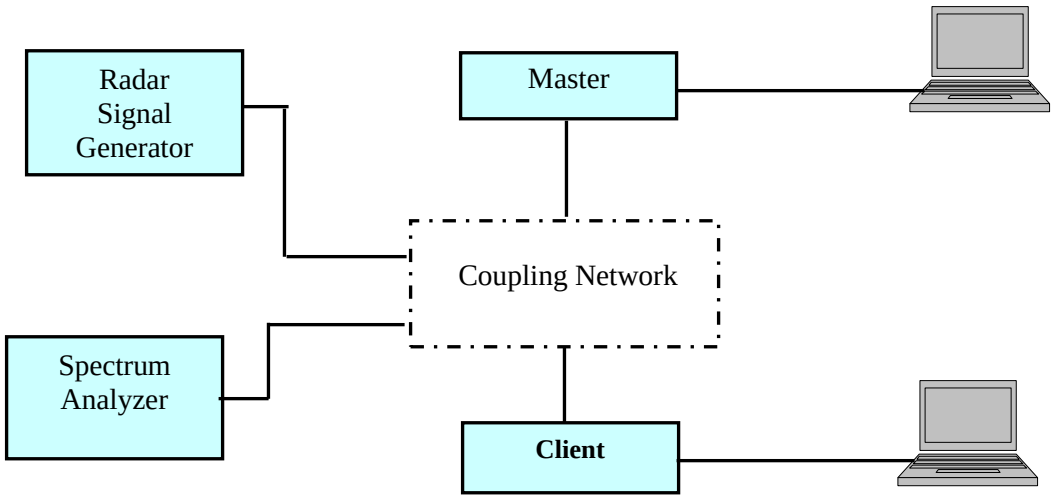
Table 7: Frequency Hopping Radar Test Signal

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

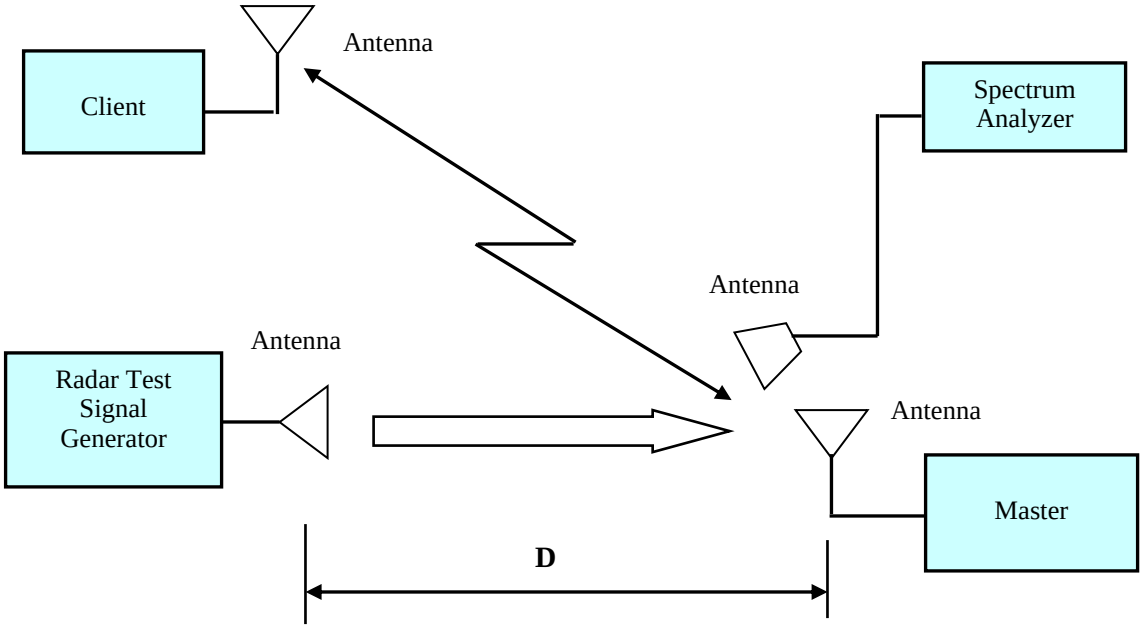
10.2 DFS Measurement System

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

10.3 System Block Diagram



10.4 Radiated Method



10.5 Test Procedure

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

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

The aggregate channel closing transmission time is calculated as follows:

Aggregate Transmission Time = N * Dwell Time

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

10.6 Test Equipment List and Details

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

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

10.7 Test Environmental Conditions

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

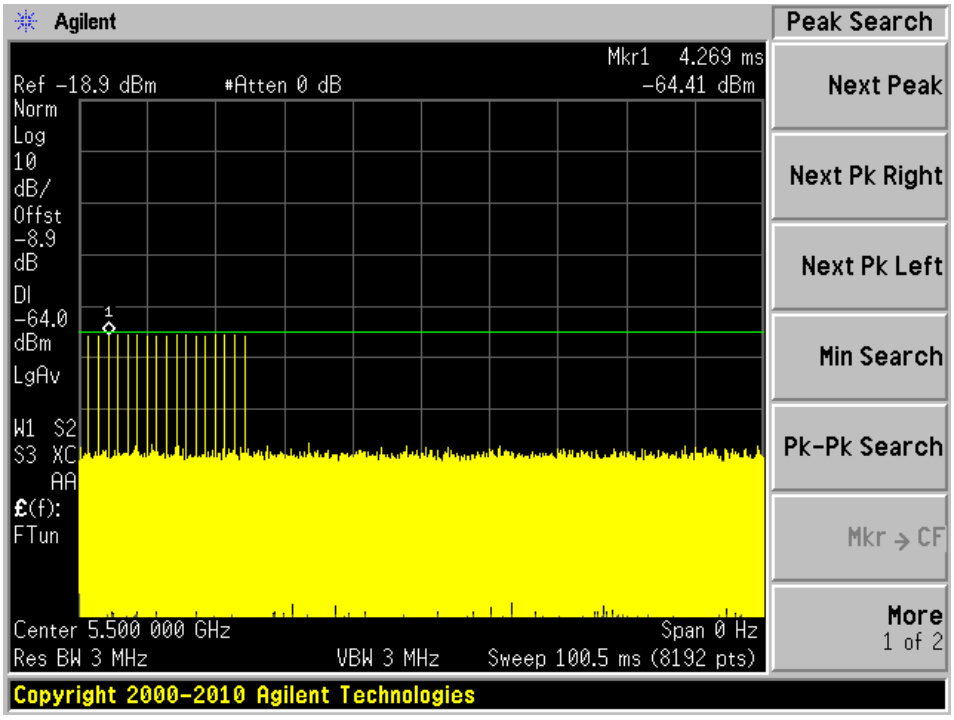
Testing was performed by Simon Ma on 2021-05-03 at the DFS testing site.

10.8 Test Results

Plots of Radar Waveforms

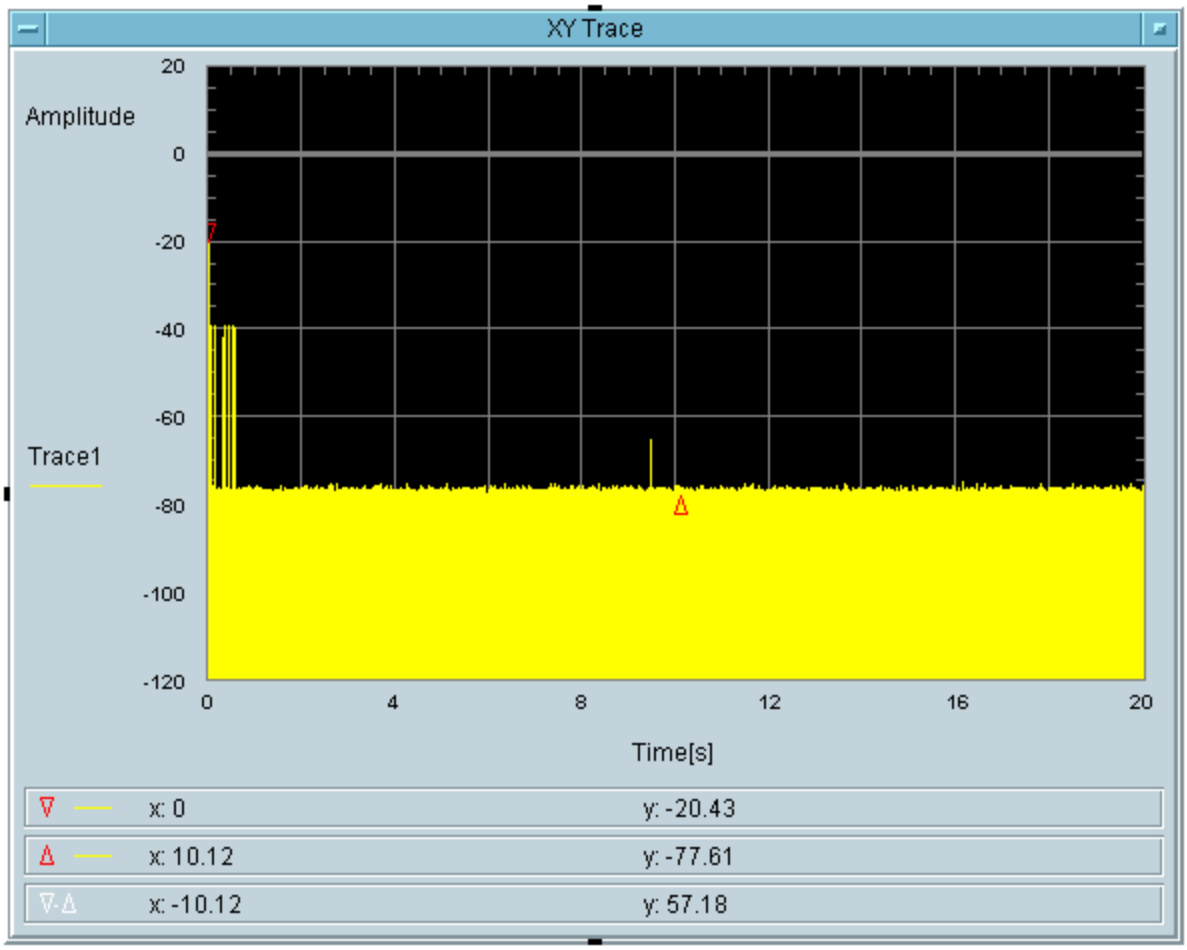
Radar Type 0

5500 MHz



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

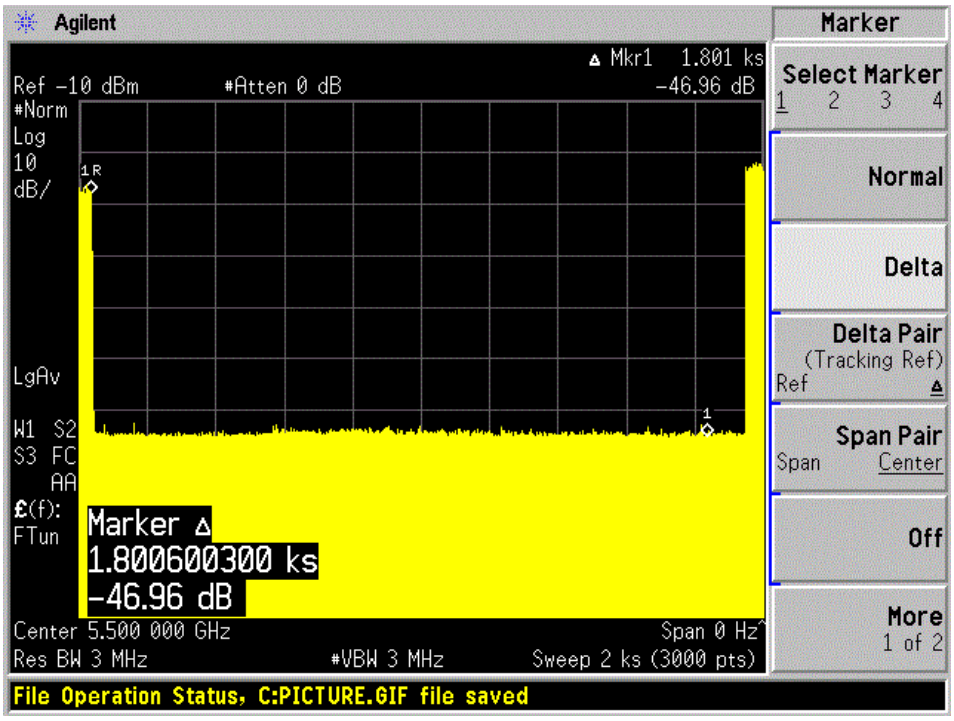
Type 0 radar channel move time less than 10s result:



Type 0 radar channel closing transmission time result:

Channel closing transmitting time (ms)	Limit (ms)	Result
80	200	Pass

Non-occupancy Time



11 Annex A (Normative) – EUT Test Setup Photographs

Please refer to the attachment.

12 Annex B (Normative) – EUT External Photographs

Please refer to the attachment.

13 Annex C (Normative) – EUT Internal Photographs

Please refer to the attachment.

14 Annex D (Informative) –Declaration of Similarity

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

DECLARATION OF SIMILARITY

April 25, 2022

To:

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

Innovation, Science and Economic Development Canada
Certification and Engineering Bureau
P.O. Box 11490, Station 'H' 3701 Carling Ave.,
Building 94 Ottawa, Ontario K2H 8S2 Canada

Dear Sir or Madam:

We, *Roku, Inc.*, hereby declare that product: Roku WiFi Remote Control, model: ***RC-GZ5*** is electrically identical to model: ***RC-GZ1*** *(FCC ID: TC2-R1047; IC ID: 5959A-R1043)* as tested by BACL, the results of which are featured in BACL project: *R2204071.*

The only difference between the models are minor external cosmetic appearances which does not affect any Electromagnetic Compatibility or RF characteristics of the device.

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

Best Regards,

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

15 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 ---