





FCC PART 15.407  
**TEST AND MEASUREMENT REPORT**

For

**Ubiquiti Networks, Inc.**

2580 Orchard Parkway,  
 San Jose, CA 95131, USA

**FCC ID: SWX-R5MU**

<b>Report Type:</b> CIIPC	<b>Product Type:</b> Outdoor Fixed Wireless Access
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<p><b>Report Number:</b> <u>R1506114-407 W52</u></p>	
<p><b>Report Date:</b> <u>2015-10-06</u></p>	
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 \* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "\*" ...

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### DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1506114-407 W52	Initial	2015-10-06

## 1 General Description

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### 1.1 Product Description for Equipment under Test (EUT)

This test and measurement report has been compiled on behalf of *Ubiquiti Networks, Inc.* And their product, *FCC ID: SWX-R5MU*, model number: *R5MU*, which henceforth is referred to as the EUT (Equipment Under Test.) The EUT is an Outdoor fixed wireless access point.

### 1.2 Mechanical Description of EUT

The EUT measures approximately 162 mm (L) x 84 mm (W) x 36 mm (H), weight is 0.5 lb.

*The data gathered are from a typical production sample provided by the manufacturer with serial number: R1506114-01, assigned by BACL.*

### 1.3 Objective

This report is prepared on behalf of *Ubiquiti Networks, Inc.* in accordance with FCC CFR47 §15.407.

The objective is to determine compliance with FCC Part 15.407 for Output Power, Antenna Requirements, AC Line Conducted Emissions, Bandwidth, and power spectral density, Band Edges Measurement, Spurious Emissions, Conducted and Radiated Spurious Emissions.

### 1.4 Related Submittal(s)/Grant(s)

N/A

### 1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices, and FCC KDB 789033 D02.

### 1.6 Measurement Uncertainty

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

Based on CISPR16-4-2:2011, The Treatment of Uncertainty in EMC Measurements, the values ranging from  $\pm 2.0$  dB for Conducted Emissions tests and  $\pm 4.0$  dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

## 1.7 Test Facility

Bay area compliance Laboratories Corp. (BACL) is:

1- An independent Commercial Test Laboratory accredited to **ISO 17025: 2005** by **A2LA**, in the fields of: Electromagnetic Compatibility & Telecommunications covering Emissions, Immunity, Radio, RF Exposure, Safety and Telecom. This includes NEBS (Network Equipment Building System), Wireless RF, Telecommunications Terminal Equipment (TTE); Network Equipment; Information Technology Equipment (ITE); Medical Electrical Equipment; Industrial, Commercial, and Medical Test Equipment; Professional Audio and Video Equipment; Electronic (Digital) Products; Industrial and Scientific Instruments; Cabled Distribution Systems and Energy Efficiency Lighting.

2- An ENERGY STAR Recognized Laboratory, for the LM80 Testing, a wide variety of Luminaires and Computers.

3- A NIST Designated Phase-I and Phase-II CAB including: ACMA (Australian Communication and Media Authority), BSMI (Bureau of Standards, Metrology and Inspection of Taiwan), IDA (Infocomm Development Authority of Singapore), IC(Industry Canada), Korea ( Ministry of Communications Radio Research Laboratory), NCC (Formerly DGT; Directorate General of Telecommunication of Chinese Taipei) OFTA (Office of the Telecommunications Authority of Hong Kong), Vietnam, VCCI - Voluntary Control Council for Interference of Japan and a designated EU CAB (Conformity Assessment Body) (Notified Body) for the EMC and R&TTE Directives.

4- A Product Certification Body accredited to **ISO Guide 65: 1996** by **A2LA** to certify:

2. Radio Standards Specifications (RSS) in the Category I Equipment Standards List and All Broadcasting Technical Standards (BETS) in Category I Equipment Standards List for Industry Canada.

3. Radio Communication Equipment for Singapore.

4. Radio Equipment Specifications, GMDSS Marine Radio Equipment Specifications, and Fixed Network Equipment Specifications for Hong Kong.

5. Japan MIC Telecommunication Business Law (A1, A2) and Radio Law (B1, B2 and B3).

6. Audio/Video, Battery Charging Systems, Computers, Displays, Enterprise Servers, Imaging Equipment, Set-Top Boxes, Telephony, Televisions, Ceiling Fans, CFLs (Including GU24s), Decorative Light Strings, Integral LED Lamps, Luminaires, Residential Ventilating Fans.

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997, and Article 8 of the VCCI regulations on December 25, 1997. The test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz as well as ANSI C63.4-2014, ANSI C63.4-2014, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: A-0027. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL Corp. is an American Association for Laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at

<http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b367816b>

## 2 EUT Test Configuration

### 2.1 Justification

The EUT was configured for testing according to ANSI C63.10-2013 and KDB-789033 D02 General UNII Test Procedures New Rules v01

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 to be as follows for each mode based upon investigation by measuring the average power, peak power and PPSD across all data rates bandwidths, and modulations.

The Channel list for different bandwidth listed below

Channel Bandwidth (MHz)	Low CH (MHz)	Middle CH (MHz)	High CH (MHz)
10	5160	5200	5245
20	5165	5200	5240
30	5170	5200	5235
40	5175	5200	5230

The power setting used for this unit was listed below

Power Setting	Covered Antenna
1	Omni, Sector
2	Dish

### 2.2 EUT Exercise Software

The test software used was ART, it was been verified by Bo Li.

### 2.3 Special Equipment

N/A

### 2.4 Equipment Modifications

No modifications were made to the EUT.

## 2.5 Local Support Equipment

Manufacturer	Description	Model No.	Serial No.
DELL	Laptop	Latitude E6530	-

## 2.6 EUT Internal Configuration Details

Manufacturer	Description	Model
Ubiquiti Networks	PCB	Rocket5

## 2.7 Interface Ports and Cables

Cable Description	Length (m)	To	From
RF Cable	< 1 m	PSA	EUT
Ethernet cable	> 1 m	POE	Laptop
Ethernet cable	> 1 m	POE	EUT

## 2.8 Power Supply List and Details

Manufacturer	Description	Model	Serial Number
Ubiquiti Networks	POE	GP-A240-050G	1441-002419



### 3 Summary of Test Results

FCC Rules	Description of Test	Result
§15.407(f), §2.1091	RF Exposure	Compliant
§15.203	Antenna Requirement	Compliant
§15.207	AC Power Line Conducted Emissions	Compliant
§15.209(a), 15.407(b)	Spurious Radiated Emissions	Compliant
§15.407(a)	Emission Bandwidth	Compliant
§15.407(a)	Peak Output Power Measurement	Compliant
§15.407(a)	Power Spectral Density	Compliant
§2.1051, §15.407(b)	Band Edge	Compliant
§15.407(h)	Dynamic Frequency Selection (DFS)	N/A

## 4 FCC §2.1091 & §15.407(f) - RF Exposure

### 4.1 Applicable Standard

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

#### Limits for General Population/Uncontrolled Exposure

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

f = frequency in MHz

\* = Plane-wave equivalent power density

### 4.2 MPE Prediction

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

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

Where: S = power density

P = power input to antenna

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna

### 4.3 MPE Results

#### Power Setting 1 – for Omni and Sector Antenna

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>12.87</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>19.36</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>5230</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>13.2</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>20.89</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm<sup>2</sup>):</u>	<u>0.081</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u>	<u>1.0</u>

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.081 mW/cm<sup>2</sup>. Limit is 1.0 mW/cm<sup>2</sup>.

#### Power Setting 2 – for Dish Antenna

<u>Maximum peak output power at antenna input terminal (dBm):</u>	<u>0.41</u>
<u>Maximum peak output power at antenna input terminal (mW):</u>	<u>1.099</u>
<u>Prediction distance (cm):</u>	<u>20</u>
<u>Prediction frequency (MHz):</u>	<u>5235</u>
<u>Maximum Antenna Gain, typical (dBi):</u>	<u>26.6</u>
<u>Maximum Antenna Gain (numeric):</u>	<u>457.089</u>
<u>Power density of prediction frequency at 20.0 cm (mW/cm<sup>2</sup>):</u>	<u>0.10</u>
<u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm<sup>2</sup>):</u>	<u>1.0</u>

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.10 mW/cm<sup>2</sup>. Limit is 1.0 mW/cm<sup>2</sup>.

## 5 FCC §15.203 - Antenna Requirements

### 5.1 Applicable Standard

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.

### 5.2 Antenna Description

Antenna Type	Maximum Antenna Gain (dBi) in 5 GHz Bands	Antenna Gain (dBi) @ 5.2 GHz Band
Dish	31	26.6
Sector	16	13.2
Omni-directional	13	13

Note 1: For those three antennas, the manufacture will use two powers setting to cover all three antennas. One power setting for dish antenna, one power setting for sector and omnidirectional.

Note 2: For Sector antenna, the Peak Gain for 5 GHz bands is 16 dBi, the effective gain for W52 is 13.2 dBi, for W58 is 13.8 dBi, so the limit calculation was based on the effective gain.

Note 3: For Dish antenna, the Peak Gain for 5 GHz bands is 31 dBi, the effective gain for W52 is 26.6 dBi, for W58 is 29.5 dBi, so the limit calculation was based on the effective gain.

The products are not marketed or sold to end users. This product requires a trained professional and is installed outdoors as part of the network infrastructure of the wireless service provider.

## 6 FCC §15.207 - AC Power Line Conducted Emissions

### 6.1 Applicable Standards

As per FCC §15.207 Conducted limits:

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

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 Note 1	56 to 46 Note 1
0.5-5	56	46
5-30	60	50

*Note 1 Decreases with the logarithm of the frequency.*

### 6.2 Test Setup

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

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

The AC/DC power adapter of the EUT was connected with LISN-1 which provided 120 V / 60 Hz AC power.

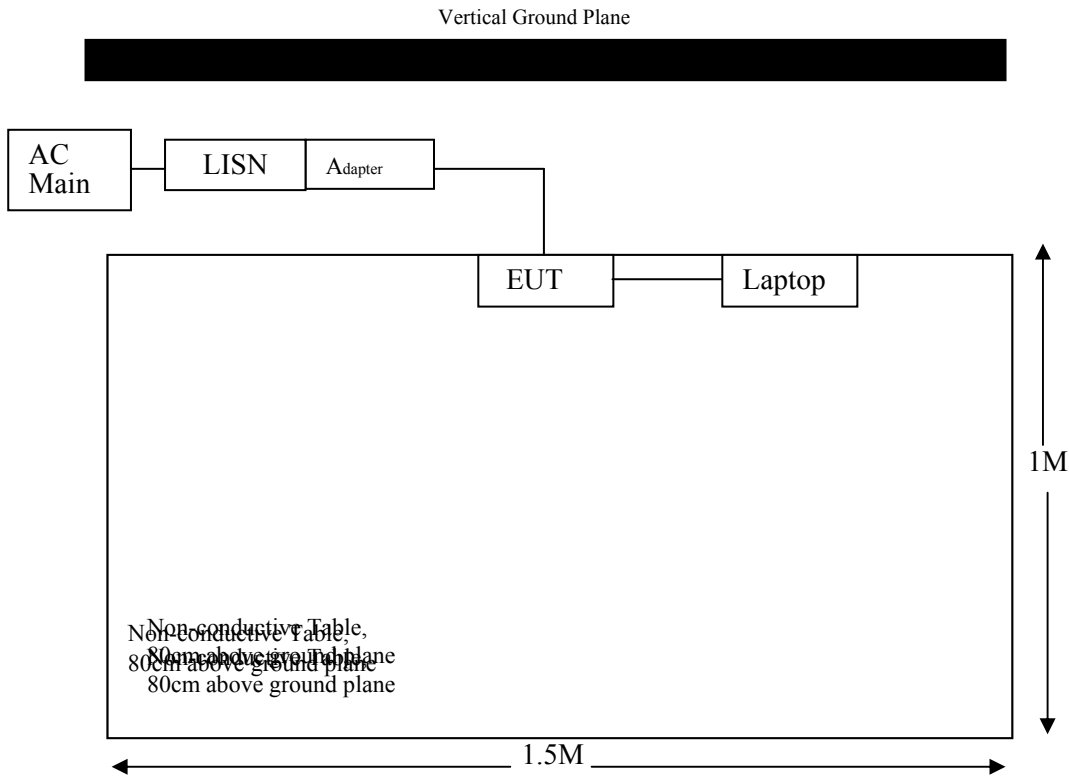
### 6.3 Test Procedure

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

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

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

## 6.4 Test Setup Block Diagram



## 6.5 Corrected Amplitude & Margin Calculation

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

$$CA = Ai + CL + Atten$$

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

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

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

## 6.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2014-09-28	1 year
Solar Electronics	LISN	9252-50-R-24-N	511205	2015-06-25	1 year
TTE	Filter, High Pass	H962-150k-50-21378	K7133	2015-01-30	1 year
Suirong	30 ft conductive emission cable	LMR 400	-	Each time	N/A
Hewlett-Packard	5 ft N-type RF cable	-	1268	Each time	N/A

*Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.*

## 6.7 Test Environmental Conditions

<b>Temperature:</b>	22 °C
<b>Relative Humidity:</b>	47 %
<b>ATM Pressure:</b>	103.24 kPa

*The testing was performed by Jin Yang on 2015-07-18 in 5m chamber3.*

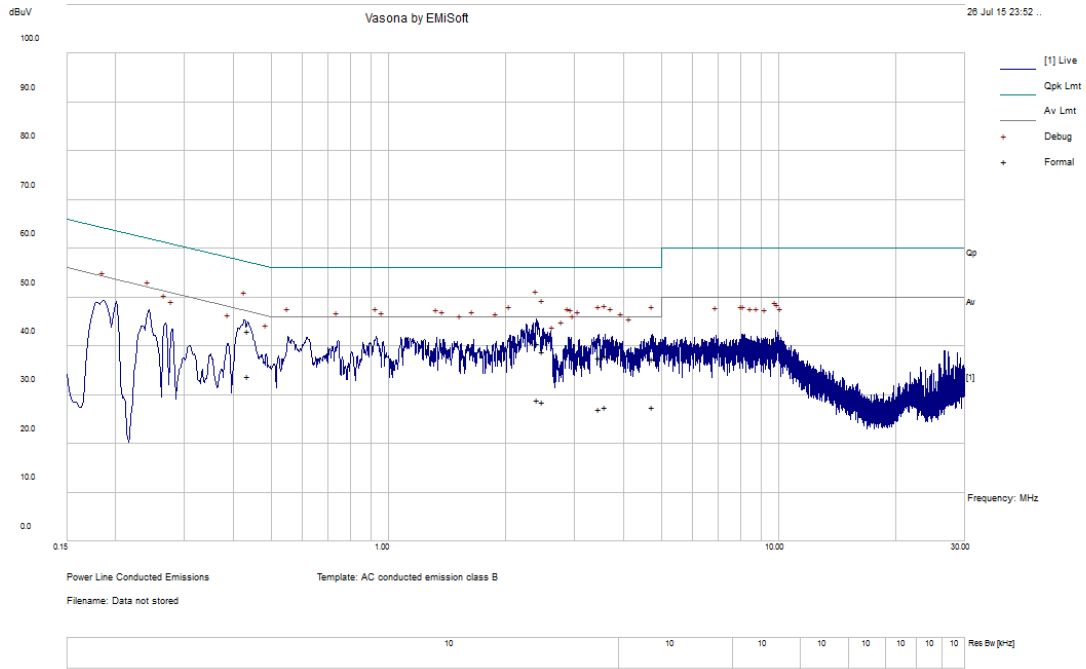
## 6.8 Summary of Test Results

According to the recorded data in following table, the EUT complied with the FCC 15.207 standard's conducted emissions limits, with the margin reading of:

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	Frequency (MHz)	Conductor Mode (Line/Neutral)	Range (MHz)
-13.22	0.435556	Line	0.15-30

### 6.9 Conducted Emissions Test Plots and Data

#### 120 V, 60 Hz – Line

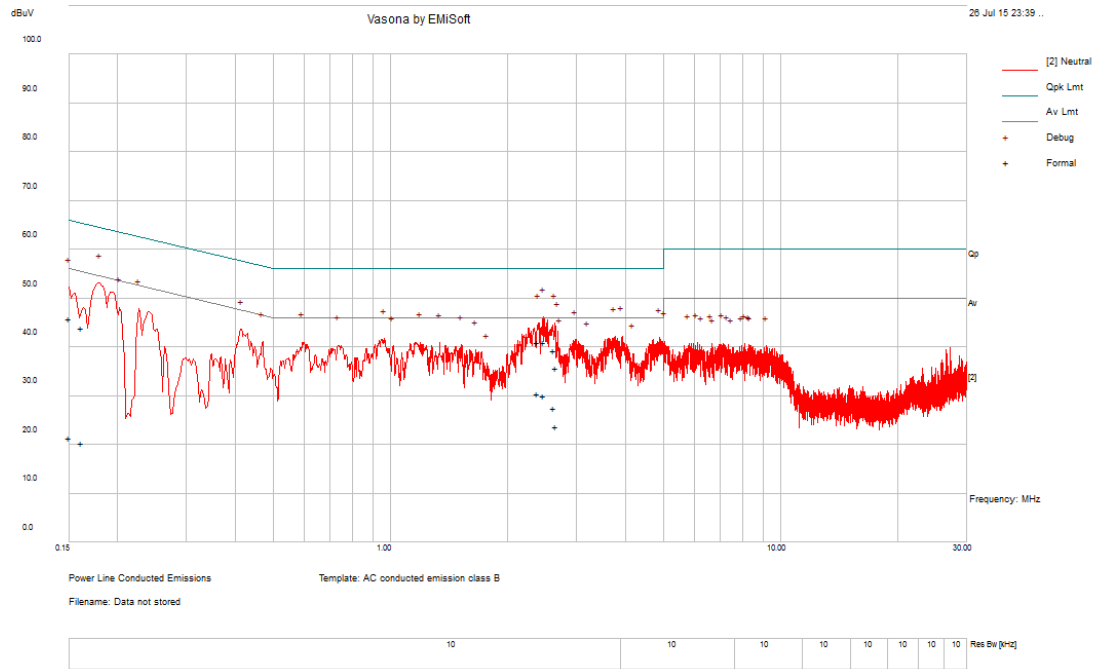


Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
2.405866	40.69	Live	56	-15.31	QP
0.435556	43.28	Live	57.15	-13.87	QP
2.484351	38.92	Live	56	-17.08	QP
3.592723	38.07	Live	56	-17.93	QP
3.471762	37.78	Live	56	-18.22	QP
4.765772	37.54	Live	56	-18.46	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
2.405866	29.07	Live	46	-16.93	Ave.
0.435556	33.93	Live	47.15	-13.22	Ave.
2.484351	28.59	Live	46	-17.41	Ave.
3.592723	27.54	Live	46	-18.46	Ave.
3.471762	27.15	Live	46	-18.85	Ave.
4.765772	27.64	Live	46	-18.36	Ave.



120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
2.474456	41.16	Neutral	56	-14.84	QP
2.620986	39.46	Neutral	56	-16.54	QP
2.382952	41.17	Neutral	56	-14.83	QP
0.161884	44.1	Neutral	65.37	-21.27	QP
2.66505	35.88	Neutral	56	-20.12	QP
0.150006	46.01	Neutral	66	-19.99	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
2.474456	30.05	Neutral	46	-15.95	Ave.
2.620986	27.57	Neutral	46	-18.43	Ave.
2.382952	30.51	Neutral	46	-15.49	Ave.
0.161884	20.51	Neutral	55.37	-34.85	Ave.
2.66505	23.71	Neutral	46	-22.29	Ave.
0.150006	21.42	Neutral	56	-34.58	Ave.

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

### 7.1 Applicable Standard

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

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 §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 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.

(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.

## 7.2 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 15E limits.

The spacing between the peripherals was 10 centimeters.

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

## 7.3 Test Procedure

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

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

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

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

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

Above 1000 MHz:

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

## 7.4 Corrected Amplitude & 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:

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

## 7.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2014-09-28	1 year
Agilent	Spectrum Analyzer	E4440A	MY44303352	2014-10-16	1 year
Sunol Science Corp	System Controller	SC99V	011003-1	N/R	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-3	2014-09-18	1 year
EMCO	Horn Antenna	3115	9511-4627	2014-10-17	1 year
Hewlett Packard	Pre-amplifier	8447D	2944A10187	2014-08-08	1 year
WiseWave	Horn Antenna	ARH-4223-02	10555-01	2014-08-09	3 Years
Suirong	30 ft conductive emission cable	LMR 400	-	Each time	N/A
-	SMA cable	-	C0002	Each time	N/A
IW Microwave	High Frequency Cable	DC-1438	SPS-2303-3840-SPS	2014-09-23	1 year
Hewlett-Packard	5 ft N-type RF cable	-	1268	Each time	N/A
Agilent	Pre-amplifier	8449B	3008A01978	Each time	N/A

**Statement of Traceability:** *BACL attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.*

## 7.6 Test Environmental Conditions

<b>Temperature:</b>	23 °C
<b>Relative Humidity:</b>	47 %
<b>ATM Pressure:</b>	103.7 kPa

The testing was performed by Jin Yang on 2015-07-22 to 2015-08-03 in 5m chamber3.

## 7.7 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Part 15.205, 15.209 and 15.407 standard's radiated emissions limits, and had the worst margin of:

### Power Setting 1

<b>Mode: Transmitting</b>			
<b>Margin (dB)</b>	<b>Frequency (MHz)</b>	<b>Polarization (Horizontal/Vertical)</b>	<b>Range</b>
-2.83	14080.99	Vertical	30 MHz to 40 GHz

### Power Setting 2

<b>Mode: Transmitting</b>			
<b>Margin (dB)</b>	<b>Frequency (MHz)</b>	<b>Polarization (Horizontal/Vertical)</b>	<b>Range</b>
-2.16	10471.67	Vertical	30 MHz to 40 GHz,

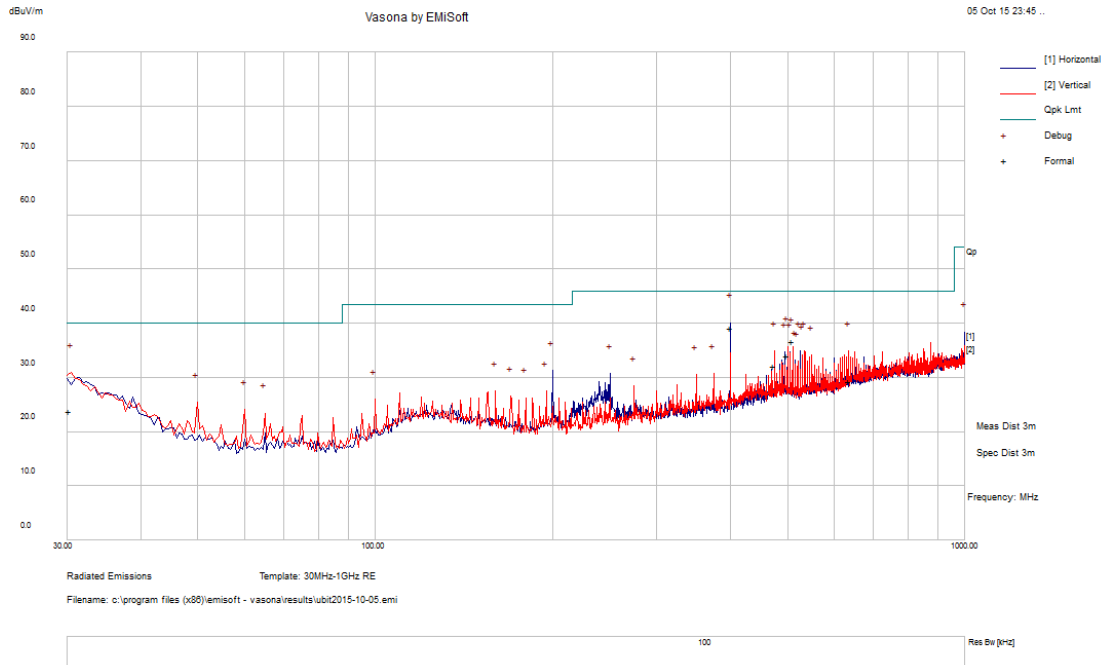
Please refer to the following table and plots for specific test result details

## 7.8 Radiated Emissions Test Result Data

### 1) 30 MHz – 1 GHz

#### Power Setting 1 – for Omni and Sector Antenna

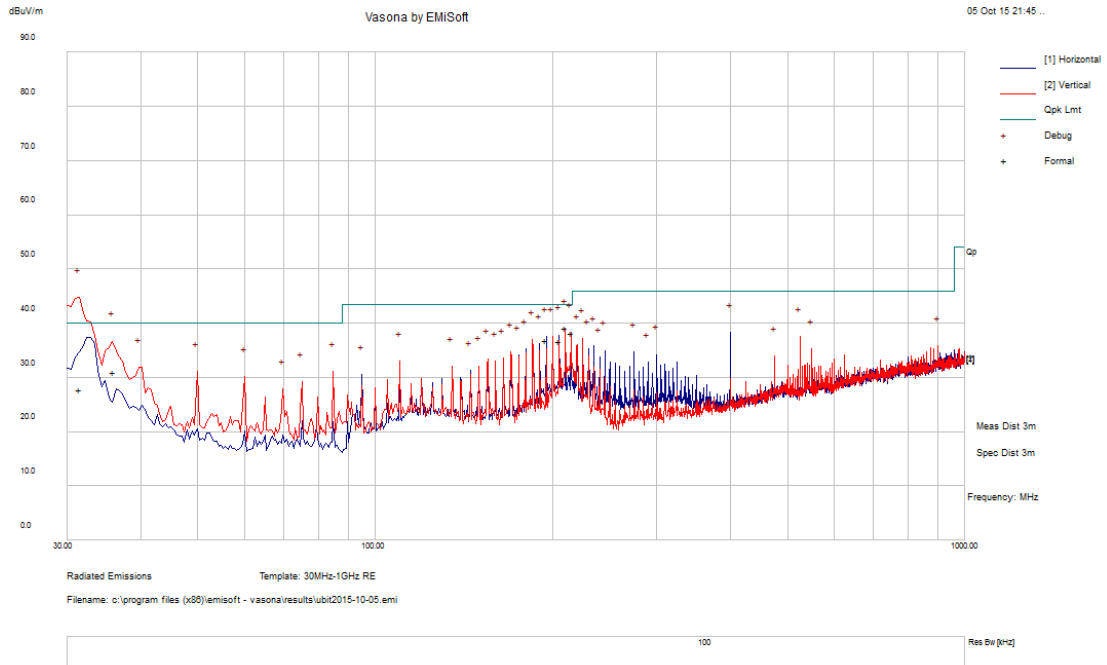
Worst case



Frequency (MHz)	Corrected Amplitude (dBμV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBμV/m)	Margin (dB)	Comments (PK/QP/Ave.)
399.9925	39.32	209	H	152	46	-6.68	QP
30.326	23.88	139	V	27	40	-16.12	QP
500.0165	34.1	184	H	279	46	-11.9	QP
510.0075	36.87	147	V	0	46	-9.13	QP
474.9915	32.14	148	V	0	46	-13.86	QP
635.0305	29.44	109	V	25	46	-16.56	QP

### Power Setting 2 – for Dish Antenna

Worst case



Frequency (MHz)	Corrected Amplitude (dBμV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBμV/m)	Margin (dB)	Comments (PK/QP/Ave.)
31.55625	27.84	111	V	161	40	-12.16	QP
36.03525	31.02	100	V	230	40	-8.98	QP
209.99425	39.16	101	V	352	43.5	-4.34	QP
214.993	38.31	103	V	0	43.5	-5.19	QP
205.01975	36.76	151	H	240	43.5	-6.74	QP
195.00325	36.91	177	H	264	43.5	-6.59	QP

## 2) 1-40 GHz

## Power Setting 1 – for Omni and Sector Antenna

10 MHz Bandwidth

Frequency (MHz)	Corrected Amplitude (dB $\mu$ V/m)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dB $\mu$ V/m)	Margin (dB)	Comments
Low Channel							
14730.28	62.01	V	232	0	68.23	-6.22	Peak
16959.9	61.16	H	298	168	68.23	-7.07	Peak
14730.28	51	V	232	0	54	-3	Ave.
16959.9	50.07	H	298	168	54	-3.93	Ave.
Middle Channel							
14420.35	59.54	V	170	7	68.23	-8.69	Peak
16999.41	59.03	H	105	90	68.23	-9.2	Peak
15278.28	56.15	H	271	211	68.23	-12.08	Peak
1448.103	35.47	H	283	56	74	-38.53	Peak
4918.888	48.04	H	159	330	74	-25.96	Peak
1290.688	34.24	H	285	299	68.23	-33.99	Peak
1180.548	35.06	H	105	315	74	-38.94	Peak
14420.35	49.77	V	170	7	54	-4.23	Ave.
16999.41	48.39	H	105	90	54	-5.61	Ave.
15278.28	45.66	H	271	211	54	-8.34	Ave.
1448.103	24.49	H	283	56	54	-29.51	Ave.
4918.888	37.42	H	159	330	54	-16.58	Ave.
1290.688	23.79	H	285	299	54	-30.21	Ave.
1180.548	24.38	H	105	315	54	-29.62	Ave.
High Channle							
14581.38	61.1	V	155	255	68.23	-7.13	Peak
17000.76	61.18	V	161	344	68.23	-7.05	Peak
14581.38	50.82	V	155	255	54	-3.18	Ave.
17000.76	50.44	V	161	344	54	-3.56	Ave.



## 20 MHz Bandwidth

Frequency (MHz)	Corrected Amplitude (dB $\mu$ V/m)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dB $\mu$ V/m)	Margin (dB)	Comments
Low Channel							
14450.4	60.91	H	296	83	68.23	-7.32	Peak
16999.49	60.99	V	160	199	68.23	-7.24	Peak
14450.4	51.02	H	296	83	54	-2.98	Ave.
16999.49	50.44	V	160	199	54	-3.56	Ave.
Middle Channel							
14488.55	60.43	H	235	43	74	-13.57	Peak
16988.18	60.82	V	225	208	68.23	-7.41	Peak
15419.93	54.80	V	176	134	74	-19.2	Peak
14488.55	49.90	H	235	43	54	-4.1	Ave.
16988.18	48.25	V	225	208	54	-5.75	Ave.
15419.93	44.42	V	176	134	54	-9.58	Ave.
High Channel							
14111.4	60.57	H	151	168	68.23	-7.66	Peak
16798.72	59.26	V	237	0	68.23	-8.97	Peak
14111.4	51.05	H	151	168	54	-2.95	Ave.
16798.72	48.9	V	237	0	54	-5.1	Ave.

## 30 MHz Bandwidth

Frequency (MHz)	Corrected Amplitude (dB $\mu$ V/m)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dB $\mu$ V/m)	Margin (dB)	Comments
Low Channel							
14080.99	61.51	V	236	228	68.23	-6.72	Peak
16991.53	61.64	H	145	91	68.23	-6.59	Peak
14080.99	51.17	V	236	228	54	-2.83	Ave.
16991.53	50.39	H	145	91	54	-3.61	Ave.
Middle Channel							
14421.18	59.67	V	165	13	68.23	-8.56	Peak
16969.59	58.61	V	292	18	68.23	-9.62	Peak
15369.76	54.52	V	230	258	74	-19.48	Peak
1530.65	35.33	V	101	226	74	-38.67	Peak
14421.18	49.77	V	165	13	54	-4.23	Ave.
16969.59	47.97	V	292	18	54	-6.03	Ave.
15369.76	44.27	V	230	258	54	-9.73	Ave.
1530.65	25.02	V	101	226	54	-28.98	Ave.
High Channel							
14630.97	61.43	H	244	177	68.23	-6.8	Peak
16999.97	61.07	H	100	8	68.23	-7.16	Peak
14630.97	50.92	H	244	177	54	-3.08	Ave.
16999.97	50.45	H	100	8	54	-3.55	Ave.

## 40 MHz Bandwidth

Frequency (MHz)	Corrected Amplitude (dB $\mu$ V/m)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dB $\mu$ V/m)	Margin (dB)	Comments
Low Channel							
14791.67	61.87	H	142	292	68.23	-6.36	Peak
16990.81	60.71	V	276	85	68.23	-7.52	Peak
14791.67	50.93	H	142	292	54	-3.07	Ave.
16990.81	50.35	V	276	85	54	-3.65	Ave.
Middle Channel							
14488.35	60.02	V	292	259	74	-13.98	Peak
16989.61	59.41	V	212	326	68.23	-8.82	Peak
15418.06	54.94	V	159	294	74	-19.06	Peak
4898.3	47.61	H	148	23	74	-26.39	Peak
14488.35	49.91	V	292	259	54	-4.09	Ave.
16989.61	48.25	V	212	326	54	-5.75	Ave.
15418.06	44.40	V	159	294	54	-9.60	Ave.
4898.3	37.38	H	148	23	54	-16.62	Ave.
High Channel							
14339.94	61.31	H	279	317	68.23	-6.92	Peak
16990.23	60.5	H	109	59	68.23	-7.73	Peak
14339.94	50.73	H	279	317	54	-3.27	Ave.
16990.23	50.34	H	109	59	54	-3.66	Ave.

**Power Setting 2 – for Dish Antenna**

10 MHz Bandwidth

Frequency (MHz)	Corrected Amplitude (dB $\mu$ V/m)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dB $\mu$ V/m)	Margin (dB)	Comments
Low Channel							
10318.84	58.35	H	135	0	68.23	-9.88	Peak
14719.85	61.36	V	224	285	68.23	-6.87	Peak
16921.88	60.16	V	293	234	68.23	-8.07	Peak
10318.84	45.33	H	135	0	54	-8.67	Ave.
14719.85	51.1	V	224	285	54	-2.9	Ave.
16921.88	49.81	V	293	234	54	-4.19	Ave.
Middle Channel							
14159.57	60.89	H	278	249	68.23	-7.34	Peak
16978.82	59.67	H	242	128	68.23	-8.56	Peak
10080.00	53.74	V	195	231	68.23	-14.49	Peak
14159.57	50.11	H	278	249	54	-3.89	Ave.
16978.82	48.97	H	242	128	54	-5.03	Ave.
10080.00	43.27	V	195	231	54	-10.73	Ave.
High Channel							
10490.96	63.17	V	150	360	68.23	-5.06	Peak
14079.03	61.41	H	250	82	68.23	-6.82	Peak
16868	59.58	V	243	174	68.23	-8.65	Peak
10490.96	50.43	V	150	360	54	-3.57	Ave.
14079.03	51.19	H	250	82	54	-2.81	Ave.
16868	49.45	V	243	174	54	-4.55	Ave.

## 20 MHz Bandwidth

Frequency (MHz)	Corrected Amplitude (dB $\mu$ V/m)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dB $\mu$ V/m)	Margin (dB)	Comments
Low Channel							
14759.99	61.63	V	141	225	68.23	-6.6	Peak
16851.81	59.63	V	156	350	68.23	-8.6	Peak
14759.99	50.95	V	141	225	54	-3.05	Ave.
16851.81	49.33	V	156	350	54	-4.67	Ave.
Middle Channel							
14338.02	59.31	H	144	16	68.23	-8.92	Peak
16948.71	59.71	V	231	241	68.23	-8.52	Peak
10091.6	53.62	H	125	19	68.23	-14.61	Peak
1328.628	38.41	V	292	113	74	-35.59	Peak
14338.02	49.25	H	144	16	54	-4.75	Ave.
16948.71	48.83	V	231	241	54	-5.17	Ave.
10091.6	43.31	H	125	19	54	-10.69	Ave.
1328.628	28.44	V	292	113	54	-25.56	Ave.
High Channel							
14271.31	60.87	V	156	234	68.23	-7.36	Peak
17000	60.16	H	207	349	68.23	-8.07	Peak
14271.31	50.76	V	156	234	54	-3.24	Ave.
17000	50.45	H	207	349	54	-3.55	Ave.

## 30 MHz Bandwidth

Frequency (MHz)	Corrected Amplitude (dB $\mu$ V/m)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dB $\mu$ V/m)	Margin (dB)	Comments
Low Channel							
14791.36	61.1	V	117	342	68.23	-7.13	Peak
16999.19	60.75	H	295	129	68.23	-7.48	Peak
14791.36	50.83	V	117	342	54	-3.17	Ave.
16999.19	50.43	H	295	129	54	-3.57	Ave.
Middle Channel							
14670.9	59.36	H	134	136	68.23	-8.87	Peak
16991.21	59.05	V	286	165	68.23	-9.18	Peak
10088.65	54.03	H	165	191	68.23	-14.2	Peak
14670.9	49.17	H	134	136	54	-4.83	Ave.
16991.21	48.97	V	286	165	54	-5.03	Ave.
10088.65	43.27	H	165	191	54	-10.73	Ave.
High Channel							
14660.37	61.7	H	207	301	68.23	-6.53	Peak
16979.81	60.39	V	202	89	68.23	-7.84	Peak
14660.37	51.05	H	207	301	54	-2.95	Ave.
16979.81	50.26	V	202	89	54	-3.74	Ave.

## 40 MHz Bandwidth

Frequency (MHz)	Corrected Amplitude (dB $\mu$ V/m)	Antenna Polarity (H/V)	Antenna Height (cm)	Turntable Azimuth (degrees)	Limit (dB $\mu$ V/m)	Margin (dB)	Comments
Low Channel							
14099.96	62.52	H	272	221	68.23	-5.71	Peak
16989.66	61	H	103	228	68.23	-7.23	Peak
10339.86	57.66	H	121	360	68.23	-10.57	Peak
14099.96	51.16	H	272	221	54	-2.84	Ave.
16989.66	50.34	H	103	228	54	-3.66	Ave.
10339.86	46.59	H	121	360	54	-7.41	Ave.
Middle Channel							
14188.08	61.15	H	189	113	68.23	-7.08	Peak
10078.95	53.66	H	124	20	68.23	-14.57	Peak
14188.08	50.00	H	189	113	54	-4.00	Ave.
10078.95	43.15	H	124	20	54	-10.85	Ave.
High Channel							
14589.36	61.58	V	258	230	68.23	-6.65	Peak
17000.31	60.55	H	104	360	68.23	-7.68	Peak
10471.67	63.48	V	144	360	68.23	-4.75	Peak
14589.36	50.93	V	258	230	54	-3.07	Ave.
17000.31	50.43	H	104	360	54	-3.57	Ave.
10471.67	51.84	V	144	360	54	-2.16	Ave.

## 8 FCC §15.407(a) & §15.407(e) - Emission Bandwidth

### 8.1 Applicable Standards

Measurements in the 5.15-5.25 GHz, 5.25-5.35 GHz, and the 5.47-5.725 GHz bands are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full reference bandwidth.

### 8.2 Measurement Procedure

The measurements are based on FCC KDB 789033 D02 General UNII Test Procedures New Rules v01: Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices section C: Emission bandwidth and section D: 99 % Occupied Bandwidth

### 8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2014-09-03	1 year

*Statement of Traceability: BACL Corp. attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.*

### 8.4 Test Environmental Conditions

<b>Temperature:</b>	21 °C
<b>Relative Humidity:</b>	43 %
<b>ATM Pressure:</b>	105.2 kPa

*The testing was performed by Jin Yang from 2015-07-22 to 2015-08-03 at RF site.*

### 8.5 Test Results

Please refer to the following tables and plots.



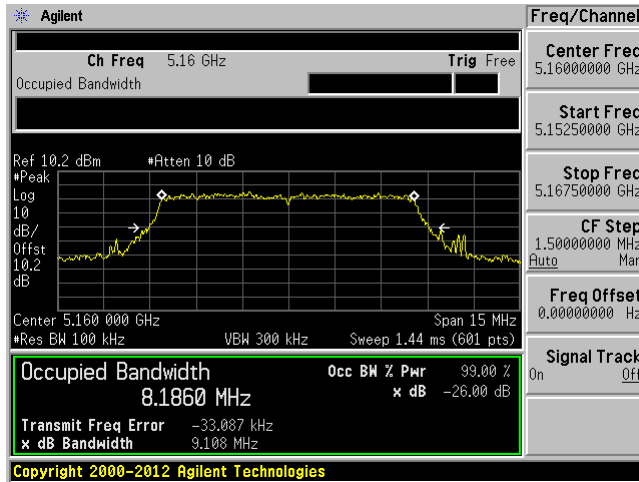
**Power Setting 1 – for Omni and Sector Antenna**

Channel	Frequency (MHz)	99% OBW (MHz)		26 dB OBW (MHz)	
		Chain 0	Chain 1	Chain 0	Chain 1
10 MHz Bandwidth					
Low	5160	8.1860	8.1756	9.108	9.140
Middle	5200	8.1508	8.1740	9.489	9.096
High	5245	8.1761	8.1535	9.376	9.198
20 MHz Bandwidth					
Low	5165	16.4955	16.4433	21.775	20.571
Middle	5200	16.5061	16.4357	21.150	20.531
High	5240	16.4976	16.4883	21.521	20.731
30 MHz Bandwidth					
Low	5170	24.8172	24.7342	31.441	32.116
Middle	5200	24.6823	24.7592	31.520	31.246
High	5235	24.6913	24.6822	32.167	30.583
40 MHz Bandwidth					
Low	5175	36.0454	36.1019	43.571	42.374
Middle	5200	36.1384	36.1451	43.840	42.883
High	5230	36.2121	36.1053	44.413	41.585

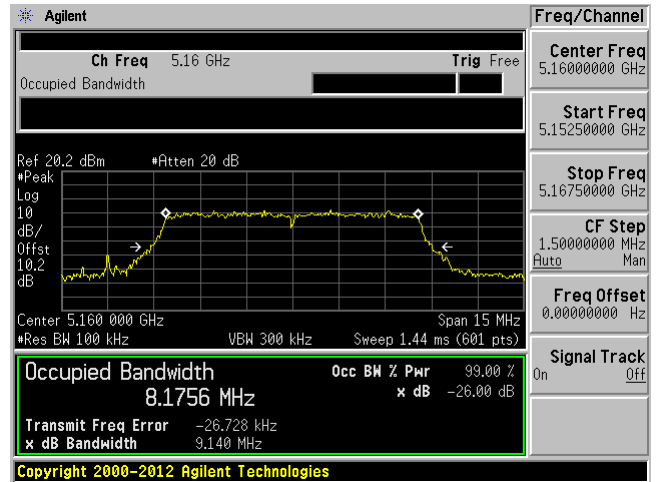
## Occupied Bandwidth

### 10 MHz Bandwidth

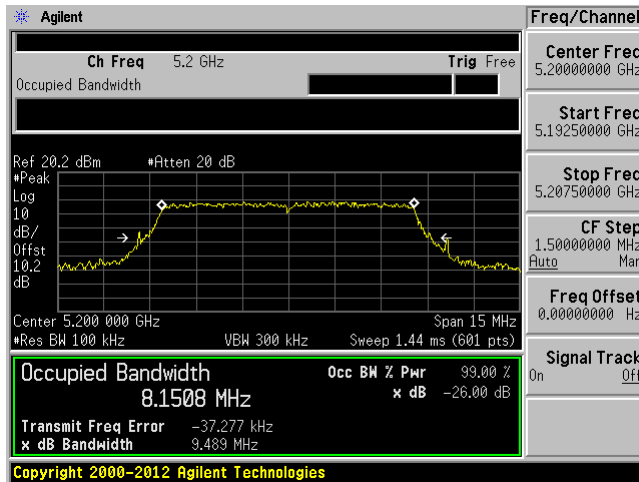
Low channel – Chain 0



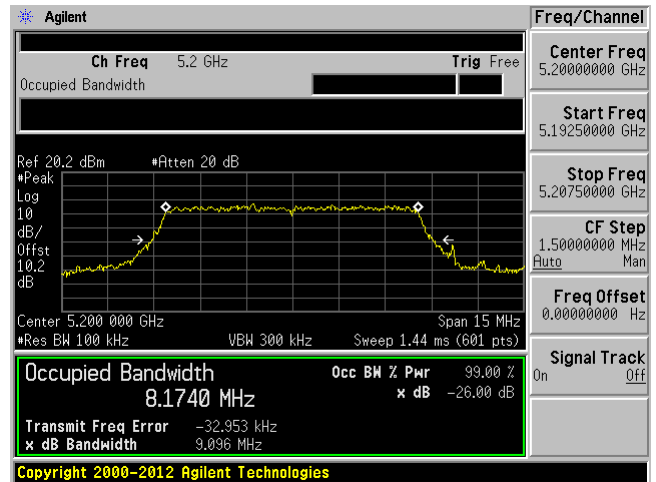
Low channel – Chain 1



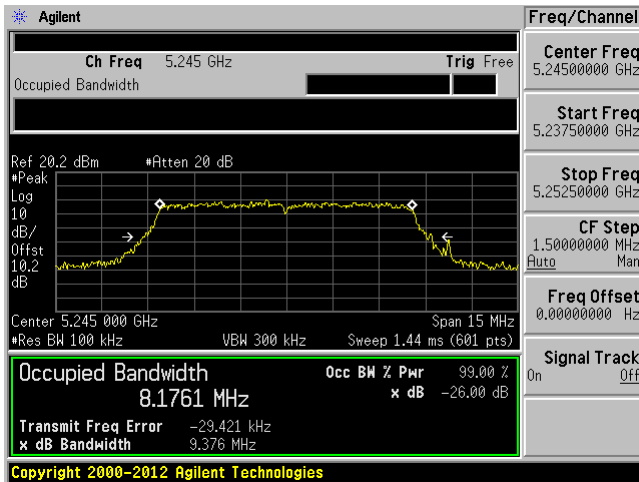
Middle channel – Chain 0



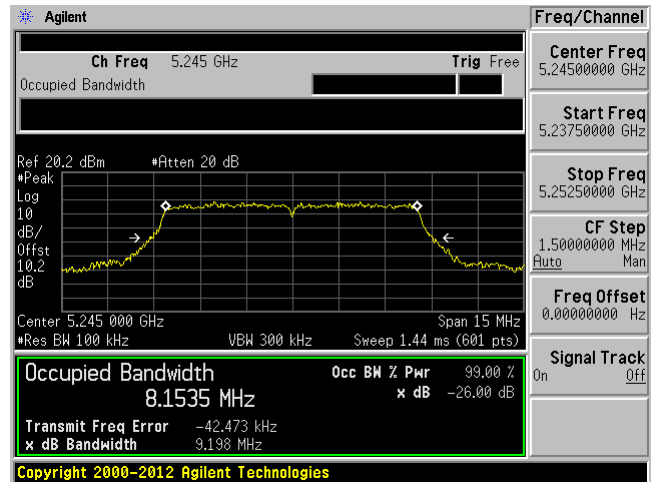
Middle channel – Chain 1



### High channel – Chain 0

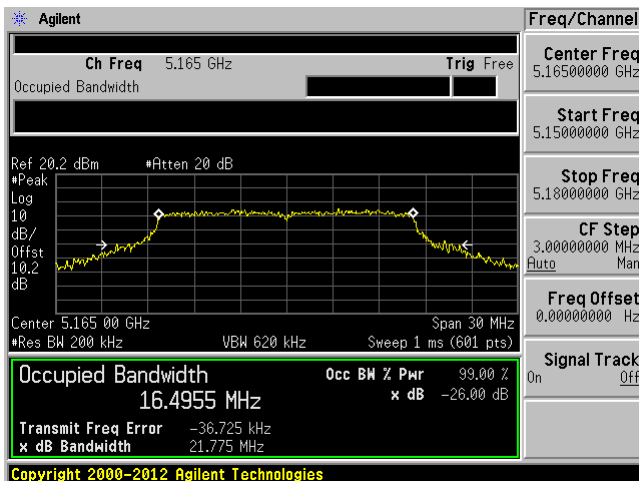


### High channel – Chain 1

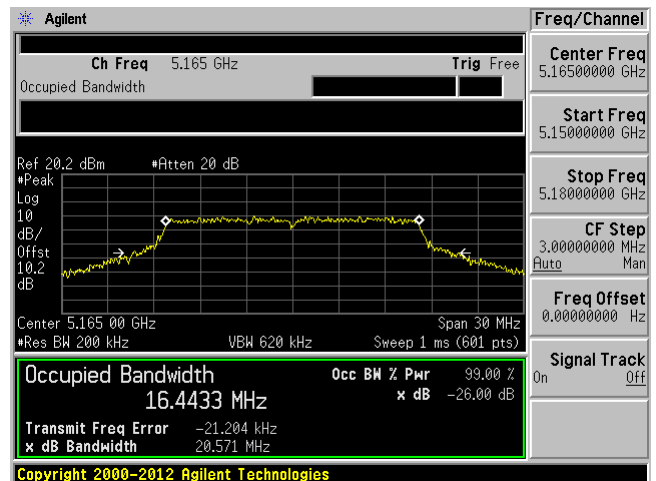


## 20 MHz Bandwidth

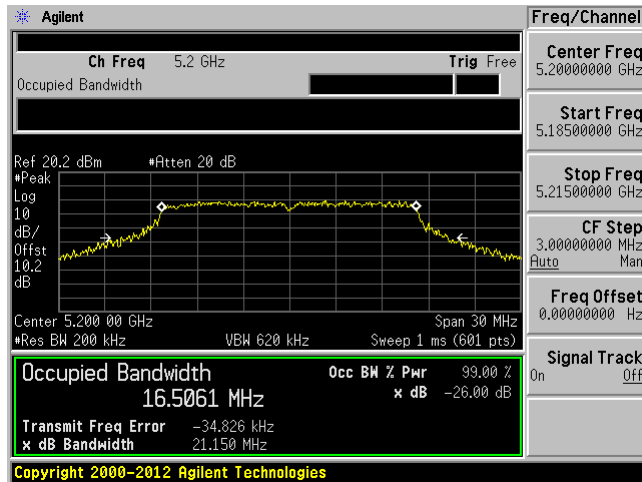
### Low channel – Chain 0



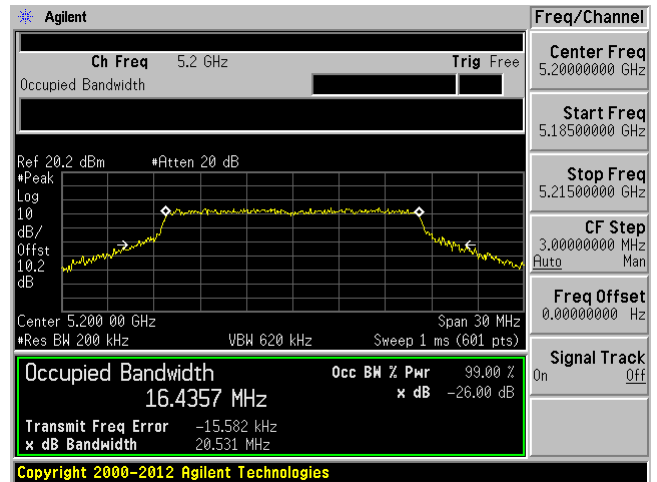
### Low channel – Chain 1



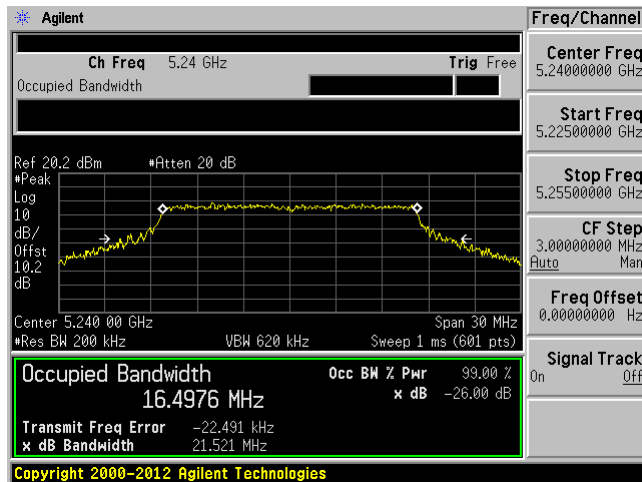
Middle channel – Chain 0



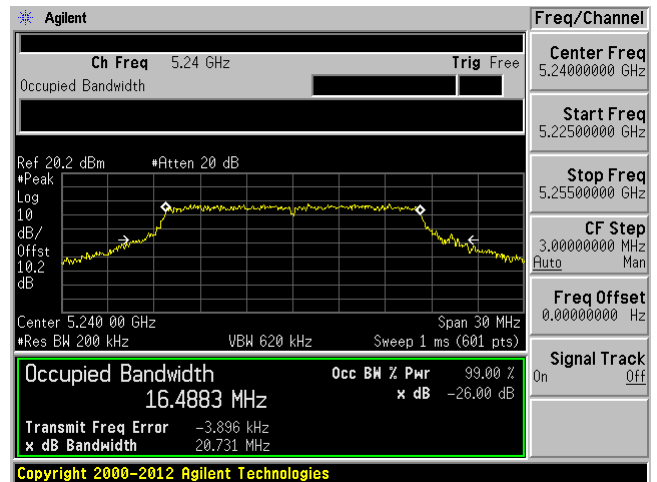
Middle channel – Chain 1



High channel – Chain 0

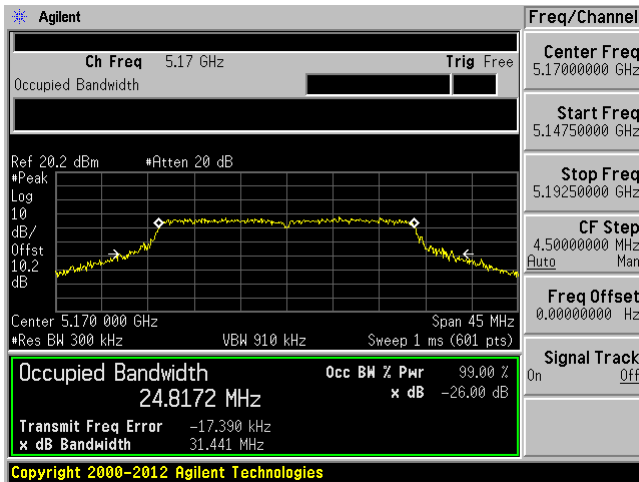


High channel – Chain 1

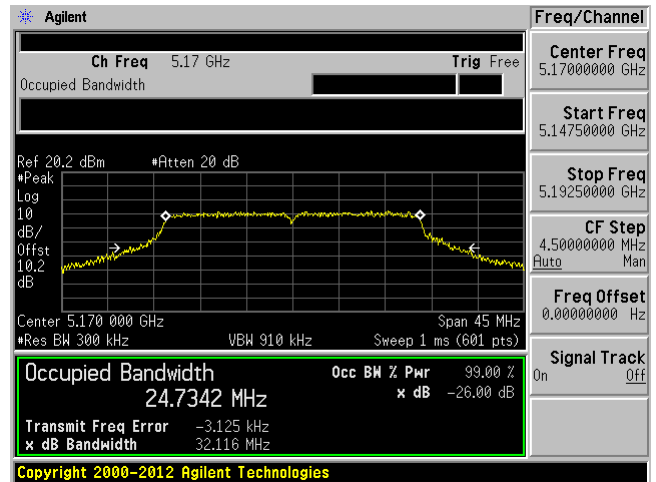


### 30 MHz Bandwidth

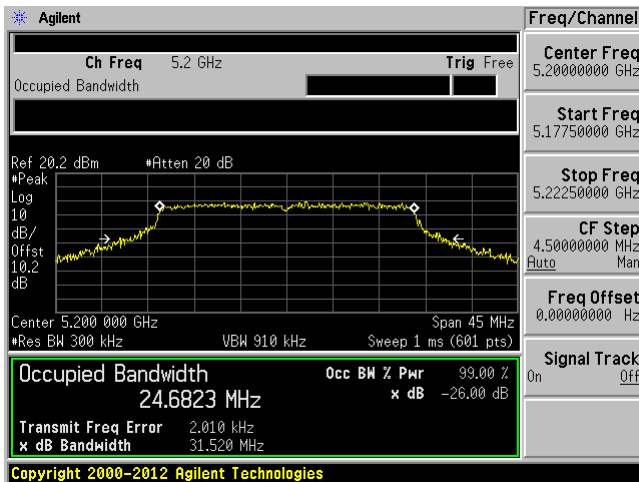
Low channel – Chain 0



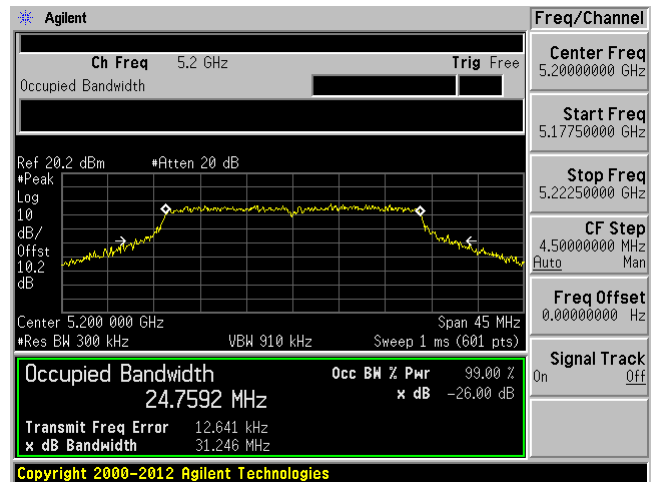
Low channel – Chain 1



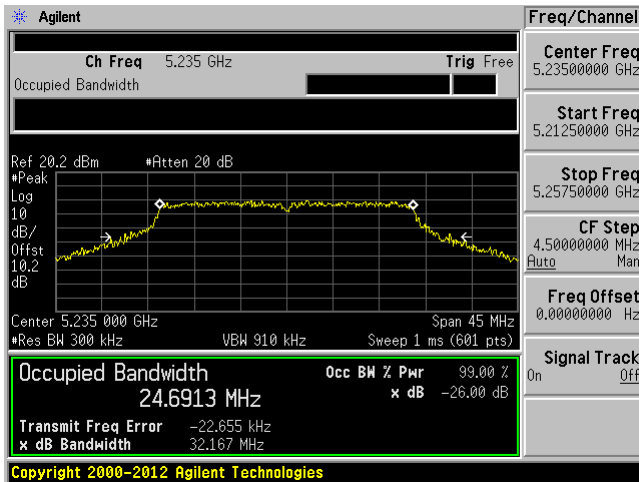
Middle channel – Chain 0



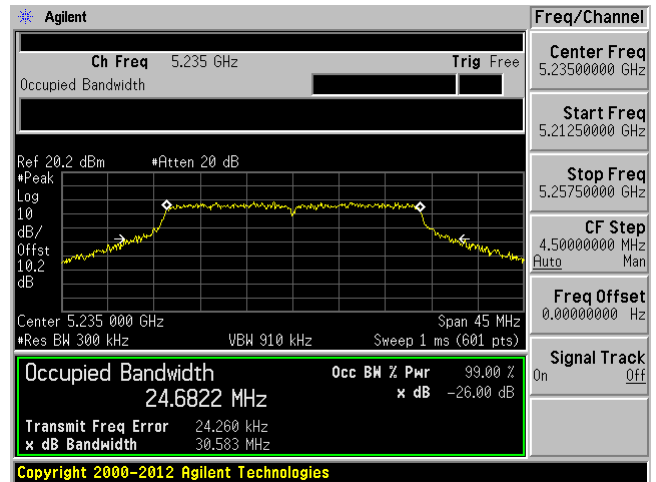
Middle channel – Chain 1



High channel – Chain 0

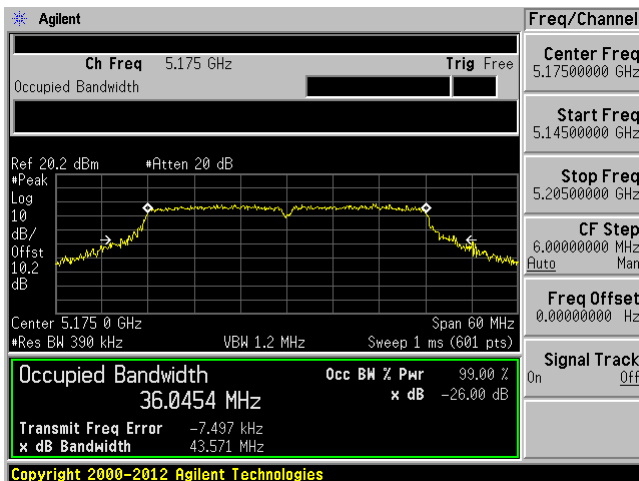


High channel – Chain 1

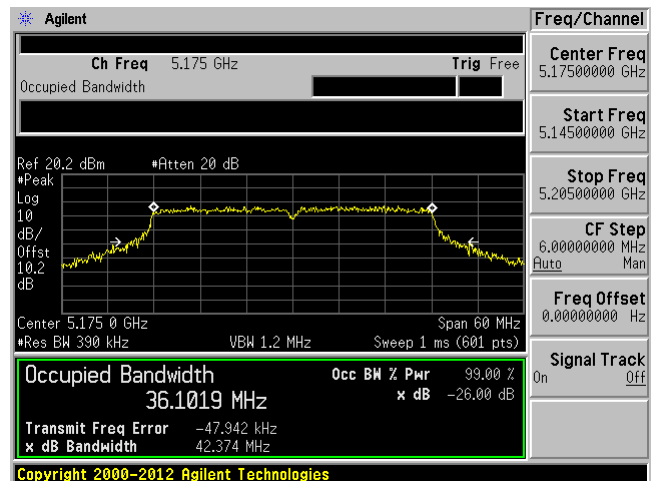


40 MHz Bandwidth

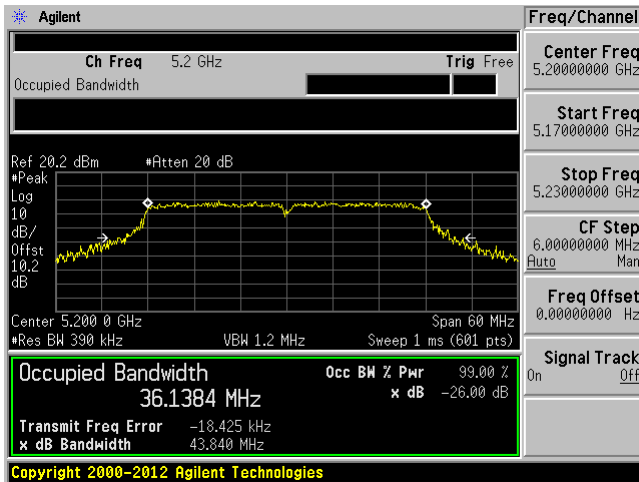
Low channel – Chain 0



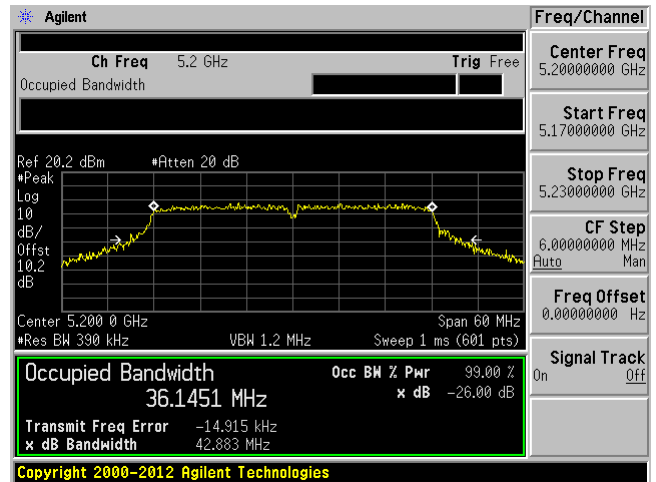
Low channel – Chain 1



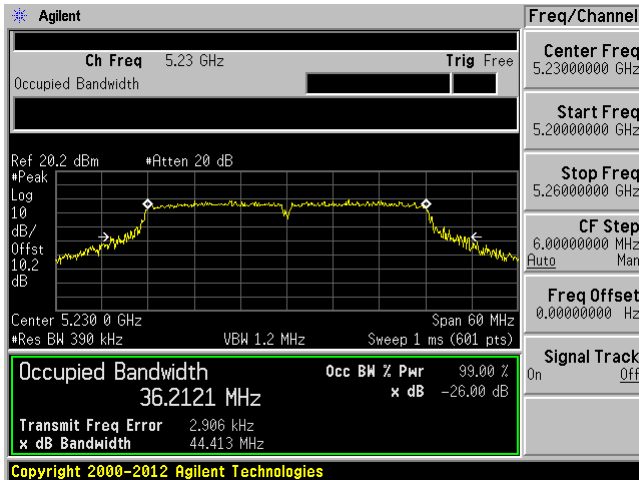
Middle channel – Chain 0



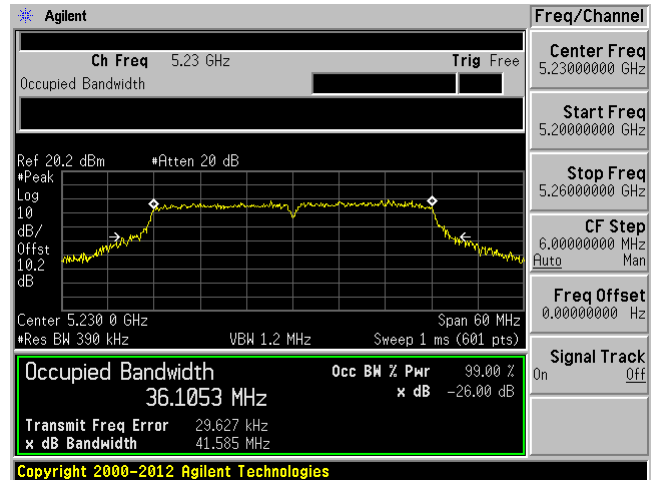
Middle channel – Chain 1



High channel – Chain 0



High channel – Chain 1



**Power Setting 2 – for Dish Antenna**

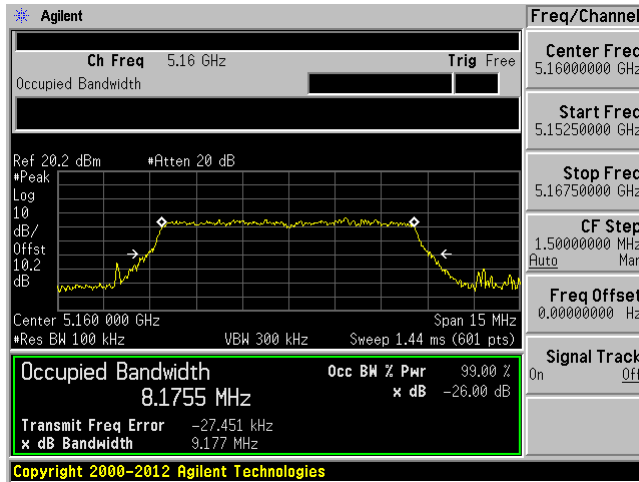
Channel	Frequency (MHz)	99% OBW (MHz)		26 dB OBW (MHz)	
		Chain 0	Chain 1	Chain 0	Chain 1
10 MHz Bandwidth					
Low	5160	8.1755	8.1751	9.177	9.149
Middle	5200	8.1820	8.1902	9.416	9.213
High	5245	8.2052	8.1857	9.343	9.287
20 MHz Bandwidth					
Low	5165	16.4991	16.5348	21.416	21.082
Middle	5200	16.4901	16.4447	21.235	20.566
High	5240	16.4760	16.4777	20.179	20.747
30 MHz Bandwidth					
Low	5170	24.7906	24.7294	32.019	32.703
Middle	5200	24.7438	24.7193	31.630	31.943
High	5235	24.8722	24.7333	32.167	30.989
40 MHz Bandwidth					
Low	5175	36.1786	36.2553	43.168	43.364
Middle	5200	36.1992	36.0258	43.296	42.824
High	5230	36.2565	36.0701	43.944	42.241



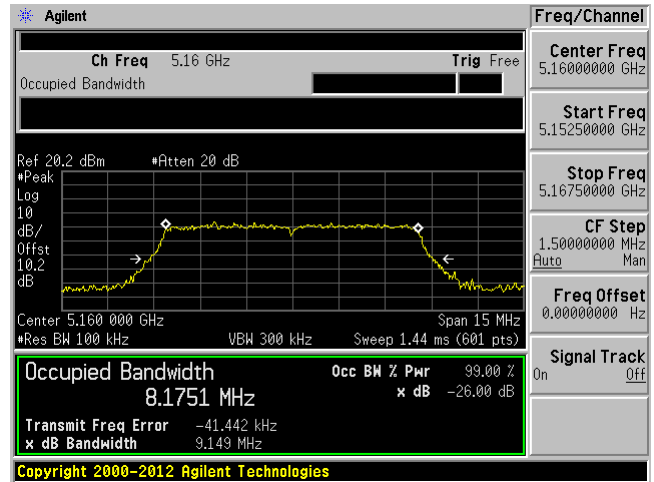
## Occupied Bandwidth

### 10 MHz Bandwidth

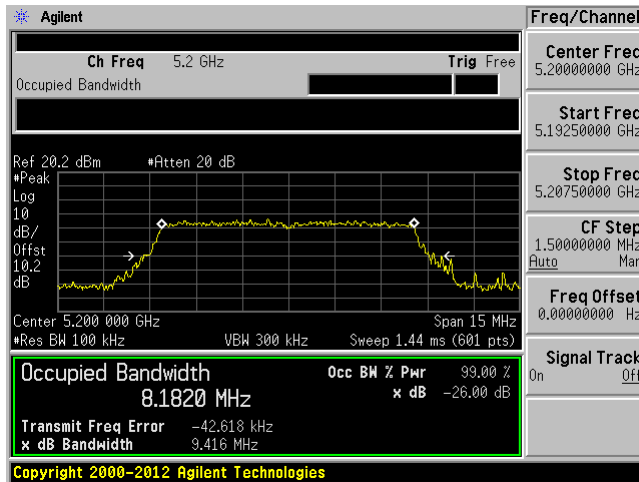
Low channel – Chain 0



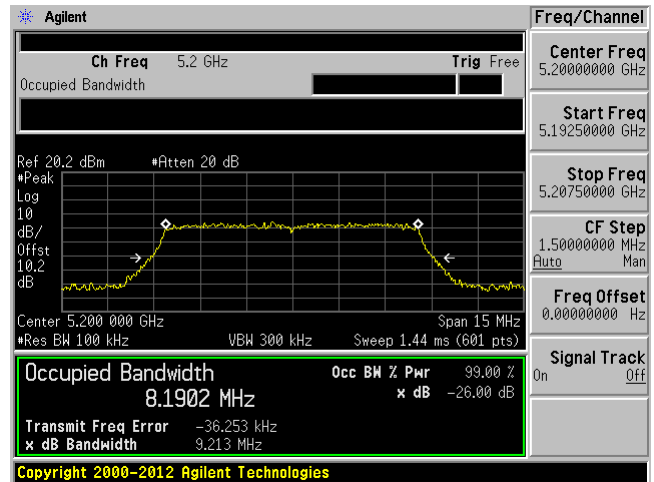
Low channel – Chain 1



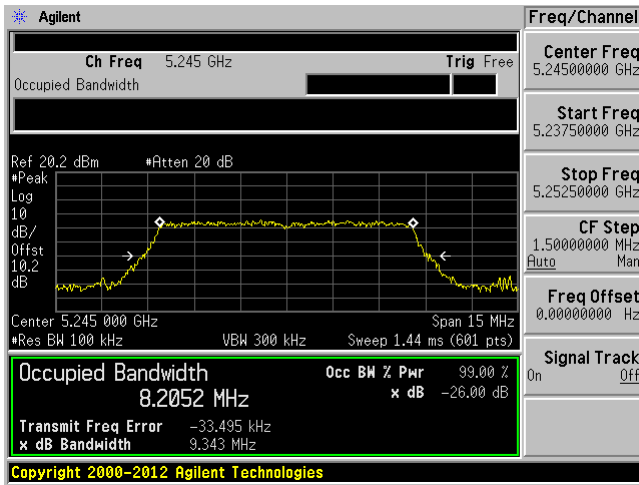
Middle channel – Chain 0



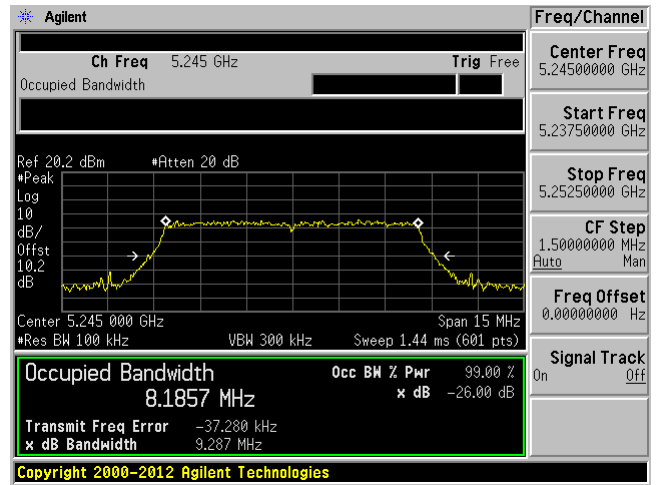
Middle channel – Chain 1



High channel – Chain 0

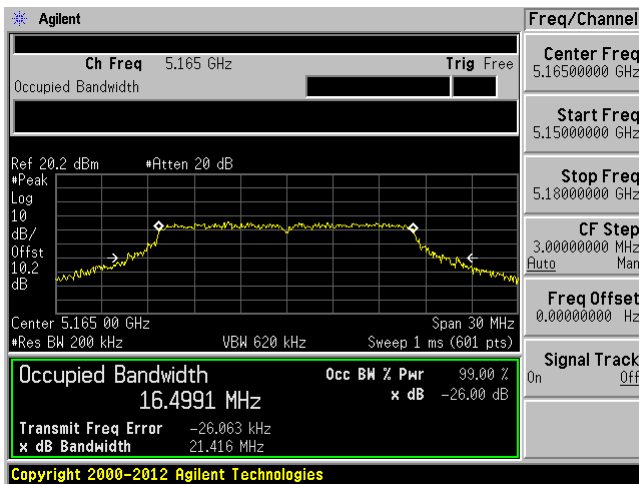


High channel – Chain 1

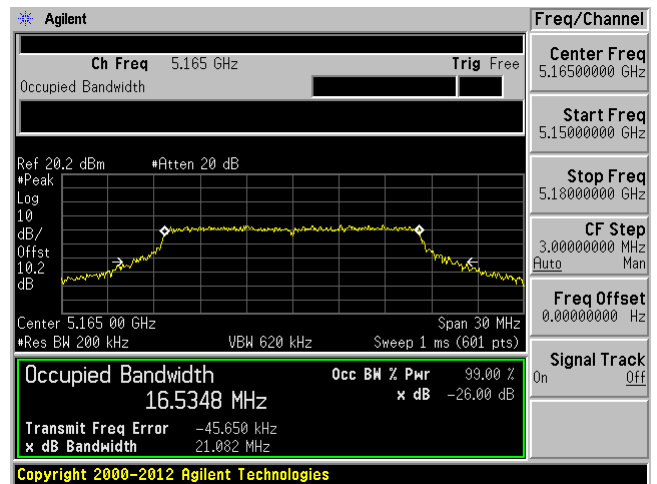


20 MHz Bandwidth

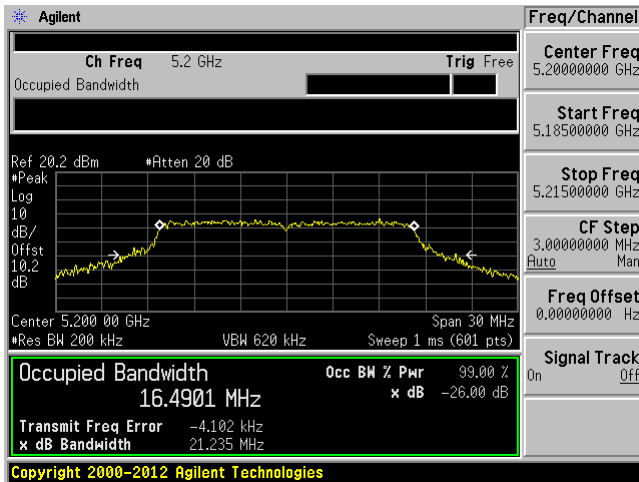
Low channel – Chain 0



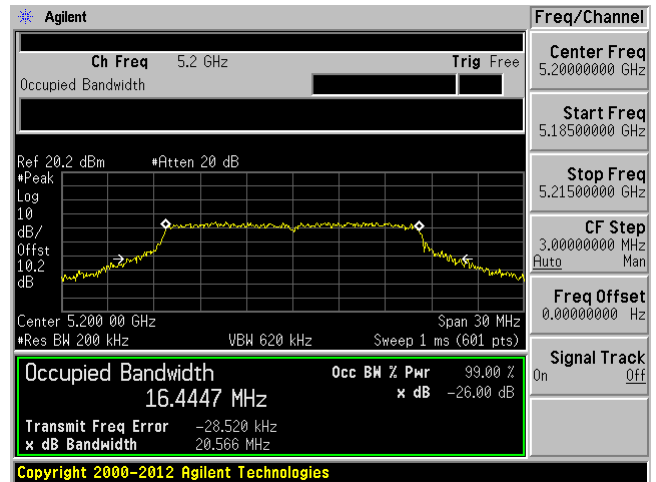
Low channel – Chain 1



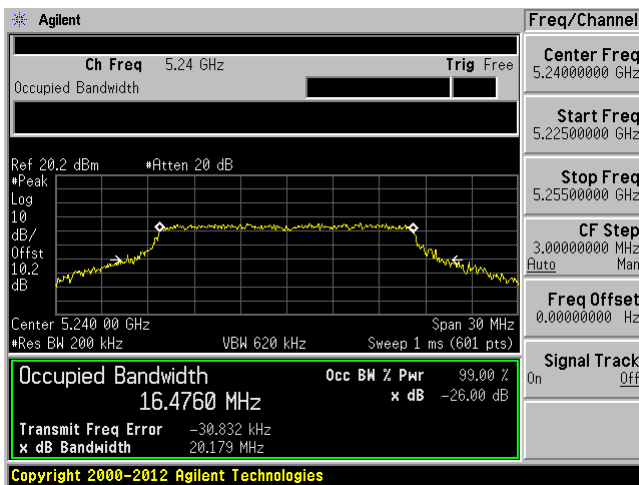
Middle channel – Chain 0



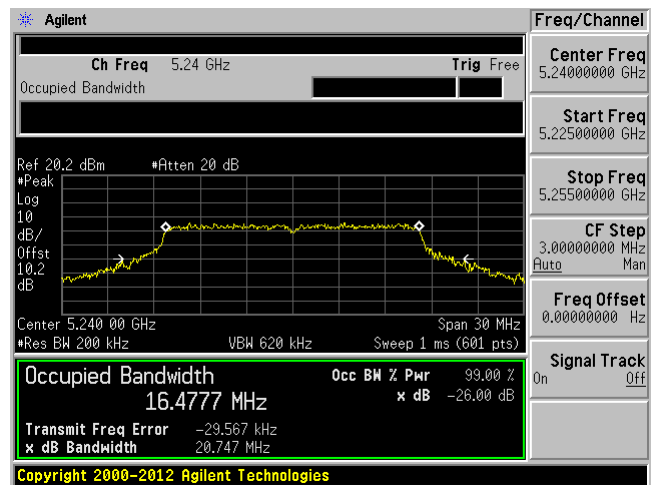
Middle channel – Chain 1



High channel – Chain 0

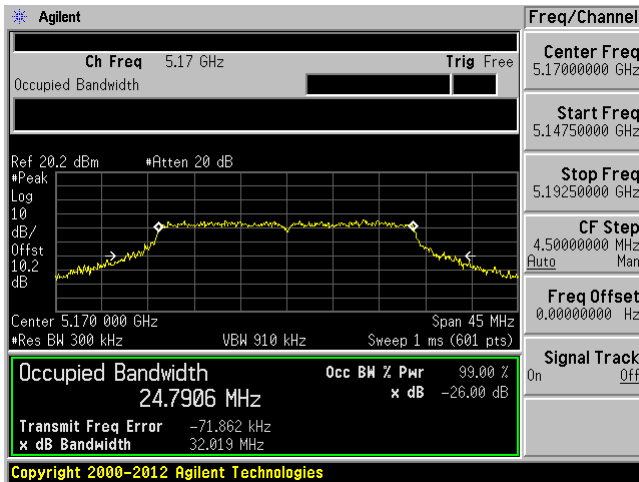


High channel – Chain 1

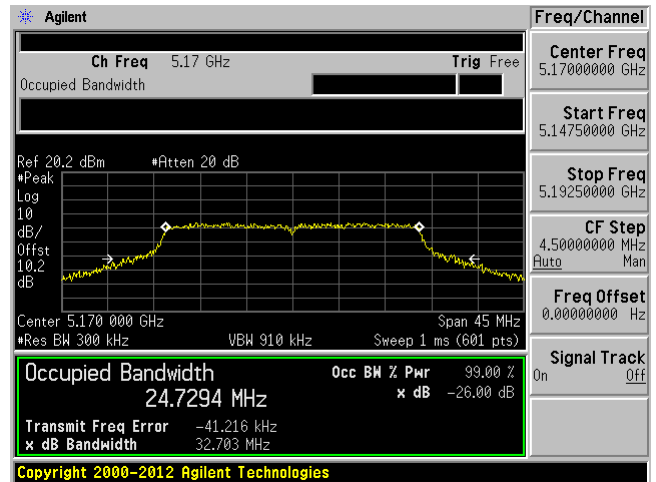


### 30 MHz Bandwidth

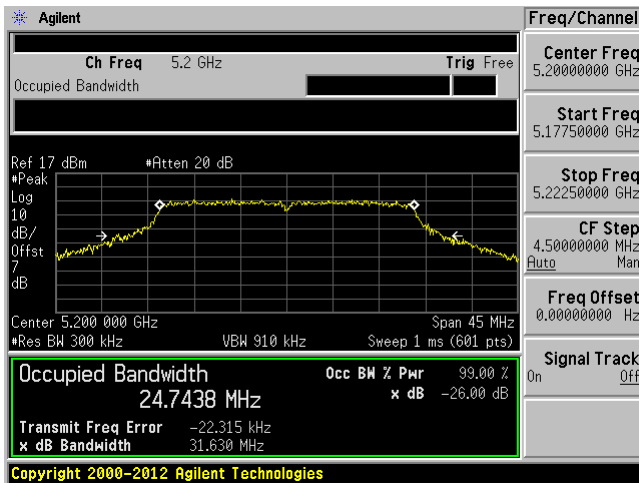
Low channel – Chain 0



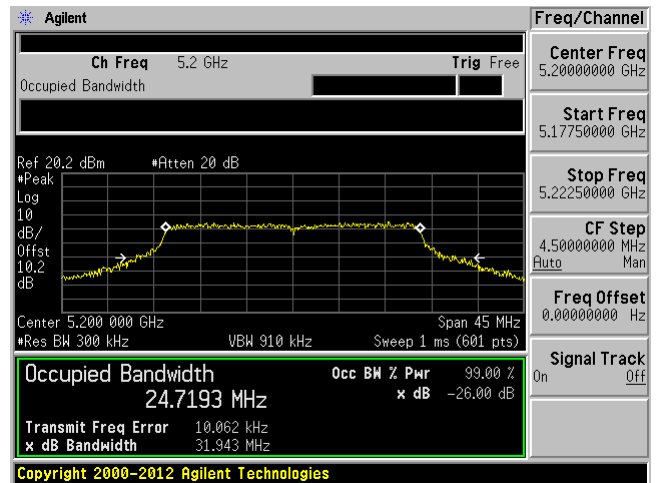
Low channel – Chain 1



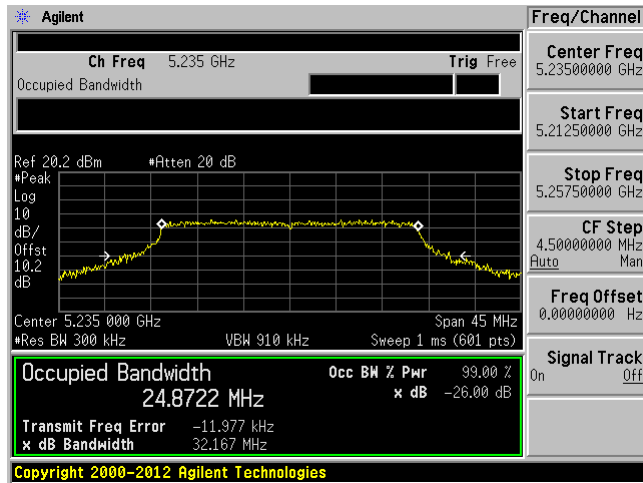
Middle channel – Chain 0



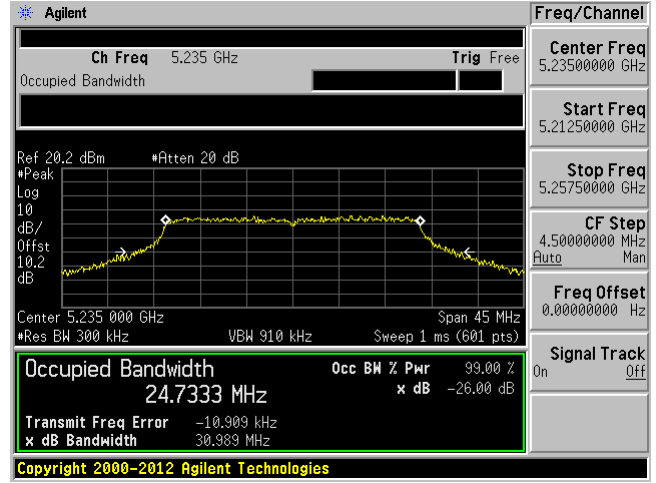
Middle channel – Chain 1



High channel – Chain 0

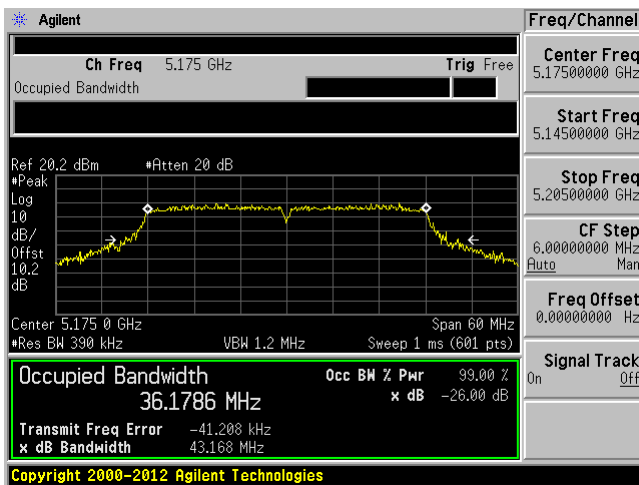


High channel – Chain 1

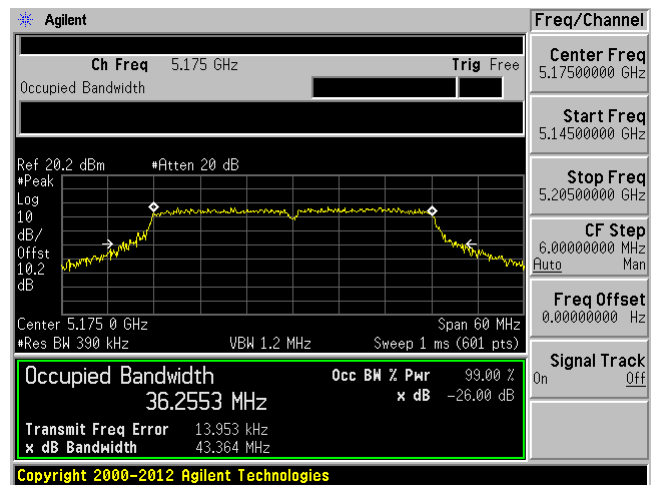


40 MHz Bandwidth

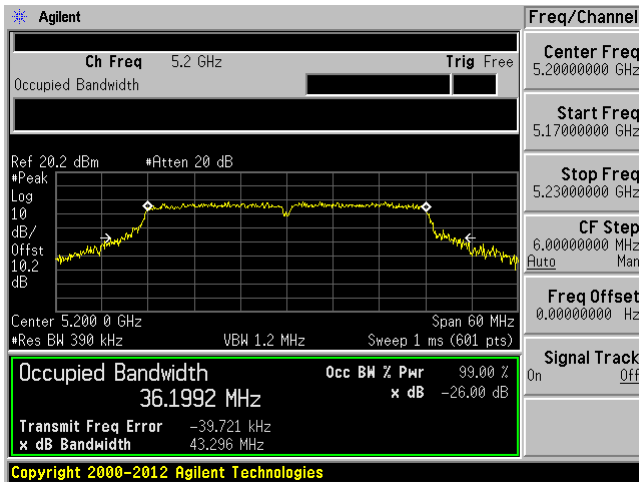
Low channel – Chain 0



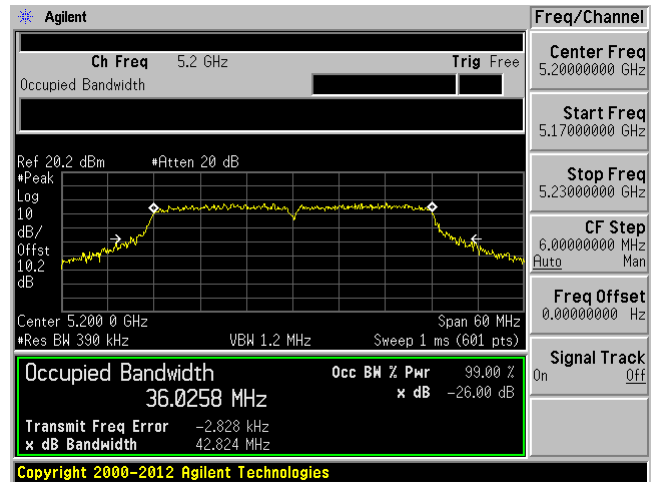
Low channel – Chain 1



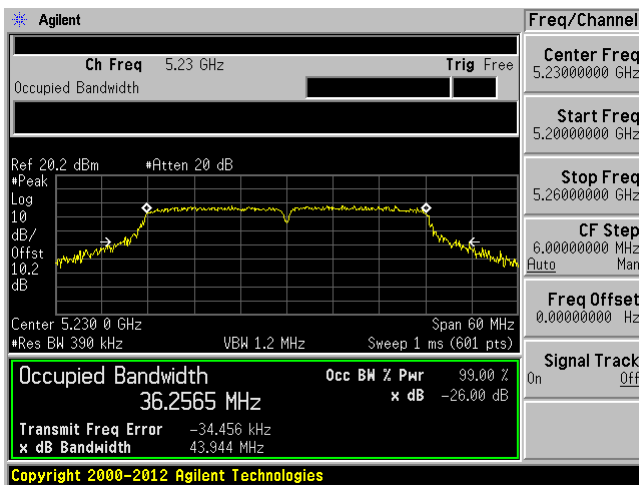
Middle channel – Chain 0



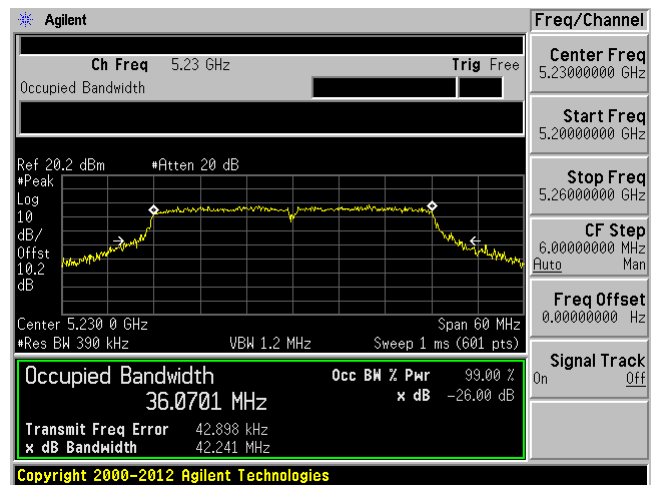
Middle channel – Chain 1



High channel – Chain 0



High channel – Chain 1



## 9 FCC §407(a) - Maximum Conducted Output Power

### 9.1 Applicable Standards

According to FCC §15.407(a)

(i) For an outdoor 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. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(iii) For fixed point-to-point access points 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. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

### 9.2 Measurement Procedure

Test measurements are based on FCC KDB 789033 D02 General UNII Test Procedures New Rules v01, GUIDELINES FOR COMPLIANCE TESTING OF UNLICENSED NATIONAL INFORMATION INFRASTRUCTURE (U-NII) DEVICES PART 15, SUBPART E

### 9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2014-09-03	1 year

*Statement of Traceability: BAACL Corp. attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.*

### 9.4 Test Environmental Conditions

Temperature:	22-25 °C
Relative Humidity:	40-43 %
ATM Pressure:	102.1-104.4 kPa

*The testing was performed by Jin Yang on 2015-07-22 to 2015-08-03 at RF site.*

## 9.5 Test Results

### Power Setting 1 – for Omni and Sector Antenna

Channel	Frequency (MHz)	Conducted Output Power (dBm)			Limit P-t-P (dBm)	Limit P-t-MP (dBm)	Result
		Chain 0	Chain 1	Combined			
10 MHz Bandwidth							
Low	5160	5.28	3.41	7.46	30	22.8	Pass
Middle	5200	10.55	8.29	12.58	30	22.8	Pass
High	5245	10.45	9.79	13.14	30	22.8	Pass
20 MHz Bandwidth							
Low	5165	6.14	3.65	8.08	30	22.8	Pass
Middle	5200	10.88	8.87	13.00	30	22.8	Pass
High	5240	10.31	10.05	13.19	30	22.8	Pass
30 MHz Bandwidth							
Low	5170	-1.03	-2.06	1.50	30	22.8	Pass
Middle	5200	10.25	8.59	12.51	30	22.8	Pass
High	5235	10.81	9.71	13.31	30	22.8	Pass
40 MHz Bandwidth							
Low	5175	9.80	8.50	12.21	30	22.8	Pass
Middle	5200	10.32	8.50	12.51	30	22.8	Pass
High	5230	10.17	9.53	12.87	30	22.8	Pass

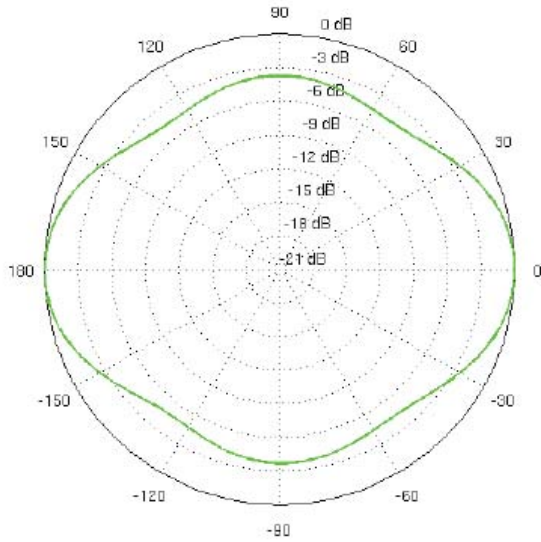
Note: (1) When the device operates as a fixed point to point (sector antenna), the output power reduction of the amount in dB that exceeds 6 dBi is not needed.

(2) When the device operates as a fixed point to multi point (Omni and sector antenna), the output power shall be reduced by the amount in dB that directional gain of the antenna exceeds 6 dBi, i.e.  $30 - (13.2 - 6) = 22.8$  dBm. of the amount in dB that exceeds 6 dBi shall be s not needed.

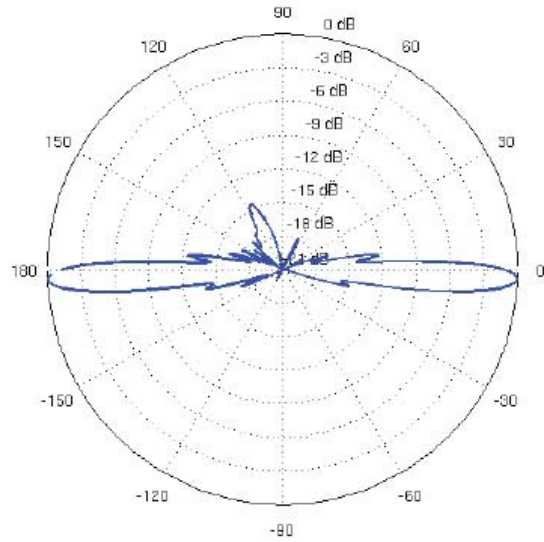


**Omni Antenna information**

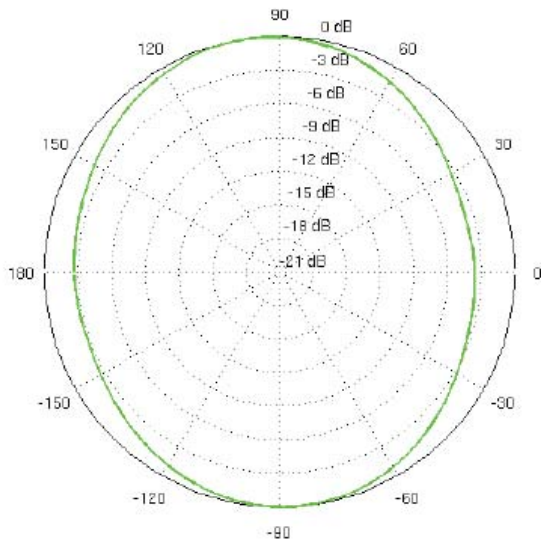
*Vertical Azimuth*



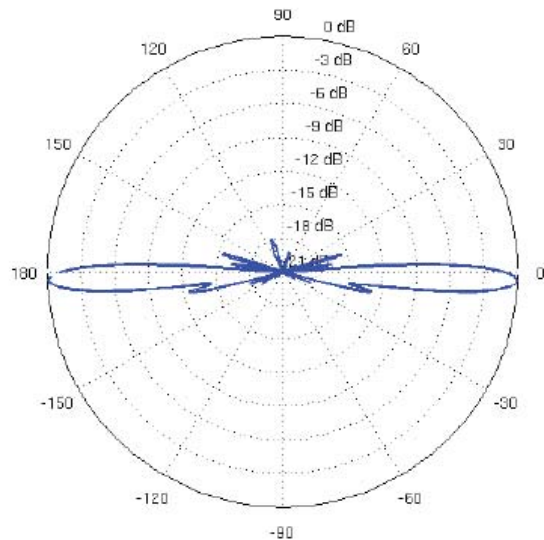
*Vertical Elevation*



*Horizontal Azimuth*



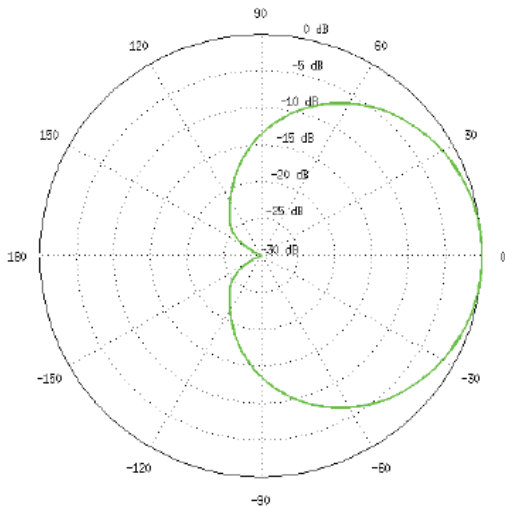
*Horizontal Elevation*



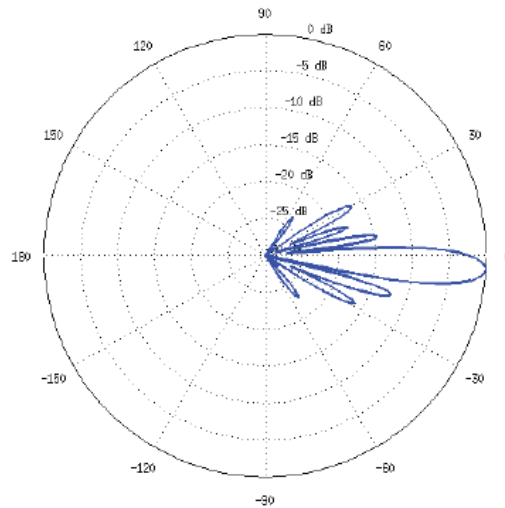
Note: Based on KDB 789033 D02General UNII Test Procedures New Rules v01 Section H “Measurement of emission at elevation angle higher than 30 degrees from horizon” and ECFR § 15.407(a)(1)(i), if the access point is an outdoor Point-to-Multipoint device operating in the band 5.15-5.25 GHz, the rules require that the maximum EIRP at any elevation angle above 30° not exceed **125 mW (21 dBm)** as measured from the horizon. Based on the “Horizontal Elevation” plot which is list above, the highest gain above 30 degree is **-18dBi**. And the highest out put power for 5.2 GHz is **13.31 dBm**, therefore the highest EIRP above 30 degree is **-4.69 dBm** which is lower than 21 dBm as listed on the regulation.

**Sector Antenna information**

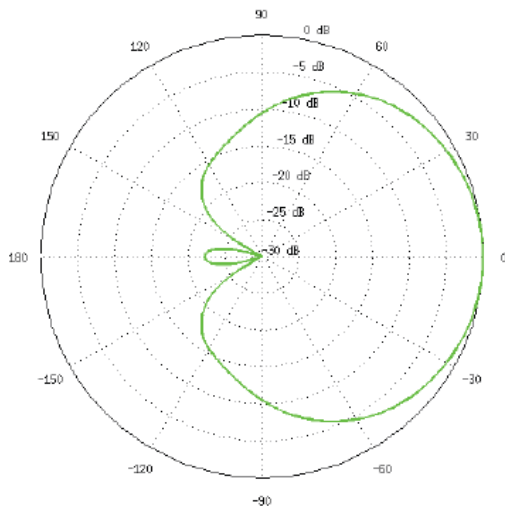
*Vertical Azimuth*



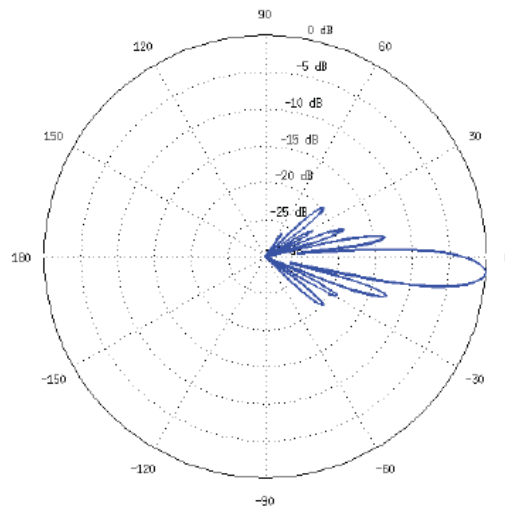
*Vertical Elevation*



*Horizontal Azimuth*



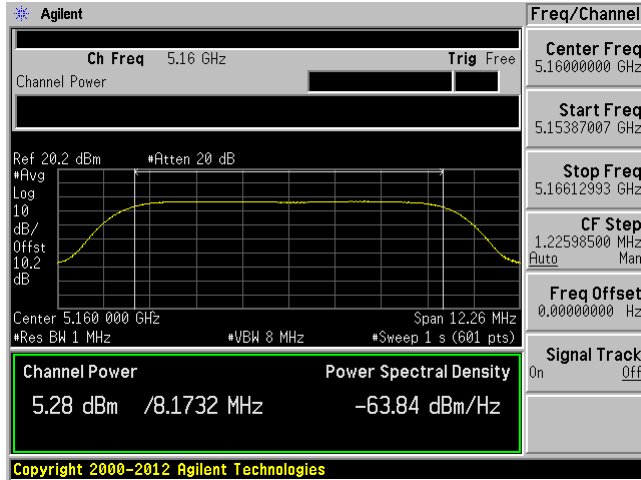
*Horizontal Elevation*



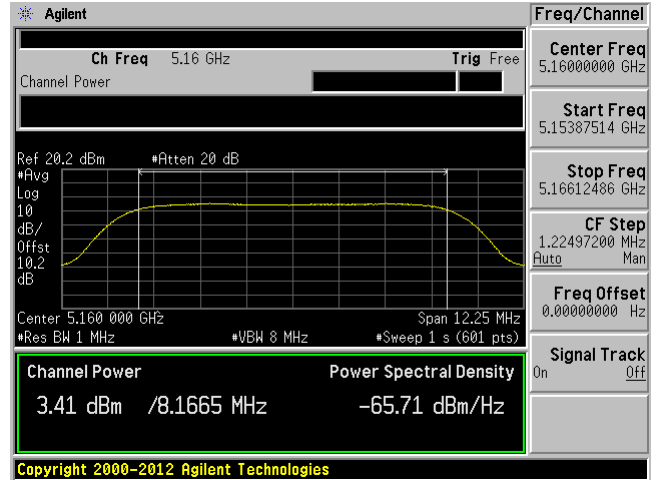
Note: Based on KDB 789033 D02General UNII Test Procedures New Rules v01 Section H “Measurement of emission at elevation angle higher than 30 degrees from horizon” and ECFR § 15.407(a)(1)(i), if the access point is an outdoor Point-to-Multipoint device operating in the band 5.15-5.25 GHz, the rules require that the maximum EIRP at any elevation angle above 30° not exceed **125 mW (21 dBm)** as measured from the horizon. Based on the “Horizontal Elevation” plot which is list above, the highest gain above 30 degree is **-20 dBi**. And the highest out put power for 5.2GHz is 13.31dBm, therefore the highest EIRP above 30 degree is **-6.69 dBm** which is lower than 21dBm as listed on the regulation.

### 10 MHz Bandwidth

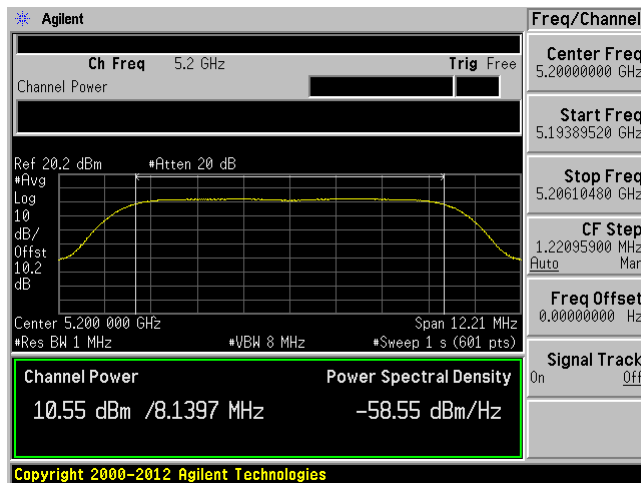
Low channel – Chain 0



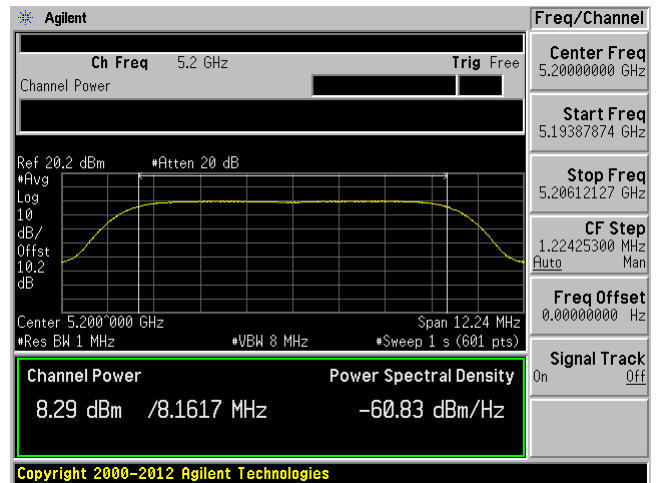
Low channel – Chain 1



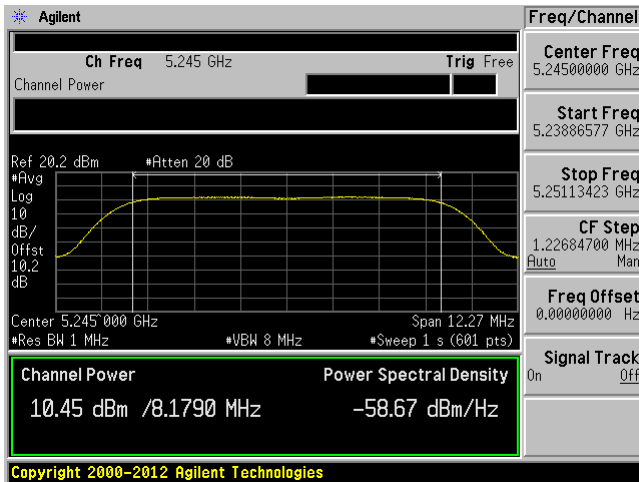
Middle channel – Chain 0



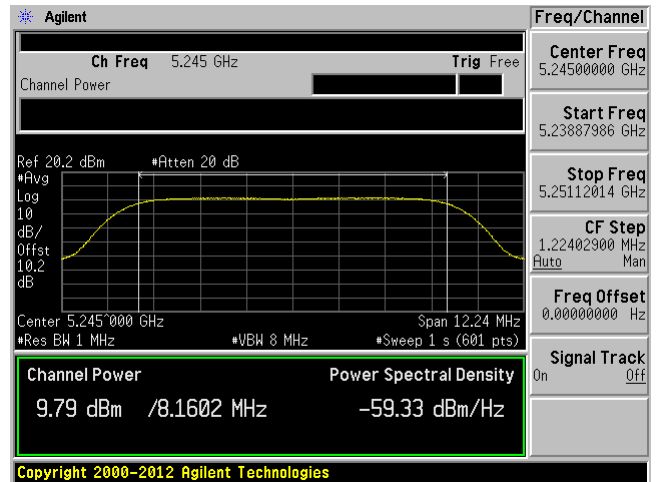
Middle channel – Chain 1



High channel – Chain 0

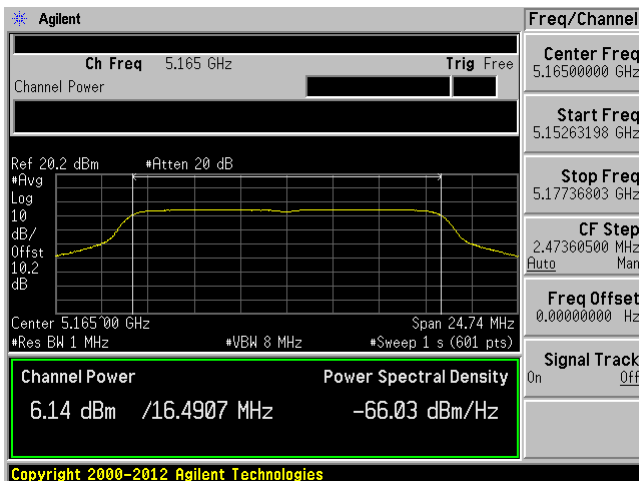


High channel – Chain 1

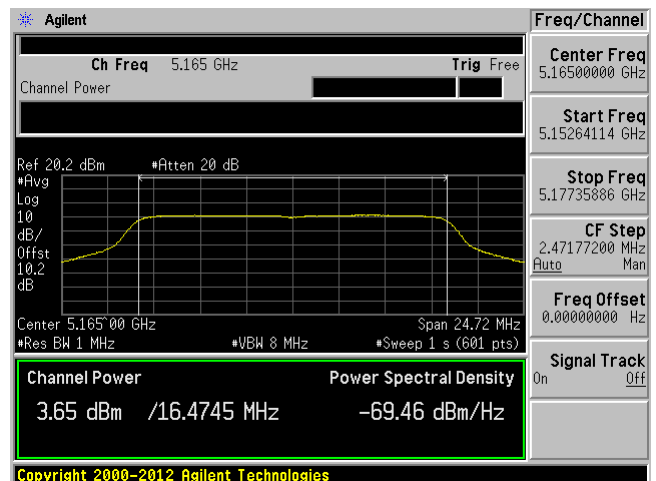


20 MHz Bandwidth

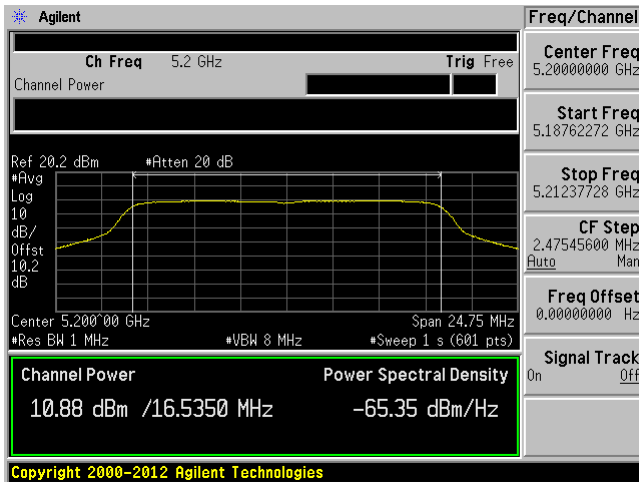
Low channel – Chain 0



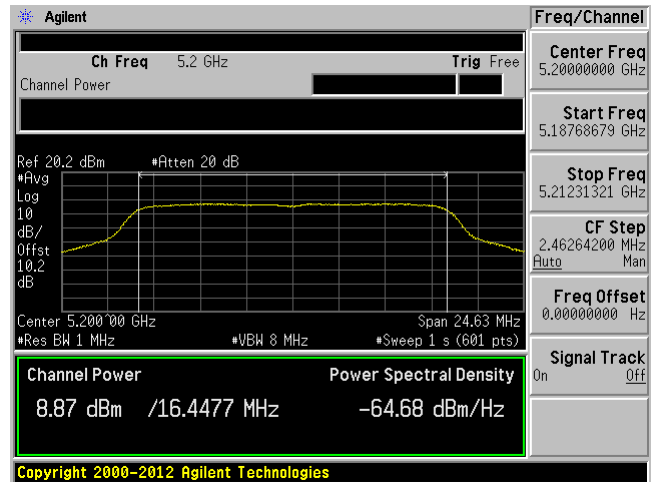
Low channel – Chain 1



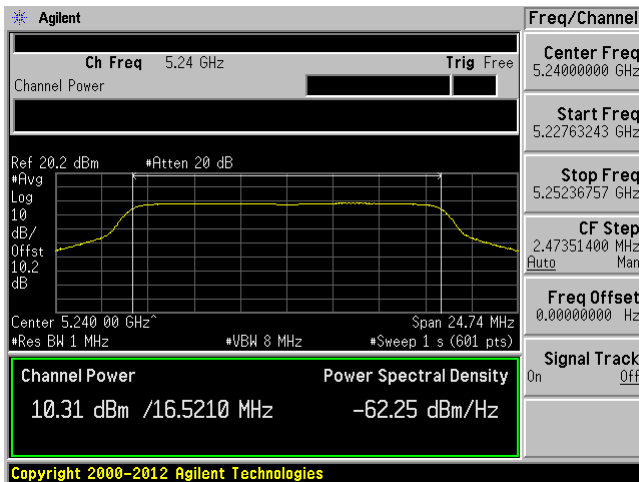
Middle channel – Chain 0



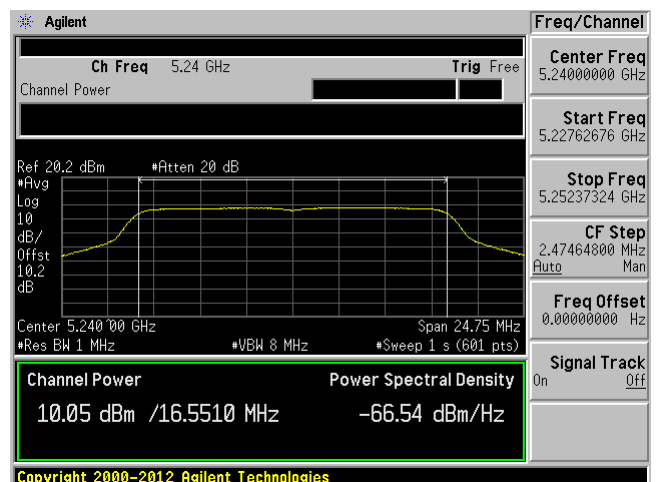
Middle channel – Chain 1



High channel – Chain 0

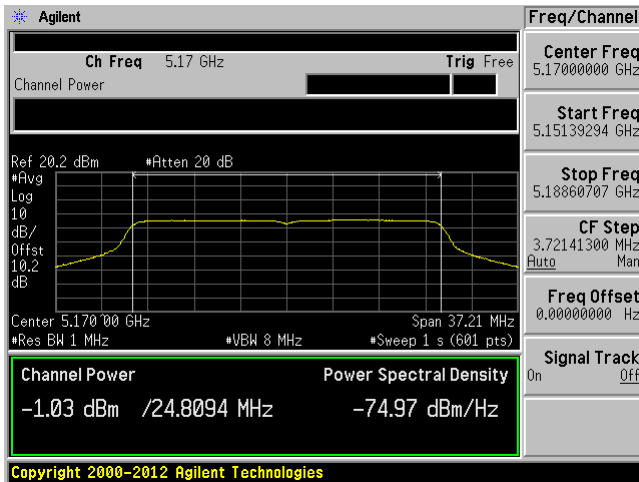


High channel – Chain 1

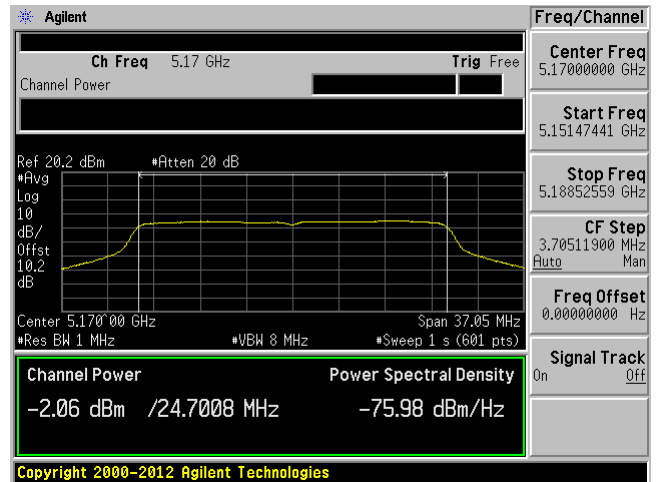


### 30 MHz Bandwidth

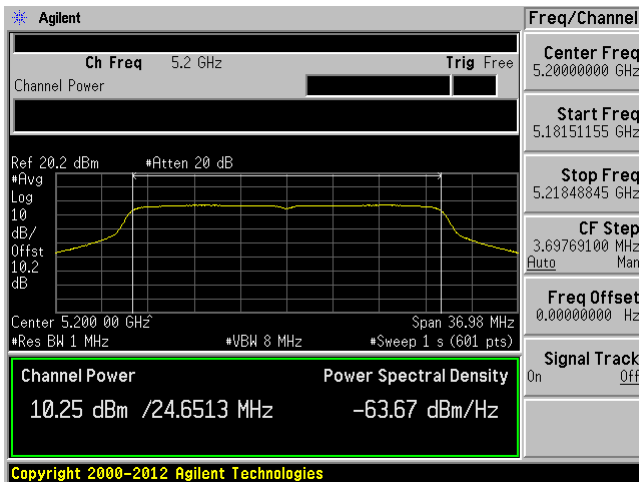
Low channel – Chain 0



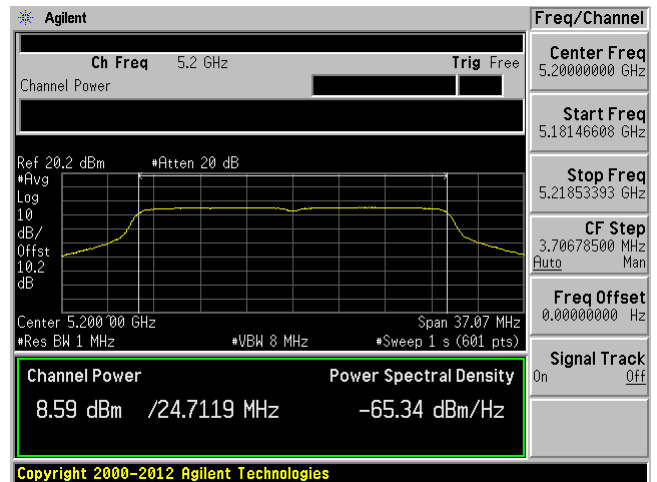
Low channel – Chain 1



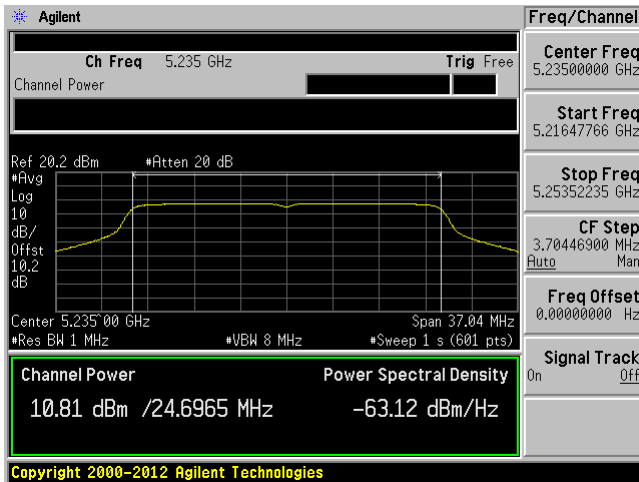
Middle channel – Chain 0



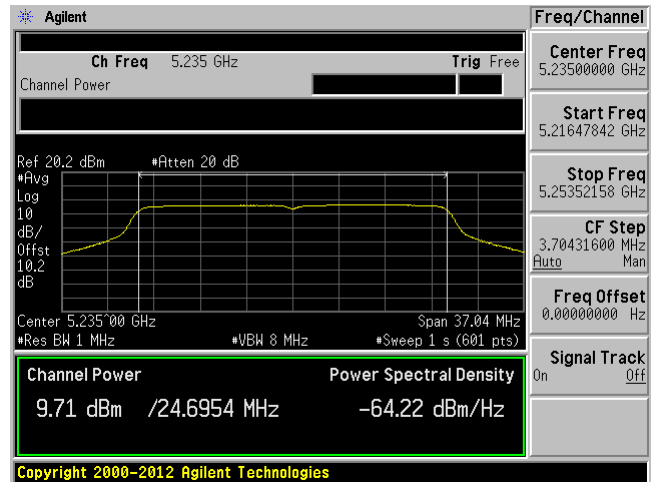
Middle channel – Chain 1



High channel – Chain 0

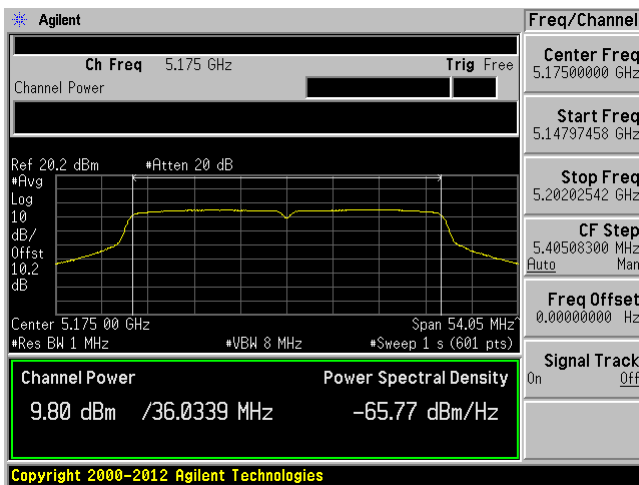


High channel – Chain 1

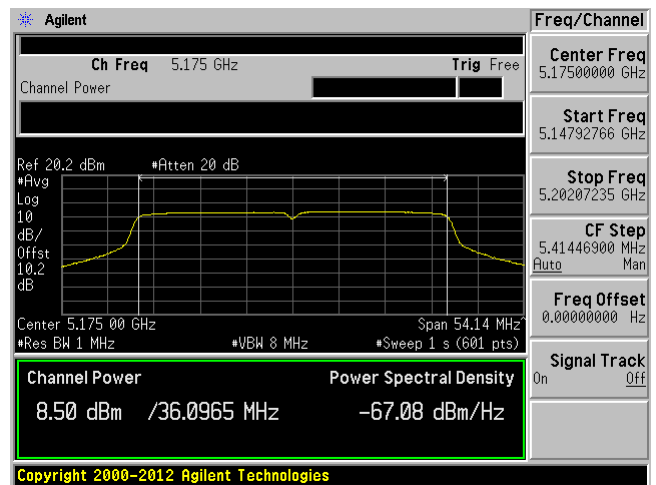


40 MHz Bandwidth

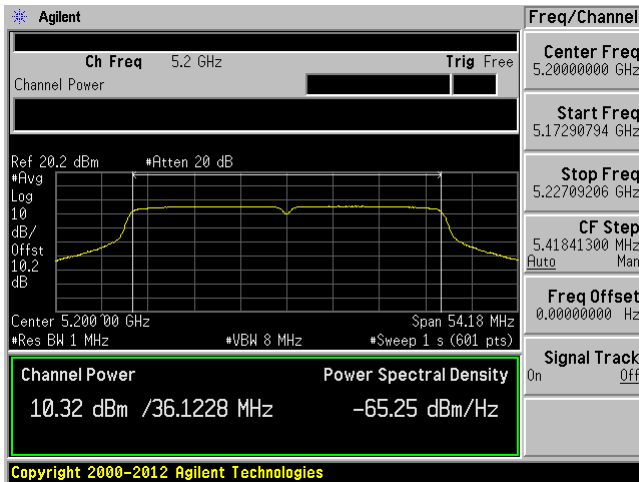
Low channel – Chain 0



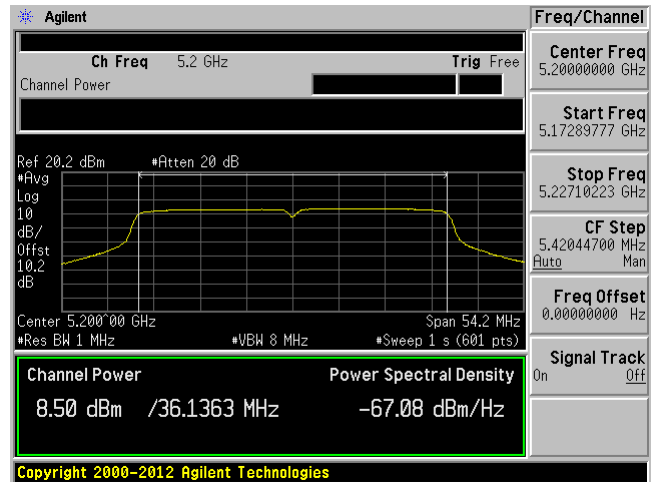
Low channel – Chain 1



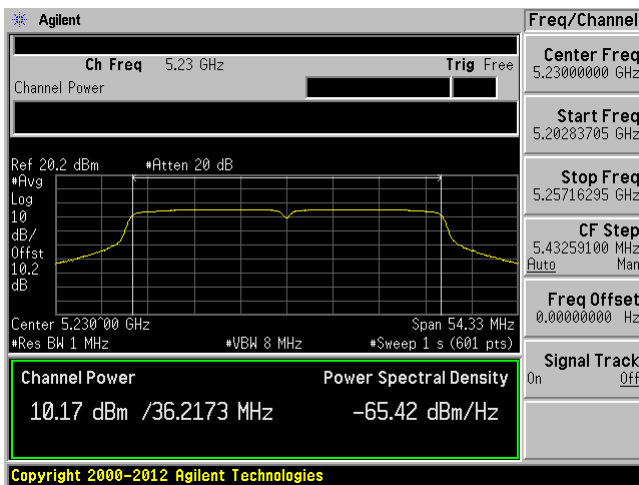
Middle channel – Chain 0



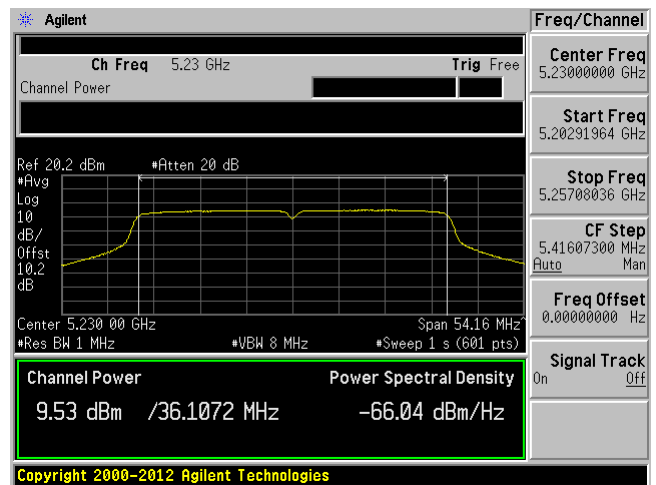
Middle channel – Chain 1



High channel – Chain 0



High channel – Chain 1





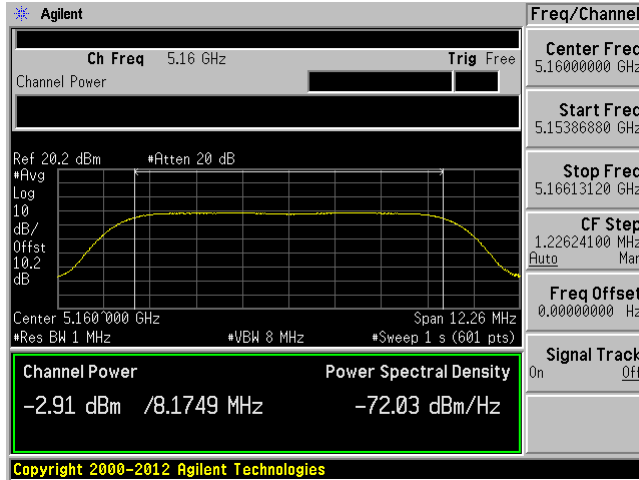
**Power Setting 2 – for Dish Antenna**

Channel	Frequency (MHz)	Conducted Output Power (dBm)			Limit (dBm)	Result
		Chain 0	Chain 1	Combined		
10 MHz Bandwidth						
Low	5160	-2.91	-5.44	-0.98	26.4	Pass
Middle	5200	-2.90	-4.27	-0.52	26.4	Pass
High	5245	-2.81	-2.79	0.21	26.4	Pass
20 MHz Bandwidth						
Low	5165	-3.03	-4.86	-0.84	26.4	Pass
Middle	5200	-2.69	-4.00	-0.29	26.4	Pass
High	5240	-2.95	-2.88	0.10	26.4	Pass
30 MHz Bandwidth						
Low	5170	-3.27	-4.46	-0.81	26.4	Pass
Middle	5200	-2.73	-3.76	-0.2	26.4	Pass
High	5235	-2.56	-2.64	0.41	26.4	Pass
40 MHz Bandwidth						
Low	5175	-7.21	-9.28	-5.11	26.4	Pass
Middle	5200	-7.54	-8.41	-4.94	26.4	Pass
High	5230	-7.14	-7.86	-4.47	26.4	Pass

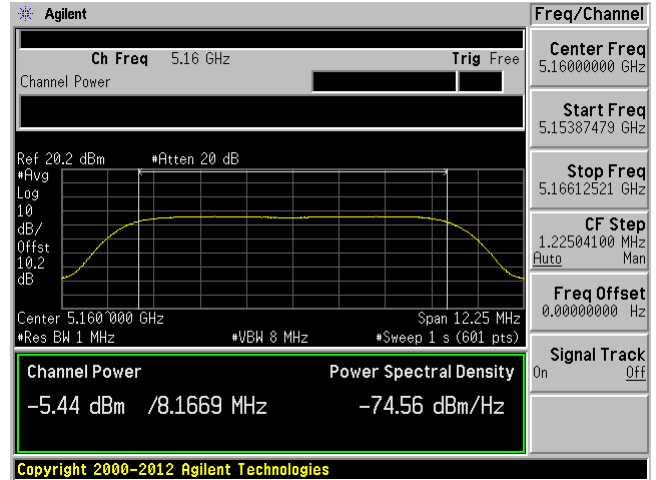
Note: The Dish antenna only used as fixed point-to-point antenna. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. So the limit is  $30 - (26.6 - 23) = 26.4$  dBm.

### 10 MHz Bandwidth

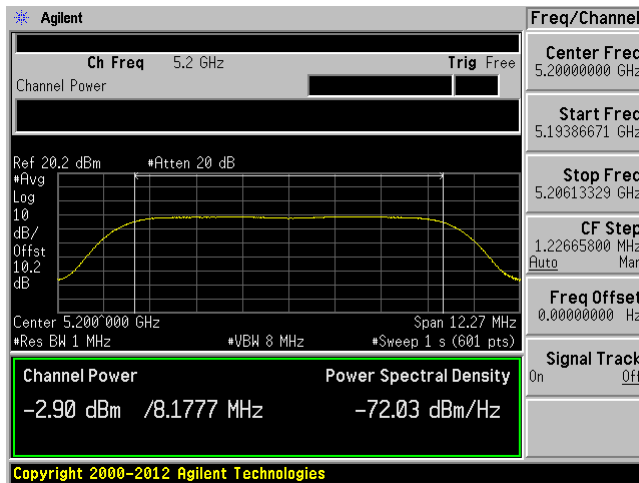
Low channel – Chain 0



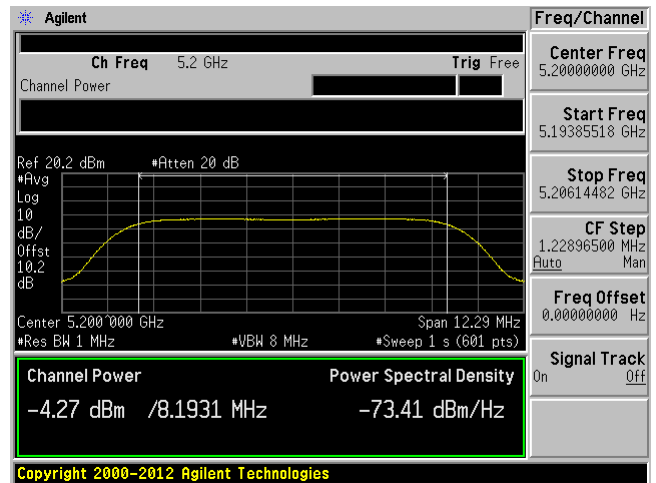
Low channel – Chain 1



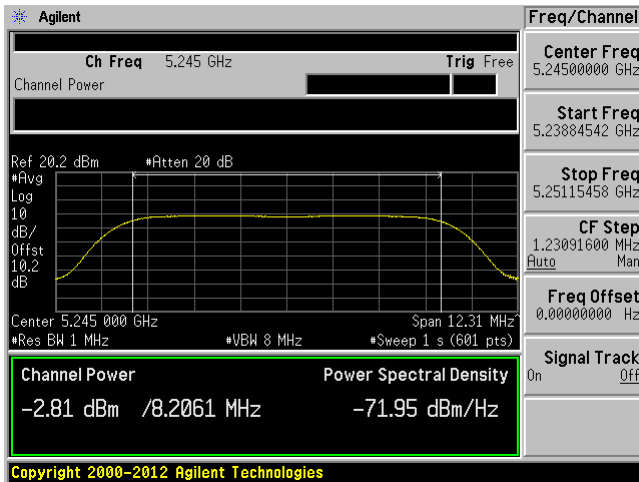
Middle channel – Chain 0



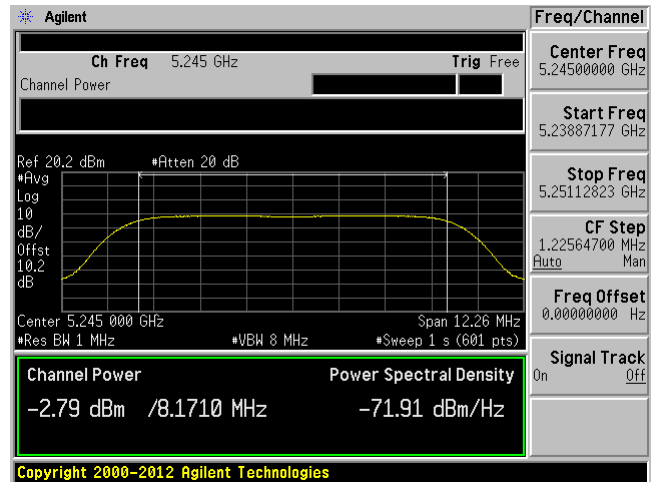
Middle channel – Chain 1



High channel – Chain 0

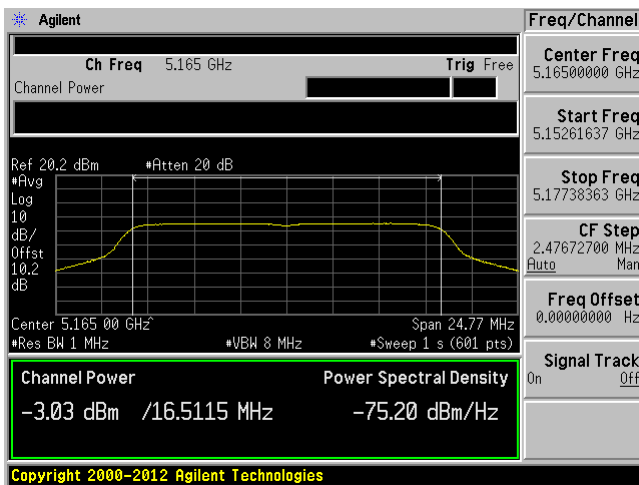


High channel – Chain 1

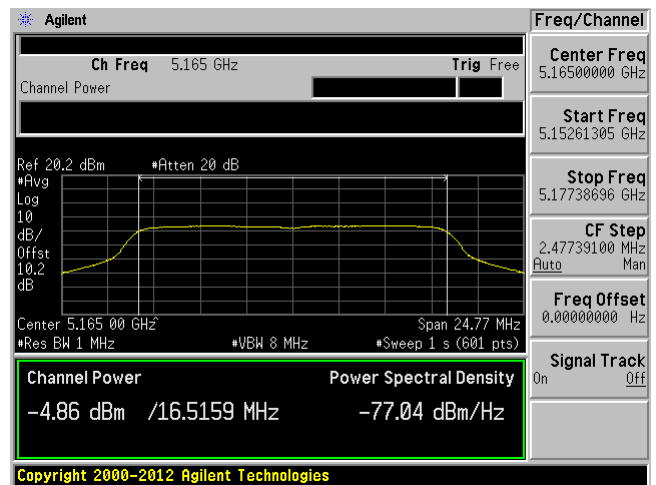


20 MHz Bandwidth

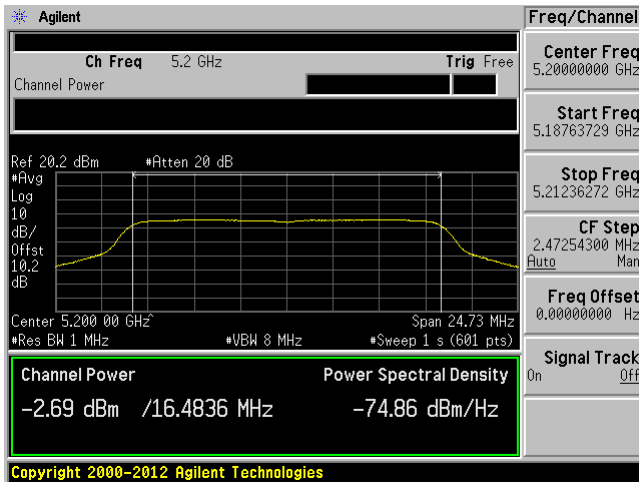
Low channel – Chain 0



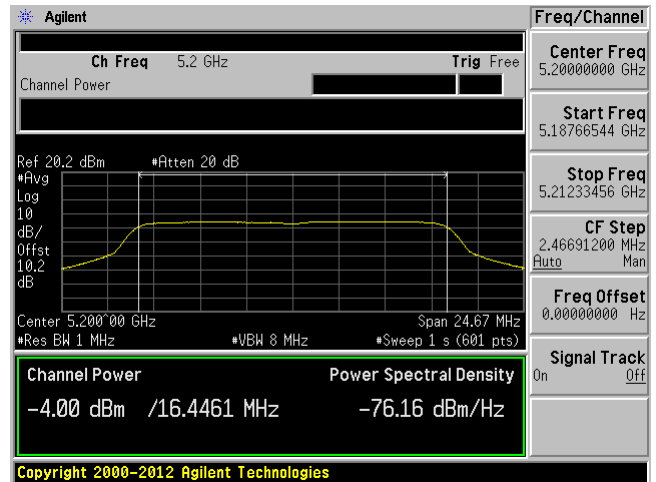
Low channel – Chain 1



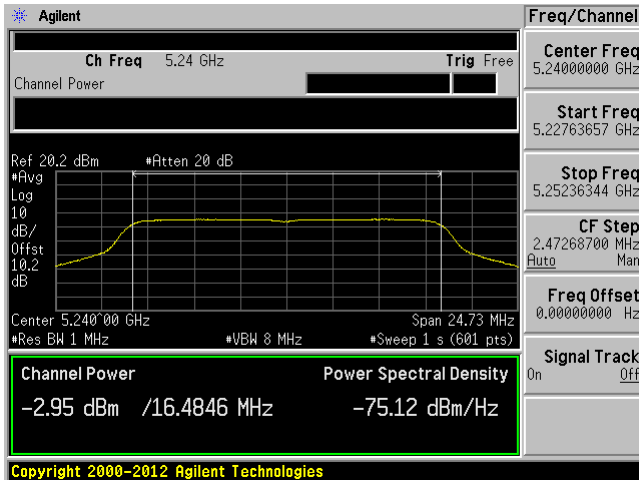
Middle channel – Chain 0



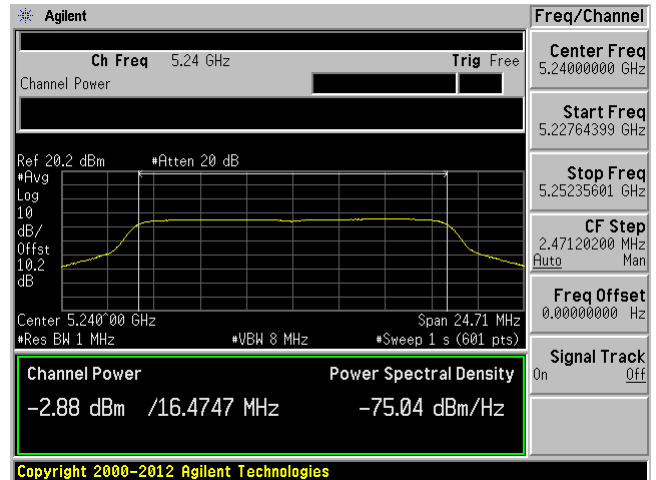
Middle channel – Chain 1



High channel – Chain 0

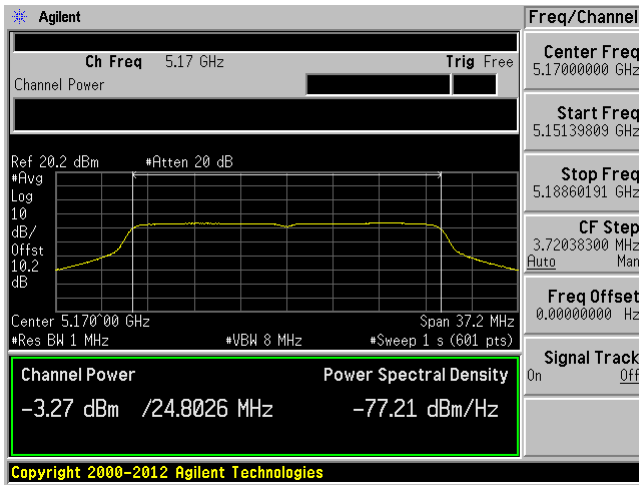


High channel – Chain 1

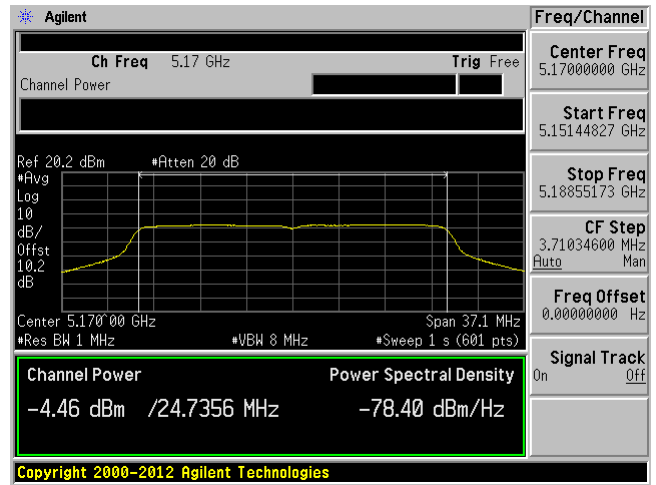


### 30 MHz Bandwidth

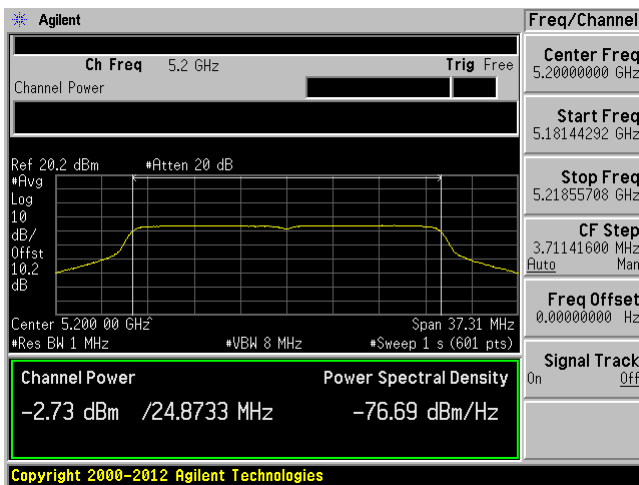
Low channel – Chain 0



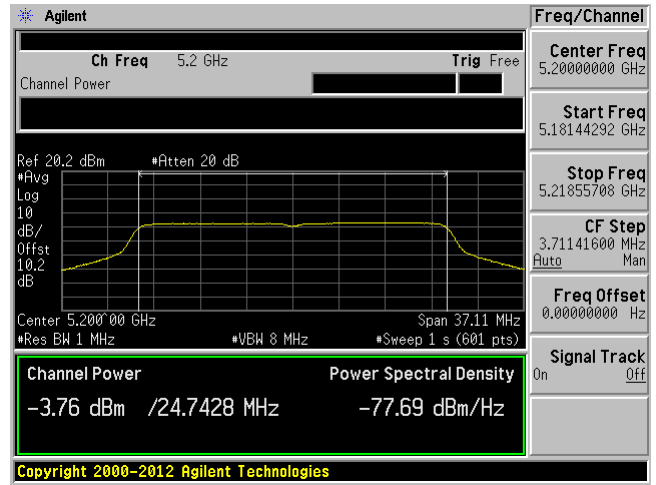
Low channel – Chain 1



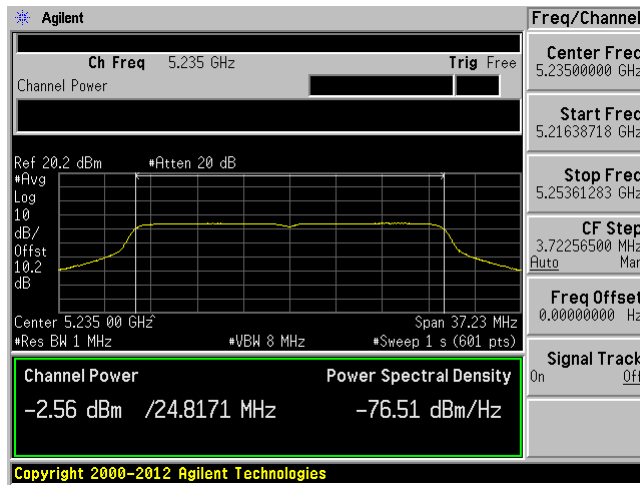
Middle channel – Chain 0



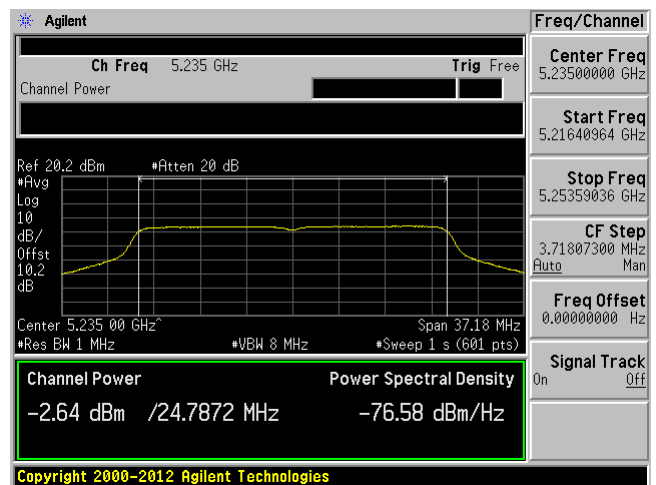
Middle channel – Chain 1



High channel – Chain 0

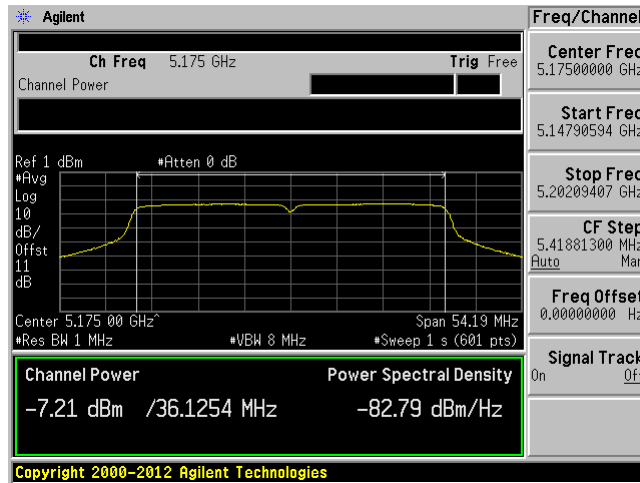


High channel – Chain 1

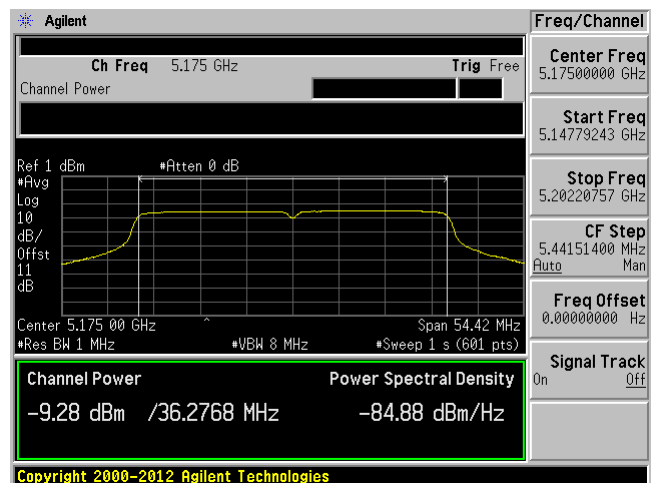


40 MHz Bandwidth

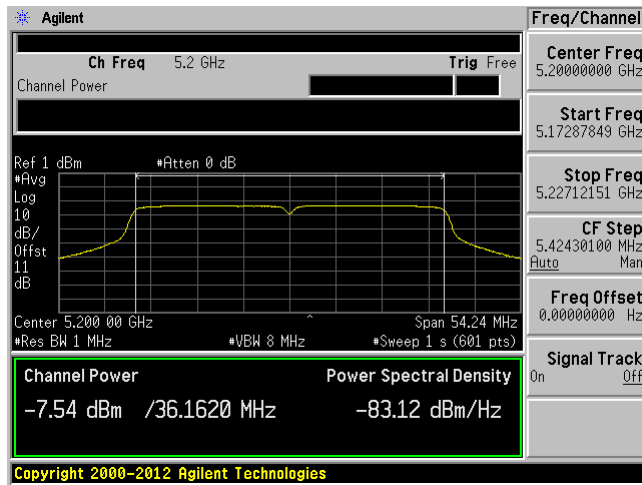
Low channel – Chain 0



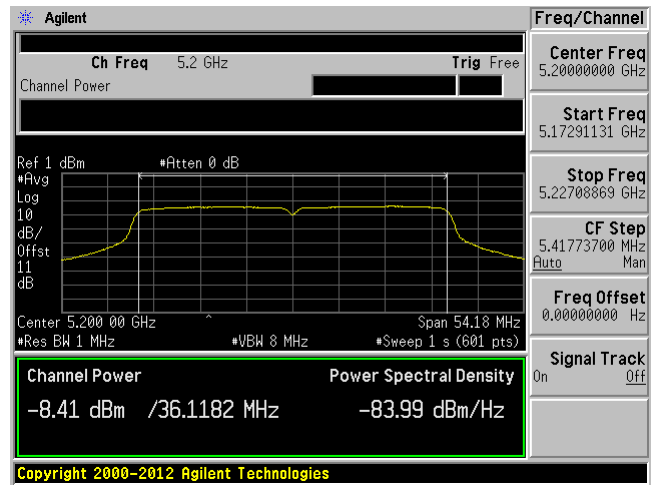
Low channel – Chain 1



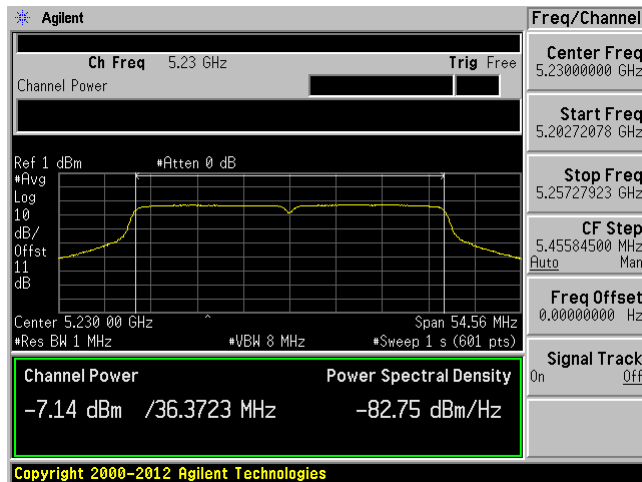
Middle channel – Chain 0



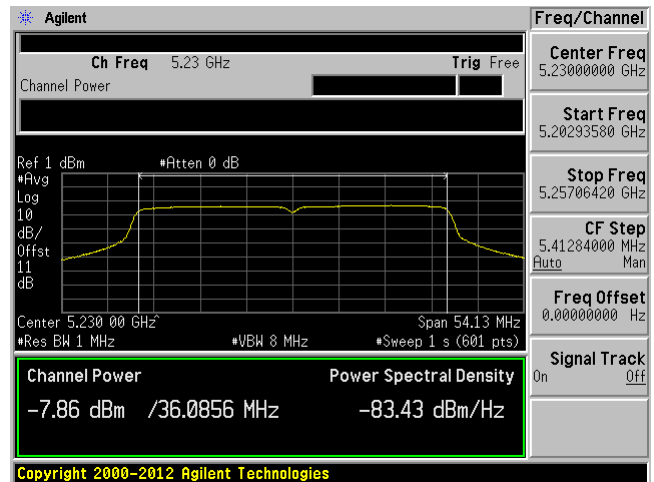
Middle channel – Chain 1



High channel – Chain 0



High channel – Chain 1



## 10 FCC §407(b) – Band Edge

### 10.1 Applicable Standards

According to FCC §15.407(b)

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.

b (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.

### 10.2 Measurement Procedure

Test measurements are based on FCC KDB 789033 D02 General UNII Test Procedures New Rules v01, GUIDELINES FOR COMPLIANCE TESTING OF UNLICENSED NATIONAL INFORMATION INFRASTRUCTURE (U-NII) DEVICES PART 15, SUBPART E

### 10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2014-09-03	1 year

*Statement of Traceability: BACL Corp. attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.*

### 10.4 Test Environmental Conditions

<b>Temperature:</b>	22-25 °C
<b>Relative Humidity:</b>	40-43 %
<b>ATM Pressure:</b>	102.1-104.4 kPa

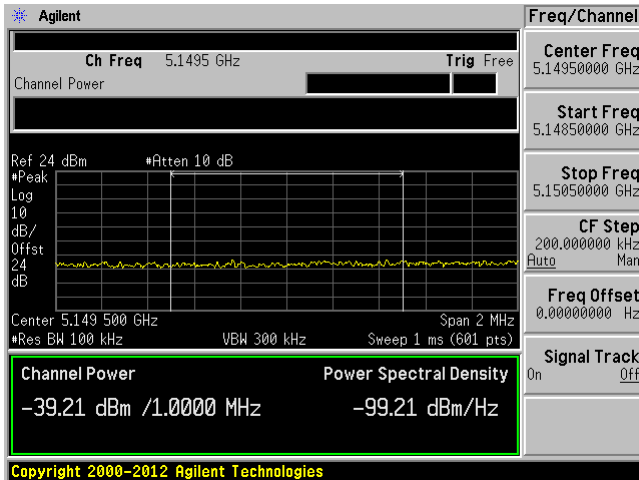
*The testing was performed by Jin Yang on 2015-07-22 to 2015-08-03 at RF site.*



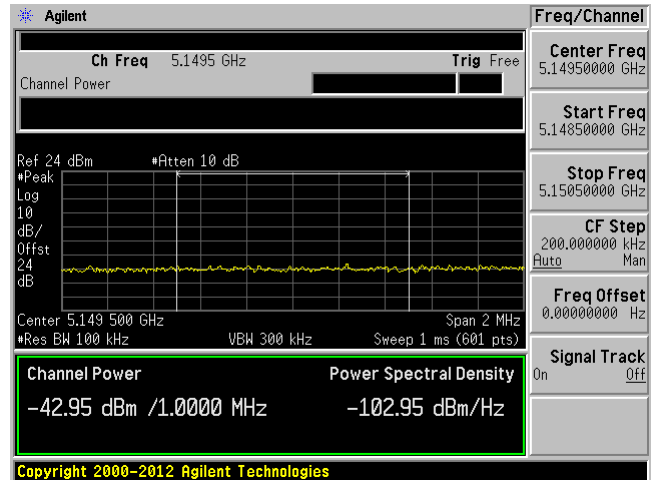
**Band Edge (Power setting for Sector Antenna)**

**10 MHz Bandwidth**

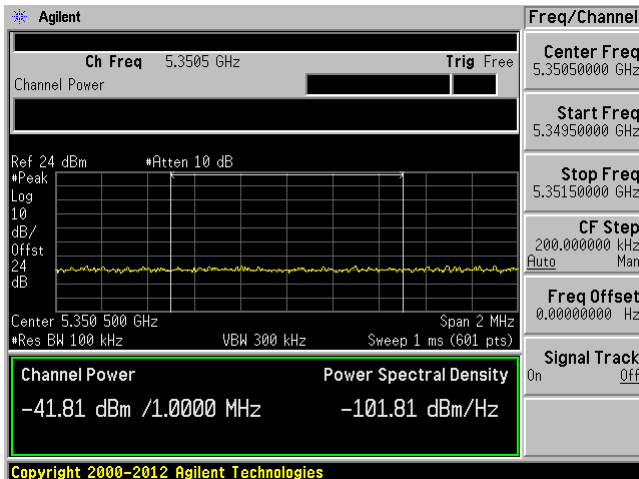
Lower Band Edge – Chain 0



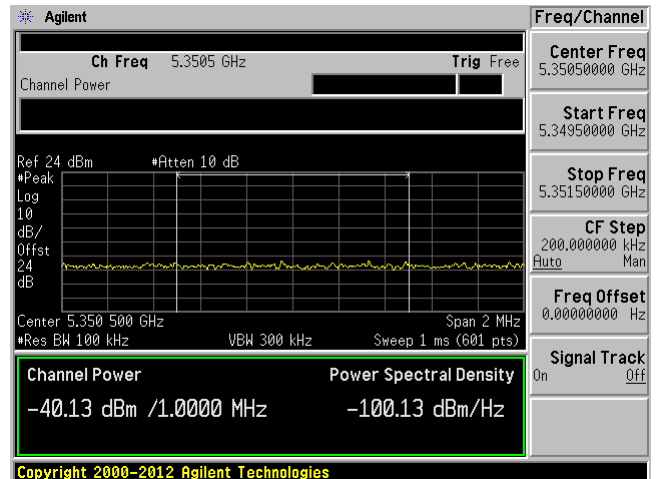
Lower Band Edge – Chain 1



Upper Band Edge – Chain 0

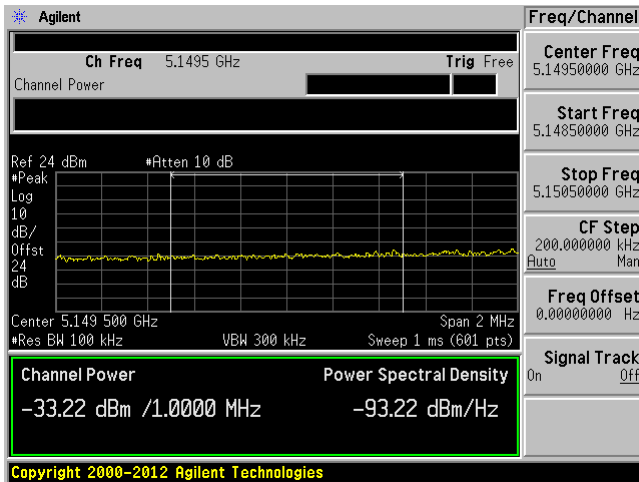


Upper Band Edge – Chain 1

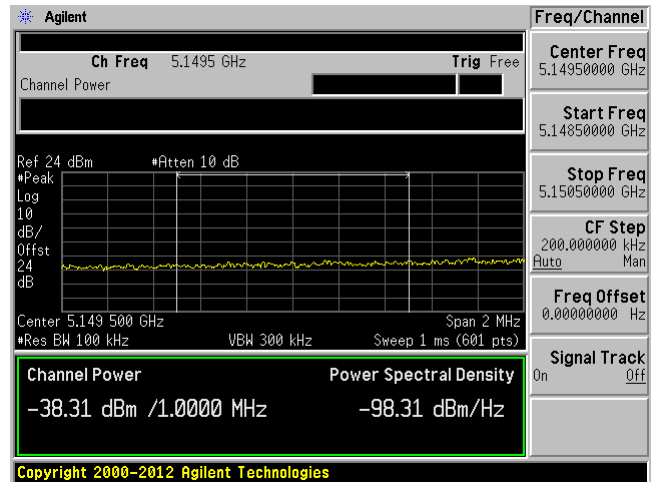


### 20 MHz Bandwidth

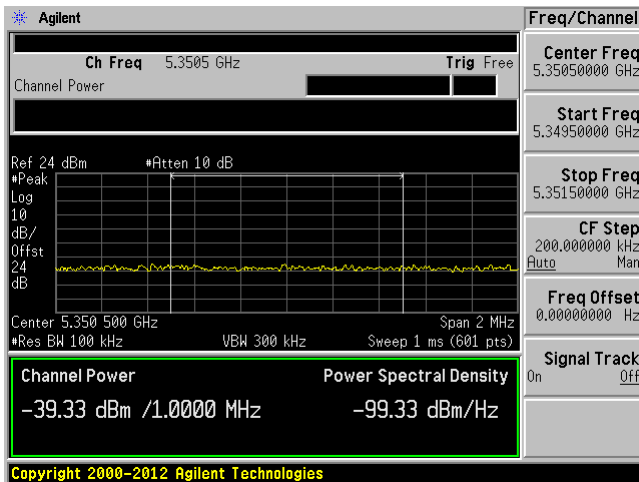
Lower Band Edge – Chain 0



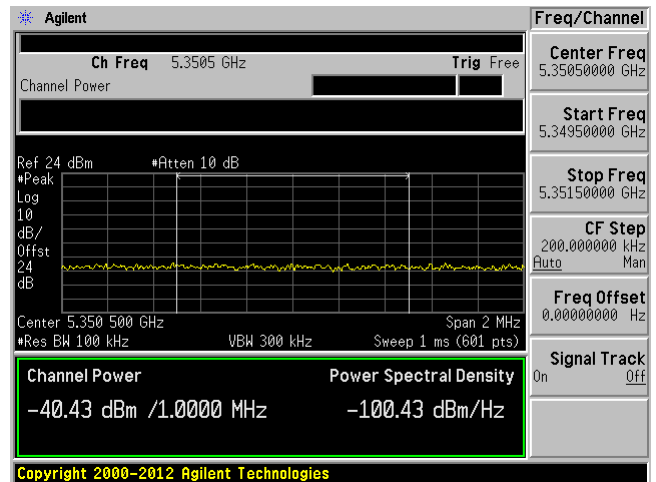
Lower Band Edge – Chain 1



Upper Band Edge – Chain 0

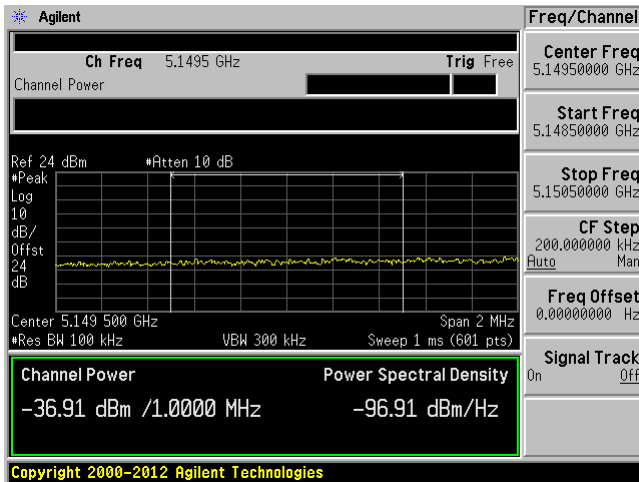


Upper Band Edge – Chain 1

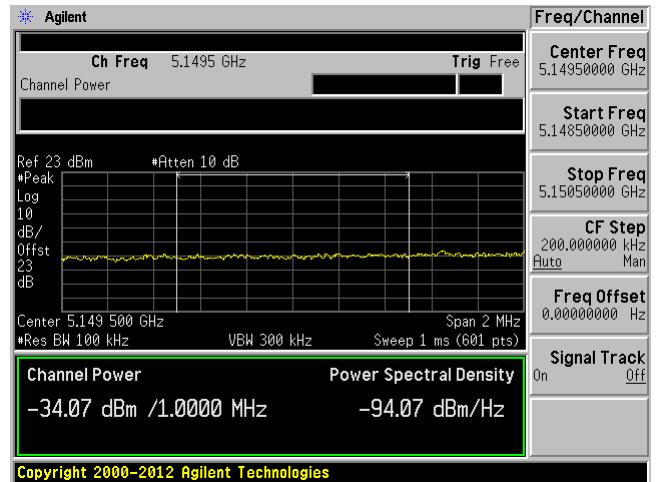


### 30 MHz Bandwidth

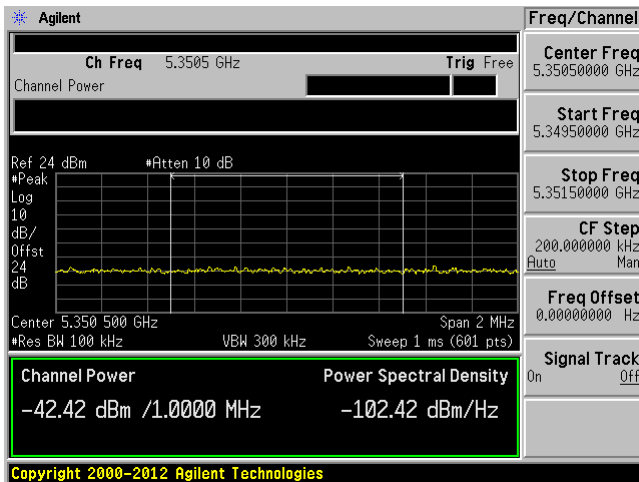
Lower Band Edge – Chain 0



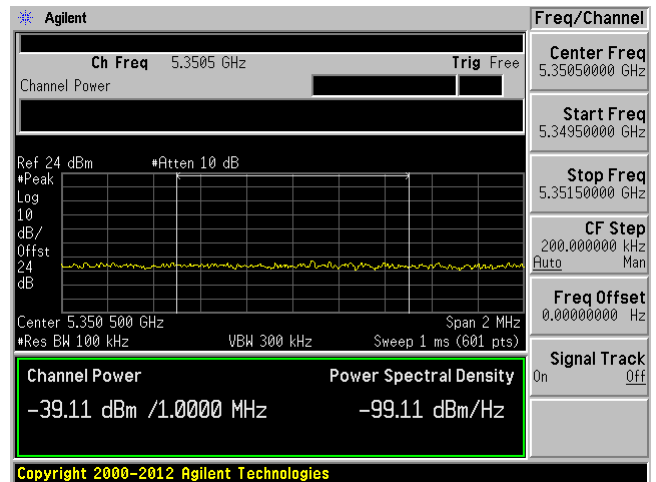
Lower Band Edge – Chain 1



Upper Band Edge – Chain 0

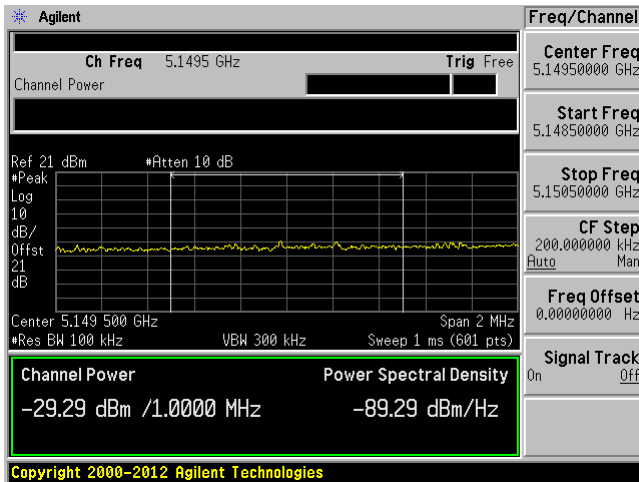


Upper Band Edge – Chain 1

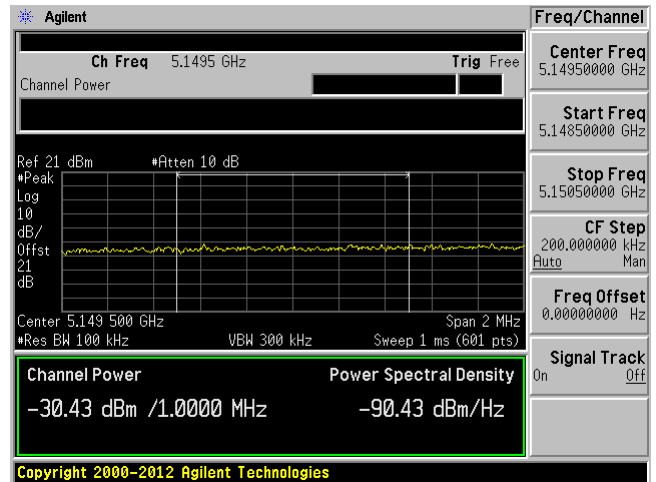


### 40 MHz Bandwidth

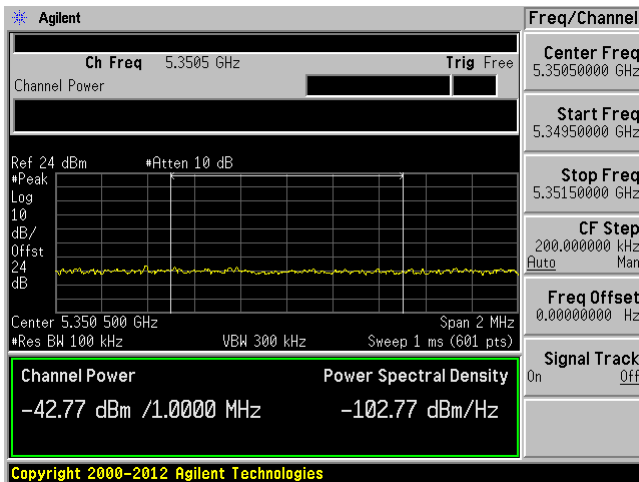
Lower Band Edge – Chain 0



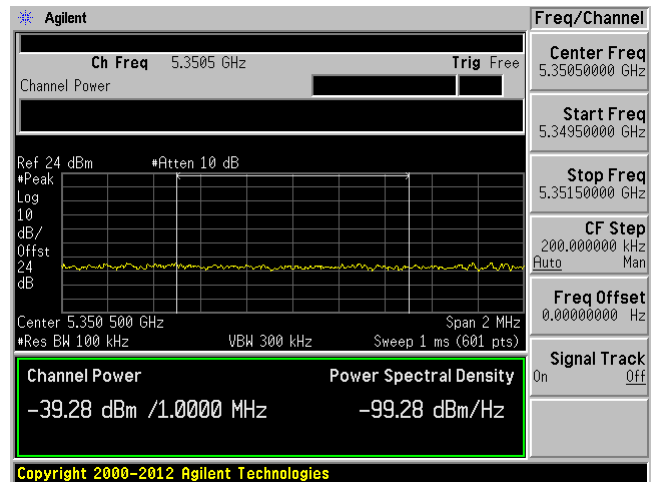
Lower Band Edge – Chain 1



Upper Band Edge – Chain 0



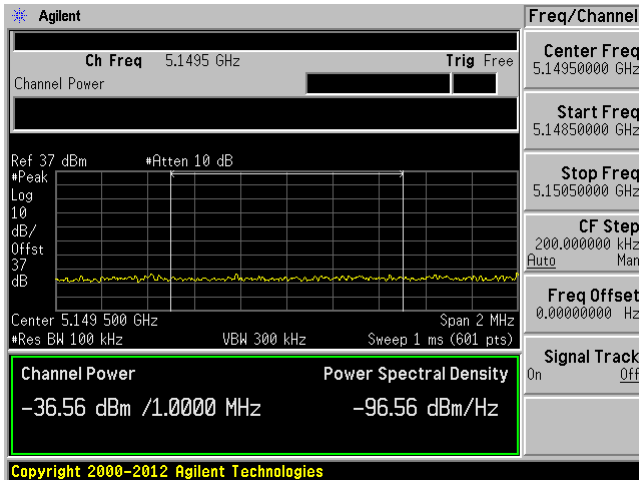
Upper Band Edge – Chain 1



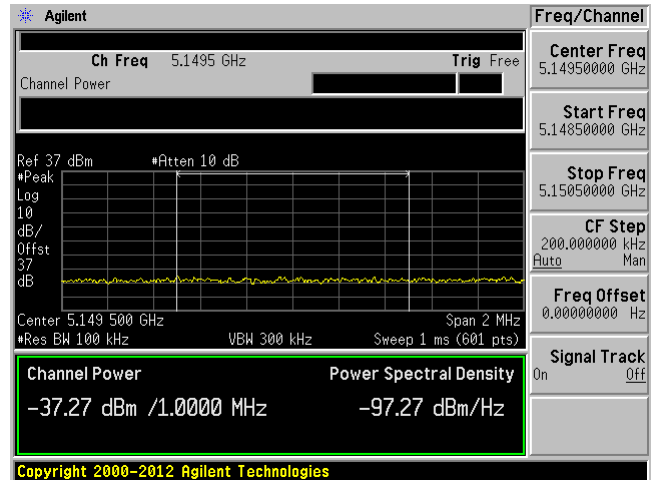
**Band Edge (Power setting for Dish Antenna)**

**10 MHz Bandwidth**

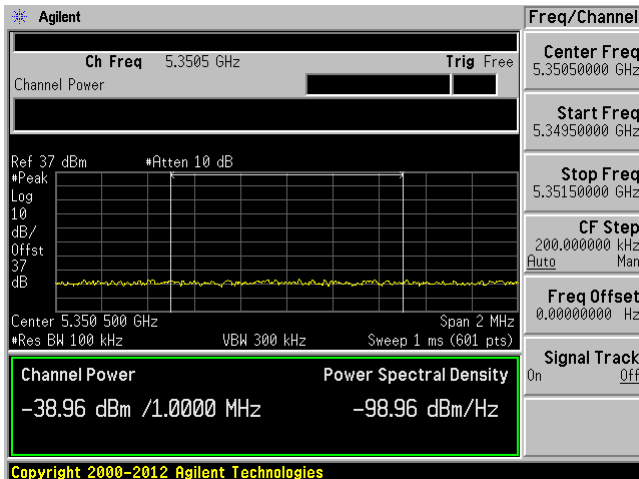
Lower Band Edge – Chain 0



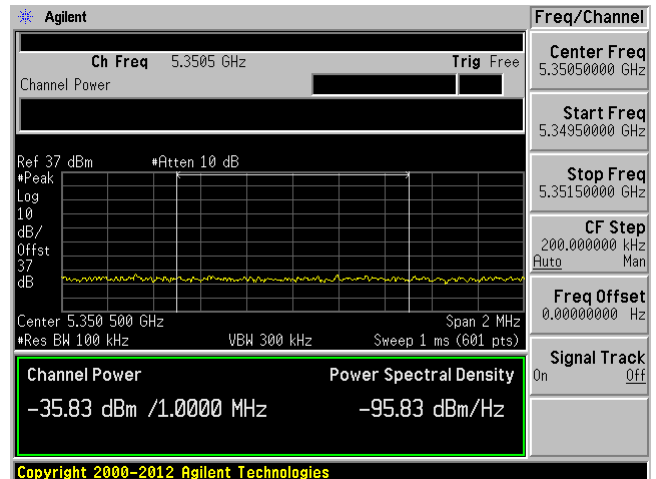
Lower Band Edge – Chain 1



Upper Band Edge – Chain 0

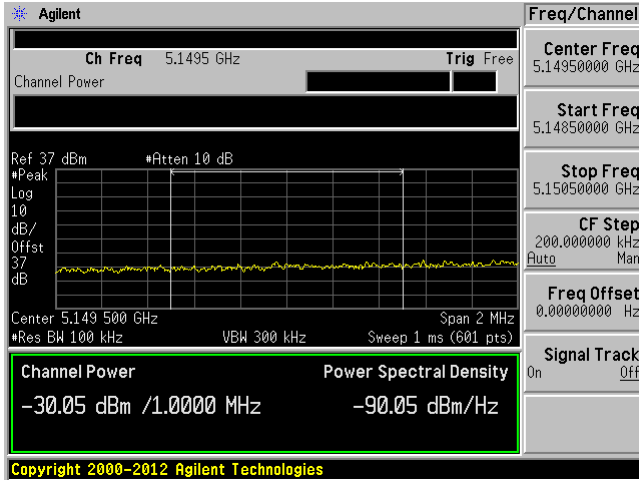


Upper Band Edge – Chain 1

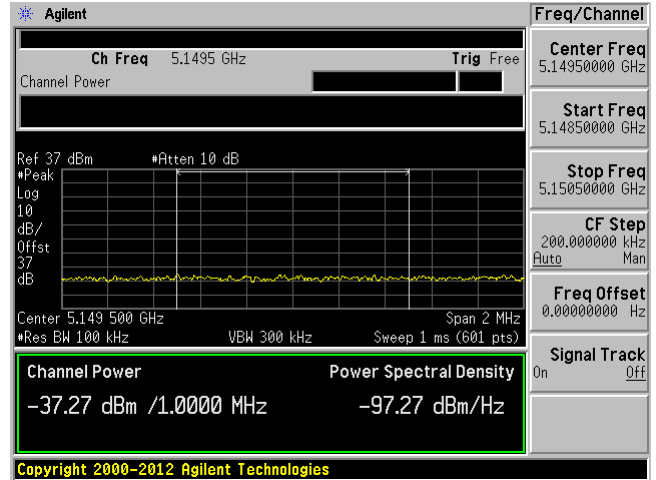


### 20 MHz Bandwidth

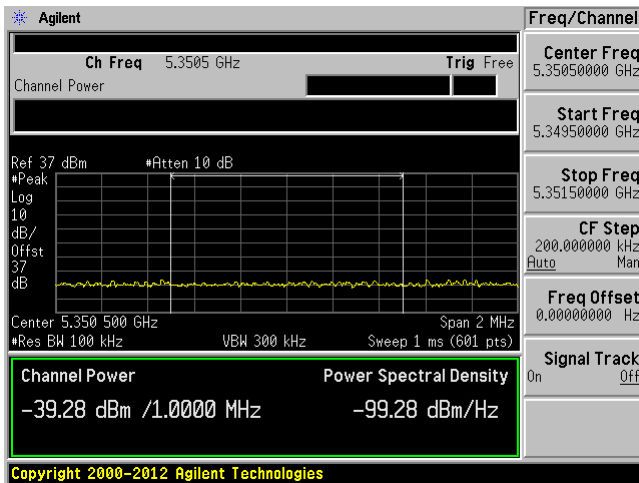
Lower Band Edge – Chain 0



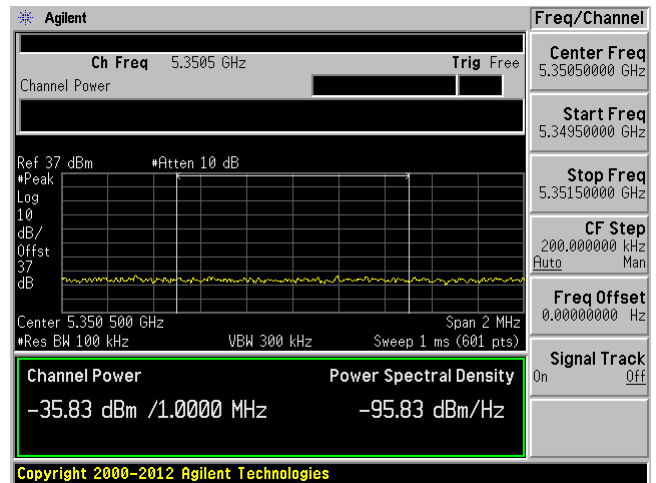
Lower Band Edge – Chain 1



Upper Band Edge – Chain 0

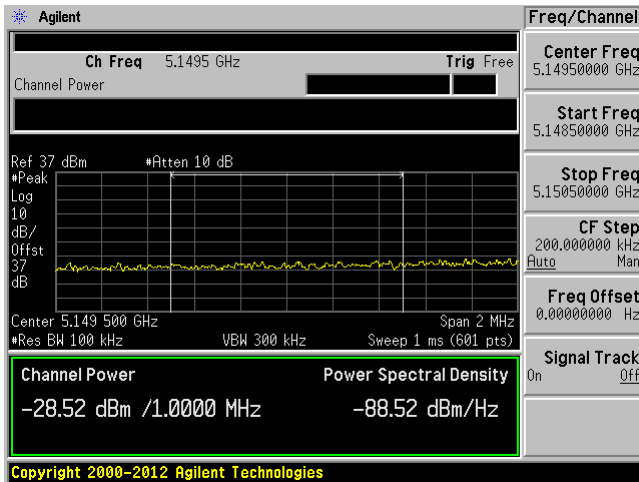


Upper Band Edge – Chain 1

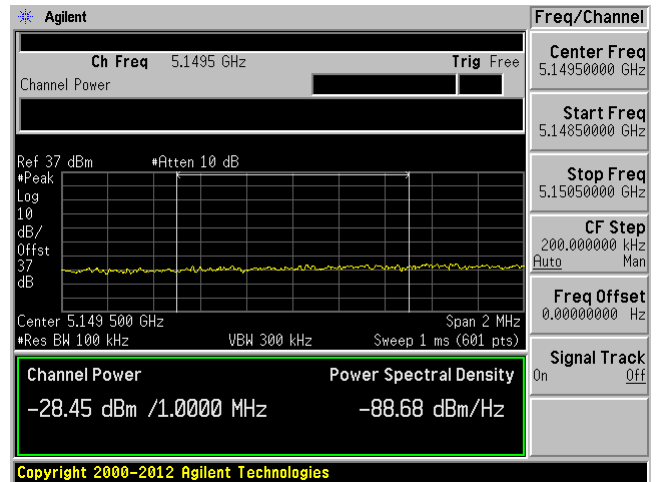


### 30 MHz Bandwidth

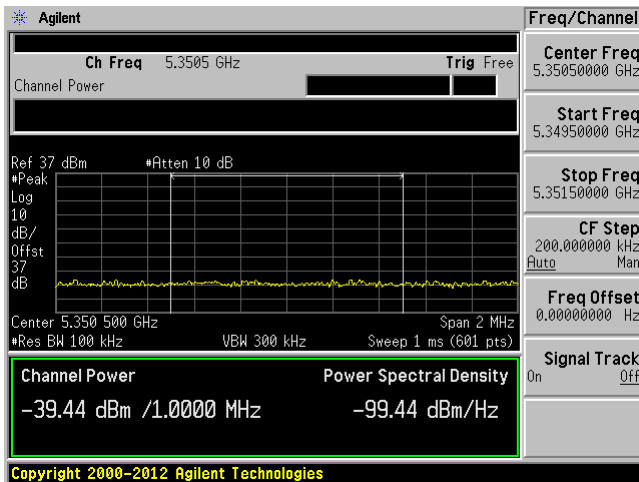
Lower Band Edge – Chain 0



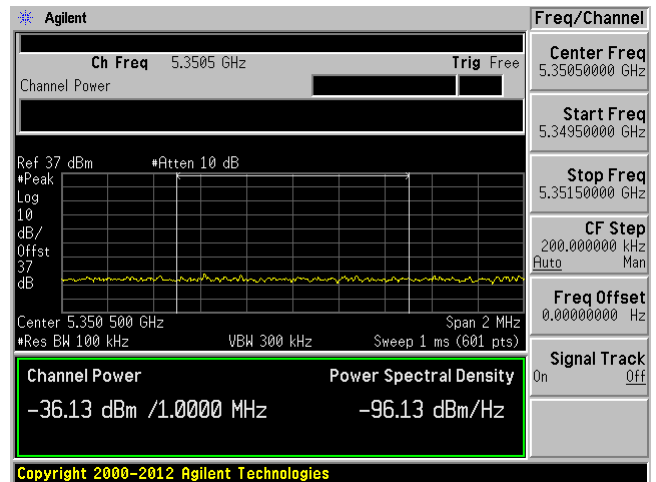
Lower Band Edge – Chain 1



Upper Band Edge – Chain 0

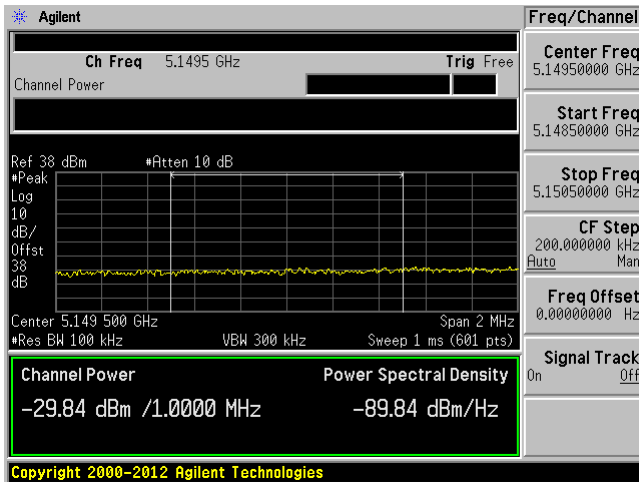


Upper Band Edge – Chain 1

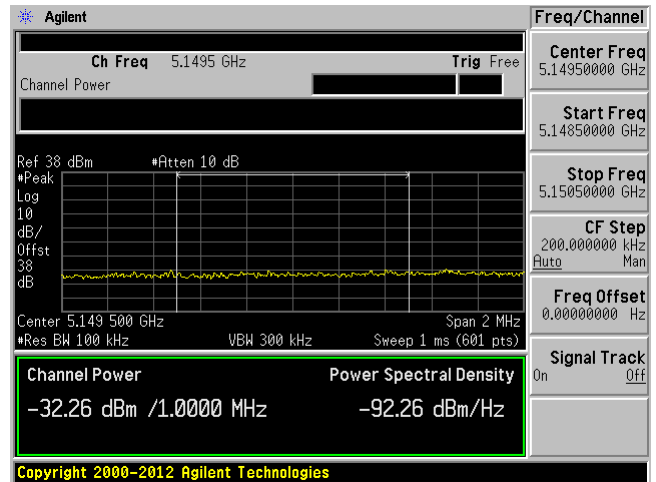


### 40 MHz Bandwidth

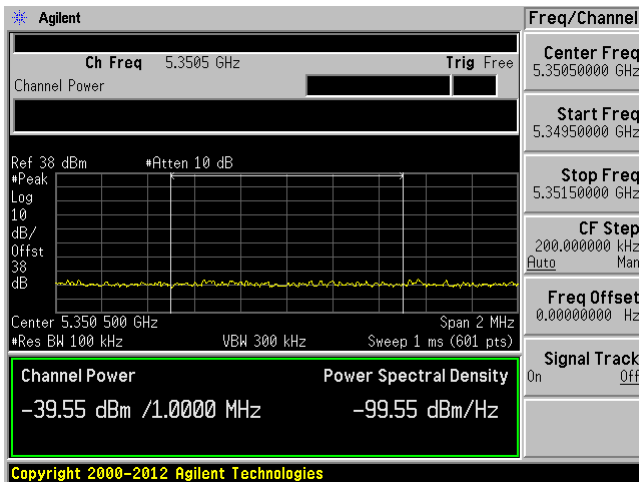
Lower Band Edge – Chain 0



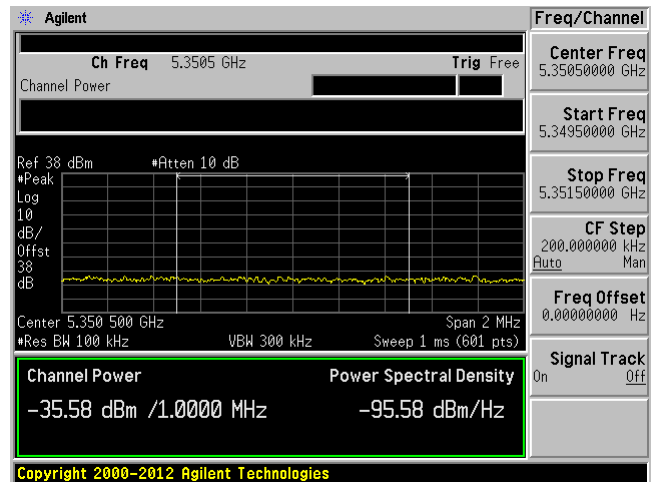
Lower Band Edge – Chain 1



Upper Band Edge – Chain 0



Upper Band Edge – Chain 1





## 11 FCC §15.407(a) - Power Spectral Density

### 11.1 Applicable Standards

According to FCC §15.407(a)

(i) For an outdoor 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. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(iii) For fixed point-to-point access points 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. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. 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.

### 11.2 Measurement Procedure

The measurements are based on FCC KDB 789033 D02 General UNII Test Procedures New Rules v01: Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices section F: Peak power spectral density (PPSD)

### 11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2014-09-03	1 year

**Statement of Traceability:** *BACL Corp.* attests that all calibrations have been performed according to A2LA requirements, traceable to the NIST.

### 11.4 Test Environmental Conditions

<b>Temperature:</b>	22-25 °C
<b>Relative Humidity:</b>	40-43 %
<b>ATM Pressure:</b>	102.1-104.4 kPa

The testing was performed by Jin Yang from 2015-07-22 to 2015-08-03 at RF site.

## 11.5 Test Results

Please refer to the following tables and plots.

### Power Setting 1 – for Omni and Sector Antenna

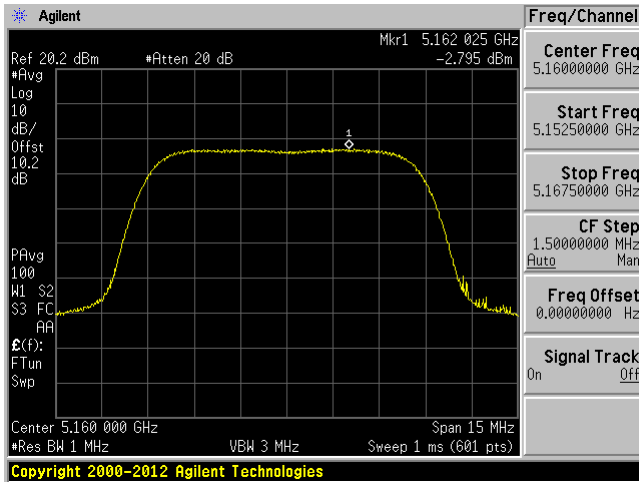
Channel	Frequency (MHz)	Power Spectral Density (dBm)			Limit P-t-P (dBm)	Limit P-t-MP (dBm)	Result
		Chain 0	Chain 1	Combined			
10 MHz Bandwidth							
Low	5160	-2.795	-4.657	-0.62	17	9.8	Pass
Middle	5200	2.736	0.651	4.83	17	9.8	Pass
High	5245	2.595	1.958	5.30	17	9.8	Pass
20 MHz Bandwidth							
Low	5165	-8.445	-9.976	-6.13	17	9.8	Pass
Middle	5200	-0.191	-2.558	1.8	17	9.8	Pass
High	5240	-1.198	-1.628	1.60	17	9.8	Pass
30 MHz Bandwidth							
Low	5170	-14.015	-14.541	-11.26	17	9.8	Pass
Middle	5200	-2.367	-3.870	-0.04	17	9.8	Pass
High	5235	-1.891	-2.611	0.77	17	9.8	Pass
40 MHz Bandwidth							
Low	5175	-4.278	-5.518	-1.84	17	9.8	Pass
Middle	5200	-3.720	-5.711	-1.59	17	9.8	Pass
High	5230	-4.086	-4.554	-1.30	17	9.8	Pass

- Note: (1) When the device operates as a fixed point to point (sector antenna), up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density  
(2) When the device operates as a fixed point to multi point (Omni and sector antenna), the output power shall be reduced by the amount in dB that directional gain of the antenna exceeds 6 dBi (i.e. 13.2 dBi) of the amount in dB that exceeds 6 dBi. The limit of PSD is  $17 - (13.2 - 6) = 9.8$  dBm/MHz.

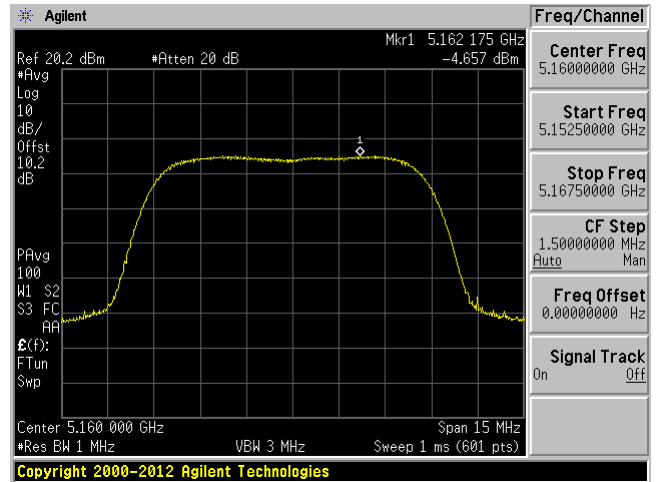
Power Setting 1 – for Omni and Sector Antenna

10 MHz Bandwidth

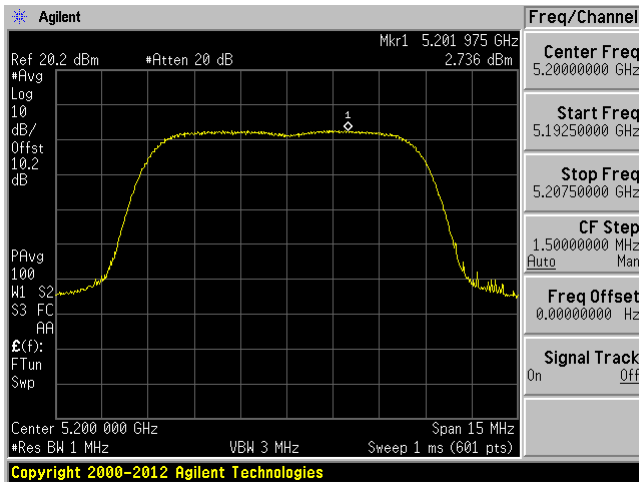
Low channel – Chain 0



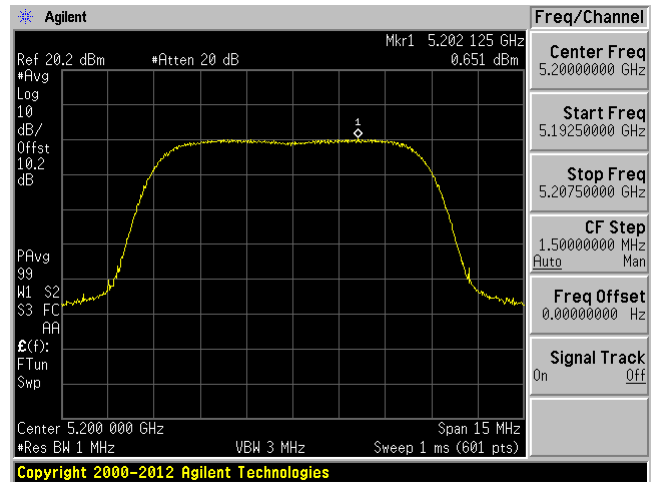
Low channel – Chain 1



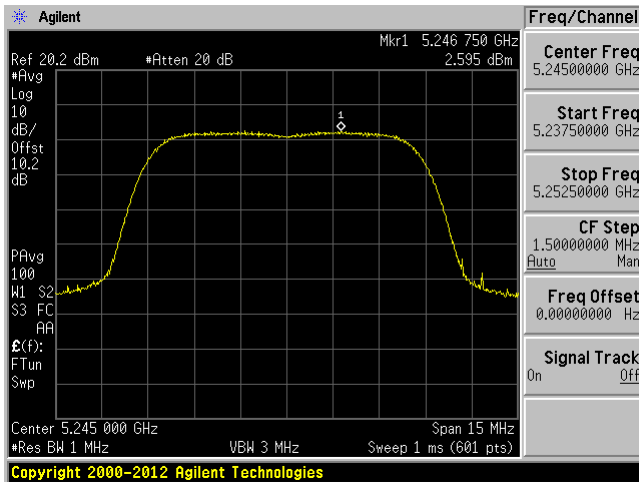
Middle channel – Chain 0



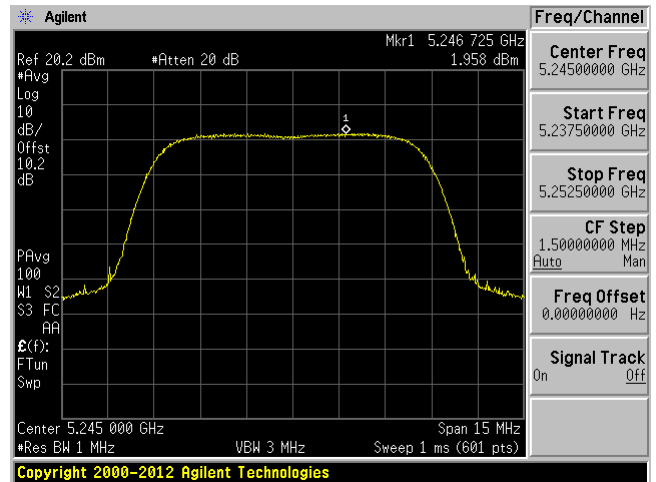
Middle channel – Chain 1



High channel – Chain 0

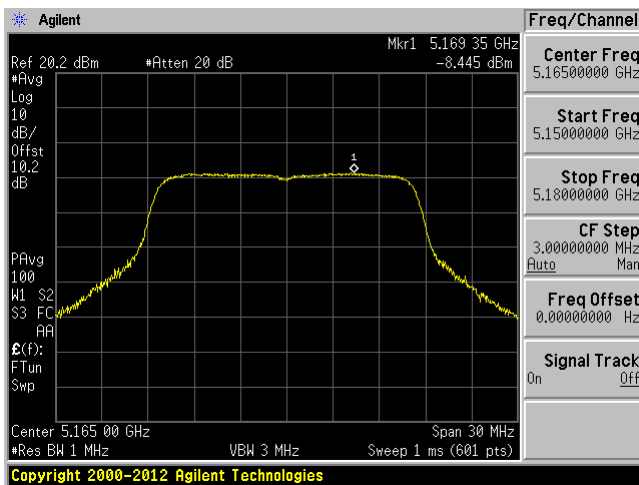


High channel – Chain 1

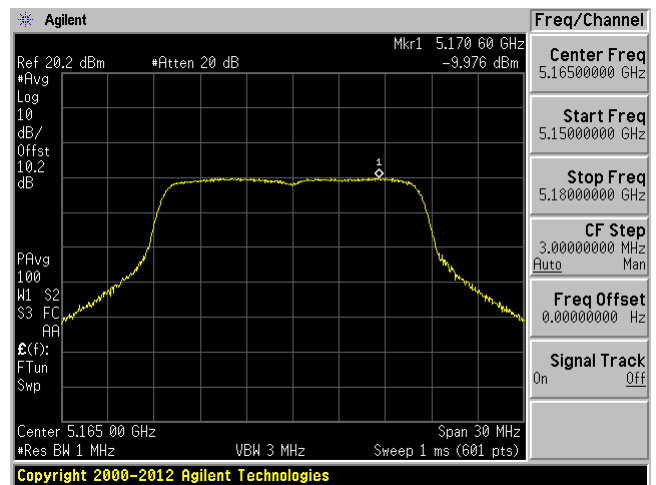


20 MHz Bandwidth

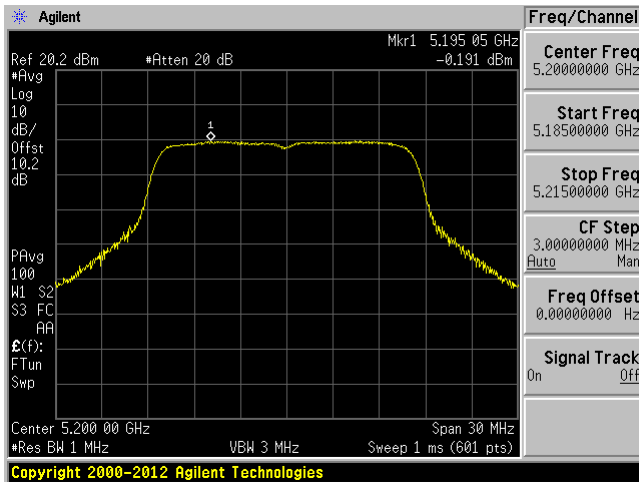
Low channel – Chain 0



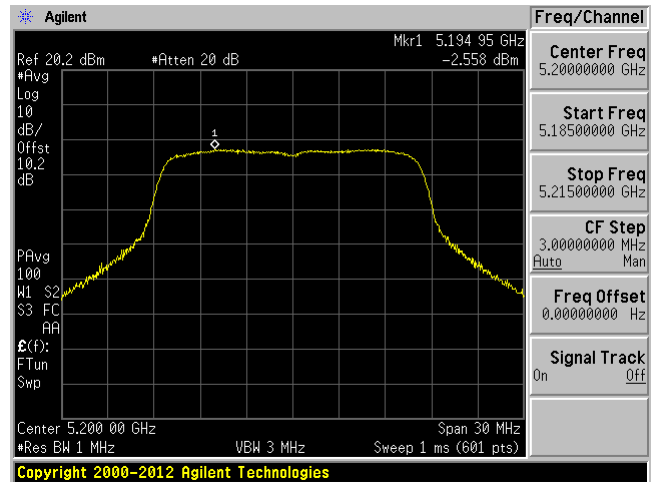
Low channel – Chain 1



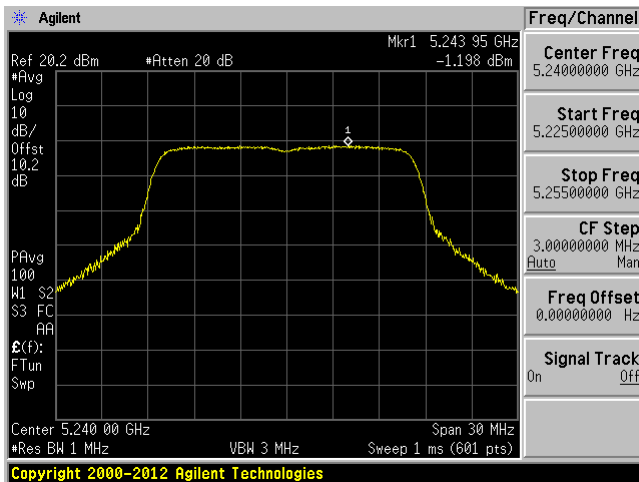
Middle channel – Chain 0



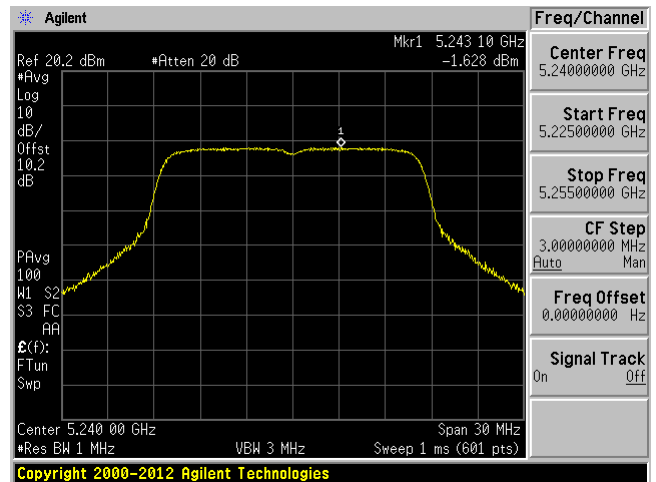
Middle channel – Chain 1



High channel – Chain 0

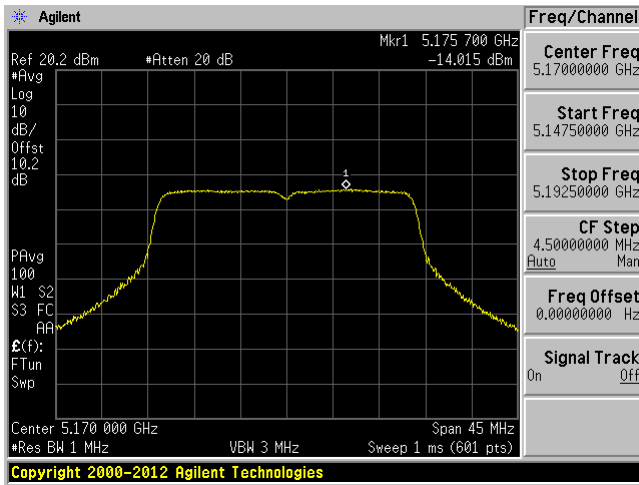


High channel – Chain 1

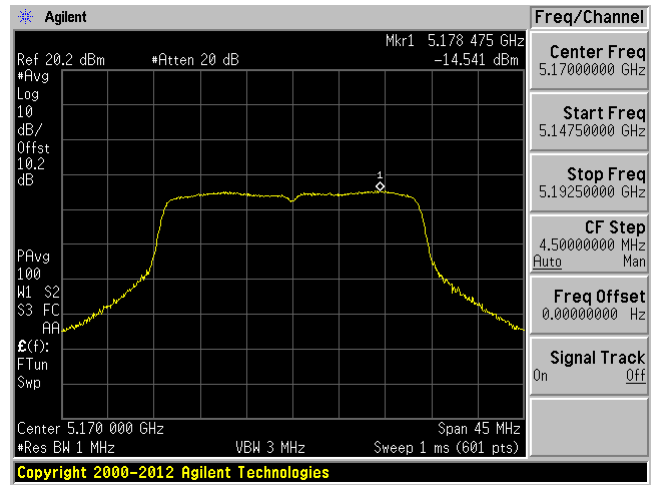


### 20 MHz Bandwidth

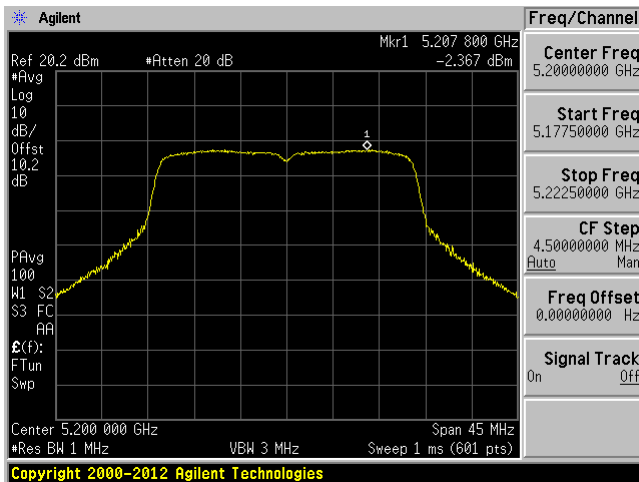
Low channel – Chain 0



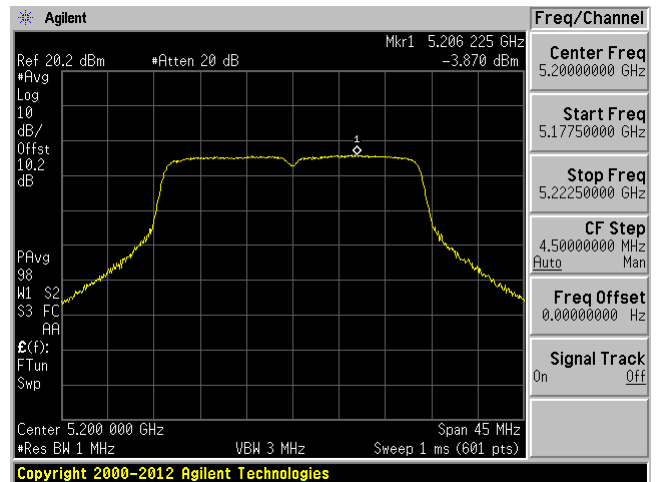
Low channel – Chain 1



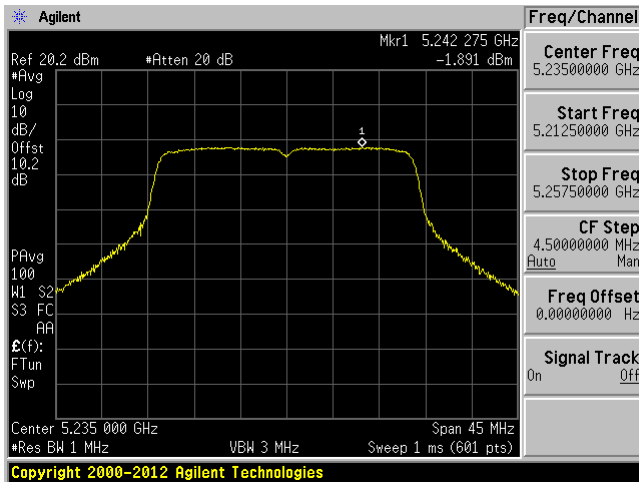
Middle channel – Chain 0



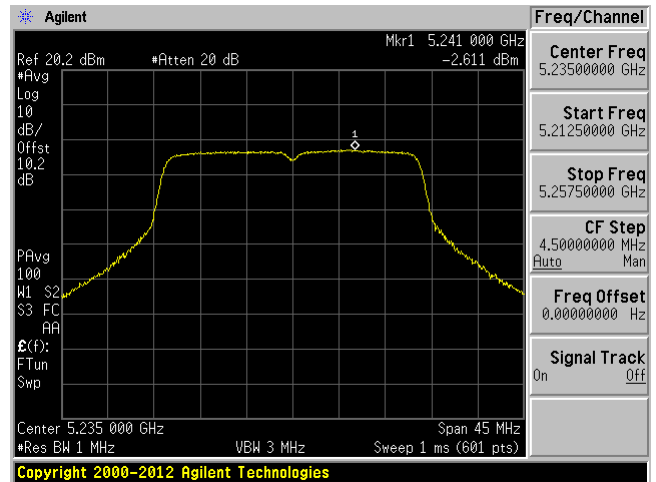
Middle channel – Chain 1



High channel – Chain 0

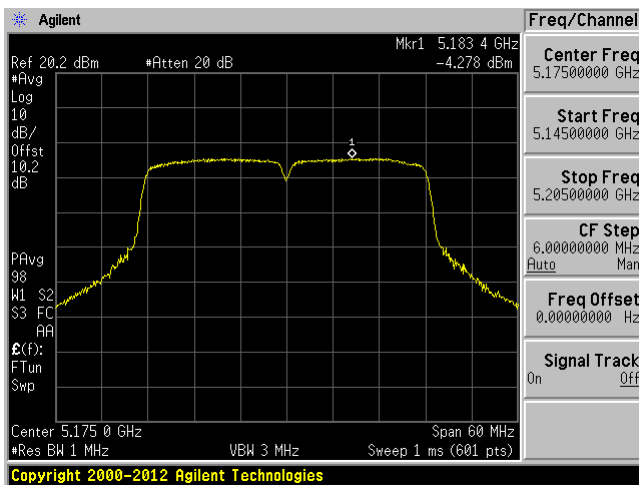


High channel – Chain 1

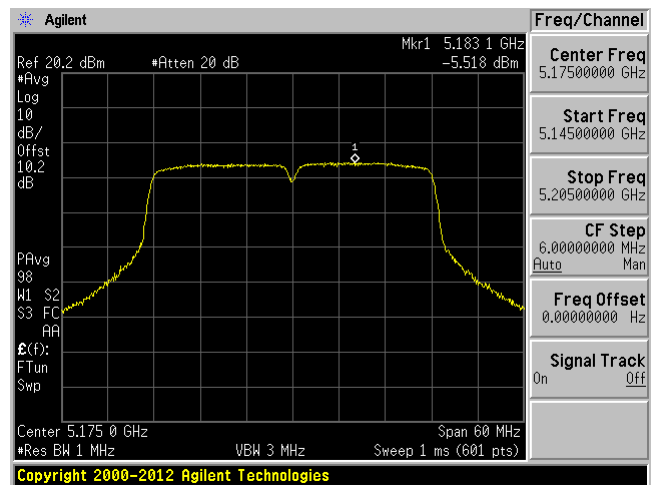


40 MHz Bandwidth

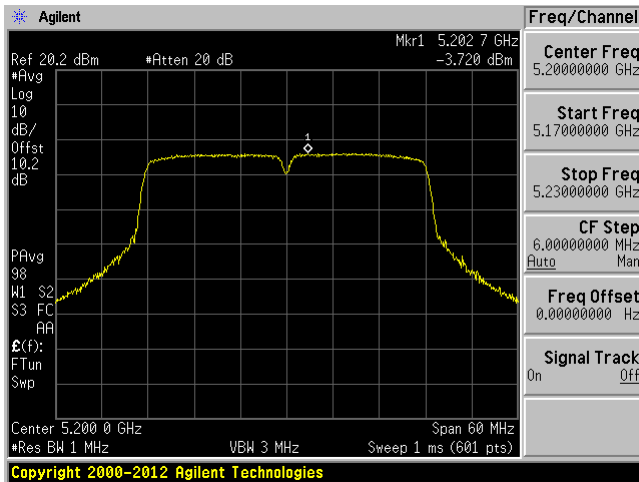
Low channel – Chain 0



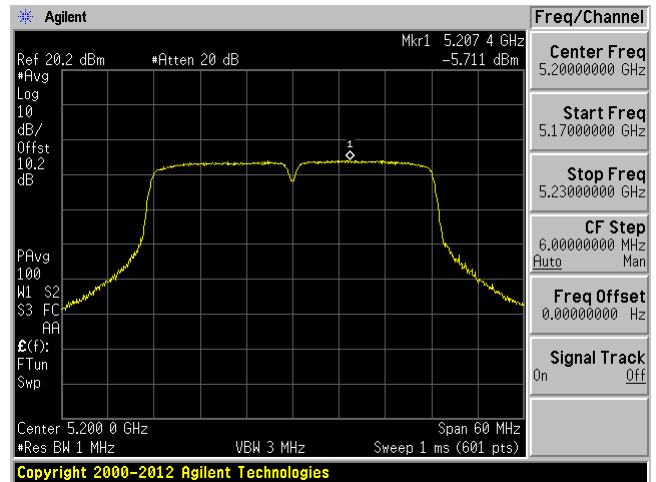
Low channel – Chain 1



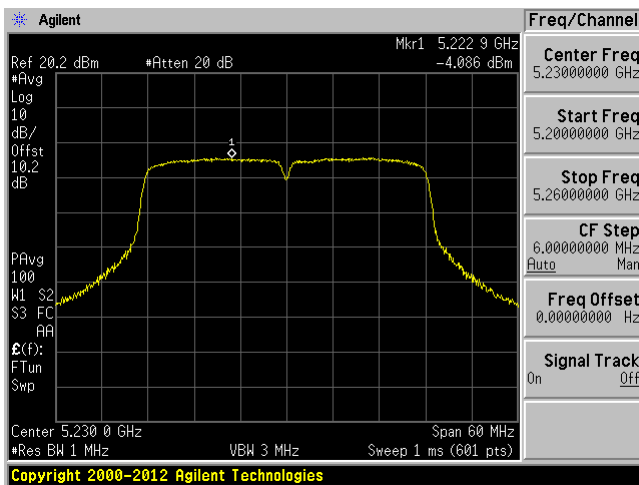
Middle channel – Chain 0



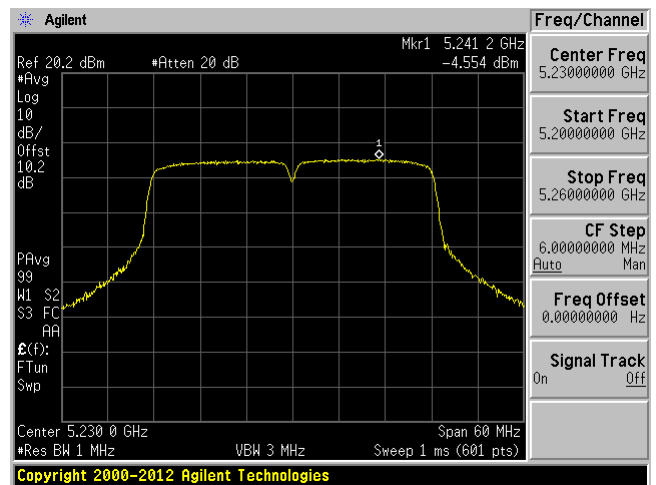
Middle channel – Chain 1



High channel – Chain 0



High channel – Chain 1





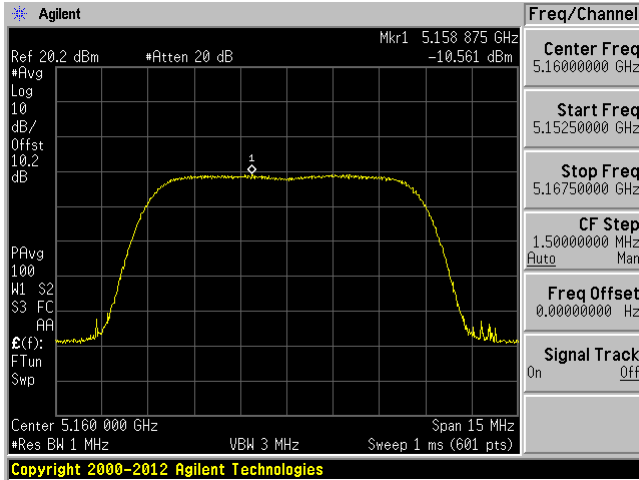
**Power Setting 2 – for Dish Antenna**

Channel	Frequency (MHz)	Power Spectral Density (dBm)			Limit (dBm)	Result
		Chain 0	Chain 0	Chain 0		
Bandwidth = 10 MHz						
Low	5160	-10.561	-13.424	-8.75	13.4	Pass
Middle	5200	-10.733	-12.372	-8.47	13.4	Pass
High	5245	-11.090	-10.591	-7.82	13.4	Pass
Bandwidth = 20 MHz						
Low	5165	-14.339	-15.879	-10.561	13.4	Pass
Middle	5200	-13.912	-15.060	-10.733	13.4	Pass
High	5240	-14.191	-13.957	-11.09	13.4	Pass
Bandwidth = 30 MHz						
Low	5170	-16.184	-16.890	-13.51	13.4	Pass
Middle	5200	-15.571	-16.862	-13.16	13.4	Pass
High	5235	-15.613	-15.404	-12.5	13.4	Pass
Bandwidth = 40 MHz						
Low	5175	-21.608	-23.597	-19.48	13.4	Pass
Middle	5200	-21.973	-22.809	-19.36	13.4	Pass
High	5230	-21.308	-22.031	-18.64	13.4	Pass

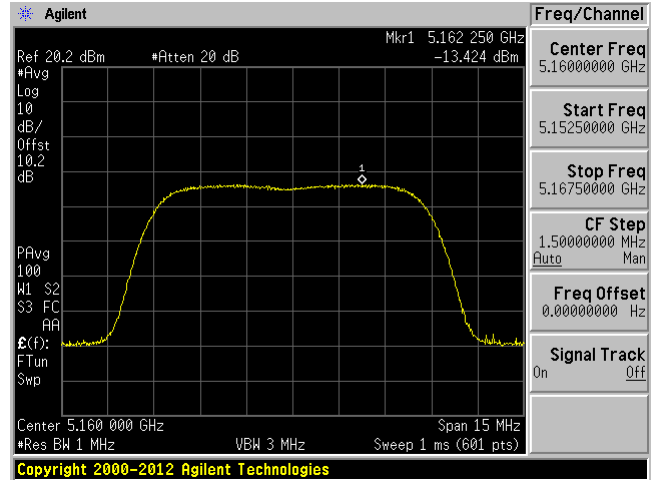
Note: For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. So the maximum power spectral density limit is  $17 - (26.6 - 23) = 13.4$  dBm/MHz.

### 10 MHz Bandwidth

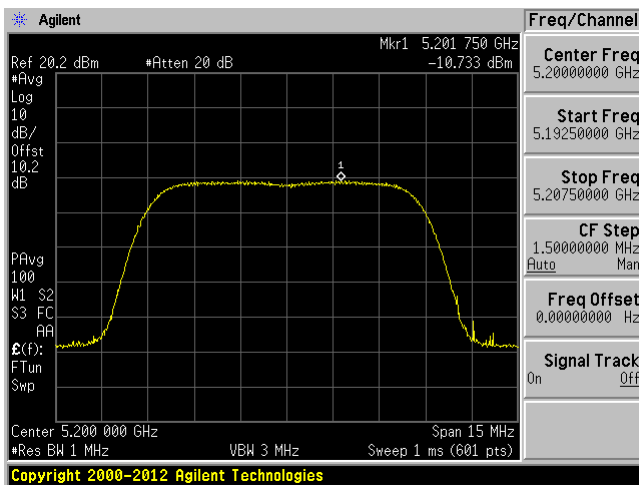
Low channel – Chain 0



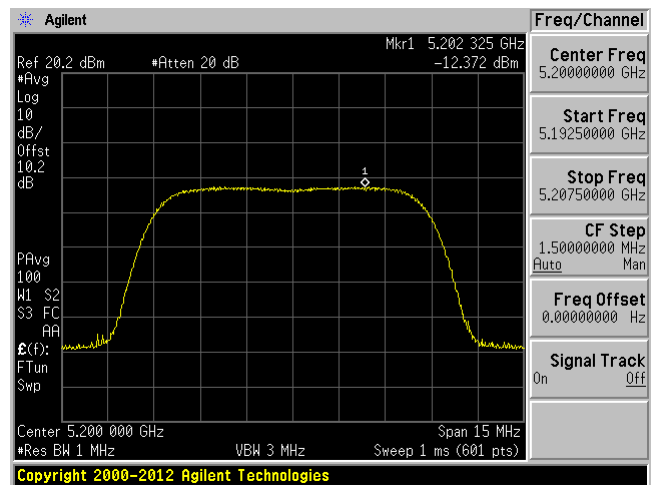
Low channel – Chain 1



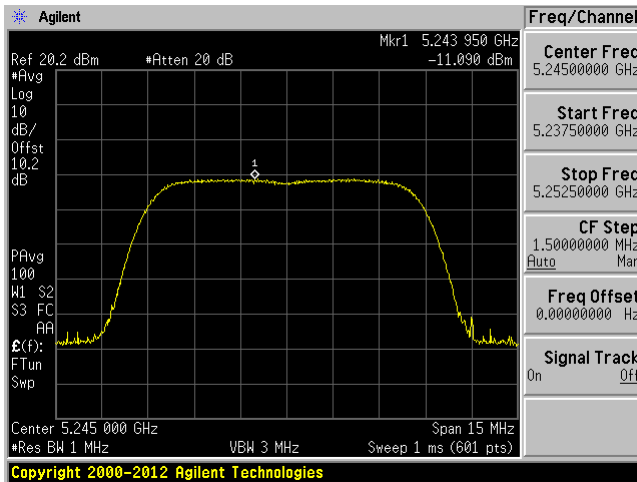
Middle channel – Chain 0



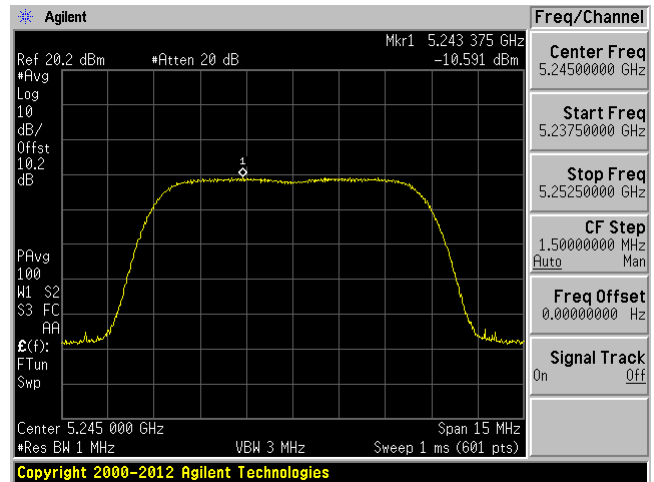
Middle channel – Chain 1



High channel – Chain 0

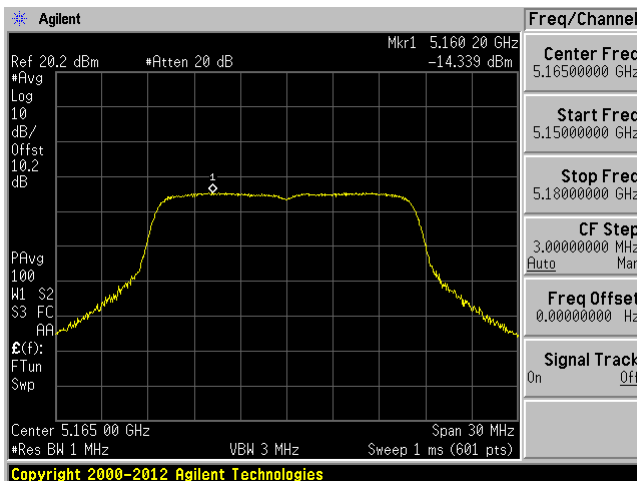


High channel – Chain 1

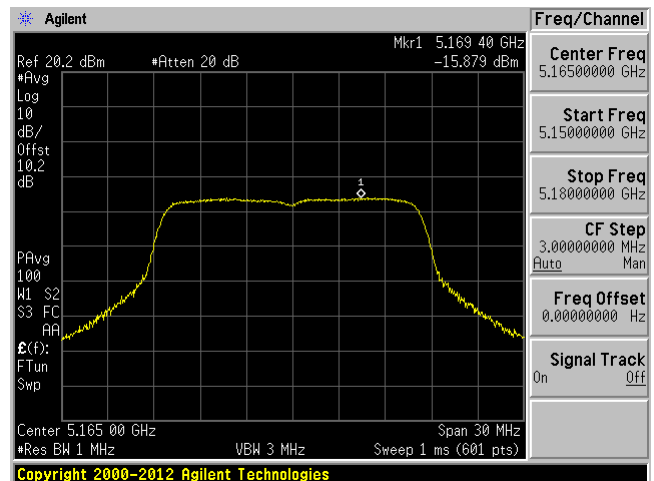


20 MHz Bandwidth

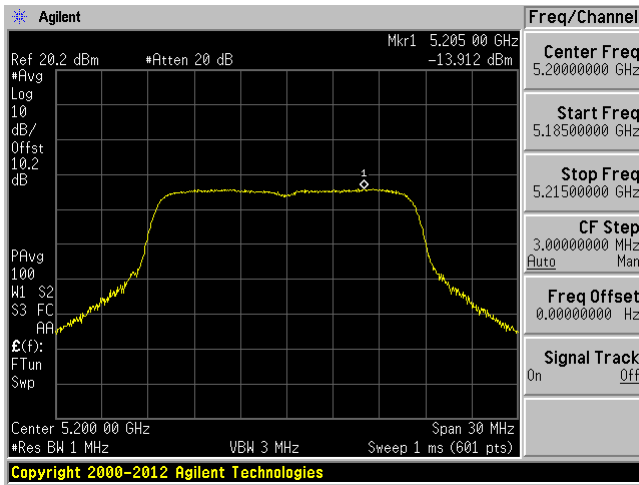
Low channel – Chain 0



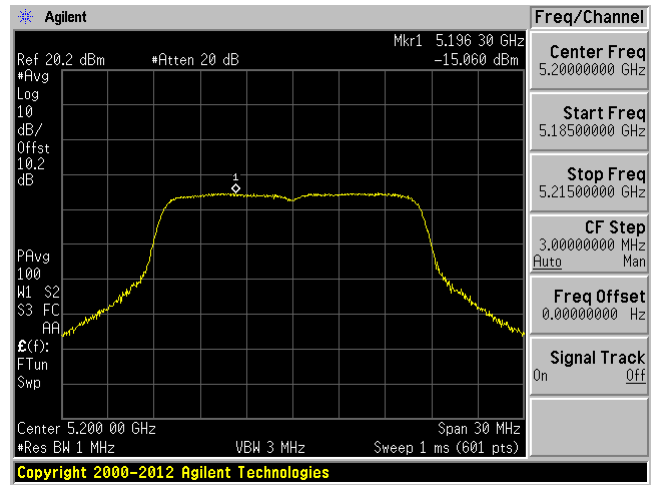
Low channel – Chain 1



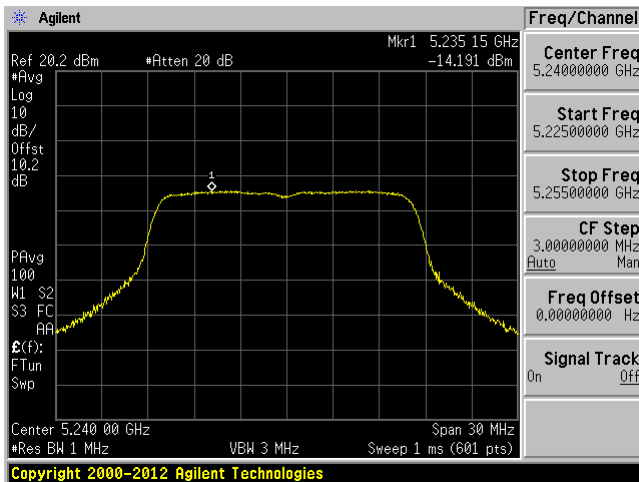
Middle channel – Chain 0



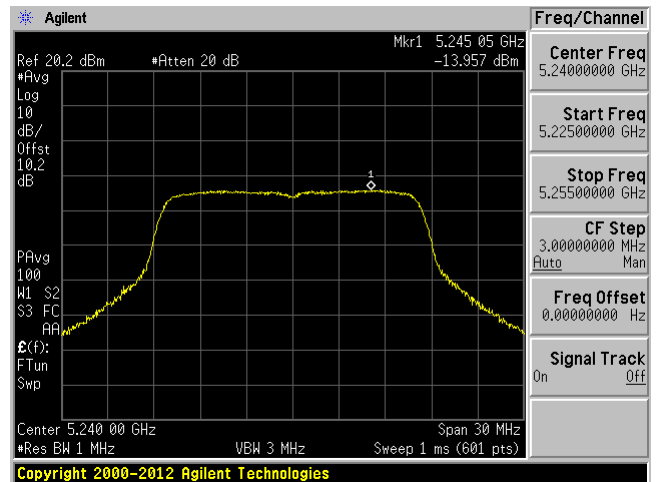
Middle channel – Chain 1



High channel – Chain 0

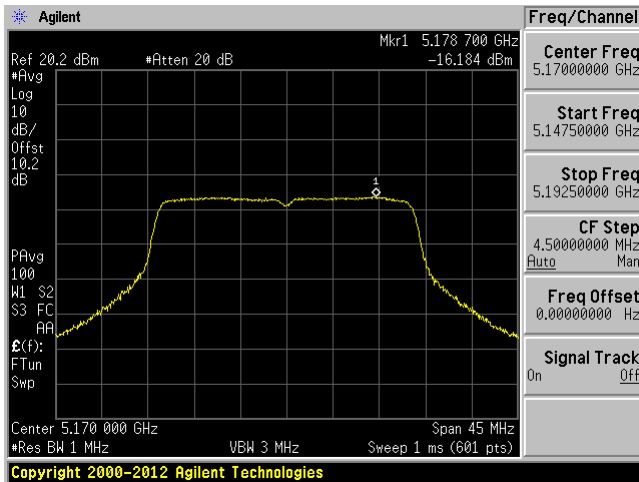


High channel – Chain 1

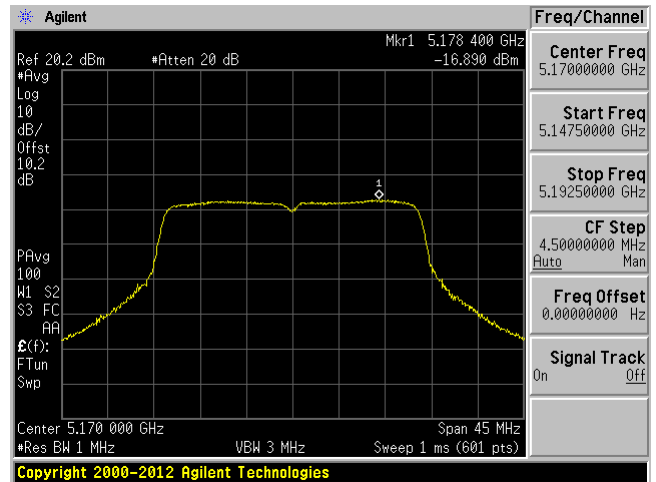


### 30 MHz Bandwidth

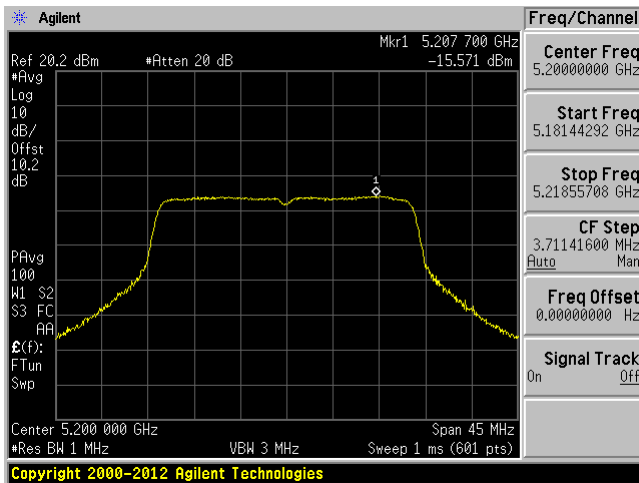
Low channel – Chain 0



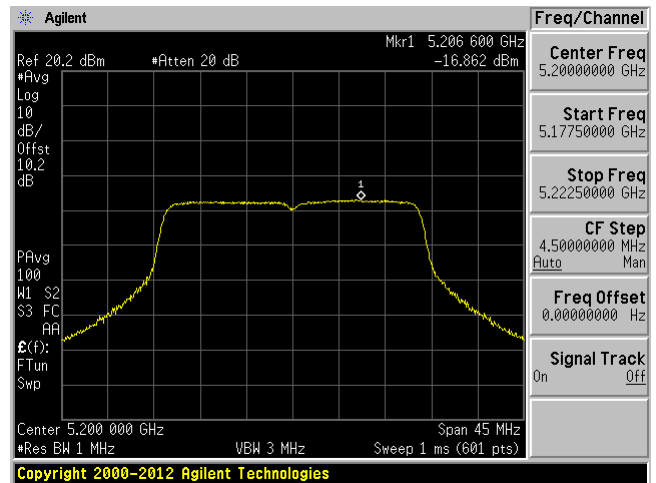
Low channel – Chain 1



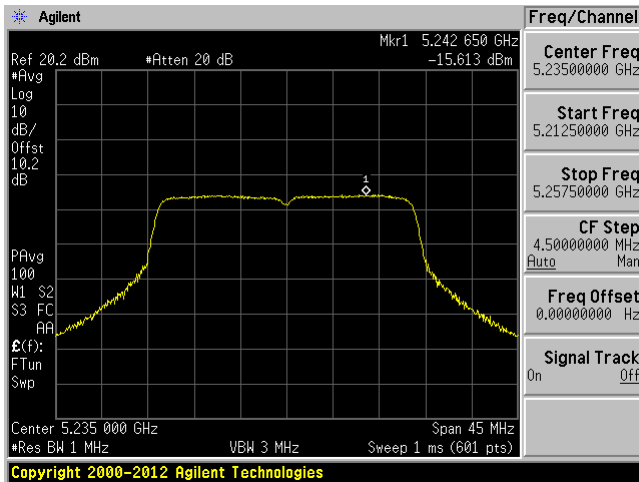
Middle channel – Chain 0



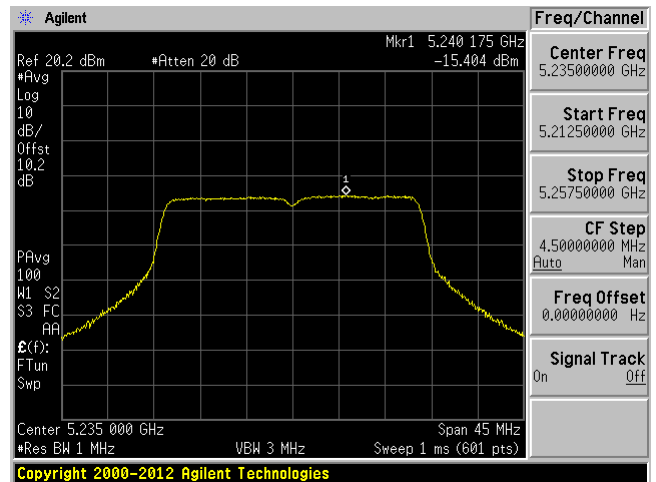
Middle channel – Chain 1



High channel – Chain 0

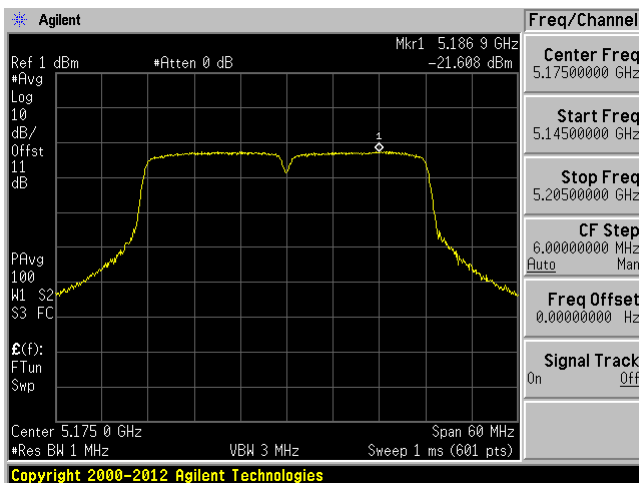


High channel – Chain 1

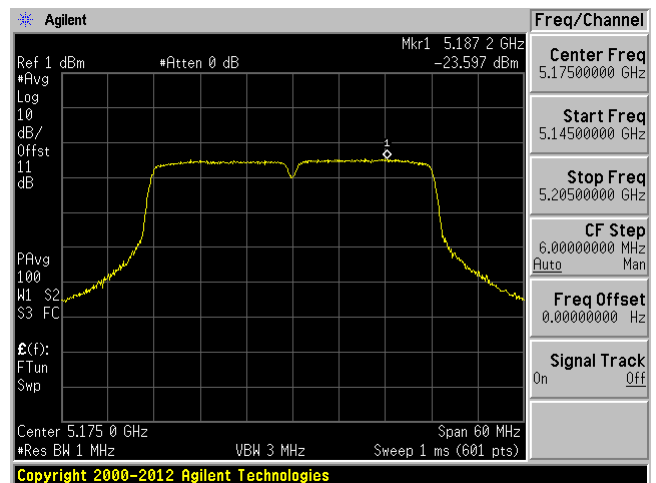


40 MHz Bandwidth

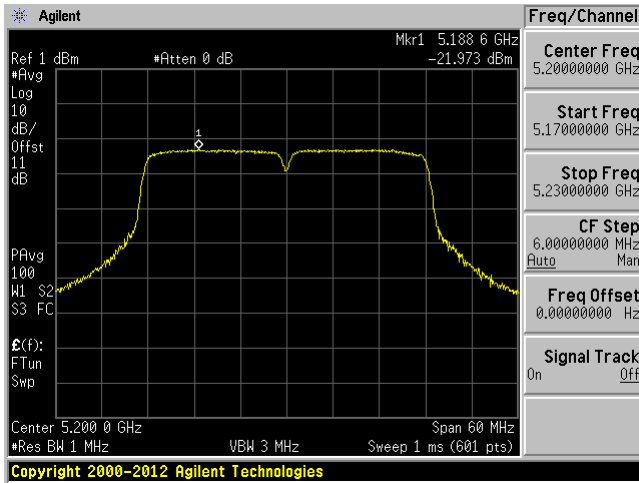
Low channel – Chain 0



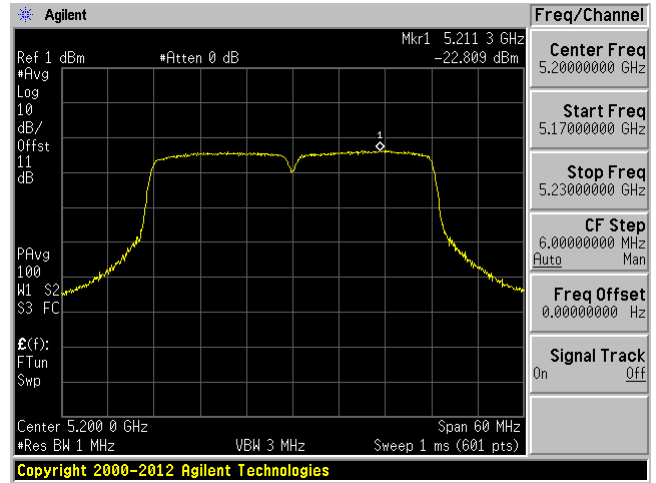
Low channel – Chain 1



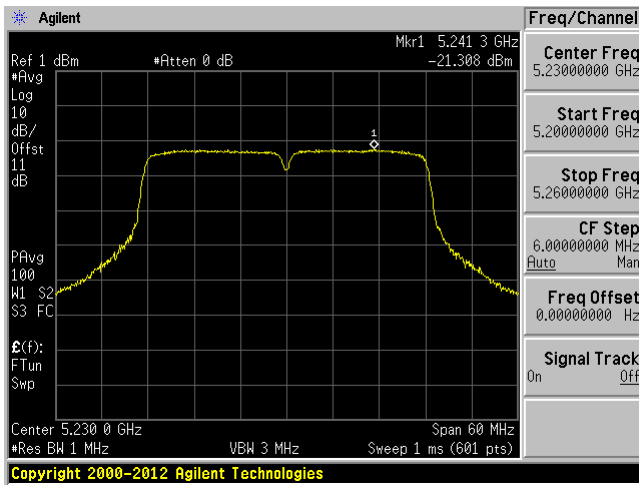
Middle channel – Chain 0



Middle channel – Chain 1



High channel – Chain 0



High channel – Chain 1

