



**FCC CFR47 PART 15 SUBPART E**

**CERTIFICATION TEST REPORT  
CLASS II PERMISSIVE CHANGE**

**FOR**

**QUAD-BAND RADIO WITH WLAN AND BT RADIO**

**MODEL NUMBER: A1530**

**FCC ID: BCG-E2643A**

**REPORT NUMBER: 15U21850-E23V2**

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*Prepared for*

**APPLE, INC.  
1 INFINITE LOOP  
CUPERTINO, CA 95014, U.S.A.**

*Prepared by*

**UL VERIFICATION SERVICES INC.  
47173 BENICIA STREET  
FREMONT, CA 94538, U.S.A.  
TEL: (510) 771-1000  
FAX: (510) 661-0888**



**NVLAP LAB CODE 200065-0**

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
V1	11/11/15	Initial issue. Upgrade 13U15037-5 report to 5.2/5.3/5.6GHz band to new rule per KDB 789033 D02 v01.	T. Chu
V2	11/23/15	Revised report to address TCB's questions	T. Chu

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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** APPLE, INC.  
1 INFINITE LOOP  
CUPERTINO, CA 95014, U.S.A.

**EUT DESCRIPTION:** QUAD-BAND RADIO WITH WLAN AND BT RADIO

**MODEL:** A1530

**SERIAL NUMBER:** C39KD00CFJOY (RF) and C39KQ006FL3K (DFS)

**DATE TESTED:** MAY 14 – JUNE (RF) and JULY 15, 2013 (DFS)

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart E	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For  
UL Verification Services Inc. By:

Tested By:



Thu Chan  
WiSE Operations Manager  
UL Verification Services Inc.

Francisco Guarnero  
WiSE Lab Technician  
UL Verification Services Inc.

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC 14-30, FCC KDB 662911 D01 v02r01, FCC KDB 905462 D02 v01r02/D03 v01r01/D06 v01, FCC KDB 789033 D02 v01, ANSI C63.10-2009.

## 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/standards/scopes/2000650.htm>.

## 4. CALIBRATION AND UNCERTAINTY

### 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

### 4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

### 4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.52 dB
Radiated Disturbance, 30 to 1000 MHz	4.94 dB

Uncertainty figures are valid to a confidence level of 95%.

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

Model A1530 is a mobile phone with multimedia functions (music, application support, and video), cellular GSM/GPRS/EGPRS/WCDMA/HSPA+/DC-HSDPA/LTE radio, IEEE 802.11a/b/g/n, Bluetooth and GPS radio. The rechargeable battery is not user accessible.

### 5.2. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

Upgrade 5.2/5.3/5.6GHz band to new rule per KDB 789033 D02 v01.

We have reviewed the original test report for UNII-1, UNII-2A and UNII-2C bands and are hereby attesting that all current technical requirements are still met and all applicable test procedures remain the same. Therefore, the original report is still applicable and no additional testing is done.

We updated the following on this report:

- Updated report to latest KDB 789033 D02 v01.
- 5.2G output power table limit/PPSD limit.
- Removed IC related information.
- Removed Peak Excursion.

### 5.3. MAXIMUM OUTPUT POWER

The transmitter has a maximum conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
5180 - 5240	802.11a	14.1	25.70
5180 - 5240	802.11n HT20	14.15	26.00
5190 - 5230	802.11n HT40	14.48	28.05
5260 - 5320	802.11a	15.46	35.16
5260 - 5320	802.11n HT20	15.33	34.12
5270 - 5310	802.11n HT40	15.5	35.48
5500 - 5700	802.11a	16.08	40.55
5500 - 5700	802.11n HT20	15.81	38.11
5510 - 5670	802.11n HT40	16.03	40.09



## 5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PiFA antenna, with a maximum gain as below table.

FREQUENCY (MHZ)	ANTENNA GAIN (dBi)
5150 - 5250	-5.91
5250 - 5350	-5.83
5500 - 5700	-4.25
5725 - 5850	-4.21

## 5.5. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was WL Tool FW 6.10.56.166.

## 5.6. WORST-CASE CONFIGURATION AND MODE

The worst-case channel for RF radiated emissions below 1GHz tests is channel with highest RF output power.

Based on the investigation results, the highest peak power and enhanced data rate is the worst-case scenario for all measurements.

For the fundamental investigation, the EUT is investigated for vertical and horizontal antenna orientations and the worst case was determined to be at X-position.

Based on the manufacturer's attestation that the nominal output power is reduced as the data rate increases, the data rates tested represent the highest power and worst-case with respect to EMC performance.

Worst-case data rates were used:

802.11b mode: 1 Mbps  
802.11g mode: 6 Mbps  
802.11a mode: 6 Mbps  
802.11n HT20mode: MCS0  
802.11n HT40mode: MCS0

## 6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST				
Description	Manufacturer	Model	Asset	Cal Due
Spectrum Analyzer, 44GHz	Agilent	N9030A	F00129	02/22/14
Spectrum Analyzer, 44GHz	Agilent	E4446A	C01159	04/10/14
Directional Coupler	Krytar	1817	N02656	CNR
Communication Test Set	Agilent / HP	E5515C	C01086	11/10/13
Communication Test Set	R & S	CMW500	F00014	02/21/14
Temperature / Humidity Chamber	Thermotron	SE 600-10-10	C00930	01/09/14
Signal generator, 6 GHz	Agilent / HP	8665B	F00066	05/07/14
Highpass Filter, 2.7 GHz	Micro-Tronics	HPM13194	N02686	CNR
Highpass Filter, 1.5 GHz	Micro-Tronics	HPM13193	N02688	CNR
Bilog, 30-1GHz	Sunol Science	JB1	C01011	03/28/14
Peak Power Meter	Boonton	4541	C01189	06/20/14
Peak Power Sensor	Agilent / HP	N1911A	F00153	04/05/14
Peak Power Meter	Agilent	N1911A	F00026	04/02/14
Peak Power Sensor	Agilent	E9323A	F00160	04/03/14
Horn Antenna	ETS Lindgren	3117	C01005	02/21/14
Horn Antenna	ETS Lindgren	3117	F00131	02/19/14
PreAmp 1-18GHz	Agilent/HP	8449B	F00167	03/23/14
PreAmp 1300MHz	Agilent	8447D	C00580	01/28/14

## 7. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

### LIMITS

None; for reporting purposes only.

### PROCEDURE

KDB 789033 Zero-Span Spectrum Analyzer Method.

#### 7.1.1. ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
802.11a 20 MHz	2.03	2.07	0.980	98.0%	0.09	0.493
802.11n HT20	1.91	1.94	0.985	98.5%	0.07	0.524
802.11n HT40	0.94	0.97	0.963	96.3%	0.16	1.070

#### 7.1.2. MEASUREMENT METHOD FOR POWER AND PPSD

The Duty Cycle is greater than or equal to 98% therefore KDB 789033 Method SA-1 is used.

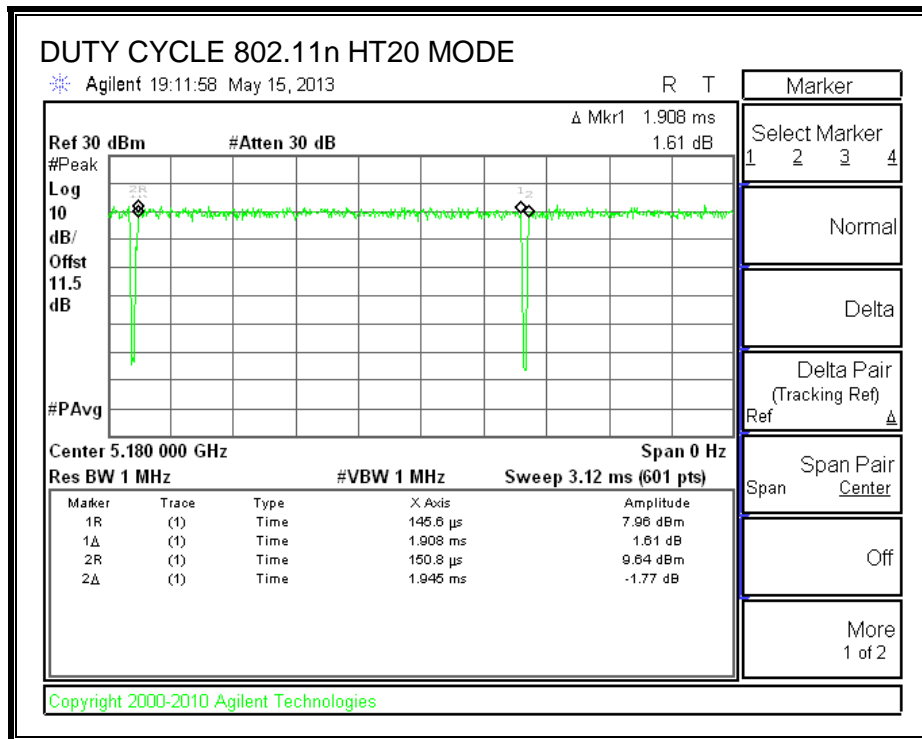
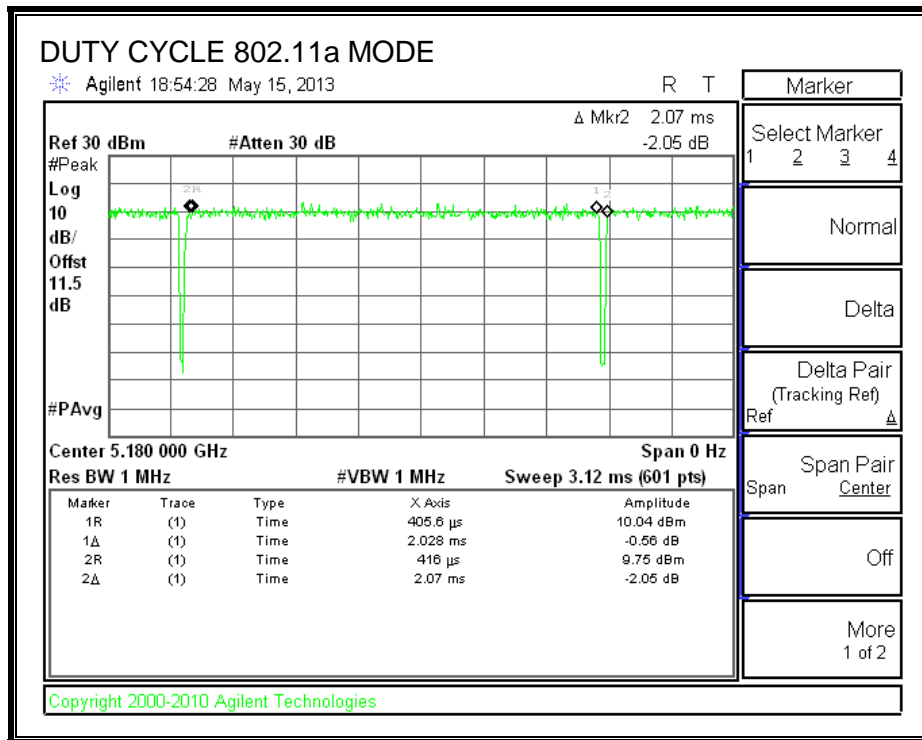
The Duty Cycle is less than 98% and consistent therefore KDB 789033 Method SA-2 is used.

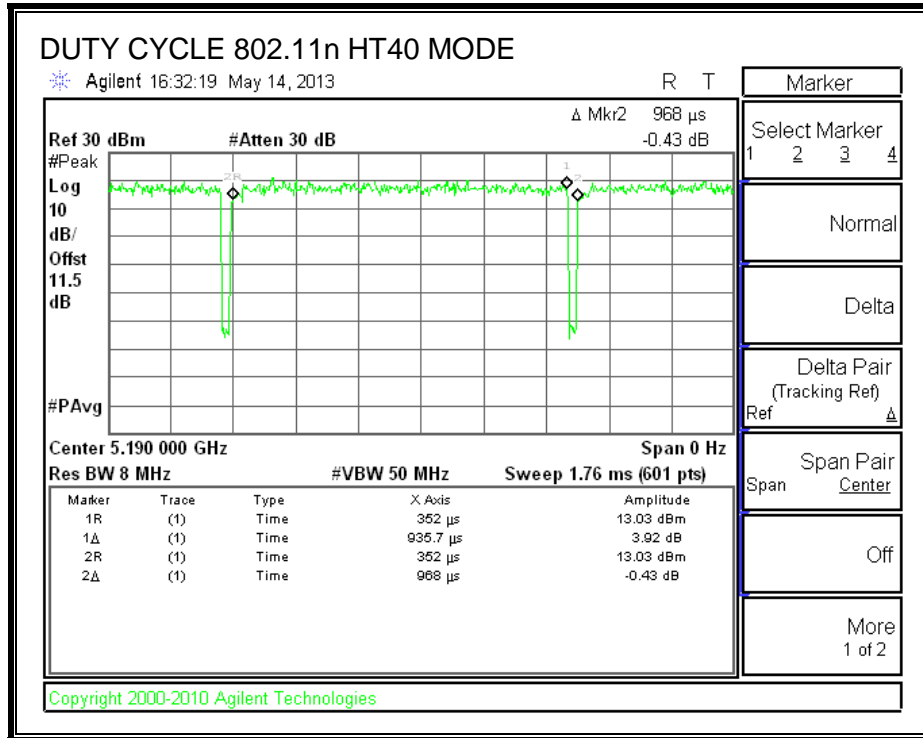
#### 7.1.3. MEASUREMENT METHOD FOR AVERAGE SPURIOUS EMISSIONS ABOVE 1 GHz

The Duty Cycle is greater than or equal to 98%, KDB 789033 Method AD with Power RMS Averaging is used.

The Duty Cycle is less than 98% and consistent, KDB 789033 Method AD with Power RMS Averaging and duty cycle correction is used.

### 7.1.4. DUTY CYCLE PLOTS





## 8. ANTENNA PORT TEST RESULTS

### 8.1. 802.11a MODE IN THE 5.2 GHz BAND

#### 8.1.1. 26 dB BANDWIDTH

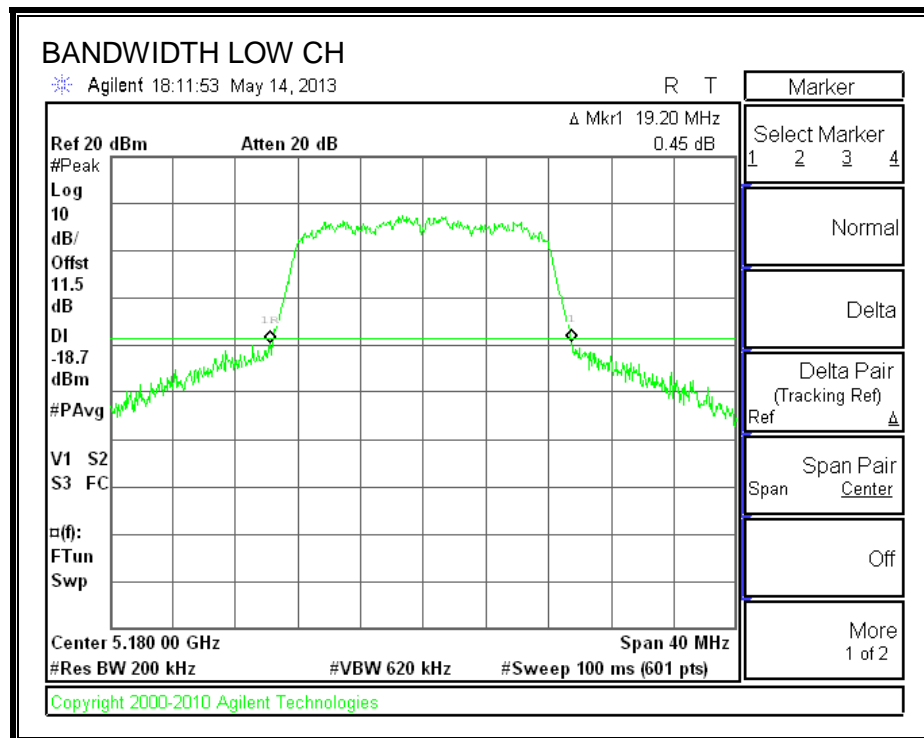
##### LIMITS

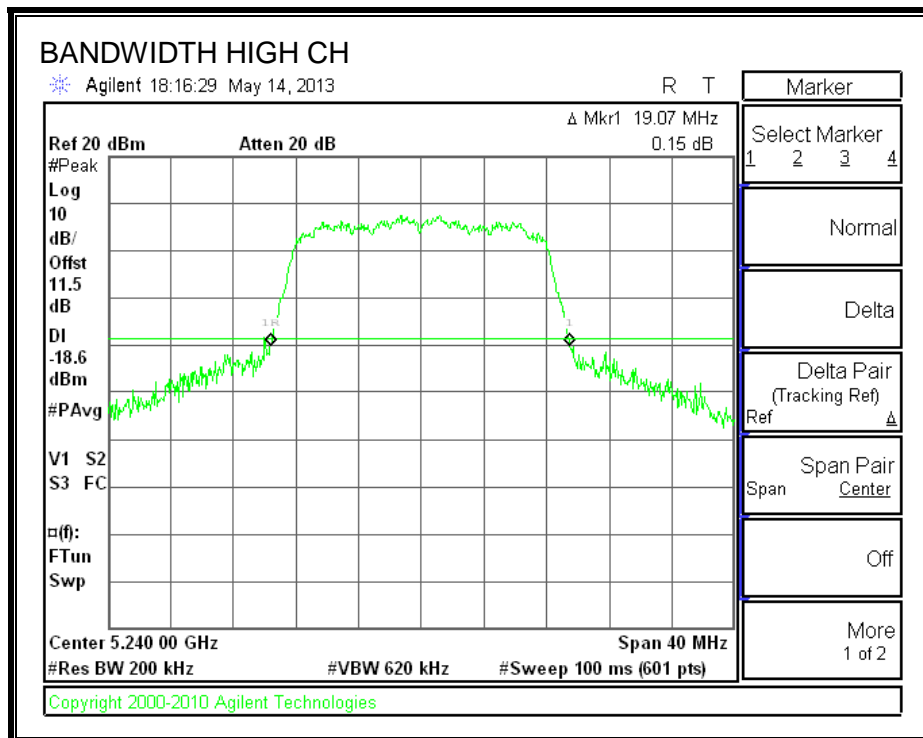
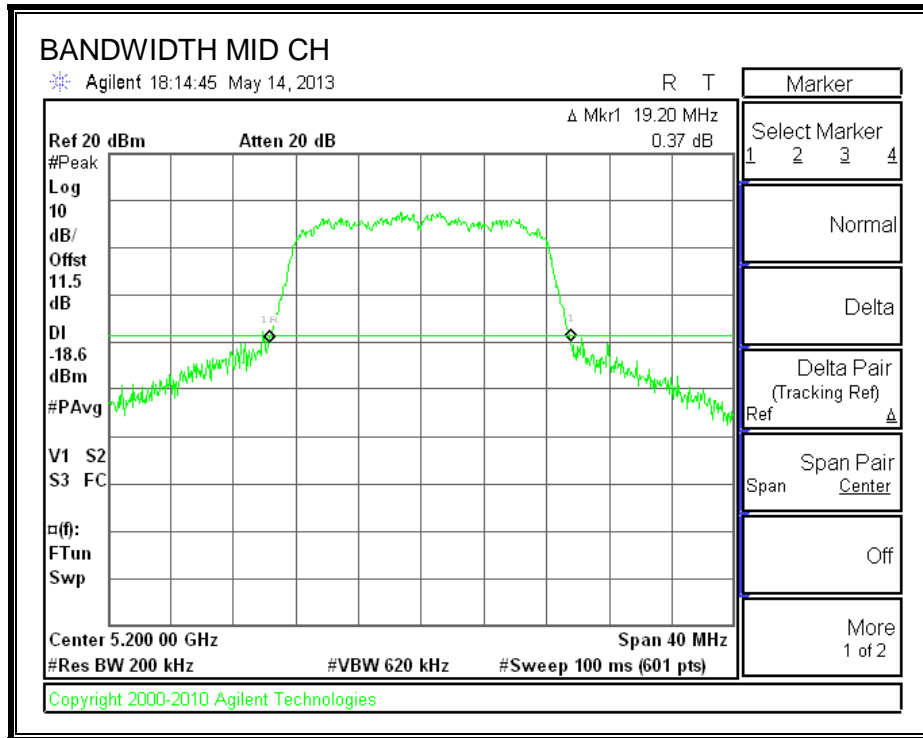
None; for reporting purposes only.

##### RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5180	19.20
Mid	5200	19.20
High	5240	19.07

##### 26 dB BANDWIDTH





### 8.1.2. 99% BANDWIDTH

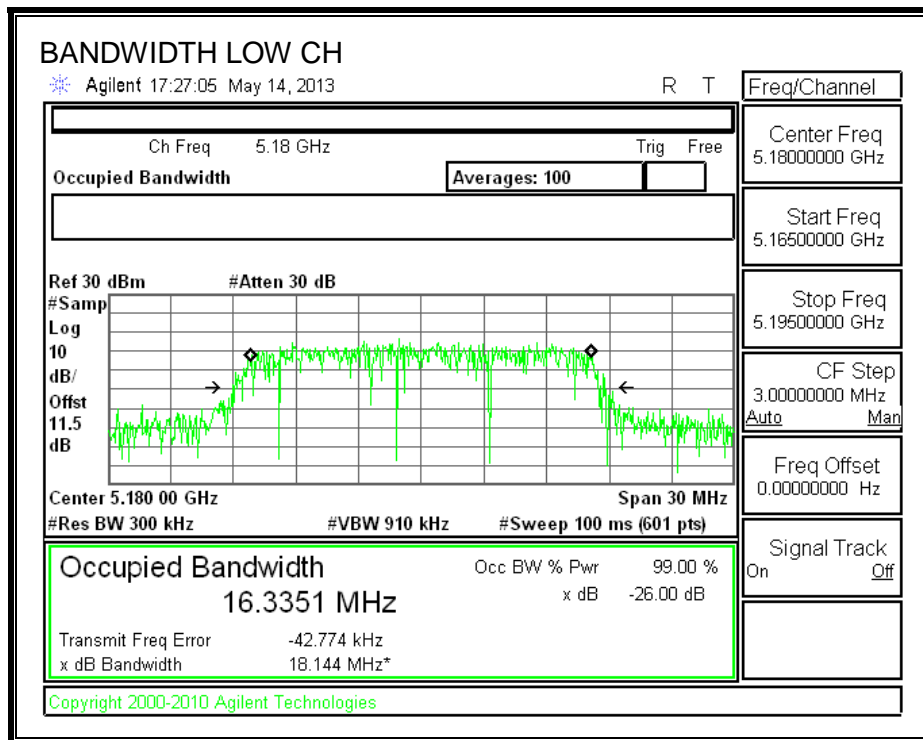
#### LIMITS

None; for reporting purposes only.

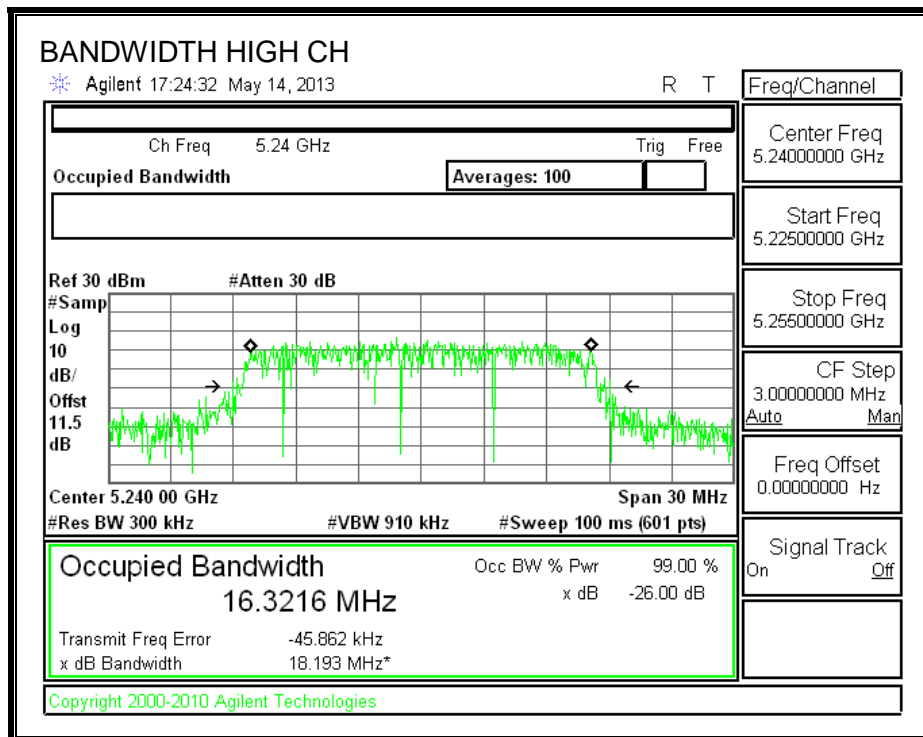
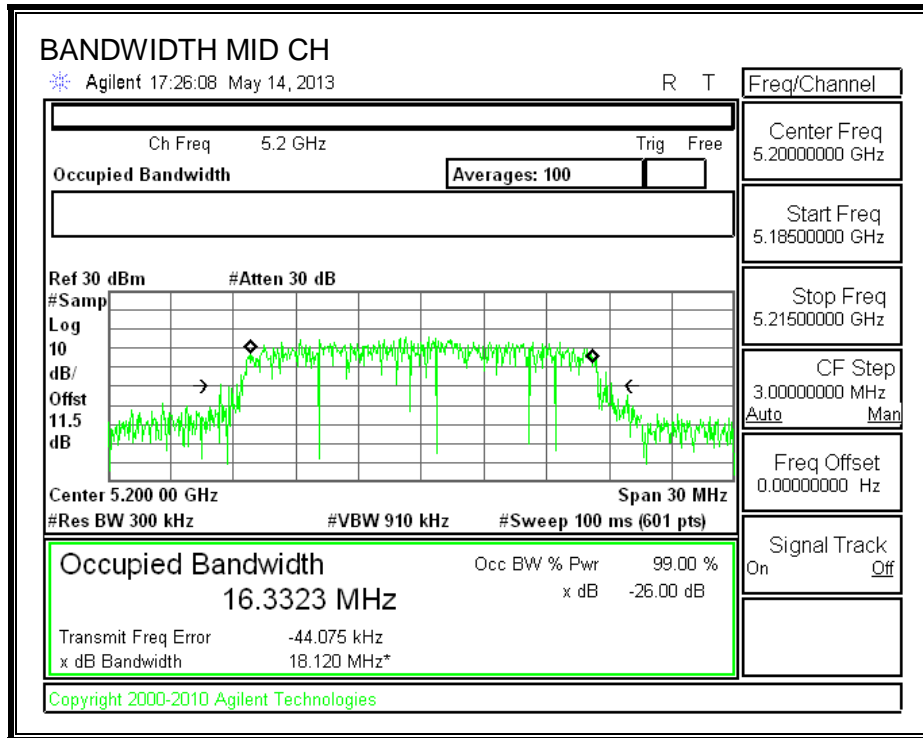
#### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5180	16.3351
Mid	5200	16.3323
High	5240	16.3216

#### 99% BANDWIDTH







### 8.1.3. AVERAGE POWER

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5180	14.00
Mid	5200	13.90
High	5240	13.91

## 8.1.4. OUTPUT POWER AND PSD

### LIMITS

FCC §15.407 (a) (1)

(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).

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

(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. 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.

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

### DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

**RESULTS**

<b>Duty Cycle CF (dB)</b>	0.09	<b>Included in Calculations of Corr'd Power &amp; PPSD</b>
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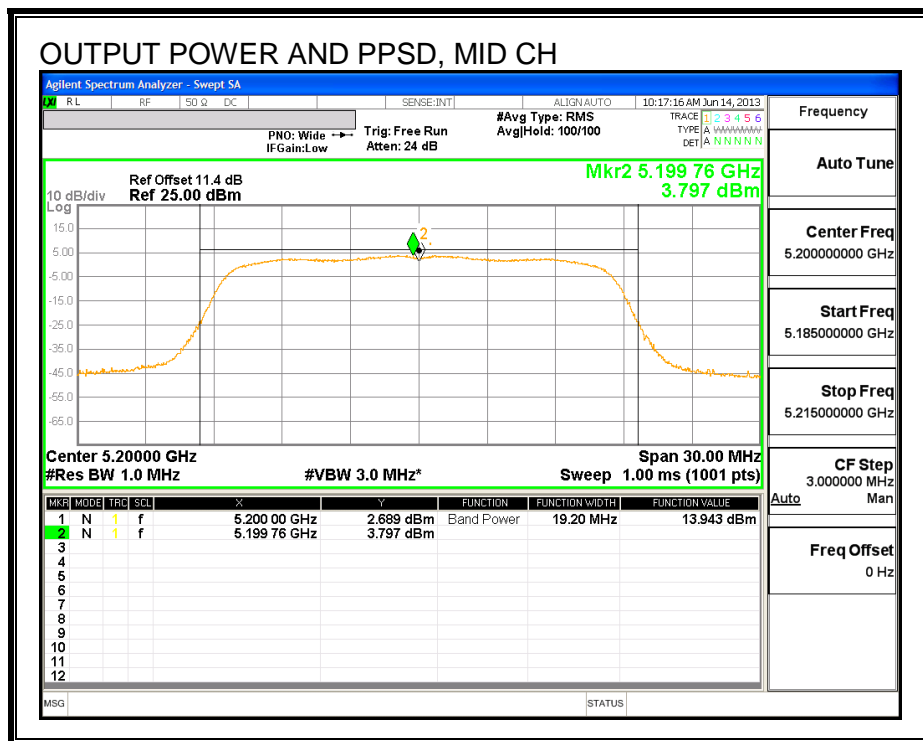
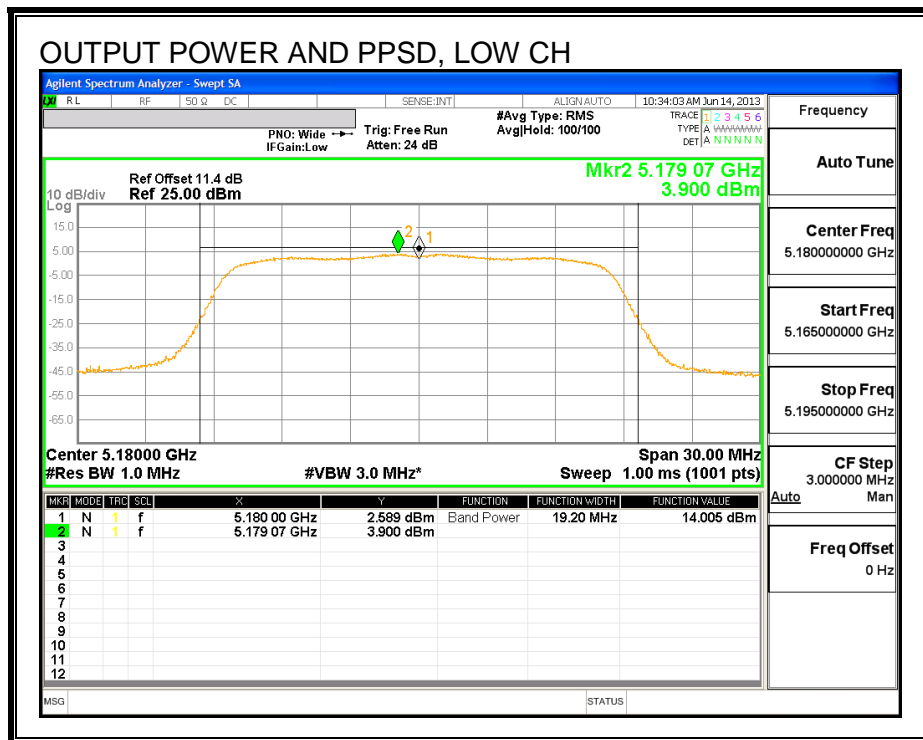
**Output Power Results**

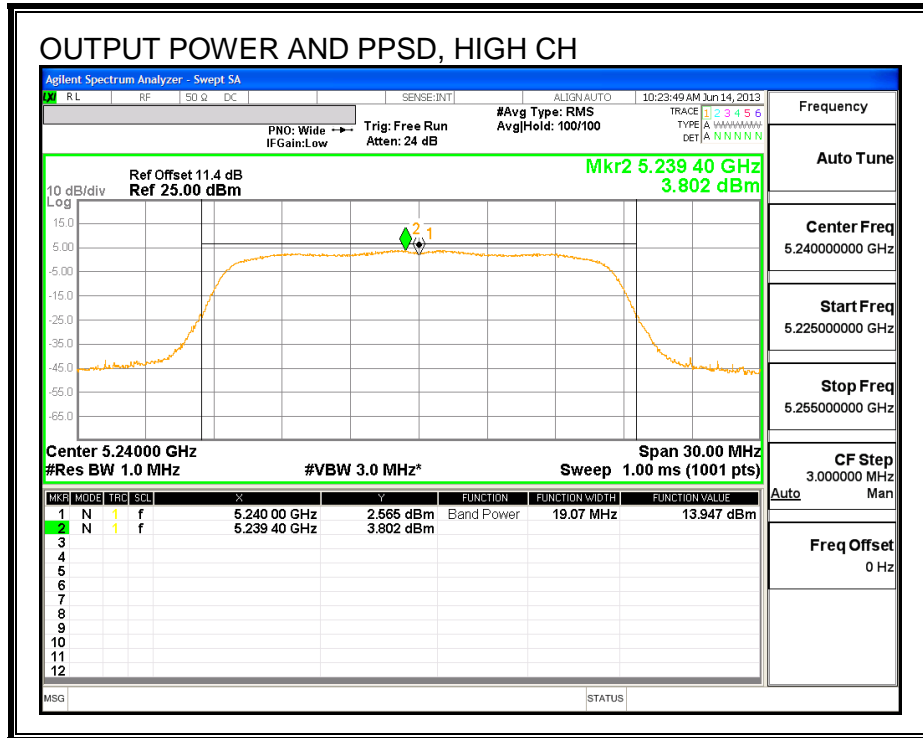
Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5180	14.005	14.10	24.00	-9.91
Mid	5200	13.943	14.03	24.00	-9.97
High	5240	13.947	14.04	24.00	-9.96

**PPSD Results**

Channel	Frequency (MHz)	Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5180	3.900	3.99	11.00	-7.01
Mid	5200	3.797	3.89	11.00	-7.11
High	5240	3.802	3.89	11.00	-7.11

**OUTPUT POWER AND PSD**





## 8.2. 802.11n HT20 MODE IN THE 5.2 GHz BAND

### 8.2.1. 26 dB BANDWIDTH

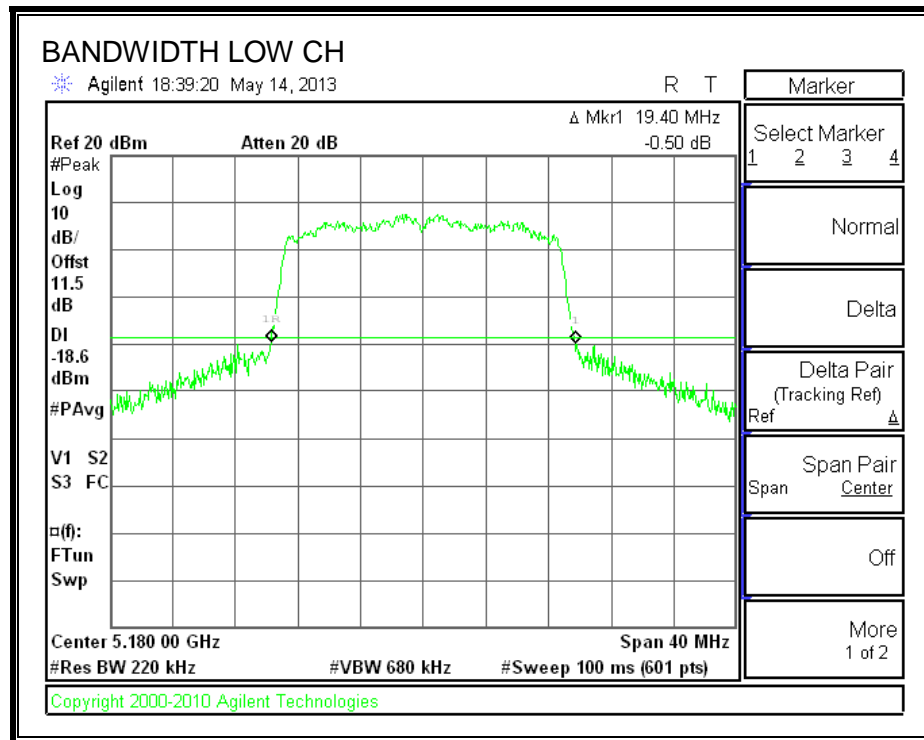
#### LIMITS

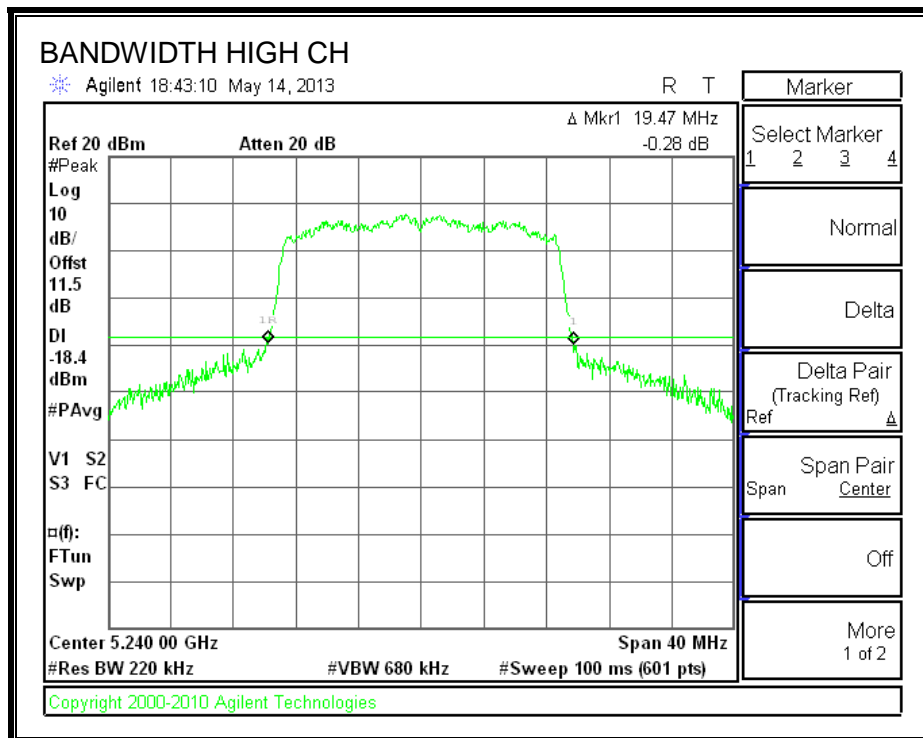
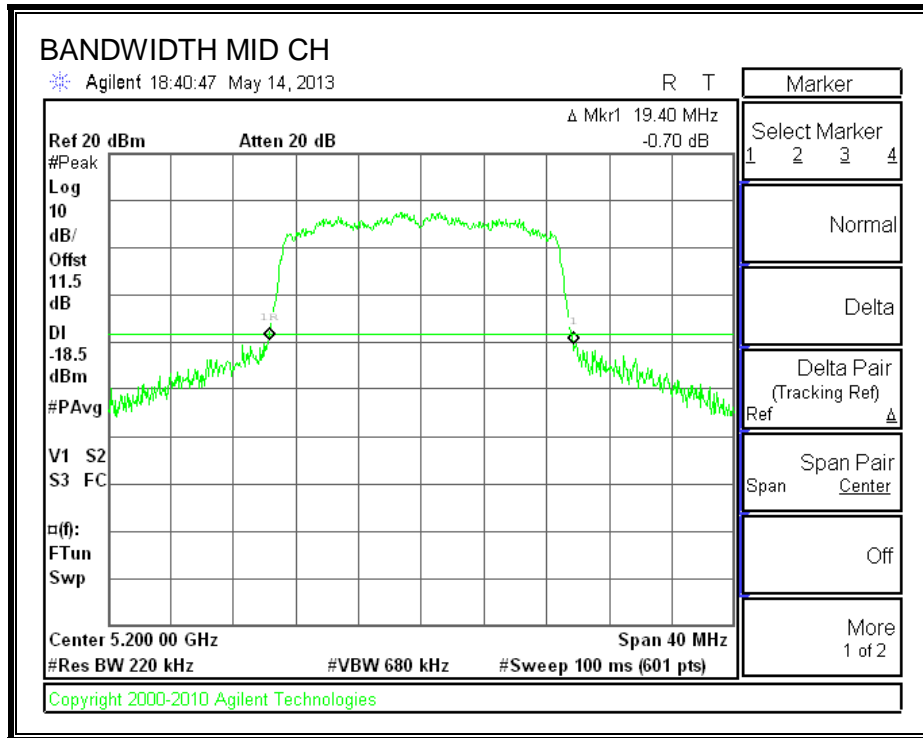
None; for reporting purposes only.

#### RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5180	19.40
Mid	5200	19.40
High	5240	19.47

#### 26 dB BANDWIDTH







### 8.2.2. 99% BANDWIDTH

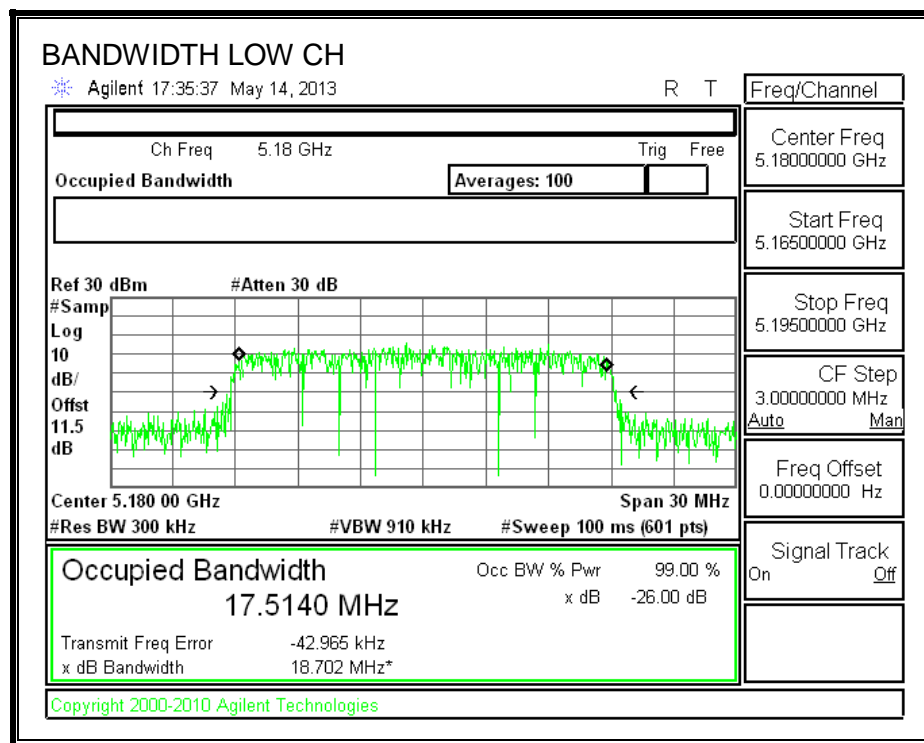
#### LIMITS

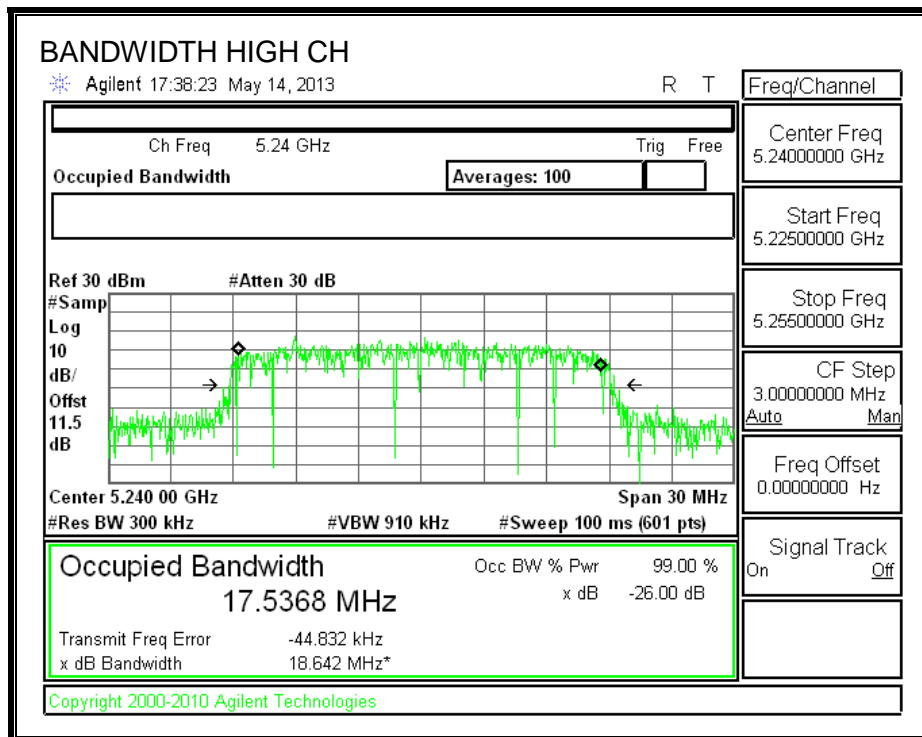
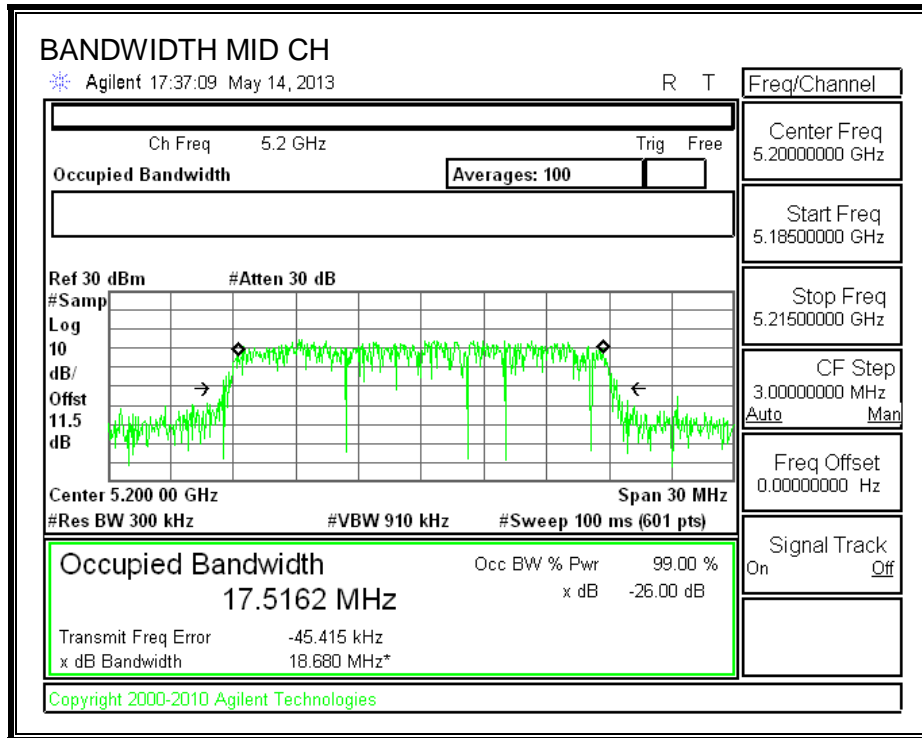
None; for reporting purposes only.

#### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5180	17.5140
Mid	5200	17.5162
High	5240	17.5368

#### 99% BANDWIDTH





### 8.2.3. AVERAGE POWER

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5180	14.21
Mid	5200	14.01
High	5240	13.50

## 8.2.4. OUTPUT POWER AND PSD

### LIMITS

FCC §15.407 (a) (1)

(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).

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

(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. 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.

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

### DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

**RESULTS**

<b>Duty Cycle CF (dB)</b>	0.07	<b>Included in Calculations of Corr'd Power &amp; PPSD</b>
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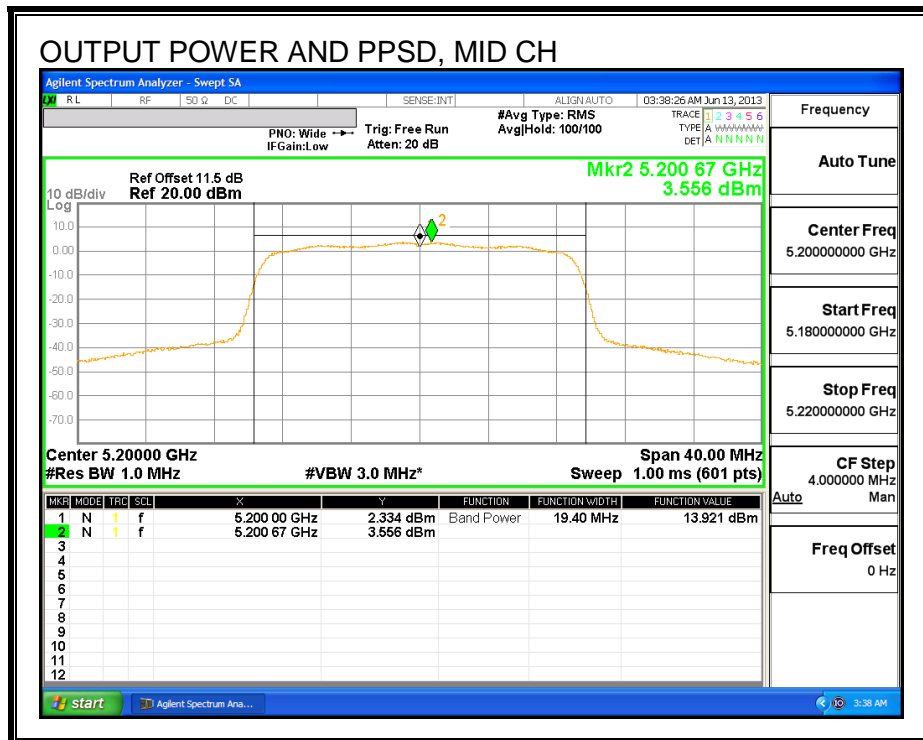
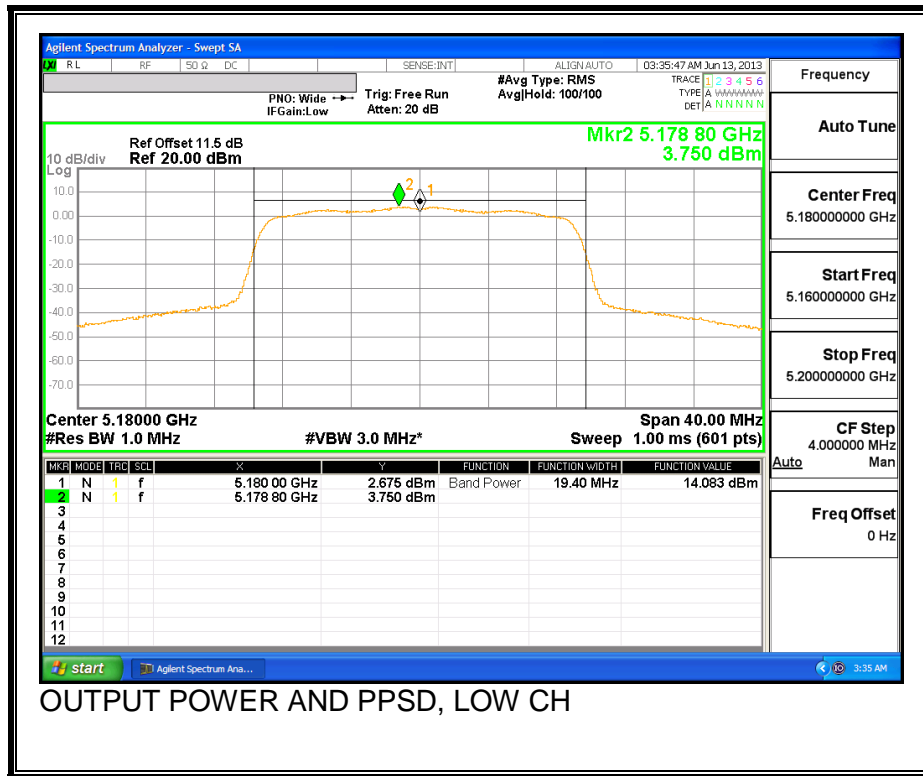
**Output Power Results**

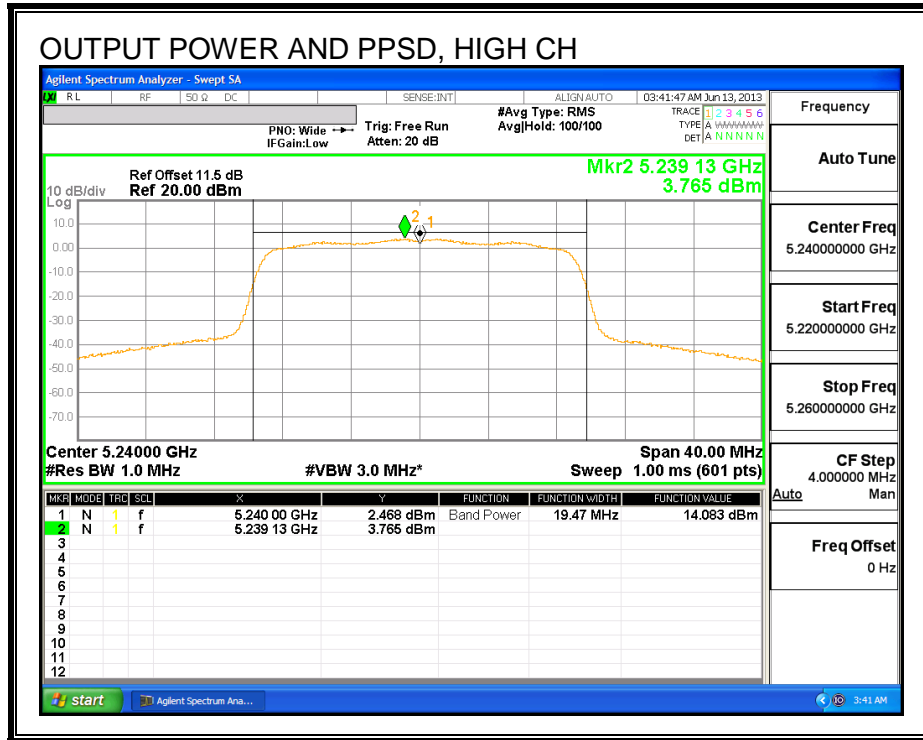
Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5180	14.083	14.15	24.00	-9.85
Mid	5200	13.921	13.99	24.00	-10.01
High	5240	14.083	14.15	24.00	-9.85

**PPSD Results**

Channel	Frequency (MHz)	Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5180	3.750	3.82	11.00	-7.18
Mid	5200	3.556	3.63	11.00	-7.37
High	5240	3.765	3.84	11.00	-7.17

**OUTPUT POWER AND PSD**





### 8.3. 802.11n HT40 MODE IN THE 5.2 GHz BAND

#### 8.3.1. 26 dB BANDWIDTH

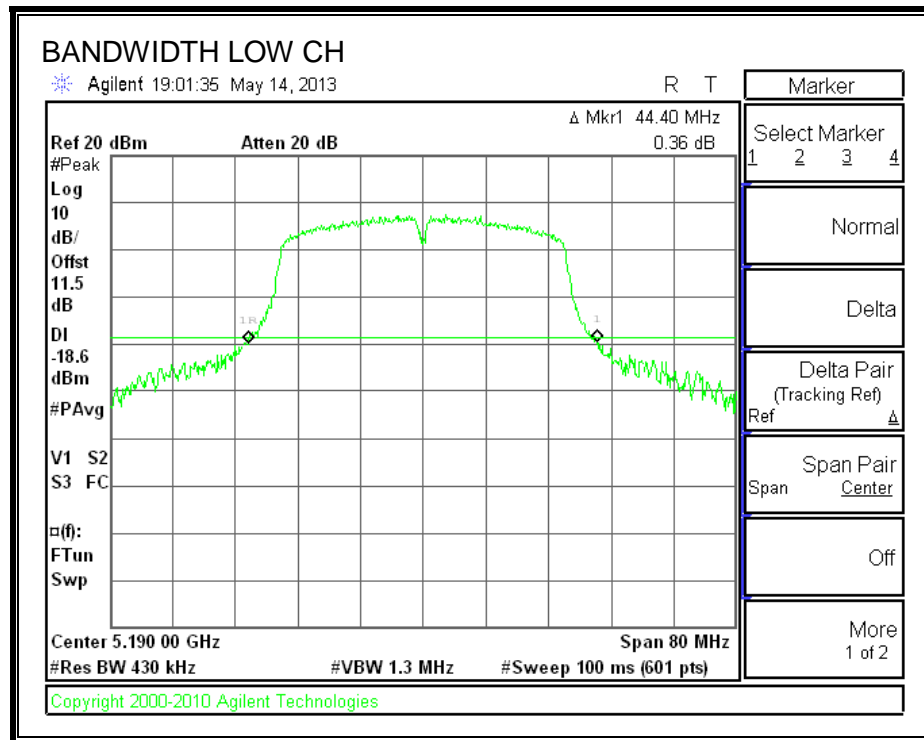
#### LIMITS

None; for reporting purposes only.

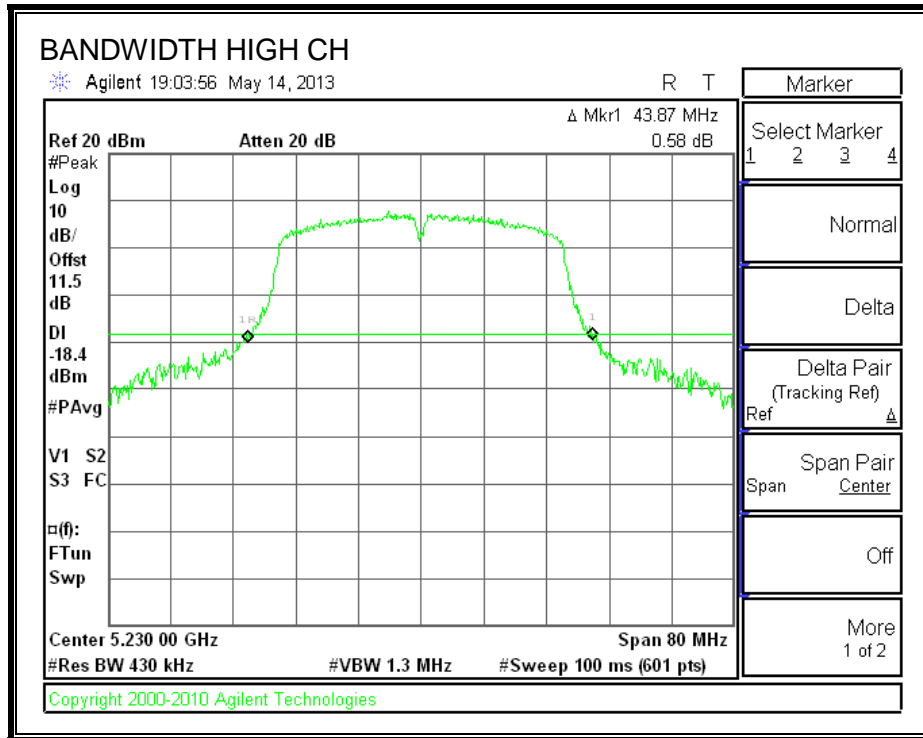
#### RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5190	44.40
5230	5230	43.87

#### 26 dB BANDWIDTH







### 8.3.2. 99% BANDWIDTH

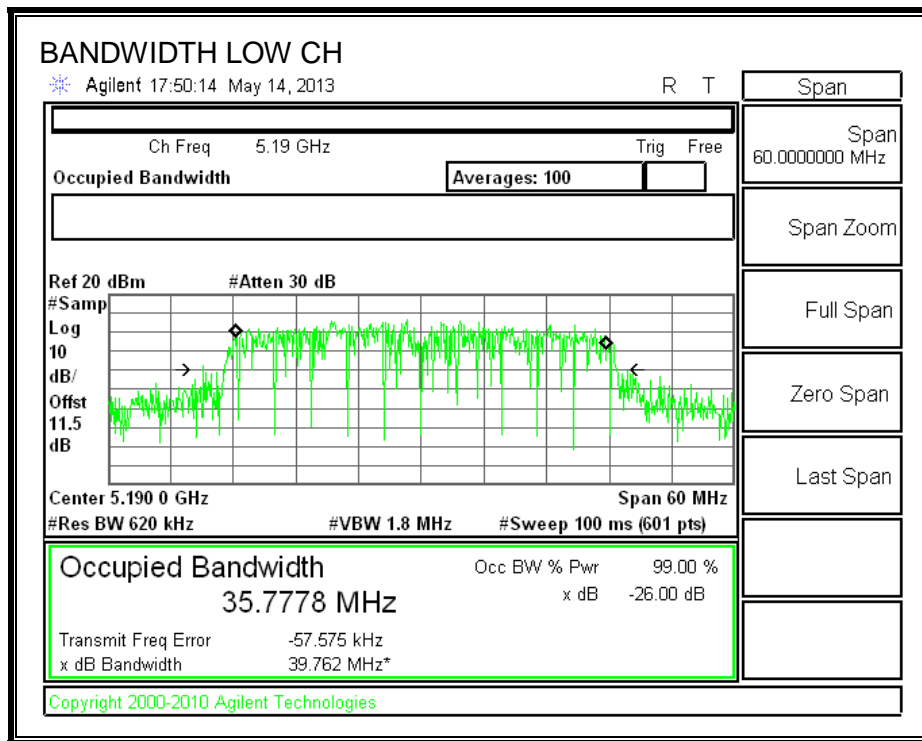
#### LIMITS

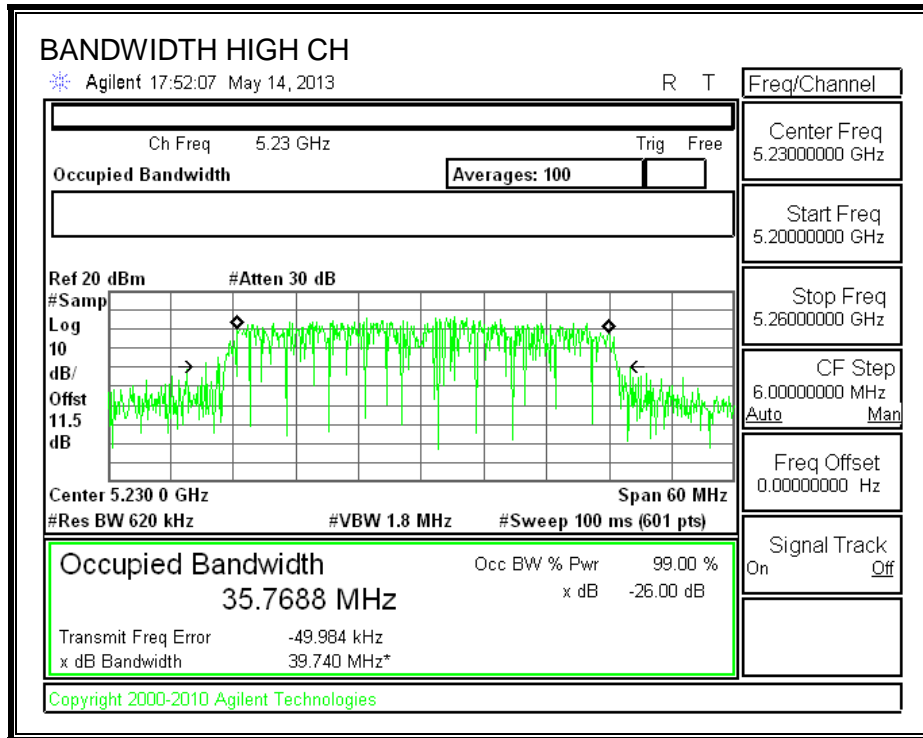
None; for reporting purposes only.

#### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5190	35.7778
High	5230	35.7688

#### 99% BANDWIDTH





### 8.3.3. AVERAGE POWER

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11.4 dB (including 10 dB pad and 1.4 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### RESULTS

Channel	Frequency (MHz)	Power (dBm)
Mid	5190	14.20
High	5230	13.91

### **8.3.4. OUTPUT POWER AND PPSD**

#### **LIMITS**

FCC §15.407 (a) (1)

(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).

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

(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. 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.

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

#### **DIRECTIONAL ANTENNA GAIN**

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

**RESULTS**

<b>Duty Cycle CF (dB)</b>	0.16	<b>Included in Calculations of Corr'd Power &amp; PPSD</b>
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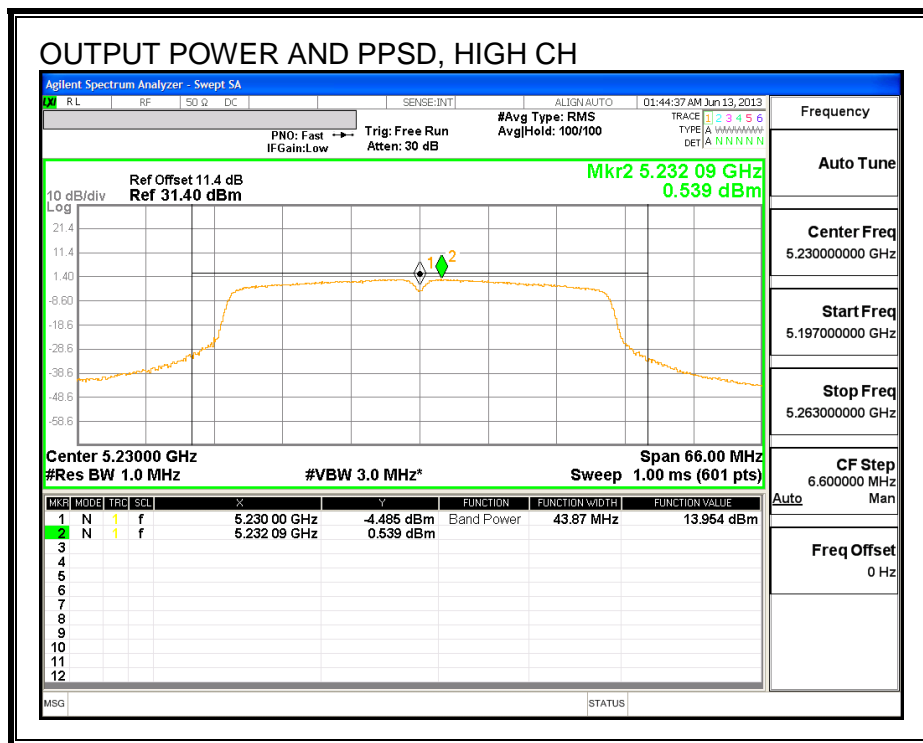
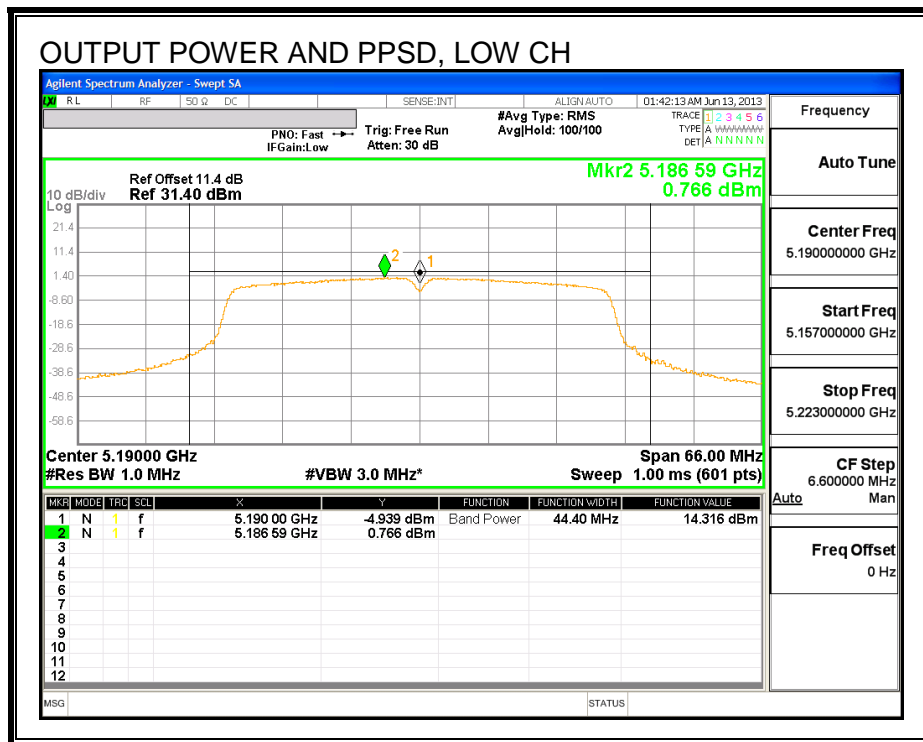
**Output Power Results**

Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5190	14.316	14.48	24.00	-9.52
High	5230	13.964	14.12	24.00	-9.88

**PPSD Results**

Channel	Frequency (MHz)	Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5190	0.766	0.93	11.00	-10.07
High	5230	0.539	0.70	11.00	-10.30

**OUTPUT POWER AND PPSD**



## 8.4. 802.11a MODE IN THE 5.3 GHz BAND

### 8.4.1. 26 dB BANDWIDTH

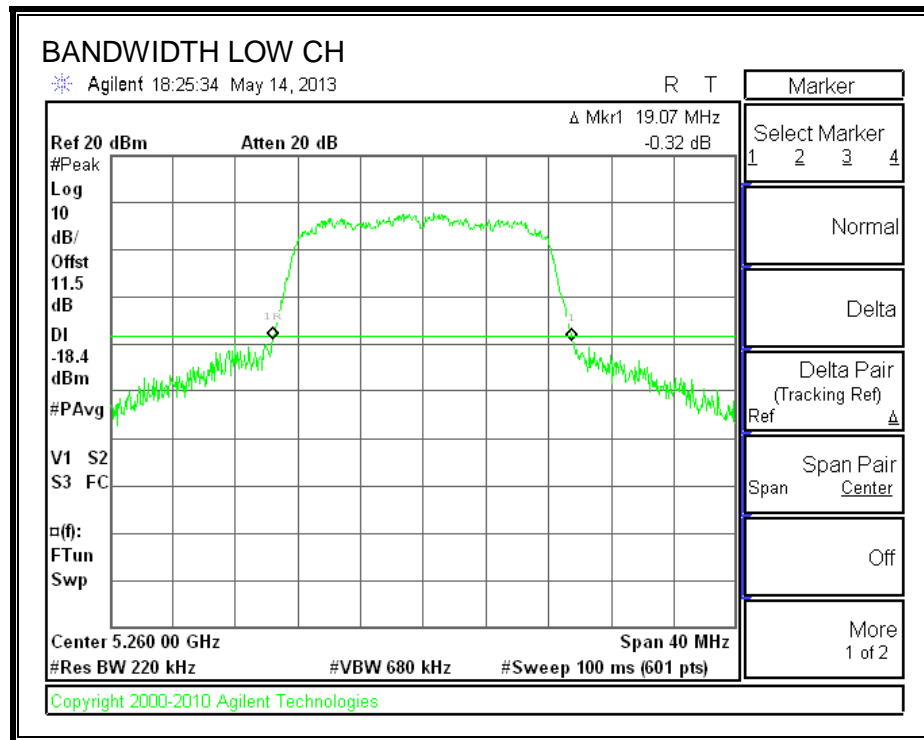
#### LIMITS

None; for reporting purposes only.

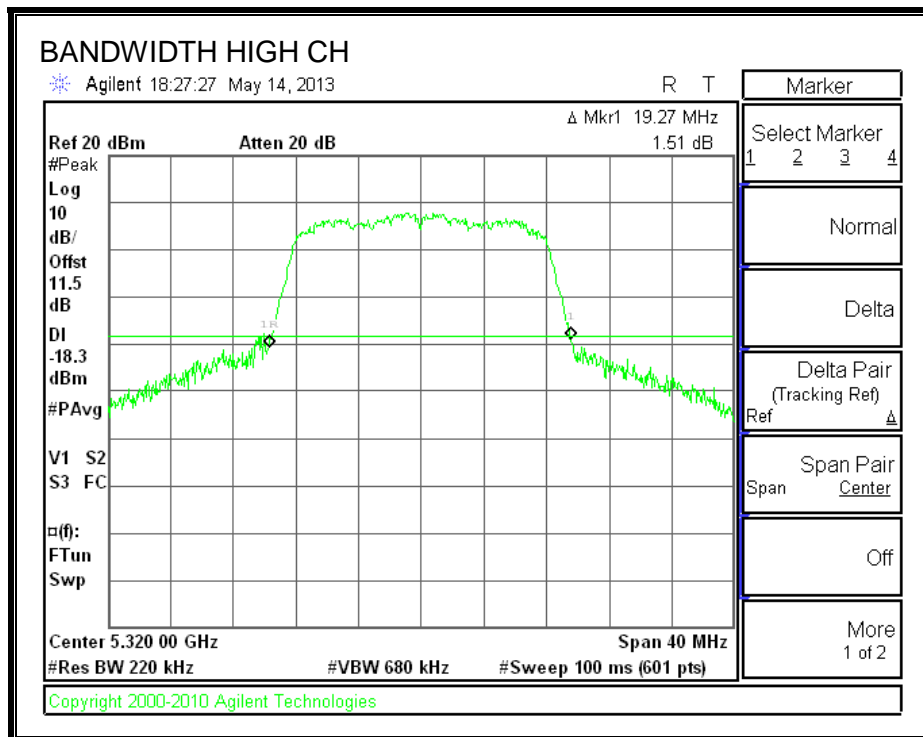
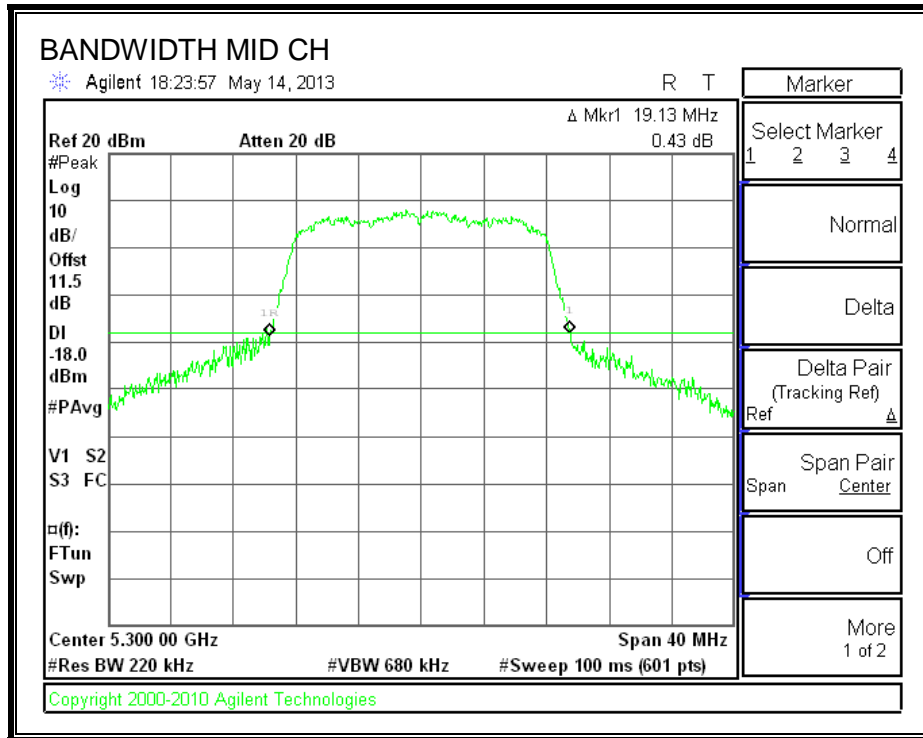
#### RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5260	19.07
Mid	5300	19.13
High	5320	19.27

#### 26 dB BANDWIDTH







### 8.4.2. 99% BANDWIDTH

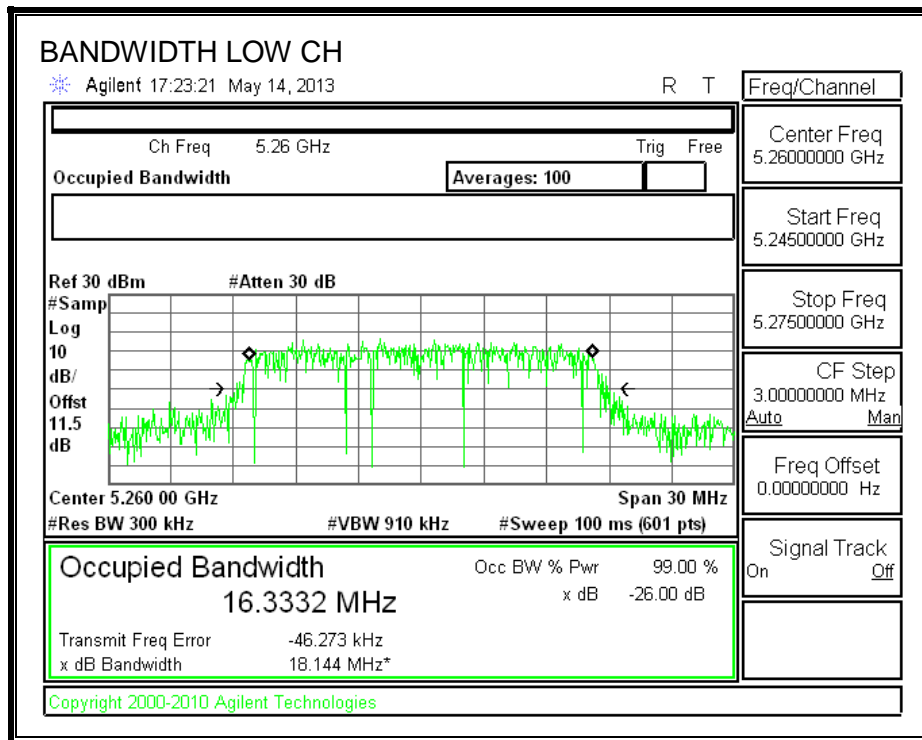
#### LIMITS

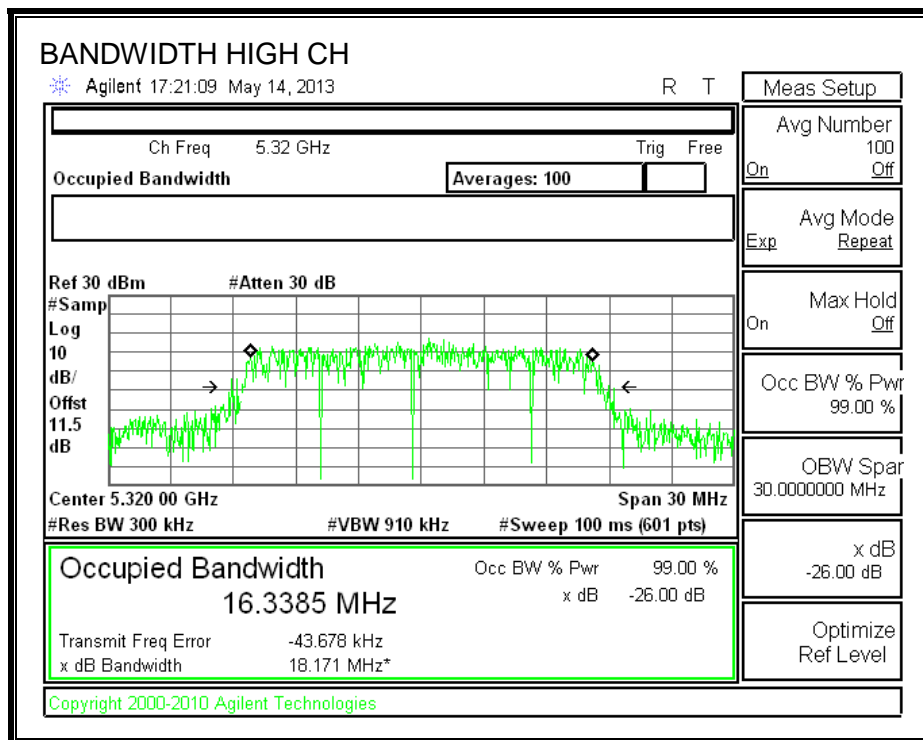
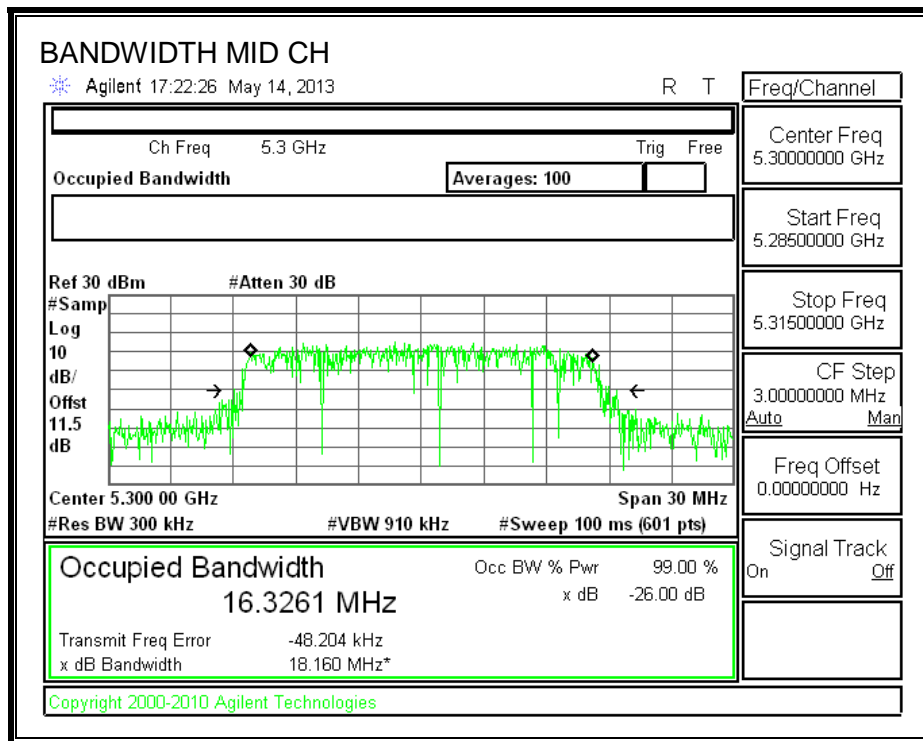
None; for reporting purposes only.

#### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5260	16.3332
Mid	5300	16.3261
High	5320	16.3385

#### 99% BANDWIDTH





### 8.4.3. AVERAGE POWER

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11.4 dB (including 10 dB pad and 1.4 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5260	15.22
Mid	5300	15.00
High	5320	14.87

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#### **8.4.4. OUTPUT POWER AND PPSD**

##### **LIMITS**

FCC §15.407 (a) (2)

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

##### **DIRECTIONAL ANTENNA GAIN**

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

**RESULTS**

**Bandwidth and Antenna Gain**

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Directio Gain (dBi)
Low	5260	19.07	-5.83
Mid	5300	19.13	-5.83
High	5320	19.27	-5.83

**Limits**

Channel	Frequency (MHz)	FCC Power Limit (dBm)	FCC PPSD Limit (dBm)
Low	5260	23.80	11.00
Mid	5300	23.82	11.00
High	5320	23.85	11.00

<b>Duty Cycle CF (dB)</b>	0.09	<b>Included in Calculations of Corr'd Power &amp; PPSD</b>
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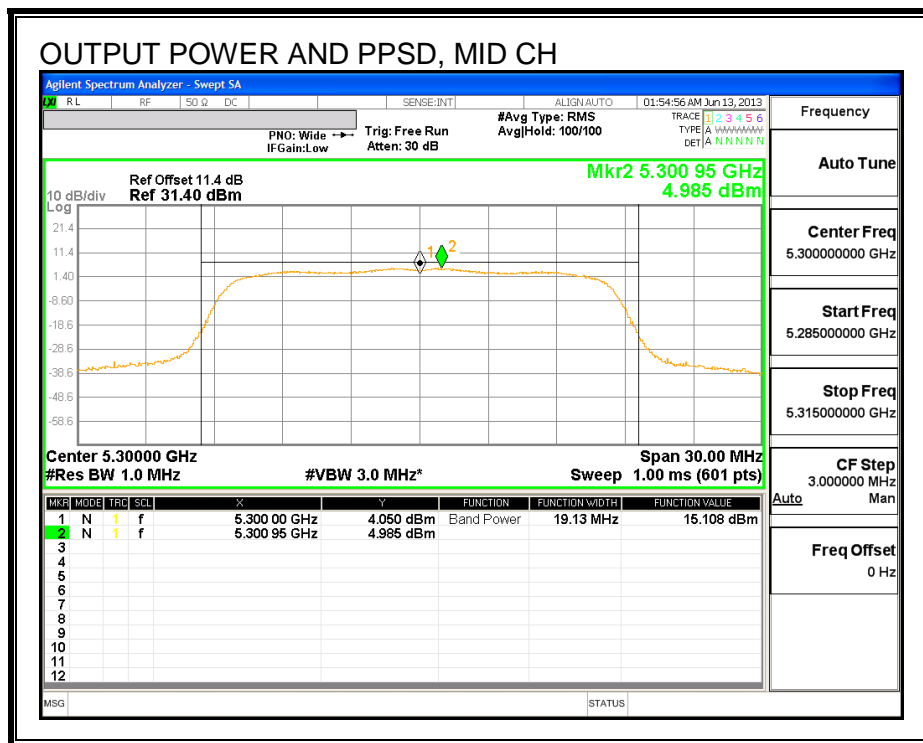
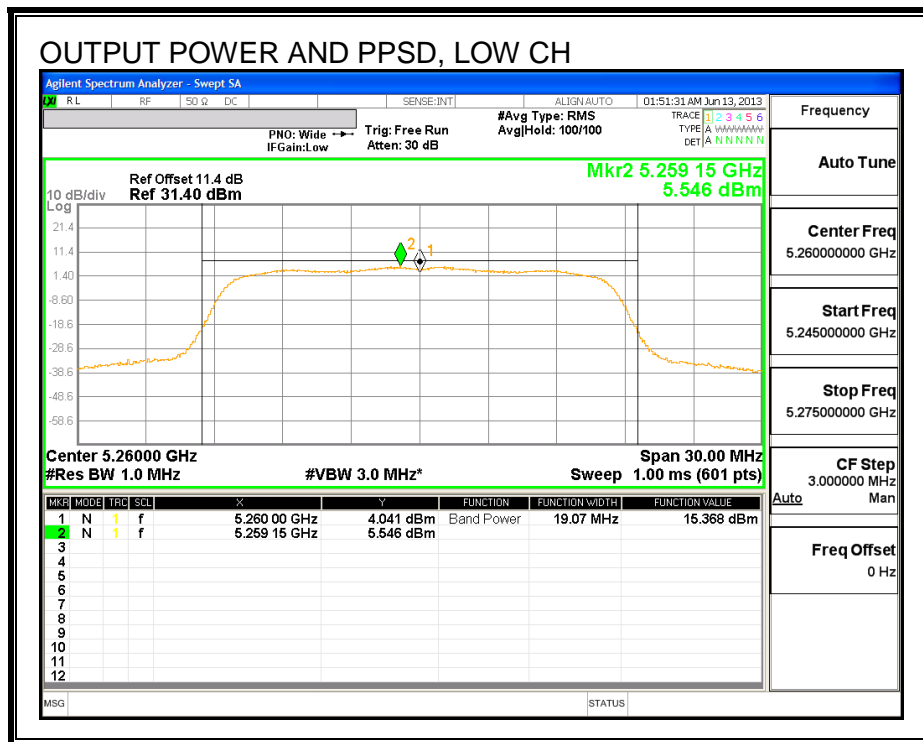
**Output Power Results**

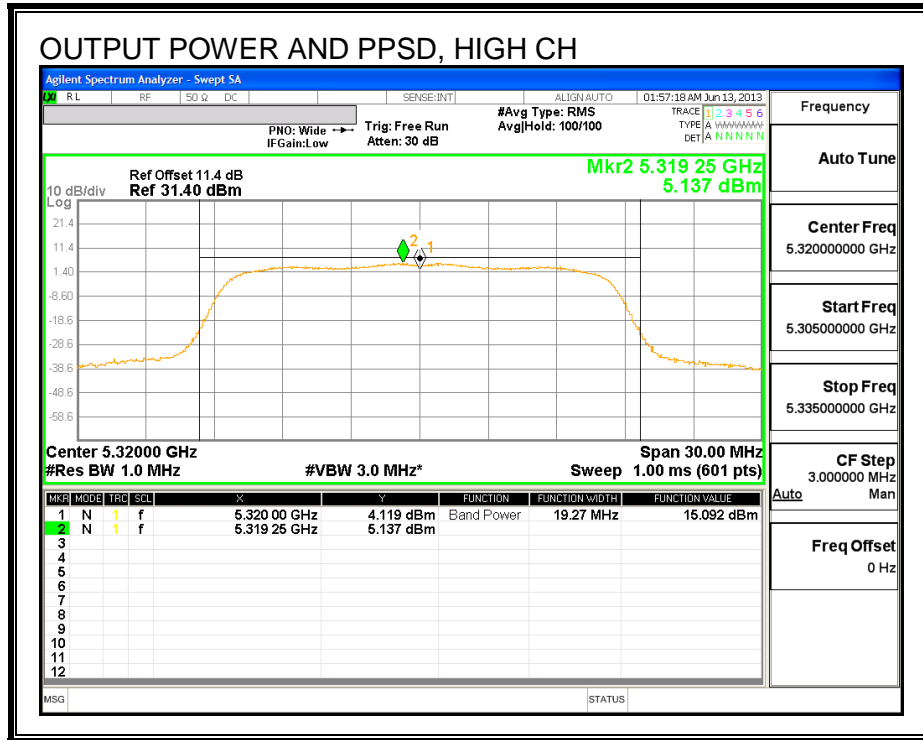
Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5260	15.368	15.46	23.80	-8.35
Mid	5300	15.108	15.20	23.82	-8.62
High	5320	15.092	15.18	23.85	-8.67

**PPSD Results**

Channel	Frequency (MHz)	Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5260	5.546	5.64	11.00	-5.36
Mid	5300	4.985	5.08	11.00	-5.93
High	5320	5.137	5.23	11.00	-5.77

**OUTPUT POWER AND PPSD**







## 8.5. 802.11n HT20 MODE IN THE 5.3 GHz BAND

### 8.5.1. 26 dB BANDWIDTH

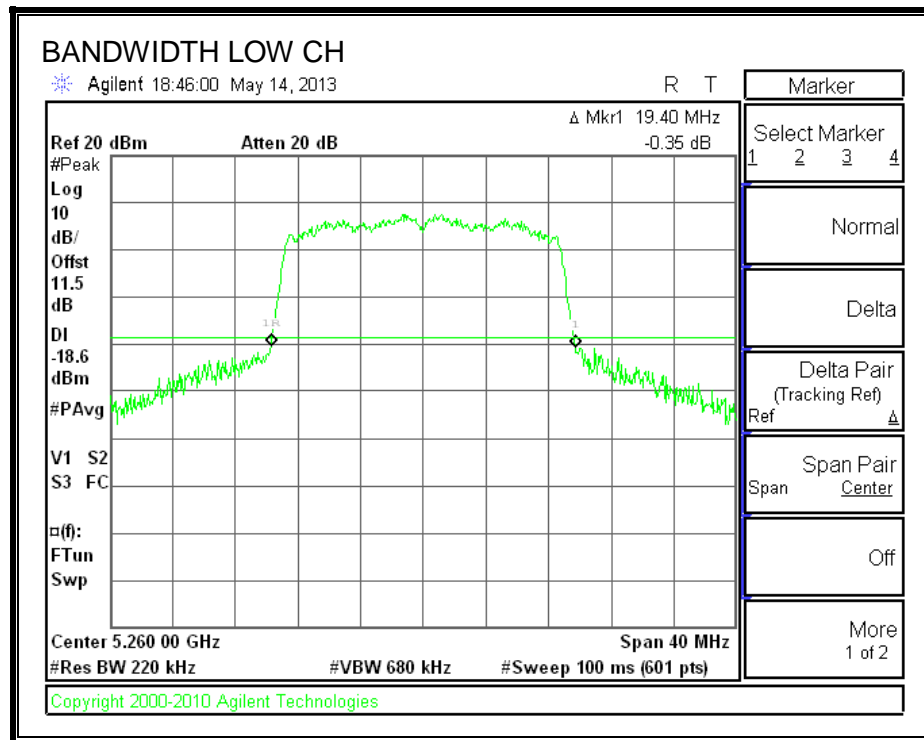
#### LIMITS

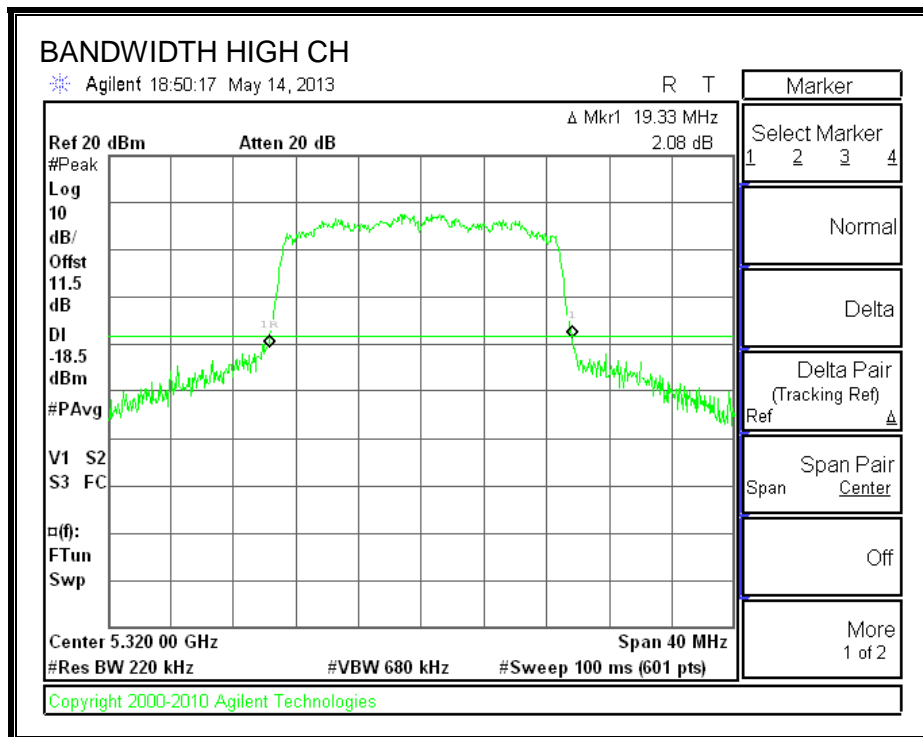
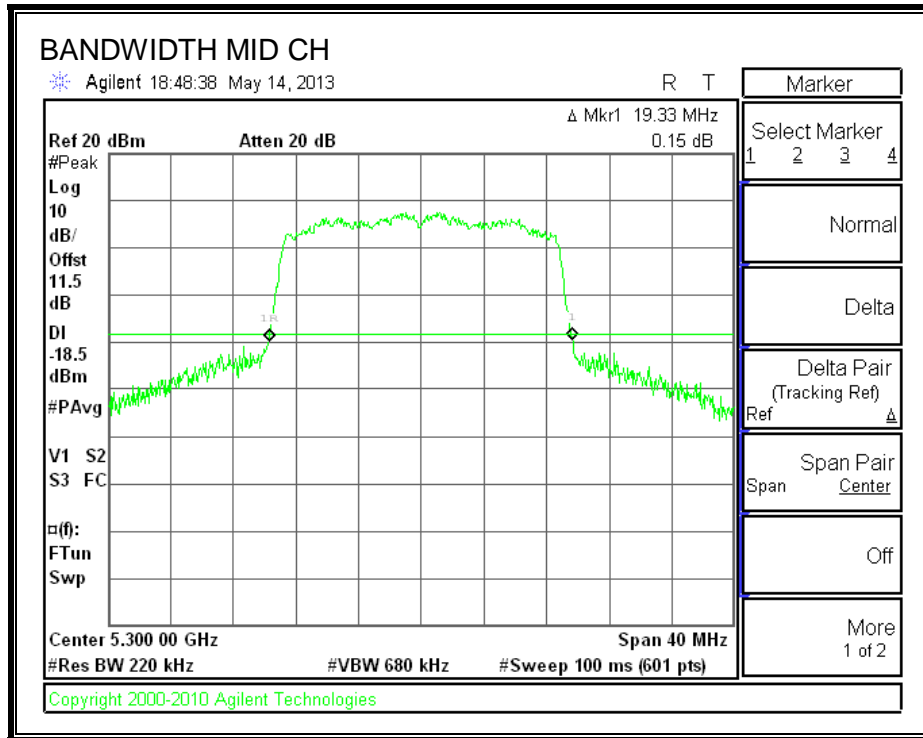
None; for reporting purposes only.

#### RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5260	19.40
Mid	5300	19.33
High	5320	19.33

#### 26 dB BANDWIDTH





### 8.5.2. 99% BANDWIDTH

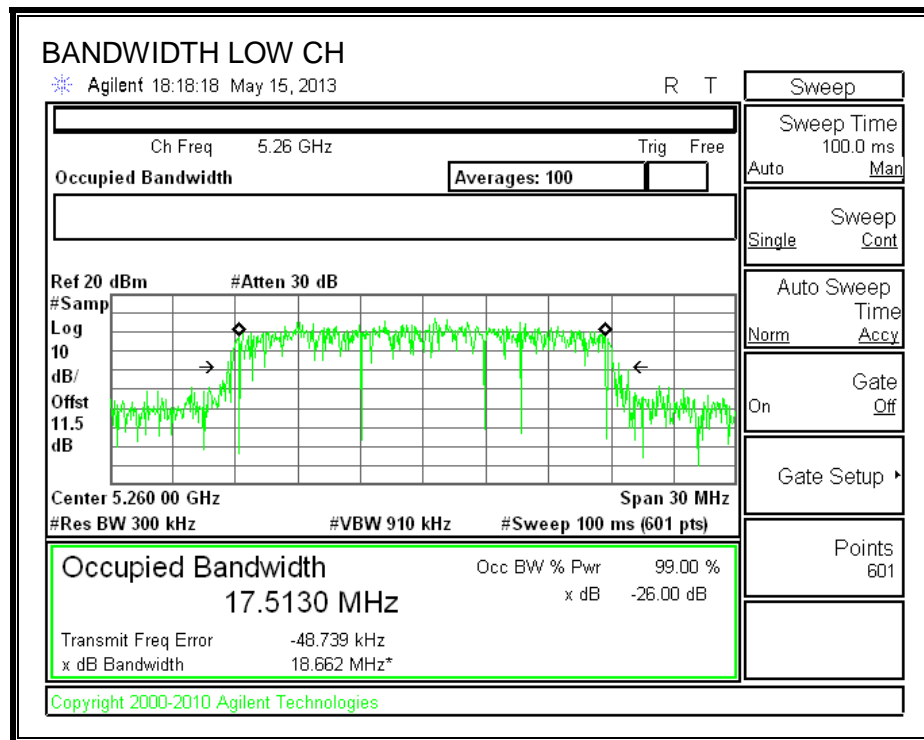
#### LIMITS

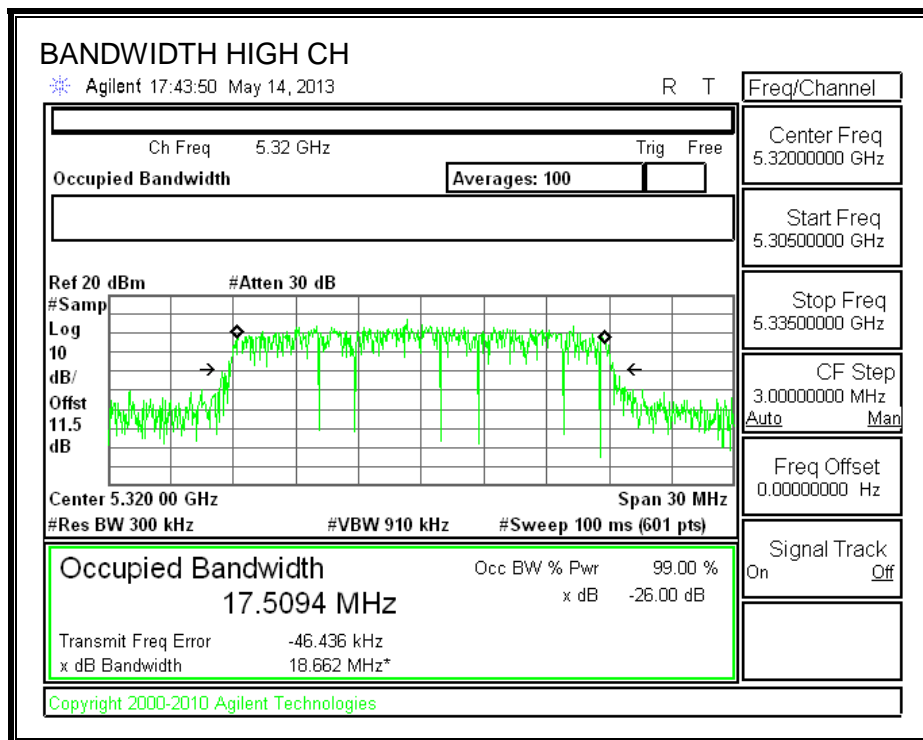
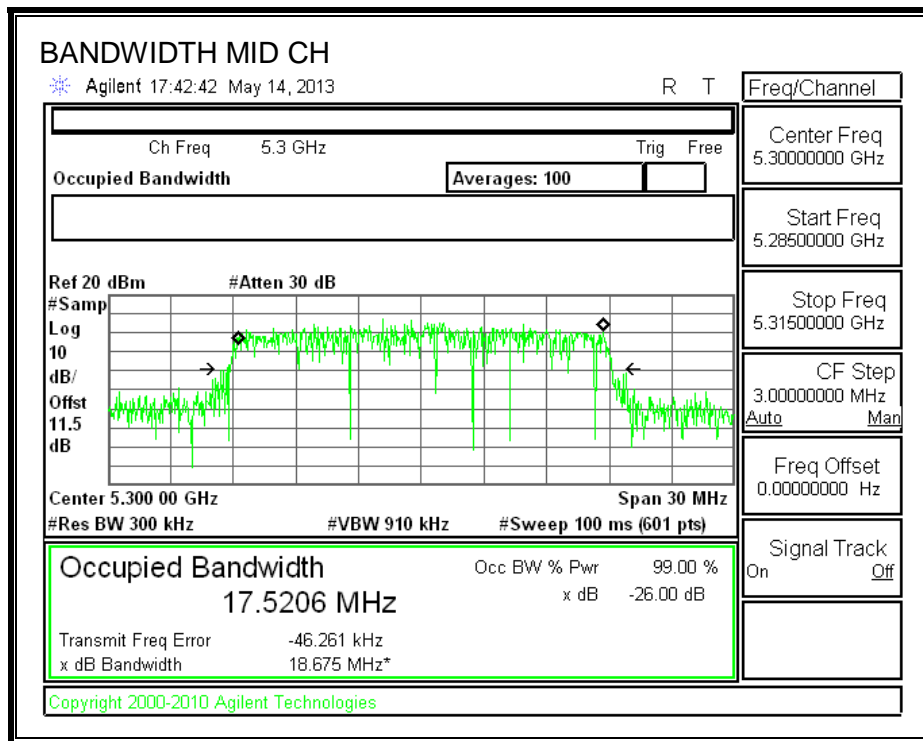
None; for reporting purposes only.

#### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5260	17.5130
Mid	5300	17.5206
High	5320	17.5094

#### 99% BANDWIDTH





### 8.5.3. AVERAGE POWER

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11.4 dB (including 10 dB pad and 1.4 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5260	15.24
Mid	5300	15.02
High	5320	14.89

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## 8.5.4. OUTPUT POWER AND PPSD

### LIMITS

FCC §15.407 (a) (2)

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

### DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

**RESULTS**

**Bandwidth and Antenna Gain**

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Direction Gain (dBi)
Low	5260	19.40	-5.83
Mid	5300	19.33	-5.83
High	5320	19.33	-5.83

**Limits**

Channel	Frequency (MHz)	FCC Power Limit (dBm)	FCC PPSD Limit (dBm)
Low	5260	23.88	11.00
Mid	5300	23.86	11.00
High	5320	23.86	11.00

<b>Duty Cycle CF (dB)</b>	0.07	<b>Included in Calculations of Corr'd Power &amp; PPSD</b>
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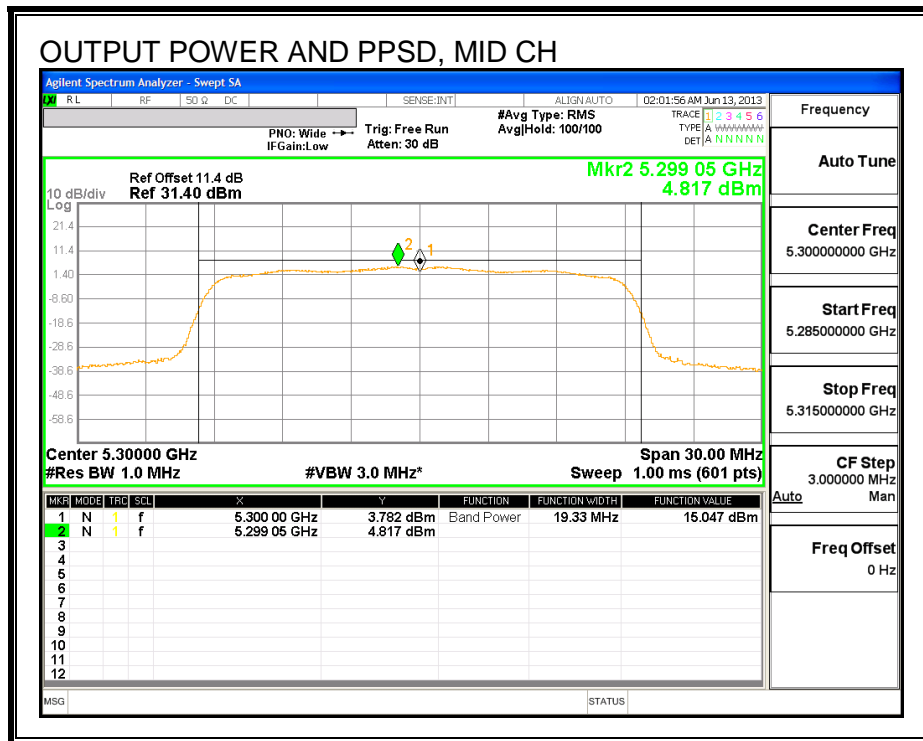
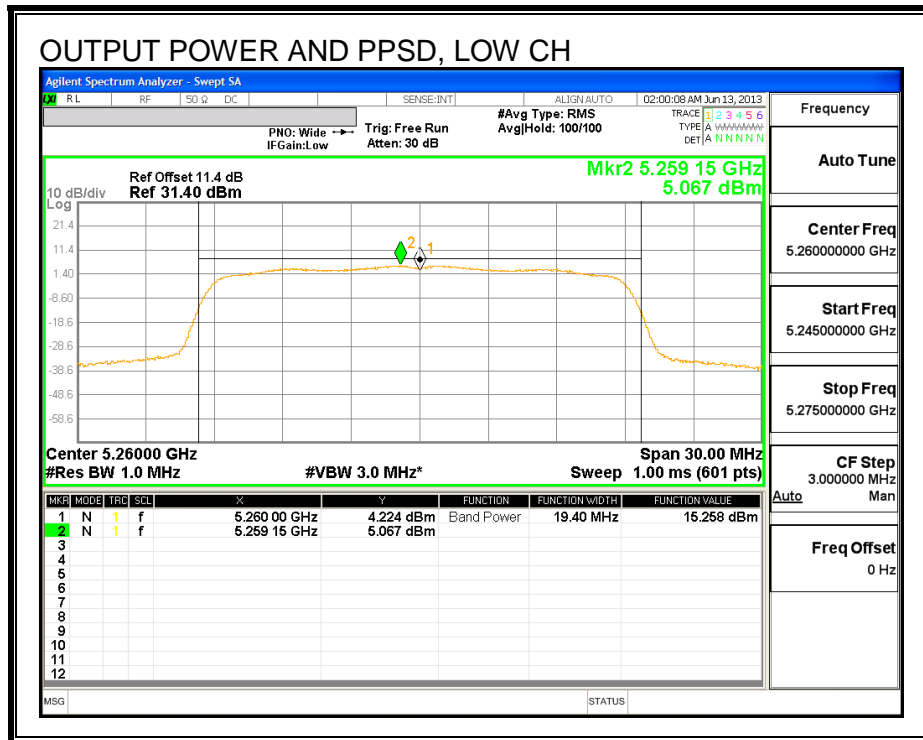
**Output Power Results**

Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5260	15.258	15.33	23.88	-8.55
Mid	5300	15.047	15.12	23.86	-8.75
High	5320	14.955	15.03	23.86	-8.84

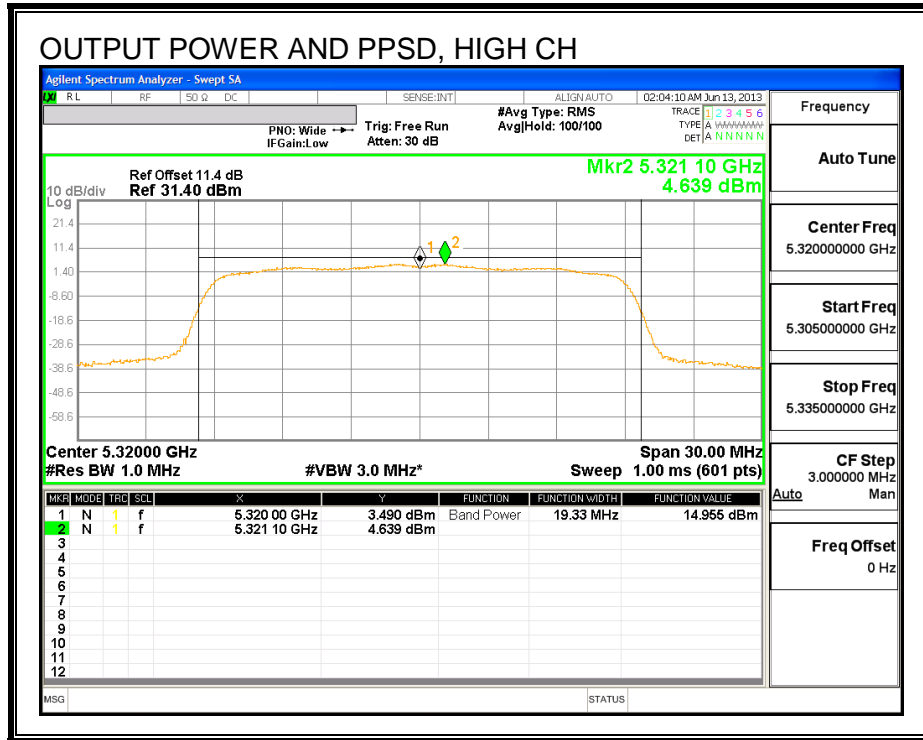
**PPSD Results**

Channel	Frequency (MHz)	Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5260	5.067	5.14	11.00	-5.86
Mid	5300	4.817	4.89	11.00	-6.11
High	5320	4.639	4.71	11.00	-6.29

**OUTPUT POWER AND PPSD**







## 8.6. 802.11n HT40 MODE IN THE 5.3 GHZ BAND

### 8.6.1. 26 dB BANDWIDTH

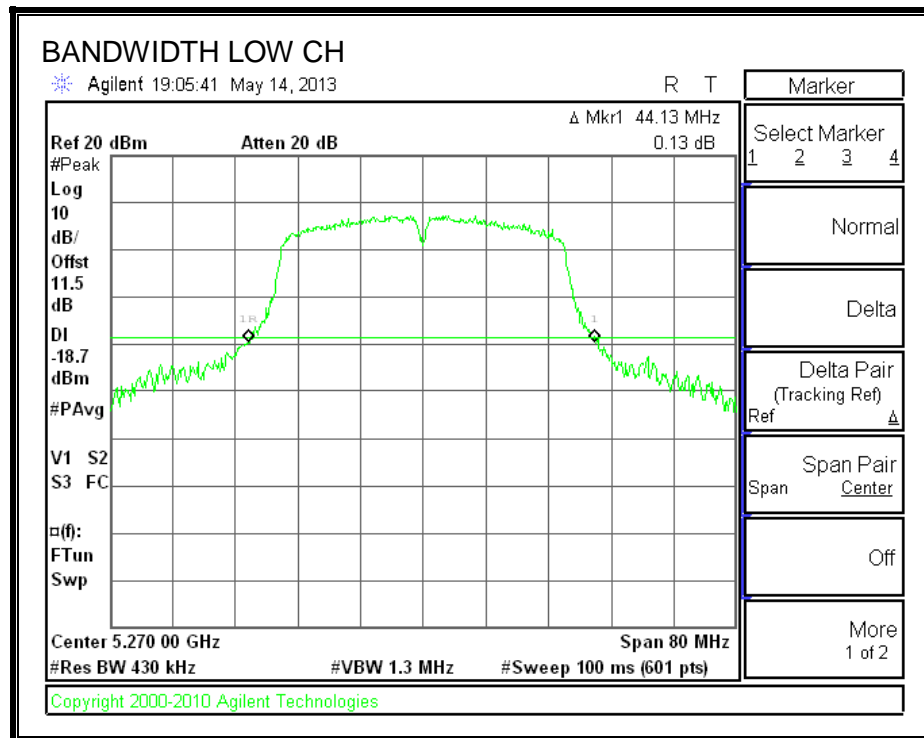
#### LIMITS

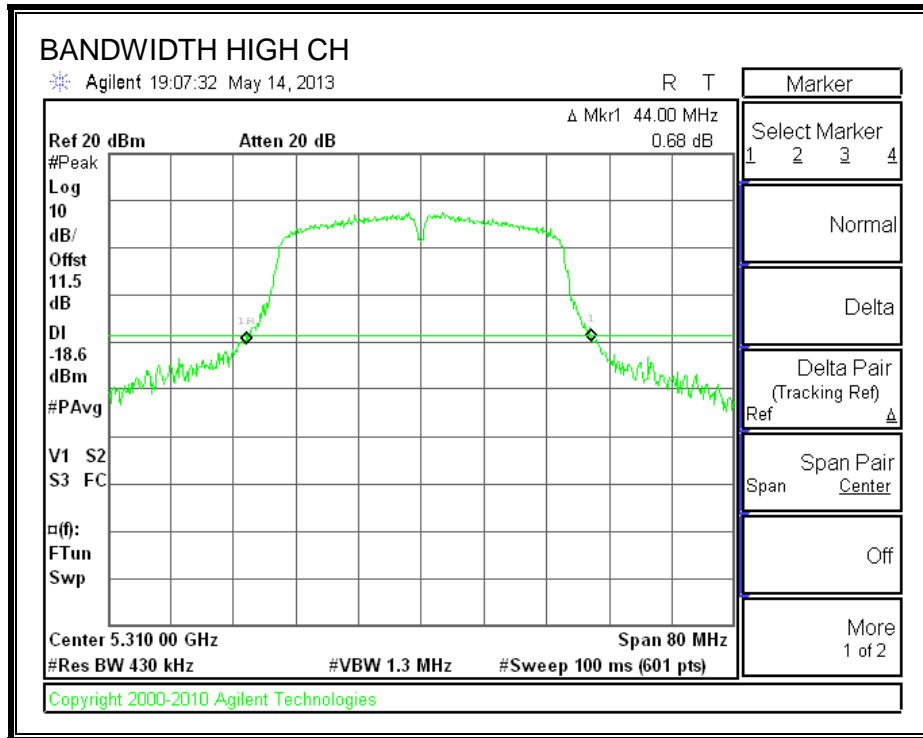
None; for reporting purposes only.

#### RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5270	44.13
High	5310	44.00

#### 26 dB BANDWIDTH





### 8.6.2. 99% BANDWIDTH

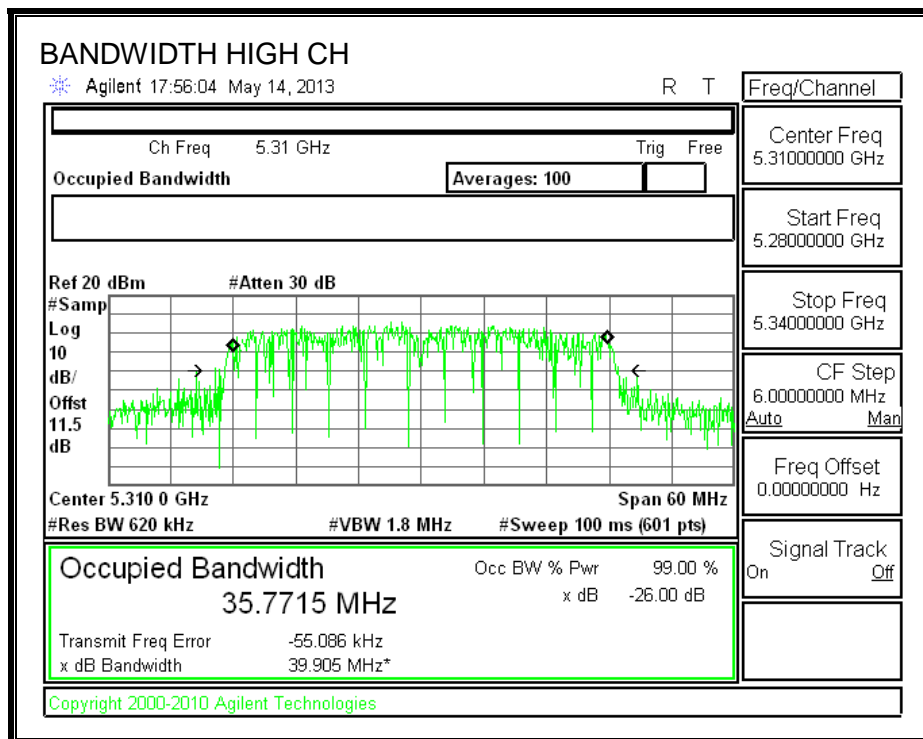
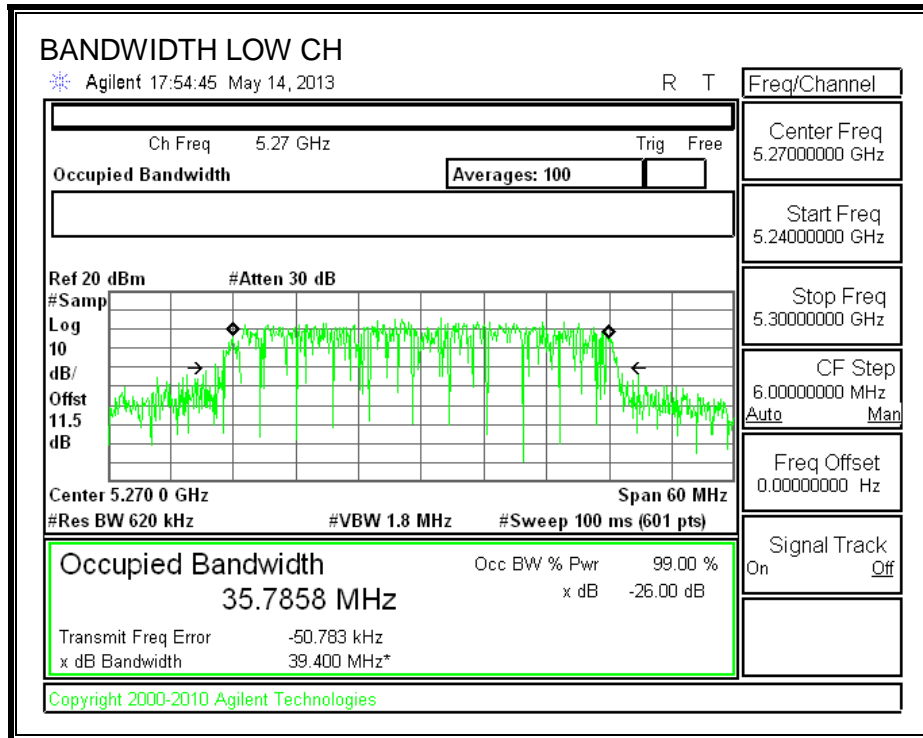
#### LIMITS

None; for reporting purposes only.

#### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5270	35.7858
High	5310	35.7715

**99% BANDWIDTH**



### 8.6.3. AVERAGE POWER

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5270	15.24
High	5310	15.00

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## 8.6.4. OUTPUT POWER AND PPSD

### LIMITS

FCC §15.407 (a) (2)

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

### DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

**RESULTS**

**Bandwidth and Antenna Gain**

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Direction Gain (dBi)
Low	5270	44.13	-5.83
High	5310	44.00	-5.83

**Limits**

Channel	Frequency (MHz)	FCC Power Limit (dBm)	FCC PPSD Limit (dBm)
Low	5270	24.00	11.00
High	5310	24.00	11.00

<b>Duty Cycle CF (dB)</b>	0.16	<b>Included in Calculations of Corr'd Power &amp; PPSD</b>
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**Output Power Results**

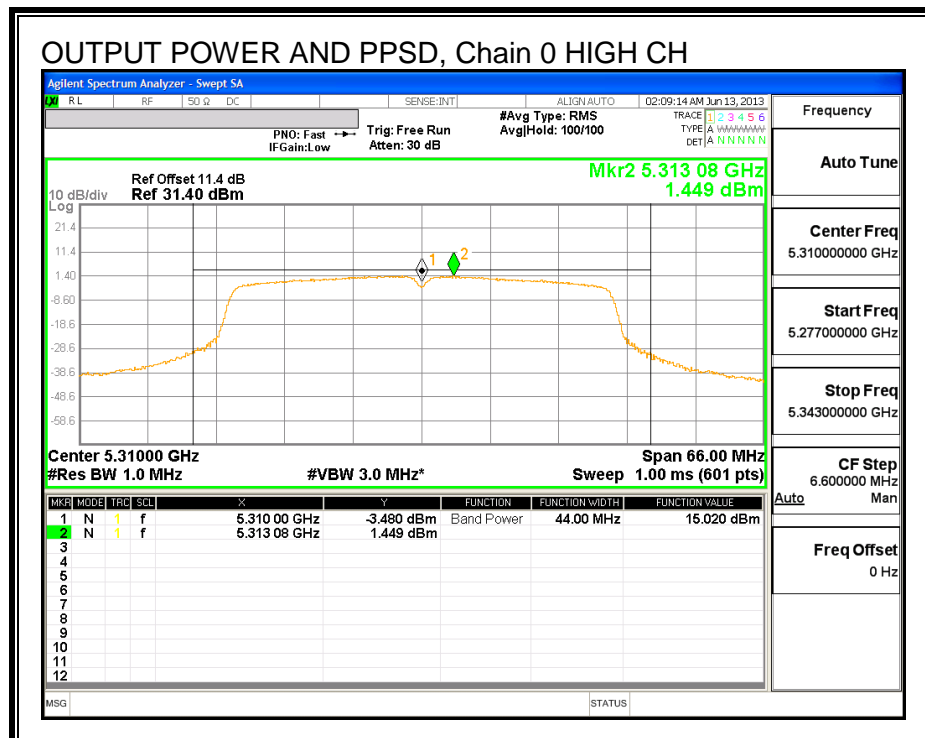
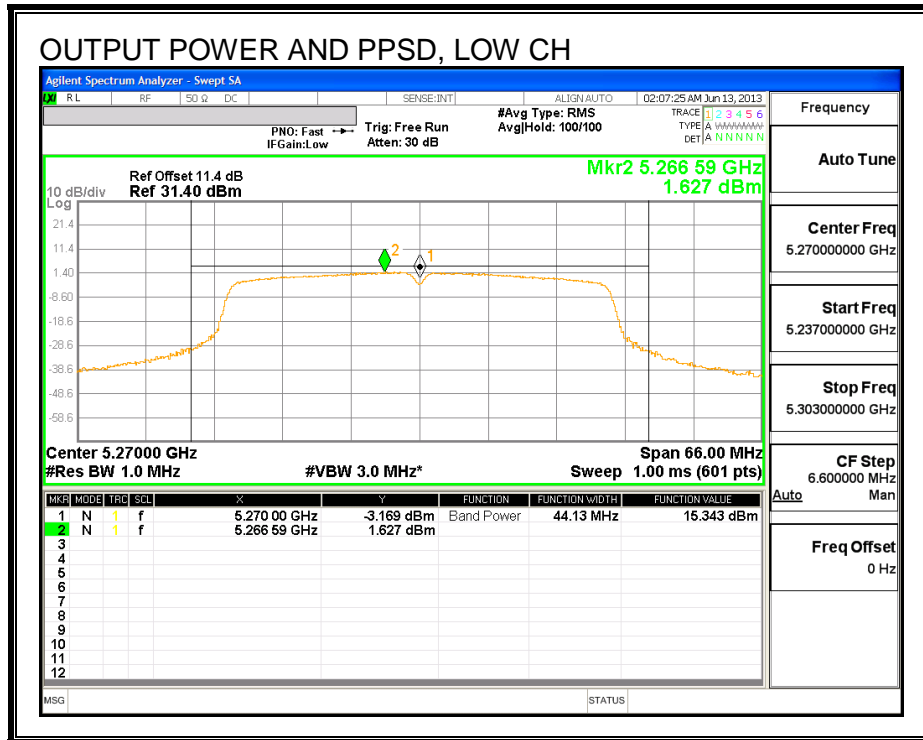
Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5270	15.343	15.50	24.00	-8.50
High	5310	15.020	15.18	24.00	-8.82

**PPSD Results**

Channel	Frequency (MHz)	Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5270	1.627	1.79	11.00	-9.21
High	5310	1.449	1.61	11.00	-9.39



**OUTPUT POWER AND PPSD,**



## 8.7. 802.11a MODE IN THE 5.6 GHz BAND

### 8.7.1. 26 dB BANDWIDTH

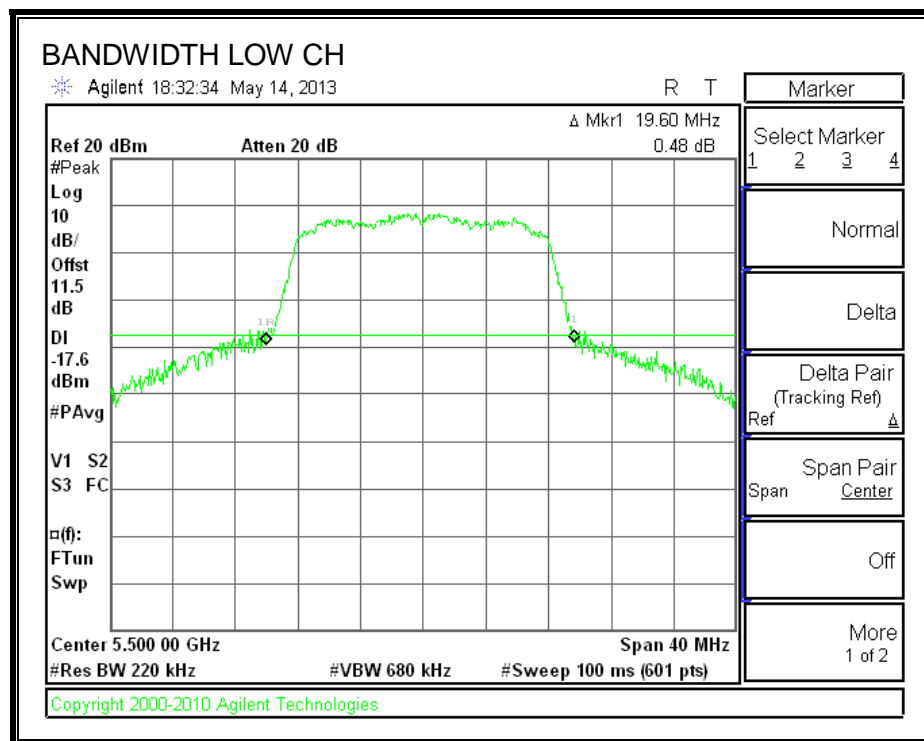
#### LIMITS

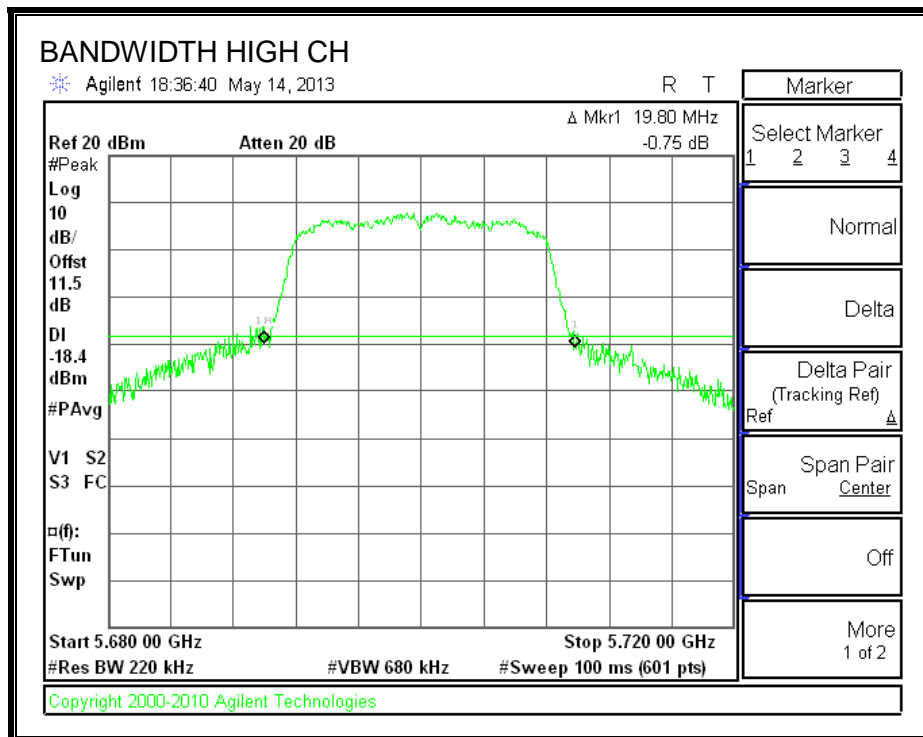
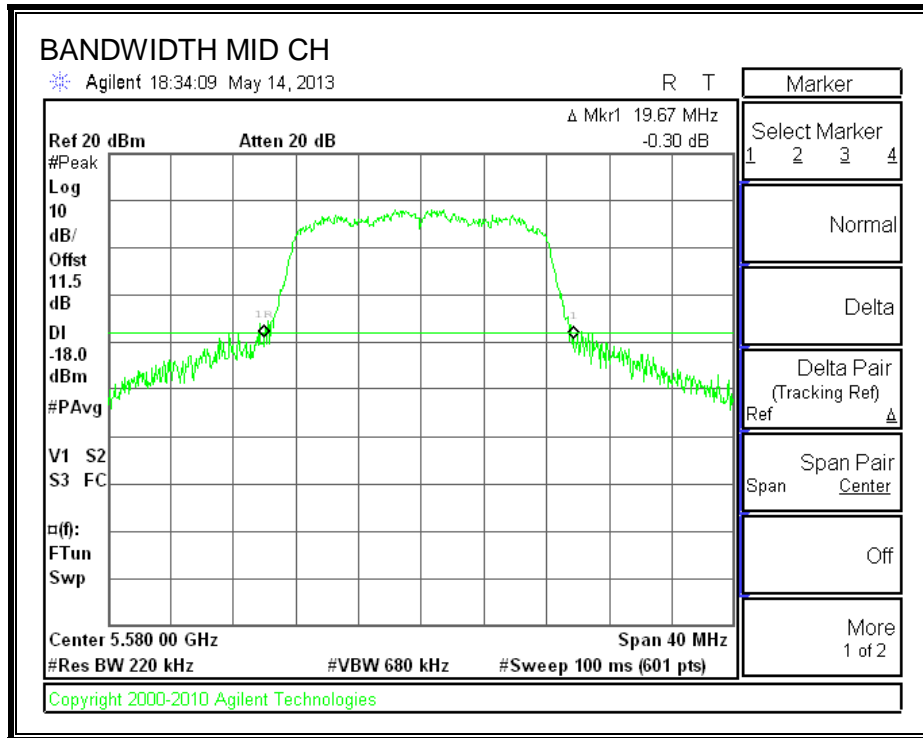
None; for reporting purposes only.

#### RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5500	19.60
Mid	5580	19.67
High	5700	19.80

#### 26 dB BANDWIDTH





### 8.7.2. 99% BANDWIDTH

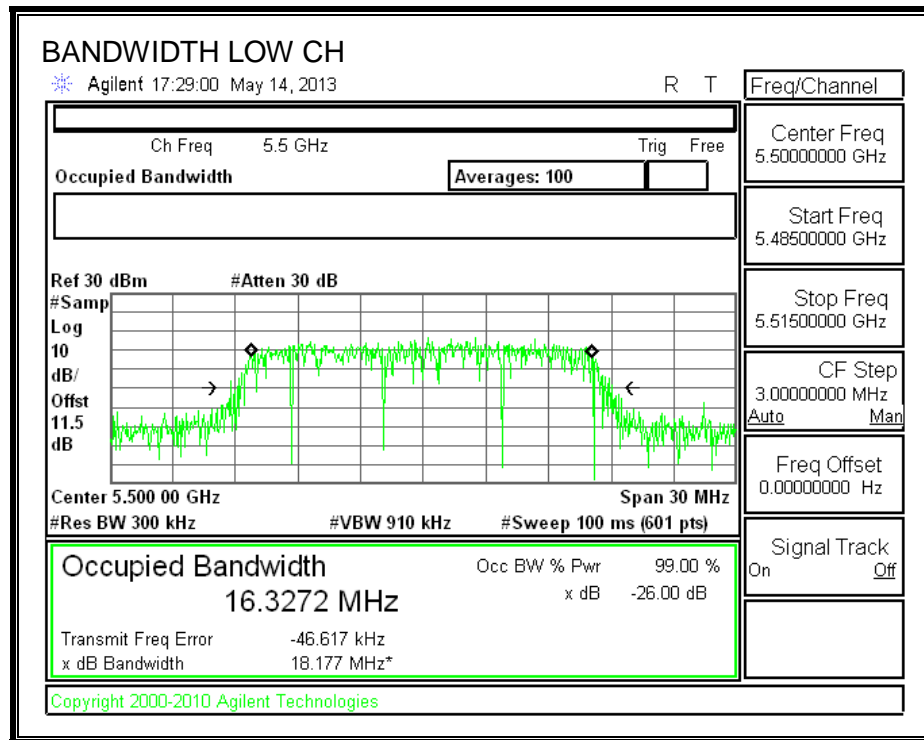
#### LIMITS

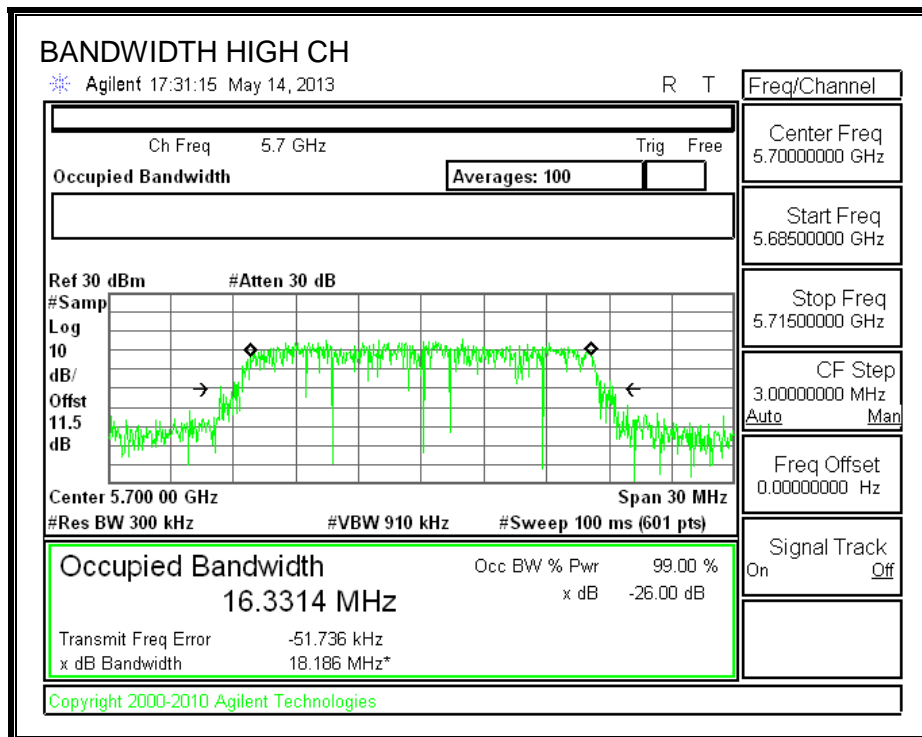
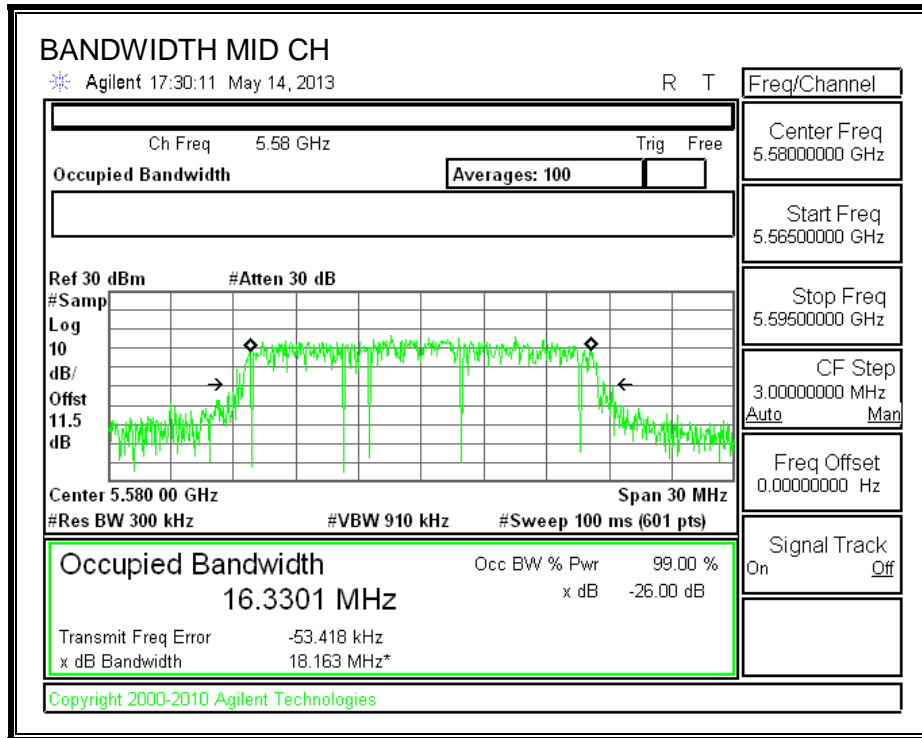
None; for reporting purposes only.

#### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5500	16.3272
Mid	5580	16.3301
High	5700	16.3314

#### 99% BANDWIDTH





### 8.7.3. AVERAGE POWER

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5500	15.66
Mid	5580	15.50
High	5700	15.58

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## 8.7.4. OUTPUT POWER AND PPSD

### LIMITS

FCC §15.407 (a) (2)

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

### DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

**RESULTS**

**Bandwidth and Antenna Gain**

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Direction Gain (dBi)
Low	5500	19.60	-4.25
Mid	5580	19.67	-4.25
High	5700	19.80	-4.25

**Limits**

Channel	Frequency (MHz)	FCC Power Limit (dBm)	FCC PPSD Limit (dBm)
Low	5500	23.92	11.00
Mid	5580	23.94	11.00
High	5700	23.97	11.00

<b>Duty Cycle CF (dB)</b>	0.09	<b>Included in Calculations of Corr'd Power &amp; PPSD</b>
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**Output Power Results**

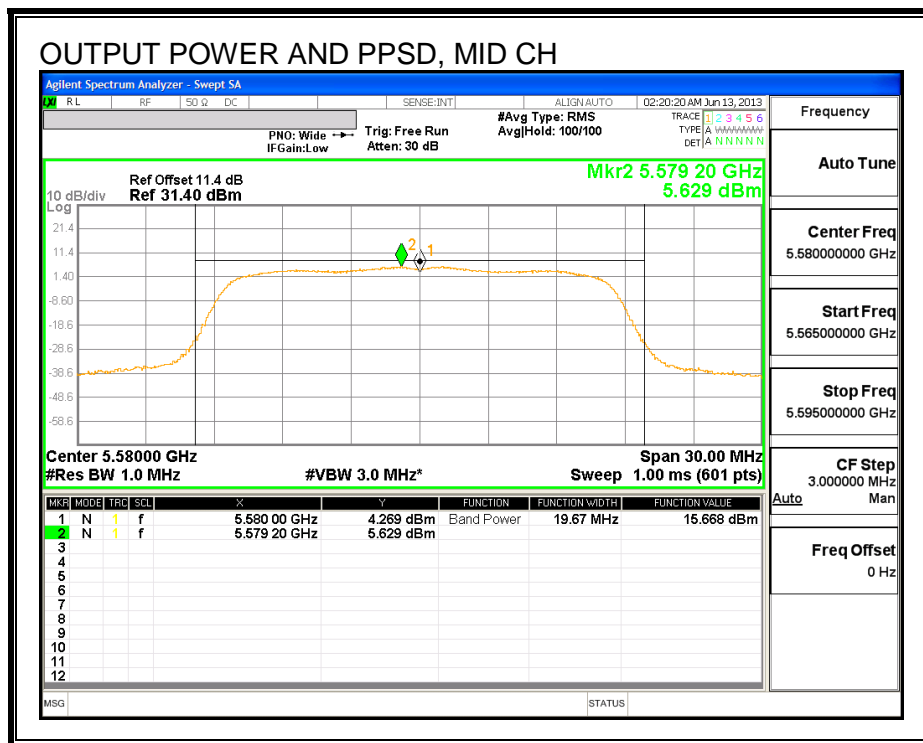
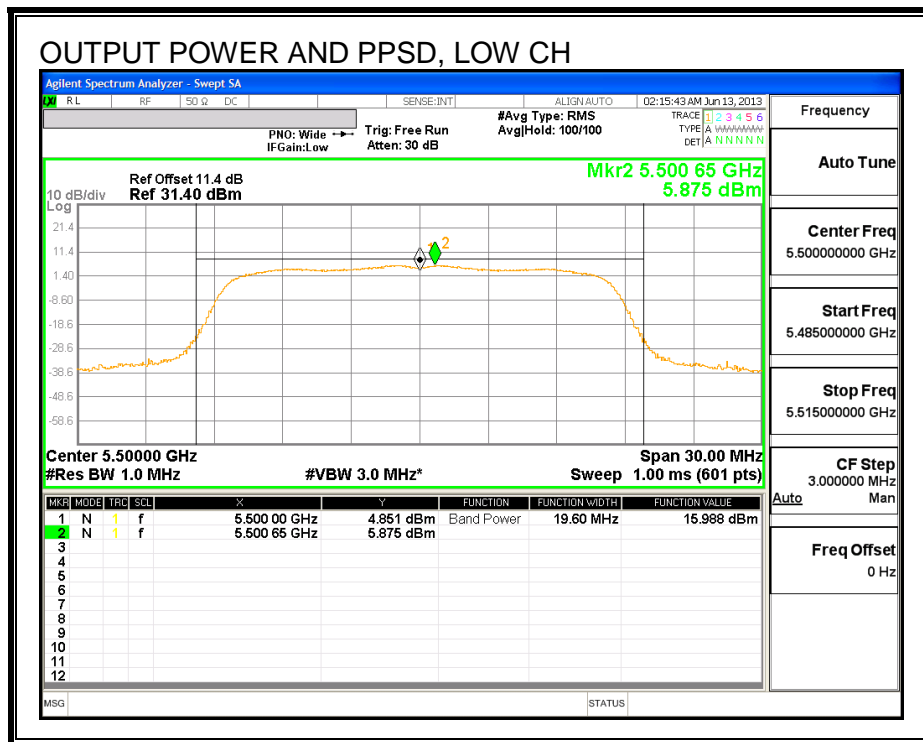
Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5500	15.988	16.08	23.92	-7.84
Mid	5580	15.668	15.76	23.94	-8.18
High	5700	15.776	15.87	23.97	-8.10

**PPSD Results**

Channel	Frequency (MHz)	Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5500	5.875	5.97	11.00	-5.04
Mid	5580	5.629	5.72	11.00	-5.28
High	5700	5.686	5.78	11.00	-5.22



**OUTPUT POWER AND PPSD**





## 8.8. 802.11n HT20 MODE IN THE 5.6 GHz BAND

### 8.8.1. 26 dB BANDWIDTH

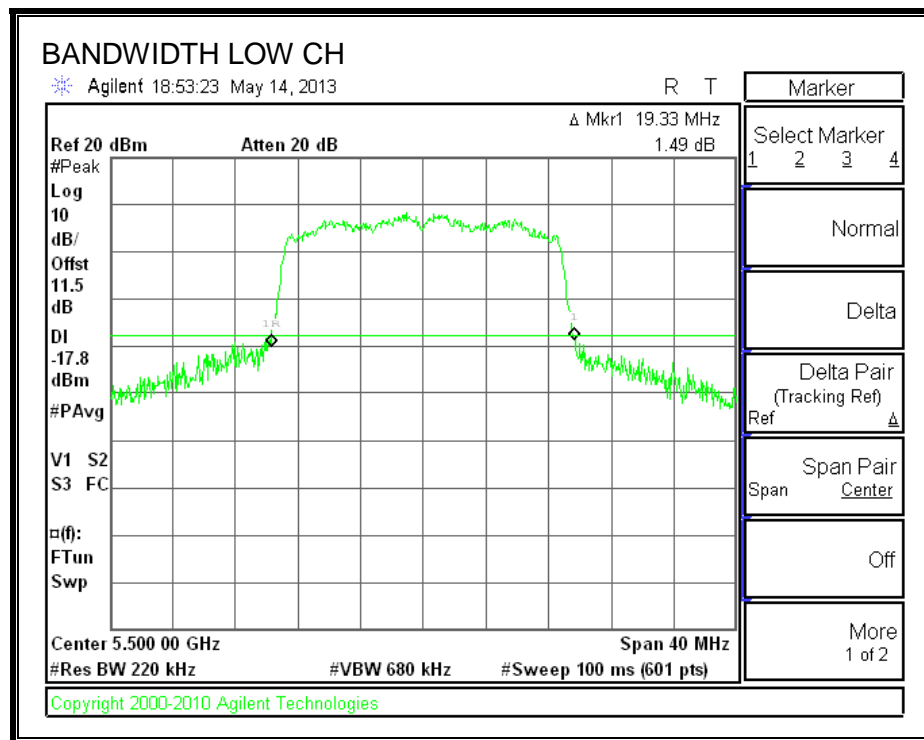
#### LIMITS

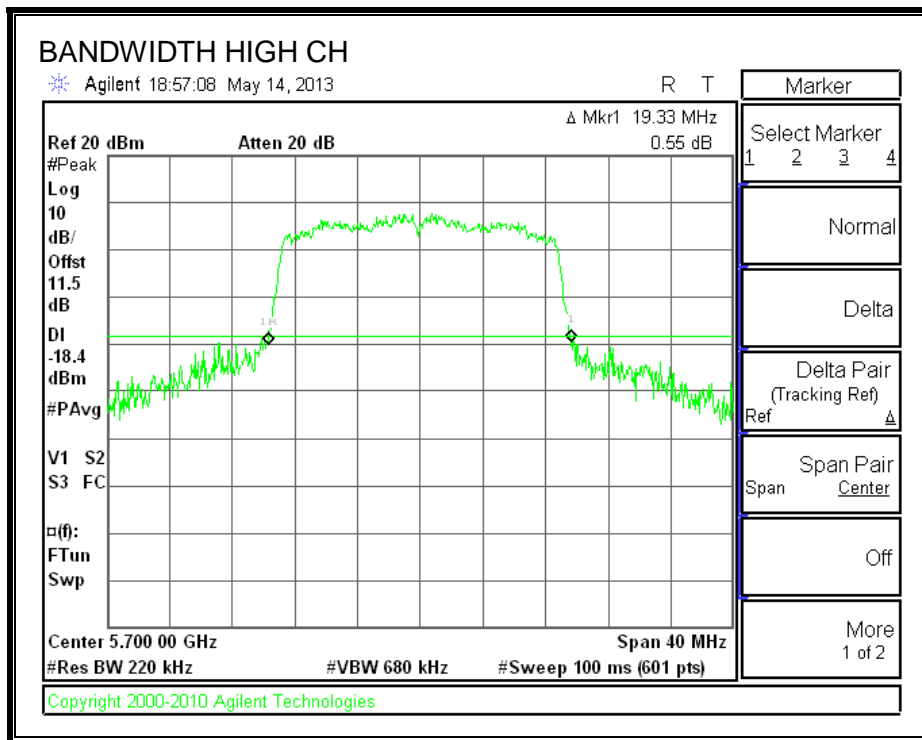
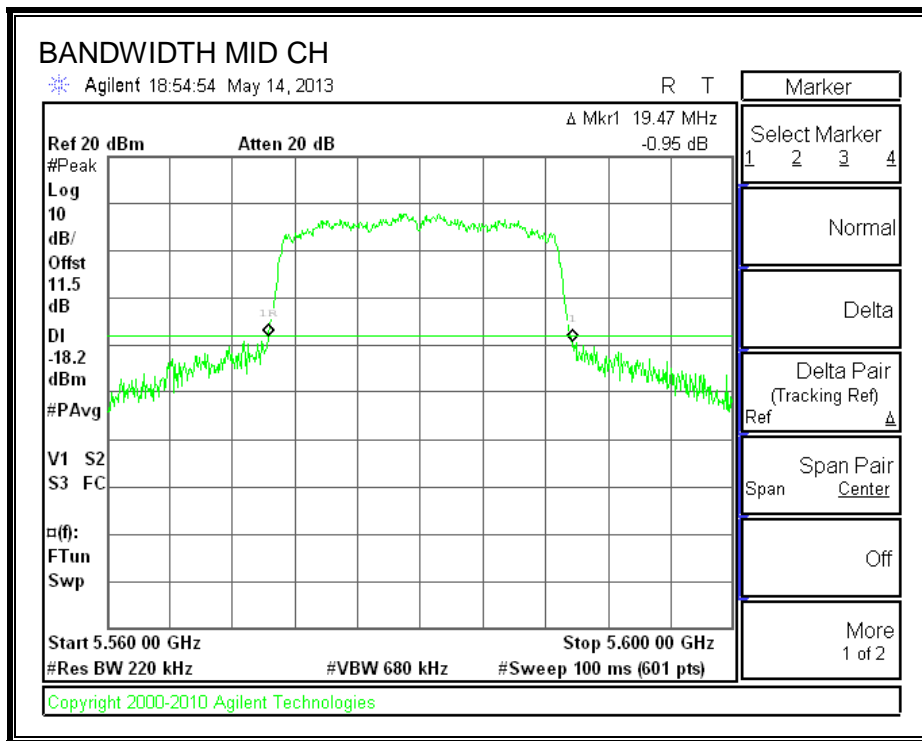
None; for reporting purposes only.

#### RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5500	19.33
Mid	5580	19.47
High	5700	19.33

#### 26 dB BANDWIDTH





### 8.8.2. 99% BANDWIDTH

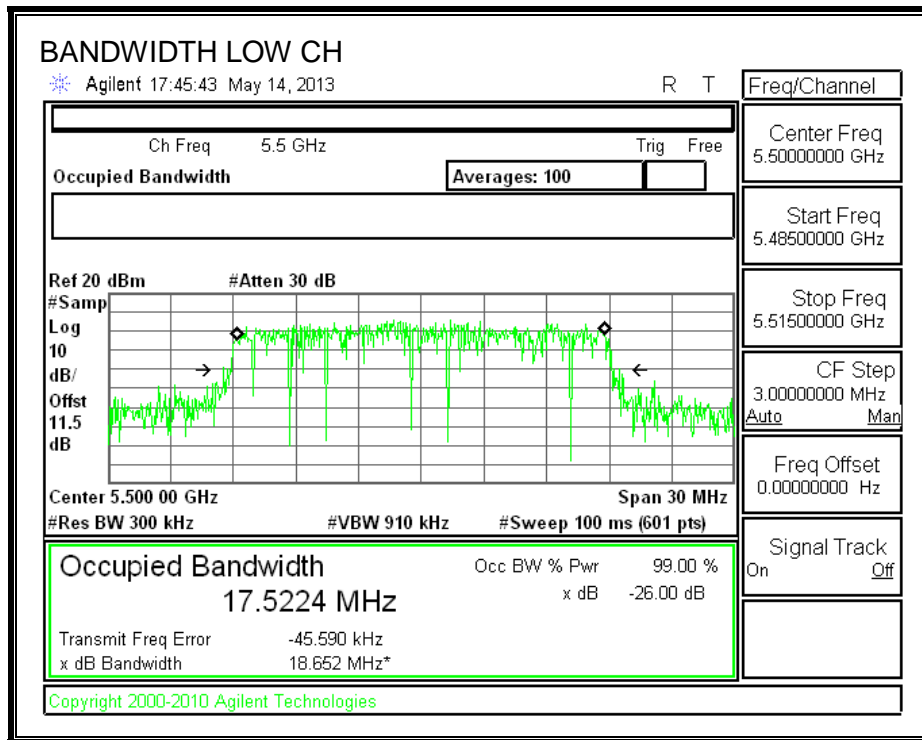
#### LIMITS

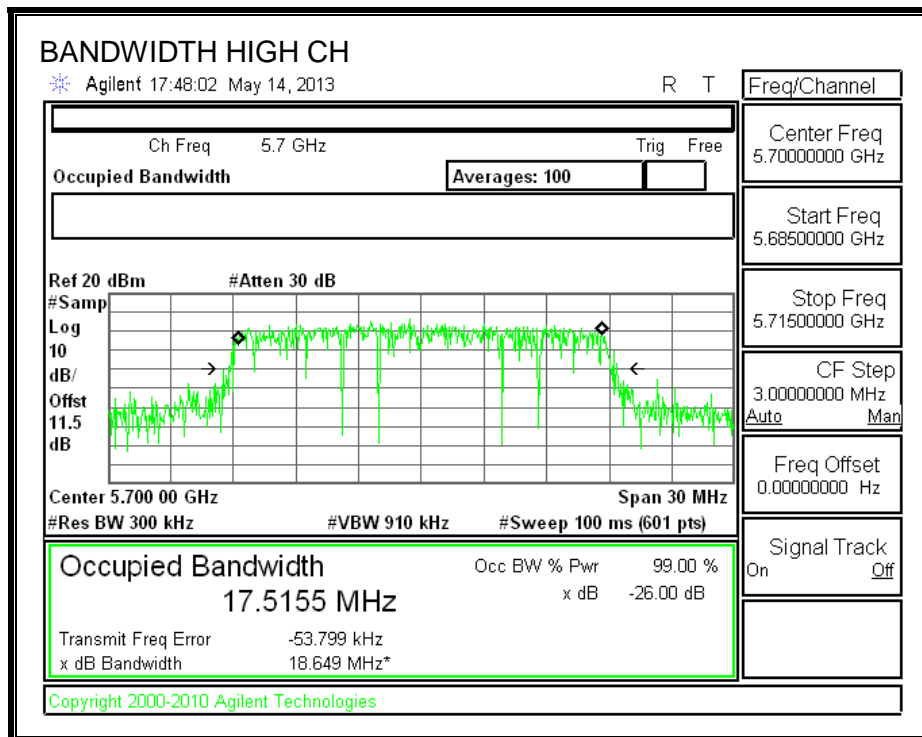
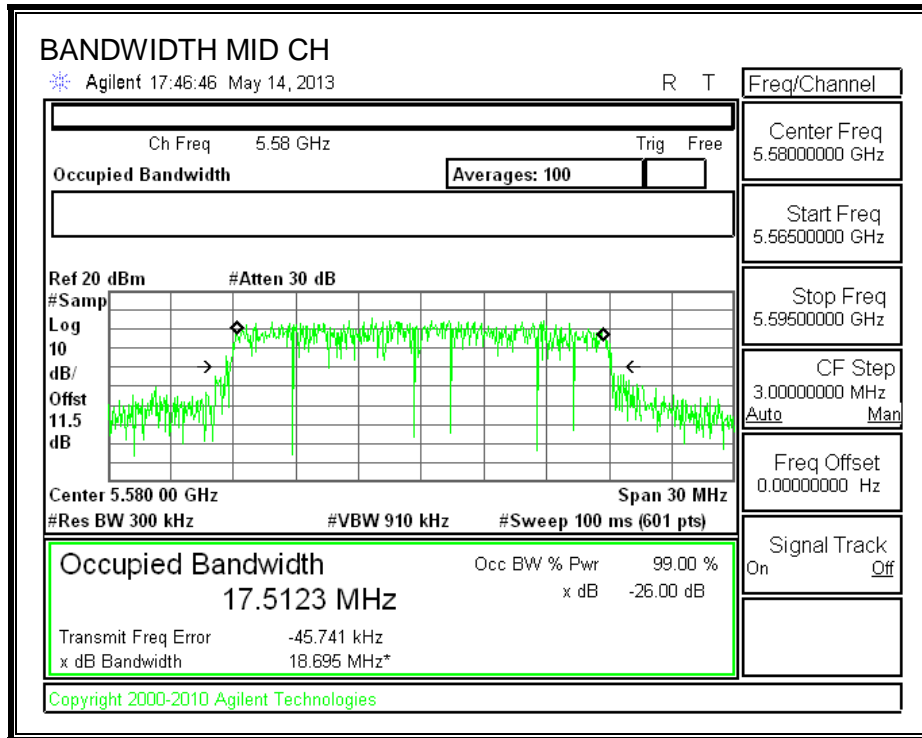
None; for reporting purposes only.

#### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5500	17.5224
Mid	5580	17.5123
High	5700	17.5155

#### 99% BANDWIDTH





### 8.8.3. AVERAGE POWER

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5500	15.69
Mid	5580	15.46
High	5700	15.62

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## 8.8.4. OUTPUT POWER AND PPSD

### LIMITS

FCC §15.407 (a) (2)

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

### DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.



**RESULTS**

**Bandwidth and Antenna Gain**

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Directio Gain (dBi)
Low	5500	19.33	-4.25
Mid	5580	19.47	-4.25
High	5700	19.33	-4.25

**Limits**

Channel	Frequency (MHz)	FCC Power Limit (dBm)	FCC PPSD Limit (dBm)
Low	5500	23.86	11.00
Mid	5580	23.89	11.00
High	5700	23.86	11.00

<b>Duty Cycle CF (dB)</b>	0.07	<b>Included in Calculations of Corr'd Power &amp; PPSD</b>
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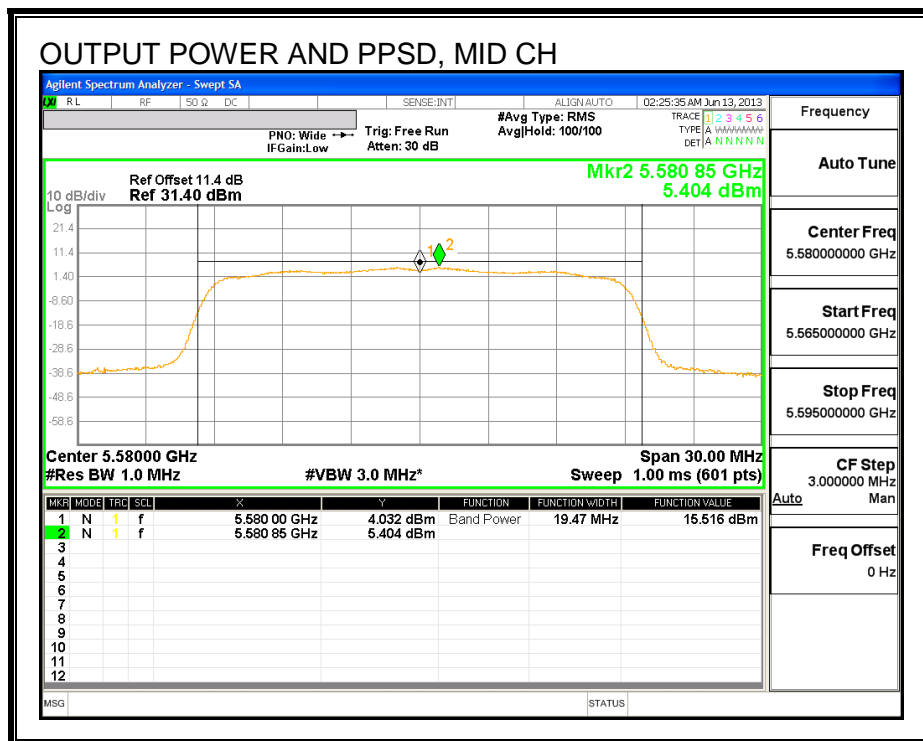
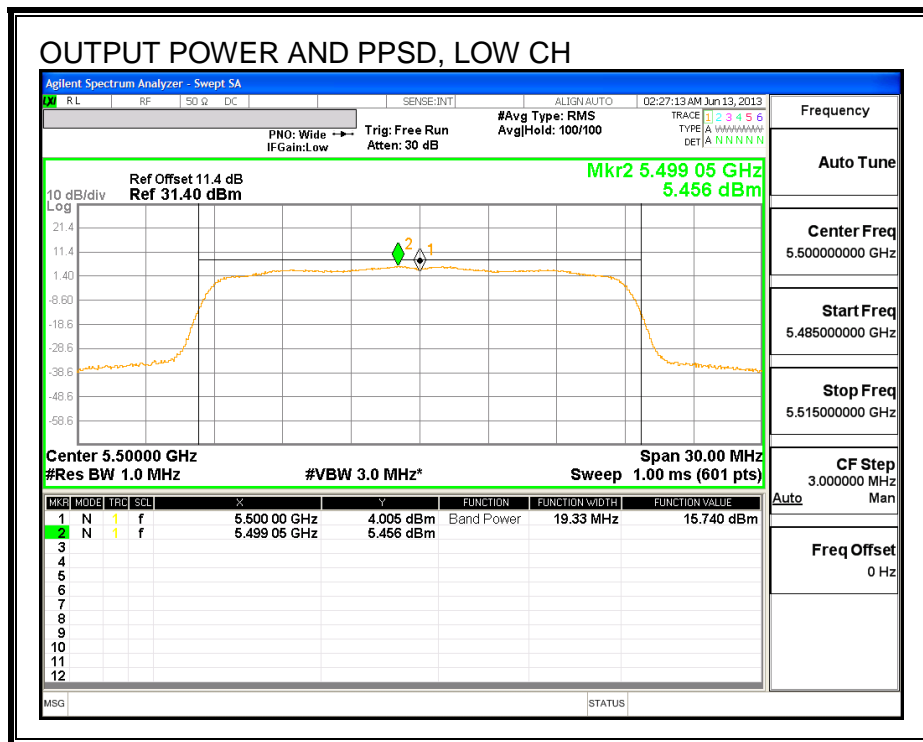
**Output Power Results**

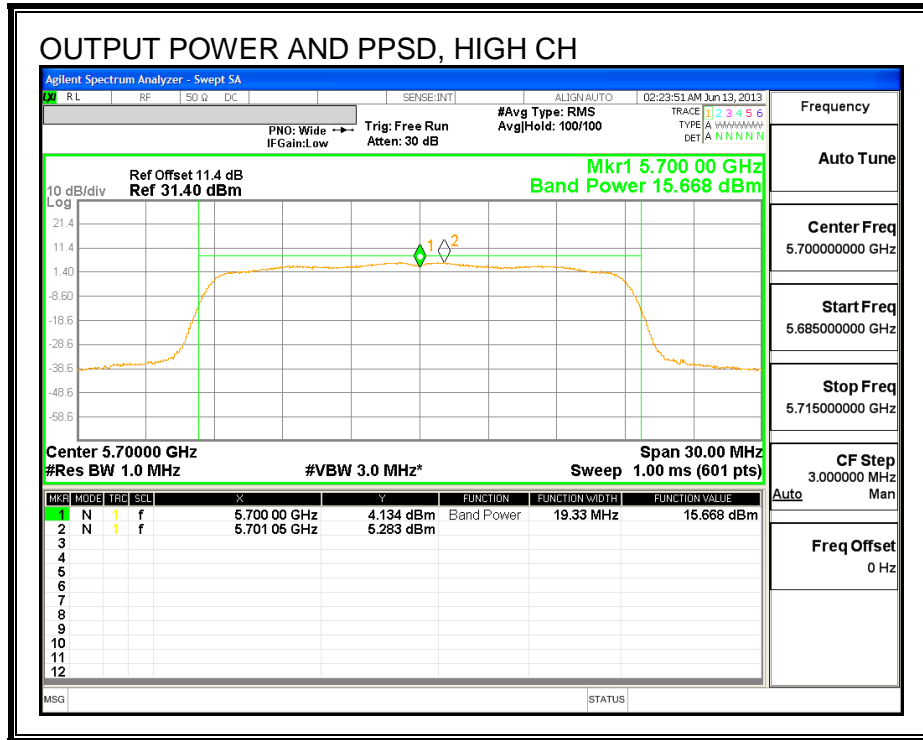
Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5500	15.740	15.81	23.86	-8.05
Mid	5580	15.516	15.59	23.89	-8.31
High	5700	15.668	15.74	23.86	-8.12

**PPSD Results**

Channel	Frequency (MHz)	Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5500	5.499	5.57	11.00	-5.43
Mid	5580	5.404	5.47	11.00	-5.53
High	5700	5.283	5.35	11.00	-5.65

**OUTPUT POWER AND PPSD**





## 8.9. 802.11n HT40 MODE IN THE 5.6 GHz BAND

### 8.9.1. 26 dB BANDWIDTH

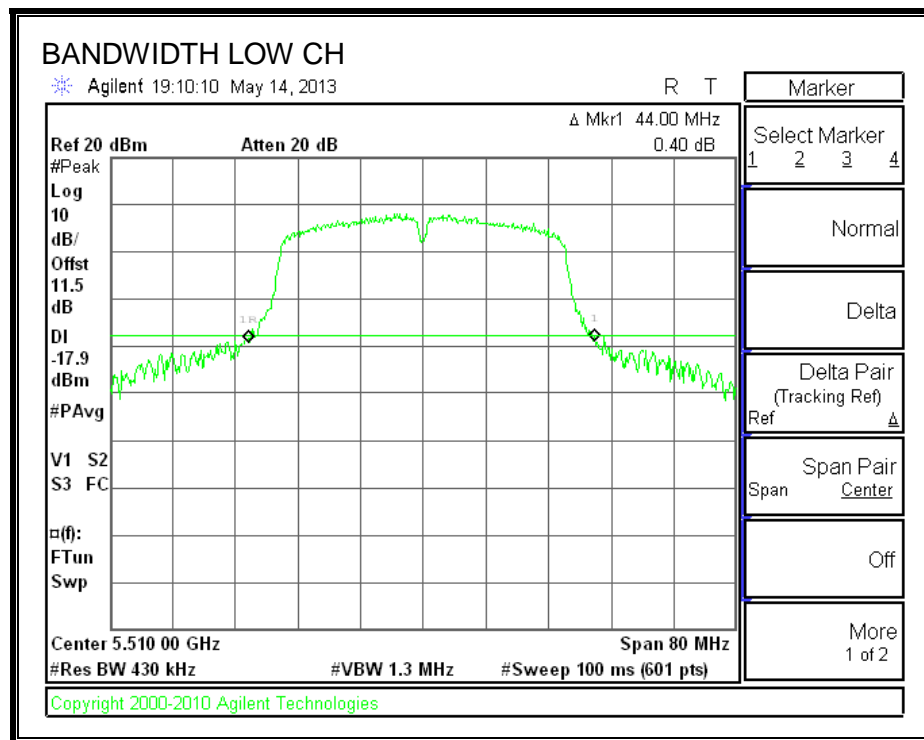
#### LIMITS

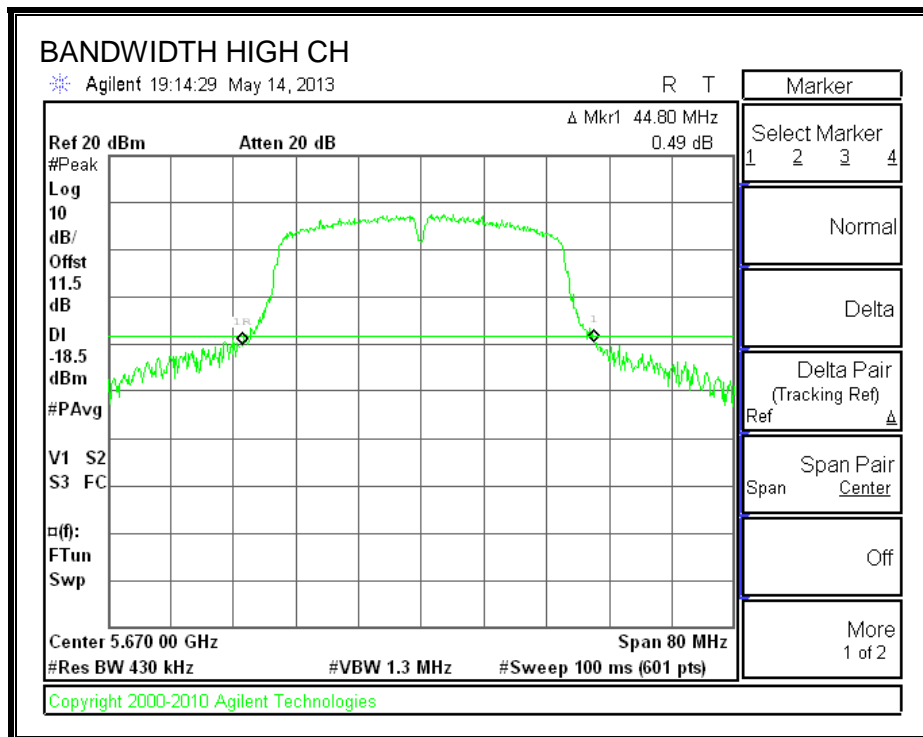
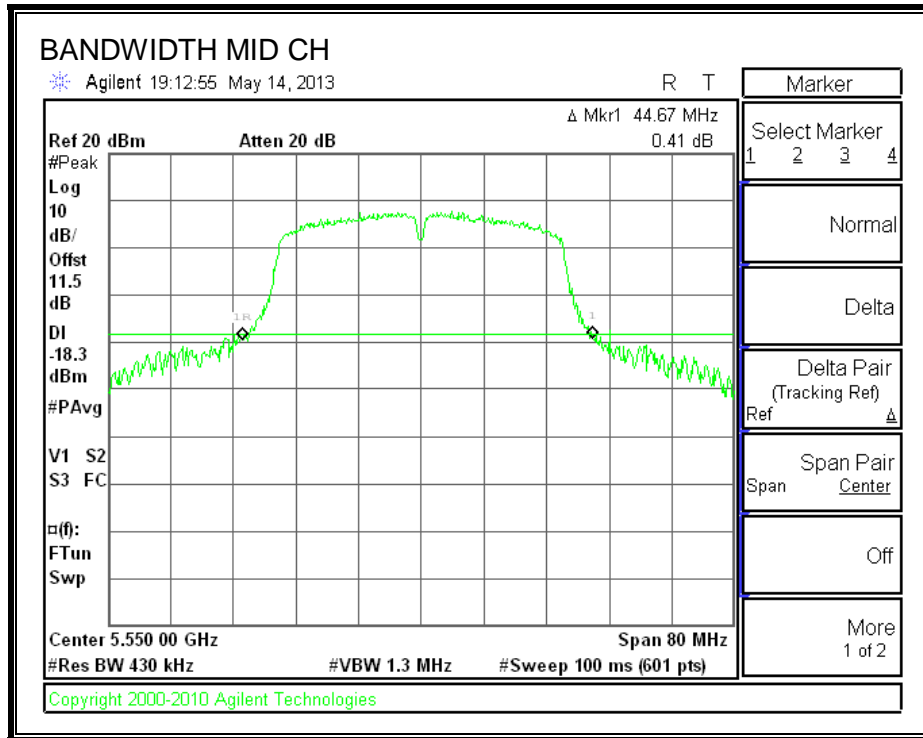
None; for reporting purposes only.

#### RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5510	44.00
Mid	5550	44.67
High	5670	44.80

#### 26 dB BANDWIDTH





### 8.9.2. 99% BANDWIDTH

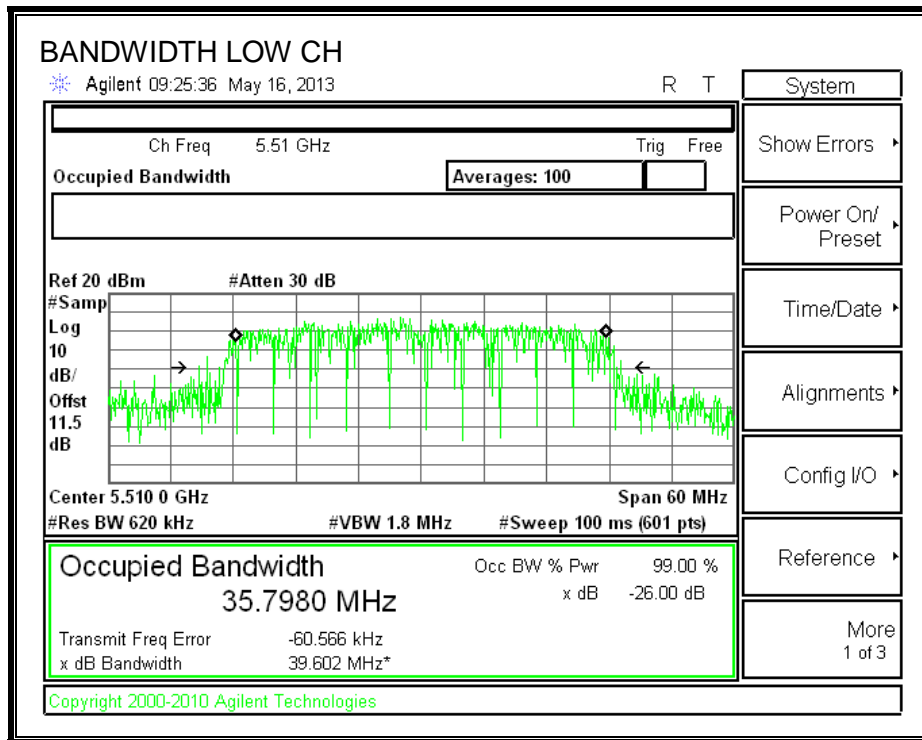
#### LIMITS

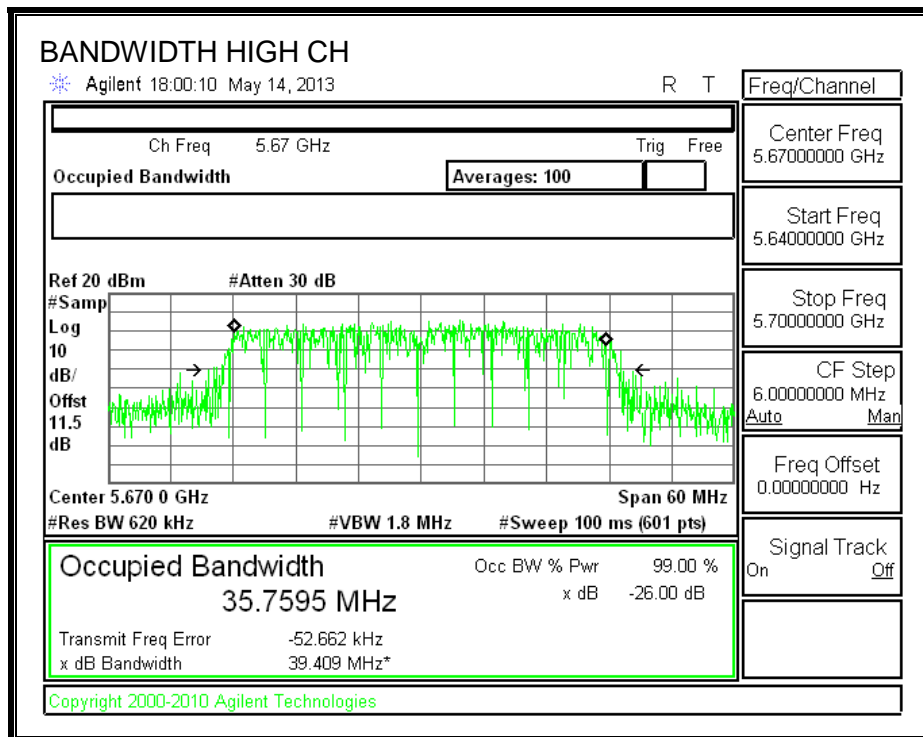
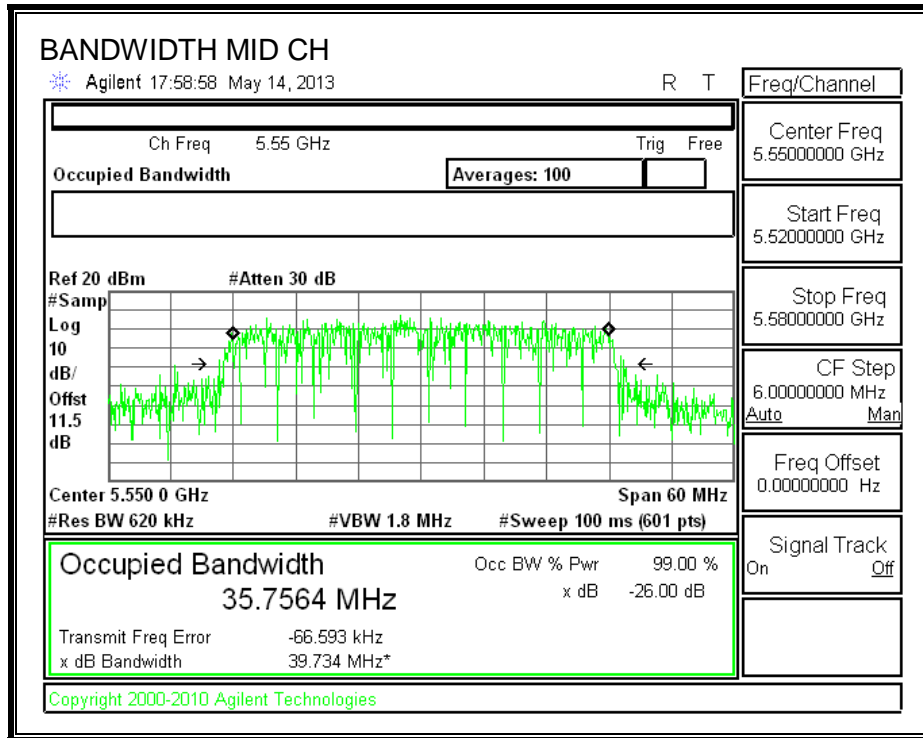
None; for reporting purposes only.

#### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	5510	35.7980
Mid	5550	35.7564
High	5670	35.7595

#### 99% BANDWIDTH





### 8.9.3. AVERAGE POWER

#### LIMITS

None; for reporting purposes only.

#### TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 11.5 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

#### RESULTS

Channel	Frequency (MHz)	Power (dBm)
Low	5510	15.40
Mid	5550	15.67
High	5670	15.57



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## 8.9.4. OUTPUT POWER AND PPSD

### LIMITS

FCC §15.407 (a) (2)

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

### DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

**RESULTS**

**Bandwidth and Antenna Gain**

Channel	Frequency (MHz)	Min 26 dB BW (MHz)	Directio Gain (dBi)
Low	5510	44.00	-4.25
Mid	5550	44.67	-4.25
High	5670	44.80	-4.25

**Limits**

Channel	Frequency (MHz)	FCC Power Limit (dBm)	FCC PPSD Limit (dBm)
Low	5510	24.00	11.00
Mid	5550	24.00	11.00
High	5670	24.00	11.00

<b>Duty Cycle CF (dB)</b>	0.16	<b>Included in Calculations of Corr'd Power &amp; PPSD</b>
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**Output Power Results**

Channel	Frequency (MHz)	Meas Power (dBm)	Total Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5510	15.548	15.71	24.00	-8.29
Mid	5550	15.871	16.03	24.00	-7.97
High	5670	15.668	15.83	24.00	-8.17

**PPSD Results**

Channel	Frequency (MHz)	Meas PPSD (dBm)	Total Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5510	1.959	2.12	11.00	-8.88
Mid	5550	2.390	2.55	11.00	-8.45
High	5670	2.068	2.23	11.00	-8.77

**OUTPUT POWER AND PPSD**

