



## **Test Report**

# **AIR-CAP3602y-A-K9**

## **Cisco Aironet 802.11n Dual Band Access Points**

**FCC ID: LDK102075**

**IC: 2461B-102075**

y = E (External Antenna) or I (Internal Antenna)

**5150-5250 MHz**

**Against the following Specifications:**

**CFR47 Part 15.407**

**RSS210**

**Cisco Systems**

170 West Tasman Drive

San Jose, CA 95134



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## Section 1: Overview

### 1.1 Test Summary

**samples were assessed against the tests detailed in section 3 under the requirements of the following specifications:**

Emission	Immunity
CFR47 Part 15.407 RSS210	N/A

The specifications listed above represent actual tests performed to demonstrate compliance against the specifications and basic standards listed on the front cover of this report. This list is not a one to one match to the front cover for one or more of the following reasons.

1. Basic standards call up many different test phenomena specifications such as the 61000-4-X series. The basic standards define which elements and levels shall be applied from these specifications and as such it is not appropriate to list the individual specifications on the front cover.
2. A Standard listed on the front cover may be required in a particular country but is not appropriate for the particular technologies included in the equipment under test. E.g. You cannot test a DC product to the mains Harmonics requirements in EN61000-3-2. See section 3.2.
3. Test results against a particular standard or specification may be included in a different test report. See section 3.2 for an EDCS reference of this data.
4. Where appropriate, Cisco may have substituted a later revision of a basic standard to those referenced in the specification on the front sheet of this test report. This decision was based upon improved test methodology and repeatability and/or where the newer revision represented a more stringent test.
5. Where relevant, testing has been carried out to the requirements of both EN and IEC Specifications. This was possible because of the similarities of the test methods involved and the Cisco EMC test procedures.
6. Testing may have been performed to an equivalent test that satisfies the requirements of the standards and specifications listed on the front cover of the report. See section 3.2.
7. Where radiated emissions testing has been performed to EN55022/CISPR22 the additional requirements of VCCI: V-3/2006.04, EN55022: 1994 +A1/2 and CAN/CSA- CISPR 22-02 have also been evaluated unless otherwise stated.
8. Testing to the requirements of CFR47 Part 15 was performed against the CISPR22 limits. The results are therefore deemed satisfactory evidence of compliance with Industry Canada Interference Causing Equipment Standard ICES-003.
9. Where assessment has been performed to CISPR24, all the applicable test requirements may have not been covered. Refer to the results section for the tests performed.

#### Notes:

- 1) Where a specification listed on the front cover of this report has deviations from the basic standards listed above, the additional technical requirements of the specification were also assessed.
- 2) Where appropriate, Cisco may have substituted a later revision of a basic standard to those referenced in the specification on the front sheet of this test report. This decision was based upon improved test methodology and repeatability and/or where the newer revision represented a more stringent test.
- 3) Where relevant, testing has been carried out to the requirements of both EN and IEC Specifications. This was possible because of the similarities of the test methods involved and the Cisco EMC test procedures.



## **Section 2: Assessment Information**

### **2.1 General**

This report contains an assessment of an apparatus against Electromagnetic Compatibility Standards based upon tests carried out on the samples submitted. The testing was performed by and for the use of Cisco systems Inc:

With regard to this assessment, the following points should be noted:

- a) The results contained in this report relate only to the items tested and were obtained in the period between the date of the initial assessment and the date of issue of the report. Manufactured products will not necessarily give identical results due to production and measurement tolerances.
- b) The apparatus was set up and exercised using the configuration and modes of operation defined in this report only.
- c) Where relevant, the apparatus was only assessed using the susceptibility criteria defined in this report and the Test Assessment Plan (TAP).
- d) All testing was performed under the following environmental conditions:

Temperature	15°C to 35°C (54°F to 95°F)
Atmospheric Pressure	860mbar to 1060mbar (25.4" to 31.3")
Humidity	10% to 75*%

\*[Where applicable] For ESD testing the humidity limits used were 30% to 60% and for EFT/B tests the humidity limits used were 25% to 75%.
- e) All AC testing was performed at one or more of the following supply voltages:

110V 60 Hz (+/-20%)
220V 50 Hz (+/-20%)

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## **2.2 Date of testing**

04-April-2011 – 04-May-2011

## **2.3 Report Issue Date**

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## **2.4 Testing facilities**

This assessment was performed by:

### **Testing Laboratory**

Cisco Systems, Inc.,	Cisco Systems, Inc.
4125 Highlander Parkway	170 West Tasman Drive
Richfield, OH 44286	San Jose, CA 95134
USA	USA

### **Test Engineers**

James Nicholson

## **2.5 Equipment Assessed (EUT)**

AIR-CAP3602E-A-K9 Cisco Aironet 802.11n Dual Band Access Point



## 2.6 EUT Description

The 3600 Series Cisco Aironet 802.11n Dual Band Access Points support the following modes of operation. The modes are further defined in the radio Theory of Operation. The modes included in this report represent the worst case data for all modes.

Non HT-20, One Antenna, 6 to 54 Mbps  
Non HT-20, Two Antennas, 6 to 54 Mbps  
Non HT-20, Three Antennas, 6 to 54 Mbps  
Non HT-20, Four Antennas, 6 to 54 Mbps

Non HT-20 Beam Forming, Two Antennas, 6 to 54 Mbps  
Non HT-20 Beam Forming, Three Antennas, 6 to 54 Mbps  
Non HT-20 Beam Forming, Four Antennas, 6 to 54 Mbps

HT-20, One Antenna, M0 to M7  
HT-20, Two Antennas, M0 to M15  
HT-20, Three Antennas, M0 to M23  
HT-20, Four Antennas, M0 to M23

HT-20 STBC, Two Antennas, M0 to M7  
HT-20 STBC, Three Antennas, M0 to M7  
HT-20 STBC, Four Antennas, M0 to M7

HT-20 Beam Forming, Two Antennas, M0 to M15  
HT-20 Beam Forming, Three Antennas, M0 to M23  
HT-20 Beam Forming, Four Antennas, M0 to M23

Non HT-40 Duplicate, One Antenna, 6-54 Mbps  
Non HT-40 Duplicate, Two Antennas, 6-54 Mbps  
Non HT-40 Duplicate, Three Antennas, 6-54 Mbps  
Non HT-40 Duplicate, Four Antennas, 6-54 Mbps

HT-40, One Antenna, M0 to M7  
HT-40, Two Antennas, M0 to M15  
HT-40, Three Antennas, M0 to M23  
HT-40, Four Antennas, M0 to M23

HT-40 STBC, Two Antennas, M0 to M7  
HT-40 STBC, Three Antennas, M0 to M7  
HT-40 STBC, Four Antennas, M0 to M7

HT-40 Beam Forming, Two Antennas, M0 to M15  
HT-40 Beam Forming, Three Antennas, M0 to M23  
HT-40 Beam Forming, Four Antennas, M0 to M23



The following antennas are supported by this product series. The items in bold will be specifically tested and cover all others. The data included in this report represent the worst case data for all antennas.

Frequency	Part Number	Antenna Type	Antenna Gain (dBi)
<b>2.4/5 GHz</b>	AIR-ANT2524DB-R	Dual-resonant black dipole	2 / 4
	AIR-ANT2524DW-R	Dual-resonant white dipole	2 / 4
	AIR-ANT2524DG-R	Dual-resonant gray dipole	2 / 4
	Internal	Dual-resonant Omni	3 / 5
	AIR-ANT2534V4C-R	Dual-resonant ceiling mount omni (4-pack)	3 / 4
	AIR-ANT2546V4M-R	Dual-resonant omni (4-pack)	4 / 6
	AIR-ANT2566P4W-R	Dual-resonant "directional" antenna (4-pack)	6 / 6



## Section 4: Sample Details

Note: Each sample was evaluated to ensure that its condition was suitable to be used as a test sample prior to the commencement of testing. Please also refer to the "Justification for worst Case test Configuration" section of this report for further details on the selection of EUT samples.

### 4.1 Sample Details (Photographs of the test samples, where appropriate can be found in appendix H)

Sample No.	Equipment Details	Part Number	Manufacturer	Hardware Rev.	Firmware Rev.	Software Rev.	Serial Number
S01	AIR-CAP3602E-A-K9		Cisco Systems	NA	NA	NA	
S02	AIR-PWR-B	341-0306-01	Cisco Systems	NA	NA	NA	
S03	AIR-ANT2455V-N						
S04	AIR-ANT5160V-R						
S05	AIR-ANT2566P4W-R						

### 4.2 System Details

System #	Description	Samples
1	EUT	S01, S02

### 4.3 Mode of Operation Details

Mode#	Description	Comments
1	Continuous Transmitting	Continuous Transmitting



**Appendix A: Emission Test Results****Testing Laboratory:** Cisco Systems, Inc., 4125 Highlander Parkway, Richfield, OH, USA**Target Maximum Channel Power**

The following table details the maximum supported Total Channel Power for all operating modes.

Operating Mode	Maximum Channel Power (dBm)	
	Frequency (MHz)	
	5180	5240
Non HT-20, 6 to 54 Mbps	14	14
Non HT-20 Beam Forming, 6 to 54 Mbps	11	11
HT-20, M0 to M23	15	15
HT-20 STBC, M0 to M7	15	15
HT-20 Beam Forming, M0 to M23	14	14
	5180/5200	5220/5240
Non HT-40 Duplicate, 6-54 Mbps	11	12
HT-40, M0 to M23	14	17
HT-40 STBC, M0 to M7	14	17
HT-40 Beam Forming, M0 to M23	14	17



## 99% and 26dB Bandwidth

Connect the antenna port(s) to the spectrum analyzer input. Using the spectrum analyzer Channel Bandwidth mode, configure the spectrum analyzer as shown below (enter all losses between the transmitter output and the spectrum analyzer).

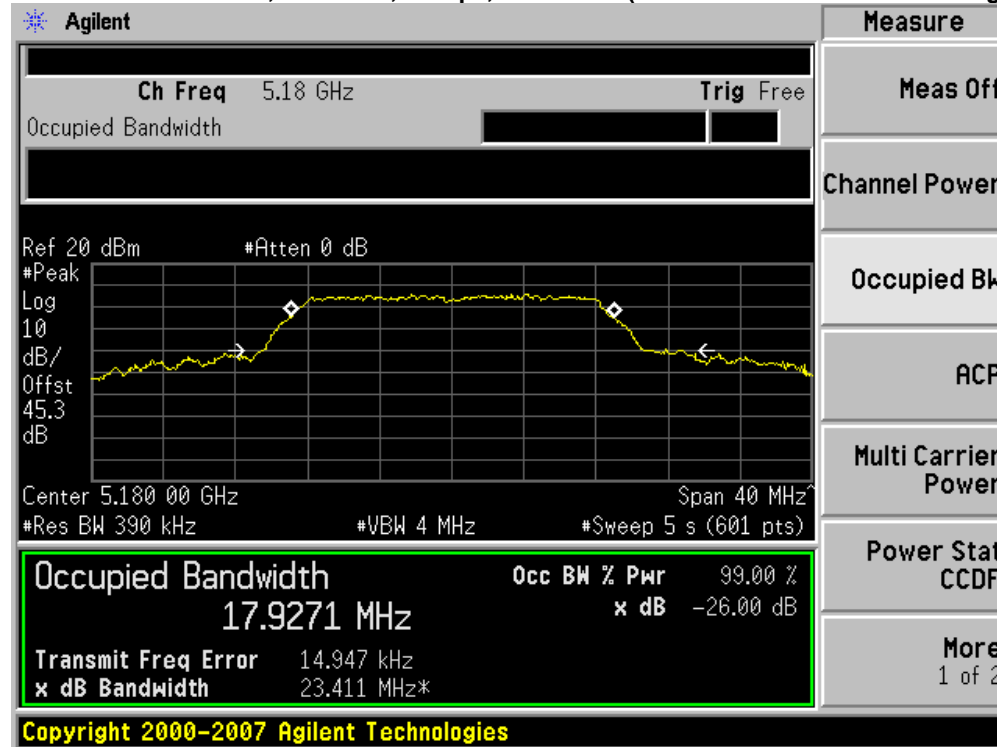
Center Frequency:	Frequency from table below
Span:	2 x Nominal Bandwidth (e.g. 40MHz for a 20MHz channel)
Reference Level:	20 dBm
Attenuation:	10 dB
Sweep Time:	5 s
Resolution Bandwidth:	1%-3% of 26 dB Bandwidth
Video Bandwidth:	≥Resolution Bandwidth
X dB Bandwidth:	26 dB
Detector:	Peak
Trace:	Single

Place the radio in continuous transmit mode. View the transmitter waveform on the spectrum analyzer, and record the pertinent measurements:

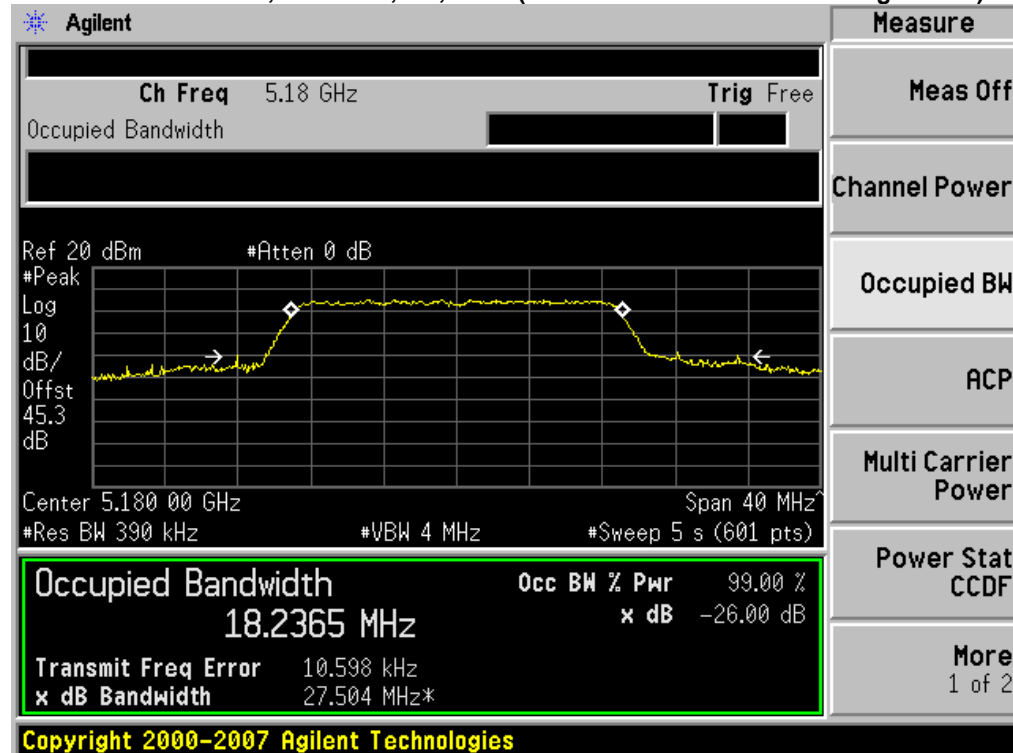


<b>Frequency (MHz)</b>	<b>Mode</b>	<b>Data Rate (Mbps)</b>	<b>26dB BW (MHz)</b>	<b>99% BW (MHz)</b>
5180	Non HT-20, 6 to 54 Mbps	6	23.4	17.9
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	23.4	17.9
	HT-20, M0 to M23	m0	27.5	18.2
	HT-20 STBC, M0 to M7	m0	27.5	18.2
	HT-20 Beam Forming, M0 to M23	m0	27.5	18.2
5240	Non HT-20, 6 to 54 Mbps	6	21.0	17.8
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	21.0	17.8
	HT-20, M0 to M23	m0	20.7	18.1
	HT-20 STBC, M0 to M7	m0	20.7	18.1
	HT-20 Beam Forming, M0 to M23	m0	20.7	18.1
5180/5200	Non HT-40 Duplicate, 6-54 Mbps	6	74.5	39.1
	HT-40, M0 to M23	m0	44.5	37.3
	HT-40 STBC, M0 to M7	m0	44.5	37.3
	HT-40 Beam Forming, M0 to M23	m0	44.5	37.3
5220/5240	Non HT-40 Duplicate, 6-54 Mbps	6	77.3	49.6
	HT-40, M0 to M23	m0	76.2	37.9
	HT-40 STBC, M0 to M7	m0	76.2	37.9
	HT-40 Beam Forming, M0 to M23	m0	76.2	37.9

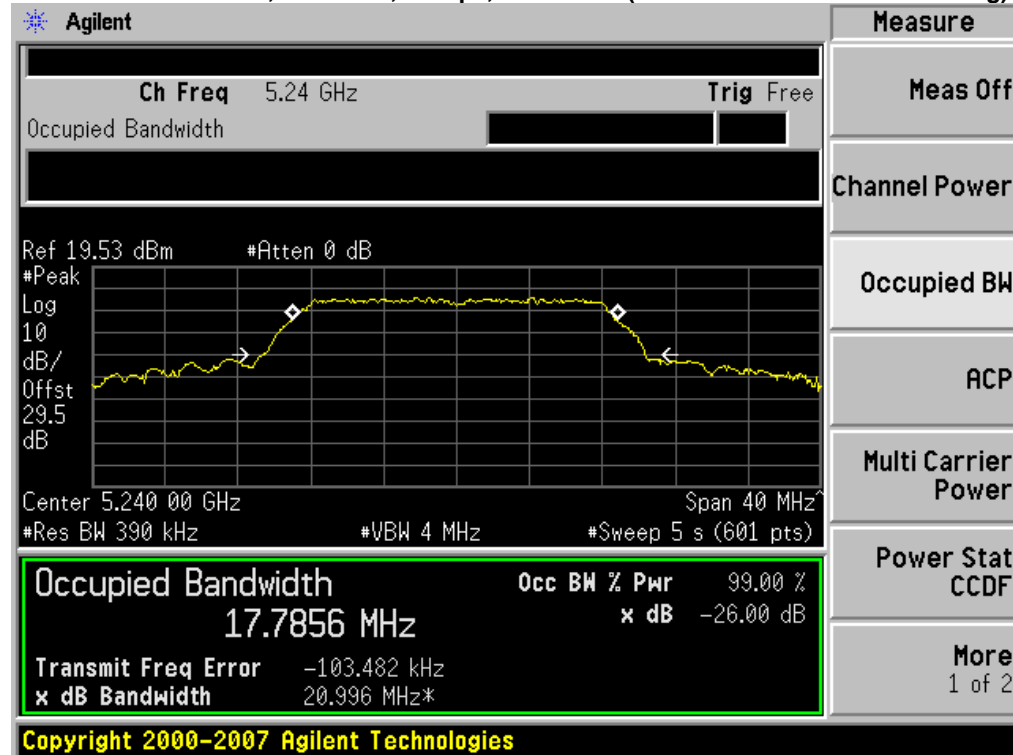
## 26dB / 99% Bandwidth, 5180 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)



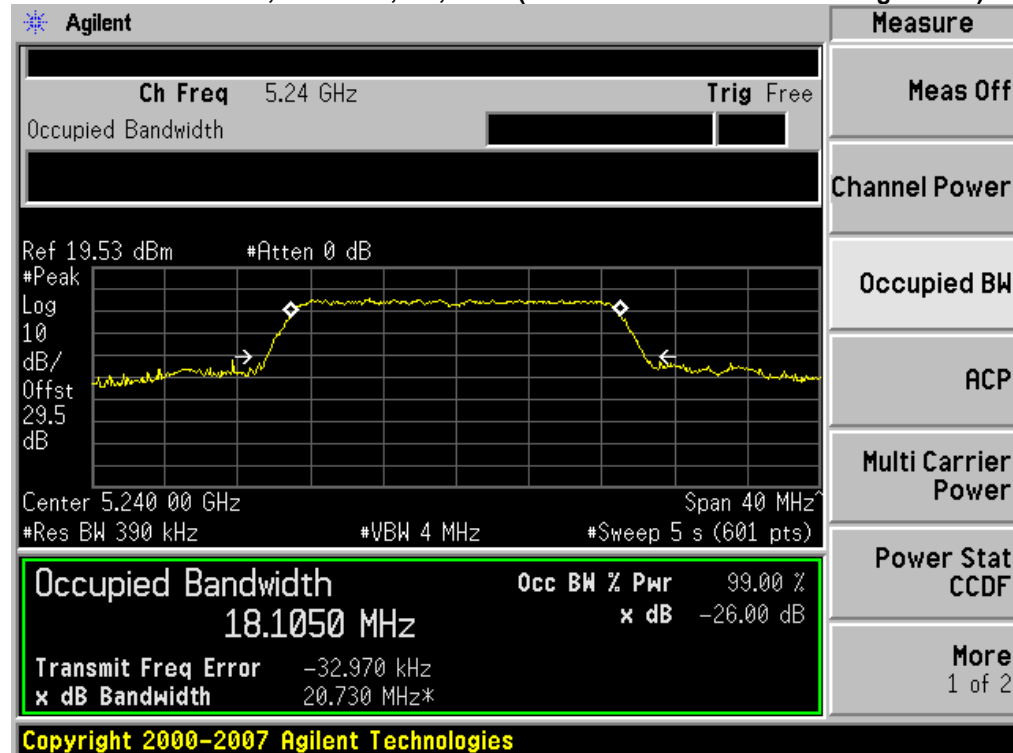
## 26dB / 99% Bandwidth, 5180 MHz, m0, HT20 (with and without Beam Forming / STBC)



## 26dB / 99% Bandwidth, 5240 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)

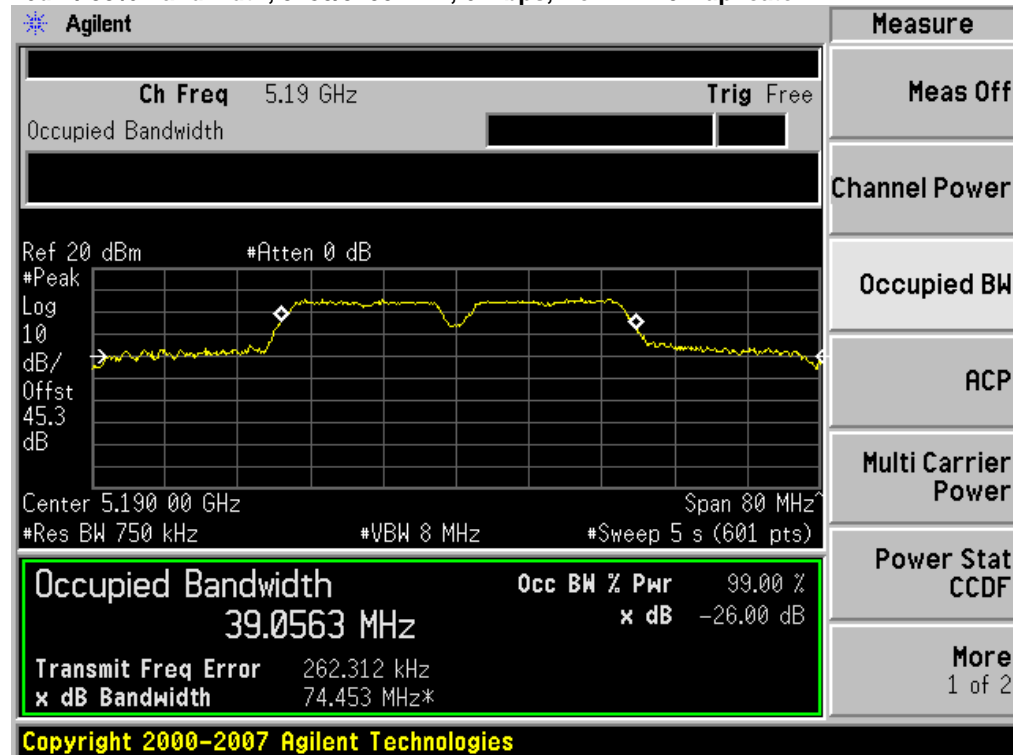


## 26dB / 99% Bandwidth, 5240 MHz, m0, HT20 (with and without Beam Forming / STBC)

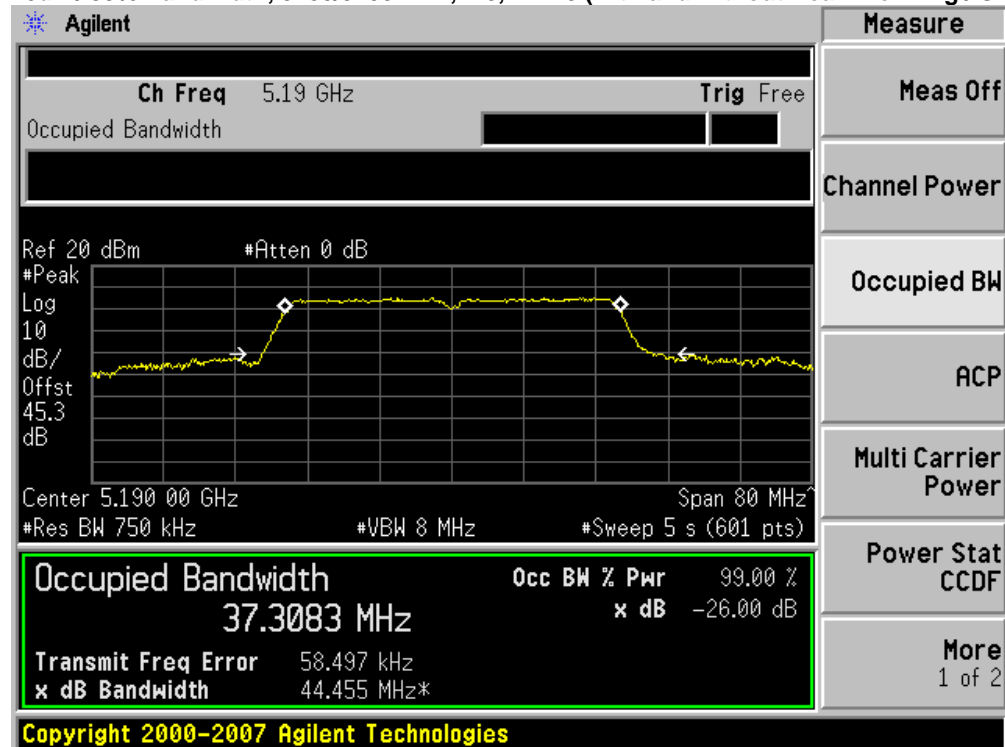




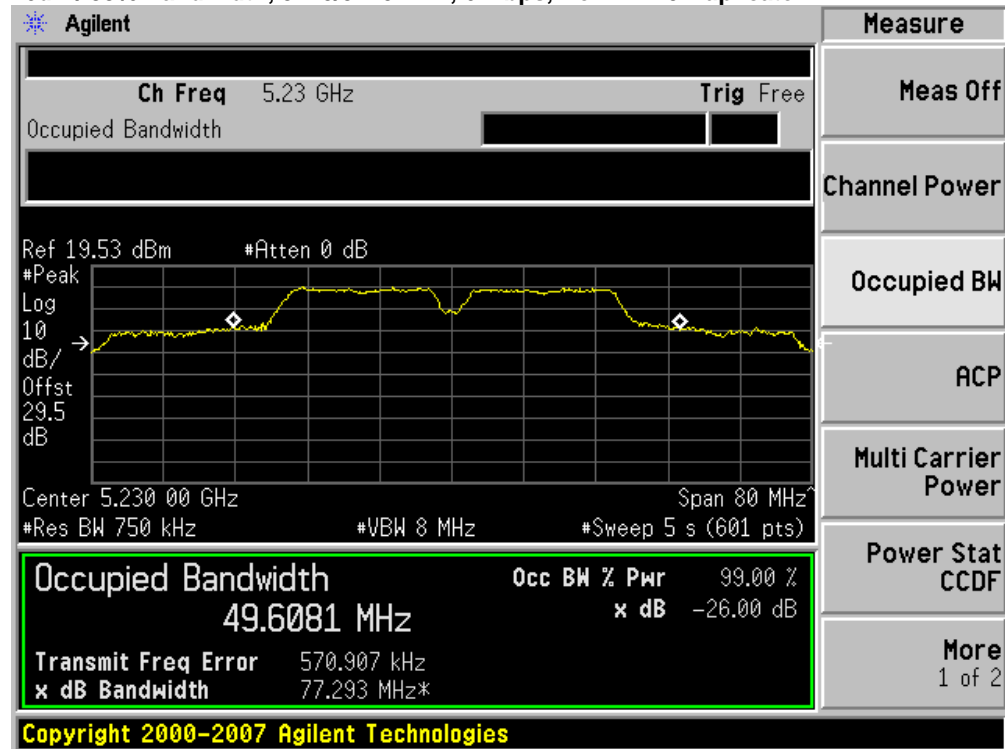
## 26dB / 99% Bandwidth, 5180/5200 MHz, 6 Mbps, Non HT-40 Duplicate



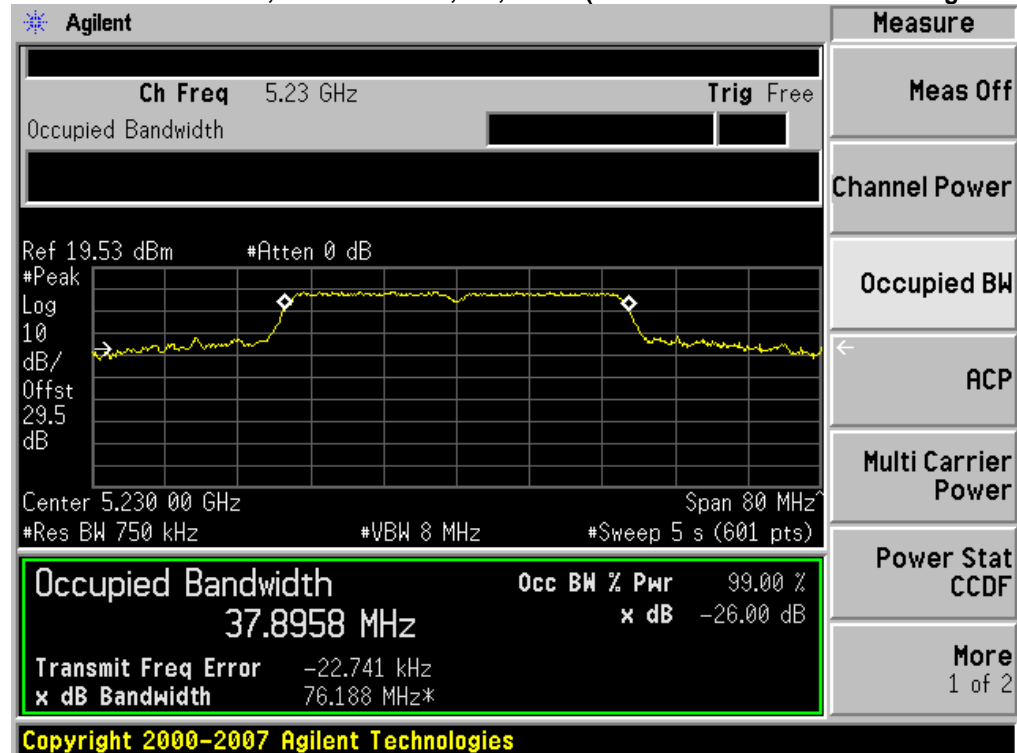
## 26dB / 99% Bandwidth, 5180/5200 MHz, m0, HT-40 (with and without Beam Forming / STBC)



## 26dB / 99% Bandwidth, 5220/5240 MHz, 6 Mbps, Non HT-40 Duplicate



## 26dB / 99% Bandwidth, 5220/5240 MHz, m0, HT-40 (with and without Beam Forming / STBC)





## Peak Output Power

15.407: For the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or  $4 \text{ dBm} + 10 \log B$ , where B is the 26-dB emission bandwidth in MHz. If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The smallest 26dB bandwidth for all channels is 20.7 MHz. The maximum conducted output power is calculated as  $4\text{dBm} + 10 \cdot \log(20.7\text{MHz}) = 17\text{dBm}$

The maximum supported antenna gain is 6dBi. The peak correlated gain for each mode is listed in the table below. See the Theory of Operation for details on the correlated gain for each mode.

The “measure-and-sum technique” is used for measuring in-band transmit power of a device. In the measure-and-sum approach, the conducted emission level is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in linear power units.

## Power Spectral Density

15.407: For the band 5.15-5.25 GHz, the peak power spectral density shall not exceed 4 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum supported antenna gain is 6dBi. The peak correlated gain for each mode is listed in the table below. See the Theory of Operation for details on the correlated gain for each mode.

The “Measure and add  $10 \log(N)$  dB technique”, where N is the number of outputs, is used for measuring in-band Power Spectral Density. With this technique, spectrum measurements are performed at each output of the device, and the quantity  $10 \log(4)$  (or 6dB) is added to the worst case spectrum value before comparing to the emission limit.





Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Configure the spectrum analyzer as shown below.

Enable "Channel Power" function of analyzer	
Center Frequency:	Frequency from table below
Span:	20 MHz (must be greater than 26dB bandwidth, adjust as necessary)
Ref Level Offset:	Correct for attenuator and cable loss.
Reference Level:	20 dBm
Attenuation:	20 dB
Sweep Time:	100ms, Single sweep
Resolution Bandwidth:	1 MHz
Video Bandwidth:	3 MHz
Detector:	Sample
Trace:	Trace Average 100 traces in Power Averaging Mode
Integration BW:	=26 dB BW from 26 dB Bandwidth Data

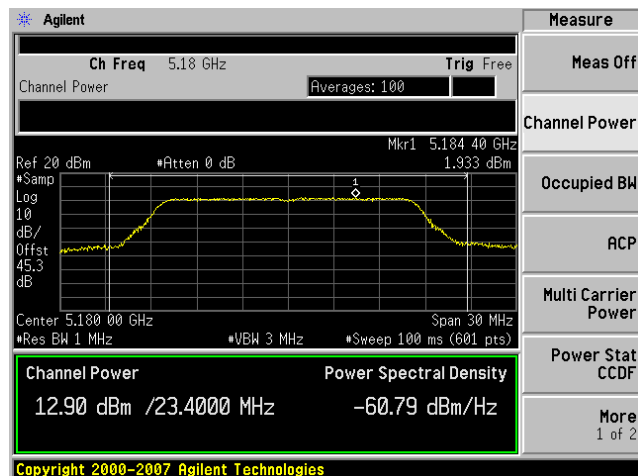
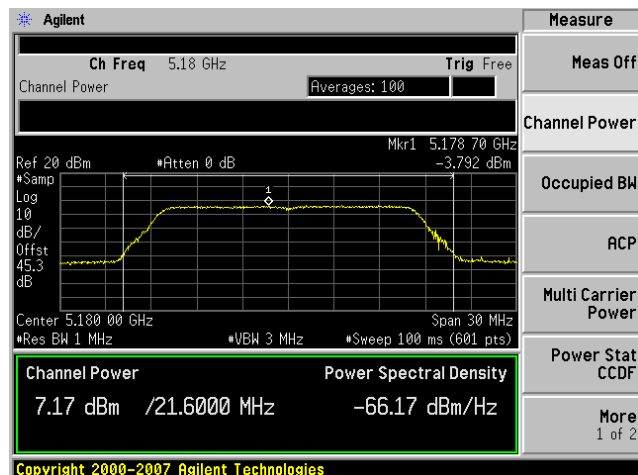
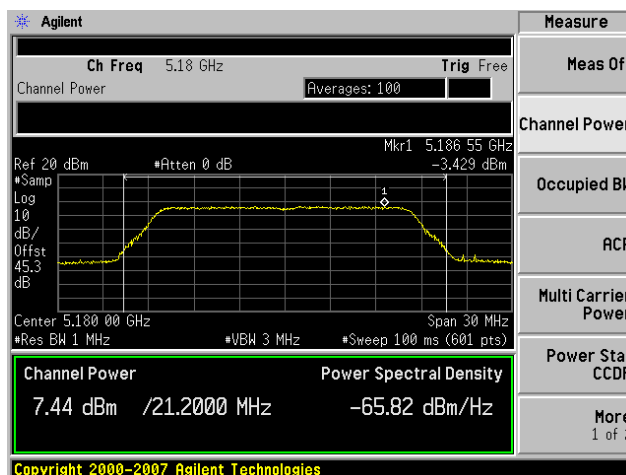
After averaging 100 traces of the transmitter waveform on the spectrum analyzer, record the spectrum analyzer Channel Power. Perform a Marker Peak Search function, and record this value as the Power Spectral Density.



Frequency (MHz)	Operating Mode	Tx Paths	Correlated Antenna Gain (dBi)	Tx 1 Peak Power (dBm)	Tx 2 Peak Power (dBm)	Tx 3 Peak Power (dBm)	Tx 4 Peak Power (dBm)	Total Tx Channel Power (dBm)	Limit (dBm)	Margin (dB)
5180	Non HT-20, 6 to 54 Mbps	1	6	12.9	-	-	-	12.9	17	4.1
	Non HT-20 Beam Forming, 6 to 54 Mbps	2	9	7.2	7.4	-	-	10.3	14	3.7
	HT-20, M0 to M7	4	6	2.3	2.7	2.4	2.3	8.4	17	8.6
	HT-20, M8 to M15	2	6	11.0	11.4	-	-	14.2	17	2.8
	HT-20, M16 to M23	3	6	9.0	9.4	9.0	-	13.9	17	3.1
	HT-20 STBC, M0 to M7	2	6	11.0	11.4	-	-	14.2	17	2.8
	HT-20 Beam Forming, M0 to M7	2	9	7.1	7.3	-	-	10.2	14	3.8
	HT-20 Beam Forming, M8 to M15	2	6	10.1	10.4	-	-	13.3	17	3.7
	HT-20 Beam Forming, M16 to M23	3	6	8.1	8.4	8.1	-	13.0	17	4.0
5240	Non HT-20, 6 to 54 Mbps	1	6	13.0	-	-	-	13.0	17	4.0
	Non HT-20 Beam Forming, 6 to 54 Mbps	2	9	7.4	7.8	-	-	10.6	14	3.4
	HT-20, M0 to M7	1	6	13.2	-	-	-	13.2	17	3.8
	HT-20, M8 to M15	2	6	11.3	11.5	-	-	14.4	17	2.6
	HT-20, M16 to M23	3	6	9.3	9.9	9.4	-	14.3	17	2.7
	HT-20 STBC, M0 to M7	2	6	11.3	11.5	-	-	14.4	17	2.6
	HT-20 Beam Forming, M0 to M7	2	9	7.3	7.7	-	-	10.5	14	3.5
	HT-20 Beam Forming, M8 to M15	2	6	10.2	10.5	-	-	13.4	17	3.6
	HT-20 Beam Forming, M16 to M23	3	6	8.3	8.6	8.5	-	13.2	17	3.8
5180/5200	Non HT-40 Duplicate, 6-54 Mbps	3	6	5.3	5.5	5.3	-	10.1	17	6.9
	HT-40, M0 to M7	3	6	5.2	5.5	5.3	-	10.1	17	6.9
	HT-40, M8 to M15	2	6	9.7	10.4	-	-	13.1	17	3.9
	HT-40, M16 to M23	3	6	7.1	7.3	7.0	-	11.9	17	5.1
	HT-40 STBC, M0 to M7	2	6	9.7	10.4	-	-	13.1	17	3.9
	HT-40 Beam Forming, M0 to M7	2	9	6.2	6.4	-	-	9.3	14	4.7
	HT-40 Beam Forming, M8 to M15	2	6	9.7	10.4	-	-	13.1	17	3.9
	HT-40 Beam Forming, M16 to M23	4	7	6.2	6.1	6.0	6.9	12.3	16	3.4
5220/5240	Non HT-40 Duplicate, 6-54 Mbps	1	6	16.5	-	-	-	16.5	17	0.5
	HT-40, M0 to M7	1	6	16.1	-	-	-	16.1	17	0.9
	HT-40, M8 to M15	2	6	13.0	13.8	-	-	16.4	17	0.6
	HT-40, M16 to M23	4	7	10.0	10.7	10.3	10.9	16.5	16	-0.5
	HT-40 STBC, M0 to M7	2	6	13.0	13.8	-	-	16.4	17	0.6
	HT-40 Beam Forming, M0 to M7	2	9	10.0	10.7	-	-	13.4	14	0.6
	HT-40 Beam Forming, M8 to M15	2	6	13.0	13.8	-	-	16.4	17	0.6
	HT-40 Beam Forming, M16 to M23	4	7	10.0	10.7	10.3	10.9	16.5	16	-0.8

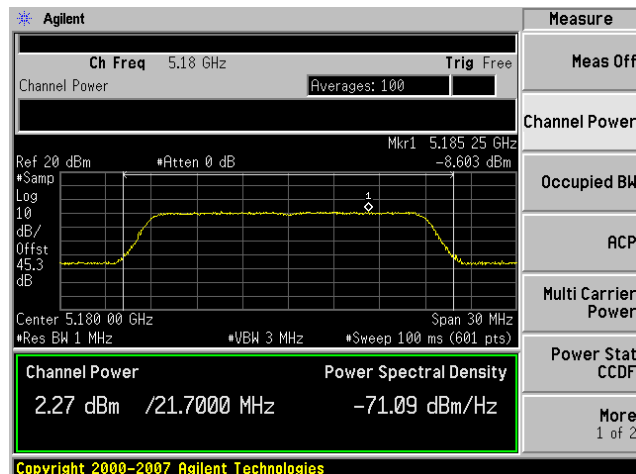


Frequency (MHz)	Mode	Data Rate (Mbps)	Tx Paths	Correlated Antenna Gain (dBi)	PSD / Antenna (dBm/MHz)	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
5180	Non HT-20, 6 to 54 Mbps	6	1	6	1.9	1.9	4.0	2.1
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	2	9	-3.4	-0.4	1.0	1.4
	HT-20, M0 to M7	m0	4	12	-8.5	-2.5	-2.0	0.5
	HT-20, M8 to M15	m8	2	6	0.4	3.4	4.0	0.6
	HT-20, M16-M23	m16	3	6	-1.5	3.3	4.0	0.7
	HT-20 STBC, M0 to M7	m0	2	6	0.4	3.4	4.0	0.6
	HT-20 Beam Forming, M0 to M7	m0	2	9	-3.9	-0.9	1.0	1.9
	HT-20 Beam Forming, M8 to M15	m8	2	6	-0.8	2.2	4.0	1.8
	HT-20 Beam Forming, M16 to M23	m16	3	6	-2.5	2.3	4.0	1.7
5240	Non HT-20, 6 to 54 Mbps	6	1	6	2.4	2.4	4.0	1.6
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	2	9	-3.2	-0.2	1.0	1.2
	HT-20, M0 to M7	m0	1	6	2.1	2.1	4.0	1.9
	HT-20, M8 to M15	m8	2	6	0.4	3.4	4.0	0.6
	HT-20, M16-M23	m16	3	6	-1.3	3.5	4.0	0.5
	HT-20 STBC, M0 to M7	m0	2	6	0.4	3.4	4.0	0.6
	HT-20 Beam Forming, M0 to M7	m0	2	9	-3.5	-0.5	1.0	1.5
	HT-20 Beam Forming, M8 to M15	m8	2	6	-0.5	2.5	4.0	1.5
	HT-20 Beam Forming, M16 to M23	m16	3	6	-2.2	2.6	4.0	1.4
5180/5200	Non HT-40 Duplicate, 6-54 Mbps	6	3	11	-8.3	-3.5	-1.0	2.5
	HT-40, M0 to M7	m0	3	11	-8.3	-3.5	-1.0	2.5
	HT-40, M8 to M15	m8	2	6	-3.9	-0.9	4.0	4.9
	HT-40, M16 to M23	m16	3	6	-6.6	-1.8	4.0	5.8
	HT-40 STBC, M0 to M7	m0	2	6	-3.9	-0.9	4.0	4.9
	HT-40 Beam Forming, M0 to M7	m0	2	9	-8.0	-5.0	1.0	6.0
	HT-40 Beam Forming, M8 to M15	m8	2	6	-3.9	-0.9	4.0	4.9
	HT-40 Beam Forming, M16 to M23	m16	4	7	-7.1	-1.1	2.8	3.8
5220/5240	Non HT-40 Duplicate, 6-54 Mbps	6	1	6	3.0	3.0	4.0	1.0
	HT-40, M0 to M7	m0	1	6	1.9	1.9	4.0	2.1
	HT-40, M8 to M15	m8	2	6	-0.3	2.7	4.0	1.3
	HT-40, M16 to M23	m16	4	7	-3.4	2.6	3.0	0.4
	HT-40 STBC, M0 to M7	m0	2	6	-0.3	2.7	4.0	1.3
	HT-40 Beam Forming, M0 to M7	m0	2	9	-3.4	-0.4	1.0	1.4
	HT-40 Beam Forming, M8 to M15	m8	2	6	-0.3	2.7	4.0	1.3
	HT-40 Beam Forming, M16 to M23	m16	4	7	-3.4	2.6	2.8	0.1

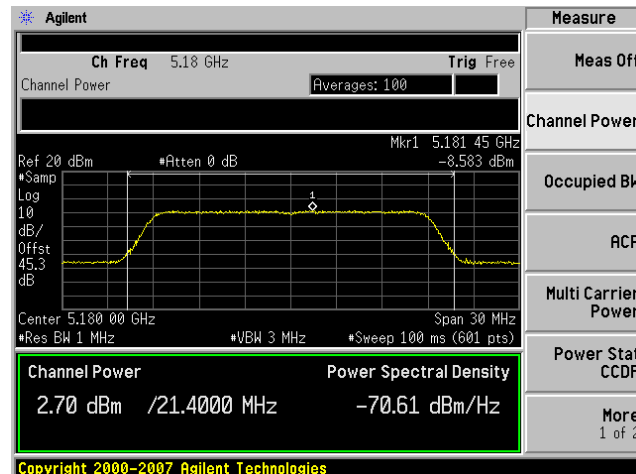
**Peak Power / PSD, 5180 MHz, 6 Mbps, Non HT-20****Antenna A****Peak Power / PSD, 5180 MHz, 6 Mbps, Non HT-20 Beam Forming****Antenna A****Antenna B**



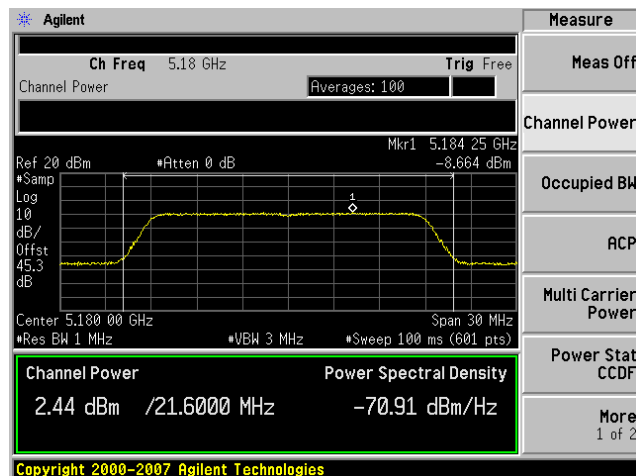
## Peak Power / PSD, 5180 MHz, m0, HT-20



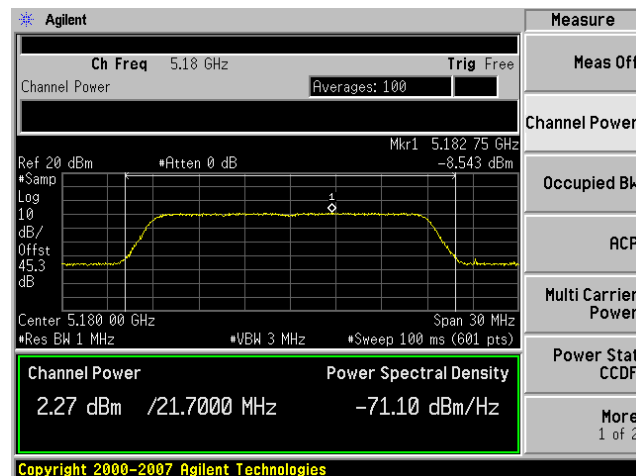
Antenna A



Antenna B

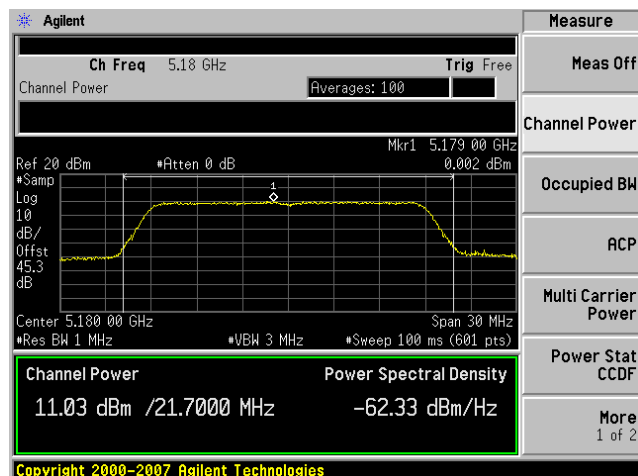


Antenna C

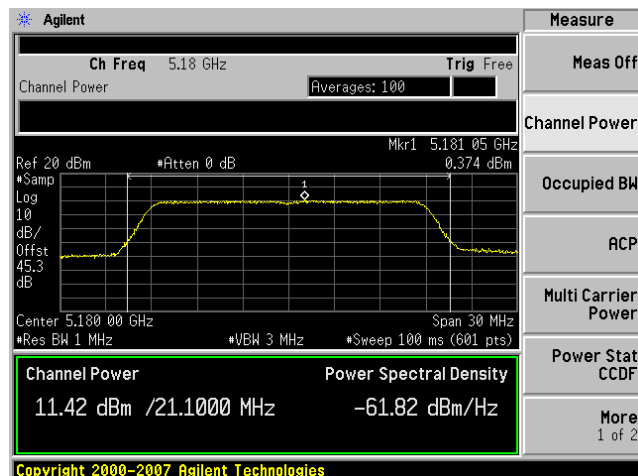


Antenna D

## Peak Power / PSD, 5180 MHz, m8, HT-20



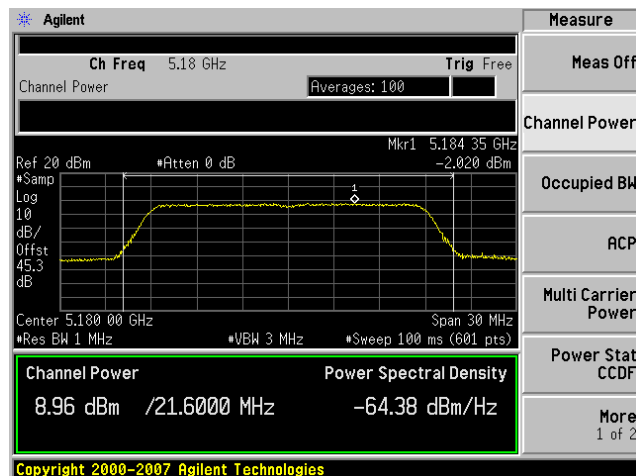
Antenna A



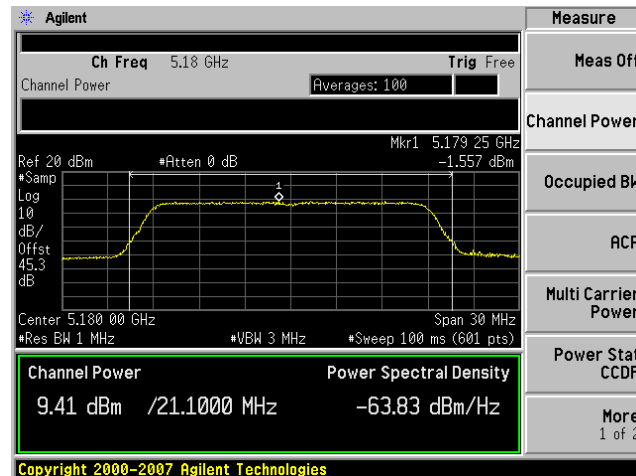
Antenna B



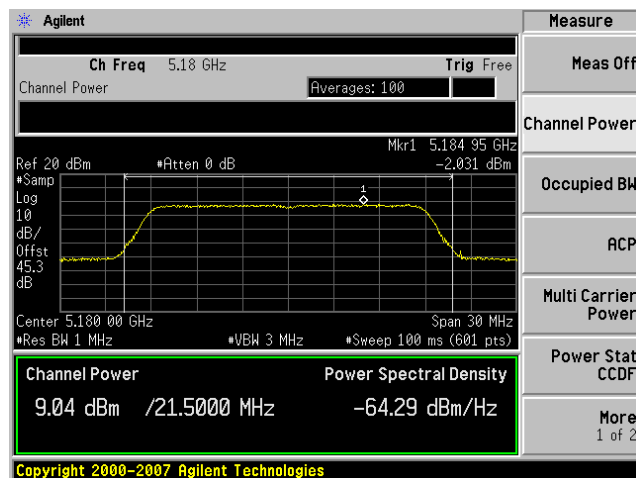
## Peak Power / PSD, 5180 MHz, m16, HT-20



Antenna A



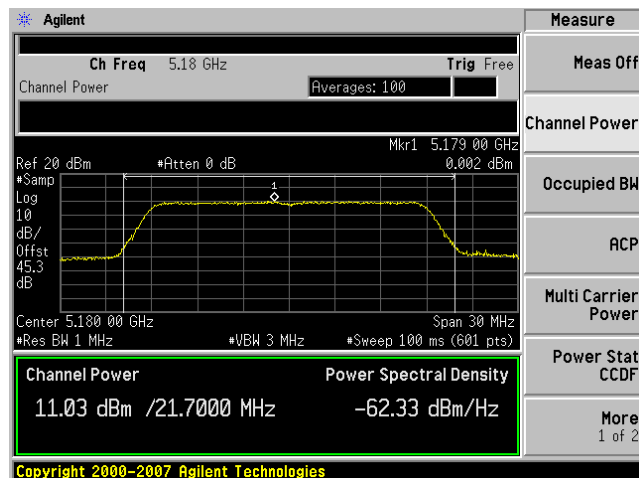
Antenna B



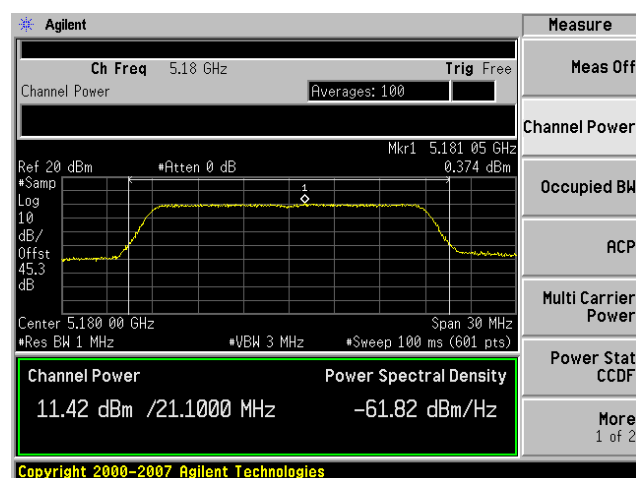
Antenna C



## Peak Power / PSD, 5180 MHz, m0, HT-20 STBC

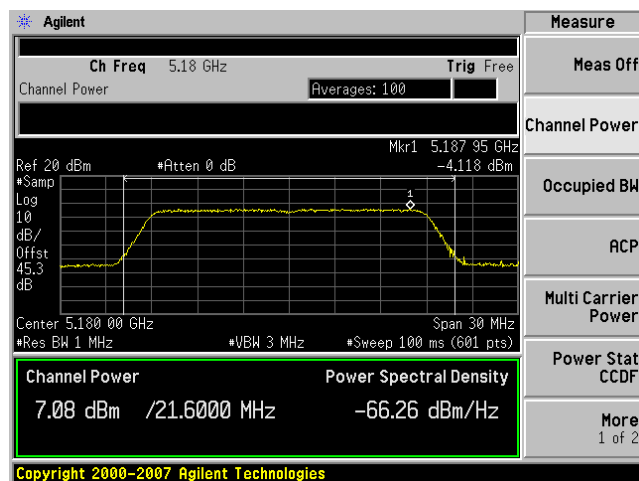


Antenna A

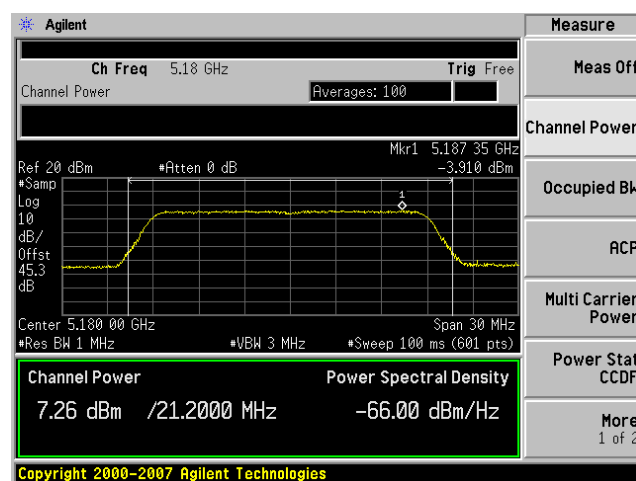


Antenna B

## Peak Power / PSD, 5180 MHz, m0, HT-20 Beam Forming



Antenna A

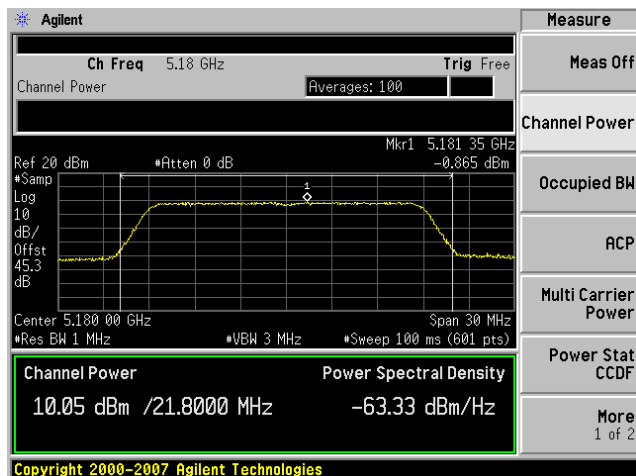


Antenna B

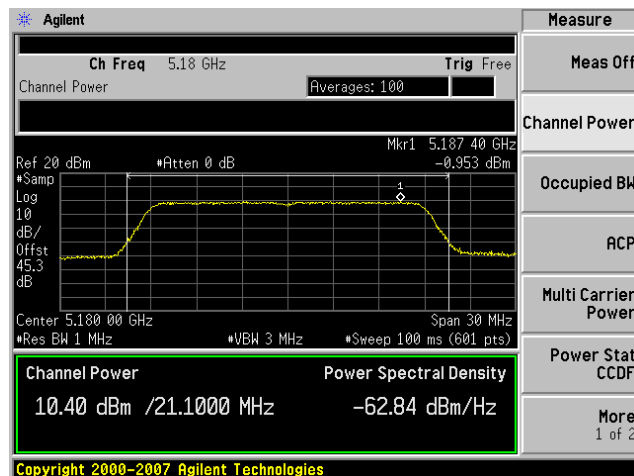




## Peak Power / PSD, 5180 MHz, m8, HT-20 Beam Forming



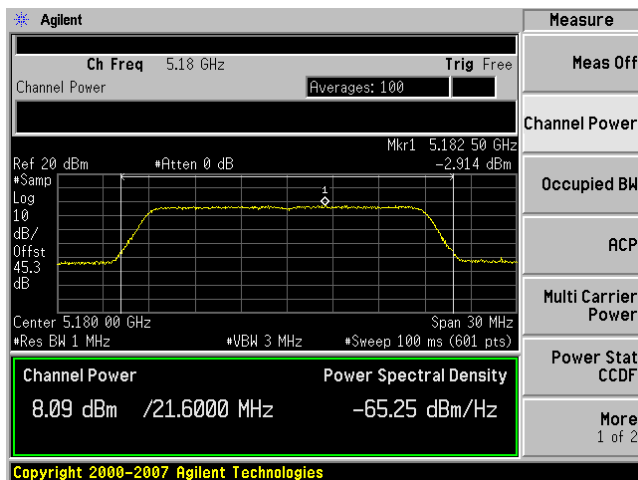
Antenna A



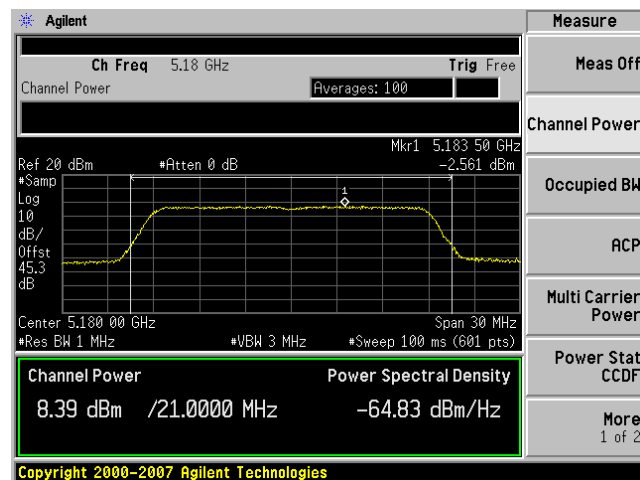
Antenna B



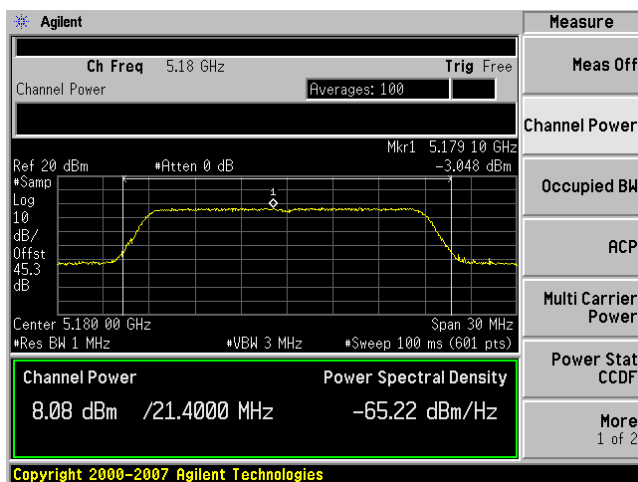
## Peak Power / PSD, 5180 MHz, m16, HT-20 Beam Forming



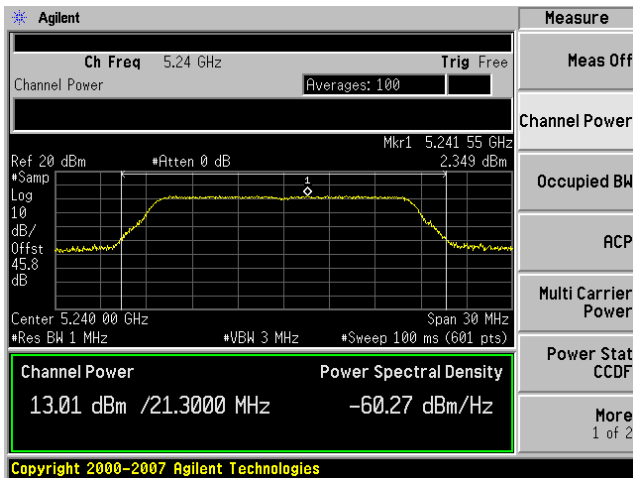
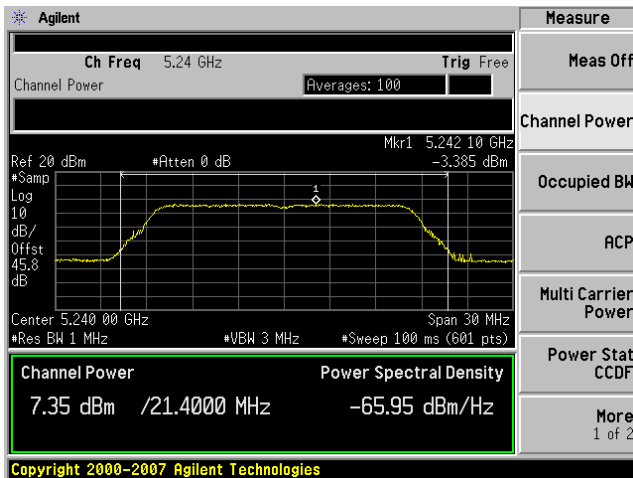
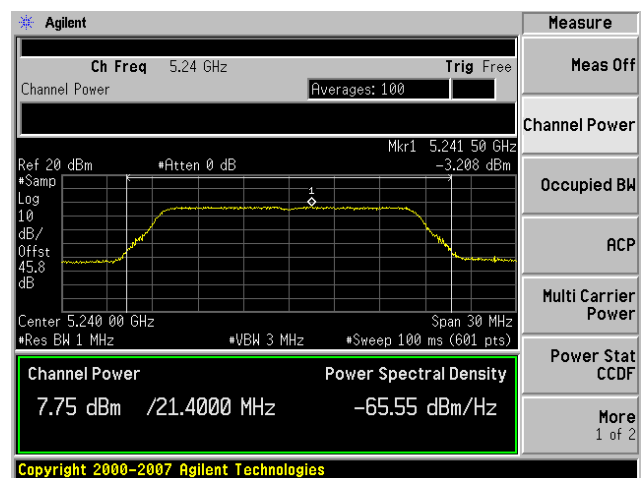
Antenna A



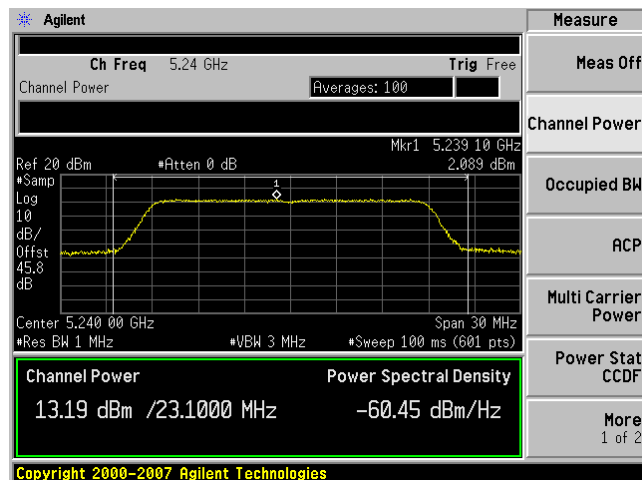
Antenna B



Antenna C

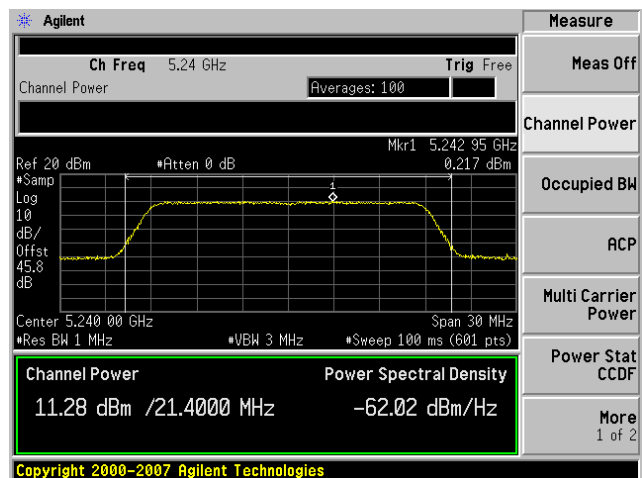
**Peak Power / PSD, 5240 MHz, 6 Mbps, Non HT-20****Antenna A****Peak Power / PSD, 5240 MHz, 6 Mbps, Non HT-20 Beam Forming****Antenna A****Antenna B**

## Peak Power / PSD, 5240 MHz, m0, HT-20

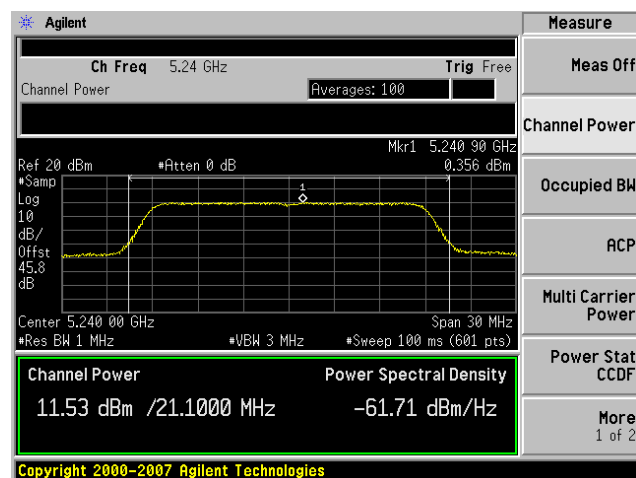


## Antenna A

## Peak Power / PSD, 5240 MHz, m8, HT-20



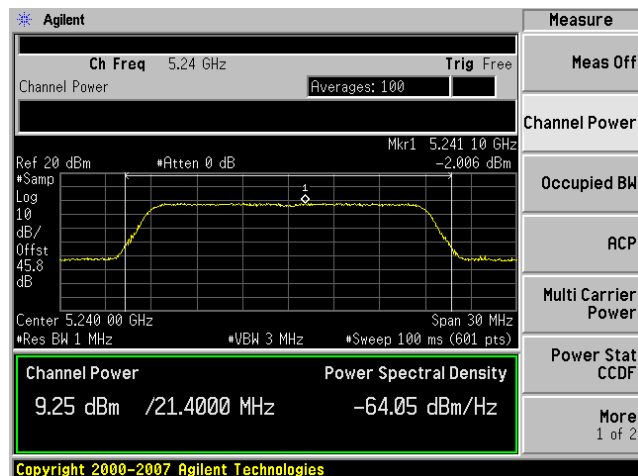
## Antenna A



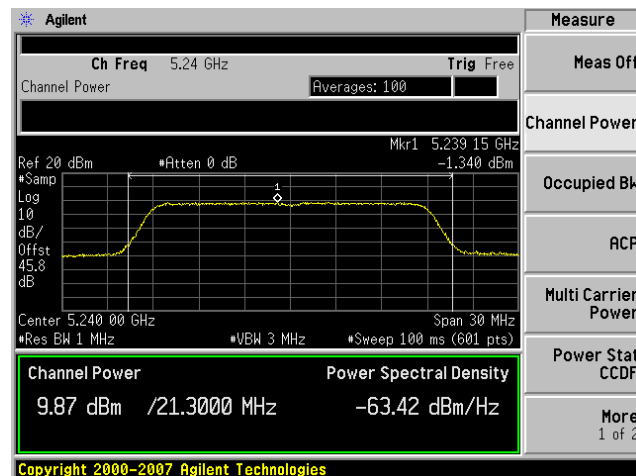
## Antenna B



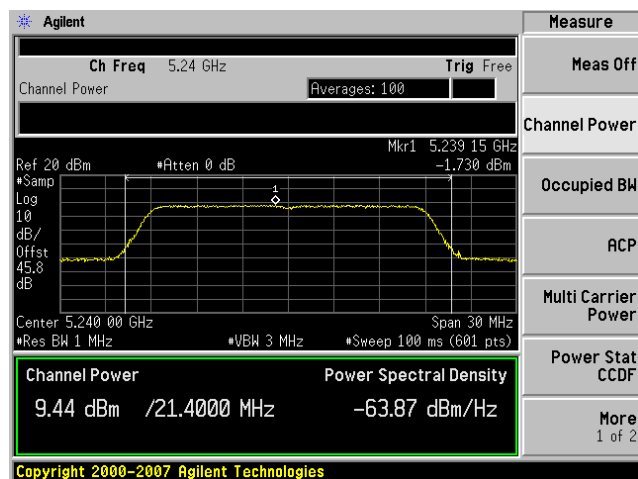
## Peak Power / PSD, 5240 MHz, m16, HT-20



Antenna A



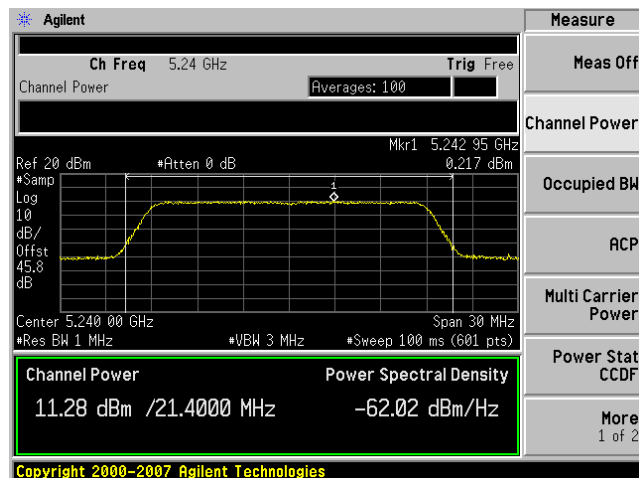
Antenna B



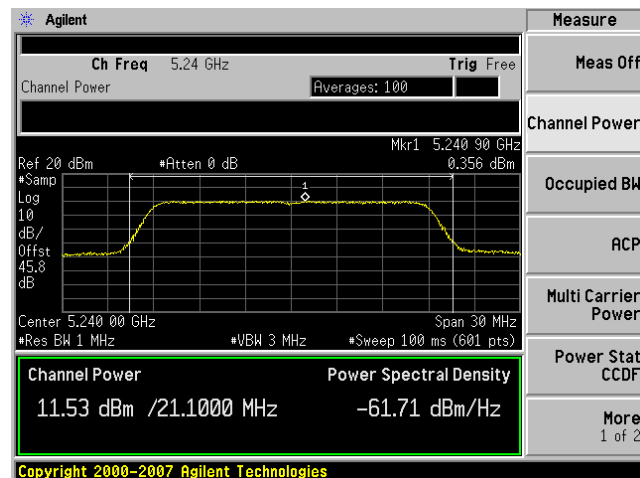
Antenna C



## Peak Power / PSD, 5240 MHz, m0, HT-20 STBC

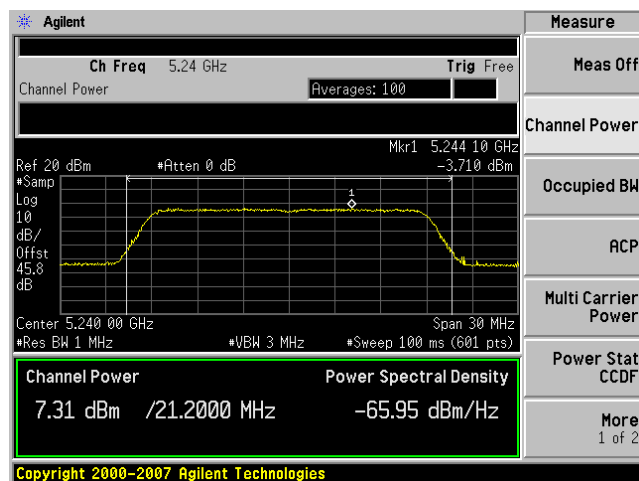


Antenna A

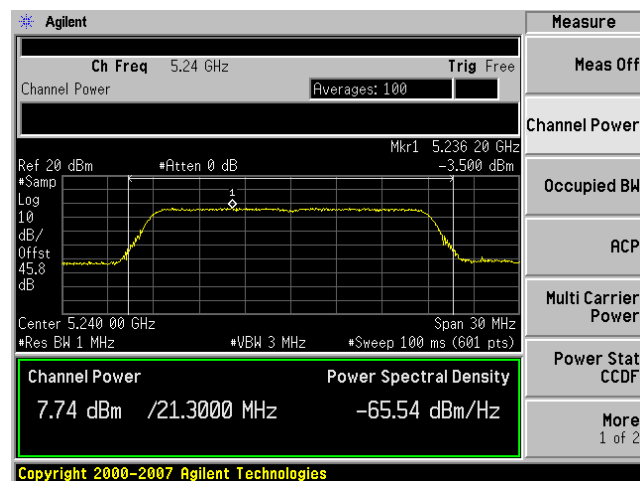


Antenna B

## Peak Power / PSD, 5240 MHz, m0, HT-20 Beam Forming

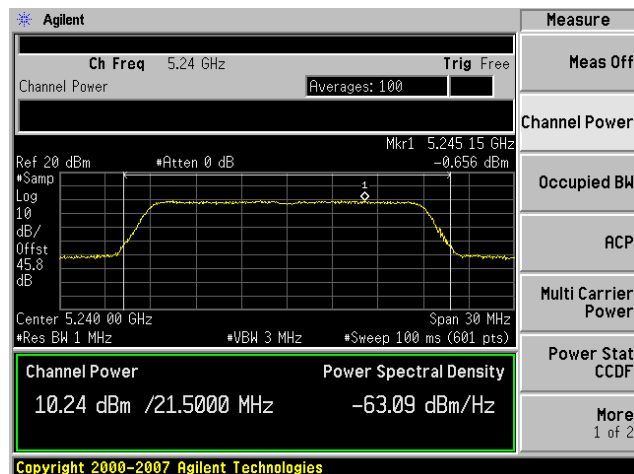


Antenna A

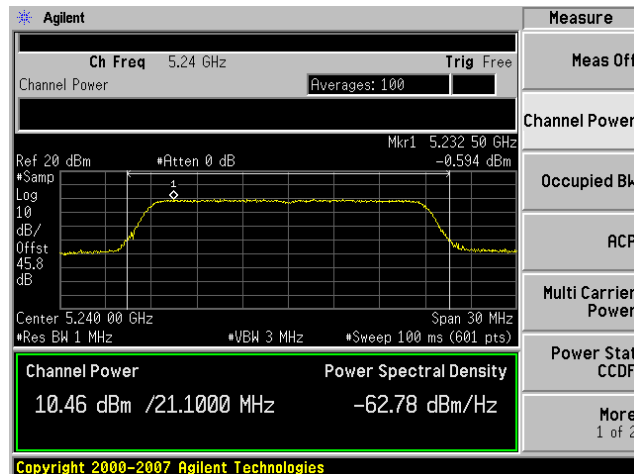


Antenna B

## Peak Power / PSD, 5240 MHz, m8, HT-20 Beam Forming



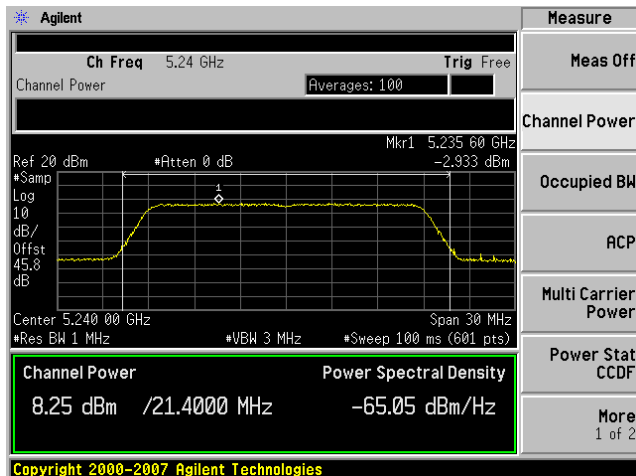
Antenna A



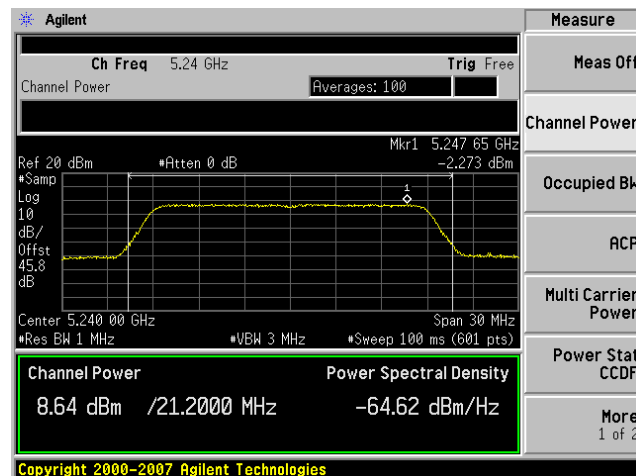
Antenna B



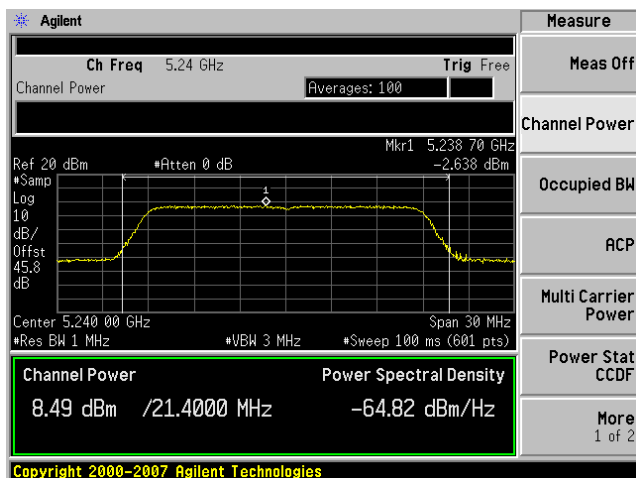
## Peak Power / PSD, 5240 MHz, m16, HT-20 Beam Forming



Antenna A

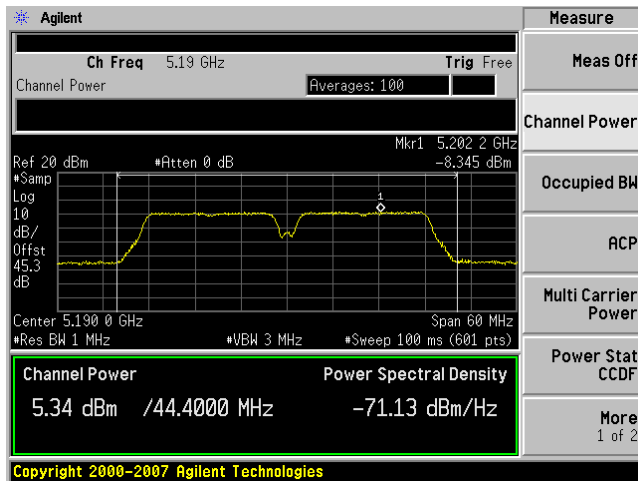
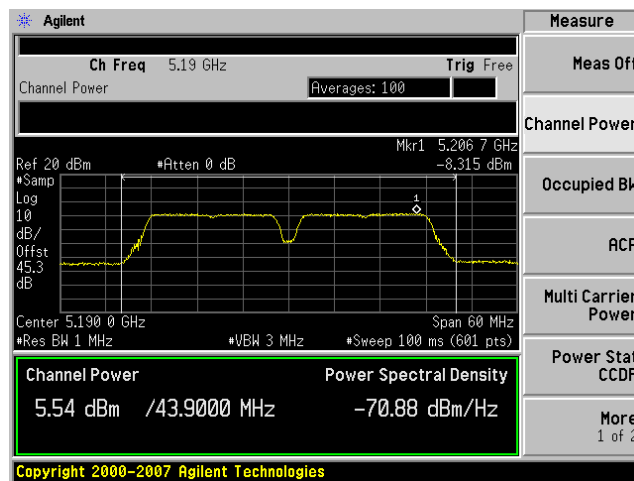
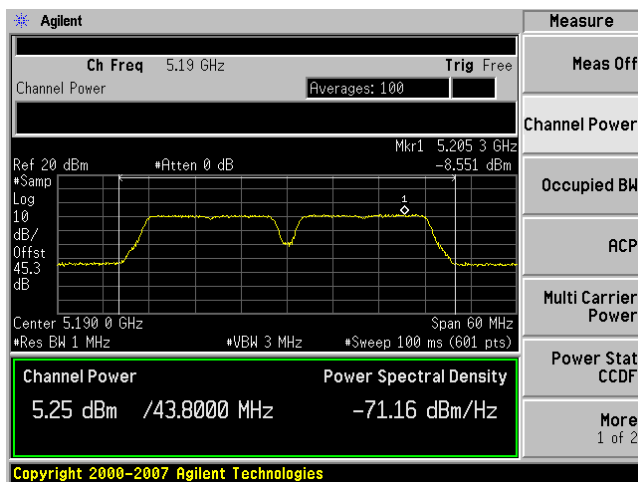


Antenna B



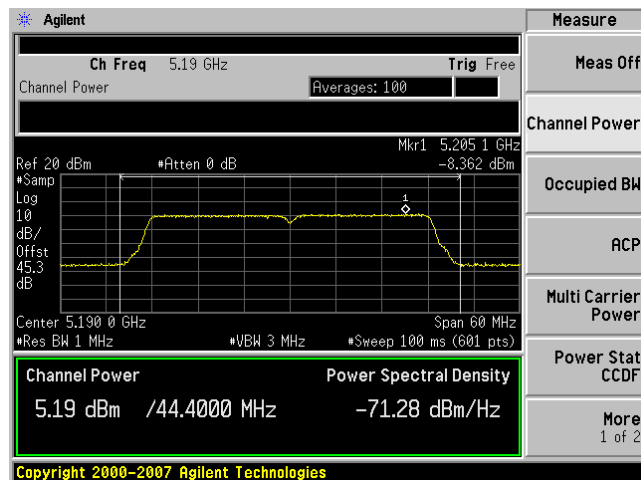
Antenna C



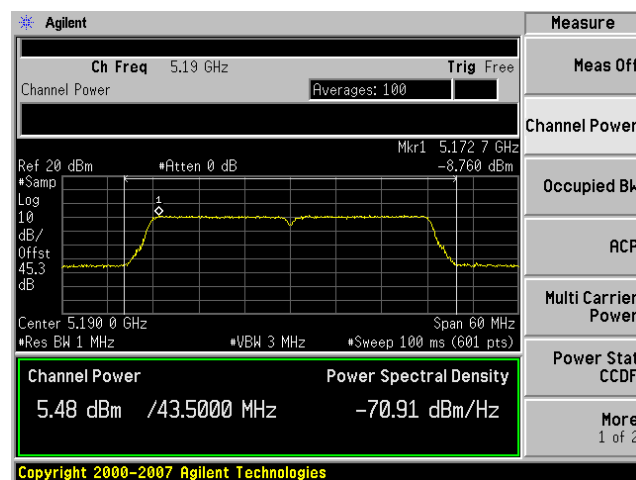
**Peak Power / PSD, 5180/5200 MHz, 6 Mbps, Non HT-40****Antenna A****Antenna B****Antenna C**



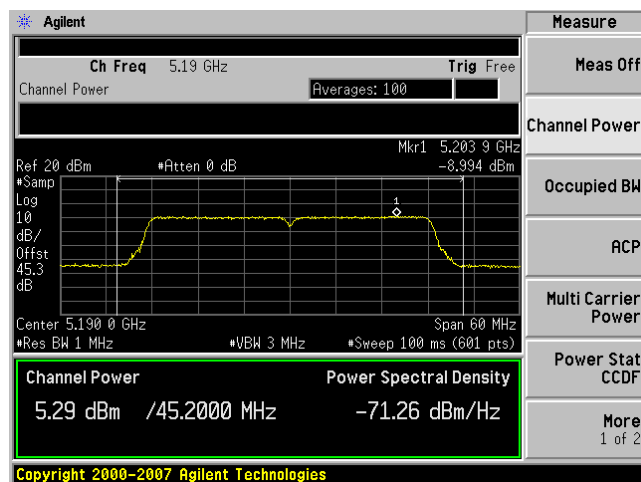
## Peak Power / PSD, 5180/5200 MHz, m0, HT-40



Antenna A



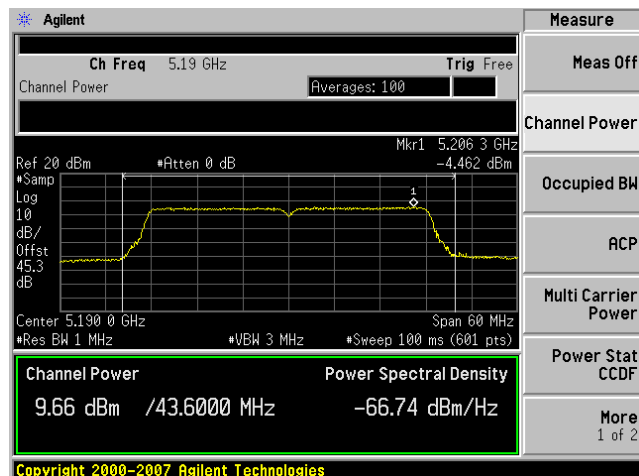
Antenna B



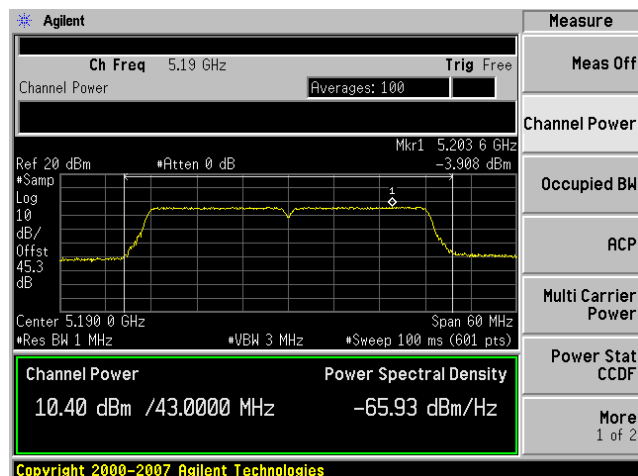
Antenna C



## Peak Power / PSD, 5180/5200 MHz, m8, HT-40



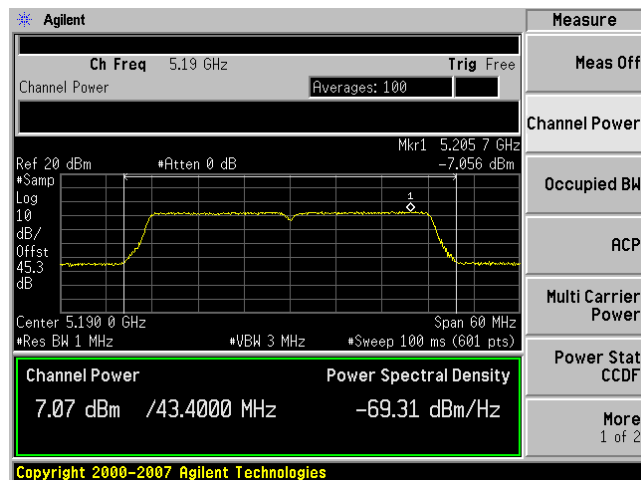
Antenna A



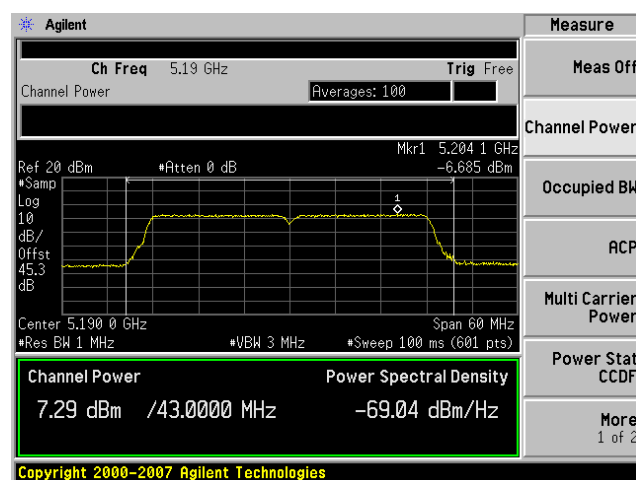
Antenna B



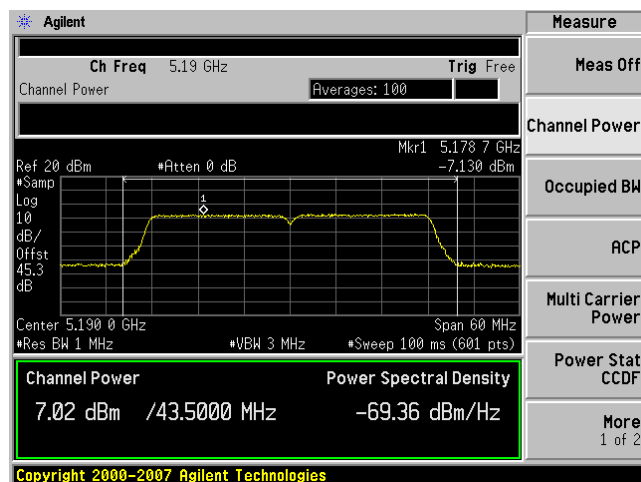
## Peak Power / PSD, 5180/5200 MHz, m16, HT-40



Antenna A



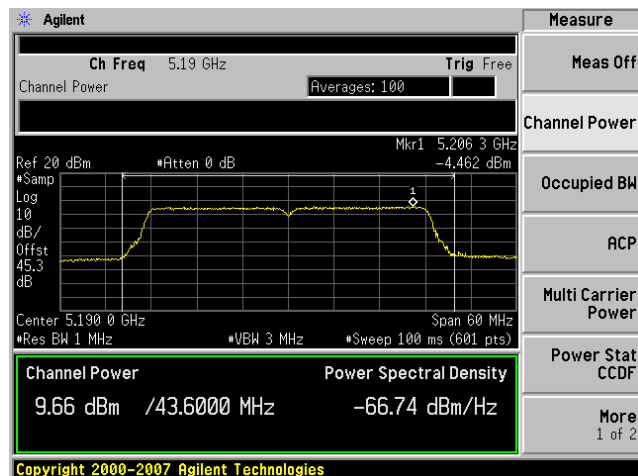
Antenna B



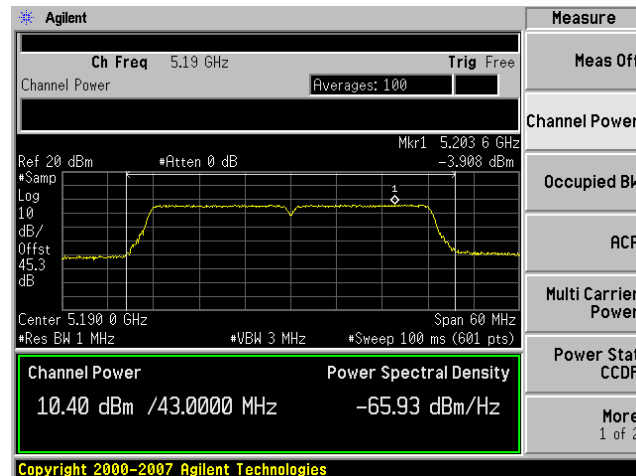
Antenna C



## Peak Power / PSD, 5180/5200 MHz, m0, HT-40 STBC

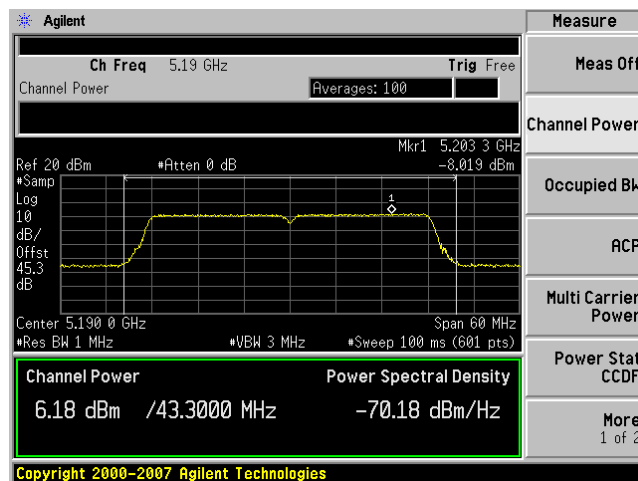


Antenna A

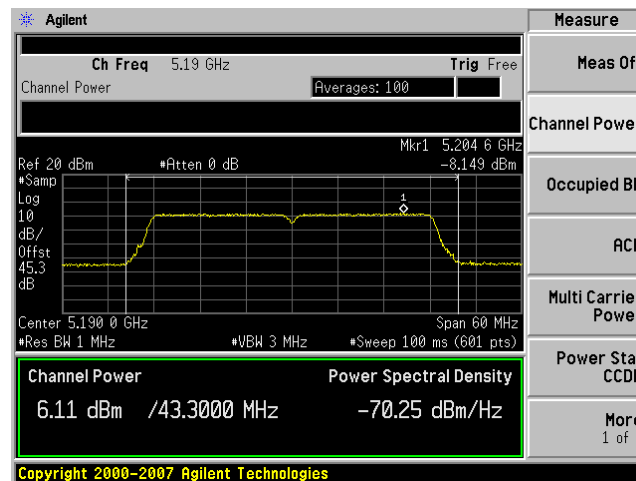


Antenna B

## Peak Power / PSD, 5180/5200 MHz, m0, HT-40 Beam Forming



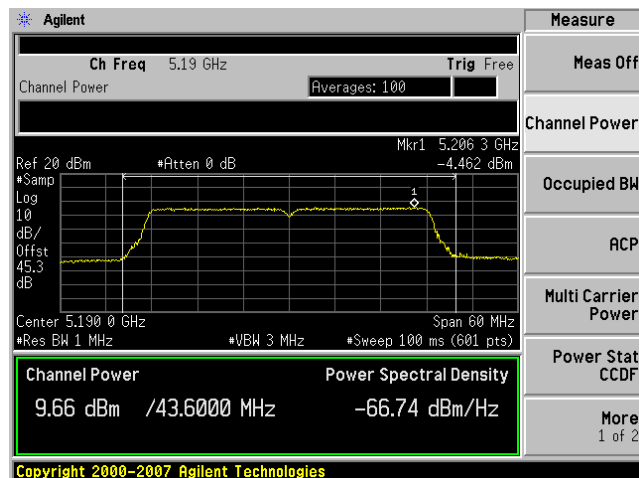
Antenna A



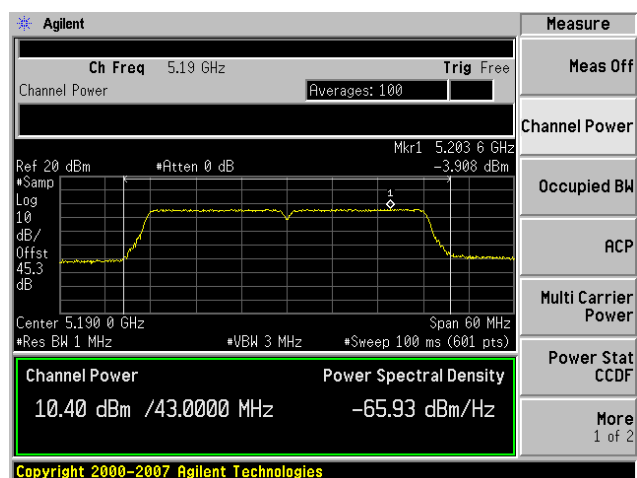
Antenna B



## Peak Power / PSD, 5180/5200 MHz, m8, HT-40 Beam Forming



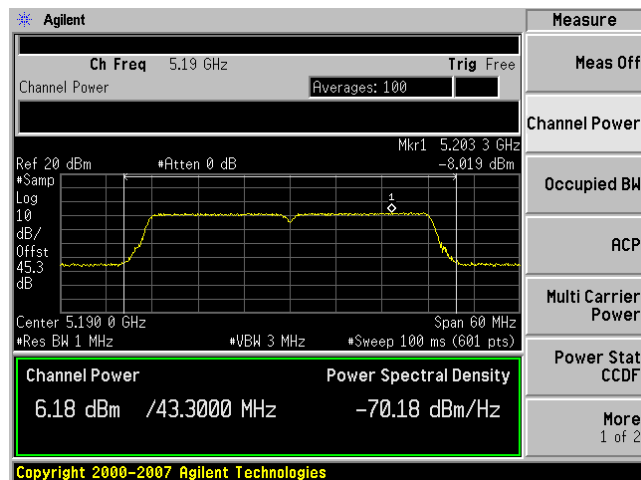
Antenna A



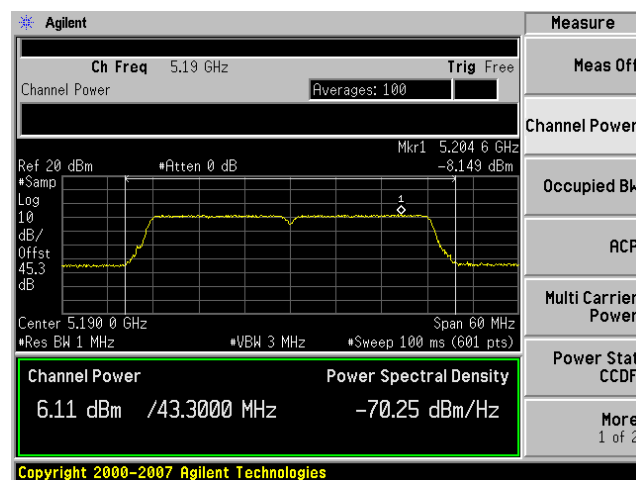
Antenna B



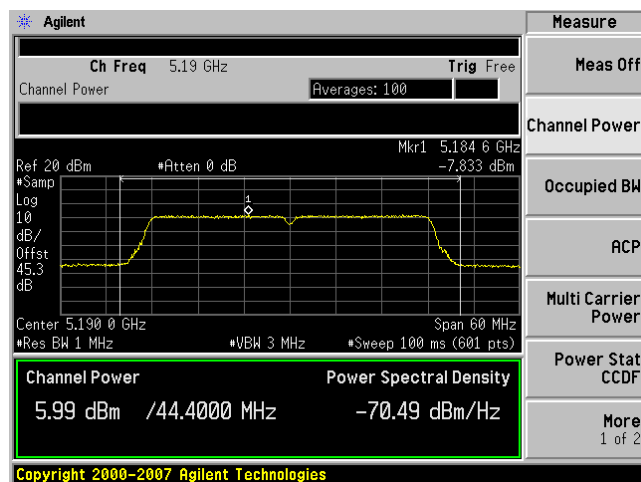
## Peak Power / PSD, 5180/5200 MHz, m16, HT-40 Beam Forming



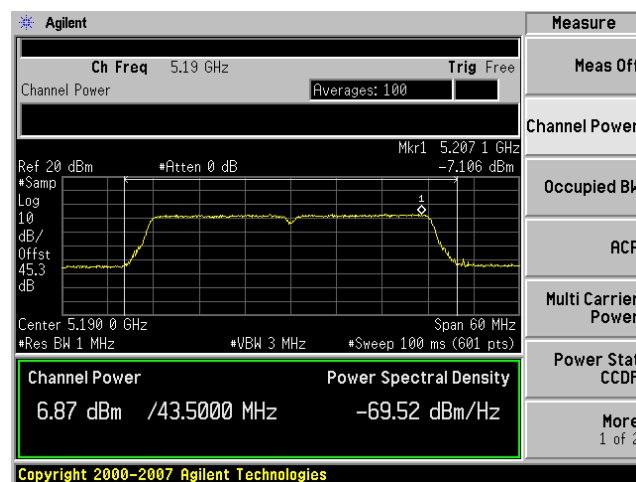
Antenna A



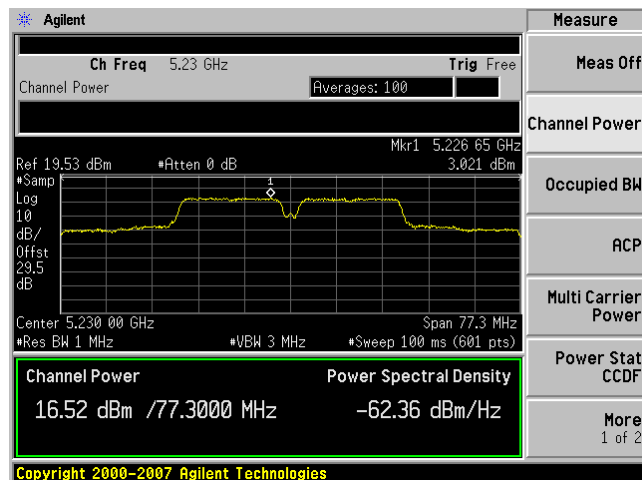
Antenna B



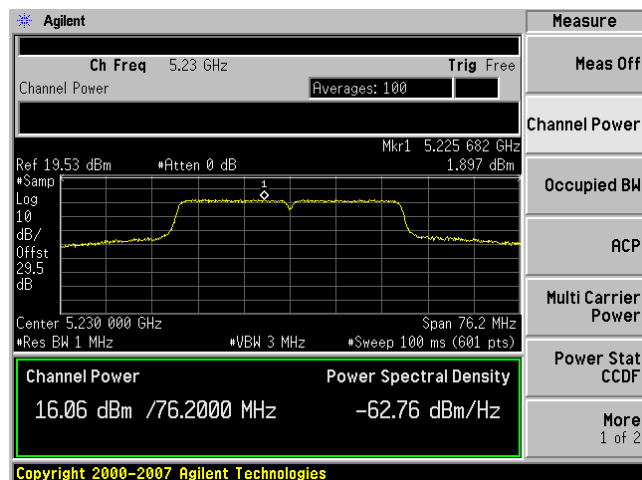
Antenna C



Antenna D

**Peak Power / PSD, 5220/5240 MHz, 6 Mbps, Non HT-40**

Antenna A

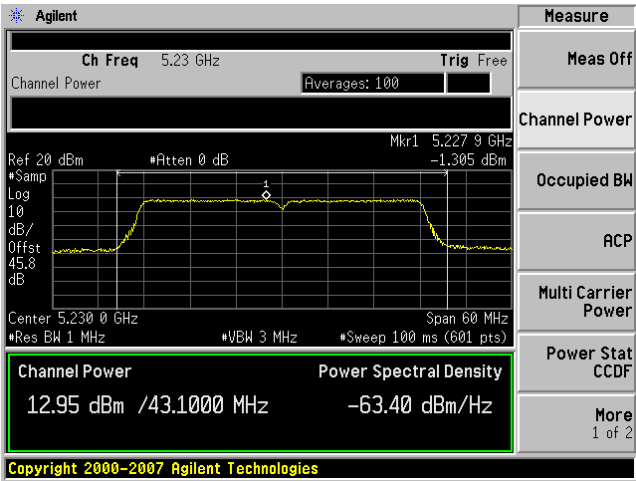
**Peak Power / PSD, 5220/5240 MHz, m0, HT-40**

Antenna A

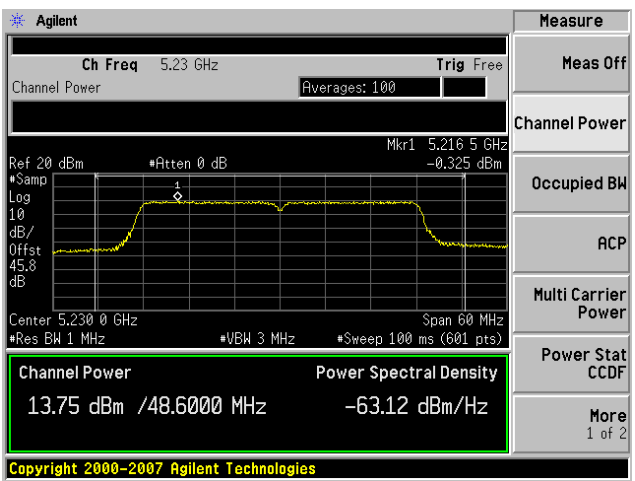




Peak Power / PSD, 5220/5240 MHz, m8, HT-40



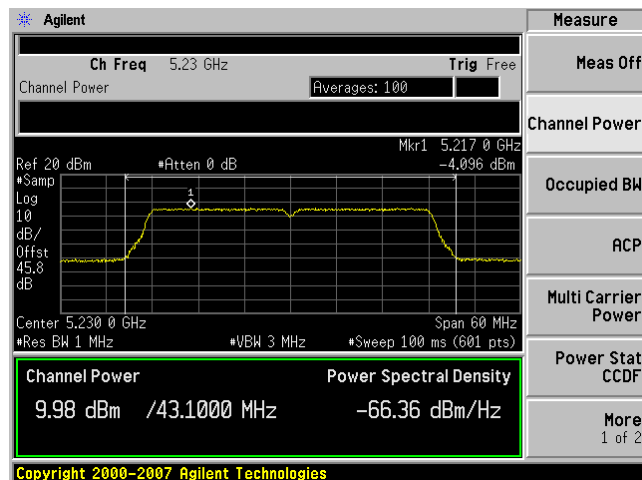
Antenna A



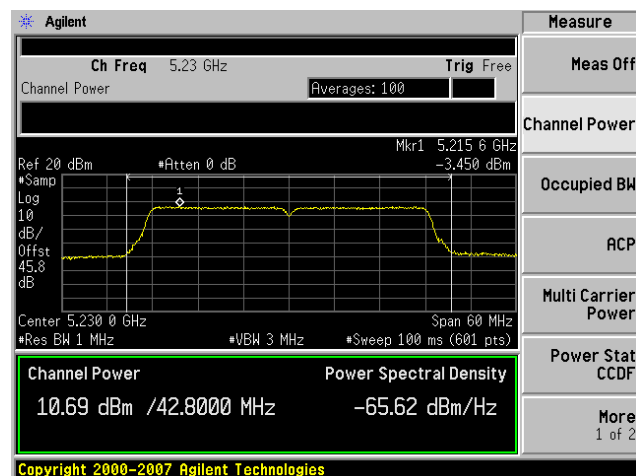
Antenna B



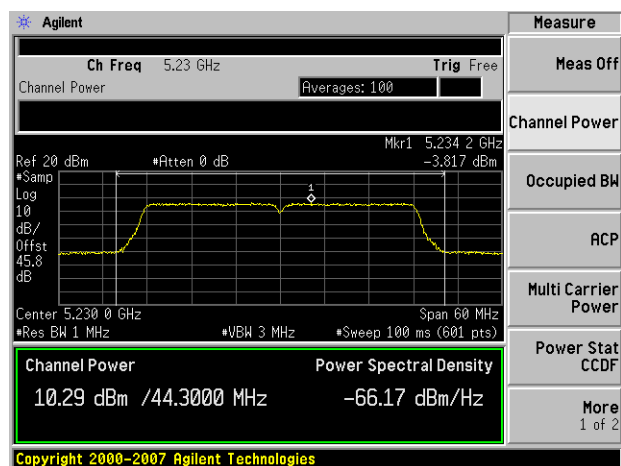
## Peak Power / PSD, 5220/5240 MHz, m16, HT-40



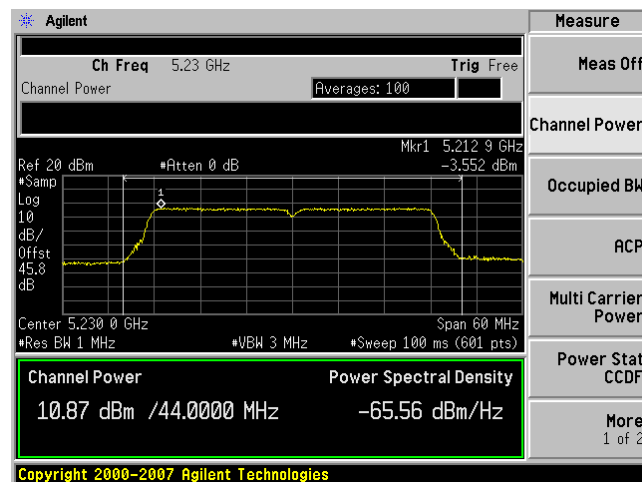
Antenna A



Antenna B



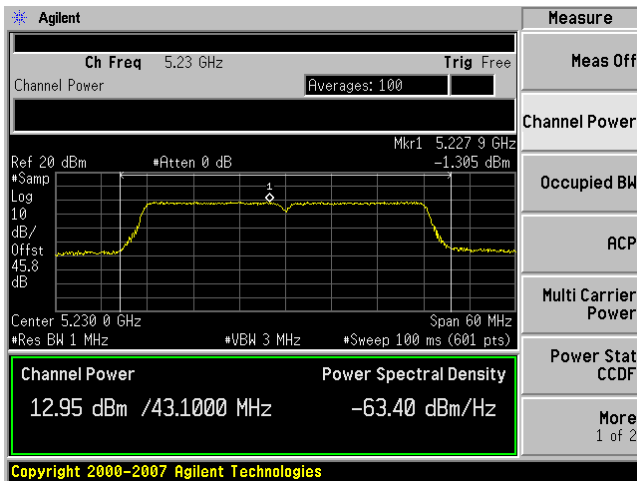
Antenna C



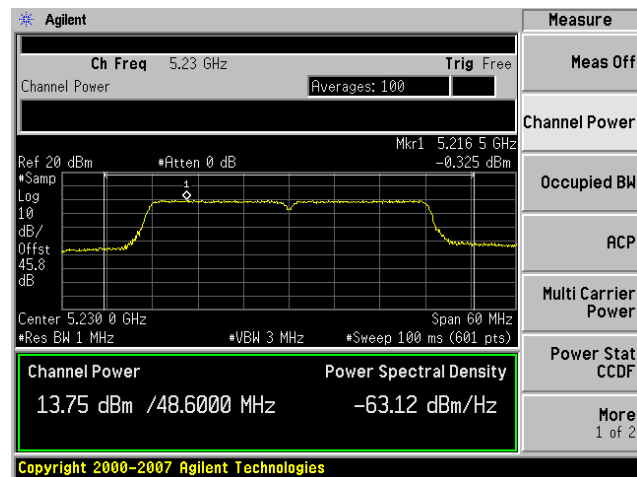
Antenna D



## Peak Power / PSD, 5220/5240 MHz, m0, HT-40 STBC

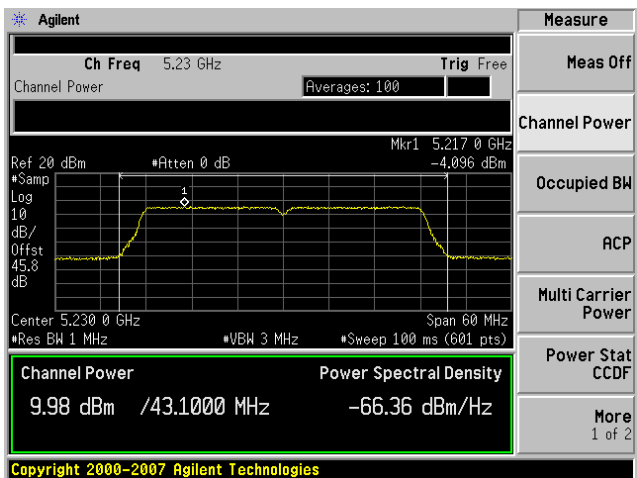


Antenna A

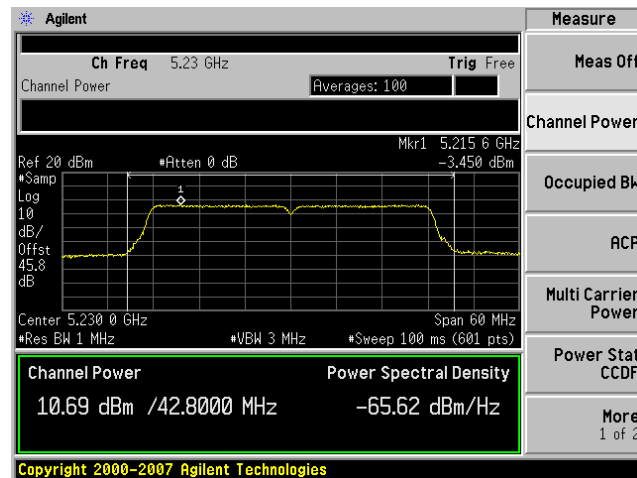


Antenna B

## Peak Power / PSD, 5220/5240 MHz, m0, HT-40 Beam Forming



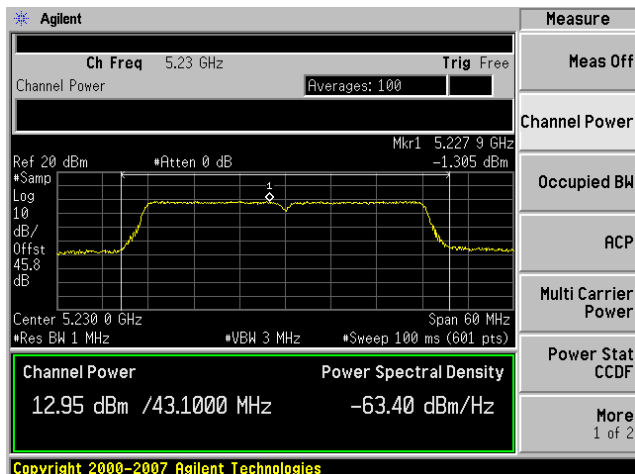
Antenna A



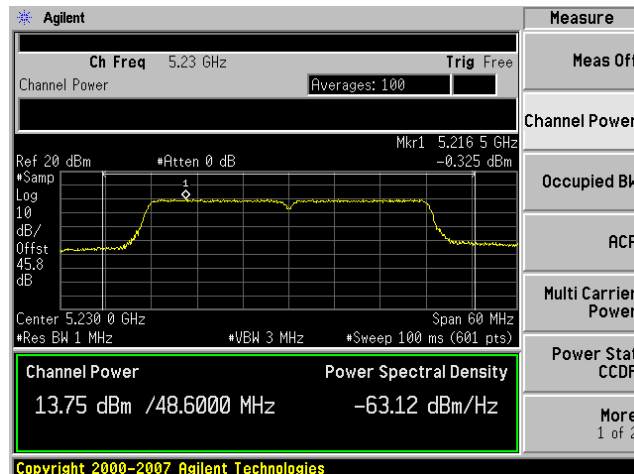
Antenna B



## Peak Power / PSD, 5220/5240 MHz, m8, HT-40 Beam Forming



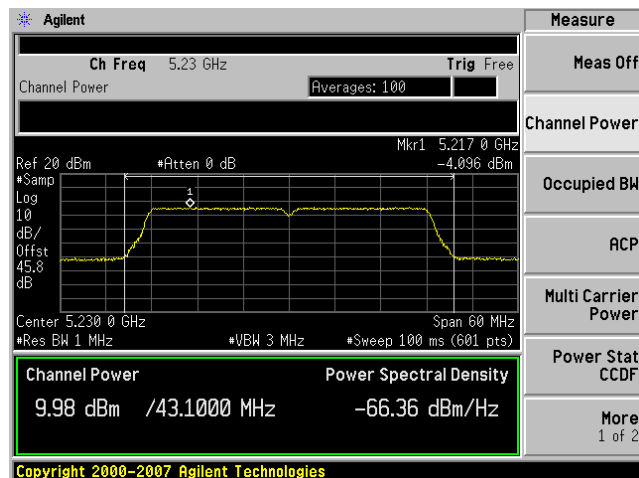
Antenna A



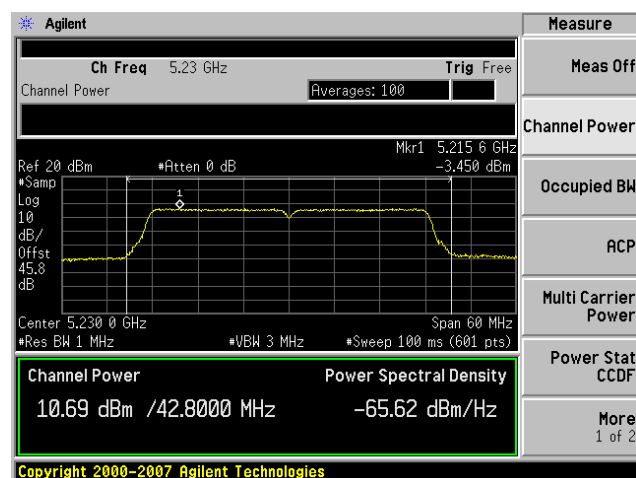
Antenna B



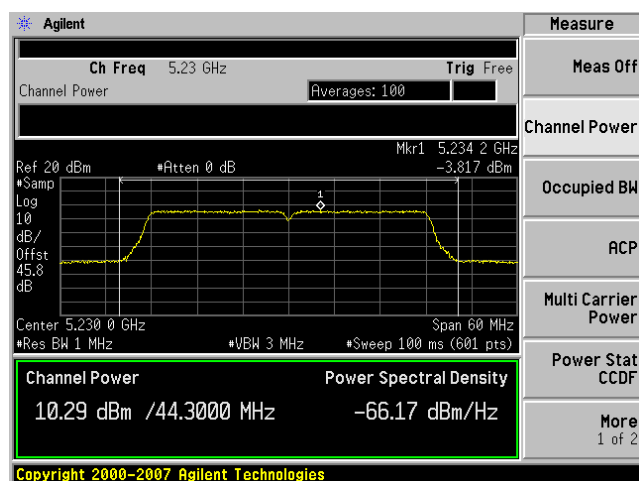
## Peak Power / PSD, 5220/5240 MHz, m16, HT-40 Beam Forming



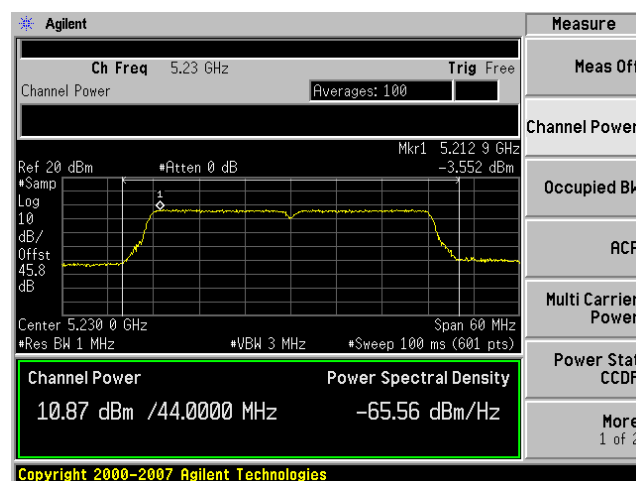
Antenna A



Antenna B



Antenna C



Antenna D



## Peak Excursion

15.407: The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

Set the spectrum analyzer span to view the entire emission bandwidth. The largest difference between the following two traces must be  $\leq 13$  dB for all frequencies across the emission bandwidth.

Set the spectrum analyzer span to view the entire emission bandwidth. The largest difference between the following two traces must be  $\leq 13$  dB for all frequencies across the emission bandwidth.

1st Trace: (Peak)

Set Span to encompass the entire emission bandwidth of the signal.

RBW = 1 MHz, VBW = 3 MHz

Detector = Peak

Sweep = 10 s

Trace 1 = Max-hold

Ref Level Offset = correct for attenuator and cable loss

Ref Level = 20dBm

Atten = 10dBm

2nd Trace: (Average)

Trace 2 = clear right

Detector = Sample

Avg/VBW type = Pwr(RMS)

Average = 100

Sweep = single

Set marker Deltas

Trace 1 & Peak search

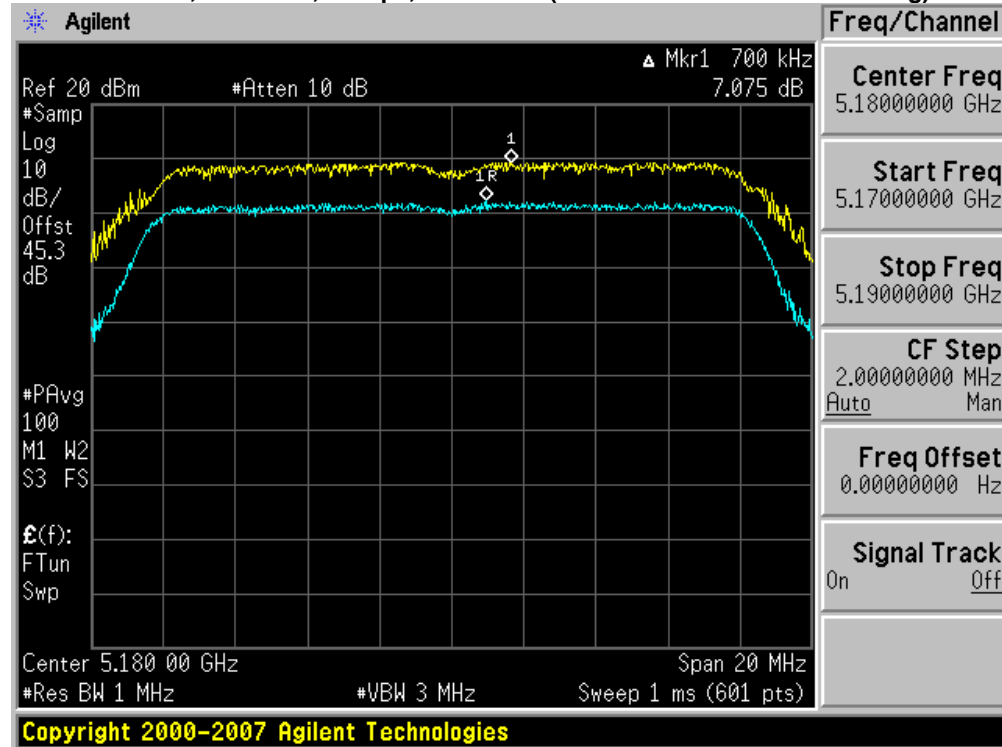
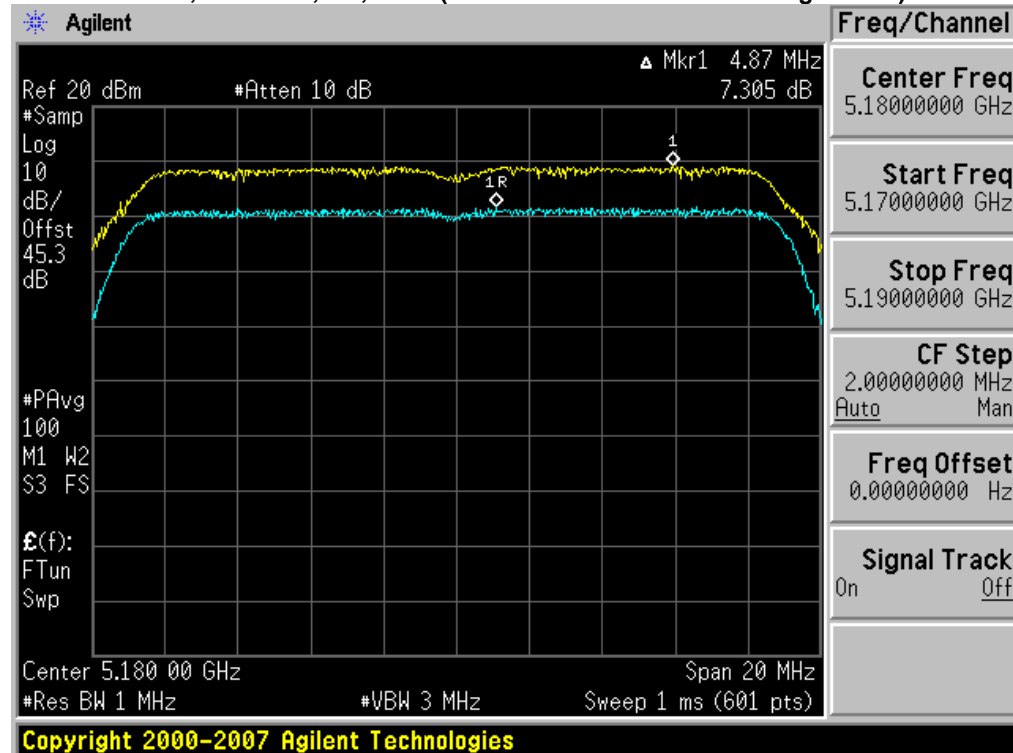
Marker Delta

Trace 2 & Peak search

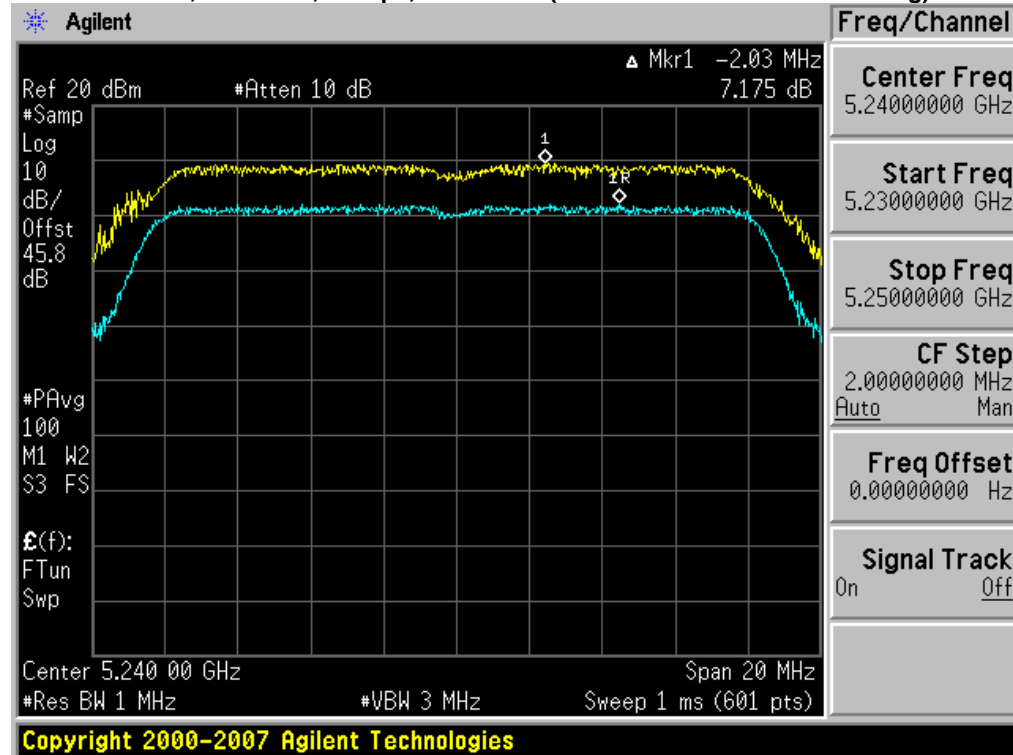
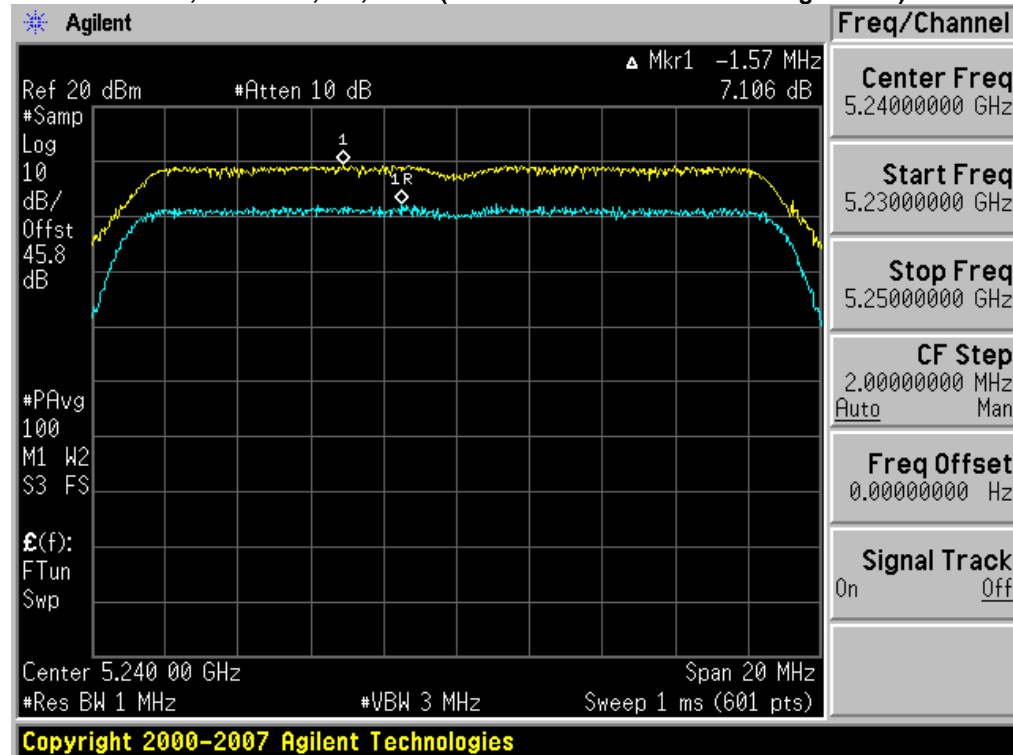
Record the difference between the Peak and Average Markers

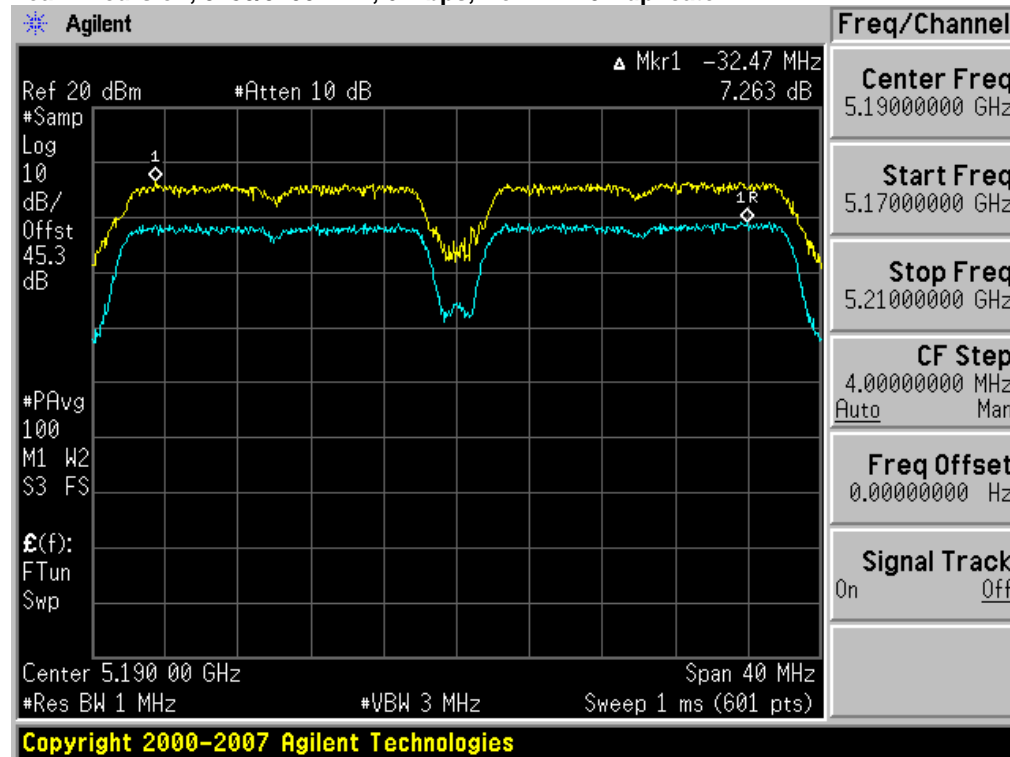
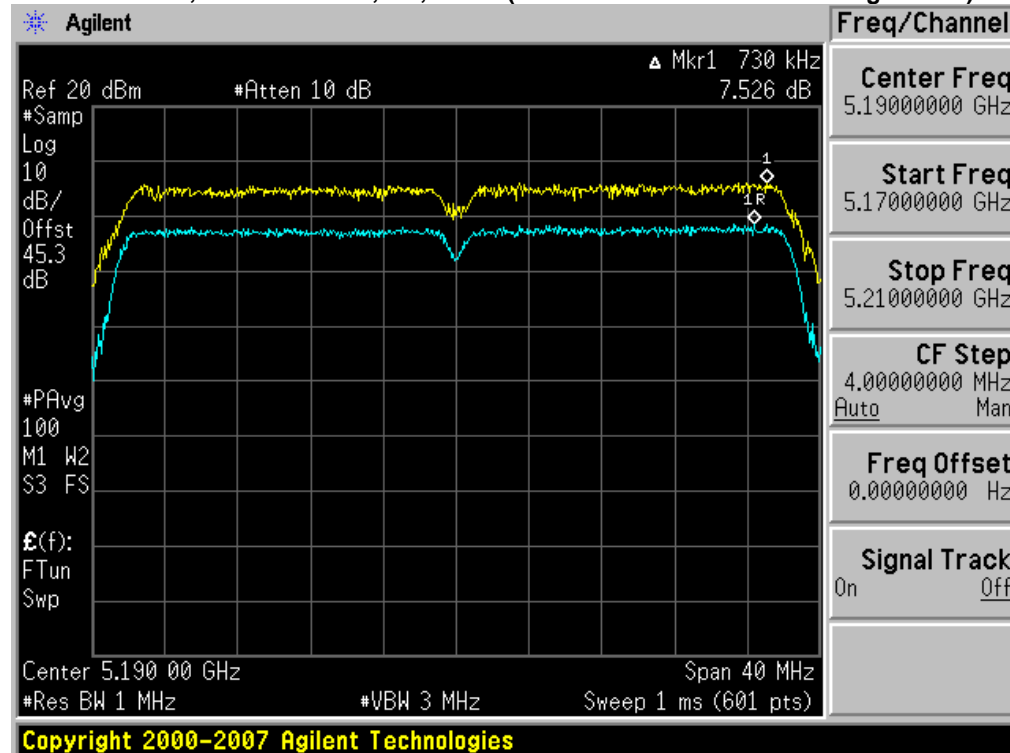


Frequency (MHz)	Mode	Data Rate (Mbps)	Peak Excursion (dB)	Limit (dBm/MHz)	Margin (dB)
5180	Non HT-20, 6 to 54 Mbps	6	7.1	13	5.9
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	7.1	13	5.9
	HT-20, M0 to M23	m0	7.3	13	5.7
	HT-20 STBC, M0 to M7	m0	7.3	13	5.7
	HT-20 Beam Forming, M0 to M23	m0	7.3	13	5.7
5240	Non HT-20, 6 to 54 Mbps	6	7.2	13	5.8
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	7.2	13	5.8
	HT-20, M0 to M23	m0	7.1	13	5.9
	HT-20 STBC, M0 to M7	m0	7.1	13	5.9
	HT-20 Beam Forming, M0 to M23	m0	7.1	13	5.9
5180/5200	Non HT-40 Duplicate, 6-54 Mbps	6	7.3	13	5.7
	HT-40, M0 to M23	m0	7.5	13	5.5
	HT-40 STBC, M0 to M7	m0	7.5	13	5.5
	HT-40 Beam Forming, M0 to M23	m0	7.5	13	5.5
5220/5240	Non HT-40 Duplicate, 6-54 Mbps	6	7.4	13	5.6
	HT-40, M0 to M23	m0	7.6	13	5.4
	HT-40 STBC, M0 to M7	m0	7.6	13	5.4
	HT-40 Beam Forming, M0 to M23	m0	7.6	13	5.4

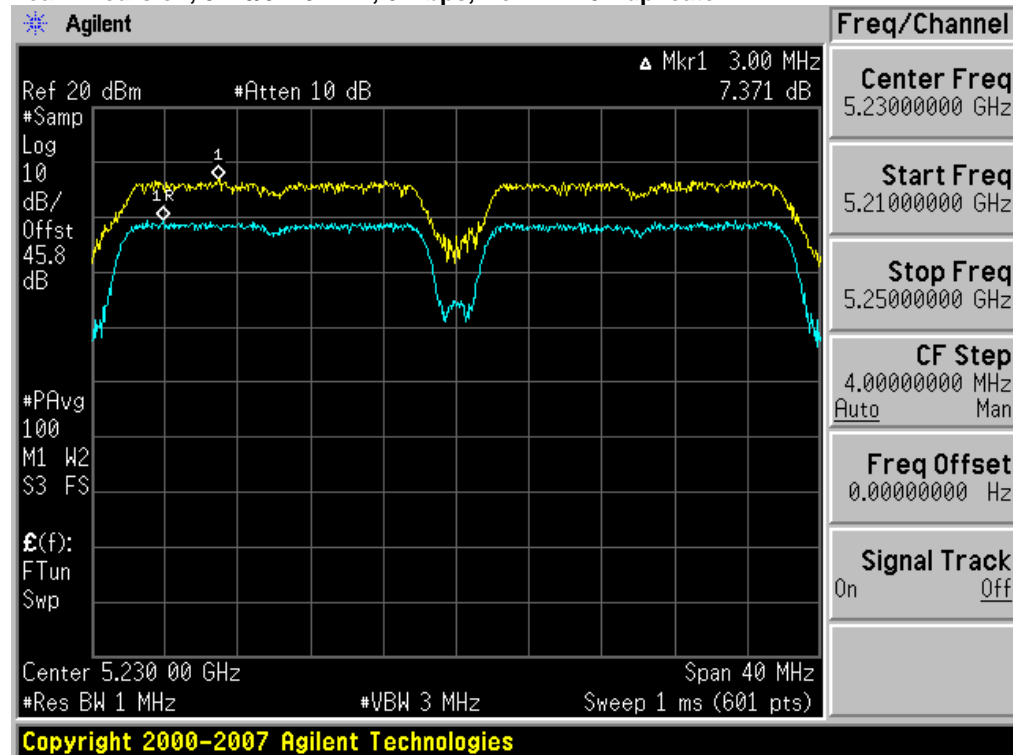
**Peak Excursion, 5180 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)****Peak Excursion, 5180 MHz, m0, HT20 (with and without Beam Forming / STBC)**



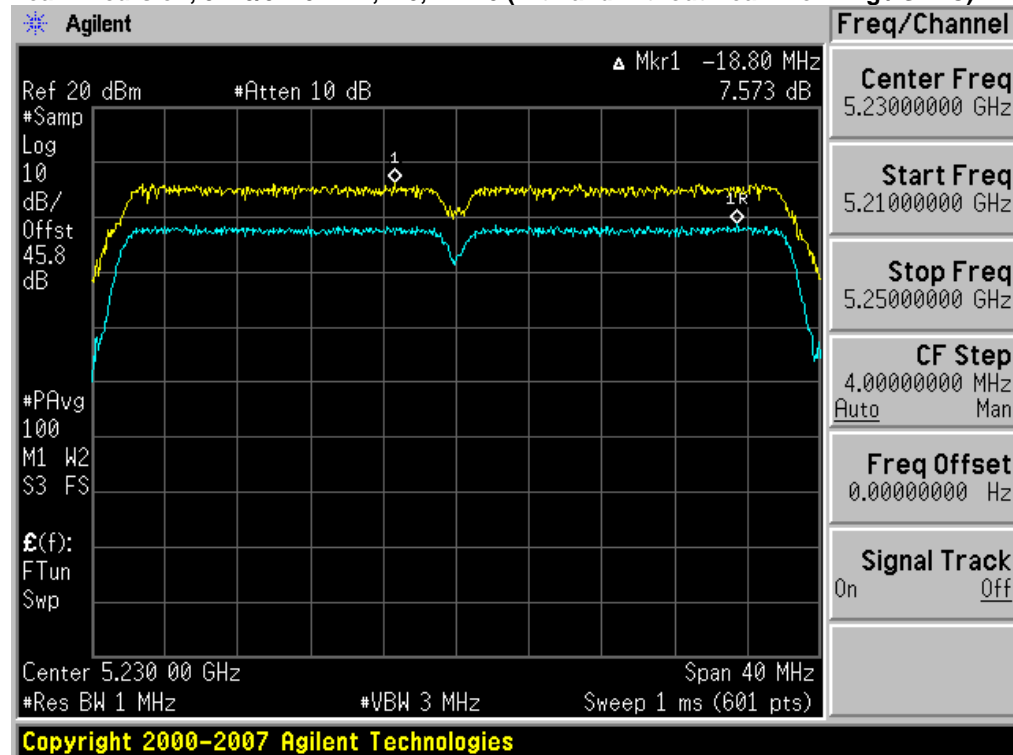
**Peak Excursion, 5240 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)****Peak Excursion, 5240 MHz, m0, HT20 (with and without Beam Forming / STBC)**

**Peak Excursion, 5180/5200 MHz, 6 Mbps, Non HT-40 Duplicate****Peak Excursion, 5180/5200 MHz, m0, HT-40 (with and without Beam Forming / STBC)**

## Peak Excursion, 5220/5240 MHz, 6 Mbps, Non HT-40 Duplicate



## Peak Excursion, 5220/5240 MHz, m0, HT-40 (with and without Beam Forming / STBC)





## Conducted Spurious Emissions

15.407: 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 EIRP of -27dBm/MHz.

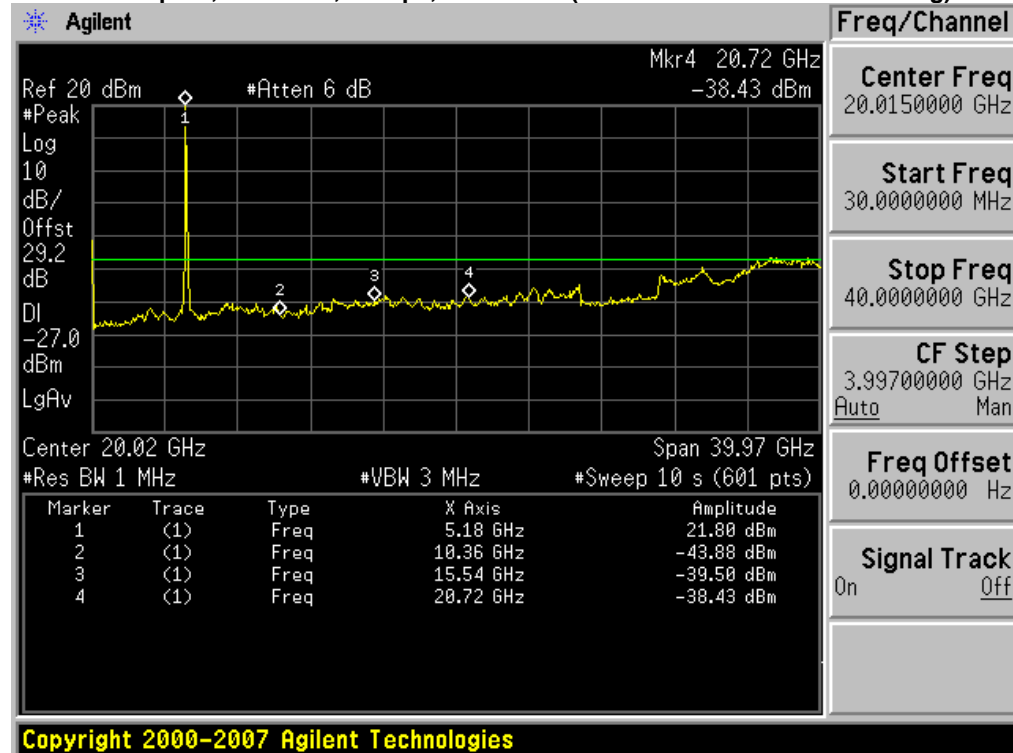
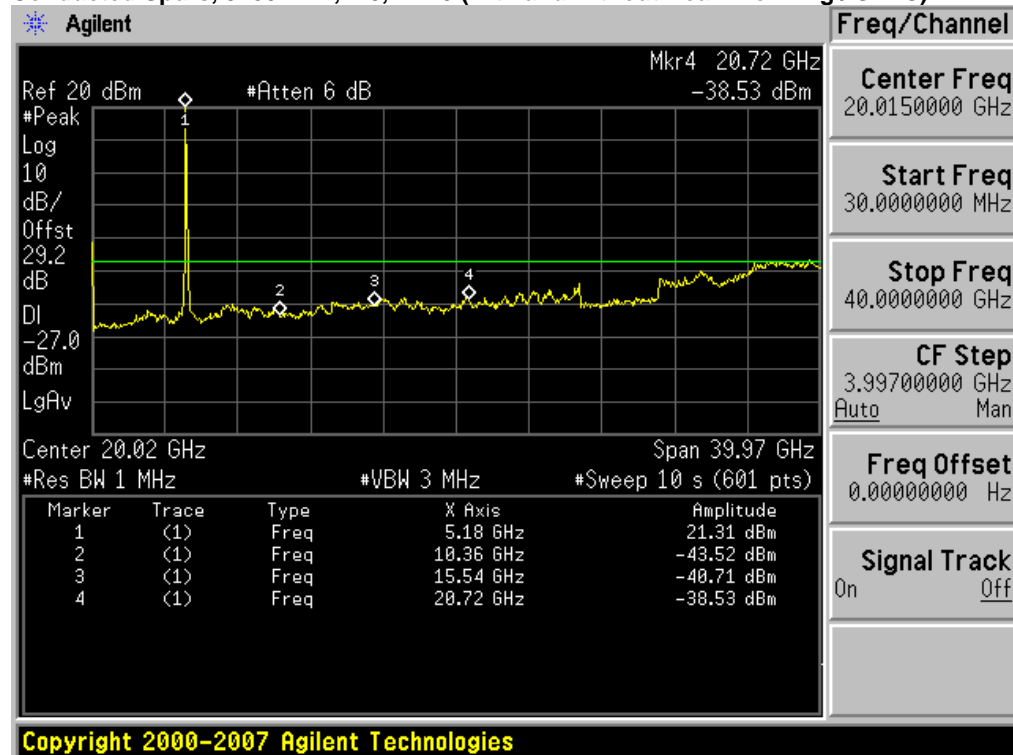
Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer).

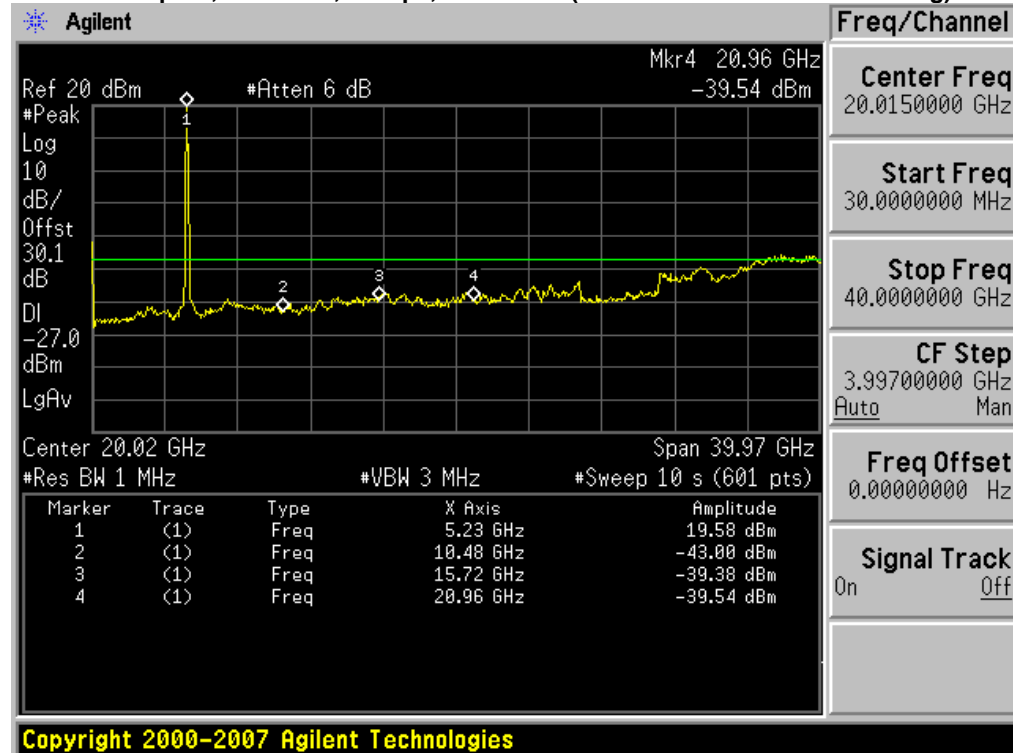
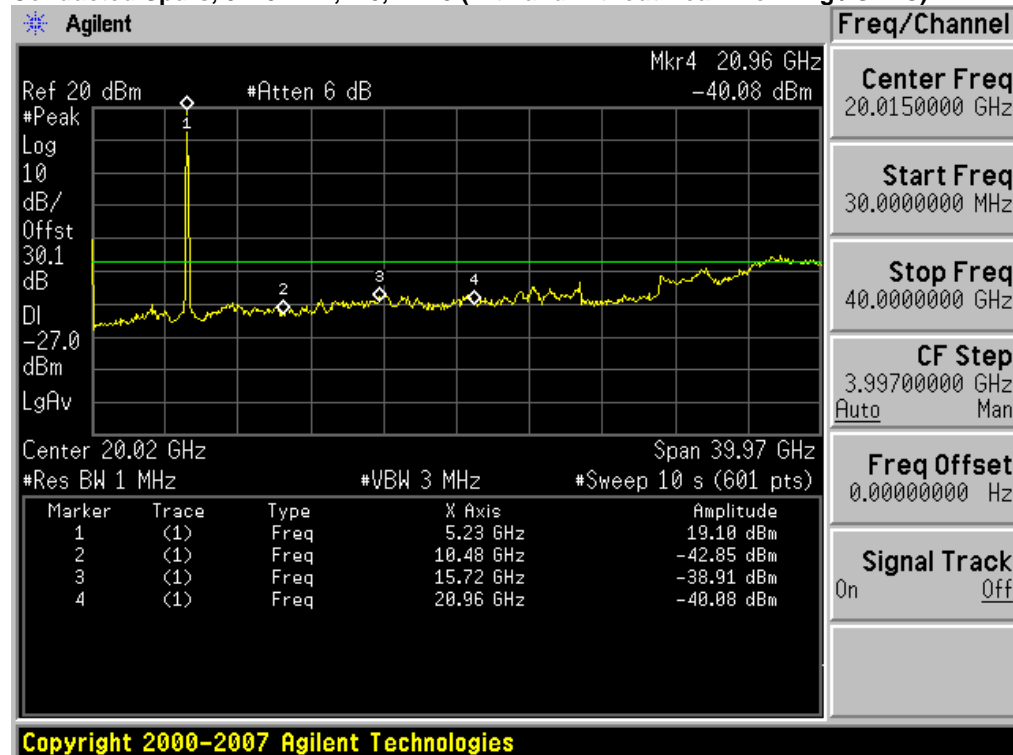
Span:	30 MHz-40 GHz
Reference Level:	20 dBm
Attenuation:	10 dB
Sweep Time:	10 s
Resolution Bandwidth:	1 MHz
Video Bandwidth:	3 MHz
Detector:	Peak
Trace:	Single
Marker:	Peak

Record the marker waveform peak to spur difference

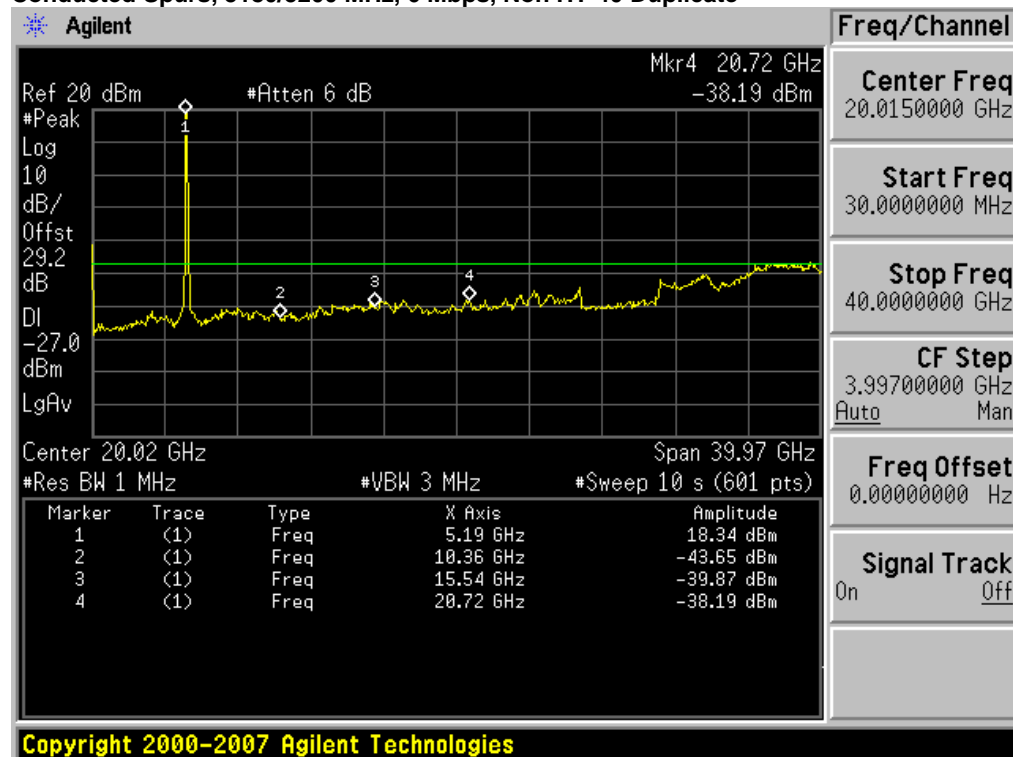


Frequency (MHz)	Mode	Data Rate (Mbps)	Conducted Spur Delta (dB)	Limit (dBm)	Margin (dB)
5180	Non HT-20, 6 to 54 Mbps	6	-38.4	-27.0	11.4
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	-38.4	-27.0	11.4
	HT-20, M0 to M23	m0	-38.5	-27.0	11.5
	HT-20 STBC, M0 to M7	m0	-38.5	-27.0	11.5
	HT-20 Beam Forming, M0 to M23	m0	-38.5	-27.0	11.5
5240	Non HT-20, 6 to 54 Mbps	6	-39.4	-27.0	12.4
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	-39.4	-27.0	12.4
	HT-20, M0 to M23	m0	-38.9	-27.0	11.9
	HT-20 STBC, M0 to M7	m0	-38.9	-27.0	11.9
	HT-20 Beam Forming, M0 to M23	m0	-38.9	-27.0	11.9
5180/5200	Non HT-40 Duplicate, 6-54 Mbps	6	-38.2	-27.0	11.2
	HT-40, M0 to M23	m0	-38.7	-27.0	11.7
	HT-40 STBC, M0 to M7	m0	-38.7	-27.0	11.7
	HT-40 Beam Forming, M0 to M23	m0	-38.7	-27.0	11.7
5220/5240	Non HT-40 Duplicate, 6-54 Mbps	6	-39.4	-27.0	12.4
	HT-40, M0 to M23	m0	-38.9	-27.0	11.9
	HT-40 STBC, M0 to M7	m0	-38.9	-27.0	11.9
	HT-40 Beam Forming, M0 to M23	m0	-38.9	-27.0	11.9

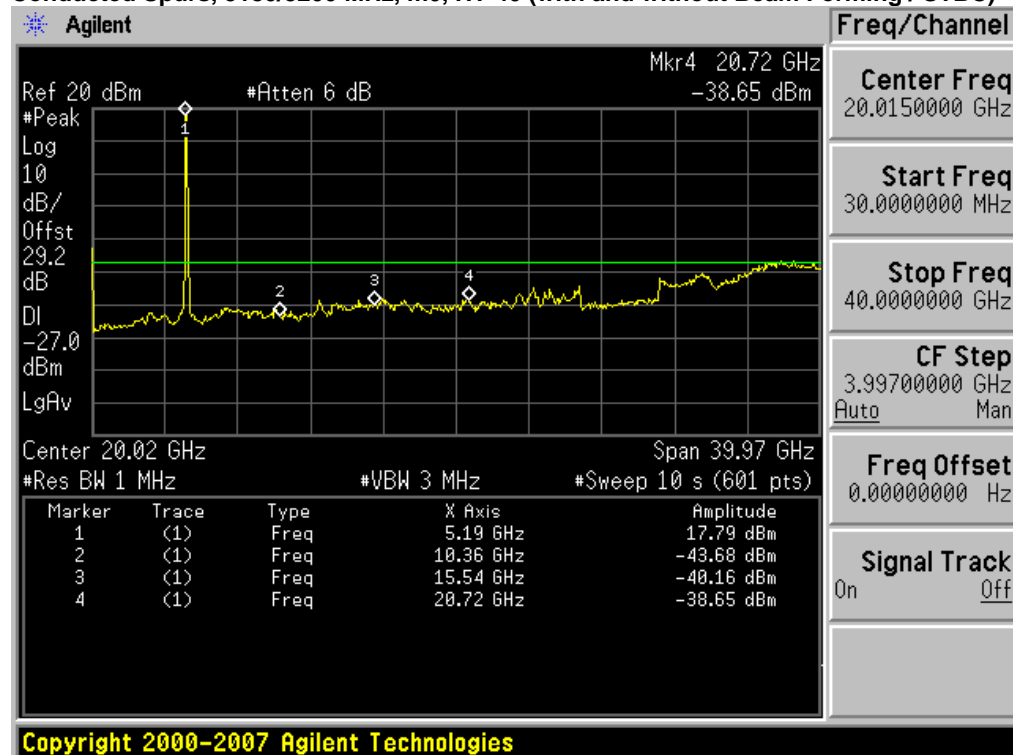
**Conducted Spurs, 5180 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)****Conducted Spurs, 5180 MHz, m0, HT20 (with and without Beam Forming / STBC)**

**Conducted Spurs, 5240 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)****Conducted Spurs, 5240 MHz, m0, HT20 (with and without Beam Forming / STBC)**

## Conducted Spurs, 5180/5200 MHz, 6 Mbps, Non HT-40 Duplicate

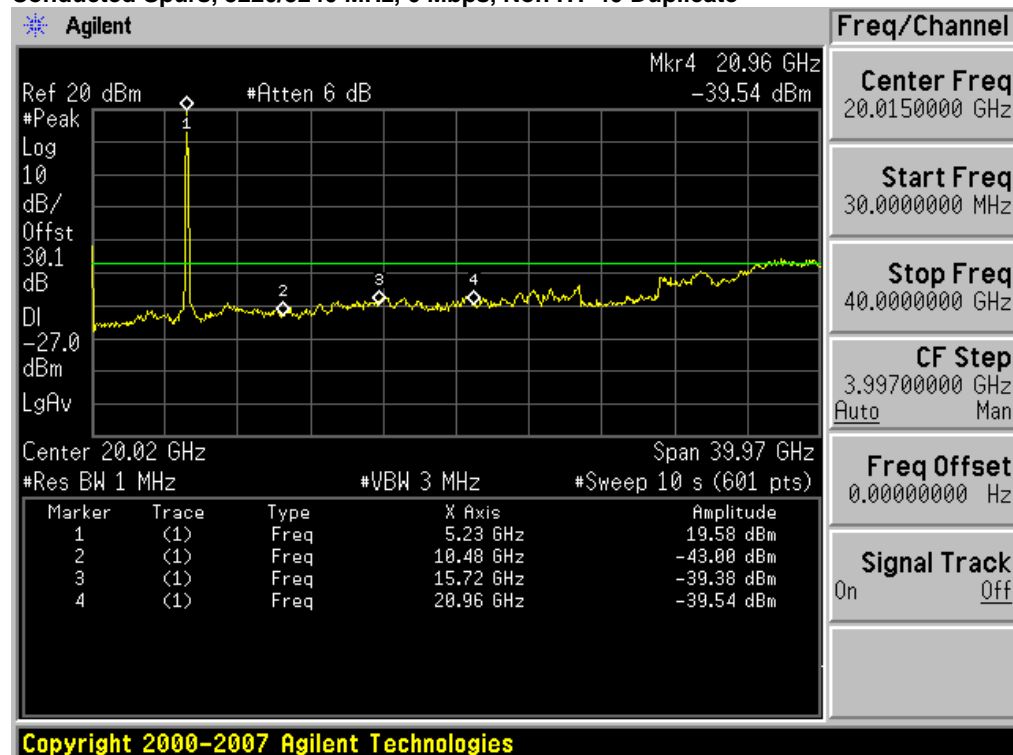


## Conducted Spurs, 5180/5200 MHz, m0, HT-40 (with and without Beam Forming / STBC)

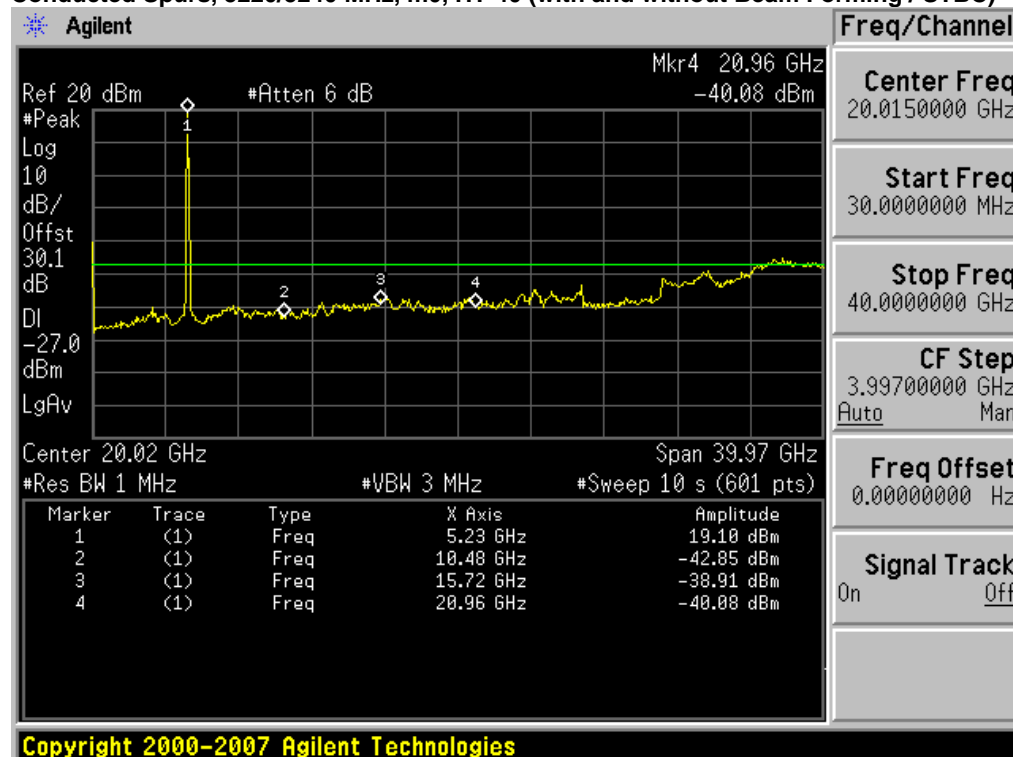


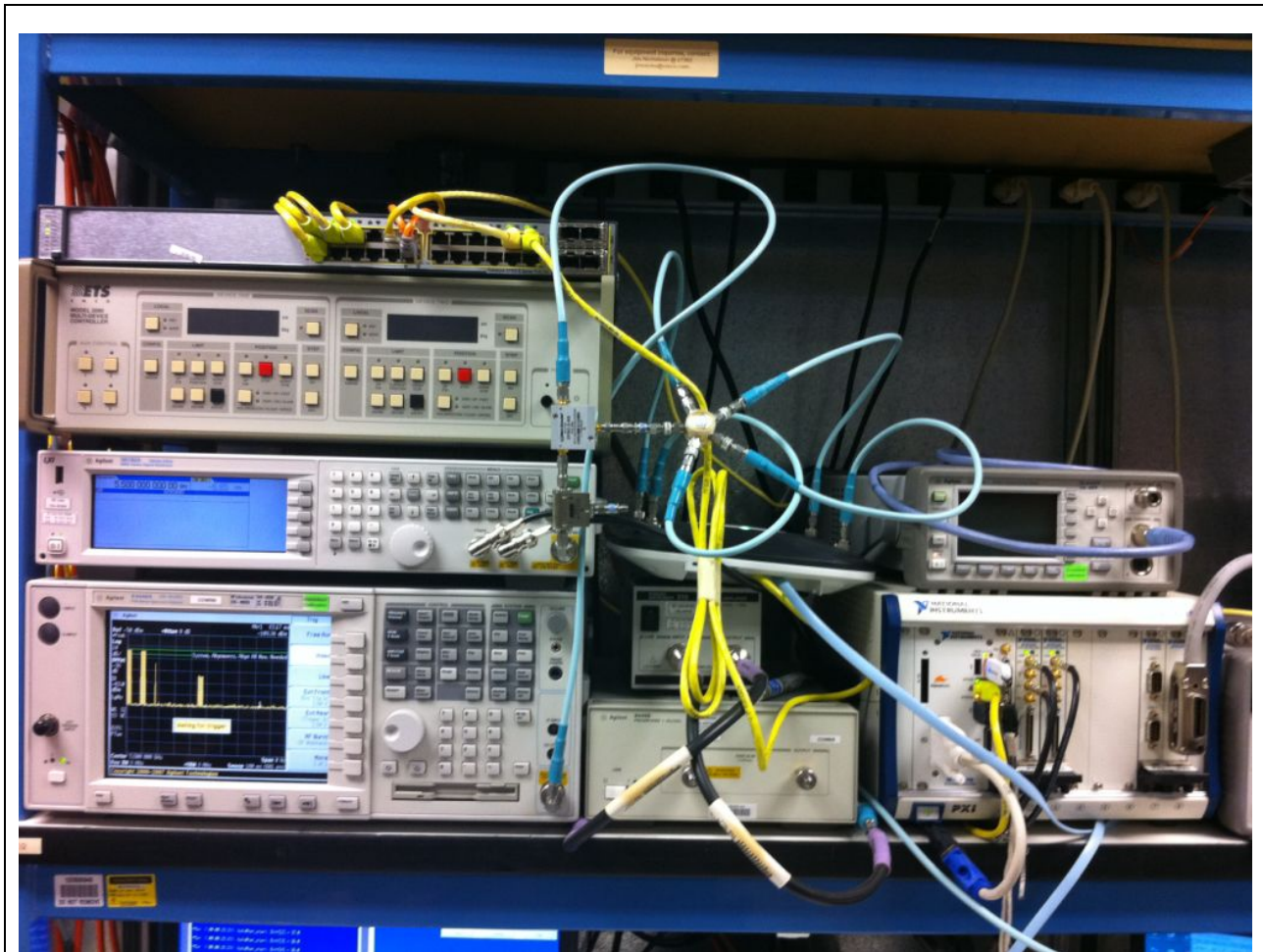


## Conducted Spurs, 5220/5240 MHz, 6 Mbps, Non HT-40 Duplicate



## Conducted Spurs, 5220/5240 MHz, m0, HT-40 (with and without Beam Forming / STBC)





**Title:** Conducted Test Setup



## **Appendix B: Emission Test Results**

**Testing Laboratory:** Cisco Systems, Inc., 170 West Tasman Drive, San Jose, CA 95134, USA

### **Radiated Bandedge**

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Using Vasona, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer). Place the radio in continuous transmit mode.

Reference Level:	110 dBuV
Attenuation:	20 dB
Sweep Time:	Coupled
Resolution Bandwidth:	1MHz
Video Bandwidth:	1 MHz for peak, 10 Hz for average
Detector:	Peak

Maximize Turntable (find worst case table angle), Maximize Antenna (find worst case height)

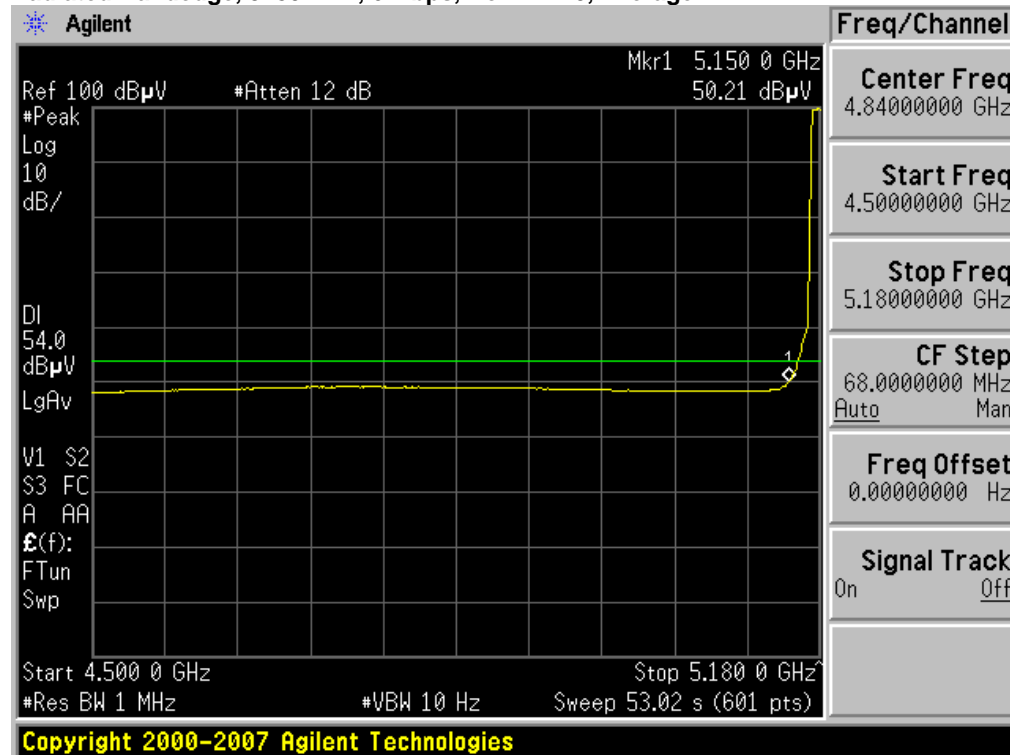
Save 2 plots:     1) Average Plot (Vertical and Horizontal), Limit= 54dBuV @3m  
                  2) Peak plot (Vertical and Horizontal), Limit = 74dBuV @3m

Place a marker at the end of the restricted band closest to the transmit frequency to show compliance.  
Also measure any emissions in the restricted bands.

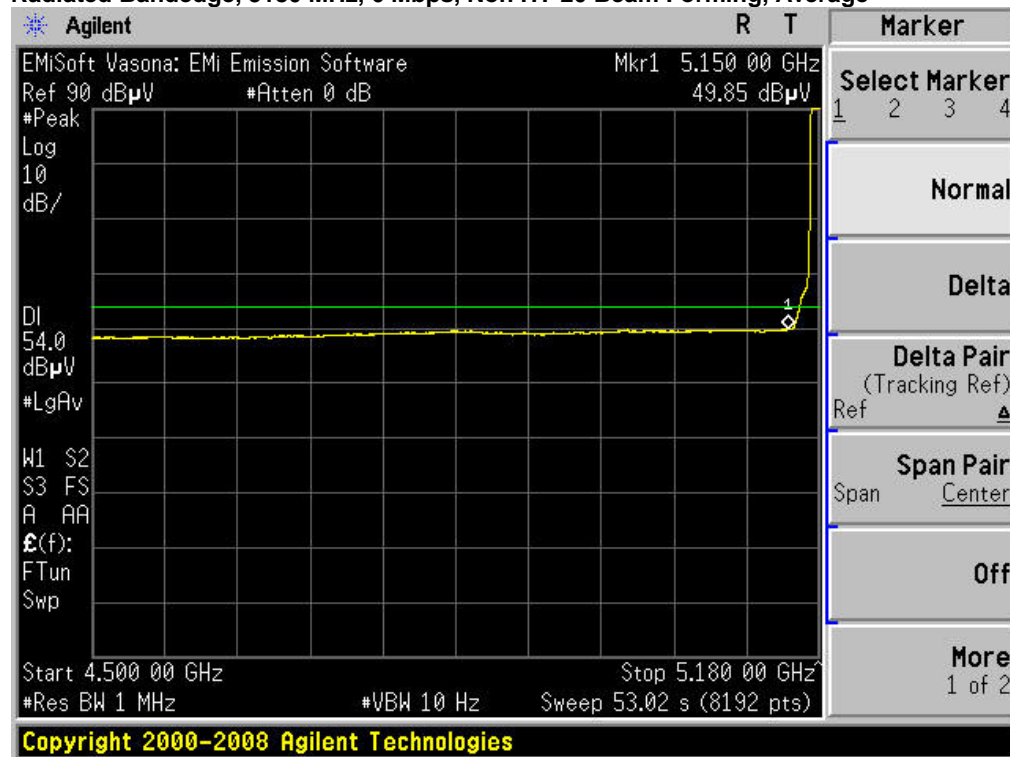
This report represents the worst case data for all supported operating modes and antennas.

Frequency (MHz)	Operating Mode	Tx Paths	Radiated Bandedge Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
5180	Non HT-20, 6 to 54 Mbps	1	<b>50.2</b>	54	3.8
	Non HT-20 Beam Forming, 6 to 54 Mbps	2	<b>49.9</b>	54	4.1
	HT-20, M0 to M7	4	<b>53.8</b>	54	0.2
	HT-20, M8 to M15	2	<b>52.4</b>	54	1.6
	HT-20, M16 to M23	3	<b>50.8</b>	54	3.2
	HT-20 STBC, M0 to M7	2	<b>52.4</b>	54	1.6
	HT-20 Beam Forming, M0 to M7	2	<b>44.1</b>	54	9.9
	HT-20 Beam Forming, M8 to M15	2	<b>42.7</b>	54	11.3
	HT-20 Beam Forming, M16 to M23	3	<b>44.7</b>	54	9.3
5180/5200	Non HT-40 Duplicate, 6-54 Mbps	3	<b>51.1</b>	54	2.9
	HT-40, M0 to M7	3	<b>54.0</b>	54	0.0
	HT-40, M8 to M15	2	<b>52.3</b>	54	1.7
	HT-40, M16 to M23	3	<b>48.8</b>	54	5.2
	HT-40 STBC, M0 to M7	2	<b>47.7</b>	54	6.3
	HT-40 Beam Forming, M0 to M7	2	<b>48.6</b>	54	5.4
	HT-40 Beam Forming, M8 to M15	2	<b>47.8</b>	54	6.2
	HT-40 Beam Forming, M16 to M23	4	<b>50.1</b>	54	3.9

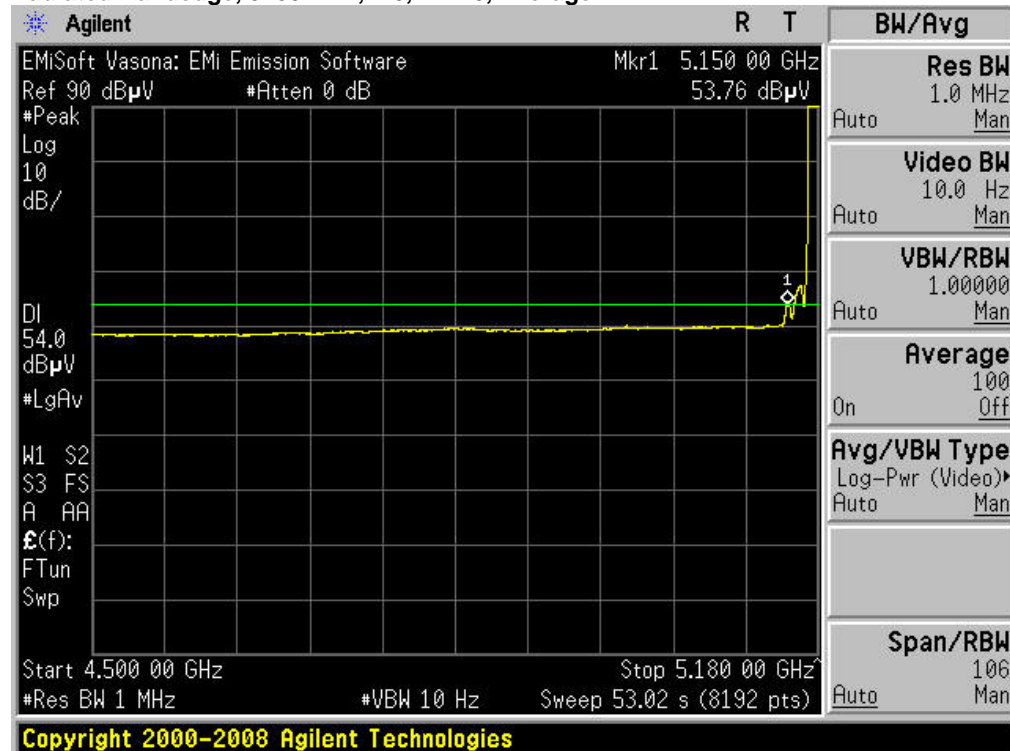
## Radiated Bandedge, 5180 MHz, 6 Mbps, Non HT-20, Average



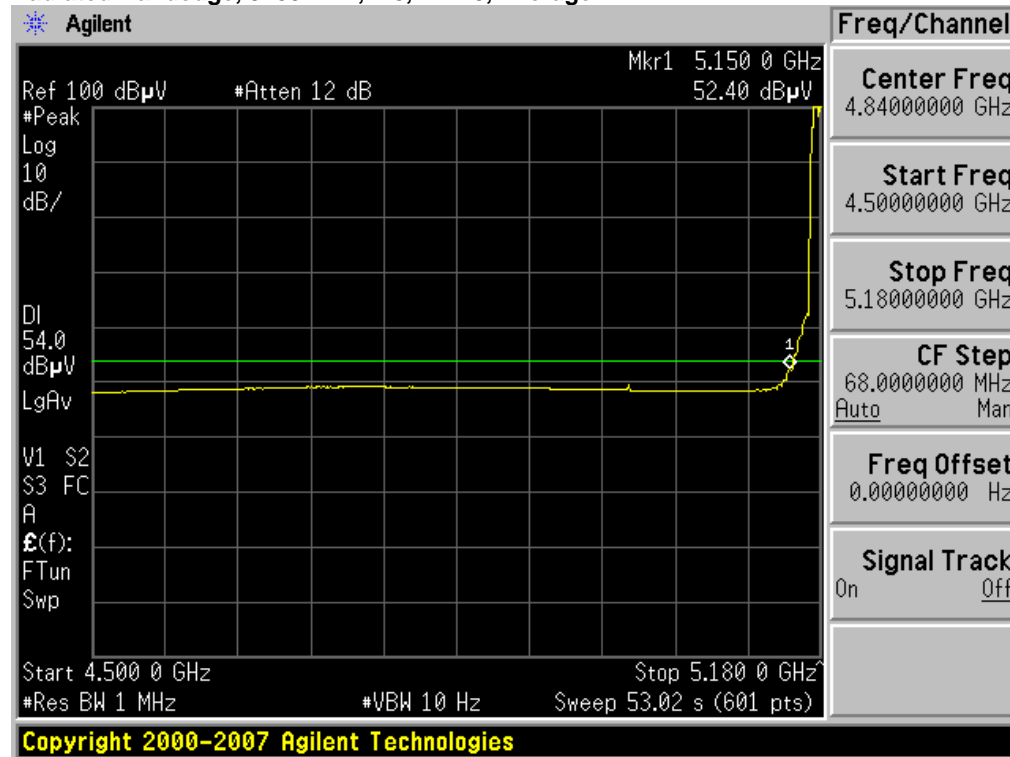
## Radiated Bandedge, 5180 MHz, 6 Mbps, Non HT-20 Beam Forming, Average



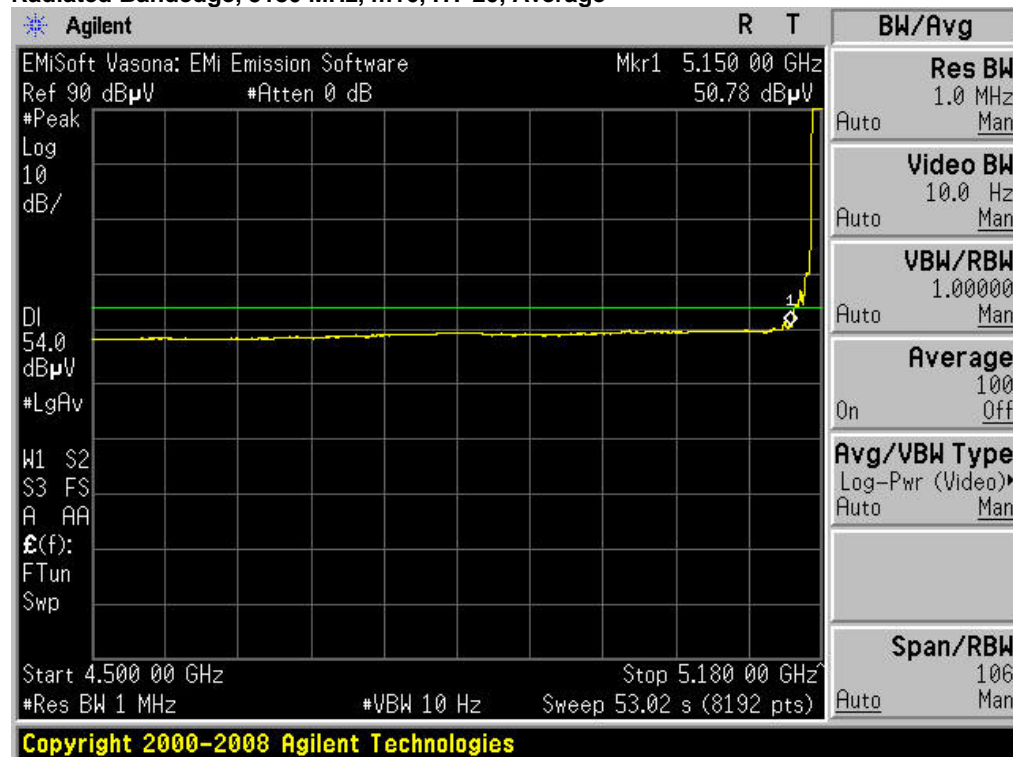
## Radiated Bandedge, 5180 MHz, m0, HT-20, Average



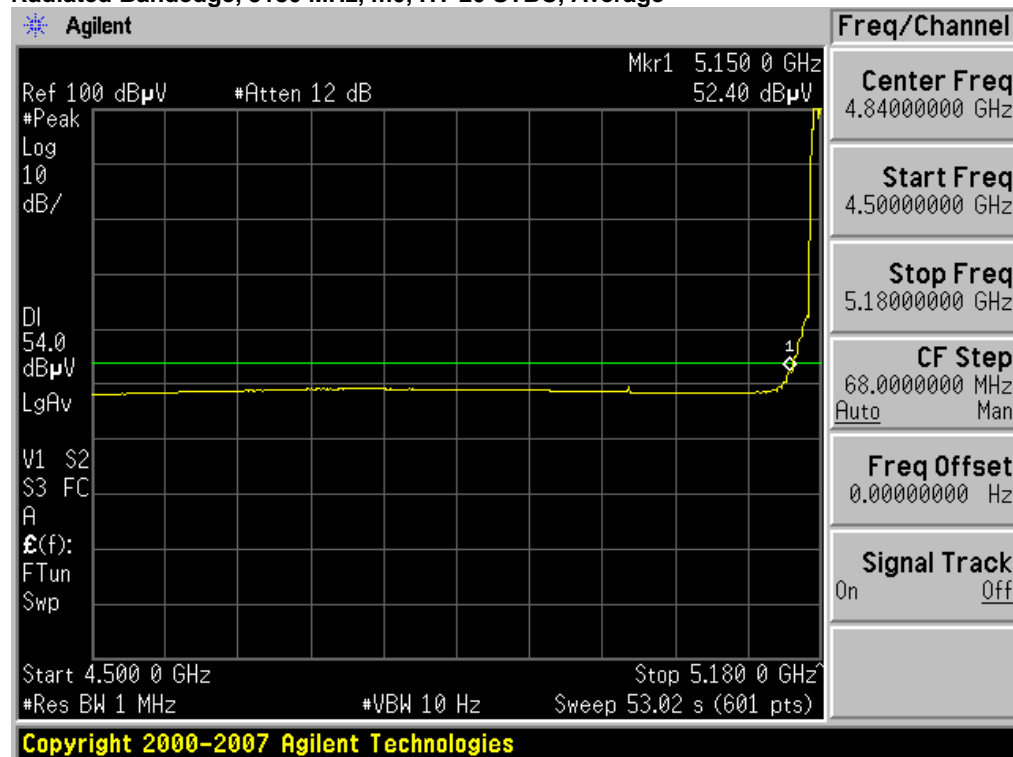
## Radiated Bandedge, 5180 MHz, m8, HT-20, Average



## Radiated Bandedge, 5180 MHz, m16, HT-20, Average

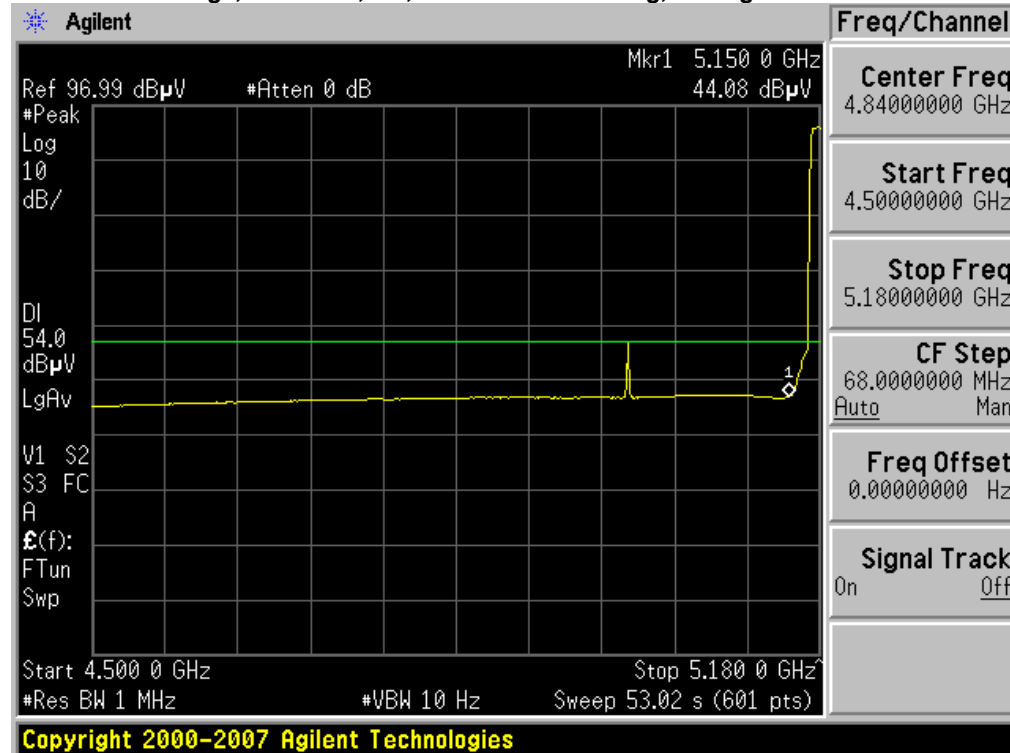


## Radiated Bandedge, 5180 MHz, m0, HT-20 STBC, Average

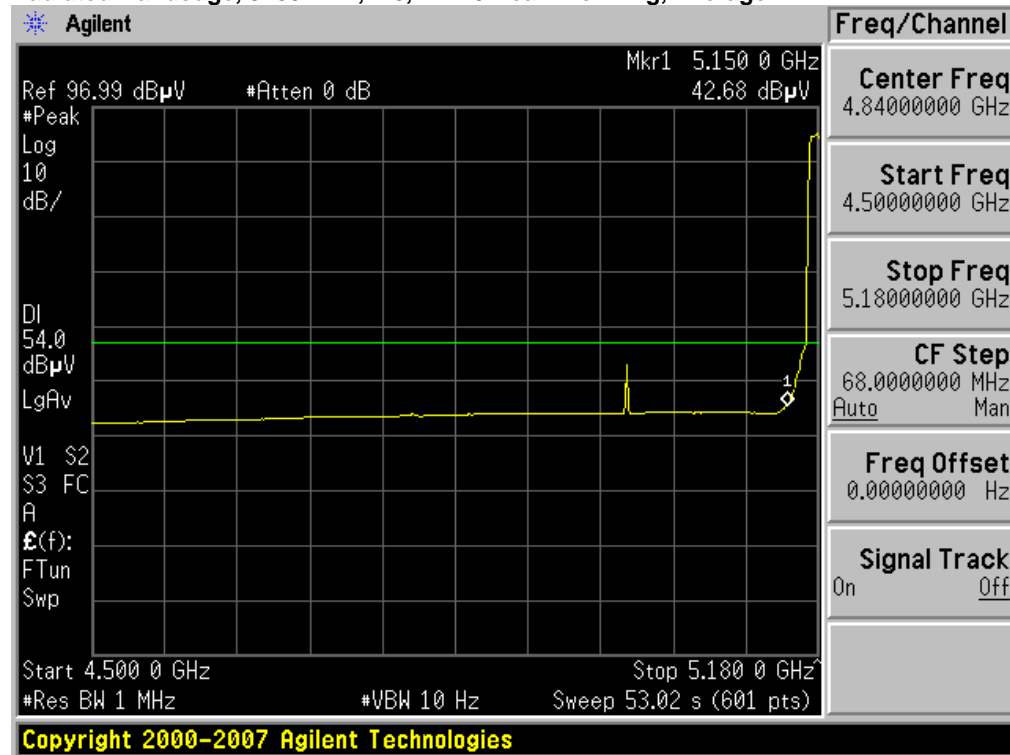




## Radiated Bandedge, 5180 MHz, m0, HT-20 Beam Forming, Average



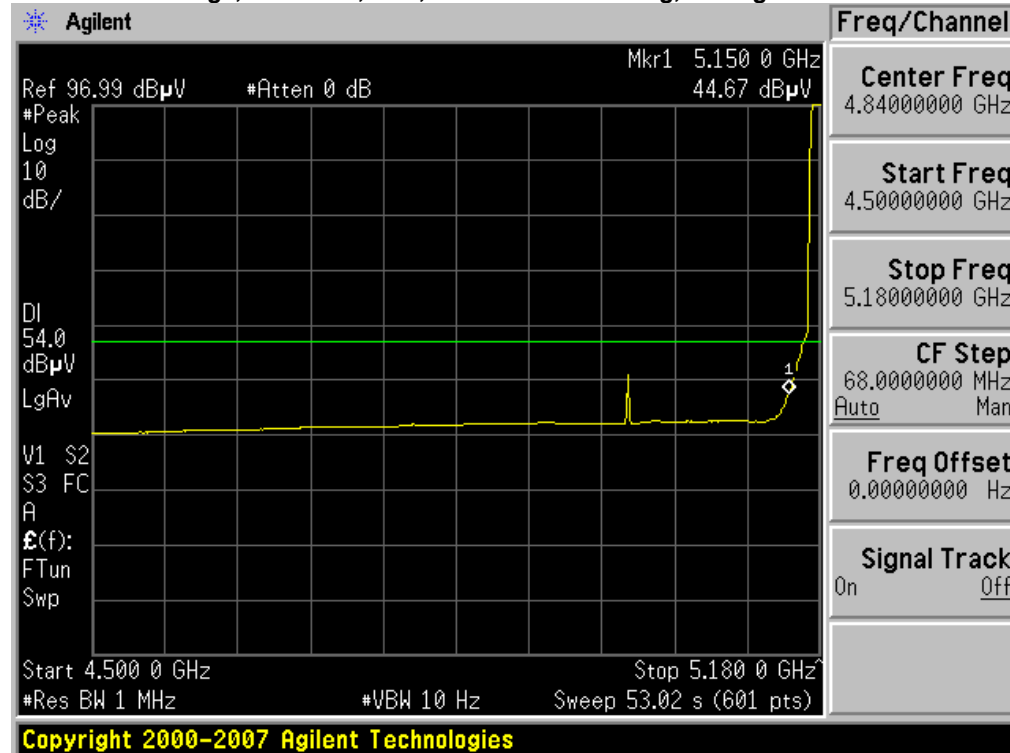
## Radiated Bandedge, 5180 MHz, m8, HT-20 Beam Forming, Average



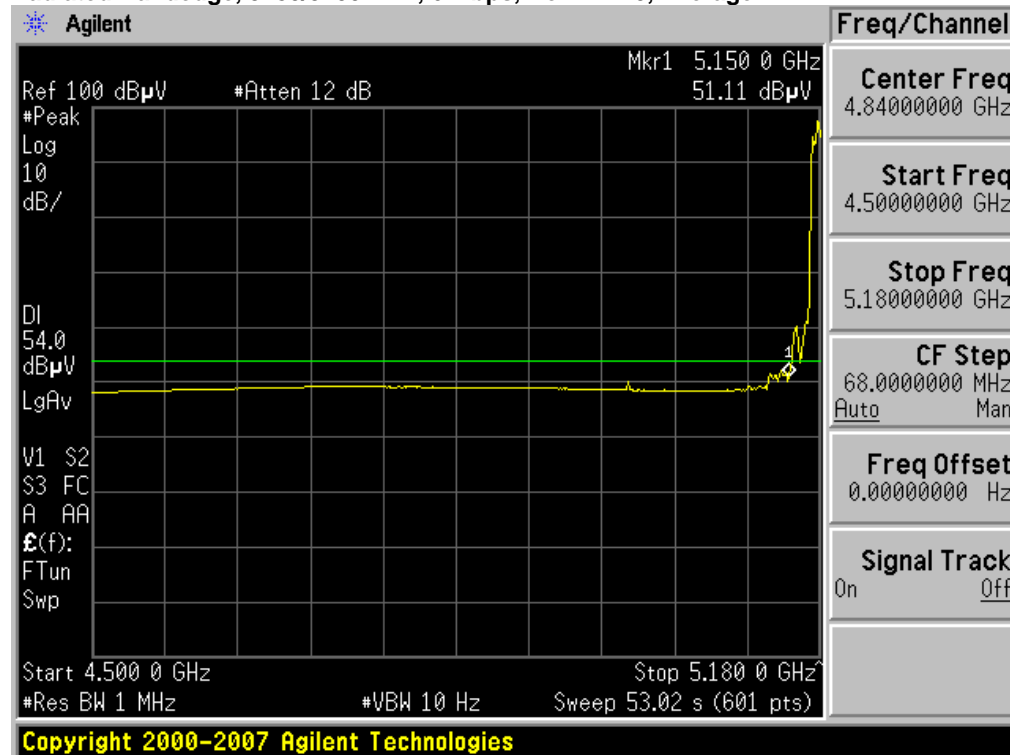




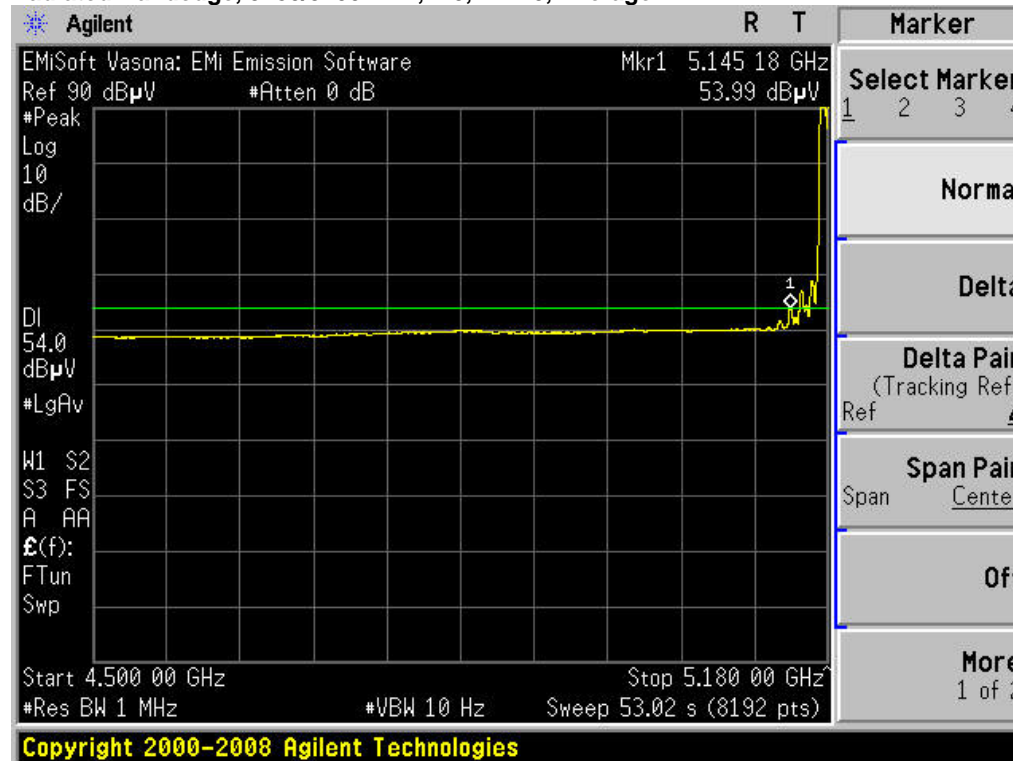
## Radiated Bandedge, 5180 MHz, m16, HT-20 Beam Forming, Average



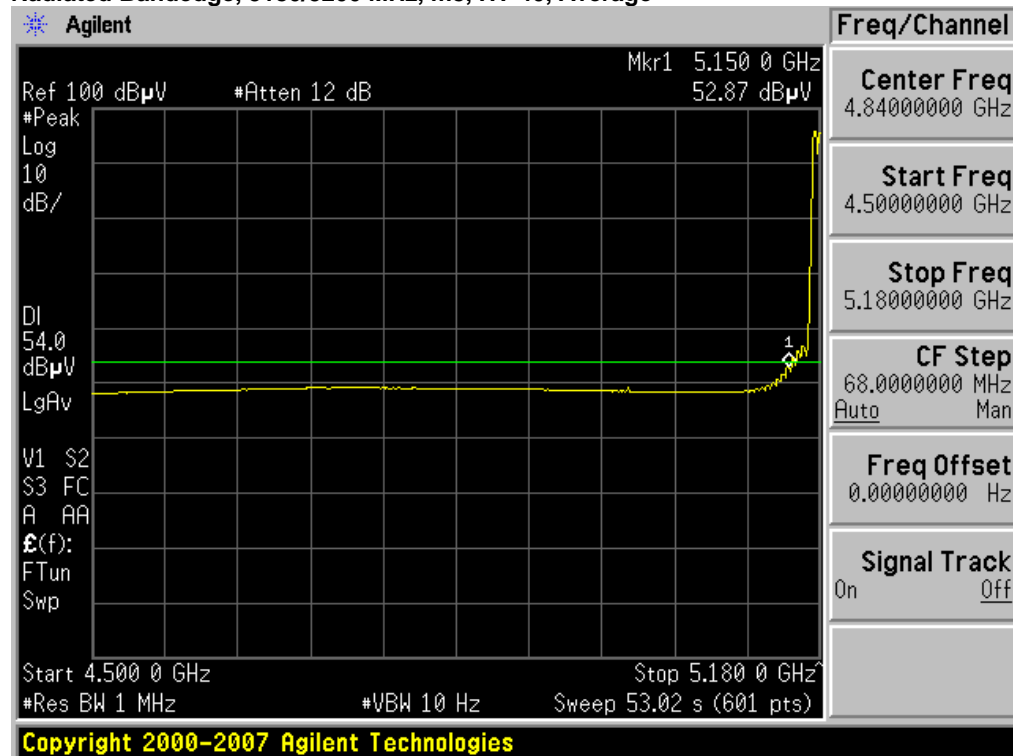
## Radiated Bandedge, 5180/5200 MHz, 6 Mbps, Non HT-40, Average



## Radiated Bandedge, 5180/5200 MHz, m0, HT-40, Average



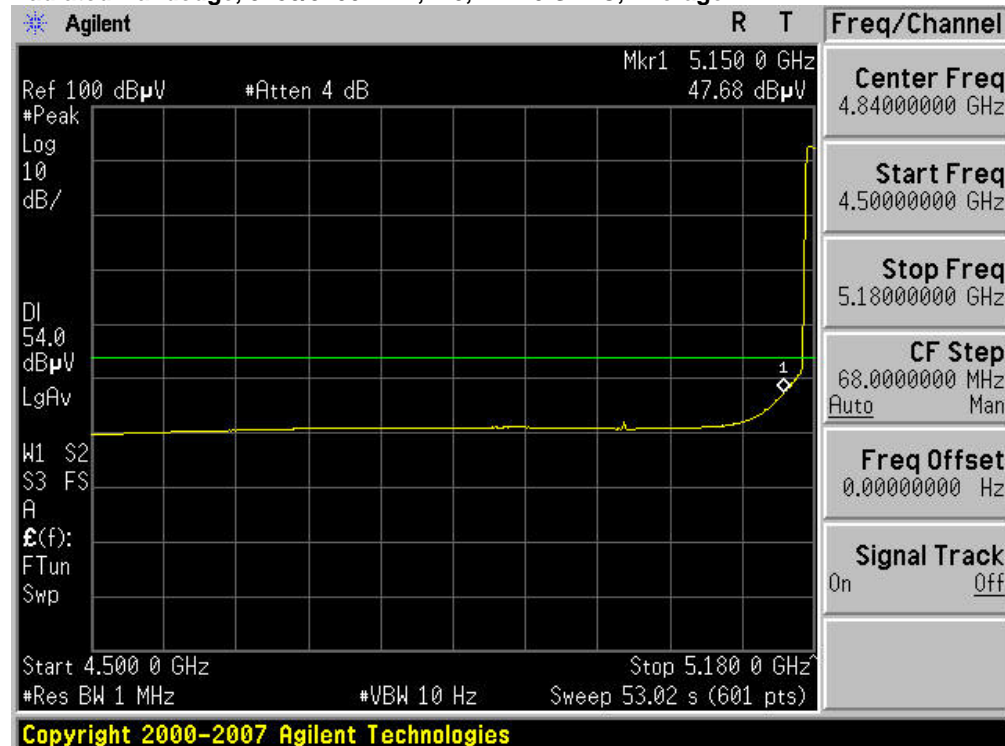
## Radiated Bandedge, 5180/5200 MHz, m8, HT-40, Average



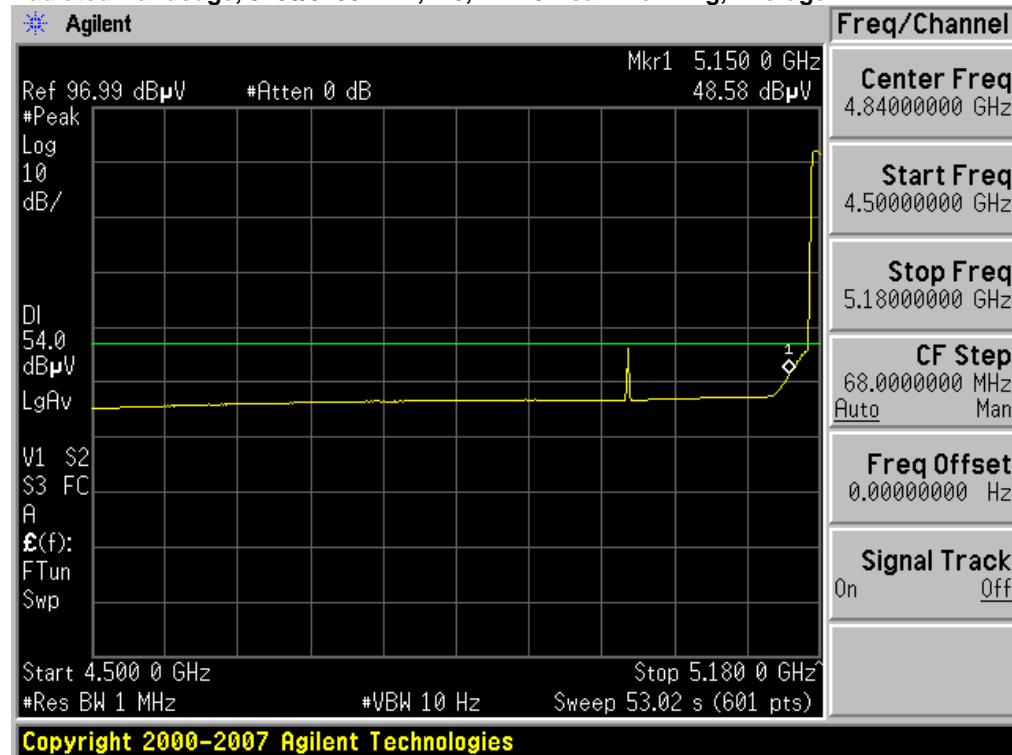
## Radiated Bandedge, 5180/5200 MHz, m16, HT-40, Average



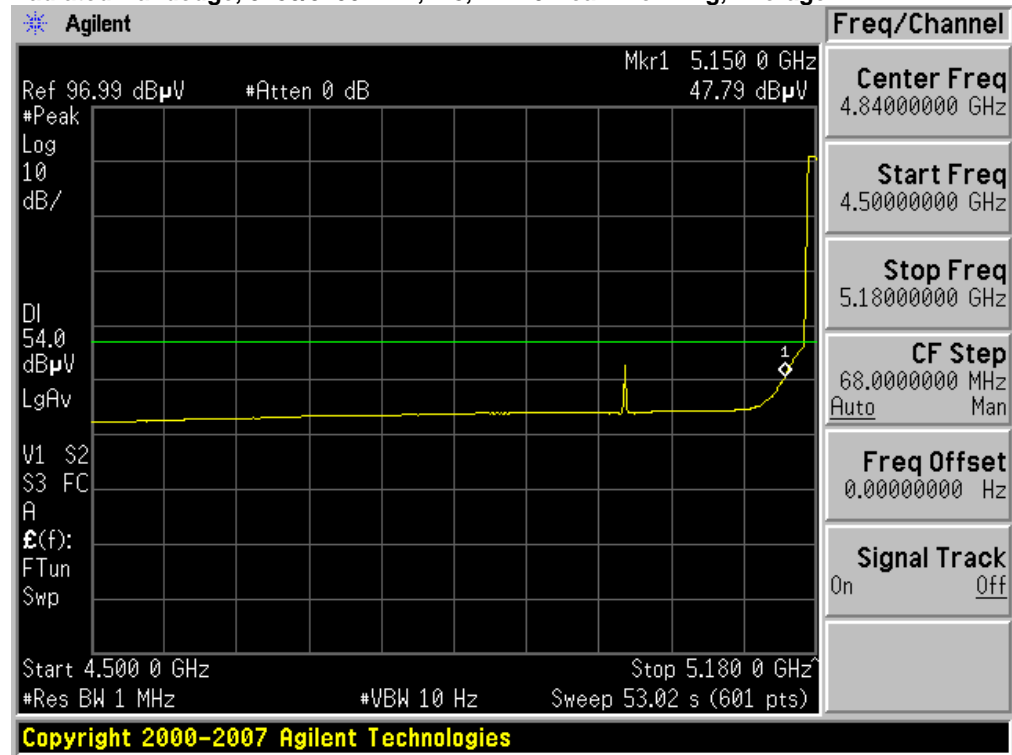
## Radiated Bandedge, 5180/5200 MHz, m0, HT-40 STBC, Average



## Radiated Bandedge, 5180/5200 MHz, m0, HT-40 Beam Forming, Average

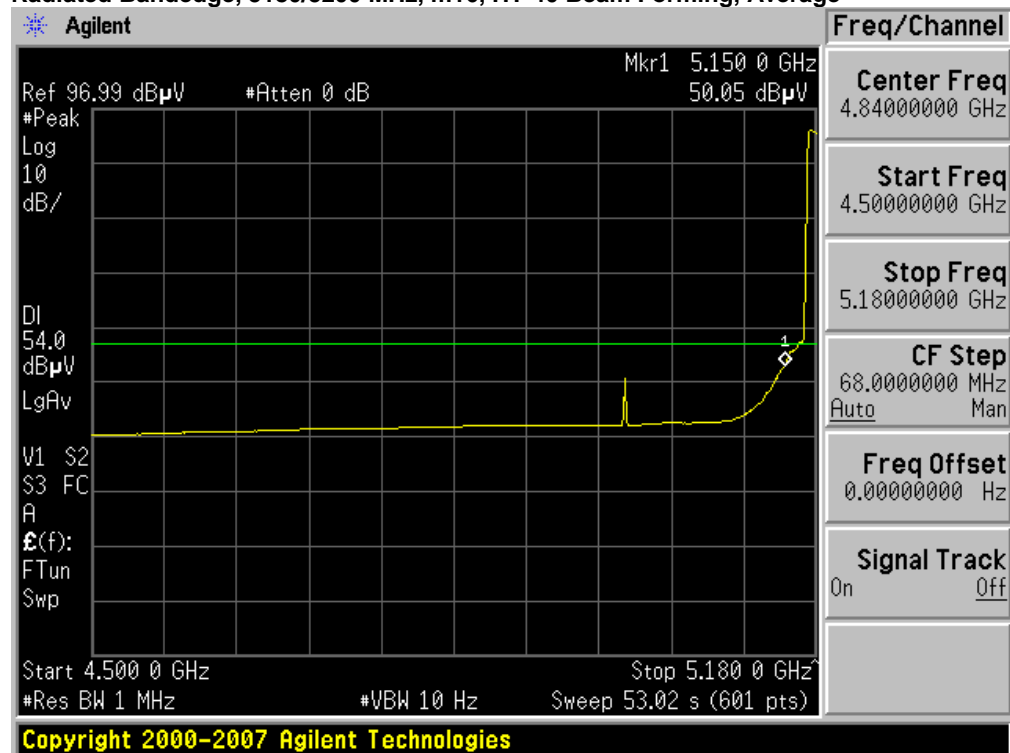


## Radiated Bandedge, 5180/5200 MHz, m8, HT-40 Beam Forming, Average

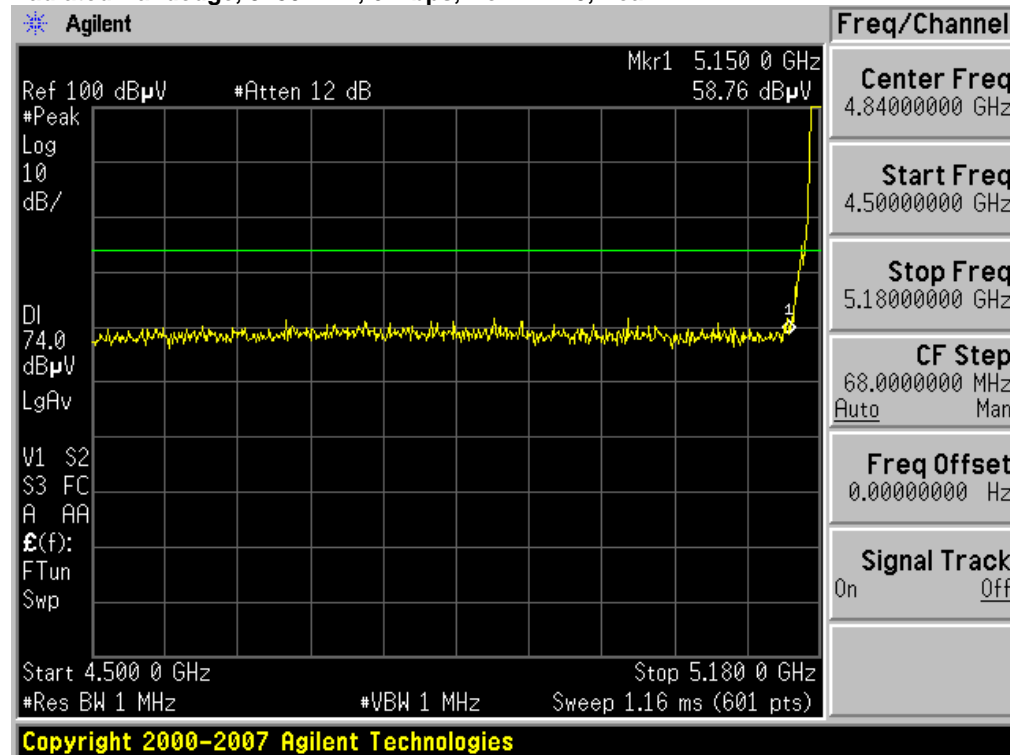




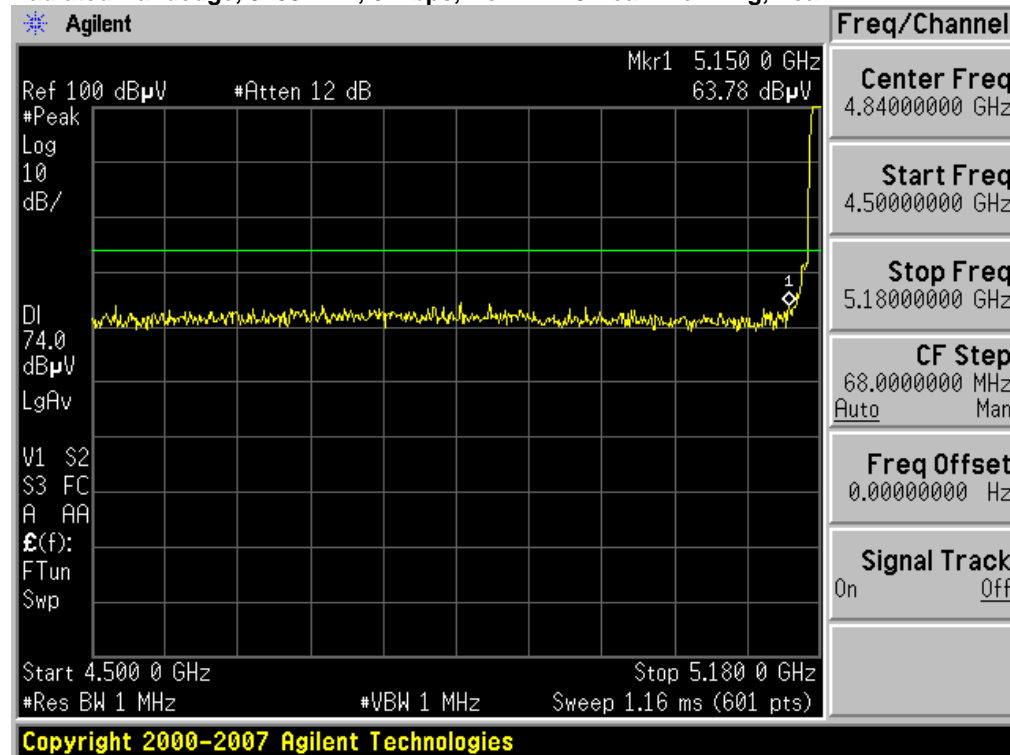
## Radiated Bandedge, 5180/5200 MHz, m16, HT-40 Beam Forming, Average



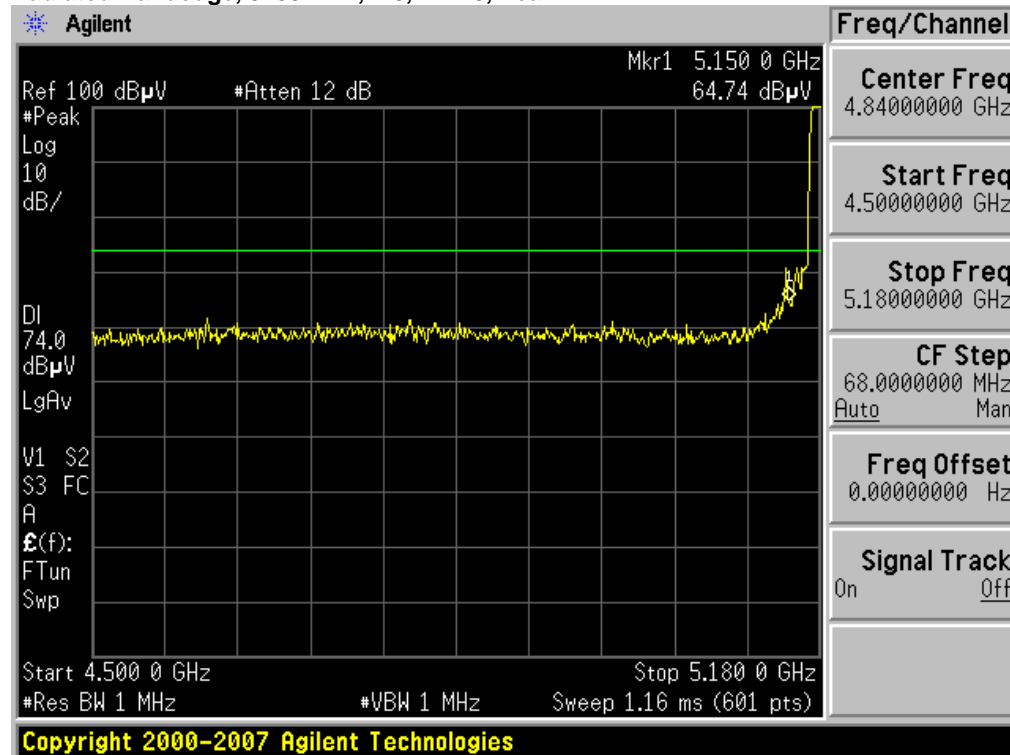
## Radiated Bandedge, 5180 MHz, 6 Mbps, Non HT-20, Peak



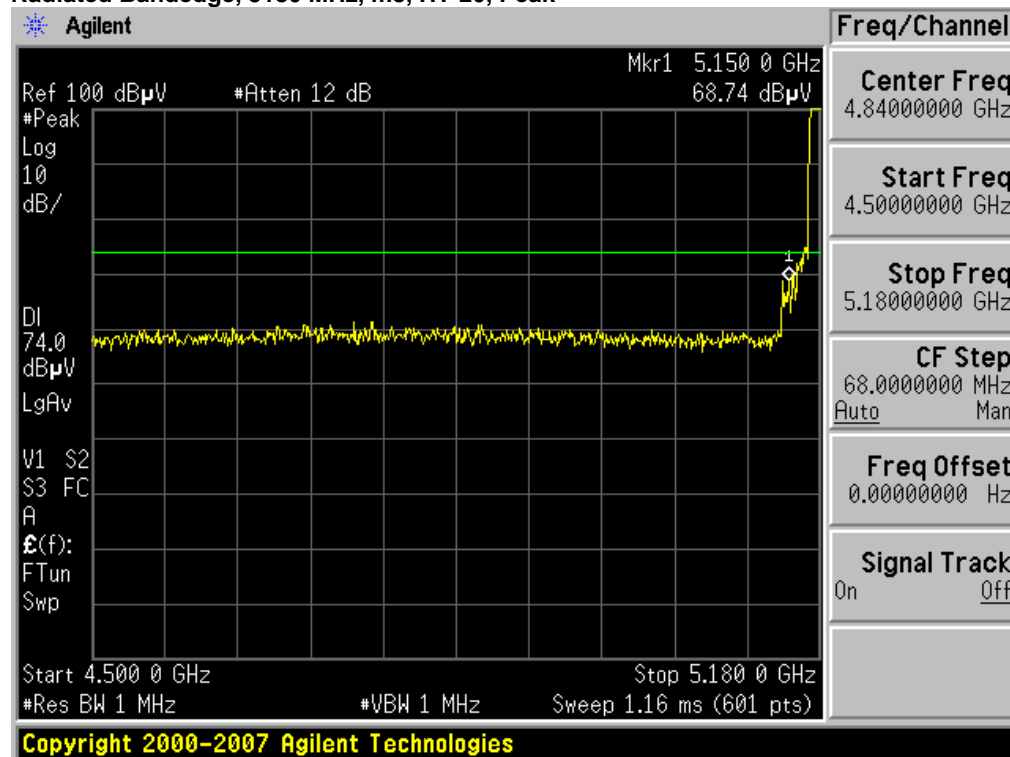
## Radiated Bandedge, 5180 MHz, 6 Mbps, Non HT-20 Beam Forming, Peak



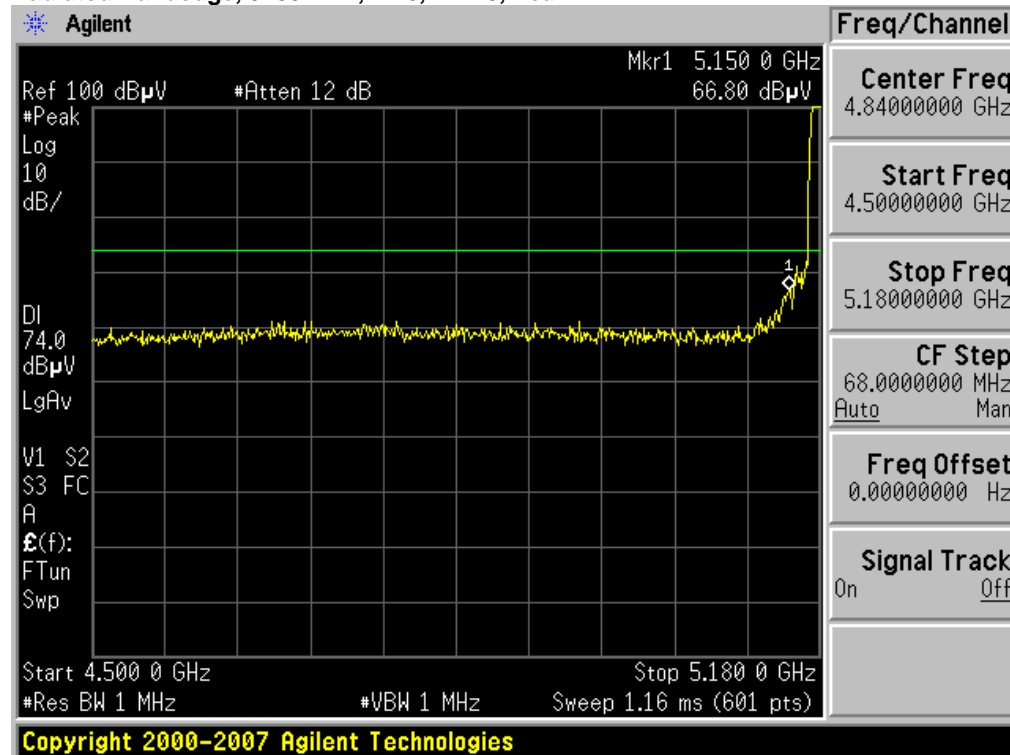
## Radiated Bandedge, 5180 MHz, m0, HT-20, Peak



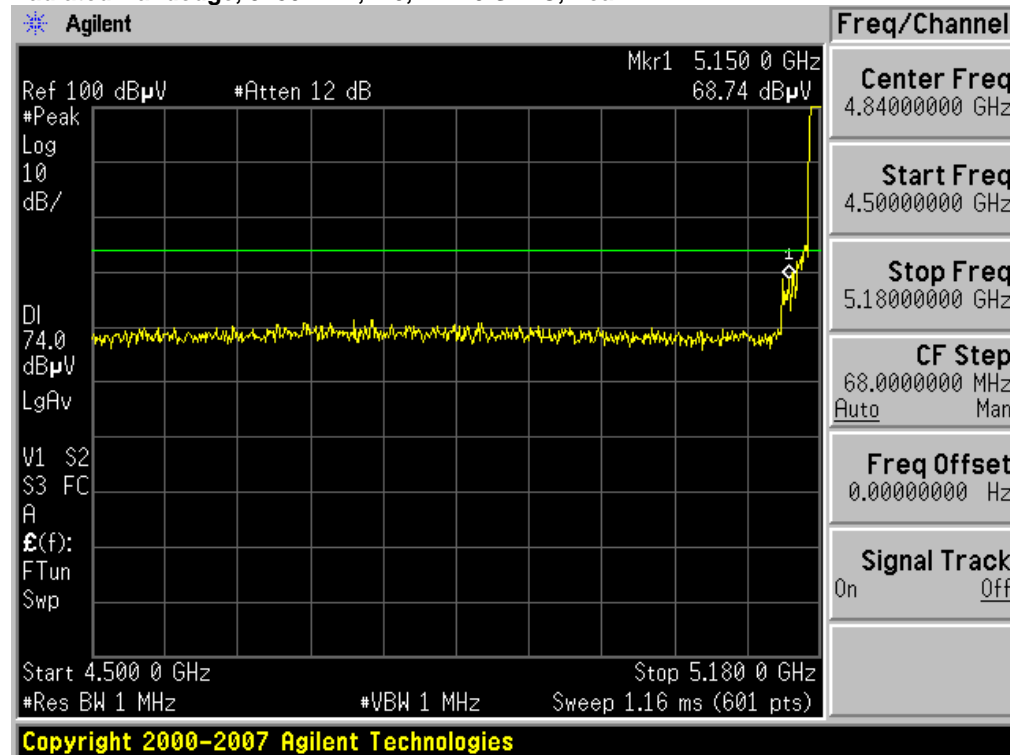
## Radiated Bandedge, 5180 MHz, m8, HT-20, Peak



## Radiated Bandedge, 5180 MHz, m16, HT-20, Peak



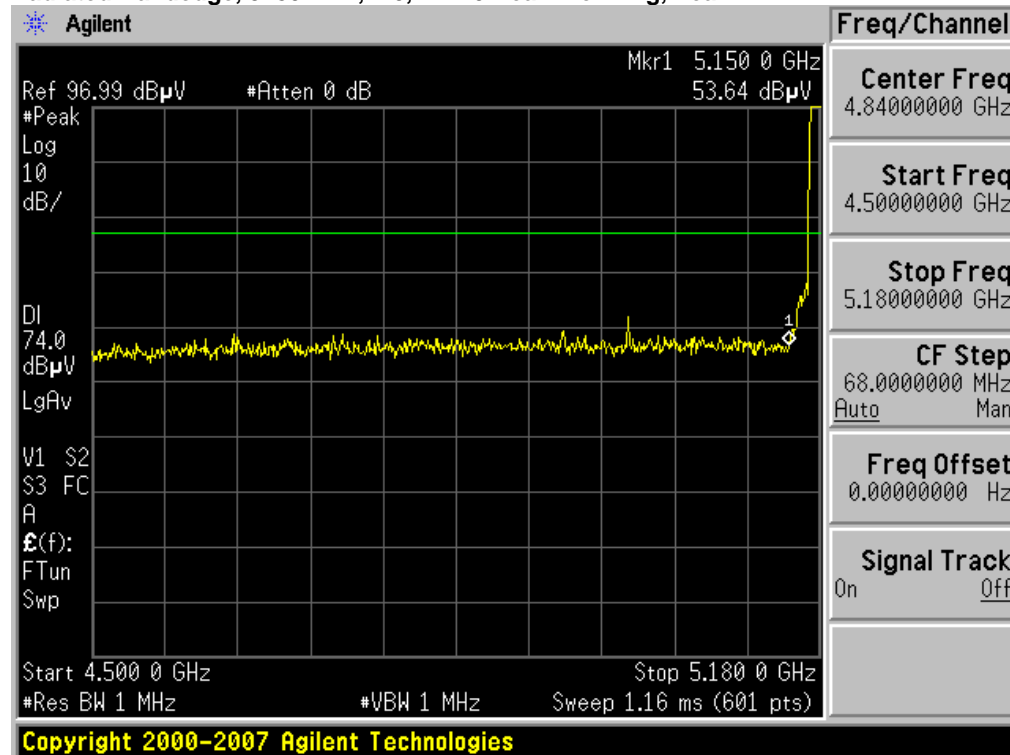
## Radiated Bandedge, 5180 MHz, m0, HT-20 STBC, Peak



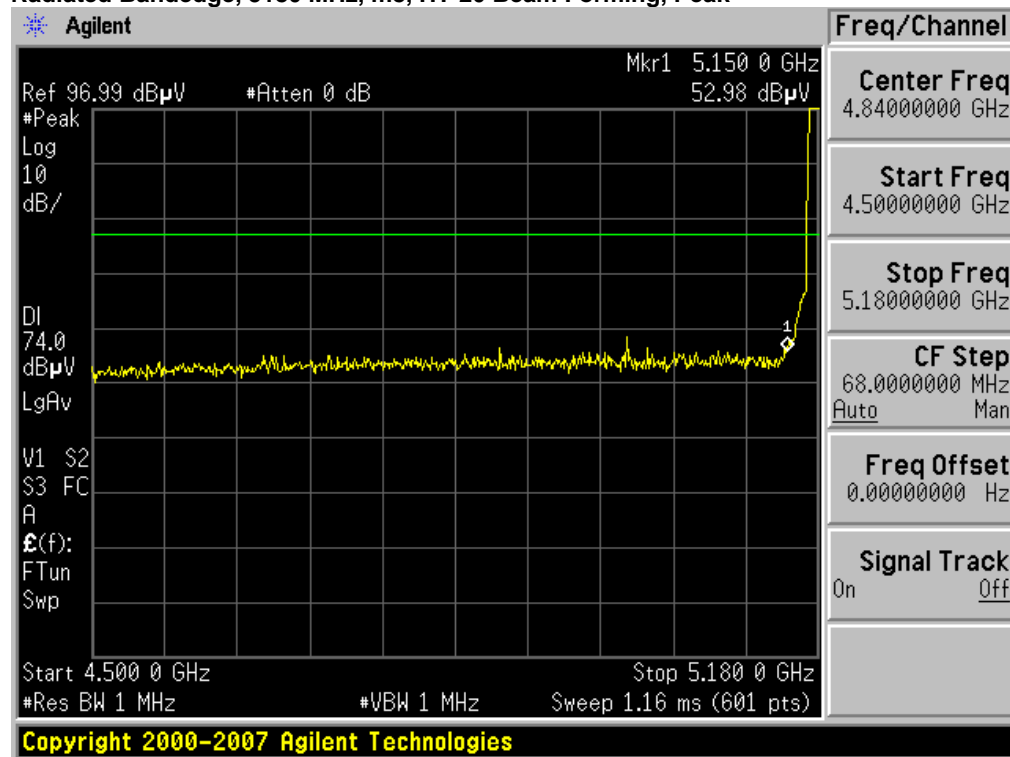




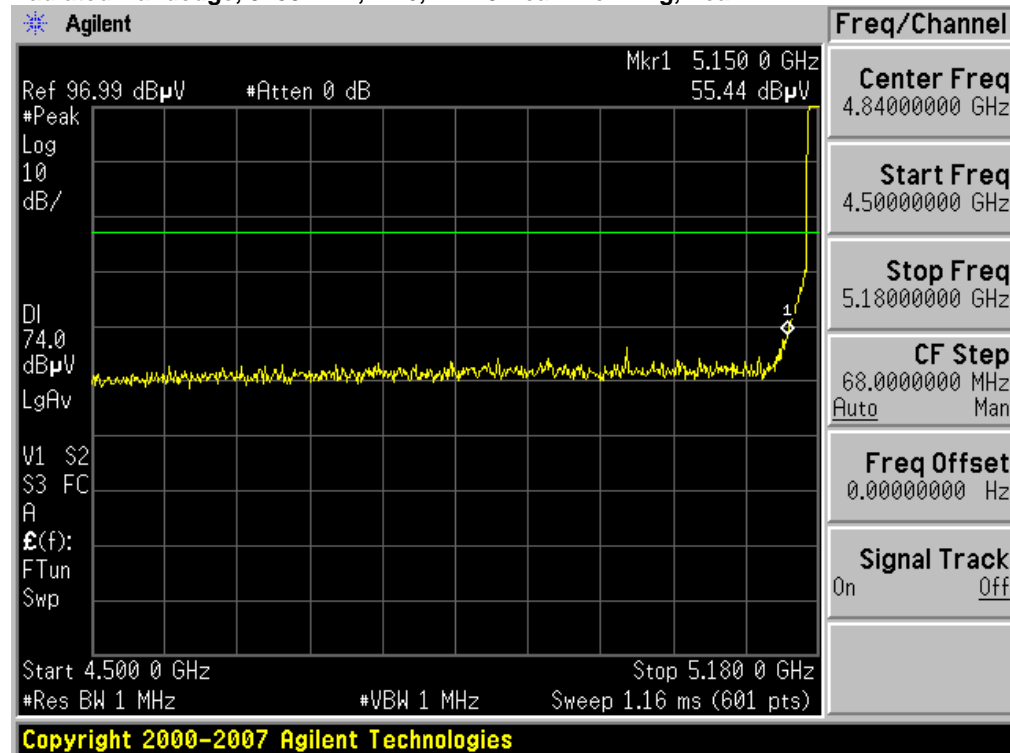
## Radiated Bandedge, 5180 MHz, m0, HT-20 Beam Forming, Peak



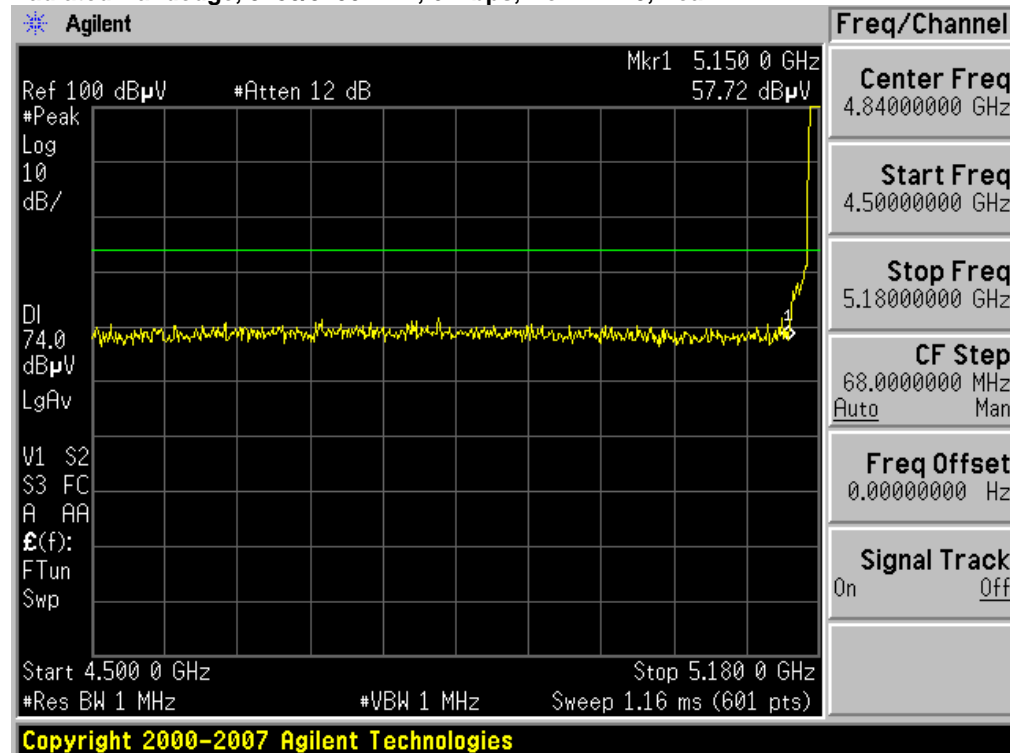
## Radiated Bandedge, 5180 MHz, m8, HT-20 Beam Forming, Peak



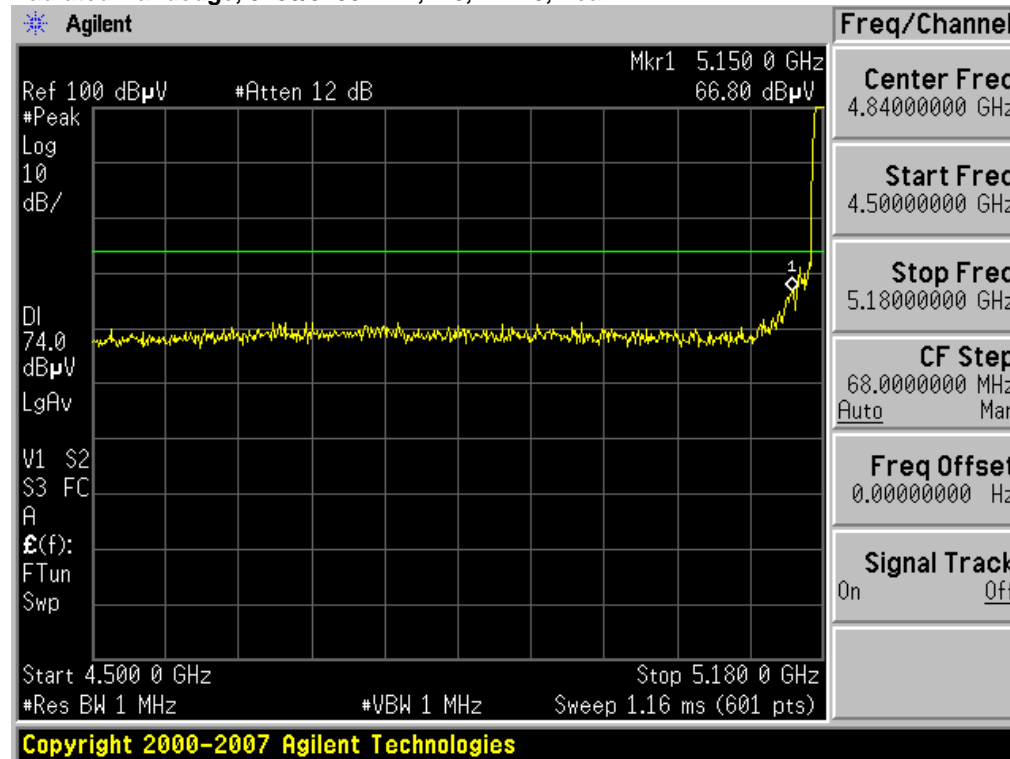
## Radiated Bandedge, 5180 MHz, m16, HT-20 Beam Forming, Peak



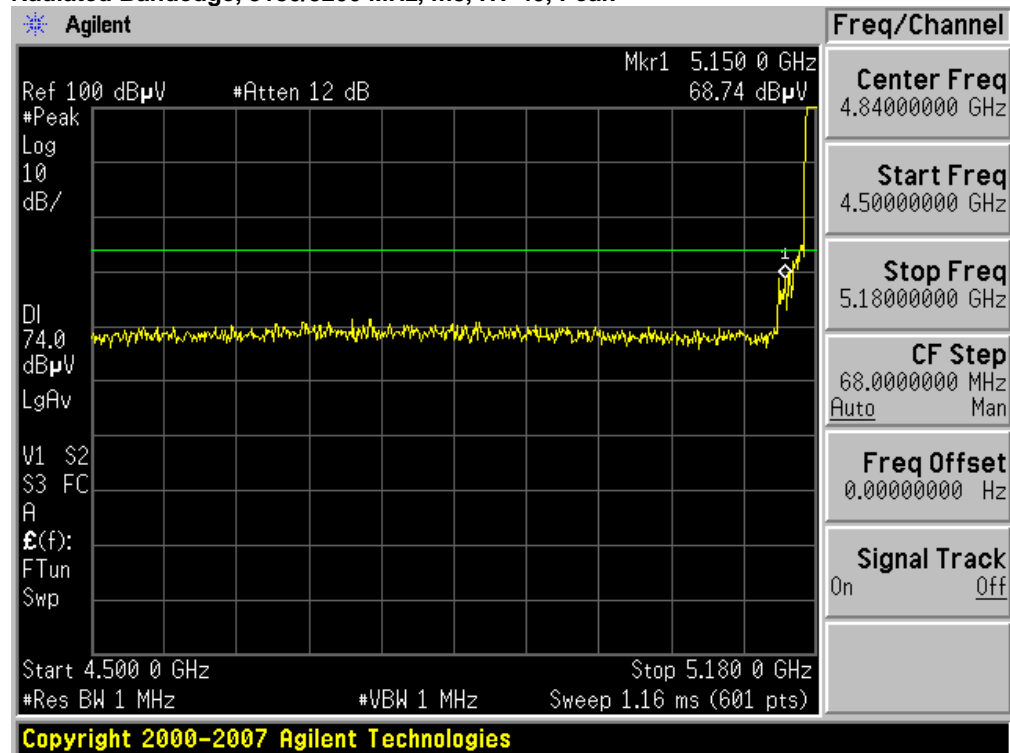
## Radiated Bandedge, 5180/5200 MHz, 6 Mbps, Non HT-40, Peak



## Radiated Bandedge, 5180/5200 MHz, m0, HT-40, Peak

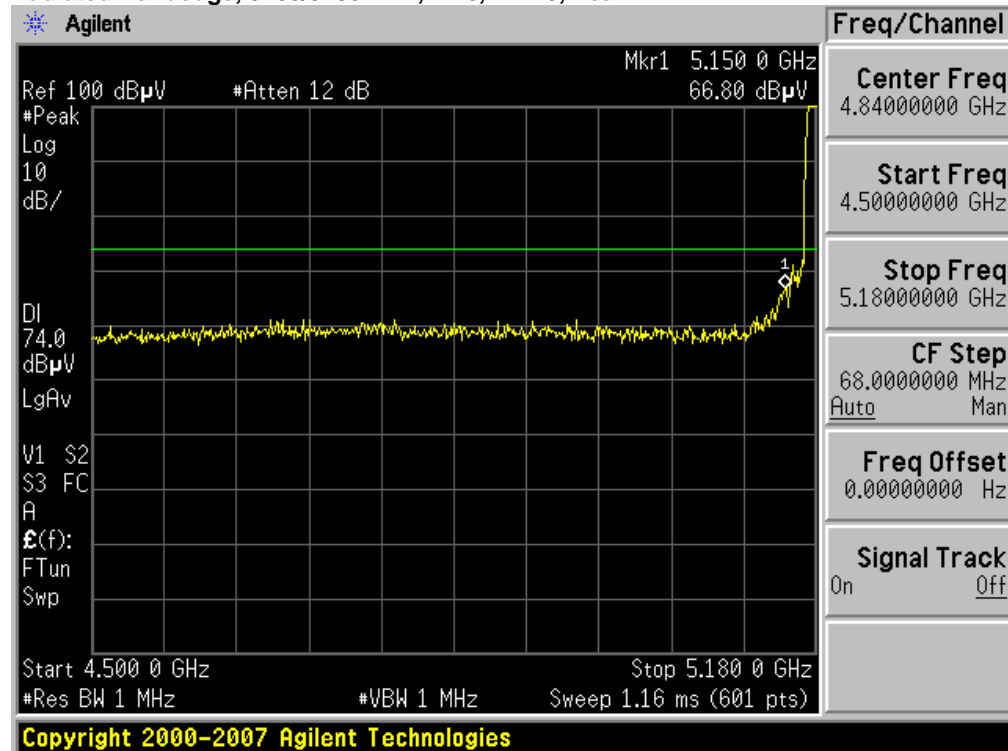


## Radiated Bandedge, 5180/5200 MHz, m8, HT-40, Peak

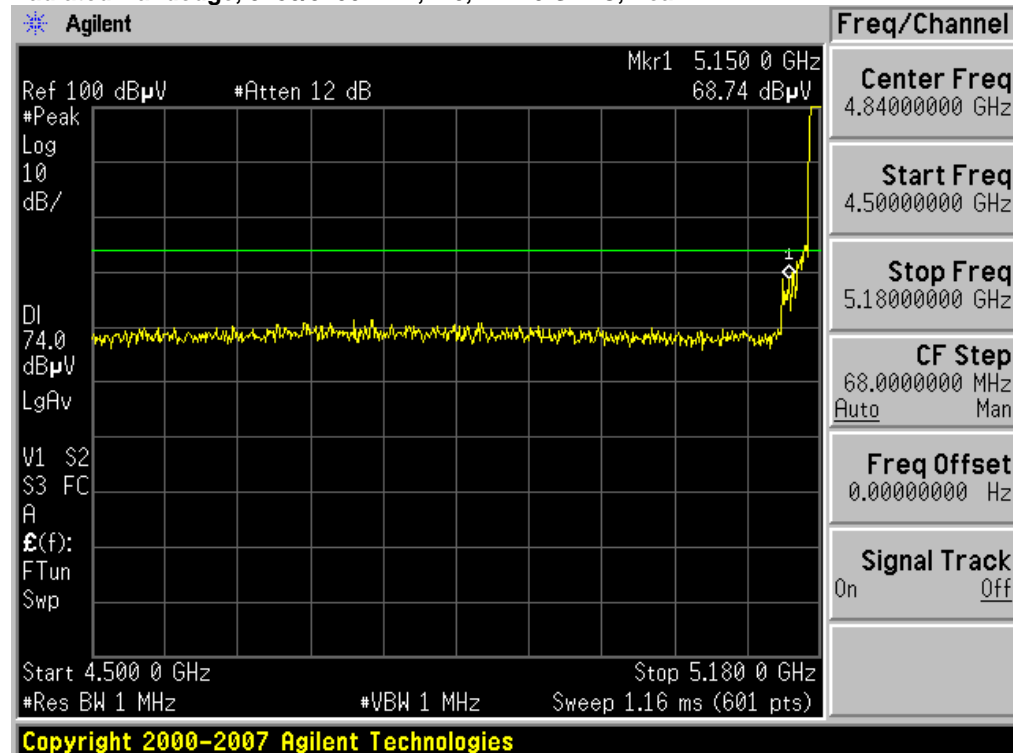




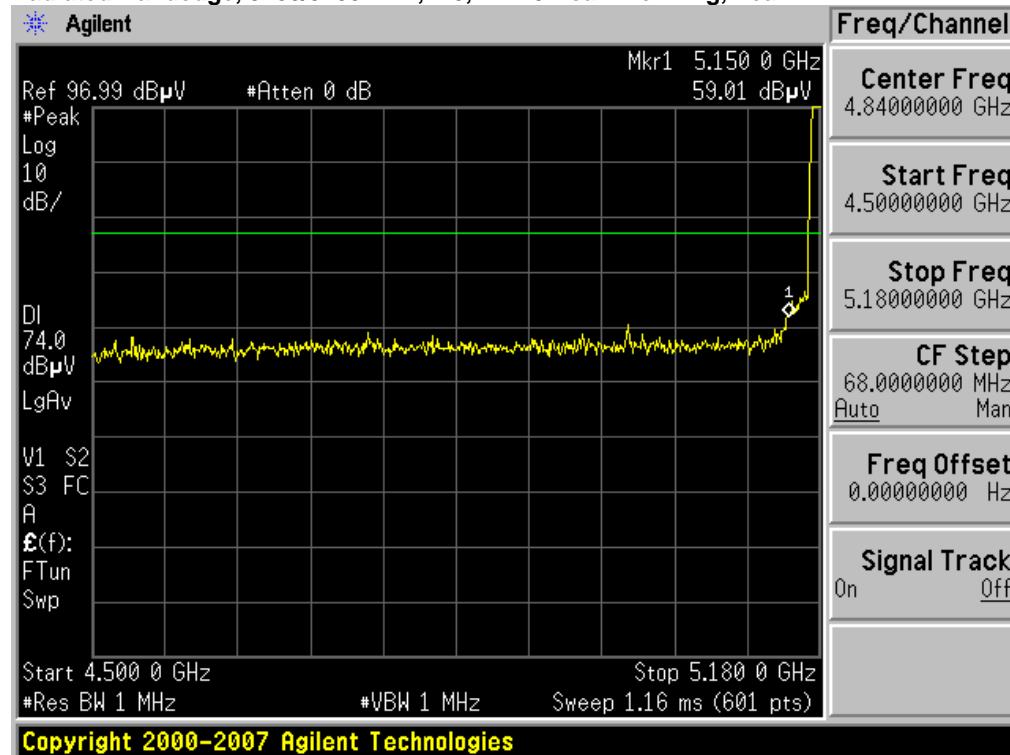
## Radiated Bandedge, 5180/5200 MHz, m16, HT-40, Peak



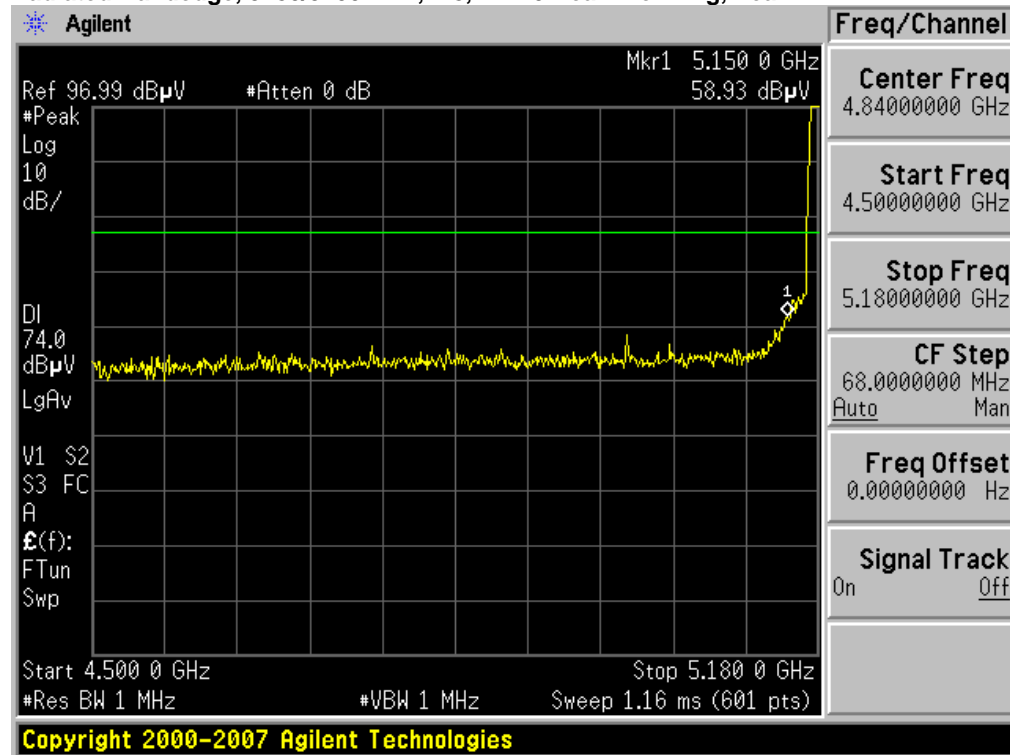
## Radiated Bandedge, 5180/5200 MHz, m0, HT-40 STBC, Peak



## Radiated Bandedge, 5180/5200 MHz, m0, HT-40 Beam Forming, Peak

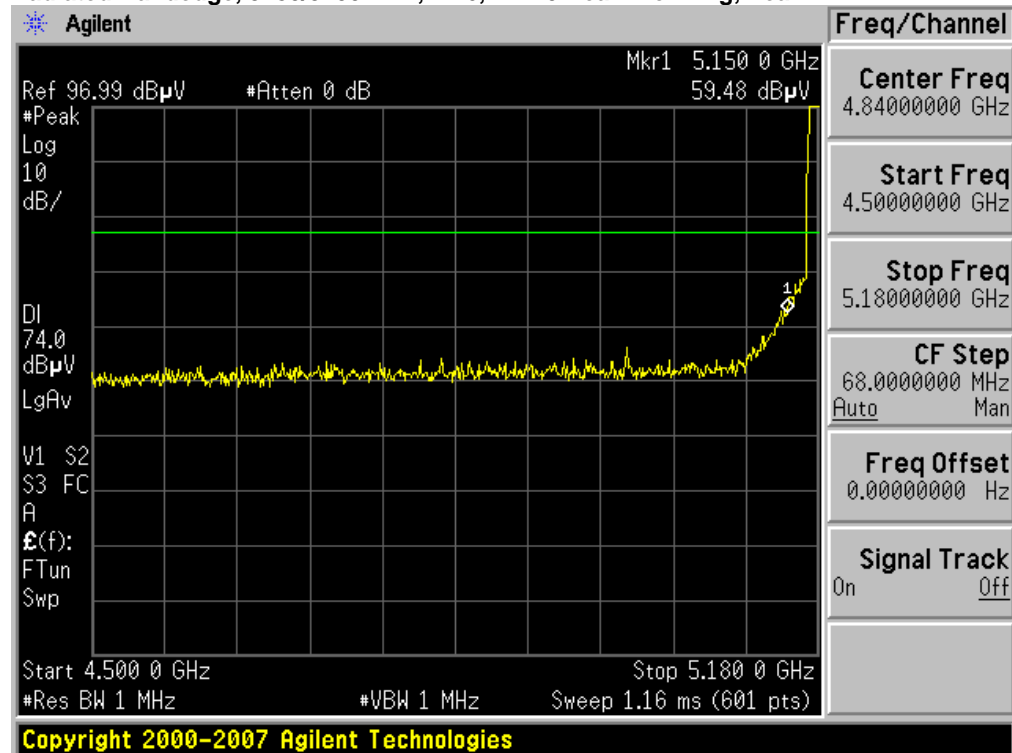


## Radiated Bandedge, 5180/5200 MHz, m8, HT-40 Beam Forming, Peak





## Radiated Bandedge, 5180/5200 MHz, m16, HT-40 Beam Forming, Peak





## **Radiated Spurious Emissions**

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Using Vasona, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer). Place the radio in continuous transmit mode.

Span:	1GHz – 18 GHz
Reference Level:	80 dBuV
Attenuation:	10 dB
Sweep Time:	Coupled
Resolution Bandwidth:	1MHz
Video Bandwidth:	1 MHz for peak, 10 Hz for average
Detector:	Peak

Maximize Turntable (find worst case table angle), Maximize Antenna (find worst case height)

Save 2 plots:     1) Average Plot (Vertical and Horizontal), Limit= 54dBuV @3m  
                      2) Peak plot (Vertical and Horizontal), Limit = 74dBuV @3m

Place a marker at the end of the restricted band closest to the transmit frequency to show compliance.  
Also measure any emissions in the restricted bands.

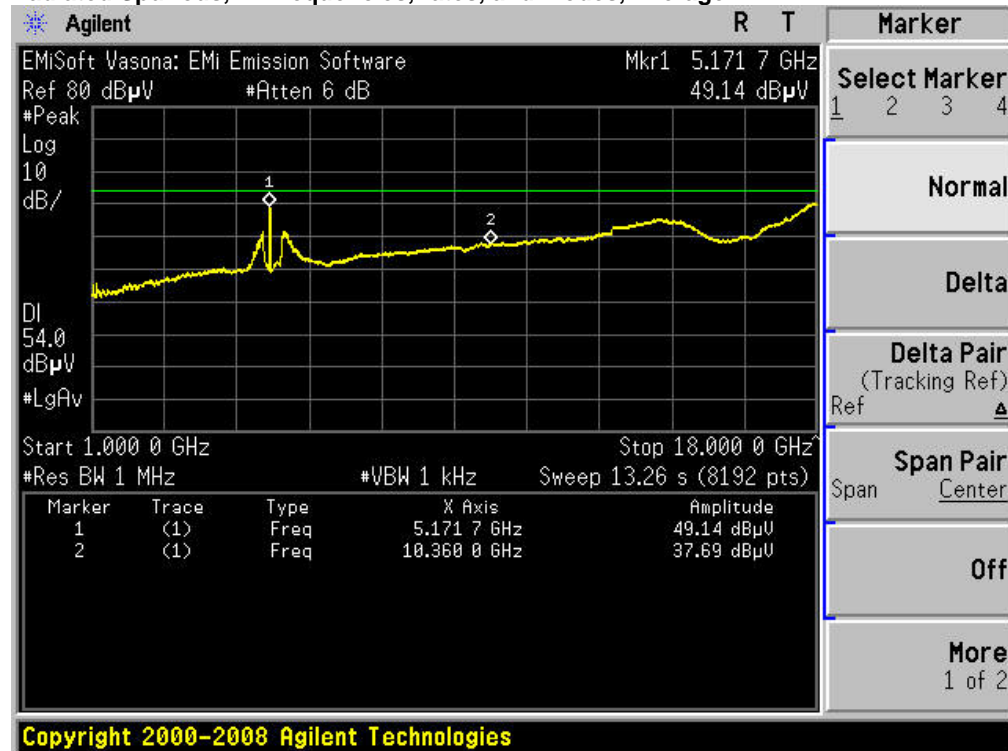
This report represents the worst case data for all supported operating modes and antennas. There are no measurable emissions above 18 GHz.



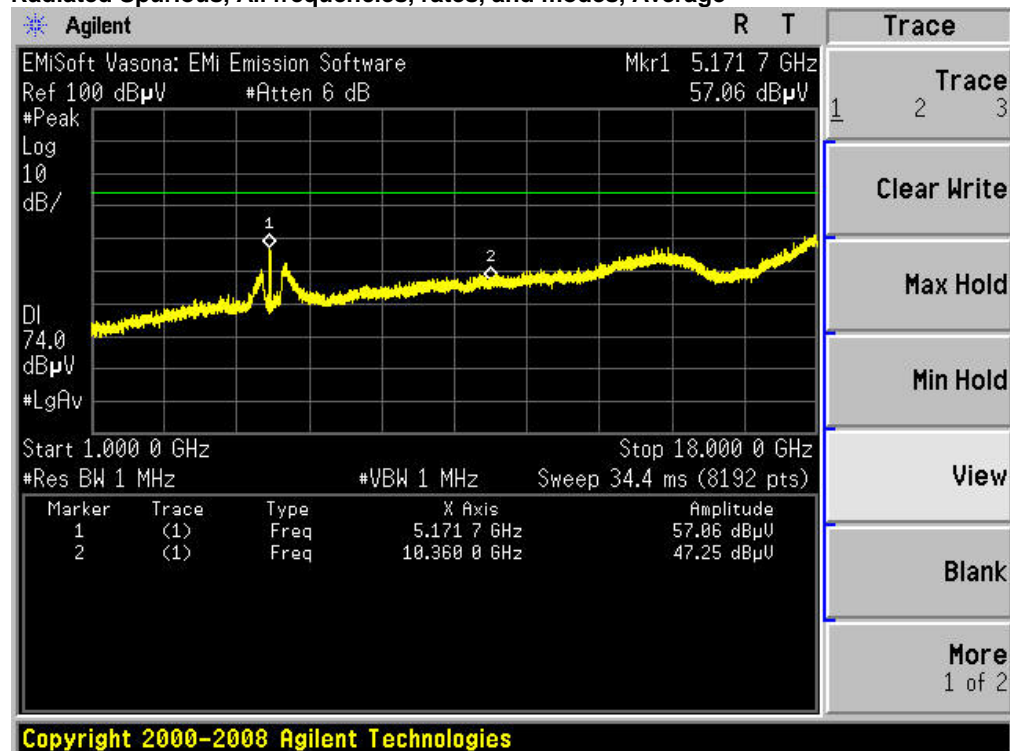
Frequency (MHz)	Mode	Data Rate (Mbps)	Spurious Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
5180	Non HT-20, 6 to 54 Mbps	6	37.7	54.0	16.3
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	37.7	54.0	16.3
	HT-20, M0 to M23	m0	37.7	54.0	16.3
	HT-20 STBC, M0 to M7	m0	37.7	54.0	16.3
	HT-20 Beam Forming, M0 to M23	m0	37.7	54.0	16.3
5240	Non HT-20, 6 to 54 Mbps	6	37.7	54.0	16.3
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	37.7	54.0	16.3
	HT-20, M0 to M23	m0	37.7	54.0	16.3
	HT-20 STBC, M0 to M7	m0	37.7	54.0	16.3
	HT-20 Beam Forming, M0 to M23	m0	37.7	54.0	16.3
5180/5200	Non HT-40 Duplicate, 6-54 Mbps	6	37.7	54.0	16.3
	HT-40, M0 to M23	m0	37.7	54.0	16.3
	HT-40 STBC, M0 to M7	m0	37.7	54.0	16.3
	HT-40 Beam Forming, M0 to M23	m0	37.7	54.0	16.3
5220/5240	Non HT-40 Duplicate, 6-54 Mbps	6	37.7	54.0	16.3
	HT-40, M0 to M23	m0	37.7	54.0	16.3
	HT-40 STBC, M0 to M7	m0	37.7	54.0	16.3
	HT-40 Beam Forming, M0 to M23	m0	37.7	54.0	16.3



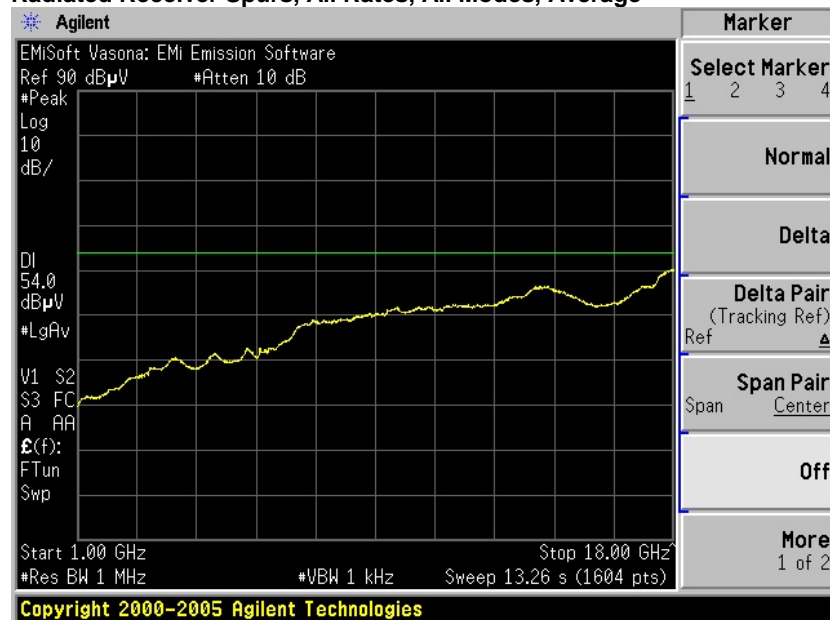
## Radiated Spurious, All frequencies, rates, and modes, Average



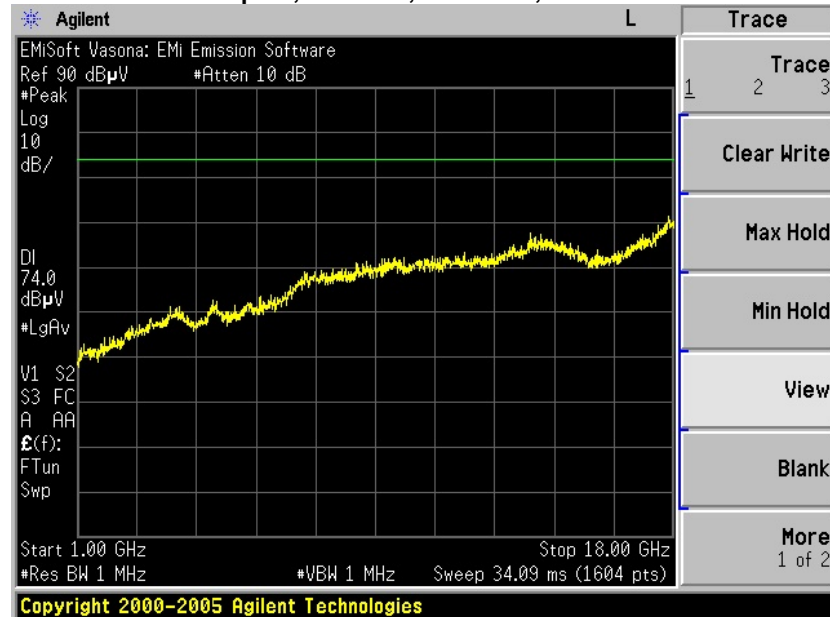
## Radiated Spurious, All frequencies, rates, and modes, Average



## Radiated Receiver Spurs, All Rates, All Modes, Average

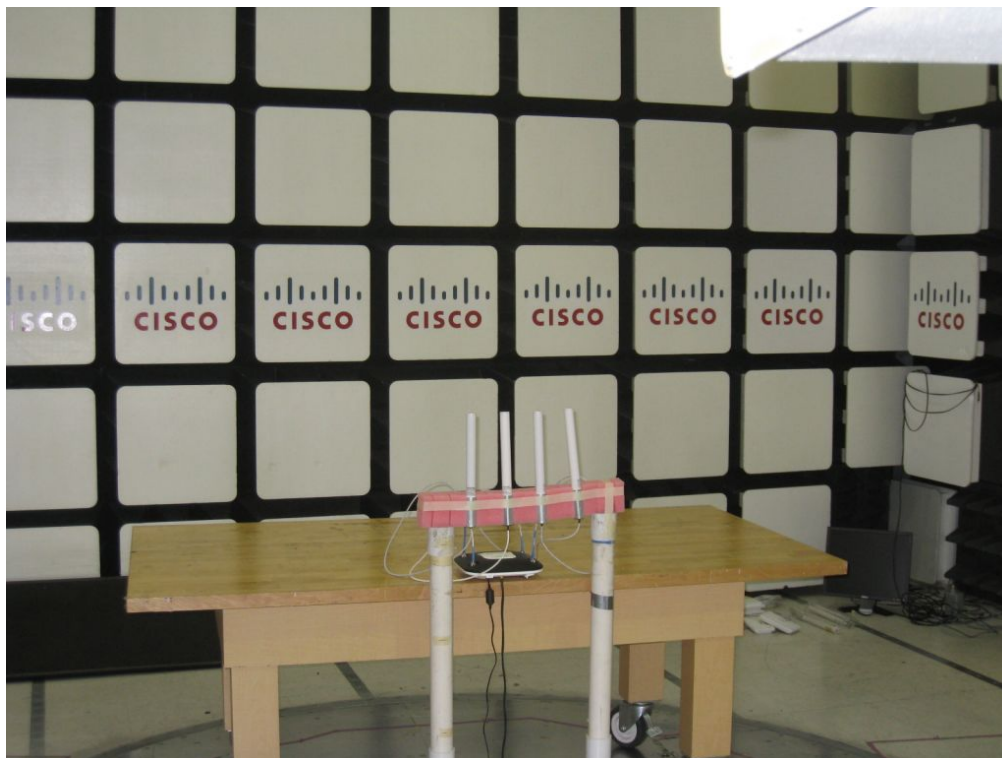


## Radiated Receiver Spurs, All Rates, All Modes, Peak



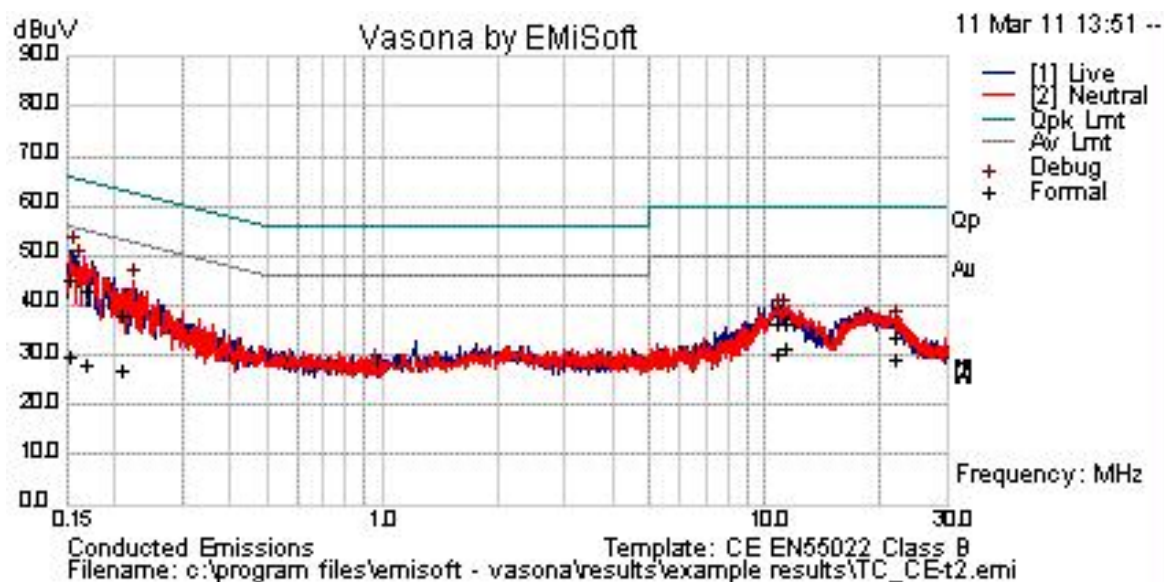


**2.4/5 GHz Dual Band 6dBi MIMO patch antenna**



**5 GHz 6 dBi Omni-directional antennas**

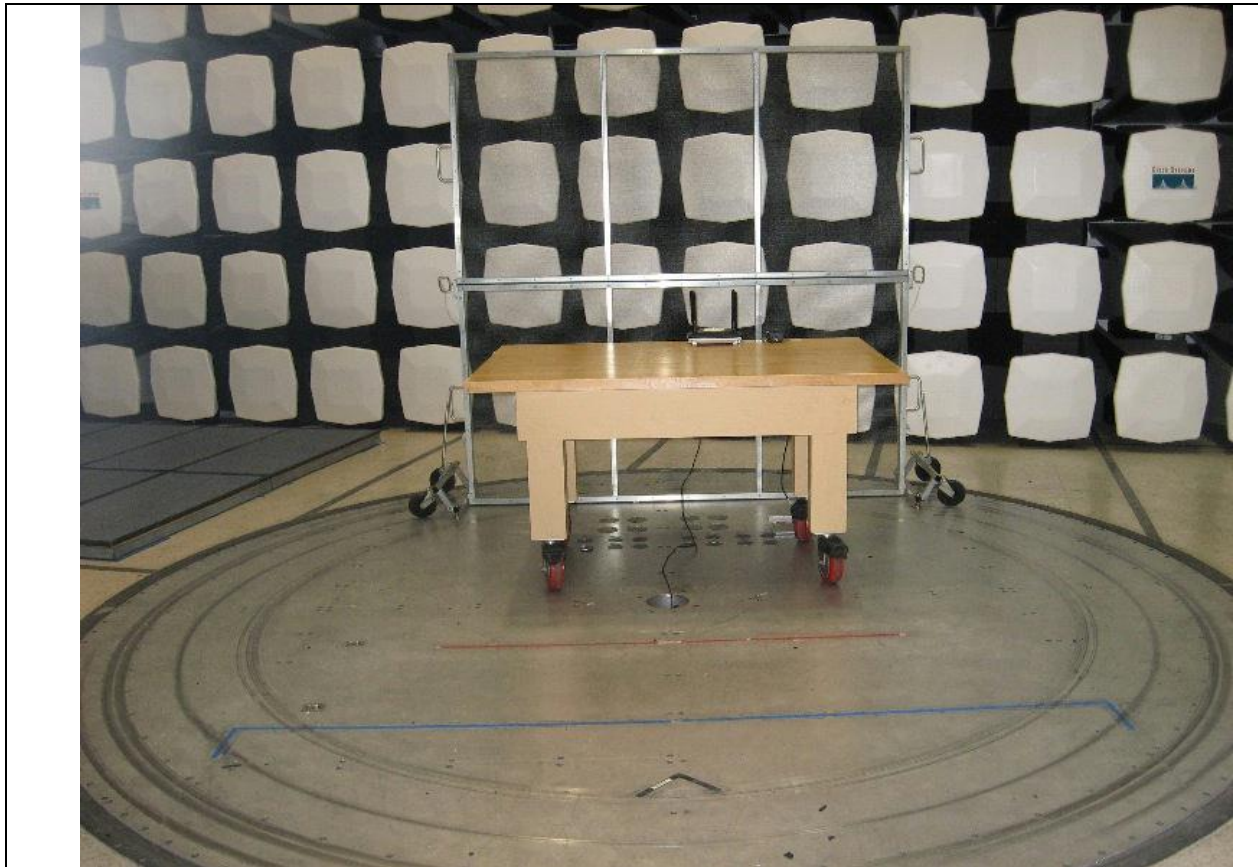
## Conducted emissions



Test Results Table

Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail	Comments
0.152537	6.9	21.3	1.5	29.7	Av	L	55.9	-26.2	Pass	
0.152537	22.4	21.3	1.5	45.2	Qp	L	65.9	-20.7	Pass	
0.167567	6.5	20.4	1.3	28.2	Av	L	55.1	-26.9	Pass	
0.167567	21.4	20.4	1.3	43.1	Qp	L	65.1	-22	Pass	
0.207367	16.8	20.2	1	38	Qp	N	63.3	-25.3	Pass	
0.207367	6	20.2	1	27.2	Av	N	53.3	-26.1	Pass	
10.834	15	21.1	0.3	36.4	Qp	N	60	-23.6	Pass	
10.834	9.1	21.1	0.3	30.5	Av	N	50	-19.5	Pass	
11.215	14.8	21.1	0.3	36.3	Qp	N	60	-23.7	Pass	
11.215	9.9	21.1	0.3	31.3	Av	N	50	-18.7	Pass	
22.011	6.9	21.8	0.4	29.1	Av	N	50	-20.9	Pass	
22.011	11.6	21.8	0.4	33.8	Qp	N	60	-26.2	Pass	

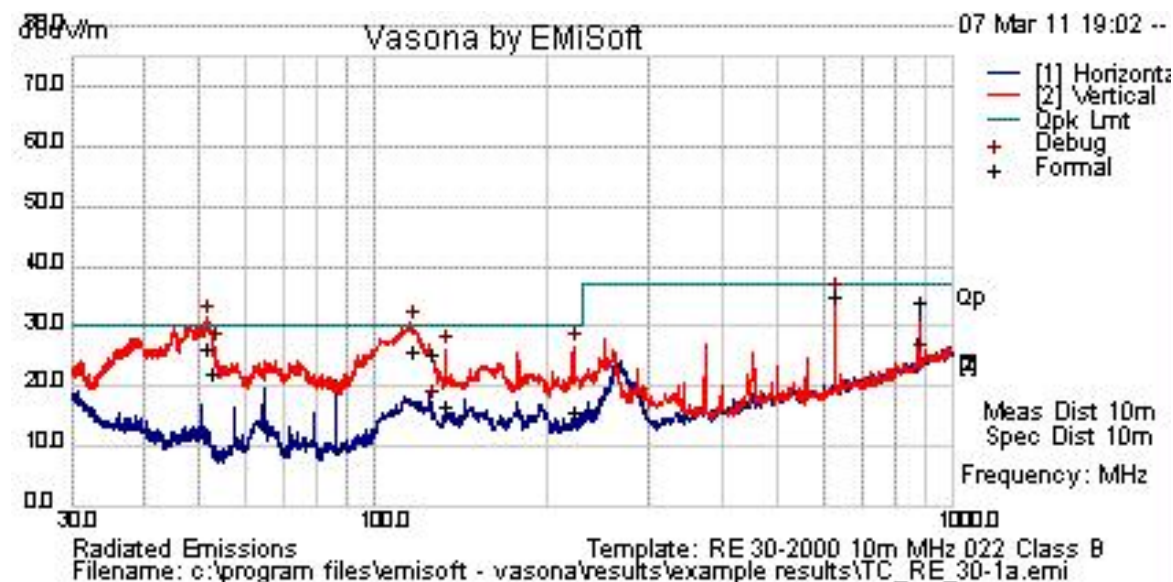




**Title:** Conducted Emissions Configuration Photograph

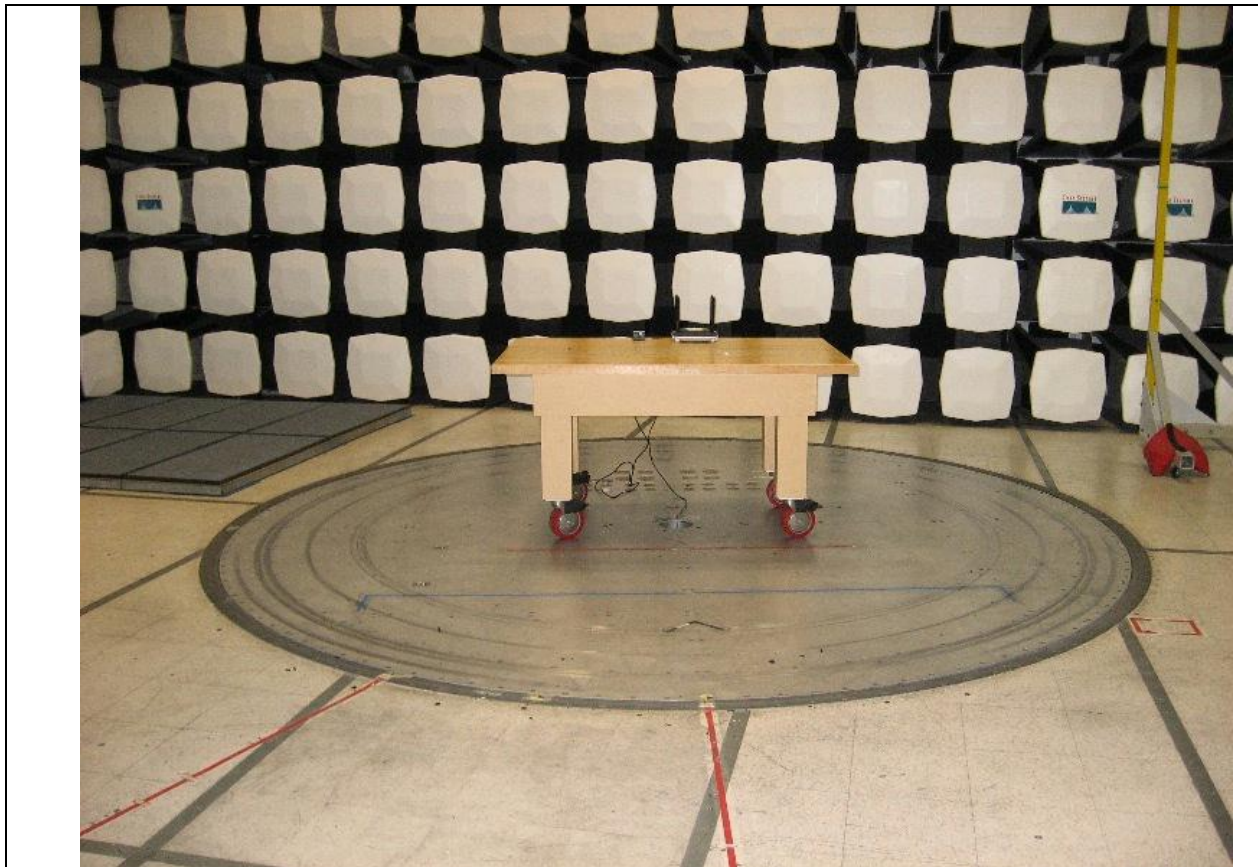


## Radiated emissions



Test Results Table

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurem ent Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
51.658	52.2	1.2	-24.6	28.9	Qp	V	115	174	30	-1.1	Pass	
52.575	45.5	1.2	-24.7	22	Qp	V	326	173	30	-8	Pass	
115.525	43	1.4	-18.6	25.8	Qp	V	253	18	30	-4.2	Pass	
124.993	42.2	1.5	-18.4	25.3	Qp	V	147	155	30	-4.7	Pass	
133.039	34.1	1.5	-18.8	16.8	Qp	V	220	145	30	-13.2	Pass	
220.884	35.4	1.7	-21.5	15.7	Qp	V	247	23	30	-14.3	Pass	
625.031	46.1	2.5	-13.1	35.5	Qp	V	289	77	37	-1.5	Pass	
875.028	42.2	2.9	-9.7	35.4	Qp	H	115	69	37	-1.6	Pass	



**Title:** Radiated Emissions Configuration Photograph



## Maximum Permissible Exposure (MPE) Calculations

15.407: U-NII devices are subject to the radio frequency radiation exposure requirements specified in Sec. 1.1307(b), Sec. 2.1091 and Sec. 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a "general population/uncontrolled" environment. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

Given

$$E = \sqrt{(30 \cdot P \cdot G)/d} \quad \text{and} \quad S = E^2/3770$$

where

E=Field Strength in Volts/meter

P=Power in Watts

G=Numeric Antenna Gain

d=Distance in meters

S=Power Density in mW/cm<sup>2</sup>

Combine equations and rearrange the terms to express the distance as a function of the remaining variables:

$$d = \sqrt{((30 \cdot P \cdot G)/(3770 \cdot S))}$$

Changing to units of power in mW and distance in cm, using:

$$P(\text{mW}) = P(\text{W})/1000 \quad d(\text{cm}) = 100 \cdot d(\text{m})$$

yields

$$d = 100 \cdot \sqrt{((30 \cdot (P/1000) \cdot G)/(3770 \cdot S))}$$

$$d = 0.282 \cdot \sqrt{(P \cdot G/S)}$$

where

d=Distance in cm

P=Power in mW

G=Numerica Antenna Gain

S=Power Density in mW/cm<sup>2</sup>

Substituting the logarithmic form of power and gain using:

$$P(\text{mW}) = 10^{(P(\text{dBm})/10)} \quad G(\text{numeric}) = 10^{(G(\text{dBi})/10)}$$

yields

$$d = 0.282 \cdot 10^{((P+G)/20)} / \sqrt{S} \quad \text{Equation (1)}$$

and

$$s = ((0.282 \cdot 10^{((P+G)/20)})/d)^2 \quad \text{Equation (2)}$$

where

d=MPE distance in cm

P=Power in dBm

G=Antenna Gain in dBi

S=Power Density in mW/cm<sup>2</sup>





Equation (1) and the measured peak power are used to calculate the MPE distance. Note that for mobile or fixed location transmitters such as an access point, the minimum separation distance is 20 cm even if the calculations indicate that the MPE distance may be less.

$S=1\text{mW/cm}^2$  maximum. Using the peak power levels recorded in the test report along with Equation 1 above, the MPE distances are calculated as follows.

Frequency (MHz)	Bit Rate (Mbps)	Power Density (mW/cm <sup>2</sup> )	Peak Transmit Power (dBm)	Antenna Gain (dBi)	MPE Distance (cm)	Limit (cm)	Margin (cm)
5180	54	1	10.3	9	<b>2.60</b>	20	17.40
5240	54	1	16.5	7	<b>4.22</b>	20	15.78

#### MPE Calculations

To maintain compliance, installations will assure a separation distance of at least 20cm.

Using Equation 2, the MPE levels (s) at 20 cm are calculated as follows:

Frequency (MHz)	Bit Rate (Mbps)	MPE Distance (cm)	Peak Transmit Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm <sup>2</sup> )	Limit (mW/cm <sup>2</sup> )	Margin (mW/cm <sup>2</sup> )
5180	54	20	10.3	9	<b>0.02</b>	1	0.98
5240	54	20	16.5	7	<b>0.04</b>	1	0.96

**Appendix C: Test Equipment/Software Used to perform the test**

Equip #	Manufacturer	Model	Description	Last Cal	Next Due
CIS004882	EMC Test Systems	3115	Double Ridged Guide Horn Antenna	4-May-10	4-May-11
CIS005691	Miteq	NSP1800-25-S1	Broadband Preamplifier	2-Feb-11	2-Feb-12
COM000210	TTE	H785-150K-50-21378	Hi Pass Filter - 150KHz cutoff	11-Aug-10	11-Aug-11
COM000214	Fischer	FCC-LISN-50-50-2M	Turntable LISN (150KHz-30MHz)	5-Mar-11	4-Mar-12
CIS021117	Micro-Coax	UFB311A-0-2484-520520	RF Coaxial Cable, to 18GHz, 248.4 in	24-Aug-10	24-Aug-11
CIS030564	Micro-Coax	UFB311A-1-0950-504504	RF Coaxial Cable, to 18GHz, 95 in	24-Aug-10	24-Aug-11
CIS044005	MegaPhase	EM18-NKNK-320	RF N Type Cable 18GHz	24-Aug-10	24-Aug-11
COM000233	Sunol Sciences	JB1	Combination Antenna, 30MHz-2GHz	19-Jul-10	19-Jul-11
CIS037227	Micro-Tronics	BRC50705	Notch Filter, SB:5.725-5.875GHz	7-Jul-10	7-Jul-11
CIS034972	Midwest Microwave	ATT-0640-20-29M-02	Attenuator, 20dB	17-May-11	16-May-12
CIS035610	Micro-Tronics	BRC50703-02	Notch Filter, SB:5.150-5.350GHz	7-Jul-10	7-Jul-11
CIS035605	Micro-Tronics	BRC50704-02	Notch Filter, SB:5.470-5.725GHz	7-Jul-10	7-Jul-11
CIS034303	Micro-Tronics	BRM50702-02	Notch Filter, SB:2.4-2.5GHz	7-Jul-10	7-Jul-11
CIS043116	Huber + Suhner	Sucoflex 104PE	N & SMA RF cable	19-Jul-10	19-Jul-11
CIS040603	Agilent	E4440A	Spectrum Analyzer	4-Aug-10	4-Aug-11
CIS040053	Agilent	E4448A	Spectrum Analyzer	29-Apr-11	28-Apr-12