Test Report

AIR-CAP3502P-A-K9

Cisco Aironet 802.11n Dual Band Access Point

FCC ID: LDK102079P

IC: 2461B-102079P

(Also covers AIR-CAP3502P-T-K9)

5470-5725 MHz

Against the following Specifications:

CFR47 Part 15.407

RSS210

Cisco Systems

170 West Tasman Drive

San Jose, CA 95134

This test report has been electronically authorized and archived using the CISCO Engineering Document Control system.

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%)

2.2 Date of start of testing

7-June-2011

2.3 Report Issue Date

Cisco uses an electronic system to issue, store and control the revision of test reports. This system is called the Engineering Document Control System (EDCS). The actual report issue date is embedded into the original file on EDCS. Any copies of this report, either electronic or paper, that are not on EDCS must be considered uncontrolled

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-CAP3502P-A-K9 Cisco Aironet 802.11n Dual Band Access Point

2.6 EUT Description

The AIR-CAP3502P Series Cisco Aironet 802.11n Dual Band Access Points require professional installation, and supports 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, 6 to 54 Mbps, Single
Non HT-20, 6 to 54 Mbps, Dual
Non HT-20 Beam Forming, 6 to 54 Mbps
HT-20, M0 to M7, Single
HT-20, M0 to M15, Dual
Non HT-40 Duplicate, 6-54 Mbps, Single
Non HT-40 Duplicate, 6-54 Mbps, Dual
HT-40, M0 to M7, Single
HT-40, M0 to M15, Dual

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)
5 GHz	AIR-ANT5135D-R	Articulating dipole	3.5
	AIR-ANT5135DB-R	Articulating dipole	3.5
	AIR-ANT5135DG-R	Non-articulating gray dipole	3.5
	AIR-ANT5135DW-R	Articulating white dipole	3.5
	AIR-ANT5135SDW-R	Stubby monopole	3.5
	AIR-ANT5140V-R	3-element MIMO ceiling mount omni	4
	AIR-ANT5160NP-R	3-element MIMO patch antenna	6
2.4/5 GHz	AIR-ANT2451NV-R	MIMO 6-Element Dual Band Omni	2.5 / 3.5
	AIR-ANT25137NP-R	Patch	13/7

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-CAP3502P-A-K9		Cisco Systems	NA	NA	NA	
S06	AIR-ANT25137NP-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.

Frequency (MHz)	Operating Mode	Max Channel Power (dBm)
5500-5560 5680-7500	Non HT-20, 6 to 54 Mbps, Single	17
	Non HT-20, 6 to 54 Mbps, Dual	20
	Non HT-20 Beam Forming, 6 to 54 Mbps	17
	HT-20, M0 to M7, Single	17
	HT-20, M0 to M7, Dual	17
	HT-20, M8 to M15, Dual	20
5500/5520 5540/5560	Non HT-40 Duplicate, 6-54 Mbps, Single	15
	Non HT-40 Duplicate, 6-54 Mbps, Dual	16
	HT-40, M0 to M7, Single	17
	HT-40, M0 to M15, Dual	20

20dB Bandwidth

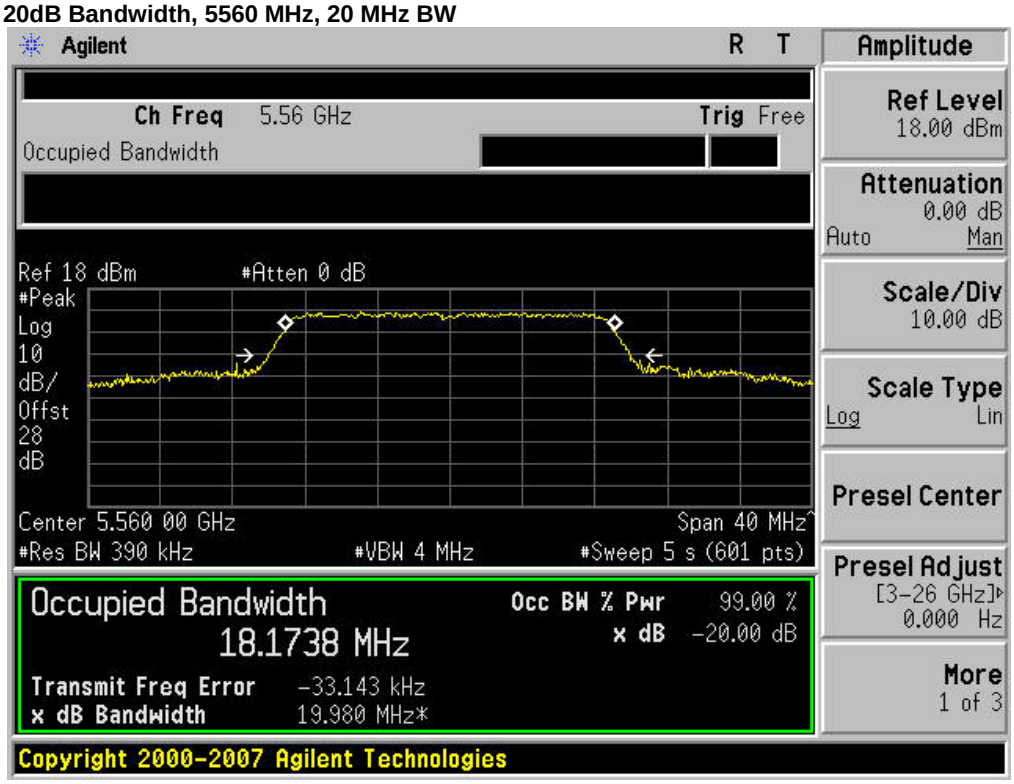
Connect the antenna port(s) to the spectrum analyzer input. Using the spectrum analyzer Channel Bandwidth mode, configure the spectrum analyzer as shown below (enter all losses between the transmitter output and the spectrum analyzer).

Center Frequency: Frequency from table be.low
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 20 dB Bandwidth
Video Bandwidth: ≥Resolution Bandwidth
X dB Bandwidth: 20 dB
Detector: Peak
Trace: Single

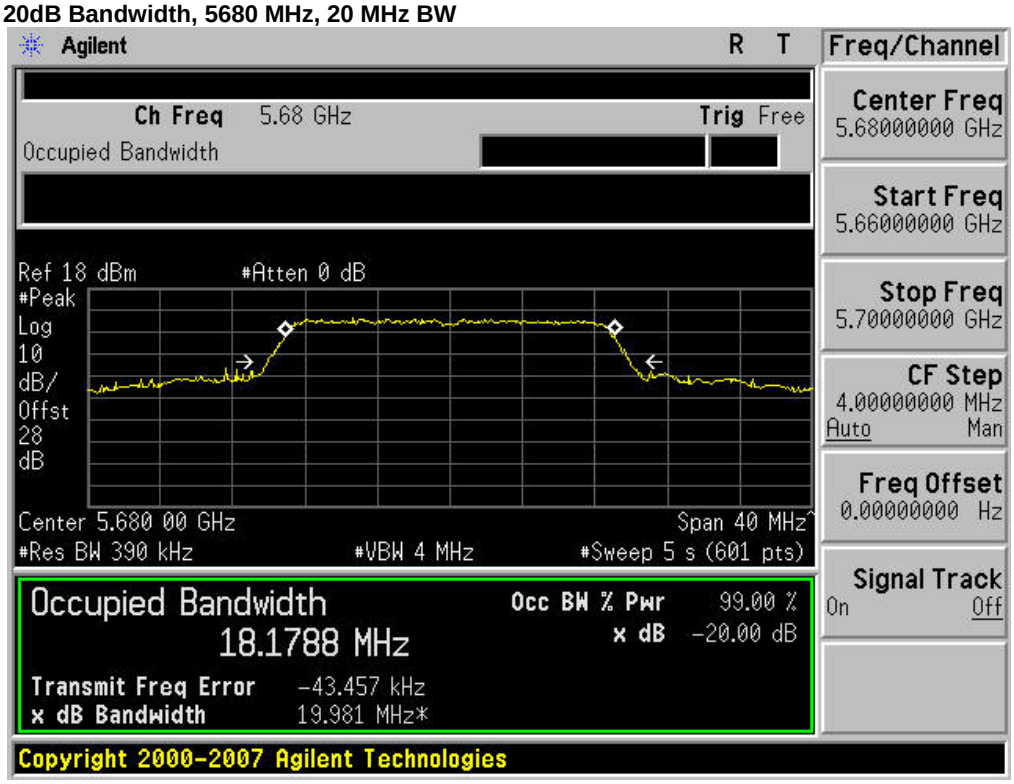
Place the radio in continuous transmit mode. View the transmitter waveform on the spectrum analyzer, and record the pertinent measurements:

Frequency (MHz)	Mode	Data Rate (Mbps)	20dB BW (MHz)	Limit (MHz)	Margin (MHz)
5560	20 MHz Bandwidth	m0	**20.0**	**20**	0.0
5680	20 MHz Bandwidth	m0	**20.0**	**20**	0.0
5540/5560	40 MHz Bandwidth	m0	**39.1**	**40**	0.9

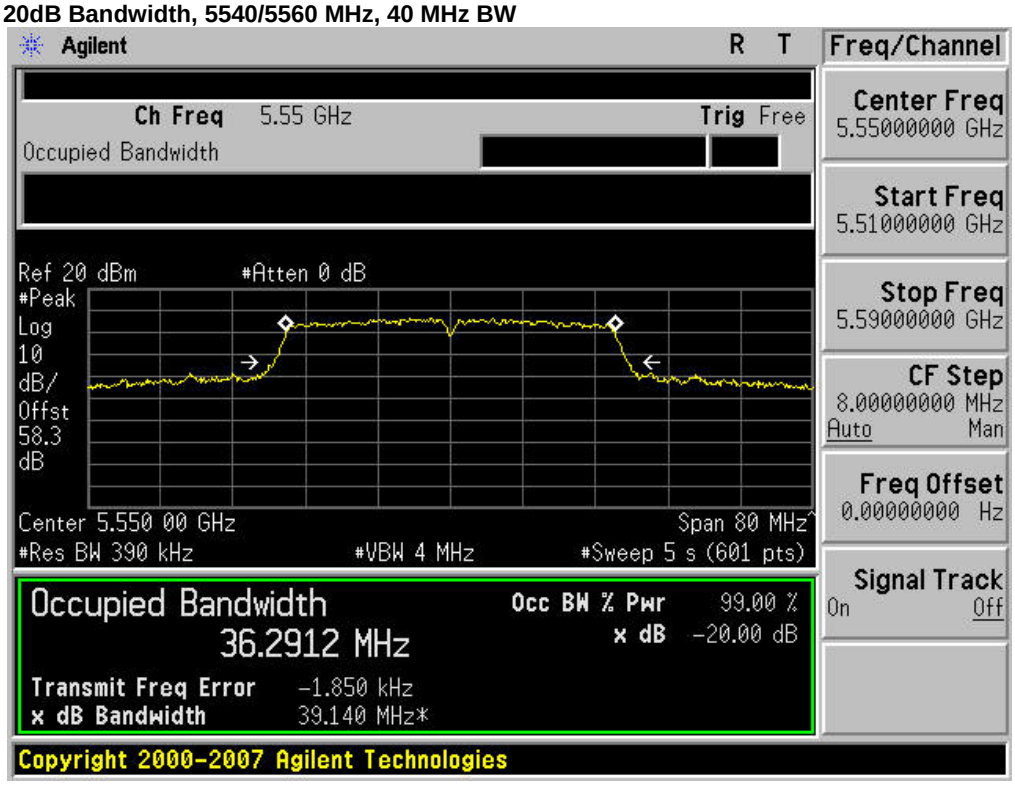
20dB Bandwidth, 5560 MHz, 20 MHz BW



20dB Bandwidth, 5680 MHz, 20 MHz BW



20dB Bandwidth, 5540/5560 MHz, 40 MHz BW



99% and 26dB Bandwidth

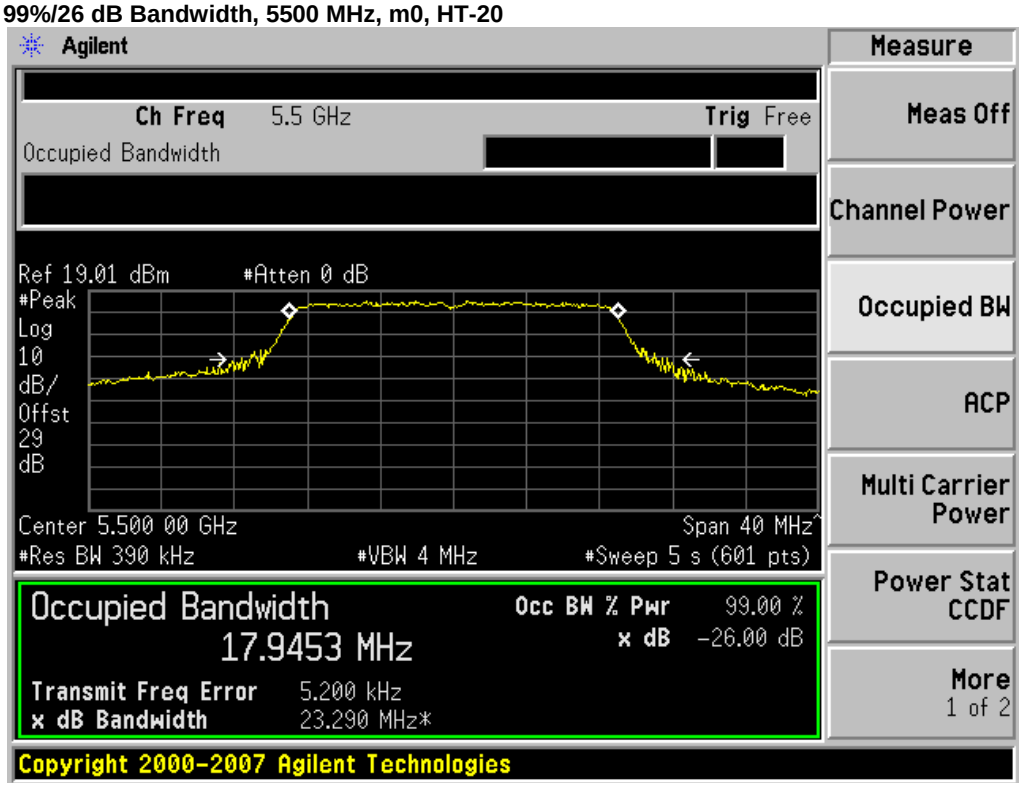
Connect the antenna port(s) to the spectrum analyzer input. Using the spectrum analyzer Channel Bandwidth mode, configure the spectrum analyzer as shown below (enter all losses between the transmitter output and the spectrum analyzer).

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

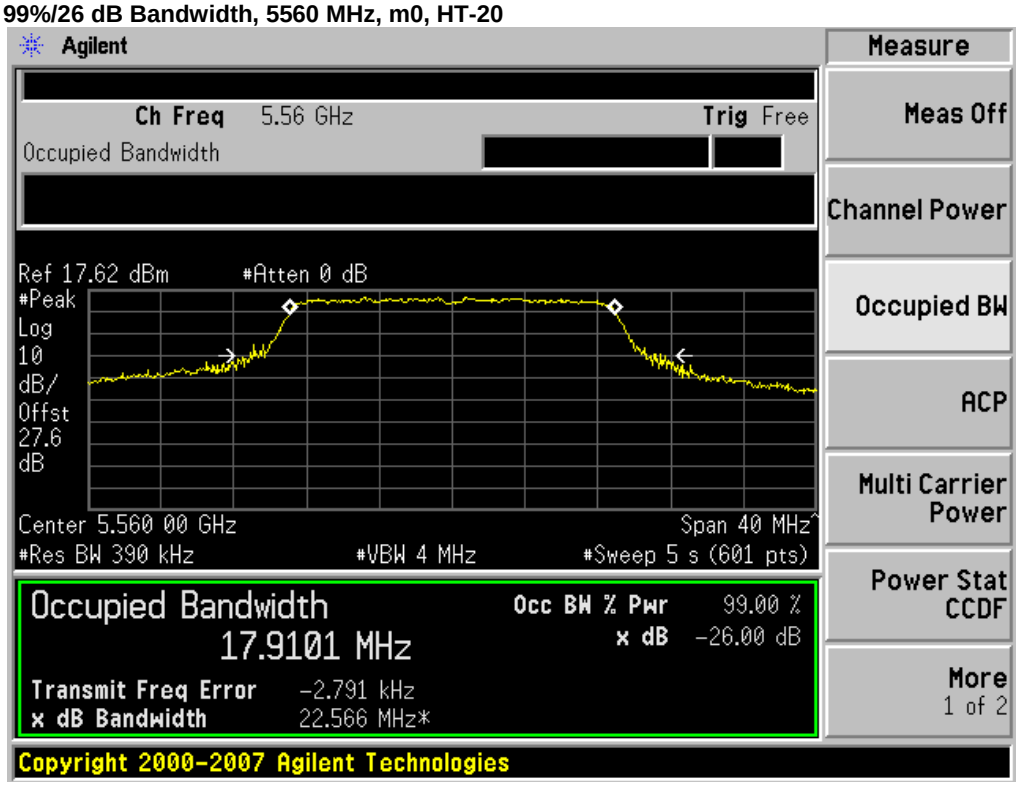
Place the radio in continuous transmit mode. View the transmitter waveform on the spectrum analyzer, and record the pertinent measurements:

Frequency (MHz)	Mode	Data Rate	99% BW (MHz)	26 dB BW (MHz)
5500	HT-20	M0	**17.94**	**23.29**
5560	HT-20	M0	**17.91**	**22.56**
5700	HT-20	M0	**17.96**	**22.91**
5500/5520	Non HT-40	6	**36.38**	**46.48**
5500/5520	HT-40	M0	**36.51**	**42.05**
5540/5560	Non HT-40	6	**36.36**	**46.1**
5540/5560	HT-40	M0	**36.41**	**42.64**

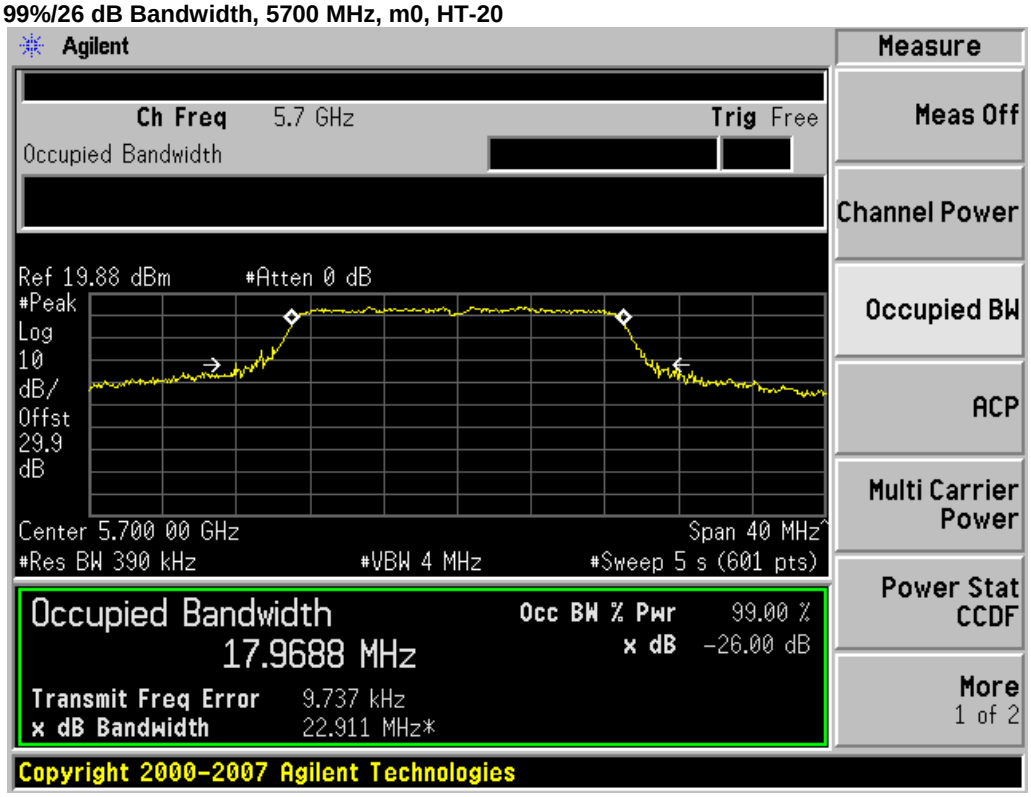
99%/26 dB Bandwidth, 5500 MHz, m0, HT-20



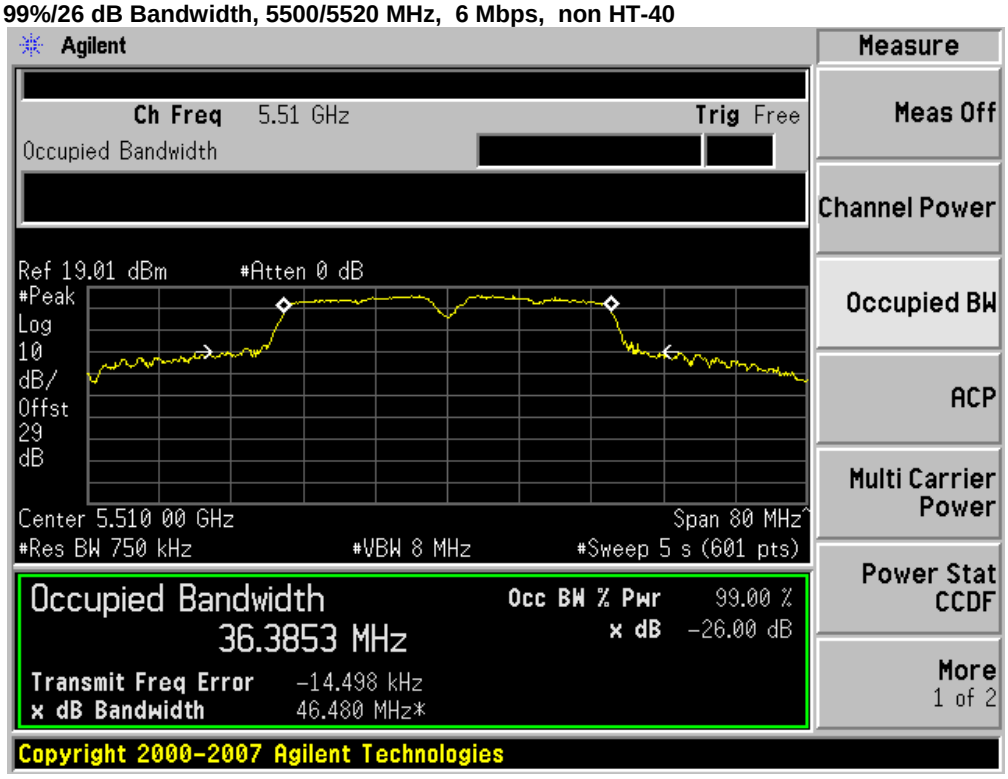
99%/26 dB Bandwidth, 5560 MHz, m0, HT-20



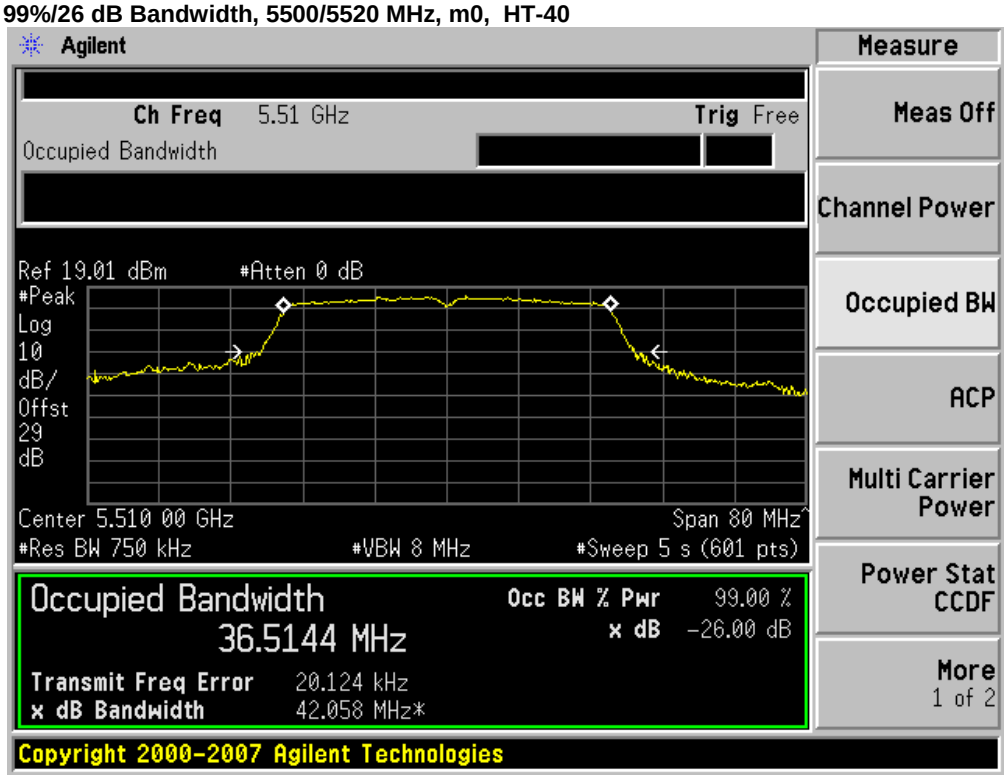
99%/26 dB Bandwidth, 5700 MHz, m0, HT-20



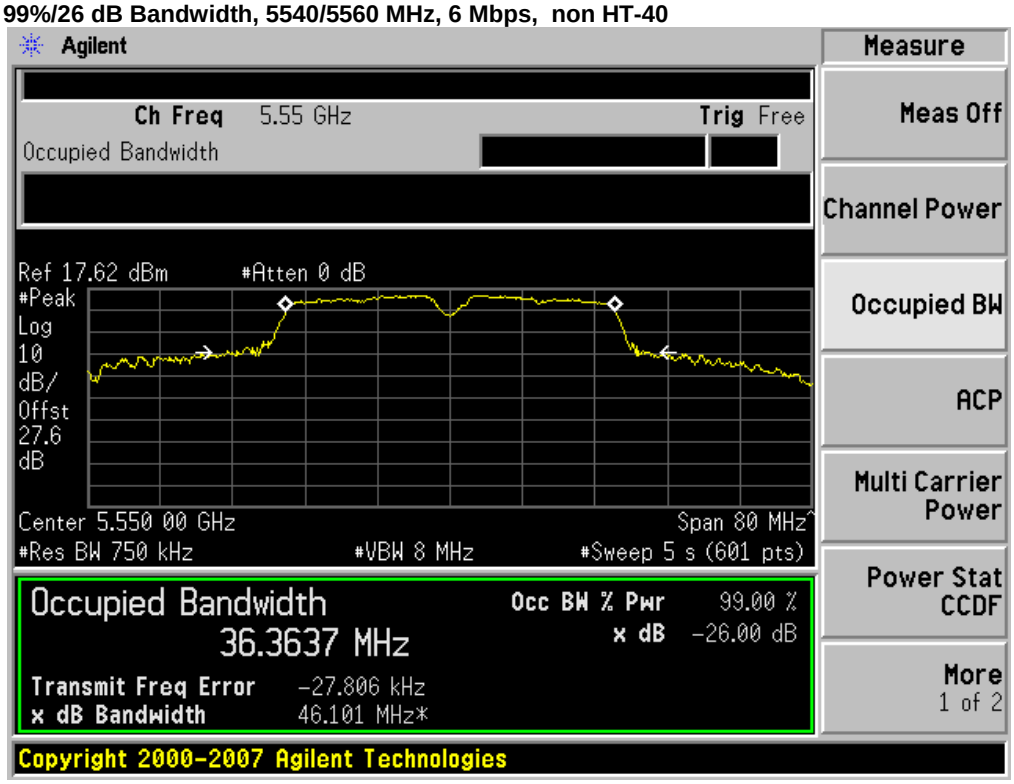
99%/26 dB Bandwidth, 5500/5520 MHz, 6 Mbps, non HT-40



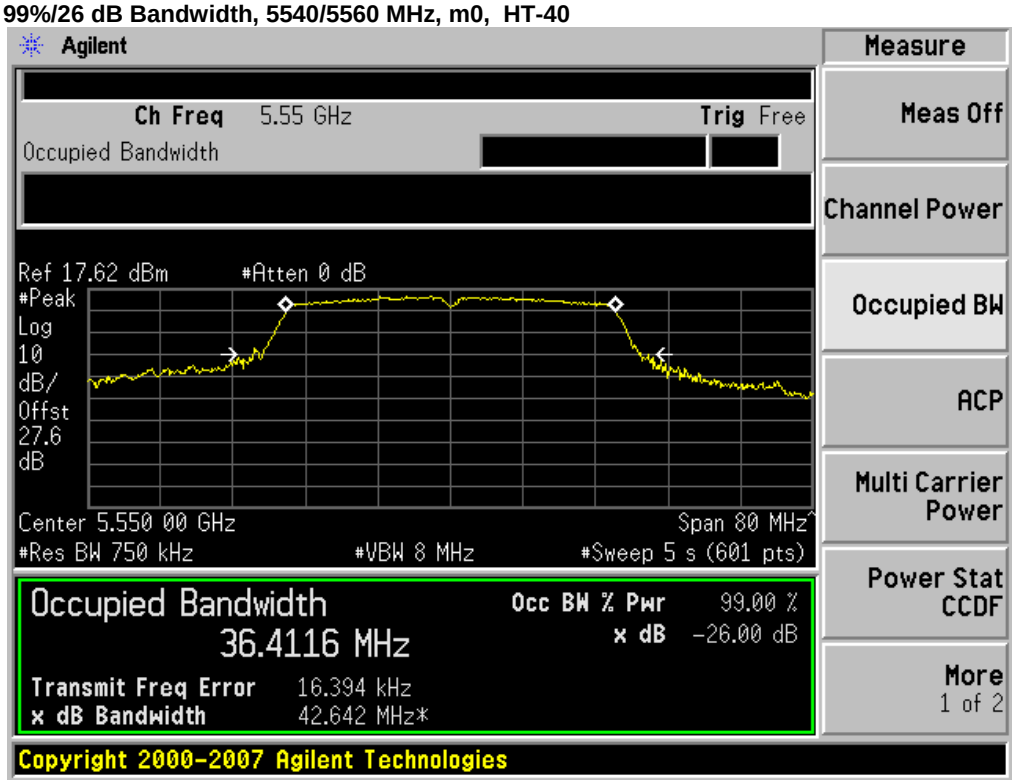
99%/26 dB Bandwidth, 5500/5520 MHz, m0, HT-40



99%/26 dB Bandwidth, 5540/5560 MHz, 6 Mbps, non HT-40



99%/26 dB Bandwidth, 5540/5560 MHz, m0, HT-40



Peak Output Power

15.407: For the bands 5.25-5.35 and 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. 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 22.6 MHz. The maximum conducted output power is calculated as 11dBm+10*log(20.4MHz) = 24.5dBm

The maximum supported antenna gain is 7dBi. 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 bands 5.25-5.35 and 5.47-5.725 GHz, the peak 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, 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 7dBi. 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(2) (or 3dB) 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.

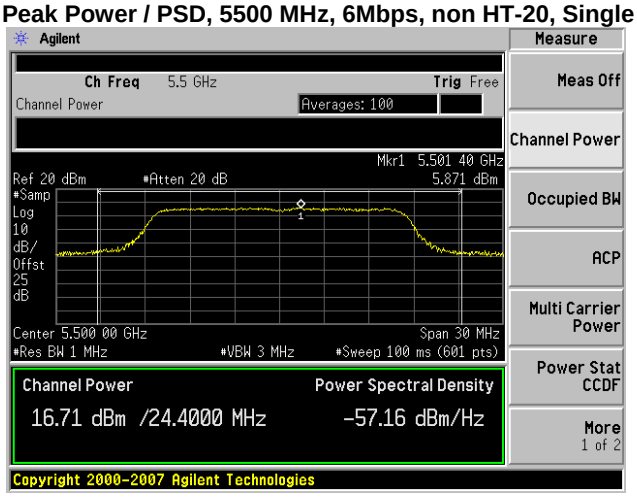
Enable "Channel Power" function of analyzer	
Center Frequency:	Frequency from table below
Span:	20 MHz (must be greater than 26dB bandwidth, adjust as necessary)
Ref Level Offset:	Correct for attenuator and cable loss.
Reference Level:	20 dBm
Attenuation:	20 dB
Sweep Time:	100ms, Single sweep
Resolution 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)	Total Tx Channel Power (dBm)	Limit (dBm)	Margin (dB)
5500	Non HT-20, 6 to 54 Mbps, Single	1	7	16.7	-	16.7	23	6.3
	Non HT-20, 6 to 54 Mbps, Dual	2	7	13.7	14.3	17.0	23	6.0
	Non HT-20 Beam Forming, 6 to 54 Mbps	2	10	13.7	14.3	17.0	20	3.0
	HT-20, M0 to M7, Single	1	7	16.6	-	16.6	23	6.4
	HT-20, M0 to M7, Dual	2	7	13.6	14.3	17.0	23	6.0
	HT-20, M8 to M15, Dual	2	7	16.6	17.3	20.0	23	3.0
5560	Non HT-20, 6 to 54 Mbps, Single	1	7	17.6	-	17.6	23	5.5
	Non HT-20, 6 to 54 Mbps, Dual	2	7	14.5	14.4	17.5	23	5.5
	Non HT-20 Beam Forming, 6 to 54 Mbps	2	10	14.5	14.4	17.5	20	2.5
	HT-20, M0 to M7, Single	1	7	17.5	-	17.5	23	5.5
	HT-20, M0 to M7, Dual	2	7	14.5	14.2	17.4	23	5.6
	HT-20, M8 to M15, Dual	2	7	17.5	17.5	20.5	23	2.5
5700	Non HT-20, 6 to 54 Mbps, Single	1	7	16.7	-	16.7	23	6.3
	Non HT-20, 6 to 54 Mbps, Dual	2	7	13.7	13.9	16.8	23	6.2
	Non HT-20 Beam Forming, 6 to 54 Mbps	2	10	13.7	13.9	16.8	20	3.2
	HT-20, M0 to M7, Single	1	7	16.7	-	16.7	23	6.3
	HT-20, M0 to M7, Dual	2	7	13.6	13.9	16.8	23	6.2
	HT-20, M8 to M15, Dual	2	7	16.7	17.2	20.0	23	3.0
5500/5520	Non HT-40 Duplicate, 6-54 Mbps, Single	1	7	16.9	-	16.9	23	6.1
	Non HT-40 Duplicate, 6-54 Mbps, Dual	2	7	16.9	17.3	20.1	23	2.9
	HT-40, M0 to M7, Single	1	7	16.6	-	16.6	23	6.4
	HT-40, M0 to M7, Dual	2	7	16.6	17.0	19.8	23	3.2
5540/5560	Non HT-40 Duplicate, 6-54 Mbps, Single	1	7	17.4	-	17.4	23	5.6
	Non HT-40 Duplicate, 6-54 Mbps, Dual	2	7	17.4	17.3	20.4	23	2.6
	HT-40, M0 to M7, Single	1	7	17.1	-	17.1	23	5.9
	HT-40, M0 to M7, Dual	2	7	17.1	16.9	20.0	23	3.0

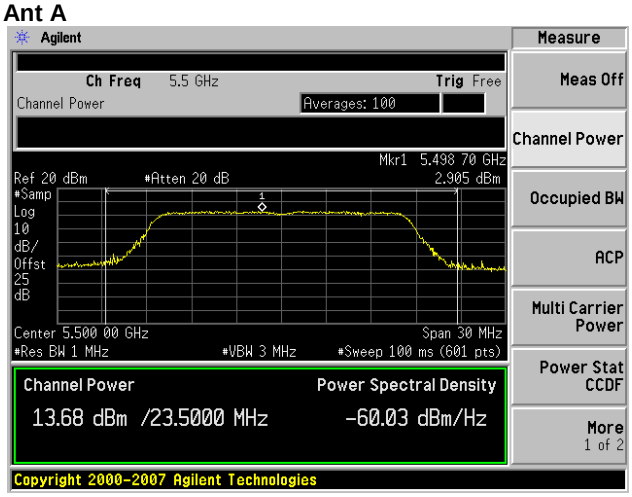
Frequency (MHz)	Operating Mode	Tx Paths	Correlated Antenna Gain (dBi)	PSD / Antenna (dBm/MHz)	Total PSD (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
5500	Non HT-20, 6 to 54 Mbps, Single	1	7	5.9	5.9	10	4.1
	Non HT-20, 6 to 54 Mbps, Dual	2	10	6.7	9.7	7	-2.7
	Non HT-20 Beam Forming, 6 to 54 Mbps	2	10	3.6	6.6	7	0.4
	HT-20, M0 to M7, Single	1	7	5.6	5.6	10	4.4
	HT-20, M0 to M7, Dual	2	10	3.5	6.5	7	0.5
	HT-20, M8 to M15, Dual	2	7	6.3	9.3	10	0.7
5560	Non HT-20, 6 to 54 Mbps, Single	1	7	7.0	7.0	10	3.0
	Non HT-20, 6 to 54 Mbps, Dual	2	10	3.7	6.7	7	0.3
	Non HT-20 Beam Forming, 6 to 54 Mbps	2	10	3.7	6.7	7	0.3
	HT-20, M0 to M7, Single	1	7	6.8	6.8	10	3.2
	HT-20, M0 to M7, Dual	2	10	3.6	6.6	7	0.4
	HT-20, M8 to M15, Dual	2	7	7.0	10.0	10	0.0
5700	Non HT-20, 6 to 54 Mbps, Single	1	7	6.2	6.2	10	3.8
	Non HT-20, 6 to 54 Mbps, Dual	2	10	3.1	6.1	7	0.9
	Non HT-20 Beam Forming, 6 to 54 Mbps	2	10	3.1	6.1	7	0.9
	HT-20, M0 to M7, Single	1	7	5.7	5.7	10	4.3
	HT-20, M0 to M7, Dual	2	10	3.0	6.0	7	1.0
	HT-20, M8 to M15, Dual	2	7	6.6	9.6	10	0.4
5500/5520	Non HT-40 Duplicate, 6-54 Mbps, Single	1	7	3.8	3.8	10	6.2
	Non HT-40 Duplicate, 6-54 Mbps, Dual	2	10	3.8	6.8	7	0.2
	HT-40, M0 to M7, Single	1	7	3.3	3.3	10	6.7
	HT-40, M0 to M7, Dual	2	10	3.6	6.6	7	0.4
	HT-20, M8 to M15, Dual	2	7	3.6	6.6	10	3.4
5540/5560	Non HT-40 Duplicate, 6-54 Mbps, Single	1	7	4.4	4.4	10	5.6
	Non HT-40 Duplicate, 6-54 Mbps, Dual	2	10	4.0	7.0	7	0.0
	HT-40, M0 to M7, Single	1	7	4.0	4.0	10	6.0
	HT-40, M0 to M7, Dual	2	10	3.8	6.8	7	0.2
	HT-20, M8 to M15, Dual	2	7	3.8	6.8	10	3.2

Peak Power / PSD, 5500 MHz, 6Mbps, non HT-20, Single Transmit Path

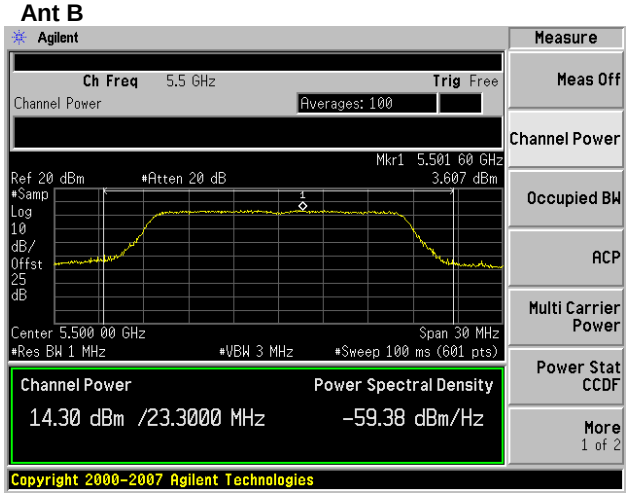


Peak Power / PSD, 5500 MHz, 6Mbps, non HT-20 / Beamform, Dual Transmit Paths

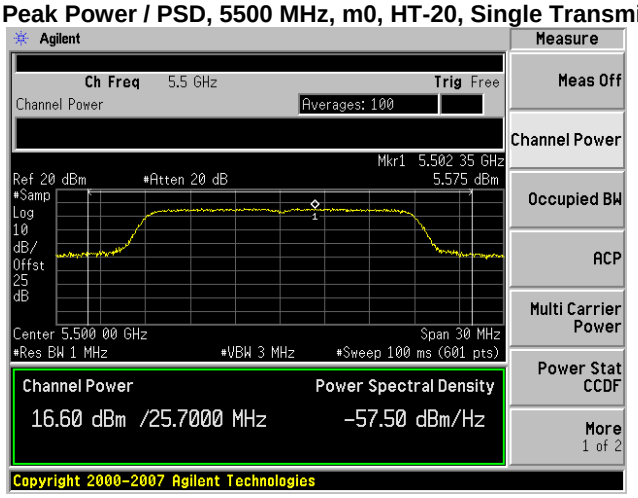
Ant A



Ant B

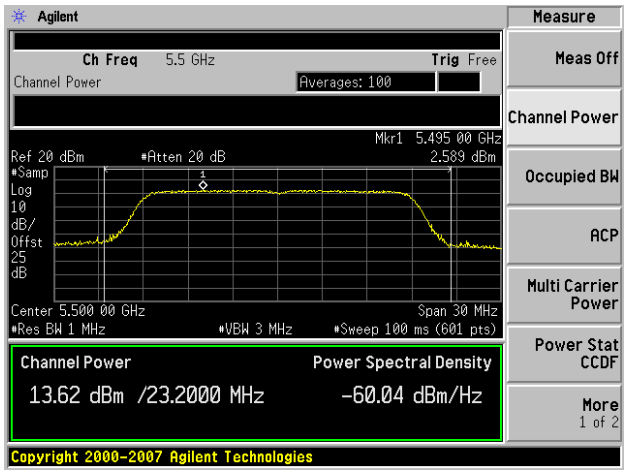


Peak Power / PSD, 5500 MHz, m0, HT-20, Single Transmit Path

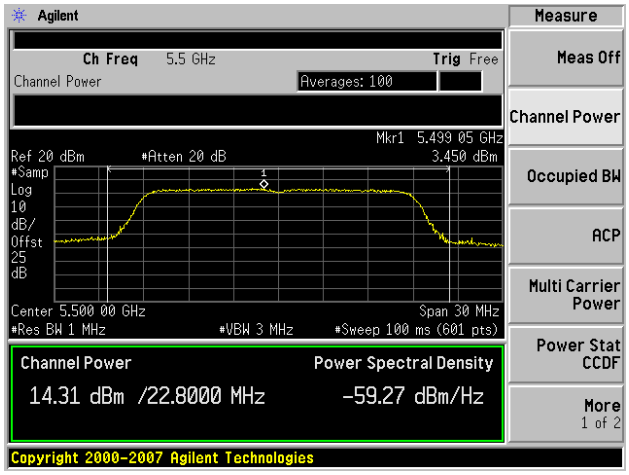


Peak Power / PSD, 5500 MHz, m0, HT-20, Dual Transmit Paths

Ant A

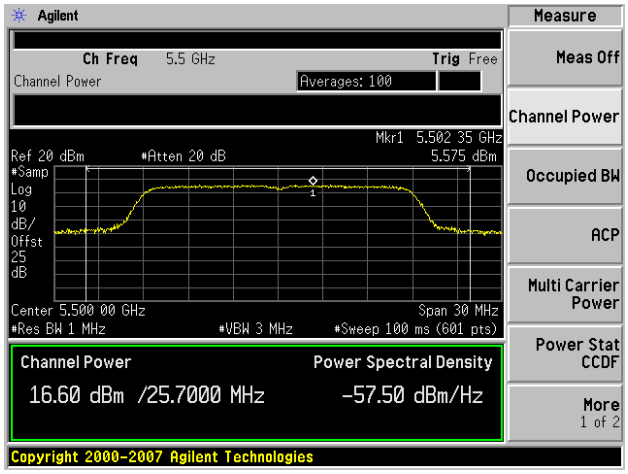


Ant B

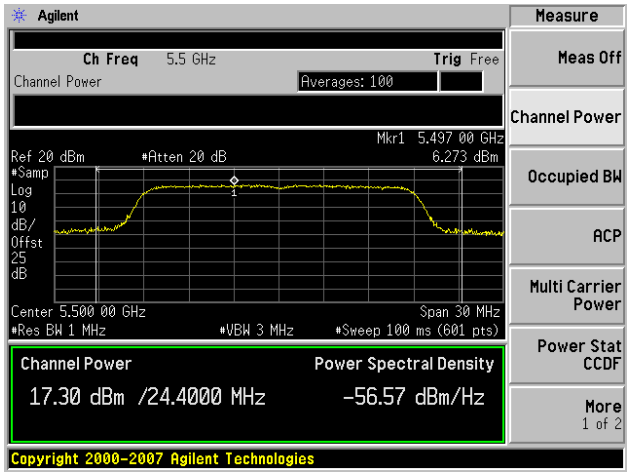


Peak Power / PSD, 5500 MHz, m8, HT-20, Dual Transmit Paths

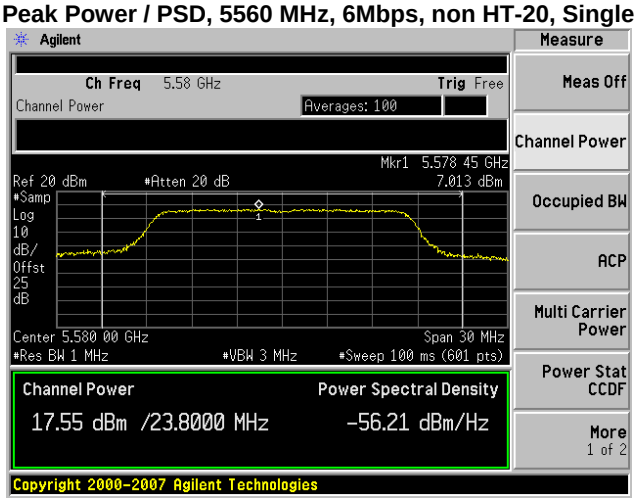
Ant A



Ant B

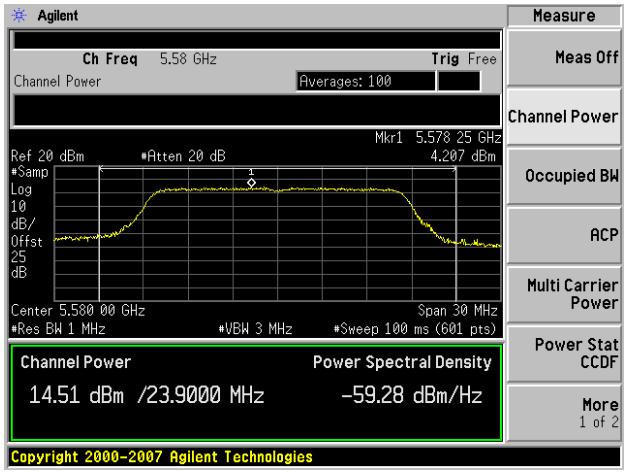


Peak Power / PSD, 5560 MHz, 6Mbps, non HT-20, Single Transmit Path

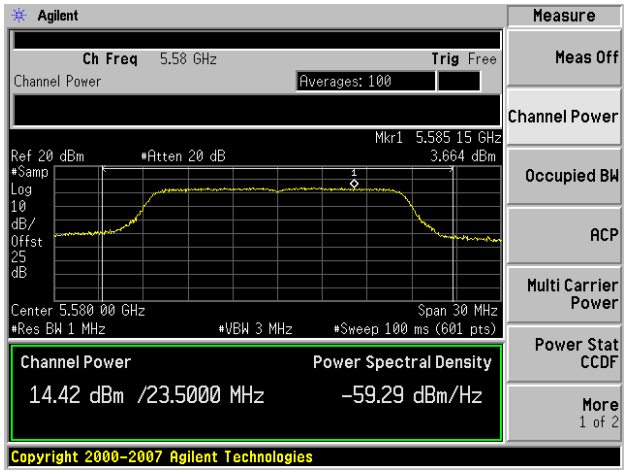


Peak Power / PSD, 5560 MHz, 6Mbps, non HT-20 / Beamform, Dual Transmit Paths

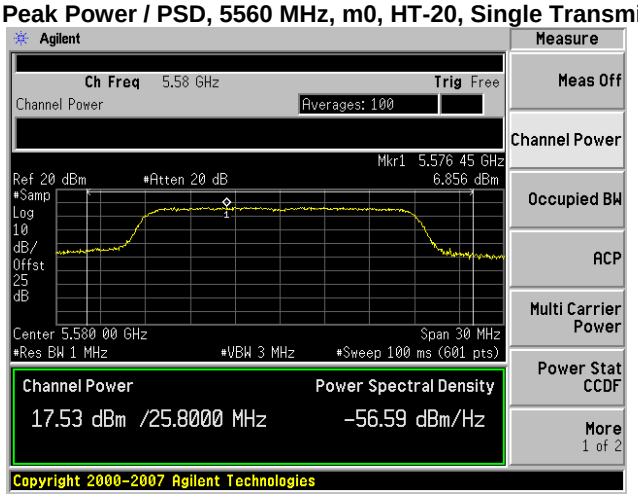
Ant A



Ant B

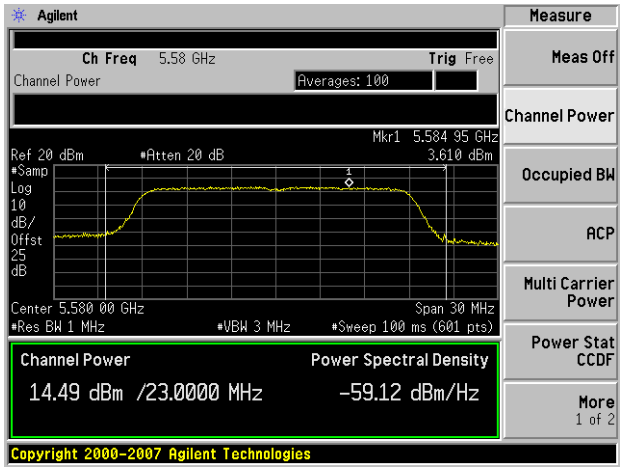


Peak Power / PSD, 5560 MHz, m0, HT-20, Single Transmit Path

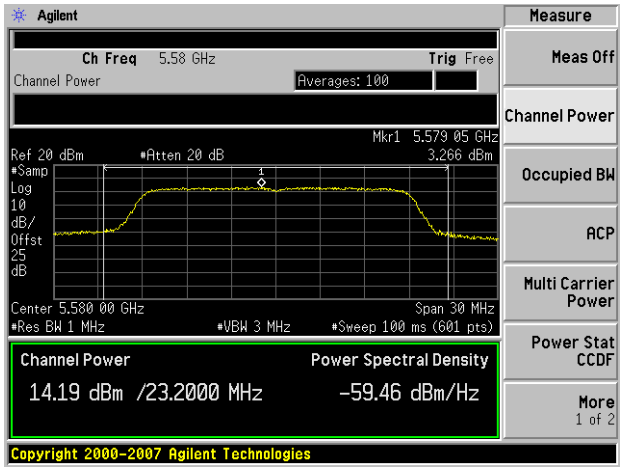


Peak Power / PSD, 5560 MHz, m0, HT-20, Dual Transmit Paths

Ant A

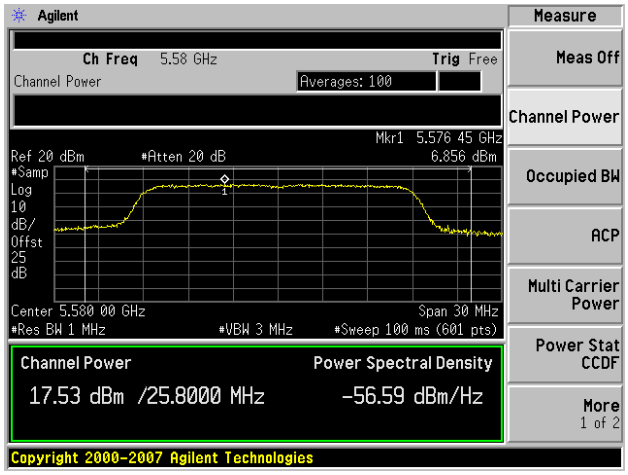


Ant B

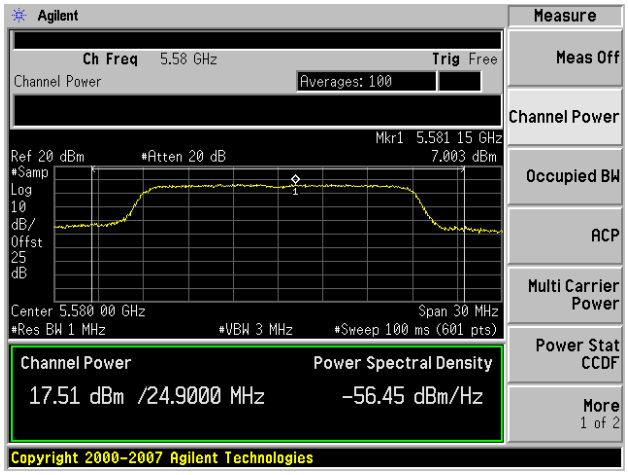


Peak Power / PSD, 5560 MHz, m8, HT-20, Dual Transmit Paths

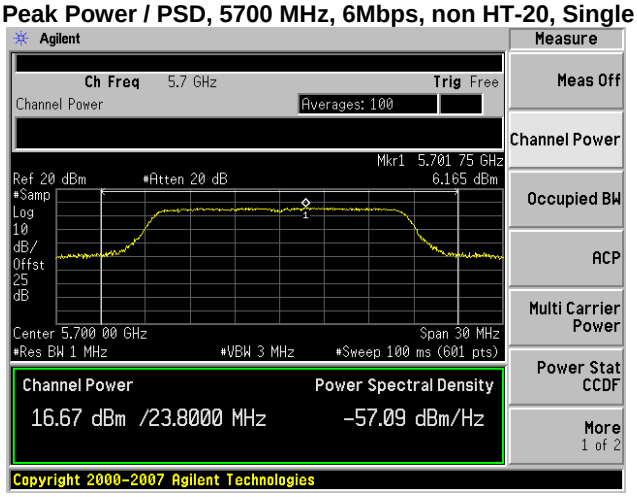
Ant A



Ant B

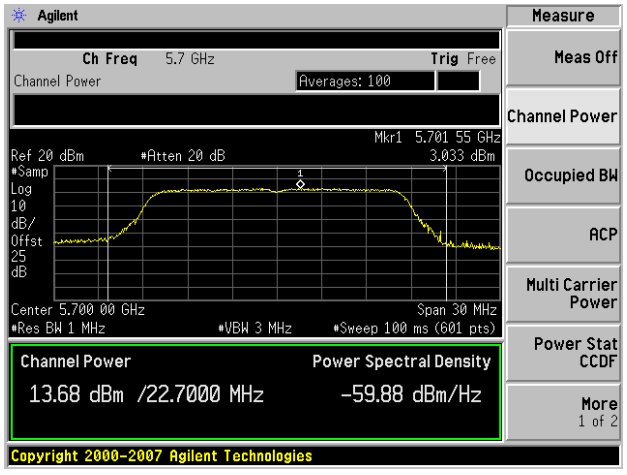


Peak Power / PSD, 5700 MHz, 6Mbps, non HT-20, Single Transmit Path

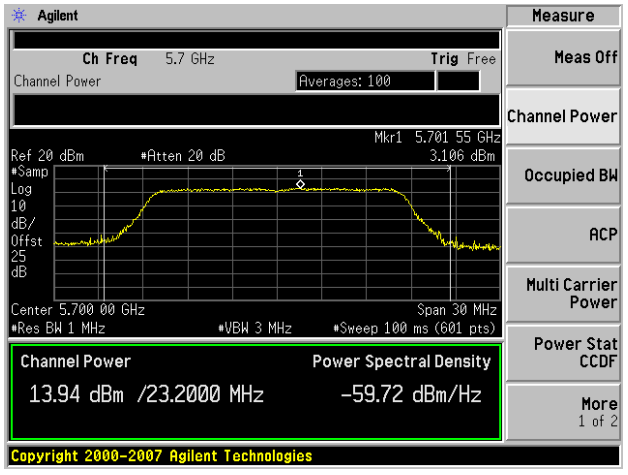


Peak Power / PSD, 5700 MHz, 6Mbps, non HT-20 / Beamform, Dual Transmit Paths

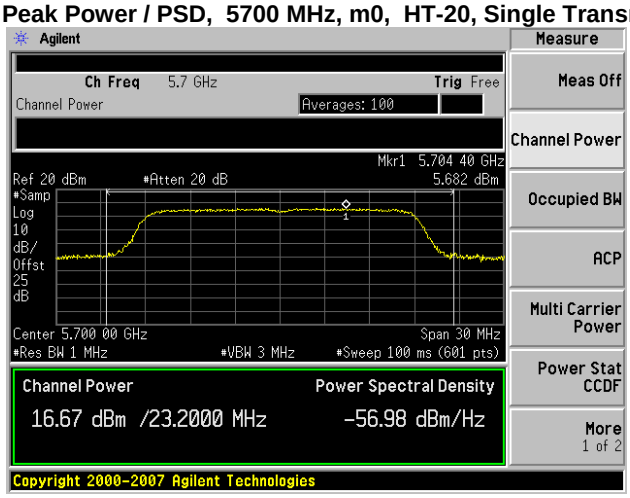
Ant A



Ant B

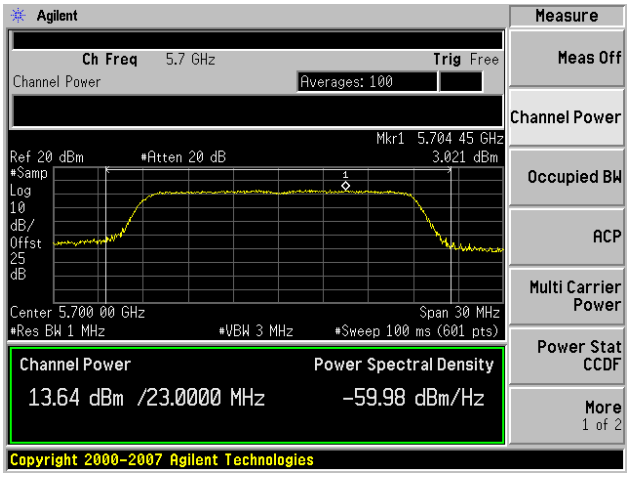


Peak Power / PSD, 5700 MHz, m0, HT-20, Single Transmit Path

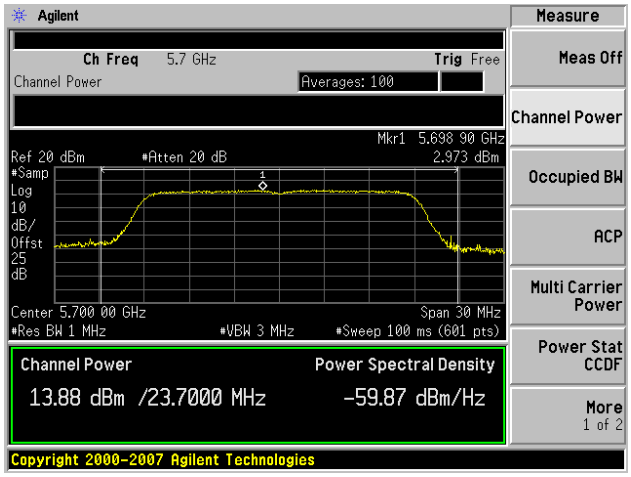


Peak Power / PSD, 5700 MHz, m0, HT-20, Dual Transmit Paths

Ant A

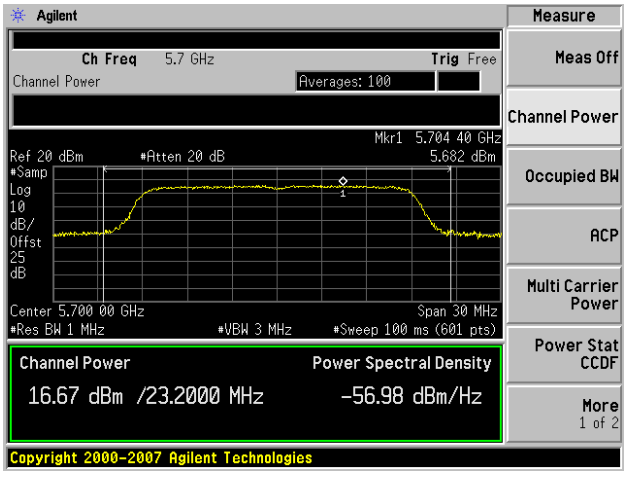


Ant B

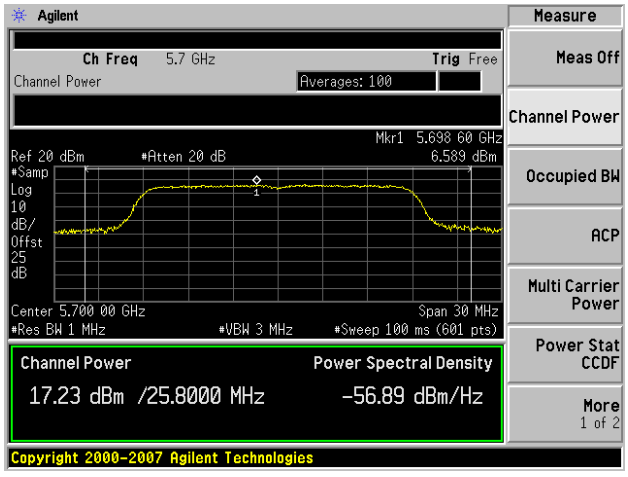


Peak Power / PSD, 5700 MHz, m8, HT-20, Dual Transmit Paths

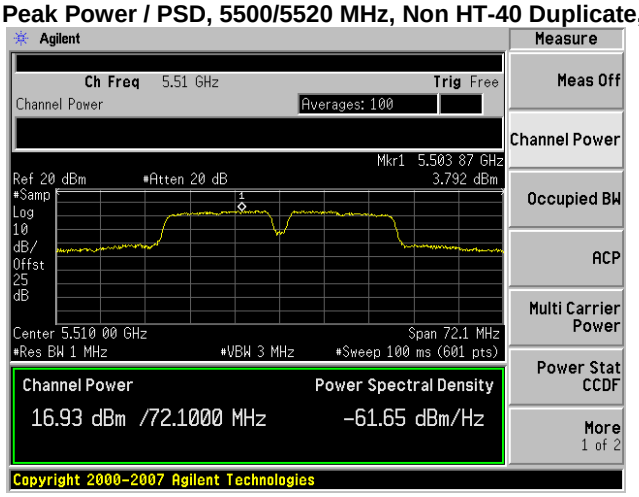
Ant A



Ant B

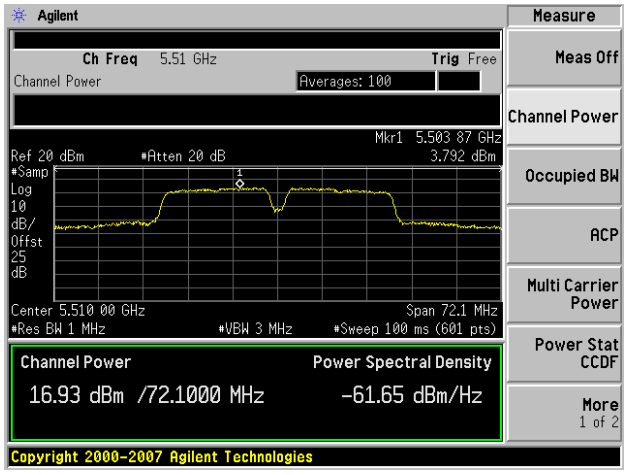


Peak Power / PSD, 5500/5520 MHz, Non HT-40 Duplicate, 6-54 Mbps, Single

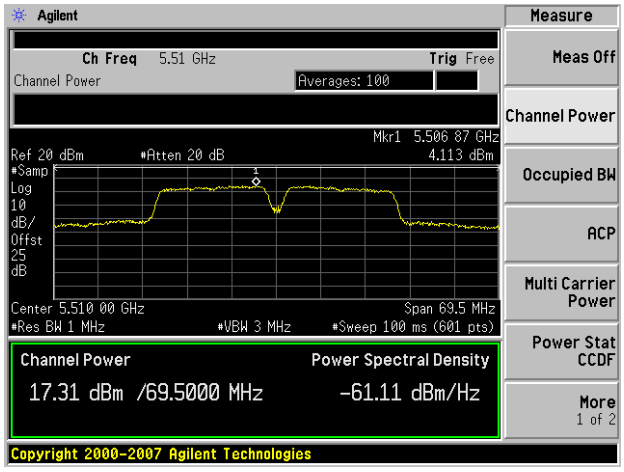


Peak Power / PSD, 5500/5520 MHz, Non HT-40 Duplicate, 6-54 Mbps, Dual

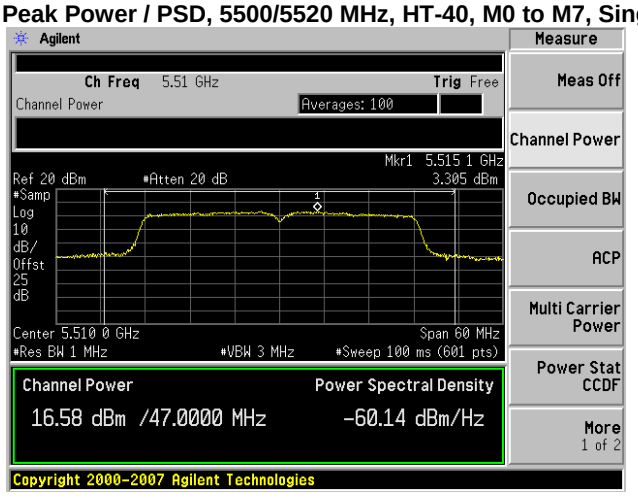
Ant A



Ant B

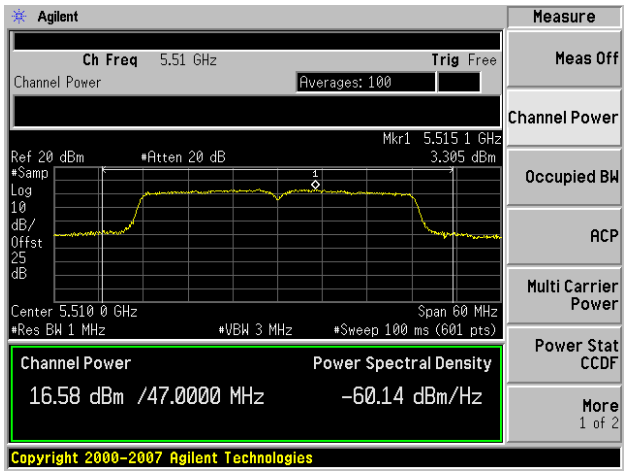


Peak Power / PSD, 5500/5520 MHz, HT-40, M0 to M7, Single

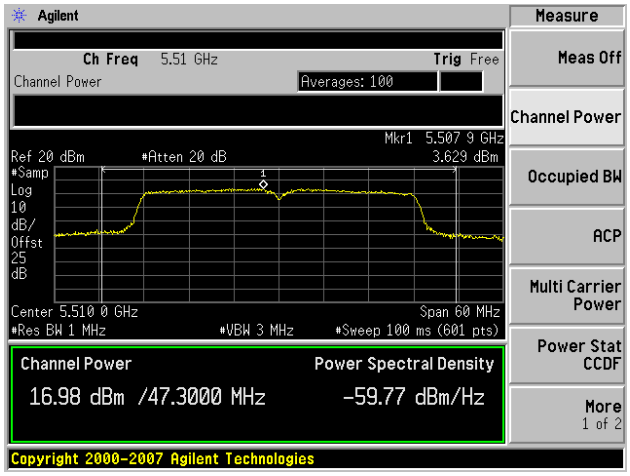


Peak Power / PSD, 5500/5520 MHz, HT-40, M0 to M15, Dual

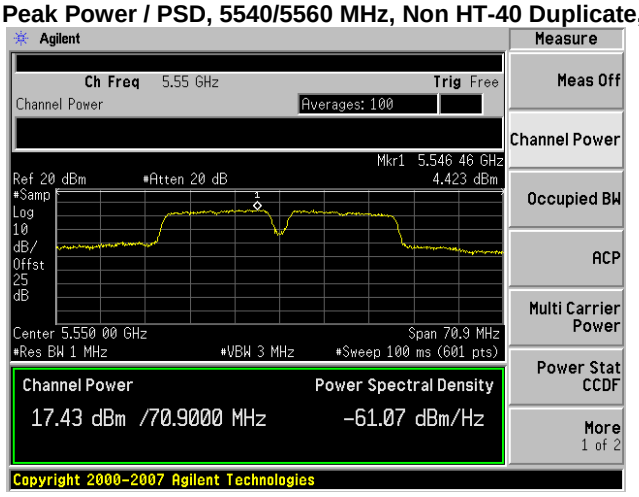
Ant A



Ant B

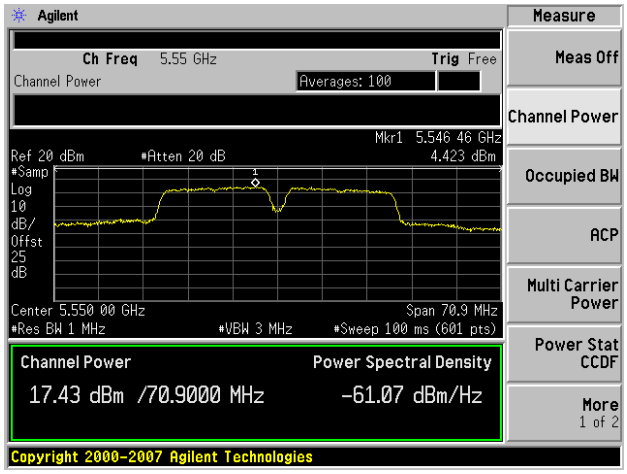


Peak Power / PSD, 5540/5560 MHz, Non HT-40 Duplicate, 6-54 Mbps, Single

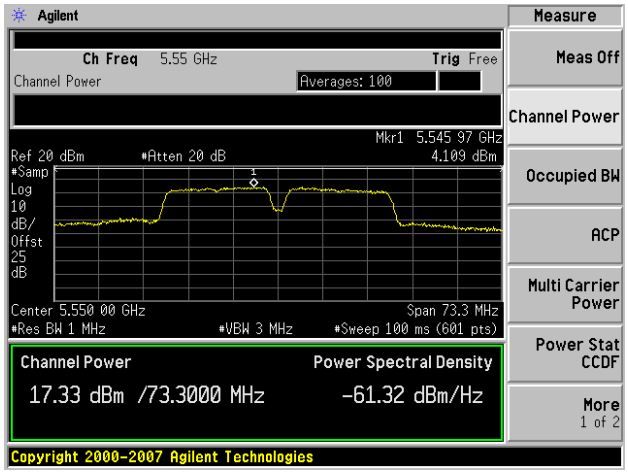


Peak Power / PSD, 5540/5560 MHz, Non HT-40 Duplicate, 6-54 Mbps, Dual

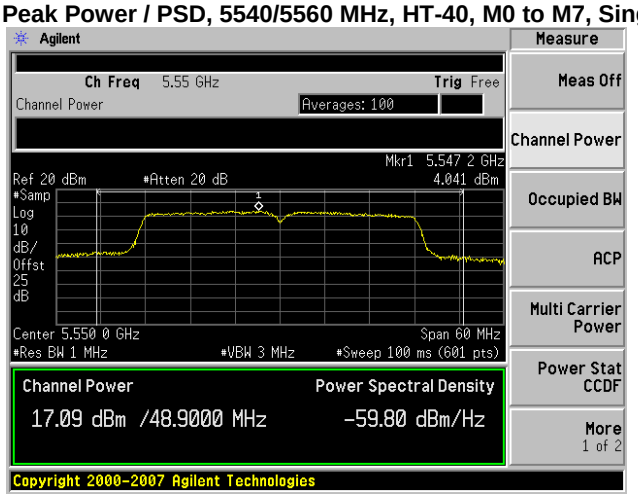
Ant A



Ant B

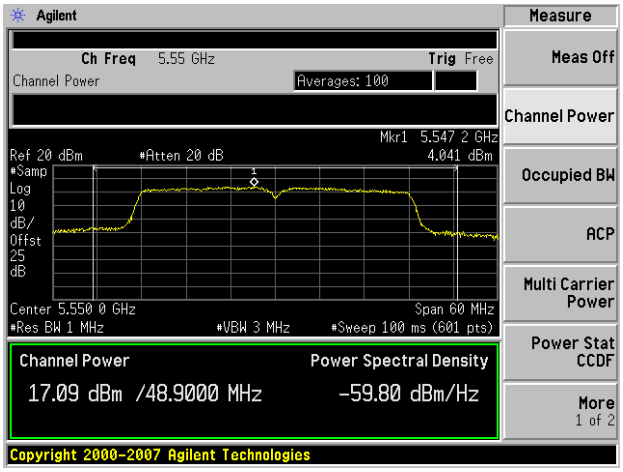


Peak Power / PSD, 5540/5560 MHz, HT-40, M0 to M7, Single

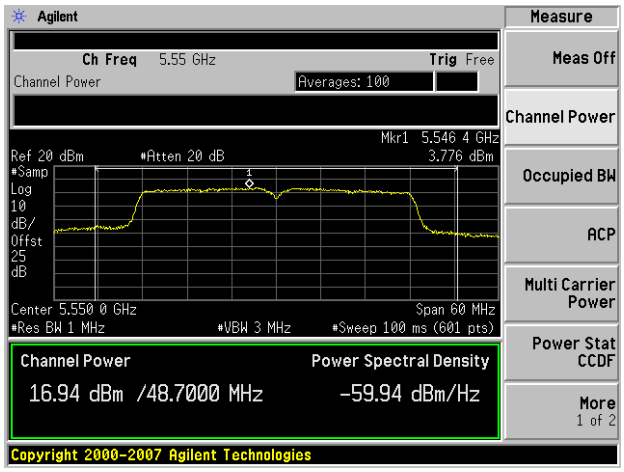


Peak Power / PSD, 5540/5560 MHz, HT-40, M0 to M15, Dual

Ant A



Ant B



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 <= 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 <= 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 = Auto
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

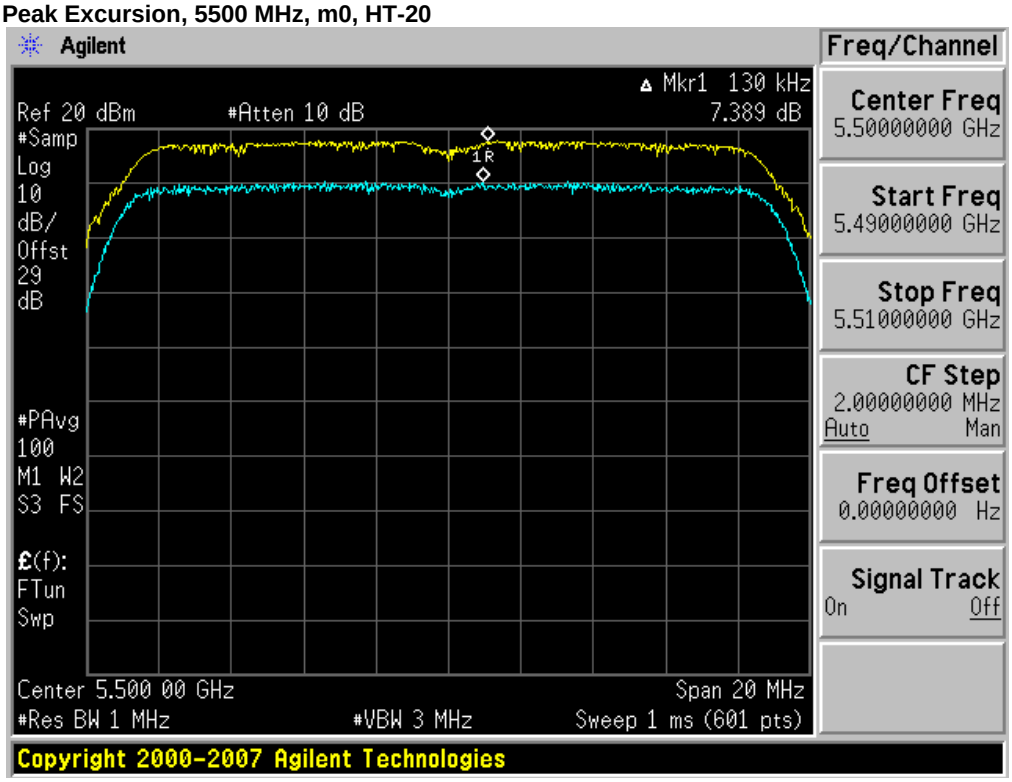
Set marker Deltas

Trace 1 & Peak search
Marker Delta
Trace 2 & Peak search

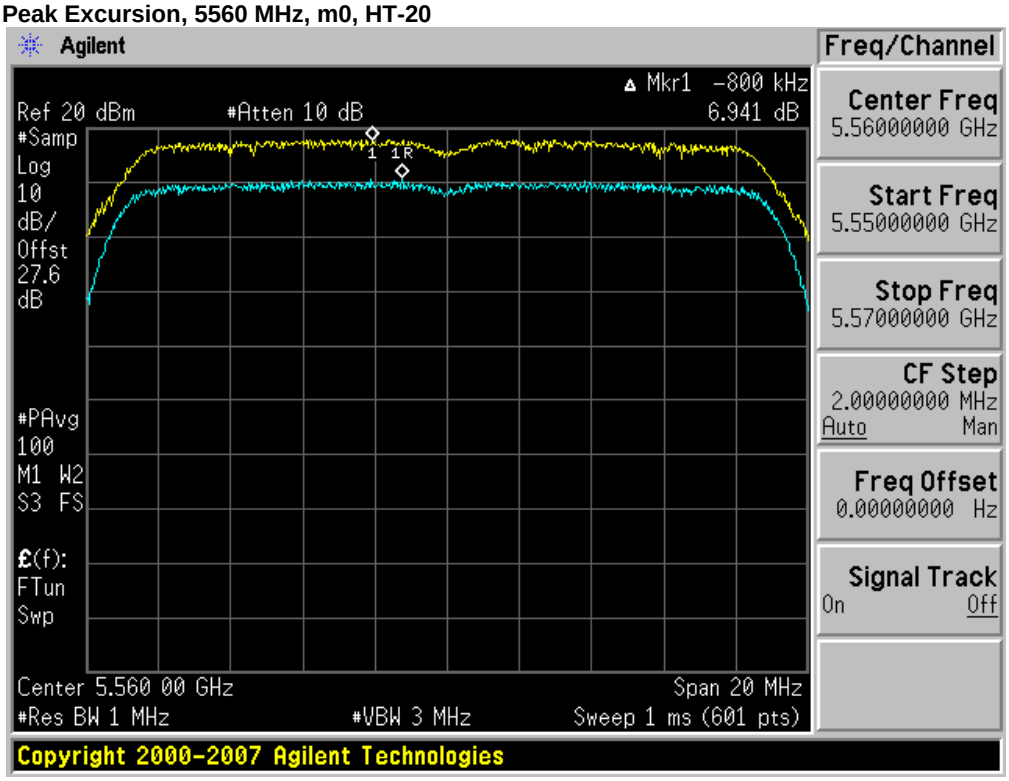
Record the difference between the Peak and Average Markers

Frequency (MHz)	Mode	Data Rate	Peak Excursion	Limit (dB)	Margin (dB)
5500	HT-20	M0	**7.4**	**13**	**5.6**
5560	HT-20	M0	**6.9**	**13**	**6.1**
5700	HT-20	M0	**7.6**	**13**	**5.4**
5500/5520	Non HT-40	6	**7.6**	**13**	**5.4**
5500/5520	HT-40	M0	**7.3**	**13**	**5.7**
5540/5560	Non HT-40	6	**7.4**	**13**	**5.6**
5540/5560	HT-40	M0	**7.9**	**13**	**5.1**

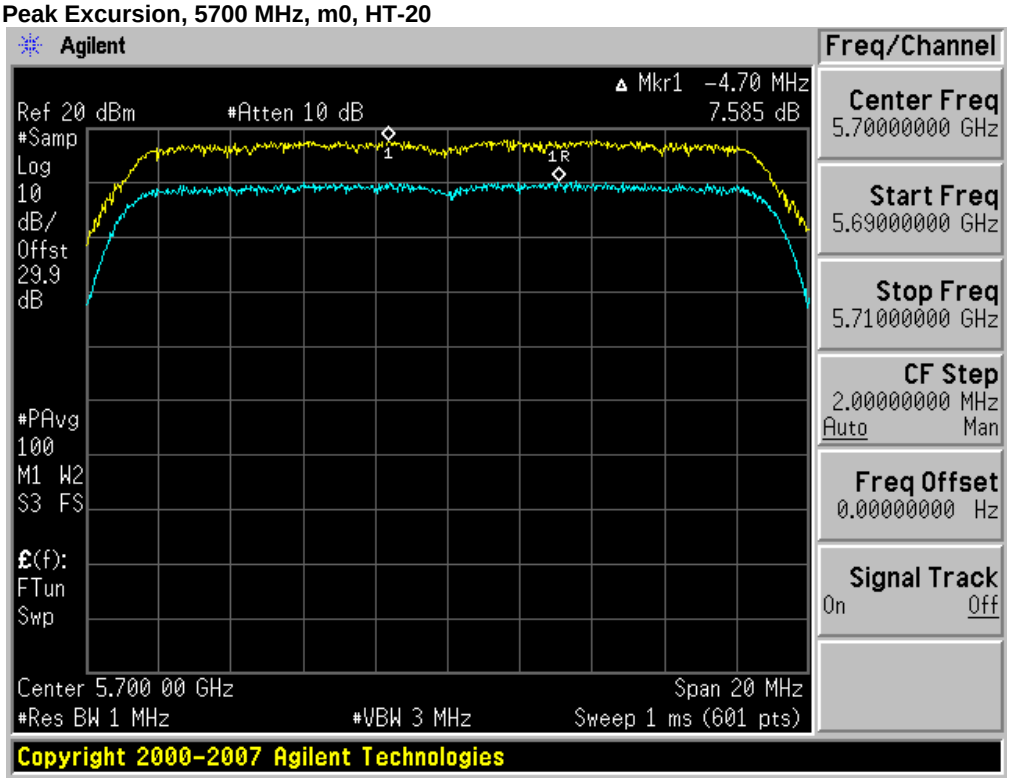
Peak Excursion, 5500 MHz, m0, HT-20



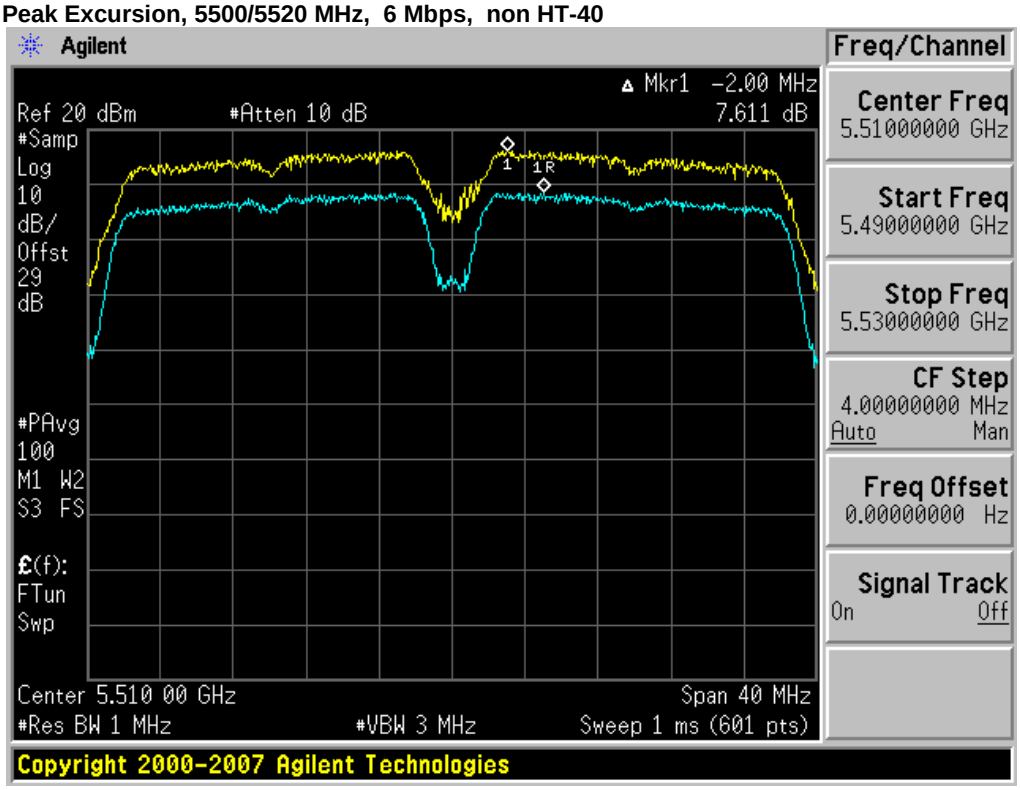
Peak Excursion, 5560 MHz, m0, HT-20



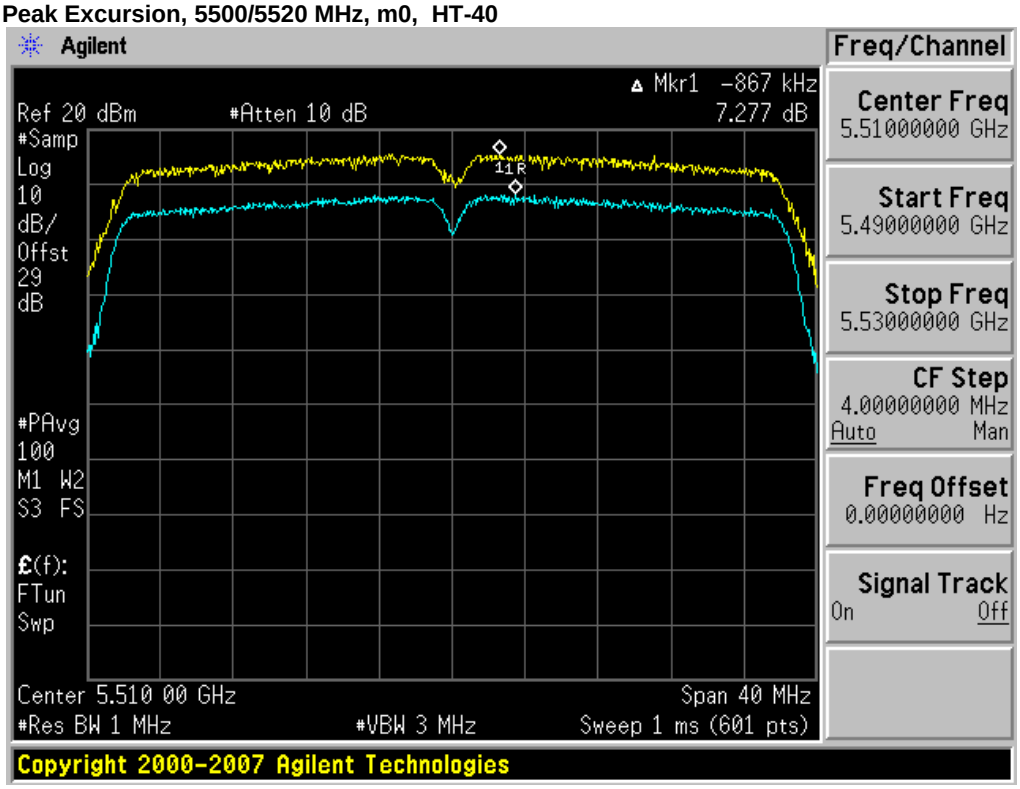
Peak Excursion, 5700 MHz, m0, HT-20



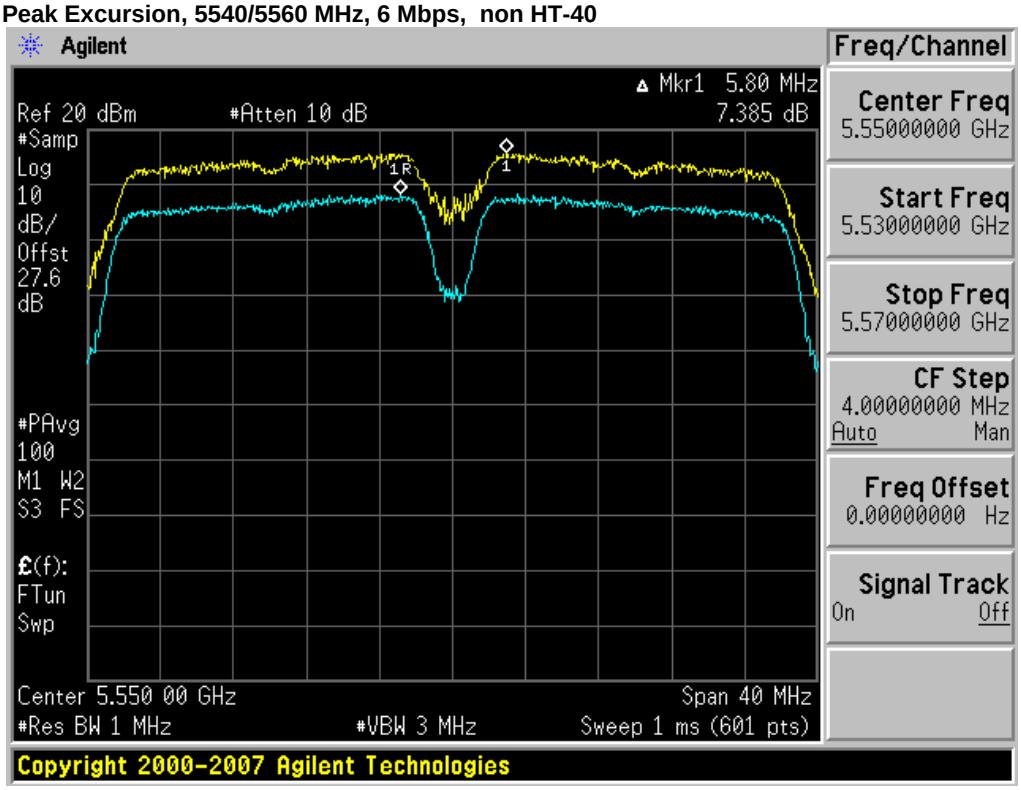
Peak Excursion, 5500/5520 MHz, 6 Mbps, non HT-40



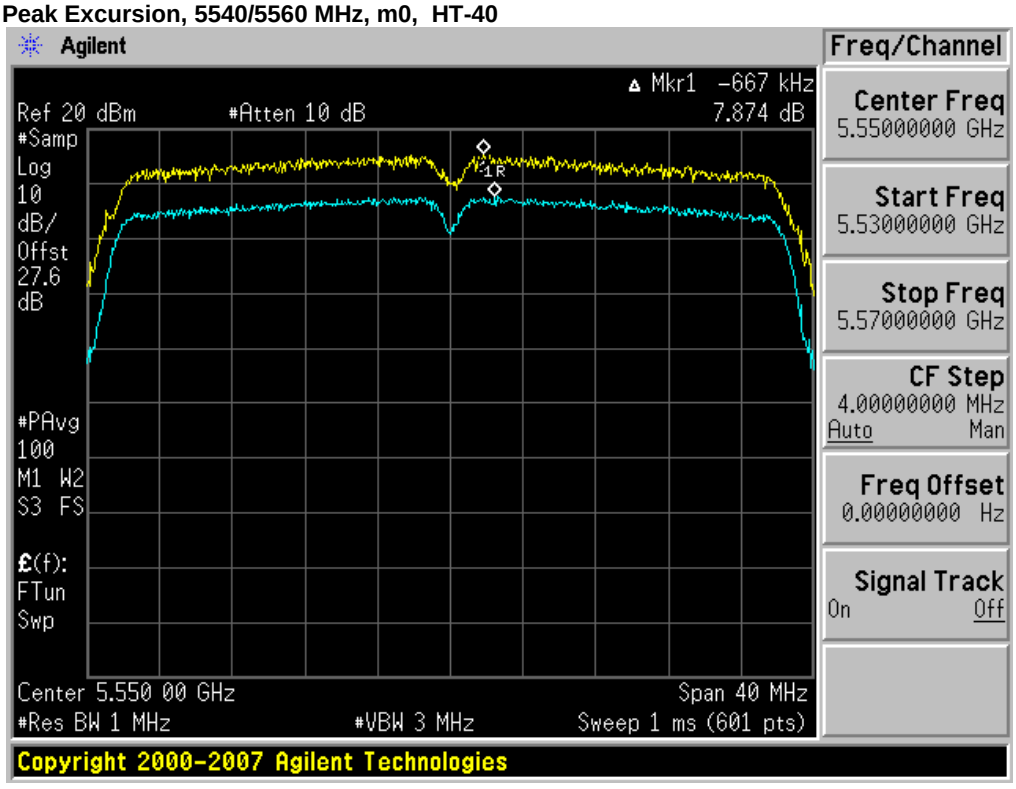
Peak Excursion, 5500/5520 MHz, m0, HT-40



Peak Excursion, 5540/5560 MHz, 6 Mbps, non HT-40



Peak Excursion, 5540/5560 MHz, m0, HT-40



Conducted Spurious Emissions

15.407: For transmitters operating in the 5.25-5.35 and 5.47-5.725 GHz band: all emissions outside of the 5.25-5.35 and 5.47-5.725 GHz bands shall not exceed an EIRP of -27dBm/MHz.

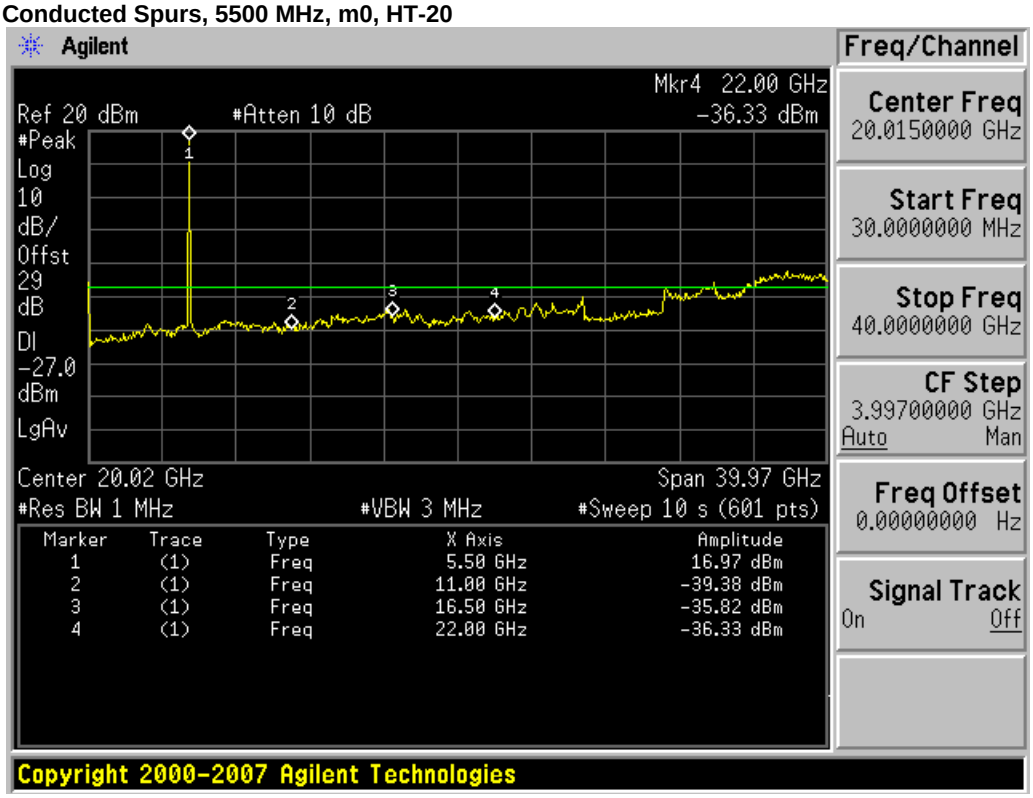
Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer).

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

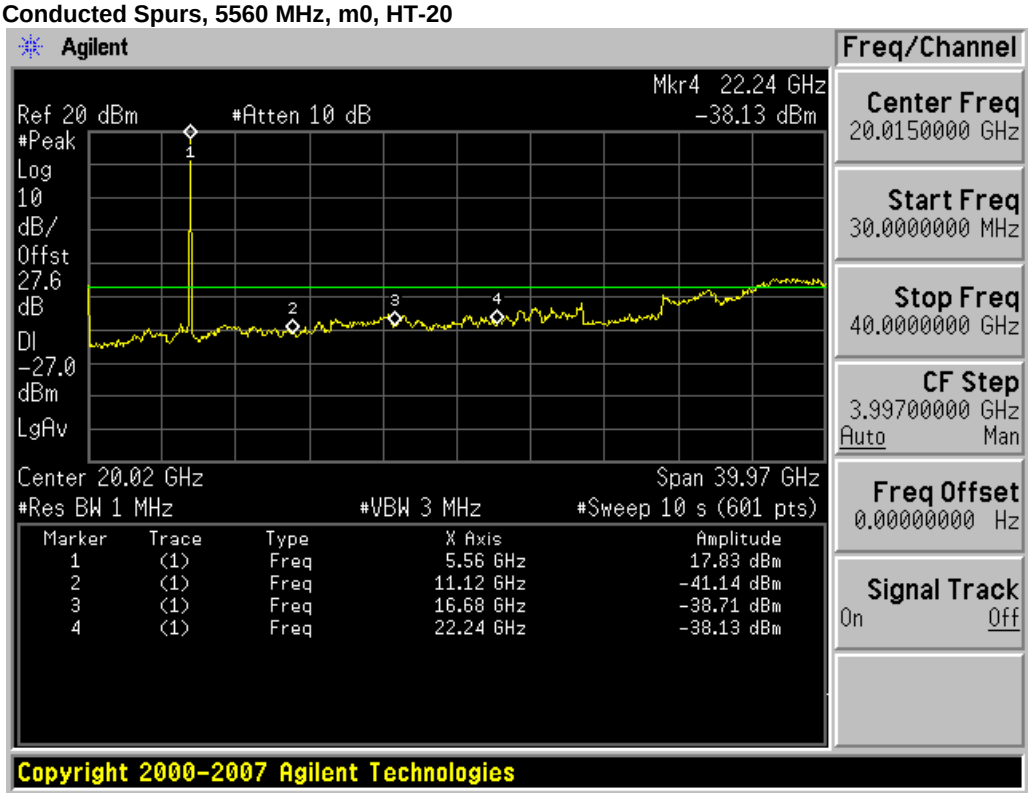
Record the marker waveform peak to spur difference

Frequency (MHz)	Mode	Data Rate	Conducted Spurs (dBm)	Limit (dB)	Margin (dB)
5500	HT-20	M0	**-35.82**	**-27**	**8.82**
5560	HT-20	M0	**-38.13**	**-27**	**11.13**
5700	HT-20	M0	**-33.63**	**-27**	**6.63**
5500/5520	Non HT-40	6	**-37.08**	**-27**	**10.08**
5500/5520	HT-40	M0	**-36.88**	**-27**	**9.88**
5540/5560	Non HT-40	6	**-38.66**	**-27**	**11.66**
5540/5560	HT-40	M0	**-37.58**	**-27**	**10.58**

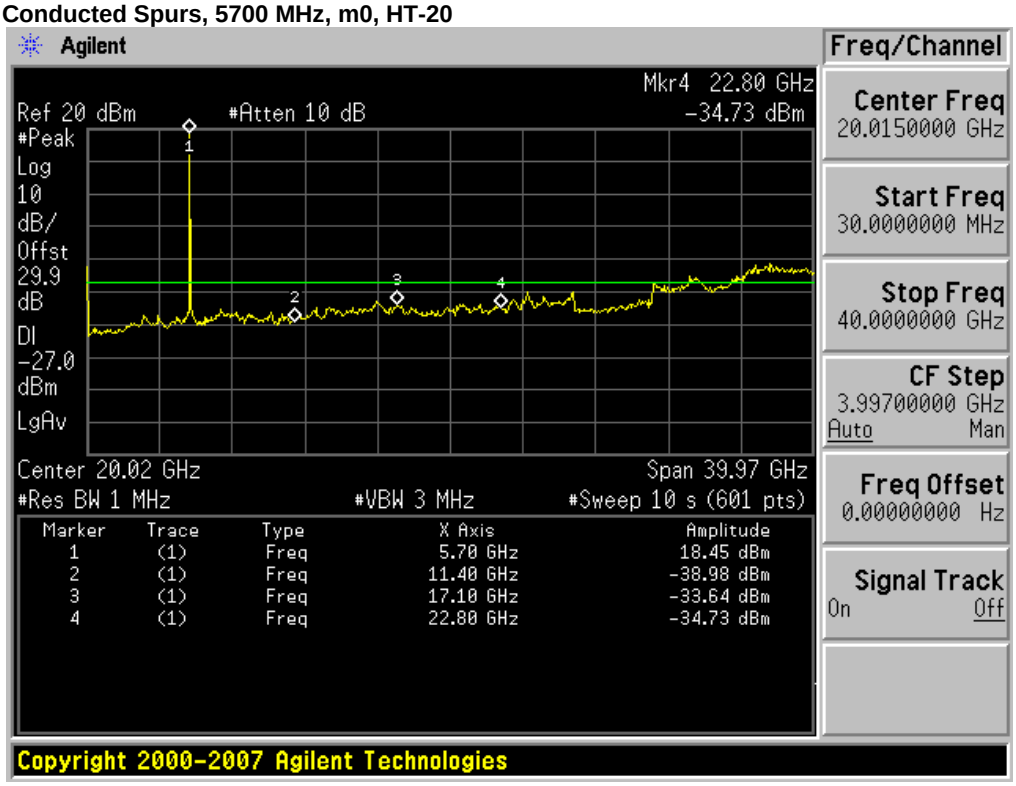
Conducted Spurs, 5500 MHz, m0, HT-20



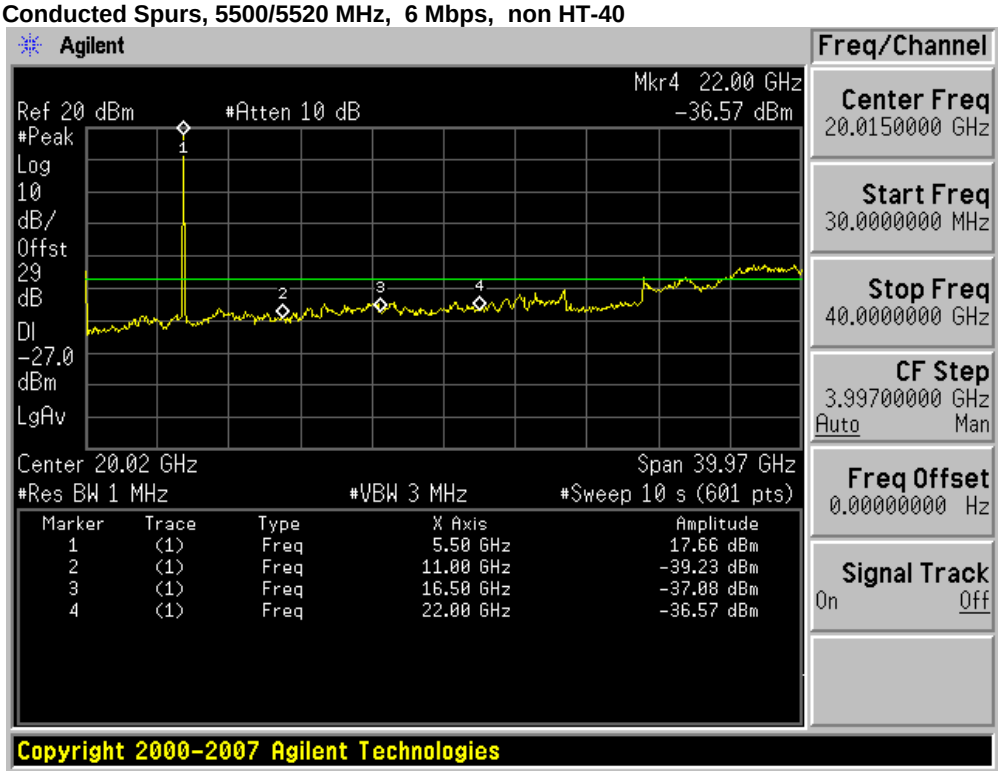
Conducted Spurs, 5560 MHz, m0, HT-20



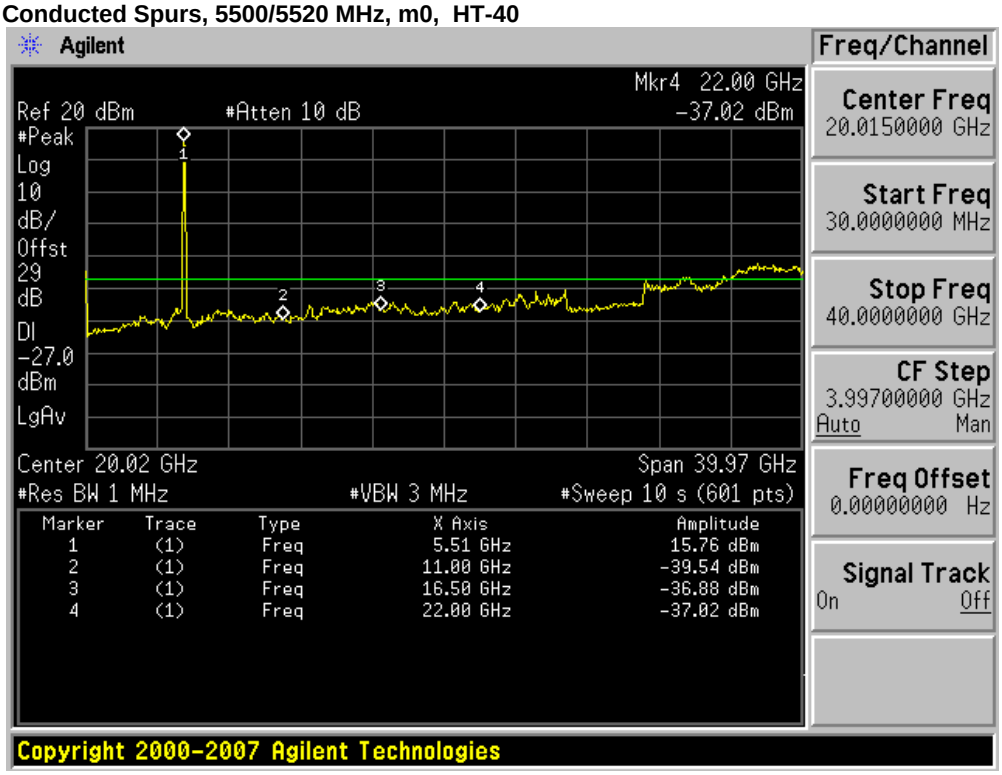
Conducted Spurs, 5700 MHz, m0, HT-20



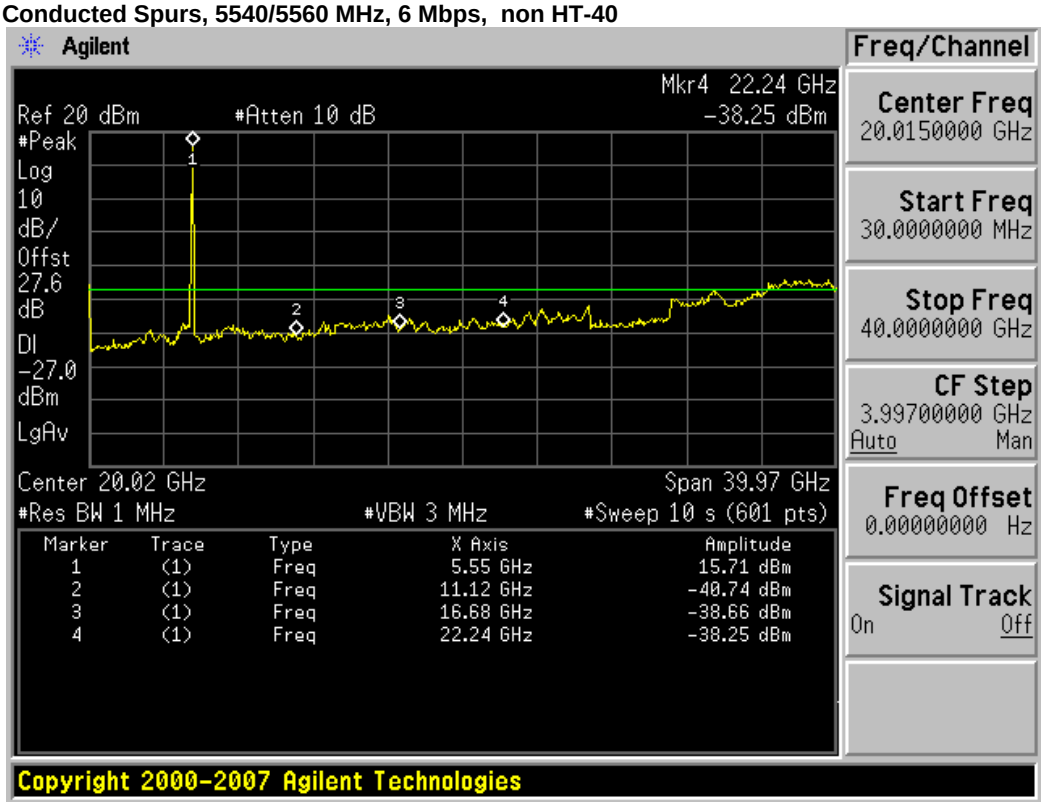
Conducted Spurs, 5500/5520 MHz, 6 Mbps, non HT-40



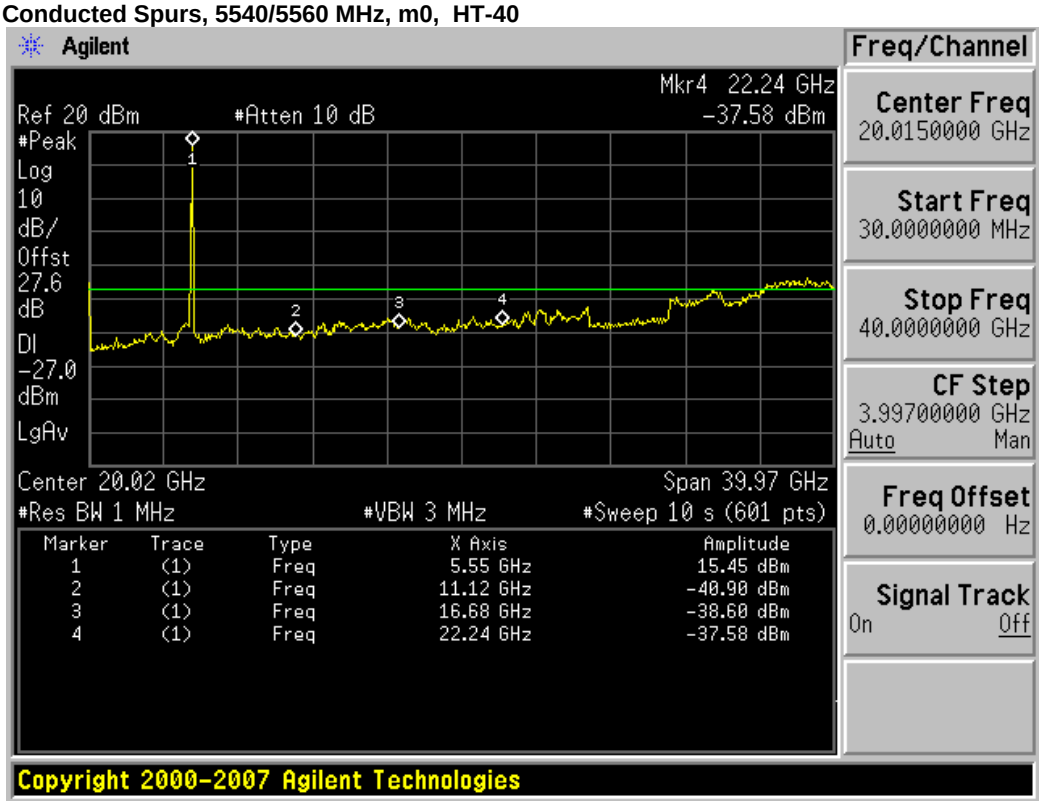
Conducted Spurs, 5500/5520 MHz, m0, HT-40



Conducted Spurs, 5540/5560 MHz, 6 Mbps, non HT-40



Conducted Spurs, 5540/5560 MHz, m0, HT-40



Conducted Bandedge

15.407: For transmitters operating in the 5.25-5.25 GHz and 5.47-5.725 GHz band: all emissions outside of the 5.25-5.35 GHz and 5.47-5.725 GHz band shall not exceed an EIRP of -27dBm/MHz.

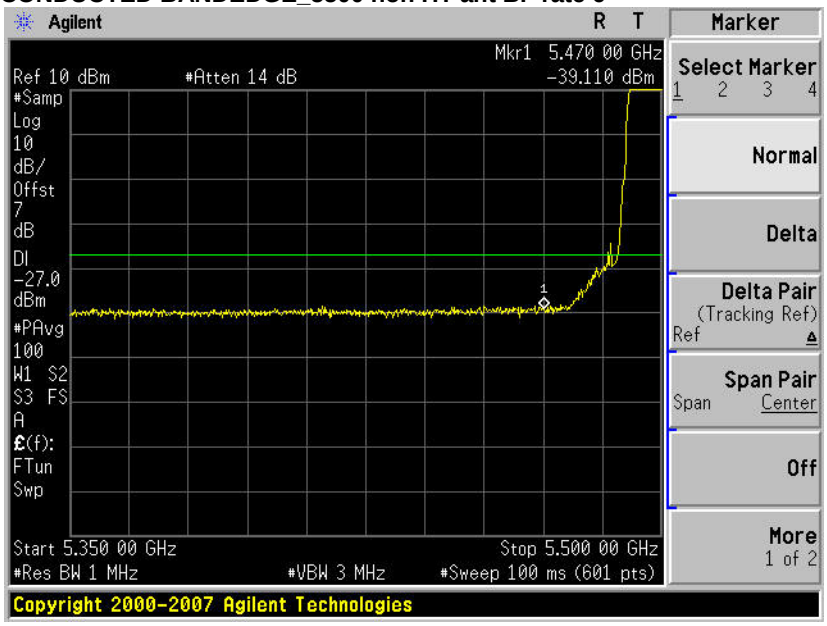
Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer).

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

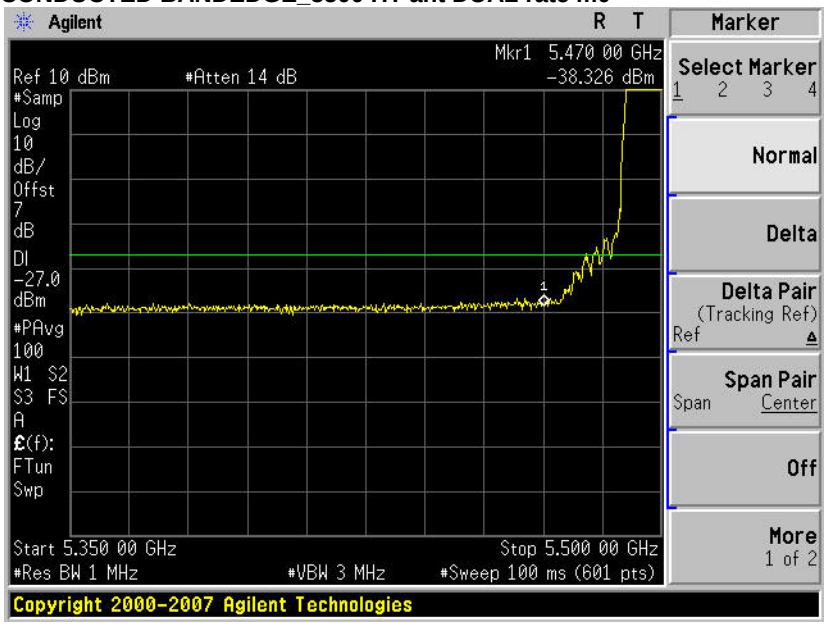
Record the marker waveform peak to spur difference

Frequency (MHz)	Operating Mode	Data Rate (Mbps)	Conducted Band Edge Level (dBm)	Limit (dBm)	Margin (dB)
5500	Non HT-20 Beam Forming, 6 to 54 Mbps	6	-39.10	-27	12.1
5500	HT-20, M0 to M7, Dual	M0	-38.30	-27	11.3
5700	Non HT-20 Beam Forming, 6 to 54 Mbps	6	-38.95	-27	11.95
5700	HT-20, M0 to M7, Dual	M0	-37.00	-27	10
5500/5520	Non HT-40 Duplicate, 6-54 Mbps, Dual	6	-31.14	-27	4.14
5500/5520	HT-40 Duplicate,M0 to M7, Dual	m0	-32.70	-27	5.7

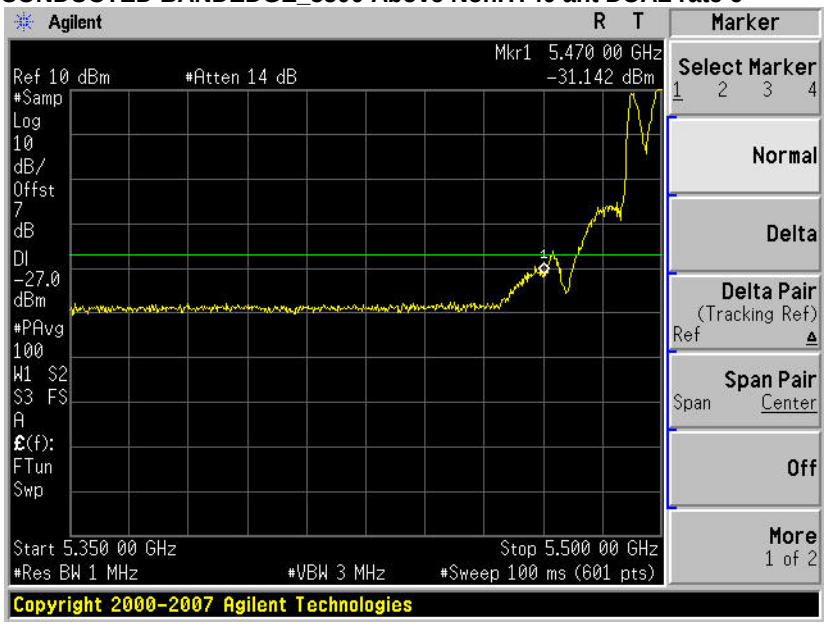
CONDUCTED BANDEDGE_5500 non HT ant BF rate 6



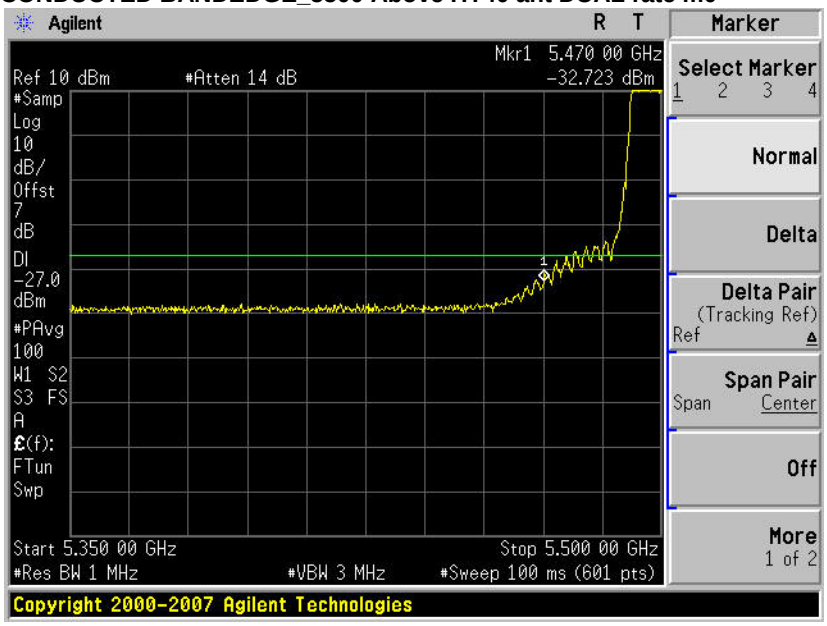
CONDUCTED BANDEDGE_5500 HT ant DUAL rate m0



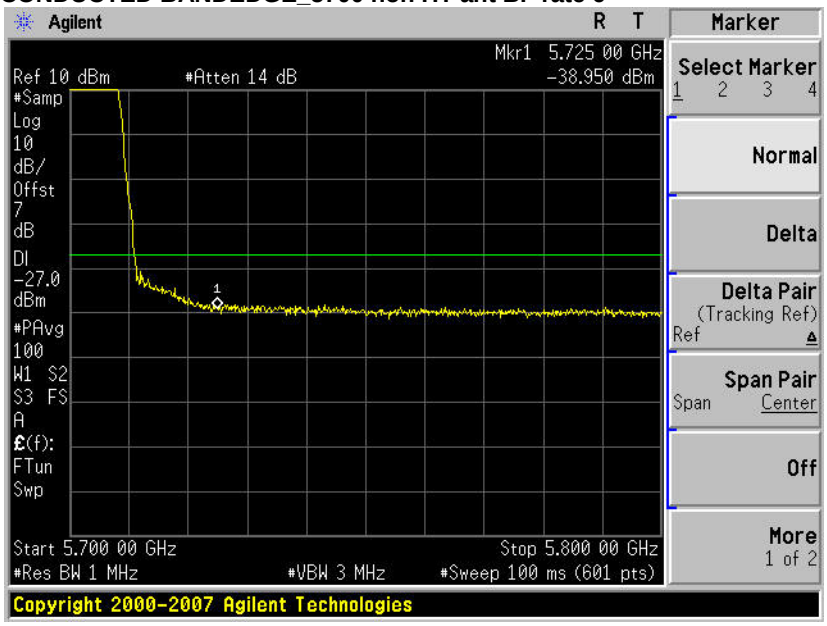
CONDUCTED BANDEDGE_5500 Above NonHT40 ant DUAL rate 6



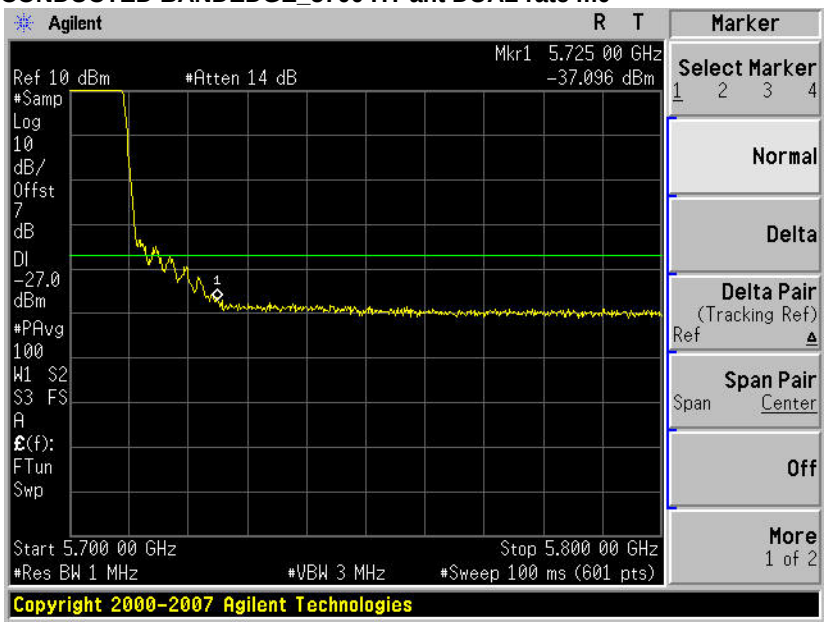
CONDUCTED BANDEDGE_5500 Above HT40 ant DUAL rate m0

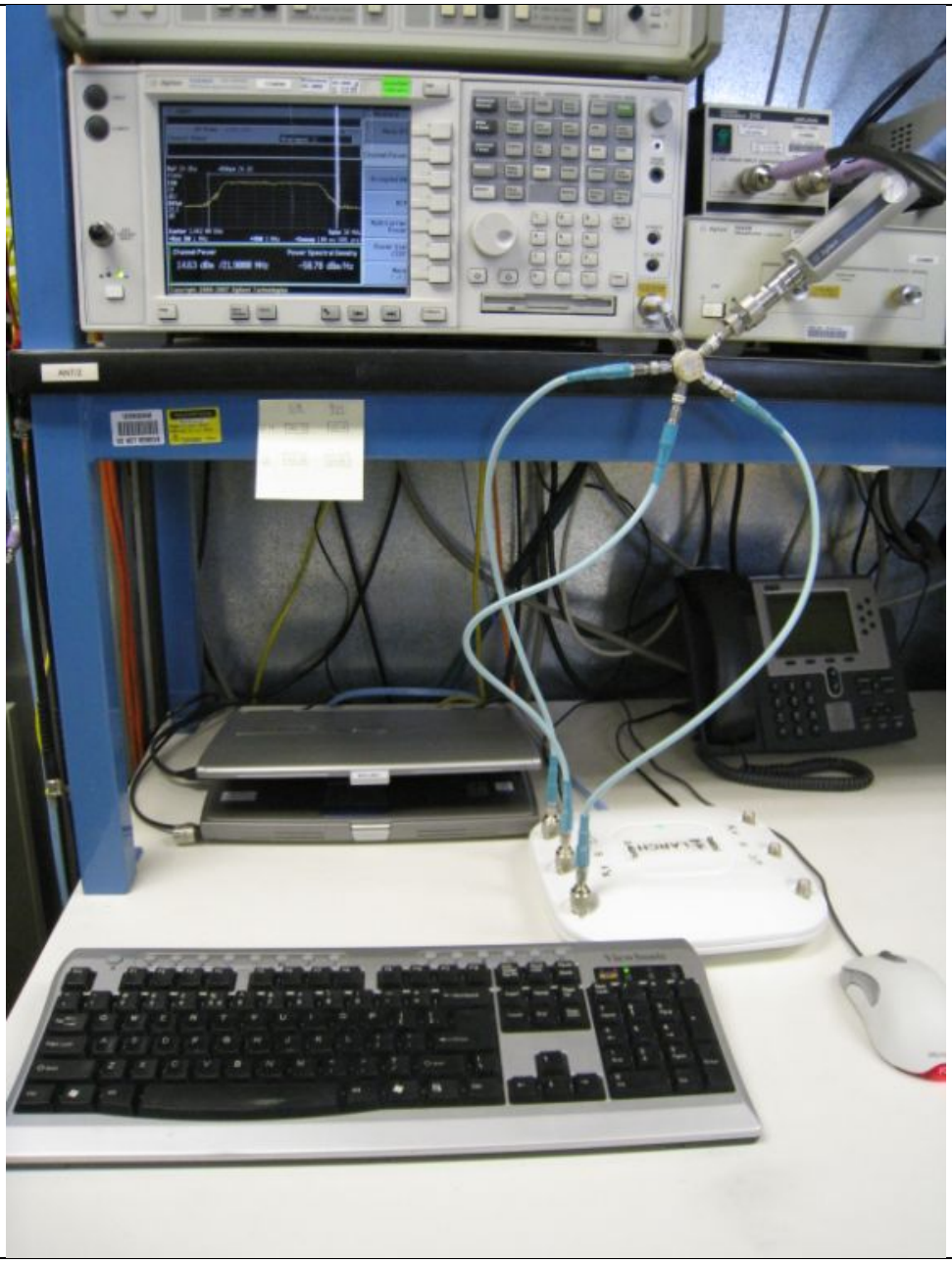


CONDUCTED BANDEDGE_5700 non HT ant BF rate 6



CONDUCTED BANDEDGE_5700 HT ant DUAL rate m0





Title: Conducted Test Setup

Appendix B: Emission Test Results

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

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

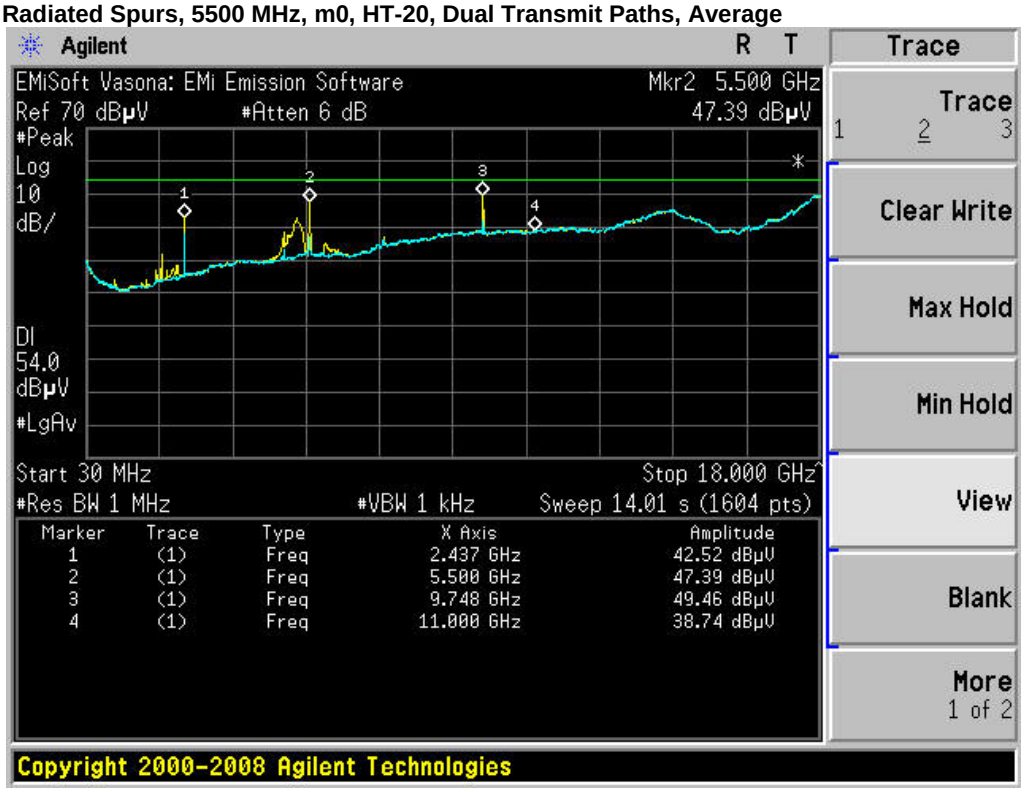
Maximize Turntable (find worst case table angle), Maximize Antenna (find worst case height)

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

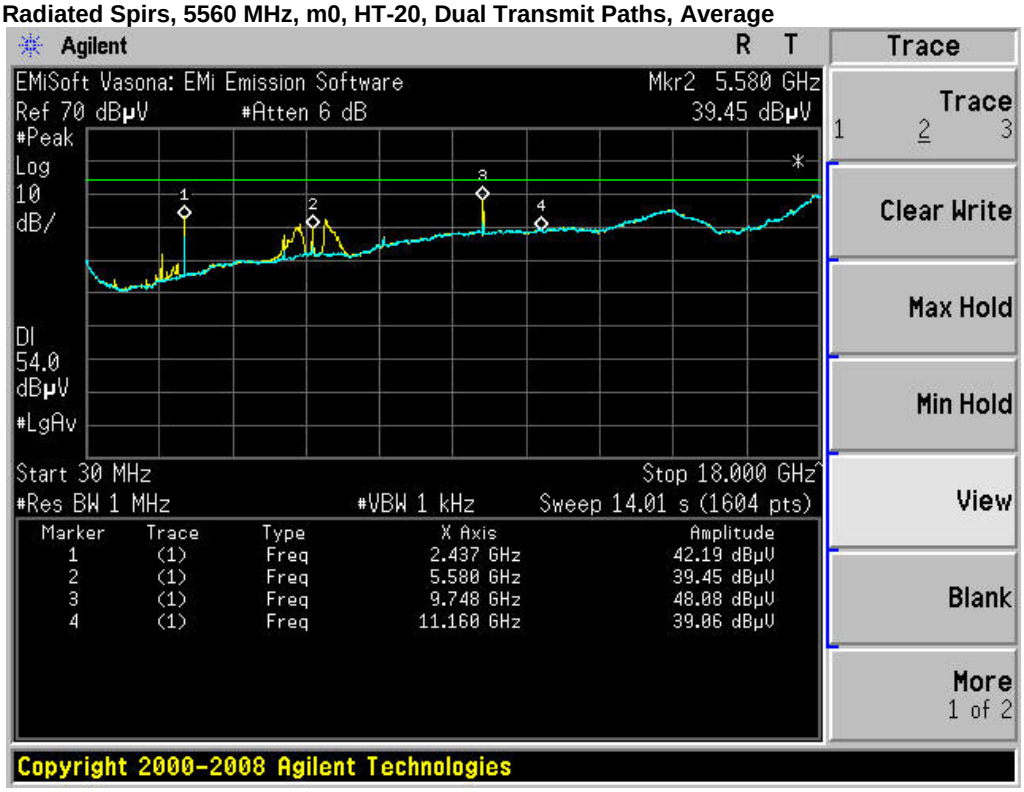
Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands.

Frequency (MHz)	Operating Mode	Data Rate (Mbps)	Radiated Spurs Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
5500	HT-20, M0 to M7, Dual	M0	49.46	54	4.54
5560	HT-20, M0 to M7, Dual	M0	48.08	54	5.92
5700	HT-20, M0 to M7, Dual	M0	49.61	54	4.39
5500/5520	HT-40 Duplicate, 6-54 Mbps, Dual	M0	49.38	54	4.62
5540/5560	HT-40 Duplicate, 6-54 Mbps, Dual	M0	49.29	54	4.71

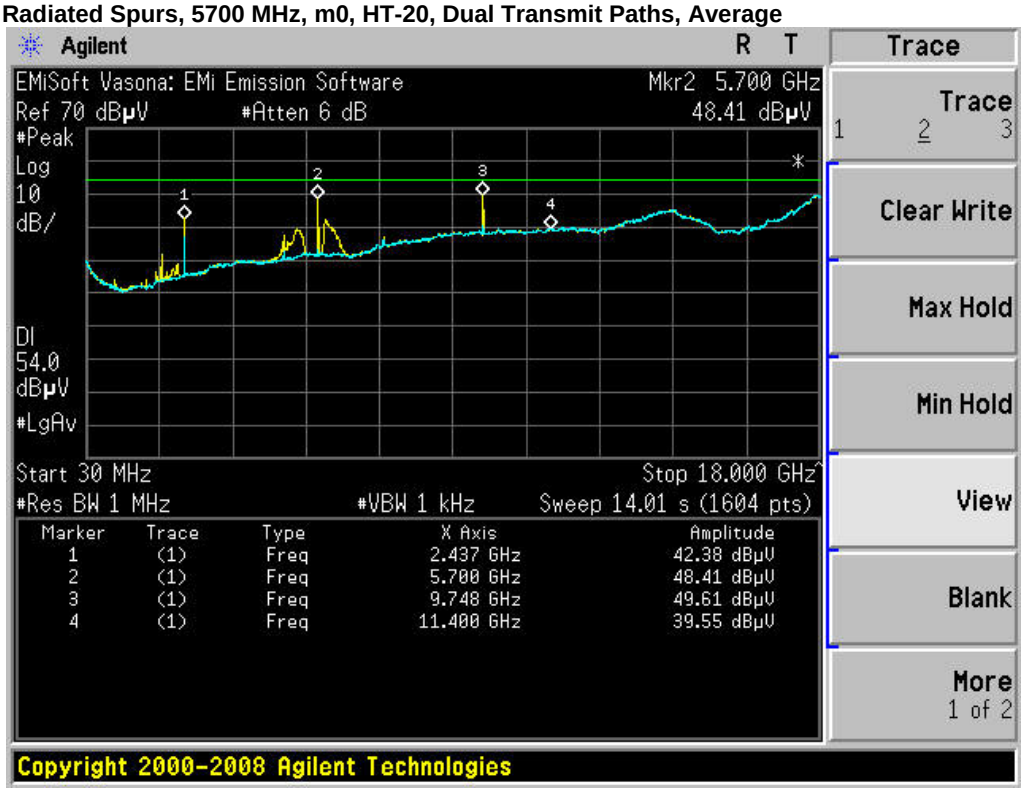
Radiated Spurs, 5500 MHz, m0, HT-20, Dual Transmit Paths, Average



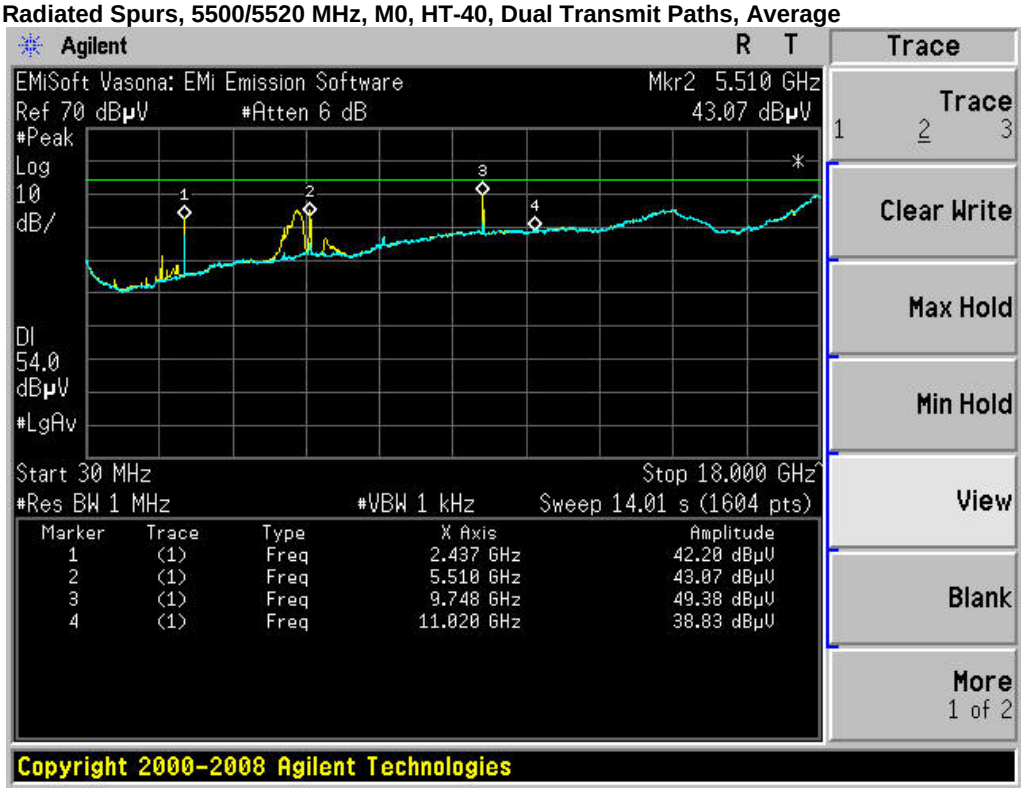
Radiated Spirs, 5560 MHz, m0, HT-20, Dual Transmit Paths, Average



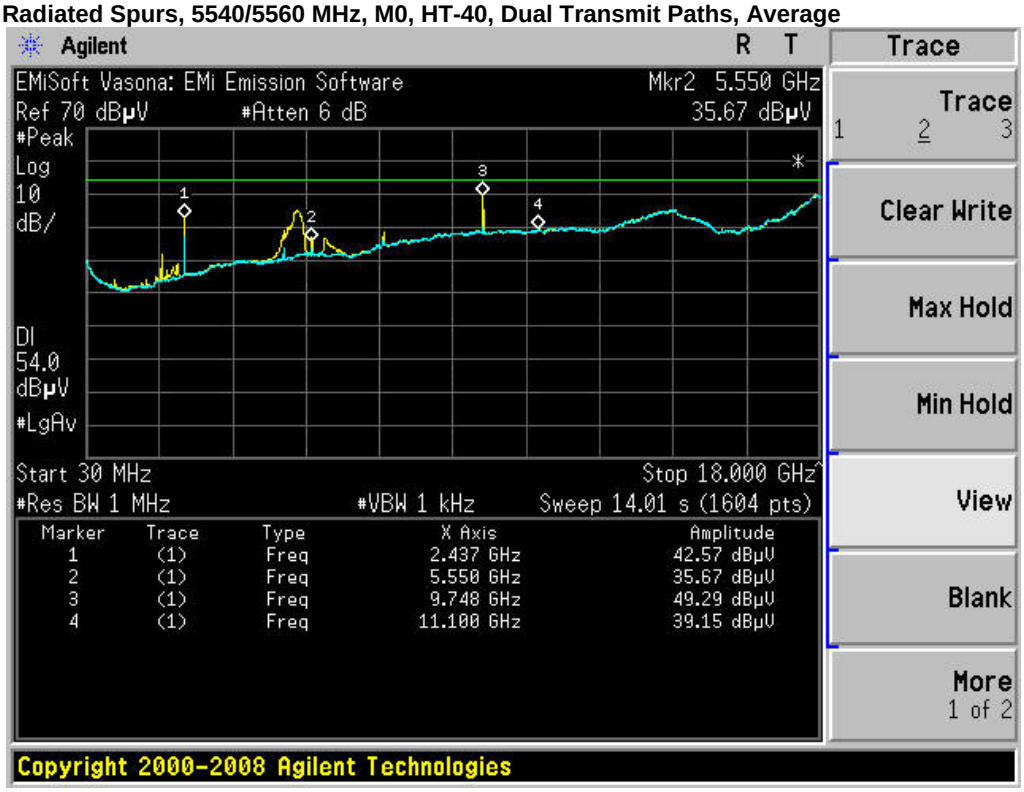
Radiated Spurs, 5700 MHz, m0, HT-20, Dual Transmit Paths, Average



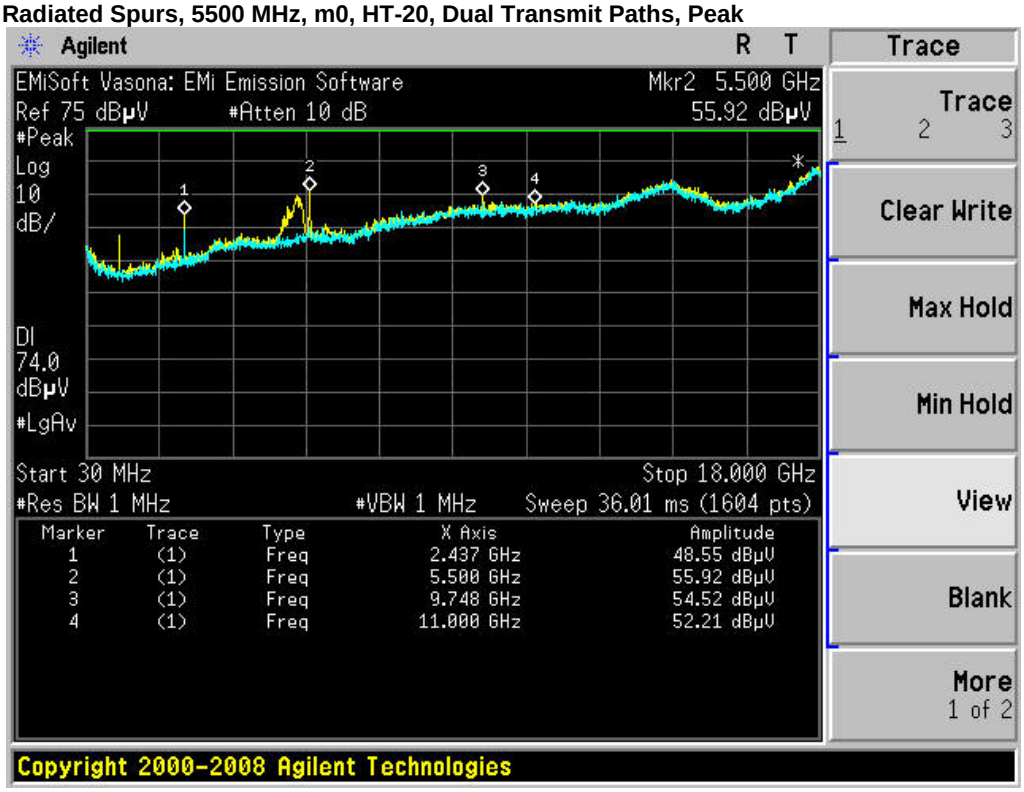
Radiated Spurs, 5500/5520 MHz, M0, HT-40, Dual Transmit Paths, Average



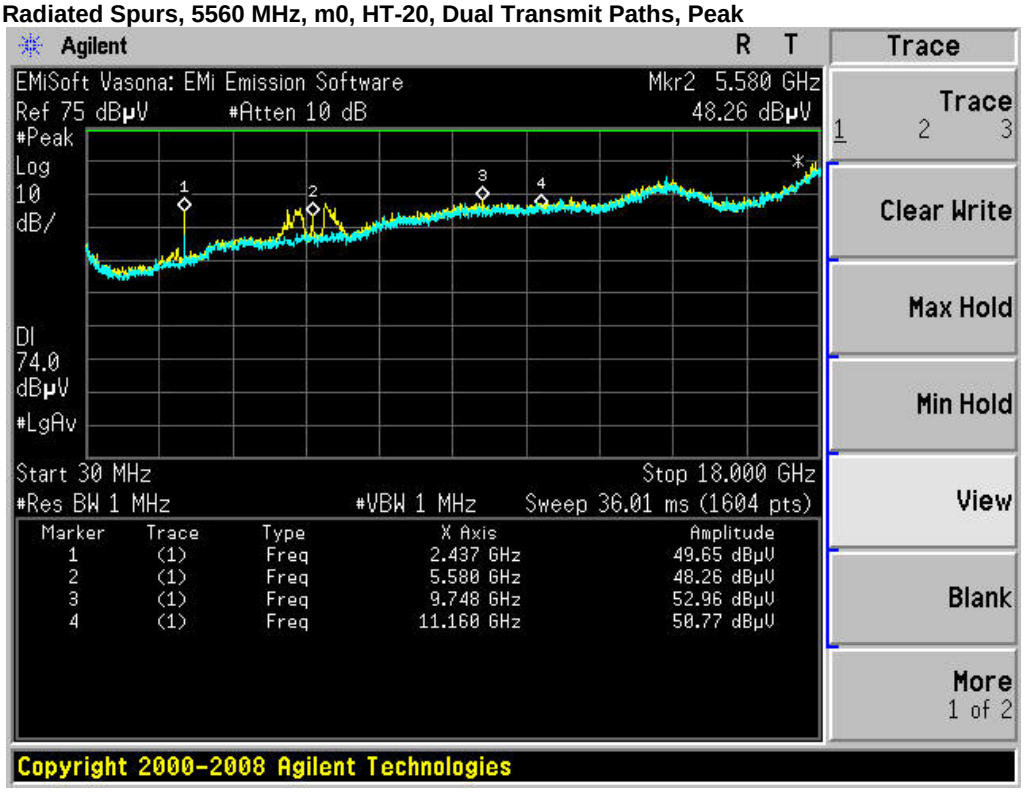
Radiated Spurs, 5540/5560 MHz, M0, HT-40, Dual Transmit Paths, Average



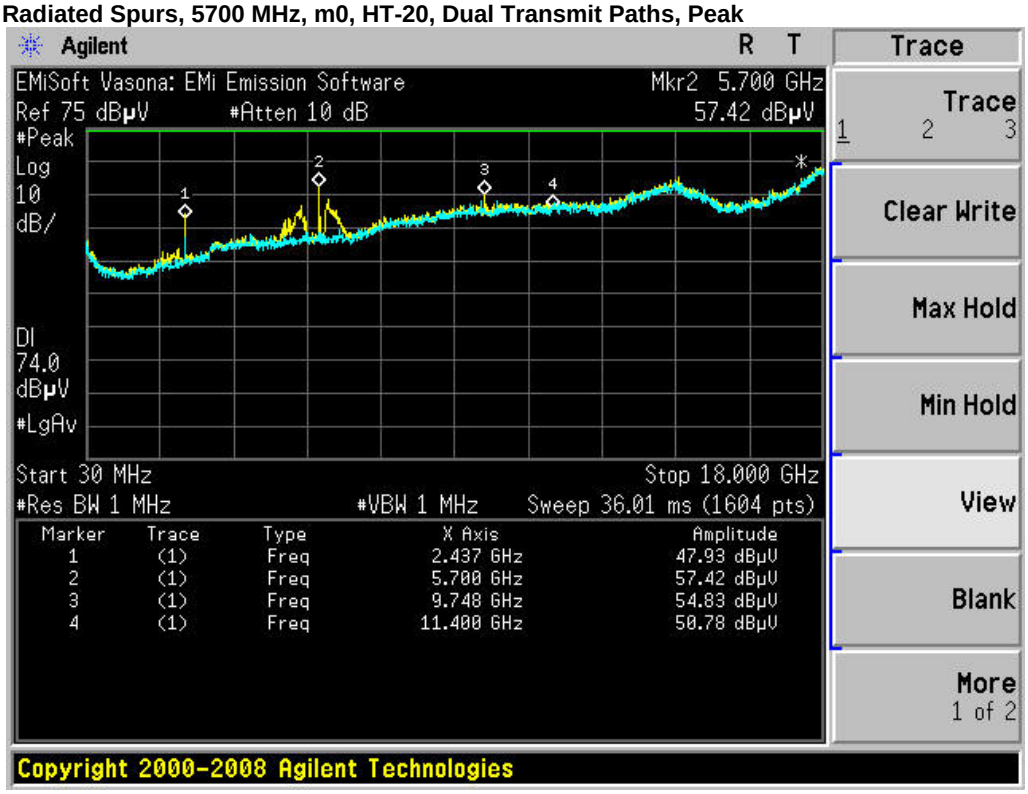
Radiated Spurs, 5500 MHz, m0, HT-20, Dual Transmit Paths, Peak



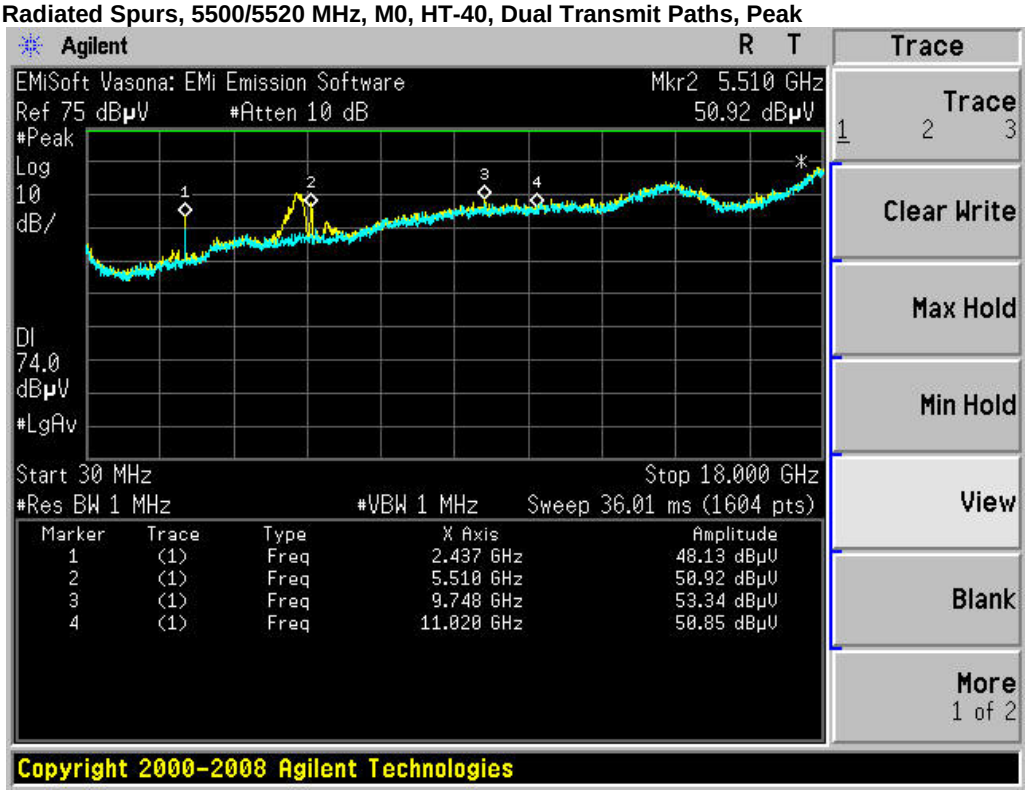
Radiated Spurs, 5560 MHz, m0, HT-20, Dual Transmit Paths, Peak



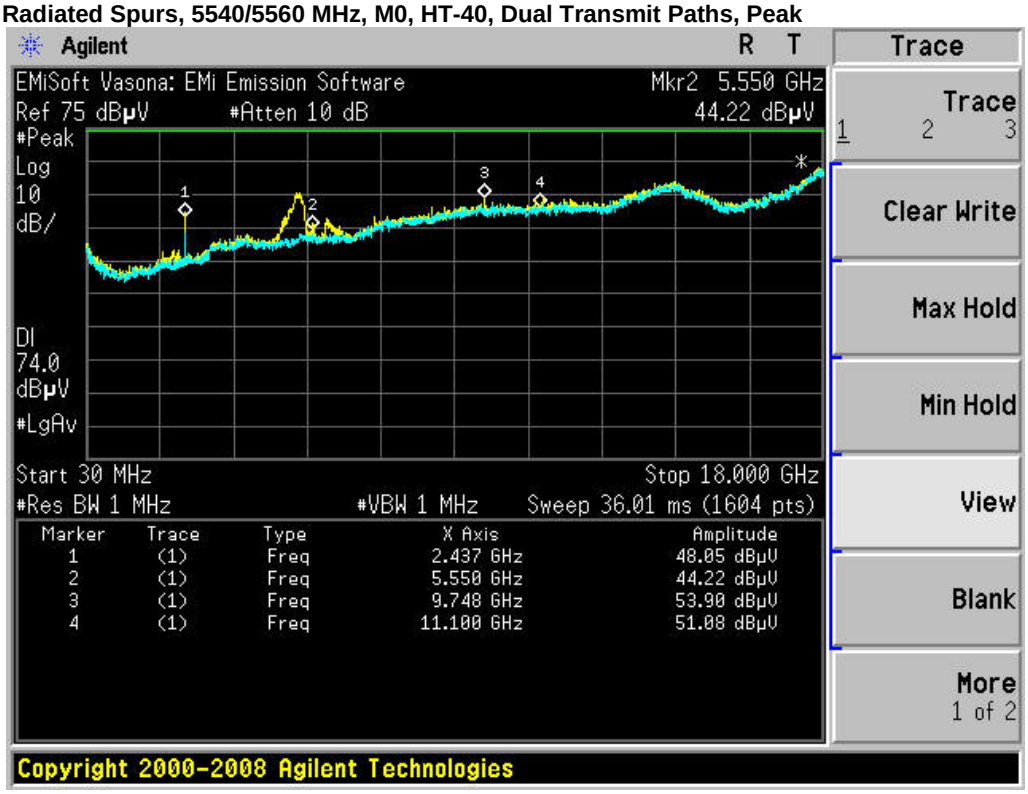
Radiated Spurs, 5700 MHz, m0, HT-20, Dual Transmit Paths, Peak



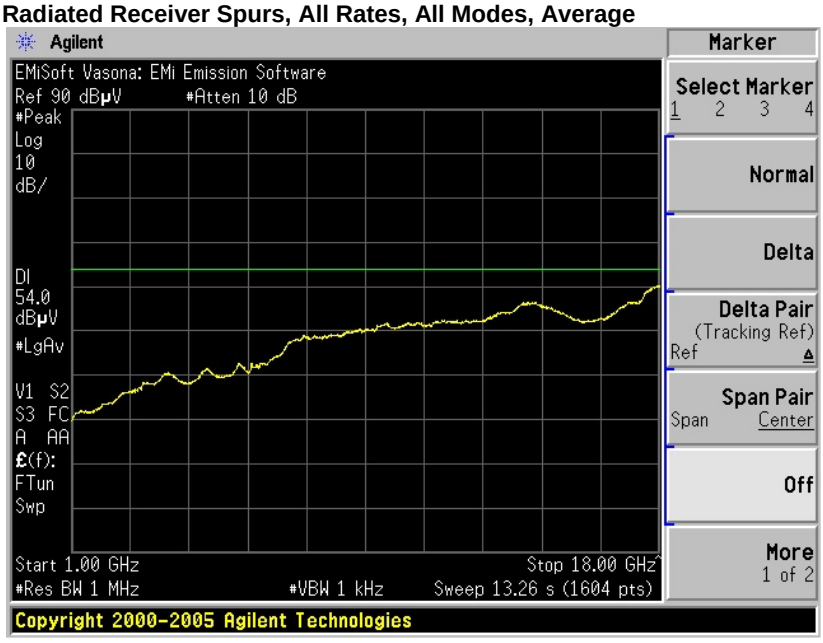
Radiated Spurs, 5500/5520 MHz, M0, HT-40, Dual Transmit Paths, Peak



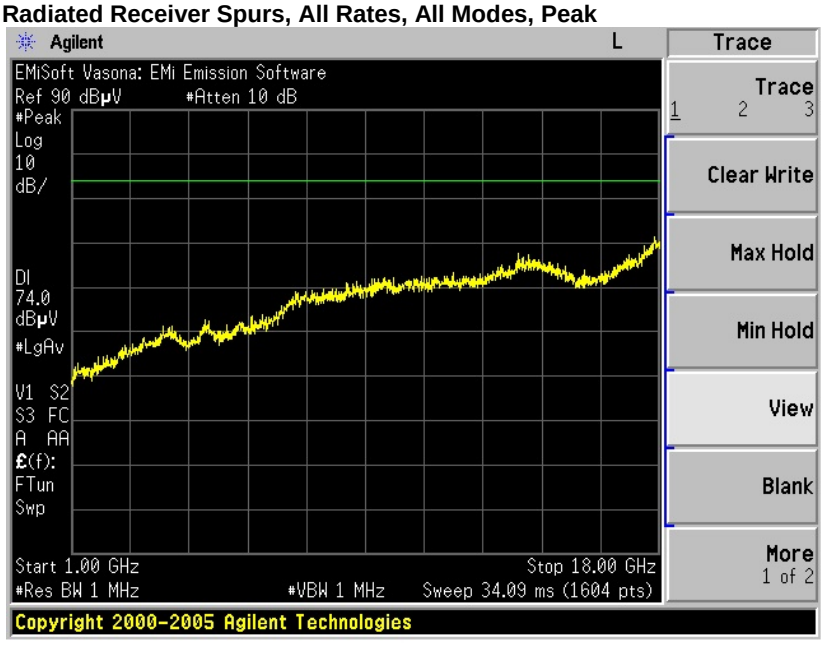
Radiated Spurs, 5540/5560 MHz, M0, HT-40, Dual Transmit Paths, Peak

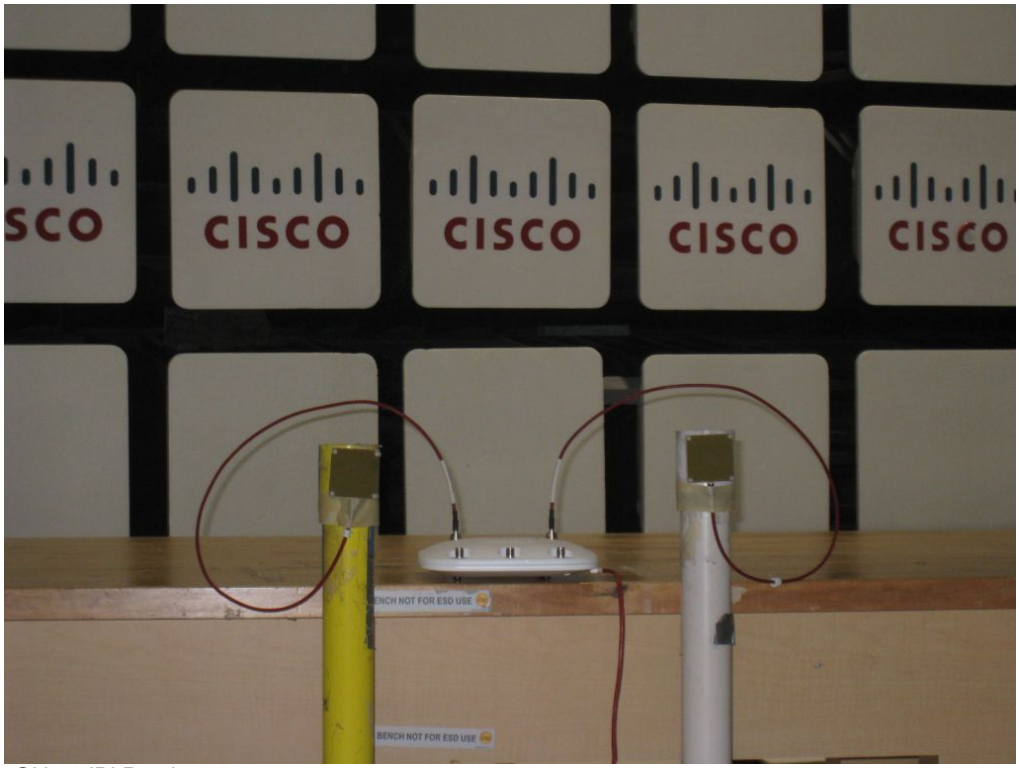


Radiated Receiver Spurs, All Rates, All Modes, Average



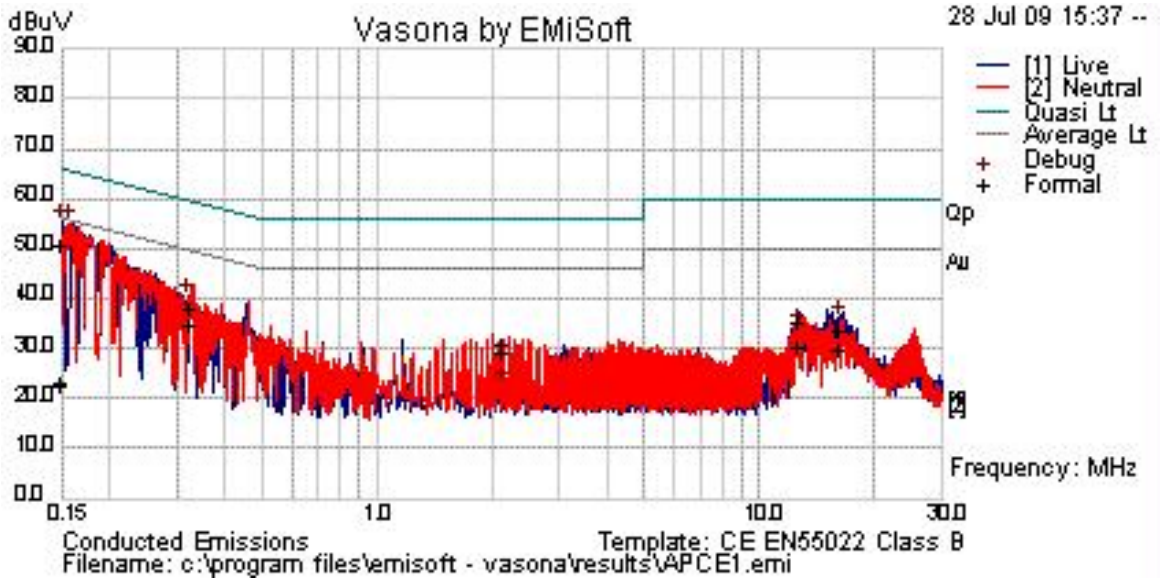
Radiated Receiver Spurs, All Rates, All Modes, Peak





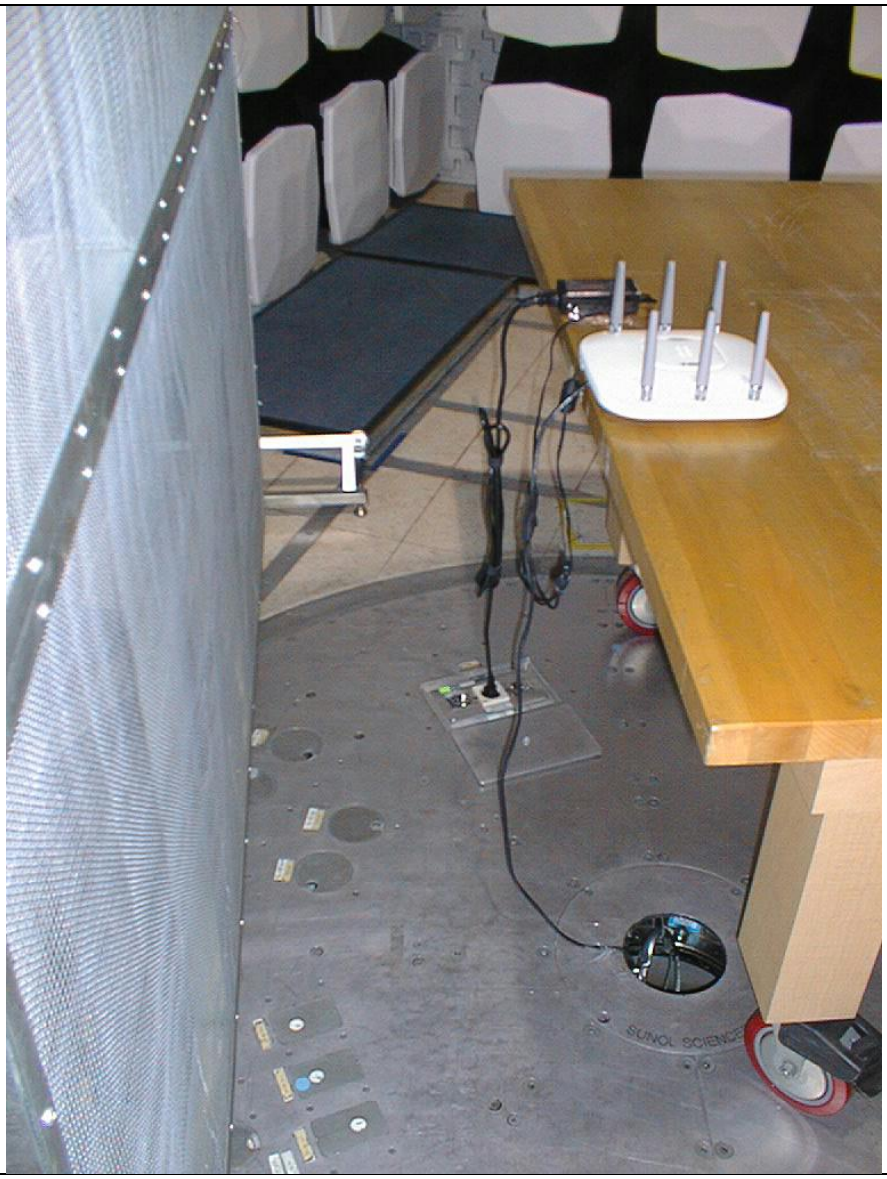
5GHz 7dBi Patch antenna

Conducted emissions



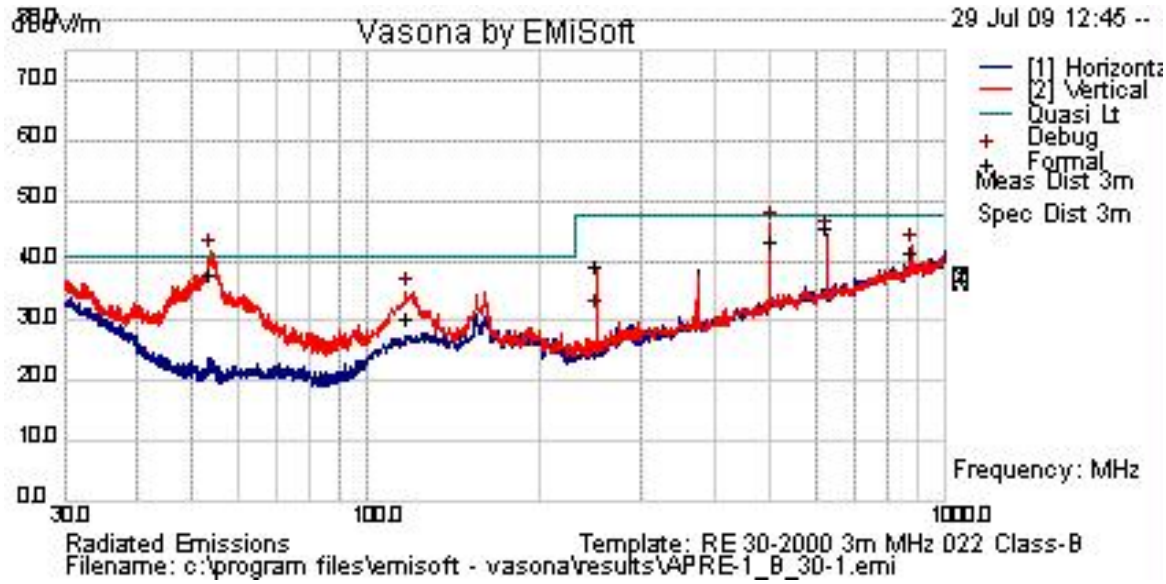
Test Results Table

Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail	Comments
0.15	11.3	10.1	1.8	23.2	Av	N	56	-32.8	Pass	
0.15	39	10.1	1.8	51	Qp	N	66	-15	Pass	
0.155	39	10.1	1.7	50.8	Qp	N	65.7	-14.9	Pass	
0.155	10.9	10.1	1.7	22.7	Av	N	55.7	-33	Pass	
0.326	23.7	10.2	0.8	34.7	Av	N	49.6	-14.8	Pass	
0.326	27.2	10.2	0.8	38.2	Qp	N	59.6	-21.4	Pass	
2.152	20.3	10.3	0.4	31	Qp	N	56	-25	Pass	
2.152	18.8	10.3	0.4	29.5	Av	N	46	-16.5	Pass	
12.769	19.2	10.8	0.5	30.5	Av	N	50	-19.5	Pass	
12.769	24.2	10.8	0.5	35.6	Qp	N	60	-24.4	Pass	
16.354	18	11	0.7	29.6	Av	N	50	-20.4	Pass	
16.354	22.3	11	0.7	33.9	Qp	N	60	-26.1	Pass	



Title: Conducted Emissions Configuration Photograph

Radiated emissions



Test Results Table

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
53.747	29.3	0.8	7.4	37.5	Qp	V	96	57	40.5	-3	Pass	
117.525	15.2	1.5	13.6	30.4	Qp	V	96	55	40.5	-10.2	Pass	
250.005	27.1	2.1	11.6	40.8	Qp	V	96	170	47.5	-6.7	Pass	
500.019	23.1	2.8	17.8	43.7	Qp	V	100	178	47.5	-3.8	Pass	
625.025	22.8	3.1	19	45	Qp	V	158	156	47.5	-2.5	Pass	
875.033	16	3.6	21.9	41.5	Qp	V	121	178	47.5	-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=√(30*P*G)/d and 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^2

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

d=√((30*P*G)/(3770*S))

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

P(mW)=P(W)/1000 d(cm)=100*d(m)

yields

d=100*√((30*(P/1000)*G)/(3770*S))
d=0.282*√(P*G/S)

where

d=Distance in cm
P=Power in mW
G=Numerica Antenna Gain
S=Power Density in mW/cm^2

Substituting the logarithmic form of power and gain using:

P(mW)=10^(P(dBm)/10) G(numeric)=10^(G(dBi)/10)

yields

d=0.282*10^((P+G)/20)/√S Equation (1)

and

s=((0.282*10^((P+G)/20))/d)^2 Equation (2)

where

d=MPE distance in cm
P=Power in dBm
G=Antenna Gain in dBi
S=Power Density in mW/cm^2

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=1mW/cm^2 maximum. The highest supported antenna gain is 7 dBi (10dBi with beamforming). 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^2)	Peak Transmit Power (dBm)	Antenna Gain (dBi)	MPE Distance (cm)	Limit (cm)	Margin (cm)
5500	54	1	20.1	7	**6.39**	20	13.61
5560	54	1	20.5	7	**6.69**	20	13.31
5700	54	1	20.0	7	**6.31**	20	13.69

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^2)	Limit (mW/cm^2)	Margin (mW/cm^2)
5500	54	20	20.1	7	**0.10**	1	0.90
5560	54	20	20.5	7	**0.11**	1	0.89
5700	54	20	20	7	**0.10**	1	0.90

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

Equip #	Manufacturer	Model	Description	Last Cal	Next Due
CIS037581	EMC Test Systems	3117	Double Ridged Guide Horn Antenna	27-Jul-10	27-Jul-11
CIS04927	Miteq	NSP1000-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
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