CISCO

Test Report

AIR-LAP1142N-A-K9

Cisco Aironet 802.11n Draft 2.0 Dual Band Access Point

5725-5850 MHz

FCC ID: LDK102070, IC: 2461B-102070

Against the following Specifications:

CFR47 Part 15.247

RSS210

Cisco Systems

170 West Tasman Drive

San Jose, CA 95134

Author: James Nicholson
Approved By:
Title:

This report replaces any previously entered test report under EDCS - 674057

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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 15.247 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 start of testing

22-May-2008

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-LAP1142N-A-K9 Cisco Aironet 802.11n Draft 2.0 Dual Band Access Point

2.6 EUT Description

The AIR-LAP1142N-A-K9 Cisco Aironet 802.11n Draft 2.0 Dual Band Access Point 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.

> Legacy OFDM, Non HT-20, Single Antenna, 6 to 54 Mbps
> Legacy OFDM, Non HT-20, Dual Antennas, 6 to 54 Mbps
> Legacy OFDM , Non HT-20 Dual Antennas with Beam Forming, 6 to 54 Mbps
> HT-20, Single Antenna, M0 to M7
> HT-20, Dual Antennas, M0 to M15
> Non HT-40 Duplicate, Single Antenna, 6-54 Mbps
> Non HT-40 Duplicate, Dual Antennas, 6-54 Mbps
> HT-40, Single Antenna, M0 to M7
> HT-40, Dual Antennas, M0 to M15

The following integral antennas are supported by this product.

> 2.4 GHz 4 dBi inverted-F Omni-directional Antenna
> 5 GHz   3 dBi inverted-F Omni-directional Antenna

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-LAP1142N-A-K9	73-11494-01	Cisco Systems	NA	NA	NA	FHH1217 00LP
S02	AIR-PWR-SPLY1	341-0211-01	Cisco Systems	NA	NA	NA	DTH1030 902Z

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

Average Output Power

Connect the antenna(s) to the power meter at the average power sensor input. Configure the power meter to measure average power for the transmitter frequencies listed below (enter all losses between the transmitter output and the power meter).

Place the radio in continuous transmit mode and record the reading on the power meter.

| Frequency | Mode | Data Rate | Target Power Level | | | Actual Power Level |
			Tx A	Tx B	Total	Total
5745	Non HT-20 Beam Forming	54	17	17	20	**20.6**
5785	Non HT-20 Beam Forming	54	17	17	20	**20.4**
5825	Non HT-20 Beam Forming	54	17	17	20	**20.5**
5745/5765	Non HT-40 Duplicate	54	17	17	20	**19.7**
5745/5765	HT-40	M7	17	17	20	**20.5**
5785/5805	Non HT-40 Duplicate	54	17	17	20	**20.2**
5785/5805	HT-40	M7	17	17	20	**20.0**

6dB Bandwidth

15.247: Systems using digital modulation techniques may operate in the 5725-5850MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz.

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).

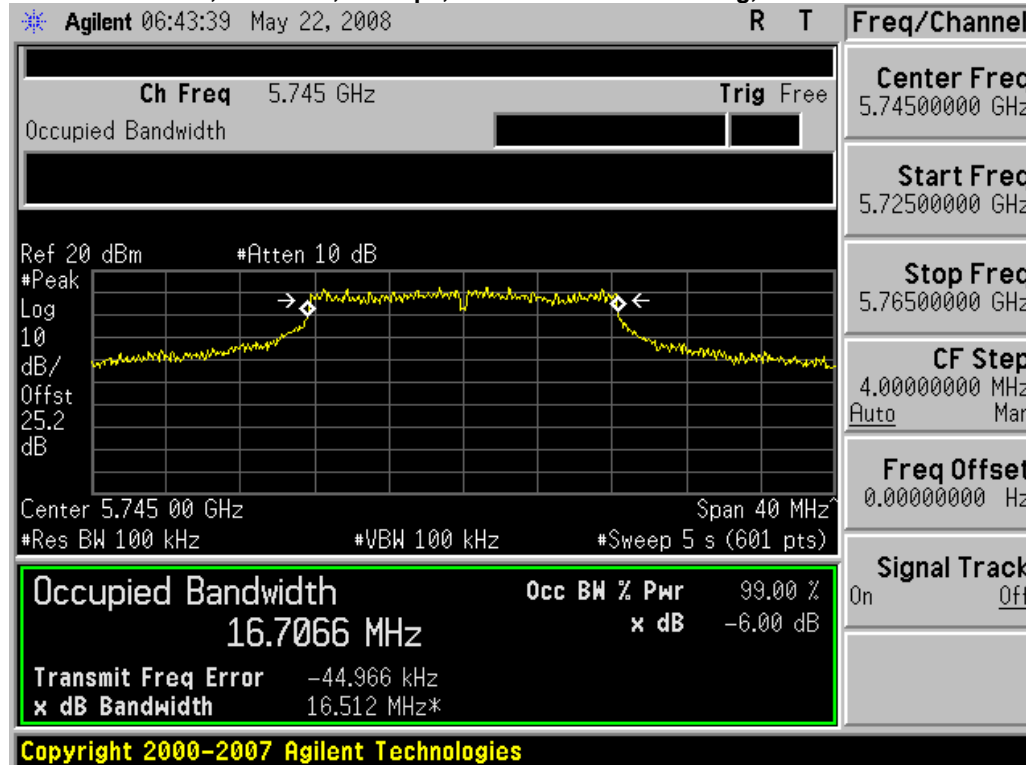|	
Center Frequency:	Frequency from table below
Span:	2 x Nominal Bandwidth (e.g. 40MHz for a 20MHz channel)
Reference Level:	20 dBm
Attenuation:	10 dB
Sweep Time:	5 s
Resolution Bandwidth:	100 kHz
Video Bandwidth:	100 kHz
X dB Bandwidth: 6 dB	
Detector:	Peak
Trace:	Single

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)	6dB BW (MHz)	Limit (kHz)	Margin (MHz)
5745	Non HT-20 Beam Forming	54	**16.5**	>500	16.0
5785	Non HT-20 Beam Forming	54	**16.5**	>500	16.0
5825	Non HT-20 Beam Forming	54	**16.5**	>500	16.0
5745/5765	Non HT-40 Duplicate	54	**36.5**	>500	36.0
5745/5765	HT-40	M7	**36.5**	>500	36.0
5785/5805	Non HT-40 Duplicate	54	**36.6**	>500	36.1
5785/5805	HT-40	M7	**36.5**	>500	36.0

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6dB BANDWIDTH, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths

Agilent 06:43:39 May 22, 2008   R   T   Freq/Channel

Ch Freq   5.745 GHz   Trig Free

Occupied Bandwidth

Center Freq 5.74500000 GHz
Start Freq 5.72500000 GHz
Stop Freq 5.76500000 GHz
CF Step 4.00000000 MHz   Auto   Man
Freq Offset 0.00000000 Hz

Ref 20 dBm   #Atten 10 dB
#Peak
Log
10
dB/
Offst
25.2
dB

Center 5.745 00 GHz   Span 40 MHz
#Res BW 100 kHz   #VBW 100 kHz   #Sweep 5 s (601 pts)

Signal Track   On   Off

Occupied Bandwidth   Occ BW % Pwr   99.00 %
16.7066 MHz   x dB   -6.00 dB
Transmit Freq Error   -44.966 kHz
x dB Bandwidth   16.512 MHz*

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6dB BANDWIDTH, 5785 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths

Agilent 06:50:29 May 22, 2008   R   T   Freq/Channel

Ch Freq   5.785 GHz   Trig Free

Occupied Bandwidth

Center Freq 5.78500000 GHz
Start Freq 5.76500000 GHz
Stop Freq 5.80500000 GHz
CF Step 4.00000000 MHz   Auto   Man
Freq Offset 0.00000000 Hz

Ref 20 dBm   #Atten 10 dB
#Peak
Log
10
dB/
Offst
25.2
dB

Center 5.785 00 GHz   Span 40 MHz
#Res BW 100 kHz   #VBW 100 kHz   #Sweep 5 s (601 pts)

Signal Track   On   Off

Occupied Bandwidth   Occ BW % Pwr   99.00 %
16.6613 MHz   x dB   -6.00 dB
Transmit Freq Error   -45.507 kHz
x dB Bandwidth   16.529 MHz*
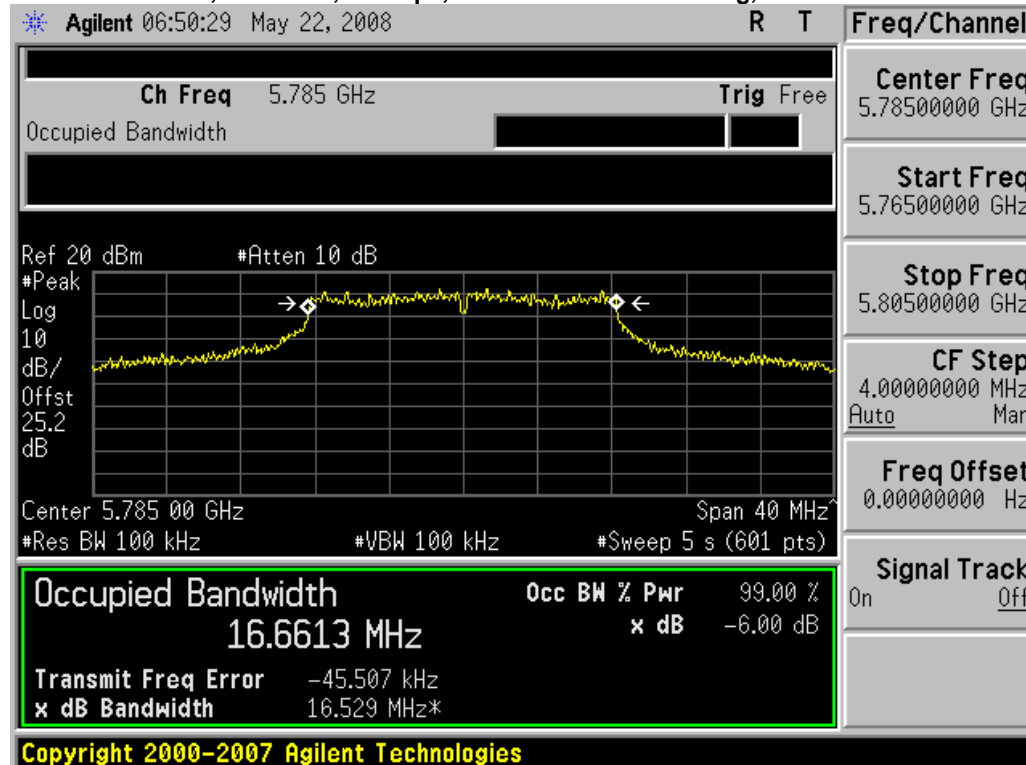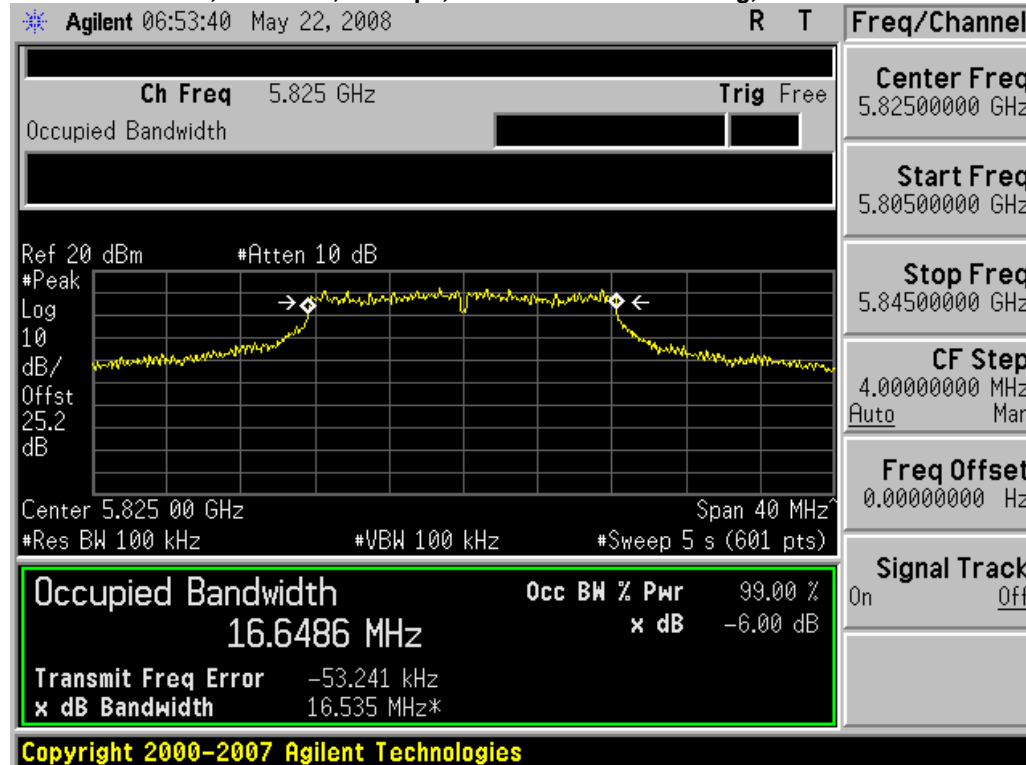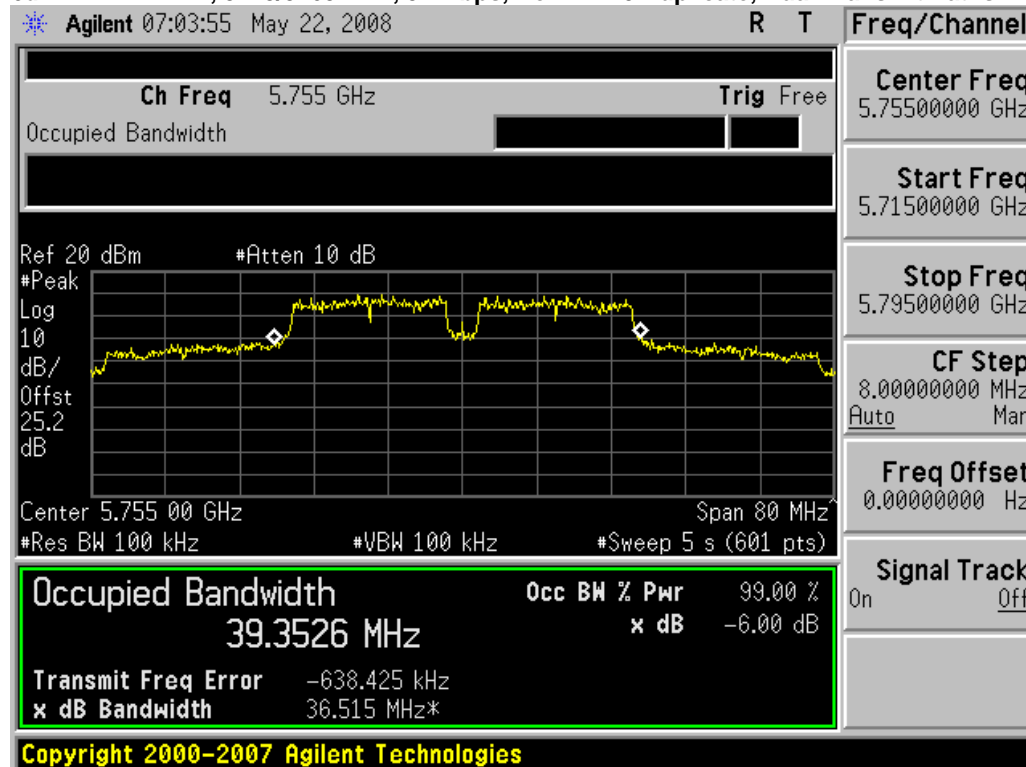
Copyright 2000-2007 Agilent Technologies

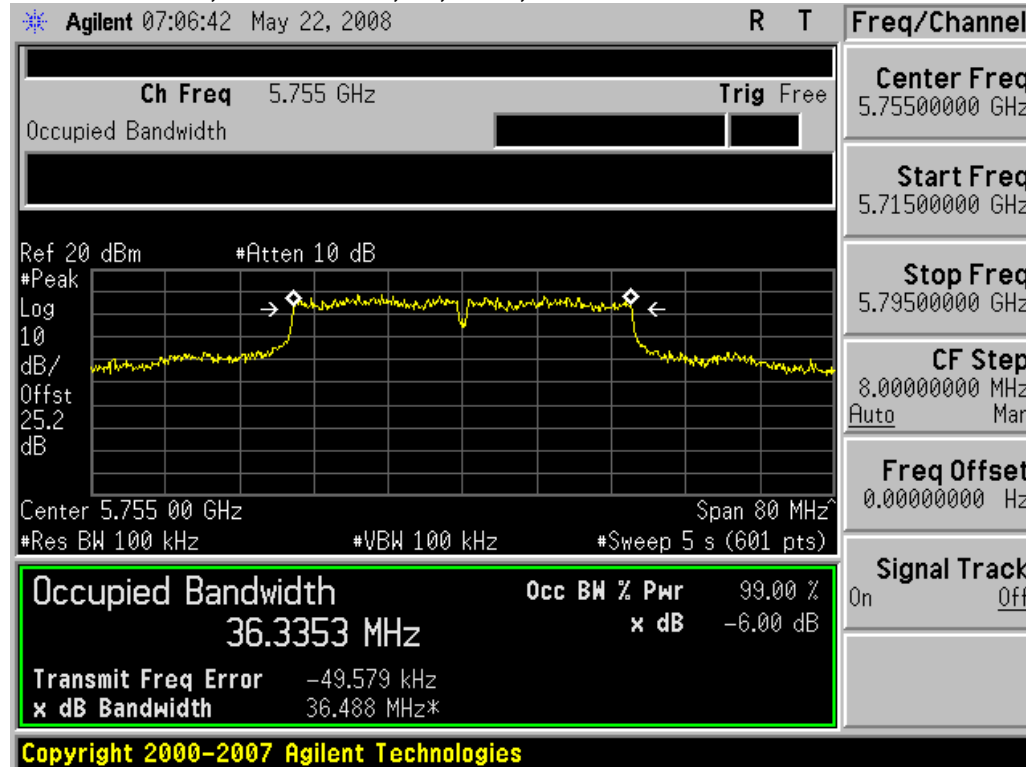**6dB BANDWIDTH, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths**

6dB BANDWIDTH, 5745/5765 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths
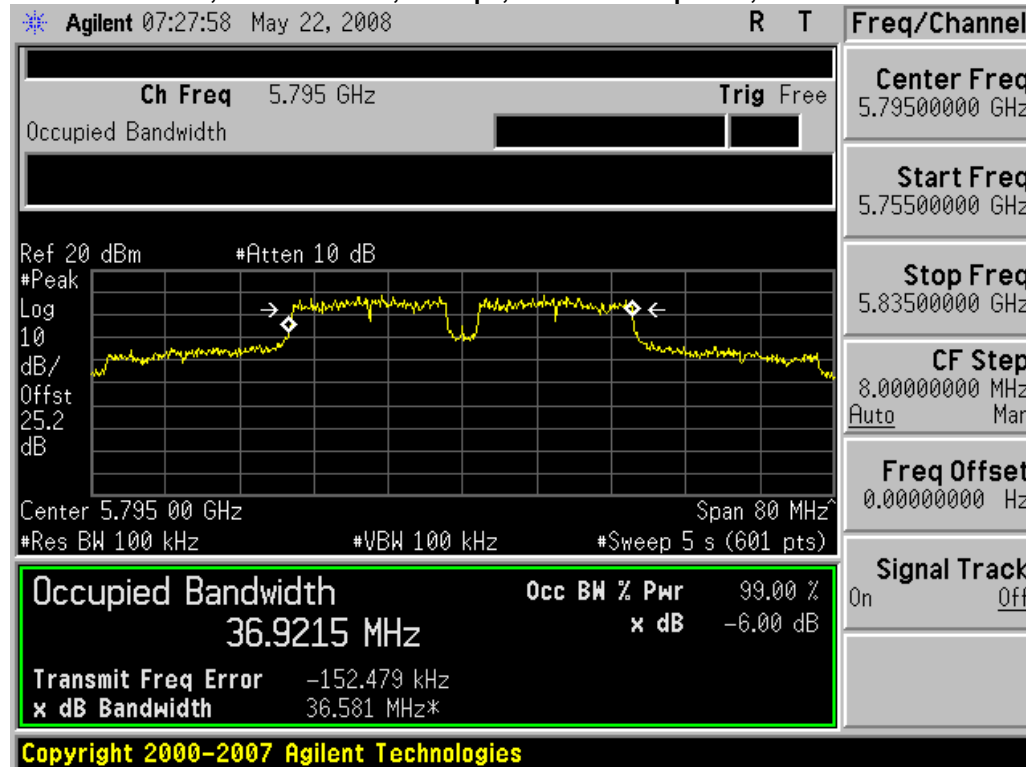
6dB BANDWIDTH, 5745/5765 MHz, M7, HT-40, Dual Transmit Paths

6dB BANDWIDTH, 5785/5805 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths

6dB BANDWIDTH, 5785/5805 MHz, M7, HT-40, Dual Transmit Paths

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:
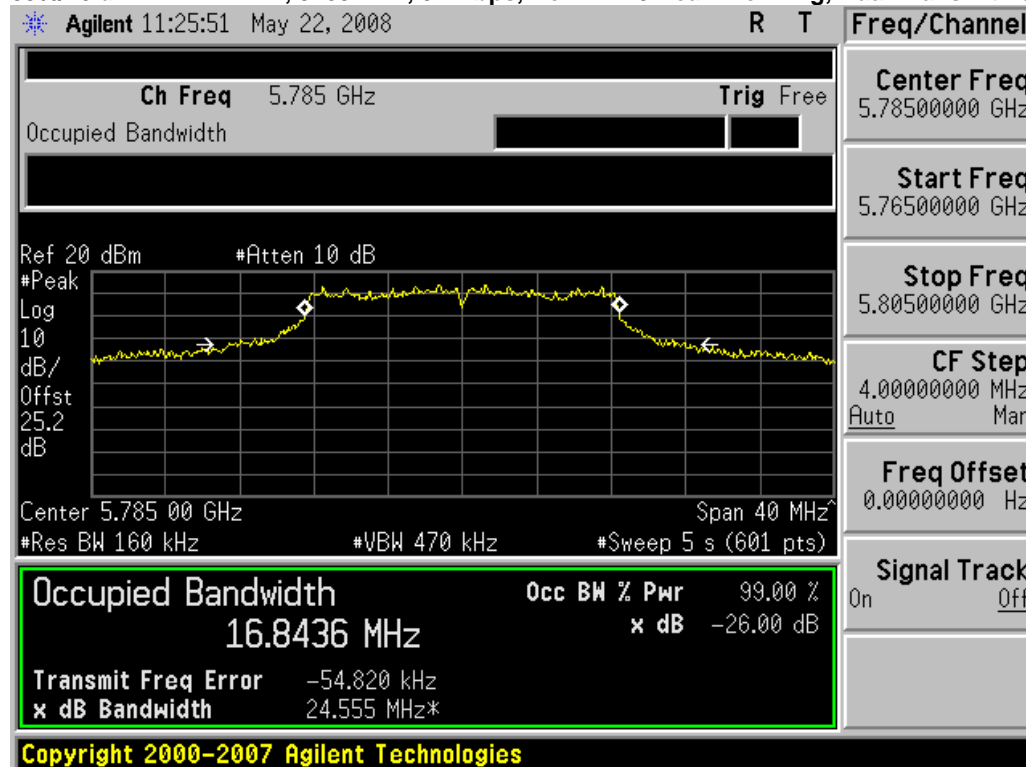
Frequency (MHz)	Mode	Data Rate (Mbps)	26dB BW (MHz)	99% BW (MHz)
5745	Non HT-20 Beam Forming	54	24.9	16.8
5785	Non HT-20 Beam Forming	54	24.6	16.8
5825	Non HT-20 Beam Forming	54	24.5	16.8
5745/5765	Non HT-40 Duplicate	54	68.9	36.7
5745/5765	HT-40	M7	60.2	36.4
5785/5805	Non HT-40 Duplicate	54	71.4	37.8
5785/5805	HT-40	M7	53.2	36.4

99%/26 dB Bandwidth, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths
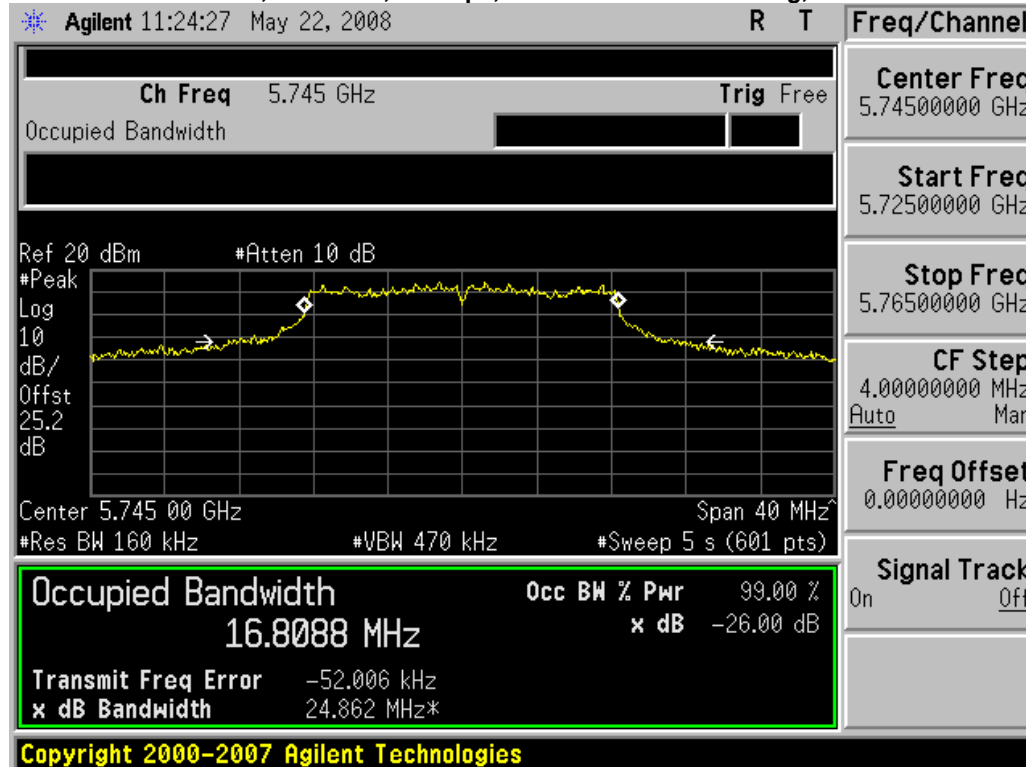
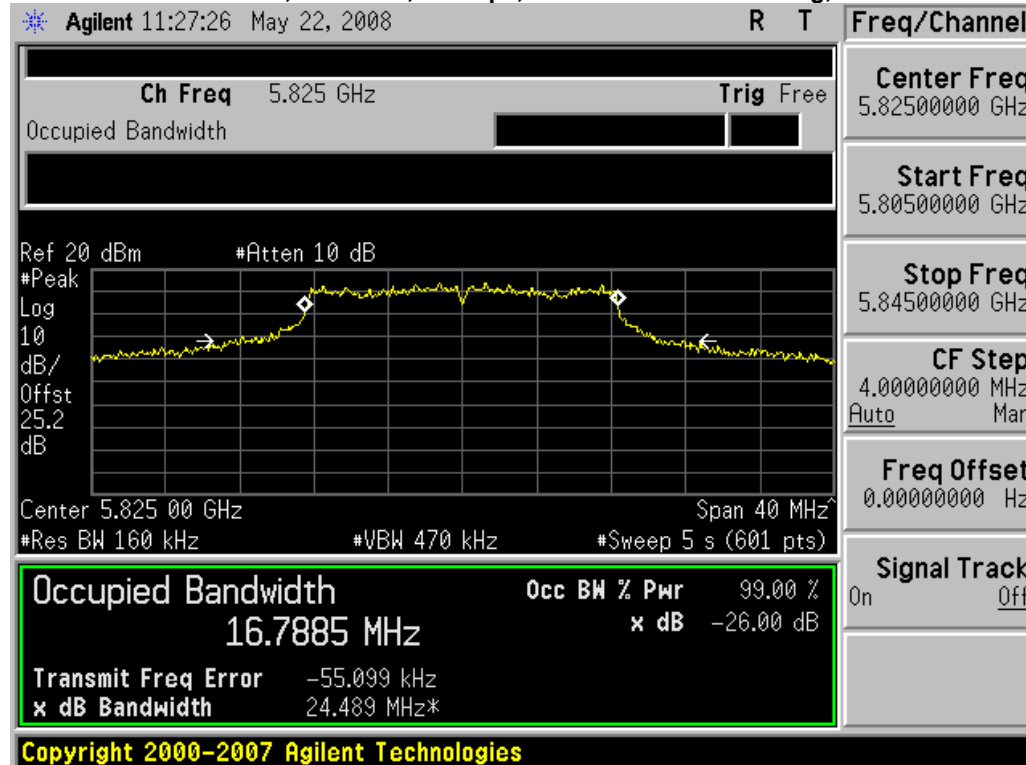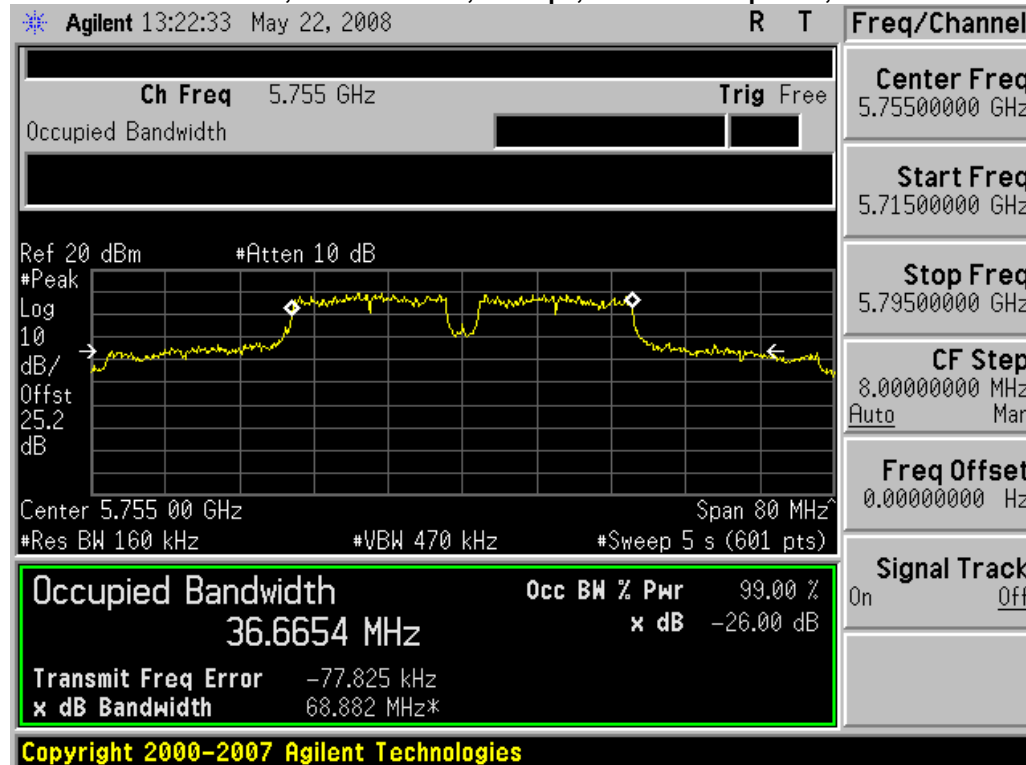**99%/26 dB BANDWIDTH, 5785 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths**

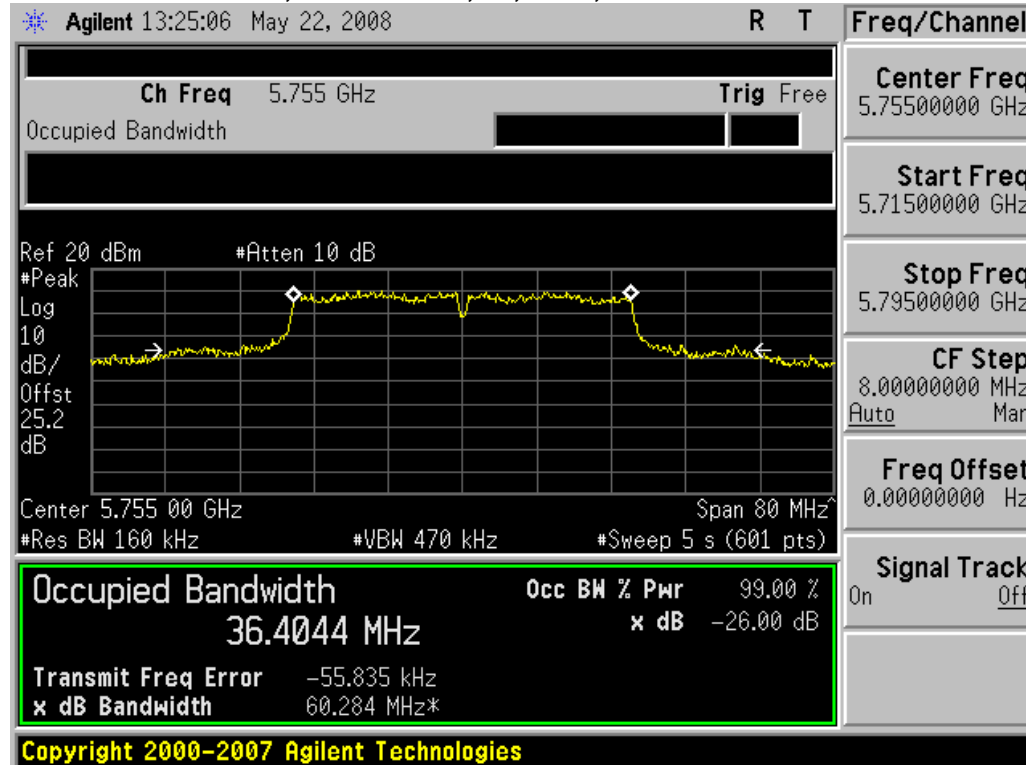**99%/26 dB BANDWIDTH, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths**

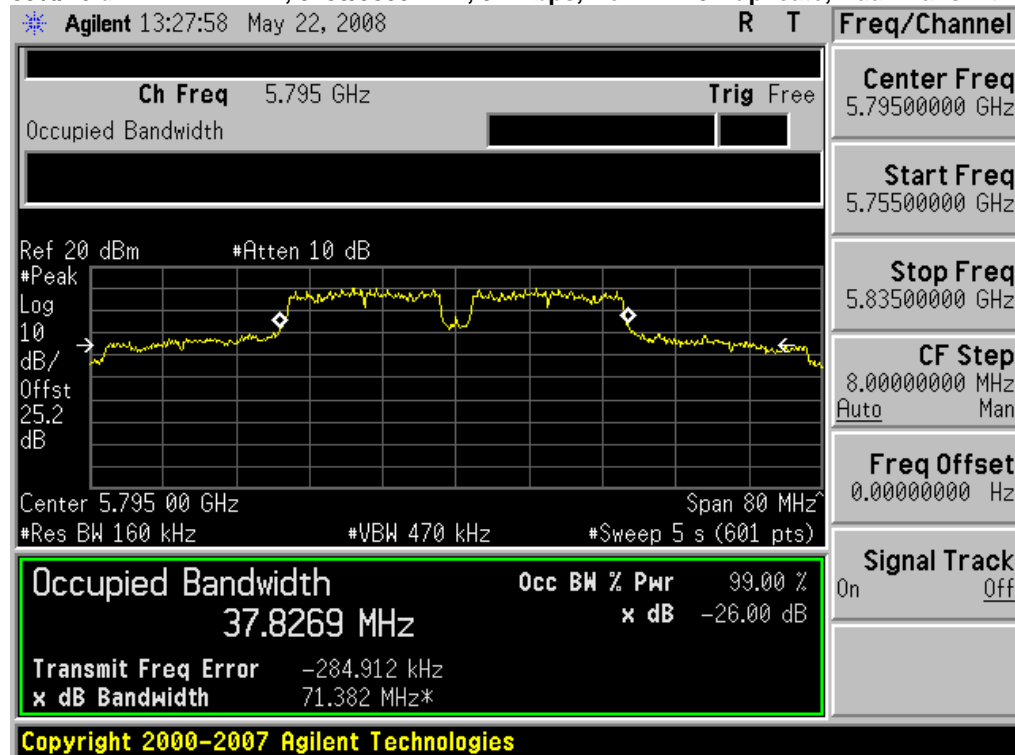**99%/26 dB BANDWIDTH, 5745/5765 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths**

99%/26 dB BANDWIDTH, 5745/5765 MHz, M7, HT-40, Dual Transmit Paths

99%/26 dB BANDWIDTH, 5785/5805 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths

99%/26 dB BANDWIDTH, 5785/5805 MHz, M7, HT-40, Dual Transmit Paths

☀ **Agilent** 13:29:59 May 22, 2008 R T	**Freq/Channel**
Ch Freq 5.795 GHz **Trig** Free Occupied Bandwidth	**Center Freq** 5.79500000 GHz
	Start Freq 5.75500000 GHz
Ref 20 dBm #Atten 10 dB #Peak Log 10 dB/ Offst 25.2 dB	**Stop Freq** 5.83500000 GHz
	CF Step 8.00000000 MHz Auto Man
Center 5.795 00 GHz Span 80 MHz^ #Res BW 160 kHz #VBW 470 kHz #Sweep 5 s (601 pts)	**Freq Offset** 0.00000000 Hz
Occupied Bandwidth Occ BW % Pwr 99.00 % **36.3659 MHz** x dB -26.00 dB Transmit Freq Error -50.953 kHz x dB Bandwidth 53.196 MHz*	**Signal Track** On Off
Copyright 2000-2007 Agilent Technologies	
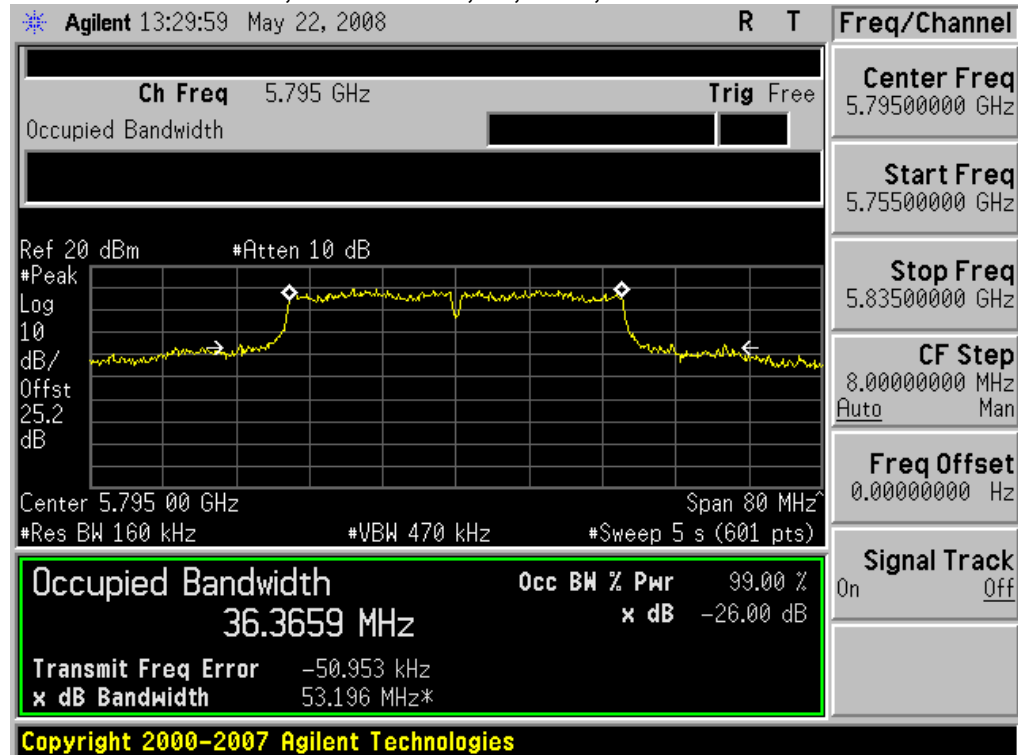
Peak Output Power

15.247: The maximum conducted output power of the intentional radiator for systems using digital modulation in the 5725-5850MHz band shall not exceed 1 Watt (30dBm). 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 maximum supported antenna gain for all bands is 3dBi. In beamforming mode, the 3dBi behaves as 3dBi+10log(n) (n=2 radiating elements) = 6dBi.Therefore the maximum allowable output power requires no reduction in beam forming mode.

Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Configure the spectrum analyzer as shown below.
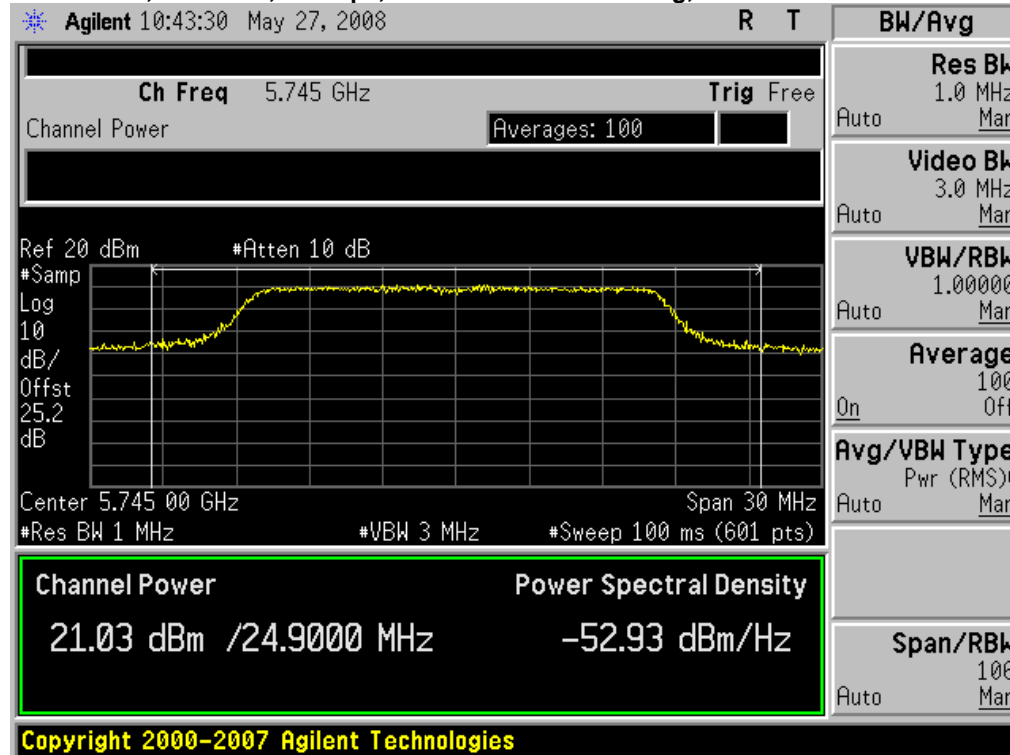
Enable "Channel Power" function of analyzer
Center Frequency: Frequency from table below
Span: 20 MHz (must be greater than 26dB bandwidth, adjust as necessary)
Ref Level Offset: Correct for attenuator and cable loss.
Reference Level: 20 dBm
Attenuation: 20 dB
Sweep Time: 100ms, Single sweep
Resolution 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.

Frequency (MHz)	Mode	Data Rate (Mbps)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
5745	Non HT-20 Beam Forming	54	21.0	30	9
5785	Non HT-20 Beam Forming	54	20.6	30	9.4
5825	Non HT-20 Beam Forming	54	20.7	30	9.3
5745/5765	Non HT-40 Duplicate	54	20.7	30	9.3
5745/5765	HT-40	M7	20.3	30	9.7
5785/5805	Non HT-40 Duplicate	54	20.1	30	9.9
5785/5805	HT-40	M7	19.7	30	10.3

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Peak Power, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths

Peak Power, 5785 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths

This document is uncontrolled. Please refer to the electronic copy within EDCS for the most up to date version.
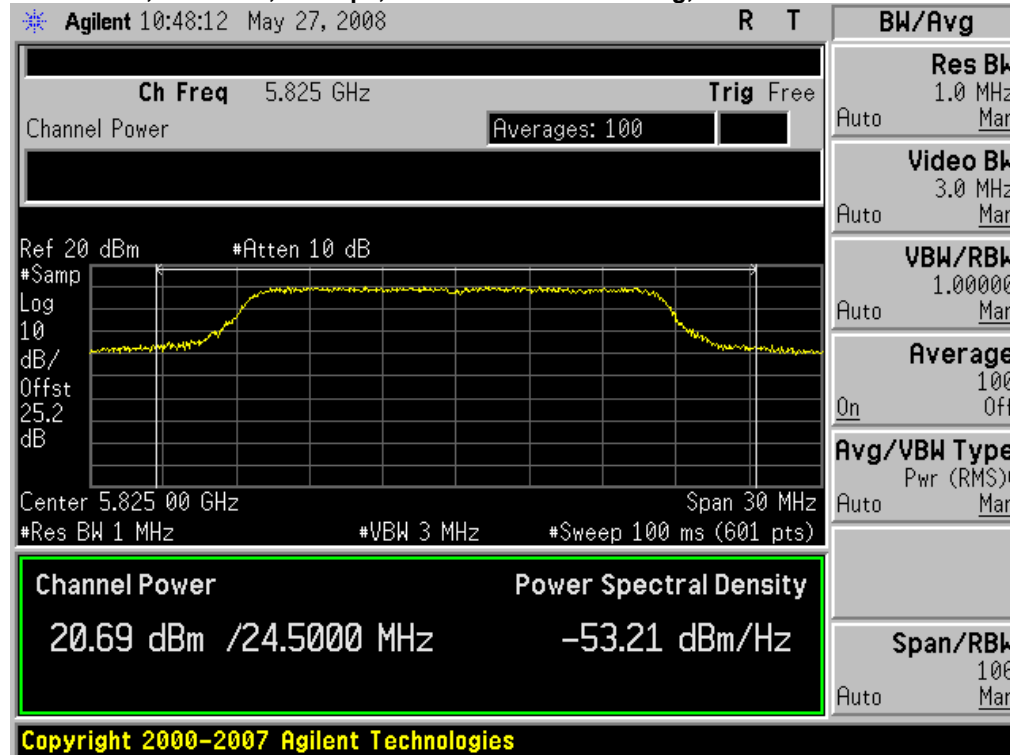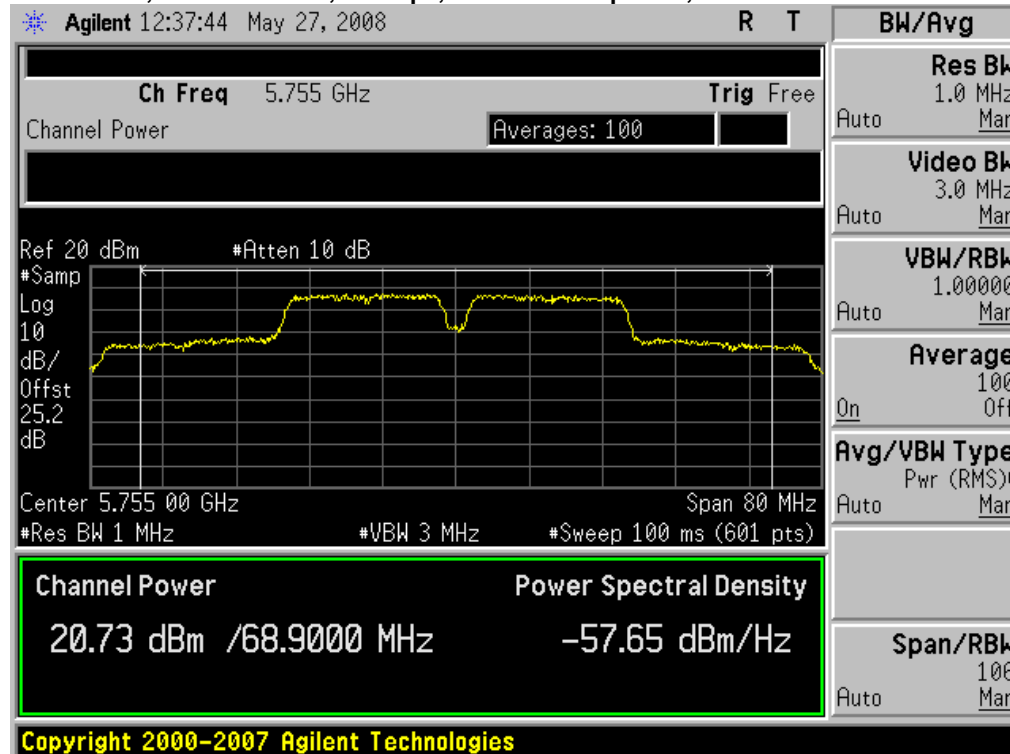Cisco Systems, Inc. Company Confidential

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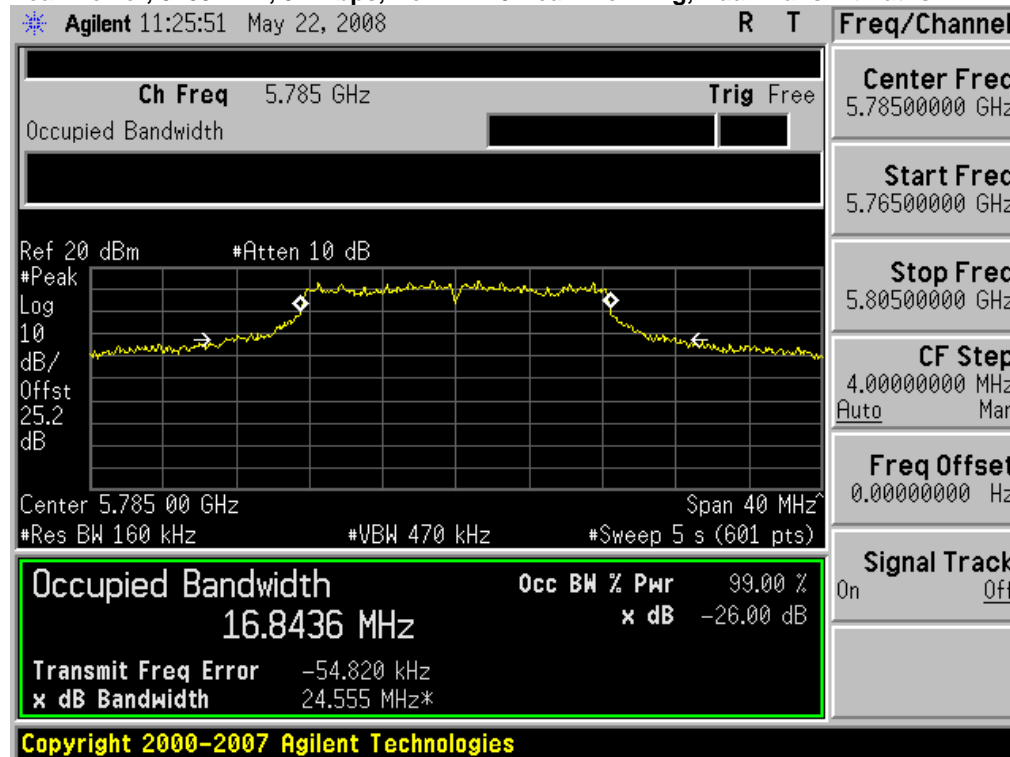
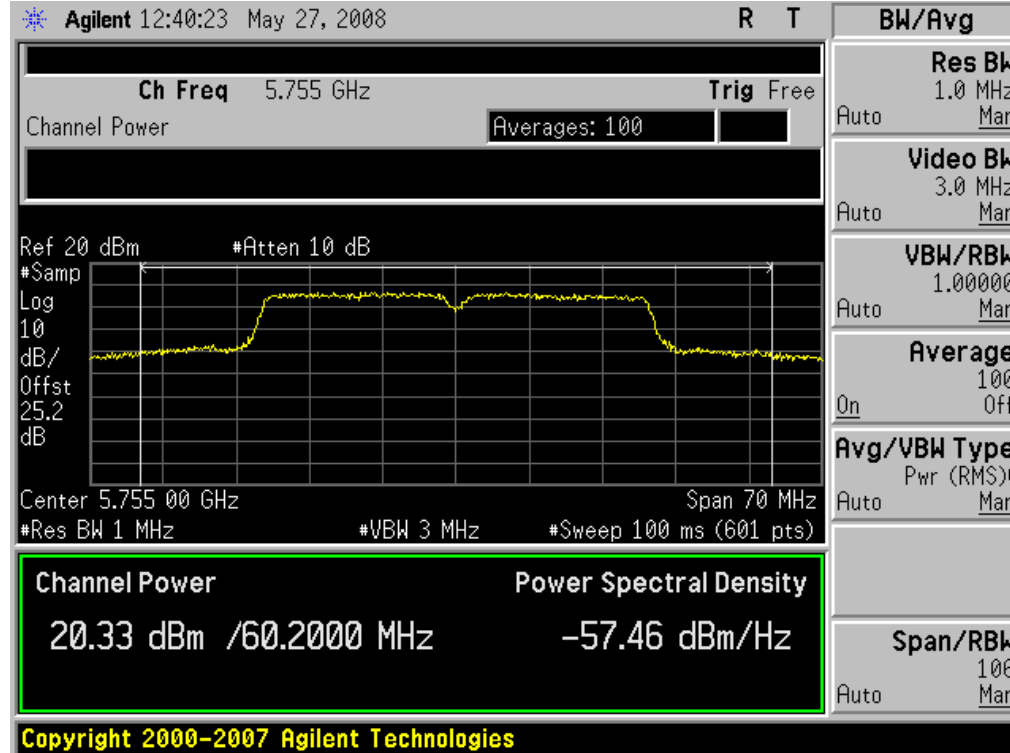**Peak Power, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths**

Peak Power, 5745/5765 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths
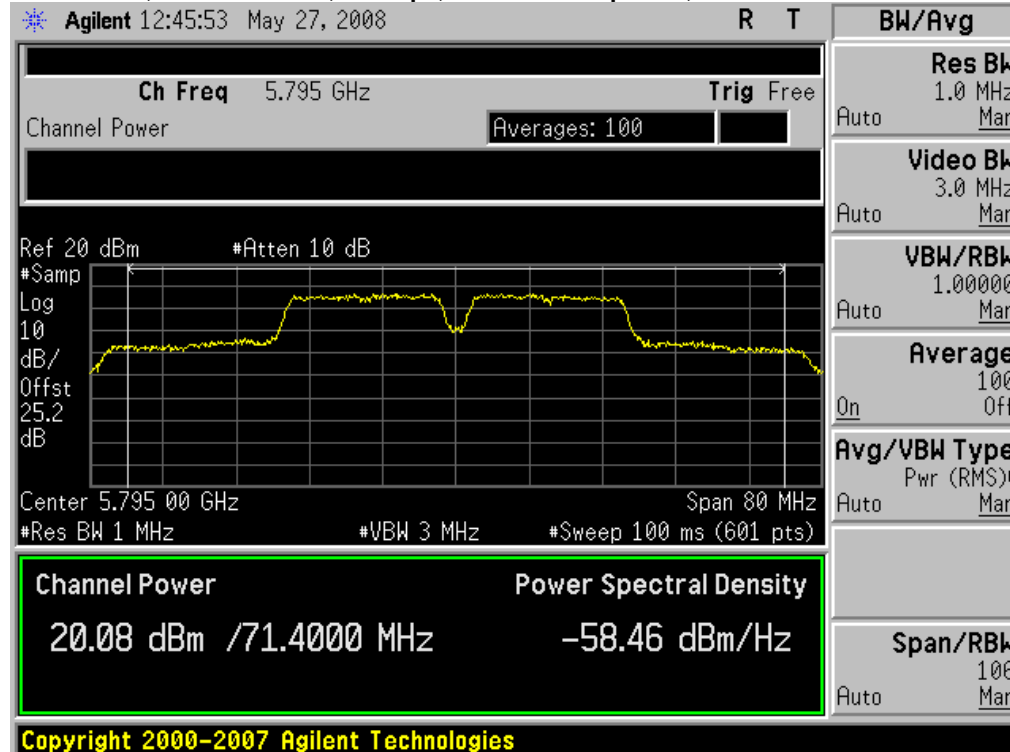
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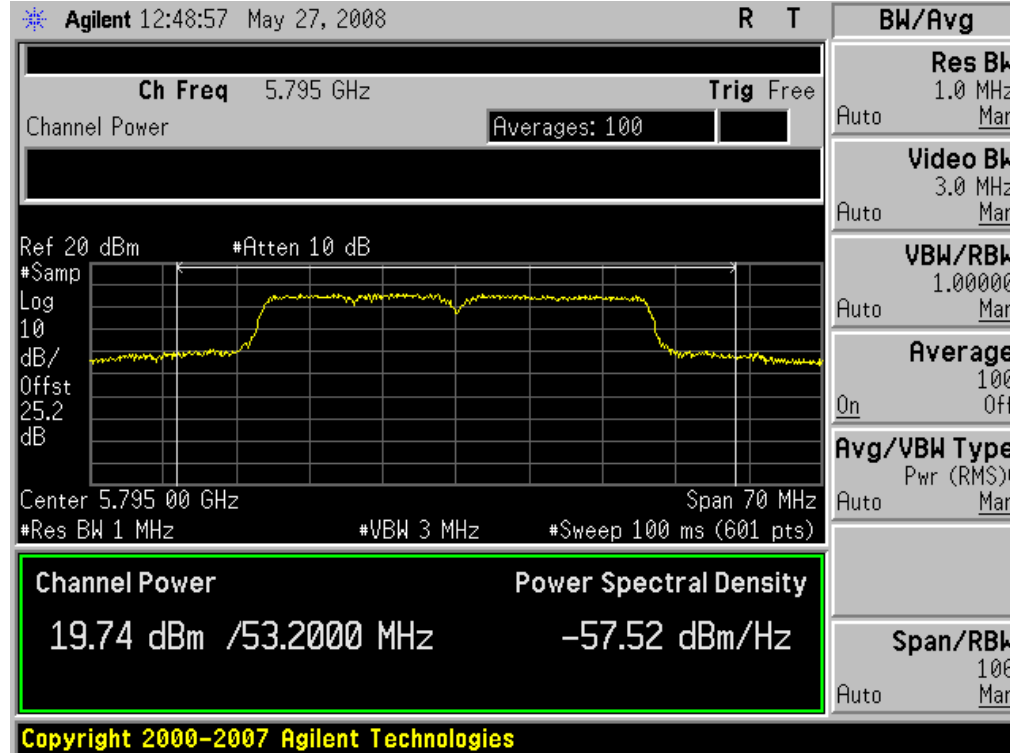**Peak Power, 5745/5765 MHz, M7, HT-40, Dual Transmit Paths**


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Agilent  12:40:23  May 27, 2008                    R   T        BW/Avg

        Ch Freq    5.755 GHz                    Trig Free      Res BW
Channel Power                    Averages: 100              Auto  1.0 MHz
                                                                   Man

                                                            Video BW
                                                              3.0 MHz
                                                            Auto   Man
Ref 20 dBm       #Atten 10 dB
#Samp                                                       VBW/RBW
Log                                                          1.00000
10                                                          Auto   Man
dB/
Offst                                                       Average
25.2                                                            100
dB                                                          On    Off

Center 5.755 00 GHz              Span 70 MHz   Avg/VBW Type
#Res BW 1 MHz       #VBW 3 MHz    #Sweep 100 ms (601 pts)   Pwr (RMS)
                                                            Auto   Man

Channel Power             Power Spectral Density

 20.33 dBm /60.2000 MHz        -57.46 dBm/Hz              Span/RBW
                                                              106
                                                           Auto   Man
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Peak Power, 5785/5805 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths


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Agilent  12:45:53  May 27, 2008                    R   T        BW/Avg

        Ch Freq    5.795 GHz                    Trig Free      Res BW
Channel Power                    Averages: 100              Auto  1.0 MHz
                                                                   Man

                                                            Video BW
                                                              3.0 MHz
                                                            Auto   Man
Ref 20 dBm       #Atten 10 dB
#Samp                                                       VBW/RBW
Log                                                          1.00000
10                                                          Auto   Man
dB/
Offst                                                       Average
25.2                                                            100
dB                                                          On    Off

Center 5.795 00 GHz              Span 80 MHz   Avg/VBW Type
#Res BW 1 MHz       #VBW 3 MHz    #Sweep 100 ms (601 pts)   Pwr (RMS)
                                                            Auto   Man

Channel Power             Power Spectral Density

 20.08 dBm /71.4000 MHz        -58.46 dBm/Hz              Span/RBW
                                                              106
                                                           Auto   Man
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Peak Power, 5785/5805 MHz, M7, HT-40, Dual Transmit Paths

Power Spectral Density

15.247: For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

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

Center Frequency: Frequency from table below
Span: 20 MHz
Ref Level Offset: Correct for attenuator and cable loss.
Reference Level: 20 dBm
Attenuation: 20 dB
Sweep Time: 100s
Resolution Bandwidth: 3 kHz
Video Bandwidth: 10 kHz
Detector: Peak
Trace: Single
Marker: Peak Search

Record the Marker value.

Frequency (MHz)	Mode	Data Rate (Mbps)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
5745	Non HT-20 Beam Forming	54	-1.5	8	9.5
5785	Non HT-20 Beam Forming	54	-2.1	8	10.1
5825	Non HT-20 Beam Forming	54	-1.6	8	9.6
5745/5765	Non HT-40 Duplicate	54	-5.4	8	13.4
5745/5765	HT-40	M7	-3.0	8	11
5785/5805	Non HT-40 Duplicate	54	-5.7	8	13.7
5785/5805	HT-40	M7	-5.1	8	13.1

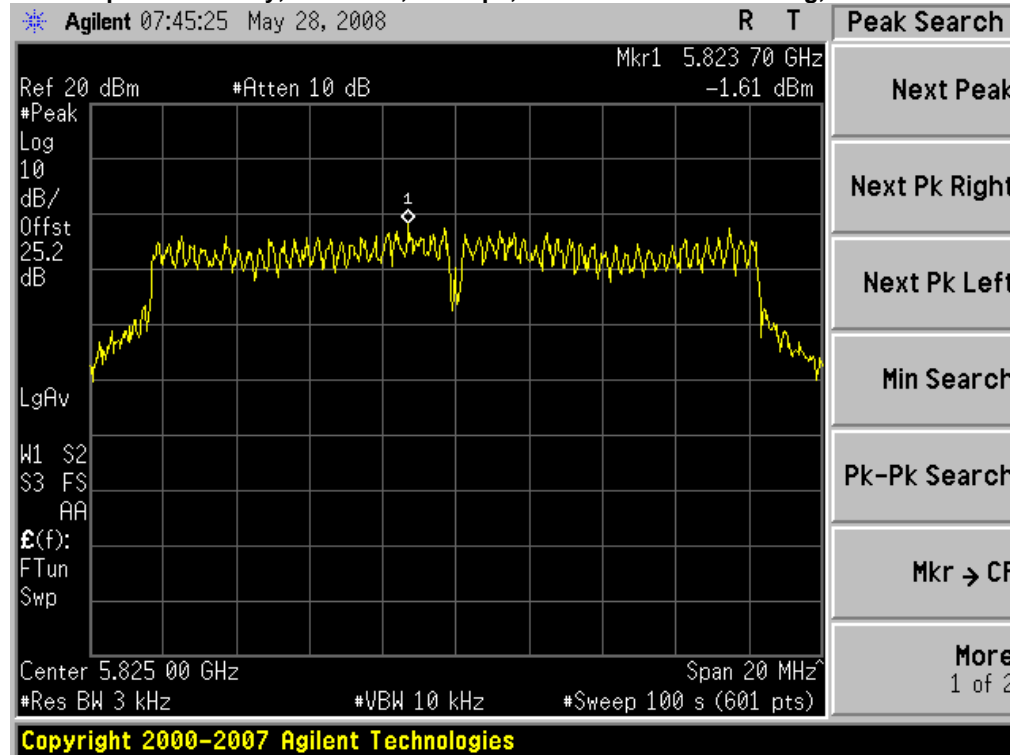**Power Spectral Density, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths**
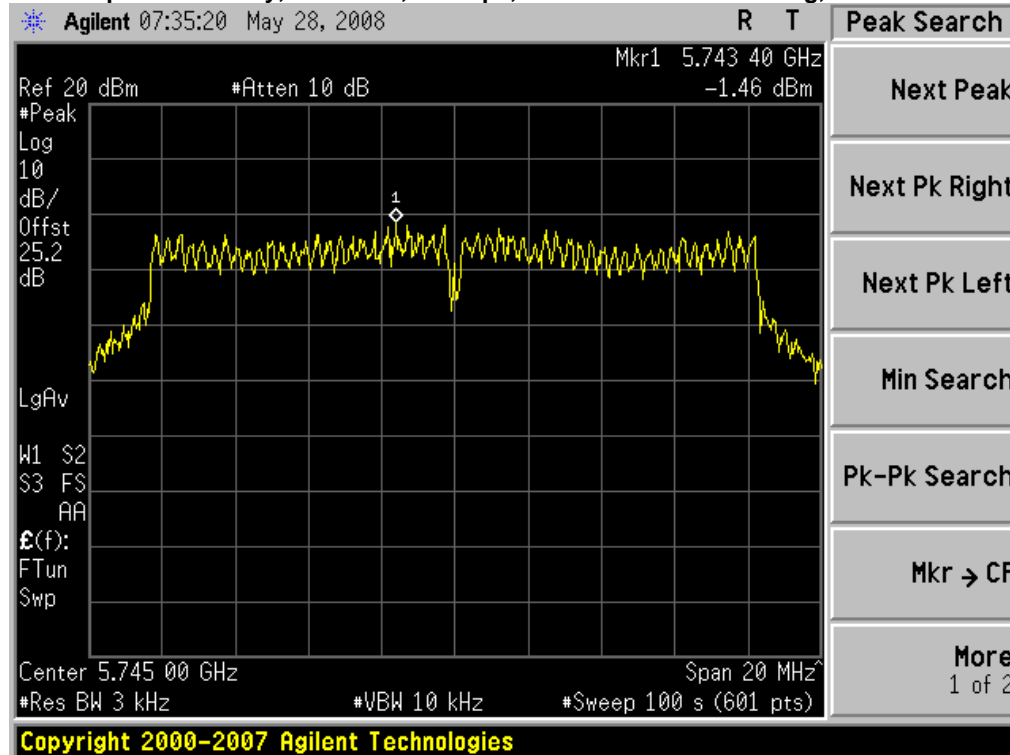
Power Spectral Density, 5785 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths
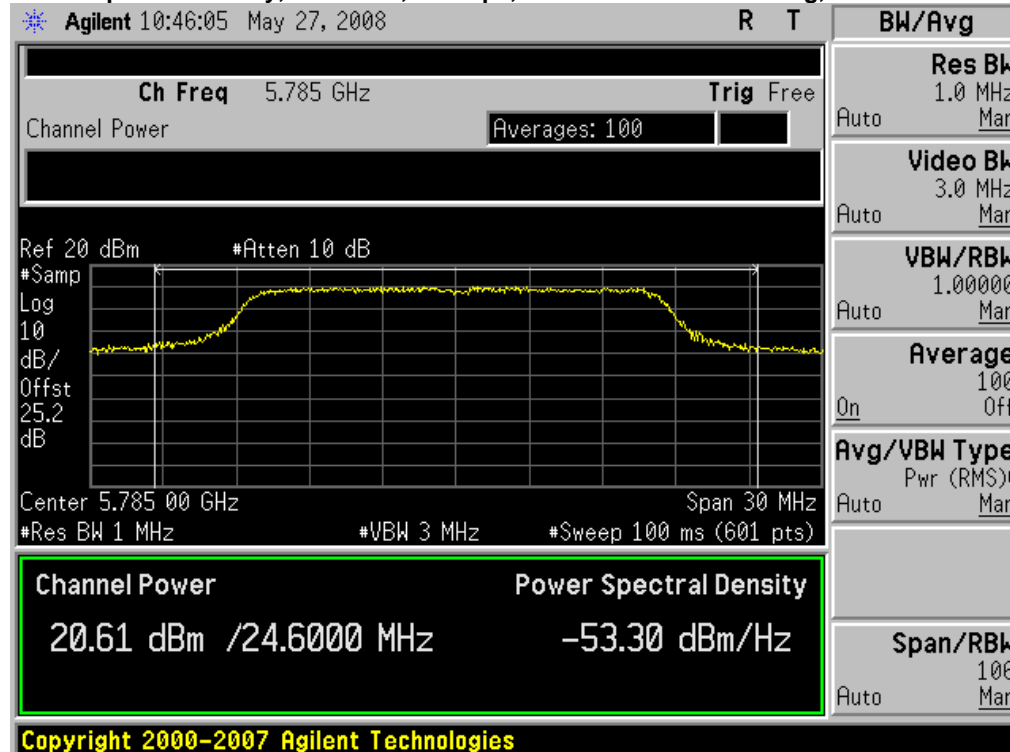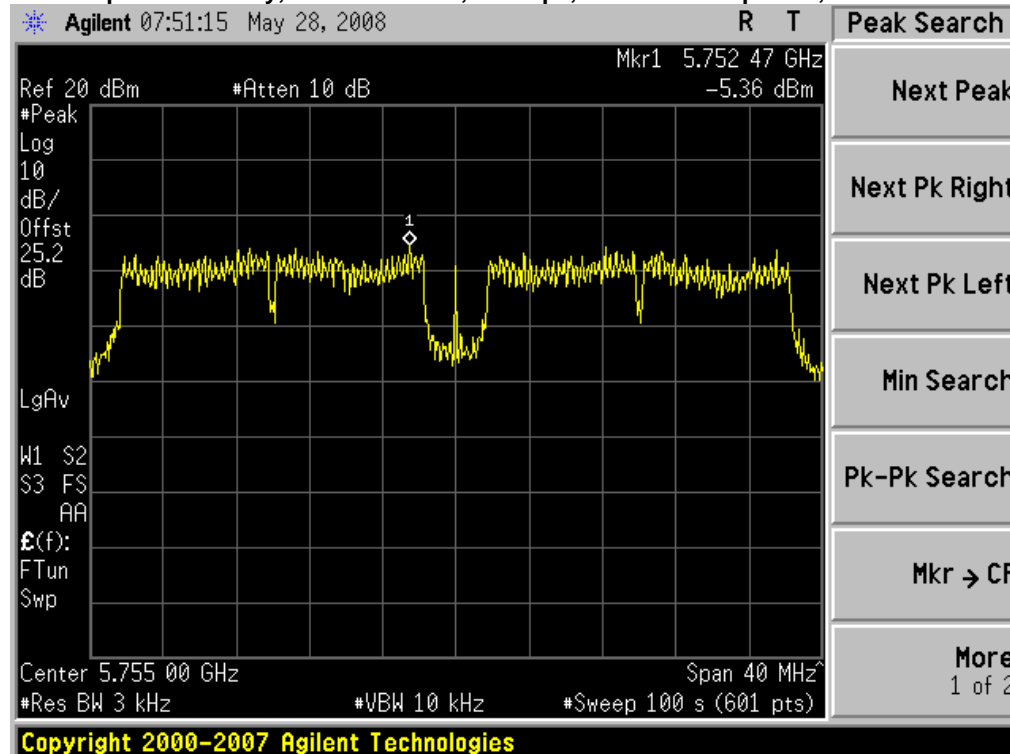
Power Spectral Density, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths
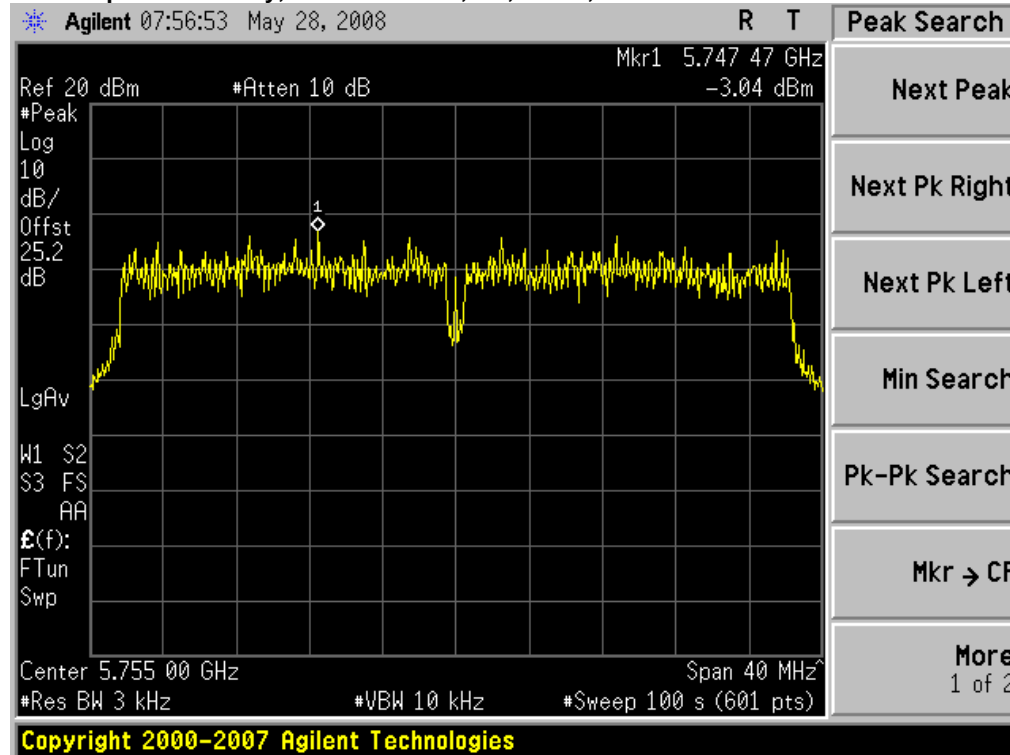

Power Spectral Density, 5745/5765 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths
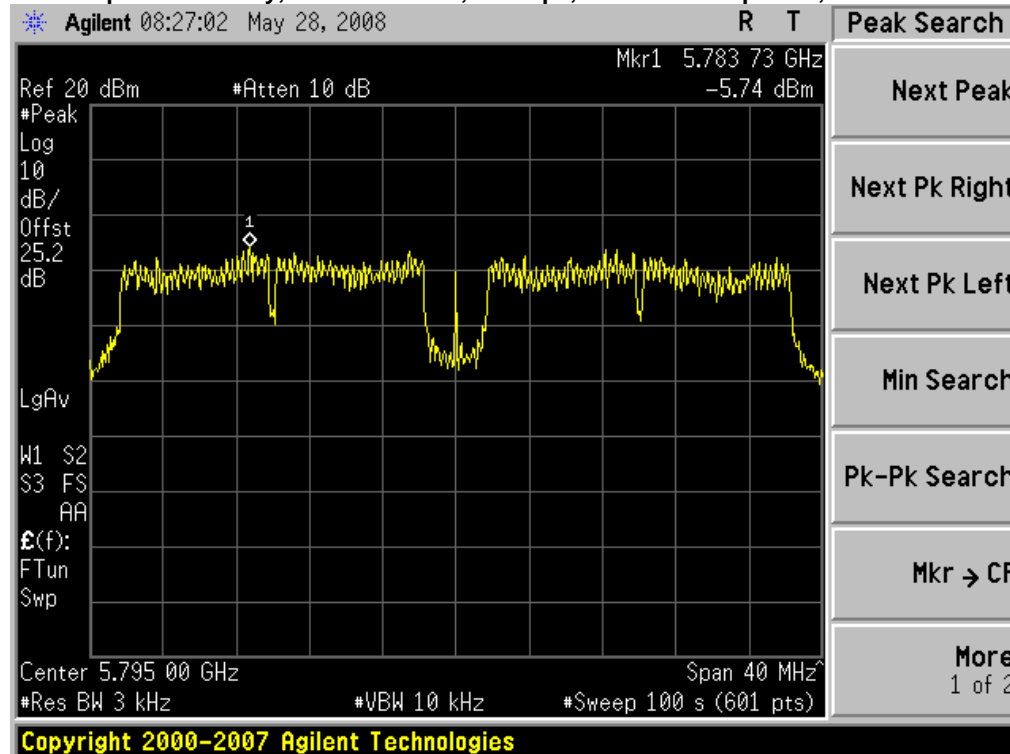
CISCO

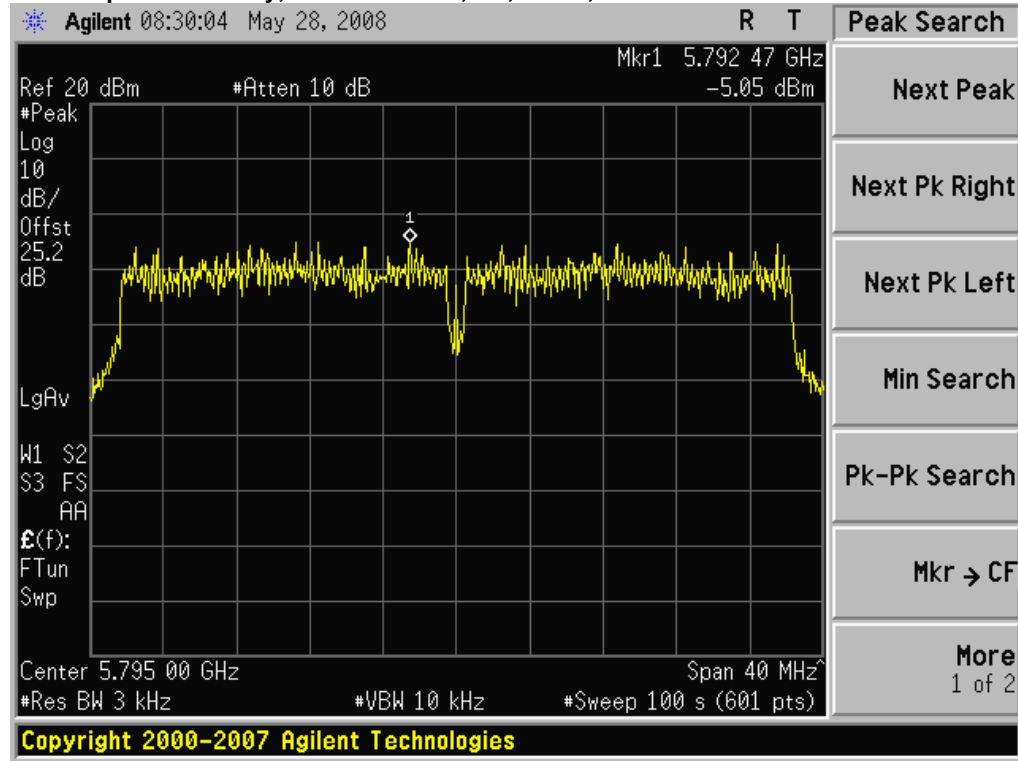**Power Spectral Density, 5745/5765 MHz, M7, HT-40, Dual Transmit Paths**

Power Spectral Density, 5785/5805 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths

Power Spectral Density, 5785/5805 MHz, M7, HT-40, Dual Transmit Paths

Conducted Spurious Emissions

15.247: In any 100 kHz bandwidth outside the frequency band in which the digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

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-26 GHz
Reference Level:	20 dBm
Attenuation:	10 dB
Sweep Time:	5s
Resolution Bandwidth:	100 kHz
Video Bandwidth:	300 kHz
Detector:	Peak
Trace:	Single
Marker:	Peak

Record the marker waveform peak to spur difference

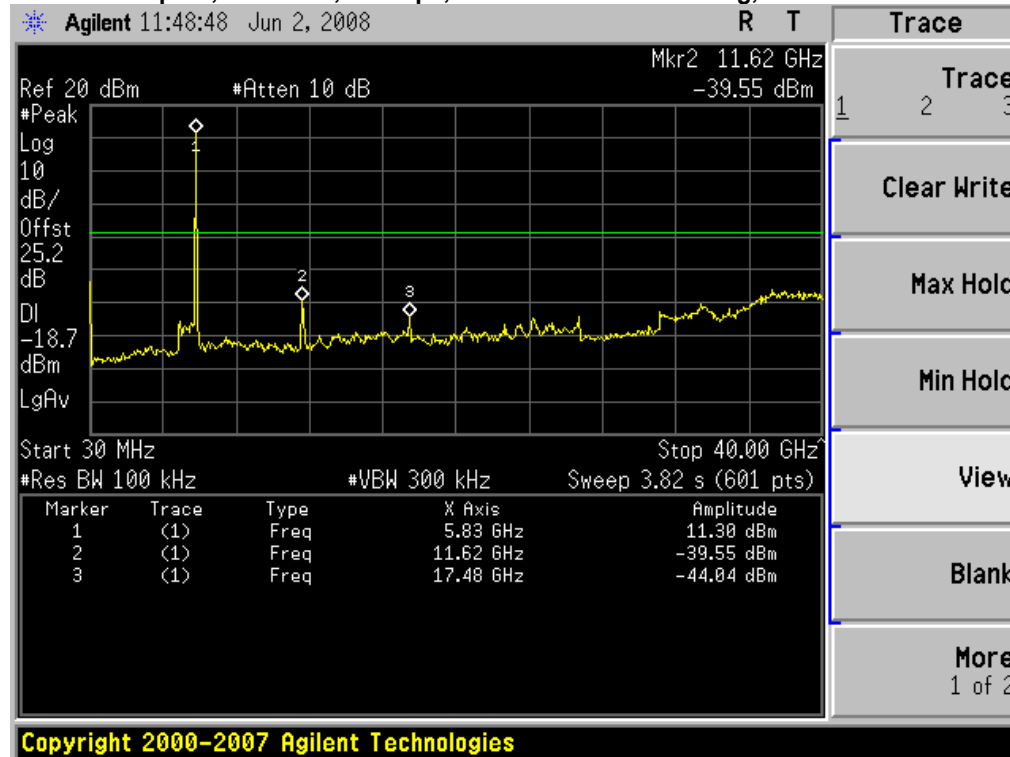| Frequency (MHz)	Mode	Data Rate (Mbps)	Conducted Spur Delta (dB)	Limit (dBc)	Margin (dB)
5745	Non HT-20 Beam Forming	54	**42.3**	30	12.3
5785	Non HT-20 Beam Forming	54	**45.7**	30	15.7
5825	Non HT-20 Beam Forming	54	**39.6**	30	9.6
5745/5765	Non HT-40 Duplicate	54	**42.7**	30	12.7
5745/5765	HT-40	M7	**42.7**	30	12.7
5785/5805	Non HT-40 Duplicate	54	**45.9**	30	15.9
5785/5805	HT-40	M7	**42.7**	30	12.7

Conducted Spurs, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths
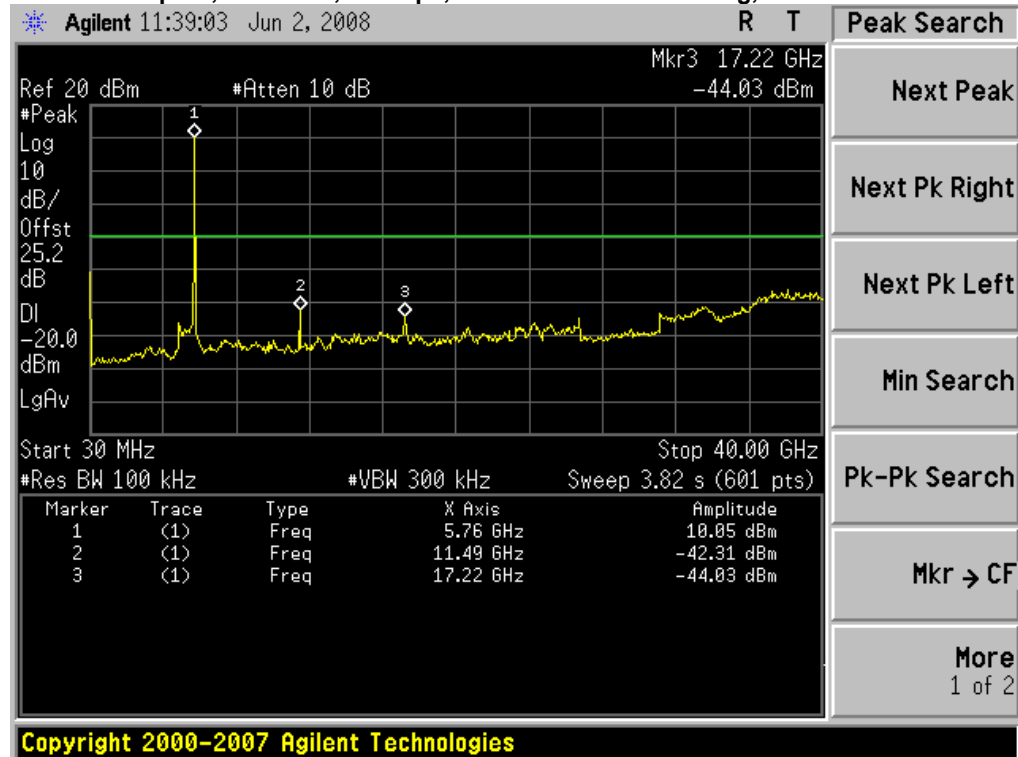
Conducted Spurs, 5785 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths
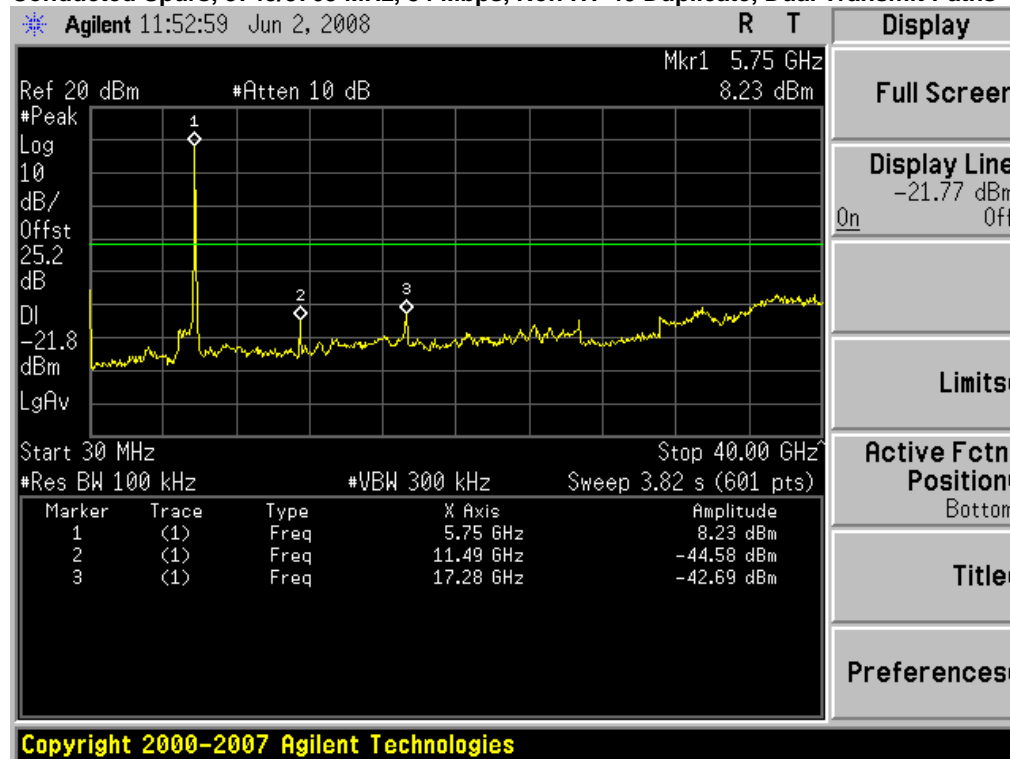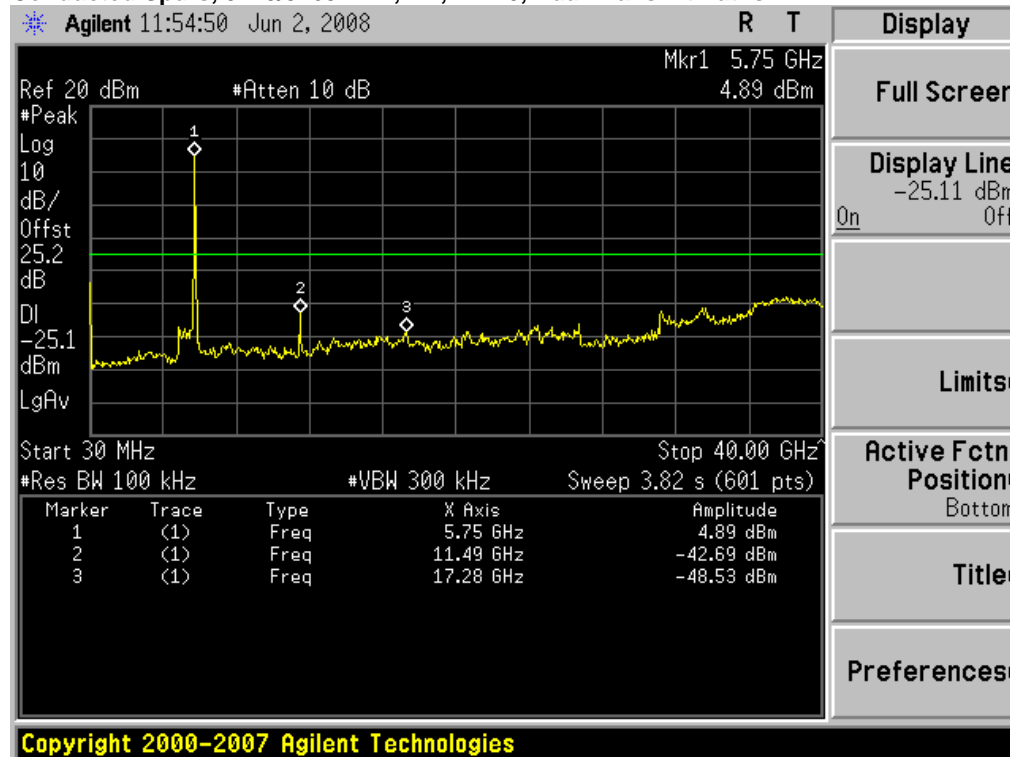
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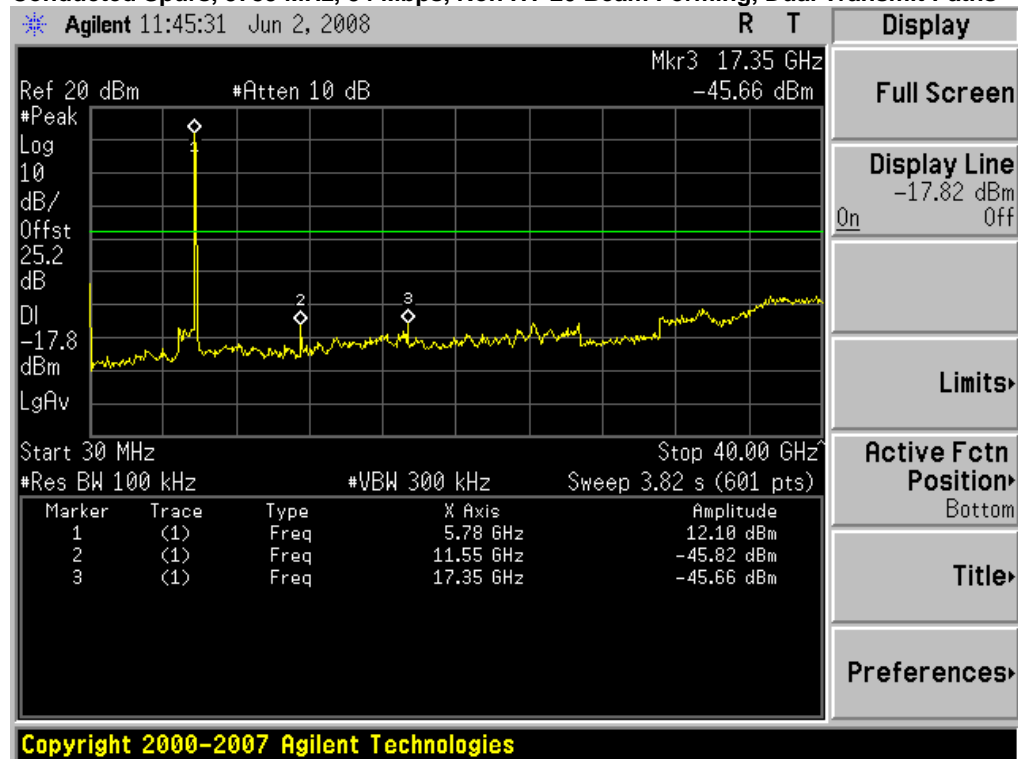
Conducted Spurs, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths

Conducted Spurs, 5745/5765 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths
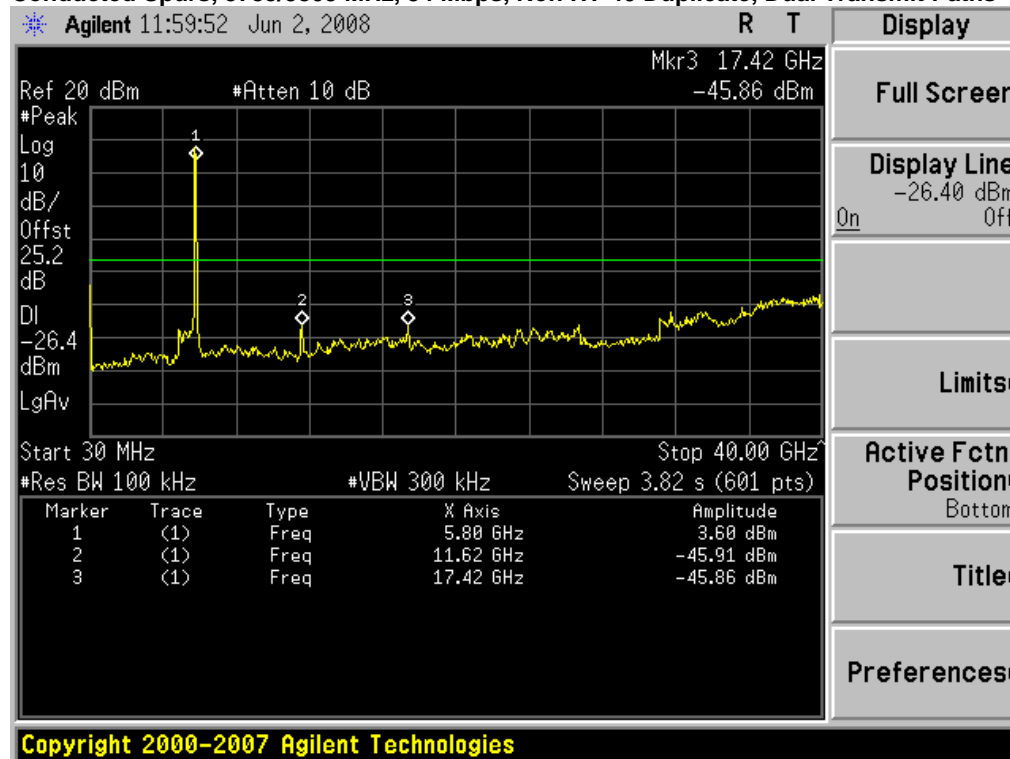
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Conducted Spurs, 5745/5765 MHz, M7, HT-40, Dual Transmit Paths


```
※ Agilent 11:54:50  Jun 2, 2008                    R   T        Display

                                              Mkr1  5.75 GHz
Ref 20 dBm        #Atten 10 dB                     4.89 dBm      Full Screen
#Peak
Log                                                              Display Line
10                                                               -25.11 dBm
dB/                                                          On            Off
Offst
25.2
dB
DI
-25.1
dBm                                                             Limits▶
LgAv

Start 30 MHz                              Stop 40.00 GHz         Active Fctn
#Res BW 100 kHz        #VBW 300 kHz    Sweep 3.82 s (601 pts)    Position▶
                                                                 Bottom
  Marker   Trace     Type      X Axis            Amplitude
    1       (1)       Freq      5.75 GHz          4.89 dBm        Title▶
    2       (1)       Freq      11.49 GHz        -42.69 dBm
    3       (1)       Freq      17.28 GHz        -48.53 dBm

                                                                Preferences▶

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Conducted Spurs, 5785/5805 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths


```
※ Agilent 11:59:52  Jun 2, 2008                    R   T        Display

                                              Mkr3  17.42 GHz
Ref 20 dBm        #Atten 10 dB                    -45.86 dBm     Full Screen
#Peak
Log                                                              Display Line
10                                                               -26.40 dBm
dB/                                                          On            Off
Offst
25.2
dB
DI
-26.4
dBm                                                             Limits▶
LgAv

Start 30 MHz                              Stop 40.00 GHz         Active Fctn
#Res BW 100 kHz        #VBW 300 kHz    Sweep 3.82 s (601 pts)    Position▶
                                                                 Bottom
  Marker   Trace     Type      X Axis            Amplitude
    1       (1)       Freq      5.80 GHz          3.60 dBm        Title▶
    2       (1)       Freq      11.62 GHz        -45.91 dBm
    3       (1)       Freq      17.42 GHz        -45.86 dBm

                                                                Preferences▶

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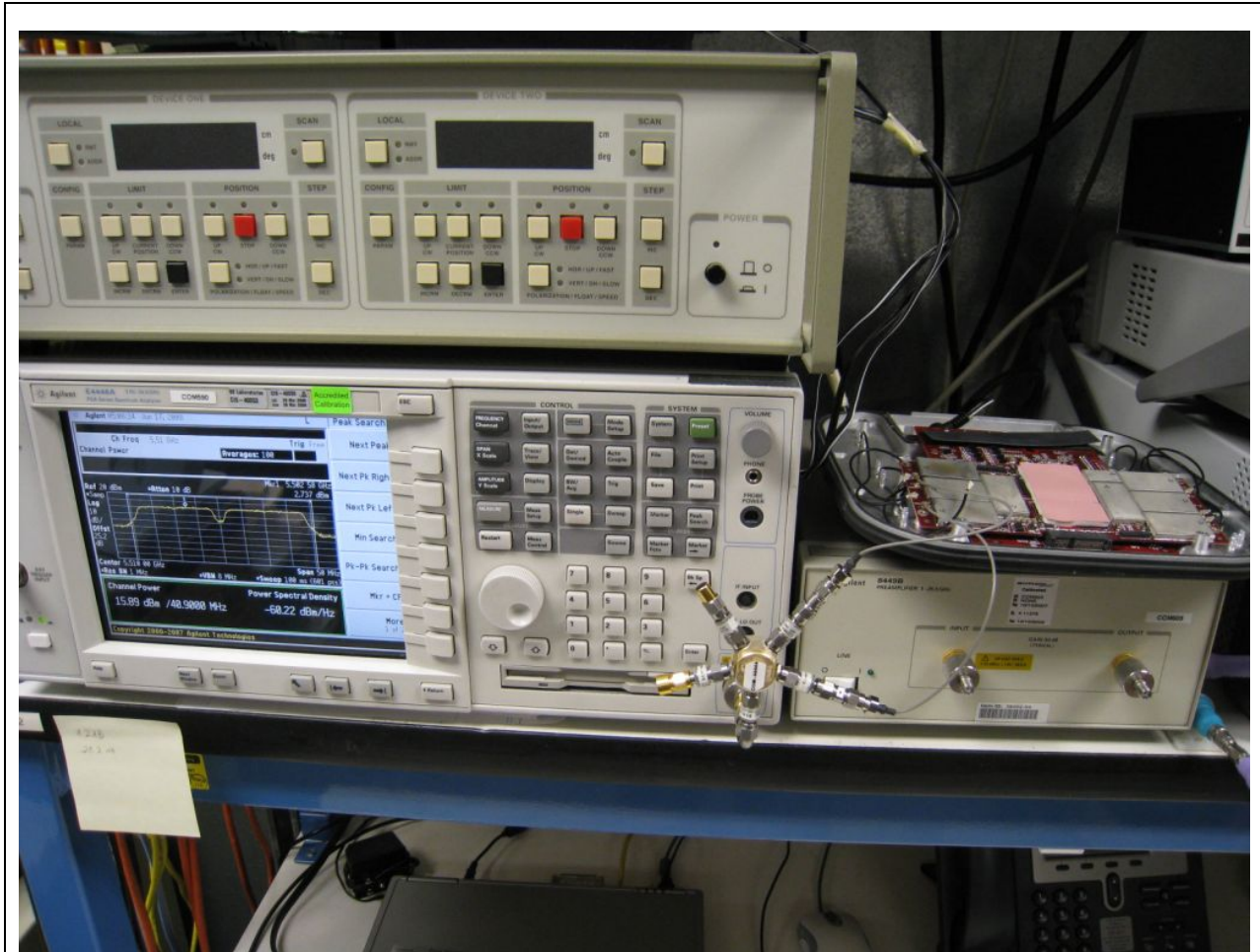
Conducted Spurs, 5785/5805 MHz, M7, HT-40, Dual Transmit Paths

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.

Span:	5350-5745 MHz for 5745MHz test, (Measure 5725MHz Horz & Vert)
	5805-6500 MHz for 5805MHz test, (Measure 5850MHz Horz & Vert)
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.

Frequency (MHz)	Mode	Data Rate (Mbps)	Radiated Band Edge Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
5745	Non HT-20 Beam Forming	54	63.1	68	4.9
5825	Non HT-20 Beam Forming	54	55.9	68	12.1
5745/5765	Non HT-40 Duplicate	54	65.0	68	3.0
5745/5765	HT-40	M7	66.6	68	1.4
5785/5805	Non HT-40 Duplicate	54	62.1	68	5.9
5785/5805	HT-40	M7	54.4	68	13.6

Radiated Bandedge, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths, Average
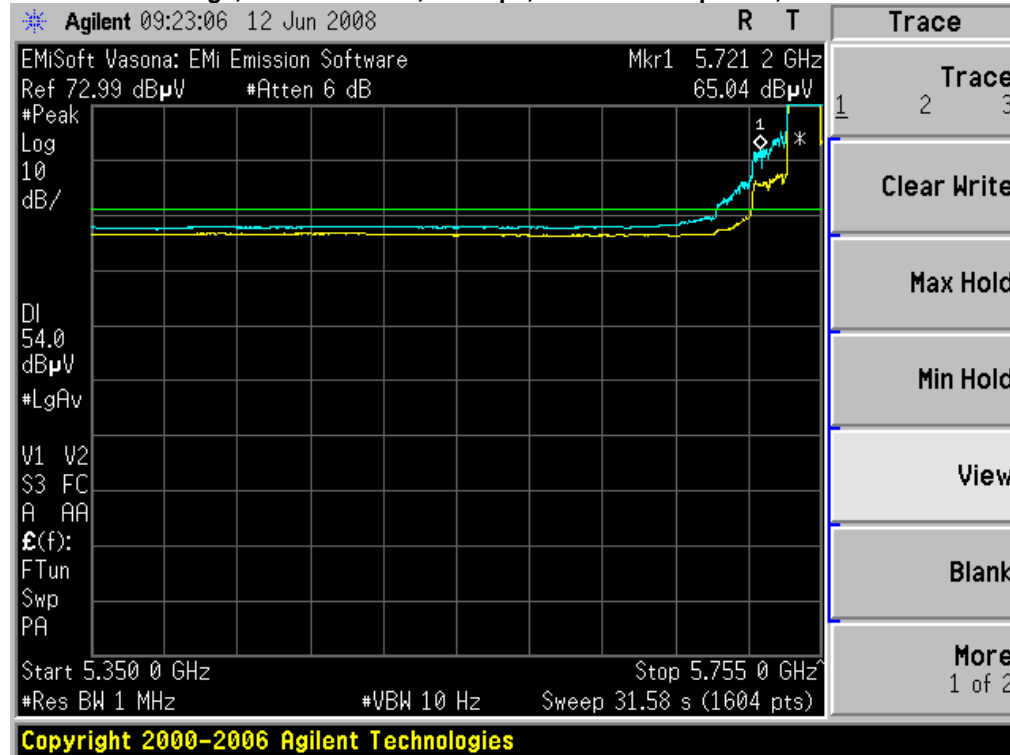

Radiated Bandedge, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths, Average
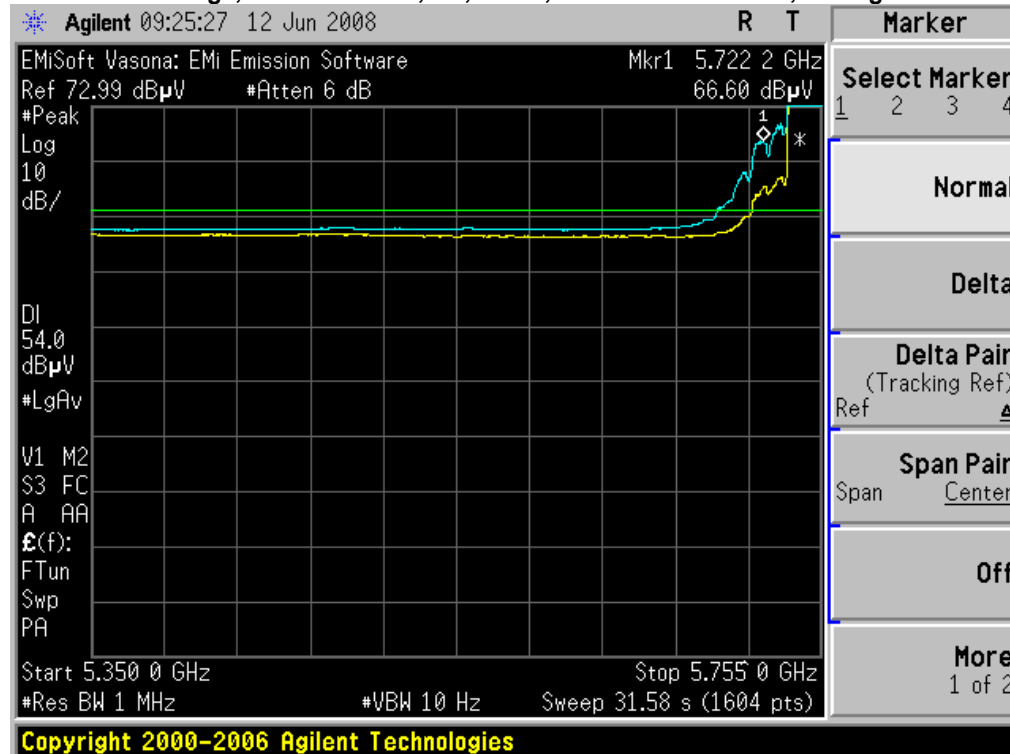
CISCO

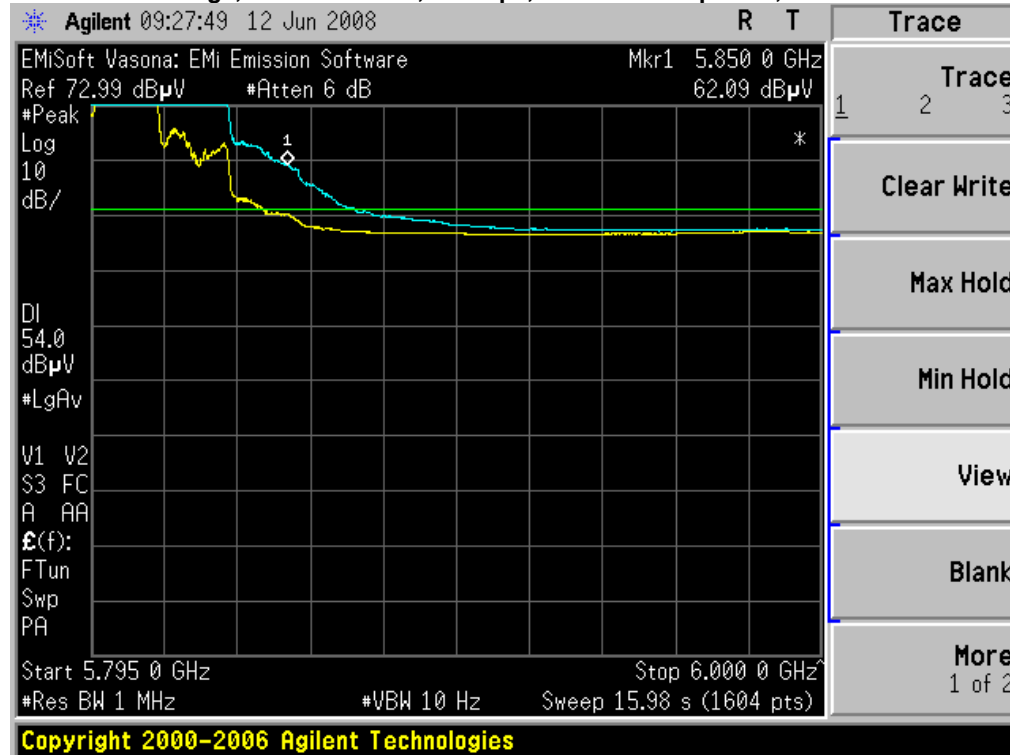**Radiated Bandedge, 5745/5765 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Average**

Radiated Bandedge, 5745/5765 MHz, M7, HT-40, Dual Transmit Paths, Average
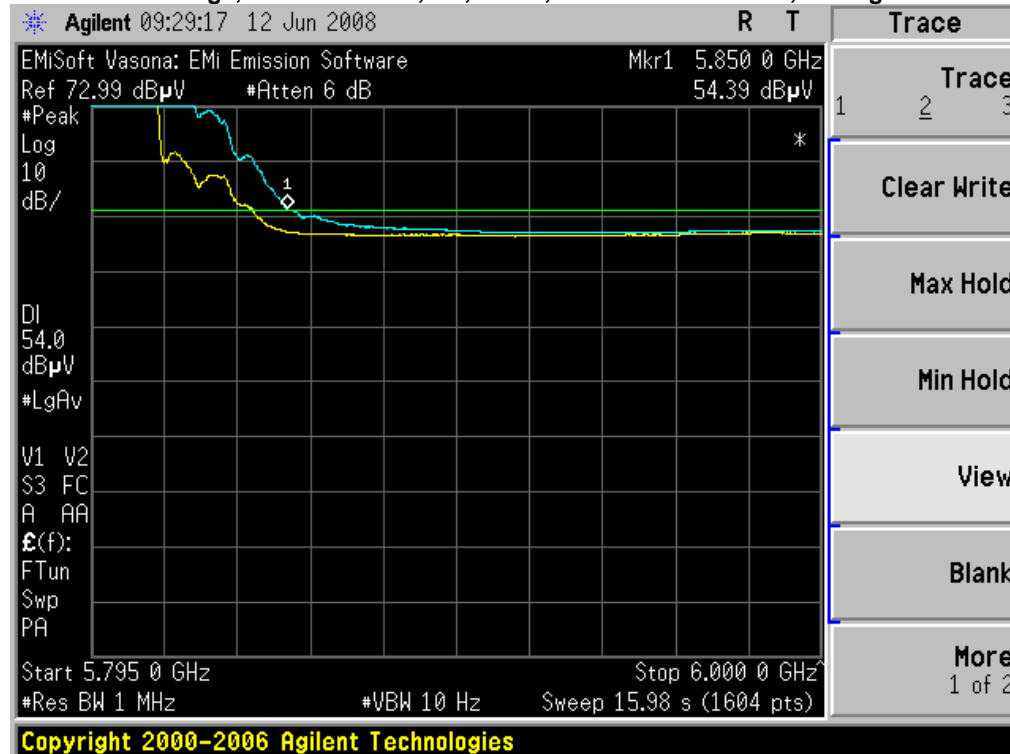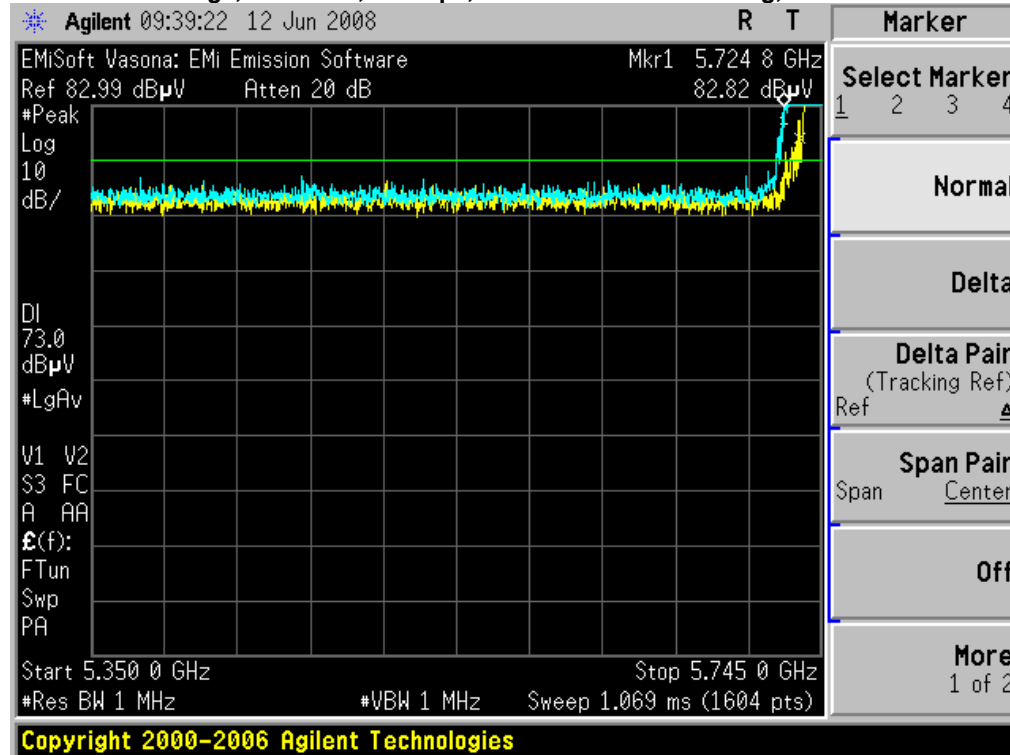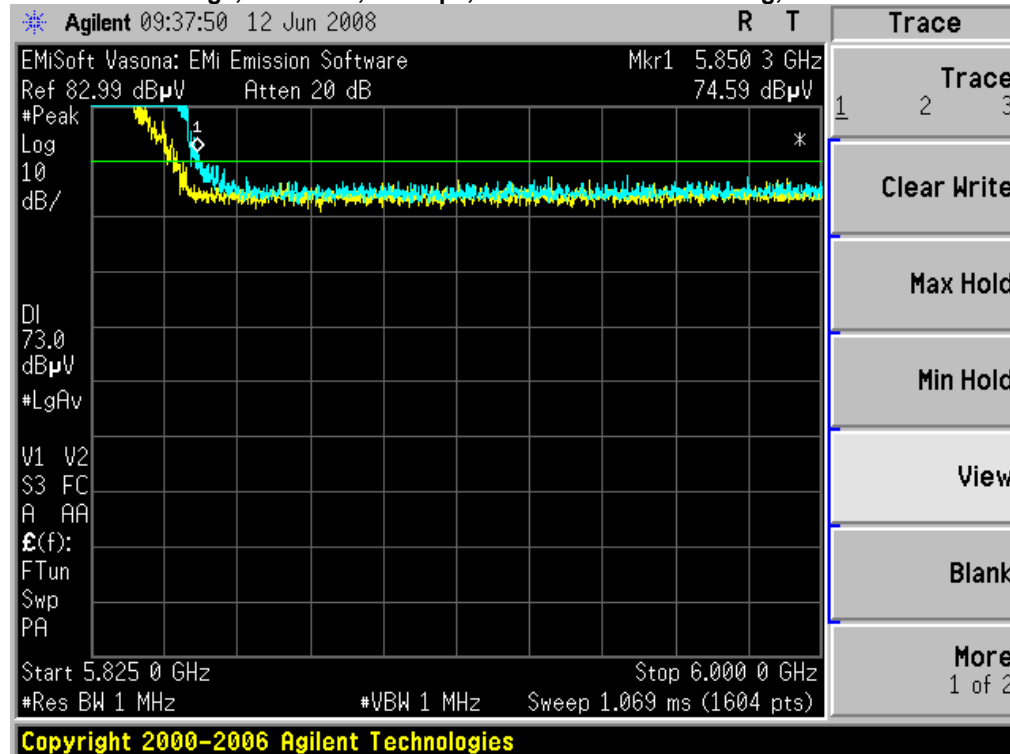
Radiated Bandedge, 5785/5805 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Average

Radiated Bandedge, 5785/5805 MHz, M7, HT-40, Dual Transmit Paths, Average

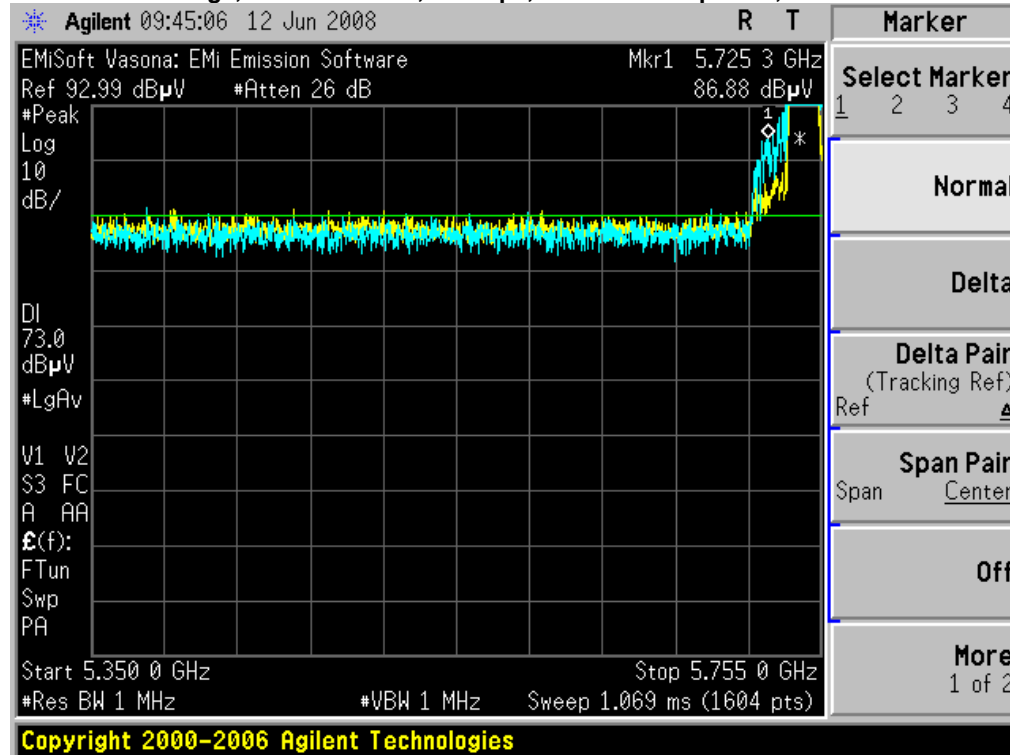**Radiated Bandedge, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths, Peak**

Radiated Bandedge, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths, Peak
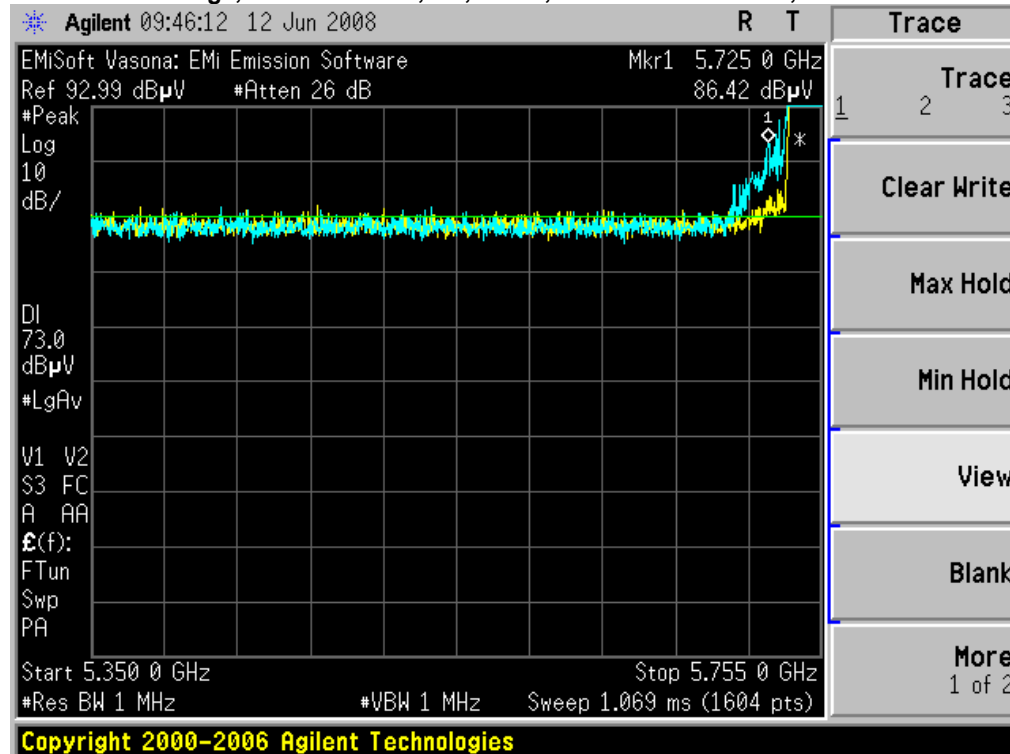
CISCO

Radiated Bandedge, 5745/5765 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Peak
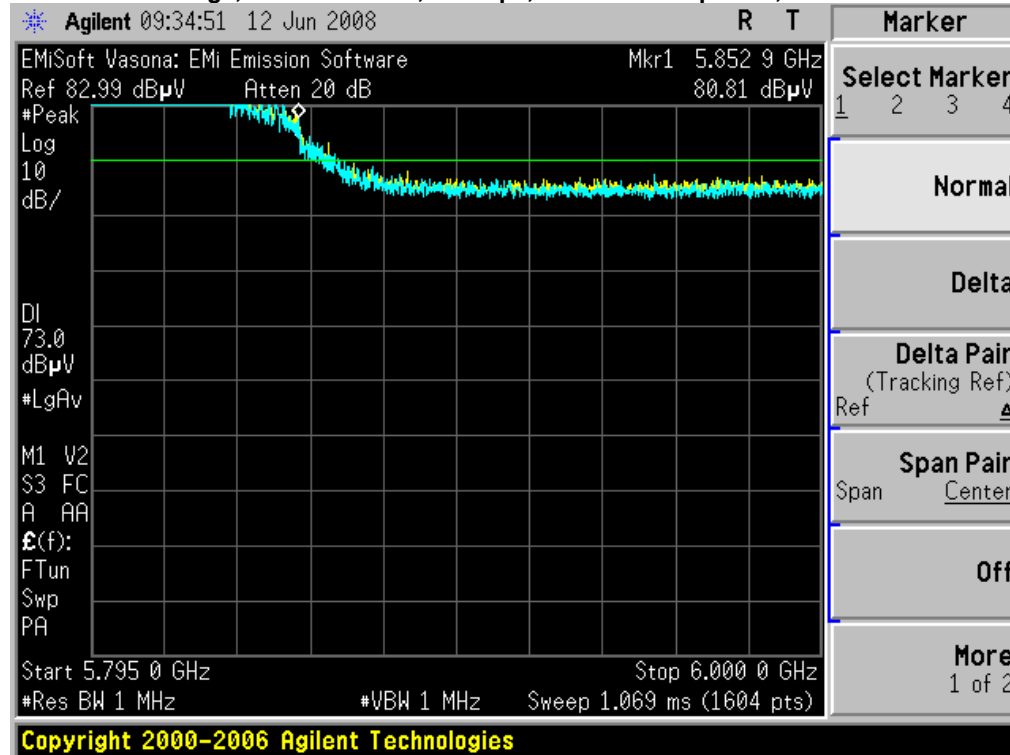

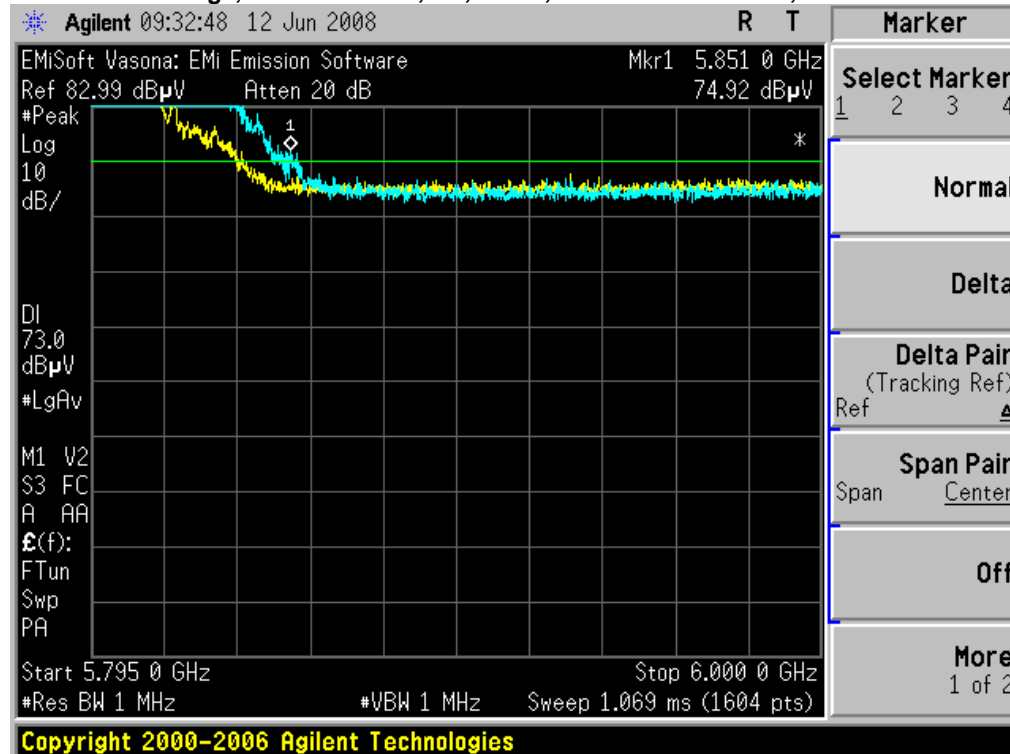**Radiated Bandedge, 5745/5765 MHz, M7, HT-40, Dual Transmit Paths, Peak**

Radiated Bandedge, 5785/5805 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Peak

Radiated Bandedge, 5785/5805 MHz, M7, HT-40, Dual Transmit Paths, 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.

Frequency (MHz)	Mode	Data Rate (Mbps)	Spurious Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
5745	Non HT-20 Beam Forming	54	50.6	54	3.4
5785	Non HT-20 Beam Forming	54	52.5	54	1.5
5825	Non HT-20 Beam Forming	54	50.8	54	3.2
5745/5765	Non HT-40 Duplicate	54	50.6	54	3.4
5745/5765	HT-40	M7	48.3	54	5.7
5785/5805	Non HT-40 Duplicate	54	51.6	54	2.4
5785/5805	HT-40	M7	47.9	54	6.1

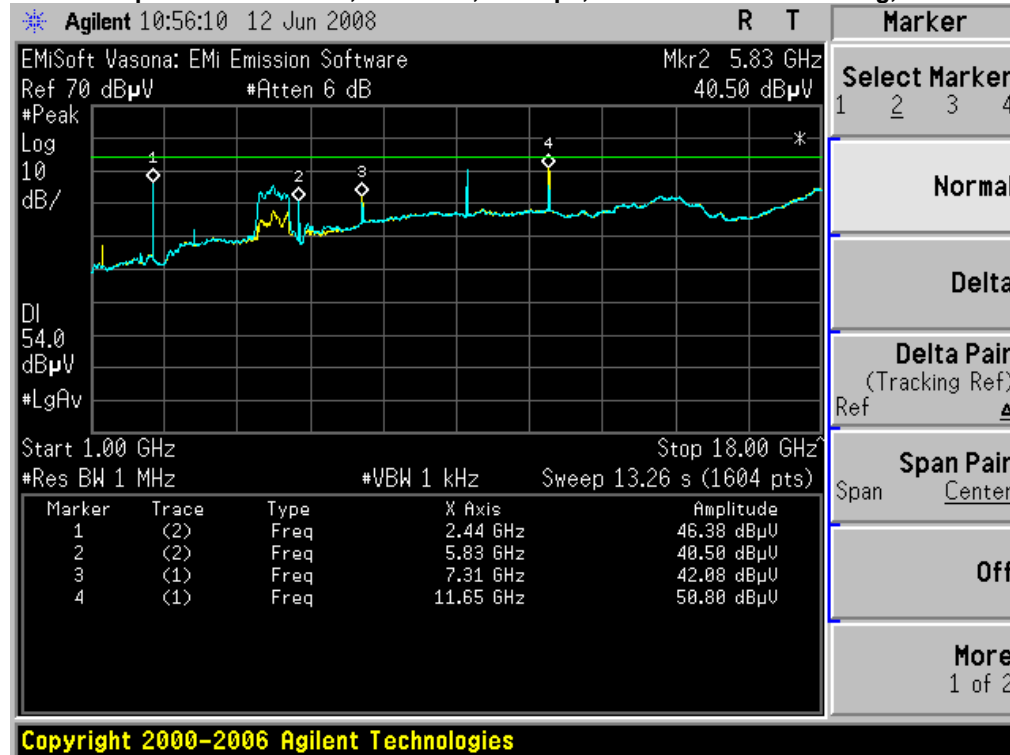**Radiated Spurious Emissions, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths, Average**

Radiated Spurious Emissions, 5785 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths, Average
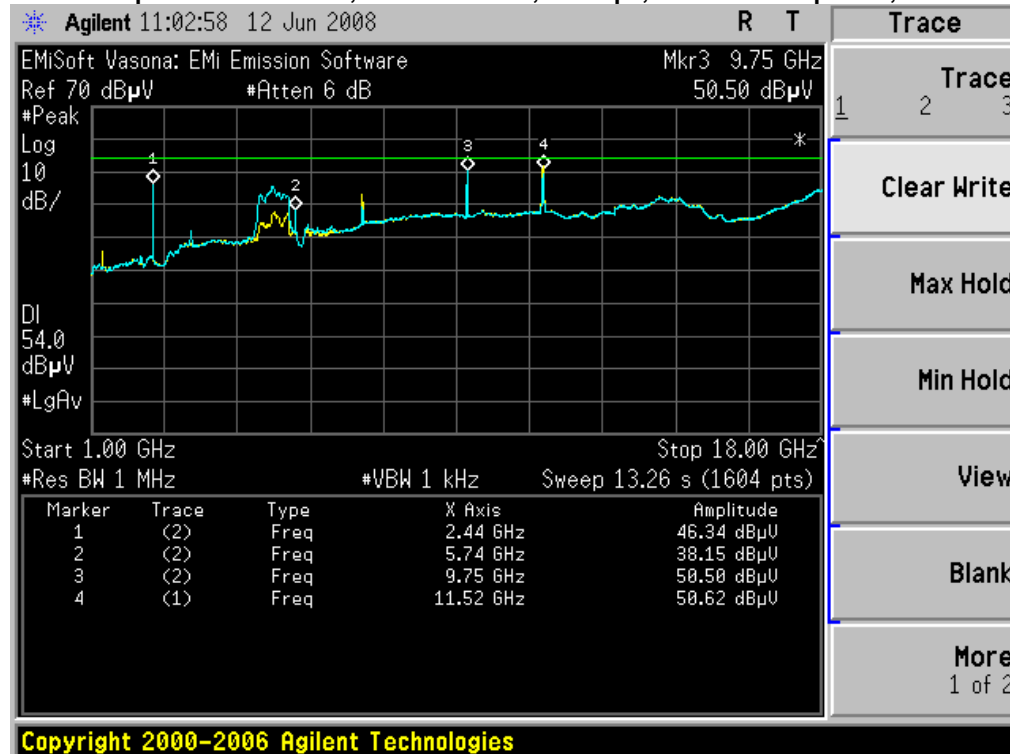
Radiated Spurious Emissions, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths, Average
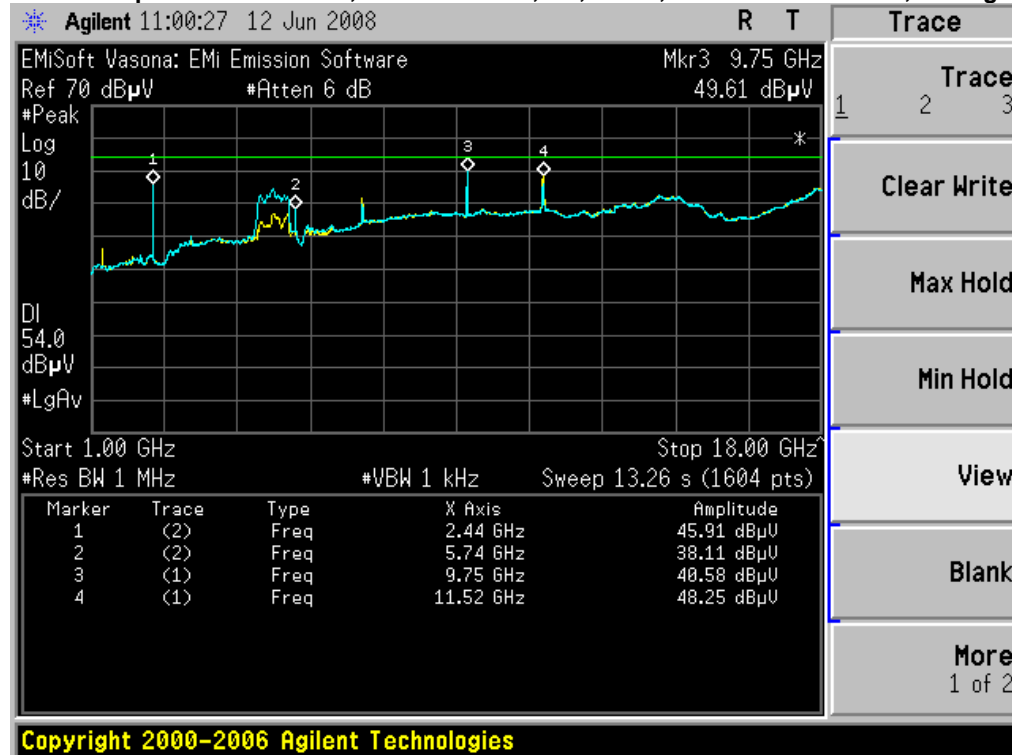

Radiated Spurious Emissions, 5745/5765 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Average
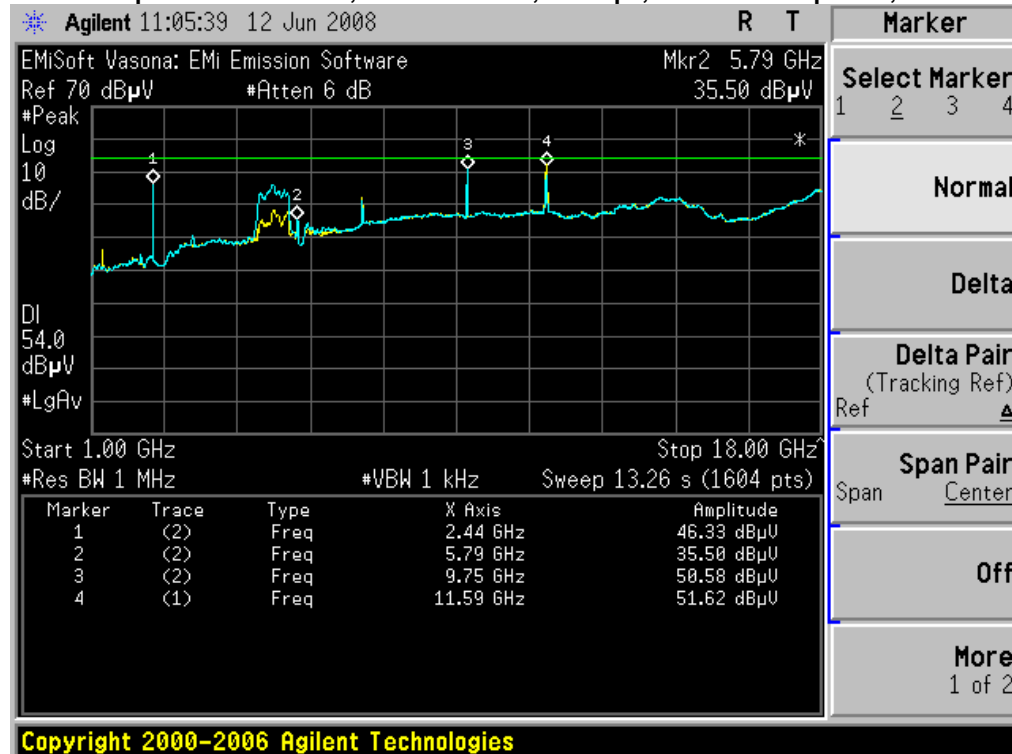
Radiated Spurious Emissions, 5745/5765 MHz, M7, HT-40, Dual Transmit Paths, Average

Agilent 11:00:27 12 Jun 2008   R T   Trace

EMiSoft Vasona: EMi Emission Software   Mkr3 9.75 GHz
Ref 70 dBµV   #Atten 6 dB   49.61 dBµV

Start 1.00 GHz   Stop 18.00 GHz
#Res BW 1 MHz   #VBW 1 kHz   Sweep 13.26 s (1604 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(2)	Freq	2.44 GHz	45.91 dBµV
2	(2)	Freq	5.74 GHz	38.11 dBµV
3	(1)	Freq	9.75 GHz	40.58 dBµV
4	(1)	Freq	11.52 GHz	48.25 dBµV

Trace panel: Trace 1 2 3, Clear Write, Max Hold, Min Hold, View, Blank, More 1 of 2

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Radiated Spurious Emissions, 5785/5805 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Average

Agilent 11:05:39 12 Jun 2008   R T   Marker

EMiSoft Vasona: EMi Emission Software   Mkr2 5.79 GHz
Ref 70 dBµV   #Atten 6 dB   35.50 dBµV

Start 1.00 GHz   Stop 18.00 GHz
#Res BW 1 MHz   #VBW 1 kHz   Sweep 13.26 s (1604 pts)

Marker	Trace	Type	X Axis	Amplitude
1	(2)	Freq	2.44 GHz	46.33 dBµV
2	(2)	Freq	5.79 GHz	35.50 dBµV
3	(2)	Freq	9.75 GHz	50.58 dBµV
4	(1)	Freq	11.59 GHz	51.62 dBµV

Marker panel: Select Marker 1 2 3 4, Normal, Delta, Delta Pair (Tracking Ref) Ref, Span Pair Span Center, Off, More 1 of 2

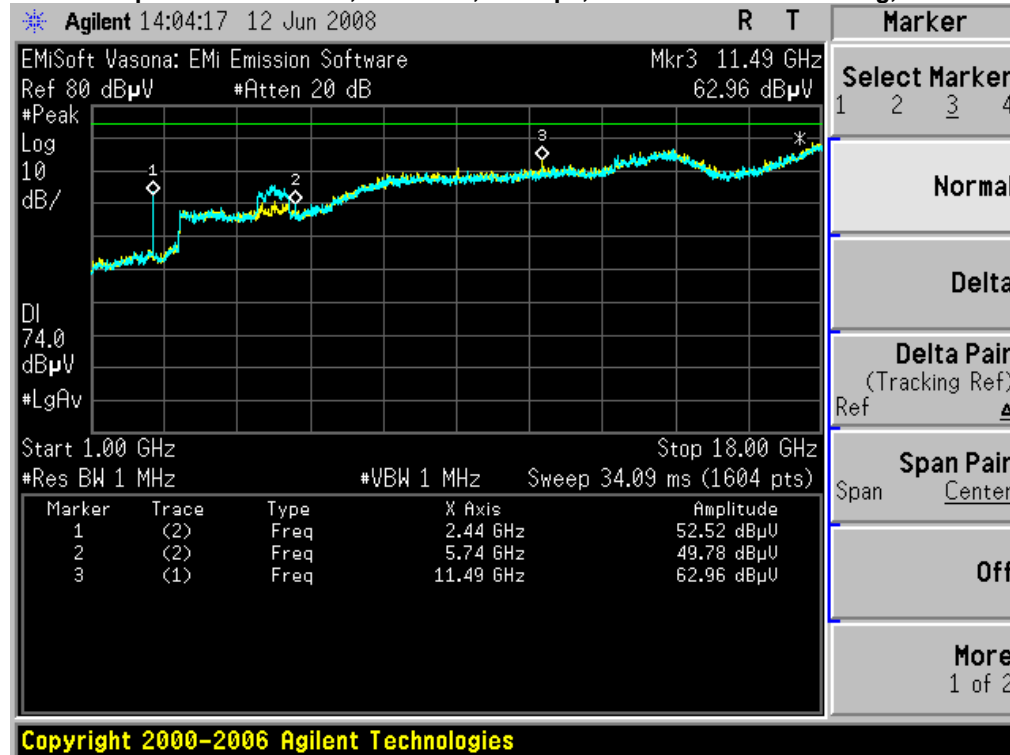Copyright 2000-2006 Agilent Technologies

Radiated Spurious Emissions, 5785/5805 MHz, M7, HT-40, Dual Transmit Paths, Average

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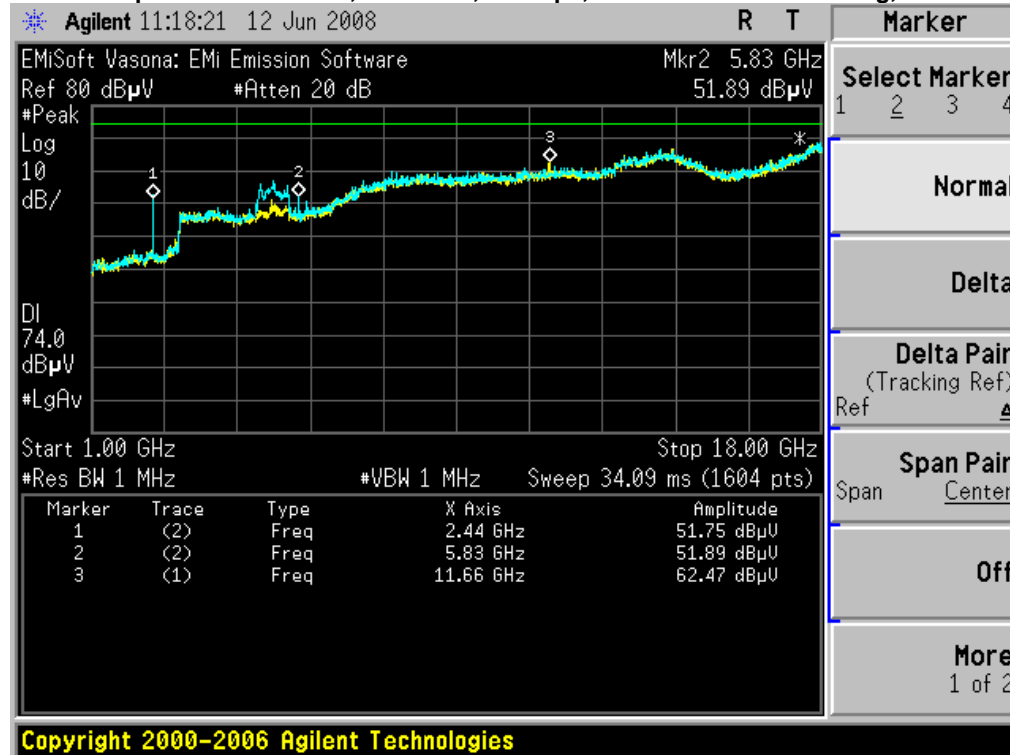**Radiated Spurious Emissions, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths, Peak**

Radiated Spurious Emissions, 5785 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths, Peak

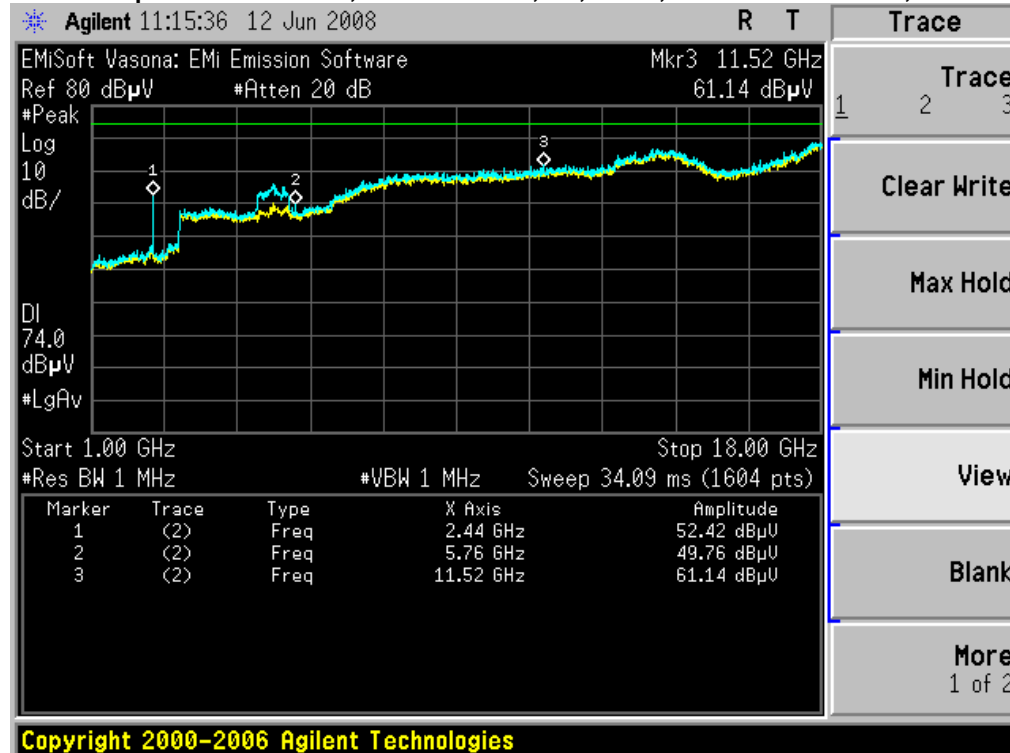**Radiated Spurious Emissions, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths, Peak**

Marker	Trace	Type	X Axis	Amplitude
1	(2)	Freq	2.44 GHz	51.75 dBµV
2	(2)	Freq	5.83 GHz	51.89 dBµV
3	(1)	Freq	11.66 GHz	62.47 dBµV

Radiated Spurious Emissions, 5745/5765 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Peak

Marker	Trace	Type	X Axis	Amplitude
1	(2)	Freq	2.44 GHz	52.73 dBµV
2	(2)	Freq	5.76 GHz	48.09 dBµV
3	(2)	Freq	11.52 GHz	63.26 dBµV

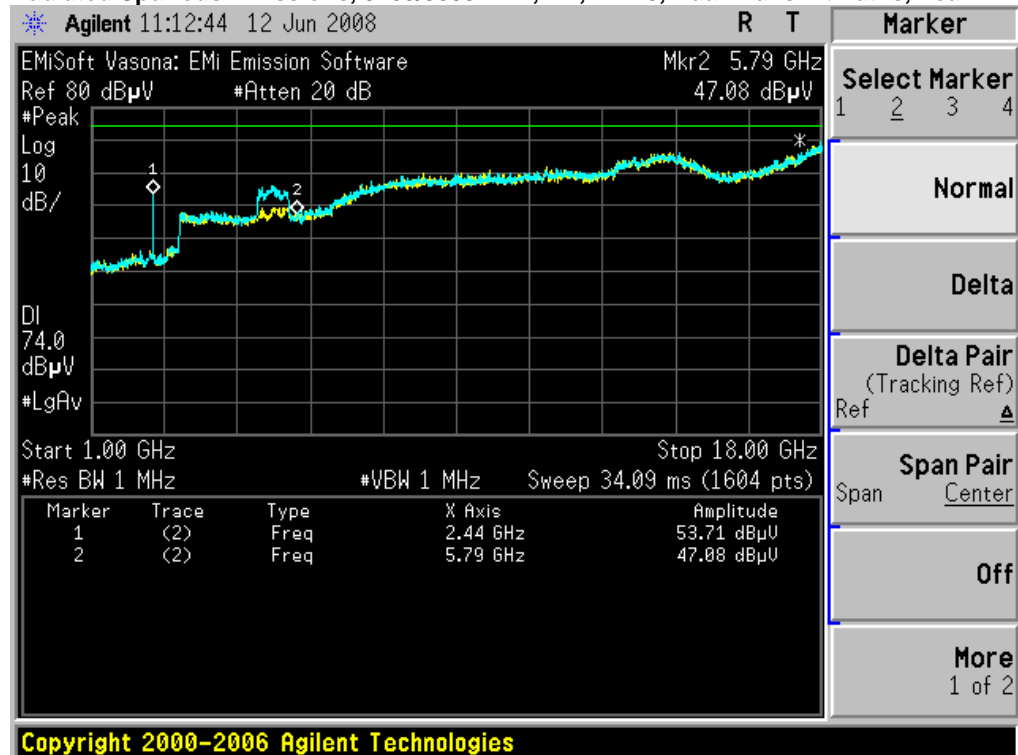**Radiated Spurious Emissions, 5745/5765 MHz, M7, HT-40, Dual Transmit Paths, Peak**

Radiated Spurious Emissions, 5785/5805 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Peak
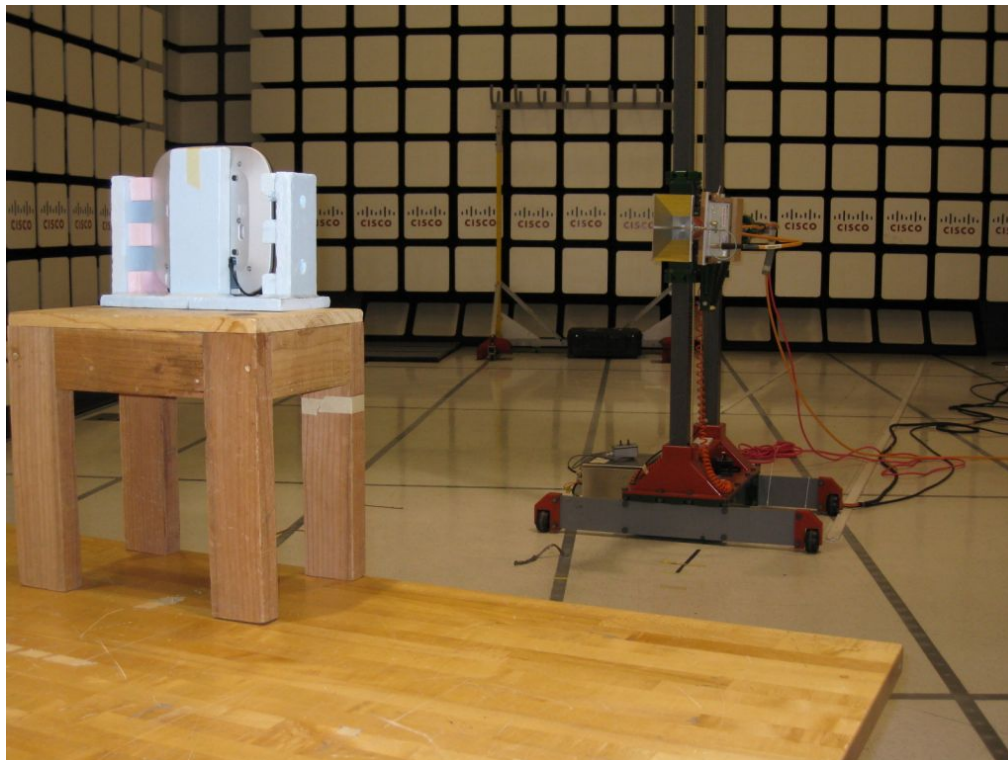
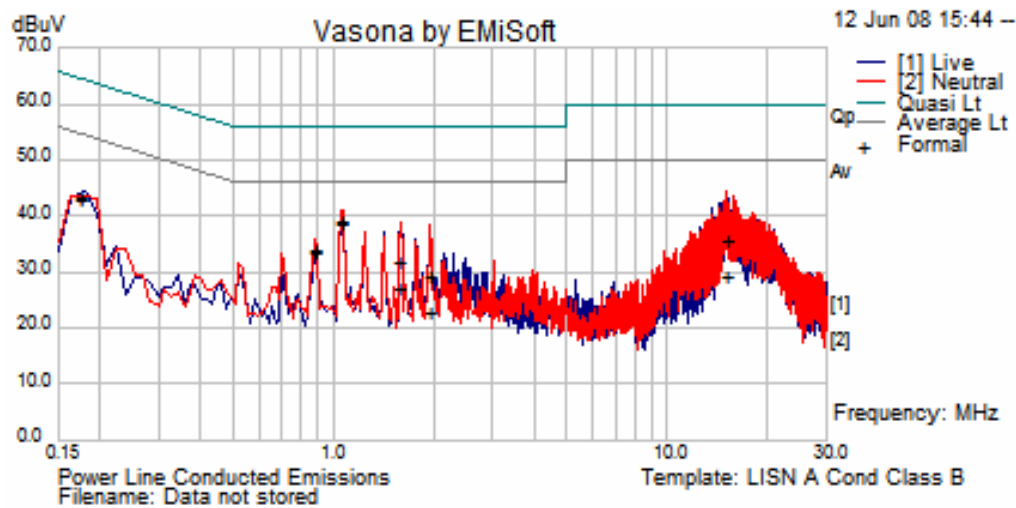**Radiated Spurious Emissions, 5785/5805 MHz, M7, HT-40, Dual Transmit Paths, Peak**

Title: Radiated Test Setup

Conducted emissions

Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail
0.178	20.32	20.41	0.18	40.91	Average	Neutral	54.58	-13.66	Pass
0.178	20.69	20.41	0.18	41.28	Quasi Peak	Neutral	64.58	-23.29	Pass
0.889	11.71	19.96	0.08	31.75	Quasi Peak	Neutral	56	-24.25	Pass
0.889	11.51	19.96	0.08	31.55	Average	Neutral	46	-14.45	Pass
1.068	16.32	19.95	0.09	36.36	Average	Neutral	46	-9.64	Pass
1.068	16.79	19.95	0.09	36.83	Quasi Peak	Neutral	56	-19.17	Pass
1.602	9.74	19.95	0.09	29.78	Quasi Peak	Neutral	56	-26.22	Pass
1.602	4.85	19.95	0.09	24.89	Average	Neutral	46	-21.11	Pass
1.96	0.48	19.95	0.09	20.52	Average	Neutral	46	-25.48	Pass
1.96	7.15	19.95	0.09	27.19	Quasi Peak	Neutral	56	-28.81	Pass
15.163	13.21	20.23	0.14	33.58	Quasi Peak	Neutral	60	-26.42	Pass
15.163	6.59	20.23	0.14	26.96	Average	Neutral	50	-23.04	Pass
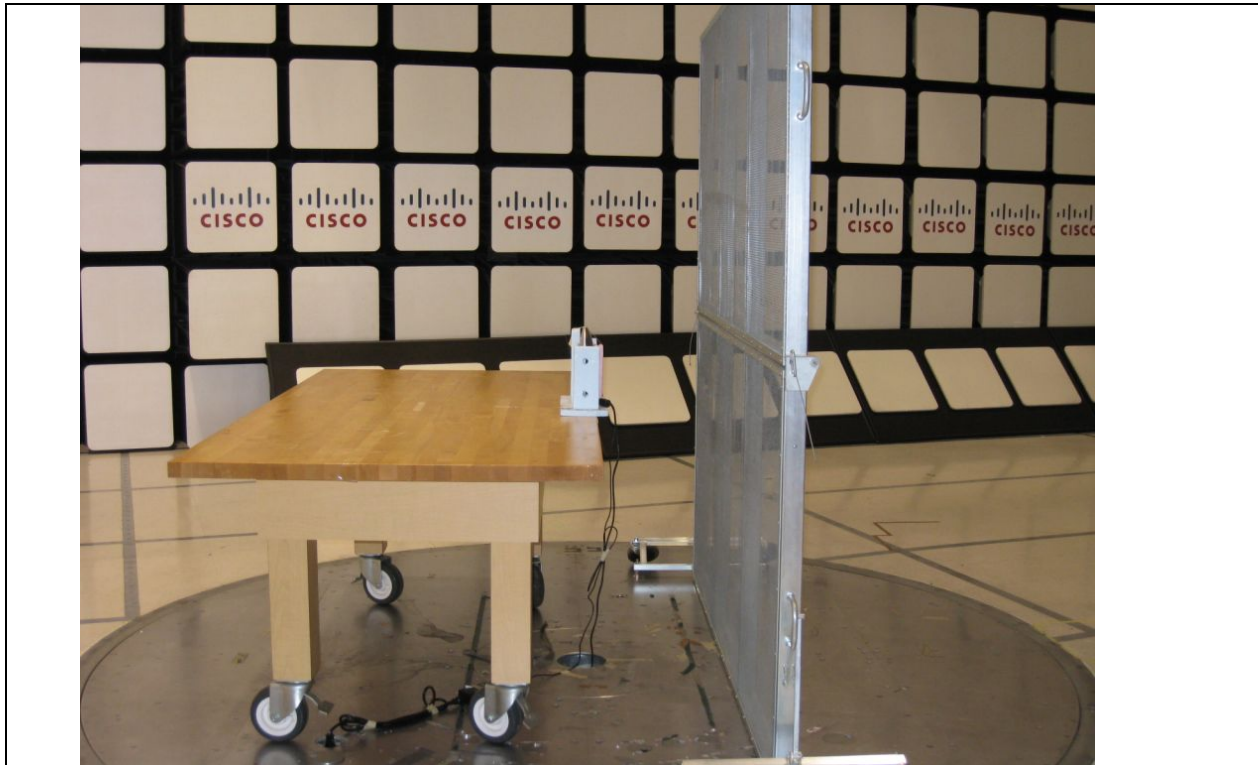
Title: Conducted Power Line Emissions

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Radiated emissions
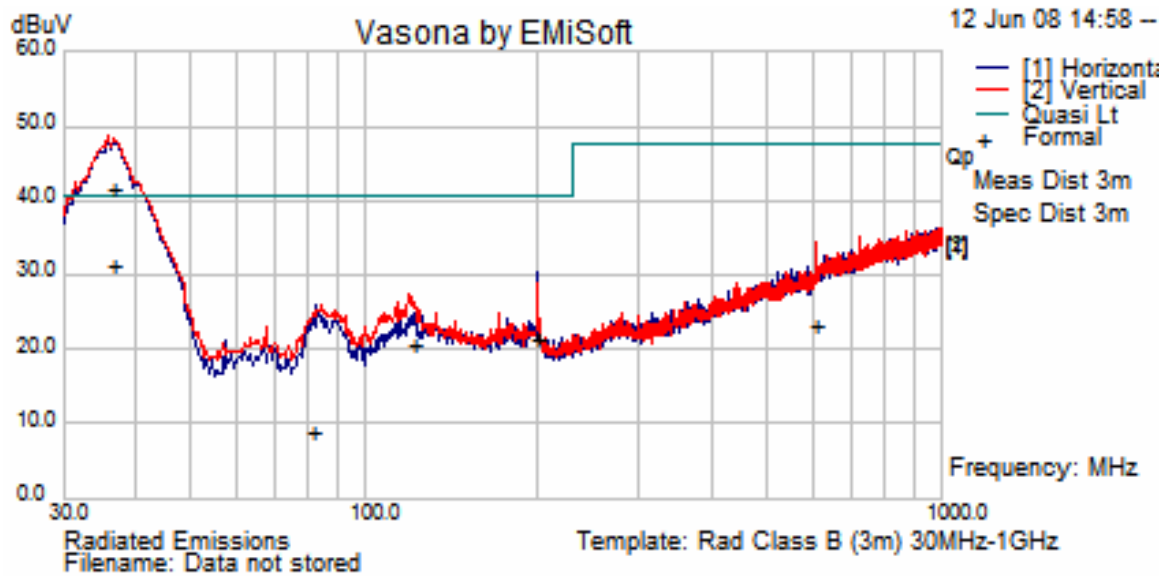
Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV	Margin dB	Pass /Fail
36.913	13.4	0.4	15.7	29.43	Quasi Peak	H	220	282	40.5	-11.1	Pass
36.915	23.8	0.4	15.7	39.85	Quasi Peak	V	180	282	40.5	-0.7	Pass
82.382	-1.1	0.7	7.4	6.88	Quasi Peak	V	240	4	40.5	-33.6	Pass
199.992	5.8	1	12.7	19.54	Quasi Peak	V	105	158	40.5	-21	Pass
122.313	4.23	0.78	13.95	18.95	Quasi Peak	V	125	162	40.5	-21.55	Pass
609.099	0.79	1.74	18.86	21.39	Quasi Peak	V	100	298	47.5	-26.11	Pass
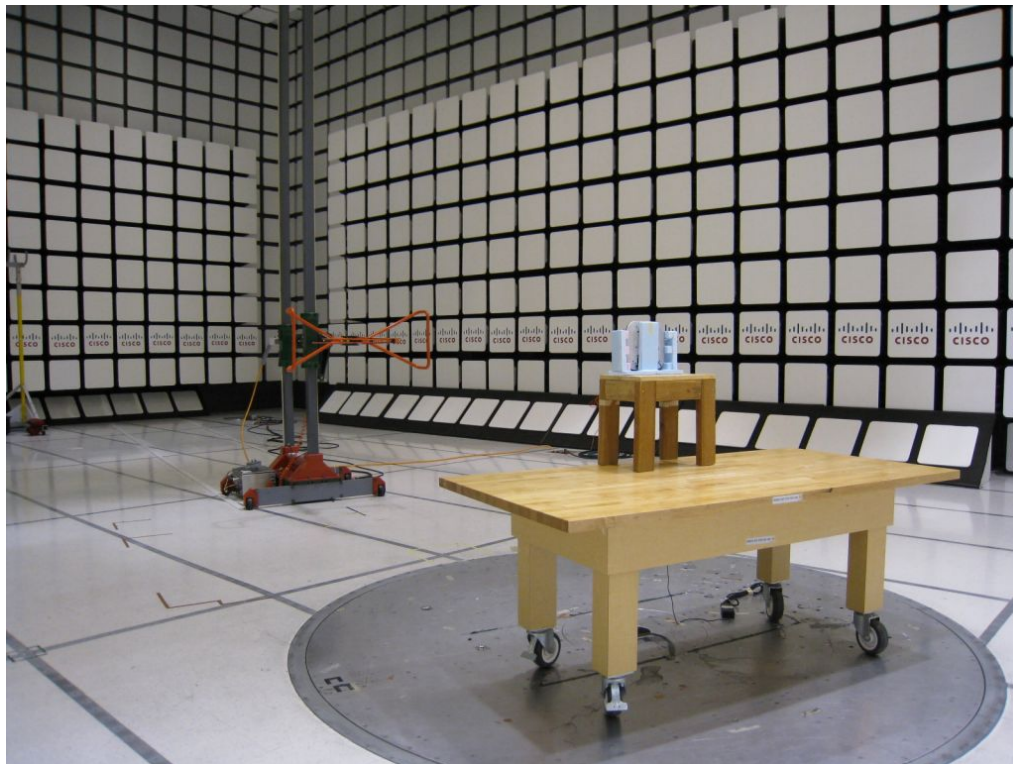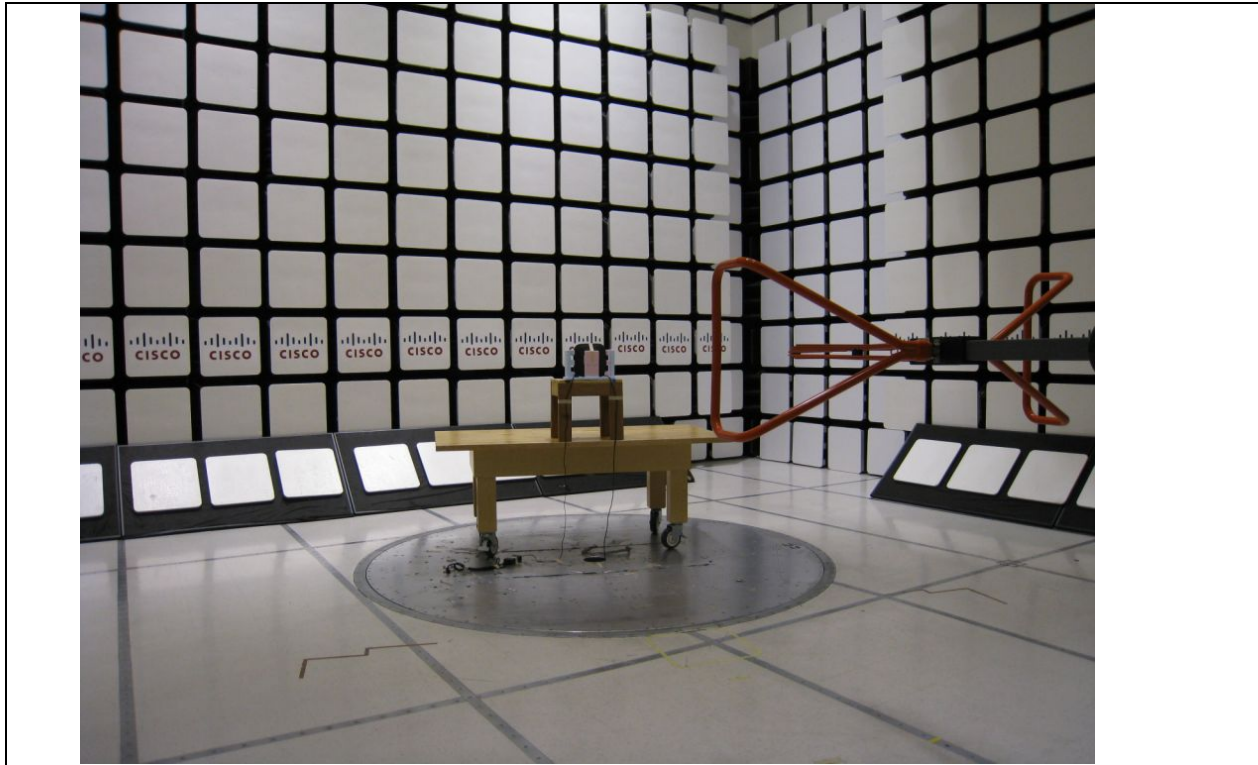
Title: Radiated Emissions 30M-1GHz

Maximum Permissible Exposure (MPE) Calculations

15.247: 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
$$E=\sqrt{(30*P*G)}/d \quad \text{and} \quad S=E^2/3770$$
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^2

Combine equations and rearrange the terms to express the distance as a function of the remaining variables:
$$d=\sqrt{((30*P*G)/(3770*S))}$$

Changing to units of power in mW and distance in cm, using:
P(mW)=P(W)/1000   d(cm)=100*d(m)
yields
$$d=100*\sqrt{((30*(P/1000)*G)/(3770*S))}$$
$$d=0.282*\sqrt{(P*G/S)}$$
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
$$d=0.282*10^{((P+G)/20)}/\sqrt{S} \qquad \text{Equation (1)}$$
and
$$s=((0.282*10^{((P+G)/20)})/d)^2 \qquad \text{Equation (2)}$$
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 6 dBi (9dBi 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)
5745	54	1	21.0	6	**6.31**	20	13.69
5785	54	1	20.6	6	**6.03**	20	13.97
5825	54	1	20.7	6	**6.10**	20	13.90

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)
5745	54	20	21.0	6	**0.10**	1	0.90
5785	54	20	20.6	6	**0.09**	1	0.91
5825	54	20	20.7	6	**0.09**	1	0.91

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

Equip #	Manufacturer	Model	Description	Last Cal	Next Due
CIS040503	Agilent	E4440A	Precision Spectrum Analyzer	20-Mar-08	20-Mar-09
CIS005568	HP	8449B	PreAmplifier (1-26.5GHz)	6-Sep-07	6-Sep-08
CIS020975	Micro-Coax	UFB311A-0-1344-520520	RF Coaxial Cable, to 18GHz, 134.4 in	15-Mar-08	15-Mar-09
CIS030559	Micro-Coax	UFB311A-1-0950-504504	RF Coaxial Cable, to 18GHz, 95 in	12-Mar-08	12-Mar-09
CIS004883	EMC Test Systems	3115	Double Ridged Guide Horn Antenna	11-Mar-08	11-Mar-09
CIS034188	Micro-Tronics	BRC50703-02	Notch Filter, SB:5.150-5.350GHz, to 11GHz	16-Jul-07	16-Jul-08
CIS035605	Micro-Tronics	BRC50704-02	Notch Filter, SB:5.470-5.725GHz, to 12GHz	16-Jul-07	16-Jul-08
CIS037228	Micro-Tronics	BRC50705	Notch Filter, SB:5.725-5.875GHz, to 12 GHz	10-Mar-08	10-Mar-09
CIS034304	Micro-Tronics	BRM50702-02	Notch Filter, SB:2.4-2.5GHz, to 18GHz	16-Jul-07	16-Jul-08
CIS034975	Midwest Microwave	ATT-0640-20-29M-02	Attenuator, 20dB, DC-40GHz	15-May-08	15-May-09
CIS030652	Sunol Sciences	JB1	Combination Antenna, 30MHz-2GHz	16-Jul-07	16-Jul-08
CIS005691	Miteq	NSP1800-25-S1	Broadband Preamplifier (1-18GHz)	9-Oct-07	9-Oct-08
CIS008375	Andrew	F4A-PNMNM	49 ft Heliax Cable	15-Mar-08	15-Mar-09
CIS030559	Micro-Coax	UFB311A-1-0950-504504	RF Coaxial Cable, to 18GHz, 95 in	12-Mar-08	12-Mar-09
CIS008195	TTE	H613-150K-50-21378	Hi Pass Filter - 150KHz cutoff	31-Dec-07	31-Dec-08
CIS008588	Fischer	FCC-RFM2F-520R	LISN AC Adaptor - Std 120V outlet	15-Mar-08	15-Mar-09
COM000590	Agilent	E4448A	Spectrum Analyzer	2-Feb-05	2-Feb-07
COM000601	Agilent	E4417A	EPM-P Series Power Meter	5-Mar-08	5-Mar-09
COM000602	Agilent	E9327A	Peak and Average Power Sensor	6-Mar-08	6-Mar-09