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Test Report

AIR-CAP1552x-A-K9 Series

Cisco Aironet 802.11n Dual Band Mesh Access Points

FCC ID: LDK102074P IC: 2461B-102074P

(Also covers AIR-CAP1552x-N-K9 and AIR-CAP1552x-T-K9 Series)

5725-5850 MHz

Against the following Specifications: CFR47 Part 15.247 RSS210

Cisco Systems

170 West Tasman Drive San Jose, CA 95134

Page No: 1 of 58

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SECTION 1: OVE	CRVIEW
1.1 TEST SUMMARY	x3
SECTION 2: ASS	ESSMENT INFORMATION
2.1 GENERAL2.4 TESTING FACIL2.6 EUT DESCRIPT	
SECTION 4: SAM	IPLE DETAILS
APPENDIX A:	EMISSION TEST RESULTS8
	Power
99% AND 26DB BA	NDWIDTH
POWER SPECTRAL	DENSITY
APPENDIX B:	EMISSION TEST RESULTS
RADIATED SPURIOU	GE
APPENDIX C:	TEST EQUIPMENT/SOFTWARE USED TO PERFORM THE TEST

Page No: 2 of 58

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.
- 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.
- 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.

Page No: 3 of 58

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:

Temperature15°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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Page No: 4 of 58



2.2 Date of start of testing

8-November-2010

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-CAP1552E-A-K9 Cisco Aironet 802.11n Dual Band Mesh Access Point

2.6 EUT Description

The AIR-CAP1552 Series Cisco Aironet 802.11n Dual Band Mesh 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.

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

Page No: 5 of 58



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.

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.

Frequency	Part Number	Antenna Type	Antenna Gain (dBi)
2.4/5 GHz	AIR-ANT2547V-N	Omni	4 / 7
2.4/3 GHZ	Internal	Omni	2/4

Page No: 6 of 58



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-CAP1552E-A-K9		Cisco Systems	NA	NA	NA	
S06	AIR-ANT2547V-N						

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

Page No: 7 of 58

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.

			Targe	et Power	Level	Actual Power Level
Frequency	Mode	Data Rate	Tx A	Tx B	Total	Total
5745	Non HT-20 Beam Forming	6	25	25	28	25.9
5785	Non HT-20 Beam Forming	6	25	25	28	25.9
5825	Non HT-20 Beam Forming	6	25	25	28	26.3
5745/5765	Non HT-40 Duplicate	6	25	25	28	27.7
5745/5765	HT-40	MO	25	25	28	27.0
5785/5805	Non HT-40 Duplicate	6	25	25	28	28.0
5785/5805	HT-40	M0	25	25	28	27.3

Page No: 8 of 58

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	6	16.62	>500	16.1
5785	Non HT-20 Beam Forming	6	16.62	>500	16.1
5825	Non HT-20 Beam Forming	6	14.44	>500	13.9
5745/5765	Non HT-40 Duplicate	6	33.21	>500	32.7
5745/5765	HT-40	m0	35.48	>500	35.0
5785/5805	Non HT-40 Duplicate	6	33.62	>500	33.1
5785/5805	HT-40	m0	35.55	>500	35.1

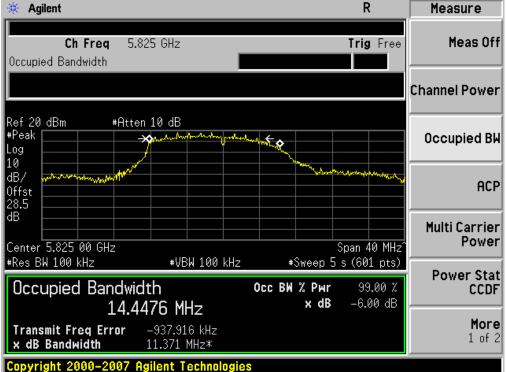
Page No: 9 of 58



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



Page No: 10 of 58



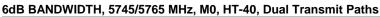
6dB BANDWIDTH, 5825 MHz, 6 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths

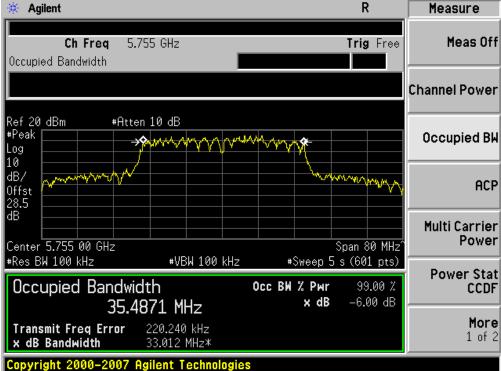
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6dB BANDWIDTH, 5745/5765 MHz, 6 Mbps, Non HT-40 Duplicate, Dual Transmit Paths R 🔆 Agilent Measure Ch Frea 5.755 GHz Meas Off Trig Free Occupied Bandwidth Channel Power Ref 20 dBm #Atten 10 dB #Peak Occupied BW Log 10 dB7 ACP Offst 28.5 dB Multi Carrier Power Center 5.755 00 GHz Span 80 MHz #Res BW 100 kHz #VBW 100 kHz #Sweep 5 s (601 pts) Power Stat Occupied Bandwidth Occ BW % Pwr 99.00 % CCDF -6.00 dB x dB 33.2185 MHz More -1.095 MHz Transmit Freq Error 1 of 2 x dB Bandwidth 28.949 MHz* 00_2007 Agilent Technologies

Page No: 11 of 58

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Page No: 12 of 58

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Agilent	,,	R	Measure
Ch Freq 5.79 Occupied Bandwidth	5 GHz	Trig Fre	Meas Off
			Channel Power
Ref 20 dBm #Atten #Peak Log 10	10 dB	M My M	Occupied BW
dB/ Offst 28.5			АСР
dB Center 5.795 00 GHz #Res BW 100 kHz	#VBW 100 kHz	Span 80 M #Sweep 5 s (601 pt	
Occupied Bandwidt		осс ВЖ % Рмг 99.00 х dB –6.00 d	Power Stat CCDF
Transmit Freq Error x dB Bandwidth	188.216 kHz 33.875 MHz*		More 1 of 2
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6dB BANDWIDTH, 5785/5805 MHz, M0, HT-40, Dual Transmit Paths

Page No: 13 of 58

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: ≥Res	olution Bandwidth
X dB Bandwidth: 26 dE	3
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	6	23.67	17.79
5785	Non HT-20 Beam Forming	6	23.91	17.86
5825	Non HT-20 Beam Forming	6	20.95	15.13
5745/5765	Non HT-40 Duplicate	6	65.28	36.79
5745/5765	HT-40	M0	41.62	35.77
5785/5805	Non HT-40 Duplicate	6	68.5	35.04
5785/5805	HT-40	M0	44.47	35.76

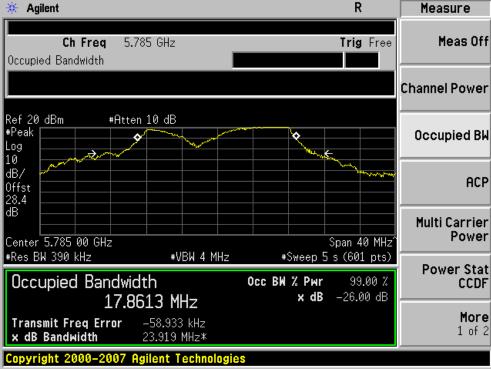
Page No: 14 of 58





99%/26 dB Bandwidth, 5745 MHz, 6 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths

99%/26 dB BANDWIDTH, 5785 MHz, 6 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths



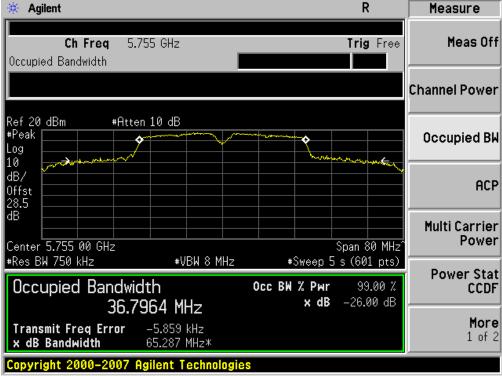
Page No: 15 of 58

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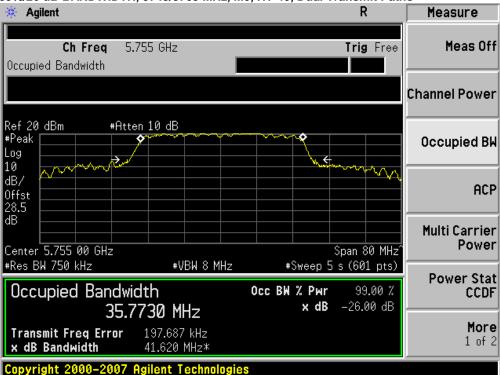


99%/26 dB BANDWIDTH, 5825 MHz, 6 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths

99%/26 dB BANDWIDTH, 5745/5765 MHz, 6 Mbps, Non HT-40 Duplicate, Dual Transmit Paths

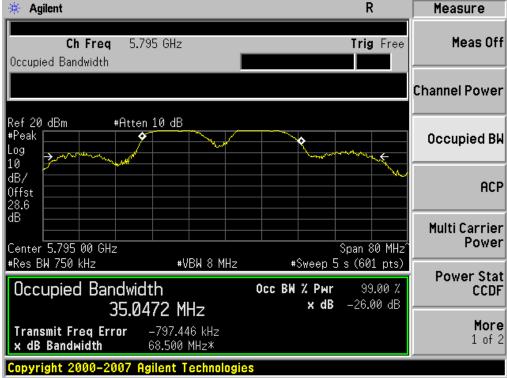


Page No: 16 of 58

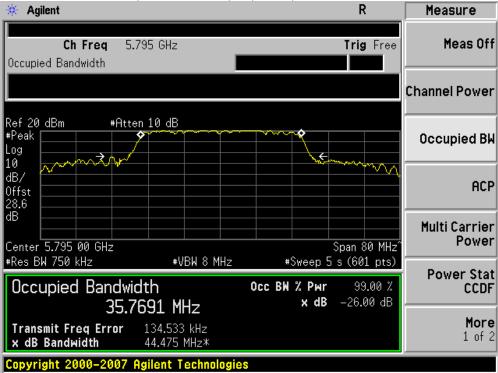


99%/26 dB BANDWIDTH, 5745/5765 MHz, M0, HT-40, Dual Transmit Paths

99%/26 dB BANDWIDTH, 5785/5805 MHz, 6 Mbps, Non HT-40 Duplicate, Dual Transmit Paths



Page No: 17 of 58



99%/26 dB BANDWIDTH, 5785/5805 MHz, M0, HT-40, Dual Transmit Paths

Page No: 18 of 58

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.

In beamforming mode, the 4dBi behaves as 4dBi+10log(n) (n=2 radiating elements) = 7dBi. Therefore the maximum allowable output power requires 1dB reduction in beam forming mode, and 0 dB reduction in all other modes.

In beamforming mode, the 7dBi behaves as 7dBi+10log(n) (n=2 radiating elements) = 10dBi. Therefore the maximum allowable output power requires 4dB reduction in beam forming mode, and 1 dB reduction in all other modes.

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					

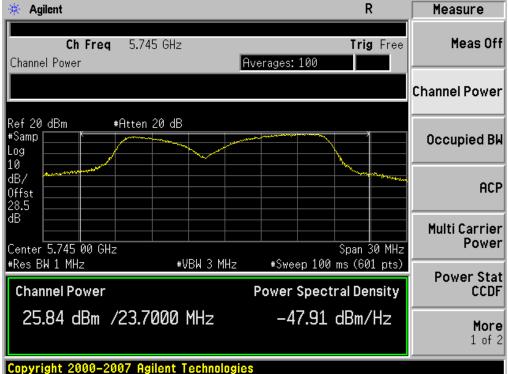
After averaging 100 traces of the transmitter waveform on the spectrum analyzer, record the spectrum analyzer Channel Power.

Page No: 19 of 58

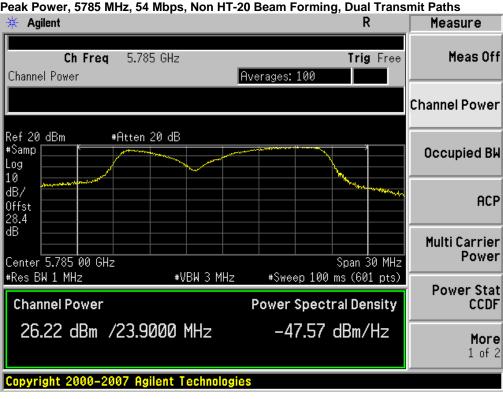
The following data reflects the worst-case emissions for all supported antennas from 0- 4 dBi

Frequency (MHz)	Mode	Data Rate (Mbps)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
5745	Non HT-20 Beam Forming	6	25.8	29	3.16
5785	Non HT-20 Beam Forming	6	26.2	29	2.78
5825	Non HT-20 Beam Forming	6	28.4	29	0.63
5745/5765	Non HT-40 Duplicate	6	27.5	30	2.49
5745/5765	HT-40	m0	27.1	30	2.95
5785/5805	Non HT-40 Duplicate	6	28.0	30	2.02
5785/5805	HT-40	m0	27.3	30	2.67

Page No: 20 of 58



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

Page No: 21 of 58



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

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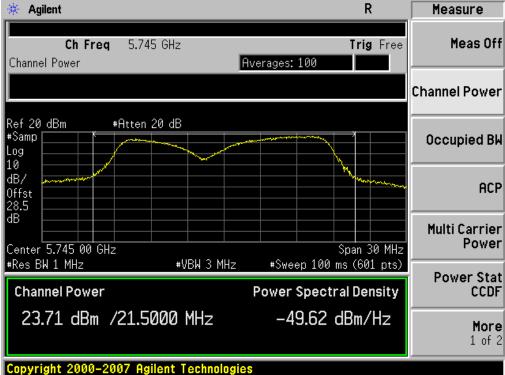
Page No: 22 of 58

Frequency (MHz)	Mode	Data Rate (Mbps)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
5745	Non HT-20 Beam Forming	6	23.7	26	2.29
5785	Non HT-20 Beam Forming	6	25.7	26	0.29
5825	Non HT-20 Beam Forming	6	24.8	26	1.23
5745/5765	Non HT-40 Duplicate	6	27.5	29	1.49
5745/5765	HT-40	m0	27.1	29	1.95
5785/5805	Non HT-40 Duplicate	6	28.0	29	1.02
5785/5805	HT-40	m0	27.3	29	1.67

The following data reflects the worst-case emissions for all supported antennas from 4.1-7 dBi

Page No: 23 of 58





Peak Power, 5745 MHz, 6 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths

🔆 Agilent R Measure Meas Off Ch Frea 5.785 GHz Trig Free Averages: 100 Channel Power Channel Power Ref 20 dBm #Atten 20 dB #Samp Occupied BW Log 10 dB/ ACP Offst 28.4 dB Multi Carrier Power Center 5.785 00 GHz Span 30 MHz #Res BW 1 MHz #VBW 3 MHz #Sweep 100 ms (601 pts) Power Stat Channel Power **Power Spectral Density** CCDF 25.71 dBm /20.7000 MHz -47.45 dBm/Hz More 1 of 2 Copyright 2000-2007 Agilent Technologies

Peak Power, 5785 MHz, 6 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths

Page No: 24 of 58

* Agilent	R	Measure
Ch Freq 5.825 GHz Channel Power Averages: 1	Trig Free 00	Meas Off
		Channel Power
Ref 20 dBm #Atten 20 dB #Samp Log		Occupied BW
10 dB/ 0ffst 29	5700 440-1870 446-1870 446-1870 446-1870 446-1870 446-1870 446-1870 446-1870 446-1870 446-1870 446-1870 446-18	ACF
dB	Span 30 MHz	Multi Carrier Power
	p 100 ms (601 pts) Spectral Density	Power Stat CCDF
24.77 dBm /24.1000 MHz -49).05 dBm/Hz	More 1 of 2
Copyright 2000–2007 Agilent Technologies		

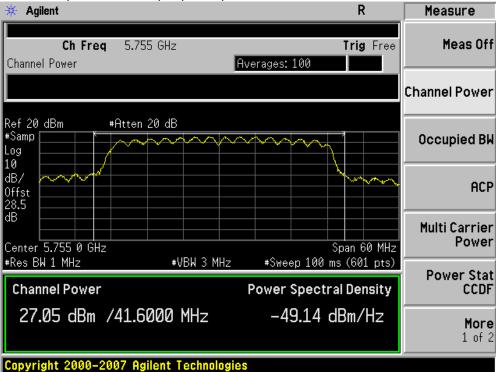
Peak Power, 5825 MHz, 6 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths

🔆 Agilent R Measure Ch Freq 5.755 GHz Meas Off Trig Free Averages: 100 Channel Power **Channel Power** Ref 20 dBm #Atten 20 dB #Samp Occupied BW Log 10 dB/ ACP Offst 28.5 dB Multi Carrier Power Span 66.9 MHz Center 5.755 00 GHz #Res BW 1 MHz #VBW 3 MHz #Sweep 100 ms (601 pts) **Power Stat Channel Power Power Spectral Density** CCDF 27.51 dBm /66.9000 MHz -50.75 dBm/Hz More 1 of 2 Copyright 2000–2007 Agilent Technologies

Peak Power, 5745/5765 MHz, 6 Mbps, Non HT-40 Duplicate, Dual Transmit Paths

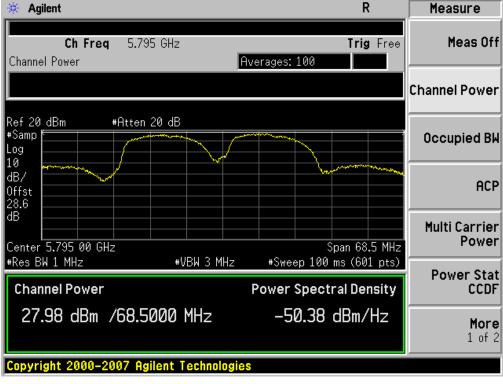
Page No: 25 of 58

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Peak Power, 5745/5765 MHz, M0, HT-40, Dual Transmit Paths

Peak Power, 5785/5805 MHz, 6 Mbps, Non HT-40 Duplicate, Dual Transmit Paths



Page No: 26 of 58

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* Agilent R	Measure
Ch Freq 5.795 GHz Trig Free Channel Power Averages: 100	Meas Off
	Channel Power
Ref 20 dBm #Atten 20 dB #Samp Log 10	Occupied BW
dB/ 0ffst 28.6	ACP
dB Center 5.795 0 GHz #Res BW 1 MHz #VBW 3 MHz #Sweep 100 ms (601 pts)	
Channel Power Power Spectral Density	Power Stat CCDF
27.33 dBm /44.5000 MHz -49.15 dBm/Hz	More 1 of 2
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Peak Power, 5785/5805 MHz, M0, HT-40, Dual Transmit Paths

Page No: 27 of 58

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.

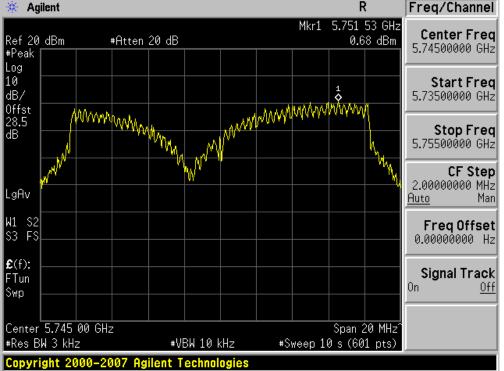
Center Frequency: Span:	Frequency from table below 20 MHz
Ref Level Offset:	Correct for attenuator and cable loss.
Reference Level:	20 dBm
Attenuation:	20 dB
Sweep Time:	100s
Resolution Bandwidth:	3 kHz
Video Bandwidth:	10 kHz
Detector:	Peak
Trace:	Single
Marker:	Peak Search

Record the Marker value.

Frequency (MHz)	Mode	Data Rate (Mbps)	-	Limit (dBm/3kHz)	Margin (dB)
5745	Non HT-20 Beam Forming	6	0.7	8	7.32
5785	Non HT-20 Beam Forming	6	0.6	8	7.41
5825	Non HT-20 Beam Forming	6	2.3	8	5.7
5745/5765	Non HT-40 Duplicate	6	0.4	8	7.64
5745/5765	HT-40	m0	-0.7	8	8.69
5785/5805	Non HT-40 Duplicate	6	0.0	8	8.03
5785/5805	HT-40	m0	-0.4	8	8.42

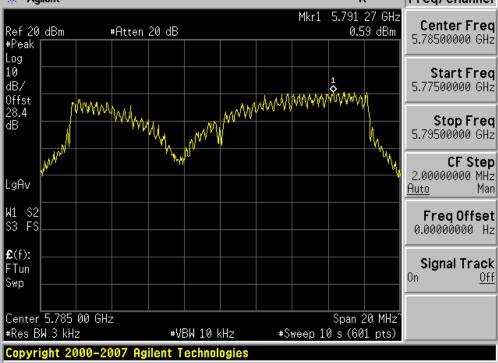
Page No: 28 of 58

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Power Spectral Density, 5745 MHz, 6 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths

Power Spectral Density, 5785 MHz, 6 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths Agilent R Freq/Channel



Page No: 29 of 58

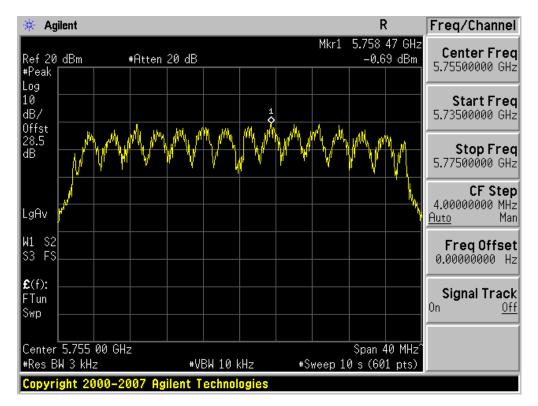
🔆 Agilent Freg/Channel R Mkr1 5.821 27 GHz **Center Freq** Ref 20 dBm #Atten 20 dB 2.31 dBm 5.82500000 GHz #Peak Log 10 Start Freq 1 \$ WWWWWWWWWWW dB/ 5.81500000 GHz WWWWW Offst NWW 29 dB Stop Freq MW 5.83500000 GHz Μ. CF Step WWW 2.00000000 MHz LgAv Auto Man W1 S2 Freq Offset S3 FS 0.00000000 Hz £(f): Signal Track FTun 0n Off Swp Center 5.825 00 GHz Span 20 MHz[^] #Res BW 3 kHz ₩VBW 10 kHz #Sweep 10 s (601 pts) Copyright 2000-2007 Agilent Technologies

Power Spectral Density, 5825 MHz, 6 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths

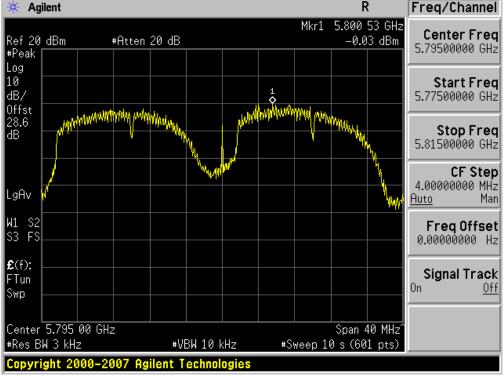


Power Spectral Density, 5745/5765 MHz, M0, HT-40, Dual Transmit Paths Page No: 30 of 58

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Power Spectral Density, 5785/5805 MHz, 6 Mbps, Non HT-40 Duplicate, Dual Transmit Paths



Power Spectral Density, 5785/5805 MHz, M0, HT-40, Dual Transmit Paths

Page No: 31 of 58



🔆 Ag	ilent								R	!	Freq/Channel
Ref 20 #Peak Log	dBm		#Atten	20 dB				Mkr1		67 GHz 2 dBm	Center Freq 5.79500000 GHz
10 dB/ Offst			1 \$	ATIA. N	Vat.dk.	N. 10		whh			Start Freq 5.77500000 GHz
28.6 dB	N ^{pri}	WMW	nų įm V	Marth		f Yr	Y WANNA WA	r'y Mi	n de la constante de la consta	V	Stop Freq 5.81500000 GHz
LgAv	, ^J										CF Step 4.0000000 MHz <u>Auto</u> Man
W1 S2 S3 FS											Freq Offset 0.00000000 Hz
£ (f): FTun Swp											Signal Track On <u>Off</u>
Center #Res B			2	#V		(Hz	#\$1	weep 10	Span 4 0 s (60	10 MHz^ 1 pts)	
Copyri	ght 20	00-20)07 Ag	ilent T	echnol	ogies					

Page No: 32 of 58

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.

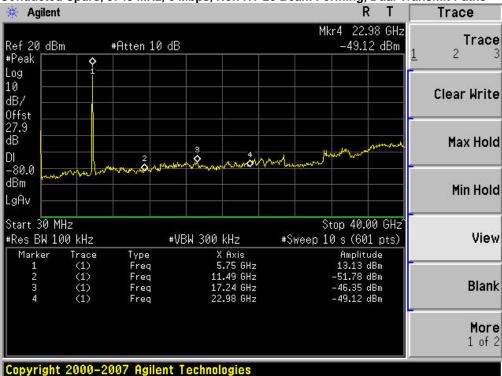
Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer).

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	6	59.5	30	29.5
5785	Non HT-20 Beam Forming	6	62.0	30	32.0
5825	Non HT-20 Beam Forming	6	60.7	30	30.7
5745/5765	Non HT-40 Duplicate	6	58.8	30	28.8
5745/5765	HT-40	m0	57.7	30	27.7
5785/5805	Non HT-40 Duplicate	6	58.7	30	28.7
5785/5805	HT-40	m0	60.4	30	30.4

Page No: 33 of 58



Conducted Spurs, 5745 MHz, 6 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths

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Conducted Spurs, 5785 MHz, 6 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths

🔆 Agilent					R		Freq/Channel
Ref 20 dBm #Peak	#Atten	10 dB		Mk	r4 23.14 -48.57 (Center Freq 20.0150000 GHz
Log 10 dB/ Offst							Start Freq 30.0000000 MHz
28.4 dB DI	2		4 AM	human	and the second	m	Stop Fred 40.0000000 GHz
-15.9 dBm LgAv	we been more thank						CF Step 3.99700000 GHz <u>Auto</u> Mar
Center 20.02 #Res BW 100 Marker Tu			X Axis	Sp #Sweep 10	Amplitude	ots)	Freq Offset 0.00000000 Hz
2 0	(1) Fred (1) Fred (1) Fred (1) Fred	ן ק 1 ק 1	5.78 GHz 1.57 GHz 7.36 GHz 3.14 GHz		14.10 dBm -49.56 dBm -47.94 dBm -48.57 dBm		Signal Track On <u>Off</u>
Copyright 20	100-2007 Ag	ilent Techno	logies				

Page No: 34 of 58

	R T Tr	ace
en 10 dB	Mkr4 23.30 GHz -47.15 dBm ₁	Trace
	Cle	ear Write
2 martin and and and	man man	Max Hold
		Min Hold
#VBW 300 kHz #Sw	Stop 40.00 GHz^ eep 10 s (601 pts)	View
req 5.83 GHz	Amplitude 14.46 dBm	
reg 17.48 GHz	-51.81 dBm -46.19 dBm -47.15 dBm	Blank
		More 1 of 2
	*VBW 300 kHz *Sw *VBW 300 kHz *Sw ype X Axis Freq 5.83 GHz Freq 11.65 GHz Freq 17.48 GHz	Mkr4 23.30 GHz

Conducted Spurs, 5825 MHz, 6 Mbps, Non HT-20 Beam Forming, Dual Transmit Paths

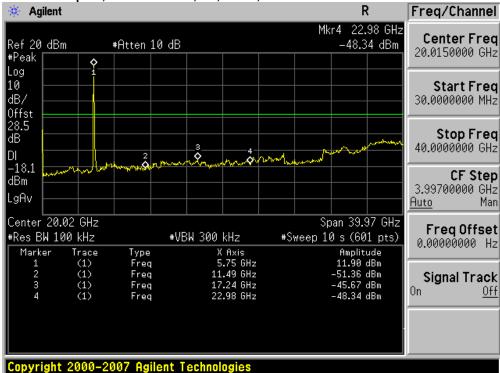
Copyright 2000–2007 Agilent Technologies

🔆 Agilent	,		•		R	Freq/Channel
Ref 20 dBm #Peak	#Atten	10 dB			2.98 GHz .78 dBm	Center Freq 20.0150000 GHz
Log 10 dB/ Offst	1					Start Freq 30.0000000 MHz
28.5 dB DI	2		free free	part of the second s	y municipality	Stop Freq 40.0000000 GHz
dBm LgAv						CF Step 3.99700000 GHz <u>Auto</u> Mar
Center 20.02 G #Res BW 100 kH Marker Tra 1 (1	lz ace Type		kHz # (Axis 5.75 GHz	Sweep 10 s (6	itude	FreqOffset 0.00000000 Hz
1 (1 2 (1 3 (1 4 (1	.) Frec .) Frec	11 1 11 1 17	2.49 GHz 2.24 GHz 2.98 GHz	-50.83 -46.91 -48.78	3 dBm L dBm	Signal Track On <u>Off</u>
Copyright 200	00-2007 Ag	ilent Technol	ogies			

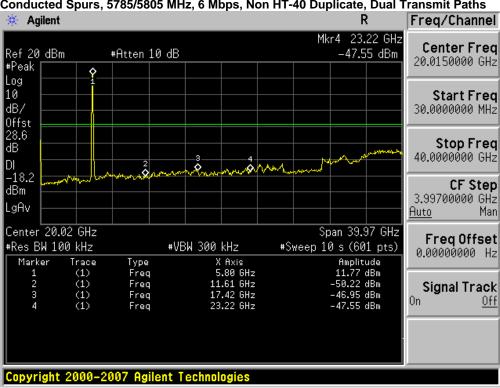
Conducted Spurs, 5745/5765 MHz, 6 Mbps, Non HT-40 Duplicate, Dual Transmit Paths

Page No: 35 of 58

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Conducted Spurs, 5745/5765 MHz, M0, HT-40, Dual Transmit Paths



Conducted Spurs, 5785/5805 MHz, 6 Mbps, Non HT-40 Duplicate, Dual Transmit Paths

Page No: 36 of 58

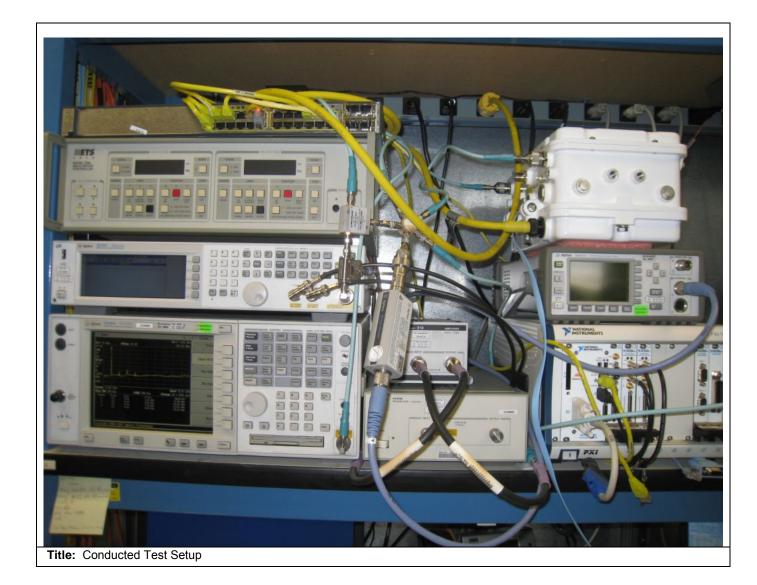
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🔆 Agilent			R	Freq/Channel
#Pool	#Atten 10 dB		Mkr4 23.22 GHz -47.37 dBm	Center Freq 20.0150000 GHz
*reak Log 1 10 dB/ Offst				Start Freq 30.0000000 MHz
28.6 dB DI -17.3	2.1 March	3 4 M	Mangaran	Stop Freq 40.0000000 GHz
dBm				CF Step 3.99700000 GHz <u>Auto</u> Man
Center 20.02 GHz #Res BW 100 kHz Marker Trace	Туре	300 kHz X Axis	Span 39.97 GHz #Sweep 10 s (601 pts) Amplitude	FreqOffset 0.00000000 Hz
$ \begin{array}{cccc} 1 & (1) \\ 2 & (1) \\ 3 & (1) \\ 4 & (1) \end{array} $	Freq Freq Freq Freq	5.80 GHz 11.61 GHz 17.42 GHz 23.22 GHz	12.66 dBm -51.70 dBm -47.78 dBm -47.37 dBm	Signal Track On <u>Off</u>
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Conducted Spurs, 5785/5805 MHz, M0, HT-40, Dual Transmit Paths

Page No: 37 of 58





Page No: 38 of 58

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)).

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The following data reflects worst-case values for all antennas.

Span:	5350-5745 MHz for 5745MHz test, (Measure 5725MHz Horz & Vert) 5805-6500 MHz for 5805MHz test, (Measure 5850MHz Horz & Vert)
Reference Level:	100 dBuV
Attenuation:	12 dB
Sweep Time:	Coupled
Resolution Bandwidth:	1MHz
Video Bandwidth:	1 MHz for peak, 10 Hz for average
Detector:	Peak

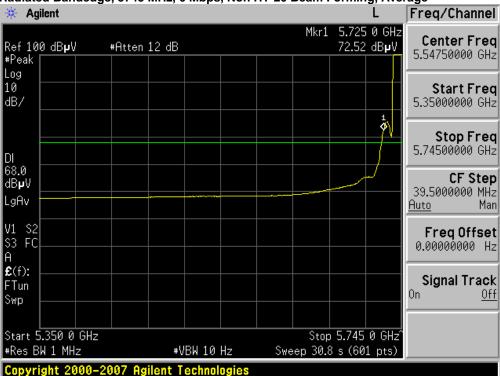
Maximize Turntable (find worst case table angle), Maximize Antenna (find worst case height)

Save 2 plots: 1) Average Plot, Limit= 54dBuV @3m 2) Peak plot, 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)		Limit (dBuV/m)	Margin (dB)
5745	Non HT-20 Beam Forming	6	72.5	>30dBc	Pass
5825	Non HT-20 Beam Forming	6	61.6	>30dBc	Pass
5745/5765	Non HT-40, Dual Tx Path	6	72.5	>30dBc	Pass
5785/5805	Non HT-40, Dual Tx Path	6	62.0	>30dBc	Pass

Page No: 39 of 58

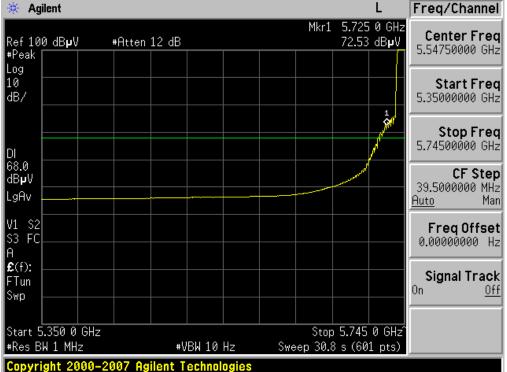


Radiated Bandedge, 5745 MHz, 6 Mbps, Non HT-20 Beam Forming, Average

🔆 Agilent Freg/Channel Mkr1 5.850 00 GHz **Center Freq** Ref 100 dB**µ**V 61.55 dBµV #Atten 12 dB 5.91250000 GHz #Peak Log 10 Start Freq dB/ 5.82500000 GHz Stop Freq 1 6.00000000 GHz DI 68.0 CF Step dB₽V 17.5000000 MHz LgAv <u>Auto</u> Man S2 FC V1 Freq Offset 0.0000000 Hz \$3 Ĥ £(f): Signal Track FTun 0n <u> 0ff</u> Swp Start 5.825 00 GHz Stop 6.000 00 GHz #Res BW 1 MHz #VBW 10 Hz Sweep 13.65 s (601 pts) Copyright 2000-2007 Agilent Technologies

Radiated Bandedge, 5825 MHz, 6 Mbps, Non HT-20 Beam Forming, Average

Page No: 40 of 58



Radiated Bandedge, 5745/5765 MHz, 6 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Average

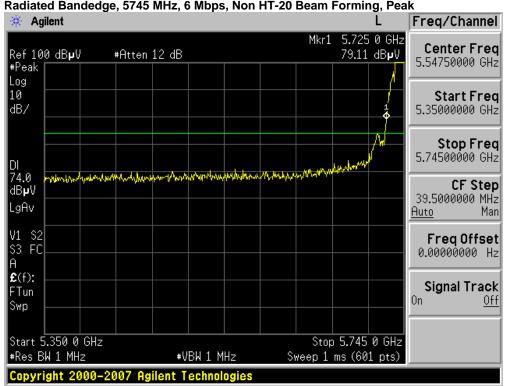
Radiated Bandedge, 5785/5805 MHz, 6 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Average



Page No: 41 of 58

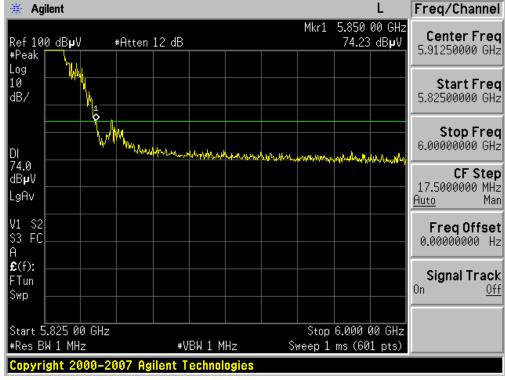
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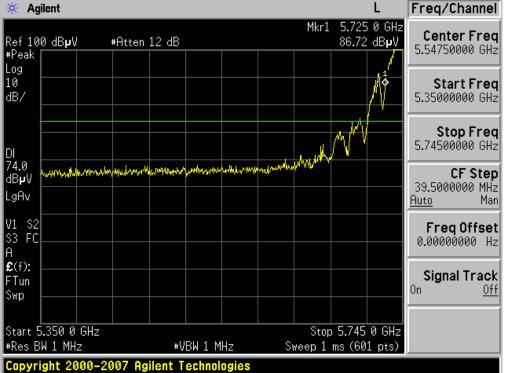
Radiated Bandedge, 5745 MHz, 6 Mbps, Non HT-20 Beam Forming, Peak

Radiated Bandedge, 5825 MHz, 6 Mbps, Non HT-20 Beam Forming, Peak

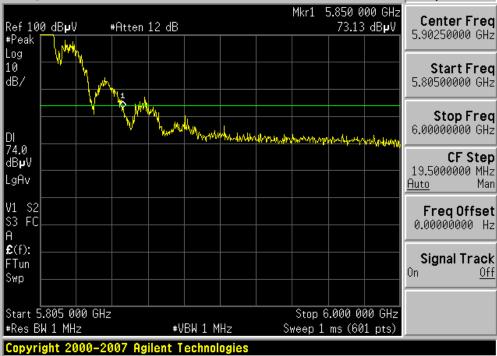


Page No: 42 of 58

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Radiated Bandedge, 5745/5765 MHz, 6 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Peak



Page No: 43 of 58

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)		Limit (dBuV/m)	Margin (dB)
5745	Non HT-20 Beam Forming	6	49.1	54	4.9
5785	Non HT-20 Beam Forming	6	48.0	54	6.0
5825	Non HT-20 Beam Forming	6	48.0	54	6.1
5745/5765	Non HT-40, Dual Tx Path	6	49.6	54	4.4
5785/5805	Non HT-40, Dual Tx Path	6	47.7	54	6.3
5805/5785	Non HT-40, Dual Tx Path	6	49.6	54	4.4

Page No: 44 of 58



Radiated Spurious Emissions, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Average

🔆 Agilent				R	T Trace
EMiSoft Vasona: Ref 70 dBµV #Peak	EMi Emission Soft #Atten 6 dl		Mk	r4 11.590 39.40 df	
Log 10 dB/		3	4		Clear Write
					Max Hold
54.0 dBµV #LgAv					e Min Hold
Start 30 MHz #Res BW 1 MHz Marker Trad		#VBW 1 kHz X Axis	S Sweep 14.0	top 18.000 1 s (1604 p Amplitude	
1 (1) 2 (1) 3 (1) 4 (1)) Freq) Freq	2.437 GHz 5.795 GHz 9.748 GHz 11.590 GHz		46.40 dBµV 35.54 dBµV 47.67 dBµV 39.40 dBµV	- Blank
					- More 1 of 2

Page No: 45 of 58



Radiated Spurious Emissions, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Average

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



Page No: 46 of 58



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

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



Page No: 47 of 58



Radiated Spurious Emissions, 5745 MHz, 54 Mbps, Non HT-20 Beam Forming, Peak

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Agilent Trace R Т -356 Mkr2 5.785 GHz EMiSoft Vasona: EMi Emission Software Ref 75 dB**µ**V #Peak Trace 50.49 dBµV #Atten 10 dB 2 Log 3 4 2 10 **Clear Write** dB/ AIA Max Hold DL 74.0 dBµV Min Hold #LgAv Stop 18.000 GHz Start 30 MHz #Res BW 1 MHz #VBW 1 MHz View Sweep 36.01 ms (1604 pts) X Axis 2.437 GHz 5.785 GHz 9.748 GHz Amplitude 52.25 dBµV Marker Trace Type (1) (1) Freq 1 50.49 dBµV 55.15 dBµV Freq 2 Blank 3 (1)Freq 51.66 dBµV 4 (1)Freq 11.570 GHz More 1 of 2 Copyright 2000-2008 Agilent Technologies

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

Page No: 48 of 58

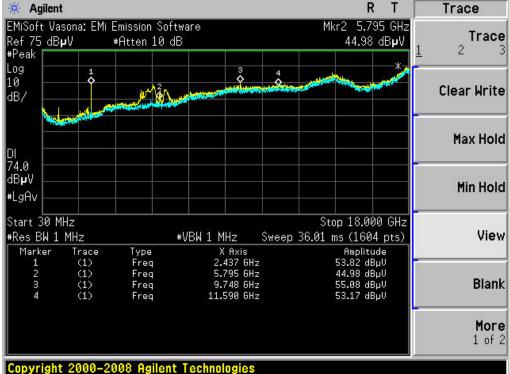


Radiated Spurious Emissions, 5825 MHz, 54 Mbps, Non HT-20 Beam Forming, Peak

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

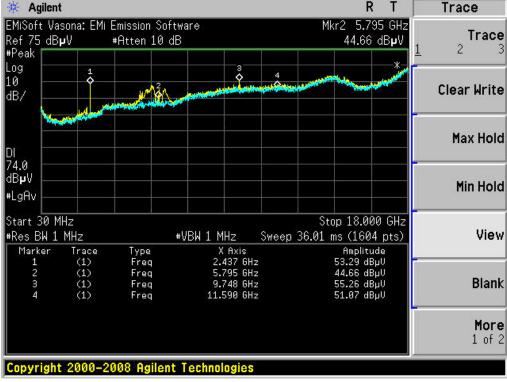


Page No: 49 of 58



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

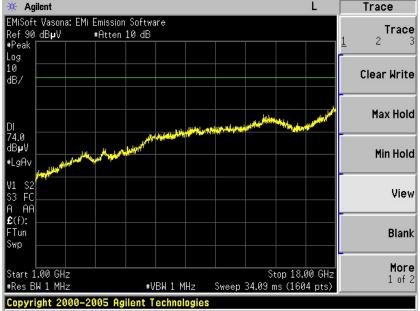
Radiated Spurious Emissions, 5805/5785 MHz, 54 Mbps, Non HT-40 Duplicate, Dual Transmit Paths, Peak



Page No: 50 of 58

Radiated Spurious Receive Emission

Average Radiated Spurious Receive Emission



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Peak Radiated Spurious Receive Emission



Page No: 51 of 58

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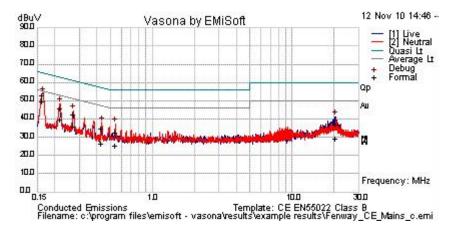
Internal 2.4/5GHz antenna (2/4 dBi)



External 2.4/5GHz antenna (4/7 dBi)

Page No: 52 of 58

Conducted emissions

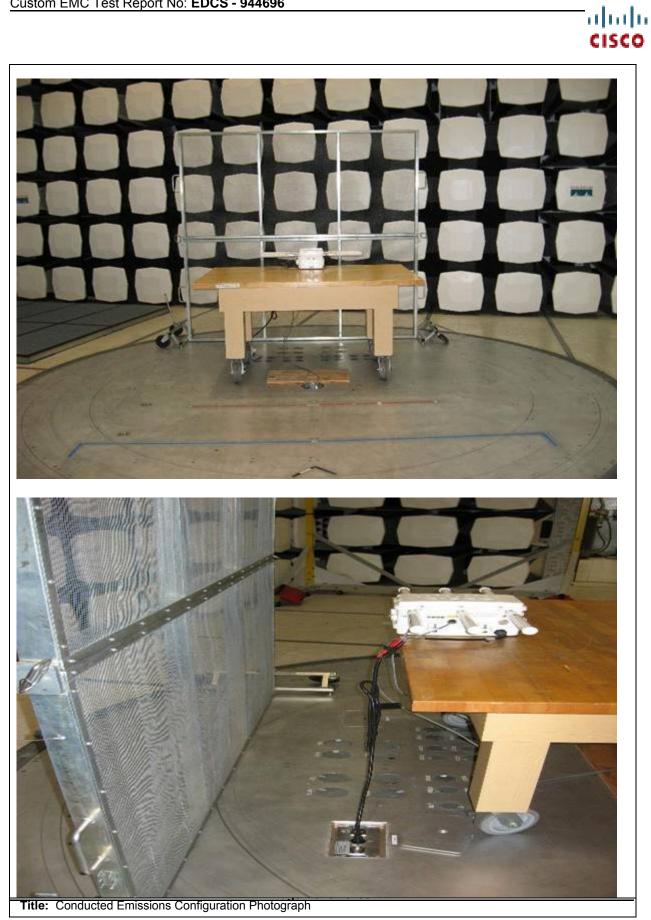


Test Result Table

Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail	Comments
0.163094	28.4	20.7	1.2	50.3	Av	N	55.3	-5	Pass	
0.163094	31.3	20.7	1.2	53.2	Qp	N	65.3	-12.1	Pass	
0.217972	24.3	20.4	0.8	45.5	Qp	N	62.9	-17.4	Pass	
0.217972	18.6	20.4	0.8	39.8	Av	N	52.9	-13.1	Pass	
0.269916	21.4	20.4	0.6	42.4	Qp	N	61.1	-18.7	Pass	
0.269916	14.9	20.4	0.6	35.9	Av	N	51.1	-15.3	Pass	
0.433371	5.8	20.4	0.4	26.7	Av	N	47.2	-20.5	Pass	
0.433371	14.1	20.4	0.4	35	Qp	N	57.2	-22.2	Pass	
0.541527	4.8	20.5	0.4	25.6	Av	N	46	-20.4	Pass	
0.541527	11.8	20.5	0.4	32.6	Qp	N	56	-23.4	Pass	
20.491	13.8	22.6	0.4	36.8	Qp	L	60	-23.2	Pass	
20.491	6	22.6	0.4	29.1	Av	L	50	-20.9	Pass	

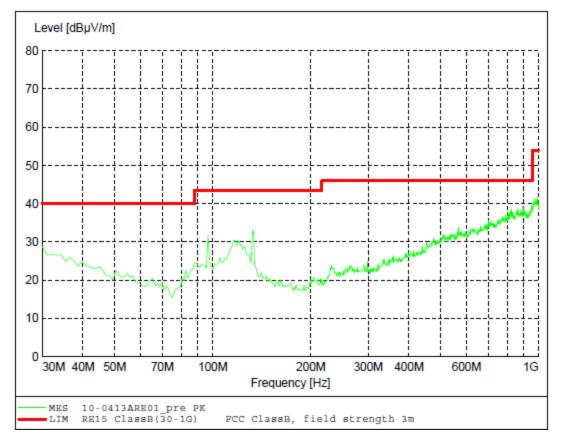
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Page No: 53 of 58



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Radiated emissions



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Test Results Table

			RADIA	TED EM	ISSION	IS - FIEL	D STF	RENGT	rH (dE	BuV/m))				
ACS Project #:	10-04	413	Test Condit	ons						Notes					
Test Date:	11/24	4/10	Temp°c	22.8	1) Peak Meas	urement									
Fechnician:	S Wis	mer	Humid. %	42.1	2)										
Manufacturer:	CISC		Conditions	NA	3)										
EUT Model Name:	Air-CAP	P1552C			4)										
UT Serial #			Antenna	s	5)										
Ant. Distance (<=1GHz):	3		9kHz-30MHz	NA	6)										
Ant. Distance (1-10GHz):	3		30MHz-200MHz	25	7)										
Ant. Distance (>10GHz):	1		200MHz-1GHz	25	8)										
Class:	B		1GHz - 18GHz	30	9)										
Duty Cycle(%):	100	0			10)										
Filter (BPF&HPF)	Nor	ne	Cable Set >1GHz	HF Set (1)	11)										
Location	SA	C			12)										
F Amp (to 1GHz):	73	3			13)										
HF Amp (1 to 26.5GHz):	33	8	Operating Voltage	90Vac	14)										
HF Amp (26.5 to 40GHz):			Pre-Scan File #	ARE01	15)										
Rule Part	15.1	109				ange Tested: 30	MHz to 25G	Hz							
Fundamental Frequency (MHz)	10	0			EUT Configu	ration/Mode of C	peration: T	ransfer files	over 2.4GH	z and 5.8GH	lz WiFi Link	t.			
Frequency	Lev (dBu		Antenna Polarity	Antenna Height	Turntable Position	Correction Factors		ted Level uV/m)		imit uV/m)		argin dB)	Restricted		
(MHz)	pk	Qpk/Avg	(H/V)	(cm)	(0)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg	Band	Required	
	F	Fundame	ntal Frequency - (Us	for Parts 15.	209, 15.231,	, 15.247 & 15.2	249 Intent	ional Radi	ators Onl	y)				·	
Do Not Populate			н										n	Y	
Do Not Populate			V										n	y	
						Spuri	ous Emis	sions							
30		33.65	V	100	223	-6.80		26.85		40.0		13.2	n	n	1
45.1		41.40	V	100	105	-14.45		26.95		40.0		13.1	n	n	1
92.8		40.10	V	100	201	-15.85		24.25		43.5		19.3	n	n	1
96.8		42.70	V	100	201	-15.21		27.49		43.5		16.0	n	n	1
133.5		39.60	Н	302	0	-13.47		26.13		43.5		17.4	у	n	
231.5		45.80	V	100	0	-13.82		31.98		46.0		14.0	n	n	1
		24.50	V	100	180	-9.81		14.69		46.0		31.3	n	n	1
336.1		24.80	н	100	0	-5.51		19.29		46.0		26.7	n	n	1
478.4						-1.01		22.89		46.0		23.1	n	n	1
478.4 701.5		23.90	V	100	0										
478.4 701.5 953.7		23.90 24.70	Ĥ	100	0	2.95		27.65		46.0		18.4	n	n	
478.4 701.5	47.30	23.90						27.65	 74.0 74.0	46.0 54.0 54.0	37.4	18.4 28.8	n y v	n y	

Page No: 55 of 58

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

 $E=\sqrt{(30^{*}P^{*}G)/d}$ 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/cm²

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

```
d=√((30*P*G)/(3770*S))
```

P(mW)=P(W)/1000

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

d(cm)=100*d(m)

yields

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

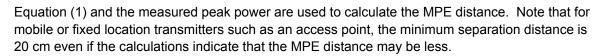
where

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 $d=0.282*10^{((P+G)/20)/\sqrt{S}} Equation (1)$ 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 $S=Power \text{ Density in mW/cm}^{2}$

Page No: 56 of 58



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S=1mW/cm² 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.

			Peak				
		Power	Transmit	Antenna	MPE		
Frequency	Bit Rate	Density	Power	Gain	Distance	Limit	Margin
(MHz)	(Mbps)	(mW/cm^2)	(dBm)	(dBi)	(cm)	(cm)	(cm)
5745	6	1	26.0	10	17.79	20	2.21
5785	6	1	26.0	10	17.79	20	2.21
5825	6	1	26.0	10	17.79	20	2.21

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:

			Peak				
		MPE	Transmit	Antenna	Power		
Frequency	Bit Rate	Distance	Power	Gain	Density	Limit	Margin
(MHz)	(Mbps)	(cm)	(dBm)	(dBi)	(mW/cm^2)	(mW/cm^2)	(mW/cm^2)
5745	6	20	26.0	10	0.79	1	0.21
5785	6	20	26.0	10	0.79	1	0.21
5825	6	20	26.0	10	0.79	1	0.21

			-		
Equip #	Manufacturer	Model	Description	Last Cal	Next Due
CIS002119	EMC Test Systems	3115	Double Ridged Guide Horn Antenna	30-Jun-10	30-Jun-11
CIS005568	НР	8449B	Broadband Preamplifier	01-Oct-10	01-Oct-11
CIS008195	TTE	H613-150K-50-21378	Hi Pass Filter - 150KHz cutoff	5-Jan-10	5-Jan-11
CIS045995	Fischer	F-090527-1009-2	LISN Adaptor	22-Jun-10	22-Jun-11
CIS020975	Micro-Coax	UFB311A-0-1344-520520	RF Coaxial Cable, to 18GHz, 134.4 in	25-Feb-10	25-Feb-11
CIS025662	Micro-Coax	UFB311A-1-0840-504504	RF Coaxial Cable, to 18GHz, 84 in	4-Mar-10	4-Mar-11
CIS030559	Micro-Coax	UFB311A-1-0950-504504	RF Coaxial Cable, to 18GHz, 95 in	25-Feb-10	25-Feb-11
CIS030652	Sunol Sciences	JB1	Combination Antenna, 30MHz-2GHz	27-Jul-10	27-Jul-11
CIS035613	Micro-Tronics	BRM50702-02	Notch Filter, SB:2.4-2.5GHz	4-Jun-10	4-Jun-11
CIS034972	Midwest Microwave	ATT-0640-20-29M-02	Attenuator, 20dB	14-May-10	14-May-11
CIS036716	Cisco	RF Coaxial Cable-SMA	Radio Test Cable, SMA-SMA	15-Dec-09	15-Dec-10
CIS037581	ETS-Lindgren	3117	Double Ridged Waveguide Horn Antenna	22-Jun-10	22-Jun-11
CIS040603	Agilent	E4440A	Spectrum Analyzer	04-Aug-10	04-Aug-11
CIS041990	MegaPhase	EM18-NKNK-320	RF 18GHz N-Type cable	25-Feb-10	25-Feb-11
COM000590	Agilent	E4448A	Spectrum Analyzer	28-May-10	28-May-11
COM000601	Agilent	E4417A	EPM-P Series Power Meter	6-Oct-10	6-Oct-11
COM000602	Agilent	E9327A	Peak and Avg Power Sensor	6-Oct-10	6-Oct-11

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

Page No: 58 of 58