



**FCC Part 15, Subpart E, UNII (Part 15.401)
Certification Application**

**Industrie Canada RSS-210
Certification Application**

**EMI Test Report
on
IEEE 802.11 Access Point.
Models: 2330**

**FCC ID: RVW2330
IC ID: 332R-2330
Report # NORT_2330**

Prepared by:

David Waitt
202 Calvert Drive #217
Cupertino, Ca. 95014
david@waitt.us
(408) 832 7053

Table of Contents

Section	Page
GENERAL INFORMATION	4
DETAILED PRODUCT INFORMATION / OPERATIONAL DESCRIPTION	5
REPORT ORGANIZATION AND RESULTS SUMMARY	6
TEST FACILITIES	7
EQUIPMENT LISTS.....	8
Instrument Calibration.....	8
Elliott Test Equipment	8
TEST METHODS	9
TEST RESULTS.....	11
802.11 A MAXIMUM RF POWER OUTPUT AND POWER SPECTRAL DENSITY AT ANTENNA TERMINALS	12
Specifications:	12
Procedure:	12
RF Transmit Power Summary Results:	12
26 dB Channel Power, PSD, 5180 MHz (High Power Setting)	13
26 dB Channel Power, PSD, 5240 MHz (High Power Setting)	13
26 dB Channel Power, PSD, 5260 MHz (High Power Setting)	14
26 dB Channel Power, PSD, 5320 MHz (High Power Setting)	14
26 dB Channel Power, PSD, 5180 MHz (Low Power Setting)	15
26 dB Channel Power, PSD, 5240 MHz (Low Power Setting)	15
26 dB Channel Power, PSD, 5260 MHz (Low Power Setting)	16
26 dB Channel Power, PSD, 5320 MHz (Low Power Setting)	16
5 GHZ POWER SPECTRAL DENSITY & PEAK EXCURSION	17
Specification	17
Procedure:	17
Results:	17
PSD and Peak Excursion, 5180 MHz, Low Power Setting	18
PSD and Peak Excursion, 5240 MHz, Low Power Setting	19
PSD and Peak Excursion, 5260 MHz, Low Power Setting	20
PSD and Peak Excursion, 5320 MHz, Low Power Setting	21
PSD and Peak Excursion, 5180 MHz, High Power Setting	22
PSD and Peak Excursion, 5240 MHz, High Power Setting	23
PSD and Peak Excursion, 5260 MHz, High Power Setting	24
PSD and Peak Excursion, 5320 MHz, High Power Setting	25
20 DB / 26 DB BANDWIDTH.....	26

Specification	26
Procedure.....	26
99% / 26 dB bandwidth Summary Results.....	26
26 dB Bandwidth Plots.....	26
99% Bandwidth Plots.....	28
5.15 - 5.35 GHZ & 5.725 – 5.825 GHZ BANDEDGE.....	30
Specification	30
Procedure:	30
5.15 - 5.35 GHZ Bandedge Results:	30
5.15 GHz bandedge (low Power Setting).....	31
5.35 GHz bandedge (Low power Setting).....	31
5.15 GHz bandedge (High Power Setting).....	32
5.35 GHz bandedge (High Power Setting).....	32
RADIATED EMISSIONS IN RESTRICTED BANDS / OUT OF BAND EMISSIONS.....	33
Specification:.....	33
Procedure:	33
Radiated Emissions in Restricted Bands Test Setup	34
Radiated Emissions in Restricted Bands Test Results.....	35
Restricted Band Emissions, UUT Transmitting on 5180 MHz, 14 dBi panel, Low Power	36
Restricted Band Emissions, UUT Transmitting on 5260 MHz, 14 dBi panel, Low Power	36
Restricted Band Emissions, UUT Transmitting on 5320 MHz, 14 dBi panel, Low Power	36
Plots - Restricted Band Emissions, UUT Transmitting on 5180 MHz, 14 dBi panel, Low Power.....	37
Plots - Restricted Band Emissions, UUT Transmitting on 5260 MHz, 14 dBi panel, Low Power.....	38
Plots - Restricted Band Emissions, UUT Transmitting on 5320 MHz, 14 dBi panel, Low Power.....	39
Restricted Band Emissions, UUT Transmitting on 5180 MHz, 6 dBi Omni, High Power	40
Restricted Band Emissions, UUT Transmitting on 5260 MHz, 6 dBi Omni, High Power	40
Restricted Band Emissions, UUT Transmitting on 5320 MHz, 6 dBi Omni, High Power	40
Plots - Restricted Band Emissions, UUT Transmitting on 5180 MHz, 6 dBi Omni, High Power.....	41
Plots - Restricted Band Emissions, UUT Transmitting on 5260 MHz, 6 dBi Omni, High Power.....	41
Plots - Restricted Band Emissions, UUT Transmitting on 5320 MHz, 6 dBi Omni, High Power.....	41
RADIATED EMISSIONS AT THE BAND EDGE (DIRECT MEASUREMENT METHOD).....	42
Specification:.....	42
Procedure.....	42
Radiated Emissions at the Band Edges Summary Table	43
FREQUENCY DRIFT VERSUS TEMPERATURE AND SUPPLY VOLTAGE.....	44
Procedure.....	44
Result	44
AC Line Conducted Emissions	45
AC line Conducted Emissions Results	45
AC Line conducted emissions, LINE	46
AC Line conducted emissions, NEUTRAL	46

General Information

Unit(s) Under Test: Nortel access point
Model: 2330
Product Description: IEEE 802.11A / B / G Access point

FCC ID: RVW2330
IC ID: 337R-2330

Tested For: Nortel Networks
4655 Great America Parkway
Santa Clara, CA 95054

Tested At: Elliott Laboratories
684 West Maude Ave
Sunnyvale, CA 94086

Tested By: M Faustino, Test Engineer, Elliott Laboratories
David Waitt, (Independent Consultant)

Test Specifications: FCC CFR 47, Part Subpart E, (15 401 UNII)
IC RSS-210 6.2.2.(O)

Test Date: May / June 2005

Requested Certification: FCC Part 15 Subpart E Certification
Industrie Canada RSS-210

Detailed Product Information / Operational Description

The access point radio is an IEEE 802.11 A / B / G Access point is intended to be professionally installed and configured in corporate and industrial environments.

The device does not include a “Turbo” mode.

The access point is powered either by an external 48V power supply or via power over Ethernet (POE)

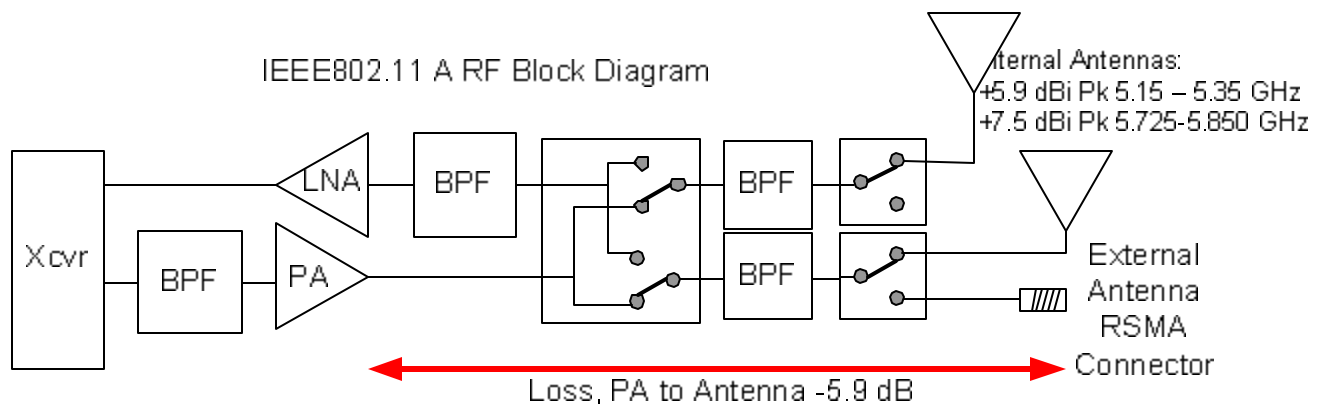
Additionally, the device has been tested for compliance to the FCC Part 15 Class B limits. A report has been prepared and is on with the manufacturer.

Internal Antennas:

The access point has two internal 5 GHz antennas. The access point also incorporates antenna diversity in which it switches rapidly between the two antennas and uses the antenna that provided the best communication link to a particular client. There is only one of the internal 5 GHz antennas in use at any one time.

The access point also allows the connection of an external 5 GHz antenna. This option can be selected by the configuration software. The external antenna connectors use reverse sex SMA connectors to meet the FCC 15.203 unique antenna requirements.

Note that in contrast to the internal antennas; only ONE external 5 GHz antenna can be used. The configuration software cannot be configured to rapidly switch between the internal and external antenna.



Report Organization and Results Summary

This report presents the results of the tests that verify compliance with FCC Part 15.401 and Industrie Canada RSS-210. Though this product must comply with FCC Part 15.247 (for 802.11 B/G) as well, only the 15.401 (UNII) results are contained in this report. The compliance information for Part 15.247 is contained in a separate report.

A brief results summary of all the in this report is below.

Part 15 Paragraph	Test	Results
15.407(a)(5)	Power Spectral Density (5.15 - 5.25)	1.4 dBm/1MHz
15.407(a)(5)	Power Spectral Density (5.25 - 5.35)	2.8 dBm/1MHz
15.407(b)(1)	Out of Band Emissions @10640 w/ 5dBi, high pwr xmit on 5320 MHz	.9 dB in spec
15.407(a)	26dB Bandwidth	22.1 MHz
15.407(a)(1)	Transmit Power (5.15 - 5.25)	13.2 dBm MAX
15.407(a)(1)	Transmit Power (5.25 - 5.35)	14.7 dBm MAX
15.407(a)(6)	Peak Excursion	9.83 dB MAX
15.205	Radiated Emissions @ bandedge	2.37dB in spec @5.15 GHz

Test Facilities

All of the certification tests were performed at:

Elliott Labs
684 West Maude Ave
Sunnyvale, CA 94086

General:

Final radiated test measurements were taken in May 2005 at Elliott Laboratories Chamber #5

The test site contains separate areas for radiated and conducted emissions testing. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception of predictable local TV, radio, and mobile communications traffic. The test site contains separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

OATS:

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated emissions are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 Guidelines.

Antenna, Antenna Mast and Turntable

The Horn antennas that are used to measure radiated emissions above 1000MHz are mounted on a non-conductive antenna mast equipped with a motor drive to vary the antenna height.

ANSI C63.4 specifies that the test height above the ground plane shall be 80cm unless the equipment is intended to be floor mounted. During the radiated emissions tests the equipment is positioned on a motorized turntable in conformance with the ANSI requirement.

Equipment Lists

Instrument Calibration

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

The following test equipment was used to perform the testing

Elliott Test Equipment

<u>Manufacturer</u>	<u>Description</u>	<u>Model #</u>	<u>Asset #</u>	<u>Cal Due</u>
Hewlett Packard	Microwave Preamplifier, 1 -26.5GHz	8449B	263	18-Jan-06
Hewlett Packard	EMC Spectrum Analyzer 9KHz-26.5GHz, non programmable	8563E	284	22-Apr-06
EMCO	Horn Antenna, D. Ridge 1-18GHz	3115	868	20-Apr-06
Hewlett Packard	Microwave EMI test system (SA40, 9kHz - 40GHz) Fremont	84125C	1410	24-Jul-05
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1290	09-May-06
Rohde & Schwarz	Peak Power Sensor 100uW - 2 Watts	NRV-Z32	1536	09-May-06

Test Methods

Many of the tests are performed at a low, middle and high channel of the applicable band. The typical frequencies used for the test for each band are listed below.

UNII 802.11 A	
5.15 – 5.25 GHz & 5.25 – 5.35 GHz	
Channel	Freq(MHz)
Low	5180
Mid	5260
High	5320

In order to comply with the maximum allowable RF power requirement in the 5.15 - 5.25 GHz band, the power setting (and thus the transmit power) is lower in this band then in the 5.25 – 5.35 GHz UNII band. The maximum power setting that yielded compliance will be programmed into the configuration firmware of the access point to ensure the maximum possible power setting will be correct for each band.

Power levels LOW and HIGH are referred to throughout the report. Low and high power is defined in the table below for each of the UNII bands. The power level will be set within the AP depending on the antenna being used.

Power setting vs Band:

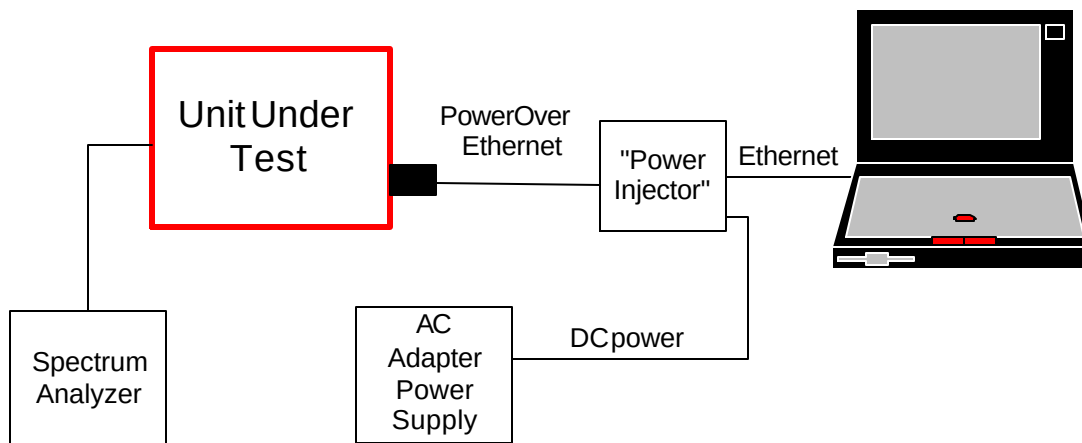
UNII Band	Power Setting	Power setting "Numeric"	For use with...
5150 - 5250	LOW	11	Panel antennas up to 14 dBi
5250 - 5350	LOW	16.5	Panel antennas up to 14 dBi
5150 - 5250	HIGH	17	Omni antennas up to 6 dBi
5250 - 5350	HIGH	18	Omni antennas up to 6 dBi

UNII Antenna List:

BAND	CushCraft / Max Rad Antenna	Freq Band	Net Gain (dBi)	Type	Comment	Allowed Power Stg
UNII	S5153WPN36RSM	5.15 - 5.35	6.0	Omni	Similar to S2403, Colinear omni 2 element	HIGH
	S51514WPN36RSM	5.15 - 5.35	14.0	Patch	Patch Directional	LOW
	S24493DS	5.15 - 5.35	5.9	Omni	Internal	HIGH
5 GHz DTS	S5153WPN36RSM	5.725 - 5.85	6.0	Omni	Similar to S2403, Colinear omni 2 element	HIGH
	S51514WPN36RSM	5.725 - 5.85	14.0	Patch	Patch Directional	LOW
	S24493DS	5.725 - 5.85	7.5	Omni	Internal	HIGH
2.4 GHz DTS	SQ2405DDN36RSM	2.4-2.5	4.0	Panel	Panel, similar to 2402 / 2409	MED
	SL2402PN36RSM	2.4-2.5	2.0	Panel	Panel	MED
	S2406PN36RSM	2.4-2.5	5.5	Panel	Panel	MED
	S2409PN36RSM	2.4-2.5	8.5	Panel	Panel, higher gain S2402	MED
	MYP24015PRSM	2.4-2.5	15.0	Yagi	Yagi (Made by Max Rad)	LOW
	S24493DS	2.4 - 2.5	4.2	Omni	Internal	HIGH

The following tests are performed using the basic test setup shown below. In several cases, the EUT was running special diagnostic firmware to allow it to transmit random data on a particular channel indefinitely.

Part 15	Test
15.407(a)(5)	Power Spectral Density
15.407(b)(1)	Out of Band Emissions (5.15 – 5.25)
15.407(b)(1)	Out of Band Emissions (5.25 – 5.35)
15.407(b)(1)	Out of Band Emissions (5.725 – 5.825)
15.407(a)	26dB Bandwidth
15.407(a)(1)	Transmit Power (5.15 – 5.25)
15.407(a)(2)	Transmit Power (5.25 – 5.35)
15.407(a)(3)	Transmit Power (5.275 – 5.825)
15.407(a)(6)	Peak Excursion



Basic Conducted RF Bench Test Setup

Unless otherwise noted, the support equipment for the bench tests is listed below.

Support Equipment				
Description	Model number	FCC ID or SN	Manufacturer	Power Cable
Laptop	Armada E 500	P31000T4X20DC12N2	Compaq	Laptop PS
Test Software	Atheros Radio Test		Atheros	
48VDC AC adapter	Generic		Generic	Standard Twin lead DC wire

Test Results

Detailed test procedures and test results are contained in the following sections. In cases where the test setup differs from the Conducted RF test setup shown above, the test setup is also presented.

Test Conditions			
Temperature	23 C	Humidity:	61%
ATM pressure	1021 mBar	Grounding:	None
Tested By	David Waitt , Yalda Noor, Adam LaCourse, Juan Martinez	Date of Test:	May 2005
Test Reference	Refer to individual test results		
Tested Range	Test Dependent		
Test Voltage	48 VDC to the access point		
Modifications	No modifications were made to the unit during the tests		

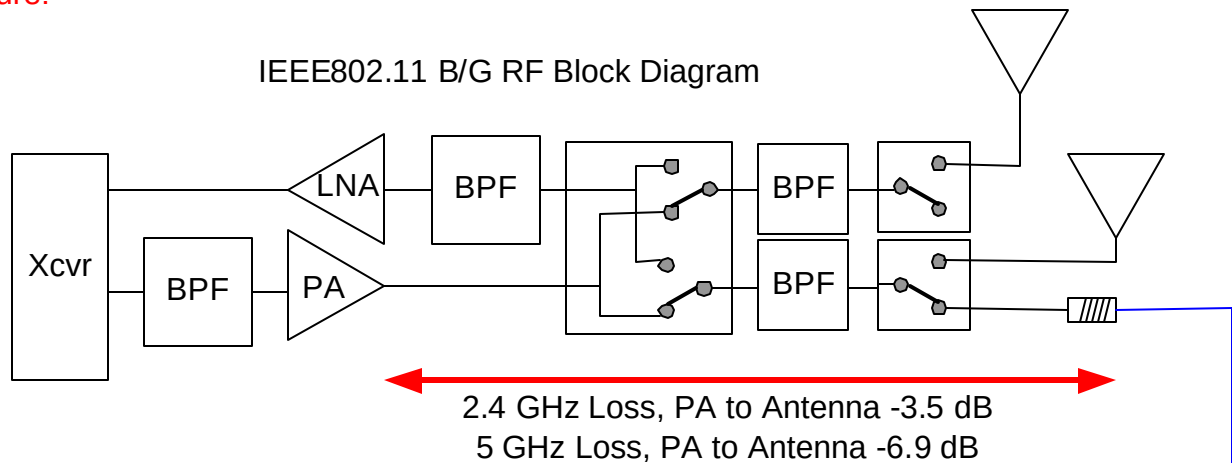
802.11 A Maximum RF Power Output and Power Spectral Density at Antenna Terminals

Specifications:

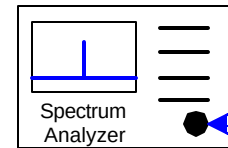
FCC Specification: Paragraph(s): 15.401(a)(1), 15.401(a)(2), 15.401(a)(3)

IC Specification: 6.2.2.(q1)i

Procedure:



Power measurements were performed with a spectrum analyzer using channel power integration over the 26 dB bandwidth. Output power measured using a spectrum analyzer with: RBW=1MHz, VB=3 MHz, sample detector, power averaging on and power integration over 26-dB BW



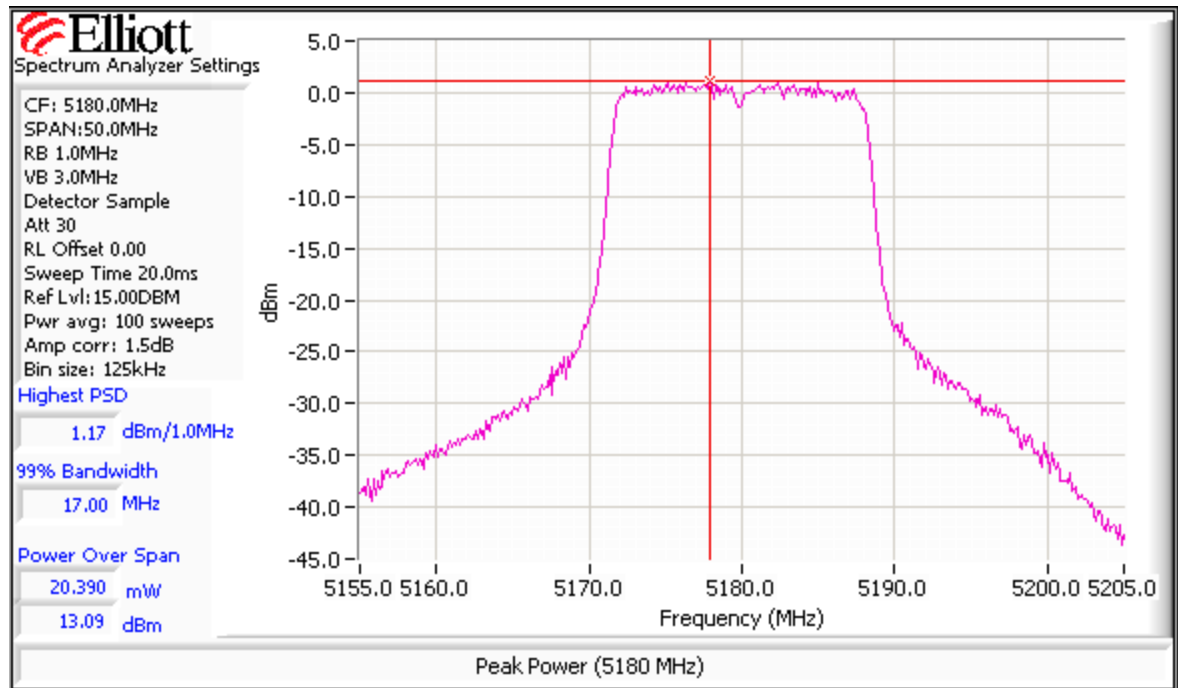
RF Transmit power is measured at two different settings (high and Low) corresponding to the antenna that is used. The low power setting is used for the 14 dBi panel (or lower) gain panel antennas. The higher power level is used for the 5.15 dBi (or lower) gain omni antennas. The PSD limit for “Low Power” below is corrected for the difference in antenna gain from 6 dBi to 14 dBi.

The RF transmit power and power spectral density can be both be determined from each of the spectrum analyzer plots below.

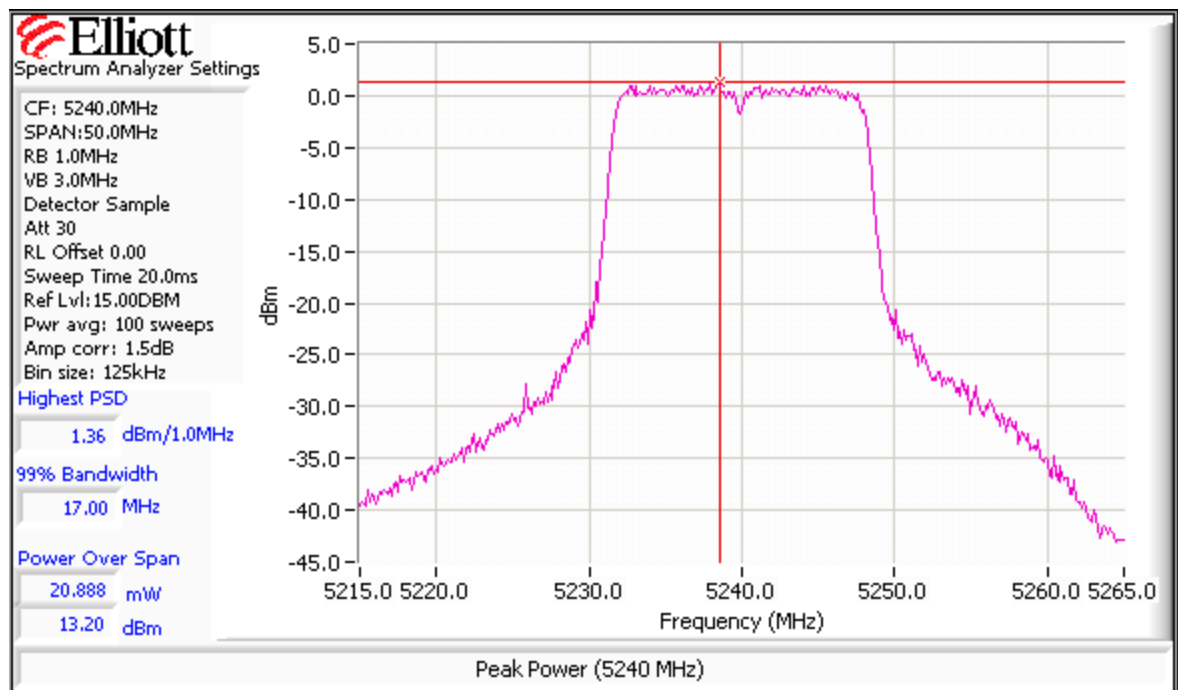
RF Transmit Power Summary Results:

	Freq (MHz)	Measured 26 dB Channel power (dBm)	Antenna Gain (dBi)	EIRP	Max Spec Pout dBm (for antenna)
Low Pwr Setting	5180	7.8	14	21.8	9
	5240	7.5	14	21.5	9
	5260	14.6	14	28.6	16
	5320	13.9	14	27.9	16
High Pwr Setting	5180	13.1	6	19.1	17
	5240	13.2	6	19.2	17
	5260	14.7	6	20.7	24
	5320	14.7	6	20.7	24

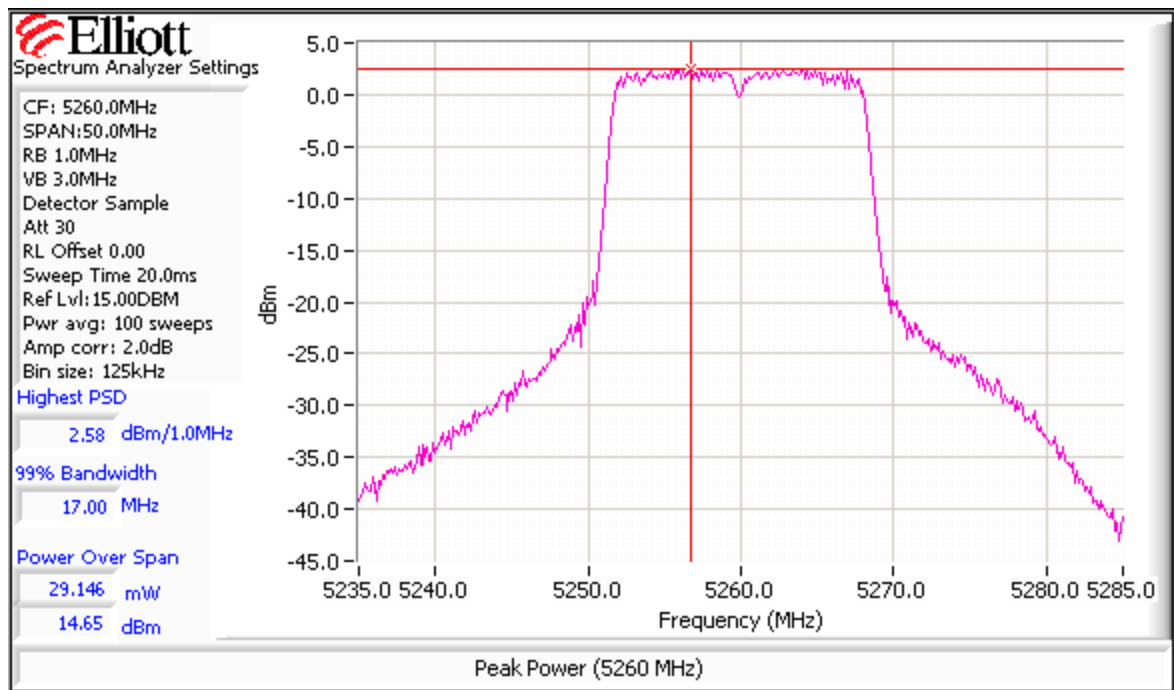
26 dB Channel Power, PSD, 5180 MHz (High Power Setting)



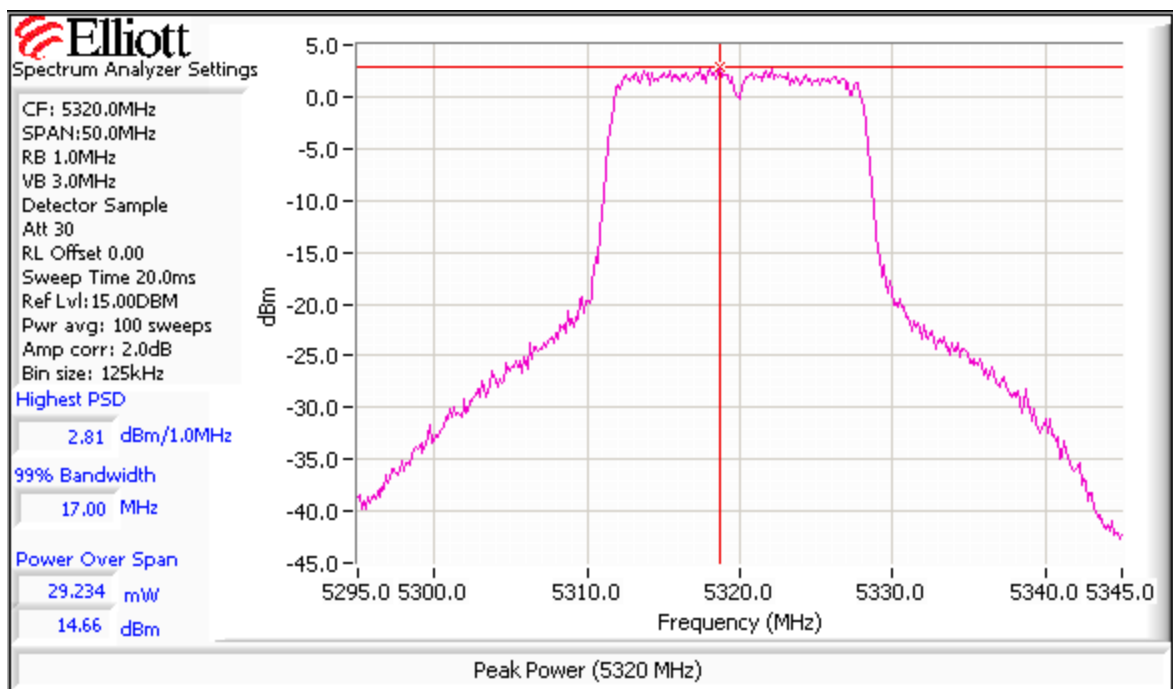
26 dB Channel Power, PSD, 5240 MHz (High Power Setting)



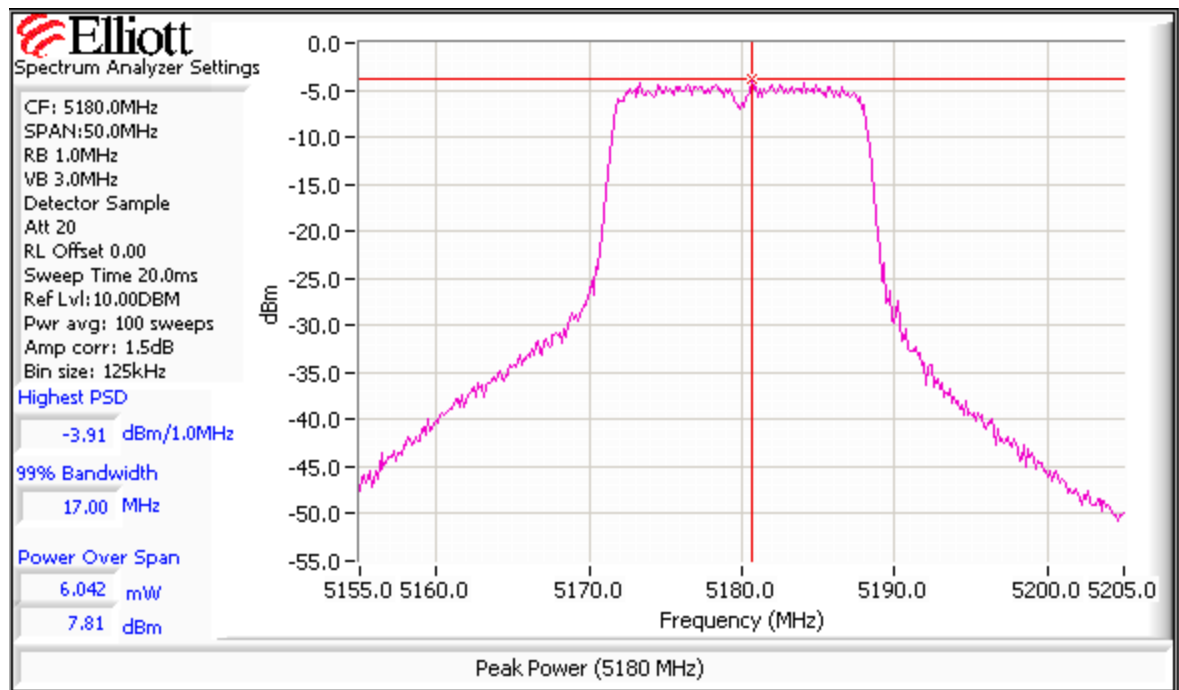
26 dB Channel Power, PSD, 5260 MHz (High Power Setting)



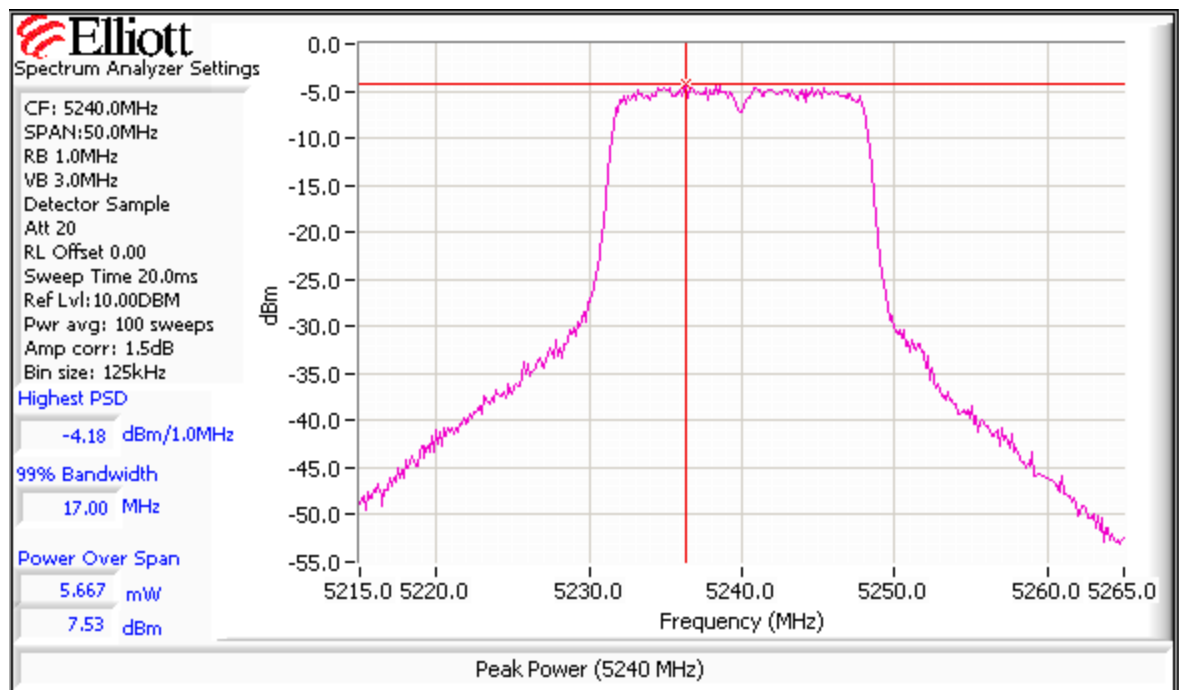
26 dB Channel Power, PSD, 5320 MHz (High Power Setting)



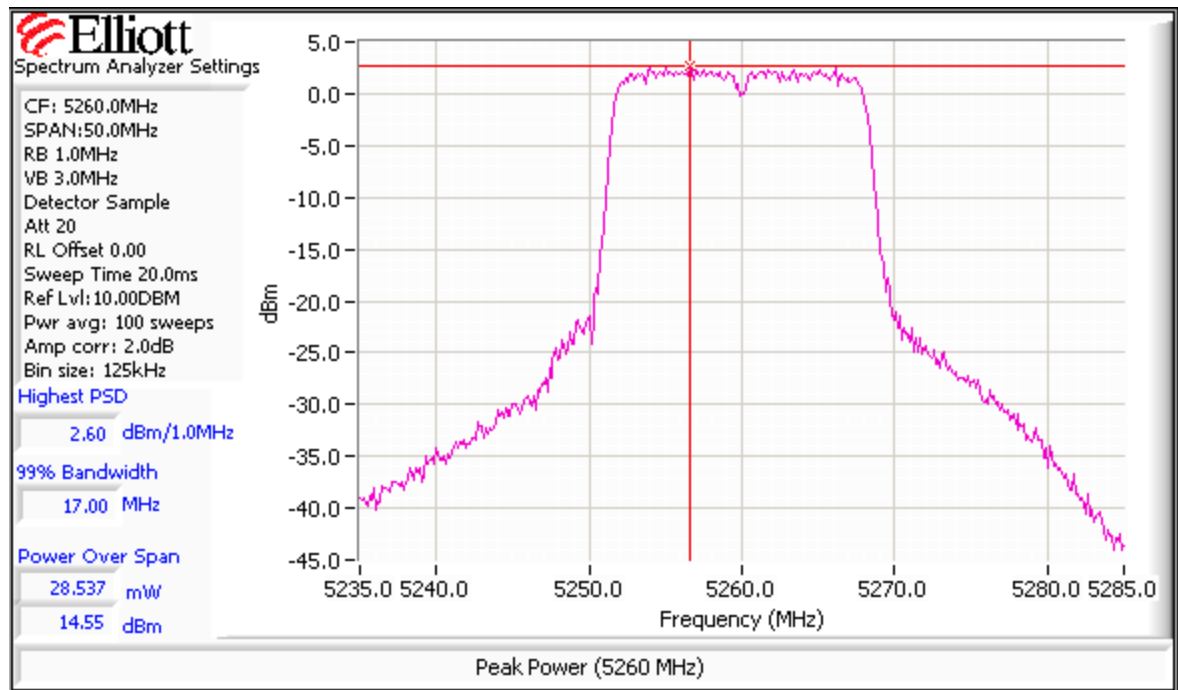
26 dB Channel Power, PSD, 5180 MHz (Low Power Setting)



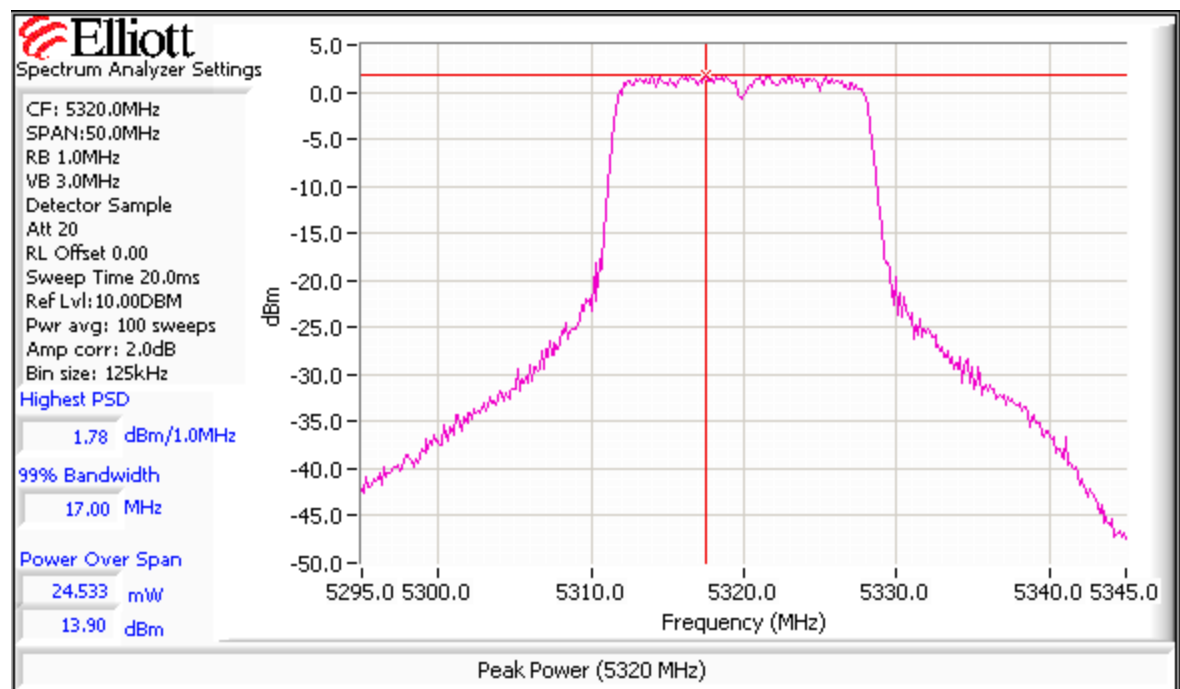
26 dB Channel Power, PSD, 5240 MHz (Low Power Setting)



26 dB Channel Power, PSD, 5260 MHz (Low Power Setting)



26 dB Channel Power, PSD, 5320 MHz (Low Power Setting)



5 GHz Power Spectral Density & Peak Excursion

Specification

FCC Specification: Paragraph 15.407(a)(5)

IC Specification: 6.2.2.(O)

Procedure:

The test setup was configured as shown in the conducted test setup. The UUT was configured to continuously transmit random data packets. Initially the bandwidth of the entire channel was examined. Using MAX HOLD and peak search, the frequency with the maximum power was determined.

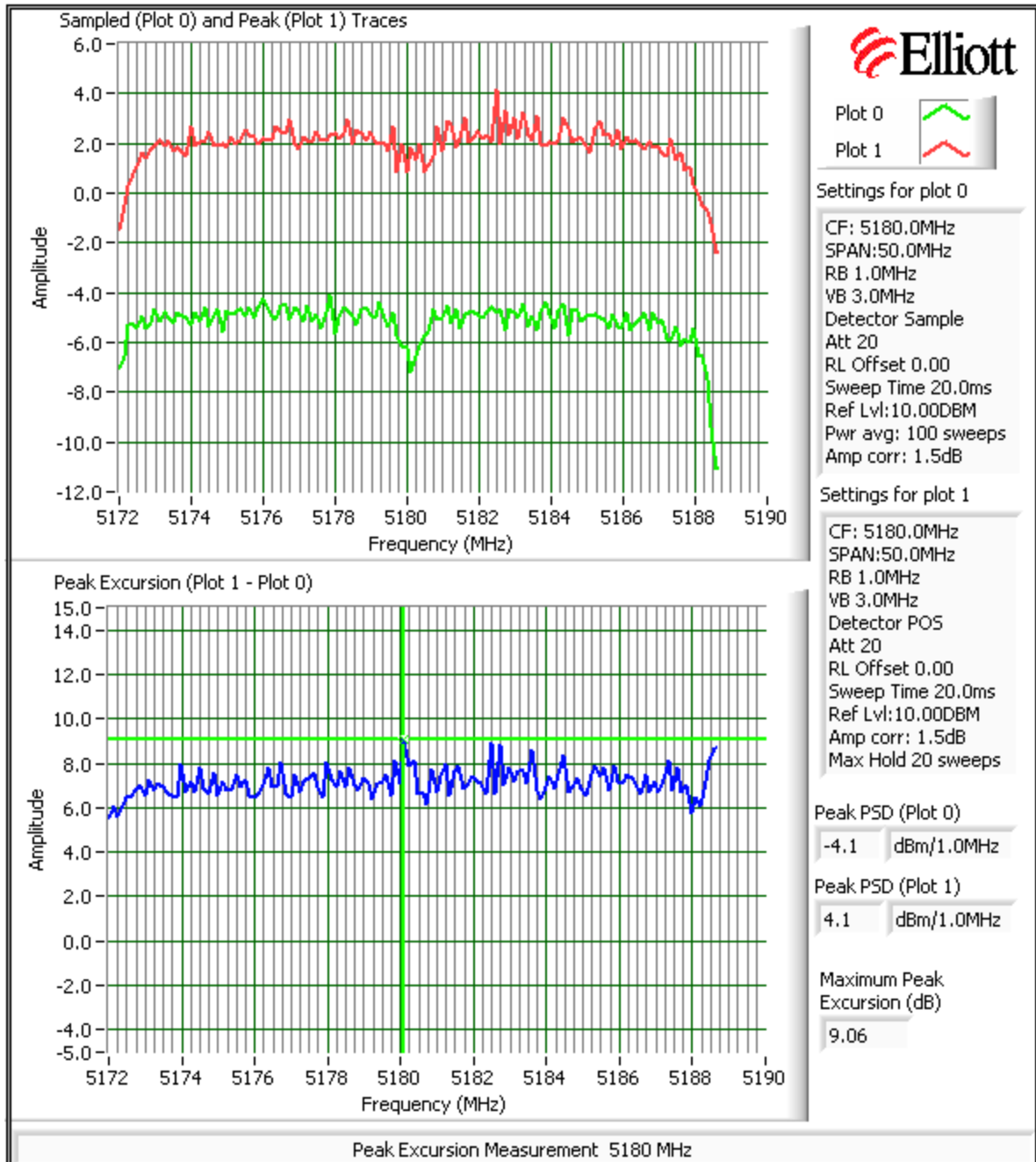
The measurements were made using RBW = 1MHz, VBW = 3MHz, sample detector and power averaging. The power spectral density was measured on the designated test channels with the appropriate power setting for the given test channel.

The low power PSD limits have been corrected to account for an antenna up to 14 dBi. (resulting in an 8 dBi reduction)

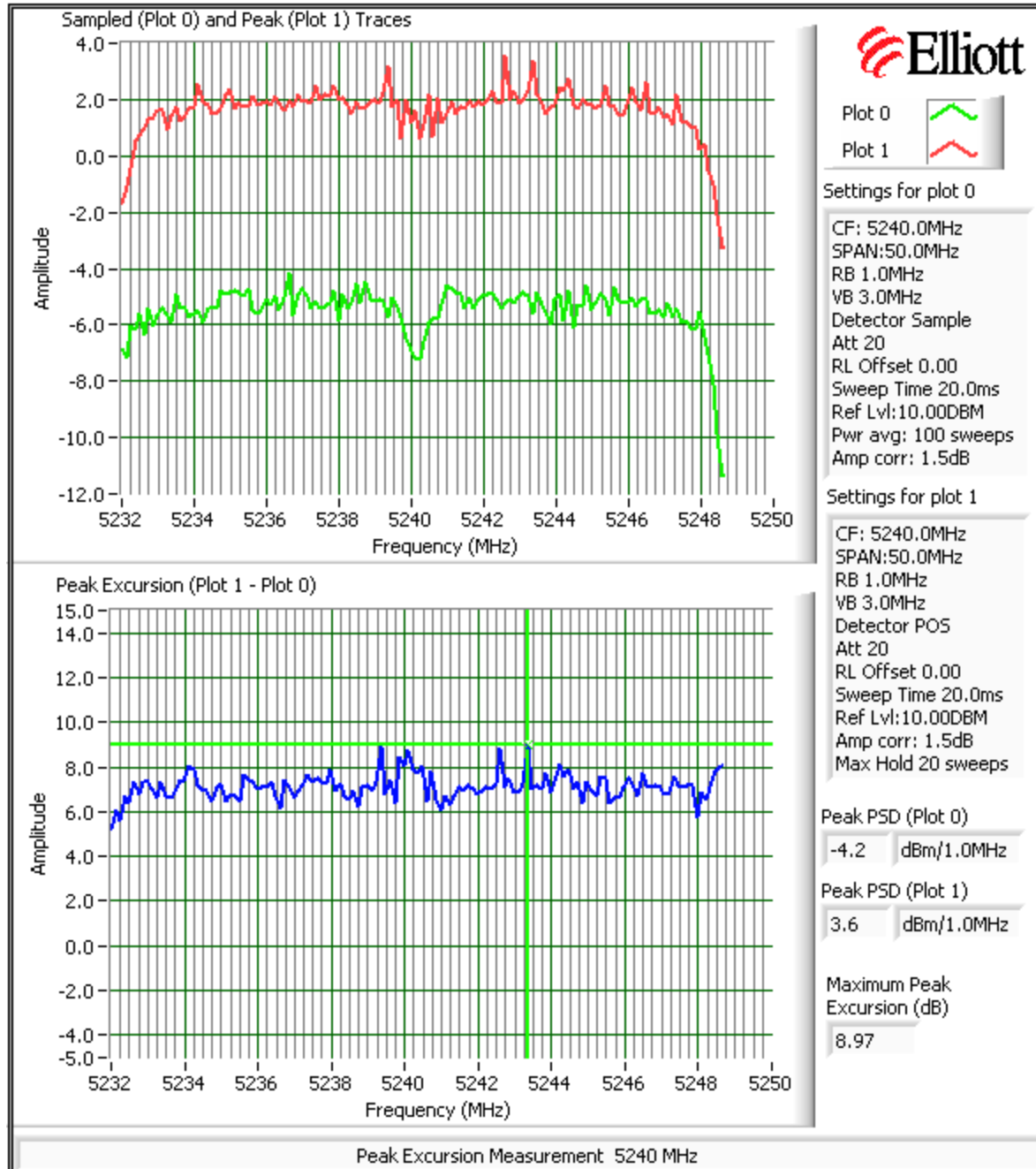
Results:

Freq (MHz)	Power Setting	PSD	Corrected FCC Limit (dBm/MHz)	PSD Spec Delta	Pk Excursion (dB)	FCC Limit (dB)	Pk Ex Spec Delta (dB)
5180	Low	-4.1	-4	0.1	9.060	13	3.940
5240	Low	-4.2	-4	0.2	8.970	13	4.030
5260	Low	2.6	3	0.4	9.830	13	3.170
5320	Low	1.8	3	1.2	9.700	13	3.300
5180	High	1.2	4	2.8	9.170	13	3.830
5240	High	1.4	4	2.6	9.310	13	3.690
5260	High	2.6	11	8.4	8.600	13	4.400
5320	High	2.8	11	8.2	9.960	13	3.040

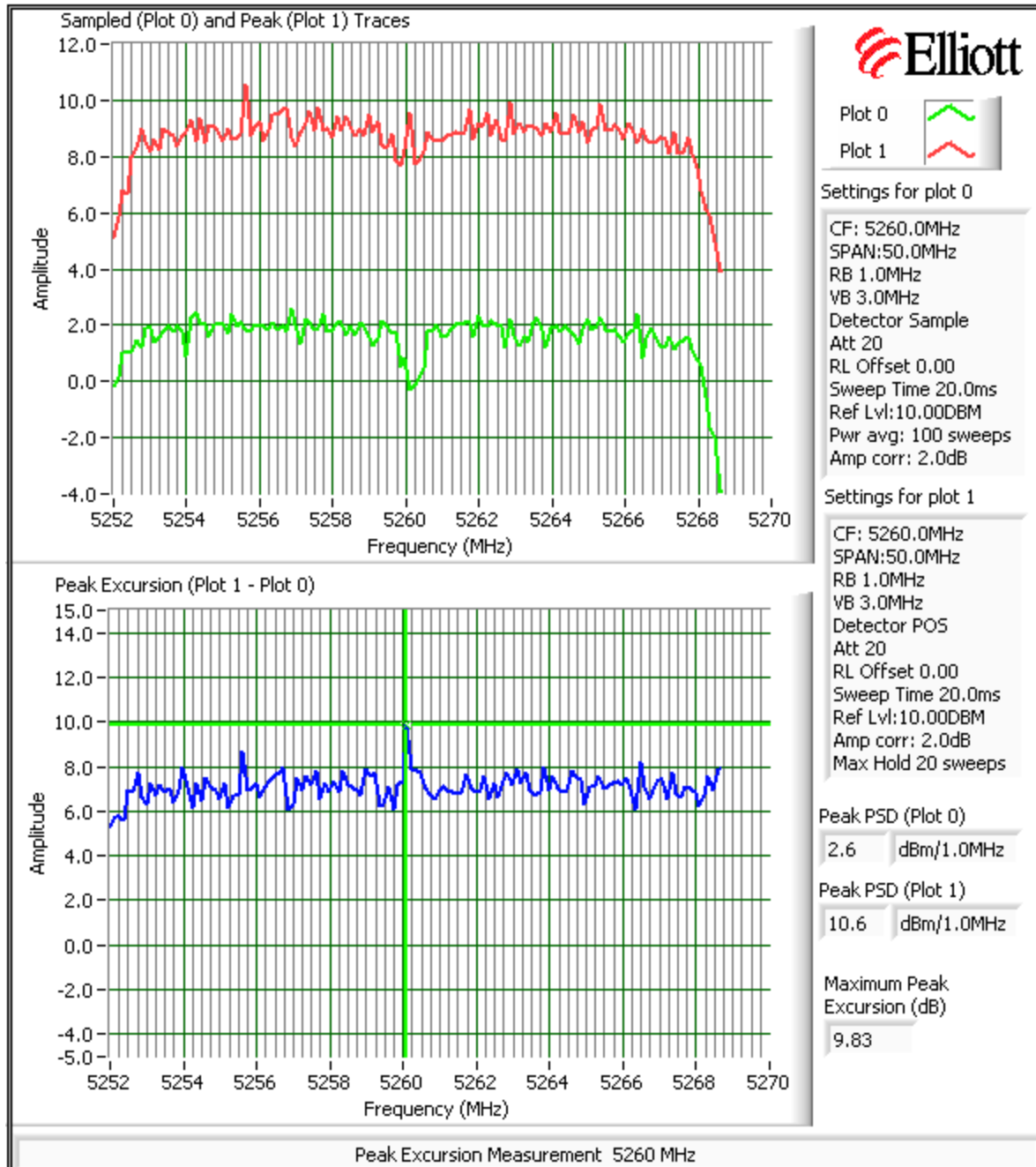
PSD and Peak Excursion, 5180 MHz, Low Power Setting



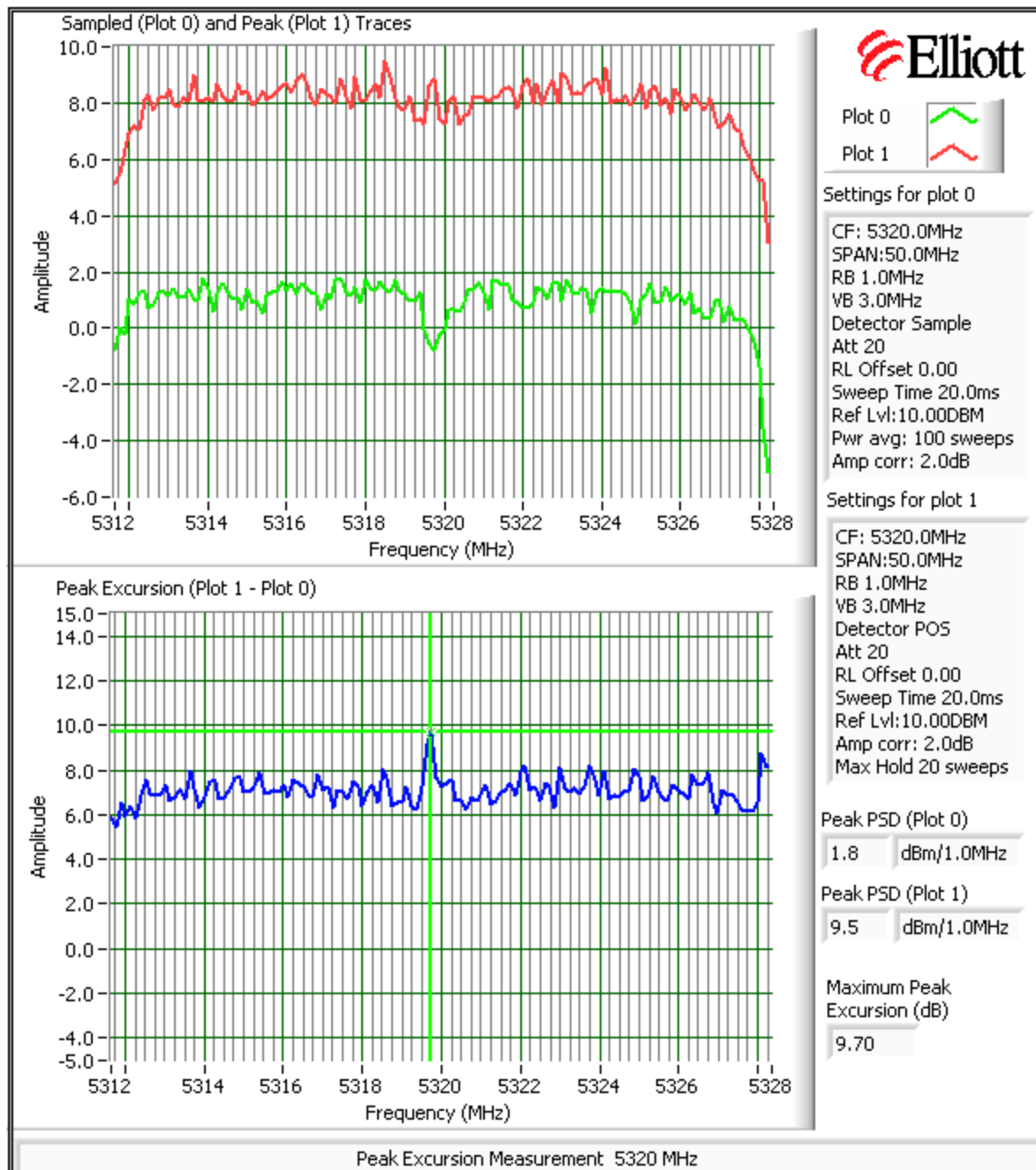
PSD and Peak Excursion, 5240 MHz, Low Power Setting



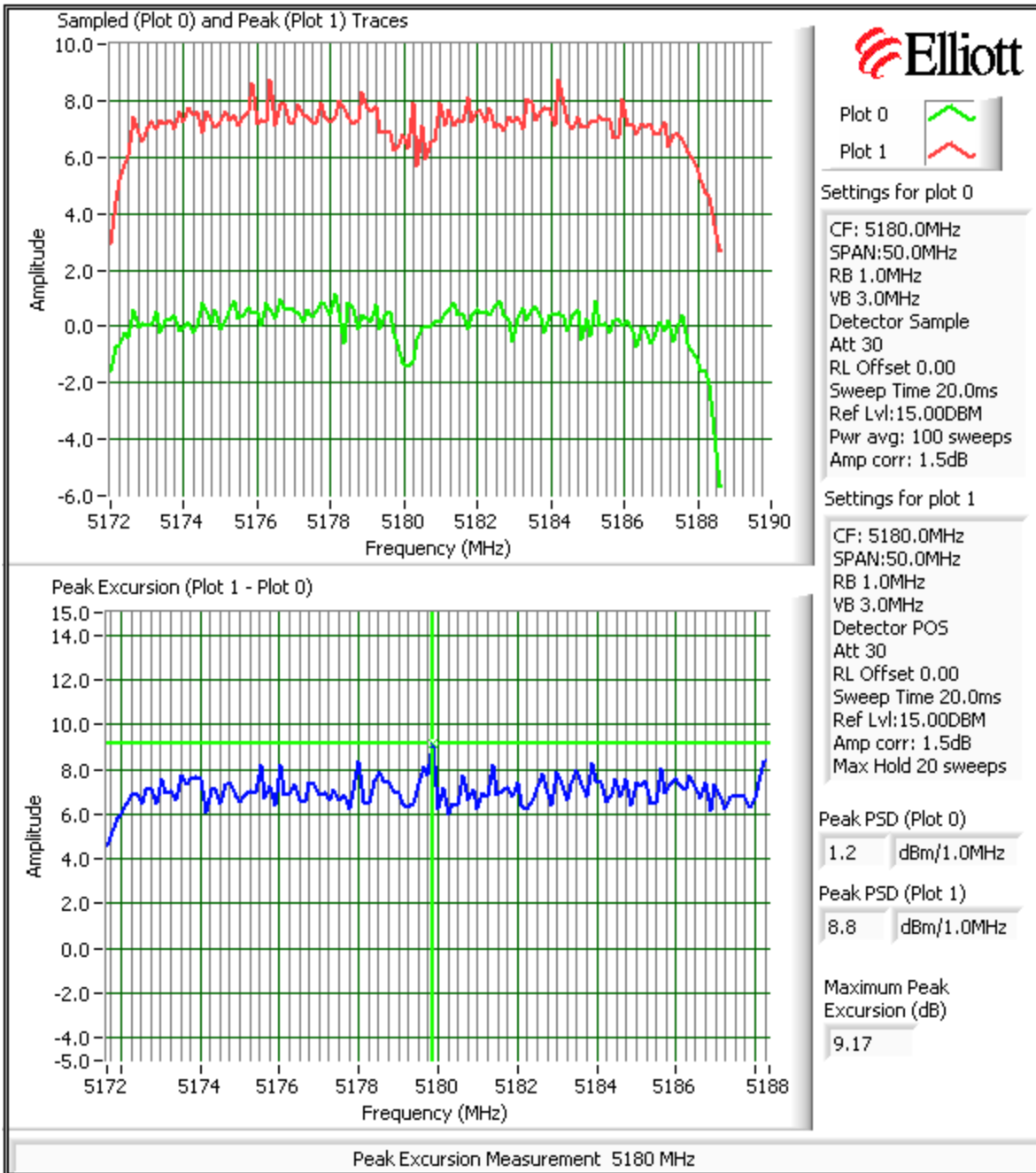
PSD and Peak Excursion, 5260 MHz, Low Power Setting



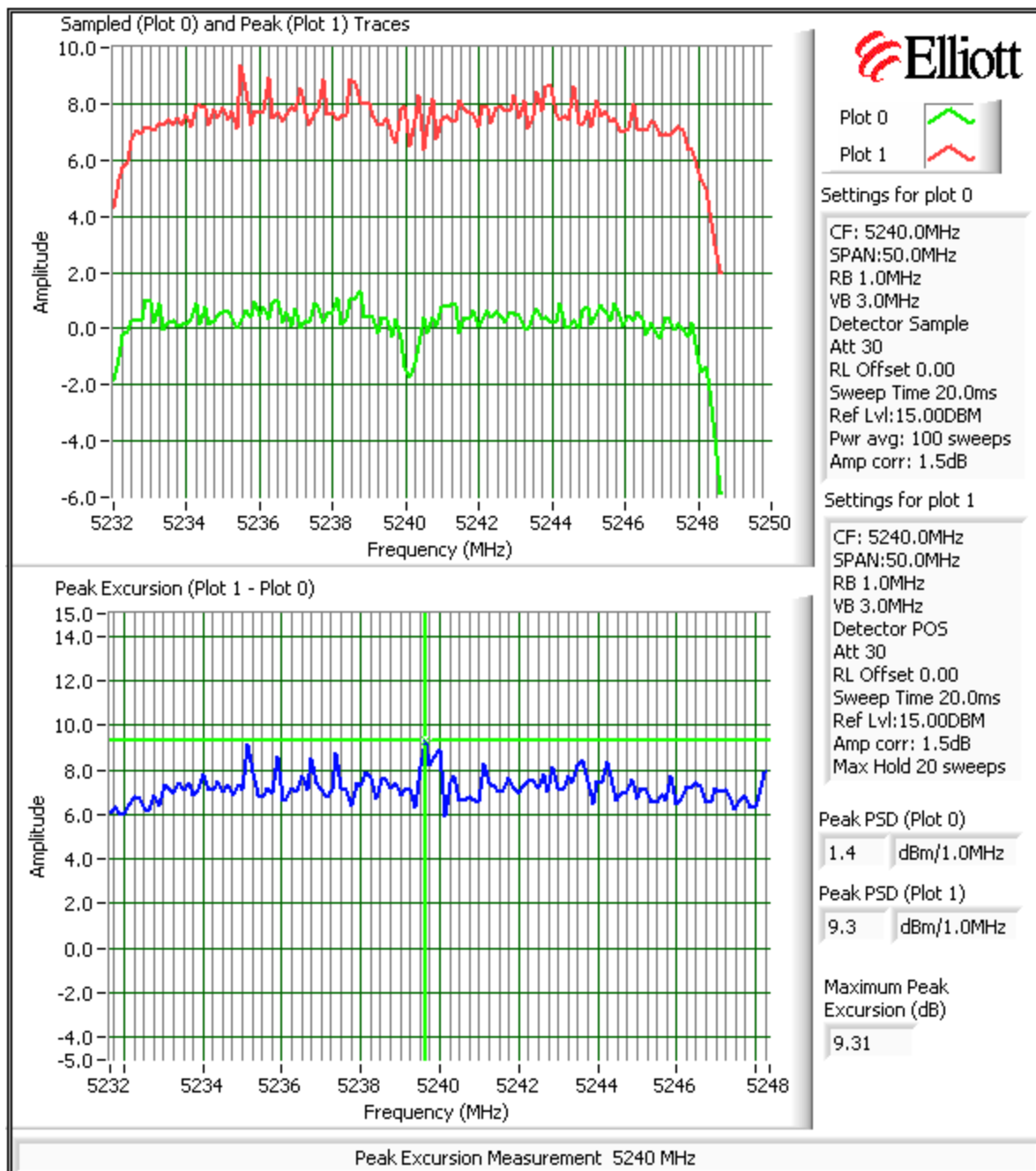
PSD and Peak Excursion, 5320 MHz, Low Power Setting



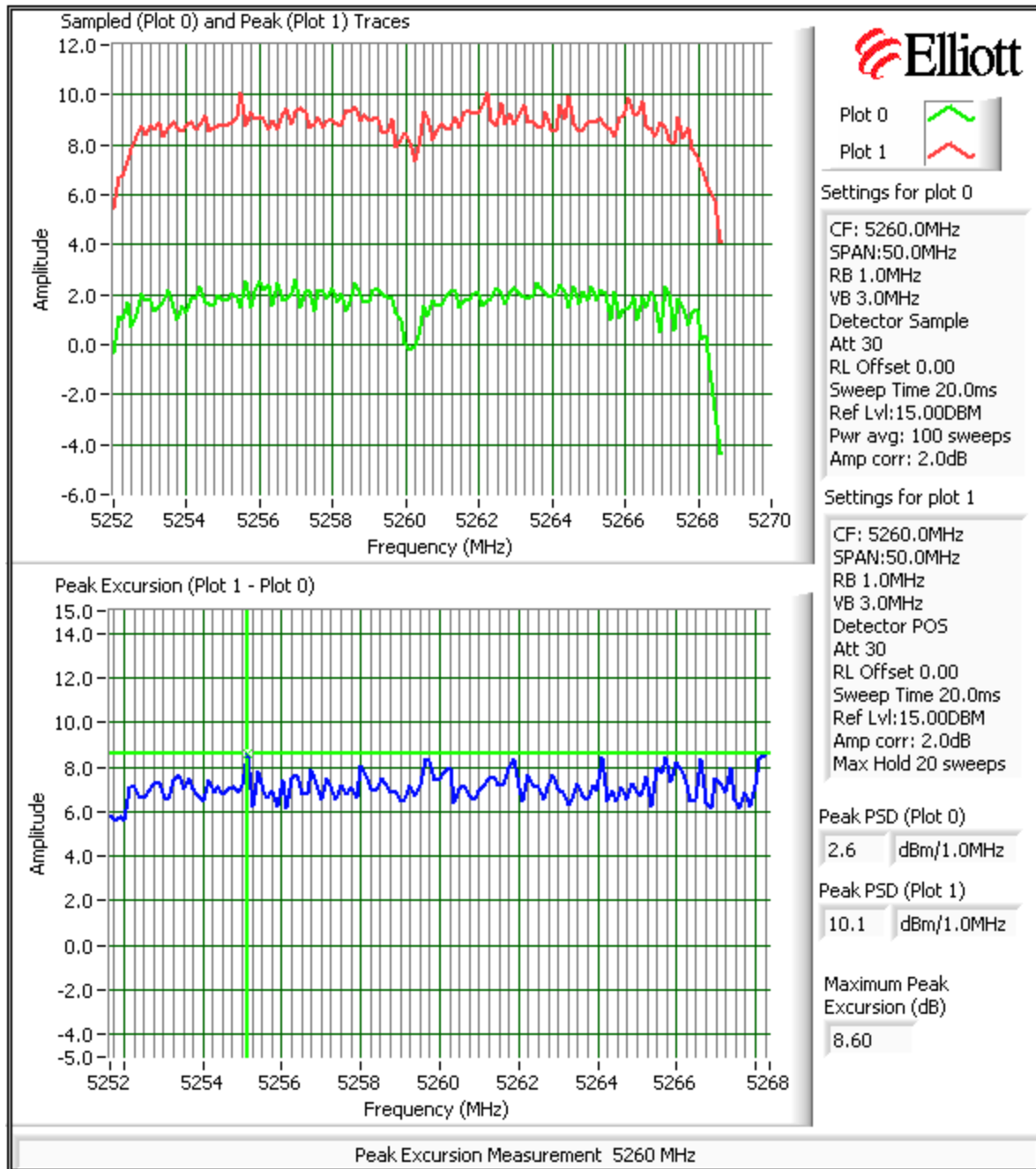
PSD and Peak Excursion, 5180 MHz, High Power Setting



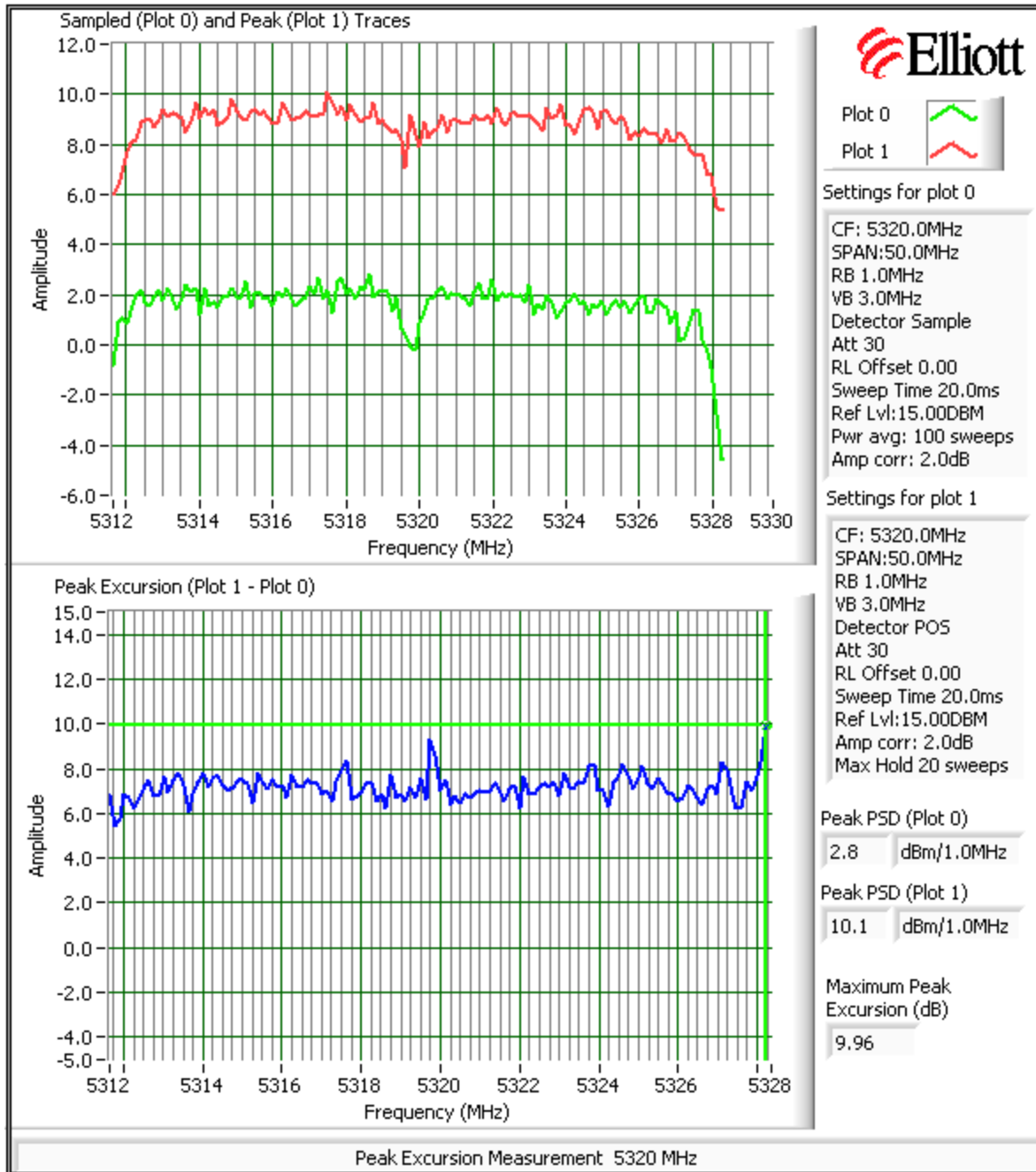
PSD and Peak Excursion, 5240 MHz, High Power Setting



PSD and Peak Excursion, 5260 MHz, High Power Setting



PSD and Peak Excursion, 5320 MHz, High Power Setting



20 dB / 26 dB bandwidth

Specification

FCC Specification: Paragraph 15.407(a)

IC Specification: 6.2.2.(O)

Procedure

The access point operates on the standard IEEE 802.11 'A' channels. The 20 dB and 26dB bandwidth was measured on the low middle and high channel of the 5 GHz UNII bands (5.15 - 5.35 GHz and 5.725-5.825GHz) using the conducted RF test setup.

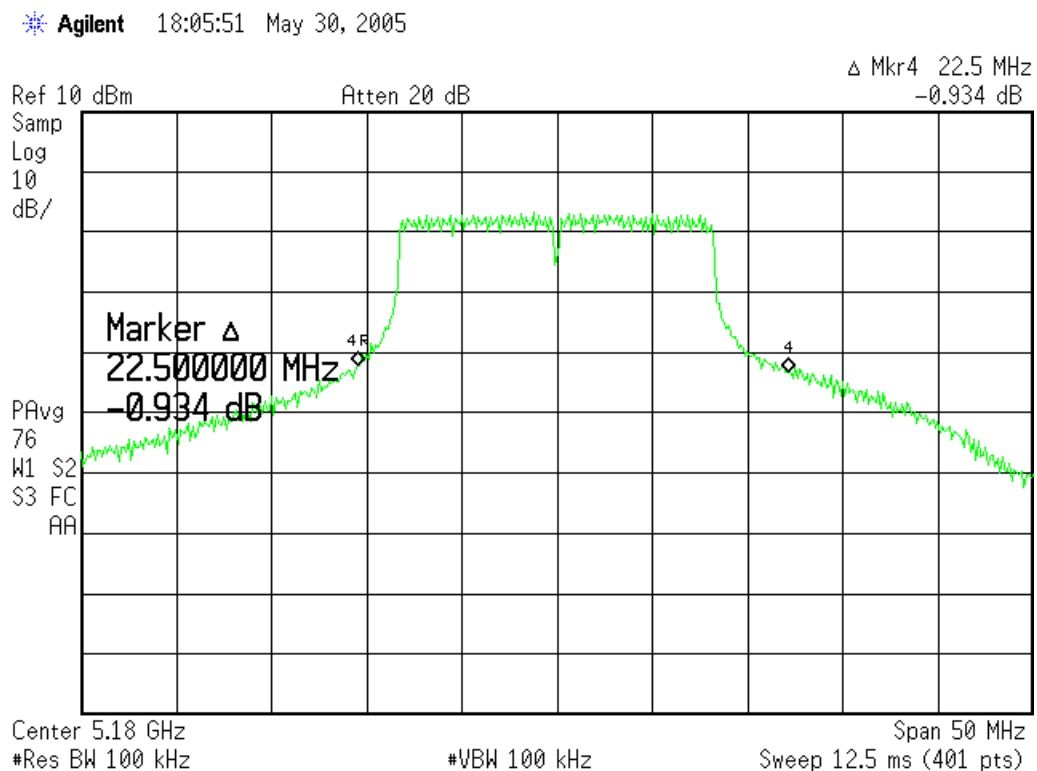
Once the trace had stabilized, a peak search was performed and a marker placed 20dB (or 26dB as applicable) below the peak. This marker was then used as a reference for a "marker-delta" measurement. The delta marker was adjusted as close as possible to the same level as the reference marker.

99% / 26 dB bandwidth Summary Results

Freq (MHz)	802.11 A Bandwidth (MHz)		Spec (MHz)	Delta (min)
	26 dB	99%		99%
5180	22.5	16.603	0.5	16.103
5260	22.1	16.659	0.5	16.159
5320	22.6	16.626	0.5	16.126

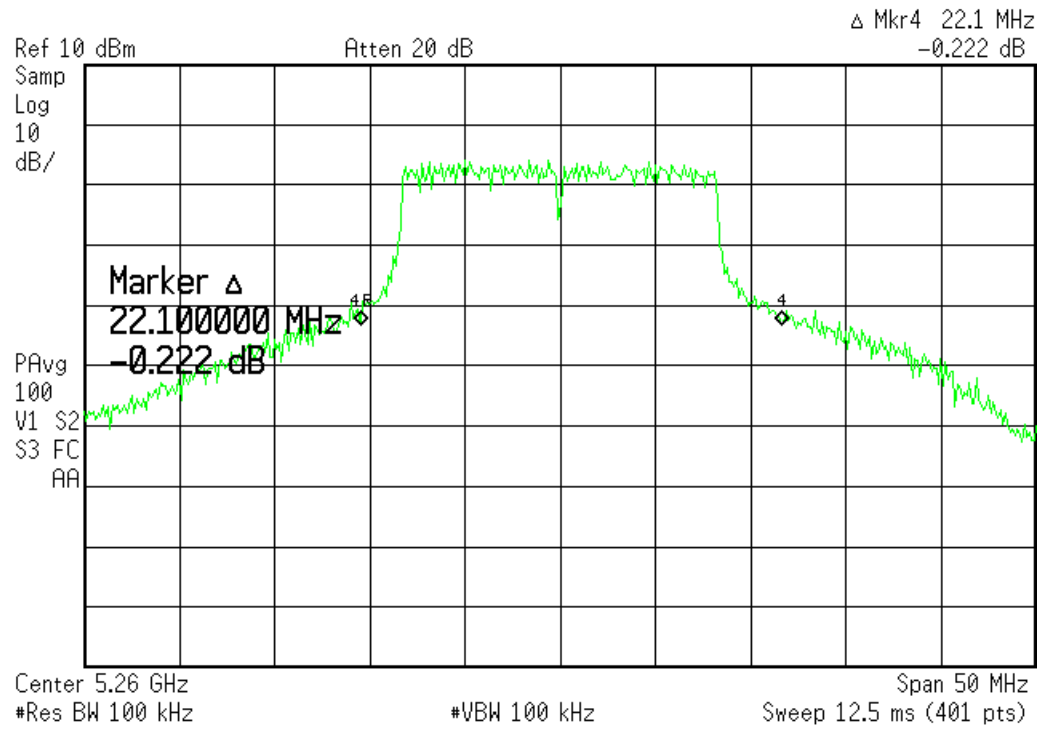
26 dB Bandwidth Plots

5180MHz 26dB BW



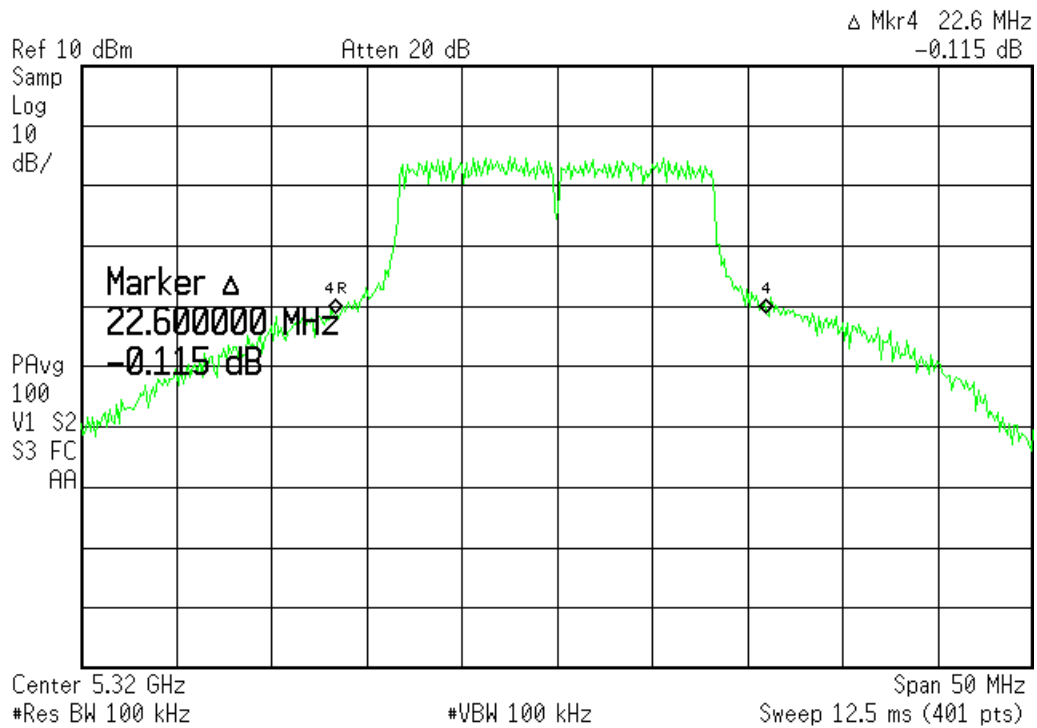
5260MHz 26dB BW

Agilent 18:04:42 May 30, 2005



5320MHz 26dB BW

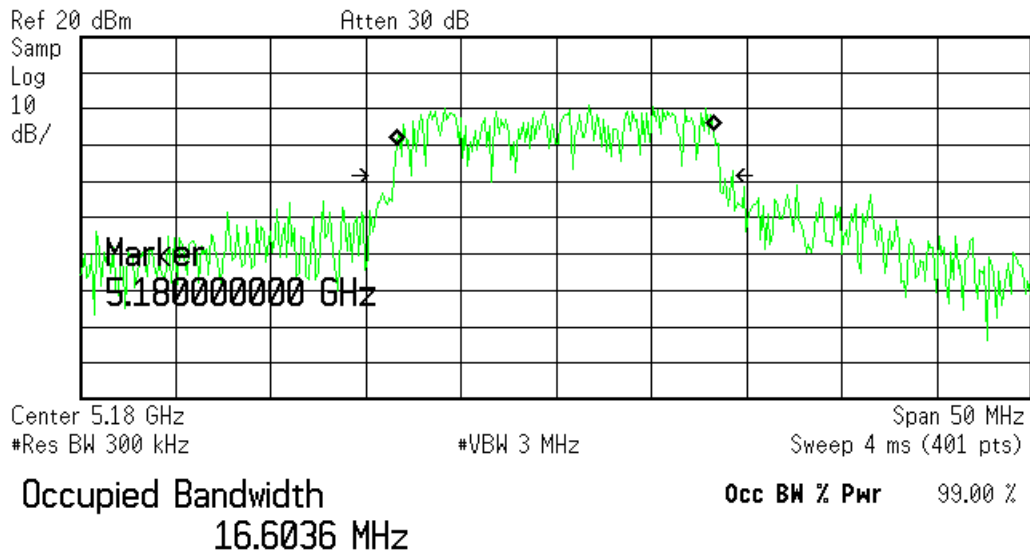
Agilent 18:03:02 May 30, 2005



99% Bandwidth Plots

5180MHz 99% BW

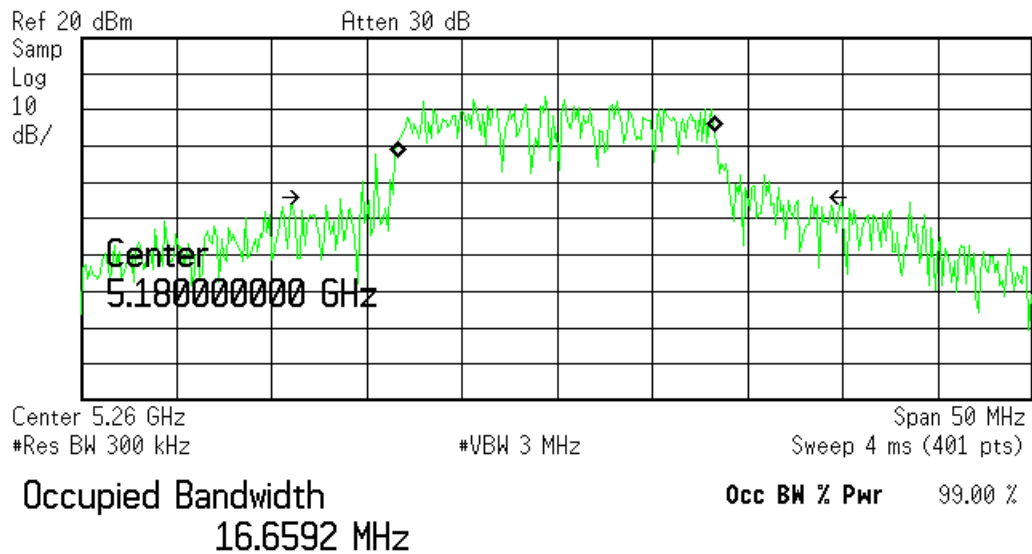
Agilent 17:47:16 May 30, 2005



Transmit Freq Error 9.406 kHz
x dB Bandwidth 18.336 MHz*

5260MHz 99% BW

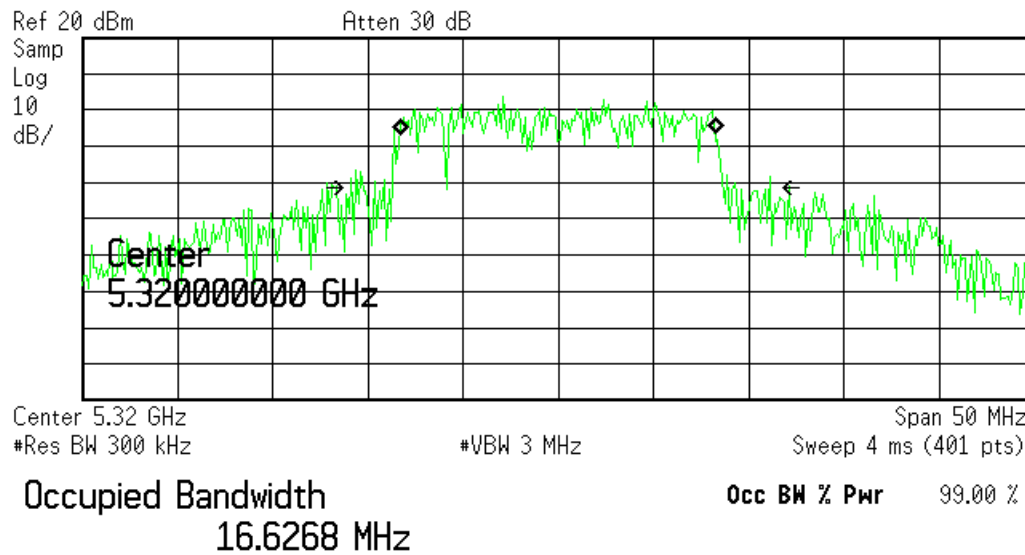
Agilent 17:51:18 May 30, 2005



Transmit Freq Error -11.784 kHz
x dB Bandwidth 25.225 MHz*

5320MHz 99% BW

Agilent 17:52:42 May 30, 2005



Transmit Freq Error 26.057 kHz
x dB Bandwidth 27.214 MHz*

5.15 - 5.35 GHZ & 5.725 – 5.825 GHz Bandedge

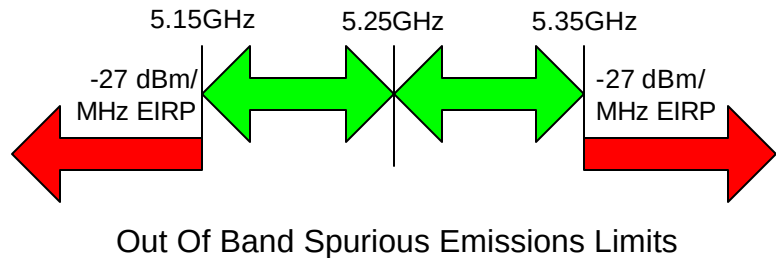
Specification

FCC Specifications: Paragraphs 15.407(b)(3)

Procedure:

For signals in the bands immediately above and below the 5.15 - 5.35GHz and 5.725 - 5.825 GHz band, conducted measurements were made at the external antenna connector. The test was configured as shown in the Conducted RF test setup. The UUT was configured to transmit continuous random data packets on the standard channel closest to the band edge being examined. The UUT was configured to the appropriate power setting depending on the test channel.

Since the specification is in EIRP, the appropriate specification limit was adjusted account for the maximum allowable antenna gain. The band edges and their appropriate limits (unadjusted for antenna gain) are shown below.



5.15 - 5.35 GHZ Bandedge Results:

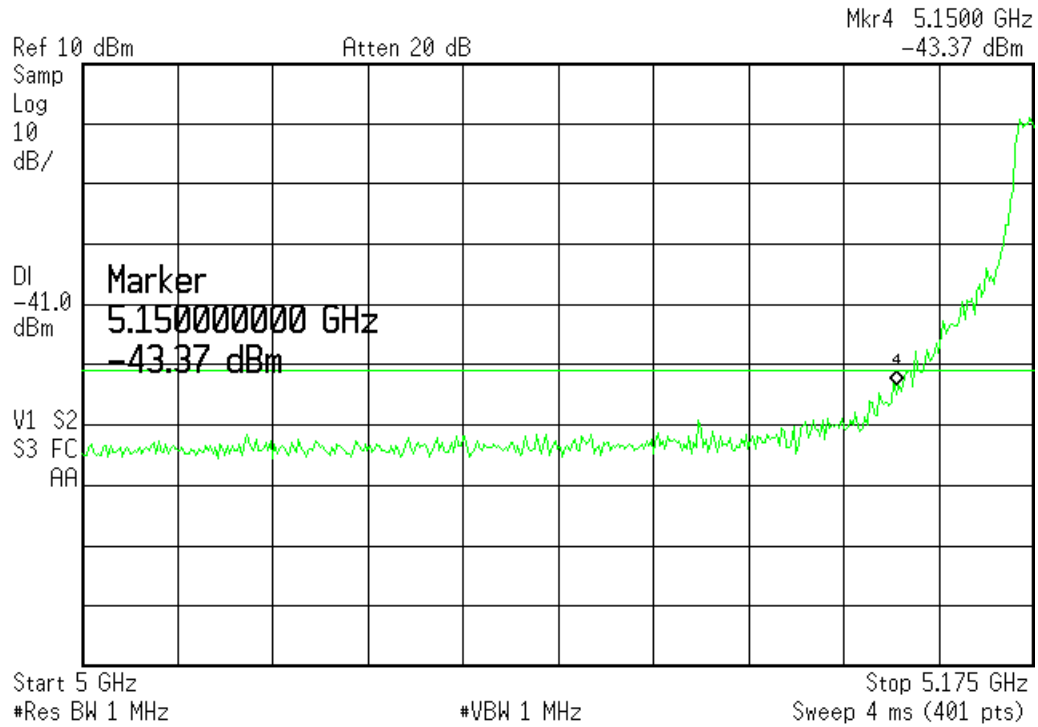
UNII band edge emissions summary. The adjusted conducted limit reflects a maximum allowable antenna gain of 14 dBi. The measurements were made with RBW = 1MHz, VBW = 1MHz, video averaging on.

Plots of the out of band emissions at the band edges are shown on the following page.

Transmit Frequency	Transmit Power Setting	Max Ant Gain Allowed (dBi)	Uncorrected Emissions Limit (dBm EIRP)	Corrected Emissions Limit (dBm)	Measured Lvl @ Bandedge (dBm)	Delta Spec (dB)
5150	Low	14	-27	-41	-43.37	2.37
5320	Low	14	-27	-41	-47.81	6.81
5150	High	6	-27	-33	-38.76	5.76
5320	High	6	-27	-33	-36.60	3.60

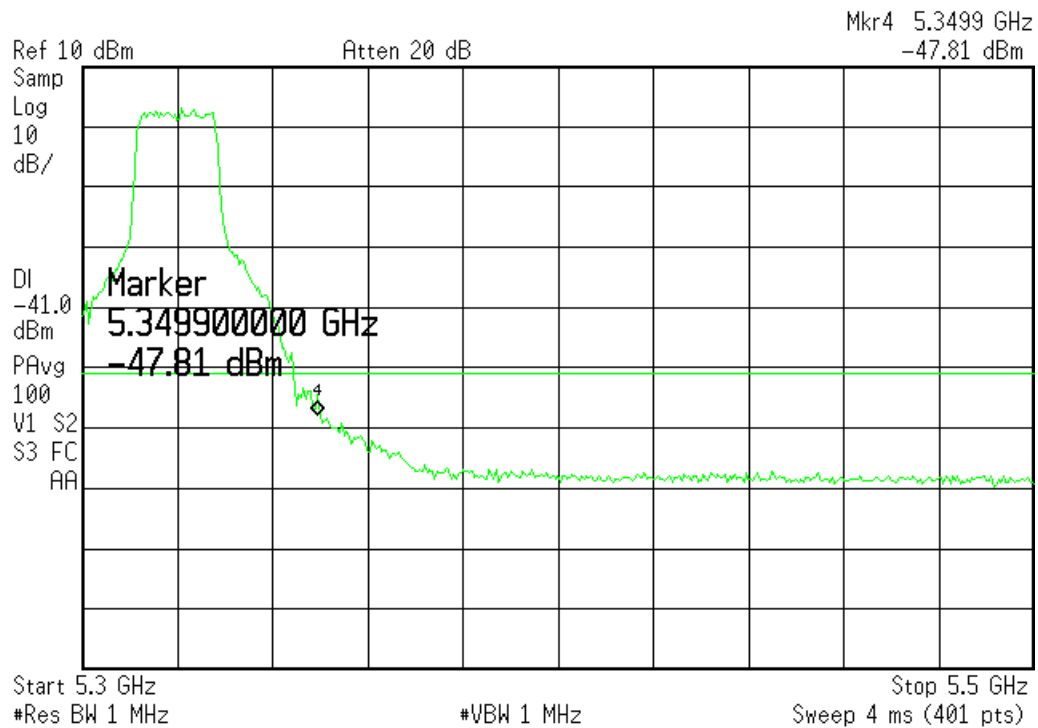
5.15 GHz bandedge (low Power Setting)

* Agilent 18:16:37 May 30, 2005

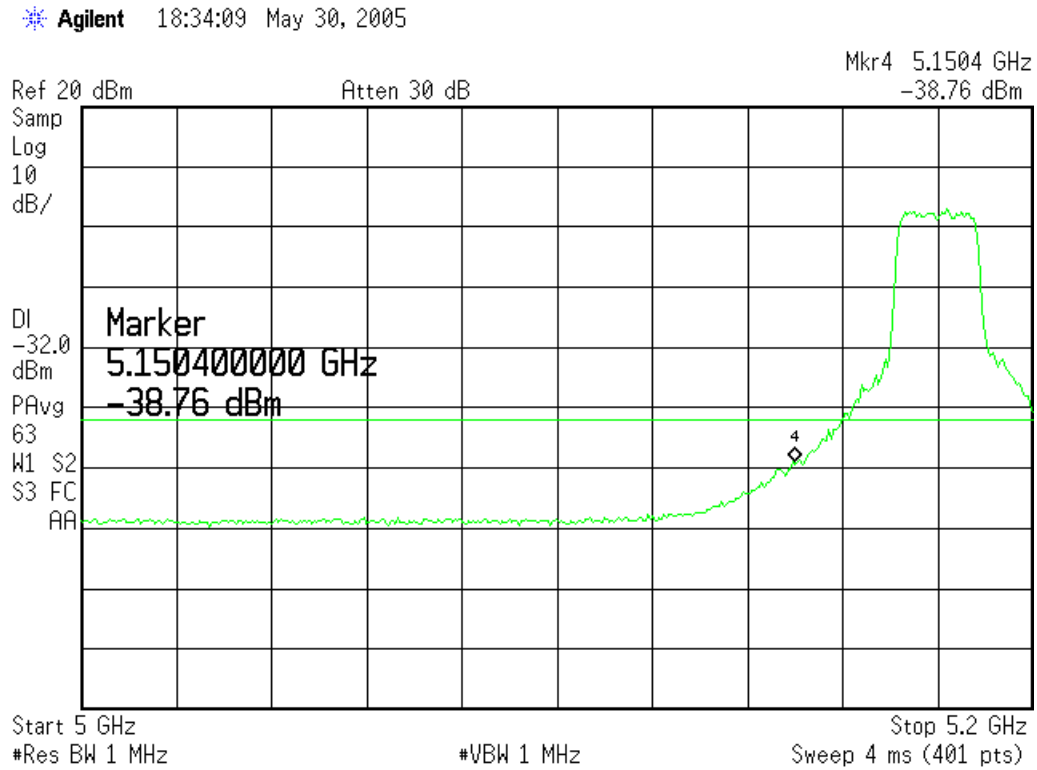


5.35 GHz bandedge (Low power Setting)

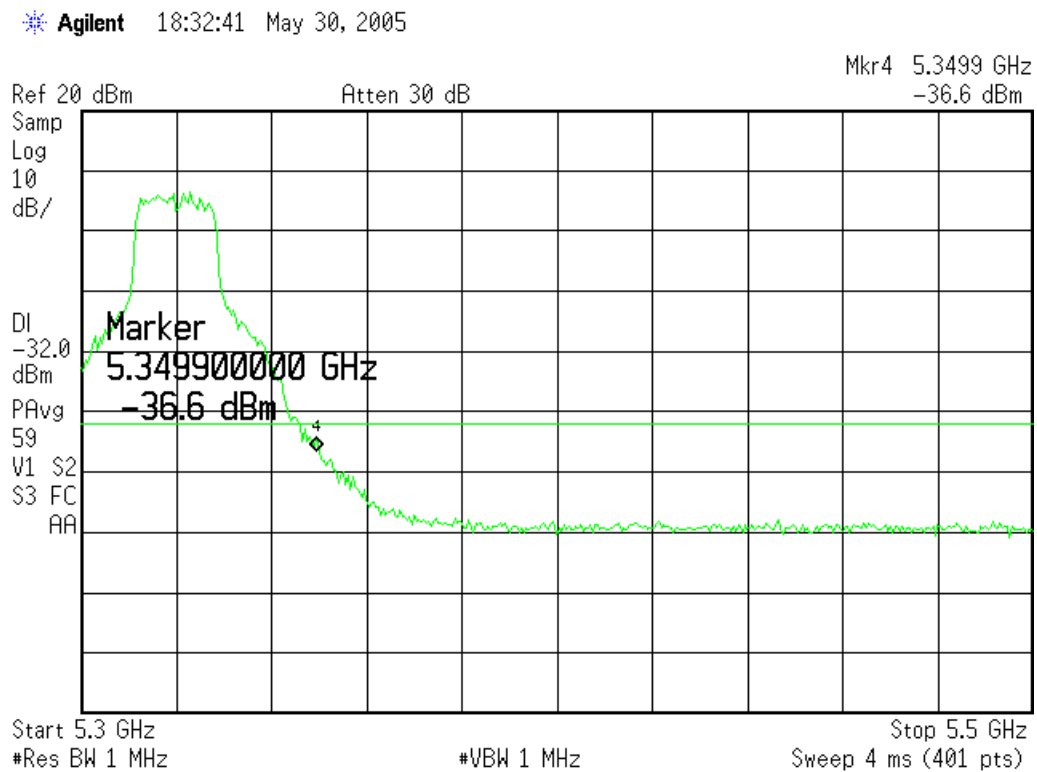
* Agilent 18:22:02 May 30, 2005



5.15 GHz bandedge (High Power Setting)



5.35 GHz bandedge (High Power Setting)



Radiated Emissions in Restricted Bands / Out of Band Emissions

Specification:

FCC Specification: Paragraph 15.407(b)(1), 15.407(b)(2), 15.407(b)(3), 15.407(b)(6)

IC Specification: 6.2.2(q1)i 6.2.2.(q1)ii 6.2.2.(q1) iii

Procedure:

This test was conducted in a 5-meter semi anechoic chamber at Elliott Laboratories. The unit was placed on a rotating wooden table 80cm above the ground plane. A Horn antenna(s) were secured to a mast 3 meters away. The unit was tested at a low, mid and high channel within the 5.15-5.35GHz bands. The UUT was configured to transmit random data. The transmit power was set to the settings outlined in the power setting table in this report. The test equipment was configured as shown below.

The band from 1 to 40 GHz was scanned (40 GHz is the limit of the available test equipment). A high pass filter prior to the pre-amplifier was required to prevent the signal level of the fundamental frequency from overloading the front end of the spectrum analyzer and creating harmonics within the analyzer.

The EUT was rotated 360 degrees and the height of the antenna adjusted from 1 to 4 meters above the ground plane to determine the maximum level of the emission. The level of the harmonic emission was measured in two modes, "Peak" and "Average".

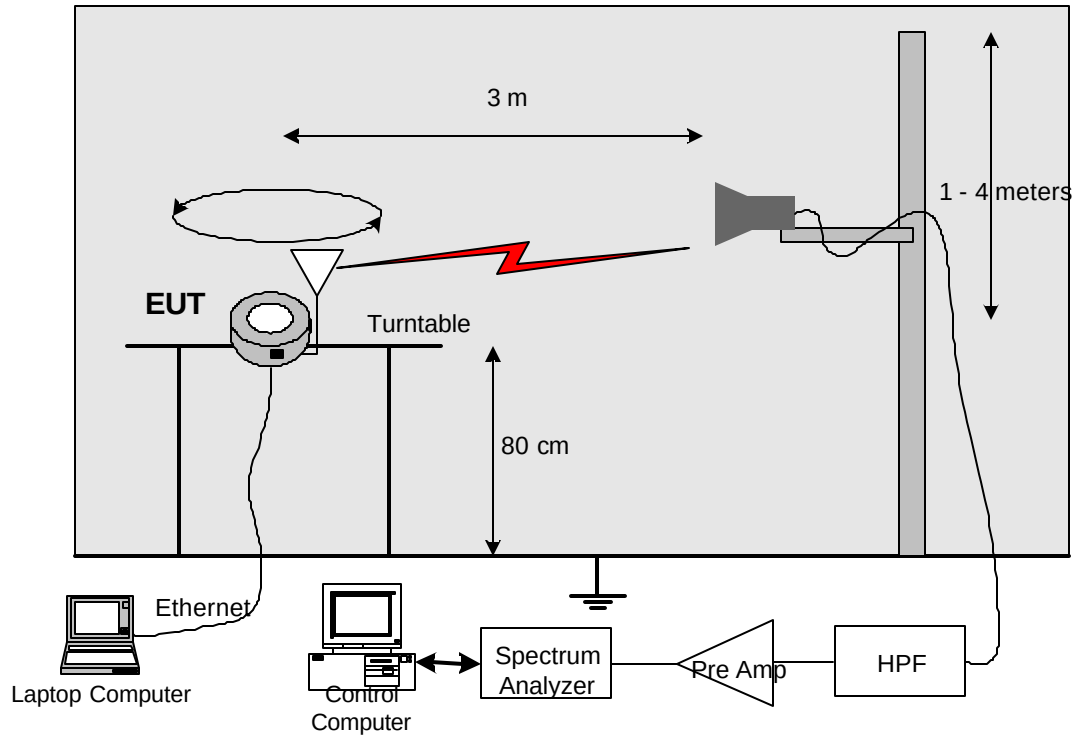
The maximum spectrum analyzer reading was captured by the automated test software where correction factors (antenna factor, cable loss, pre-amplifier gain, HPF loss...) were then applied to obtain a final corrected measurement.

Fund	2	3	4	5	6	7	8	9	10
5180	10360	15540	20720	25900	31080	36260	41440	46620	51800
5260	10520	15780	21040	26300	31560	36820	42080	47340	52600
5320	10640	15960	21280	26600	31920	37240	42560	47880	53200
5745	11490	17235	22980	28725	34470	40215	45960	51705	57450
5765	11530	17295	23060	28825	34590	40355	46120	51885	57650
5805	11610	17415	23220	29025	34830	40635	46440	52245	58050

15.407(b)(6) Harmonic test table

NOTE: **RED** indicates a harmonic that falls within a restricted band, the harmonics in **gray** are NOT in restricted bands.

Radiated Emissions in Restricted Bands Test Setup



Support Equipment

Description	Model number	FCC ID or SN	Manufacturer	Power Cable
Laptop	Armada E 500	P31000T4X20DC12N2	Compaq	Laptop PS
Test Software	Atheros Radio Test		Atheros	

Test Conditions

Temperature	22.8 C	Humidity:	72%
ATM pressure	1020 mBar	Grounding:	None
Tested By	Y Noor, A Lacourse, J Martinez, Elliott Labs	Date of Test:	May / June 2005
Test Reference	FCC Part 15.205 IC Paragraph RSS210, 6.2.3 (c)		
Setup Method	ANSI C63.4		
Tested Range	1 GHz to 40 GHz		
Test Voltage	48 VDC		
Modifications	No modifications were made to the unit		

Radiated Emissions in Restricted Bands Test Results

There were some emissions detected during the test. The results are below. In cases where the emission was not within a restricted band the Out Of Band Emission limit is applied. No emissions above approximately the third harmonic (16 GHz) were detected. The band up to 40 GHz was examined.

Notes:

#1 Emission is within a restricted band. (Labeled Restricted)

Peak measurements:	Resolution and Video BW: 1 MHz, 74 dBuV Limit
Average Measurements:	Resolution BW: 1MHz and Video BW: 10 Hz, 54 dBuV Limit
Peak measurements:	74 dBuV Limit
Average Measurements:	54 dBuV Limit

#2 Emission is NOT within a restricted band. (Labeled Non-Restricted)

Measurement settings:	Resolution BW = 1MHz and VBW = 3MHz. Video averaging on (100 samples).
Limit	-27 dBm / MHz EIRP, adjusted to 3M field strength: 68.3 dBuV

For emissions falling in the restricted bands detailed in 15.205 the general limits of 15.209 apply. For all other emissions the limit is EIRP < -27dBm (equivalent to a field strength at 3m of 68.3 dBuV/m)

Restricted Band Emissions, UUT Transmitting on 5180 MHz, 14 dBi panel, Low Power

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5180.910	102.4	V	-	-	AVG	353	1.3	Fundamental
5180.910	110.4	V	-	-	PK	353	1.3	Fundamental
5180.760	86.5	H	-	-	AVG	343	1.3	Fundamental
5180.760	95.2	H	-	-	PK	343	1.3	Fundamental
4991.840	41.2	V	54.0	-12.8	AVG	0	1.0	Restricted
4991.840	51.4	V	74.0	-22.6	PK	0	1.0	Restricted
1100.040	44.6	V	54.0	-9.4	AVG	127	1.0	Restricted
1100.040	49.4	V	74.0	-24.6	PK	127	1.0	Restricted
10358.58	53.1	V	68.3	-15.2	PK	354	1.5	Non-Restricted

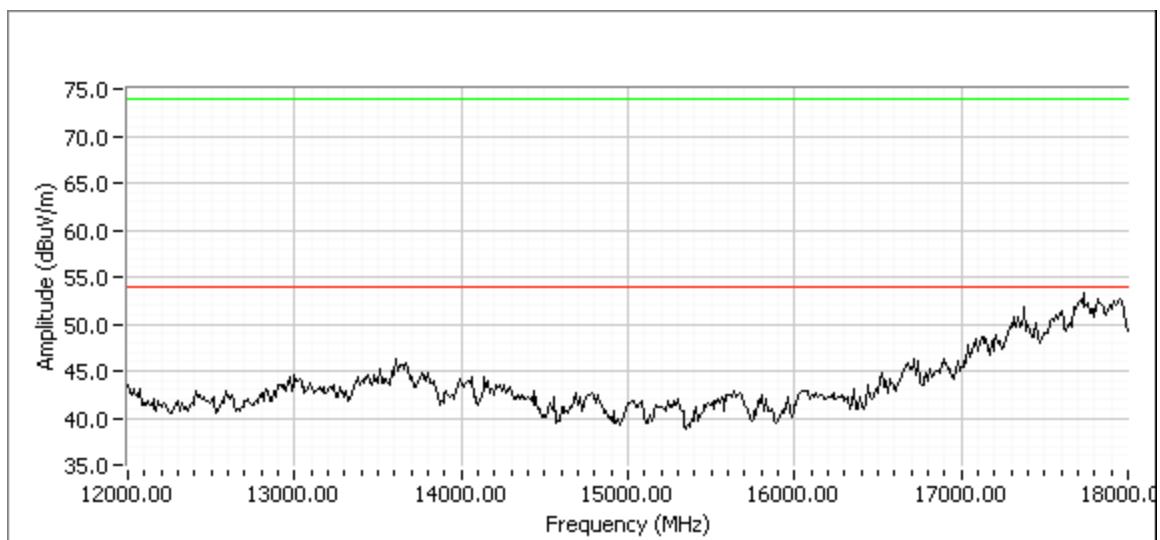
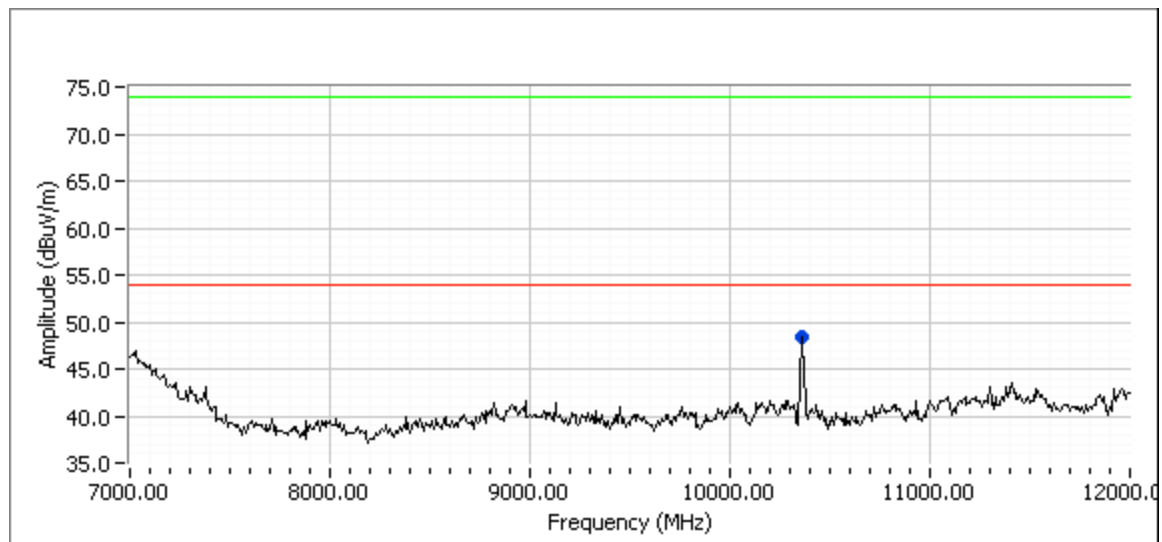
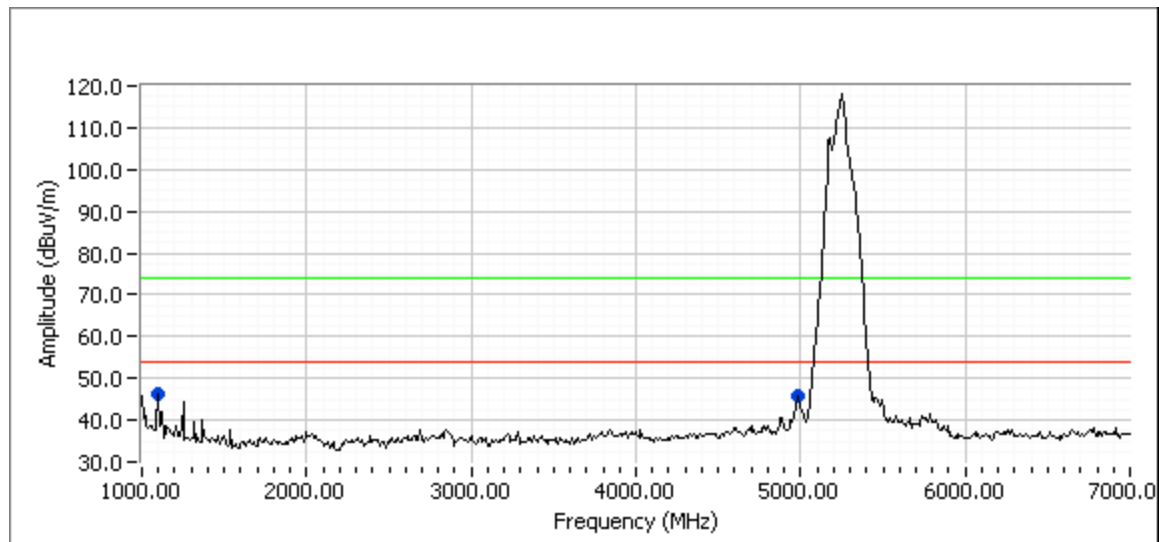
Restricted Band Emissions, UUT Transmitting on 5260 MHz, 14 dBi panel, Low Power

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5459.464	47.2	V	54.0	-6.8	AVG	0	1.0	Restricted
5459.464	57.9	V	74.0	-16.1	PK	0	1.0	Restricted
1099.785	43.7	V	54.0	-10.3	AVG	349	0.0	Restricted
1099.785	49.1	V	74.0	-24.9	PK	349	0.0	Restricted
10518.67	45.3	V	68.3	-23.0	AVG	360	2.0	Non-Restricted
10518.67	57.5	V	68.3	-10.8	PK	360	2.0	Non-Restricted

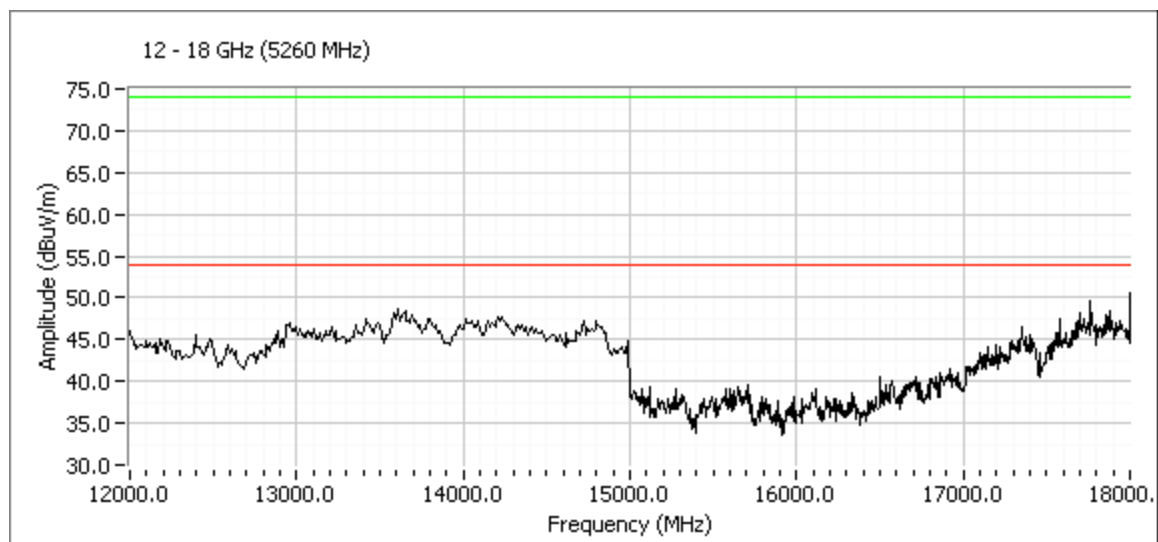
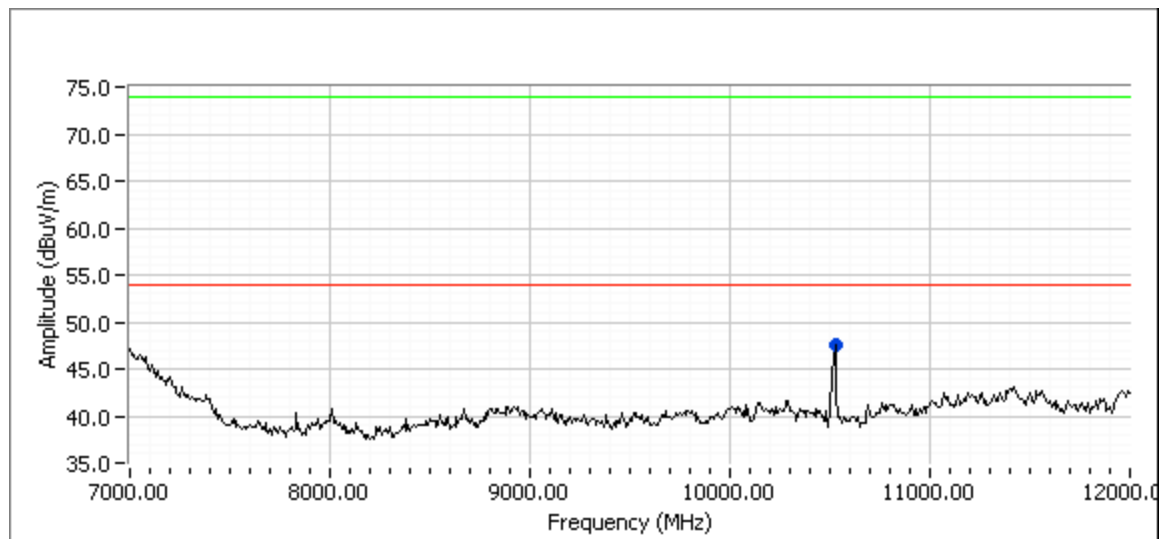
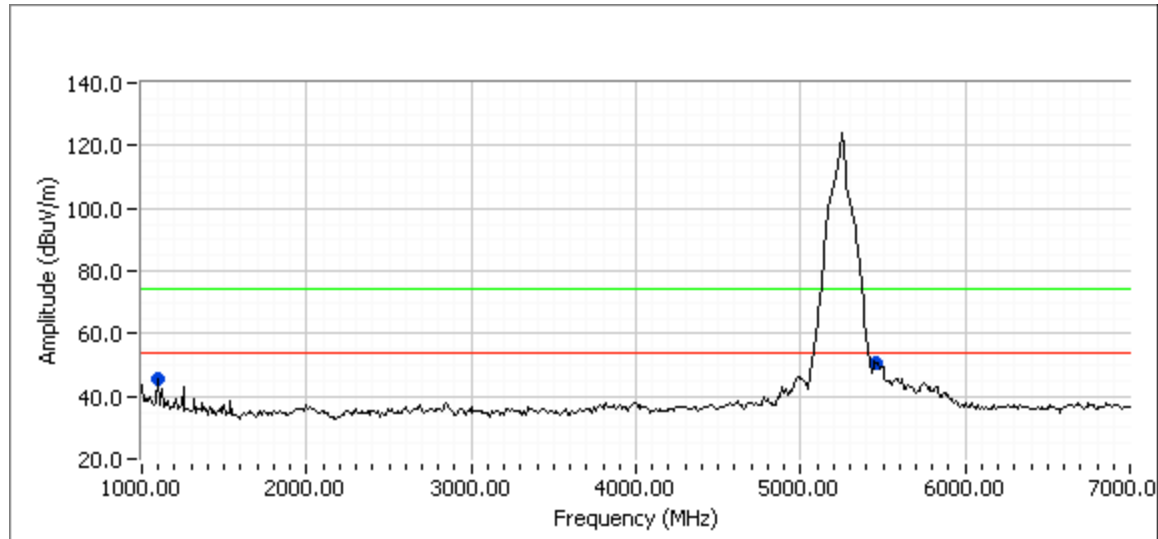
Restricted Band Emissions, UUT Transmitting on 5320 MHz, 14 dBi panel, Low Power

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5318.640	107.7	V	-	-	AVG	355	1.0	Fundamental
5318.640	116.0	V	-	-	PK	355	1.0	Fundamental
5318.790	93.8	H	-	-	AVG	340	1.4	Fundamental
5318.790	102.1	H	-	-	PK	340	1.4	Fundamental
5450.105	44.3	V	54.0	-9.8	AVG	3	1.0	Restricted
5450.105	55.3	V	74.0	-18.7	PK	3	1.0	Restricted
4994.793	44.4	V	54.0	-9.6	AVG	3	1.0	Restricted
4994.793	55.8	V	74.0	-18.2	PK	3	1.0	Restricted
1249.918	44.6	H	68.3	-23.7	AVG	145	1.0	Non-Restricted
1249.918	52.0	H	68.3	-16.3	PK	145	1.0	Non-Restricted
1099.933	45.8	V	54.0	-8.2	AVG	179	1.0	Restricted
1099.933	50.2	V	74.0	-23.8	PK	179	1.0	Restricted
10638.83	42.8	V	54.0	-11.2	AVG	360	2.0	Restricted
10638.83	54.2	V	74.0	-19.8	PK	360	2.0	Restricted

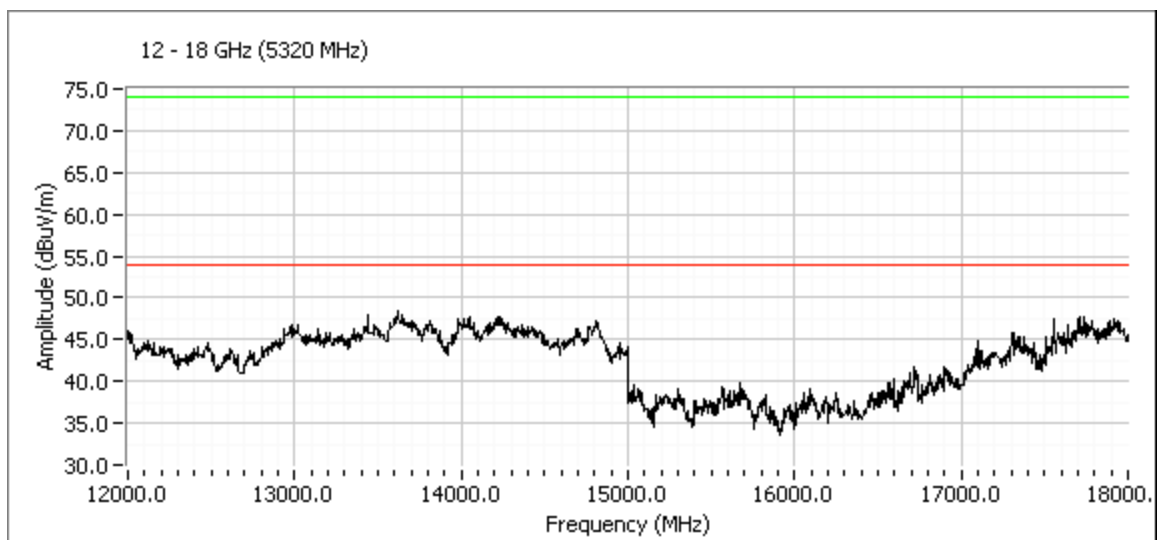
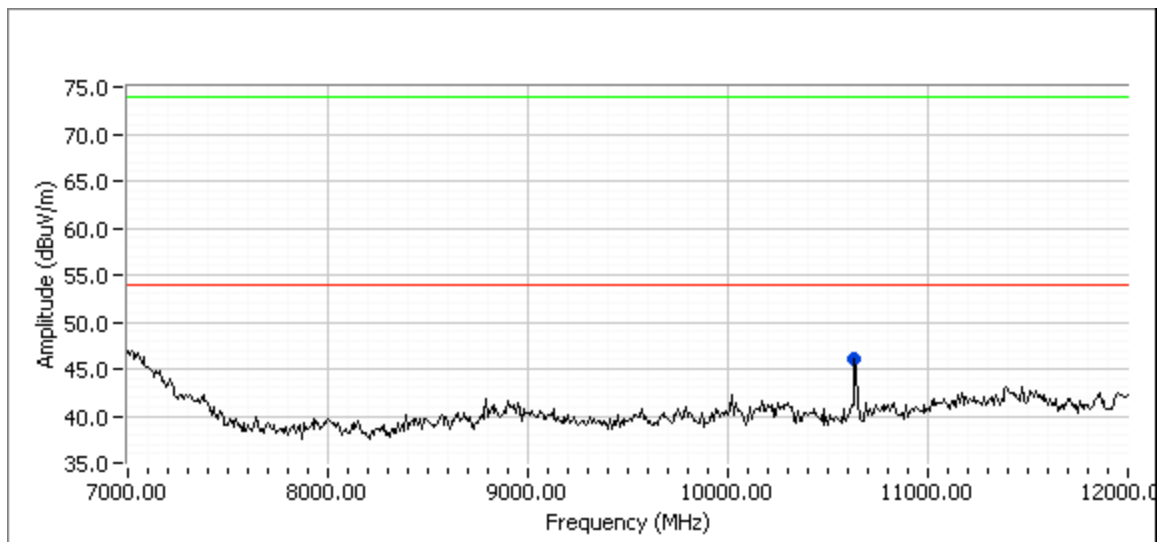
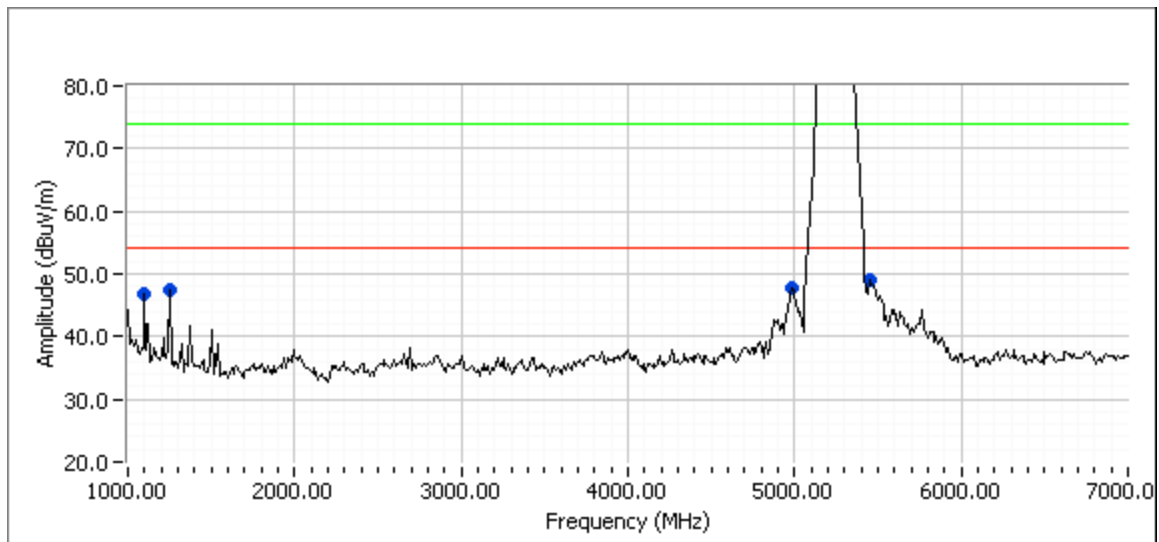
Plots - Restricted Band Emissions, UUT Transmitting on 5180 MHz, 14 dBi panel, Low Power



Plots - Restricted Band Emissions, UUT Transmitting on 5260 MHz, 14 dBi panel, Low Power



Plots - Restricted Band Emissions, UUT Transmitting on 5320 MHz, 14 dBi panel, Low Power



Restricted Band Emissions, UUT Transmitting on 5180 MHz, 6 dBi Omni, High Power

Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5181.140	101.3	V	-	-	AVG	315	1.0	Fundamental
5181.140	110.6	V	-	-	PK	315	1.0	Fundamental
5178.970	89.2	H	-	-	AVG	297	1.0	Fundamental
5178.970	97.2	H	-	-	PK	297	1.0	Fundamental
10361.74	48.9	H	68.3	-19.4	AVG	104	1.2	Non Restricted
15539.29	45.2	H	54.0	-8.8	AVG	163	1.0	Restricted
15539.29	57.0	H	74.0	-17.0	PK	163	1.0	Restricted

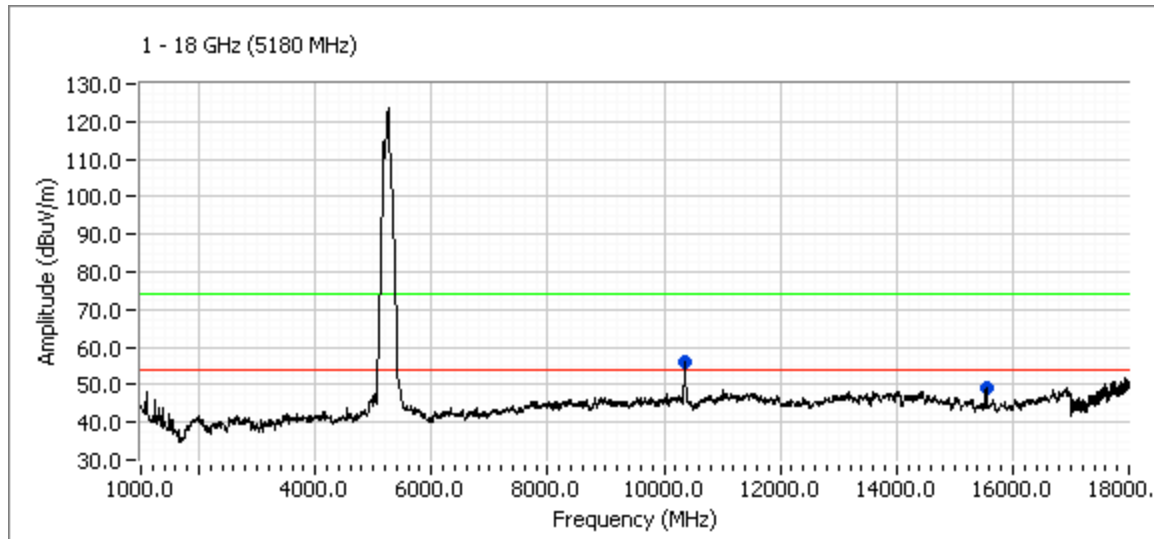
Restricted Band Emissions, UUT Transmitting on 5260 MHz, 6 dBi Omni, High Power

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
10520.36	41.5	H	68.3	-26.8	AVG	103	1.4	Non Restricted
10520.36	54.8	H	68.3	-13.5	PK	103	1.4	Non Restricted
15781.95	50.9	V	54.0	-3.1	AVG	185	1.4	Restricted
15781.95	62.5	V	74.0	-11.5	PK	185	1.4	Restricted

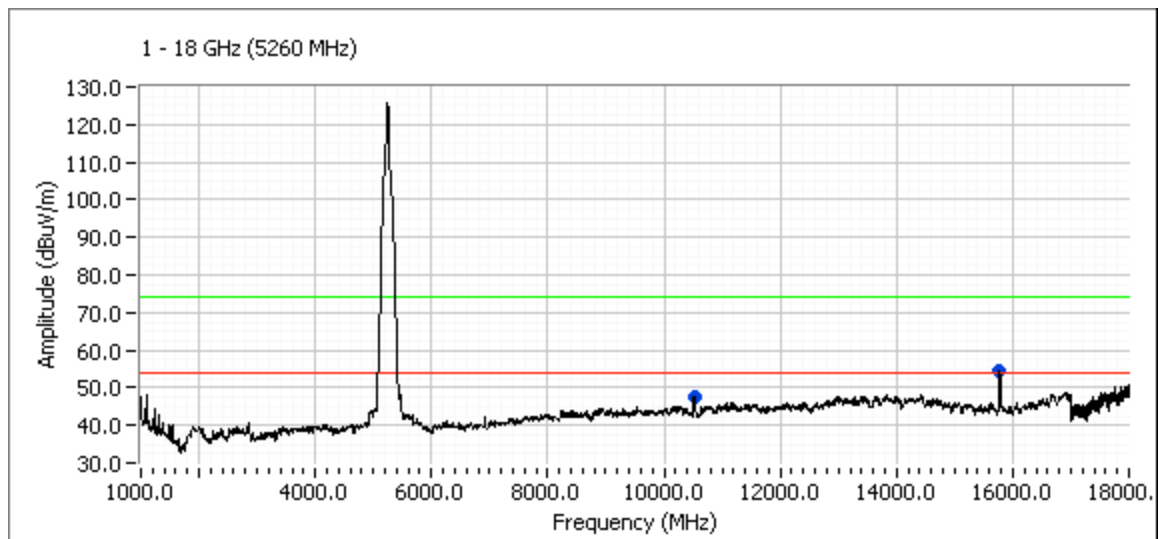
Restricted Band Emissions, UUT Transmitting on 5320 MHz, 6 dBi Omni, High Power

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBμV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5318.500	105.1	V	-	-	AVG	300	1.0	Fundamental
5318.500	114.4	V	-	-	PK	300	1.0	Fundamental
5321.130	94.7	H	-	-	AVG	178	1.0	Fundamental
5321.130	103.7	H	-	-	PK	178	1.0	Fundamental
10640.19	53.1	H	54.0	-0.9	AVG	98	1.2	Restricted
10640.19	64.3	H	74.0	-9.7	PK	98	1.2	Restricted
15959.76	50.2	V	54.0	-3.8	AVG	215	1.2	Restricted
15959.76	62.5	V	74.0	-11.5	PK	215	1.2	Restricted

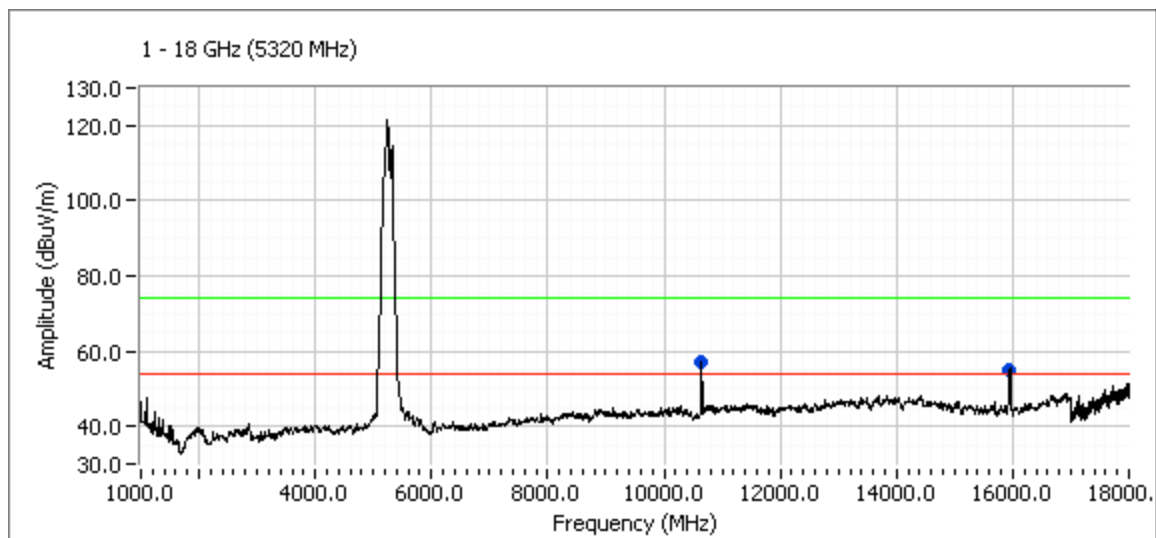
Plots - Restricted Band Emissions, UUT Transmitting on 5180 MHz, 6 dBi Omni, High Power



Plots - Restricted Band Emissions, UUT Transmitting on 5260 MHz, 6 dBi Omni, High Power



Plots - Restricted Band Emissions, UUT Transmitting on 5320 MHz, 6 dBi Omni, High Power



Radiated Emissions at the Band Edge (Direct Measurement Method)

Specification:

FCC Specification: Paragraph 15.407(b)(1), 15.407(b)(2), 15.407(b)(3), 15.407(b)(6)

IC Specification: 6.2.2.(q1)i 6.2.2.(q1)ii 6.2.2.(q1) iii

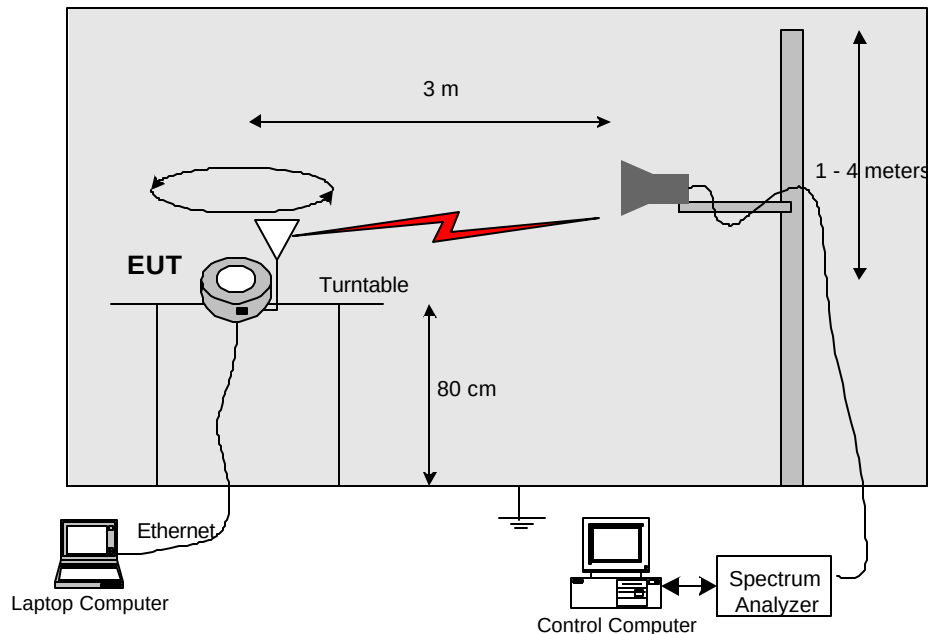
Procedure

The analyzer was set to examine the restricted band at the edges of the 5.15 – 5.35GHz UNII band.



The maximum level within the band was determined and then moved to the center of the span. The span was then narrowed to 10kHz with the RBW= 1MHz and VBW = 10 Hz for the average measurement and RBW = VBW = 1MHz for the peak measurement.

The test equipment was configured as shown below.



The measurement was made at the band edges for the restricted bands just below 5150MHz and just above 5350MHz. The level for the emission within the restricted band was measured for each of the two power settings / antenna combinations. (low power high gain antenna, high power low gain antenna)

Radiated Emissions at the Band Edges Summary Table

Radiated Spurious Emissions, Low Channel @ 5180 MHz

Power	Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
Setting	MHz	dBmV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
High	w/ 14dBi Panel Antenna								
	5148.498	51.6	V	54.0	-2.4	Avg	3	1.0	14dBi Panel, 11.0 STG
	5148.500	69.7	V	74.0	-4.3	PK	3	1.0	14dBi Panel, 11.0 STG
Low	w/ 6dBi Omni (S5153) Antenna								
	5148.496	53.7	V	54.0	-0.3	Avg	195	1.0	6dBi Omni, 17.0 STG
	5148.497	70.6	V	74.0	-3.4	PK	195	1.0	6dBi Omni, 17.0 STG

Radiated Spurious Emissions, High Channel @ 5320 MHz

Power	Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
Setting	MHz	dBmV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
High	w/ 14dBi Panel								
	5351.495	53.7	V	54.0	-0.3	Avg	6	1.2	14dBi Panel, 16.5 STG
	5351.501	73.8	V	74.0	-0.2	PK	6	1.2	14dBi Panel, 16.5 STG
Low	w/ 6dBi Omni (S5153) Antenna								
	5351.496	51.4	V	54.0	-2.6	Avg	292	1.1	6dBi Omni 18.0 STG
	5351.500	73.2	V	74.0	-0.8	PK	292	1.1	6dBi Omni 18.0 STG

Frequency Drift Versus Temperature and Supply Voltage.

Procedure

The AP was placed into a temperature chamber and powered with its typical supply voltage. the temperature of the AP was allowed to stabilize. Once stabile, the carrier frequent was measure. This frequency was defined as “Zero Drift”

The temperature was then lowered to the low specified operating temperature of the product (0C) and the temperature was allowed to stabilize. One stabile, the frequency drift was measured with the unit running on its Low supply voltage and then its high supply voltage.

The temperature was then raised to the unit maximum temperature (55C) and the frequency drift measure at the low and high supply voltage.

This test was performed for the low middle and high channel

Result

The maximum measured drift over these temperature and supply voltage extremes was: **5.32 ppm**

AC Line Conducted Emissions

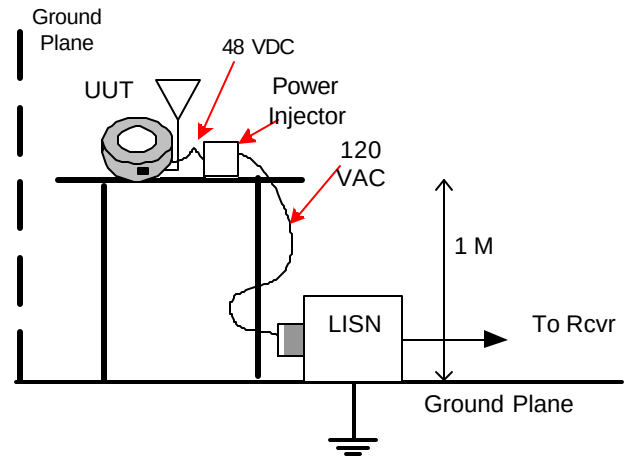
Specification:

Specification: CISPR 22

Procedure:

The test was set up according to the guidelines set forth in EN55022:1998 and FCC Part 2 for AC Line Conducted Emissions. The measurement used a LISN line on each AC line and an EMI receiver. A peak scan was made over the measurement frequency range (150 kHz to 30 MHz). The highest peaks were then marked and re-measured and quasi-peaked and averaged.

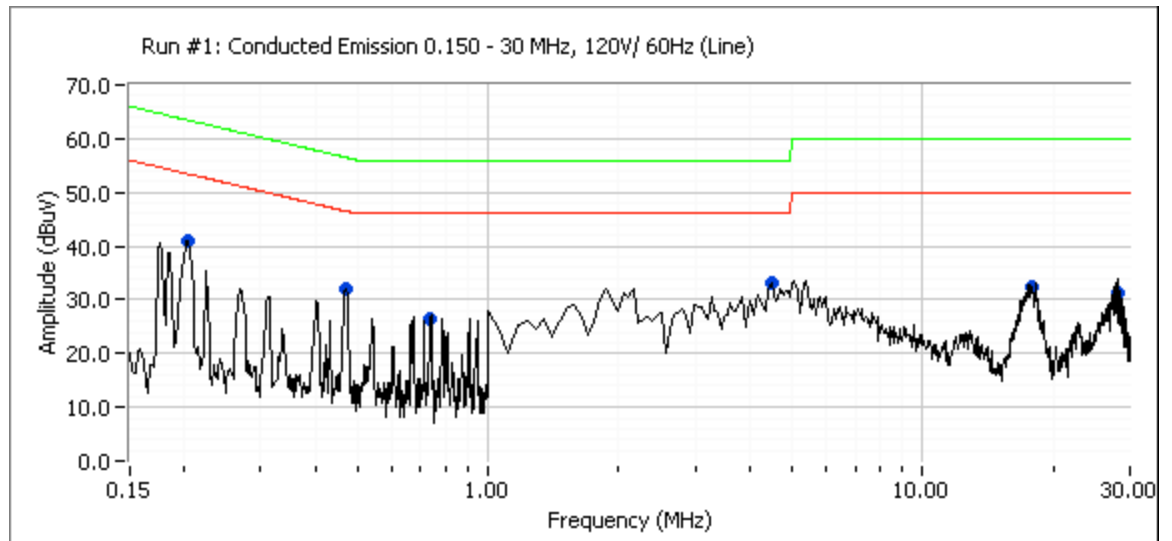
The test was configured as shown below. The product was tested with "power injector" running on 120 VAC @ 60 Hz. The power injector provides -48VDC onto an Ethernet cable to power the access point. The AP was configured to transmit high power on both 2.4 and 5 GHz simultaneously. This presents the largest load to the power supply and results in the worst case conducted emissions.



AC line Conducted Emissions Results

Frequency MHz	Level dB μ V	AC Line	EN55022 B Limit	Margin	Detector QP/Ave
0.469	27.4	Line	46.5	-19.1	Average
4.478	26.9	Neutral	46.0	-19.1	Average
0.469	26.2	Neutral	46.5	-20.3	Average
2.206	24.7	Line	46.0	-21.3	Average
17.440	28.2	Line	50.0	-21.8	Average
0.200	30.4	Neutral	53.6	-23.2	Average
0.200	40.0	Neutral	63.6	-23.6	QP
4.478	31.6	Neutral	56.0	-24.4	QP
0.202	38.5	Line	63.5	-25.0	QP
0.469	31.2	Line	56.5	-25.4	QP
0.469	31.1	Neutral	56.5	-25.5	QP
0.736	20.5	Neutral	46.0	-25.5	Average
0.202	27.8	Line	53.5	-25.8	Average
2.206	27.9	Line	56.0	-28.2	QP
17.440	30.4	Line	60.0	-29.6	QP
0.164	35.4	Line	65.3	-29.8	QP
0.736	25.3	Neutral	56.0	-30.7	QP
0.164	13.4	Line	55.3	-41.8	Average

AC Line conducted emissions, LINE



AC Line conducted emissions, NEUTRAL

