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“Wireless that Works”SM

1279 Quarry Lane • Suite B, Pleasanton, CA 94566-8499 USA
Phone: +1.925.462.9105 Fax: +1.925.280.7751

EMC Test Report

Report No.: 0208009_80211_2

Product Name: 802.11 Combo MiniPCI WLAN Card
Issued Date: October 17, 2002

Applicant: Philips Components
Philips Silicon Valley Center
1000 West Maude Avenue
Sunnyvale, CA 94085-2810, USA
Phone: + 1 (408) 617 5893
Fax: + 1 (408) 617 7731



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Signature Page

The below listed Hyper Corporation Personnel takes responsibility for the contents of this Test Report.

Signatures

Test Engineer(s):

Original signed	10.17.02
_____	_____
Munir Chhibber	Date

**Reviewed by
Technical
Manager:**

Original signed	10.17.02
_____	_____
Kevin Marquess	Date

1. List of Revisions

Version	Date	Author(s)	Description
001	October 17, 2002	William Elliott	Initial Version

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2. Disclaimer Notice

This test report applies only to the EUT (Equipment Under Test) and the results of the specifications called out in this report.

The test results contained herein relate only to the model(s) identified. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical characteristics.

This Report must not be used to claim product endorsement by A2LA or any agency of the U.S. Government.

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4. General Information

4.1 Identification of the EUT

Manufacturer: Philips Components

Model No.: PH11107-E

Hardware Version: Rev. 1.0

Software Version: ART Vers. 2.2 Build 7

FCC ID: PUBWCM1008

Frequency Range: 5150 ~ 5350MHz

Channel Number: 36 – 64 (8 channels – inc. of 4 – i.e. 36,40,44,etc,)

Frequency of Each Channel: $5180 + k \cdot 20$ (MHz), $k=0 \sim 7$

Sample Received Date: September 24, 2002

Test Dates: September 30, 2002 – October 18, 2002

Test Facility: Hyper Corporation

1279 Quarry Lane, Suite B
Pleasanton, CA 94566, USA

4.2 Antenna Description

Antenna Gain: Peak Gain (5150 - 5350): 2.98 dBi
 Ave. Gain (5150 - 5350): -1.29 dBi

5. Test Summary

This test report is prepared for the project of Philips 802.11 Combo MiniPCI WLAN Card.

5.1 Summary of Test Results – Conducted Only

Test	Reference	Results
Peak Power	FCC 15.407(a)(1)(2) IC RSS210 6.2.2(q1)(i-ii)	Compliant
Peak Power Spectral Density	FCC 15.247(a)(1)(2)(3) IC RSS210 6.2.2(q1)(i-ii)	Compliant
Peak Excursion	FCC 15.407(a)(6) IC RSS210 6.2.2(q1)(i-ii)	Compliant
Out of Band Emissions (Conducted)	FCC 15.407(b)(1)(2) IC RSS210 6.2.2(q1)(i-ii)	Compliant
Frequency Stability	FCC 15.407(b)(1)(2) IC RSS210 6.4	Compliant
Band-Edge Emission Requirements (Cond.)	FCC 15.407(b)(1)(2) IC RSS210 6.2.2(q1)(i-ii)	Compliant

5.2 Test Specifications

The EUT was performed according to the requirements in FCC Part 15 Subpart C section 15.407 and also compliance with Industry Canada RSS-210. Specifically, these tests were performed in accordance with FCC Public Notice DA 02-2138 where applicable. These tests are for conducted measurement requirements only. Radiated measurement requirements are addressed in a separate report.

5.3 Operation Mode

The EUT was tested in a laptop computer for this testing. The EUT was placed into the necessary test modes using “ART” software supplied by the product manufacturer.

5.4 Documentation of test device

Documentation of the tested device has been reviewed by Hyper Corporation Engineers and found to be in compliance with applicable test specifications. All documentation is kept at Hyper Corporation's Quality Department in the Philips EMC Test Folder for this project number.

5.5 General and Special Conditions

The device inside a host laptop and received power from the mini-pci bus of the host controller. All testing was done in an indoor controlled environment with an average temperature of 25.8° C and relative humidity of 45%.

5.6 Equipment and Cable Configurations

The EUT was connected to the spectrum analyzer via a cable connected to the antenna connector of the EUT. There were no other cabling considerations for the tests.

Manufacturer	Description	Model Number	Serial Number	CAL Date
Agilent Technology	PSA Series Spec. Analyzer	E4440A	US40420768	04/23/02
IBM	ThinkPad Laptop	2366-21U	78-CRC14	N/A
Dell	PC	Precision	N/A	N/A

6.1 Emissions Bandwidth – FCC 15.403

6.1.1 Operation Environment

Temperature: 25.8°C

Relative Humidity: 45%

6.1.2 Test Setup



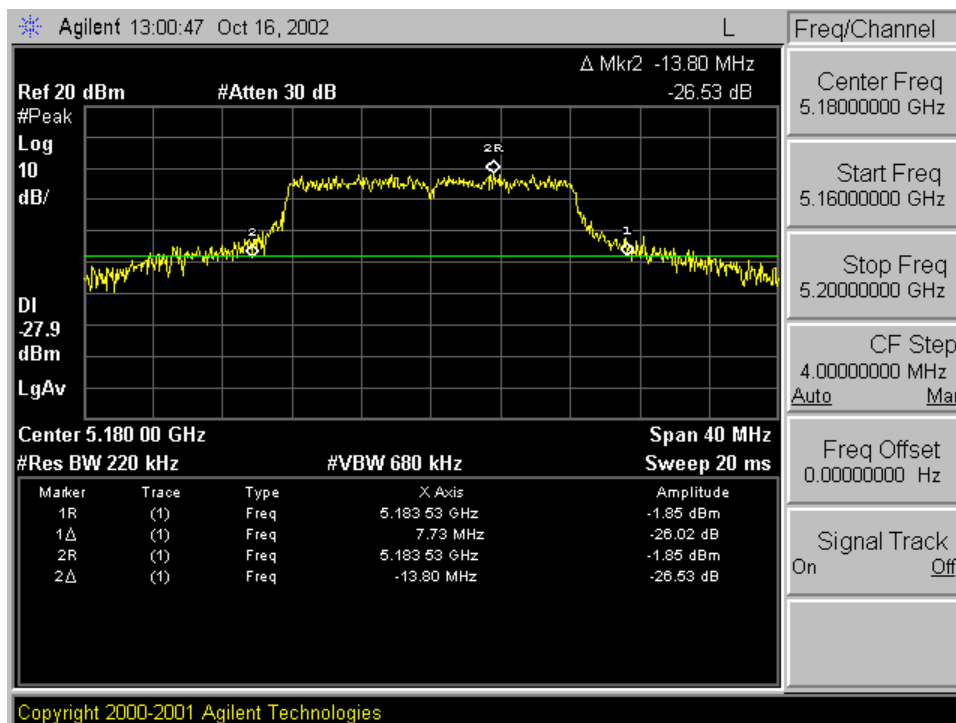
6.1.3 Test procedure

This measurement is used to determine the channel bandwidth for the peak power measurement.

The transmitter output is connected to the spectrum analyzer. The RBW is set to approximately 1% of the emission bandwidth and peak detection is used. VBW = 3RBW. View button is used to capture the emission. The emission bandwidth is determined by determining the points where the spectrum is 26 dB down from the peak power. Repeated measurement by readjusting RBW until RBW/EBW ratio is approximately 1%.

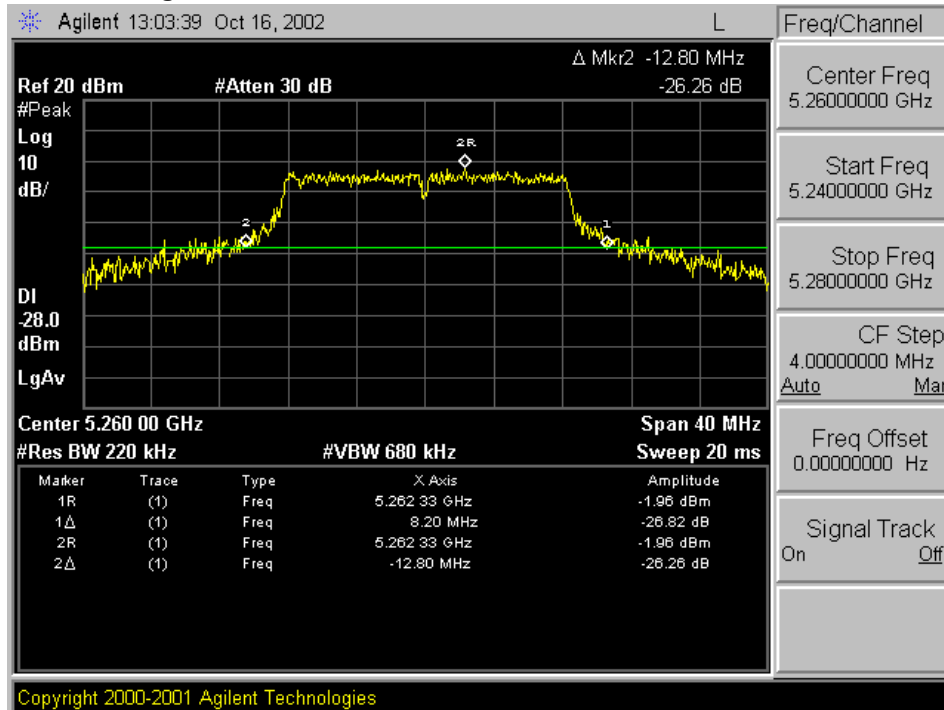
6.1.4 Results

Figure 6.1-1: Emissions Bandwidth Low Channel



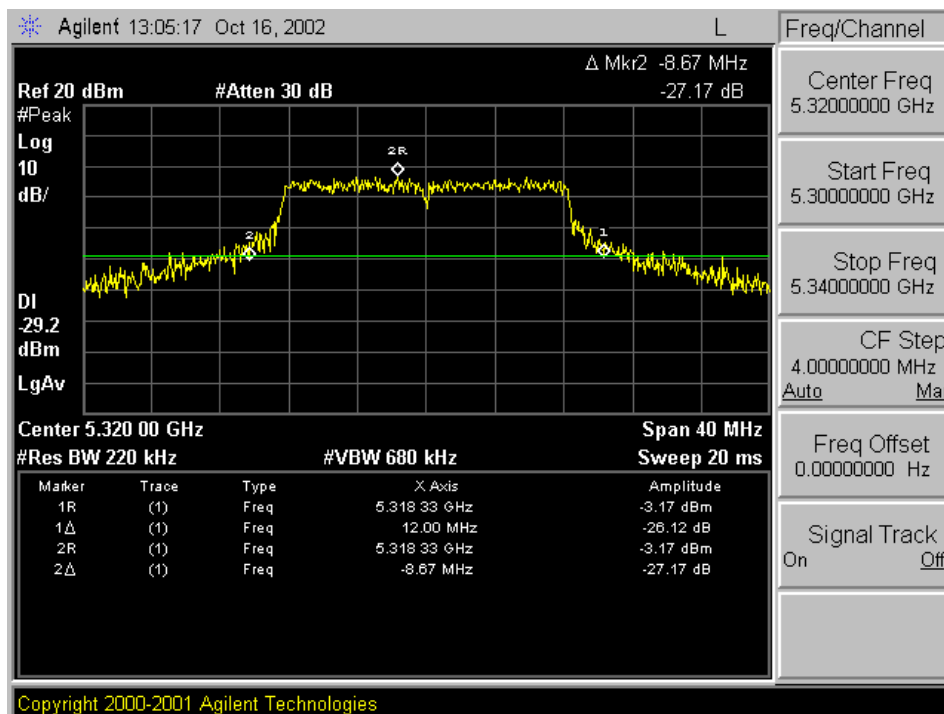
Result = 21.53 MHz

Figure 6.1-2: Emissions Bandwidth Mid Channel



Result = 21.00 MHz

Figure 6.1-2: Emissions Bandwidth Hi Channel



Result = 20.67 MHz

Channel	Frequency (MHz)	Emissions Bandwidth (MHz)	10*Log B (dB)
Lo	5180	21.53	13.33
Mid	5260	21.00	13.22
Hi	5320	20.67	13.15

Table 6.1a – 5.15 – 5.35 Emission Bandwidth Results

Peak Power Limit Calculations

Channel	Frequency (MHz)	4+10*LogB or 11+10*LogB	Power Limit (dBm)
Lo	5180	25.53	17
Mid	5260	32.00	24
Hi	5320	31.67	24

Table 6.1b – 5.15 – 5.35 Peak Power Limit Calculations

Per 15.407(a), the peak transmit power level cannot exceed the lesser of +17 dBm or $4 + 10 \log B$ (where B is the emissions bandwidth) for 5.15 – 5.25 GHz and +24 dBm or $11 + 10 \log B$ for 5.25 – 5.35 GHz.

In both cases the Power Limit is lower, so will be the limit for measuring the Peak Power requirement in Section 6.3.

6.2 Band-edge and Adjacent Restricted Bands– FCC 15.407 (b)

6.2.1 Operation Environment

Temperature: 25.8°C

Relative Humidity: 45%

6.2.2 Test Setup



6.2.3 Test Procedure

The EUT transmitter output is connected to the analyzer. RBW=VBW= 1 MHz. Measurements are made at the lower band edge with the transmitter set to the lowest channel. Measurements are made at the upper band edge with the transmitter set to the highest channel. Three highest points outside the frequency band of operation are indicated.

6.2.4 Results

No non-compliance observed.

Figure 6.2-1: Lo Band-Edge Peak Measurement

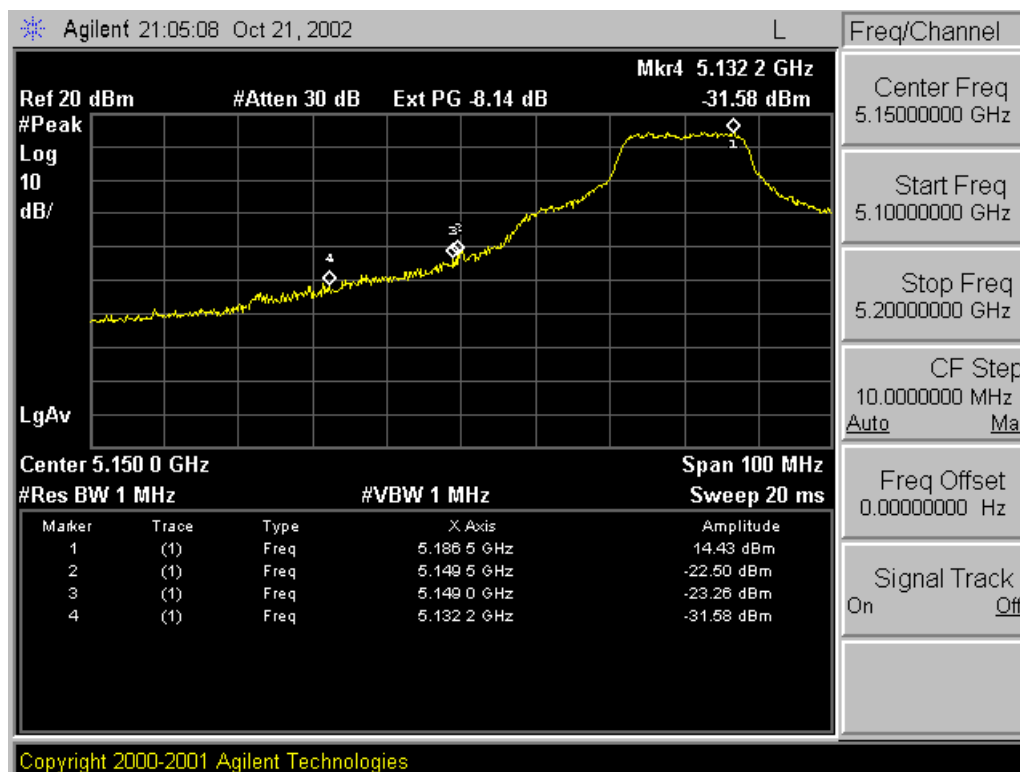


Figure 6.2-2: Lo Band-Edge Average Measurement

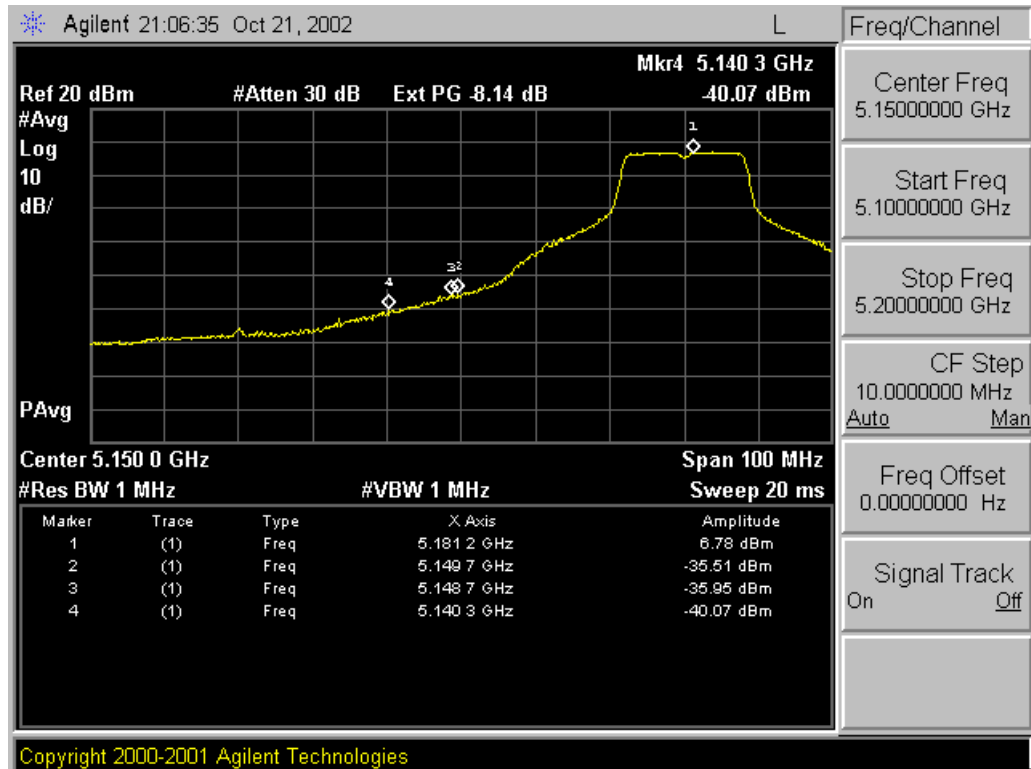


Figure 6.2-3: Hi Band-Edge Peak Measurement

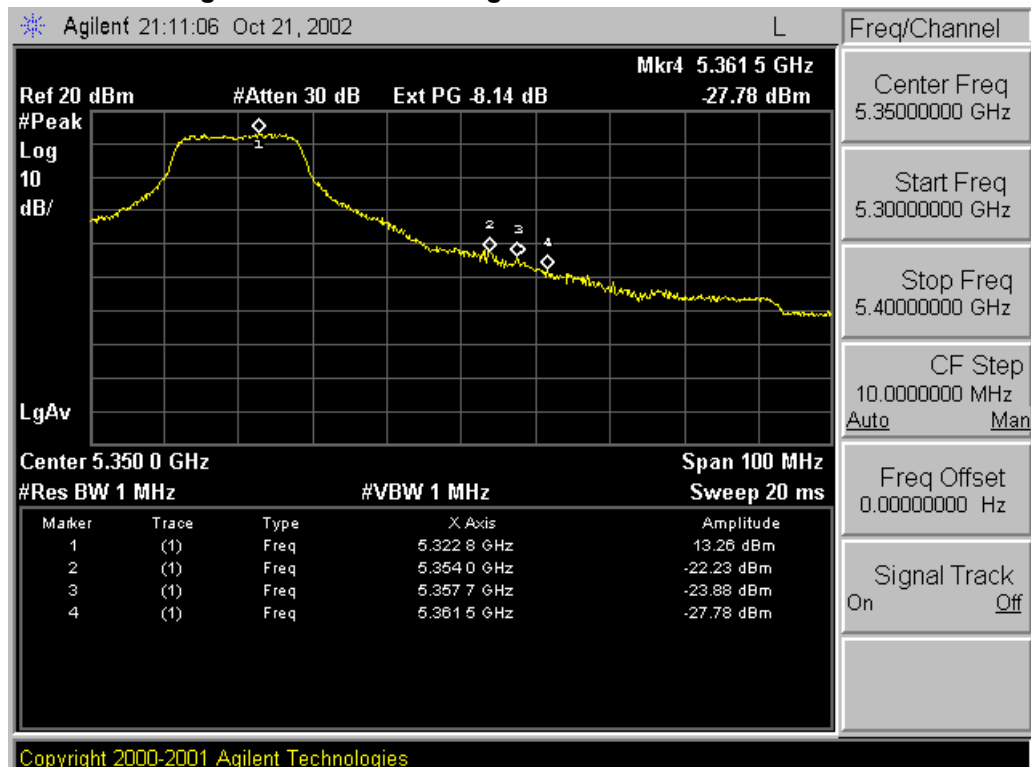
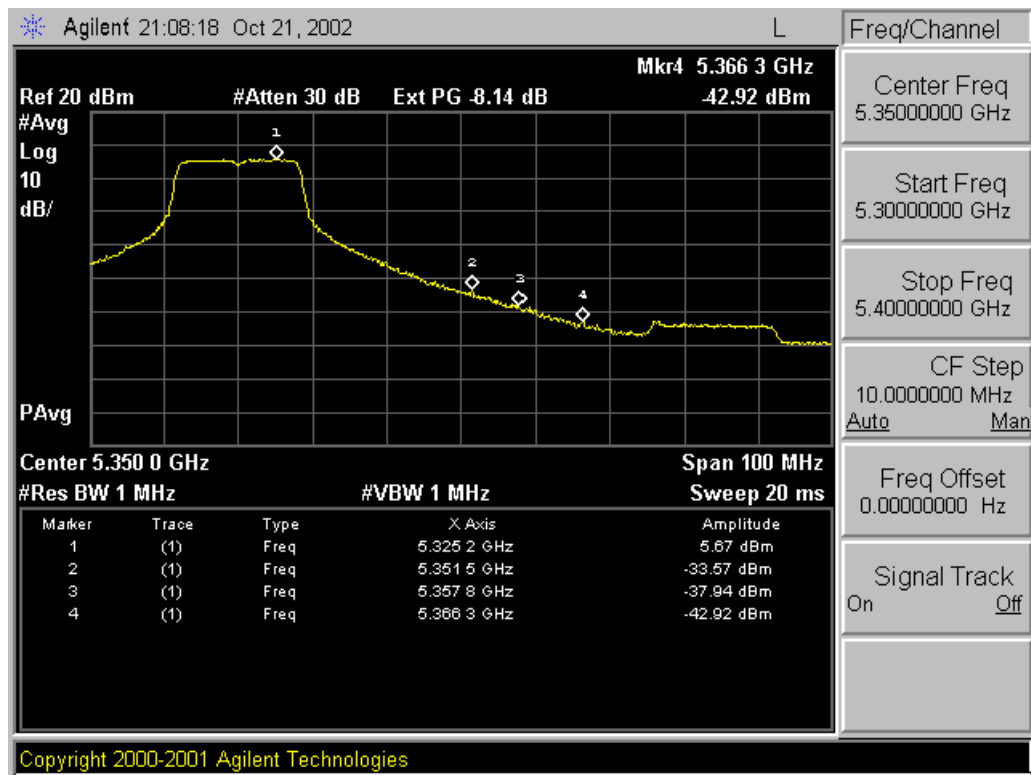


Figure 6.2-4: Hi Band-Edge Average Measurement



Conducted Emissions Over Adjacent Restricted Bands

Figure 6.2-4: Low Band Restricted Band Measurement

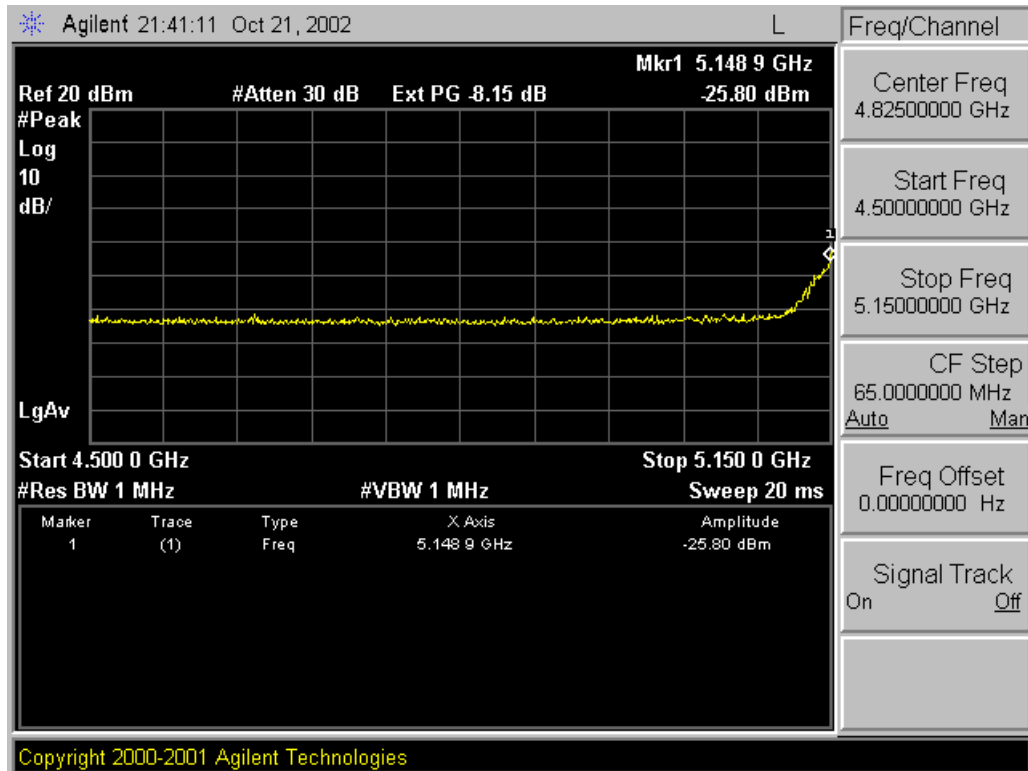
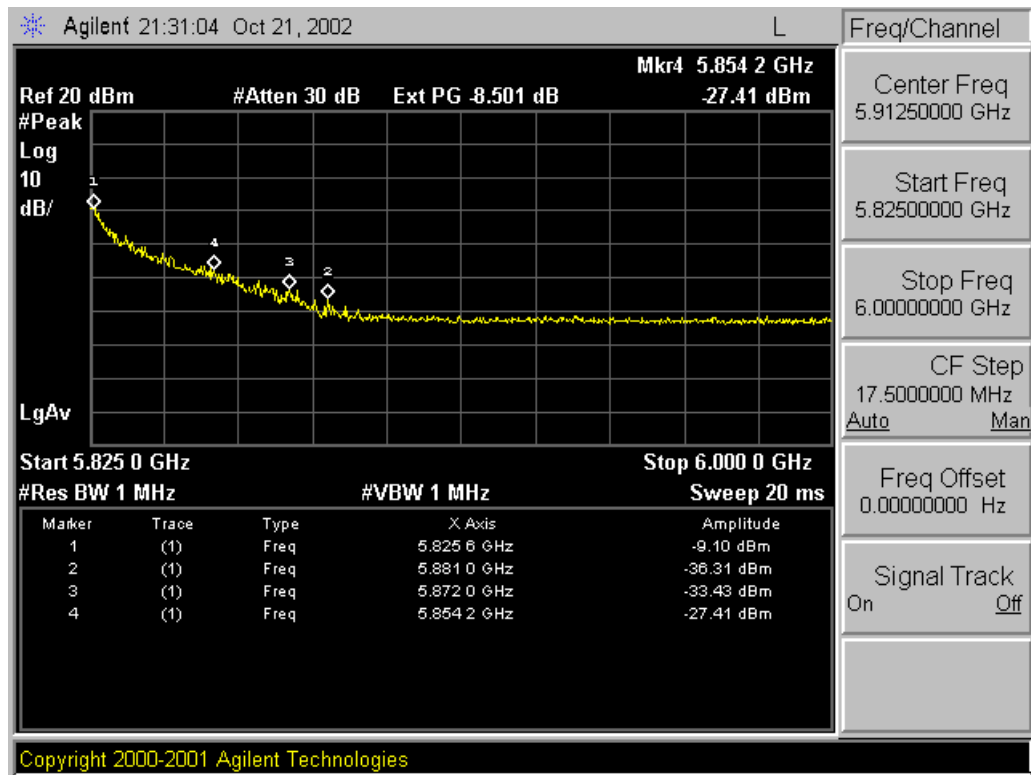


Figure 6.2-4: High Band Restricted Band Measurement



6.3 Peak Power – FCC 15.407 (a)

6.3.1 Operation Environment

Temperature: 25.8°C

Relative Humidity: 46%

6.3.2 Test Setup



6.3.3 Test procedure

The EUT transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz and the video bandwidth is set to 3 MHz. Use Sample detector mode. Set max hold. Sweep = Auto(Accuracy). Allow max hold to run for 60 seconds. Computed power by integrating the spectrum across the 26 dB Emission Bandwidth. The integration was performed using the spectrum analyzer's band power measurement function with band limits set to the Emission Bandwidth band edges.

6.3.4 Results

Table 6.3-1 Results of Peak Power Measurements

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm/MHz)
Low	5180	14.36	17
Middle	5260	16.68	24
High	5320	13.23	24

Figure 6.3-1: Peak Power Measurement – Lo Channel

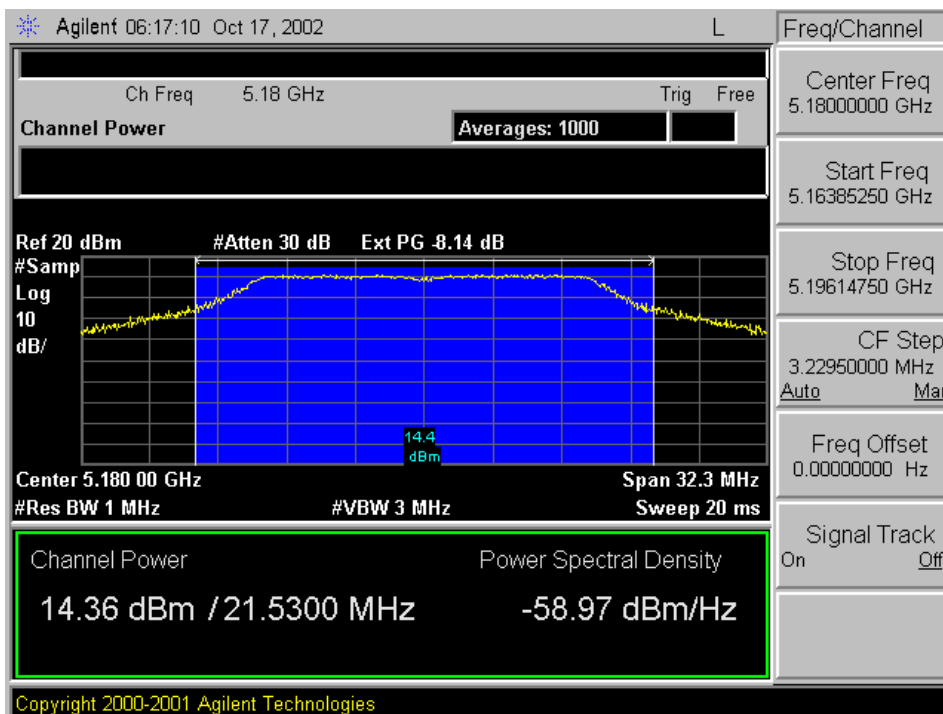


Figure 6.3-2: Peak Power Measurement – Mid Channel

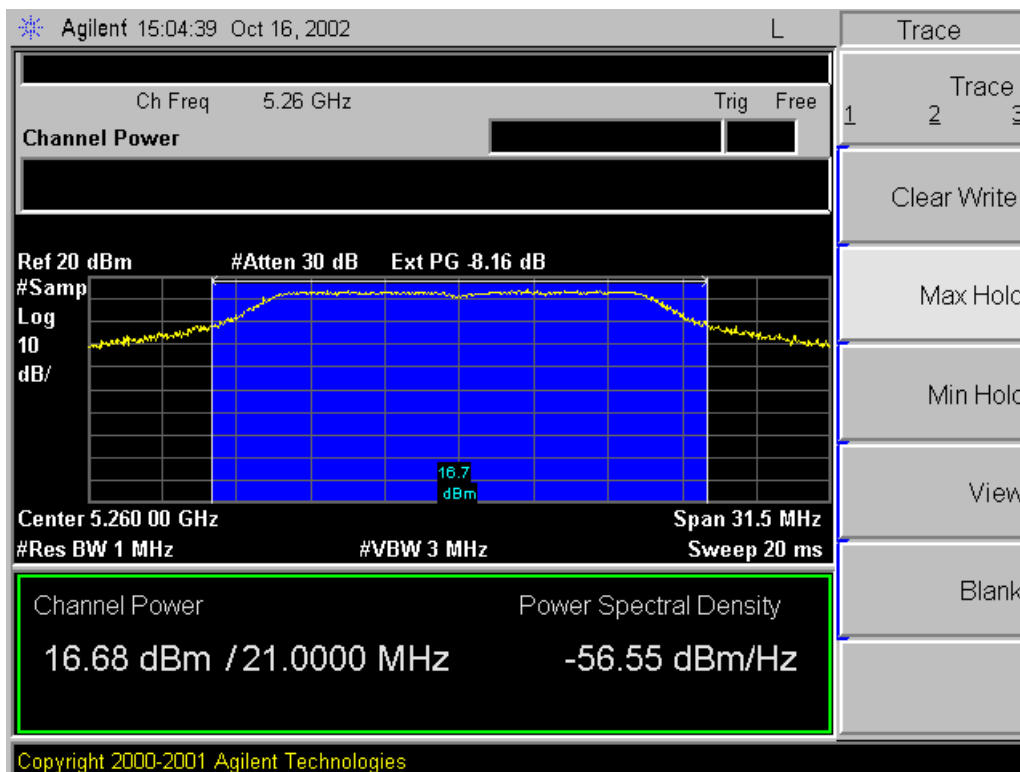
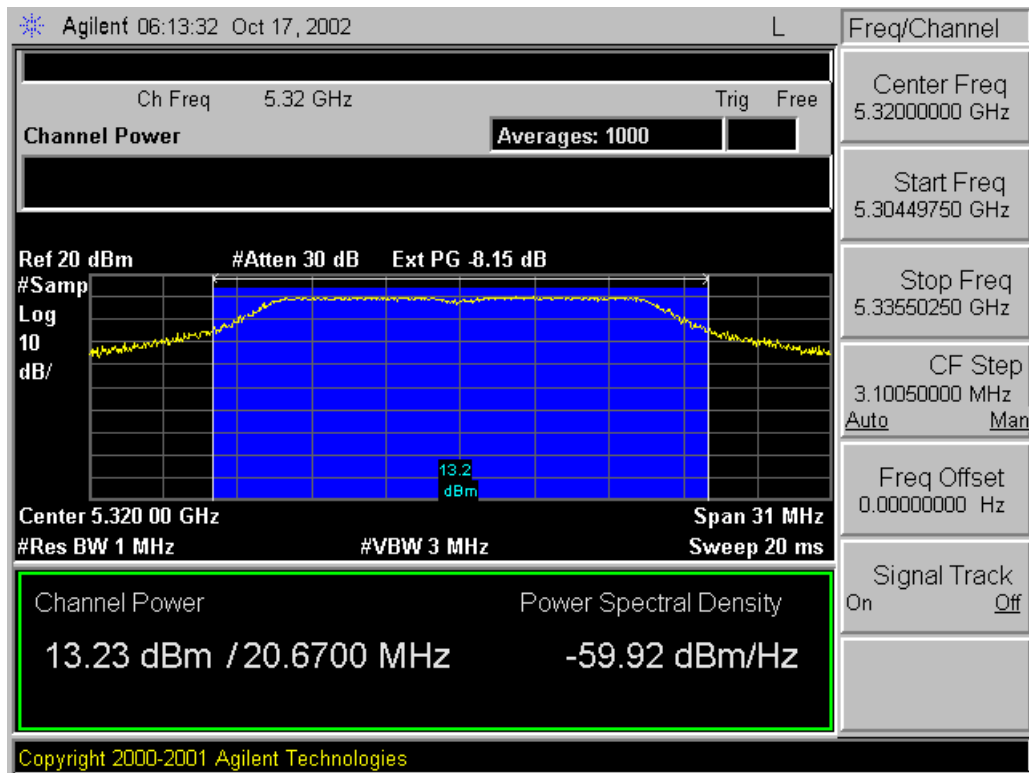


Figure 6.3-3: Peak Power Measurement – Hi Channel



6.4 Peak Excursion – FCC 15.407 (a)

6.4.1 Operation Environment

Temperature: 26°C

Relative Humidity: 40%

6.4.2 Test Setup



6.4.3 Test procedure

The EUT transmitter output is connected to the spectrum analyzer. The Span is set to view the entire emission bandwidth. Two trace are done for each channel low, mid and high.

Trace A : RBW=1 MHz, VBW=3 MHz, Peak Detector and Max Hold

Trace B : RBW=1 MHz, VBW= 3 MHz, Sample Detector.Max Hold,

6.4.4 Test Condition

“The largest difference between the two traces must be ≤ 13 dBm”

6.4.5 Results

Figure 6.4-1a: Peak Excursion – Lo Channel Trace A

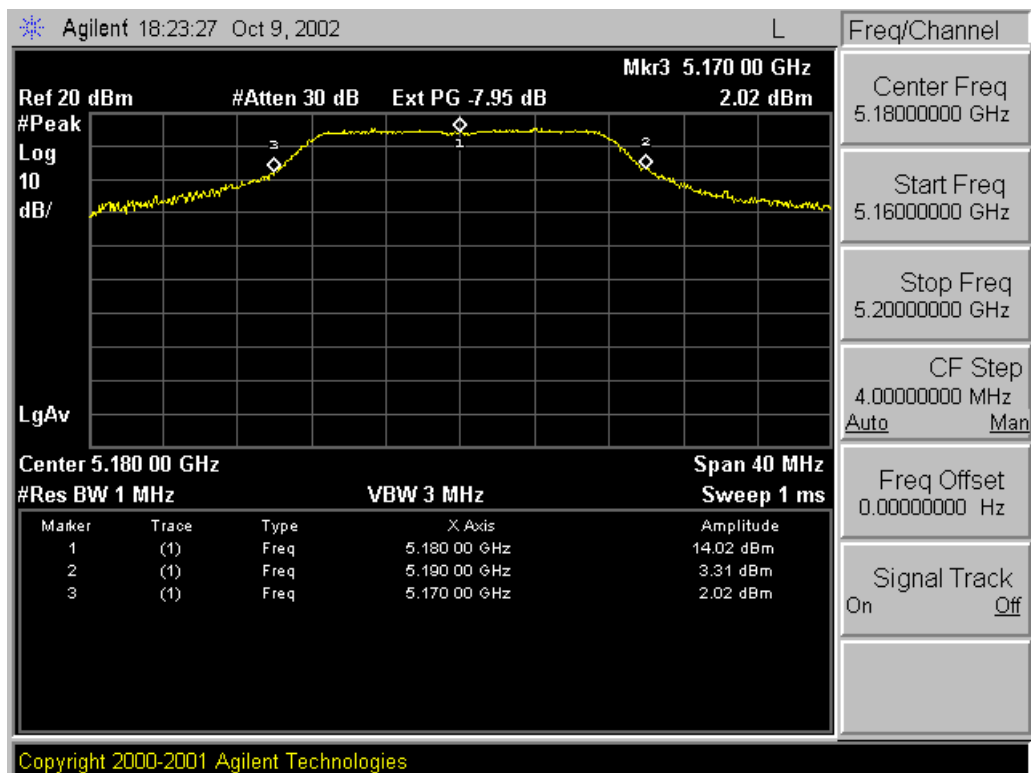
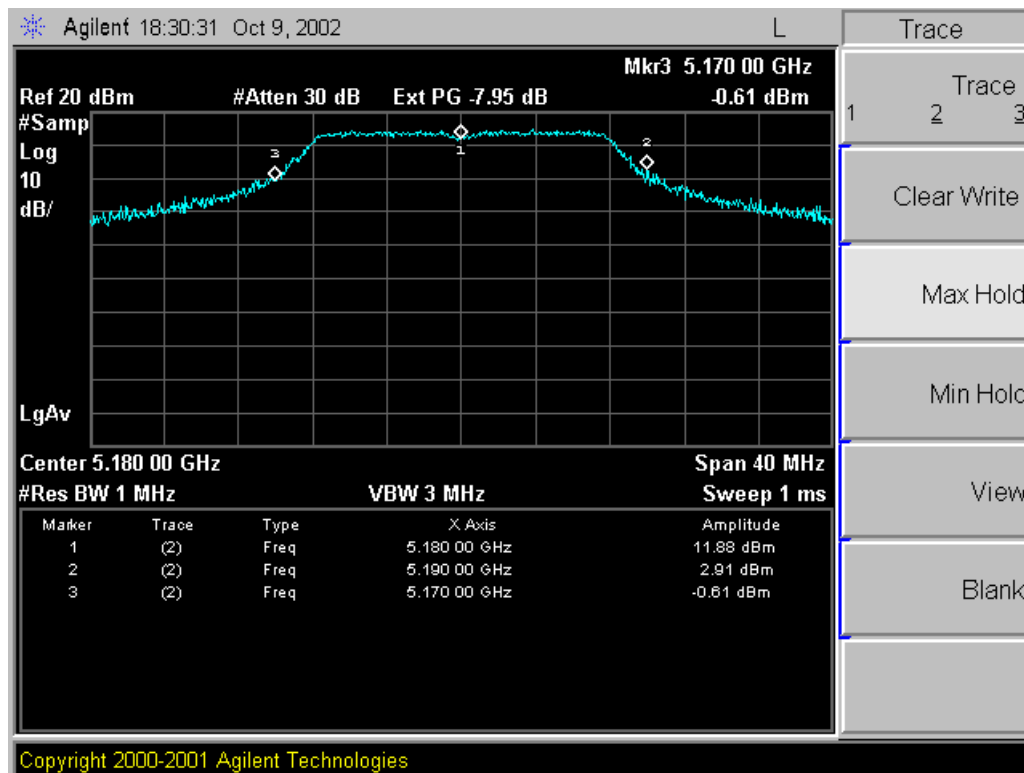


Figure 6.4-1a: Peak Excursion – Lo Channel Trace B



Frequency (MHz)	Trace A (dBm)	Trace B (dBm)	Delta	Limit	Margin
5180	14.02	11.99	2.03	13	10.97
5190	3.31	2.91	.4	13	12.6
5170	2.02	-.61	2.63	13	10.37

Table 6.4a Low Channel Peak Excursion Results

Figure 6.4-1c: Peak Excursion – Mid Channel Trace A

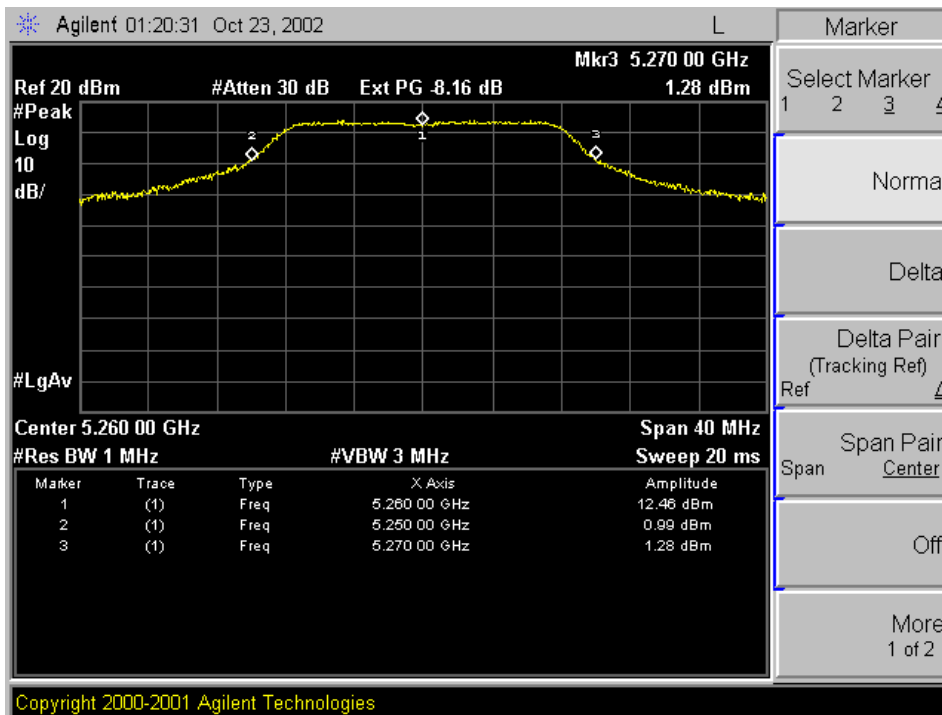
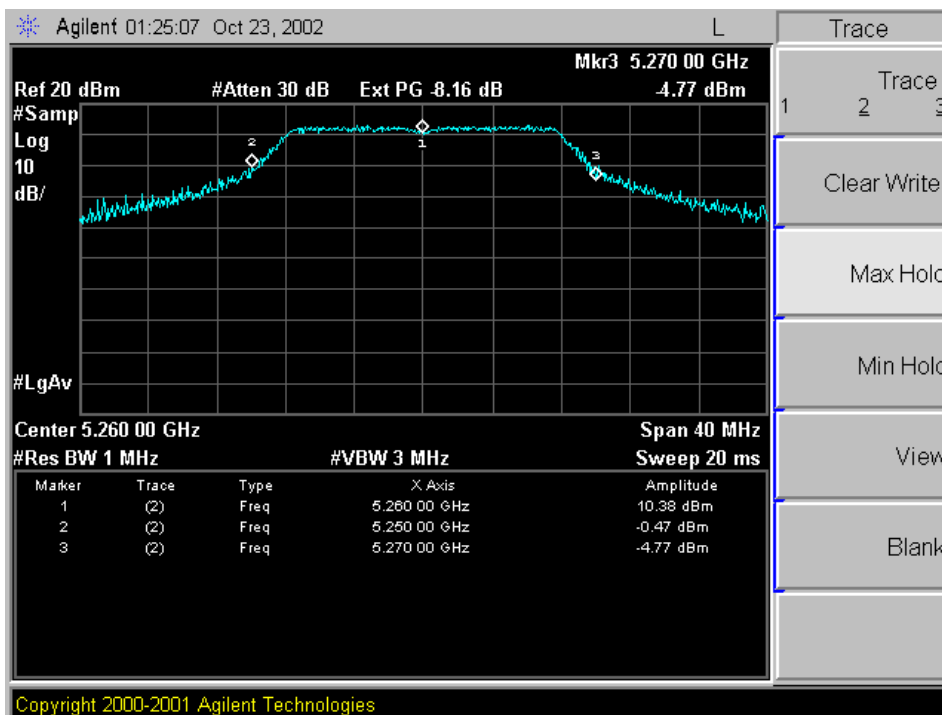


Figure 6.4-1d: Peak Excursion – Mid Channel Trace B



Frequency (MHz)	Trace A (dBm)	Trace B (dBm)	Delta	Limit	Margin
5260	12.46	10.38	2.08	13	10.38
5250	.99	-.47	1.46	13	11.54
5270	1.28	-4.77	6.05	13	6.95

Table 6.4b Mid Channel Peak Excursion Results

Figure 6.4-1e: Peak Excursion – Hi Channel Trace A

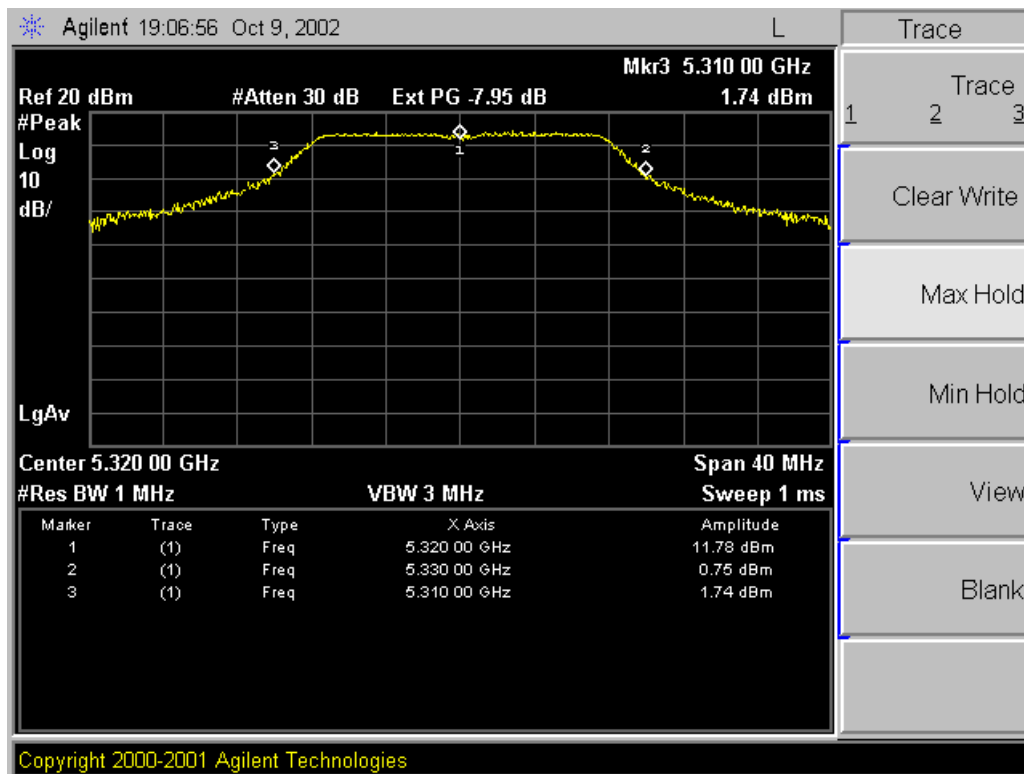
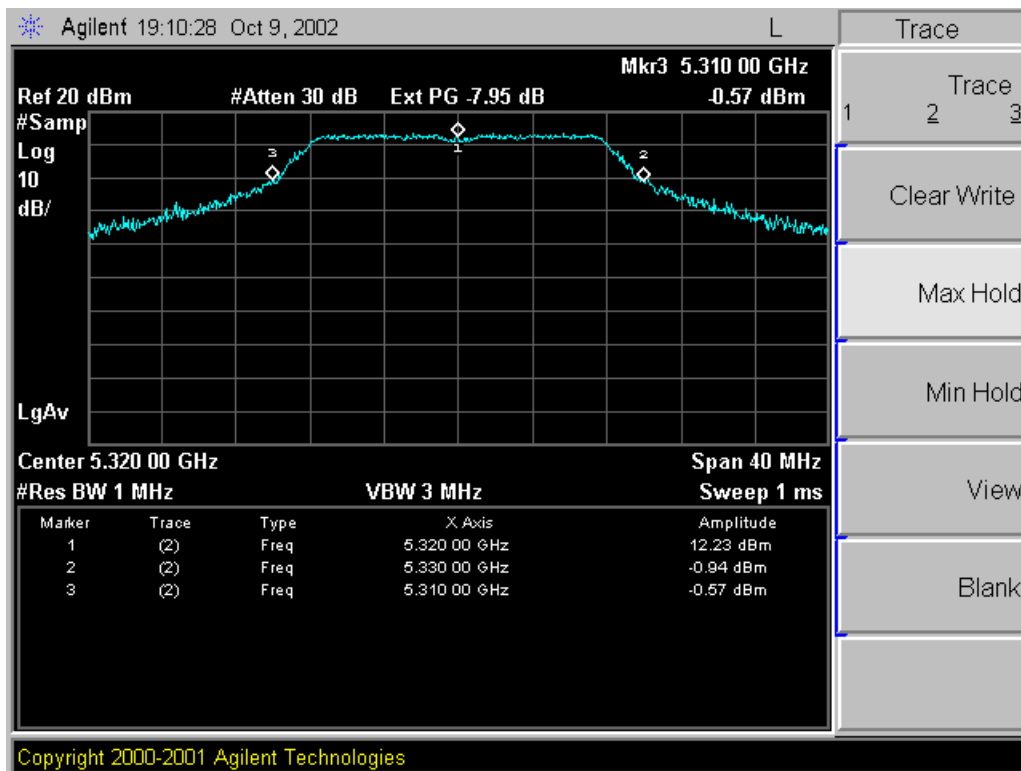


Figure 6.4-1f: Peak Excursion – Hi Channel Trace B



Frequency (MHz)	Trace A (dBm)	Trace B (dBm)	Delta	Limit	Margin
5260	11.78	12.23	-.45	13	12.55
5250	.75	-.94	1.69	13	11.31
5270	1.74	-.57	2.31	13	10.69

Table 6.4c Hi Channel Peak Excursion Results

6.5 Maximum Permissible Exposure – FCC 15.407 (f)

6.5.1 Calculations

$$E = \text{SQR ROOT } (30 * P * G) / d$$

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 / square cm

Combining equations and rearranging the terms to express d as a function of the other variables yields:

$$d = \text{SQR ROOT } (30 * P * G) / (3770 * S)$$

Changing to units of mW and cm::

$$P(\text{mW}) = P(\text{W}) / 1000$$

And

$$d(\text{cm}) = 100 * d(\text{m})$$

Yields

$$d = 100 * \text{SQR ROOT } ((30 * P * G) / (3770 * S))$$

Therefore

$$d = 0.282 * \text{SQR ROOT } (P * G / S)$$

Where

d = Distance in Meters
P = Power In mW
G = Numeric Antenna Gain
S = Power Density in mW / cm²

Substituting the log form of gain and power:

$$P \text{ (mW)} = 10^{(P(\text{dBm})/10)}$$

And

$$G \text{ (numeric)} = 10^{(G(\text{dBi}) / 10)}$$

Yields

$$\underline{d = .282 * 10^{((P+G) / 20)} / (\text{SQR ROOT } (S))}$$

Where

$$\begin{aligned} d &= \text{MPE Safe Distance in cm} \\ P &= \text{Power In dBm} \\ G &= \text{Antenna Gain in dBi} \\ S &= \text{Power Density Limit in mW / cm}^2 \end{aligned}$$

6.5.2 Results

$$\begin{aligned} \text{EUT Output Power} &= \underline{16.68 \text{ dBm}} \quad (\text{Table 6.3-1}) \\ \text{Antenna Gain} &= \underline{2.98 \text{ dBi}} \quad (\text{Section 4.2}) \\ S &= \underline{1.0 \text{ mW / cm}^2} \quad (\text{CFR 47 Part 1.1310}) \end{aligned}$$

$$\underline{\text{Minimum MPE safe distance (using equation above) = 1.91 cm}}$$

Safe distance compliant with 20 cm separation distance mandatory for mobile transmitters.

Unit is compliant

6.6 Transmission in the Absence of Data – 15.407 c

6.6.1 Technical Description

“Data transmission is always initiated by software, which is then passed down through the MAC, through the digital and analog baseband, and finally to the RF chip. Several special packets (ACKs, CTS, PSpoll, etc...) are initiated by the MAC.

“These are the only ways the digital baseband portion will turn on the RF transmitter, which it then turns off at the end of the packet. Therefore, the transmitter will be on only while one of the aforementioned packets are being transmitted.”

(from Technical Description - WCM-HW-TR-048 Issue 5)

6.6.2 Results

No non-compliance observed.

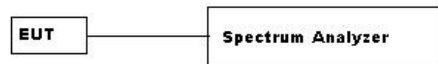
6.7 Peak Power Spectral Density

6.7.1 Operation Environment

Temperature: 26°C

Relative Humidity: 46%

6.7.2 Test Setup



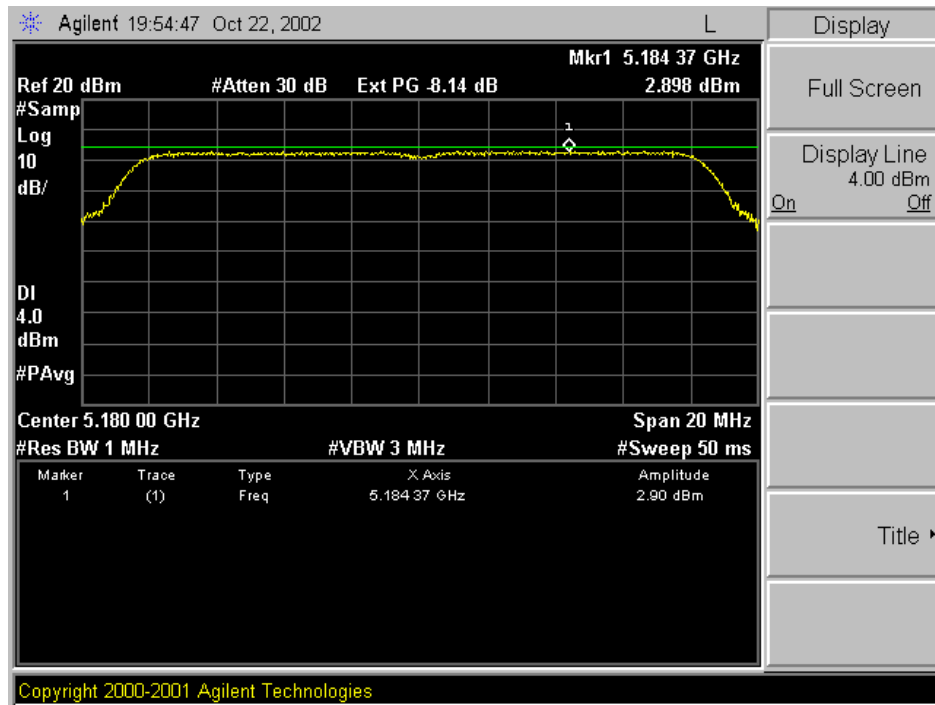
6.7.3 Test procedure

The transmitter output is connected to the spectrum analyzer.
RBW=1 MHz, VBW=3 MHz, Sample Detector, Power Averaging. The
PPSD is the highest level found across the emission in any 1 MHz band
after 100 sweeps of averaging.

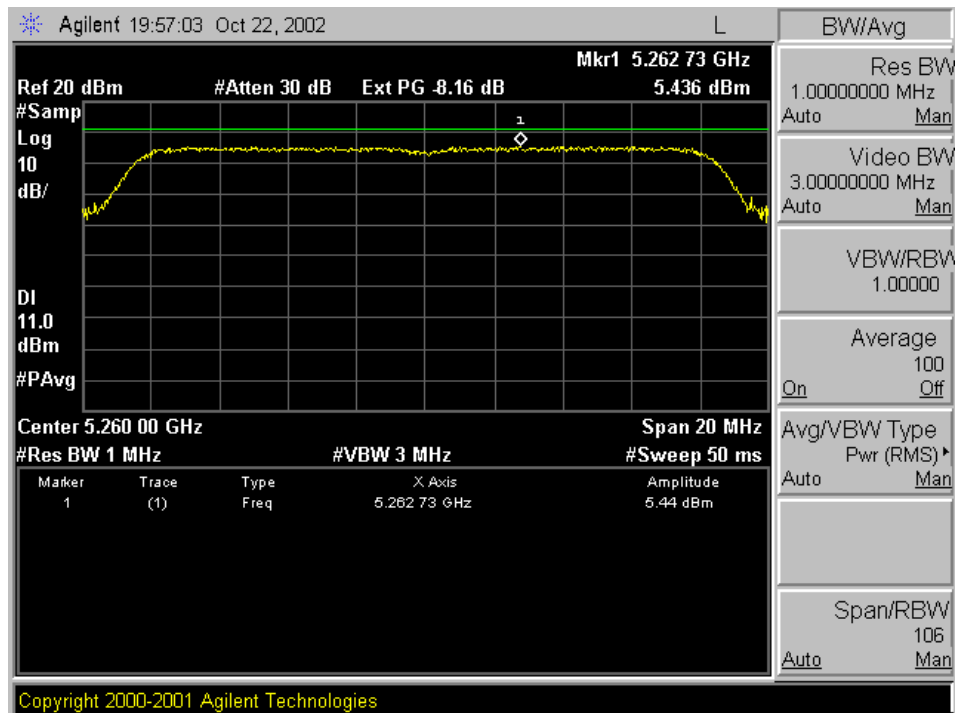
6.7.4 Results

5 GHz Band – 802.11a

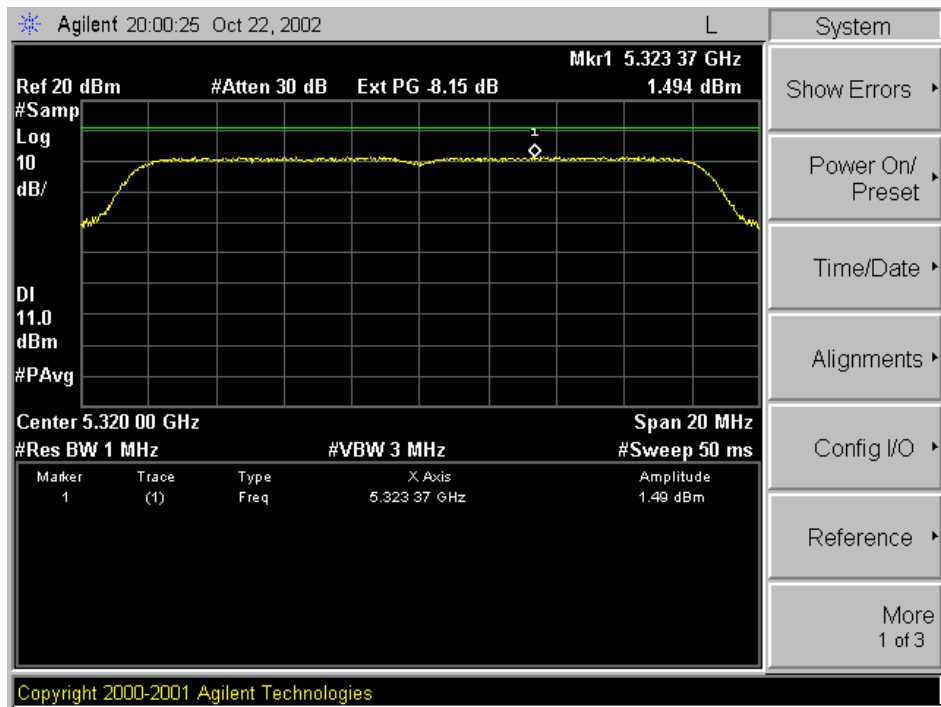
Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	2.90	4	1.10
Middle	5260	5.44	11	5.56
High	5320	1.49	11	9.51



Low Channel



Mid Channel



High Channel

6.8 Spurious RF Conducted Emissions

6.8.1 Operation Environment

Temperature: 25.8°C

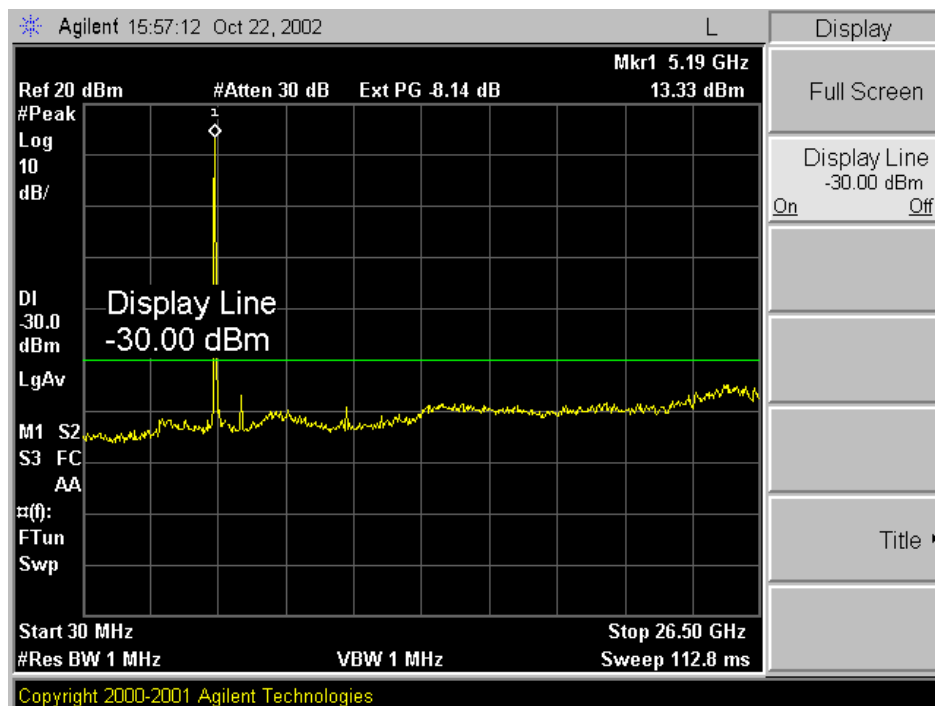
Relative Humidity: 46%

6.8.2 Test Setup

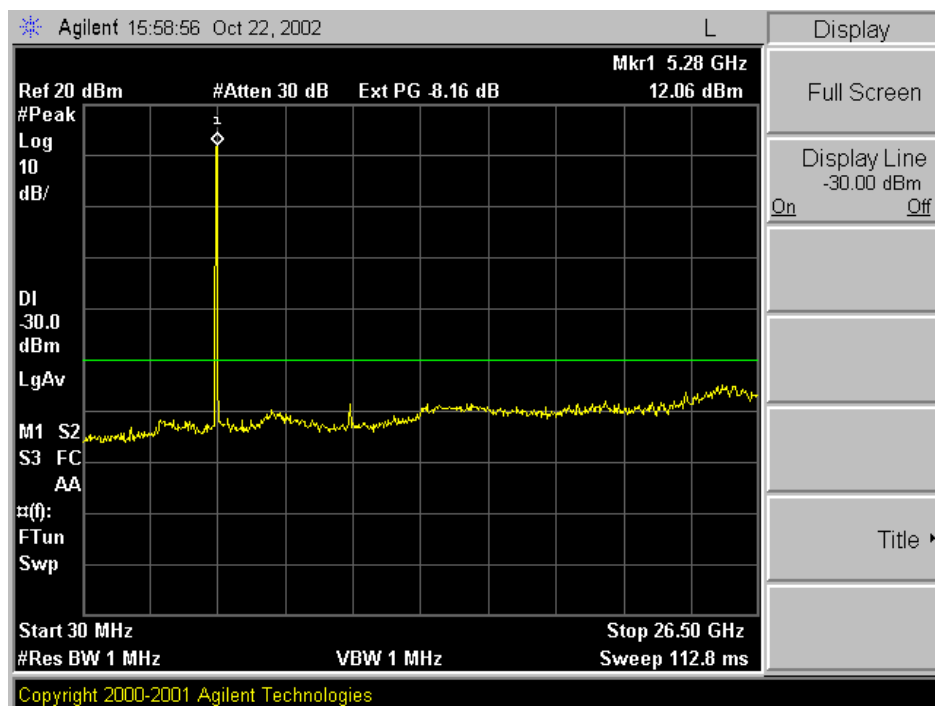


6.8.3 Test Procedure

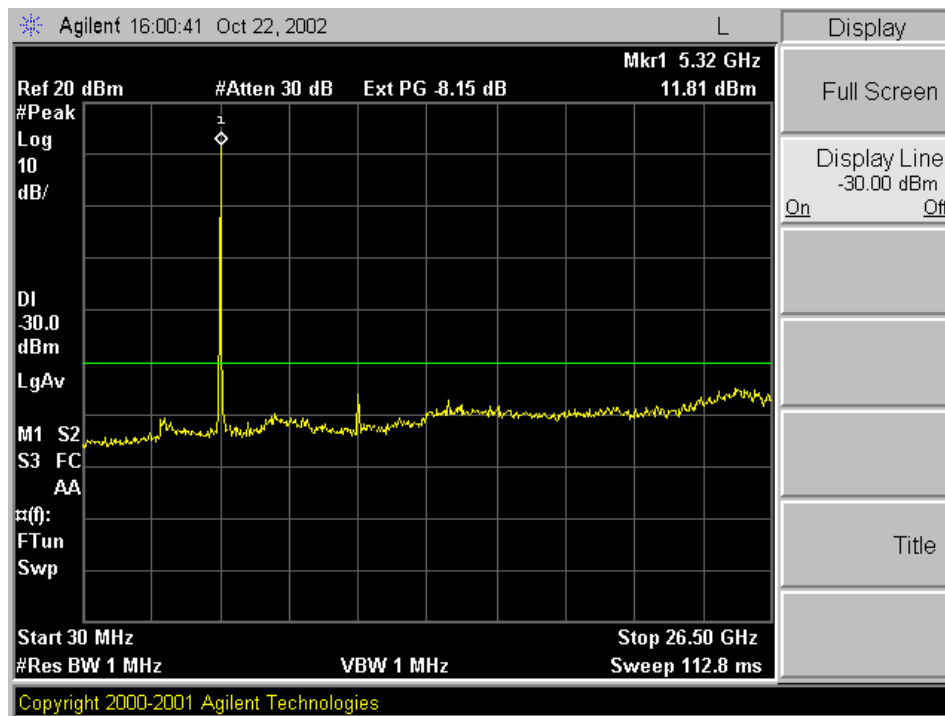
The spurious RF conducted emissions were measured with the EUT set to low, middle and high channel. At each channel the measurement was done by scanning the channel from 30 MHz to 26.5 GHz. RBW=VBW= 1 MHz.



Low Channel



Mid Channel



High Channel

6.9 Frequency Stability FCC 15.407 (g)

FCC 15.407(g) states: "Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the users manual."

The PH11107-X device uses 18 between 5.18GHz-5.32GHz and 5.745GHz-5.825GHz. The 5.745GHz base mode channel has the tightest guard band of all the channels (10MHz from the 5.725GHz band edge).

The PH11107-X device uses a XTAL with a +/- 20 ppm tolerance over temperature and aging. This is required per the 802.11a specification.

Based on the tolerance of the XTAL and the 10MHz worst-case guard band at 5.745GHz the device will maintain emissions within the UNII1, UNII2, and UNII3 bands under normal operating conditions specified in the user manual.

(from Technical Description - WCM-HW-TR-048 Issue 5)