



**FCC CFR47 PART 15 SUBPART C  
INDUSTRY CANADA RSS-210 ISSUE 8  
CLASS II PERMISSIVE CHANGE**

**CERTIFICATION TEST REPORT**

**FOR**

**802.11 a/b/g/n + BT2.1**

**MODEL NUMBER: A1395**

**FCC ID: BCGA1395  
IC: 579C-A1395**

**REPORT NUMBER: 11U14145-4**

**ISSUE DATE: FEBRUARY 15, 2012**

*Prepared for*  
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**NVLAP LAB CODE 200065-0**

Revision History

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Rev.	Issue Date	Revisions	Revised By
--	02/15/12	Initial Issue	F. Ibrahim

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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** APPLE, INC.  
1 INFINITE LOOP  
CUPERTINO, CA, 95014, U.S.A.

**EUT DESCRIPTION:** 802.11a/b/g/n + BT 2.1

**MODEL:** A1395

**SERIAL NUMBER:** PT629353

**DATE TESTED:** FEBRUARY 13, 2011

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-210 Issue 8	Pass
INDUSTRY CANADA RSS-GEN Issue 3	Pass

Compliance Certification Services (UL CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL CCS based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL CCS will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For UL CCS By:



FRANK IBRAHIM  
EMC SUPERVISOR  
UL CCS

Tested By:



CHIN PANG  
EMC ENGINEER  
UL CCS

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 3, and RSS-210 Issue 8.

## 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

UL CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsemc.com>.

## 4. CALIBRATION AND UNCERTAINTY

### 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

### 4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamp Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

### 4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.52 dB
Radiated Disturbance, 30 to 1000 MHz	4.94 dB

Uncertainty figures are valid to a confidence level of 95%.

## 5. EQUIPMENT UNDER TEST

802.11 a/b/g/n + BT2.1

The radio module is manufactured by Apple, Inc.

### 5.1. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

The major changes filed under this application are as following:

1. New boards - MLB, Sensor
2. Flex - Mic/Button/Sensor Flex
3. Front Camera
4. Housing (laser etching changes on the inside of the housing for grounding effects)
5. 51-pin ZIF connector (new)

### 5.2. MAXIMUM OUTPUT POWER

The output power values were verified to be within +/- 0.5 dB from the original values under reports number "10U13548-2A FCC IC UNII WLAN Report".

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes the following antenna:

Antenna Name	Description	Manufacturer	Cable Length
631-1482 WiFi / Bluetooth	PIFA	Amphenol / Tyco	81.6 mm

	631-1482 WiFi / Bluetooth
	Peak Gain (includes Cable)
Freq [GHz]	dBi
2.4-2.484	0.59
5.15 - 5.25	4.07
5.25 - 5.35	4.2
5.47-5.725	4.21
5.725-5.85	3.57

## 5.4. SOFTWARE AND FIRMWARE

The firmware installed on the EUT was version 4.221.53.13

The test utility software: wl.exe version: 4.221.53.13

## 5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case data rate for each mode is determined to be as follows, based on preliminary tests of the chipset utilized in this radio.

All final tests in the 802.11a mode were made at 6 Mb/s.

All final tests in the 802.11n HT20 SISO mode were made at MCS0.

For radiated emissions the following were performed according to worst case on the original report 10U13548-2A FCC IC UNII WLAN Report.

BAND	Modulation	Channel Tested
5.2GHz	802.11n HT20	Low Channel
5.3GHz	802.11a	High Channel
5.6GHz	802.11n HT20	Low and High Channel

To determine the worst-position of highest emissions, the EUT's antenna was investigated for X, Y, Z positions, and the worst position was turned out to be a Y-position.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

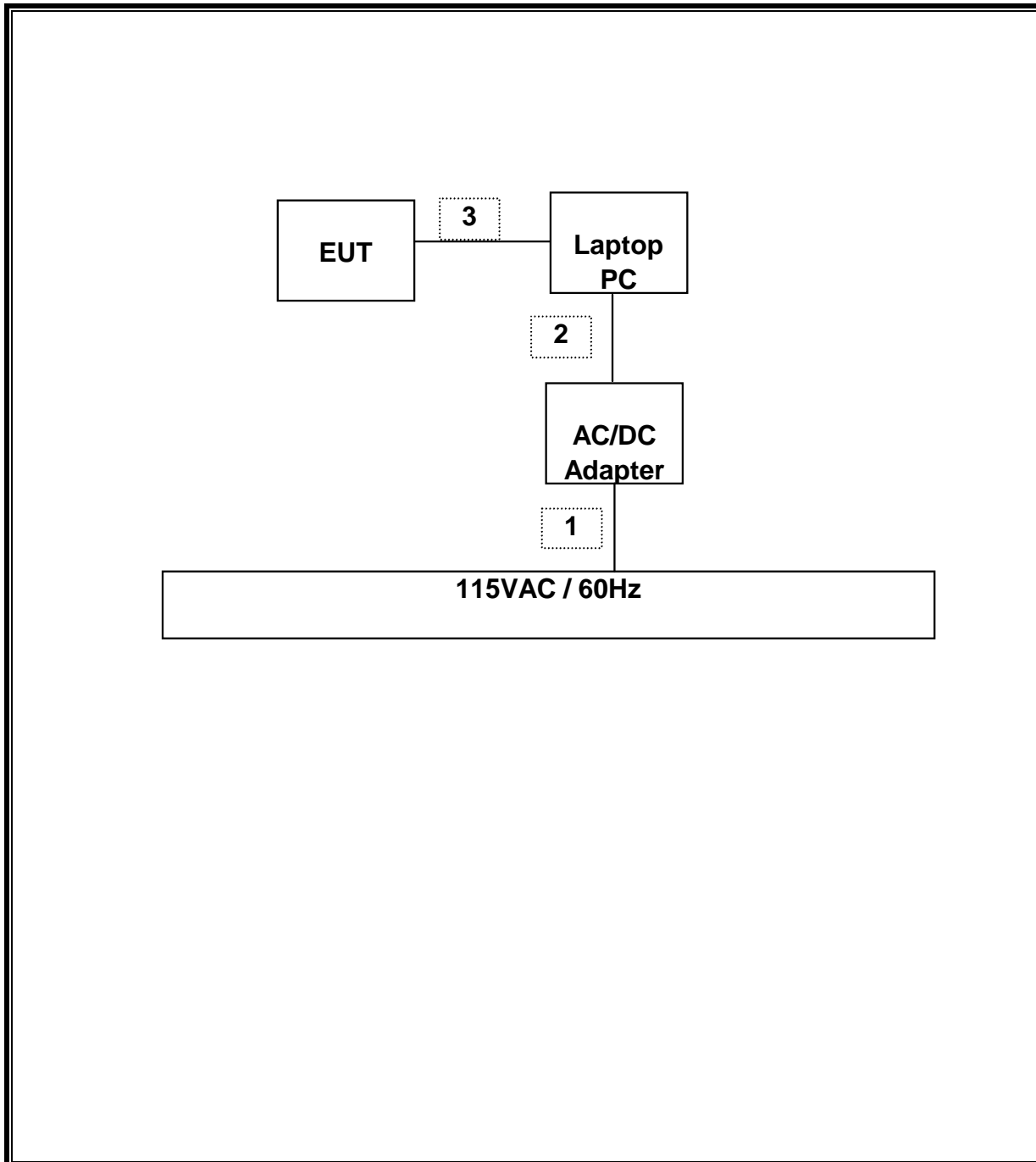
PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Apple	A1286	W8917005998	DoC
Laptop AC Adapter	Apple	A1290	N/A	DoC

### I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	US 115V	Un-shielded	2m	N/A
2	DC	1	DC	Un-shielded	2m	N/A
3	USB	1	USB	Un-shielded	1m	Connect to Laptop



**SETUP DIAGRAM FOR TESTS**



**Note:** Laptop PC was used to control the operation of the EUT.

## 6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST					
Description	Manufacturer	Model	Asset	Cal Date	Cal Due
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01012	09/02/11	09/02/12
Pre-amplifier, 26.5 GHz	Agilent / HP	8449B	C01063	07/12/11	07/12/12
Highpass Filter, 7.6 GHz	Micro-Tronics	HPM13195	N02682	CNR	CNR
Antenna, Horn, 18 GHz	EMCO	3115	C00783	06/29/11	06/29/12
Peak Power Meter	Agilent / HP	E4416A	C00963	03/22/11	03/22/13
Peak / Average Power Sensor	Agilent / HP	E9327A	C00964	04/13/11	04/13/12
Antenna, Horn, 26.5 GHz	ARA	MMH-1826/B	C00589	07/28/11	07/28/12
Antenna, Horn, 40 GHz	ARA	MMH-2640/B	C00981	06/14/11	06/14/12
Pre-amplifier, 40 GHz	Mteq	NSP4000-SP2	C00990	08/02/11	08/02/12

## 7. ANTENNA PORT TEST RESULTS

### 7.1. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

#### LIMITS

None; for reporting purposes only.

#### PROCEDURE

KDB 789033 Zero-Span Spectrum Analyzer Method.

#### 7.1.1. ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
5.2GHz, HT20	1.31	1.335	0.981	98.1%	0.08	0.763
5.3GHz, Legacy	1.400	1.427	0.981	98.1%	0.08	0.714
5.6GHz, HT20	1.875	1.910	0.982	98.2%	0.08	0.533

#### 7.1.2. MEASUREMENT METHOD FOR POWER AND PPSD

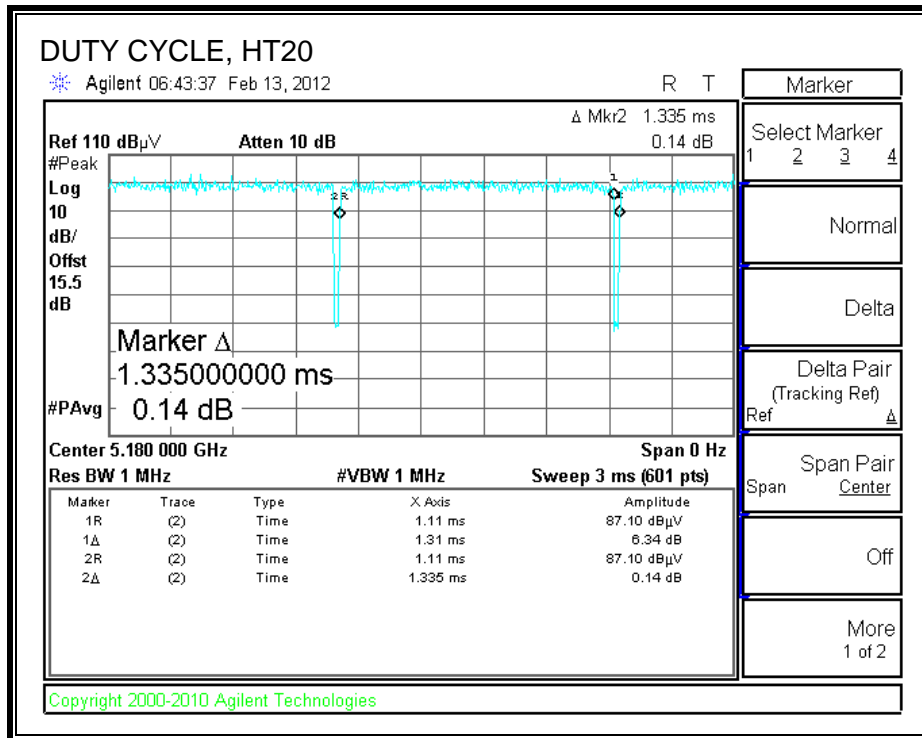
The Duty Cycle is greater than or equal to 98% therefore KDB 789033 Method SA-1 is used.

#### 7.1.3. MEASUREMENT METHOD FOR AVG SPURIOUS EMISSIONS > 1 GHz

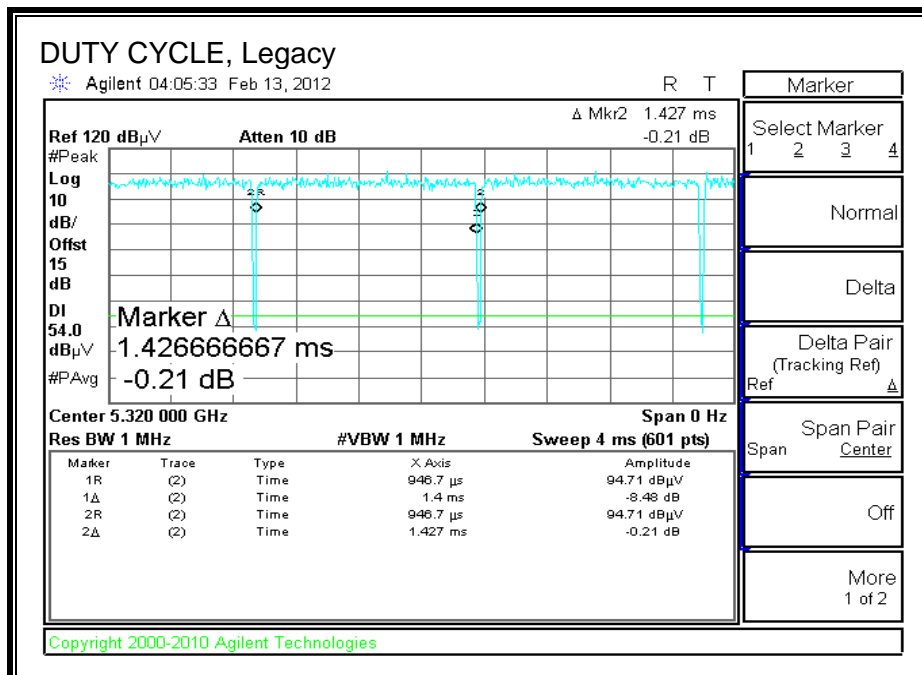
The Duty Cycle is greater than or equal to 98%, KDB 789033 Method AD with Power RMS Averaging is used.

### 7.1.4. DUTY CYCLE PLOTS

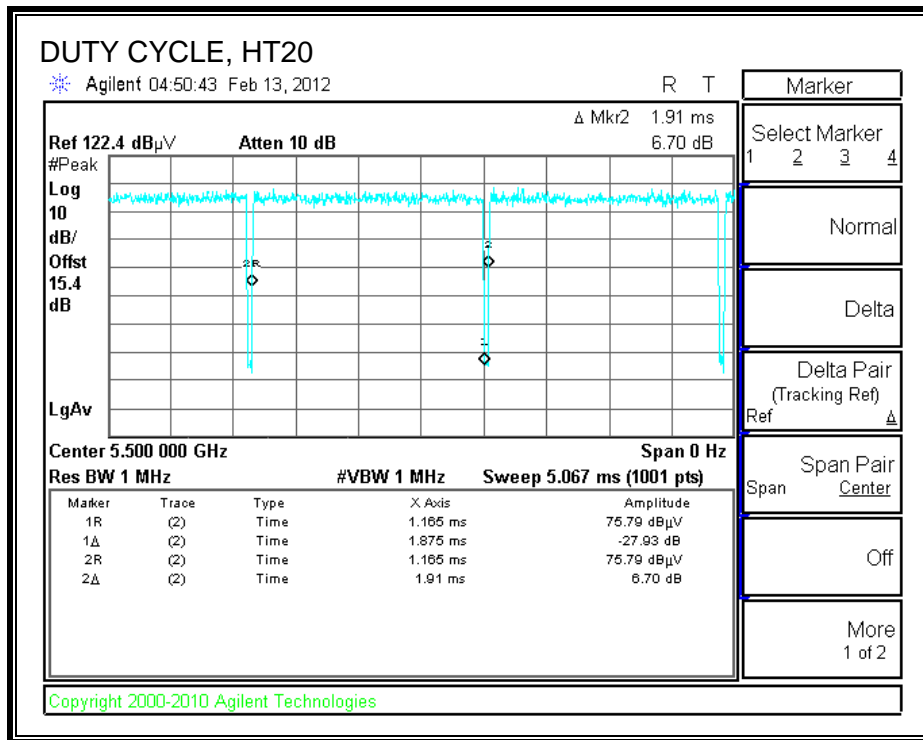
#### 5.2GHz HT20



#### 5.3GHz Legacy Mode



**5.6GHz, HT20**



## 8. RADIATED TEST RESULTS

### 8.1. LIMITS AND PROCEDURE

#### LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

#### TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

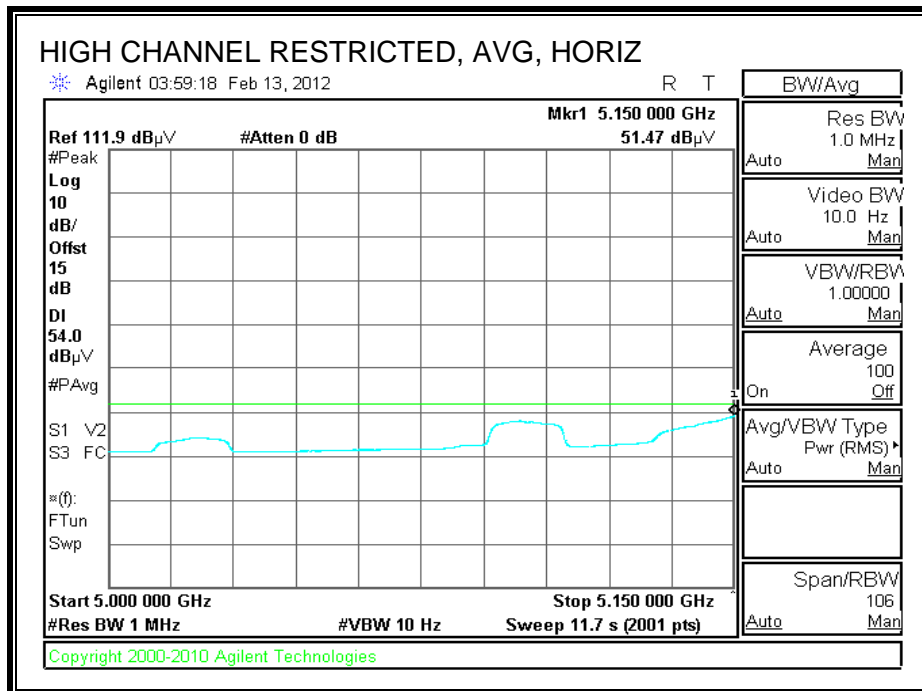
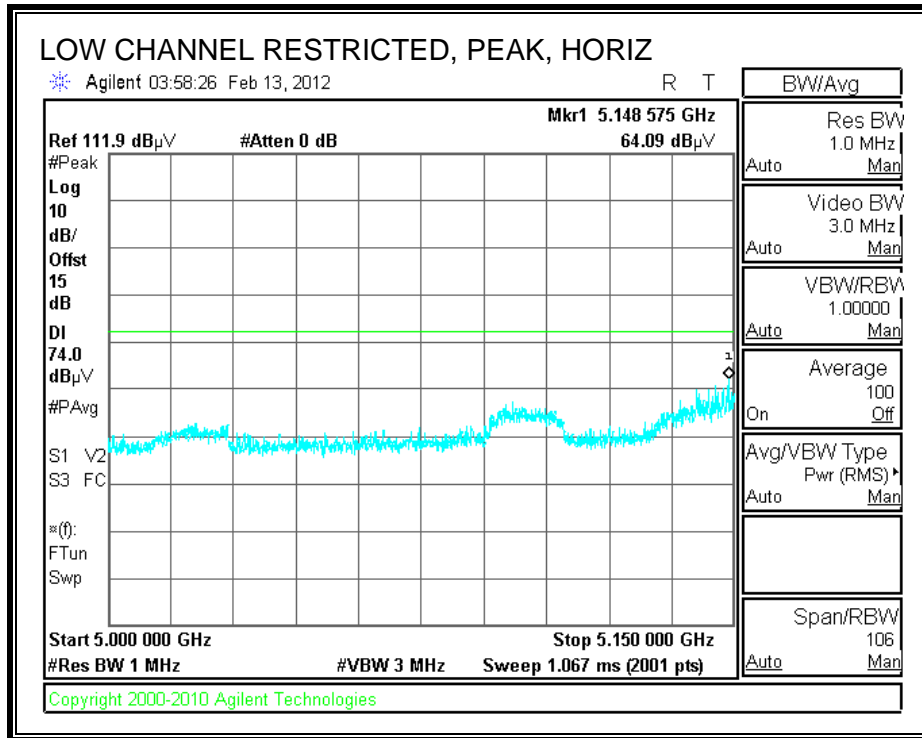
For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

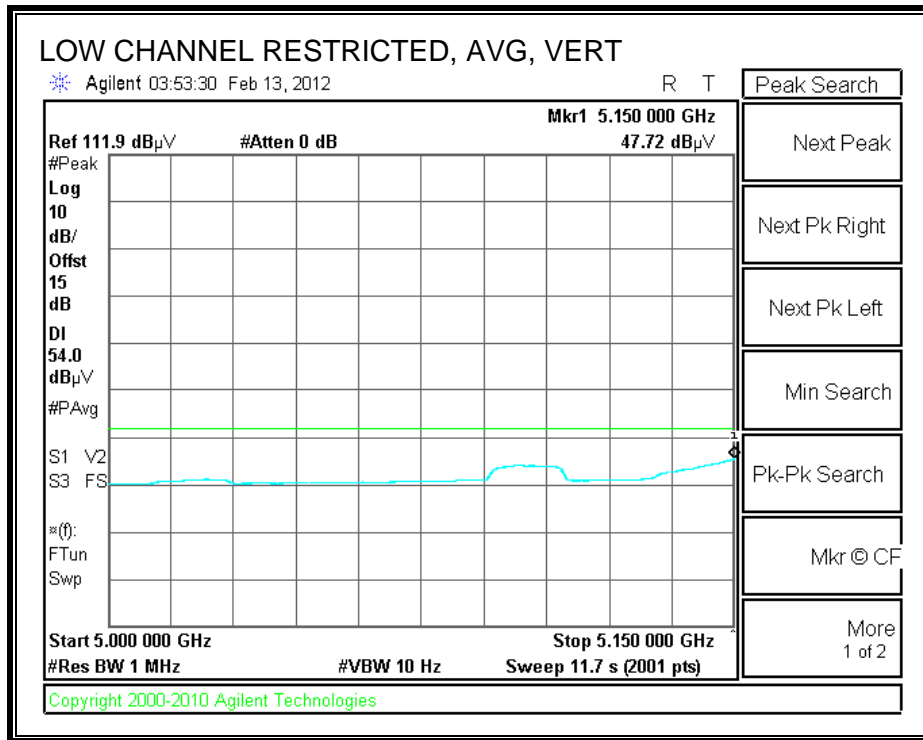
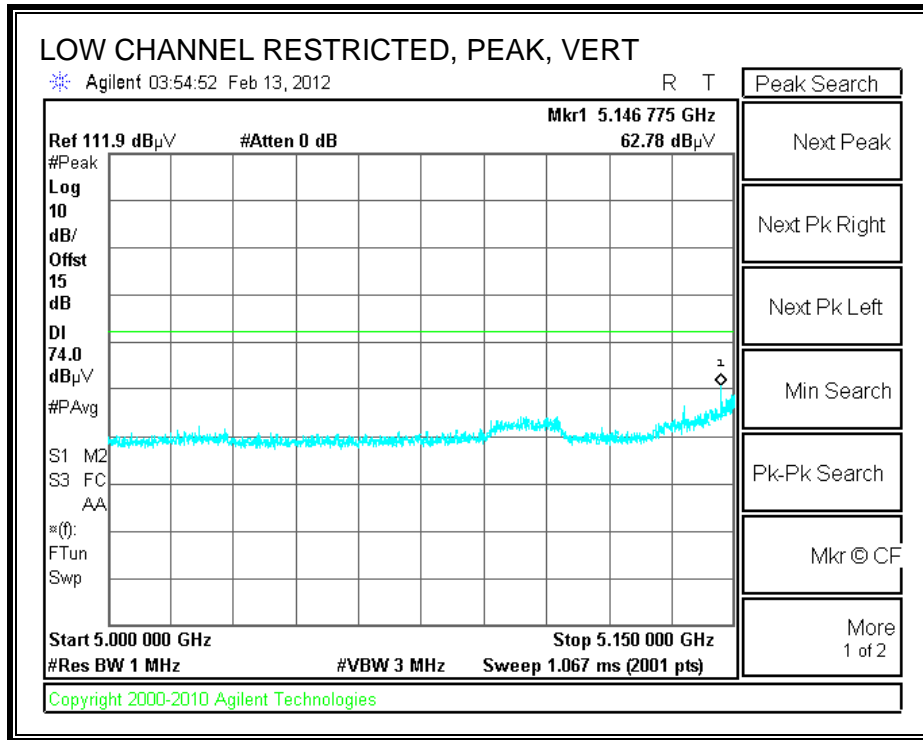
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

## 8.2. TX ABOVE 1 GHz (802.11n HT20 MODE IN THE 5.2 GHz BAND)

### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



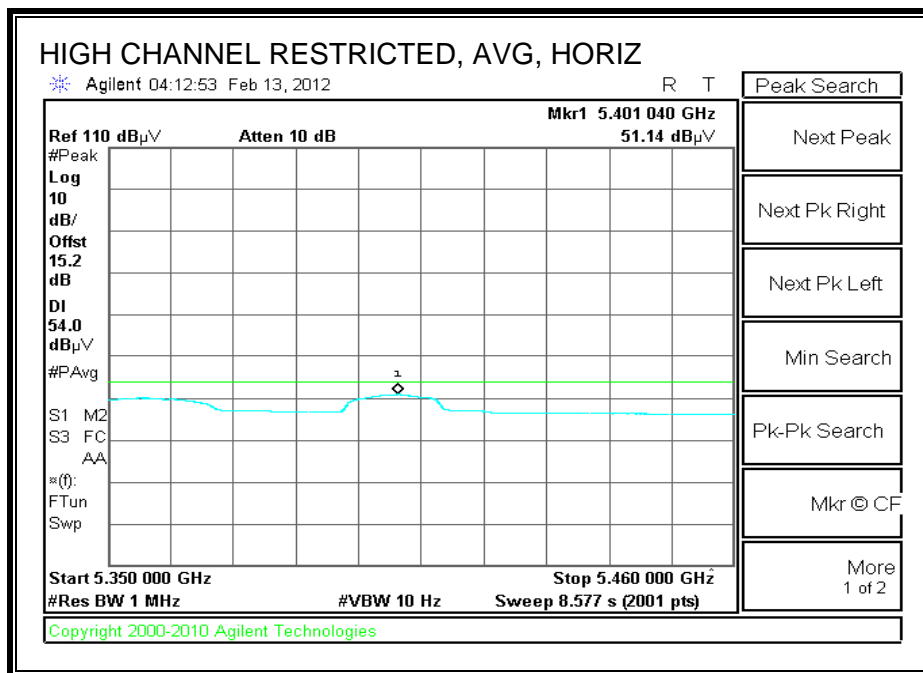
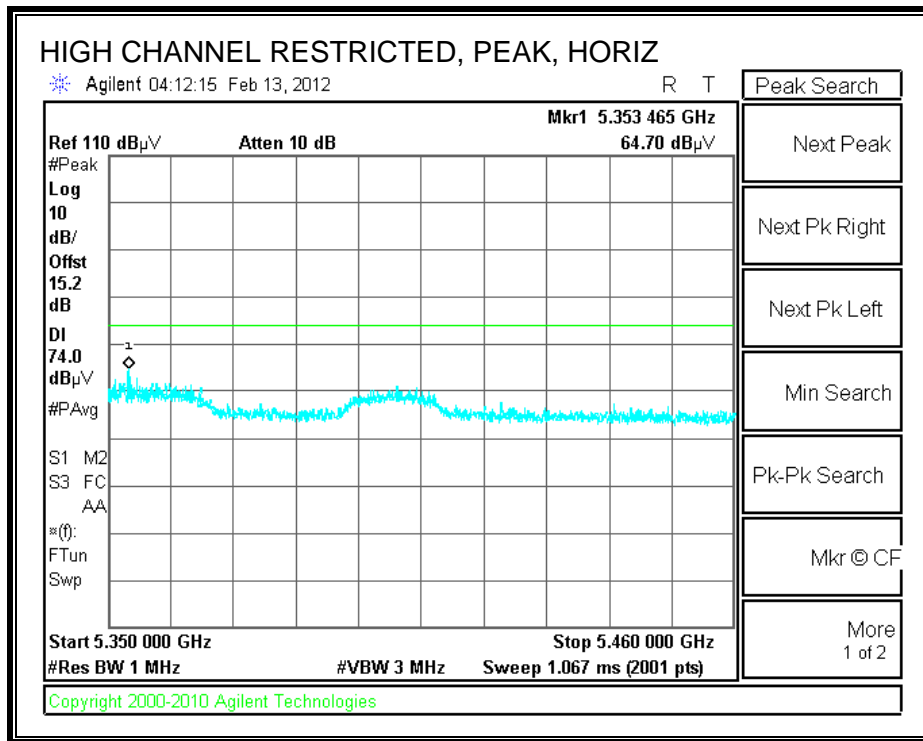
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



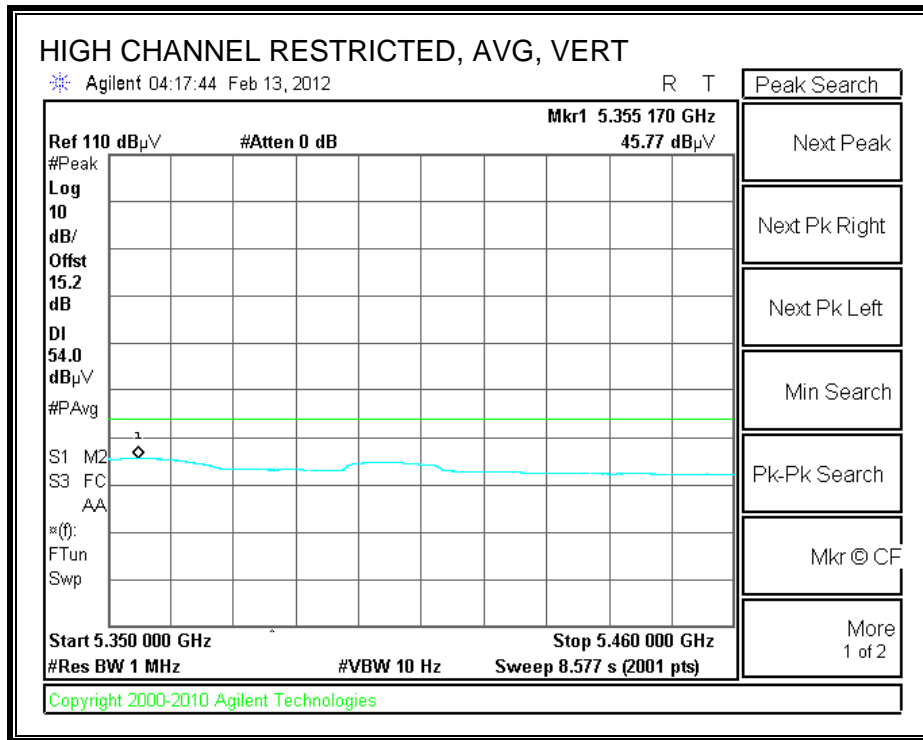
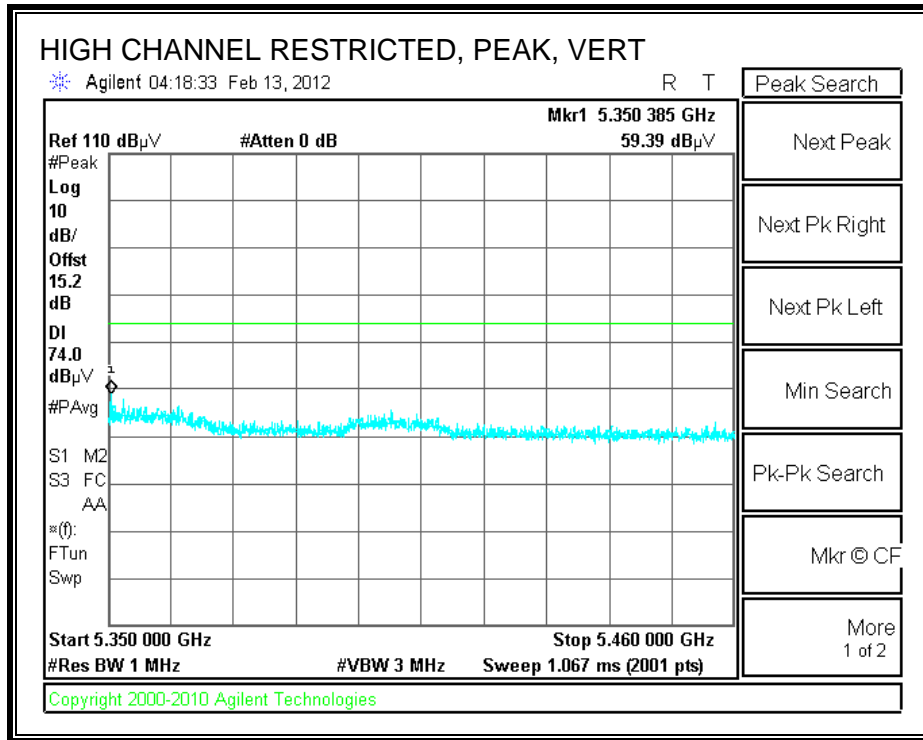


### 8.3. TX ABOVE 1 GHz (802.11a MODE IN THE 5.3 GHz BAND)

#### RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



**RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**

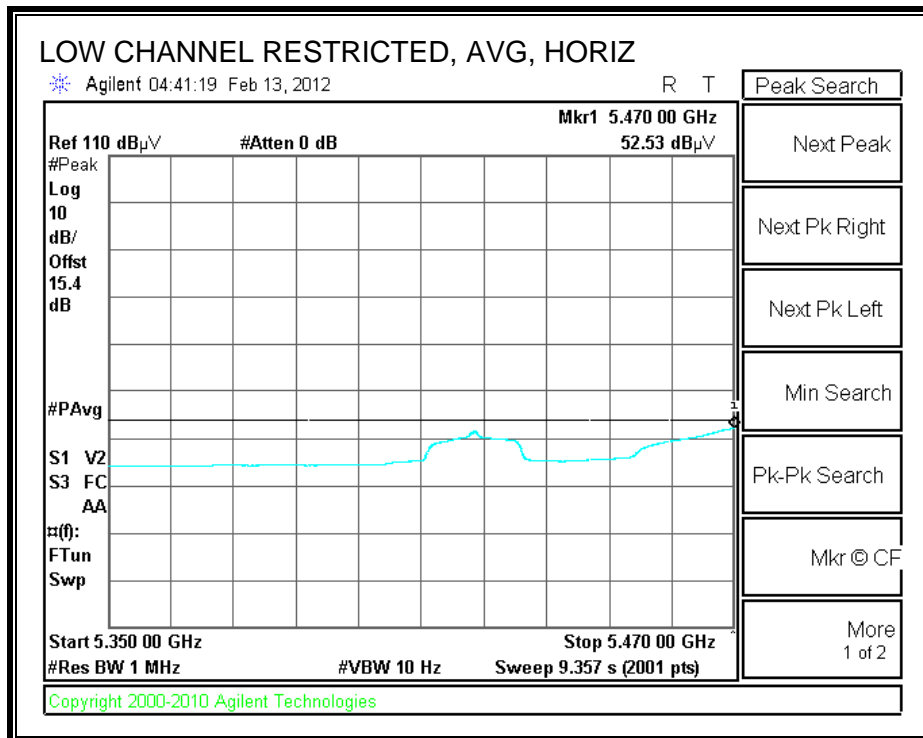
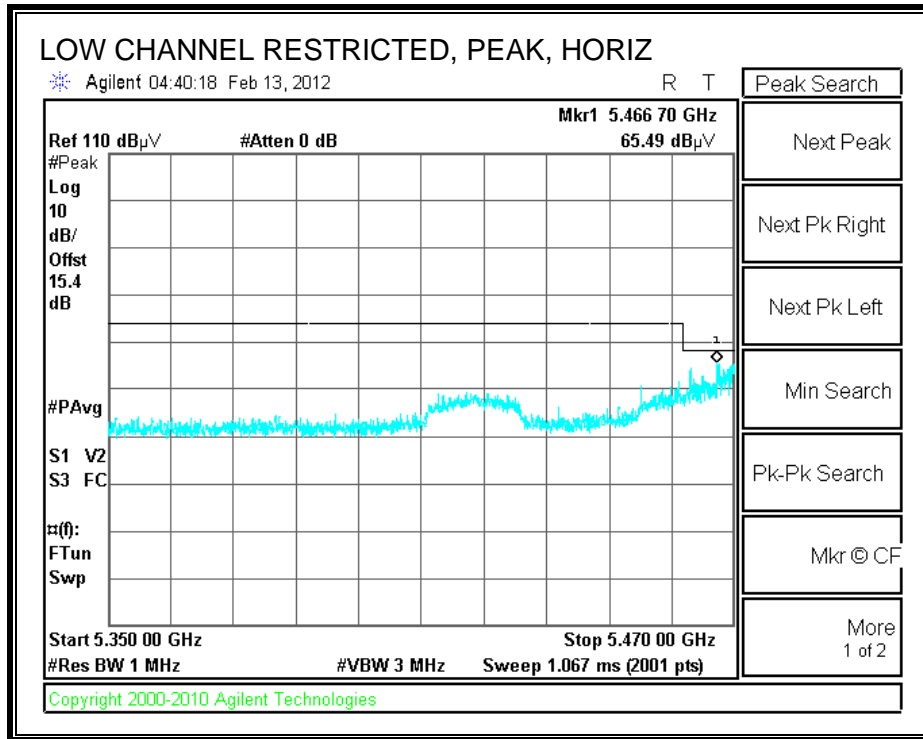


**HARMONICS AND SPURIOUS EMISSIONS**

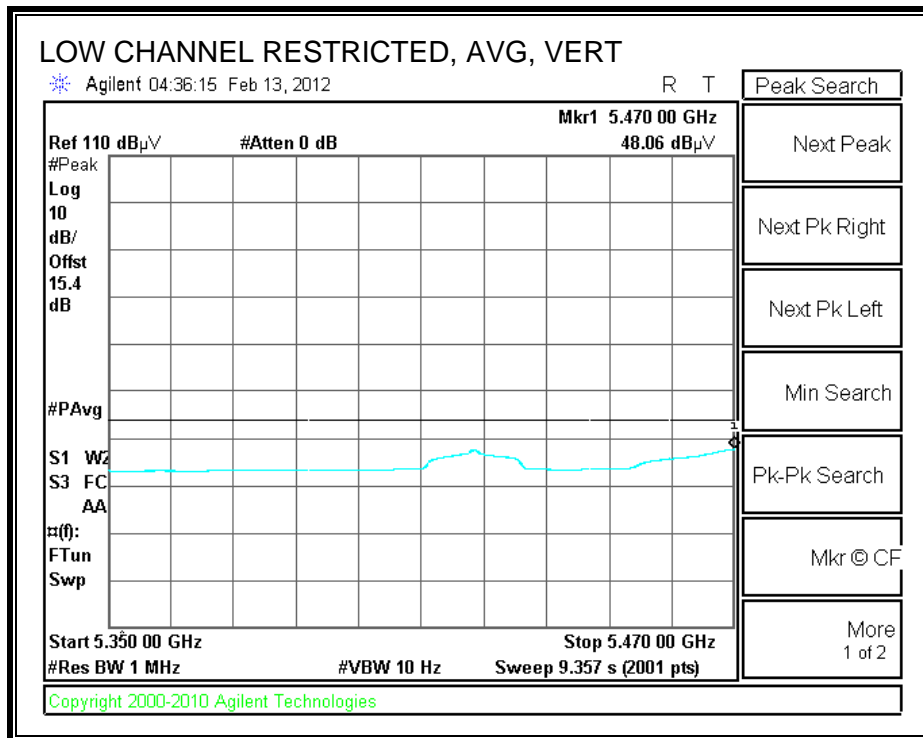
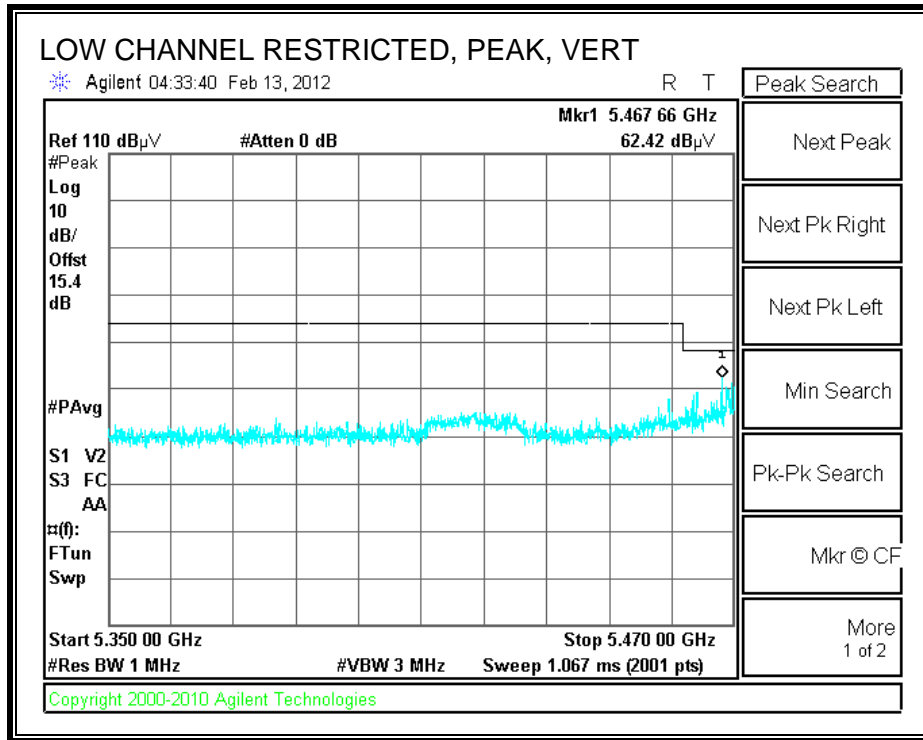
High Frequency Measurement													
Compliance Certification Services, Fremont 5m Chamber													
Test Engr:		Chin Pang											
Date:		02/13/12											
Project #:		11U14145											
Company:		Apple											
Test Target:		FCC 15.407											
Mode Oper:		TX, 5GHz Band, Legacy											
f	Measurement Frequency	Amp	Preamp Gain	Average Field Strength Limit									
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Peak Field Strength Limit									
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Margin vs. Average Limit									
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Margin vs. Peak Limit									
CL	Cable Loss	HPF	High Pass Filter										
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fitr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
<b>Mid Ch, 5300MHz</b>													
10.600	3.0	36.6	38.4	9.0	-34.3	0.0	0.8	50.5	74.0	-23.5	V	P	
10.600	3.0	23.3	38.4	9.0	-34.3	0.0	0.8	37.2	54.0	-16.8	V	A	
15.900	3.0	35.1	38.9	11.5	-32.2	0.0	0.7	54.0	74.0	-20.0	V	P	
15.900	3.0	22.5	38.9	11.5	-32.2	0.0	0.7	41.4	54.0	-12.6	V	A	
10.600	3.0	35.4	38.4	9.0	-34.3	0.0	0.8	49.3	74.0	-24.7	H	P	
10.600	3.0	23.6	38.4	9.0	-34.3	0.0	0.8	37.5	54.0	-16.5	H	A	
15.900	3.0	35.3	38.9	11.5	-32.2	0.0	0.7	54.2	74.0	-19.8	H	P	
15.900	3.0	22.8	38.9	11.5	-32.2	0.0	0.7	41.7	54.0	-12.3	H	A	
Rev. 4.1.2.7													
Note: No other emissions were detected above the system noise floor.													

### 8.4. TX ABOVE 1 GHz (802.11HT20 MODE IN THE 5.6 GHz BAND)

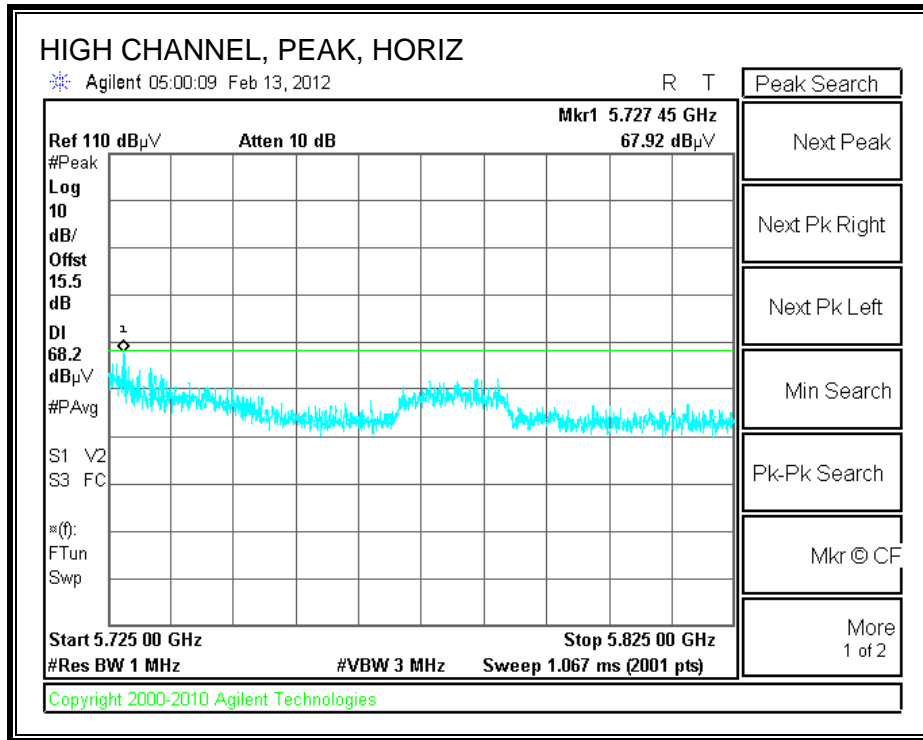
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



**AUTHORIZED BANDEGE (HIGH CHANNEL, HORIZONTAL)**



**AUTHORIZED BANDEGE (HIGH CHANNEL, VERTICAL)**

