



**FCC CFR47 PART 15 SUBPART E  
INDUSTRY CANADA RSS-210 ISSUE 7  
CLASS II PERMISSIVE CHANGE  
CERTIFICATION TEST REPORT**

**FOR**

**802.11n 2x2 PCIE MINICARD  
(INSTALLED IN DELL LAPTOP, MODEL NUMBER: PP24L)**

**FCC ID: PPD-AR5BHB92-D  
FCC MODEL: AR5BHB92**

**IC: 4104A-ARBHB92D  
IC MODEL: AR5BHB92-D**

**REPORT NUMBER: 08U11860-2B**

**ISSUE DATE: JULY 15, 2008**

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

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
--	6/16/08	Initial Issue	T. Chan
A	06/30/08	Per client's request, added host model number	A. Zaffar
B	07/15/08	Changed IC model due to typo	A. Zaffar

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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** ATHEROS COMMUNICATION, INC  
5480 GREAT AMERICA PARKWAY  
SANTA CLARA, CA 95054 USA

**EUT DESCRIPTION:** 802.11n 2x2 PCIE MINICARD  
(INSTALLED IN DELL LAPTOP, MODEL NUMBER: PP24L)

**FCC MODEL:** AR5BHB92  
**IC MODEL:** AR5BHB92-D

**SERIAL NUMBER:** 001644CF9517

**DATE TESTED:** JUNE 04-09, 2008

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart E	Pass
INDUSTRY CANADA RSS-210 Issue 7 Annex 9	Pass
INDUSTRY CANADA RSS-GEN Issue 2	Pass

Compliance Certification Services, Inc. (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 CCS based on interpretations and/or observations of test results. 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 CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by CCS will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:

Tested By:



THU CHAN  
EMC SUPERVISOR  
COMPLIANCE CERTIFICATION SERVICES

CHIN PANG  
EMC ENGINEER  
COMPLIANCE CERTIFICATION SERVICES

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 2, and RSS-210 Issue 7.

## 3. FACILITIES AND ACCREDITATION

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

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. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Power Line Conducted Emission	+/- 2.3 dB
Radiated Emission	+/- 3.4 dB

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

## **5. EQUIPMENT UNDER TEST**

### **5.1. DESCRIPTION OF EUT**

The EUT is an 802.11n 2x2 PCIe minicard transceiver, FCC Model AR5BHB92/ IC Model AR5BHB92-D installed in Dell laptop, model number: PP24L

### **5.2. DESCRIPTION OF CLASS II CHANGE**

The module installed inside a Dell laptop with two PIFA antennas.

### **5.3. DESCRIPTION OF AVAILABLE ANTENNAS**

The 2x2 configuration utilizes a set of PIFA antennas with peak gain of 2.1 dBi from 5150 – 5250 MHz, 2.3 dBi from 5250 – 5350 MHz, and 2.1 dBi from 5470 – 5725 MHz.

### **5.4. SOFTWARE AND FIRMWARE**

The test utility and driver software used during testing was Art ANWI 1.4 and Devlib Revision 0.6 Build #18 Art\_11n.

### **5.5. WORST-CASE CONFIGURATION AND MODE**

The worst-case data rates are determined to be as follows for each mode, based on the previous investigations by measuring the average power, peak power and PPSD across all the data rates, bandwidths, modulations and spatial stream modes.

Thus all emissions tests were made with following data rates:

- 802.11a mode, 20 MHz Channel Bandwidth, 9 Mb/s, OFDM Modulation, Spatial Stream 1.
- 802.11n HT20 mode, 20 MHz Channel Bandwidth, MCS0, 6.5 Mb/s, OFDM Modulation, Spatial Stream 1.
- 802.11n HT40 mode, 40 MHz Channel Bandwidth, MCS0, 13.5 Mb/s, OFDM Modulation, Spatial Stream 1.

All radiated emissions were performed at FEM1 board.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Dell	Inspiron	20311221G0I0Q	DoC
AC Adapter	Dell	LA90PSI	CN-ODF315-71615-814-3092	DoC

### I/O CABLES

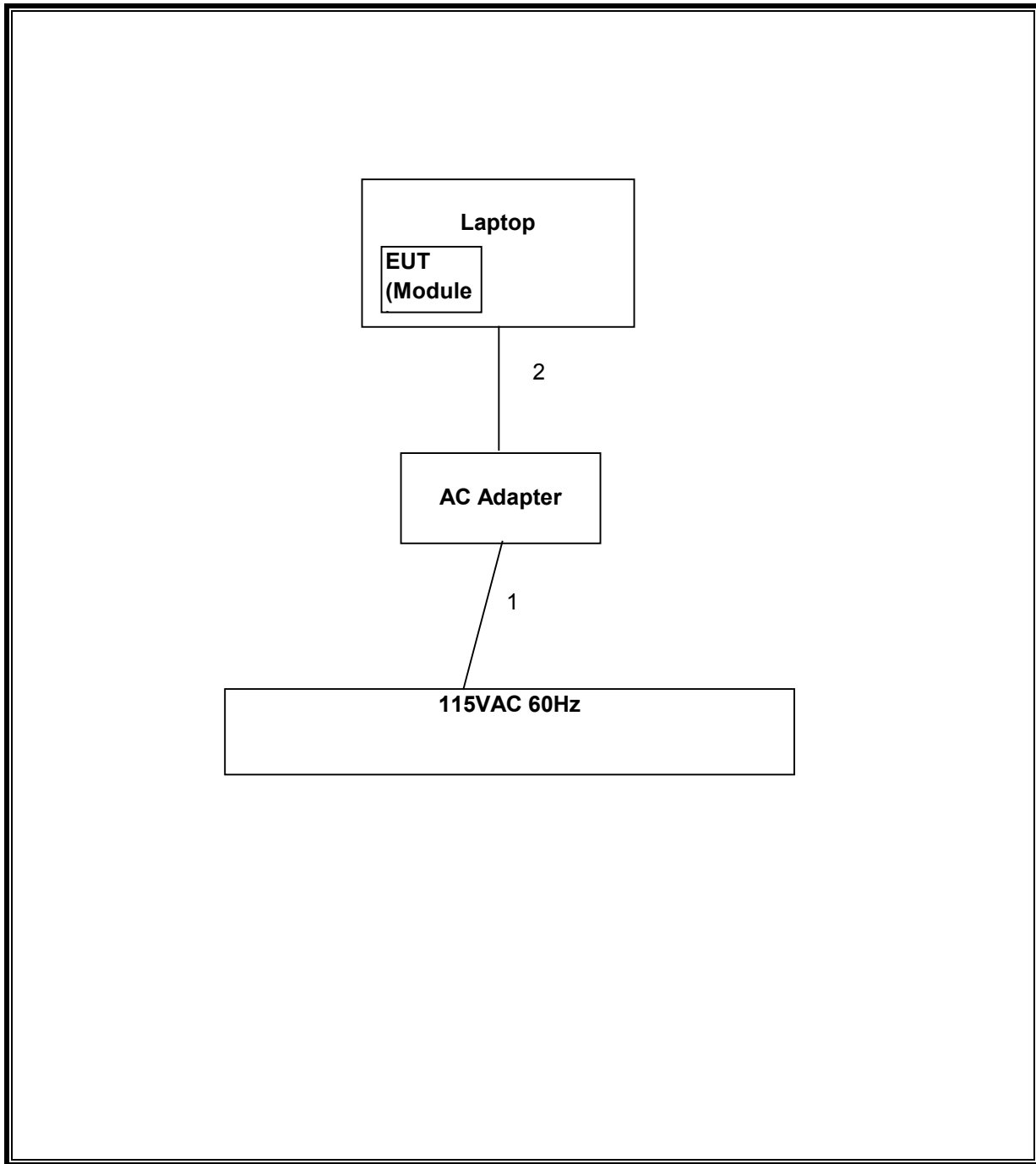
I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	US 115V	Un-shielded	2m	NA
2	DC	1	DC	Un-shielded	2m	NA

### TEST SETUP

The EUT is installed in a host laptop computer during the tests. Test software exercised the radio card.



**SETUP DIAGRAM FOR TESTS**



## 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	12/3/2007	3/3/2009
Peak Power Meter	Agilent / HP	E4416A	C00963	12/4/2007	12/4/2009
Peak / Average Power Sensor	Agilent	E9327A	C00964	12/7/2007	12/7/2009
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01011	9/28/2007	9/28/2008
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01063	9/27/2007	9/27/2008
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00589	9/29/2007	9/29/2008
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	10/11/2007	10/11/2008
EMI Receiver, 2.9 GHz	Agilent / HP	8542E	C00957	2/6/2007	6/12/2008
RF Filter Section, 2.9 GHz	Agilent / HP	85420E	C00958	2/6/2007	6/12/2008
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	2/6/2008	8/6/2009
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	10/25/2007	10/25/2008
High Pass Filter 7.6GHz	Micro Tronics	HPM13195	N02681	CNR	CNR
Reject Filter, 5.15-5.35 GHz	Micro-Tronics	BRC13190	N02679	CNR	CNR
Reject Filter, 5.47-5.725 GHz	Micro-Tronics	BRC13191	N02678	CNR	CNR
Antenna, Horn, 18 GHz	EMCO	3115	C00945	4/22/2008	4/22/2009
Antenna, Horn, 18 GHz	EMCO	3115	C00872	4/22/2008	4/22/2009

## 7. RADIATED TEST RESULTS

### 7.1. 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.

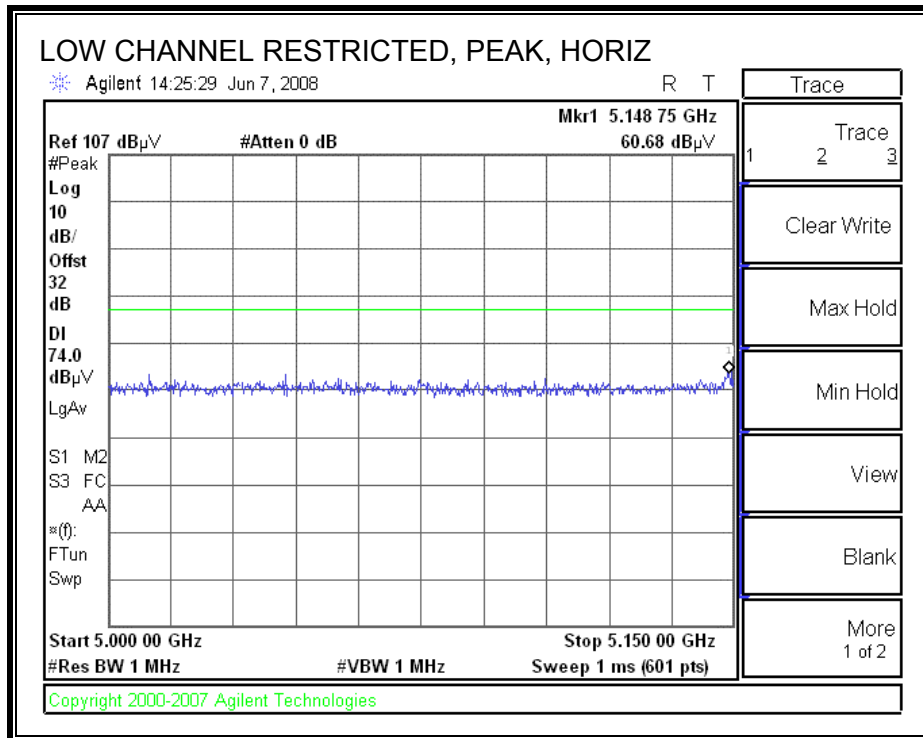
For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

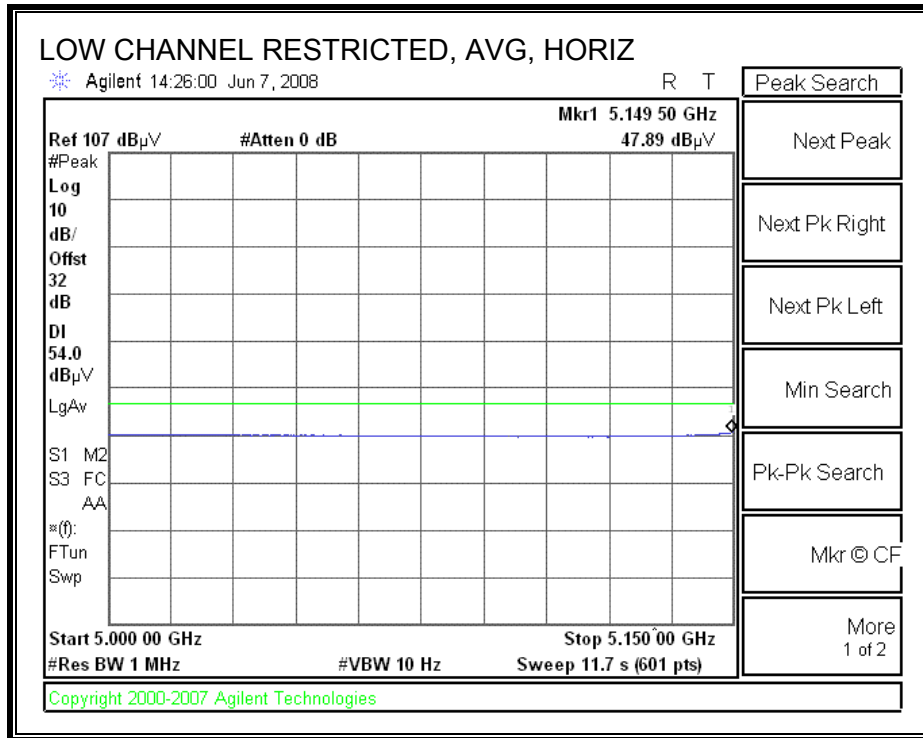
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

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.

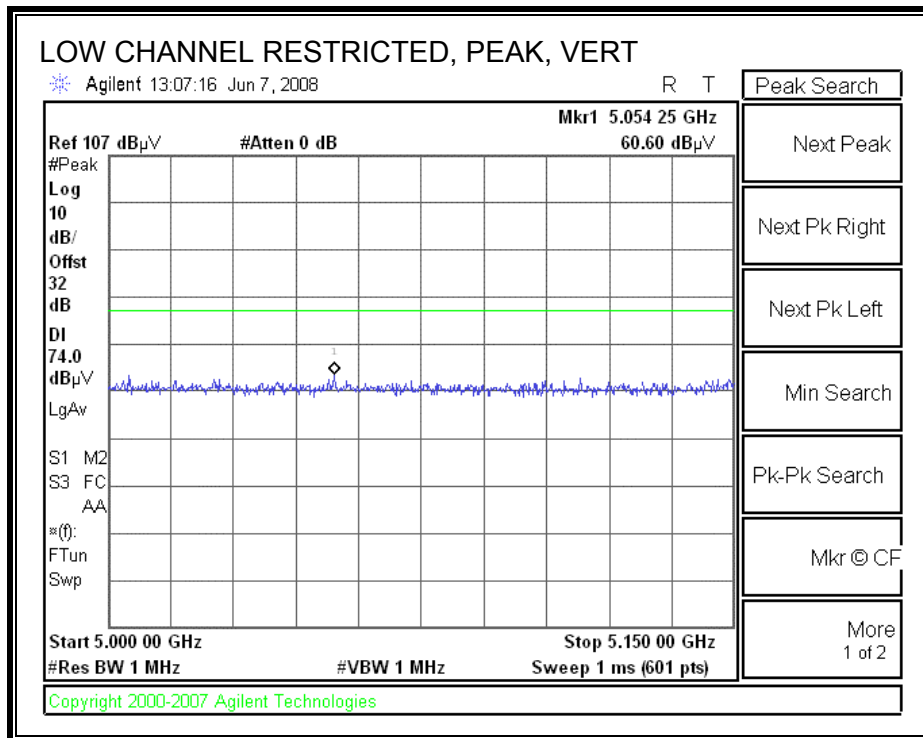
### 7.1.1. TRANSMITTER ABOVE 1 GHz FOR 802.11a MODE IN THE LOWER 5.2 GHz BAND

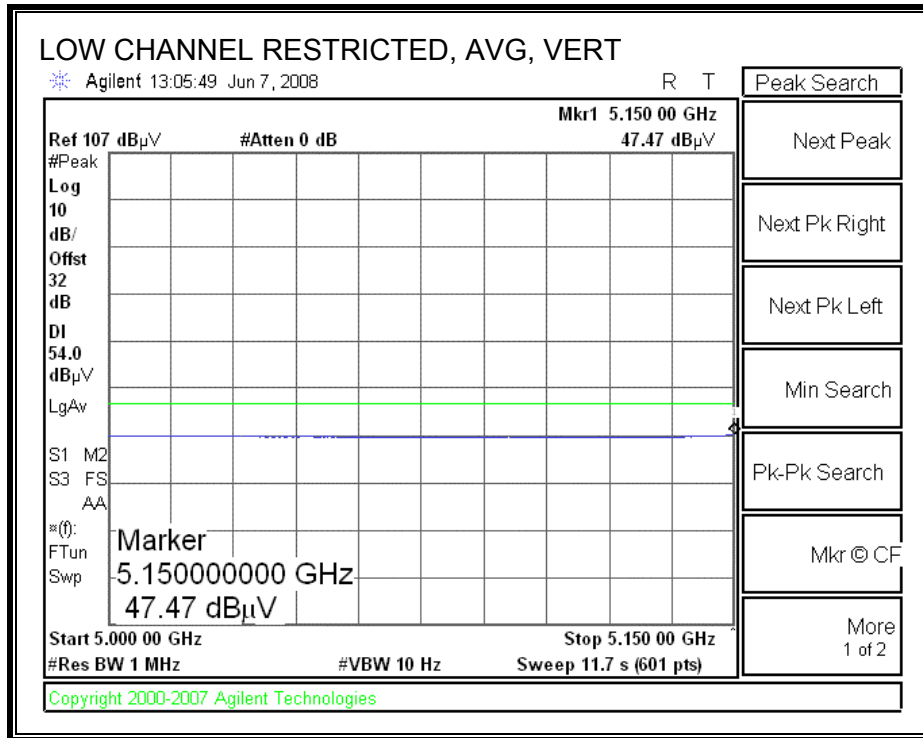
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





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





**HARMONICS AND SPURIOUS EMISSIONS**

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 5m Chamber

Company: Atheros Communication Inc.  
 Project #: 08U11860  
 Date: 6/7/2008  
 Test Engineer: Chin Pang  
 Configuration: EUT with Laptop  
 Mode: Tx, a Mode, 5.2GHz Band

**Test Equipment:**

Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931		T89; ARA 18.26GHz; S/N:1049	FCC 15.205

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter	Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz ; VBW=10Hz
		A.5m Chamber	HPF_7.6GHz		

f GHz	Dist (m)	Read Pk dBuV	Read Avg dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fldr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
<b>Low Ch. 5180MHz</b>															
15.540	3.0	43.5	30.5	38.1	12.7	-34.8	0.0	0.7	60.1	47.1	74	54	-13.9	-6.9	V
15.540	3.0	44.0	31.0	38.1	12.7	-34.8	0.0	0.7	60.6	47.6	74	54	-13.4	-6.4	H
<b>Mid Ch. 5220MHz</b>															
15.660	3.0	43.4	30.7	37.8	12.7	-34.7	0.0	0.7	59.9	47.2	74	54	-14.1	-6.8	V
15.660	3.0	43.6	30.8	37.8	12.7	-34.7	0.0	0.7	60.1	47.3	74	54	-13.9	-6.7	H
<b>High Ch. 5240MHz</b>															
15.720	3.0	43.0	30.2	37.6	12.8	-34.7	0.0	0.7	59.4	46.6	74	54	-14.6	-7.4	V
15.720	3.0	43.8	30.6	37.6	12.8	-34.7	0.0	0.7	60.2	47.0	74	54	-13.8	-7.0	H

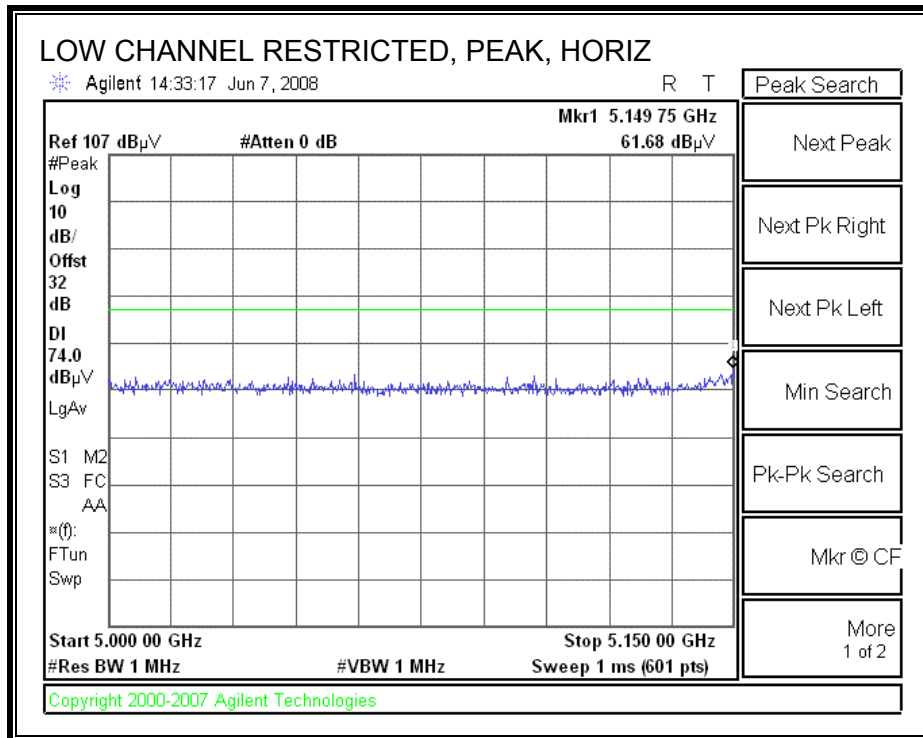
Rev. 4.12.7  
**Note: No other emissions were found above the noise floor.**

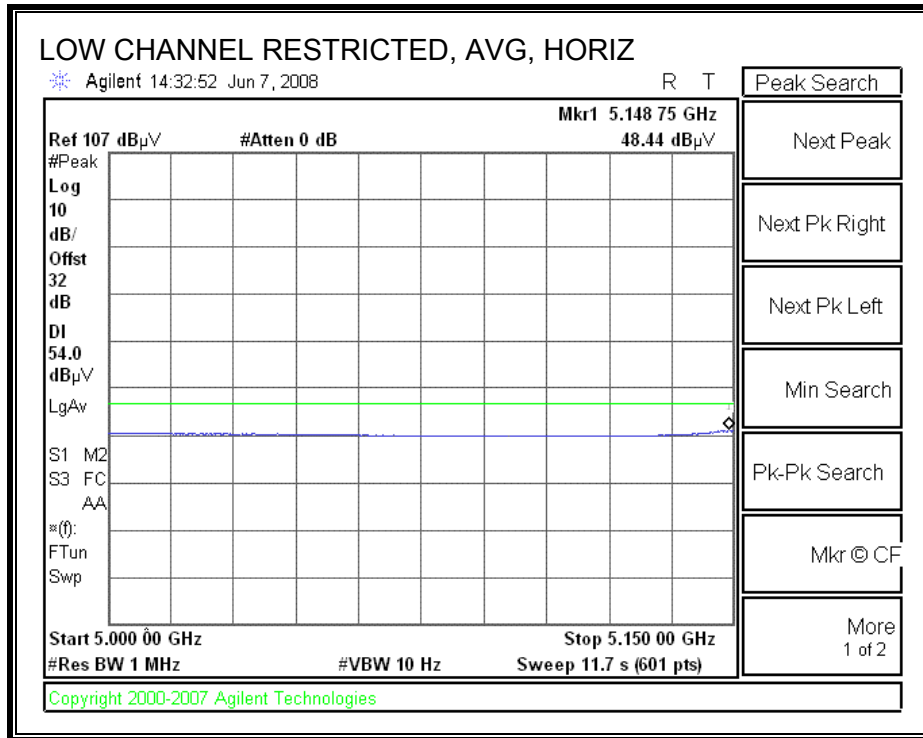
f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		



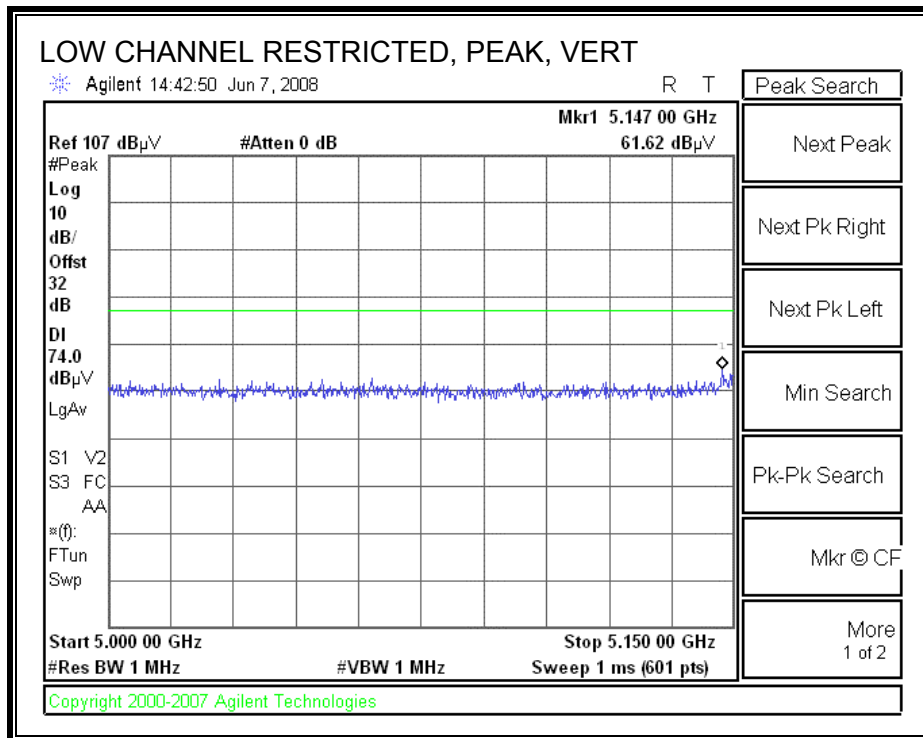
### 7.1.2. TRANSMITTER ABOVE 1 GHz FOR 802.11n HT20 MODE IN THE LOWER 5.2 GHz BAND

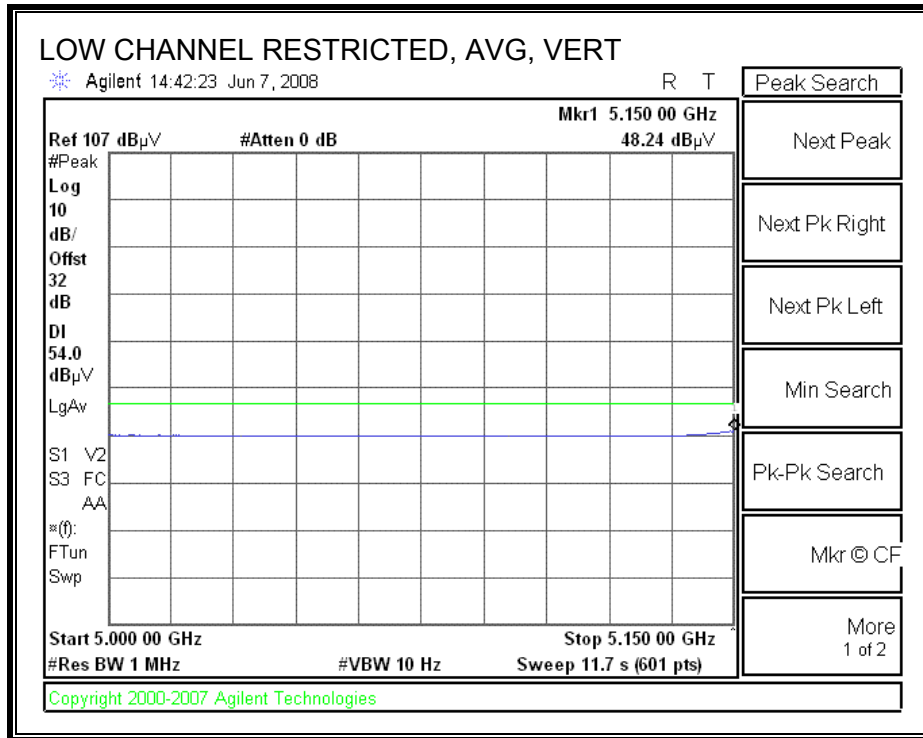
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





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





**HARMONICS AND SPURIOUS EMISSIONS**

**High Frequency Measurement**

Compliance Certification Services, Fremont 5m Chamber

Company: Atheros Communication Inc.  
 Project #: 08U11860  
 Date: 6/7/2008  
 Test Engineer: Chin Pang  
 Configuration: EUT with Laptop  
 Mode: Tx, 5.2GHz HT20

**Test Equipment:**

Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931		T89; ARA 18-26GHz; S/N:1049	FCC 15.205

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter	Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz; VBW=10Hz
		A5m Chamber	HPF_7.6GHz		

f GHz	Dist (m)	Read Pk dBuV	Read Avg dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
<b>Low Ch. 5180MHz</b>															
15.540	3.0	44.0	31.2	38.1	12.7	-34.8	0.0	0.7	60.6	47.8	74	54	-13.4	-6.2	V
15.540	3.0	44.5	31.5	38.1	12.7	-34.8	0.0	0.7	61.1	48.1	74	54	-12.9	-5.9	H
<b>Mid Ch. 5220MHz</b>															
15.660	3.0	44.3	31.3	37.8	12.7	-34.7	0.0	0.7	60.8	47.8	74	54	-13.2	-6.2	V
15.660	3.0	44.7	32.0	37.8	12.7	-34.7	0.0	0.7	61.2	48.5	74	54	-12.8	-5.5	H
<b>High Ch. 5240MHz</b>															
15.720	3.0	44.0	31.0	37.6	12.8	-34.7	0.0	0.7	60.4	47.4	74	54	-13.6	-6.6	V
15.720	3.0	44.6	31.5	37.6	12.8	-34.7	0.0	0.7	61.0	47.9	74	54	-13.0	-6.1	H

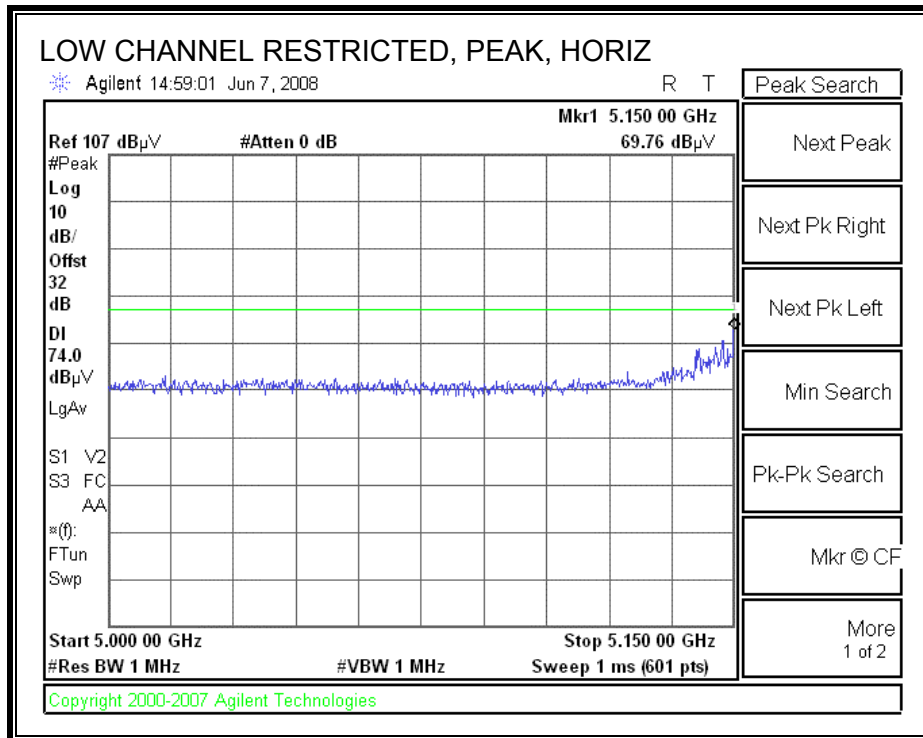
Rev. 4127

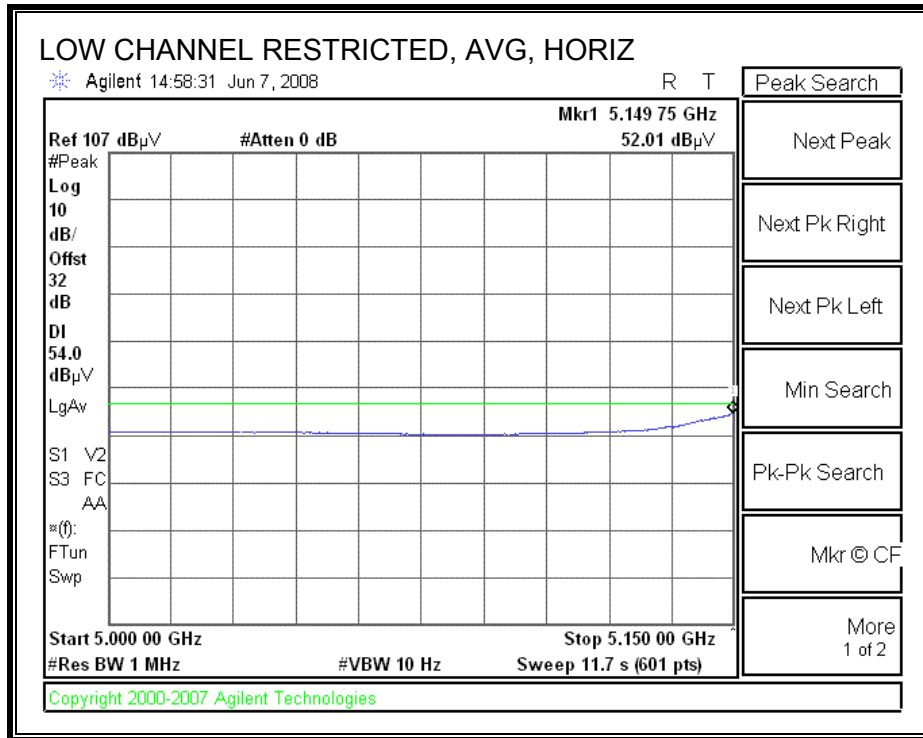
**Note: No other emissions were detected above the system noise floor.**

f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

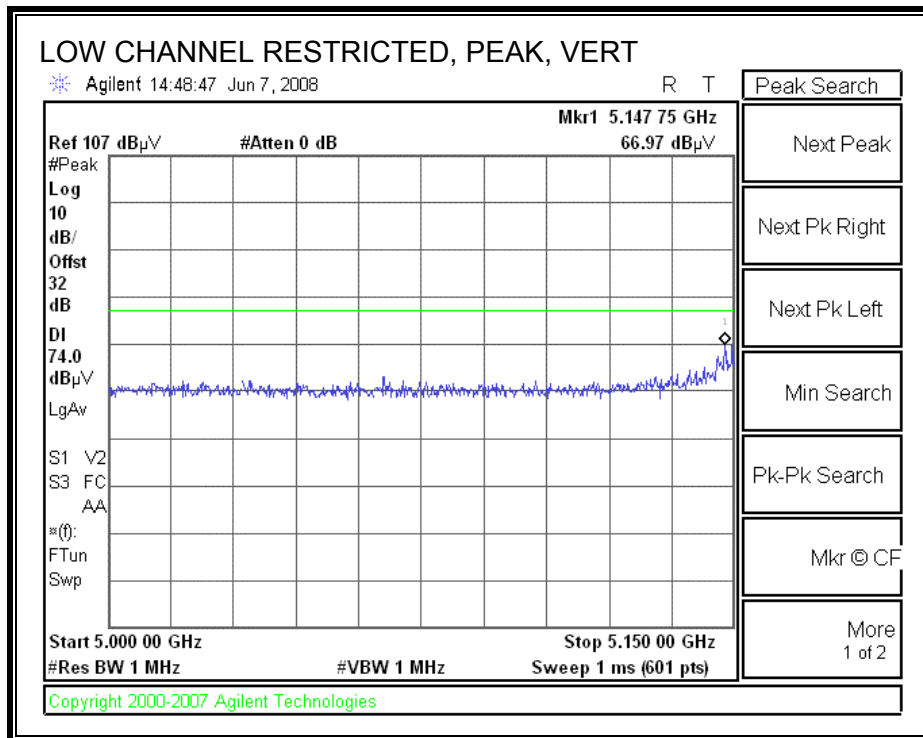
### 7.1.3. TRANSMITTER ABOVE 1 GHz FOR 802.11n HT40 MODE IN THE LOWER 5.2 GHz BAND

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

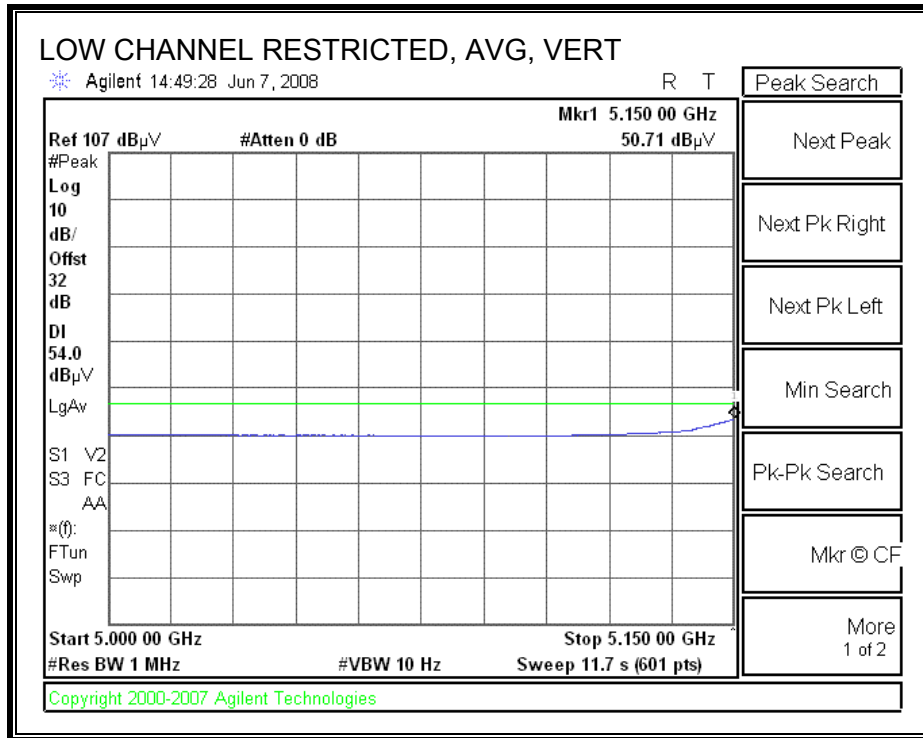




**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**





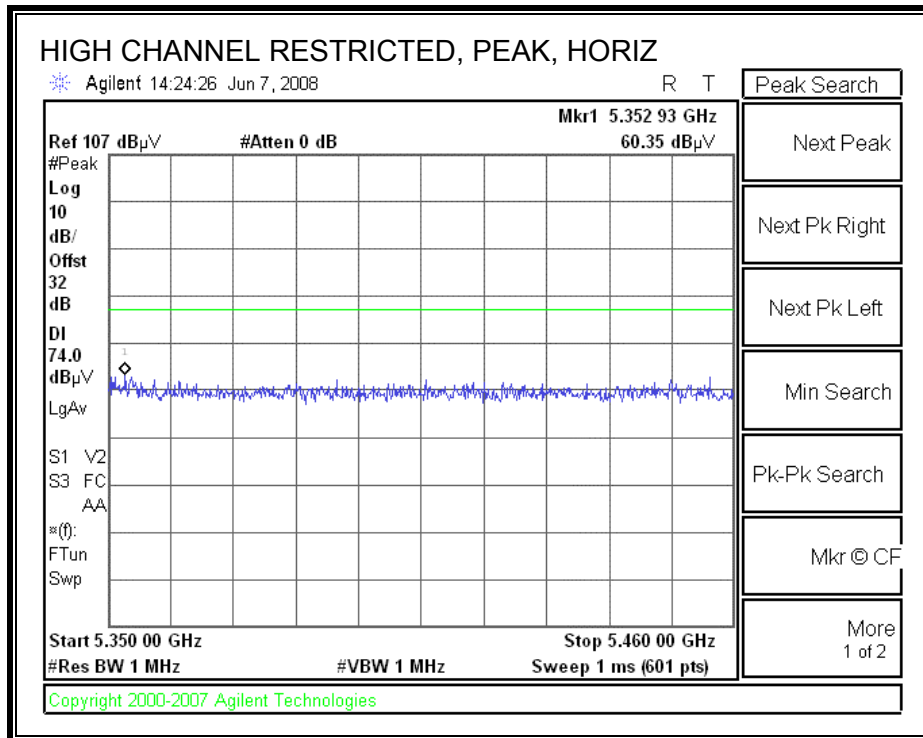


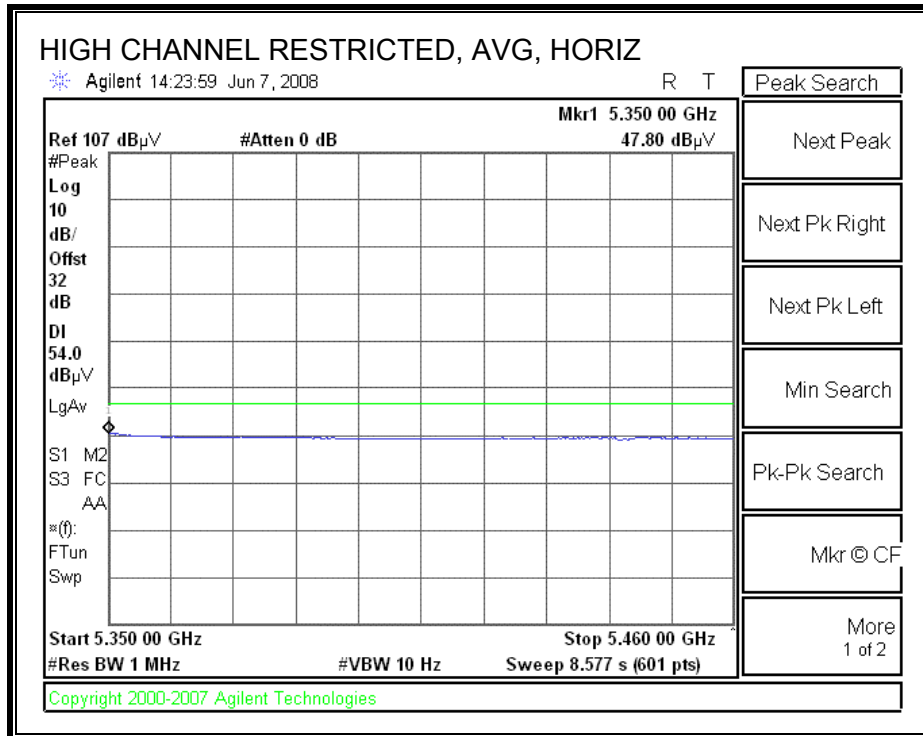
**HARMONICS AND SPURIOUS EMISSIONS**

<p align="center"><b>High Frequency Measurement</b></p> <p>Compliance Certification Services, Fremont 5m Chamber</p> <p>Company: Atheros Communication Inc.                  Project #: 08U11860                  Date: 6/7/2008                  Test Engineer: Chin Pang                  Configuration: EUT with Laptop                  Mode: Tx, a Mode, HT40, Lower Band</p> <p><u>Test Equipment:</u></p> <table border="1"> <tr> <td>Horn 1-18GHz T73; S/N: 6717 @3m</td> <td>Pre-amplifier 1-26GHz T144 Miteq 3008A00931</td> <td>Pre-amplifier 26-40GHz</td> <td>Horn &gt; 18GHz T89; ARA 18-26GHz; S/N:1049</td> <td>Limit FCC 15.205</td> </tr> </table> <p>Hi Frequency Cables</p> <table border="1"> <tr> <td>2 foot cable</td> <td>3 foot cable</td> <td>12 foot cable A-5m Chamber</td> <td>HPF HPF_7.6GHz</td> <td>Reject Filter</td> <td>Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz ; VBW=10Hz</td> </tr> </table>																	Horn 1-18GHz T73; S/N: 6717 @3m	Pre-amplifier 1-26GHz T144 Miteq 3008A00931	Pre-amplifier 26-40GHz	Horn > 18GHz T89; ARA 18-26GHz; S/N:1049	Limit FCC 15.205	2 foot cable	3 foot cable	12 foot cable A-5m Chamber	HPF HPF_7.6GHz	Reject Filter	Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz ; VBW=10Hz
Horn 1-18GHz T73; S/N: 6717 @3m	Pre-amplifier 1-26GHz T144 Miteq 3008A00931	Pre-amplifier 26-40GHz	Horn > 18GHz T89; ARA 18-26GHz; S/N:1049	Limit FCC 15.205																							
2 foot cable	3 foot cable	12 foot cable A-5m Chamber	HPF HPF_7.6GHz	Reject Filter	Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz ; VBW=10Hz																						
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)												
<b>Low Ch. 5190MHz:</b>																											
15.570	3.0	43.5	30.5	38.0	12.7	-34.8	0.0	0.7	60.1	47.1	74	54	-13.9	-6.9	V												
15.570	3.0	44.0	31.0	38.0	12.7	-34.8	0.0	0.7	60.6	47.6	74	54	-13.4	-6.4	H												
<b>High Ch. 5230MHz:</b>																											
15.690	3.0	43.5	31.0	37.7	12.7	-34.7	0.0	0.7	60.0	47.5	74	54	-14.0	-6.5	V												
15.690	3.0	43.8	31.3	37.7	12.7	-34.7	0.0	0.7	60.3	47.8	74	54	-13.7	-6.2	H												
Rev. 4.12.7																											
<b>Note: No other emissions w</b>																											
f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit																						
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit																						
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit																						
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit																						
CL	Cable Loss	HPF	High Pass Filter																								

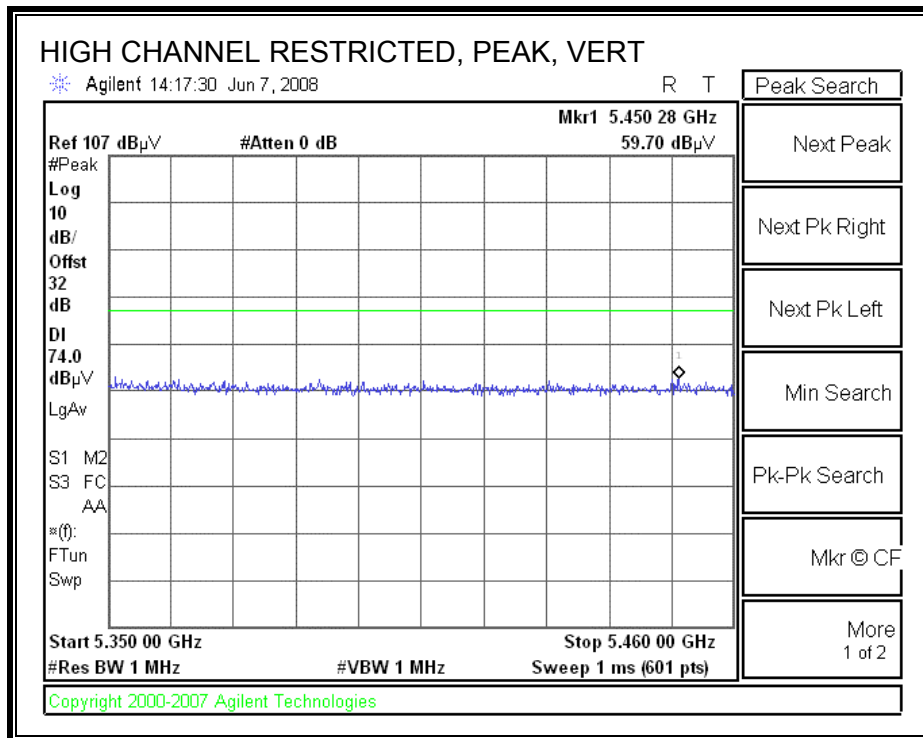
### 7.1.4. TRANSMITTER ABOVE 1 GHz FOR 802.11a MODE IN THE UPPER 5.2 GHz BAND

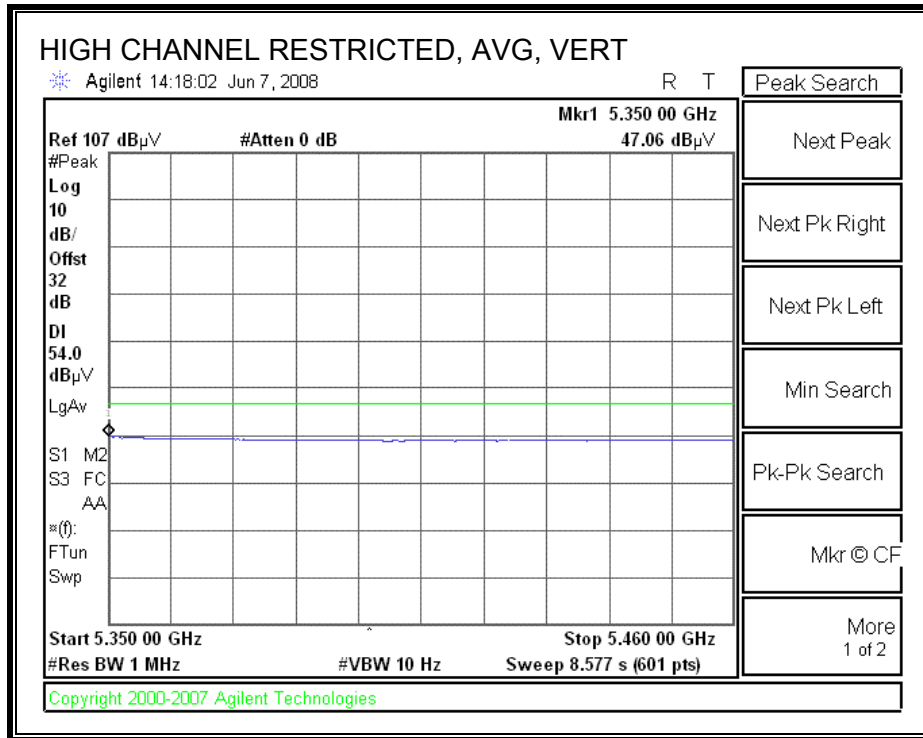
#### RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





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





**HARMONICS AND SPURIOUS EMISSIONS**

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 5m Chamber

Company: Atheros Communication Inc.  
 Project #: 08U11860  
 Date: 6/7/2008  
 Test Engineer: Chin Pang  
 Configuration: EUT with Laptop  
 Mode: Tx, a Mode, 5.3GHz Upper Band

**Test Equipment:**

Horn 1-18GHz T73; S/N: 6717 @3m	Pre-amplifier 1-26GHz T144 Miteq 3008A00931	Pre-amplifier 26-40GHz	Horn > 18GHz T89; ARA 18-26GHz; S/N:1049	Limit FCC 15.205
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Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable A-5m Chamber	HPF HPF_7.6GHz	Reject Filter
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Peak Measurements  
 RBW=VBW=1MHz  
Average Measurements  
 RBW=1MHz ; VBW=10Hz

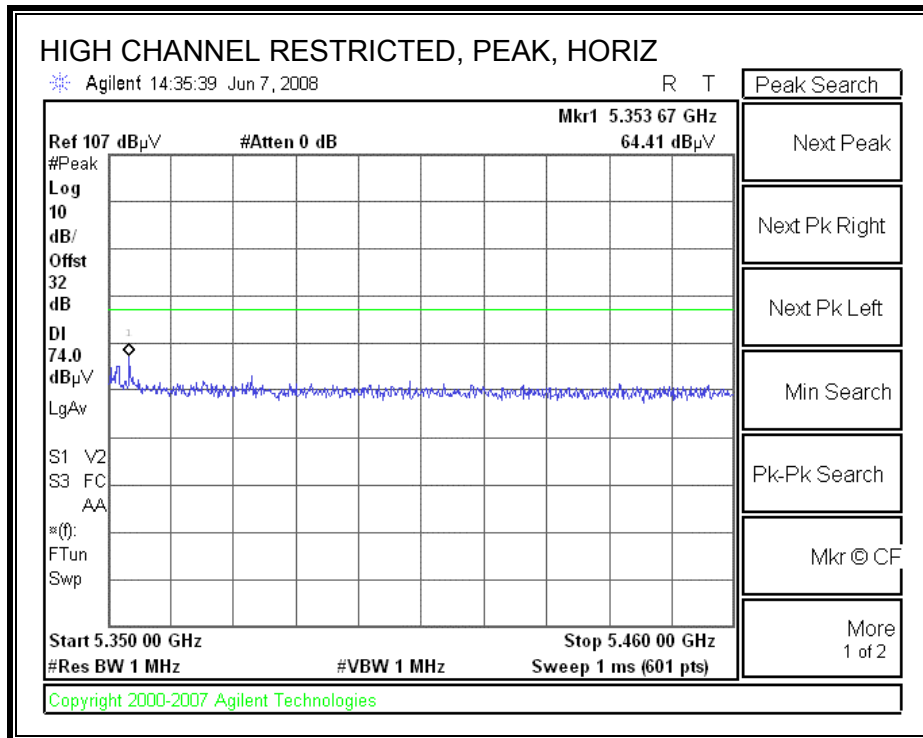
f GHz	Dist (m)	Read Pk dBuV	Read Avg dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
<b>Low Ch. 5260MHz</b>															
15.780	3.0	45.0	33.0	37.5	12.8	-34.6	0.0	0.7	61.4	49.4	74	54	-12.6	-4.6	V
15.780	3.0	45.6	33.3	37.5	12.8	-34.6	0.0	0.7	62.0	49.7	74	54	-12.0	-4.3	H
<b>Mid Ch. 5300MHz</b>															
10.600	3.0	42.8	29.5	37.1	10.7	-36.6	0.0	0.8	54.7	41.4	74	54	-19.3	-12.6	V
15.900	3.0	43.6	30.5	37.2	12.8	-34.6	0.0	0.7	59.8	46.7	74	54	-14.2	-7.3	V
10.600	3.0	43.5	30.0	37.1	10.7	-36.6	0.0	0.8	55.4	41.9	74	54	-18.6	-12.1	H
15.900	3.0	44.0	30.8	37.2	12.8	-34.6	0.0	0.7	60.2	47.0	74	54	-13.8	-7.0	H
<b>High Ch.5320MHz</b>															
10.640	3.0	41.3	29.0	37.1	10.7	-36.6	0.0	0.8	53.3	41.0	74	54	-20.7	-13.0	V
15.960	3.0	44.4	31.5	37.1	12.8	-34.5	0.0	0.7	60.5	47.6	74	54	-13.5	-6.4	V
10.640	3.0	41.5	29.3	37.1	10.7	-36.6	0.0	0.8	53.5	41.3	74	54	-20.5	-12.7	H
15.960	3.0	44.8	32.0	37.1	12.8	-34.5	0.0	0.7	60.9	48.1	74	54	-13.1	-5.9	H

Rev. 4.12.7  
**Note: No other emissions were found above the noise floor.**

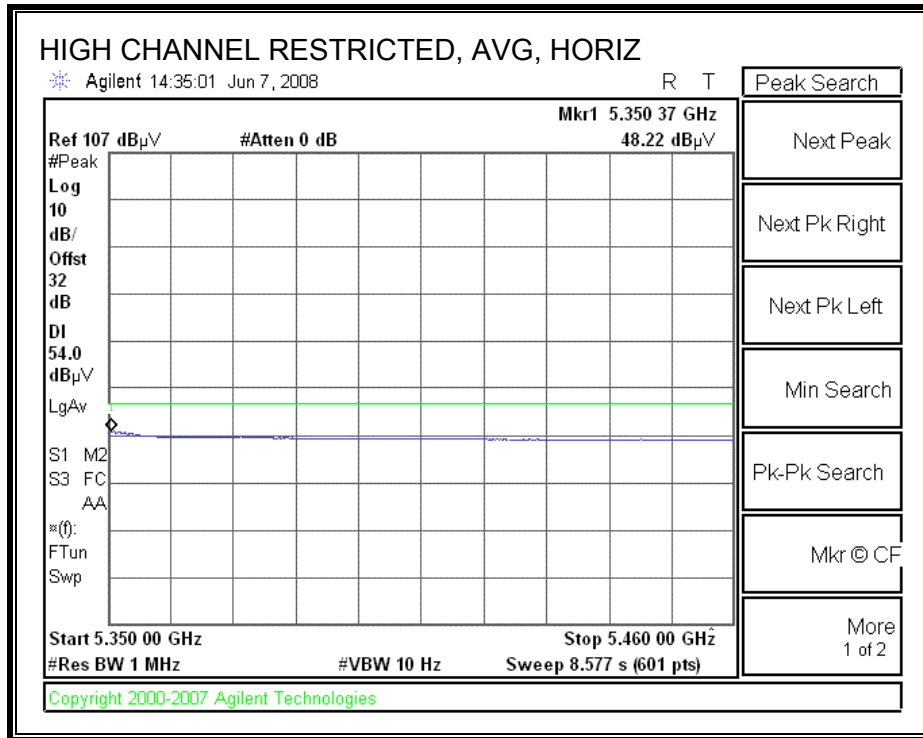
f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

### 7.1.5. TRANSMITTER ABOVE 1 GHz FOR 802.11n HT20 MODE IN THE UPPER 5.2 GHz BAND

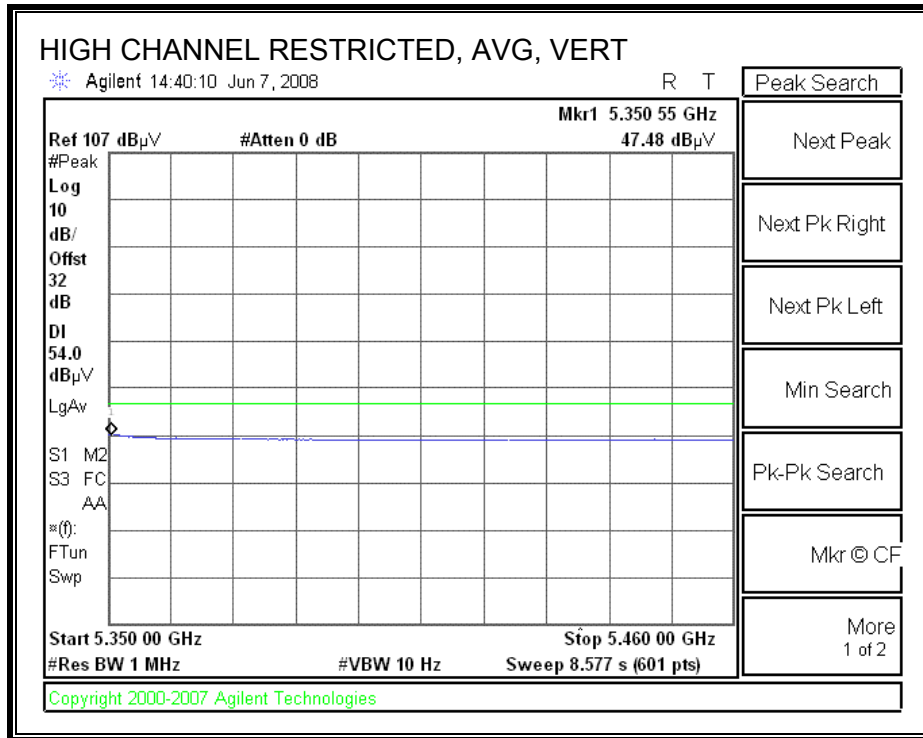
#### RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)











**HARMONICS AND SPURIOUS EMISSIONS**

**High Frequency Measurement**

Compliance Certification Services, Fremont 5m Chamber

Company: Atheros Communication Inc.  
 Project #: 08U11860  
 Date: 6/7/2008  
 Test Engineer: Chin Pang  
 Configuration: EUT with Laptop  
 Mode: Tx, 5.3GHz Band, HT20 Mode

**Test Equipment:**

Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931		T89; ARA 18-26GHz; S/N:1049	FCC 15.205

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter	Peak Measurements RBW=VBW=1MHz
		A-5m Chamber	HPF_7.6GHz		Average Measurements RBW=1MHz ; VBW=10Hz

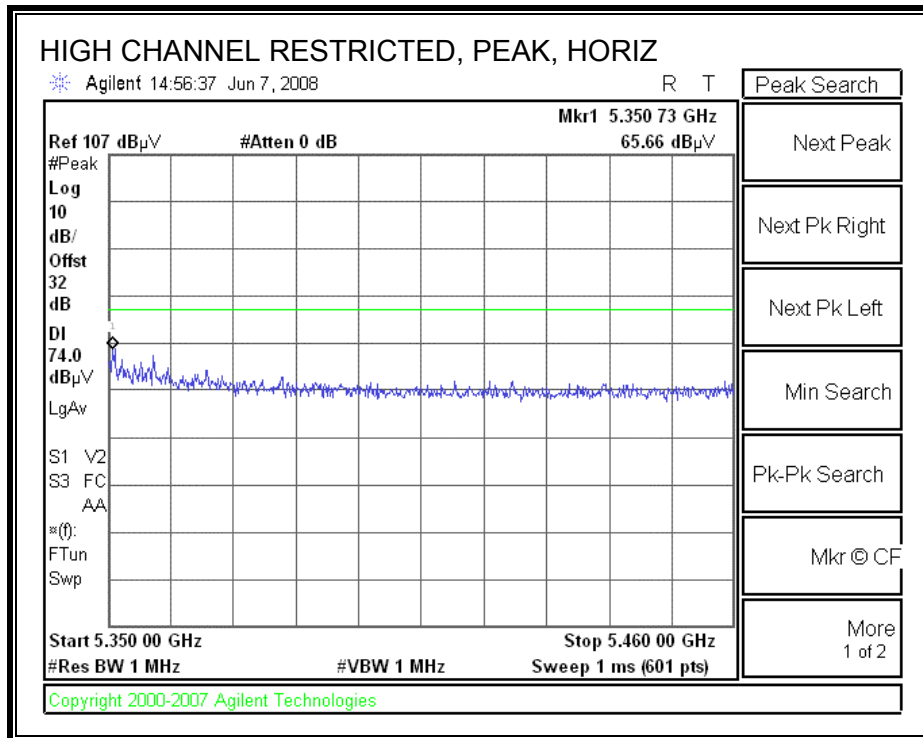
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
<b>Low Ch. 5260MHz</b>															
15.780	3.0	45.5	33.0	37.5	12.8	-34.6	0.0	0.7	61.9	49.4	74	54	-12.1	-4.6	V
15.780	3.0	45.0	32.2	37.5	12.8	-34.6	0.0	0.7	61.4	48.6	74	54	-12.6	-5.4	H
<b>Mid Ch. 5300MHz</b>															
10.600	3.0	43.8	31.5	37.1	10.7	-36.6	0.0	0.8	55.7	43.4	74	54	-18.3	-10.6	V
15.900	3.0	45.0	32.6	37.2	12.8	-34.6	0.0	0.7	61.2	48.8	74	54	-12.8	-5.2	V
10.600	3.0	43.3	31.7	37.1	10.7	-36.6	0.0	0.8	55.2	43.6	74	54	-18.8	-10.4	H
15.900	3.0	46.0	33.0	37.2	12.8	-34.6	0.0	0.7	62.2	49.2	74	54	-11.8	-4.8	H
<b>High Ch. 5320MHz</b>															
10.640	3.0	44.0	32.0	37.1	10.7	-36.6	0.0	0.8	56.0	44.0	74	54	-18.0	-10.0	V
15.960	3.0	44.6	32.5	37.1	12.8	-34.5	0.0	0.7	60.7	48.6	74	54	-13.3	-5.4	V
10.640	3.0	44.4	32.2	37.1	10.7	-36.6	0.0	0.8	56.4	44.2	74	54	-17.6	-9.8	H
15.960	3.0	45.2	32.8	37.1	12.8	-34.5	0.0	0.7	61.3	48.9	74	54	-12.7	-5.1	H

Rev. 4.12.7  
**Note: No other emissions were found above the noise floor.**

f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

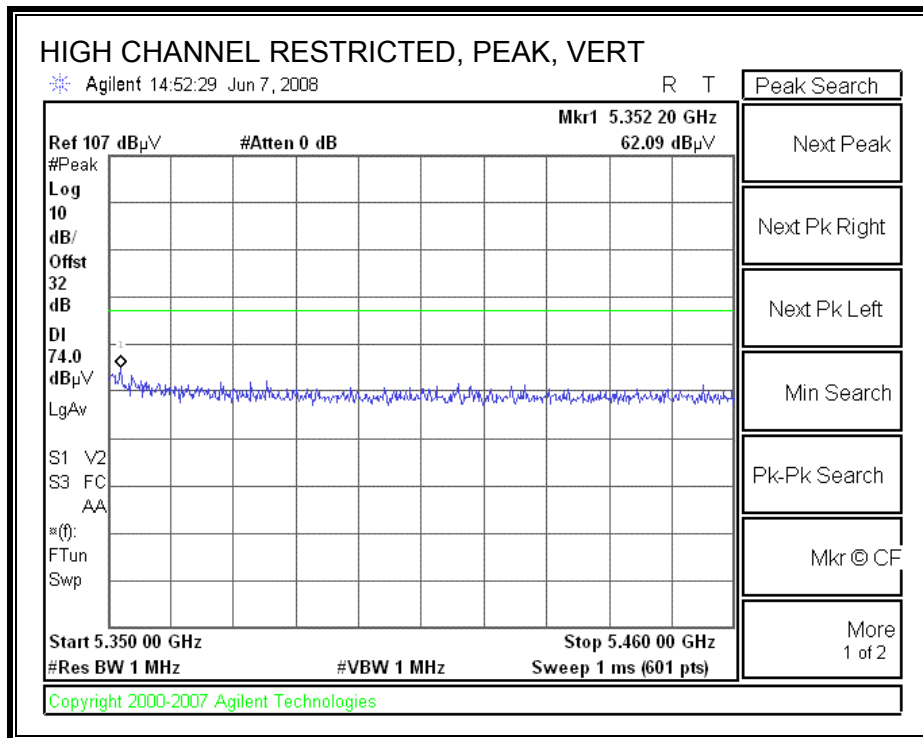
### 7.1.6. TRANSMITTER ABOVE 1 GHz FOR 802.11n HT40 MODE IN THE UPPER 5.2 GHz BAND

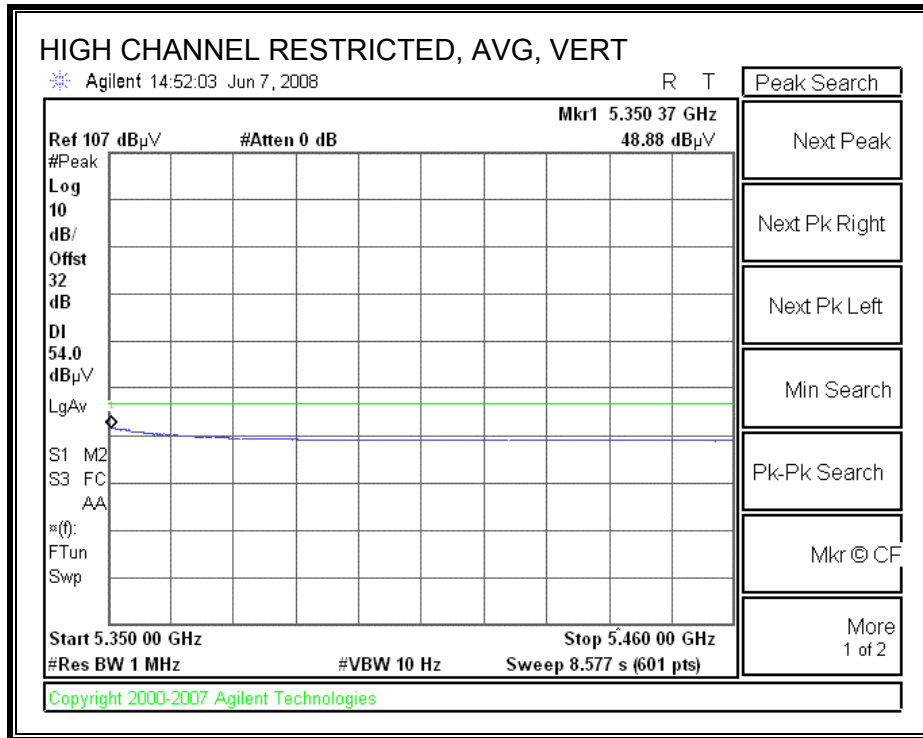
#### RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





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





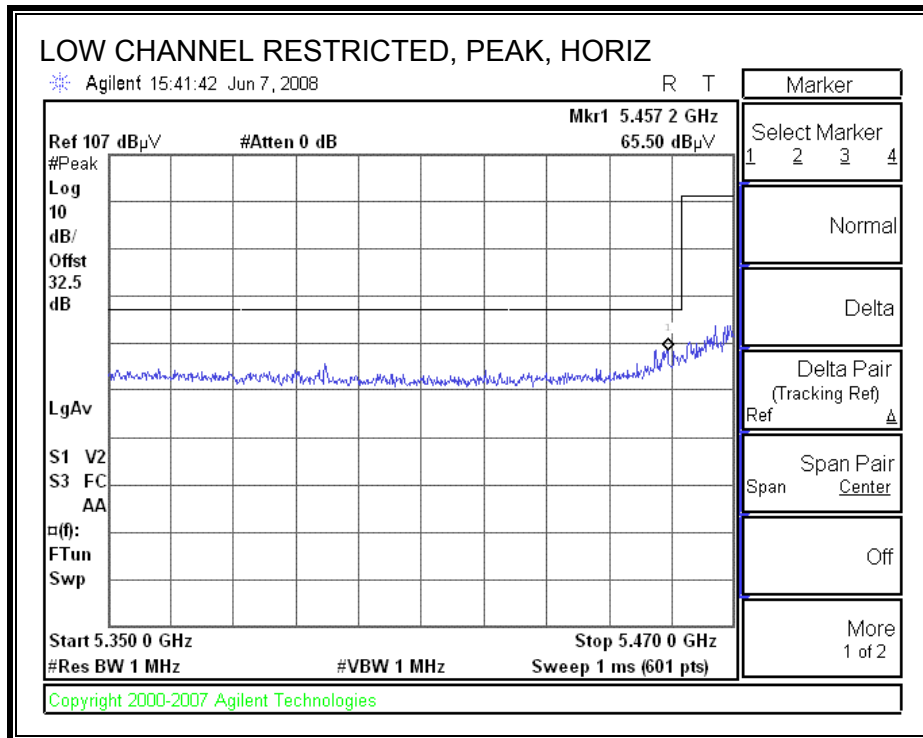


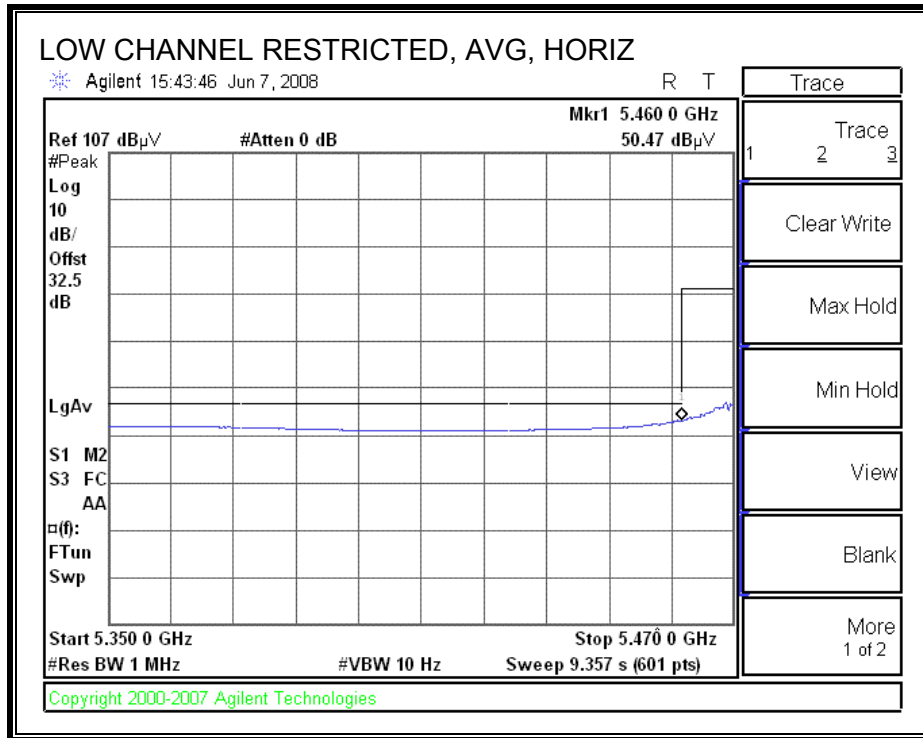
**HARMONICS AND SPURIOUS EMISSIONS**

High Frequency Measurement																	
Compliance Certification Services, Fremont 5m Chamber																	
Company: Atheros Communication Inc.																	
Project #: 08U11860																	
Date: 6/7/2008																	
Test Engineer: Chin Pang																	
Configuration: EUT with Laptop																	
Mode: Tx, a Mode, HT40, Upper Band																	
<u>Test Equipment:</u>																	
Horn 1-18GHz			Pre-amplifier 1-26GHz			Pre-amplifier 26-40GHz			Horn > 18GHz			Limit					
T73; S/N: 6717 @3m			T144 Miteq 3008A00931						T89; ARA 18-26GHz; S/N:1049			FCC 15.205					
Hi Frequency Cables																	
2 foot cable			3 foot cable			12 foot cable			HPF			Reject Filter			Peak Measurements		
						A-5m Chamber			HPF_7.6GHz						RBW=VBW=1MHz		
Average Measurements																	
RBW=1MHz ; VBW=10Hz																	
f	Dist	Read Pk	Read Avg.	AF	CL	Amp	D Corr	Filtr	Peak	Avg	Pk Lim	Avg Lim	Pk Mar	Avg Mar	Notes		
GHz	(m)	dBuV	dBuV	dB/m	dB	dB	dB	dB	dBuV/m	dBuV/m	dBuV/m	dBuV/m	dB	dB	(V/H)		
<b>Low Ch. 5270MHz</b>																	
15.810	3.0	44.5	31.4	37.4	12.8	-34.6	0.0	0.7	60.8	47.7	74	54	-13.2	-6.3	V		
15.810	3.0	43.6	30.4	37.4	12.8	-34.6	0.0	0.7	59.9	46.7	74	54	-14.1	-7.3	H		
<b>High Ch. 5310MHz</b>																	
10.620	3.0	44.4	31.3	37.1	10.7	-36.6	0.0	0.8	56.4	43.3	74	54	-17.6	-10.7	V		
15.930	3.0	44.0	30.6	37.2	12.8	-34.5	0.0	0.7	60.2	46.8	74	54	-13.8	-7.2	V		
10.620	3.0	43.2	30.8	37.1	10.7	-36.6	0.0	0.8	55.2	42.8	74	54	-18.8	-11.2	H		
15.930	3.0	43.6	30.3	37.2	12.8	-34.5	0.0	0.7	59.8	46.5	74	54	-14.2	-7.5	H		
Rev. 4.12.7																	
Note: No other emissions were detected above the system noise floor.																	
f	Measurement Frequency					Amp	Preamp Gain					Avg Lim	Average Field Strength Limit				
Dist	Distance to Antenna					D Corr	Distance Correct to 3 meters					Pk Lim	Peak Field Strength Limit				
Read	Analyzer Reading					Avg	Average Field Strength @ 3 m					Avg Mar	Margin vs. Average Limit				
AF	Antenna Factor					Peak	Calculated Peak Field Strength					Pk Mar	Margin vs. Peak Limit				
CL	Cable Loss					HPF	High Pass Filter										

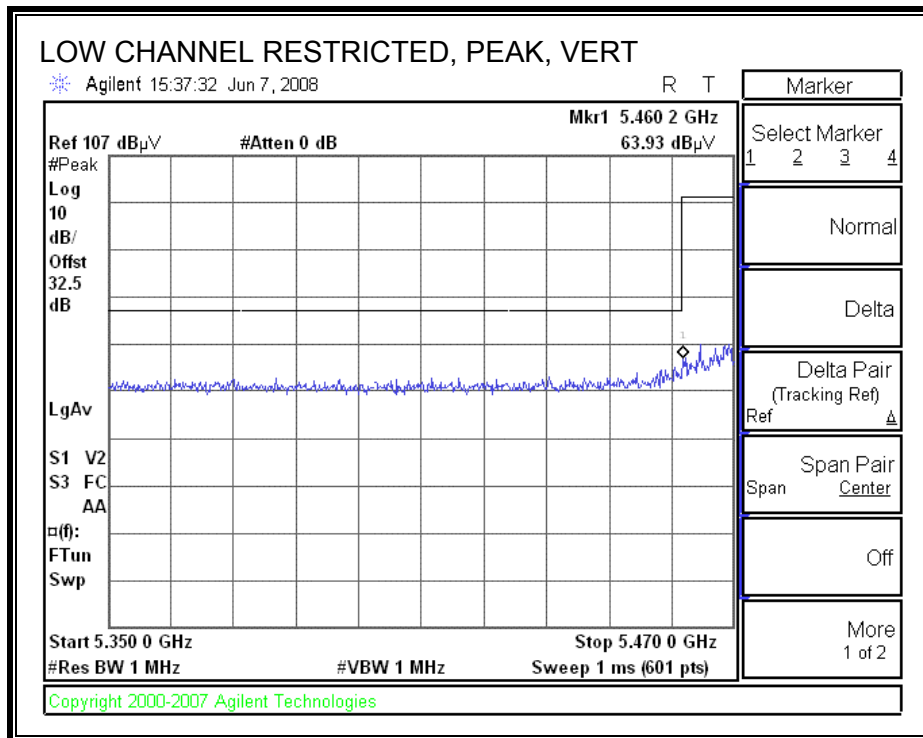
### 7.1.7. TRANSMITTER ABOVE 1 GHz FOR 802.11a MODE IN THE 5.5 GHz BAND

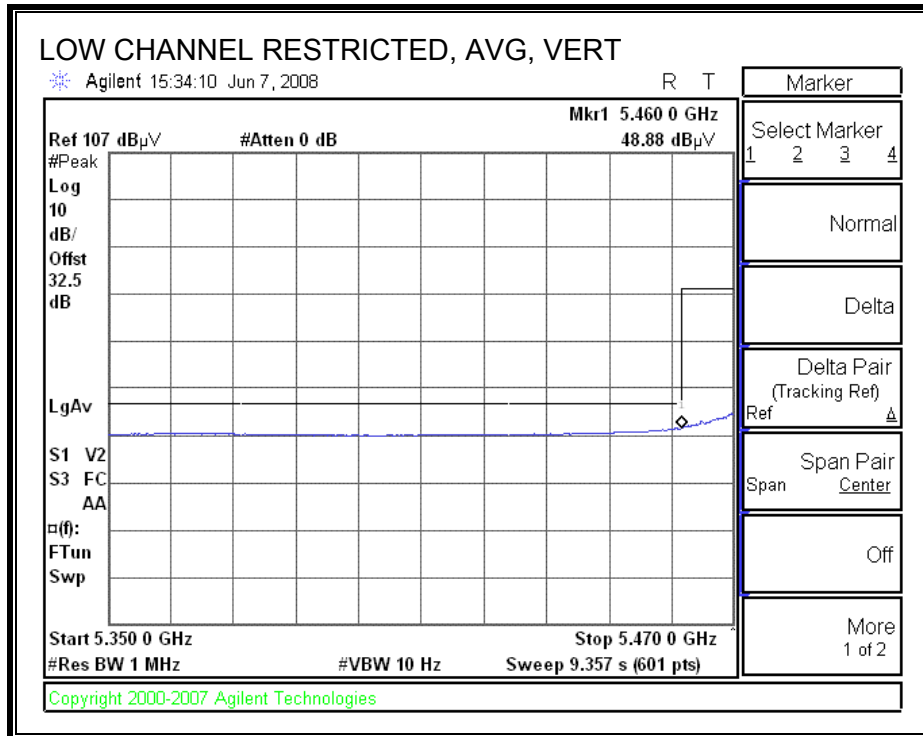
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



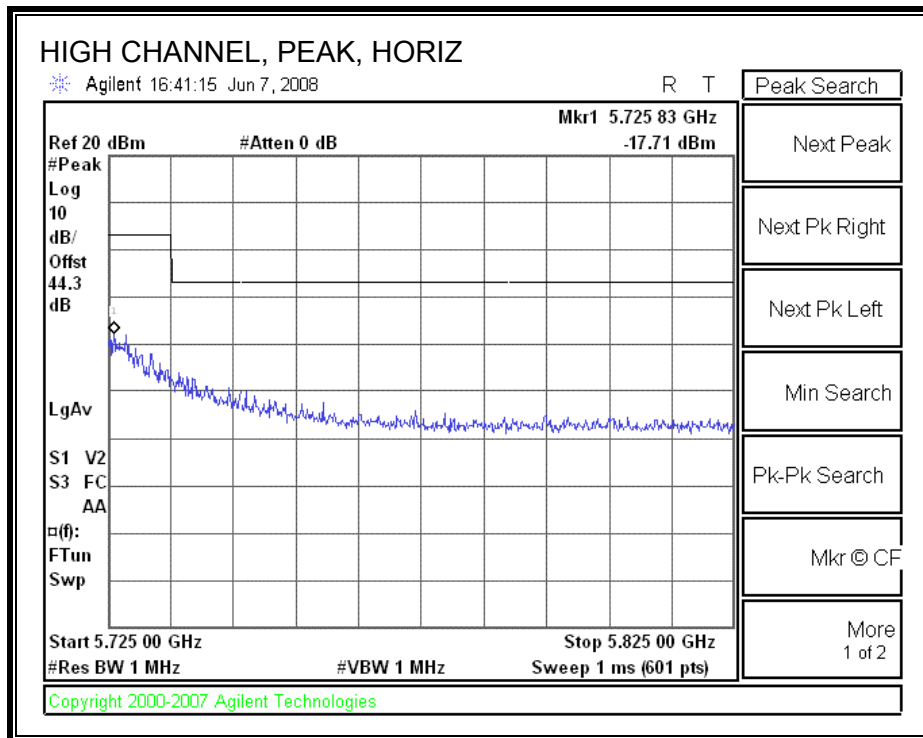


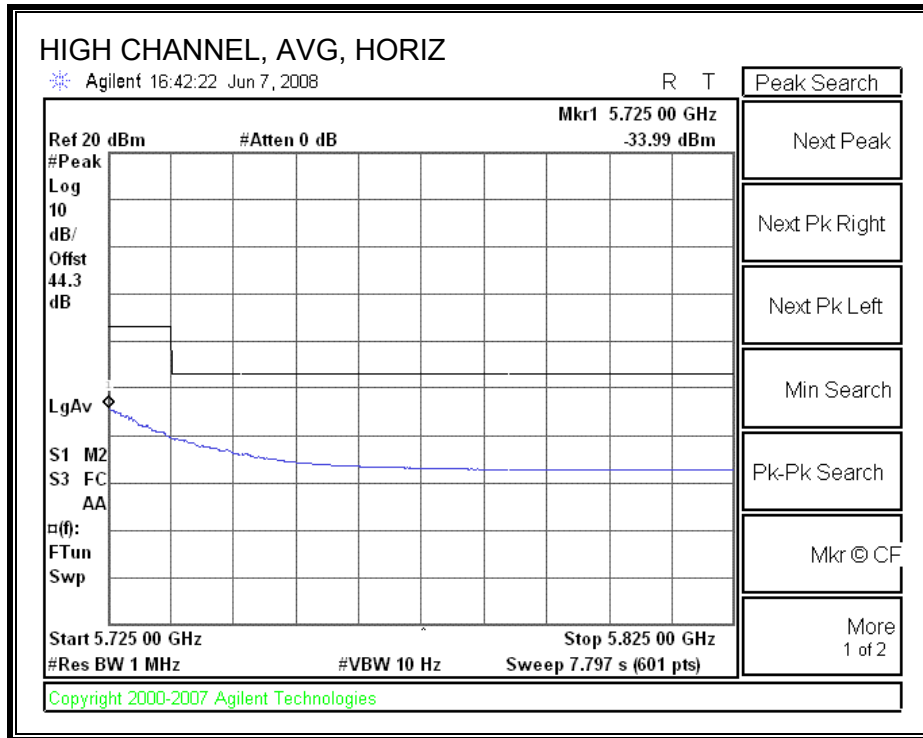
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



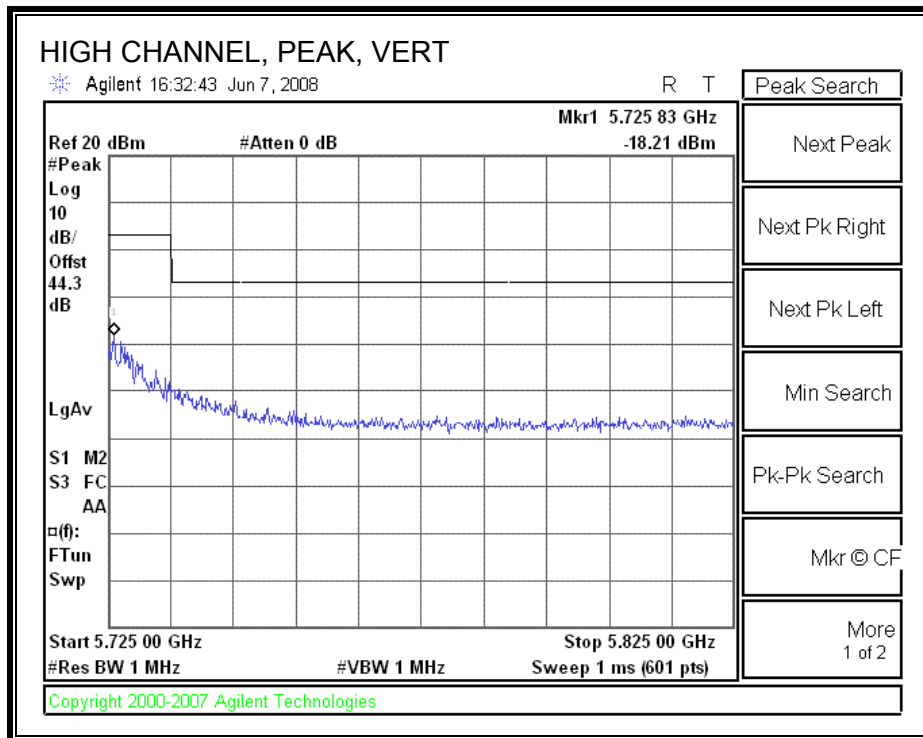


**AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**

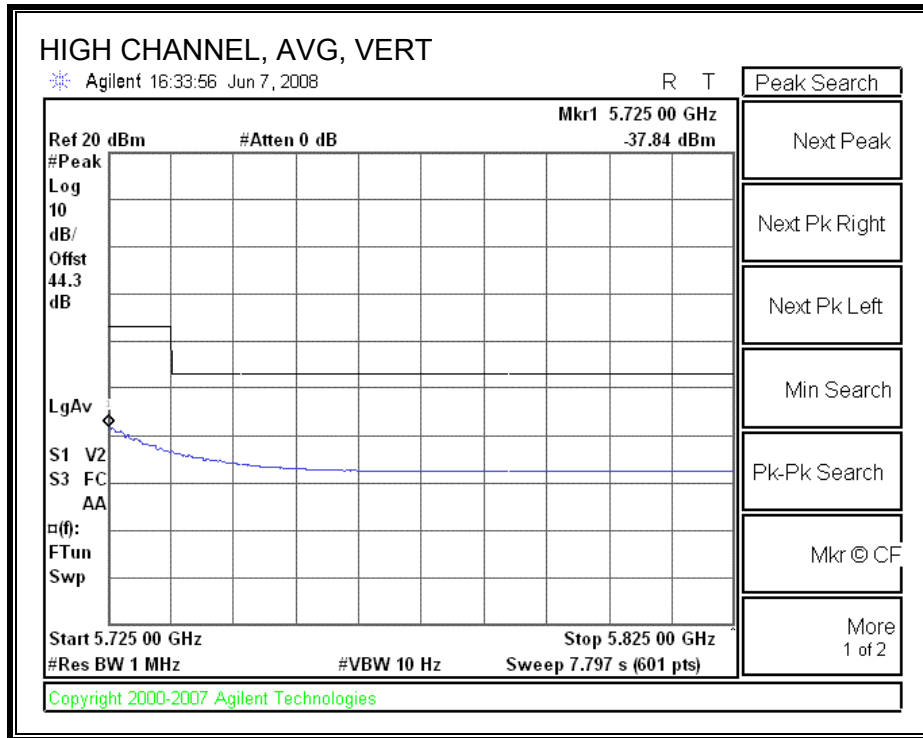




**AUTHORIZED BANDEDGE (HIGH CHANNEL, VERTICAL)**







**HARMONICS AND SPURIOUS EMISSIONS**

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 5m Chamber

Company: Atheros  
 Project #: 08U11860  
 Date: 6/9/2008  
 Test Engineer: Chin Pang  
 Configuration: EUT with Laptop  
 Mode: TX, a mode, 5.6GHz Band

**Test Equipment:**

<b>Horn 1-18GHz</b>	<b>Pre-amplifer 1-26GHz</b>	<b>Pre-amplifer 26-40GHz</b>	<b>Horn &gt; 18GHz</b>	<b>Limit</b>
T60; S/N: 2238 @3m	T145 Agilent 3008A005		T89; ARA 18.26GHz; S/N:1049	FCC 15.205

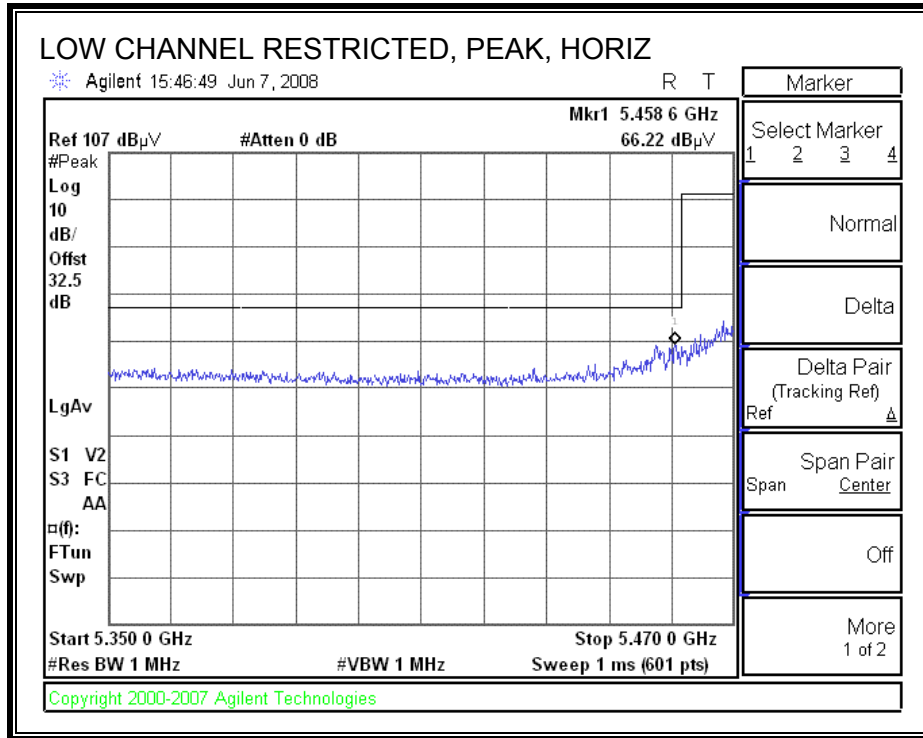
Hi Frequency Cables

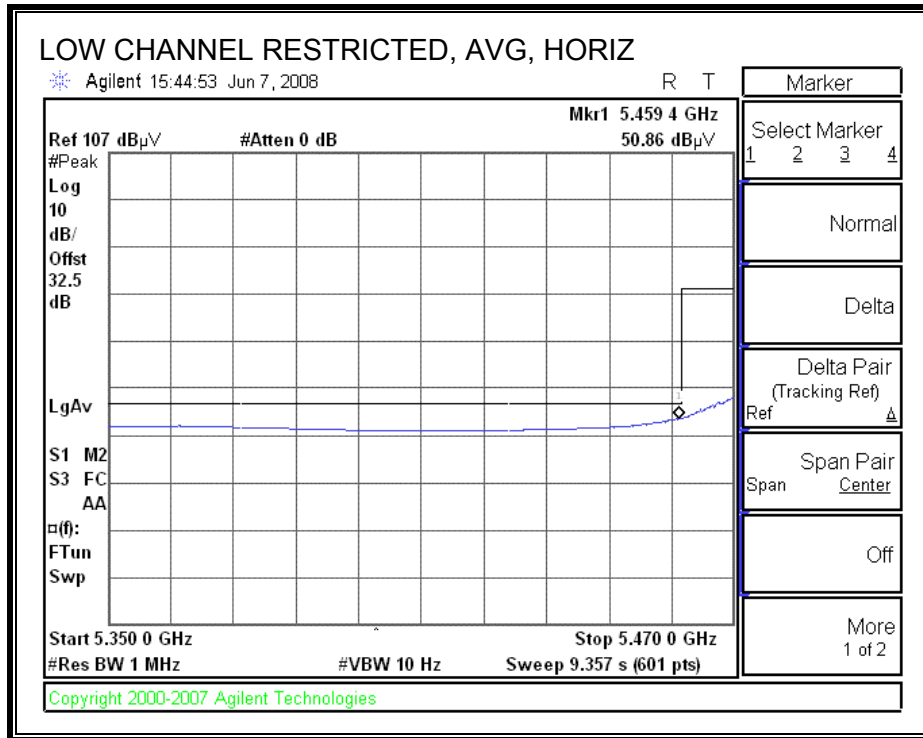
<b>2 foot cable</b>	<b>3 foot cable</b>	<b>12 foot cable</b>	<b>HPF</b>	<b>Reject Filter</b>	<b>Peak Measurements</b> RBW=VBW=1MHz
Thanh 177079008		C.5m Chamber	HPF_7.6GHz		<b>Average Measurements</b> RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
<b>Low Ch, 5500MHz</b>															
11.000	3.0	45.7	32.0	38.6	4.1	-33.8	0.0	0.7	55.4	41.7	74	54	-18.6	-12.3	V
11.000	3.0	44.2	31.7	38.6	4.1	-33.8	0.0	0.7	53.9	41.4	74	54	-20.1	-12.6	H
<b>Mi Ch, 5600MHz</b>															
11.200	3.0	46.6	34.0	38.7	4.1	-33.5	0.0	0.7	56.6	44.0	74	54	-17.4	-10.0	V
11.200	3.0	44.0	31.6	38.7	4.1	-33.5	0.0	0.7	54.0	41.6	74	54	-20.0	-12.4	H
<b>High Ch, 5700MHz</b>															
11.400	3.0	47.0	34.6	38.7	4.2	-33.2	0.0	0.7	57.4	45.0	74	54	-16.6	-9.0	V
11.400	3.0	43.7	31.3	38.7	4.2	-33.2	0.0	0.7	54.1	41.7	74	54	-19.9	-12.3	H

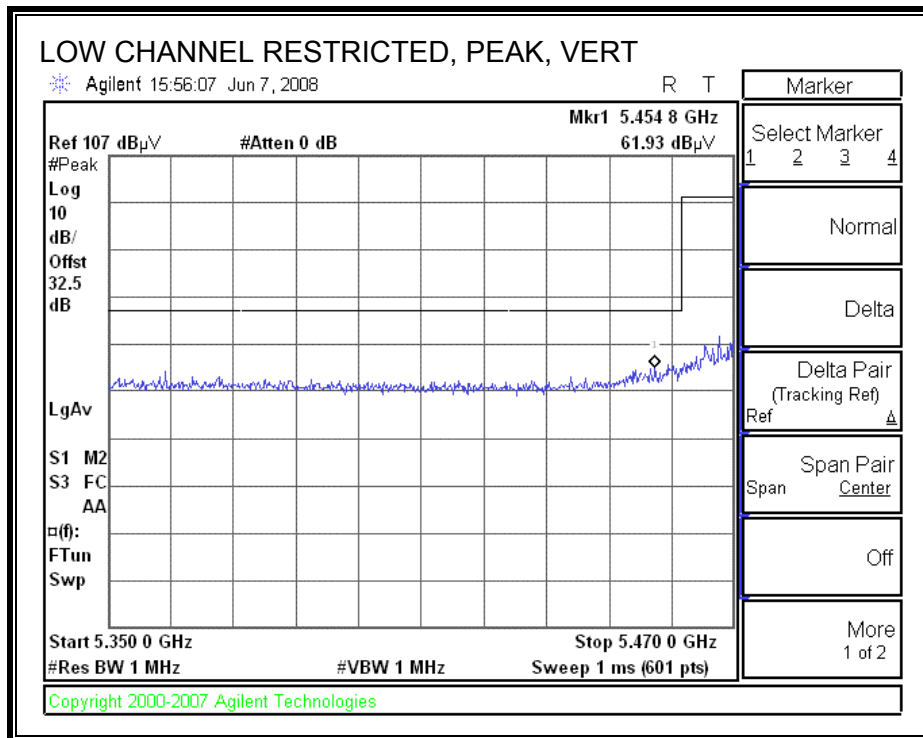
### 7.1.8. TRANSMITTER ABOVE 1 GHz FOR 802.11n HT20 MODE IN THE 5.5 GHz BAND

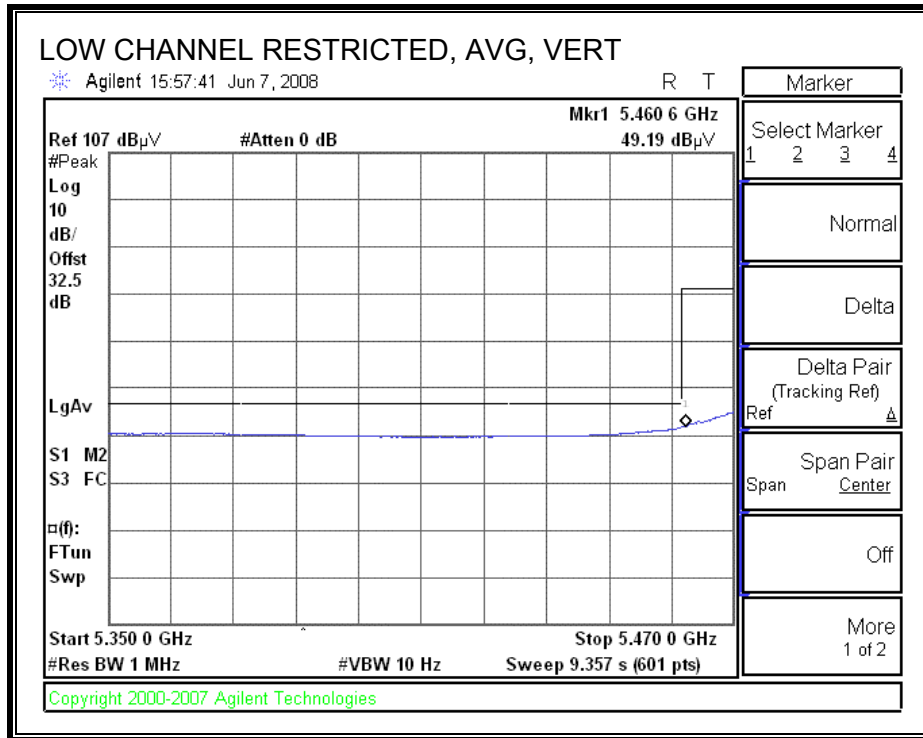
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



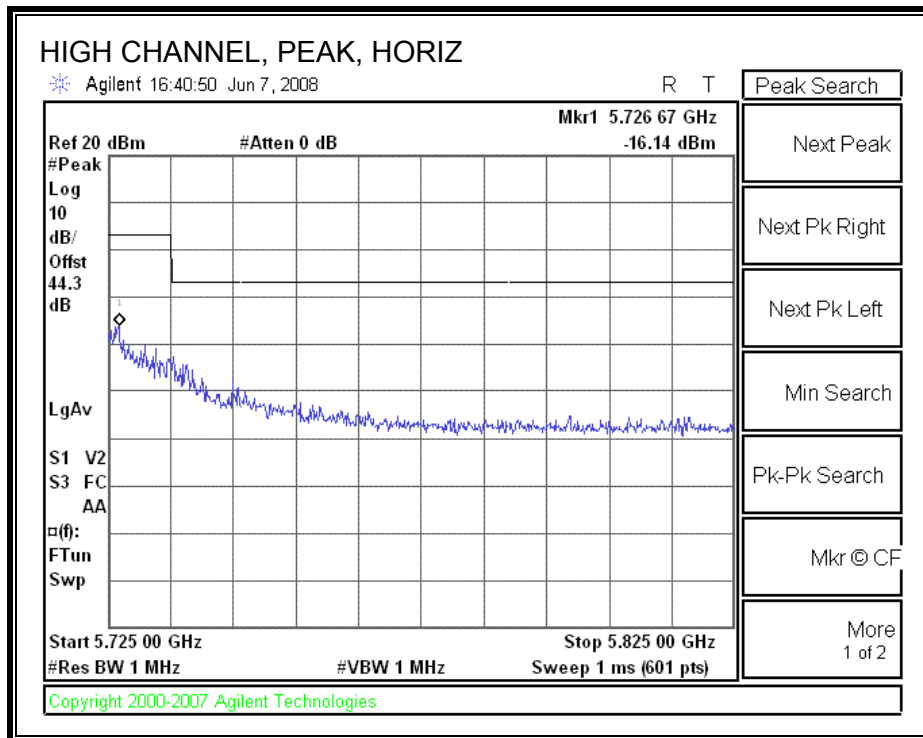


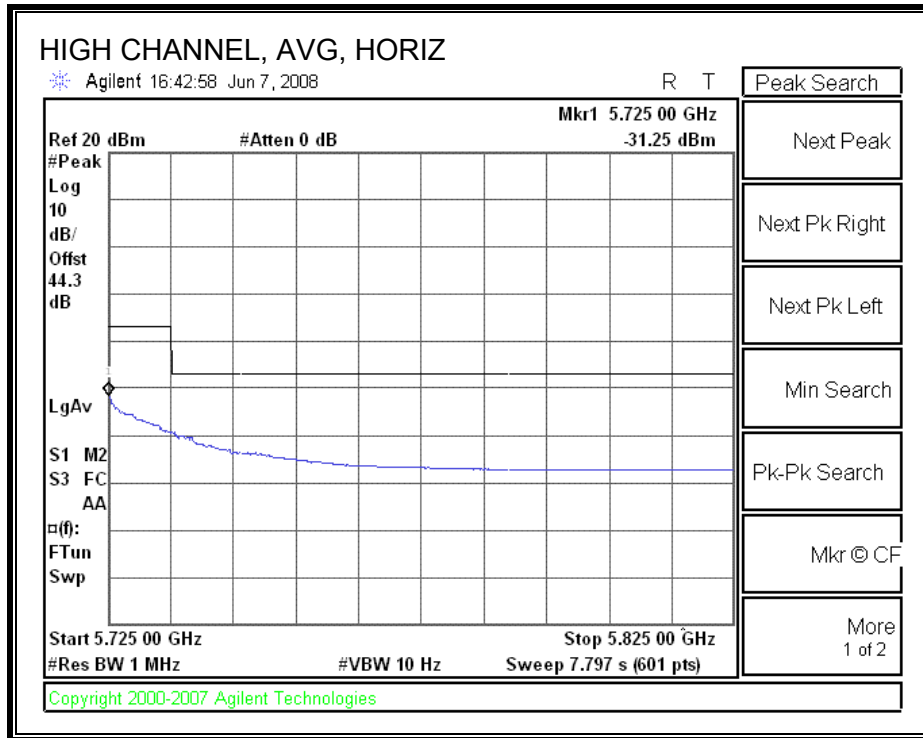
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**





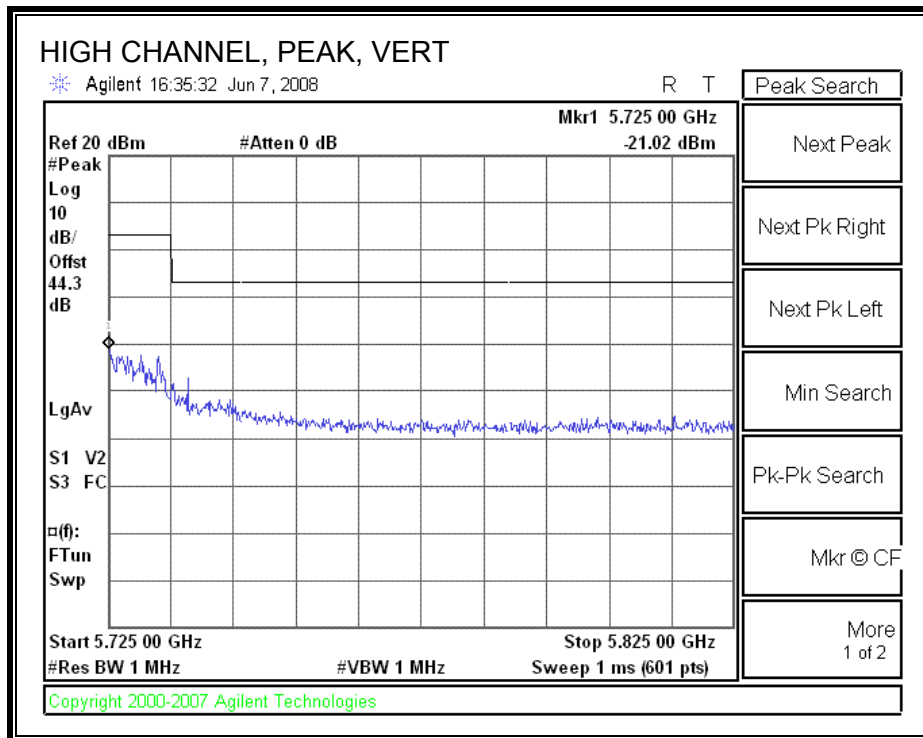
**AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**

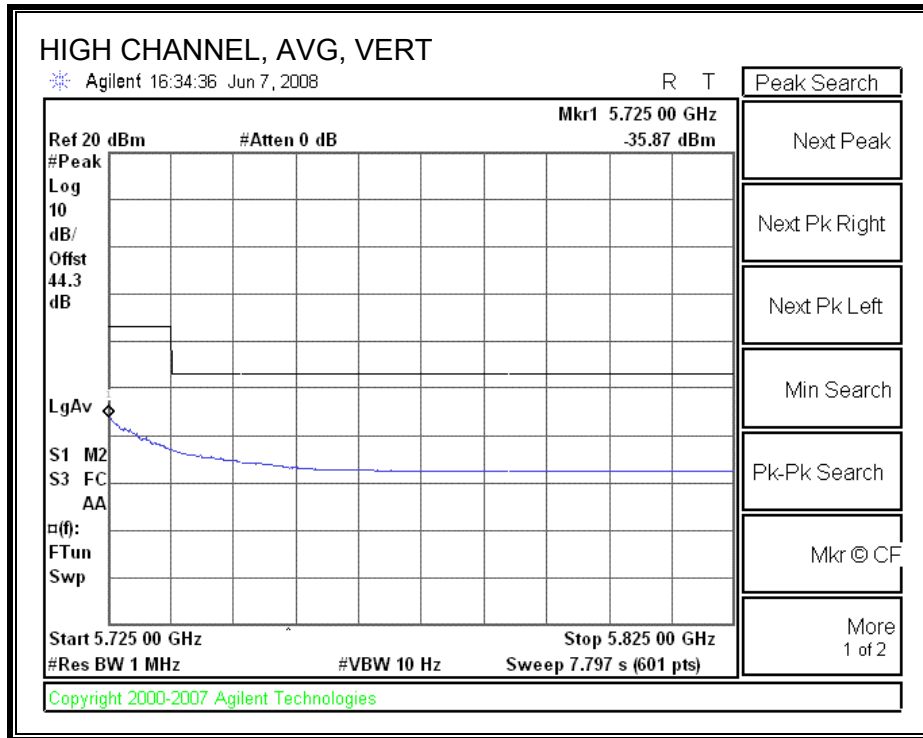






**AUTHORIZED BANDEDGE (HIGH CHANNEL, VERTICAL)**





**HARMONICS AND SPURIOUS EMISSIONS**

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 5m Chamber

Company: Atheros  
 Project #: 08U11860  
 Date: 6/9/2008  
 Test Engineer: Chin Pang  
 Configuration: EUT with Laptop  
 Mode: TX, HT20, 5.6GHz Band

**Test Equipment:**

<b>Horn 1-18GHz</b>	<b>Pre-amplifer 1-26GHz</b>	<b>Pre-amplifer 26-40GHz</b>	<b>Horn &gt; 18GHz</b>	<b>Limit</b>
T60; S/N: 2238 @3m	T145 Agilent 3008A005		T89; ARA 18.26GHz; S/N:1049	FCC 15.205

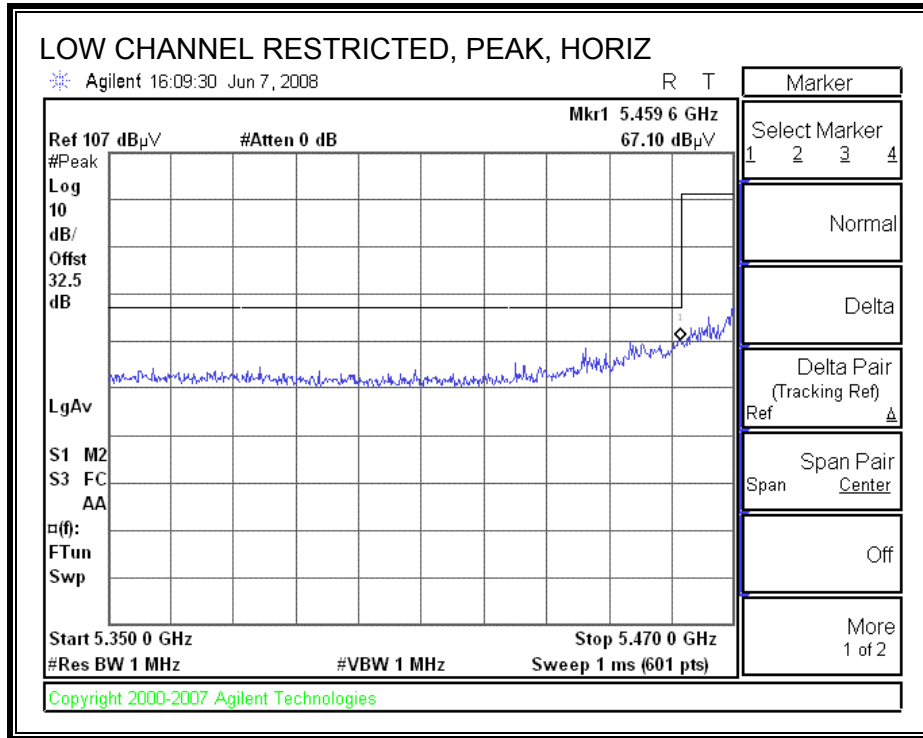
Hi Frequency Cables

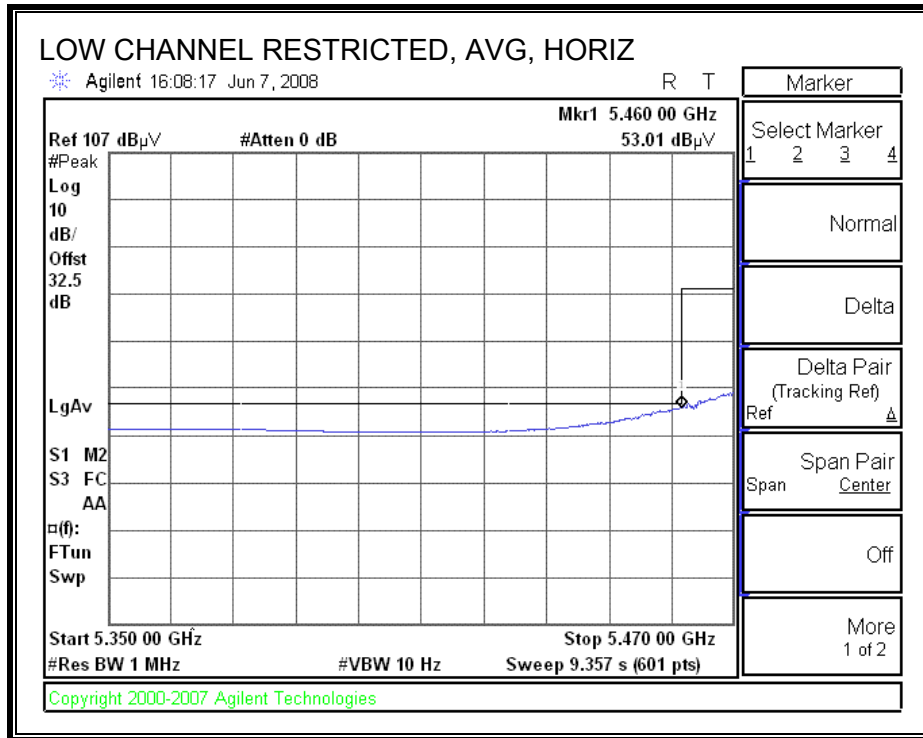
<b>2 foot cable</b>	<b>3 foot cable</b>	<b>12 foot cable</b>	<b>HPF</b>	<b>Reject Filter</b>	<b>Peak Measurements</b> RBW=VBW=1MHz
Thanh 177079008		C.5m Chamber	HPF_7.6GHz		<b>Average Measurements</b> RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
<b>Low Ch, 5500MHz</b>															
11.000	3.0	46.5	33.0	38.6	4.1	-33.8	0.0	0.7	56.2	42.7	74	54	-17.8	-11.3	V
11.000	3.0	44.0	31.3	38.6	4.1	-33.8	0.0	0.7	53.7	41.0	74	54	-20.3	-13.0	H
<b>Mi Ch, 5600MHz</b>															
11.200	3.0	47.5	34.5	38.7	4.1	-33.5	0.0	0.7	57.5	44.5	74	54	-16.5	-9.5	V
11.200	3.0	44.3	31.8	38.7	4.1	-33.5	0.0	0.7	54.3	41.8	74	54	-19.7	-12.2	H
<b>High Ch, 5700MHz</b>															
11.400	3.0	47.4	34.5	38.7	4.2	-33.2	0.0	0.7	57.8	44.9	74	54	-16.2	-9.1	V
11.400	3.0	44.2	31.6	38.7	4.2	-33.2	0.0	0.7	54.6	42.0	74	54	-19.4	-12.0	H

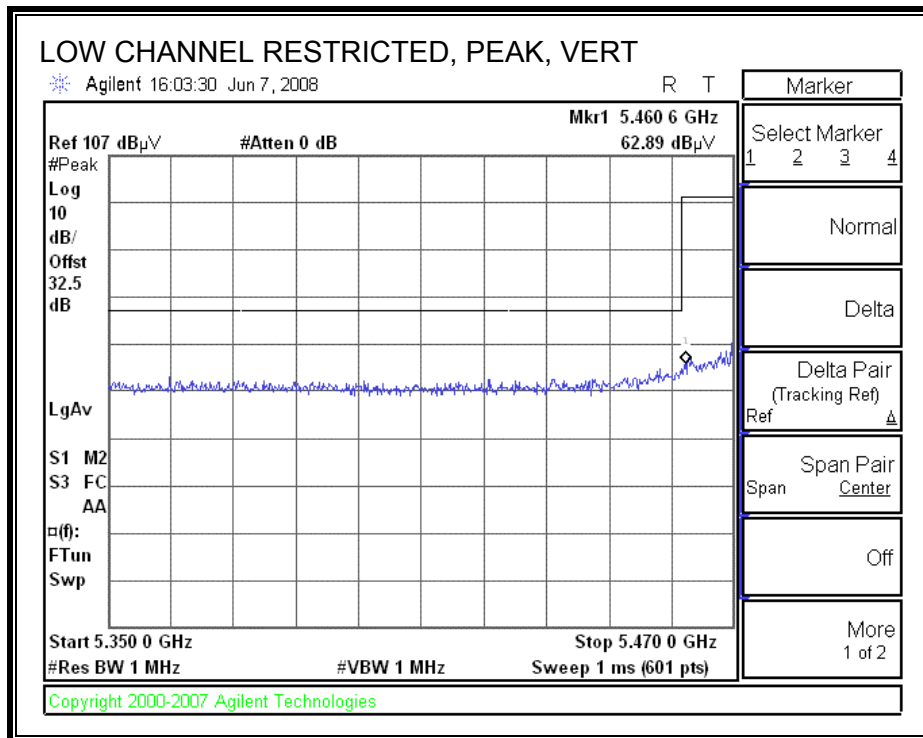
### 7.1.9. TRANSMITTER ABOVE 1 GHz FOR 802.11n HT40 MODE IN THE 5.5 GHz BAND

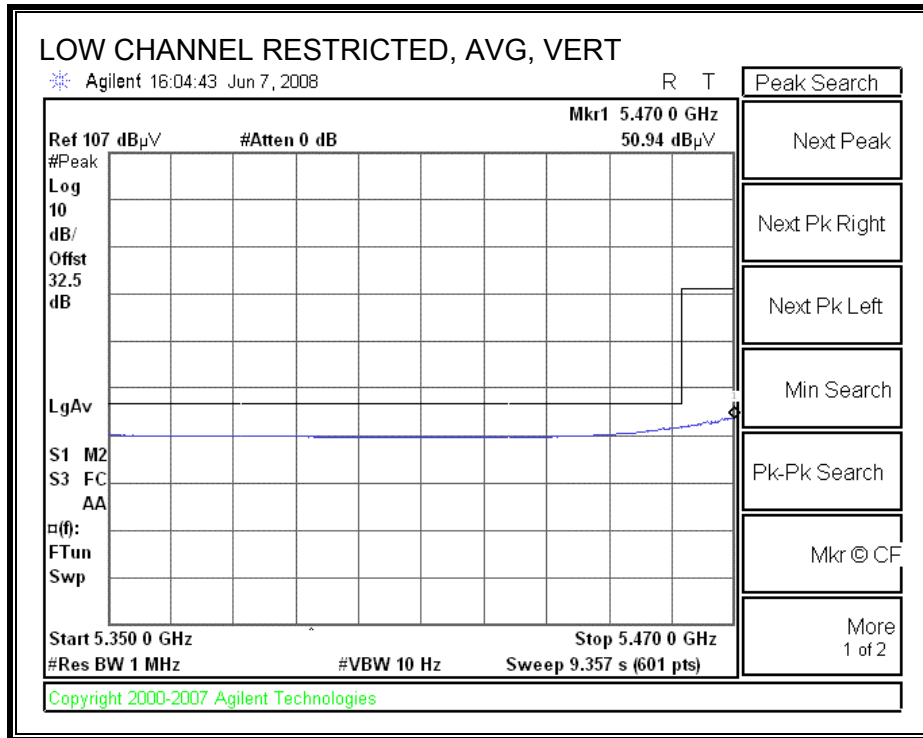
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



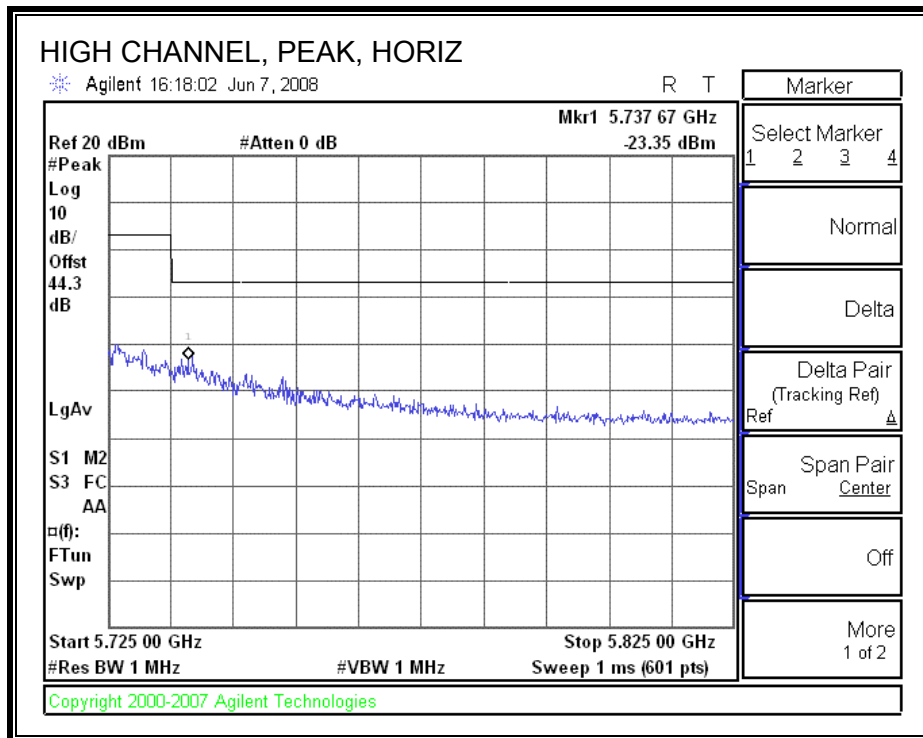


**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**

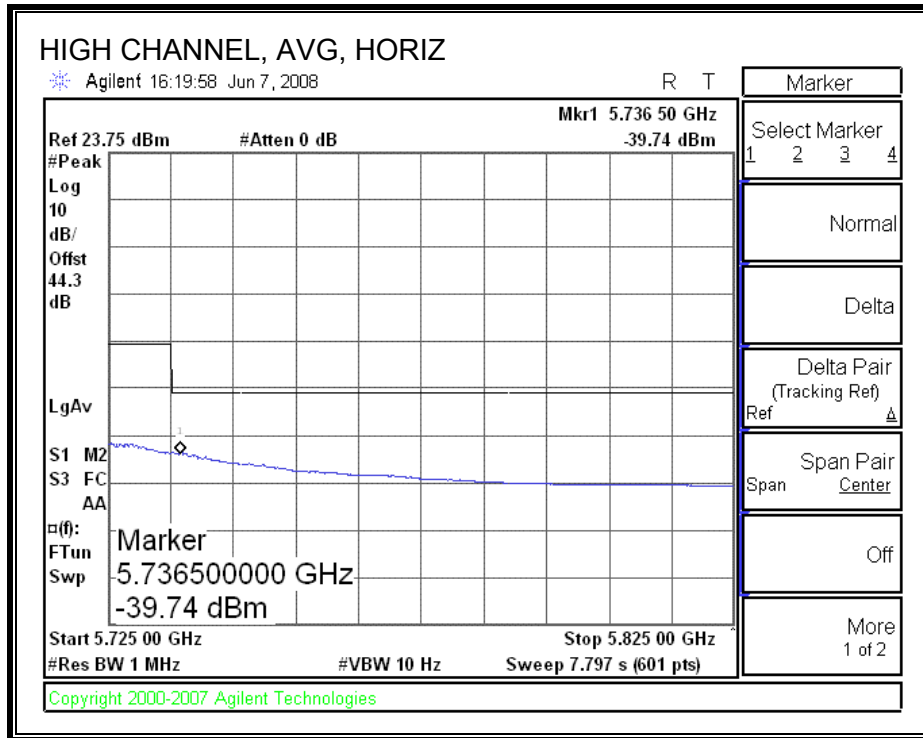




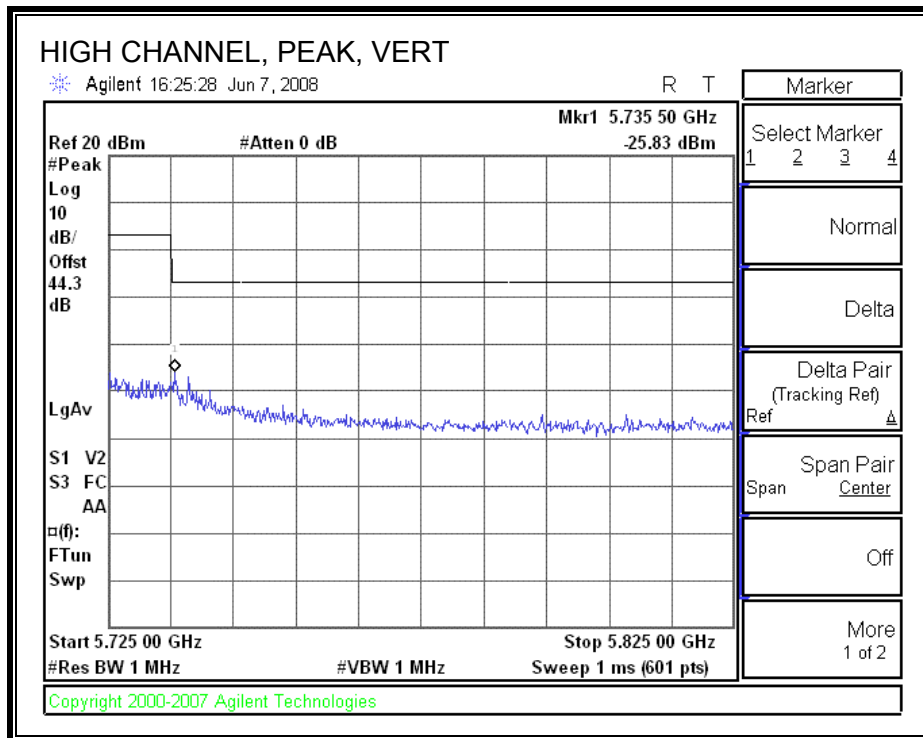
**AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**

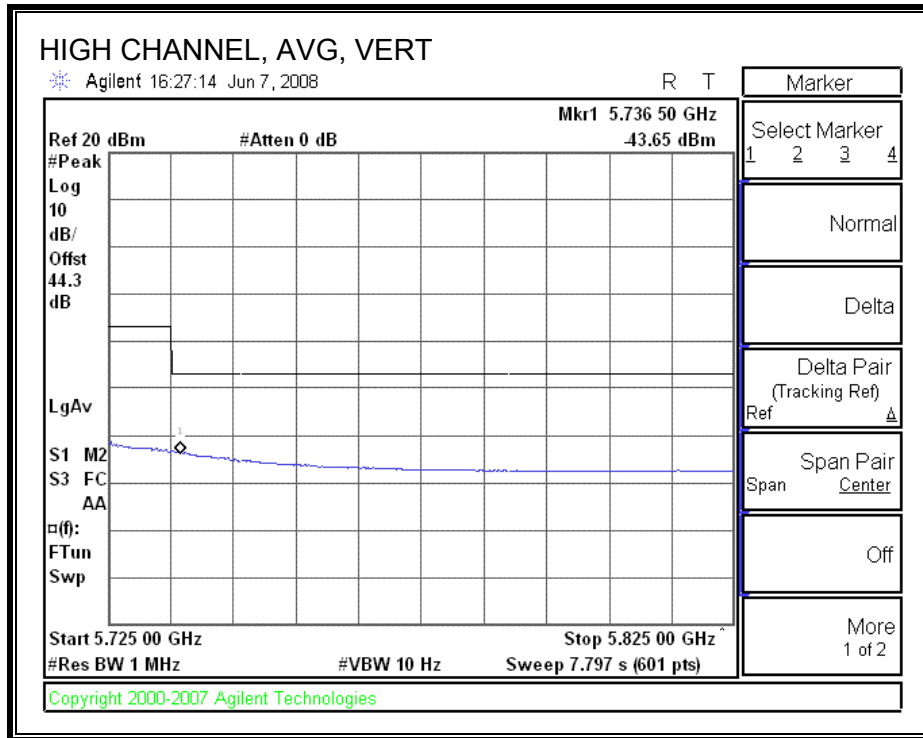






**AUTHORIZED BANDEDGE (HIGH CHANNEL, VERTICAL)**





**HARMONICS AND SPURIOUS EMISSIONS**

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 5m Chamber

Company: Atheros  
 Project #: 08U11860  
 Date: 6/9/2008  
 Test Engineer: Chin Pang  
 Configuration: EUT with Laptop  
 Mode: TX, HT40, 5.6GHz Band

Test Equipment:

Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T145 Agilent 3008A0050		T89; ARA 18.26GHz; S/N:1049	FCC 15.205

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter	Peak Measurements RBW=VBW=1MHz Average Measurements RBW=1MHz ; VBW=10Hz
Thanh 177079008		C.5m Chamber	HPF_7.6GHz		

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
<b>Low Ch, 5510MHz</b>															
11.020	3.0	44.5	31.4	38.6	4.1	-33.7	0.0	0.7	54.2	41.1	74	54	-19.8	-12.9	V
11.020	3.0	43.8	31.0	38.6	4.1	-33.7	0.0	0.7	53.5	40.7	74	54	-20.5	-13.3	H
<b>Mi Ch, 55900MHz</b>															
11.180	3.0	47.2	34.3	38.7	4.1	-33.5	0.0	0.7	57.2	44.3	74	54	-16.8	-9.7	V
11.180	3.0	44.0	31.6	38.7	4.1	-33.5	0.0	0.7	54.0	41.6	74	54	-20.0	-12.4	H
<b>High Ch, 5670MHz</b>															
11.340	3.0	46.0	33.0	38.7	4.2	-33.3	0.0	0.7	56.3	43.3	74	54	-17.7	-10.7	V
11.340	3.0	43.5	31.0	38.7	4.2	-33.3	0.0	0.7	53.8	41.3	74	54	-20.2	-12.7	H

## 8. RECEIVER ABOVE 1 GHz

### 8.1. RECEIVER ABOVE 1 GHz IN THE 5.2 GHz BAND

**High Frequency Measurement**

Compliance Certification Services, Fremont 5m Chamber

Company: Atheros  
 Project #: 08U11860  
 Date: 6/9/2008  
 Test Engineer: Chin Pang  
 Configuration: EUT with Laptop  
 Mode: RX, 5GHz Band ( Worst Case )

**Test Equipment:**

Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T145 Agilent 3008A005f			FCC 15.209

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter	Peak Measurements RBW=VBW=1MHz
Thanh 177079008		C-5m Chamber			Average Measurements RBW=1MHz ; VBW=10Hz

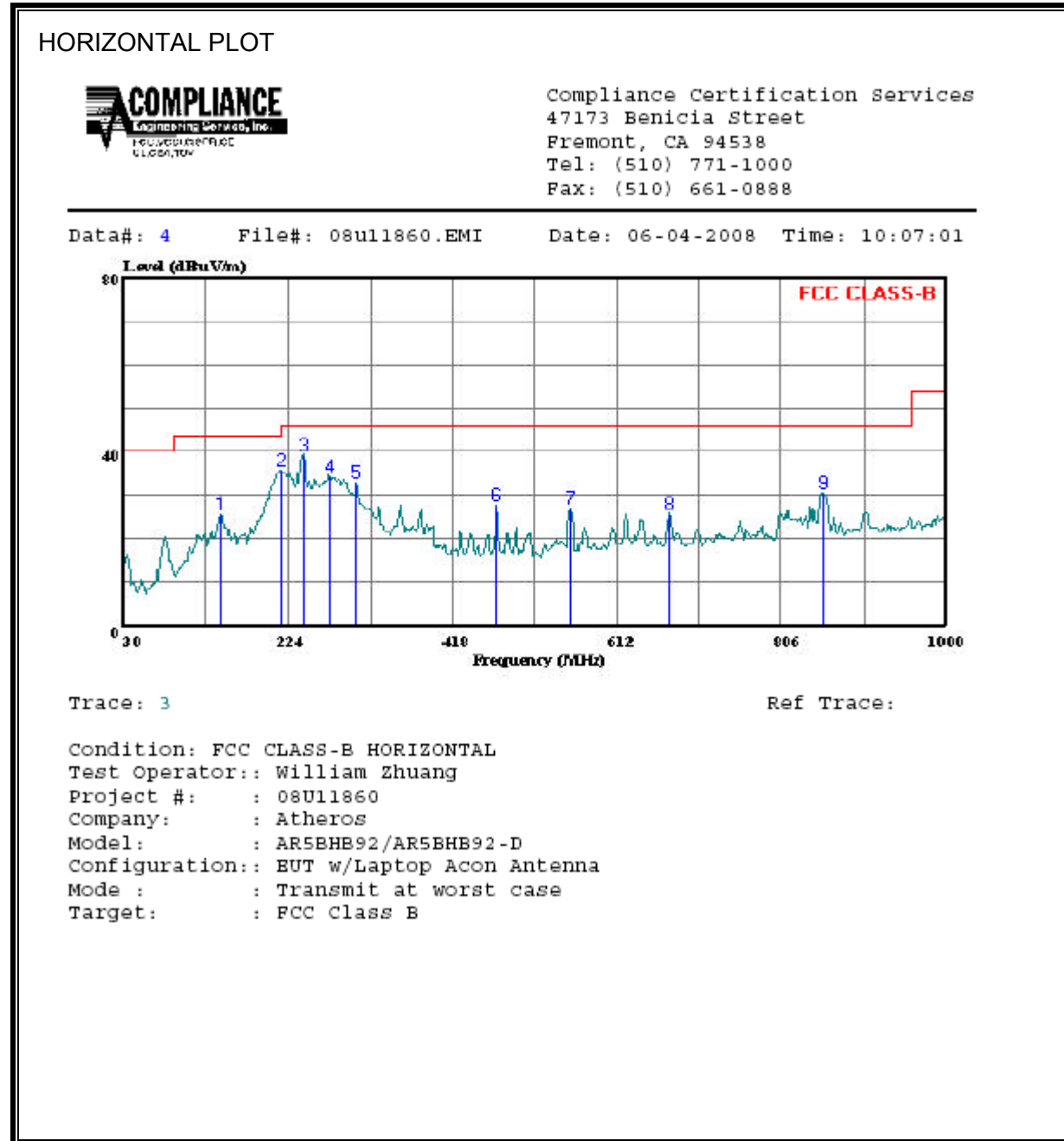
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
1.333	3.0	54.3	38.6	27.3	1.4	-35.9	0.0	0.0	47.1	31.4	74	54	-26.9	-22.6	V
1.595	3.0	52.0	36.0	28.0	1.6	-35.7	0.0	0.0	45.9	29.9	74	54	-28.1	-24.1	V
2.500	3.0	50.5	35.4	29.7	2.1	-35.1	0.0	0.0	47.2	32.1	74	54	-26.8	-21.9	V
1.333	3.0	52.8	36.1	27.3	1.4	-35.9	0.0	0.0	45.6	28.9	74	54	-28.4	-25.1	H
1.595	3.0	50.0	34.3	28.0	1.6	-35.7	0.0	0.0	43.9	28.2	74	54	-30.1	-25.8	H
1.992	3.0	52.8	35.4	29.0	1.8	-35.4	0.0	0.0	48.3	30.9	74	54	-25.7	-23.1	H

Rev. 4127  
**Note: No other emissions were detected above the system noise floor.**

f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

## 8.2. WORST-CASE BELOW 1 GHz

### SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)



HORIZONTAL DATA

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	145.430	42.74	-17.02	25.72	43.50	-17.78	Peak
2	216.240	54.25	-18.74	35.51	46.00	-10.49	Peak
3	241.460	57.30	-18.06	39.24	46.00	-6.76	Peak
4	272.500	51.30	-17.03	34.27	46.00	-11.73	Peak
5	305.480	48.56	-15.50	33.06	46.00	-12.94	Peak
6	470.380	39.55	-11.79	27.76	46.00	-18.24	Peak
7	557.680	37.39	-10.49	26.90	46.00	-19.10	Peak
8	673.110	34.64	-8.92	25.72	46.00	-20.28	Peak
9	855.470	36.23	-5.88	30.35	46.00	-15.65	Peak

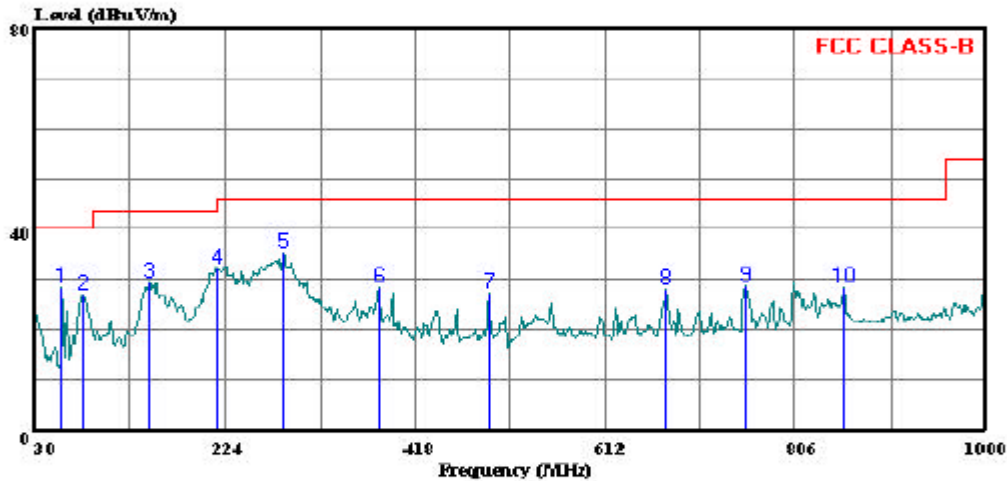
**SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)**

VERTICAL PLOT



Compliance Certification Services  
47173 Benicia Street  
Fremont, CA 94538  
Tel: (510) 771-1000  
Fax: (510) 661-0888

Data#: 2 File#: 08u11860.EMI Date: 06-04-2008 Time: 09:52:48



Trace: 1

Ref Trace:

Condition: FCC CLASS-B VERTICAL  
Test Operator:: William Zhuang  
Project #: : 08U11860  
Company: : Atheros  
Model: : AR5BHB92/AR5BHB92-D  
Configuration:: EUT w/Laptop Acon Antenna  
Mode : : Transmit at worst case  
Target: : FCC Class B



VERTICAL DATA

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	58.130	51.28	-23.02	28.27	40.00	-11.74	Peak
2	77.530	49.69	-22.79	26.90	40.00	-13.10	Peak
3	148.340	46.65	-17.23	29.42	43.50	-14.08	Peak
4	216.240	51.12	-18.74	32.38	46.00	-13.62	Peak
5	284.140	51.70	-16.53	35.17	46.00	-10.83	Peak
6	381.140	42.15	-13.74	28.41	46.00	-17.59	Peak
7	492.690	38.66	-11.41	27.25	46.00	-18.75	Peak
8	674.080	36.90	-8.88	28.02	46.00	-17.98	Peak
9	754.590	36.27	-7.68	28.59	46.00	-17.41	Peak
10	856.440	34.29	-5.92	28.37	46.00	-17.63	Peak

## 9. AC POWER LINE CONDUCTED EMISSIONS

### LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

\*Decreases with the logarithm of the frequency.

### TEST PROCEDURE

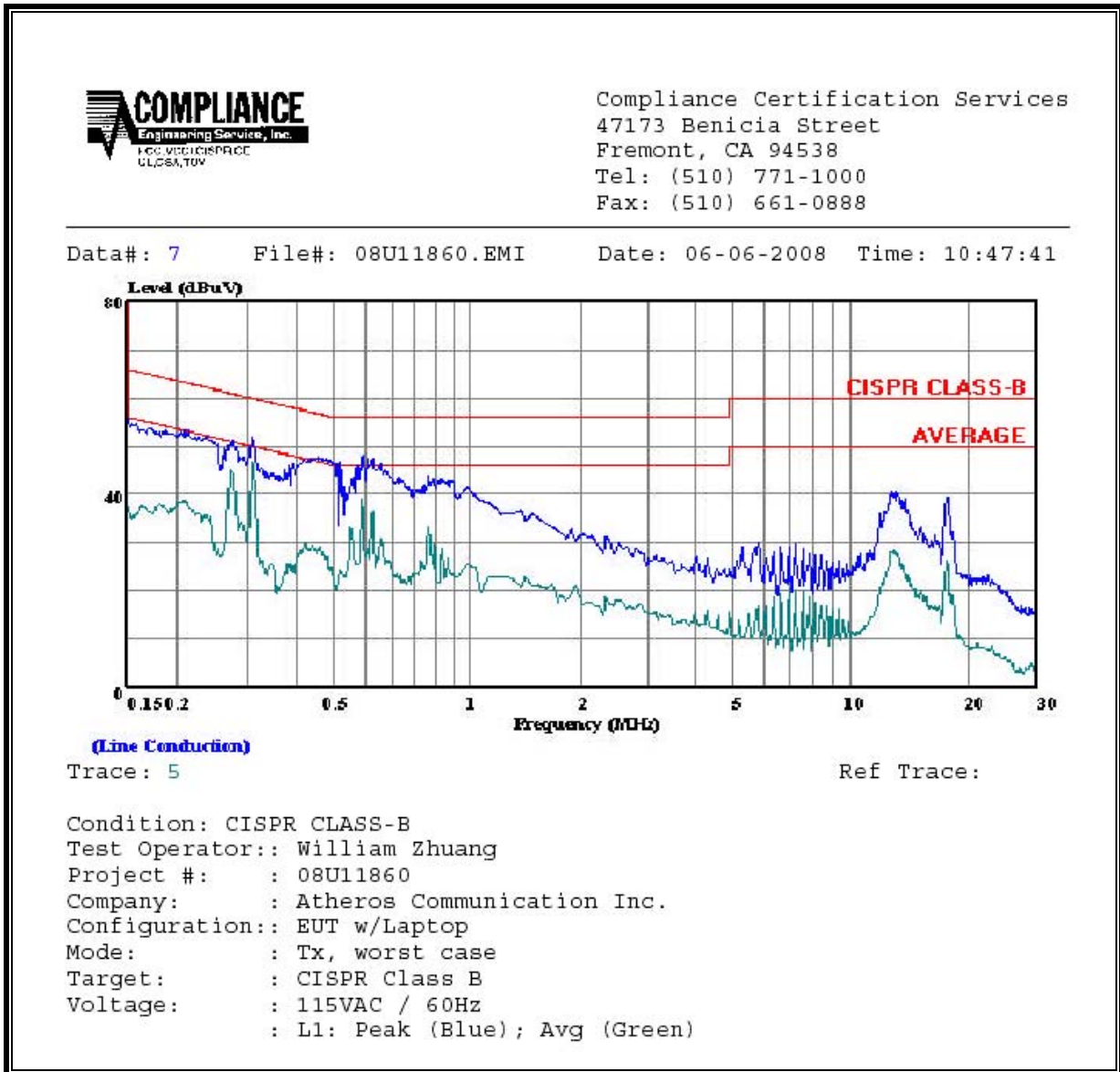
ANSI C63.4

### RESULTS

**6 WORST EMISSIONS**

CONDUCTED EMISSIONS DATA (115VAC 60Hz)										
Freq. (MHz)	Reading			Class (dB)	Limit QP	FCC B		Margin		Remark L1 / L2
	PK (dBuV)	QP (dBuV)	AV (dBuV)			AV	QP (dB)	AV (dB)		
0.28	51.23	--	44.92	0.00	60.91	50.91	-9.68	-5.99	L1	
0.31	51.78	--	46.67	0.00	59.97	49.97	-8.19	-3.30	L1	
0.59	48.16	--	39.09	0.00	56.00	46.00	-7.84	-6.91	L1	
0.28	51.64	--	45.74	0.00	60.91	50.91	-9.27	-5.17	L2	
0.31	51.16	--	46.35	0.00	59.97	49.97	-8.81	-3.62	L2	
0.59	47.70	--	39.05	0.00	56.00	46.00	-8.30	-6.95	L2	
6 Worst Data										

**LINE 1 RESULTS**

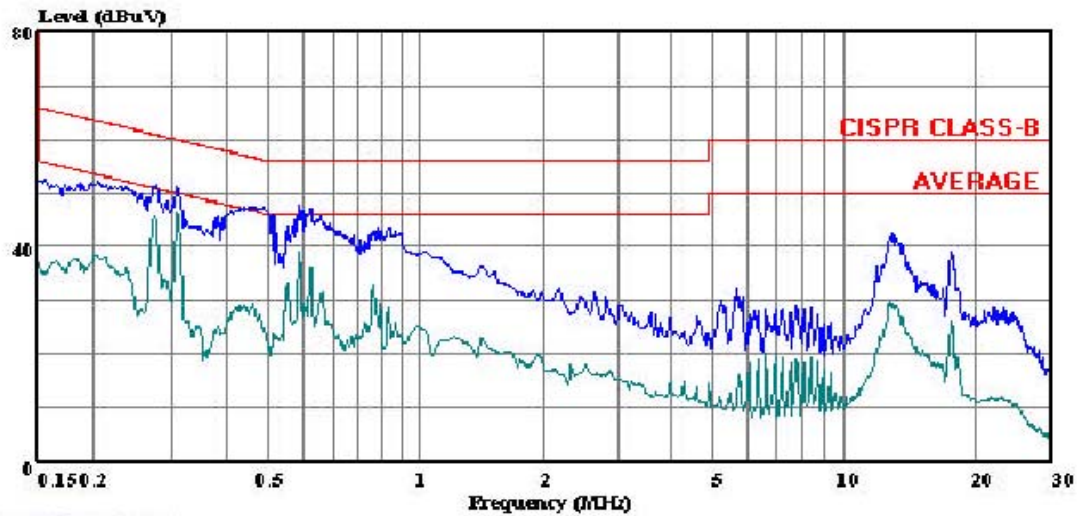


**LINE 2 RESULTS**



Compliance Certification Services  
47173 Benicia Street  
Fremont, CA 94538  
Tel: (510) 771-1000  
Fax: (510) 661-0888

Data#: 14 File#: 08U11860.EMI Date: 06-06-2008 Time: 10:56:17



(Line Conduction)

Trace: 12

Ref Trace:

Condition: CISPR CLASS-B  
Test Operator:: William Zhuang  
Project #: : 08U11860  
Company: : Atheros Communication Inc.  
Configuration:: EUT w/Laptop  
Mode: : Tx, worst case  
Target: : CISPR Class B  
Voltage: : 115VAC / 60Hz  
: L2: Peak (Blue) ; Avg (Green)

## 10. MAXIMUM PERMISSIBLE EXPOSURE

### FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0 .....	614	1.63	*(100)	6
3.0–30 .....	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30–300 .....	61.4	0.163	1.0	6
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34 .....	614	1.63	*(100)	30
1.34–30 .....	824/f	2.19/f	*(180/f <sup>2</sup> )	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm <sup>2</sup> )	Averaging time (minutes)
30–300 .....	27.5	0.073	0.2	30
300–1500 .....	.....	.....	f/1500	30
1500–100,000 .....	.....	.....	1.0	30

f = frequency in MHz

\* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

**IC RULES**

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

**Table 5  
 Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers (Including the General Public)**

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m <sup>2</sup> )	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	280/ <i>f</i>	2.19/ <i>f</i>		6
10–30	28	2.19/ <i>f</i>		6
30–300	28	0.073	2*	6
300–1 500	1.585 <i>f</i> <sup>0.5</sup>	0.0042 <i>f</i> <sup>0.5</sup>	<i>f</i> /150	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	616 000 / <i>f</i> <sup>1.2</sup>
150 000–300 000	0.158 <i>f</i> <sup>0.5</sup>	4.21 x 10 <sup>-4</sup> <i>f</i> <sup>0.5</sup>	6.67 x 10 <sup>-5</sup> <i>f</i>	616 000 / <i>f</i> <sup>1.2</sup>

\* Power density limit is applicable at frequencies greater than 100 MHz.

- Notes:**
1. Frequency, *f*, is in MHz.
  2. A power density of 10 W/m<sup>2</sup> is equivalent to 1 mW/cm<sup>2</sup>.
  3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

## CALCULATIONS

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 milliwatts/square centimeter

Combining equations, rearranging the terms to express the distance as a function of the remaining variables, changing to units of Power to mW and Distance to cm, and substituting the logarithmic form of power and gain yields:

$$d = 0.282 * 10^{((P + G) / 20)} / \sqrt{S}$$

where

d = MPE distance in cm

P = Power in dBm

G = Antenna Gain in dBi

S = Power Density Limit in mW/cm<sup>2</sup>

Rearranging terms to calculate the power density at a specific distance yields

$$S = 0.0795 * 10^{((P + G) / 10)} / (d^2)$$

The power density in units of mW/cm<sup>2</sup> is converted to units of W/m<sup>2</sup> by multiplying by a factor of 10.



**LIMITS**

From FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm<sup>2</sup>

From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m<sup>2</sup>

**RESULTS**

Mode	Band (MHz)	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	FCC Power Density (mW/cm <sup>2</sup> )	IC Power Density (W/m <sup>2</sup> )
Legacy CDD	5150 - 5250	20.0	15.82	3.93	0.02	0.19
HT20	5150 - 5250	20.0	16.81	2.10	0.02	0.15
HT40	5150 - 5250	20.0	16.89	2.10	0.02	0.16
Legacy CDD	5250 - 5350	20.0	21.07	4.27	0.07	0.68
HT20	5250 - 5350	20.0	23.68	2.30	0.08	0.79
HT40	5250 - 5350	20.0	23.43	2.30	0.07	0.74
Legacy CDD	5470 - 5725	20.0	21.47	4.19	0.07	0.73
HT20	5470 - 5725	20.0	22.16	2.10	0.05	0.53
HT40	5470 - 5725	20.0	23.58	2.10	0.07	0.74