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 TRANSCEIVER

MODEL NUMBER: AR5BXB92

FCC ID: PPD-AR5BXB92
IC: 4104A-AR5BXB92

REPORT NUMBER: 09U12718-2

ISSUE DATE: AUGUST 04, 2009

Prepared for
ATHEROS COMMUNICATIONS, INC.
5480 GREAT AMERICA PARKWAY
SANTA CLARA, CA 95054, U.S.A.

Prepared by
COMPLIANCE CERTIFICATION SERVICES
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	08/04/09	Initial Issue	T. Chan

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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 TRANSCEIVER

MODEL: AR5BXB92

SERIAL NUMBER: XB92-040-S0656

DATE TESTED: JULY 18-20, 2009

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

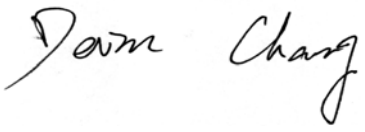
Compliance Certification Services, Inc. (CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by CCS based on interpretations and/or observations of test results. Measurement Uncertainties 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 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. 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 CCS By:

THU CHAN
EMC MANAGER
COMPLIANCE CERTIFICATION SERVICES

Tested By:



DEVIN CHANG
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, FCC 06-96, 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. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

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

5.1. DESCRIPTION OF EUT

The EUT is an 802.11n 2x2 PCIe minicard transceiver, model AR5BXB92P with SiGe (FEM1). The radio module is manufactured by Atheros Communications, Inc.

5.2. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

The major change filed under this application is adding a new PIFA antenna.

5.3. MAXIMUM OUTPUT POWER

The test measurement passed within ± 0.5dBm of the original output power.

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The 2x2 configuration utilizes a set of PIFA antennas with maximum gain as below:

MIMO Antenna Gain:
_Original antenna gain: 3.62 dBi from 2400 – 2483.5 MHz, 4.63 dBi from 5150 – 5350 MHz, 5.56 dBi from 5250 – 5350 MHz, 5.34 dBi from 5470 – 5725 MHz, and 4.76 dBi from 5725 - 5850 MHz.

_ K22 & K23 antenna gain: 3.90 dBi from 2400 – 2483.5 MHz, 5.23 dBi from 5150 – 5250 MHz, 5.53 dBi from 5250 – 5350 MHz, 5.71 dBi from 5470 – 5725 MHz, and 4.52 dBi from 5725 - 5850 MHz.

Legacy Antenna Gain:
_Original antenna gain: 6.331 dBi from 2400 – 2483.5 MHz, 7.064 dBi from 5150 – 5350 MHz, 7.755 dBi from 5250 – 5350 MHz, 8.198 dBi from 5470 – 5725 MHz, and 6.756 dBi from 5725 - 5850 MHz.

_ K22 & K23 antenna gain: 6.821 dBi from 2400 – 2483.5 MHz, 6.909 dBi from 5150 – 5250 MHz, 7.436 dBi from 5250 – 5350 MHz, 7.478 dBi from 5470 – 5725 MHz, and 6.614 dBi from 5725 - 5850 MHz.

5.5. 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.

5.6. WORST-CASE CONFIGURATION AND MODE

The 2x2 configuration was used for all testing in this report.
The worst-case data rates are determined to be as follows for each mode, thus all emissions tests were made with following data rates:

- 802.11b mode, 20 MHz Channel Bandwidth, 1 Mb/s, CCK Modulation, Spatial Stream 1.
- 802.11g mode, 20 MHz Channel Bandwidth, 9 Mb/s, OFDM Modulation, Spatial Stream 1.
- 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.

After the investigation and comparison between original and new antennas gains as section above, the tests only need to be performed as below:
_ 2.4GHz low and high channels bandedge at b/g/HT20, mid channel harmonic spurious at b/HT20 mode.
_5.2GHz mid channel harmonic spurious at legacy/HT20.
_5.6GHz low and high channels bandedge at legacy/HT20/HT40, low and high channels harmonic spurious at legacy mode.

For 5.6GHz band on low and high channels, in order to pass the bandedge limits, the powers need to be reduced please refer to the output power section, and no change on mid-band channels.

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 Due**
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C00986	02/03/10
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01063	02/04/10
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	12/16/09
Antenna, Horn, 18 GHz	EMCO	3115	C00783	01/29/10
Peak / Average Power Sensor	Agilent / HP	E9327A	C00964	12/07/09
Peak Power Meter	Agilent / HP	E4416A	C00963	12/04/09
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01011	01/14/10
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00980	01/29/10
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	02/03/10
2.4-2.5GHz Reject Filter	Micro Tronics	BRM50702	N02685	CNR
Reject Filter, 5.15-5.35 GHz	Micro-Tronics	BRC13190	N02679	CNR
Reject Filter, 5.47-5.725 GHz	Micro-Tronics	BRC13191	N02678	CNR
Reject Filter, 5.725-5.85 GHz	Micro-Tronics	BRC13192	N02676	CNR

7. ANTENNA PORT TEST RESULTS

7.1. 802.11a, HT20 & HT40 MODE IN THE 5.6 GHz BAND

7.1.1. OUTPUT POWER

LIMITS

FCC §15.407 (a) (2)
IC RSS-210 A9.2 (2)

For the 5.47-5.725 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Effective Legacy Gain (dBi)
7.48

TEST PROCEDURE

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.
The transmitter output operates continuously therefore Method # 1 is used.

RESULTS

The cable assembly insertion loss of 11.3 dB (including 10 dB pad and 1.3 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Limit Legacy Mode

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5500	24	28.551	25.56	7.48	22.52
High	5700	24	26.394	25.22	7.48	22.52

Individual Chain Results

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5500	14.64	14.55	17.61	22.52	-4.91
High	5700	12.19	11.95	15.08	22.52	-7.44

Limit HT20 Mode

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5500	24	31.90	26.04	5.71	24.00
High	5700	24	33.96	26.31	5.71	24.00

Individual Chain Results

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5500	14.69	14.62	17.67	24.00	-6.33
High	5700	12.26	12.33	15.31	24.00	-8.69

Limit HT40 Mode

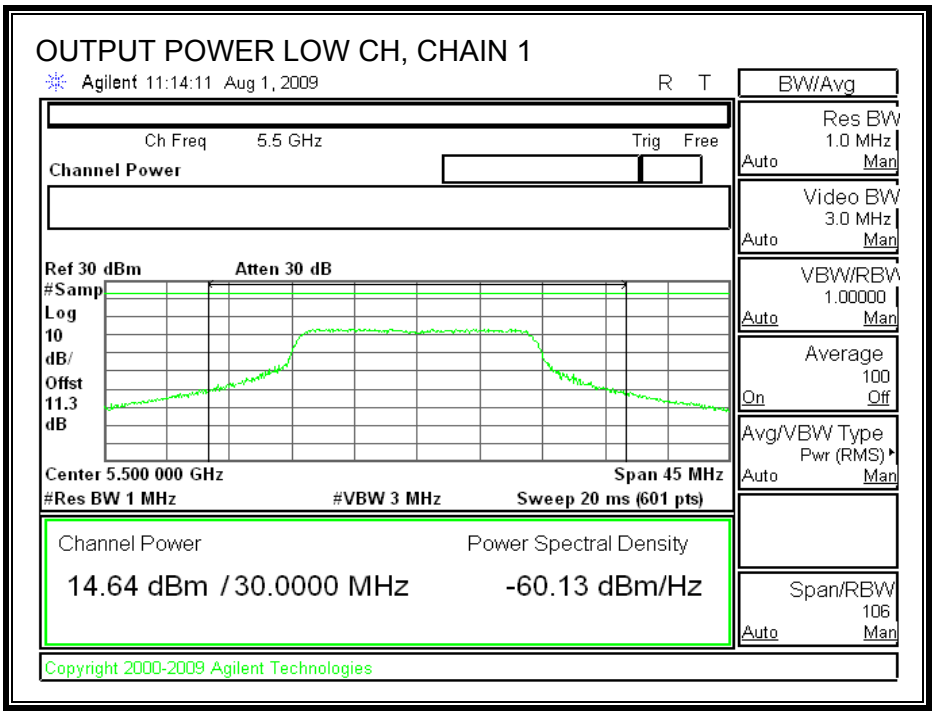
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5510	24	42.52	27.29	5.71	24.00
High	5670	24	49.96	27.99	5.71	24.00

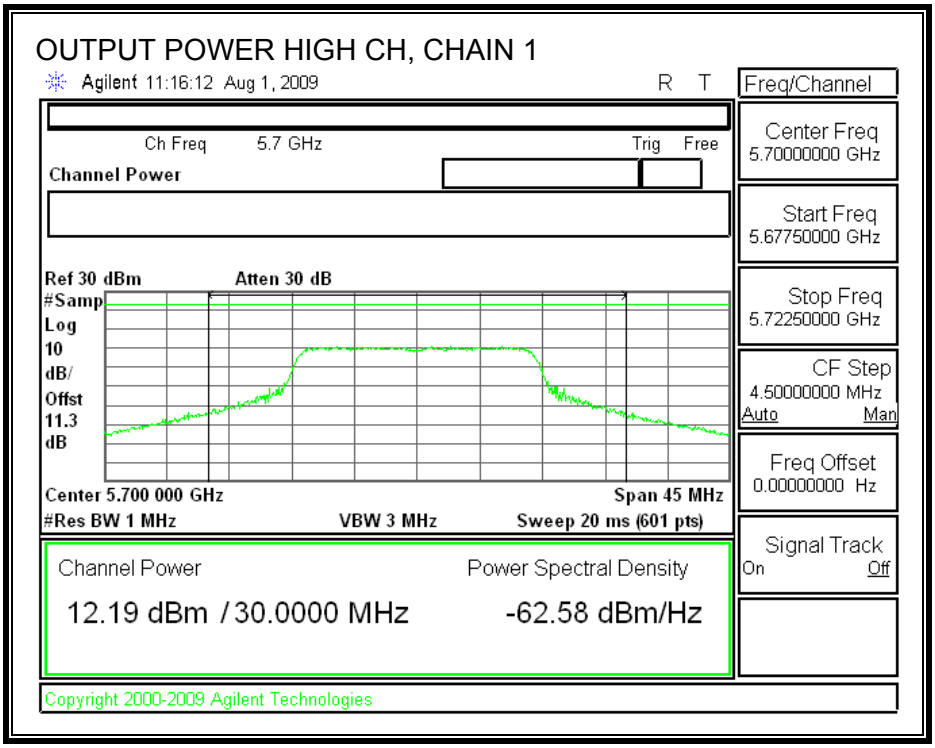
Individual Chain Results

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5510	10.37	10.65	13.52	24.00	-10.48
High	5670	13.92	14.20	17.07	24.00	-6.93

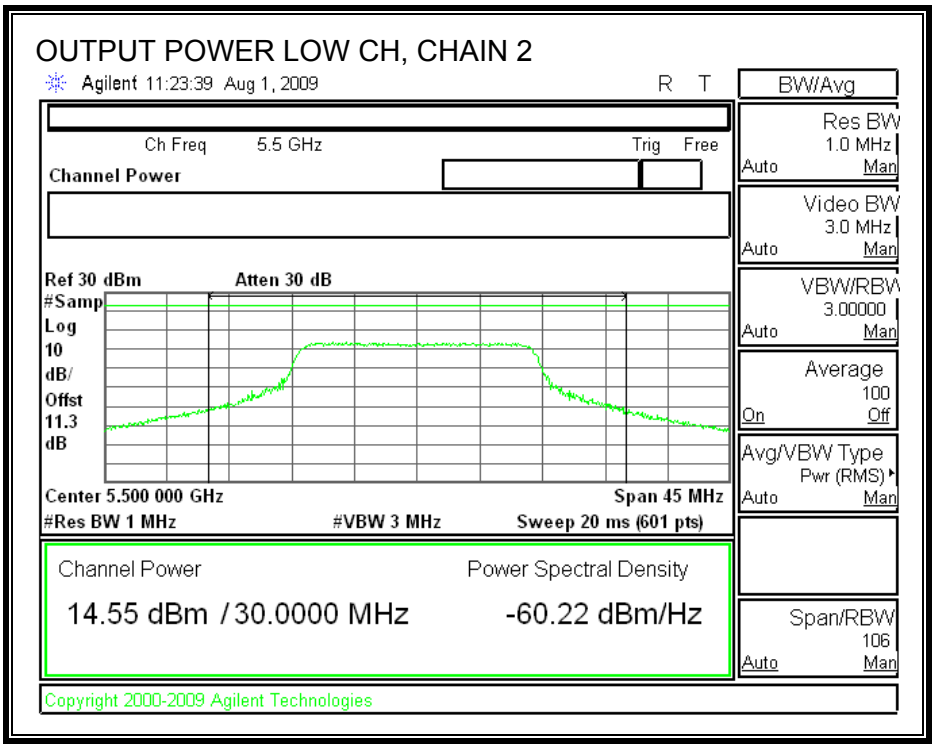
11a Mode

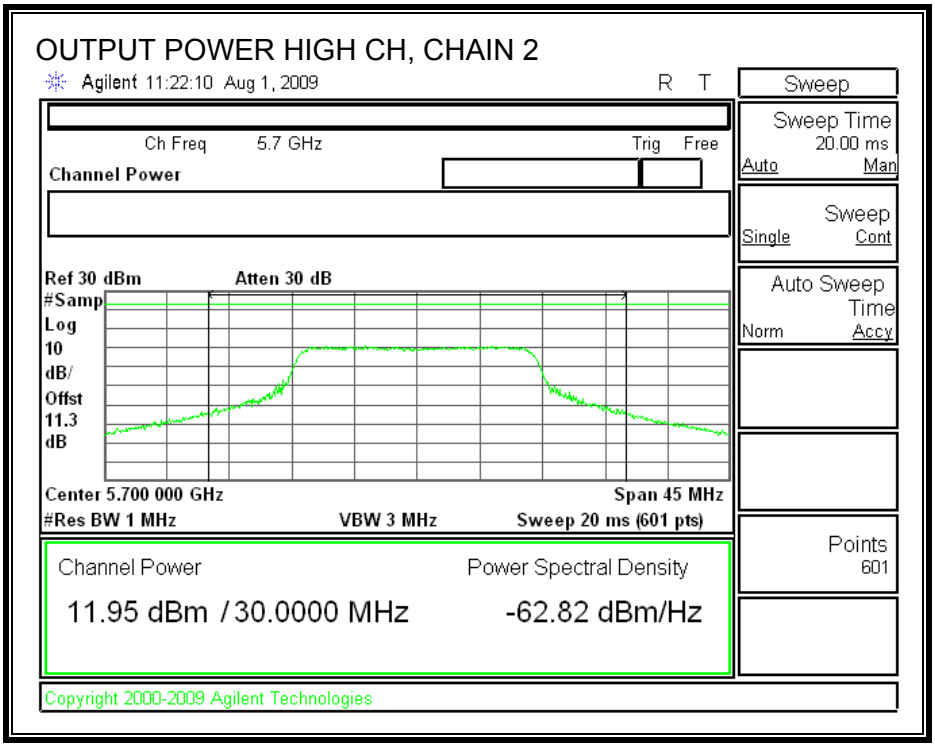
CHAIN 1 OUTPUT POWER





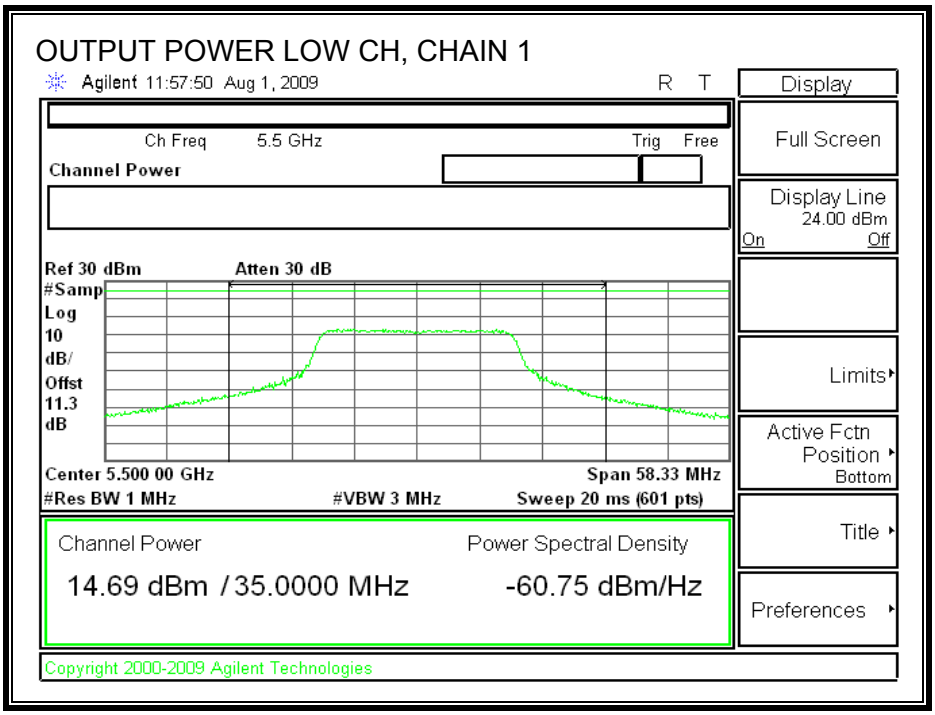
CHAIN 2 OUTPUT POWER

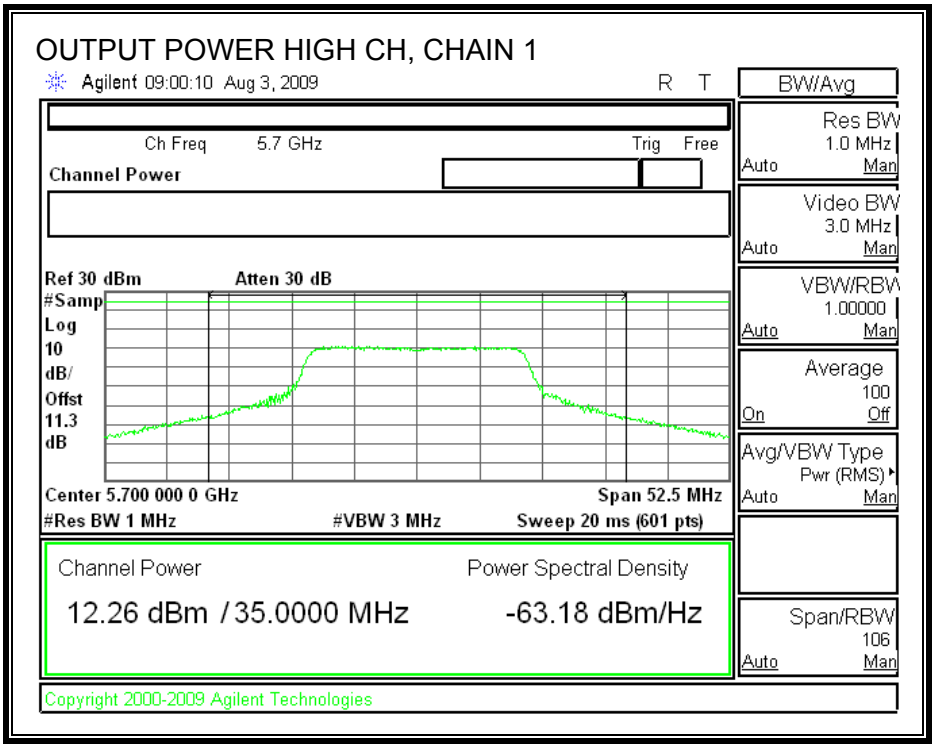




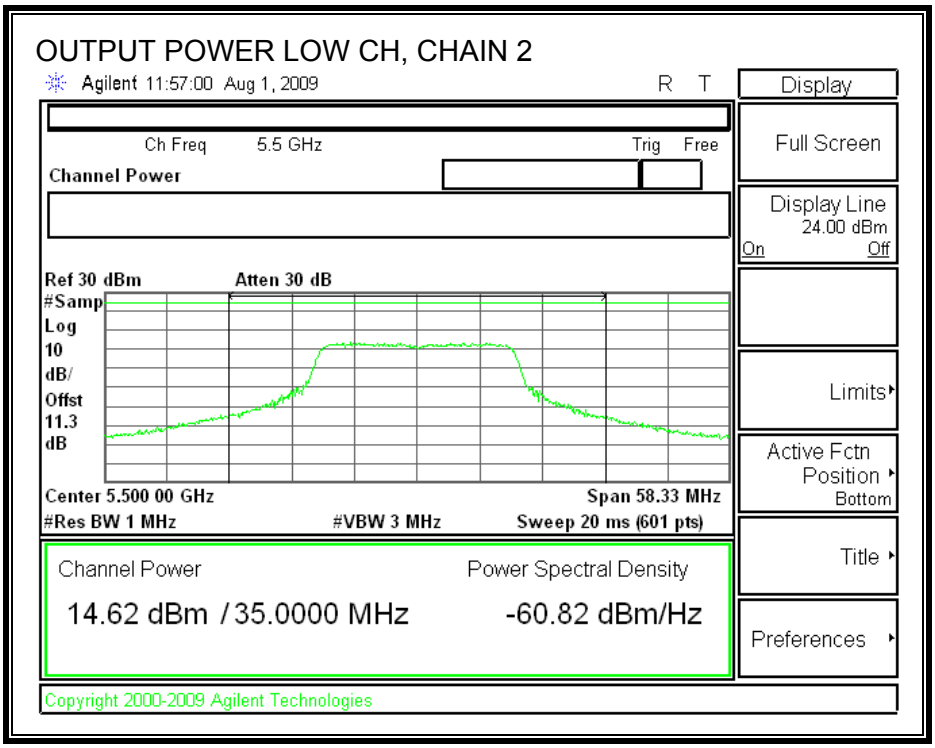
HT20

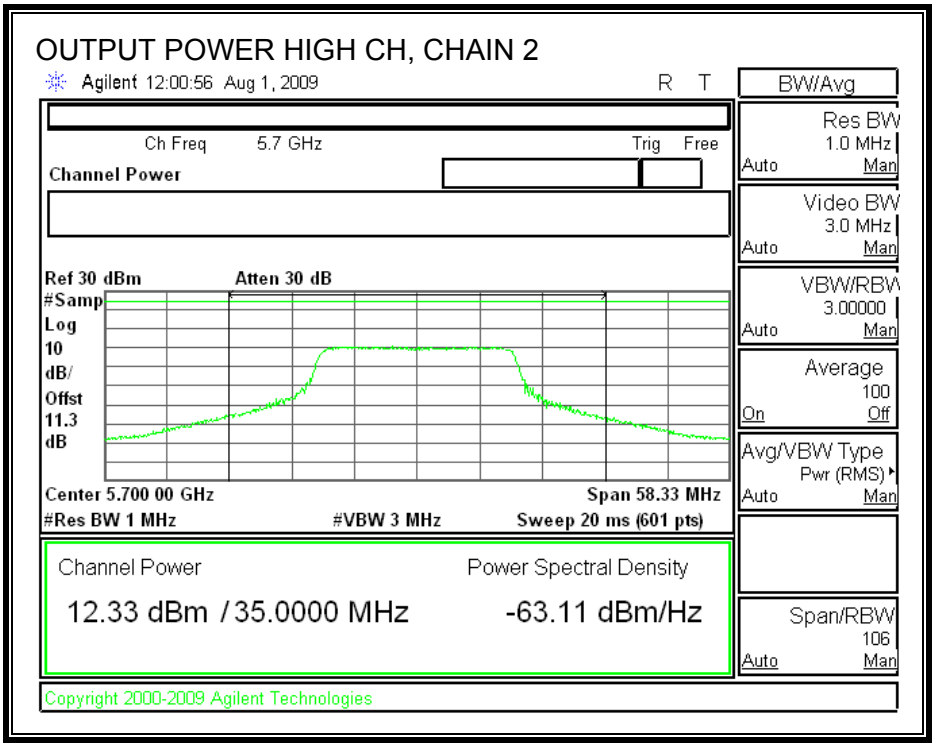
CHAIN 1 OUTPUT POWER





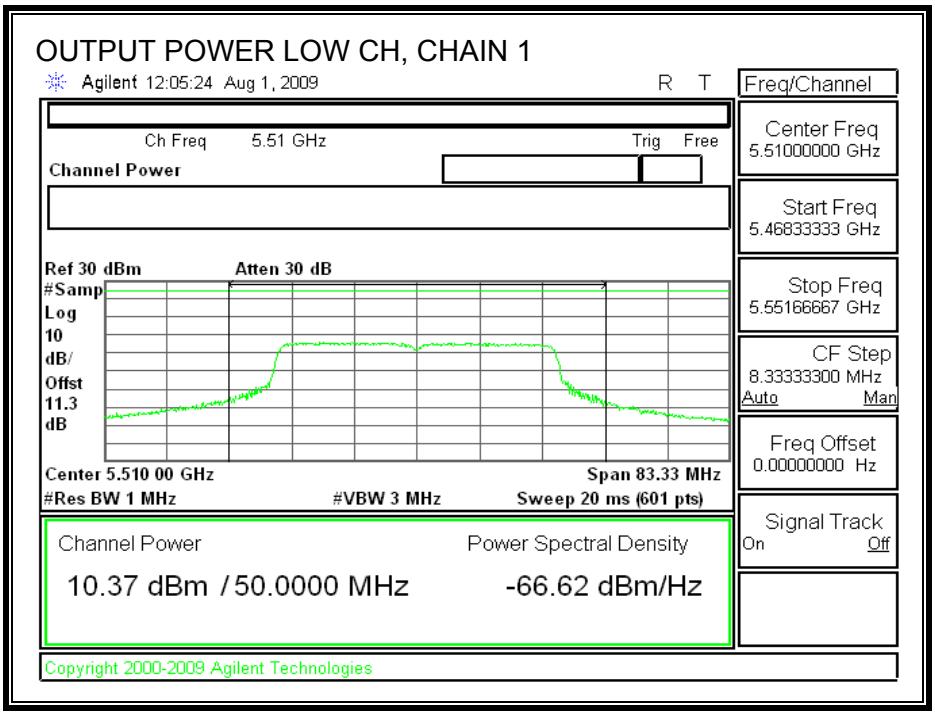
CHAIN 2 OUTPUT POWER

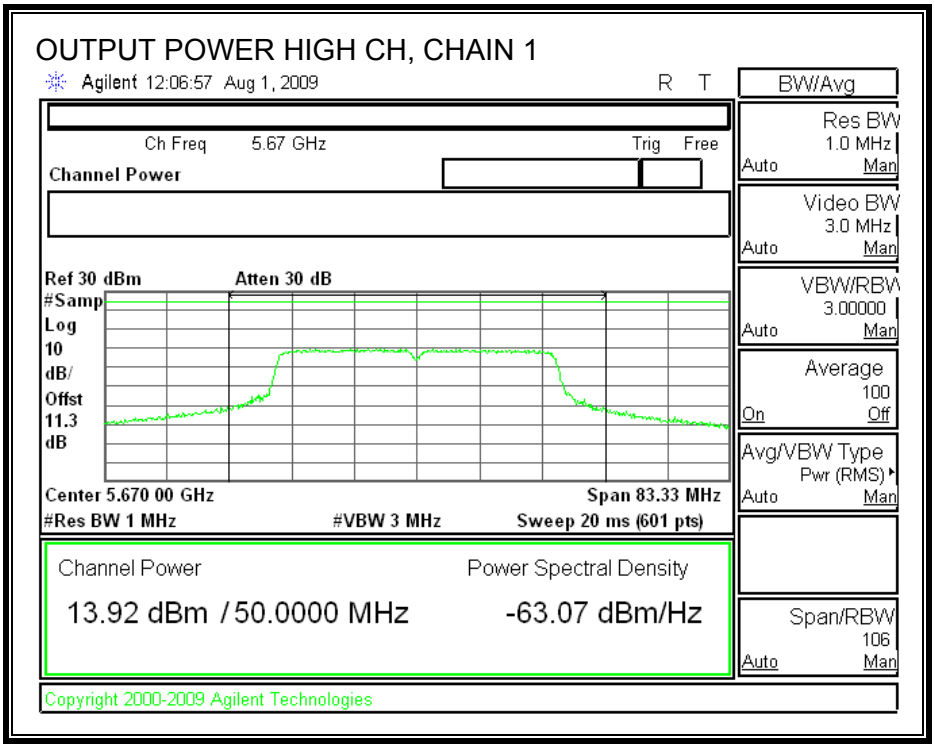




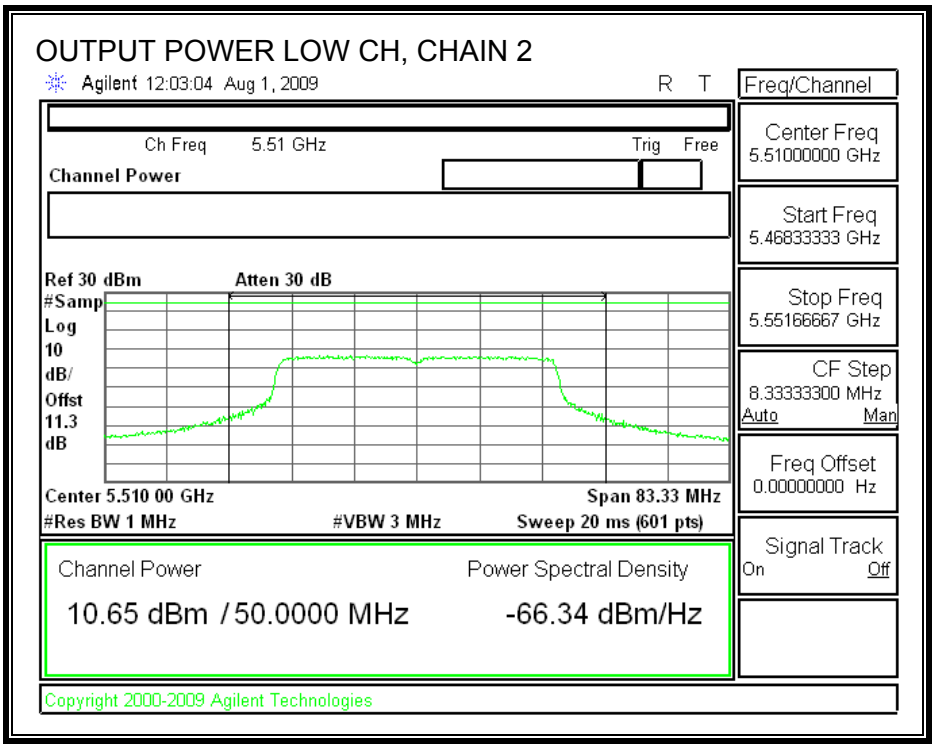
HT40

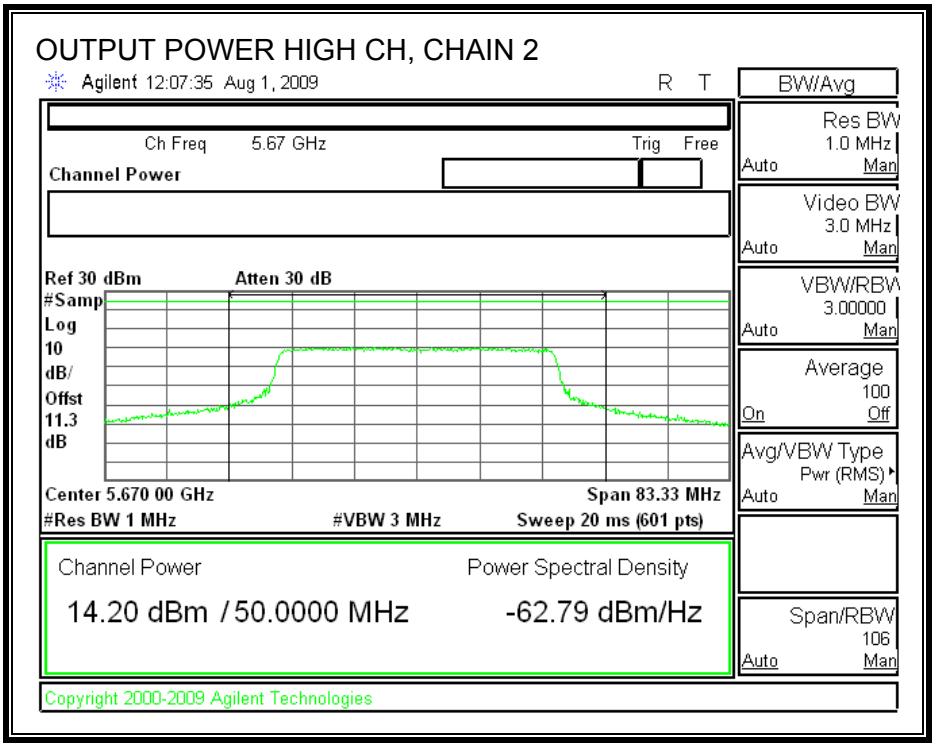
CHAIN 1 OUTPUT POWER





CHAIN 2 OUTPUT POWER





7.1.2. AVERAGE POWER

LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 11.3dB (including 10 dB pad and 1.3 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

11a Mode

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5500	14.50	14.49	17.51
High	5700	12.20	11.89	15.06

HT20 Mode

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)
Low	5500	14.58	14.52	17.56
High	5700	12.19	12.30	15.26

HT40 Mode

Channel	Frequency (MHz)	Chain 0 Power (dBm)	Chain 1 Power (dBm)	Total Power (dBm)
Low	5510	10.36	10.53	13.46
High	5670	13.94	14.04	17.00

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.

Note: All the bandedge measurement at horizontal worst polarization after the investigation.

8.1.1. TX ABOVE 1 GHz FOR 802.11a and HT20 IN LOWER 5.2 GHz BAND

HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Devin Chang
Date: 07/18/09
Project #: 09U12718
Company: Atheros
EUT Description: EUT with Laptop
EUT M/N: AR5BXB92
Mode Oper: 5240MHz

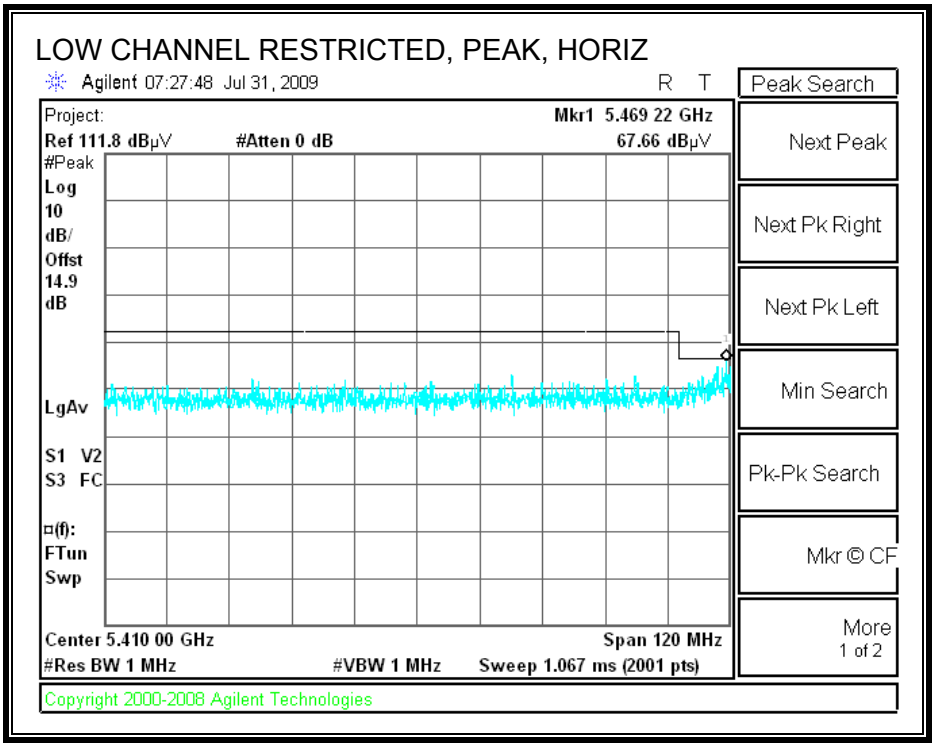
f	Measurement Frequency	Amp	Preamp Gain		Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m		Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength		Margin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

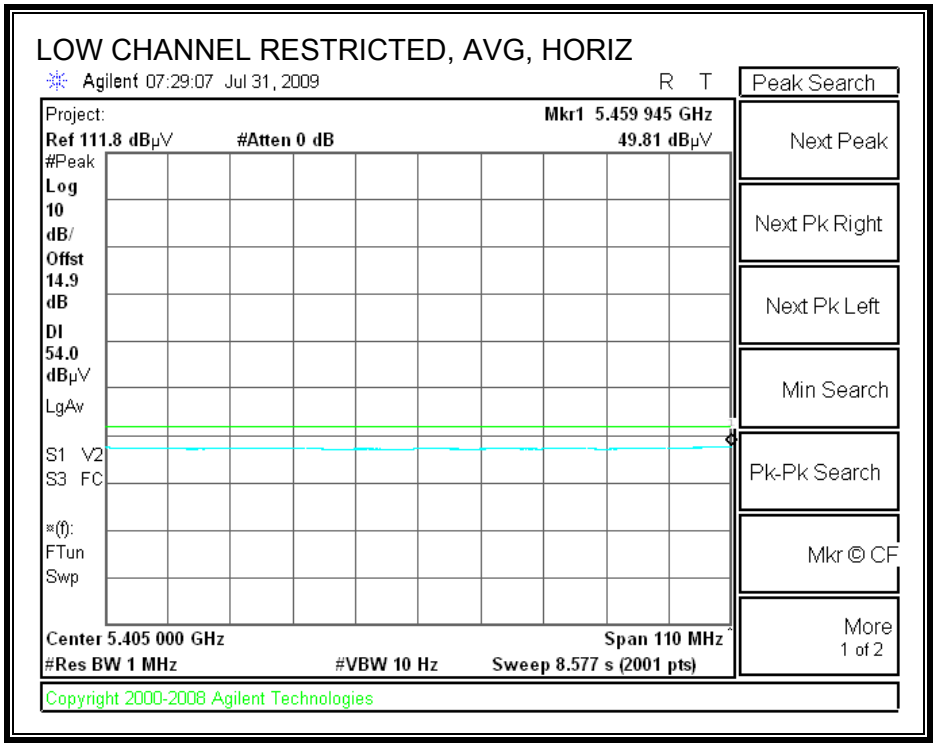
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
a mode_5240MHz													
15.720	3.0	40.9	38.2	11.4	-34.7	0.0	0.7	56.5	74.0	-17.5	V	P	
15.720	3.0	26.8	38.2	11.4	-34.7	0.0	0.7	42.5	54.0	-11.5	V	A	
15.720	3.0	39.9	38.2	11.4	-34.7	0.0	0.7	55.6	74.0	-18.4	H	P	
15.720	3.0	26.2	38.2	11.4	-34.7	0.0	0.7	41.9	54.0	-12.1	H	A	
HT20 mode_5240MHz													
15.720	3.0	46.9	38.2	11.4	-34.7	0.0	0.7	62.5	74.0	-11.5	V	P	
15.720	3.0	30.7	38.2	11.4	-34.7	0.0	0.7	46.3	54.0	-7.7	V	A	
15.720	3.0	44.5	38.2	11.4	-34.7	0.0	0.7	60.2	74.0	-13.8	H	P	
15.720	3.0	28.9	38.2	11.4	-34.7	0.0	0.7	44.5	54.0	-9.5	H	A	

Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

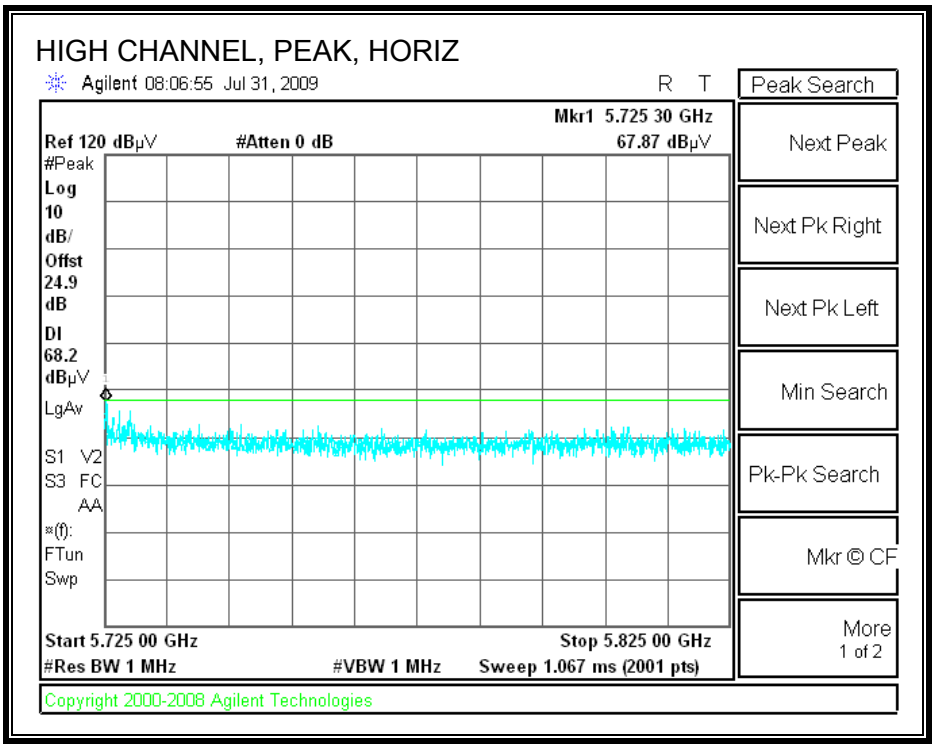
8.1.2. TX ABOVE 1 GHz FOR 802.11a MODE IN THE 5.6 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Vien Tran
Date: 07/31/09
Project #: 09U12718
Company: Atheros
EUT M/N: PPD-AR5BXB92
Test Target: FCC
Mode Oper: Tx 11a_5.6GHz Band

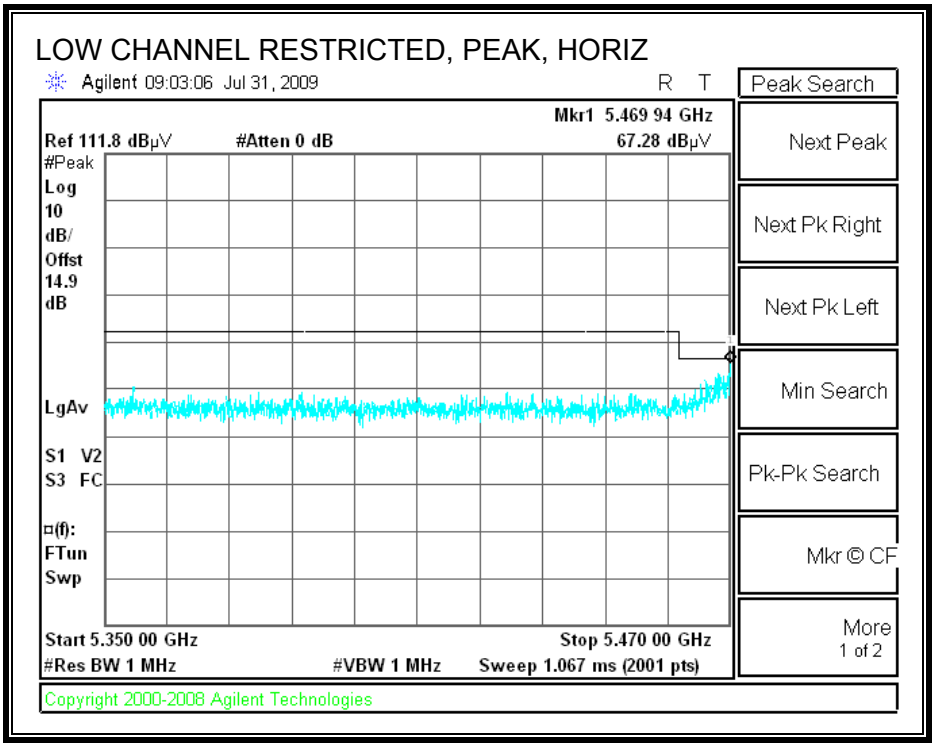
f	Measurement Frequency	Amp	Preamp Gain		Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m		Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength		Margin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

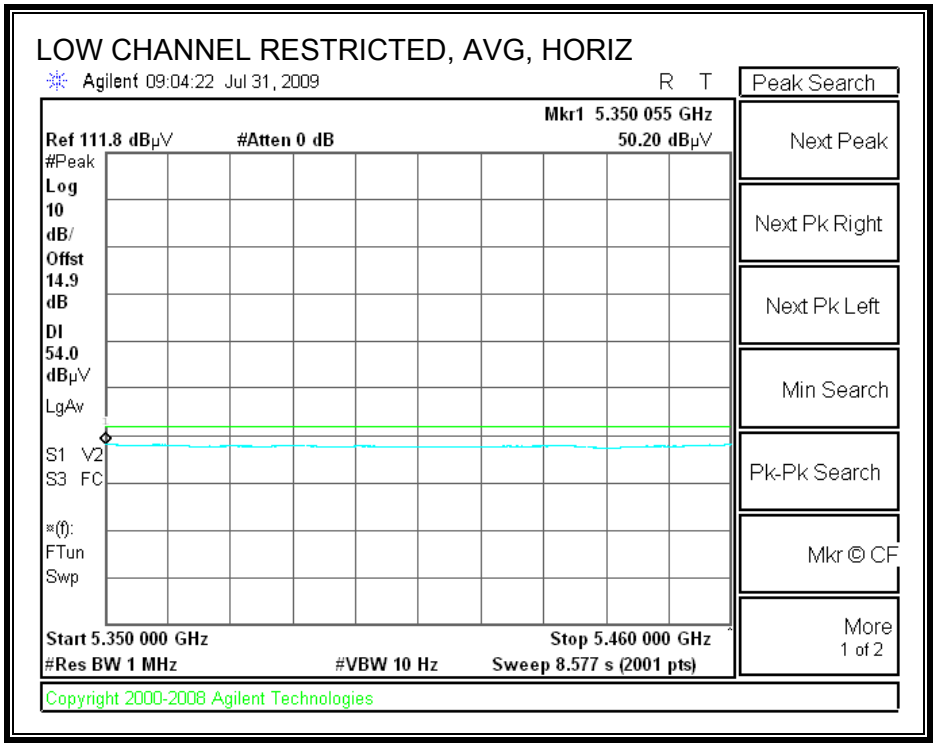
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant.High cm	Table Angle Degree	Notes
Low Channel 5500MHz															
11.000	3.0	35.7	37.7	9.2	-33.8	0.0	0.7	49.6	74.0	-24.4	H	P	100.5	139.3	
11.000	3.0	24.1	37.7	9.2	-33.8	0.0	0.7	38.0	54.0	-16.0	H	A	100.5	139.3	
11.000	3.0	35.9	37.7	9.2	-33.8	0.0	0.7	49.8	74.0	-24.2	V	P	120.6	114.5	
11.000	3.0	23.3	37.7	9.2	-33.8	0.0	0.7	37.2	54.0	-16.8	V	A	120.6	114.5	
Mid Channel 5600MHz															
11.200	3.0	43.2	37.9	9.3	-33.5	0.0	0.7	57.7	74.0	-16.3	H	P	141.8	72.7	
11.200	3.0	31.9	37.9	9.3	-33.5	0.0	0.7	46.3	54.0	-7.7	H	A	141.8	72.7	
11.200	3.0	40.2	37.9	9.3	-33.5	0.0	0.7	54.6	74.0	-19.4	V	P	137.0	137.2	
11.200	3.0	28.0	37.9	9.3	-33.5	0.0	0.7	42.4	54.0	-11.6	V	A	137.0	137.2	

Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

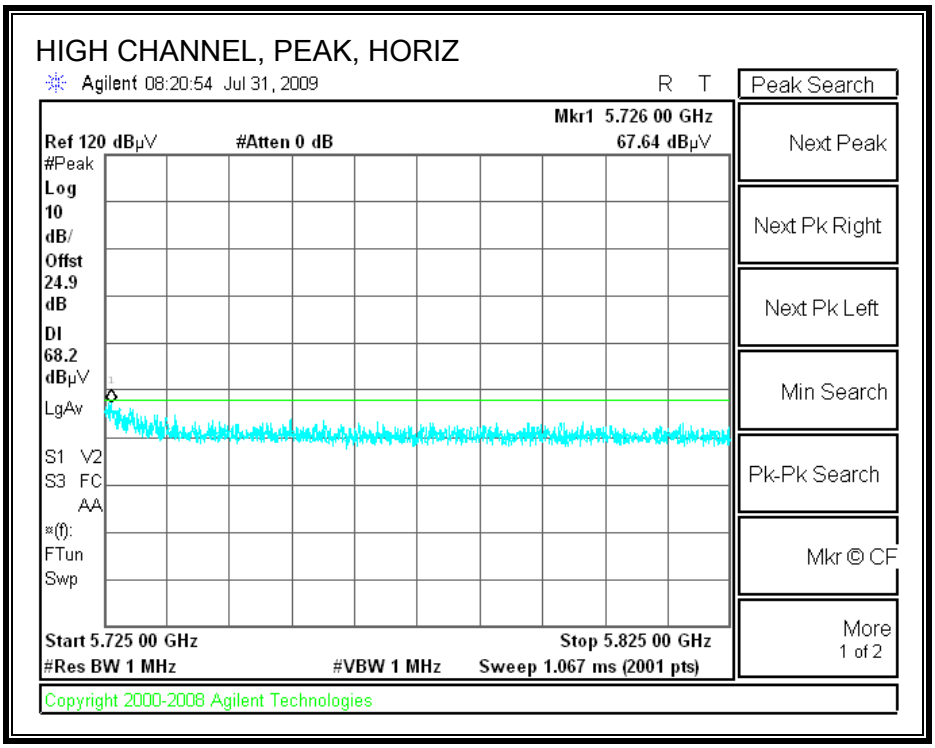
8.1.3. TX ABOVE 1 GHz FOR 802.11n HT20 MODE IN THE 5.6 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



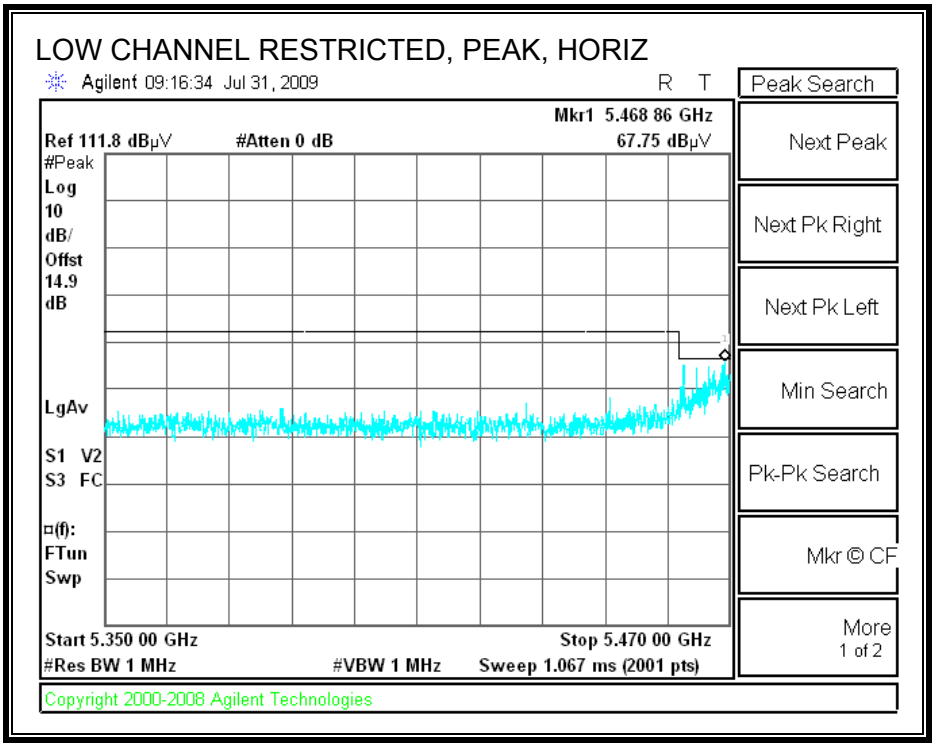


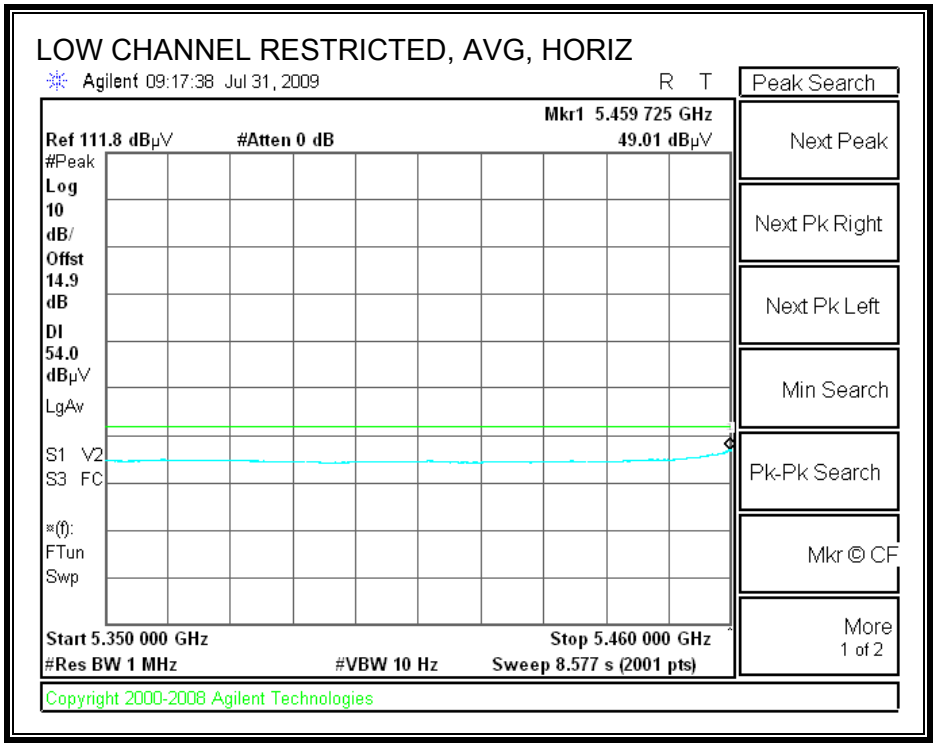
AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



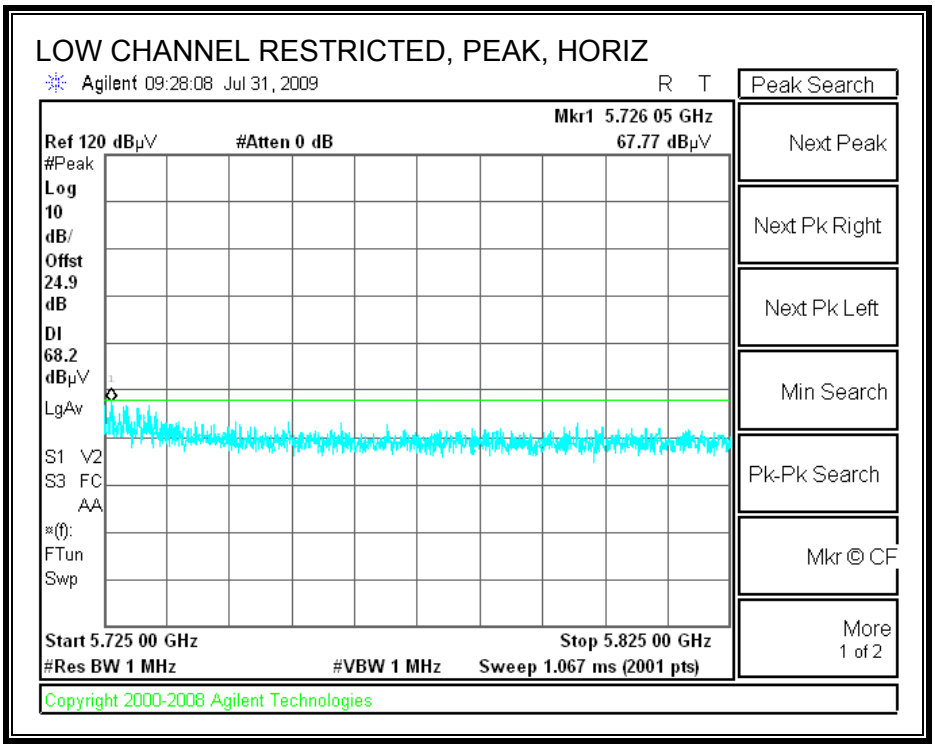
8.1.4. TX ABOVE 1 GHz FOR 802.11n HT40 MODE IN THE 5.6 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





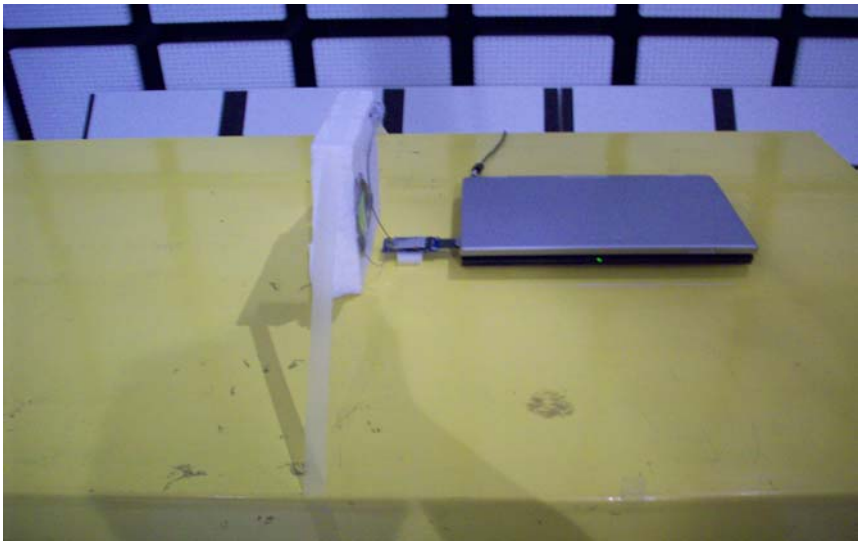
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



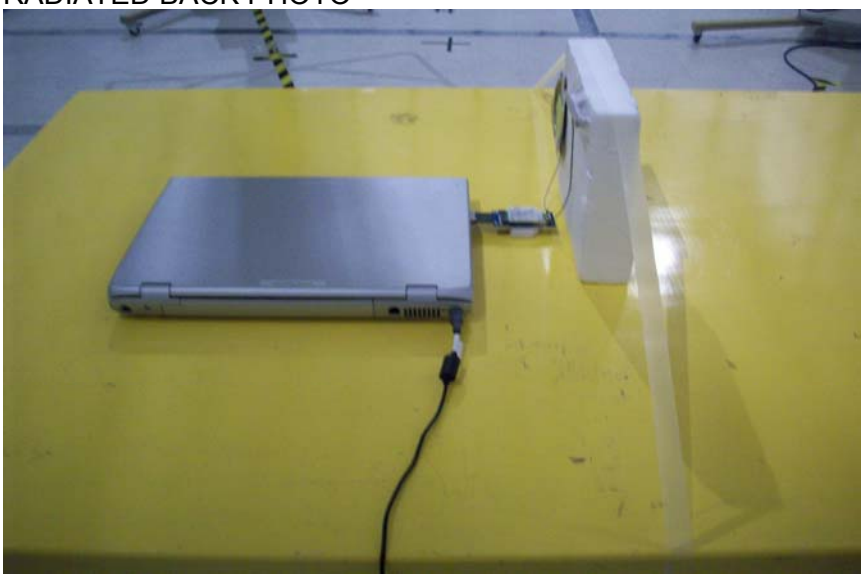
9. SETUP PHOTOS

RADIATED RF MEASUREMENT SETUP

RADIATED FRONT PHOTO



RADIATED BACK PHOTO



END OF REPORT