



**FCC CFR47 PART 15 SUBPART E
INDUSTRY CANADA RSS-210 ISSUE 8**

**CERTIFICATION CLASS II PERMISSIVE CHANGE
TEST REPORT**

FOR

802.11n + BT MODULE

MODEL NUMBER: WCN3660

**FCC ID: PPD-WCN3660
IC: 4104A-WCN3660**

REPORT NUMBER: 12U14585-2

ISSUE DATE: OCTOBER 15, 2012

Prepared for
**QUALCOMM Atheros, INC.
1700 TECHNOLOGY DRIVE
SAN JOSE, CA 95110, U.S.A.**

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NVLAP LAB CODE 200065-0

Revision History

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: QUALCOMM Atheros, INC.
1700 TECHNOLOGY DRIVE
SAN JOSE, CA, 95110, U.S.A.

EUT DESCRIPTION: 802.11n + BT MODULE

MODEL: WCN3660

SERIAL NUMBER: N10GB6RFK

DATE TESTED: May 31 – September 29, 2012

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart E	Pass
INDUSTRY CANADA RSS-210 Issue 8 Annex 9	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.

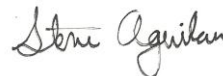
Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL CCS and all revisions are duly noted in the revisions section. Any alteration of this 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:



STEVE AGUILAR
EMC TECHNICIAN
UL CCS

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC CFR 47 Part 2, FCC CFR 47 Part 15, FCC 06-96, FCC KDB 789033, ANSI C63.4-2003, 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

5.1. DESCRIPTION OF EUT

Refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

5.2. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

Digital processor on the host, APQ8060A, was replaced by APQ8064.

5.3. MODIFICATIONS

Refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

5.4. MAXIMUM OUTPUT POWER

Maximum conducted output power is within +/-0.5 dB from the original values except for the following two modes where the power had to be reduced to pass BE, the new output power values for these two modes are shown below.

5GHz band				
Frequency Range (MHz)	Mode	Channel	New Average Output Power (dBm)	Output Power (mW)
5150 - 5250	802.11n HT40	Low	15.345	34.237
5500 - 5700	802.11n HT20	High	14.016	25.212

5.5. DESCRIPTION OF AVAILABLE ANTENNAS

Refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

5.6. SOFTWARE AND FIRMWARE

Refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

5.7. WORST-CASE CONFIGURATION AND MODE

Refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

For this Class II Permissive Change, an investigation was done to determine test items with worst-case margins and re-testing was performed for those items as covered by this report.

5.8. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

I/O CABLES

Refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

TEST SETUP

Refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

SETUP DIAGRAM FOR TESTS

Refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

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 Date
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	07/14/12
Antenna, Horn, 18 GHz	EMCO	3115	C00945	06/29/12
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00580	11/11/12
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01016	07/12/12
Horn Antenna, 26.5 GHz	ARA	MWH-1826/B	C00589	07/28/12
Horn Antenna, 40 GHz	ARA	MWH-2640/B	C00981	06/14/12
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	03/14/13
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C00986	03/22/13
Power Meter	Agilent / HP	437B	N02778	08/11/12
Power Sensor, 18 GHz	Agilent / HP	8481A	N02782	07/29/12
High pass Filter, 7.6 GHz	Micro-Tronics	HPM13195	N02682	CNR
Reject Notch Filter, 2.4 GHz	Micro-Tronics	-	-	CNR
EMI Test Receiver, 9 kHz-7 GHz	R & S	ESCI 7	1000741	08/08/13

7. ANTENNA PORT TEST RESULTS

Refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report"; except for the following:

7.1. 802.11n HT40 MODE IN THE 5.2 GHz BAND

7.1.1. 26 dB BANDWIDTH

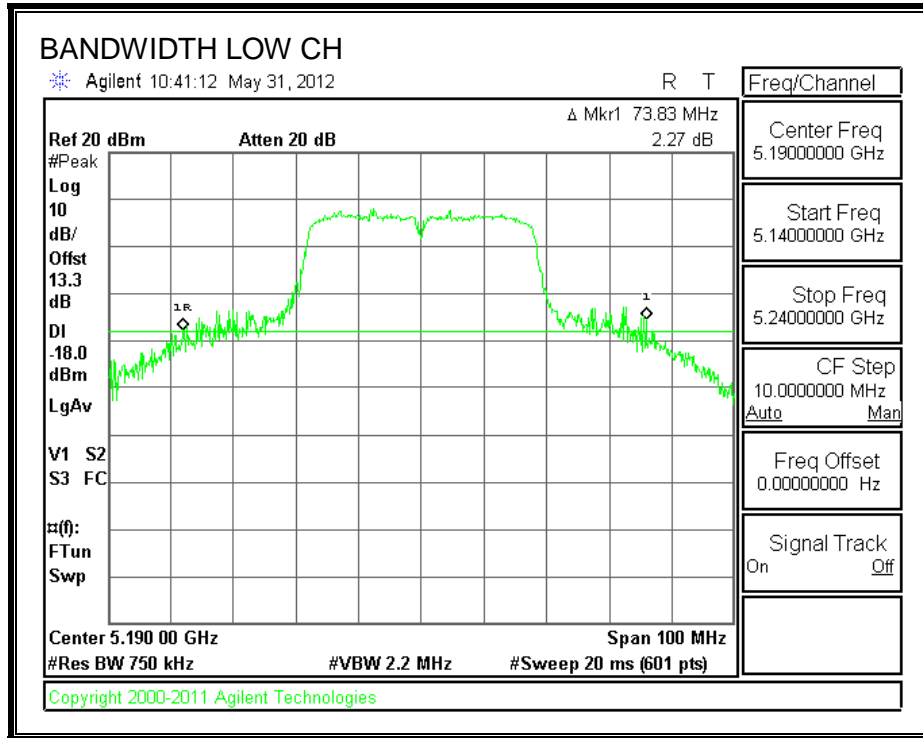
LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
Low	5190	73.83

26 dB BANDWIDTH



7.1.2. OUTPUT POWER AND PPSD

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

For the band 5.15–5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or $4 \text{ dBm} + 10 \log B$, where B is the 26-dB emission bandwidth in MHz. In addition, the peak power spectral density shall not exceed 4 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output 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.

DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

RESULTS

Limits

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Directional Gain (dBi)	Power Limit (dBm)	PPSD Limit (dBm)
Low	5190	17	73.80	22.68	5.60	17.00	4.00

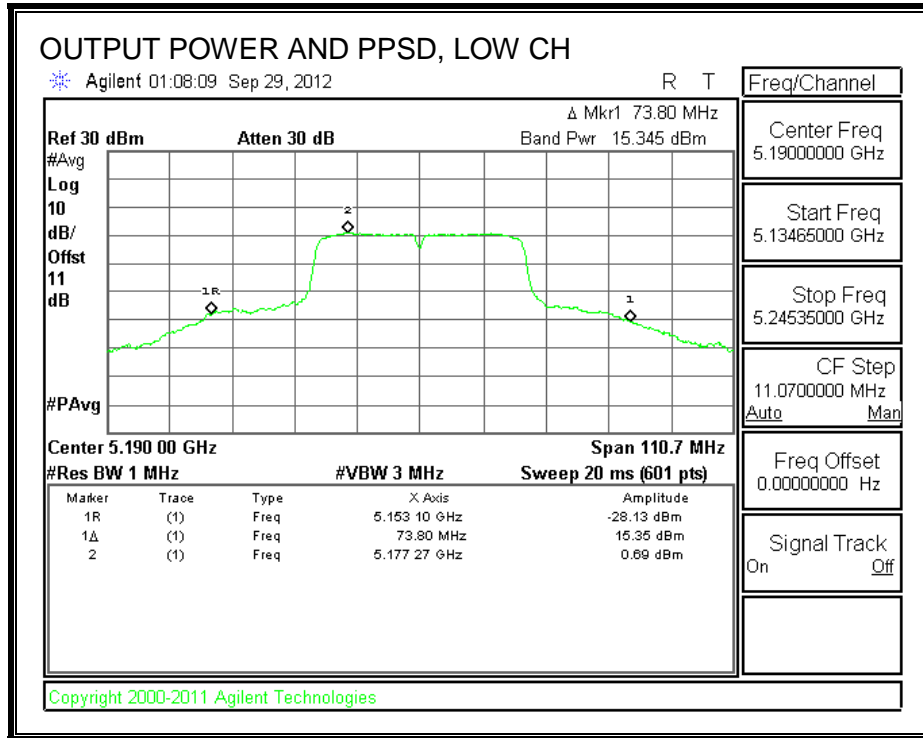
Output Power Results

Channel	Frequency (MHz)	Meas Power (dBm)	Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
Low	5190	15.345	15.345	17.00	-1.655

PPSD Results

Channel	Frequency (MHz)	Meas PPSD (dBm)	Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
Low	5190	0.69	0.69	4.00	-3.31

OUTPUT POWER AND PPSD



7.1.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 13.3 dB (including 12 dB pad and 1.3 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

Original

Channel	Frequency (MHz)	Power (dBm)
Low	5190	15.4

New value for C2PC

Channel	Frequency (MHz)	Power (dBm)
Low	5190	14.0

7.2. 802.11n HT20 MODE IN THE 5.6 GHz BAND

7.2.1. 26 dB BANDWIDTH

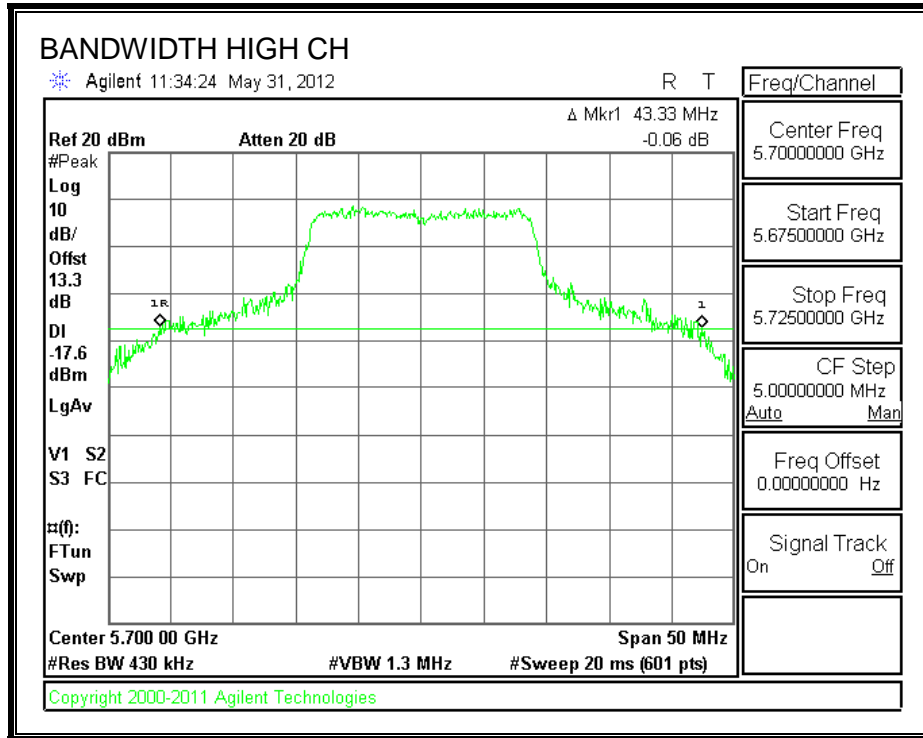
LIMITS

None; for reporting purposes only.

RESULTS

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
High	5700	43.30

26 dB BANDWIDTH



7.2.2. OUTPUT POWER AND PPSD

LIMITS

FCC §15.407 (a) (2)

IC RSS-210 A9.2 (3)

For the 5.25–5.35 GHz and 5.47–5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz. In addition, the peak power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output 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.

DIRECTIONAL ANTENNA GAIN

There is only one transmitter output therefore the directional gain is equal to the antenna gain.

RESULTS

Limits

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Log B Limit (dBm)	Directional Gain (dBi)	Power Limit (dBm)	PPSD Limit (dBm)
High	5700	24	43.30	27.36	5.30	24.00	11.00

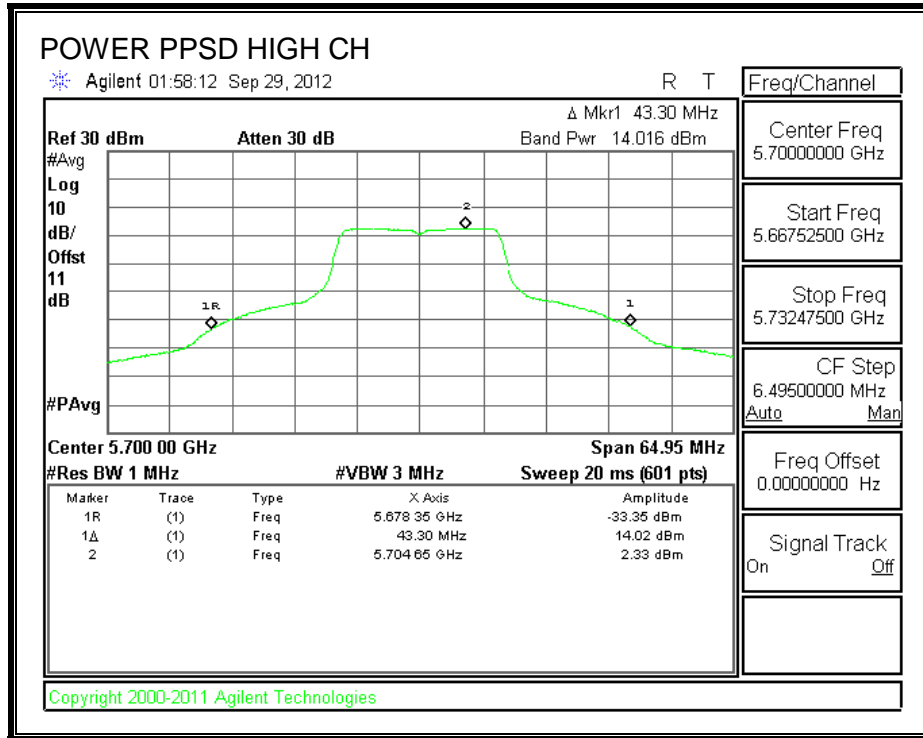
Output Power Results

Channel	Frequency (MHz)	Meas Power (dBm)	Corr'd Power (dBm)	Power Limit (dBm)	Power Margin (dB)
High	5700	14.016	14.016	24.00	-9.984

PPSD Results

Channel	Frequency (MHz)	Meas PPSD (dBm)	Corr'd PPSD (dBm)	PPSD Limit (dBm)	PPSD Margin (dB)
High	5700	2.33	2.33	11.00	-8.67

OUTPUT POWER AND PPSD



7.2.3. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

The cable assembly insertion loss of 13.3 dB (including 12 dB pad and 1.3 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

Original

Channel	Frequency (MHz)	Power (dBm)
High	5700	16.0

New values for C2PC

Channel	Frequency (MHz)	Power (dBm)
High	5700	13.4

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.

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; the video bandwidth is set to 1 MHz for peak measurements and as applicable 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. TRANSMITTER ABOVE 1 GHz

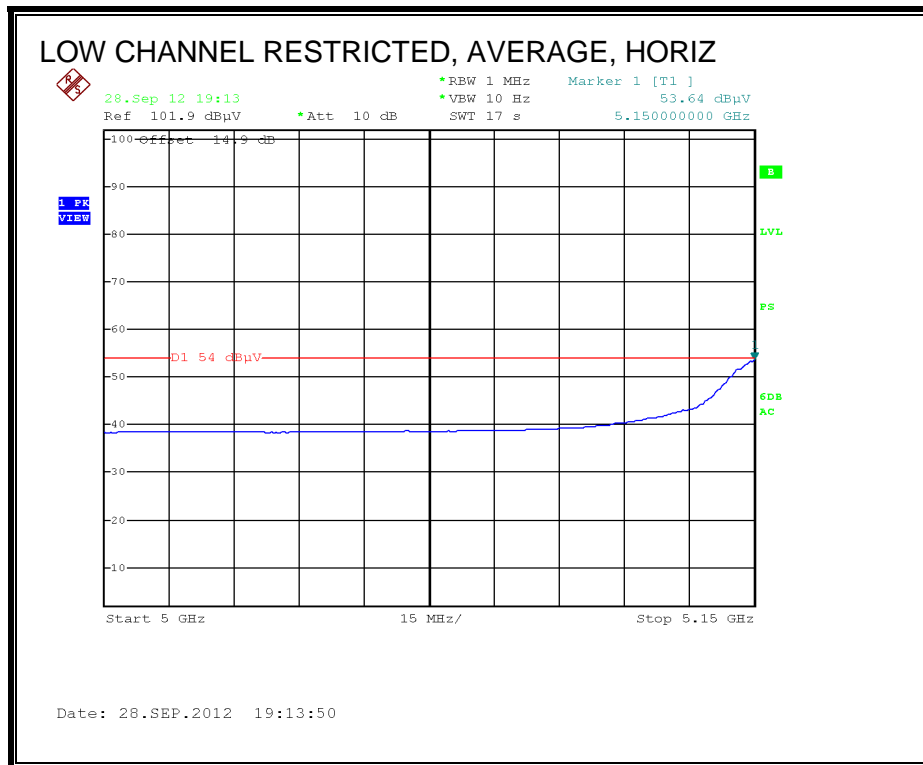
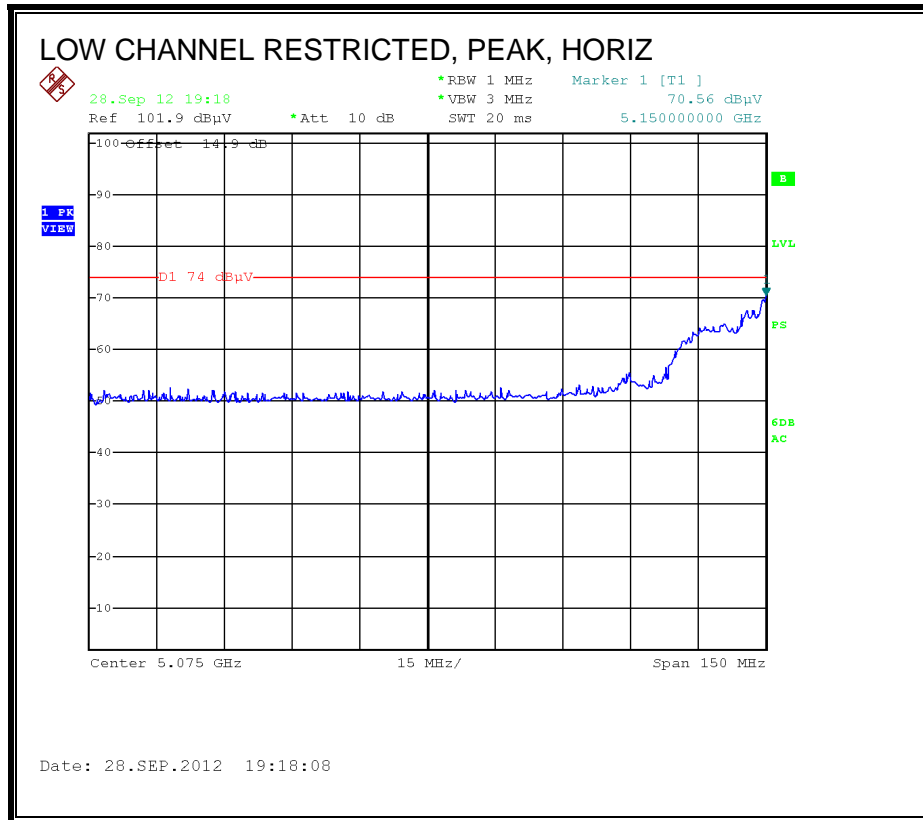
8.2.1. TX ABOVE 1 GHz 802.11a MODE IN THE 5.2 GHz BAND

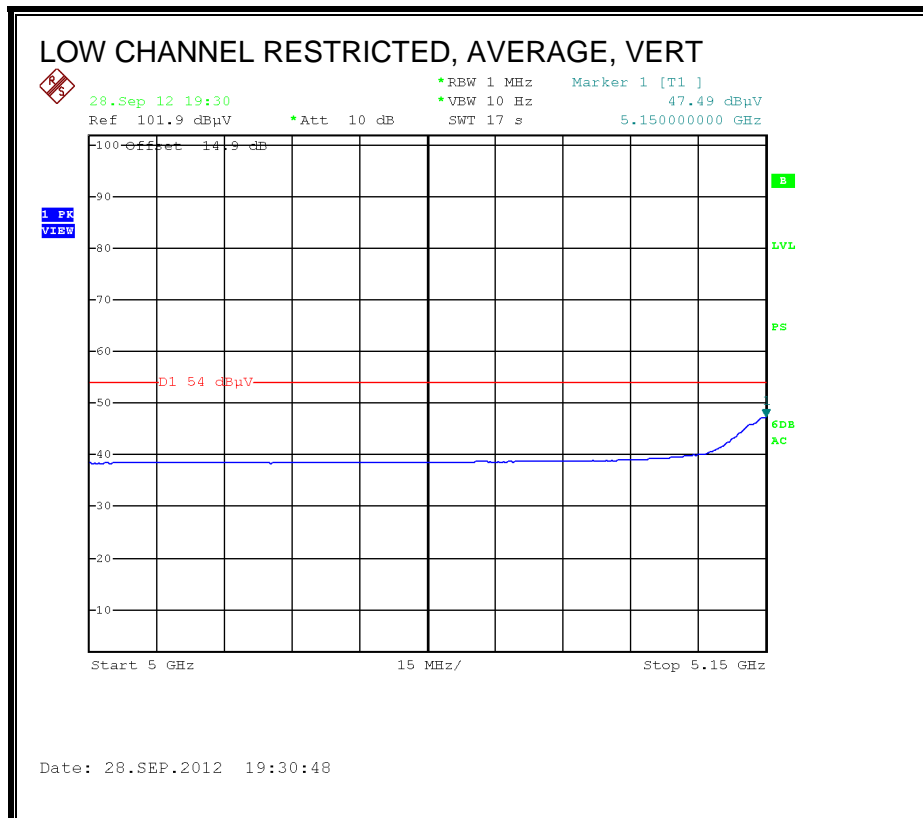
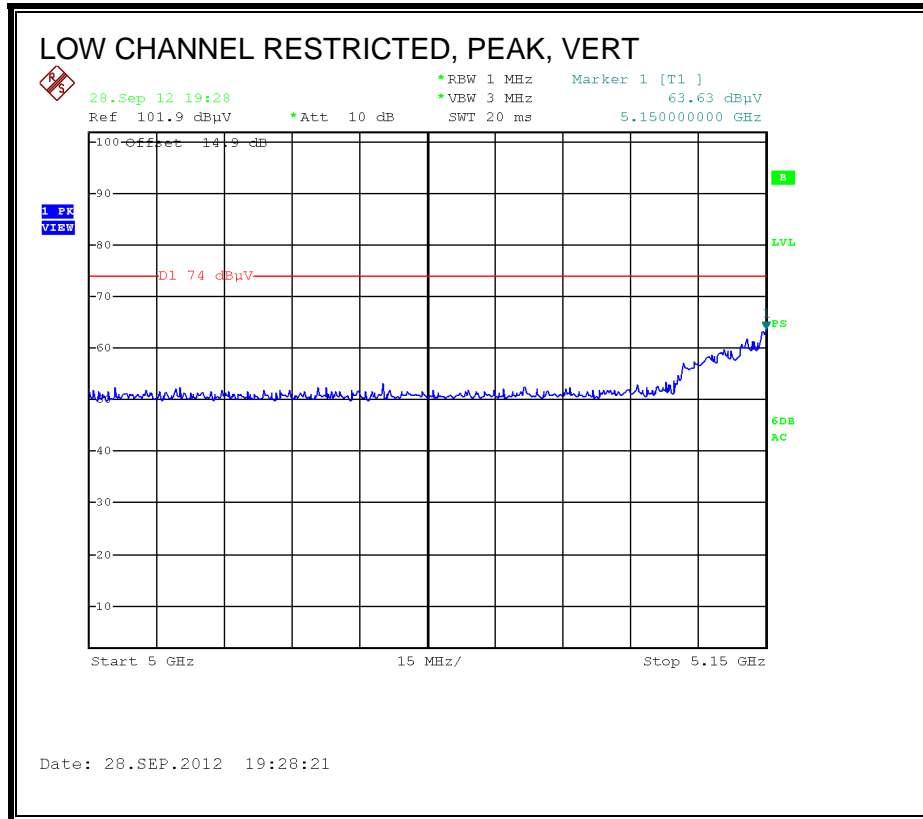
Refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

8.2.2. TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.2 GHz BAND

Refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

8.2.3. TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 5.2 GHz BAND





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
 Compliance Certification Services, Fremont 5m Chamber-A

Company: Qualcomm Atheros
Project #: 12U14585
Date: 9/28/2012
Test Engineer: Steve Aguilar
Configuration: EUT, TX mode
Mode: 802.11N, HT40

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

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter	Peak Measurements RBW=VBW=1MHz/3MHz
3' cable 22807700	12' cable 22807600	20' cable 22807500		R_001	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)
Low Channel (5190 MHz)															
15.570	3.0	34.45	21.58	38.9	12.2	-34.0	0.0	0.0	51.6	38.7	74	54	-22.4	-15.3	H
15.570	3.0	34.08	21.71	38.9	12.2	-34.0	0.0	0.0	51.2	38.8	74	54	-22.8	-15.2	V

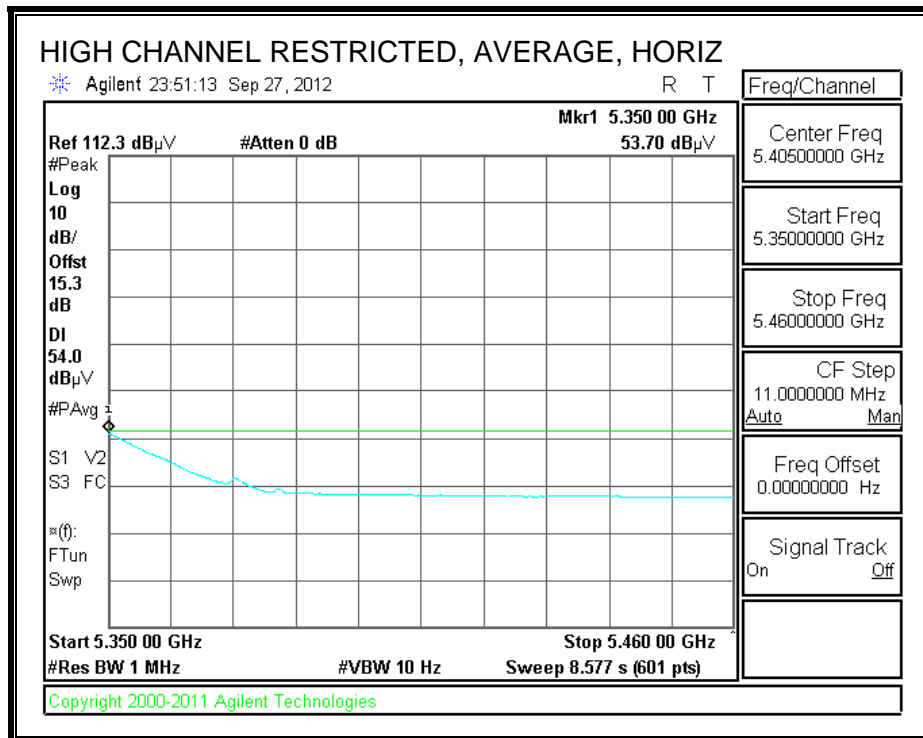
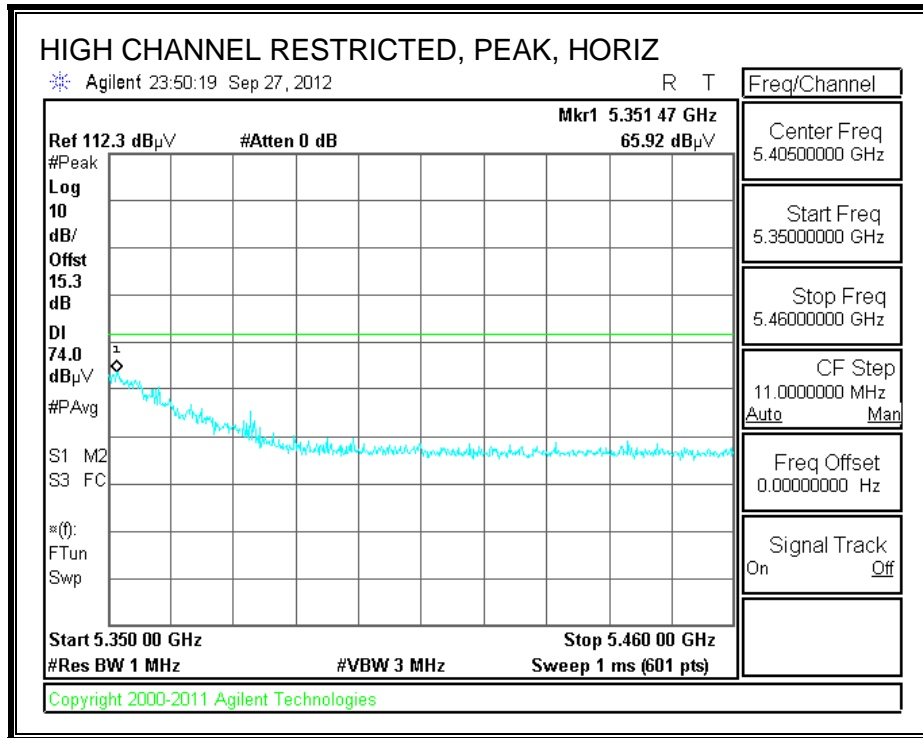
Rev. 11.10.11 Note: No other emissions were detected above the system noise floor.

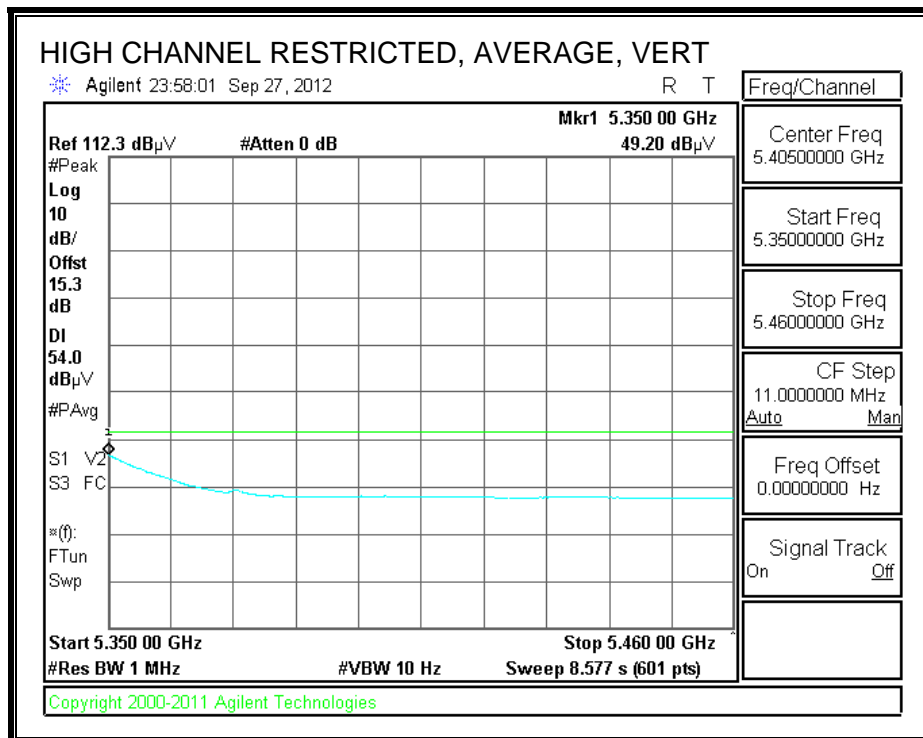
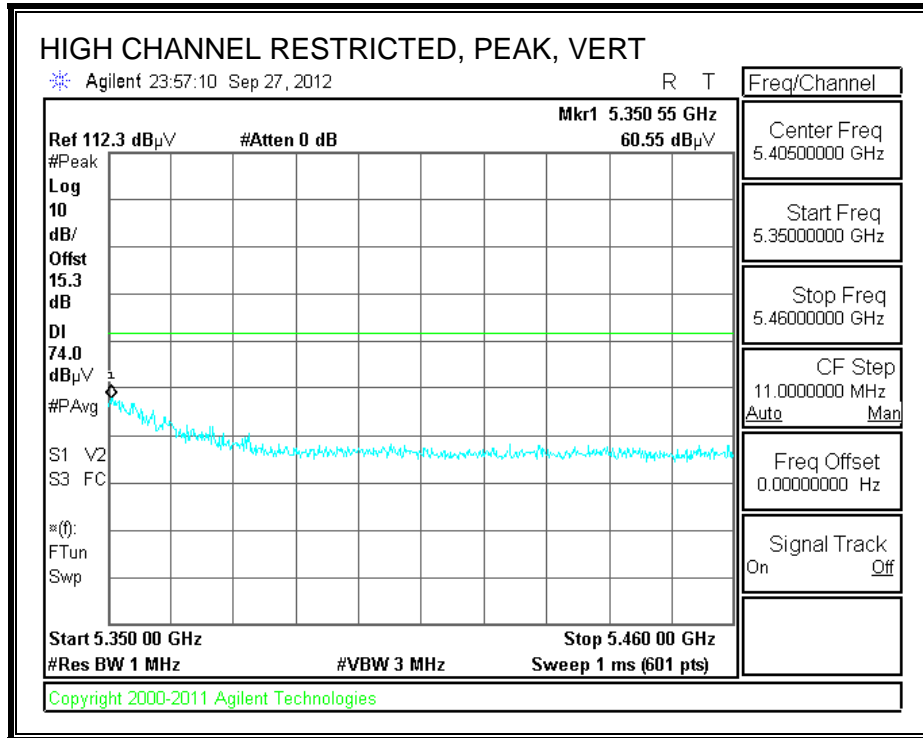
f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field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

Note: harmonics for low channel was conducted and shown to be of more margin than original. For high channel, refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

8.2.4. TX ABOVE 1 GHz 802.11a MODE IN THE 5.3 GHz BAND

RESTRICTED BANDEDGE (HIGH CHANNEL)





HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement																																																																																																														
Compliance Certification Services, Fremont 5m Chamber-A																																																																																																														
Company:		Qualcomm Atheros																																																																																																												
Project #:		12U14585																																																																																																												
Date:		9/28/2012																																																																																																												
Test Engineer:		Steve Aguilar																																																																																																												
Configuration:		EUT, TX mode																																																																																																												
Mode:		802.11A																																																																																																												
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																																																																																																														
3' cable 22807700			12' cable 22807600			20' cable 22807500			HPF			Reject Filter																																																																																																		
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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)																																																																																															
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Rev. 11.10.11 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																																																																																																							

Note: harmonics for high channel was conducted and shown to be of more margin than original. For low channel, refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

8.2.5. TX ABOVE 1 GHz 802.11n HT20 MODE IN THE 5.3 GHz BAND

Refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

8.2.6. TX ABOVE 1 GHz 802.11n HT40 MODE IN THE 5.3 GHz BAND

Refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

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

HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
 Compliance Certification Services, Fremont 5m Chamber-A

Company: Qualcomm Atheros
 Project #: 12U14585
 Date: 9/28/2012
 Test Engineer: Steve Aguilar
 Configuration: EUT, TX mode
 Mode: 802.11A

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

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter	Peak Measurements RBW=VBW=1MHz/3MHz
3' cable 22807700	12' cable 22807600	20' cable 22807500		R_001	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)
Low Channel (5500 MHz)															
11.000	3.0	33.84	20.63	38.4	10.2	-35.6	0.0	0.0	46.7	33.5	74	54	-27.3	-20.5	H
11.000	3.0	35.03	25.81	38.4	10.2	-35.6	0.0	0.0	47.9	38.7	74	54	-26.1	-15.3	V

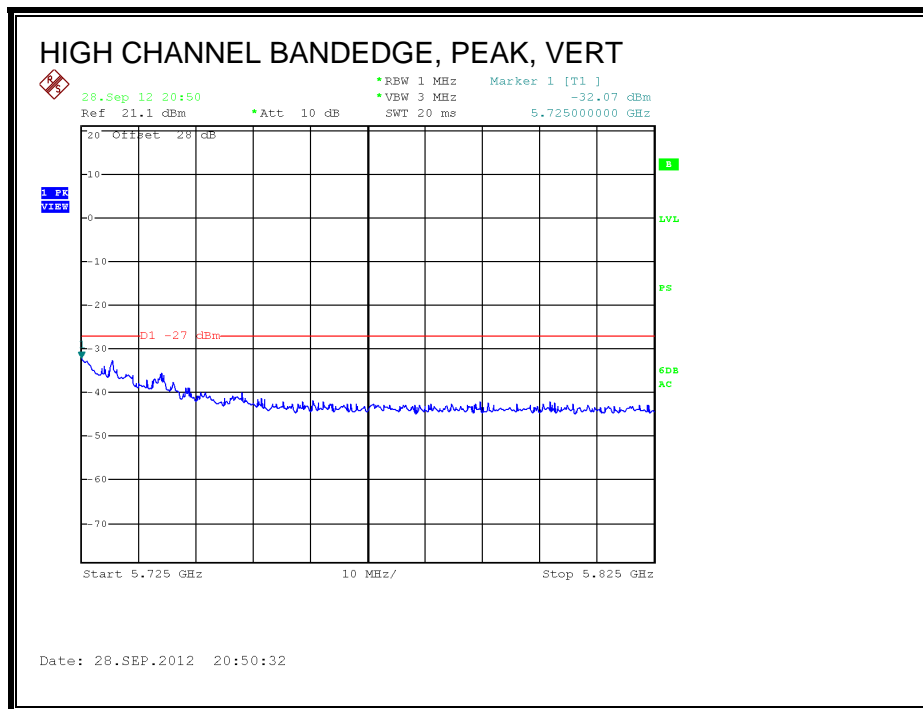
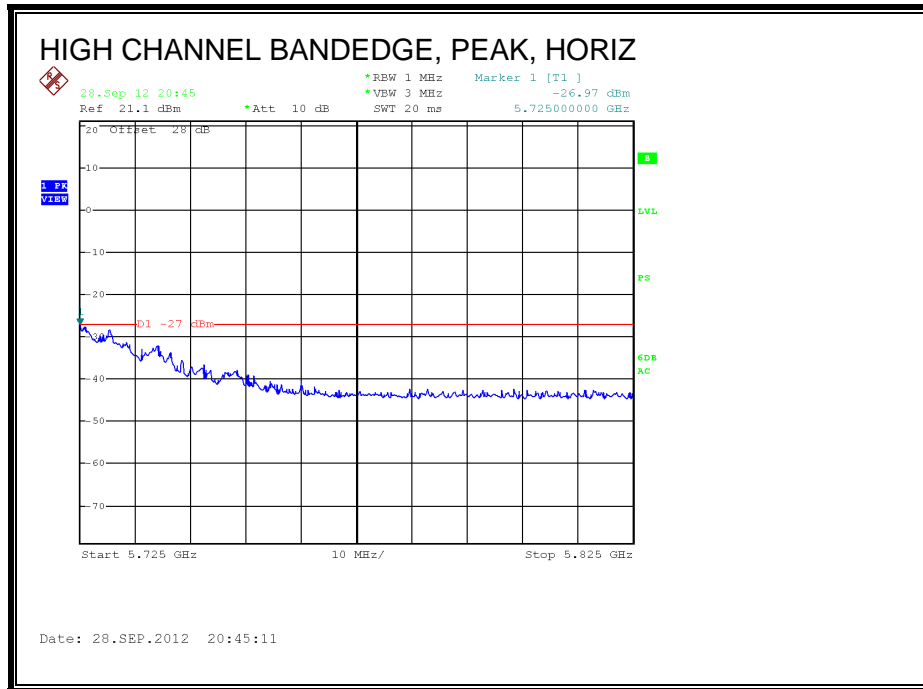
Rev. 11.10.11 Note: No other emissions were detected above the system noise floor.

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		

Note: harmonics for low channel was conducted and shown to be of more margin than original. For mid channel harmonics, high channel harmonics and band edge, refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

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

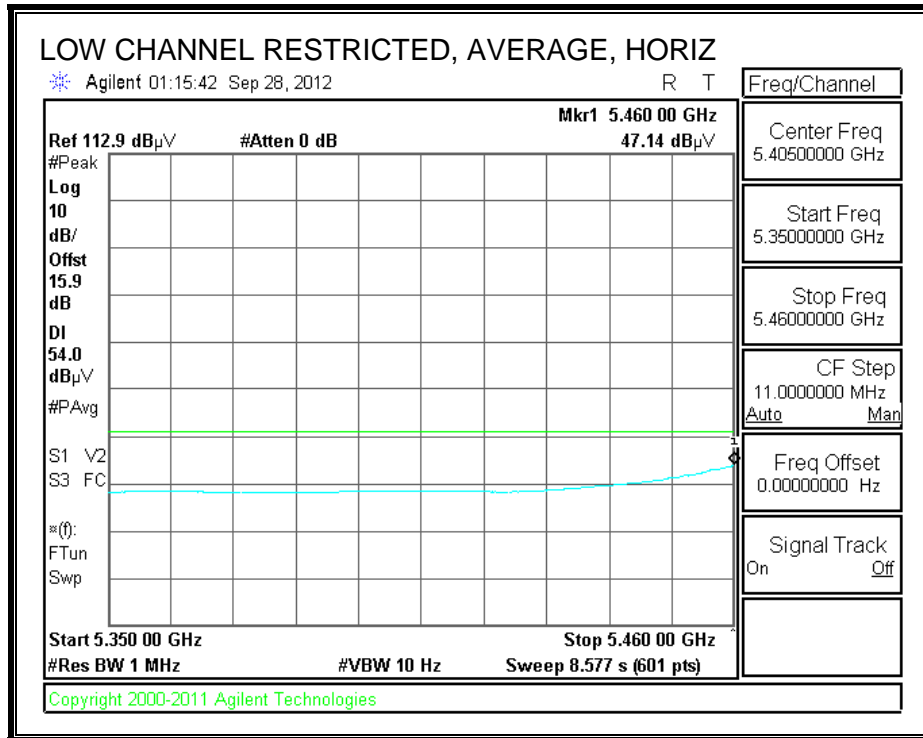
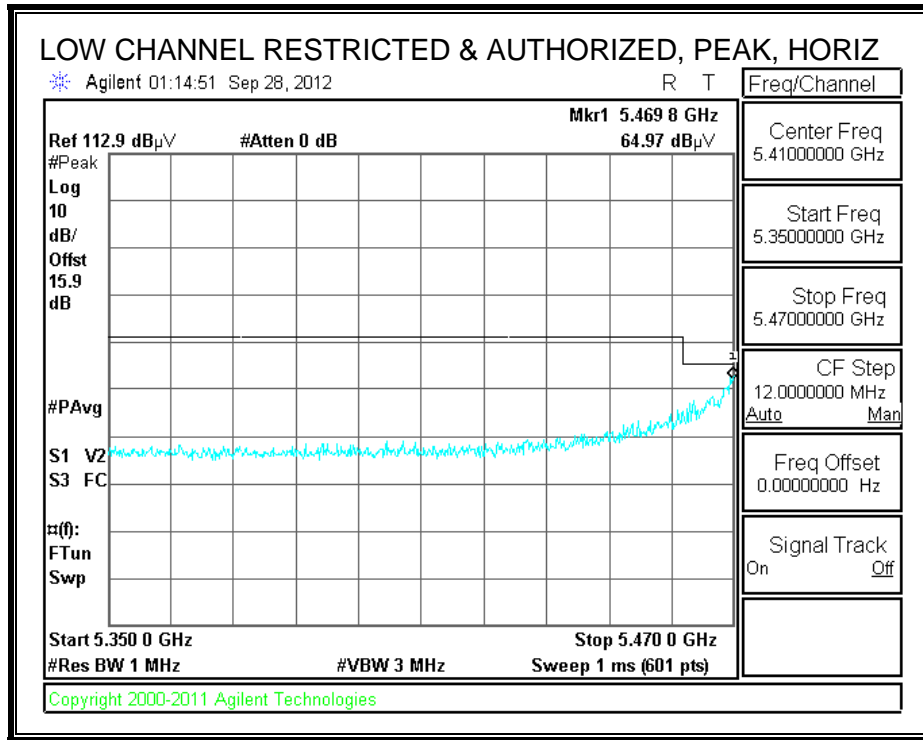
AUTHORIZED BANDEDGE (HIGH CHANNEL)

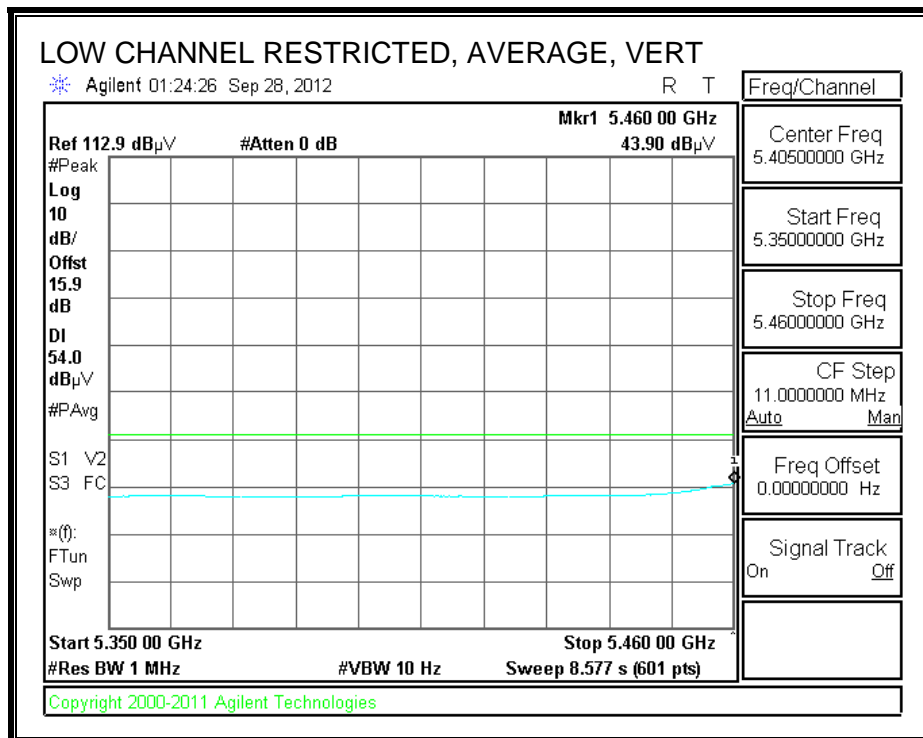
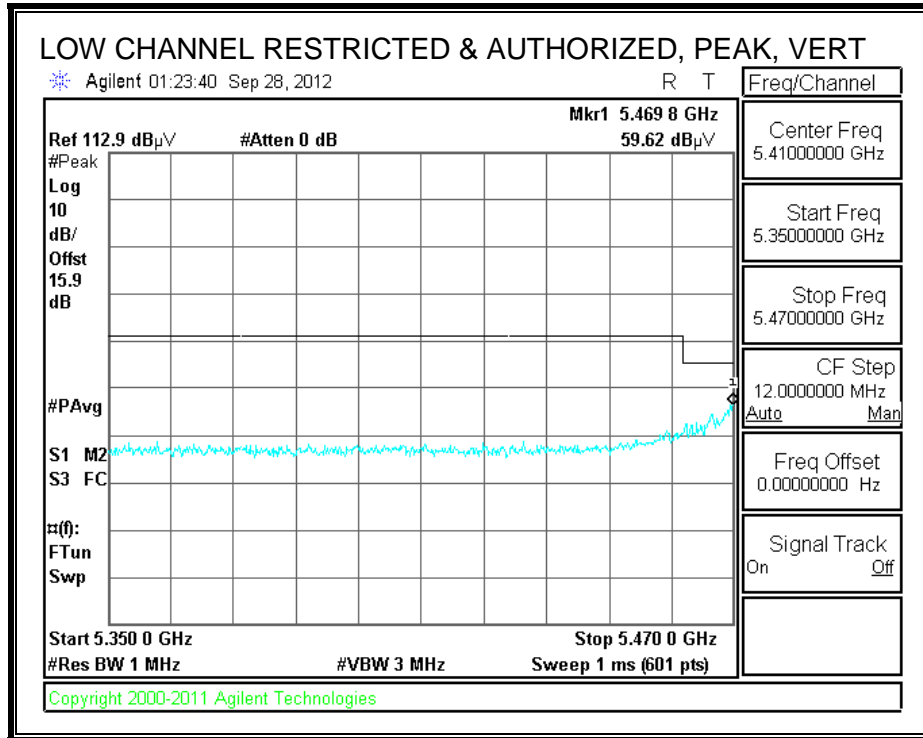


Note: For harmonics data and the rest of band edge data, refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

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

RESTRICTED & AUTHORIZED BANDEDGE (LOW CHANNEL)





Note: For harmonics data and the rest of band edge data, refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

8.3. WORST-CASE BELOW 1 GHz

Refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

9. AC POWER LINE CONDUCTED EMISSIONS

Refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".

10. MAXIMUM PERMISSIBLE EXPOSURE

Refer to original report number "12U14222-7B FCC IC UNII WLAN w DFS Report".