



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

**CLASS II PERMISSIVE CHANGE
CERTIFICATION TEST REPORT**

FOR

**802.11a/g/n WLAN + Bluetooth PCI-E Custom Combination Card
(Tested inside of MacBook Pro. model A1398)**

MODEL NUMBER: BCM94331CSAX

**FCC ID: QDS-BRCM1062
IC: 4324A-BRCM1062**

REPORT NUMBER: 12U14283-1, Revision B

ISSUE DATE: MAY 24, 2012

Prepared for
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NVLAP LAB CODE 200065-0

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--	05/17/12	Initial Issue	F. Ibrahim
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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: BROADCOM CORPORATION
190 MATHILDA PLACE
SUNNYVALE, CA 94086, U.S.A

EUT DESCRIPTION: 802.11a/g/n WLAN + Bluetooth PCI-E Custom Combination Card (Tested inside of MacBook Pro. model A1398)

MODEL: BCM94331CSAX

SERIAL NUMBER: C86201300XKDNP6'

DATE TESTED: FEB 21 – APR 19, 2012

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

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

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

Approved & Released For UL CCS By:



FRANK IBRAHIM
EMC SUPERVISOR
UL CCS

Tested By:



TOM CHEN
EMC ENGINEER
UL CCS

2. TEST METHODOLOGY

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

3. FACILITIES AND ACCREDITATION

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

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

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

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

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

4.3. MEASUREMENT UNCERTAINTY

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

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

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is 802.11a/g/n WLAN + Bluetooth PCI-E Custom Combination Card (Tested inside of MacBook Pro. model A1398)

The radio module is manufactured by Broadcom.

5.2. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

Different antennas with different gains were used and the radio module was installed inside a specific host laptop PC.

5.3. MAXIMUM OUTPUT POWER

Average Power was measured and verified to be within +/- 0.5 dB from the original values covered under report number "11U14154-8 FCC IC DTS WLAN Report".

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

No.	Antenna Manufacturer	Antenna Type	Model	Peak gain 2402 to 2484Mhz dBi	Peak gain 5150 to 5250MHz dBi	Peak gain 5250 to 5350MHz dBi	Peak gain 5470 to 5725MHz dBi	Peak gain 5725 to 5850MHz dBi
1	Amphenol	802.11abgn WLAN Antenna		0.12	7.04	7.09	5.03	2.66
2	Amphenol	802.11abgn WLAN/BT Antenna		5.30	6.70	7.06	6.66	5.93
3	Amphenol	802.11abgn WLAN Antenna		4.69	3.79	3.58	3.94	6.04
total (mW)				7.36	12.13	12.48	10.30	9.78
Composite 3x3 CDD mode testing for FCC/NCC ONLY dBi				8.6687781	10.838219	10.961713	10.126723	9.903389
No.	Antenna Manufacturer	Antenna Type	Model	Peak gain 2402 to 2484Mhz dBi	Peak gain 5150 to 5250MHz dBi	Peak gain 5250 to 5350MHz dBi	Peak gain 5470 to 5725MHz dBi	Peak gain 5725 to 5850MHz dBi
1	Molex	802.11abgn WLAN Antenna		-0.79	5.87	5.12	4.16	3.21
2	Molex	802.11abgn WLAN/BT Antenna		4.67	6.60	6.46	6.25	5.41
3	Molex	802.11abgn WLAN Antenna		2.92	4.15	4.32	4.31	4.06
total (mW)				5.72	11.03	10.38	9.52	8.12
Composite 3x3 CDD mode testing for FCC/NCC ONLY dBi				7.5765555	10.42761	10.162273	9.7867609	9.093583

Note: Since the Amphenol combined antennas gain is higher than the Molex combined antennas gain, Amphenol antenna was selected for testing as worst-case scenario to cover the Molex antenna.

5.5. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Broadcom, rev. 5.106.192.12
 The test utility software used during testing was BCM Internal, rev. 5.106.RC192.12.

5.6. WORST-CASE CONFIGURATION AND MODE

The EUT was tested as radio module installed inside a host laptop PC.

Worst-Case data rates, from the original reports, were as follows:

For 2.4 GHz Band:

802.11b: 1 Mb/s

802.11g: 6 Mb/s

802.11n 20MHz: MCS0

For 5.8 GHz Band:

802.11a: 6 Mb/s

802.11n 20MHz: MCS0

802.11n 40MHz: MCS0

Worst-case mode and channel used for 30-1000 MHz radiated and power line conducted emissions was the mode and channel with the highest output power.

All legacy modes were measured with the highest gain for each type of antenna.

5.7. DESCRIPTION OF TEST SETUP

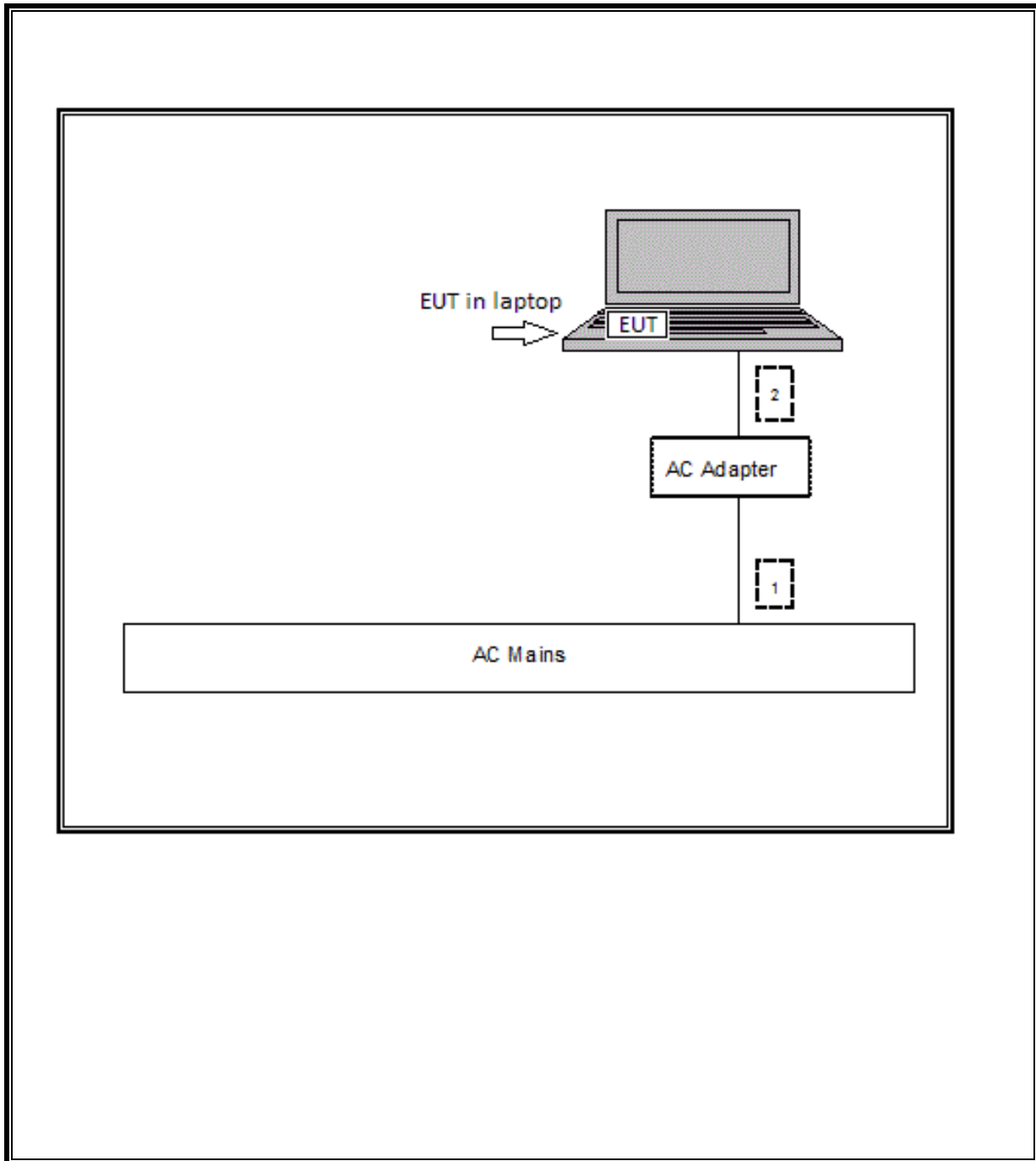
SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
AC Adapter	Apple	ADP-85FB TA	C04203404B6DT9PhH	DoC

I/O CABLES

Channel	Frequency (MHz)	Chain 1 PK Power (dBm)	Chain 2 PK Power (dBm)	Chain 3 PK Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5755	19.30	19.24	19.05	23.97	26.22	-2.25
High	5795	19.57	19.34	18.55	23.95	26.22	-2.27

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 Due
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
Reject Filter, 2.0-2.9 GHz	Micro-Tronics	BRM50702	N02684	CNR
High Pass Filter, 7.6 GHz	Micro-Tronics	HPM13195	N02682	CNR
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	MY461804919	04/09/13
Peak Power Meter	Agilent	N1911A	1282124A	08/04/12
Peak Power Sensor	Agilent	E9323A	1240537J	08/04/12
Reject Filter, 5.725-5.825 GHz	Micro-Tronics	BRC13192	N02676	CNR
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRM50702	N02685	CNR
Highpass Filter, 7.6 GHz	Micro-Tronics	HPM13195	N02682	CNR
EMI Test Receiver, 30MHz	R & S	ESHS 20	N02396	08/19/13
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	12/13/12

7. ANTENNA PORT TEST RESULTS

For all antenna port test results refer to the original report “11U14154-8 FCC IC DTS WLAN Report”, except for the following items:

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 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

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. OUTPUT POWER (FROM ORIGINAL REPORT WITH NEW AG)

8.2.1. 2.4GHz 802.11g 1TX OUTPUT POWER

LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

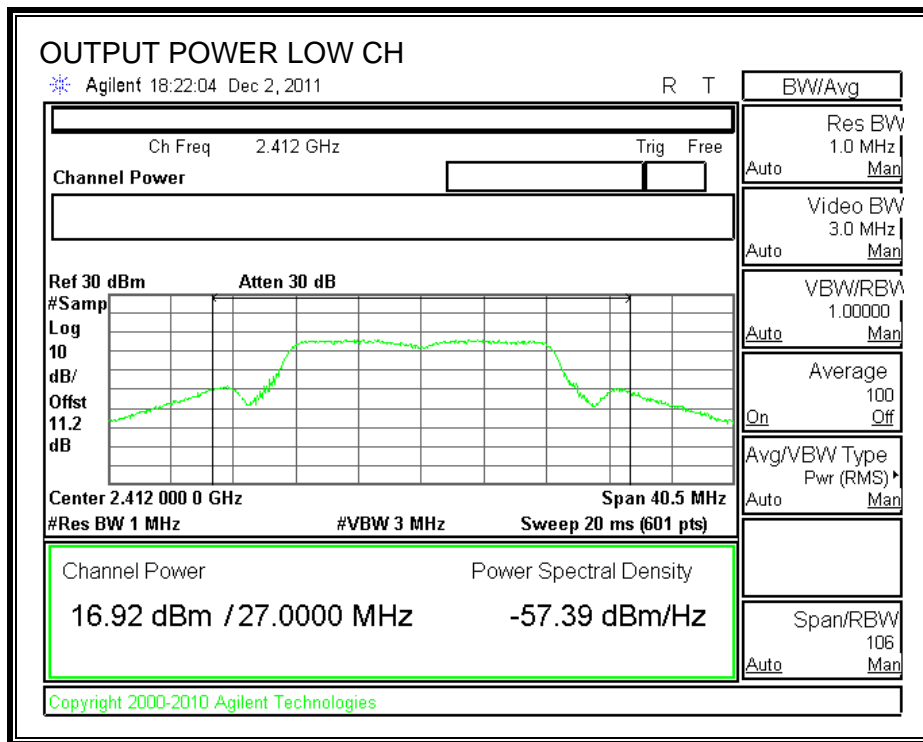
TEST PROCEDURE

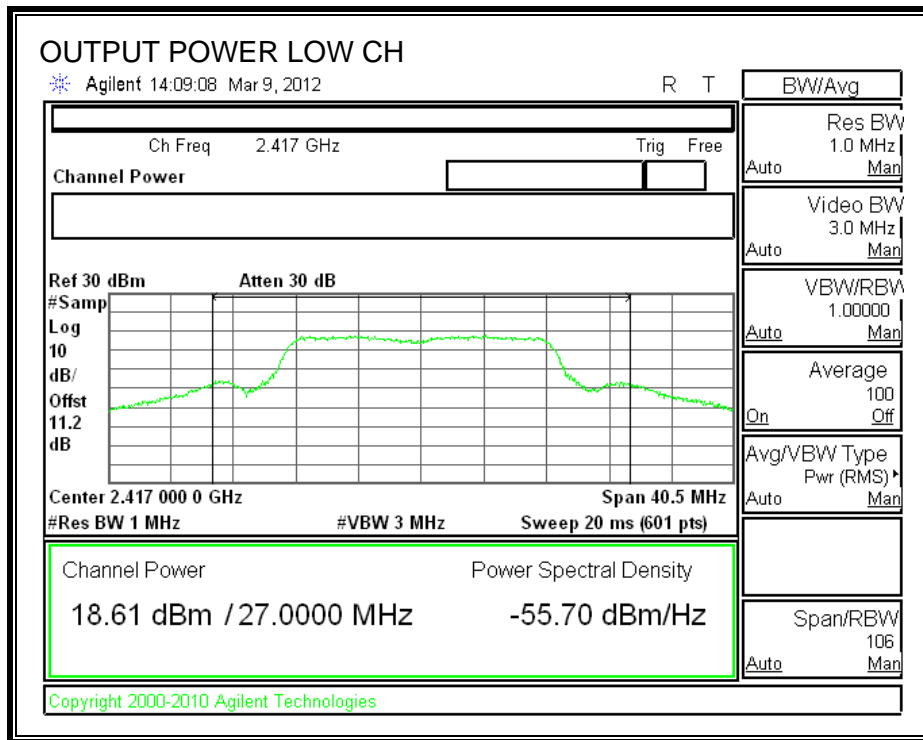
Peak power is measured using the Channel bandwidth Alternative peak output power procedure specified in "TCB Training for Devices covered under Scopes A1 - A4" by Joe Dichoso, May 2003.

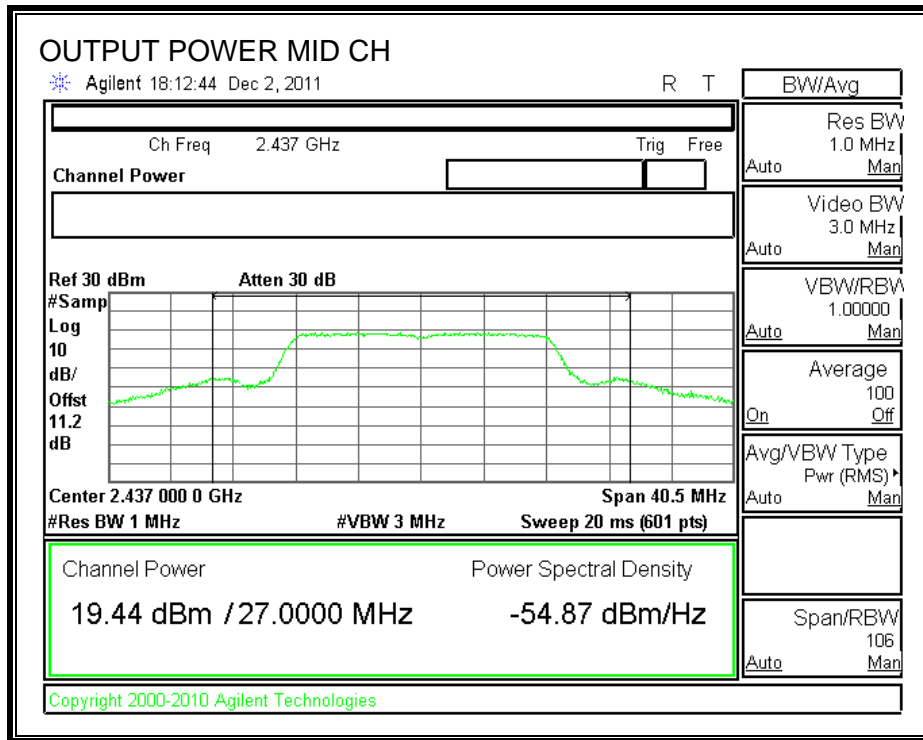
RESULTS

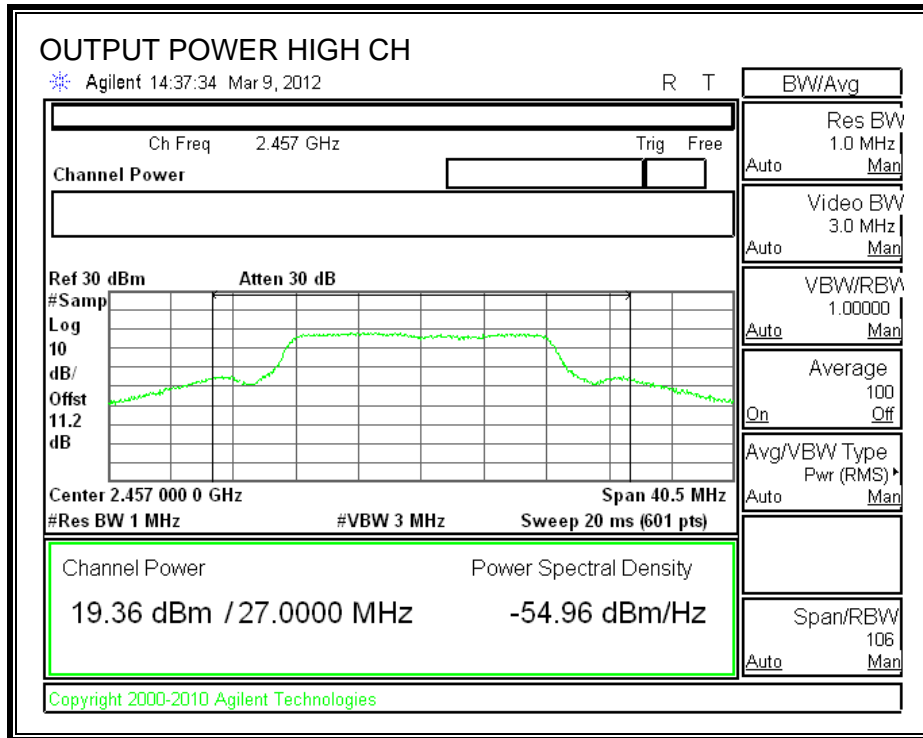
Channel Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
2412	16.92	30	-13.08
2437	18.61	30	-11.39
2437	19.44	30	-10.56
2457	19.36	30	-10.64
2462	17.92	30	-12.08

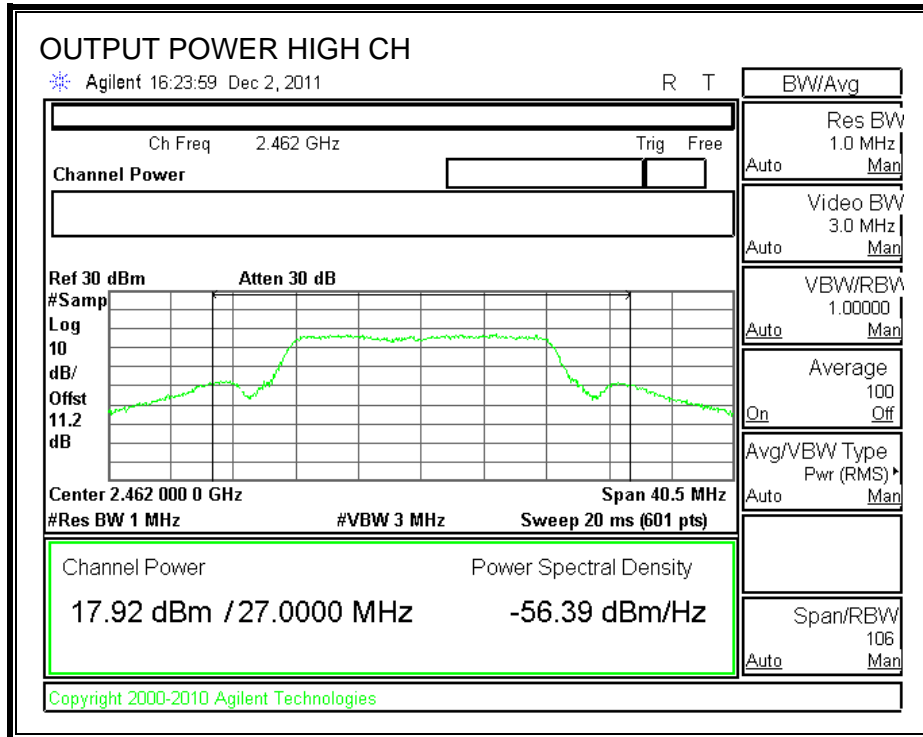
OUTPUT POWER











8.2.2. 2.4GHz 802.11b 3TX OUTPUT POWER

LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The TX chains are correlated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Chain 2 Antenna Gain (dBi)	Correlated Chains Directional Gain (dBi)
0.12	5.30	4.69	8.43

The maximum effective legacy gain is 8.43 dBi for other than fixed, point-to-point operations, therefore the limit is 27.57 dBm.

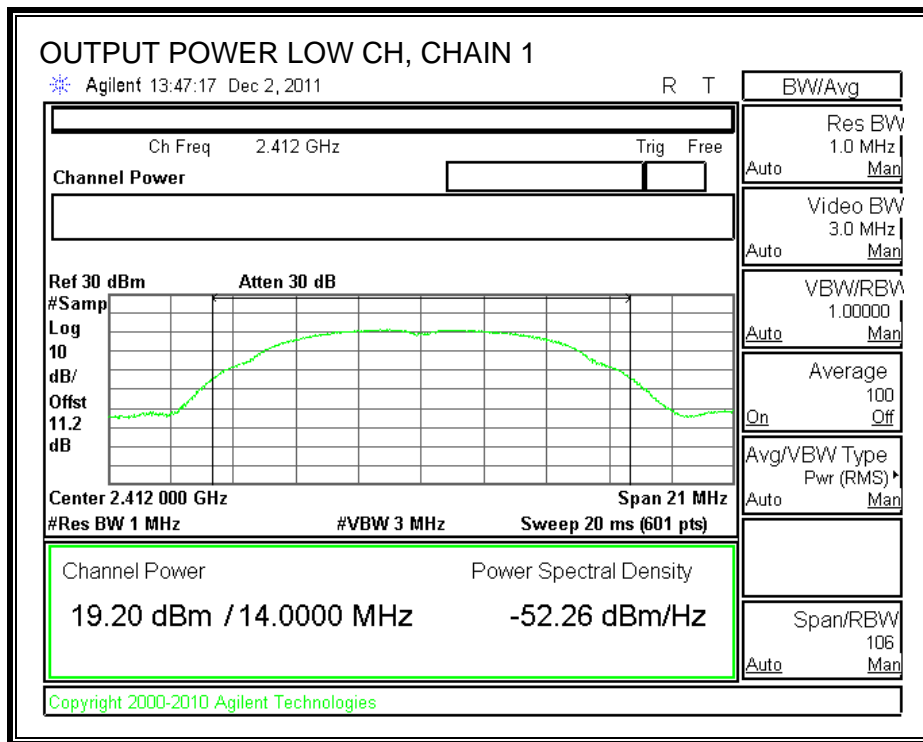
TEST PROCEDURE

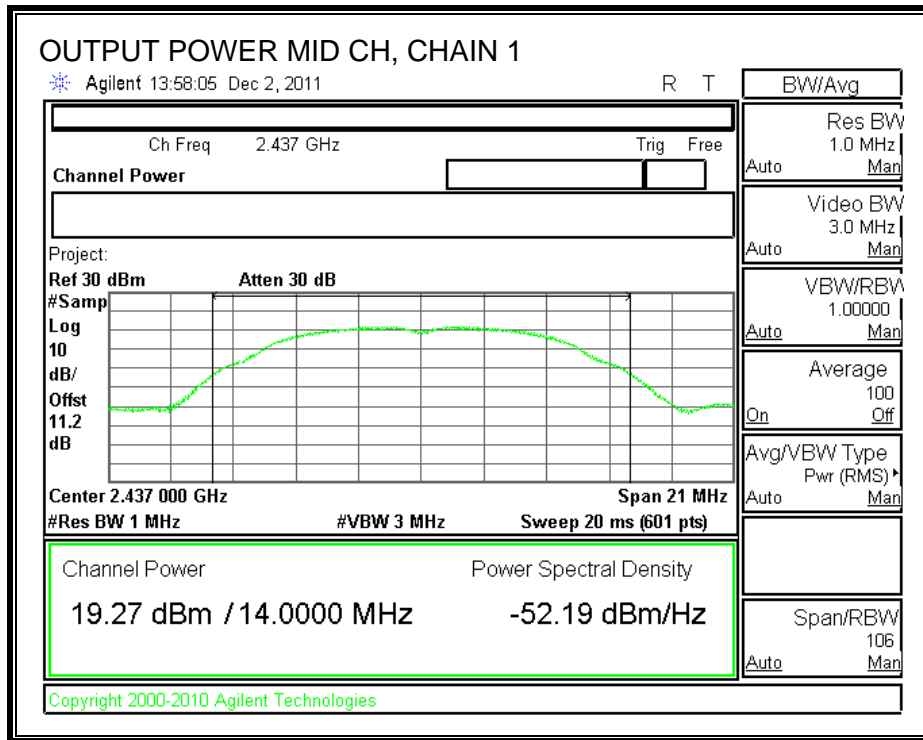
Peak power is measured using the Channel bandwidth Alternative peak output power procedure specified in "TCB Training for Devices covered under Scopes A1 - A4" by Joe Dichoso, May 2003.

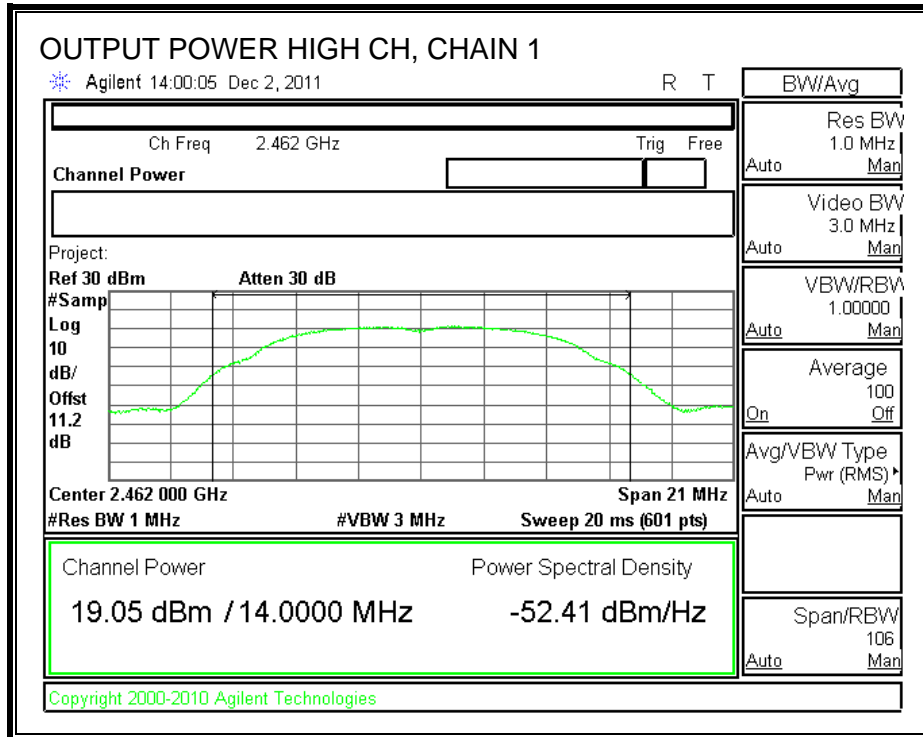
RESULTS

Channel	Frequency (MHz)	Chain 1 PK Power (dBm)	Chain 2 PK Power (dBm)	Chain 3 PK Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	2412	19.20	18.76	18.52	23.61	27.57	-3.96
Mid	2437	19.27	18.76	18.95	23.77	27.57	-3.80
High	2462	19.05	18.65	18.80	23.61	27.57	-3.96

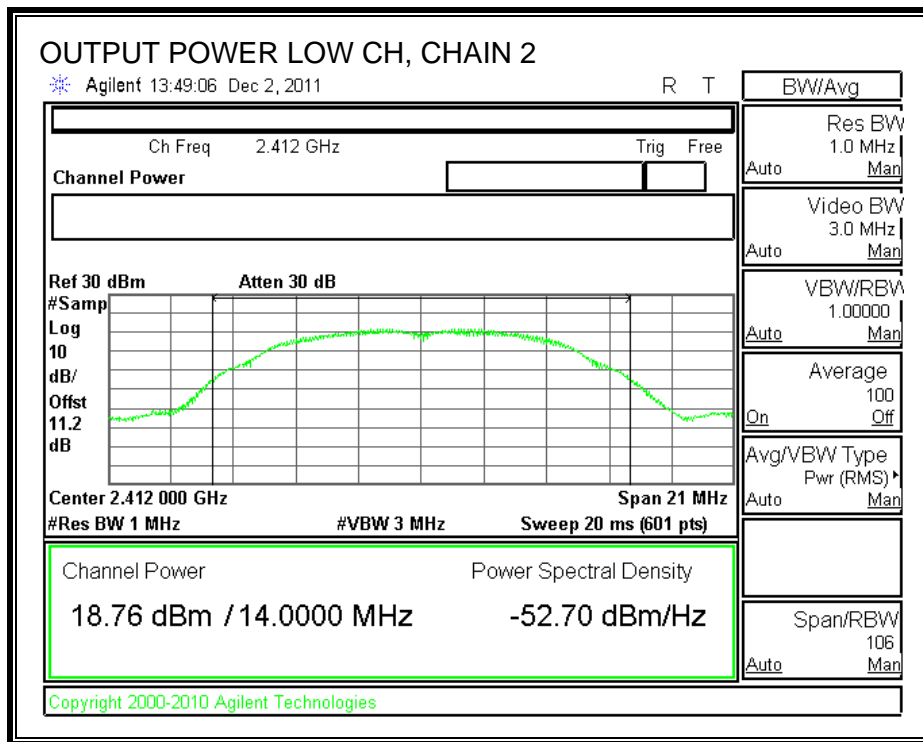
CHAIN 1 OUTPUT POWER

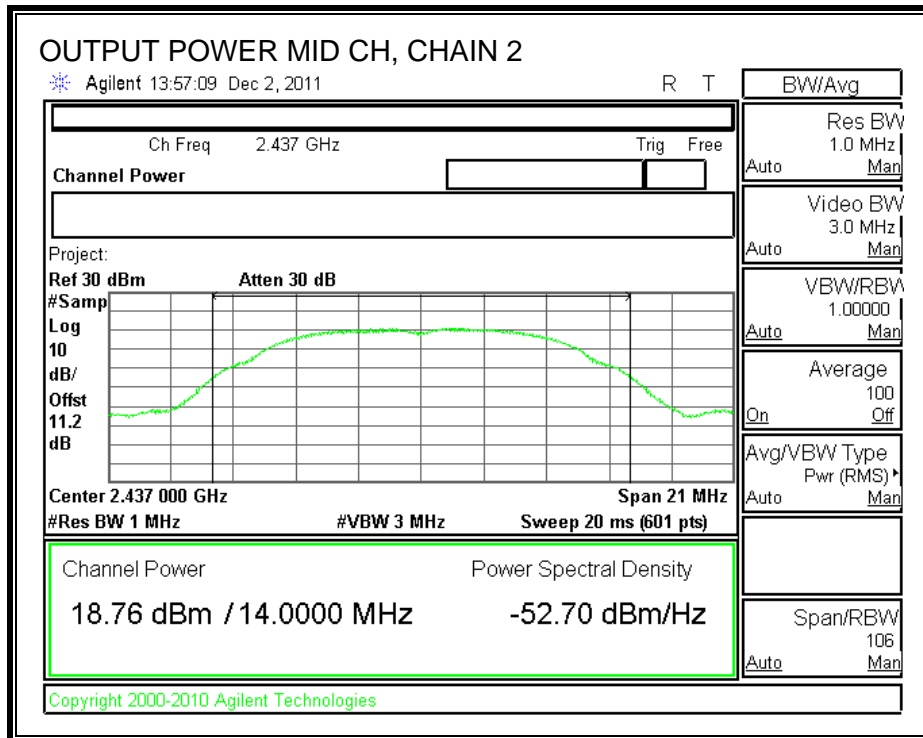


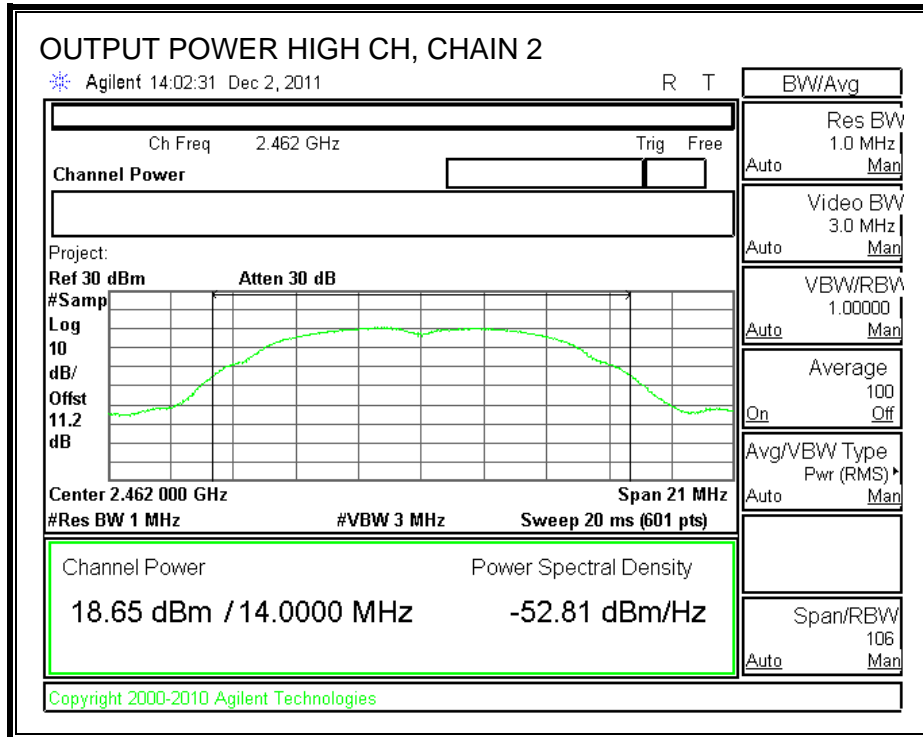




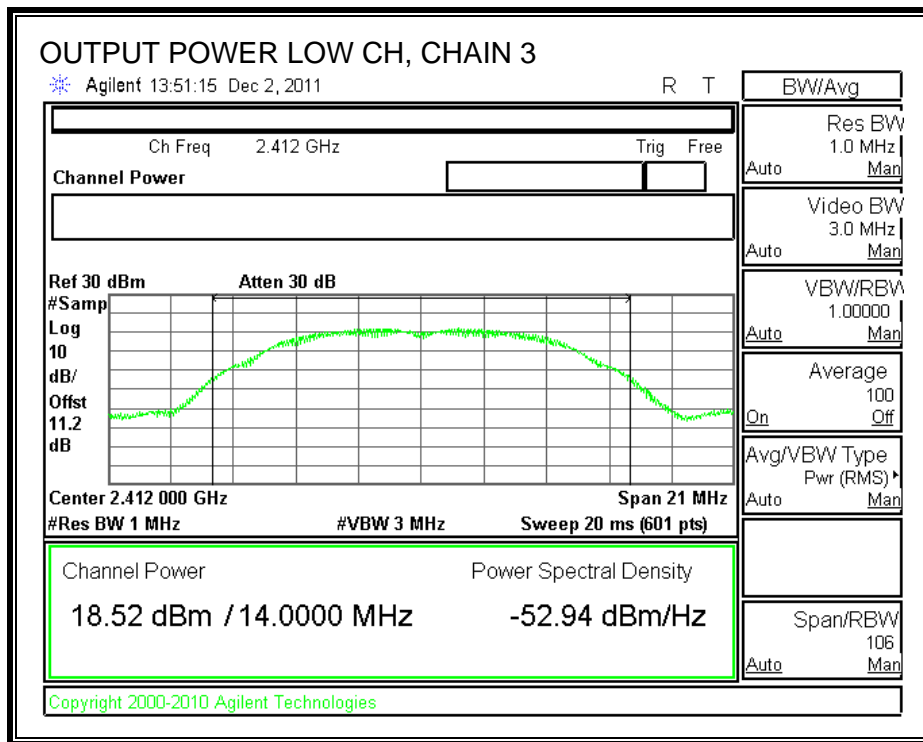
CHAIN 2 OUTPUT POWER

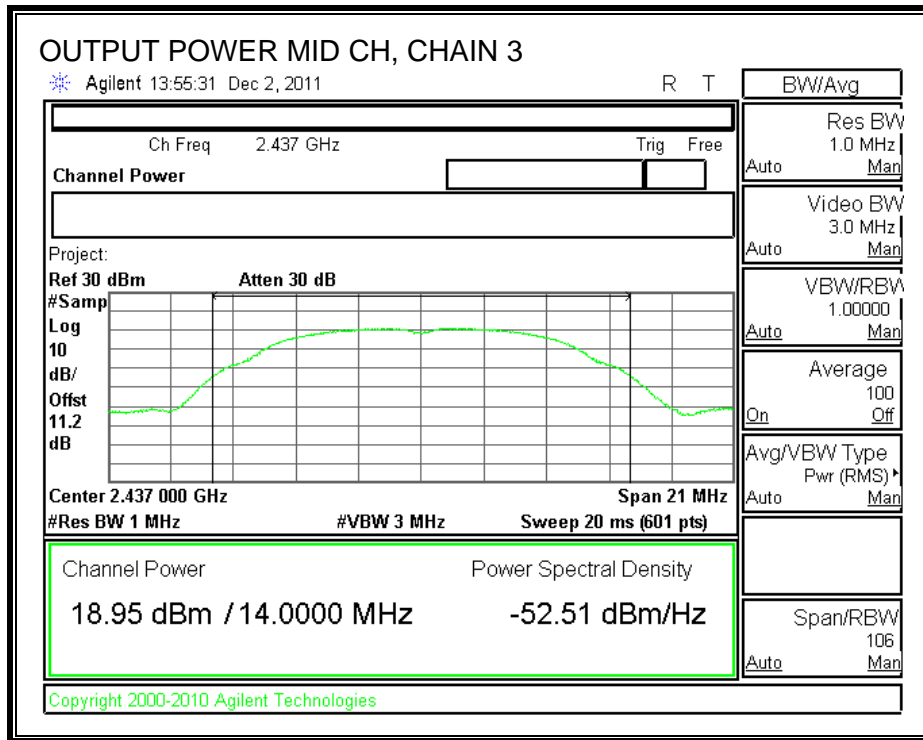


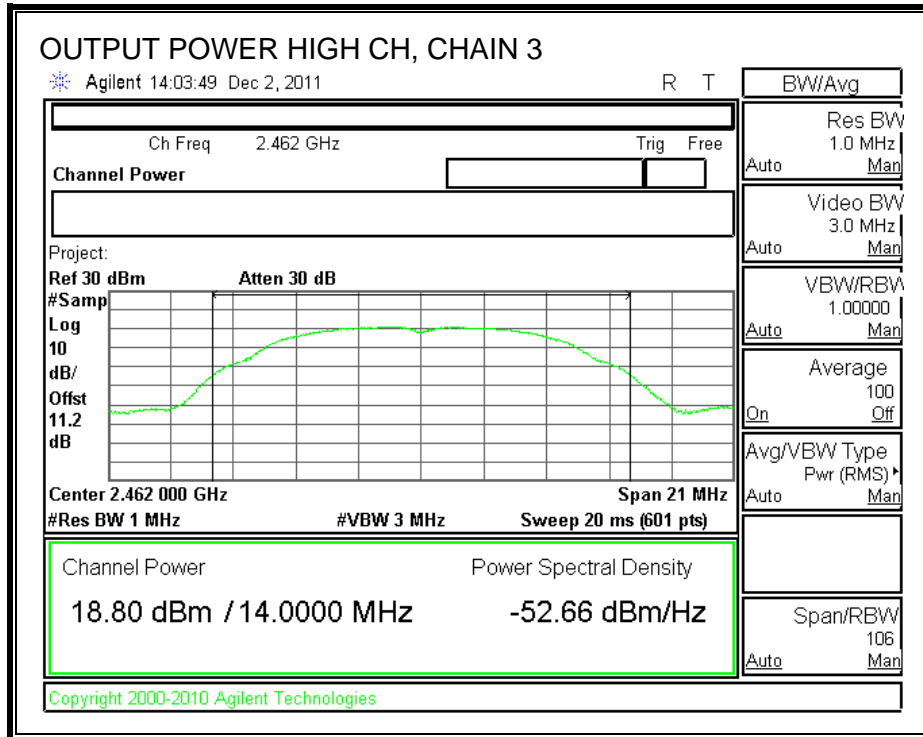




CHAIN 3 OUTPUT POWER







8.2.3. 2.4GHz 802.11n HT20 3TX OUTPUT POWER

LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Chain 2 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
0.12	5.30	4.69	3.90

The directional gain is less than 6 dBi; therefore, the limit is 30 dBm.

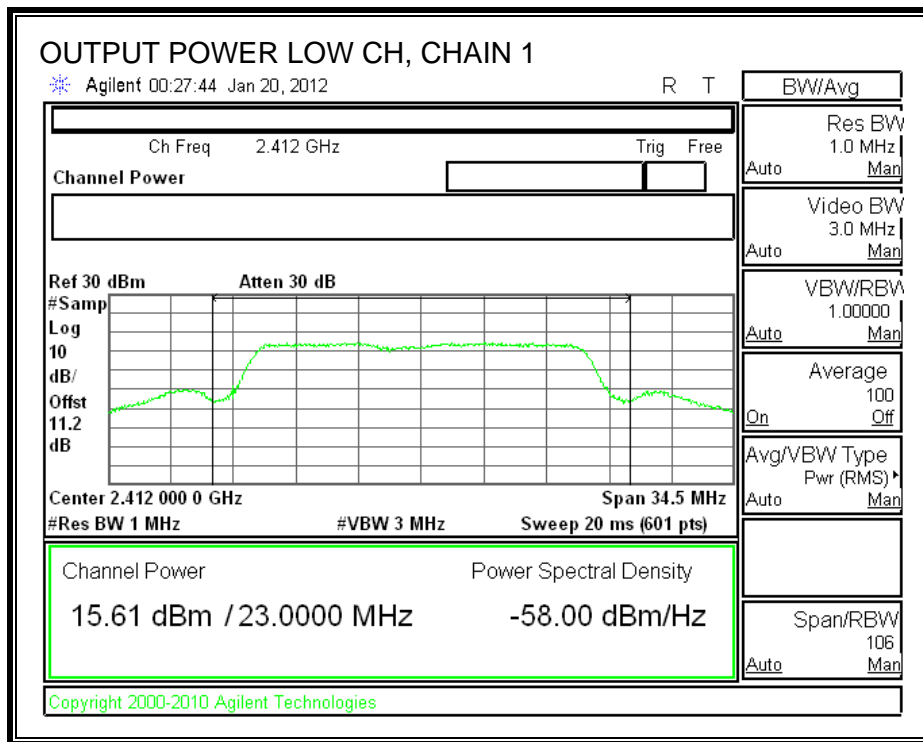
TEST PROCEDURE

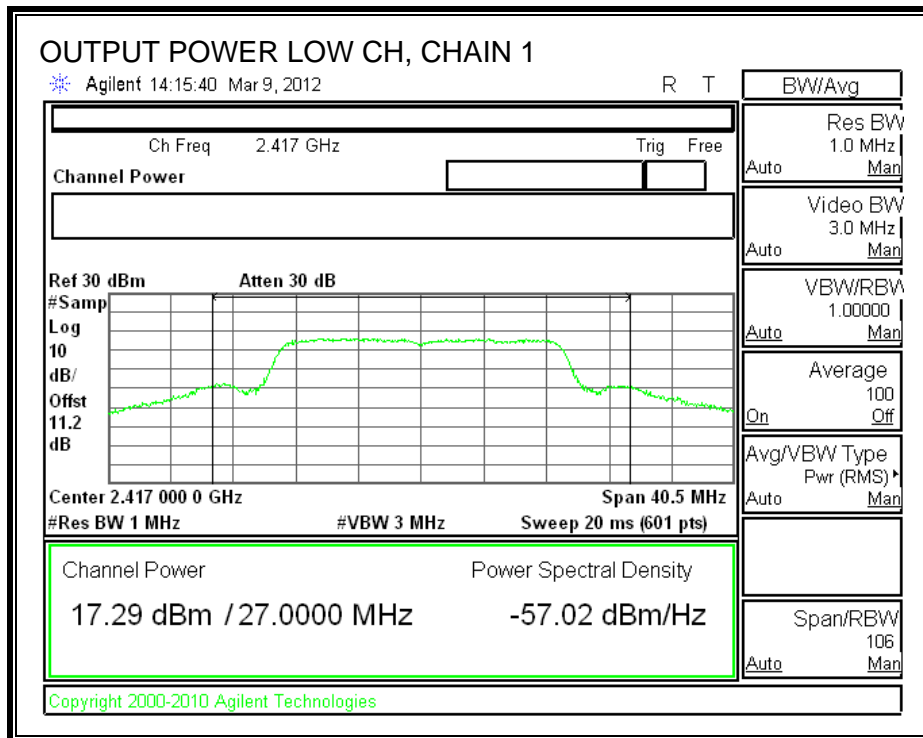
Peak power is measured using the Channel bandwidth Alternative peak output power procedure specified in "TCB Training for Devices covered under Scopes A1 - A4" by Joe Dichoso, May 2003.

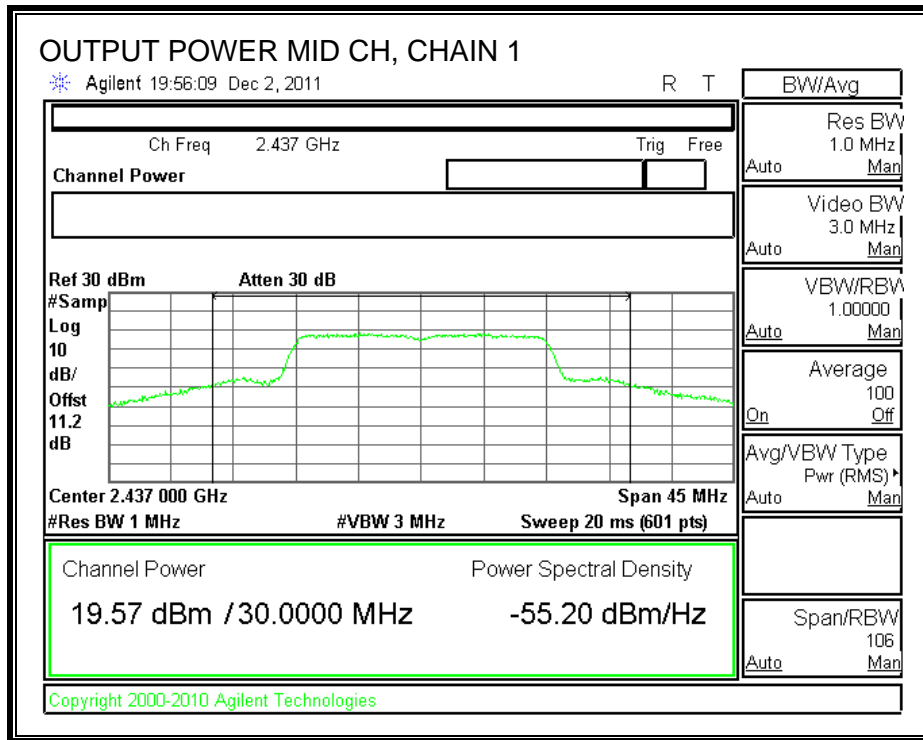
RESULTS

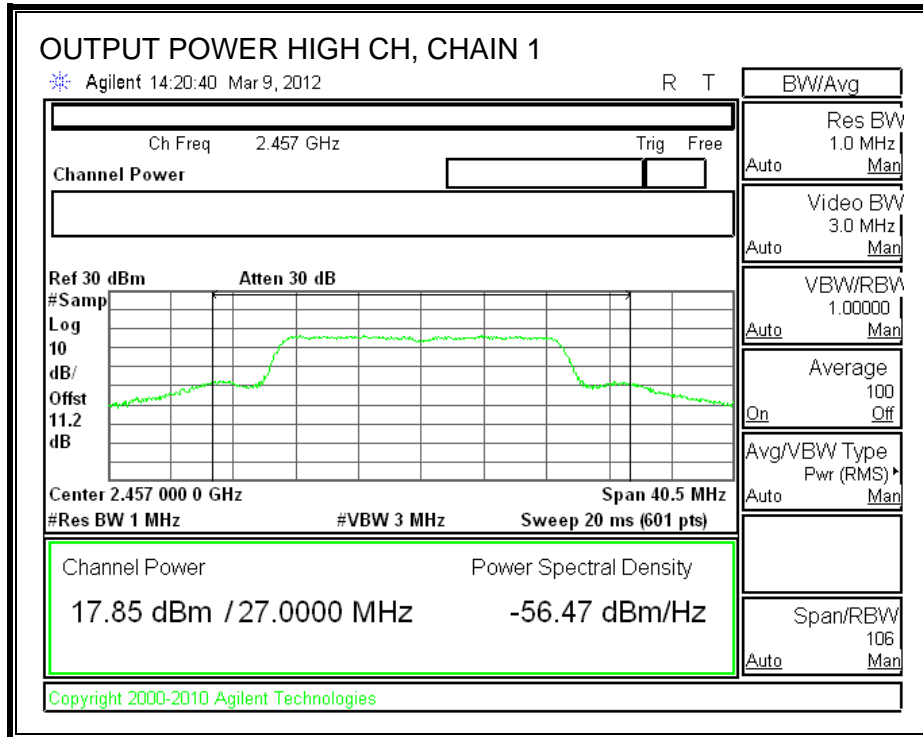
Frequency (MHz)	Chain 1 PK Power (dBm)	Chain 2 PK Power (dBm)	Chain 3 PK Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
2412	15.61	15.58	15.18	20.23	30.00	-9.77
2417	17.29	17.13	17.20	21.98	30.00	-8.02
2437	19.57	18.95	18.94	23.93	30.00	-6.07
2457	17.85	17.55	17.63	22.45	30.00	-7.55
2462	15.48	15.47	15.49	20.25	30.00	-9.75

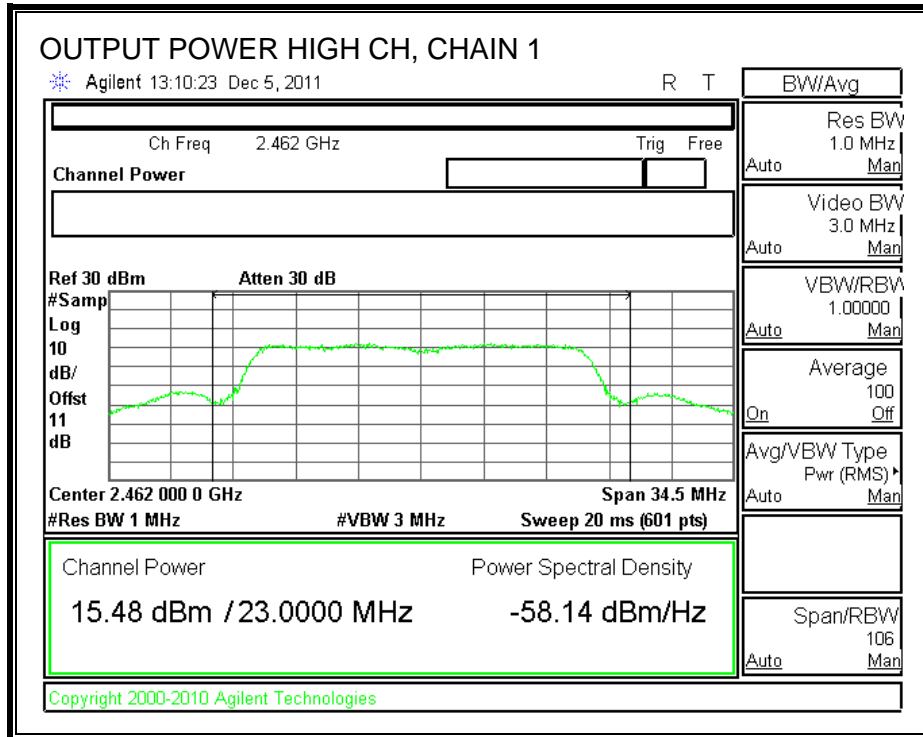
CHAIN 1 OUTPUT POWER



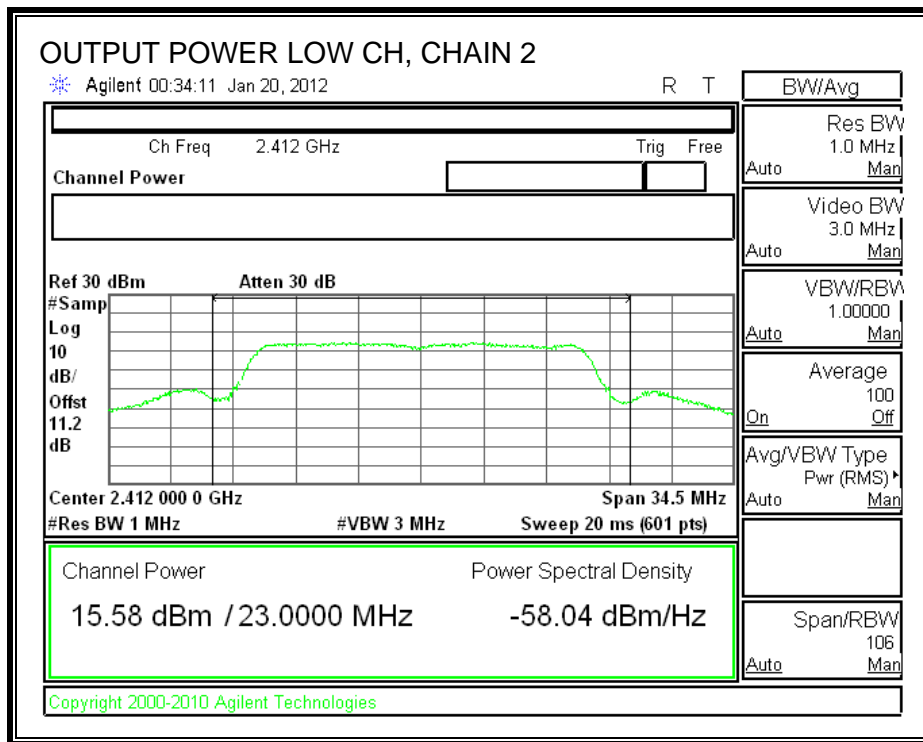


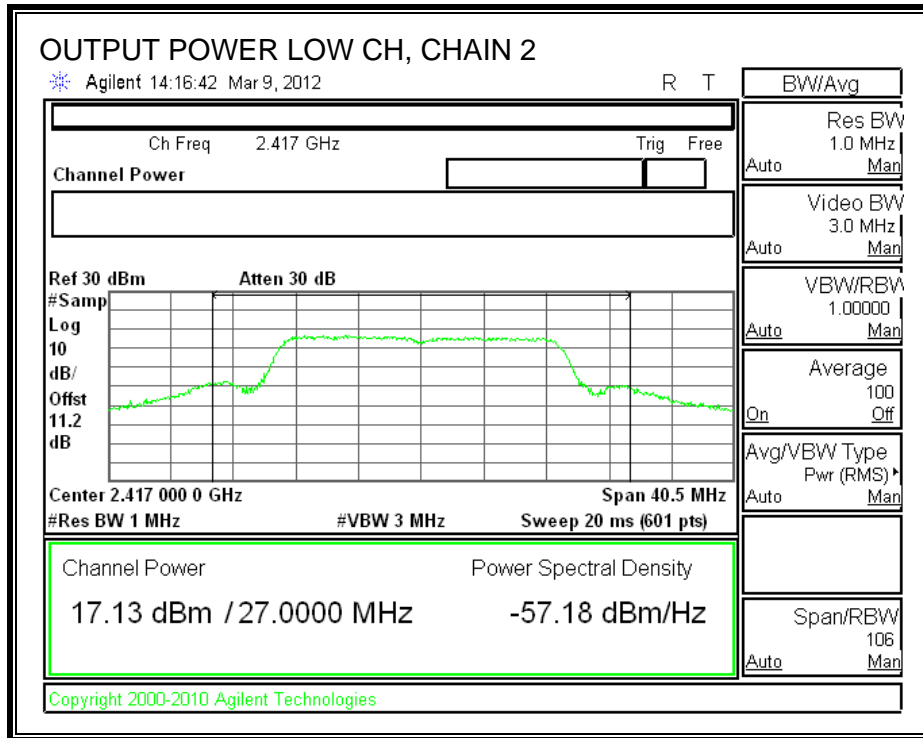


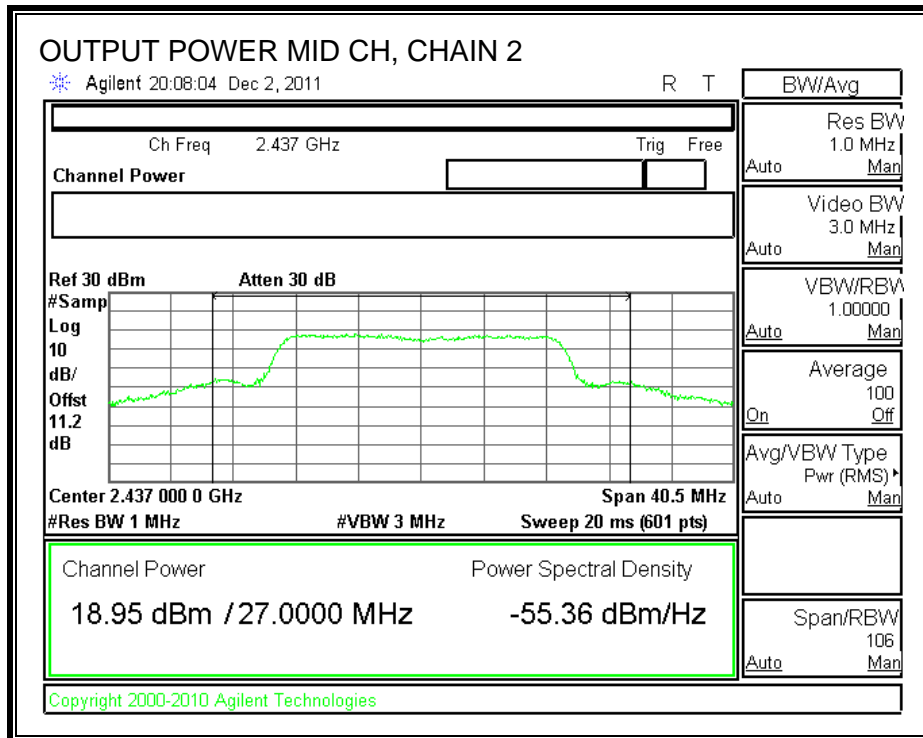


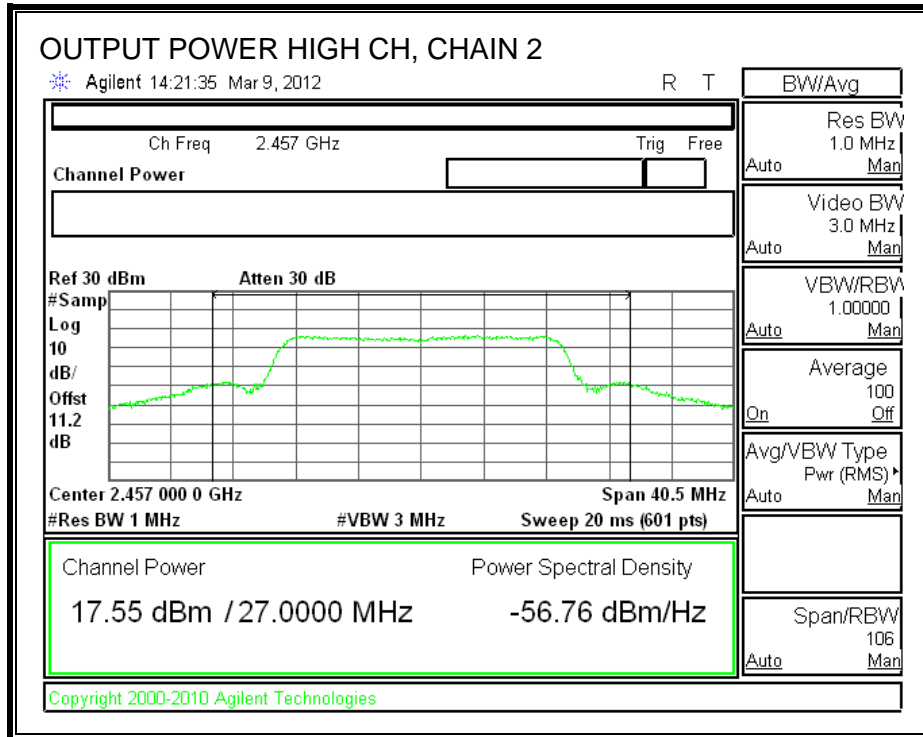


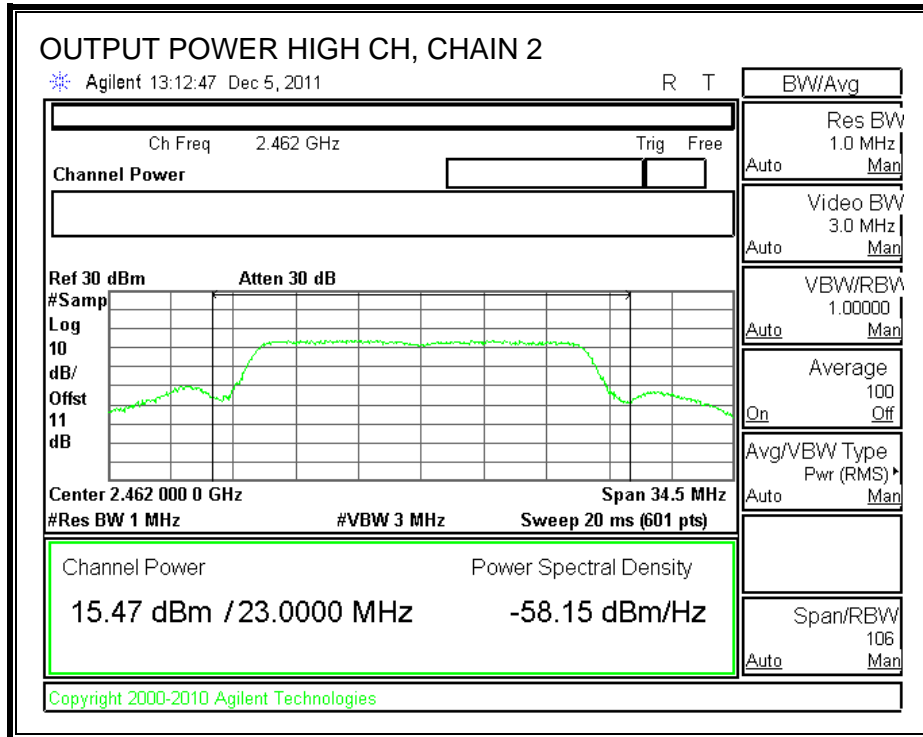
CHAIN 2 OUTPUT POWER



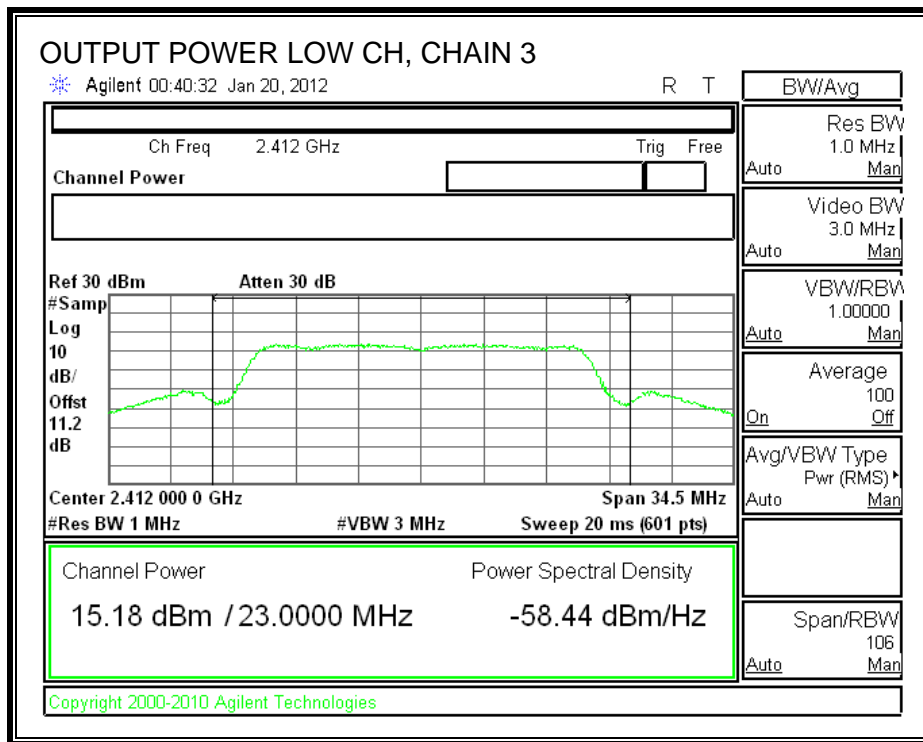


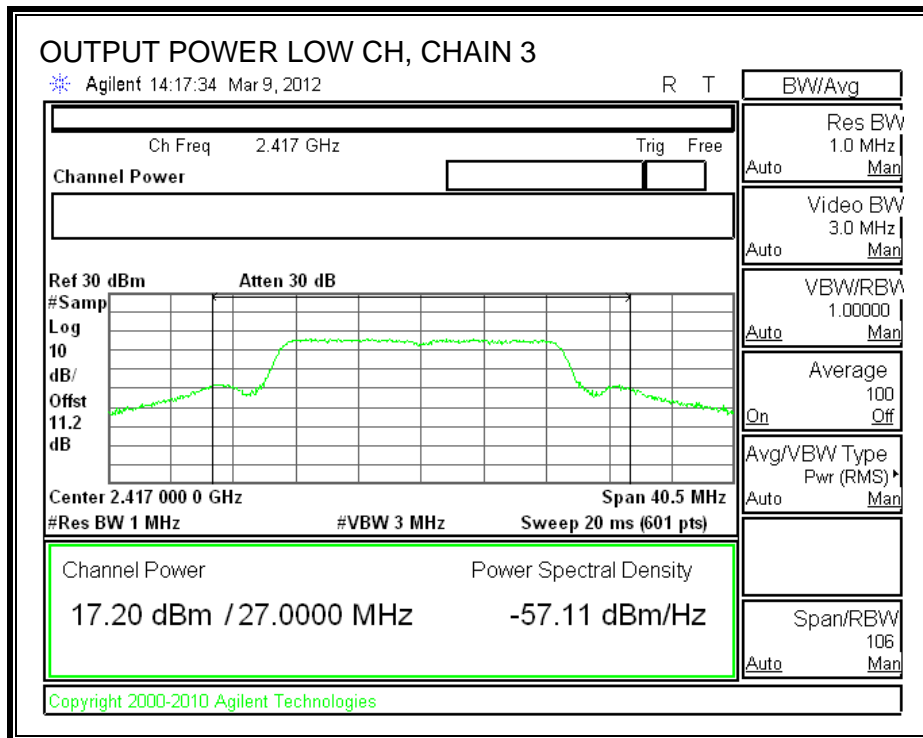


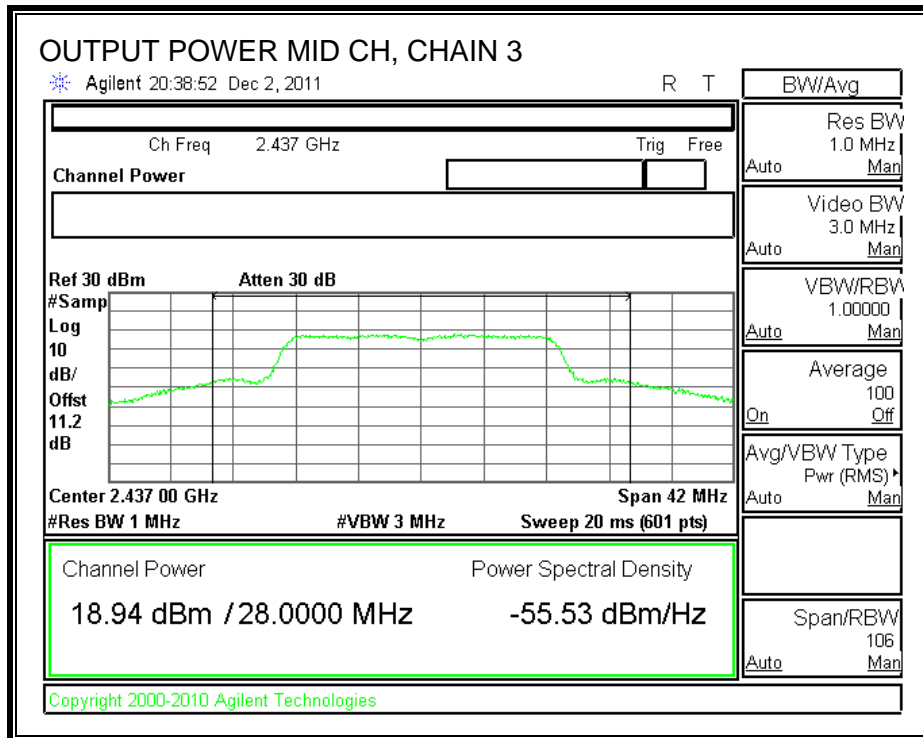


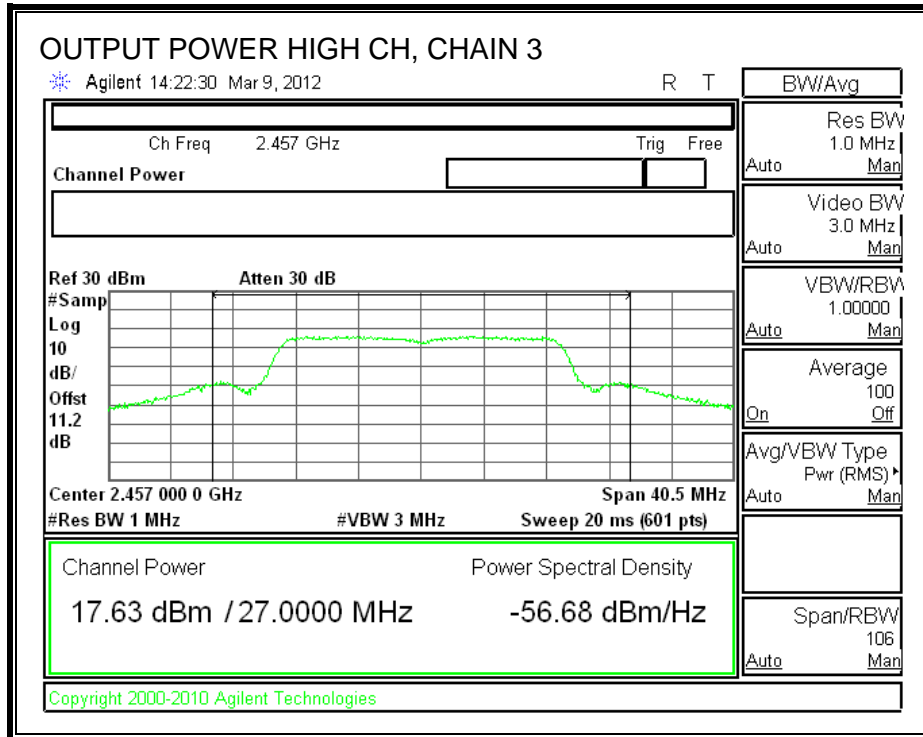


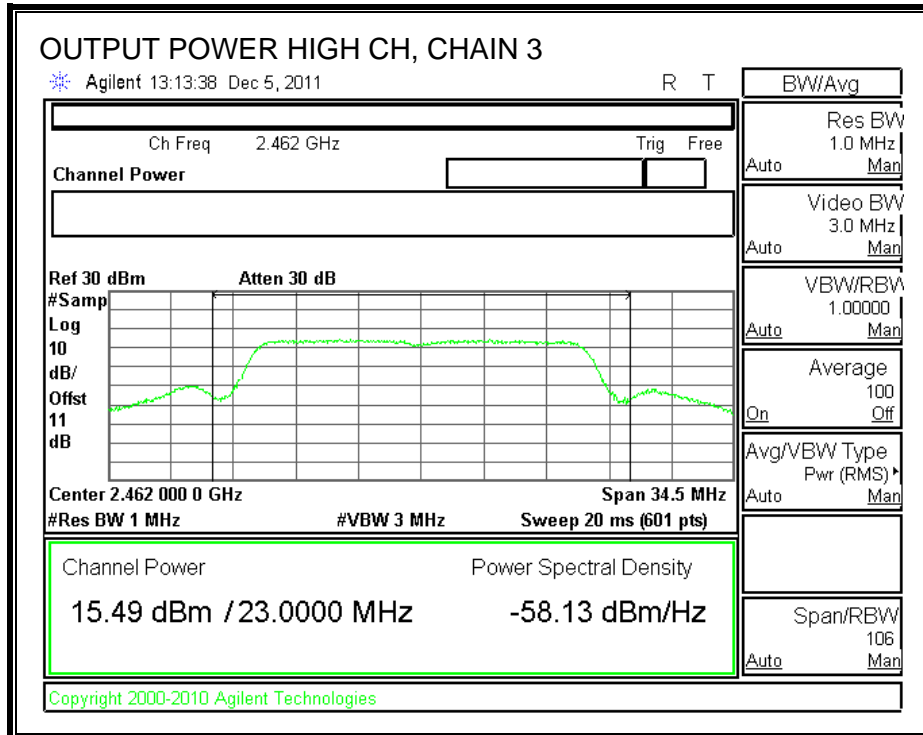
CHAIN 3 OUTPUT POWER











8.2.4. 5.8GHz 802.11n HT20 3TX OUTPUT POWER

LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Chain 2 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
2.66	5.93	6.04	5.13

The directional gain is less than 6 dBi; therefore, the limit is 30 dBm.

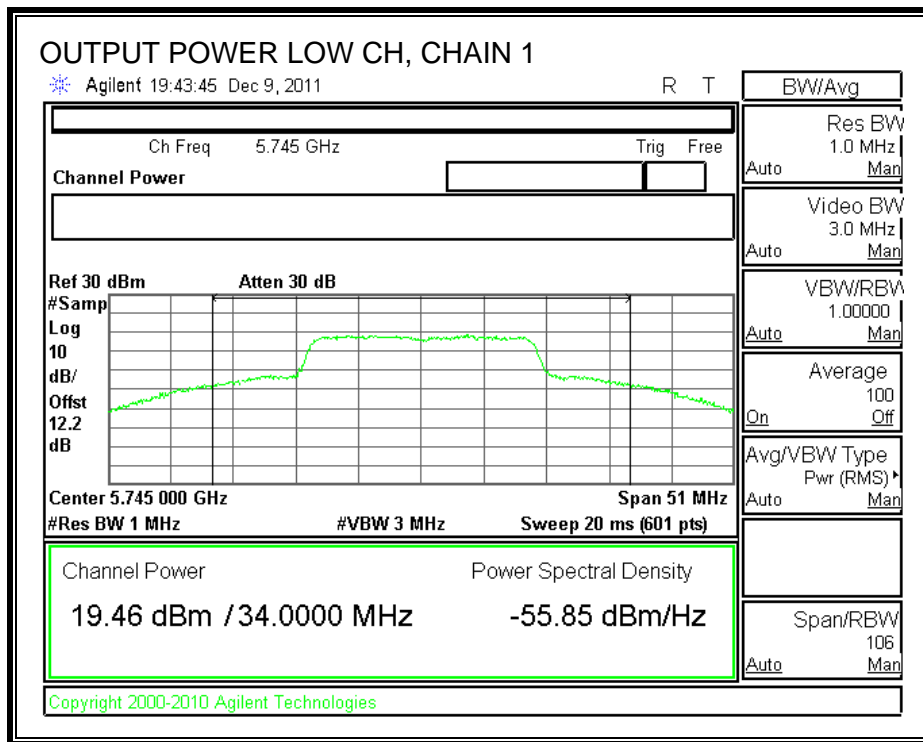
TEST PROCEDURE

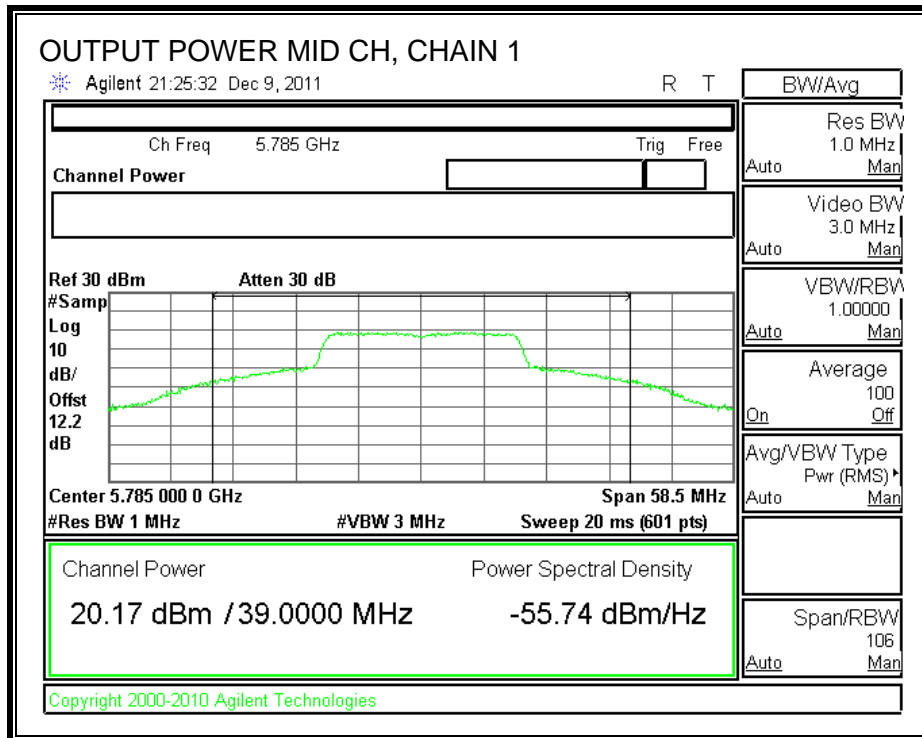
Peak power is measured using the Channel bandwidth Alternative peak output power procedure specified in "TCB Training for Devices covered under Scopes A1 - A4" by Joe Dichoso, May 2003.

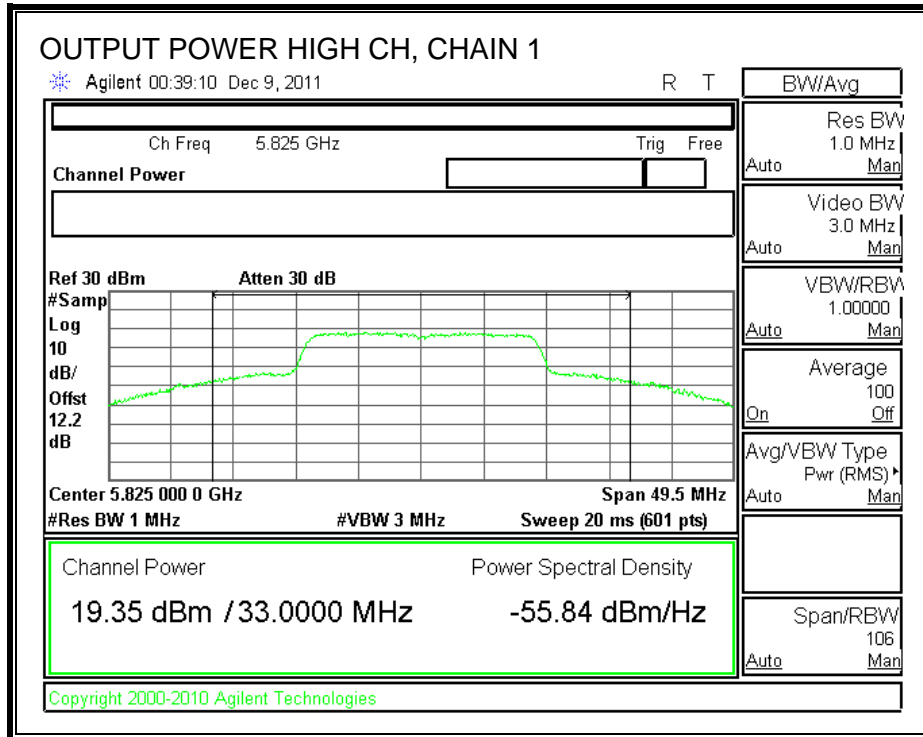
RESULTS

Channel	Frequency (MHz)	Chain 1 PK Power (dBm)	Chain 2 PK Power (dBm)	Chain 3 PK Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5745	19.46	18.83	18.86	23.83	30.00	-6.17
Mid	5785	20.17	19.37	19.66	24.52	30.00	-5.48
High	5825	19.35	19.02	18.96	23.88	30.00	-6.12

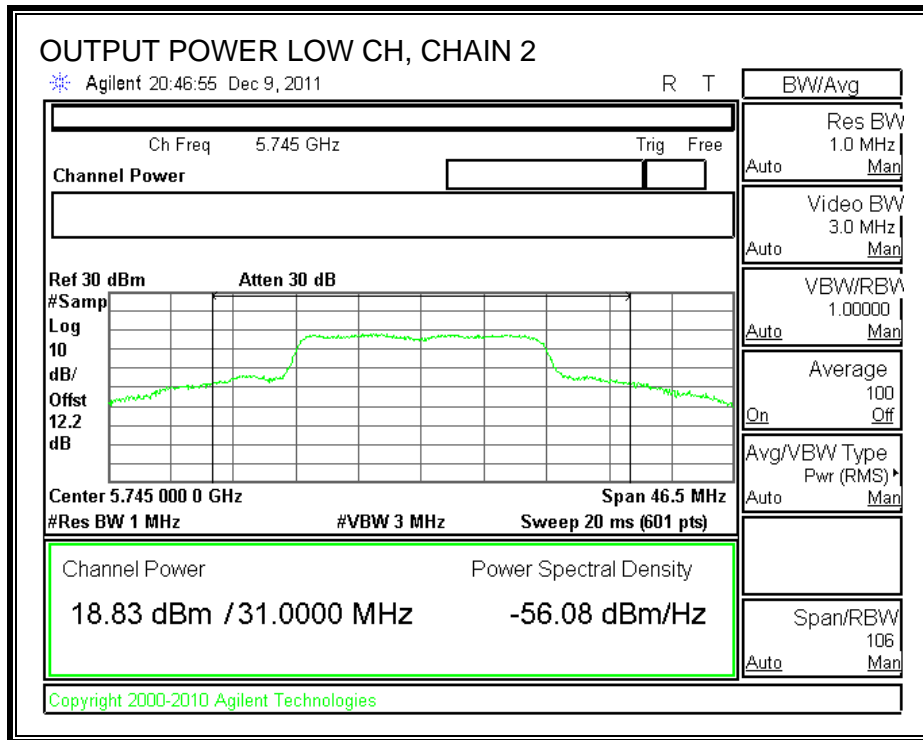
CHAIN 1 OUTPUT POWER

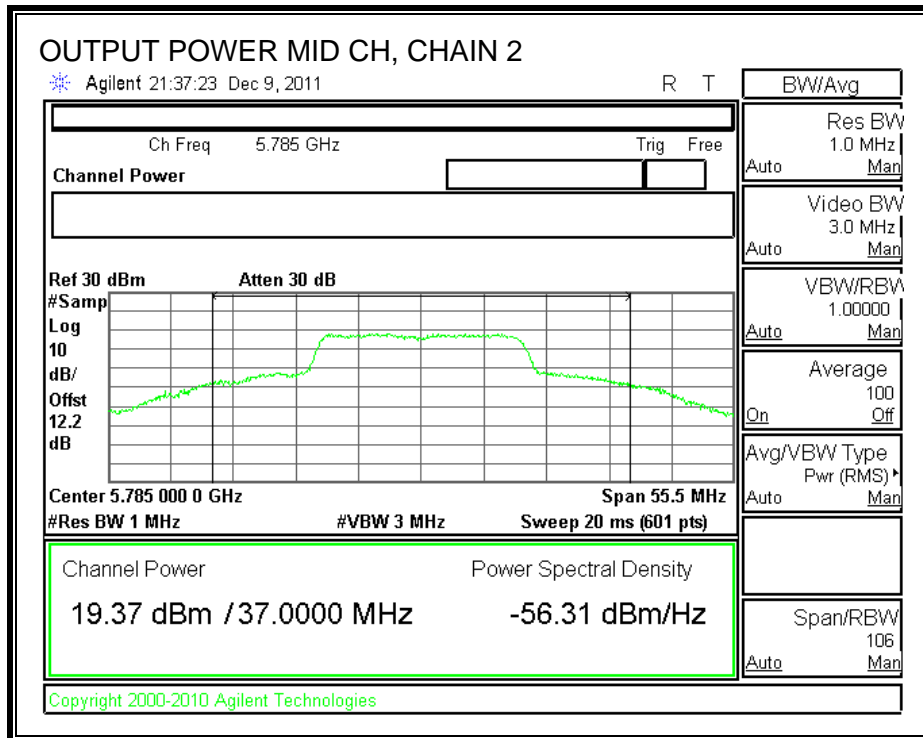


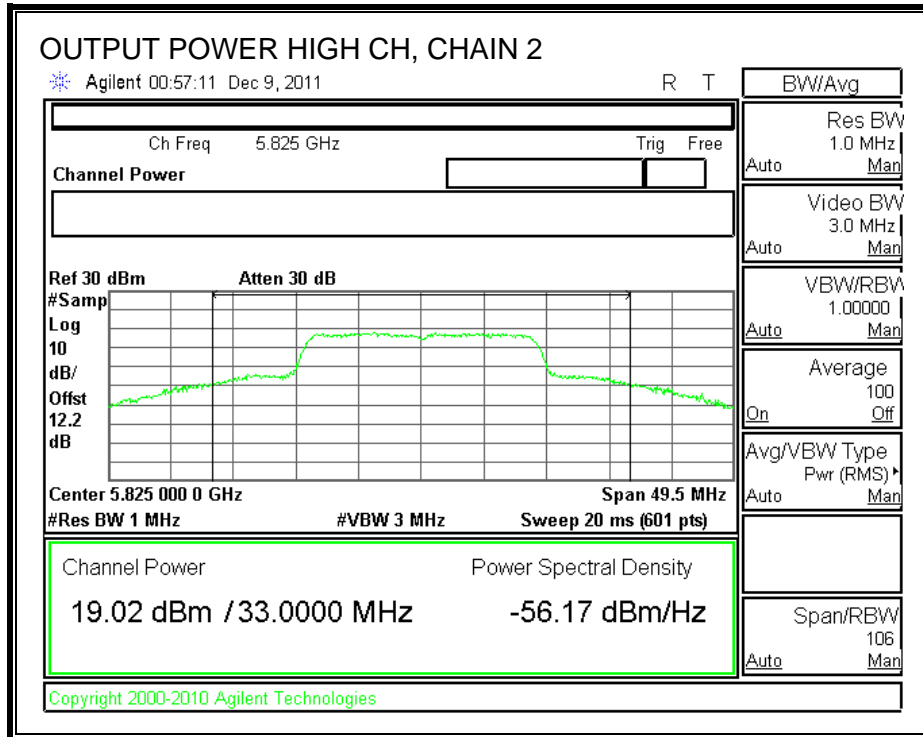




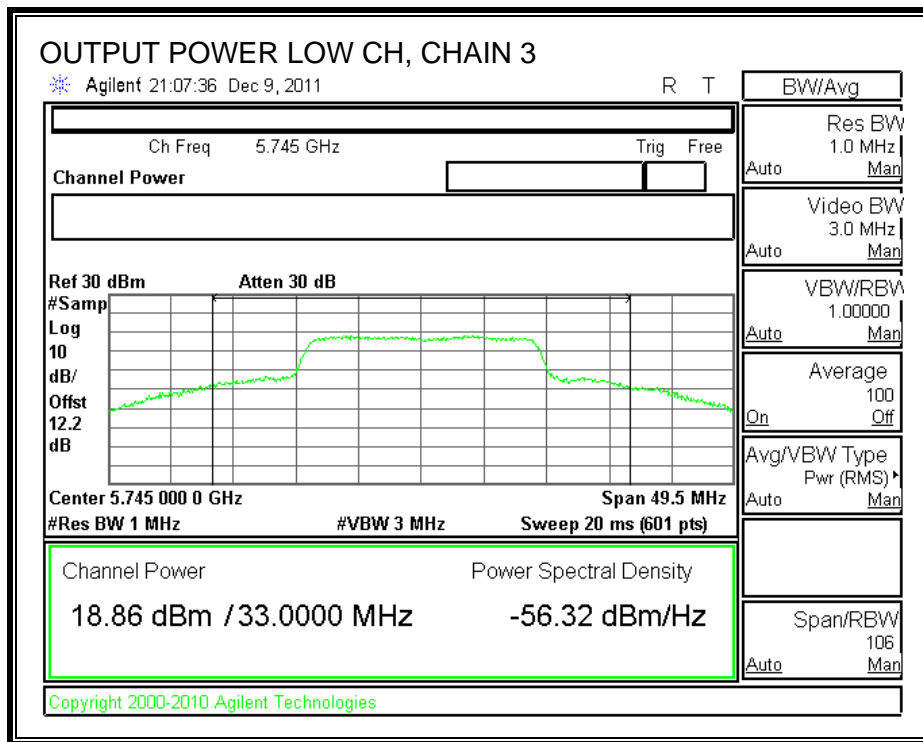
CHAIN 2 OUTPUT POWER

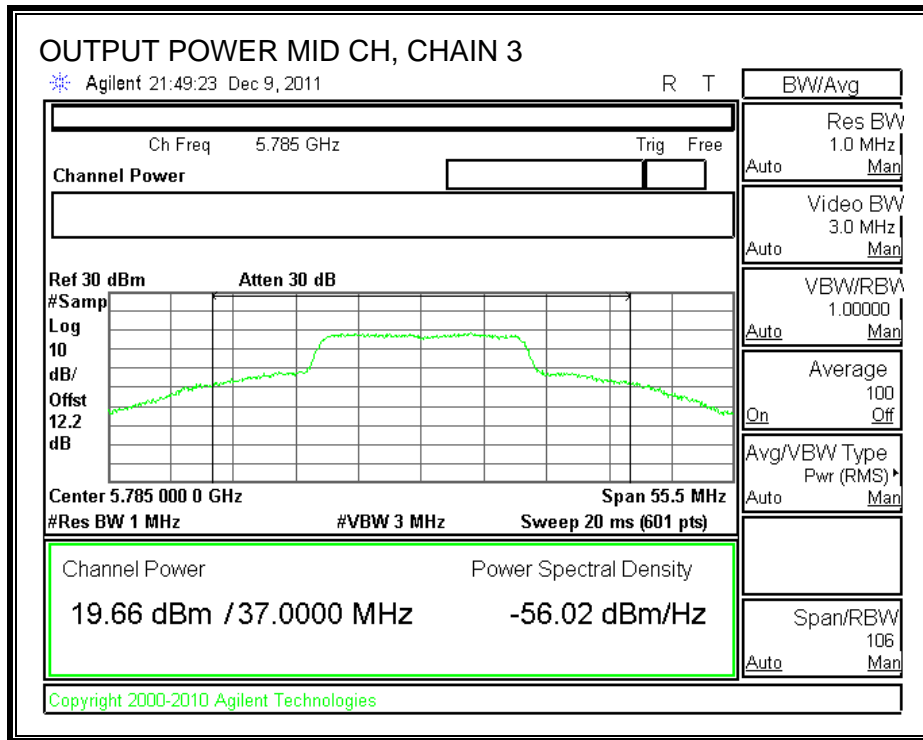


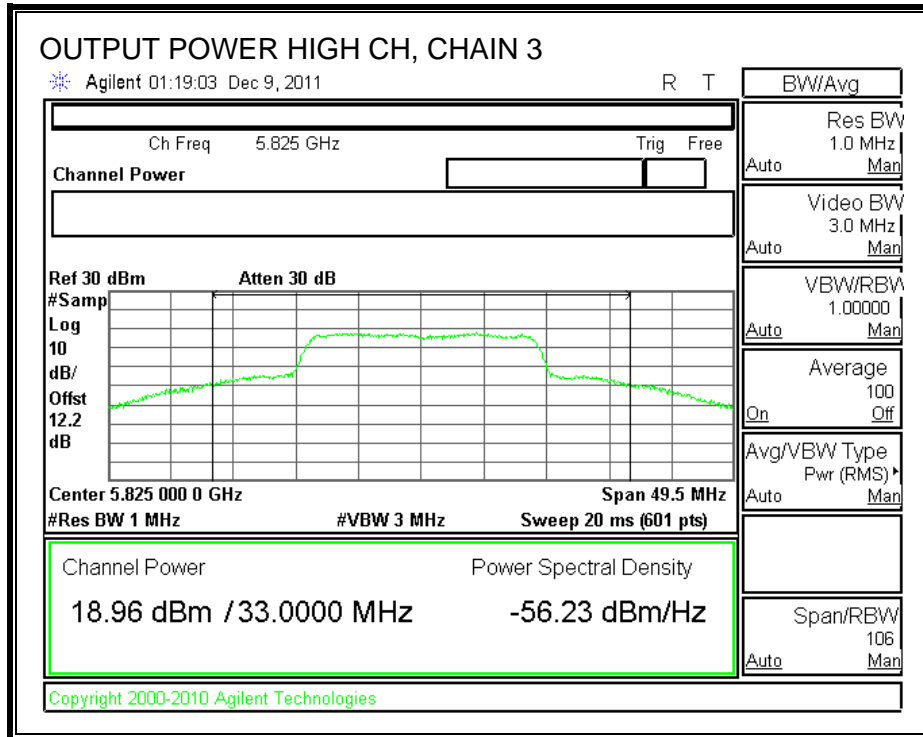




CHAIN 3 OUTPUT POWER







8.2.5. 5.8GHz 802.11n HT40 3TX OUTPUT POWER

LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The TX chains are uncorrelated and the antenna gain is unequal among the chains. The directional gain is:

Chain 0 Antenna Gain (dBi)	Chain 1 Antenna Gain (dBi)	Chain 2 Antenna Gain (dBi)	Uncorrelated Chains Directional Gain (dBi)
2.66	5.93	6.04	5.13

The directional gain is less than 6 dBi; therefore, the limit is 30 dBm.

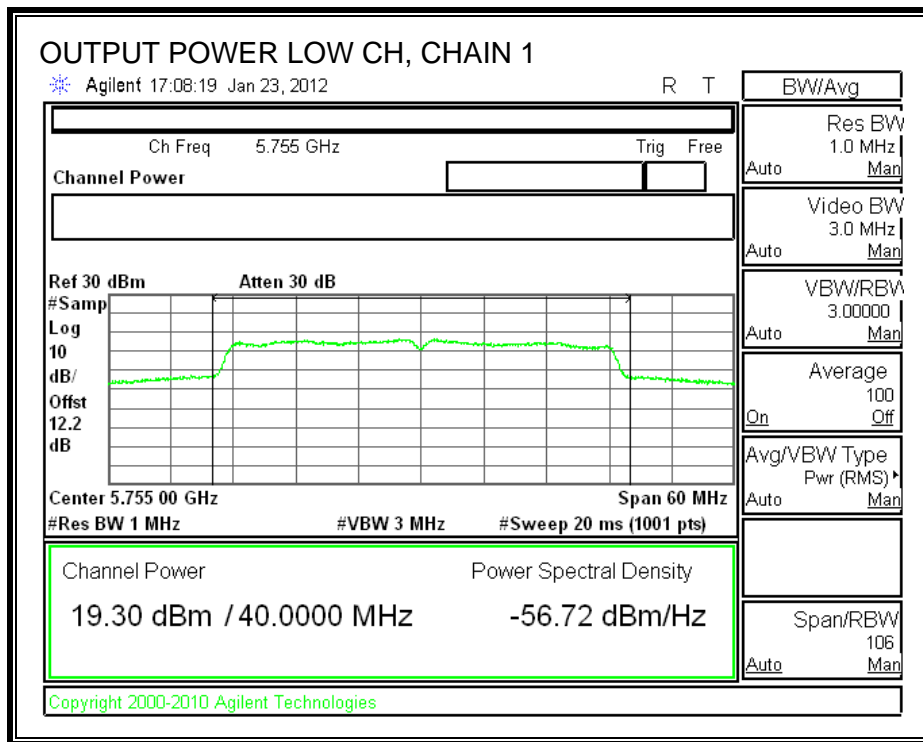
TEST PROCEDURE

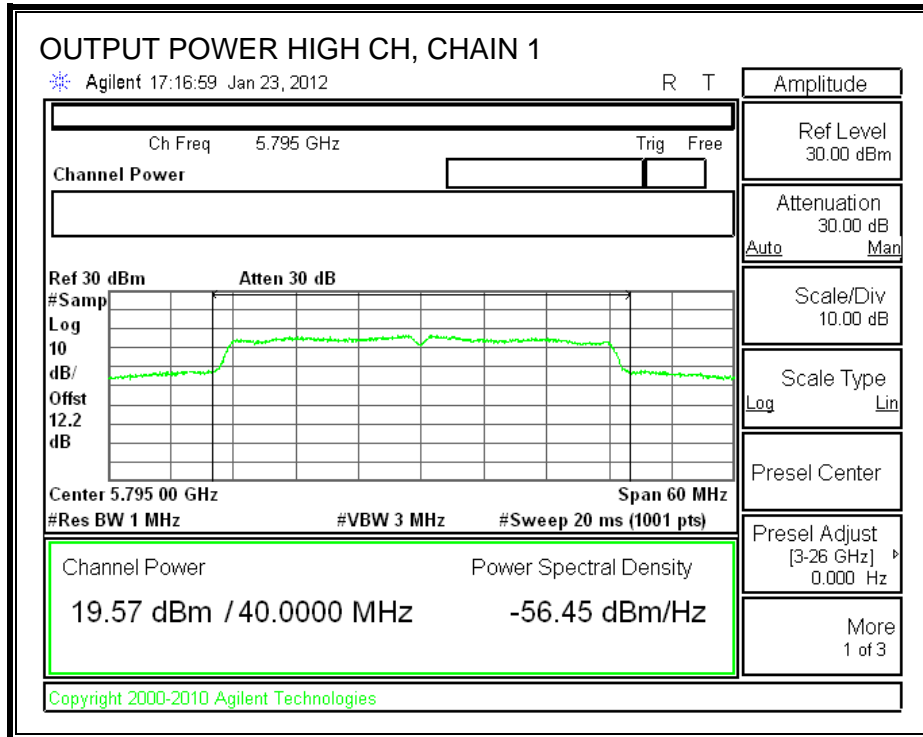
Peak power is measured using the Channel bandwidth Alternative peak output power procedure specified in "TCB Training for Devices covered under Scopes A1 - A4" by Joe Dichoso, May 2003.

RESULTS

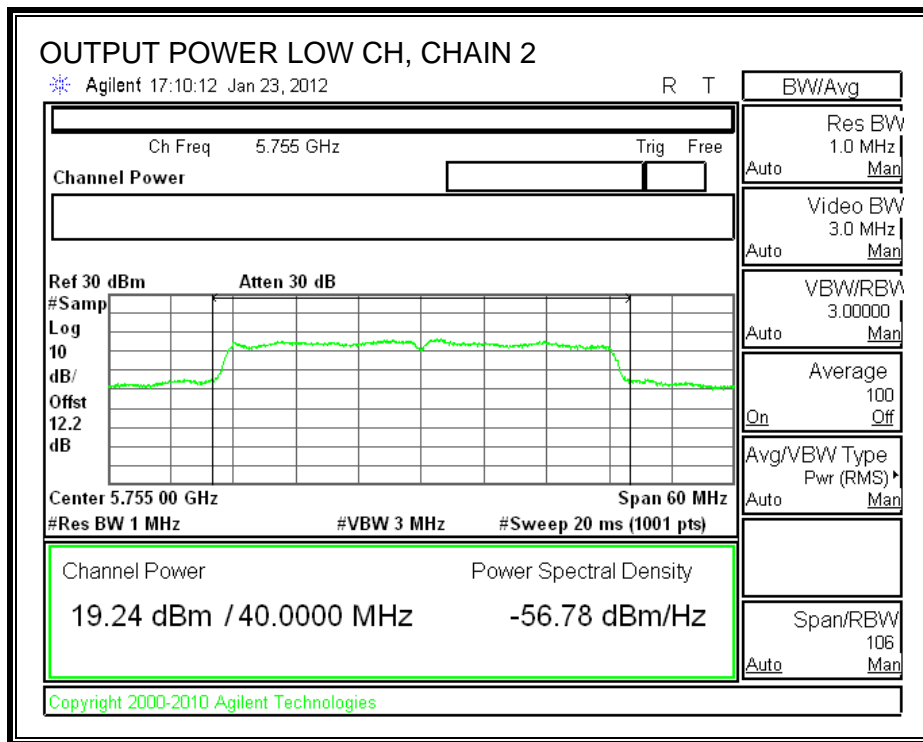
Channel	Frequency (MHz)	Chain 1 PK Power (dBm)	Chain 2 PK Power (dBm)	Chain 3 PK Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5755	19.30	19.24	19.05	23.97	30.00	-6.03
High	5795	19.57	19.34	18.55	23.95	30.00	-6.05

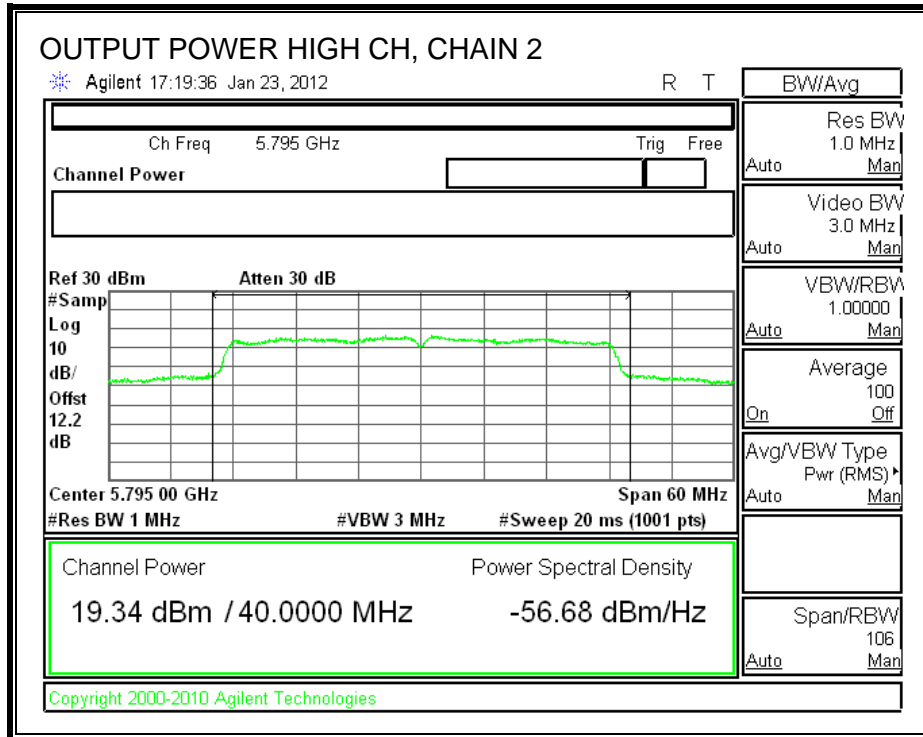
CHAIN 1 OUTPUT POWER



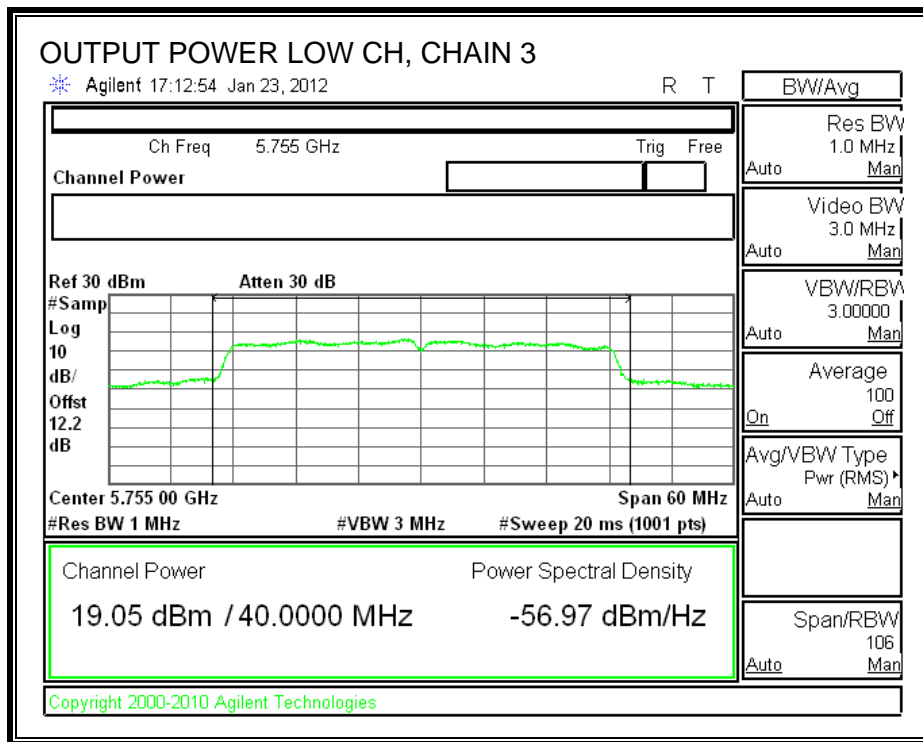


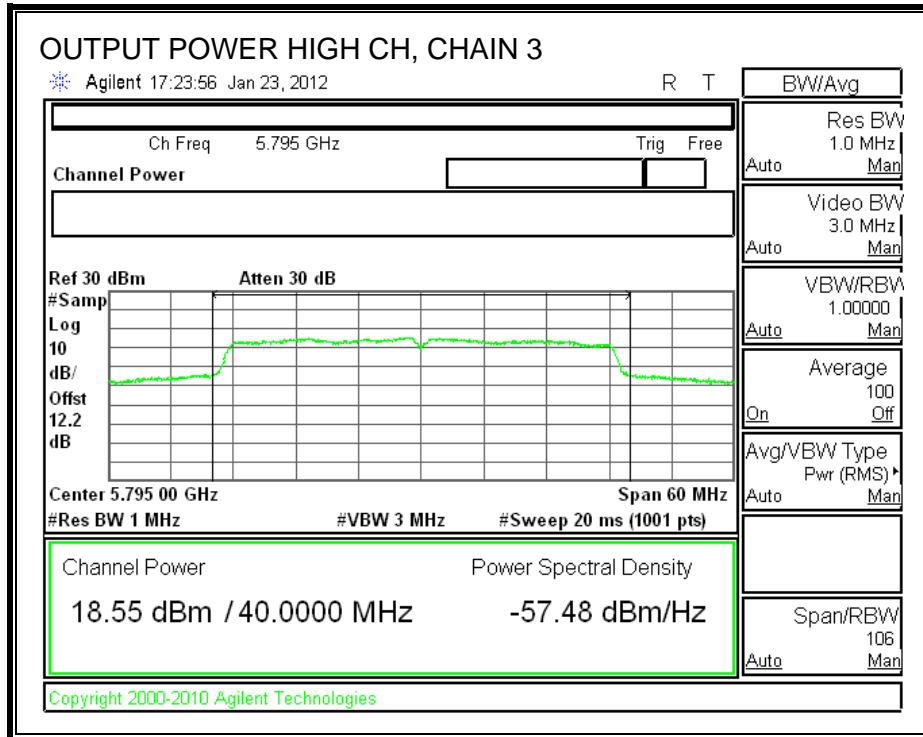
CHAIN 2 OUTPUT POWER





CHAIN 3 OUTPUT POWER

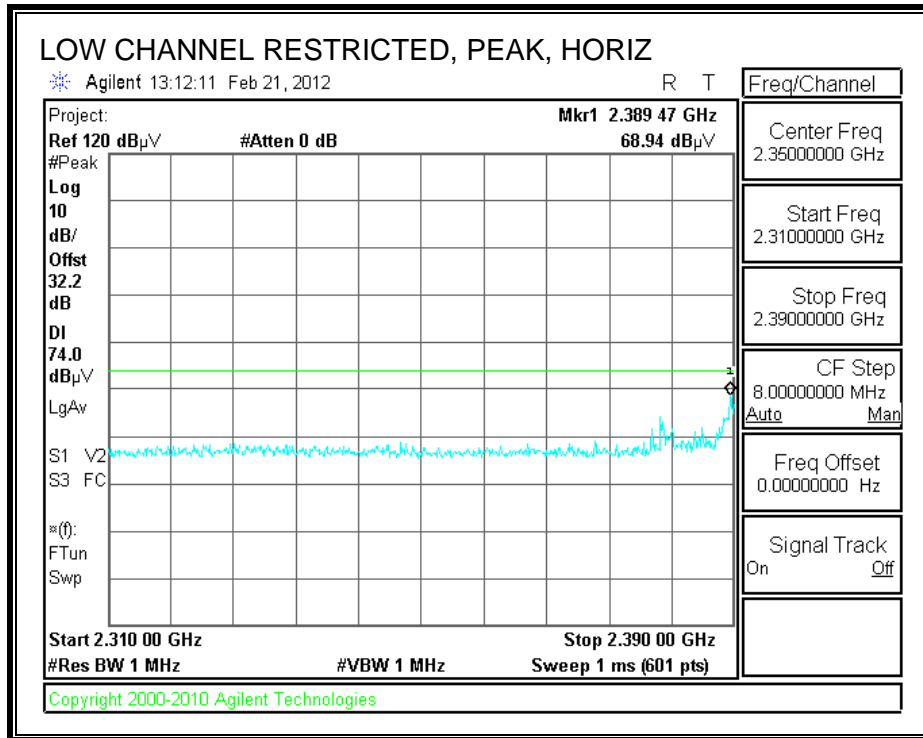


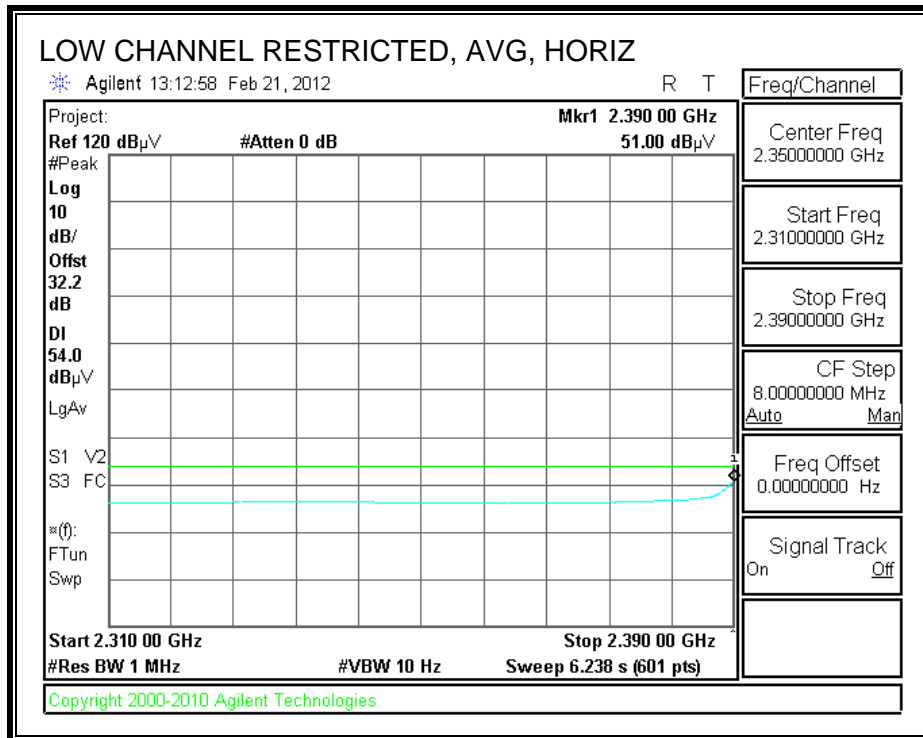


8.3. TRANSMITTER ABOVE 1 GHz

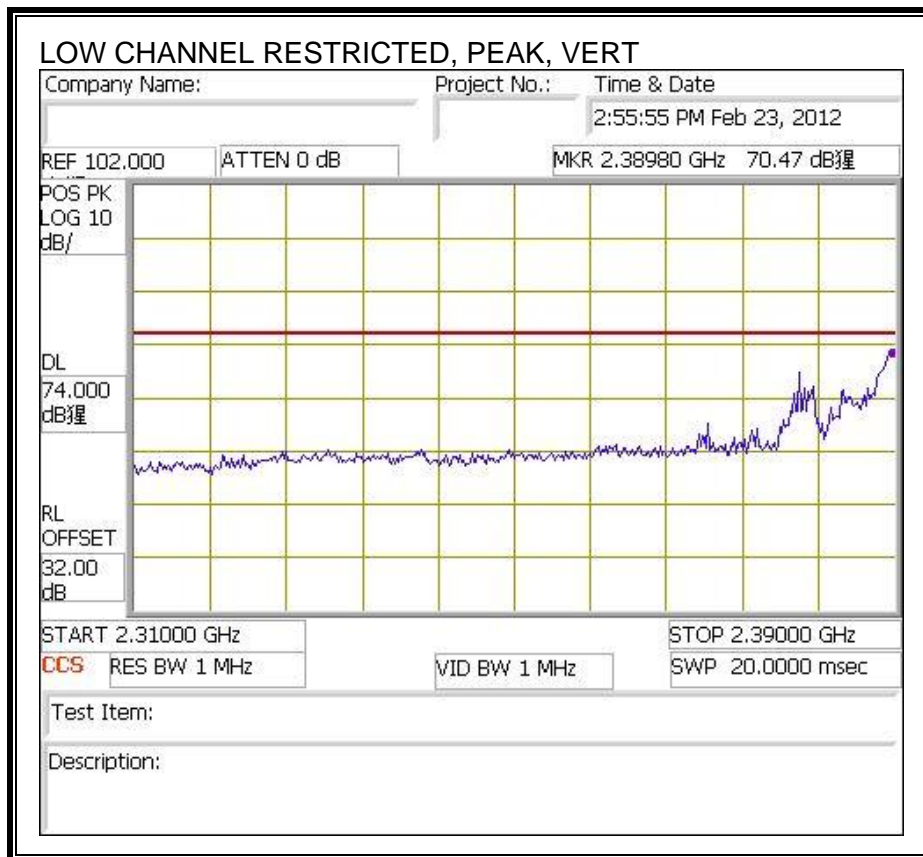
8.3.1. TX ABOVE 1 GHz, 802.11g 1TX MODE IN THE 2.4 GHz BAND

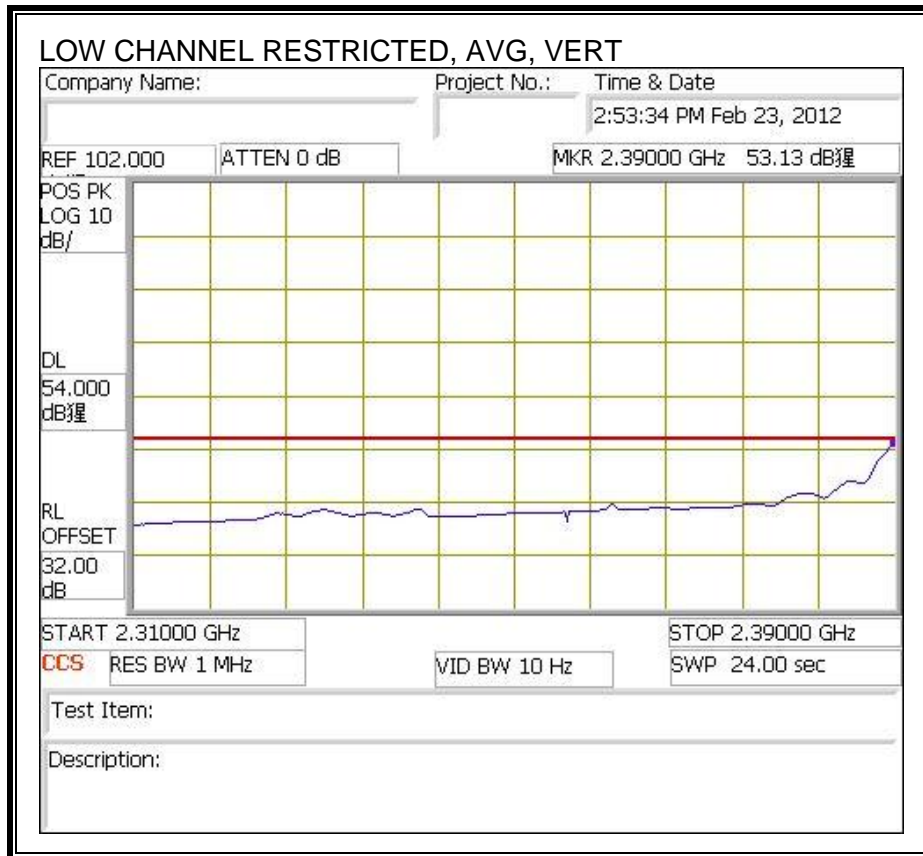
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



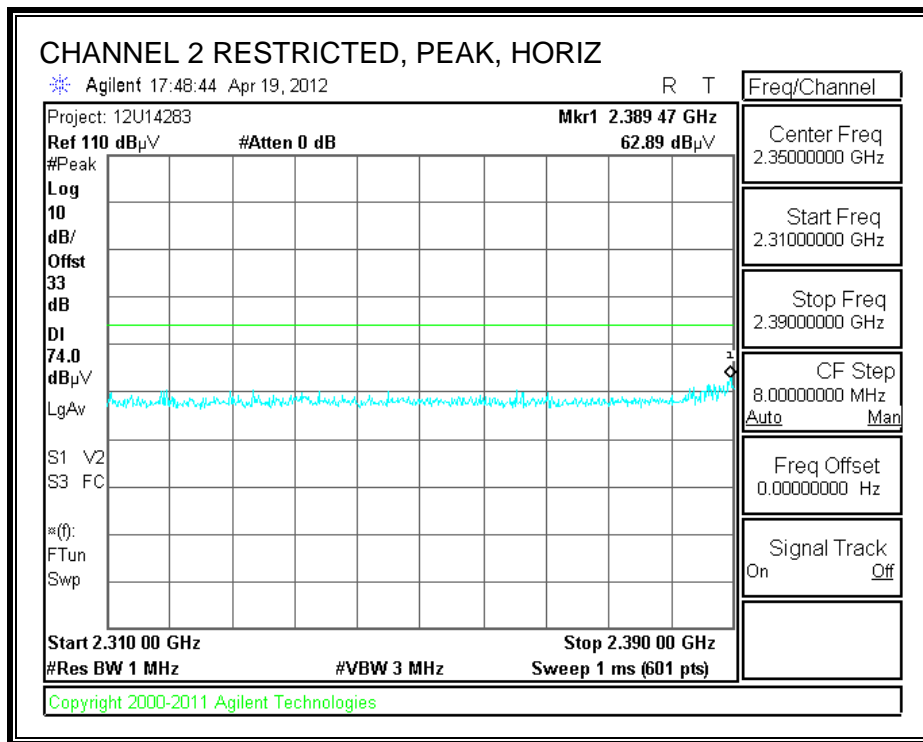


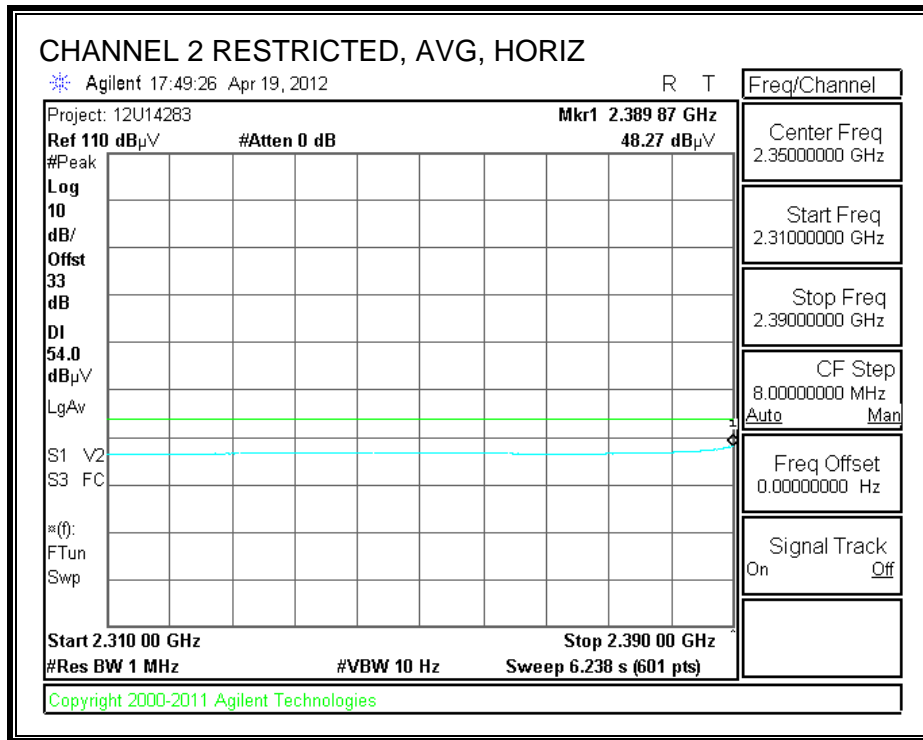
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



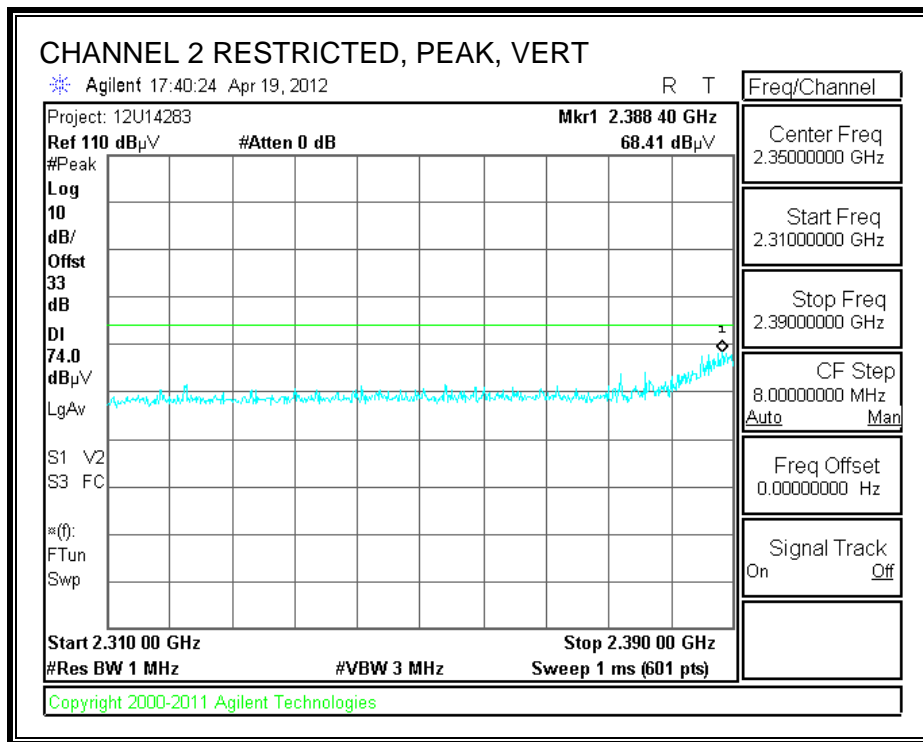


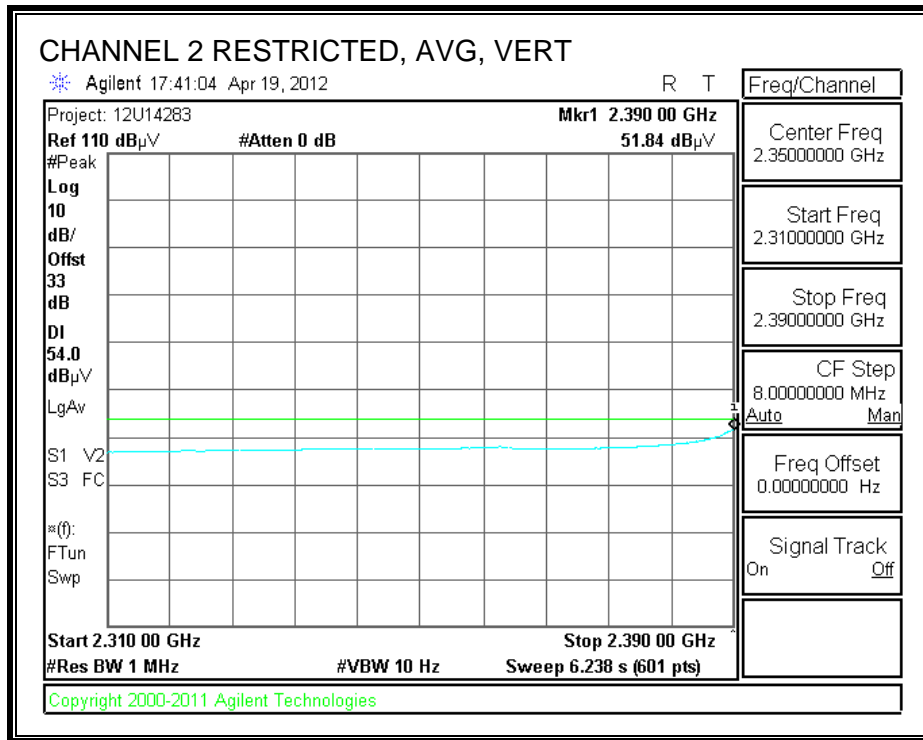
RESTRICTED BANDEDGE (CHANNEL 2, HORIZONTAL)



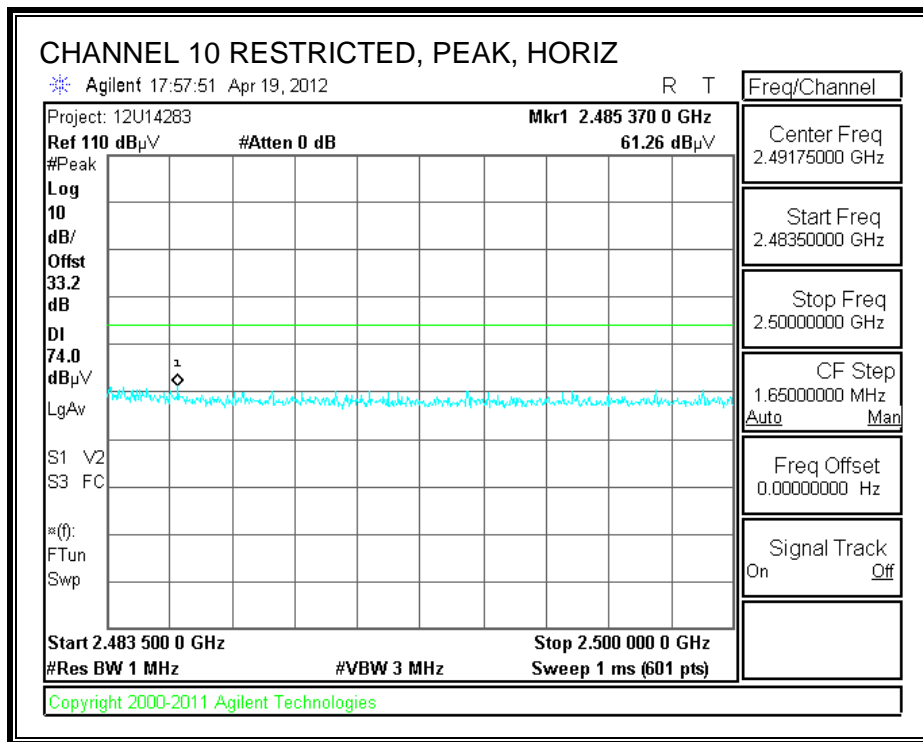


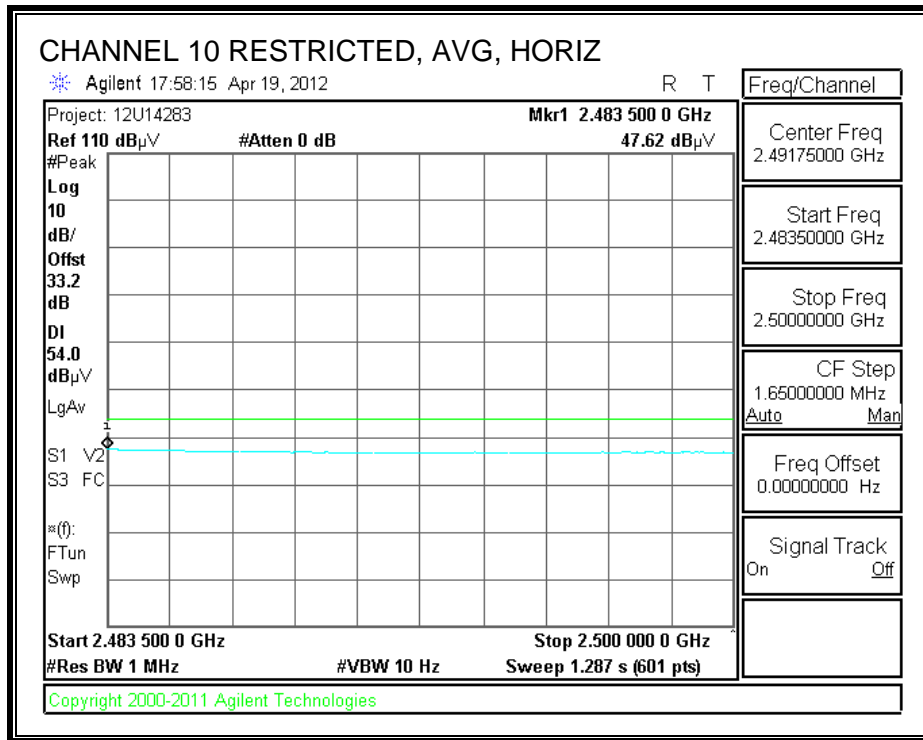
RESTRICTED BANDEDGE (CHANNEL 2, VERTICAL)



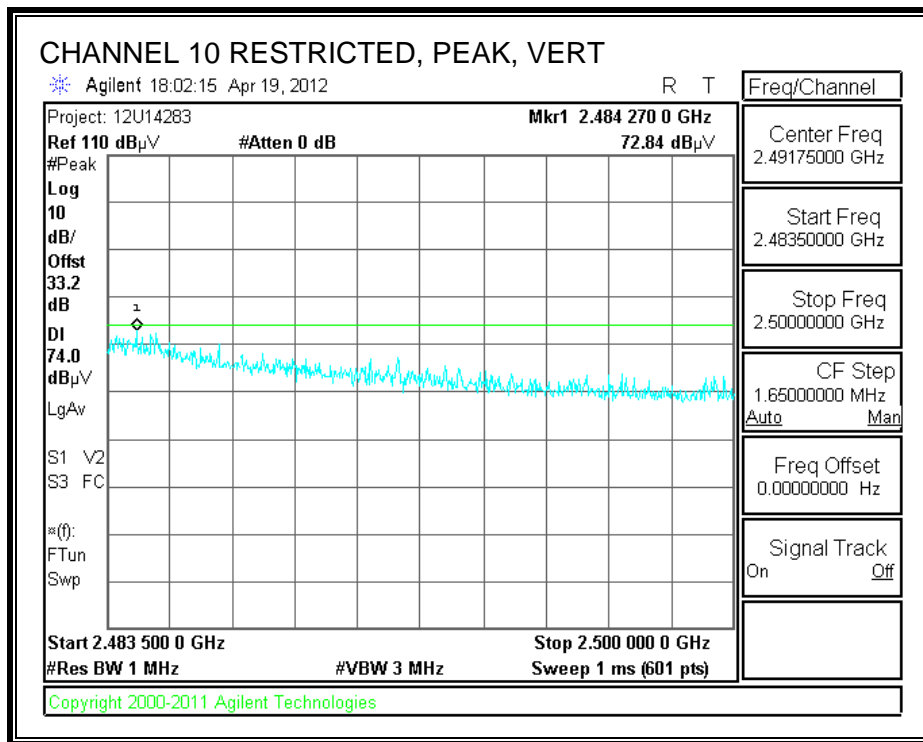


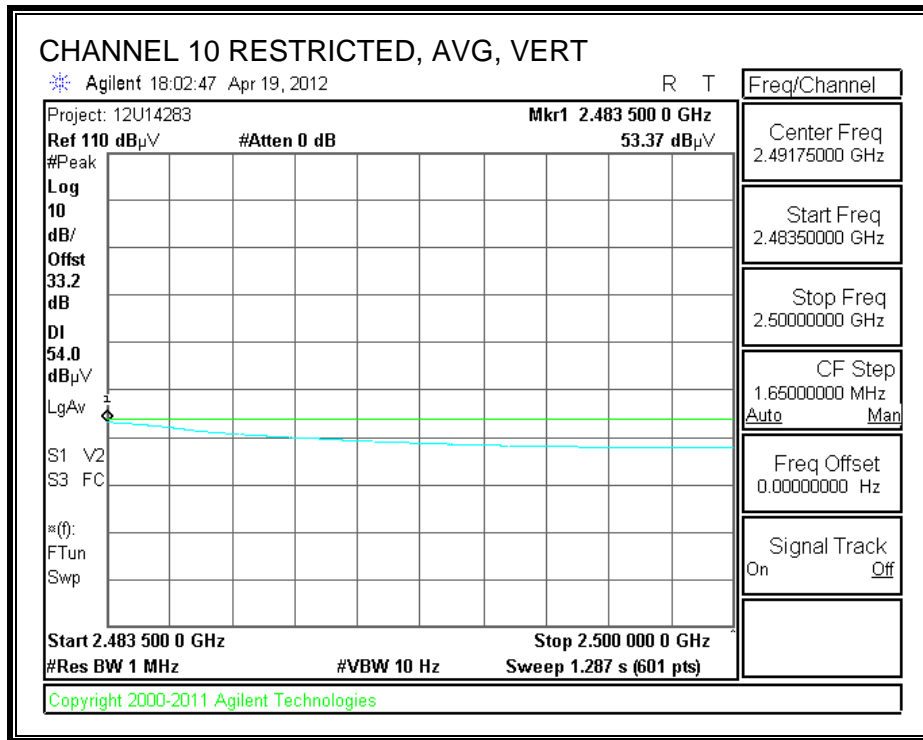
RESTRICTED BANDEDGE (CHANNEL 10, HORIZONTAL)



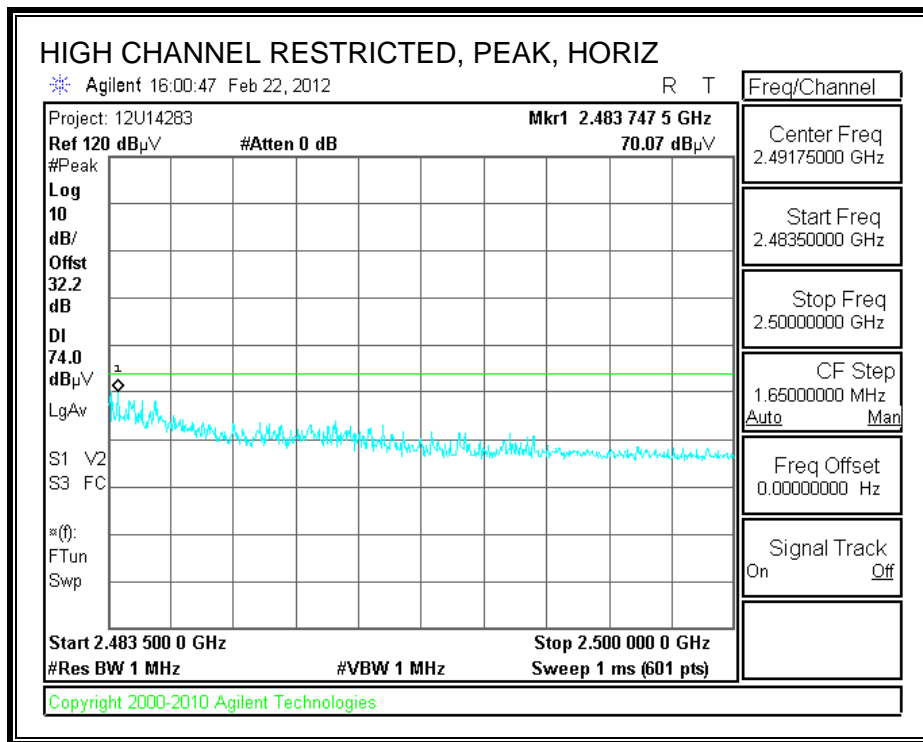


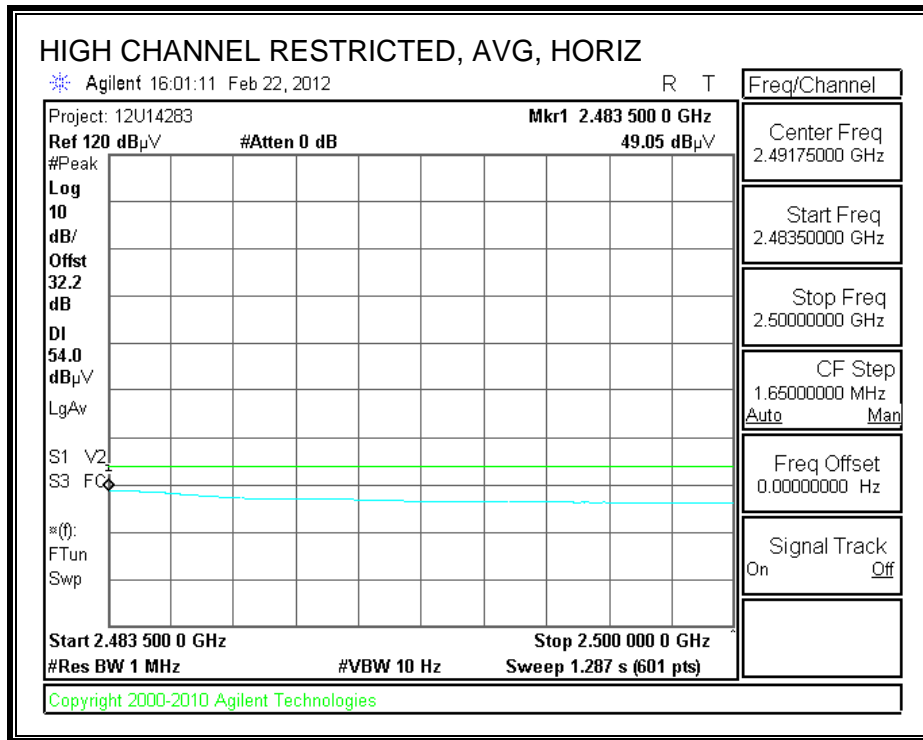
RESTRICTED BANDEDGE (CHANNEL 10, VERTICAL)



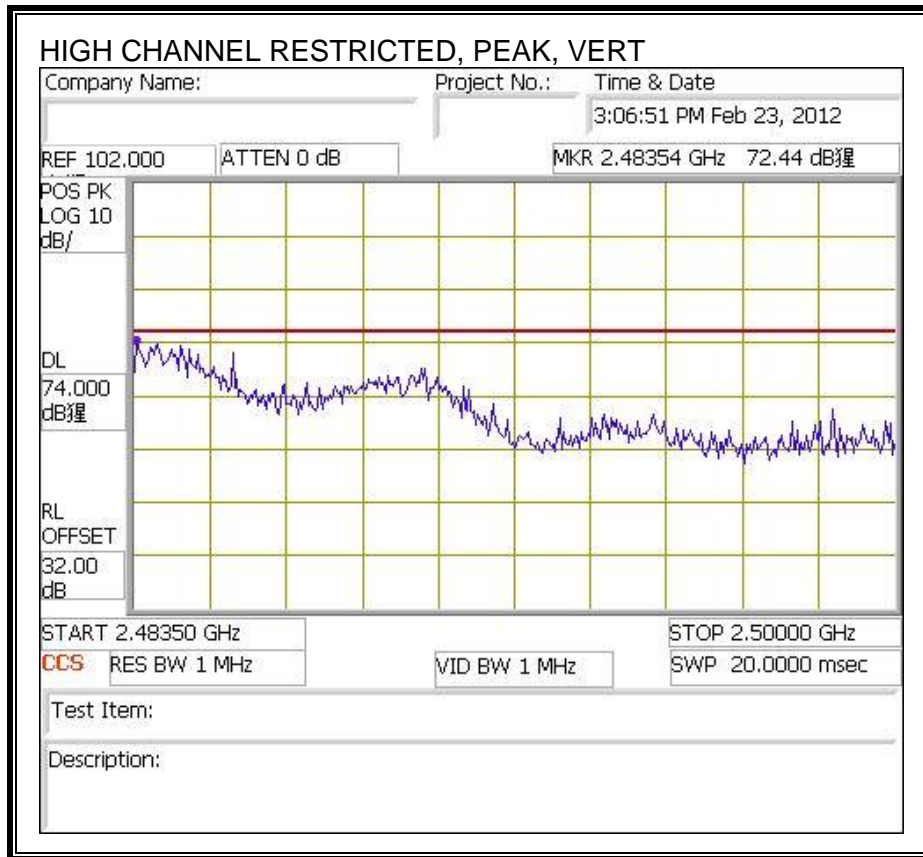


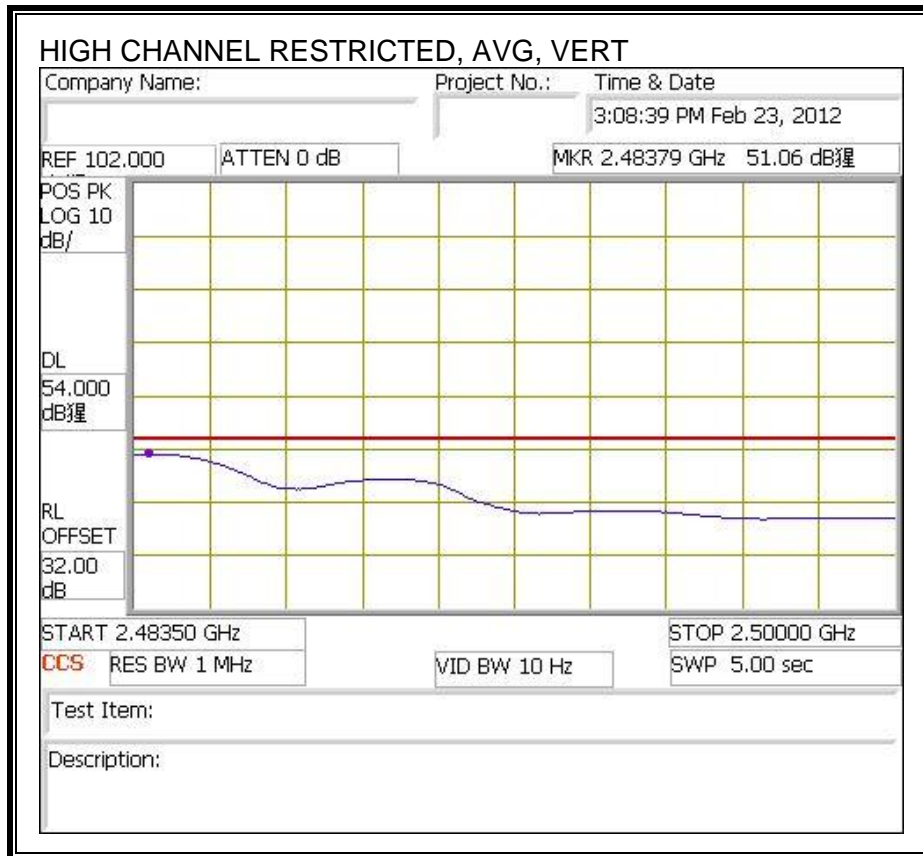
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





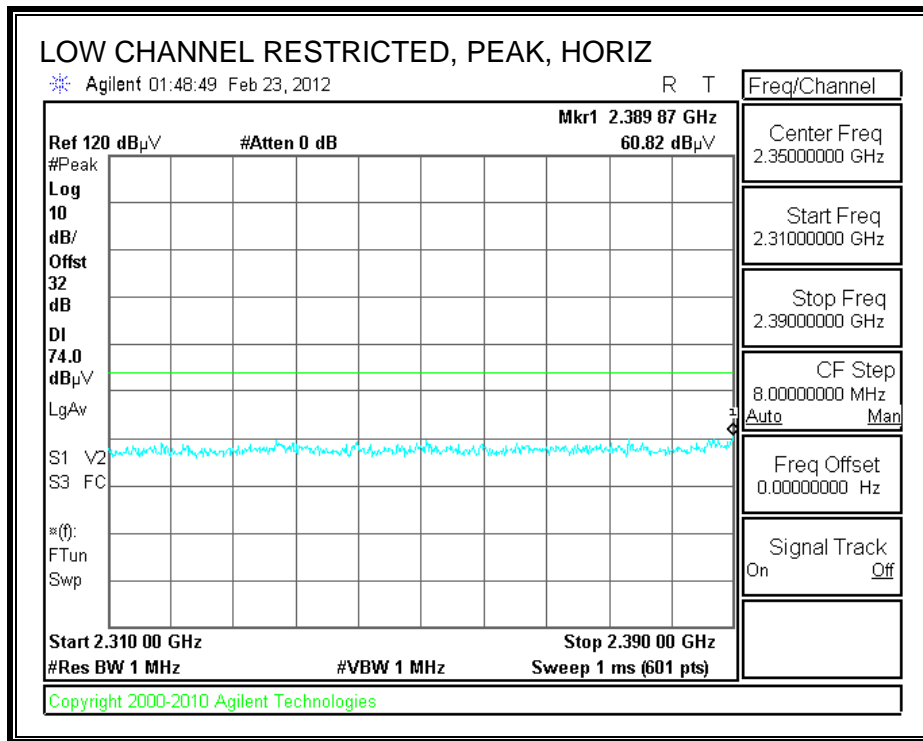
RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)

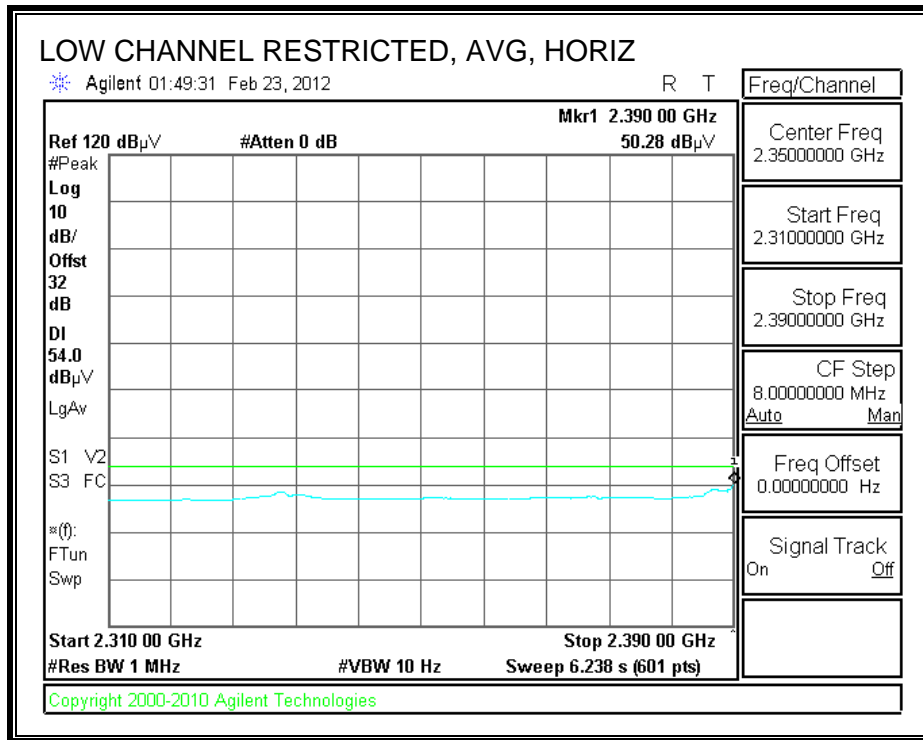




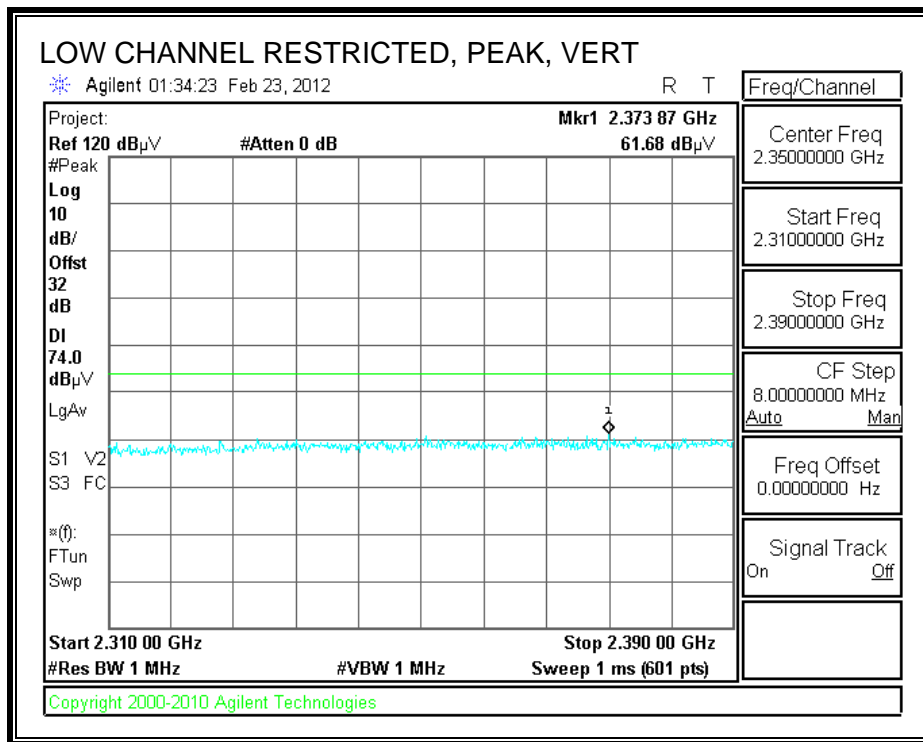
8.3.2. TX ABOVE 1 GHz, 802.11b CDD 3TX MODE IN THE 2.4 GHz BAND

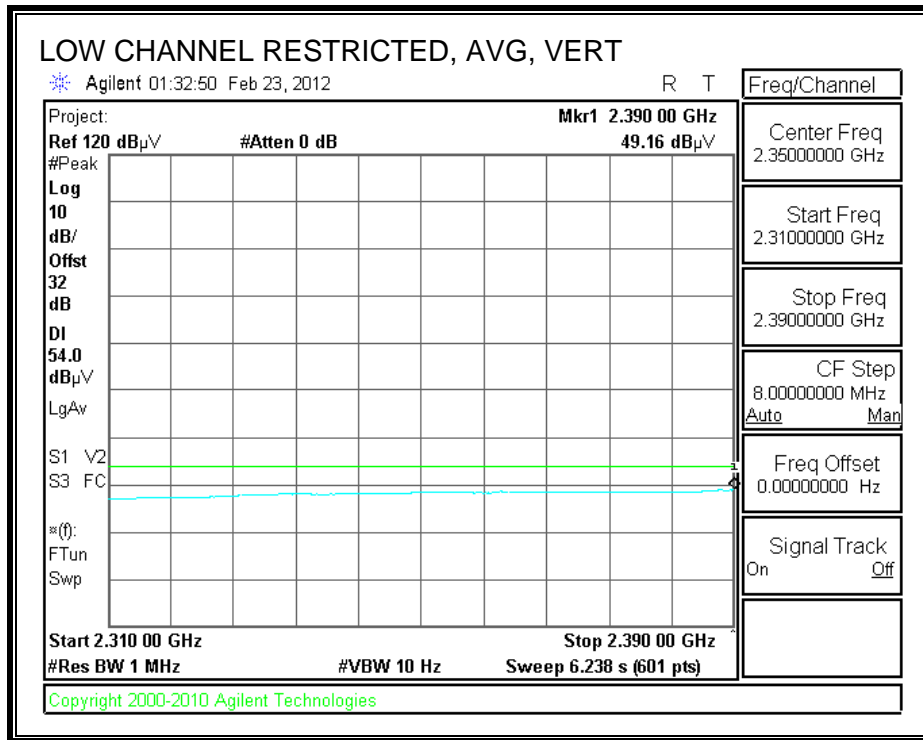
RESTRICTED BANEDGE (LOW CHANNEL, HORIZONTAL)



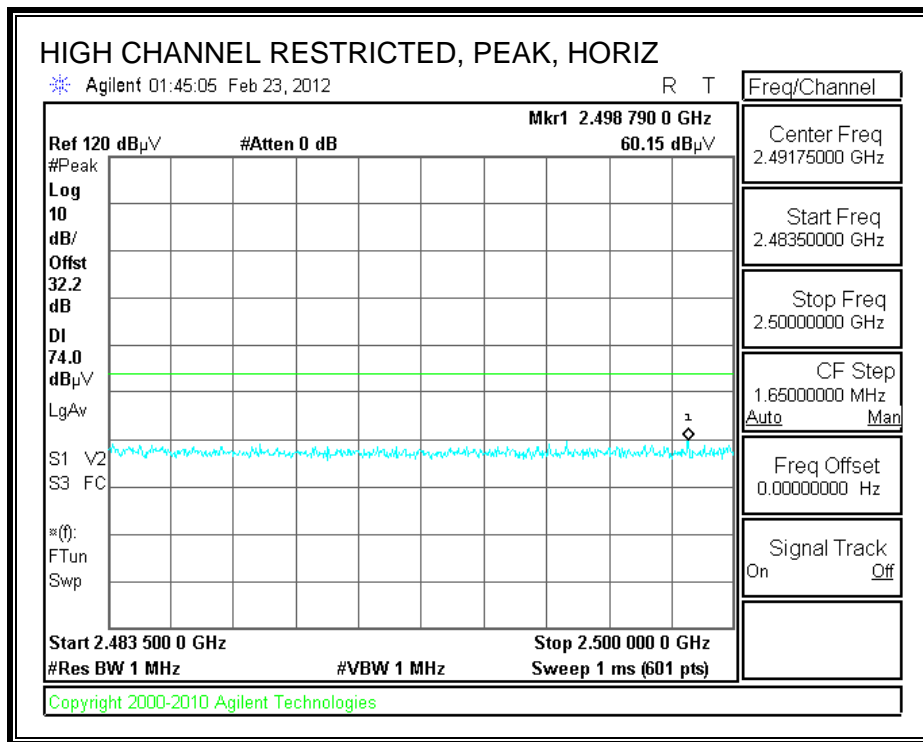


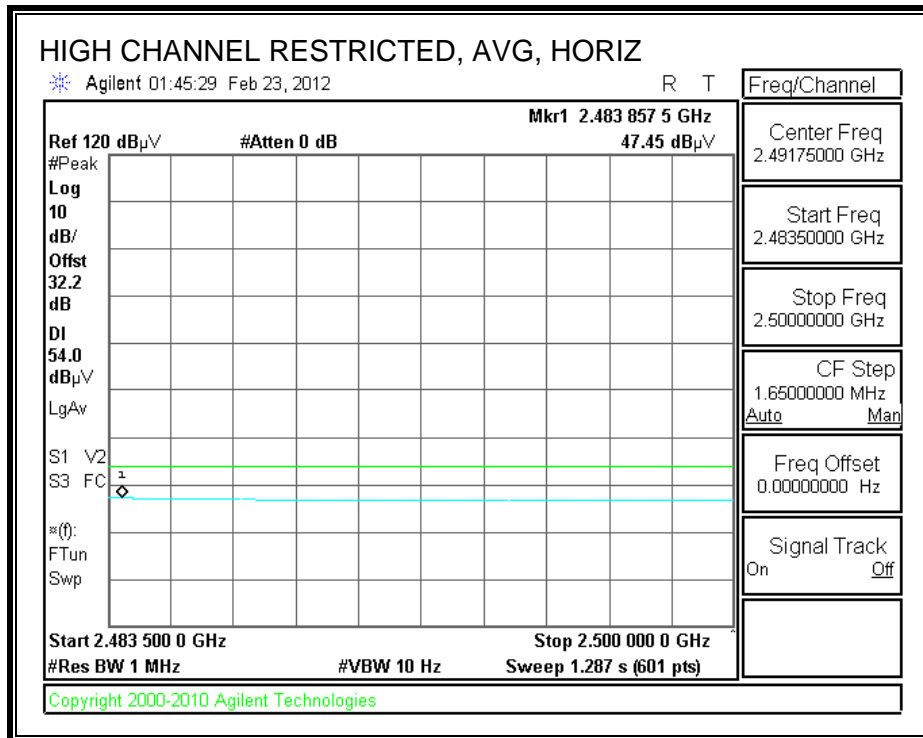
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



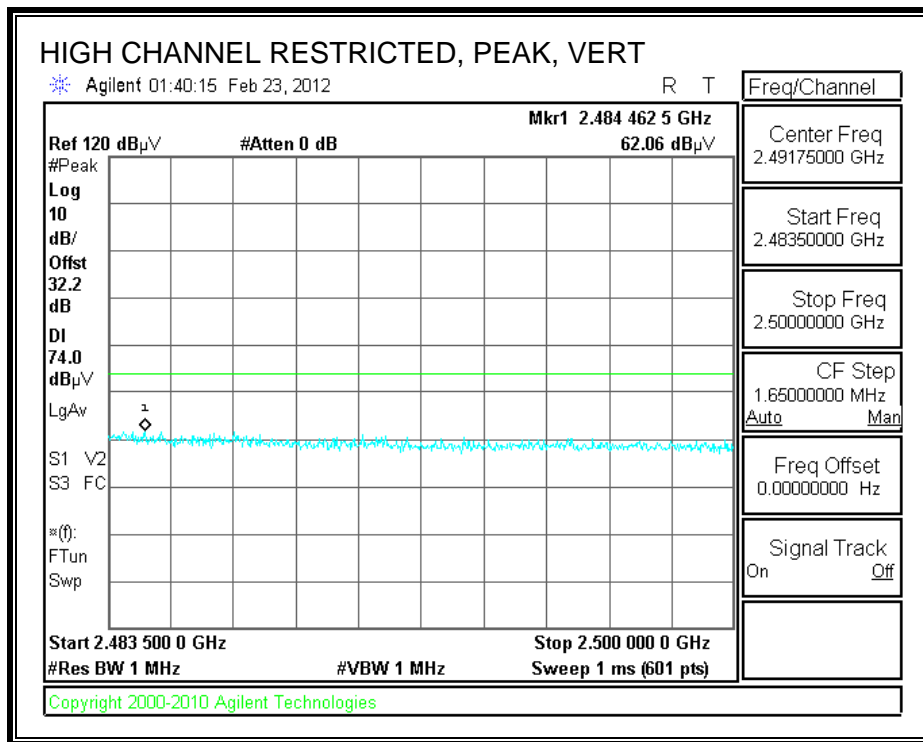


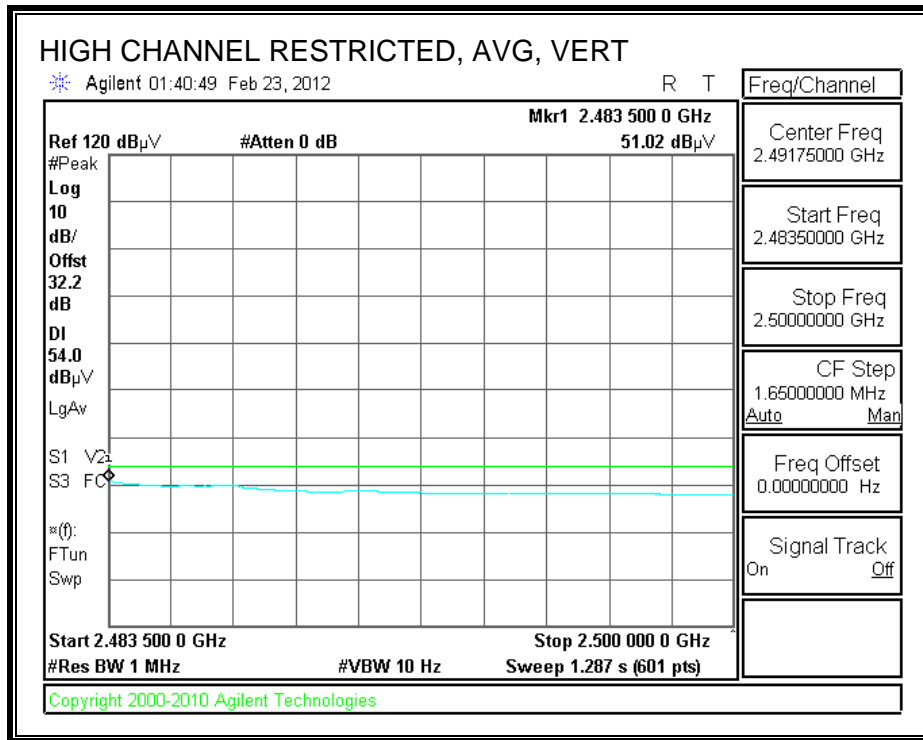
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

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

Test Engr: Dennis Huang
 Date: 02/21/12
 Project #: 12U14283
 Company: Apple Inc
 Test Target: FCC 15.205
 Mode Oper: 802.11b Tx

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

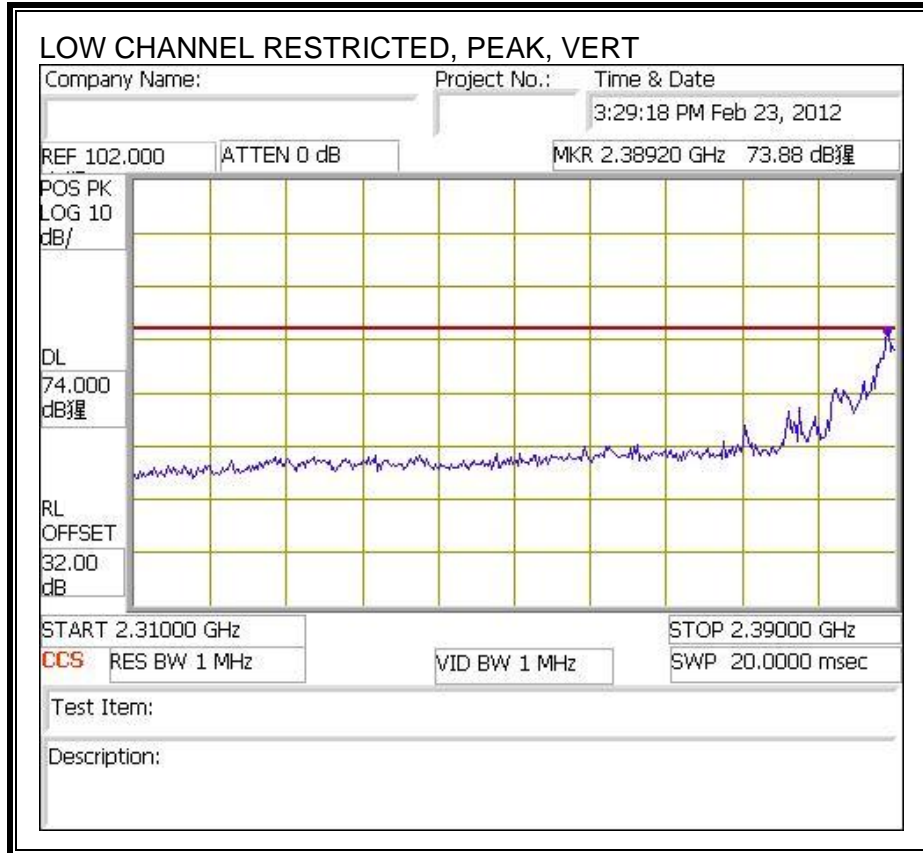
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant.High cm	Table Angle Degree	Notes
Low Channel - 2412MHz															
4.824	3.0	43.8	33.2	5.8	-34.8	0.0	0.2	48.2	74.0	-25.8	V	P	100.3	290.0	
4.824	3.0	38.5	33.2	5.8	-34.8	0.0	0.2	42.8	54.0	-11.2	V	A	100.3	290.0	
4.824	3.0	43.1	33.2	5.8	-34.8	0.0	0.2	47.4	74.0	-26.6	H	P	107.9	270.4	
4.824	3.0	36.5	33.2	5.8	-34.8	0.0	0.2	40.8	54.0	-13.2	H	A	107.9	270.4	
Mid Channel - 2437MHz															
4.874	3.0	41.1	33.2	5.8	-34.9	0.0	0.2	45.6	74.0	-28.4	V	P	100.2	299.8	
4.874	3.0	34.0	33.2	5.8	-34.9	0.0	0.2	38.4	54.0	-15.6	V	A	100.2	299.8	
4.874	3.0	39.1	33.2	5.8	-34.9	0.0	0.2	43.5	74.0	-30.5	H	P	100.7	294.8	
4.874	3.0	29.2	33.2	5.8	-34.9	0.0	0.2	33.6	54.0	-20.4	H	A	100.7	294.8	
7.311	3.0	39.7	36.2	7.3	-34.7	0.0	0.2	48.7	74.0	-25.3	V	P	150.6	160.5	
7.311	3.0	30.7	36.2	7.3	-34.7	0.0	0.2	39.7	54.0	-14.3	V	A	150.6	160.5	
7.311	3.0	38.8	36.2	7.3	-34.7	0.0	0.2	47.8	74.0	-26.2	H	P	160.7	122.8	
7.311	3.0	28.6	36.2	7.3	-34.7	0.0	0.2	37.6	54.0	-16.4	H	A	160.7	122.8	
High Channel - 2462MHz															
4.924	3.0	40.6	33.3	5.9	-34.9	0.0	0.2	45.1	74.0	-28.9	V	P	110.4	289.8	
4.924	3.0	31.3	33.3	5.9	-34.9	0.0	0.2	35.8	54.0	-18.2	V	A	110.4	289.8	
4.924	3.0	38.2	33.3	5.9	-34.9	0.0	0.2	42.7	74.0	-31.3	H	P	118.7	227.5	
4.924	3.0	26.1	33.3	5.9	-34.9	0.0	0.2	30.6	54.0	-23.4	H	A	118.7	227.5	
7.386	3.0	38.3	36.3	7.3	-34.6	0.0	0.2	47.4	74.0	-26.6	V	P	169.4	188.5	
7.386	3.0	27.2	36.3	7.3	-34.6	0.0	0.2	36.3	54.0	-17.7	V	A	169.4	188.5	
7.386	3.0	39.4	36.3	7.3	-34.6	0.0	0.2	48.5	74.0	-25.5	H	P	144.9	120.8	
7.386	3.0	29.0	36.3	7.3	-34.6	0.0	0.2	38.1	54.0	-15.9	H	A	144.9	120.8	

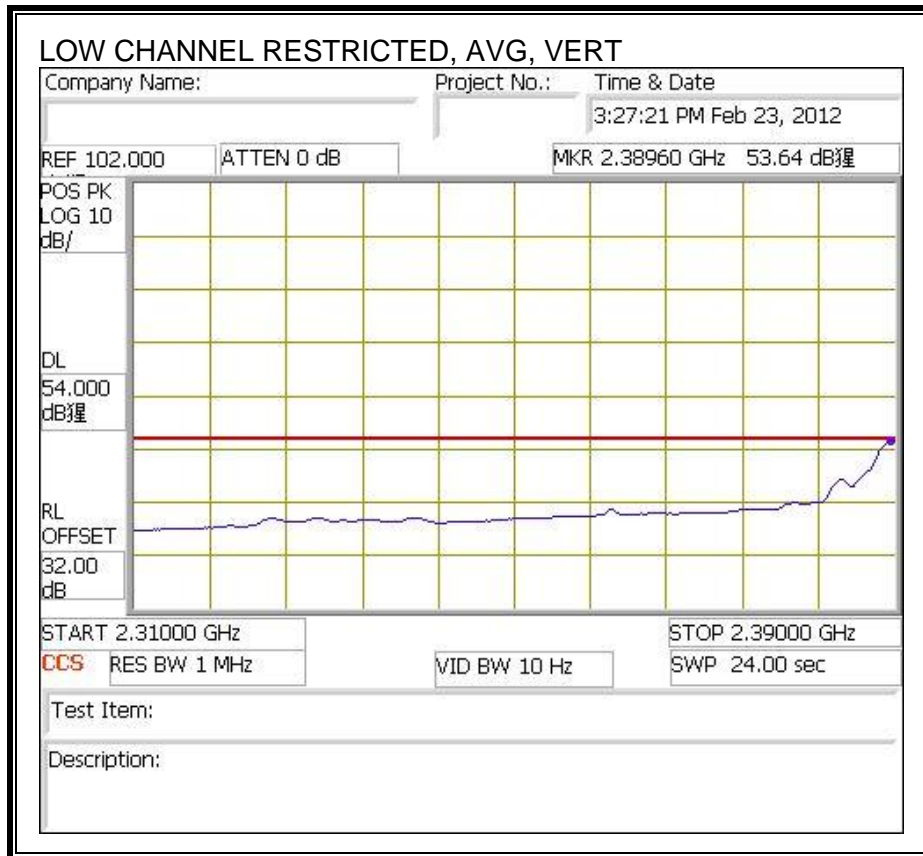
Rev. 4.1.2.7

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

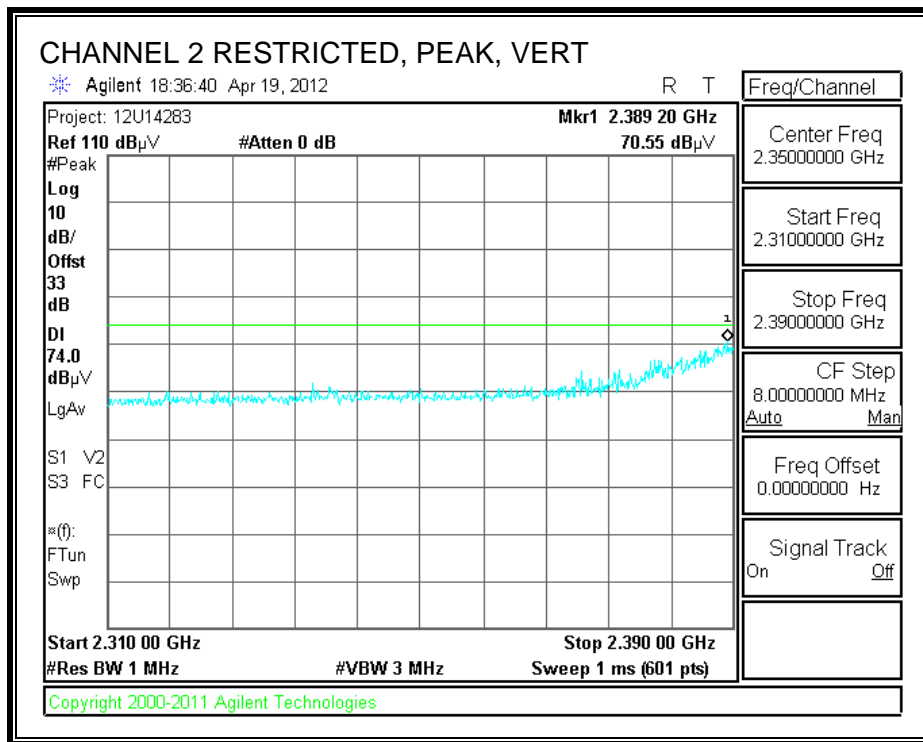
8.3.3. TX ABOVE 1 GHz, 802.11n HT20 CDD 3TX MODE IN THE 2.4 GHz BAND

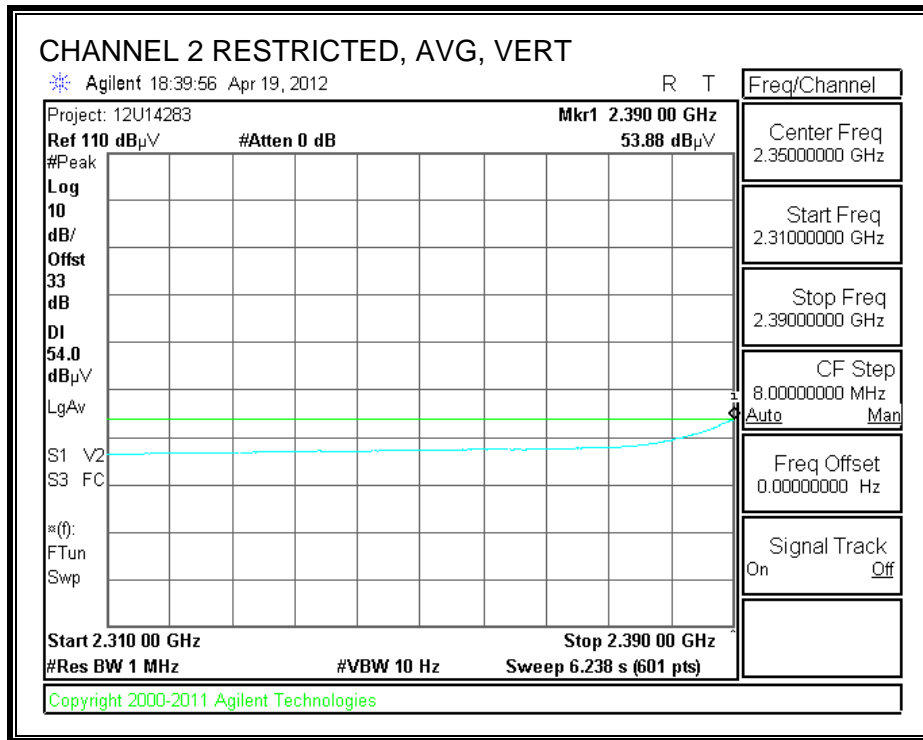
RESTRICTED BANEDGE (LOW CHANNEL, VERTICAL)



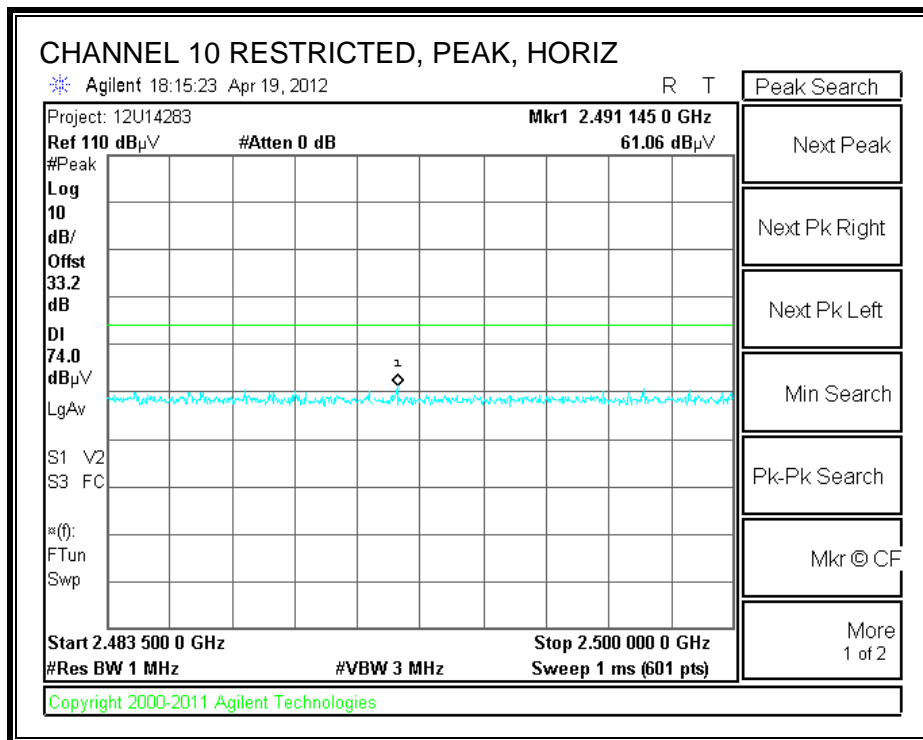


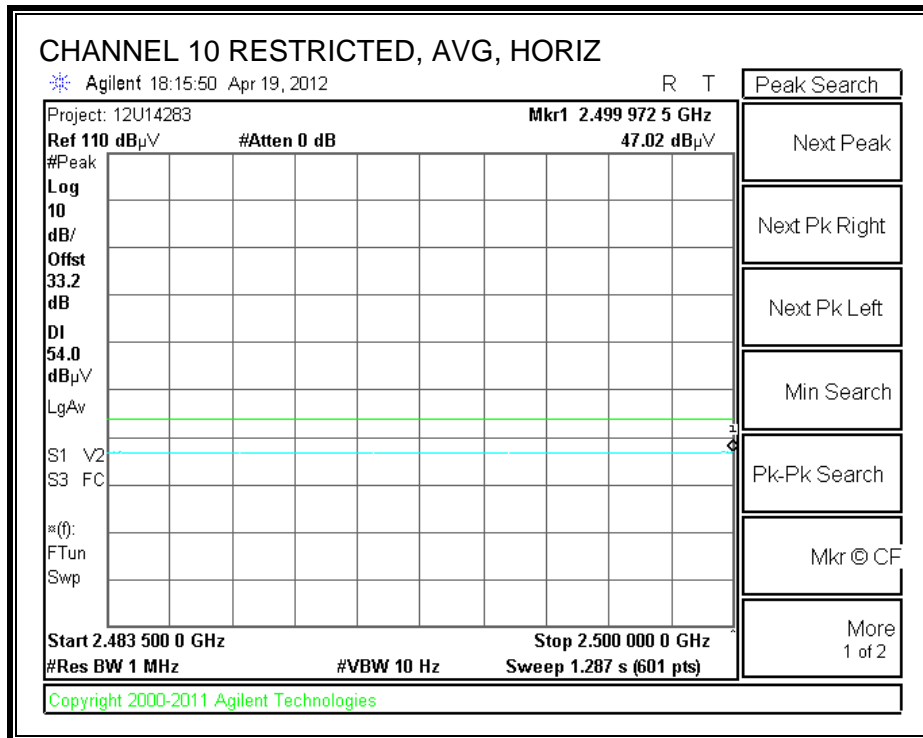
RESTRICTED BANDEDGE (CHANNEL 2, VERTICAL)



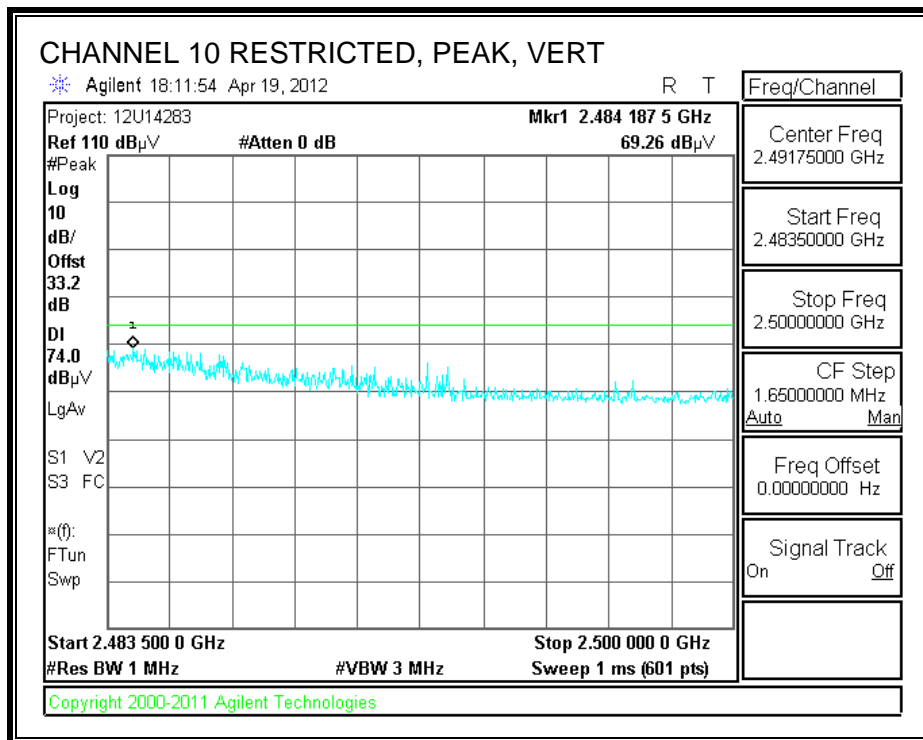


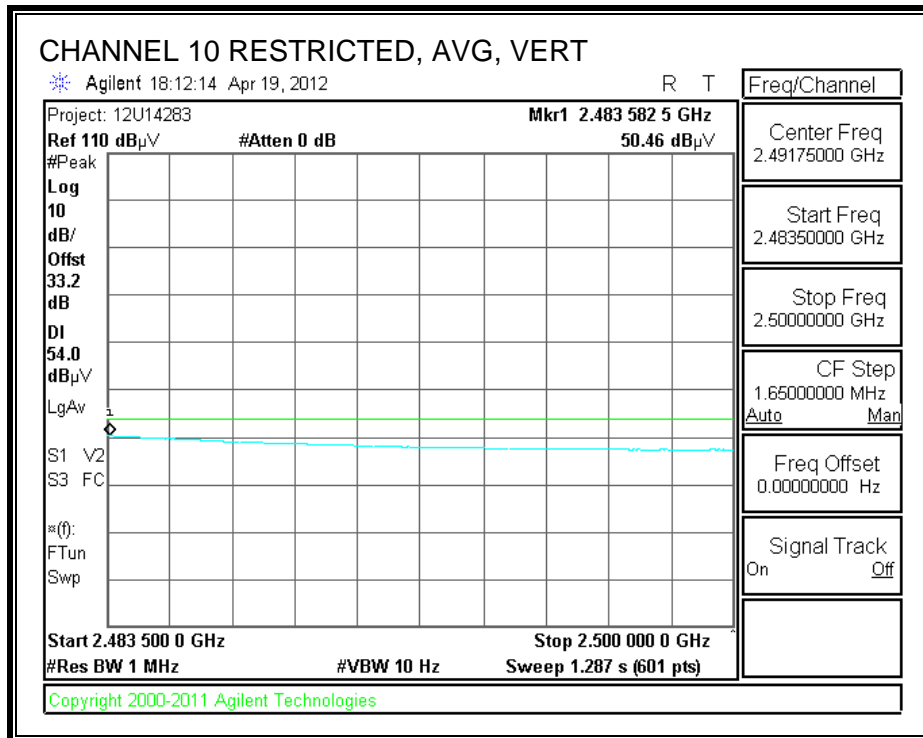
RESTRICTED BANDEDGE (CHANNEL 10, HORIZONTAL)



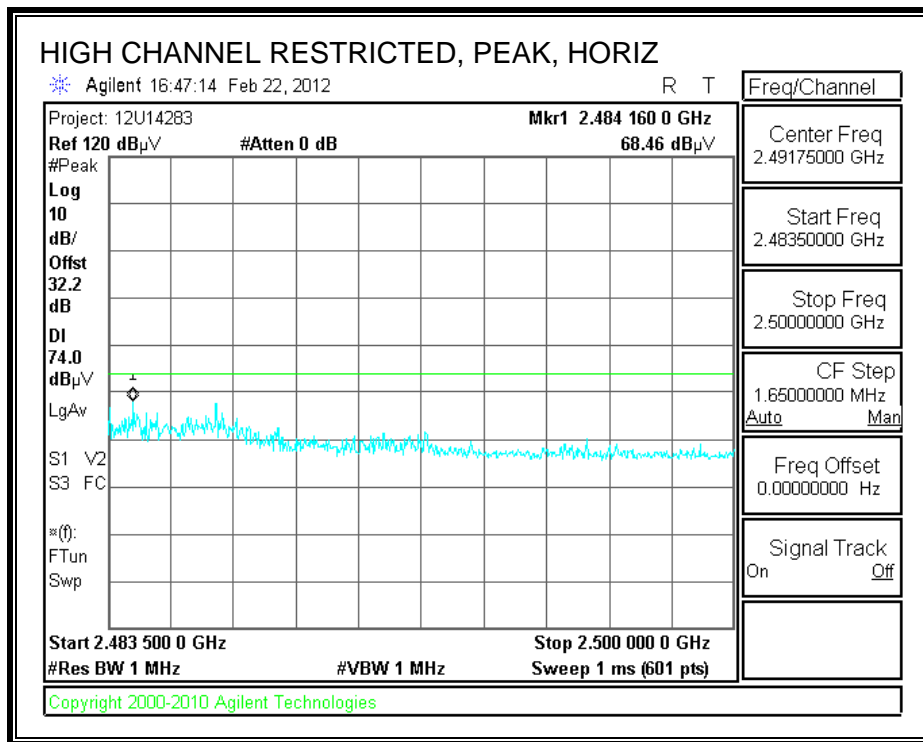


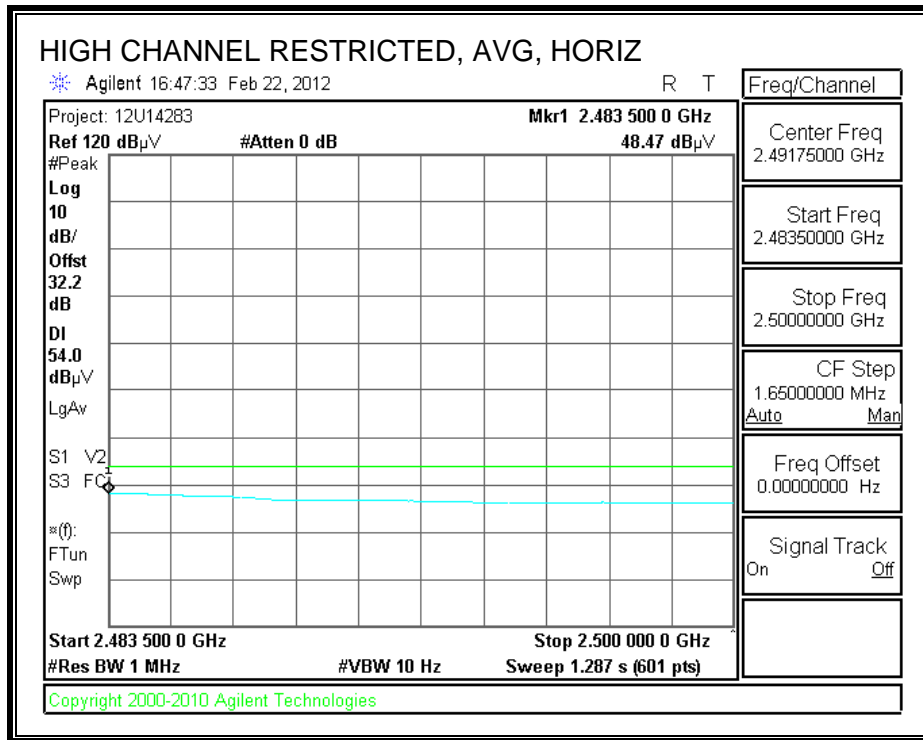
RESTRICTED BANDEDGE (CHANNEL 10, VERTICAL)



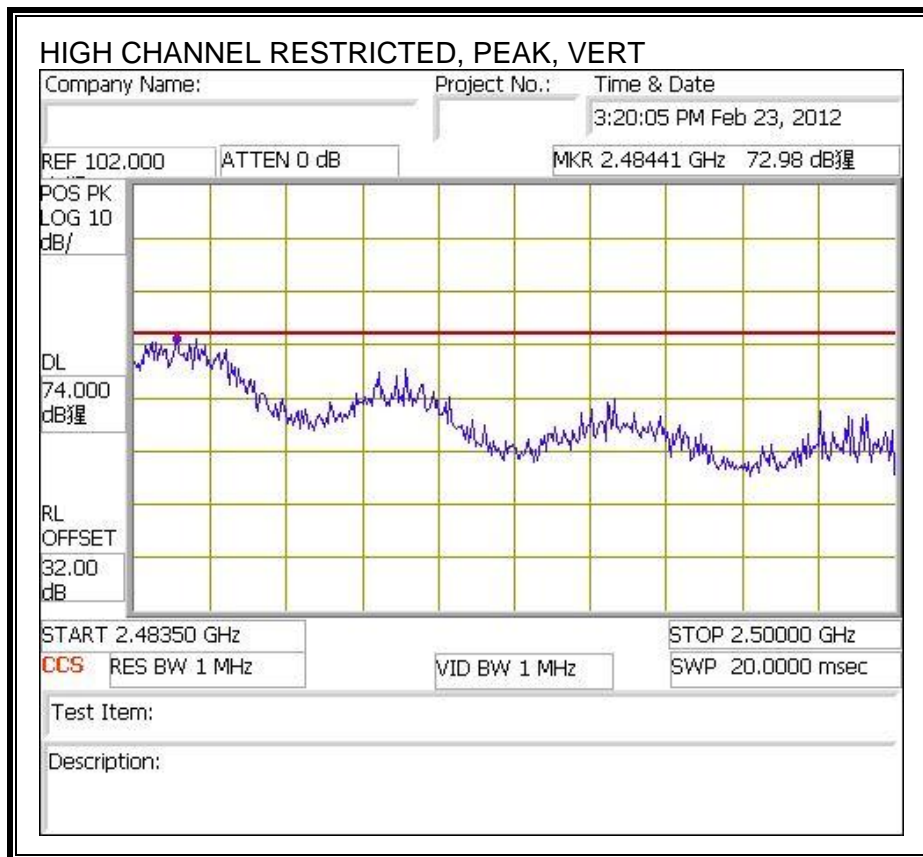


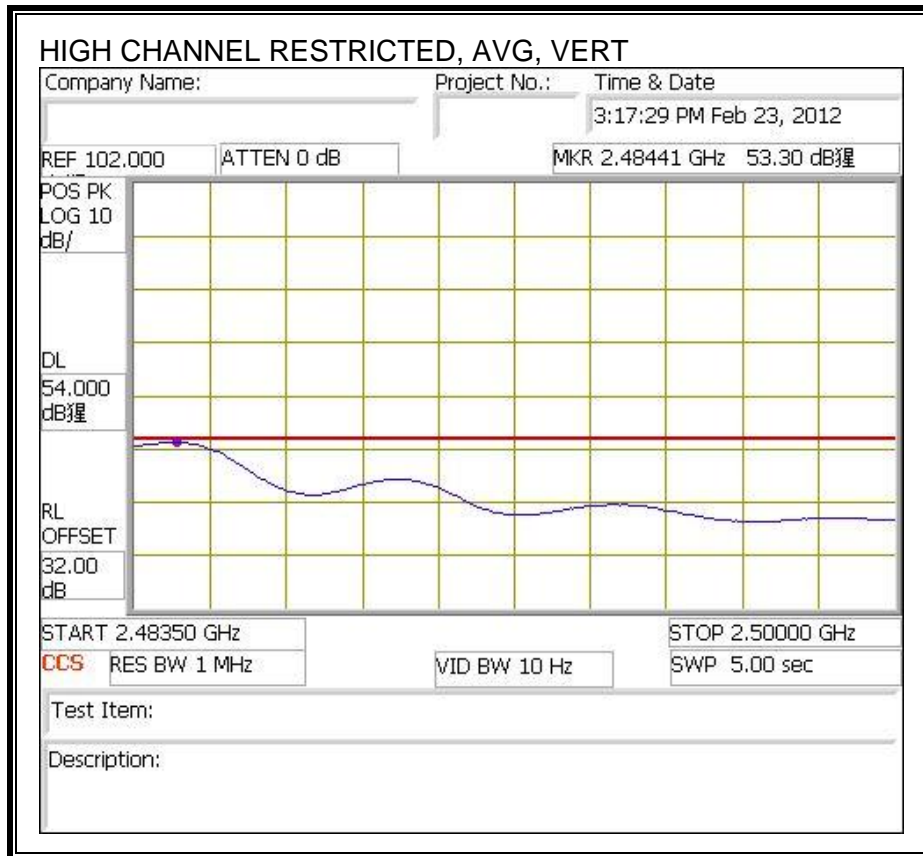
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)





RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)





HARMONICS AND SPURIOUS EMISSIONS

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

Test Engr: Dennis Huang
 Date: 02/21/12
 Project #: 12U14283
 Company: Apple Inc
 Test Target: FCC 15.205
 Mode Oper: 802.11 n HT20 Tx

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	Filtr dB	Corr. dB	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant.High cm	Table Angle Degree	Notes
Low Channel - 2412MHz															
4.824	3.0	41.0	33.2	5.8	-34.8	0.0	0.2	45.4	74.0	-28.6	V	P	100.4	292.0	
4.824	3.0	27.9	33.2	5.8	-34.8	0.0	0.2	32.3	54.0	-21.8	V	A	100.4	292.0	
4.824	3.0	39.4	33.2	5.8	-34.8	0.0	0.2	43.7	74.0	-30.3	H	P	170.5	323.7	
4.824	3.0	26.7	33.2	5.8	-34.8	0.0	0.2	31.1	54.0	-22.9	H	A	170.5	323.7	
Mid Channel - 2437MHz															
4.874	3.0	42.0	33.2	5.8	-34.9	0.0	0.2	46.4	74.0	-27.6	V	P	164.0	50.1	
4.874	3.0	29.7	33.2	5.8	-34.9	0.0	0.2	34.1	54.0	-19.9	V	A	164.0	50.1	
4.874	3.0	41.3	33.2	5.8	-34.9	0.0	0.2	45.7	74.0	-28.3	H	P	105.4	297.0	
4.874	3.0	29.3	33.2	5.8	-34.9	0.0	0.2	33.7	54.0	-20.3	H	A	105.4	297.0	
7.311	3.0	45.1	36.2	7.3	-34.7	0.0	0.2	54.1	74.0	-19.9	V	P	159.5	187.4	
7.311	3.0	31.5	36.2	7.3	-34.7	0.0	0.2	40.5	54.0	-13.5	V	A	159.5	187.4	
7.311	3.0	39.8	36.2	7.3	-34.7	0.0	0.2	48.8	74.0	-25.2	H	P	151.7	287.1	
7.311	3.0	27.5	36.2	7.3	-34.7	0.0	0.2	36.5	54.0	-17.5	H	A	151.7	287.1	
High Channel - 2462MHz															
4.924	3.0	45.5	33.3	5.9	-34.9	0.0	0.2	50.0	74.0	-24.0	V	P	102.2	329.1	
4.924	3.0	31.2	33.3	5.9	-34.9	0.0	0.2	35.7	54.0	-18.3	V	A	102.2	329.1	
4.924	3.0	40.9	33.3	5.9	-34.9	0.0	0.2	45.4	74.0	-28.6	H	P	100.1	261.0	
4.924	3.0	28.1	33.3	5.9	-34.9	0.0	0.2	32.6	54.0	-21.4	H	A	100.1	261.0	
7.386	3.0	44.0	36.3	7.3	-34.6	0.0	0.2	53.2	74.0	-20.8	V	P	149.1	171.4	
7.386	3.0	30.2	36.3	7.3	-34.6	0.0	0.2	39.3	54.0	-14.7	V	A	149.1	171.4	
7.386	3.0	41.5	36.3	7.3	-34.6	0.0	0.2	50.6	74.0	-23.4	H	P	187.5	285.0	
7.386	3.0	27.9	36.3	7.3	-34.6	0.0	0.2	37.0	54.0	-17.0	H	A	187.5	285.0	

Rev. 4.1.2.7

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

8.3.4. TX ABOVE 1 GHz, 802.11n HT20 3TX MODE IN THE 5.8 GHz BAND

HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement															
Compliance Certification Services, Fremont 5m Chamber															
Test Engr:		William Zhuang													
Date:		02/22/12													
Project #:		12U14283													
Company:		Apple													
Test Target:		FCC IC 15.205													
Mode Oper:		HT20, Tx On													
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 Ch.															
11.490	3.0	37.4	39.2	9.5	-33.1	0.0	0.0	52.9	74.0	-21.1	V	P	142.6	183.3	
11.490	3.0	26.1	39.2	9.5	-33.1	0.0	0.0	41.7	54.0	-12.3	V	A	142.6	183.3	
11.490	3.0	36.6	39.2	9.5	-33.1	0.0	0.0	52.1	74.0	-21.9	H	P	137.3	236.1	
11.490	3.0	22.9	39.2	9.5	-33.1	0.0	0.0	38.4	54.0	-15.6	H	A	137.3	236.1	
22.980	3.0	33.5	35.5	14.6	-32.4	0.0	0.0	51.2	74.0	-22.8	V	P	112.5	9.2	
22.980	3.0	21.2	35.5	14.6	-32.4	0.0	0.0	38.9	54.0	-15.1	V	A	112.5	9.2	
22.980	3.0	34.3	35.5	14.6	-32.4	0.0	0.0	52.0	74.0	-22.0	H	P	112.5	9.2	
22.980	3.0	21.2	35.5	14.6	-32.4	0.0	0.0	38.9	54.0	-15.1	H	A	112.5	9.2	
Mid Ch.															
11.570	3.0	40.2	39.2	9.5	-33.0	0.0	0.0	56.0	74.0	-18.0	V	P	138.2	21.8	
11.570	3.0	27.9	39.2	9.5	-33.0	0.0	0.0	43.6	54.0	-10.4	V	A	138.2	21.8	
11.570	3.0	35.9	39.2	9.5	-33.0	0.0	0.0	51.7	74.0	-22.3	H	P	131.1	298.9	
11.570	3.0	24.6	39.2	9.5	-33.0	0.0	0.0	40.3	54.0	-13.7	H	A	131.1	298.9	
High Ch.															
11.650	3.0	40.5	39.3	9.6	-32.9	0.0	0.0	56.5	74.0	-17.5	V	P	133.4	195.6	
11.650	3.0	28.3	39.3	9.6	-32.9	0.0	0.0	44.3	54.0	-9.7	V	A	133.4	195.6	
11.650	3.0	36.1	39.3	9.6	-32.9	0.0	0.0	52.1	74.0	-21.9	H	P	141.0	191.2	
11.650	3.0	23.4	39.3	9.6	-32.9	0.0	0.0	39.3	54.0	-14.7	H	A	141.0	191.2	

Rev. 4.1.12.7

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

8.3.5. TX ABOVE 1 GHz, 802.11n HT40 3TX MODE IN THE 5.8 GHz BAND

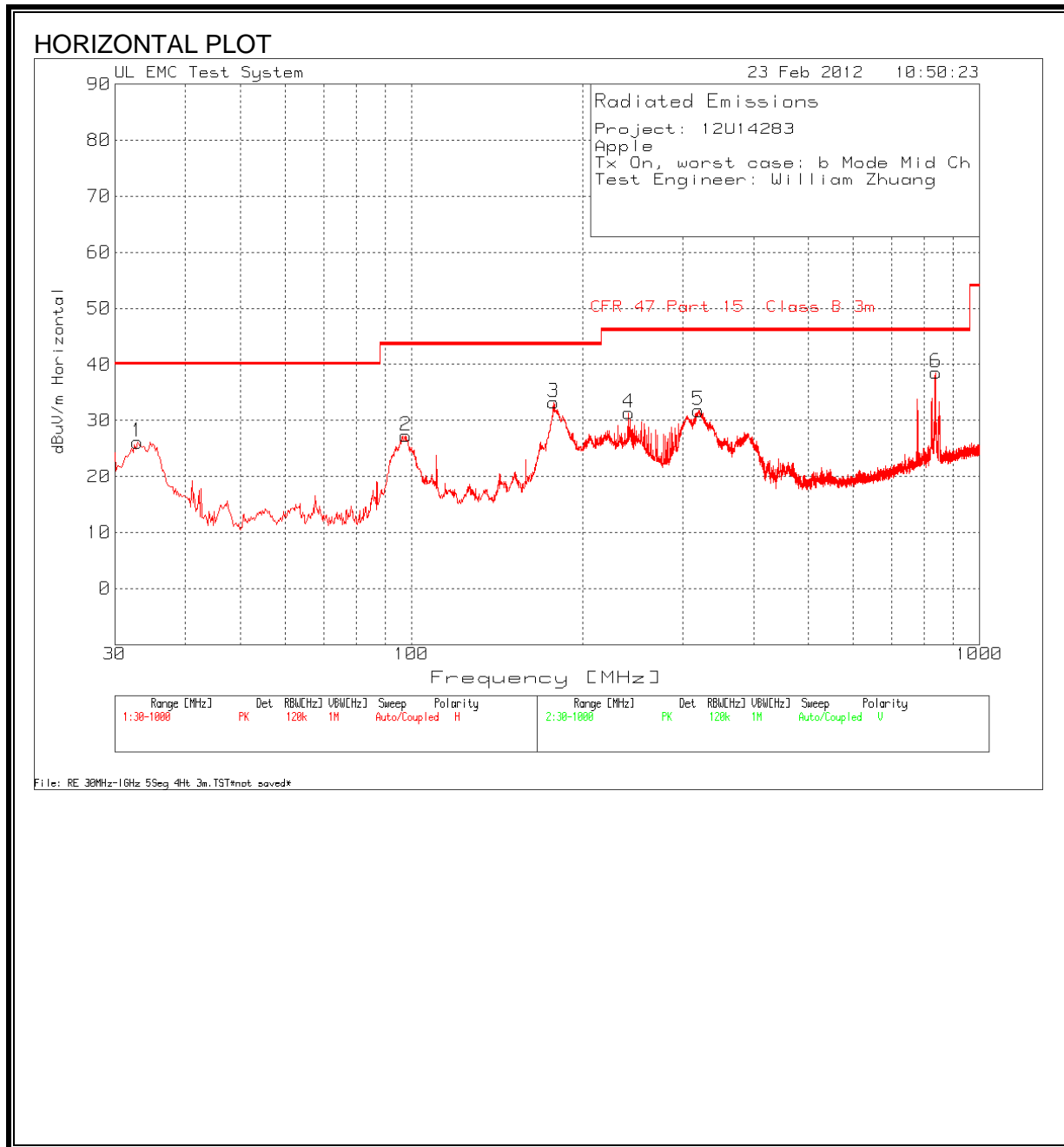
HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement															
Compliance Certification Services, Fremont 5m Chamber															
Test Engr:		William Zhuang													
Date:		02/22/12													
Project #:		12U14283													
Company:		Apple													
Test Target:		FCC IC 15.205													
Mode Oper:		HT40, Tx On													
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	Fldr dB	Corr. dB	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant.High cm	Table Angle Degree	Notes
Low Ch.															
11.510	3.0	34.9	39.2	9.5	-33.1	0.0	0.0	50.5	74.0	-23.5	V	P	144.4	20.4	
11.510	3.0	23.3	39.2	9.5	-33.1	0.0	0.0	38.9	54.0	-15.1	V	A	144.4	20.4	
11.510	3.0	35.3	39.2	9.5	-33.1	0.0	0.0	50.9	74.0	-23.1	H	P	167.6	126.4	
11.510	3.0	22.3	39.2	9.5	-33.1	0.0	0.0	37.9	54.0	-16.1	H	A	167.6	126.4	
23.020	3.0	33.1	35.4	14.6	-32.4	0.0	0.0	50.7	74.0	-23.3	V	P	153.5	159.3	
23.020	3.0	21.4	35.4	14.6	-32.4	0.0	0.0	39.0	54.0	-15.0	V	A	153.5	159.3	
23.020	3.0	34.1	35.4	14.6	-32.4	0.0	0.0	51.7	74.0	-22.3	H	P	100.7	294.3	
23.020	3.0	21.4	35.4	14.6	-32.4	0.0	0.0	39.0	54.0	-15.0	H	A	100.7	294.3	
High Ch.															
11.590	3.0	40.5	39.3	9.6	-32.9	0.0	0.0	56.5	74.0	-17.5	V	P	133.4	195.6	
11.590	3.0	28.3	39.3	9.6	-32.9	0.0	0.0	44.3	54.0	-9.7	V	A	133.4	195.6	
11.590	3.0	36.1	39.3	9.6	-32.9	0.0	0.0	52.1	74.0	-21.9	H	P	141.0	191.2	
11.590	3.0	23.4	39.3	9.6	-32.9	0.0	0.0	39.3	54.0	-14.7	H	A	141.0	191.2	

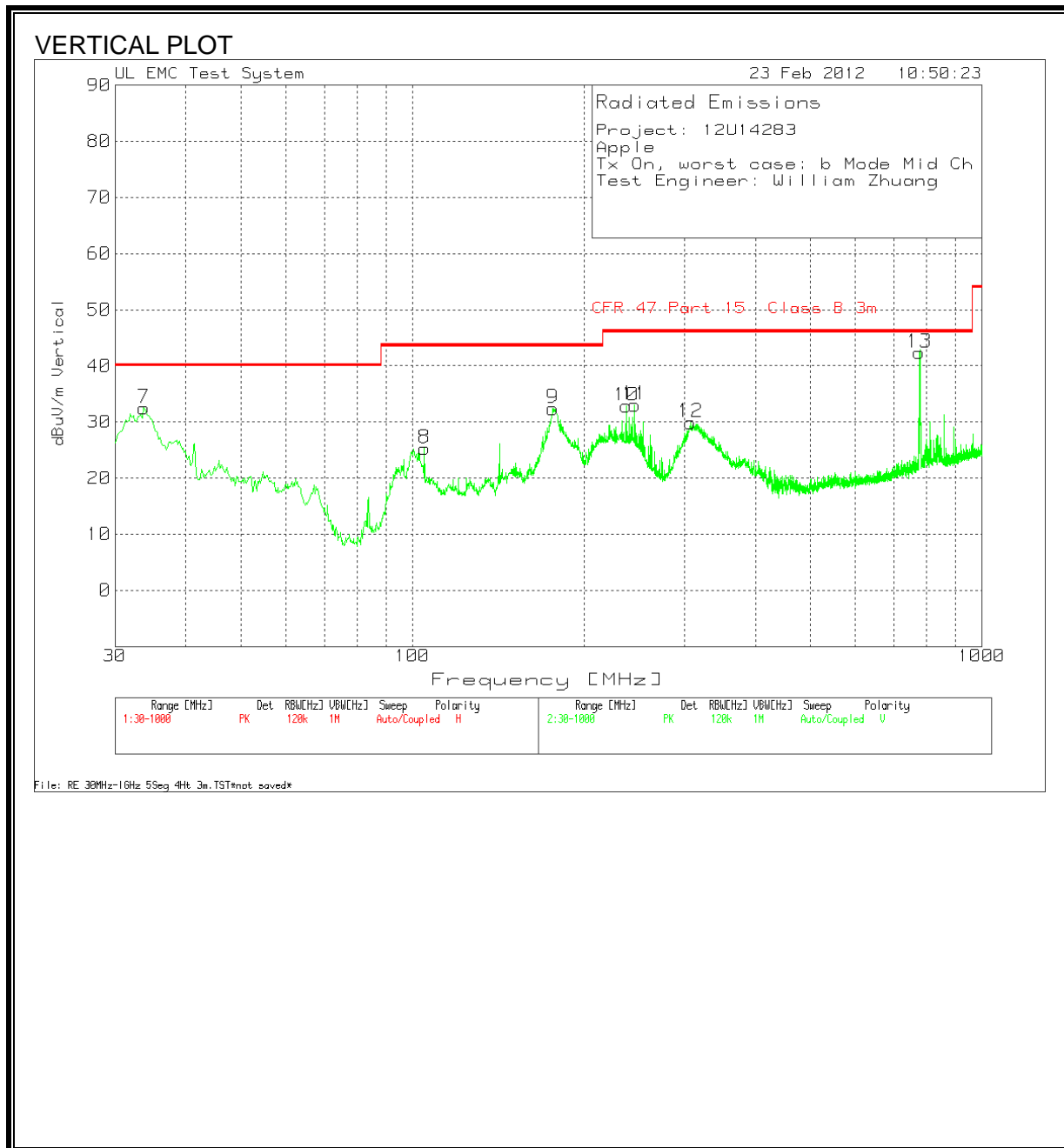
Rev. 4.1.2.7
 Note: No other emissions were detected above the system noise floor.

8.4. WORST-CASE BELOW 1 GHz

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



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



EMI DATA

Project: 12U14283									
Apple									
Tx On, worst case: b Mode Mid Ch									
Test Engineer: William Zhuang									
Range 1 30 - 1000MHz									
Test Frequency	Meter Reading	Detector	25MHz-1Ghz ChmbrB Amp [dB]	T130 Bilog Factors.T XT [dB]	dBuV/m	CFR 47 Part 15 Class B 3m	Margin	Height [cm]	Polarity
32.9077	36.35	PK	-29.2	19	26.15	40	-13.85	200	Horz
97.6519	46.37	PK	-28.6	9.5	27.27	43.5	-16.23	300	Horz
178.0975	50.54	PK	-27.8	10.5	33.24	43.5	-10.26	200	Horz
241.291	46.86	PK	-27.3	11.8	31.36	46	-14.64	100	Horz
320.3797	44.99	PK	-26.8	13.6	31.79	46	-14.21	100	Horz
837.9456	42.54	PK	-25.2	21.2	38.54	46	-7.46	100	Horz
Range 2 30 - 1000MHz									
Test Frequency	Meter Reading	Detector	25MHz-1Ghz ChmbrB Amp [dB]	T130 Bilog Factors.T XT [dB]	dBuV/m	CFR 47 Part 15 Class B 3m	Margin	Height [cm]	Polarity
33.6831	43.02	PK	-29.2	18.7	32.52	40	-7.48	100	Vert
104.8241	42.81	PK	-28.5	11	25.31	43.5	-18.19	100	Vert
176.3529	49.99	PK	-27.8	10.2	32.39	43.5	-11.11	100	Vert
237.2202	48.24	PK	-27.3	11.9	32.84	46	-13.16	100	Vert
245.5556	48.41	PK	-27.2	11.8	33.01	46	-12.99	100	Vert
307.7798	43.27	PK	-26.8	13.4	29.87	46	-16.13	100	Vert
776.303	47.39	PK	-25.6	20.6	42.39	46	-3.61	100	Vert
Project: 12U14283									
Apple									
Tx On, worst case: b Mode Mid Ch									
Test Engineer: William Zhuang									

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

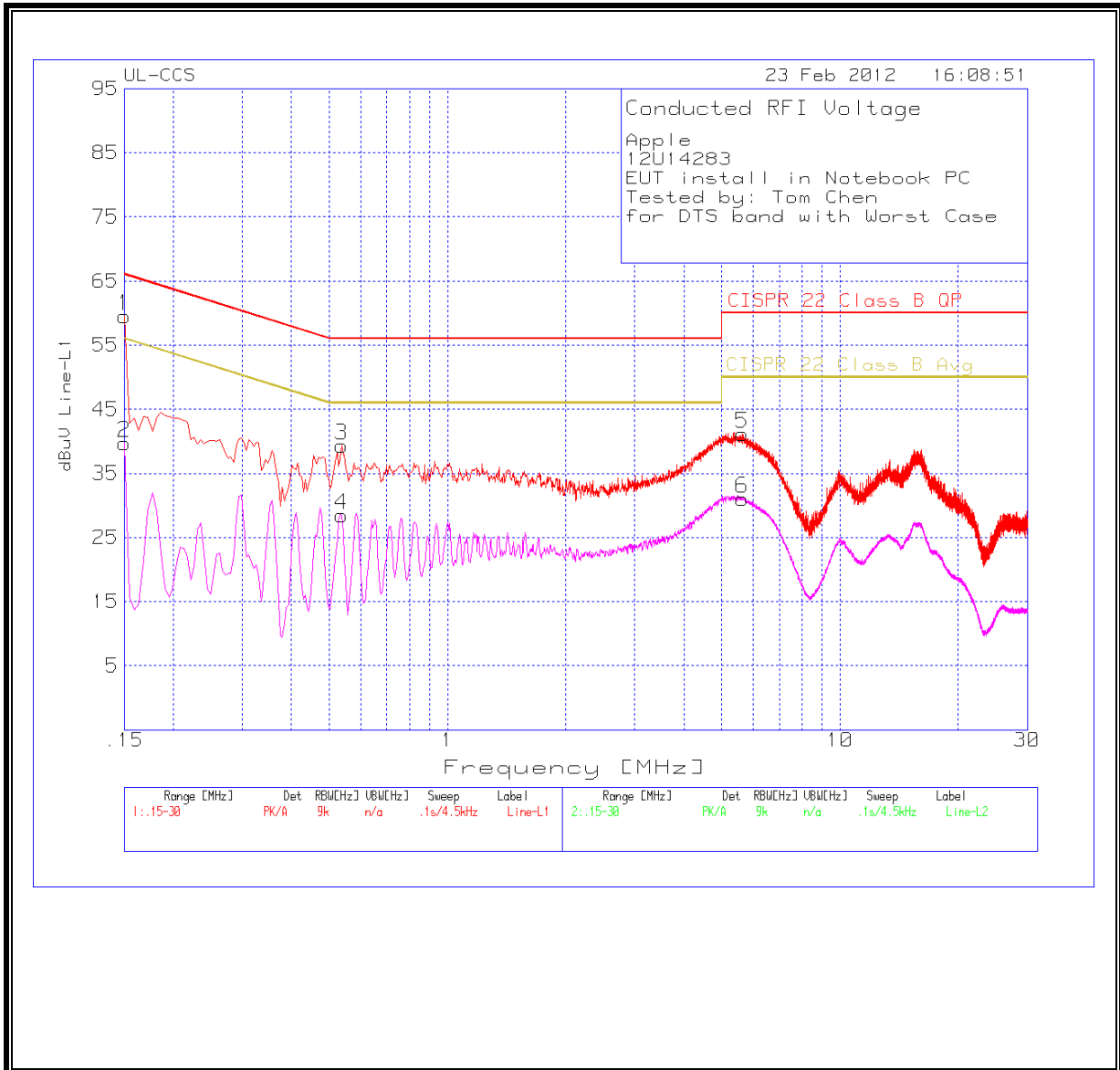
ANSI C63.4

RESULTS

6 WORST EMISSIONS

Apple									
12U14283									
EUT install in Notebook PC									
Tested by: Tom Chen									
for DTS band with Worst Case									
Line-L1 .15 - 30MHz									
Test Frequency	Meter Reading	Detector	T24 IL L1.TXT [dB]	LC Cables 1&3.TXT [dB]	dBuV	CISPR 22 Class B QP	Margin	CISPR 22 Class B Avg	Margin
0.15	59.41	PK	0.1	0	59.51	66	-6.49	-	-
0.15	39.66	Av	0.1	0	39.76	-	-	56	-16.24
0.537	39.28	PK	0.1	0	39.38	56	-16.62	-	-
0.537	28.4	Av	0.1	0	28.5	-	-	46	-17.5
5.6265	40.94	PK	0.1	0.1	41.14	60	-18.86	-	-
5.6265	30.82	Av	0.1	0.1	31.02	-	-	50	-18.98
Line-L2 .15 - 30MHz									
Test Frequency	Meter Reading	Detector	T24 IL L2.TXT [dB]	LC Cables 2&3.TXT [dB]	dBuV	CISPR 22 Class B QP	Margin	CISPR 22 Class B Avg	Margin
0.15	59.32	PK	0.1	0	59.42	66	-6.58	-	-
0.15	30.38	Av	0.1	0	30.48	-	-	56	-25.52
0.249	39.73	PK	0.1	0	39.83	61.8	-21.97	-	-
0.249	31.09	Av	0.1	0	31.19	-	-	51.8	-20.61
5.6625	41.42	PK	0.1	0.1	41.62	60	-18.38	-	-
5.6625	31.01	Av	0.1	0.1	31.21	-	-	50	-18.79
Apple									
12U14283									
EUT install in Notebook PC									
Tested by: Tom Chen									
for DTS band with Worst Case									

LINE 1 RESULTS



LINE 2 RESULTS

