FCC CFR47 PART 15 SUBPART E
CERTIFICATION
TEST REPORT

FOR

BROADCOM 802.11 ag /DRAFT 802.11n
WIRELESS LAN PCI-E MINI CARD

MODEL NUMBER: BCM94321MC

FCC ID: QDS-BRCM1022HR1

REPORT NUMBER: 06U10708-2B

ISSUE DATE: JUNE 29, 2007

Prepared for
BROADCOM CORPORATION
190 MATHILDA PLACE
SUNNYVALE, CA 94086, USA

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

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	06/26/2007	Initial Issue	M. Heckrotte
B	06/29/2007	Editorial changes and clarification	M. Heckrotte

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	BROADCOM CORP. 190 MATHILDA PLACE SUNNYVALE, CA 94086, USA
EUT DESCRIPTION:	BROADCOM 802.11 AG /DRAFT 802.11n WIRELESS LAN PCI-E MINI CARD
MODEL:	BCM94321MC
SERIAL NUMBER:	6F632058LWQXE; 6F634002HWQXE
DATE TESTED:	DECEMBER 21, 2006 TO JANUARY 18, 2007

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC PART 15 SUBPART E	NO NON-COMPLIANCE NOTED

Compliance Certification Services, Inc. tested the above equipment in accordance with the requirements set forth in the above standards. 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 Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services 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:

MICHAEL HECKROTTE
ENGINEERING MANAGER
COMPLIANCE CERTIFICATION SERVICES

Tested By:

VIEN TRAN
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 and FCC CFR 47 Part 15.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 561F Monterey Road, Morgan Hill, California, USA and 47173 Benicia Street, Fremont, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

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
Radiated Emission, 30 to 200 MHz	+/- 3.3 dB
Radiated Emission, 200 to 1000 MHz	+4.5 / -2.9 dB
Radiated Emission, 1000 to 2000 MHz	+4.5 / -2.9 dB
Power Line Conducted Emission	+/- 2.9 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 MIMO transceiver chipset. The chipset is installed on a Mini PCI–E card, model number BCM94321MC.

The radio module is manufactured by Broadcom Corp.

5.2. TEST RESULT CONCLUSIONS

The worst-case data rates in each mode is based on the investigations by measuring the PSD, peak power, average power on conducted emissions, bandedge and 2nd harmonic (5GHz only) on radiated emissions across all the data rates, bandwidths, modulations and spatial stream modes.

For the Legacy Mode, the worst case is 1Mb/s @ 11b mode & 6Mb/s @ 11g mode.
For MCS Index and MIMO operation modes covered under this evaluation it was determined that MCS Index 0 is worst case for all testing performed at 20MHz (including Band-edge, Emissions testing, PSD).
MCS Index 32 is worst case for 40MHz mode.
Both MCS 0 and MCS 32 were set to CDD mode.

Based on the preliminary test results, the following modes were tested:

5.2 GHz UNII BAND

1/ SISO MODE:
_802.11a LEGACY MODE
_802.11n 20 MHz SISO MODE (covered by the worst case Legacy testing)
_802.11n 40 MHz SISO MODE

2/ MIMO MODE:
_802.11a CDD (covered by 20 MHz CDD MCS 0)
_802.11n 20 MHz CDD MCS 0
_802.11n 40 MHz CDD MCS 32
_802.11n 40 MHz SDM MCS 15

Comparative test results for Output Power and PPSD in the MIMO modes demonstrated close correlation (on the order of +/- 0.1 to 0.4 dB) between the mathematical addition of Chain 0 and Chain 1 (using linear units), as compared to measurements made using an RF combiner. Therefore all results presented in this report for the above parameters are Chain 0, Chain 1, and the mathematical sum of Chain 0 + Chain 1.

Comparative test results for Conducted Spurious in the MIMO modes demonstrated close correlation (on the order of +/- 1 dB) between individual chain and measurements made using an RF combiner. Therefore all results presented in this report for the above parameter is Chain 0 and Chain 1.

5.3. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

5.2 GHz BAND

LEGACY MODE

802.11a LEGACY MODE

5150 to 5250 MHz Authorized Band

Frequency Range (MHz)	Mode	Peak Power (dBm)	Output (mW)
5150 - 5250	11a Legacy	14.18	26.18

5250 to 5350 MHz Authorized Band

Frequency Range (MHz)	Mode	Peak Power (dBm)	Output (mW)
5250 - 5350	11a Legacy	17.68	58.61

802.11n 20 MHz SISO MODE is covered by the worst case Legacy testing

802.11n 40 MHz SISO MODE

5150 to 5250 MHz Authorized Band

Frequency Range (MHz)	Mode	Peak Power (dBm)	Output (mW)
5150 - 5250	11n 40 MHz SISO	16.67	46.45

5250 to 5350 MHz Authorized Band

Frequency Range (MHz)	Mode	Peak Chain 0 (dBm)	Output (mW)
5250 - 5350	11n 40 MHz SISO	18.19	65.92

MIMO MODE

802.11a CDD MODE is covered by worst case 802.11n 20 MHz CDD

802.11n 20 MHz CDD

Frequency Range (MHz)	Mode	Peak Chain 0 (dBm)	Peak Chain 1 (dBm)	Total Peak Power (dBm)	Output (mW)
5180 - 5240	802.11n 20 MHz CDD	10.34	10.29	13.33	21.50
5260 - 5320	802.11n 20 MHz CDD	16.22	16.34	19.29	84.93

802.11n 40 MHz CDD

Frequency Range (MHz)	Mode	Peak Chain 0 (dBm)	Peak Chain 1 (dBm)	Total Peak Power (dBm)	Output (mW)
5190 - 5230	802.11n 40 MHz CDD	12.37	12.36	15.38	34.48
5270 - 5310	802.11n 40 MHz CDD	17.13	17.22	20.19	104.36

802.11n 40 MHz SDM

Frequency Range (MHz)	Mode	Peak Chain 0 (dBm)	Peak Chain 1 (dBm)	Total Peak Power (dBm)	Output (mW)
5190	802.11n 40 MHz SDM	13.57	13.67	16.63	46.03

5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The EUT has 2 Tx/Rx antennas that are automatically selected for use as per the MCS index and STF mode selections. The EUT was tested with Monopole (Main) and PIFA (Aux) antennas as described below:

Band	Ant Main	Ant Aux	10^(Ant Main /10)	10^(Ant Aux/10)	10^(ant main/10)+10^(ant aux/10)	10*log[10^(ant main/10)+10^(ant aux/10)] (dBm)
2.4GHz	1.70	3.90	1.479	2.455	3.934	5.948
5.15GHz	2.90	3.90	1.950	2.455	4.405	6.439
5.35GHz	3.50	5.60	2.239	3.631	5.870	7.686
5.8GHz	4.20	5.80	2.630	3.802	6.432	8.084

5.5. SOFTWARE AND FIRMWARE

The EUT was tested in the following manner:
- "epi_ttcp.exe" was used to transmit UDP packets to a broadcast IP address (192.168.66.255) – i.e. no ACK required. This test mode sends a continuous packetized data stream with duty cycles that vary dependant upon data rate/MCS Index selected.
- "wl ampdu" and "frameburst" were enabled to ensure worst case data packet transfer and duty cycle.
- Worst case packet length have also been used to ensure max duty cycle

5.6. CONFIGURATION AND MODE

Operating modes were changed directly in software with no other changes to the set up. Power levels were verified across all the MCS Index at the start of test and as required throughout testing.

Prior to each test a power meter was used to tune the gated average power within a Tx packet. The channel gates on the meter were set to ensure that, at the time of recording, only packet power was captured without including duty cycle off time.

Power was tuned for different modes, channels and antennas based on the power tuning table contained in the Operational Description submitted under the same filing.

5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop PC	Dell	Inspiron 0000	CN-901014-70166-57K-01JT	DOC
AC Adapter	Dell	PA-1600-06D1	F9710	DOC

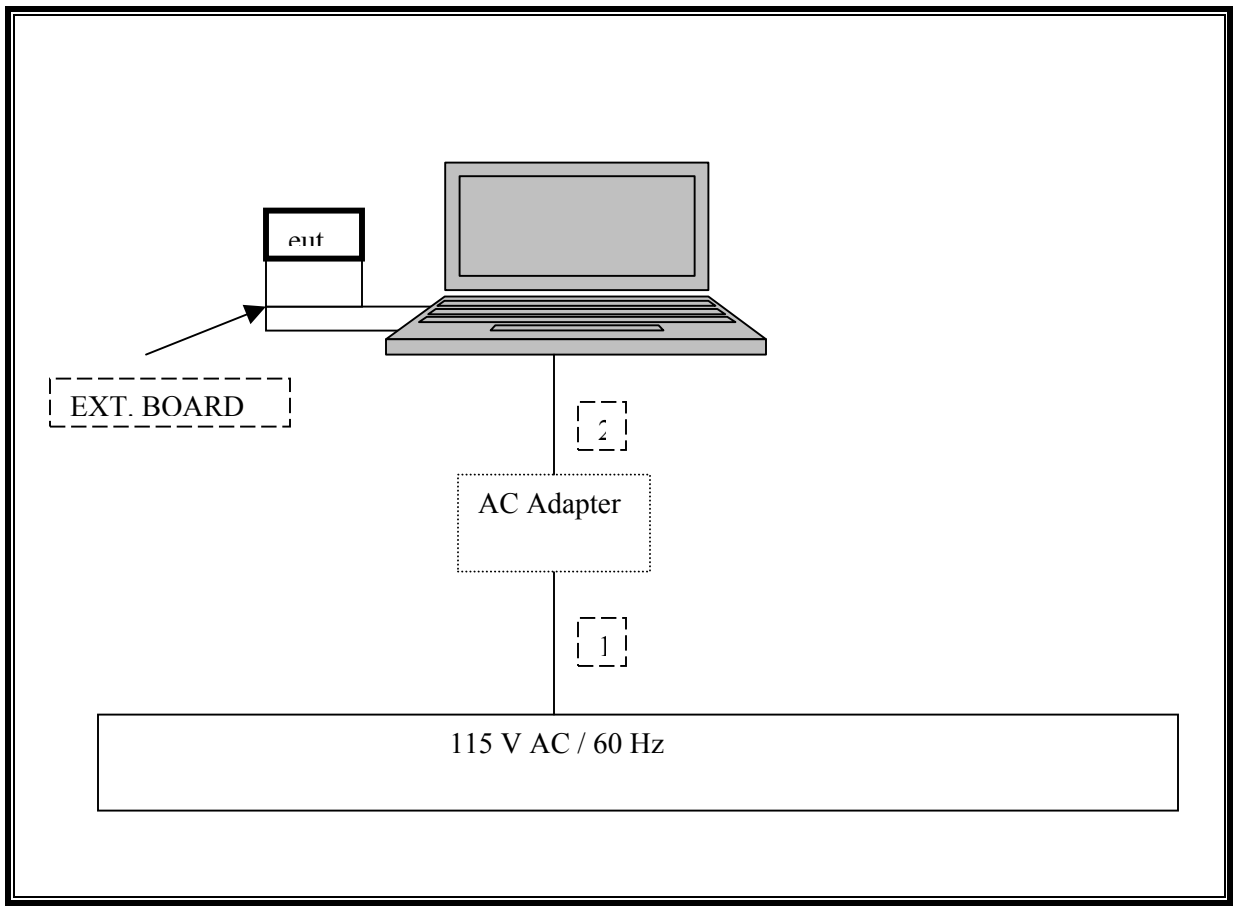
I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	AC	1	AC	Unshielded	1.2 m	N/A
2	DC	1	DC	Unshielded	1.2 m	N/A

TEST SETUP

The EUT is installed in a host laptop computer via Expresscard to MiniPCI-E adapter boards during the tests. Test software exercised the radio card.

SETUP DIAGRAM



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**	**Serial Number**	**Cal Due**
Spectrum Analyzer 3 Hz ~ 44 GHz	Agilent / HP	E4446A	US42510266	10/19/2007
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	2238	4/15/2008
Antenna, Horn 26 ~ 40 GHz	ARA	MWH-2640/B	1029	4/11/2008
Preamplifier, 1 ~ 26.5 GHz	Agilent / HP	8449B	3008A00561	10/3/2007
Preamplifier, 26 ~ 40 GHz	Miteq	NSP4000-SP2	924343	8/18/2007
LISN, 10 kHz ~ 30 MHz	FCC	LISN-50/250-25-2	2023	8/30/2007
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-BNC	8379443	8/30/2007
EMI Test Receiver	R & S	ESHS 20	827129/006	11/3/2007
AC Power Source, 10 kVA	ACS	AFC-10K-AFC-2	J1568	CNR
EMI Receiver, 9 kHz ~ 2.9 GHz	Agilent / HP	8542E	3942A00286	6/12/2008
RF Filter Section	Agilent / HP	85420E	3705A00256	6/12/2008
Antenna, Bilog 30 MHz ~ 2 Ghz	Sunol Sciences	JB1	A121003	8/13/2007
4.6 - 5.8 GHz Combiner	Mini-Circuits	ZB4PD1-5.8	SN649900514	N/A
Peak Power Meter	Agilent / HP	E4416A	GB41291160	12/2/2007
Antenna, Horn 18 ~ 26 GHz	ARA	SWH-28	1007	8/6/2007
7.6 GHz High Pass Filter	Micro Tronics	HPM13350	1	N/A
5.75 - 5.8 Reject Filter	Micro Tronics	BRC13192	2	N/A

7. LIMITS AND RESULT

7.1. CHANNEL TESTS FOR THE 5150 TO 5350 MHz BAND

LEGACY MODE

7.1.1. EMISSION BANDWIDTH

LIMIT

§15.403 (i) Emission bandwidth. For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolutions bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1% to 3% of the 26 dB bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled.

RESULTS

No non-compliance noted:

802.11a LEGACY MODE

Channel	Frequency (MHz)	B (MHz)	10 Log B (dB)
Low	5180	19.36	12.87
Middle	5260	33.76	15.28
High	5320	21.47	13.32

802.11n 20 MHz SISO MODE is covered by the worst case Legacy testing

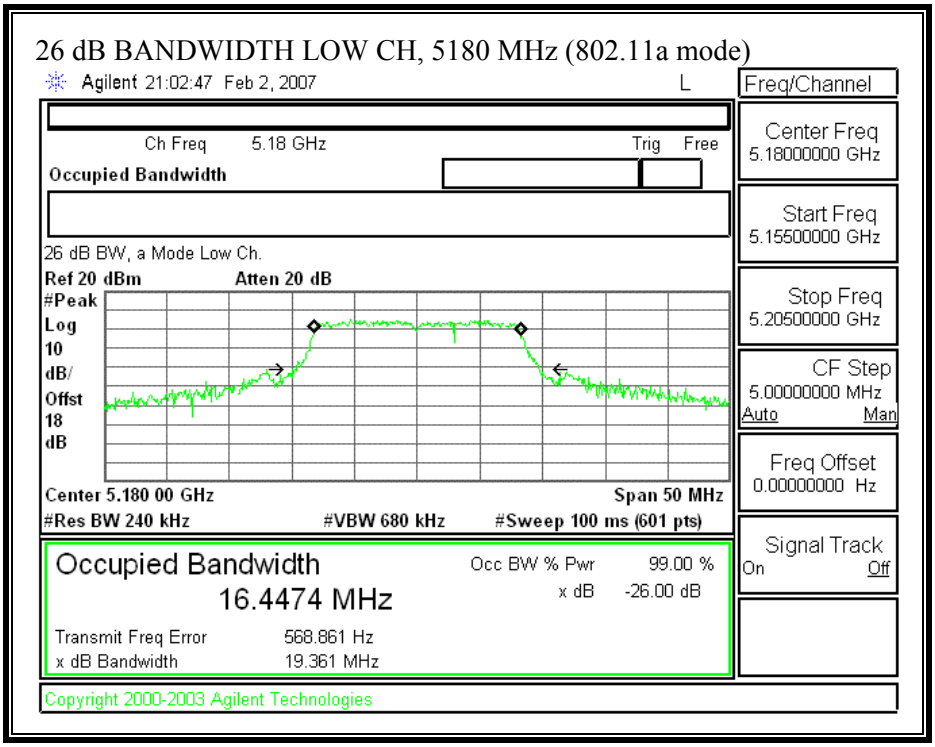
802.11n 40 MHz SISO MODE

802.11a Mode

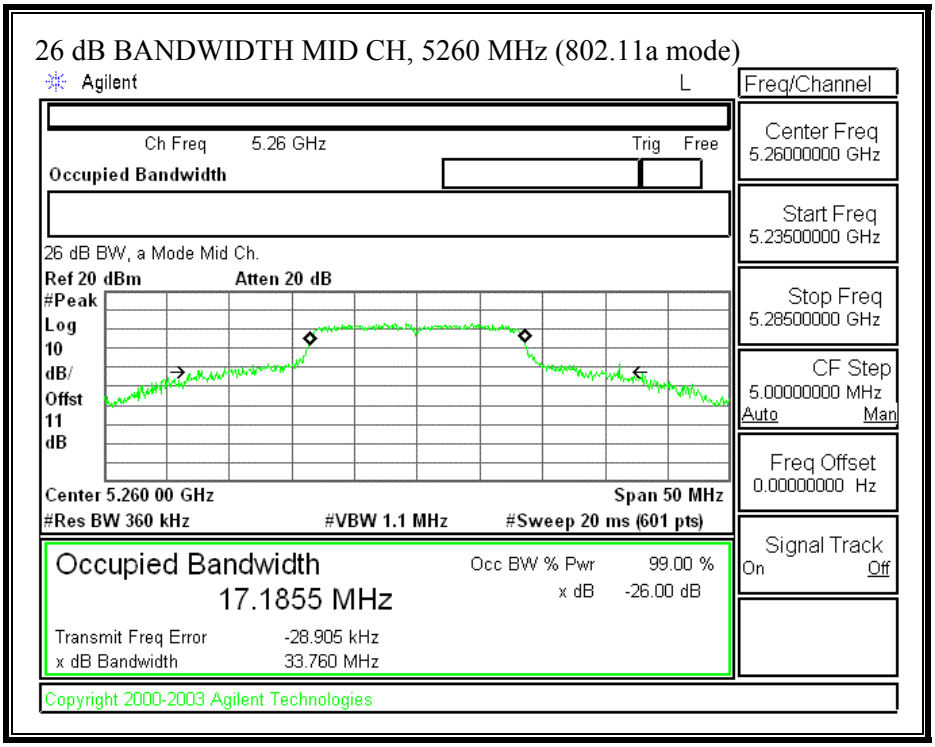
Channel	Frequency (MHz)	B (MHz)	10 Log B (dB)
Low	5190	44.43	16.48
Middle	5270	73.53	18.66
High	5310	42.07	16.24

802.11a MODE

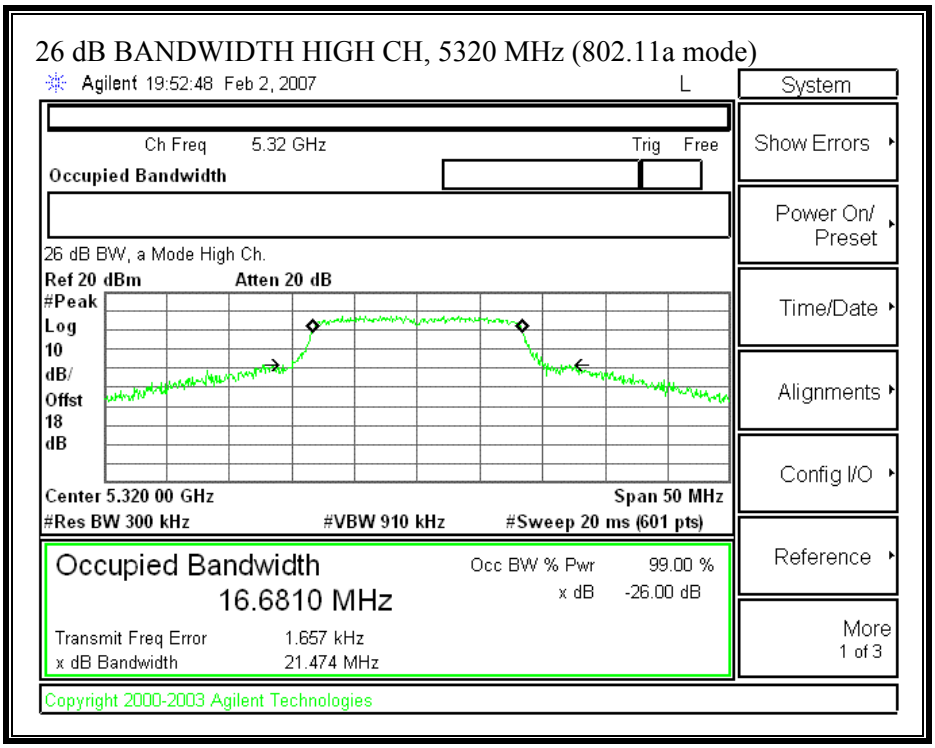
26 dB EMISSION BANDWIDTH (802.11a MODE)



26 dB BANDWIDTH MID CH, 5260 MHz (802.11a mode)

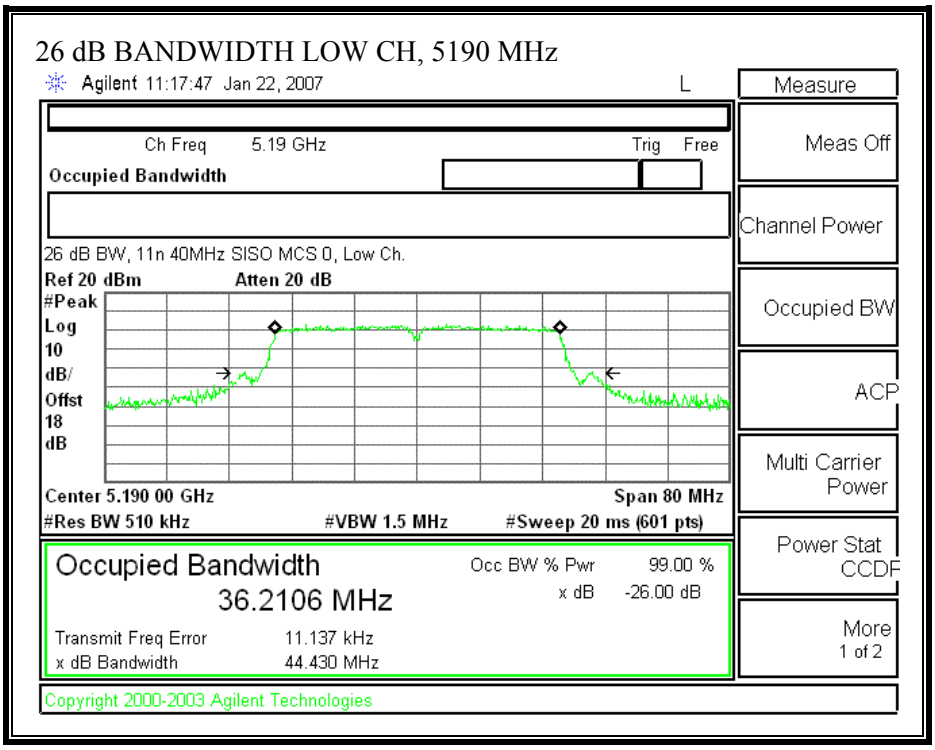


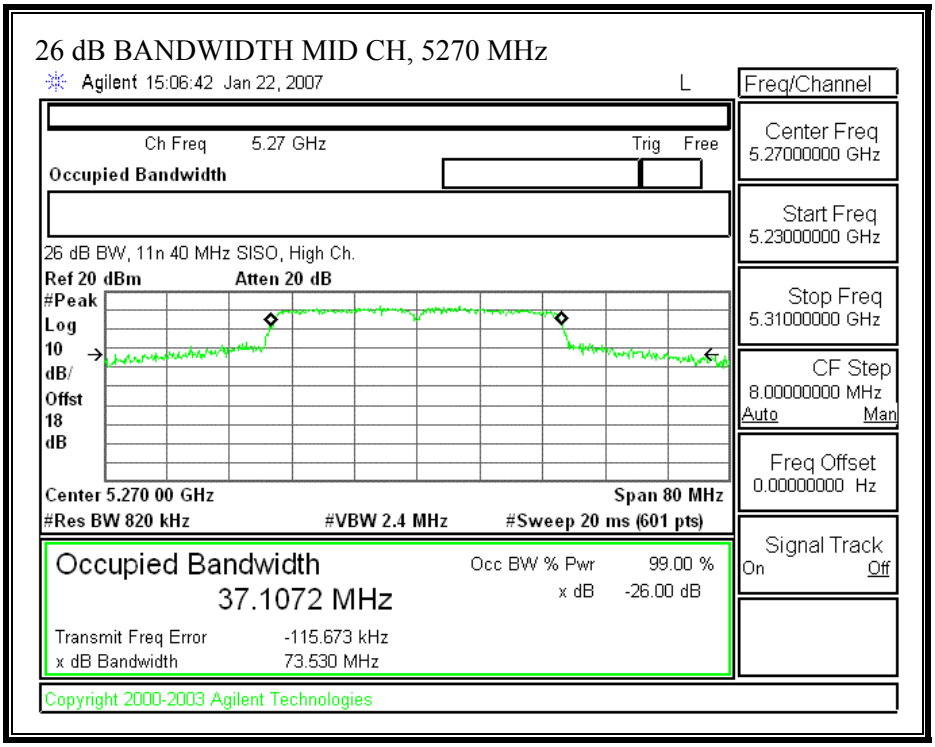
26 dB BANDWIDTH HIGH CH, 5320 MHz (802.11a mode)



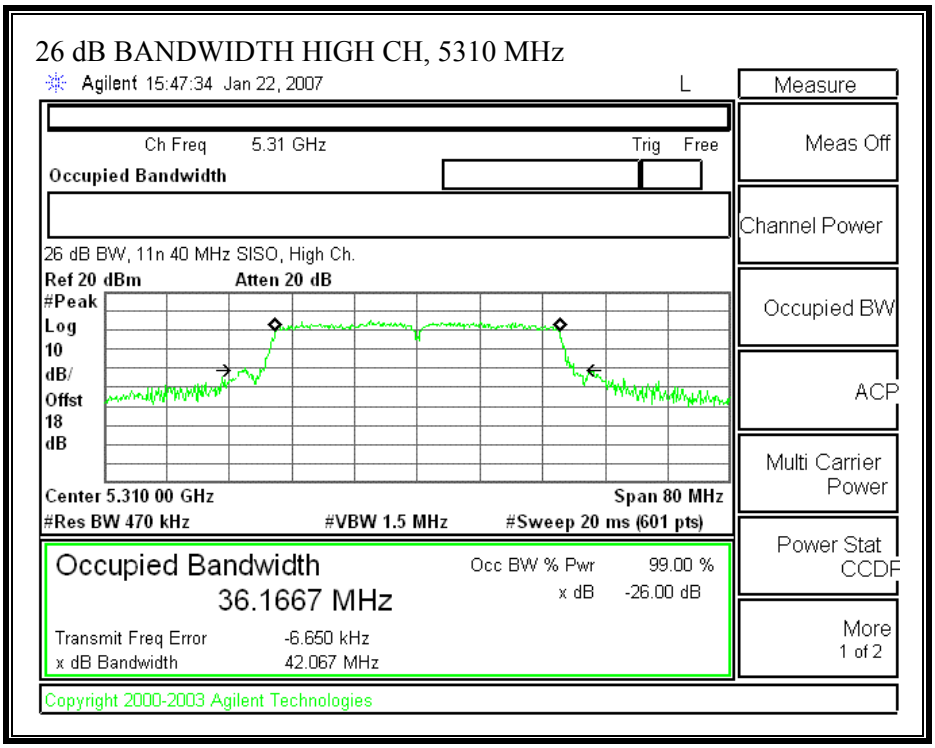
11n 40 MHz SISO MODE

26 dB EMISSION BANDWIDTH (802.11n 40MHz SISO MODE)





26 dB BANDWIDTH HIGH CH, 5310 MHz



7.1.2. PEAK POWER

LIMIT

§15.407 (a) (1) For the band 5.15-5.25 GHz, the peak transmit power over the frequency band of operation shall not exceed the lesser of 50 mW or 4 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.

§15.407 (a) (1) For the band 5.25-5.35 GHz, the peak transmit 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.

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.

5.15 – 5.25GHz band: 3.90dBi
5.25 – 5.35GHz band: 5.60dBi

LIMITS AND RESULTS

No non-compliance noted:

802.11a MODE

Limit in 5150 to 5250 MHz Band

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5180	17	19.36	16.869	3.900	16.87

Limit in 5250 to 5350 MHz Band

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Mid	5260	24	33.76	26.284	5.600	24.00
High	5300	24	33.82	26.292	5.600	24.00
High	5320	24	21.47	24.319	5.600	24.00

Results

Channel	Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	14.18	16.87	-2.69
Mid	5260	17.68	24.00	-6.32
High	5300	17.61	24.00	-6.39
High	5320	15.86	24.00	-8.14

802.11n 20 MHz SISO MODE is covered by the worst case Legacy testing

802.11n 40 MHz SISO MODE

No non-compliance noted:

Limit in 5150 to 5250 MHz Band

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5190	17	44.430	20.477	3.900	17.00
Low	5230	17	64.073	22.067	3.900	17.00

Limit in 5250 to 5350 MHz Band

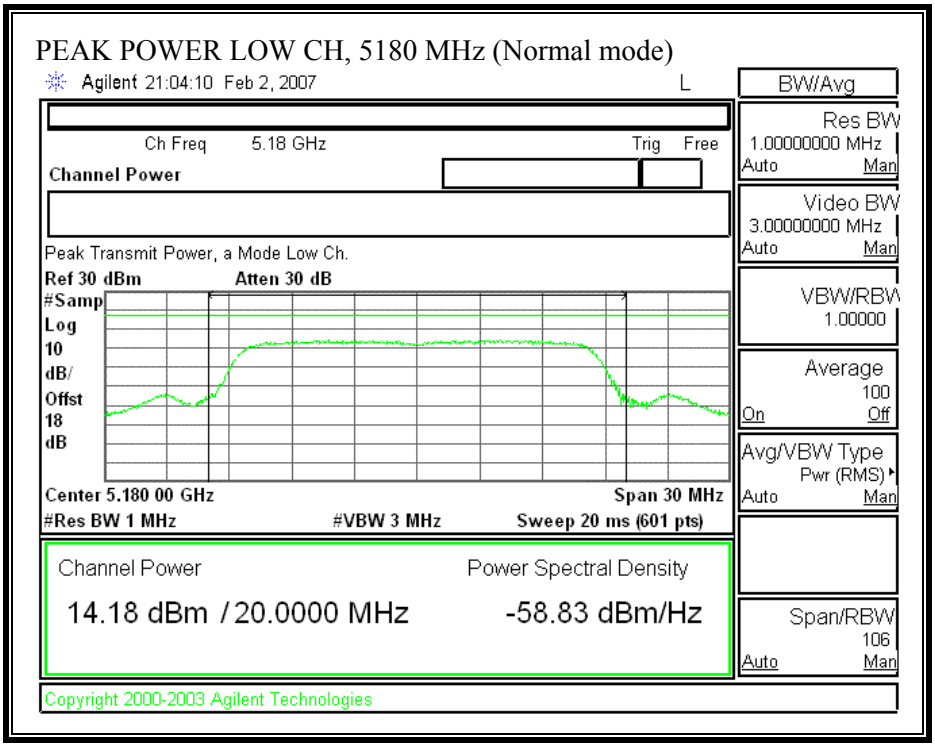
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	11 + 10 Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Mid	5270	24	73.53	29.665	5.600	24.00
High	5310	24	42.067	27.239	5.600	24.00

Results

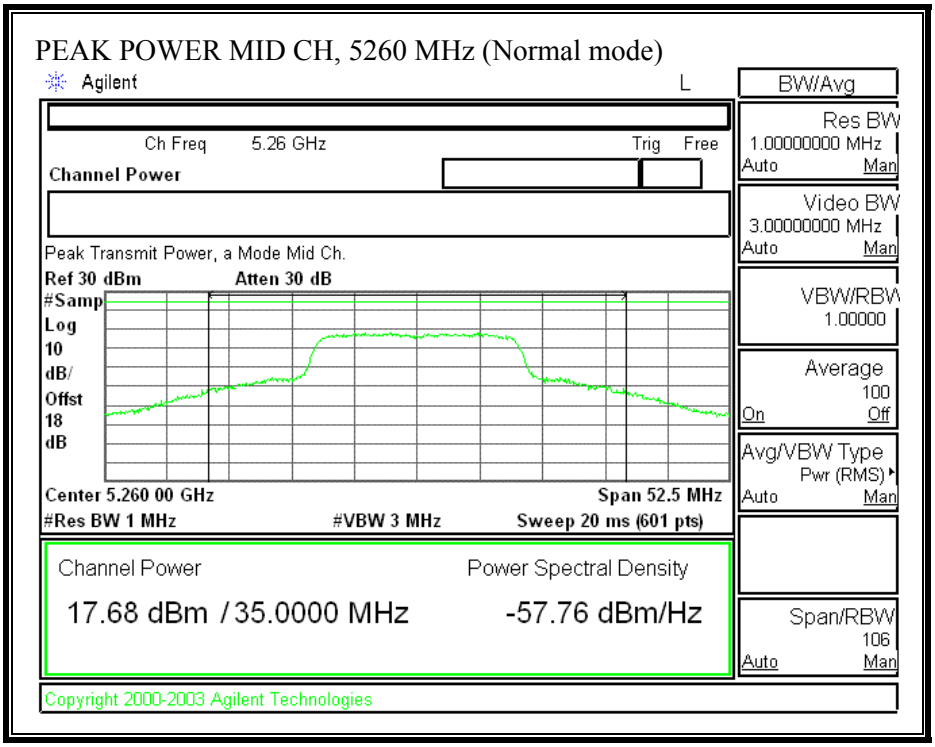
Channel	Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
Low	5190	13.24	17.00	-3.76
Low	5230	16.67	17.00	-0.33
Mid	5270	18.19	24.00	-5.81
High	5310	14.36	24.00	-9.64

802.11a MODE

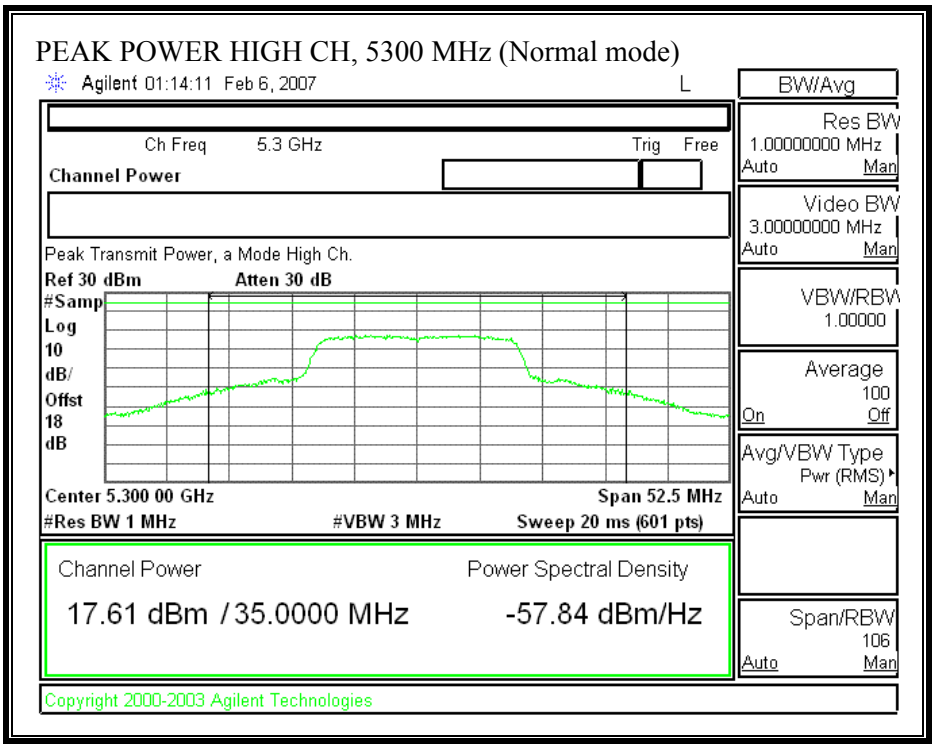
PEAK POWER (NORMAL MODE)



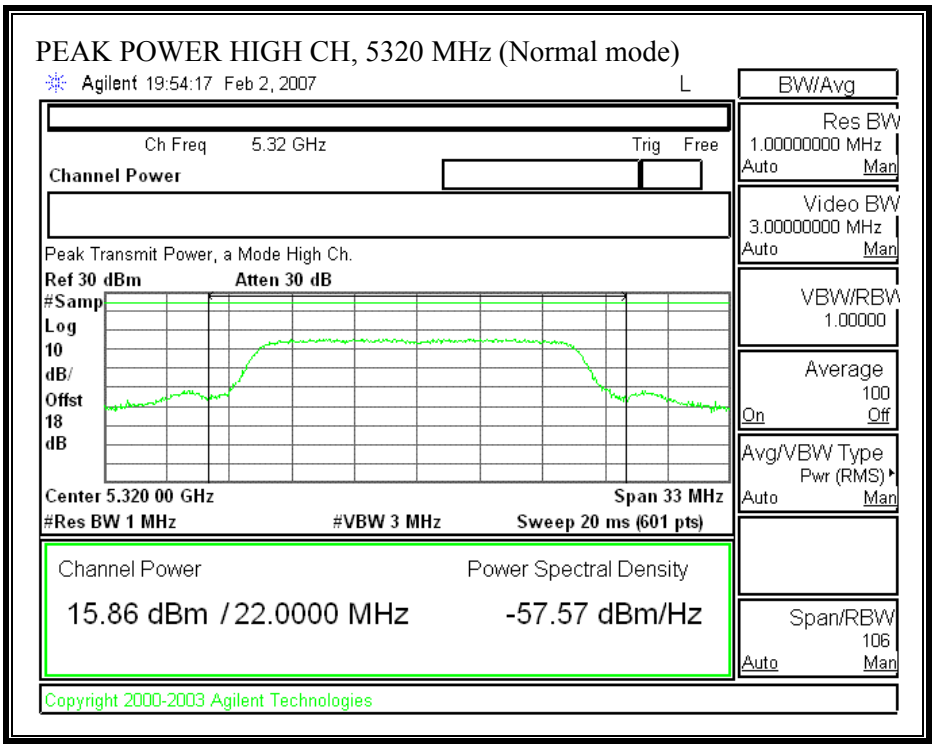
PEAK POWER MID CH, 5260 MHz (Normal mode)



PEAK POWER HIGH CH, 5300 MHz (Normal mode)

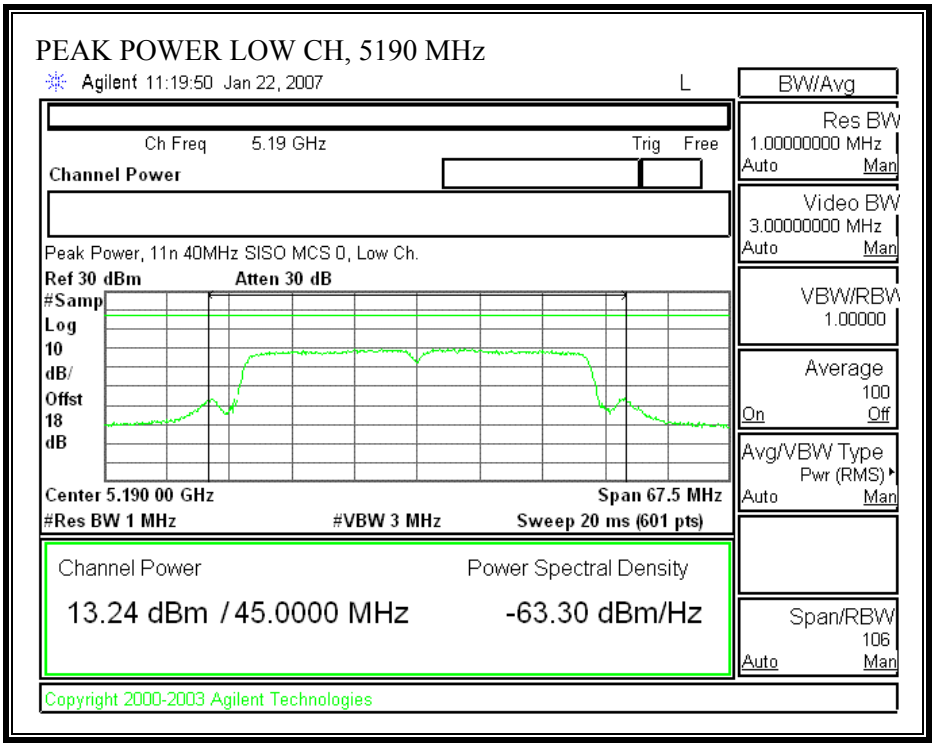


PEAK POWER HIGH CH, 5320 MHz (Normal mode)

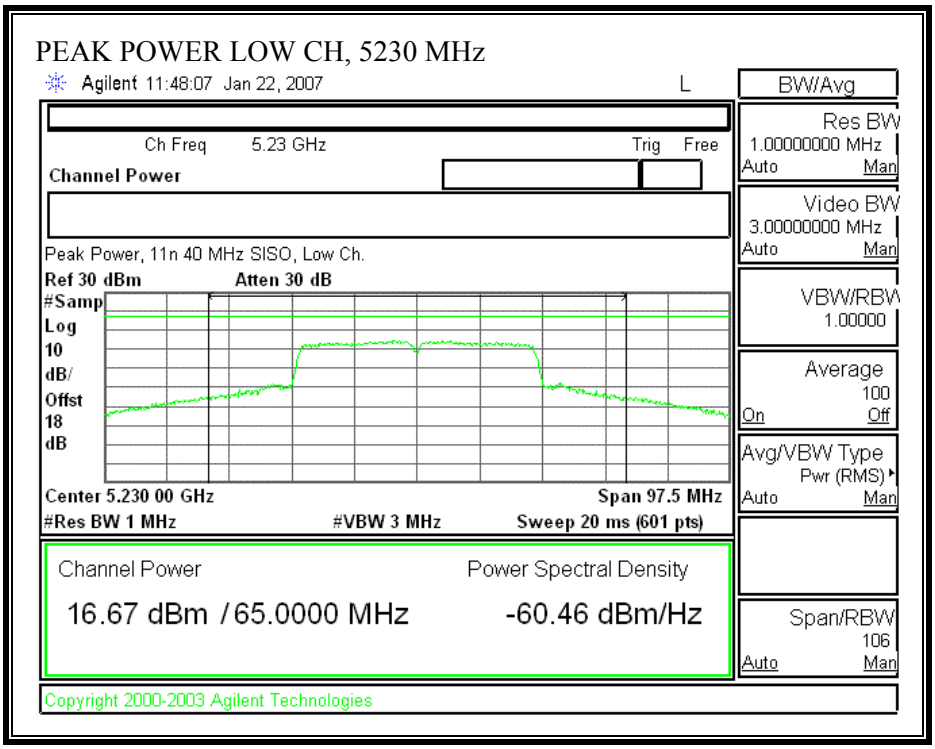


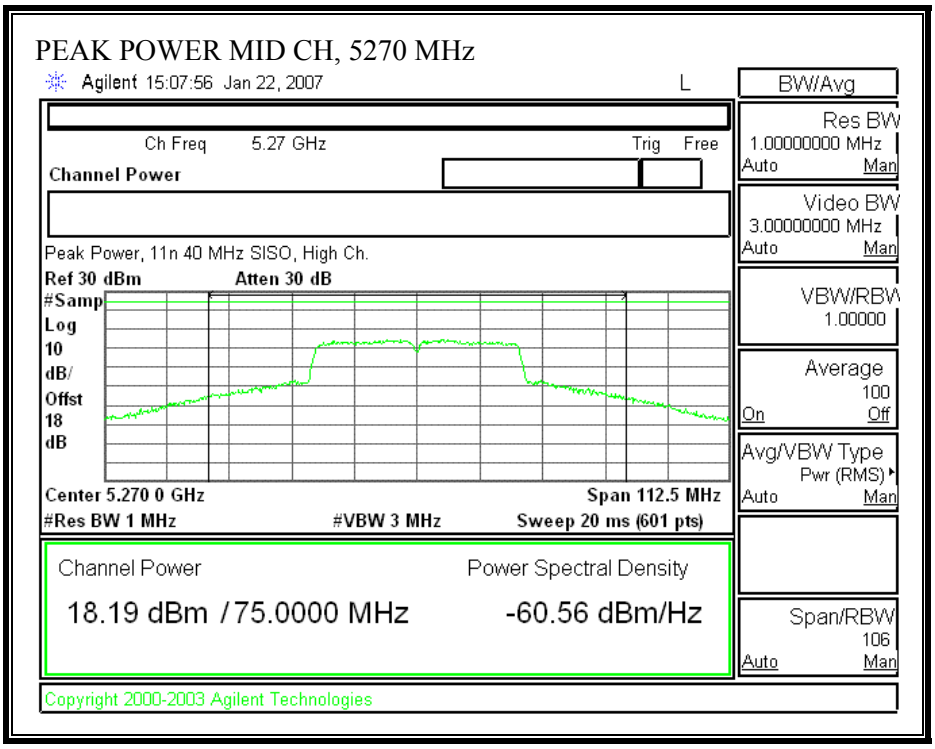
802.11n 40 MHz SISO MODE

PEAK POWER (11n 40MHz SISO MODE)

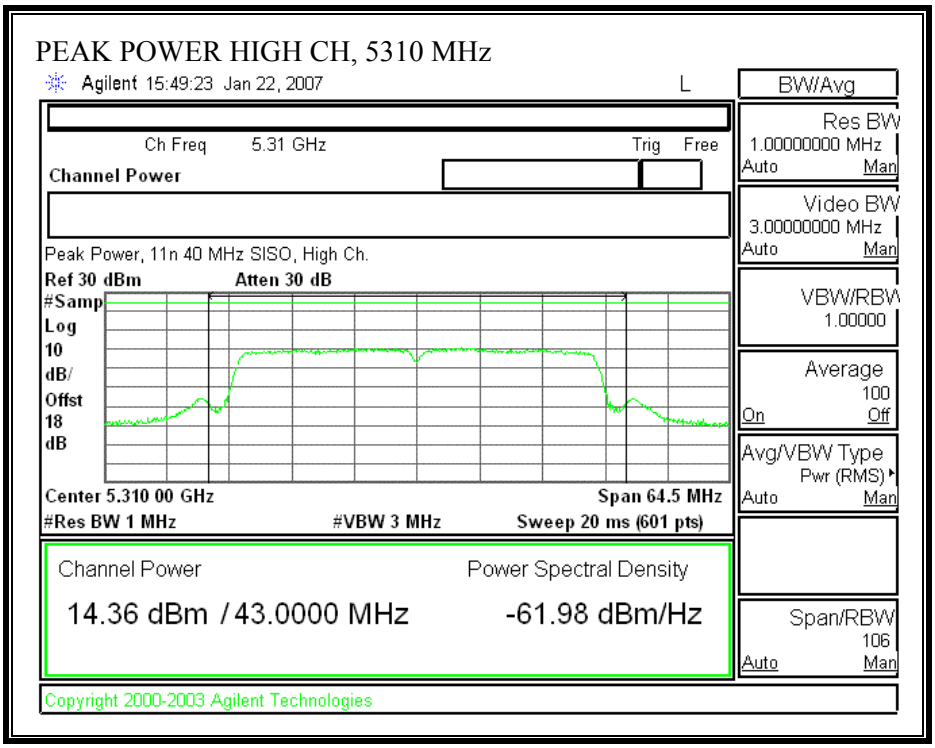


PEAK POWER LOW CH, 5230 MHz





PEAK POWER HIGH CH, 5310 MHz



7.1.3. MAXIMUM PERMISSIBLE EXPOSURE

LIMITS

§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^2)	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^2)	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^2)	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^2)	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.

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 and rearranging the terms to express the distance as a function of the remaining variables yields:

$d = \sqrt{((30 * P * G) / (3770 * S))}$

Changing to units of Power to mW and Distance to cm, using:

P (mW) = P (W) / 1000 and
d (cm) =100 * d (m)

yields

$d = 100 * \sqrt{((30 * (P / 1000) * G) / (3770 * S))}$
$d = 0.282 * \sqrt{(P * G / S)}$

where

d = distance in cm
P = Power in mW
G = Numeric antenna gain
S = Power Density in mW/cm^2

Substituting the logarithmic form of power and gain using:

P (mW) = 10 ^ (P (dBm) / 10) and
G (numeric) = 10 ^ (G (dBi) / 10)

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^2

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

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

LIMITS

From §1.1310 Table 1 (B), S = 1.0 mW/cm^2 in the 5.2 / 5.3 GHz band.

RESULTS

No non-compliance noted

802.11a LEGACY MODE

Mode	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
802.11a	20.0	17.68	5.60	0.04

802.11n 20 MHz SISO MODE is covered by the worst case Legacy testing

802.11n 40 MHz SISO MODE

Mode	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
802.11n 40 MHz SISO	20.0	18.19	5.60	0.05

NOTE: For mobile or fixed location transmitters, the minimum separation distance is 20 cm, even if calculations indicate that the MPE distance would be less.

7.1.4. PEAK POWER SPECTRAL DENSITY

LIMIT

§15.407 (a) (1) For the band 5.15-5.25 GHz, 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 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.

§15.407 (a) (1) For the band 5.25-5.35 GHz, the peak power spectral density shall not exceed 11 dBm in any 1-MHz band. 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.

The maximum antenna gain < 6 dBi, therefore there is no reduction due to antenna gain.

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. PPSD method #2 was used.

RESULTS

No non-compliance noted:

802.11a MODE

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5180	3.81	4.000	-0.19
Middle	5260	7.73	11.000	-3.27
High	5300	7.50	11.000	-3.50
High	5320	5.23	11.000	-5.77

802.11n 20 MHz SISO MODE is covered by the worst case Legacy testing

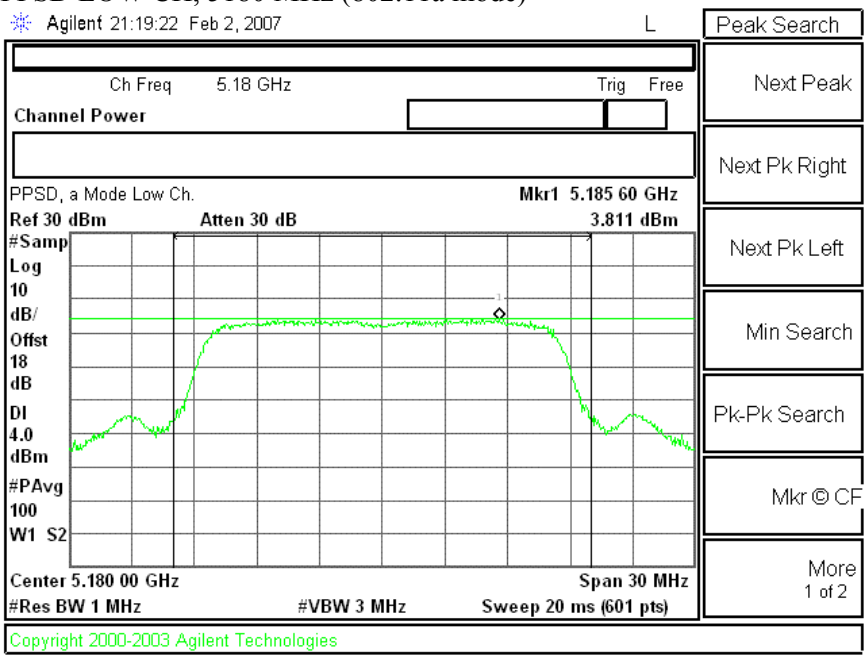
802.11n 40 MHz SISO MODE

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	5190	-0.59	4.00	-4.59
Middle	5230	3.89	4.00	-0.11
High	5270	4.90	11.00	-6.10
High	5310	0.61	11.00	-10.39

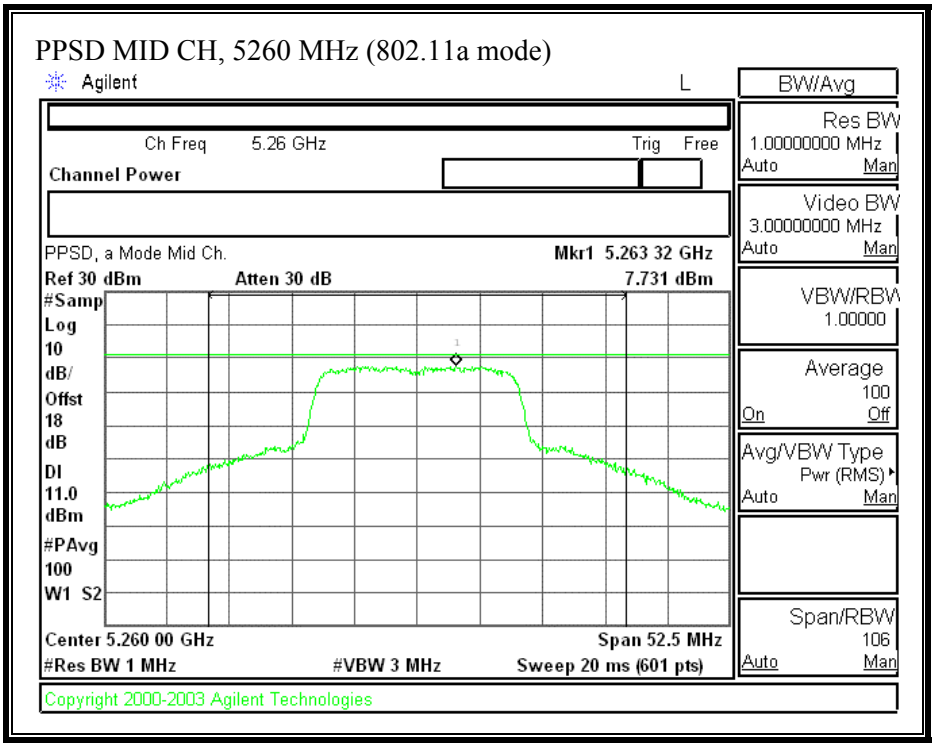
802.11a LEGACY MODE

PEAK POWER SPECTRAL DENSITY (802.11a MODE)

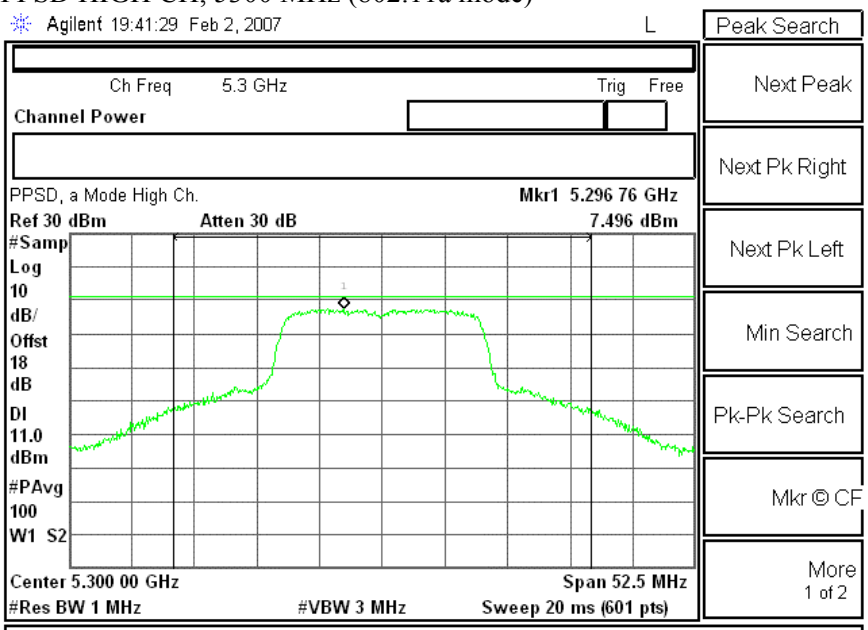
PPSD LOW CH, 5180 MHz (802.11a mode)



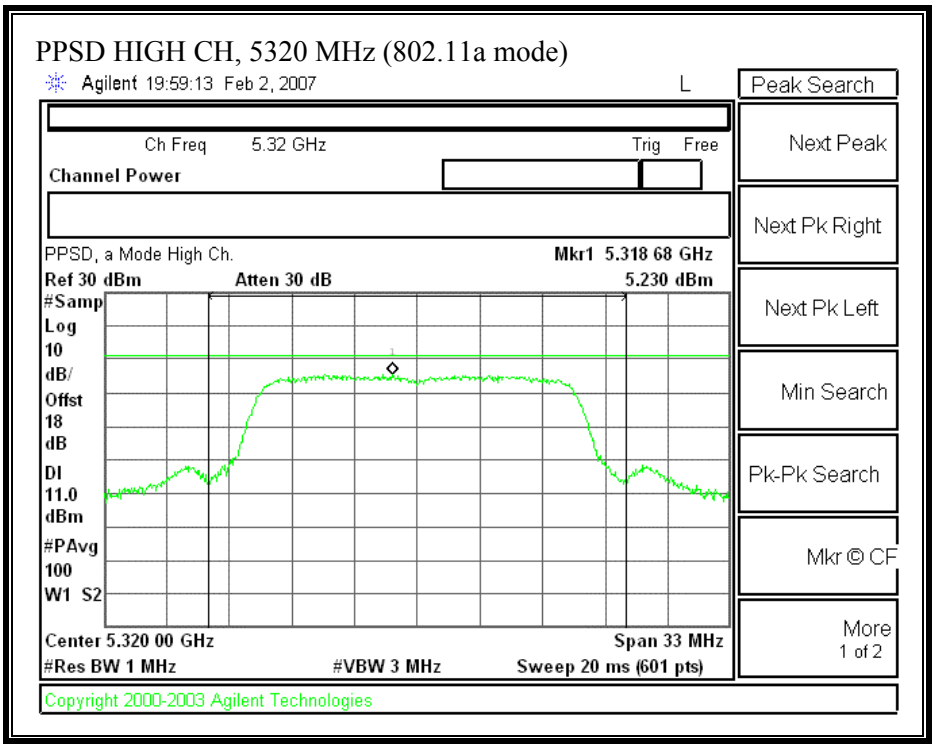
PPSD MID CH, 5260 MHz (802.11a mode)



PPSD HIGH CH, 5300 MHz (802.11a mode)

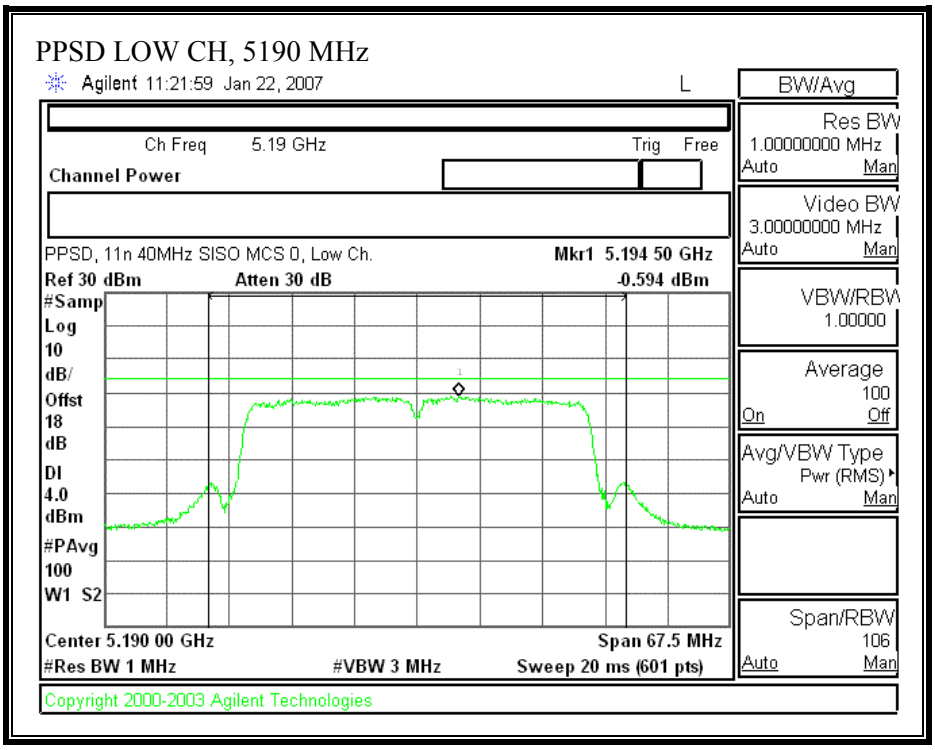


PPSD HIGH CH, 5320 MHz (802.11a mode)

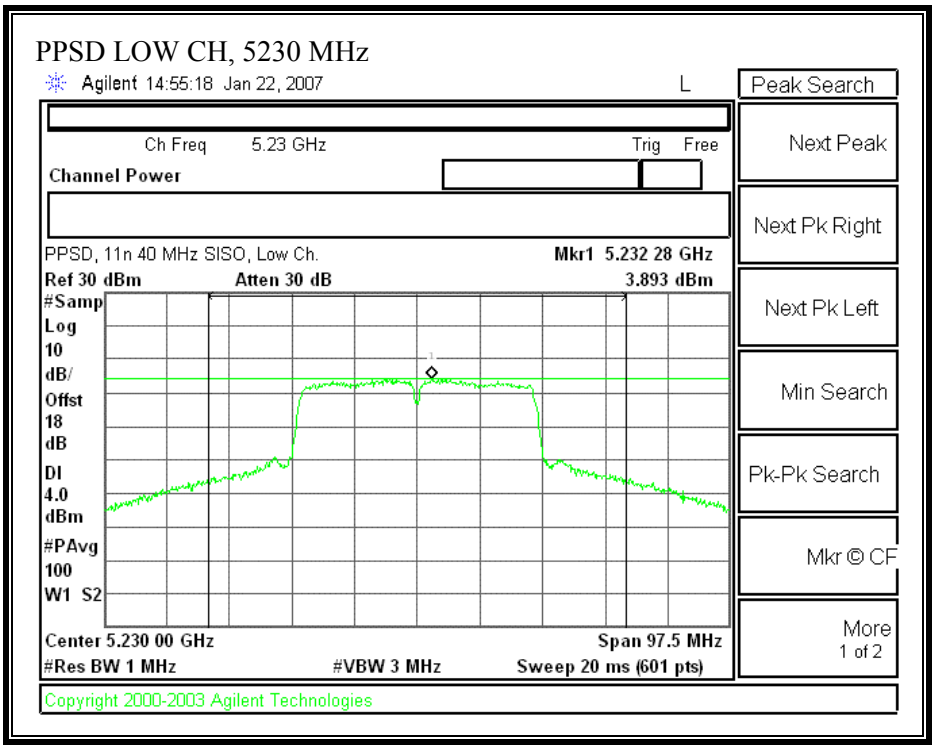


802.11n 40 MHz SISO MODE

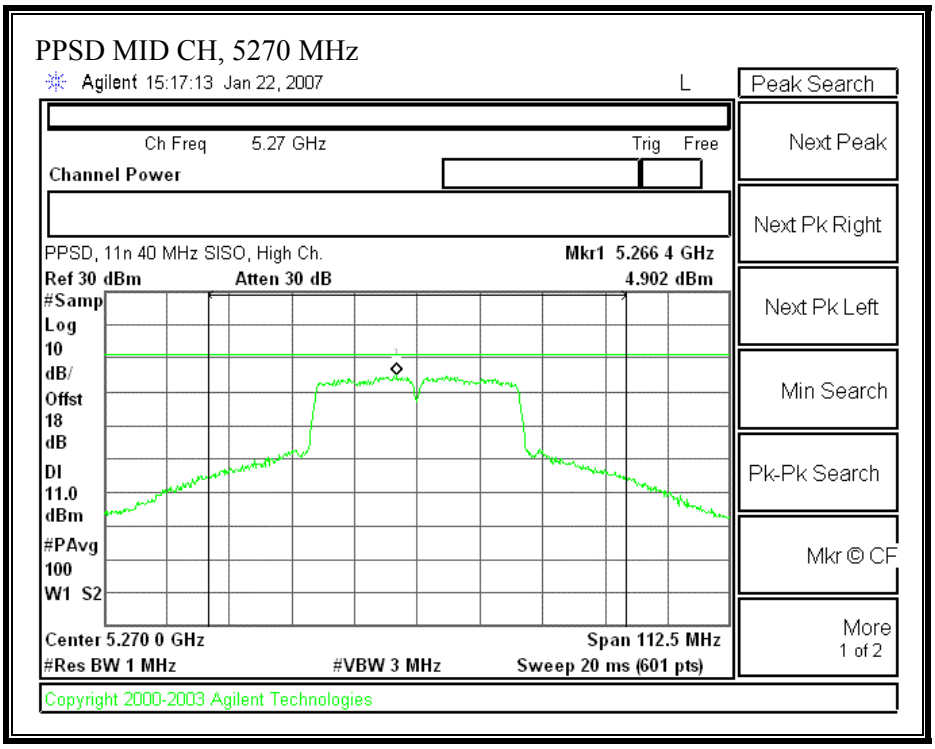
PEAK POWER SPECTRAL DENSITY (802.11n 40MHz SISO MODE)



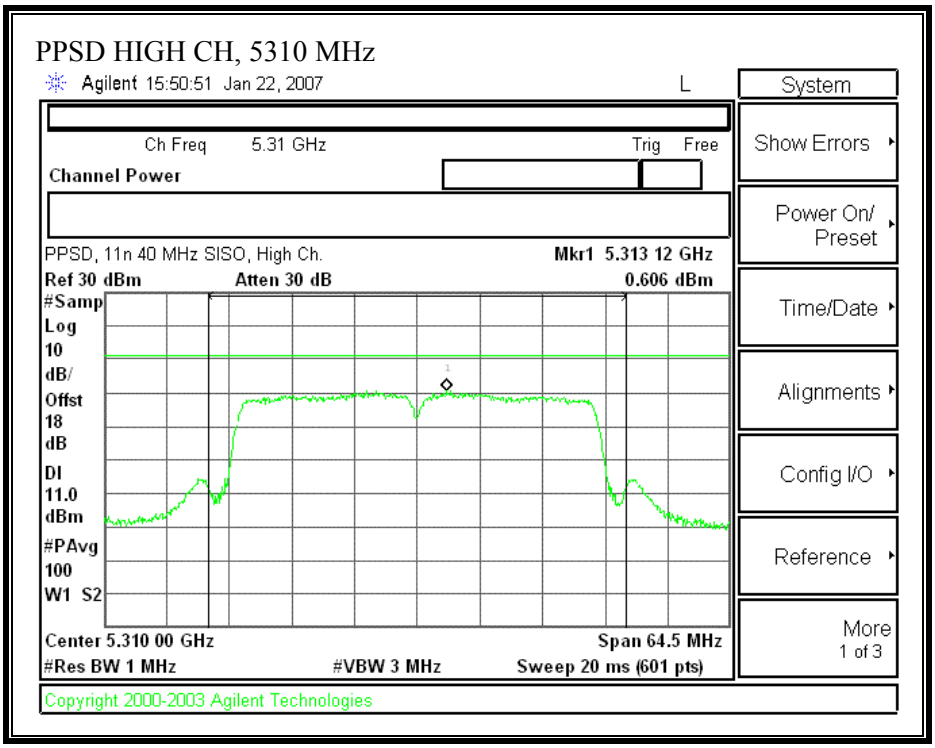
PPSD LOW CH, 5230 MHz



PPSD MID CH, 5270 MHz



PPSD HIGH CH, 5310 MHz



7.1.5. PEAK EXCURSION

LIMIT

§15.407 (a) (6) The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

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.

Since Method # 1 was used for peak power measurements, Method # 1 settings are used for the second PPSD trace.

RESULTS

No non-compliance noted:

802.11a MODE

Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5180	7.76	13	-5.24
Middle	5260	9.21	13	-3.79
High	5300	11.25	13	-1.75
High	5320	8.05	13	-4.95

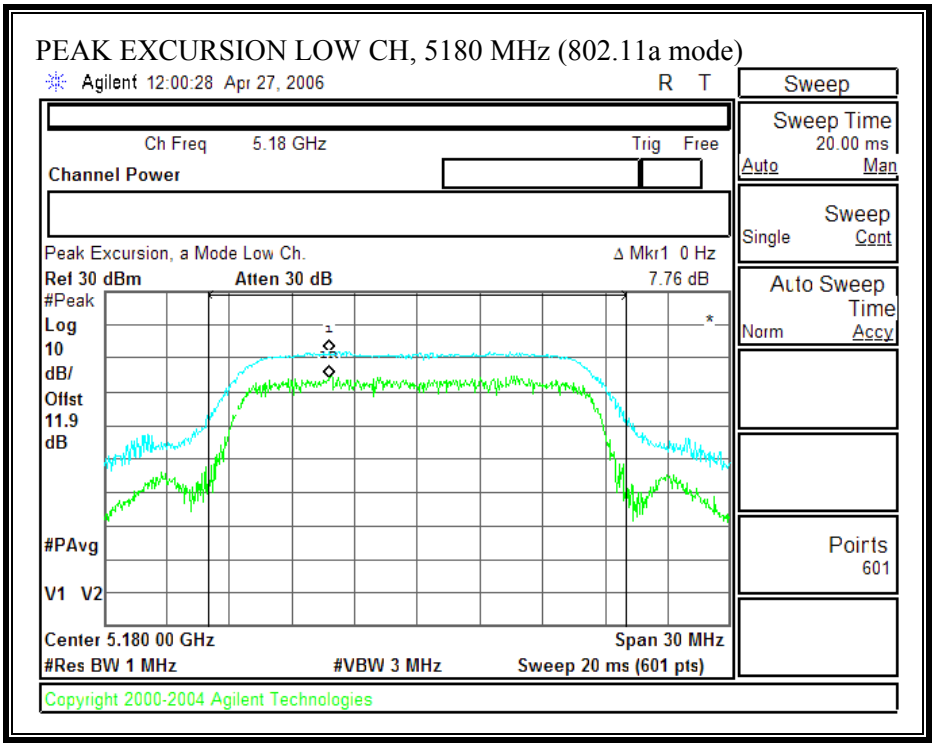
802.11n 20 MHz SISO MODE is covered by the worst case Legacy testing

802.11n 40 MHz MODE

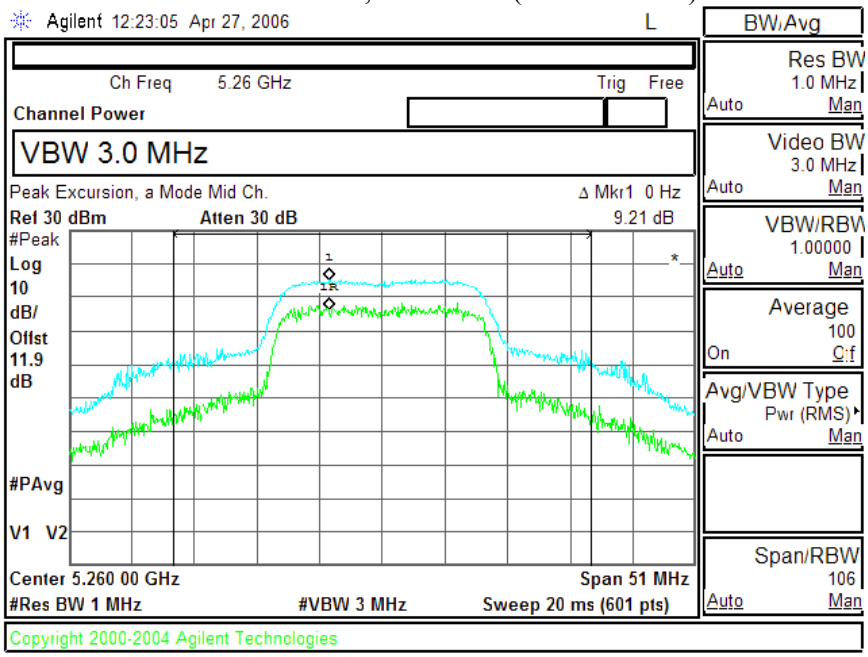
Channel	Frequency (MHz)	Peak Excursion (dB)	Limit (dB)	Margin (dB)
Low	5190	12.04	13	-0.96
Low	5230	9.60	13	-3.40
Middle	5270	10.77	13	-2.23
High	5310	8.68	13	-4.32

802.11a MODE

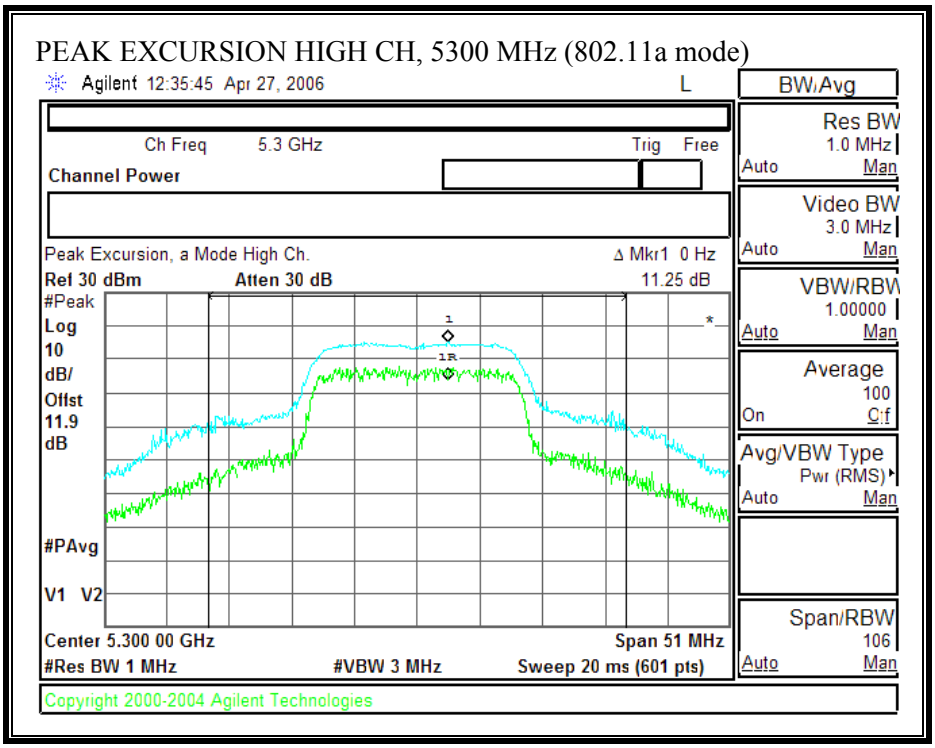
PEAK EXCURSION (802.11a MODE)



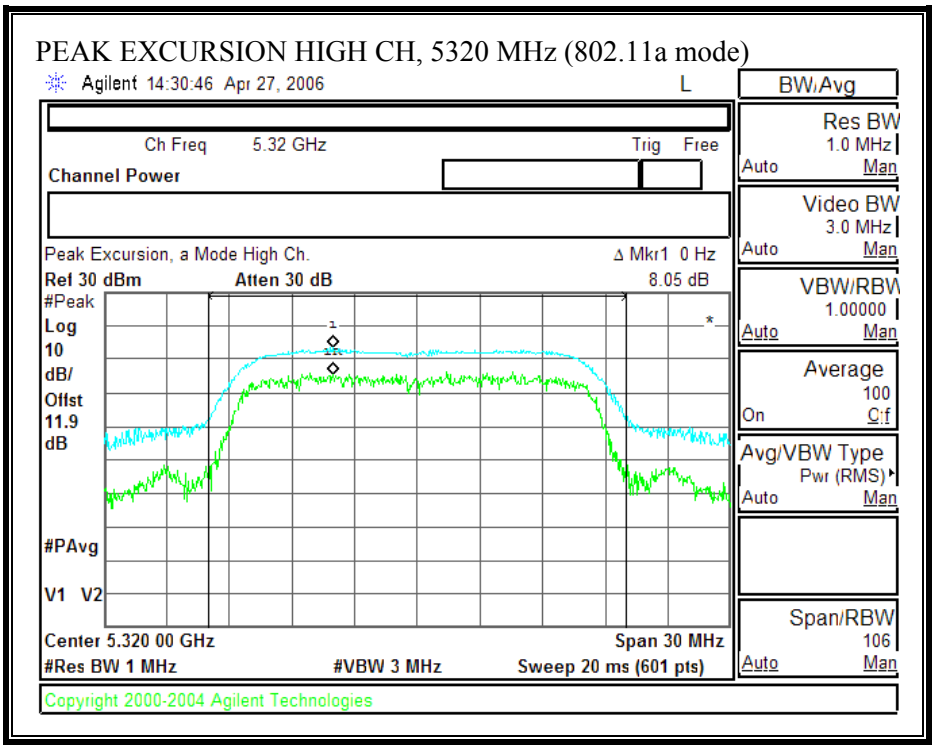
PEAK EXCURSION MID CH, 5260 MHz (802.11a mode)



PEAK EXCURSION HIGH CH, 5300 MHz (802.11a mode)



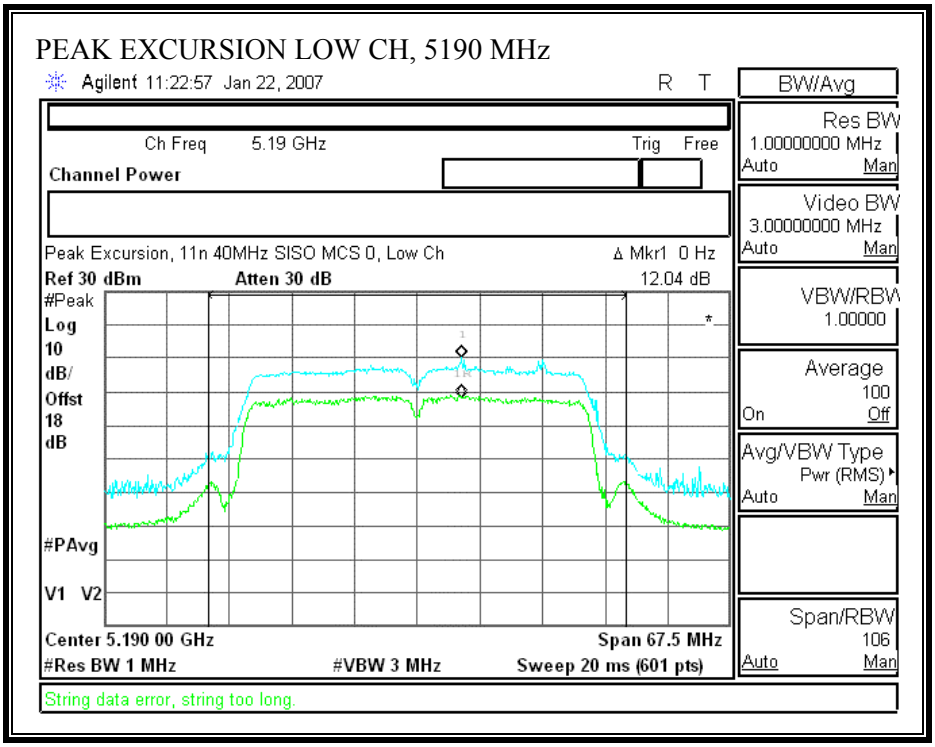
PEAK EXCURSION HIGH CH, 5320 MHz (802.11a mode)



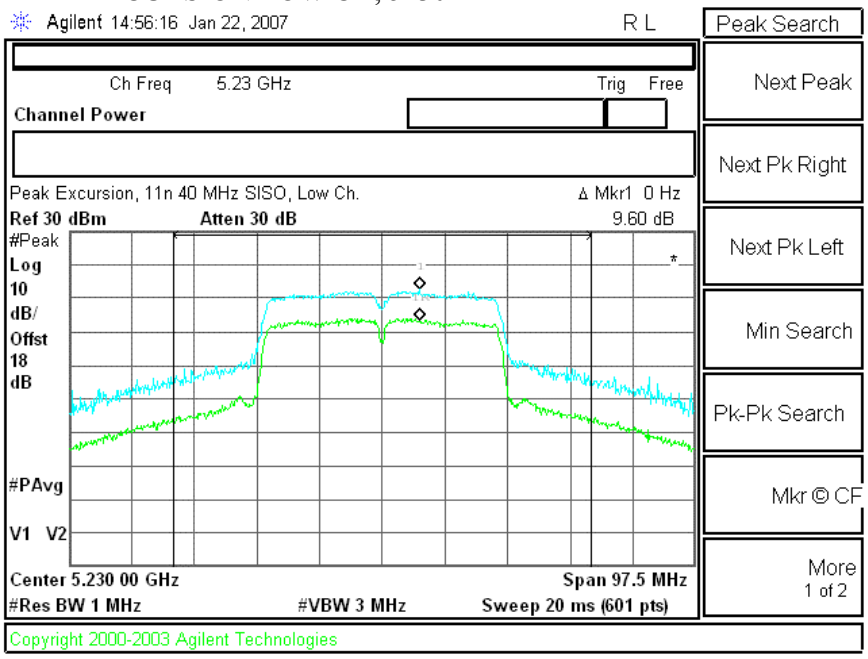
802.11n 20 MHz SISO MODE is covered by the worst case Legacy testing

802.11n 40 MHz SISO MODE

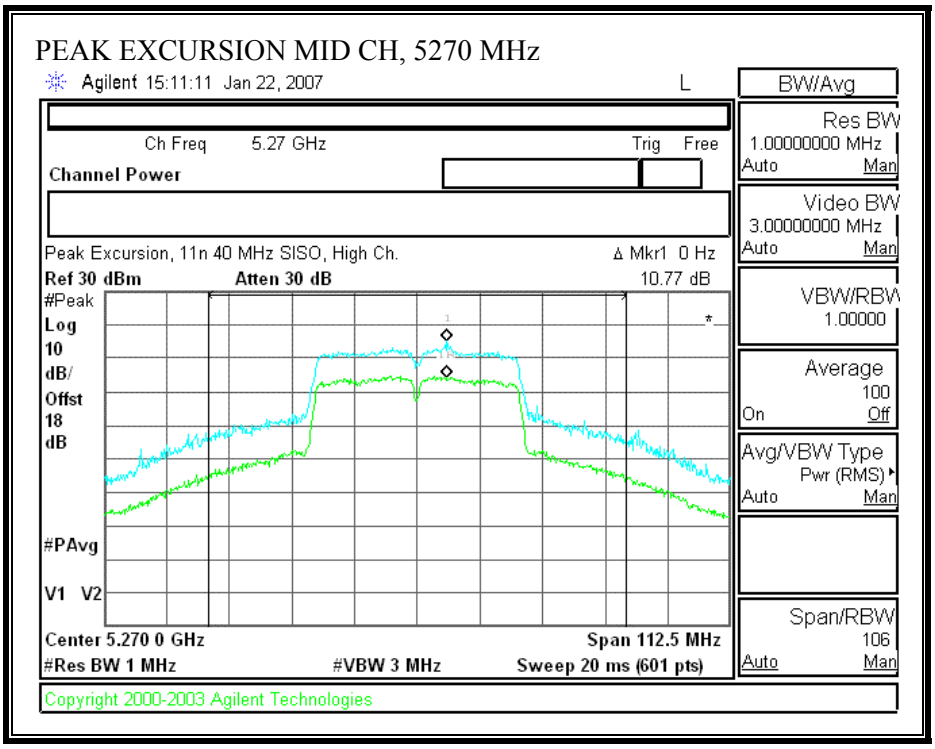
PEAK EXCURSION (802.11n 40MHz SISO MODE)



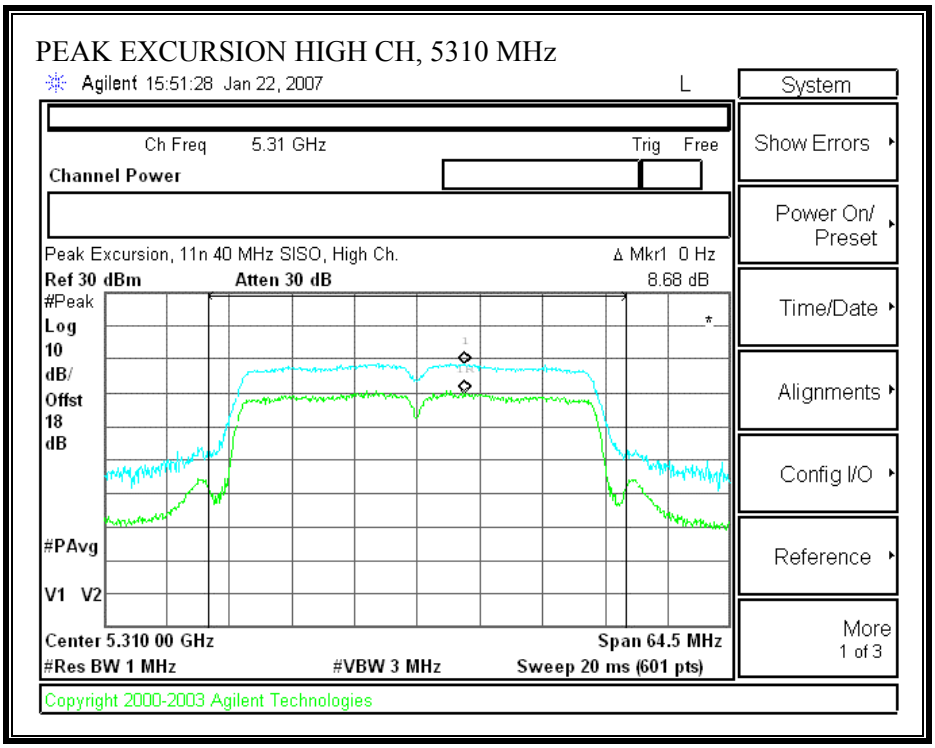
PEAK EXCURSION LOW CH, 5230 MHz



PEAK EXCURSION MID CH, 5270 MHz



PEAK EXCURSION HIGH CH, 5310 MHz



7.1.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

§15.407 (b) (1 & 2) For transmitters operating in the 5.15-5.35 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27dBm / MHz.

TEST PROCEDURE

Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to the average EIRP limit, adjusted for the maximum antenna gain. If necessary, additional average detection measurements are made.

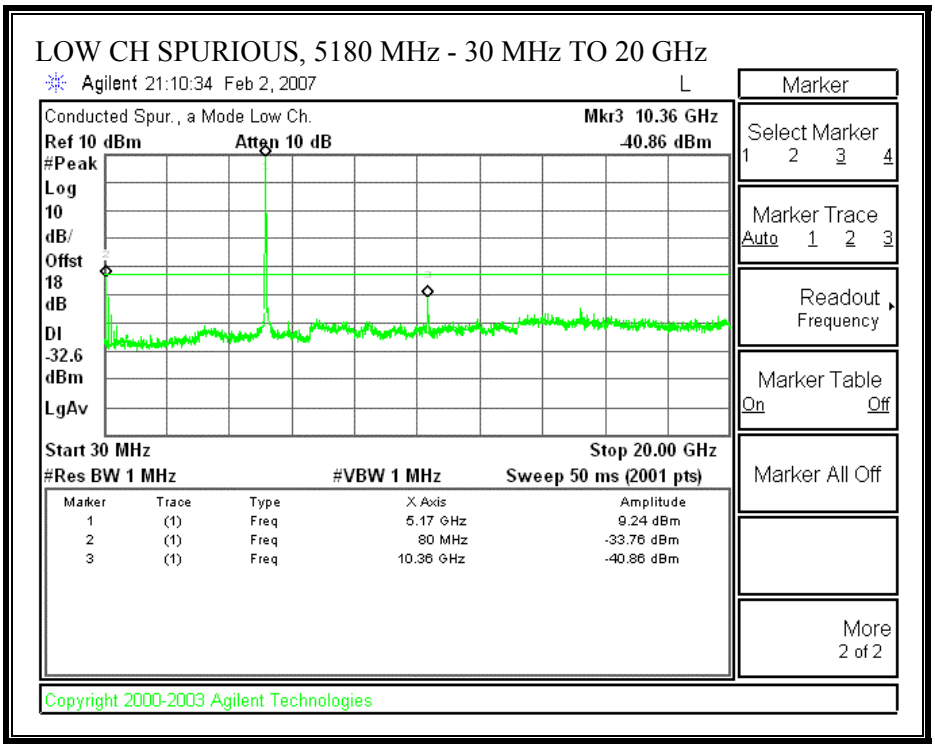
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

RESULTS

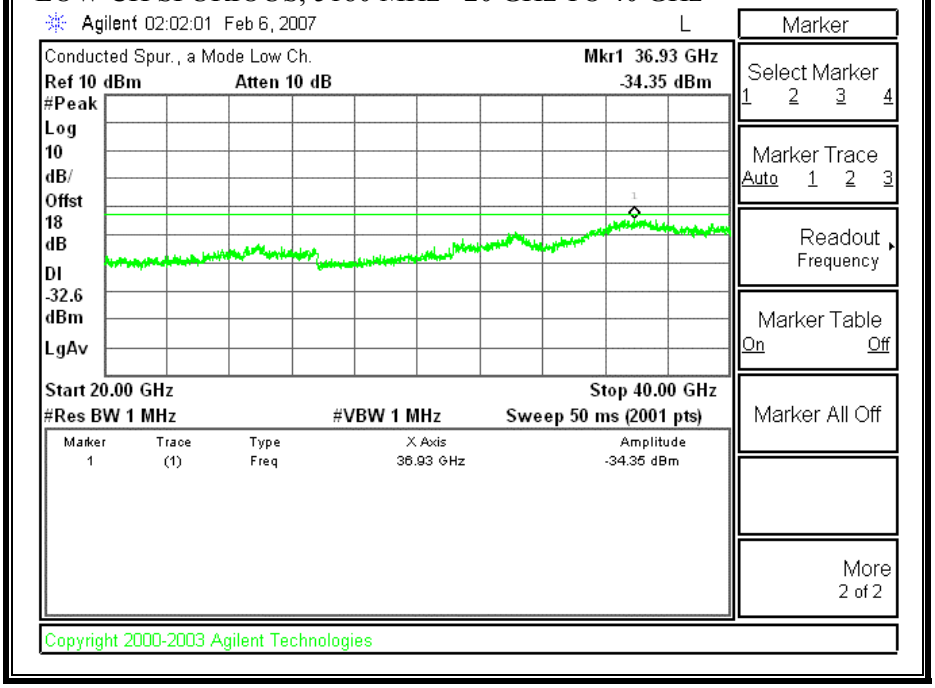
No non-compliance noted:

802.11a MODE

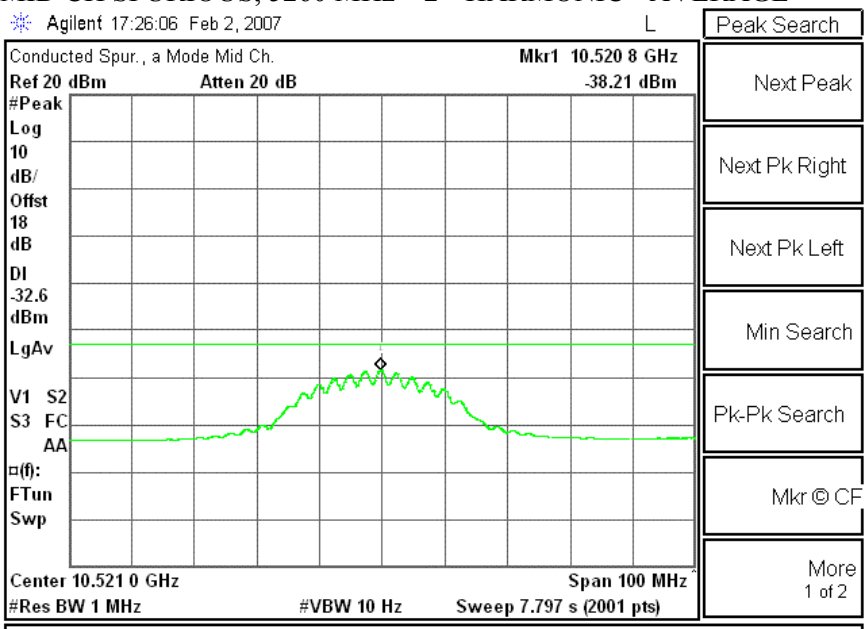
SPURIOUS EMISSIONS (802.11a MODE)



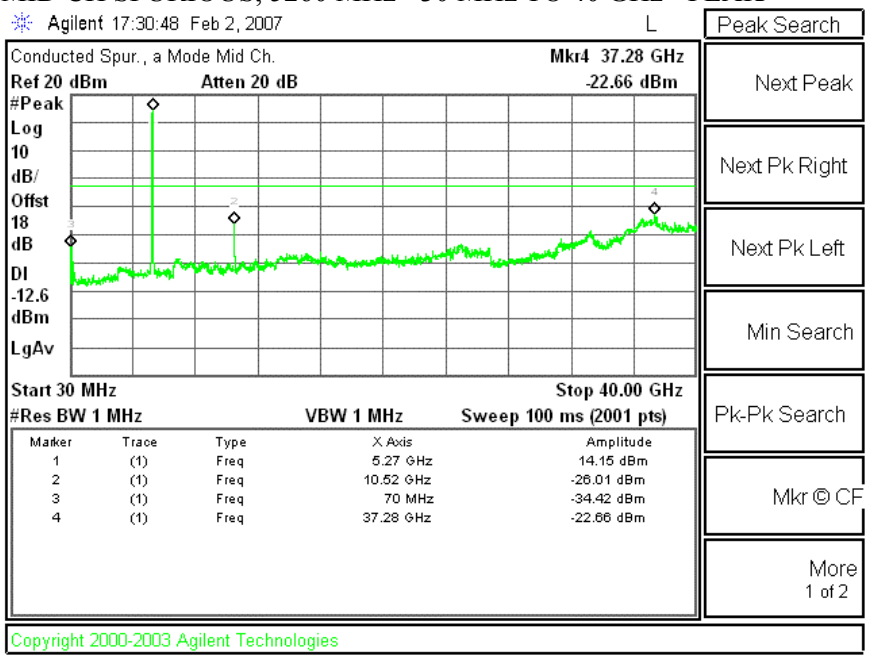
LOW CH SPURIOUS, 5180 MHz - 20 GHz TO 40 GHz



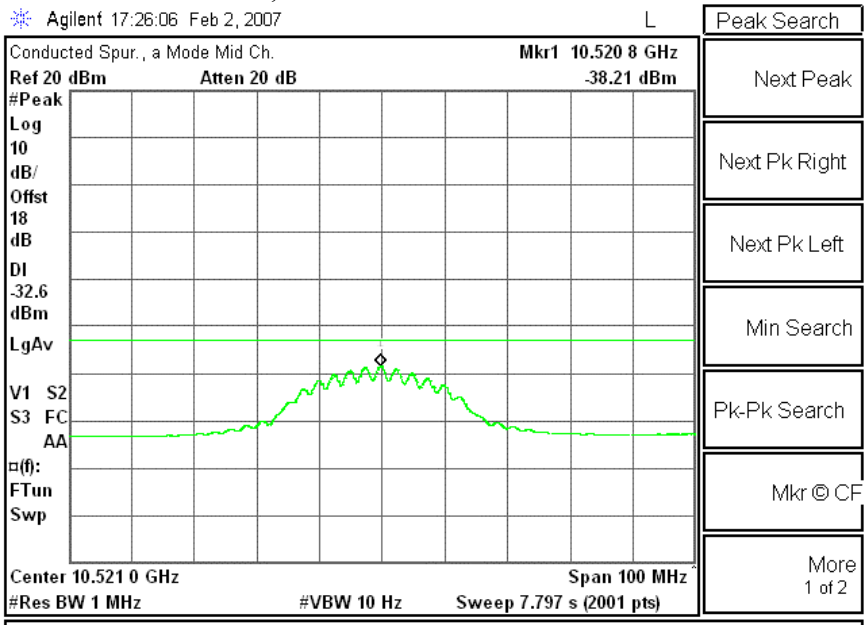
MID CH SPURIOUS, 5260 MHz – 2nd HARMONIC - AVERAGE

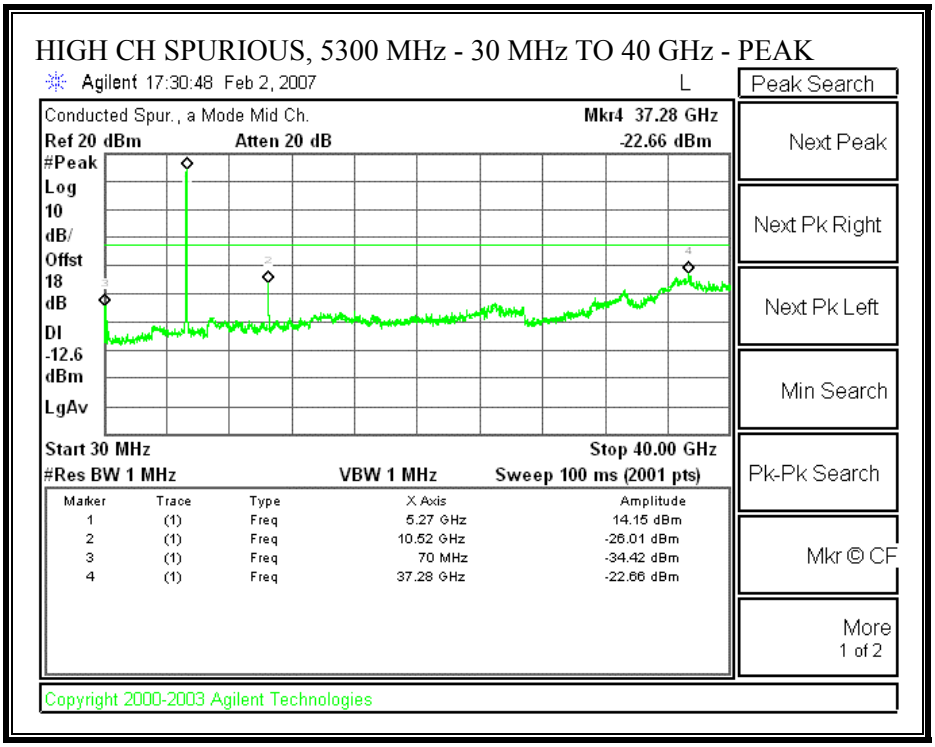


MID CH SPURIOUS, 5260 MHz - 30 MHz TO 40 GHz - PEAK

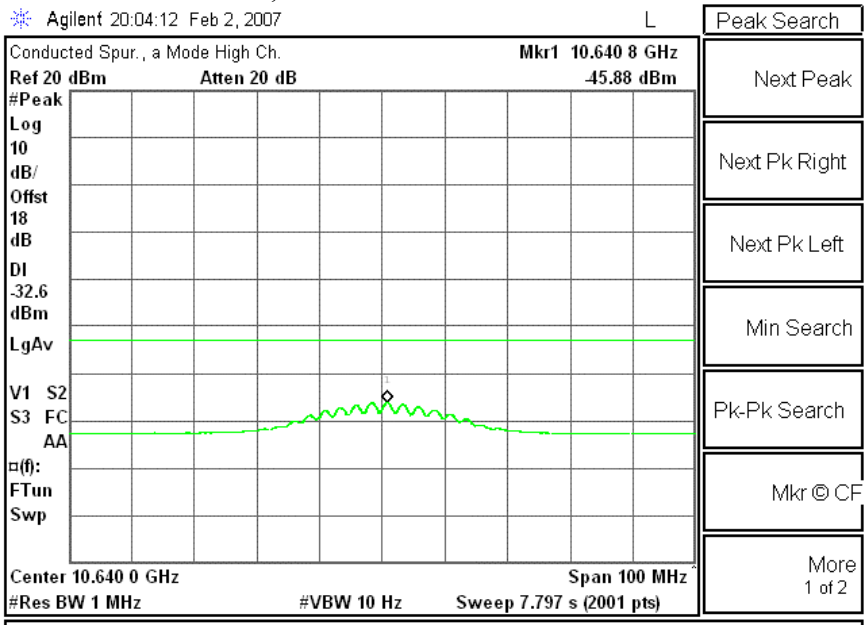


HIGH CH SPURIOUS, 5300 MHz – 2nd HARMONIC - AVERAGE

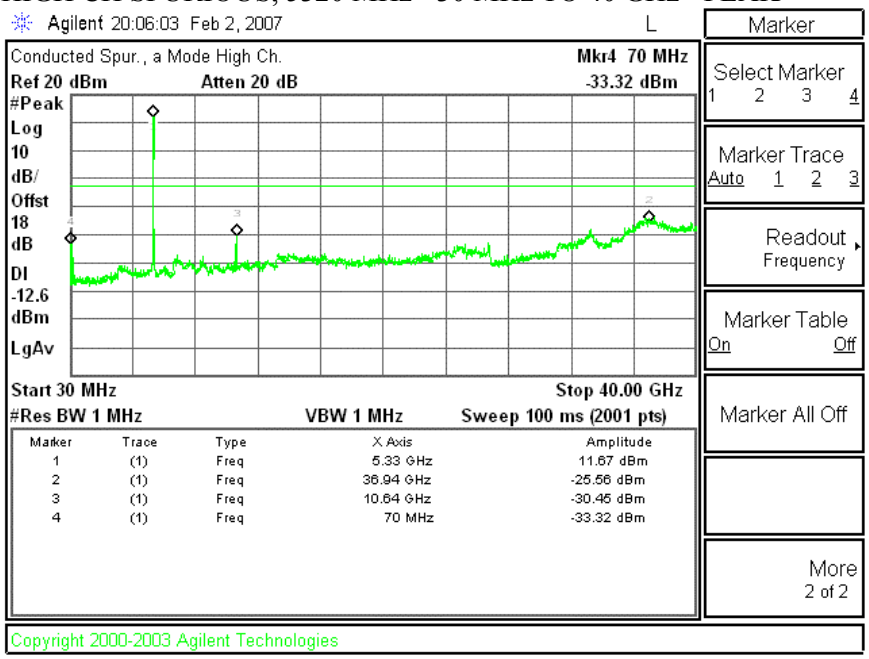




HIGH CH SPURIOUS, 5320 MHz – 2nd HARMONIC - AVERAGE



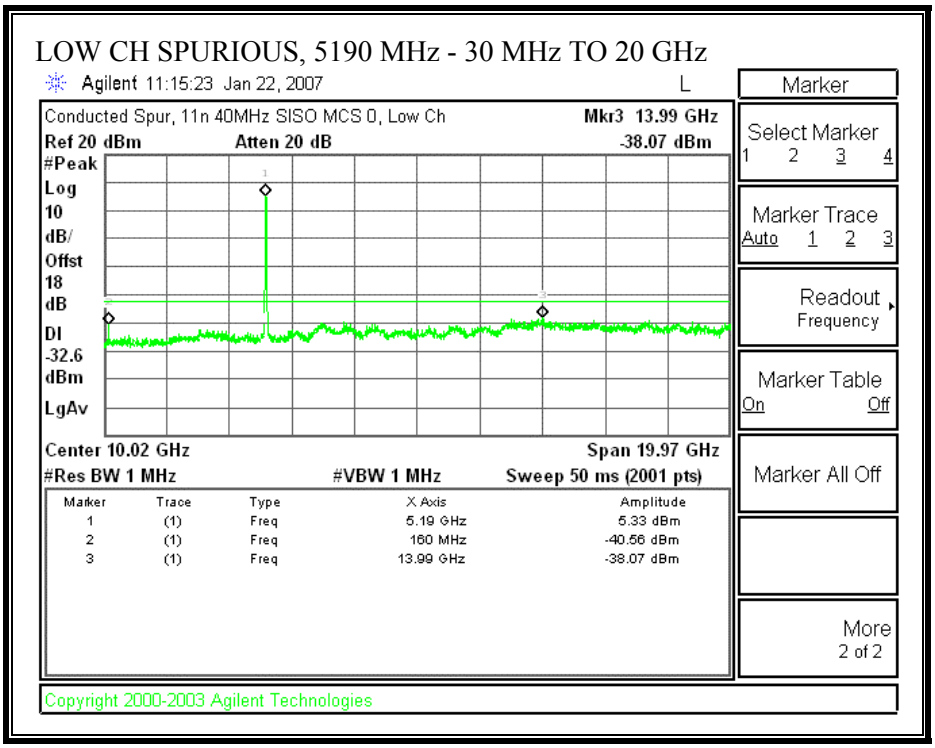
HIGH CH SPURIOUS, 5320 MHz - 30 MHz TO 40 GHz - PEAK

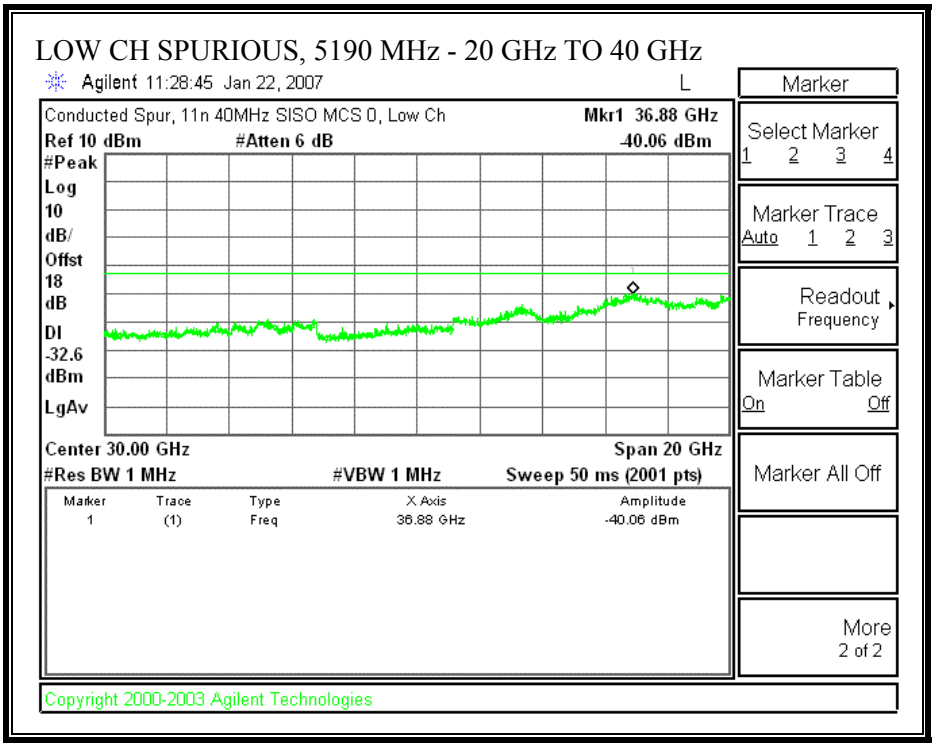


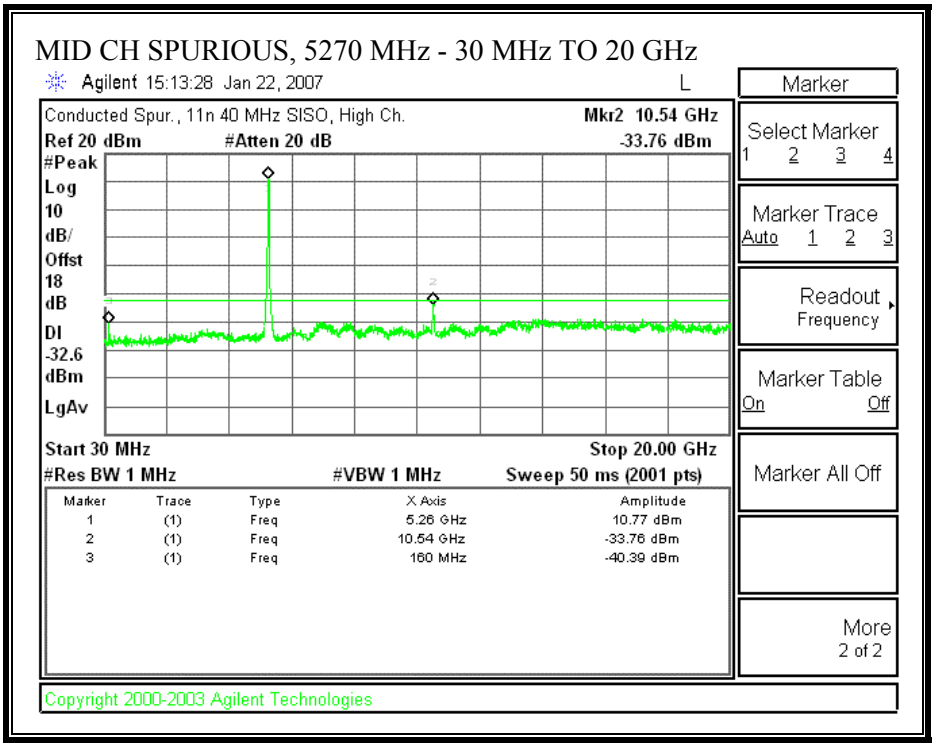
802.11n 20 MHz SISO MODE is covered by the worst case Legacy testing

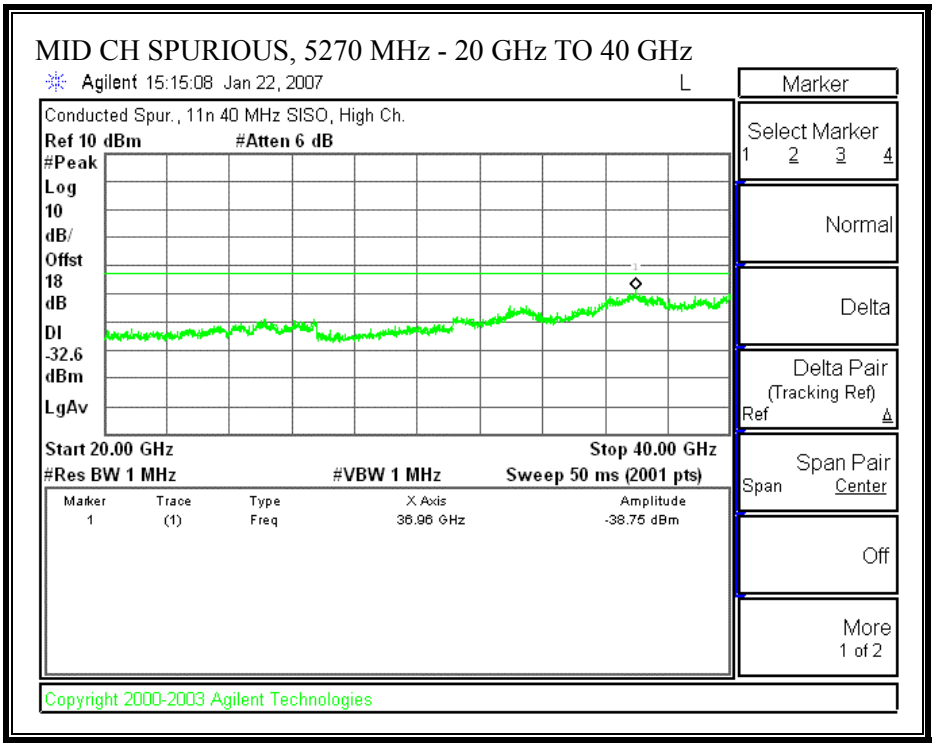
802.11n 40 MHz SISO MODE

SPURIOUS EMISSIONS (802.11n 40MHz SISO MODE)

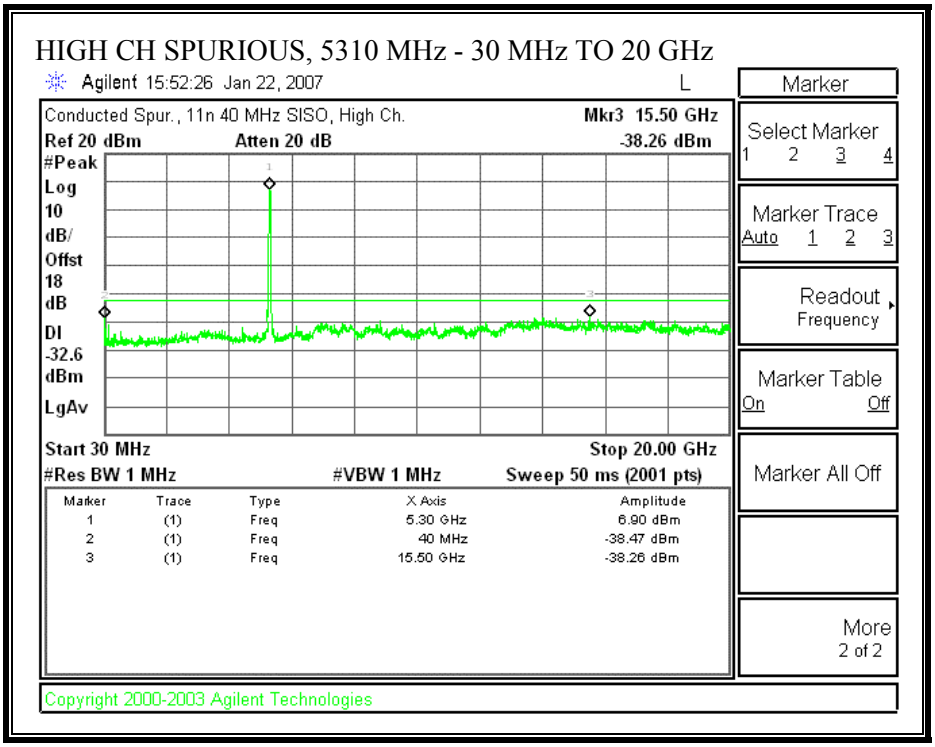




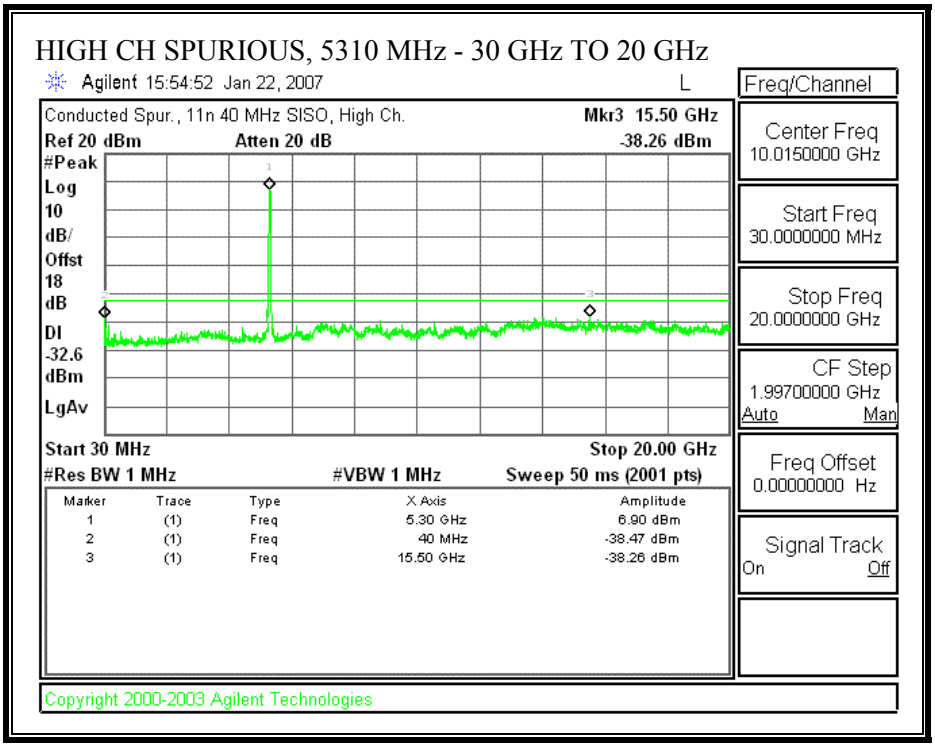


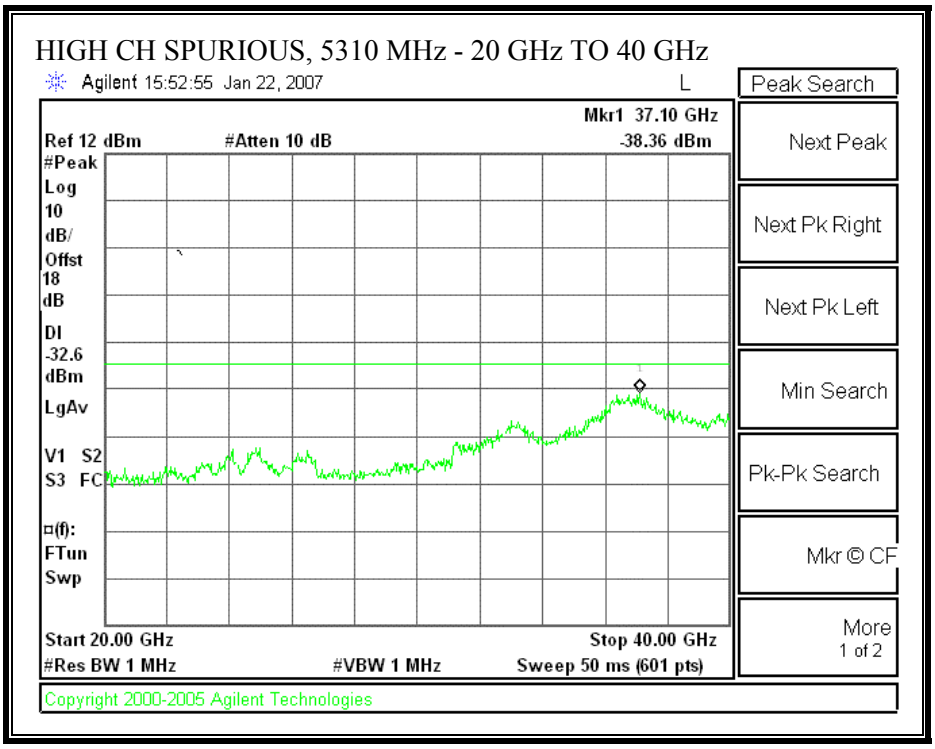


HIGH CH SPURIOUS, 5310 MHz - 30 MHz TO 20 GHz



HIGH CH SPURIOUS, 5310 MHz - 30 GHz TO 20 GHz





MIMO MODE

7.2. CHANNEL TESTS FOR THE 5150 TO 5350 MHz BAND

7.2.1. EMISSION BANDWIDTH

LIMIT

§15.403 (i) Emission bandwidth. For purposes of this subpart the emission bandwidth shall be determined by measuring the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, that are 26 dB down relative to the maximum level of the modulated carrier. Determination of the emissions bandwidth is based on the use of measurement instrumentation employing a peak detector function with an instrument resolutions bandwidth approximately equal to 1.0 percent of the emission bandwidth of the device under measurement.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 1% to 3% of the 26 dB bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled.

RESULTS

No non-compliance noted:

802.11a CDD MODE is covered by worst case 802.11n 20 MHz CDD MCS 0

802.11n 20 MHz CDD MCS 0

802.11 - 20 MHz Tx BANDWIDTH - CHAIN 0

Channel	Frequency (MHz)	B (MHz)	10 Log B (dB)
Low	5180	19.255	12.845
Middle	5260	35.328	15.481
High	5320	37.726	15.766

802.11 - 20 MHz Tx BANDWIDTH - CHAIN 1

Channel	Frequency (MHz)	B (MHz)	10 Log B (dB)
Low	5180	22.998	13.617
Middle	5260	31.637	15.002
High	5320	34.464	15.374

802.11n 40 MHz CDD MCS 32

802.11 - 40 MHz Tx BANDWIDTH - CHAIN 0

Channel	Frequency (MHz)	B (MHz)	10 Log B (dB)
Low	5190	44.836	16.516
Middle	5270	76.184	18.819
High	5310	65.430	18.158

802.11 - 40 MHz Tx BANDWIDTH - CHAIN 1

Channel	Frequency (MHz)	B (MHz)	10 Log B (dB)
Low	5190	39.829	16.002
Middle	5270	74.998	18.750
High	5310	61.061	17.858

802.11n 40 MHz SDM MCS 15

802.11 - 40 MHz Tx BANDWIDTH - CHAIN 0

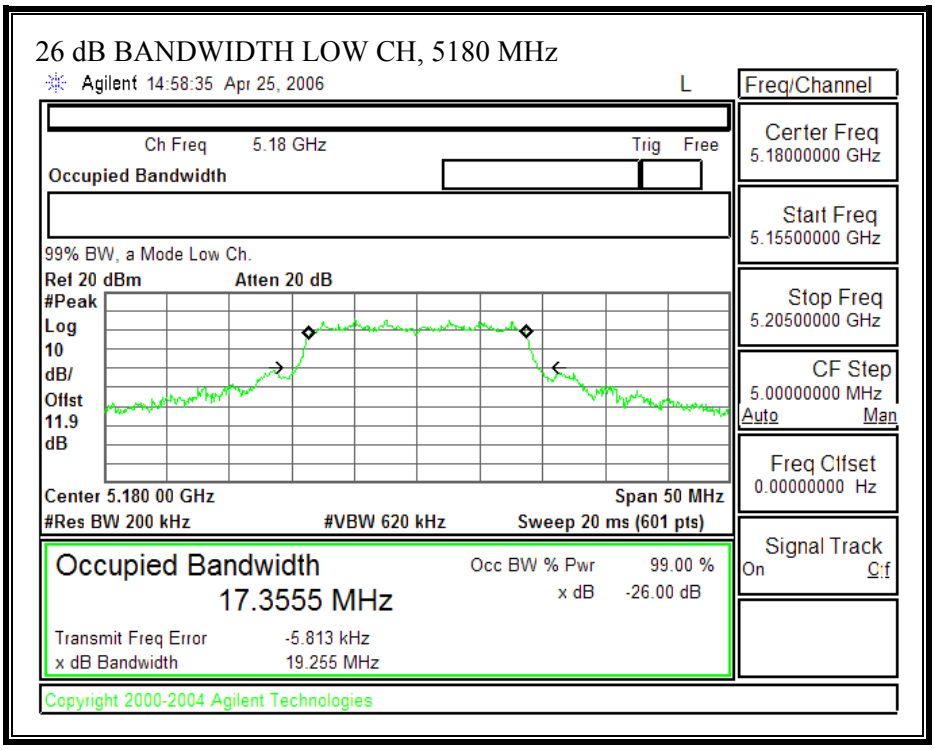
Channel	Frequency (MHz)	B (MHz)	10 Log B (dB)
Low	5190	45.178	16.549

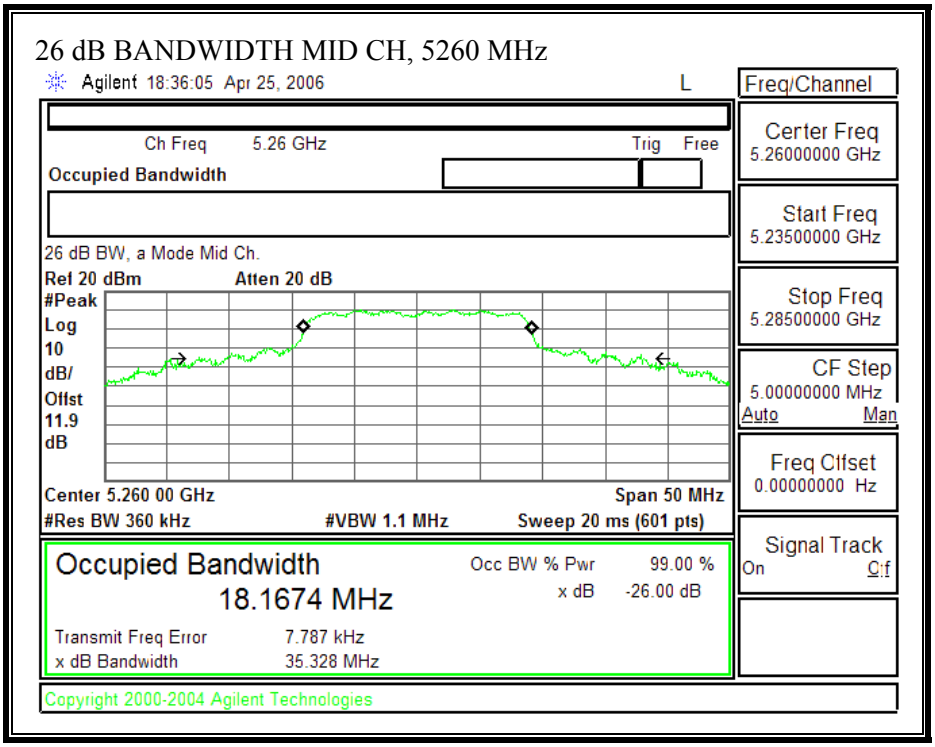
802.11 - 40 MHz Tx BANDWIDTH - CHAIN 1

Channel	Frequency (MHz)	B (MHz)	10 Log B (dB)
Low	5190	42.039	16.237

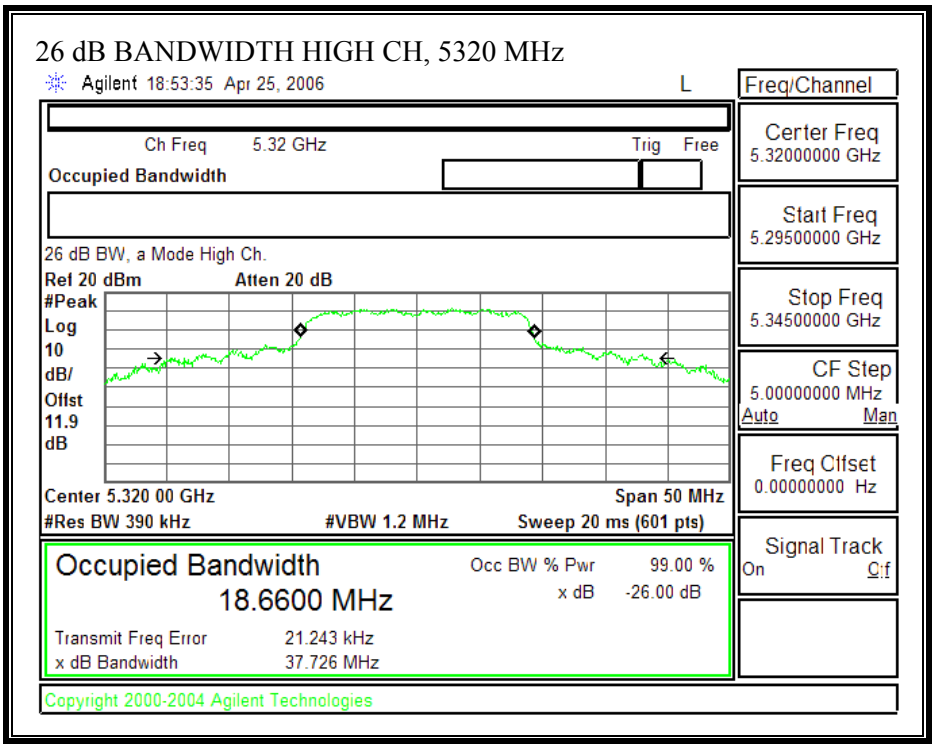
802.11n 20 MHz CDD MCS 0

26 dB EMISSION BANDWIDTH (802.11 - 20 MHz TX BANDWIDTH- CHAIN 0)

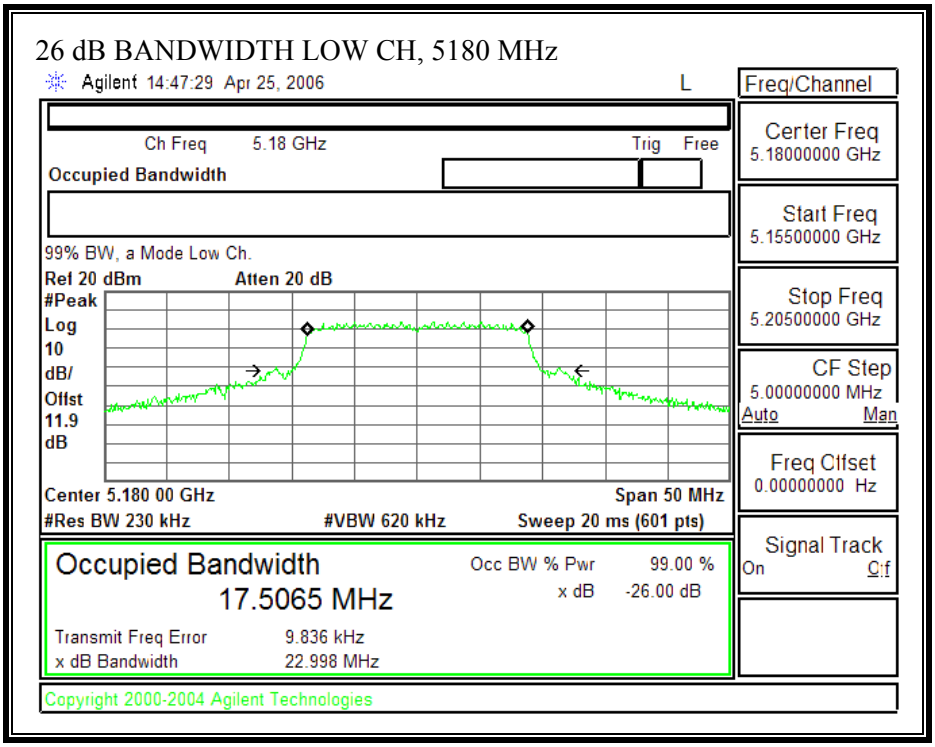


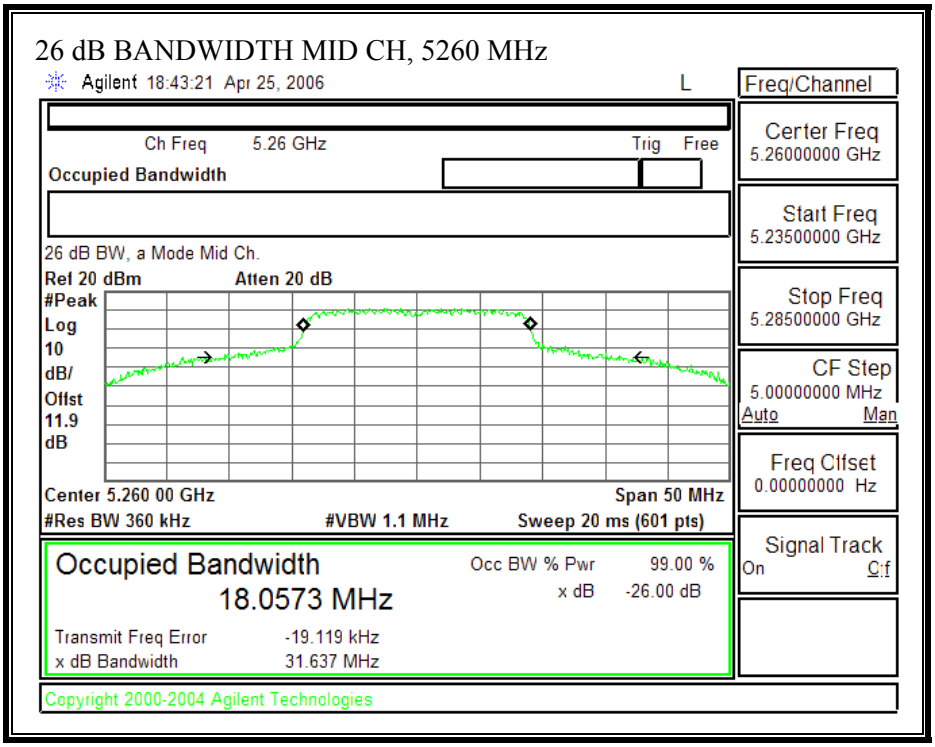


26 dB BANDWIDTH HIGH CH, 5320 MHz

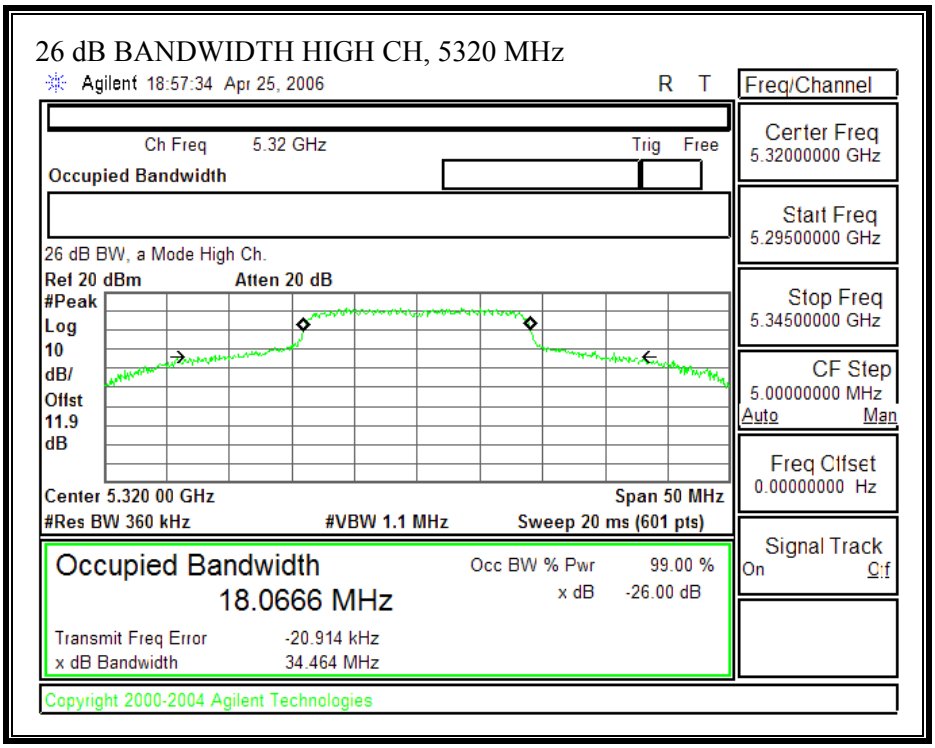


26 dB EMISSION BANDWIDTH (802.11 - 20 MHz TX BANDWIDTH- CHAIN 1)



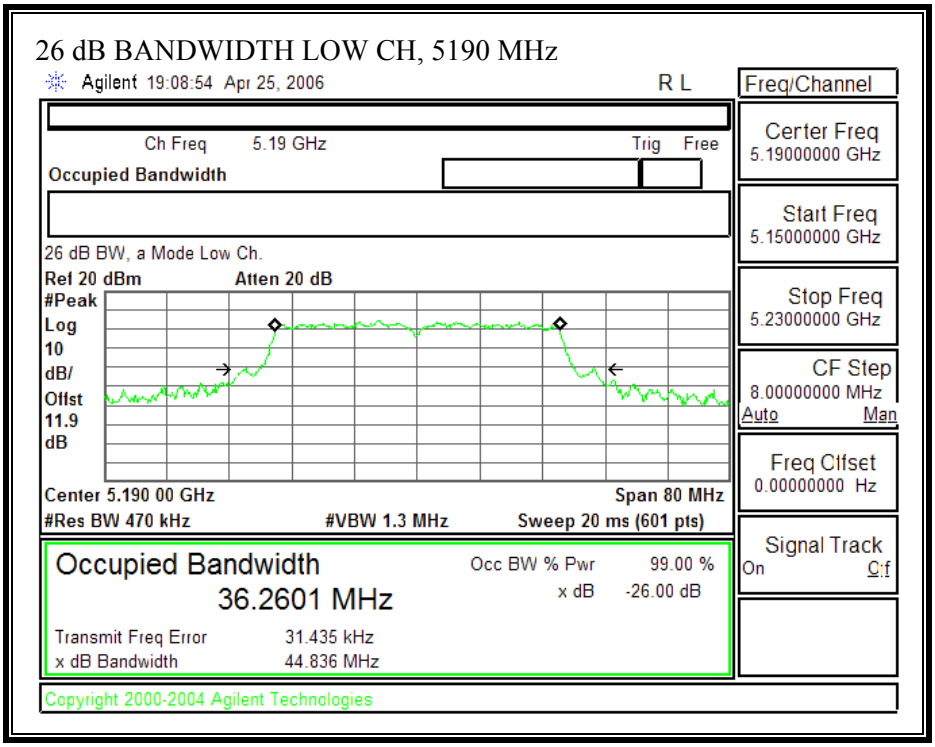


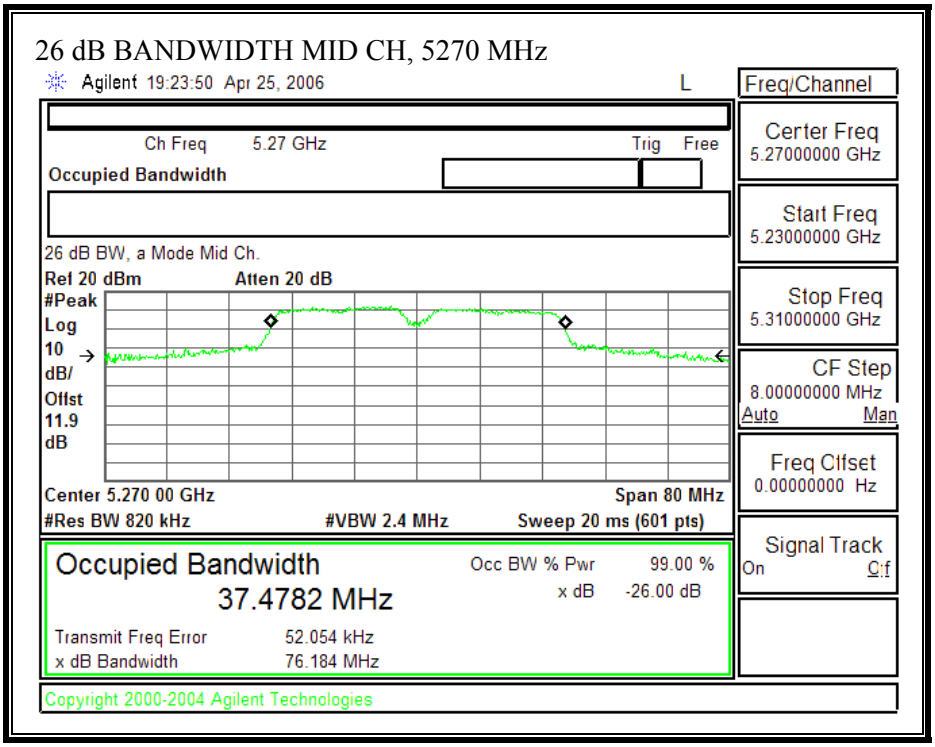
26 dB BANDWIDTH HIGH CH, 5320 MHz



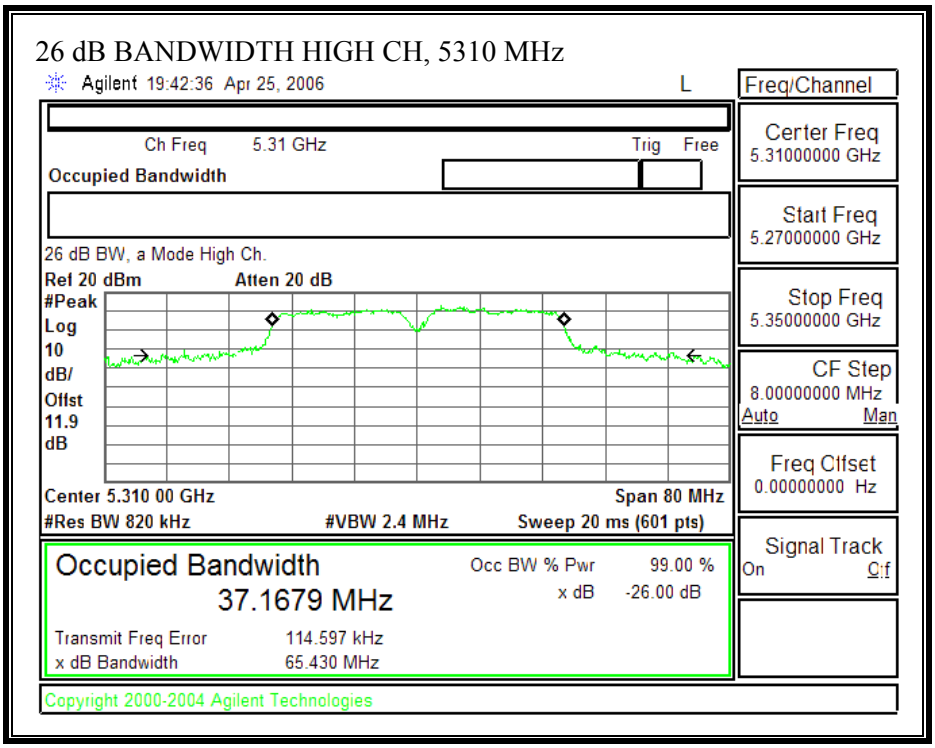
802.11n 40 MHz CDD MCS 32

26 dB EMISSION BANDWIDTH (802.11 - 40 MHz TX BANDWIDTH- CHAIN 0)

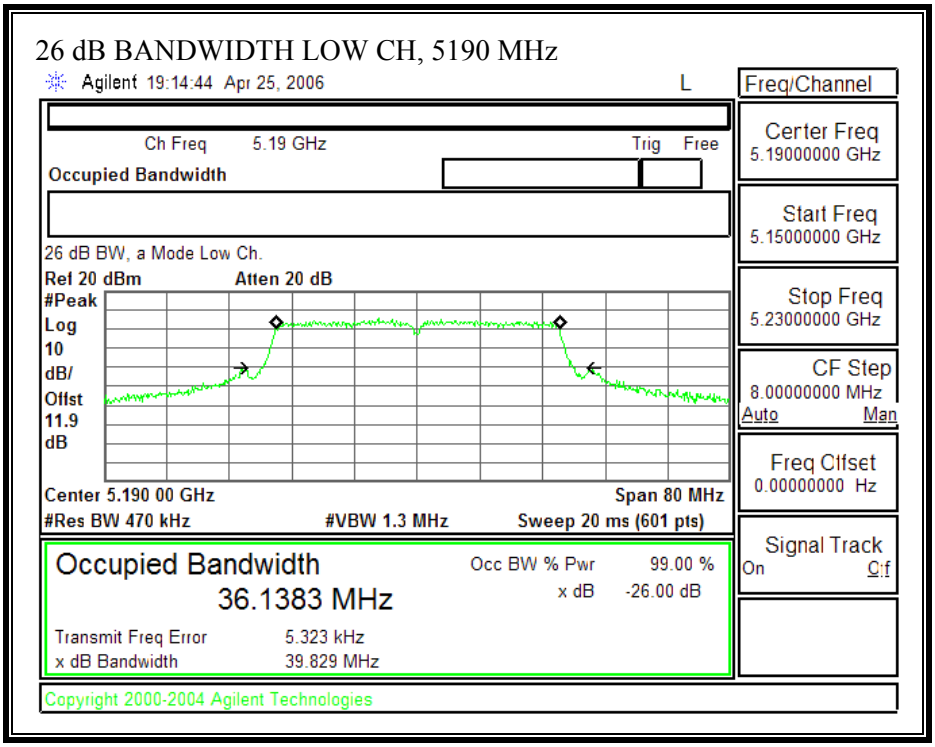


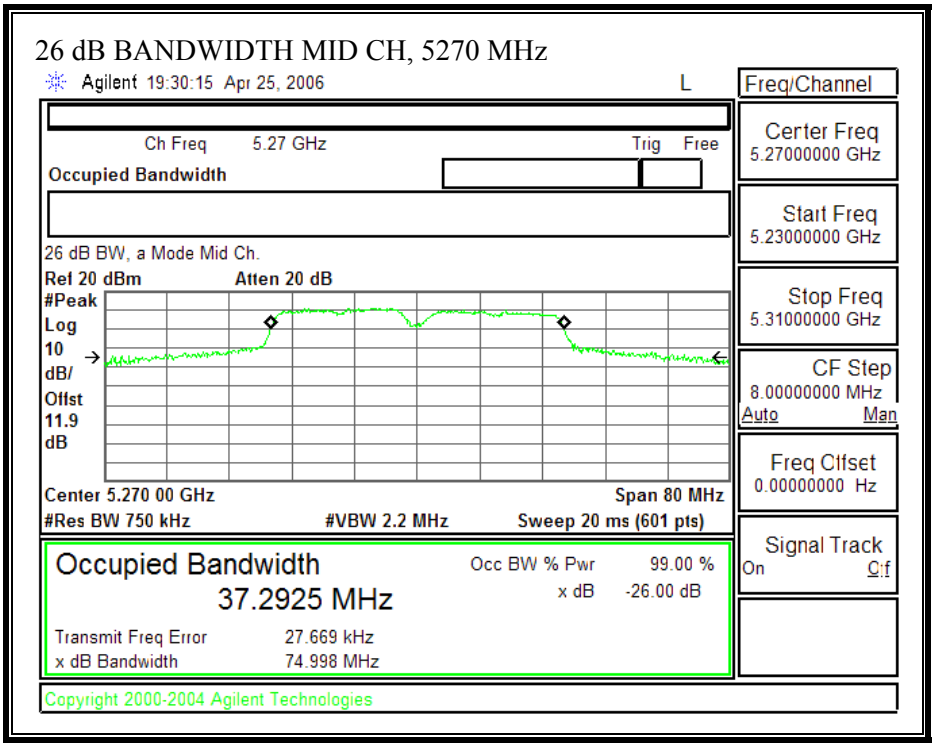


26 dB BANDWIDTH HIGH CH, 5310 MHz

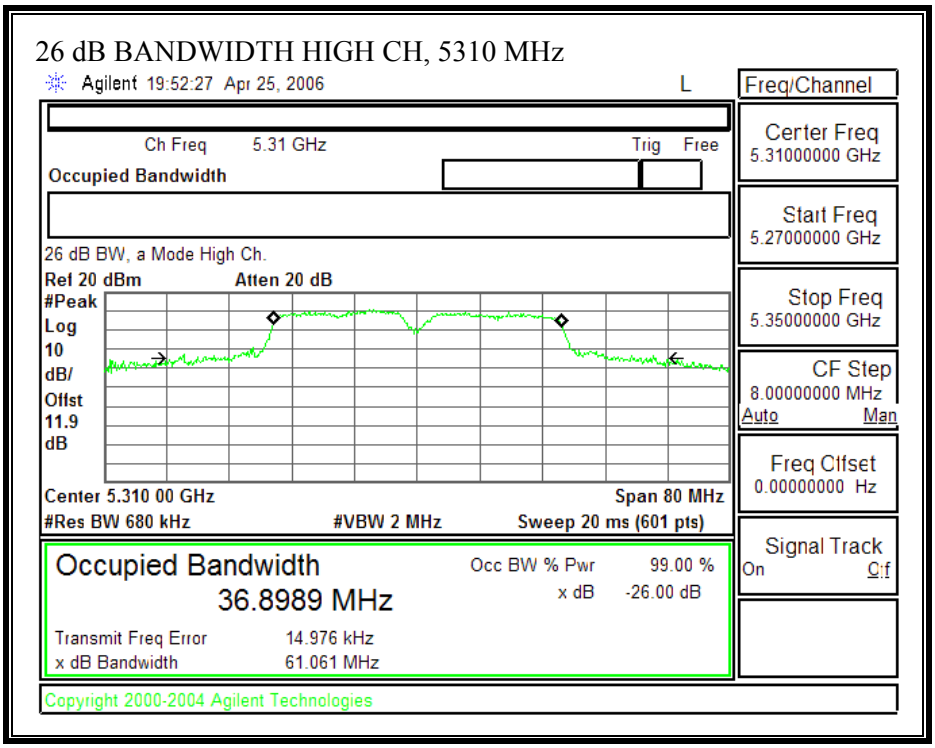


26 dB EMISSION BANDWIDTH (802.11 - 40 MHz TX BANDWIDTH- CHAIN 1)



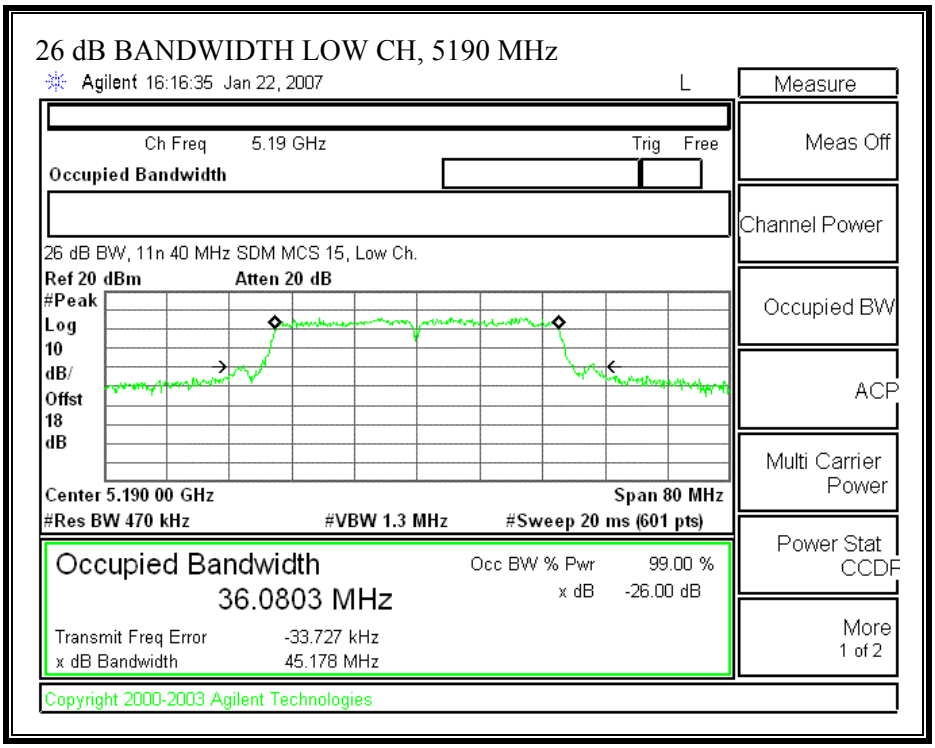


26 dB BANDWIDTH HIGH CH, 5310 MHz

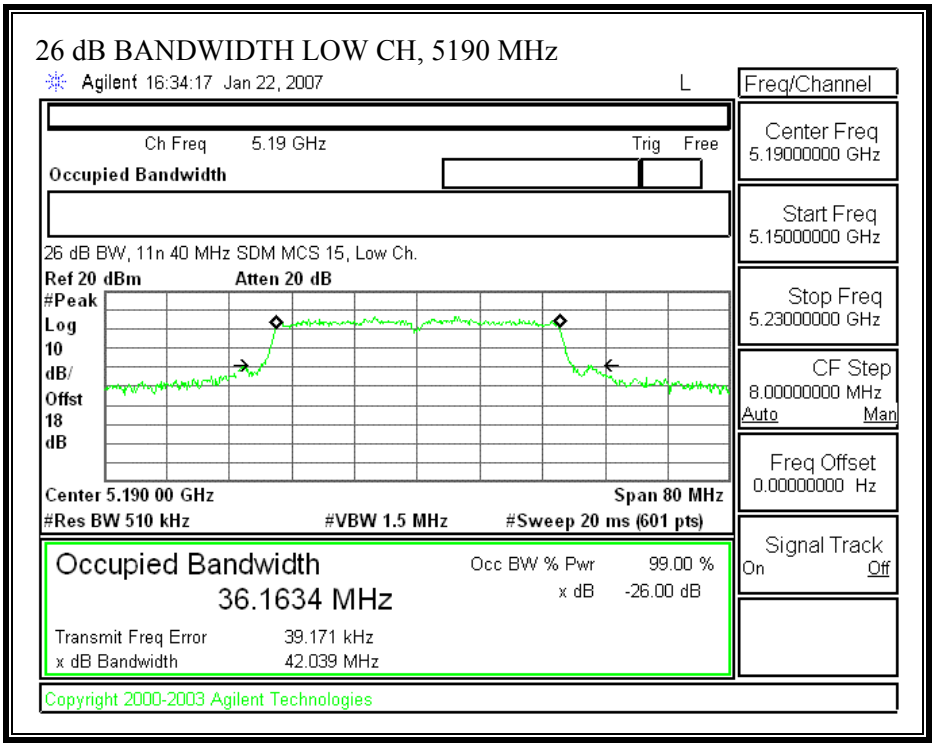


802.11n 40 MHz SDM MCS 15

26 dB EMISSION BANDWIDTH (802.11 - 40 MHz TX BANDWIDTH- CHAIN 0)



26 dB EMISSION BANDWIDTH (802.11 - 40 MHz TX BANDWIDTH- CHAIN 1)



7.2.2. PEAK POWER

LIMIT

§15.407 (a) (1) For the band 5.15-5.25 GHz, the peak transmit power over the frequency band of operation shall not exceed the lesser of 50 mW or 4 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.

§15.407 (a) (1) For the band 5.25-5.35 GHz, the peak transmit 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.

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,

Total peak power calculation formula: 10 log (10^ (Pchain0 / 10) + 10^ (Pchain1 / 10))

Note: Pchain 0 and Pchain1 are in dBm

Following formula to calculate the array gain:

Array gain = 10*log (10^ (main gain/10) + 10^ (aux gain/10))

5.15 – 5.35GHz band: 6.439 dBi
5.15 – 5.35GHz band: 7.686 dBi

For single chain:

5.15 – 5.25GHz band: 3.90dBi
5.25 – 5.35GHz band: 5.60dBi

LIMITS AND RESULTS

No non-compliance noted:

802.11a CDD MODE is covered by worst case 802.11n 20 MHz CDD MCS 0

802.11n 20 MHz CDD MCS 0

20 MHz TX BANDWIDTH - CHAIN 0 & CHAIN 1

Limit in 5150 to 5250 MHz Band

Channel	Frequency (MHz)	Fixed Limit (dBm)	B Chain 0 (MHz)	B Chain 1 (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5180	17	19.255	22.998	16.845	6.44	16.41

Limit in 5250 to 5350 MHz Band

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	B (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Mid	5260	24	35.328	31.637	26.002	7.69	22.31
High	5320	24	37.726	34.464	26.374	7.69	22.31

Results

Channel	Frequency (MHz)	Power Chain 0 (dBm)	Power Chain 1 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	10.34	10.29	13.33	16.41	-3.08
Mid	5260	16.22	16.34	19.29	22.31	-3.02
High	5320	14.22	14.32	17.28	22.31	-5.03

802.11n 40 MHz CDD MCS 32

40 MHz TX BANDWIDTH - CHAIN 0 & CHAIN 1

Limit in 5150 to 5250 MHz Band

Channel	Frequency (MHz)	Fixed Limit (dBm)	B Chain 0 (MHz)	B Chain 1 (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5190	17	44.836	39.829	20.002	6.44	16.56

Limit in 5250 to 5350 MHz Band

Channel	Frequency (MHz)	Fixed Limit (dBm)	B Chain 0 (MHz)	B Chain 1 (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Mid	5270	24	76.184	74.998	29.750	7.69	22.31
High	5310	24	65.430	61.061	28.858	7.69	22.31

Results

Channel	Frequency (MHz)	Power Chain 0 (dBm)	Power Chain 1 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5190	12.37	12.36	15.38	16.56	-1.18
Mid	5270	17.13	17.22	20.19	22.31	-2.12
High	5310	12.73	12.72	15.74	22.31	-6.57

802.11n 40 MHz SDM MCS 15

40 MHz TX BANDWIDTH - CHAIN 0 & CHAIN 1

Limit in 5150 to 5250 MHz Band

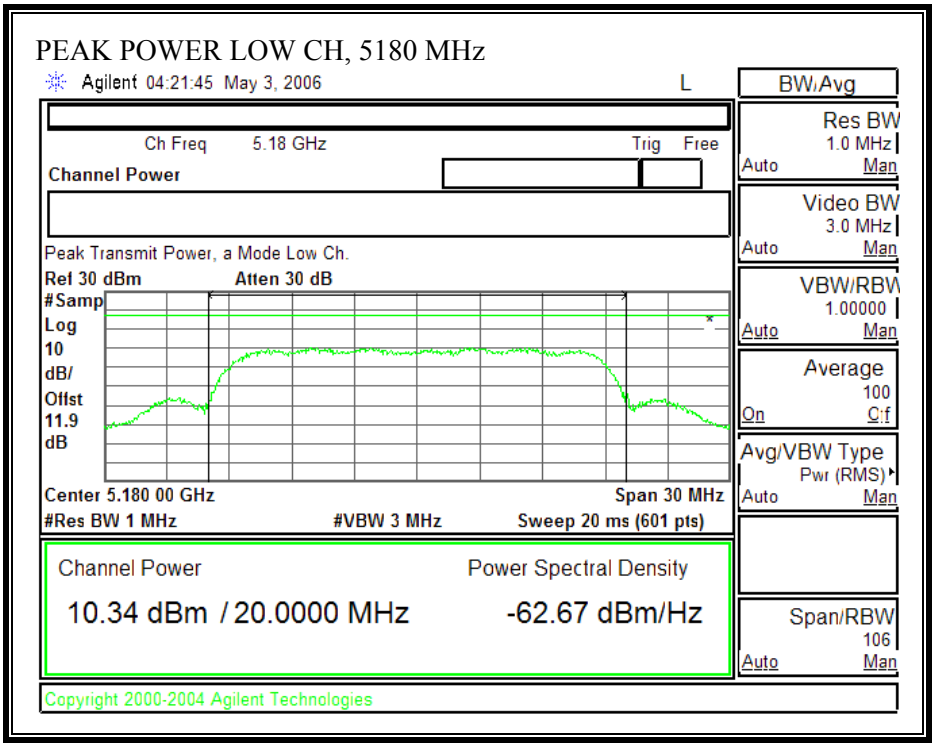
Channel	Frequency (MHz)	Fixed Limit (dBm)	B Chain 0 (MHz)	B Chain 1 (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5190	17	45.178	42.039	20.237	3.90	17.00

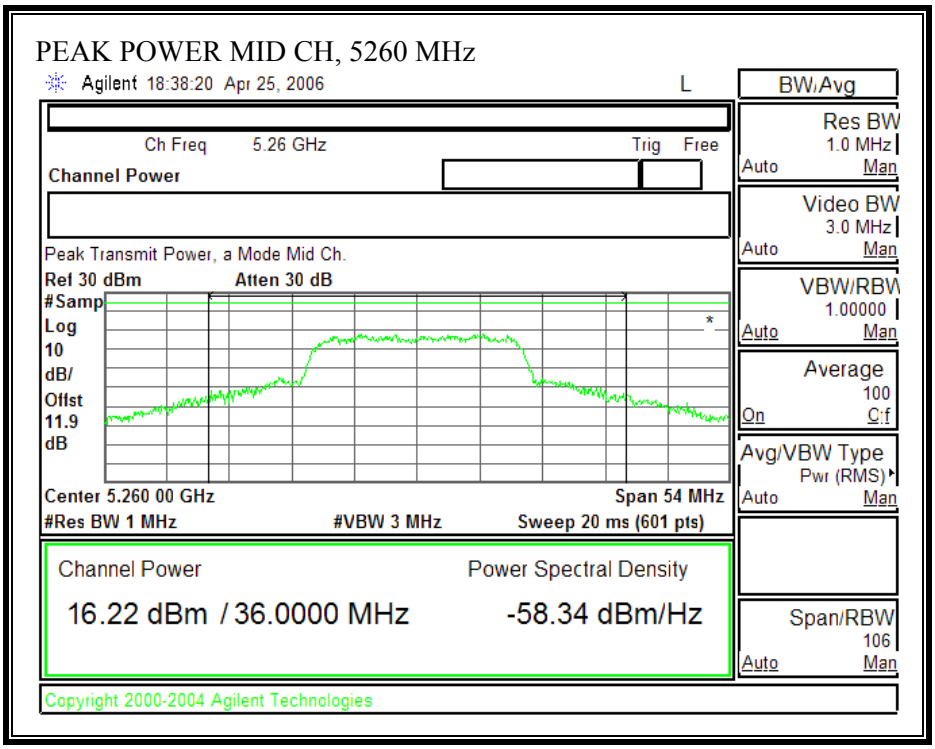
Results

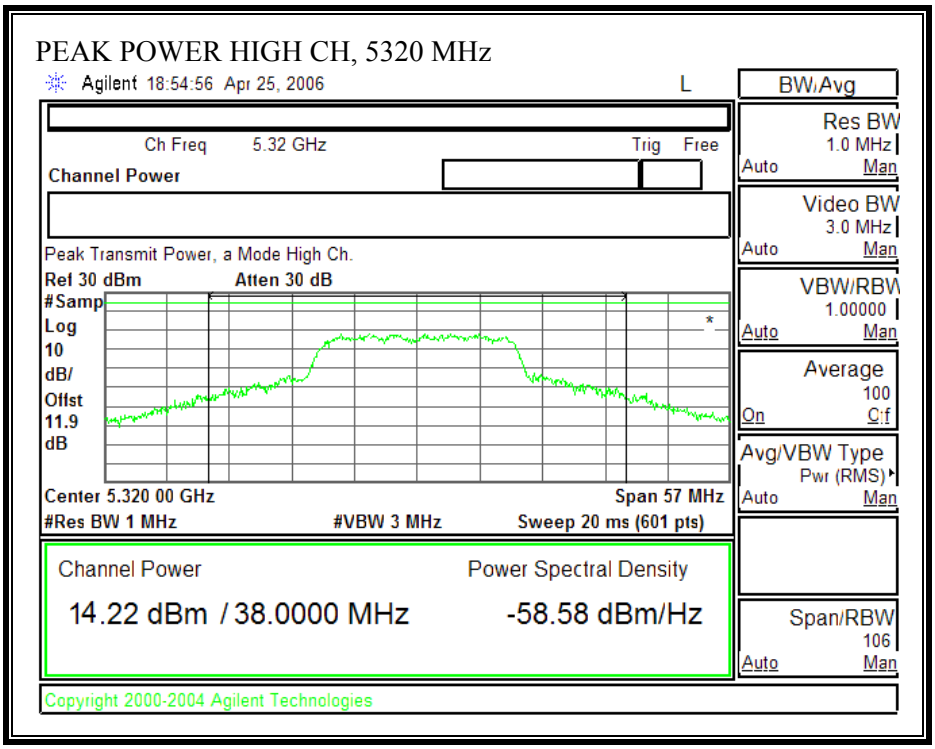
Channel	Frequency (MHz)	Power Chain 0 (dBm)	Power Chain 1 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5190	13.57	13.67	16.63	17.00	-0.37

802.11n 20 MHz CDD MCS 0

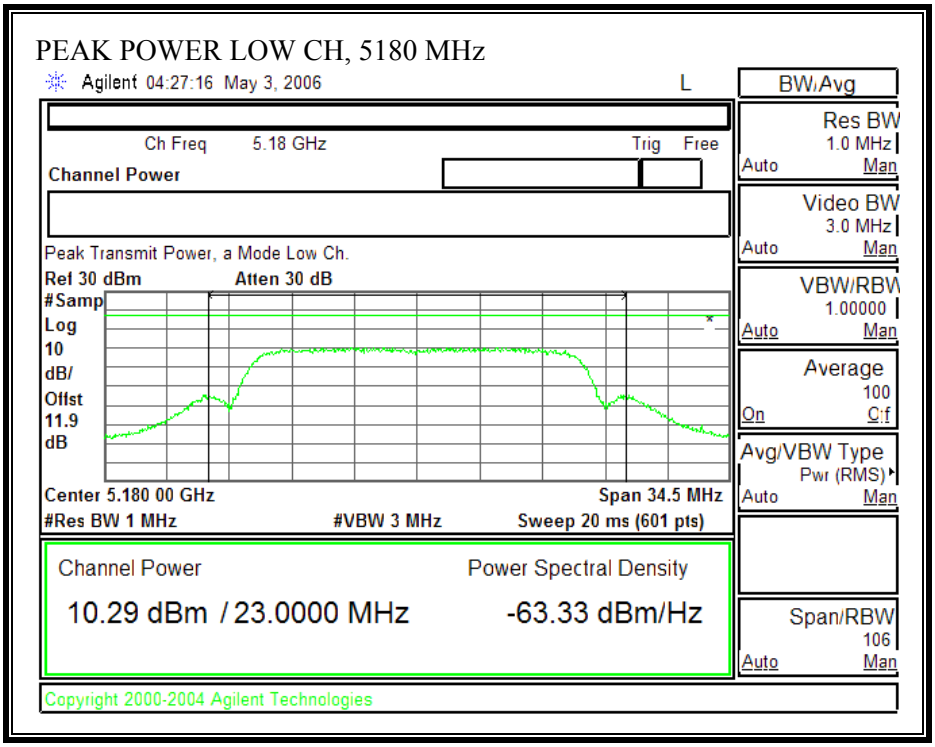
PEAK POWER (802.11 – 20MHz TX BANDWIDTH – CHAIN 0)

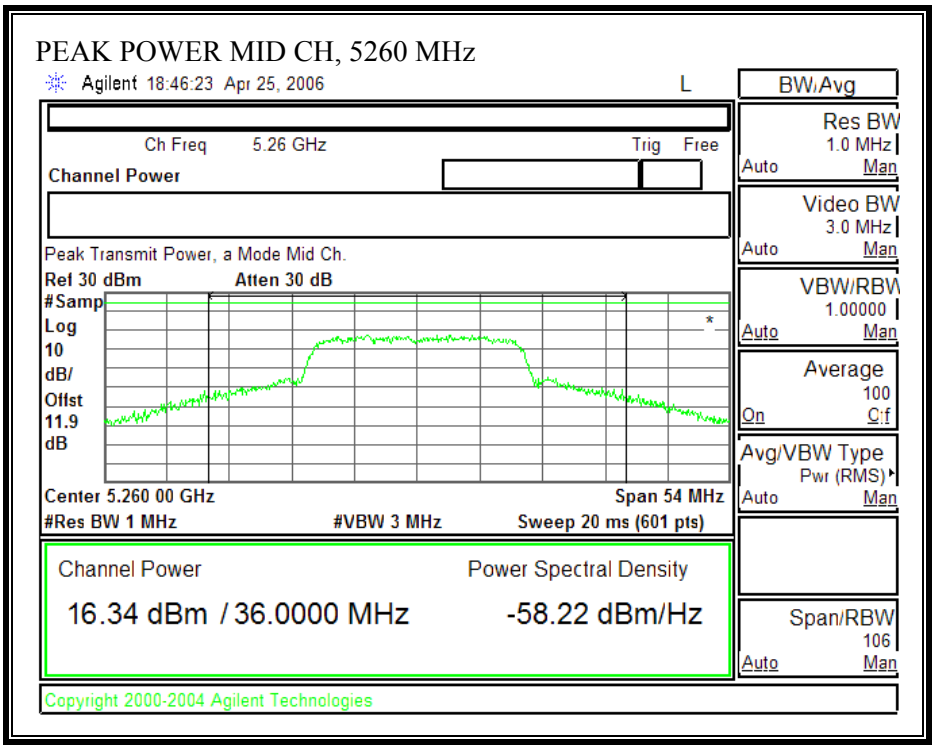


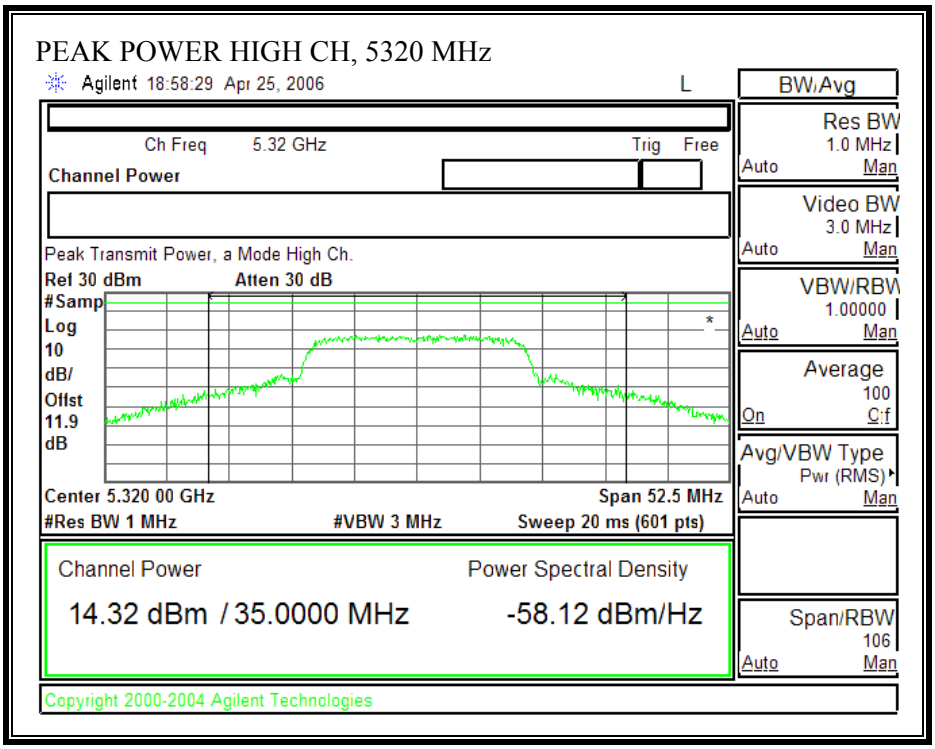




PEAK POWER (802.11 – 20MHz TX BANDWIDTH – CHAIN 1)

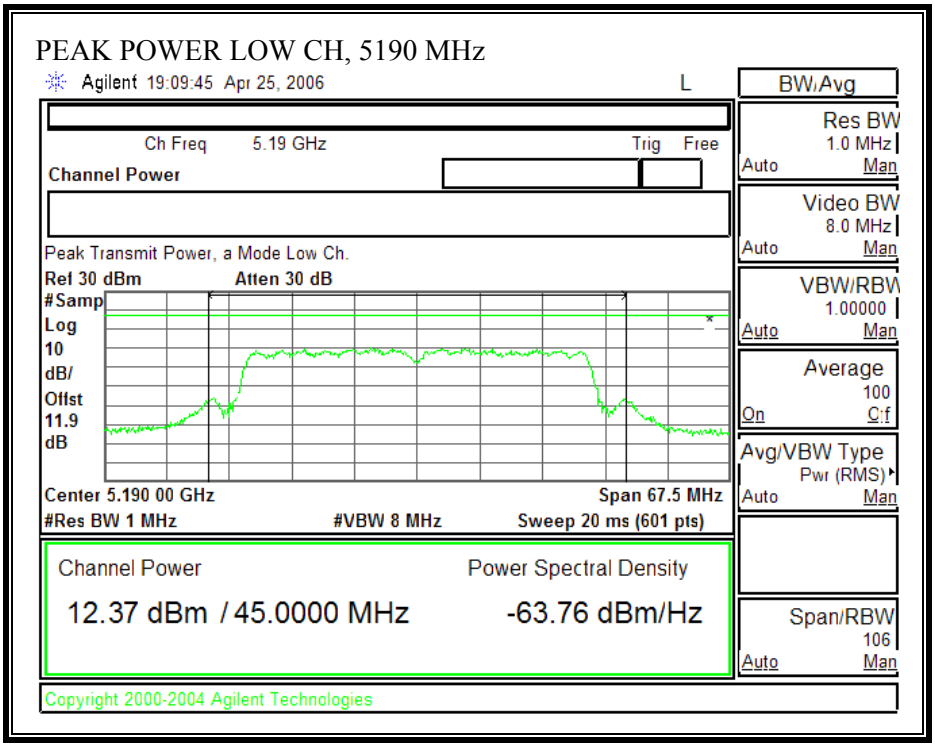


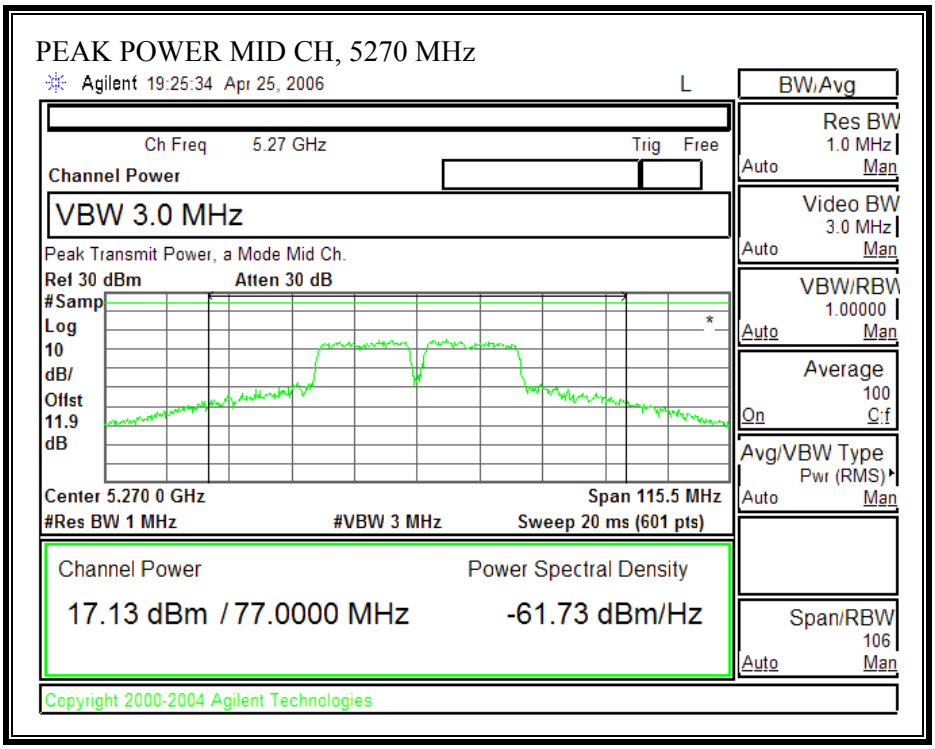


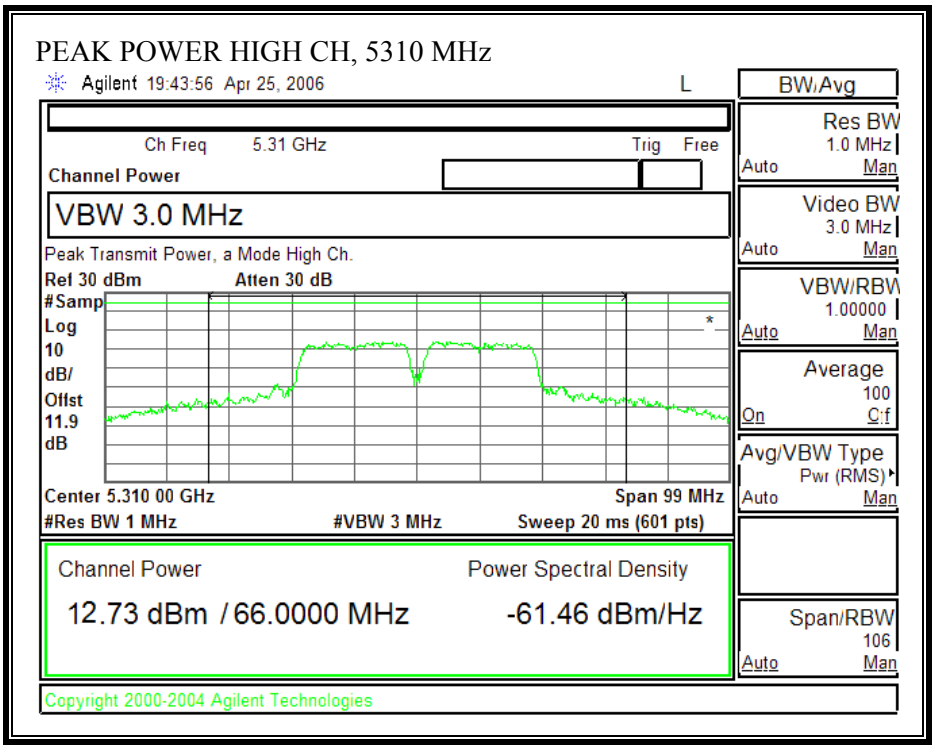


802.11n 40 MHz CDD MCS 32

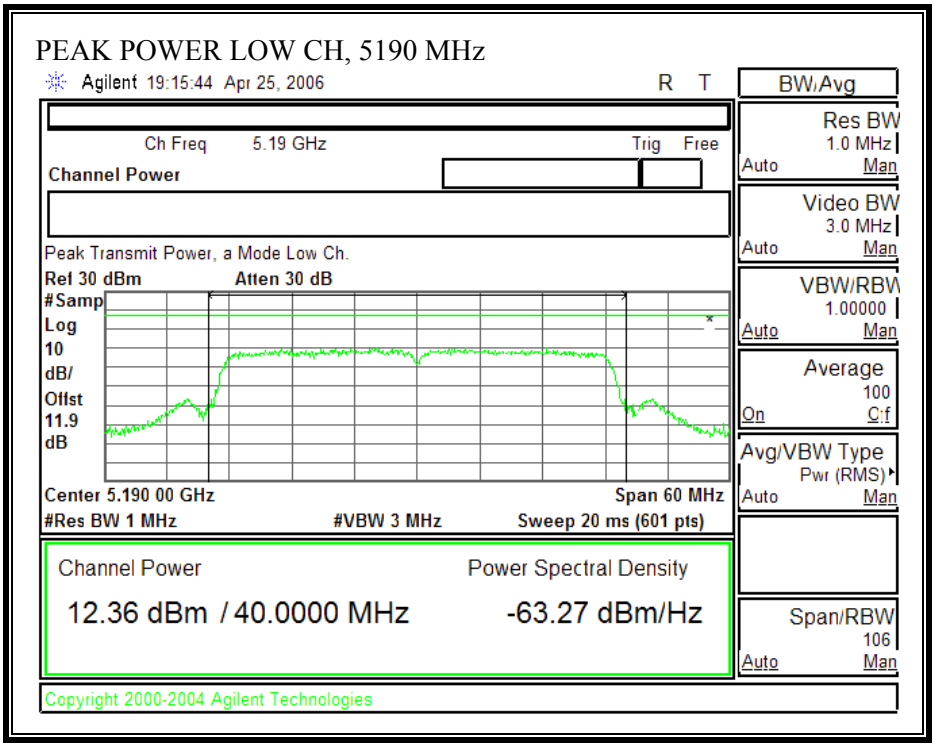
PEAK POWER (802.11 – 40MHz TX BANDWIDTH – CHAIN 0)

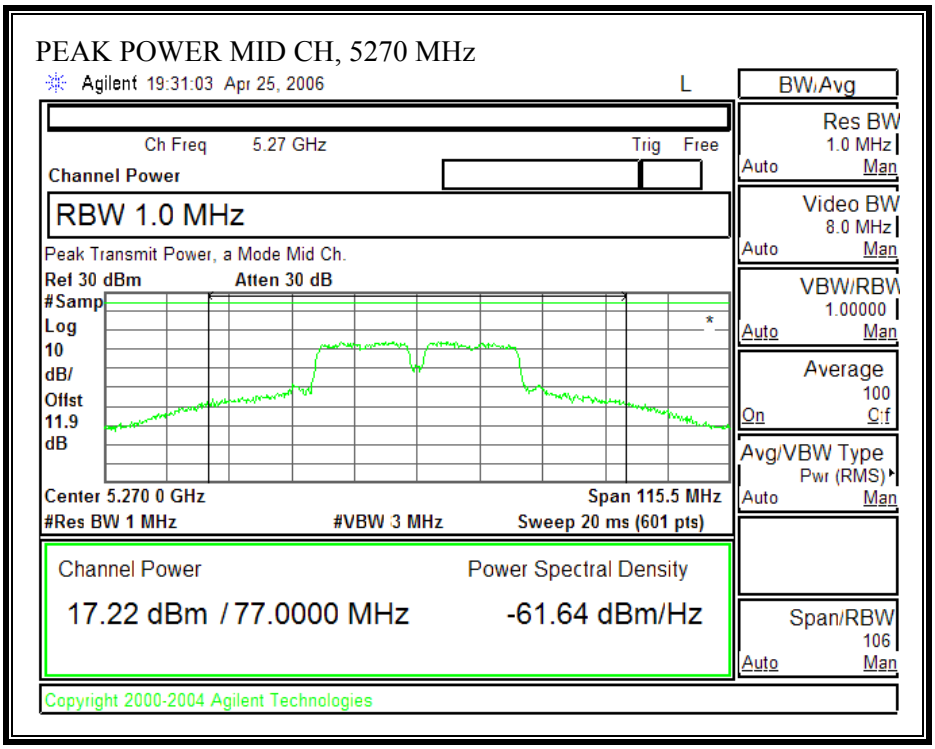


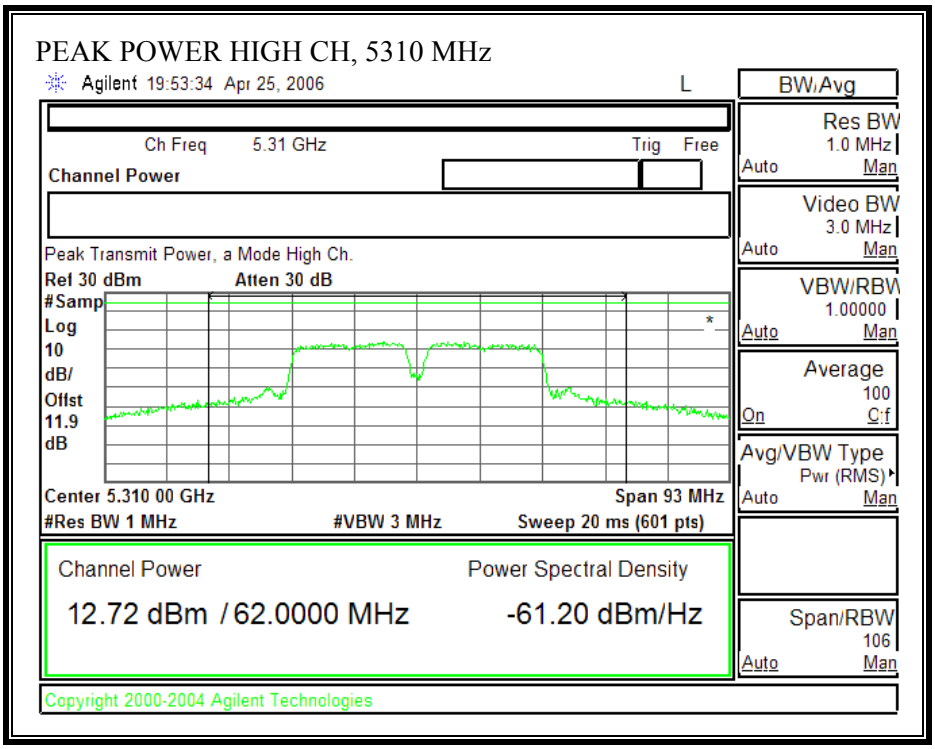




PEAK POWER (802.11 – 40MHz TX BANDWIDTH – CHAIN 1)

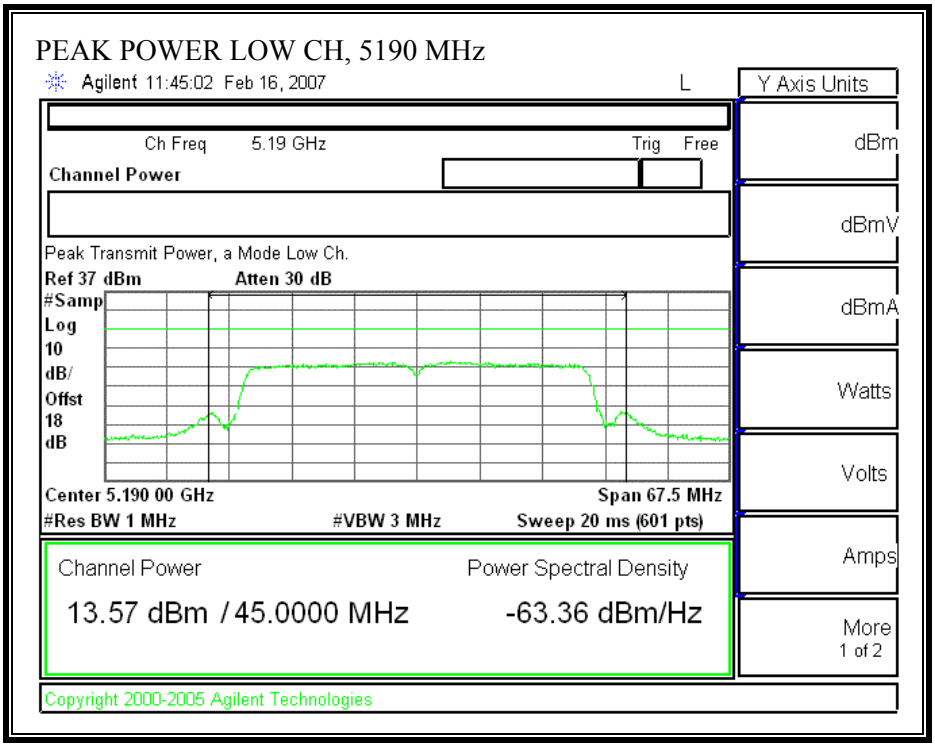




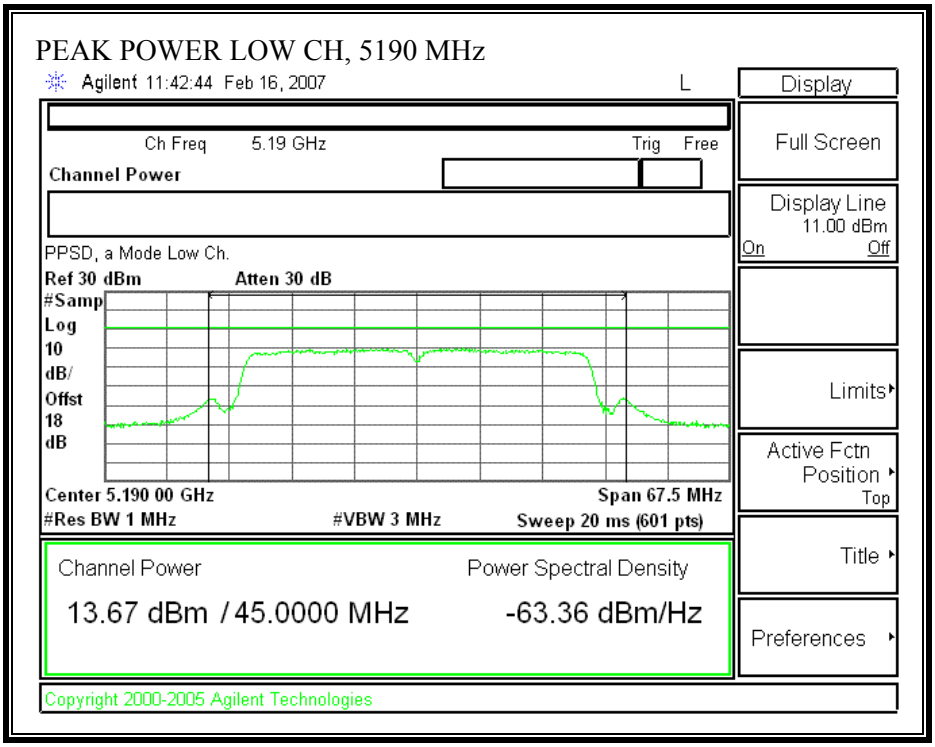


802.11n 40 MHz SDM MCS 15

PEAK POWER (802.11 – 40MHz TX BANDWIDTH – CHAIN 0)



PEAK POWER (802.11 – 40MHz TX BANDWIDTH – CHAIN 1)



7.2.3. MAXIMUM PERMISSIBLE EXPOSURE

LIMITS

§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^2)	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^2)	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^2)	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^2)	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.

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 and rearranging the terms to express the distance as a function of the remaining variables yields:

$d = \sqrt{((30 * P * G) / (3770 * S))}$

Changing to units of Power to mW and Distance to cm, using:

P (mW) = P (W) / 1000 and
d (cm) =100 * d (m)

yields

$d = 100 * \sqrt{((30 * (P / 1000) * G) / (3770 * S))}$
$d = 0.282 * \sqrt{(P * G / S)}$

where

d = distance in cm
P = Power in mW
G = Numeric antenna gain
S = Power Density in mW/cm^2

Substituting the logarithmic form of power and gain using:

P (mW) = 10 ^ (P (dBm) / 10) and
G (numeric) = 10 ^ (G (dBi) / 10)

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^2

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

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

LIMITS

From §1.1310 Table 1 (B), S = 1.0 mW/cm^2 in the 5.2 / 5.3 GHz band.

RESULTS

No non-compliance noted

802.11a CDD MODE is covered by worst case 802.11n 20 MHz CDD MCS 0

802.11n 20 MHz CDD MCS 0

Mode	MPE Distance (cm)	Power Chain 0 (dBm)	Power Chain 1 (dBm)	Total Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
802.11n 20 MHz CDD MCS 0	20.0	16.22	16.34	19.29	7.69	0.05

802.11n 40 MHz CDD MCS 32

Mode	MPE Distance (cm)	Power Chain 0 (dBm)	Power Chain 1 (dBm)	Total Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
802.11n 40 MHz CDD MCS 32	20.0	17.13	17.22	20.19	7.69	0.06

802.11n 40 MHz SDM MCS 15

Mode	MPE Distance (cm)	Output Power (dBm)	Output Power (dBm)	Total Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
802.11n 40 MHz SDM MCS 15	20.0	13.57	13.67	16.63	5.60	0.02

NOTE: For mobile or fixed location transmitters, the minimum separation distance is 20 cm, even if calculations indicate that the MPE distance would be less.

7.2.4. PEAK POWER SPECTRAL DENSITY

LIMIT

§15.407 (a) (1) For the band 5.15-5.25 GHz, 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 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.

§15.407 (a) (1) For the band 5.25-5.35 GHz, the peak power spectral density shall not exceed 11 dBm in any 1-MHz band. 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.

The maximum antenna gain > 6dBi for CDD modes, therefore there is a reduction due to antenna gain.

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. PPSD method #2 was used.

Following formula to calculate the array gain:

Array gain = 10*log (10^ (main gain/10) + 10^ (aux gain/10))

5.15 – 5.25GHz band: 6.439 dBi, limit = 3.56 dBm
5.25 – 5.35GHz band: 7.686 dBi, limit = 9.31 dBm

For single chain SDM, no reduction:

5.15 – 5.25GHz band: 3.90dBi
5.25 – 5.35GHz band: 5.60dBi

RESULTS

No non-compliance noted:

802.11n 20 MHz CDD MCS 0

Channel	Frequency (MHz)	PPSD Chain 0 (dBm)	PPSD Chain 1 (dBm)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Low	5180	-0.89	-1.64	1.76	3.56	-1.80
Middle	5260	4.05	4.24	7.16	9.31	-2.16
High	5320	3.66	2.49	6.13	9.31	-3.19

802.11n 40 MHz CDD MCS 32

Channel	Frequency (MHz)	PPSD Chain 0 (dBm)	PPSD Chain 1 (dBm)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Low	5190	0.05	-0.06	3.01	3.56	-0.56
Middle	5270	5.11	3.82	7.52	9.31	-1.79
High	5310	3.87	3.61	6.75	9.31	-2.56

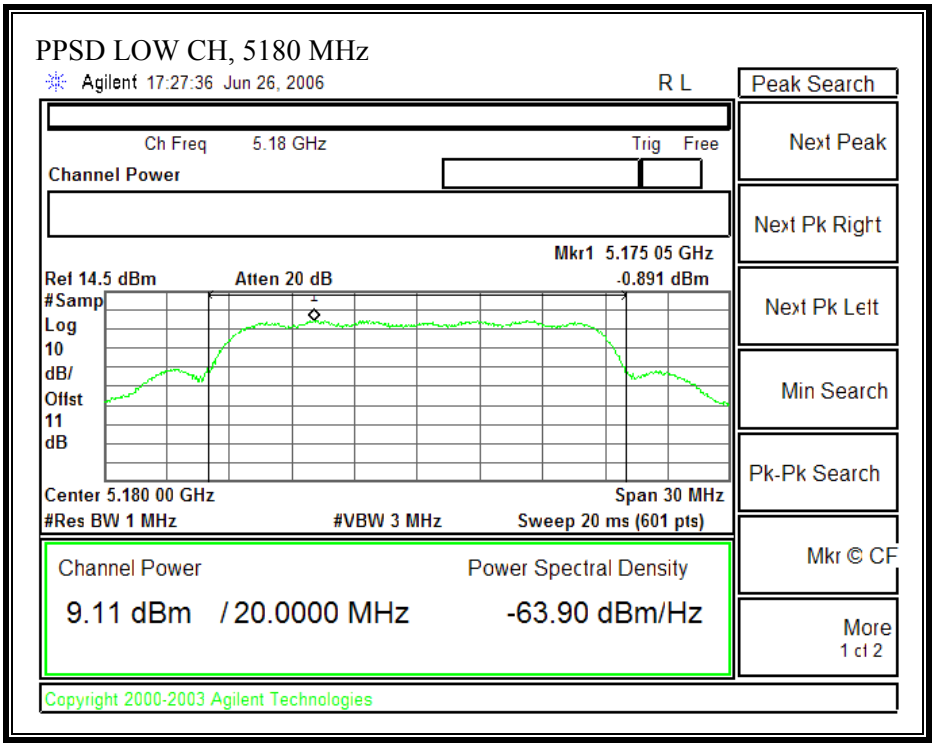
Note: The power in the 40 MHz SDM mode is increased, relative to the power in the 40 MHz CDD mode, only in the 5150 to 5250 MHz band. The power in the 40 MHz SDM mode is identical to the power in the 40 MHz CDD mode in the 5250 to 5350 MHz band, with lower antenna gain for the SDM mode. Data in the table below only shows the differences within the 5150 to 5250 MHz band.

802.11n 40 MHz SDM MCS 15

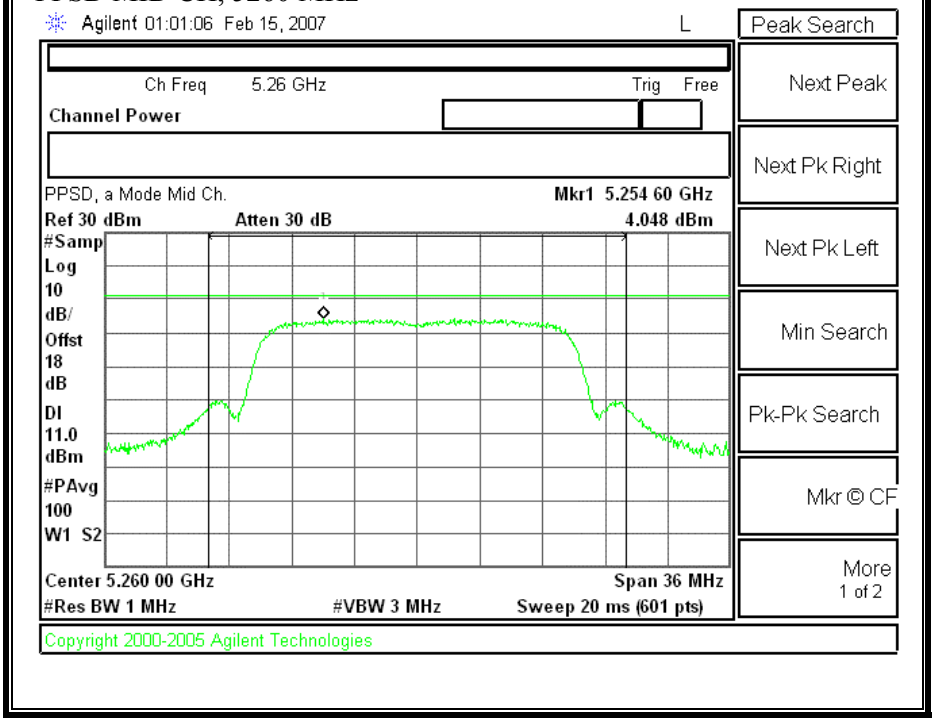
Channel	Frequency (MHz)	PPSD Chain 0 (dBm)	PPSD Chain 1 (dBm)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Low	5190	0.58	0.39	3.50	4.00	-0.50

802.11n 20 MHz CDD MCS 0

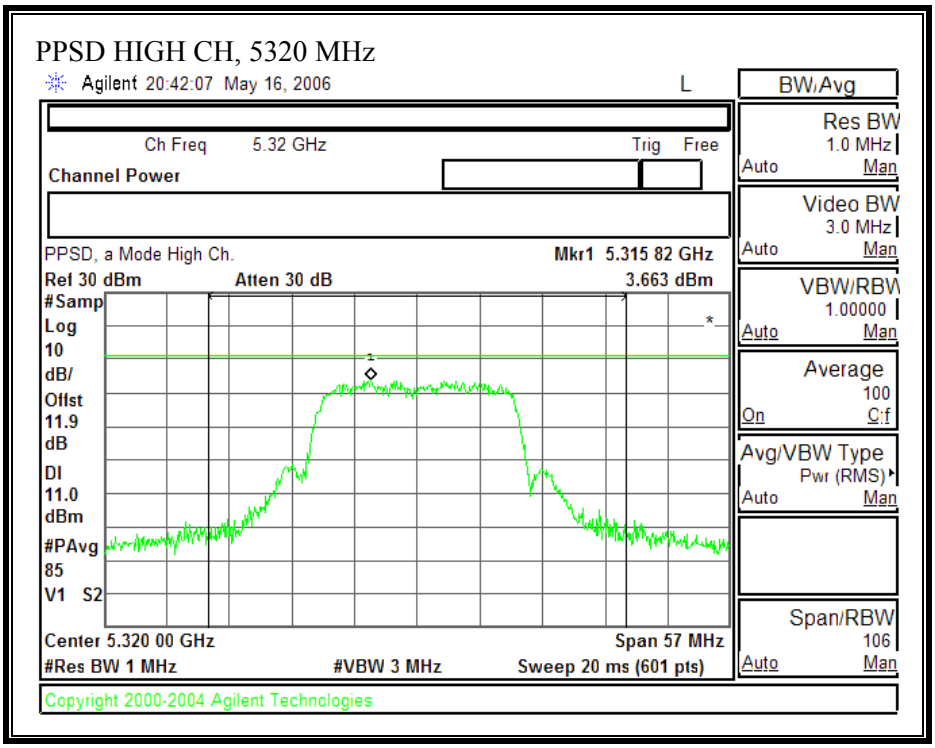
PEAK POWER SPECTRAL DENSITY (802.11 - 20 MHz TX BANDWIDTH – CHAIN 0)



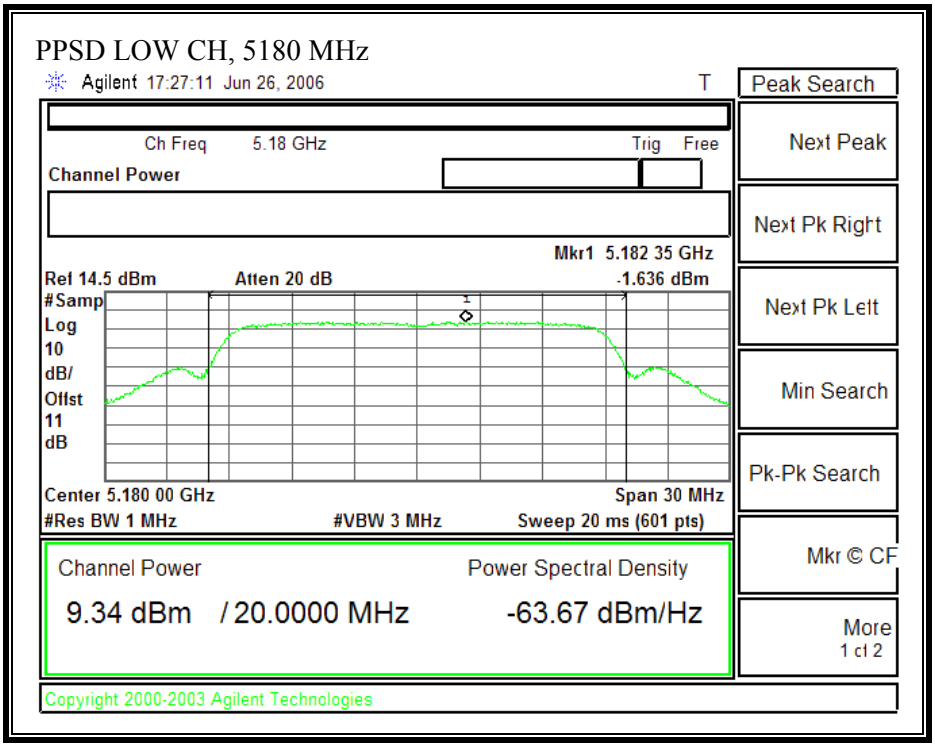
PPSD MID CH, 5260 MHz



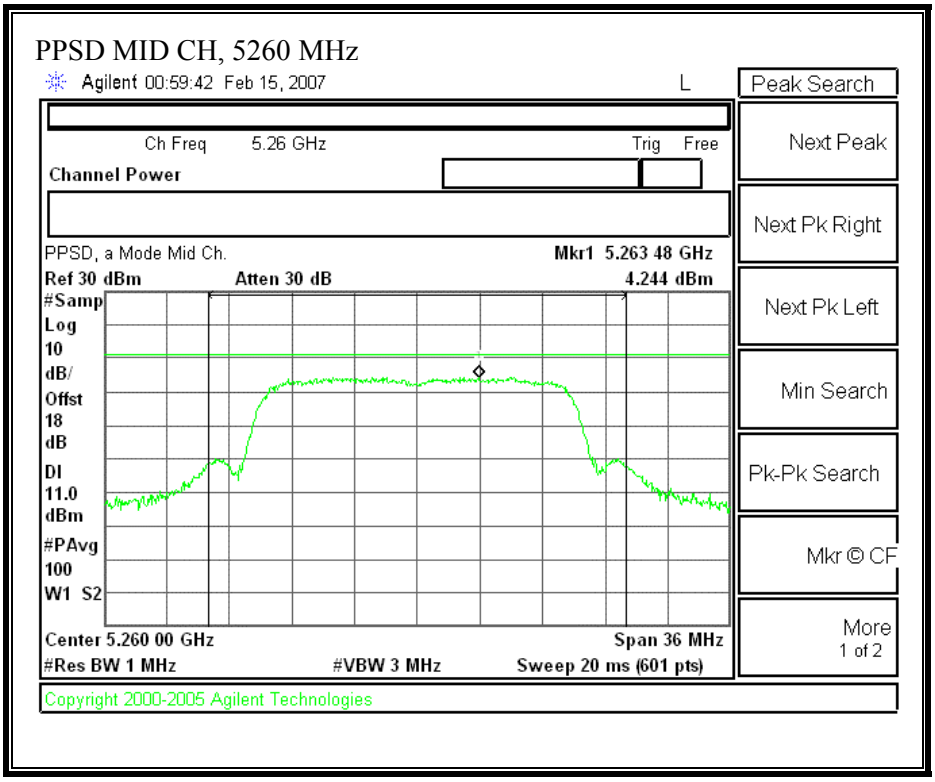
PPSD HIGH CH, 5320 MHz



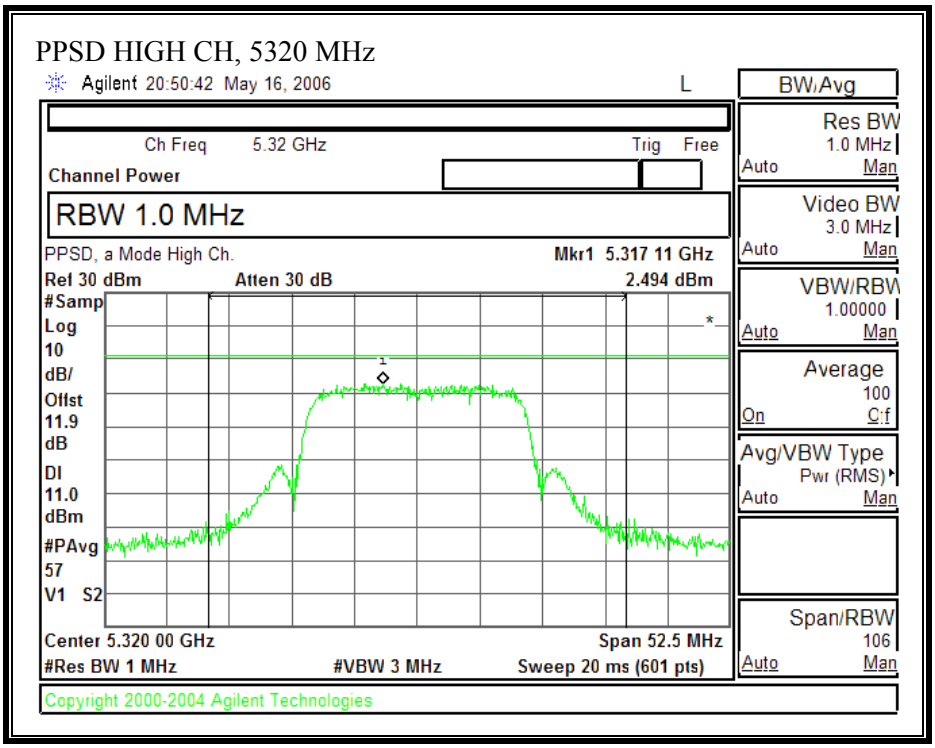
PEAK POWER SPECTRAL DENSITY (802.11 - 20 MHz TX BANDWIDTH – CHAIN 1)



PPSD MID CH, 5260 MHz

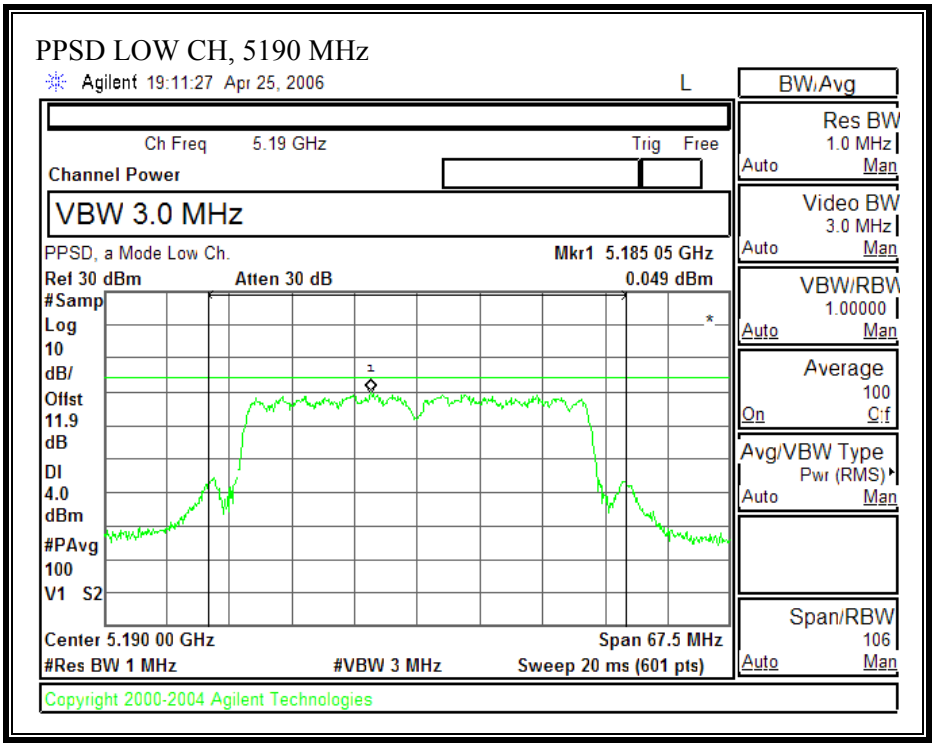


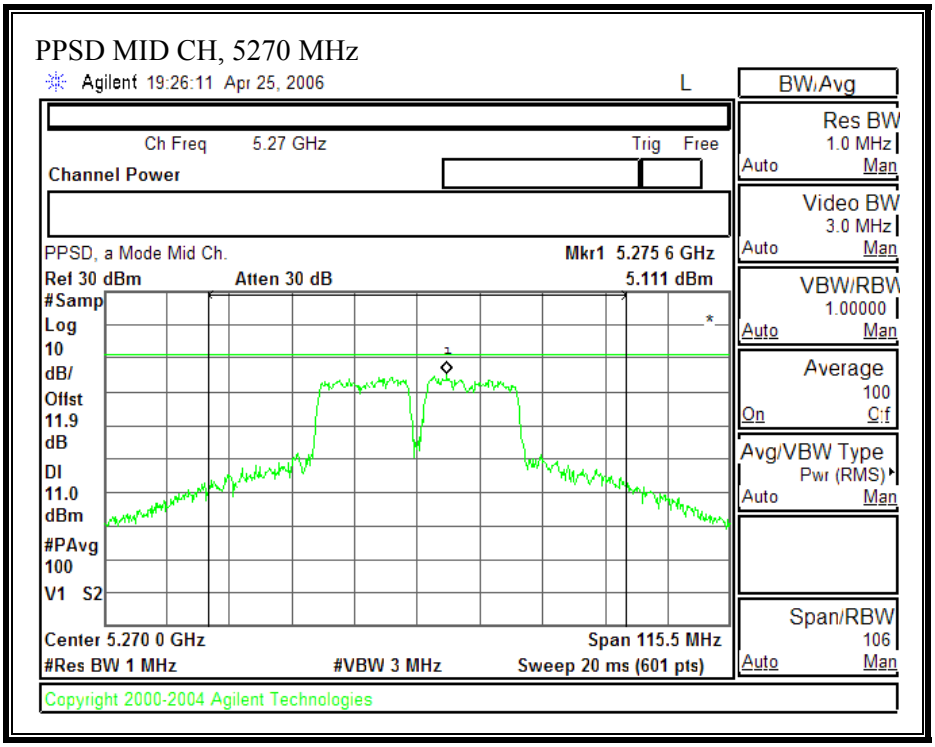
PPSD HIGH CH, 5320 MHz

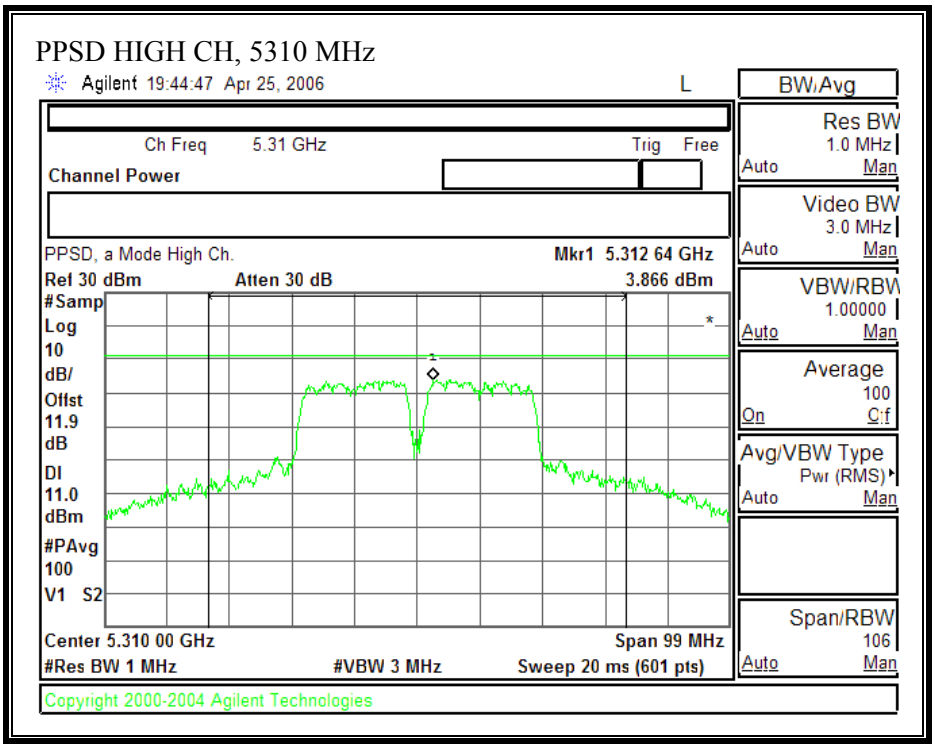


802.11n 40 MHz CDD MCS 32

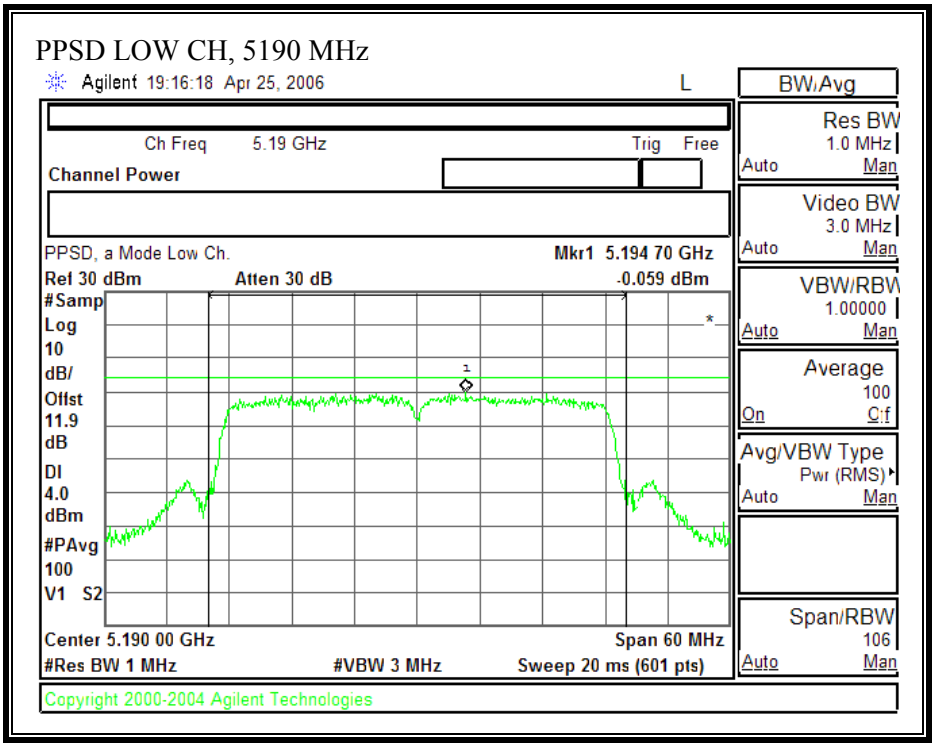
PEAK POWER SPECTRAL DENSITY (802.11 - 40 MHz TX BANDWIDTH – CHAIN 0)



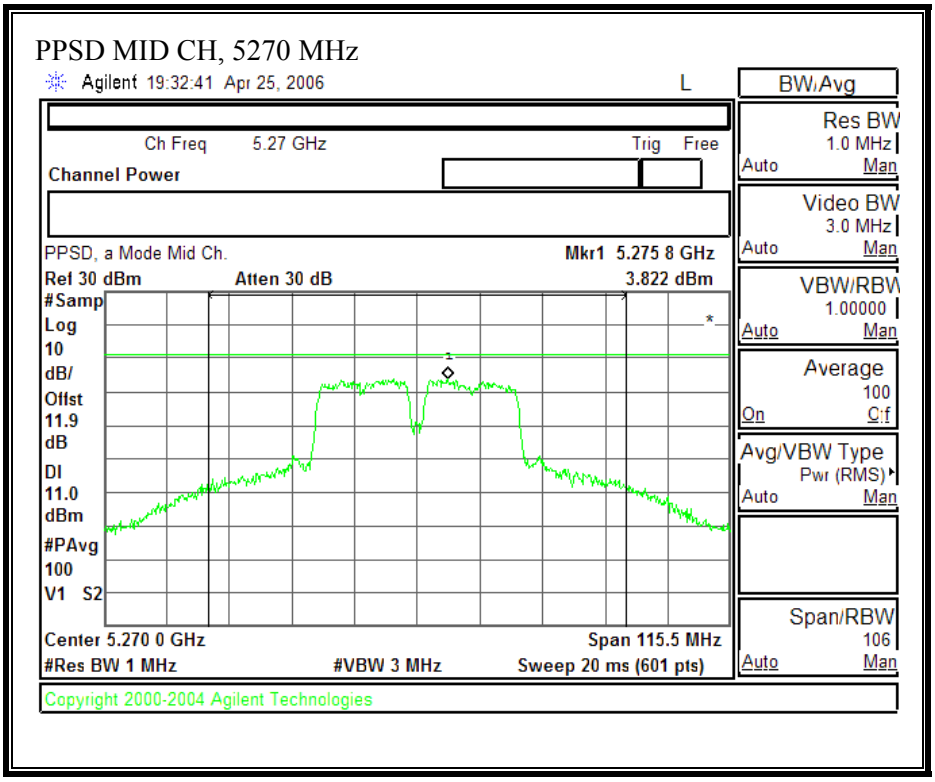




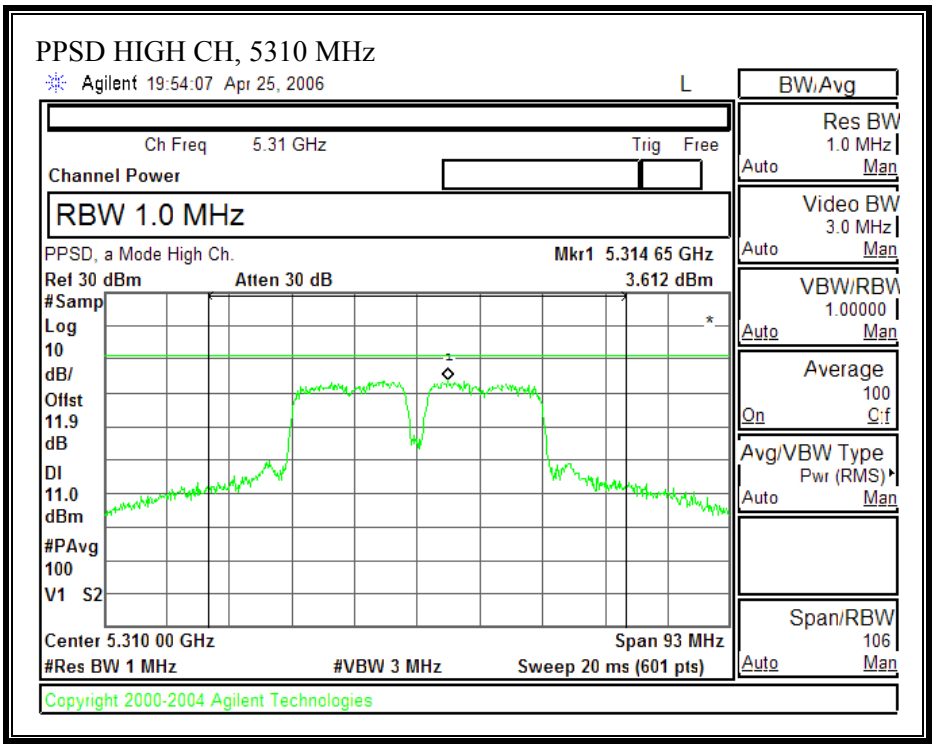
PEAK POWER SPECTRAL DENSITY (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)



PPSD MID CH, 5270 MHz

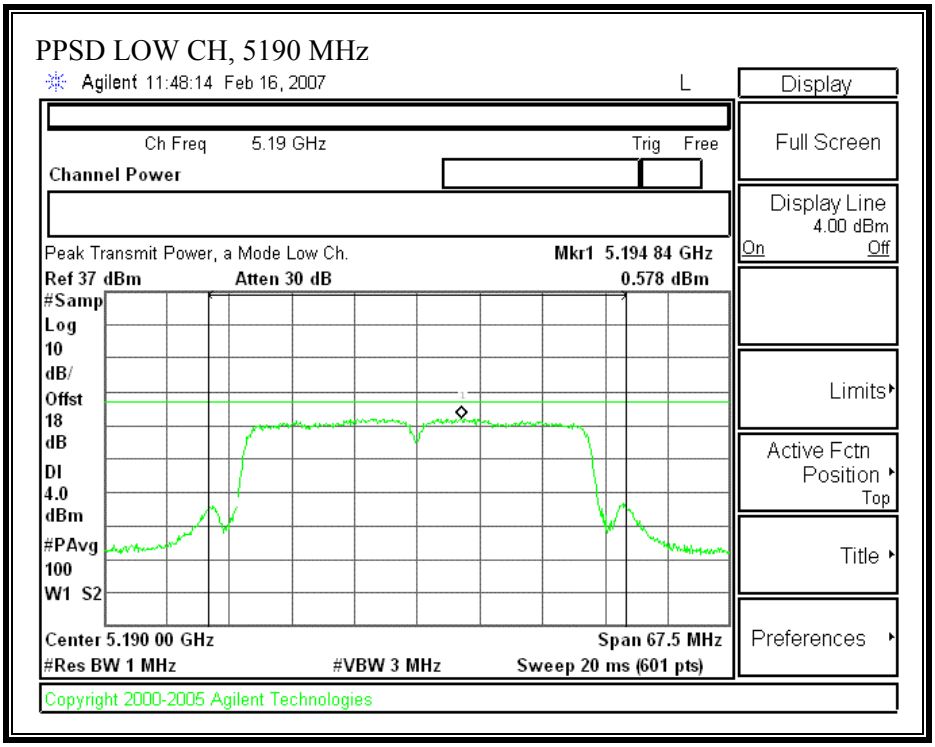


PPSD HIGH CH, 5310 MHz

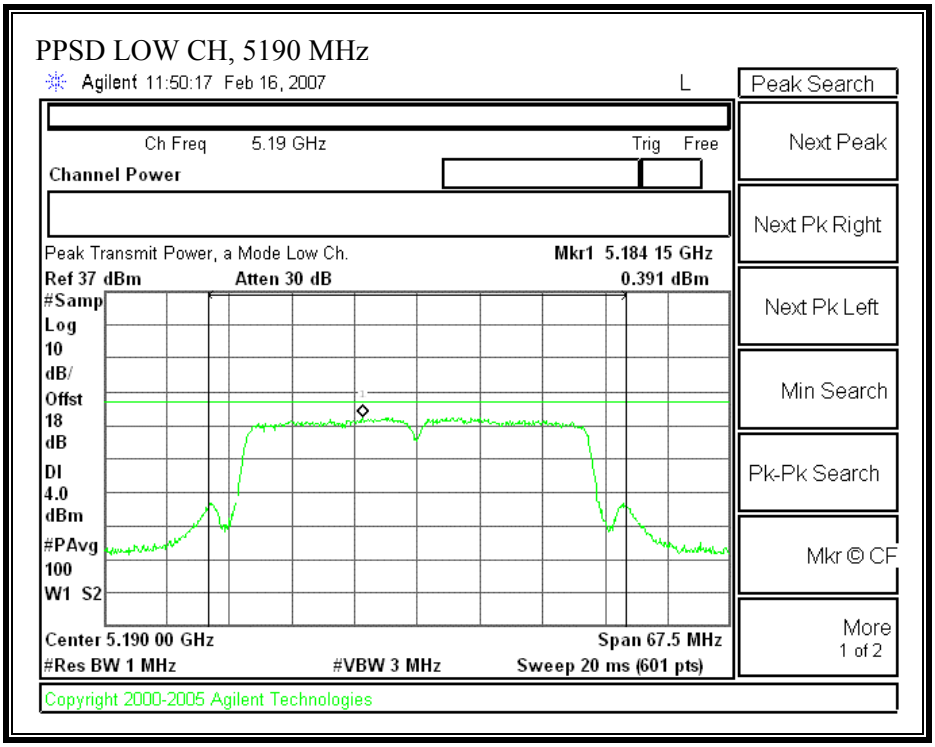


802.11n 40 MHz SDM MCS 15

PEAK POWER SPECTRAL DENSITY (802.11 - 40 MHz TX BANDWIDTH – CHAIN 0)



PEAK POWER SPECTRAL DENSITY (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)



7.2.5. PEAK EXCURSION

LIMIT

§15.407 (a) (6) The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified above) shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

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.

Since Method # 1 was used for peak power measurements, Method # 1 settings are used for the second PPSD trace.

RESULTS

No non-compliance noted:

802.11n 20 MHz CDD MCS 0

20 MHz TX BANDWIDTH - CHAIN 0

Channel	Frequency (MHz)	Peak Excursion Chain 0 (dB)	Limit (dB)	Margin (dB)
Low	5180	8.60	13	-4.40
Middle	5260	8.31	13	-4.69
High	5320	9.14	13	-3.86

20 MHz TX BANDWIDTH - CHAIN 1

Channel	Frequency (MHz)	Peak Excursion Chain 1 (dB)	Limit (dB)	Margin (dB)
Low	5180	10.72	13	-2.28
Middle	5260	8.01	13	-4.99
High	5320	11.25	13	-1.75

802.11n 40 MHz CDD MCS 32

40 MHz TX BANDWIDTH - CHAIN 0

Channel	Frequency (MHz)	Peak Excursion Chain 0 (dB)	Limit (dB)	Margin (dB)
Low	5190	11.18	13	-1.82
Middle	5270	9.57	13	-3.43
High	5310	9.23	13	-3.77

40 MHz TX BANDWIDTH - CHAIN 1

Channel	Frequency (MHz)	Peak Excursion Chain 1 (dB)	Limit (dB)	Margin (dB)
Low	5190	10.34	13	-2.66
Middle	5270	11.72	13	-1.28
High	5310	9.60	13	-3.40

802.11n 40 MHz SDM MCS15

40 MHz TX BANDWIDTH - CHAIN 0

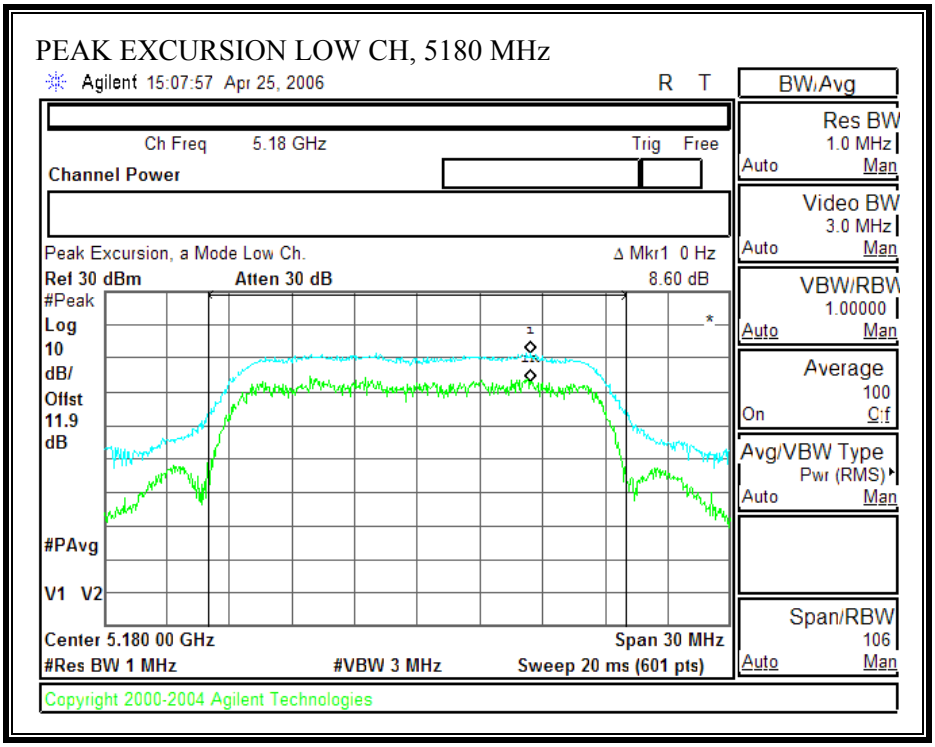
Channel	Frequency (MHz)	Peak Excursion Chain 0 (dB)	Limit (dB)	Margin (dB)
Low	5190	12.03	13	-0.97

40 MHz TX BANDWIDTH - CHAIN 1

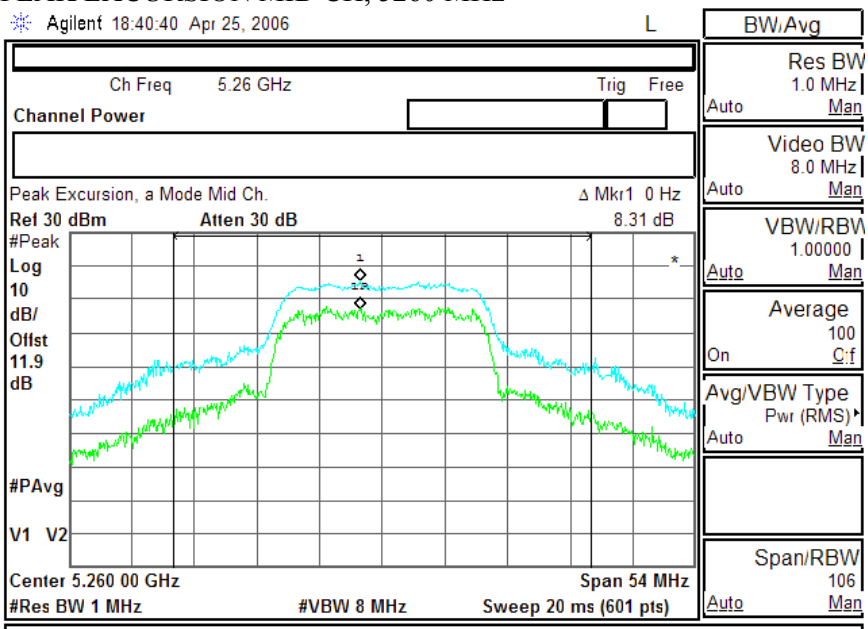
Channel	Frequency (MHz)	Peak Excursion Chain 1 (dB)	Limit (dB)	Margin (dB)
Low	5190	12.18	13	-0.82

802.11n 20 MHz CDD MCS 0

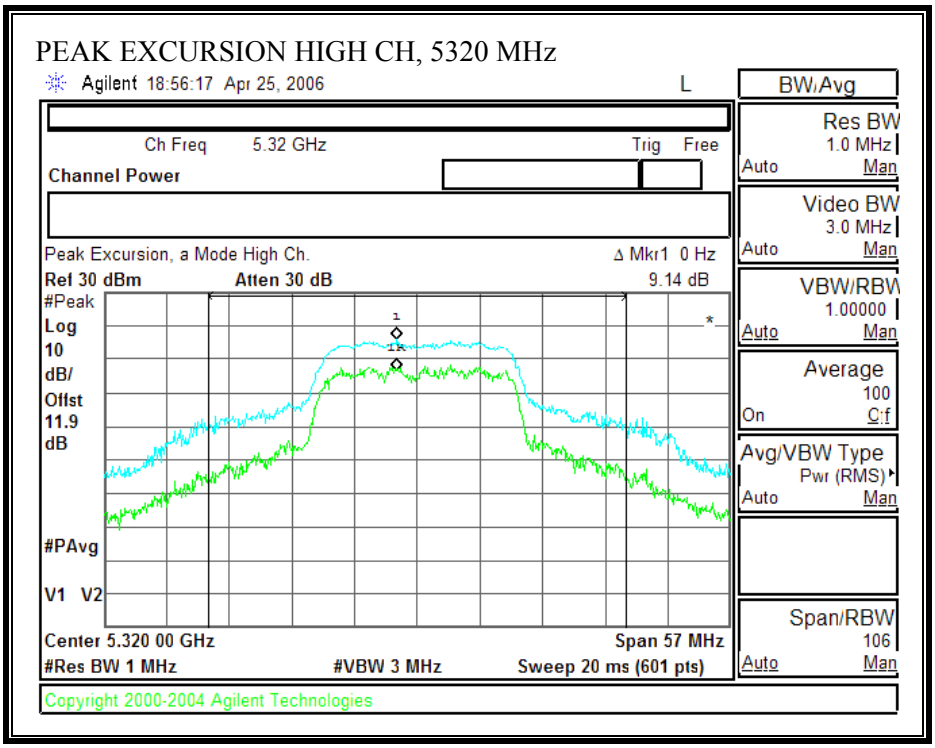
PEAK EXCURSION (802.11 - 20 MHz TX BANDWIDTH – CHAIN 0)



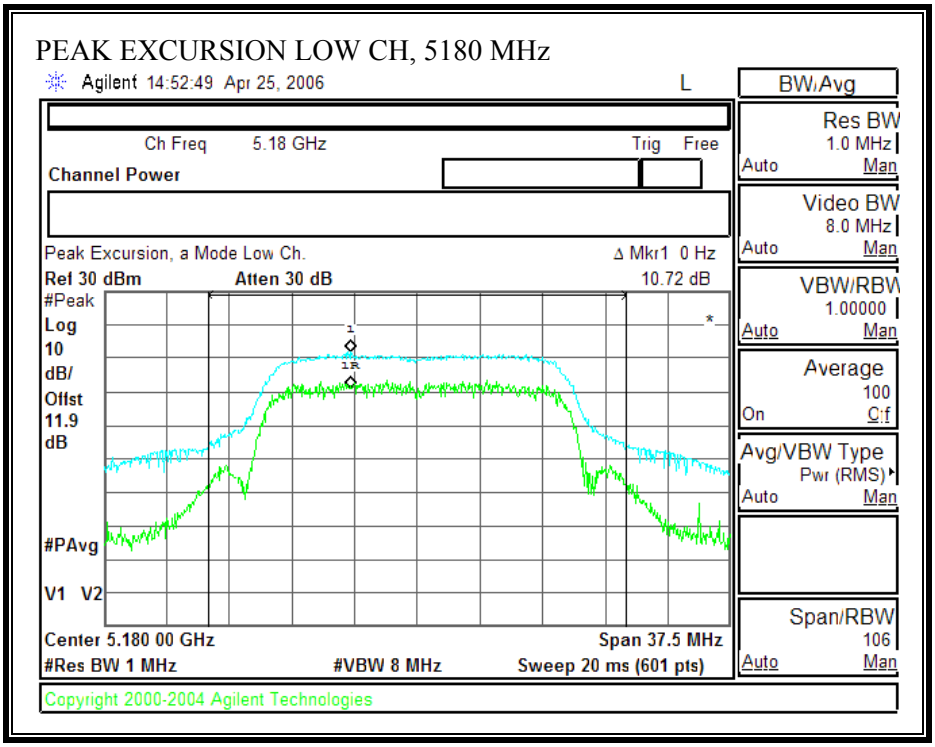
PEAK EXCURSION MID CH, 5260 MHz



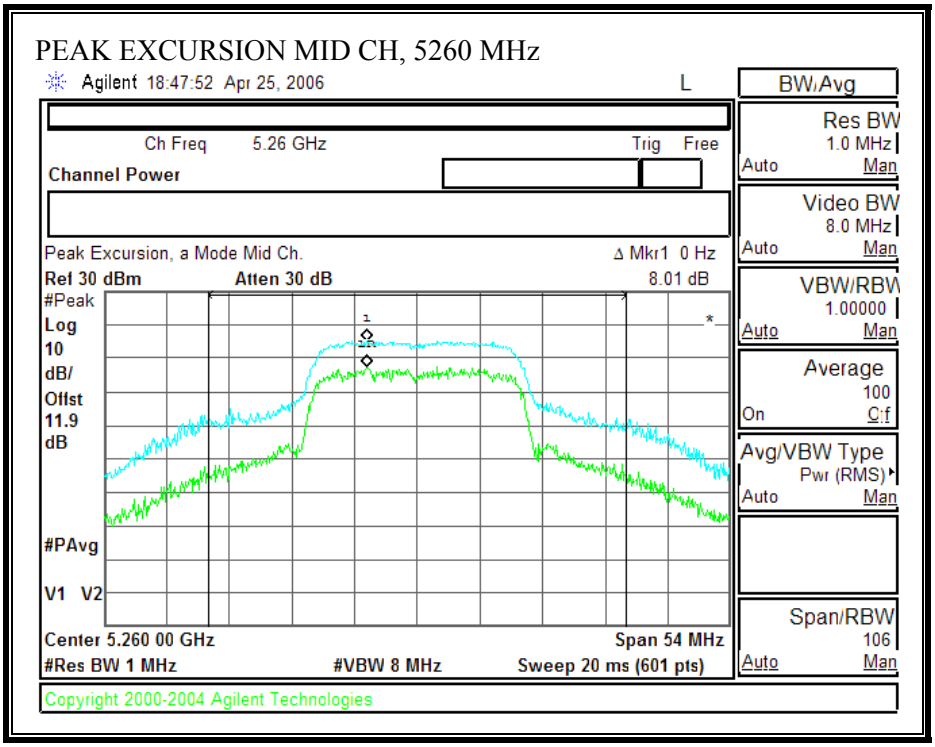
PEAK EXCURSION HIGH CH, 5320 MHz



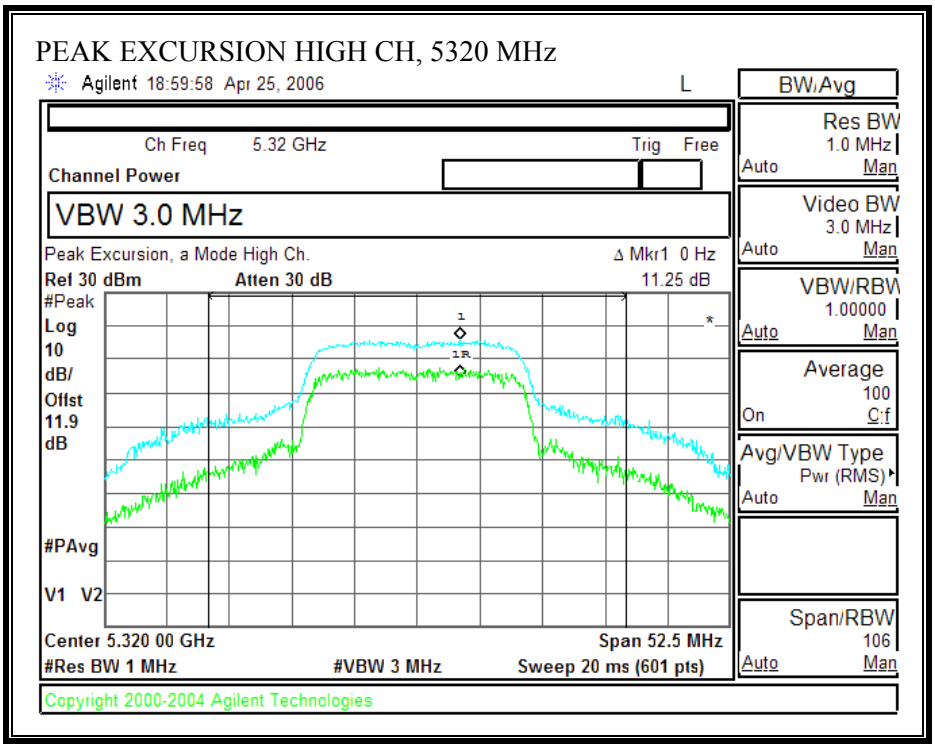
PEAK EXCURSION (802.11 - 20 MHz TX BANDWIDTH – CHAIN 1)



PEAK EXCURSION MID CH, 5260 MHz

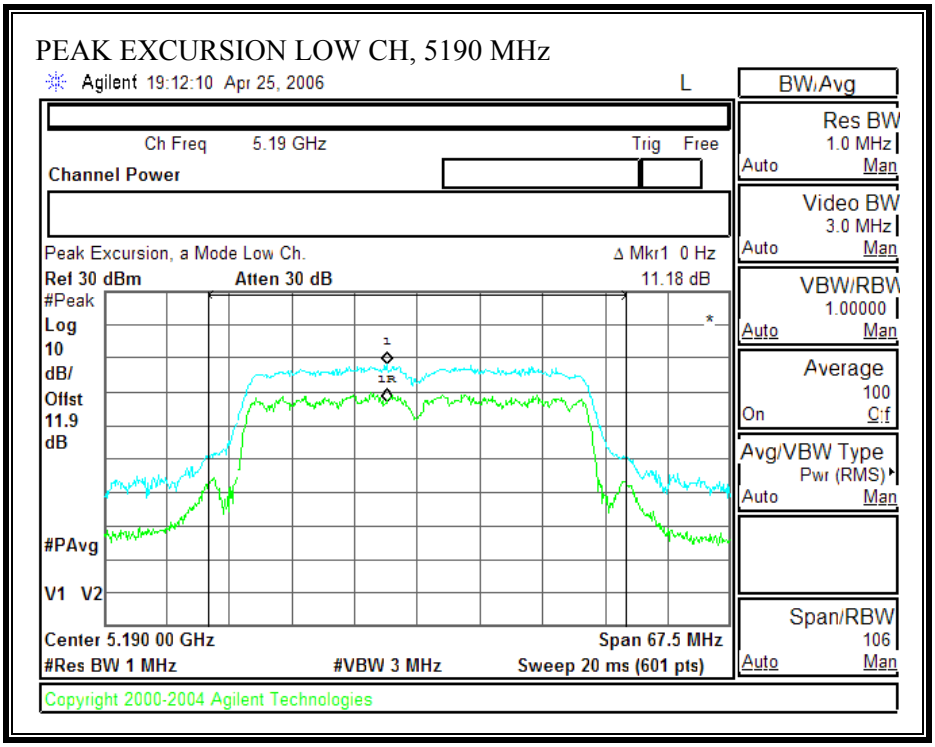


PEAK EXCURSION HIGH CH, 5320 MHz

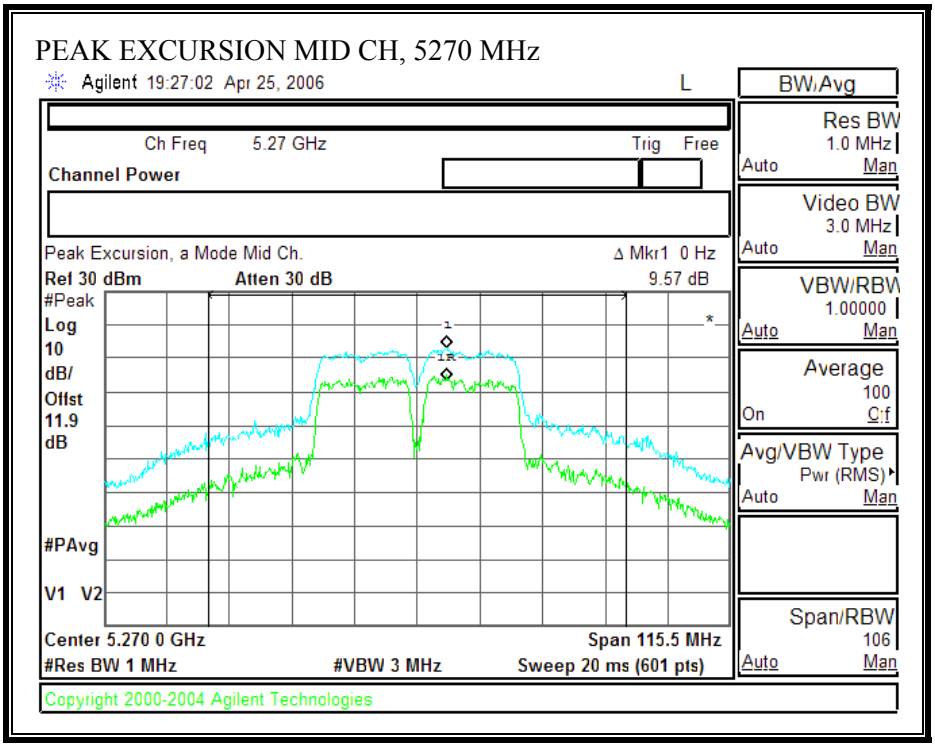


802.11n 40 MHz CDD MCS 32

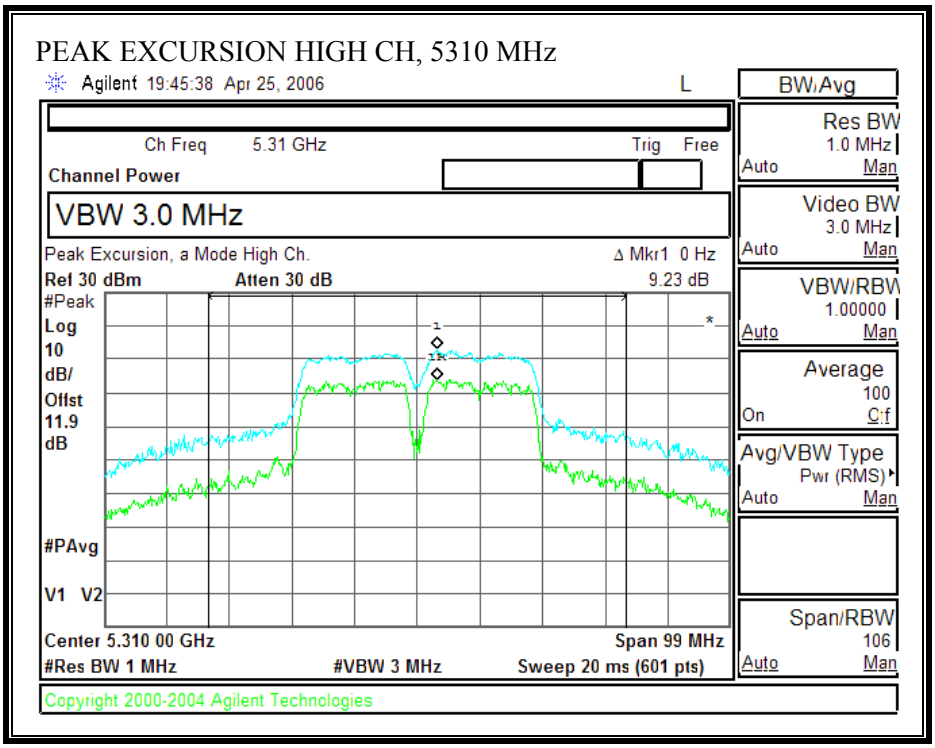
PEAK EXCURSION (802.11 - 40 MHz TX BANDWIDTH – CHAIN 0)



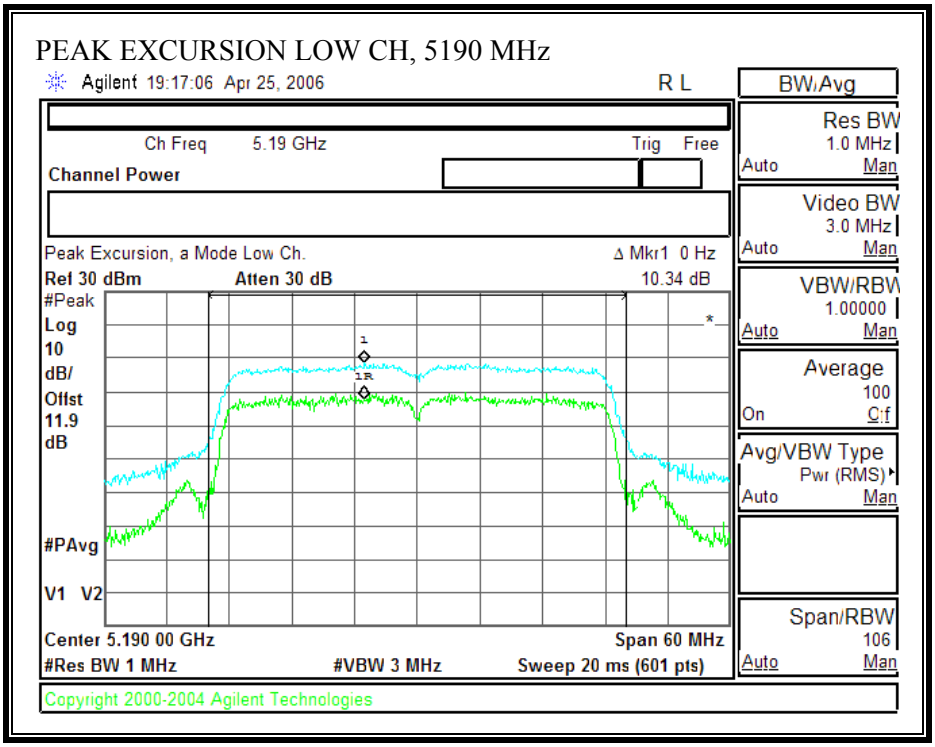
PEAK EXCURSION MID CH, 5270 MHz



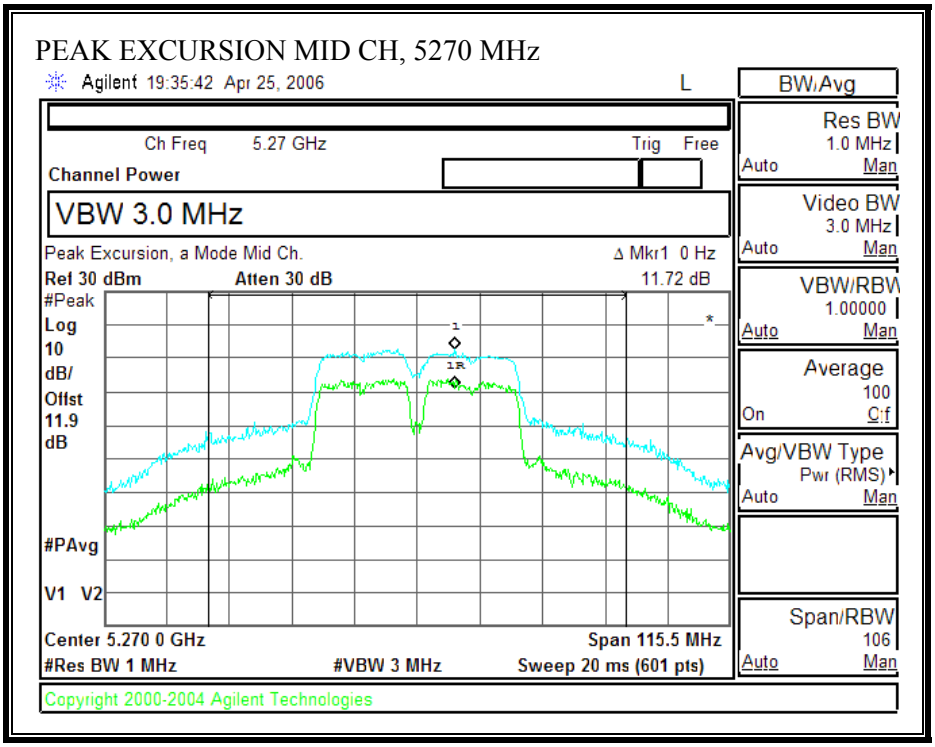
PEAK EXCURSION HIGH CH, 5310 MHz



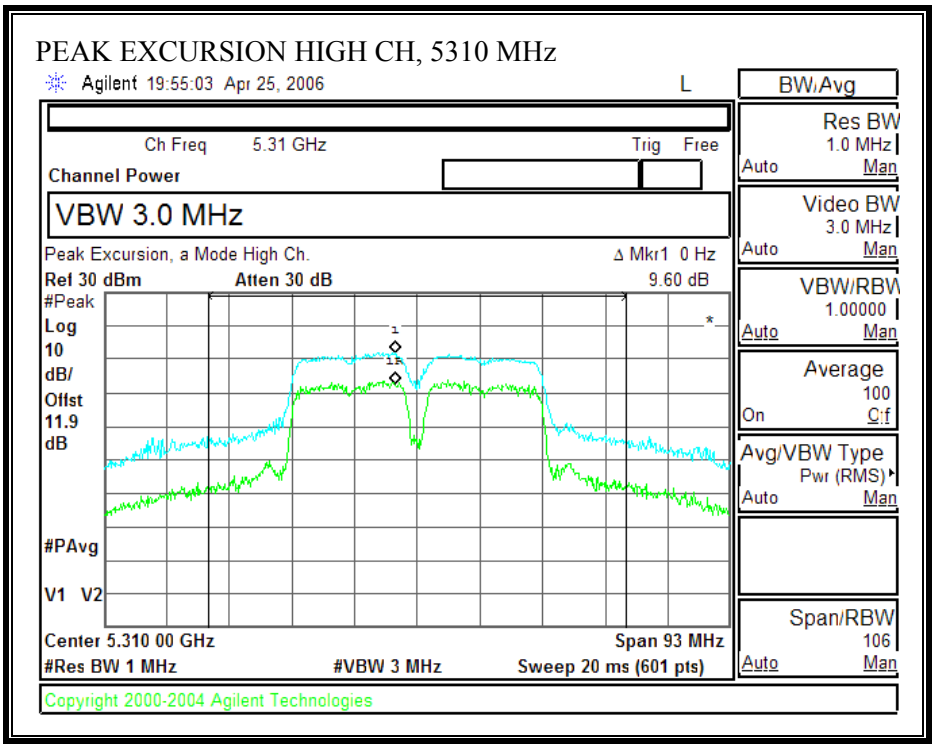
PEAK EXCURSION (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)



PEAK EXCURSION MID CH, 5270 MHz

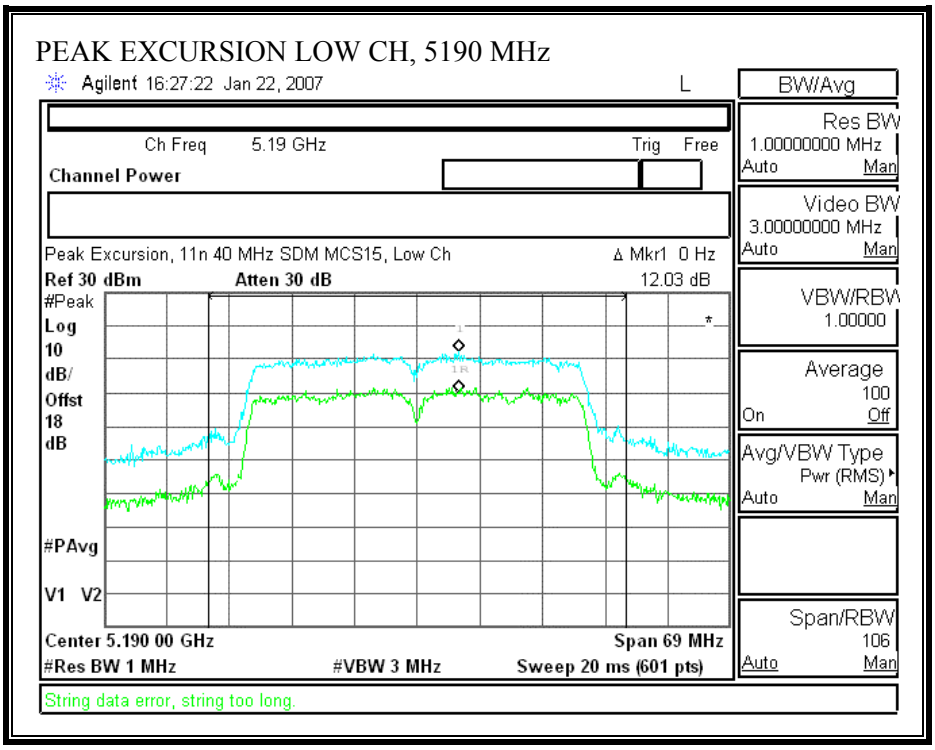


PEAK EXCURSION HIGH CH, 5310 MHz

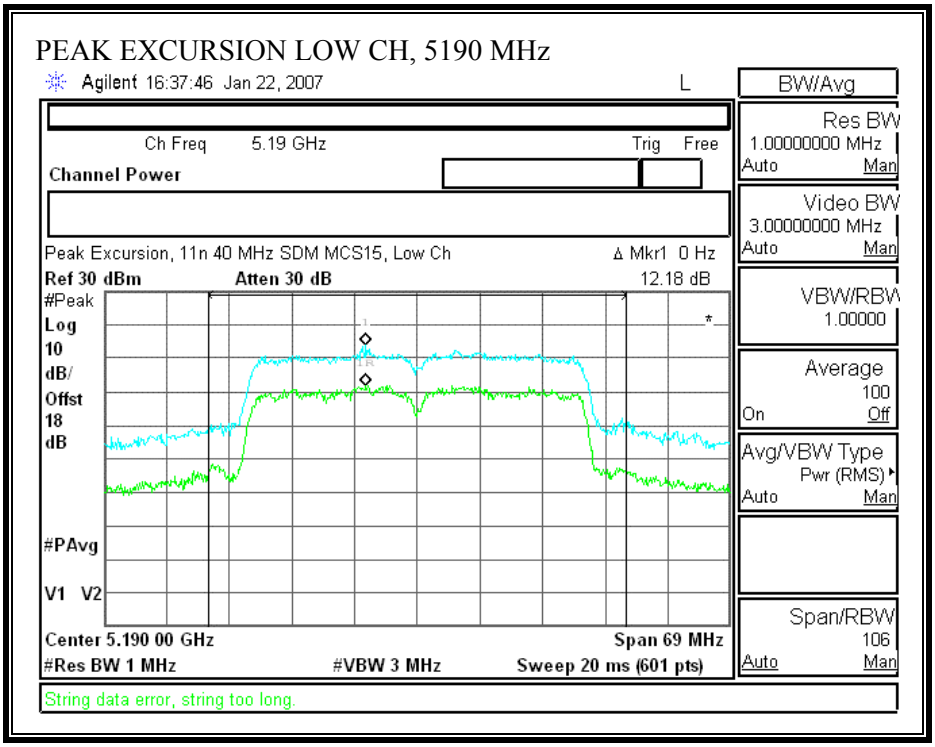


802.11n 40 MHz SDM MCS 15

PEAK EXCURSION (802.11 - 40 MHz TX BANDWIDTH – CHAIN 0)



PEAK EXCURSION (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)



7.2.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

§15.407 (b) (1 & 2) For transmitters operating in the 5.15-5.35 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27dBm / MHz.

TEST PROCEDURE

Conducted RF measurements of the transmitter output are made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to the average EIRP limit, adjusted for the maximum antenna gain. If necessary, additional average detection measurements are made.

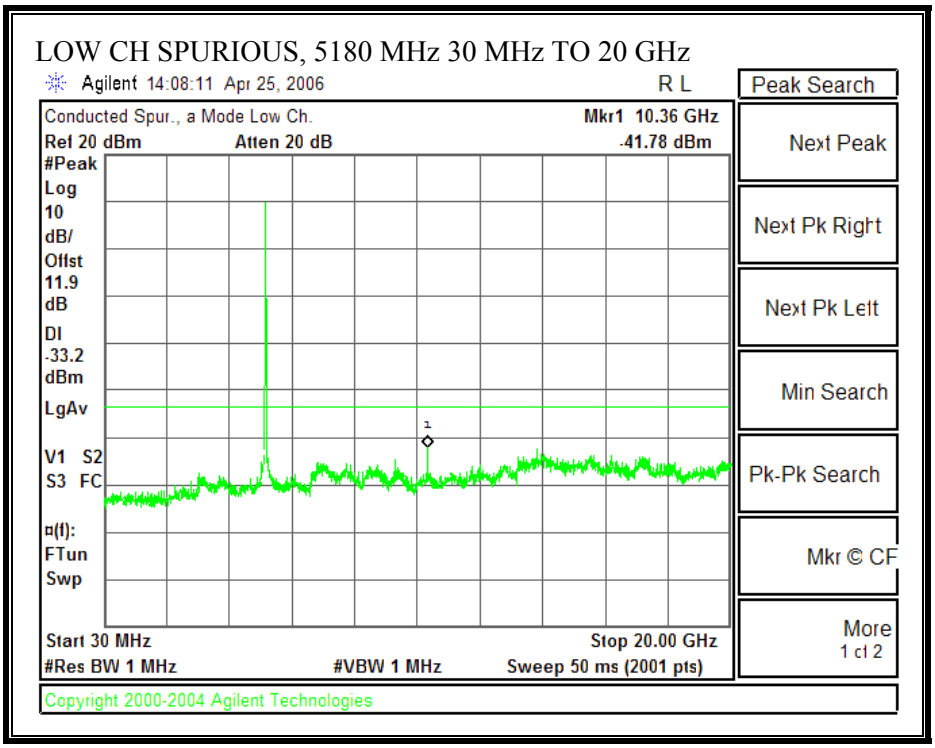
Measurements are made over the 30 MHz to 40 GHz range with the transmitter set to the lowest, middle, and highest channels.

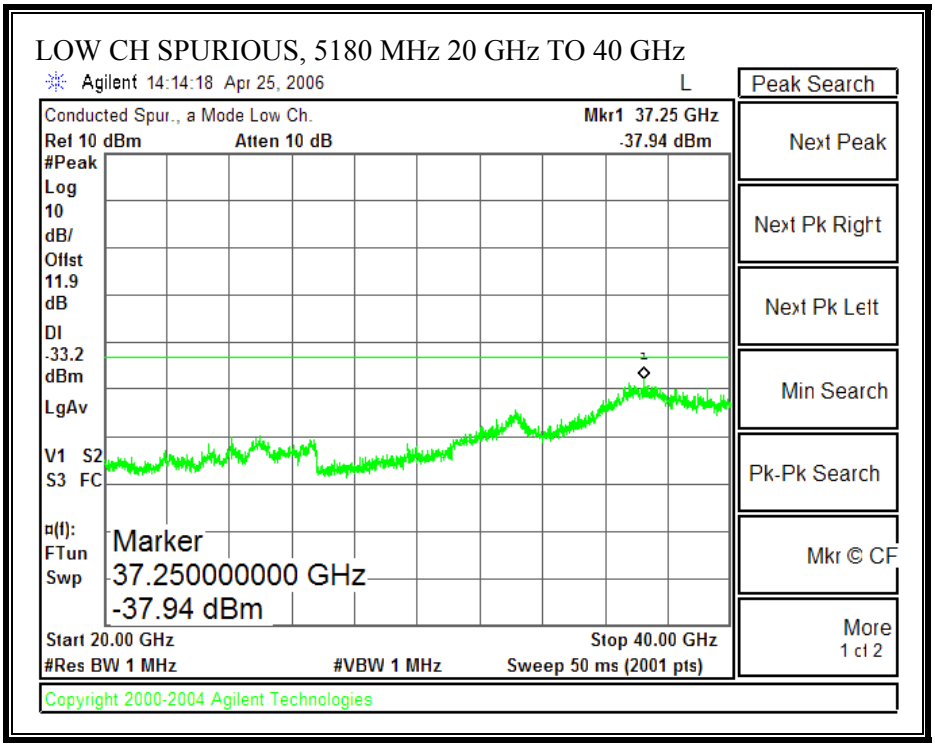
RESULTS

No non-compliance noted:

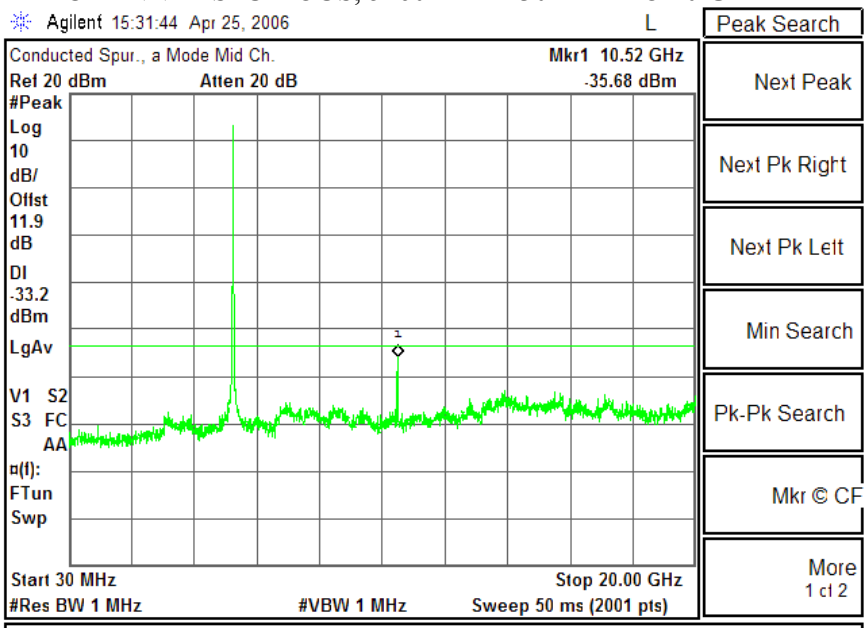
802.11n 20 MHz CDD MCS 0

SPURIOUS EMISSIONS - 802.11a -20 MHz TX BANDWIDTH - CHAIN 0

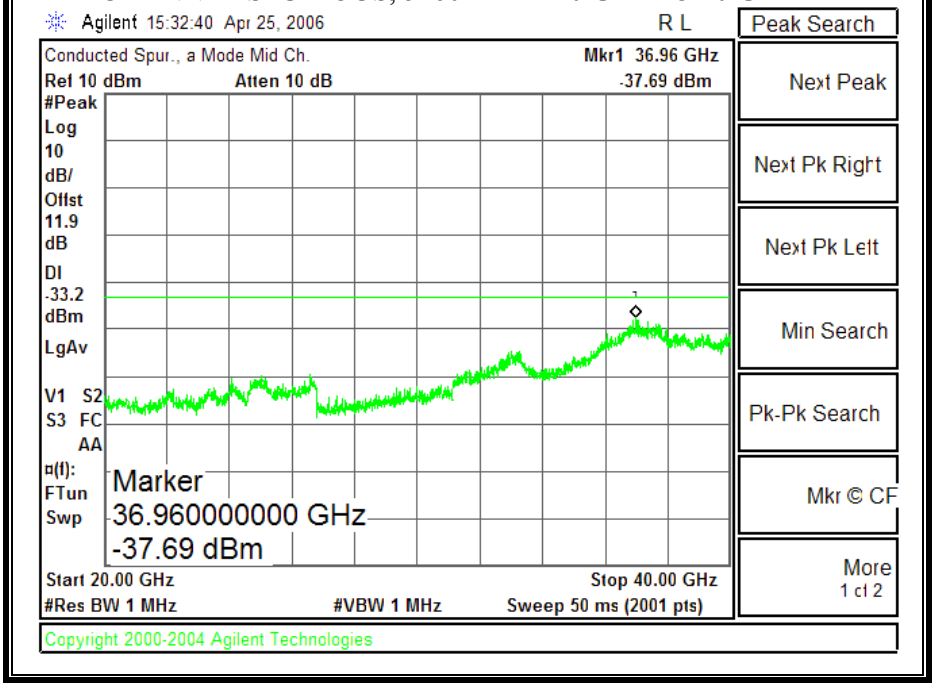




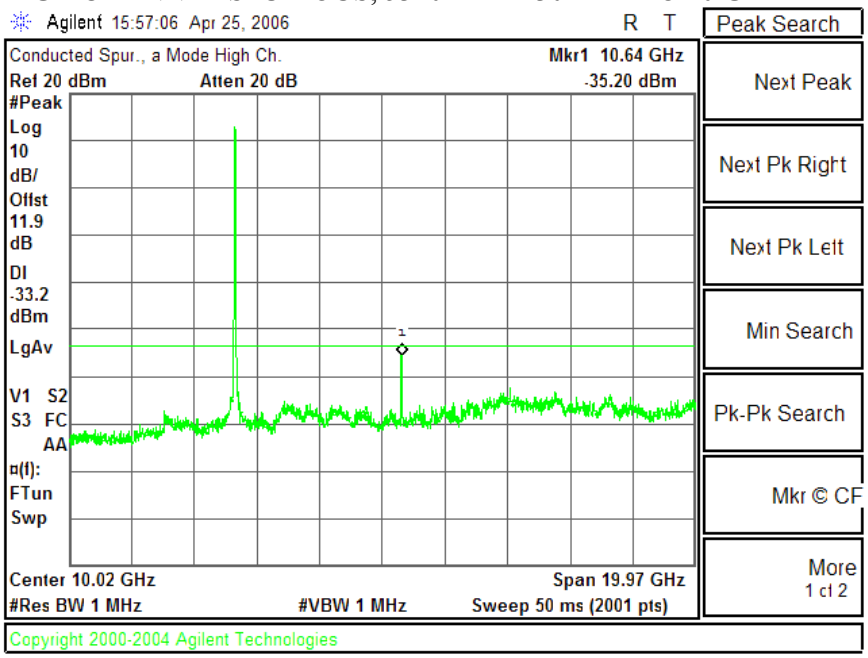
MID CHANNEL SPURIOUS, 5260 MHz - 30 MHz TO 20 GHz



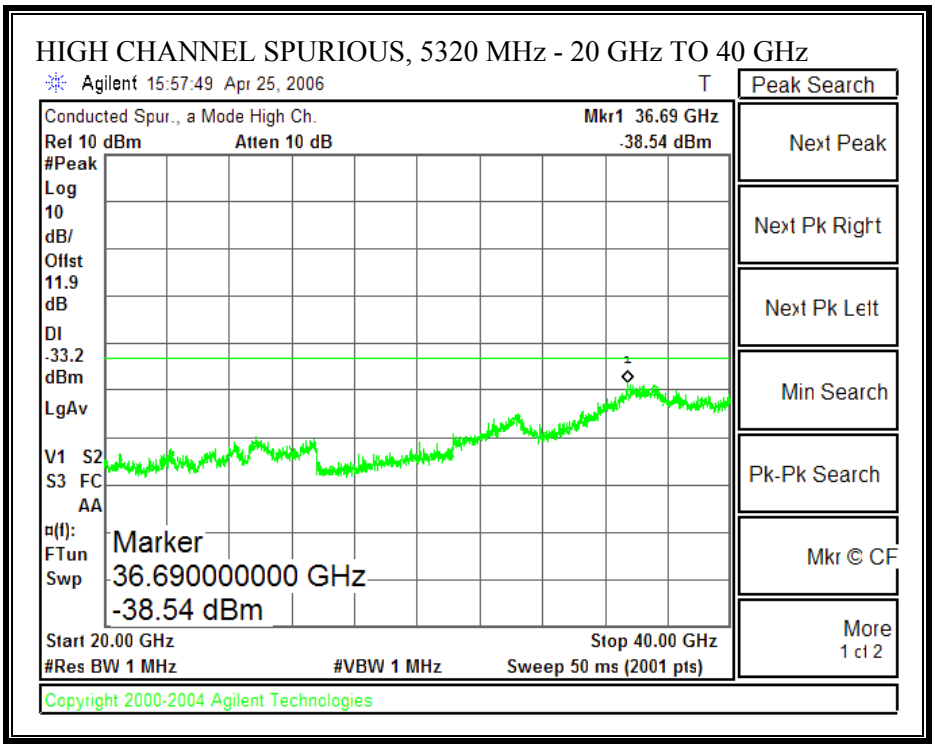
MID CHANNEL SPURIOUS, 5260 MHz - 20 GHz TO 40 GHz



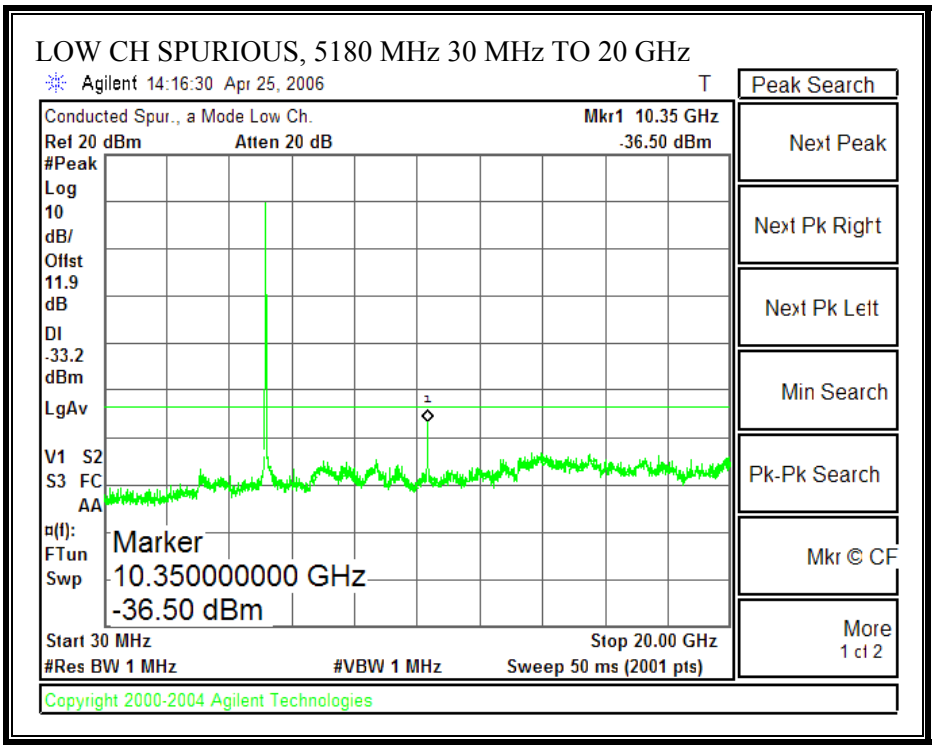
HIGH CHANNEL SPURIOUS, 5320 MHz - 30 MHz TO 20 GHz



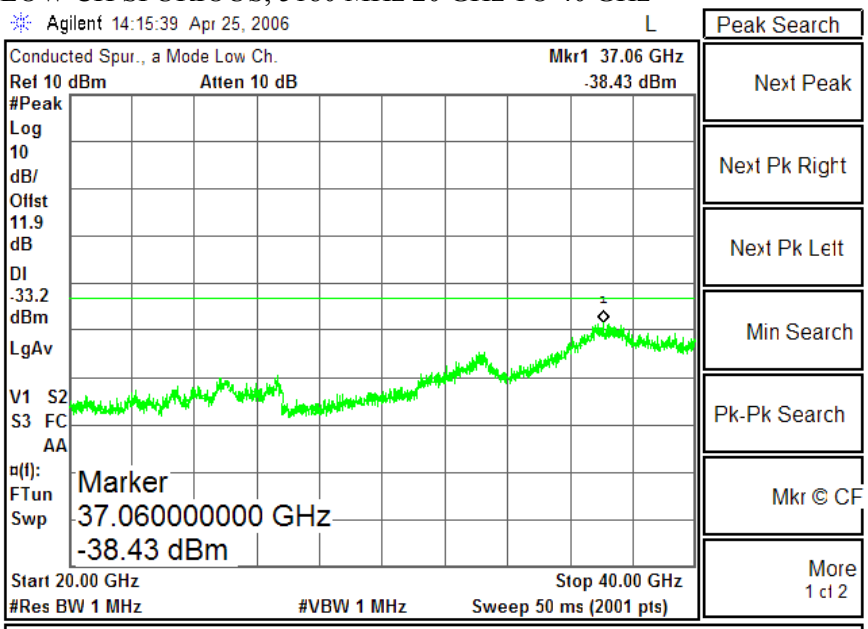
HIGH CHANNEL SPURIOUS, 5320 MHz - 20 GHz TO 40 GHz



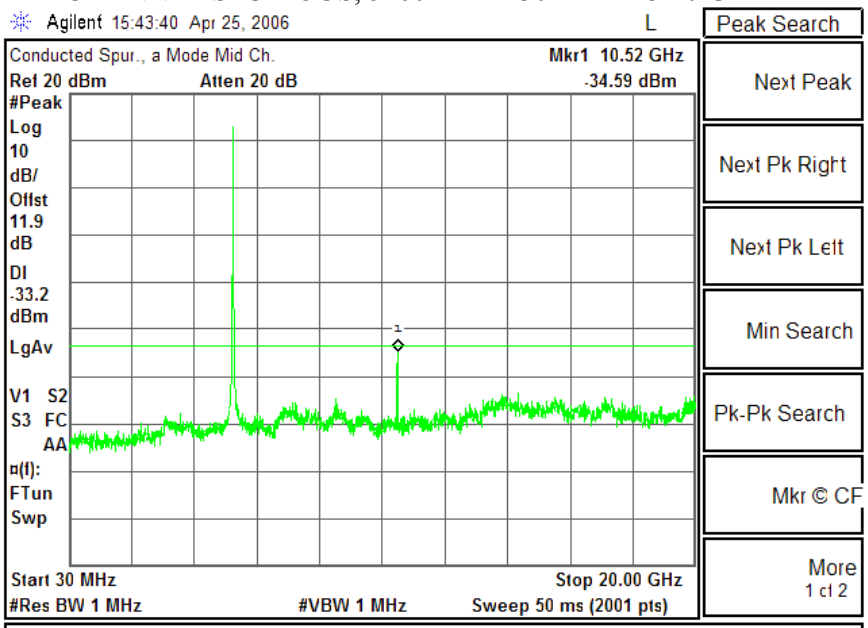
SPURIOUS EMISSIONS - 802.11a -20 MHz TX BANDWIDTH - CHAIN 1



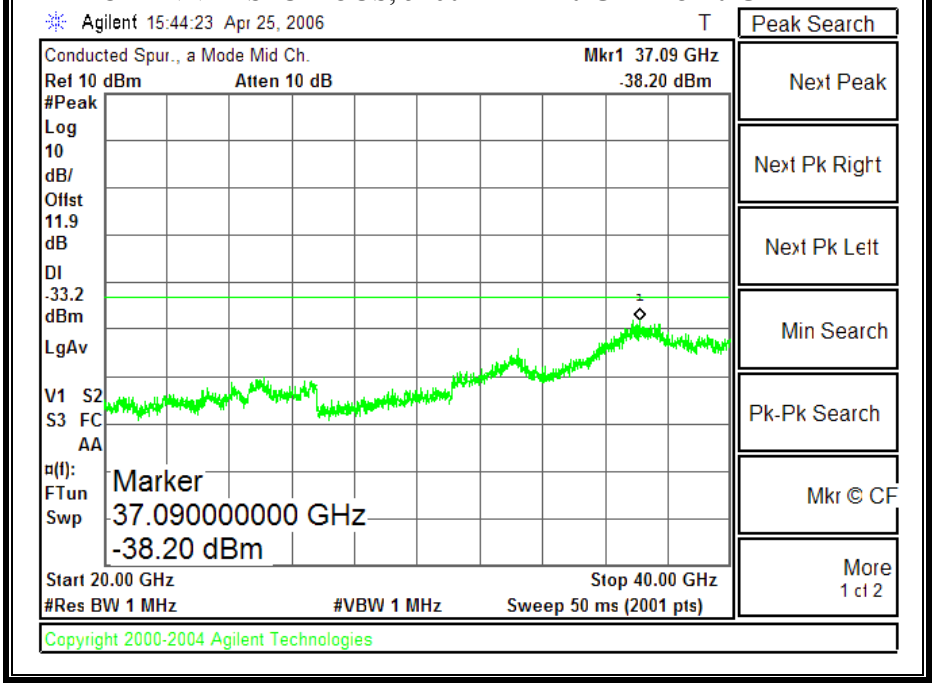
LOW CH SPURIOUS, 5180 MHz 20 GHz TO 40 GHz



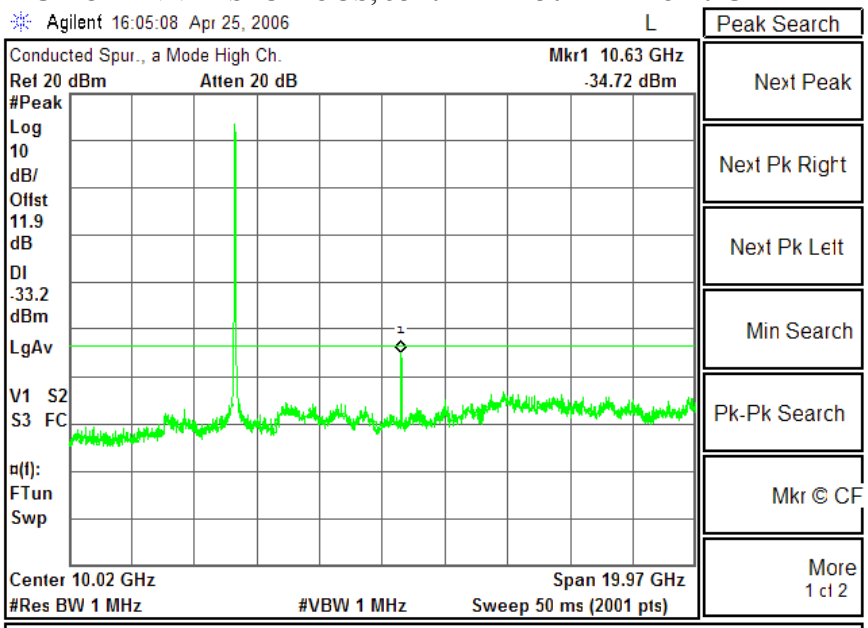
MID CHANNEL SPURIOUS, 5260 MHz - 30 MHz TO 20 GHz



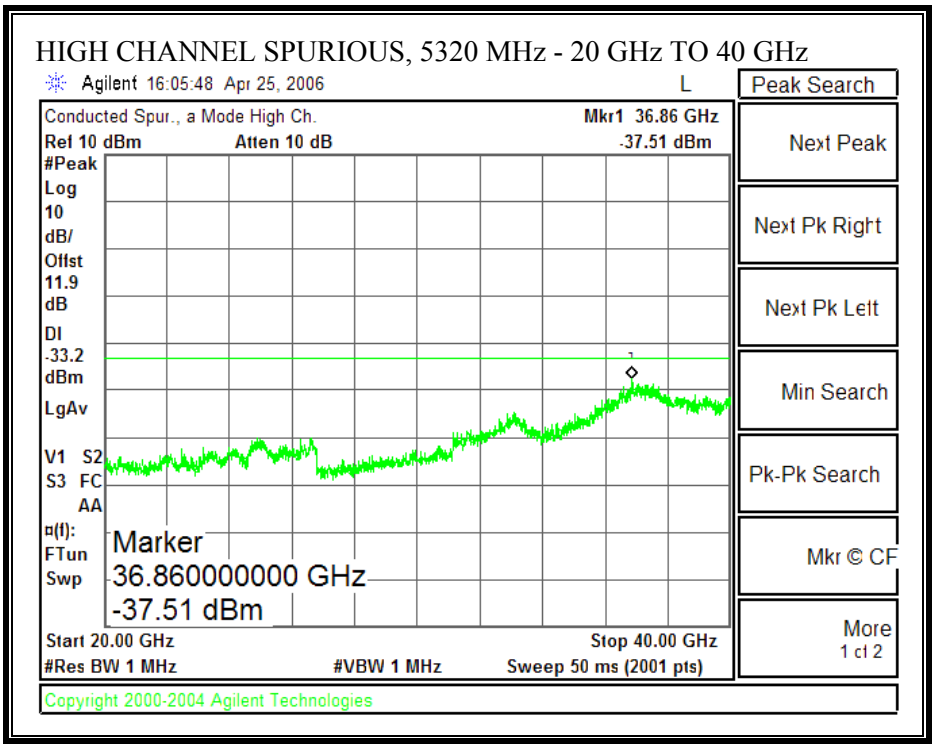
MID CHANNEL SPURIOUS, 5260 MHz - 20 GHz TO 40 GHz



HIGH CHANNEL SPURIOUS, 5320 MHz - 30 MHz TO 20 GHz

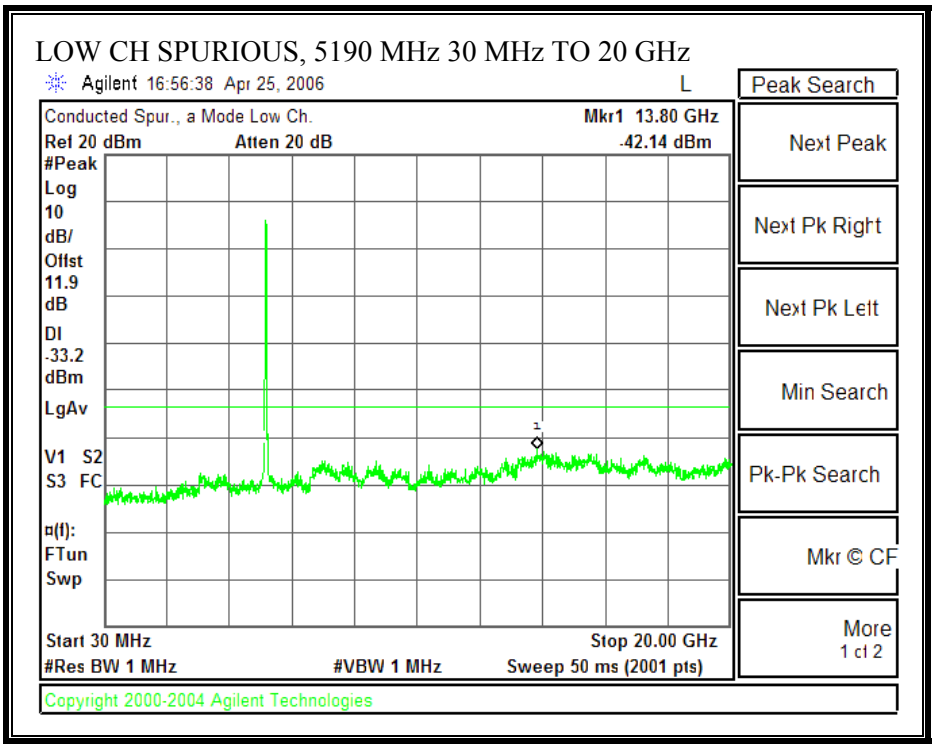


HIGH CHANNEL SPURIOUS, 5320 MHz - 20 GHz TO 40 GHz

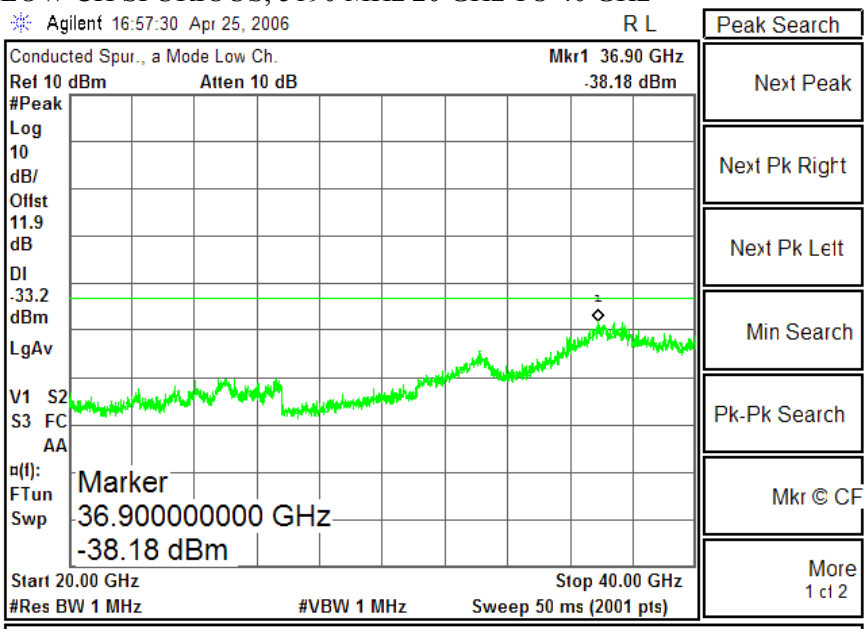


802.11n 40 MHz CDD MCS 32

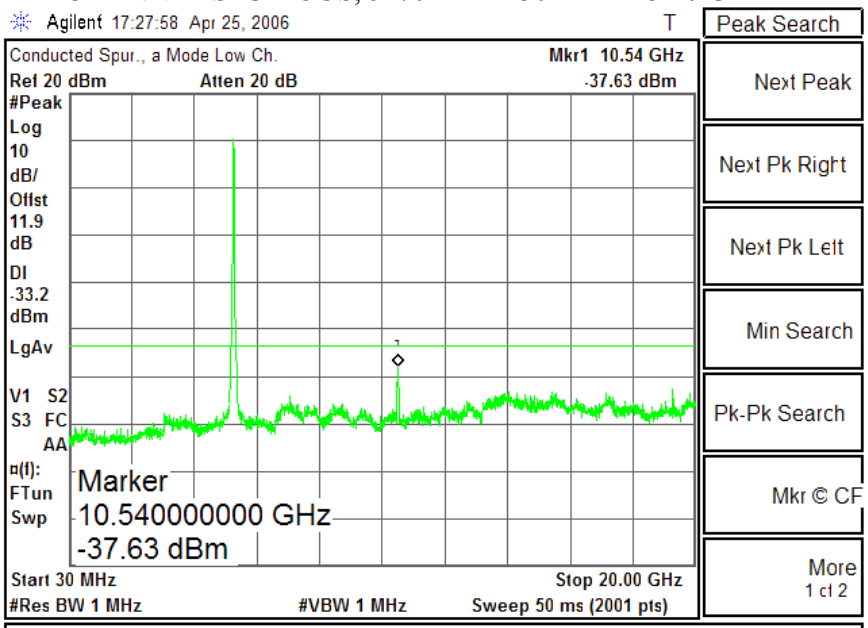
SPURIOUS EMISSIONS - 802.11a -40 MHz TX BANDWIDTH - CHAIN 0



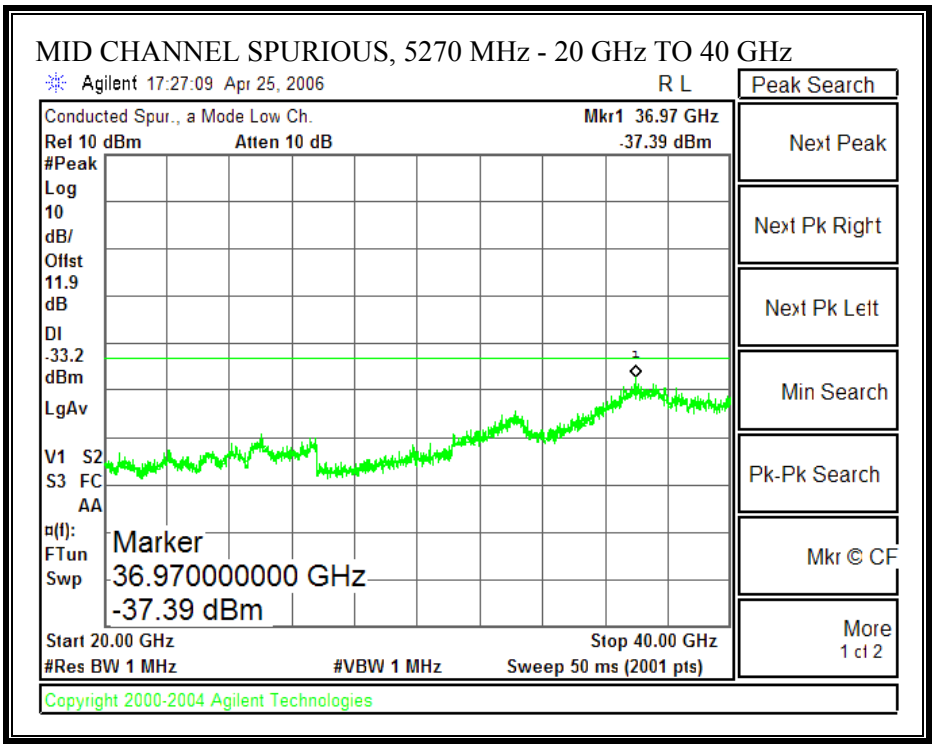
LOW CH SPURIOUS, 5190 MHz 20 GHz TO 40 GHz



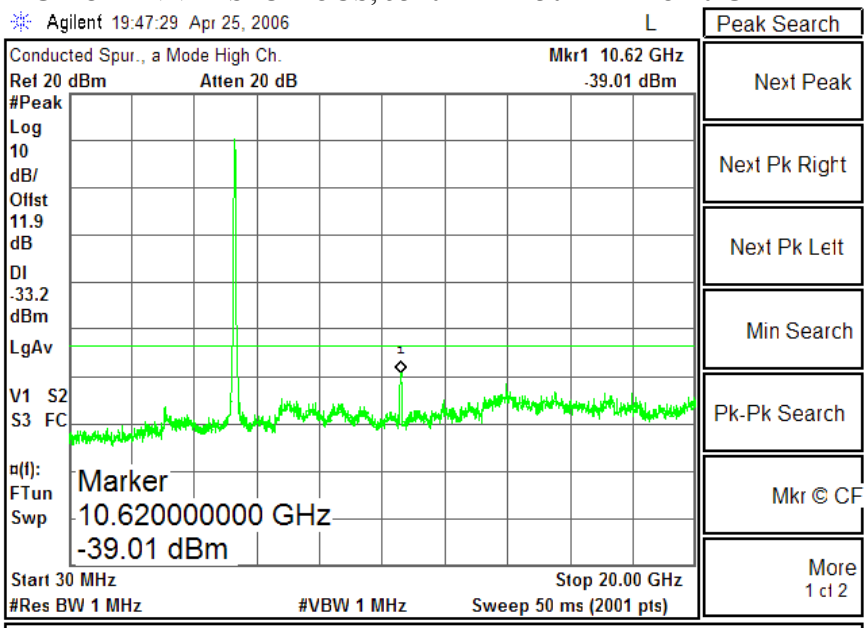
MID CHANNEL SPURIOUS, 5270 MHz - 30 MHz TO 20 GHz



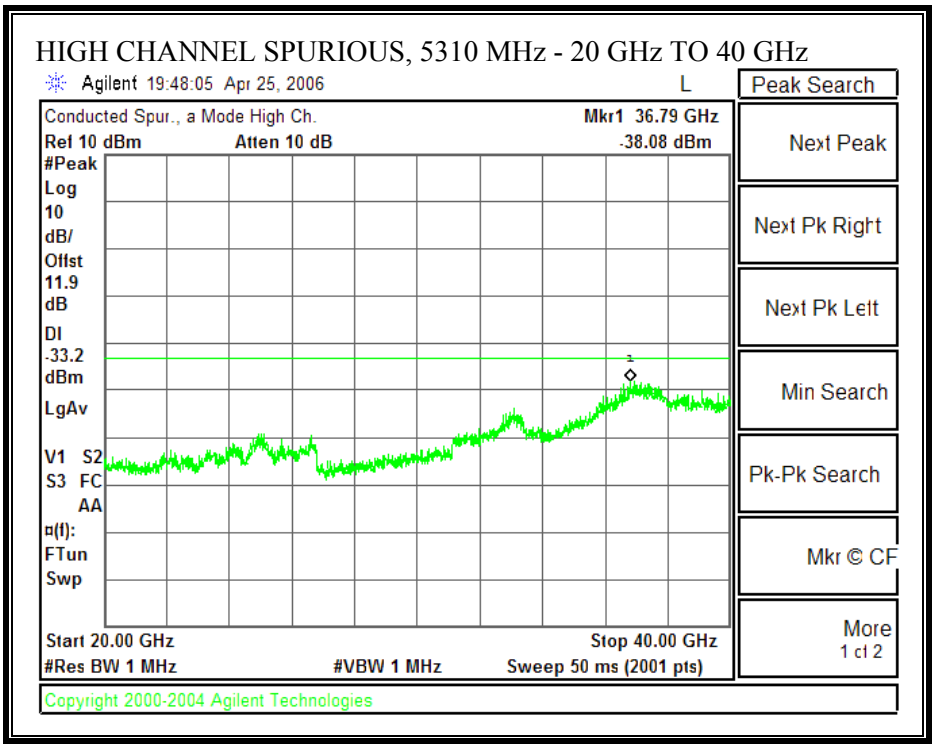
MID CHANNEL SPURIOUS, 5270 MHz - 20 GHz TO 40 GHz



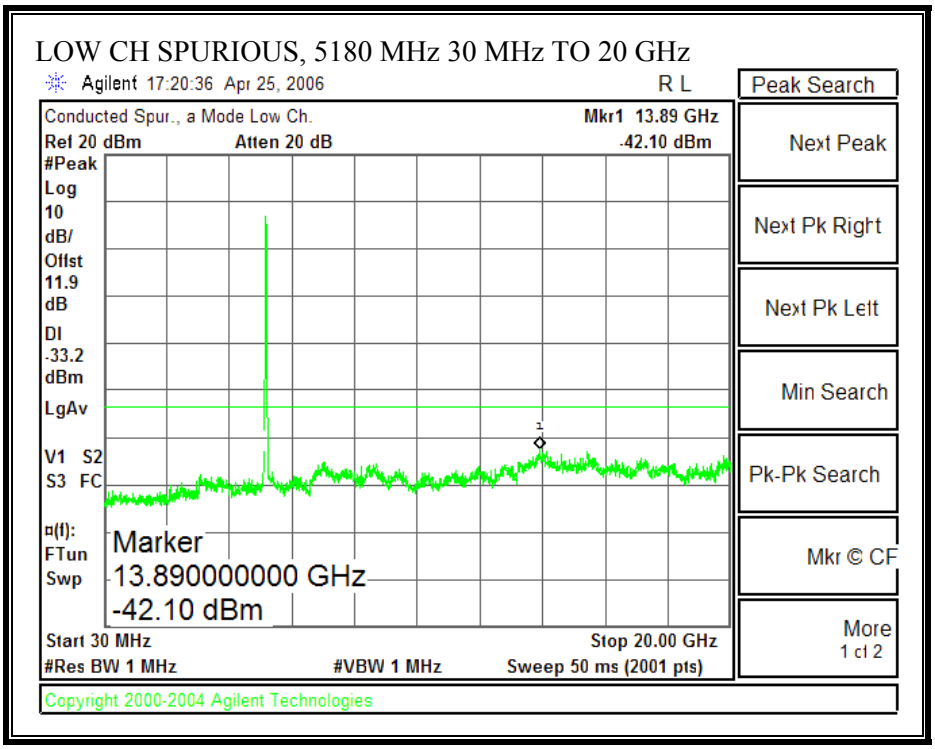
HIGH CHANNEL SPURIOUS, 5310 MHz - 30 MHz TO 20 GHz



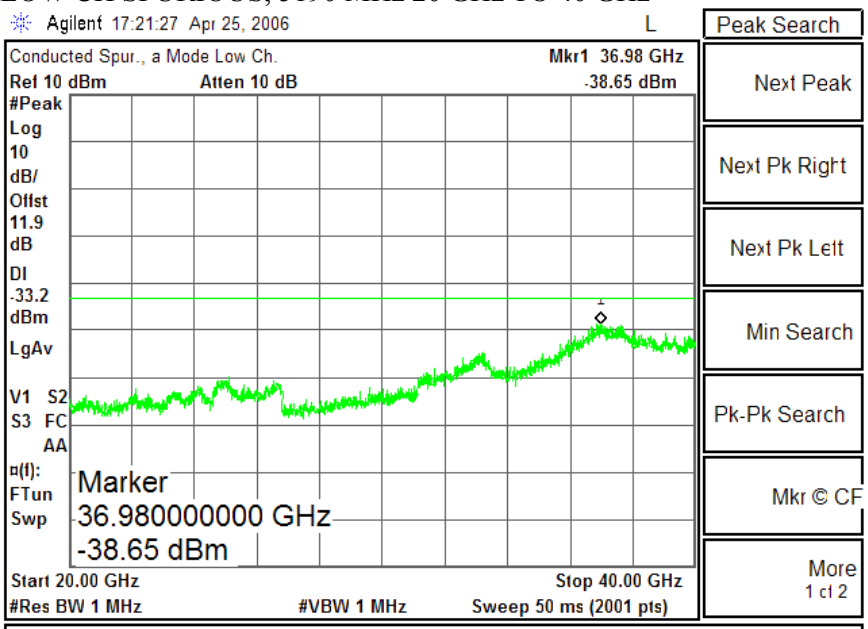
HIGH CHANNEL SPURIOUS, 5310 MHz - 20 GHz TO 40 GHz



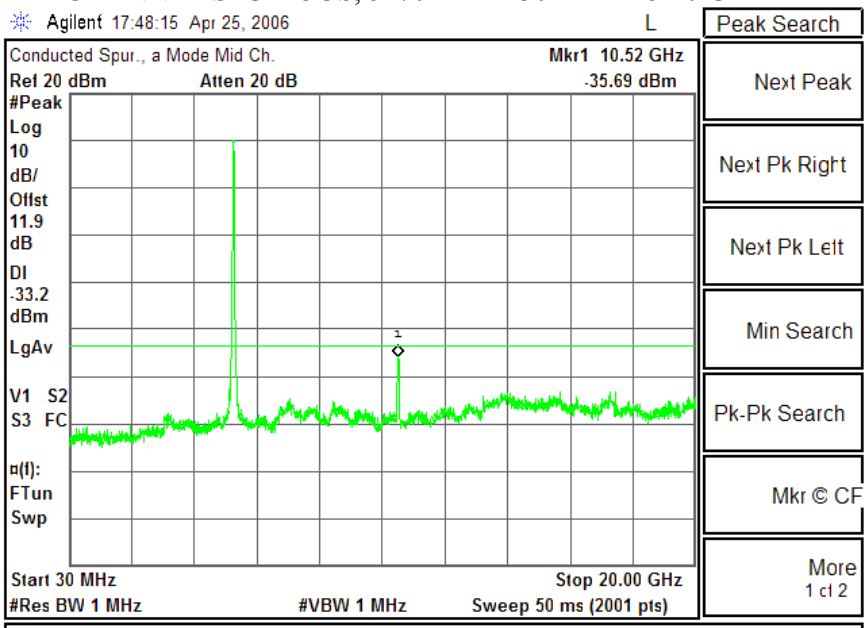
SPURIOUS EMISSIONS - 802.11a -20 MHz TX BANDWIDTH - CHAIN 1



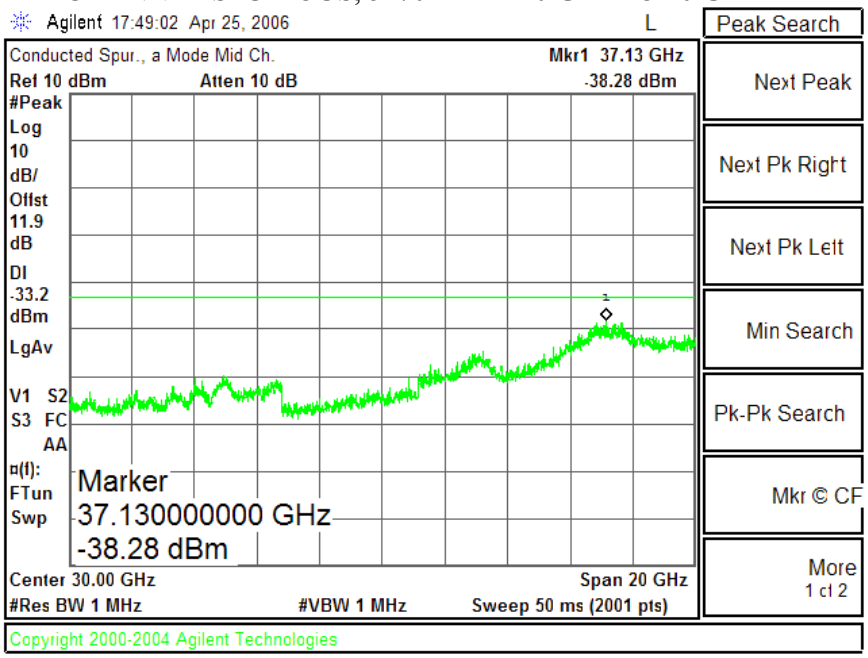
LOW CH SPURIOUS, 5190 MHz 20 GHz TO 40 GHz



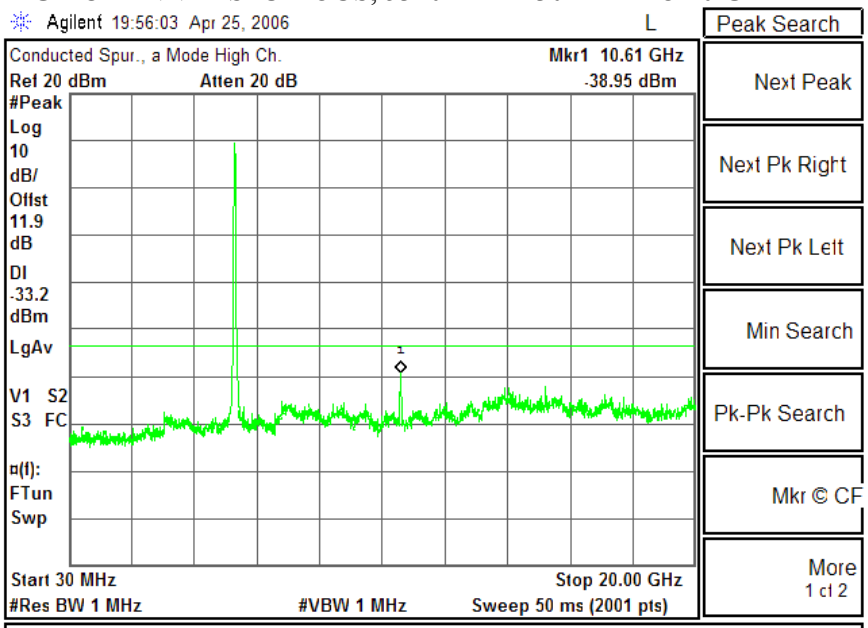
MID CHANNEL SPURIOUS, 5270 MHz - 30 MHz TO 20 GHz



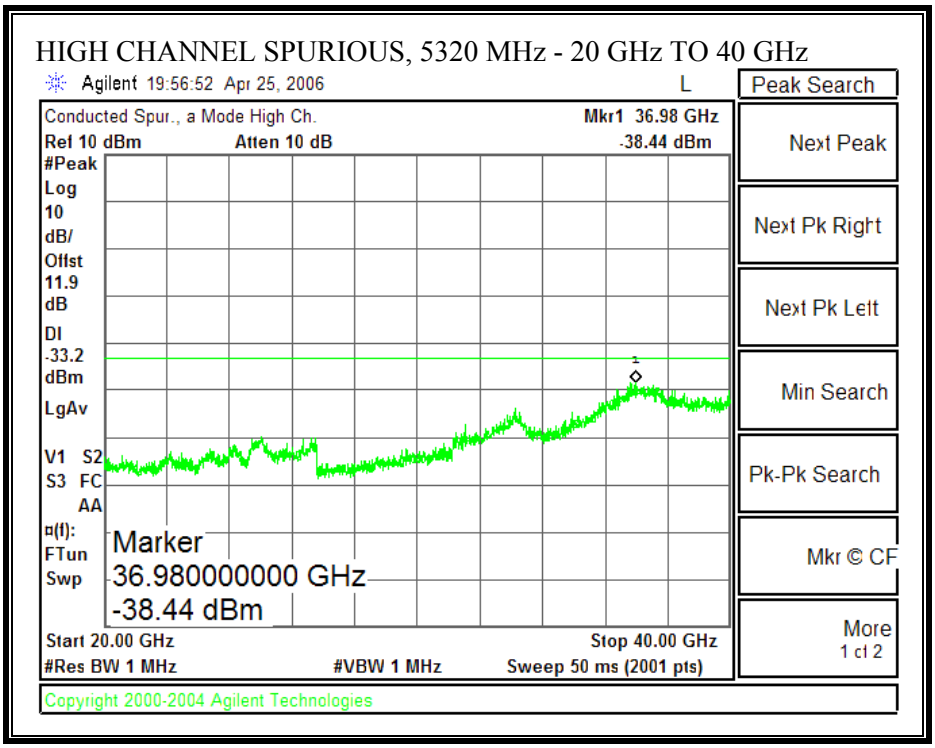
MID CHANNEL SPURIOUS, 5270 MHz - 20 GHz TO 40 GHz



HIGH CHANNEL SPURIOUS, 5310 MHz - 30 MHz TO 20 GHz

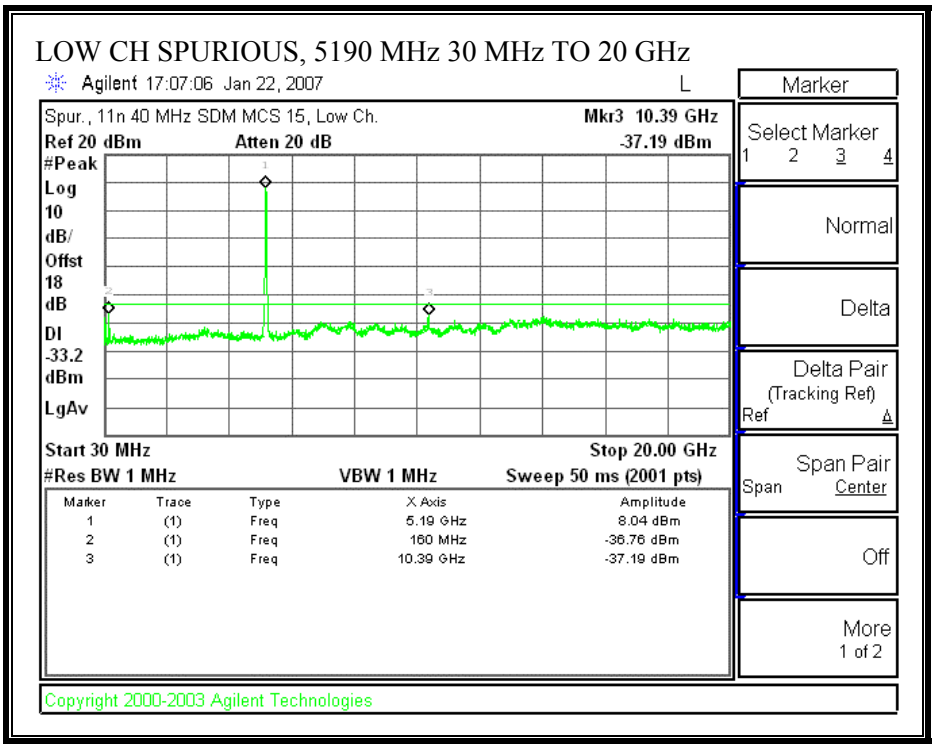


HIGH CHANNEL SPURIOUS, 5320 MHz - 20 GHz TO 40 GHz

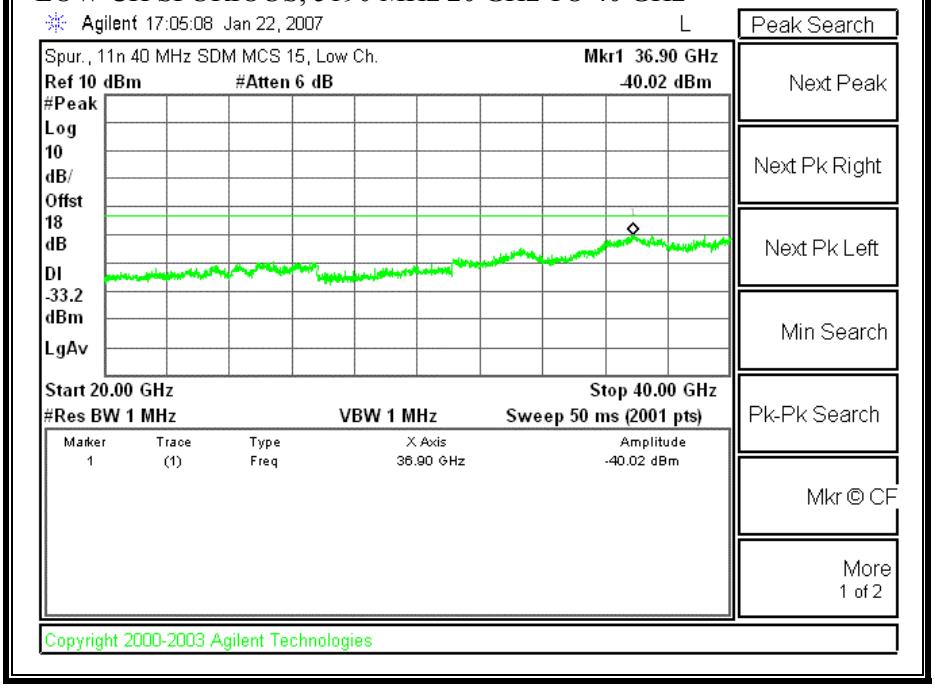


802.11n 40 MHz SDM MCS 15

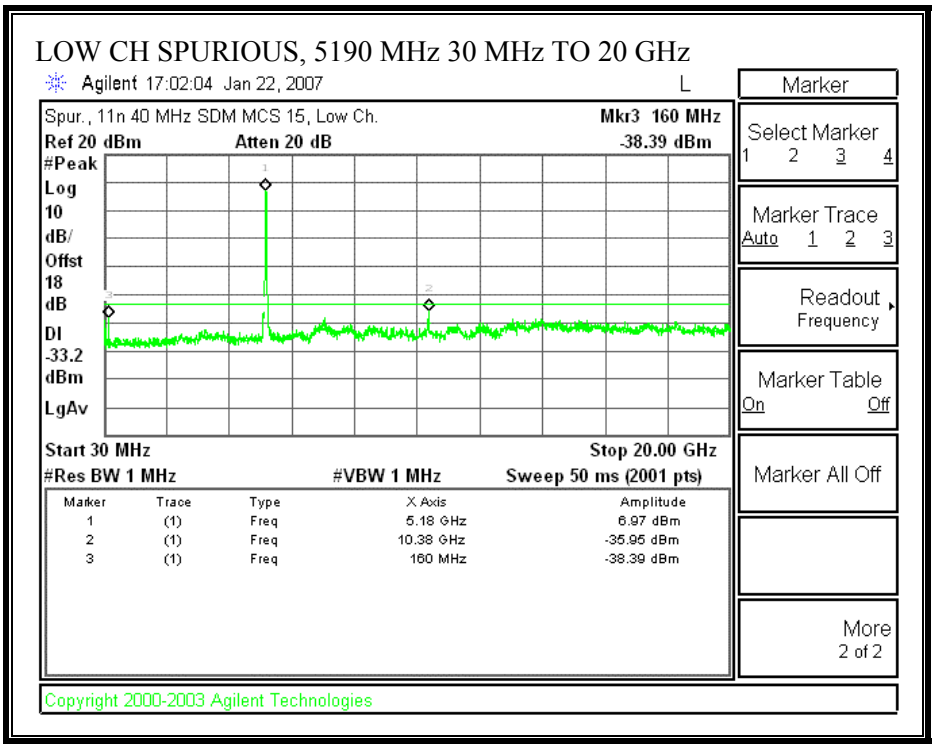
SPURIOUS EMISSIONS - 802.11a -40 MHz TX BANDWIDTH - CHAIN 0

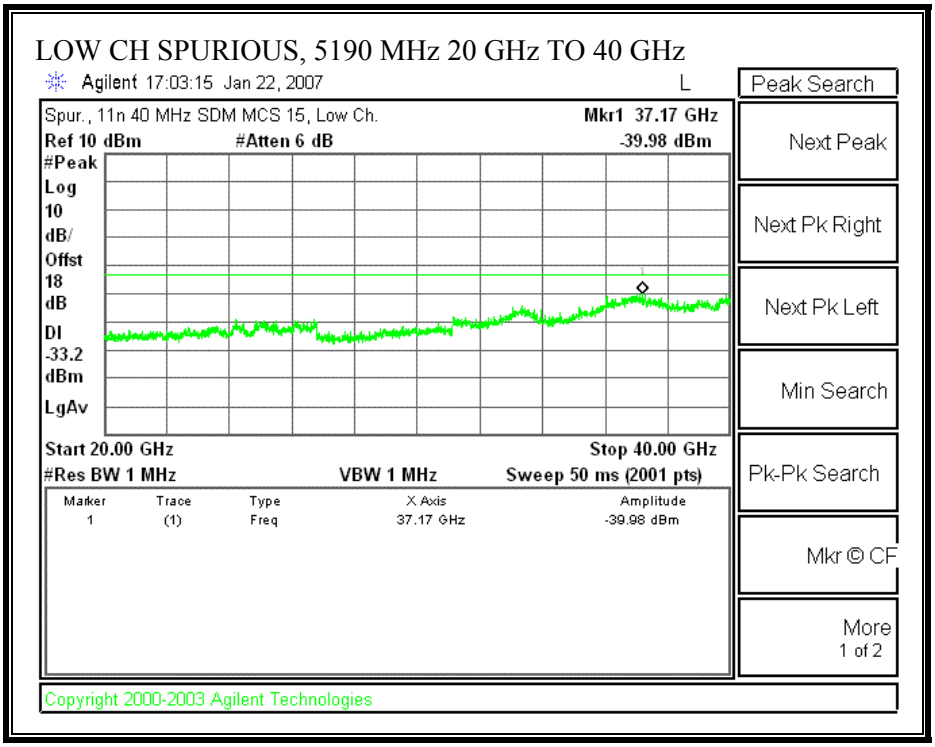


LOW CH SPURIOUS, 5190 MHz 20 GHz TO 40 GHz



SPURIOUS EMISSIONS - 802.11a -40 MHz TX BANDWIDTH - CHAIN 1





7.3. RADIATED EMISSIONS

7.3.1. TRANSMITTER RADIATED SPURIOUS EMISSIONS

LIMITS

§15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])
13.36 - 13.41			

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.
[2] Above 38.6

§15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

§15.209 (b) In the emission table above, the tighter limit applies at the band edges.

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 5 GHz 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.

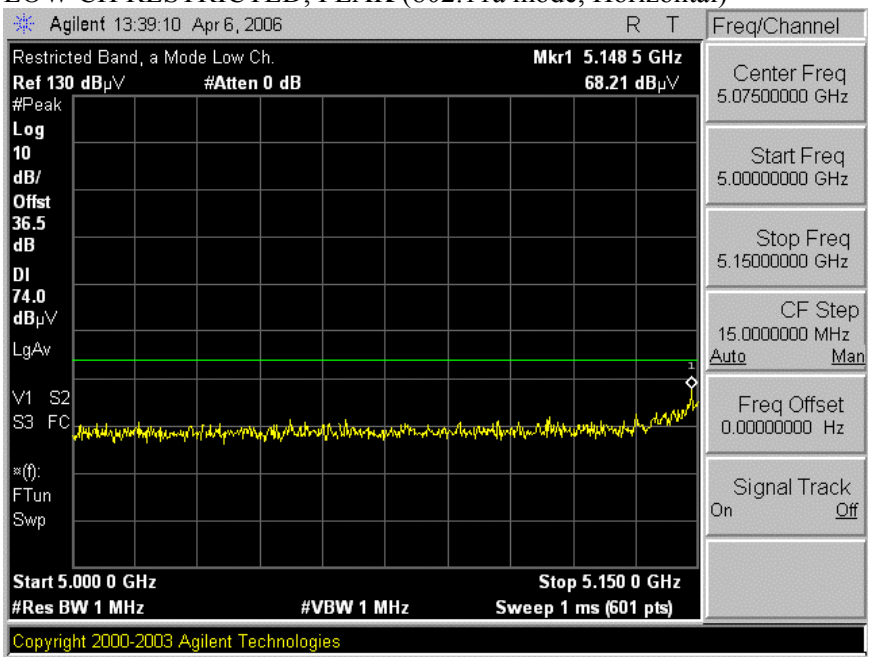
LEGACY MODE

7.3.2. TRANSMITTER ABOVE 1 GHZ FOR 5150 TO 5350 MHz BAND

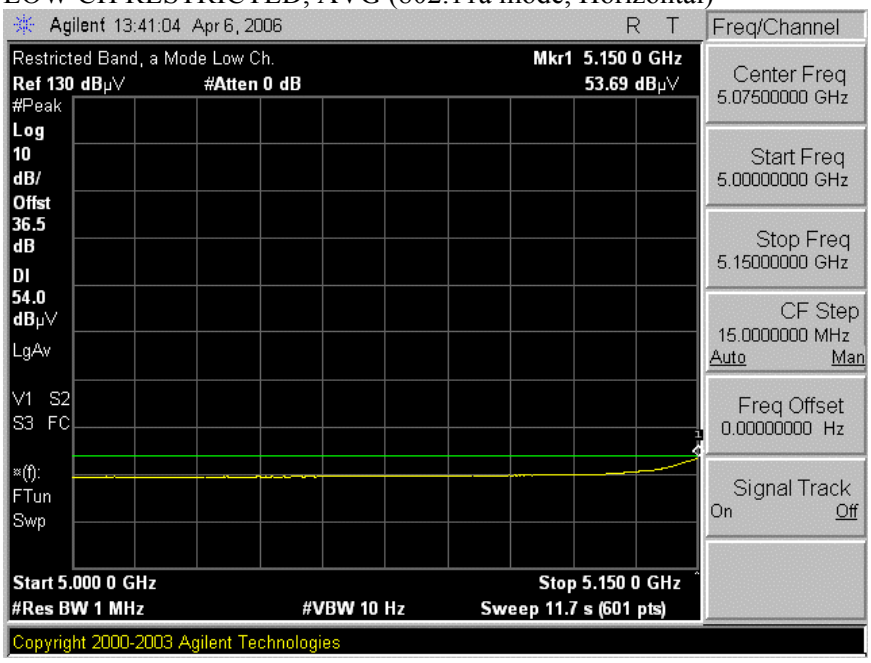
802.11a LEGACY MODE

RESTRICTED BANDEDGE (802.11a MODE, LOW CHANNEL, 5180 MHz - HORIZONTAL)

LOW CH RESTRICTED, PEAK (802.11a mode, Horizontal)

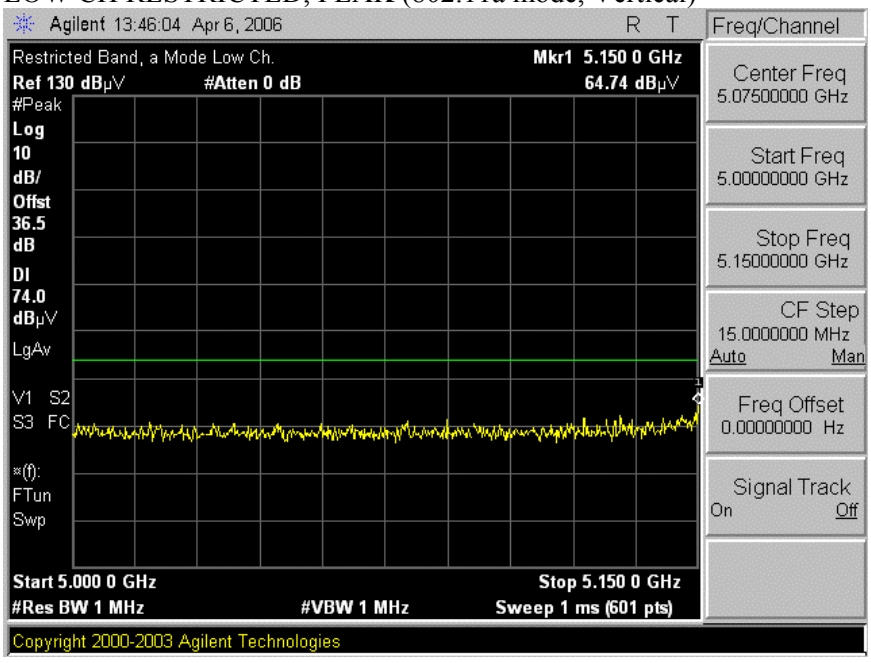


LOW CH RESTRICTED, AVG (802.11a mode, Horizontal)

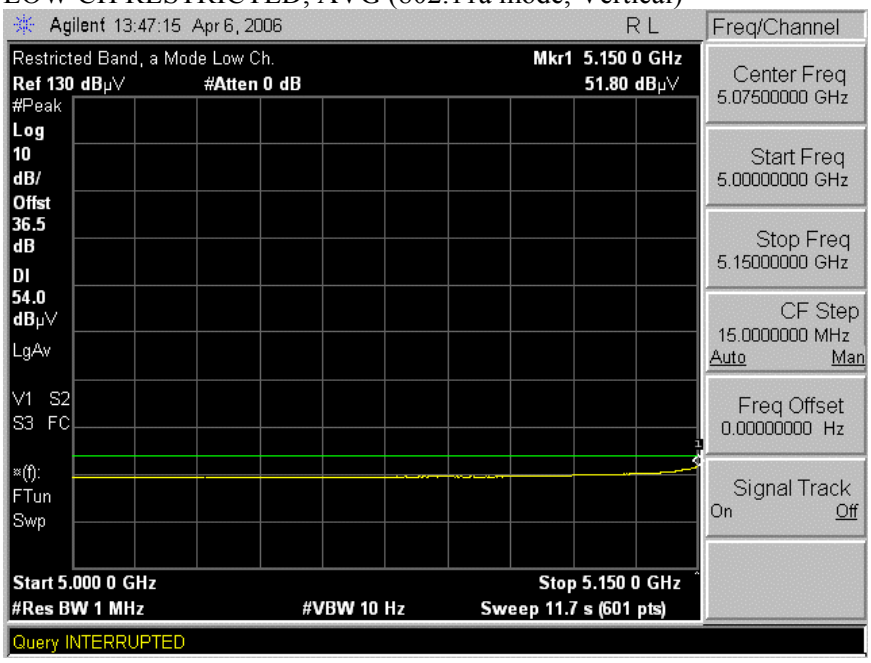


RESTRICTED BANDEDGE (802.11a MODE, LOW CHANNEL, 5180 MHz - VERTICAL)

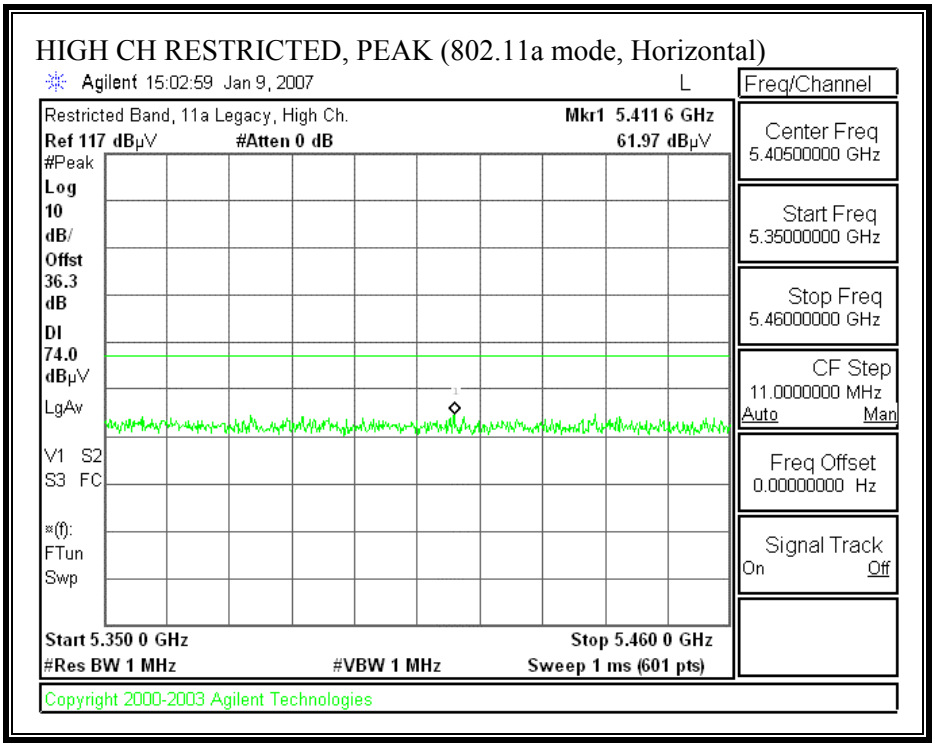
LOW CH RESTRICTED, PEAK (802.11a mode, Vertical)



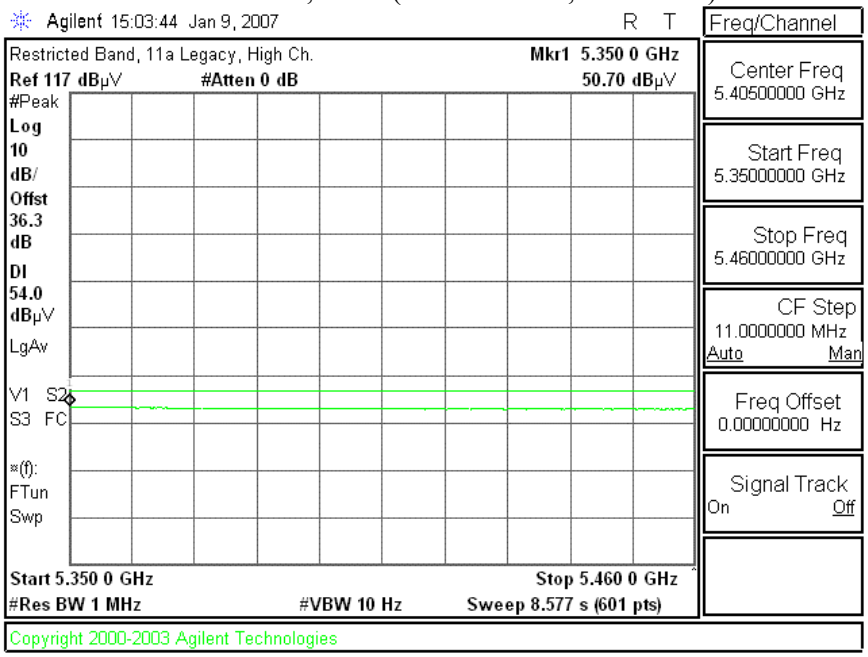
LOW CH RESTRICTED, AVG (802.11a mode, Vertical)



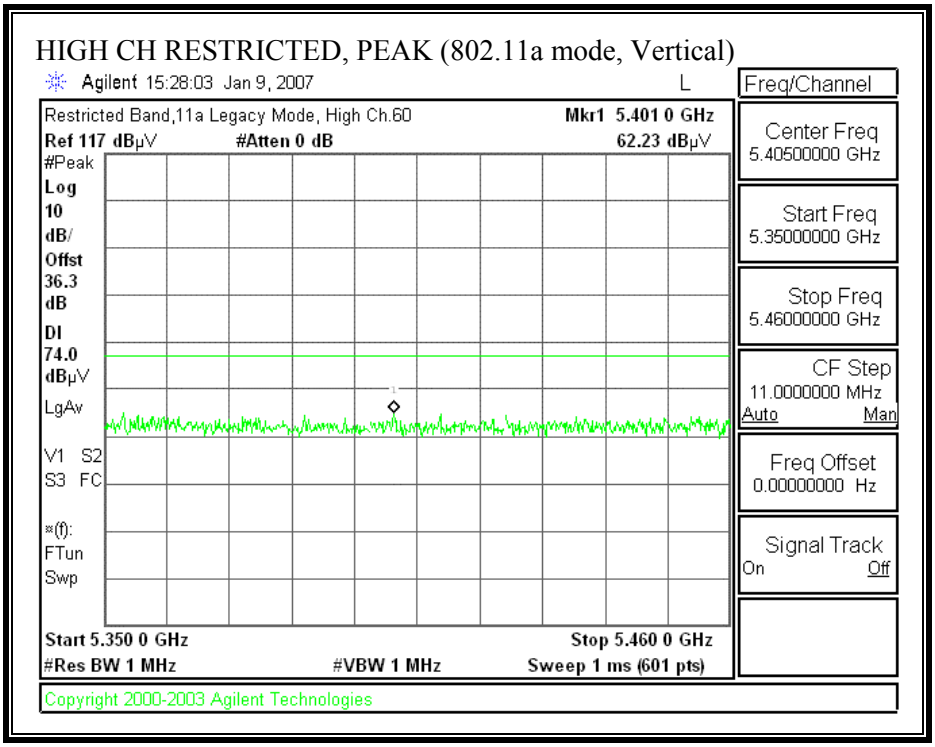
RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5300 MHz - HORIZONTAL)



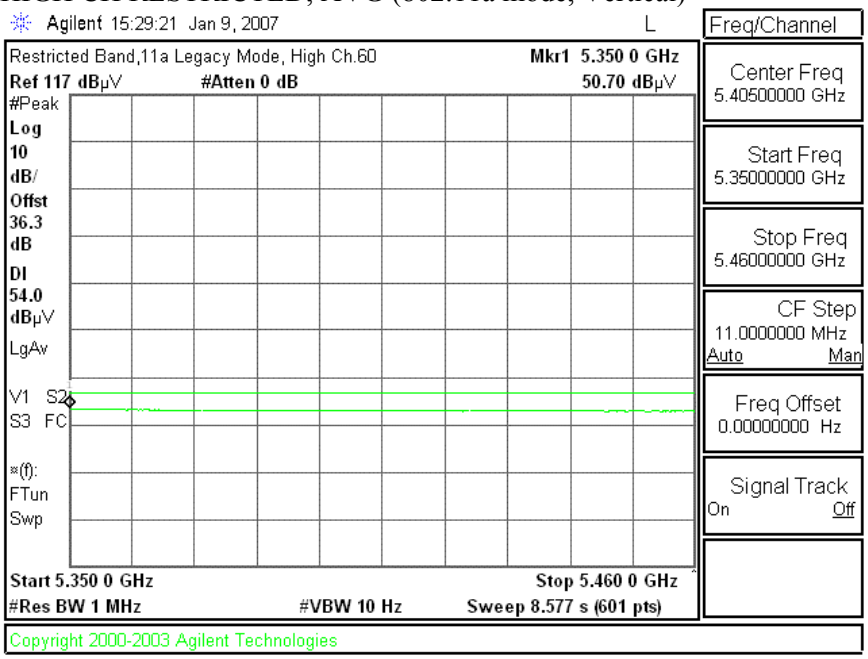
HIGH CH RESTRICTED, AVG (802.11a mode, Horizontal)



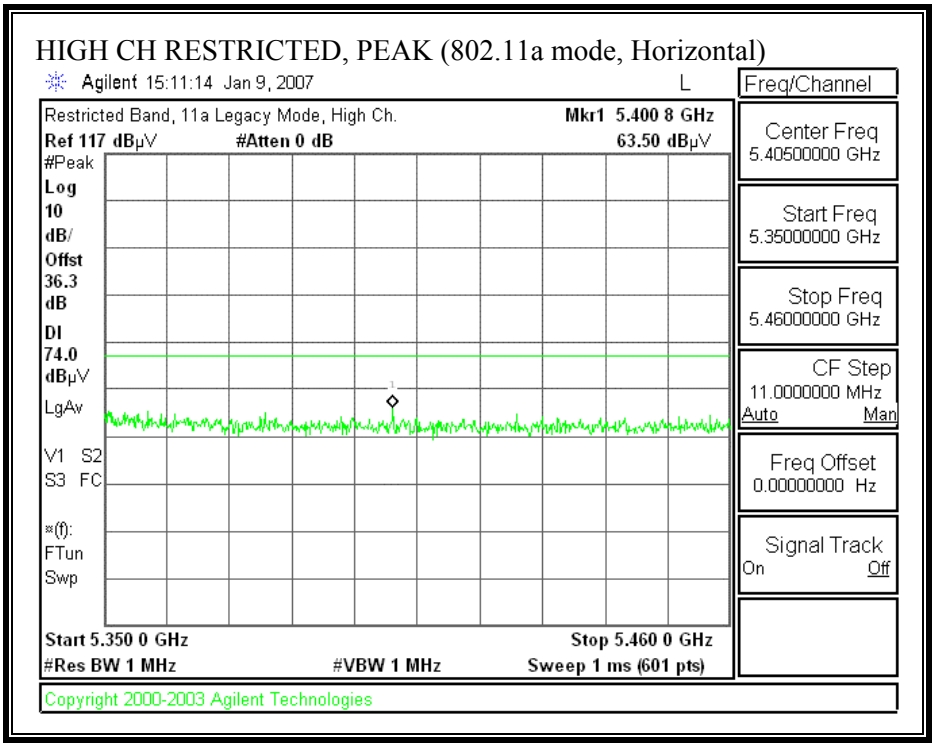
RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5300 MHz - VERTICAL)



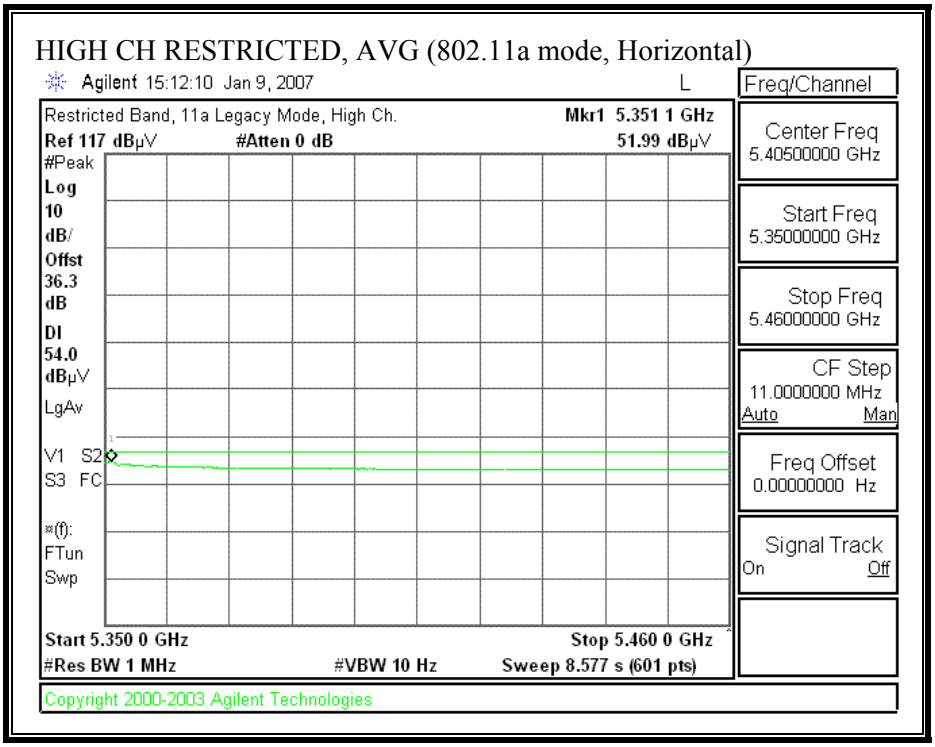
HIGH CH RESTRICTED, AVG (802.11a mode, Vertical)



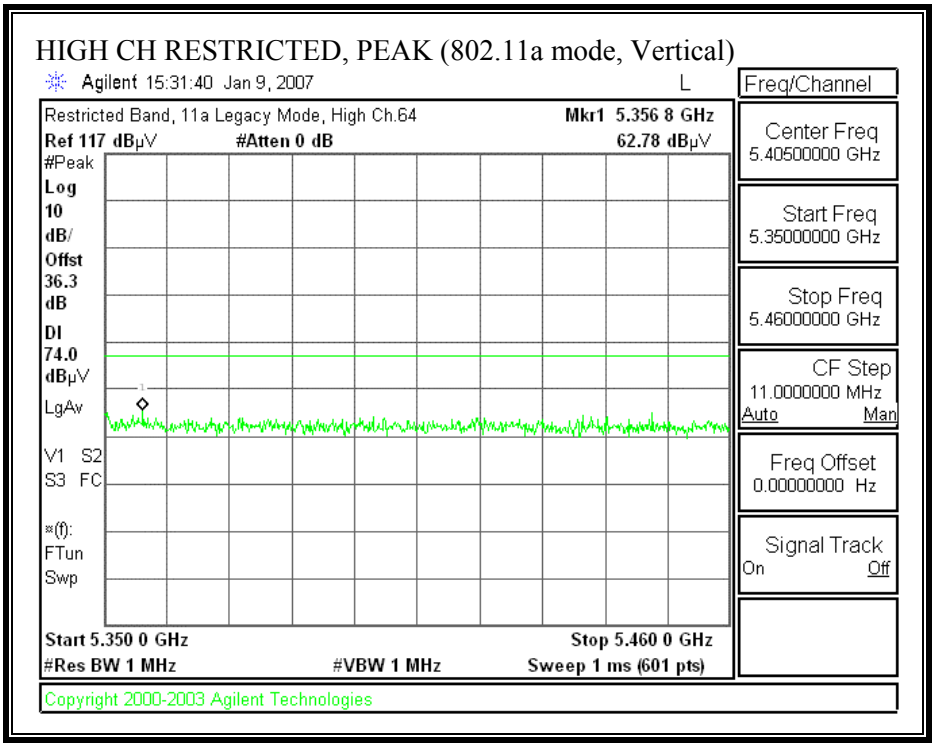
RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5320 MHz - HORIZONTAL)



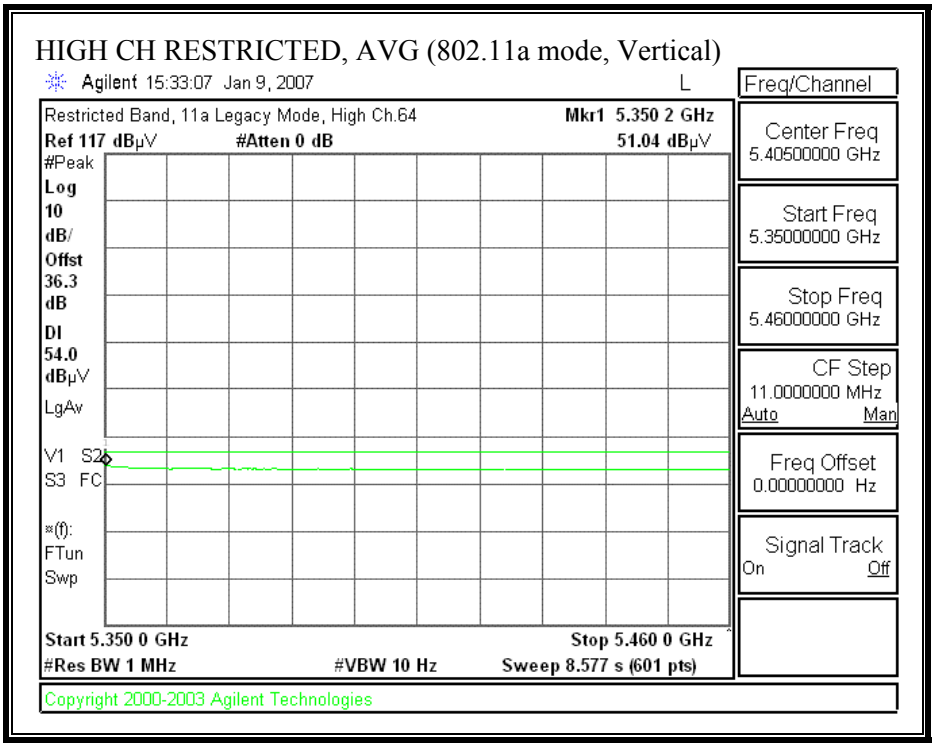
HIGH CH RESTRICTED, AVG (802.11a mode, Horizontal)



RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5320 MHz - VERTICAL)



HIGH CH RESTRICTED, AVG (802.11a mode, Vertical)



HARMONICS AND SPURIOUS EMISSIONS (802.11a MODE)

High Frequency Measurement
Compliance Certification Services, Morgan Hill Open Field Site

Company: Broadcom
Project #: 06U10708
Date: 01/16/07
Test Engineer: Vien Tran
Configuration: EUT & Antenna
Mode: Tx_5.2GHz Band_ 11a Legacy

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T145 Agilent 3008A005(			FCC 15.209

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
Vien 177079005		Vien 197209005	HPF_7.6GHz	

Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

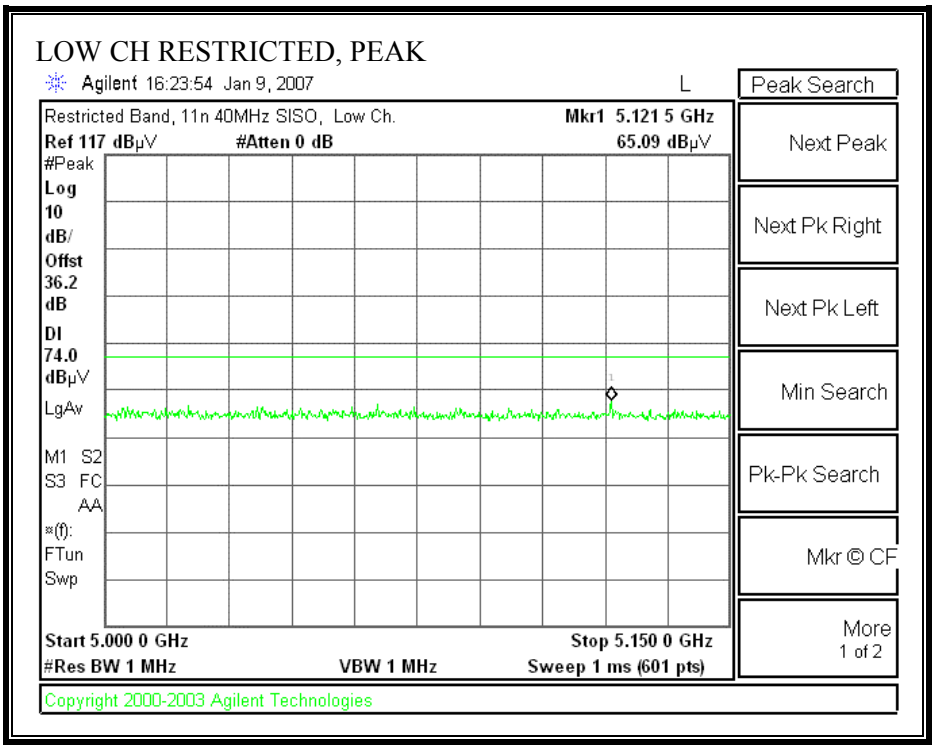
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
CH 52, 5260 MHz															
10.520	3.0	56.5	40.1	37.4	4.8	-34.4	0.0	0.8	65.0	48.6	74	54	-9.0	-5.4	H
15.780	3.0	45.1	33.5	37.9	5.9	-32.2	0.0	0.7	57.3	45.7	74	54	-16.7	-8.3	H
10.520	3.0	53.3	39.0	37.4	4.8	-34.4	0.0	0.8	61.8	47.5	74	54	-12.2	-6.5	V
15.780	3.0	44.5	33.0	37.9	5.9	-32.2	0.0	0.7	56.7	45.2	74	54	-17.3	-8.8	V
CH 60, 5300 MHz															
10.600	3.0	55.0	40.6	37.4	4.8	-34.3	0.0	0.8	63.6	49.2	74	54	-10.4	-4.8	H
15.900	3.0	45.1	33.9	37.9	5.9	-32.2	0.0	0.7	57.3	46.1	74	54	-16.7	-7.9	H
10.600	3.0	53.1	38.0	37.4	4.8	-34.3	0.0	0.8	61.7	46.6	74	54	-12.3	-7.4	H
15.900	3.0	44.1	32.8	37.9	5.9	-32.2	0.0	0.7	56.3	45.0	74	54	-17.7	-9.0	
CH 64, 5320 MHz															
10.640	3.0	55.4	40.8	37.3	4.8	-34.2	0.0	0.8	64.1	49.5	74	54	-9.9	-4.5	H
15.930	3.0	46.3	33.5	37.8	5.9	-32.2	0.0	0.7	58.5	45.7	74	54	-15.5	-8.3	H
10.620	3.0	53.5	39.5	37.4	4.8	-34.3	0.0	0.8	62.2	48.2	74	54	-11.8	-5.8	V
15.930	3.0	44.5	33.3	37.8	5.9	-32.2	0.0	0.7	56.7	45.5	74	54	-17.3	-8.5	V
			No other emissions were detected above 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		

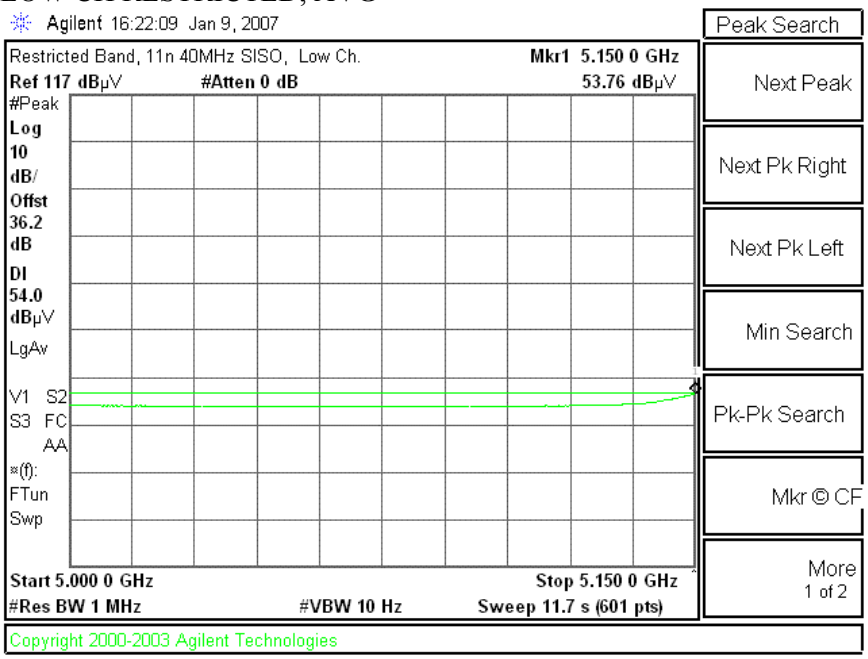
802.11n 40 MHz SISO MODE

RESTRICTED BANDEDGE (802.11n 40 MHz SIS0 MODE)

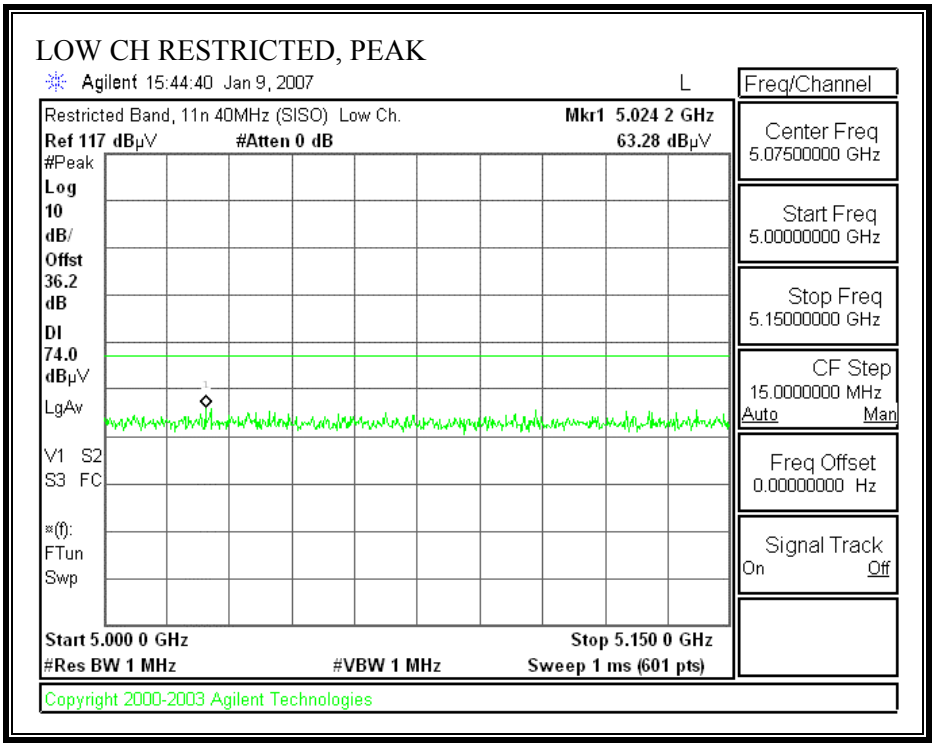
LOW CHANNEL, 5190 MHz - HORIZONTAL)



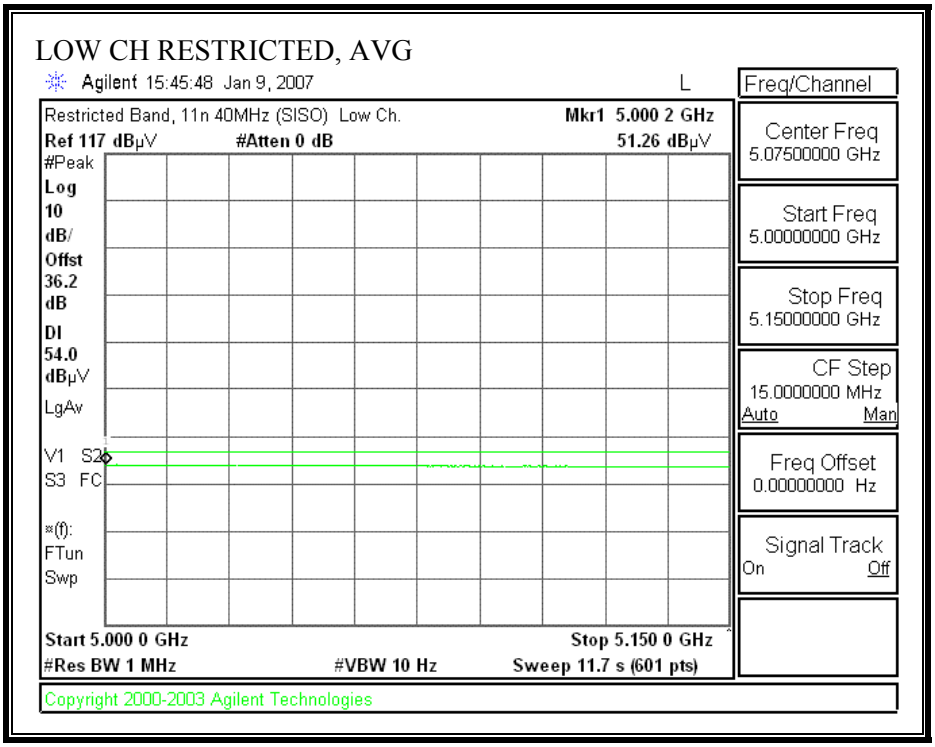
LOW CH RESTRICTED, AVG



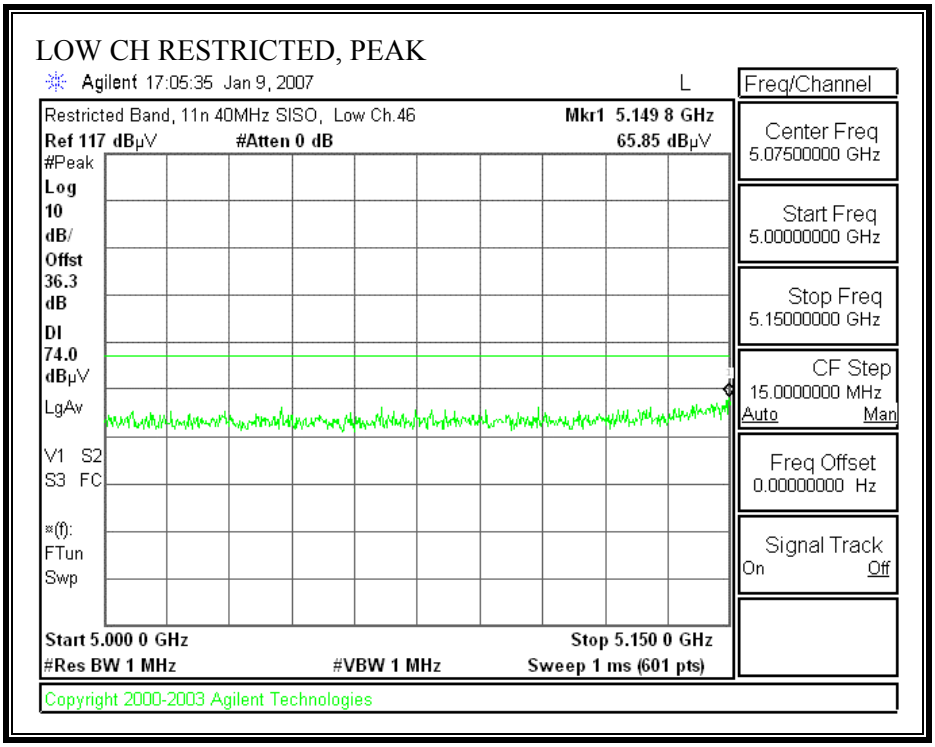
LOW CHANNEL, 5190 MHz - VERTICAL)



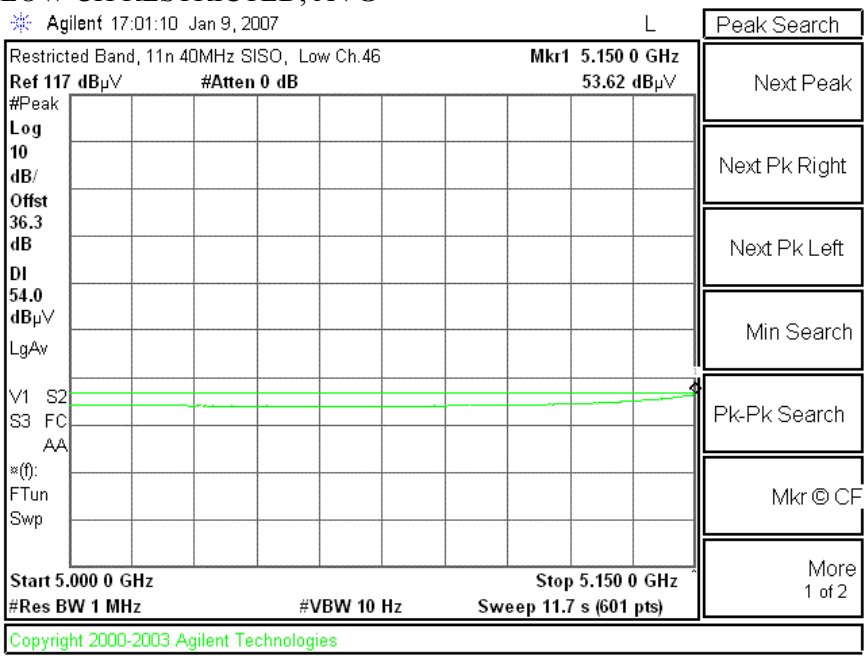
LOW CH RESTRICTED, AVG



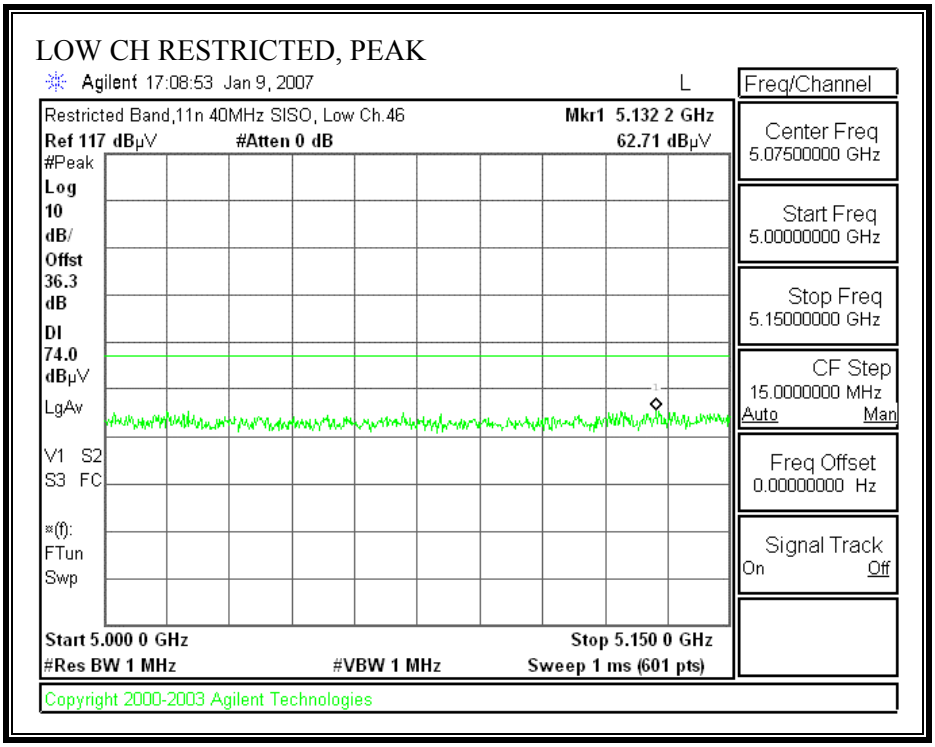
LOW CHANNEL, 5230 MHz - HORIZONTAL)



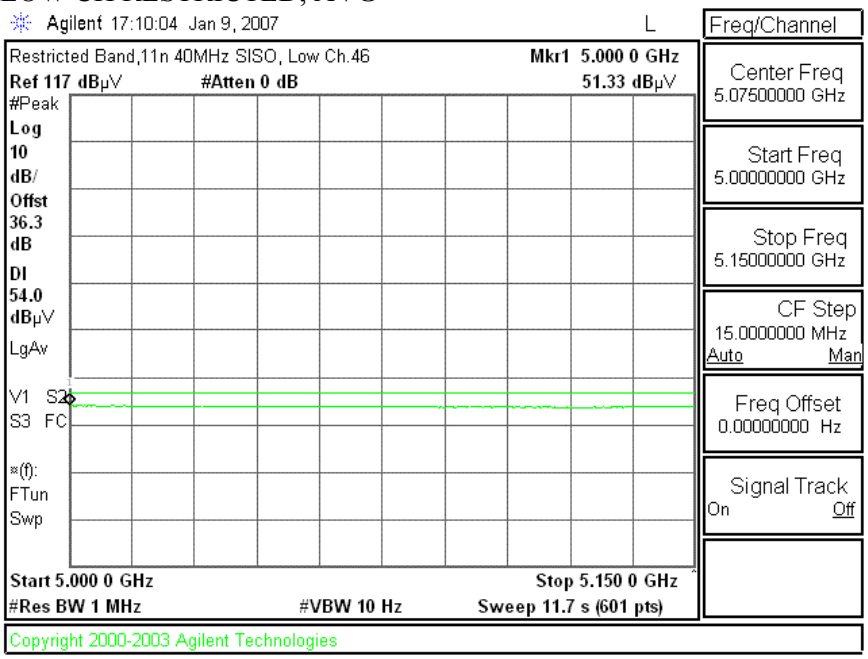
LOW CH RESTRICTED, AVG



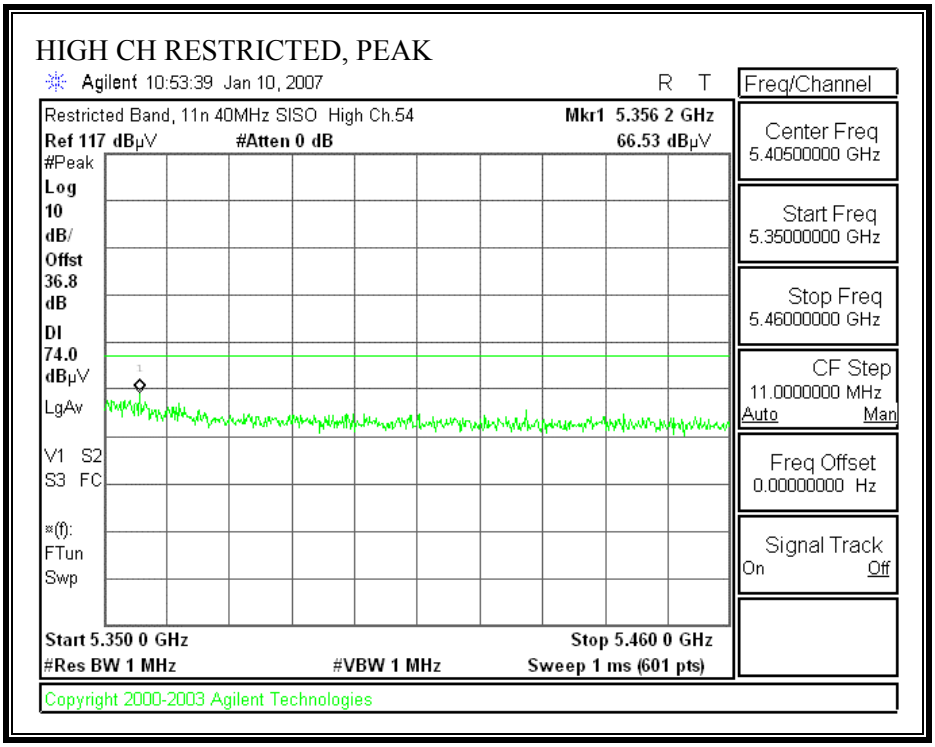
LOW CHANNEL, 5230 MHz - VERTICAL)



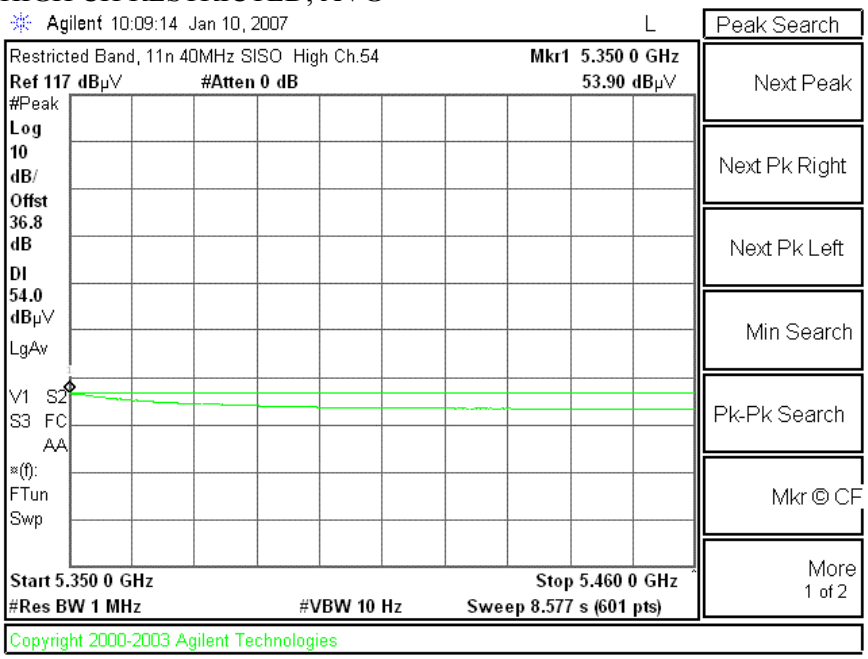
LOW CH RESTRICTED, AVG



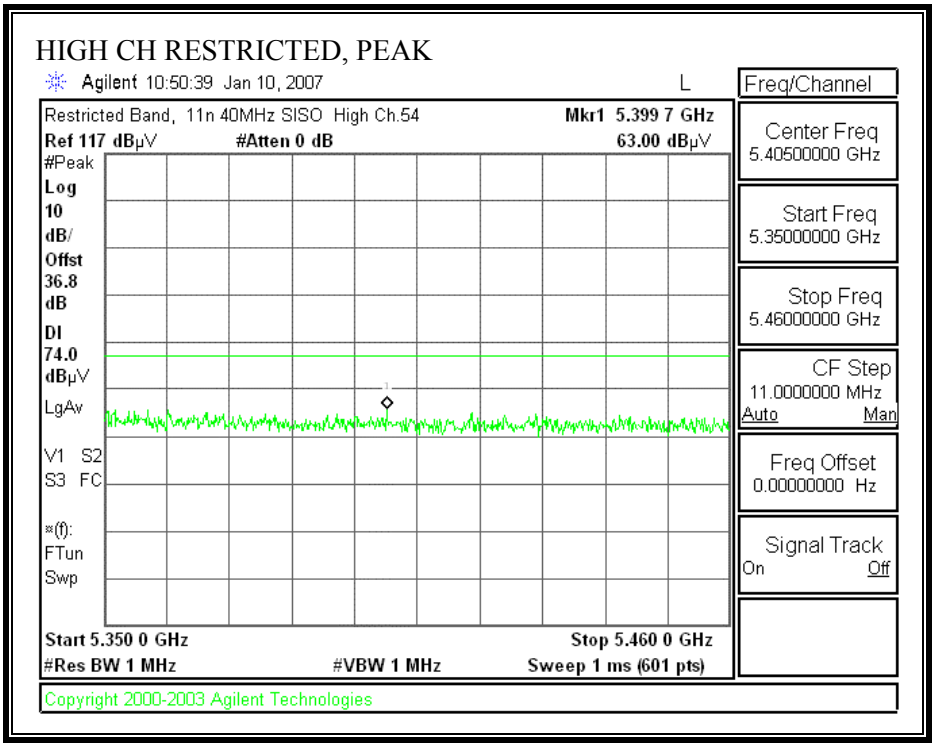
HIGH CHANNEL, 5270 MHz - HORIZONTAL)



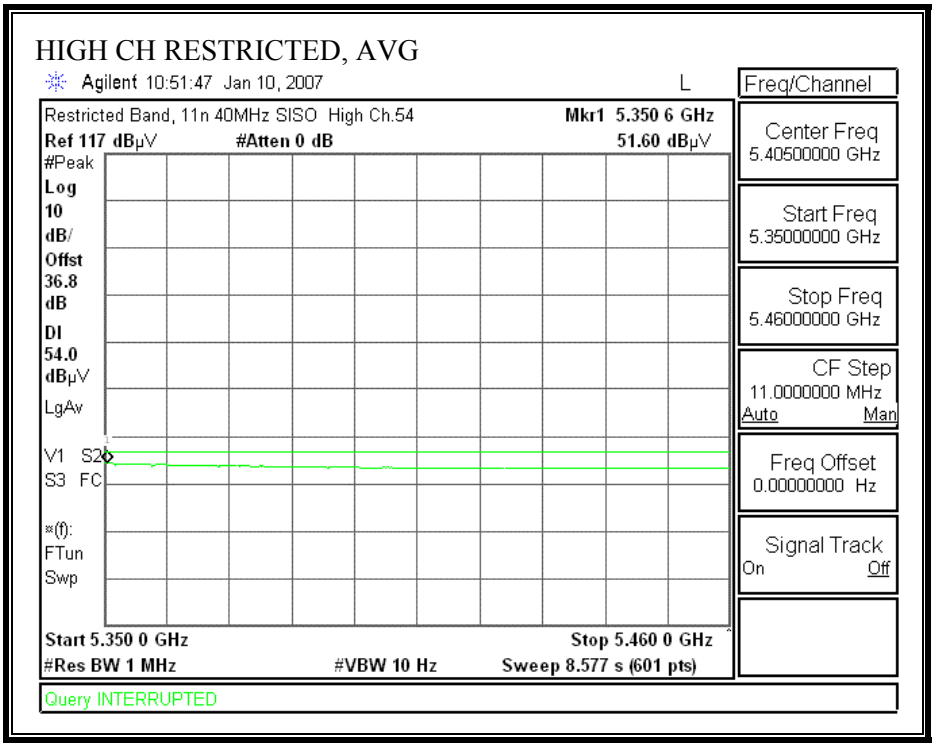
HIGH CH RESTRICTED, AVG



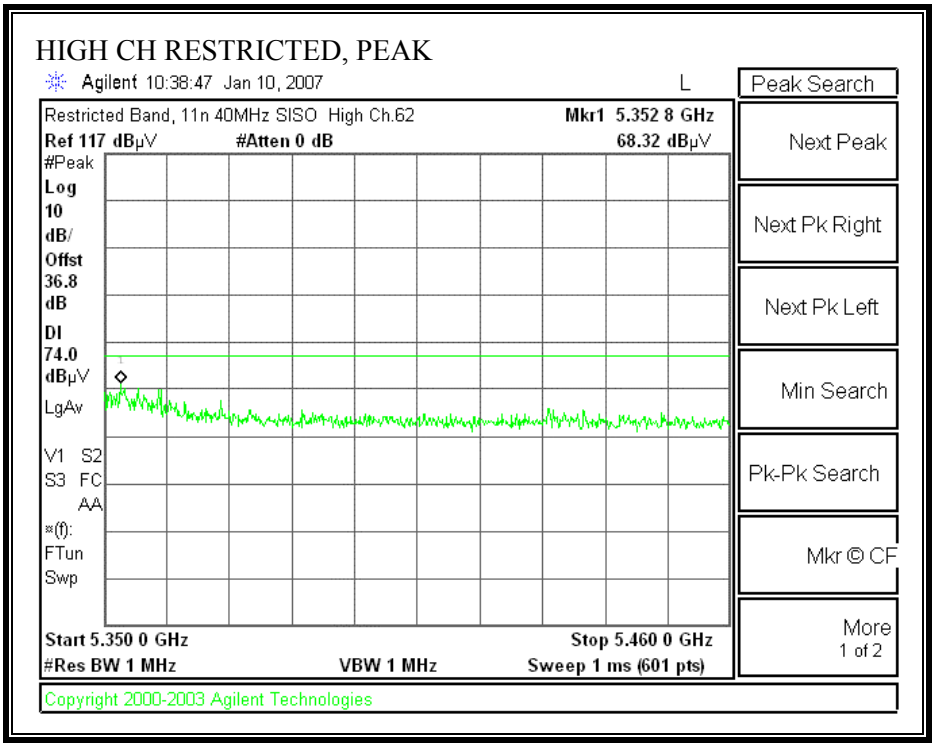
HIGH CHANNEL, 5270 MHz - VERTICAL)



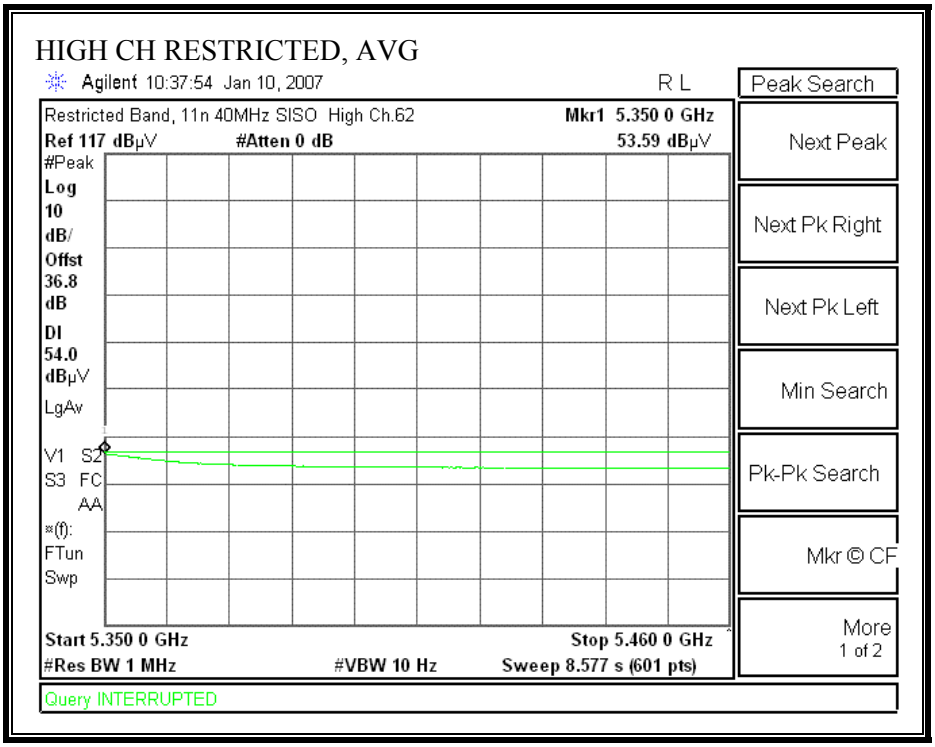
HIGH CH RESTRICTED, AVG



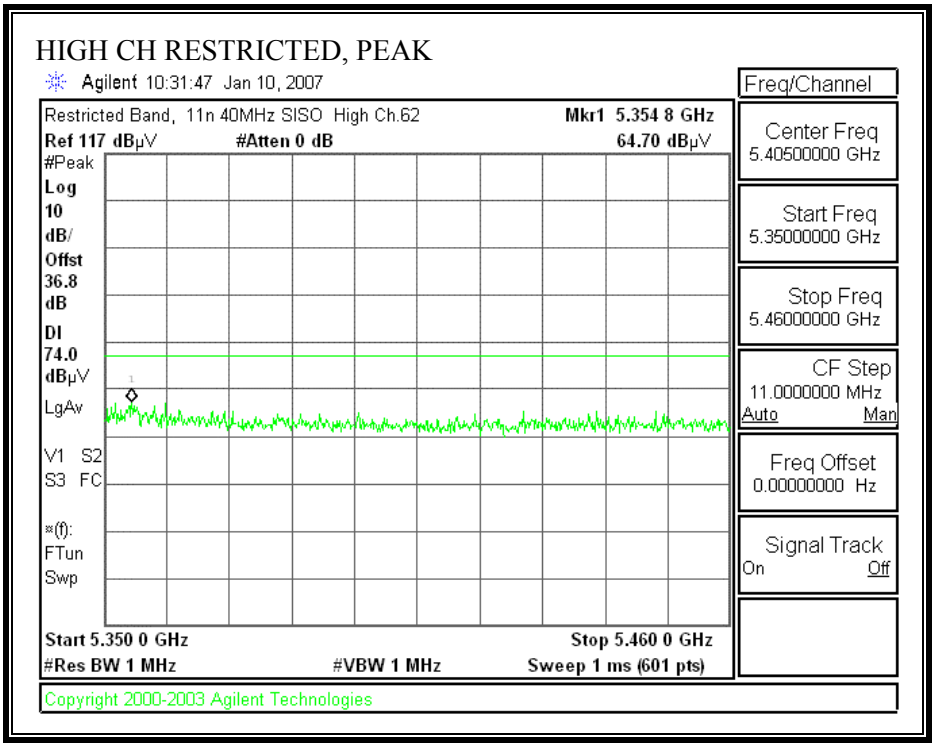
HIGH CHANNEL, 5310 MHz - HORIZONTAL)



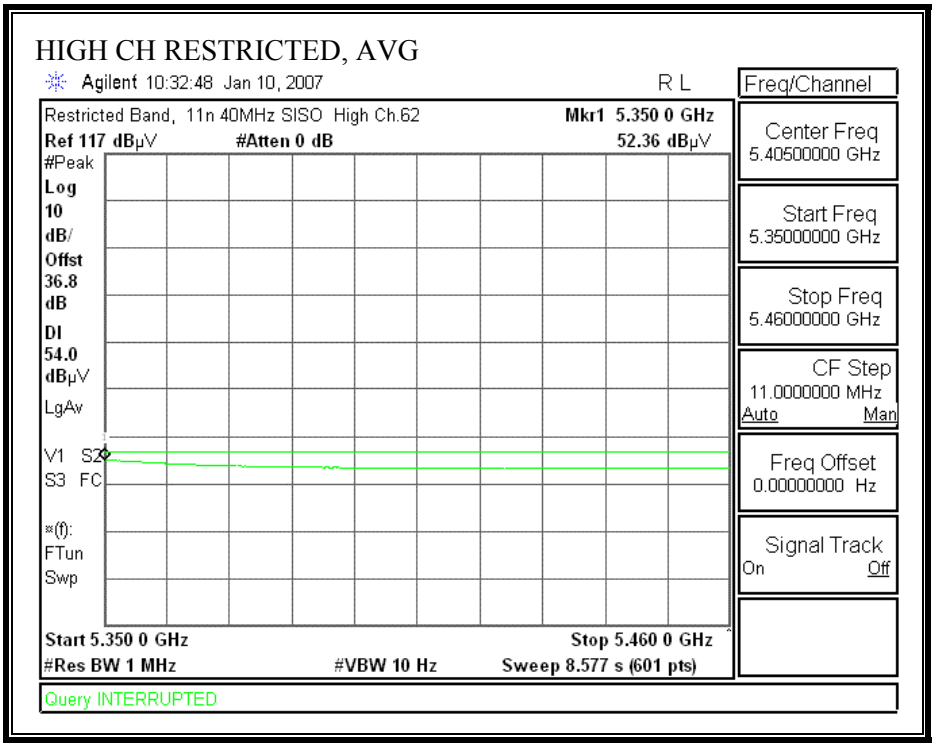
HIGH CH RESTRICTED, AVG



HIGH CHANNEL, 5310 MHz - VERTICAL)



HIGH CH RESTRICTED, AVG



802.11n 40 MHz SISO MODE

HARMONICS AND SPURIOUS EMISSIONS (802.11n 40 MHz SISO MODE)

High Frequency Measurement
Compliance Certification Services, Morgan Hill Open Field Site

Company: Broadcom
Project #: 06U10708
Date: 01/16/07
Test Engineer: Vien Tran
Configuration: EUT & Antenna
Mode: Tx_5.2GHz Band_ 11n 40 MHz SISO

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T145 Agilent 3008A005(			FCC 15.209

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
Vien 177079005		Vien 197209005	HPF_7.6GHz	

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)
CH 38, 5190 MHz															
10.380	3.0	57.8	44.5	37.4	4.8	-34.6	0.0	0.8	66.1	52.8	74	54	-7.9	-1.2	H
15.570	3.0	45.6	34.4	38.0	5.8	-32.3	0.0	0.7	57.9	46.7	74	54	-16.1	-7.3	H
10.380	3.0	52.3	39.8	37.4	4.8	-34.6	0.0	0.8	60.6	48.1	74	54	-13.4	-5.9	V
15.570	3.0	43.8	33.2	38.0	5.8	-32.3	0.0	0.7	56.1	45.5	74	54	-17.9	-8.5	V
CH 46, 5230 MHz															
10.460	3.0	52.9	40.4	37.4	4.8	-34.5	0.0	0.8	61.3	48.8	74	54	-12.7	-5.2	H
15.690	3.0	45.1	33.9	37.9	5.8	-32.3	0.0	0.7	57.3	46.1	74	54	-16.7	-7.9	H
10.460	3.0	51.4	39.7	37.4	4.8	-34.5	0.0	0.8	59.8	48.1	74	54	-14.2	-5.9	V
15.690	3.0	43.9	33.6	37.9	5.8	-32.3	0.0	0.7	56.1	45.8	74	54	-17.9	-8.2	V
CH 54, 5270 MHz															
10.540	3.0	51.5	39.9	37.4	4.8	-34.4	0.0	0.8	60.0	48.4	74	54	-14.0	-5.6	H
15.810	3.0	43.7	33.6	37.9	5.9	-32.2	0.0	0.7	55.9	45.8	74	54	-18.1	-8.2	H
10.540	3.0	50.1	39.4	37.4	4.8	-34.4	0.0	0.8	58.6	47.9	74	54	-15.4	-6.1	V
15.810	3.0	43.9	33.0	37.9	5.9	-32.2	0.0	0.7	56.1	45.2	74	54	-17.9	-8.8	V
CH 62, 5310 MHz															
10.620	3.0	54.7	41.5	37.4	4.8	-34.3	0.0	0.8	63.4	50.2	74	54	-10.6	-3.8	H
15.930	3.0	45.5	33.6	37.8	5.9	-32.2	0.0	0.7	57.7	45.8	74	54	-16.3	-8.2	H
10.620	3.0	52.4	40.6	37.4	4.8	-34.3	0.0	0.8	61.1	49.3	74	54	-12.9	-4.7	V
15.930	3.0	43.7	32.9	37.8	5.9	-32.2	0.0	0.7	55.9	45.1	74	54	-18.1	-8.9	V
			No other emissions were detected above 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		

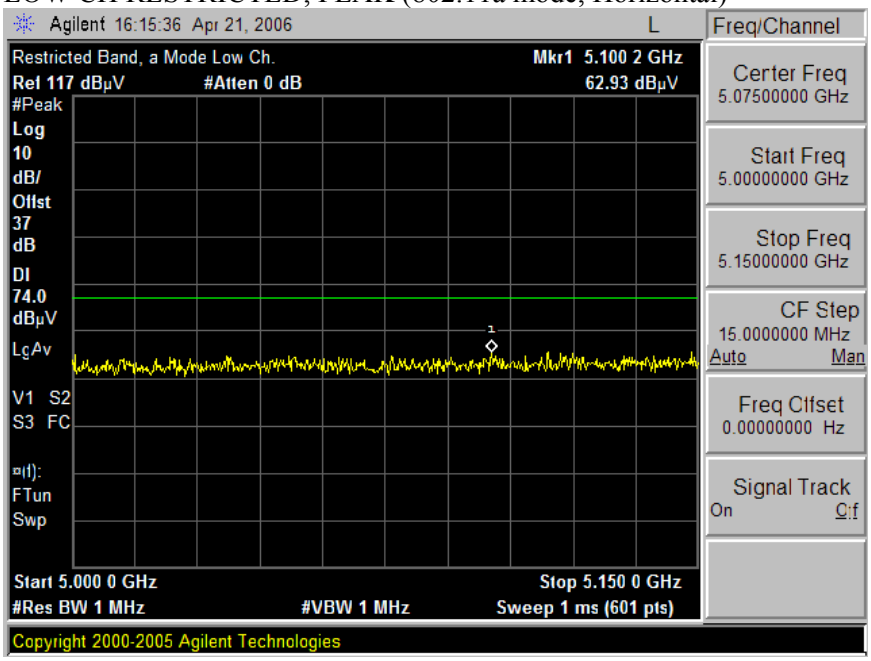
MIMO MODE

7.3.3. TRANSMITTER ABOVE 1 GHZ FOR 5150 TO 5350 MHz BAND

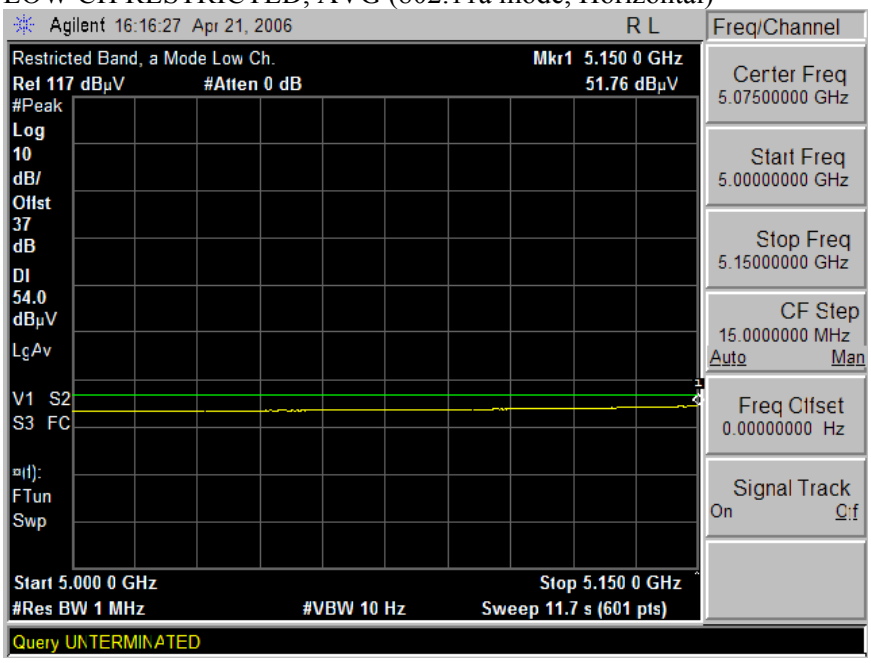
802.11n 20 MHz CDD MCS 0

RESTRICTED BANDEDGE (LOW CHANNEL, 5180 MHz - HORIZONTAL)

LOW CH RESTRICTED, PEAK (802.11a mode, Horizontal)

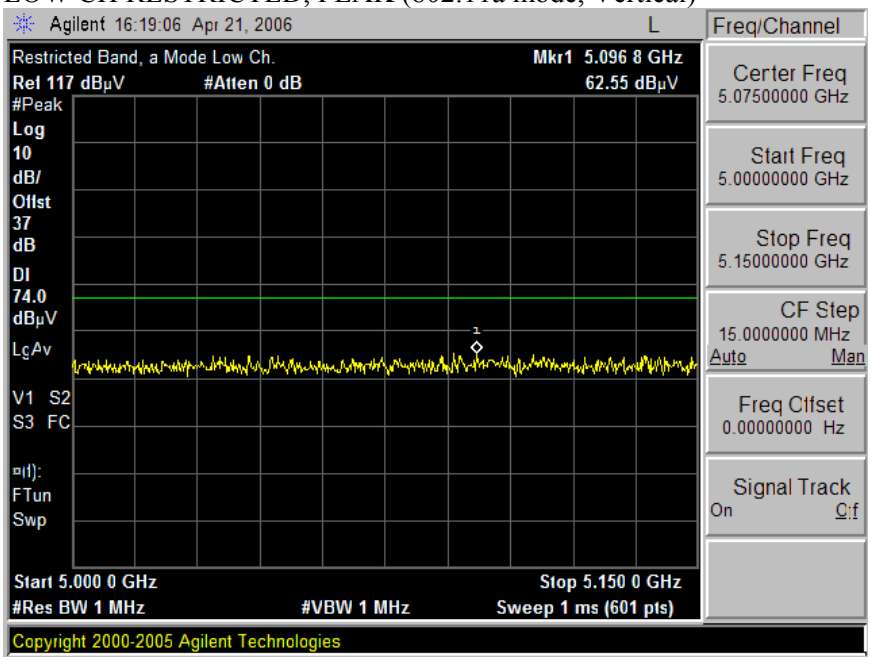


LOW CH RESTRICTED, AVG (802.11a mode, Horizontal)

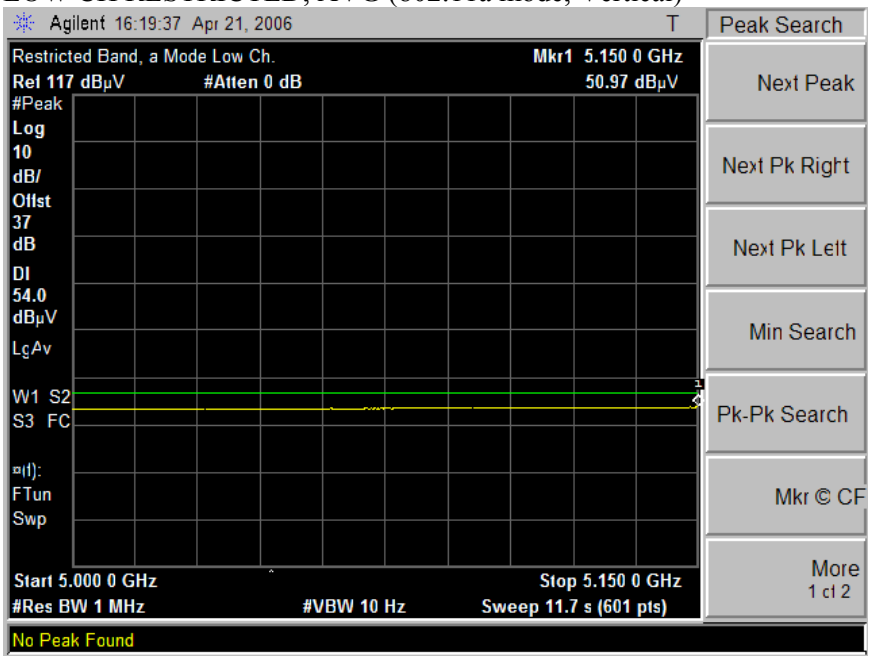


RESTRICTED BANDEDGE (802.11a MODE, LOW CHANNEL, 5180 MHz - VERTICAL)

LOW CH RESTRICTED, PEAK (802.11a mode, Vertical)

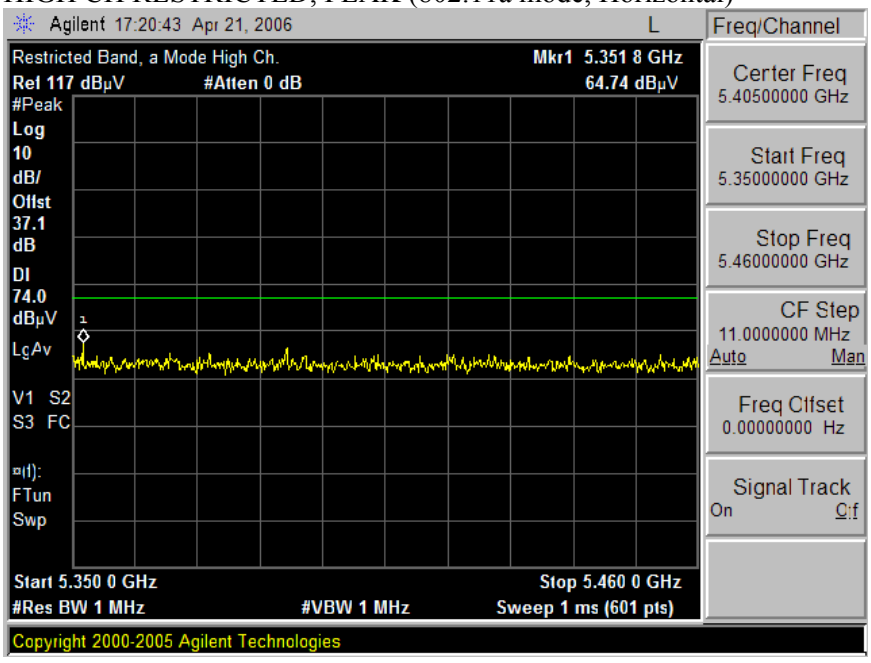


LOW CH RESTRICTED, AVG (802.11a mode, Vertical)

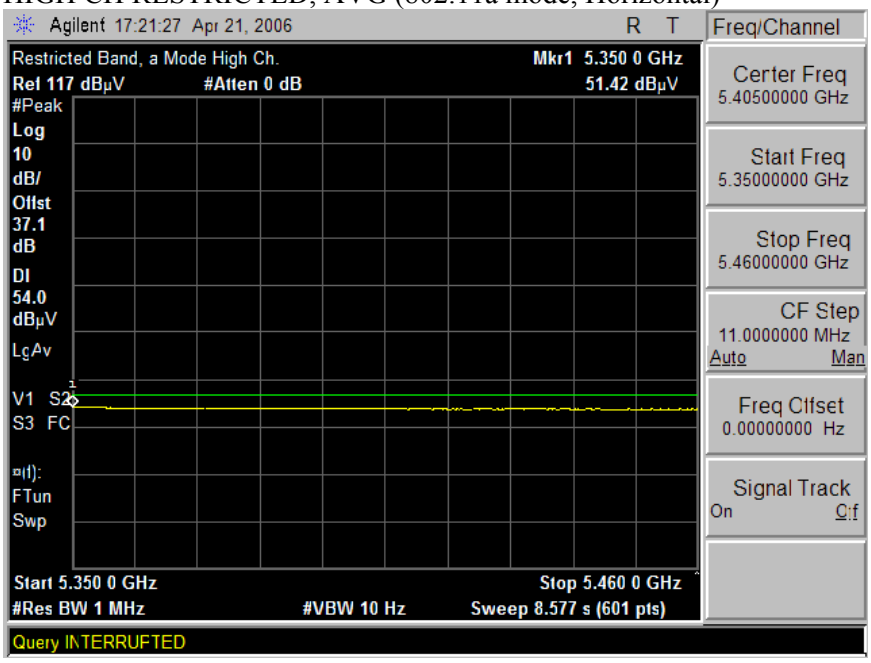


RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5320 MHz - HORIZONTAL)

HIGH CH RESTRICTED, PEAK (802.11a mode, Horizontal)

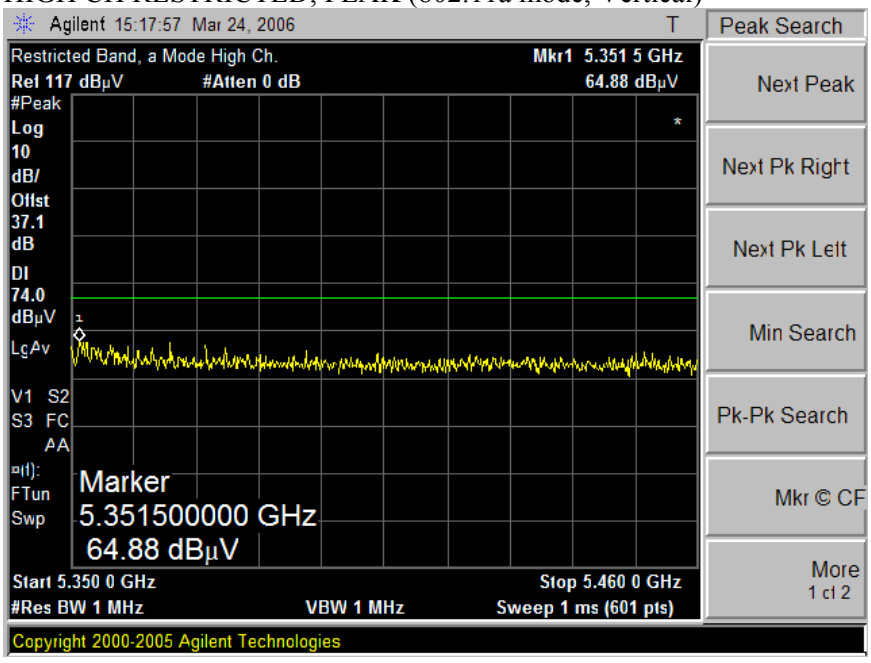


HIGH CH RESTRICTED, AVG (802.11a mode, Horizontal)

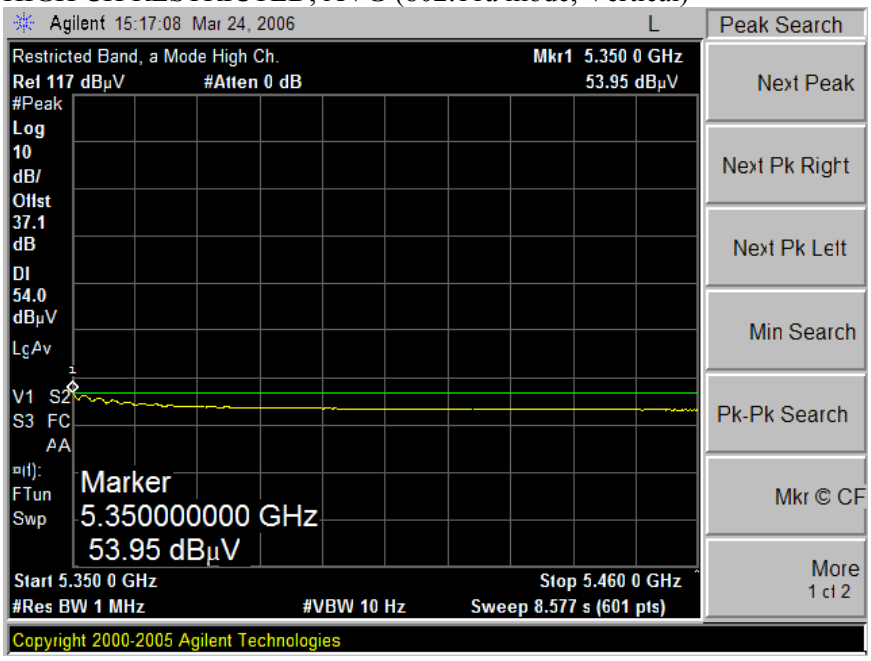


RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5320 MHz - VERTICAL)

HIGH CH RESTRICTED, PEAK (802.11a mode, Vertical)



HIGH CH RESTRICTED, AVG (802.11a mode, Vertical)



HARMONICS AND SPURIOUS EMISSIONS (802.11a – 20 MHz TX BANDWIDTH

03/24/06 **High Frequency Measurement**
Compliance Certification Services, Morgan Hill Open Field Site

Test Engineer:	Vien Tran
Project #:	06U10233
Company:	Broadcom
EUT Description:	2x2 Dual Band MIMO Device
EUT M/N:	BCM94321MC
EUT S/N:	107
Test Target:	FCC 15.407
Mode Of Operation:	5.2 GHz Band_Tx MIMO Txbw 2_Mode 0 1

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T119; S/N: 29301 @3m	T145 Agilent 3008A0056			FCC 15.209

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
	Vien 187215002	Vien 197209005	HPF_7.6GHz	

Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

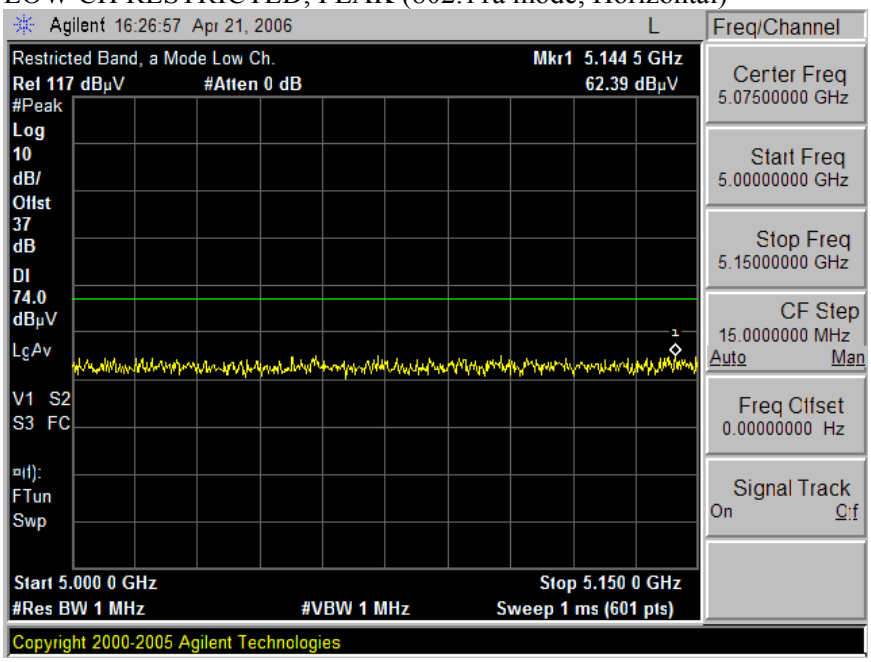
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
Ch 36, 5180 MHz_15.5dBm															
10.360	3.0	48.9	35.7	37.6	4.7	-34.6	0.0	0.8	57.4	44.2	74	54	-16.6	-9.8	V
15.540	3.0	43.7	32.7	40.1	5.8	-32.3	0.0	0.7	58.0	47.0	74	54	-16.0	-7.0	V, Noise Floor
10.360	3.0	46.2	35.3	37.6	4.7	-34.6	0.0	0.8	54.7	43.8	74	54	-19.3	-10.2	H
15.540	3.0	44.0	32.5	40.1	5.8	-32.3	0.0	0.7	58.3	46.8	74	54	-15.7	-7.2	H, Noise Floor
Ch 52, 5260 MHz_17dBm															
10.520	3.0	55.6	42.2	37.6	4.7	-34.4	0.0	0.8	64.3	50.9	74	54	-9.7	-3.1	V
15.780	3.0	43.0	32.6	40.3	5.8	-32.2	0.0	0.7	57.6	47.2	74	54	-16.4	-6.8	V, Noise Floor
10.520	3.0	55.1	42.0	37.6	4.7	-34.4	0.0	0.8	63.8	50.7	74	54	-10.2	-3.3	H
15.780	3.0	44.0	32.8	40.3	5.8	-32.2	0.0	0.7	58.6	47.4	74	54	-15.4	-6.6	H, Noise Floor
Ch 64, 5320 MHz_17dBm															
10.640	3.0	51.5	38.0	37.6	4.8	-34.2	0.0	0.8	60.4	46.9	74	54	-13.6	-7.1	V
15.960	3.0	44.5	32.3	40.3	5.9	-32.2	0.0	0.7	59.2	47.0	74	54	-14.8	-7.0	V, Noise Floor
10.640	3.0	49.8	37.2	37.6	4.8	-34.2	0.0	0.8	58.7	46.1	74	54	-15.3	-7.9	H
15.960	3.0	43.0	32.0	40.3	5.9	-32.2	0.0	0.7	57.7	46.7	74	54	-16.3	-7.3	H, Noise Floor
Note: No other emissions were detected 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		

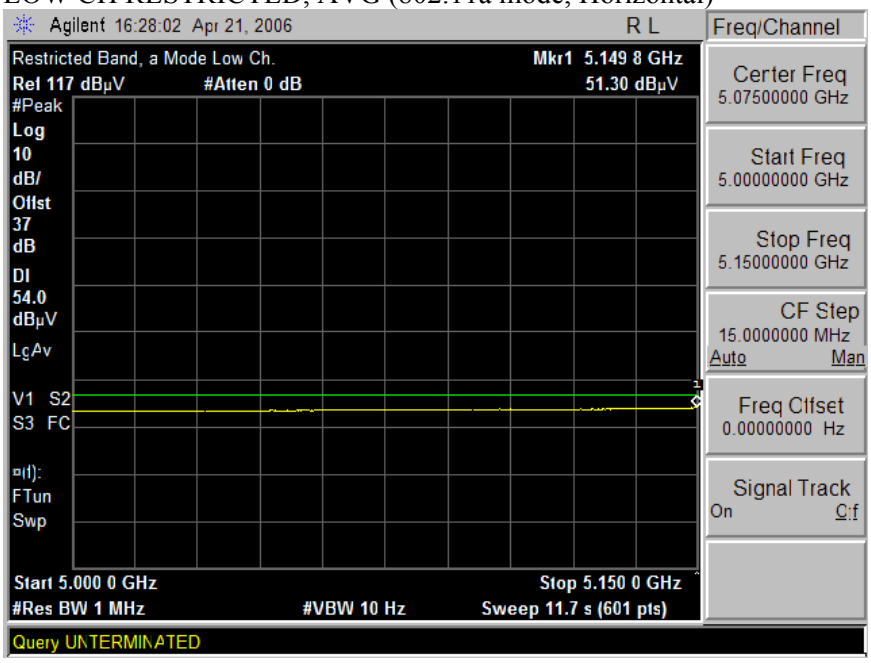
802.11n 40 MHz CDD MCS 32

RESTRICTED BANDEDGE (LOW CHANNEL, 5190 MHz - HORIZONTAL)

LOW CH RESTRICTED, PEAK (802.11a mode, Horizontal)

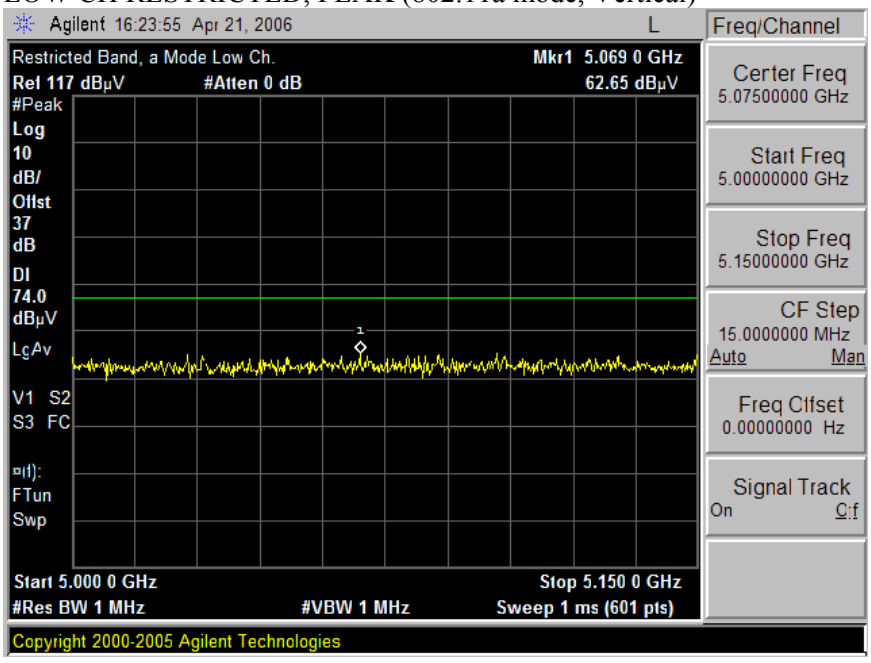


LOW CH RESTRICTED, AVG (802.11a mode, Horizontal)

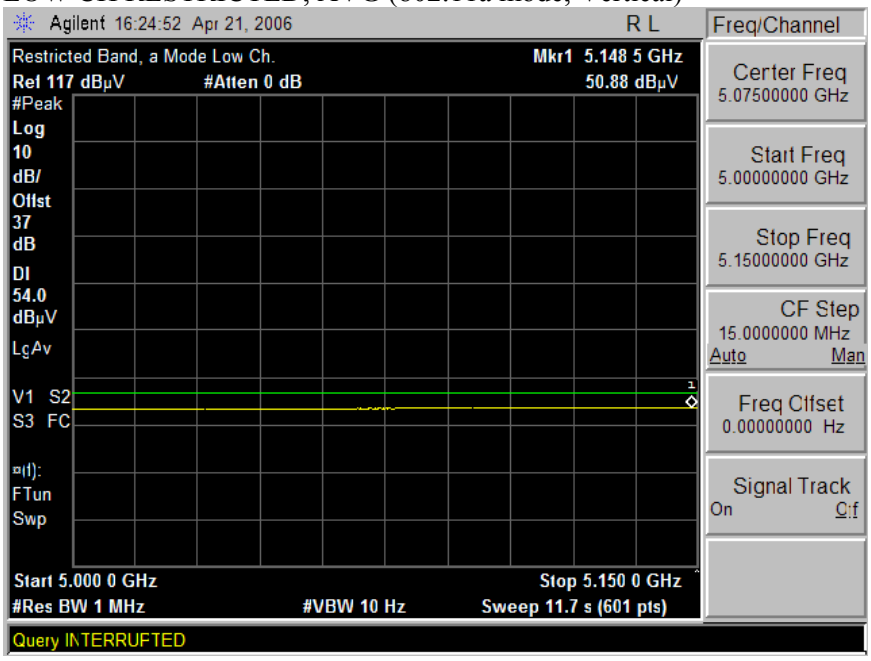


RESTRICTED BANDEDGE (802.11a MODE, LOW CHANNEL, 5190 MHz - VERTICAL)

LOW CH RESTRICTED, PEAK (802.11a mode, Vertical)

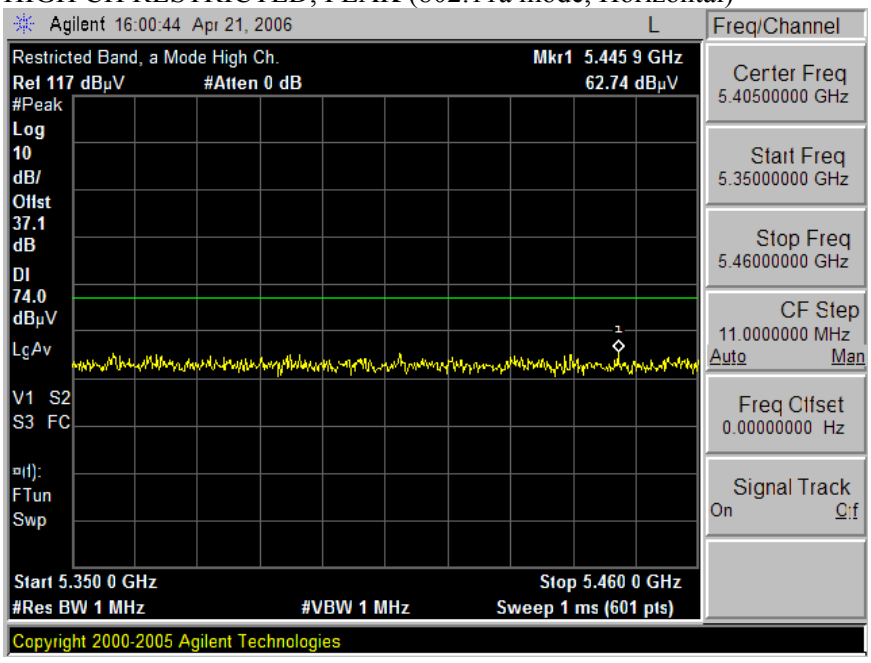


LOW CH RESTRICTED, AVG (802.11a mode, Vertical)

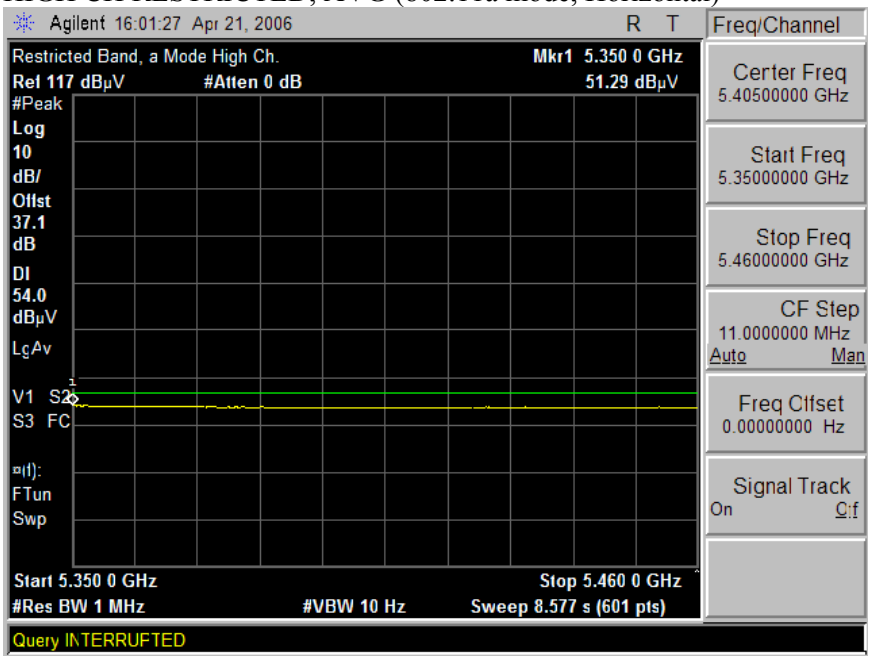


RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5310 MHz - HORIZONTAL)

HIGH CH RESTRICTED, PEAK (802.11a mode, Horizontal)

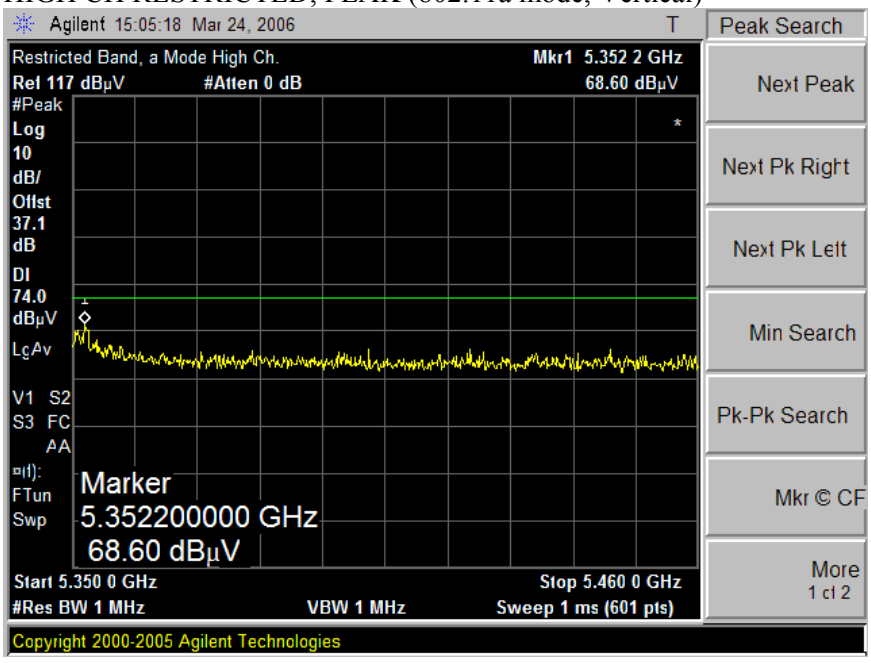


HIGH CH RESTRICTED, AVG (802.11a mode, Horizontal)

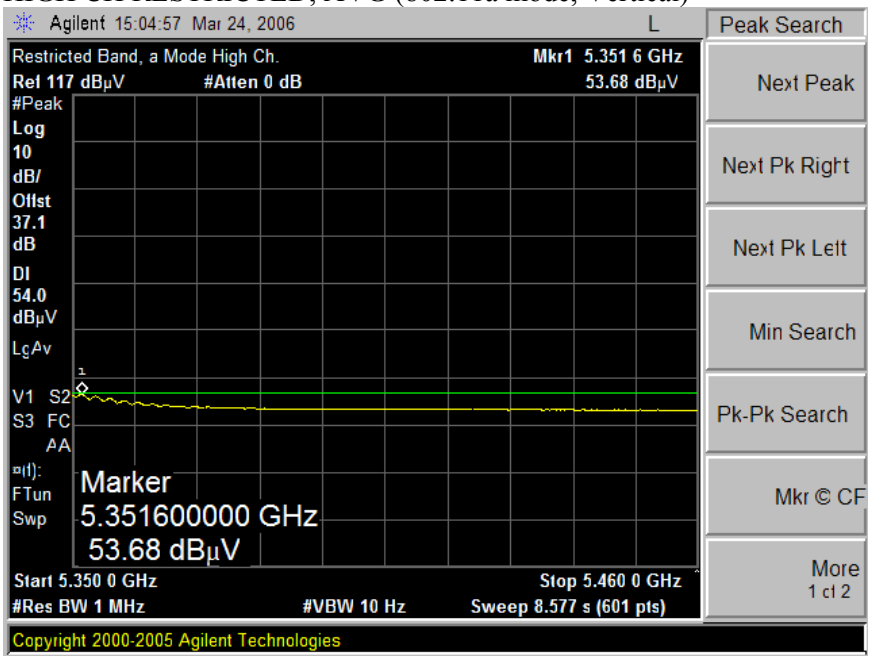


RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5310 MHz - VERTICAL)

HIGH CH RESTRICTED, PEAK (802.11a mode, Vertical)



HIGH CH RESTRICTED, AVG (802.11a mode, Vertical)



HARMONICS AND SPURIOUS EMISSIONS (802.11a – 40 MHz TX BANDWIDTH

03/27/06 **High Frequency Measurement**
Compliance Certification Services, Morgan Hill Open Field Site

Test Engineer: Vien Tran
Project #: 06U10233
Company: Broadcom
EUT Description: 2x2 Dual Band MIMO Device
EUT M/N: BCM94321MC
EUT S/N: 107
Test Target: FCC 15.407
Mode Of Operation: 5.2 GHz Band_Tx MIMO Txbw 4_Mode 0 1_Ch 38, 54 & 62

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T145 Agilent 3008A0056			FCC 15.209

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
	Vien 187215002	Vien 197209005	HPF_7.6GHz	R_001

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)
Ch 38, 5190 MHz_17dBm															
10.380	3.0	47.4	34.8	38.3	4.7	-34.6	0.0	0.8	56.6	44.0	74	54	-17.4	-10.0	V
15.570	3.0	44.9	32.8	39.0	5.8	-32.3	0.0	0.7	58.1	46.0	74	54	-15.9	-8.0	V, Noise Floor
10.380	3.0	48.7	37.0	38.3	4.7	-34.6	0.0	0.8	57.9	46.2	74	54	-16.1	-7.8	H
15.570	3.0	44.1	32.5	39.0	5.8	-32.3	0.0	0.7	57.3	45.7	74	54	-16.7	-8.3	H, Noise Floor
Ch 54, 5270 MHz_17dBm															
10.540	3.0	50.8	38.7	38.2	4.7	-34.4	0.0	0.8	60.2	48.1	74	54	-13.8	-5.9	V
15.810	3.0	42.5	32.6	38.8	5.8	-32.2	0.0	0.7	55.6	45.7	74	54	-18.4	-8.3	V, Noise Floor
10.540	3.0	48.9	38.5	38.2	4.7	-34.4	0.0	0.8	58.3	47.9	74	54	-15.7	-6.1	H
15.810	3.0	44.4	32.6	38.8	5.8	-32.2	0.0	0.7	57.5	45.7	74	54	-16.5	-8.3	H, Noise Floor
Ch 62, 5310 MHz_17dBm															
10.620	3.0	49.5	37.7	38.2	4.8	-34.3	0.0	0.8	58.9	47.1	74	54	-15.1	-6.9	V
15.930	3.0	43.4	31.9	38.7	5.9	-32.2	0.0	0.7	56.5	45.0	74	54	-17.5	-9.0	V, Noise Floor
10.620	3.0	50.1	39.9	38.2	4.8	-34.3	0.0	0.8	59.5	49.3	74	54	-14.5	-4.7	H
15.930	3.0	43.6	32.2	38.7	5.9	-32.2	0.0	0.7	56.7	45.3	74	54	-17.3	-8.7	H, Noise Floor
Note: No other emissions were detected 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		

7.3.4. WORST-CASE RADIATED EMISSIONS BELOW 1 GHz

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

HORIZONTAL

COMPLIANCE Engineering Services, Inc.
561F Monterey Road
Morgan Hill, CA 95037
Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 12 File#: 06U10708.EMI Date: 01-03-2007 Time: 14:20:15
Audix ATC

Condition: FCC CLASS-B HORIZONTAL
Test Operator: : William Zhuang
Company: : Broadcom
Project #: : 06U10708
Configuration: : EUT/ Laptop
Mode of Operation:: TX 5.2GHz band, Worst Case
Target: : FCC Class B

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	121.180	21.14	15.16	36.30	43.50	-7.20	Peak
2	203.630	23.12	14.01	37.13	43.50	-6.37	Peak
3	303.540	24.02	15.75	39.77	46.00	-6.23	Peak
4	402.480	25.75	18.11	43.86	46.00	-2.14	Peak
5	634.310	15.81	22.07	37.87	46.00	-8.13	Peak
6	897.180	15.83	25.85	41.68	46.00	-4.32	Peak

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

VERTICAL

COMPLIANCE Engineering Services, Inc.
561F Monterey Road
Morgan Hill, CA 95037
Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 10 File#: 06U10708.EMI Date: 01-03-2007 Time: 14:08:12
Audix ATC

Condition: FCC CLASS-B VERTICAL
Test Operator: : William Zhuang
Company: : Broadcom
Project #: : 06U10708
Configuration: : EUT/ Laptop
Mode of Operation:: TX 5.2GHz band, Worst Case
Target: : FCC Class B

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	104.690	26.92	12.38	39.30	43.50	-4.20	Peak
2	126.030	18.58	15.25	33.83	43.50	-9.67	Peak
3	203.630	19.17	14.01	33.18	43.50	-10.32	Peak
4	405.390	20.21	18.18	38.39	46.00	-7.61	Peak
5	523.730	15.62	20.62	36.24	46.00	-9.76	Peak
6	594.540	15.51	21.41	36.92	46.00	-9.08	Peak
7	643.040	16.28	22.23	38.51	46.00	-7.49	Peak
8	907.850	12.83	26.00	38.84	46.00	-7.16	Peak

7.4. POWERLINE CONDUCTED EMISSIONS

LIMIT

§15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal.

The lower limit applies at the boundary between the frequency ranges.

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

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

The resolution bandwidth is set to 9 kHz for both peak detection and quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

No non-compliance noted:

5 GHz BAND

6 WORST EMISSIONS

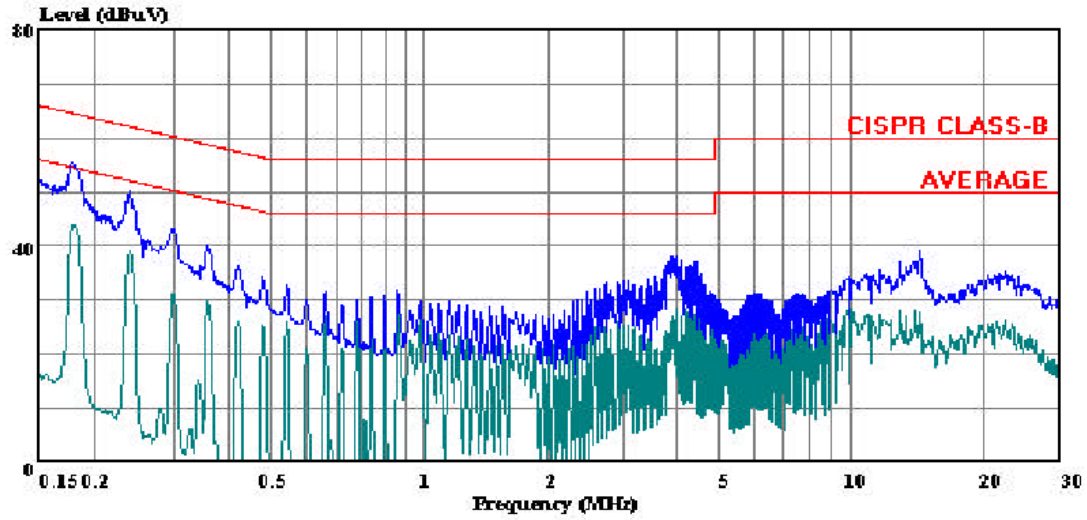
CONDUCTED EMISSIONS DATA (115VAC 60Hz)

Freq.	Reading			Closs	Limit	FCC_B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.18	55.32	--	44.00	0.00	64.49	54.49	-9.17	-10.49	L1
0.24	50.36	--	38.98	0.00	62.10	52.10	-11.74	-13.12	L1
4.05	37.97	--	28.50	0.00	56.00	46.00	-18.03	-17.50	L1
0.18	51.51	--	39.12	0.00	64.49	54.49	-12.98	-15.37	L2
0.24	42.85	--	20.62	0.00	62.10	52.10	-19.25	-31.48	L2
4.05	35.63	--	18.90	0.00	56.00	46.00	-20.37	-27.10	L2
6 Worst Data									

LINE 1 RESULTS

Compliance Certification Services
561F Monterey Road
Morgan Hill, CA 95037
Tel: (408) 463-0885
Fax: (408) 463-0888

Data#: 7 File#: 06u10708.EMI Date: 12-07-2006 Time: 14:27:02



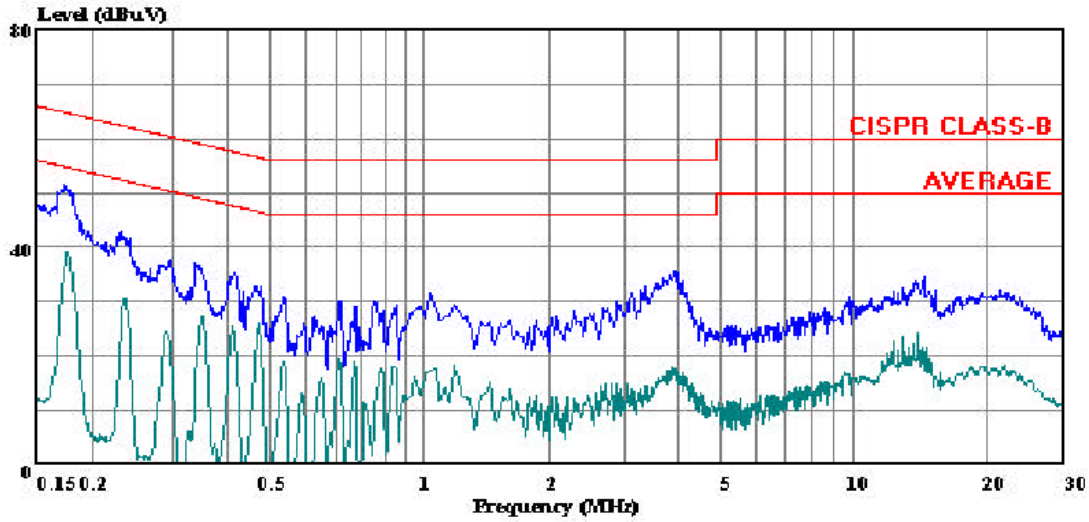
Trace: 5 Ref Trace:

Condition: CISPR CLASS-B
Test Operator : Vien Tran
Project # : 06U10708
Company : Broadcom
EUT configuration: EUT & Laptop
Mode of operation: Tx worst case 5 GHz
Power Source : 115VAC / 60Hz
: Line 1: Peak (Blue), Avg (Green)
: FCC Class B

LINE 2 RESULTS

Compliance Certification Services
561F Monterey Road
Morgan Hill, CA 95037
Tel: (408) 463-0885
Fax: (408) 463-0888

Data#: 28 File#: 06u10708.EMI Date: 12-07-2006 Time: 15:30:52



Trace: 26 Ref Trace:

Condition: CISPR CLASS-B
Test Operator : Vien Tran
Project # : 06U10708
Company : Broadcom
EUT configuration: EUT & Laptop
Mode of operation: Tx worst case 5 GHz
Power Source : 115VAC / 60Hz
: Line 2: Peak (Blue), Avg (Green)
: FCC Class B