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-BRCM1022

REPORT NUMBER: 06U10233-2C

ISSUE DATE: JUNE 26, 2006

Prepared for
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Revision History

Rev.	Issue Date	Revisions	Revised By
--	06/08/06	Initial Issue	Thu
B	06/14/06	Further detailed explanation of the investigations on section 5.2	Thu
C	06/26/06	Revised the report to document the highest antenna gain for each band Formula to show the array gain & result calculation Performed additional PPSD test in legacy/H20/H40	Thu

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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:	107 & 316
DATE TESTED:	MARCH 27 – MAY 30, 2006

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:

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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. 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.

5.3. MAXIMUM OUTPUT POWER

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

HITACHI (PIFA Stamped Antenna) & PHYCOMP (PCB Antenna)

LEGACY MODE

5150 to 5250 MHz Authorized Band

Frequency Range (MHz)	Mode	Peak Chain 0 (dBm)	Peak Chain 1 (dBm)	Total Peak Power (dBm)	Output (mW)
5150 - 5250	a-mode	7.32	7.20	10.27	10.64

5250 to 5350 MHz Authorized Band

Frequency Range (MHz)	Mode	Peak Chain 0 (dBm)	Peak Chain 1 (dBm)	Total Peak Power (dBm)	Output (mW)
5250 - 5350	a-mode	15.83	16.95	19.44	87.83

MIMO MODE

5150 to 5250 MHz Authorized Band

Frequency Range (MHz)	Mode	Peak Chain 0 (dBm)	Peak Chain 1 (dBm)	Total Peak Power (dBm)	Output (mW)
5150 - 5250	20 MHz BANDWIDTH	10.34	10.29	13.33	21.50
5150 - 5250	40 MHz BANDWIDTH	12.77	12.76	15.78	37.80

5250 to 5350 MHz Authorized Band

Frequency Range (MHz)	Mode	Peak Chain 0 (dBm)	Peak Chain 1 (dBm)	Total Peak Power (dBm)	Output (mW)
5250 - 5350	20 MHz BANDWIDTH	16.22	16.34	19.29	84.93
5250 - 5350	40 MHz BANDWIDTH	17.13	17.22	20.19	104.36

FOXCONN (PCB Antenna)

LEGACY MODE

5150 to 5250 MHz Authorized Band

Frequency Range (MHz)	Mode	Peak Chain 0 (dBm)	Peak Chain 1 (dBm)	Total Peak Power (dBm)	Output (mW)
5150 - 5250	a-mode	7.32	7.20	10.27	10.64

5250 to 5350 MHz Authorized Band

Frequency Range (MHz)	Mode	Peak Chain 0 (dBm)	Peak Chain 1 (dBm)	Total Peak Power (dBm)	Output (mW)
5250 - 5350	a-mode	15.83	16.95	19.44	87.83

MIMO MODE

5150 to 5250 MHz Authorized Band

Frequency Range (MHz)	Mode	Peak Chain 0 (dBm)	Peak Chain 1 (dBm)	Total Peak Power (dBm)	Output (mW)
5150 - 5250	20 MHz BANDWIDTH	9.11	9.34	12.24	16.74
5150 - 5250	40 MHz BANDWIDTH	11.59	12.19	14.91	30.98

5250 to 5350 MHz Authorized Band

Frequency Range (MHz)	Mode	Peak Chain 0 (dBm)	Peak Chain 1 (dBm)	Total Peak Power (dBm)	Output (mW)
5250 - 5350	20 MHz BANDWIDTH	17.22	17.34	20.29	106.92
5250 - 5350	40 MHz BANDWIDTH	15.53	15.83	18.69	74.01

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. And the EUT was tested with three different antennas as described below:
_ Hitachi, HMT-05 / HFT17-DL17 Model, PIFA Stamped Metal Antenna: 3.9dBi @ 2.4GHz, 3.9dBi @ 5.15GHz, 5.6dBi @ 5.35GHz, & 5.8dBi @ 5.725GHz.
_ Foxconn, 820-2032, PCB Antenna: 2.15dBi @ 2.4GHz, 7.44dBi @ 5.15GHz, 6.25dBi @ 5.35GHz, & 5.79dBi @ 5.850GHz.
_ Phycomp, 4313 33401250 (left), 4313 3402250 (right), PCB Antenna: 2.2dBi @ 2.4GHz & 3.9dBi @ 5GHz.

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

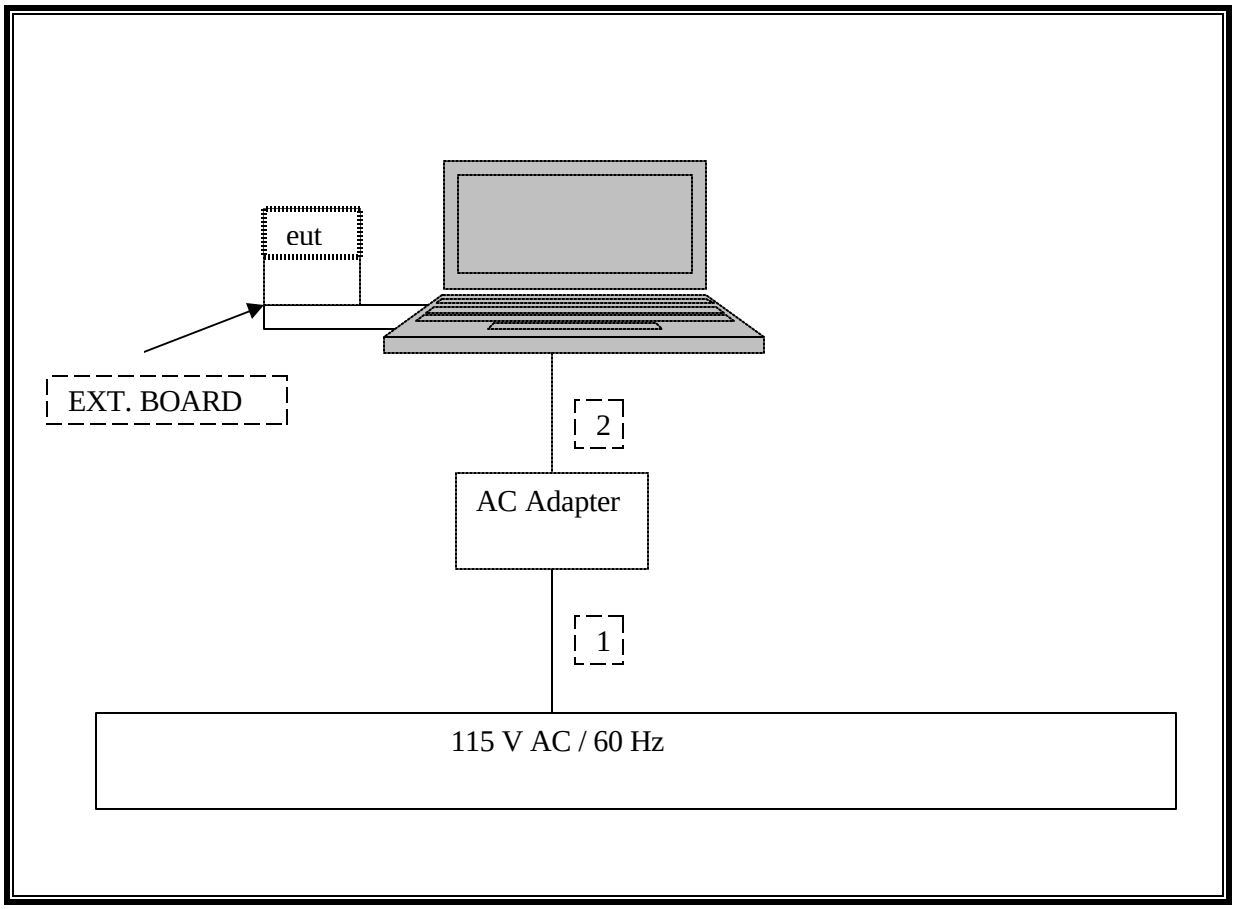
I/O CABLES

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	10/19/2006
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	2238	4/22/2007
Antenna, Horn 26 ~ 40 GHz	ARA	MWH-2640/B	1029	4/13/2007
Preamplifier, 1 ~ 26.5 GHz	Agilent / HP	8449B	3008A00561	10/3/2007
Preamplifier, 26 ~ 40 GHz	Miteq	NSP4000-SP2	924343	8/18/2006
LISN, 10 kHz ~ 30 MHz	FCC	LISN-50/250-25-2	2023	8/30/2006
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-BNC	8379443	8/30/2006
EMI Test Receiver	R & S	ESHS 20	827129/006	6/3/2006
AC Power Source, 10 kVA	ACS	AFC-10K-AFC-2	J1568	CNR
EMI Receiver, 9 kHz ~ 2.9 GHz	Agilent / HP	8542E	3942A00286	2/4/2007
RF Filter Section	Agilent / HP	85420E	3705A00256	2/4/2007
Antenna, Bilog 30 MHz ~ 2 Ghz	Sunol Sciences	JB1	A121003	3/3/2007
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	6/2/2006
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

HITACHI, PIFA STAMPED METAL ANTENNA

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.

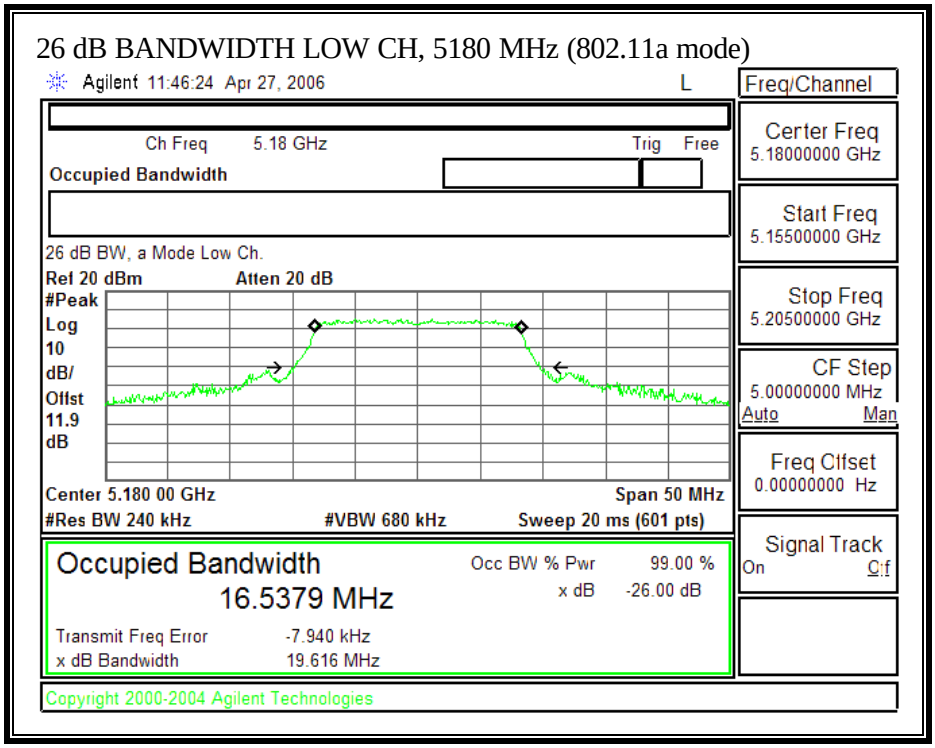
RESULTS

No non-compliance noted:

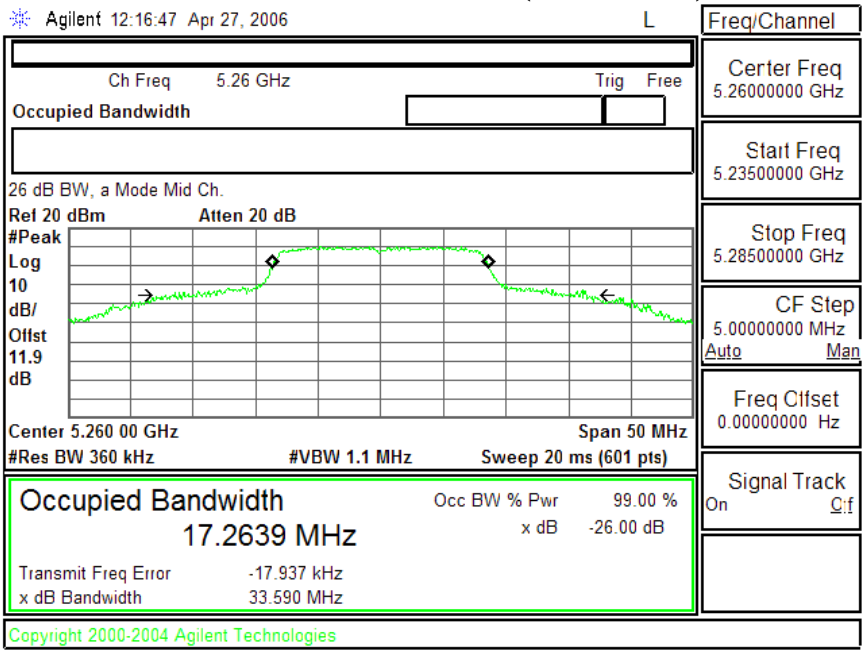
802.11a Mode

Channel	Frequency (MHz)	B (MHz)	10 Log B (dB)
Low	5180	19.62	12.93
Middle	5260	33.59	15.26
High	5300	33.22	15.21
High	5320	19.81	12.97

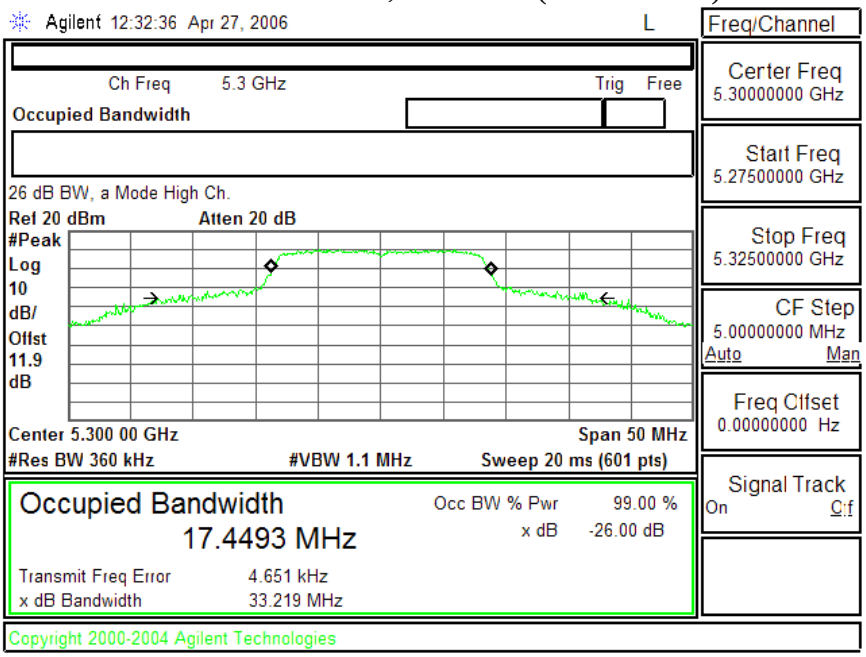
26 dB EMISSION BANDWIDTH (802.11a MODE)



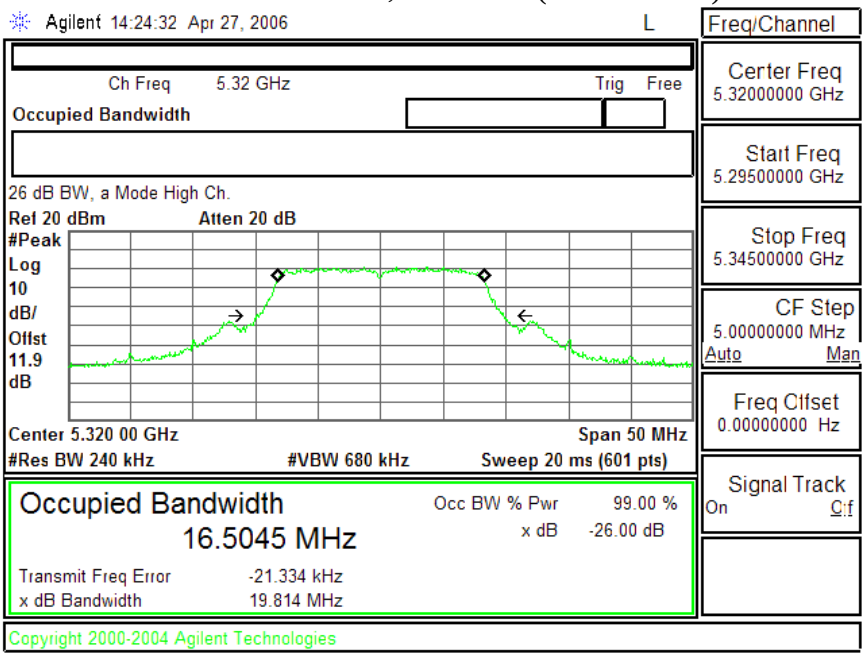
26 dB BANDWIDTH MID CH, 5260 MHz (802.11a mode)



26 dB BANDWIDTH HIGH CH, 5300 MHz (802.11a mode)



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



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.

Following formula to calculate the array gain:

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

5.15 – 5.25GHz band: 8.039 dBi
5.25 – 5.35GHz band: 7.686 dBi

LIMITS AND RESULTS

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	5180	17	19.616	16.926	8.039	14.89

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	33.59	26.262	7.686	22.31
High	5300	24	33.219	26.214	7.686	22.31
High	5320	24	19.814	23.970	7.686	22.28

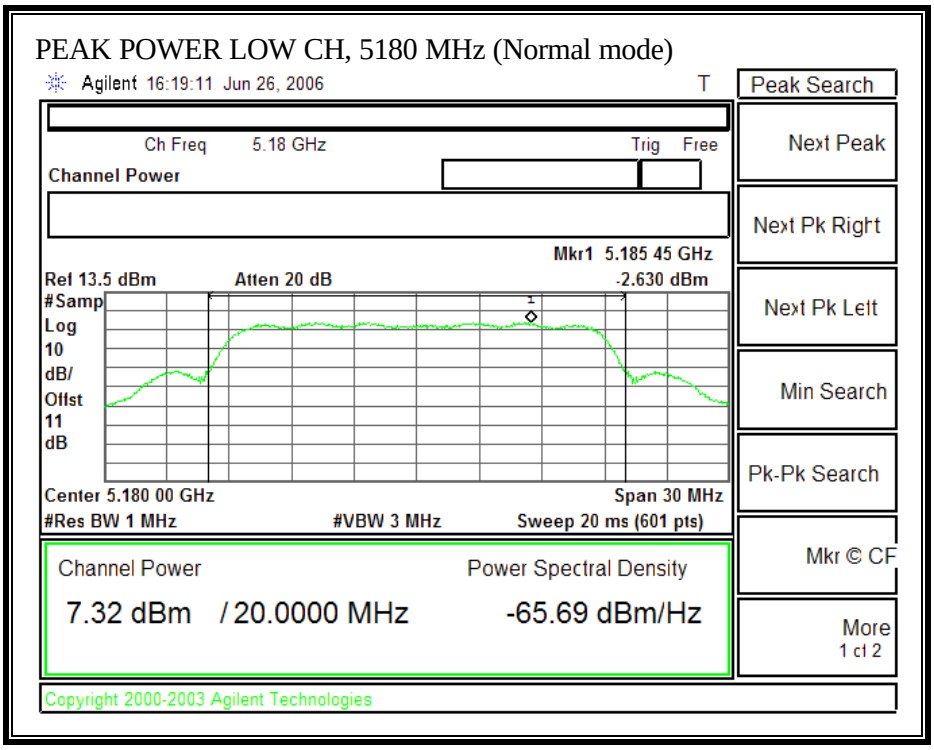
Results

Channel	Frequency (MHz)	Power Chain 0 (dBm)	Power Chain 1 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	7.32	7.20	10.27	14.89	-4.62
Mid	5260	15.83	16.95	19.44	22.31	-2.88
High	5300	14.21	15.51	17.92	22.31	-4.40
High	5320	14.95	16.02	18.53	22.28	-3.76

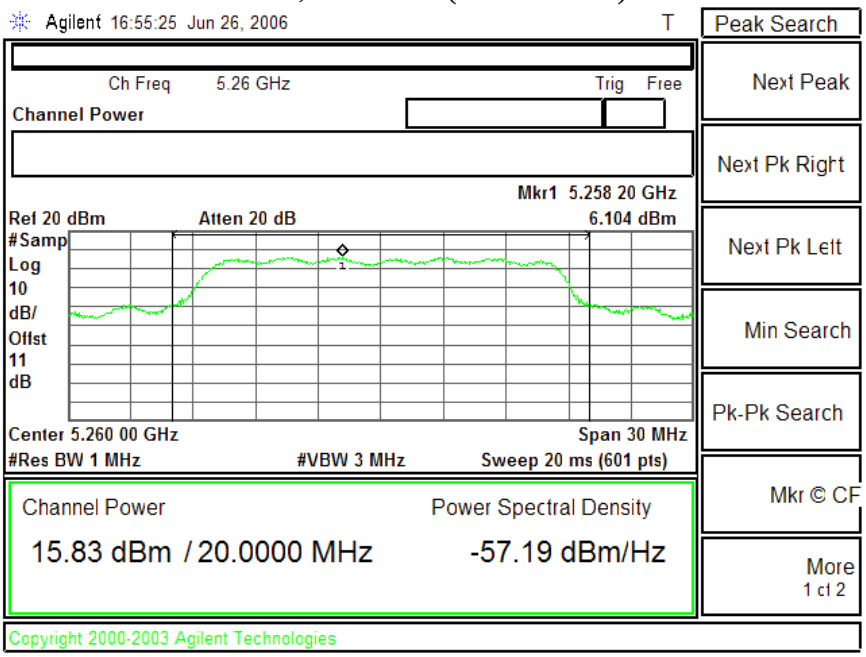
Results

Channel	Frequency (MHz)	Combiner Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	10.37	14.89	-4.52
Mid	5260	18.59	22.31	-3.72
High	5300	17.29	22.31	-5.02
High	5320	17.73	22.28	-4.55

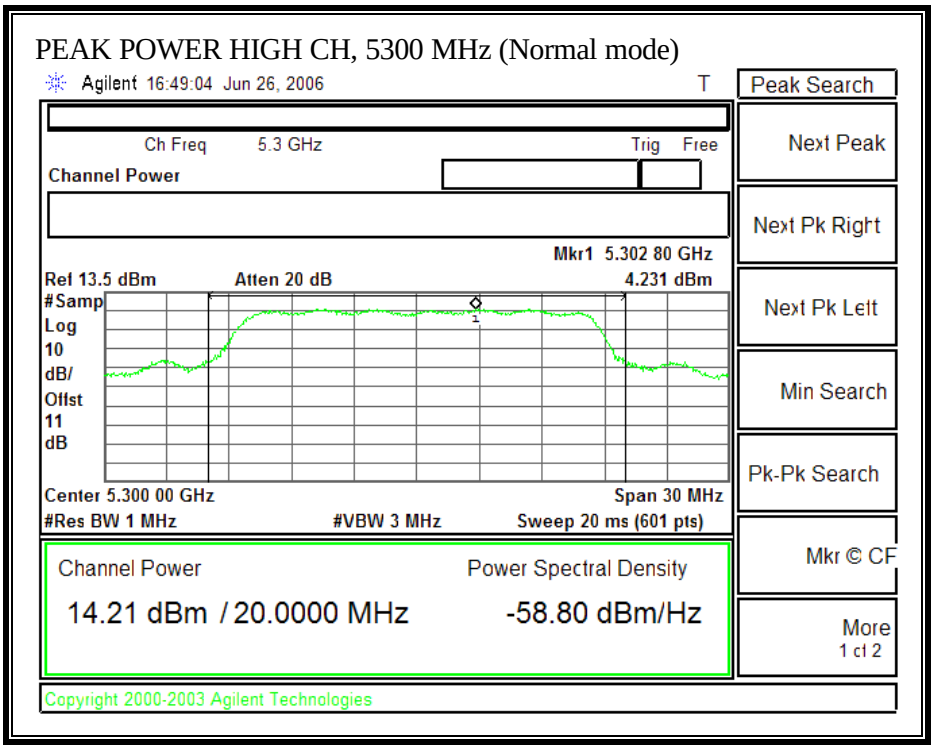
PEAK POWER (NORMAL MODE) (Chain 0)



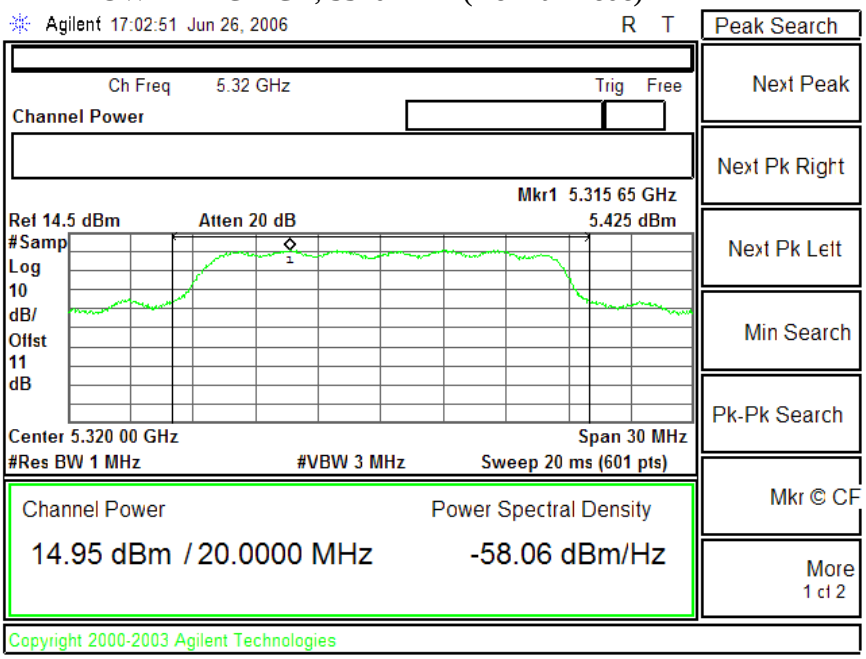
PEAK POWER MID CH, 5260 MHz (Normal mode)



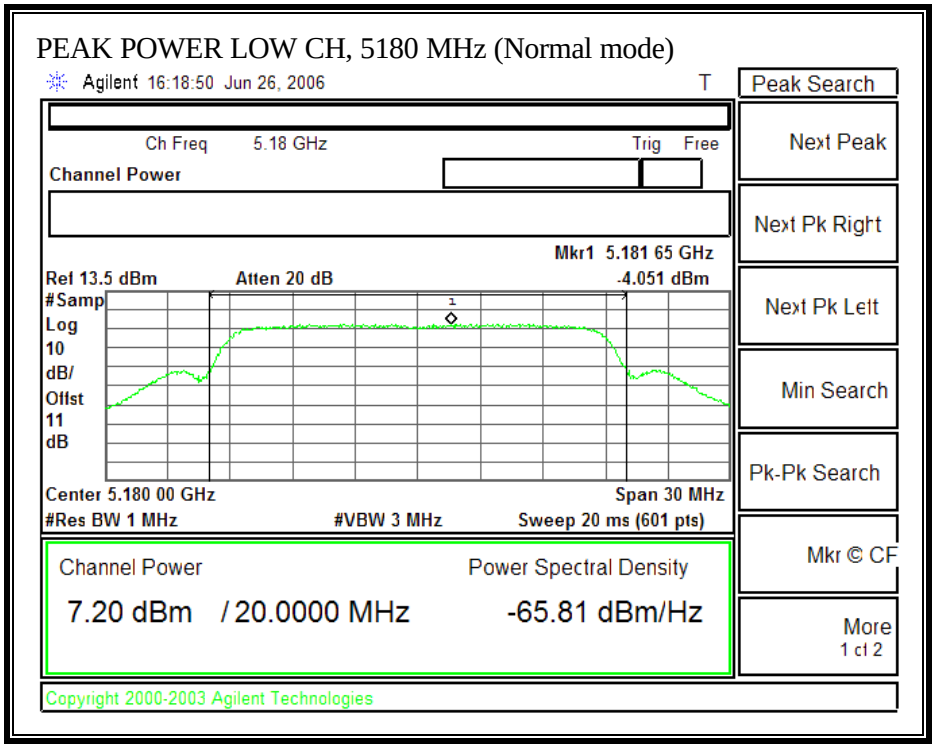
PEAK POWER HIGH CH, 5300 MHz (Normal mode)



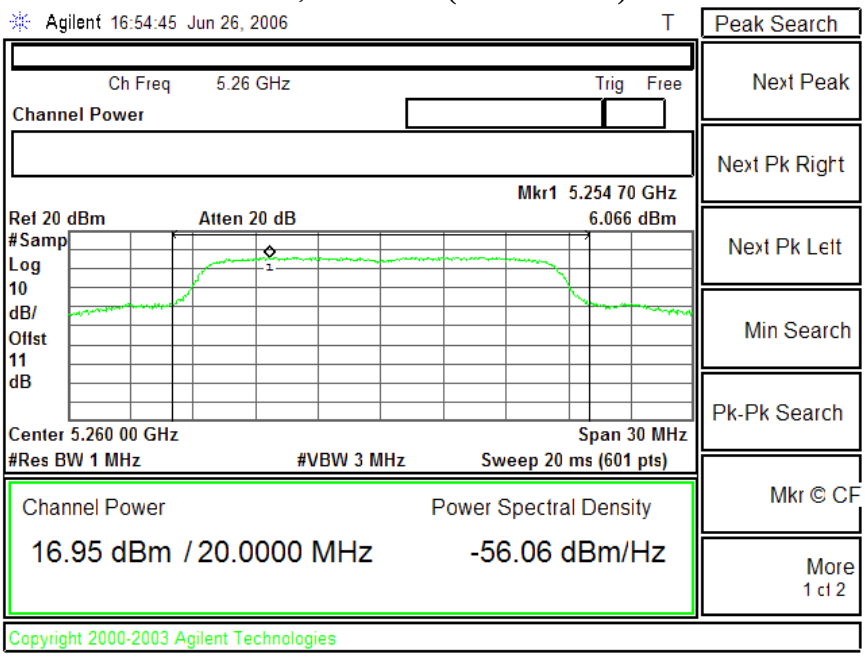
PEAK POWER HIGH CH, 5320 MHz (Normal mode)



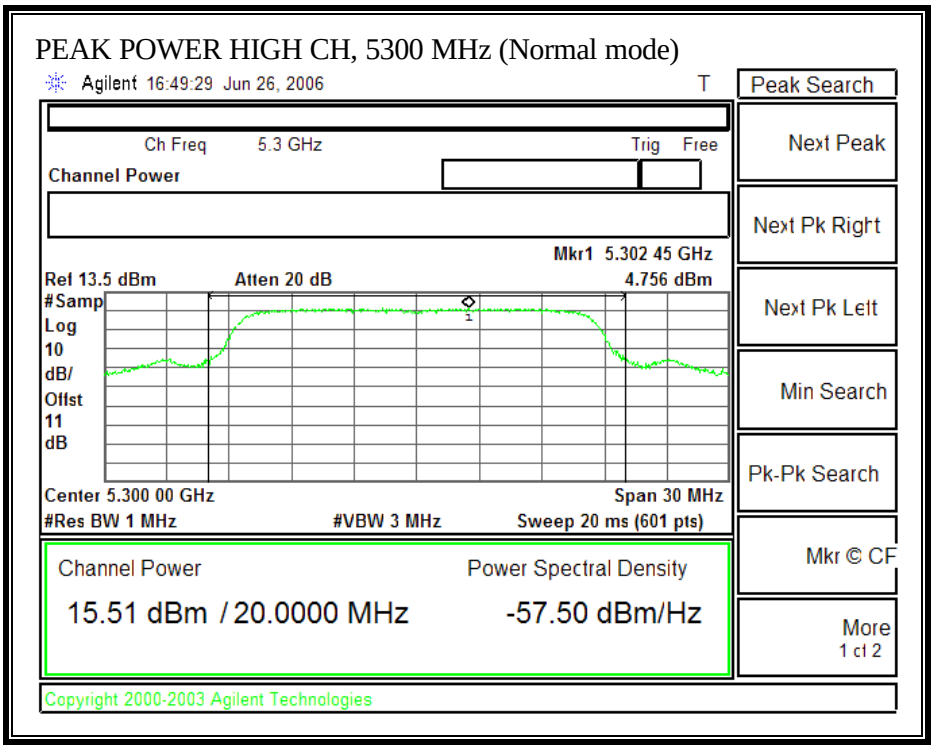
PEAK POWER (NORMAL MODE) (Chain 1)



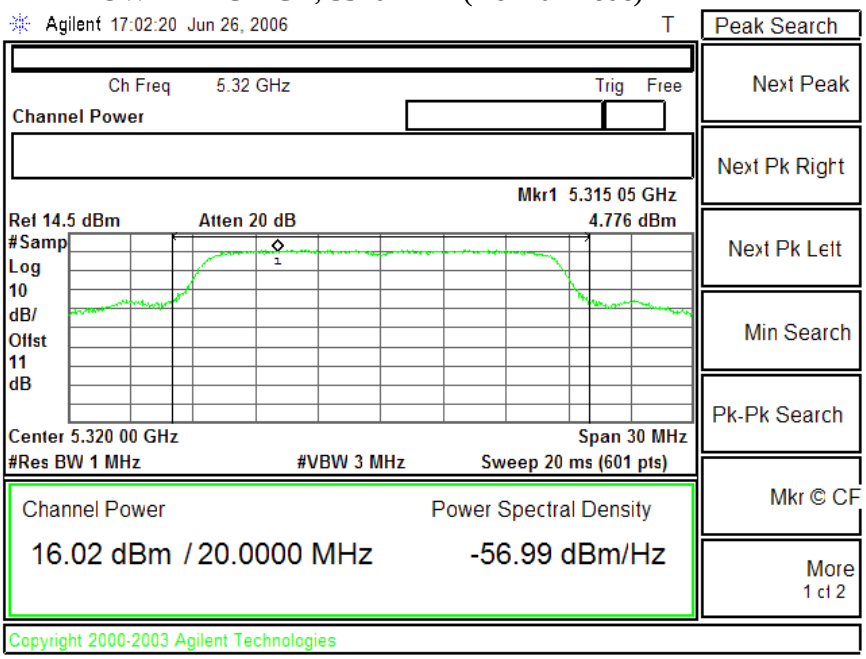
PEAK POWER MID CH, 5260 MHz (Normal mode)



PEAK POWER HIGH CH, 5300 MHz (Normal mode)



PEAK POWER HIGH CH, 5320 MHz (Normal mode)



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

$S = E \wedge 2 / 3770$

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

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

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

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

LIMITS

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

RESULTS

No non-compliance noted

Mode	MPE Distance (cm)	Output Power (dBm)	Output Power (dBm)	Total Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
802.11a	20.0	15.83	16.95	19.44	8.039	0.06

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. AVERAGE POWER

AVERAGE POWER LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

No non-compliance noted:

The cable assembly insertion loss of 11.9 dB (including 10 dB pad and 1.9 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

802.11a Mode

Channel	Frequency (MHz)	Average Power (dBm)
Low	5180	7.00
Middle	5260	14.00
High	5300	14.00
High	5320	15.00

7.1.5. 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 = 6.2 dBi, 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: 8.039 dBi
5.25 – 5.35GHz band: 7.686 dBi

RESULTS

No non-compliance noted:

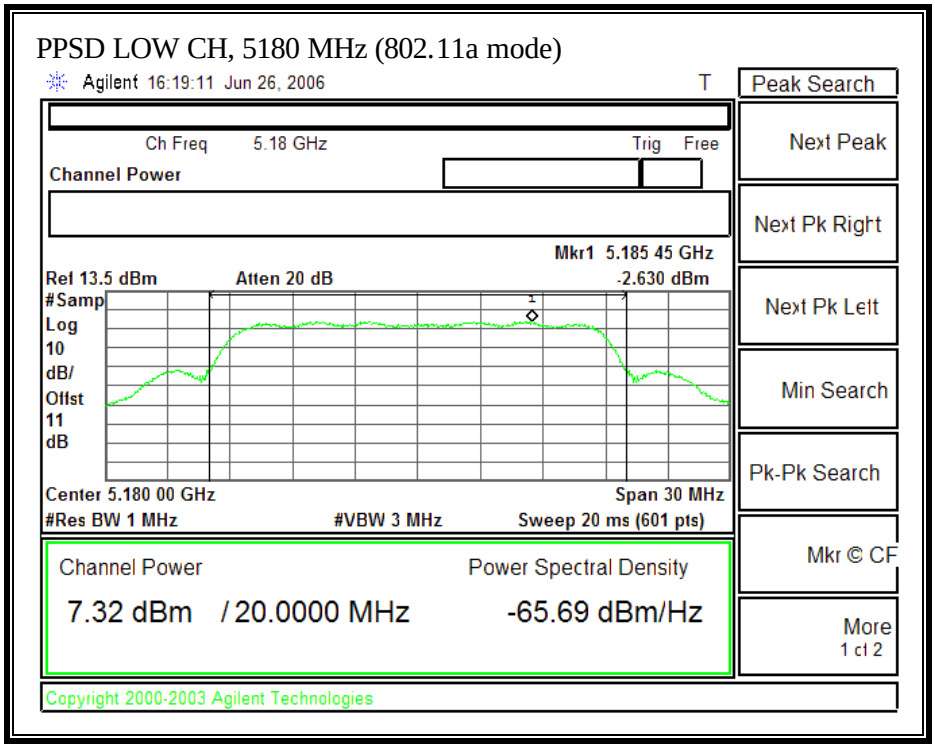
802.11a Mode

Channel	Frequency (MHz)	PPSD Chain 0 (dBm)	PPSD Chain 1 (dBm)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Low	5180	-2.63	-4.05	-0.27	1.961	-2.23
Middle	5260	6.01	6.07	9.05	9.314	-0.26
High	5300	4.23	4.76	7.51	9.314	-1.80
High	5320	5.43	4.78	8.12	9.314	-1.19

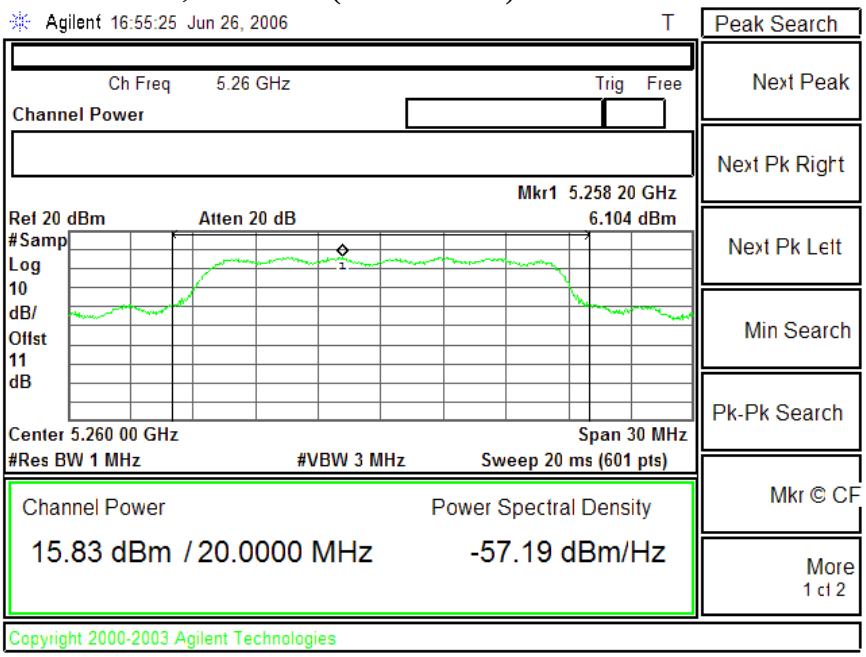
802.11a Mode with Combiner

Channel	Frequency (MHz)	PPSD With Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	5180	1.37	1.961	-0.593
Middle	5260	9.22	9.314	-0.091
High	5300	8.35	9.314	-0.963
High	5320	8.56	9.314	-0.75

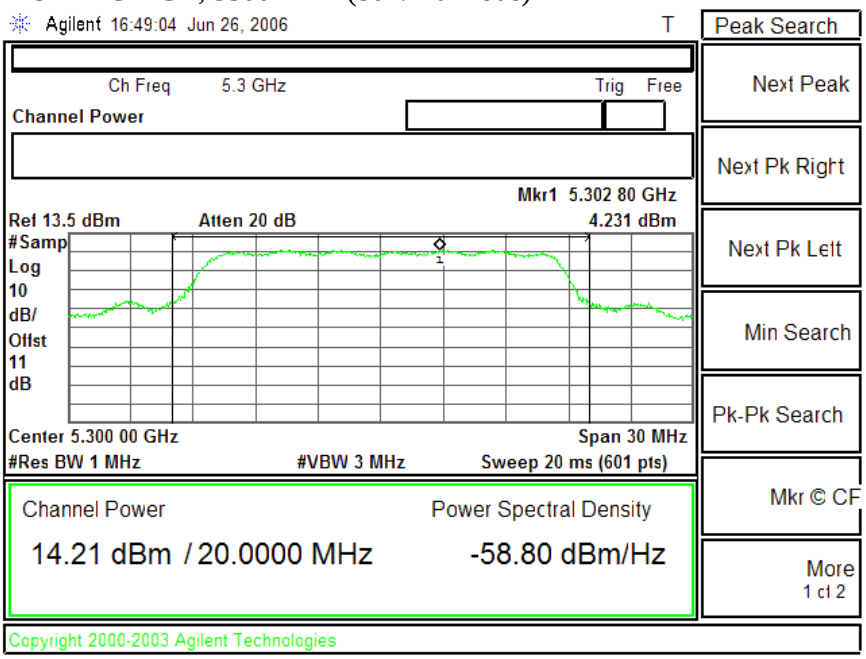
PEAK POWER SPECTRAL DENSITY (802.11a MODE) (Chain 0)



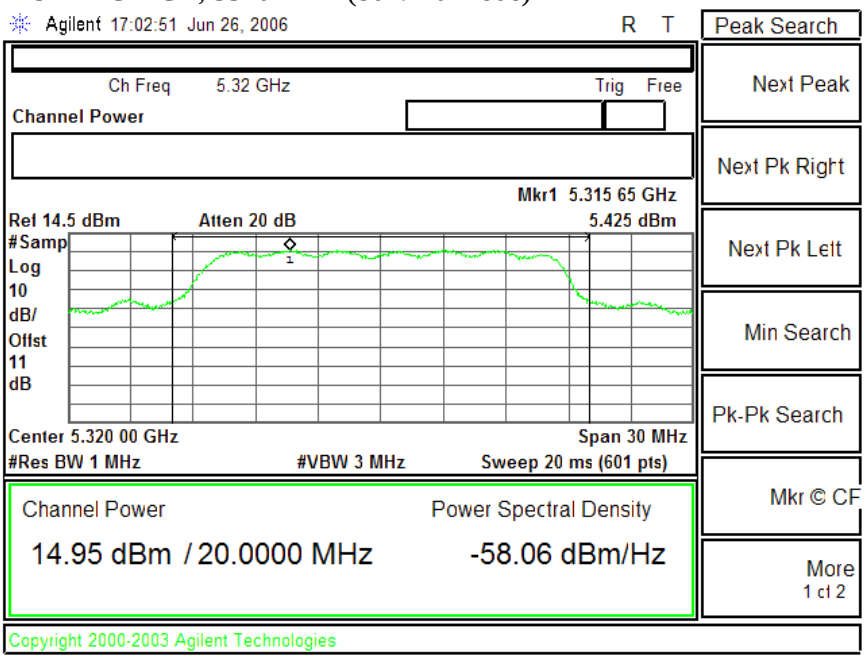
PPSD MID CH, 5260 MHz (802.11a mode)



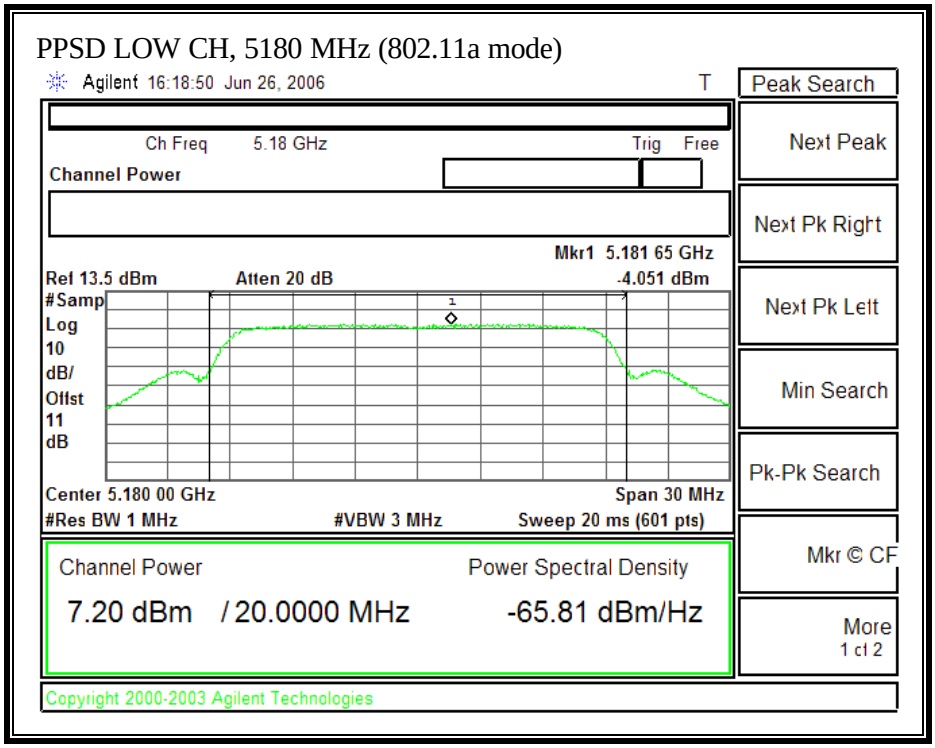
PPSD HIGH CH, 5300 MHz (802.11a mode)



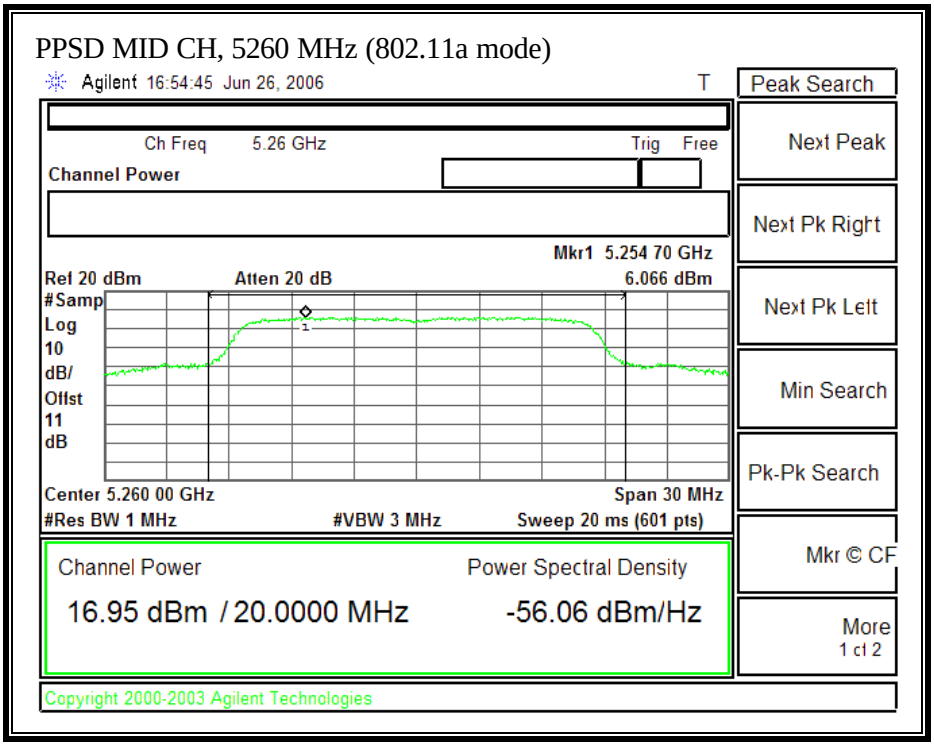
PPSD HIGH CH, 5320 MHz (802.11a mode)



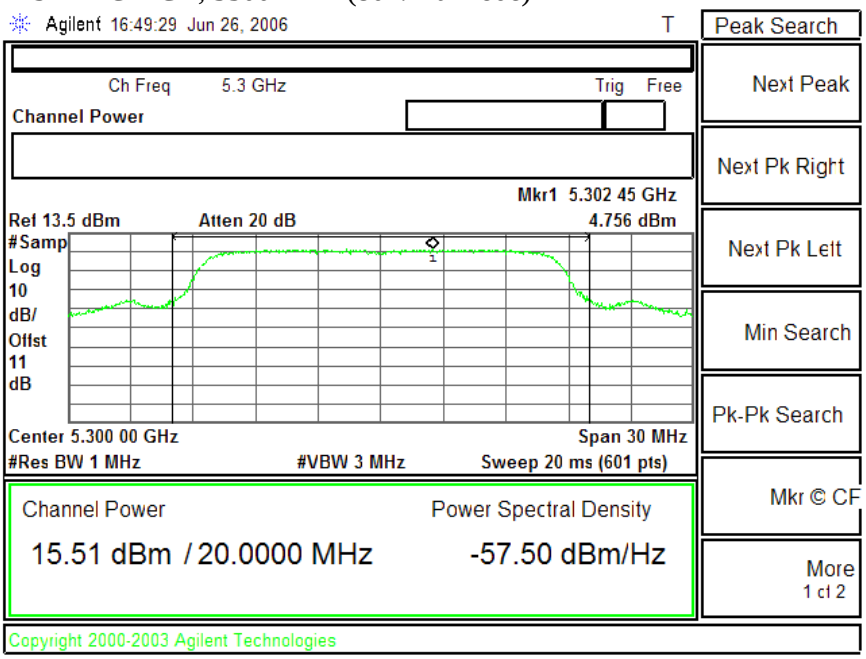
PEAK POWER SPECTRAL DENSITY (802.11a MODE) (Chain1)



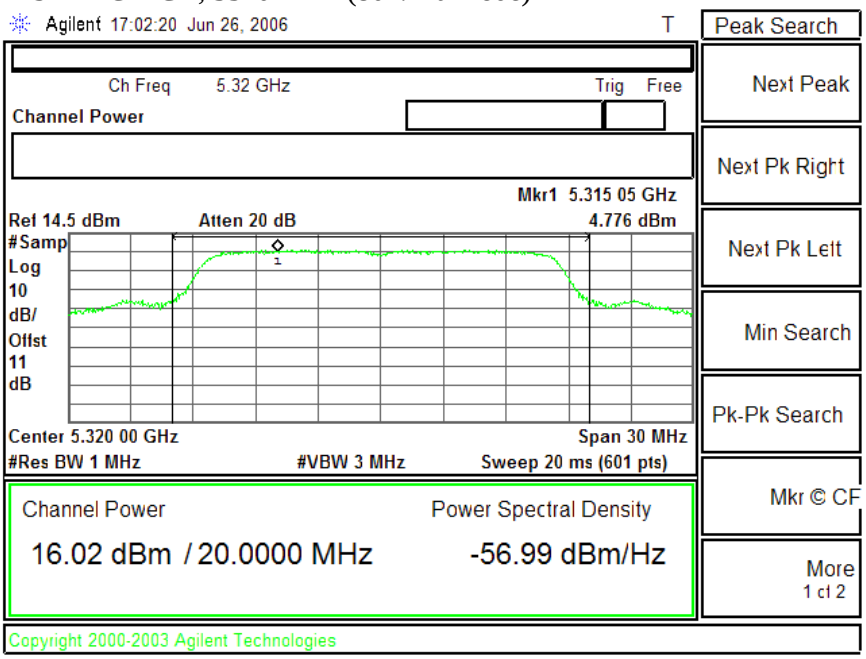
PPSD MID CH, 5260 MHz (802.11a mode)



PPSD HIGH CH, 5300 MHz (802.11a mode)



PPSD HIGH CH, 5320 MHz (802.11a mode)



7.1.6. 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.

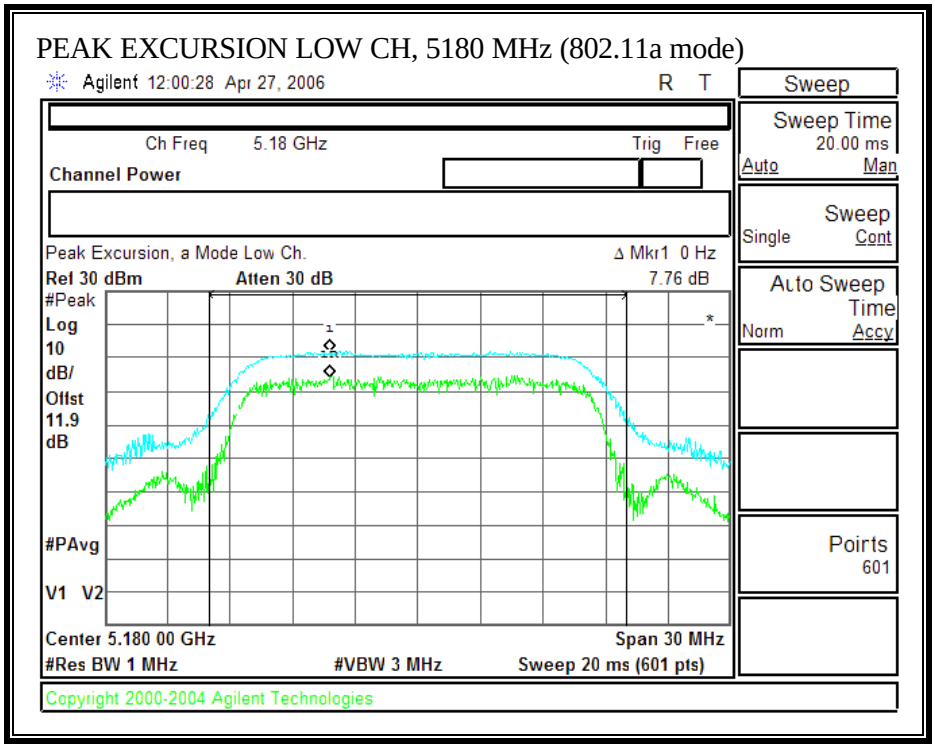
RESULTS

No non-compliance noted:

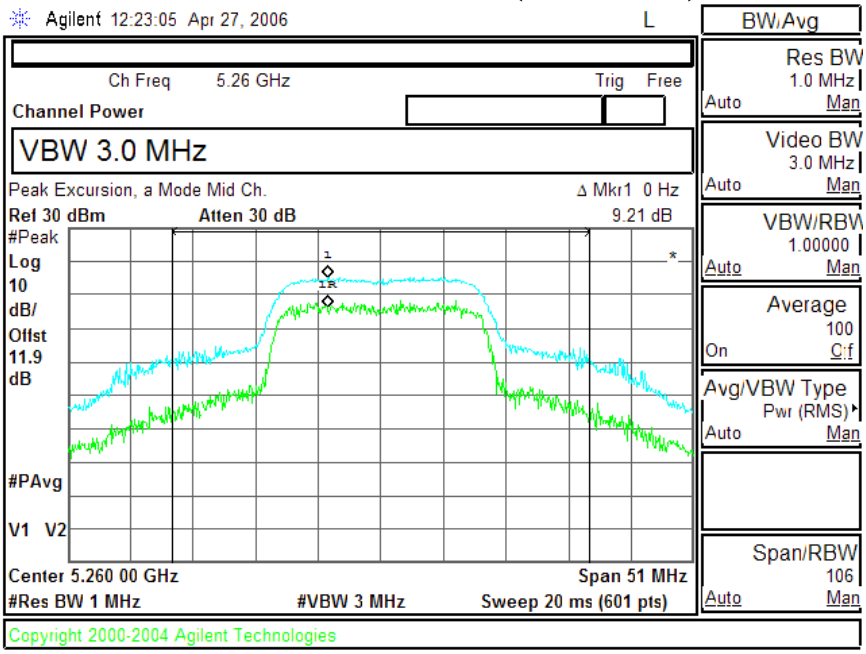
802.11a Mode

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

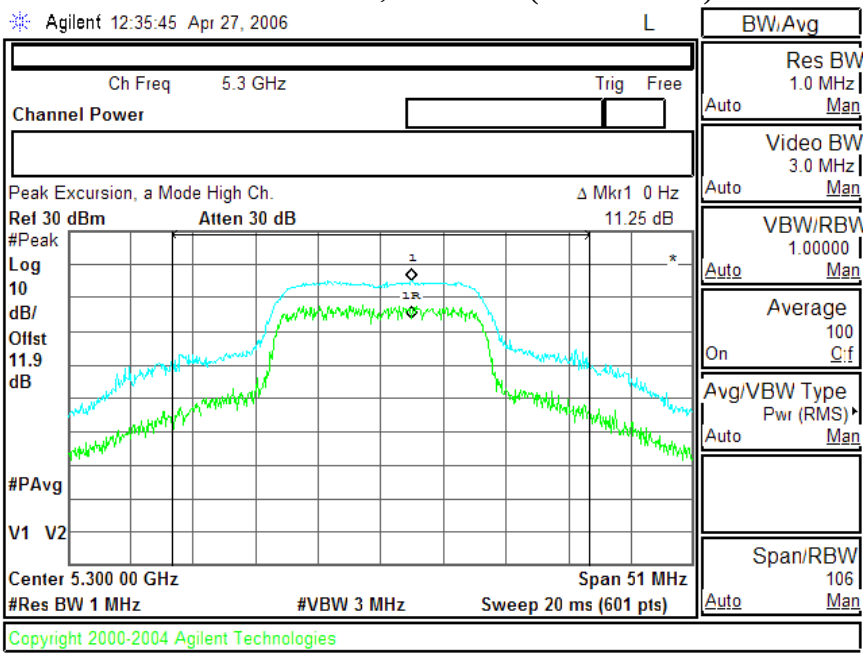
PEAK EXCURSION (802.11a MODE)



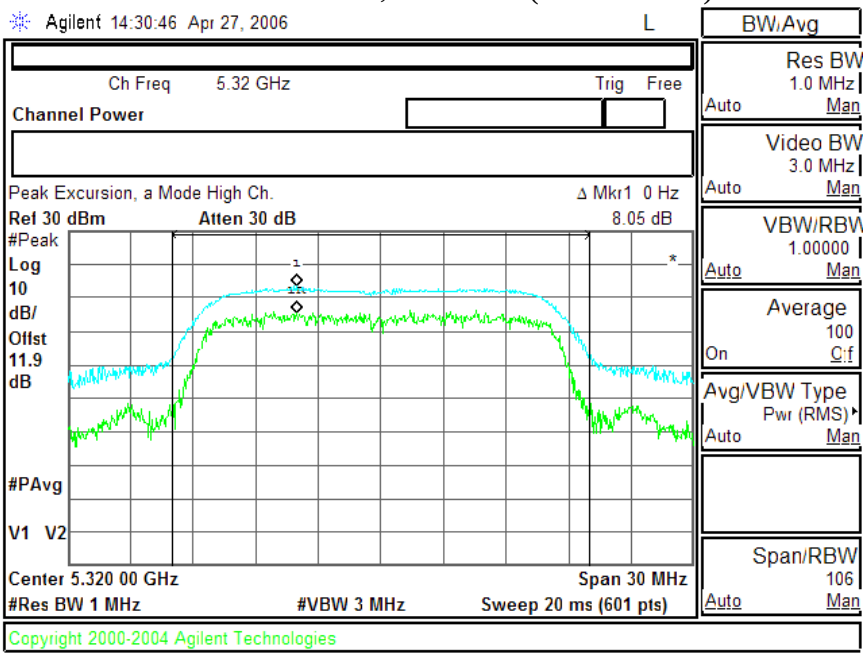
PEAK EXCURSION MID CH, 5260 MHz (802.11a mode)



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



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



7.1.7. 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.

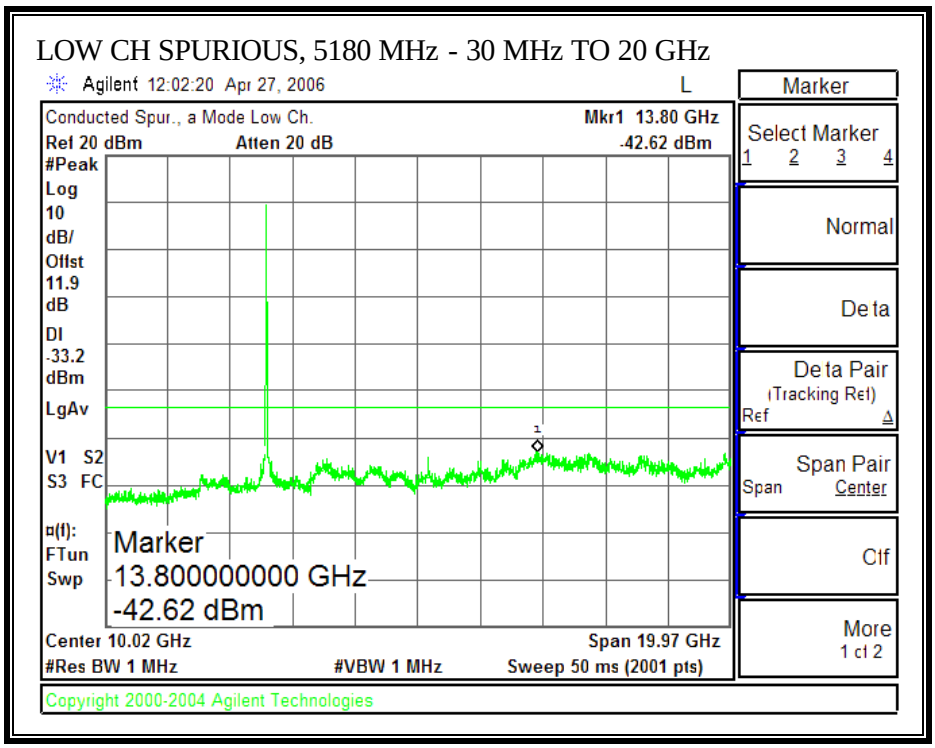
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to the average EIRP limit, adjusted for the maximum antenna gain. If necessary, additional average detection measurements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

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

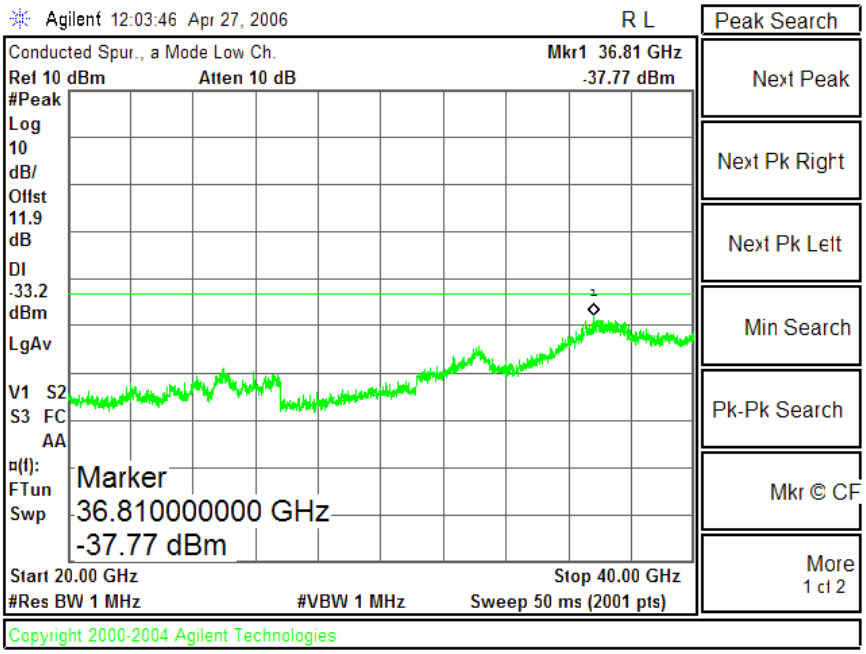
RESULTS

No non-compliance noted:

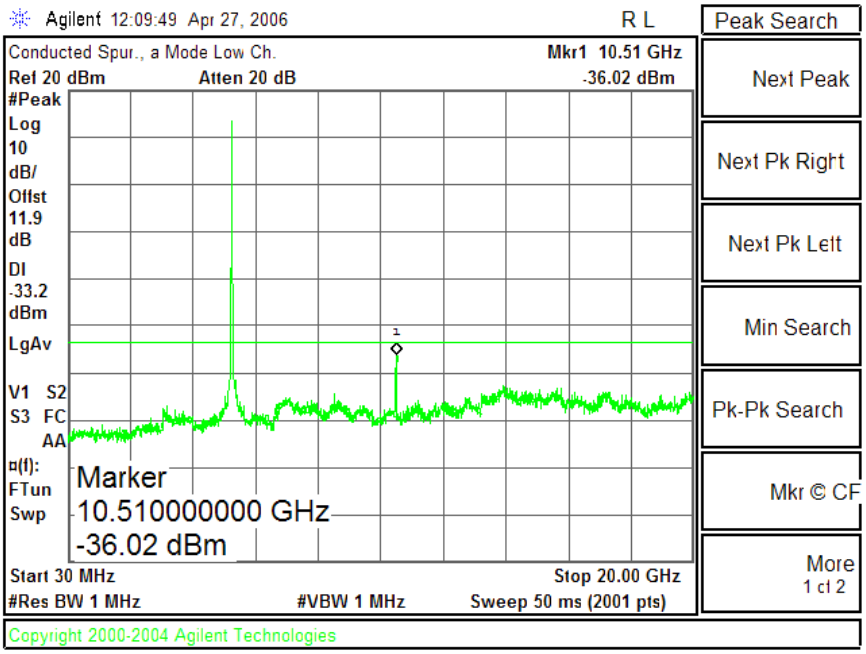
SPURIOUS EMISSIONS (802.11a MODE)



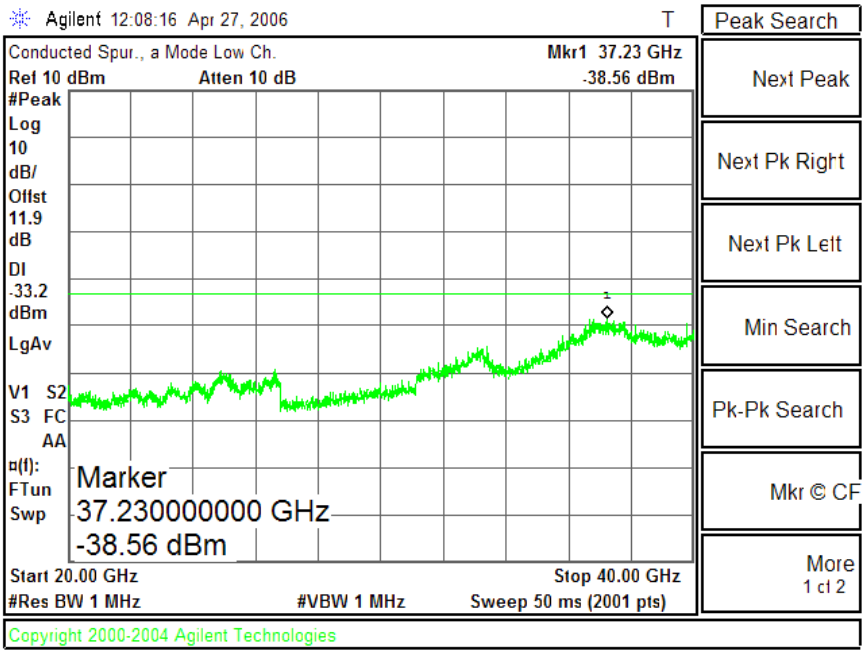
LOW CH SPURIOUS, 5180 MHz - 20 GHz TO 40 GHz



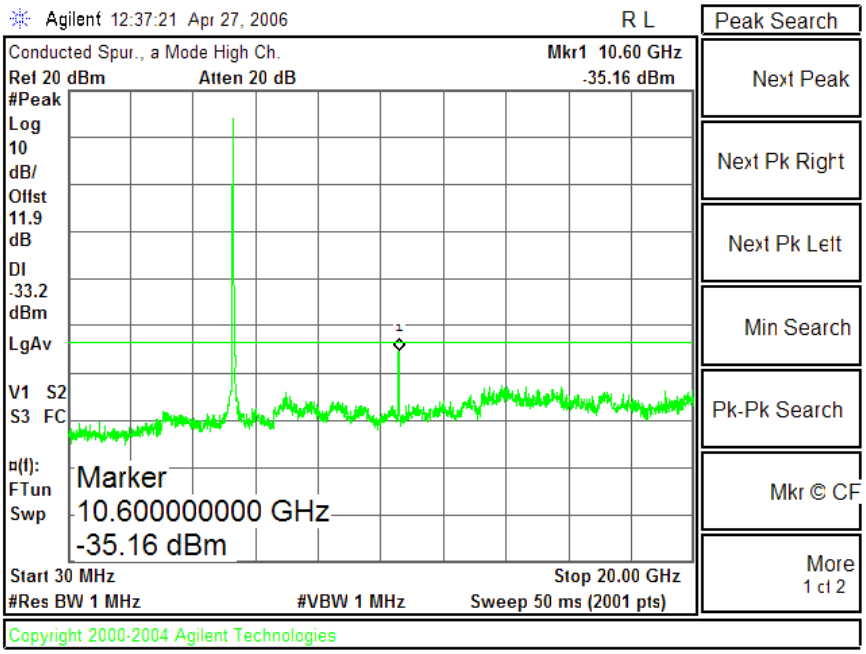
MID CH SPURIOUS, 5260 MHz - 30 MHz TO 20 GHz



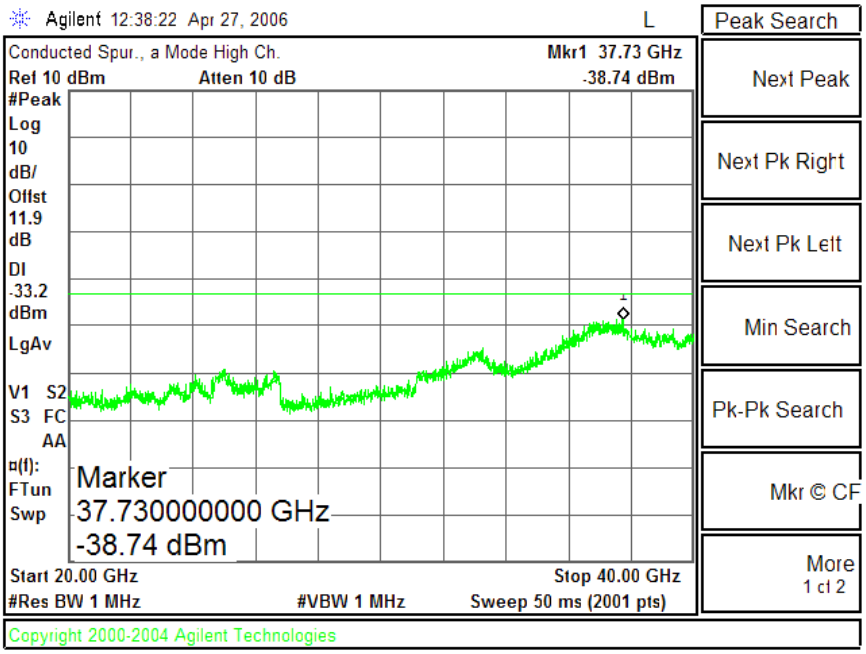
MID CH SPURIOUS, 5260 MHz - 20 GHz TO 40 GHz



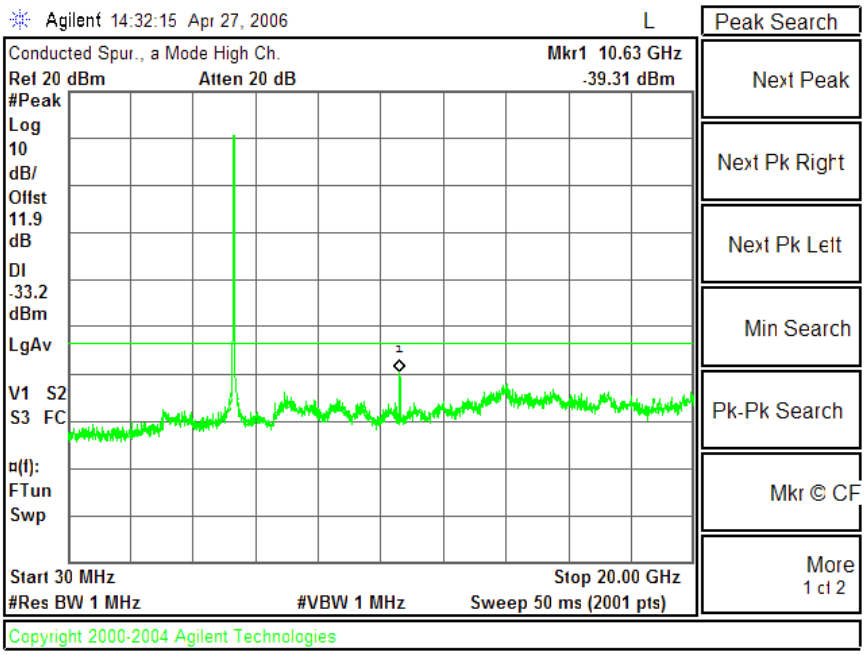
HIGH CH SPURIOUS, 5300 MHz - 30 MHz TO 20 GHz



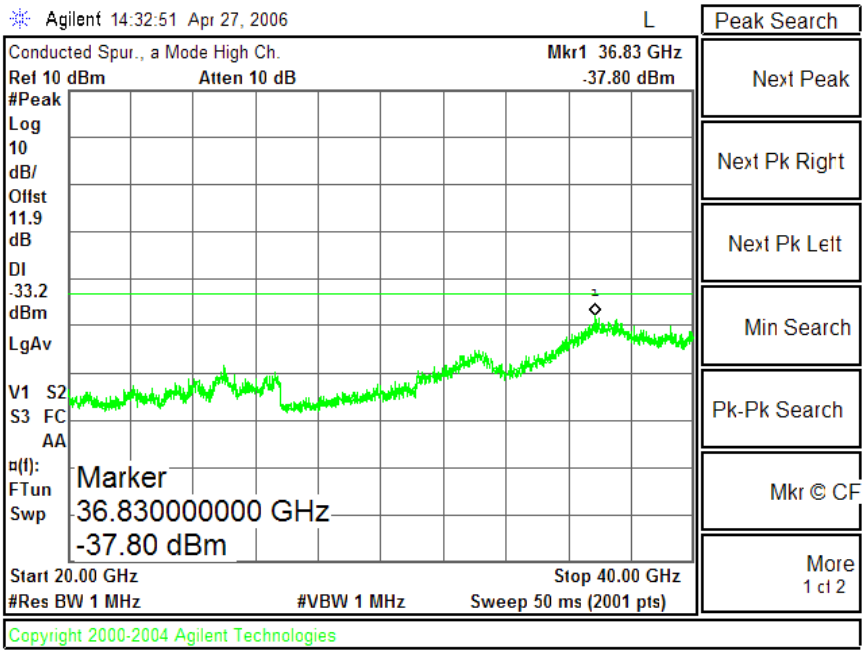
HIGH CH SPURIOUS, 5300 MHz - 20 GHz TO 40 GHz



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



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



MIMO MODE

7.1.8. 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:

802.11 - 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

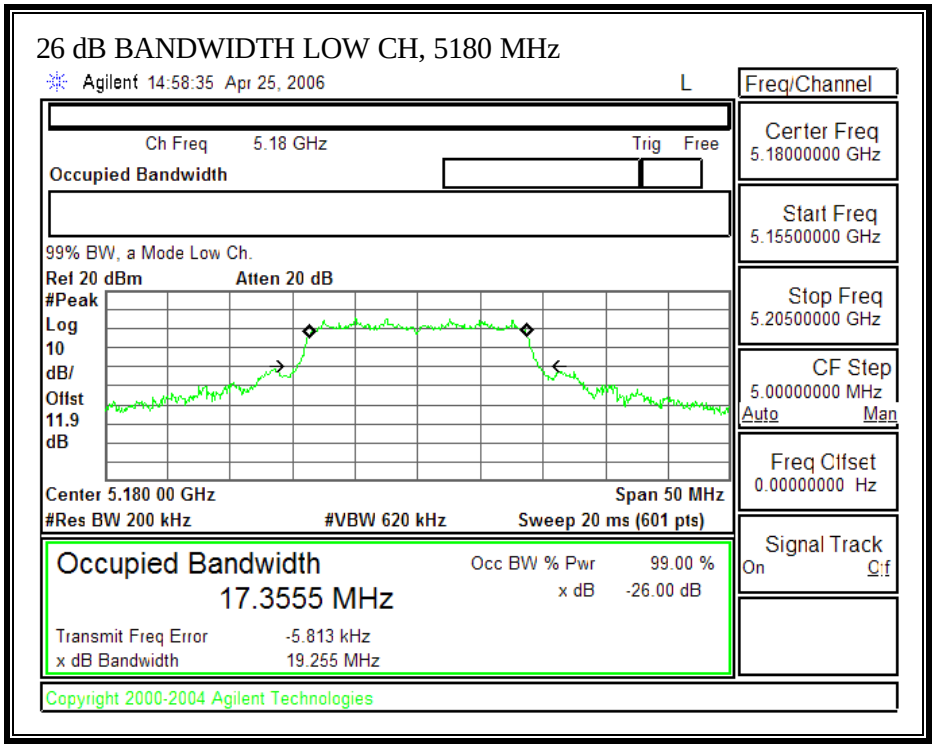
802.11 - 40 MHz Tx BANDWIDTH - CHAIN 0

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

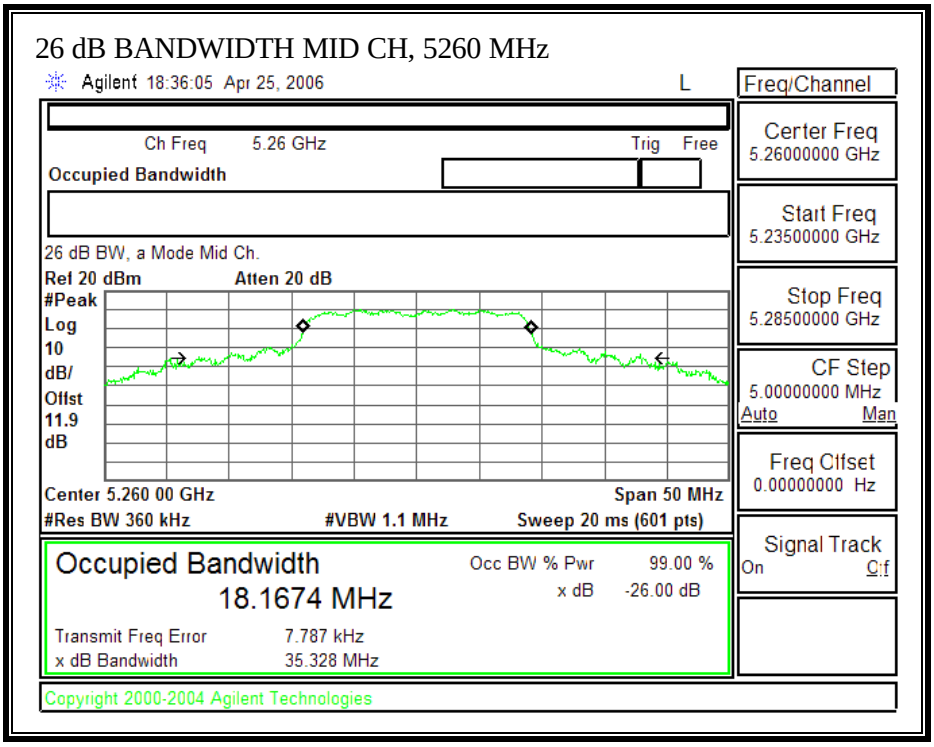
802.11 - 40 MHz Tx BANDWIDTH - CHAIN 1

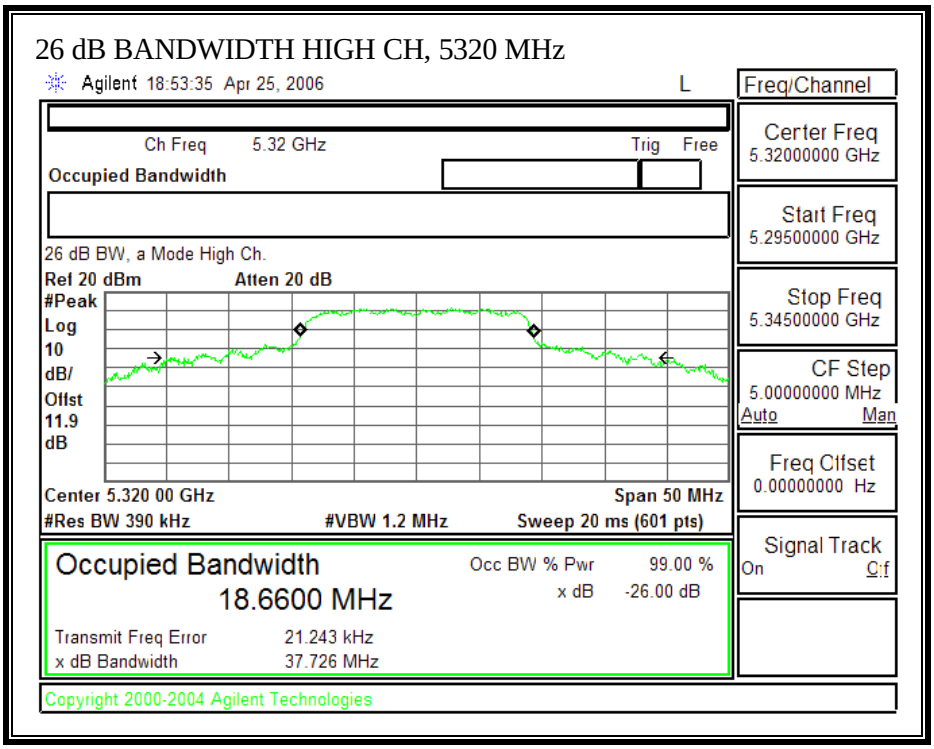
Channel	Frequency (MHz)	B (MHz)	10 Log B (dB)
Low	5190	39.829	16.002
Middle	5270	74.998	18.750
High	5310	61.061	17.858

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

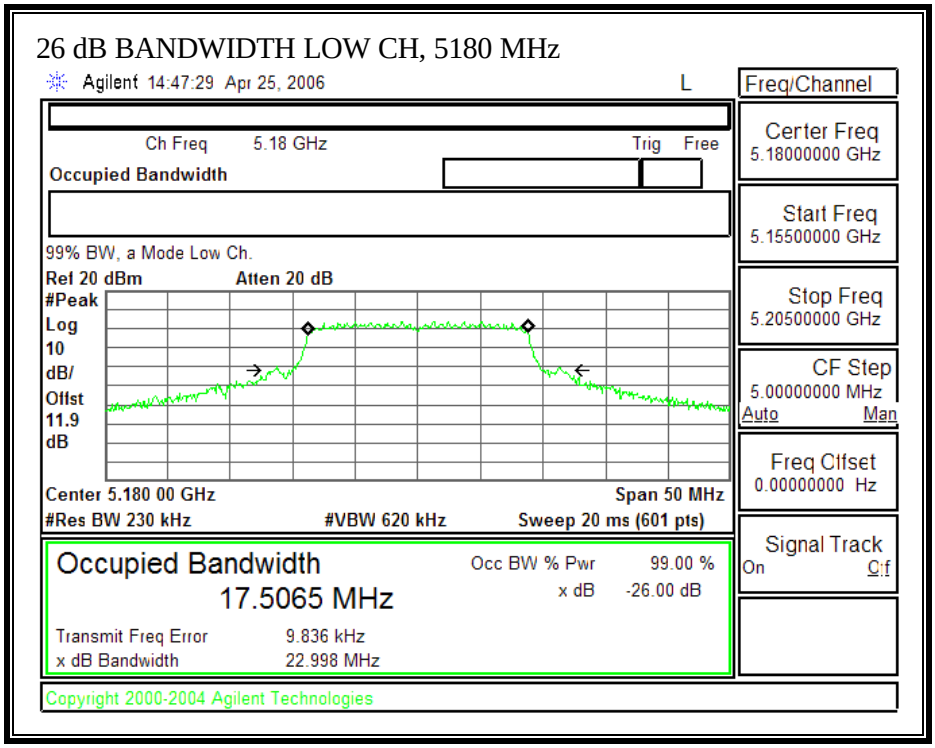


26 dB BANDWIDTH MID CH, 5260 MHz

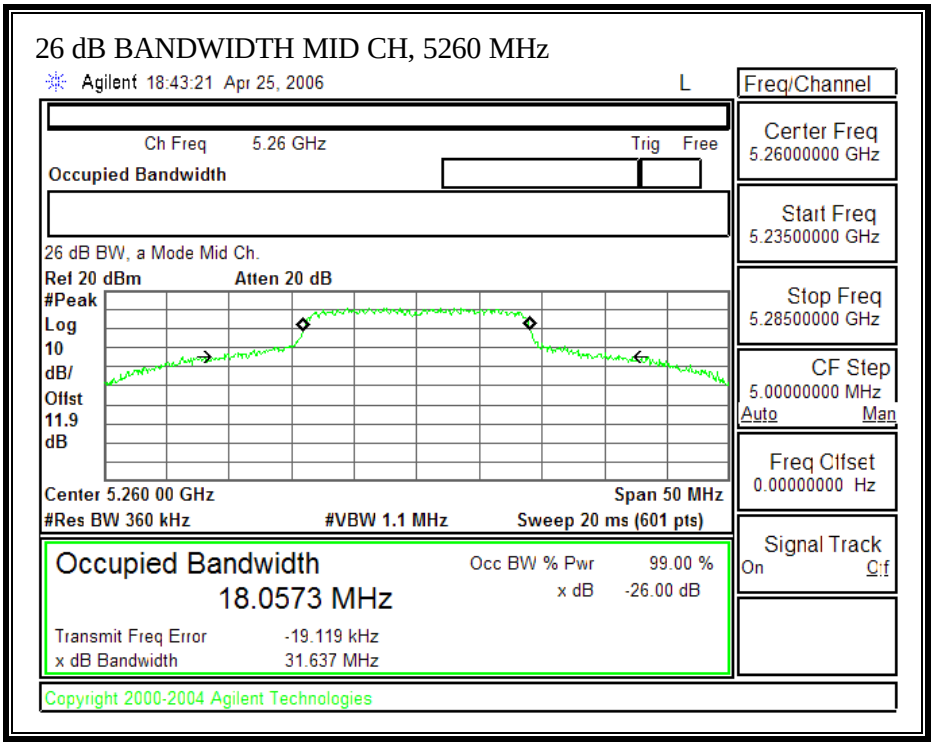


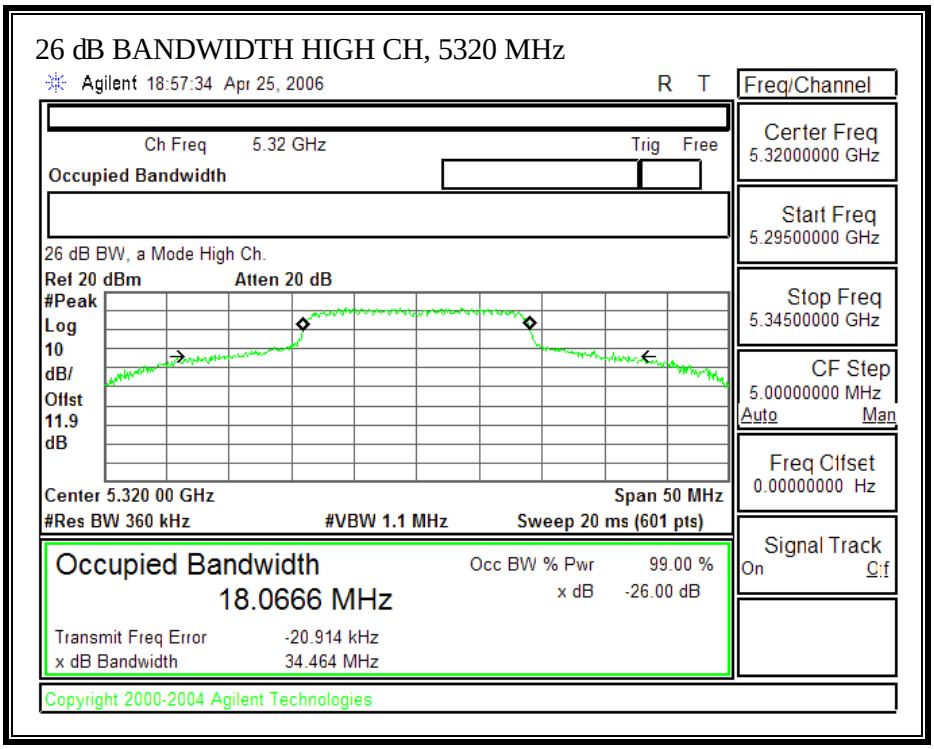


26 dB EMISSION BANDWIDTH (802.11 - 20 MHz TX BANDWIDTH- CHAIN 1)

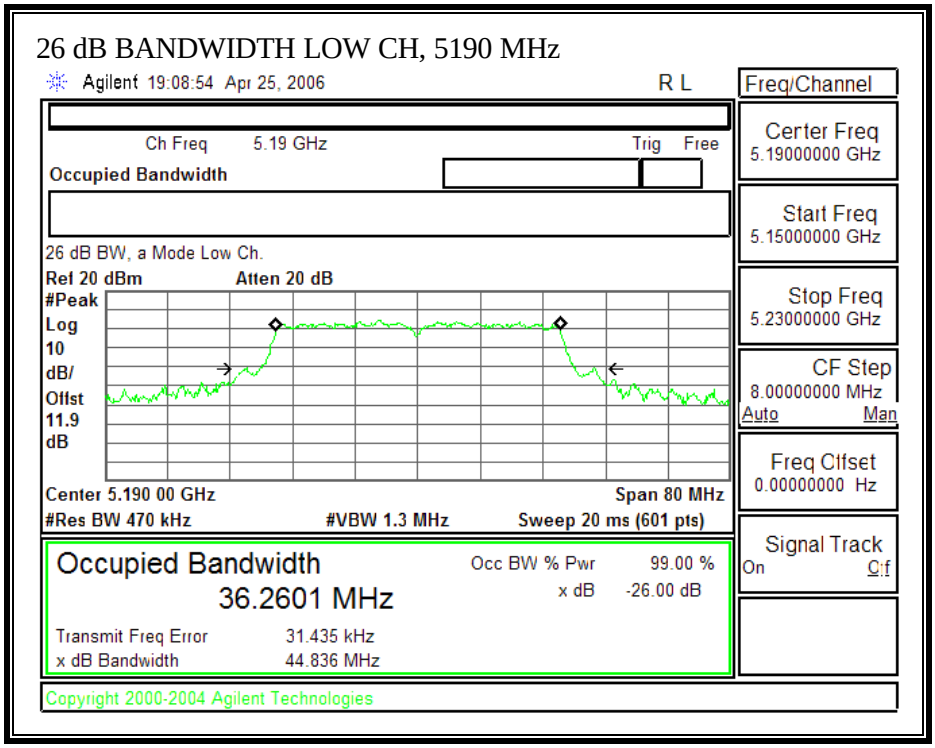


26 dB BANDWIDTH MID CH, 5260 MHz

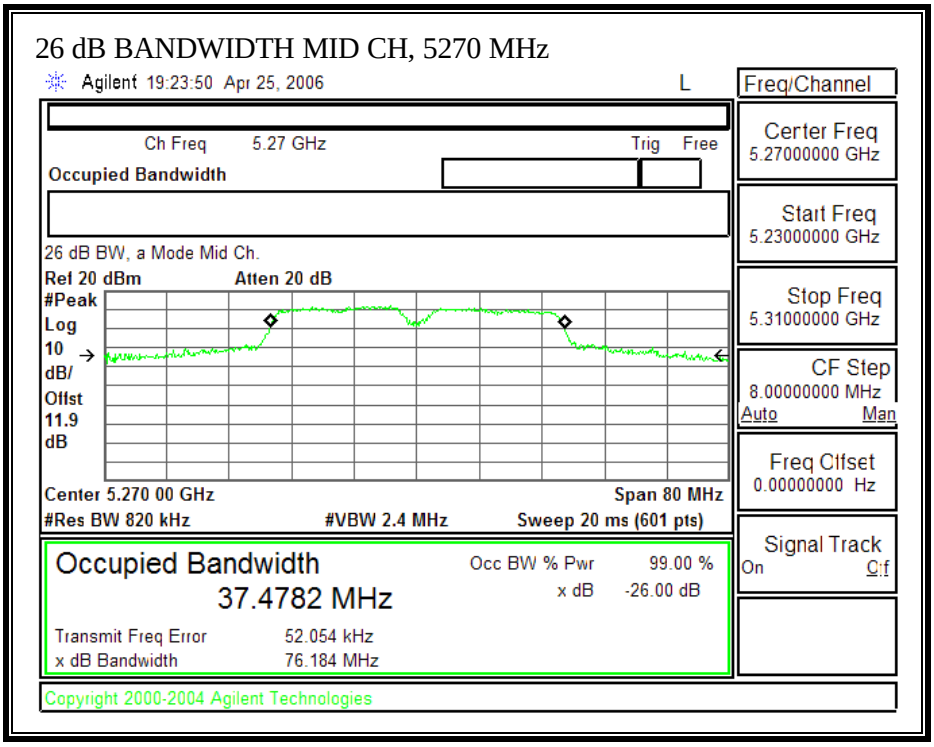


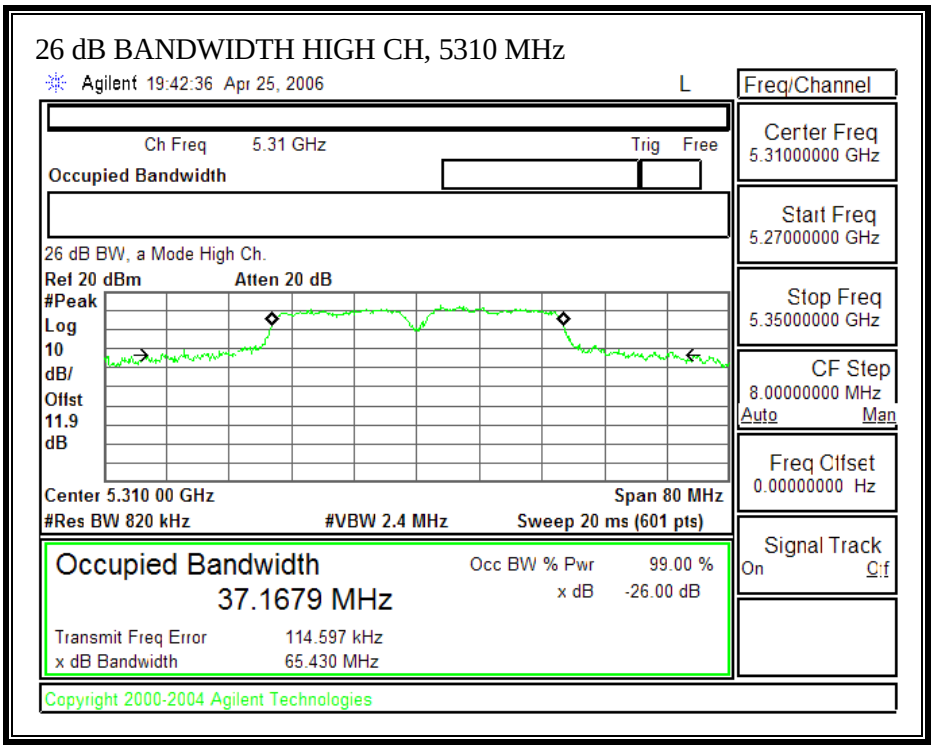


26 dB EMISSION BANDWIDTH (802.11 - 40 MHz TX BANDWIDTH- CHAIN 0)

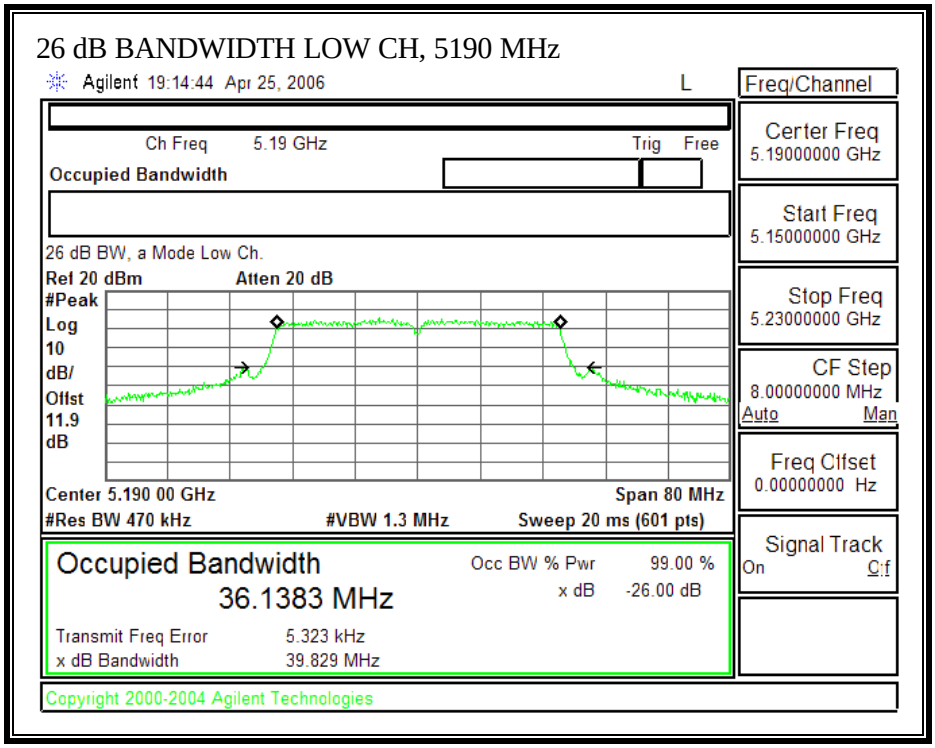


26 dB BANDWIDTH MID CH, 5270 MHz

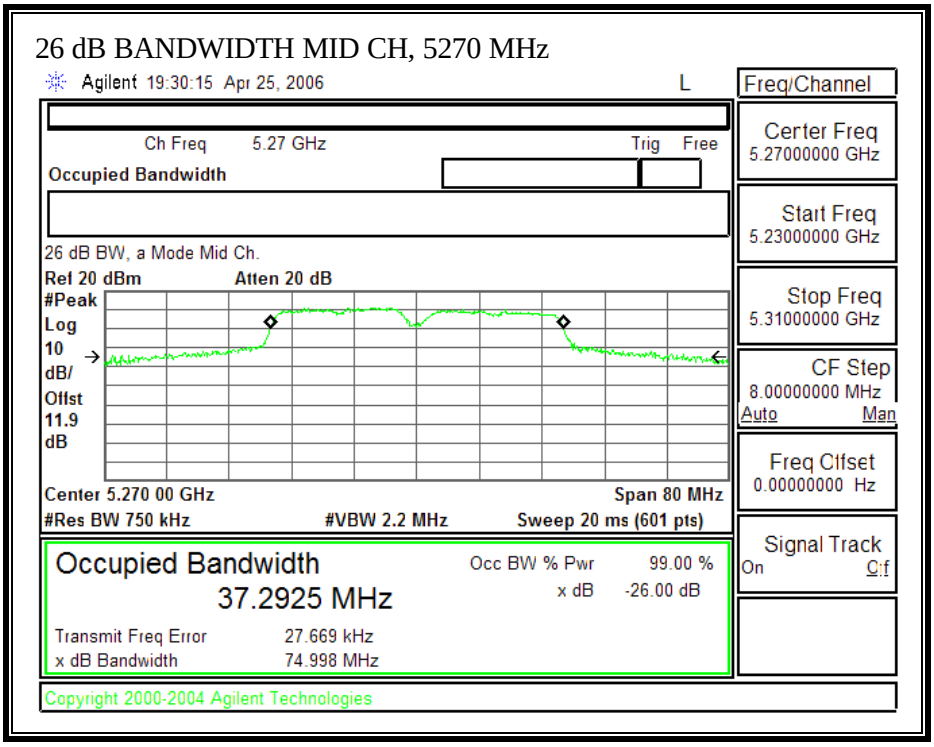


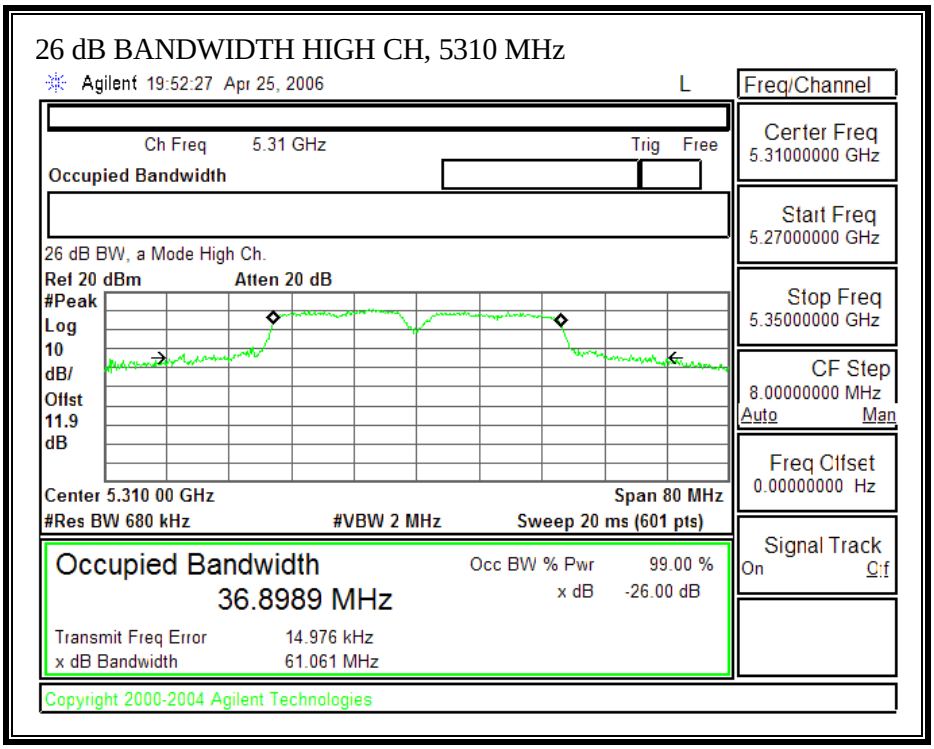


26 dB EMISSION BANDWIDTH (802.11 - 40 MHz TX BANDWIDTH- CHAIN 1)



26 dB BANDWIDTH MID CH, 5270 MHz





7.1.9. 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

LIMITS AND RESULTS

No non-compliance noted:

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	3.90	16.85

Limit in 5250 to 5350 MHz Band

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	B (MHz)	11 + 10 Log Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Mid	5260	24	35.328	31.637	26.002	5.60	24.00
High	5320	24	37.726	34.464	26.374	5.60	24.00

Results

Channel	Frequency (MHz)	Power Chain 0 (dBm)	Power Chain 0 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	10.34	10.29	13.33	16.85	-3.52
Mid	5260	16.22	16.34	19.29	24.00	-4.71
High	5320	14.22	14.32	17.28	24.00	-6.72

Results

Channel	Frequency (MHz)	Combiner Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	13.25	16.85	-3.60
Mid	5260	19.25	24.00	-4.75
High	5320	17.05	24.00	-6.95

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	3.90	17.00

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	5.60	24.00
High	5310	24	65.430	61.061	28.858	5.60	24.00

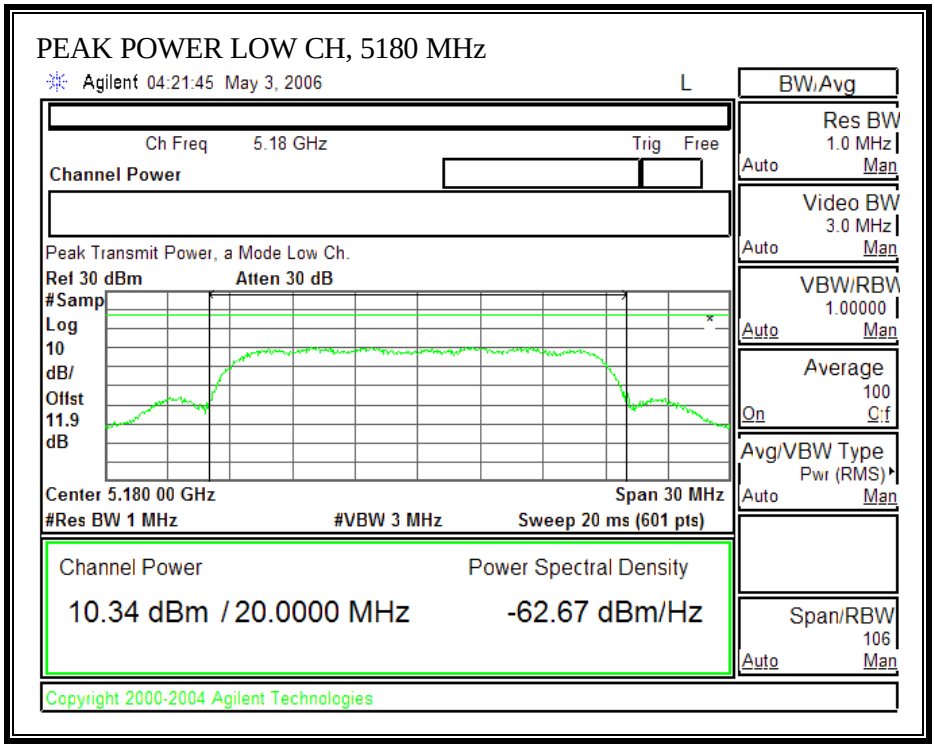
Results

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	17.00	-1.62
Mid	5270	17.13	17.22	20.19	24.00	-3.81
High	5310	12.73	12.72	15.74	24.00	-8.26

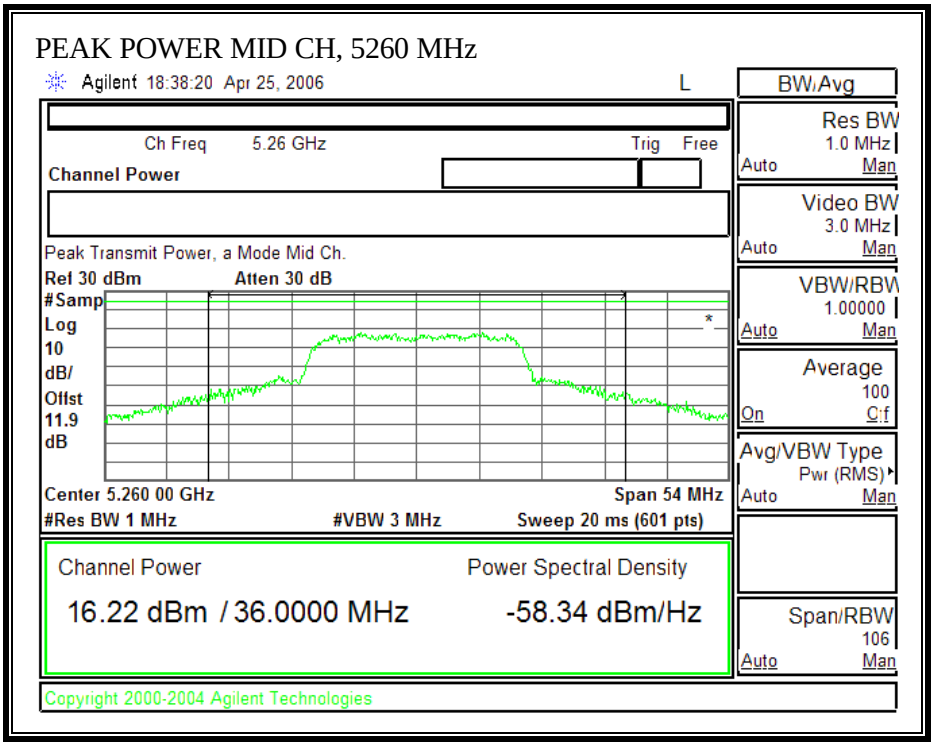
Results

Channel	Frequency (MHz)	Combiner Power (dBm)	Limit (dBm)	Margin (dB)
Low	5190	15.45	17.00	-1.55
Mid	5270	20.50	24.00	-3.50
High	5310	15.50	24.00	-8.50

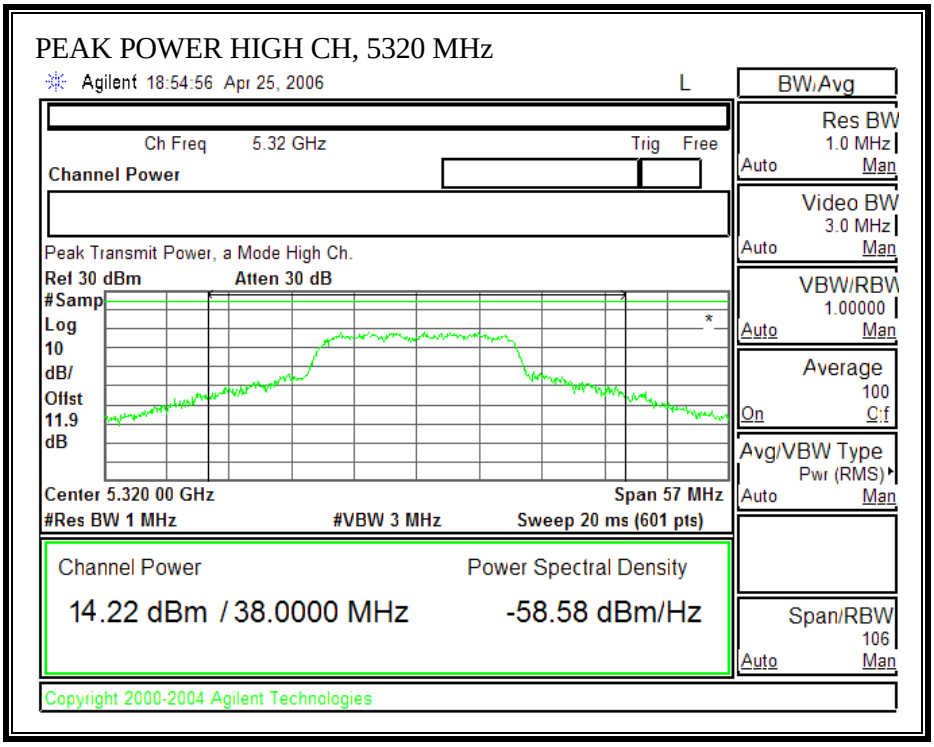
PEAK POWER (802.11 – 20MHz TX BANDWIDTH – CHAIN 0)



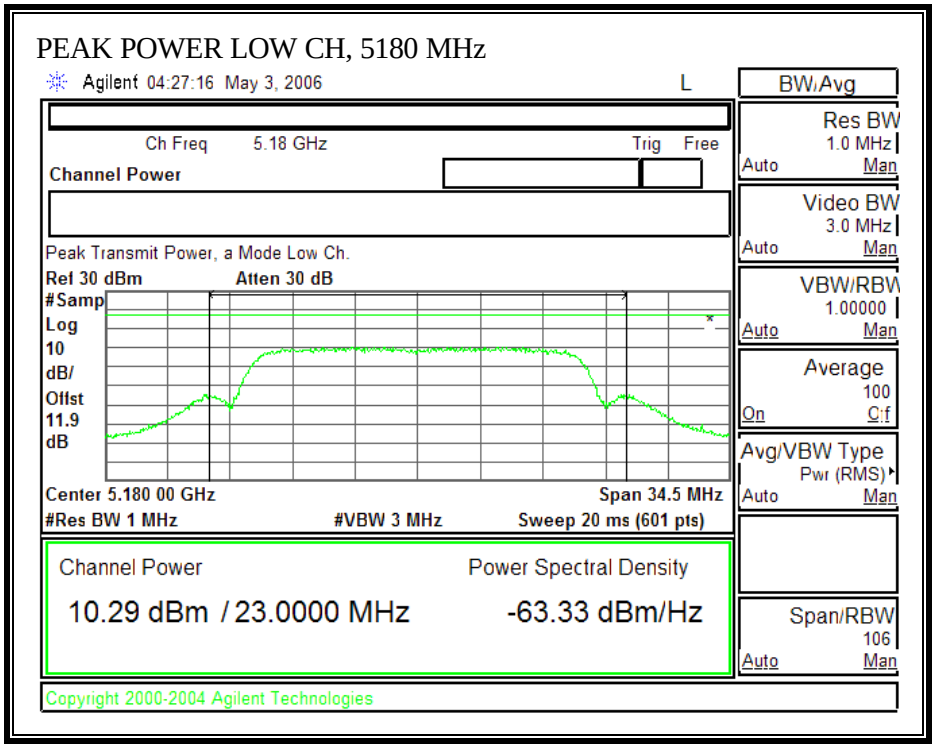
PEAK POWER MID CH, 5260 MHz



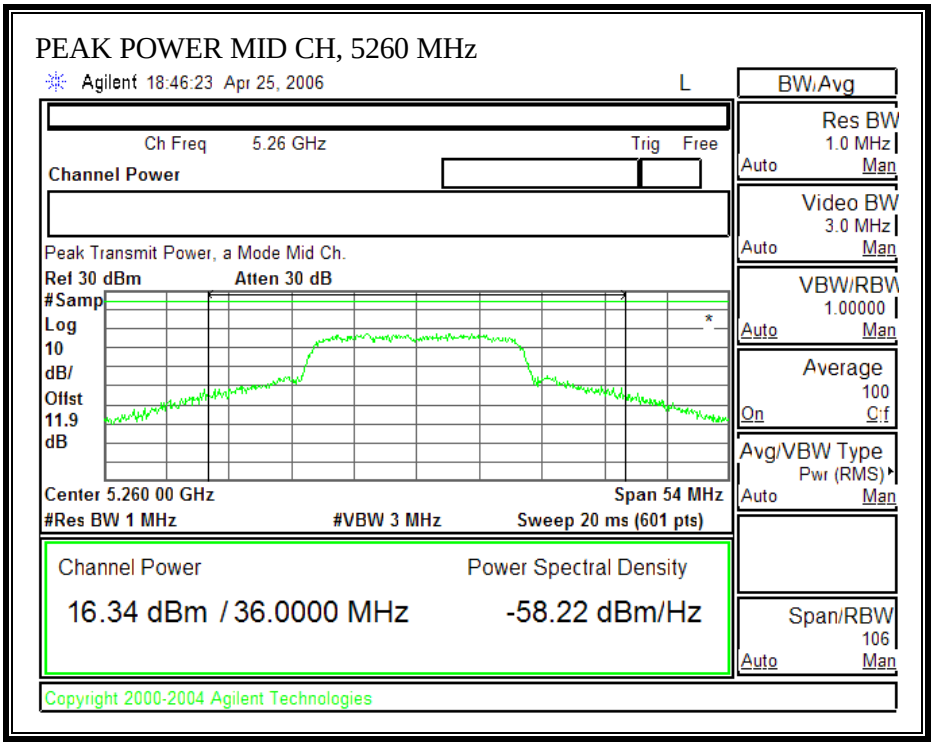
PEAK POWER HIGH CH, 5320 MHz



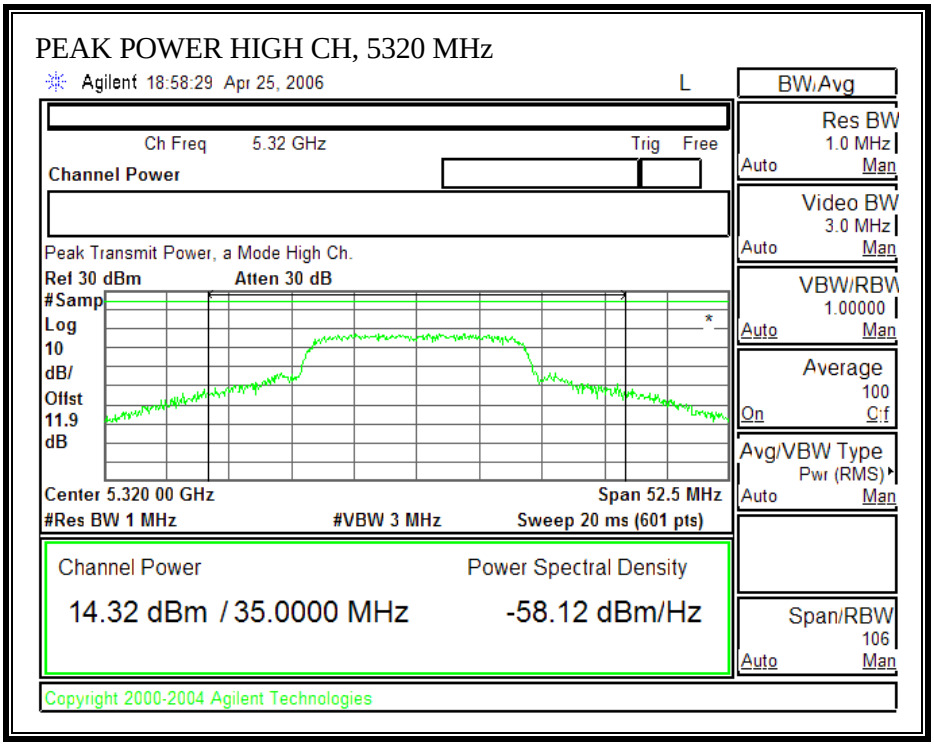
PEAK POWER (802.11 – 20MHz TX BANDWIDTH – CHAIN 1)



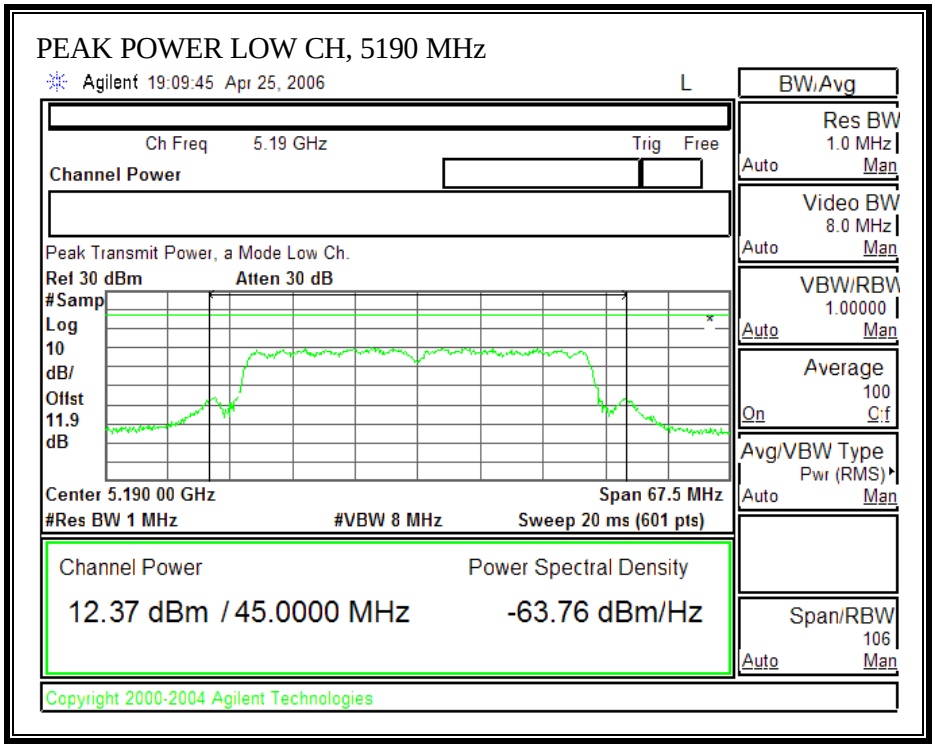
PEAK POWER MID CH, 5260 MHz



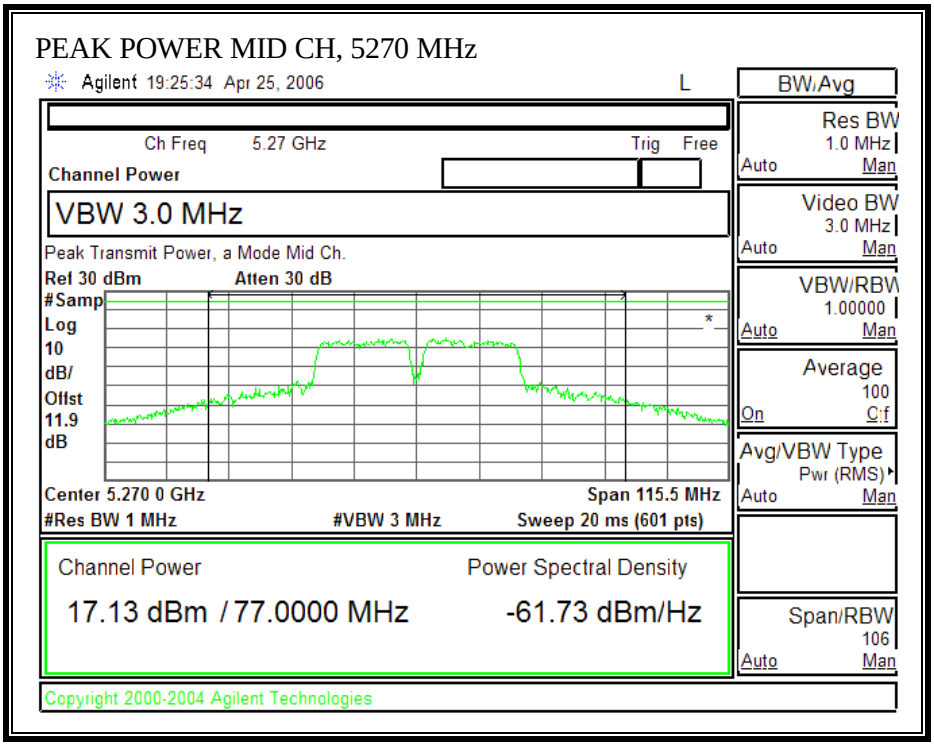
PEAK POWER HIGH CH, 5320 MHz



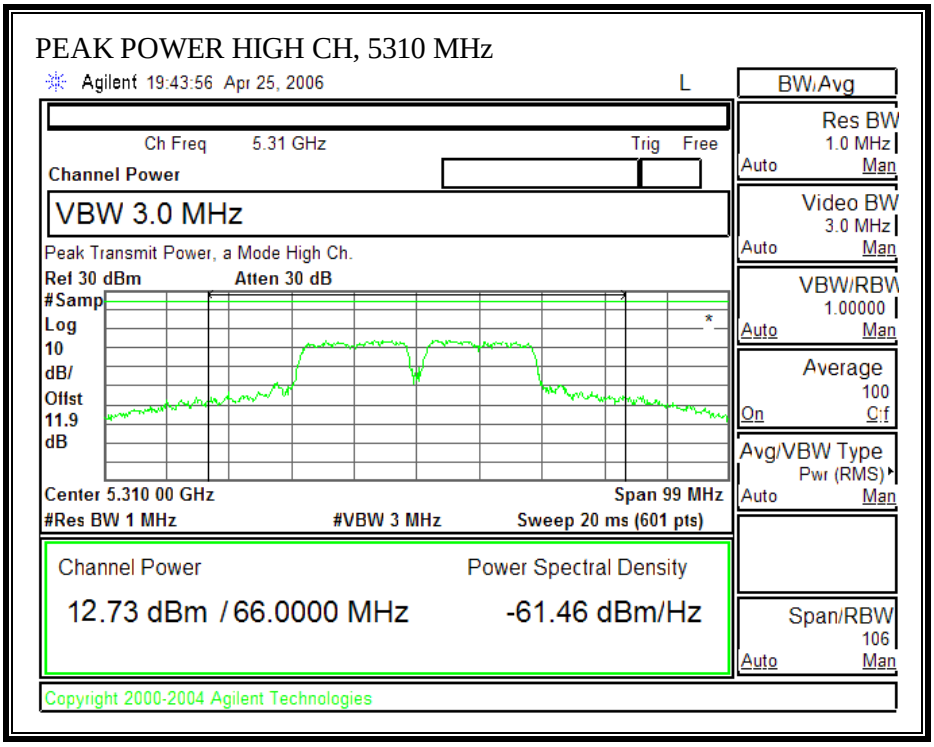
PEAK POWER (802.11 – 40MHz TX BANDWIDTH – CHAIN 0)



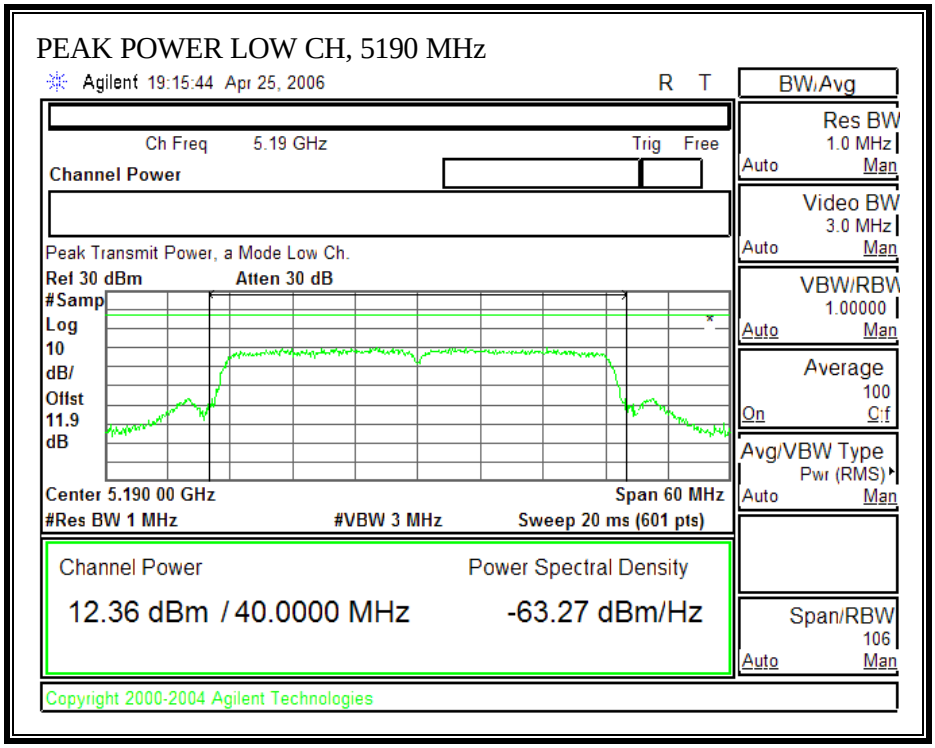
PEAK POWER MID CH, 5270 MHz



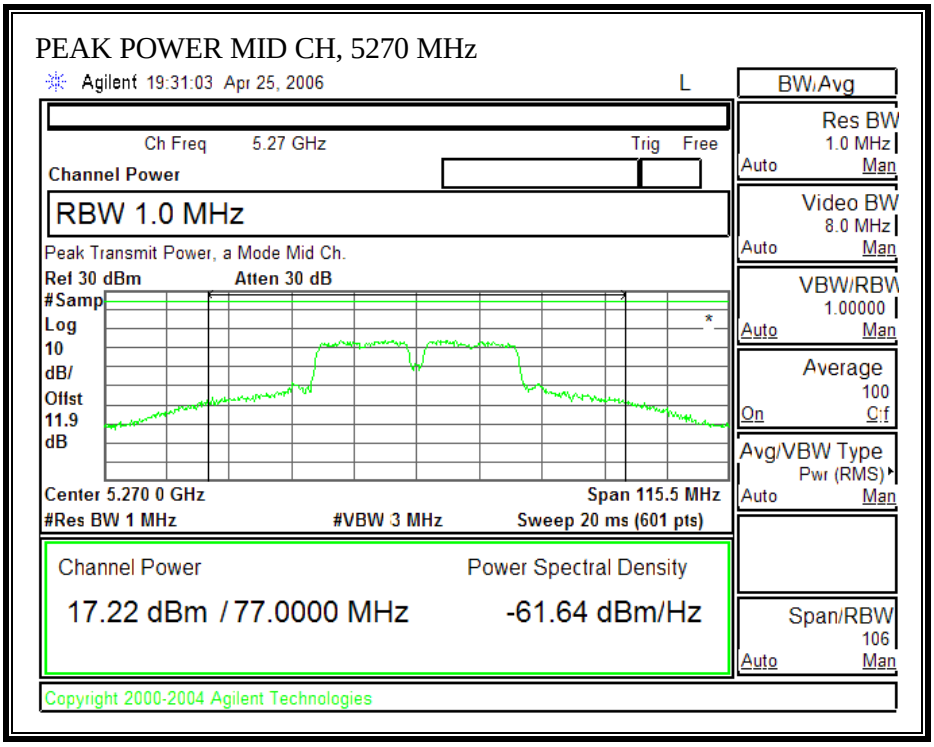
PEAK POWER HIGH CH, 5310 MHz



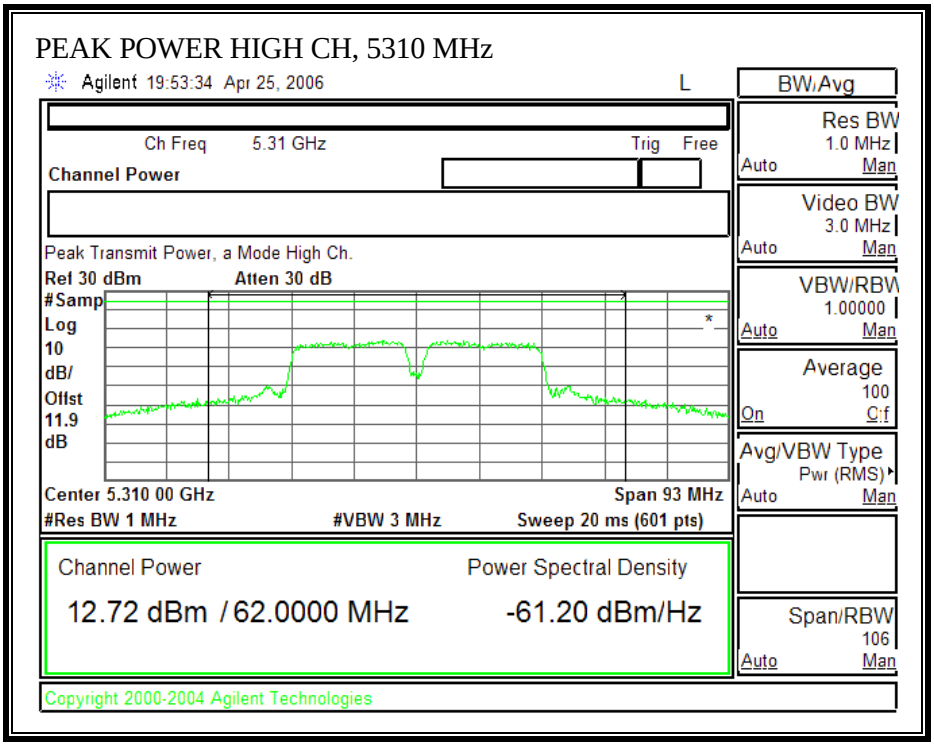
PEAK POWER (802.11 – 40MHz TX BANDWIDTH – CHAIN 1)



PEAK POWER MID CH, 5270 MHz



PEAK POWER HIGH CH, 5310 MHz



7.1.10. 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

$S = E \wedge 2 / 3770$

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

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

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

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

LIMITS

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

RESULTS

No non-compliance noted

Mode	MPE Distance (cm)	Power Chain 0 (dBm)	Power Chain 1 (dBm)	Total Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
20 MHz TX BANDWIDTH	20.0	16.22	16.34	19.29	5.60	0.03
40 MHz TX BANDWIDTH	20.0	17.13	17.22	20.19	5.60	0.04

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.

7.1.11. AVERAGE POWER

AVERAGE POWER LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

No non-compliance noted:

The cable assembly insertion loss of 11.9 dB (including 10 dB pad and 1.9 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

20 MHz TX BANDWIDTH

Channel	Frequency (MHz)	Average Power Chain 0 (dBm)	Average Power Chain 1 (dBm)
Low	5180	10.25	10.30
Middle	5260	16.20	16.25
High	5320	14.56	14.53

40 MHz TX BANDWIDTH

Channel	Frequency (MHz)	Average Power Chain 0 (dBm)	Average Power Chain 1 (dBm)
Low	5190	12.60	12.75
Middle	5270	17.35	17.33
High	5310	12.75	12.55

7.1.12. 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, 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:

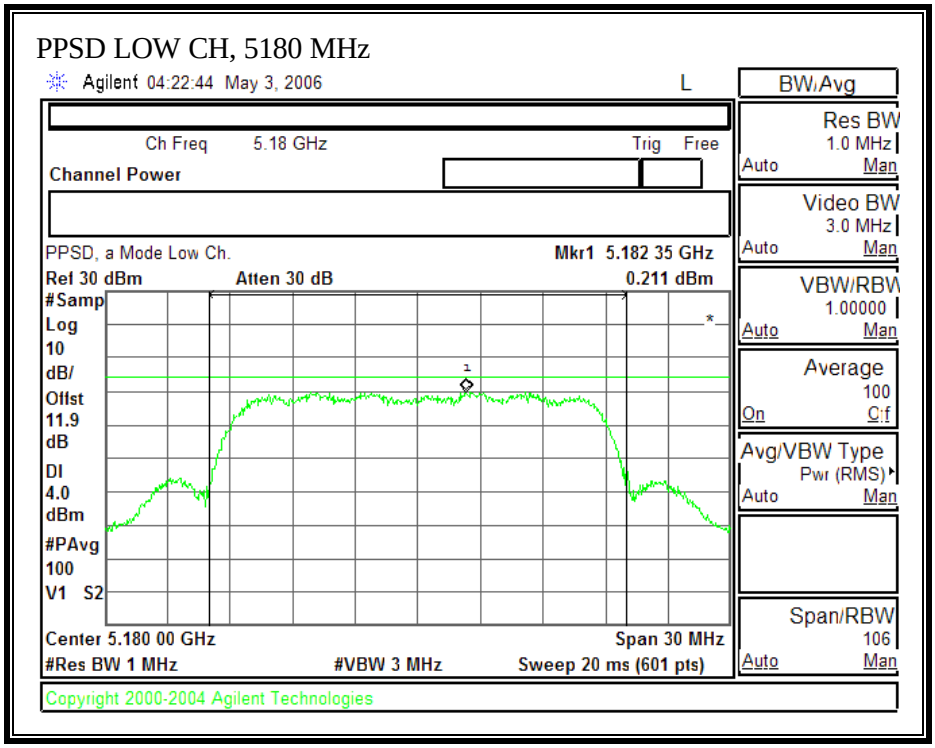
20 MHz TX BANDWIDTH

Channel	Frequency (MHz)	PPSD Chain 0 (dBm)	PPSD Chain 1 (dBm)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Low	5180	0.21	0.26	3.25	4.0	-0.75
Middle	5260	7.79	7.34	10.58	11.0	-0.42
High	5320	6.69	6.63	9.67	11.0	-1.33

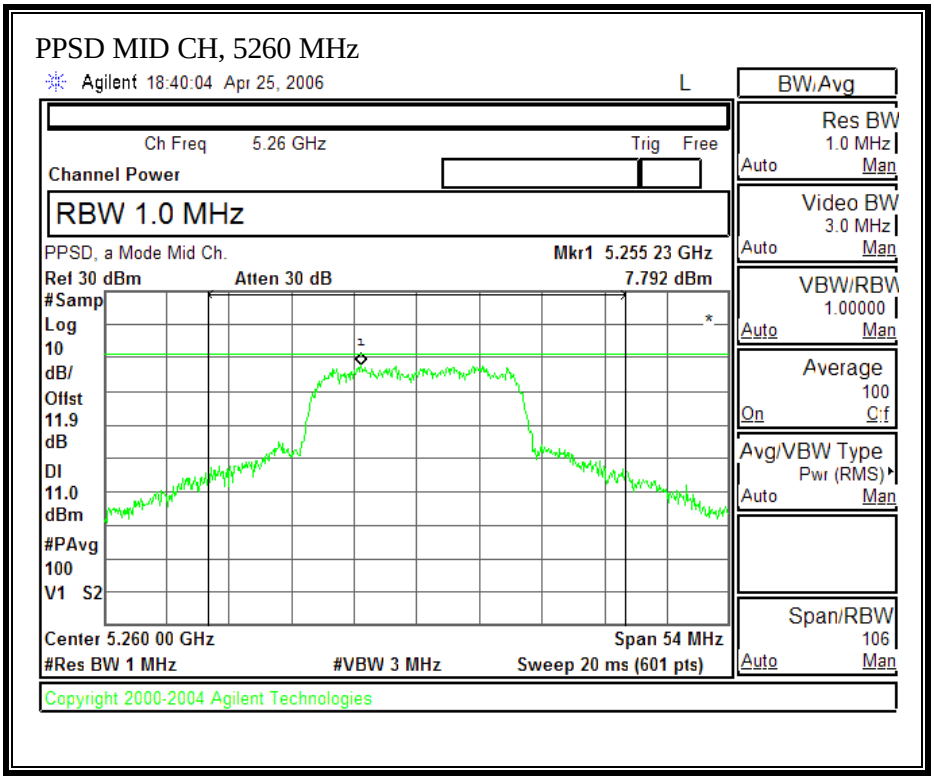
40 MHz TX BANDWIDTH

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	4.0	-0.99
Middle	5270	5.11	3.82	7.52	11.0	-3.48
High	5310	3.87	3.61	6.75	11.0	-4.25

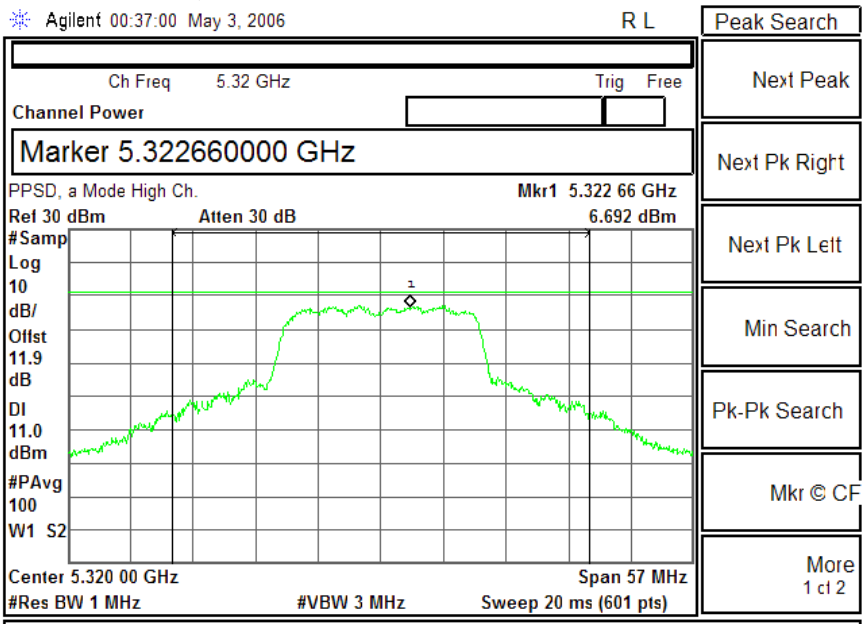
PEAK POWER SPECTRAL DENSITY (802.11 - 20 MHz TX BANDWIDTH – CHAIN 0)



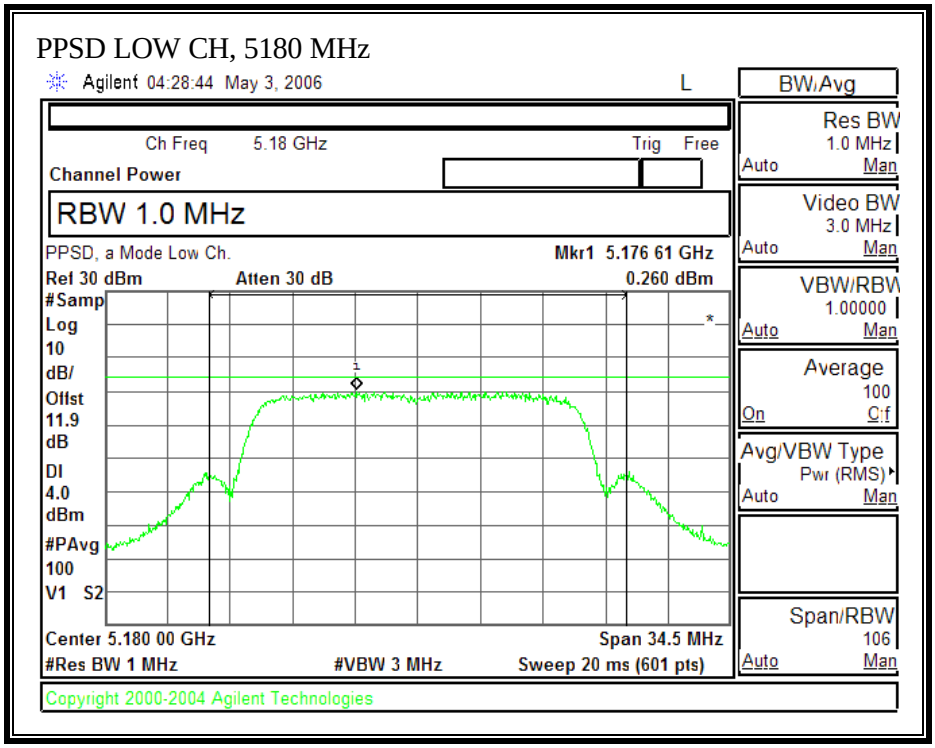
PPSD MID CH, 5260 MHz



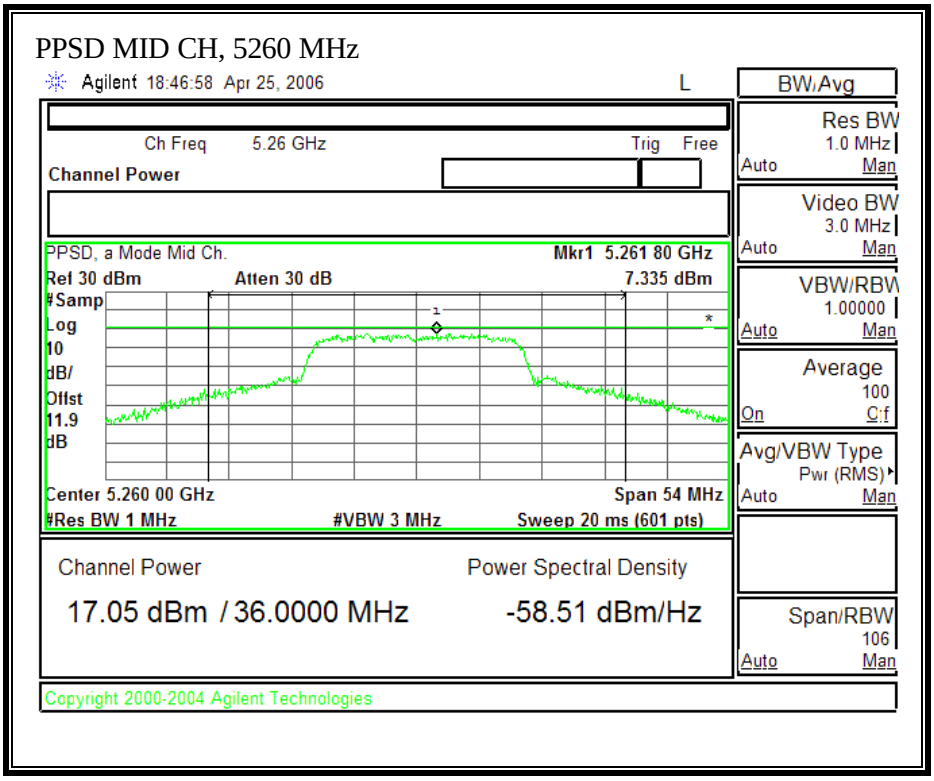
PPSD HIGH CH, 5320 MHz



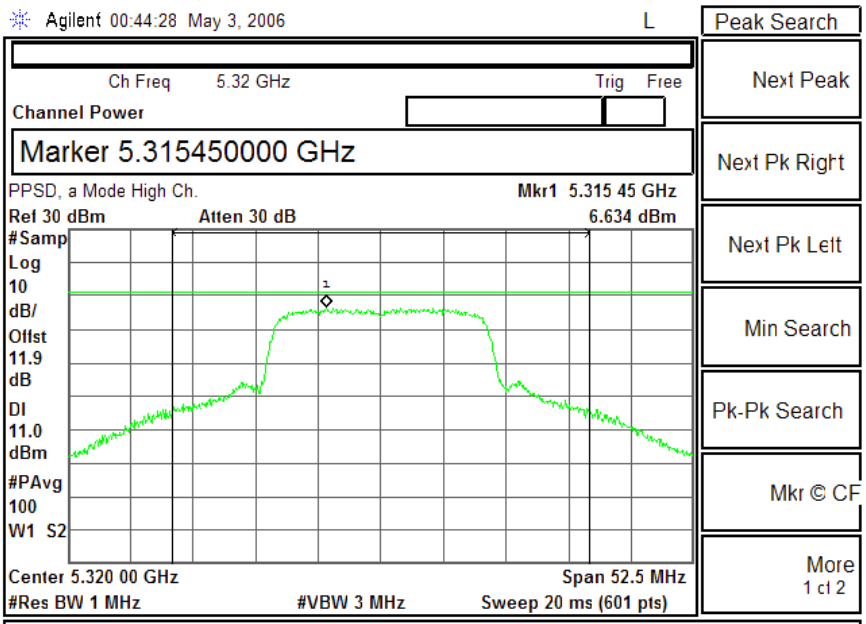
PEAK POWER SPECTRAL DENSITY (802.11 - 20 MHz TX BANDWIDTH – CHAIN 1)



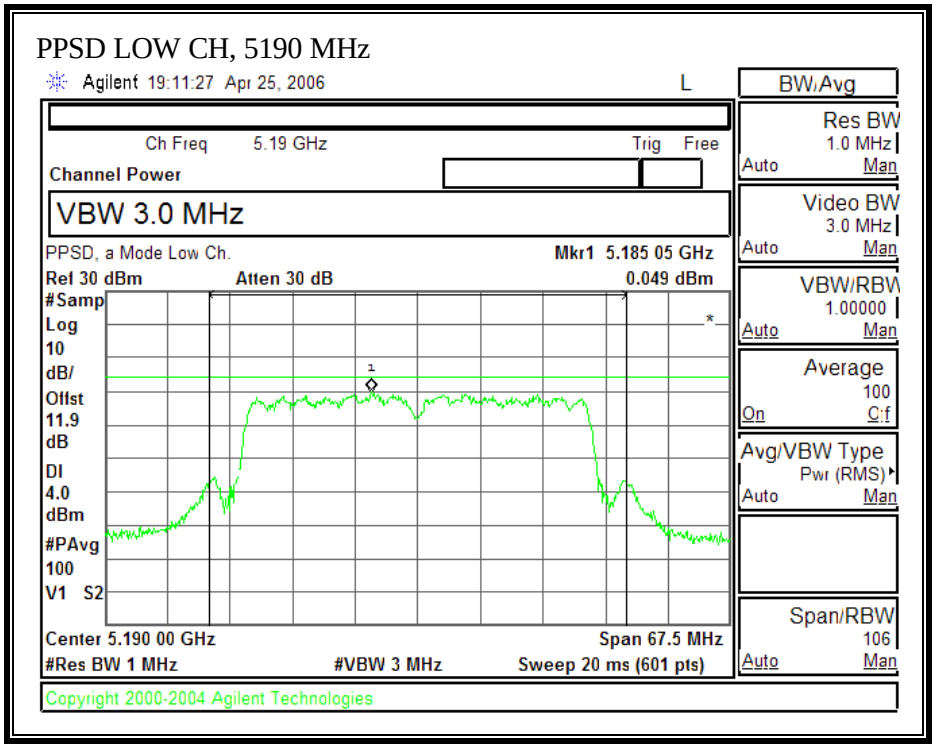
PPSD MID CH, 5260 MHz



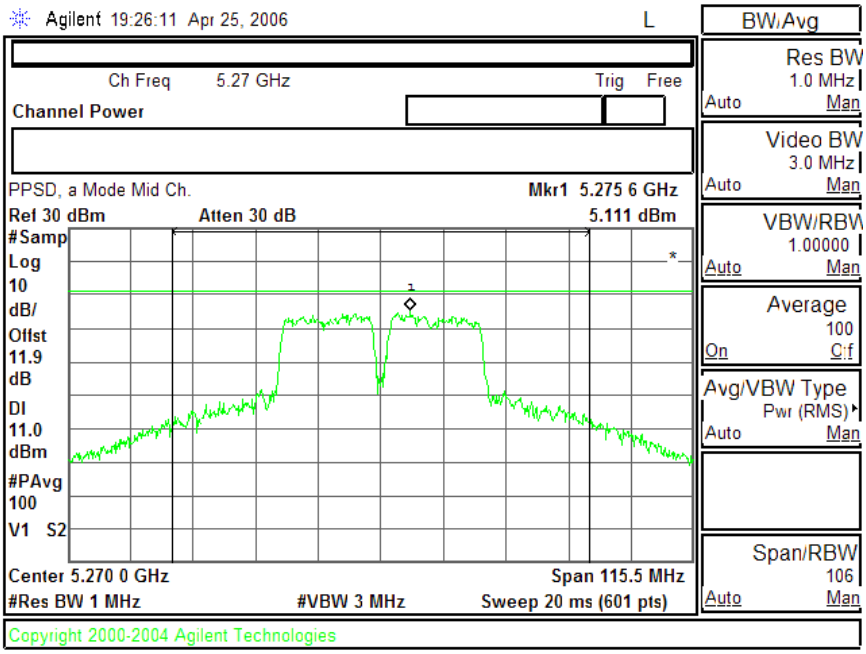
PPSD HIGH CH, 5320 MHz



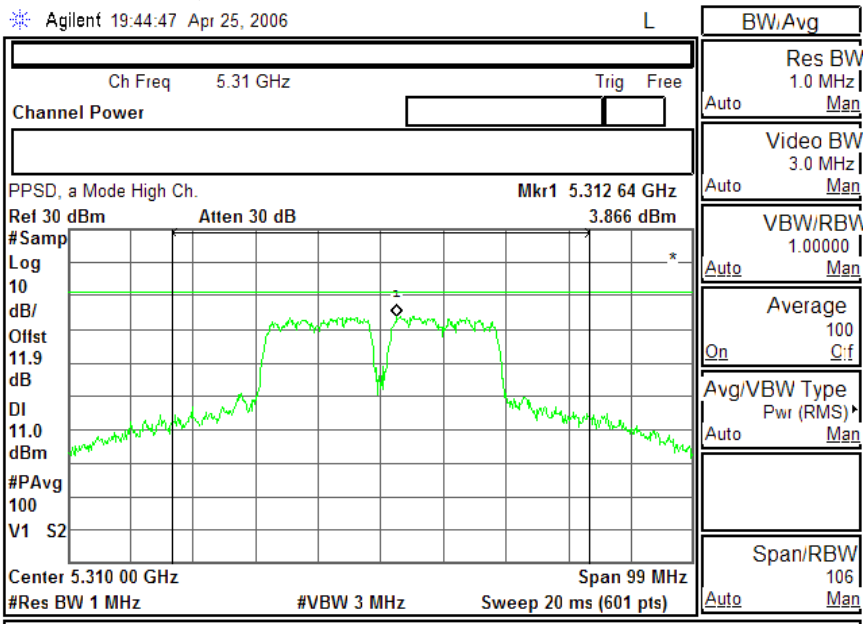
PEAK POWER SPECTRAL DENSITY (802.11 - 40 MHz TX BANDWIDTH – CHAIN 0)



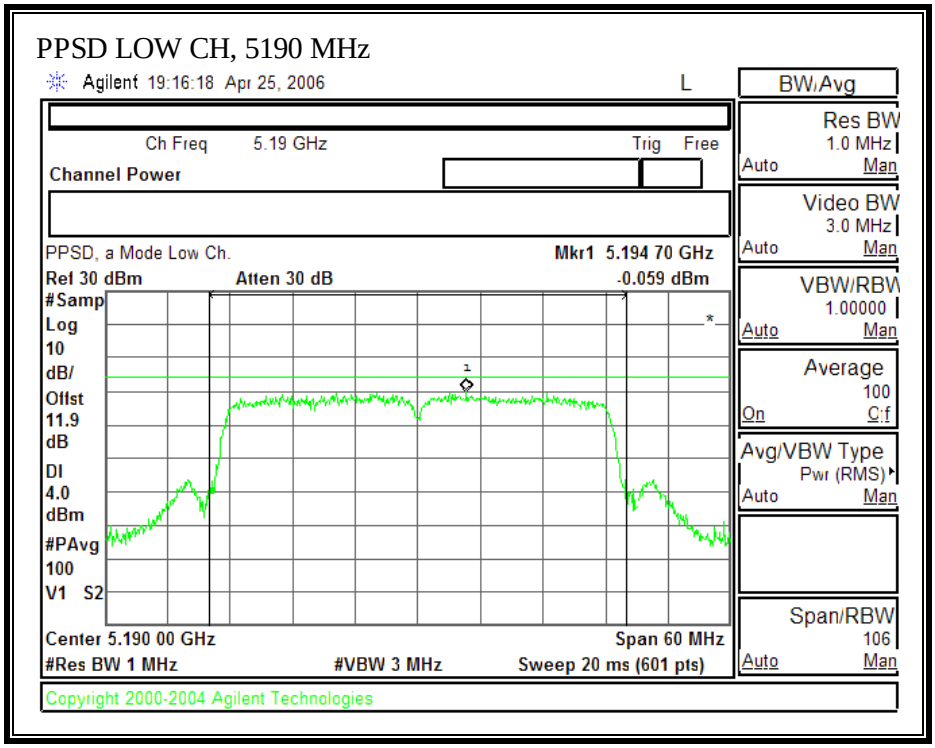
PPSD MID CH, 5270 MHz



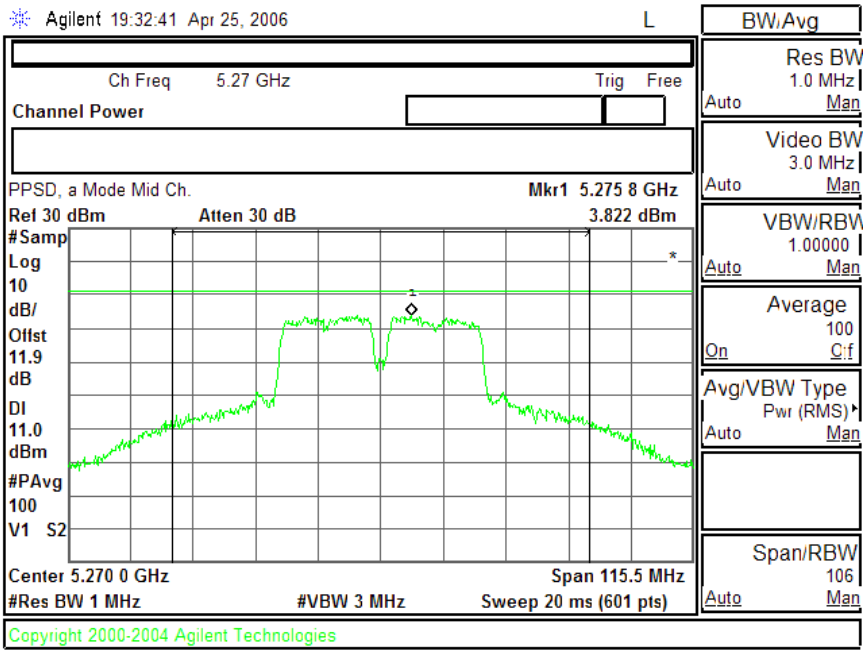
PPSD HIGH CH, 5310 MHz



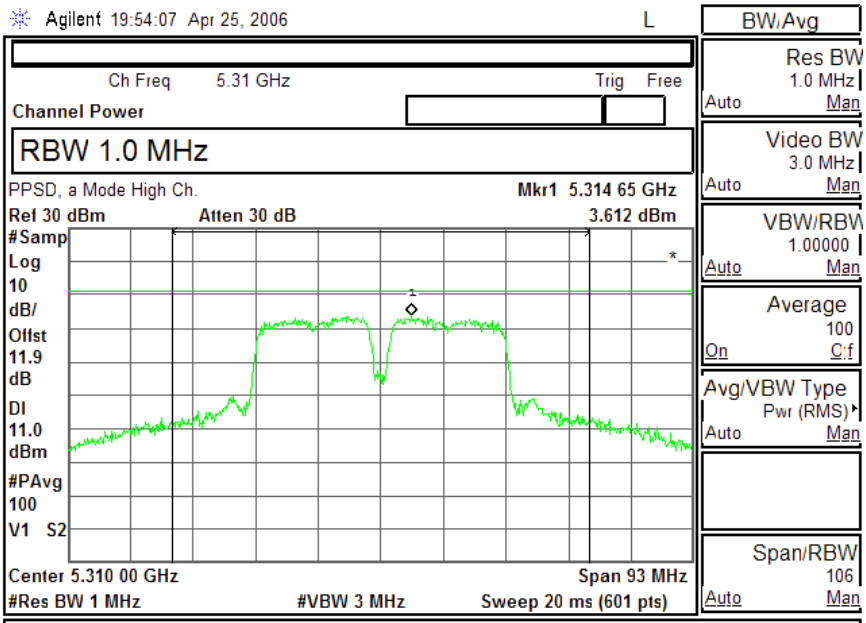
PEAK POWER SPECTRAL DENSITY (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)



PPSD MID CH, 5270 MHz



PPSD HIGH CH, 5310 MHz



7.1.13. 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:

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

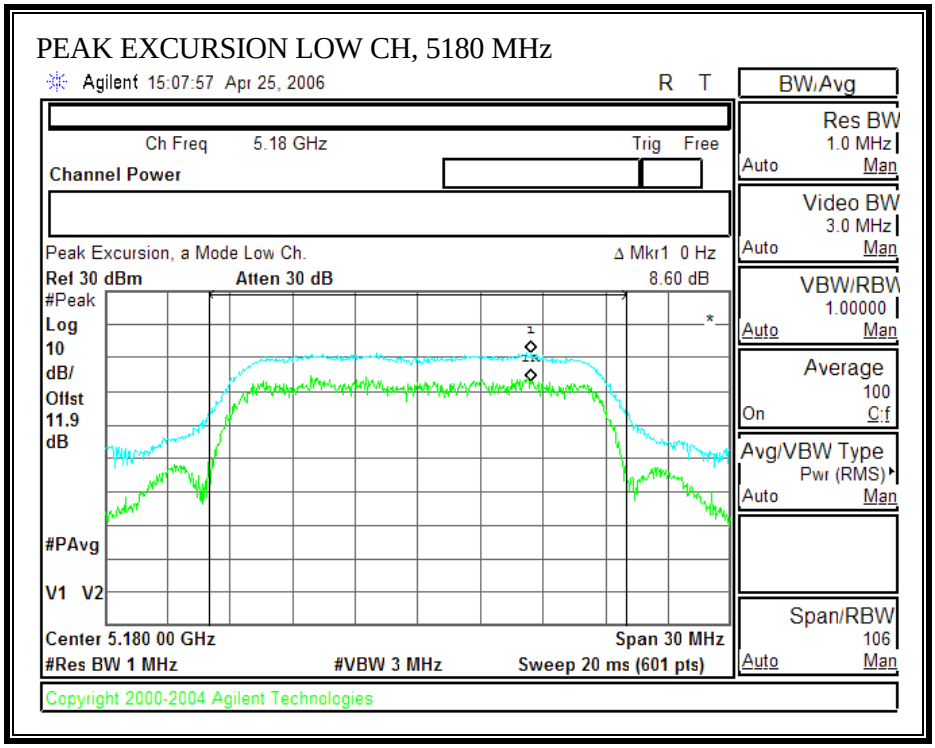
40 MHz TX BANDWIDTH - CHAIN 0

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

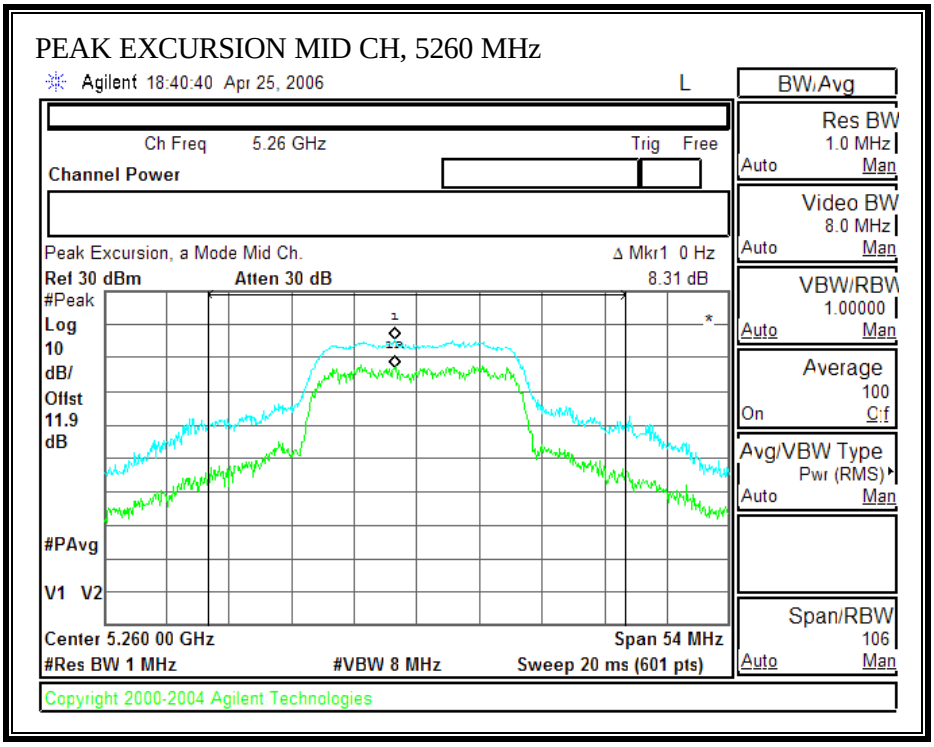
40 MHz TX BANDWIDTH - CHAIN 1

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

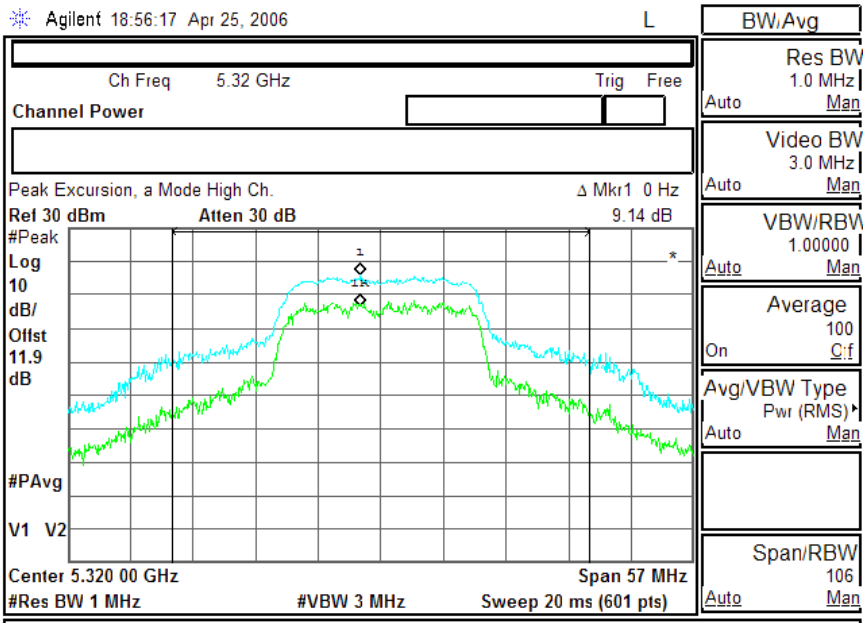
PEAK EXCURSION (802.11 - 20 MHz TX BANDWIDTH – CHAIN 0)



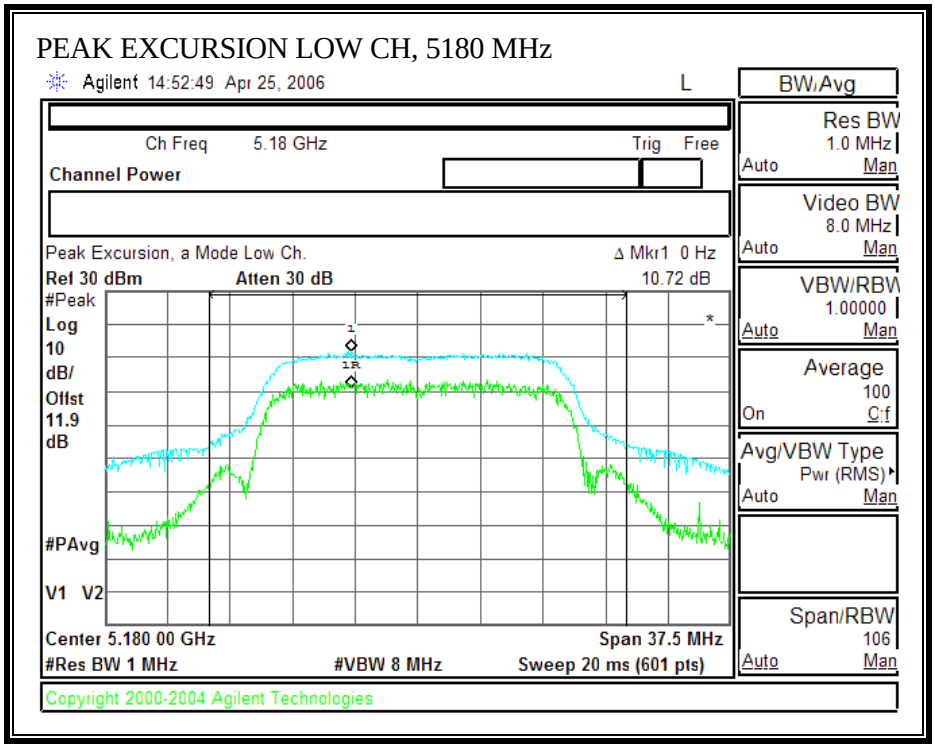
PEAK EXCURSION MID CH, 5260 MHz



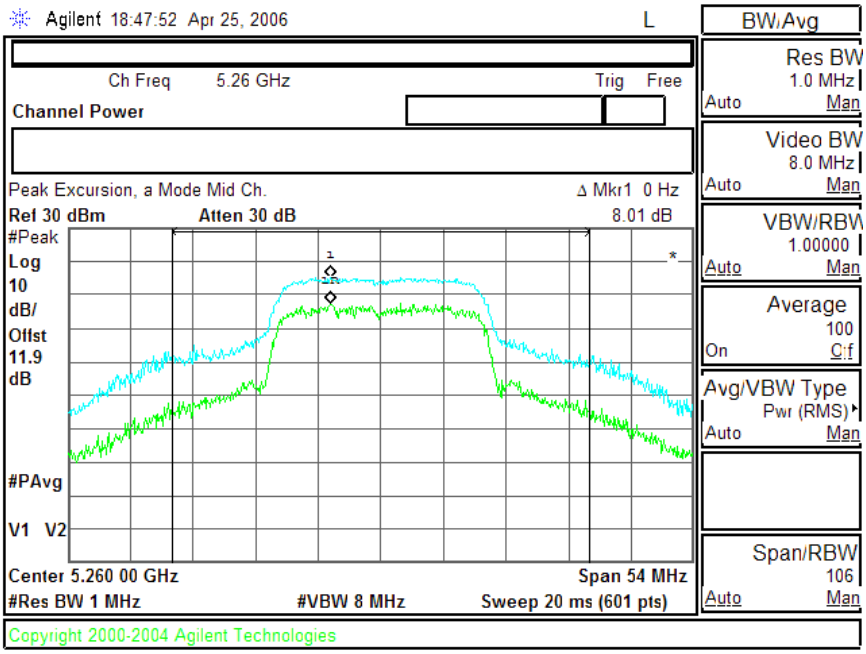
PEAK EXCURSION HIGH CH, 5320 MHz



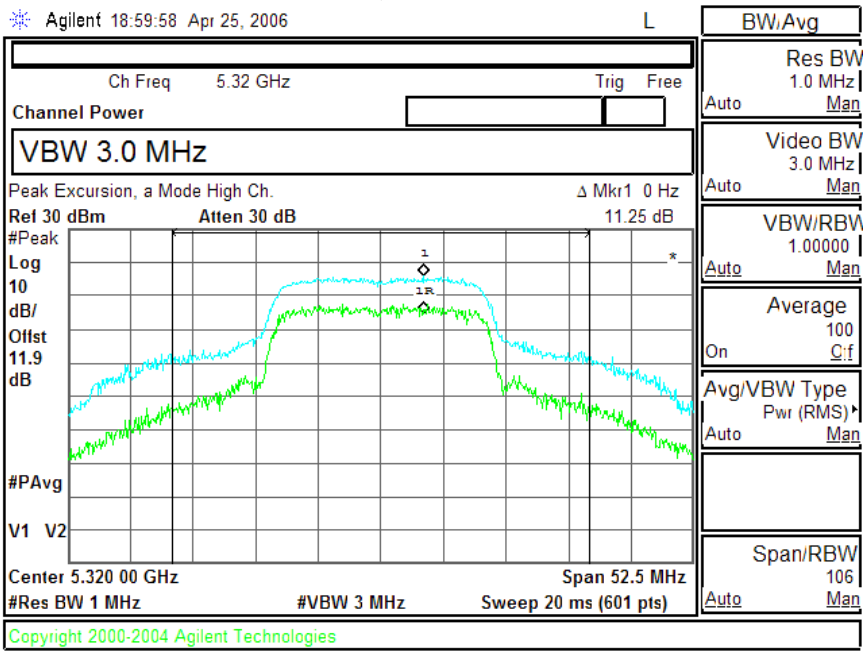
PEAK EXCURSION (802.11 - 20 MHz TX BANDWIDTH – CHAIN 1)



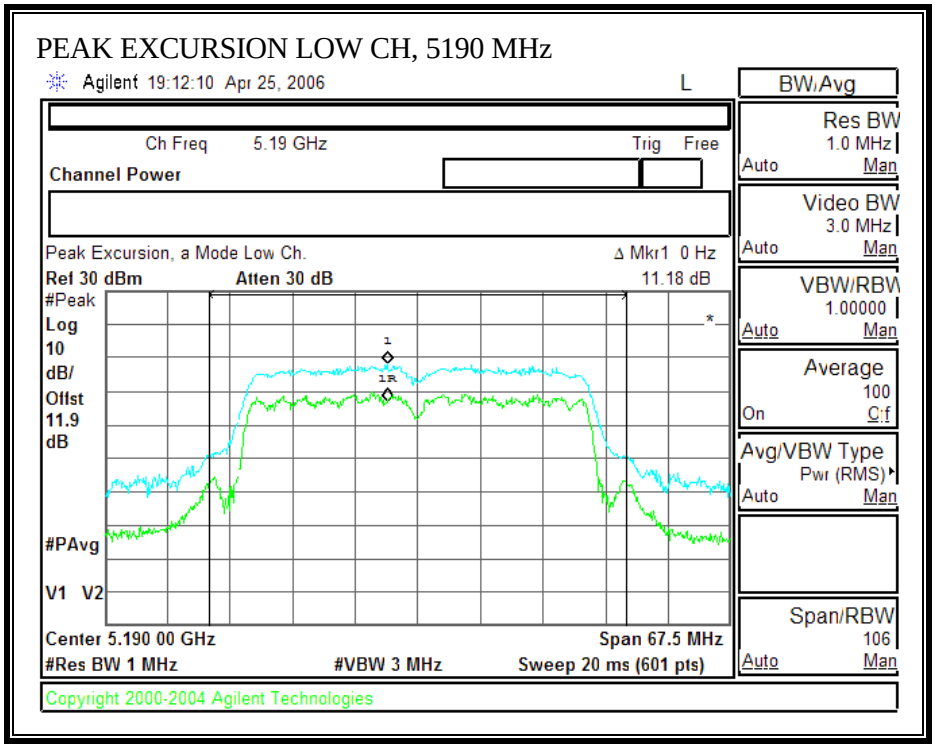
PEAK EXCURSION MID CH, 5260 MHz



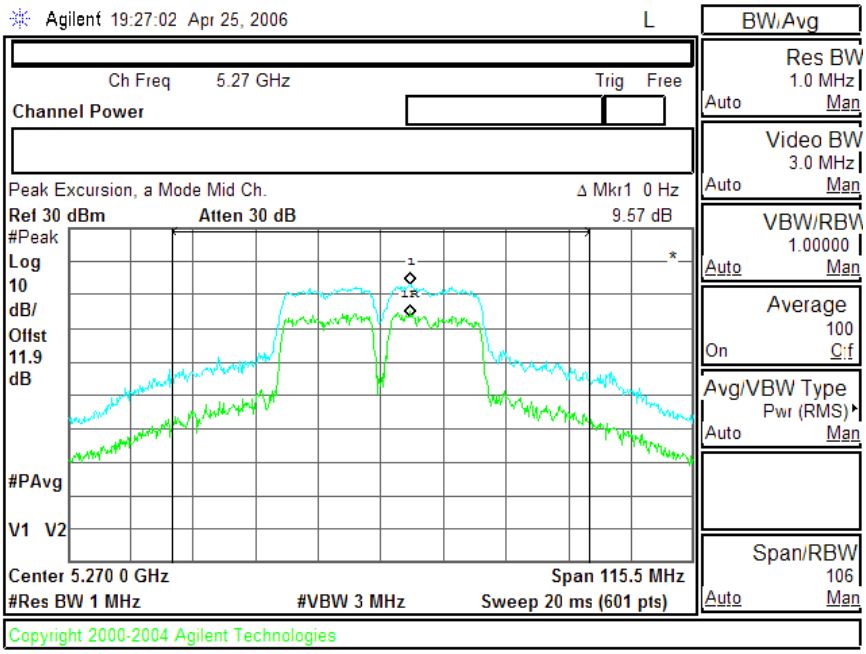
PEAK EXCURSION HIGH CH, 5320 MHz



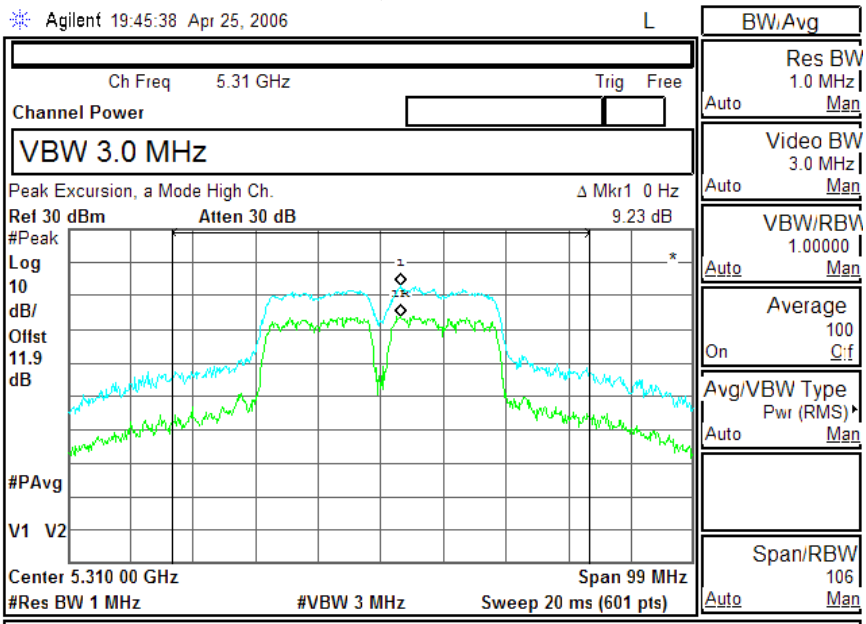
PEAK EXCURSION (802.11 - 40 MHz TX BANDWIDTH – CHAIN 0)



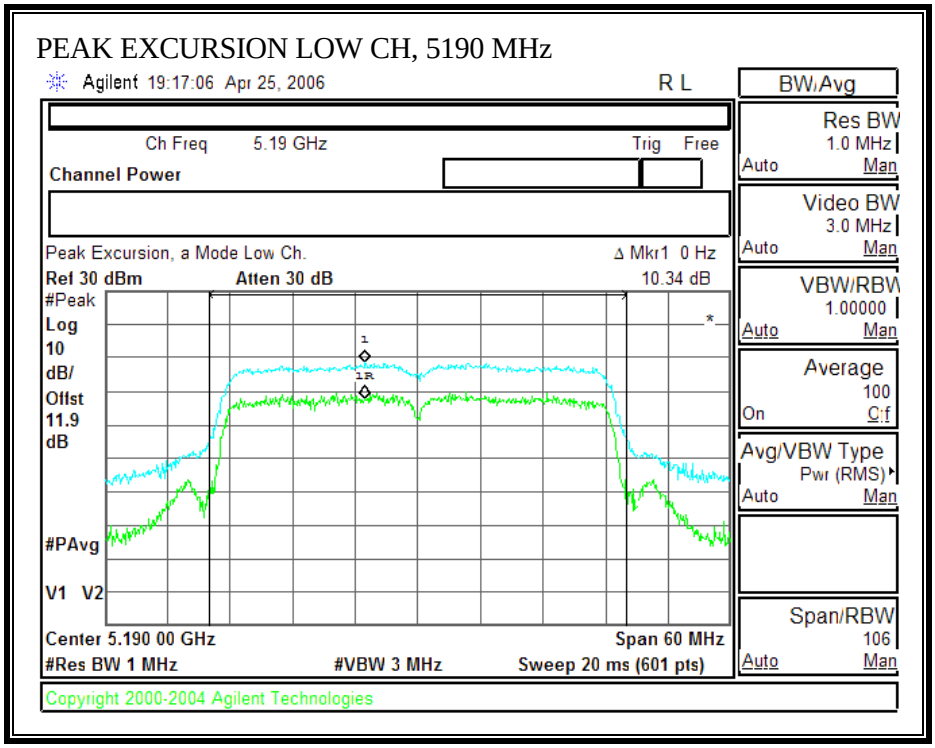
PEAK EXCURSION MID CH, 5270 MHz



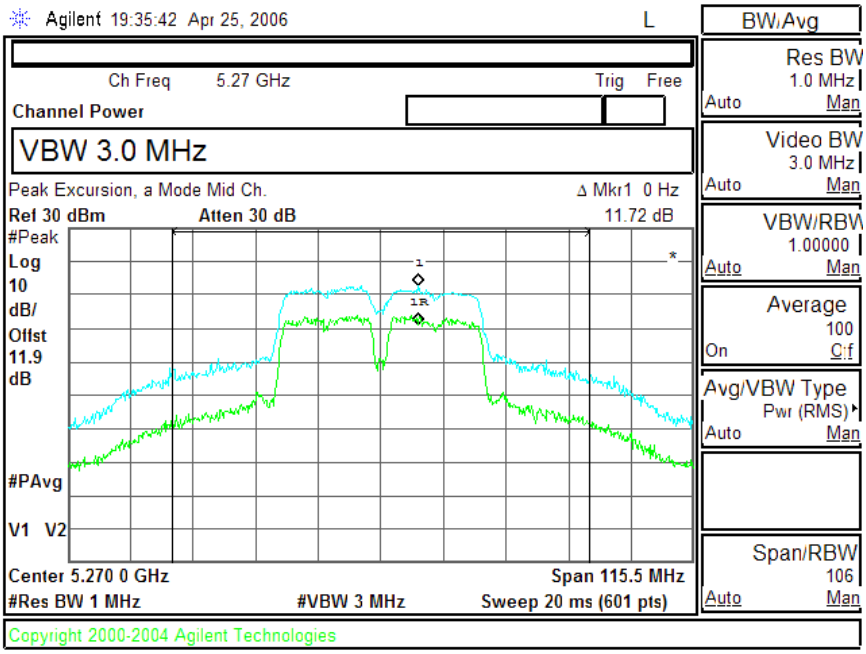
PEAK EXCURSION HIGH CH, 5310 MHz



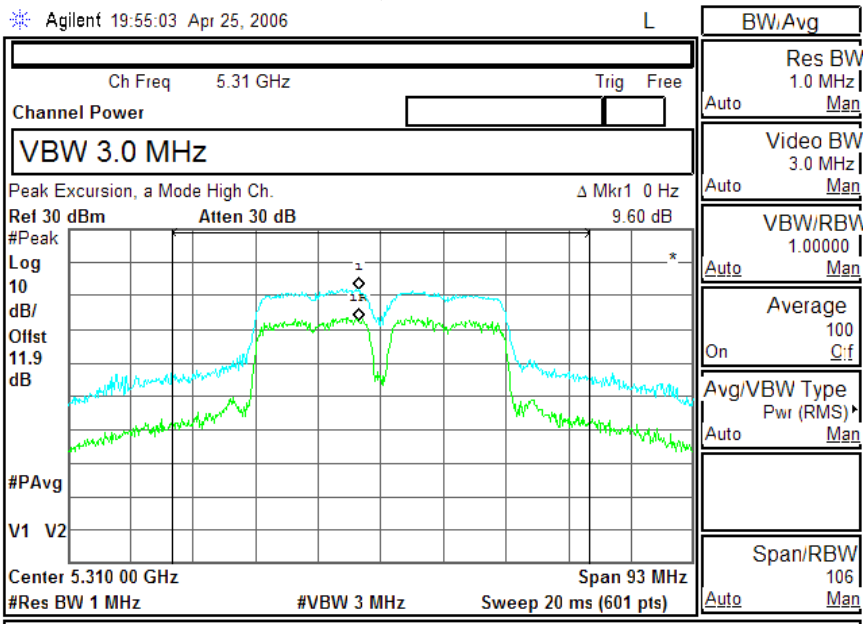
PEAK EXCURSION (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)



PEAK EXCURSION MID CH, 5270 MHz



PEAK EXCURSION HIGH CH, 5310 MHz



7.1.14. 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.

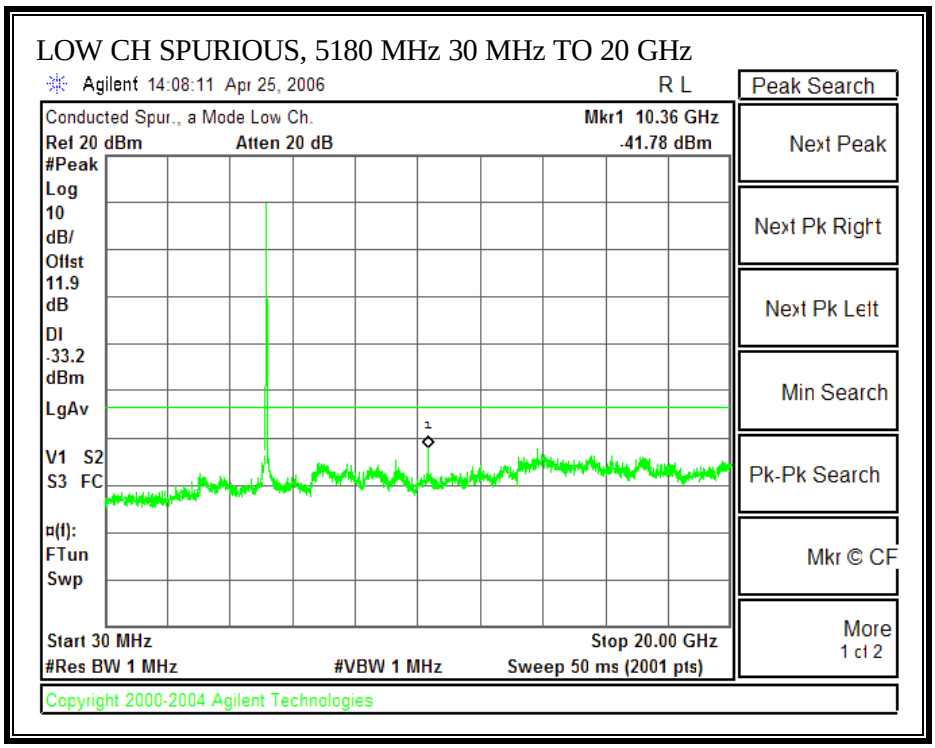
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to the average EIRP limit, adjusted for the maximum antenna gain. If necessary, additional average detection measurements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

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

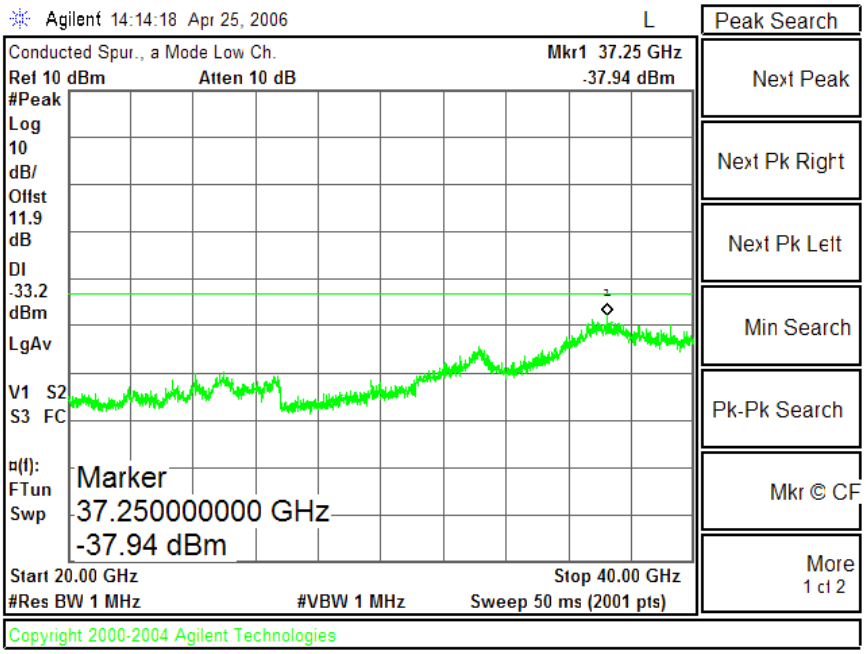
RESULTS

No non-compliance noted:

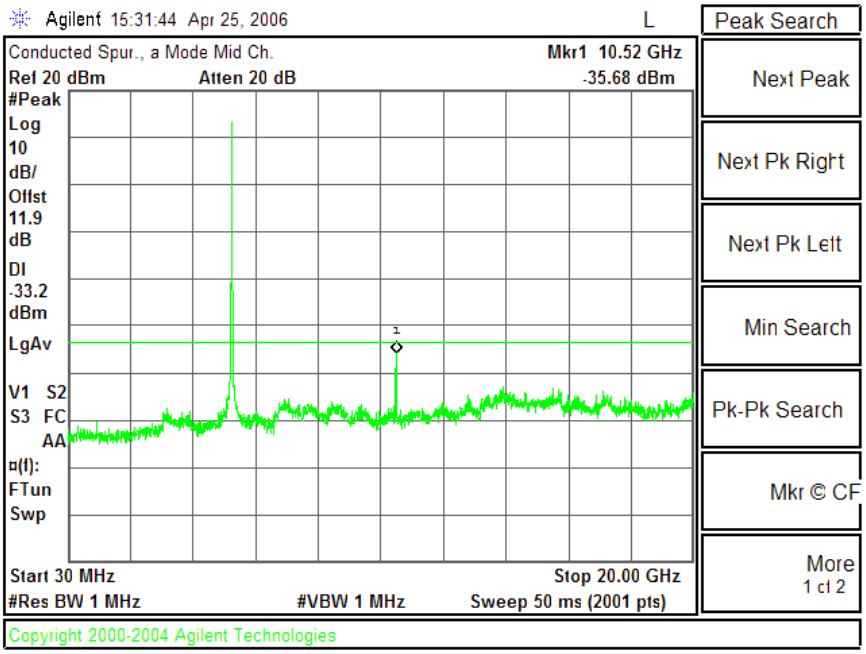
SPURIOUS EMISSIONS - 802.11a -20 MHz TX BANDWIDTH - CHAIN 0



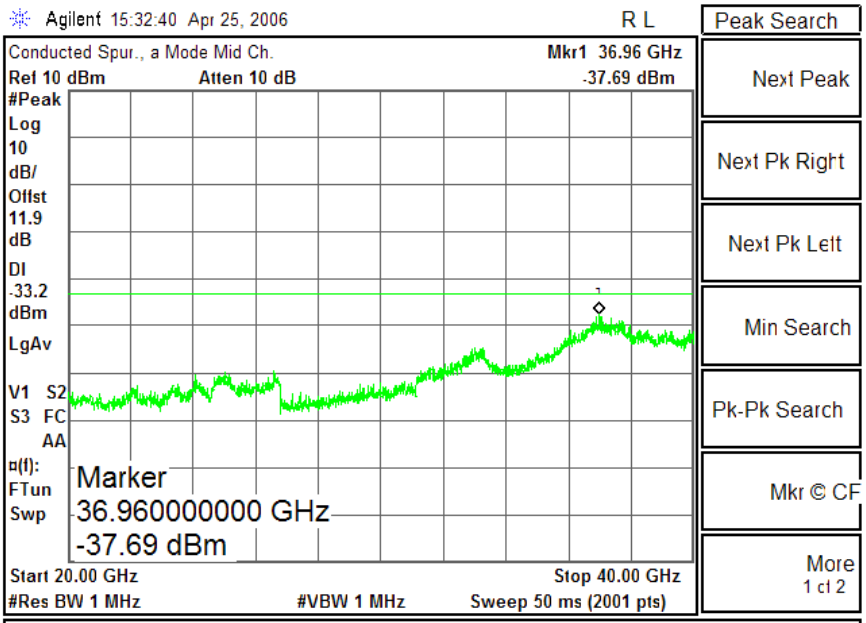
LOW CH SPURIOUS, 5180 MHz 20 GHz TO 40 GHz



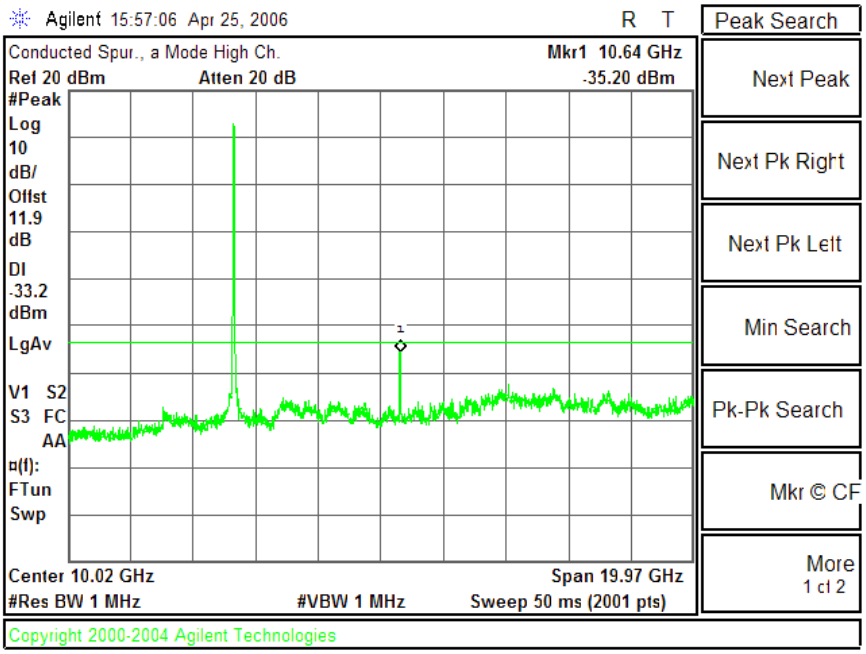
MID CHANNEL SPURIOUS, 5260 MHz - 30 MHz TO 20 GHz



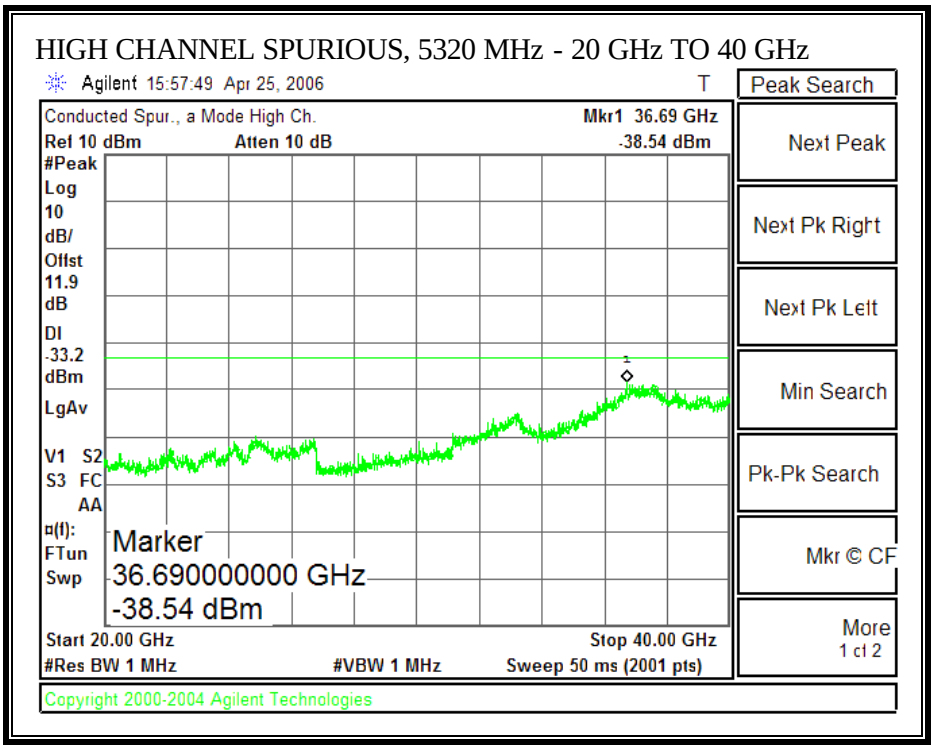
MID CHANNEL SPURIOUS, 5260 MHz - 20 GHz TO 40 GHz



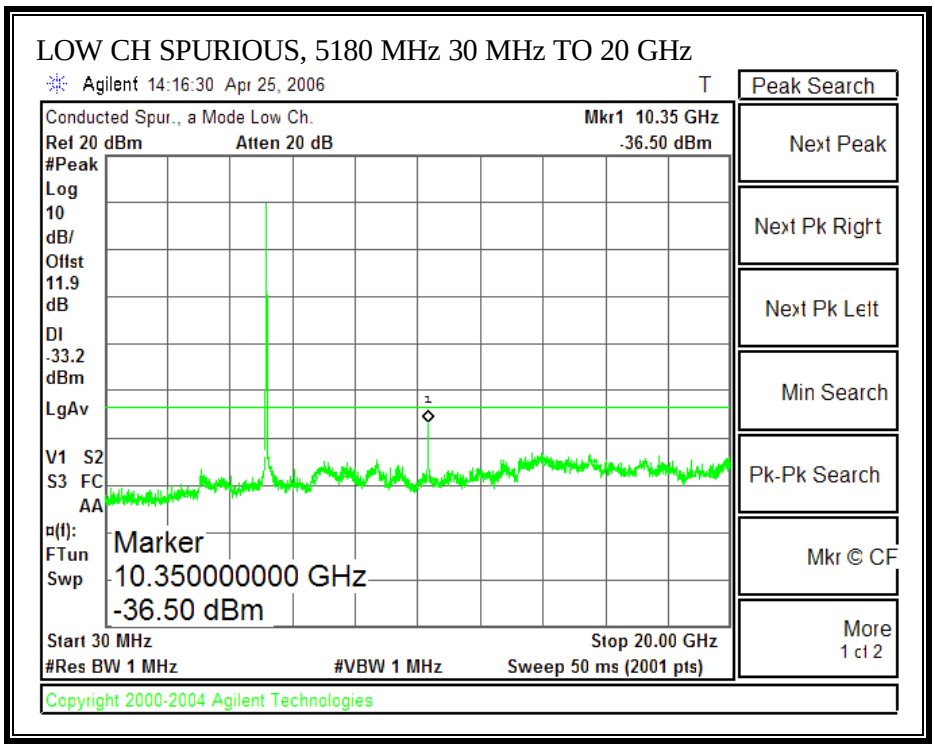
HIGH CHANNEL SPURIOUS, 5320 MHz - 30 MHz TO 20 GHz



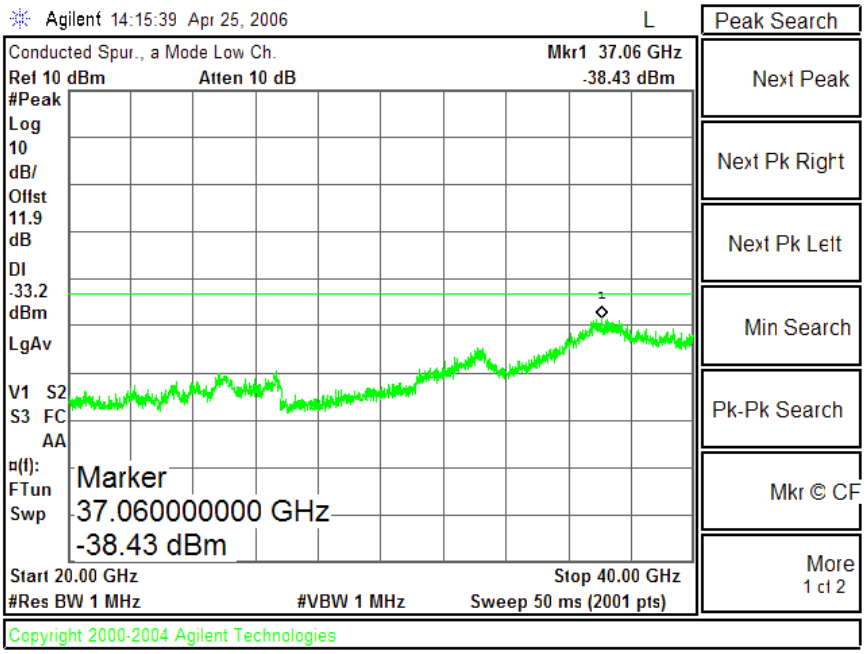
HIGH CHANNEL SPURIOUS, 5320 MHz - 20 GHz TO 40 GHz



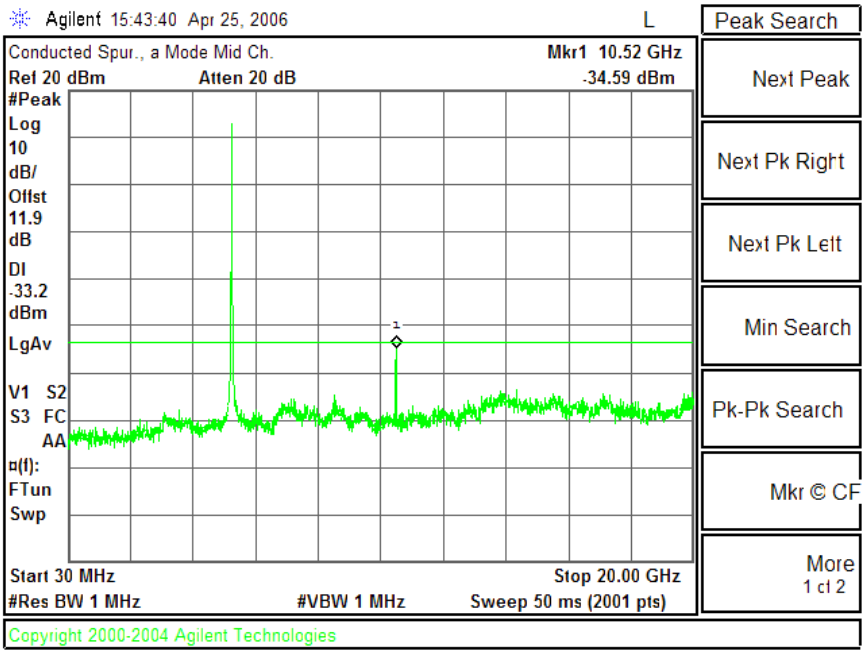
SPURIOUS EMISSIONS - 802.11a -20 MHz TX BANDWIDTH - CHAIN 1



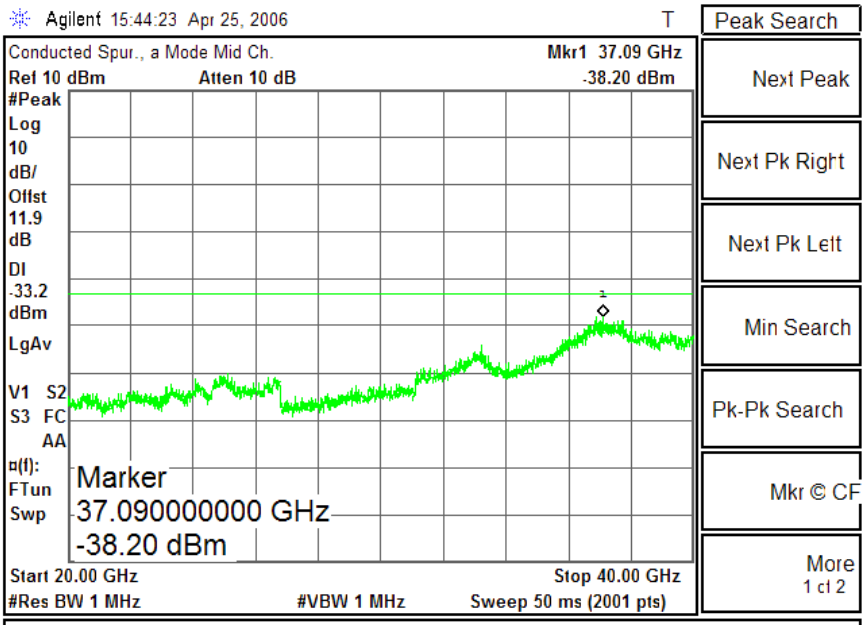
LOW CH SPURIOUS, 5180 MHz 20 GHz TO 40 GHz



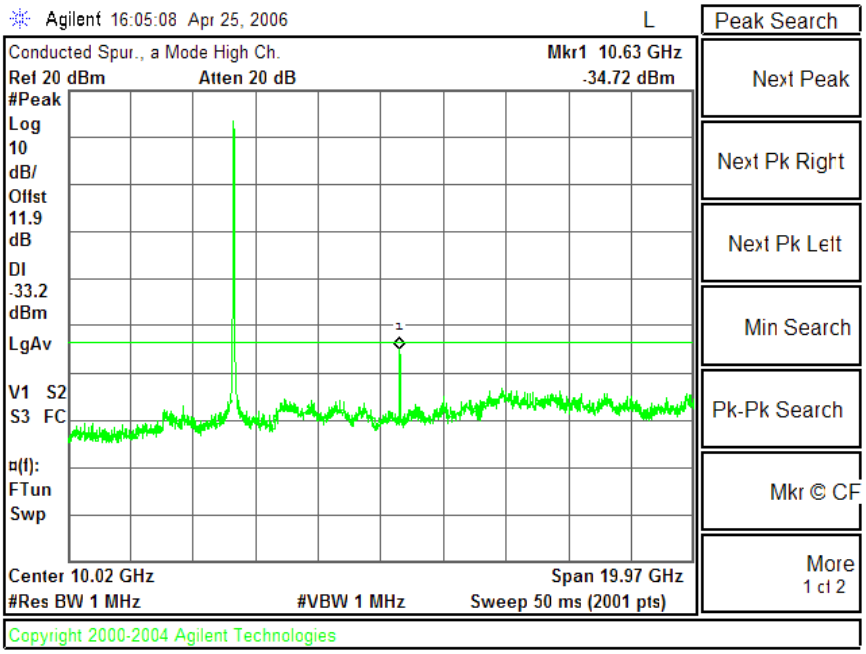
MID CHANNEL SPURIOUS, 5260 MHz - 30 MHz TO 20 GHz



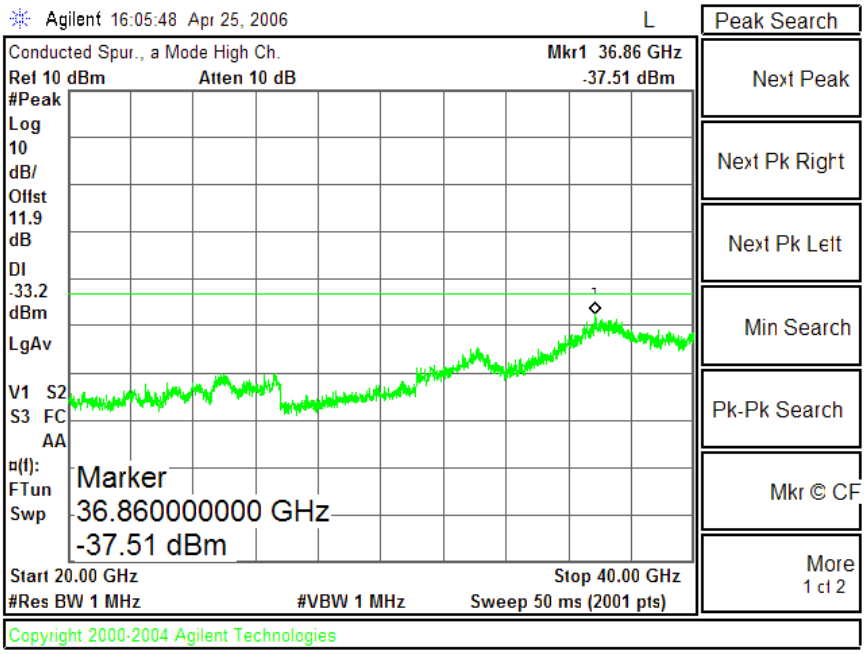
MID CHANNEL SPURIOUS, 5260 MHz - 20 GHz TO 40 GHz



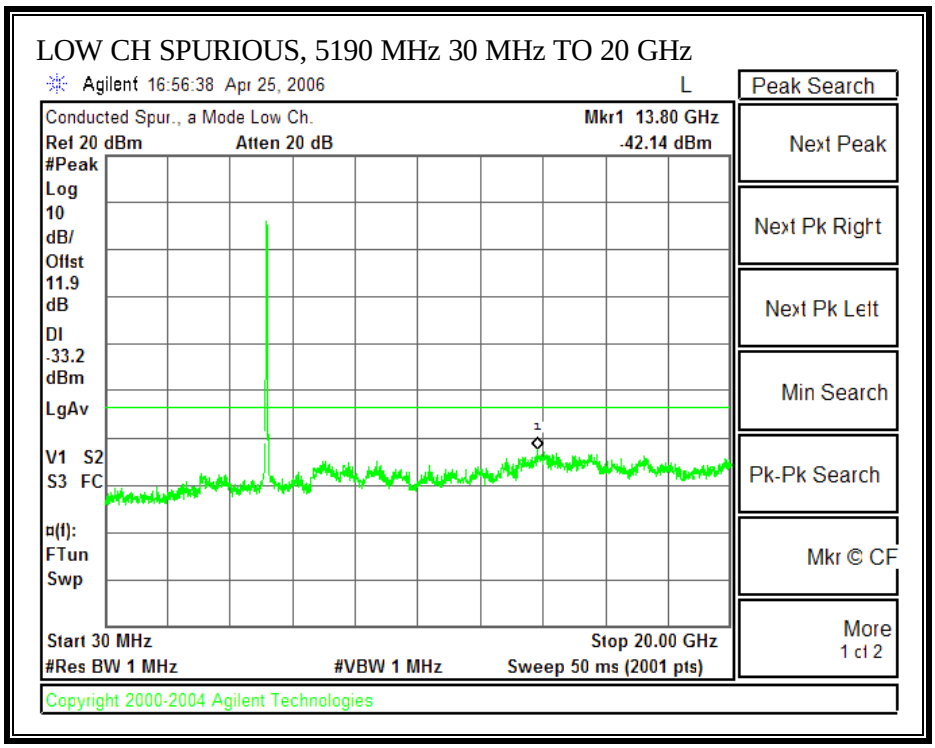
HIGH CHANNEL SPURIOUS, 5320 MHz - 30 MHz TO 20 GHz



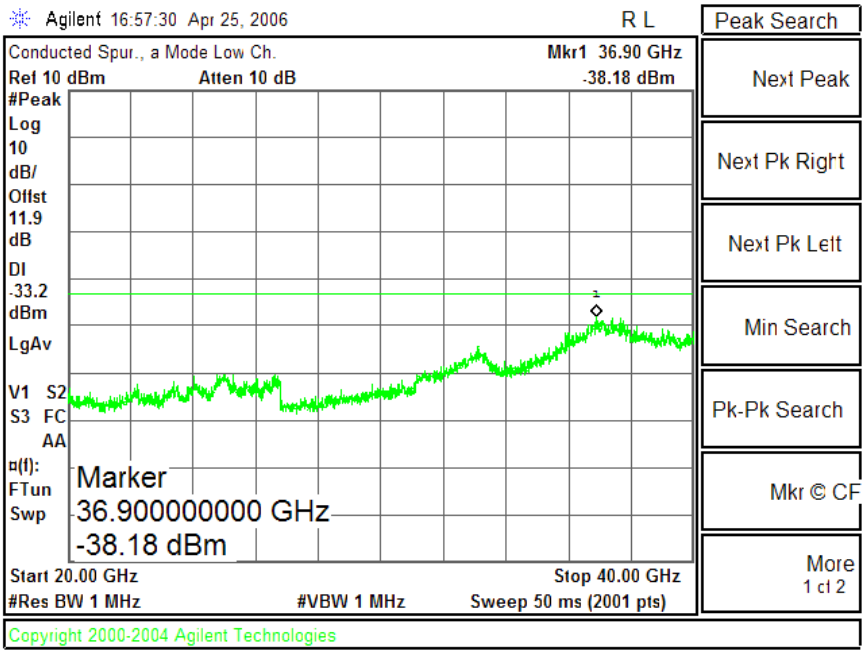
HIGH CHANNEL SPURIOUS, 5320 MHz - 20 GHz TO 40 GHz



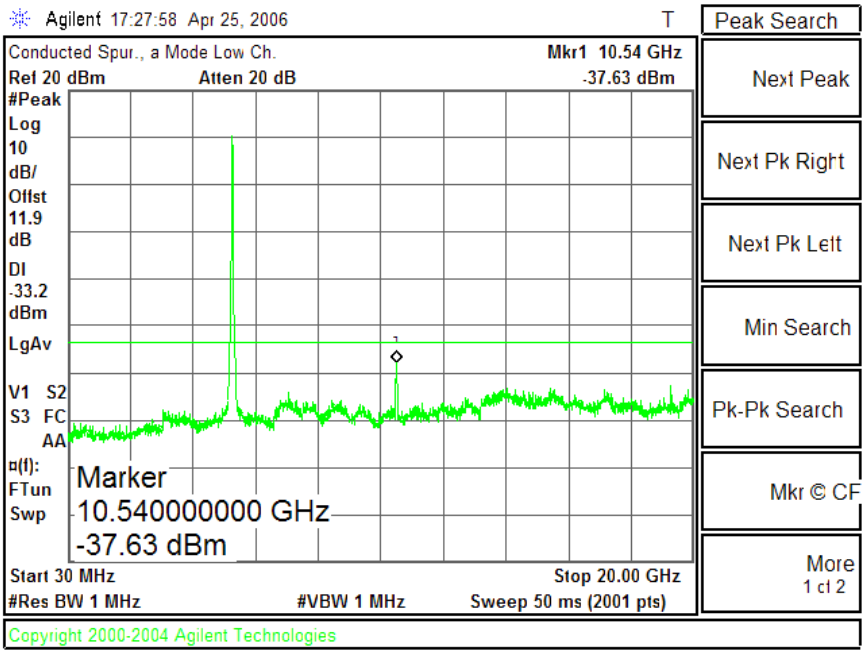
SPURIOUS EMISSIONS - 802.11a -40 MHz TX BANDWIDTH - CHAIN 0

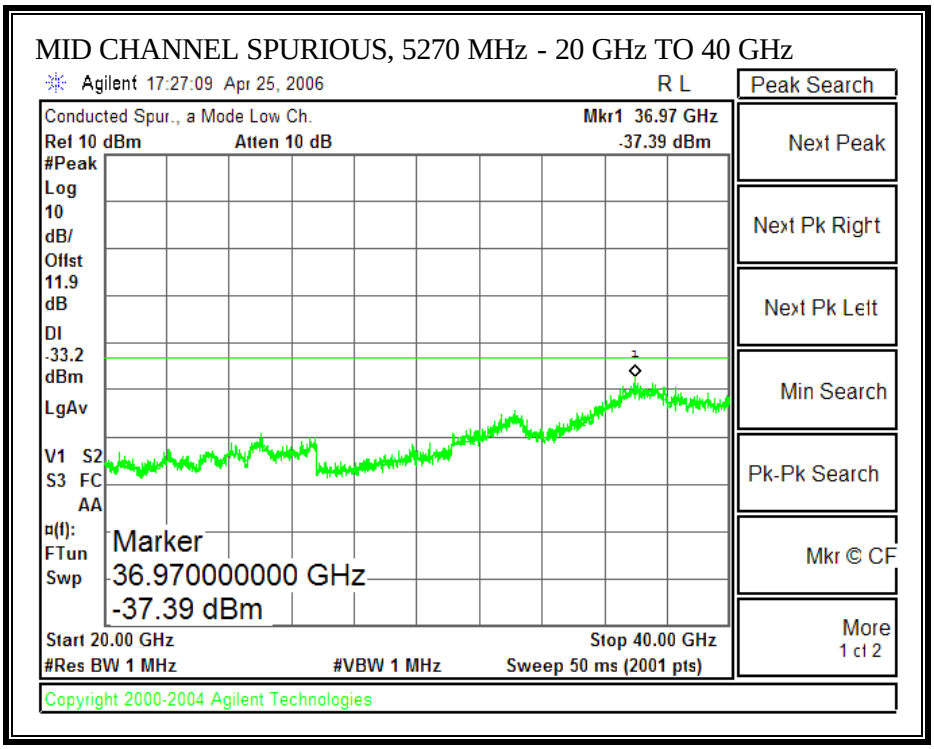


LOW CH SPURIOUS, 5190 MHz 20 GHz TO 40 GHz

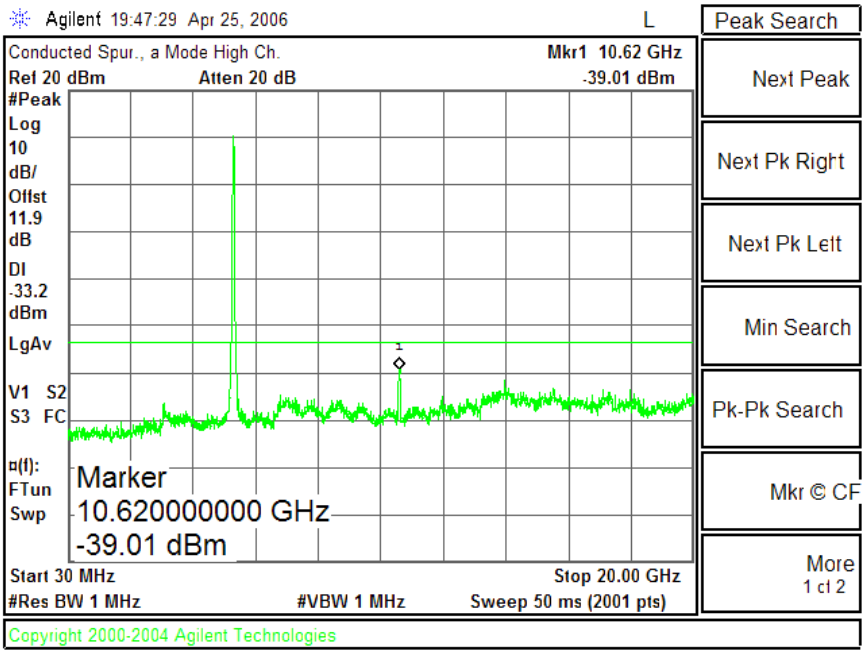


MID CHANNEL SPURIOUS, 5270 MHz - 30 MHz TO 20 GHz

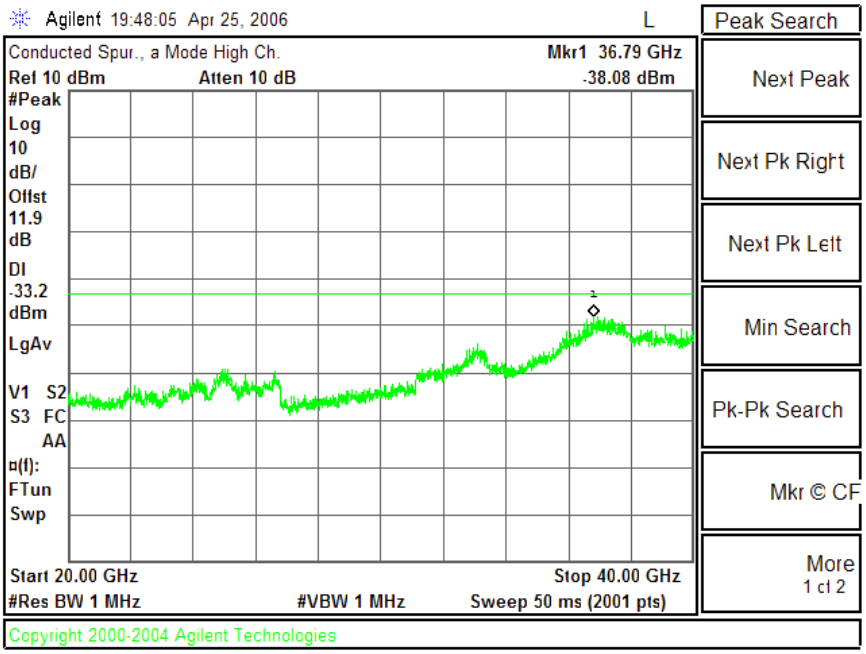




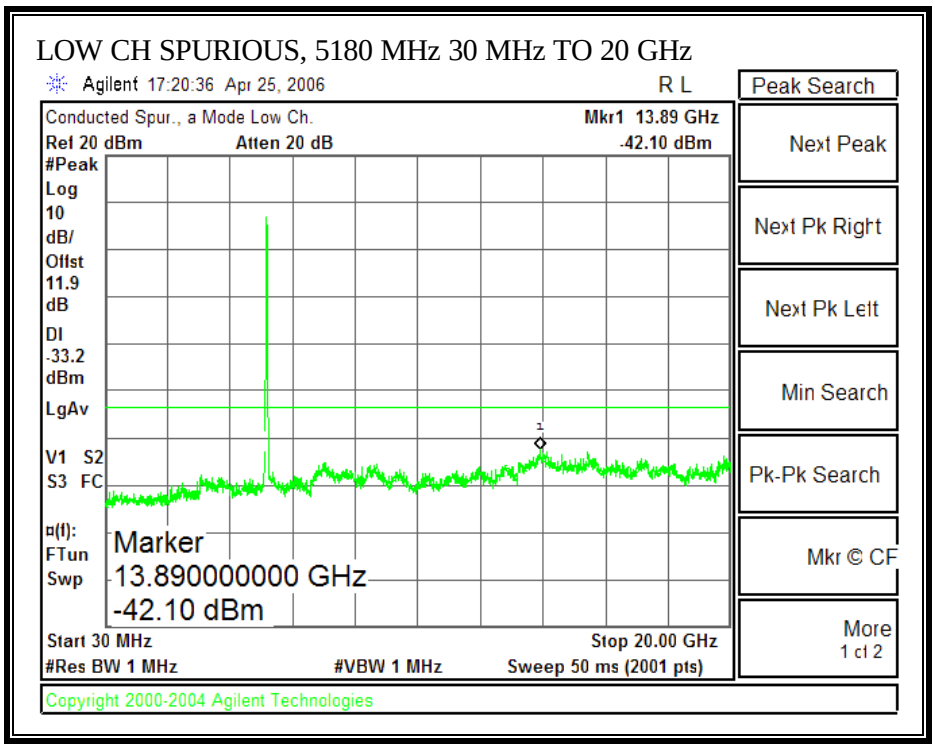
HIGH CHANNEL SPURIOUS, 5310 MHz - 30 MHz TO 20 GHz



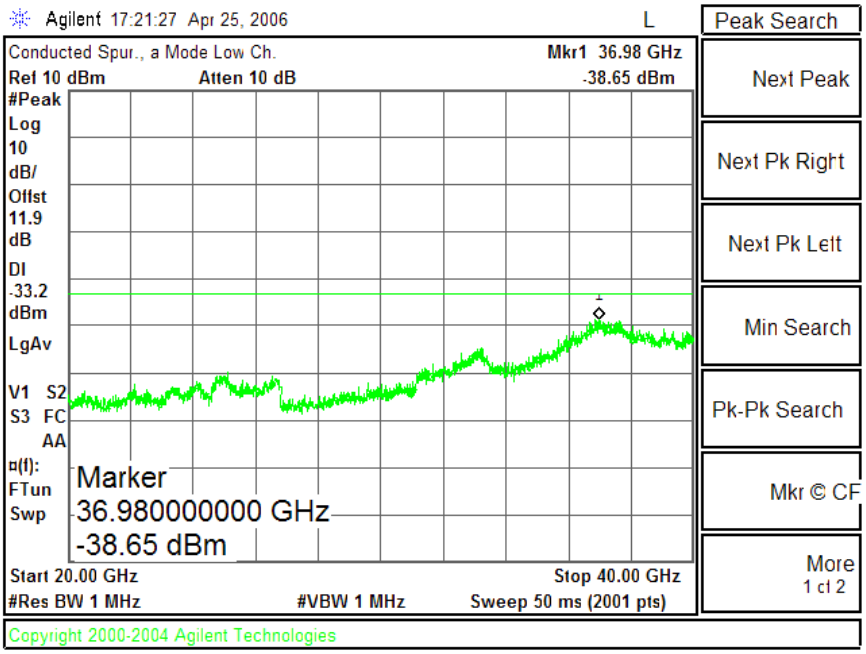
HIGH CHANNEL SPURIOUS, 5310 MHz - 20 GHz TO 40 GHz



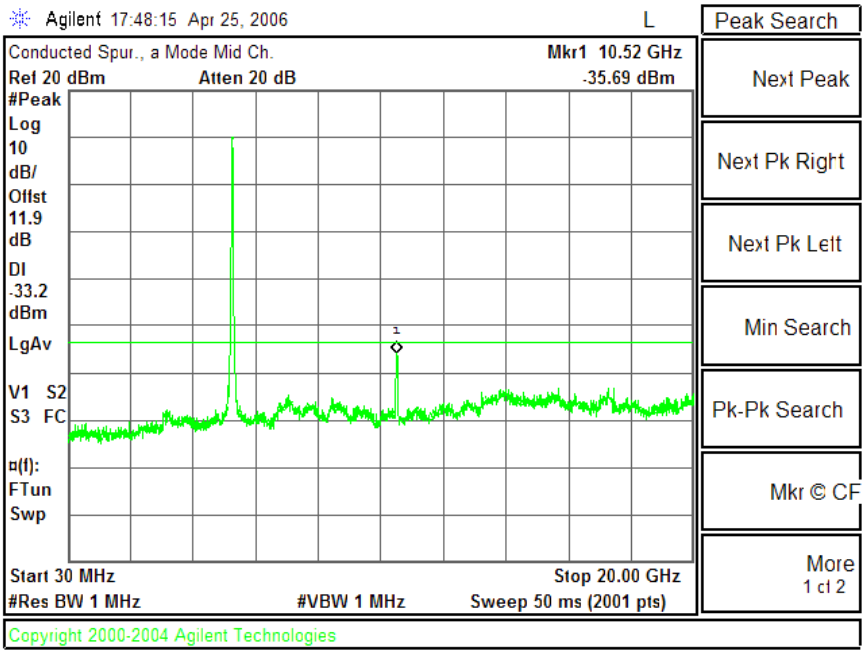
SPURIOUS EMISSIONS - 802.11a -20 MHz TX BANDWIDTH - CHAIN 1



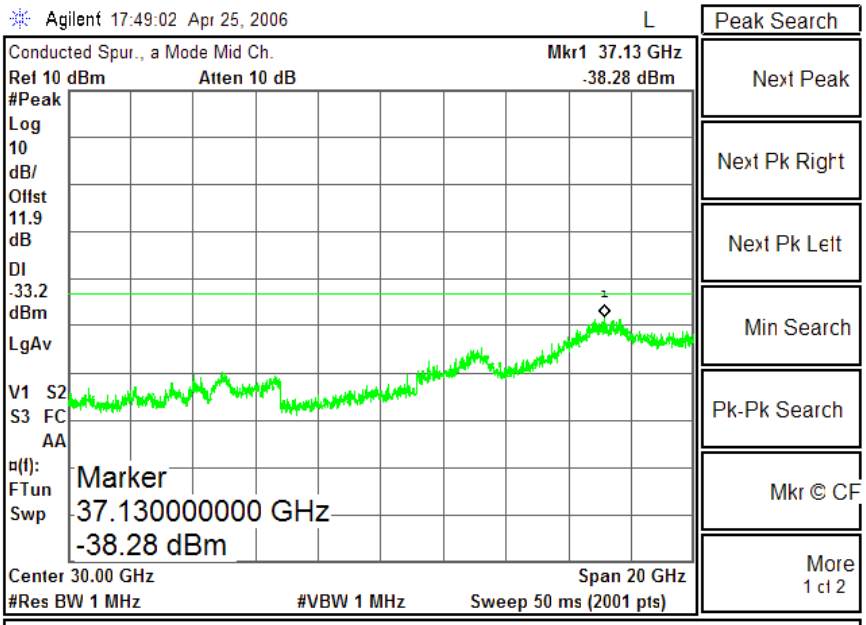
LOW CH SPURIOUS, 5190 MHz 20 GHz TO 40 GHz



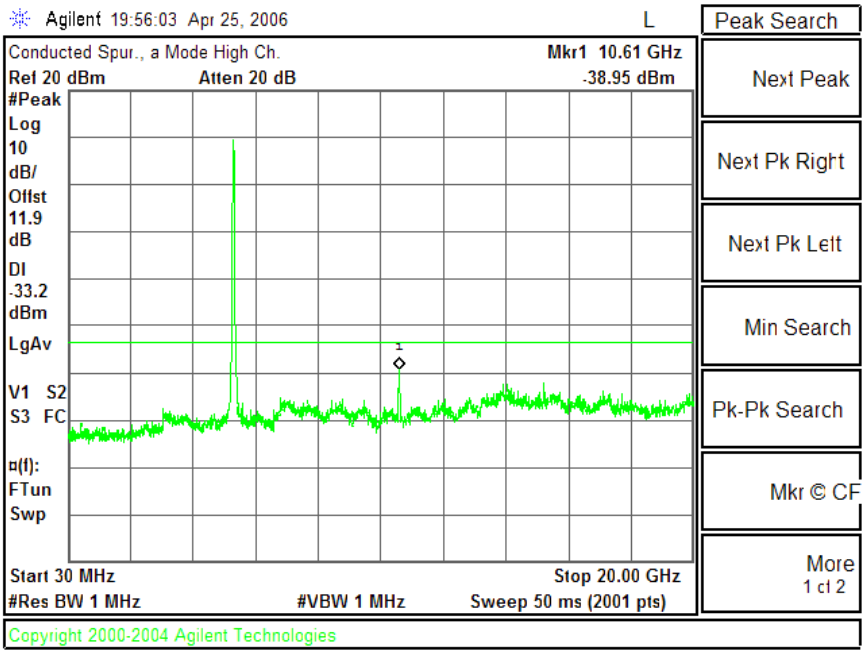
MID CHANNEL SPURIOUS, 5270 MHz - 30 MHz TO 20 GHz



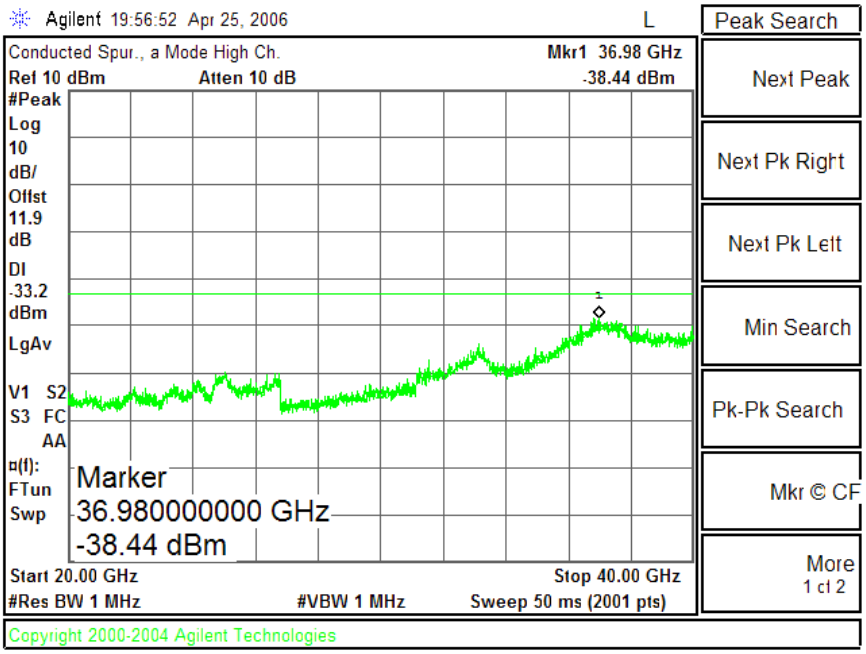
MID CHANNEL SPURIOUS, 5270 MHz - 20 GHz TO 40 GHz



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



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



FOXCONN, PCB ANTENNA

LEGACY MODE

7.2. CHANNEL TESTS FOR THE 5150 TO 5350 MHz BAND

7.2.1. 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.

Following formula to calculate the array gain:

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

5.15 – 5.25GHz band: 8.039 dBi
5.25 – 5.35GHz band: 7.686 dBi

LIMITS AND RESULTS

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	5180	17	19.616	16.926	8.039	14.89

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	33.59	26.262	7.686	22.31
High	5300	24	33.219	26.214	7.686	22.31
High	5320	24	19.814	23.970	7.686	22.28

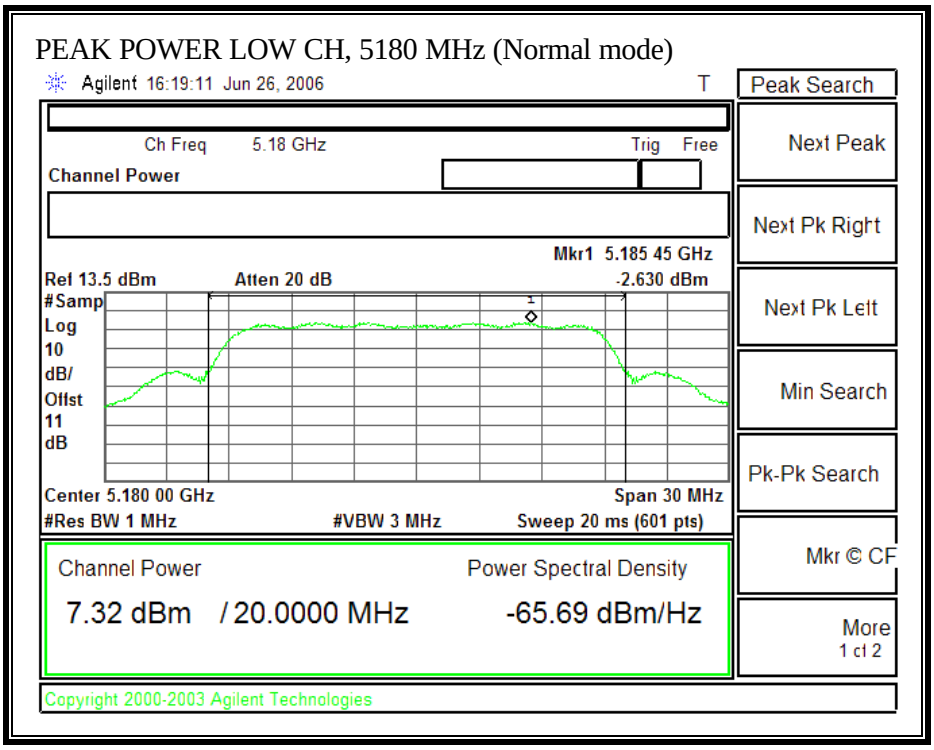
Results

Channel	Frequency (MHz)	Power Chain 0 (dBm)	Power Chain 1 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	7.32	7.20	10.27	14.89	-4.62
Mid	5260	15.83	16.95	19.44	22.31	-2.88
High	5300	14.21	15.51	17.92	22.31	-4.40
High	5320	14.95	16.02	18.53	22.28	-3.76

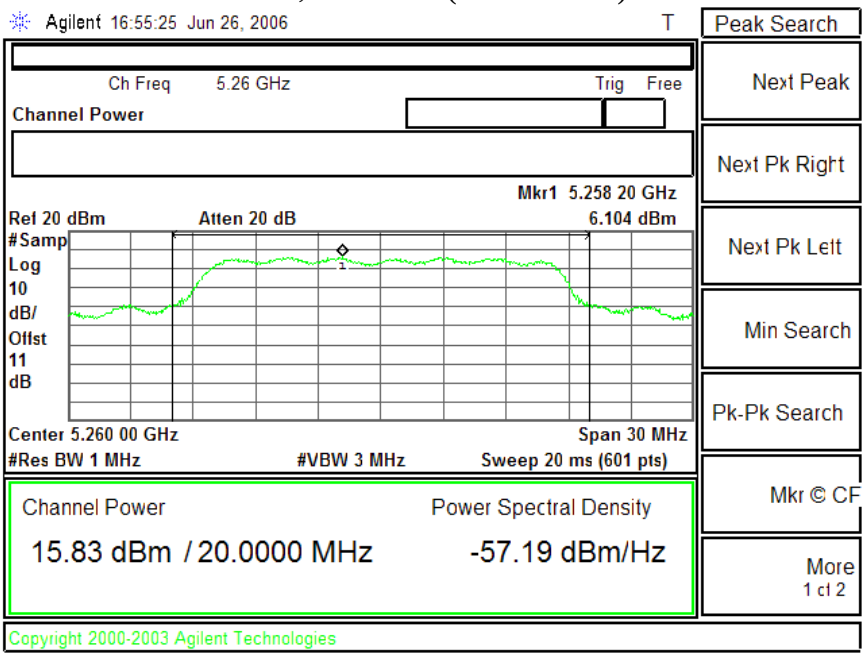
Results

Channel	Frequency (MHz)	Combiner Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	10.37	14.89	-4.52
Mid	5260	18.59	22.31	-3.72
High	5300	17.29	22.31	-5.02
High	5320	17.73	22.28	-4.55

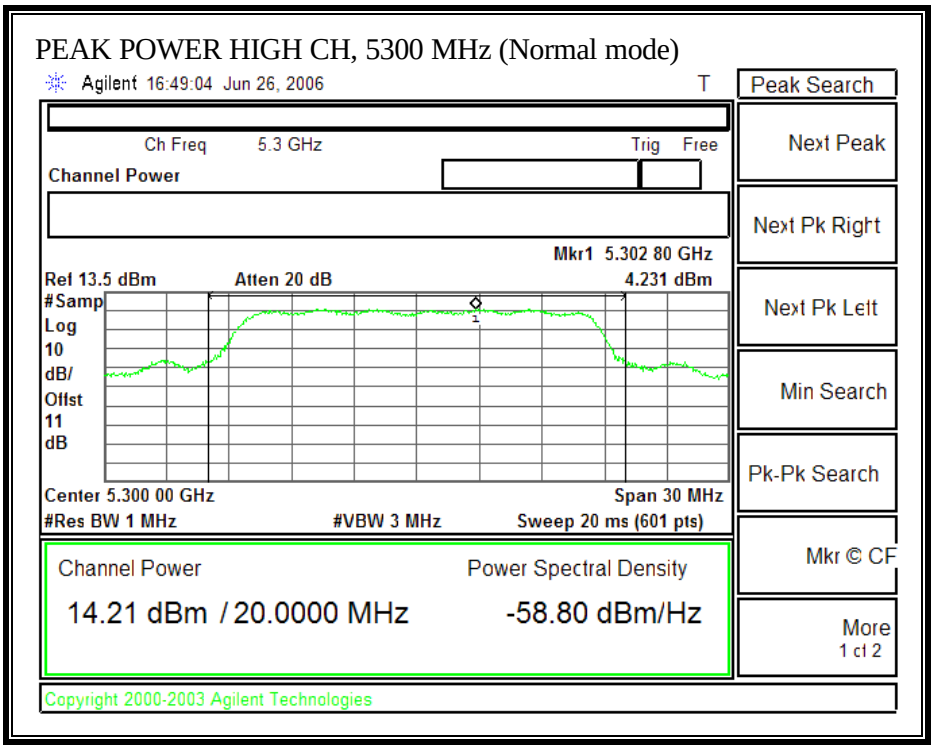
PEAK POWER (NORMAL MODE) (Chain 0)



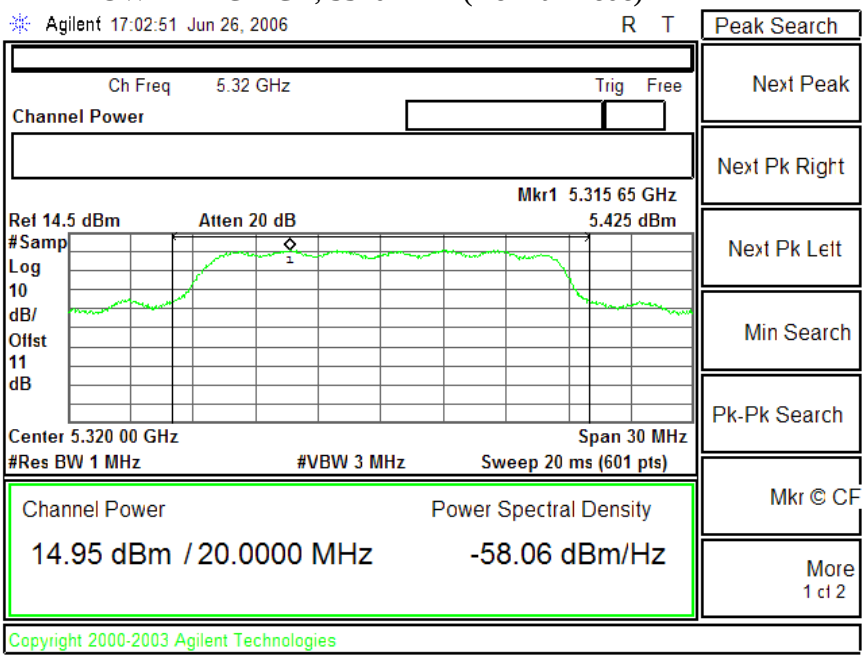
PEAK POWER MID CH, 5260 MHz (Normal mode)



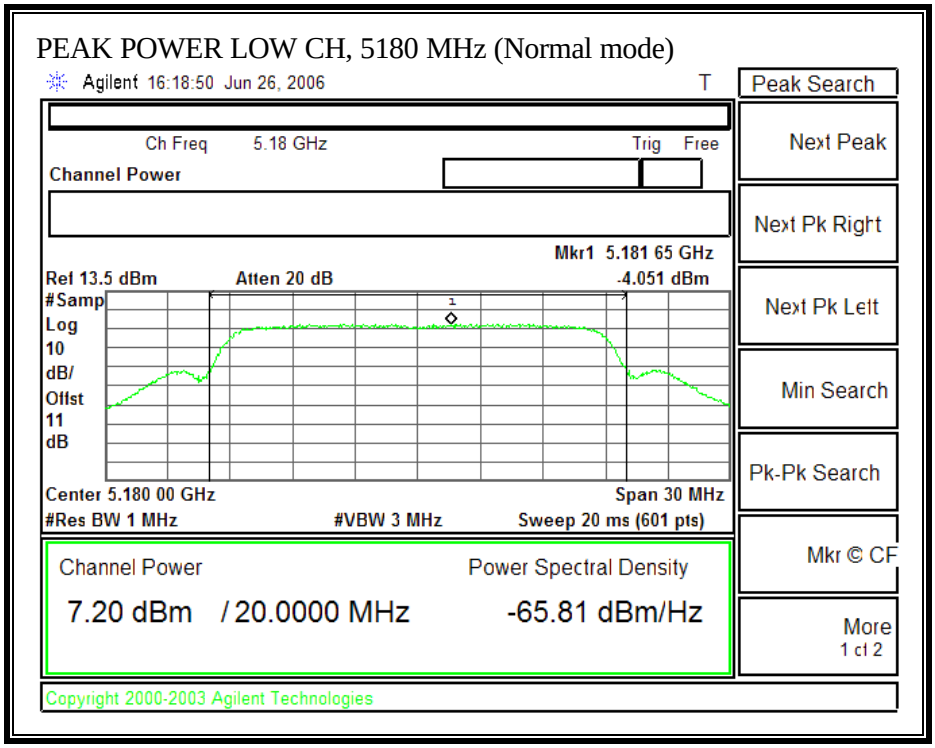
PEAK POWER HIGH CH, 5300 MHz (Normal mode)



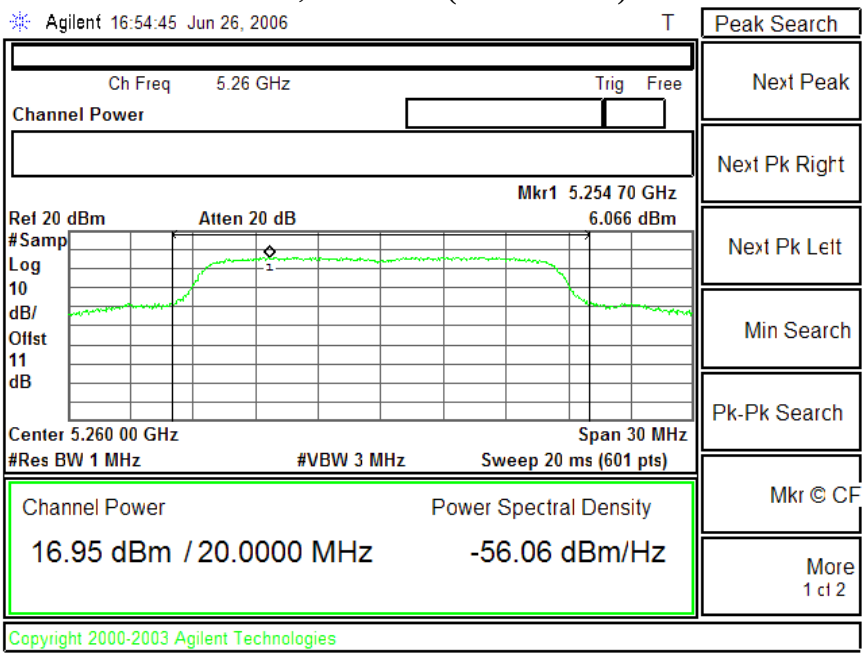
PEAK POWER HIGH CH, 5320 MHz (Normal mode)



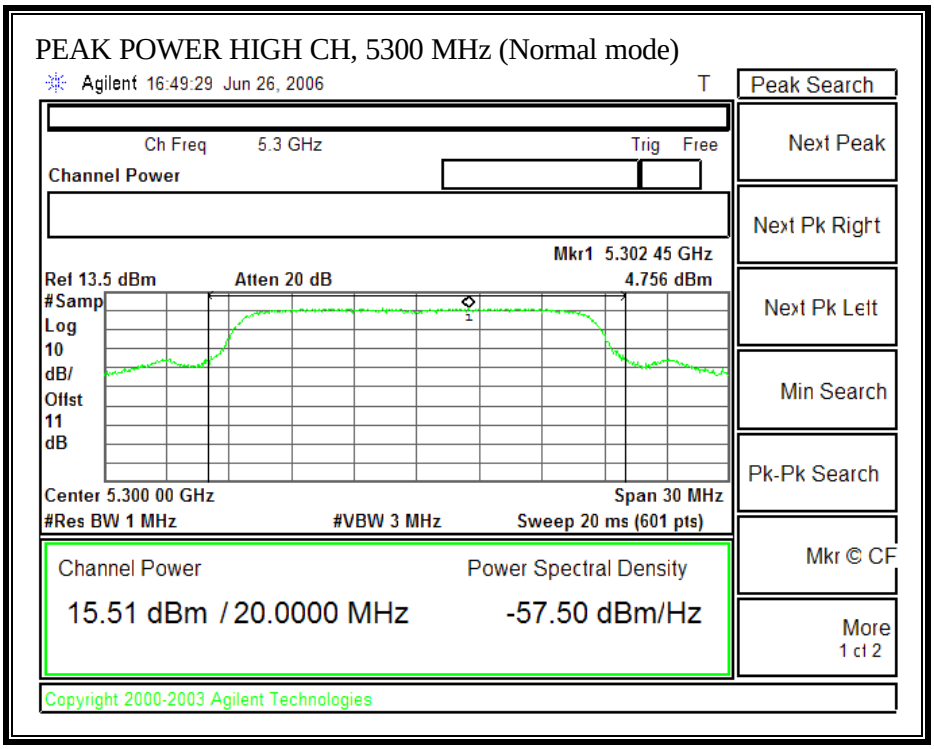
PEAK POWER (NORMAL MODE) (Chain 1)



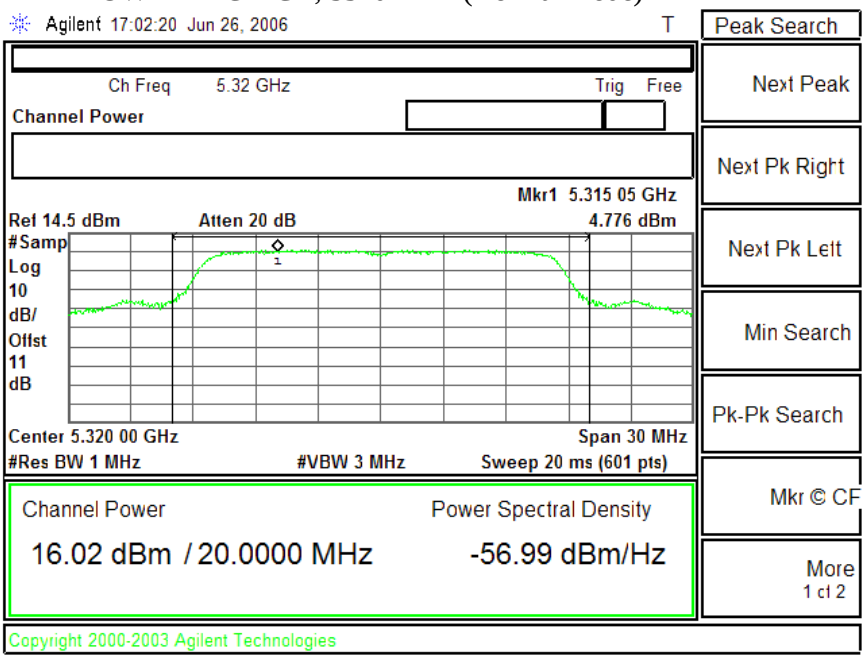
PEAK POWER MID CH, 5260 MHz (Normal mode)



PEAK POWER HIGH CH, 5300 MHz (Normal mode)



PEAK POWER HIGH CH, 5320 MHz (Normal mode)



7.2.2. 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

$S = E \wedge 2 / 3770$

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

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

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

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

LIMITS

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

RESULTS

No non-compliance noted

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.

Mode	MPE Distance (cm)	Output Power (dBm)	Output Power (dBm)	Total Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
802.11a	20.0	15.83	16.95	19.44	8.039	0.06

7.2.3. AVERAGE POWER

AVERAGE POWER LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

No non-compliance noted:

The cable assembly insertion loss of 11.9 dB (including 10 dB pad and 1.9 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

802.11a Mode

Channel	Frequency (MHz)	Average Power (dBm)
Low	5180	7.00
Middle	5260	14.00
High	5300	14.00
High	5320	14.50

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 = 7.44 dBi, 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: 8.039 dBi
5.25 – 5.35GHz band: 7.686 dBi

RESULTS

No non-compliance noted:

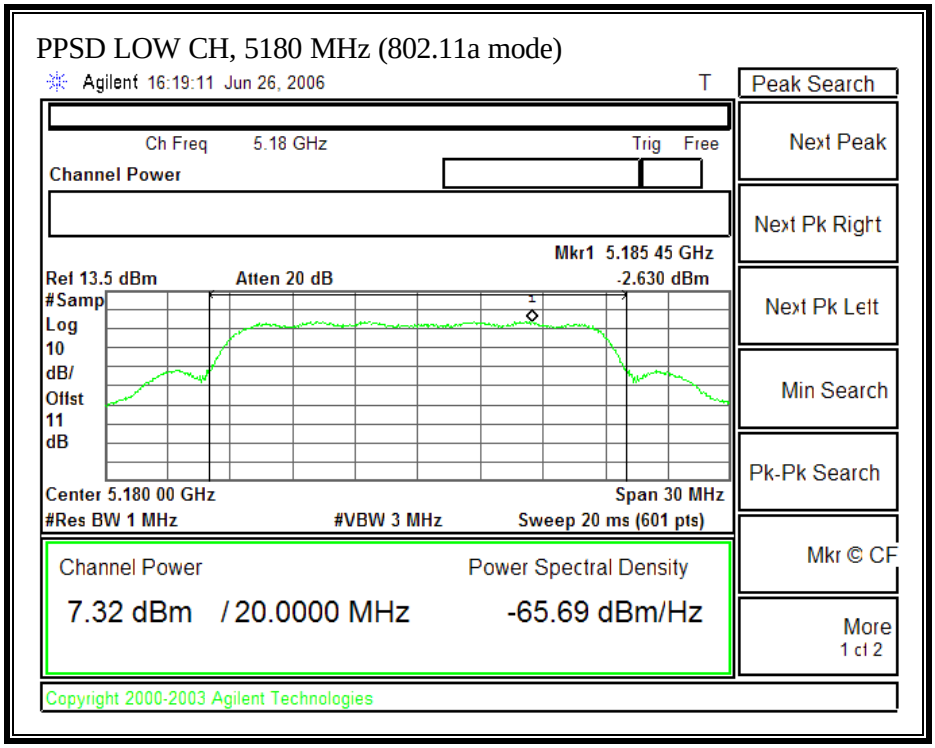
802.11a Mode

Channel	Frequency (MHz)	PPSD Chain 0 (dBm)	PPSD Chain 1 (dBm)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Low	5180	-2.63	-4.05	-0.27	1.961	-2.23
Middle	5260	6.01	6.07	9.05	9.314	-0.26
High	5300	4.23	4.76	7.51	9.314	-1.80
High	5320	5.43	4.78	8.12	9.314	-1.19

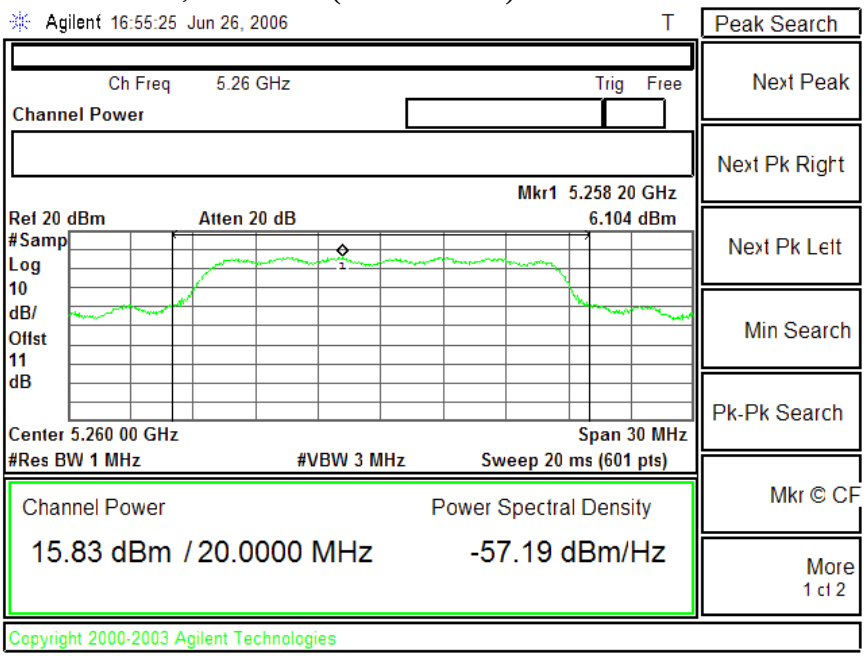
802.11a Mode with Combiner

Channel	Frequency (MHz)	PPSD With Combiner (dBm)	Limit (dBm)	Margin (dB)
Low	5180	1.37	1.961	-0.593
Middle	5260	9.22	9.314	-0.091
High	5300	8.35	9.314	-0.963
High	5320	8.56	9.314	-0.75

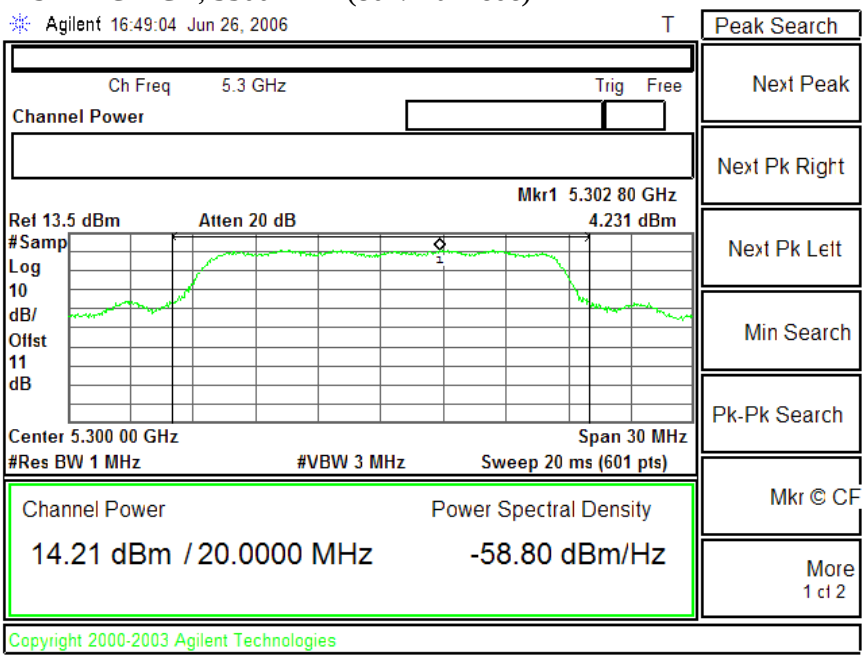
PEAK POWER SPECTRAL DENSITY (802.11a MODE) (Chain 0)



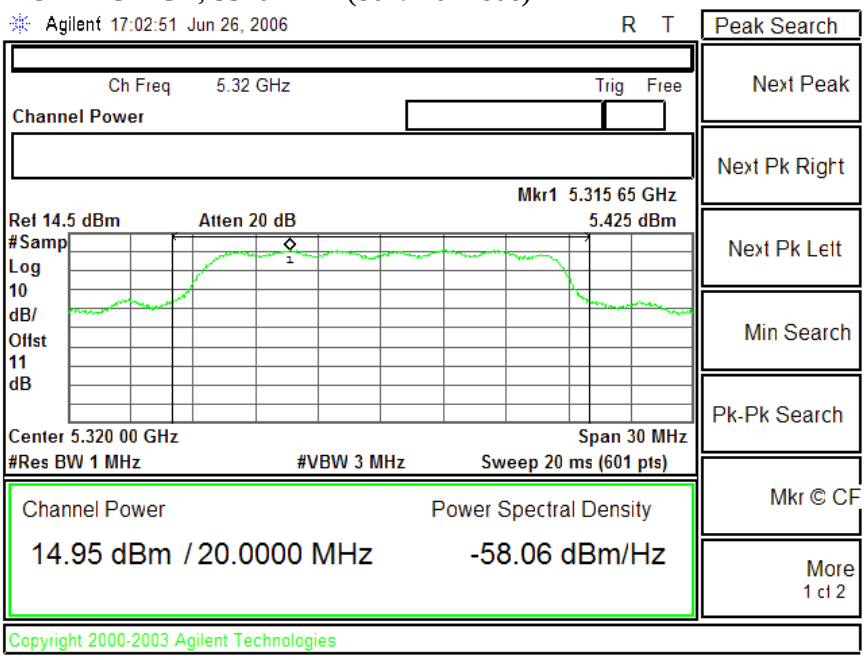
PPSD MID CH, 5260 MHz (802.11a mode)



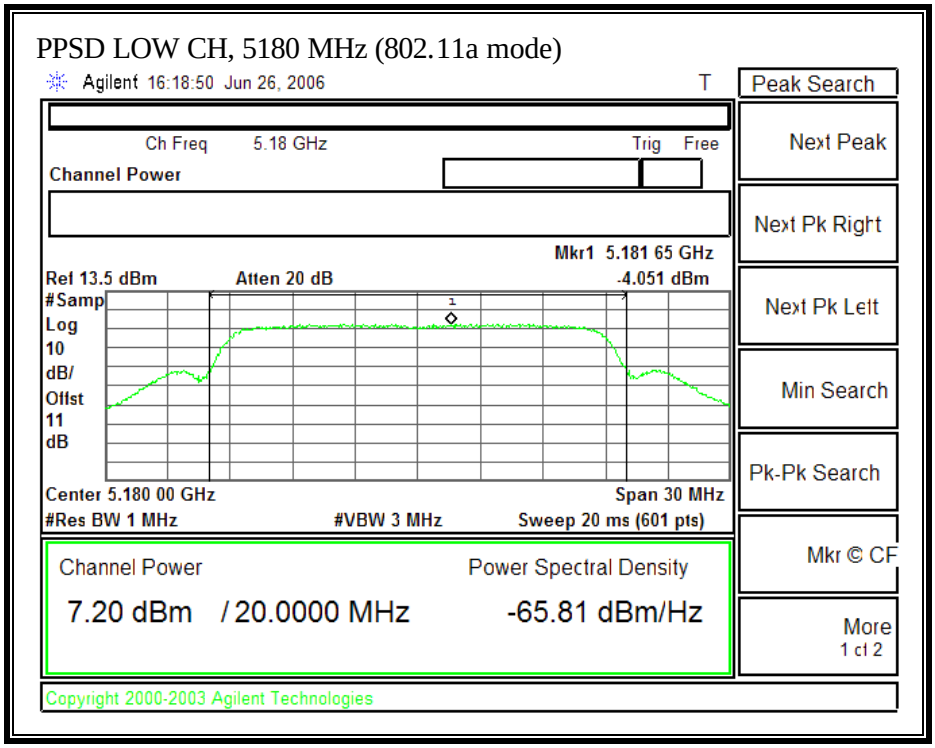
PPSD HIGH CH, 5300 MHz (802.11a mode)



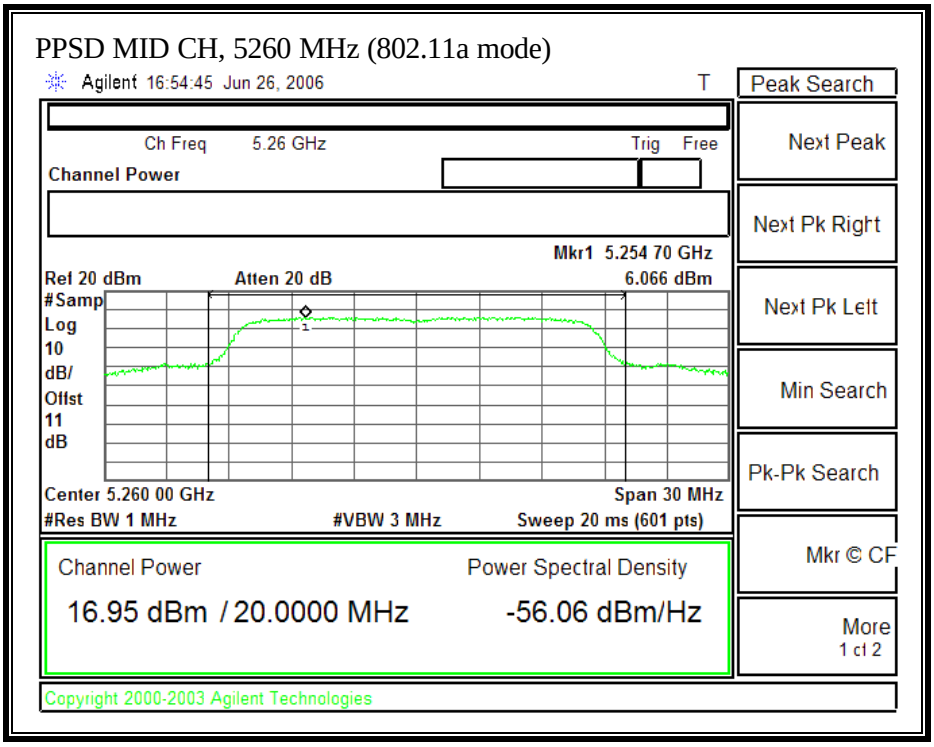
PPSD HIGH CH, 5320 MHz (802.11a mode)



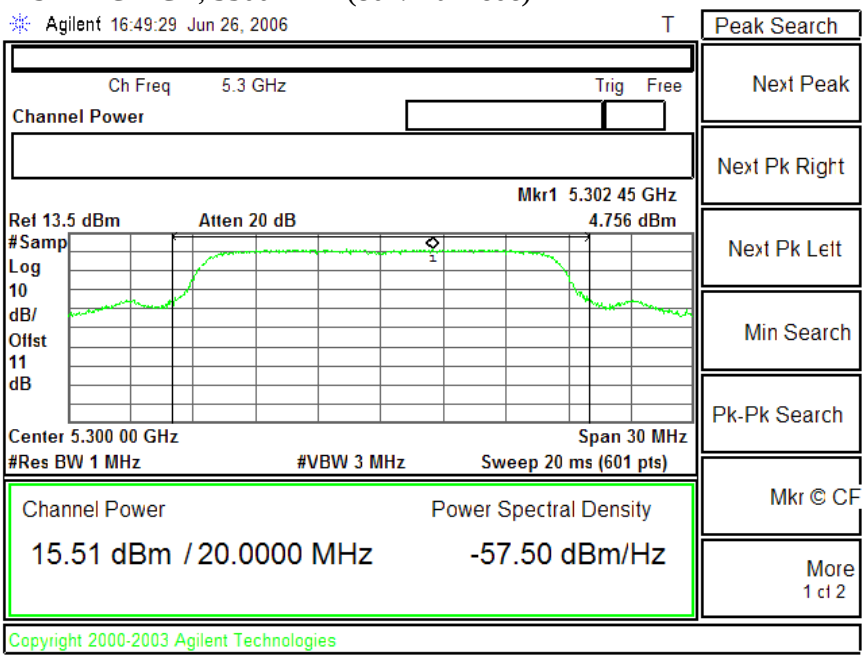
PEAK POWER SPECTRAL DENSITY (802.11a MODE) (Chain1)



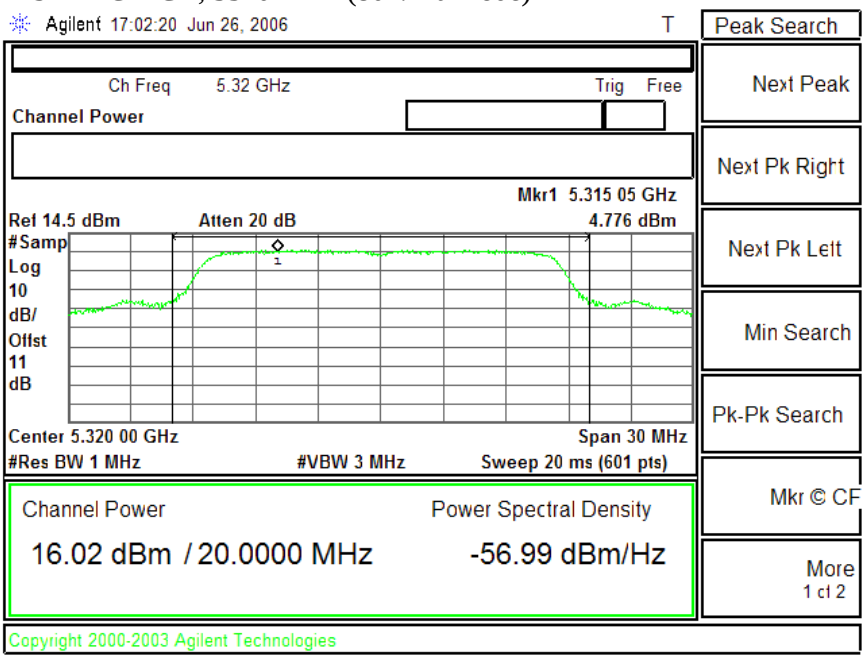
PPSD MID CH, 5260 MHz (802.11a mode)



PPSD HIGH CH, 5300 MHz (802.11a mode)



PPSD HIGH CH, 5320 MHz (802.11a mode)



7.2.5. 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.

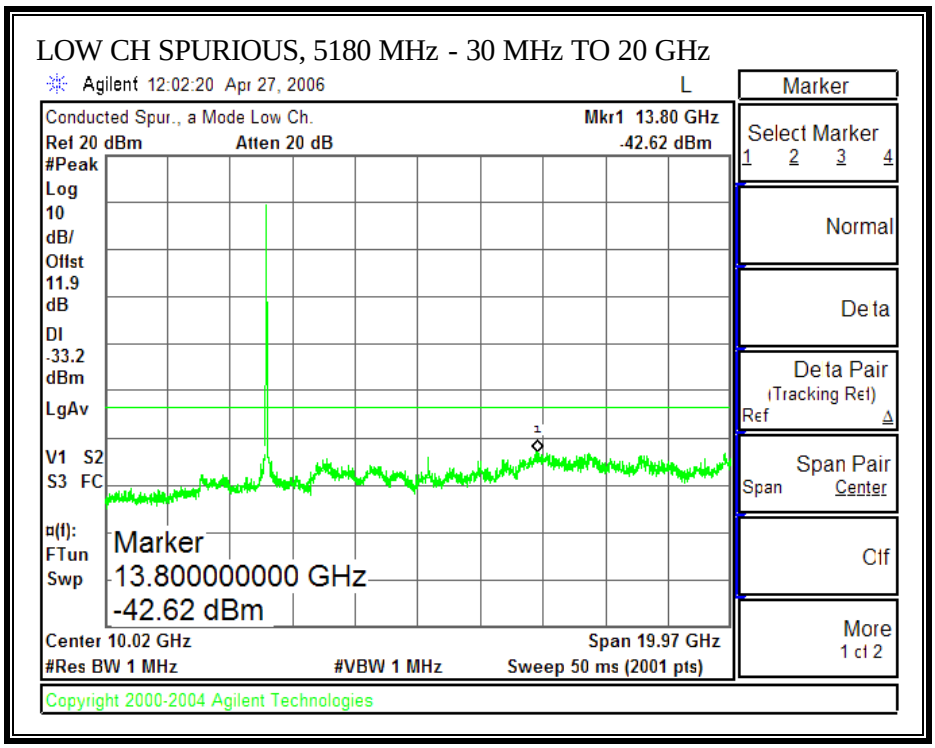
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to the average EIRP limit, adjusted for the maximum antenna gain. If necessary, additional average detection measurements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

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

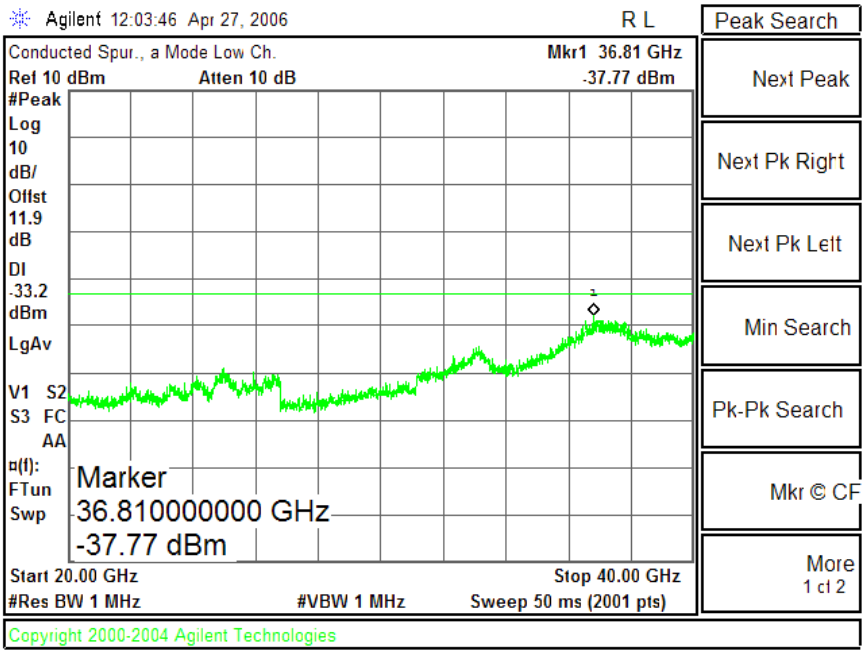
RESULTS

No non-compliance noted:

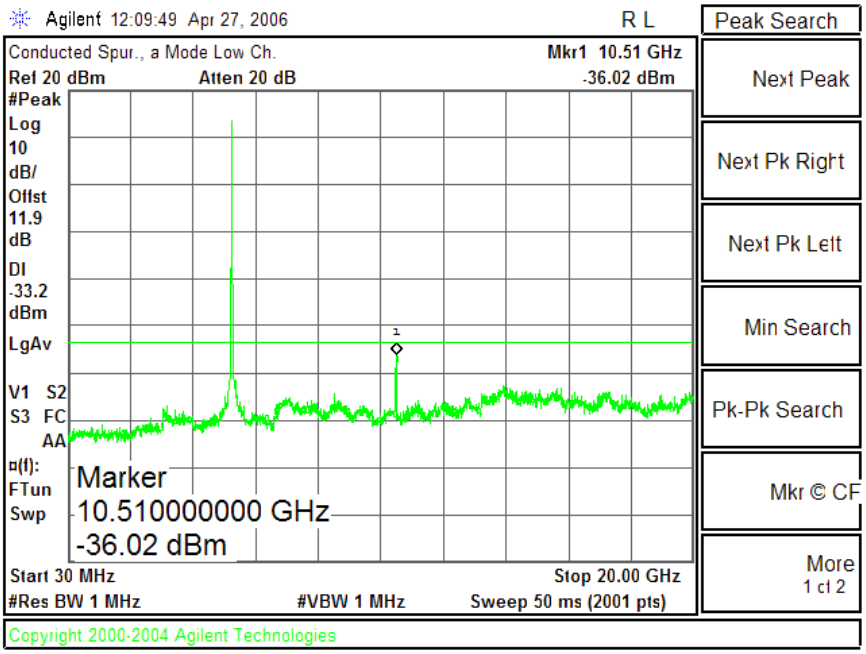
SPURIOUS EMISSIONS (802.11a MODE)



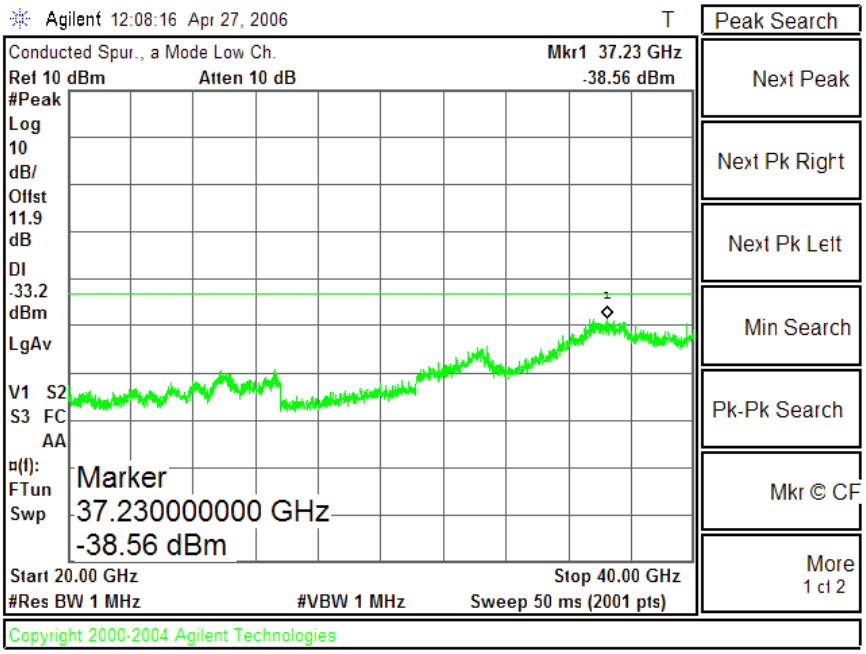
LOW CH SPURIOUS, 5180 MHz - 20 GHz TO 40 GHz



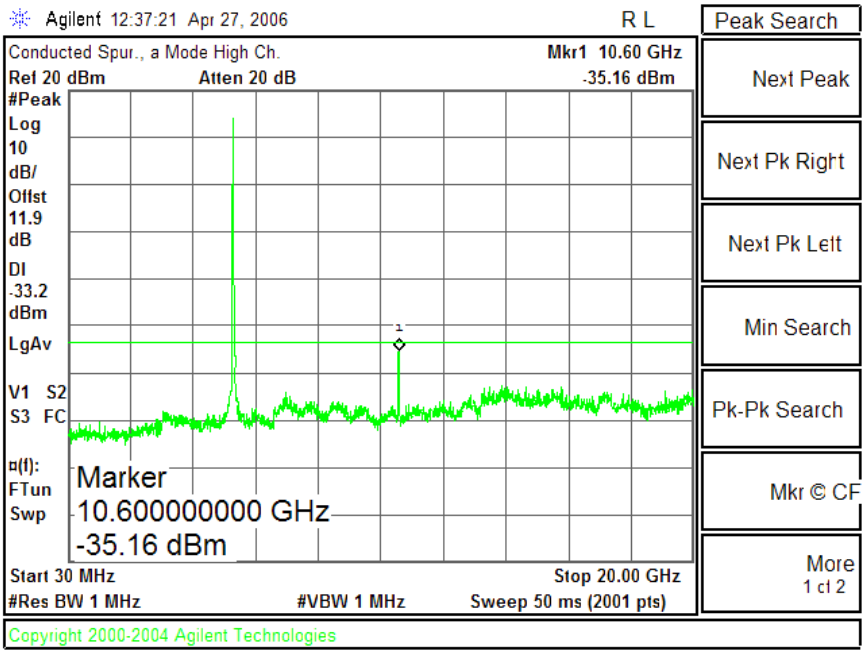
MID CH SPURIOUS, 5260 MHz - 30 MHz TO 20 GHz



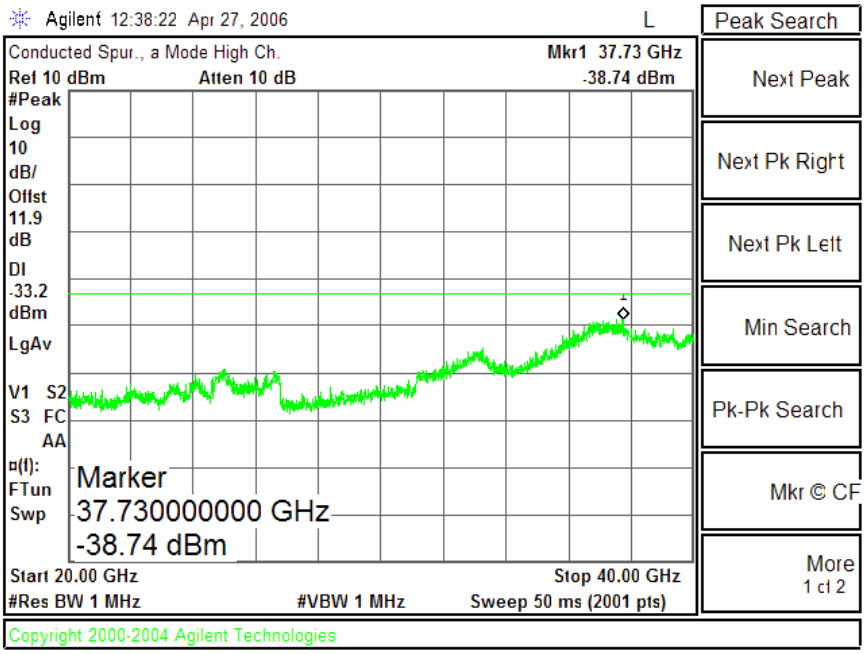
MID CH SPURIOUS, 5260 MHz - 20 GHz TO 40 GHz



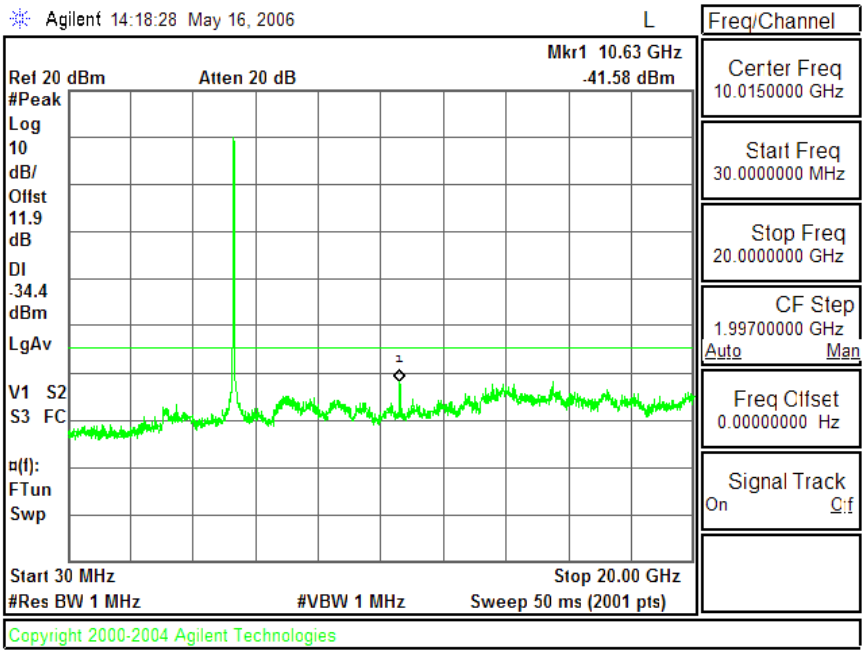
HIGH CH SPURIOUS, 5300 MHz - 30 MHz TO 20 GHz



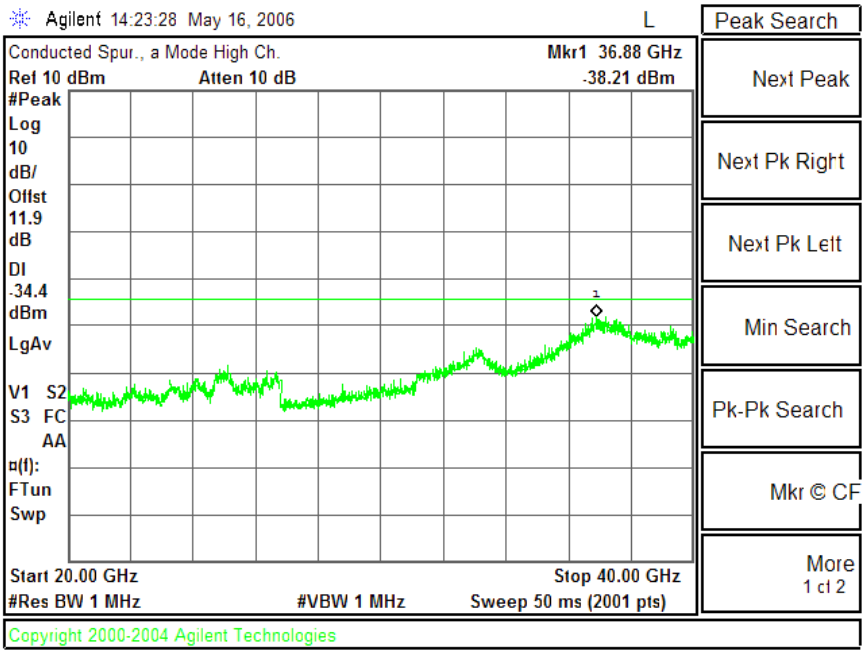
HIGH CH SPURIOUS, 5300 MHz - 20 GHz TO 40 GHz



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



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



MIMO MODE

7.3. CHANNEL TESTS FOR THE 5150 TO 5350 MHz BAND

7.3.1. 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

LIMITS AND RESULTS

No non-compliance noted:

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	7.44	15.41

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	6.25	23.75
High	5320	24	37.726	34.464	26.374	6.25	23.75

Results

Channel	Frequency (MHz)	Power Chain 0 (dBm)	Power Chain 0 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	9.11	9.34	12.24	15.41	-3.17
Mid	5260	11.59	12.19	14.91	23.75	-8.84
High	5320	13.07	13.04	16.07	23.75	-7.68

Results

Channel	Frequency (MHz)	Combiner Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	12.00	15.41	-3.41
Mid	5260	14.50	23.75	-9.25
High	5320	16.05	23.75	-7.70

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	7.44	15.56

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	6.25	23.75
High	5310	24	65.430	61.061	28.858	6.25	23.75

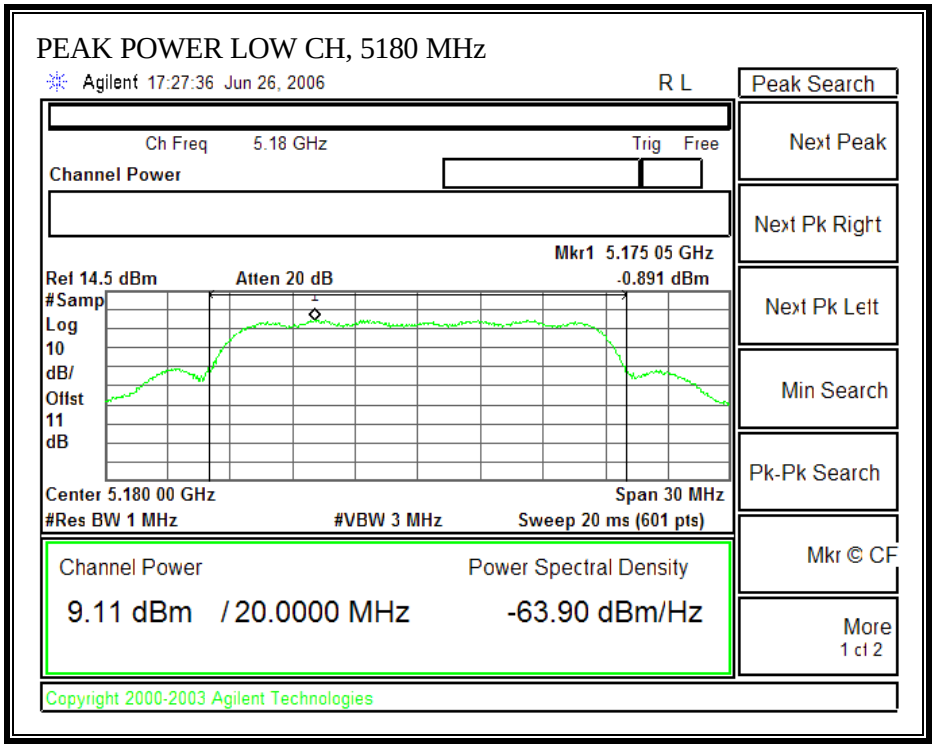
Results

Channel	Frequency (MHz)	Power Chain 0 (dBm)	Power Chain 1 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5190	11.59	12.19	14.91	15.56	-0.65
Mid	5270	15.53	15.83	18.69	23.75	-5.06
High	5310	12.17	12.12	15.16	23.75	-8.59

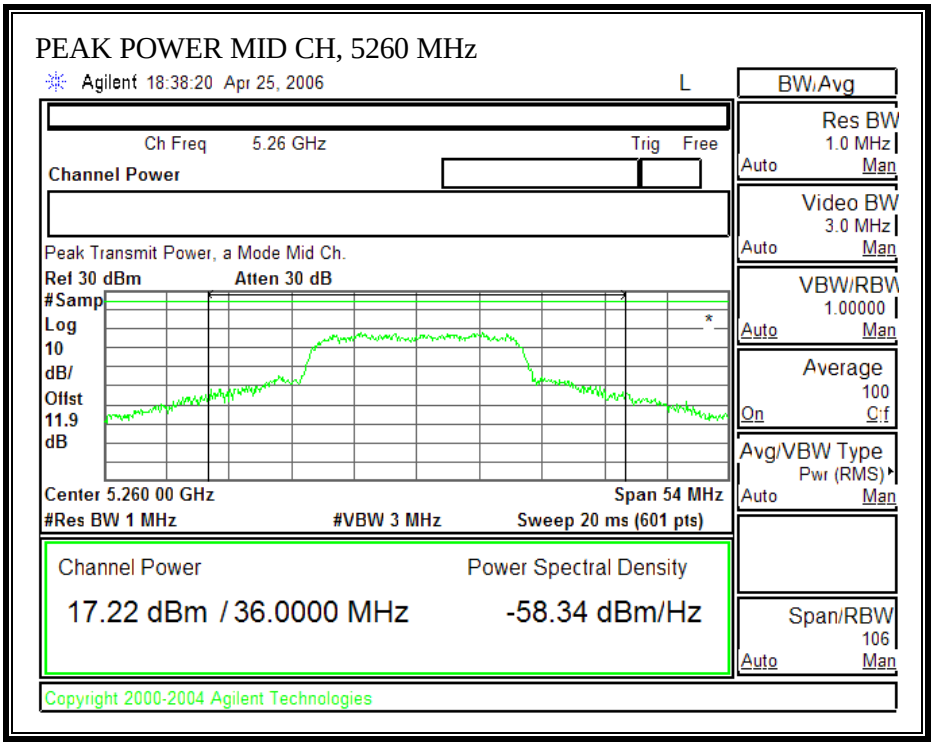
Results

Channel	Frequency (MHz)	Combiner Power (dBm)	Limit (dBm)	Margin (dB)
Low	5190	14.90	15.56	-0.66
Mid	5270	18.50	23.75	-5.25
High	5310	15.10	23.75	-8.65

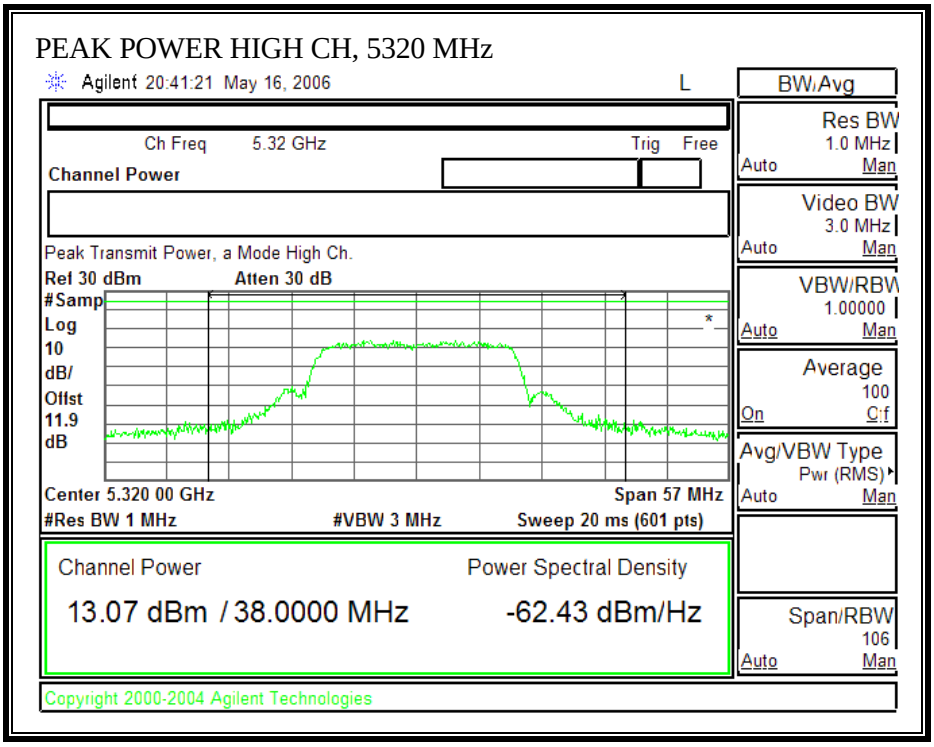
PEAK POWER (802.11 – 20MHz TX BANDWIDTH – CHAIN 0)



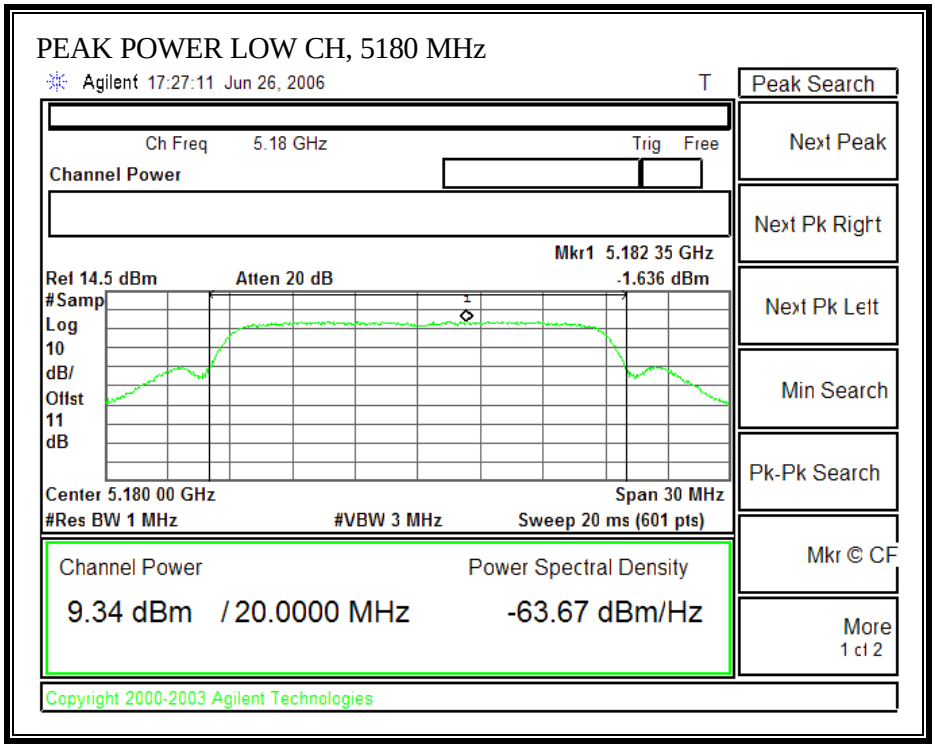
PEAK POWER MID CH, 5260 MHz



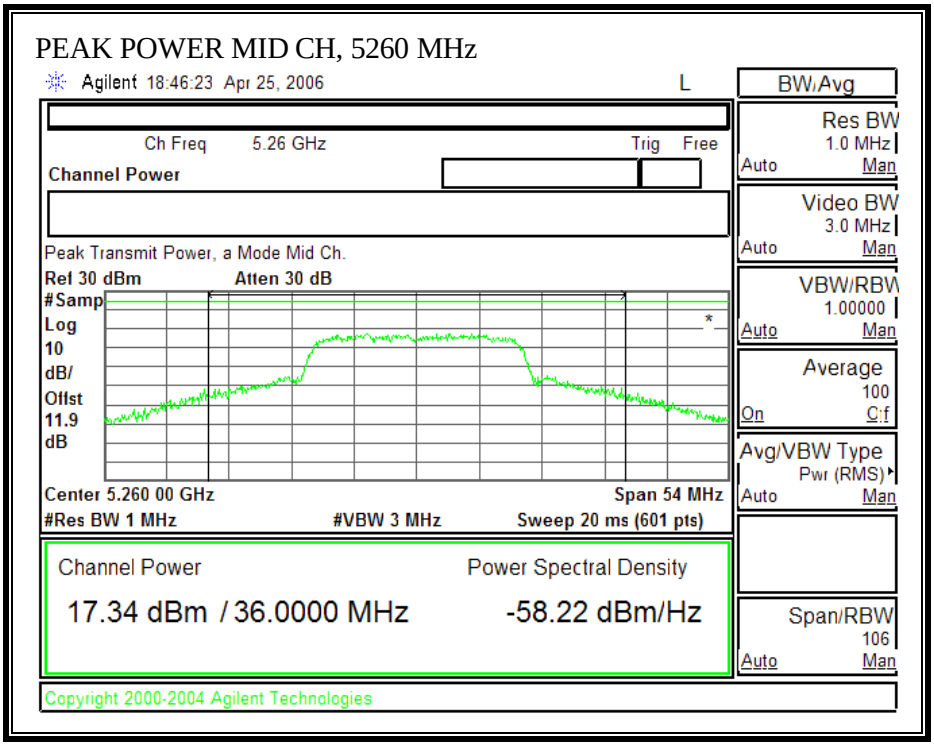
PEAK POWER HIGH CH, 5320 MHz



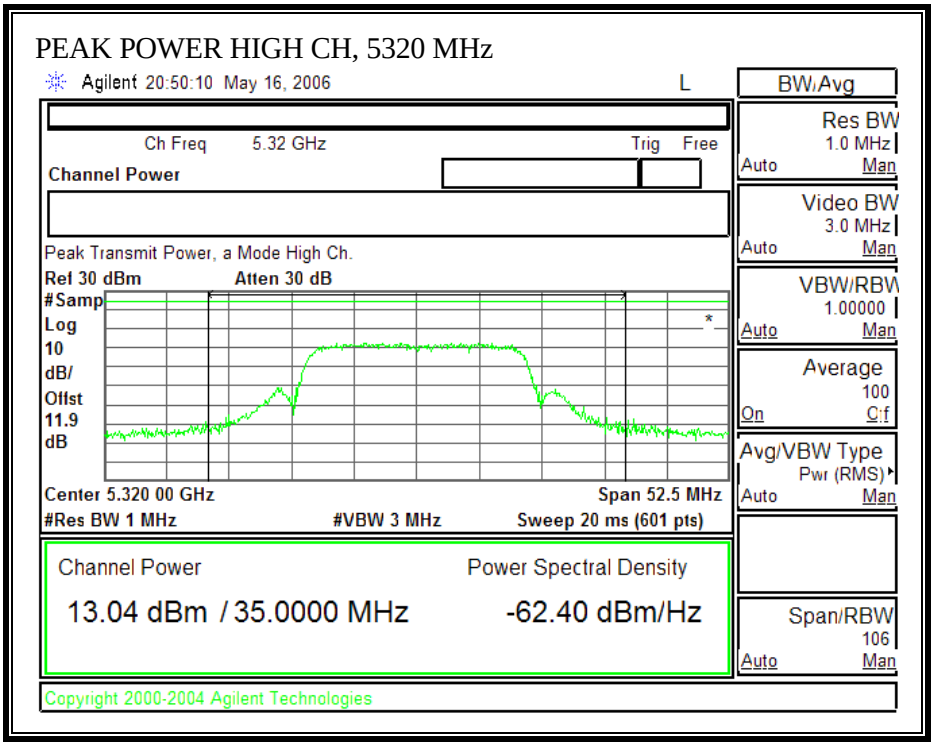
PEAK POWER (802.11 – 20MHz TX BANDWIDTH – CHAIN 1)



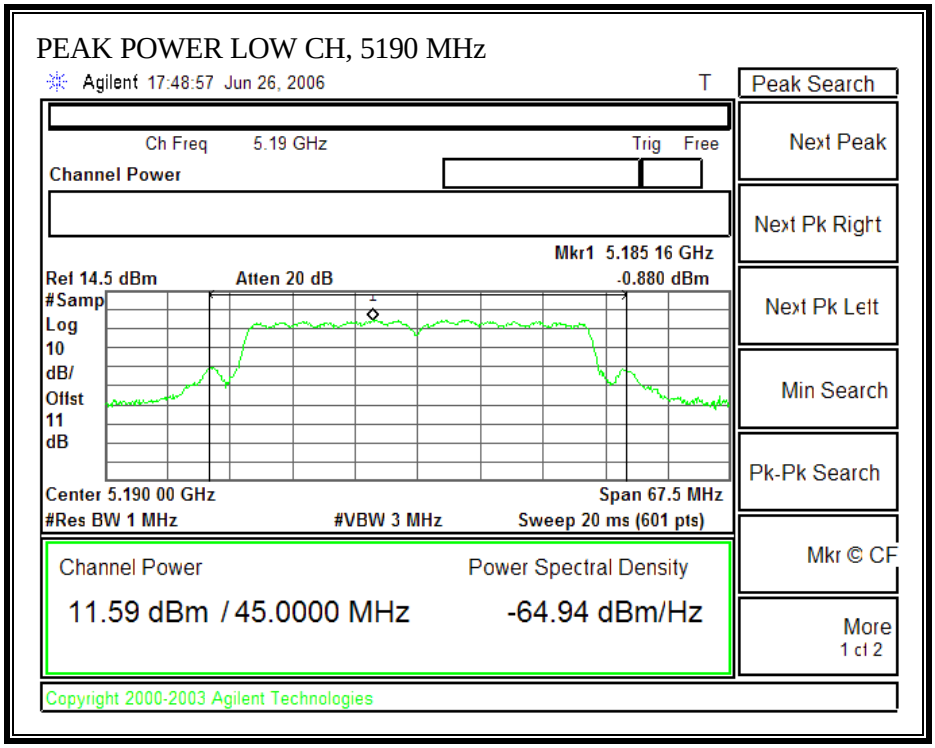
PEAK POWER MID CH, 5260 MHz



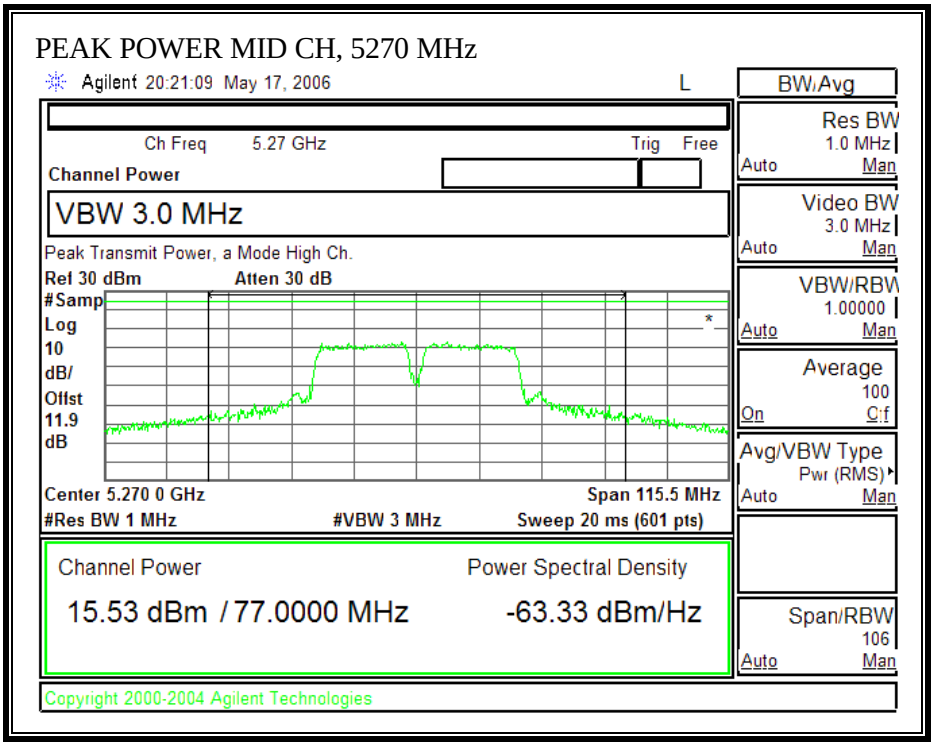
PEAK POWER HIGH CH, 5320 MHz



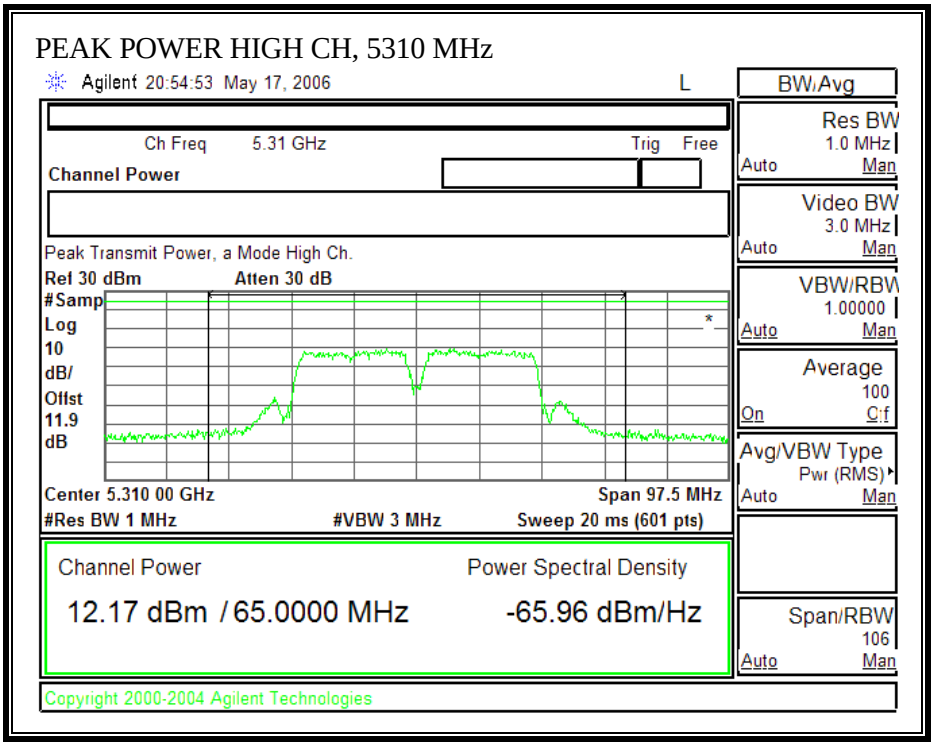
PEAK POWER (802.11 – 40MHz TX BANDWIDTH – CHAIN 0)



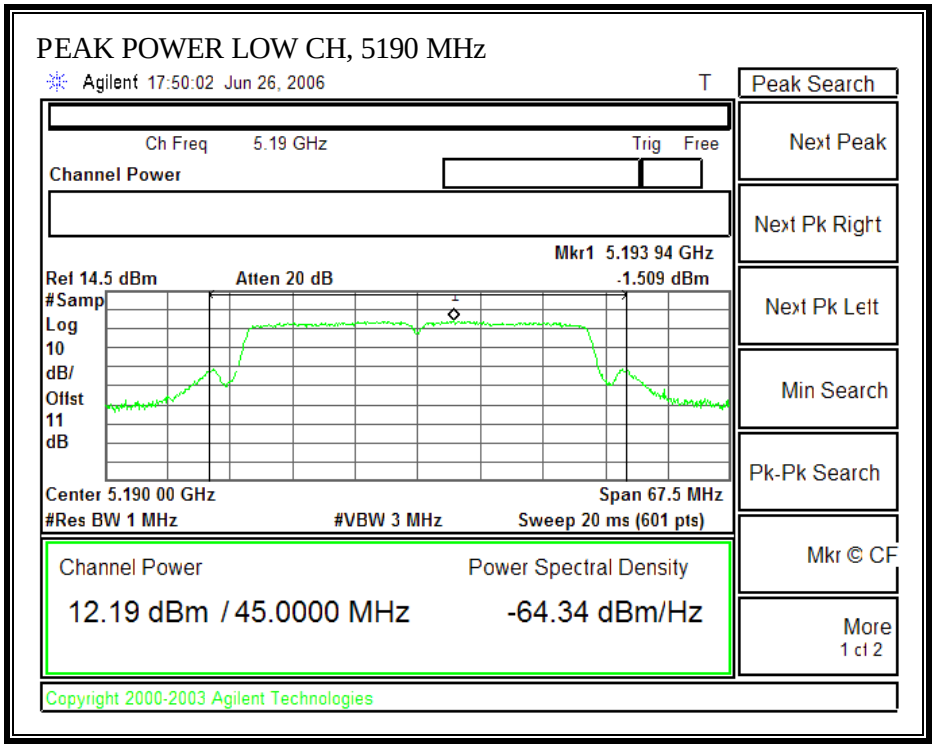
PEAK POWER MID CH, 5270 MHz



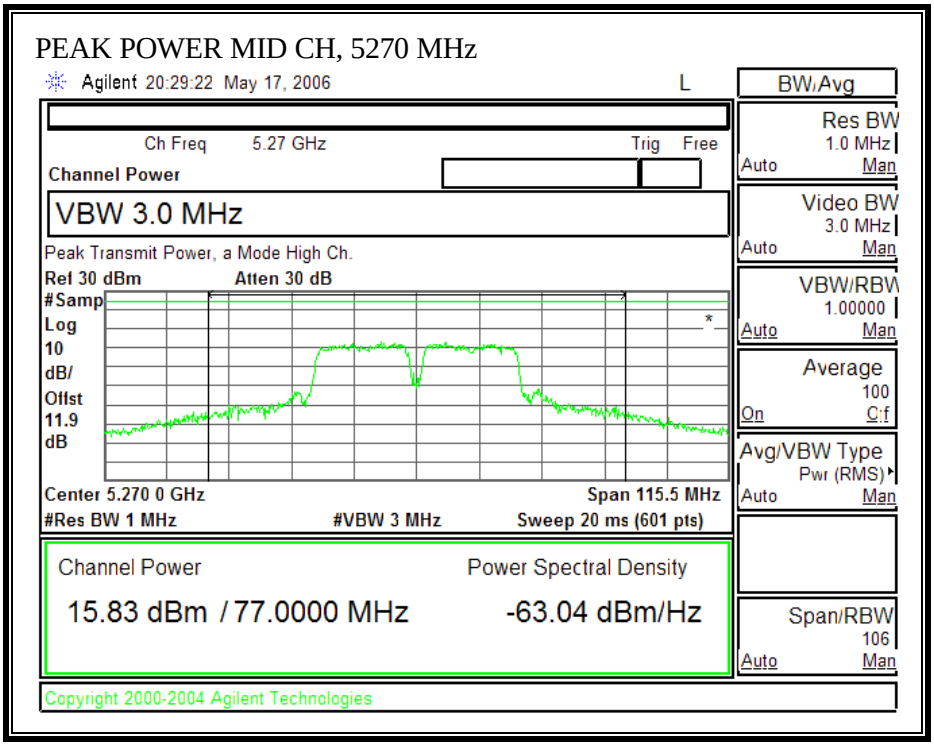
PEAK POWER HIGH CH, 5310 MHz



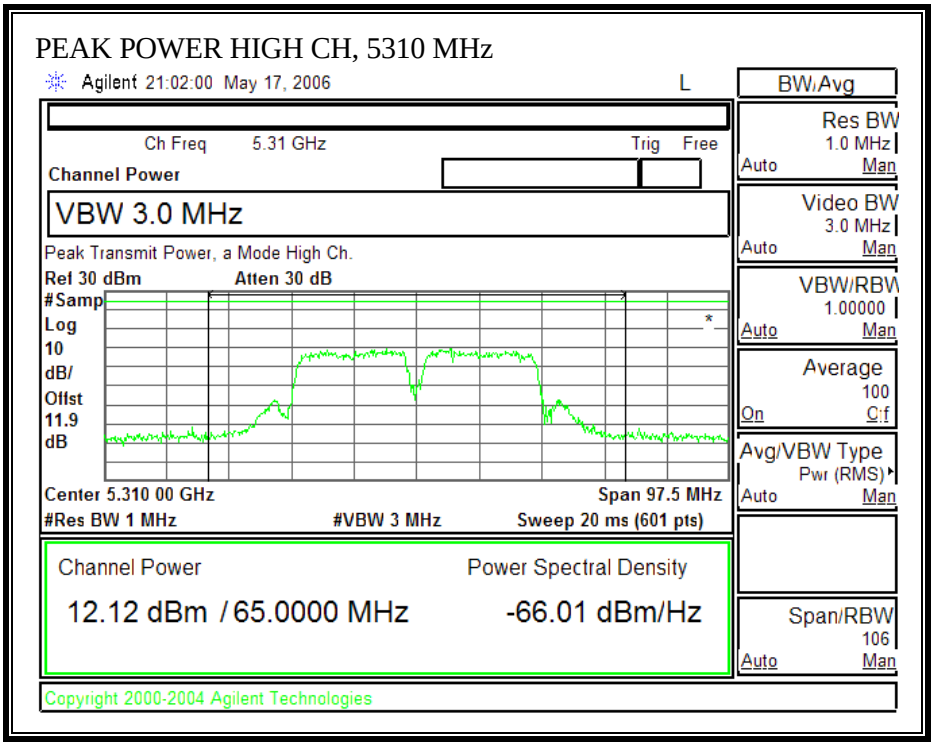
PEAK POWER (802.11 – 40MHz TX BANDWIDTH – CHAIN 1)



PEAK POWER MID CH, 5270 MHz



PEAK POWER HIGH CH, 5310 MHz



7.3.2. 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

$S = E \wedge 2 / 3770$

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

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

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

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

LIMITS

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

RESULTS

No non-compliance noted

Mode	MPE Distance (cm)	Output Power (dBm)	Output Power (dBm)	Total Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
20 MHz TX BANDWIDTH	20.0	17.22	17.34	20.29	7.44	0.06
40 MHz TX BANDWIDTH	20.0	15.53	15.83	18.69	7.44	0.04

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.

7.3.3. AVERAGE POWER

AVERAGE POWER LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

No non-compliance noted:

The cable assembly insertion loss of 11.9 dB (including 10 dB pad and 1.9 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

20 MHz TX BANDWIDTH

Channel	Frequency (MHz)	Average Power Chain 0 (dBm)	Average Power Chain 1 (dBm)
Low	5180	10.20	10.25
Middle	5260	16.20	16.25
High	5320	13.21	13.13

40 MHz TX BANDWIDTH

Channel	Frequency (MHz)	Average Power Chain 0 (dBm)	Average Power Chain 1 (dBm)
Low	5190	12.30	12.35
Middle	5270	15.85	15.83
High	5310	12.33	12.18

7.3.4. 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 = 7.44dBi @ 5.15GHz & 6.25dBi @ 5.35GHz, 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.

RESULTS

No non-compliance noted:

20 MHz TX BANDWIDTH

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	2.56	-0.80
Middle	5260	7.79	7.34	10.58	10.75	-0.17
High	5320	3.66	2.49	6.13	10.75	-4.62

40 MHz TX BANDWIDTH

Channel	Frequency (MHz)	PPSD Chain 0 (dBm)	PPSD Chain 1 (dBm)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Low	5190	-0.88	-1.51	1.83	2.56	-0.73
Middle	5270	3.08	2.73	5.92	10.75	-4.83
High	5310	-0.85	-0.94	2.12	10.75	-8.63

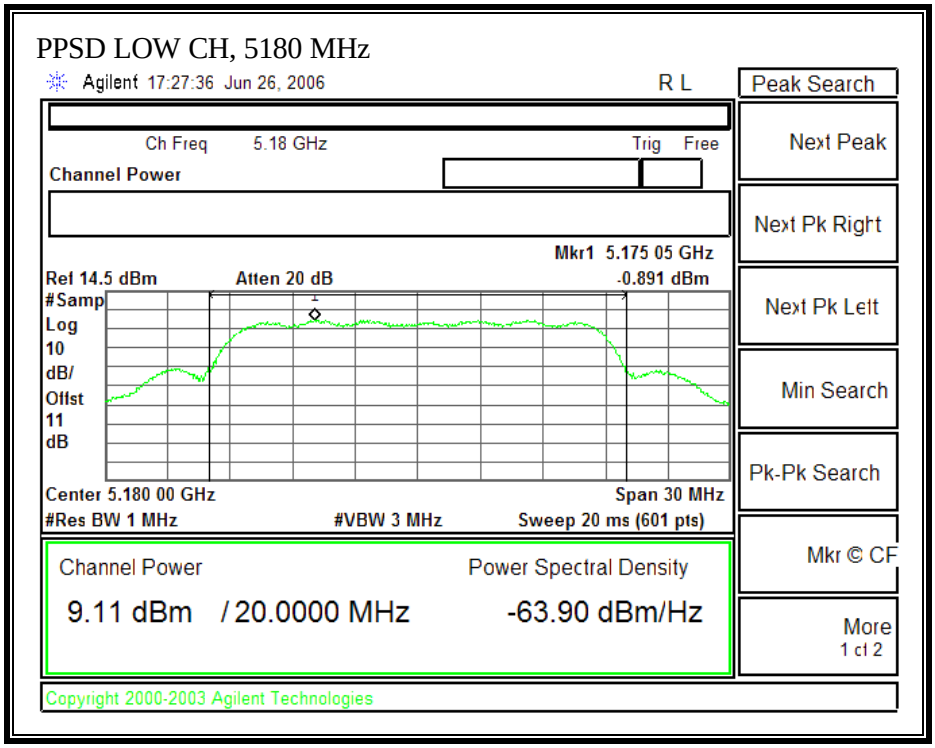
20 MHz TX BANDWIDTH WITH COMBINER

Channel	Frequency (MHz)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Low	5180	2.47	2.56	-0.09
Middle	5260	10.55	10.75	-0.20
High	5320	6.05	10.75	-4.70

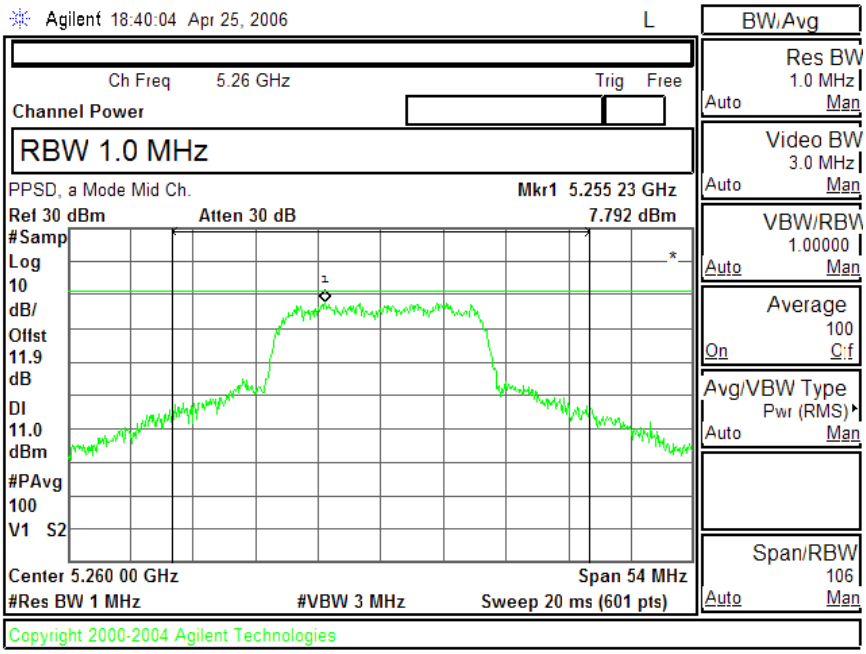
40 MHz TX BANDWIDTH WITH COMINER

Channel	Frequency (MHz)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Low	5190	2.55	2.56	-0.02
Middle	5270	5.85	10.75	-4.90
High	5310	2.05	10.75	-8.70

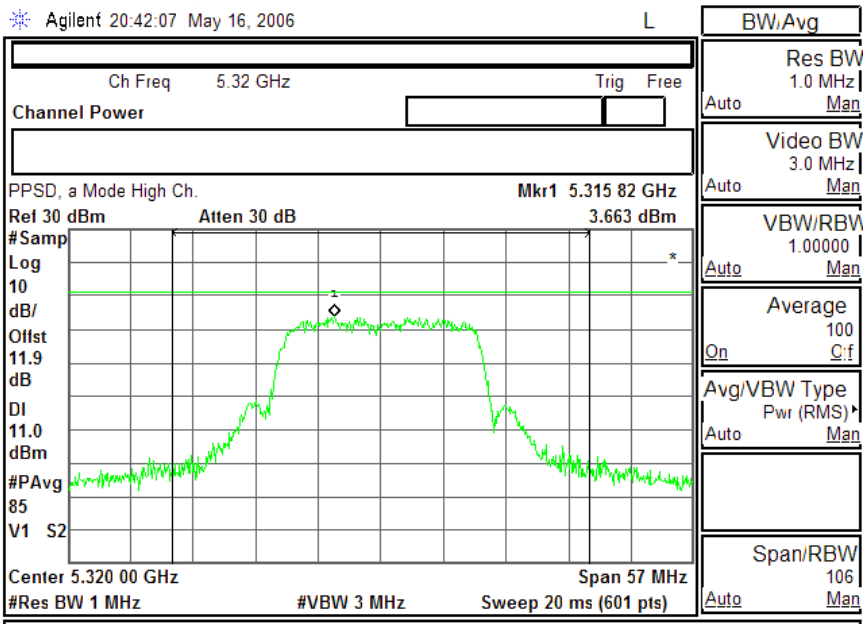
PEAK POWER SPECTRAL DENSITY (802.11 - 20 MHz TX BANDWIDTH – CHAIN 0)



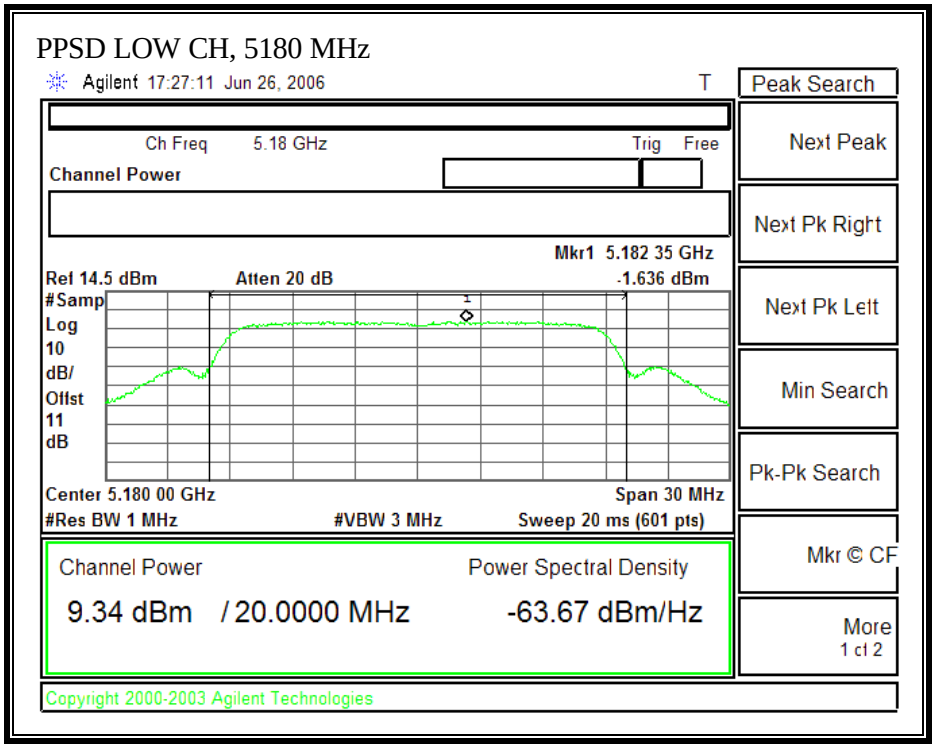
PPSD MID CH, 5260 MHz



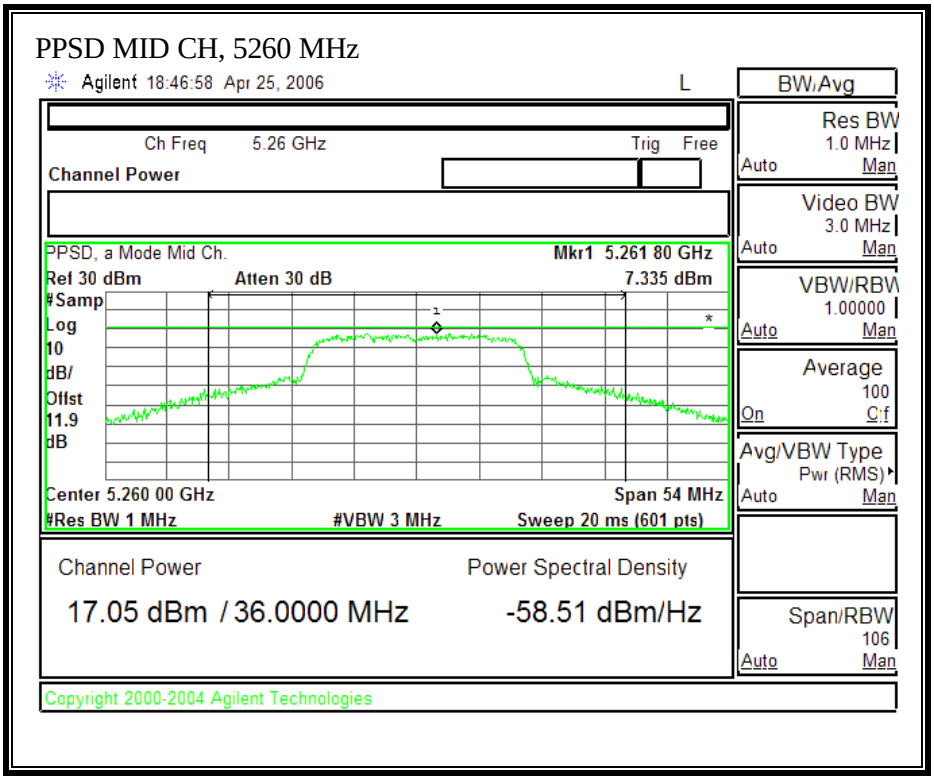
PPSD HIGH CH, 5320 MHz



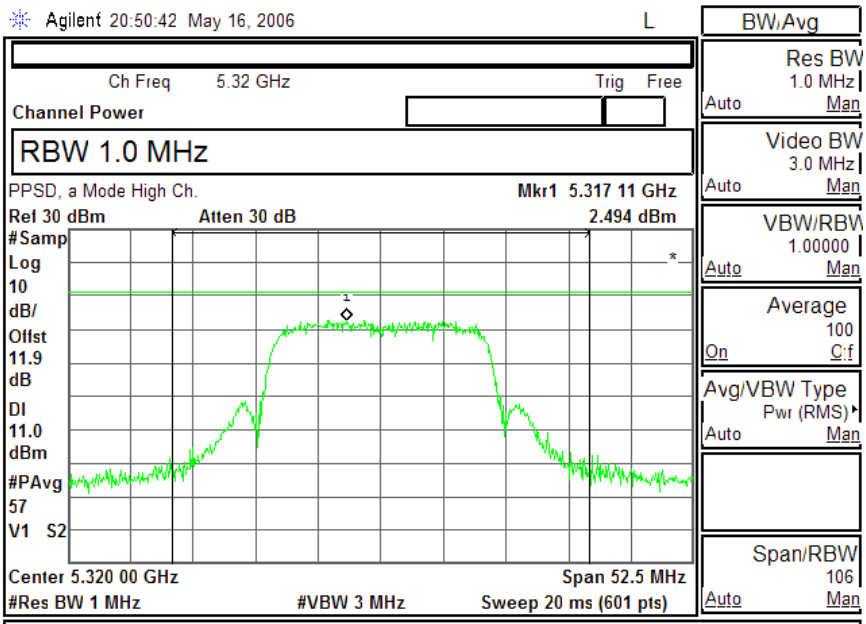
PEAK POWER SPECTRAL DENSITY (802.11 - 20 MHz TX BANDWIDTH – CHAIN 1)



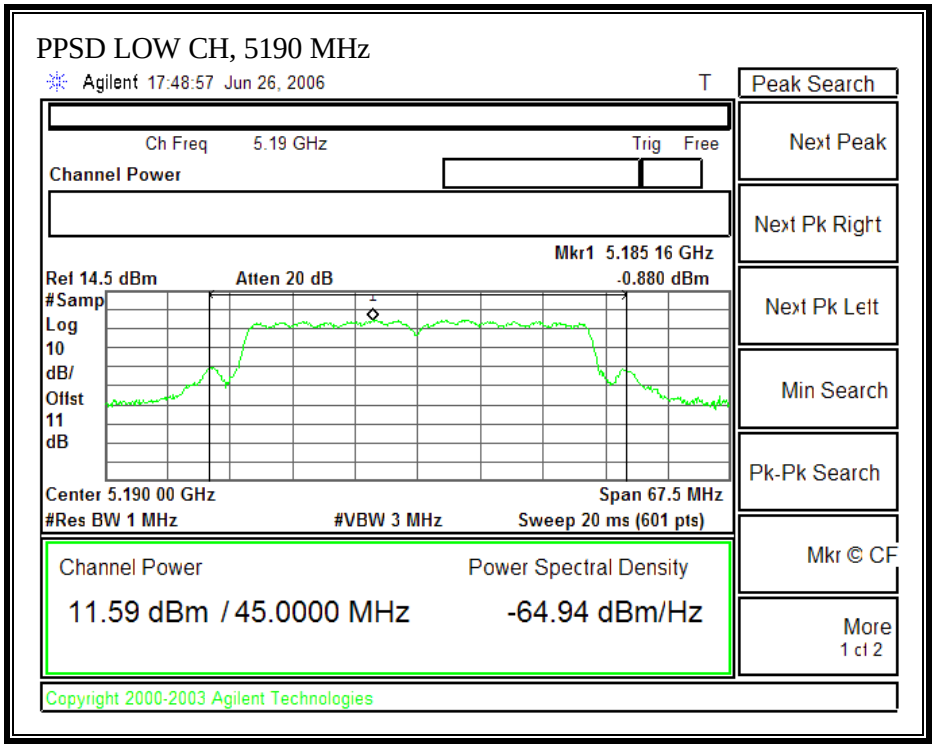
PPSD MID CH, 5260 MHz



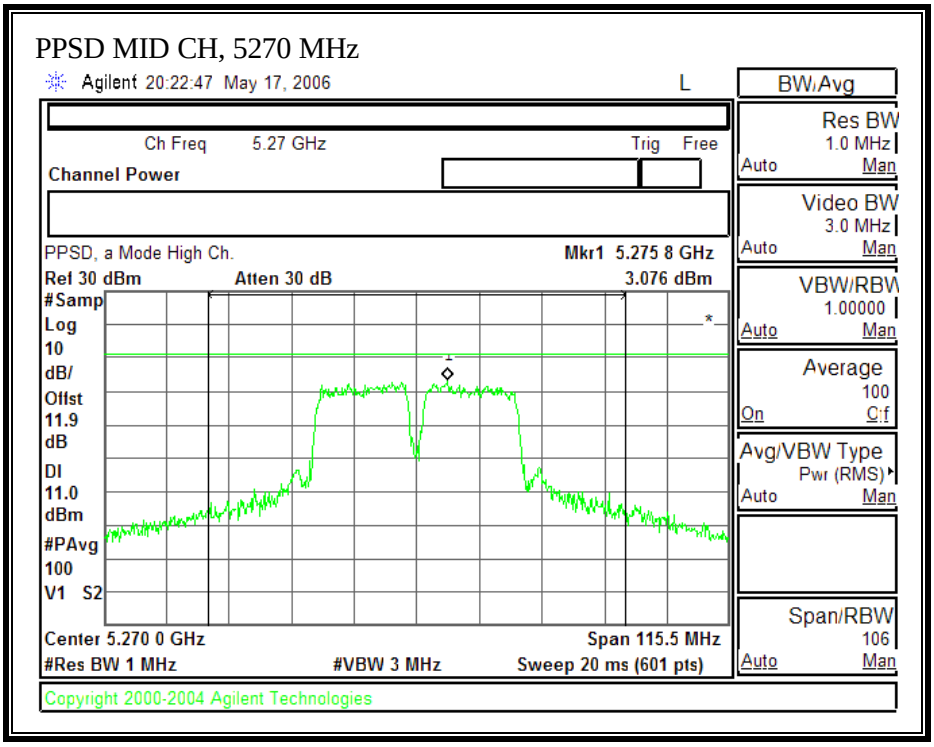
PPSD HIGH CH, 5320 MHz



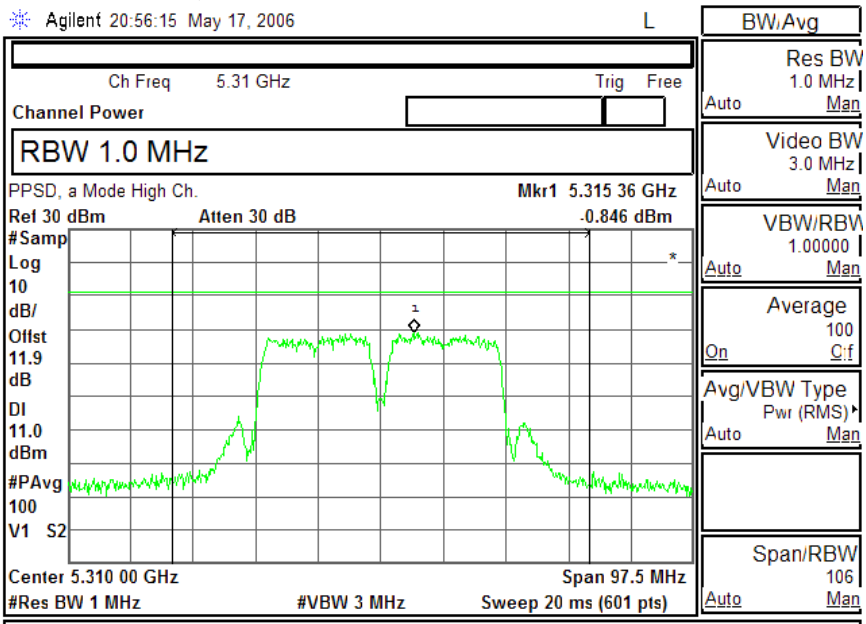
PEAK POWER SPECTRAL DENSITY (802.11 - 40 MHz TX BANDWIDTH – CHAIN 0)



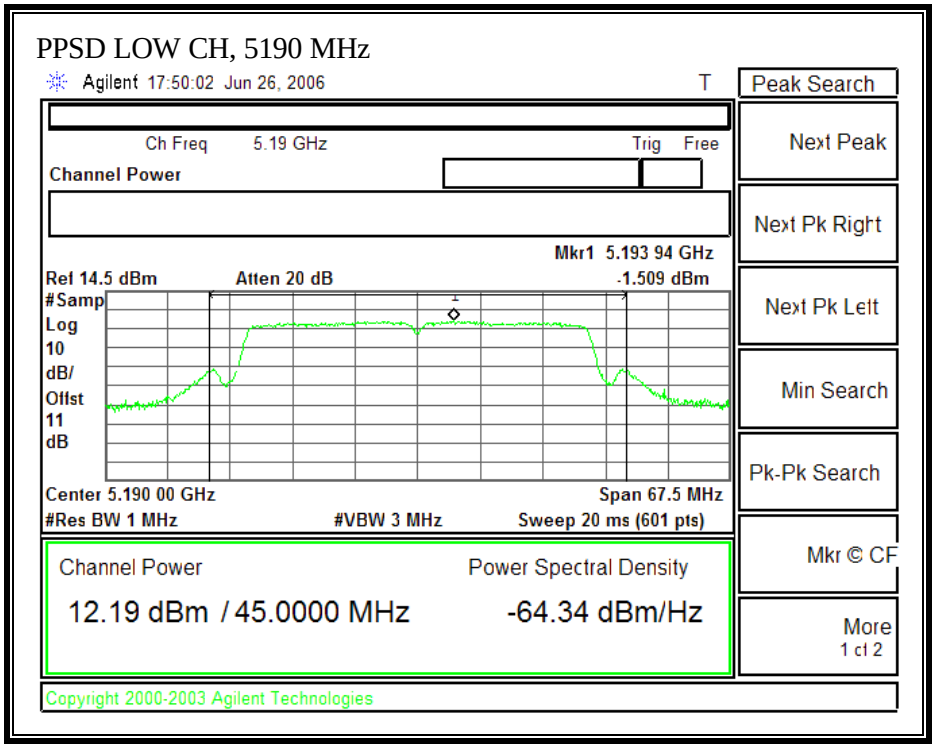
PPSD MID CH, 5270 MHz



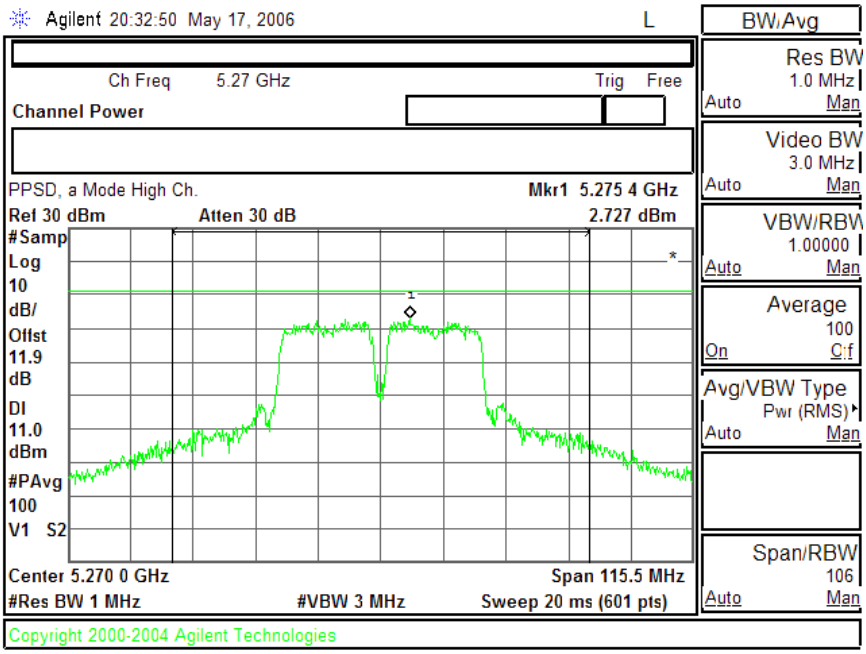
PPSD HIGH CH, 5310 MHz



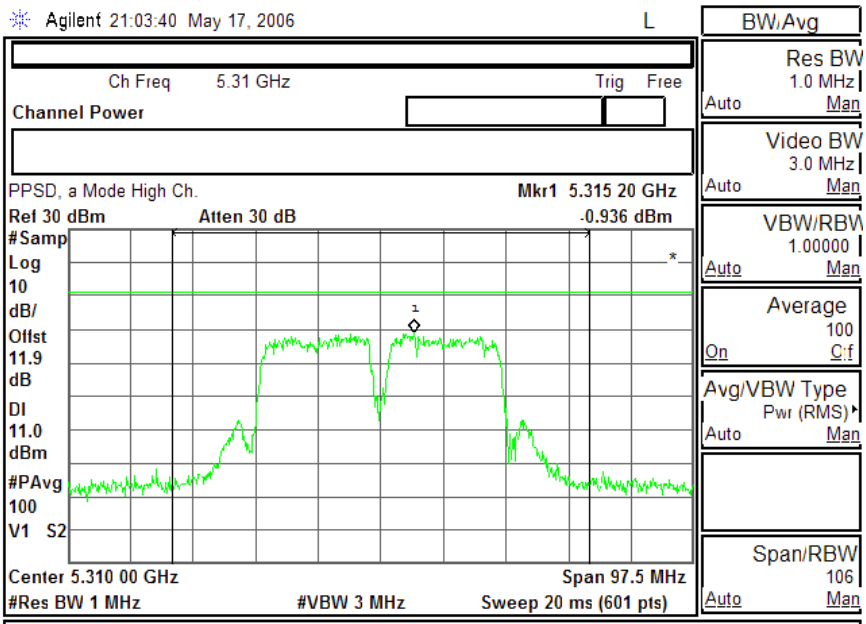
PEAK POWER SPECTRAL DENSITY (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)



PPSD MID CH, 5270 MHz



PPSD HIGH CH, 5310 MHz



7.3.5. 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.

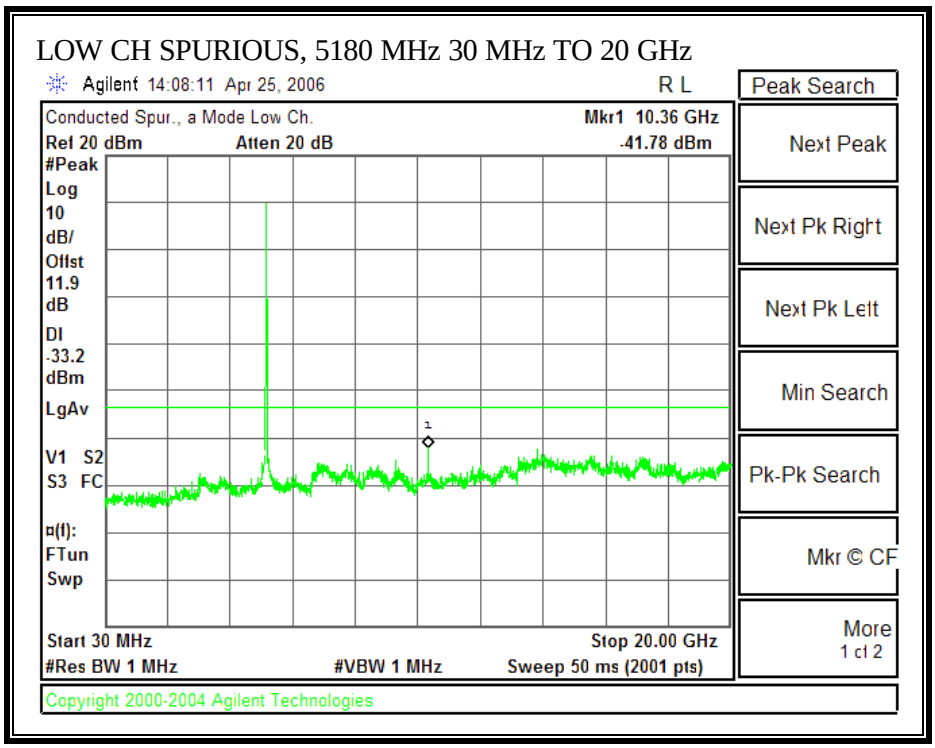
The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 1 MHz. The video bandwidth is set to 1 MHz. Peak detection measurements are compared to the average EIRP limit, adjusted for the maximum antenna gain. If necessary, additional average detection measurements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

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

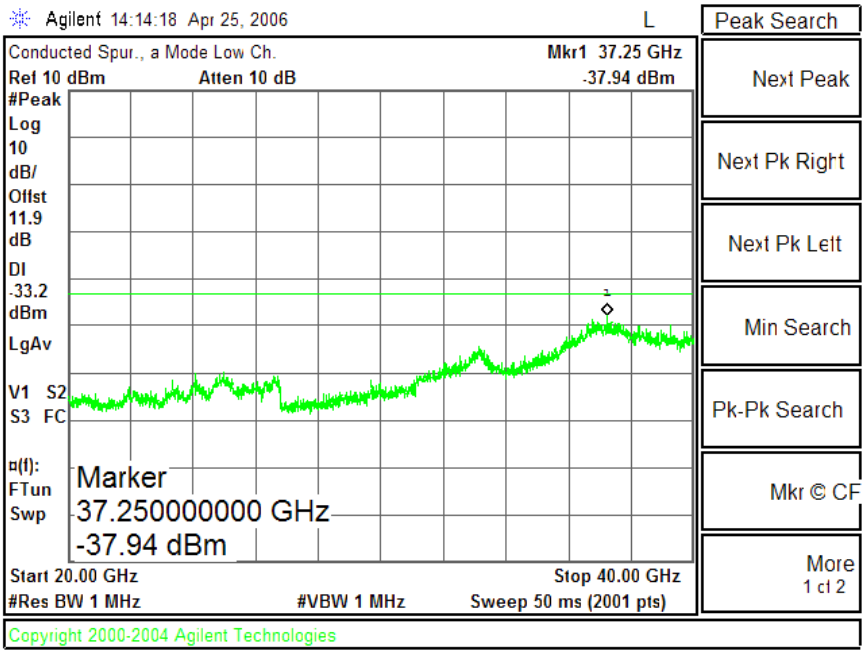
RESULTS

No non-compliance noted:

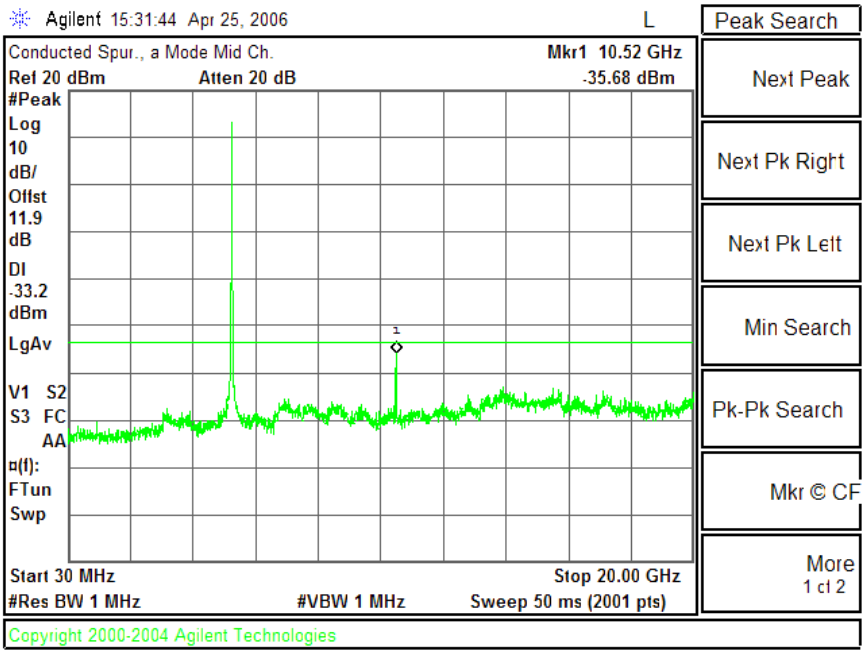
SPURIOUS EMISSIONS - 802.11a -20 MHz TX BANDWIDTH - CHAIN 0



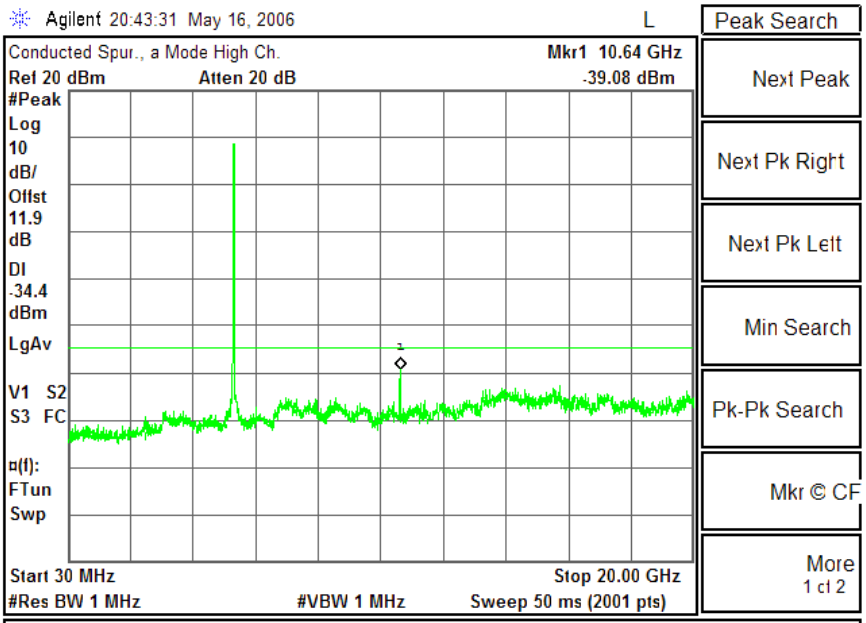
LOW CH SPURIOUS, 5180 MHz 20 GHz TO 40 GHz



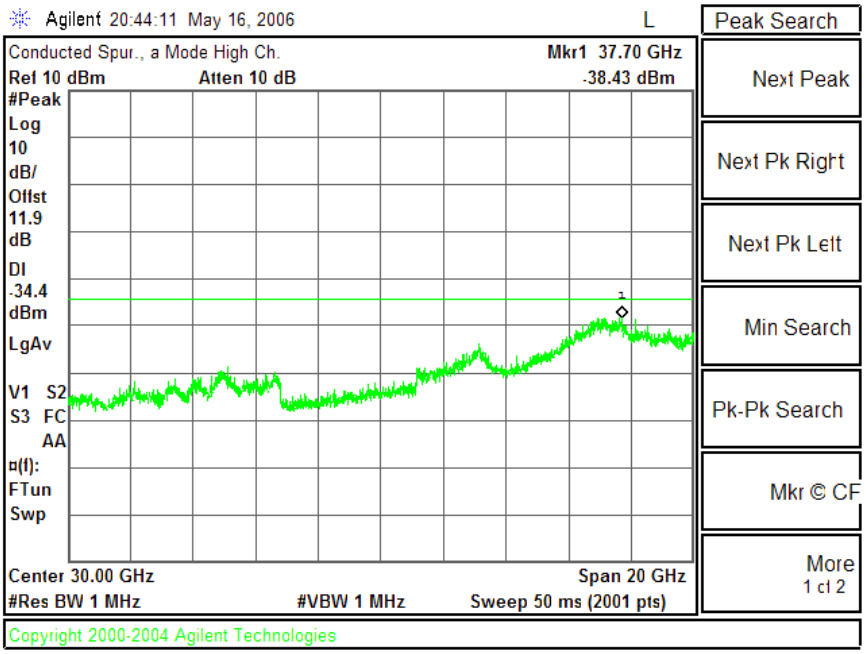
MID CHANNEL SPURIOUS, 5260 MHz - 30 MHz TO 20 GHz



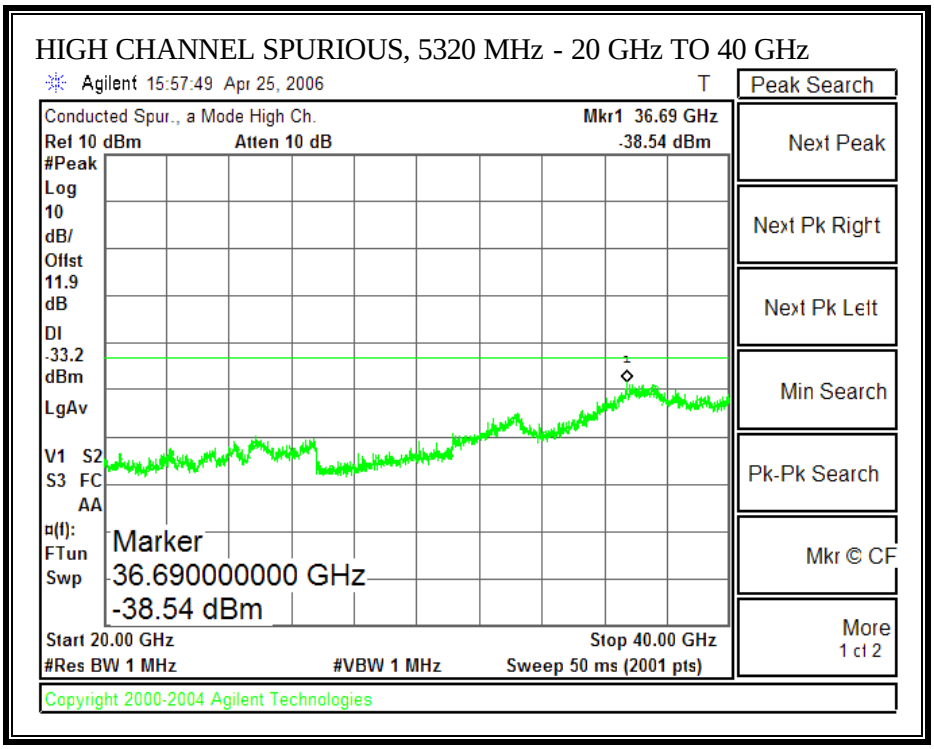
MID CHANNEL SPURIOUS, 5260 MHz - 20 GHz TO 40 GHz



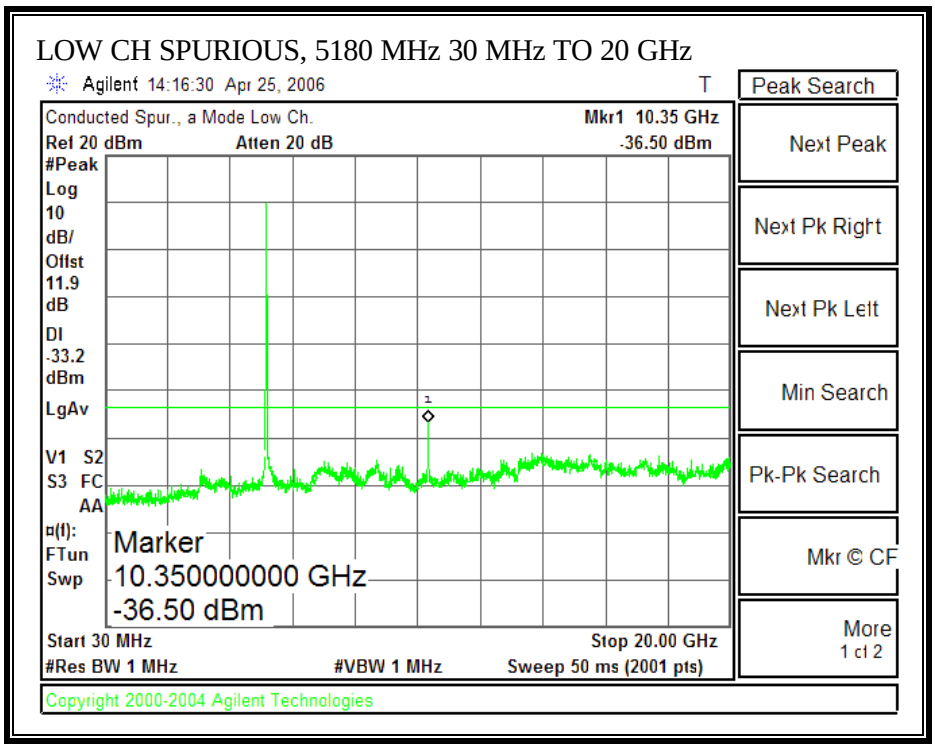
HIGH CHANNEL SPURIOUS, 5320 MHz - 30 MHz TO 20 GHz



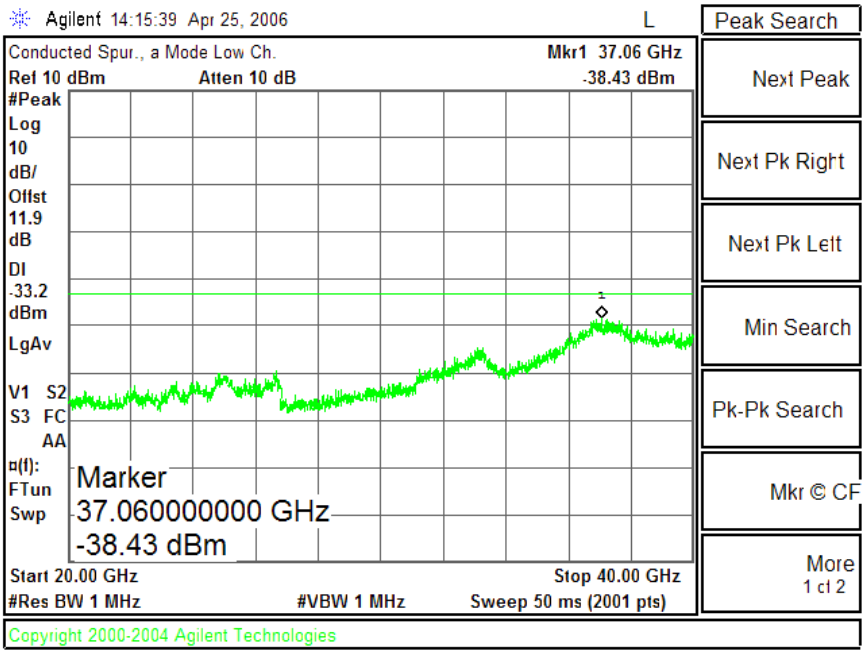
HIGH CHANNEL SPURIOUS, 5320 MHz - 20 GHz TO 40 GHz



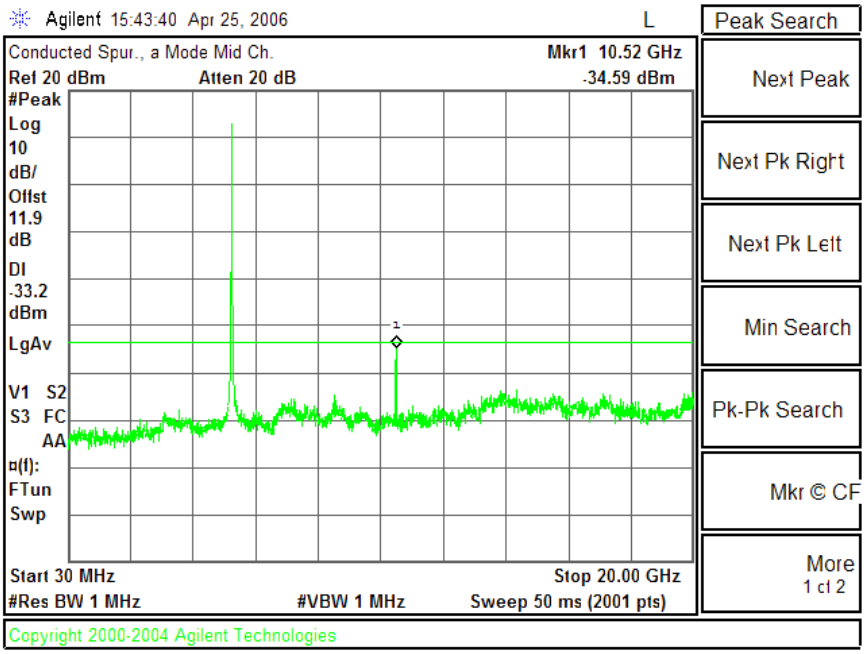
SPURIOUS EMISSIONS - 802.11a -20 MHz TX BANDWIDTH - CHAIN 1



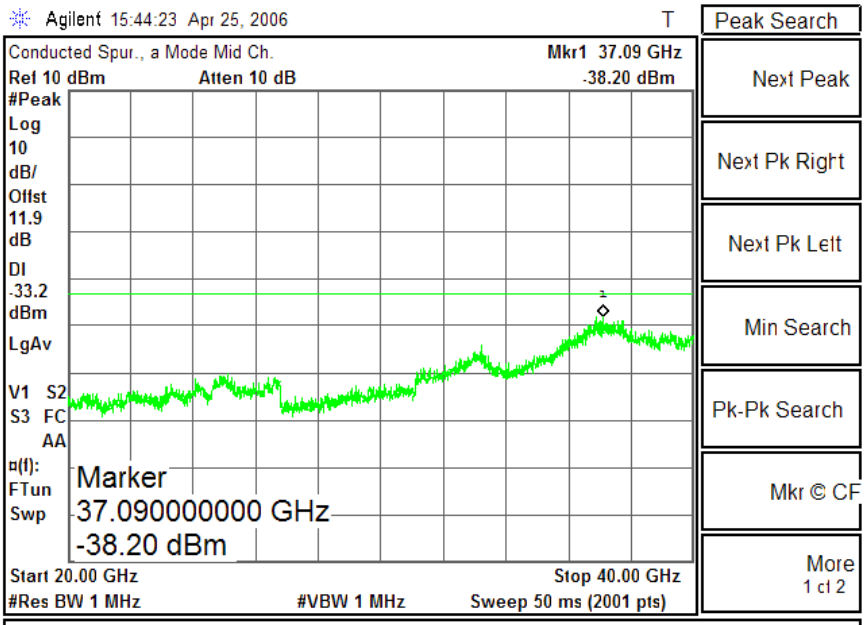
LOW CH SPURIOUS, 5180 MHz 20 GHz TO 40 GHz



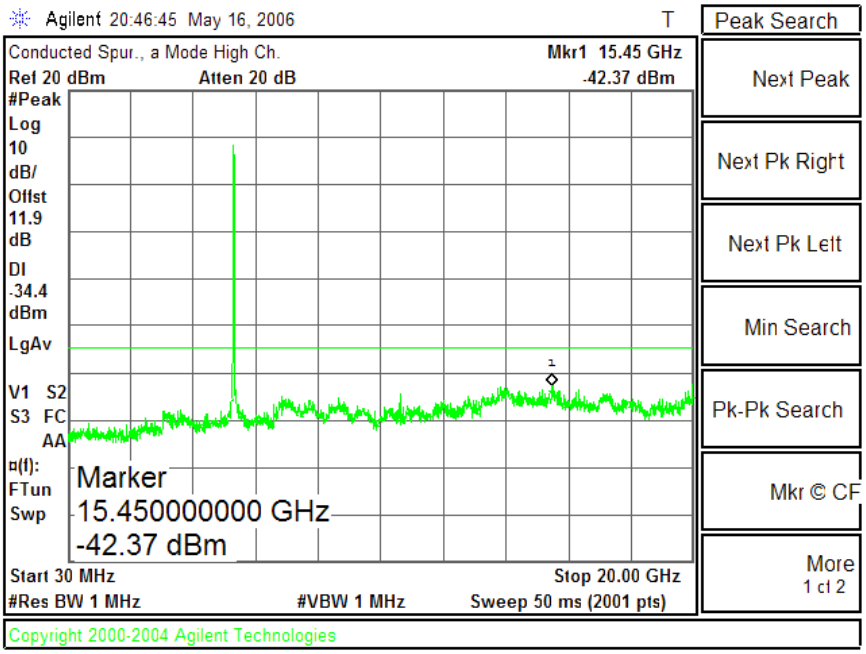
MID CHANNEL SPURIOUS, 5260 MHz - 30 MHz TO 20 GHz



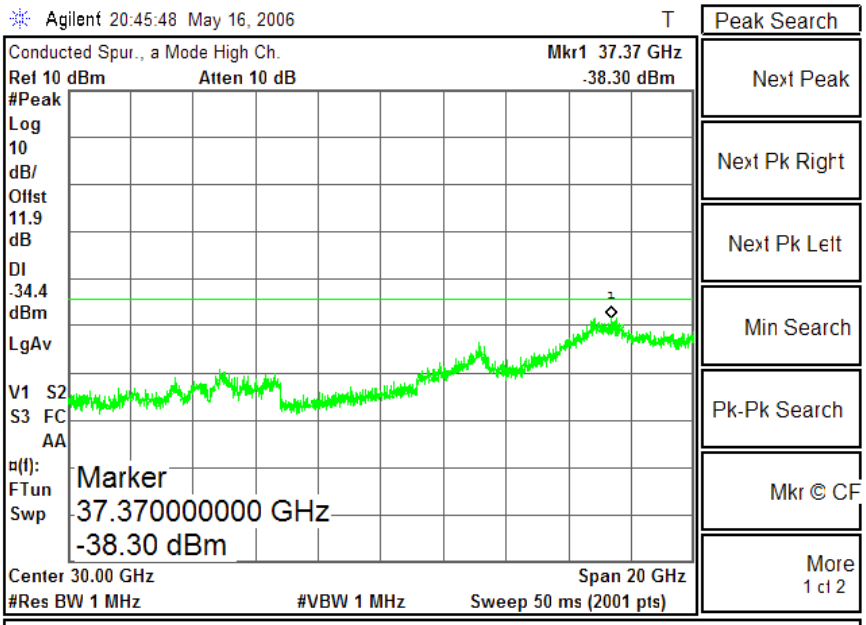
MID CHANNEL SPURIOUS, 5260 MHz - 20 GHz TO 40 GHz



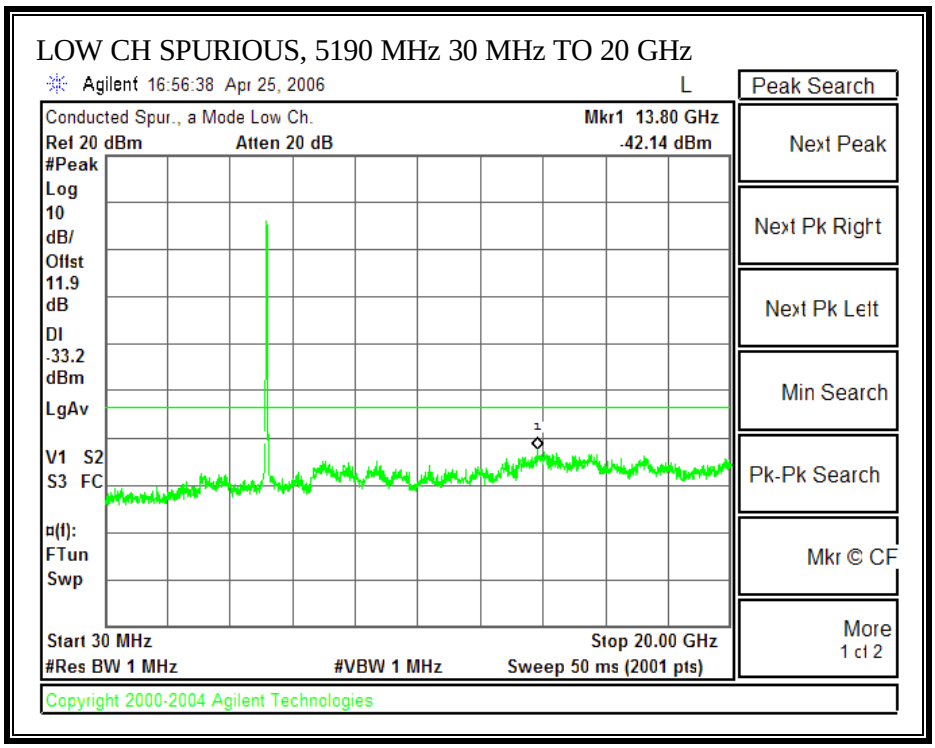
HIGH CHANNEL SPURIOUS, 5320 MHz - 30 MHz TO 20 GHz



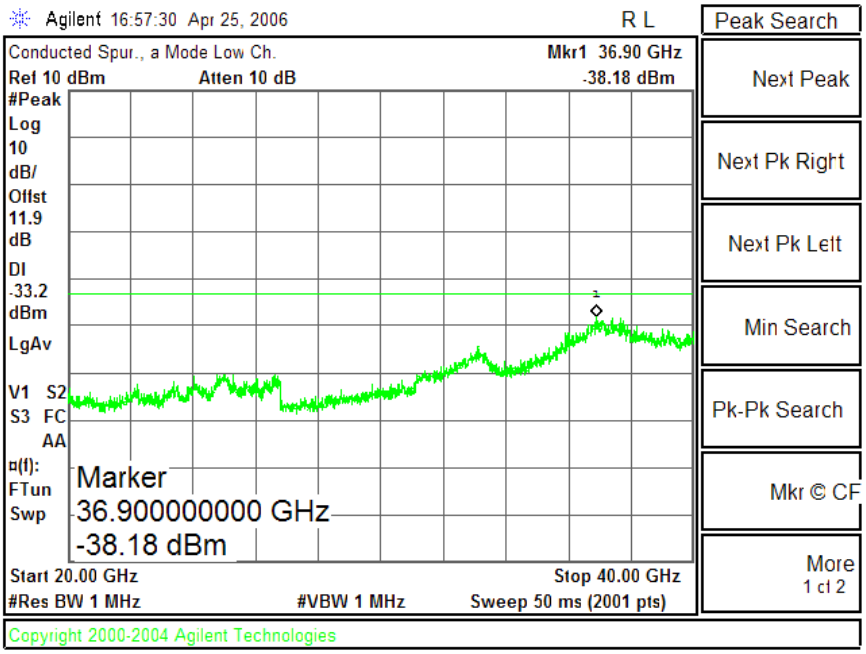
HIGH CHANNEL SPURIOUS, 5320 MHz - 20 GHz TO 40 GHz



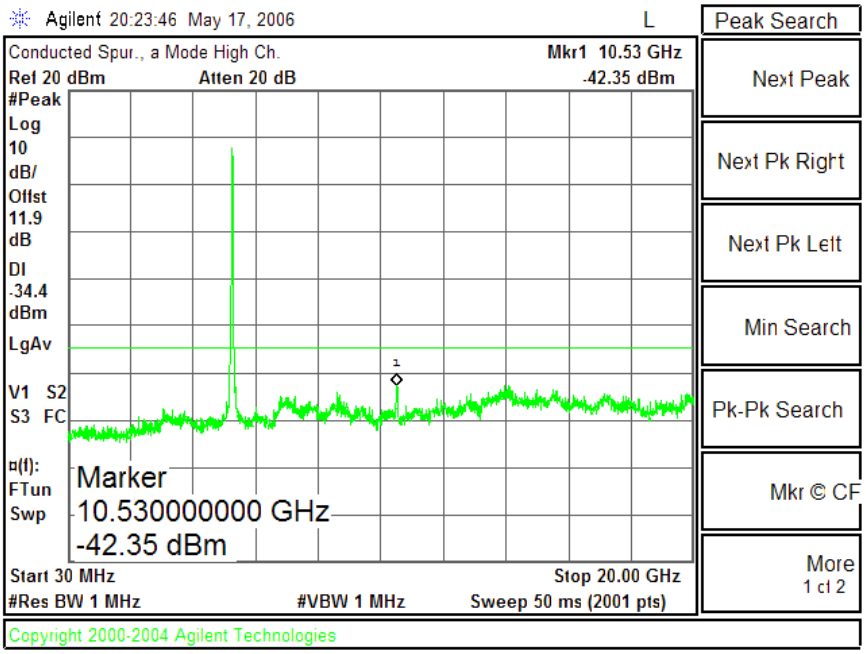
SPURIOUS EMISSIONS - 802.11a -40 MHz TX BANDWIDTH - CHAIN 0



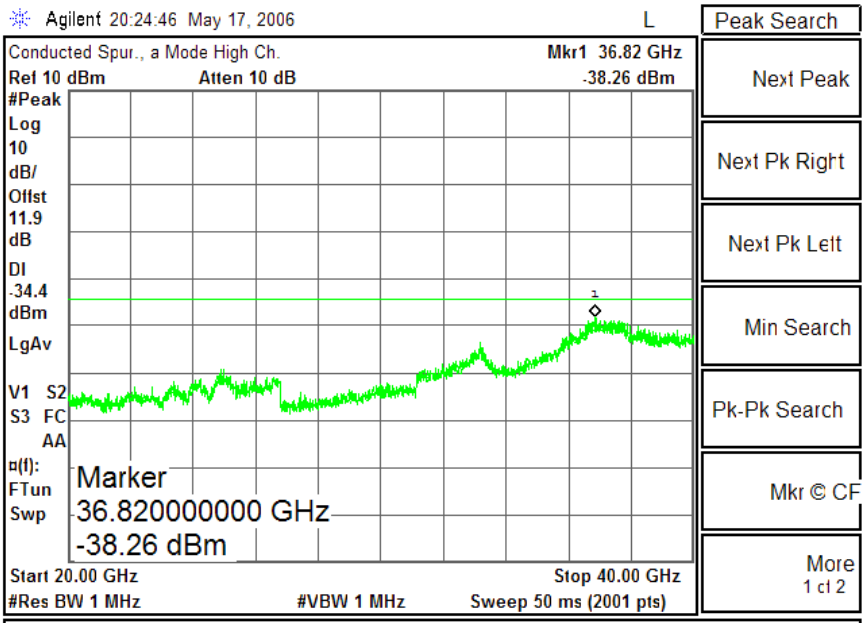
LOW CH SPURIOUS, 5190 MHz 20 GHz TO 40 GHz



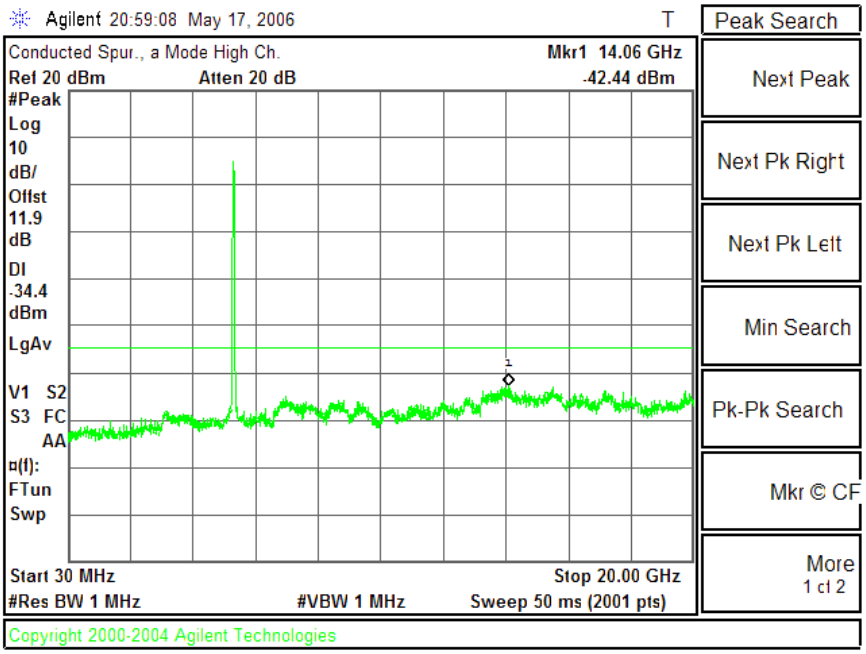
MID CHANNEL SPURIOUS, 5270 MHz - 30 MHz TO 20 GHz



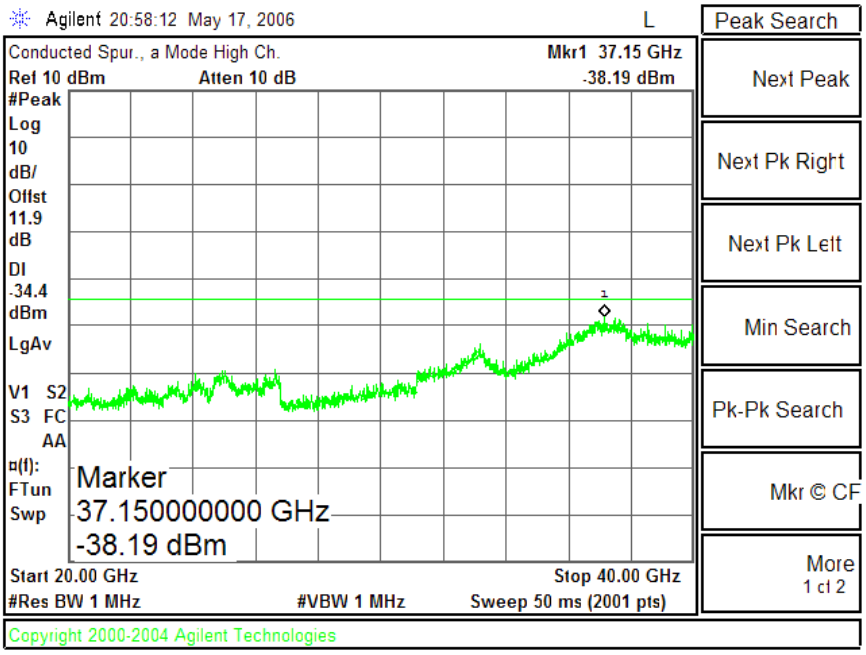
MID CHANNEL SPURIOUS, 5270 MHz - 20 GHz TO 40 GHz



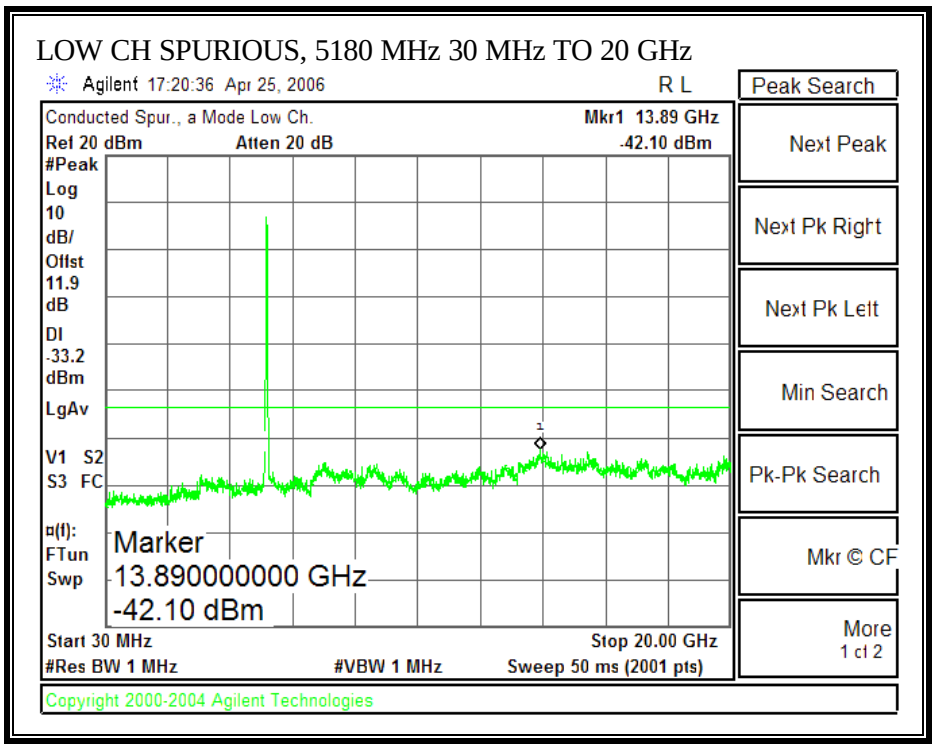
HIGH CHANNEL SPURIOUS, 5310 MHz - 30 MHz TO 20 GHz



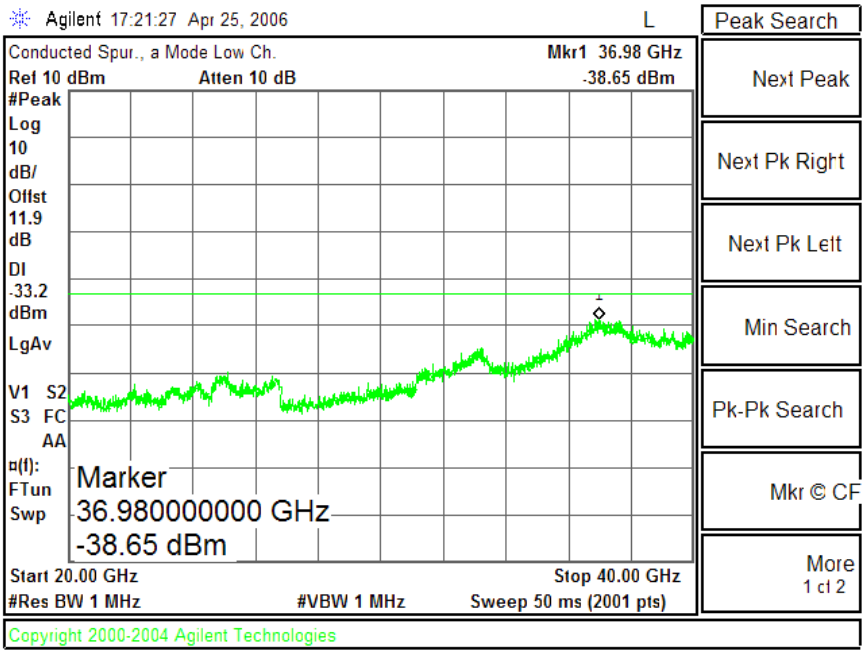
HIGH CHANNEL SPURIOUS, 5310 MHz - 20 GHz TO 40 GHz



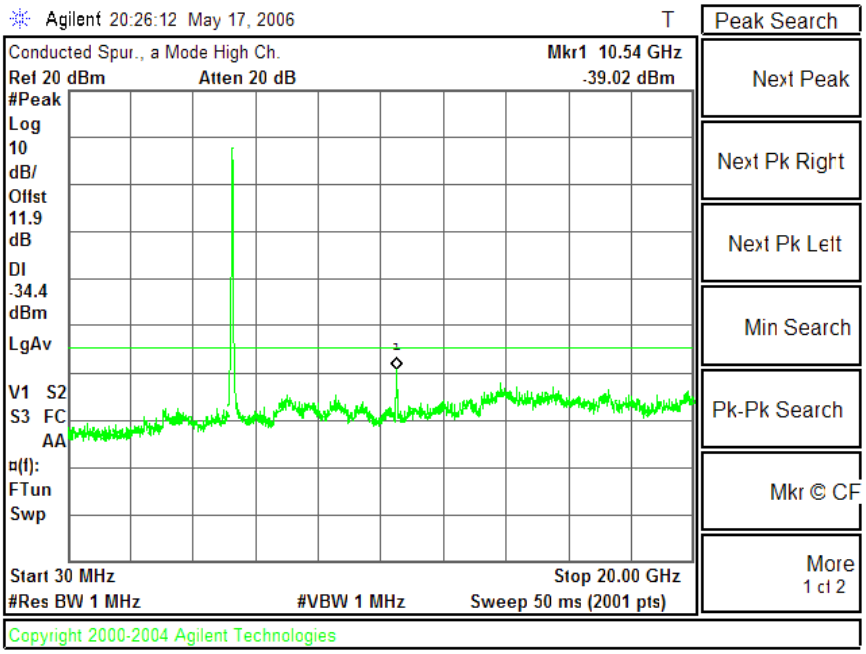
SPURIOUS EMISSIONS - 802.11a -20 MHz TX BANDWIDTH - CHAIN 1



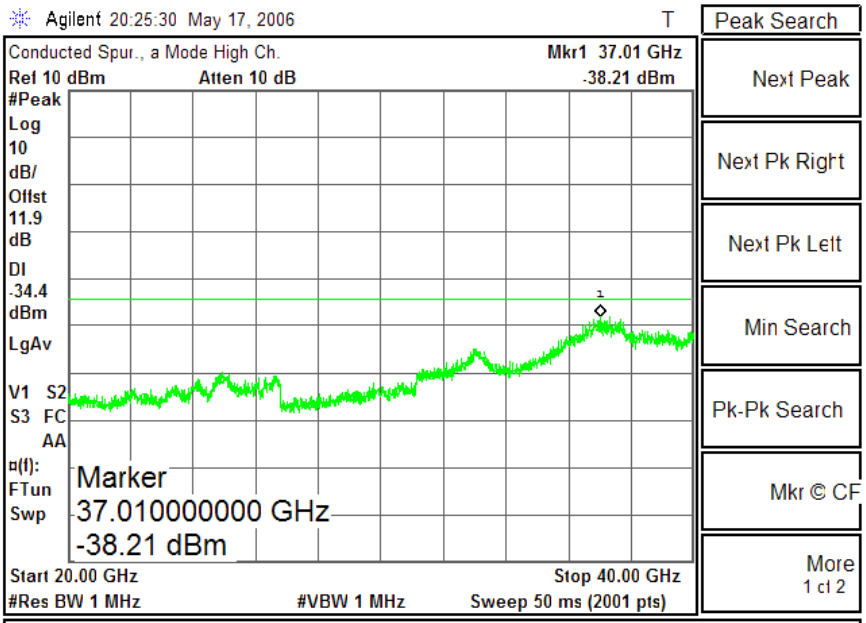
LOW CH SPURIOUS, 5190 MHz 20 GHz TO 40 GHz



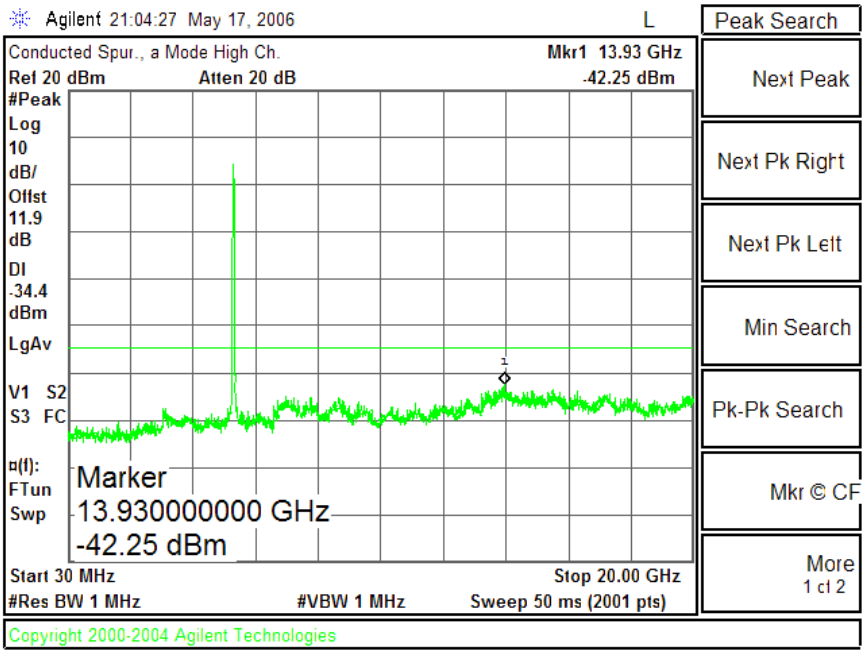
MID CHANNEL SPURIOUS, 5270 MHz - 30 MHz TO 20 GHz



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