FCC CFR47 PART 15 SUBPART C
CERTIFICATION
TEST REPORT

FOR

MC85 MINI CARD 11b/g/a/n RADIO CARD

MODEL NUMBER: MC85

FCC ID: UAY-MMC85M

REPORT NUMBER: 06U10359-1D

ISSUE DATE: JULY 18, 2006

Prepared for
MARVELL SEMICONDUCTOR, INC.
5488 MARVELL LANE
SANTA CLARA
CALIFORNIA, 95054, USA

Prepared by
COMPLIANCE CERTIFICATION SERVICES
561F MONTEREY ROAD
MORGAN HILL, CA 95037, USA
TEL: (408) 463-0885
FAX: (408) 463-0888

LAB CODE:200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	7/12/2006	- Initial Release	A. Ilarina
B	7/15/2006	- Updated table section 5.2 - Clarify Foxconn antenna gain for 5.8GHz in section 5.3. - Clarify description of baseline testing for worst case in Section 5.5. - Include Combiner information in section 6. - Include formula for Effective Legacy Gain in section 7.1.3 and 7.2.3. - Remove "Fixed Limit" in sections 7.1.3 and 7.2.3. - Updated Plots Section 7.2.2 - Updated Plots Section 7.2.3 - Updated table section 7.2.4 - Remove co-located radiated test description in section 7.3.1.	A. Ilarina
C	7/17/2006	- Updated table & plots section 7.2.2 - Updated table 5.2	A. Ilarina
D	7/18/2006	- Change Mode description in Harmonic and Spurious Tables in Section 7.3.2	A. Ilarina

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: MARVELL SEMICONDUCTOR, INC.
5488 MARVELL LANE
SANTA CLARA, CA, 95054, USA

EUT DESCRIPTION: MC85 MINI CARD 802.11b/g/a/n RADIO CARD

MODEL: MC85

SERIAL NUMBER: 099; 098; 010

DATE TESTED: JUNE 12-30, 2006

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC PART 15 SUBPART C	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: Tested By:

ALVIN ILARINA
EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

FRANK IBRAHIM
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

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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%.

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is an 802.11a/b/g/n transceiver.

The radio module is manufactured by Marvell Semiconductor.

5.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2400 to 2483.5 MHz Authorized Band			
2412 - 2462	802.11b	25.50	354.81
2412 - 2462	802.11g 20M	27.29	535.80
2412 - 2462	802.11g 40M	23.65	231.74
2412 - 2462	802.11n HT20	26.55	451.86
2422 - 2452	802.11n HT40	24.92	310.46
5725 to 5850 MHz Authorized Band			
5745 - 5825	802.11a 20MHz	27.21	526.02
5755 - 5795	802.11a 40MHz	24.58	287.08
5745 - 5825	802.11n HT20	27.12	515.23
5755 - 5795	802.11n HT40	26.60	457.09

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5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes two antennas for diversity:

1) Foxconn Model 820-2032 with a maximum gain of 4.4 dBi for 5.8GHz band, and 1.5 dBi gain for 2.4GHz band.
2) Mega Chip Model QRANTDPLWPS008, Dipole, with a maximum gain of 6 dBi for 5.8GHz band, and 1.9 dBi gain for 2.4GHz band.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was PCI rev. 1.0.0.0.2, MFG 2.1.0.36

The EUT driver software installed in the Laptop during testing was Marvell Semiconductor, Inc. Labtools rev. 1.0.3.p3.

The board revision of the EUT tested is 1.8.

The test utility software used during testing was PCI.exe.

5.5. WORST-CASE CONFIGURATION AND MODE

The 2x3 configuration was used for all testing in this report.

The worst- case data rates are determined to be as follows for each mode based on investigation by measuring the average power, peak power and PPSD across all data rates, bandwidths, and modulations.

The worst-case data rates for the 2GHz bands are: 11 Mbps for 802.11b; 54Mbps for 802.11g; MCS11 for 802.11n HT20; MCS15 for 802.11n HT40. These are based on baseline testing with this chipset.

The worst-case data rates for the 5GHz bands are: 9 Mbps for 802.11a 20MHz and 802.11a 40MHz; MCS0 for 802.11n HT20 and 802.11n HT40. These are based on baseline testing with this chipset.

All emissions tests were made with the worst-case data rates.

5.6. MODIFICATIONS

There were no modifications made to the revision EUT during the testing.

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5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	IBM	ThinkPad T60	L3-M5371	DoC
Extend PCB	Marvell	N/A	02V20806	N/A

TEST SETUP

The EUT is installed in a host laptop computer via a extension board during the tests. Test software exercised the radio card.

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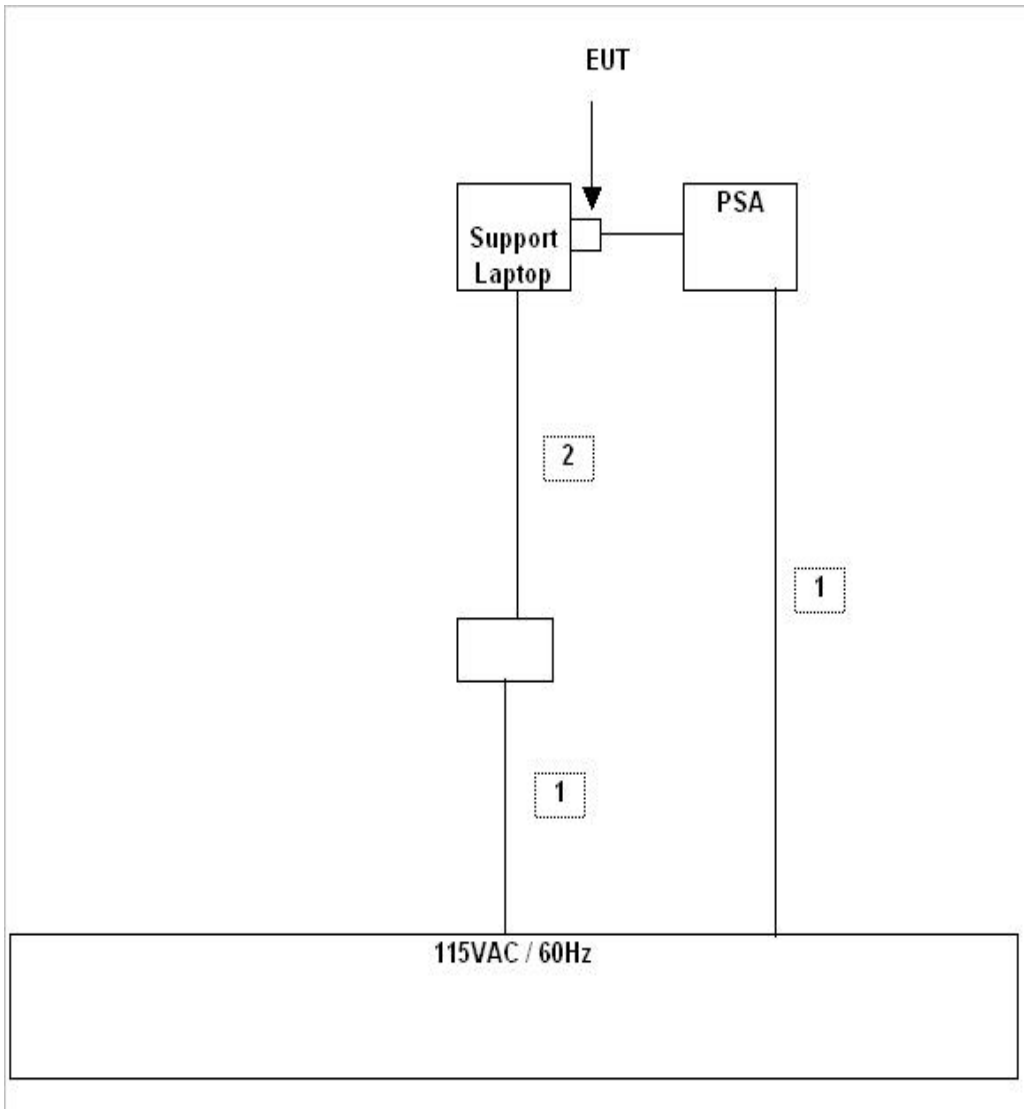
SETUP DIAGRAM FOR TESTS



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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**
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	9/3/2006
Antenna, Horn 1 ~ 18 GHz	ETS	3117	29301	4/22/2007
Preamplifier, 1 ~ 26.5 GHz	Agilent / HP	8449B	3008A00931	6/24/2006
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	11/3/2006
Spectrum Analyzer 3 Hz ~ 44 GHz	Agilent / HP	E4446A	MY45300064	12/19/2006
Power Meter	Agilent / HP	438B	3125U09516	2/15/2007
Power Sensor 10MHz - 18GHz	Agilent / HP	8481A	2702A66876	1/11/2007
4.0 High Pass Filter	Micro Tronics	HPM13351	3	N/A
Combiner	HP	11667B	324	N/A*

* Combiner is characterized to 40GHz at time of test.

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7. LIMITS AND RESULTS

7.1. CHANNEL TESTS FOR THE 2400 TO 2483.5 MHz BAND

7.1.1. 6 dB BANDWIDTH

LIMIT

§15.247 (a) (2) For direct sequence systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

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RESULTS

No non-compliance noted:

Mode Channel	Frequency (MHz)	6 dB BW Chain A (kHz)	6 dB BW Chain B (kHz)	Minimum Limit (kHz)	Minimum Margin (kHz)
802.11b Mode					
Low	2412	8930	10070	500	8430
Middle	2437	10070	10130	500	9570
High	2462	9470	9930	500	8970
802.11g 20M Mode					
Low	2412	16670	16670	500	16170
Middle	2437	16670	16670	500	16170
High	2462	16670	16670	500	16170
802.11g 40M Mode					
Low	2422	36800	36800	500	36300
Middle	2437	36800	36800	500	36300
High	2452	36800	36800	500	36300
802.11n HT20 Mode					
Low	2412	17870	17870	500	17370
Mid	2437	17870	17870	500	17370
High	2462	17870	17870	500	17370
802.11n HT40 Mode					
Low	2422	36800	36800	500	36300
Mid	2437	36800	36800	500	36300
High	2452	36800	36800	500	36300

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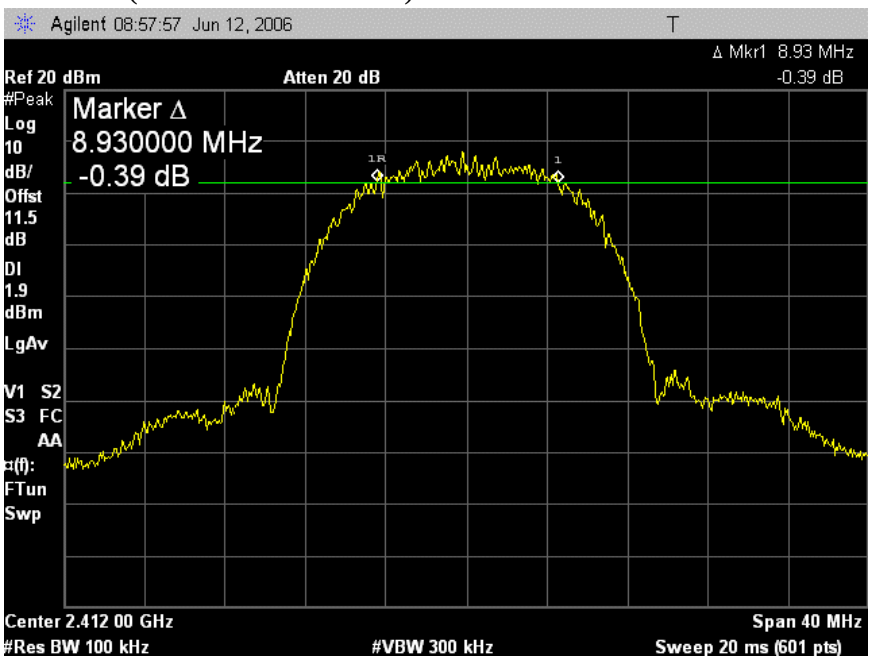
(802.11b MODE CHAIN A)

LOW CH (802.11b mode chain A)



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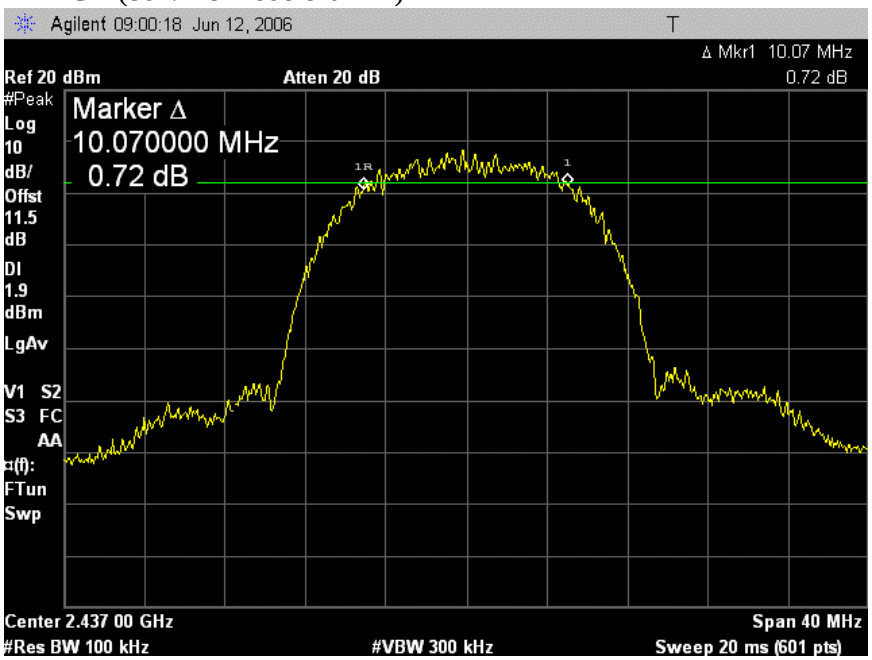
MID CH (802.11b mode chain A)



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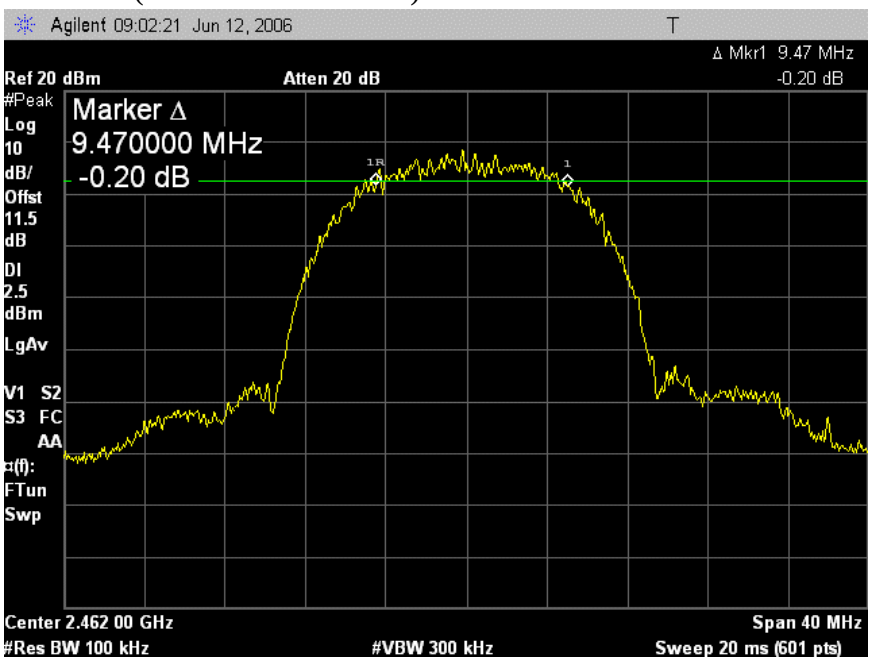
HIGH CH (802.11b mode chain A)



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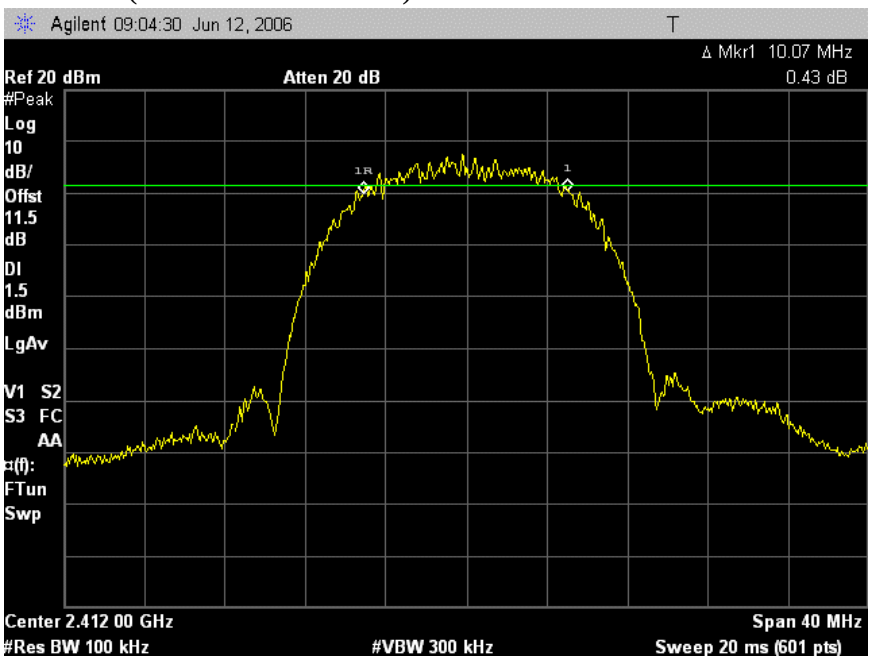
(802.11b MODE CHAIN B)

LOW CH (802.11b mode chain B)



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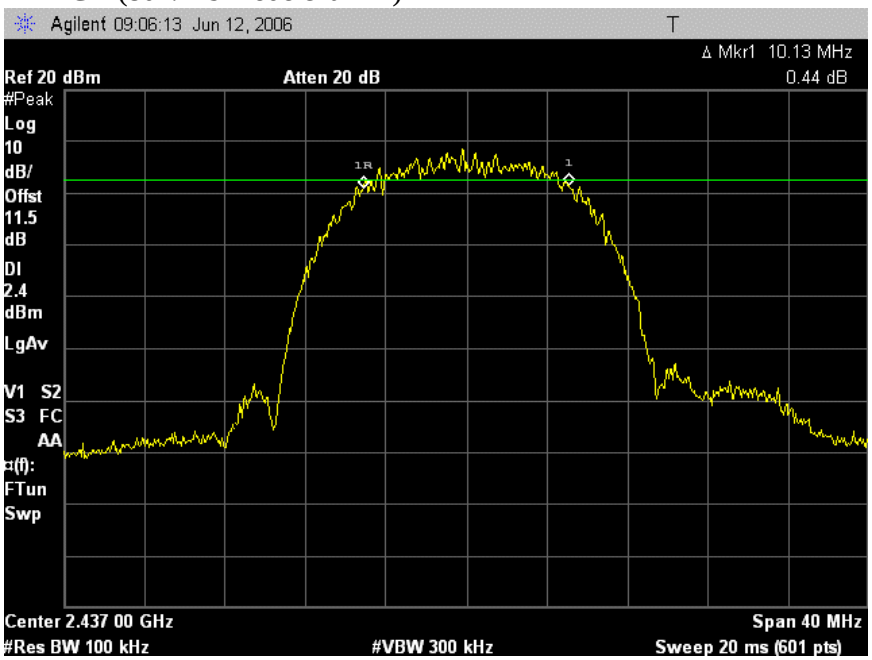
MID CH (802.11b mode chain B)



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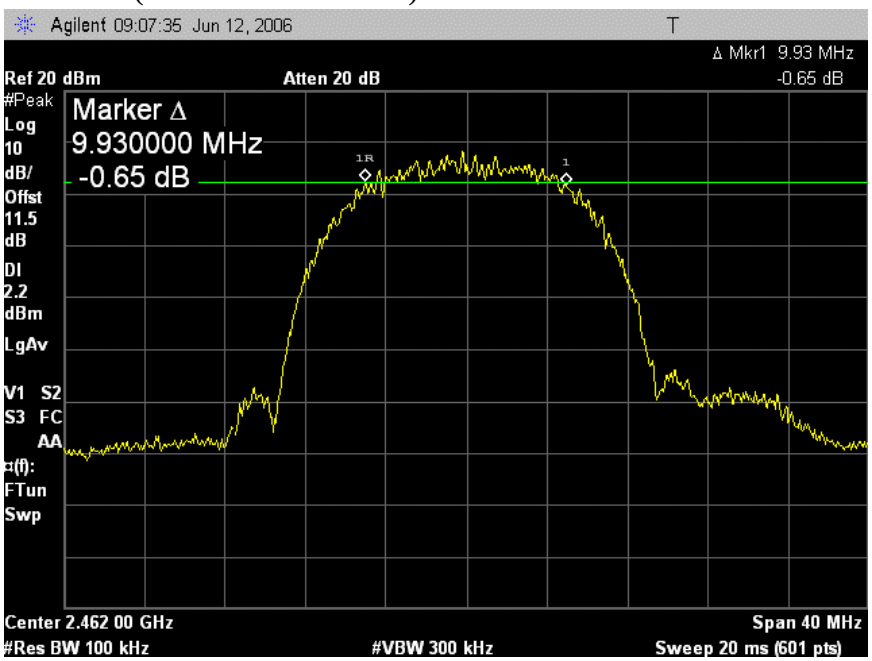
HIGH CH (802.11b mode chain B)



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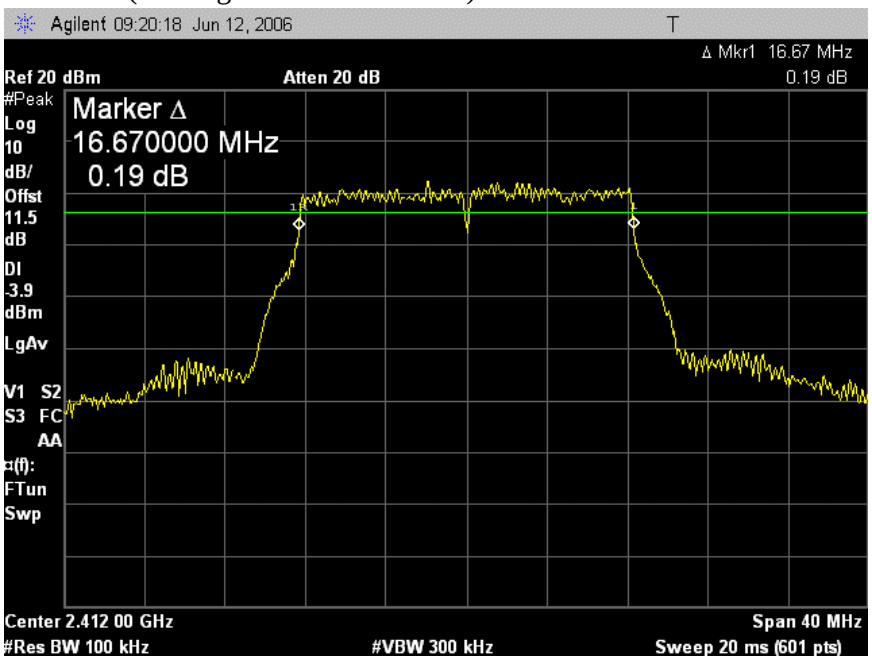
(802.11g 20M MODE CHAIN A)

LOW CH (802.11g 20M mode chain A)



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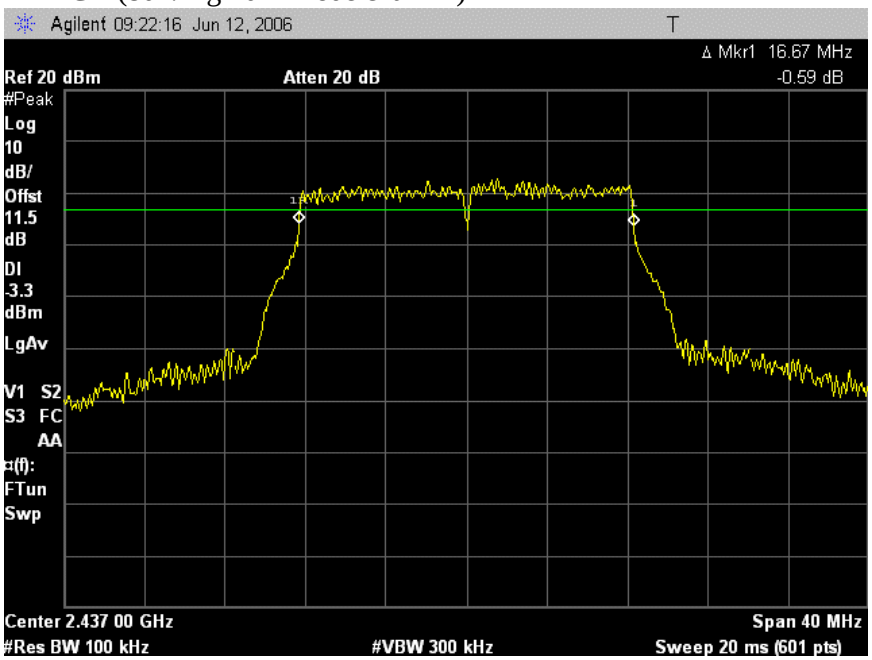
MID CH (802.11g 20M mode chain A)



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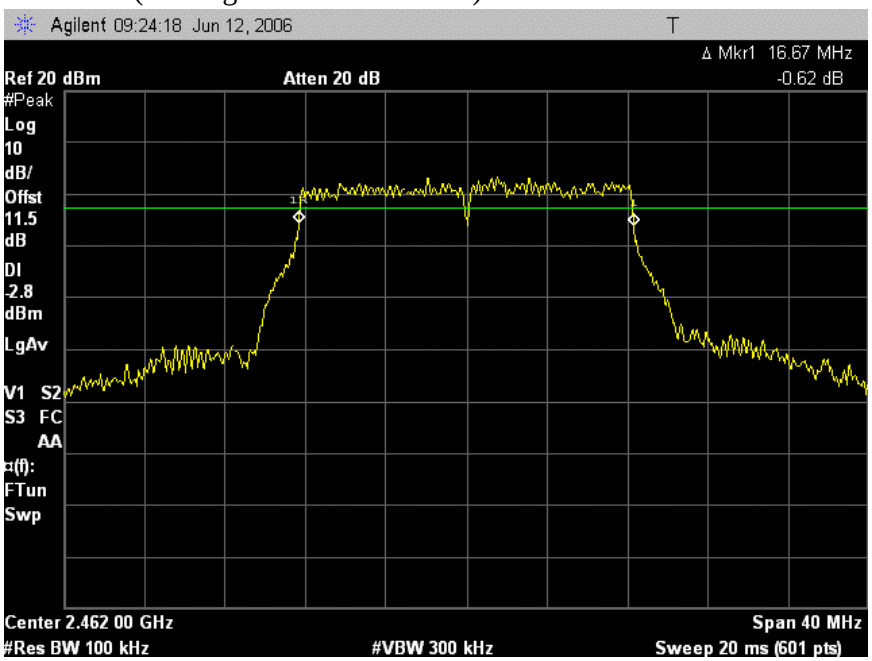
HIGH CH (802.11g 20M mode chain A)



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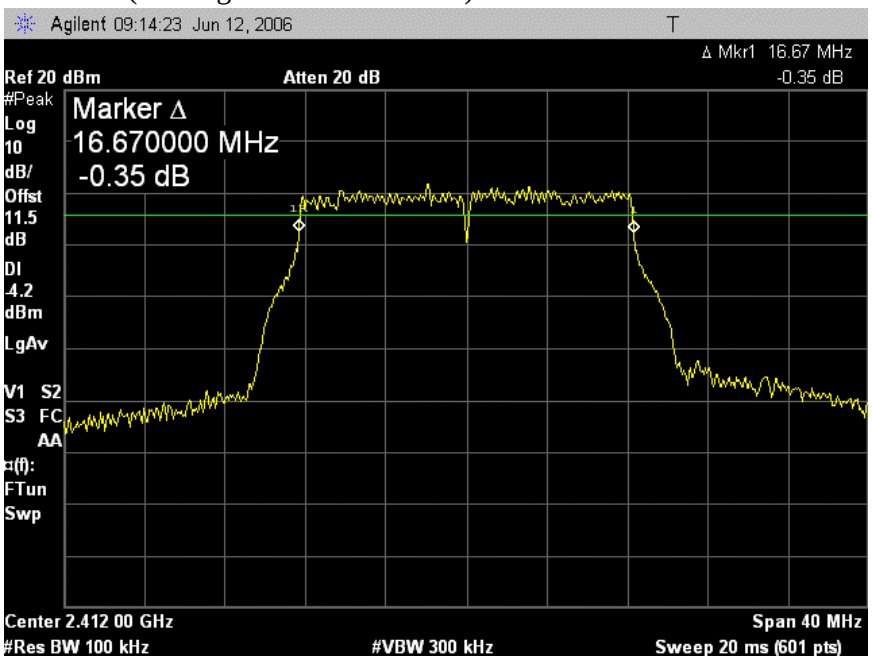
(802.11g 20M MODE CHAIN B)

LOW CH (802.11g 20M mode chain B)



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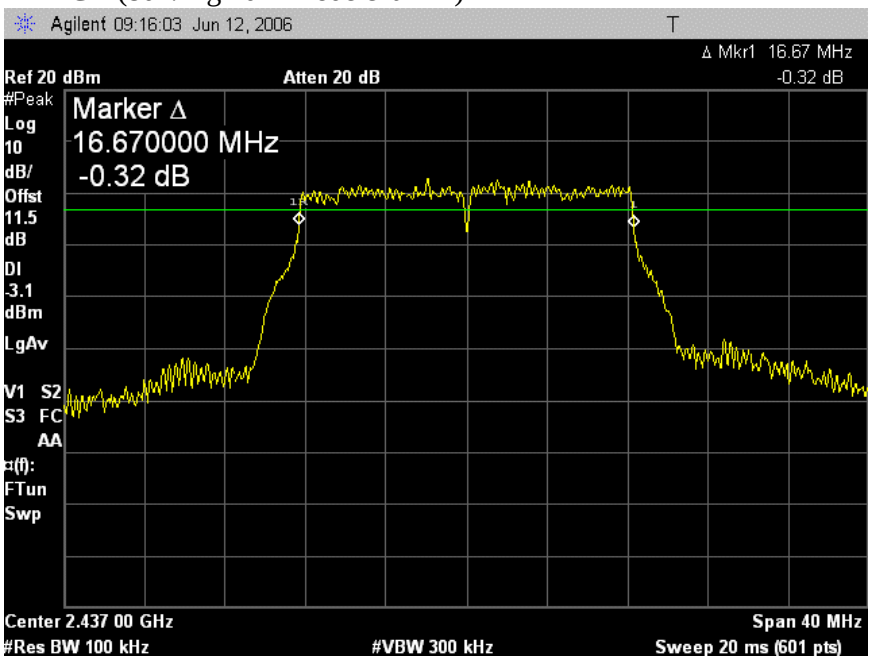
MID CH (802.11g 20M mode chain B)



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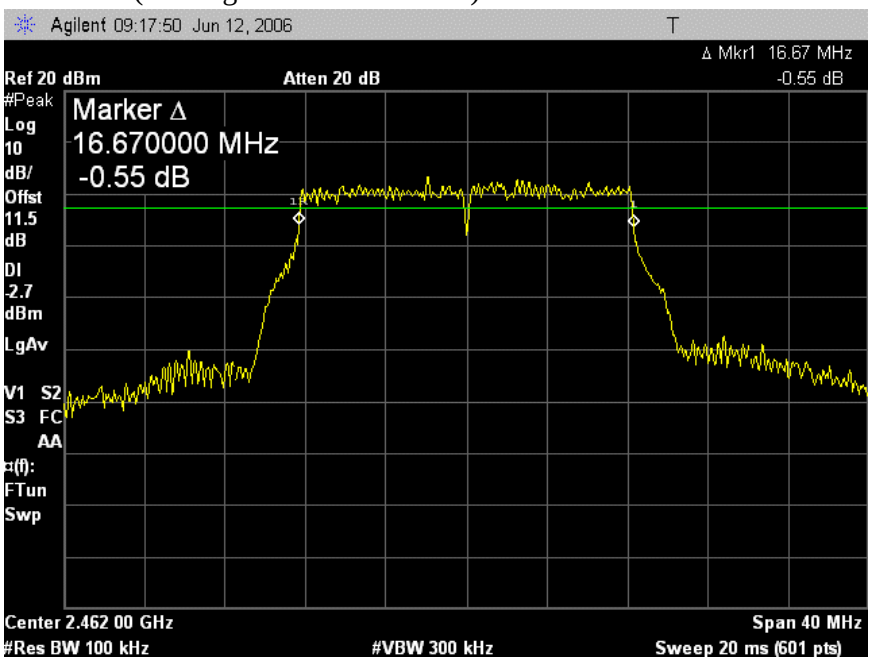
HIGH CH (802.11g 20M mode chain B)



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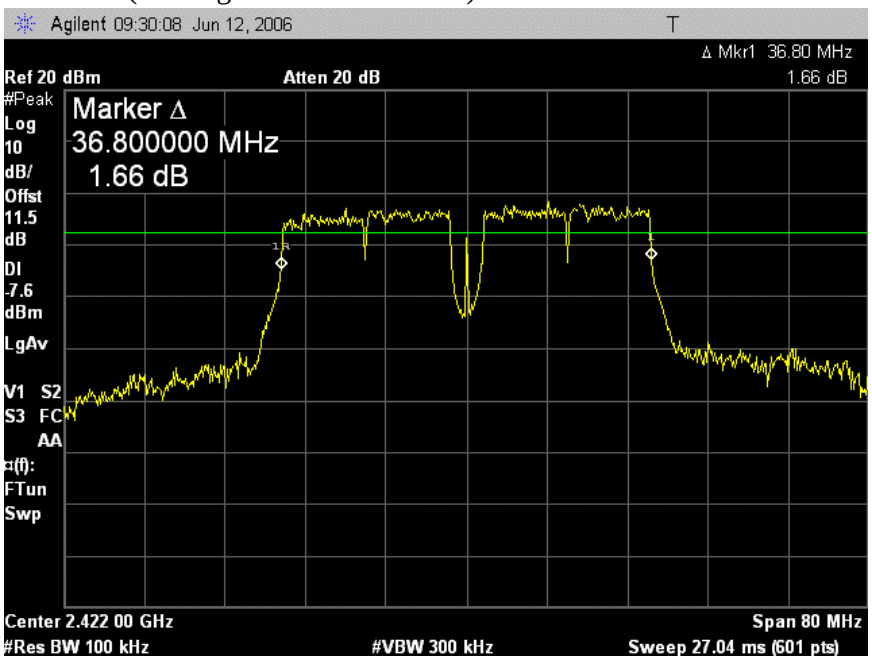
(802.11g 40M MODE CHAIN A)

LOW CH (802.11g 40M mode chain A)



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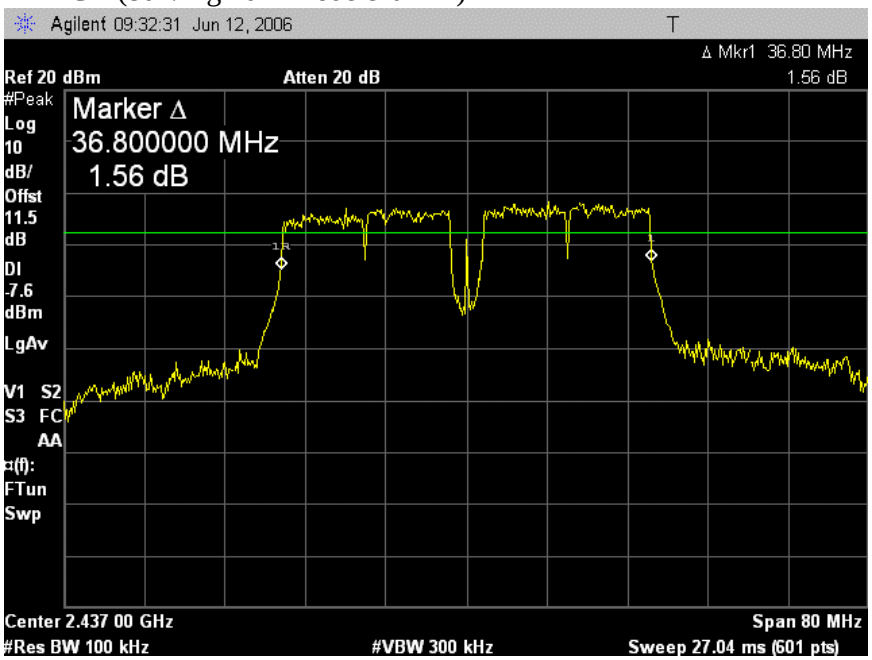
MID CH (802.11g 40M mode chain A)



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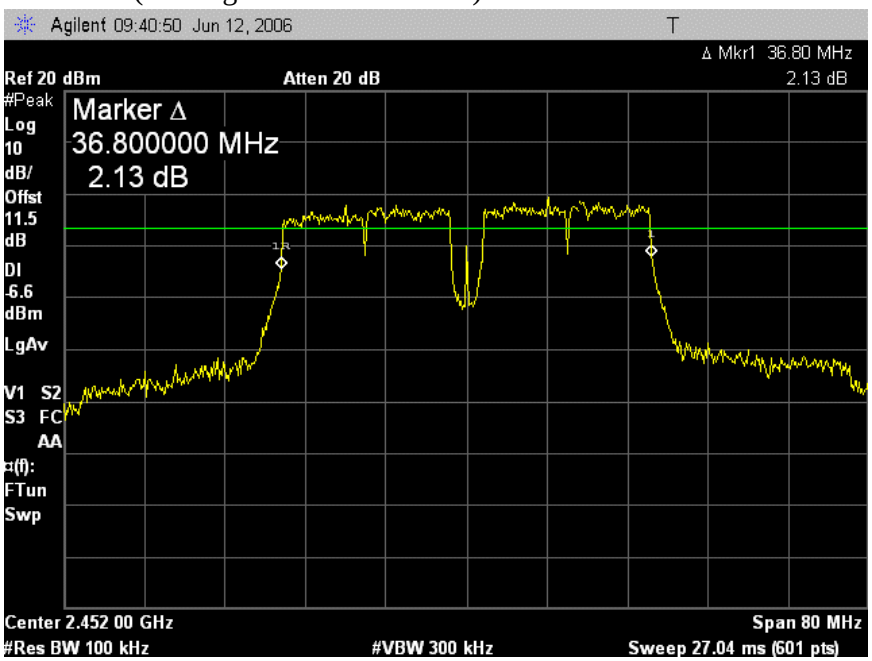
HIGH CH (802.11g 40M mode chain A)



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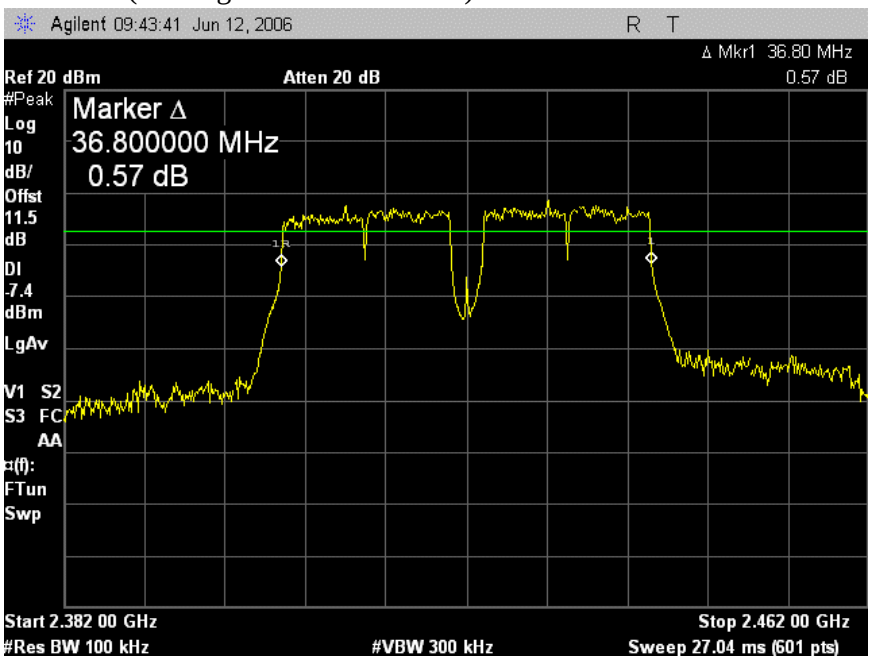
(802.11g 40M MODE CHAIN B)

LOW CH (802.11g 40M mode chain B)



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MID CH (802.11g 40M mode chain B)

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HIGH CH (802.11g 40M mode chain B)

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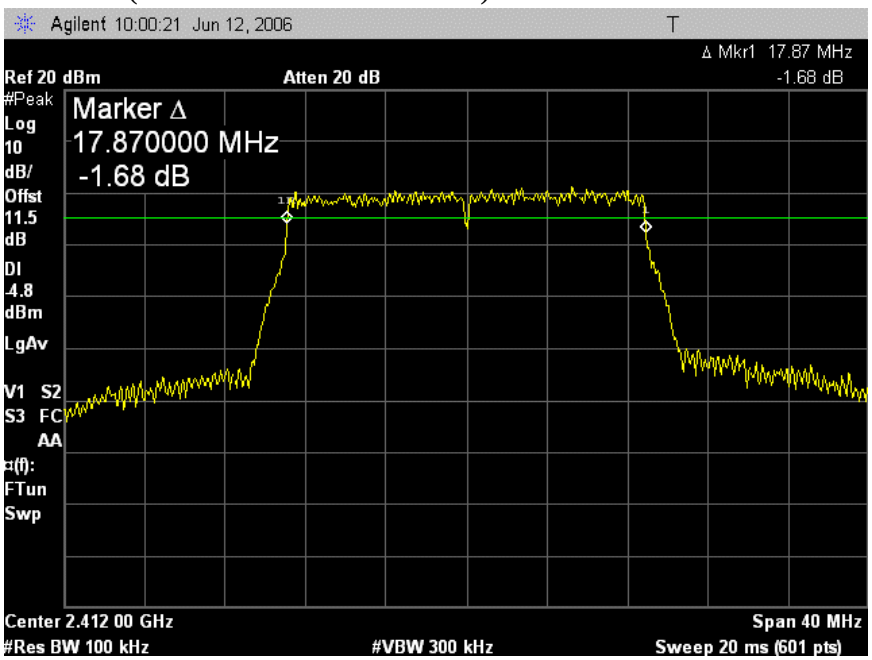
(802.11n HT20 MODE CHAIN A)

LOW CH (802.11n HT20 mode chain A)



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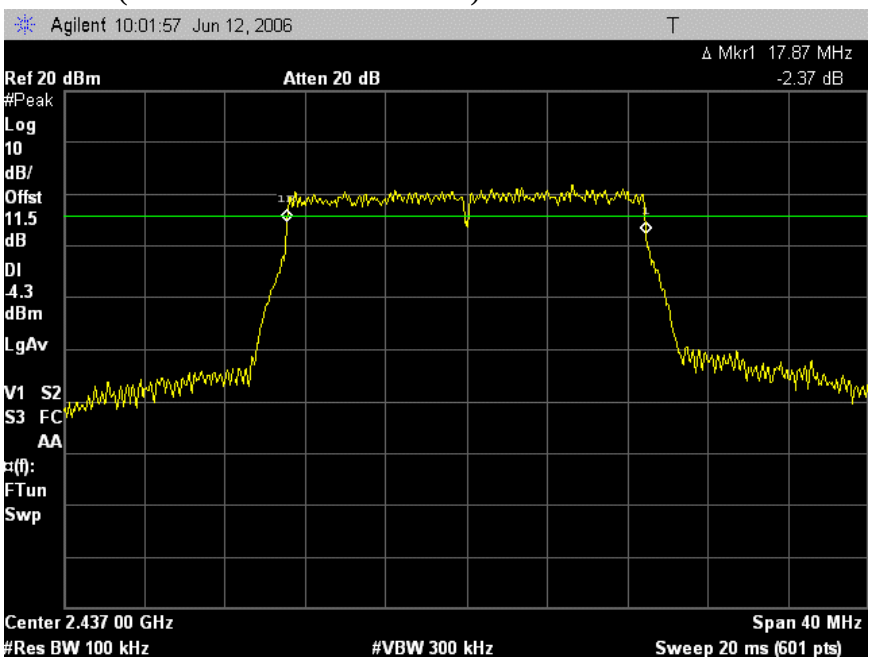
MID CH (802.11n HT20 mode chain A)



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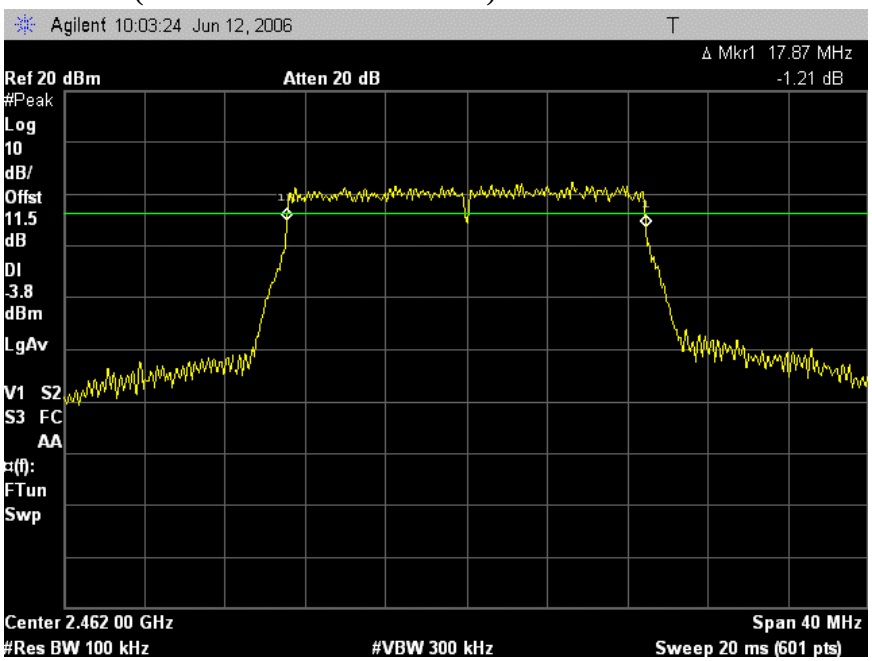
HIGH CH (802.11n HT20 mode chain A)



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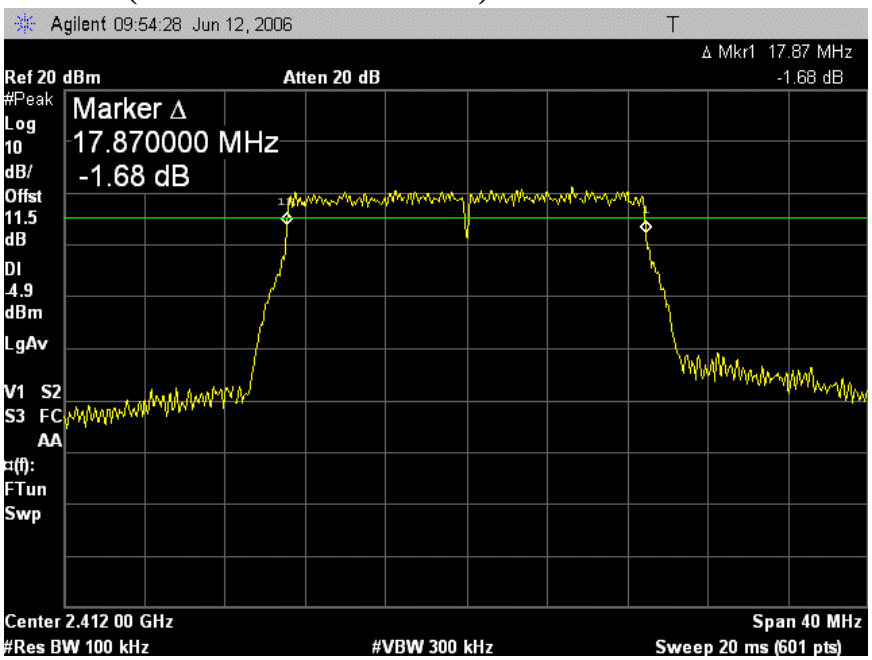
(802.11 HT20 MODE CHAIN B)

LOW CH (802.11n HT20 mode chain B)



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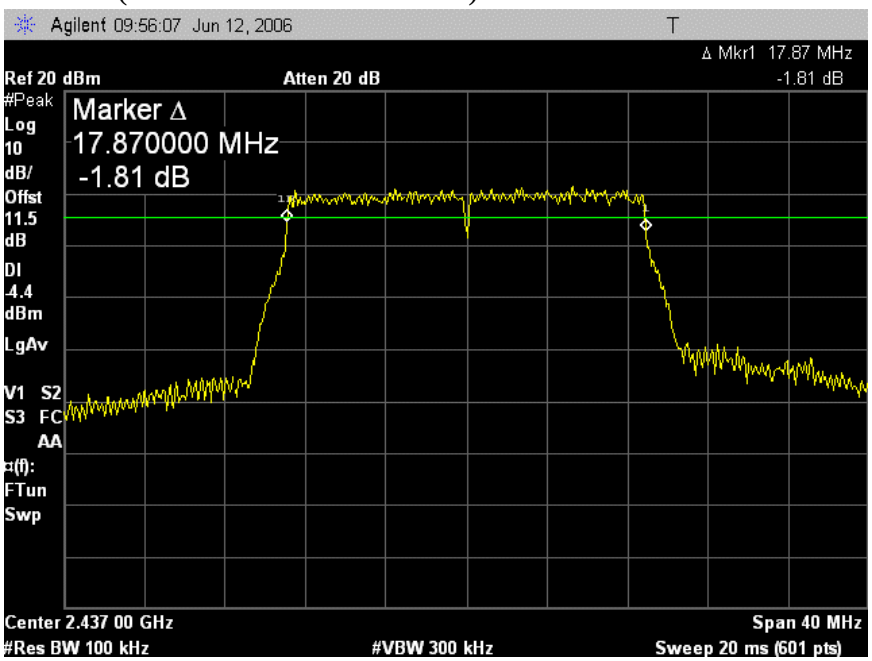
MID CH (802.11n HT20 mode chain B)



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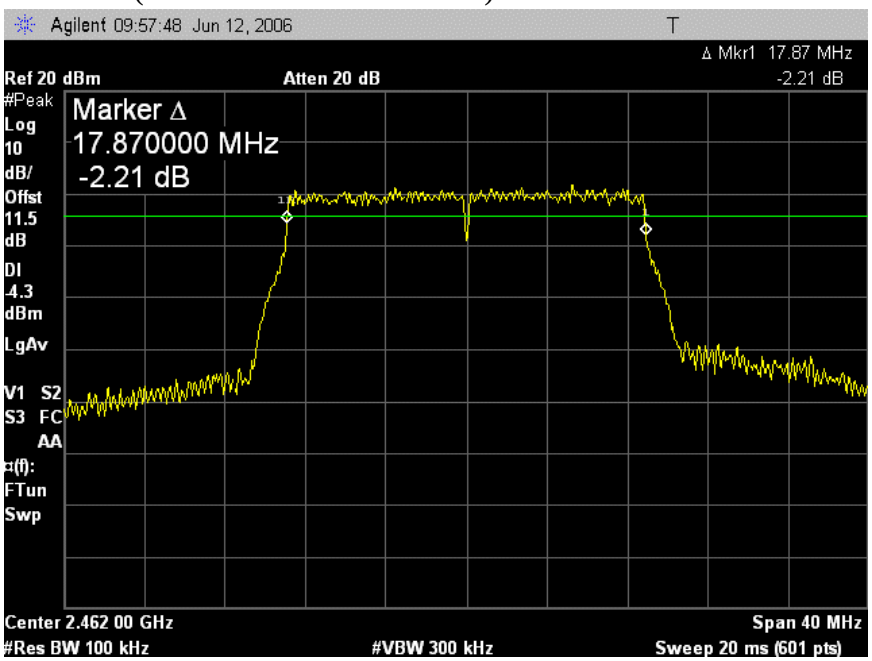
HIGH CH (802.11n HT20 mode chain B)



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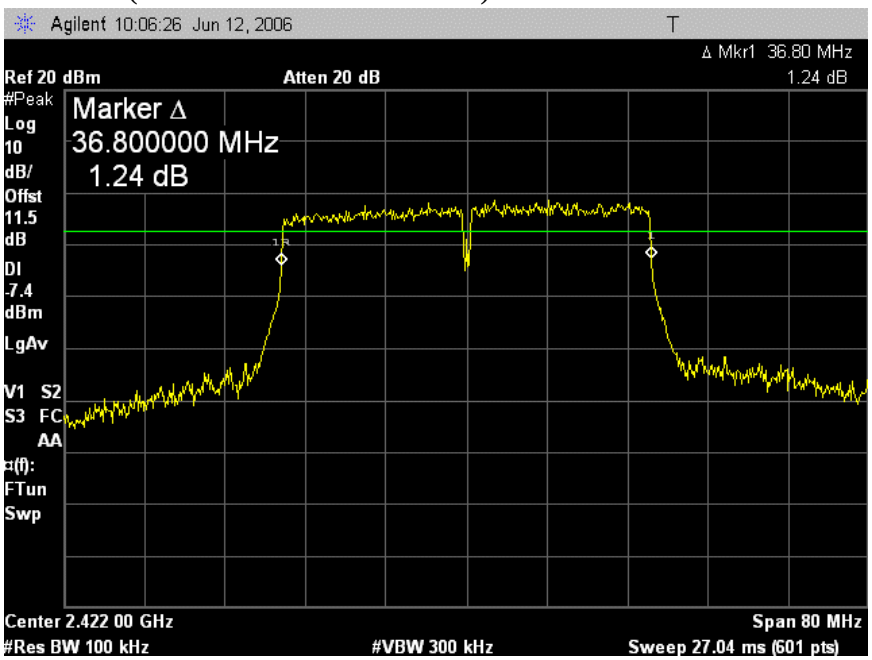
(802.11 HT40 MODE CHAIN A)

LOW CH (802.11n HT40 mode chain A)



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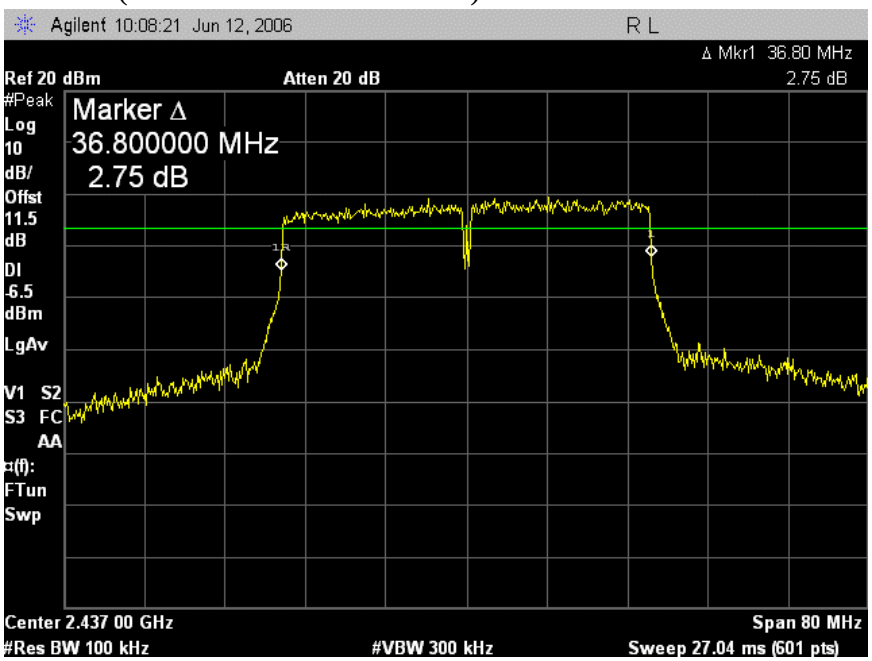
MID CH (802.11n HT40 mode chain A)



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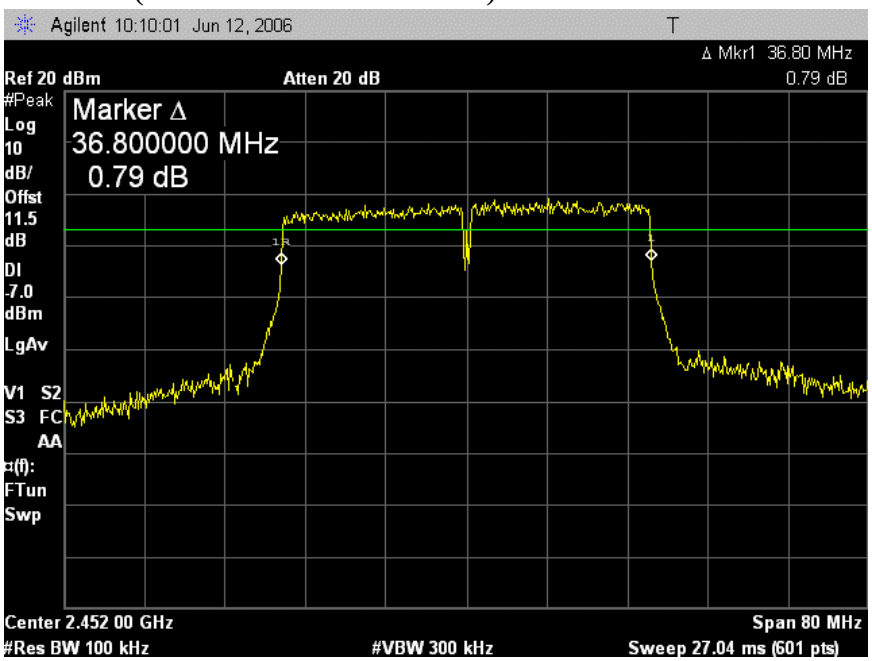
HIGH CH (802.11n HT40 mode chain A)



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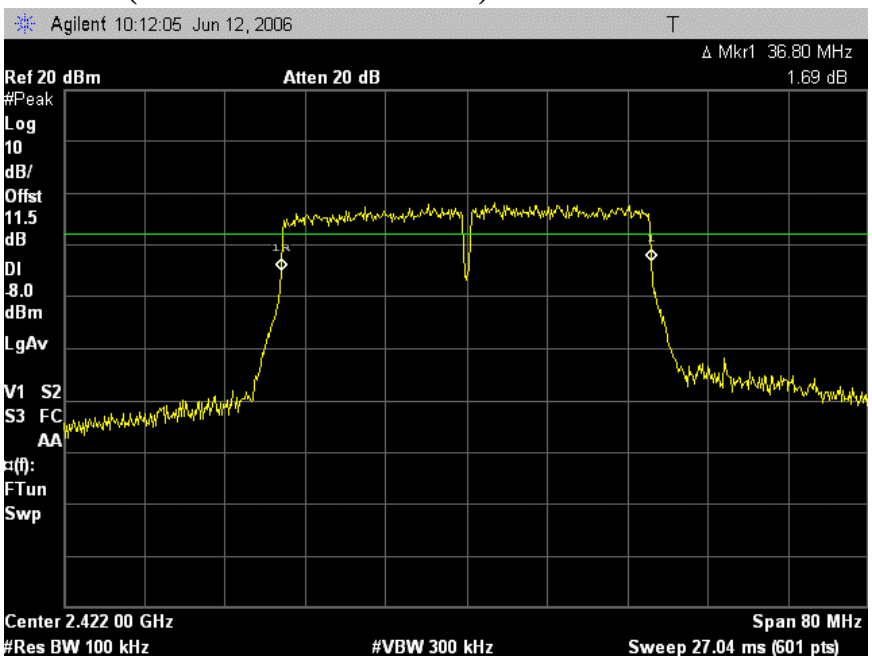
(802.11 HT40 MODE CHAIN B)

LOW CH (802.11n HT40 mode chain B)



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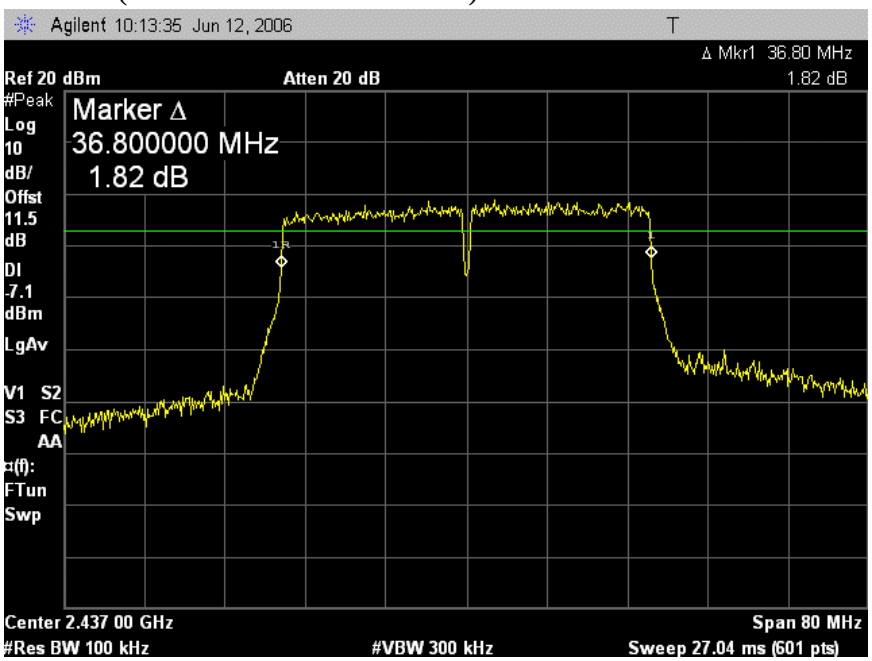
MID CH (802.11n HT40 mode chain B)



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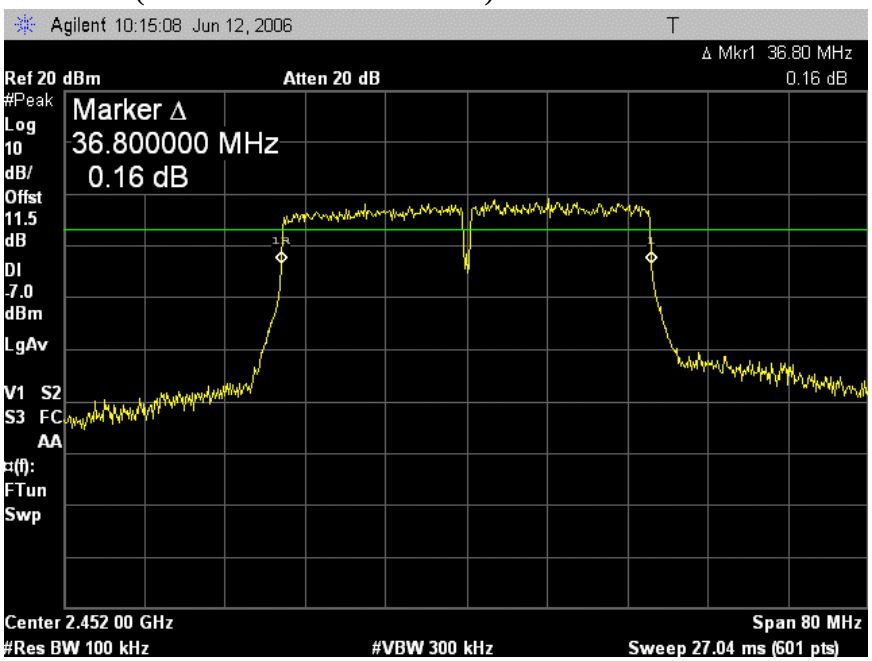
HIGH CH (802.11n HT40 mode chain B)



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7.1.2. 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

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RESULTS

No non-compliance noted:

Mode Channel	Frequency (MHz)	99% BW Chain A (MHz)	99% BW Chain B (MHz)
802.11b Mode			
Low	2412	13.2413	13.1906
Middle	2437	13.2601	13.2695
High	2462	13.2430	13.1940
802.11g 20M Mode			
Low	2412	16.5092	16.4964
Middle	2437	16.5079	16.4936
High	2462	16.4928	16.4709
802.11g 40M Mode			
Low	2422	36.5971	36.5592
Middle	2437	36.6026	36.5350
High	2452	36.6003	36.5605
802.11n HT20 Mode			
Low	2412	17.6977	17.6875
Mid	2437	17.6814	17.6926
High	2462	17.6901	17.7137
802.11n HT40 Mode			
Low	2422	36.3713	36.4256
Mid	2437	36.4241	36.4642
High	2452	36.4822	36.4873

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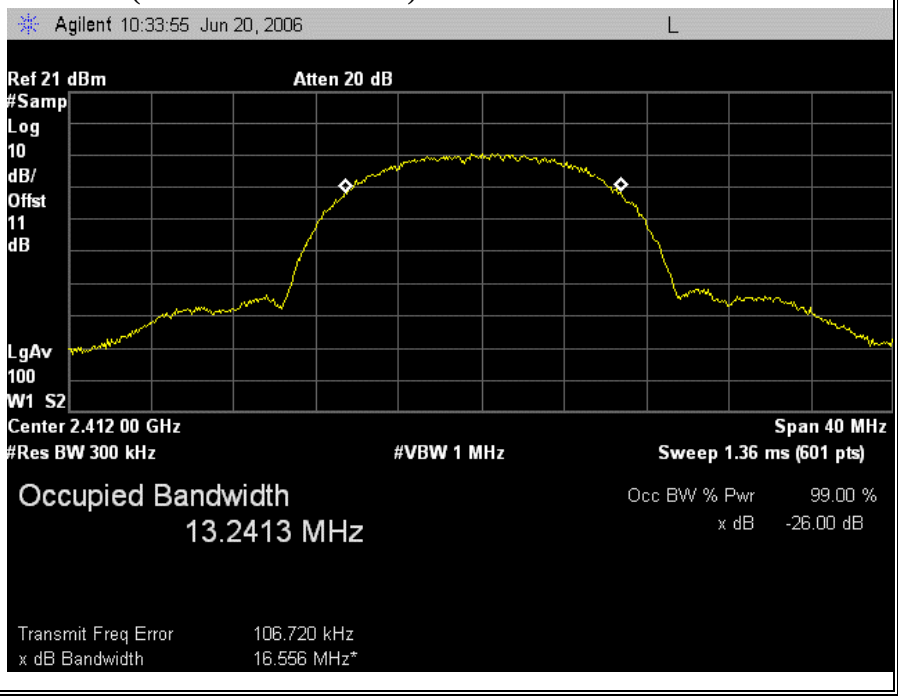
(802.11b MODE CHAIN A)

LOW CH (802.11b mode chain A)



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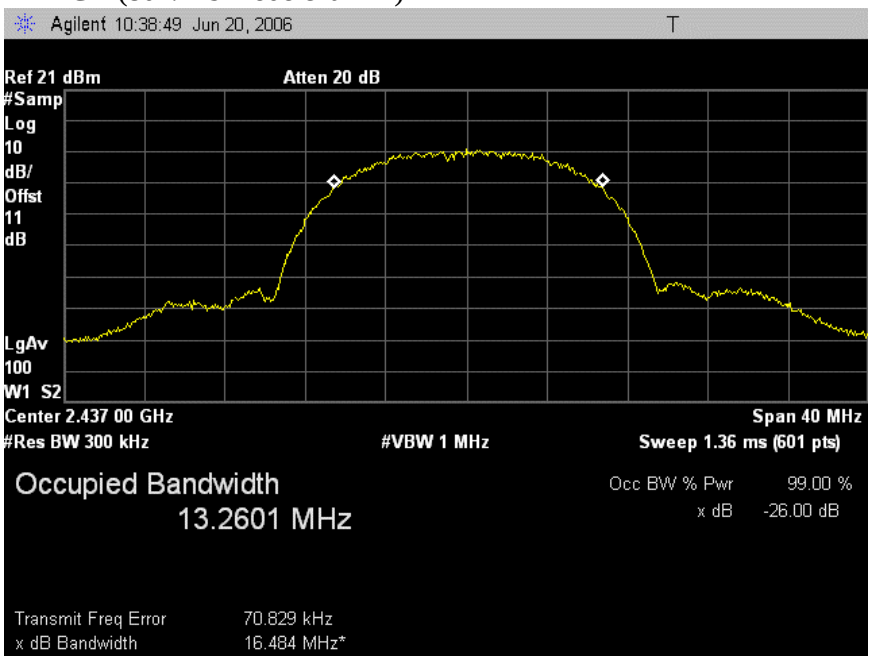
MID CH (802.11b mode chain A)



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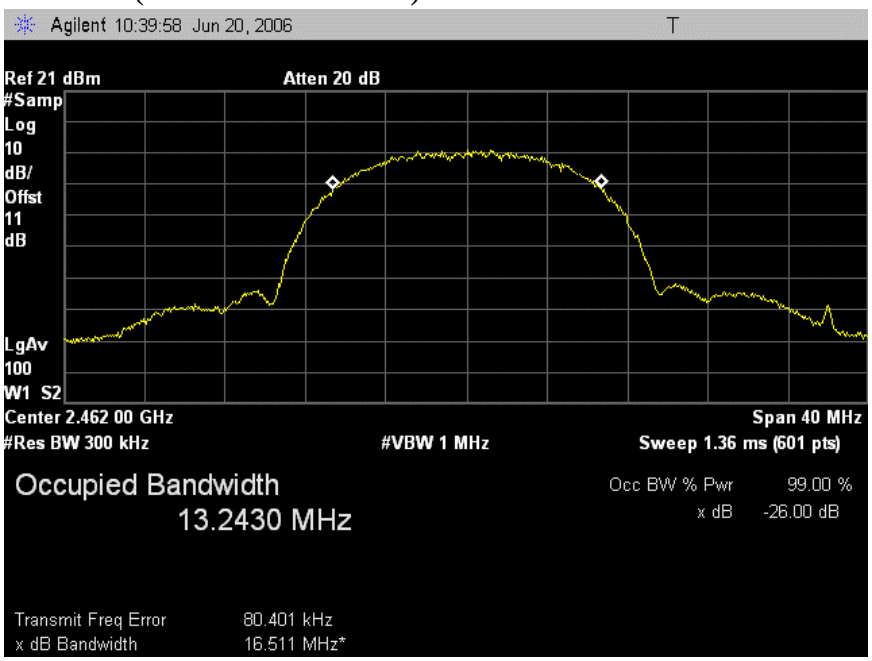
HIGH CH (802.11b mode chain A)



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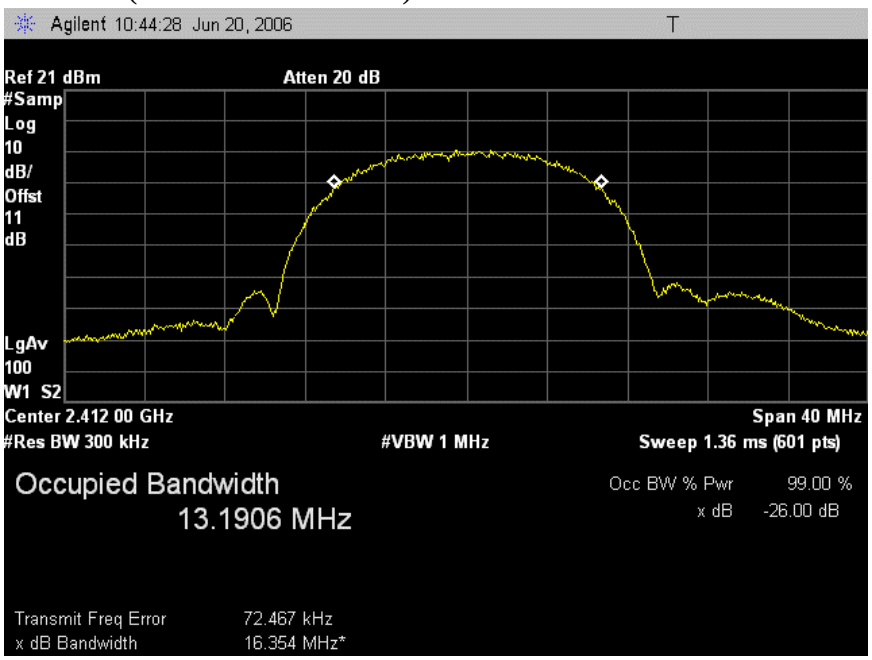
(802.11b MODE CHAIN B)

LOW CH (802.11b mode chain B)



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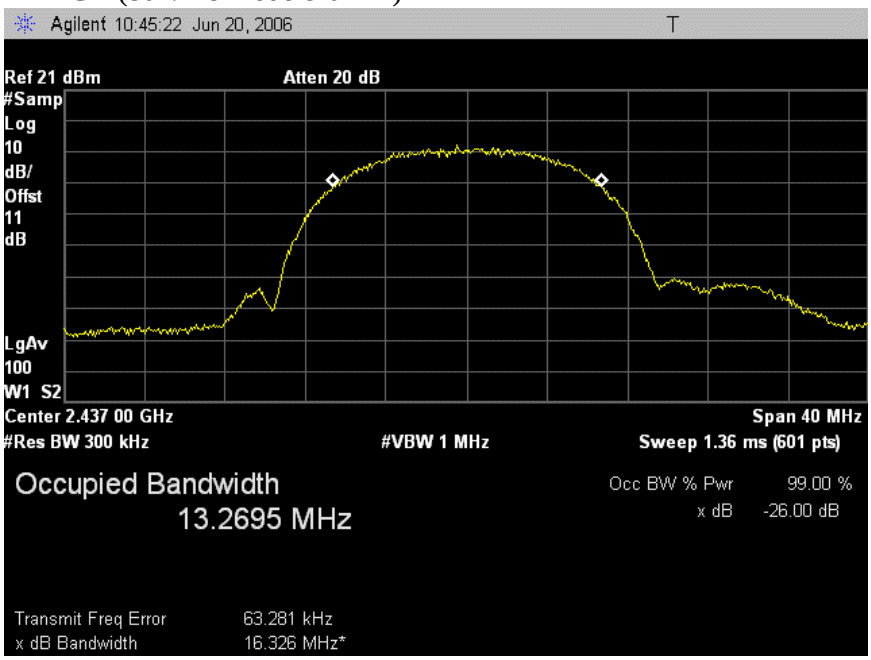
MID CH (802.11b mode chain B)



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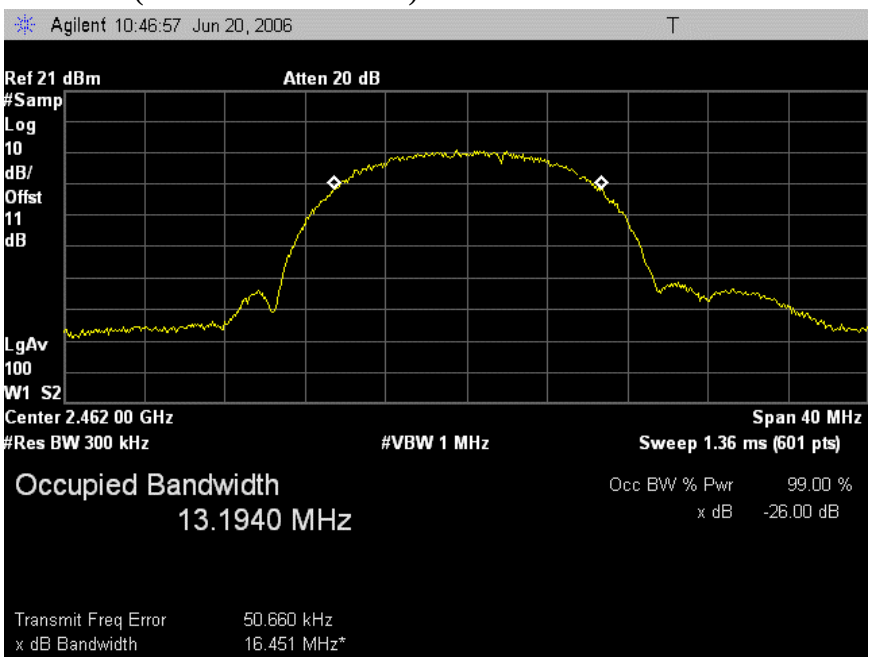
HIGH CH (802.11b mode chain B)



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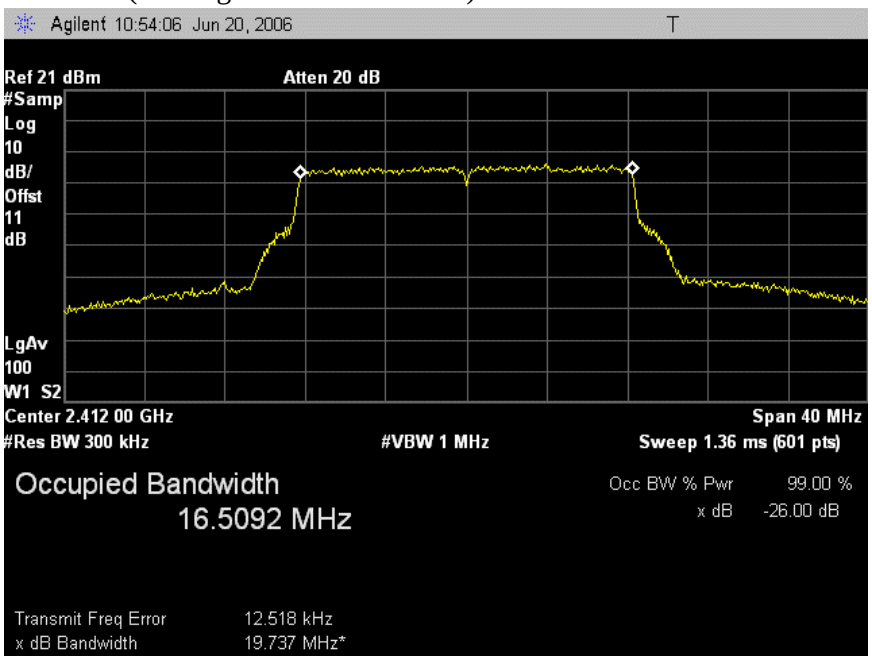
(802.11g 20M MODE CHAIN A)

LOW CH (802.11g 20M mode chain A)



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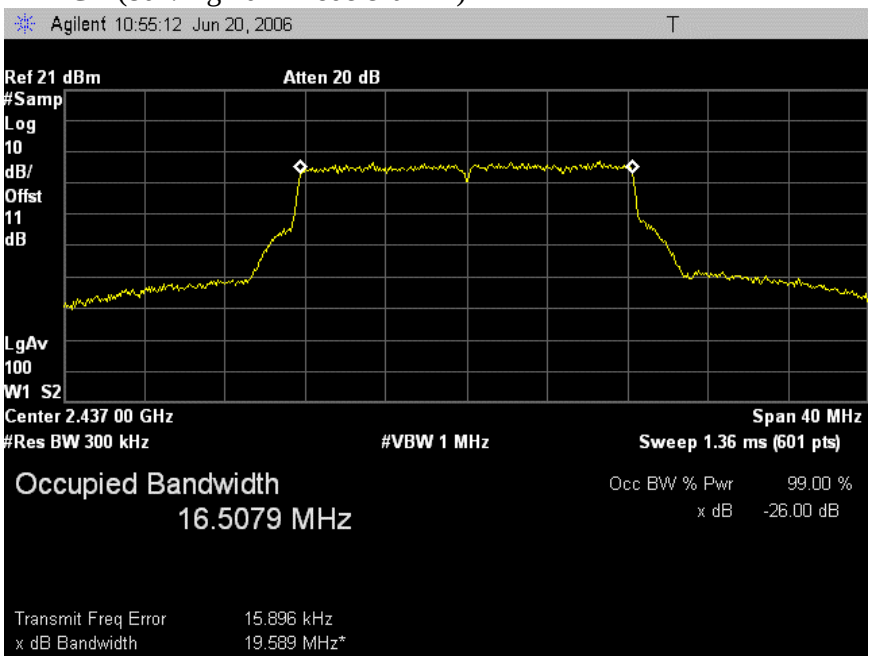
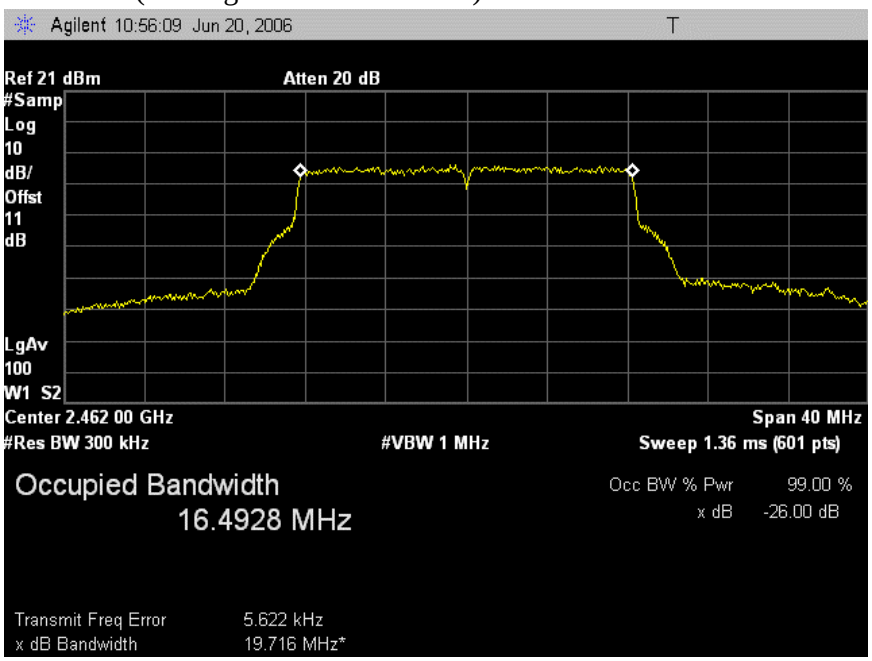
MID CH (802.11g 20M mode chain A)



This report shall not be reproduced except in full, without the written approval of CCS.

HIGH CH (802.11g 20M mode chain A)



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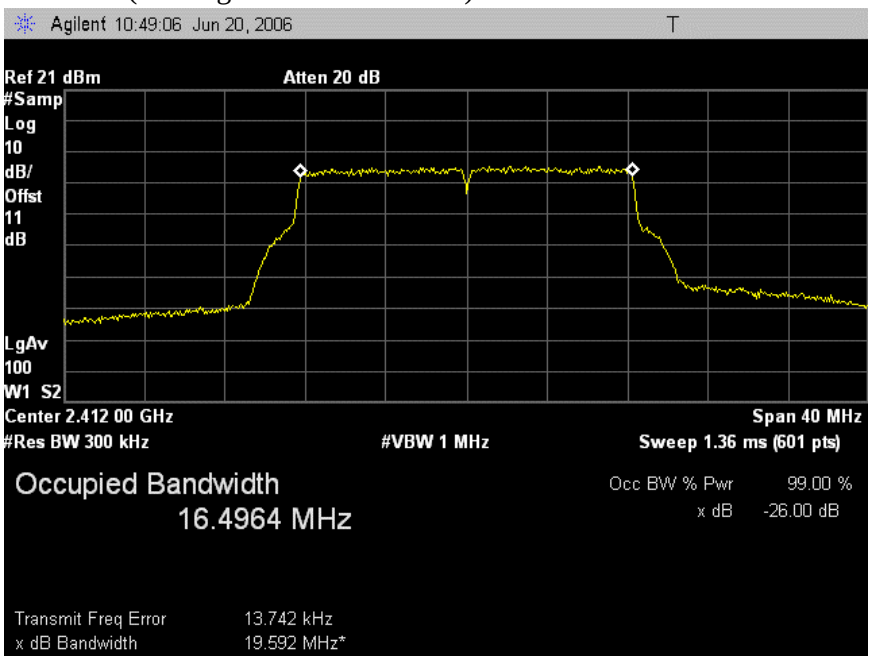
(802.11g 20M MODE CHAIN B)

LOW CH (802.11g 20M mode chain B)



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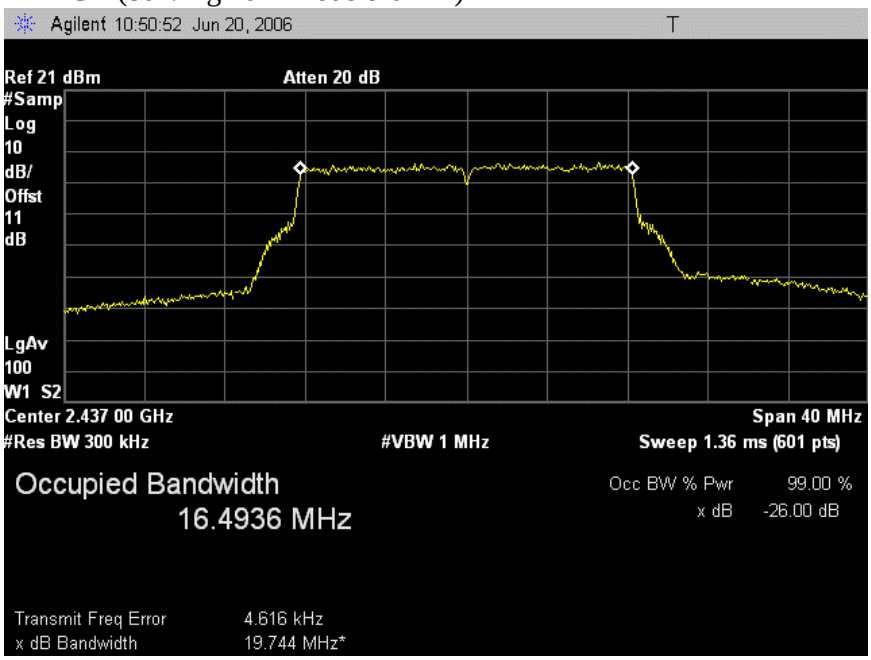
MID CH (802.11g 20M mode chain B)



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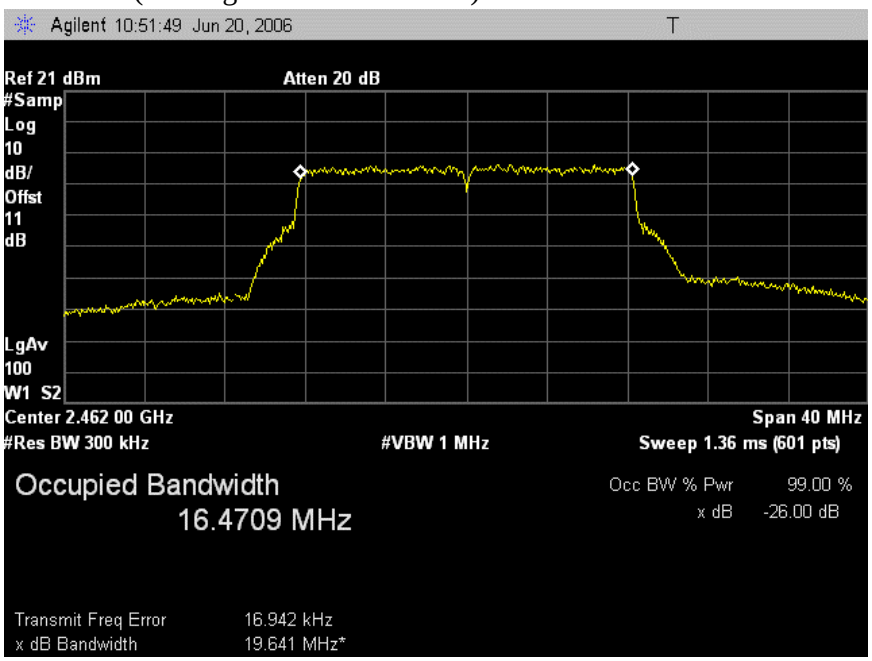
HIGH CH (802.11g 20M mode chain B)



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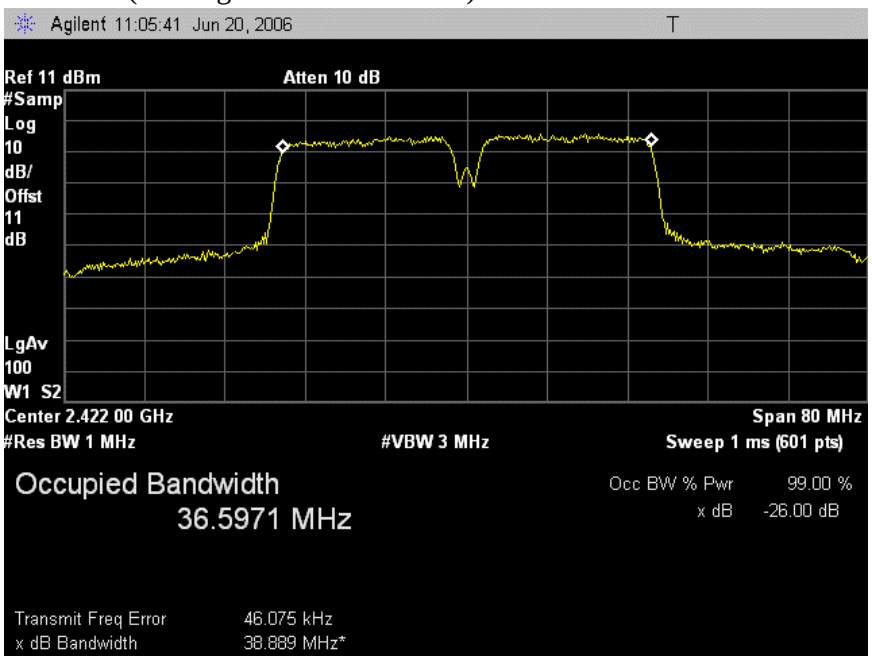
(802.11g 40M MODE CHAIN A)

LOW CH (802.11g 40M mode chain A)



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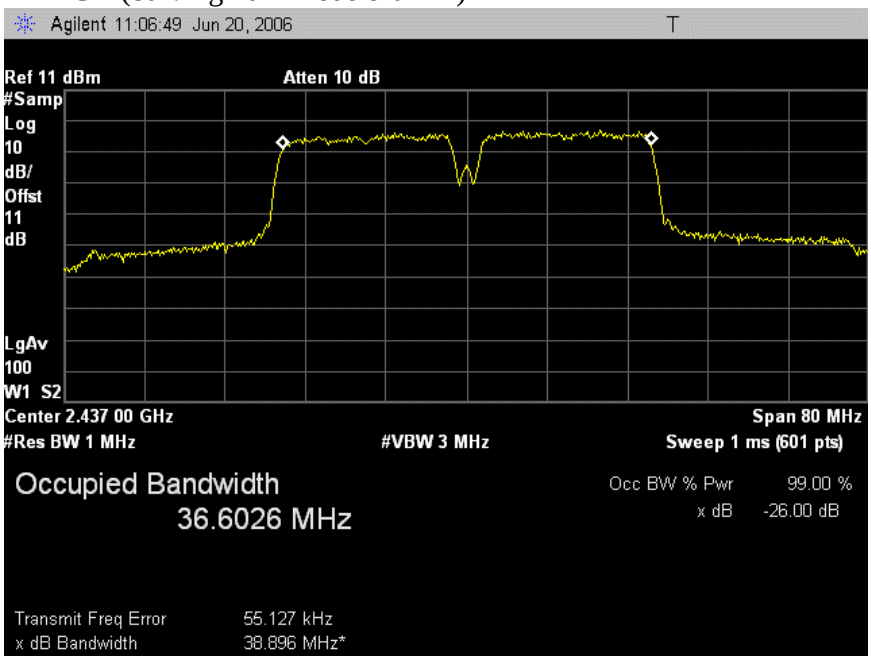
MID CH (802.11g 40M mode chain A)



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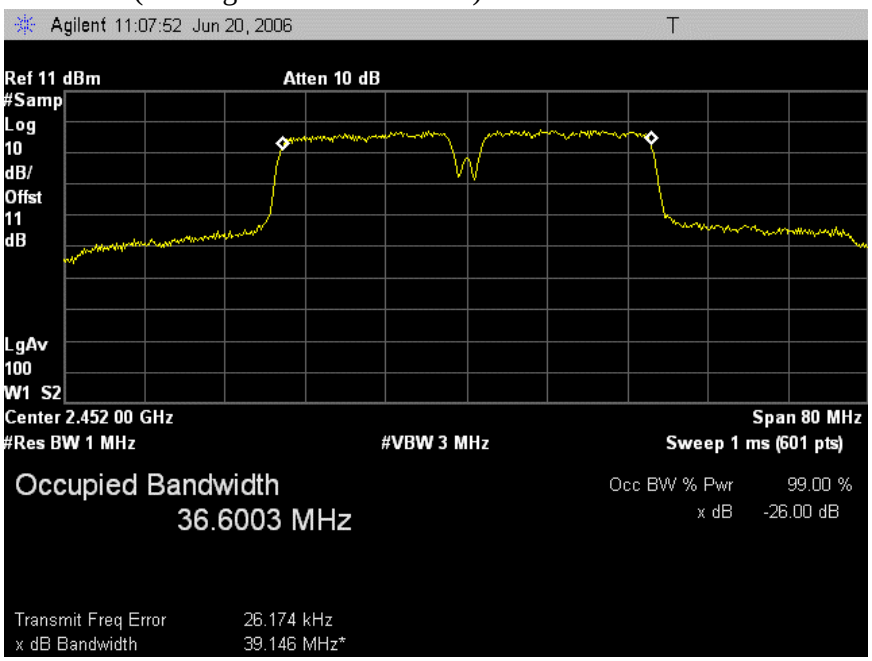
HIGH CH (802.11g 40M mode chain A)



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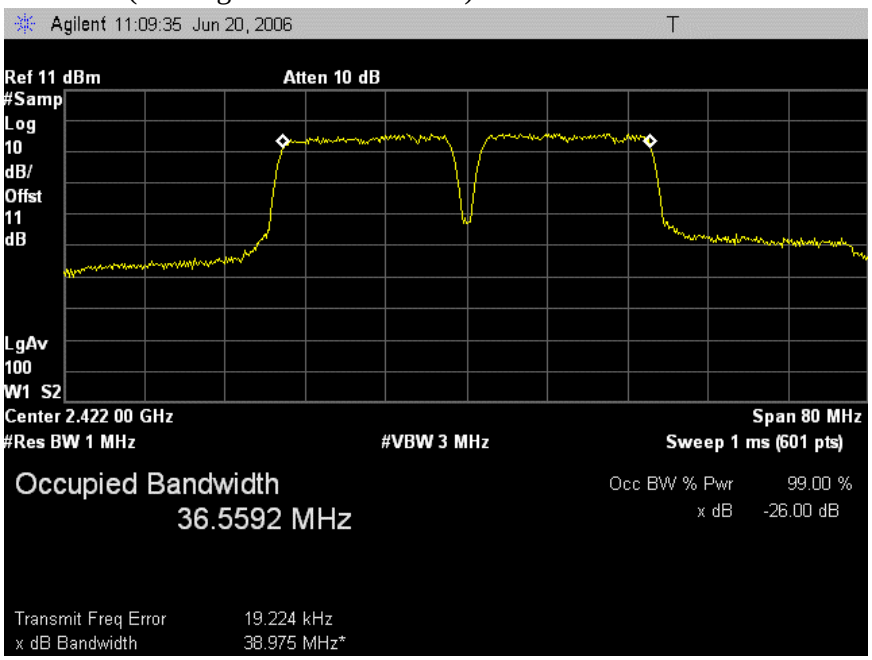
(802.11g 40M MODE CHAIN B)

LOW CH (802.11g 40M mode chain B)



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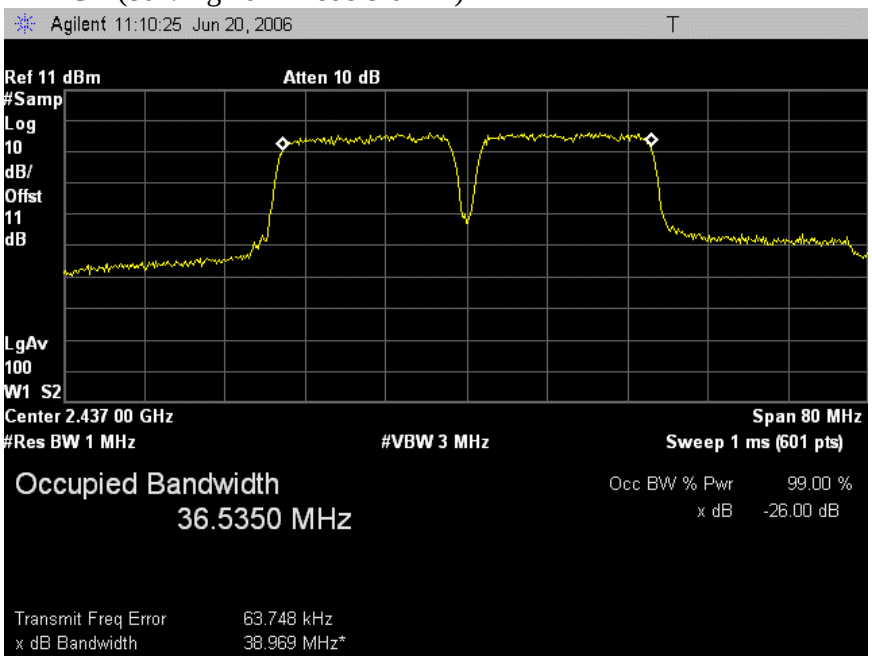
MID CH (802.11g 40M mode chain B)



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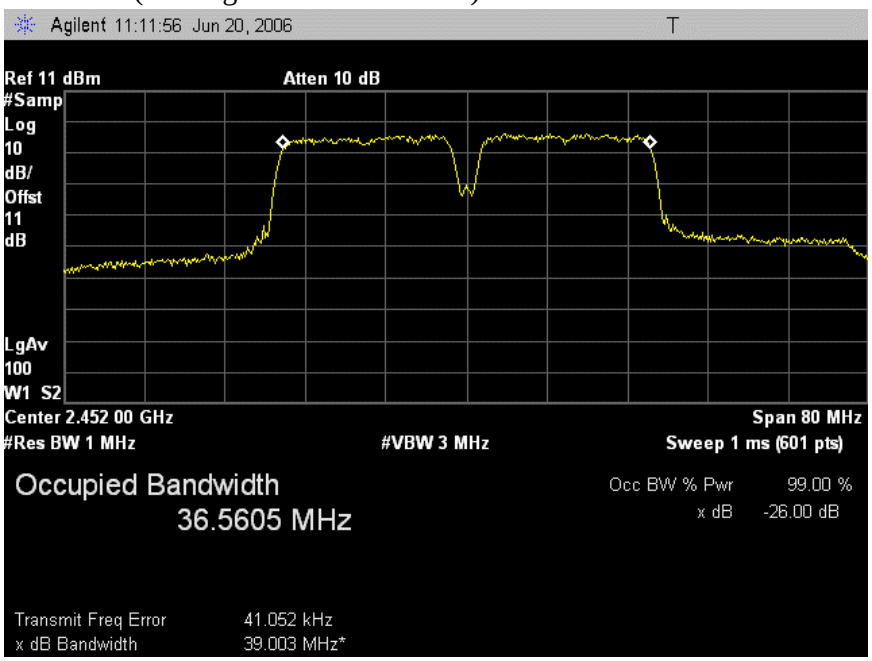
HIGH CH (802.11g 40M mode chain B)



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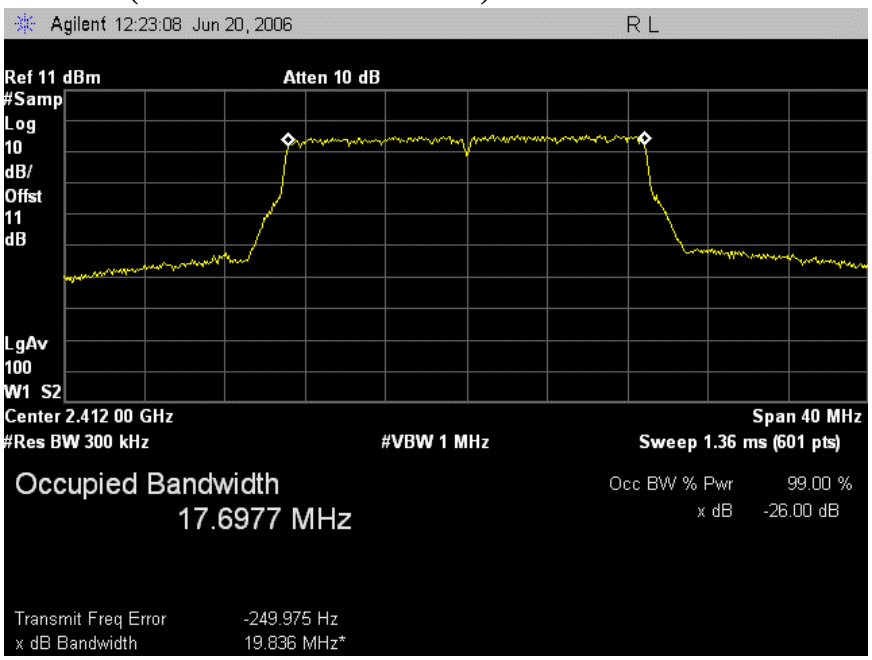
(802.11n HT20 MODE CHAIN A)

LOW CH (802.11n HT20 mode chain A)



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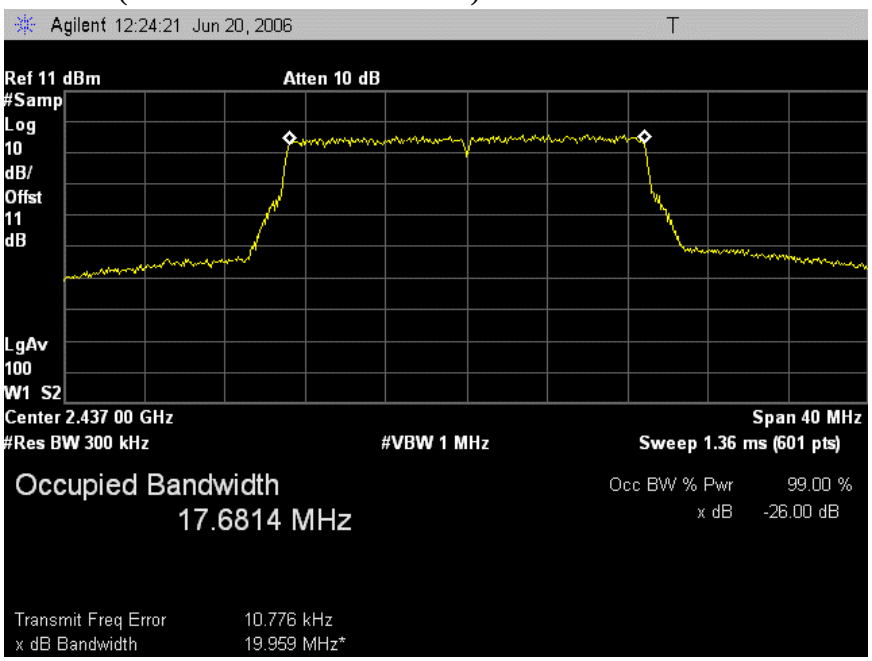
MID CH (802.11n HT20 mode chain A)



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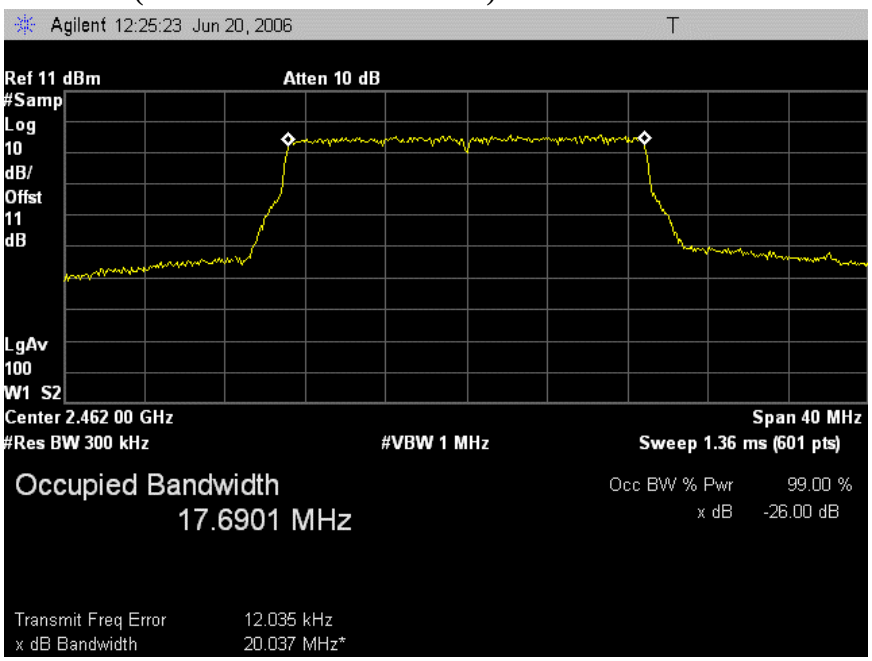
HIGH CH (802.11n HT20 mode chain A)



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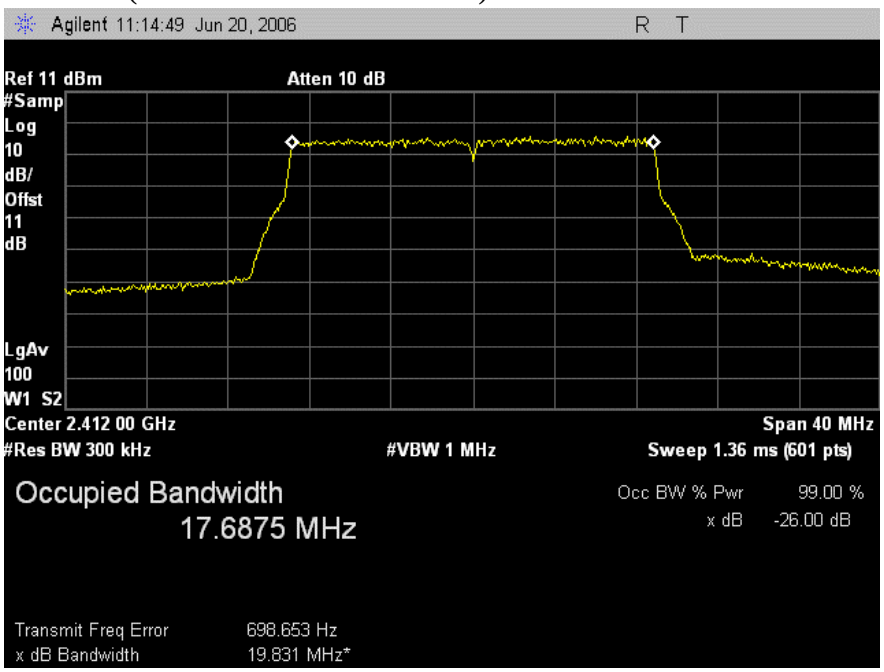
(802.11 HT20 MODE CHAIN B)

LOW CH (802.11n HT20 mode chain B)



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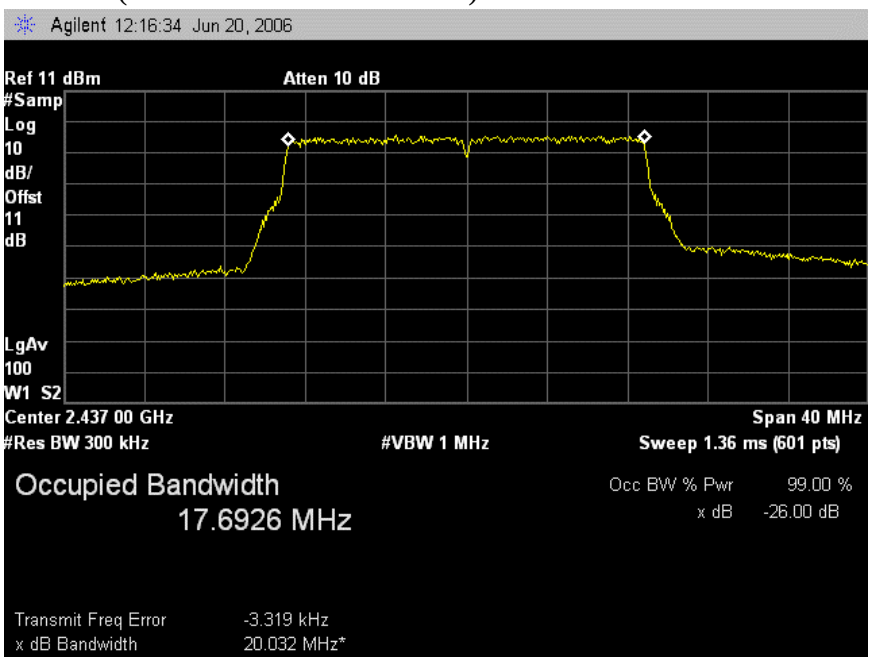
MID CH (802.11n HT20 mode chain B)



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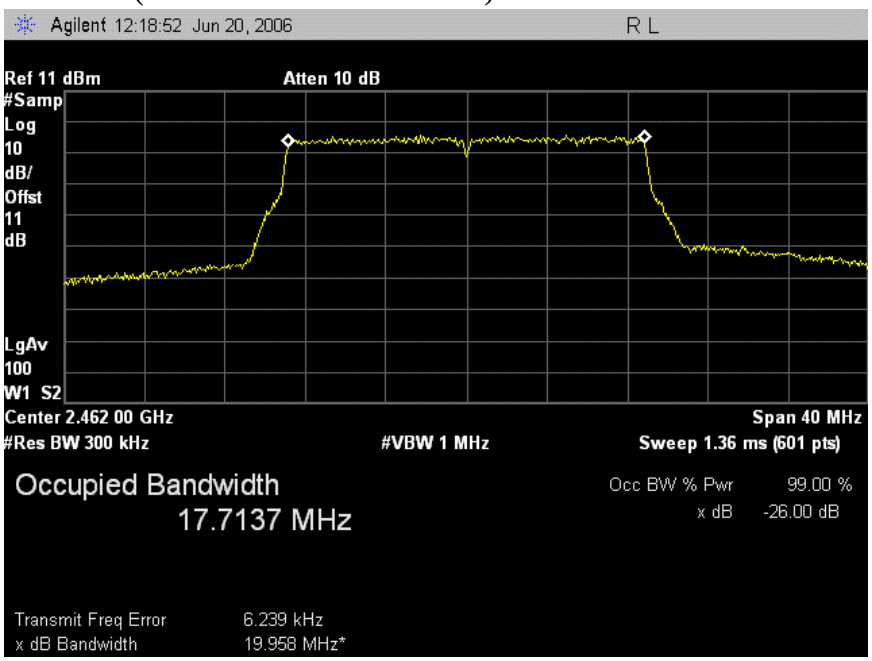
HIGH CH (802.11n HT20 mode chain B)



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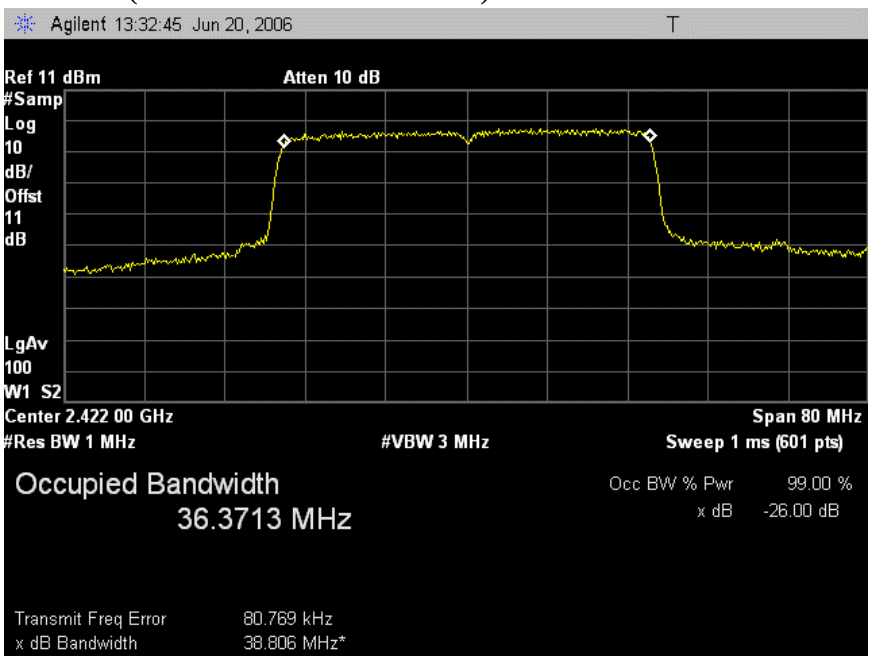
(802.11 HT40 MODE CHAIN A)

LOW CH (802.11n HT40 mode chain A)



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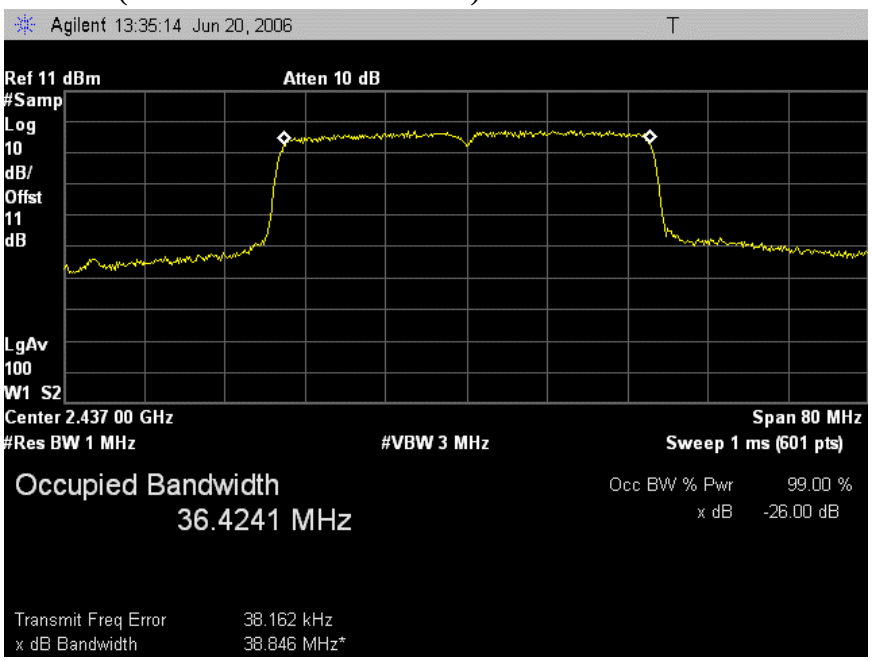
MID CH (802.11n HT40 mode chain A)



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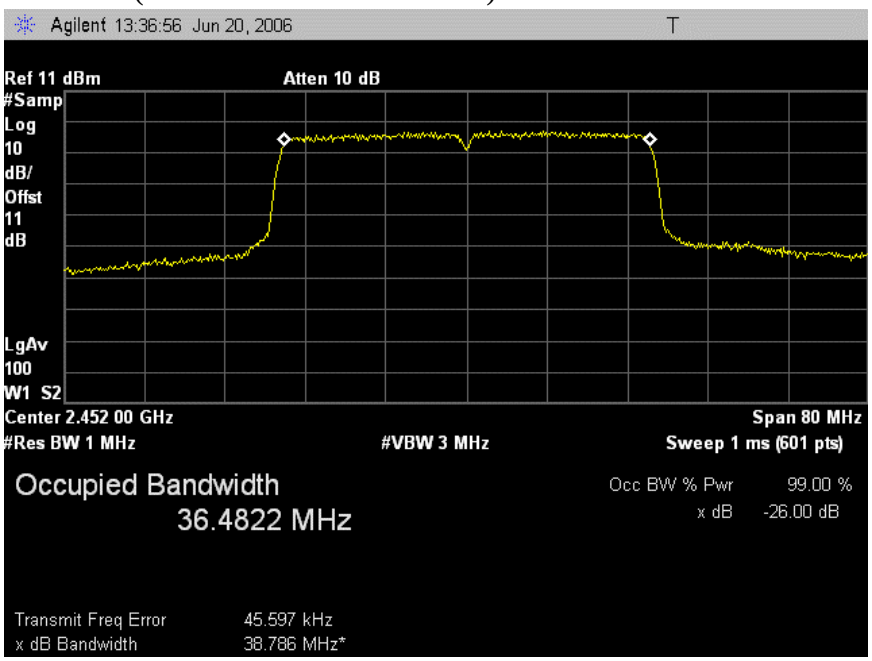
HIGH CH (802.11n HT40 mode chain A)



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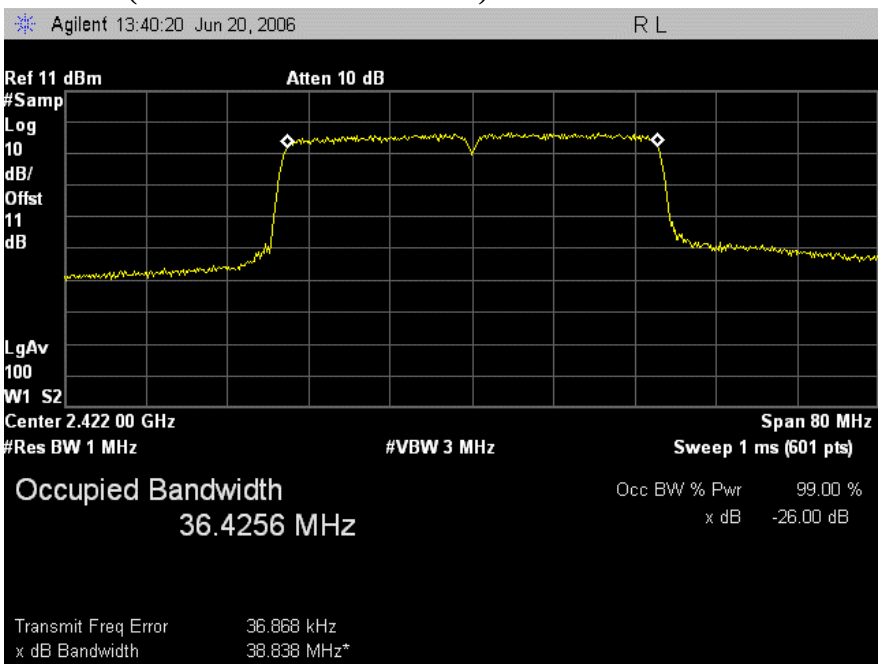
(802.11 HT40 MODE CHAIN B)

LOW CH (802.11n HT40 mode chain B)



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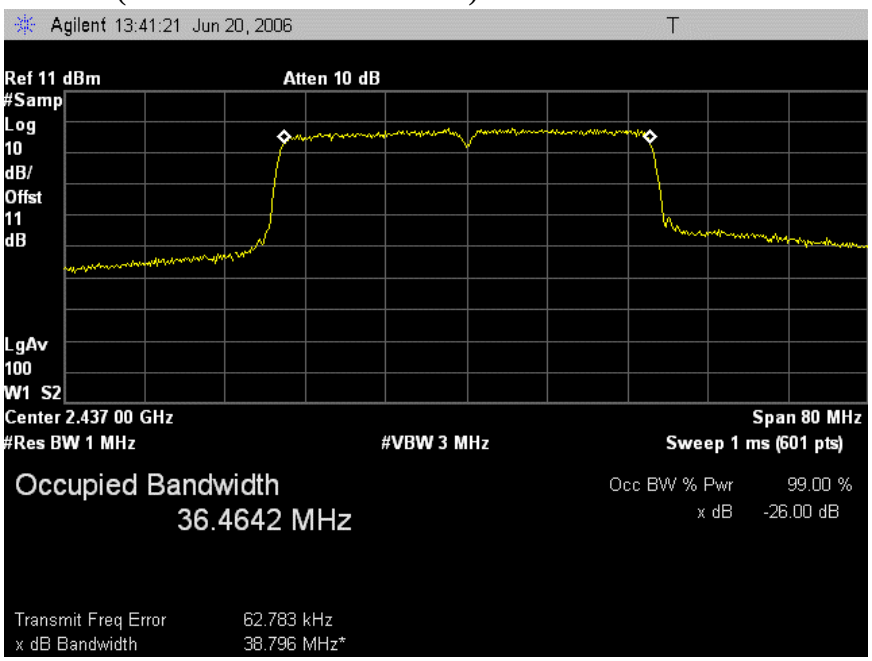
MID CH (802.11n HT40 mode chain B)



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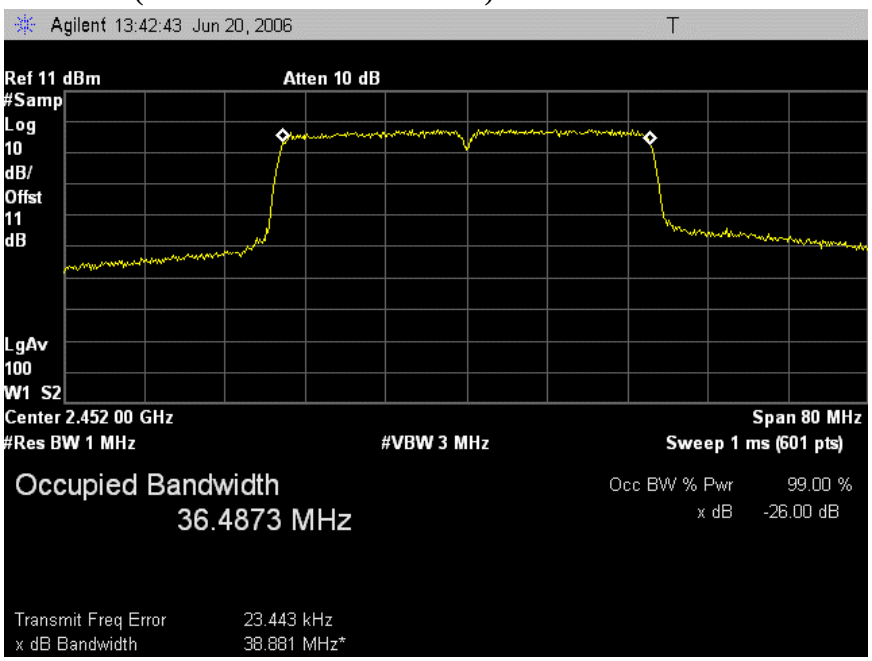
HIGH CH (802.11n HT40 mode chain B)



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7.1.3. PEAK OUTPUT POWER

LIMIT

§15.247 (b) The maximum peak output power of the intentional radiator shall not exceed the following:

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz , and 5725-5850 MHz bands: 1 watt.

§15.247 (b) (4) (i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer and the analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99% bandwidth.

Each chain is measured separately and the total power is calculated using:

Total Power = 10 log (10^ (Chain 0 Power / 10) + 10^ (Chain 2 Power / 10))

Effective Legacy Gain = antenna gain + 10 log(# Tx Chains)

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RESULTS

No non-compliance noted:

Antenna Gain (dBi)	1.9
10 Log (# Tx Chains)	3.01
Effective Legacy Gain	4.91

Mode Channel	Frequency (MHz)	Max Power Chain A (dBm)	Max Power Chain B (dBm)	Max Power Total (dBm)	Limit (dBm)	Margin (dB)
802.11b Mode						
Low	2412	21.64	21.64	24.65	30.00	-5.35
Middle	2437	22.58	22.33	25.47	30.00	-4.53
High	2462	22.29	22.68	25.50	30.00	-4.50
802.11g 20M Mode						
Low	2412	22.19	22.10	25.16	30.00	-4.84
Middle	2437	24.53	24.02	27.29	30.00	-2.71
High	2462	21.38	21.96	24.69	30.00	-5.31
802.11g 40M Mode						
Low	2422	20.51	20.77	23.65	30.00	-6.35
Middle	2437	20.25	19.64	22.97	30.00	-7.03
High	2452	20.34	20.14	23.25	30.00	-6.75
802.11n HT20 Mode						
Low	2412	20.36	20.38	23.38	30.00	-6.62
Middle	2437	23.13	23.91	26.55	30.00	-3.45
High	2462	20.34	20.14	23.25	30.00	-6.75
802.11n HT40 Mode						
Low	2422	20.95	20.77	23.87	30.00	-6.13
Middle	2437	21.24	21.32	24.29	30.00	-5.71
High	2452	20.92	20.86	23.90	30.00	-6.10

COMPLIANCE CERTIFICATION SERVICES DOCUMENT NO: CCSUP4031A
561F MONTEREY ROAD, MORGAN HILL, CA 95037 USA TEL: (408) 463-0885 FAX: (408) 463-0888
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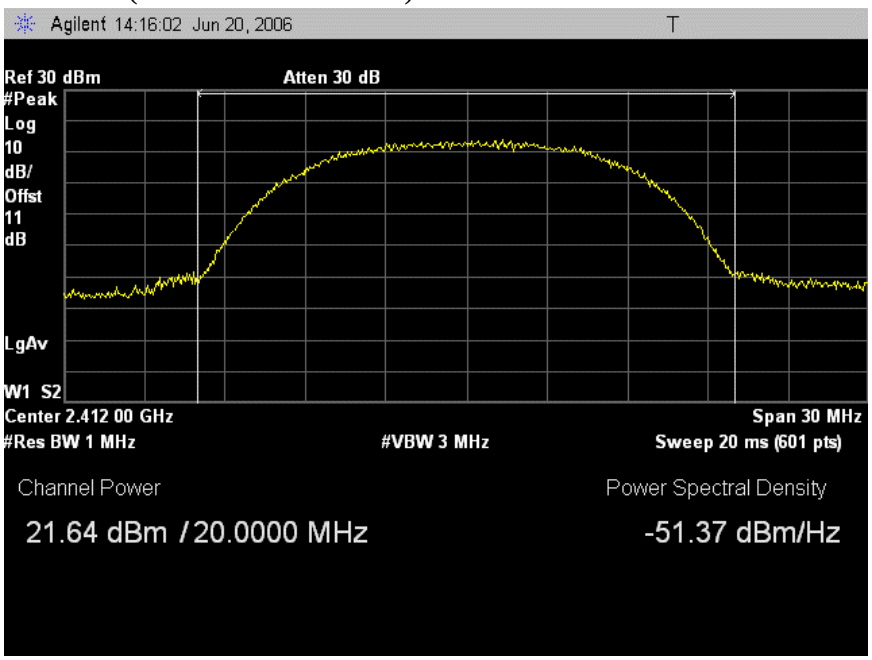
(802.11b MODE CHAIN A)

LOW CH (802.11b mode chain A)



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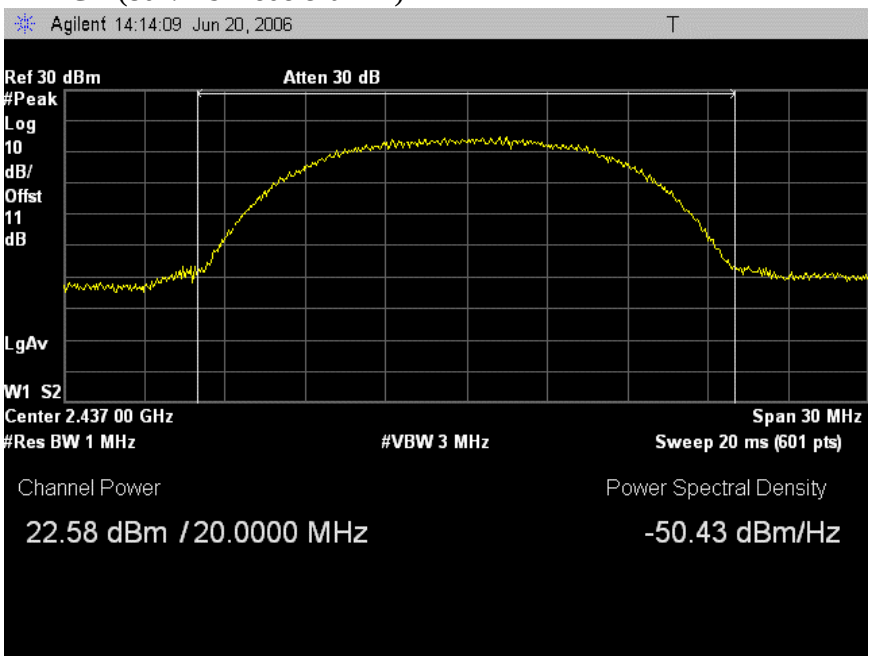
MID CH (802.11b mode chain A)



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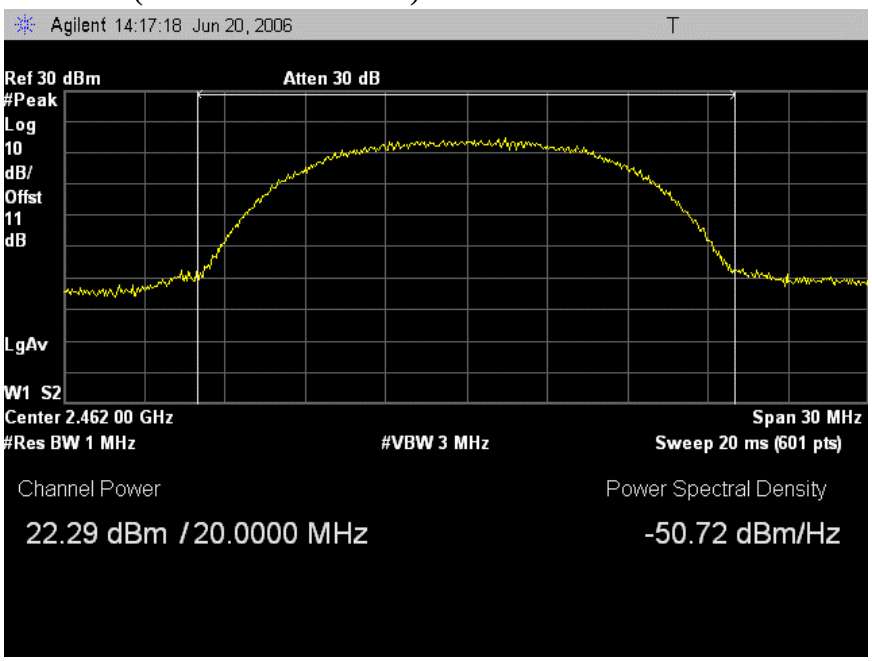
HIGH CH (802.11b mode chain A)



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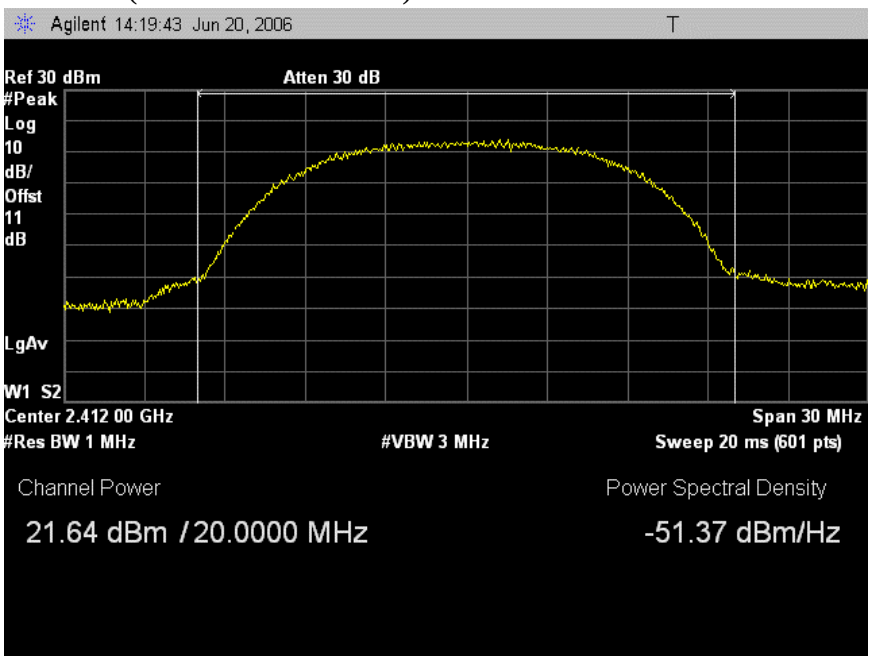
(802.11b MODE CHAIN B)

LOW CH (802.11b mode chain B)



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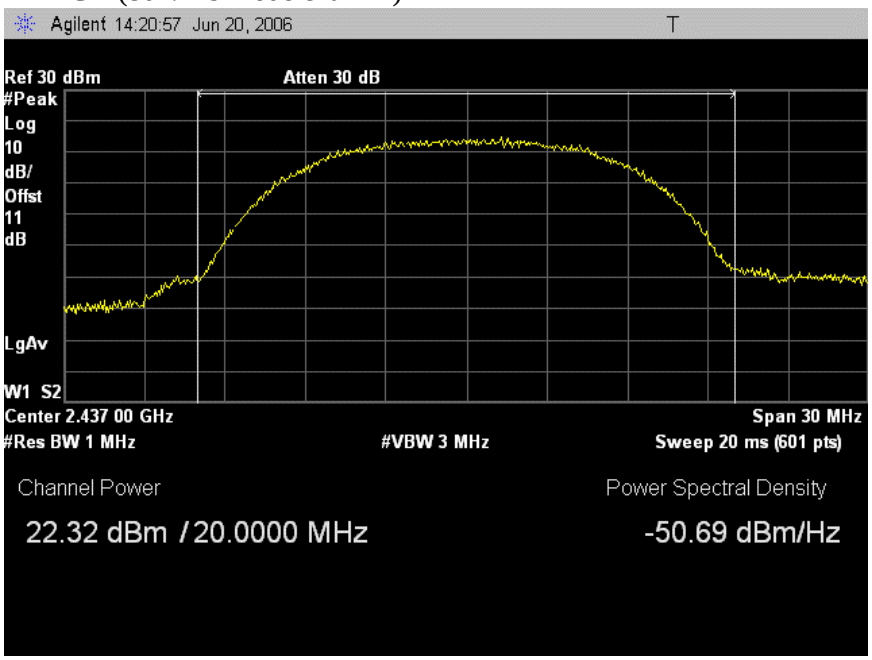
MID CH (802.11b mode chain B)



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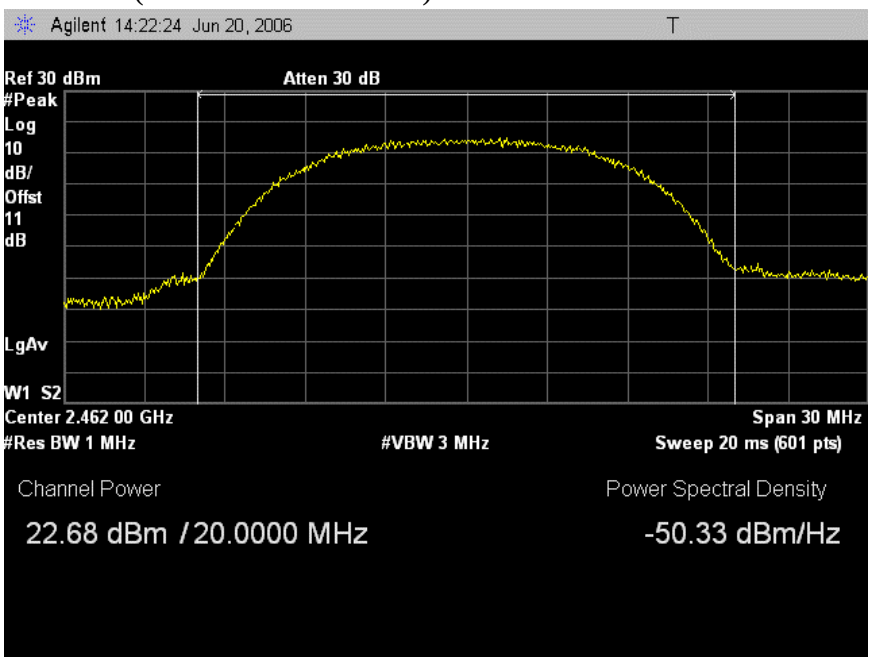
HIGH CH (802.11b mode chain 2B)



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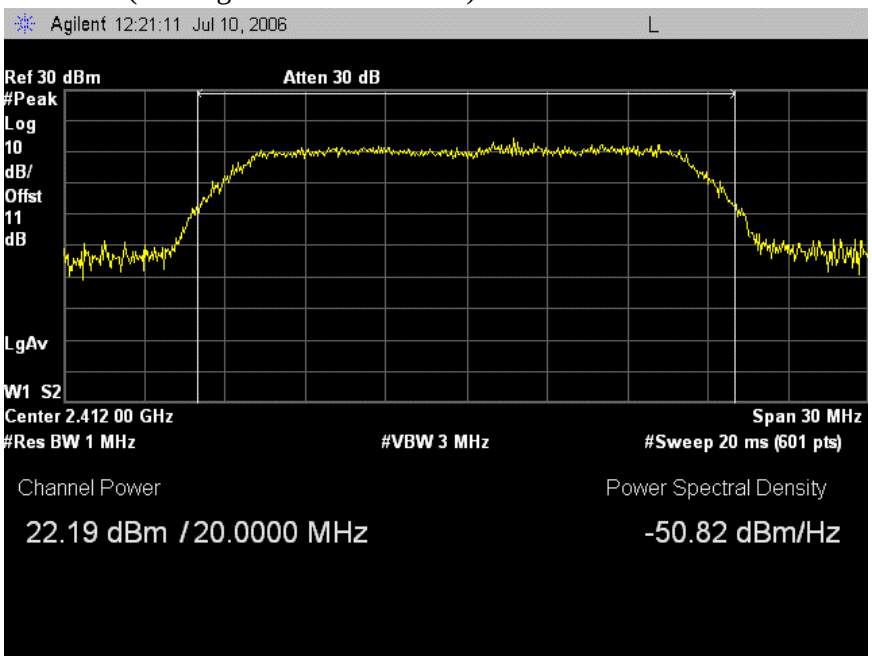
(802.11g 20M MODE CHAIN A)

LOW CH (802.11g 20M mode chain A)



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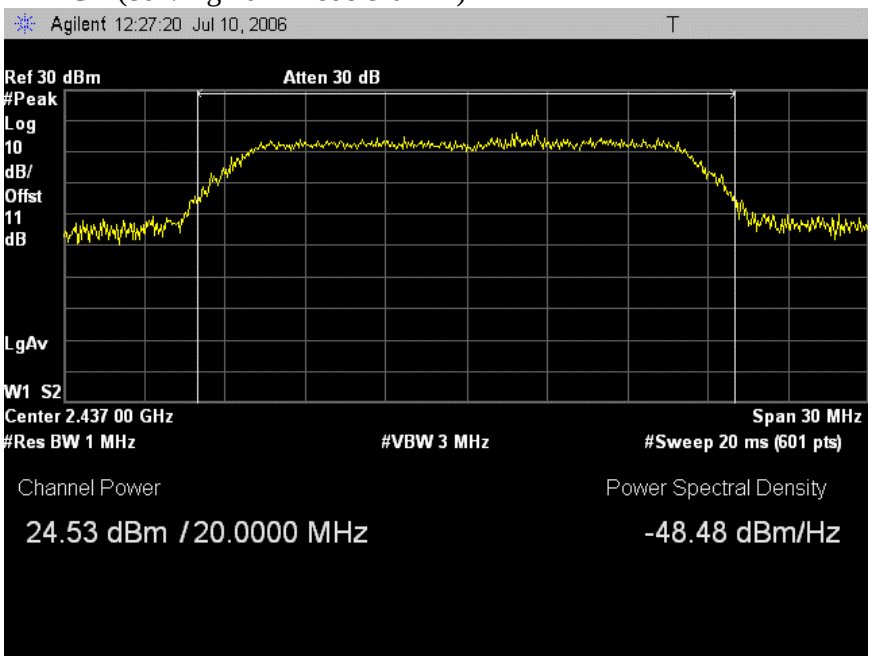
MID CH (802.11g 20M mode chain A)



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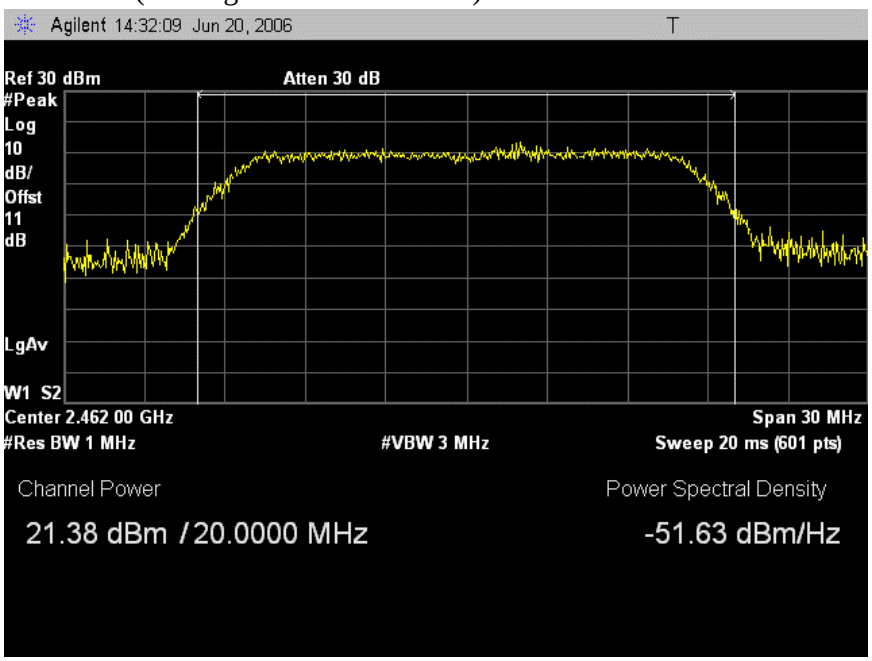
HIGH CH (802.11g 20M mode chain A)



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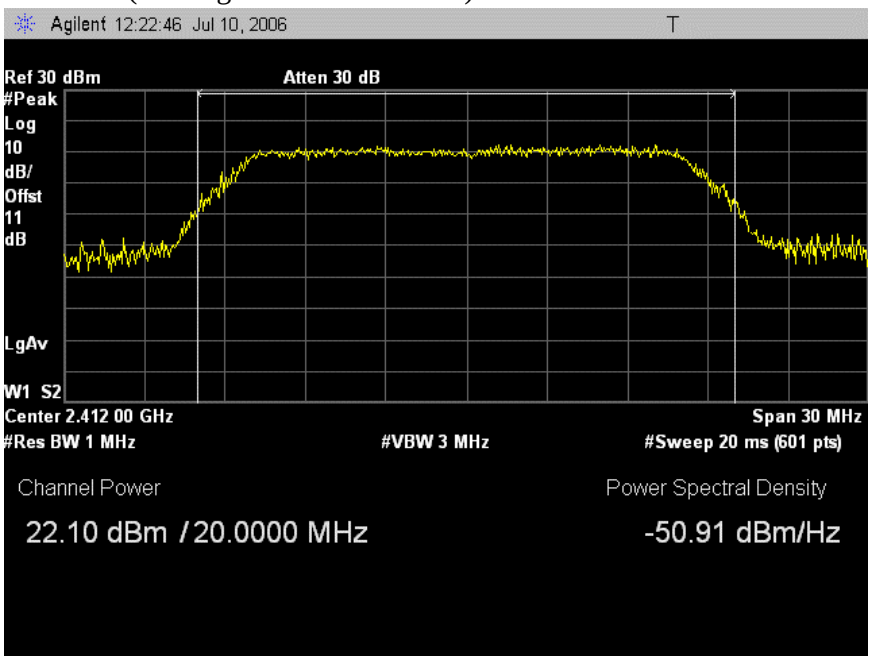
(802.11g 20M MODE CHAIN B)

LOW CH (802.11g 20M mode chain B)



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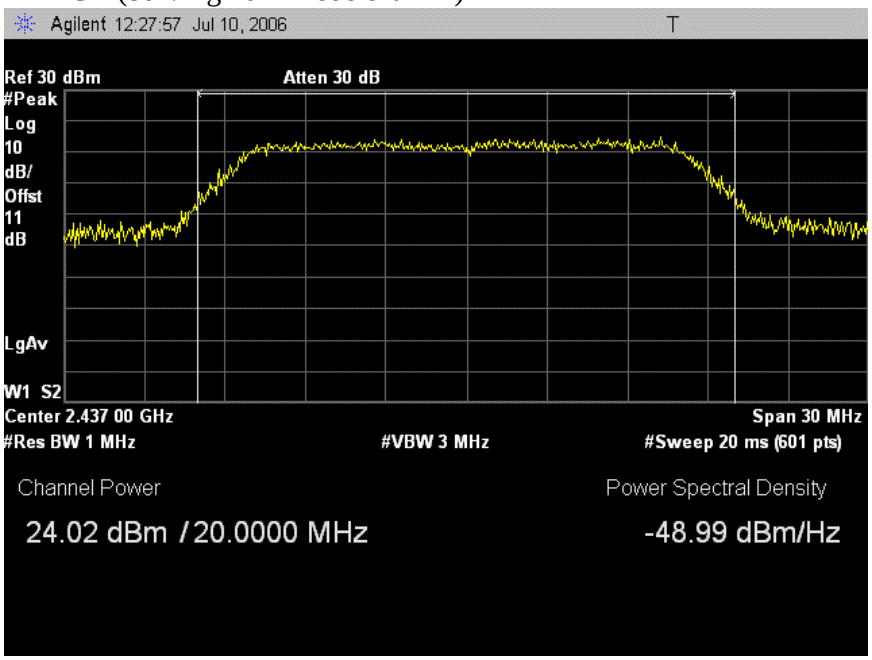
MID CH (802.11g 20M mode chain B)



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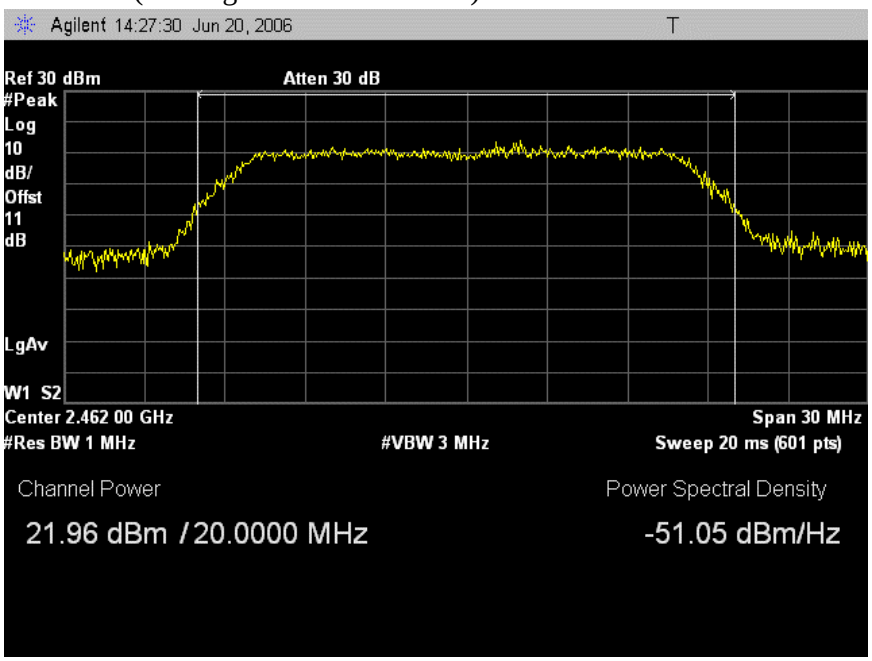
HIGH CH (802.11g 20M mode chain B)



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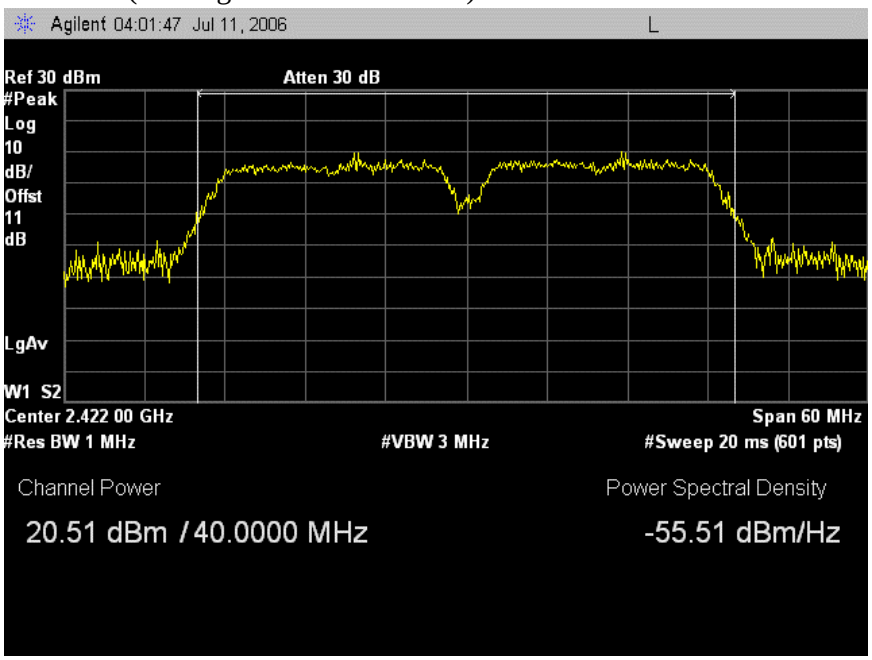
(802.11g 40M MODE CHAIN A)

LOW CH (802.11g 40M mode chain A)



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MID CH (802.11g 40M mode chain A)

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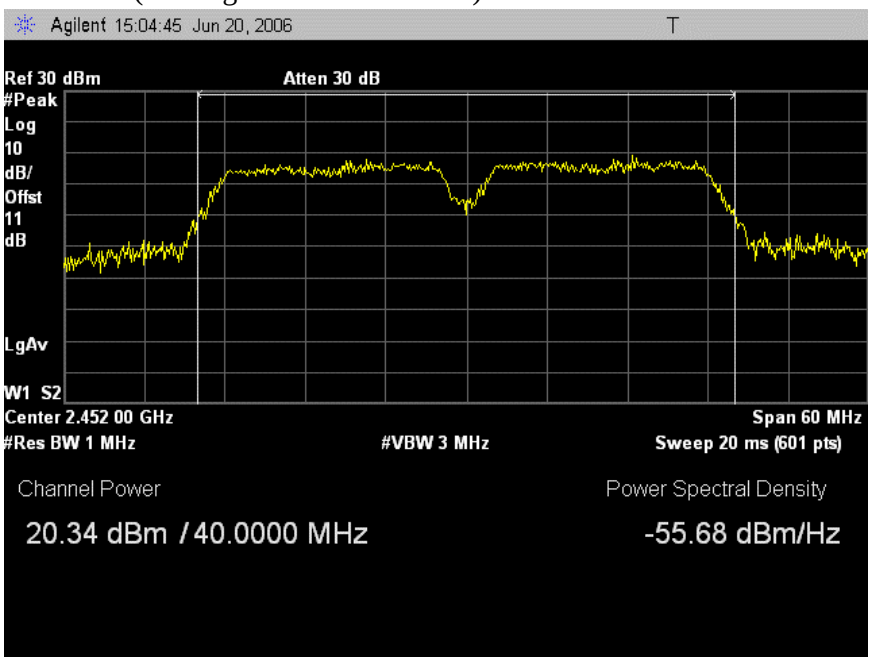
HIGH CH (802.11g 40M mode chain A)



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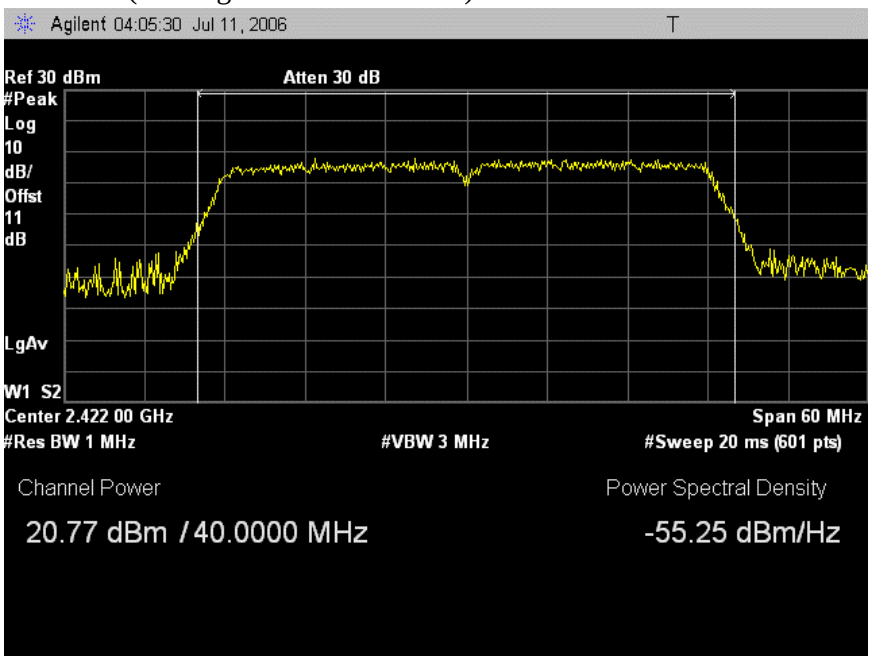
(802.11g 40M MODE CHAIN B)

LOW CH (802.11g 40M mode chain B)



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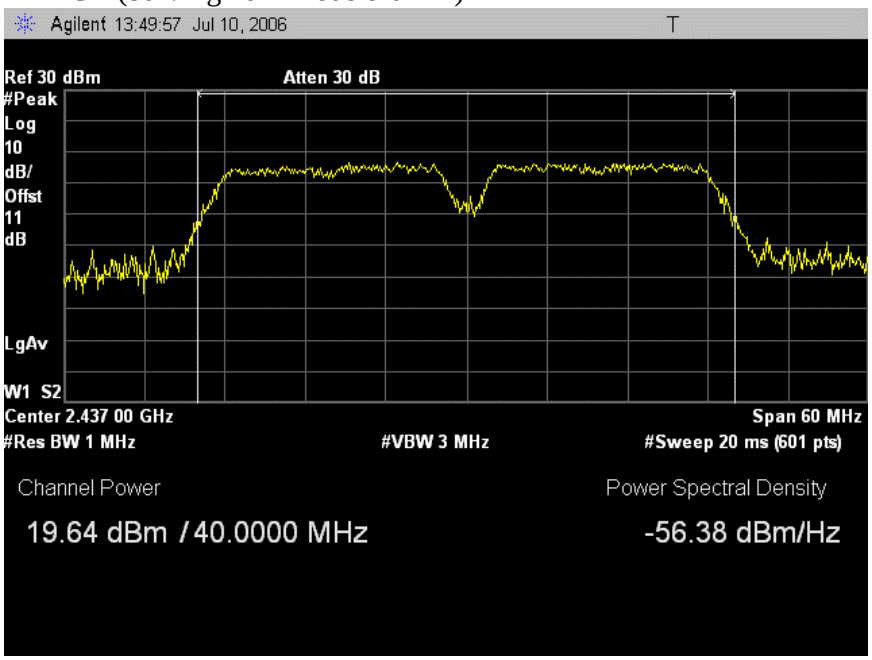
MID CH (802.11g 40M mode chain B)



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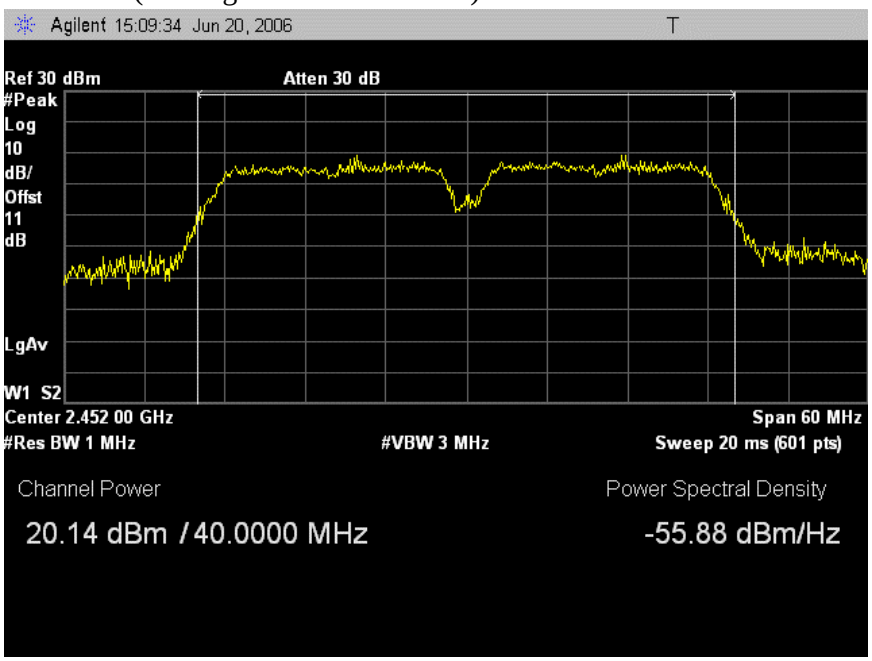
HIGH CH (802.11g 40M mode chain B)



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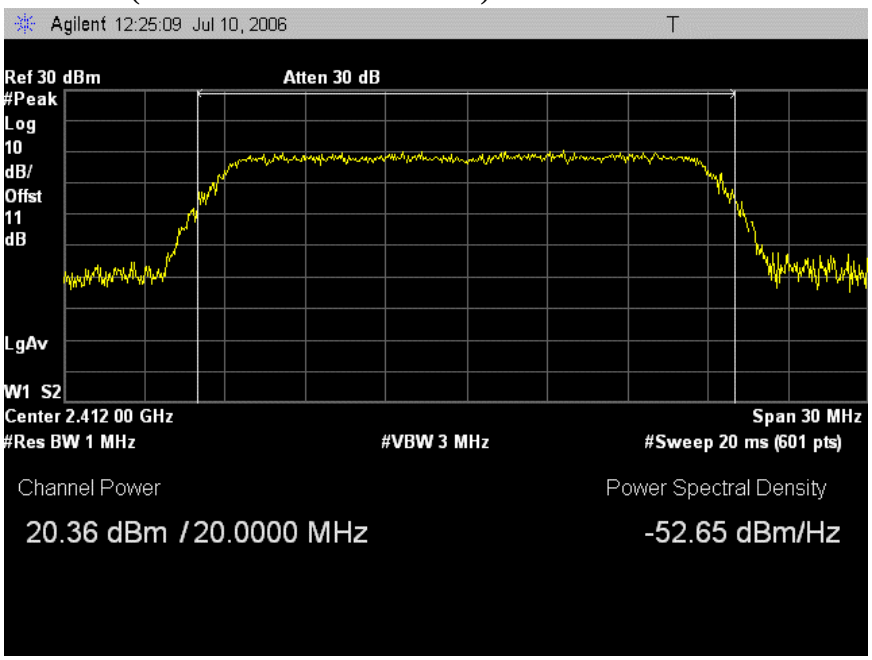
(802.11n HT20 MODE CHAIN A)

LOW CH (802.11n HT20 mode chain A)



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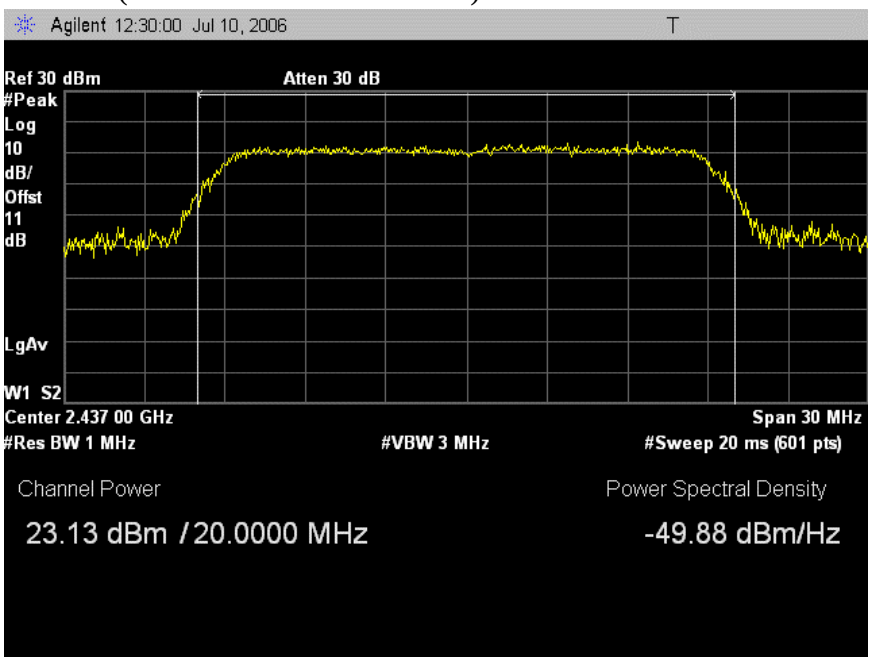
MID CH (802.11n HT20 mode chain A)



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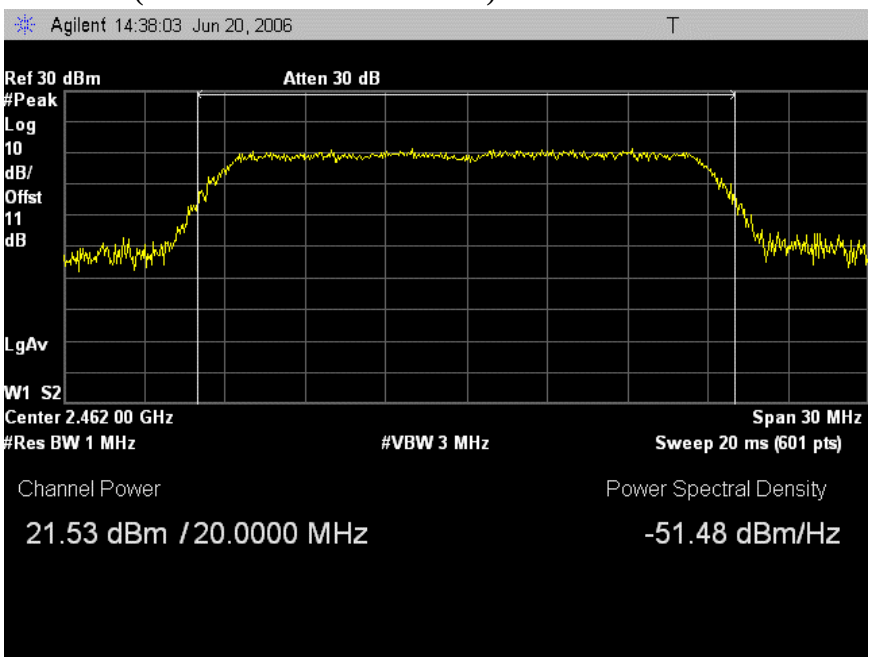
HIGH CH (802.11n HT20 mode chain A)



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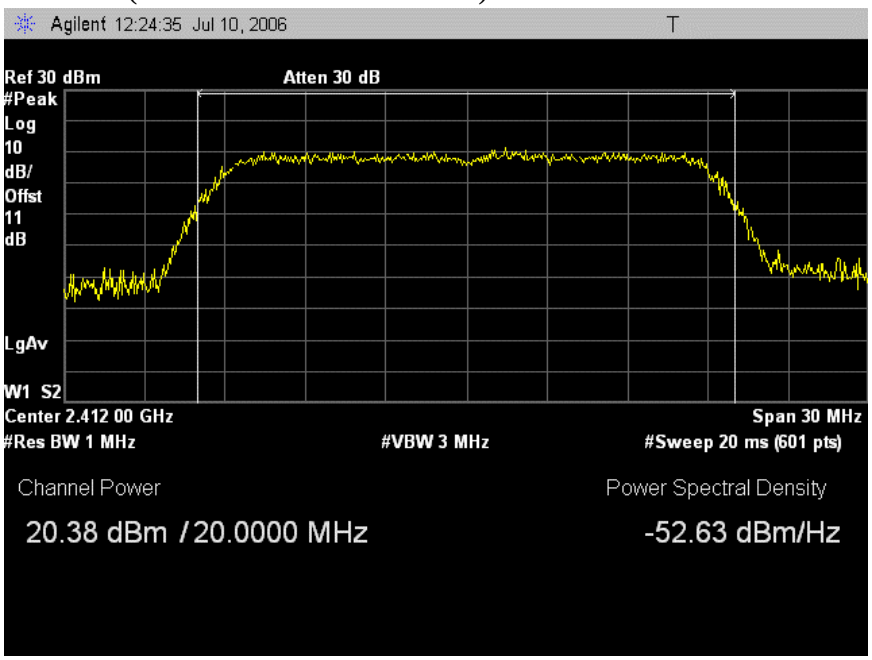
(802.11 HT20 MODE CHAIN B)

LOW CH (802.11n HT20 mode chain B)



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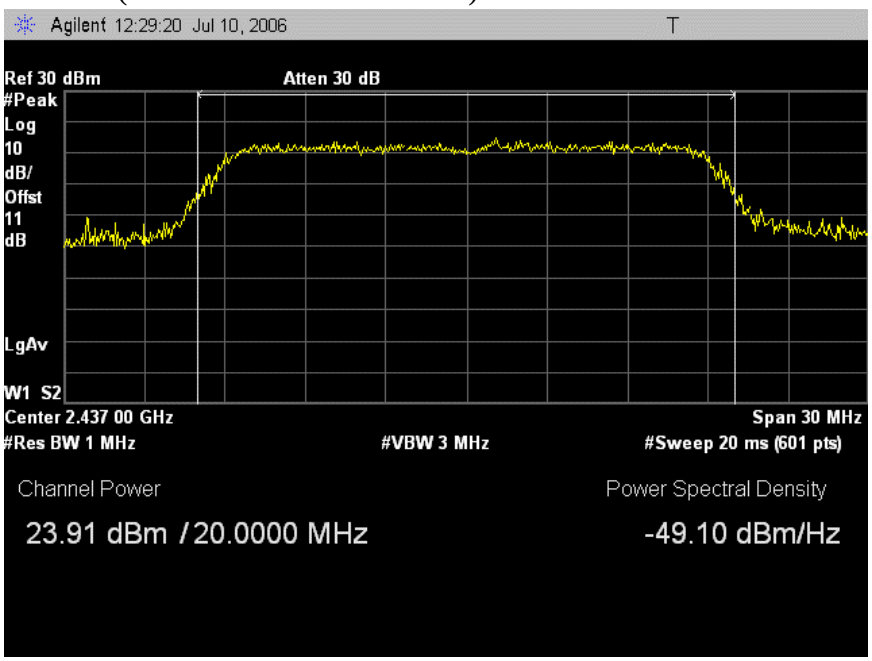
MID CH (802.11n HT20 mode chain B)



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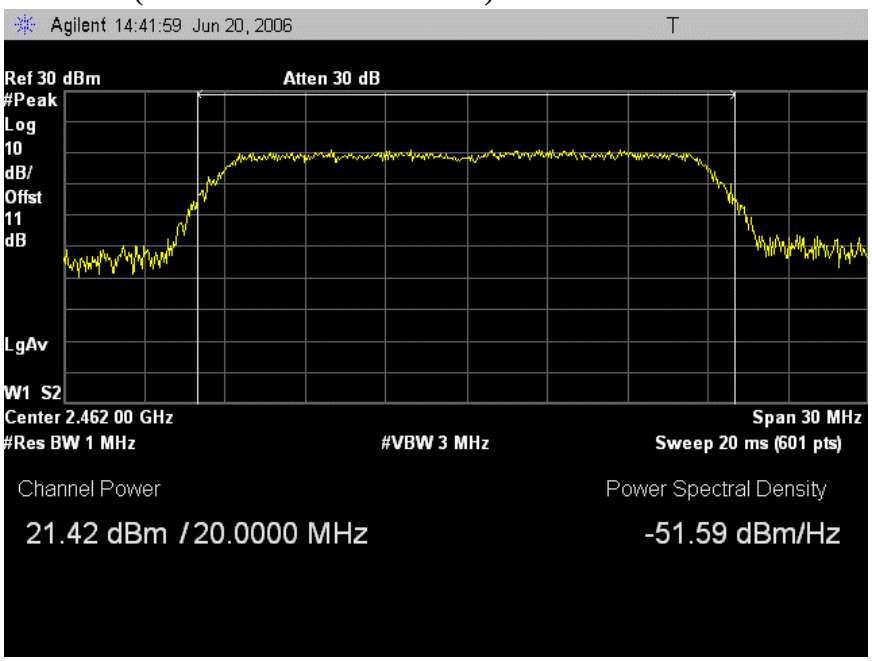
HIGH CH (802.11n HT20 mode chain B)



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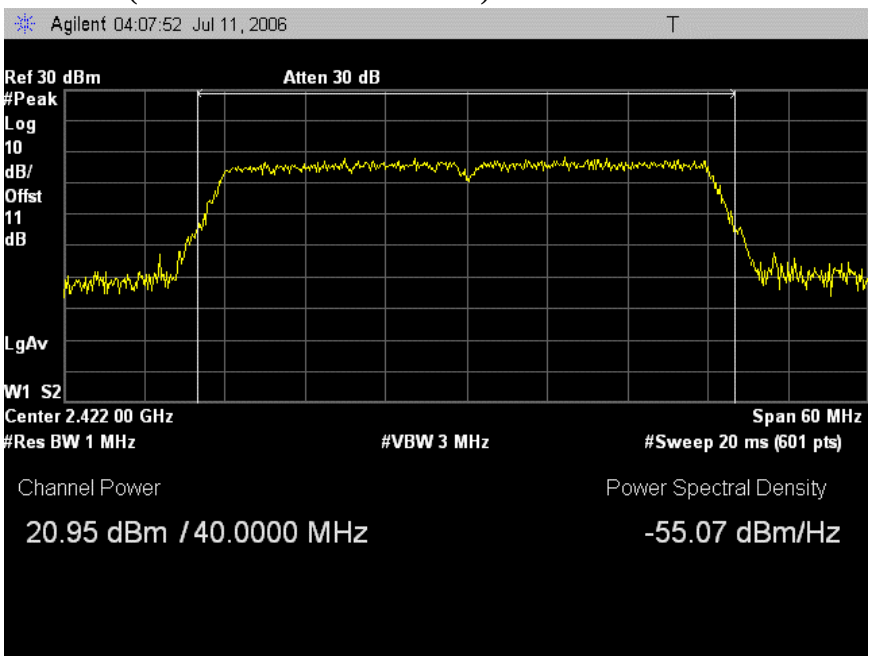
(802.11 HT40 MODE CHAIN A)

LOW CH (802.11n HT40 mode chain A)



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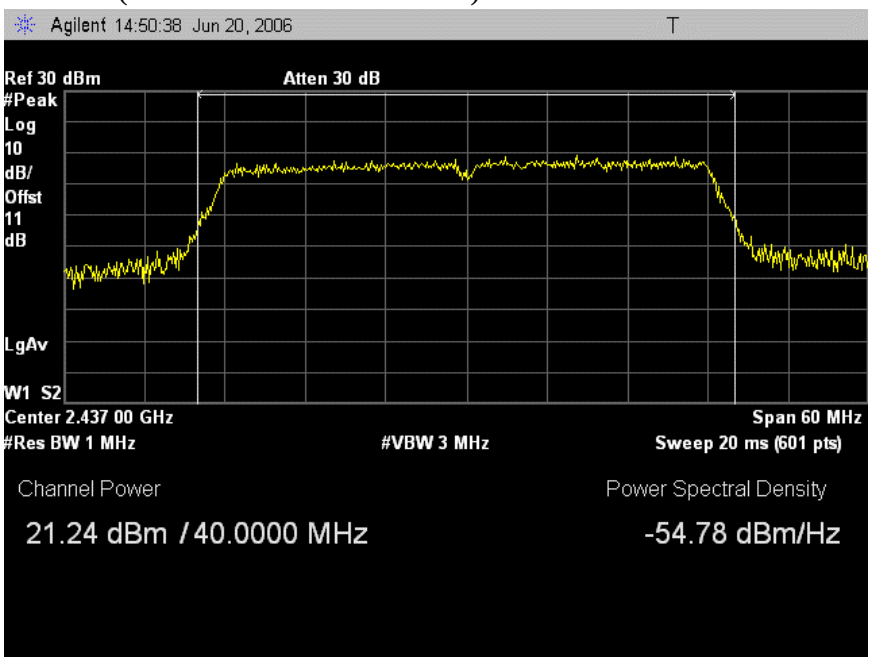
MID CH (802.11n HT40 mode chain A)



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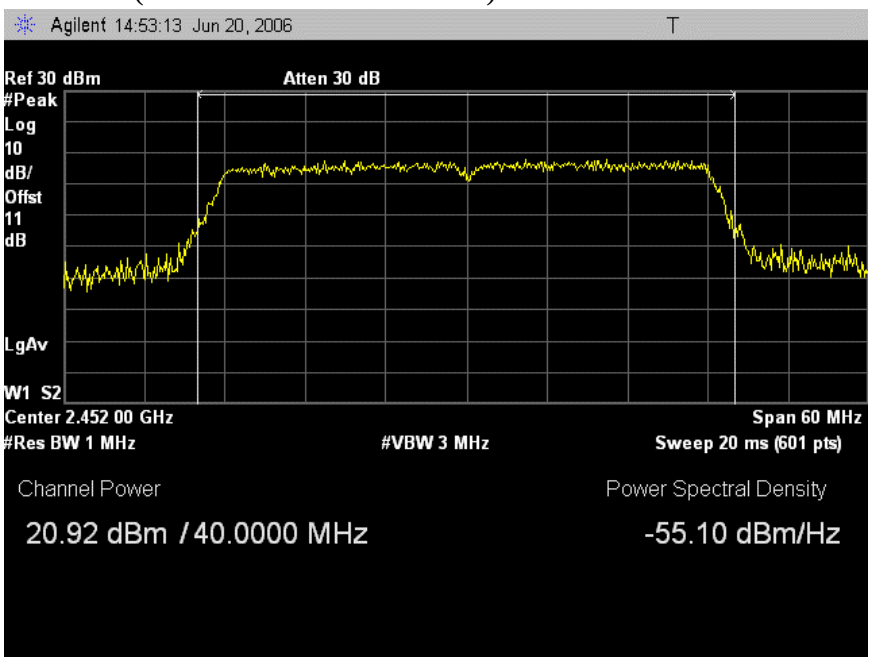
HIGH CH (802.11n HT40 mode chain A)



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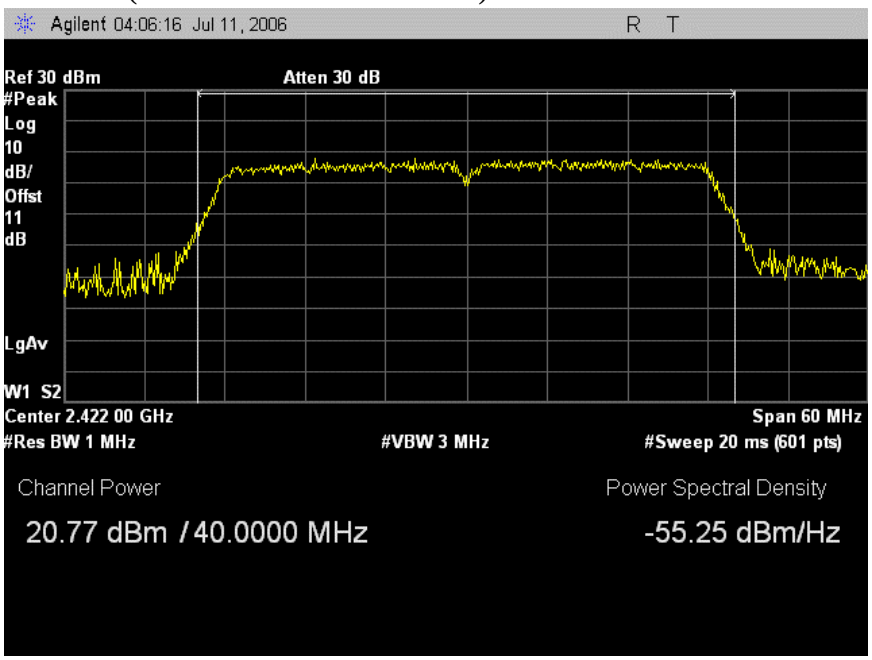
(802.11 HT40 MODE CHAIN B)

LOW CH (802.11n HT40 mode chain B)



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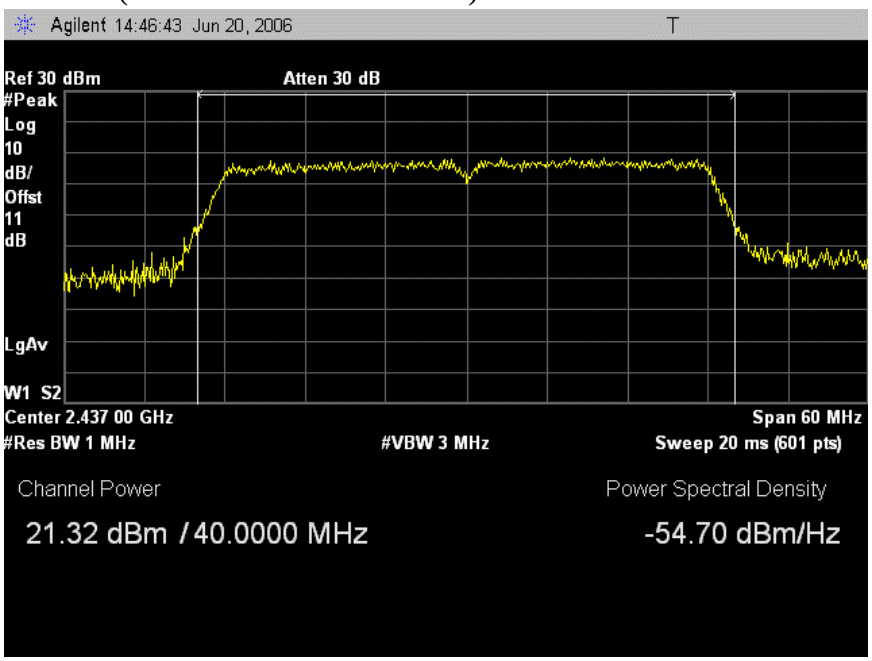
MID CH (802.11n HT40 mode chain B)



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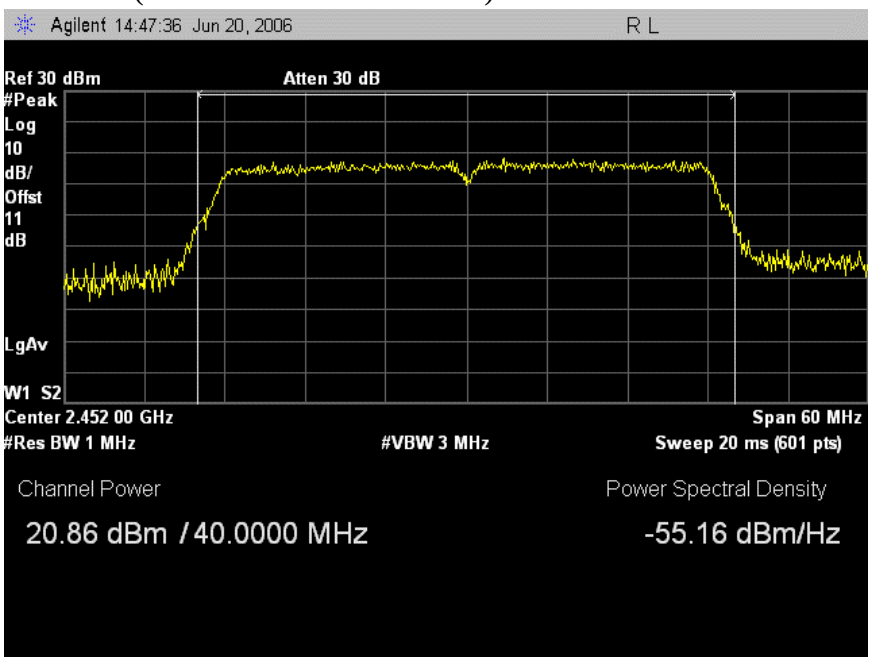
HIGH CH (802.11n HT40 mode chain B)



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7.1.4. AVERAGE POWER

AVERAGE POWER LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

Each chain is measured separately and the total power is calculated using:

Total Power = 10 log (10^ (Chain 0 Power / 10) + 10^ (Chain 2 Power / 10))

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RESULTS

No non-compliance noted:

The cable assembly insertion loss of 11.5 dB (including 10 dB pad and 1.5 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Mode Channel	Frequency (MHz)	Average Power Chain A (dBm)	Average Power Chain B (dBm)	Average Power Total (dBm)
802.11b Mode				
Low	2412	18.2	17.6	20.9
Middle	2437	18.4	18.0	21.2
High	2462	18.5	18.0	21.3
802.11g 20MHz Mode				
Low	2412	15.3	15.4	18.4
Middle	2437	17.5	17.4	20.5
High	2462	16.4	15.2	18.9
802.11g 40MHz Mode				
Low	2422	12.5	12.6	15.6
Middle	2437	12.4	11.7	15.1
High	2452	11.6	10.5	14.1
802.11n HT20 Mode				
Low	2412	14.8	14.9	17.9
Middle	2437	16.9	16.9	19.9
High	2462	14.1	13.7	16.9
802.11n HT40 Mode				
Low	2422	13.9	14.0	17.0
Middle	2437	12.1	12.6	15.3
High	2452	12.4	12.1	15.3

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7.1.5. PEAK POWER SPECTRAL DENSITY

LIMIT

§15.247 (d) For direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer, the maximum level in a 3 kHz bandwidth is measured with the spectrum analyzer using RBW = 3 kHz and VBW > 3 kHz, sweep time = span / 3 kHz, and video averaging is turned off. The PPSD is the highest level found across the emission in any 3 kHz band.

Each chain is measured separately and the total PPSD is calculated using:

Total PPSD = 10 log (10^ (Chain 0 PPSD / 10) + 10^ (Chain 2 PPSD / 10))

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RESULTS

No non-compliance noted:

Mode Channel	Frequency (MHz)	PPSD Chain A (dBm)	PPSD Chain B (dBm)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
802.11b Mode						
Low	2412	-5.77	-7.43	-3.51	8	-11.51
Middle	2437	-6.81	-6.51	-3.65	8	-11.65
High	2462	-5.77	-5.67	-2.71	8	-10.71
802.11g 20M Mode						
Low	2412	-11.90	-10.78	-8.29	8	-16.29
Middle	2437	-9.17	-9.78	-6.45	8	-14.45
High	2462	-11.74	-5.67	-4.71	8	-12.71
802.11g 40M Mode						
Low	2422	-17.24	-16.81	-14.01	8	-22.01
Middle	2437	-17.09	-17.09	-14.08	8	-22.08
High	2452	-9.09	-13.81	-7.83	8	-15.83
802.11n HT20 Mode						
Low	2412	-9.66	-5.23	-3.89	8	-11.89
Middle	2437	-7.08	-1.95	-0.79	8	-8.79
High	2462	-8.34	-8.21	-5.26	8	-13.26
802.11n HT40 Mode						
Low	2422	-14.52	-13.40	-10.91	8	-18.91
Middle	2437	-7.92	-14.69	-7.09	8	-15.09
High	2452	-9.73	-14.33	-8.44	8	-16.44

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RESULTS WITH COMBINER

No non-compliance noted:

Mode Channel	Frequency (MHz)	PPSD Using Combiner (dBm)	Limit (dBm)	Margin (dB)
802.11b Mode				
Low	2412	-1.77	8	-9.77
Middle	2437	0.49	8	-7.51
High	2462	1.56	8	-6.44
802.11g 20M Mode				
Low	2412	-5.30	8	-13.30
Middle	2437	-3.58	8	-11.58
High	2462	-4.49	8	-12.49
802.11g 40M Mode				
Low	2412	-10.02	8	-18.02
Middle	2437	-11.67	8	-19.67
High	2462	-9.62	8	-17.62
802.11n HT20 Mode				
Low	2412	-4.26	8	-12.26
Middle	2437	1.19	8	-6.81
High	2462	-0.10	8	-8.10
802.11n HT40 Mode				
Low	2422	-8.65	8	-16.65
Middle	2437	-5.84	8	-13.84
High	2452	-8.08	8	-16.08

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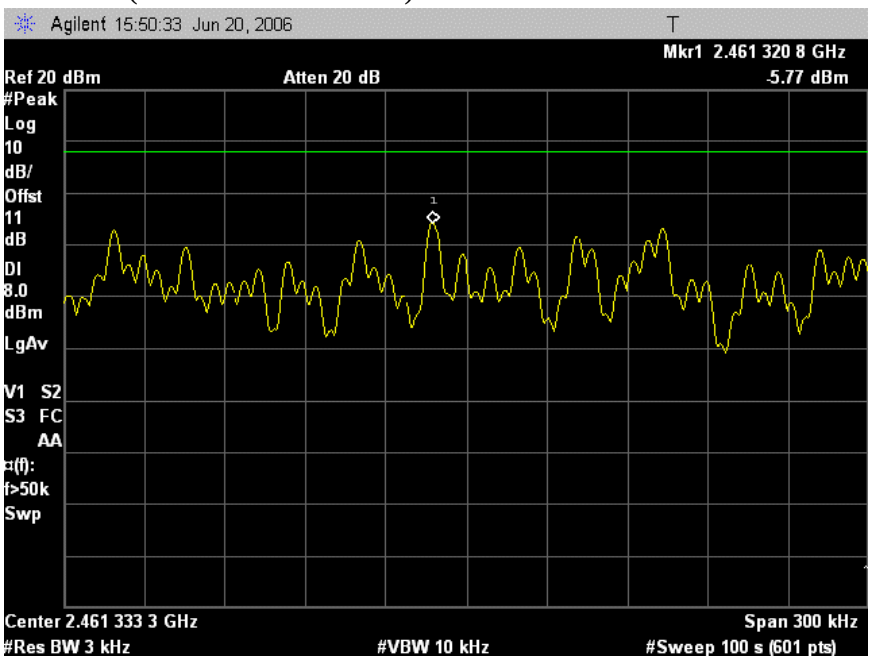
(802.11b MODE CHAIN A)

LOW CH (802.11b mode chain A)



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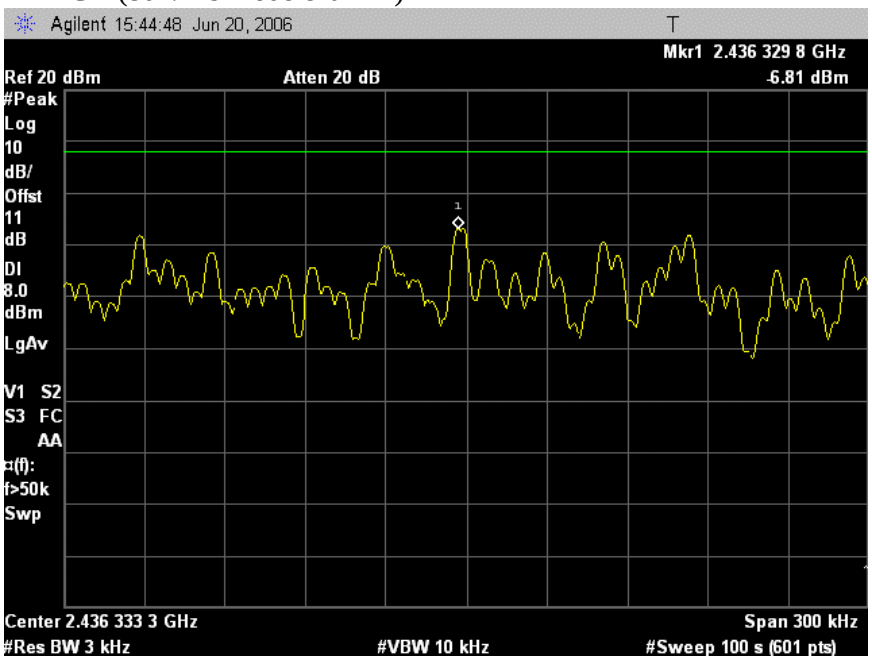
MID CH (802.11b mode chain A)



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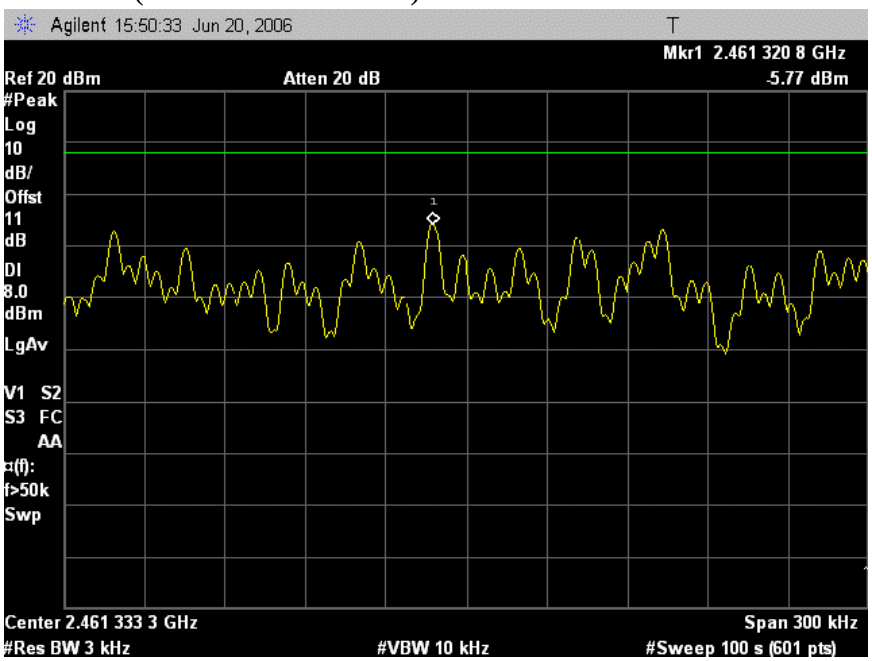
HIGH CH (802.11b mode chain A)



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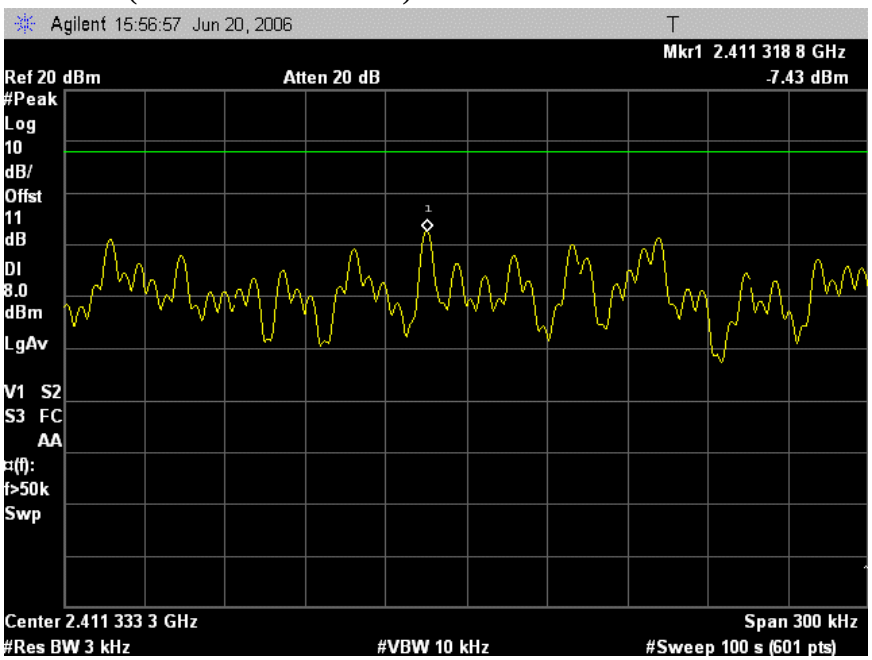
(802.11b MODE CHAIN B)

LOW CH (802.11b mode chain B)



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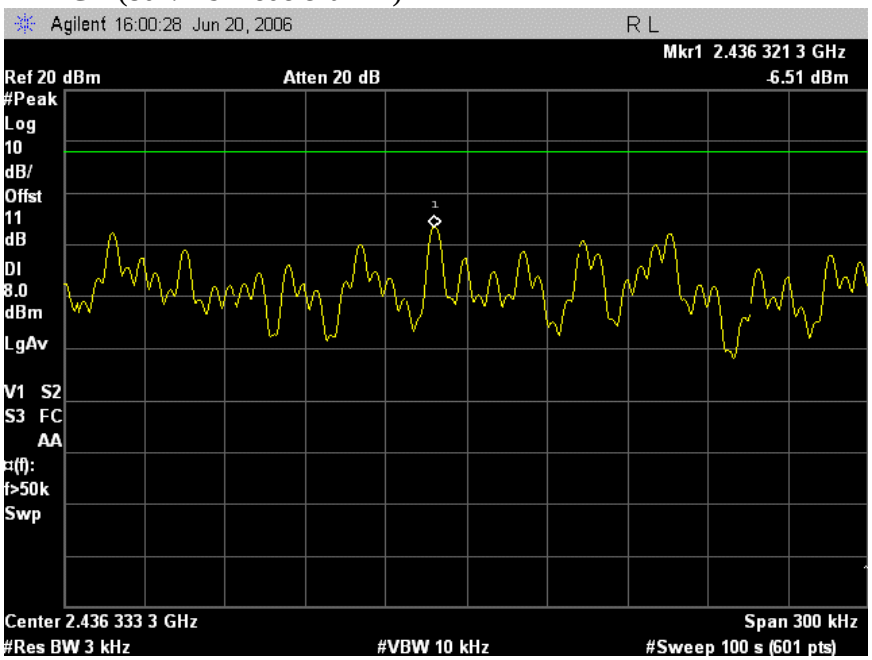
MID CH (802.11b mode chain B)



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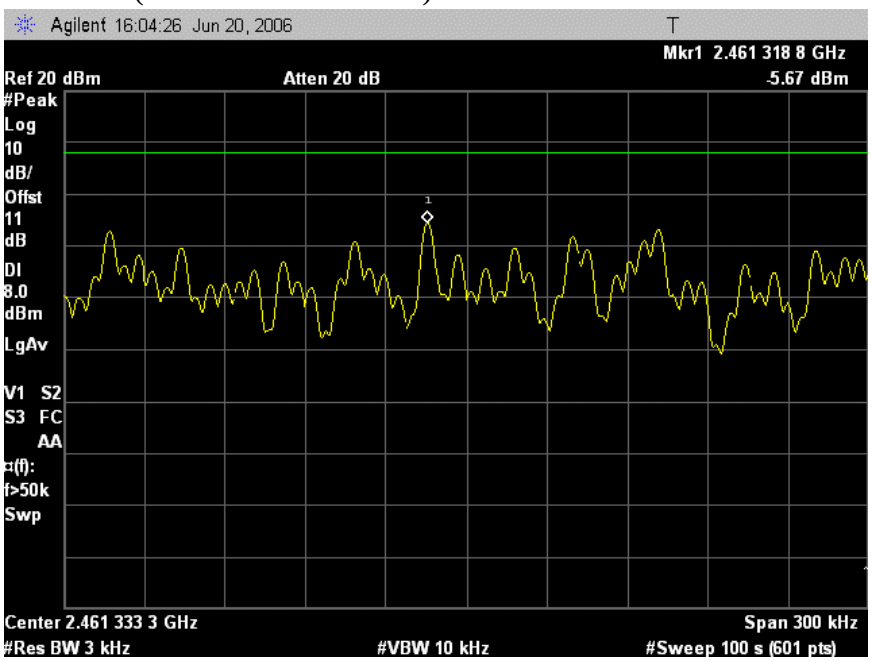
HIGH CH (802.11b mode chain 2B)



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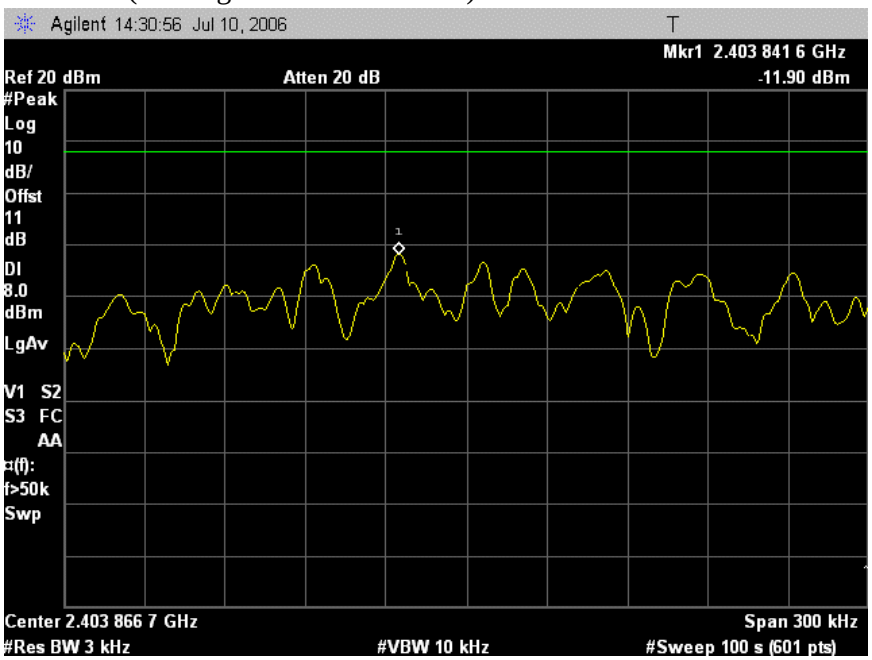
(802.11g 20M MODE CHAIN A)

LOW CH (802.11g 20M mode chain A)



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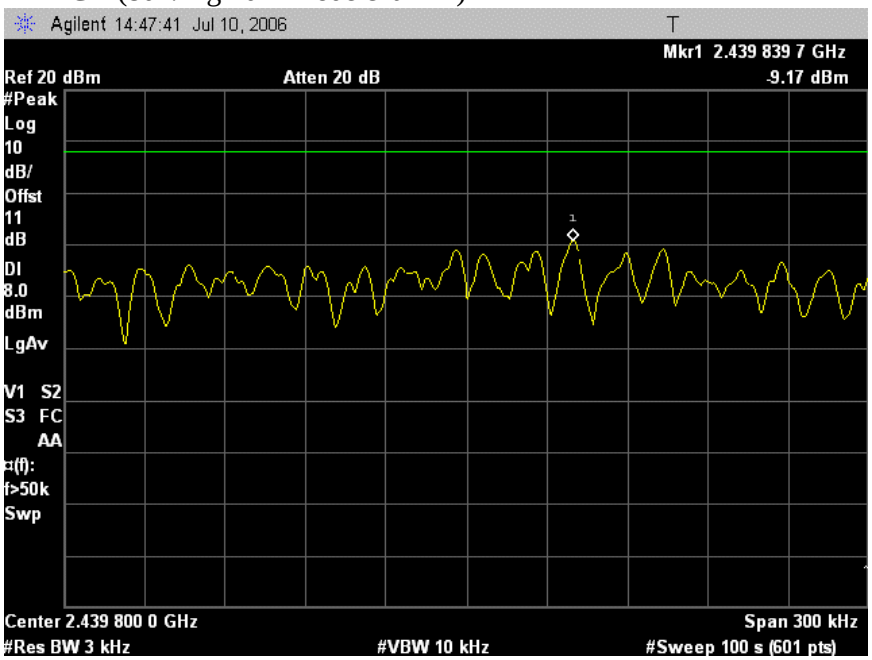
MID CH (802.11g 20M mode chain A)



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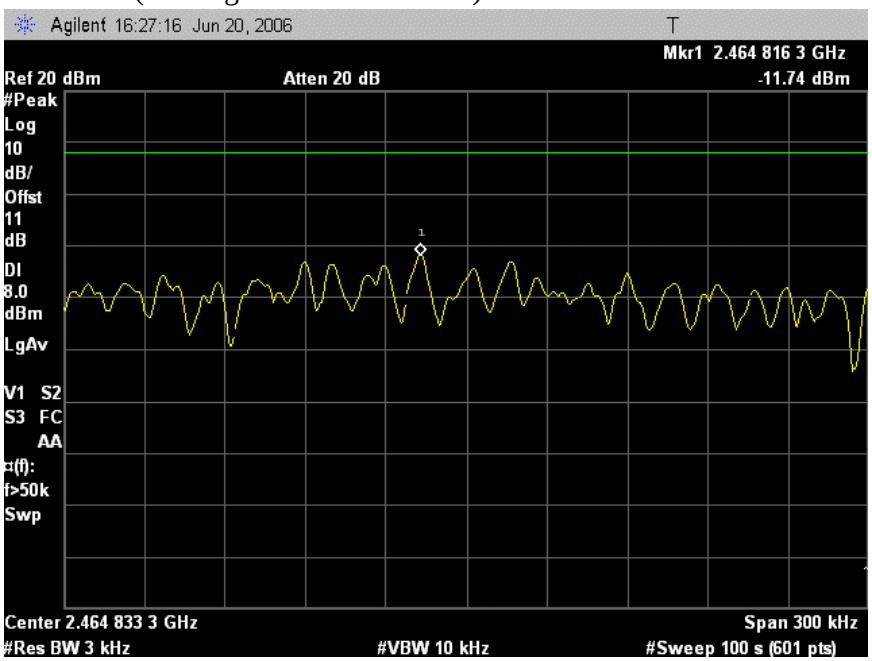
HIGH CH (802.11g 20M mode chain A)



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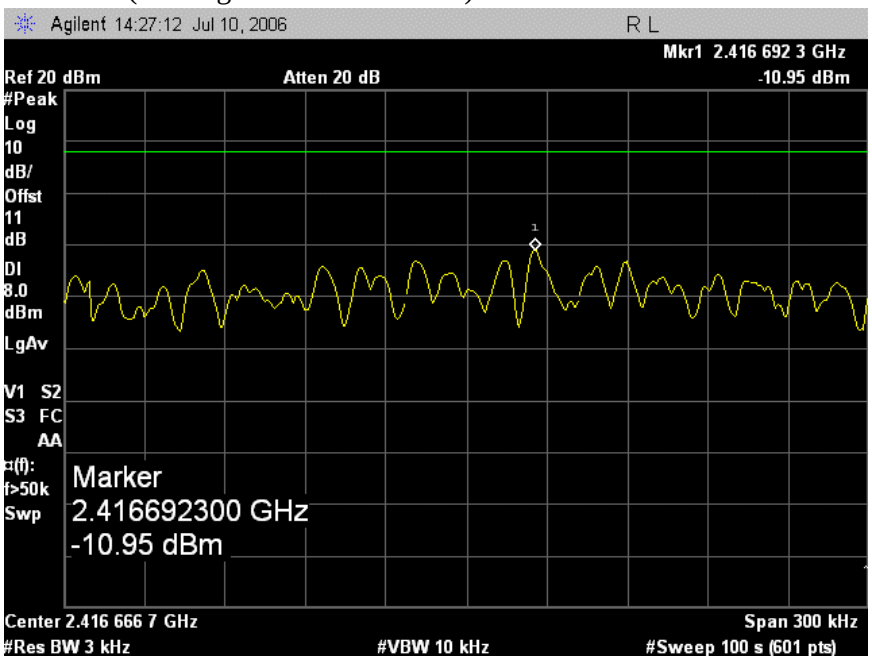
(802.11g 20M MODE CHAIN B)

LOW CH (802.11g 20M mode chain B)



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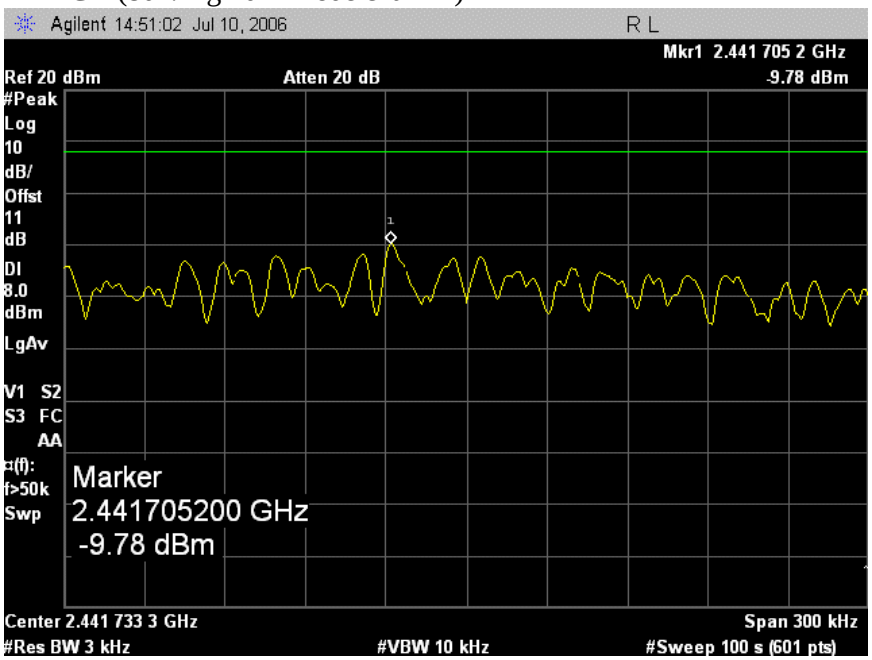
MID CH (802.11g 20M mode chain B)



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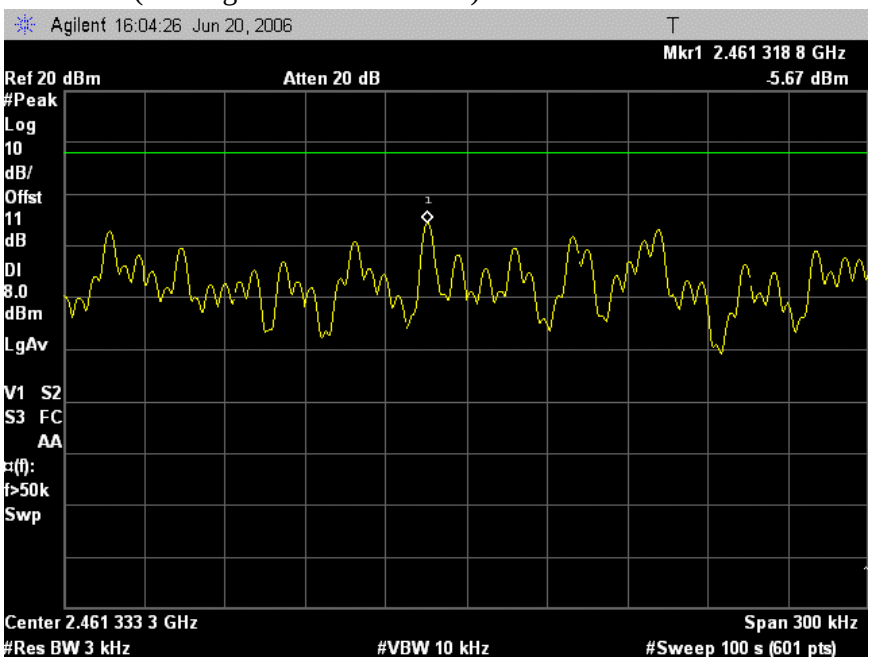
HIGH CH (802.11g 20M mode chain B)



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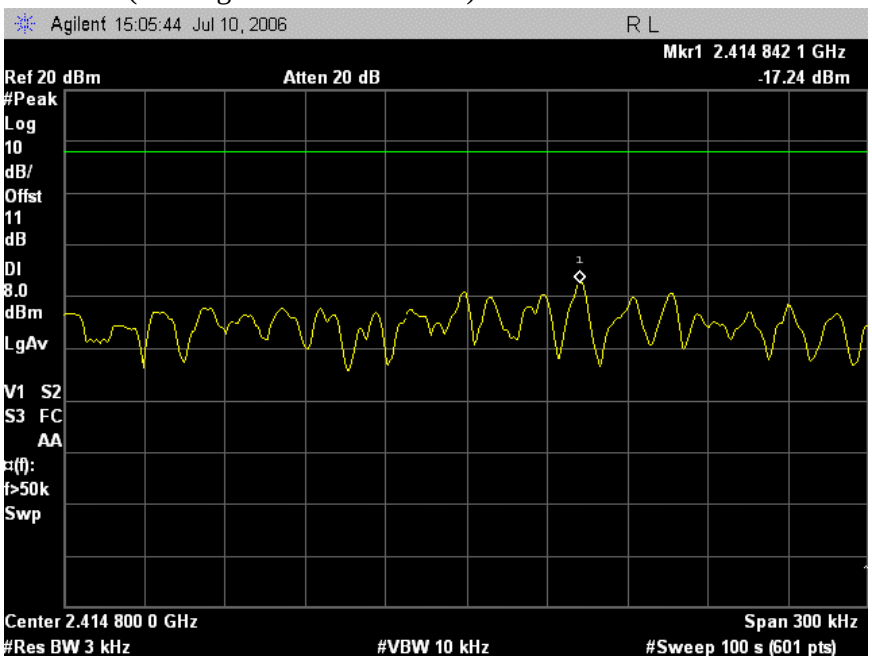
(802.11g 40M MODE CHAIN A)

LOW CH (802.11g 40M mode chain A)



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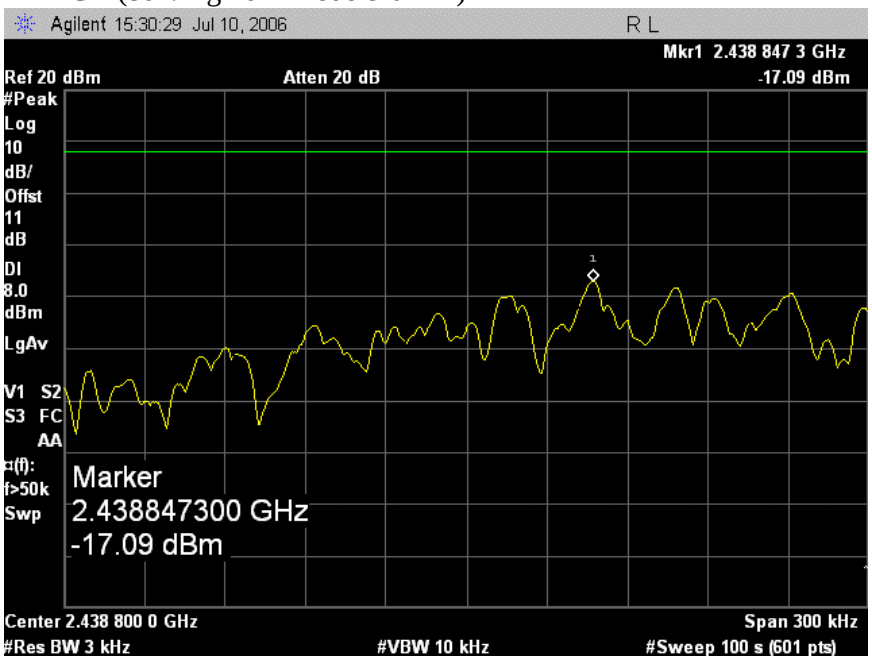
MID CH (802.11g 40M mode chain A)



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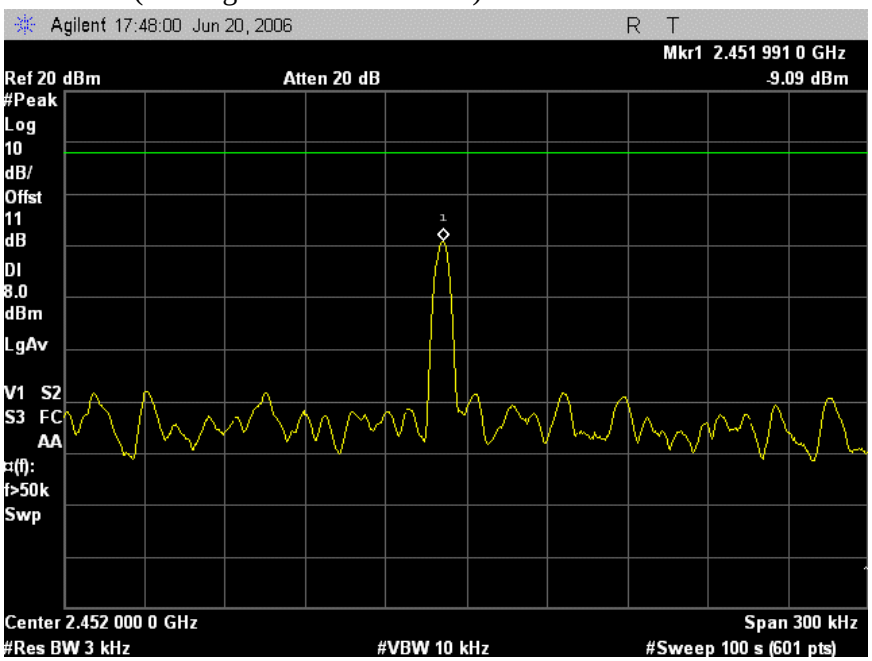
HIGH CH (802.11g 40M mode chain A)



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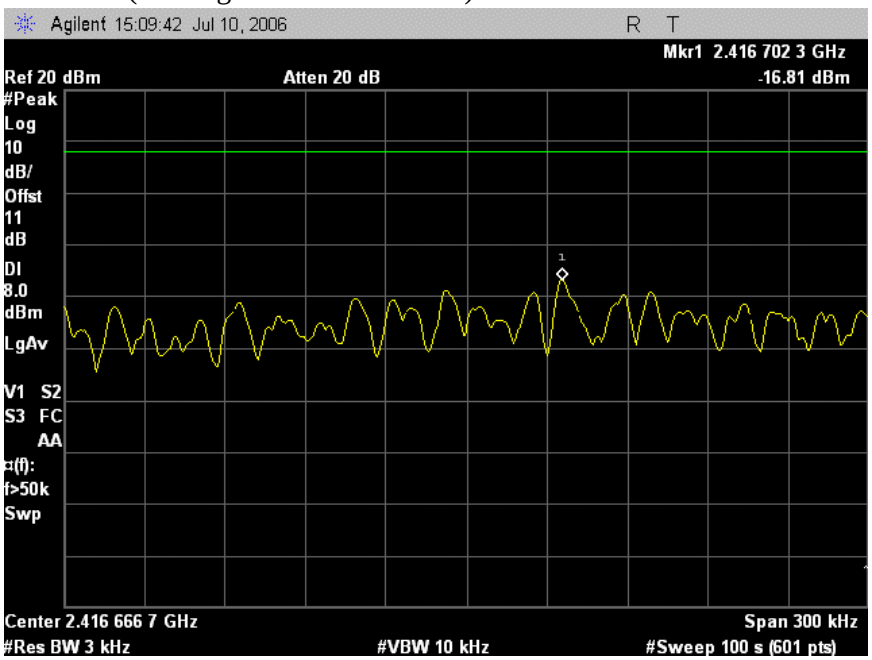
(802.11g 40M MODE CHAIN B)

LOW CH (802.11g 40M mode chain B)



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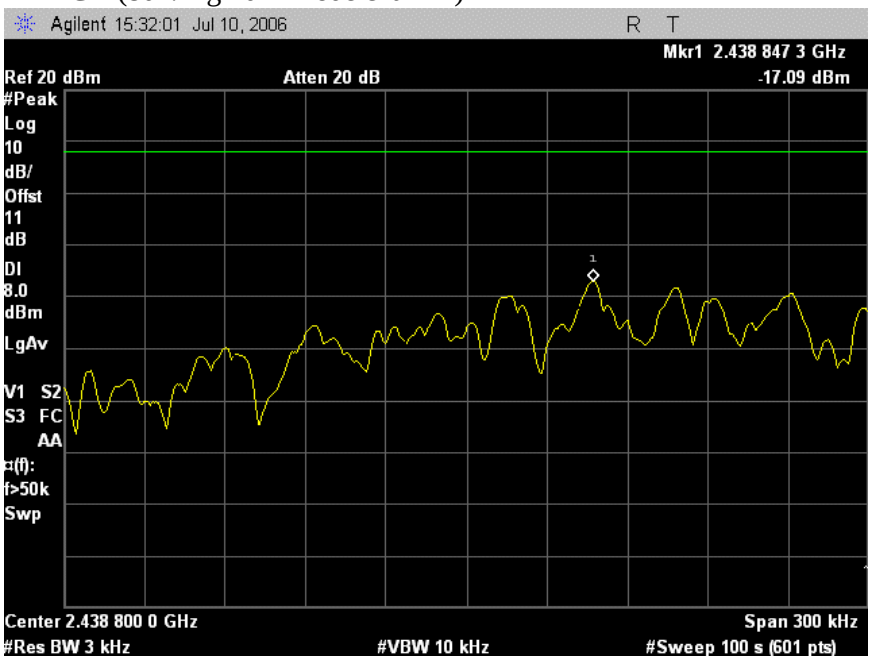
MID CH (802.11g 40M mode chain B)



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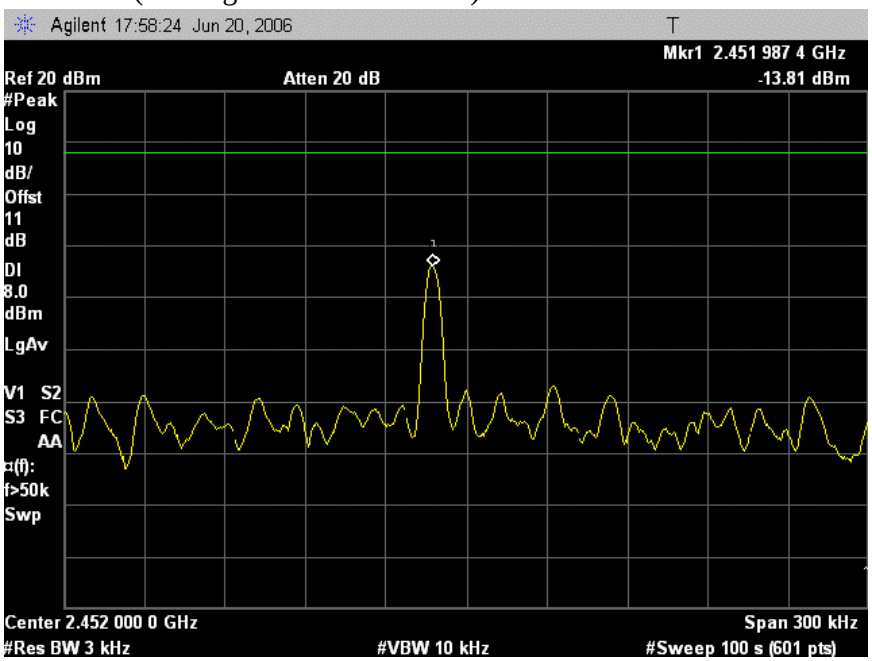
HIGH CH (802.11g 40M mode chain B)



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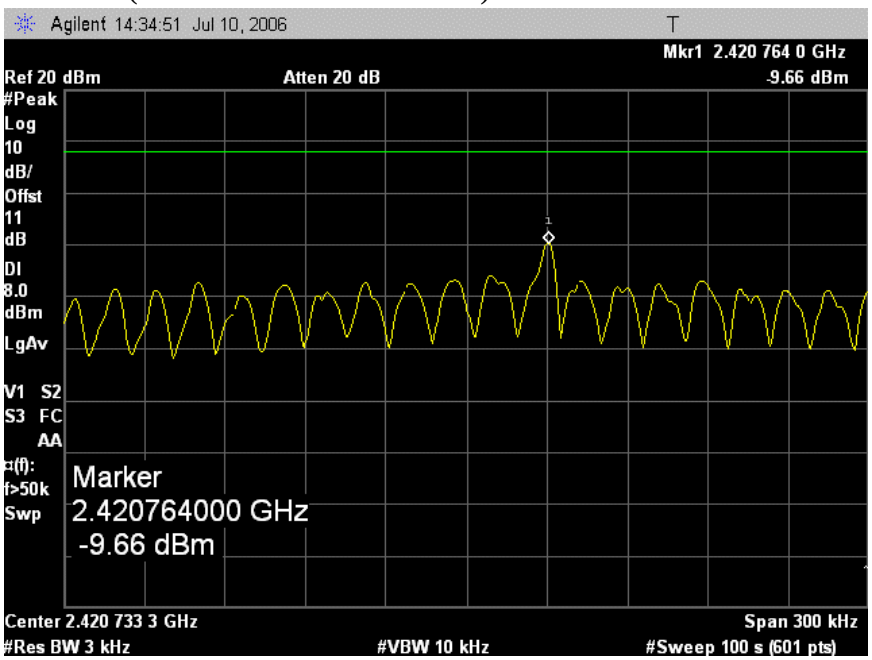
(802.11n HT20 MODE CHAIN A)

LOW CH (802.11n HT20 mode chain A)



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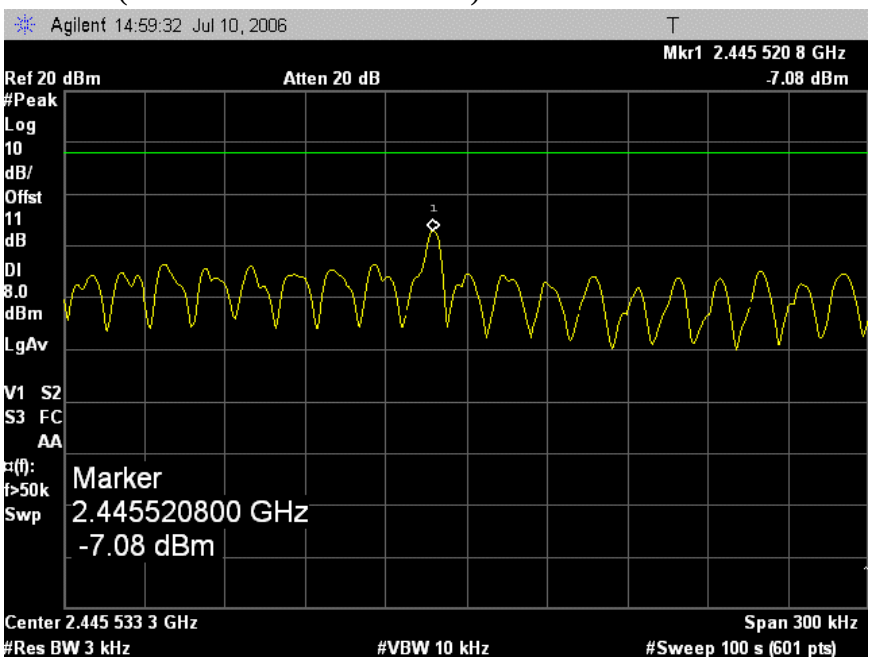
MID CH (802.11n HT20 mode chain A)



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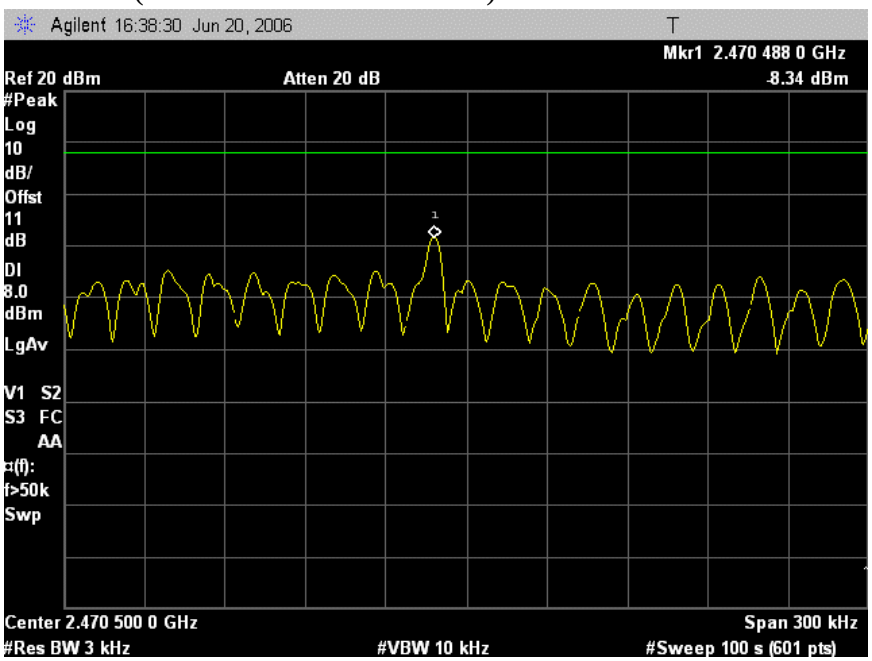
HIGH CH (802.11n HT20 mode chain A)



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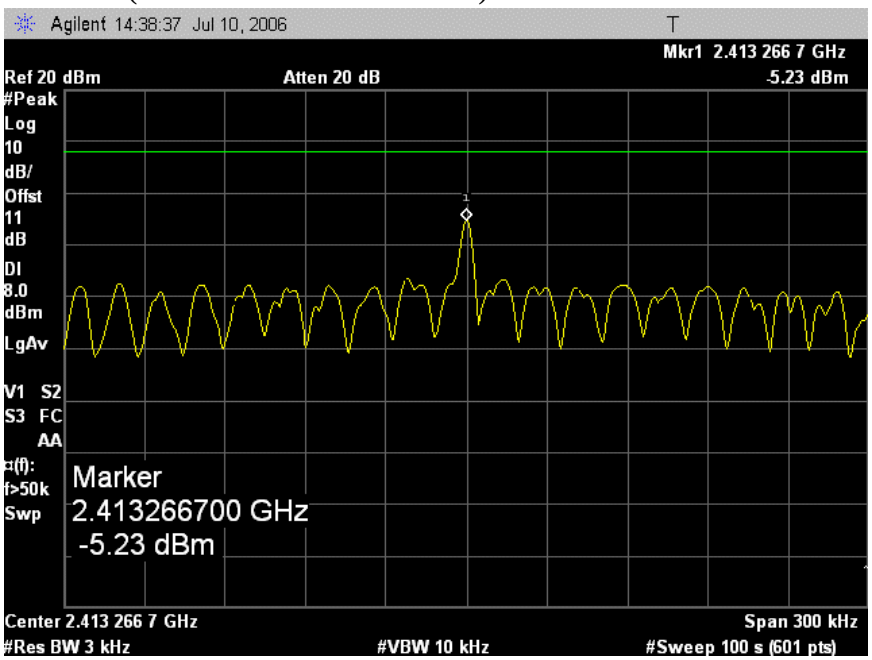
(802.11 HT20 MODE CHAIN B)

LOW CH (802.11n HT20 mode chain B)



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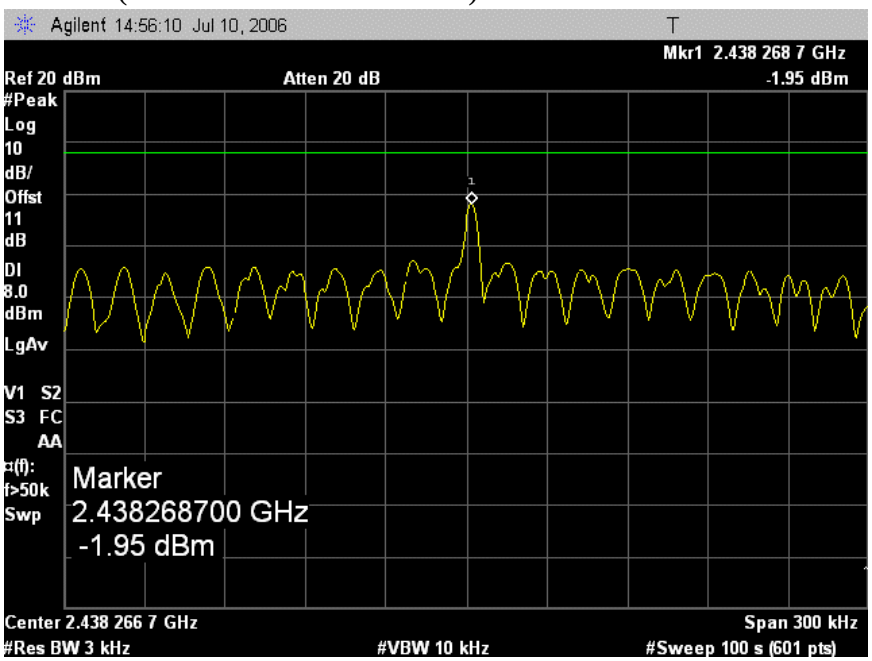
MID CH (802.11n HT20 mode chain B)



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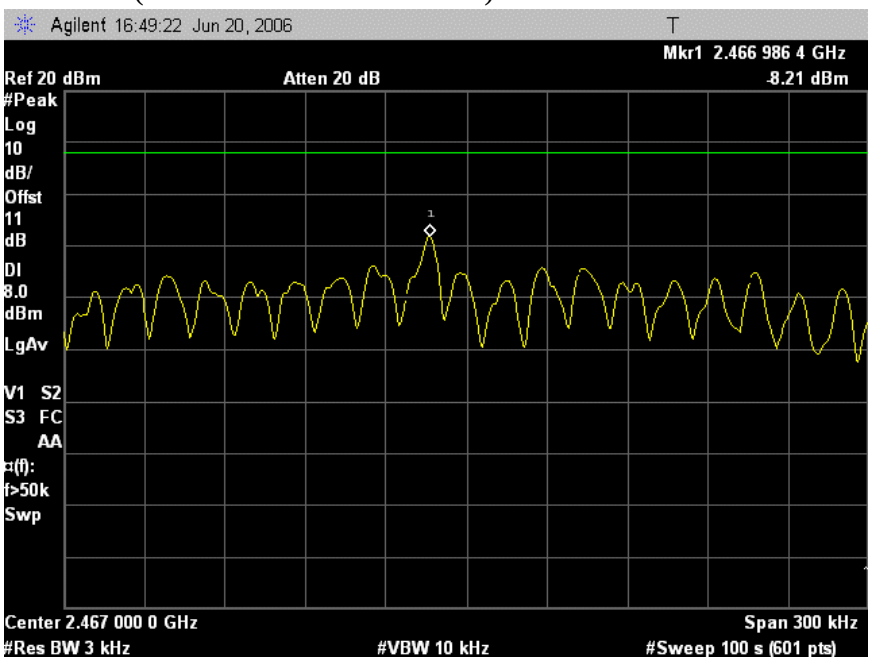
HIGH CH (802.11n HT20 mode chain B)



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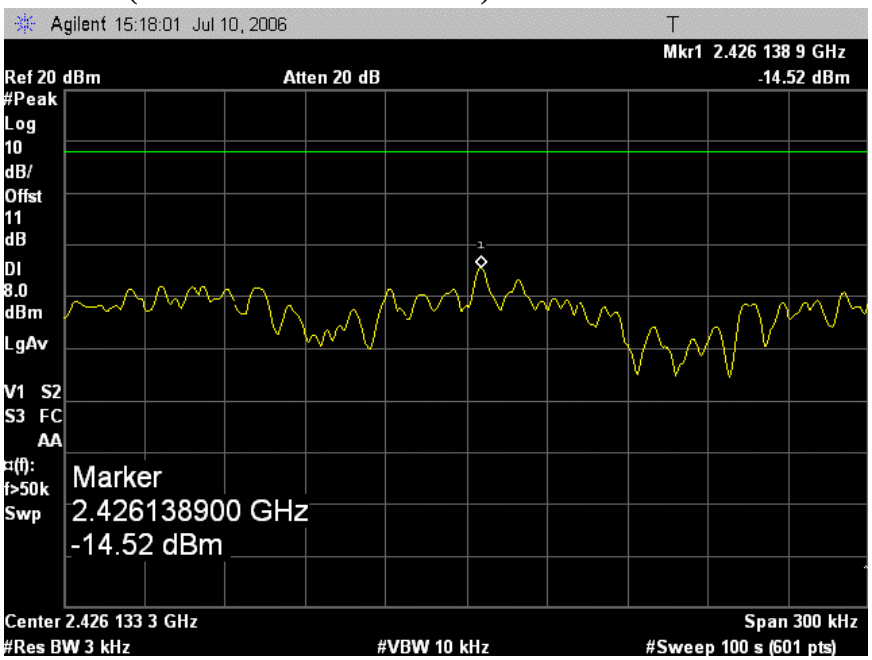
(802.11 HT40 MODE CHAIN A)

LOW CH (802.11n HT40 mode chain A)



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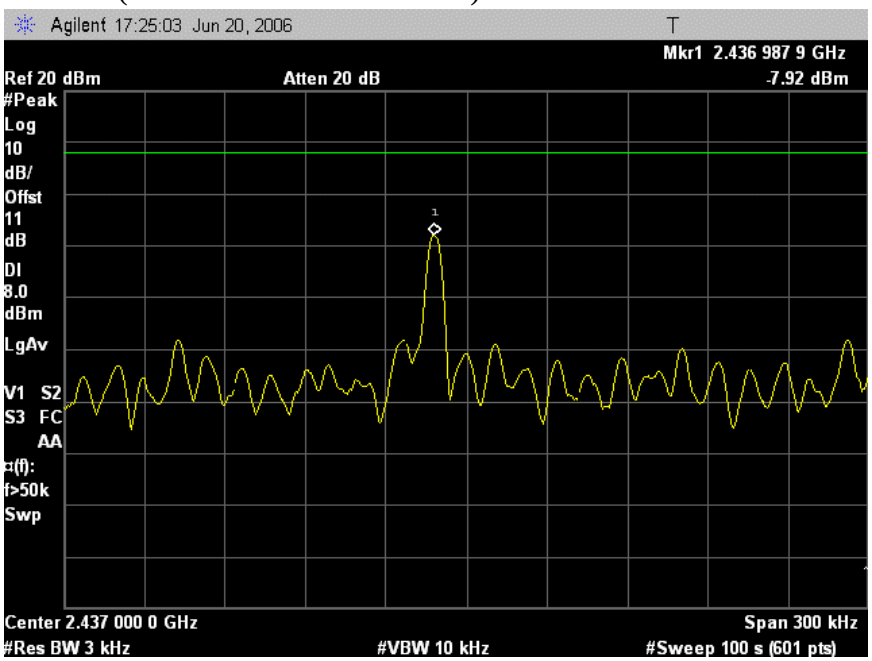
MID CH (802.11n HT40 mode chain A)



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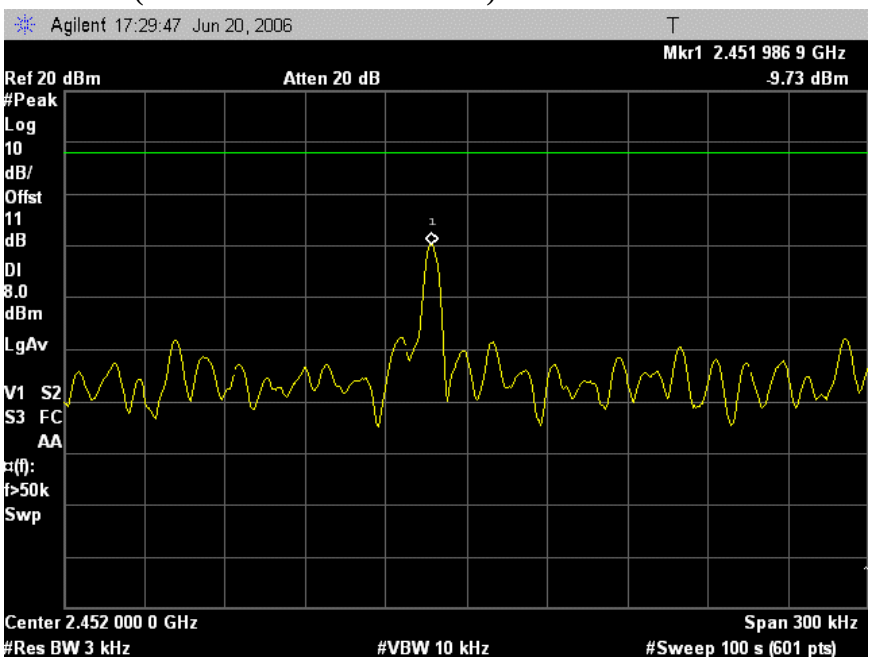
HIGH CH (802.11n HT40 mode chain A)



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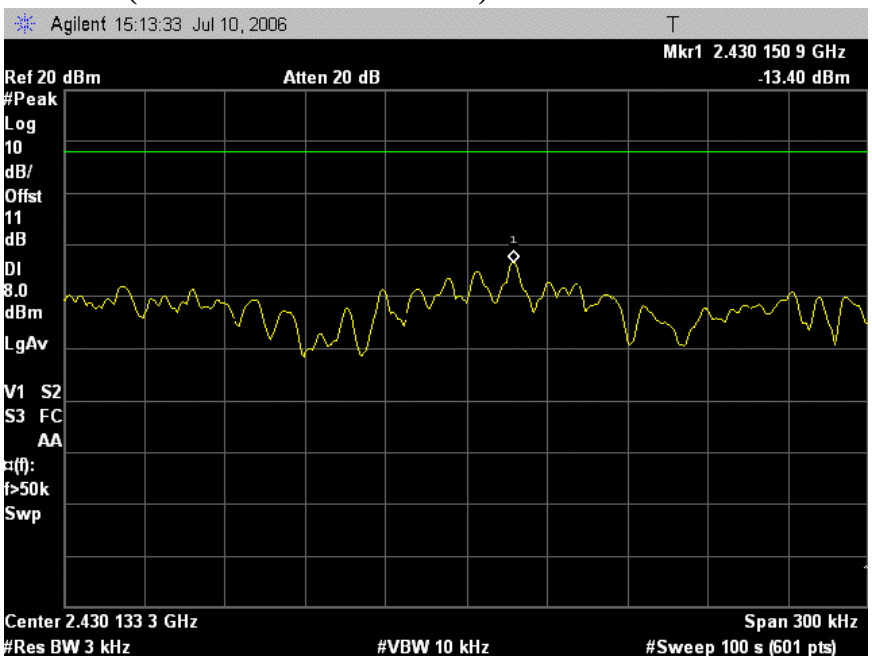
(802.11 HT40 MODE CHAIN B)

LOW CH (802.11n HT40 mode chain B)



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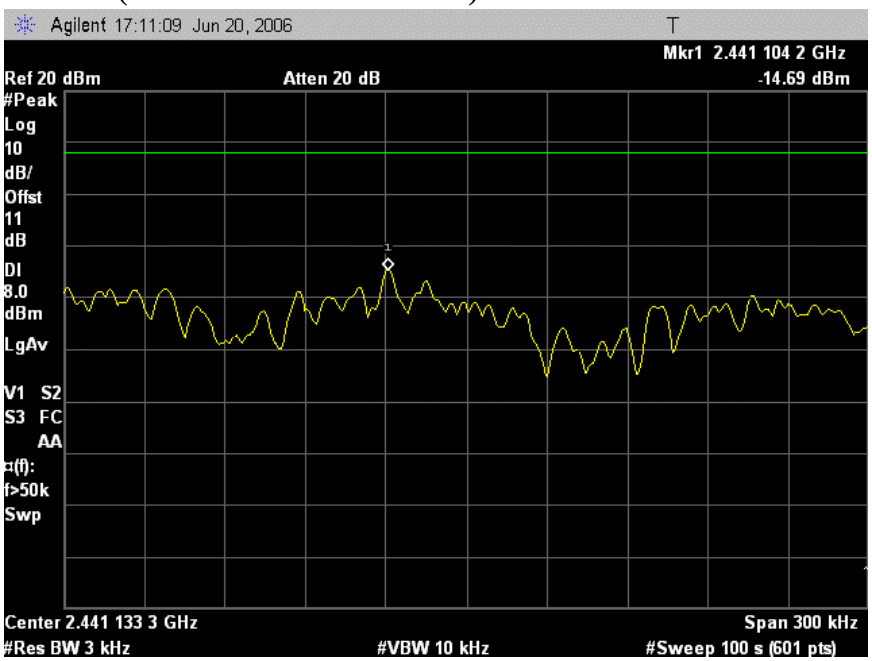
MID CH (802.11n HT40 mode chain B)



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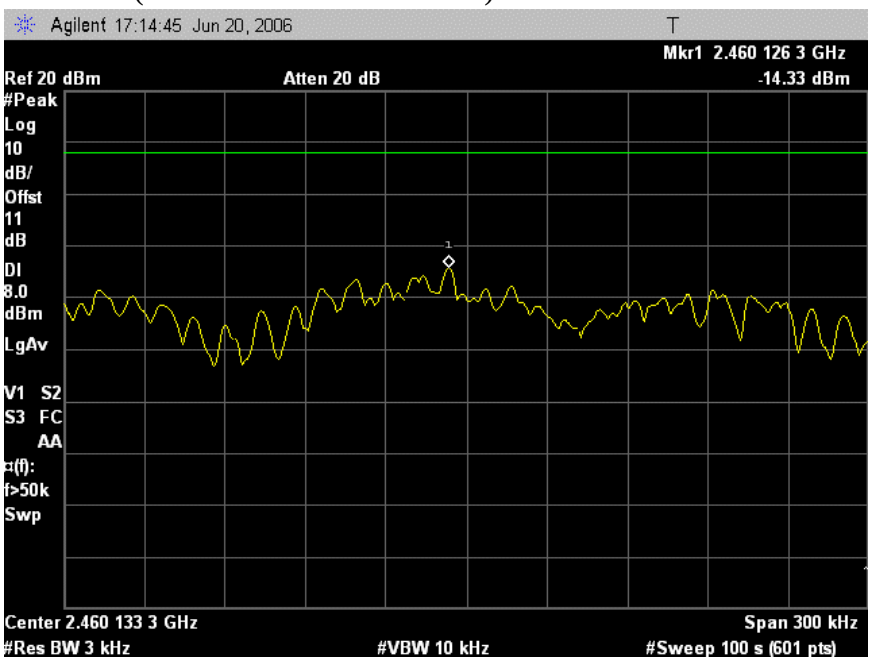
HIGH CH (802.11n HT40 mode chain B)



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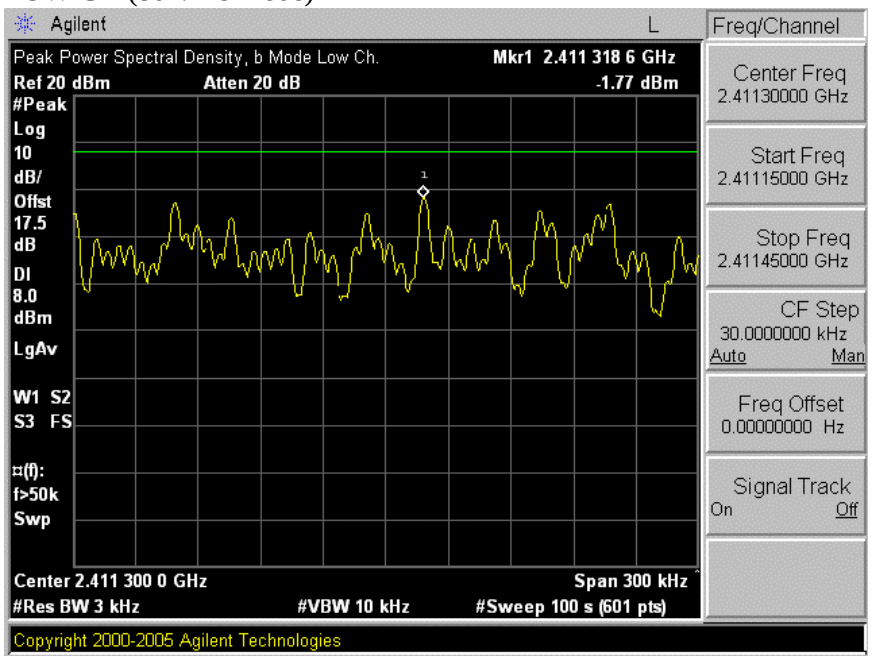
PLOTS USING COMBINER

(802.11b MODE)

LOW CH (802.11b mode)



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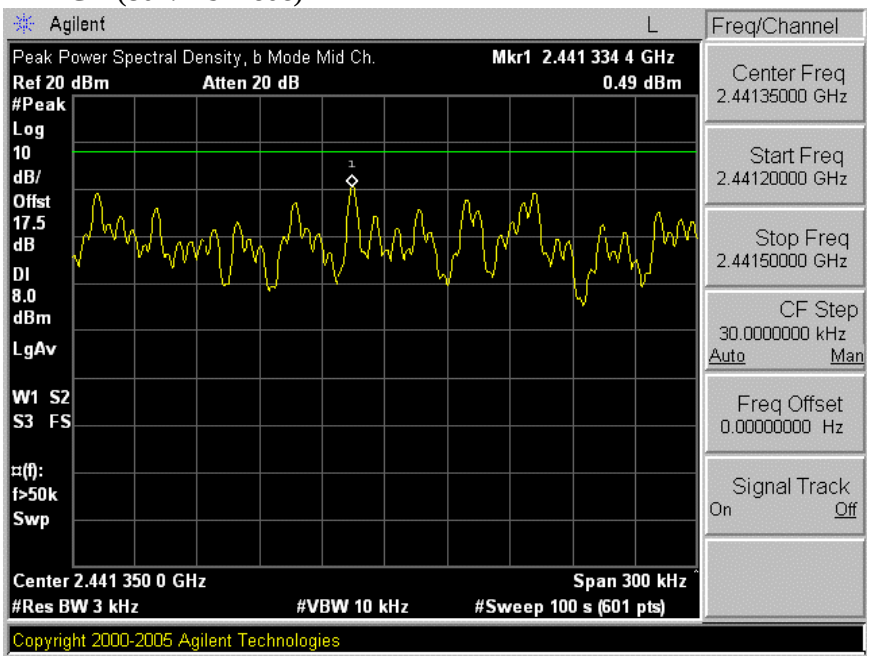
MID CH (802.11b mode)



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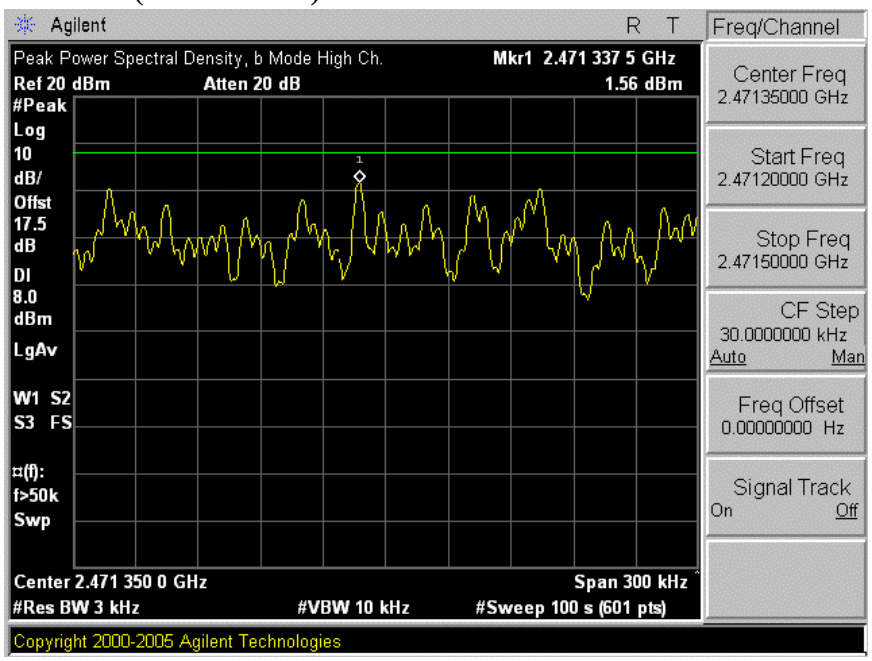
HIGH CH (802.11b mode)



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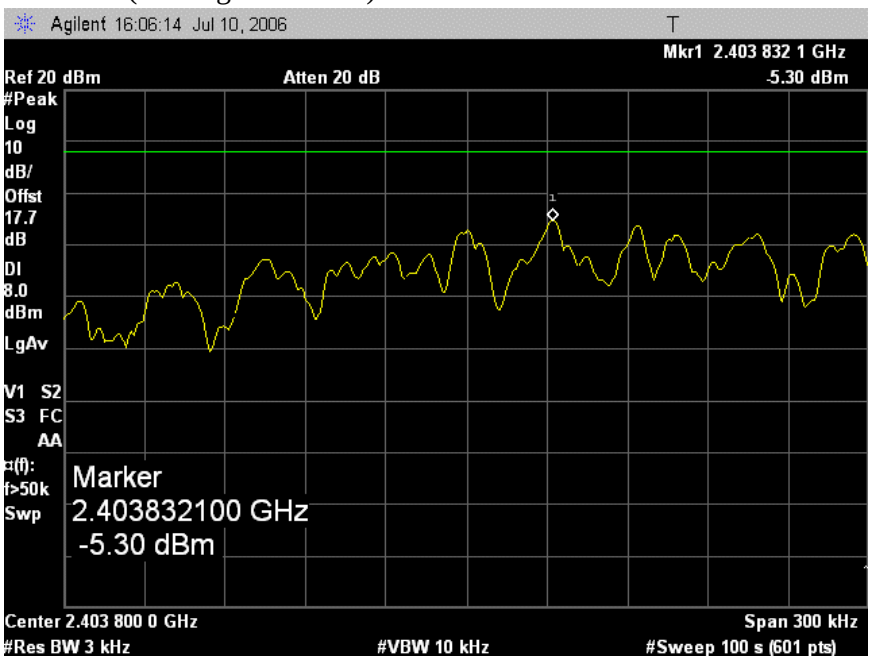
(802.11g 20M MODE)

LOW CH (802.11g 20M mode)



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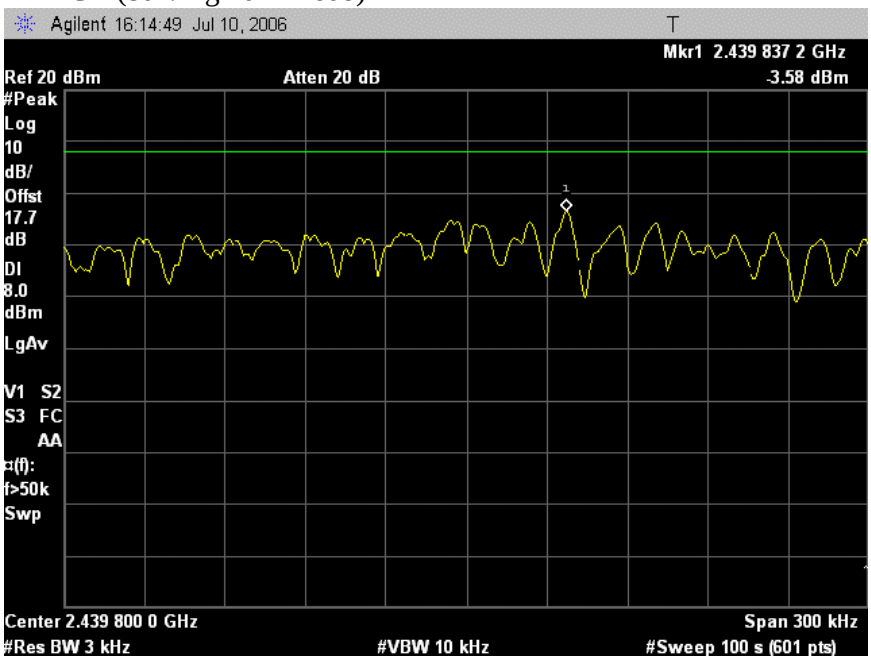
MID CH (802.11g 20M mode)



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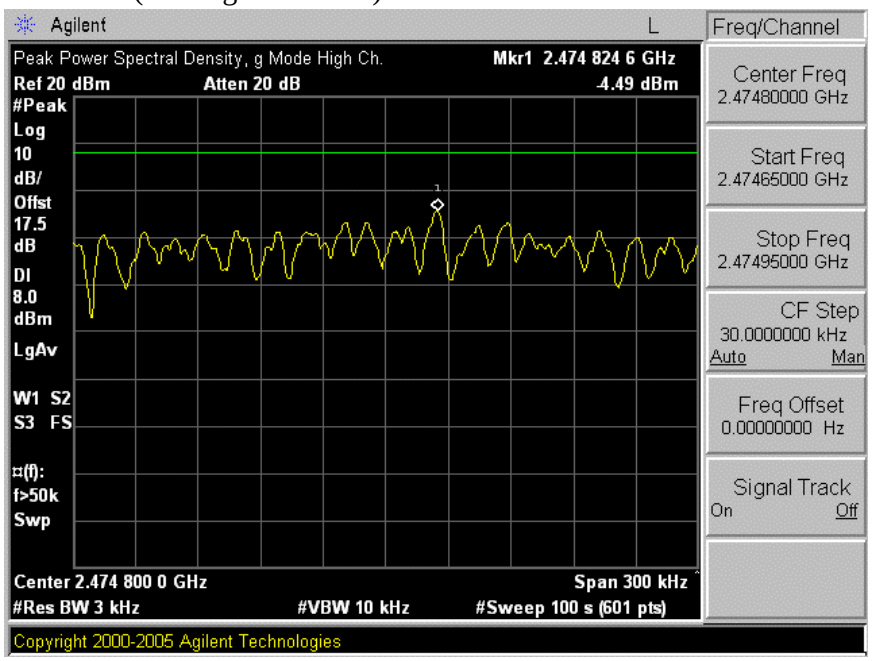
HIGH CH (802.11g 20M mode)



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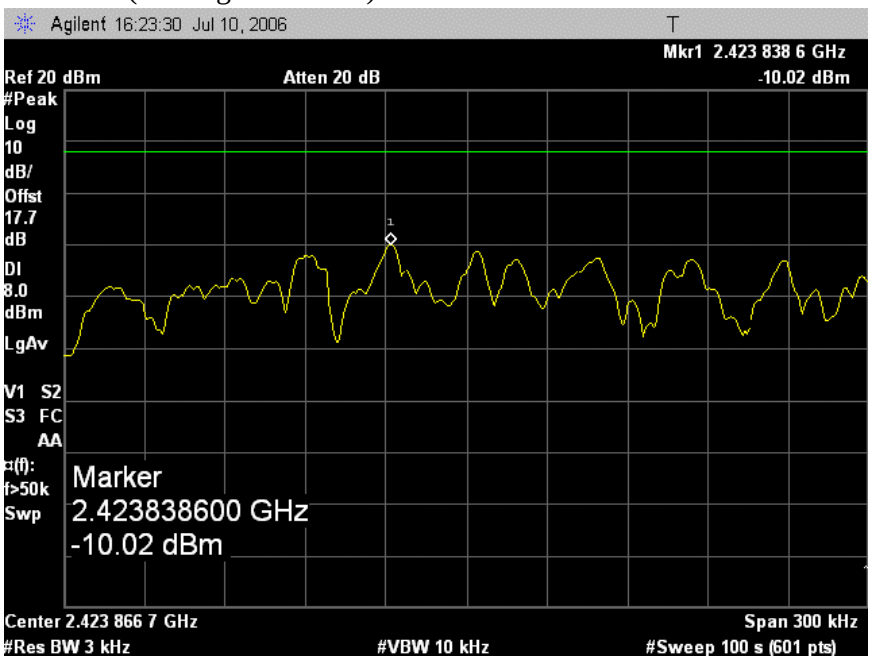
(802.11g 40M MODE)

LOW CH (802.11g 40M mode)



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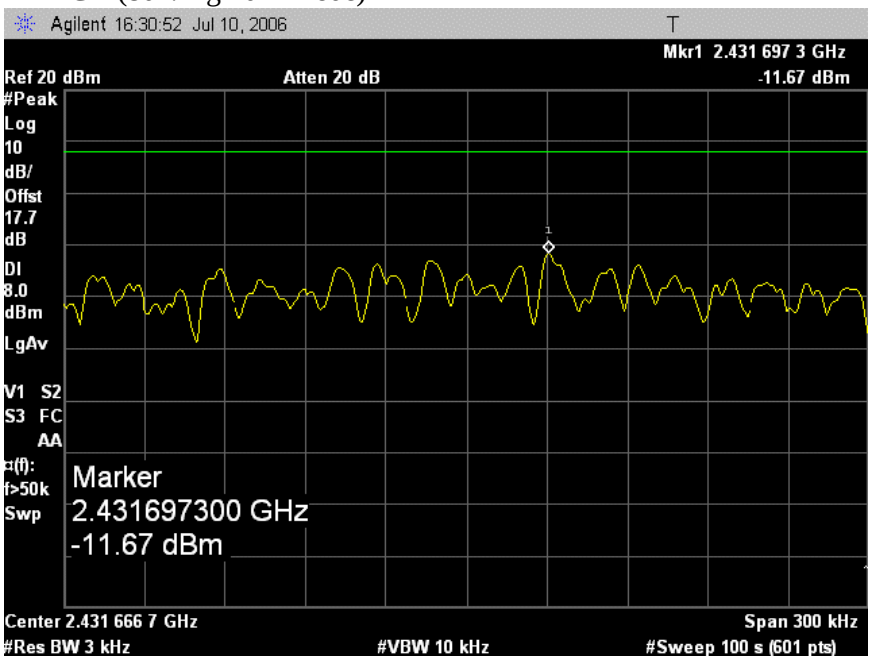
MID CH (802.11g 40M mode)



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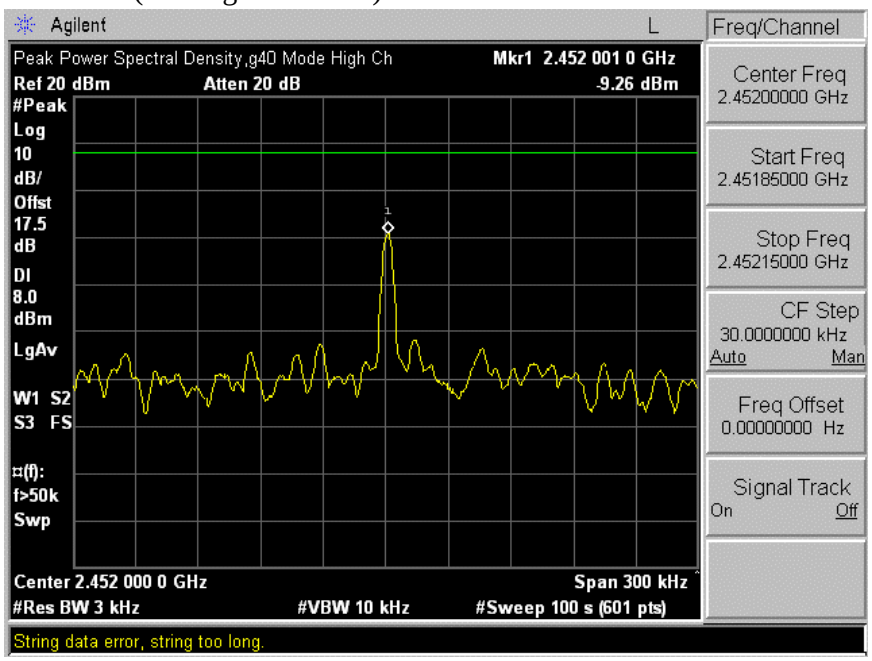
HIGH CH (802.11g 40M mode)



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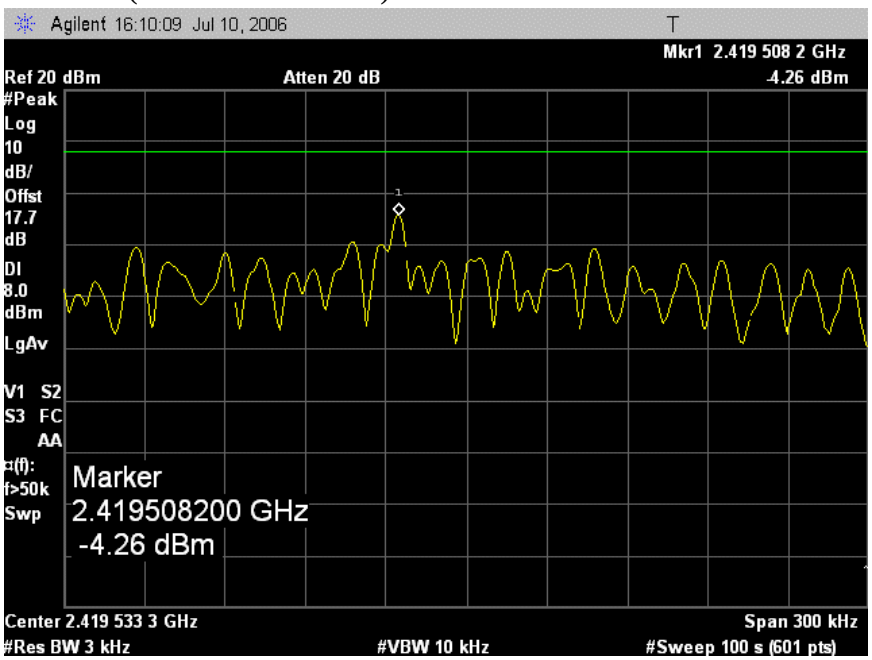
(802.11n HT20 MODE)

LOW CH (802.11n HT20 mode)



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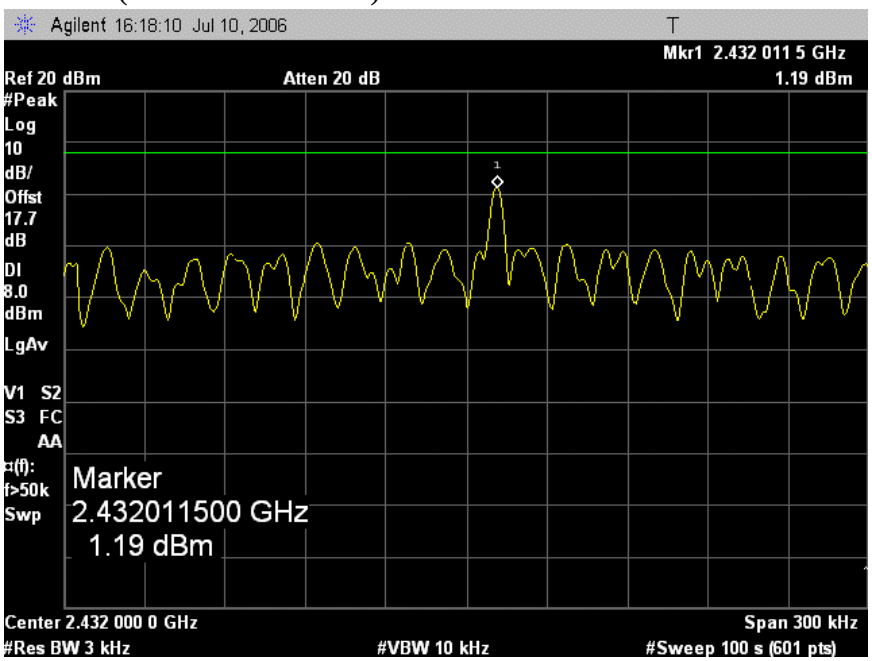
MID CH (802.11n HT20 mode)



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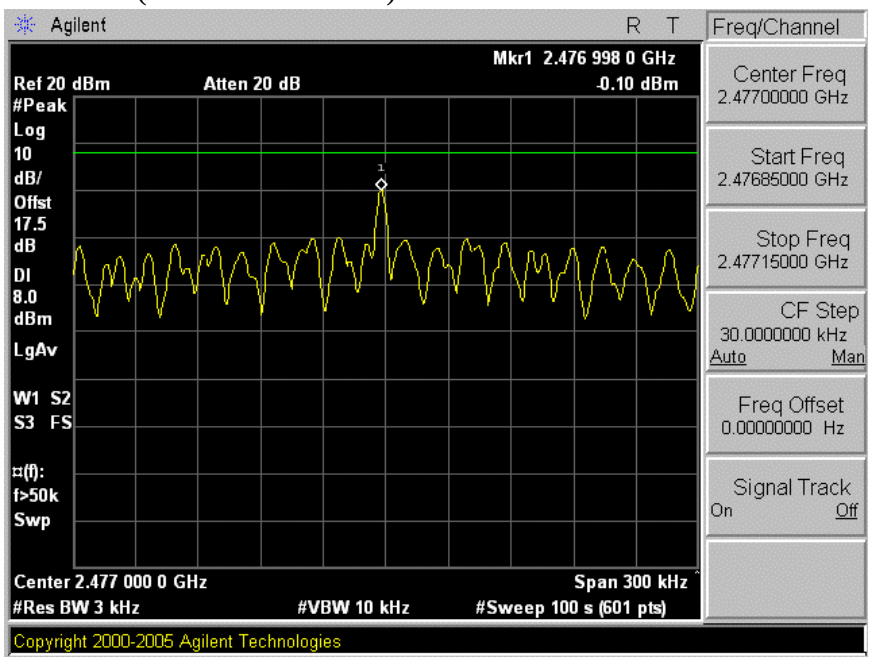
HIGH CH (802.11n HT20 mode)



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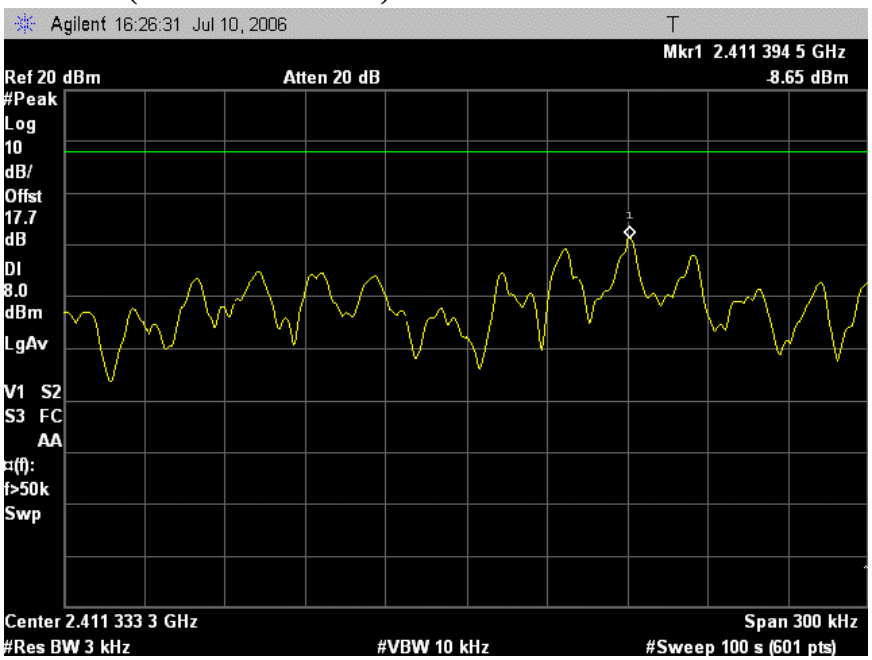
(802.11 HT40 MODE)

LOW CH (802.11n HT40 mode)



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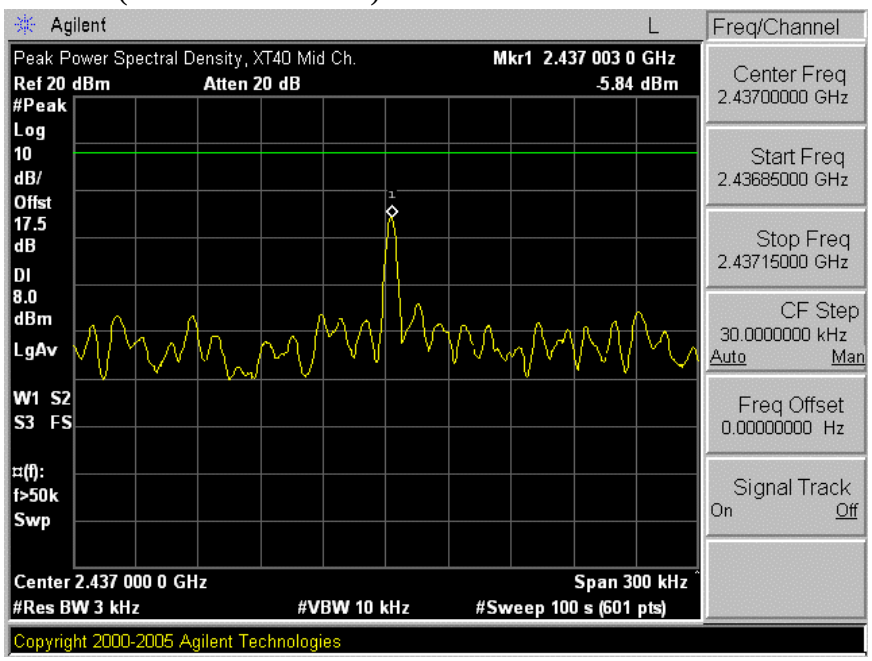
MID CH (802.11n HT40 mode)



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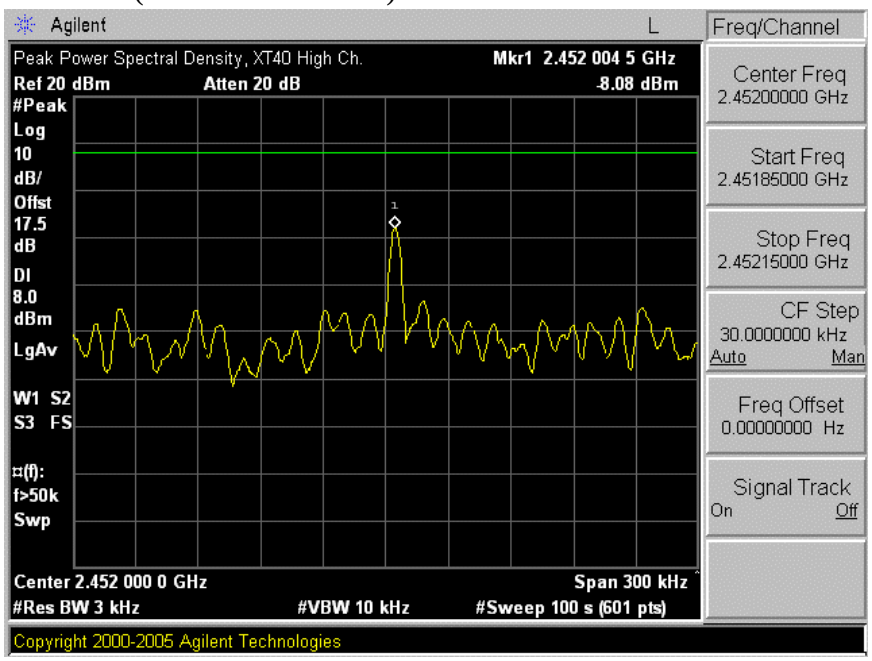
HIGH CH (802.11n HT40 mode)



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7.1.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

§15.247 (c) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in§15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

RESULTS

No non-compliance noted:

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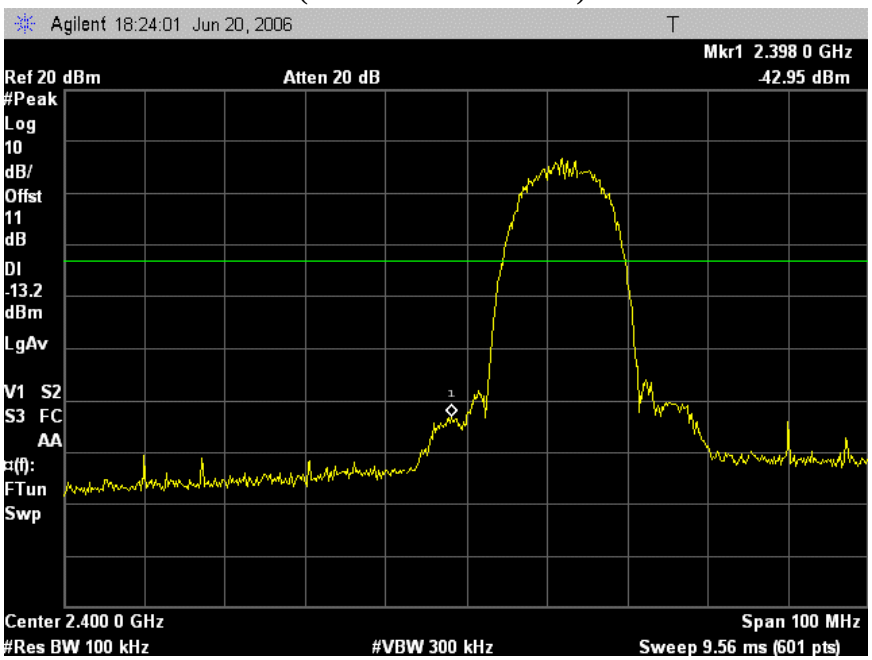
SPURIOUS EMISSIONS (802.11b MODE CHAIN A)

LOW CH BANDEDGE (802.11b mode chain A)



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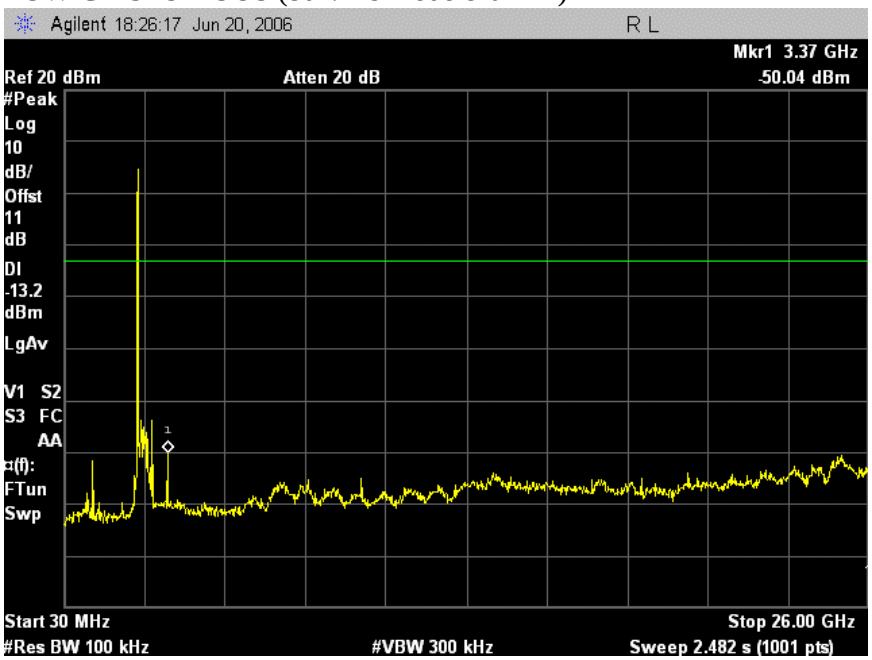
LOW CH SPURIOUS (802.11b mode chain A)



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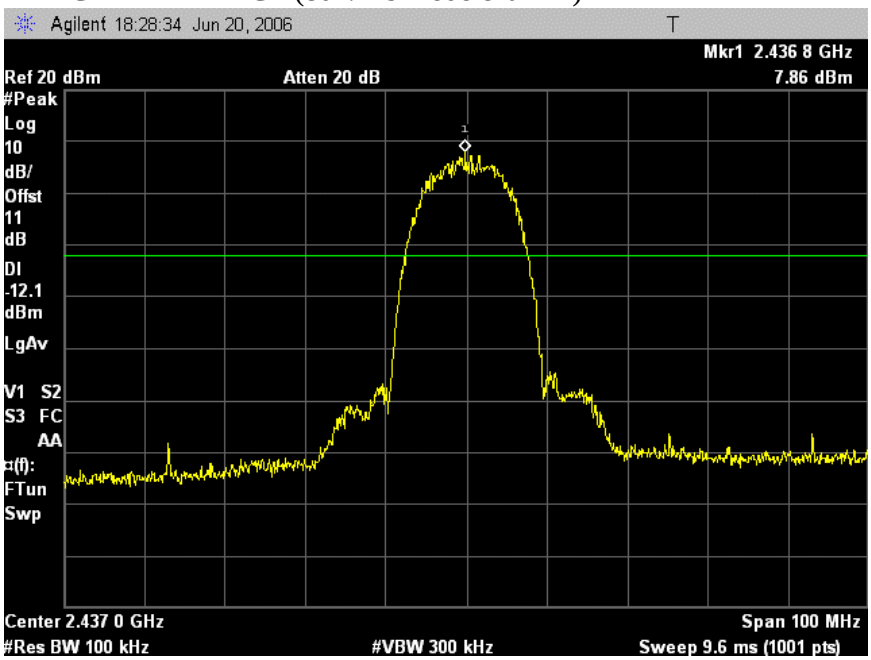
MID CH REFERENCE (802.11b mode chain A)



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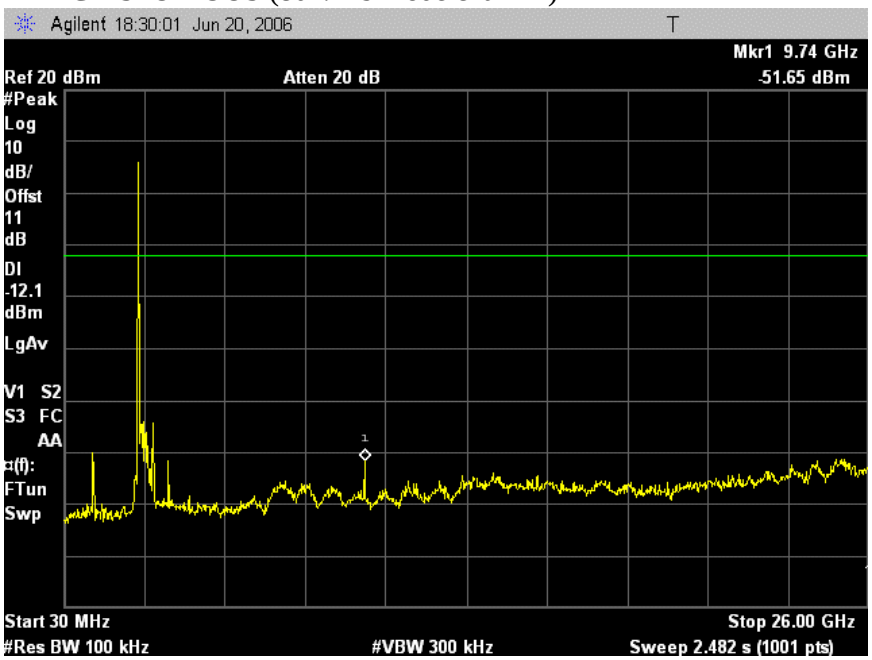
MID CH SPURIOUS (802.11b mode chain A)



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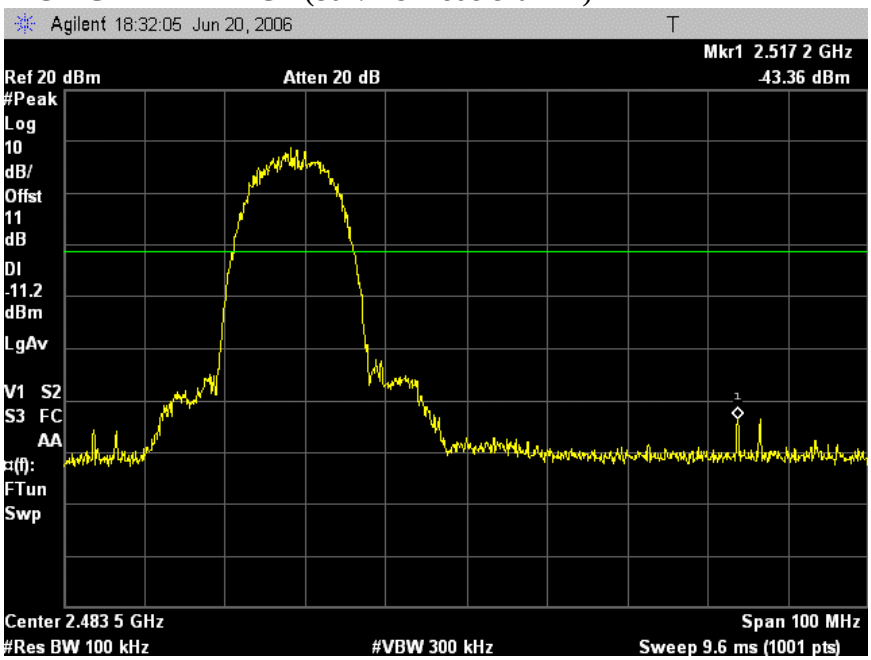
HIGH CH BANDEDGE (802.11b mode chain A)



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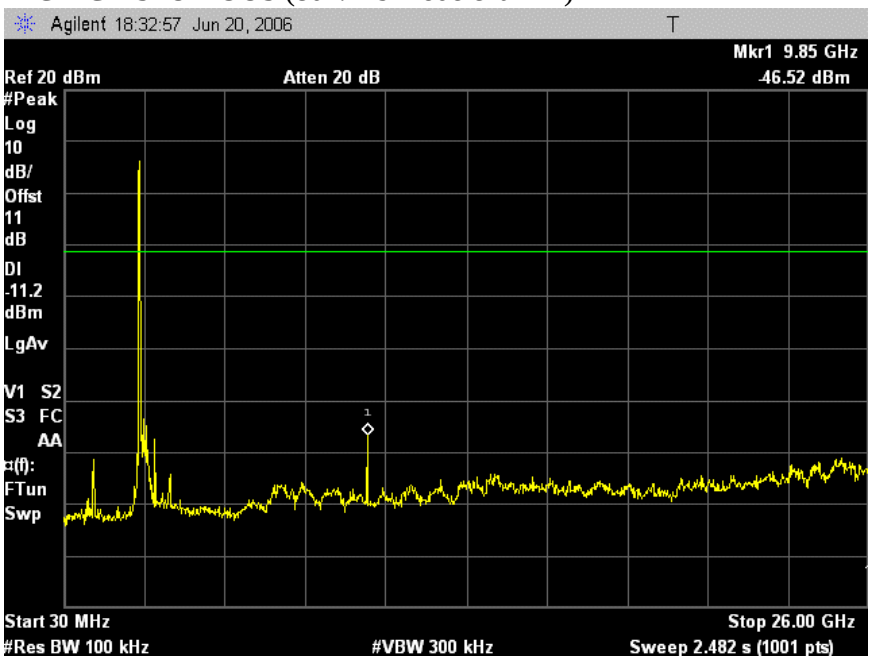
HIGH CH SPURIOUS (802.11b mode chain A)



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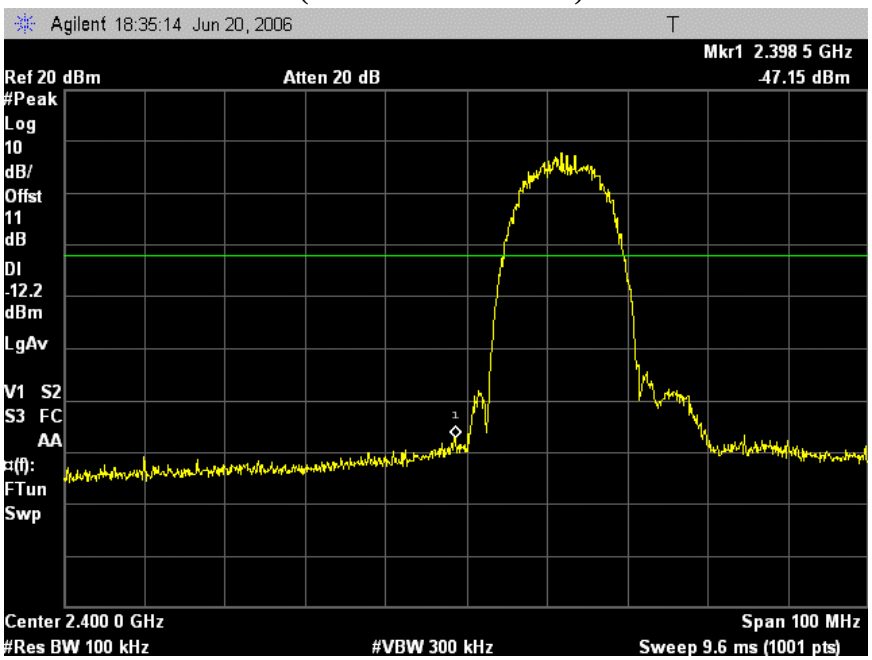
SPURIOUS EMISSIONS (802.11b MODE CHAIN B)

LOW CH BANDEDGE (802.11b mode chain B)



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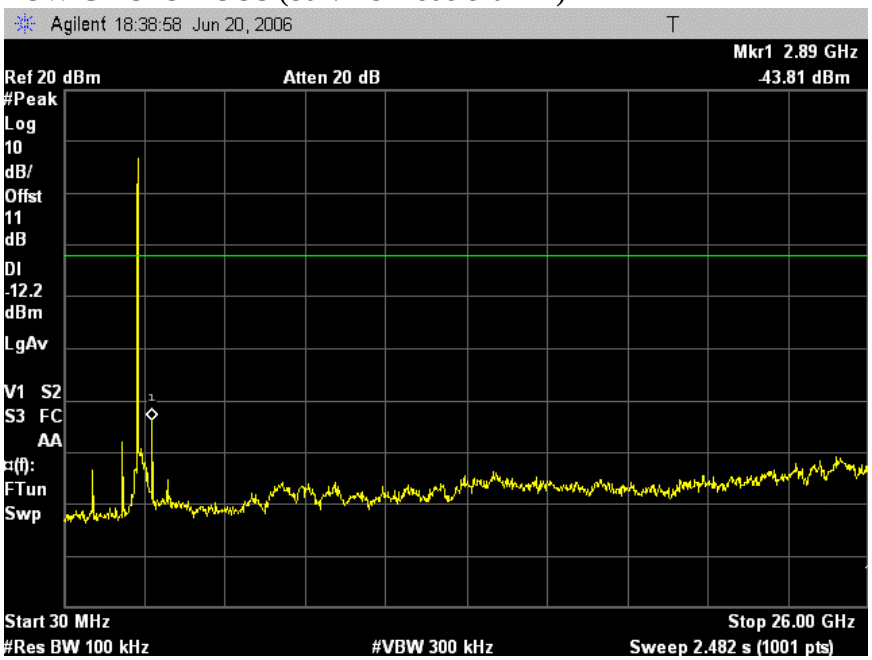
LOW CH SPURIOUS (802.11b mode chain B)



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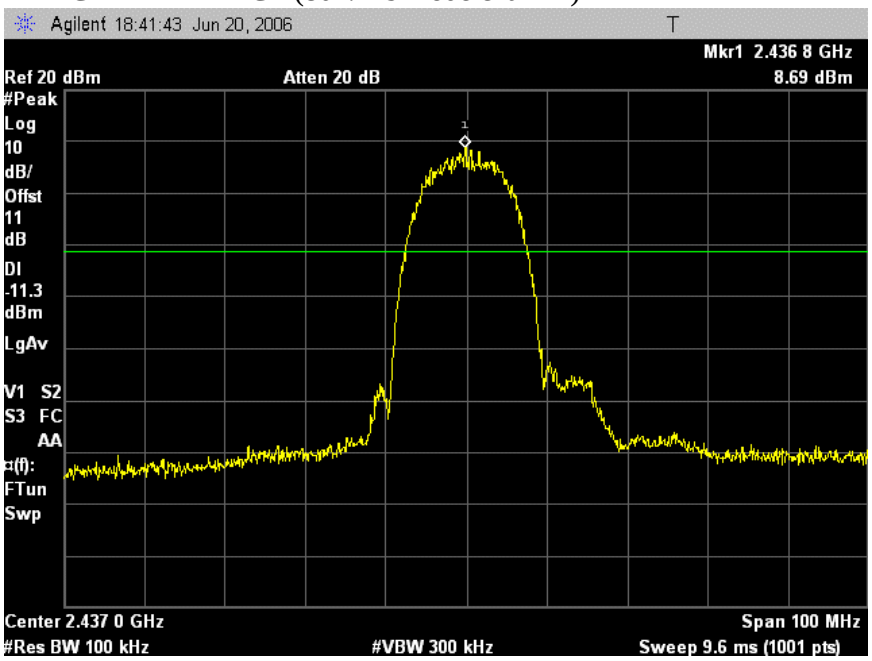
MID CH REFERENCE (802.11b mode chain B)



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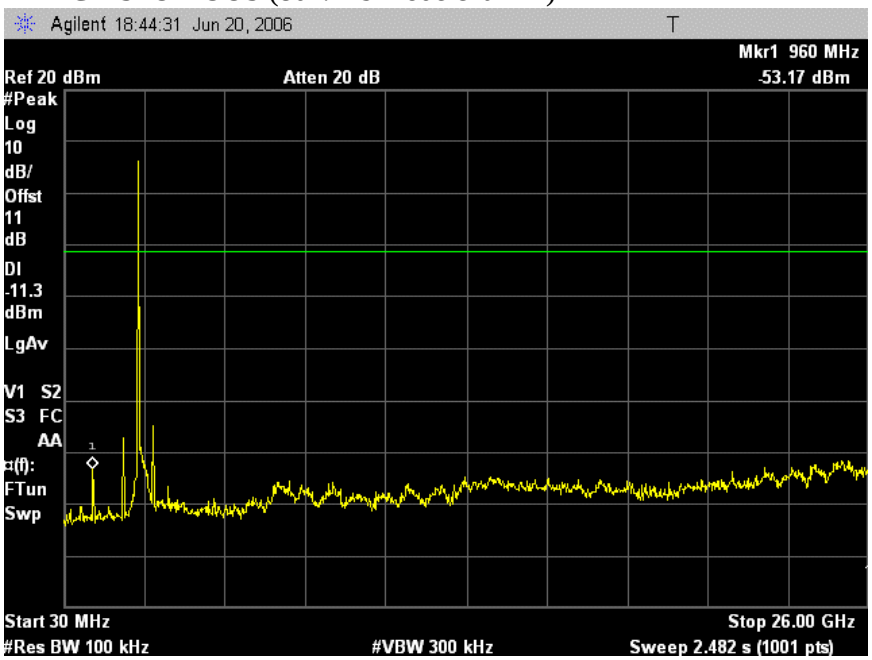
MID CH SPURIOUS (802.11b mode chain B)



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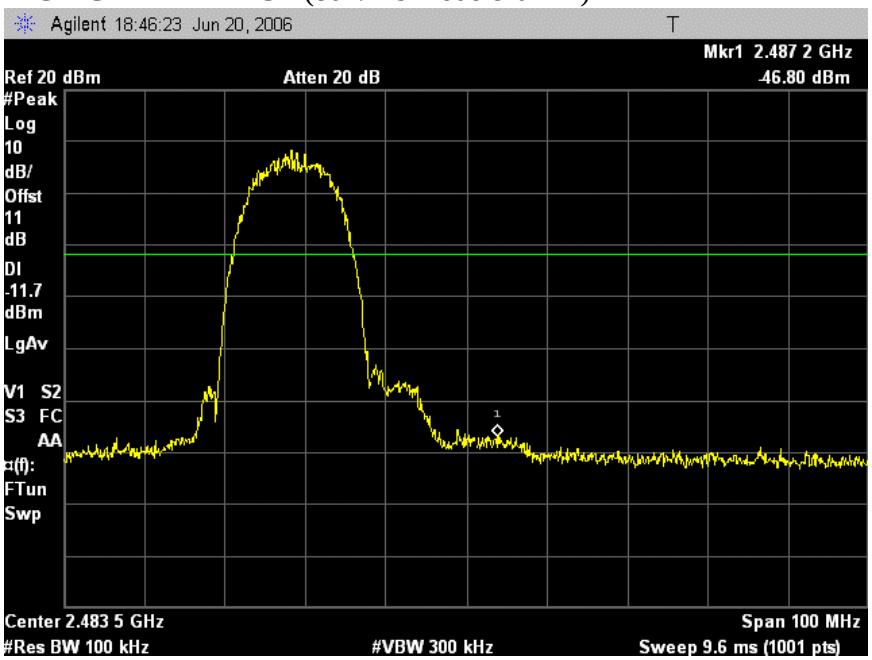
HIGH CH BANDEDGE (802.11b mode chain B)



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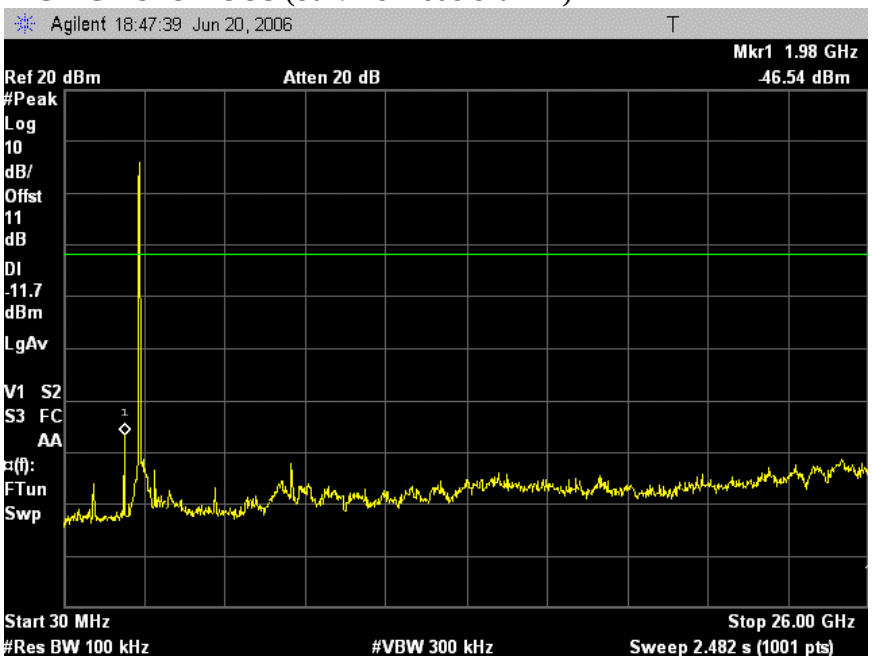
HIGH CH SPURIOUS (802.11b mode chain B)



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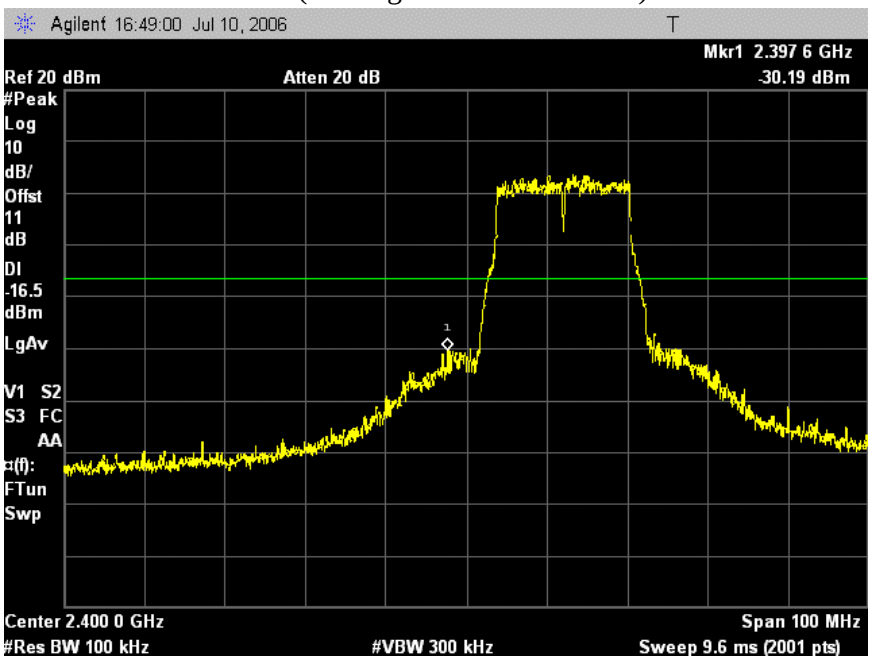
SPURIOUS EMISSIONS (802.11g 20M MODE CHAIN A)

LOW CH BANDEDGE (802.11g 20M mode chain A)



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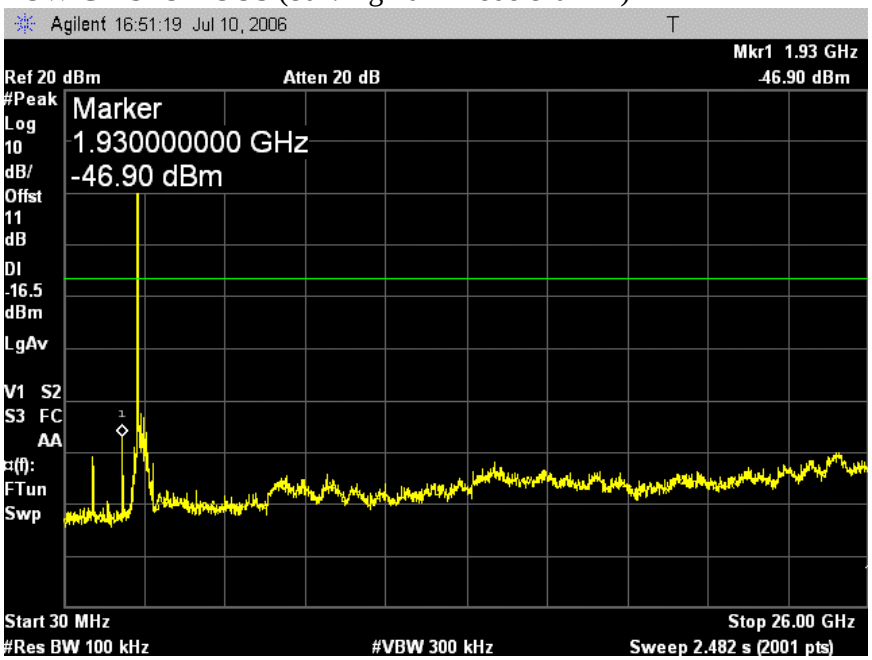
LOW CH SPURIOUS (802.11g 20M mode chain A)



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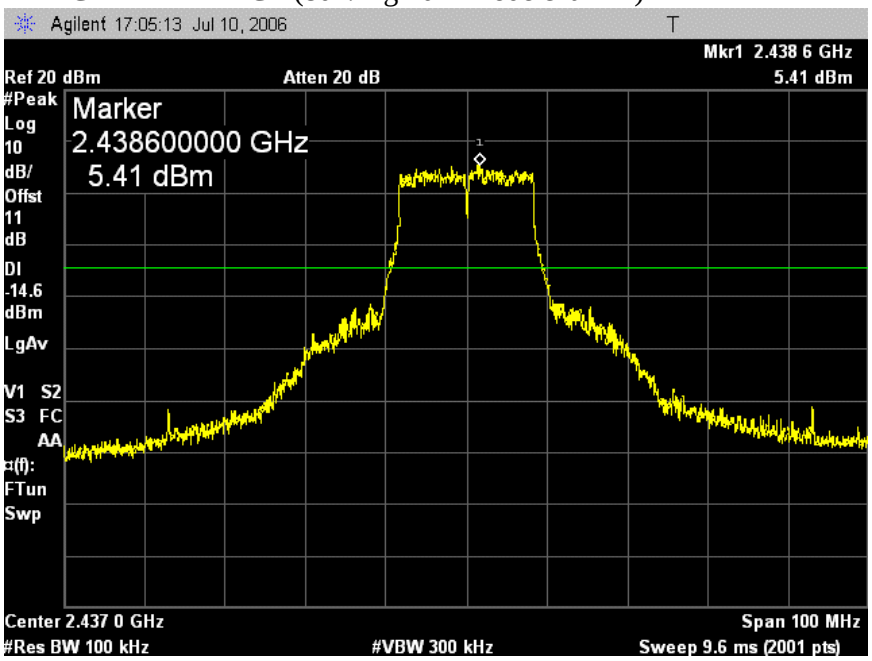
MID CH REFERENCE (802.11g 20M mode chain A)



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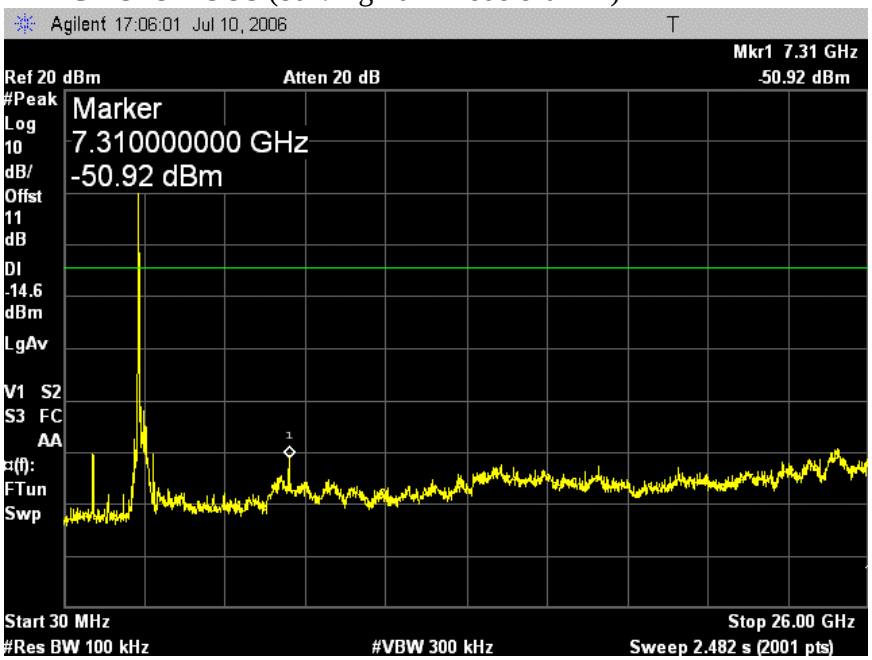
MID CH SPURIOUS (802.11g 20M mode chain A)



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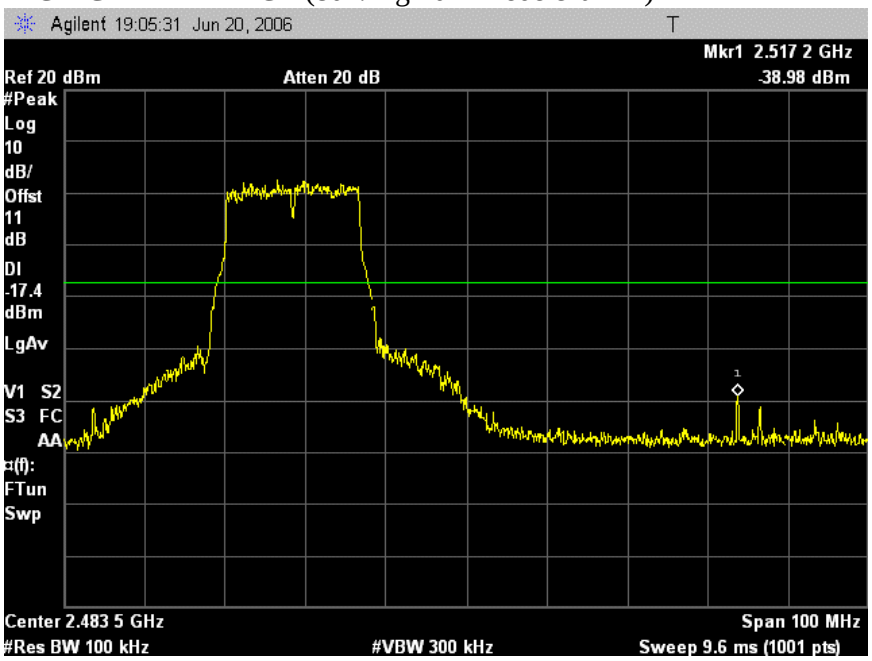
HIGH CH BANDEDGE (802.11g 20M mode chain A)



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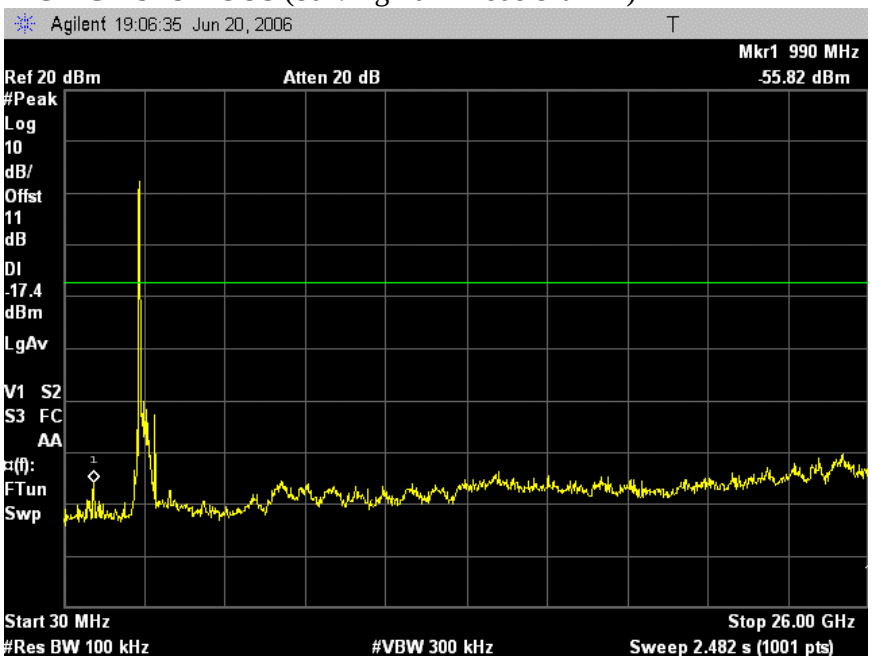
HIGH CH SPURIOUS (802.11g 20M mode chain A)



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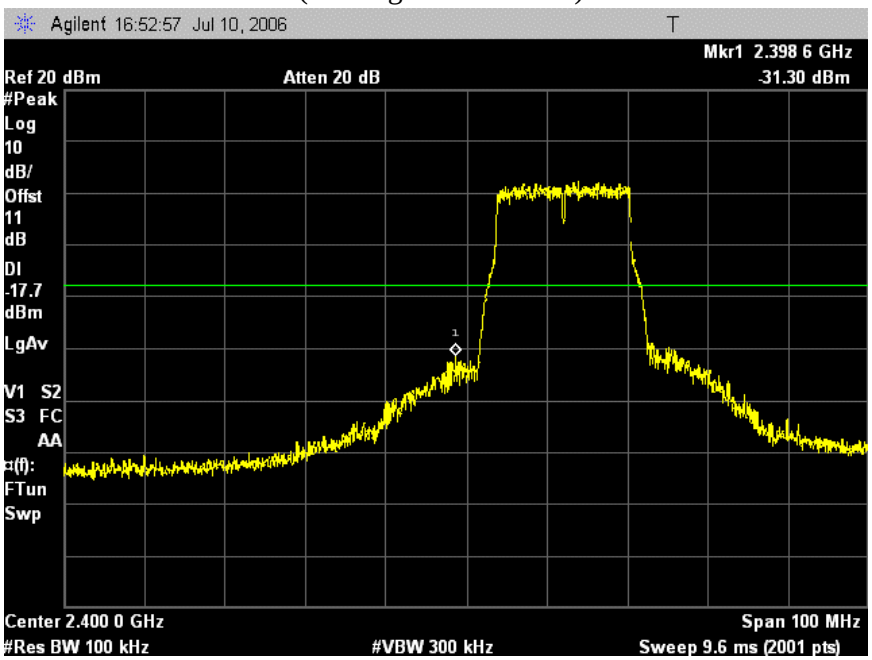
SPURIOUS EMISSIONS (802.11g 20M MODE CHAIN B)

LOW CH BANDEDGE (802.11g mode chain B)



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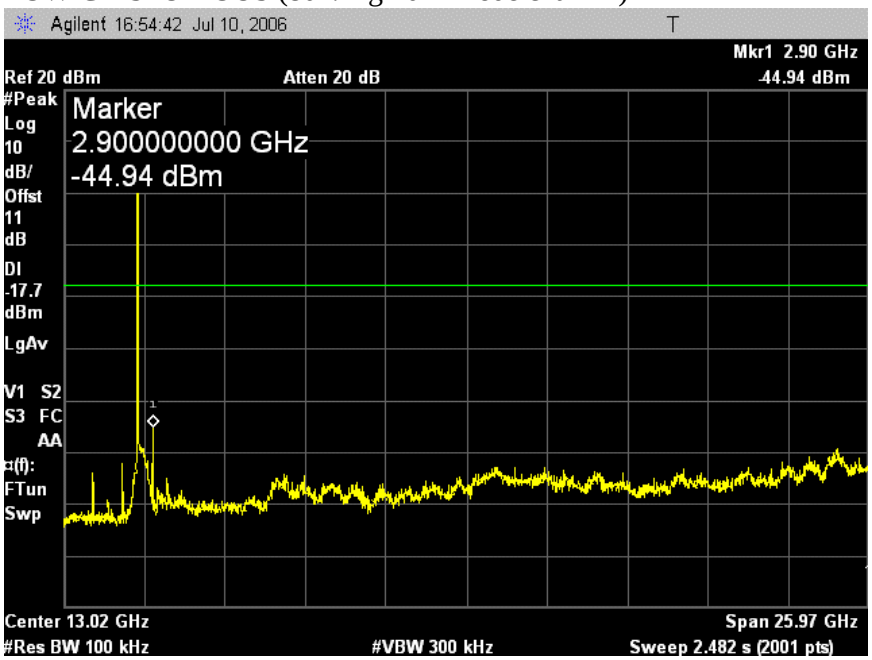
LOW CH SPURIOUS (802.11g 20M mode chain B)



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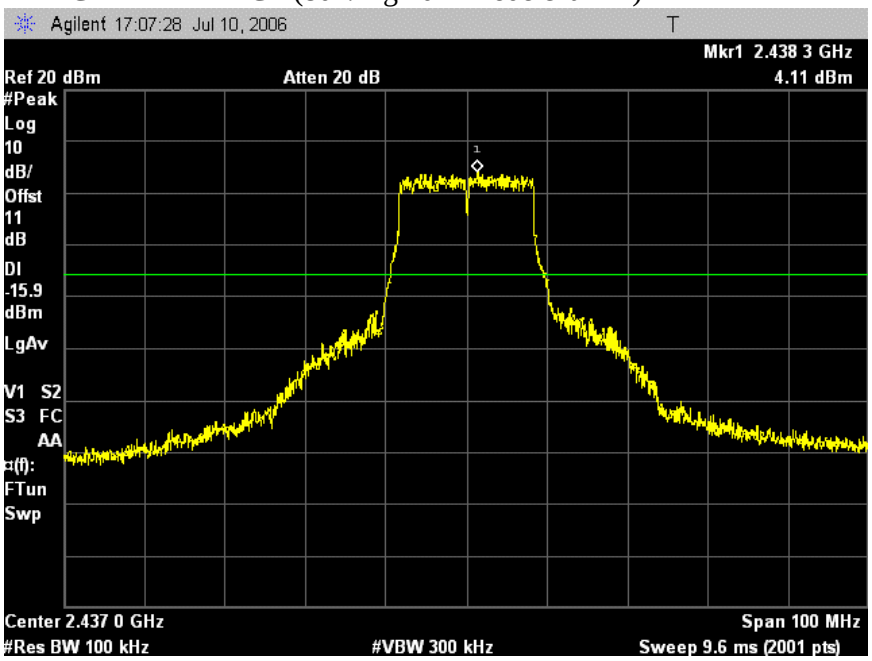
MID CH REFERENCE (802.11g 20M mode chain B)



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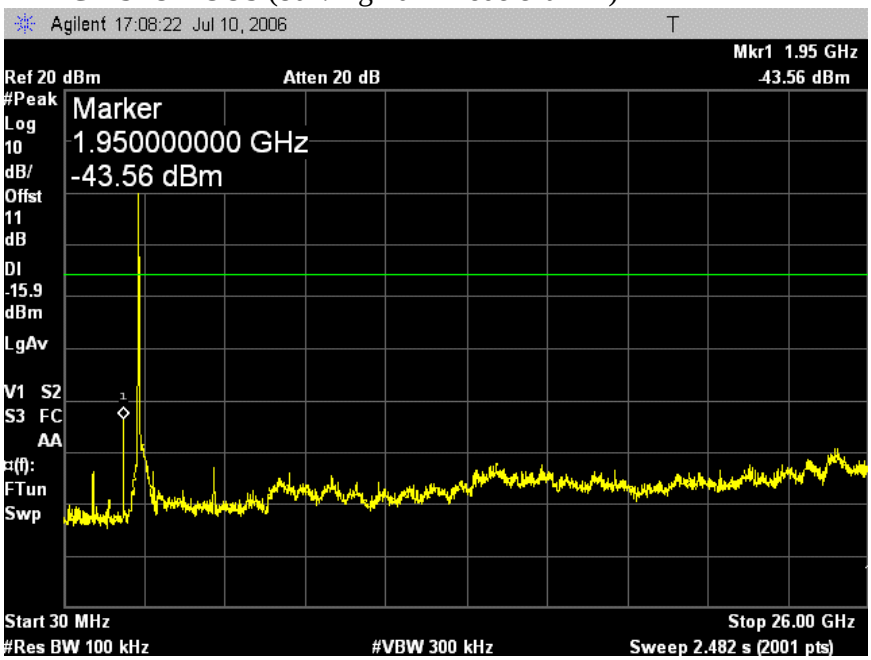
MID CH SPURIOUS (802.11g 20M mode chain B)



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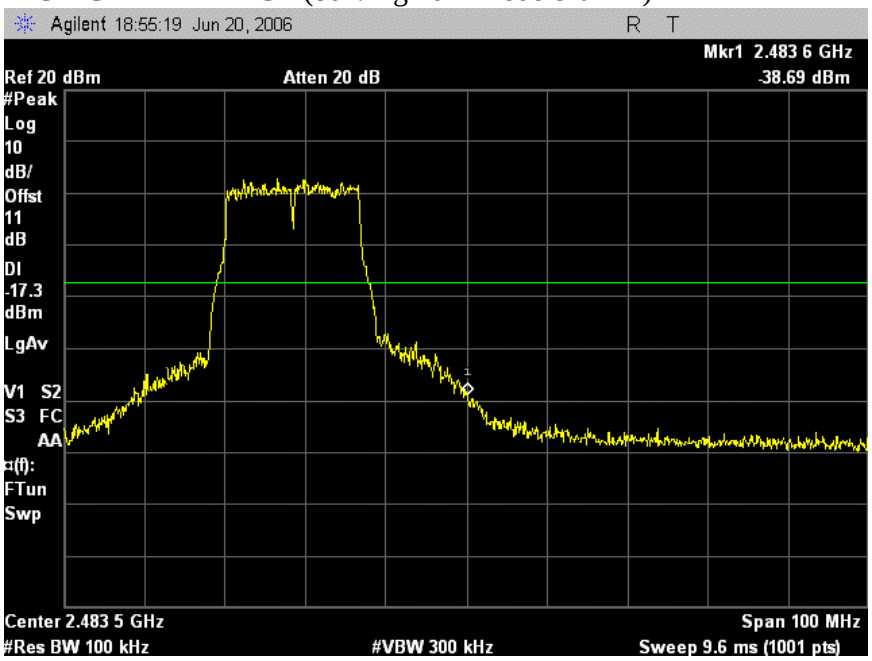
HIGH CH BANDEDGE (802.11g 20M mode chain B)



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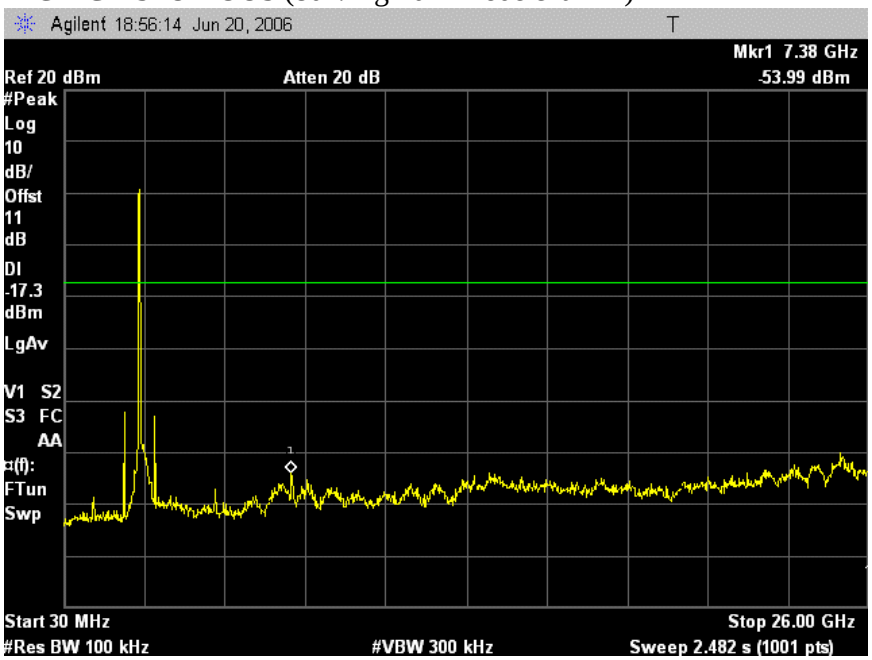
HIGH CH SPURIOUS (802.11g 20M mode chain B)



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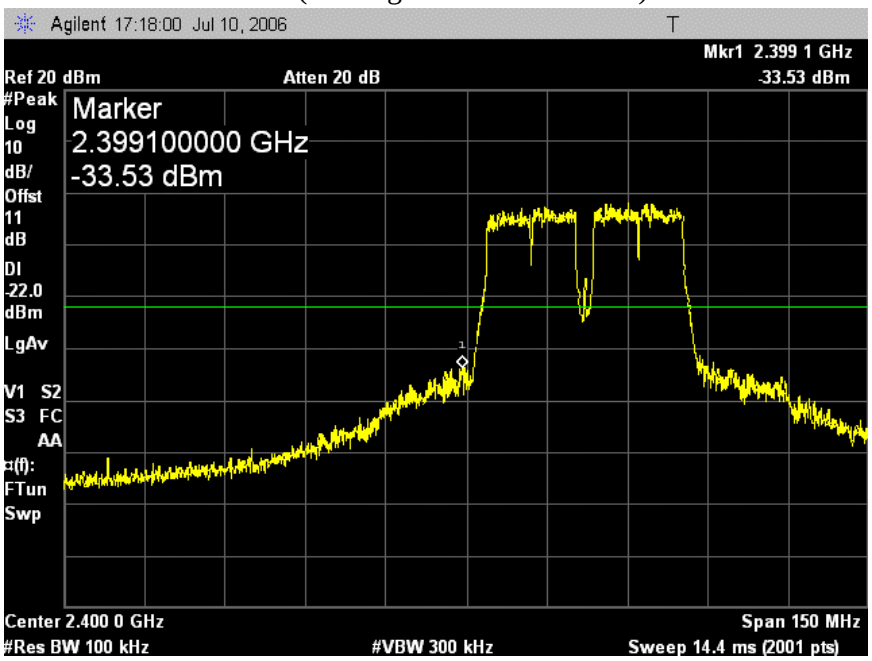
SPURIOUS EMISSIONS (802.11g 40M MODE CHAIN A)

LOW CH BANDEDGE (802.11g 40M mode chain A)



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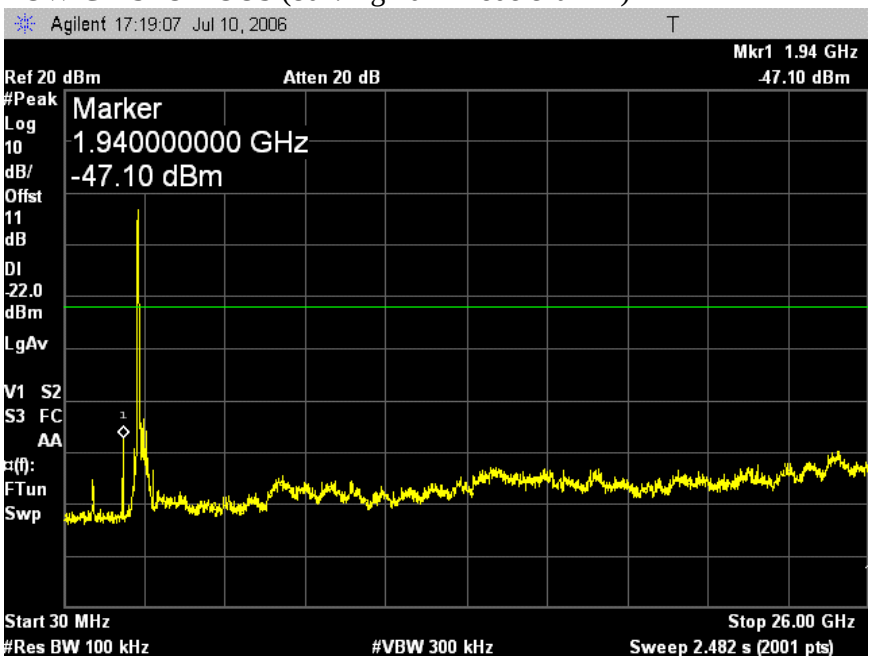
LOW CH SPURIOUS (802.11g 40M mode chain A)



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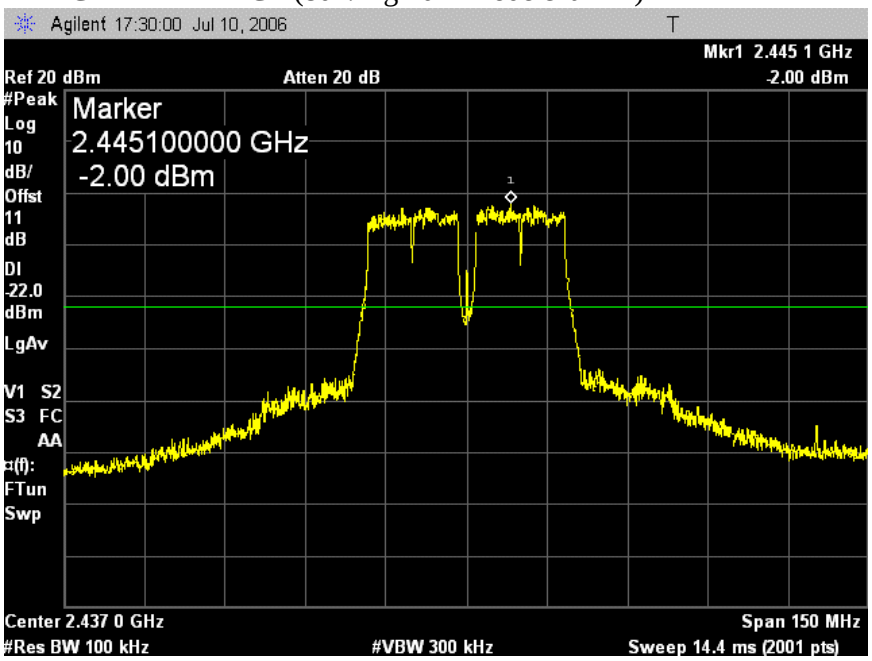
MID CH REFERENCE (802.11g 40M mode chain A)



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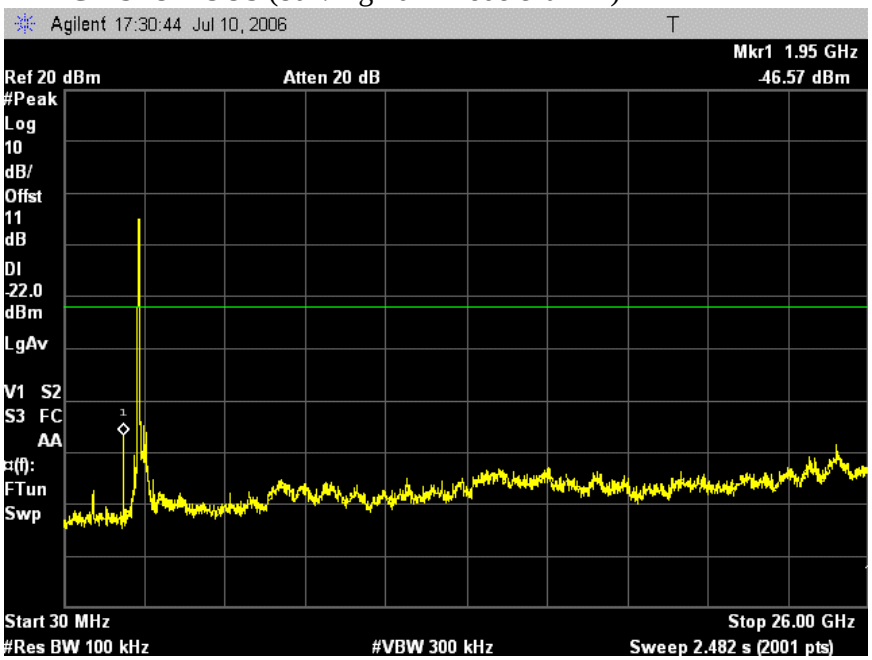
MID CH SPURIOUS (802.11g 40M mode chain A)



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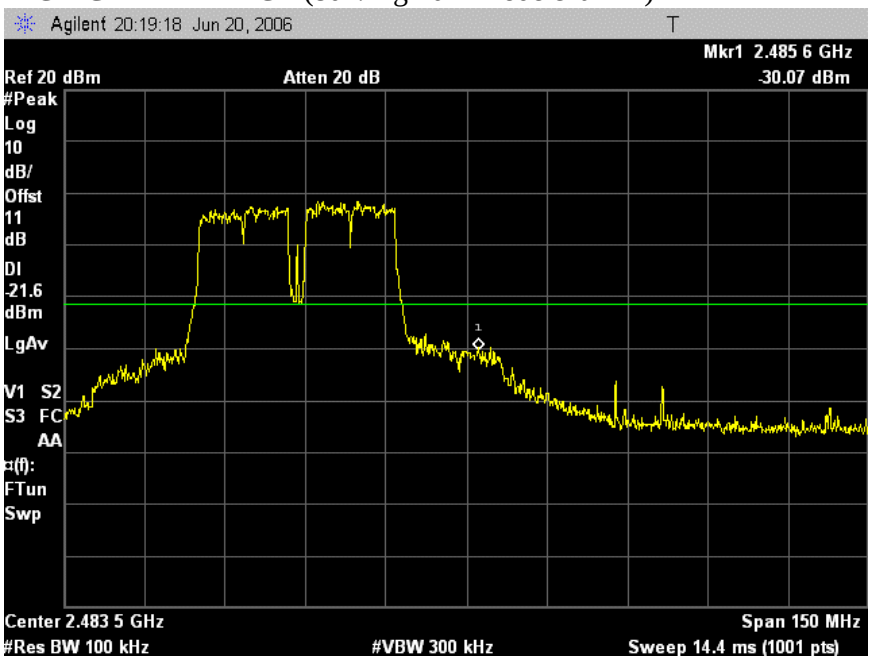
HIGH CH BANDEDGE (802.11g 40M mode chain A)



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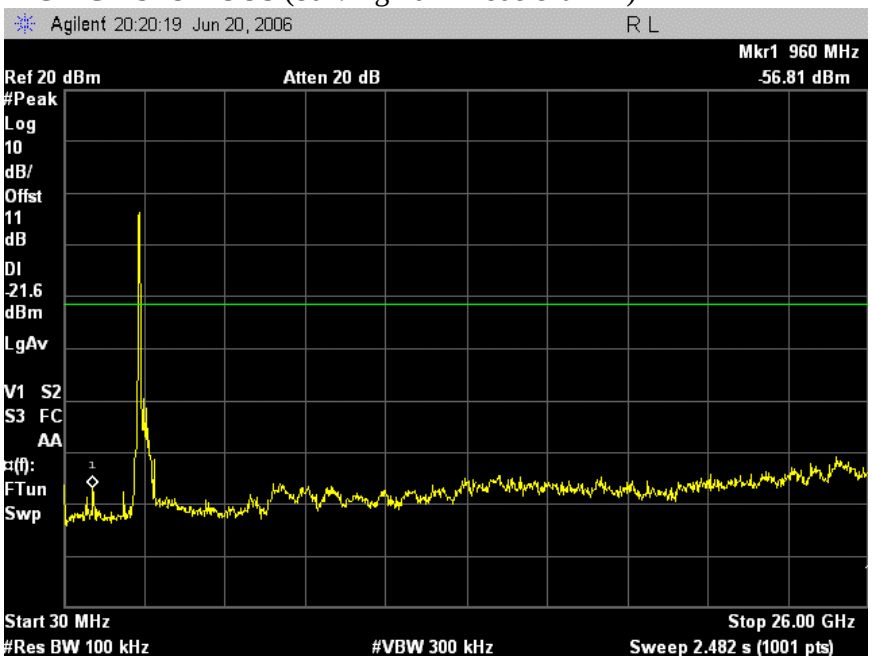
HIGH CH SPURIOUS (802.11g 40M mode chain A)



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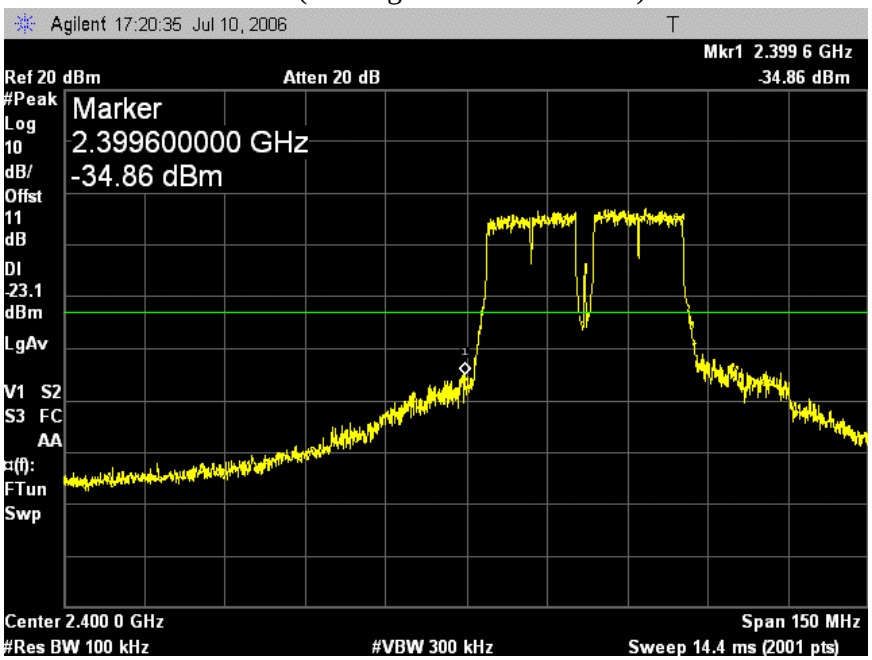
SPURIOUS EMISSIONS (802.11g 40M MODE CHAIN B)

LOW CH BANDEDGE (802.11g 40M mode chain B)



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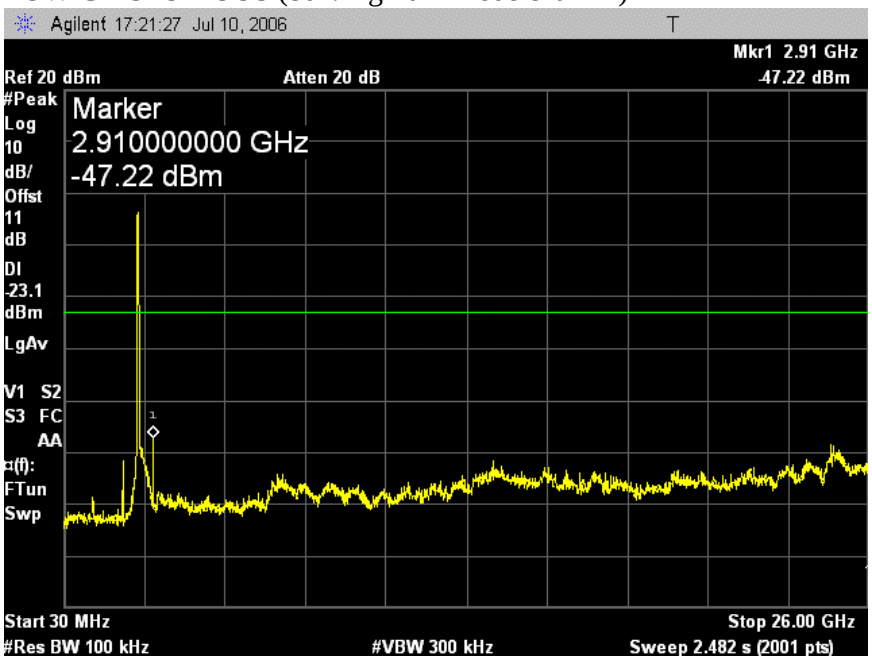
LOW CH SPURIOUS (802.11g 40M mode chain B)



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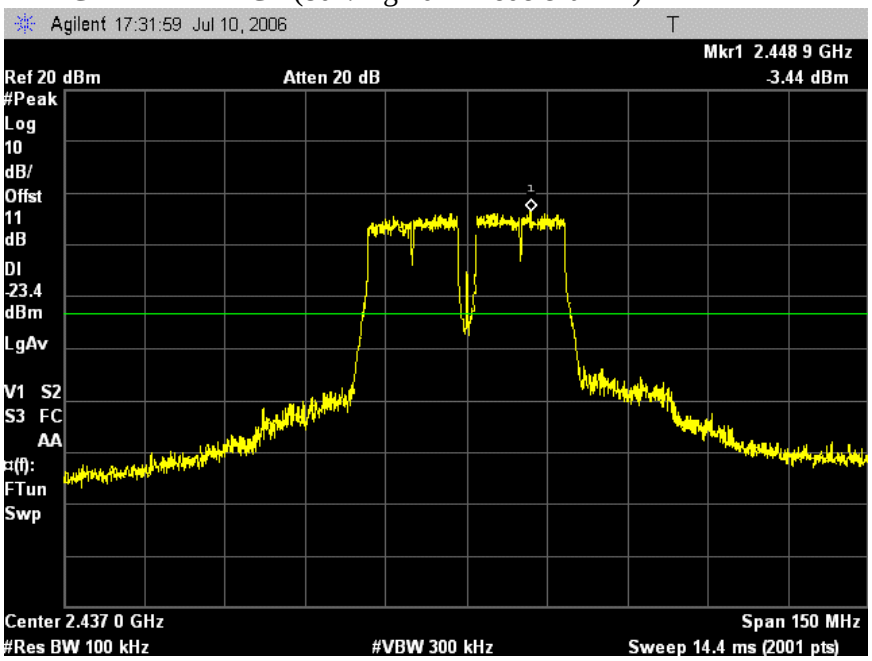
MID CH REFERENCE (802.11g 40M mode chain B)



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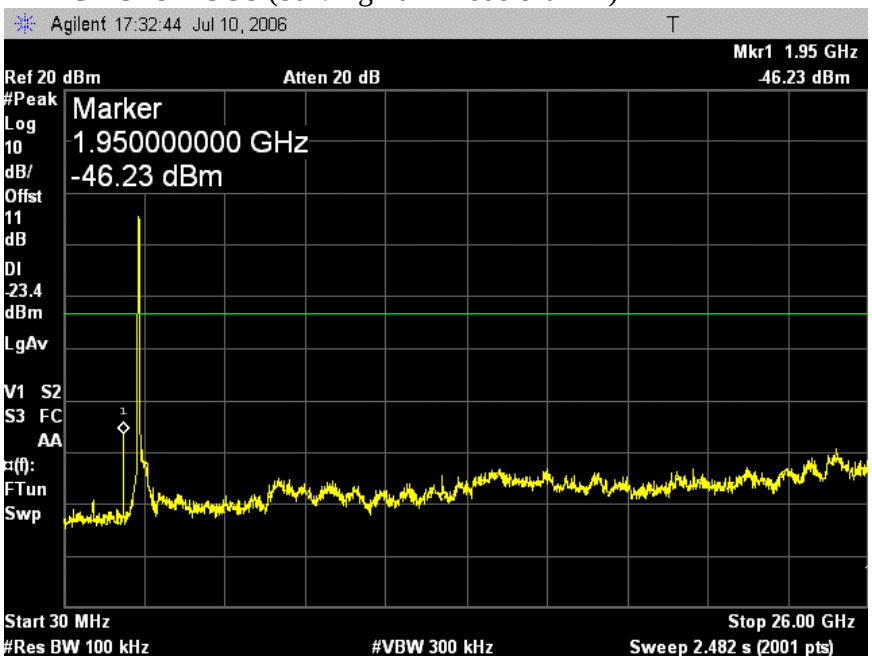
MID CH SPURIOUS (802.11g 40M mode chain B)



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HIGH CH BANDEDGE (802.11g 40M mode chain B)

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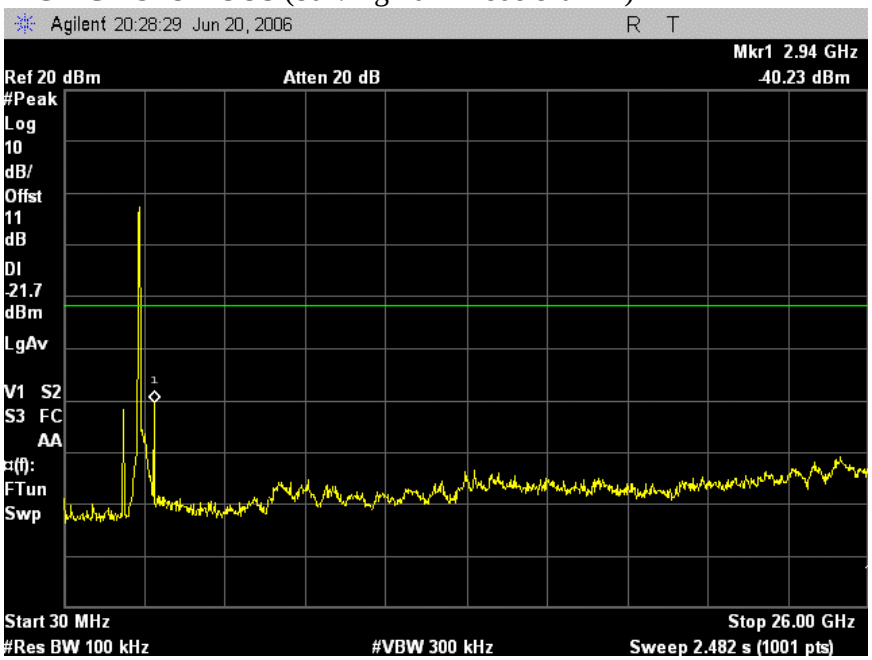
HIGH CH SPURIOUS (802.11g 40M mode chain B)



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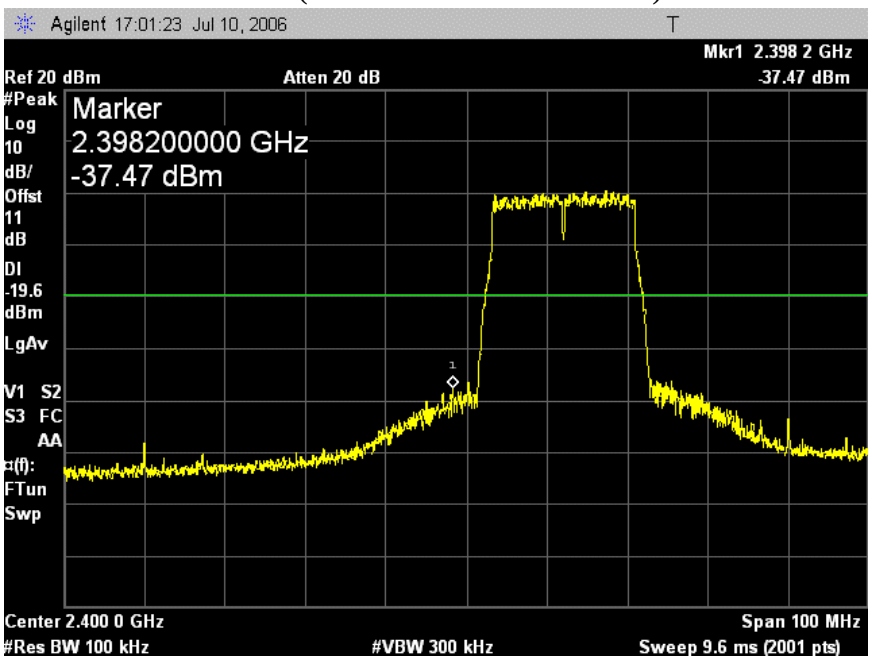
SPURIOUS EMISSIONS (802.11n HT20 MODE CHAIN A)

LOW CH BANDEDGE (802.11n HT20 mode chain A)



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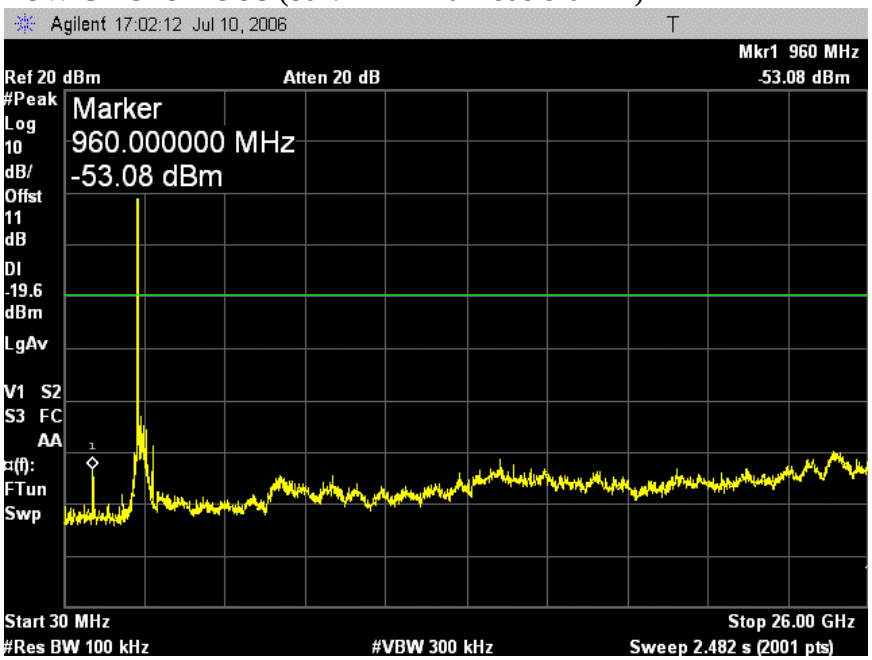
LOW CH SPURIOUS (802.11n HT20 mode chain A)



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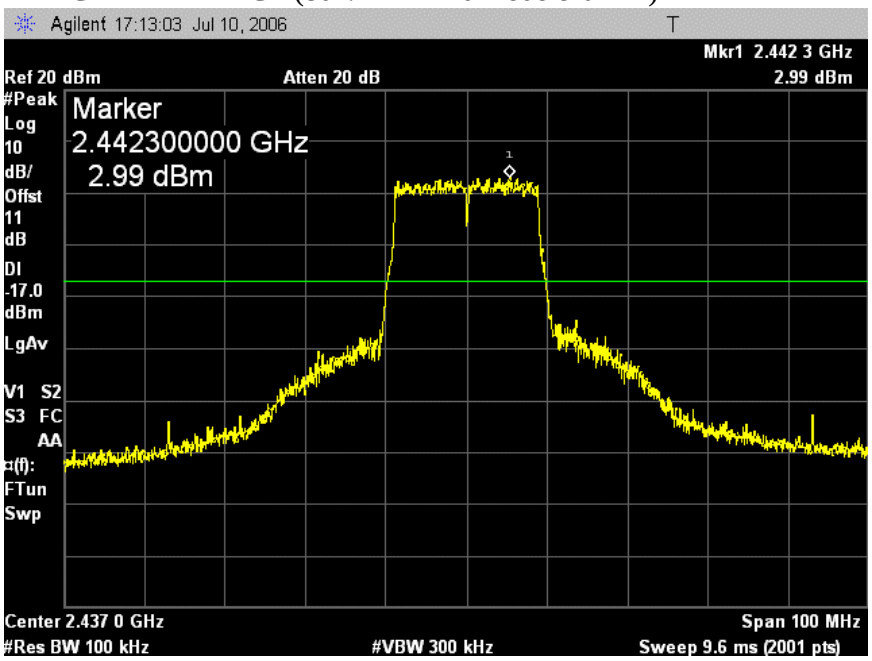
MID CH REFERENCE (802.11n HT20 mode chain A)



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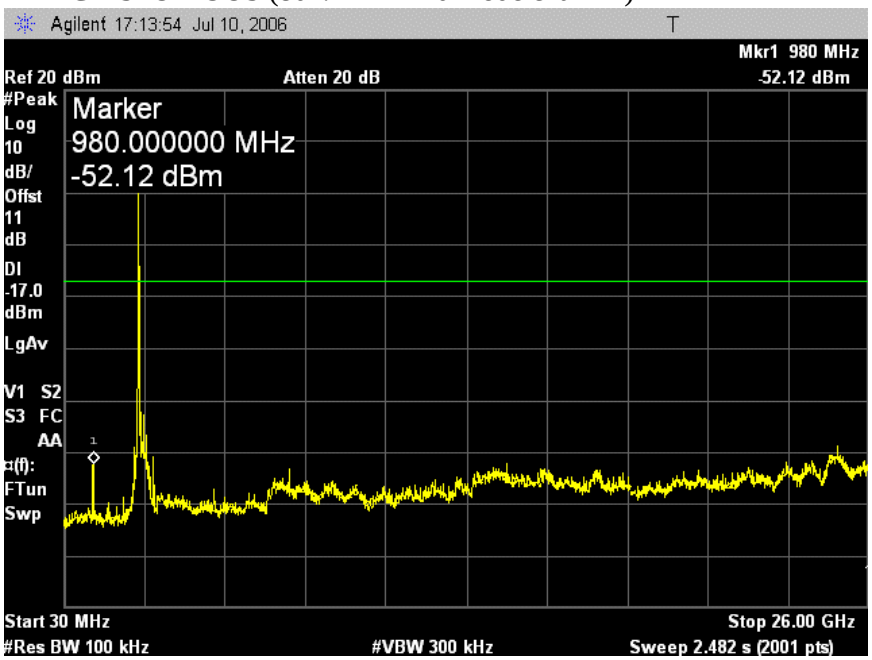
MID CH SPURIOUS (802.11n HT20 mode chain A)



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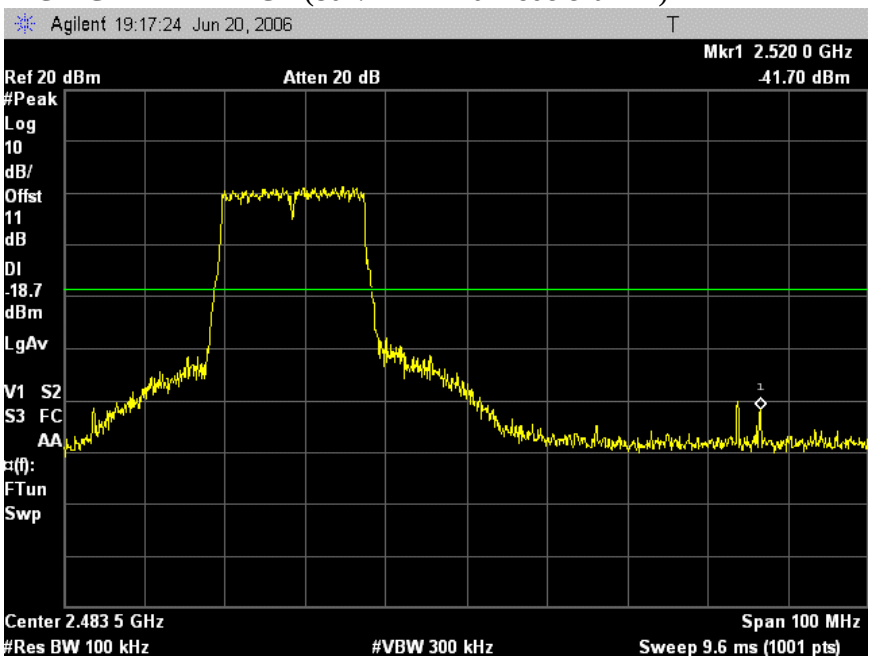
HIGH CH BANDEDGE (802.11n HT20 mode chain A)



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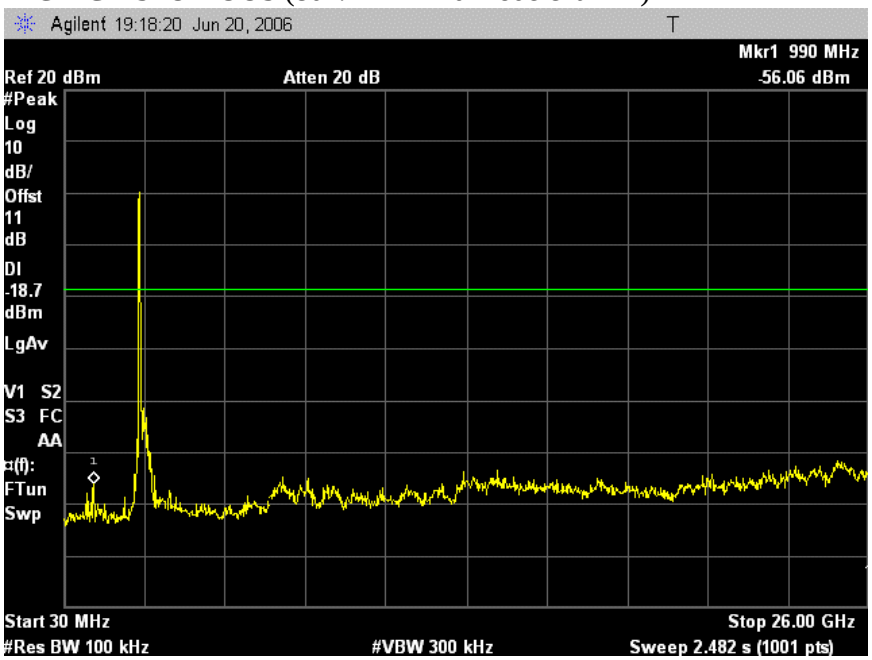
HIGH CH SPURIOUS (802.11n HT20 mode chain A)



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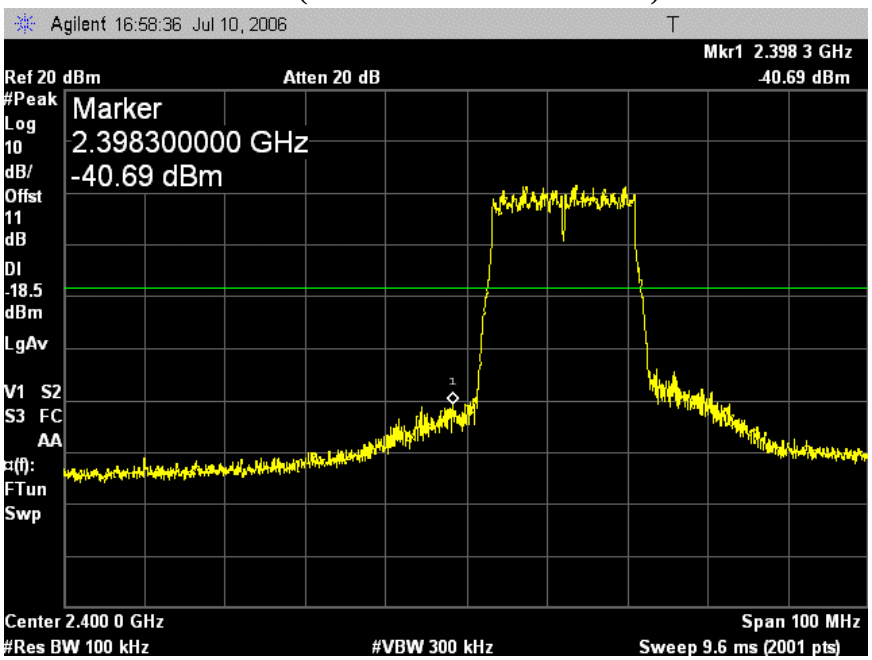
SPURIOUS EMISSIONS (802.11 HT20 MODE CHAIN B)

LOW CH BANDEDGE (802.11n HT20 mode chain B)



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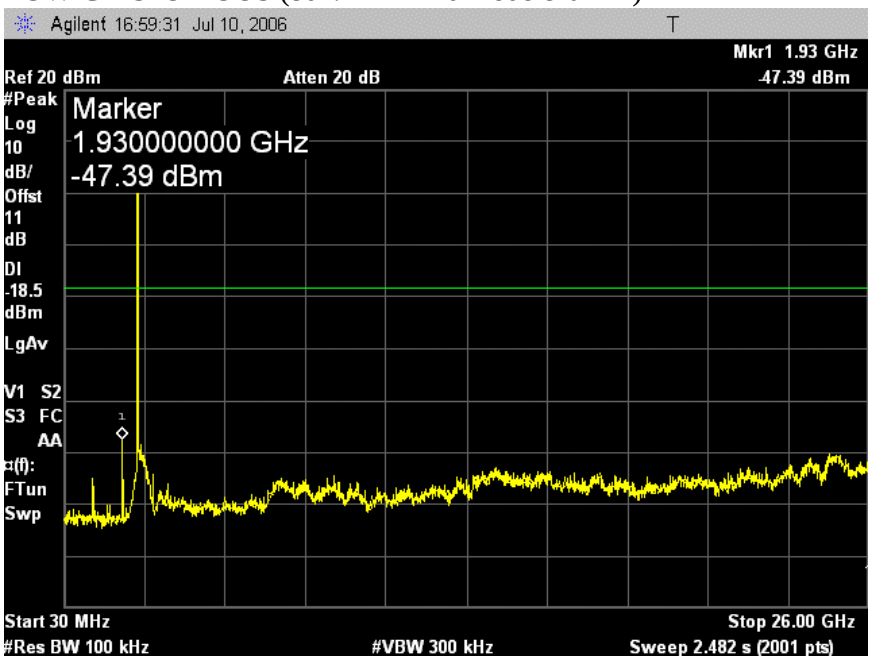
LOW CH SPURIOUS (802.11n HT20 mode chain B)



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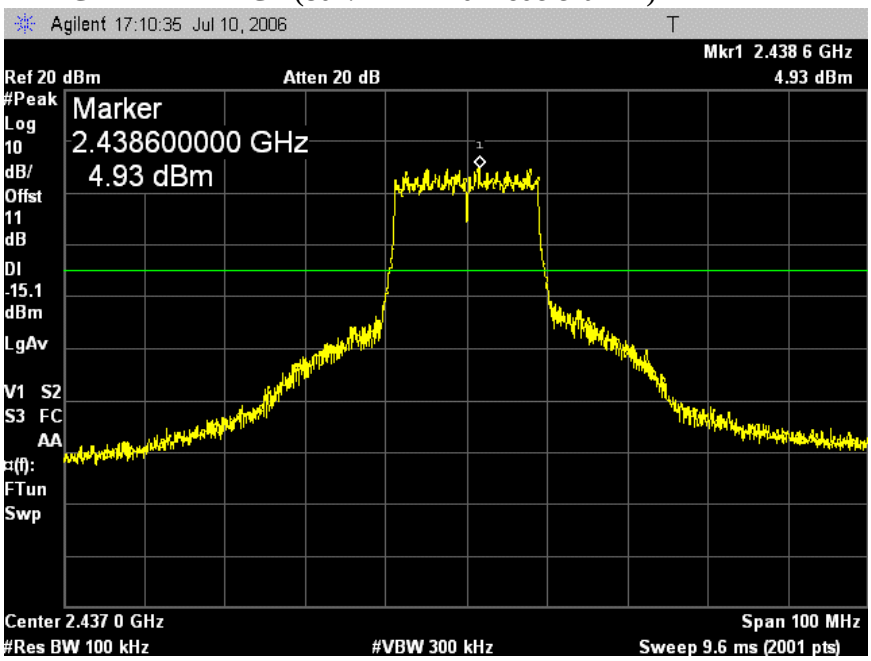
MID CH REFERENCE (802.11n HT20 mode chain B)



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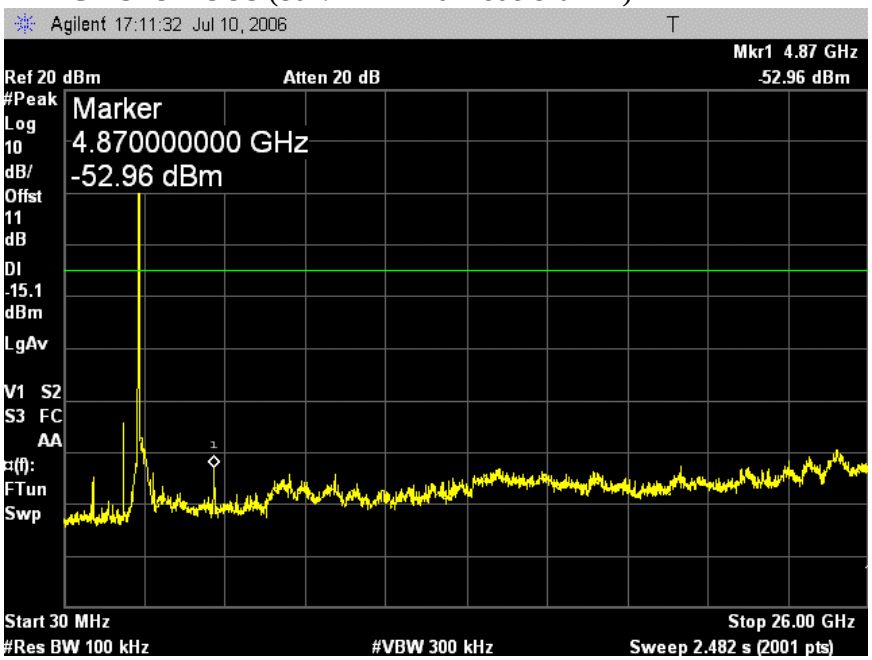
MID CH SPURIOUS (802.11n HT20 mode chain B)



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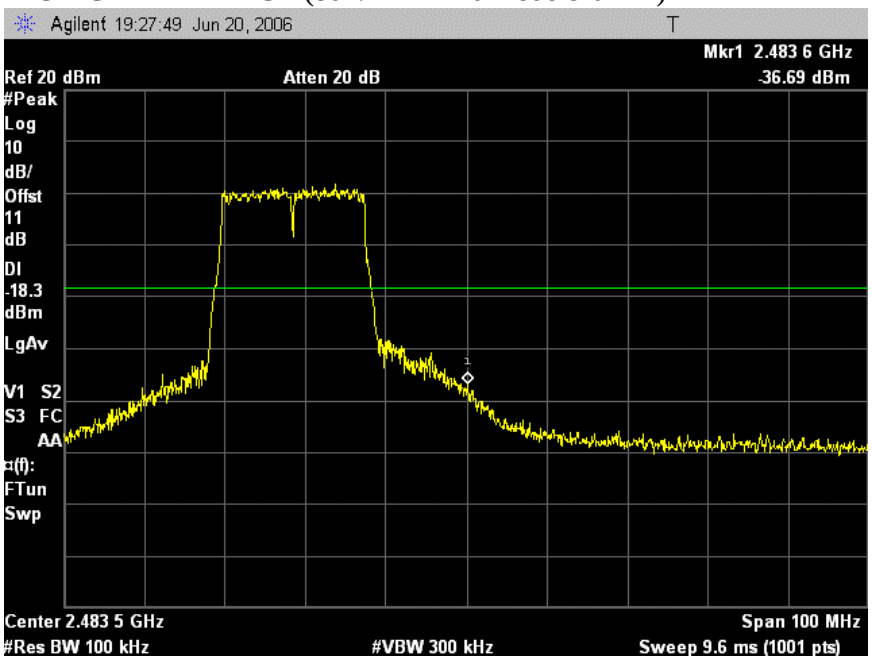
HIGH CH BANDEDGE (802.11n HT20 mode chain B)



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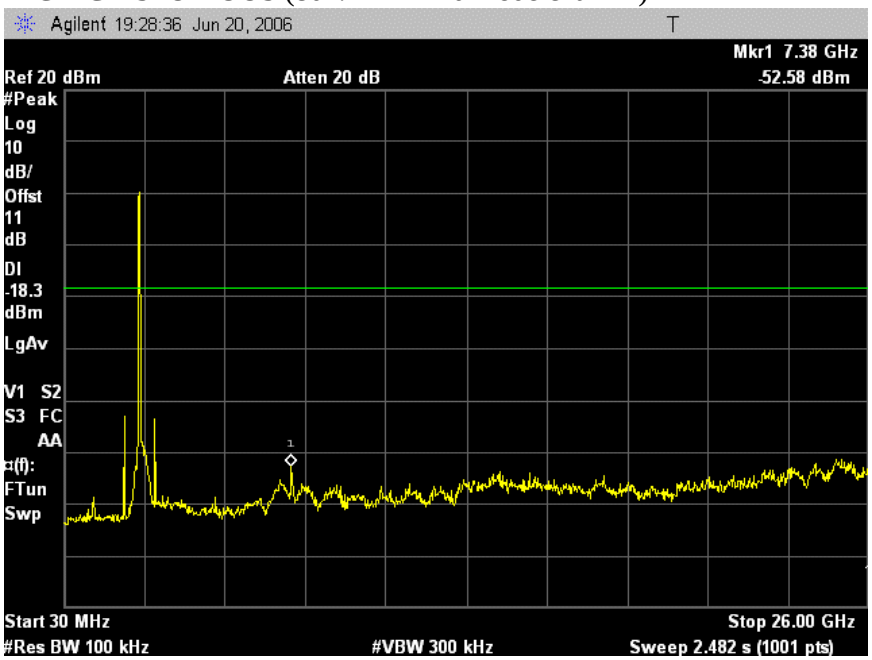
HIGH CH SPURIOUS (802.11n HT20 mode chain B)



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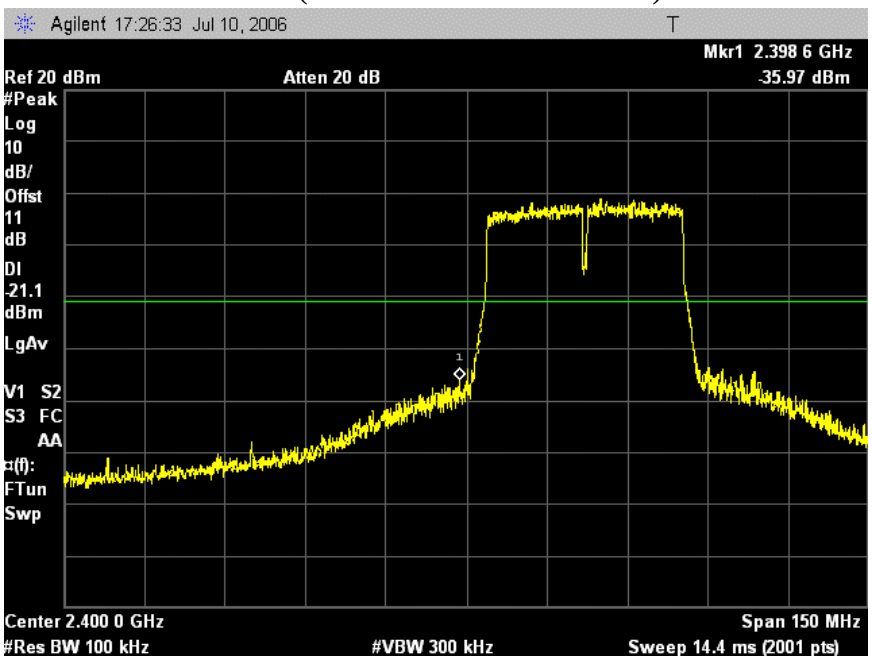
SPURIOUS EMISSIONS (802.11 HT40 MODE CHAIN A)

LOW CH BANDEDGE (802.11n HT40 mode chain A)



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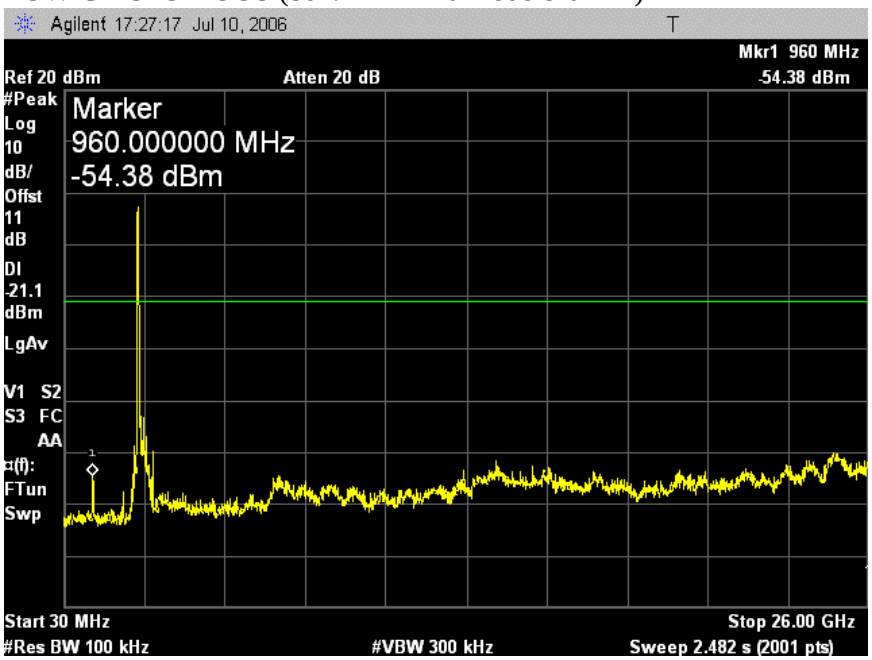
LOW CH SPURIOUS (802.11n HT40 mode chain A)



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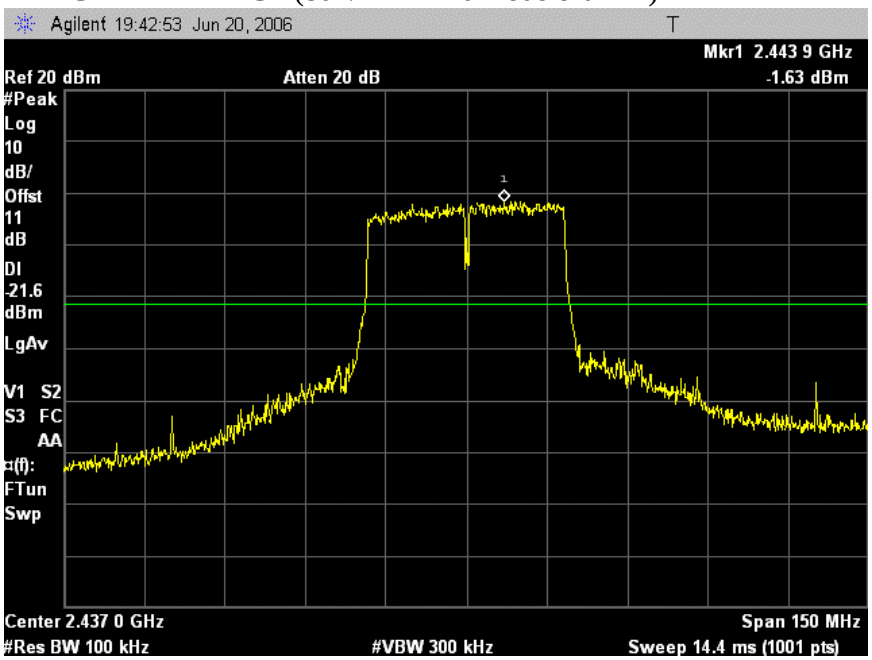
MID CH REFERENCE (802.11n HT40 mode chain A)



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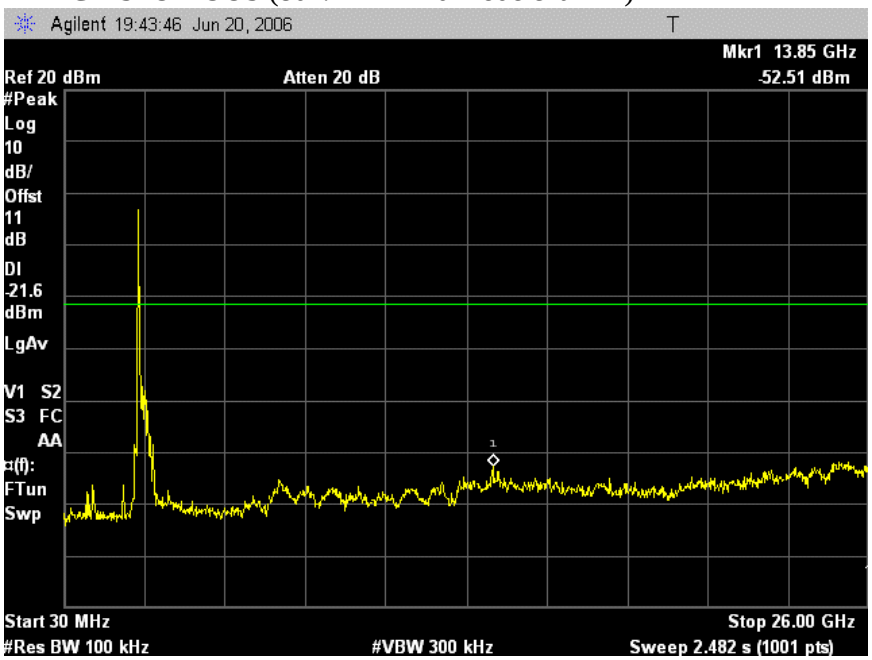
MID CH SPURIOUS (802.11n HT40 mode chain A)



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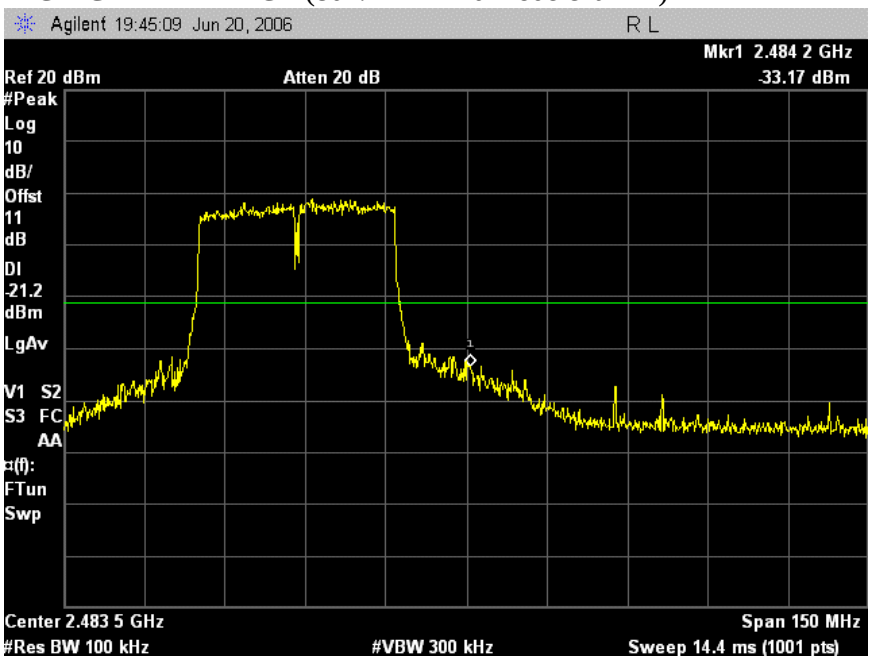
HIGH CH BANDEDGE (802.11n HT40 mode chain A)



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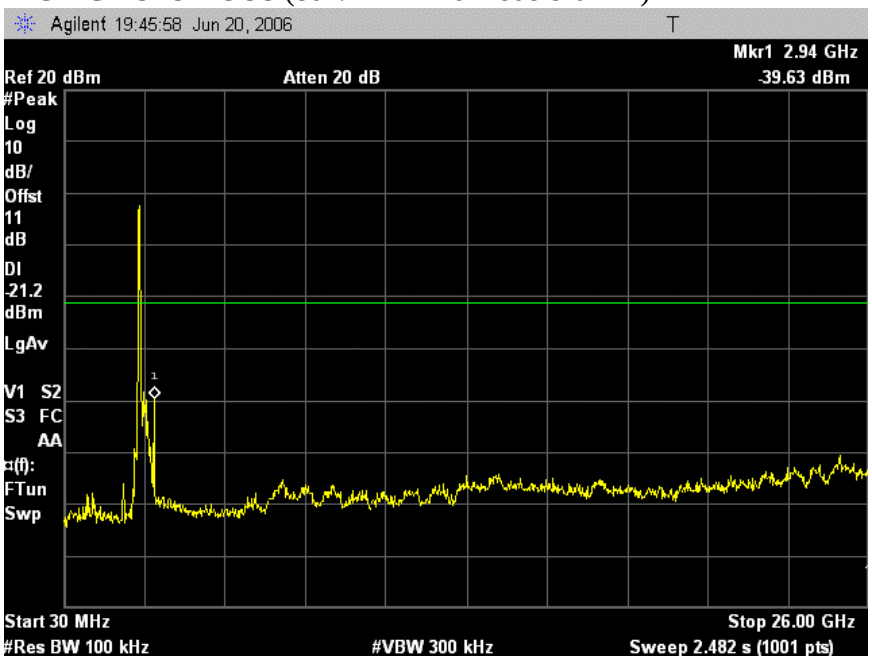
HIGH CH SPURIOUS (802.11n HT40 mode chain A)



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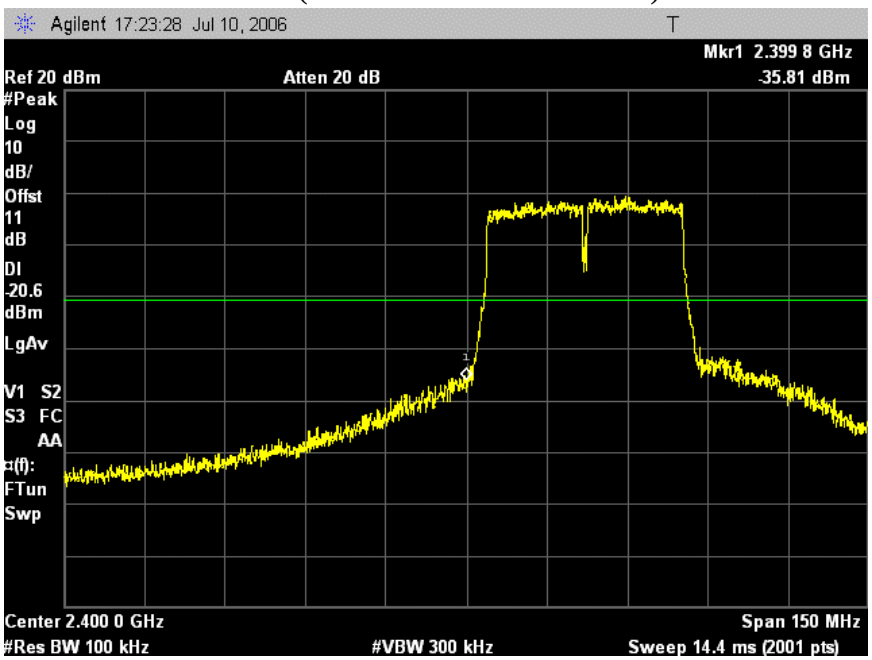
SPURIOUS EMISSIONS (802.11 HT40 MODE CHAIN B)

LOW CH BANDEDGE (802.11n HT40 mode chain B)



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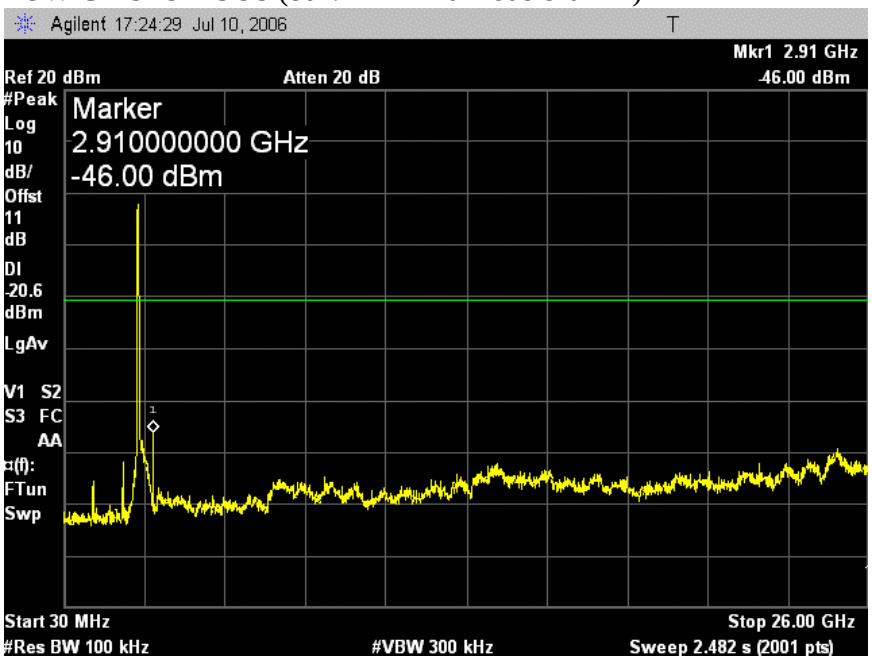
LOW CH SPURIOUS (802.11n HT40 mode chain B)



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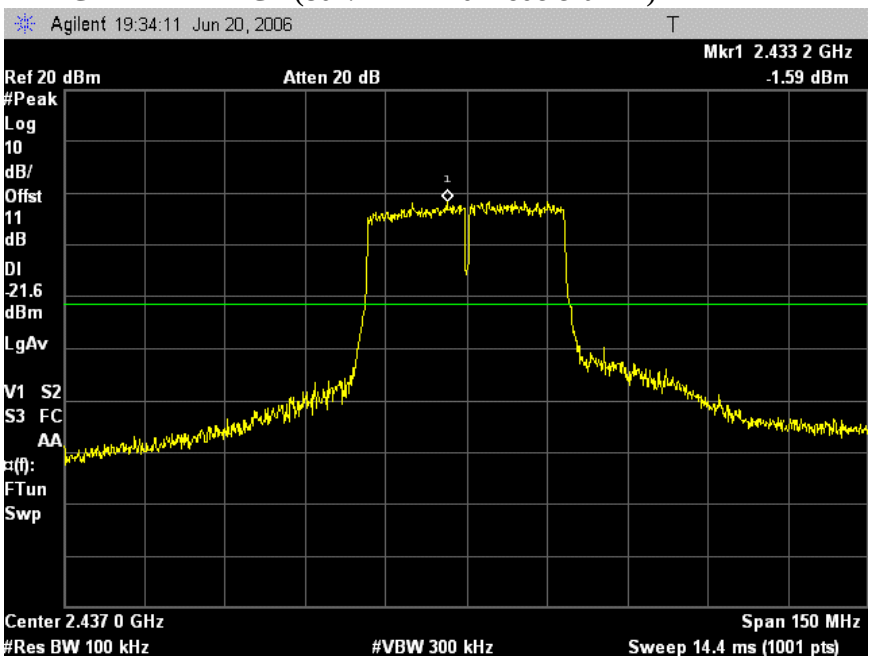

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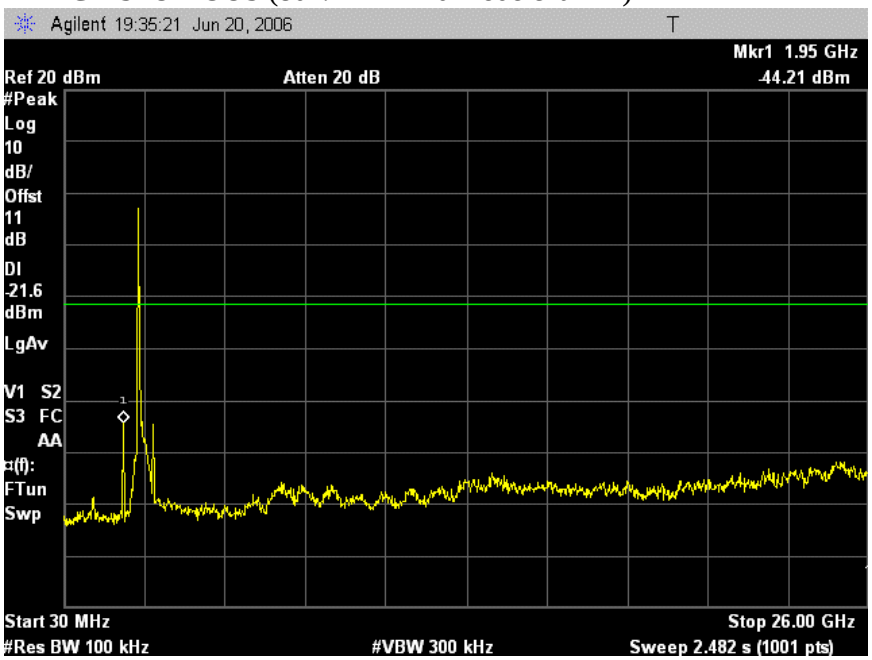
MID CH SPURIOUS (802.11n HT40 mode chain B)



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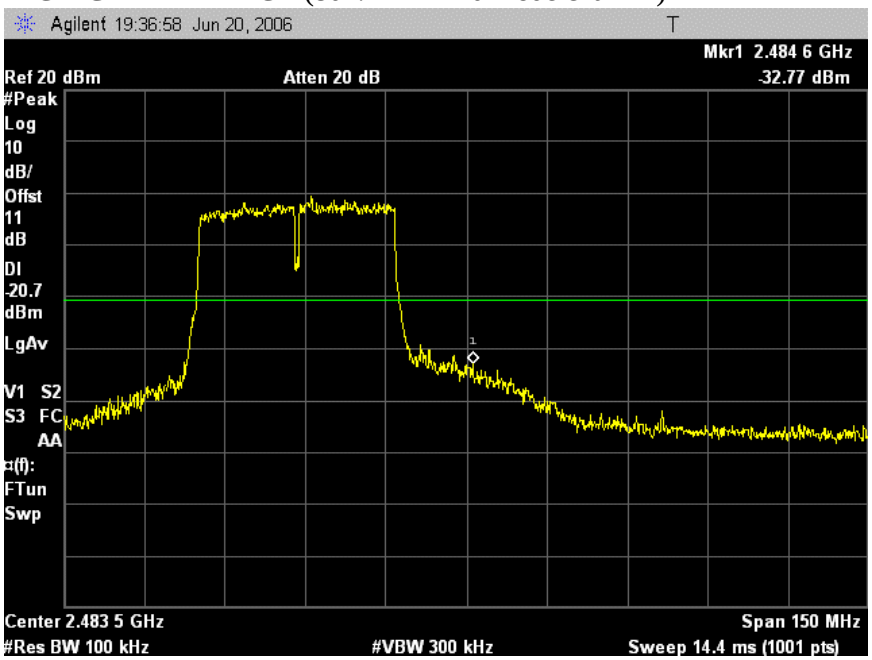
HIGH CH BANDEDGE (802.11n HT40 mode chain B)



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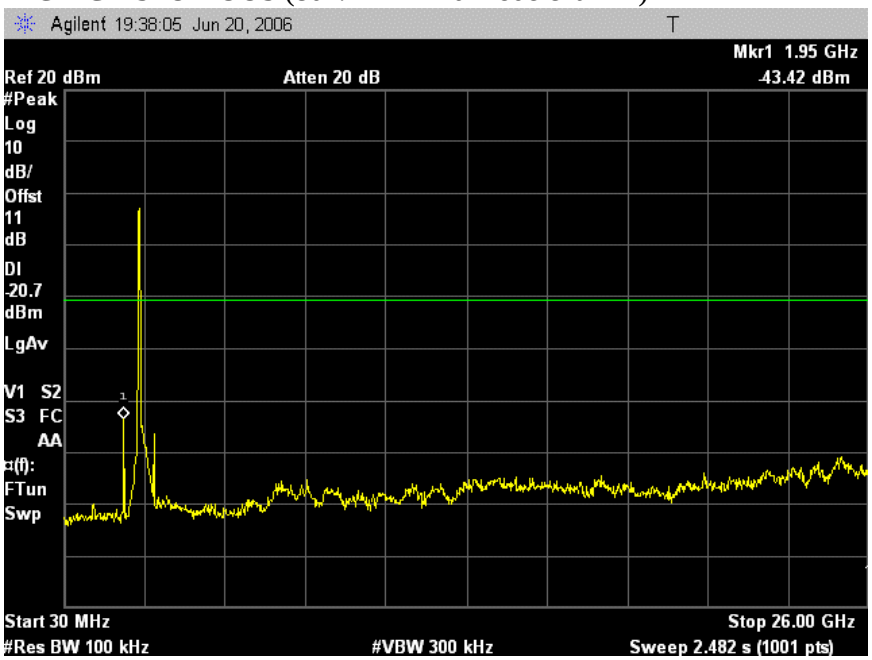
HIGH CH SPURIOUS (802.11n HT40 mode chain B)



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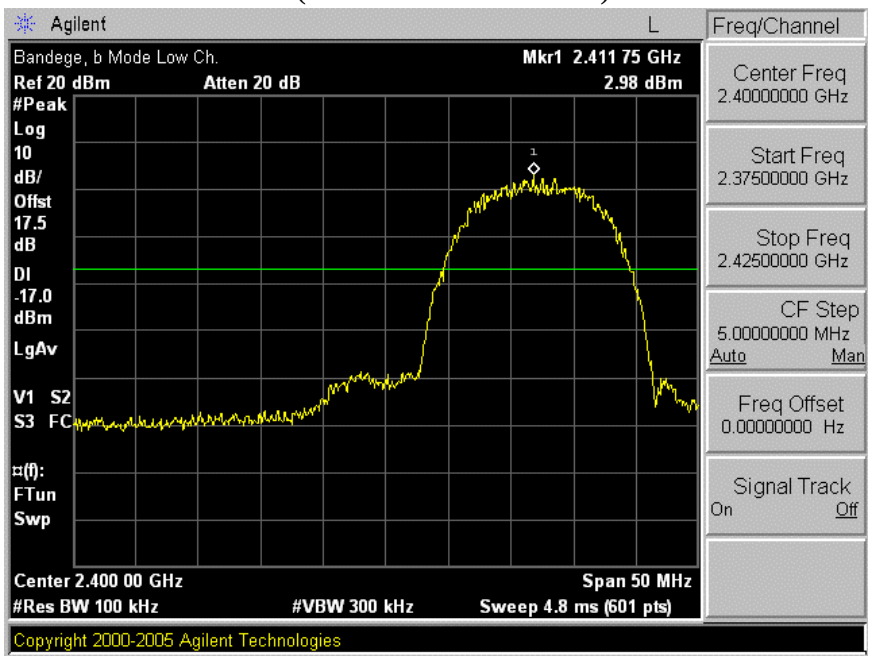
COMBINED SPURIOUS EMISSIONS (802.11b MODE)

LOW CH BANDEDGE (802.11b mode Combined)



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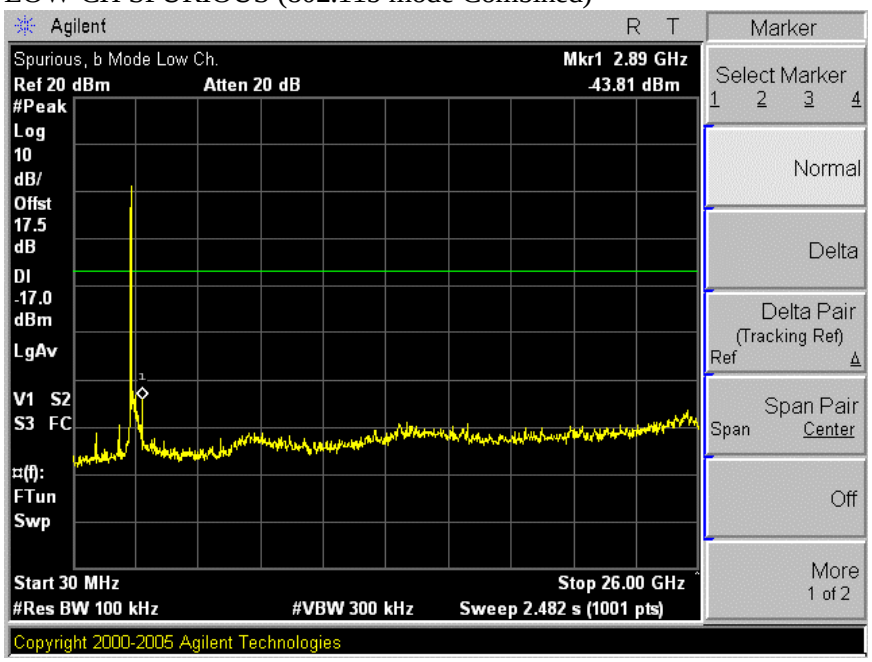
LOW CH SPURIOUS (802.11b mode Combined)



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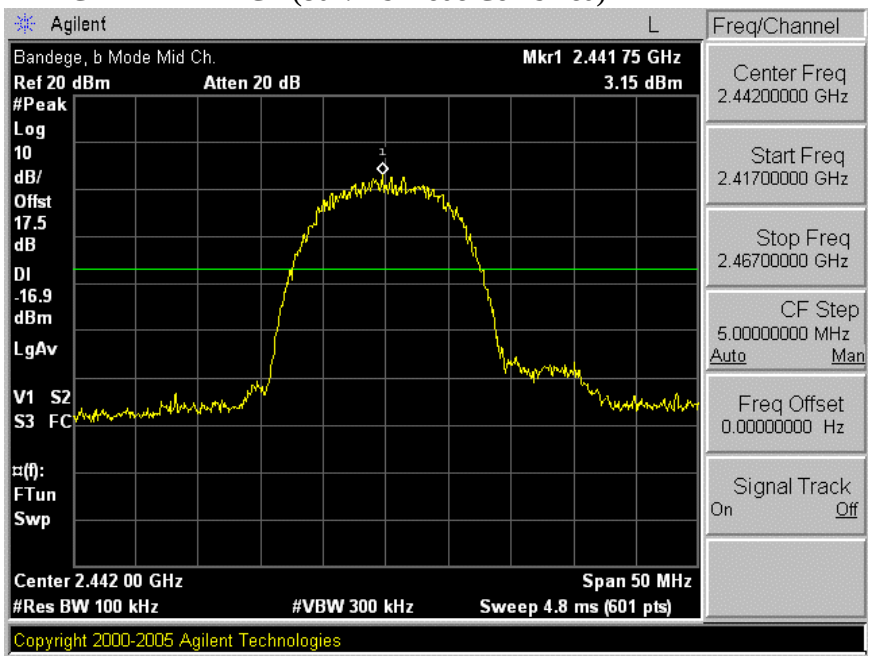
MID CH REFERENCE (802.11b mode Combined)



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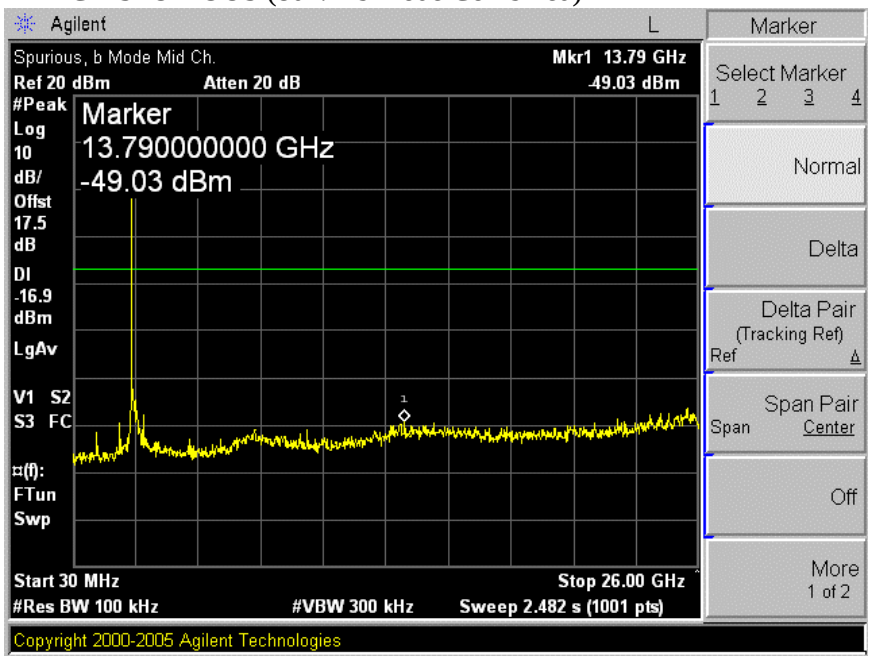
MID CH SPURIOUS (802.11b mode Combined)



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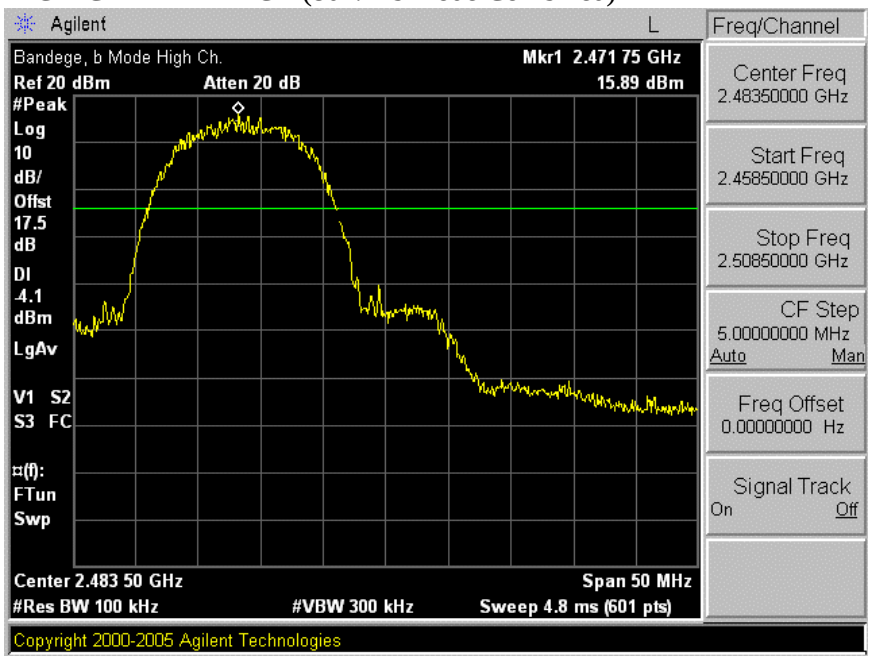
HIGH CH BANDEDGE (802.11b mode Combined)



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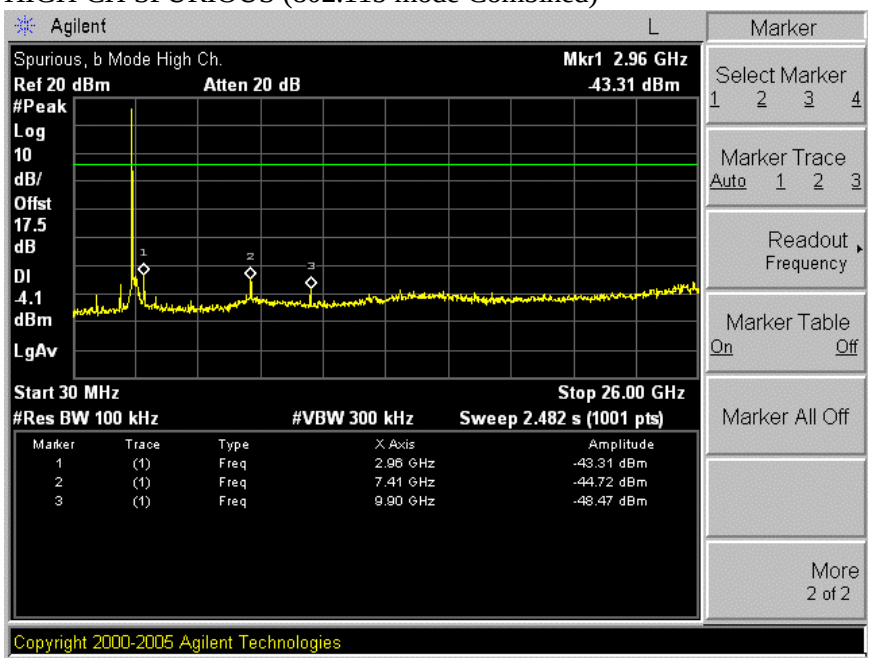
HIGH CH SPURIOUS (802.11b mode Combined)



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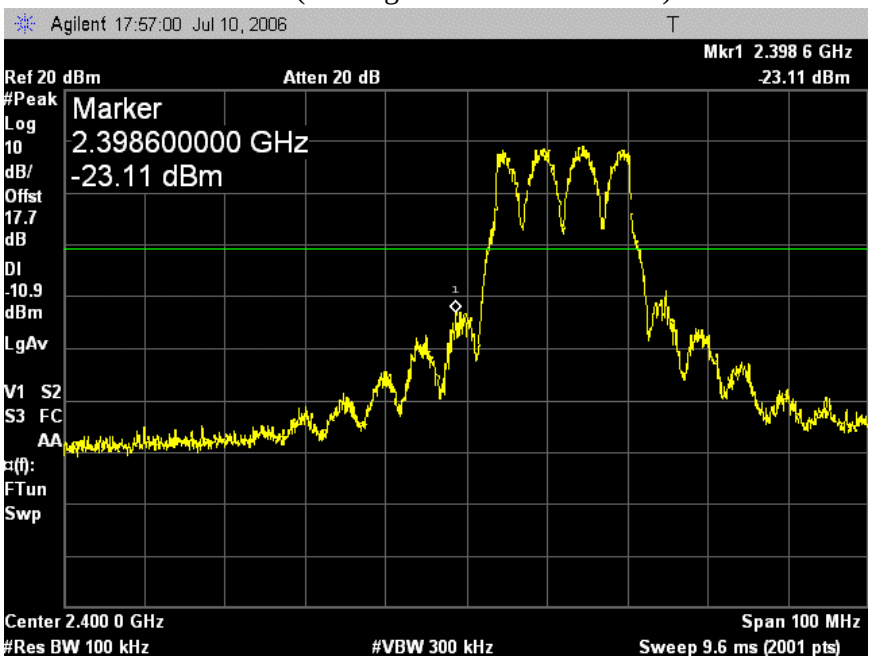
COMBINED SPURIOUS EMISSIONS (802.11g 20M MODE)

LOW CH BANDEDGE (802.11g 20M mode Combined)



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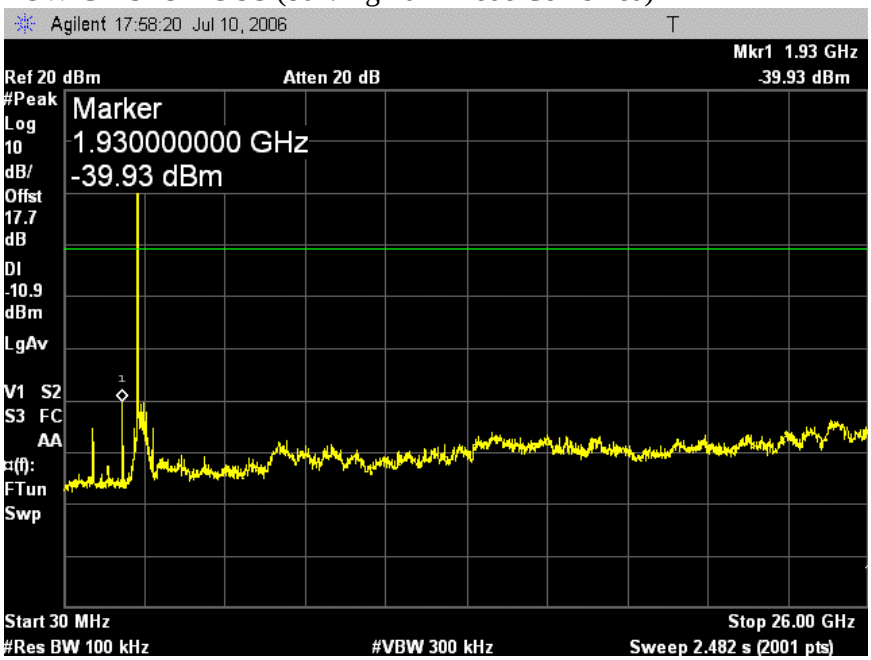
LOW CH SPURIOUS (802.11g 20M mode Combined)



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MID CH REFERENCE (802.11g 20M mode Combined)

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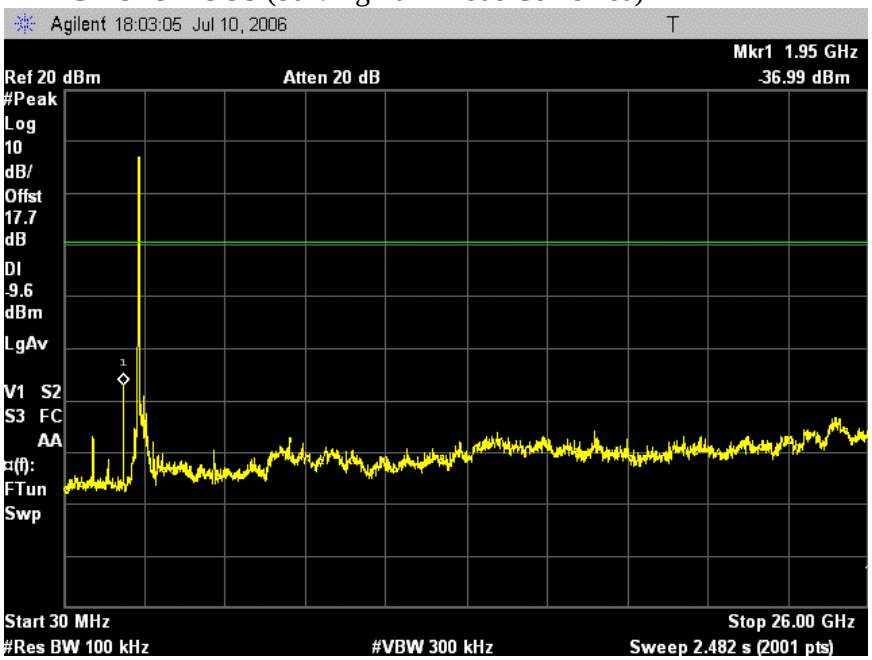
MID CH SPURIOUS (802.11g 20M mode Combined)



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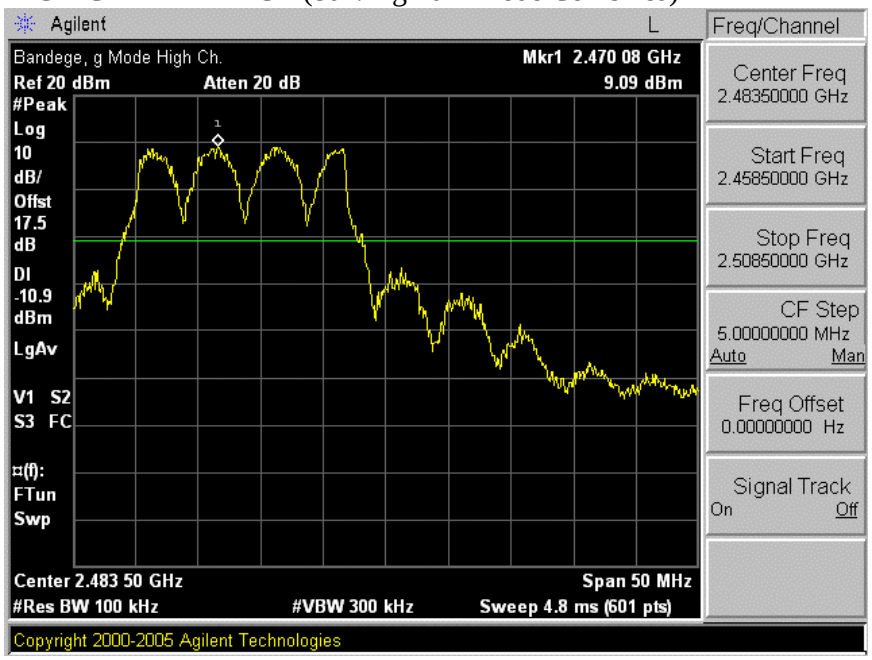
HIGH CH BANDEDGE (802.11g 20M mode Combined)



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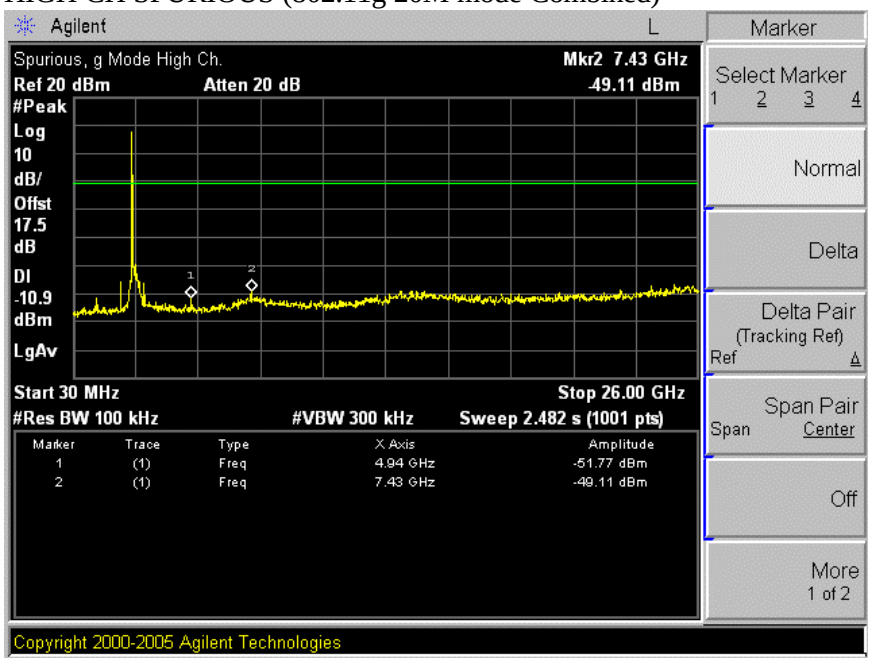

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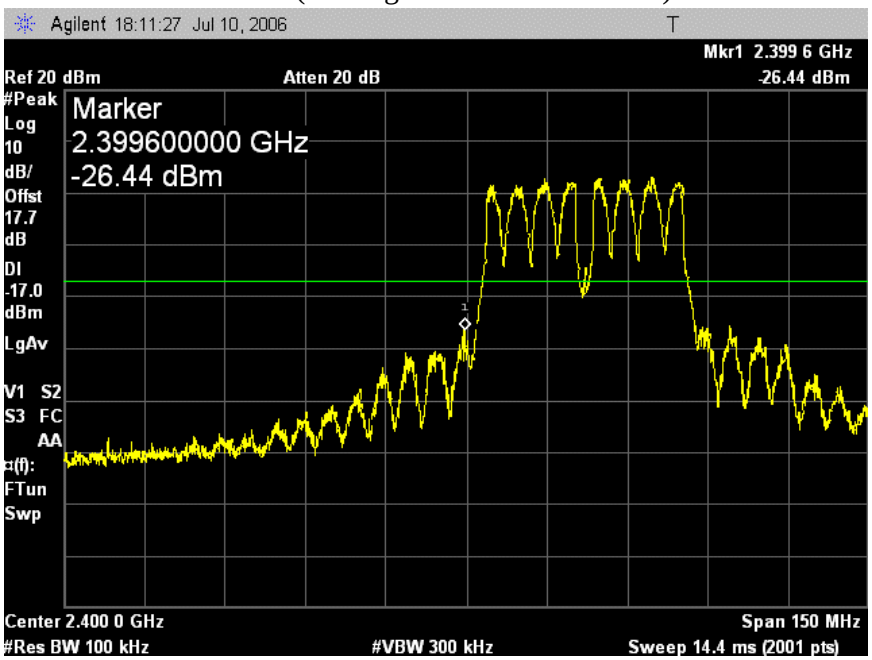
COMBINED SPURIOUS EMISSIONS (802.11g 40M MODE)

LOW CH BANDEDGE (802.11g 40M mode Combined)



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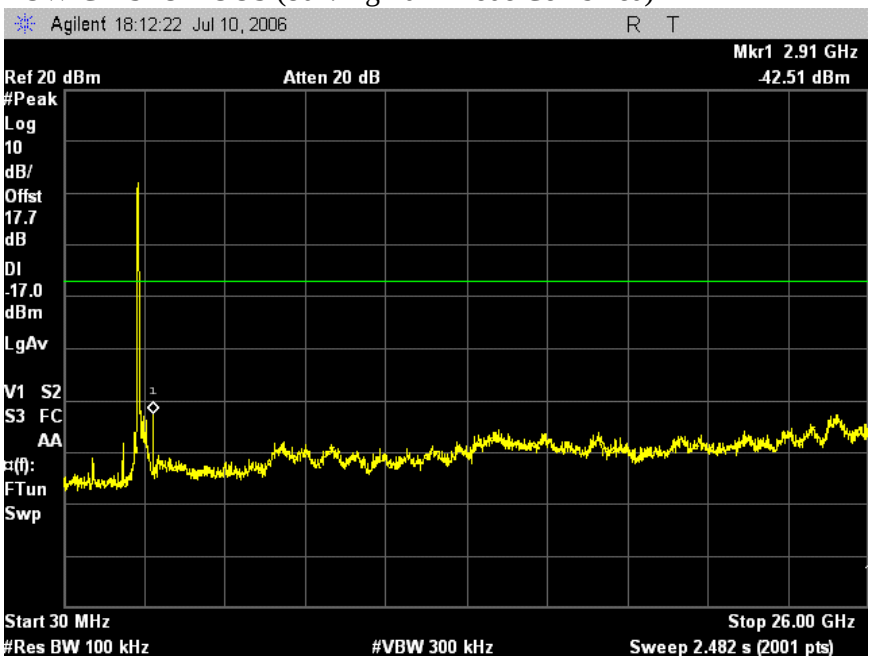
LOW CH SPURIOUS (802.11g 40M mode Combined)



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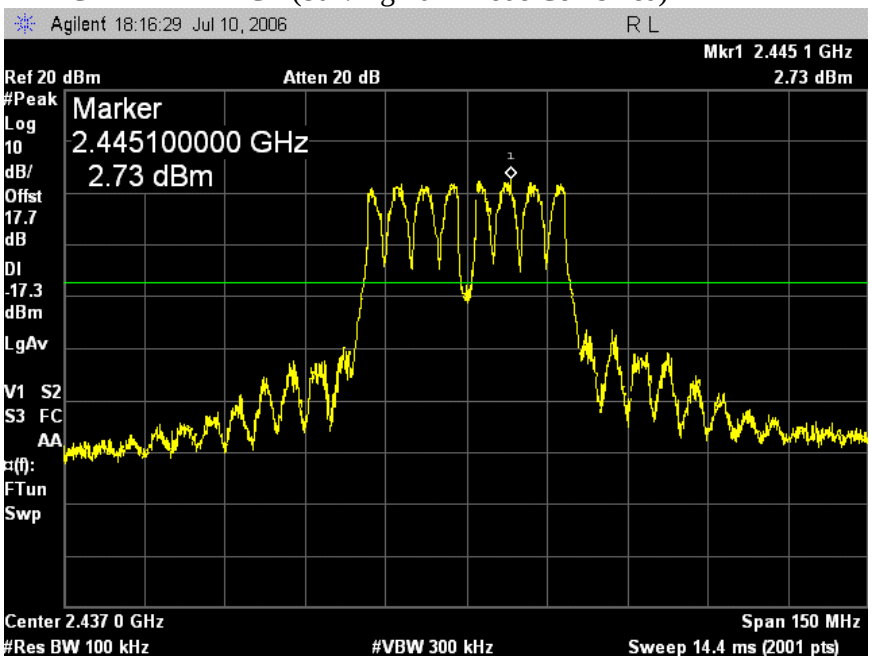
MID CH REFERENCE (802.11g 40M mode Combined)



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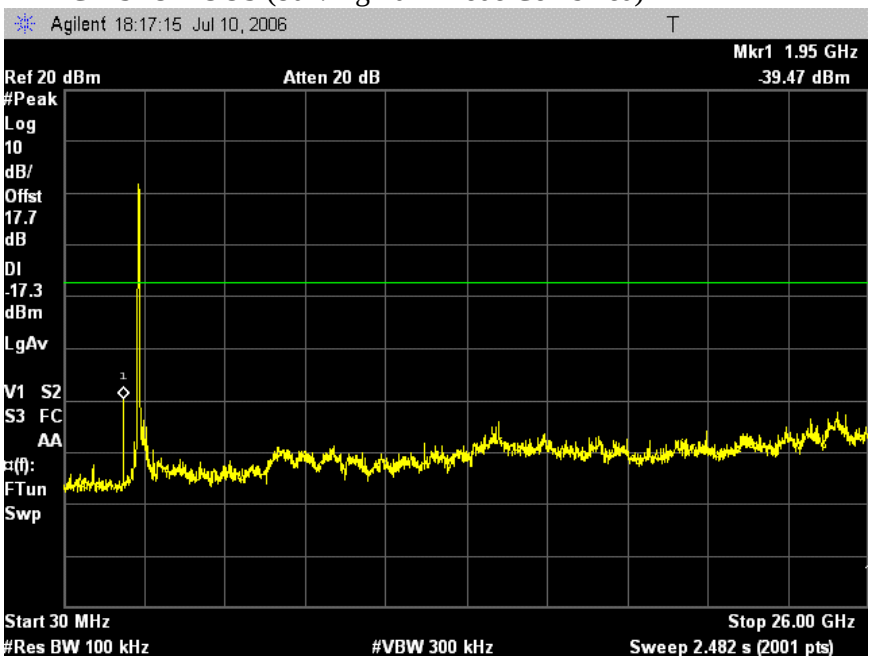

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HIGH CH BANDEDGE (802.11g 40M mode Combined)

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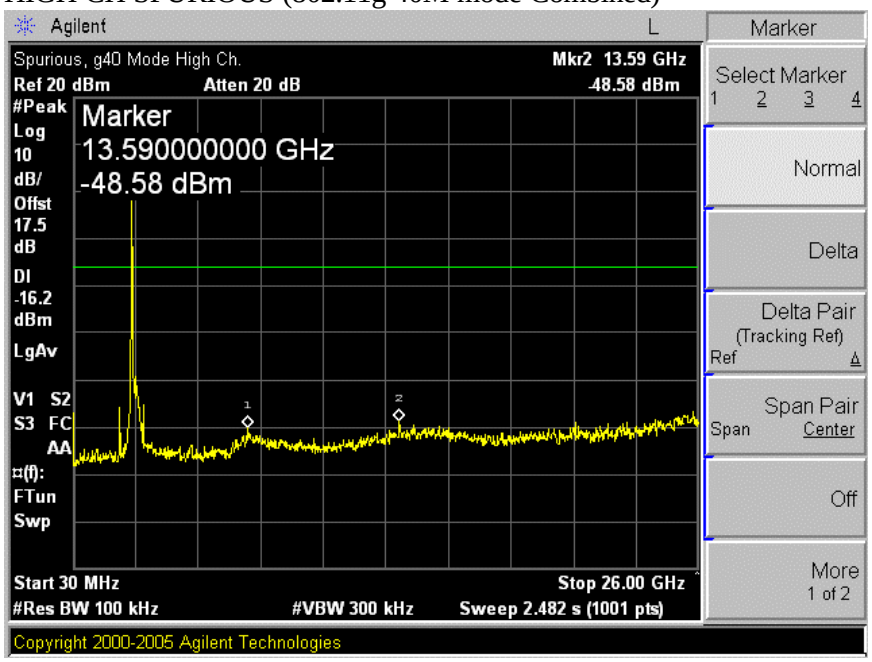
HIGH CH SPURIOUS (802.11g 40M mode Combined)



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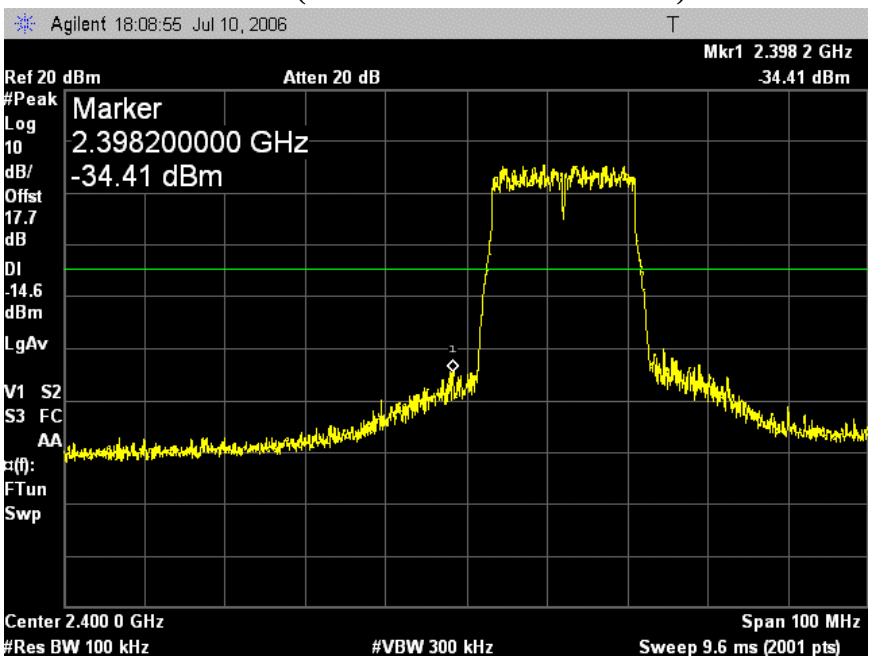
COMBINED SPURIOUS EMISSIONS (802.11n HT20 MODE)

LOW CH BANDEDGE (802.11n HT20 mode Combined)



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LOW CH SPURIOUS (802.11n HT20 mode Combined)

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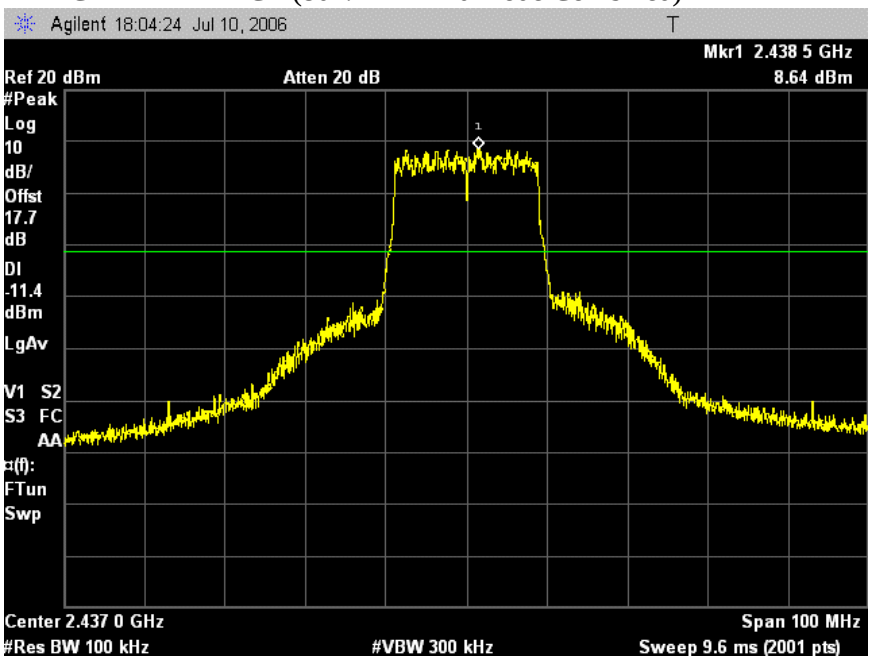
MID CH REFERENCE (802.11n HT20 mode Combined)



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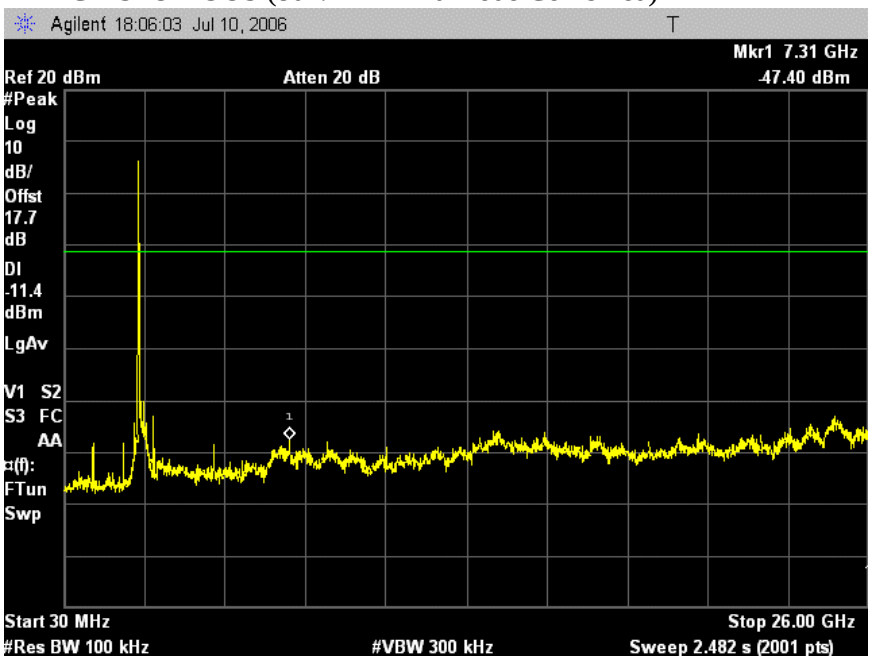

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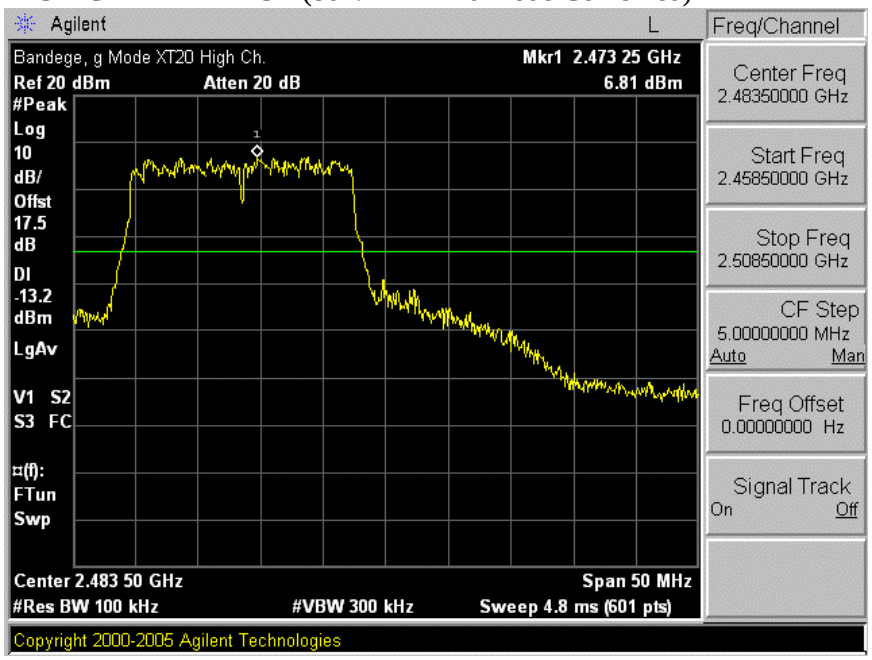
HIGH CH BANDEDGE (802.11n HT20 mode Combined)



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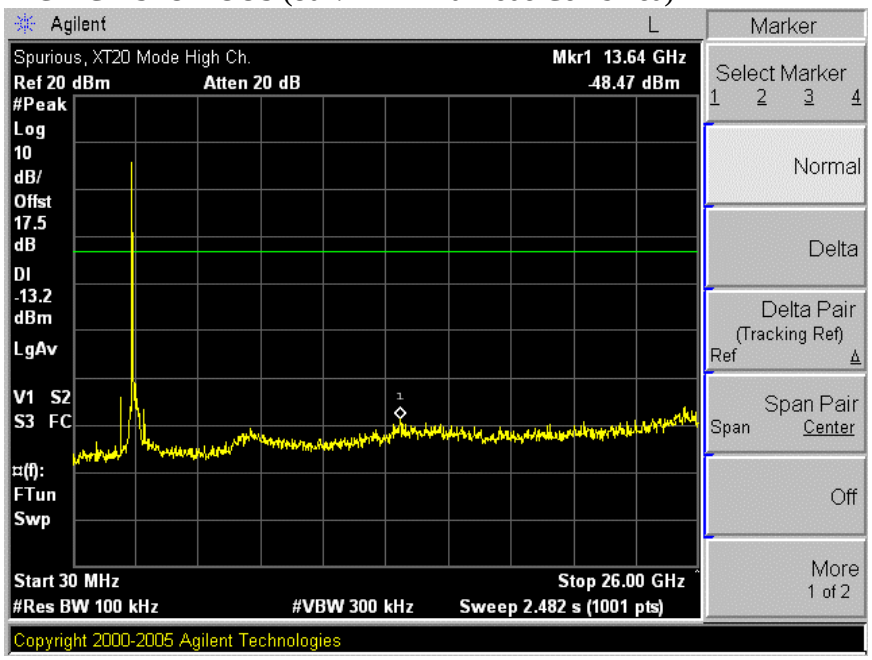
HIGH CH SPURIOUS (802.11n HT20 mode Combined)



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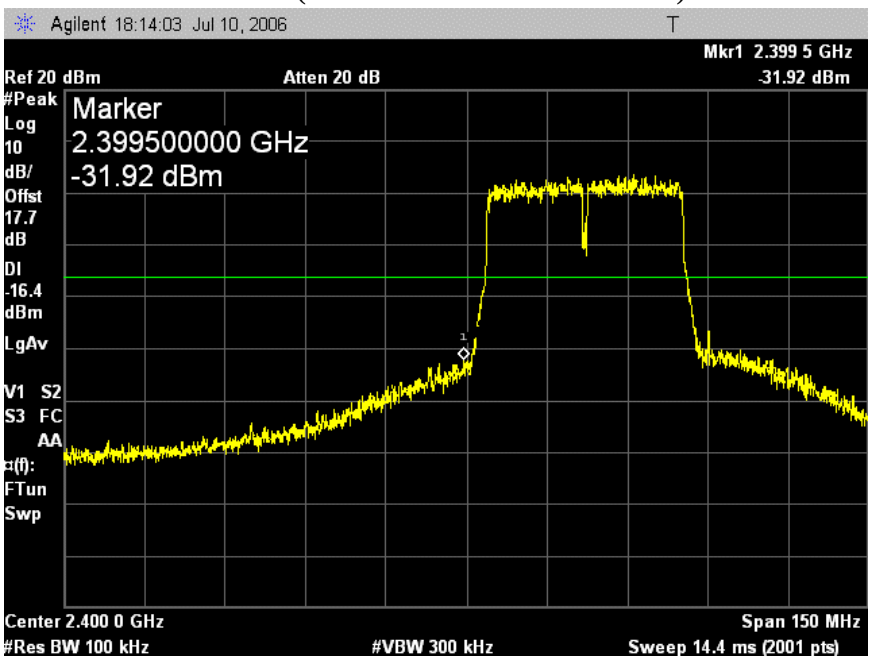
COMBINED SPURIOUS EMISSIONS (802.11 HT40 MODE)

LOW CH BANDEDGE (802.11n HT40 mode Combined)



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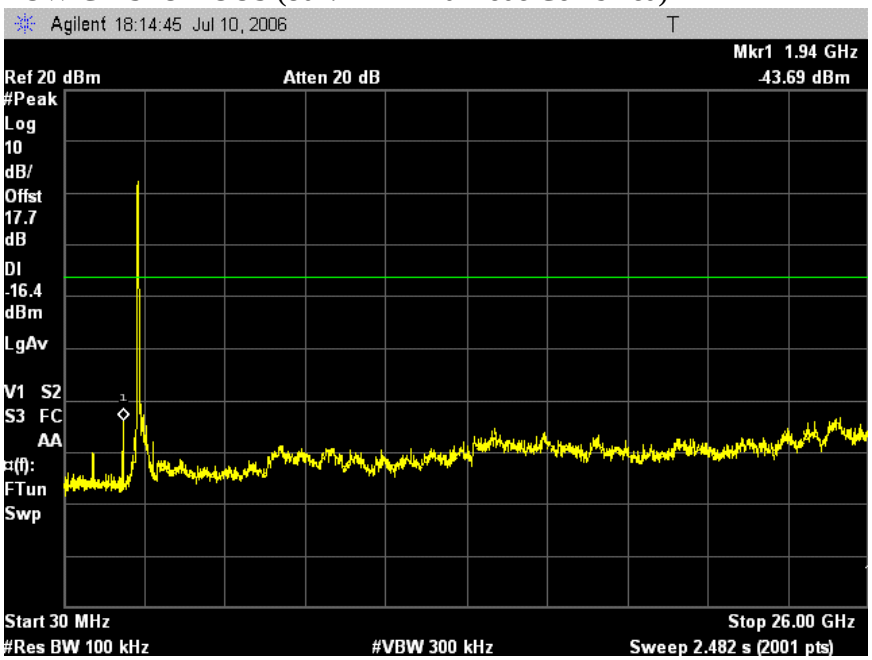
LOW CH SPURIOUS (802.11n HT40 mode Combined)



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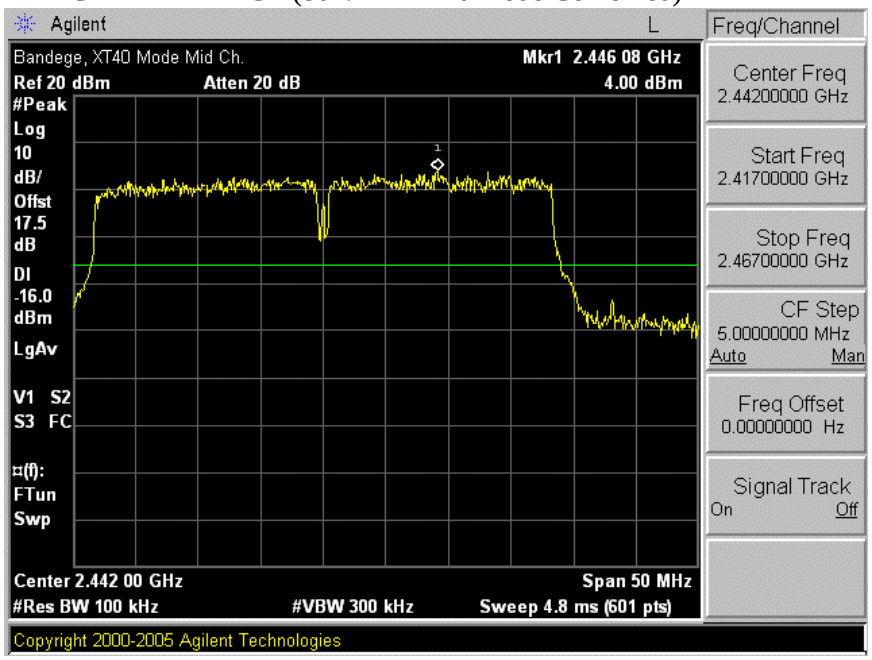
MID CH REFERENCE (802.11n HT40 mode Combined)



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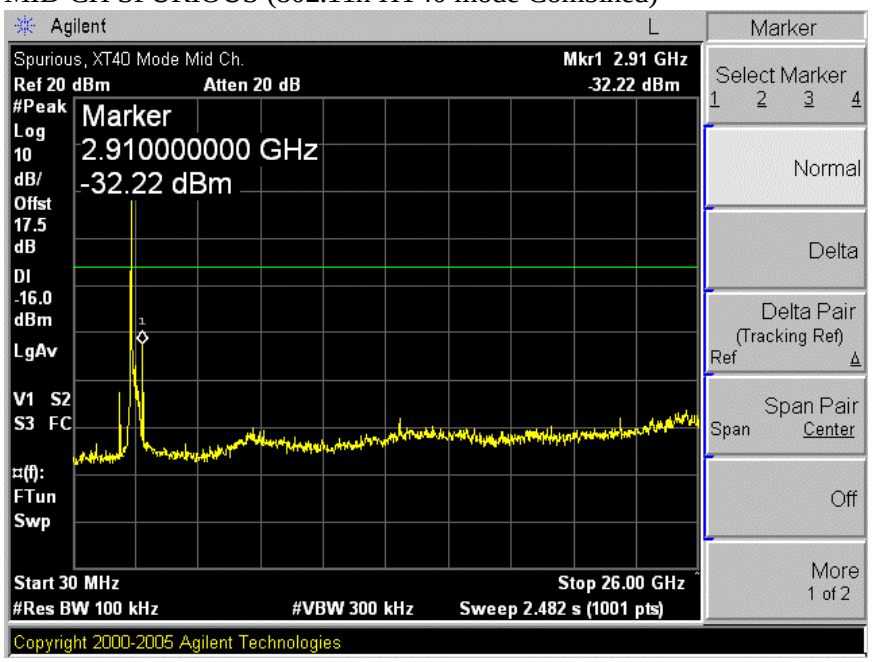
MID CH SPURIOUS (802.11n HT40 mode Combined)



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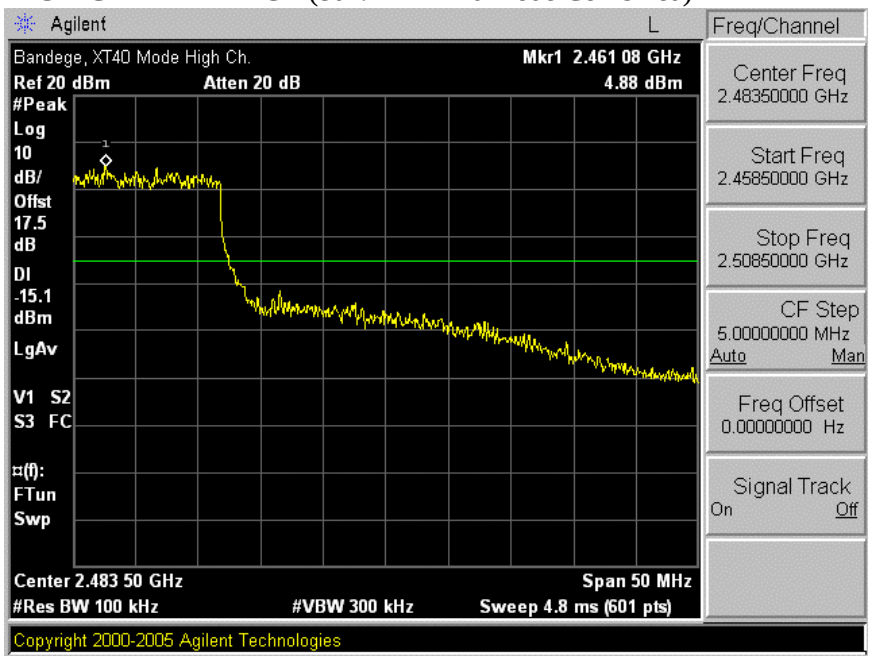
HIGH CH BANDEDGE (802.11n HT40 mode Combined)



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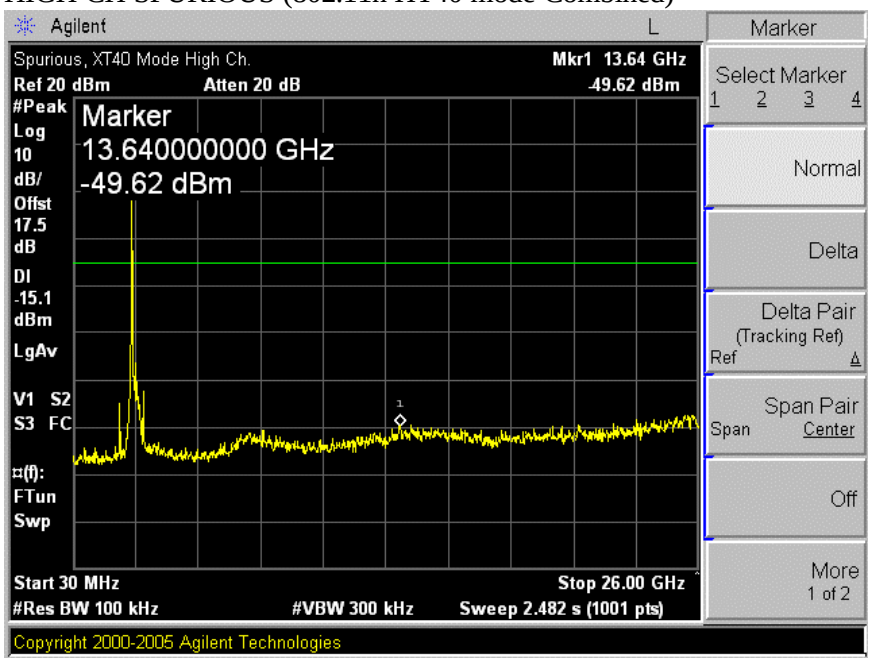
HIGH CH SPURIOUS (802.11n HT40 mode Combined)



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7.1.7. 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/cm²)	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/f²)	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/f²)	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/cm²)	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.

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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 yields:

$S = (30 * P * G) / (3770 * (d \wedge 2))$

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

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

and substituting the logarithmic form of power and gain using:

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

yields

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

where

d = MPE distance in cm
P = Power in dBm
G = Antenna Gain in dBi
S = Power Density Limit in mW/cm^2

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LIMITS

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

RESULTS

No non-compliance noted:

Band (MHz)	Power Density Limit (mW/cm^2)	Total Power (dBm)	Antenna Gain (dBi)	MPE Distance (cm)
2400 to 2483.5	1.0	25.50	1.90	6.61

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.

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7.2. CHANNEL TESTS FOR THE 5725 TO 5850 MHz BAND

7.2.1. 6 dB BANDWIDTH

LIMIT

§15.247 (a) (2) For direct sequence systems, the minimum 6 dB bandwidth shall be at least 500 kHz.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz. The sweep time is coupled.

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RESULTS

No non-compliance noted:

802.11a 20M Mode

Low	5745	16700	16700	500	16200
Middle	5785	16700	16700	500	16200
High	5825	16700	16700	500	16200

802.11a 40M Mode

Low	5755	36800	36800	500	36300
High	5795	37000	37000	500	36500

802.11n HT20 Mode

Low	5745	18000	17900	500	17400
Mid	5785	18000	18100	500	17500
High	5825	18100	17900	500	17400

802.11n HT40 Mode

Low	5755	36800	37000	500	36300
High	5795	37000	37000	500	36500

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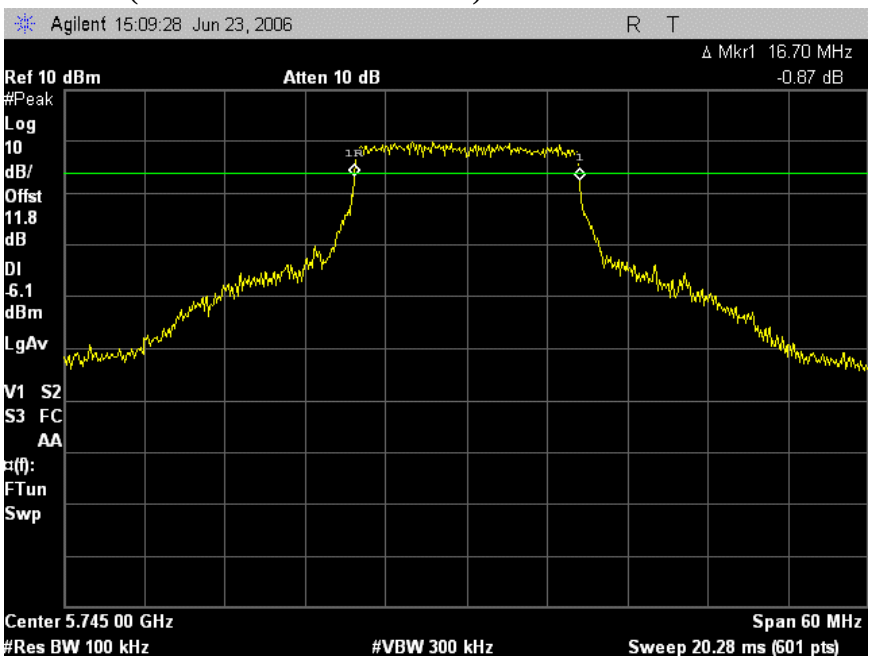
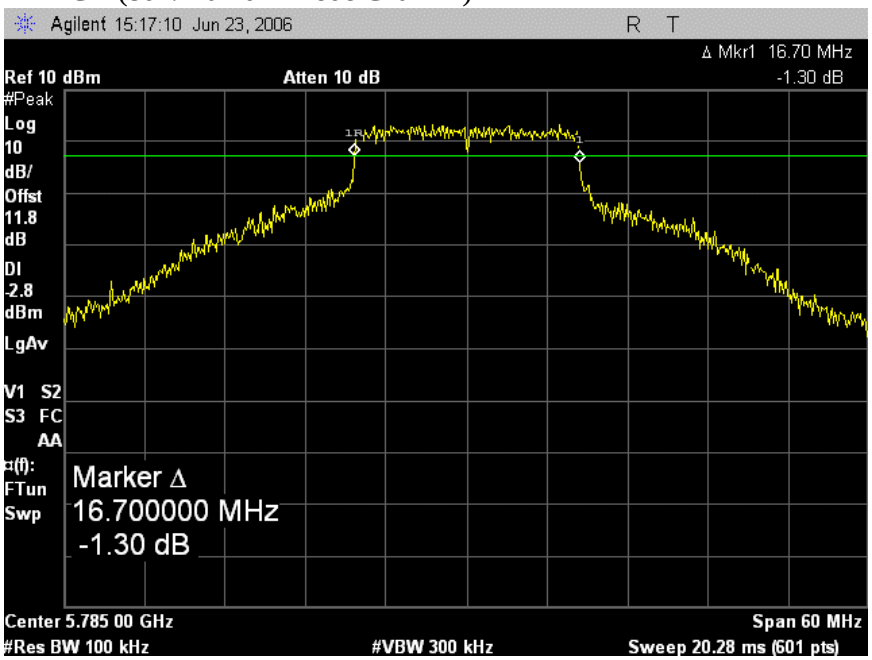
(802.11a 20M MODE CHAIN A)

LOW CH (802.11a 20M mode Chain A)



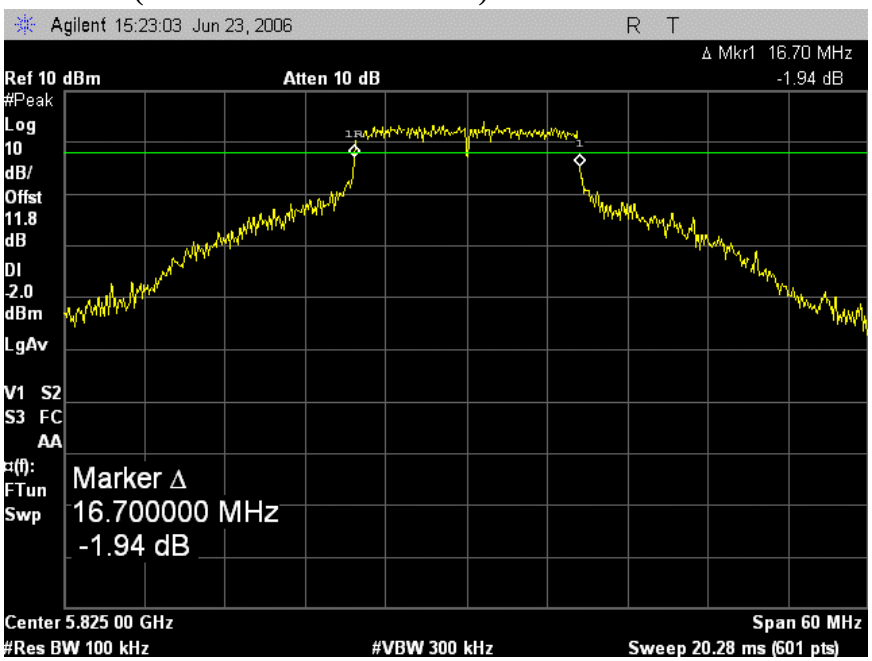
This report shall not be reproduced except in full, without the written approval of CCS.

MID CH (802.11a 20M mode Chain A)



This report shall not be reproduced except in full, without the written approval of CCS.

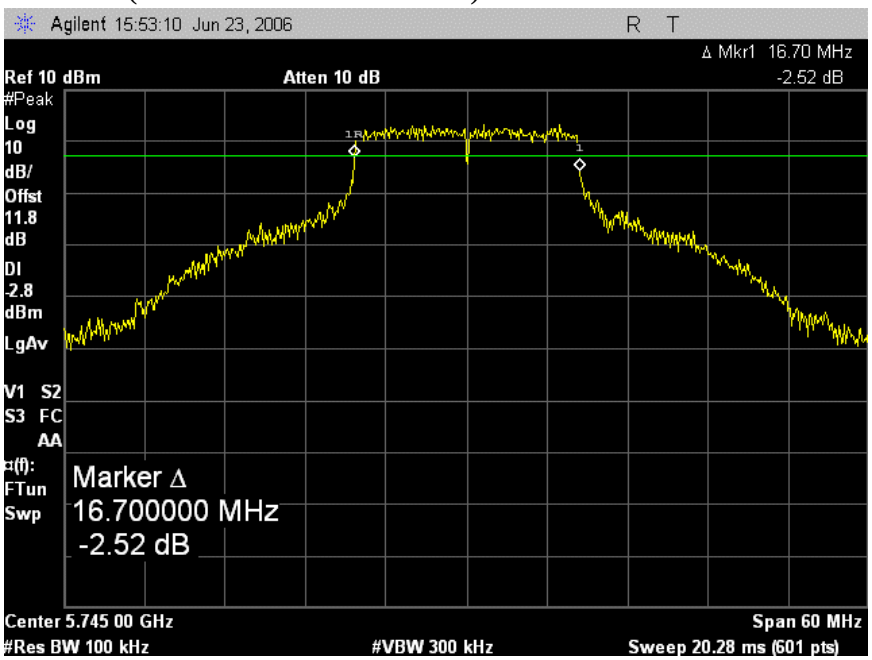
HIGH CH (802.11a 20M mode Chain A)



This report shall not be reproduced except in full, without the written approval of CCS.

(802.11a 20M MODE CHAIN B)

LOW CH (802.11a 20M mode Chain B)

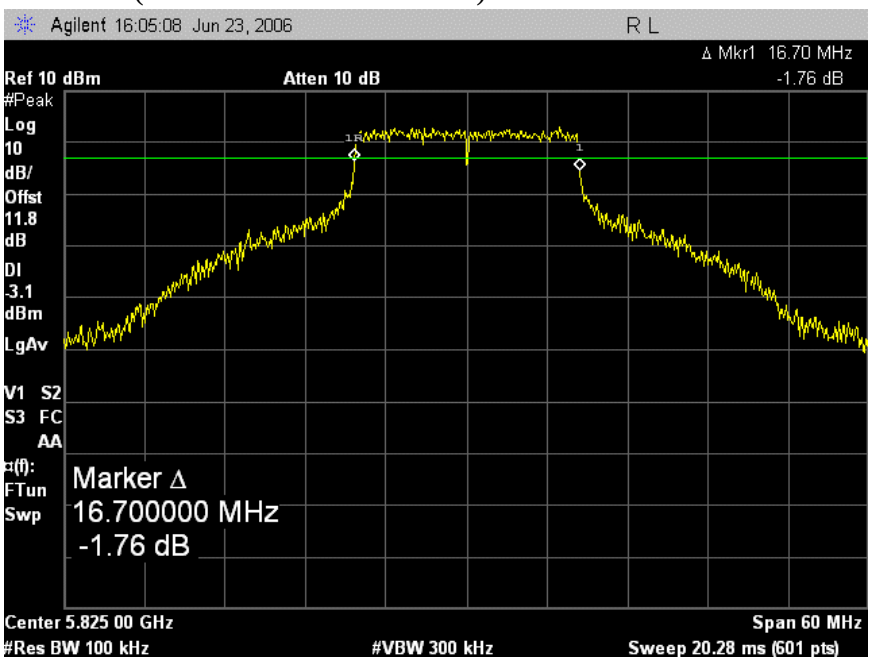


This report shall not be reproduced except in full, without the written approval of CCS.

MID CH (802.11a 20M mode Chain B)

This report shall not be reproduced except in full, without the written approval of CCS.

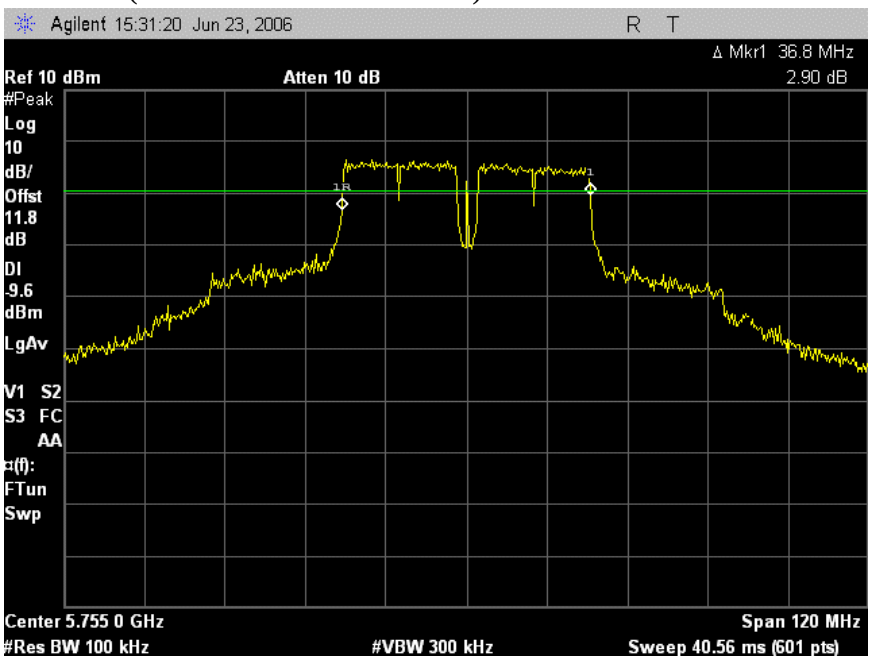
HIGH CH (802.11a 20M mode Chain B)



This report shall not be reproduced except in full, without the written approval of CCS.

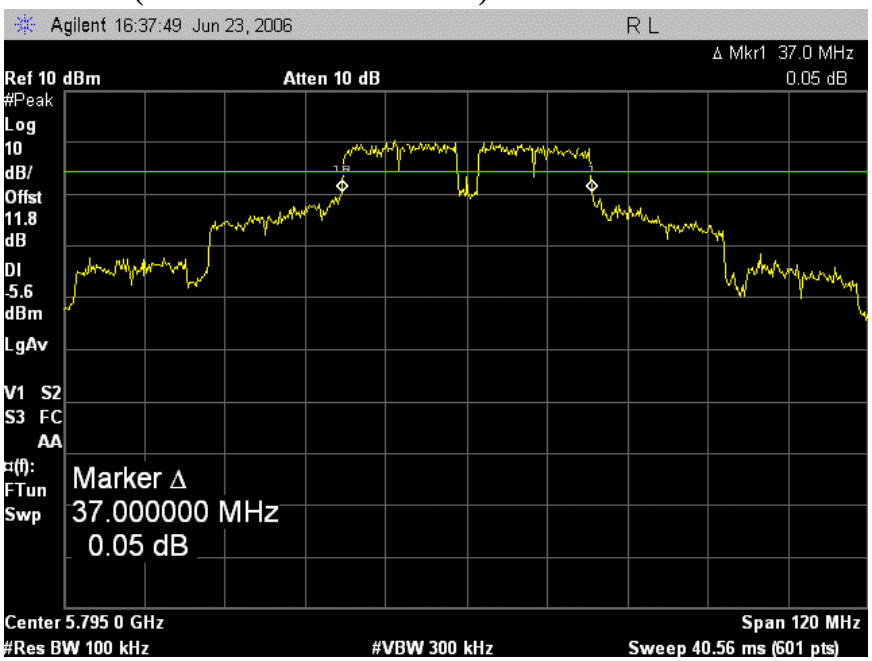
(802.11a 40M MODE CHAIN A)

LOW CH (802.11a 40M mode Chain A)



This report shall not be reproduced except in full, without the written approval of CCS.

HIGH CH (802.11a 40M mode Chain A)



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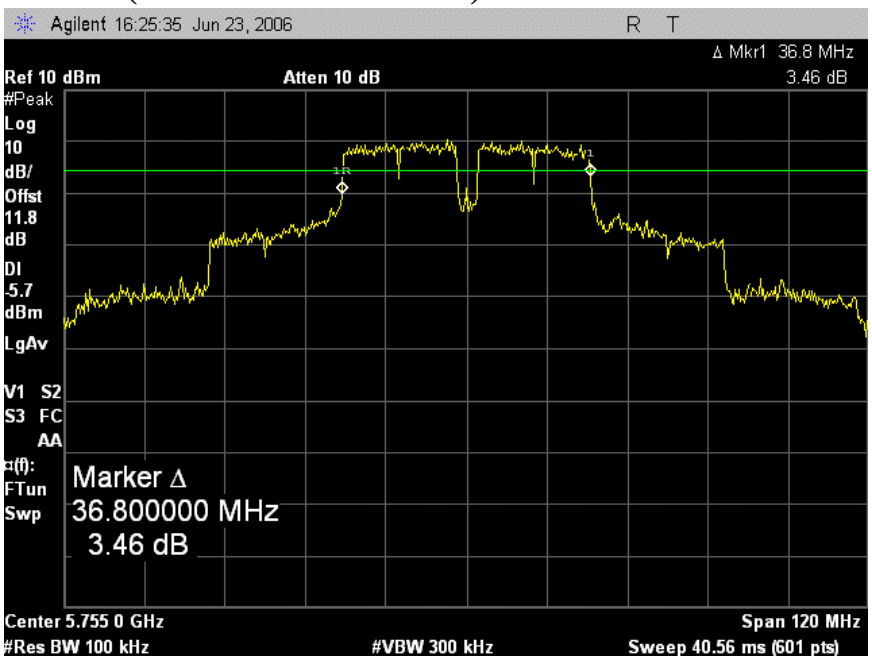
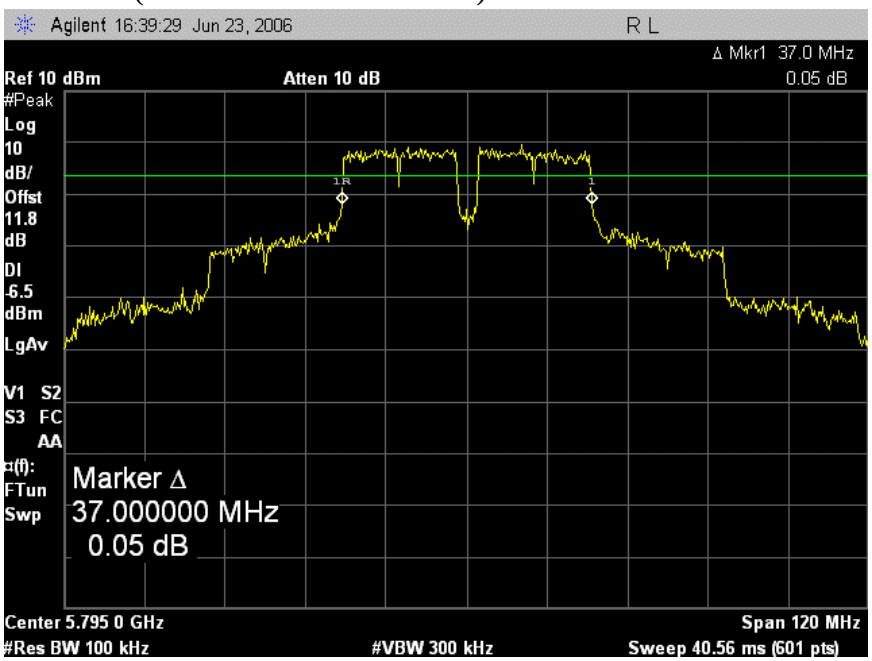
(802.11a 40M MODE CHAIN B)

LOW CH (802.11a 40M mode Chain B)



This report shall not be reproduced except in full, without the written approval of CCS.

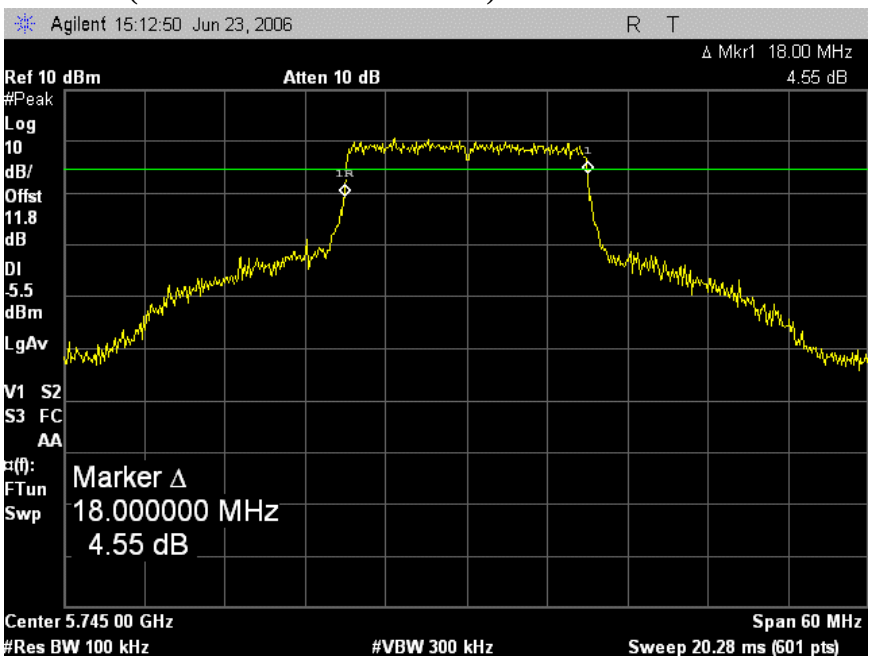
HIGH CH (802.11a 40M mode Chain B)



This report shall not be reproduced except in full, without the written approval of CCS.

(802.11n HT20 MODE CHAIN A)

LOW CH (802.11n HT20 mode Chain A)



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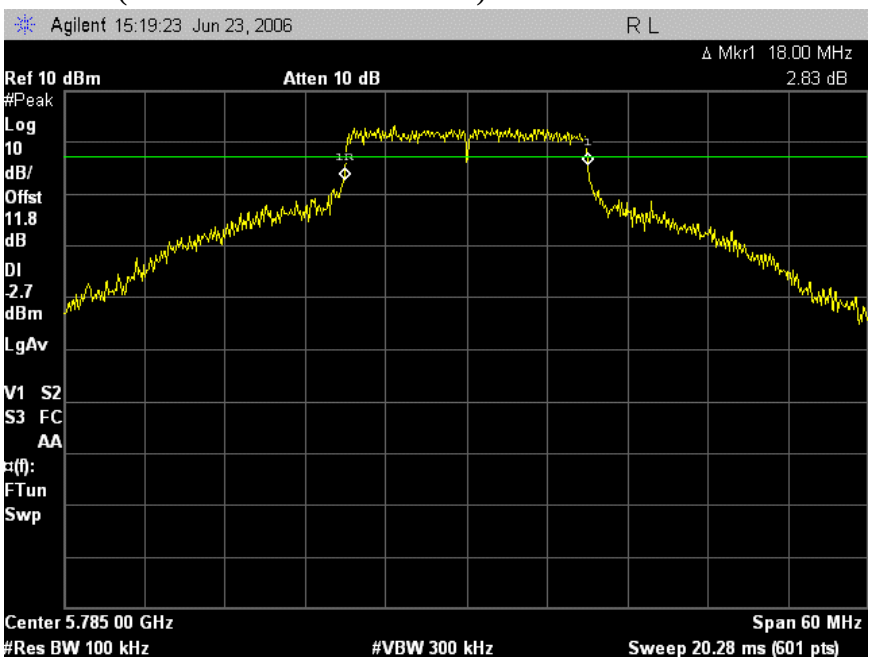
MID CH (802.11n HT20 mode Chain A)



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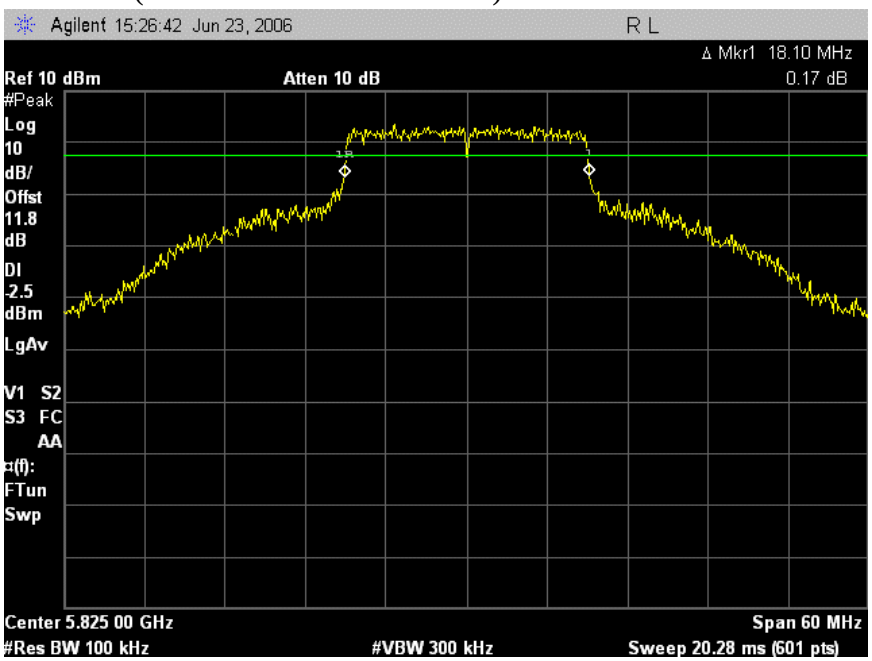
HIGH CH (802.11n HT20 mode Chain A)



7

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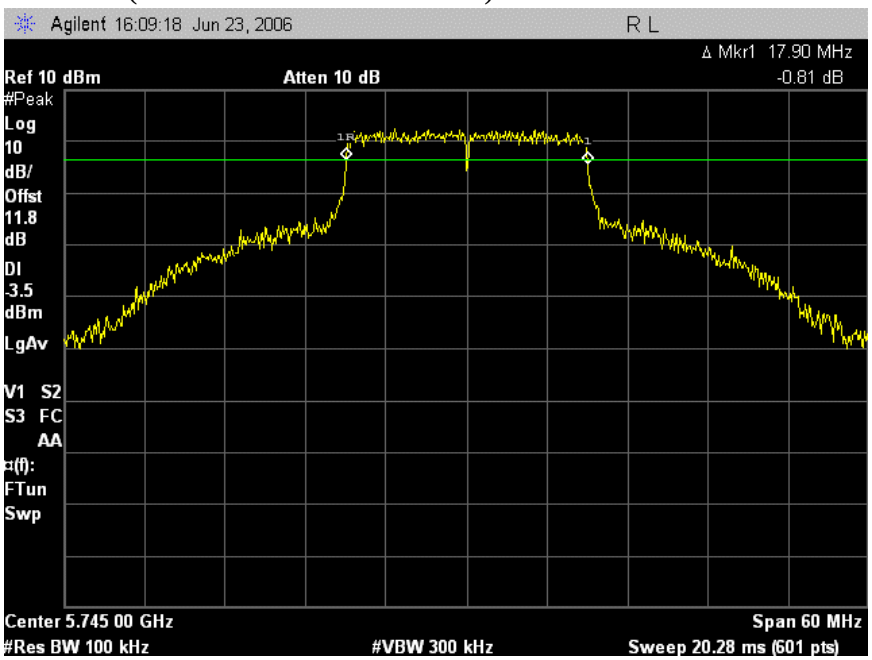
(802.11 HT20 MODE CHAIN B)

LOW CH (802.11n HT20 mode Chain B)



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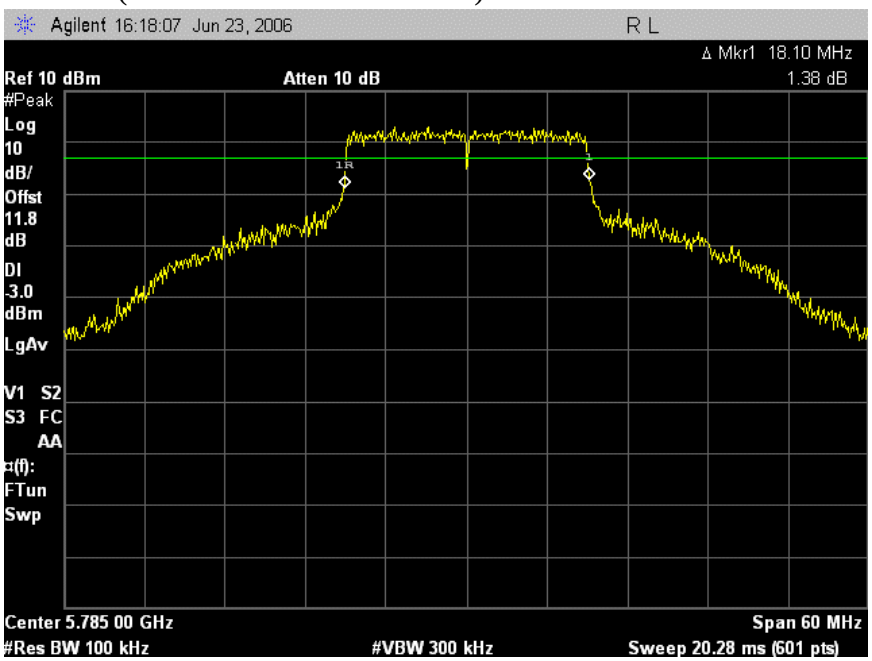
MID CH (802.11n HT20 mode Chain B)



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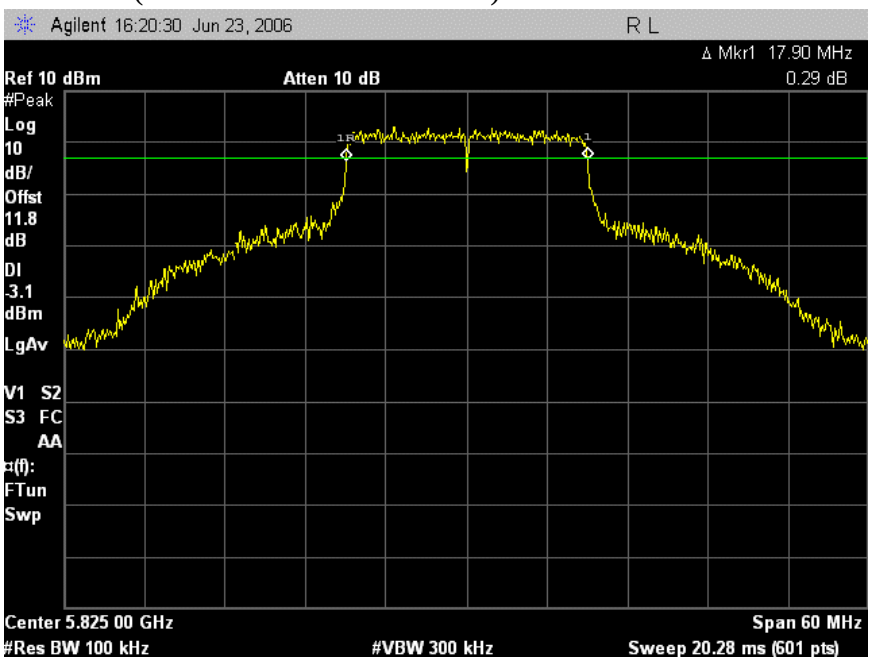
HIGH CH (802.11n HT20 mode Chain B)



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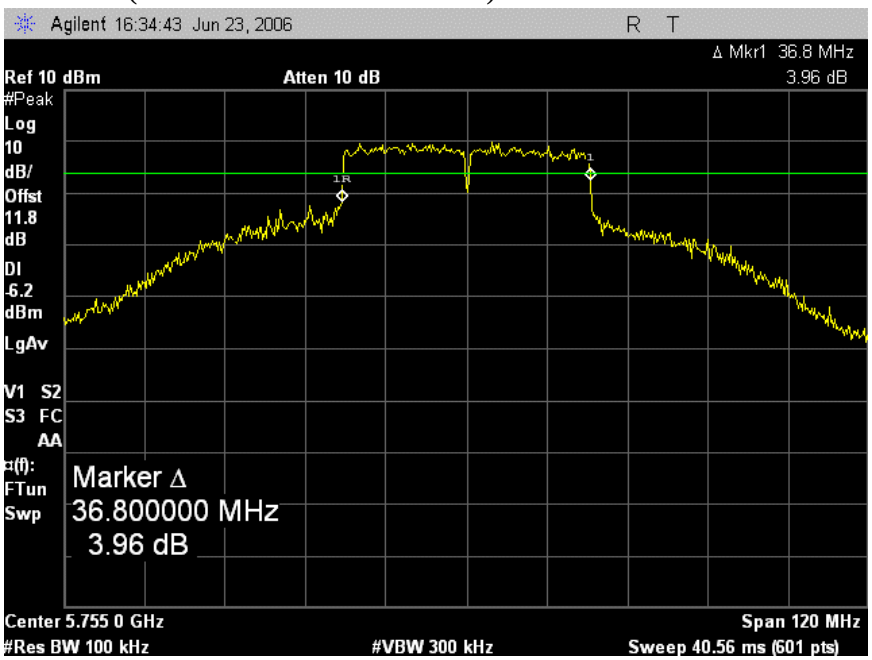
(802.11 HT40 MODE CHAIN A)

LOW CH (802.11n HT40 mode Chain A)



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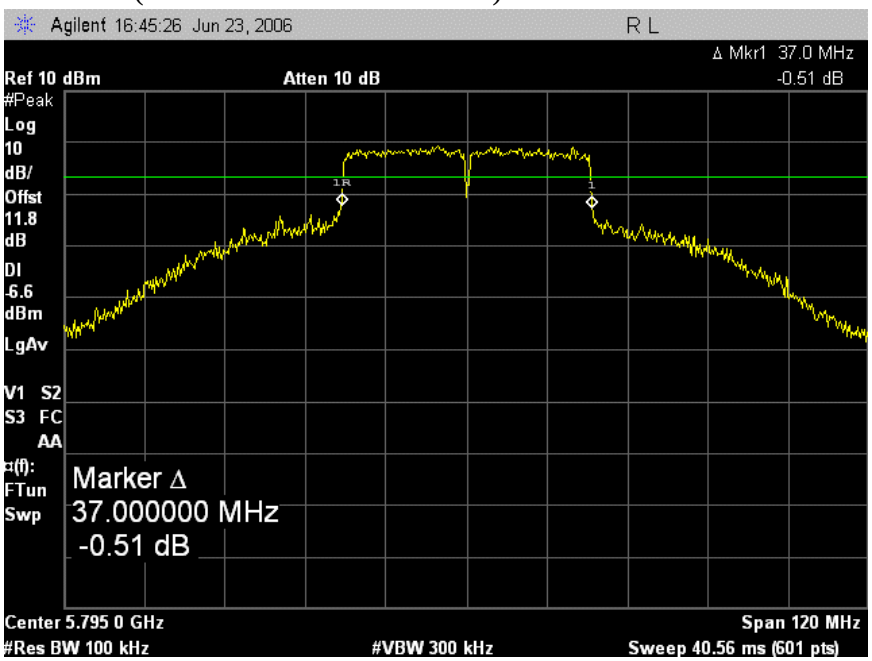
HIGH CH (802.11n HT40 mode Chain A)



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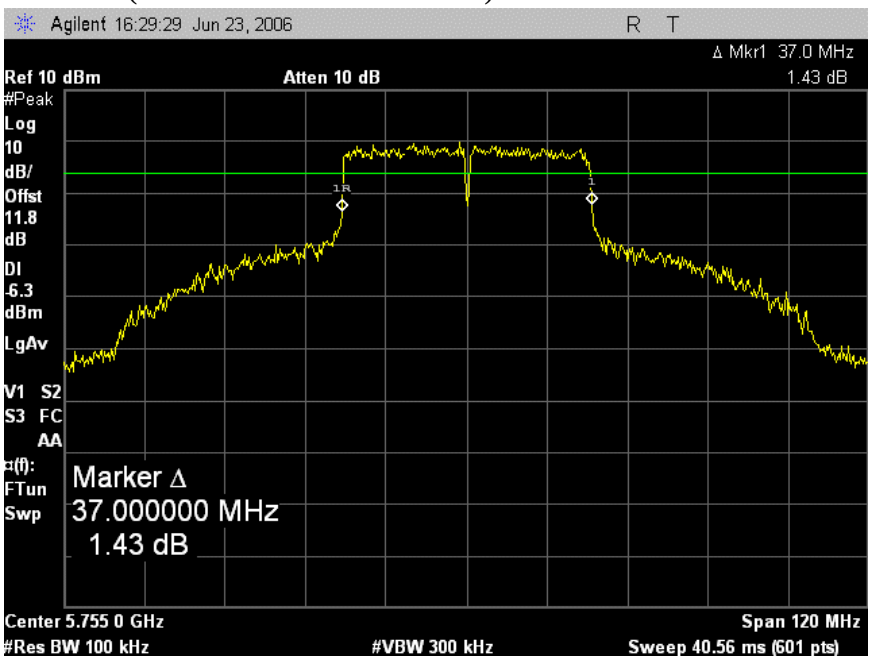
(802.11 HT40 MODE CHAIN B)

LOW CH (802.11n HT40 mode Chain B)



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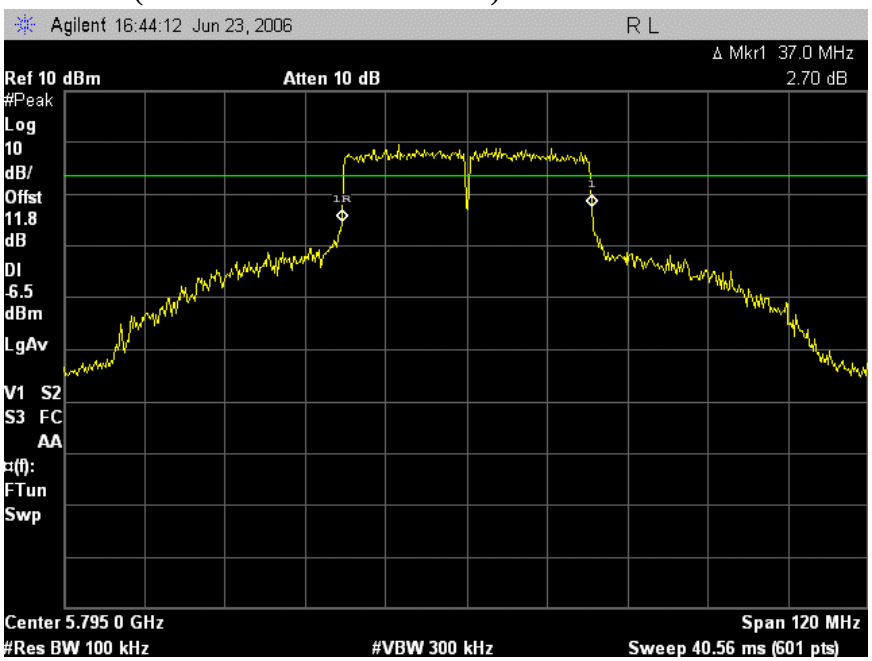
HIGH CH (802.11n HT40 mode Chain B)



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7.2.2. 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

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RESULTS

No non-compliance noted:

Mode Channel	Frequency (MHz)	99% BW Chain A (MHz)	99% BW Chain B (MHz)
802.11a 20M Mode			
Low	5745	16.8638	17.3605
Middle	5785	16.8506	17.3792
High	5825	17.2563	17.8518
802.11a 40M Mode			
Low	5755	36.6045	36.6689
High	5795	37.3728	37.8906
802.11n HT20 Mode			
Low	5745	17.9111	19.4753
Mid	5785	18.0267	19.0341
High	5825	16.8733	18.9198
802.11n HT40 Mode			
Low	5755	36.4496	36.5032
High	5795	37.4606	38.8924

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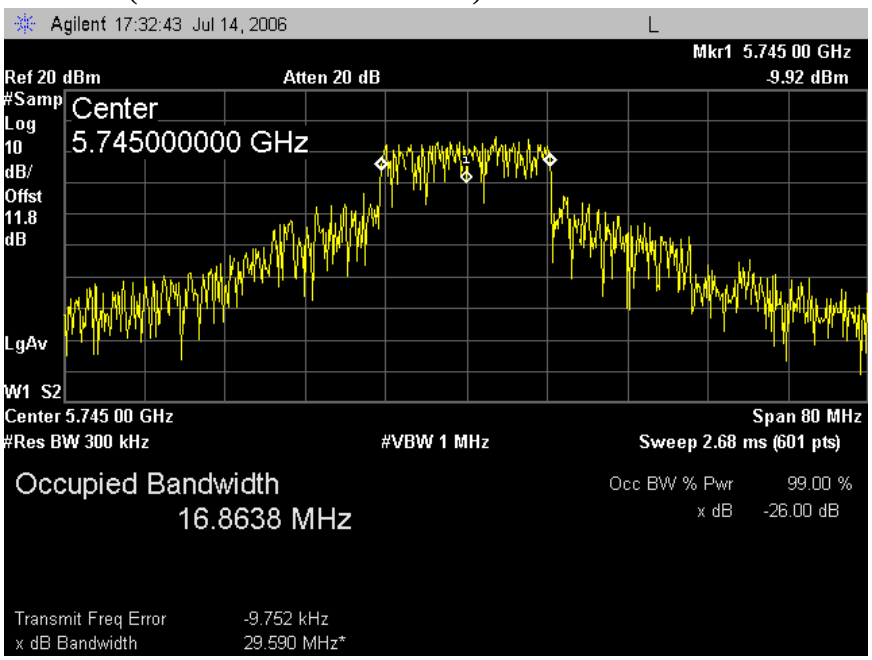
(802.11a 20M MODE CHAIN A)

LOW CH (802.11a 20M mode Chain A)



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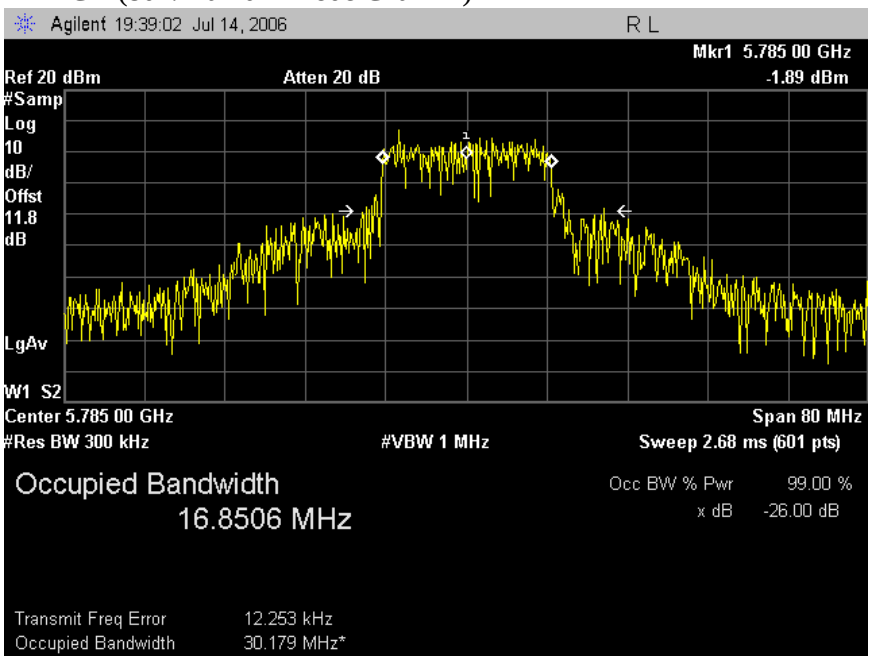
MID CH (802.11a 20M mode Chain A)



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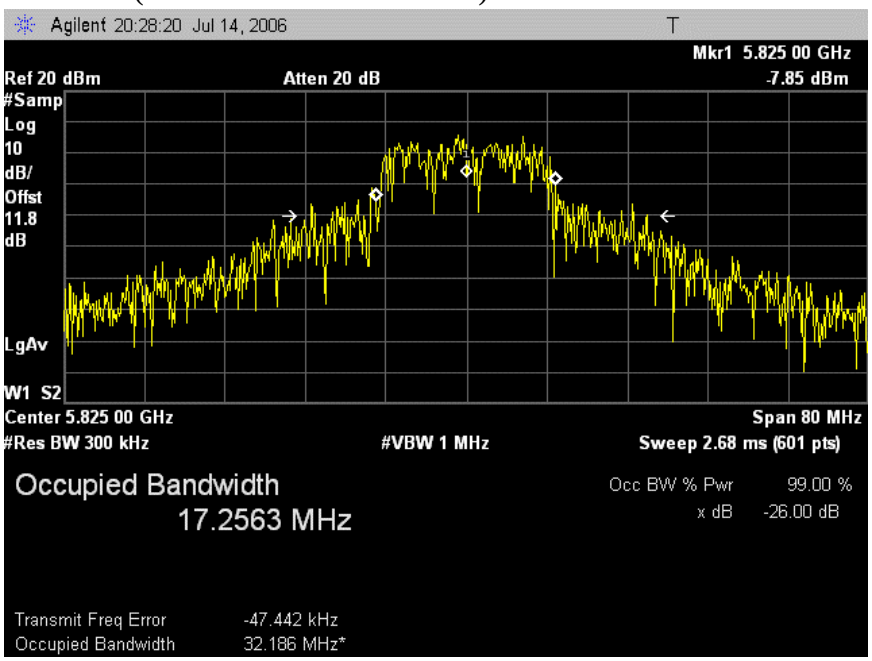
HIGH CH (802.11a 20M mode Chain A)



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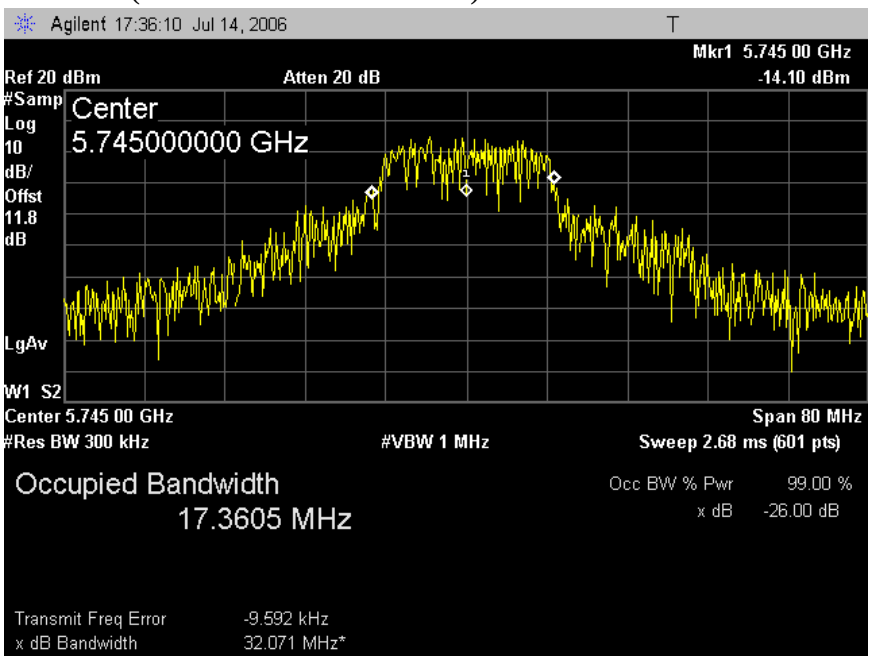
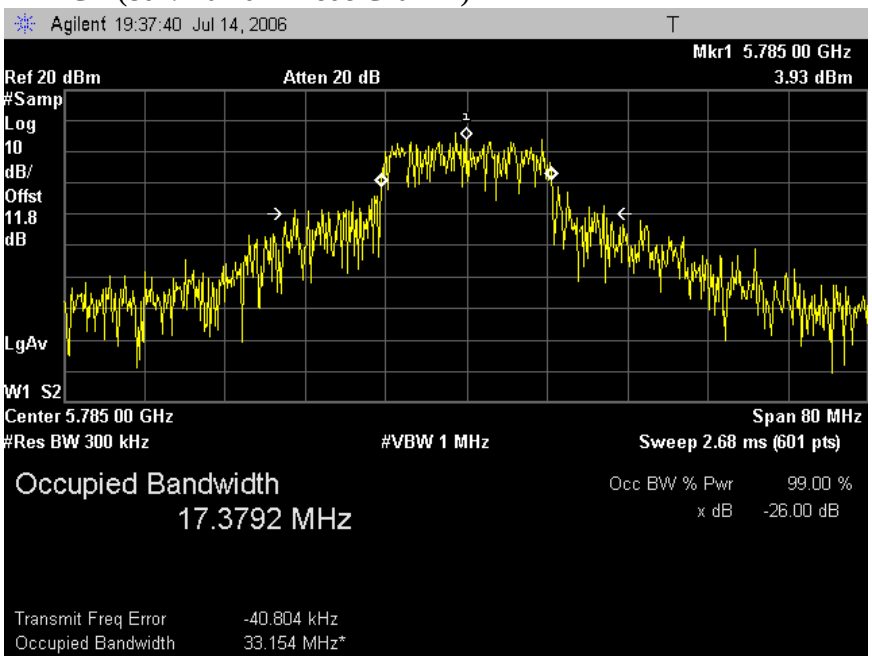
(802.11a 20M MODE CHAIN B)

LOW CH (802.11a 20M mode Chain B)



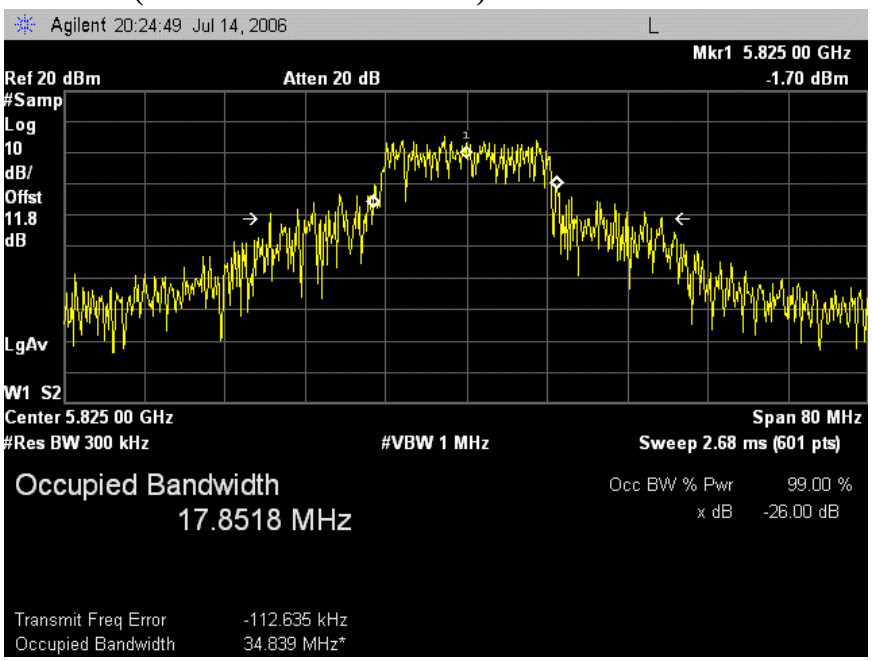
This report shall not be reproduced except in full, without the written approval of CCS.

MID CH (802.11a 20M mode Chain B)



This report shall not be reproduced except in full, without the written approval of CCS.

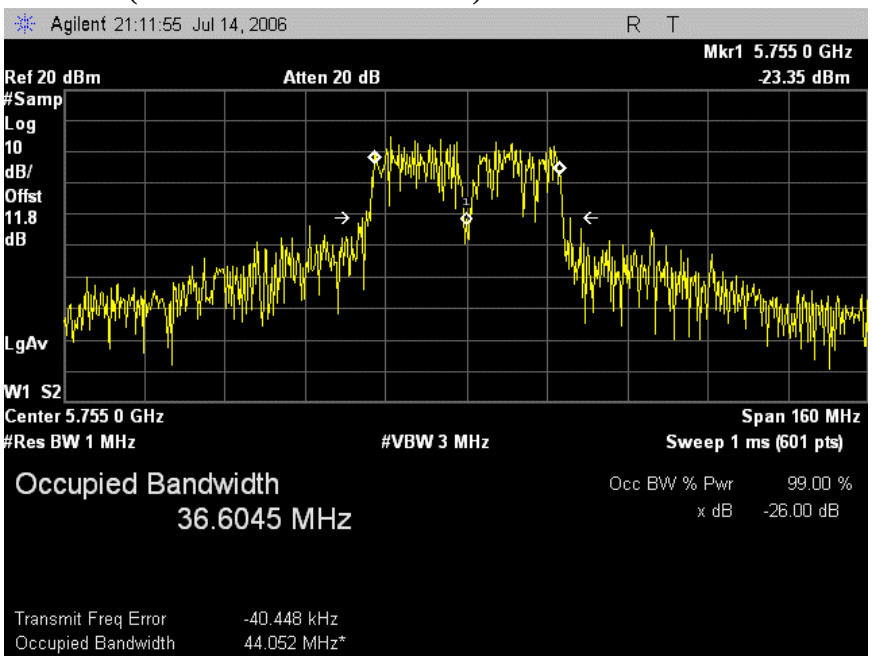
HIGH CH (802.11a 20M mode Chain B)



This report shall not be reproduced except in full, without the written approval of CCS.

(802.11a 40M MODE CHAIN A)

LOW CH (802.11a 40M mode Chain A)



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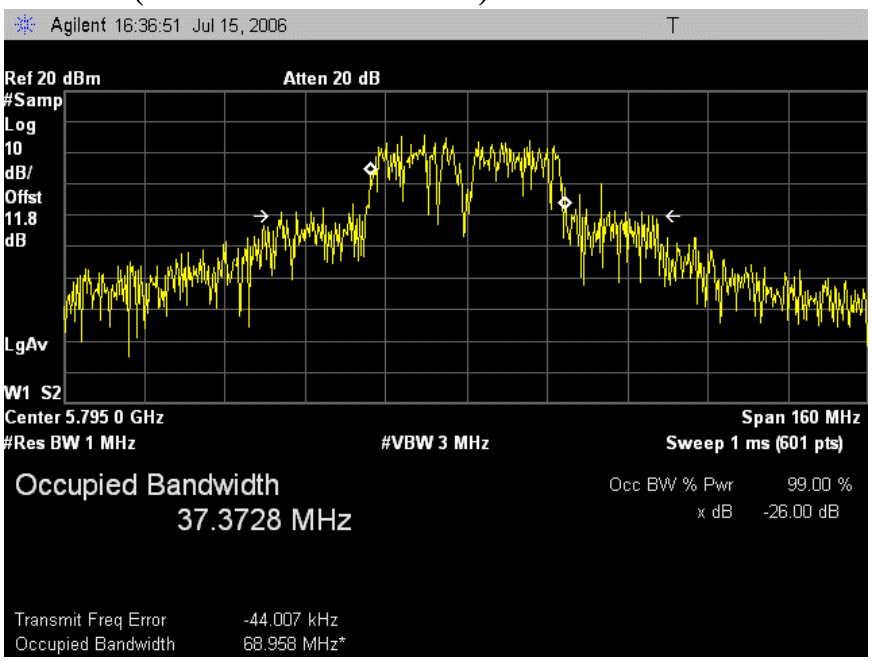
HIGH CH (802.11a 40M mode Chain A)



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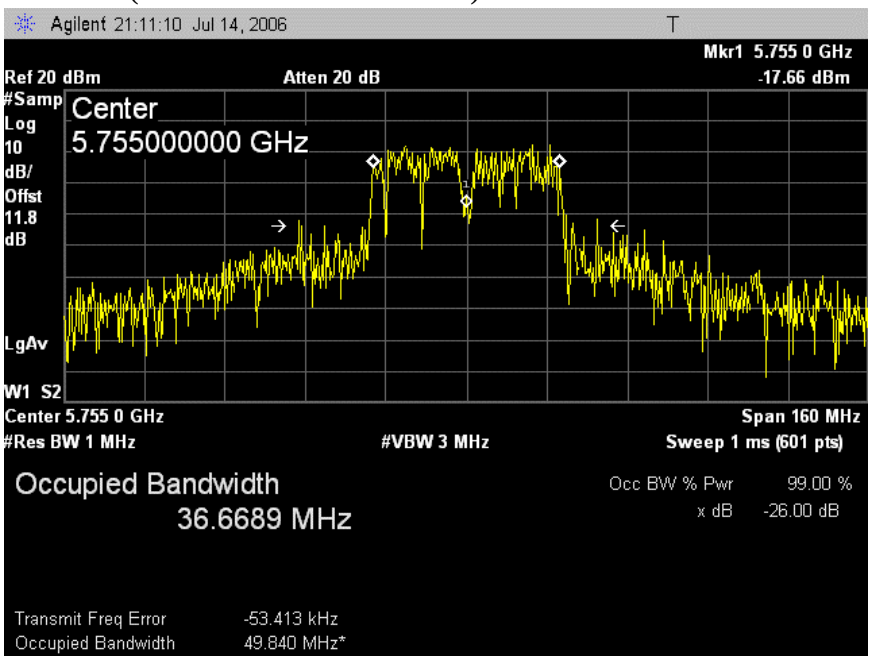
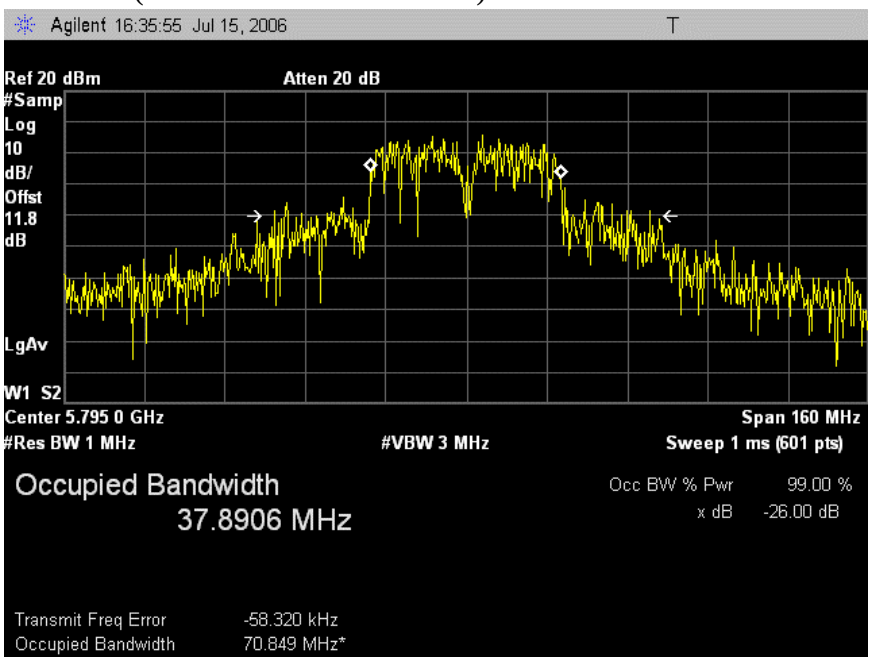
(802.11a 40M MODE CHAIN B)

LOW CH (802.11a 40M mode Chain B)



This report shall not be reproduced except in full, without the written approval of CCS.

HIGH CH (802.11a 40M mode Chain B)



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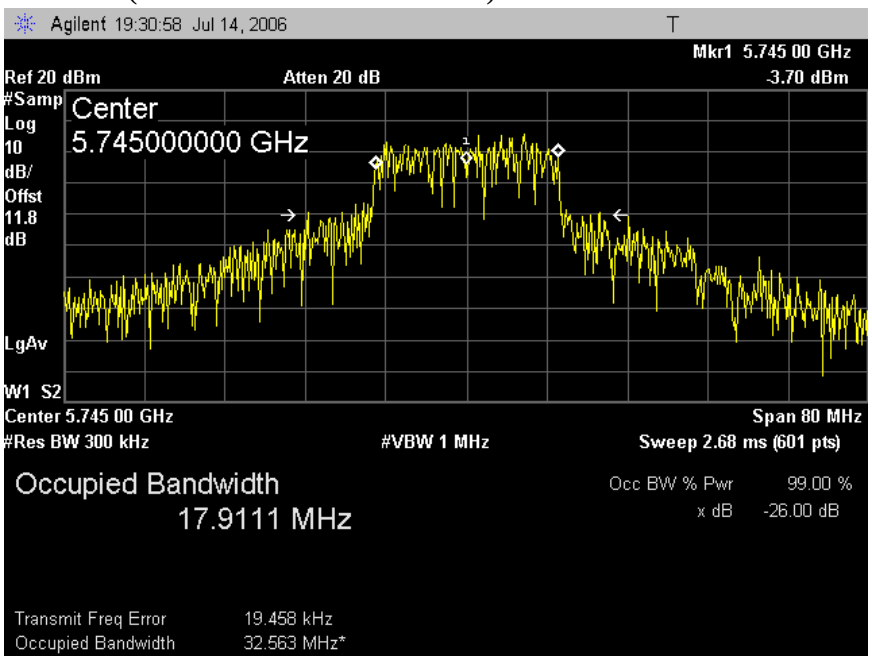
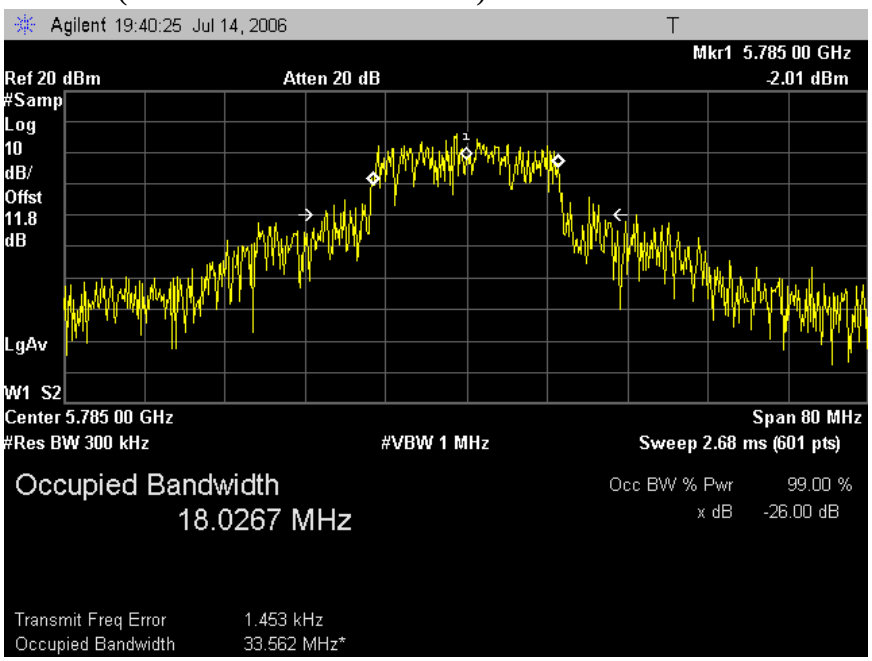
(802.11n HT20 MODE CHAIN A)

LOW CH (802.11n HT20 mode Chain A)



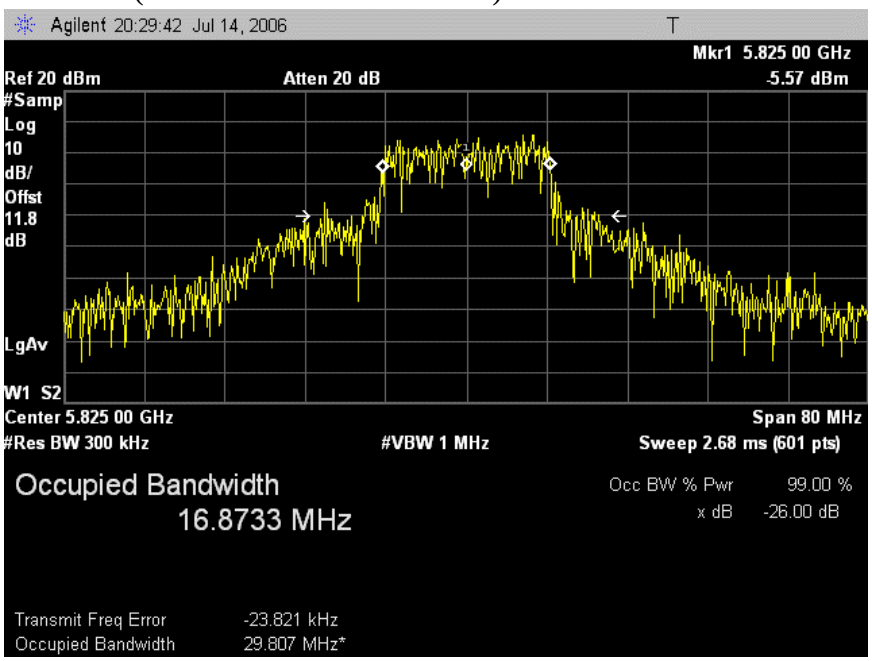
This report shall not be reproduced except in full, without the written approval of CCS.

MID CH (802.11n HT20 mode Chain A)



This report shall not be reproduced except in full, without the written approval of CCS.

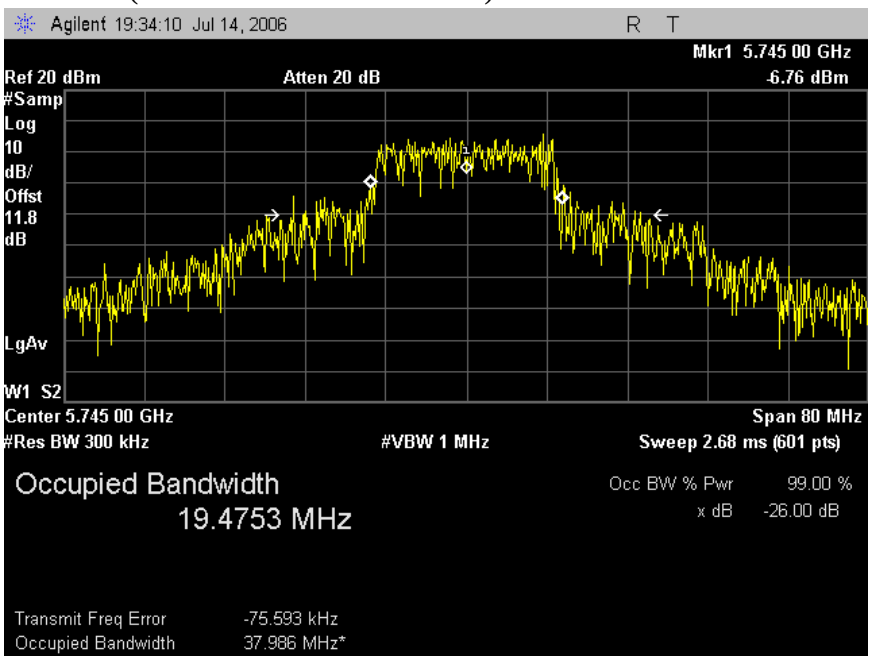
HIGH CH (802.11n HT20 mode Chain A)



This report shall not be reproduced except in full, without the written approval of CCS.

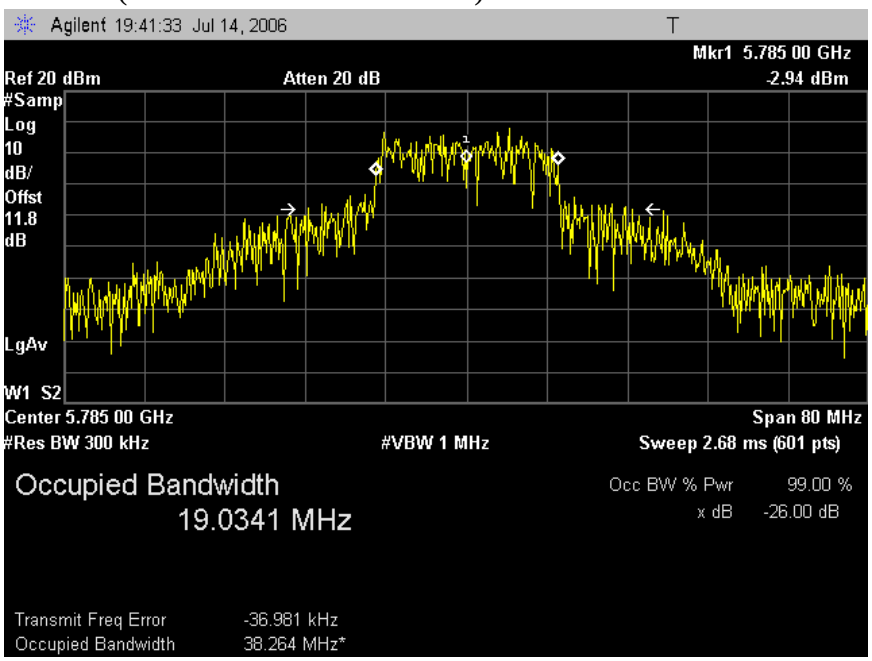
(802.11 HT20 MODE CHAIN B)

LOW CH (802.11n HT20 mode Chain B)



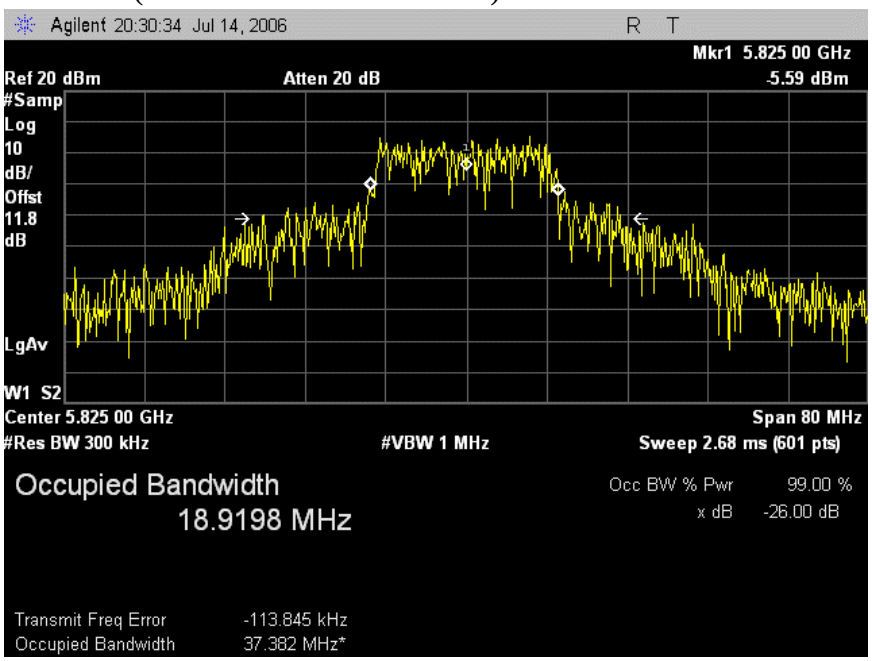
This report shall not be reproduced except in full, without the written approval of CCS.

MID CH (802.11n HT20 mode Chain B)



This report shall not be reproduced except in full, without the written approval of CCS.

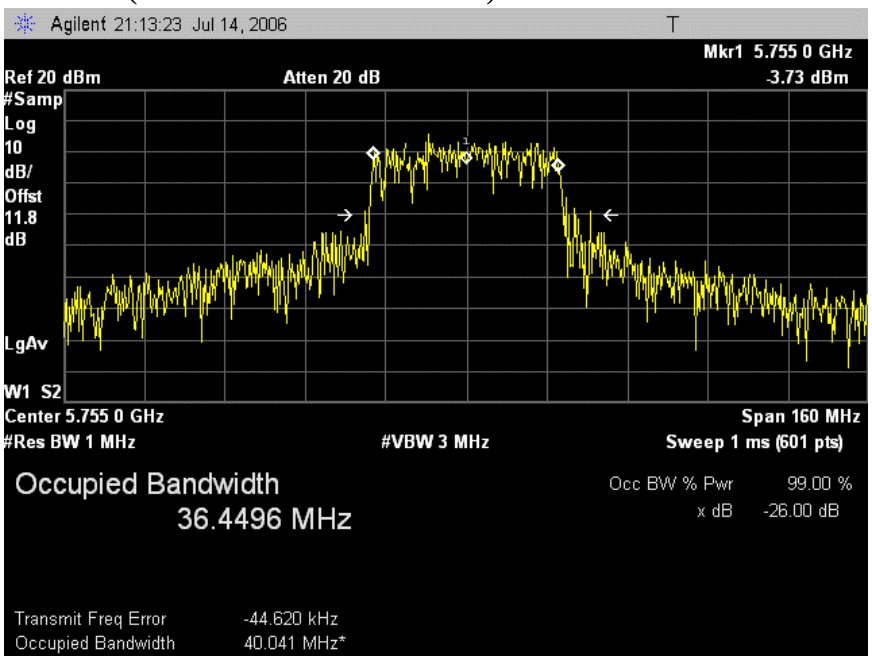
HIGH CH (802.11n HT20 mode Chain B)



This report shall not be reproduced except in full, without the written approval of CCS.

(802.11 HT40 MODE CHAIN A)

LOW CH (802.11n HT40 mode Chain A)



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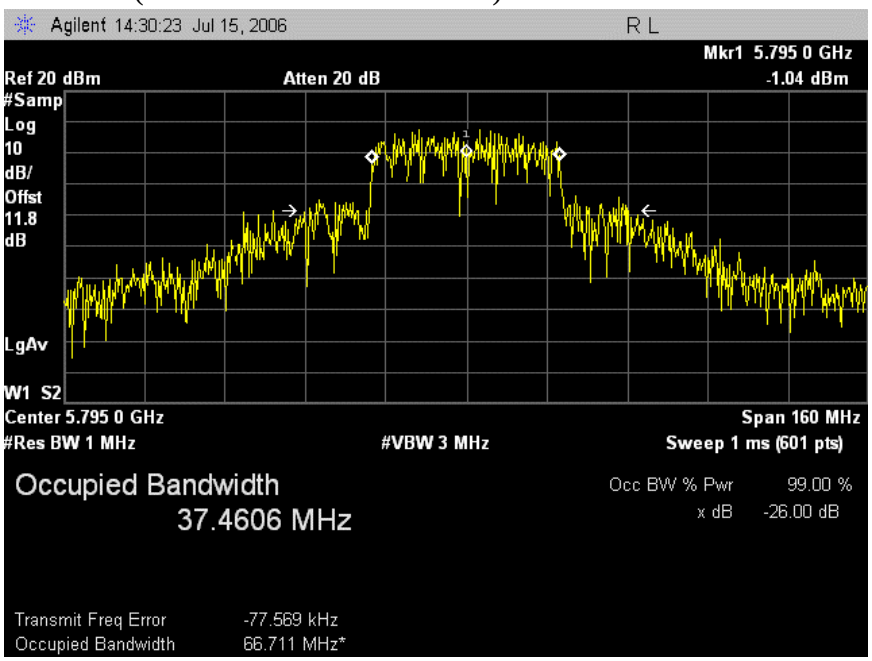
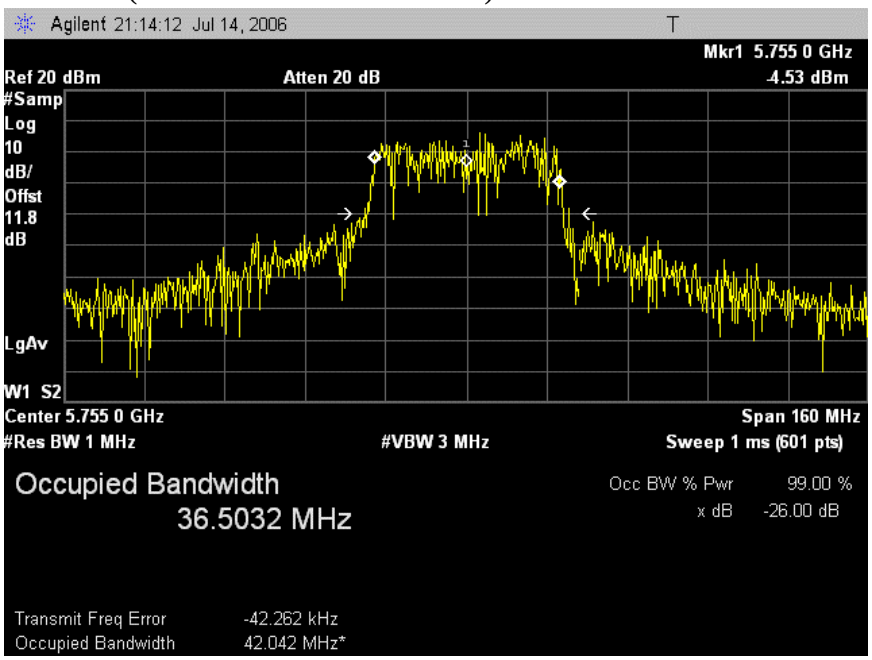
HIGH CH (802.11n HT40 mode Chain A)



This report shall not be reproduced except in full, without the written approval of CCS.

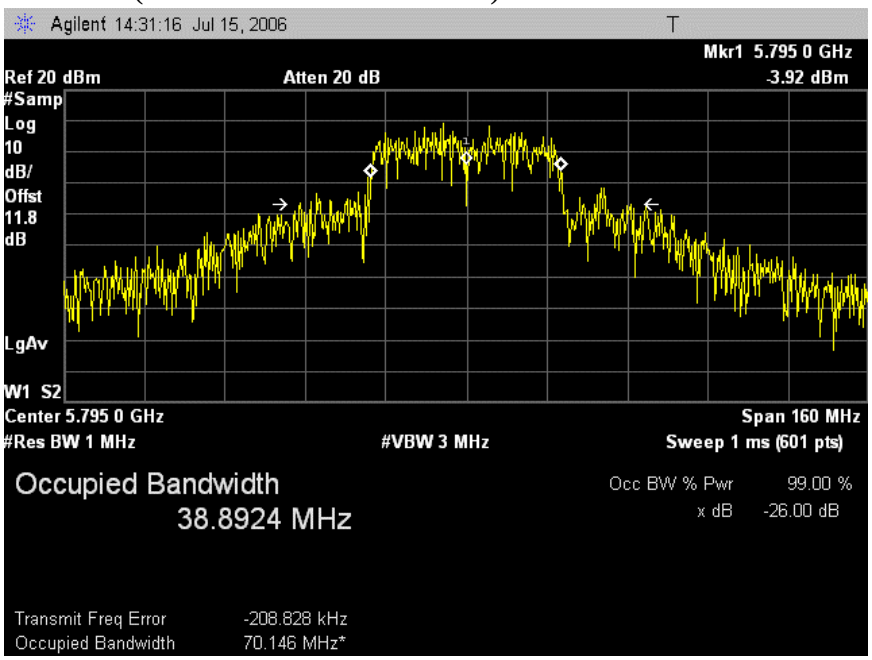
(802.11 HT40 MODE CHAIN B)

LOW CH (802.11n HT40 mode Chain B)



This report shall not be reproduced except in full, without the written approval of CCS.

HIGH CH (802.11n HT40 mode Chain B)



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7.2.3. PEAK OUTPUT POWER

LIMIT

§15.247 (b) The maximum peak output power of the intentional radiator shall not exceed the following:

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz , and 5725-5850 MHz bands: 1 watt.

§15.247 (b) (4) (i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer and the analyzer's internal channel power integration function is used to integrate the power over a bandwidth greater than or equal to the 99% bandwidth.

Each chain is measured separately and the total power is calculated using:

Total Power = 10 log (10^ (Chain 0 Power / 10) + 10^ (Chain 2 Power / 10))

Effective Legacy Gain = antenna gain + 10 log(# Tx Chains)

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RESULTS

No non-compliance noted:

Antenna Gain (dBi)	4.4
10 Log (# Tx Chains)	3.01
Effective Legacy Gain	7.41

Mode Channel	Frequency (MHz)	Max Power Chain A (dBm)	Max Power Chain B (dBm)	Max Power Total (dBm)	Limit (dBm)	Margin (dB)
802.11a 20M Mode						
Low	5745	23.52	23.93	26.74	28.59	-1.85
Middle	5785	23.50	24.80	27.21	28.59	-1.38
High	5825	24.11	24.19	27.16	28.59	-1.43
802.11a 40M Mode						
Low	5755	19.57	19.41	22.50	28.59	-6.09
High	5795	21.74	21.39	24.58	28.59	-4.01
802.11n HT20 Mode						
Low	5745	23.62	24.19	26.92	30.00	-3.08
Mid	5785	23.72	24.11	26.93	30.00	-3.07
High	5825	23.90	24.31	27.12	30.00	-2.88
802.11n HT40 Mode						
Low	5755	21.00	21.25	24.14	30.00	-5.86
High	5795	23.73	23.45	26.60	30.00	-3.40

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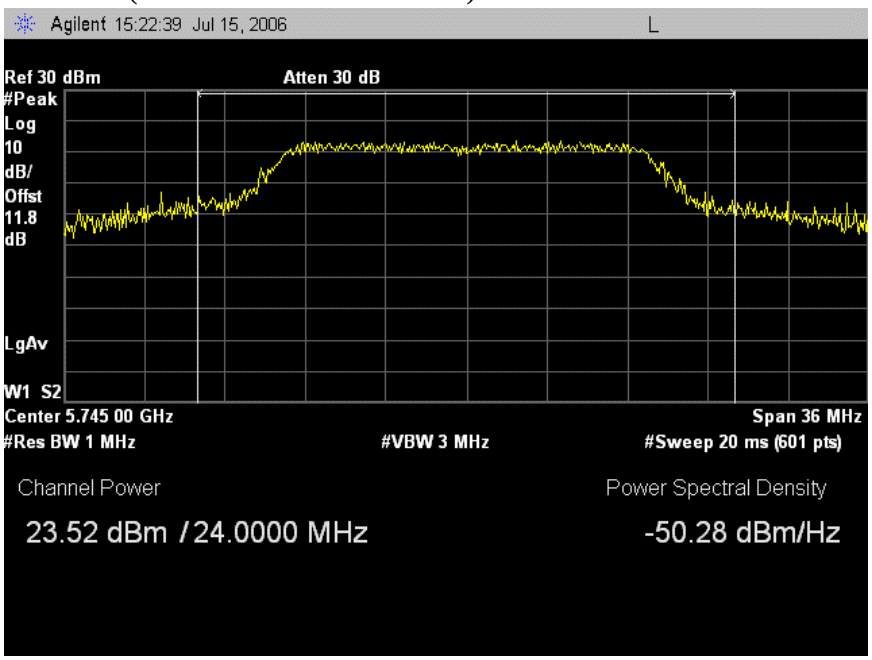
(802.11a 20M MODE CHAIN A)

LOW CH (802.11a mode 20M chain A)



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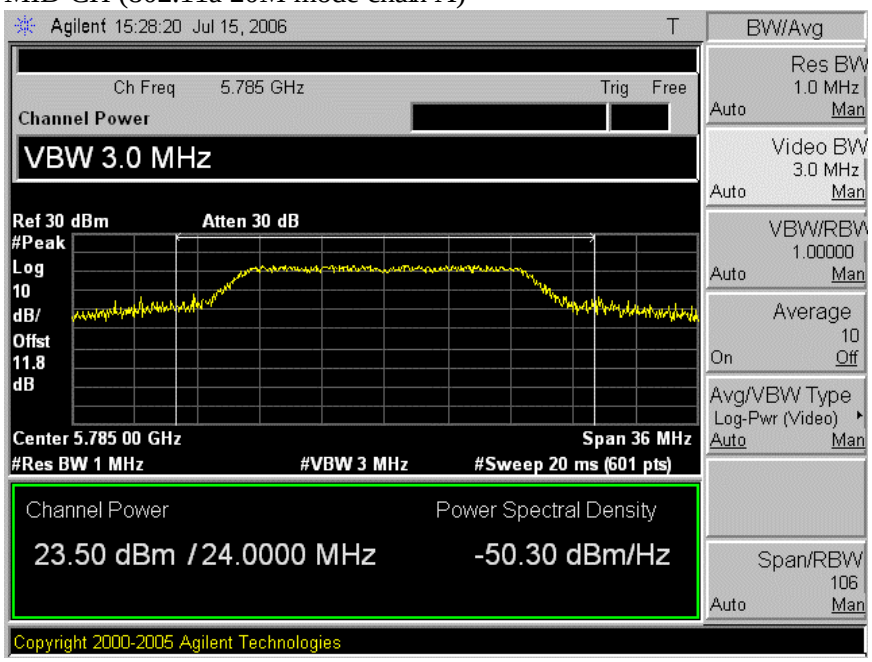
MID CH (802.11a 20M mode chain A)



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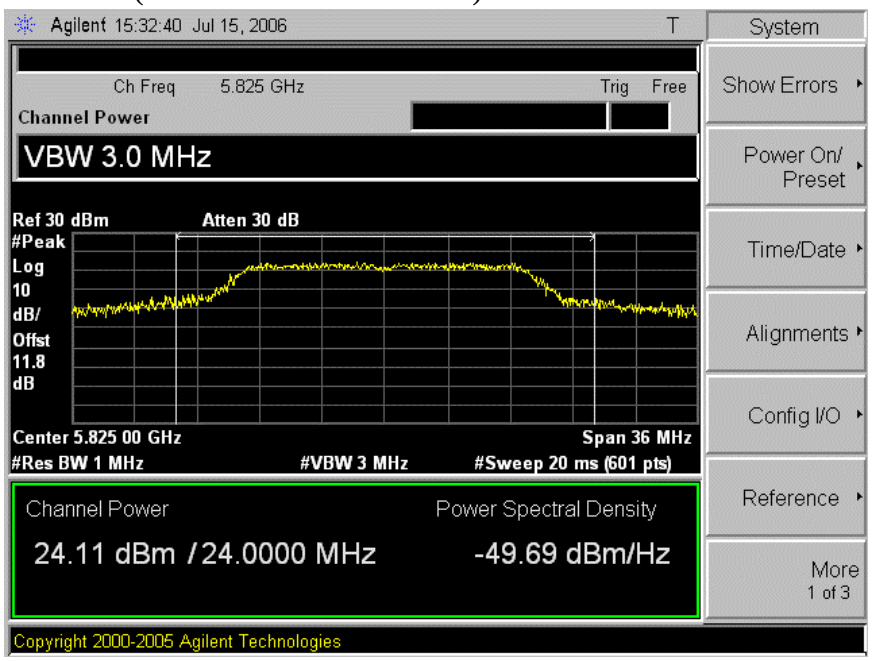
HIGH CH (802.11a 20M mode chain A)



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