FCC CFR47 PART 15 SUBPART E
INDUSTRY CANADA RSS-210 ISSUE 7
CERTIFICATION TEST REPORT

FOR

ACCESS POINT

MODEL NUMBER: A1301

FCC ID: BCGA1301
IC: 579C-A1301

REPORT NUMBER: 08U12079-2, revision A

ISSUE DATE: FEBRUARY 09, 2009

Prepared for
APPLE, INC.
1 INFINITE LOOP
CUPERTINO, CA 95014, U.S.A.

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

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	01/20/09	Initial Issue	F. Ibrahim
A	02/09/09	Revised antenna gain.	F. Ibrahim

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: APPLE, INC.
1 INFINITE LOOP
CUPERTINO, CA 95014, U.S.A.

EUT DESCRIPTION: ACCESS POINT

MODEL: A1301

SERIAL NUMBER: 6F83403J31S

DATE TESTED: September 9, 2008 - January 20, 2009

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C and Subpart E	PASS
RSS-210 Issue 7 Annex 8 and RSS-GEN Issue 2	PASS

Compliance Certification Services, Inc. (CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by CCS based on interpretations and/or observations of test results. 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 CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by CCS 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:

FRANK IBRAHIM
ENGINEERING SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

Tested By:

THANH NGUYEN
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 2, and RSS-210 Issue 7.

3. FACILITIES AND ACCREDITATION

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

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

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

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

4.2. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Radiated Emission, 30 to 200 MHz	+/- 3.3 dB
Radiated Emission, 200 to 1000 MHz	+4.5 / -2.9 dB
Radiated Emission, 1000 to 2000 MHz	+4.5 / -2.9 dB
Power Line Conducted Emission	+/- 2.9 dB

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

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

The radio module is manufactured by Ambit subsidiary of Foxconn, which is located in Hon Hai.

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)
5180 to 5240	802.11a	15.84	38.37
5180 to 5240	802.11n HT20	15.35	34.28
5190 to 5230	802.11n HT40	16.86	48.53

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes PIFA antennas, with a maximum gain of 2.72 dBi in the 5.2 GHz band.

5.4. SOFTWARE AND FIRMWARE

Firmware: k10_7.4d4auto20080826T0200

EUT Driver Software: ARTR07B13

The test utility software used during testing was ART Build #13, rev. 0.79

5.5. WORST-CASE CONFIGURATION AND MODE

For Radiated Emissions and Power line Conducted Emissions, the channel with the highest conducted output power was selected.

Worst-case data rates as provided by the manufacturer are:
For 11a mode: 6Mbps
For 11n HT20 (5.2 GHz band): MCS1
For 11n HT40 (5.2 GHz band): MCS0

Peak Power Spectral Density was investigated in the 11b mode at Low Channel, for individual chains versus combiner, and it was determined that combiner is worst-case; therefore, all other measurements of PPSD in other channels and modes were performed using a combiner.

RF Conducted Spurious was investigated in the 11a mode for Low Channel, for individual chains versus combiner, and it was determined that combiner is worst-case; therefore, all other measurements of RF conducted spurious were performed with combiner in the 5.2 GHz band.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST			
Description	**Manufacturer**	**Model**	**Serial Number**
Laptop	Apple Inc.	Mac Book	PT405200
AC/DC adapter	Delta Electronics	ADP-20BH AA	MV83303WZ8REVT
AC/DC adapter	Delta Electronics	ADP-60AD BR	MV83304125SDVT

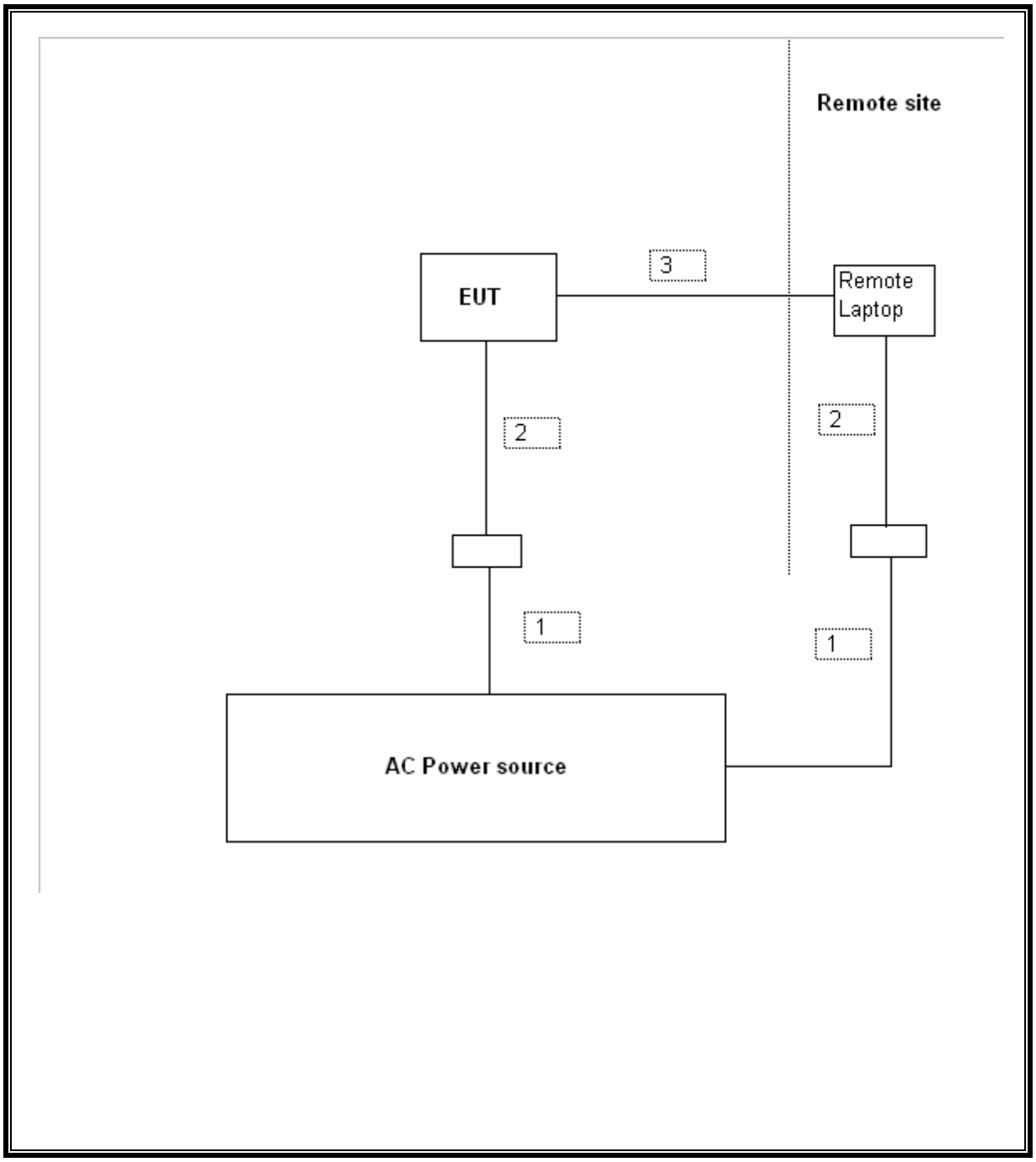
I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identica Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	AC	2	US 115V	Un-shielded	2m	N/A
2	DC	2	DC	Un-shielded	2m	N/A
3	Ethernet	1	RJ45	Un-shielded	1.5m	N/A

TEST SETUP

The EUT is connected to a support laptop computer during the tests. Test software exercised the radio card

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**Cal Due**
Peak Power Meter	Agilent / HP	E4416A	GB41291160	12/04/09
Peak / Average Power Sensor	Agilent	E9327A	US40440755	12/07/09
Spectrum Analyzer 3 Hz ~ 44 GHz	Agilent / HP	E4446A	MY43360112	10/08/09
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	2238	09/29/09
Preamplifier, 1 ~ 26.5 GHz	Agilent / HP	8449B	3008A00931	09/27/09
LISN, 10 kHz ~ 30 MHz	FCC	LISN-50/250-25-2	2023	10/15/09
EMI Test Receiver	R & S	ESHS 20	827129/006	09/27/09
SA Display Section 2	Agilent / HP	85662A	2816A16696	09/29/09
SA RF Section, 1.5 GHz	Agilent / HP	85680B	2814A04227	09/29/09
Quasi-Peak Adaptor	Agilent / HP	85650A	3145A01654	09/29/09
Antenna, Bilog 30 MHz ~ 2 GHz	Sunol Sciences	JB1	A121003	09/28/09
Preamp 30-1000MHz	Sonoma	310N	185623	07/20/09
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	10/11/09
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00589	01/29/09
Antenna, Horn, 40 GHz	ARA	MWH-2640/B	C00981	04/29/09

7. ANTENNA PORT TEST RESULTS

7.1. 802.11a MODE IN THE 5.2 GHz BAND

7.1.1. 26 dB and 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

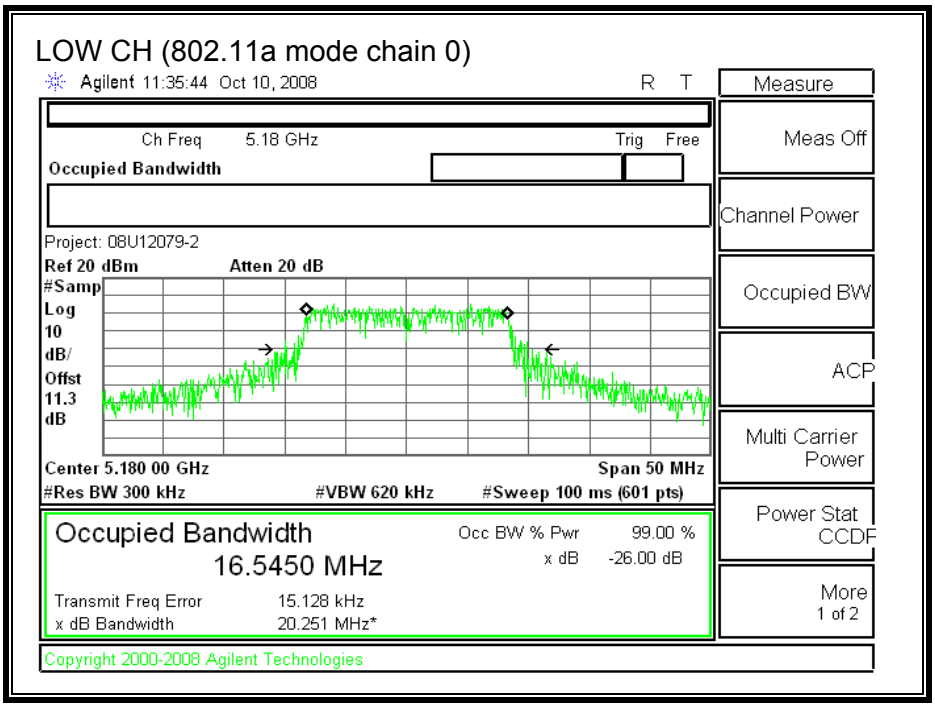
The transmitter outputs are connected to the spectrum analyzer via a combiner. The RBW is set to 1% to 3% of the measured bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal bandwidth function is utilized.

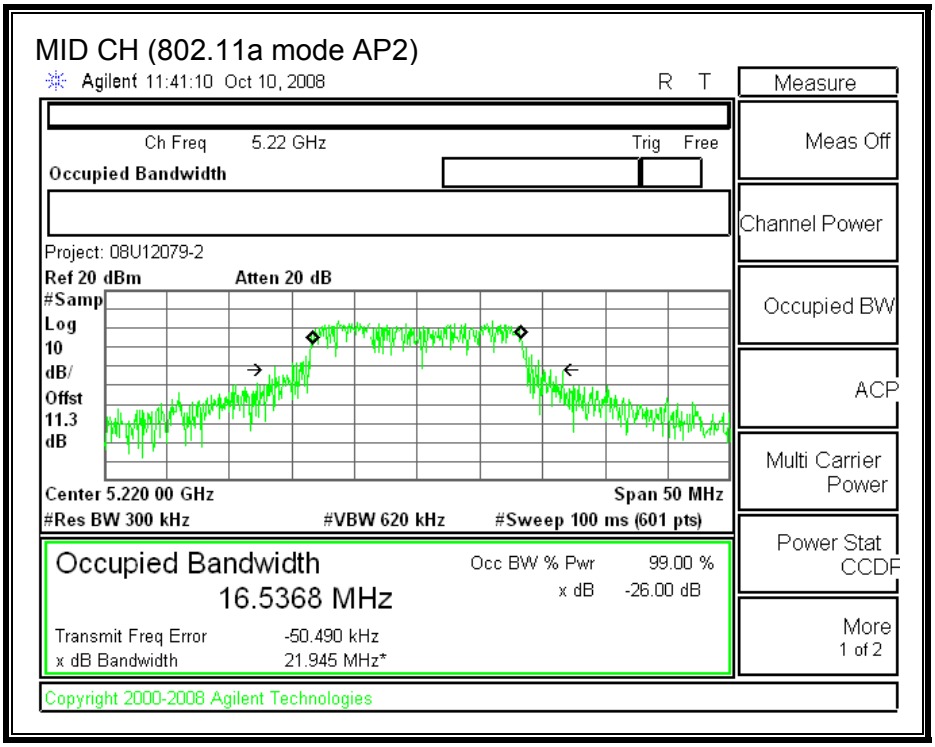
RESULTS

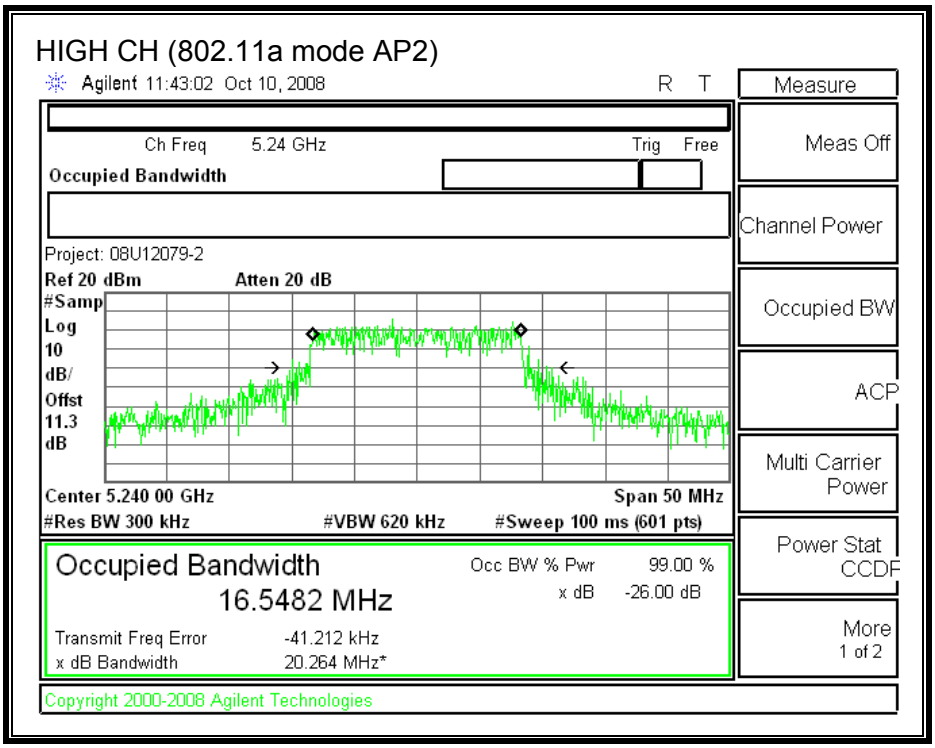
Mode Channel	Frequency (MHz)	99% BW AP2 (MHz)	99% BW AP4 (MHz)	26 dB BW AP2 (MHz)	26 dB BW AP4 (MHz)
802.11a Mode					
Low	5180	16.5450	16.6278	20.251	21.944
Middle	5220	16.5368	16.5210	21.945	21.452
High	5240	16.5482	16.4251	20.264	22.437
802.11n HT20 Mode					
Low	5180	17.6603	17.6599	21.192	21.052
Middle	5220	17.6935	17.6992	21.242	21.201
High	5240	17.5273	17.5613	20.931	20.225
802.11n HT40 Mode					
Low	5190	36.0552	36.0407	42.611	41.255
High	5230	36.2208	36.0812	41.118	41.074

26 dB and 99% BANDWIDTH

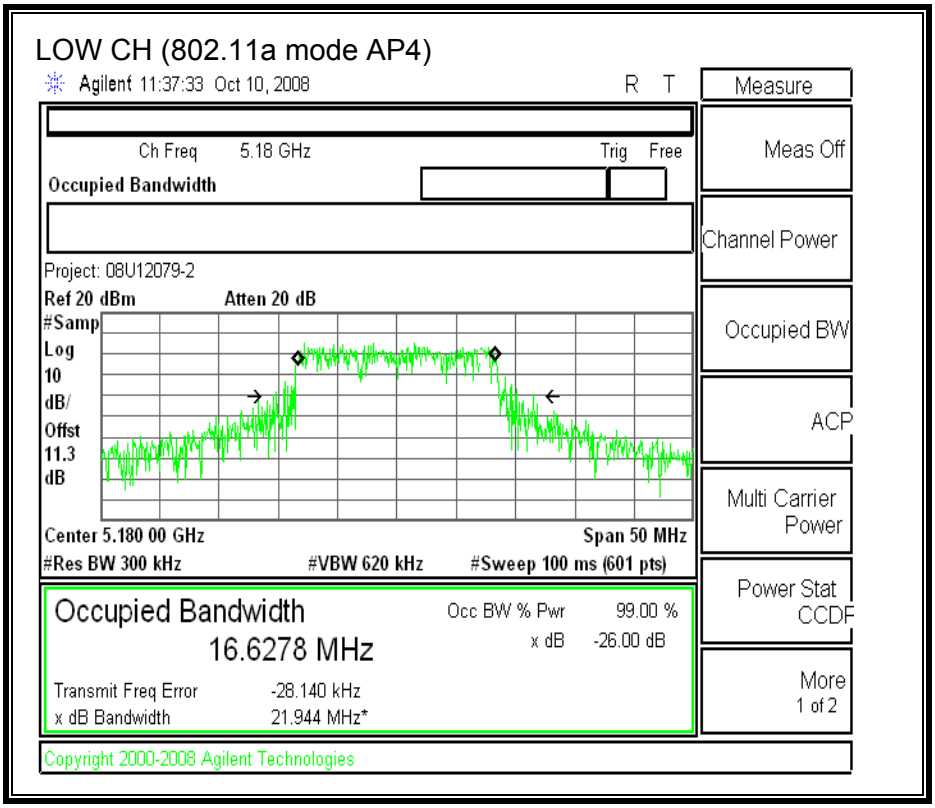
(802.11a MODE AP2)

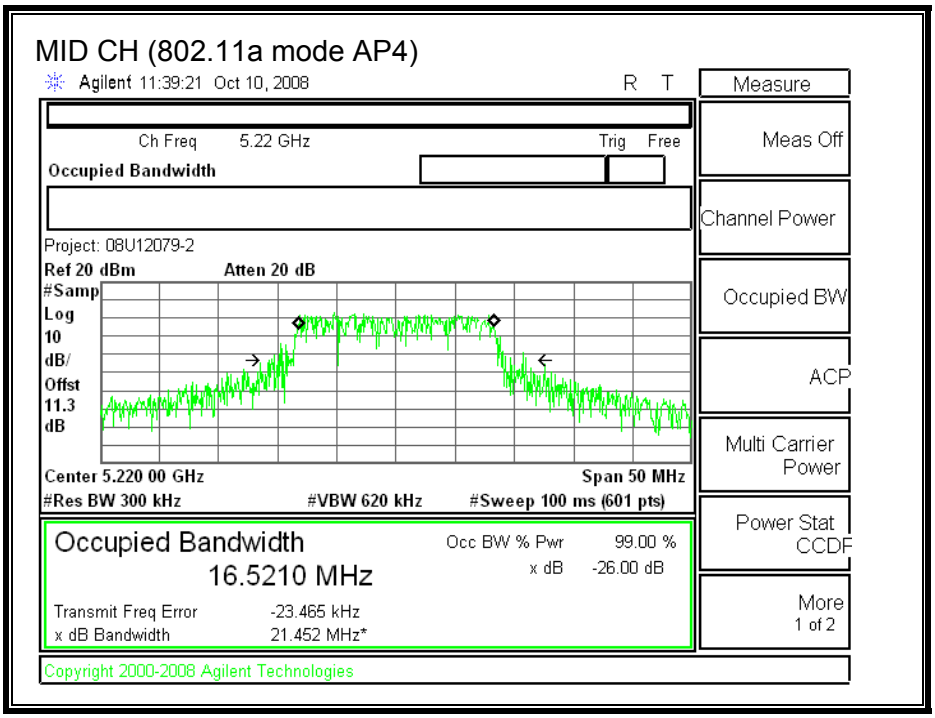


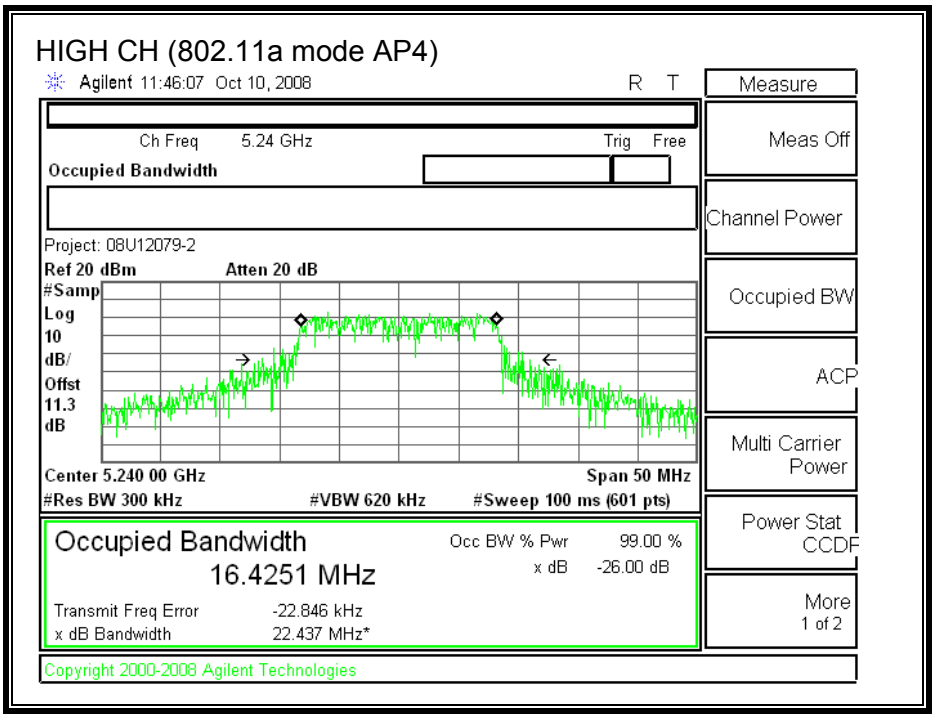




(802.11a MODE AP4)

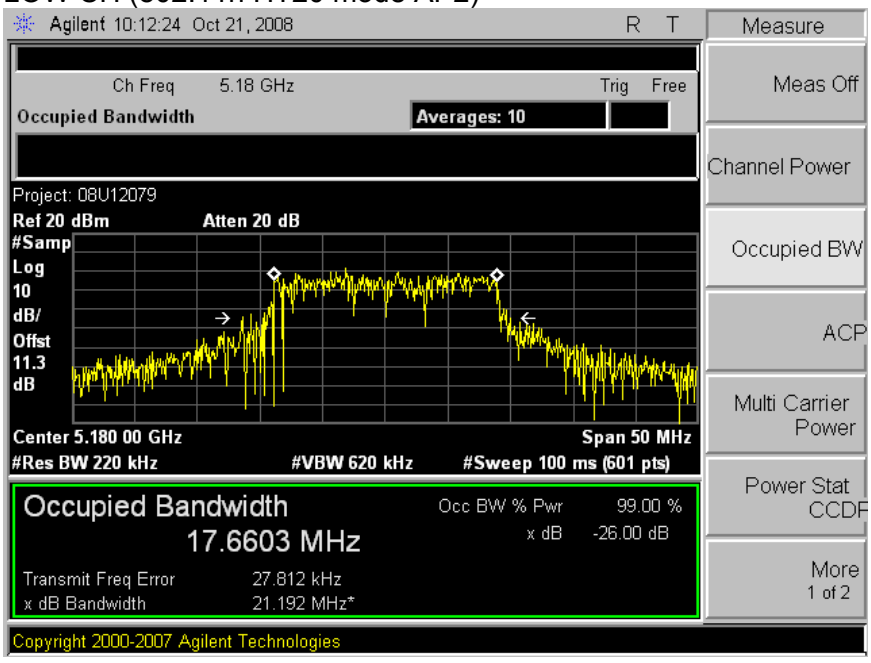




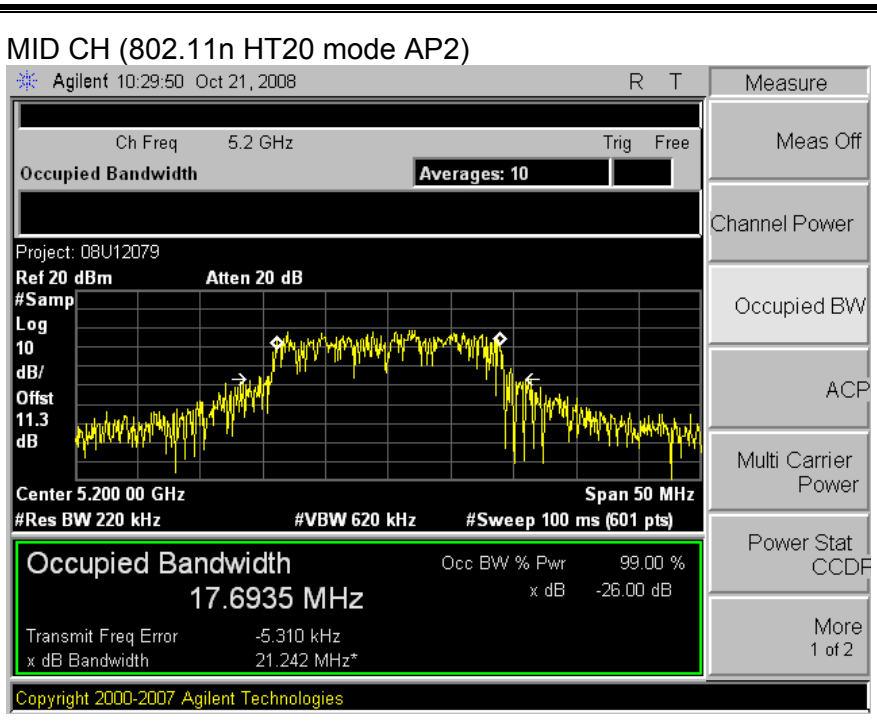


(802.11n HT20 MODE AP2)

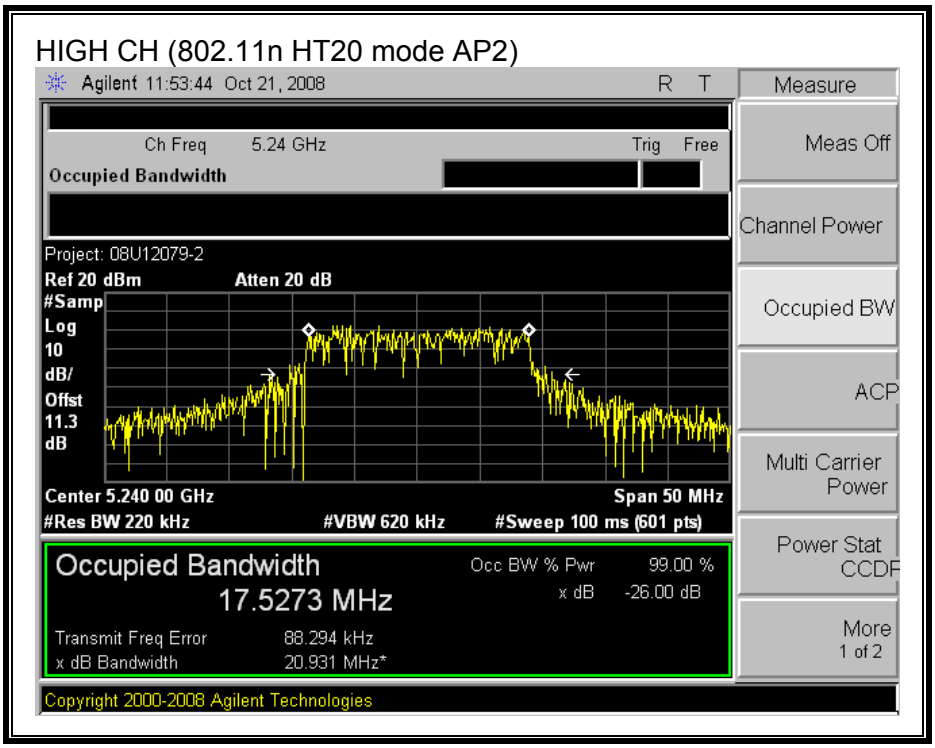
LOW CH (802.11n HT20 mode AP2)



MID CH (802.11n HT20 mode AP2)

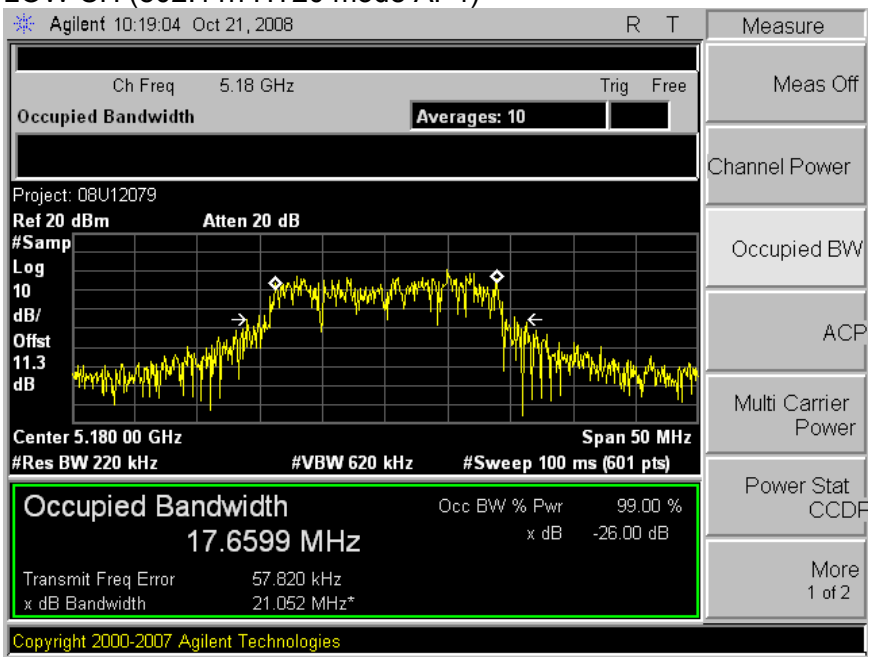


HIGH CH (802.11n HT20 mode AP2)

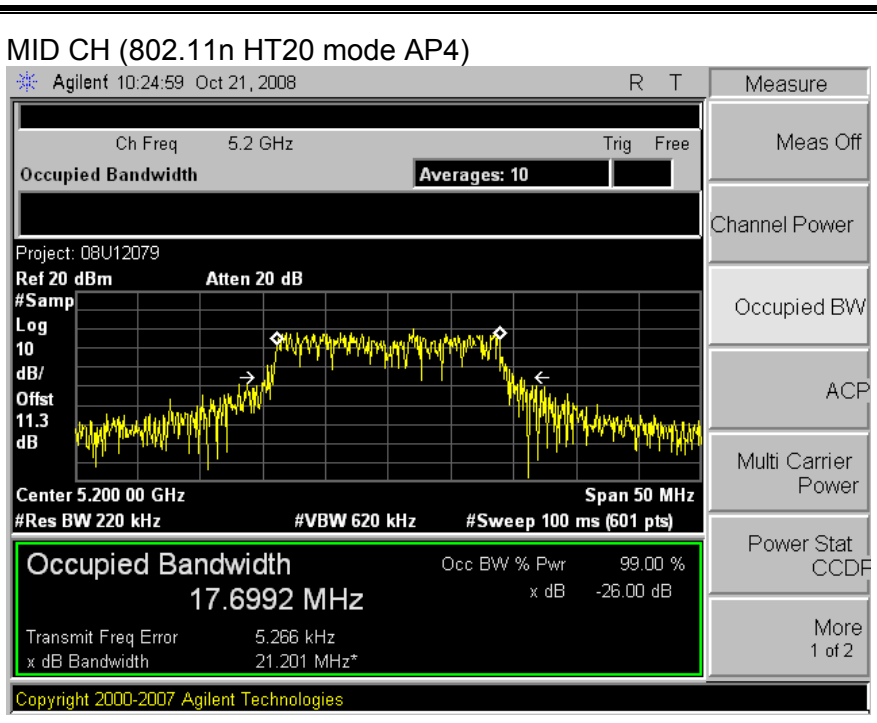


(802.11 HT20 MODE AP4)

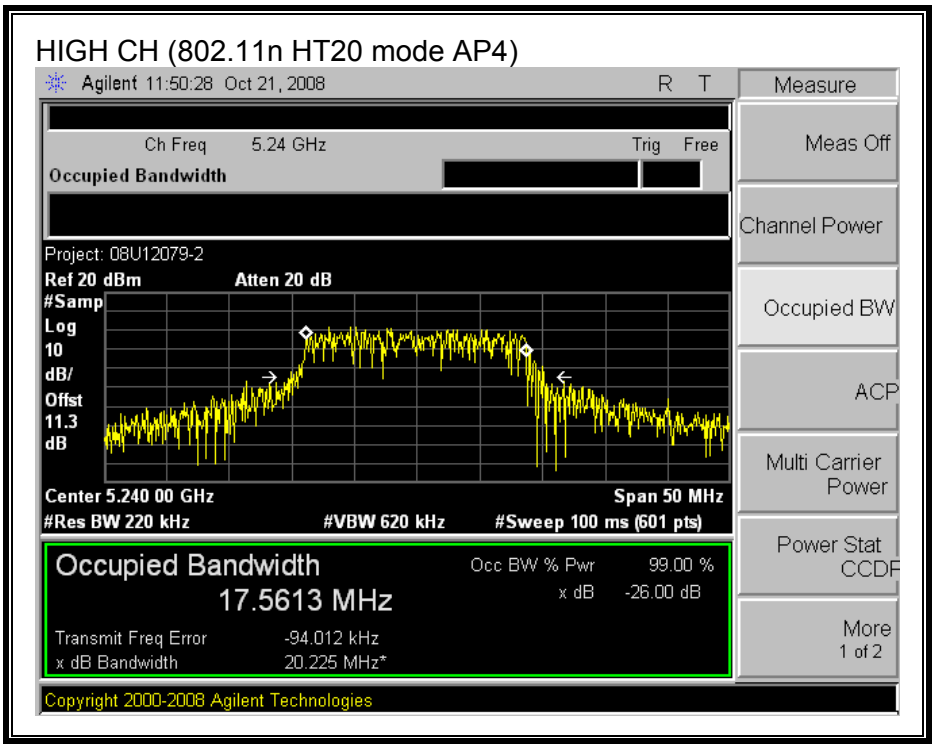
LOW CH (802.11n HT20 mode AP4)



MID CH (802.11n HT20 mode AP4)

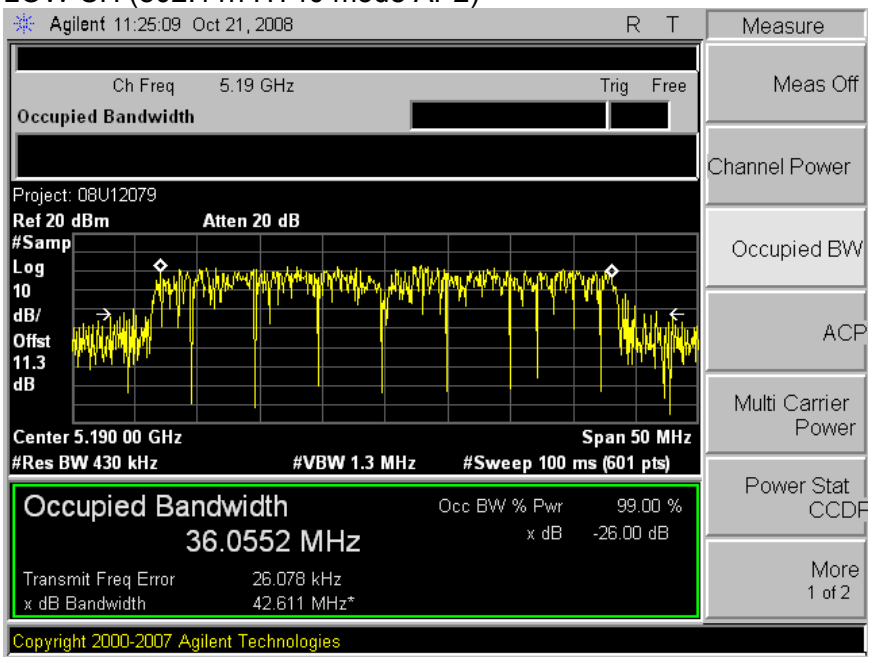


HIGH CH (802.11n HT20 mode AP4)

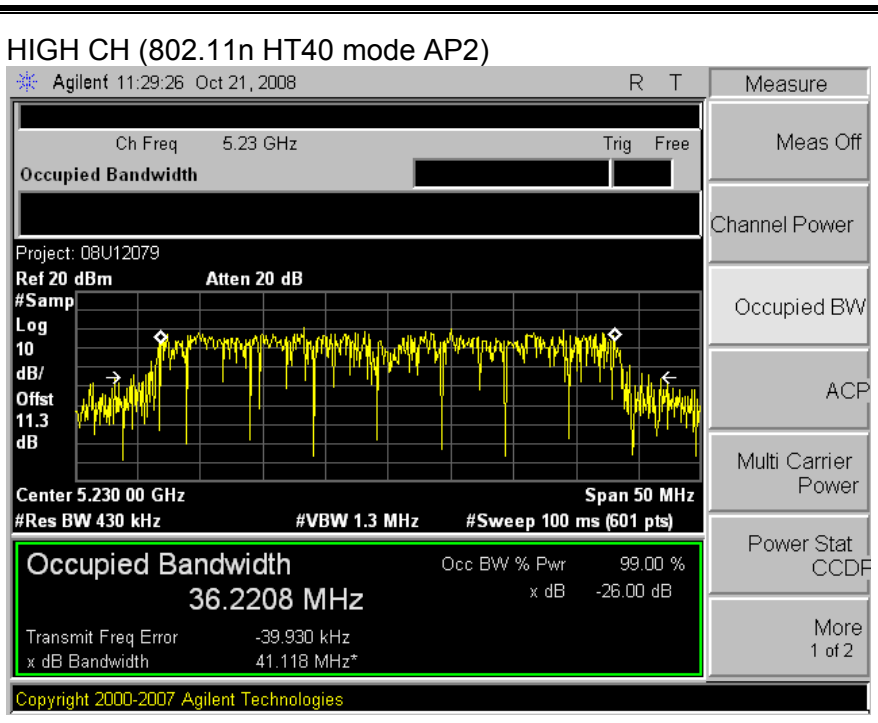


(802.11 HT40 MODE AP2)

LOW CH (802.11n HT40 mode AP2)

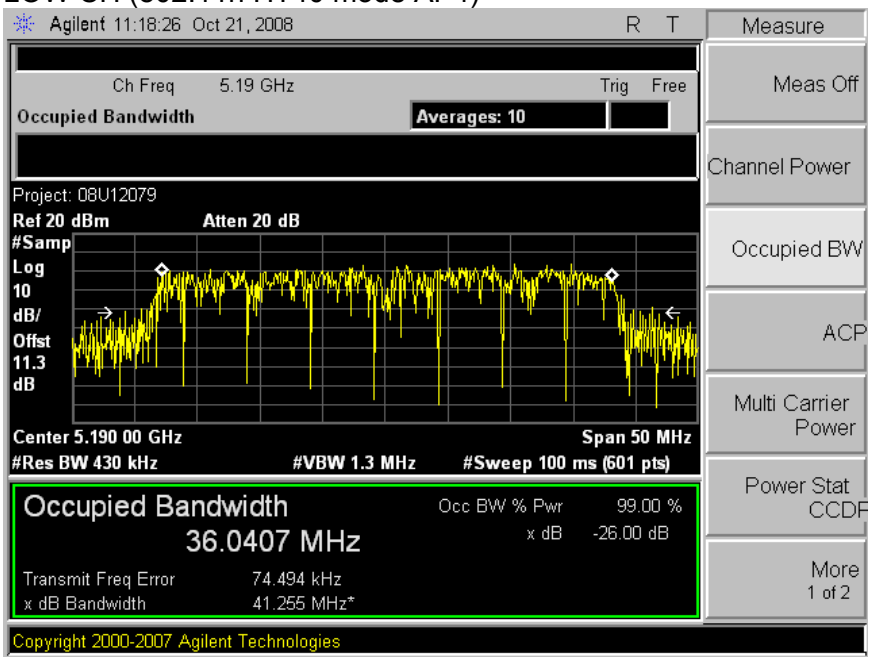


HIGH CH (802.11n HT40 mode AP2)

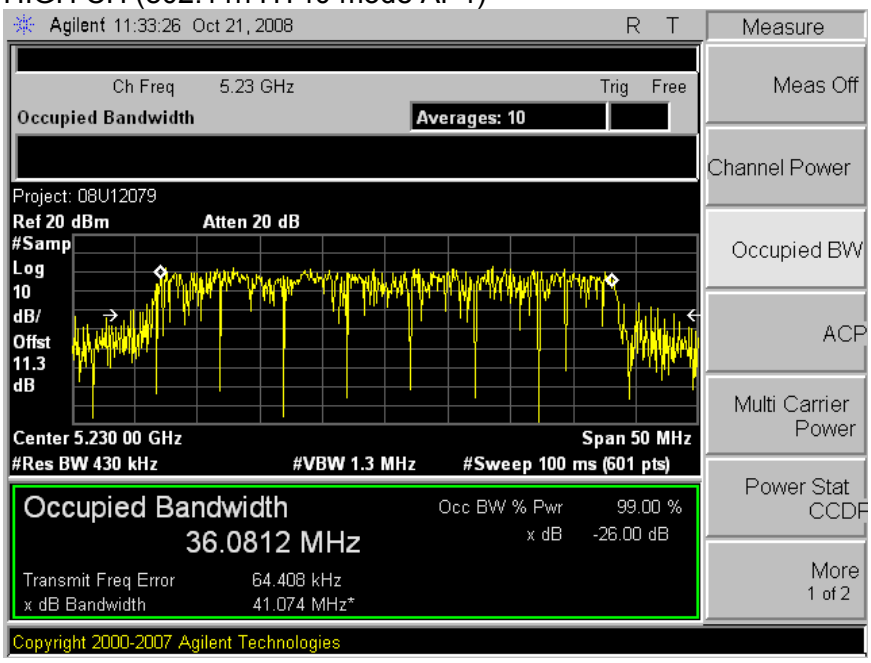


(802.11 HT40 MODE AP4)

LOW CH (802.11n HT40 mode AP4)



HIGH CH (802.11n HT40 mode AP4)



7.1.2. OUTPUT POWER

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

For the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or 4 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

TEST PROCEDURE

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

The transmitter output operates continuously therefore Method # 1 is used.

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))

RESULTS

802.11a MODE

Antenna Gain (dBi)	10 Log (# Tx Chains) (dB)	Effective Legacy Gain (dBi)
2.72	3.01	5.73

Limit

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5180	17	20.251	17.06	5.73	17.00
Mid	5220	17	21.452	17.31	5.73	17.00
High	5240	17	20.264	17.07	5.73	17.00

Individual Chain Results

Channel	Frequency (MHz)	AP2 Power (dBm)	AP4 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	13.28	12.33	15.84	17.00	-1.16
Mid	5220	12.62	12.92	15.78	17.00	-1.22
High	5240	11.39	11.02	14.22	17.00	-2.78

802.11n HT20 MODE

Limit

Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5180	17	21.052	17.23	2.72	17.00
Mid	5220	17	21.201	17.26	2.72	17.00
High	5240	17	20.225	17.06	2.72	17.00

Individual Chain Results

Channel	Frequency (MHz)	AP2 Power (dBm)	AP4 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5180	12.73	11.25	15.06	17.00	-1.94
Mid	5220	11.77	12.02	14.91	17.00	-2.09
High	5240	10.80	13.47	15.35	17.00	-1.65

802.11n HT40 MODE

Limit

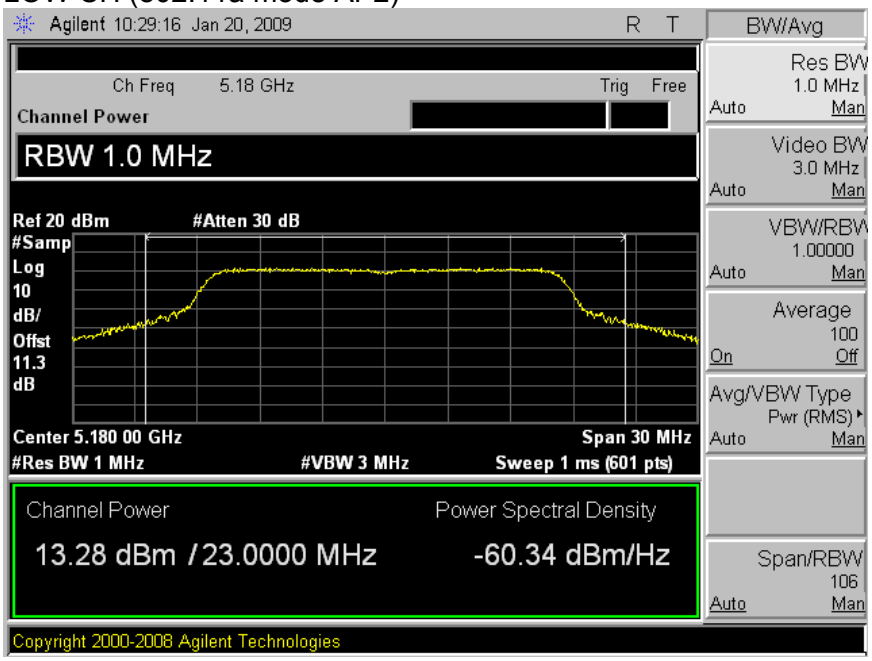
Channel	Frequency (MHz)	Fixed Limit (dBm)	B (MHz)	4 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5190	17	41.255	20.15	2.72	17.00
High	5230	17	41.074	20.14	2.72	17.00

Individual Chain Results

Channel	Frequency (MHz)	Chain 1 Power (dBm)	Chain 2 Power (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5190	13.06	13.36	16.22	17.00	-0.78
High	5230	12.25	15.01	16.86	17.00	-0.14

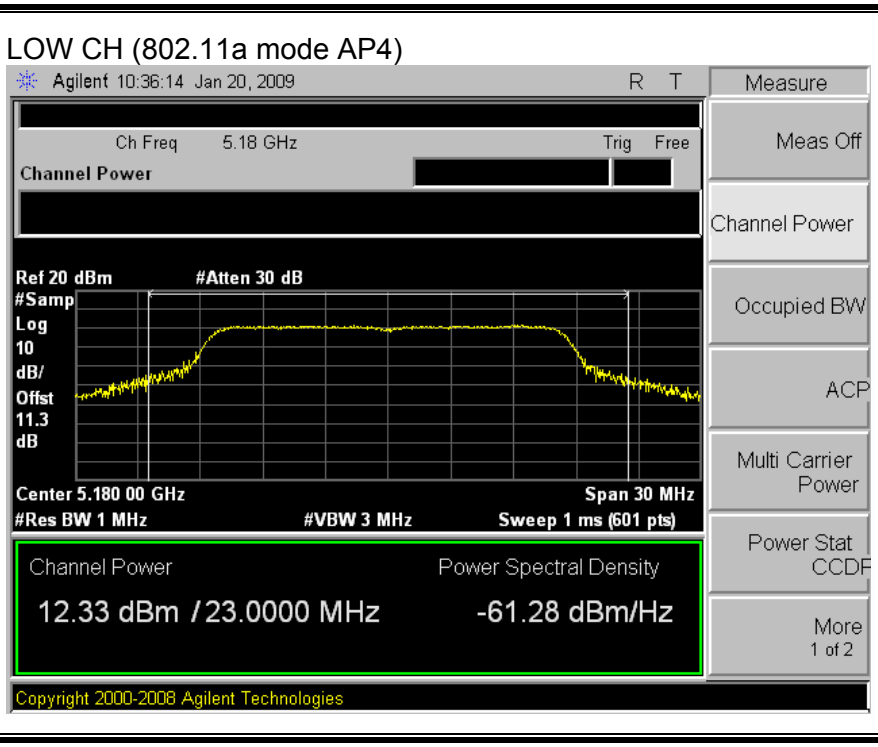
(802.11a MODE AP2)

LOW CH (802.11a mode AP2)



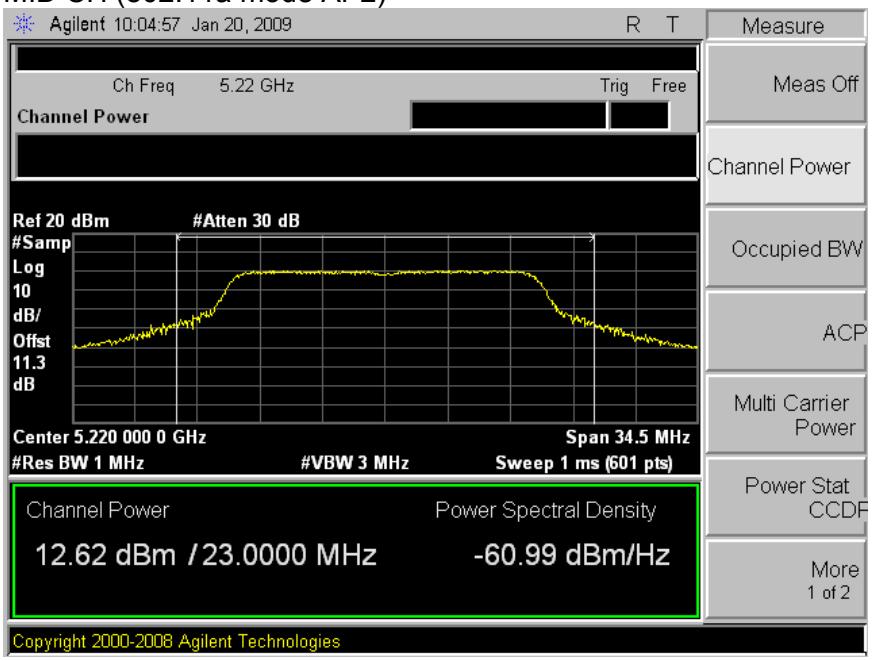
(802.11a MODE AP4)

LOW CH (802.11a mode AP4)



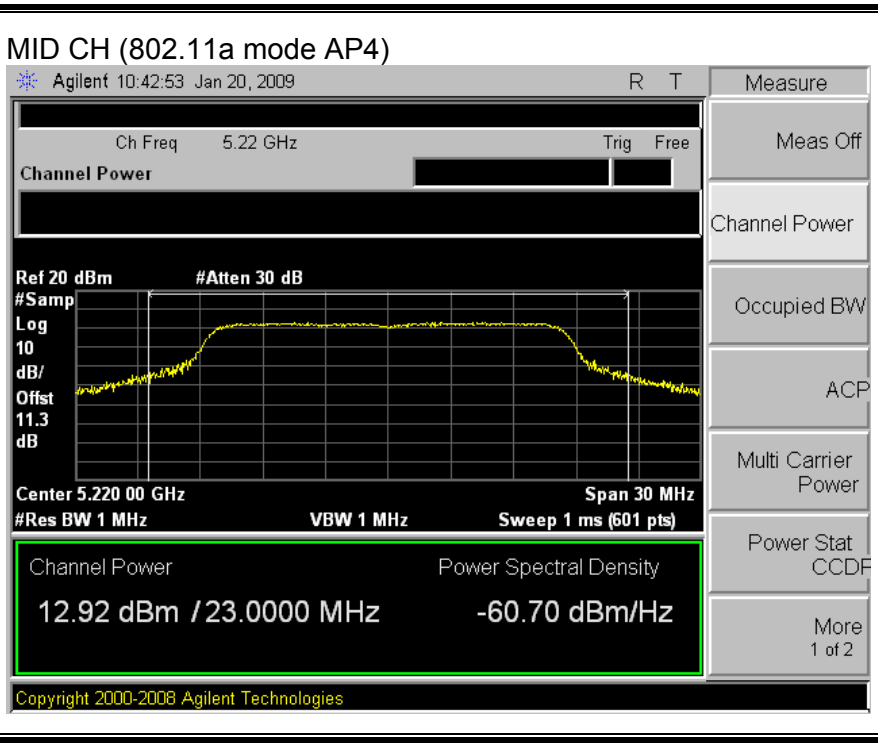
(802.11a MODE AP2)

MID CH (802.11a mode AP2)



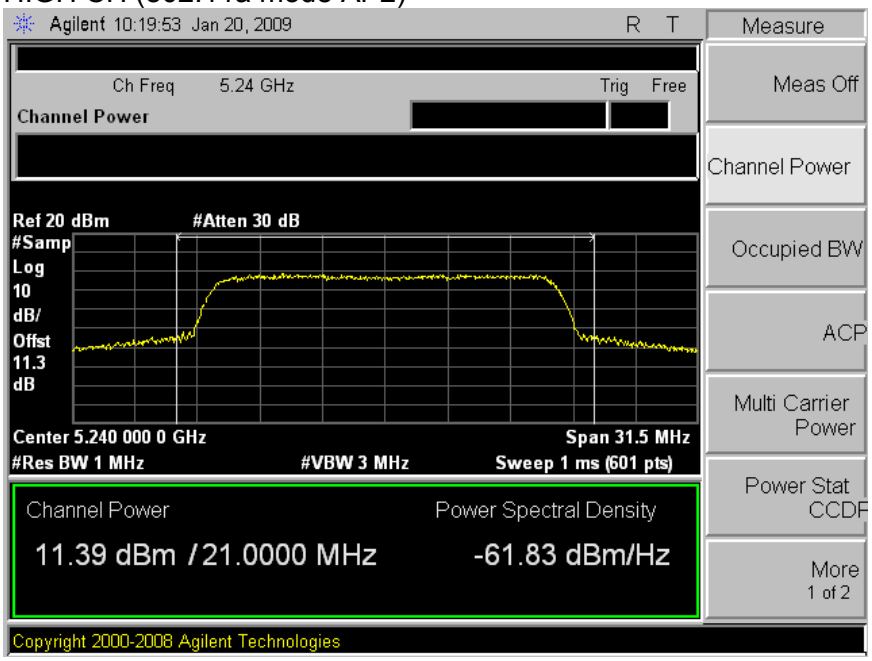
(802.11a MODE AP4)

MID CH (802.11a mode AP4)



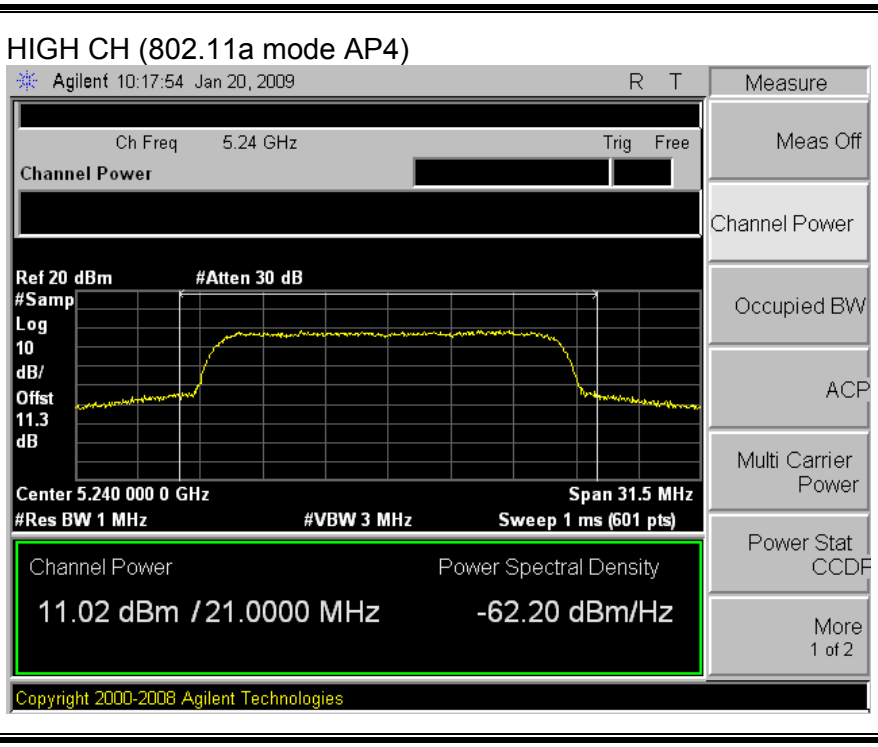
(802.11a MODE AP2)

HIGH CH (802.11a mode AP2)



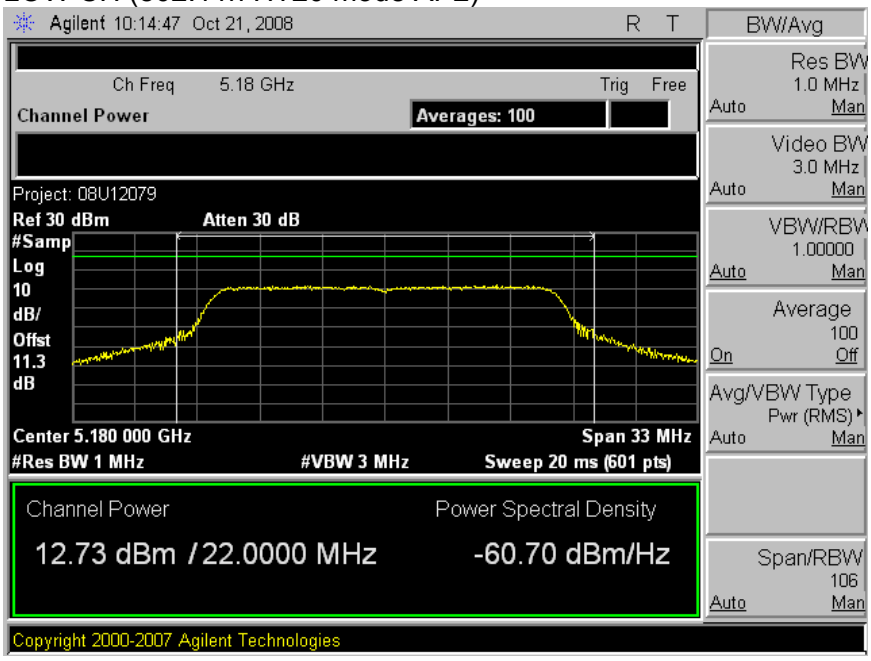
(802.11a MODE AP4)

HIGH CH (802.11a mode AP4)



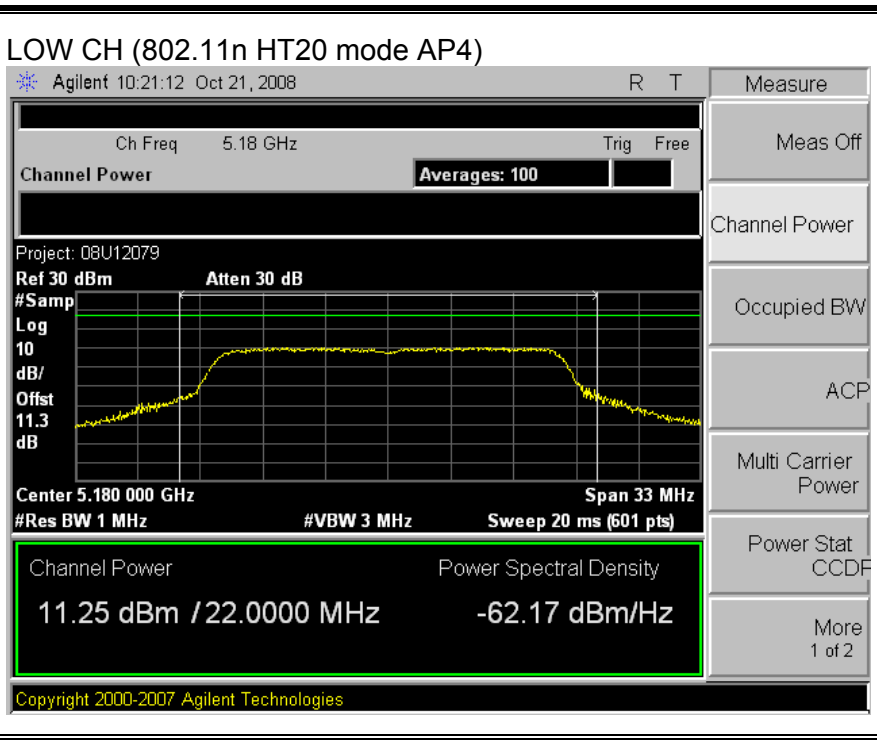
(802.11n HT20 MODE AP2)

LOW CH (802.11n HT20 mode AP2)



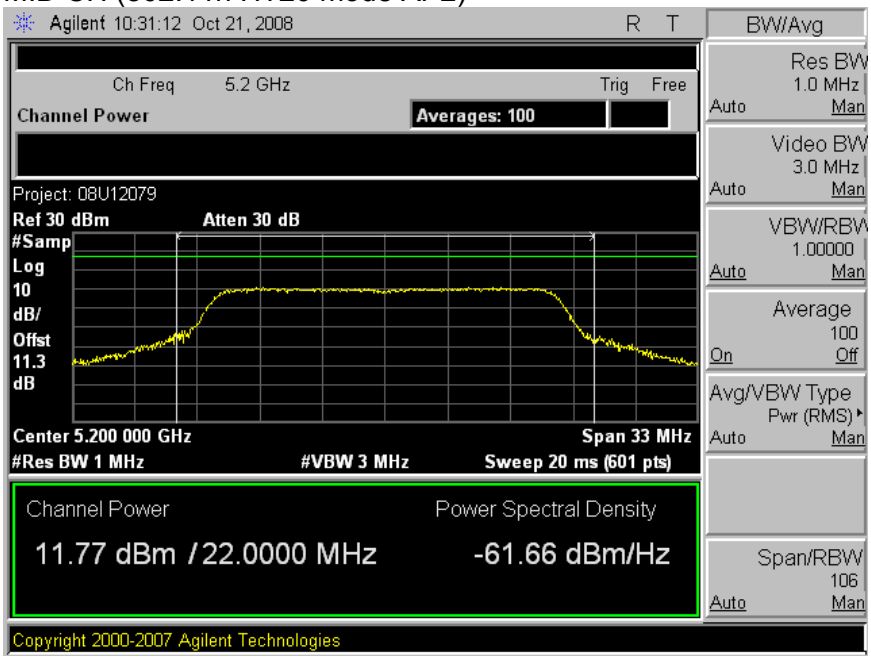
(802.11 HT20 MODE AP4)

LOW CH (802.11n HT20 mode AP4)



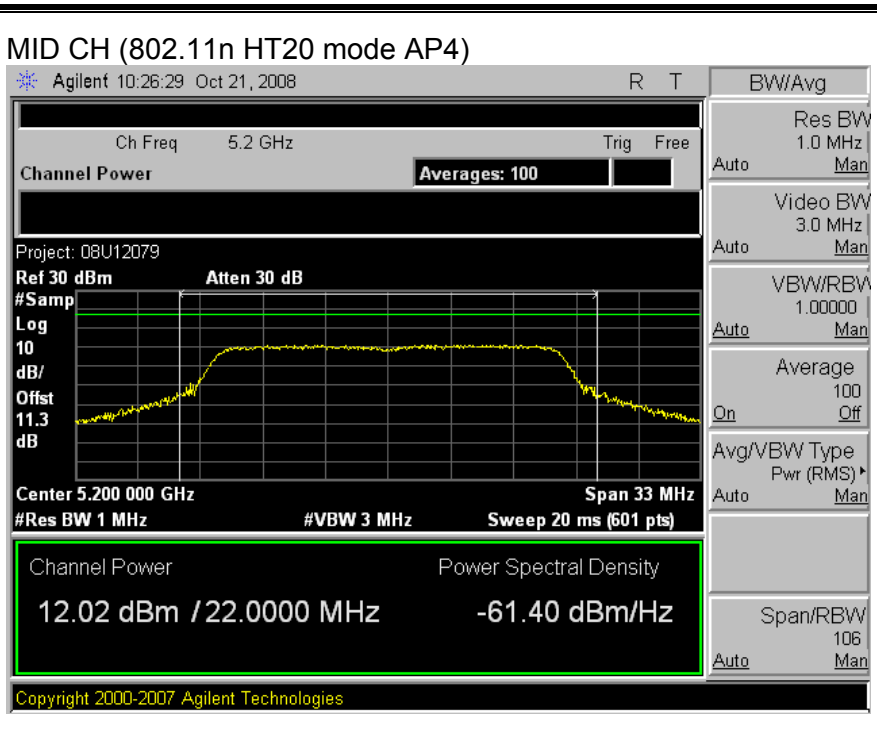
(802.11n HT20 MODE AP2)

MID CH (802.11n HT20 mode AP2)

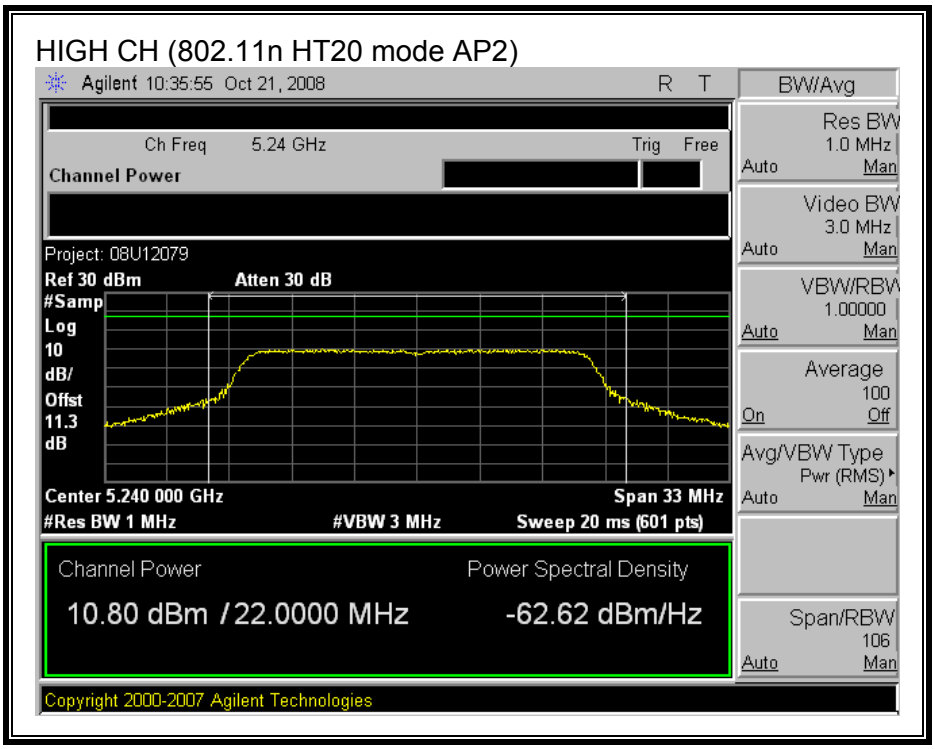


(802.11 HT20 MODE AP4)

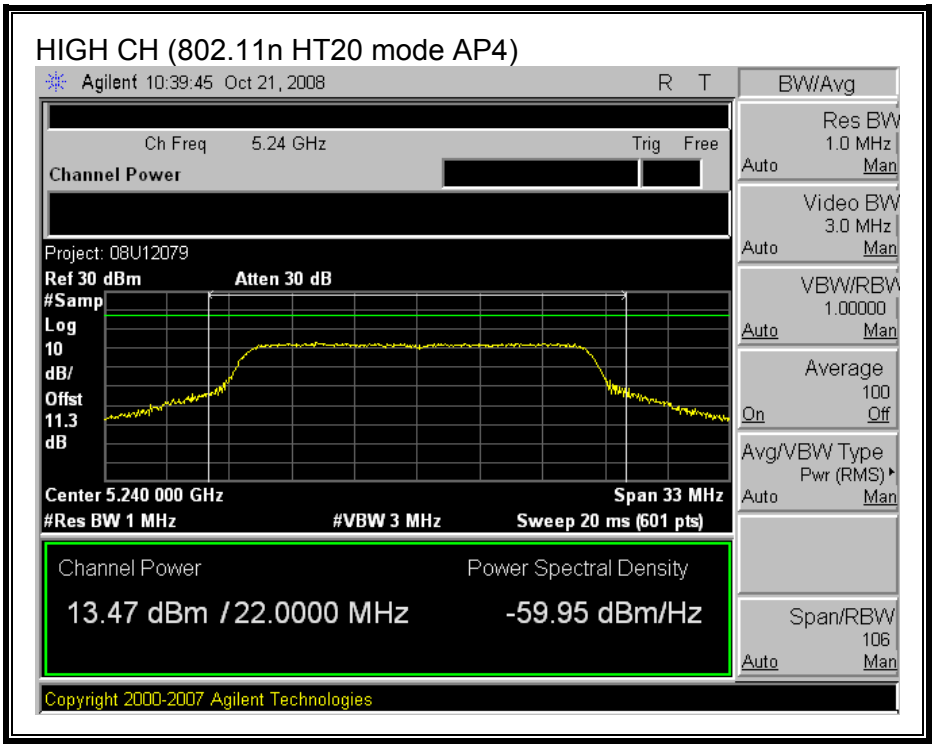
MID CH (802.11n HT20 mode AP4)



(802.11n HT20 MODE AP2)

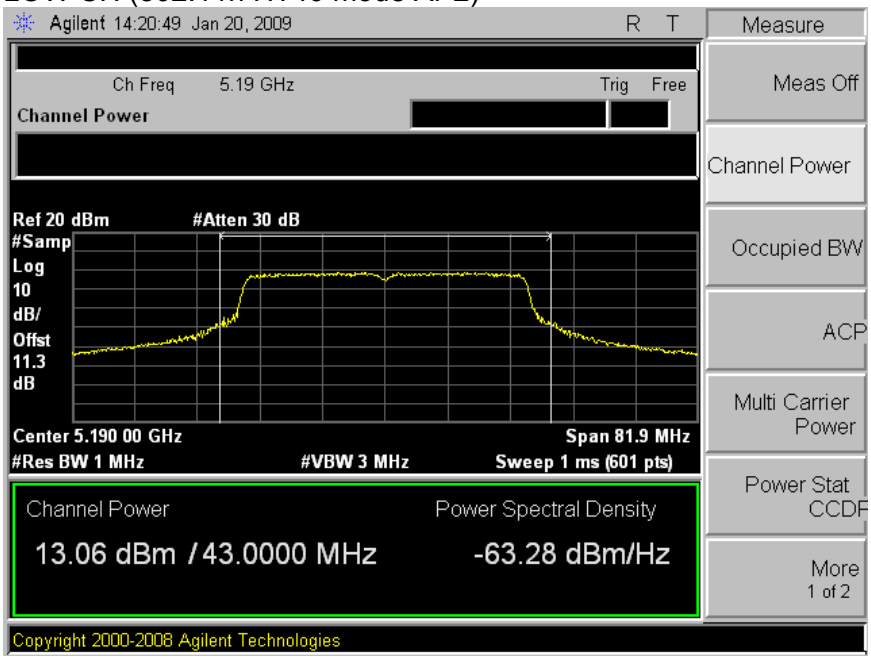


(802.11 HT20 MODE AP4)



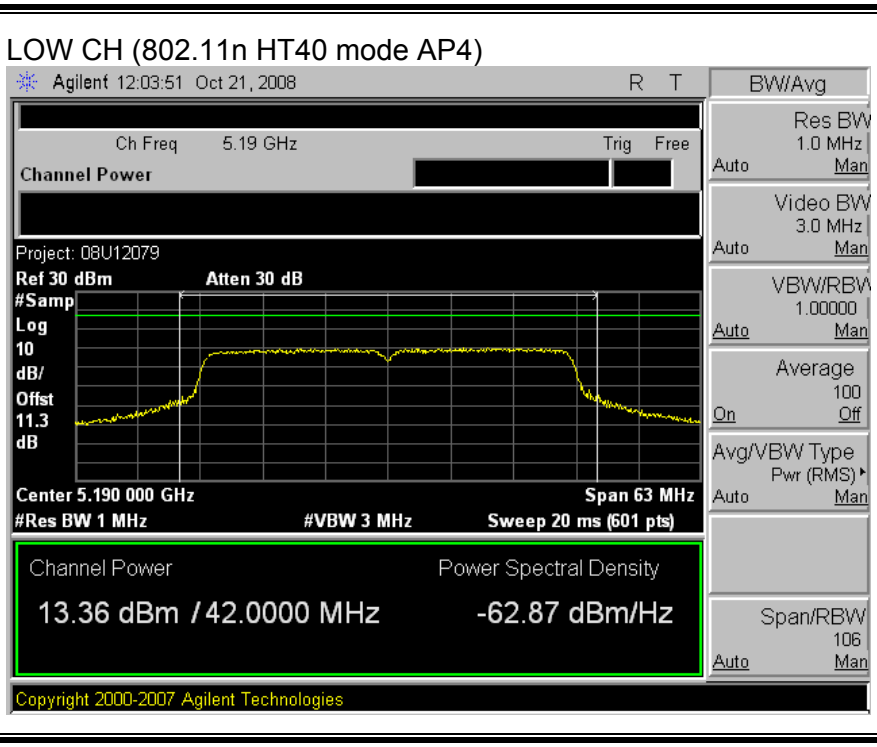
(802.11 HT40 MODE AP2)

LOW CH (802.11n HT40 mode AP2)



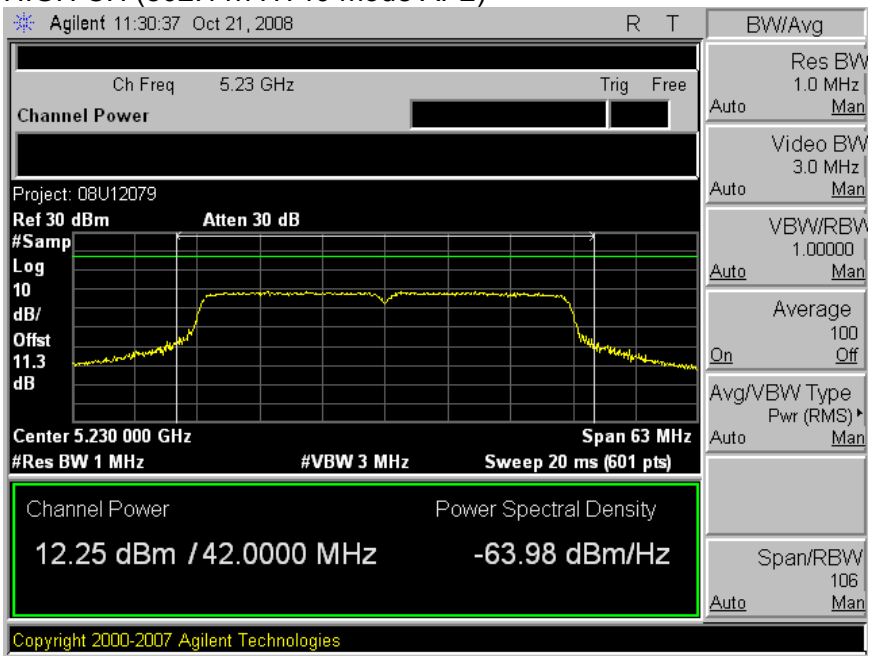
(802.11 HT40 MODE AP4)

LOW CH (802.11n HT40 mode AP4)



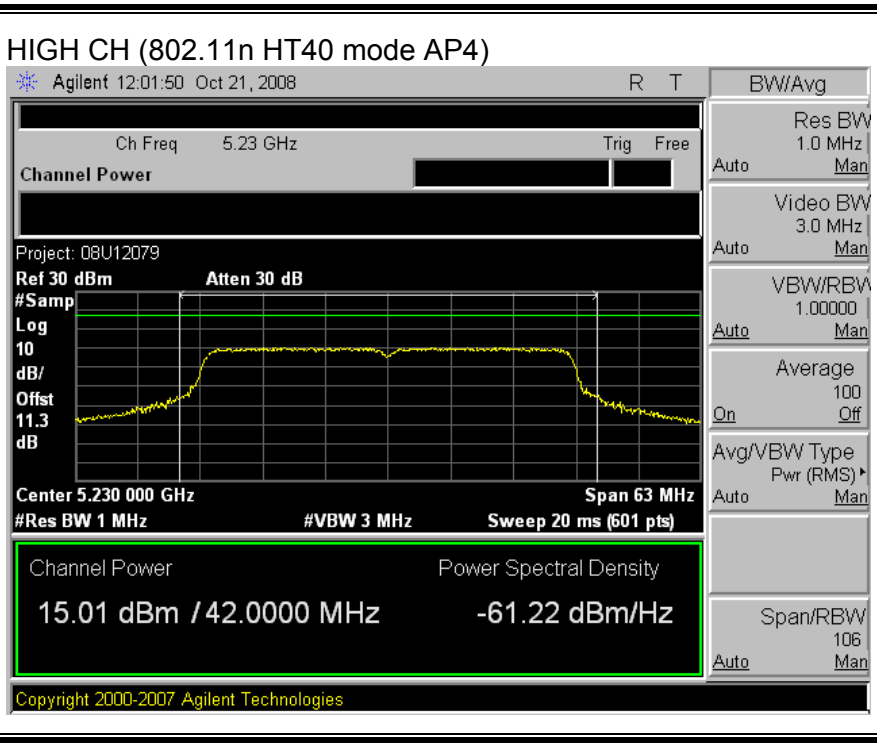
(802.11 HT40 MODE AP2)

HIGH CH (802.11n HT40 mode AP2)



(802.11 HT40 MODE AP4)

HIGH CH (802.11n HT40 mode AP4)



7.1.3. PEAK POWER SPECTRAL DENSITY

LIMITS

FCC §15.407 (a) (1)

IC RSS-210 A9.2 (1)

For the 5.15-5.25 GHz band, the peak power spectral density shall not exceed 4 dBm in any 1 MHz band.

If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 4 dBm.

TEST PROCEDURE

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002. PPSD method #2 was used.

RESULTS

POWER SPECTRAL DENSITY WITH COMBINER

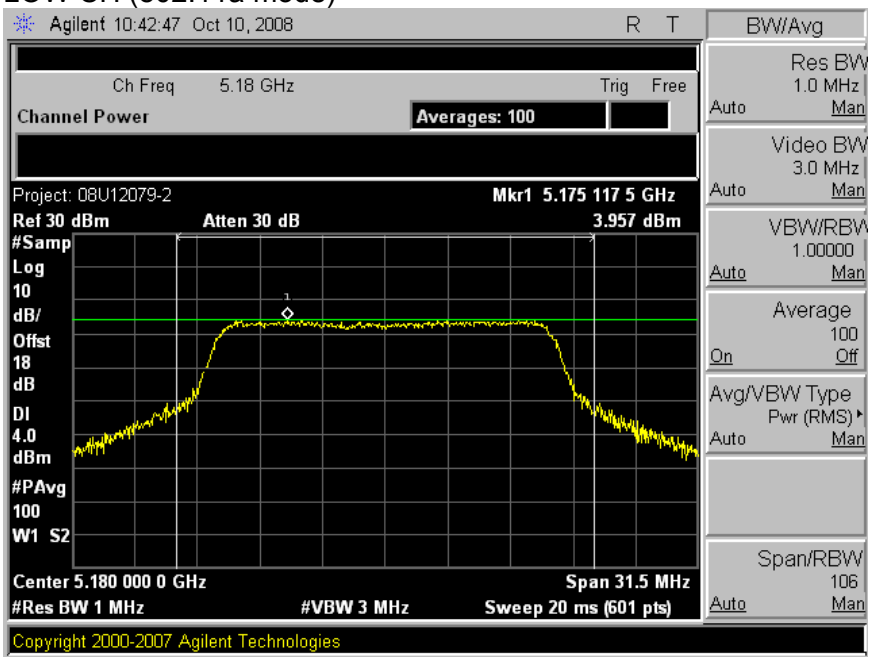
5150 to 5250MHz Band

Antenna Gain (dBi) # 0	2.72
Antenna Gain (dBi) # 2	2.72
Effective Legacy Gain	5.73

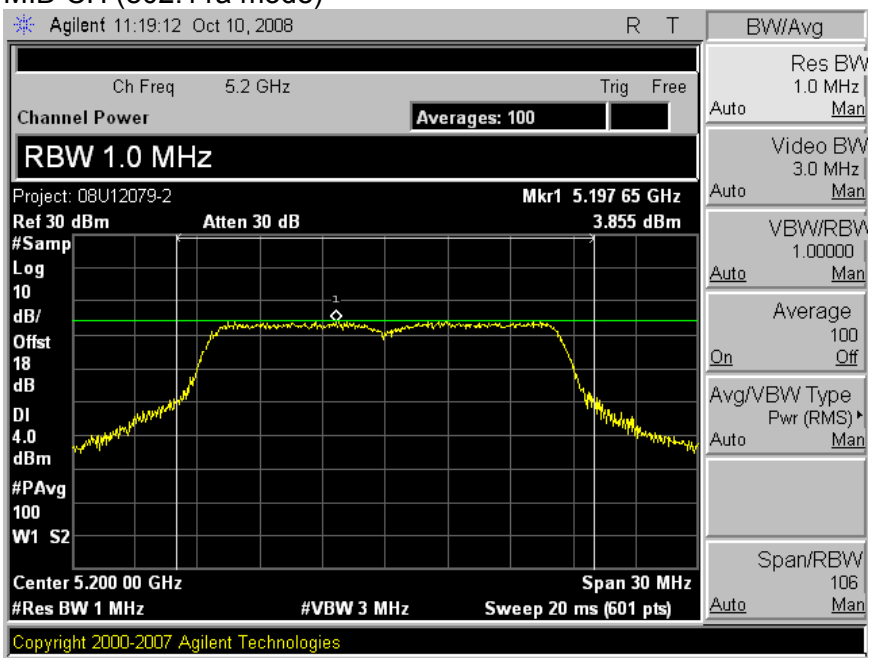
Mode Channel	Frequency (MHz)	PPSD With Combiner (dBm)	Limit (dBm)	Margin (dB)
802.11a Mode				
Low	5180	3.96	4.00	-0.04
Middle	5220	3.86	4.00	-0.15
High	5240	3.93	4.00	-0.07
802.11n HT20 Mode				
Low	5180	3.62	4.00	-0.38
Middle	5220	3.87	4.00	-0.13
High	5240	3.97	4.00	-0.03
802.11n HT40 Mode				
Low	5190	3.86	4.00	-0.14
High	5230	3.65	4.00	-0.35

POWER SPECTRAL DENSITY WITH COMBINER
(802.11a MODE)

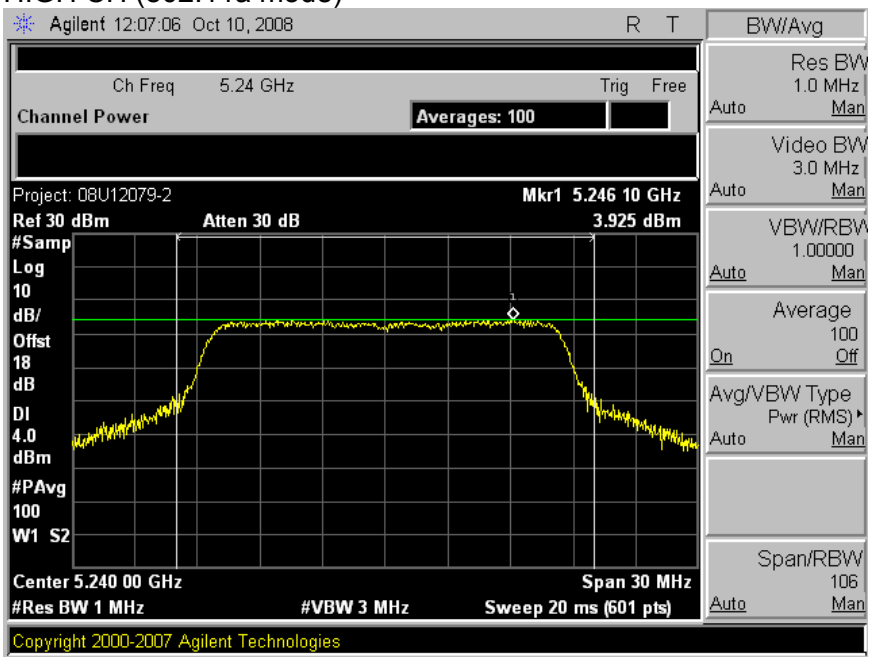
LOW CH (802.11a mode)



MID CH (802.11a mode)

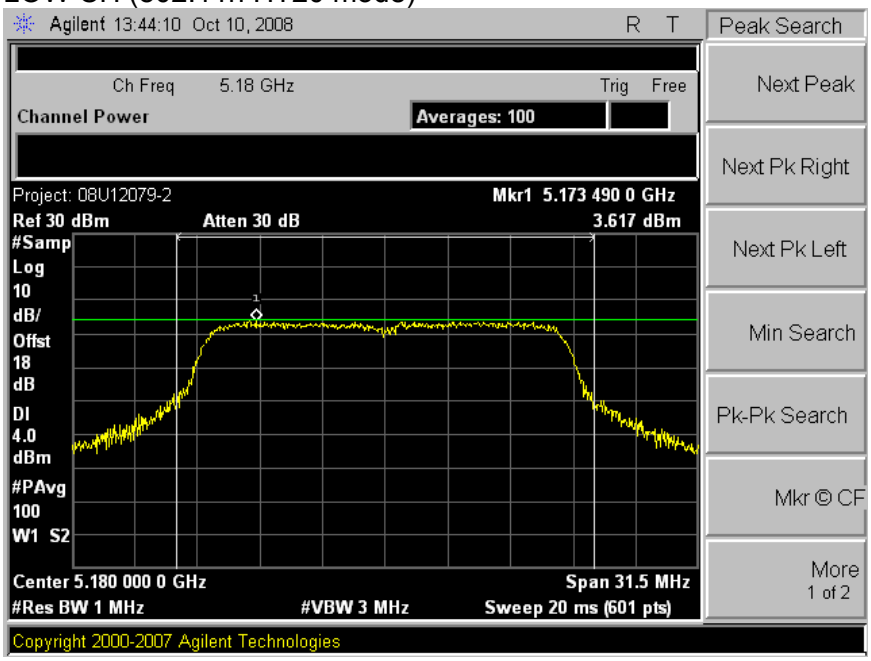


HIGH CH (802.11a mode)

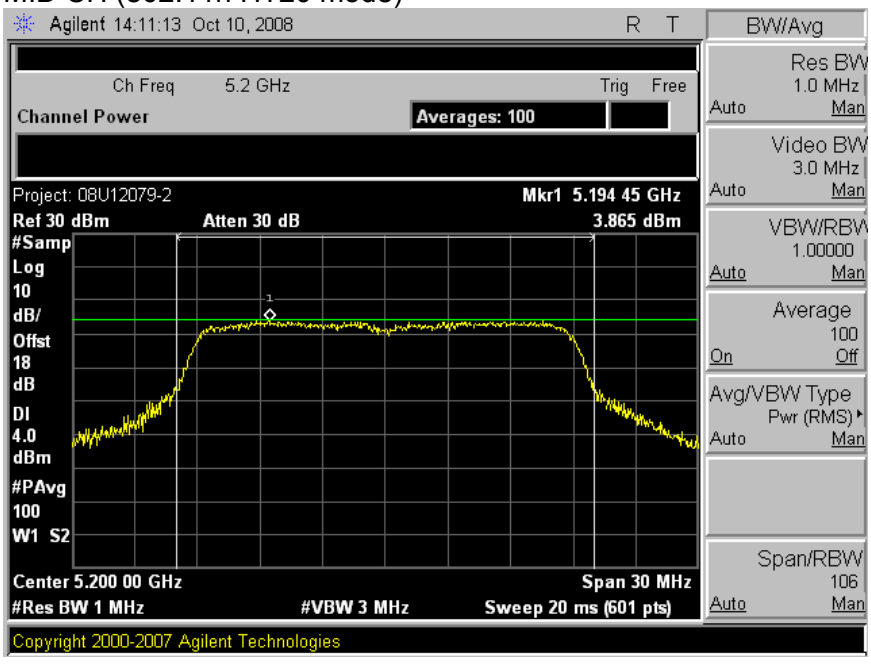


(802.11n HT20 MODE)

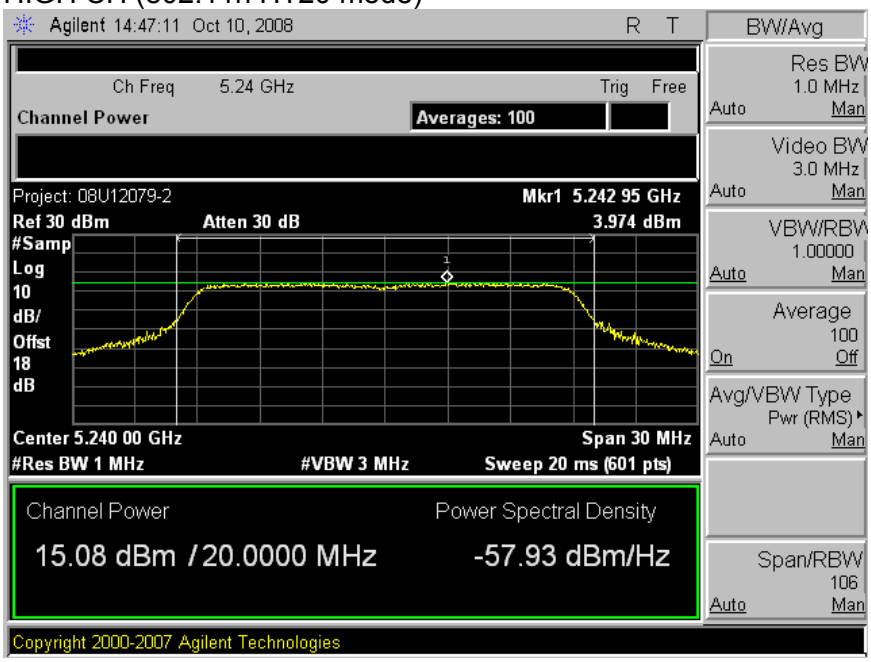
LOW CH (802.11n HT20 mode)



MID CH (802.11n HT20 mode)

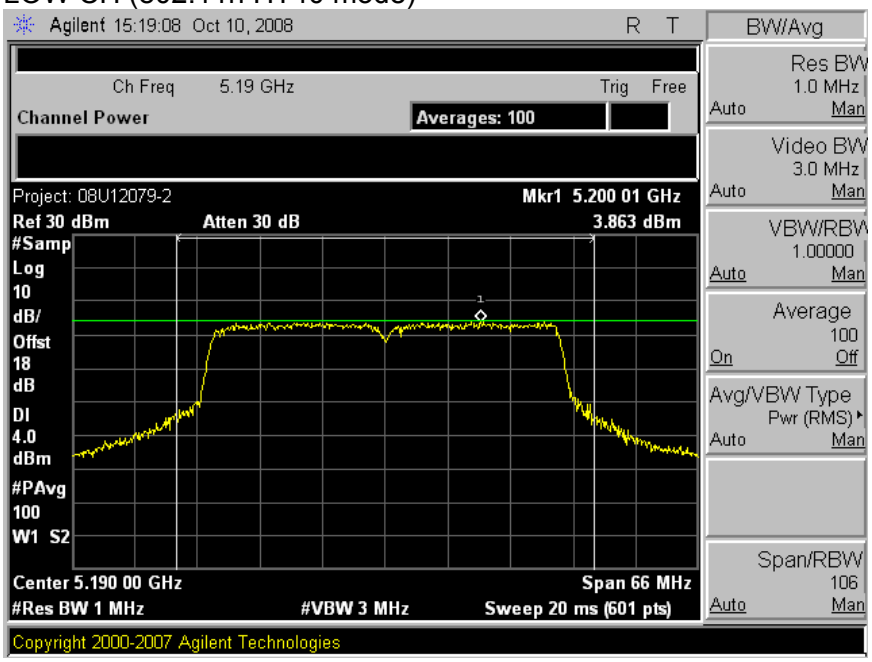


HIGH CH (802.11n HT20 mode)

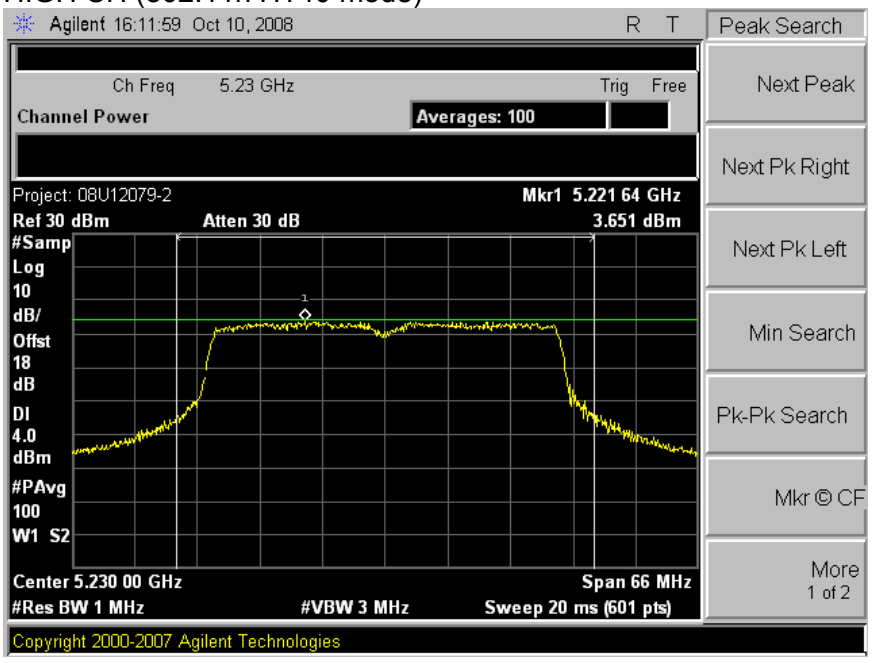


(802.11n HT40 MODE)

LOW CH (802.11n HT40 mode)



HIGH CH (802.11n HT40 mode)



7.1.4. PEAK EXCURSION

LIMITS

FCC §15.407 (a) (6)

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

TEST PROCEDURE

The transmitter outputs are connected to the spectrum analyzer via a combiner.

The test is performed in accordance with FCC Public Notice: APPENDIX A Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices – Part 15, Subpart E, August 2002.

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

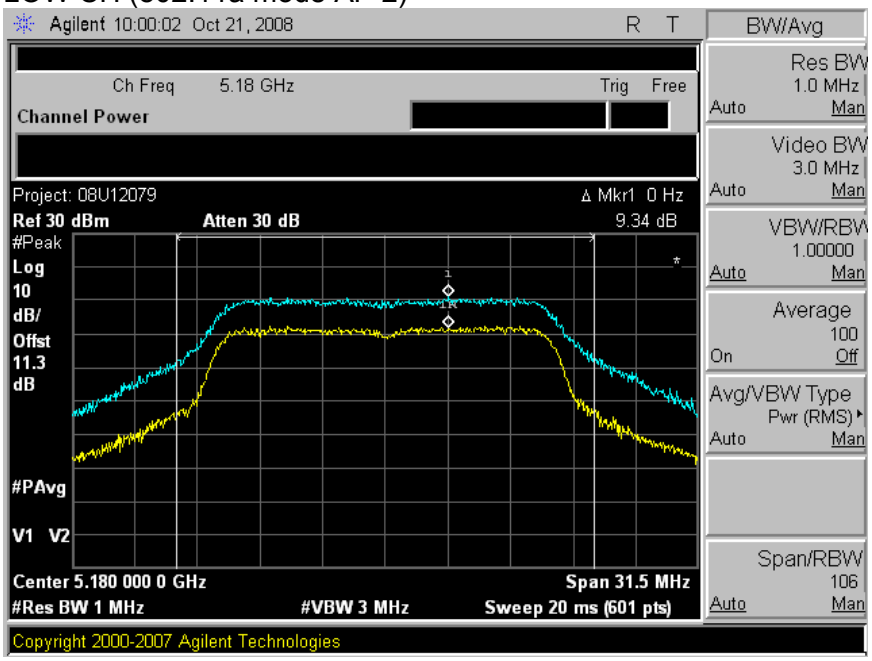
RESULTS

Mode Channel	Frequency (MHz)	Peak Excursion AP2 (dBm)	Peak Excursion AP4 (dBm)	Limit (dBm)	Worst Case Margin (dB)
802.11a Mode					
Low	5180	9.34	9.93	13	-3.07
Middle	5200	11.21	10.72	13	-1.79
High	5240	11.47	8.90	13	-1.53
802.11n HT20 Mode					
Low	5180	9.76	11.30	13	-1.70
Middle	5200	10.79	10.52	13	-2.21
High	5240	10.77	11.48	13	-1.52
802.11n HT40 Mode					
Low	5190	9.45	10.10	13	-2.90
High	5230	9.31	10.34	13	-2.66

PEAK EXCURSION

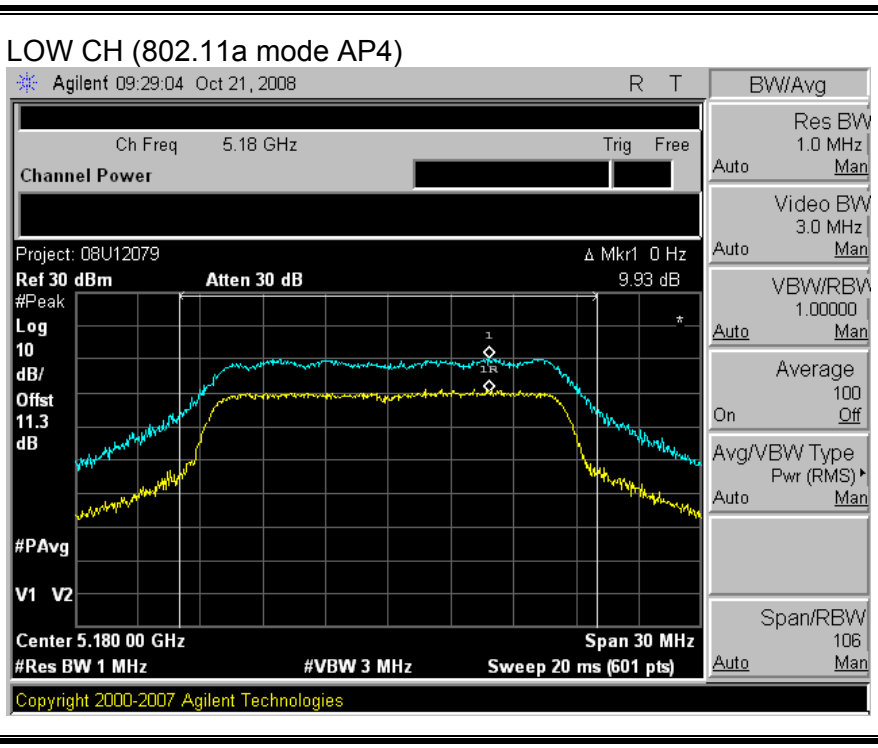
(802.11a MODE AP2)

LOW CH (802.11a mode AP 2)



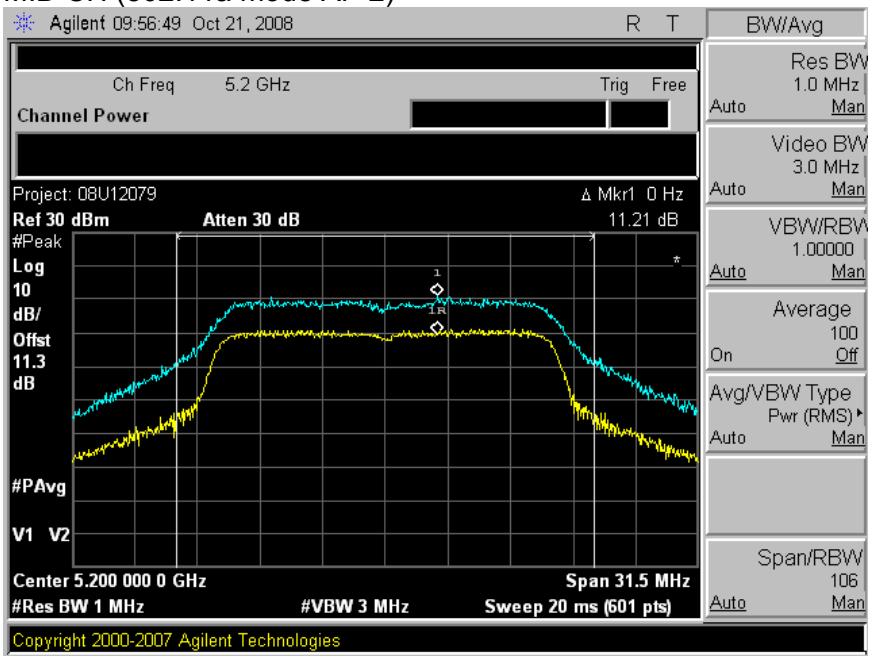
(802.11a MODE AP4)

LOW CH (802.11a mode AP4)



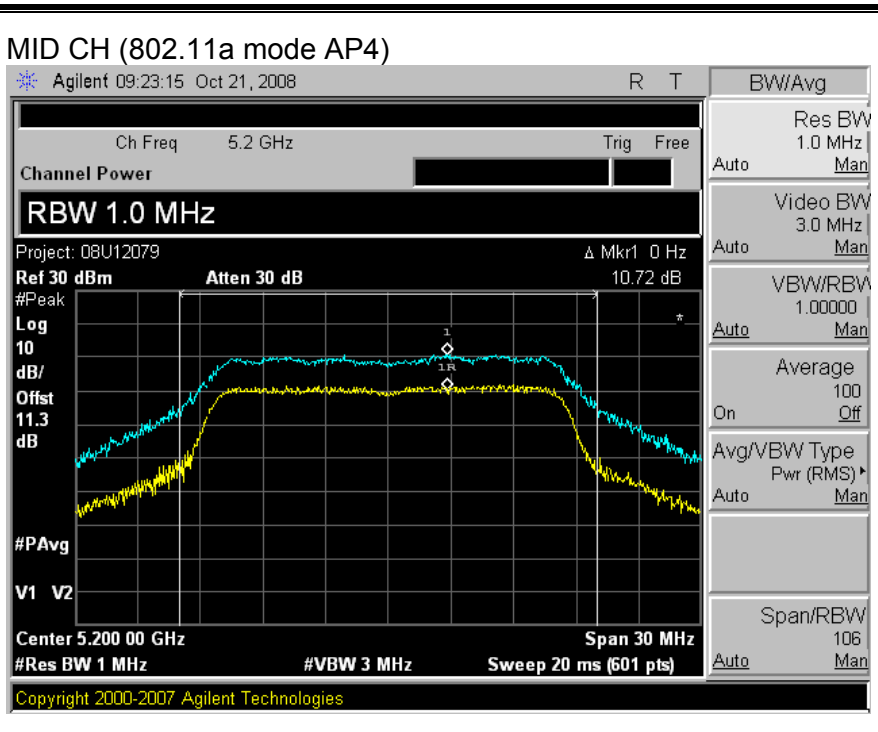
(802.11a MODE AP2)

MID CH (802.11a mode AP 2)



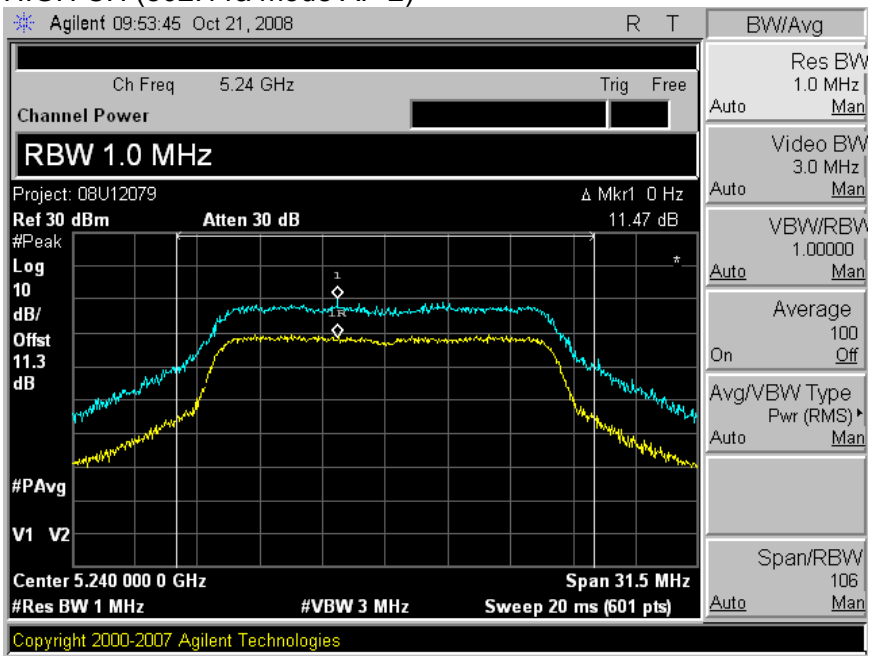
(802.11a MODE AP4)

MID CH (802.11a mode AP4)



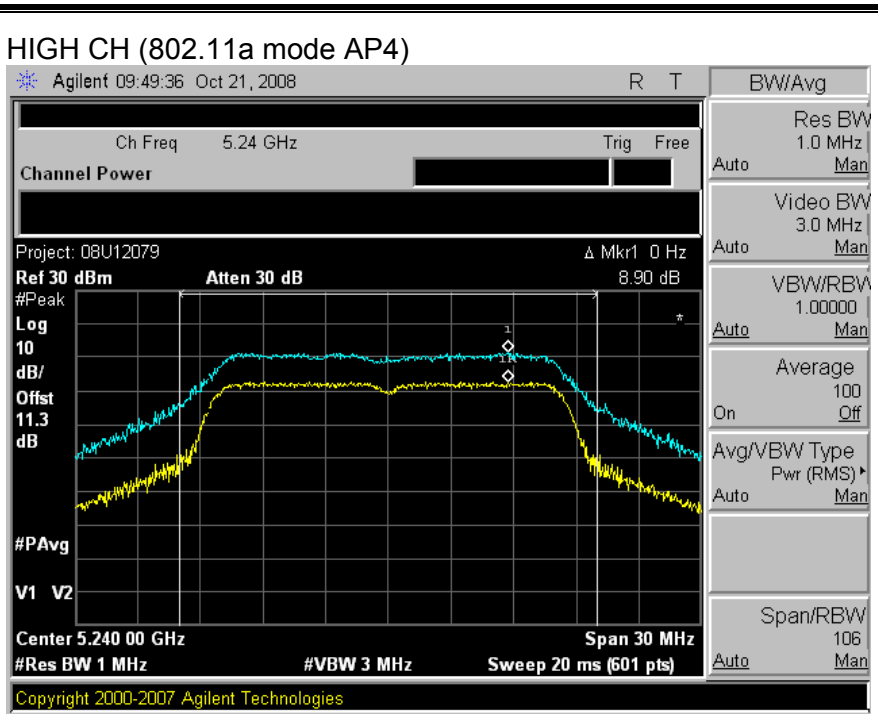
(802.11a MODE AP2)

HIGH CH (802.11a mode AP 2)



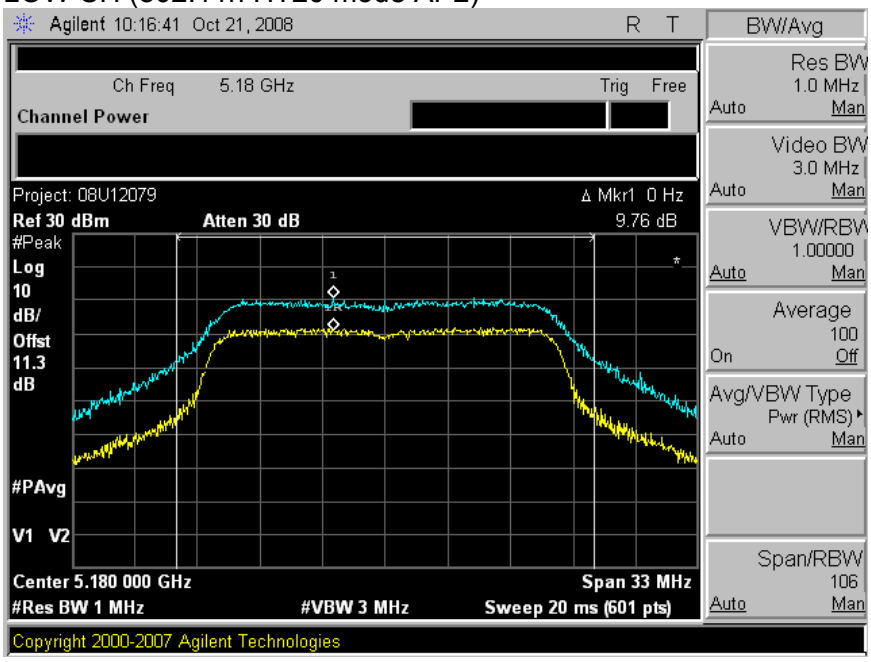
(802.11a MODE AP4)

HIGH CH (802.11a mode AP4)



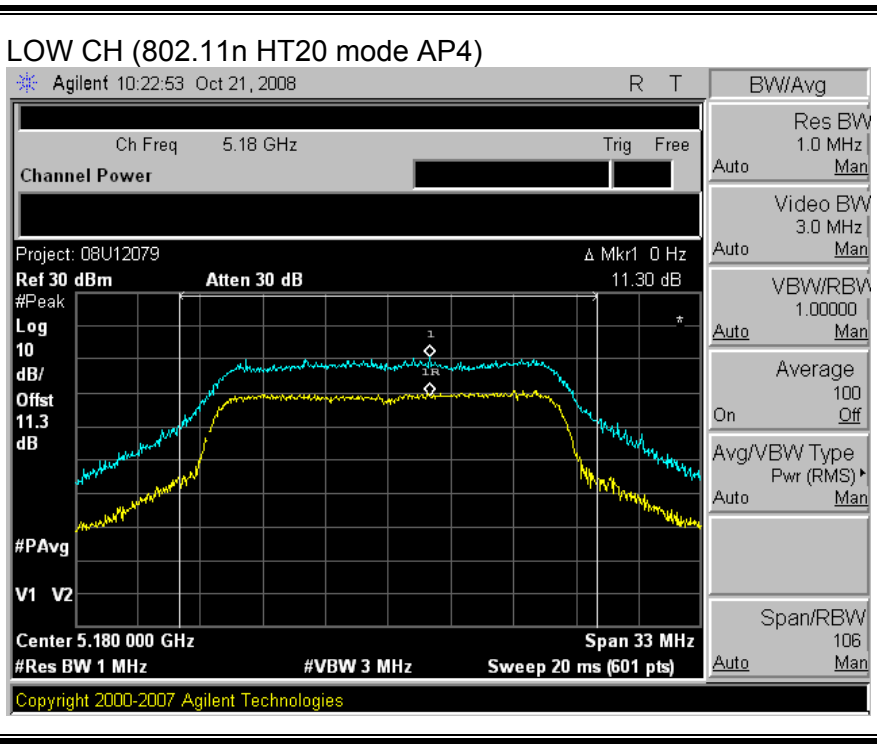
(802.11n HT20 MODE AP2)

LOW CH (802.11n HT20 mode AP2)



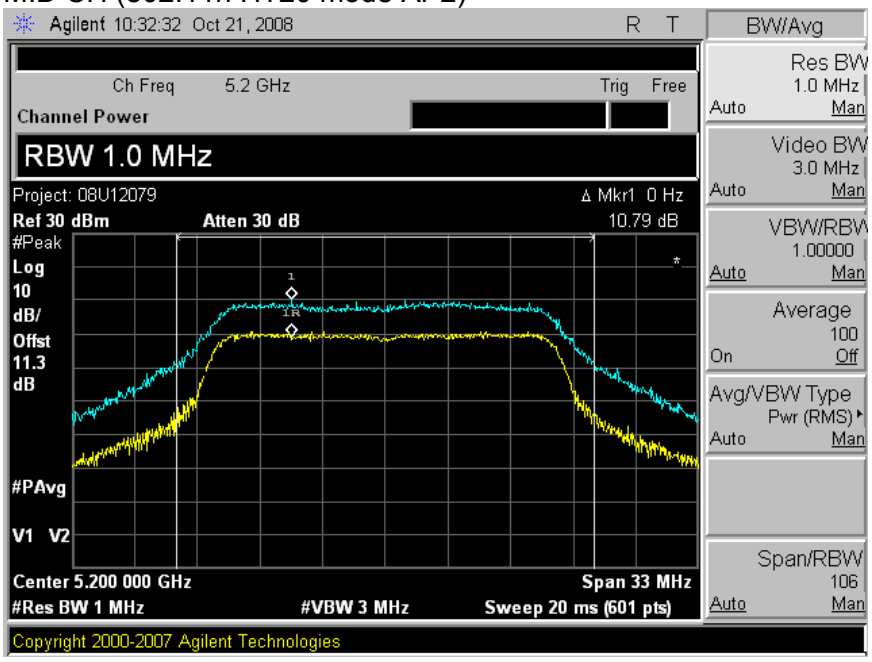
(802.11n HT20 MODE AP4)

LOW CH (802.11n HT20 mode AP4)



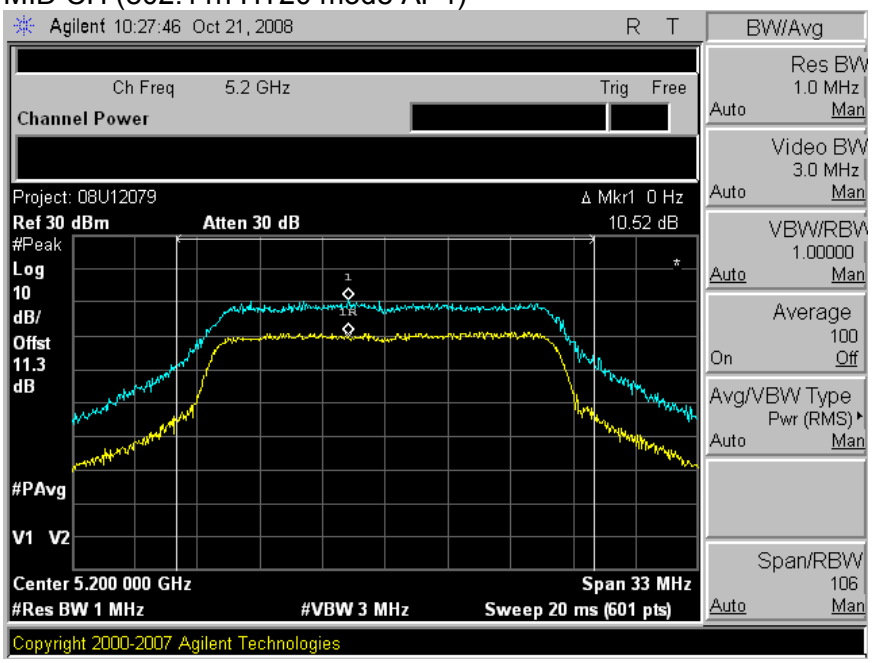
(802.11n HT20 MODE AP2)

MID CH (802.11n HT20 mode AP2)



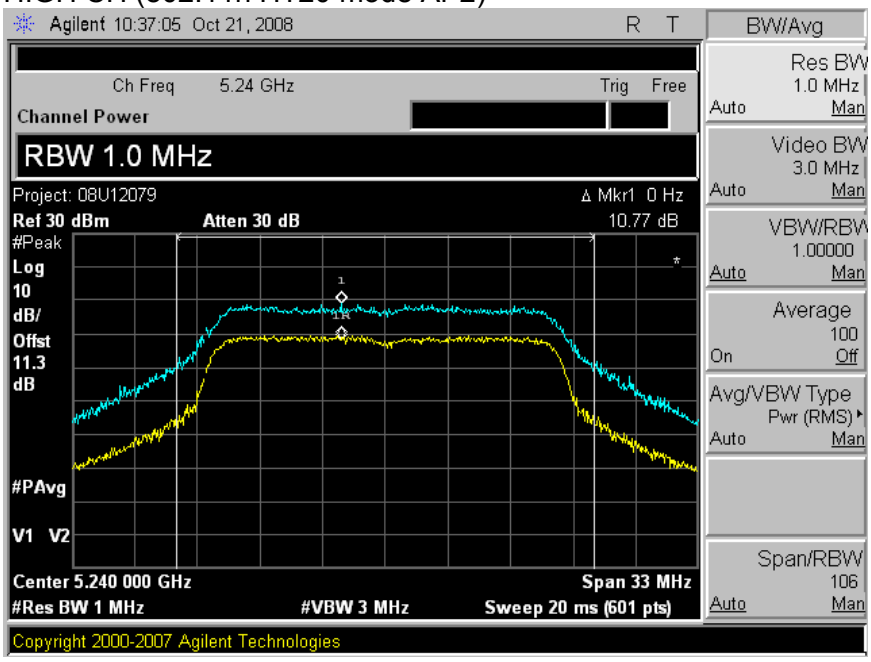
(802.11n HT20 MODE AP4)

MID CH (802.11n HT20 mode AP4)



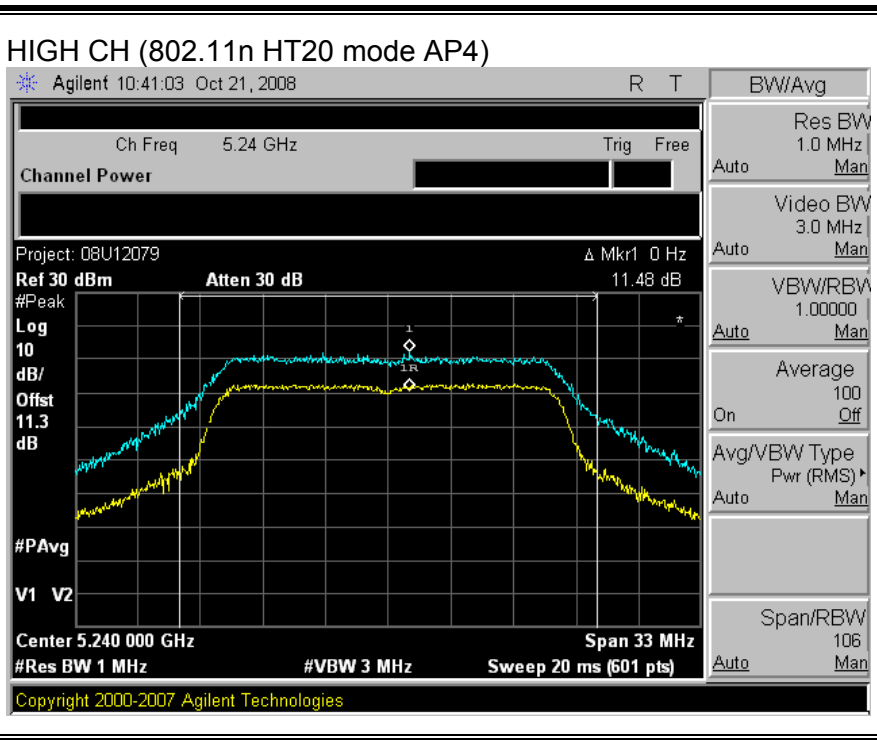
(802.11n HT20 MODE AP2)

HIGH CH (802.11n HT20 mode AP2)



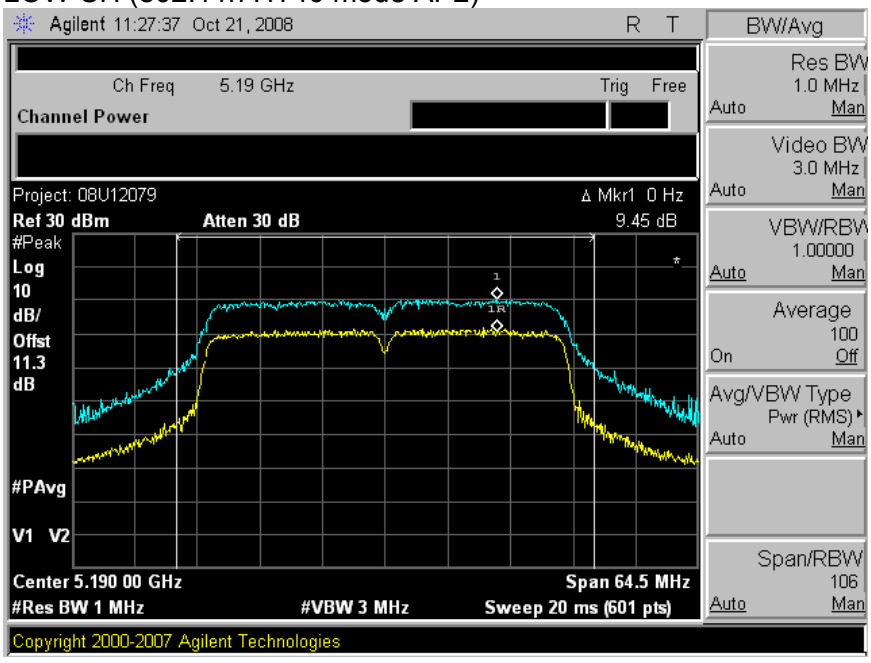
(802.11n HT20 MODE AP4)

HIGH CH (802.11n HT20 mode AP4)



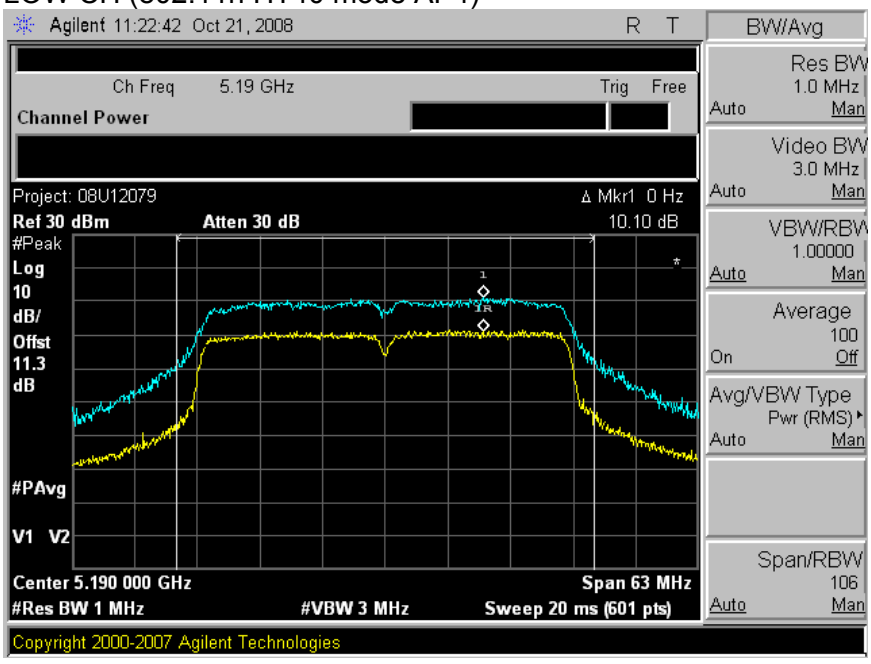
(802.11n HT40 MODE AP2)

LOW CH (802.11n HT40 mode AP2)



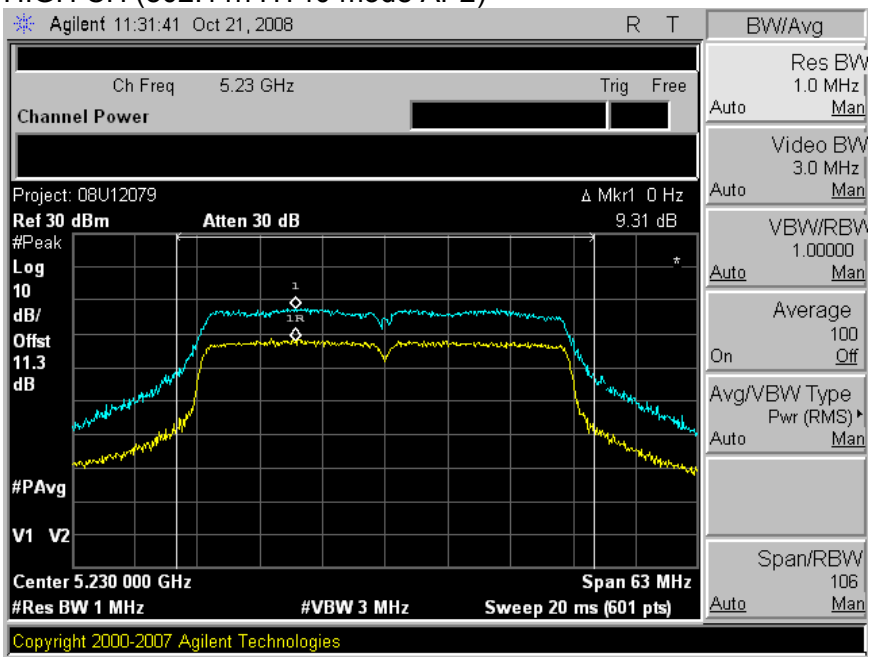
(802.11n HT40 MODE AP4)

LOW CH (802.11n HT40 mode AP4)



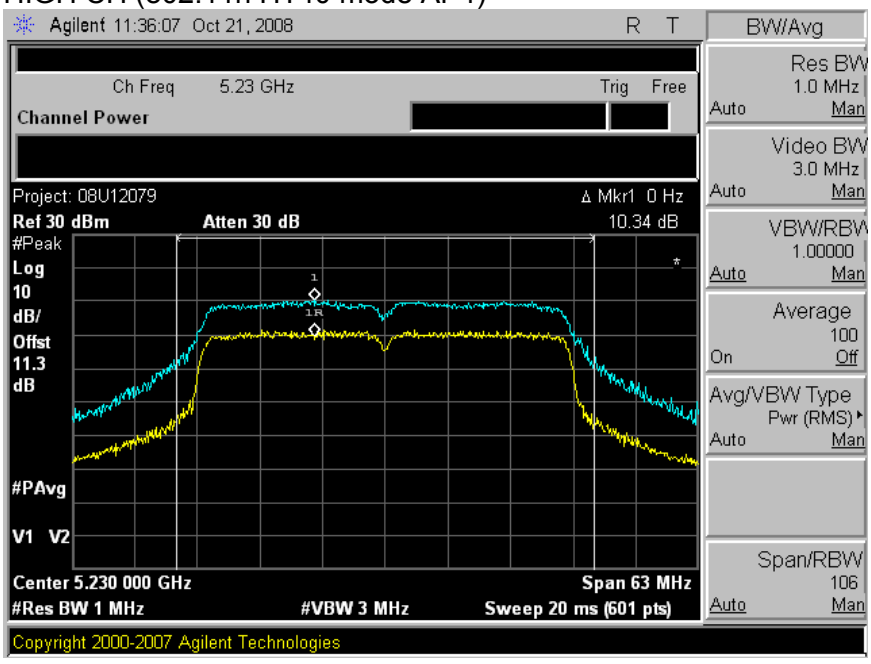
(802.11n HT40 MODE AP2)

HIGH CH (802.11n HT40 mode AP2)



(802.11n HT40 MODE AP4)

HIGH CH (802.11n HT40 mode AP4)



7.1.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.407 (b) (1)

IC RSS-210 A9.3 (1)

For transmitters operating in the 5.15-5.25 GHz band: all emissions outside of the 5.15-5.35 GHz band shall not exceed an EIRP of -27 dBm / MHz.

TEST PROCEDURE

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

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

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

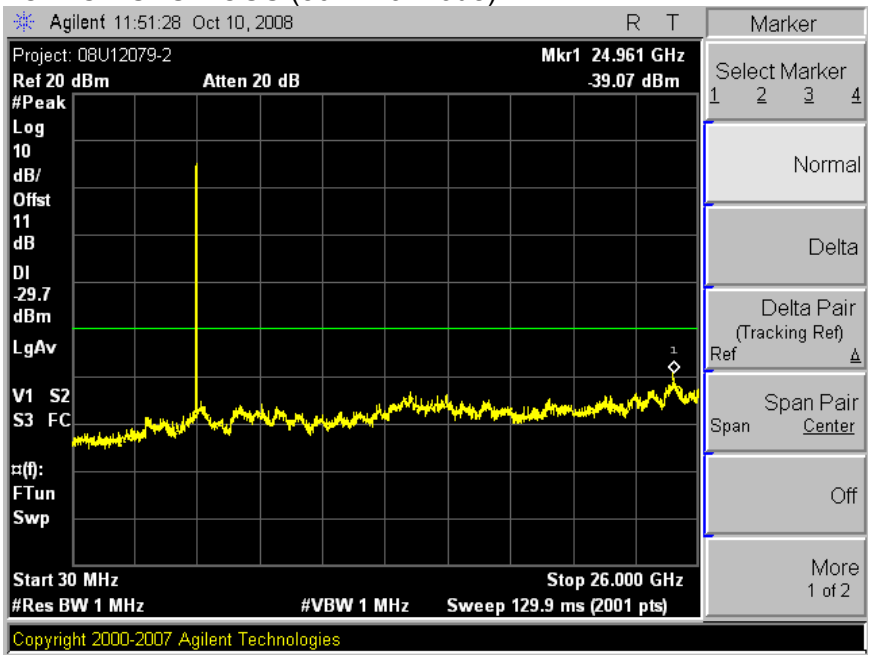
Offset Value = Cable Loss + Attenuation + Antenna Gain + Combiner Loss

RESULTS

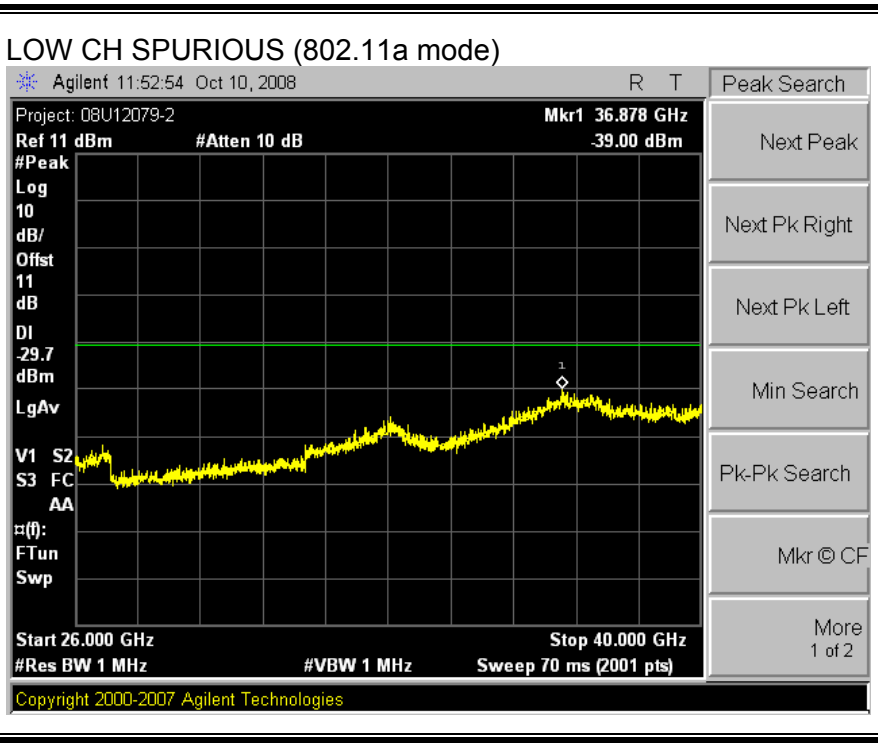
SPURIOUS EMISSIONS WITH COMBINER

(802.11a MODE)

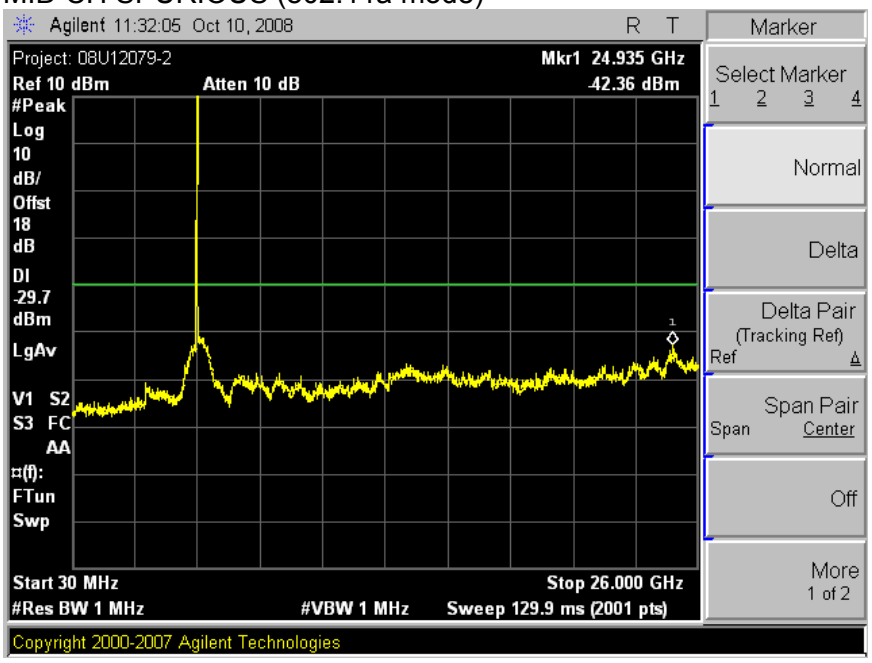
LOW CH SPURIOUS (802.11a mode)



LOW CH SPURIOUS (802.11a mode)



MID CH SPURIOUS (802.11a mode)



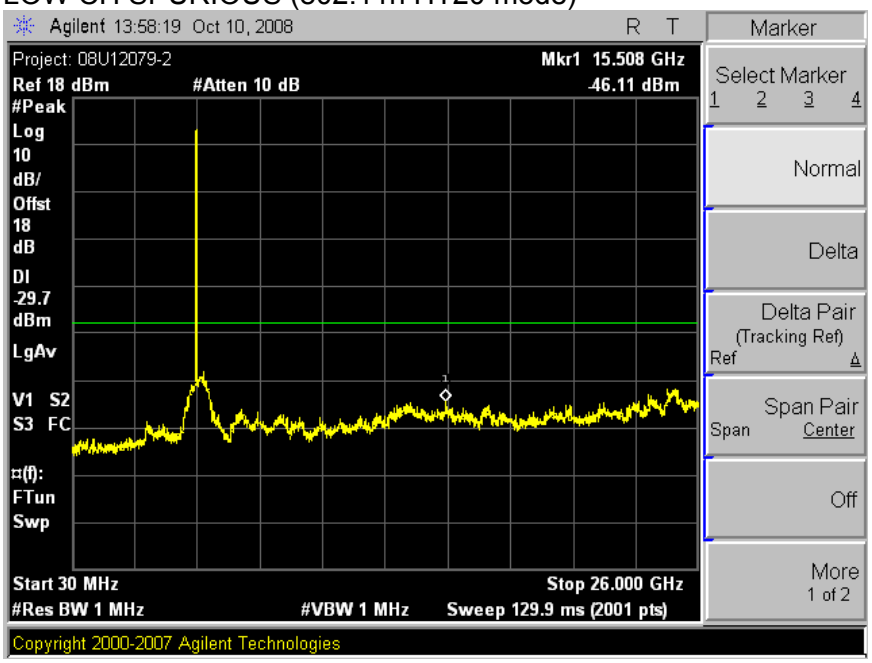
MID CH SPURIOUS (802.11a mode)

HIGH CH SPURIOUS (802.11a mode)

HIGH CH SPURIOUS (802.11a mode)

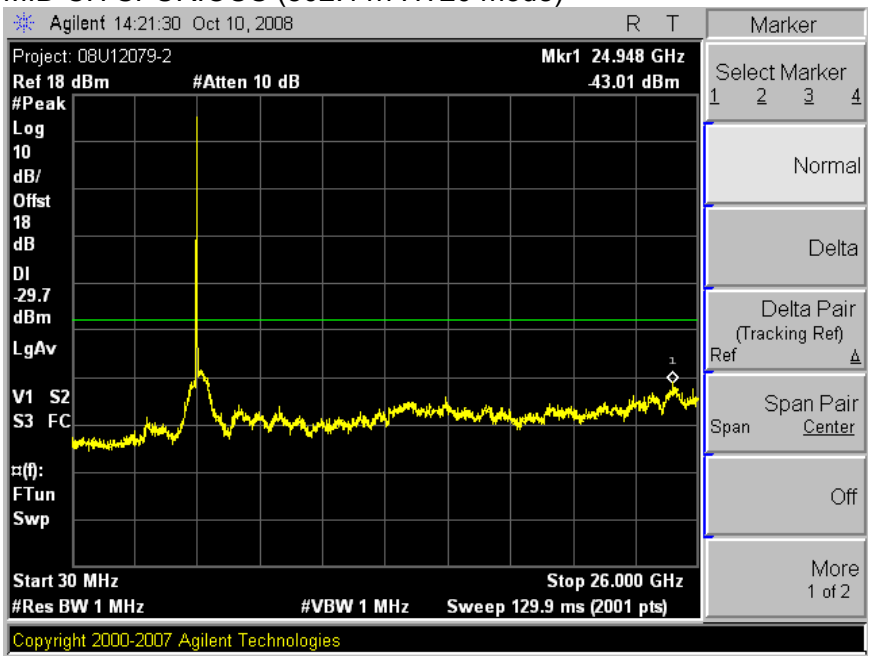
(802.11n HT20 MODE)

LOW CH SPURIOUS (802.11n HT20 mode)



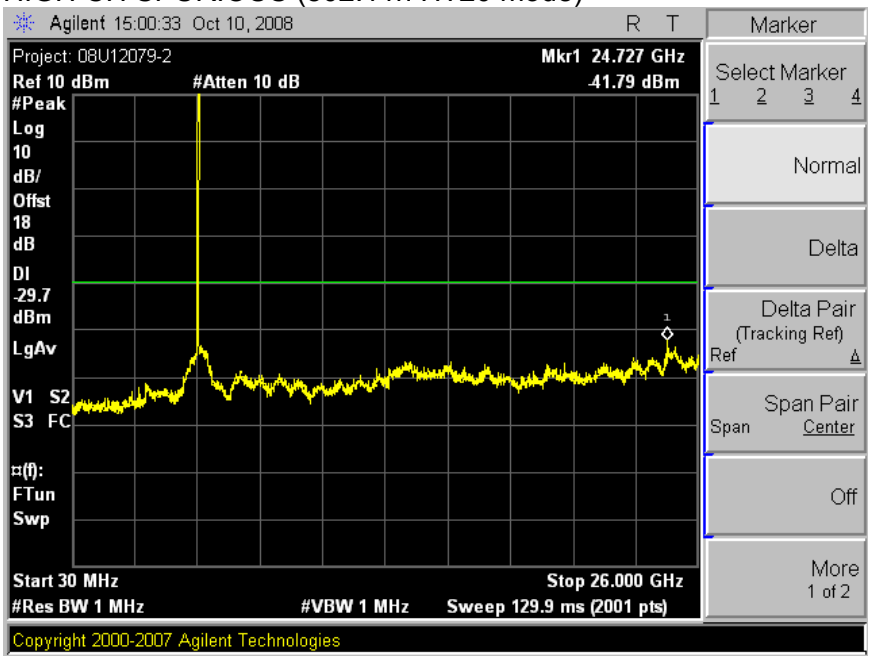
LOW CH SPURIOUS (802.11n HT20 mode)

MID CH SPURIOUS (802.11n HT20 mode)



MID CH SPURIOUS (802.11n HT20 mode)

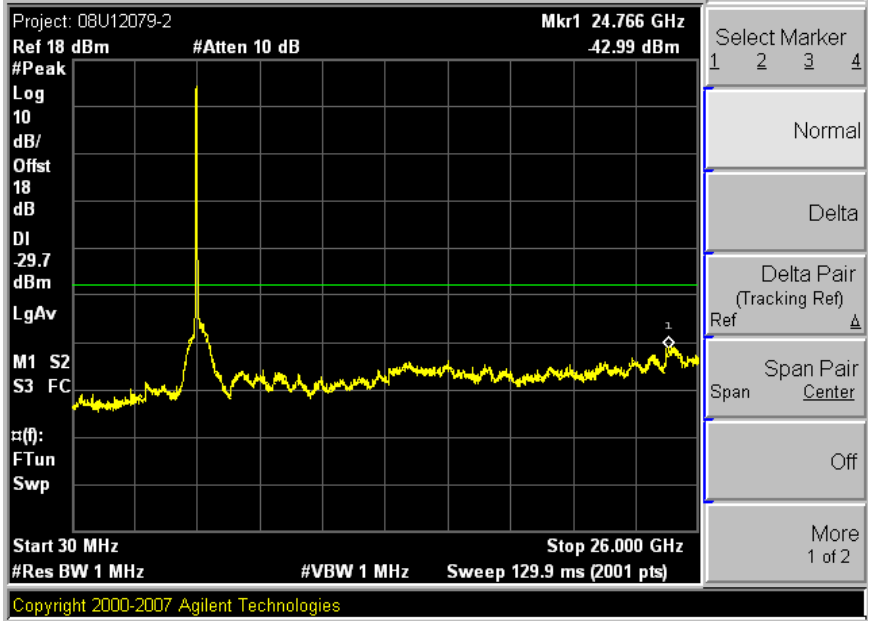
HIGH CH SPURIOUS (802.11n HT20 mode)



HIGH CH SPURIOUS (802.11n HT20 mode)

(802.11n HT40 MODE)

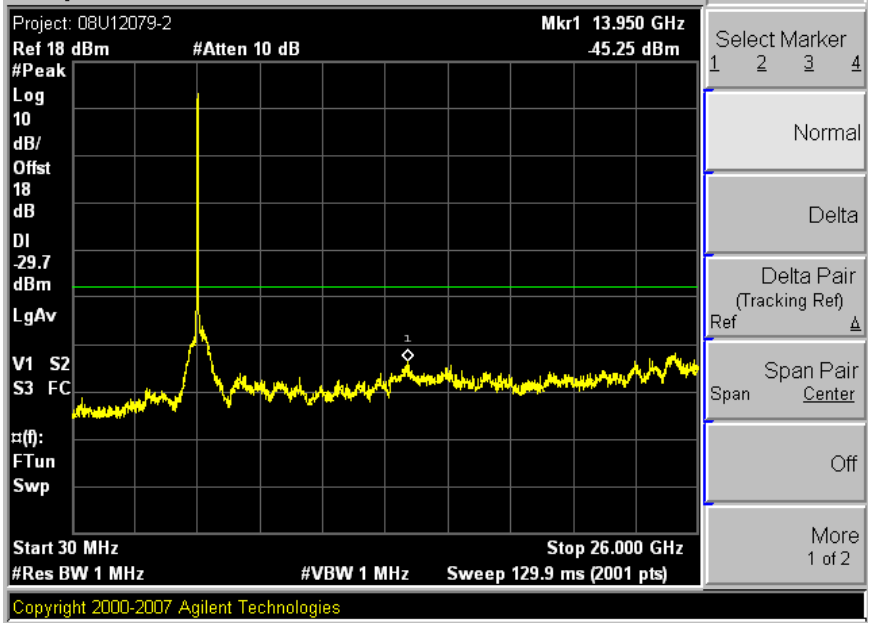
LOW CH SPURIOUS (802.11n HT40 mode)



LOW CH SPURIOUS (802.11n HT40 mode)

(802.11n HT40 MODE)

HIGH CH SPURIOUS (802.11n HT40 mode)



HIGH CH SPURIOUS (802.11n HT40 mode)

8. RADIATED TEST RESULTS

8.1LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 5.2 GHz band.

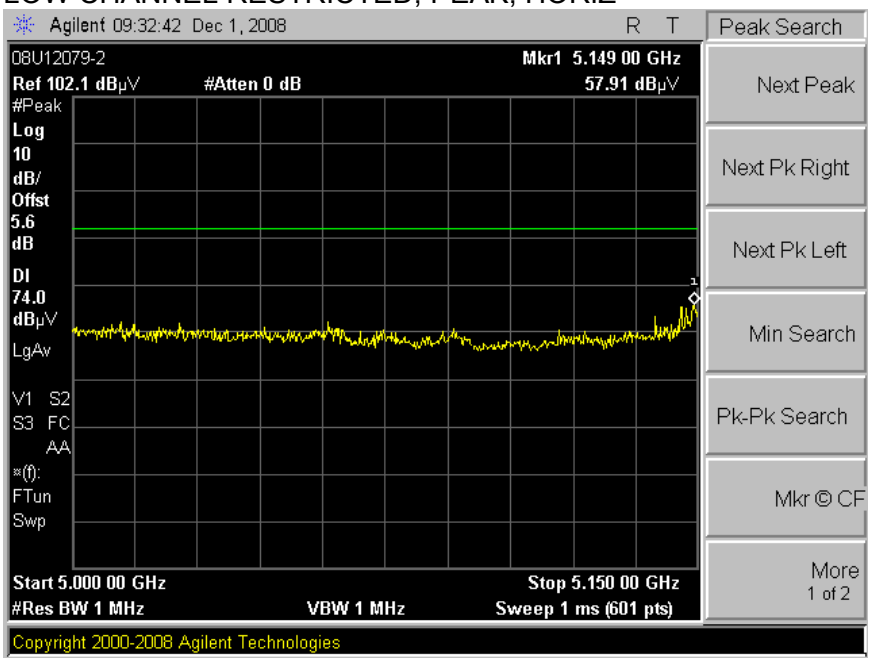
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

8.1. TRANSMITTER ABOVE 1 GHz IN THE 5.2 GHz BAND

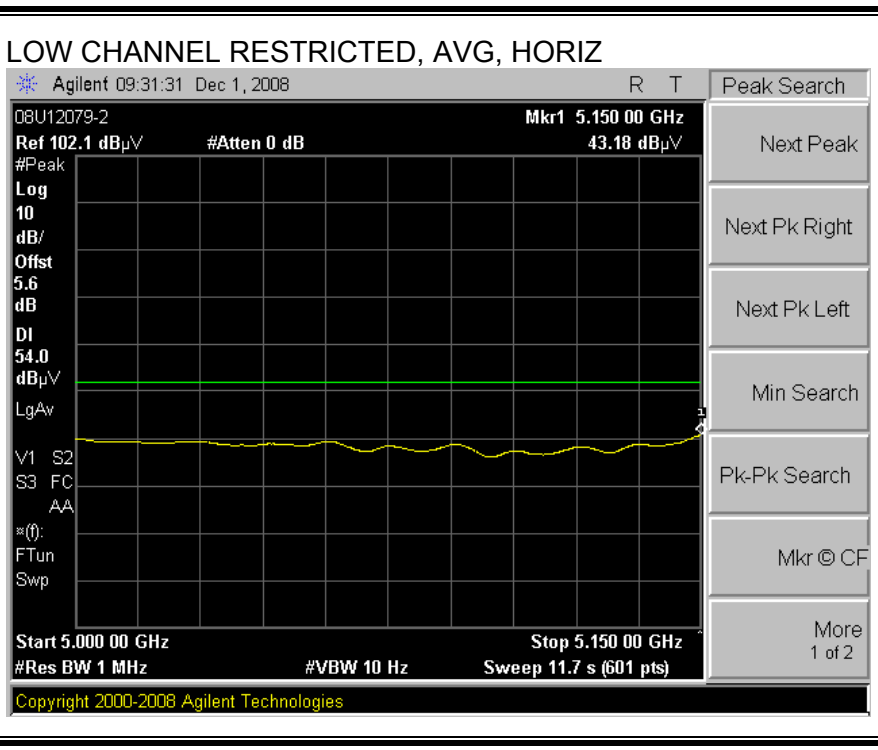
8.1.1. 802.11a MODE IN THE 5.2 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

LOW CHANNEL RESTRICTED, PEAK, HORIZ

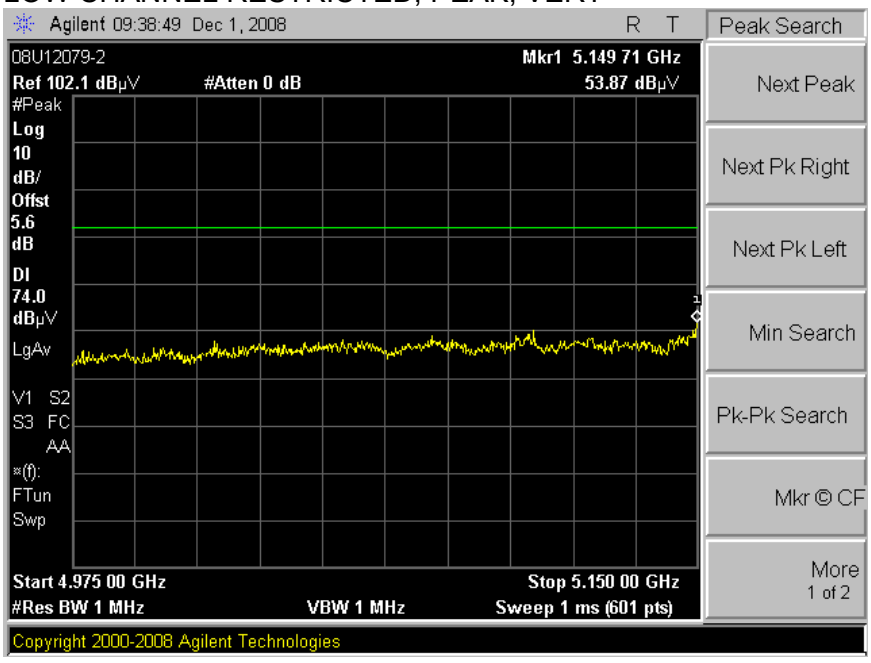


LOW CHANNEL RESTRICTED, AVG, HORIZ

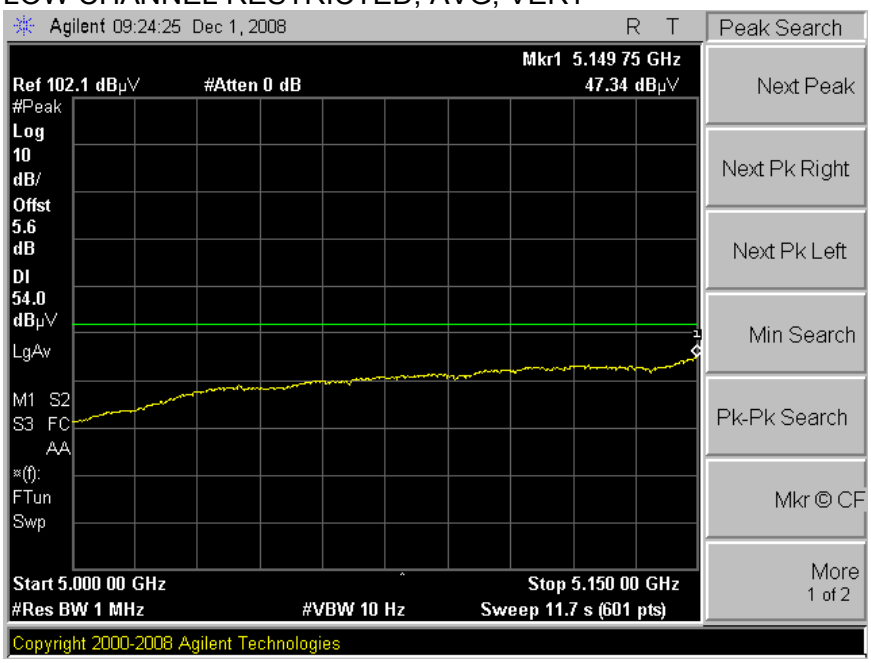


RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)

LOW CHANNEL RESTRICTED, PEAK, VERT

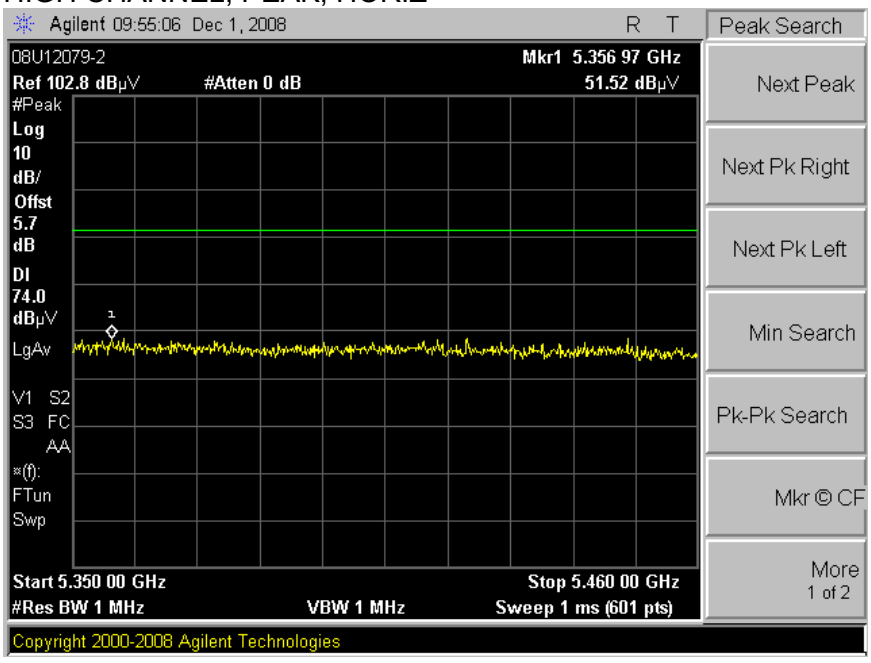


LOW CHANNEL RESTRICTED, AVG, VERT

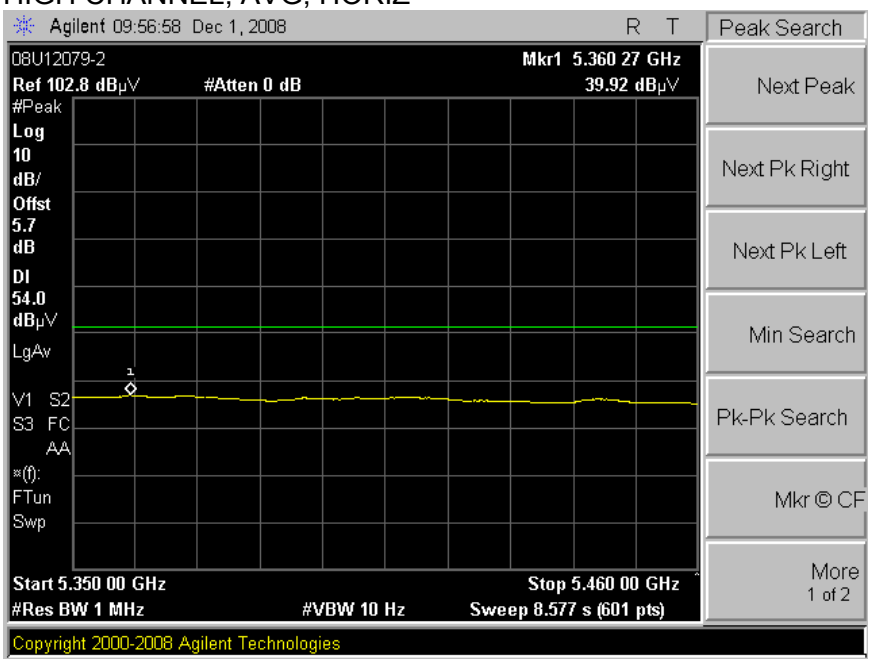


AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)

HIGH CHANNEL, PEAK, HORIZ

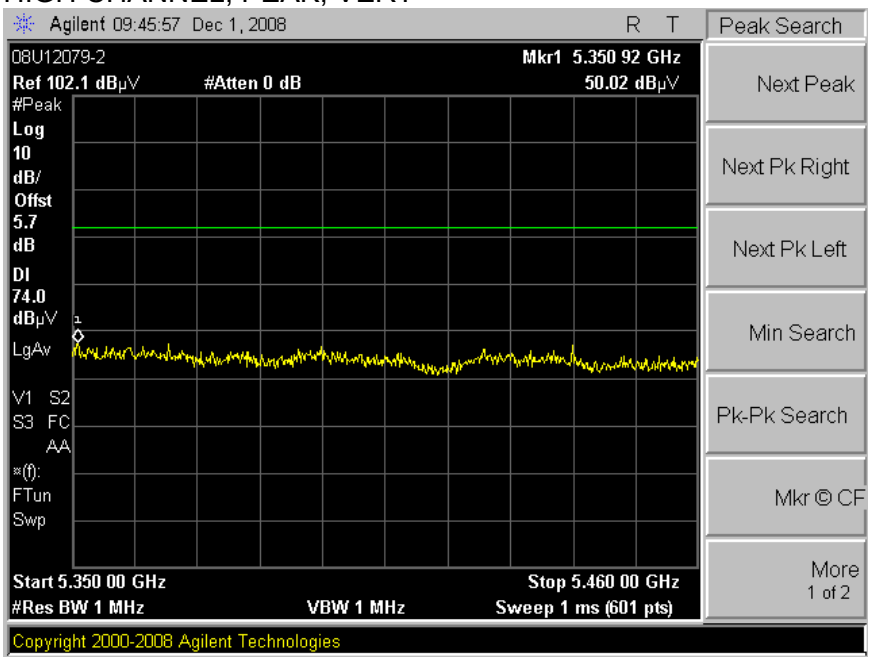


HIGH CHANNEL, AVG, HORIZ

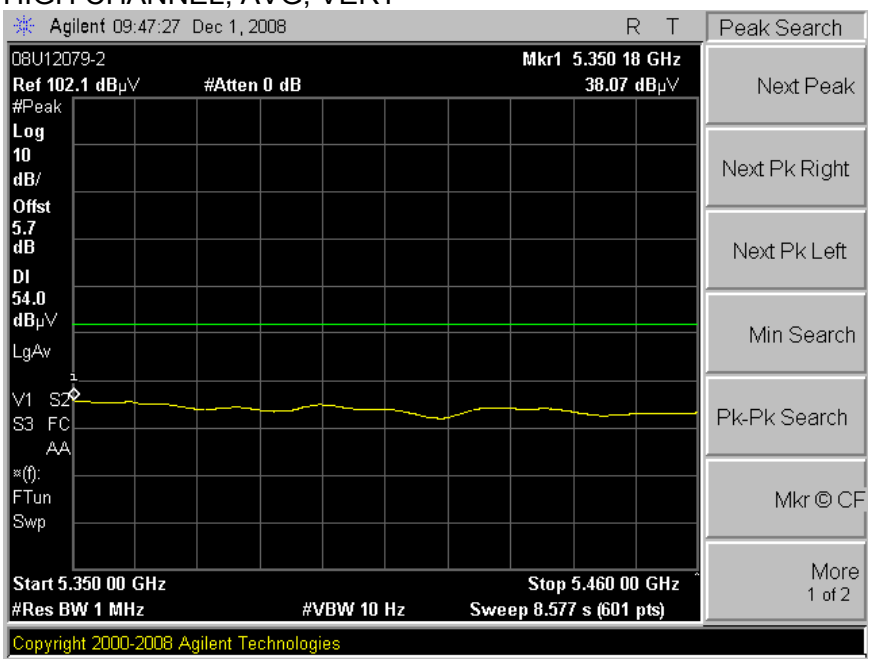


AUTHORIZED BANDEDGE (HIGH CHANNEL, VERTICAL)

HIGH CHANNEL, PEAK, VERT



HIGH CHANNEL, AVG, VERT



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company:	Apple Inc.
Project #:	08U12079-2
Date:	12/01/08
Test Engineer:	Thanh Nguyen
Configuration:	EUT and remote support Laptop
Mode:	Transmit 802.11 a

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T34 HP 8449B	T88 Miteq 26-40GHz	T39; ARA 18-26GHz; S/N:1013	FCC 15.205

Hi Frequency Cables

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter
3' cable 22807700	12' cable 22807600	20' cable 22807500		R_001

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
High Ch 5240MHz															
15.750	3.0	34.9	21.6	42.9	11.4	-32.2	0.0	0.0	57.1	43.9	74	54	-16.9	-10.1	H
15.750	3.0	34.7	21.7	42.9	11.4	-32.2	0.0	0.0	56.9	43.9	74	54	-17.1	-10.1	V
Mid Ch 5200MHz															
15.600	3.0	35.3	22.2	42.5	11.4	-32.2	0.0	0.0	57.0	43.9	74	54	-17.0	-10.1	H
15.600	3.0	34.2	21.8	42.5	11.4	-32.2	0.0	0.0	55.9	43.5	74	54	-18.1	-10.5	V
Low Ch 5180MHz															
15.540	3.0	35.3	22.3	42.4	11.3	-32.2	0.0	0.0	56.8	43.8	74	54	-17.2	-10.2	H
15.540	3.0	34.4	22.6	42.4	11.3	-32.2	0.0	0.0	55.9	44.1	74	54	-18.1	-9.9	V
No other emissions were detected above 3rd harmonic.															

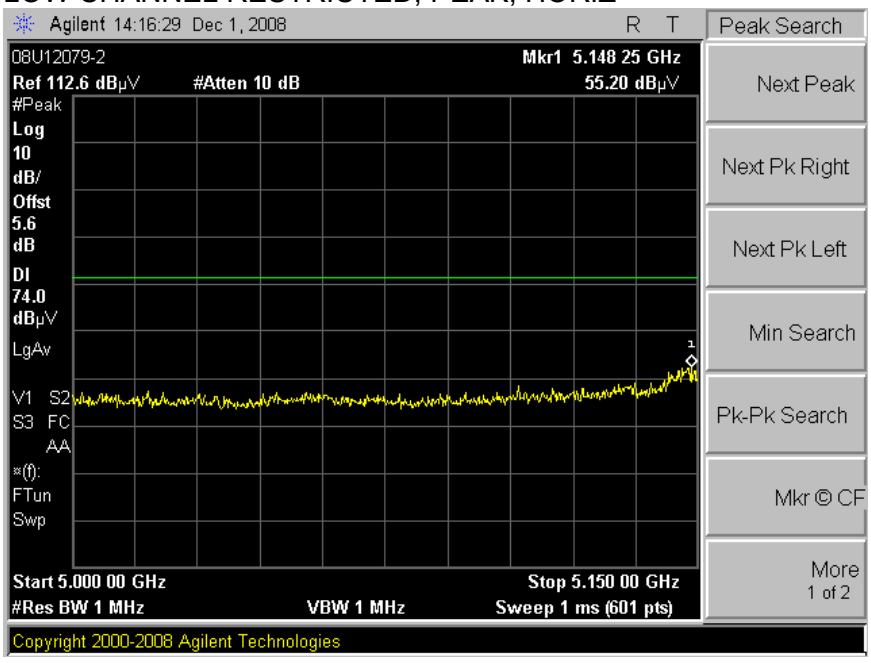
Rev. 10.15.08

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

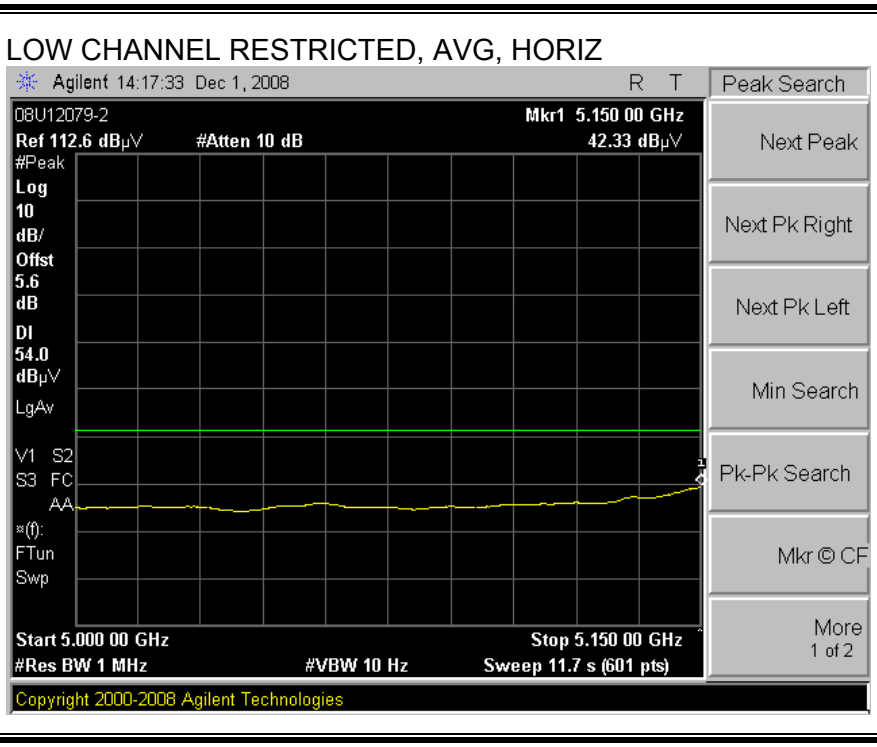
8.1.2. 802.11n HT20 MODE IN THE 5.2 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

LOW CHANNEL RESTRICTED, PEAK, HORIZ

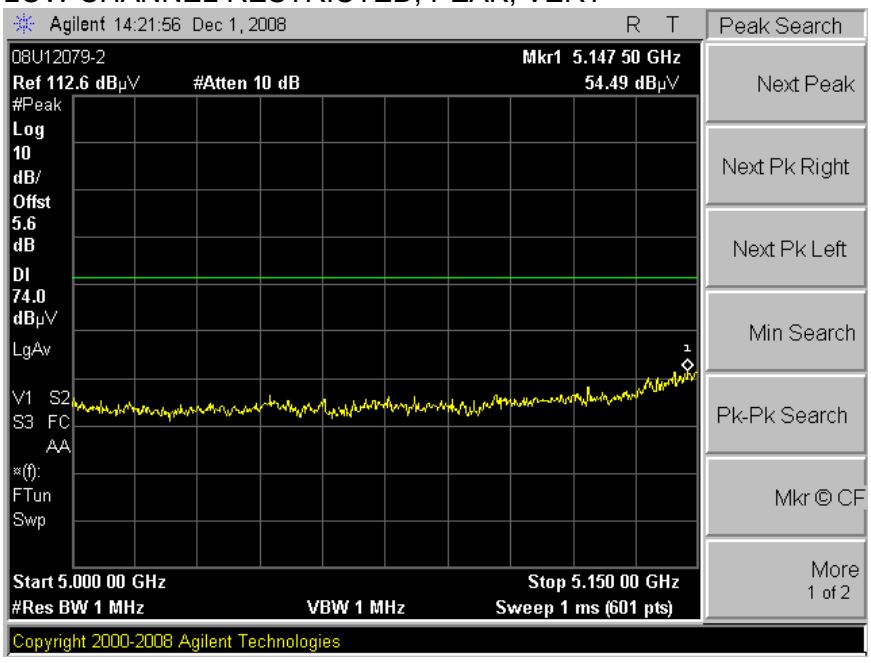


LOW CHANNEL RESTRICTED, AVG, HORIZ

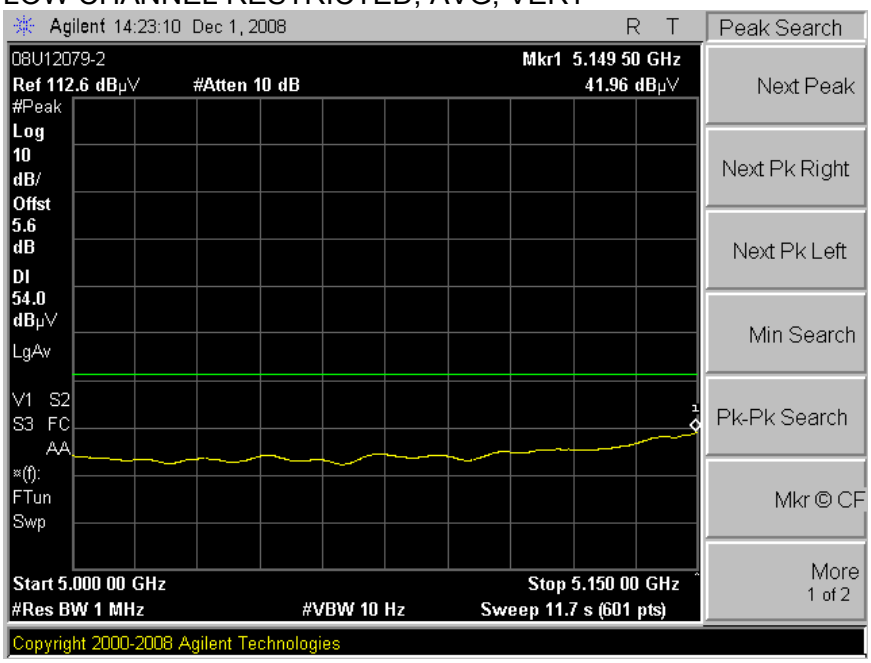


RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)

LOW CHANNEL RESTRICTED, PEAK, VERT

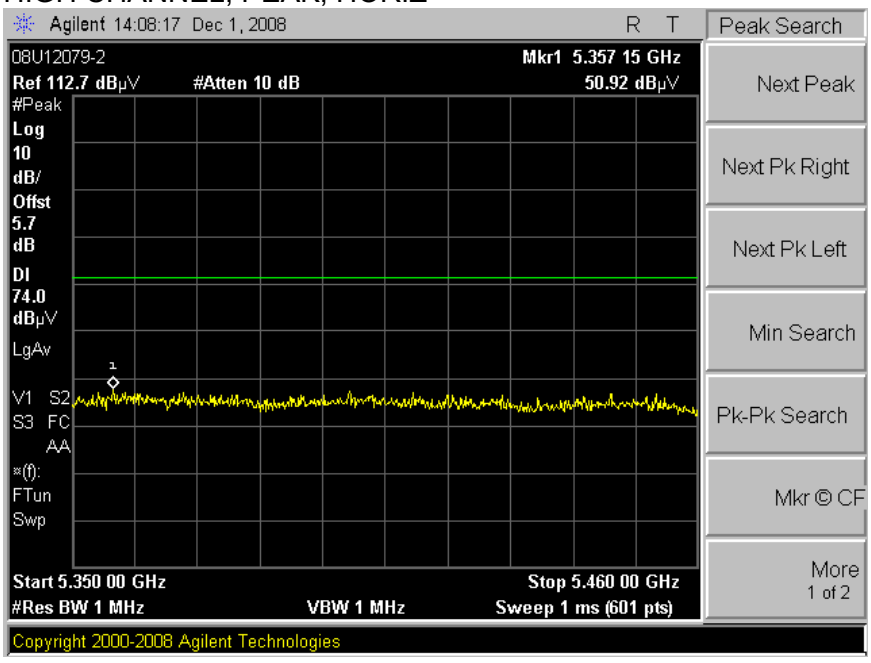


LOW CHANNEL RESTRICTED, AVG, VERT

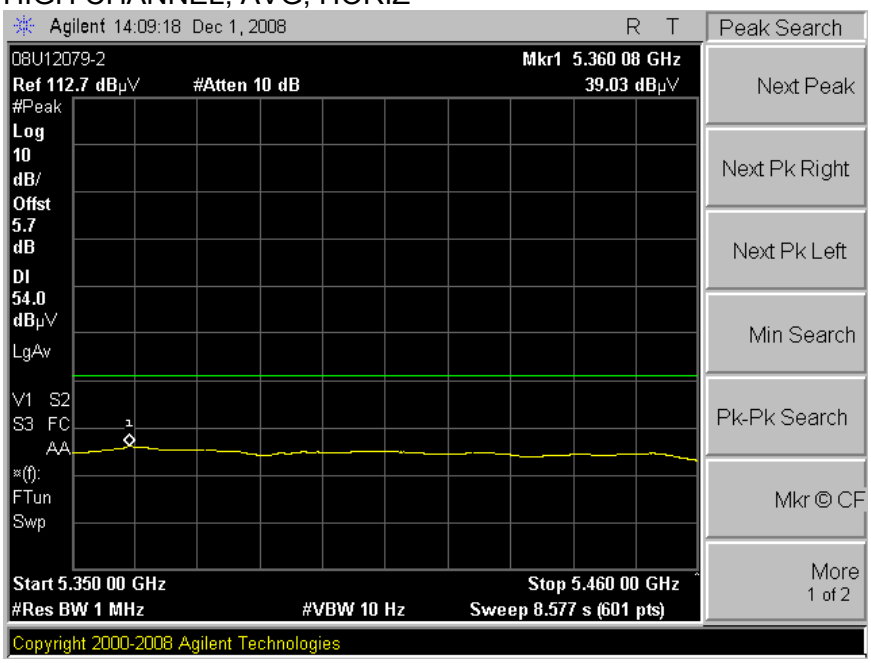


AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)

HIGH CHANNEL, PEAK, HORIZ

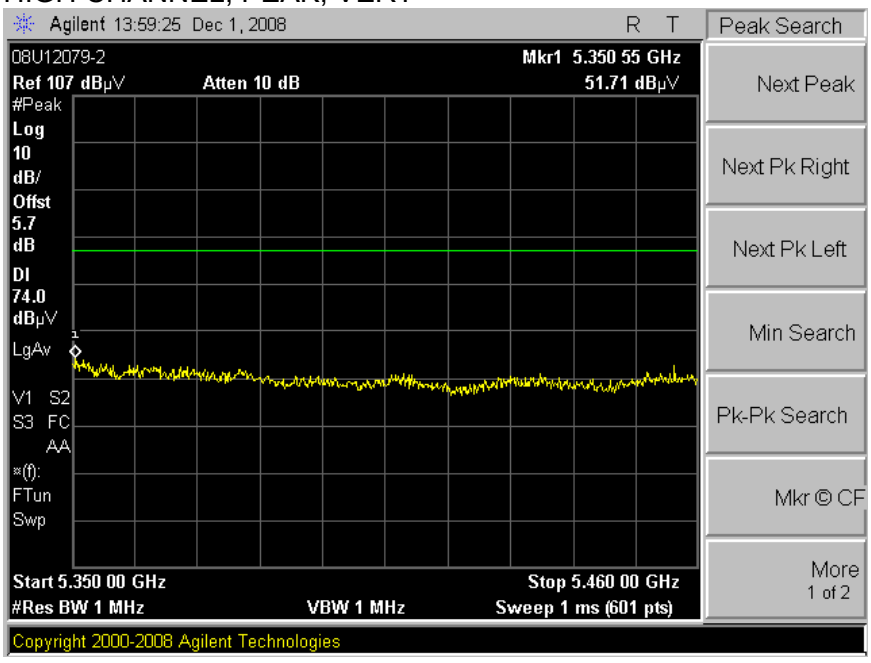


HIGH CHANNEL, AVG, HORIZ

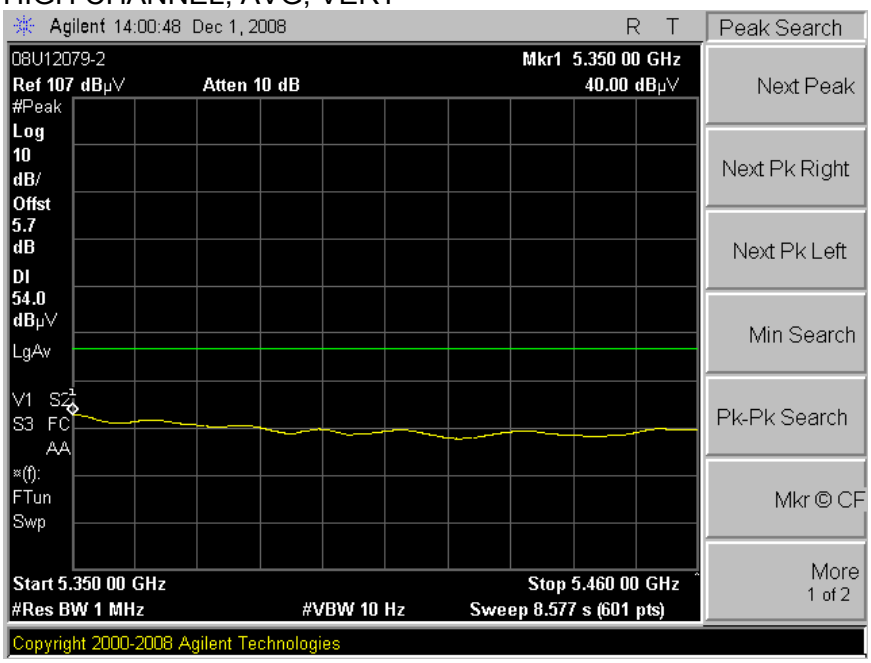


AUTHORIZED BANDEDGE (HIGH CHANNEL, VERTICAL)

HIGH CHANNEL, PEAK, VERT



HIGH CHANNEL, AVG, VERT



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company:	Apple Inc.
Project #:	08U12079-2
Date:	12/01/08
Test Engineer:	Thanh Nguyen
Configuration:	EUT and remote support Laptop
Mode:	Transmit HT 20

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T34 HP 8449B	T88 Miteq 26-40GHz	T39-T88 ARA 18-40GHz & Mixer > 40GHz	FCC 15.205

Hi Frequency Cables

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter
3' cable 22807700	12' cable 22807600	20' cable 22807500		R_001

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
Low Ch 5180MHz															
15.540	3.0	34.5	21.8	42.4	11.3	-32.2	0.0	0.0	56.0	43.3	74	54	-18.0	-10.7	V
15.540	3.0	36.4	22.4	42.4	11.3	-32.2	0.0	0.0	57.9	43.9	74	54	-16.1	-10.1	H
Mid Ch 5200MHz															
15.600	3.0	34.0	21.7	42.5	11.4	-32.2	0.0	0.0	55.8	43.4	74	54	-18.2	-10.6	H
15.600	3.0	34.0	21.7	42.5	11.4	-32.2	0.0	0.0	55.7	43.4	74	54	-18.3	-10.6	V
High Ch 5240MHz															
15.720	3.0	34.0	21.8	42.9	11.4	-32.2	0.0	0.0	56.1	43.9	74	54	-17.9	-10.1	V
15.720	3.0	35.4	22.1	42.9	11.4	-32.2	0.0	0.0	57.5	44.2	74	54	-16.5	-9.8	H
No other emissions were detected above 3rd harmonic.															

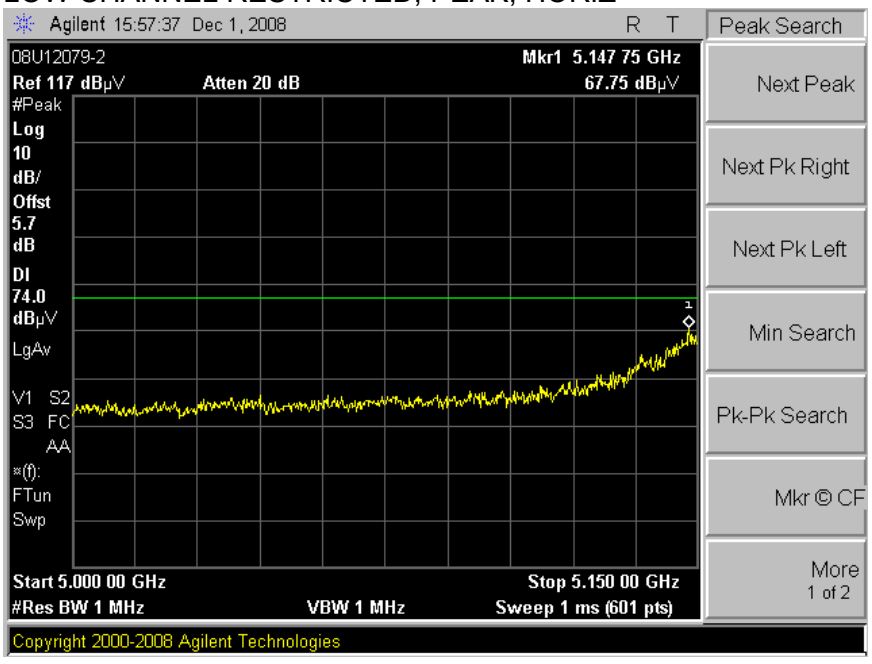
Rev. 10.15.08

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

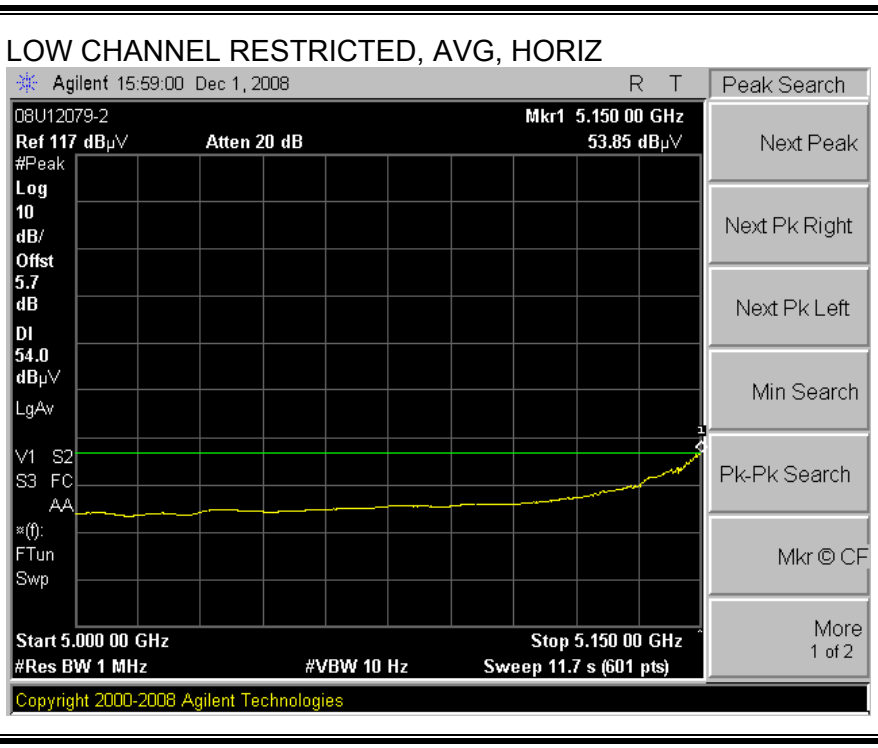
8.1.3. 802.11n HT40 MODE IN THE 5.2 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

LOW CHANNEL RESTRICTED, PEAK, HORIZ

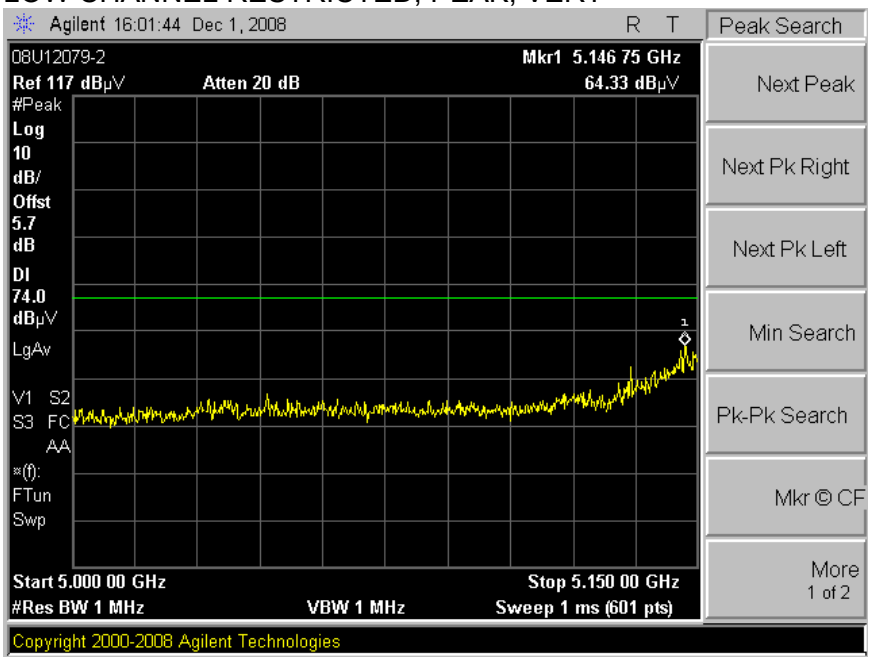


LOW CHANNEL RESTRICTED, AVG, HORIZ

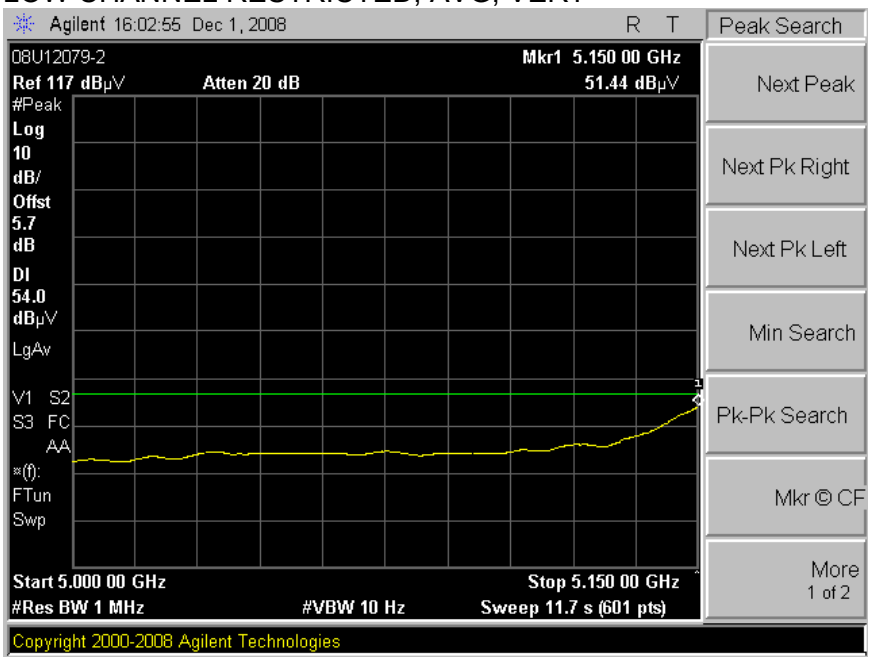


RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)

LOW CHANNEL RESTRICTED, PEAK, VERT

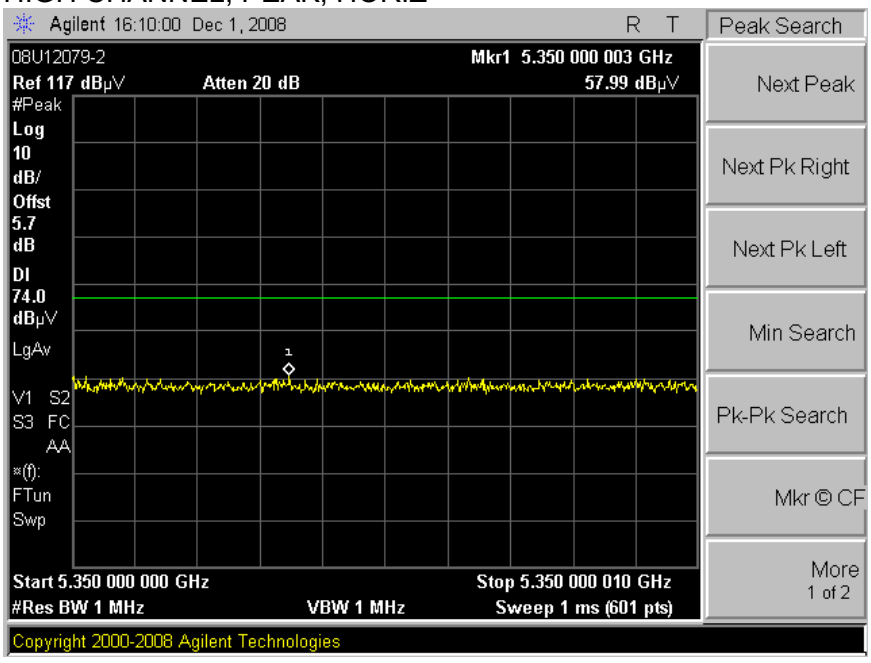


LOW CHANNEL RESTRICTED, AVG, VERT

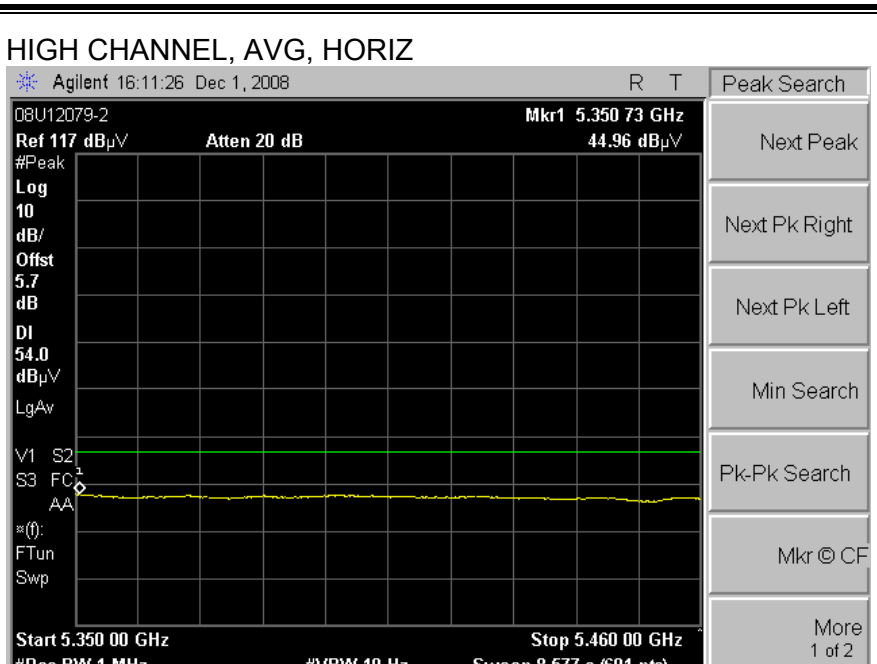


AUTHORIZED BANDEDGE (HIGH CHANNEL, HORIZONTAL)

HIGH CHANNEL, PEAK, HORIZ

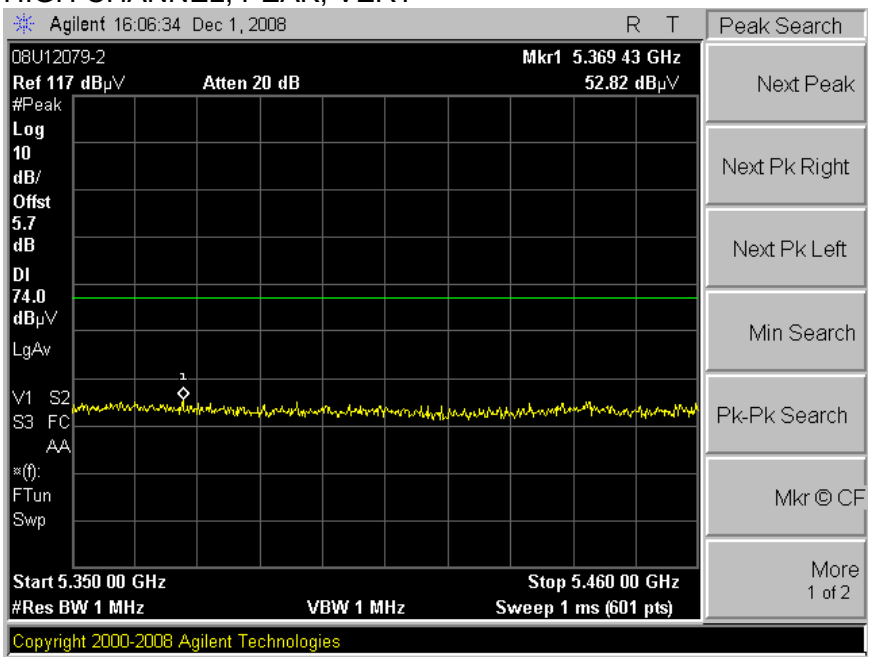


HIGH CHANNEL, AVG, HORIZ

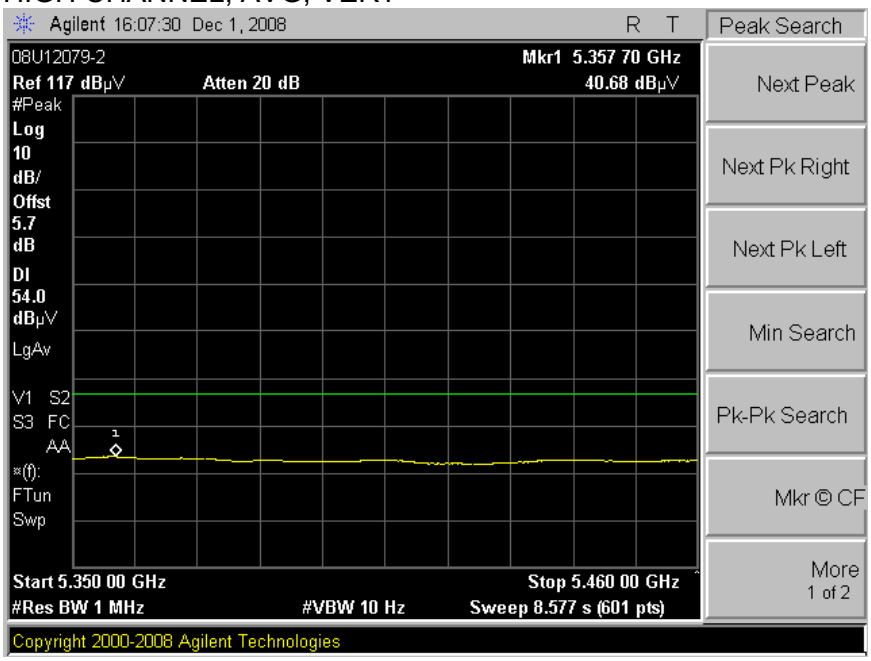


AUTHORIZED BANDEDGE (HIGH CHANNEL, VERTICAL)

HIGH CHANNEL, PEAK, VERT



HIGH CHANNEL, AVG, VERT



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company:	Apple Inc.
Project #:	08U12079-2
Date:	12/01/08
Test Engineer:	Thanh Nguyen
Configuration:	EUT and remote support Laptop
Mode:	Transmit HT40

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T34 HP 8449B	T88 Miteq 26-40GHz	T39; ARA 18-26GHz; S/N:1013	FCC 15.205

Hi Frequency Cables

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter
3' cable 22807700	12' cable 22807600	20' cable 22807500		R_001

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
Low Ch 5190MHz															
15.570	3.0	35.3	22.1	42.5	11.4	-32.2	0.0	0.0	57.0	43.7	74	54	-17.0	-10.3	V
15.570	3.0	34.2	22.0	42.5	11.4	-32.2	0.0	0.0	55.8	43.6	74	54	-18.2	-10.4	H
High Ch 5230MHz															
15.690	3.0	33.9	21.8	42.8	11.4	-32.2	0.0	0.0	55.9	43.8	74	54	-18.1	-10.2	V
15.690	3.0	35.3	21.9	42.8	11.4	-32.2	0.0	0.0	57.3	43.9	74	54	-16.7	-10.1	H
No other emissions were detected above 3rd harmonic.															

Rev. 10.15.08

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

8.2. RECEIVER ABOVE 1 GHz IN THE WORST CASE MODE

8.2.1. RX ABOVE 1 GHz FOR 20 MHz BANDWIDTH IN THE 5.2 GHz BAND

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company:	Apple Inc.
Project #:	08U12079-2
Date:	12/01/08
Test Engineer:	Thanh Nguyen
Configuration:	EUT and remote support Laptop
Mode:	Receive mode 20MHz

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T34 HP 8449B			RX RSS 210

Hi Frequency Cables

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter
3' cable 22807700	12' cable 22807600	20' cable 22807500		

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
1.000	3.0	53.9	46.8	25.7	2.4	-38.3	0.0	0.0	43.8	36.7	74	54	-30.2	-17.3	V
1.627	3.0	49.1	30.9	27.4	3.1	-37.4	0.0	0.0	42.2	24.0	74	54	-31.8	-30.0	V
1.997	3.0	48.4	32.1	28.4	3.5	-36.9	0.0	0.0	43.4	27.1	74	54	-30.6	-26.9	V
2.497	3.0	44.2	30.5	29.5	3.9	-36.3	0.0	0.0	41.4	27.7	74	54	-32.6	-26.3	V
1.033	3.0	50.9	43.0	25.8	2.4	-38.2	0.0	0.0	40.9	33.0	74	54	-33.1	-21.0	H
1.527	3.0	49.6	22.3	27.1	3.0	-37.5	0.0	0.0	42.2	14.8	74	54	-31.8	-39.2	H
2.000	3.0	46.3	39.9	28.4	3.5	-36.9	0.0	0.0	41.2	34.9	74	54	-32.8	-19.1	H
2.447	3.0	48.2	28.9	29.4	3.9	-36.3	0.0	0.0	45.2	25.9	74	54	-28.8	-28.1	H
No other emissions were detected above 2.5GHz															

Rev. 10.15.08

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

8.2.2. RX ABOVE 1 GHz FOR 40 MHz BANDWIDTH IN THE 5.2 GHz BAND

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Apple Inc.
Project #: 08U12079-2
Date: 12/01/08
Test Engineer: Thanh Nguyen
Configuration: EUT and remote support Laptop
Mode: Receive mode 40MHz

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T34 HP 8449B			RX RSS 210

Hi Frequency Cables

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter
3' cable 22807700	12' cable 22807600	20' cable 22807500		

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
1.030	3.0	58.3	47.5	25.8	2.4	-38.2	0.0	0.0	48.3	37.4	74	54	-25.7	-16.6	V
1.627	3.0	49.1	30.9	27.4	3.1	-37.4	0.0	0.0	42.2	24.0	74	54	-31.8	-30.0	V
1.997	3.0	56.6	35.6	28.4	3.5	-36.9	0.0	0.0	51.5	30.5	74	54	-22.5	-23.5	V
2.497	3.0	52.5	32.5	29.5	3.9	-36.3	0.0	0.0	49.7	29.7	74	54	-24.3	-24.3	V
1.033	3.0	50.9	43.0	25.8	2.4	-38.2	0.0	0.0	40.9	33.0	74	54	-33.1	-21.0	H
1.330	3.0	53.3	38.6	26.6	2.7	-37.8	0.0	0.0	44.8	30.1	74	54	-29.2	-23.9	H
2.000	3.0	57.4	43.4	28.4	3.5	-36.9	0.0	0.0	52.3	38.3	74	54	-21.7	-15.7	H
2.447	3.0	47.7	31.3	29.4	3.9	-36.3	0.0	0.0	44.7	28.3	74	54	-29.3	-25.7	H

No other emissions were detected above 2.5GHz

Rev. 10.15.08

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

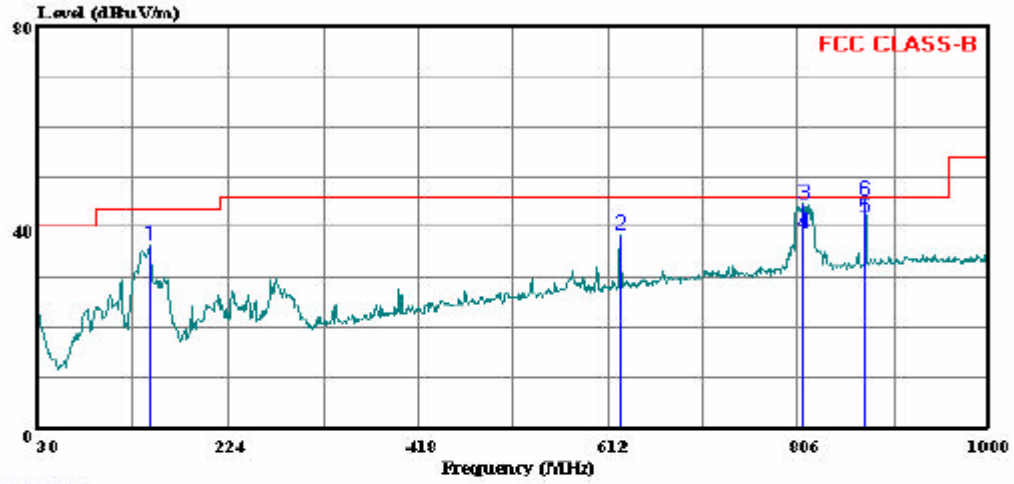
8.3. WORST-CASE BELOW 1 GHz

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

HORIZONTAL PLOT& DATA

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 45 File#: 08U12079EMI.EMI Date: 09-11-2008 Time: 16:33:12



(Fremont)

Trace: 42 Ref Trace:

Condition: FCC CLASS-B 3m ANTENNA B_5M 021109 HORIZONTAL
Test Operator:: Thanh Nguyen
Project #: : 08U12079
Company: : Apple Inc.
Configuration:: EUT only
Mode : : Transmit worst case
Target: : FCC class B

Page: 1

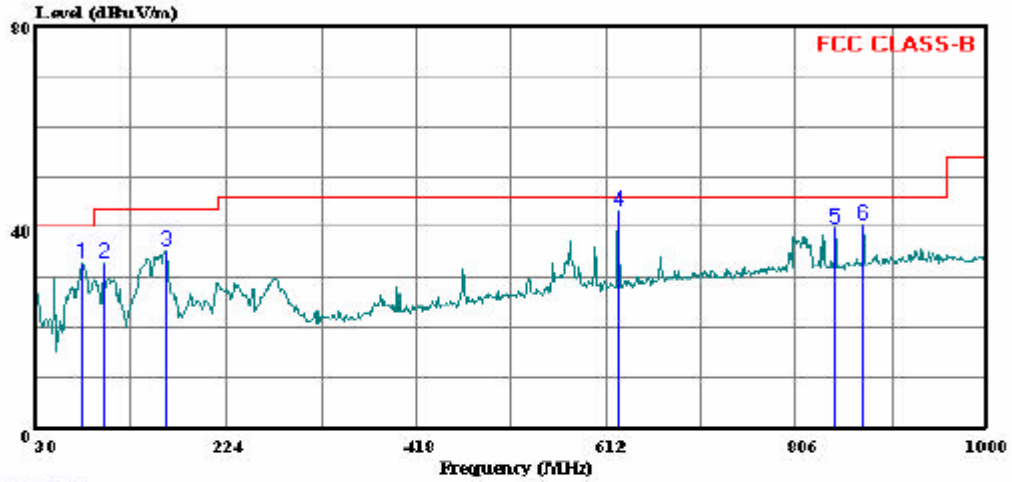
	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	144.460	49.83	-13.61	36.22	43.50	-7.28	Peak
2	624.610	40.67	-2.21	38.45	46.00	-7.55	Peak
3	811.820	43.33	1.35	44.68	46.00	-1.32	Peak
4	811.820	37.48	1.35	38.83	46.00	-7.17	QP
5	874.870	39.60	2.33	41.93	46.00	-4.07	QP
6	874.870	43.17	2.33	45.49	46.00	-0.51	Peak

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

VERTICAL PLOT& DATA

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 40 File#: 08U12079EMI.EMI Date: 09-11-2008 Time: 15:25:14



Trace: 39 Ref Trace:

Condition: FCC CLASS-B 3m ANTENNA B_5M 021109 VERTICAL
Test Operator:: Thanh Nguyen
Project #: : 08U12079
Company: : Apple Inc.
Configuration:: EUT only
Mode : : Transmit worst case
Target: : FCC class B

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	76.560	51.70	-18.88	32.82	40.00	-7.18	Peak
2	98.870	49.67	-16.66	33.01	43.50	-10.49	Peak
3	160.950	49.67	-14.41	35.26	43.50	-8.24	Peak
4	624.610	45.50	-2.21	43.29	46.00	-2.71	Peak
5	845.770	37.83	1.83	39.67	46.00	-6.33	Peak
6	874.870	38.17	2.33	40.49	46.00	-5.51	Peak

8.4. POWERLINE CONDUCTED EMISSIONS

LIMIT

RSS-Gen 7.2.2

Except when the requirements applicable to a given device state otherwise, for any licence-exempt radio communication device equipped to operate from the public utility AC power supply, either directly or indirectly, the radio frequency voltage that is conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in Table 2. The tighter limit applies at the frequency range boundaries.

Table 2 – AC Power Lines Conducted Emission Limits

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

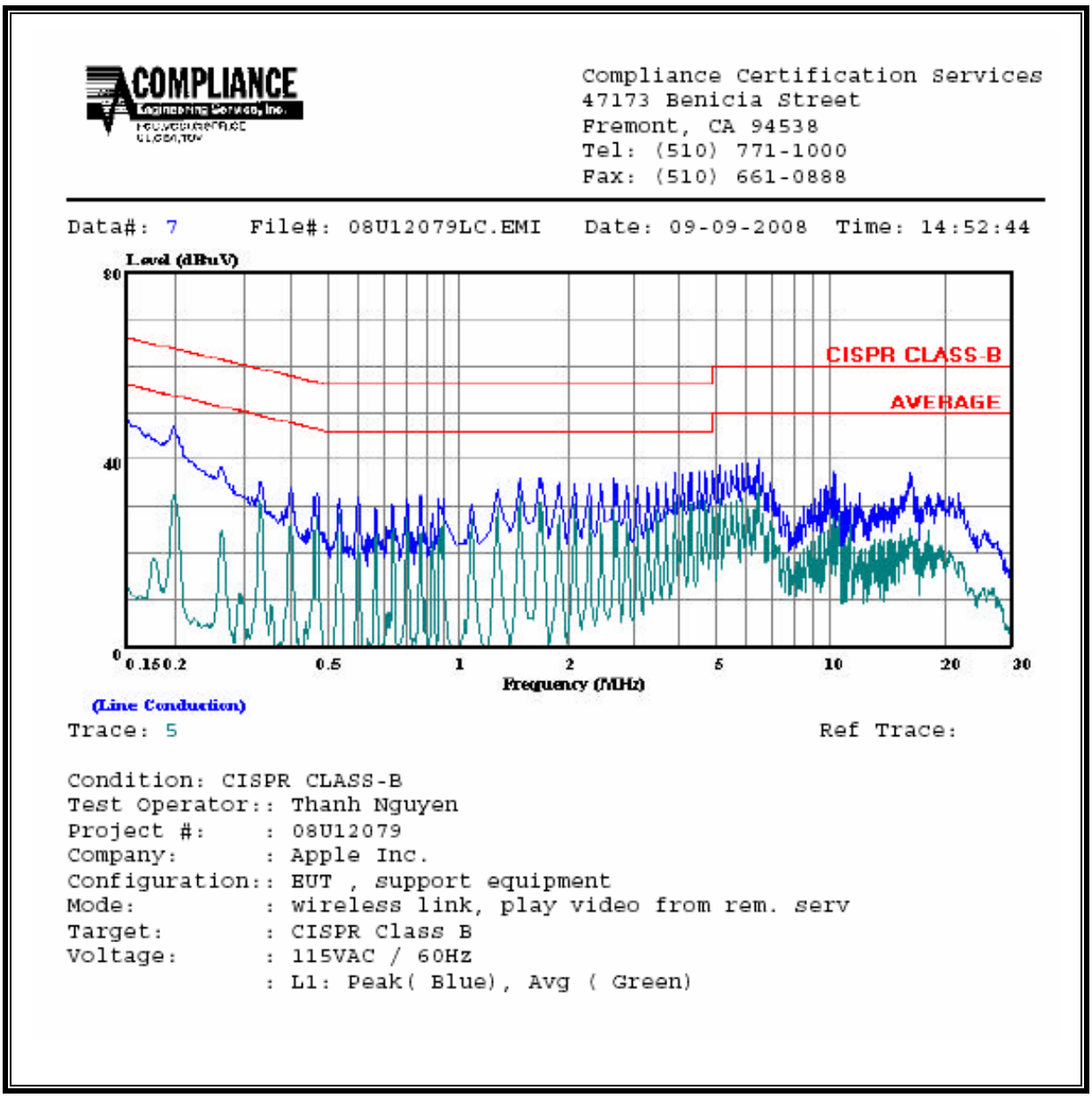
* Decreases with the logarithm of the frequency.

RESULTS

6 WORST EMISSIONS

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Closs	Limit	EN_B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.20	46.99	--	--	0.00	63.69	53.69	-16.70	-6.70	L1
1.58	35.99	--	--	0.00	56.00	46.00	-20.01	-10.01	L1
6.59	40.30	--	--	0.00	60.00	50.00	-19.70	-9.70	L1
0.20	47.33	--	--	0.00	63.69	53.69	-16.36	-6.36	L2
2.78	39.87	--	--	0.00	56.00	46.00	-16.13	-6.13	L2
6.59	39.40	--	--	0.00	60.00	50.00	-20.60	-10.60	L2
6 Worst Data									

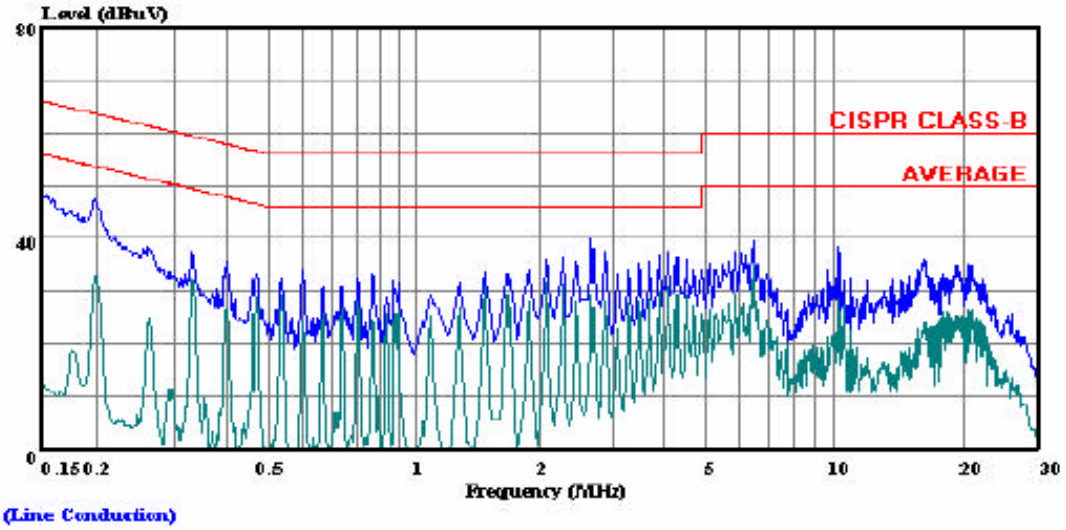
LINE 1 RESULTS



LINE 2 RESULTS

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 14 File#: 08U12079LC.EMI Date: 09-09-2008 Time: 14:58:43



(Line Conduction)

Trace: 12 Ref Trace:

Condition: CISPR CLASS-B
Test Operator:: Thanh Nguyen
Project #: : 08U12079
Company: : Apple Inc.
Configuration:: EUT , support equipment
Mode: : wireless link, play video from rem. serv
Target: : CISPR Class B
Voltage: : 115VAC / 60Hz
: L2: Peak(Blue), Avg (Green)

9. MAXIMUM PERMISSIBLE EXPOSURE

FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

IC RULES

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

Table 5
Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers (Including the General Public)

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m^2)	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	$280/f$	$2.19/f$		6
10–30	28	$2.19/f$		6
30–300	28	0.073	2*	6
300–1 500	$1.585f^{0.5}$	$0.0042f^{0.5}$	$f/150$	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	$616\,000/f^{1.2}$
150 000–300 000	$0.158f^{0.5}$	$4.21 \times 10^{-4}f^{0.5}$	$6.67 \times 10^{-5}f$	$616\,000/f^{1.2}$

* Power density limit is applicable at frequencies greater than 100 MHz.

Notes: 1. Frequency, f, is in MHz.
2. A power density of 10 W/m^2 is equivalent to 1 mW/cm^2.
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

CALCULATIONS

Given

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

and

$S = E ^ 2 / 3770$

where

E = Field Strength in Volts/meter
P = Power in Watts
G = Numeric antenna gain
d = Distance in meters
S = Power Density in milliwatts/square centimeter

Combining equations, rearranging the terms to express the distance as a function of the remaining variables, changing to units of Power to mW and Distance to cm, and substituting the logarithmic form of power and gain yields:

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

where

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

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

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

The power density in units of mW/cm^2 is converted to units of W/m^2 by multiplying by a factor of 10.

LIMITS

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

From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m^2

RESULTS

Mode	Band	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	FCC Power Density (mW/cm^2)	IC Power Density (W/m^2)
WLAN, 11b	2.4 GHz	20.0	26.39	4.22	0.23	2.29
WLAN, 11g	2.4 GHz	20.0	28.11	4.22	0.34	3.40
WLAN, HT20	2.4 GHz	20.0	28.29	1.21	0.18	1.77
WLAN, 11a	5.8 GHz	20.0	26.98	5.19	0.33	3.28
WLAN, HT20	5.8 GHz	20.0	26.99	2.18	0.16	1.64
WLAN, HT40	5.8 GHz	20.0	26.56	2.18	0.15	1.49
WLAN, 11a	5.2 GHz	20.0	15.84	5.73	0.03	0.29
WLAN, HT20	5.2 GHz	20.0	15.35	2.72	0.01	0.13
WLAN, HT40	5.2 GHz	20.0	16.86	2.72	0.02	0.18

Notes:
Antenna Gain for 11b, 11g and 11a is the combined antenna gain for both chains.
Antenna gain for HT20 and HT40 is the maximum antenna gain of both chains.
Output power is the combined output power for both chains.

CO-LOCATED MPE CALCULATIONS

For multiple colocated transmitters operating simultaneously the total power density can be calculated by summing the Power * Gain product (in linear units) of each transmitter.

yields

$$d = 0.282 * \sqrt{((P1 * G1) + (P2 * G2) + ... + (Pn * Pn)) / S}$$

where

d = distance in cm
Px = Power of transmitter x in mW
Gx = Numeric gain of antenna x
S = Power Density in mW/cm^2

In the table below, Power and Gain are entered in units of dBm and dBi respectively, then converted to their linear forms for the purpose of the calculations.

LIMITS

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

From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m^2

RESULTS

Mode	Band	Output Power (dBm)	Antenna Gain (dBi)	MPE Distance (cm)	FCC Power Density (mW/cm^2)	IC Power Density (W/m^2)
WLAN, 11g	2.4 GHz	28.11	4.22			
WLAN, 11a	5.8 GHz	26.98	5.19			
Combined				20.0	0.67	6.67