MIMO MODE

7.4. CHANNEL TESTS FOR THE 5470 TO 5725 MHz BAND

7.4.1. EMISSION BANDWIDTH

LIMIT

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

TEST PROCEDURE

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

RESULTS

No non-compliance noted:

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

802.11n 20 MHz CDD MCS 0 MODE

802.11 - 20 MHz Tx BANDWIDTH - CHAIN 0

Channel	Frequency (MHz)	B (MHz)	10 Log B (dB)
Low	5500	22.655	13.552
Middle	5560	23.011	13.619
High	5700	30.014	14.773

802.11 - 20 MHz Tx BANDWIDTH - CHAIN 1

Channel	Frequency (MHz)	B (MHz)	10 Log B (dB)
Low	5500	23.607	13.730
Middle	5560	26.739	14.271
High	5700	24.773	13.940

802.11n 40 MHz CDD MCS 32 MODE

802.11 - 40 MHz Tx BANDWIDTH - CHAIN 0

Channel	Frequency (MHz)	B (MHz)	10 Log B (dB)
Low	5510	38.925	15.902
Middle	5590	44.480	16.482
High	5670	47.317	16.750

802.11 - 40 MHz Tx BANDWIDTH - CHAIN 1

Channel	Frequency (MHz)	B (MHz)	10 Log B (dB)
Low	5510	38.118	15.811
Middle	5590	43.629	16.398
High	5670	44.396	16.473

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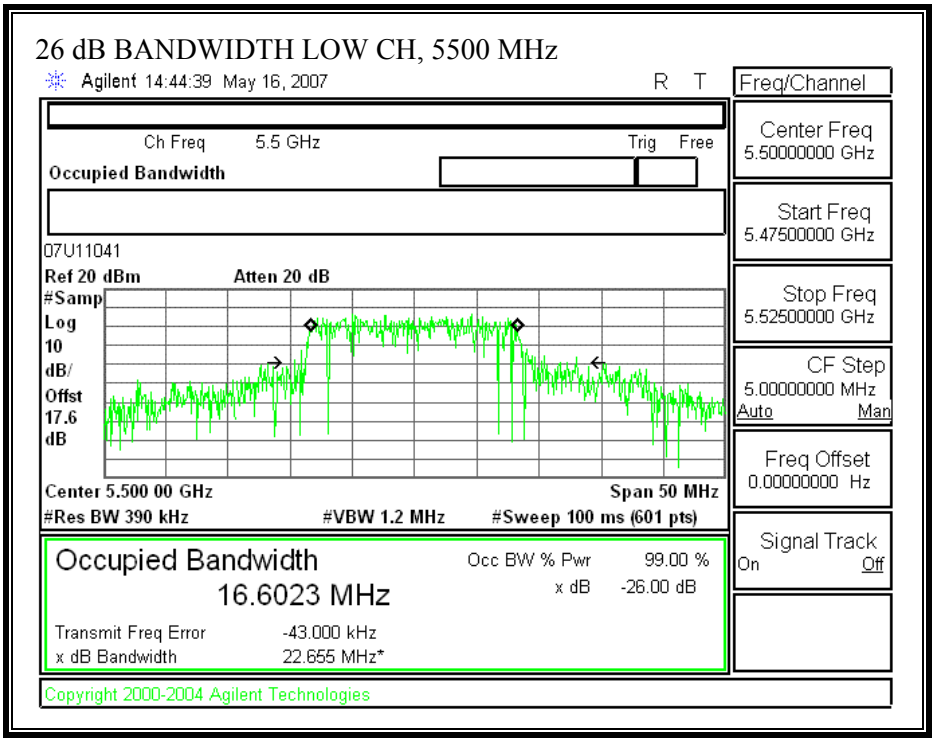
802.11n 20 MHz CDD MCS 0

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



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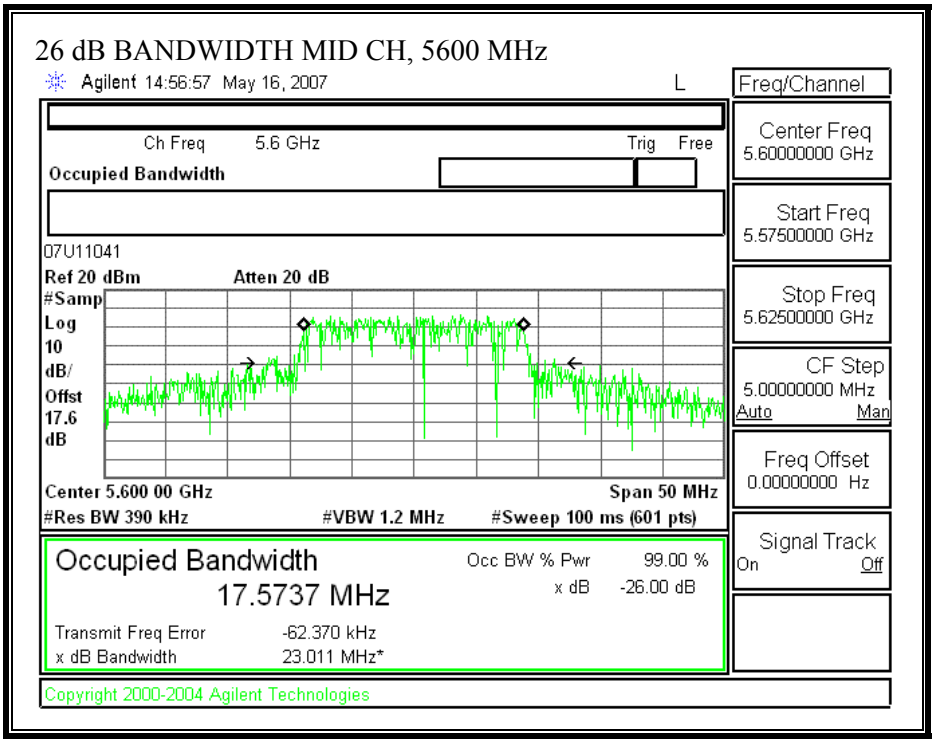

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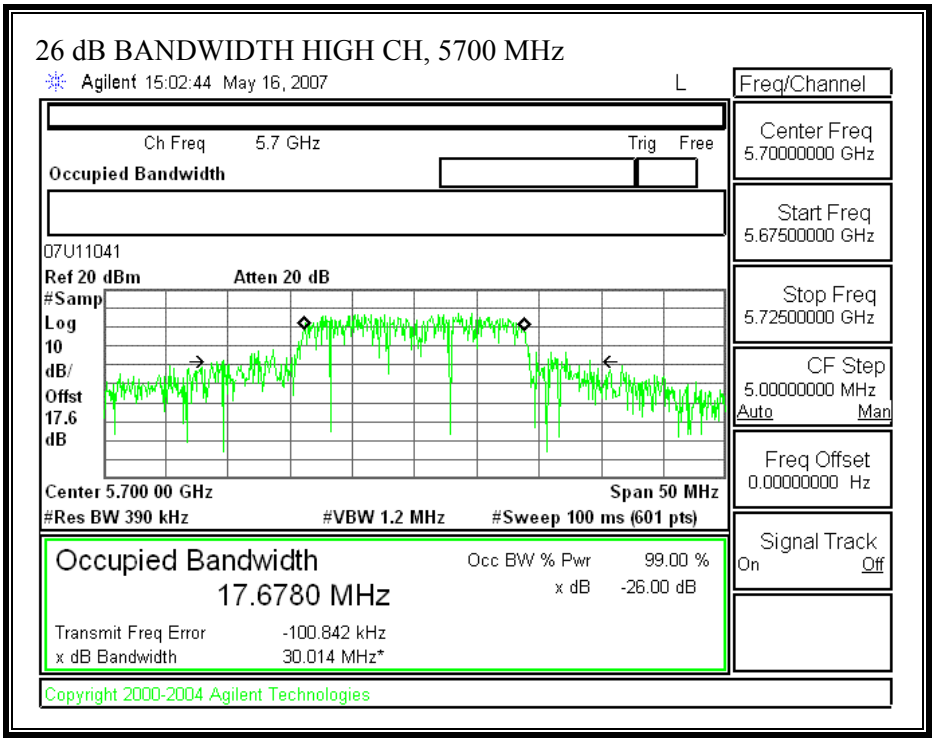

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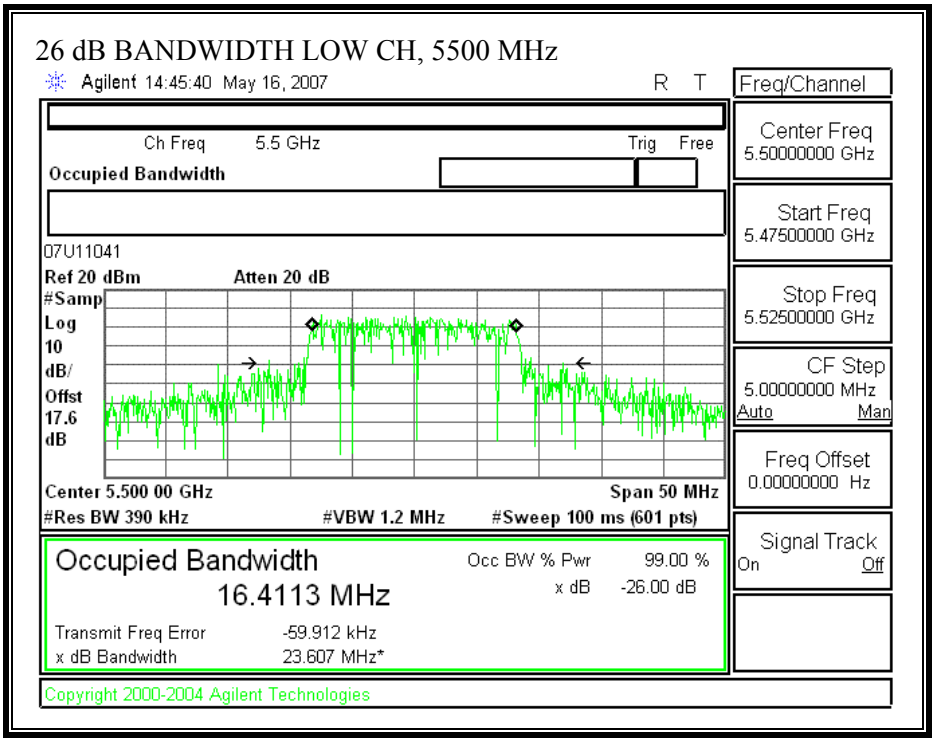
26 dB EMISSION BANDWIDTH (802.11 - 20 MHz TX BANDWIDTH- CHAIN 1)



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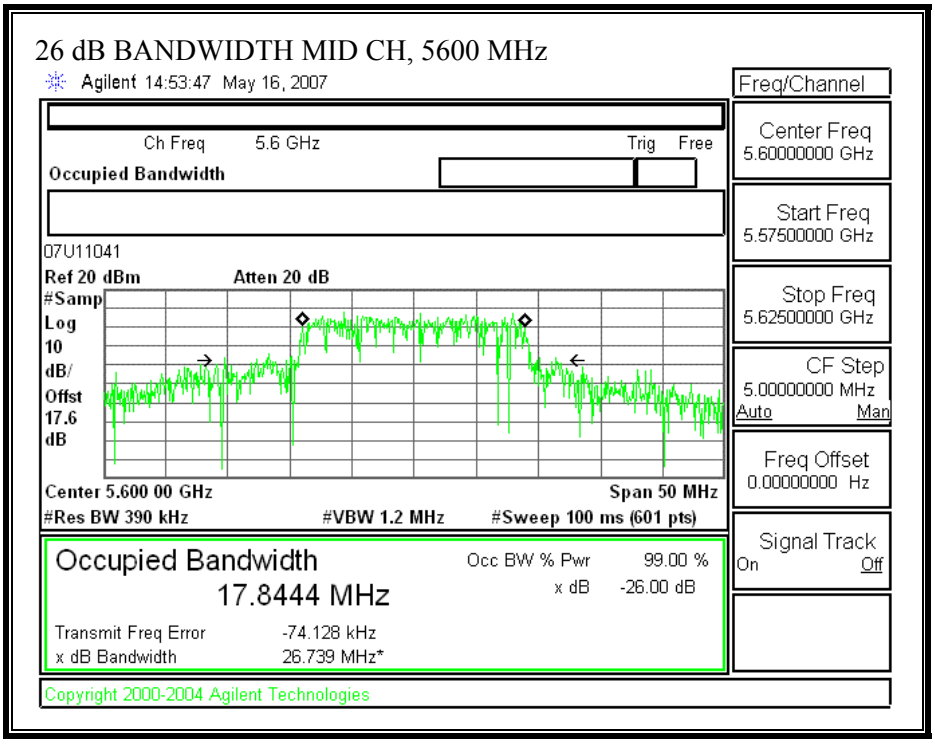

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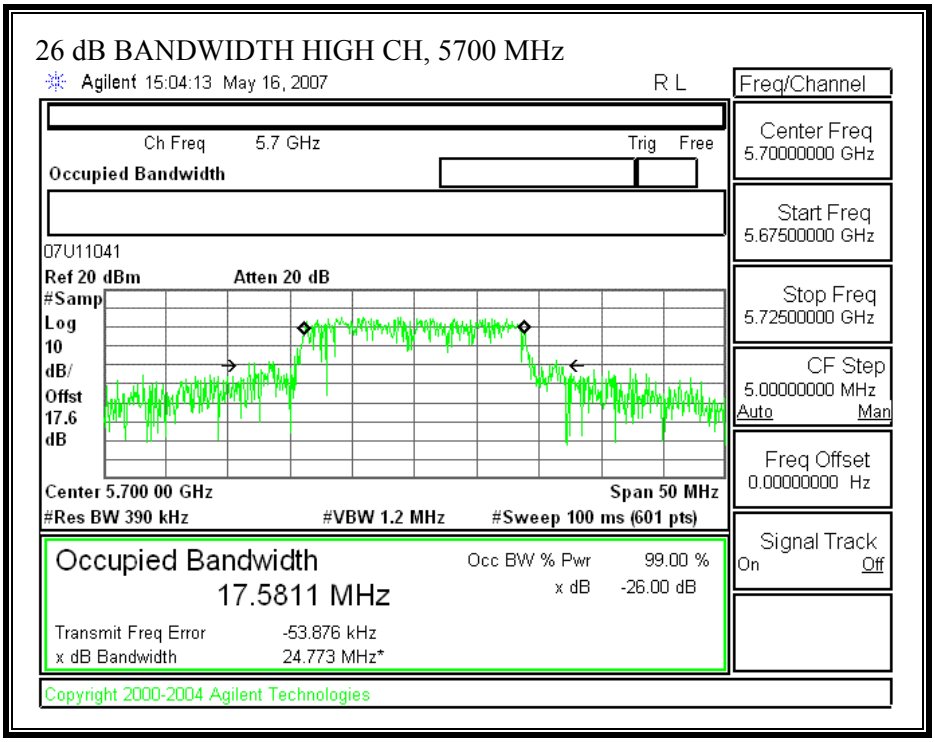

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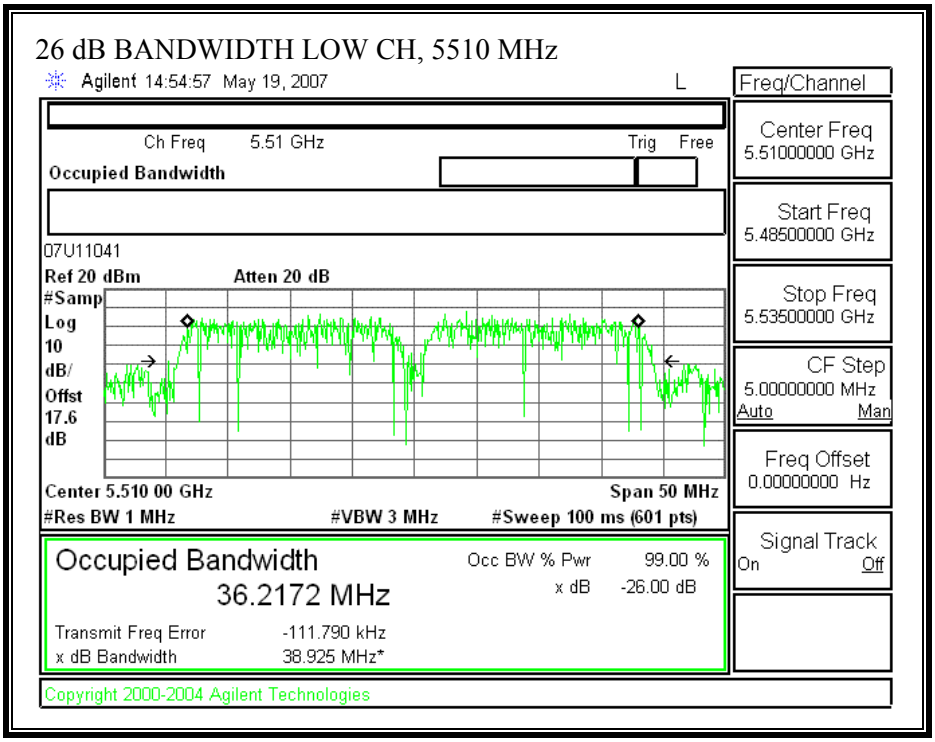
802.11n 40 MHz CDD MCS 32

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



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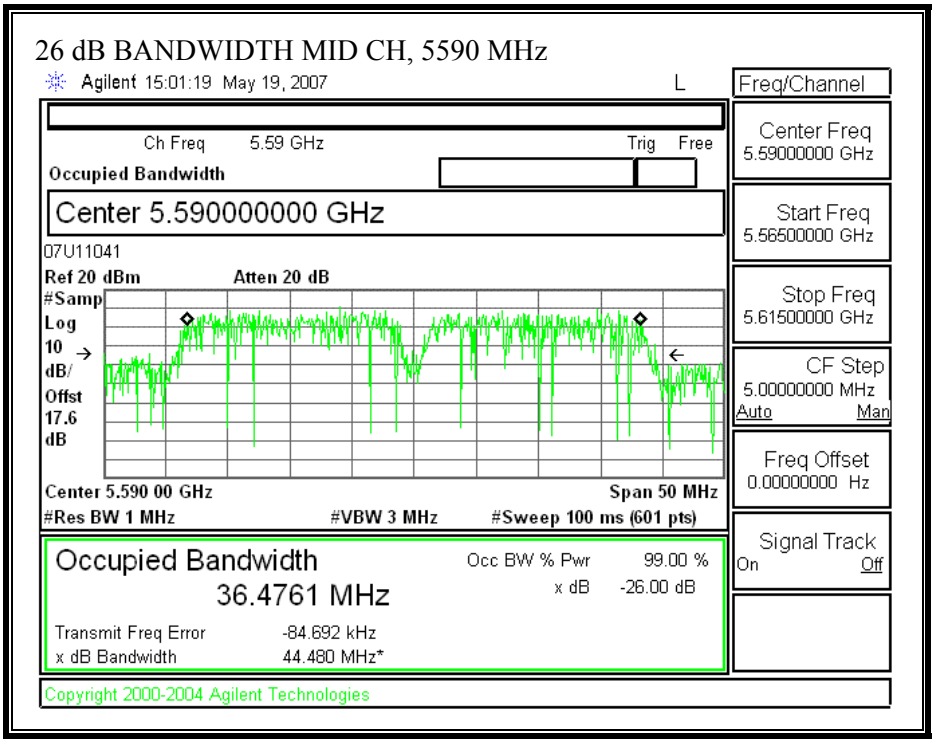

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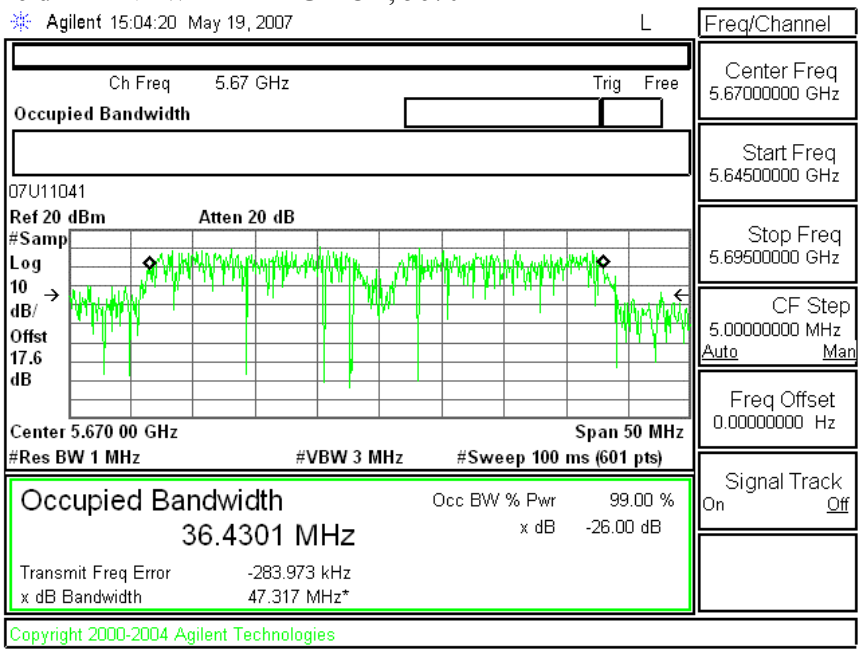
26 dB BANDWIDTH HIGH CH, 5670MHz



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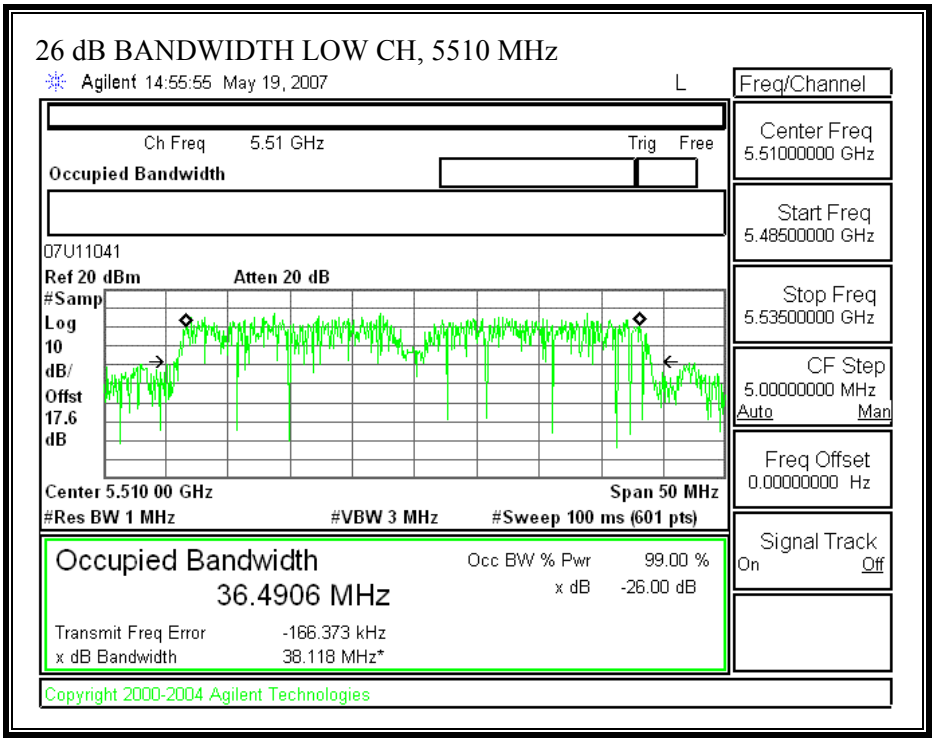
26 dB EMISSION BANDWIDTH (802.11 - 40 MHz TX BANDWIDTH- CHAIN 1)



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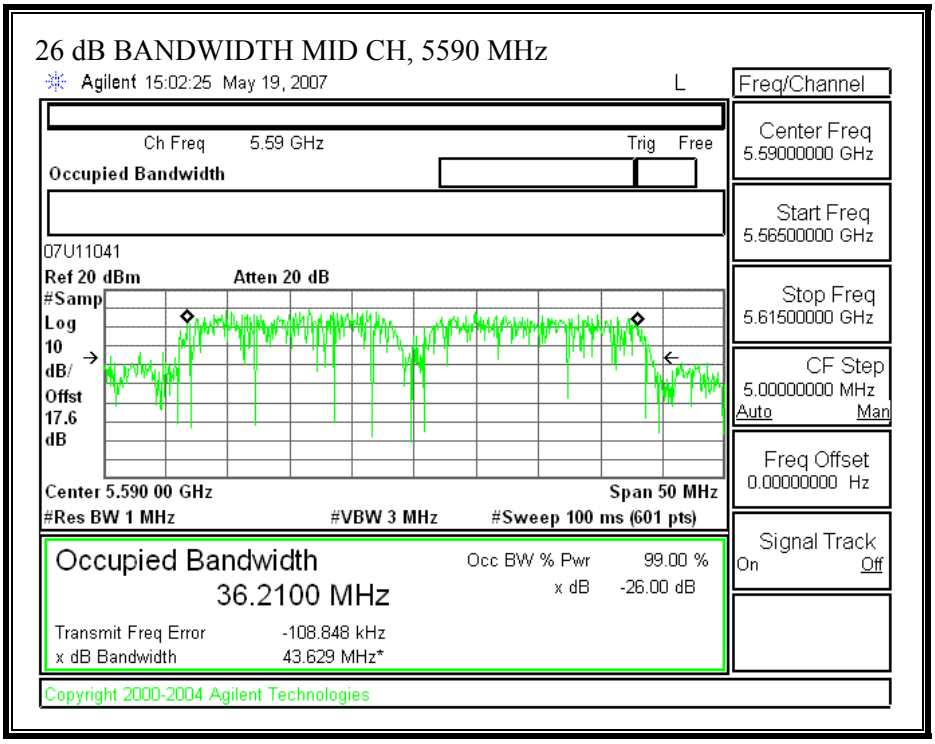

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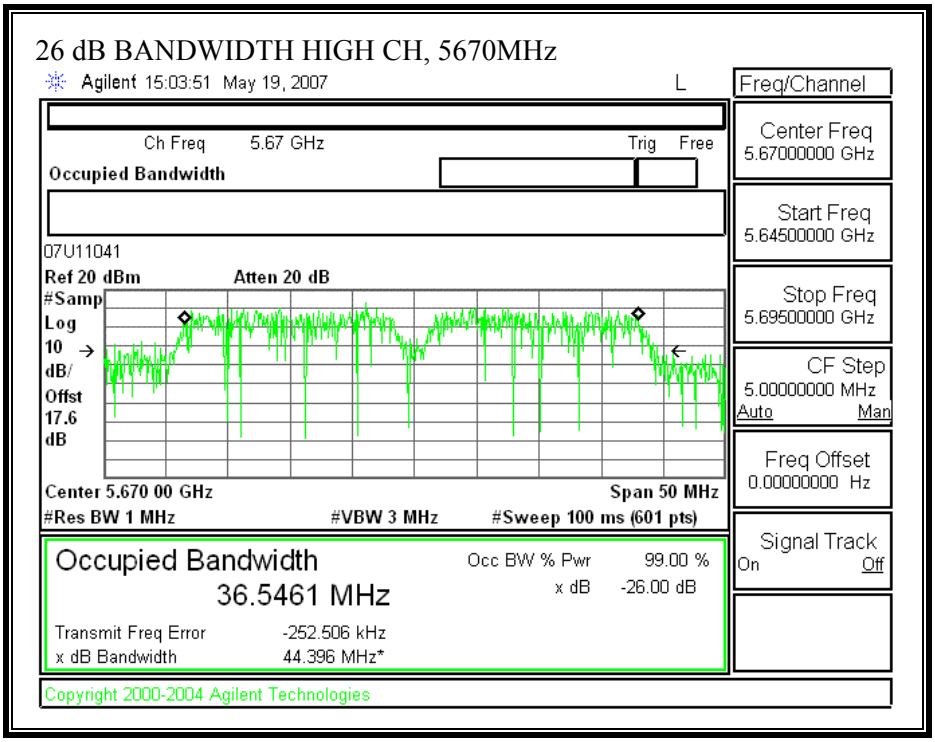

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7.4.2. PEAK POWER

LIMIT

§15.407 (a) (2) For the 5.47–5.725 GHz band, the peak transmit power over the frequency band of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26-dB emission bandwidth in MHz. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

TEST PROCEDURE

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

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

LIMITS AND RESULTS

No non-compliance noted:

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

Note: Pchain 0 and Pchain1 are in dBm

For combiner: Following formula to calculate the array gain:

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

5.470 – 5.725GHz band: 8.75dBi

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

802.11n 20 MHz CDD MCS 0 MODE

8.75dBi Antenna

Channel	Frequency (MHz)	Fixed Limit (dBm)	B Chain 0 (MHz)	B Chain 1 (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5500	24	22.655	23.607	24.552	8.750	21.250
Mid	5600	24	23.011	26.739	24.619	8.750	21.250
High	5700	24	30.014	24.773	24.940	8.750	21.250

Results

Channel	Frequency (MHz)	Power Chain 0 (dBm)	Power Chain 1 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5500	13.25	13.45	16.36	21.250	-4.889
Mid	5600	14.08	14.02	17.06	21.250	-4.190
High	5700	14.35	14.26	17.32	21.250	-3.934

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6dBi Antenna

Channel	Frequency (MHz)	Fixed Limit (dBm)	B Chain 0 (MHz)	B Chain 1 (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5500	24	22.655	23.607	24.552	6.00	24.00
Mid	5600	24	23.011	26.739	24.619	6.00	24.00
High	5700	24	30.014	24.773	24.940	6.00	24.00

Results

Channel	Frequency (MHz)	Power Chain 0 (dBm)	Power Chain 1 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5500	15.98	16.54	19.28	24.00	-4.72
Mid	5600	15.19	15.96	18.60	24.00	-5.40
High	5700	16.93	16.46	19.71	24.00	-4.29

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802.11n 40 MHz CDD MCS 32 MODE

8.75dBi antenna

Channel	Frequency (MHz)	Fixed Limit (dBm)	B Chain 0 (MHz)	B Chain 1 (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Low	5510	24	38.925	38.118	26.811	8.750	21.250
Mid	5590	24	44.480	43.629	27.398	8.750	21.250
High	5670	24	47.317	44.396	27.473	8.750	21.250

Results

Channel	Frequency (MHz)	Power Chain 0 (dBm)	Power Chain 1 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Low	5510	15.56	15.59	18.59	21.250	-2.665
Mid	5590	18.26	17.71	21.00	21.250	-0.246
High	5670	15.46	16.44	18.99	21.250	-2.262

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6dBi antenna

Note: The low channel utilizes the same power level for all antennas. Data in the table below only shows the differences for the mid and high channels.

Channel	Frequency (MHz)	Fixed Limit (dBm)	B Chain 0 (MHz)	B Chain 1 (MHz)	11 + 10 Log B Limit (dBm)	Antenna Gain (dBi)	Limit (dBm)
Mid	5590	24	36.476	36.210	26.588	6.00	24.00
High	5670	24	47.317	44.396	27.473	6.00	24.00

Results

Channel	Frequency (MHz)	Power Chain 0 (dBm)	Power Chain 1 (dBm)	Total Power (dBm)	Limit (dBm)	Margin (dB)
Mid	5590	19.53	19.39	22.47	24.00	-1.53
High	5670	19.30	19.67	22.50	24.00	-1.50

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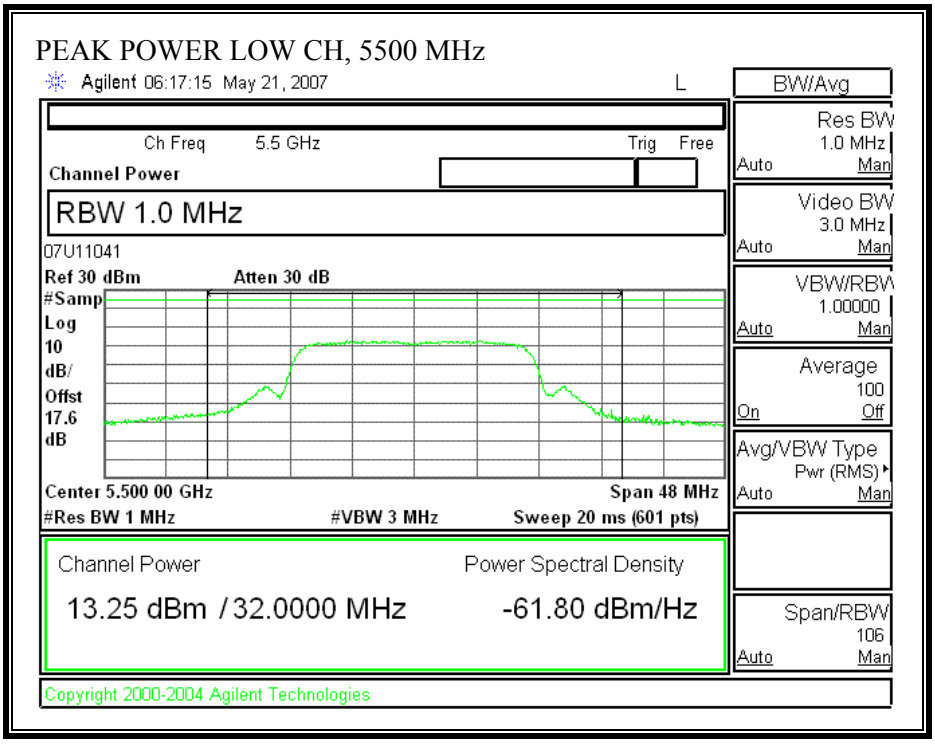
802.11n 20 MHz CDD MCS 0 MODE

8.75dBi Antenna

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



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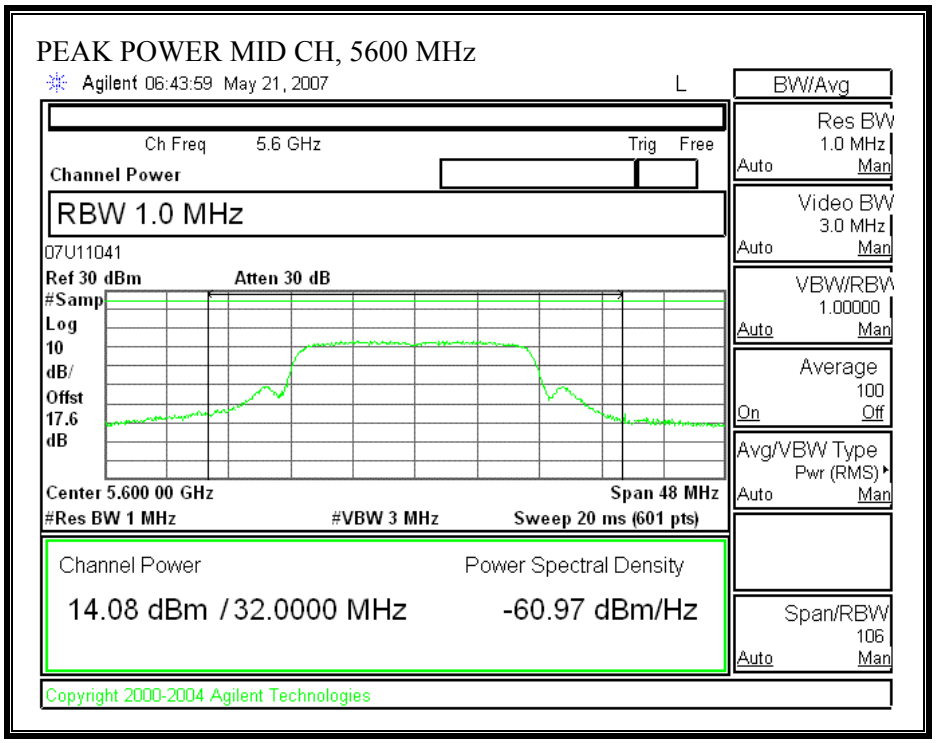
PEAK POWER MID CH, 5600 MHz



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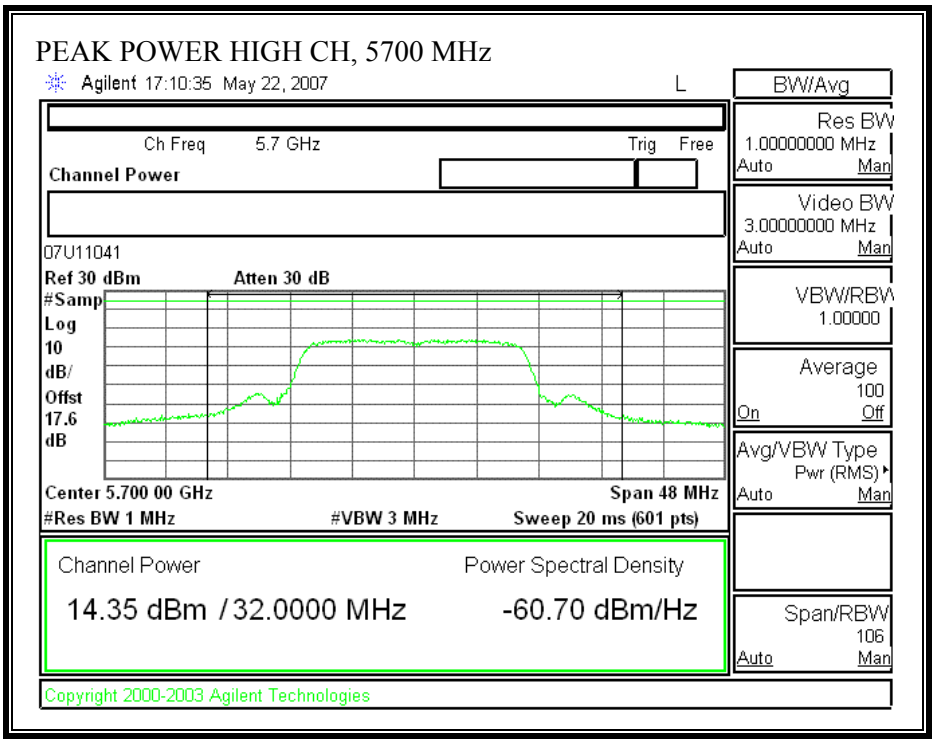

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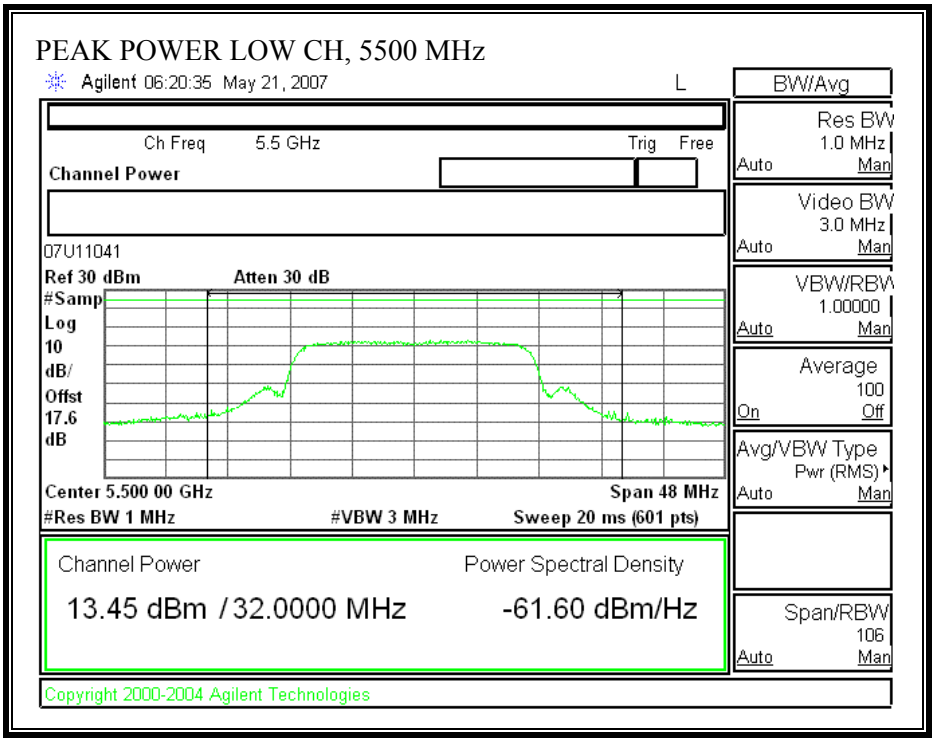
PEAK POWER (802.11 – 20MHz TX BANDWIDTH – CHAIN 1)



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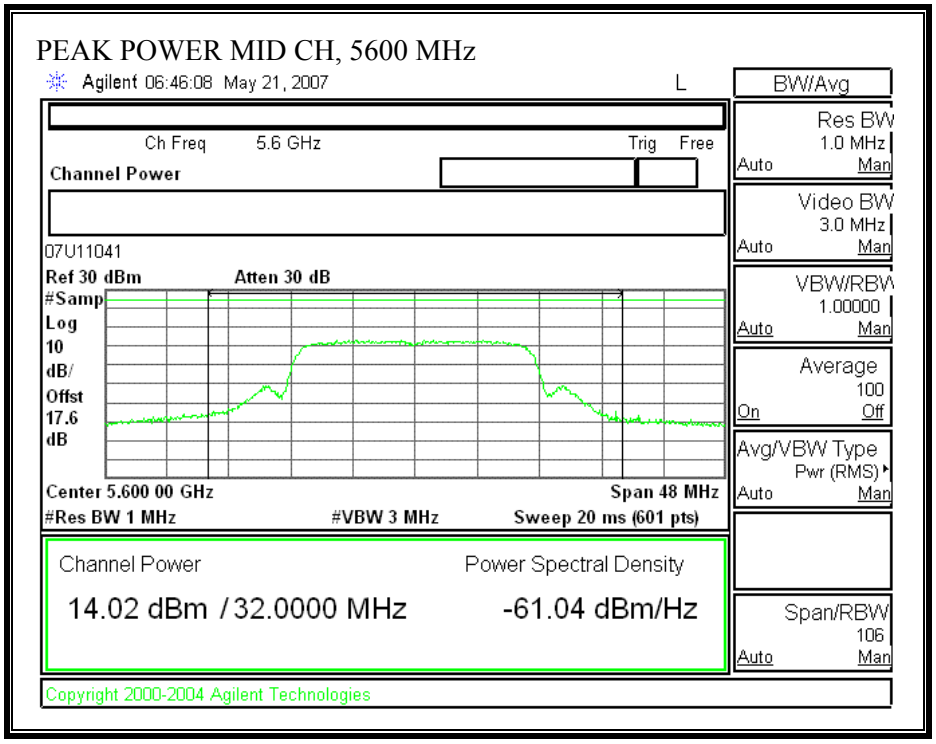
PEAK POWER MID CH, 5600 MHz



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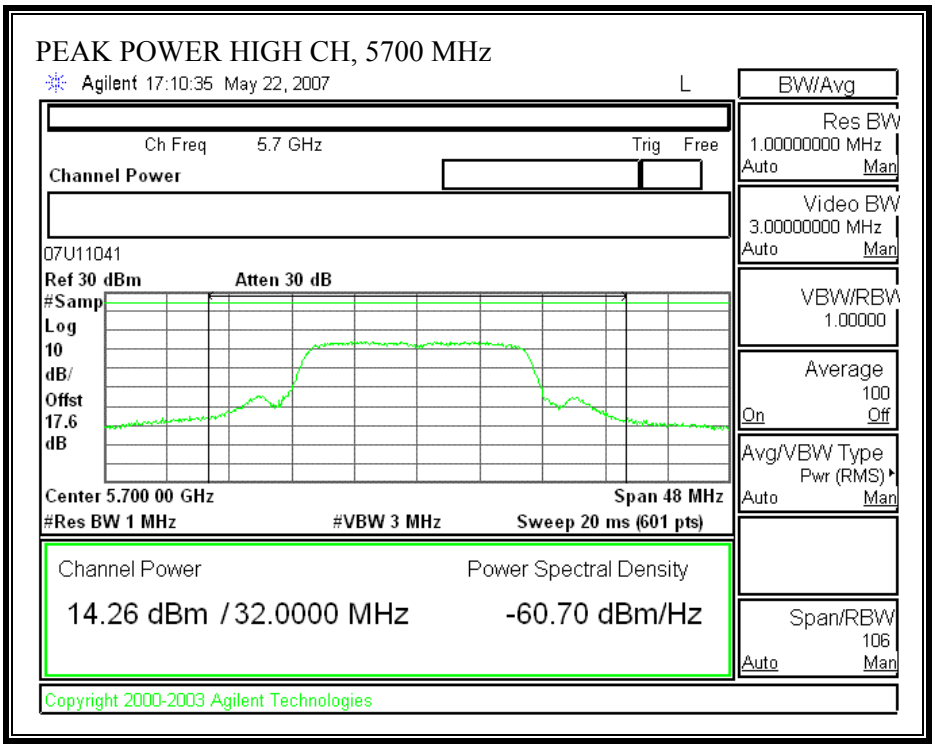

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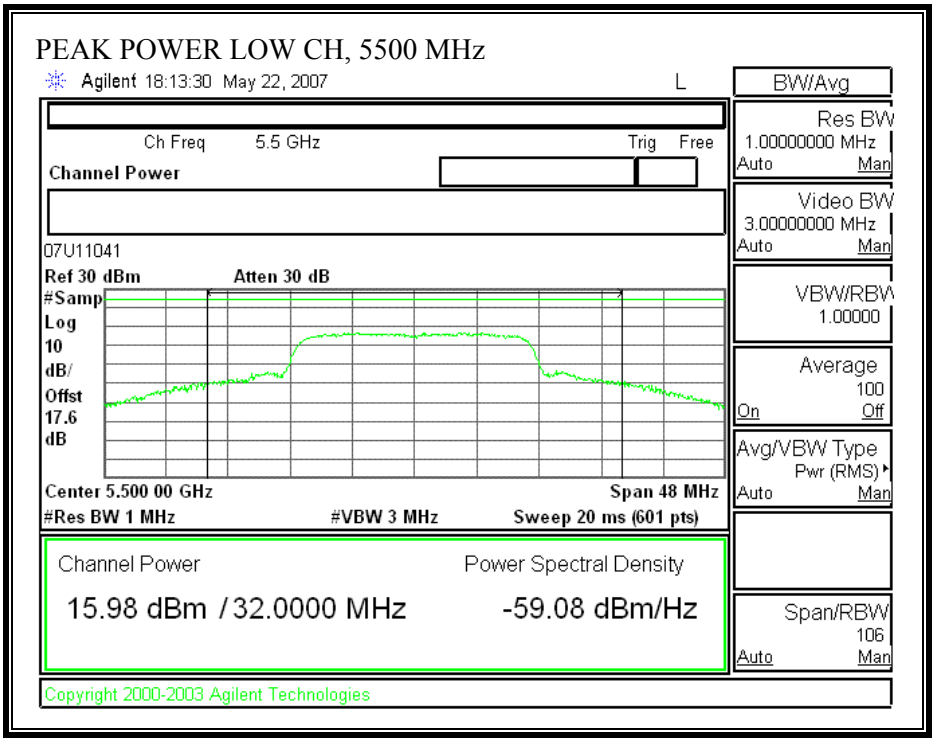
6dBi Antenna

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



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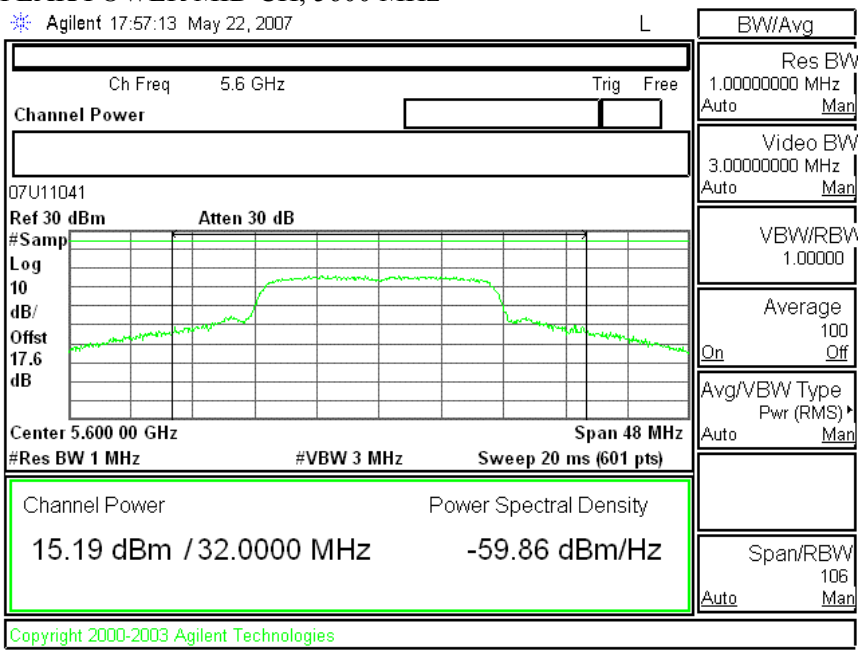
PEAK POWER MID CH, 5600 MHz



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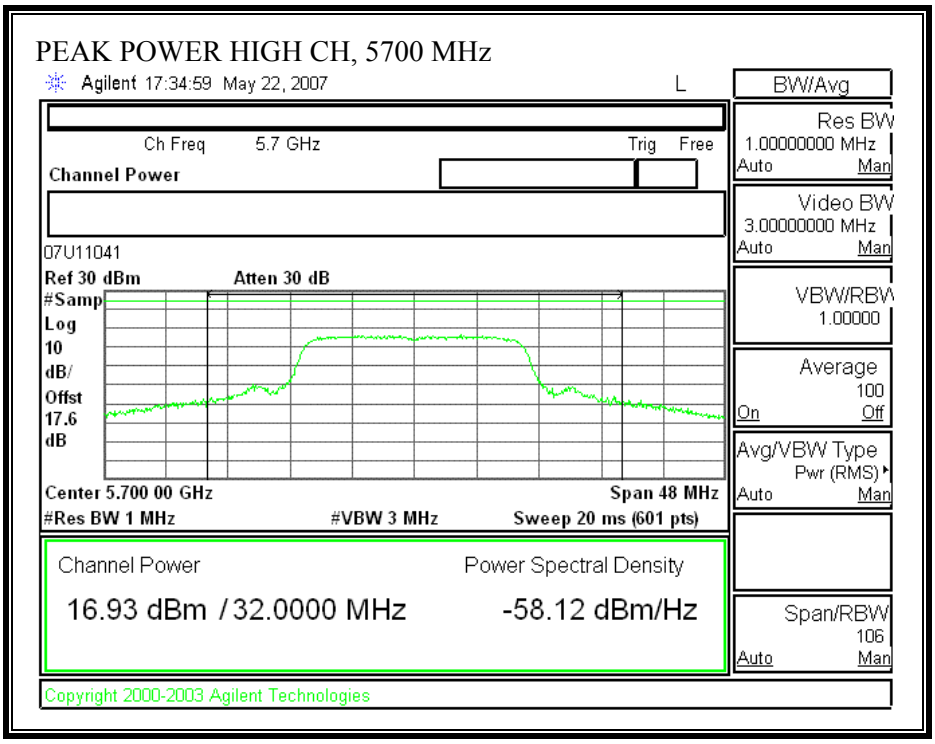
PEAK POWER HIGH CH, 5700 MHz



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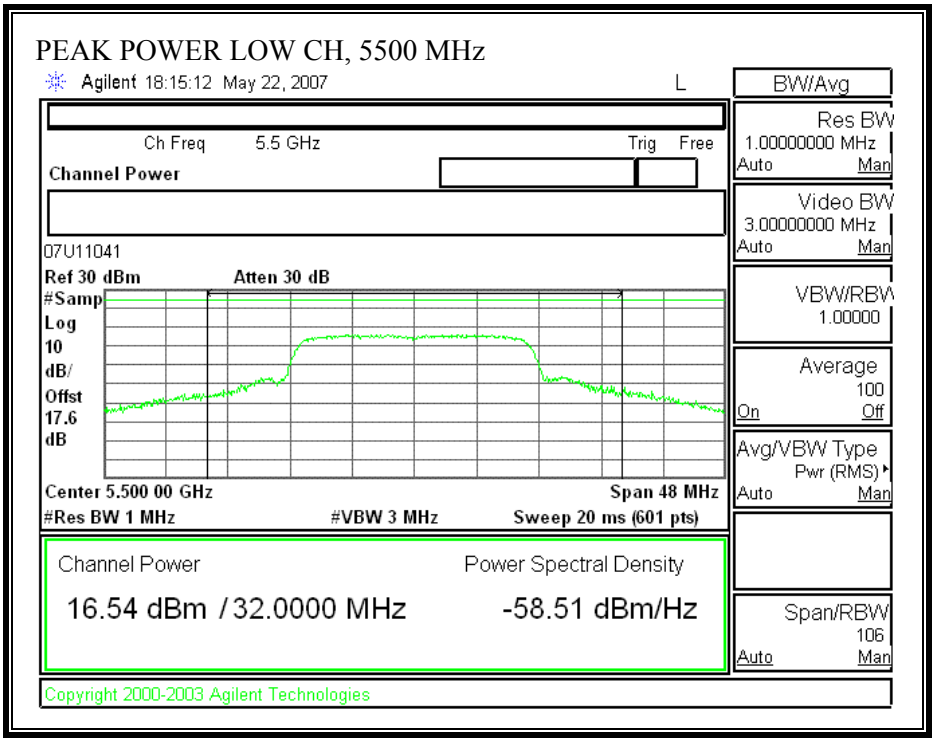
PEAK POWER (802.11 – 20MHz TX BANDWIDTH – CHAIN 1)



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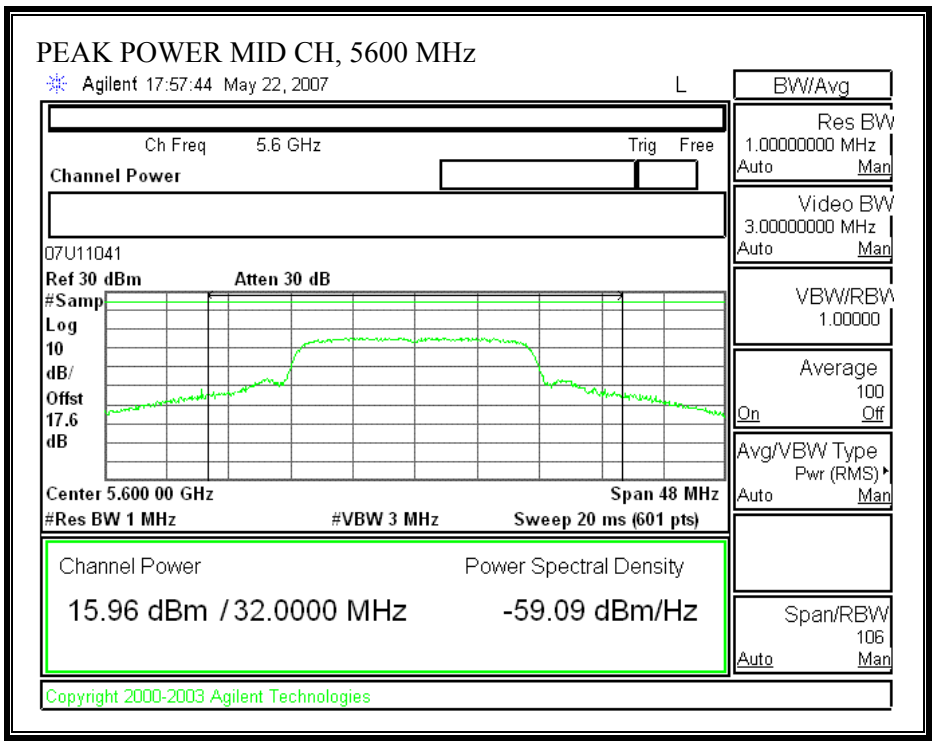

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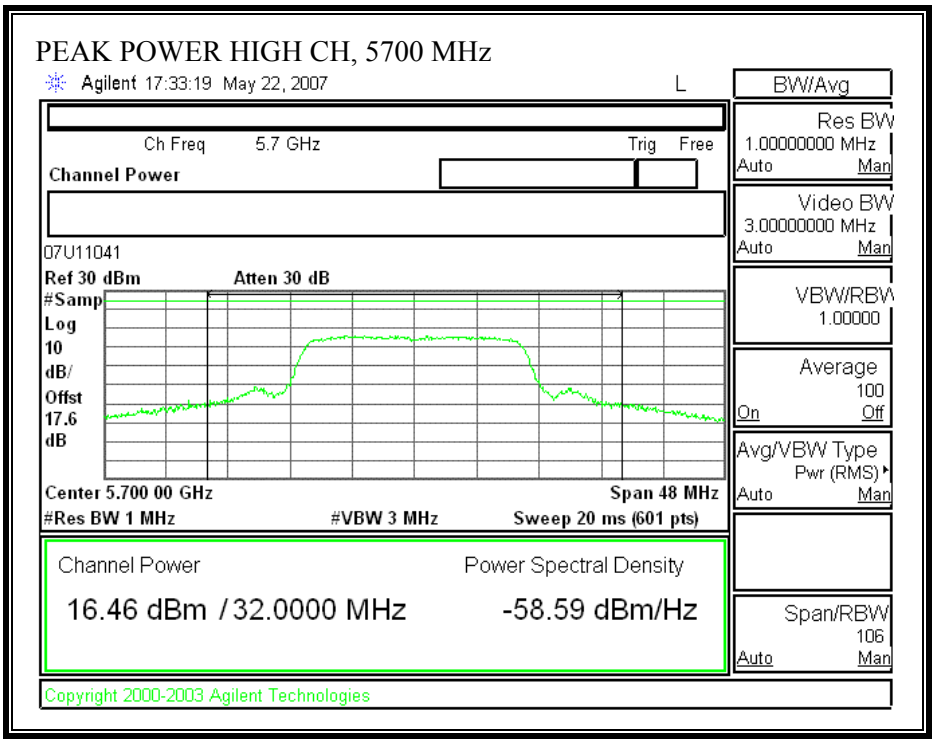
PEAK POWER HIGH CH, 5700 MHz



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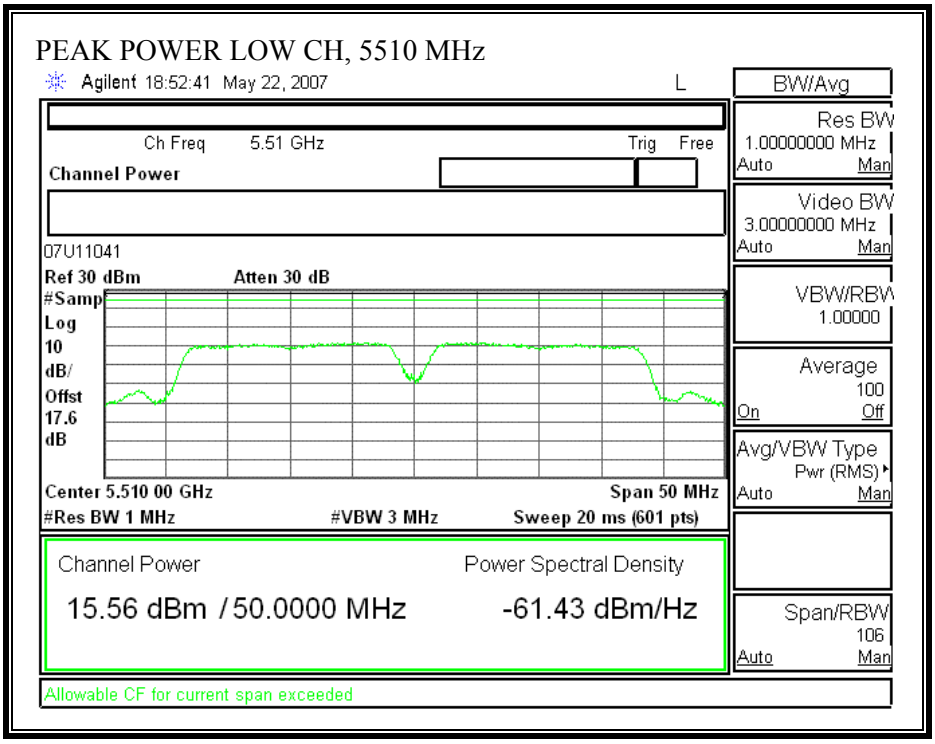
802.11n 40 MHz CDD MCS 32 MODE

8.75dBi antenna

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



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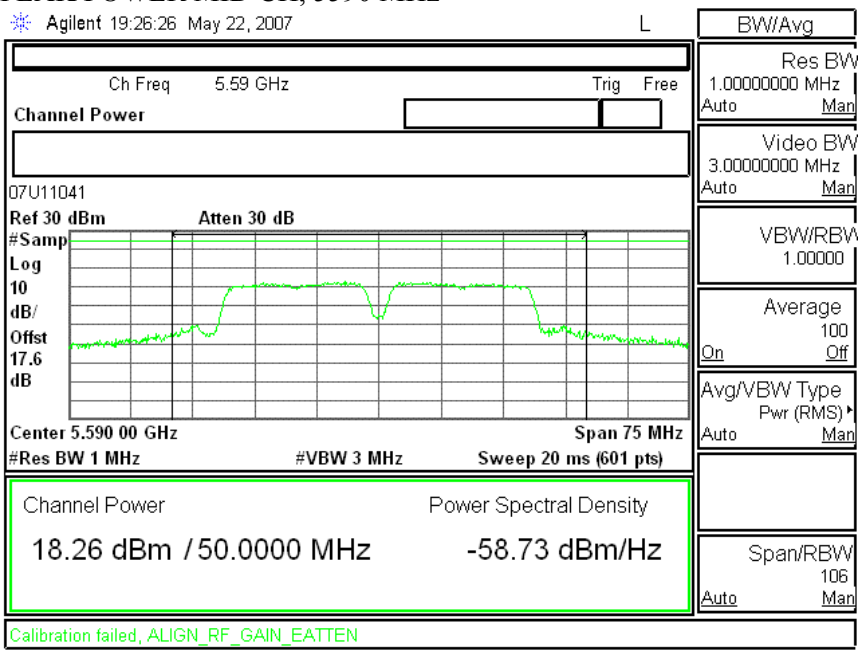
PEAK POWER MID CH, 5590 MHz



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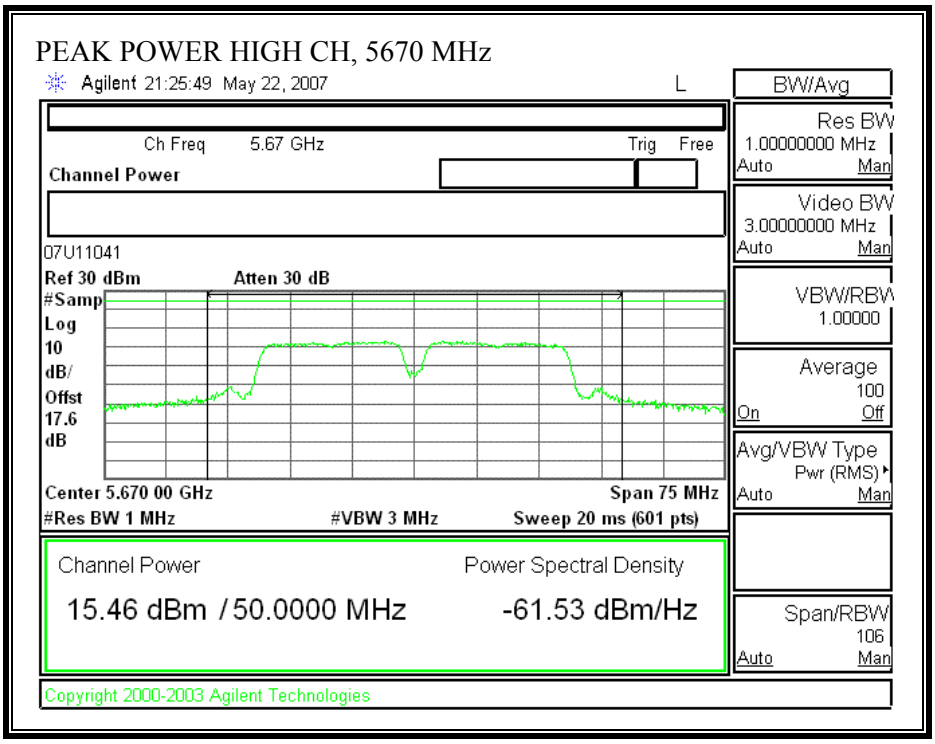
PEAK POWER HIGH CH, 5670 MHz



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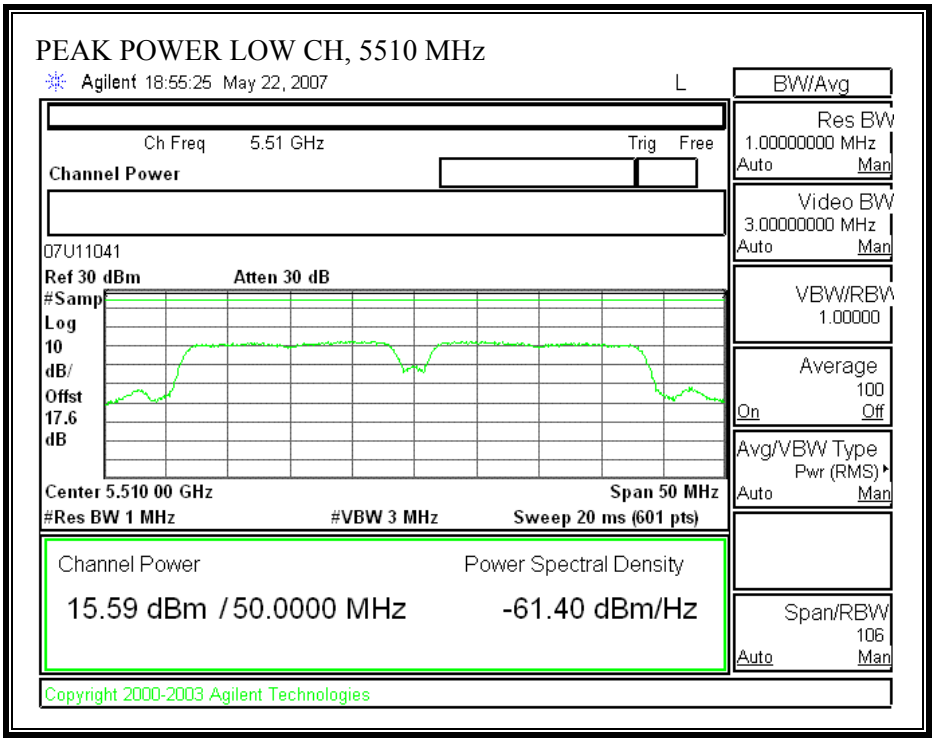
PEAK POWER (802.11 – 40MHz TX BANDWIDTH – CHAIN 1)



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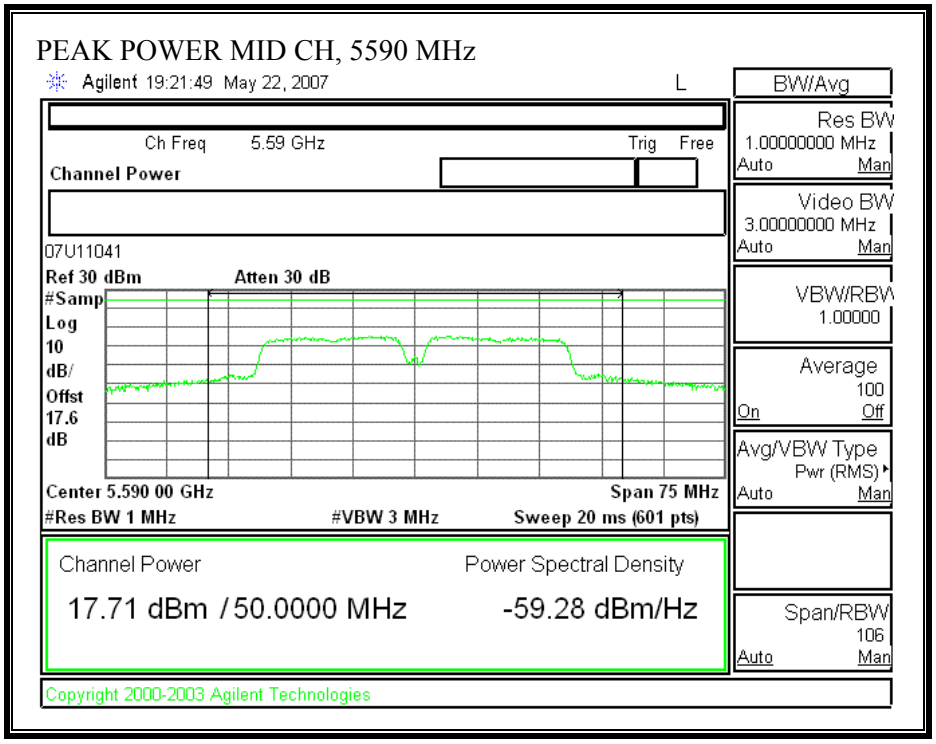
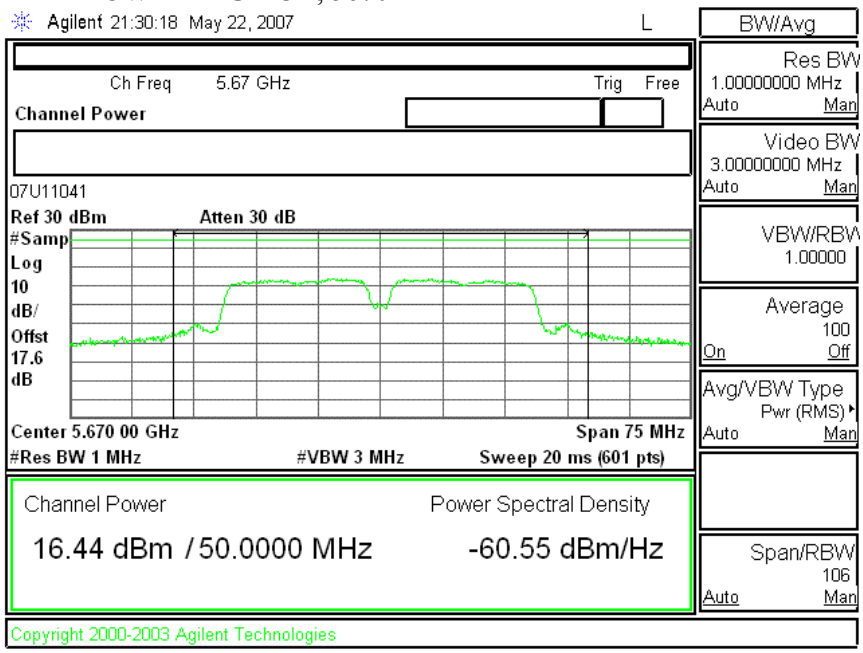
PEAK POWER MID CH, 5590 MHz



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

PEAK POWER HIGH CH, 5670 MHz



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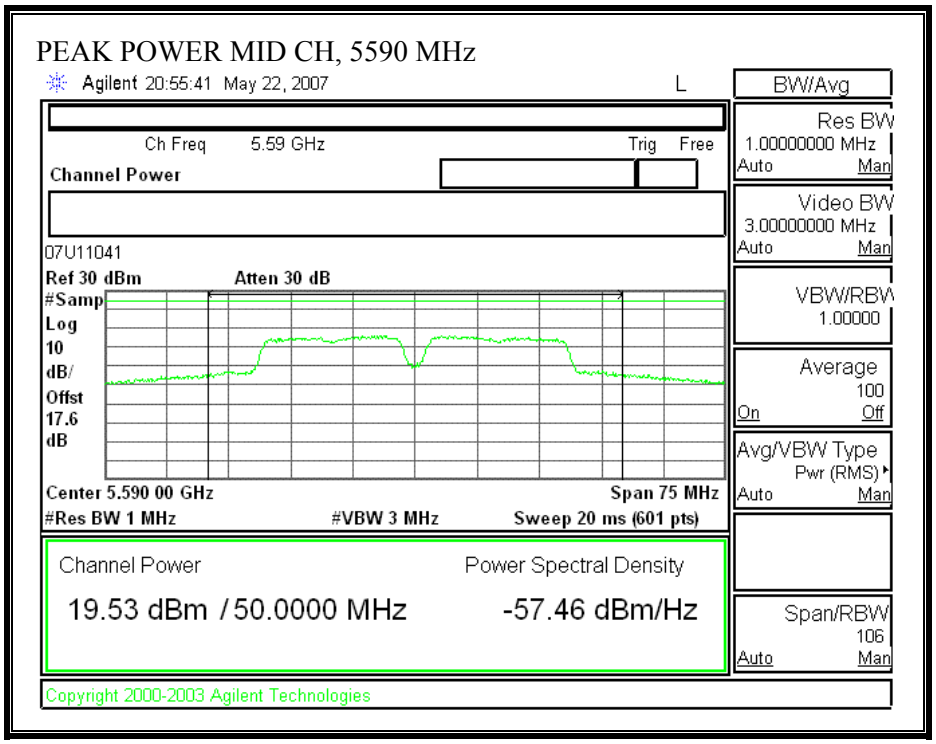
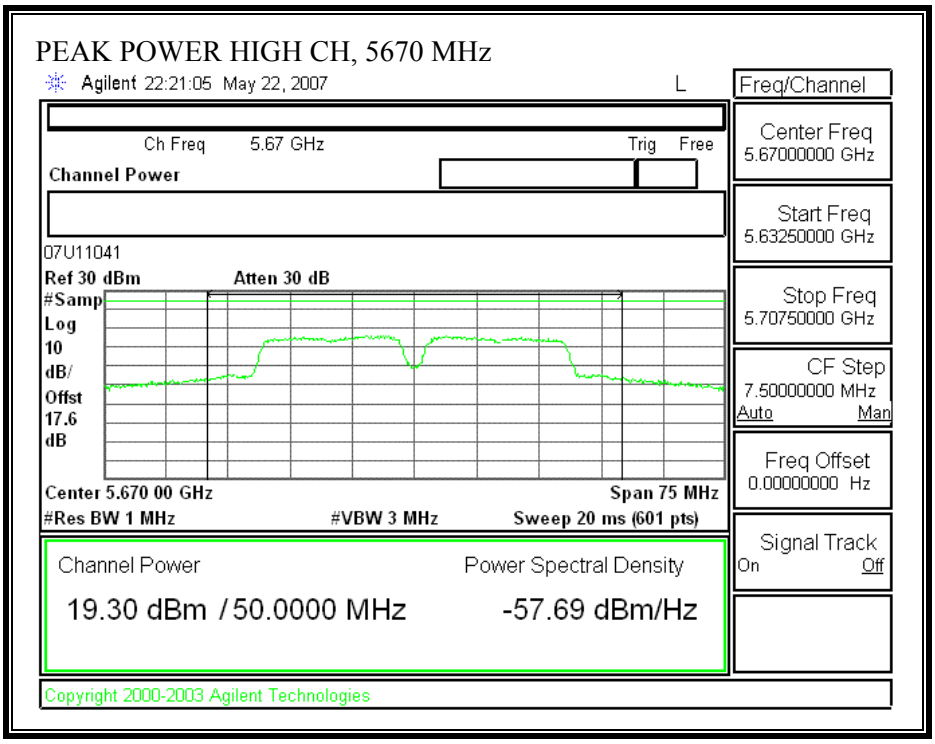
6dBi Antenna

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



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

PEAK POWER HIGH CH, 5670 MHz



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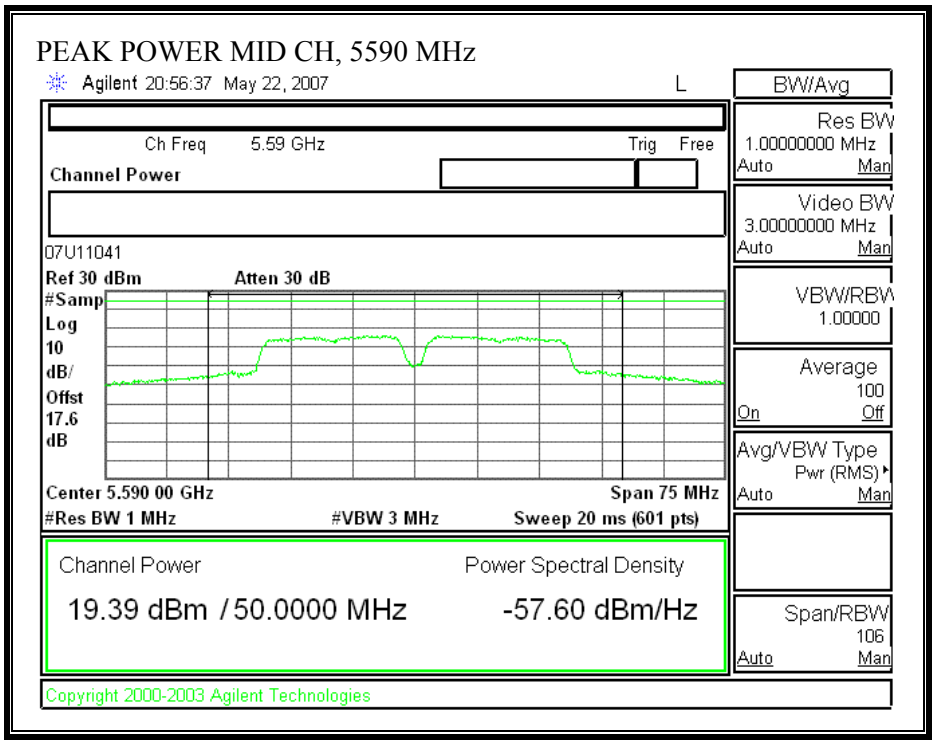
PEAK POWER (802.11 – 40MHz TX BANDWIDTH – CHAIN 1)



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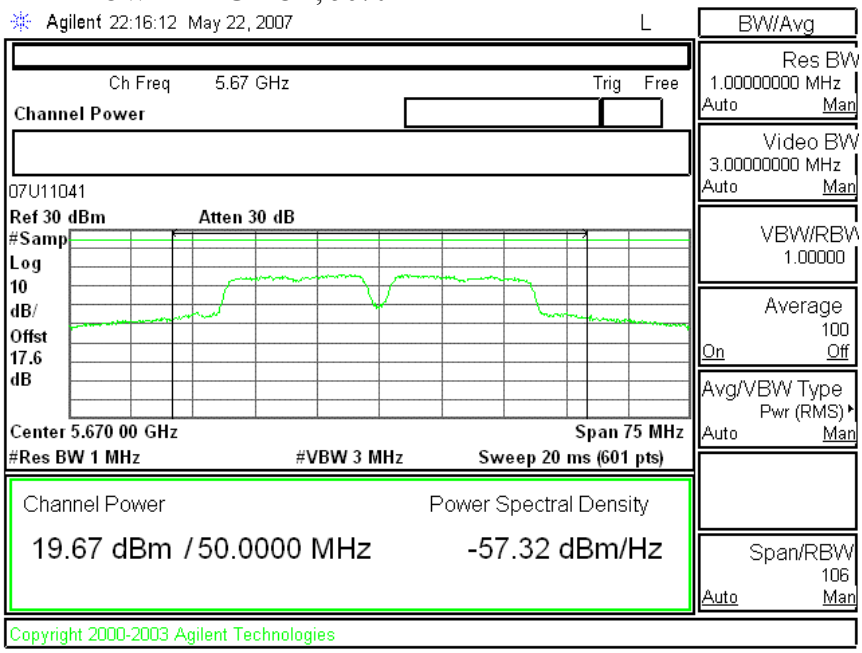
PEAK POWER HIGH CH, 5670 MHz



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7.4.3. MAXIMUM PERMISSIBLE EXPOSURE

LIMITS

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

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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

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

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

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

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

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

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CALCULATIONS

Given

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

and

$S = E ^ 2 / 3770$

where

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

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

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

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

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

yields

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

where

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

Substituting the logarithmic form of power and gain using:

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

yields

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

where

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

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

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

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LIMITS

From §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm^2 in the 5.6 GHz band

RESULTS

No non-compliance noted

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

802.11n 20 MHz CDD MCS 0 MODE

8.75dBi Antenna

Mode	MPE Distance (cm)	Total Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
802.11n 20 MHz CDD	20.0	17.32	8.750	0.08

6dBi Antenna

Mode	MPE Distance (cm)	Total Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
802.11n 20 MHz CDD	20.0	19.71	6.00	0.07

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802.11n 40 MHz CDD MCS 32 MODE

8.75dBi Antenna

Mode	MPE Distance (cm)	Total Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
802.11n 40 MHz CDD	20.0	21.00	8.750	0.19

6dBi Antenna

Mode	MPE Distance (cm)	Total Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
802.11n 40 MHz CDD	20.0	22.50	6.00	0.14

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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7.4.4. PEAK POWER SPECTRAL DENSITY

LIMIT

§15.407 (a) (2) For the 5.47–5.725 GHz band, the peak power spectral density shall not exceed 11 dBm in any 1-MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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

TEST PROCEDURE

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

For combiner: Following formula to calculate the array gain:

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

5.470 – 5.725GHz band: 8.75dBi, limit = 8.25 dBm

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

802.11n 20 MHz CDD

8.555dBi Antenna

Channel	Frequency (MHz)	PPSD Chain 0 (dBm)	PPSD Chain 1 (dBm)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Low	5500	2.865	2.736	5.811	8.250	-2.439
Middle	5600	3.051	2.677	5.878	8.250	-2.372
High	5700	3.698	3.164	6.450	8.250	-1.800

COMBINER (8.555dBi antenna)

Channel	Frequency (MHz)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Low	5500	7.930	8.250	-0.320
Middle	5600	7.790	8.250	-0.460
High	5700	7.904	8.250	-0.346

6dBi Antenna

Channel	Frequency (MHz)	PPSD Chain 0 (dBm)	PPSD Chain 1 (dBm)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Low	5500	6.933	5.626	9.339	11.000	-1.661
Middle	5600	6.443	6.429	9.446	11.000	-1.554
High	5700	5.700	5.882	8.802	11.000	-2.198

COMBINER (6dBi antenna)

Channel	Frequency (MHz)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Low	5500	10.235	11.000	-0.765
Middle	5600	10.816	11.000	-0.184
High	5700	10.272	11.000	-0.728

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802.11n 40 MHz CDD

Note: The low channel utilizes the same power level for all antennas. Data for the 6 dBi antenna gain in the table below only shows the differences for the mid and high channels.

8.555dBi Antenna

Channel	Frequency (MHz)	PPSD Chain 0 (dBm)	PPSD Chain 1 (dBm)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Low	5510	1.522	2.317	4.948	8.250	-3.302
Middle	5590	4.028	4.997	7.550	8.250	-0.700
High	5670	4.159	4.379	7.281	8.250	-0.969

COMBINER (8.622dBi antenna)

Channel	Frequency (MHz)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Low	5510	7.204	8.250	-1.046
Middle	5590	8.355	8.250	0.105
High	5670	8.380	8.250	0.130

6dBi Antenna

Channel	Frequency (MHz)	PPSD Chain 0 (dBm)	PPSD Chain 1 (dBm)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Middle	5590	4.755	4.885	7.831	11.000	-3.169
High	5670	6.237	6.446	9.353	11.000	-1.647

COMBINER (6dBi antenna)

Channel	Frequency (MHz)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Middle	5590	9.744	11.000	-1.256
High	5670	10.657	11.000	-0.343

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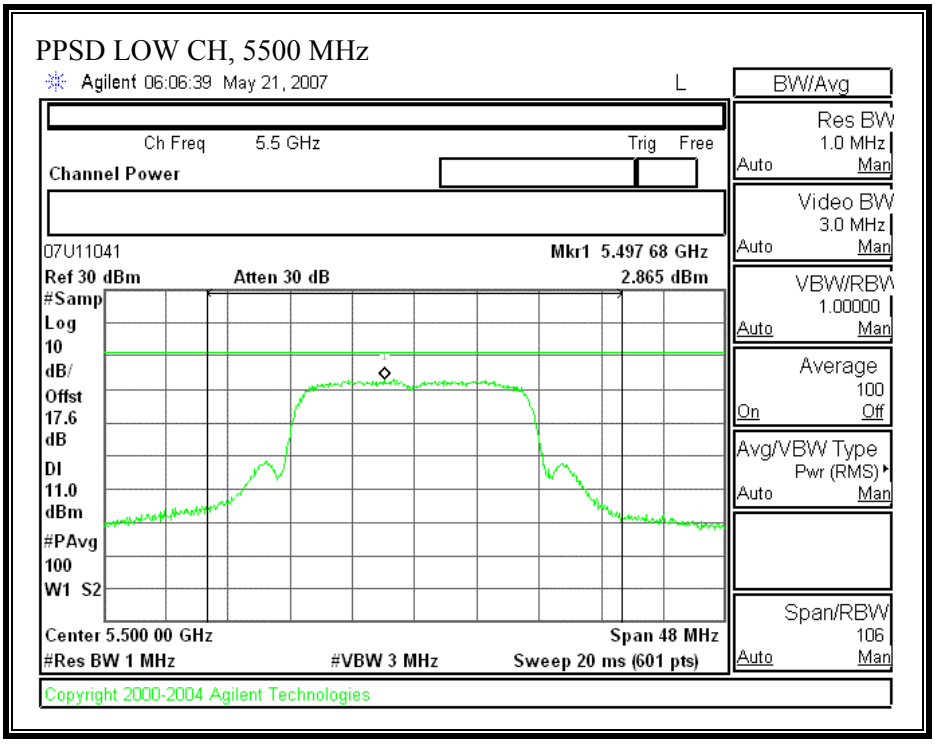
802.11n 20 MHz CDD MCS 0 MODE

8.75dBi Antenna

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



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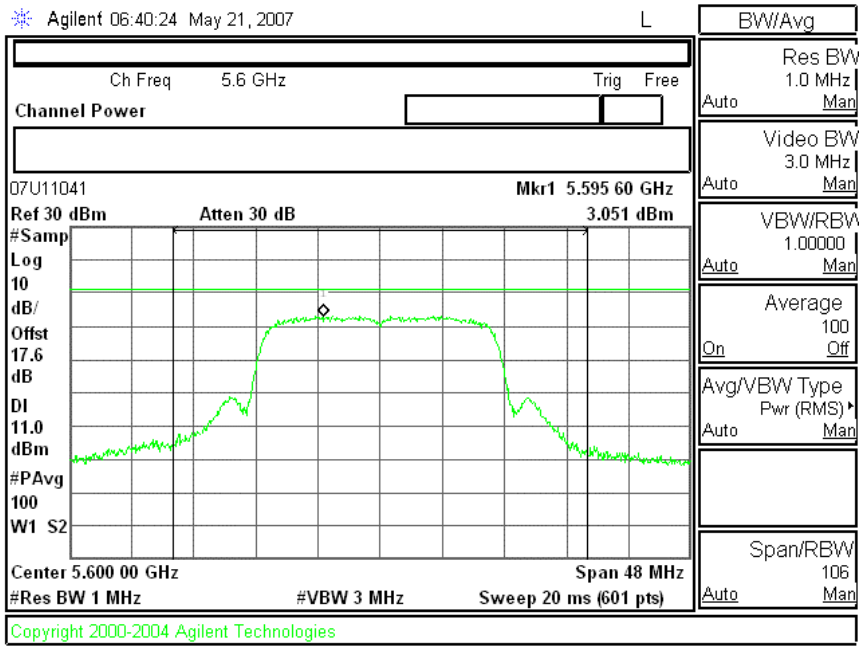
PPSD MID CH, 5600 MHz



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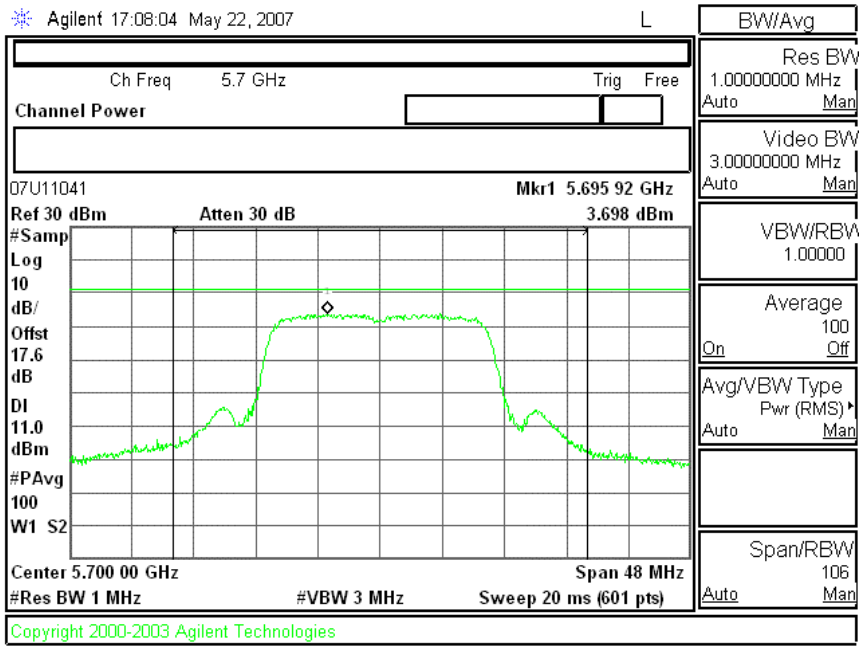
PPSD HIGH CH, 5700 MHz



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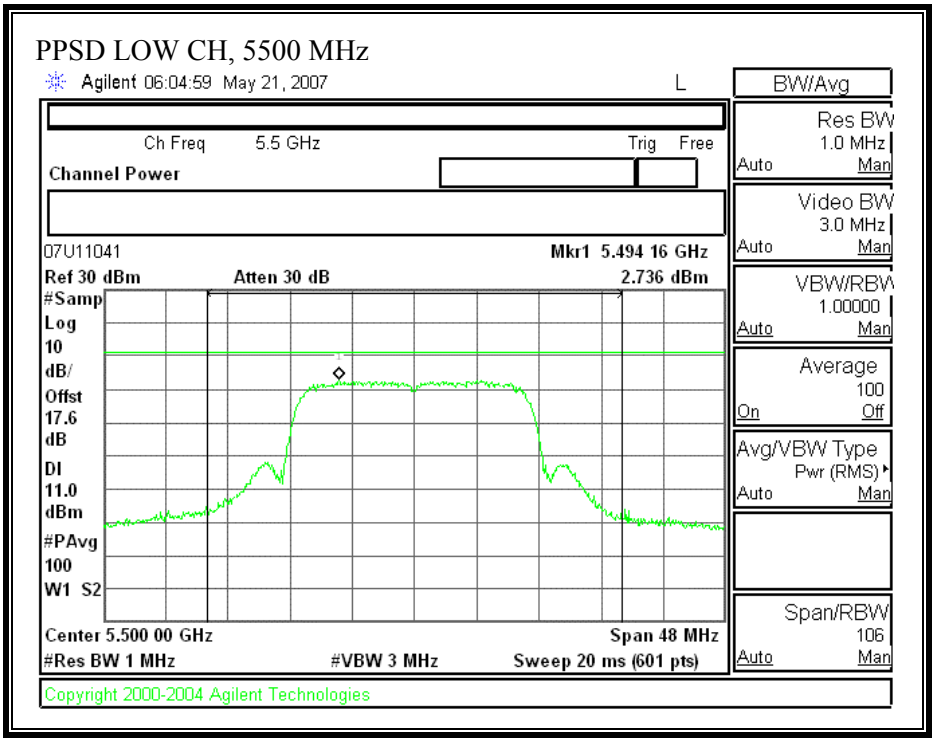
PEAK POWER SPECTRAL DENSITY (802.11 - 20 MHz TX BANDWIDTH – CHAIN 1)



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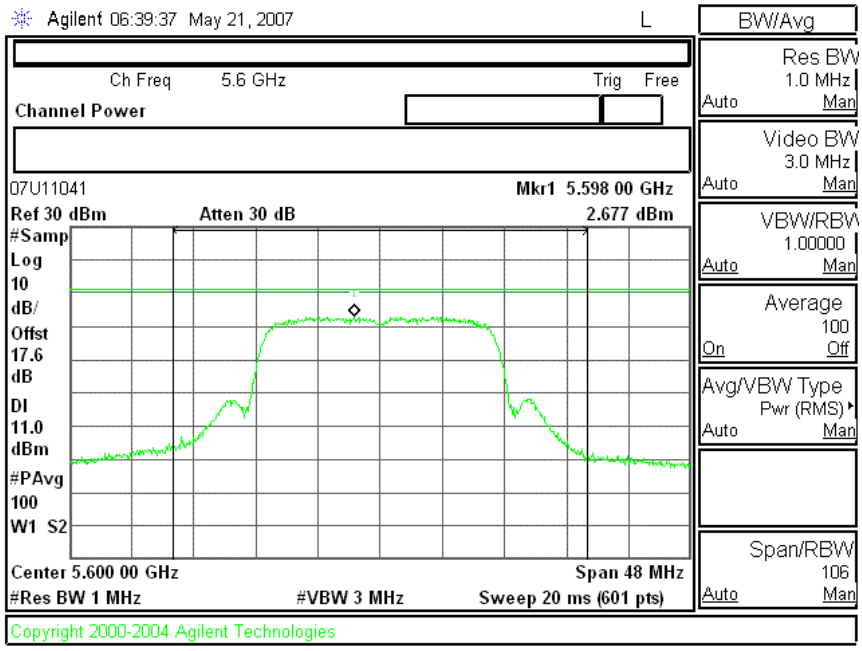
PPSD MID CH, 5600 MHz



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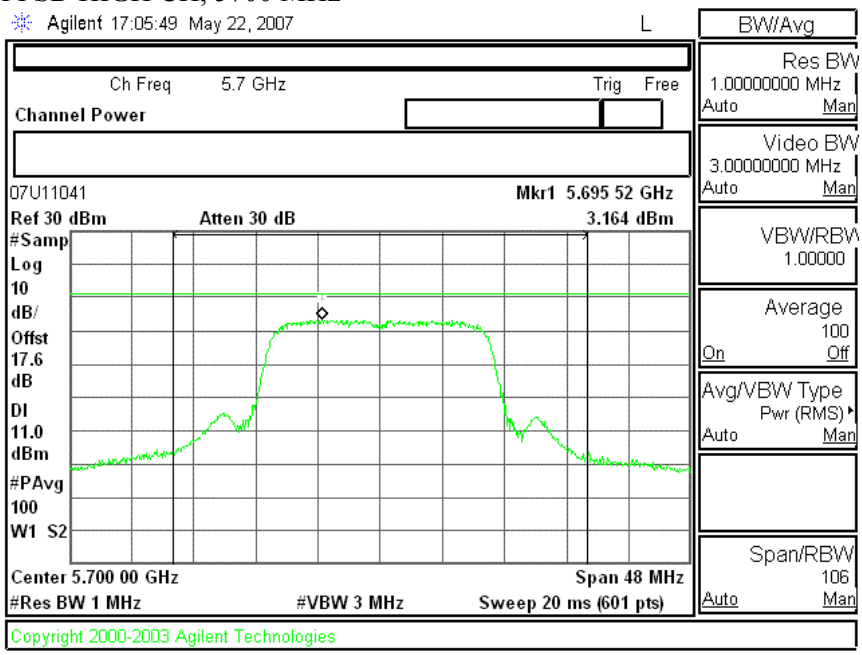
PPSD HIGH CH, 5700 MHz



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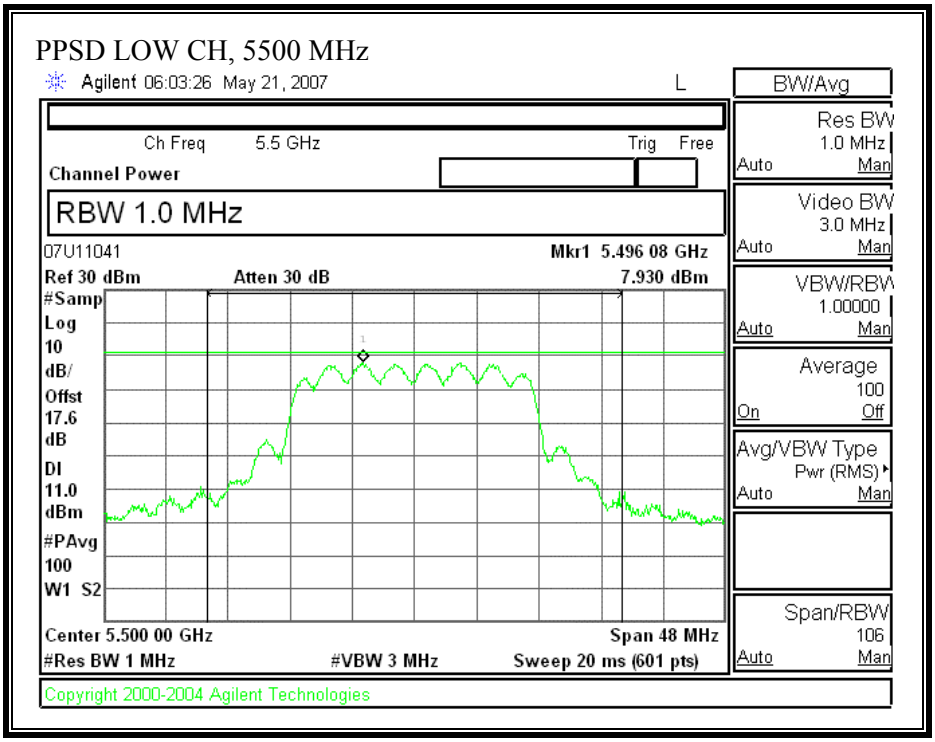
PEAK POWER SPECTRAL DENSITY (802.11 - 20 MHz TX BANDWIDTH – COMNINER)



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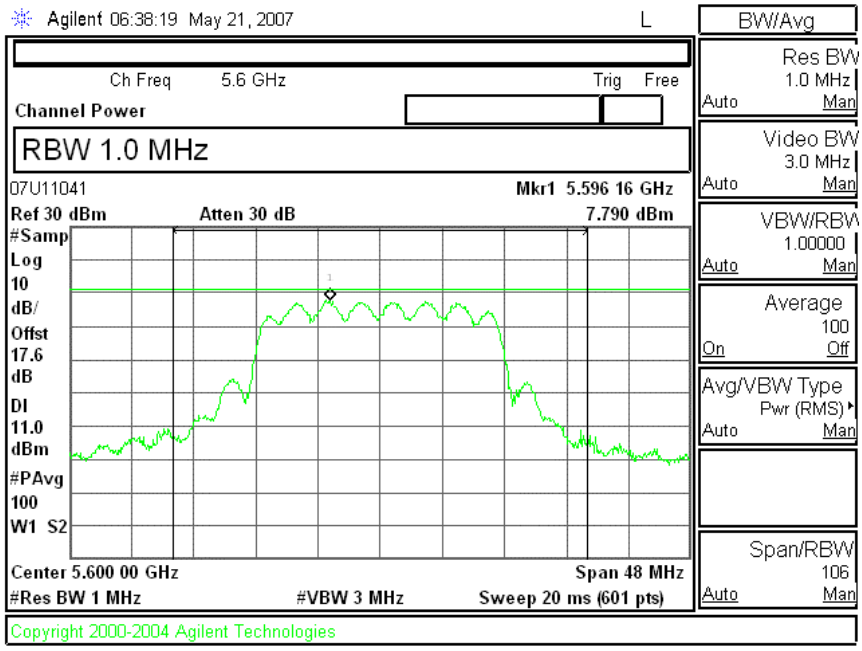
PPSD MID CH, 5600 MHz



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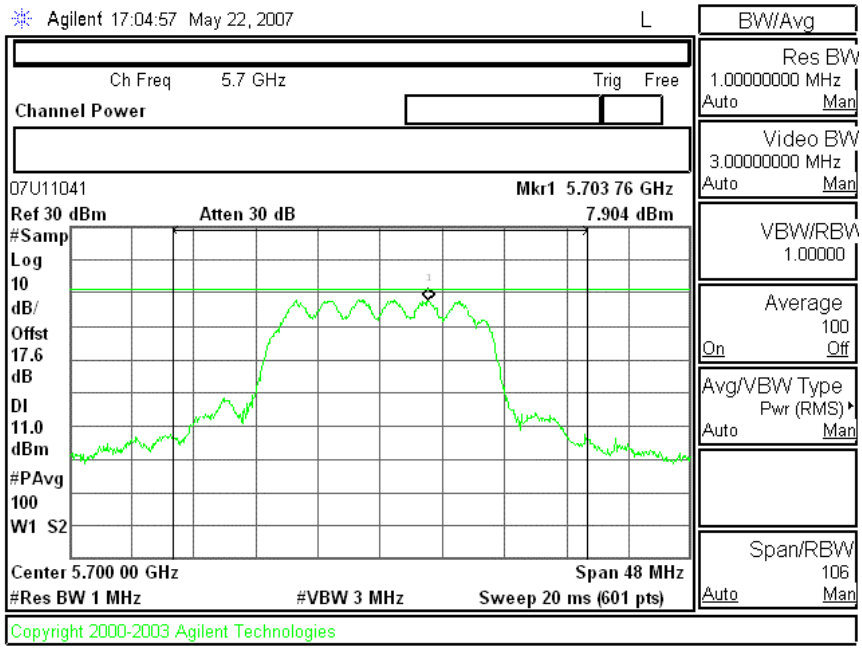
PPSD HIGH CH, 5700 MHz



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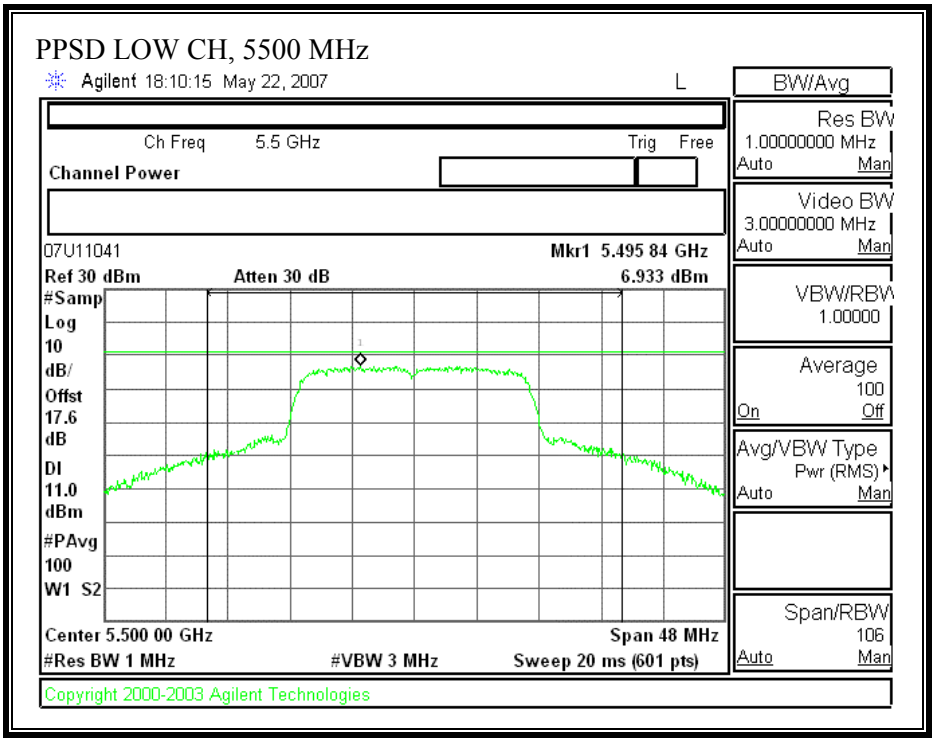
6dBi Antenna

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



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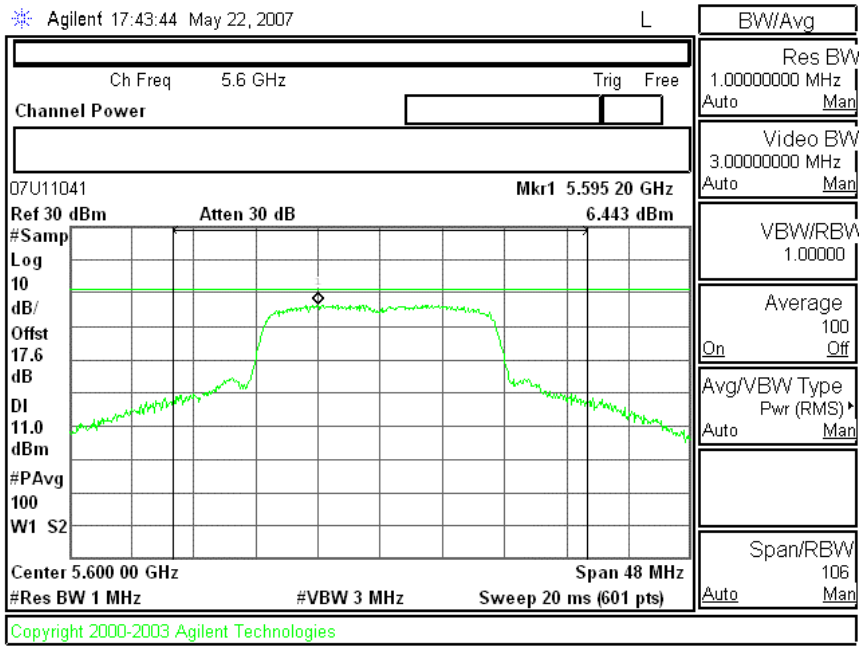
PPSD MID CH, 5600 MHz



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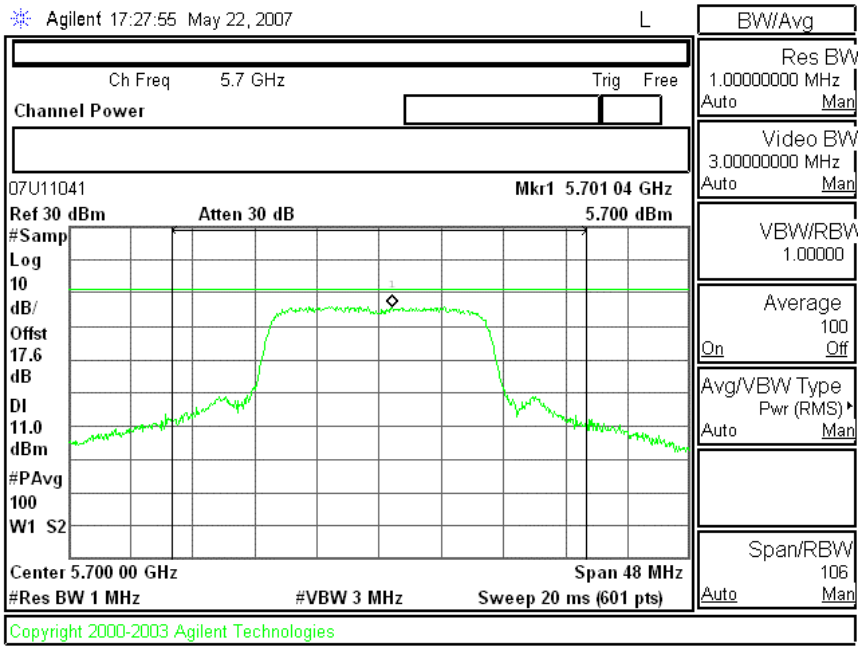
PPSD HIGH CH, 5700 MHz



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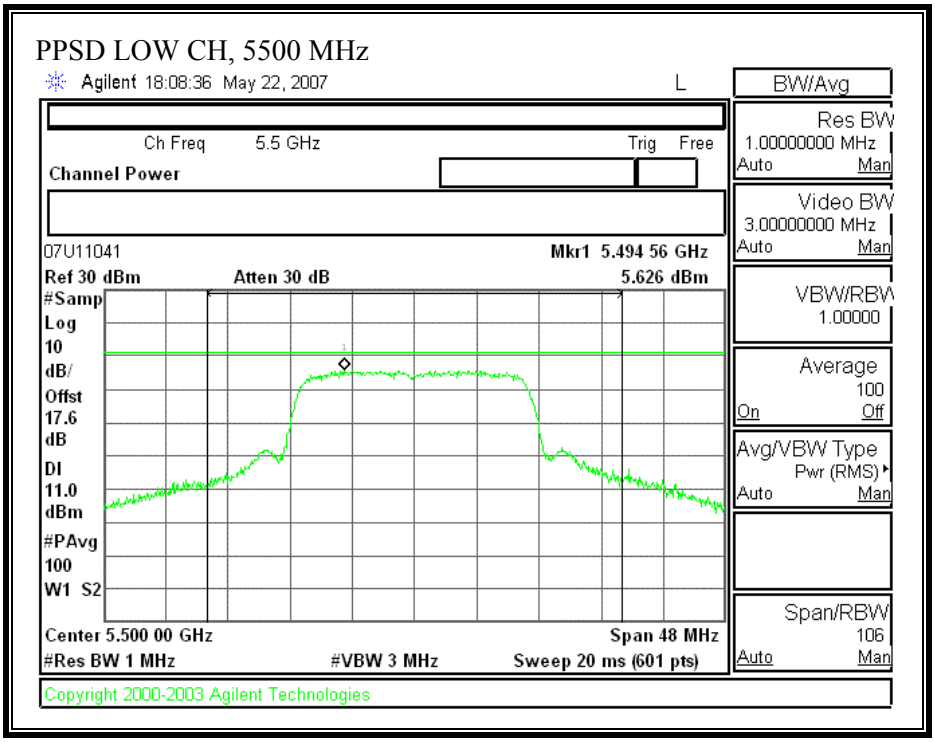
PEAK POWER SPECTRAL DENSITY (802.11 - 20 MHz TX BANDWIDTH – CHAIN 1)



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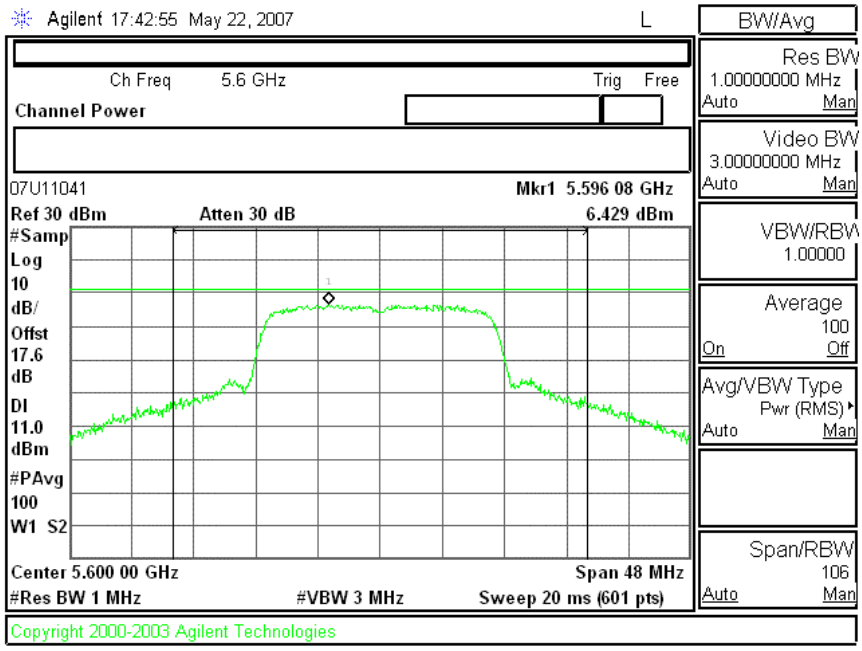
PPSD MID CH, 5600 MHz



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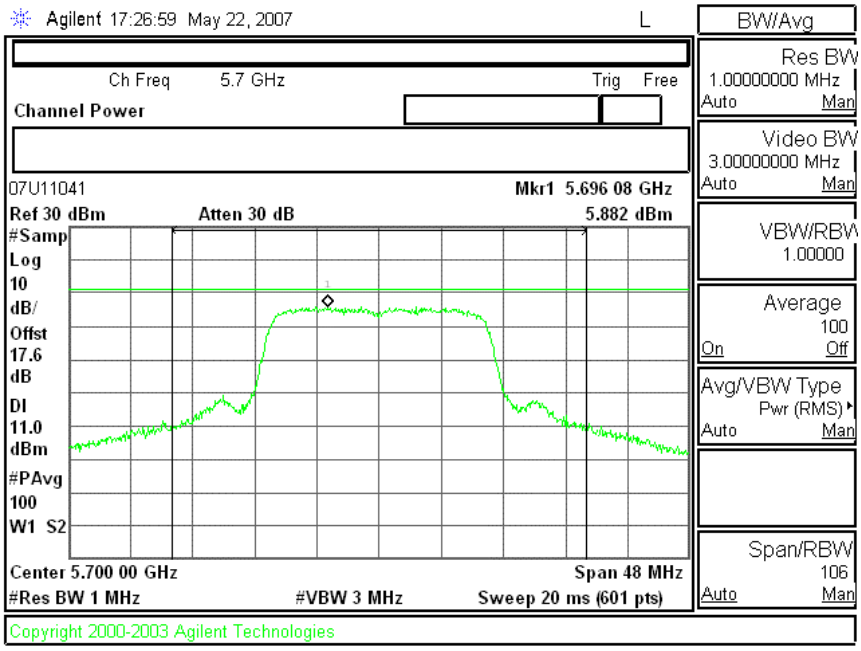
PPSD HIGH CH, 5700 MHz



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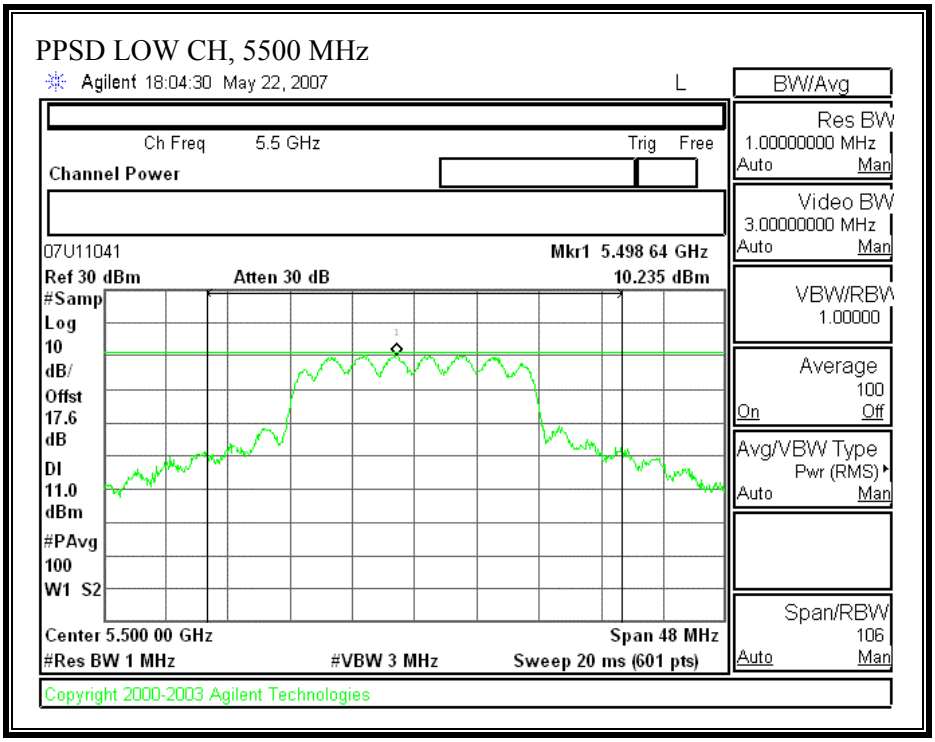
PEAK POWER SPECTRAL DENSITY (802.11 - 20 MHz TX BANDWIDTH – COMBINER)



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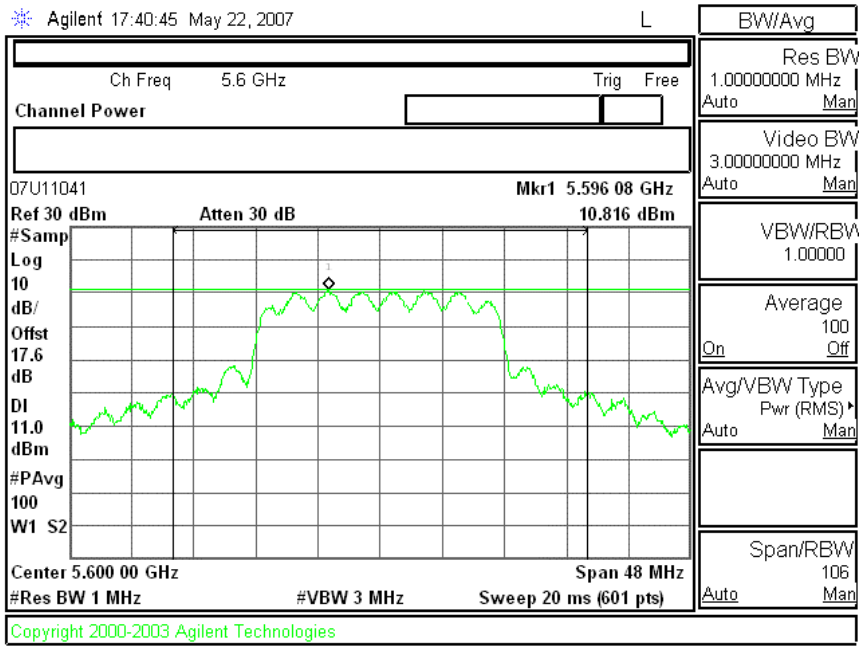
PPSD MID CH, 5600 MHz



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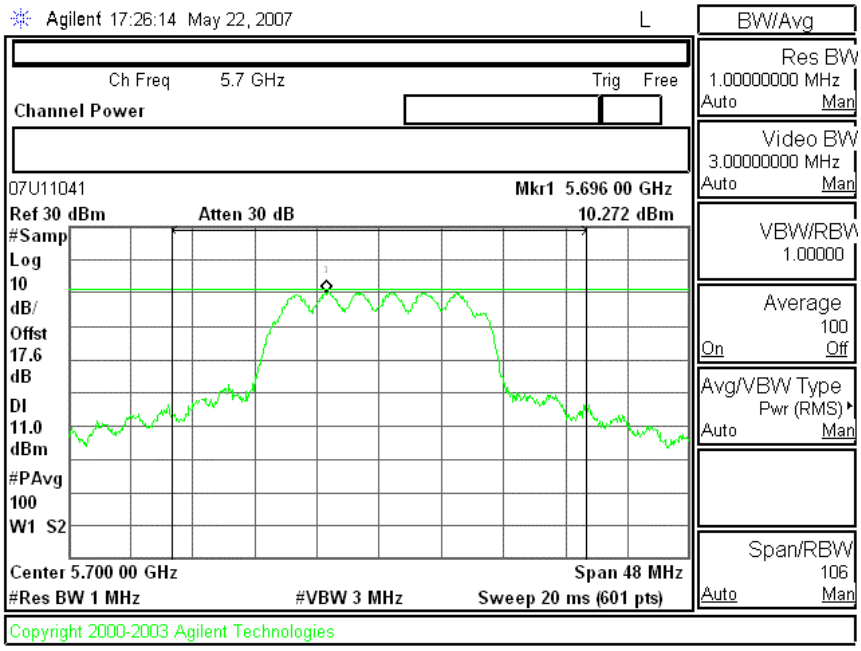
PPSD HIGH CH, 5700 MHz



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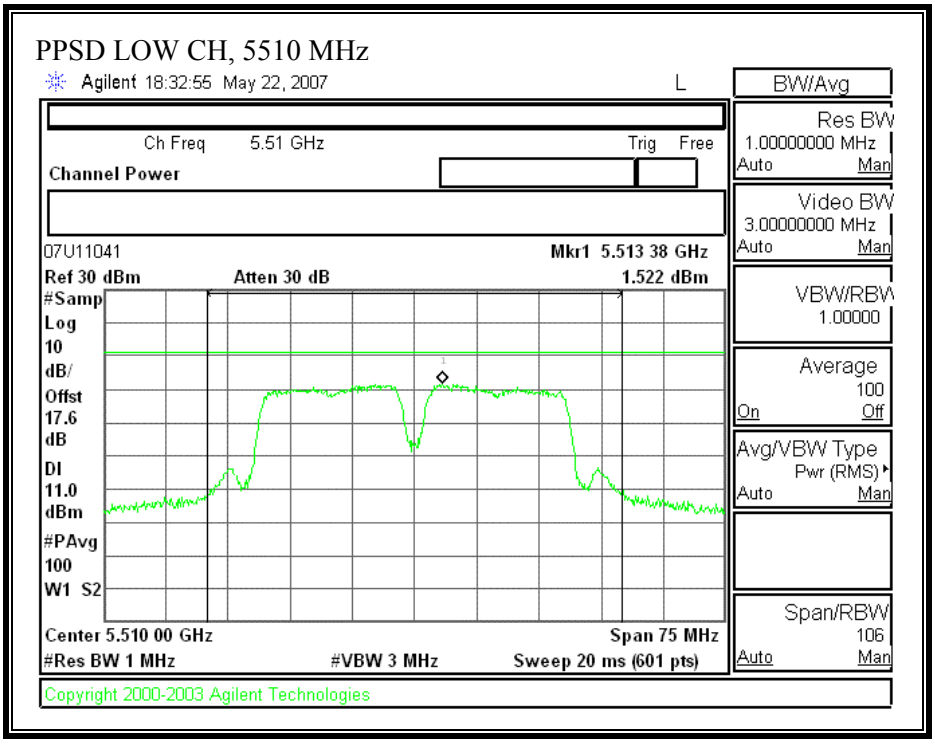
802.11n 40 MHz CDD MCS 32 MODE

8.75dBi Antenna

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



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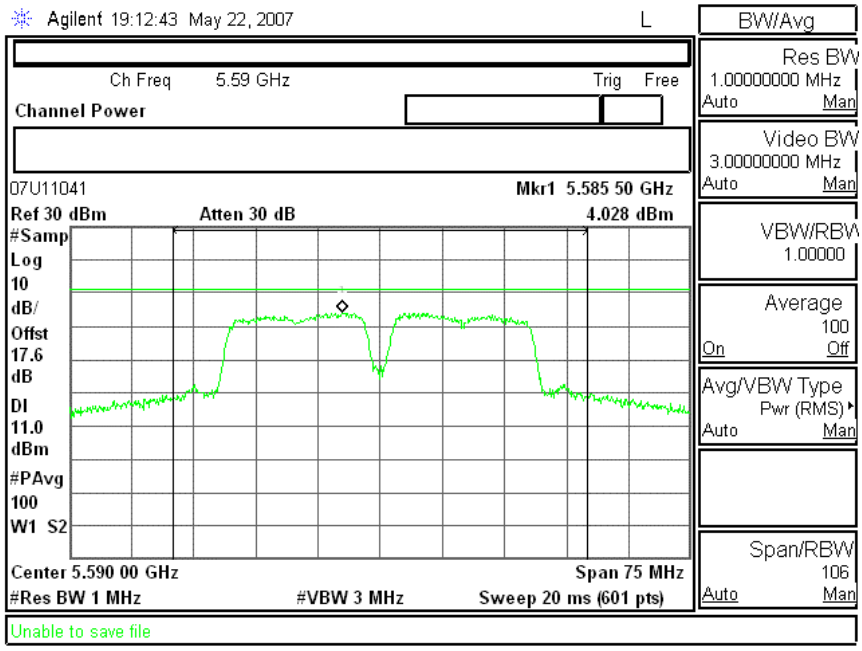
PPSD MID CH, 5590 MHz



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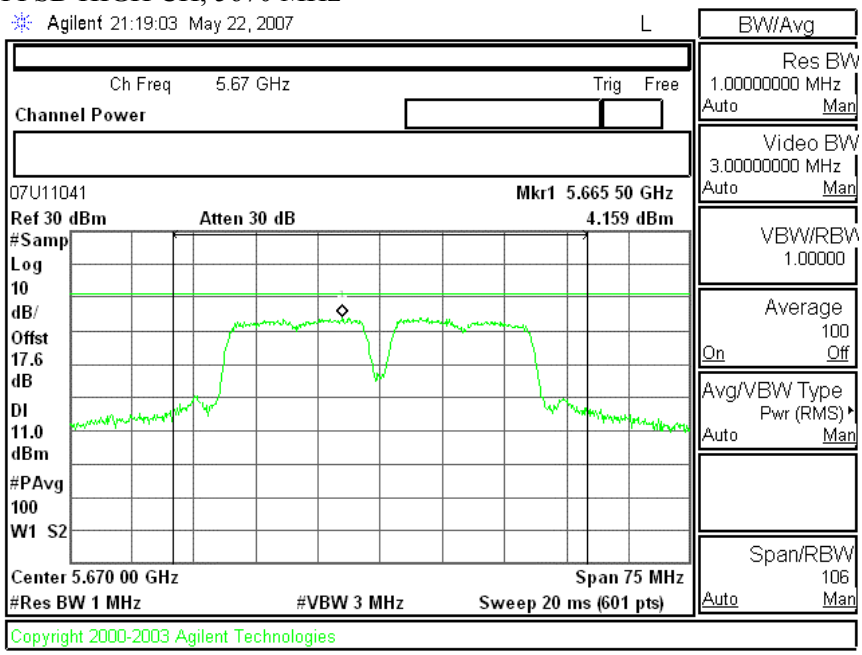
PPSD HIGH CH, 5670 MHz



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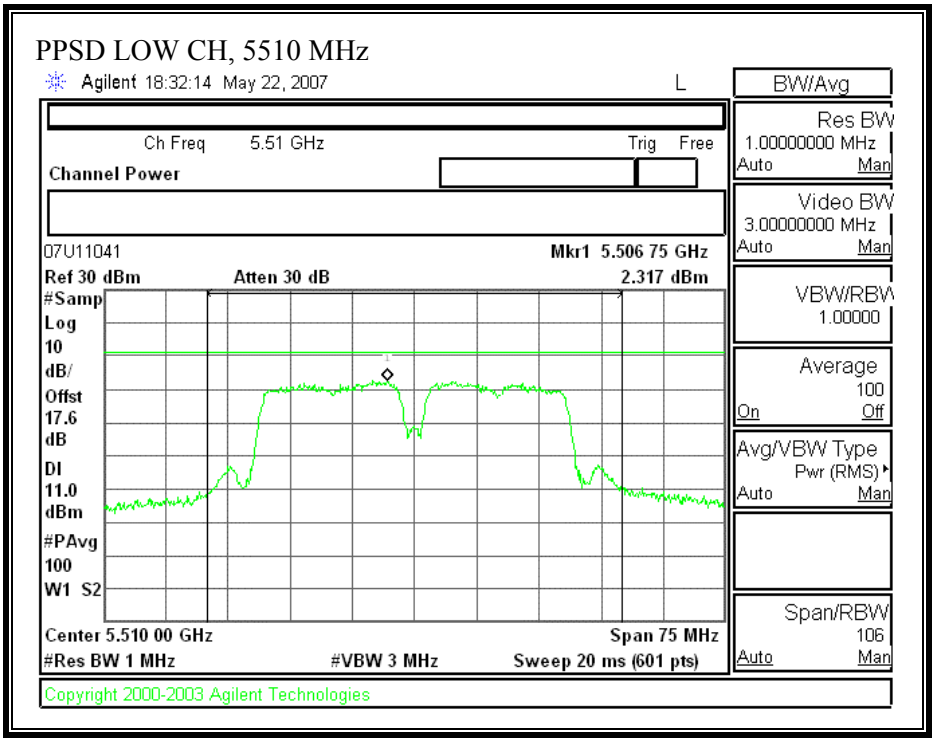
PEAK POWER SPECTRAL DENSITY (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)



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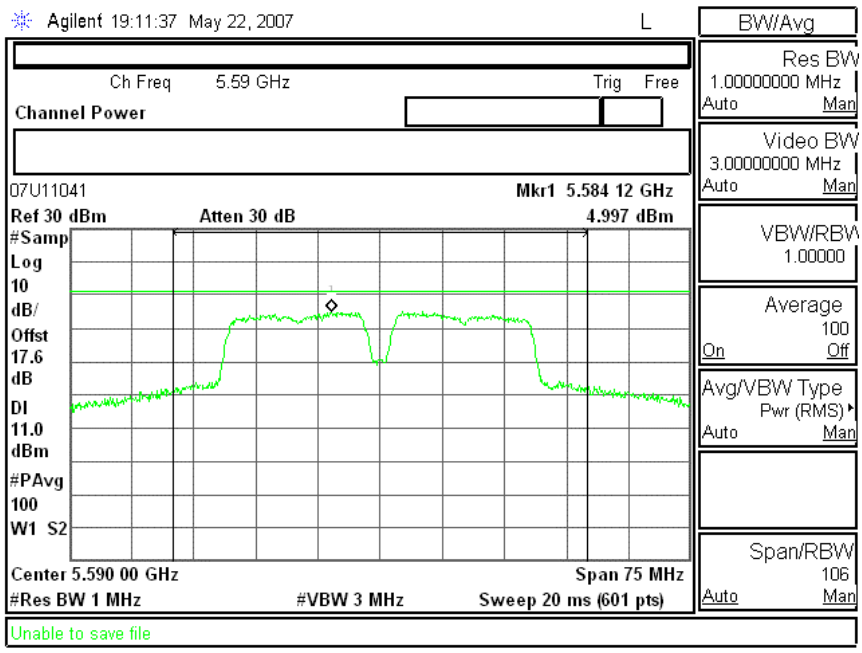
PPSD MID CH, 5590 MHz



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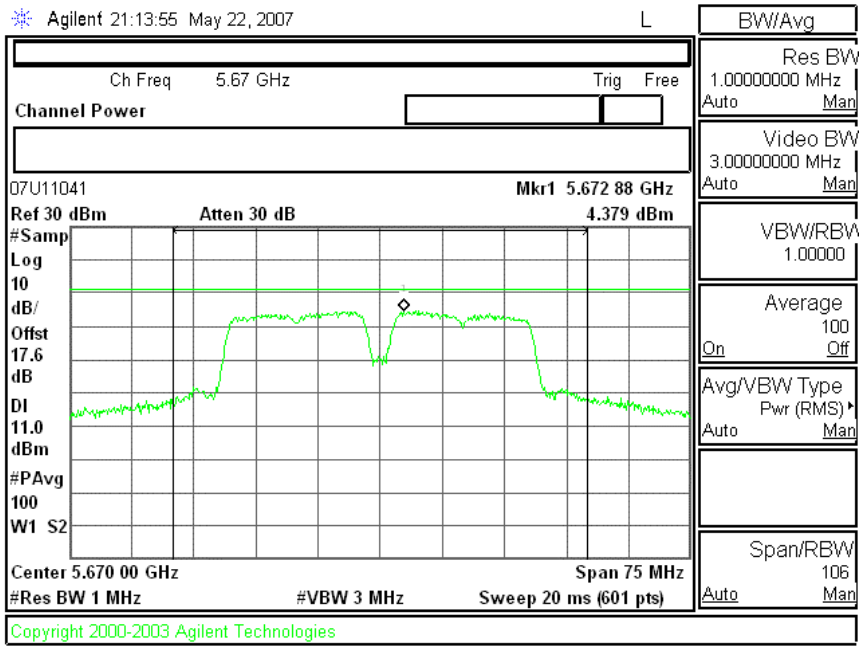
PPSD HIGH CH, 5670 MHz



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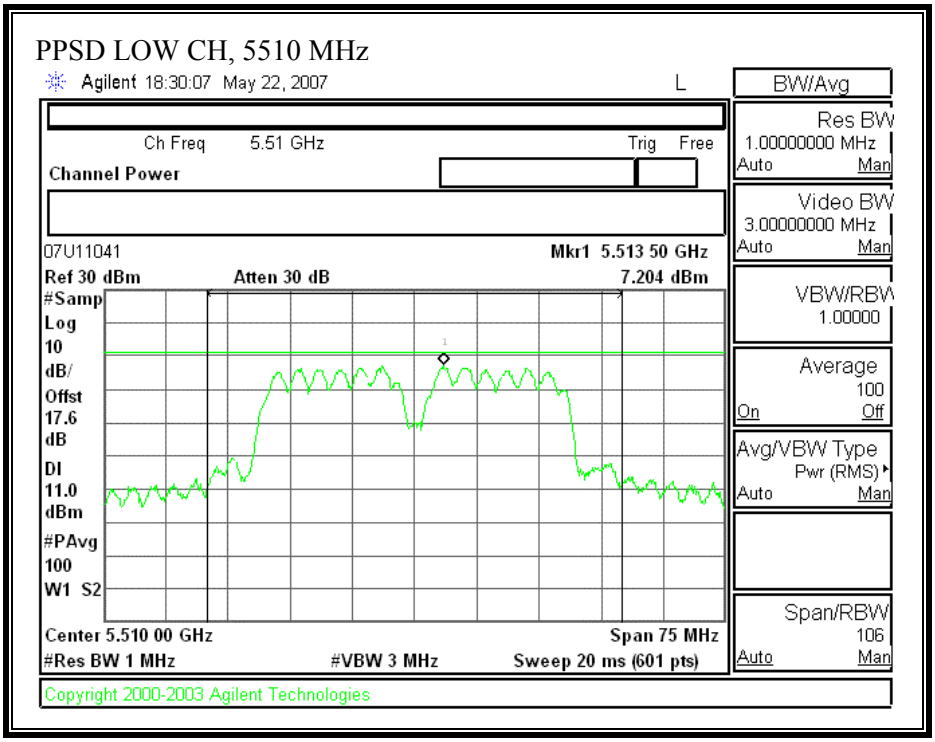
PEAK POWER SPECTRAL DENSITY (802.11 - 40 MHz TX BANDWIDTH – COMBINER)



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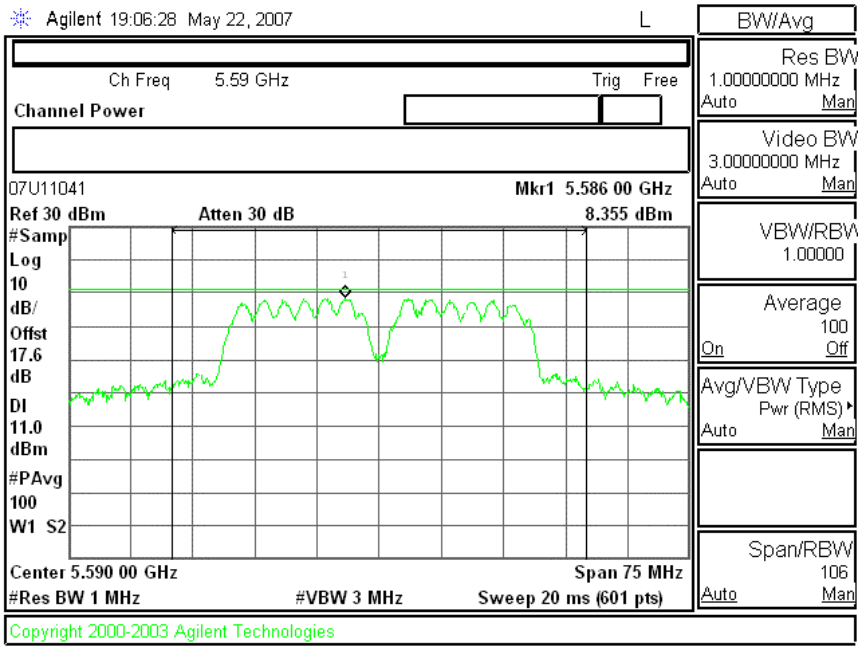
PPSD MID CH, 5590 MHz



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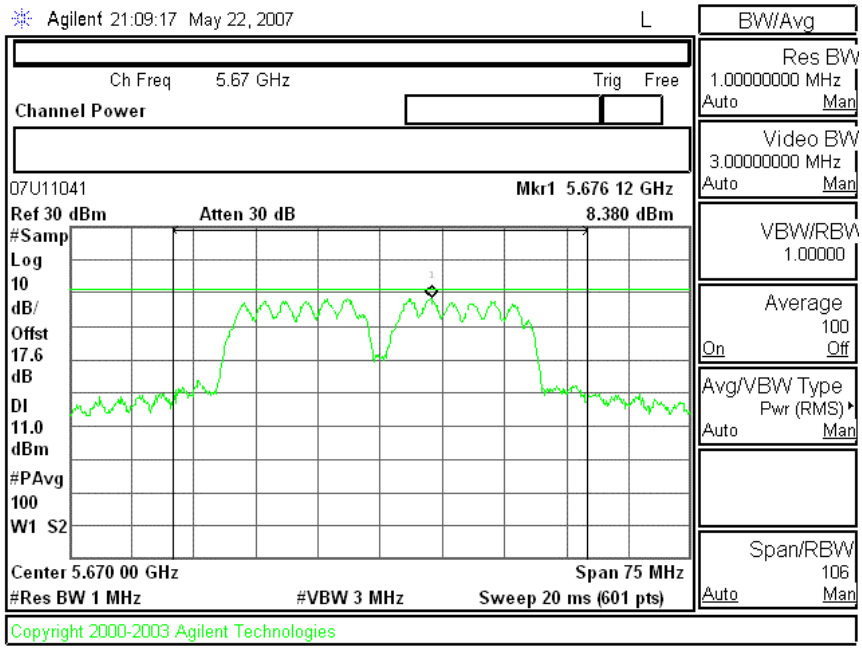
PPSD HIGH CH, 5670 MHz



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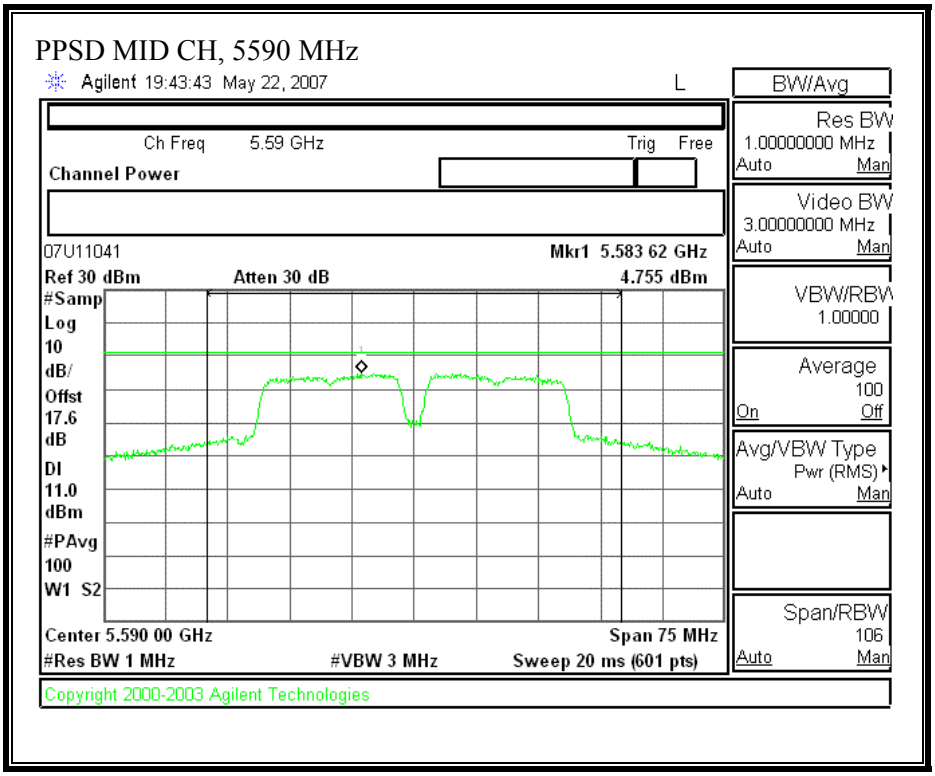
6dBi Antenna

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



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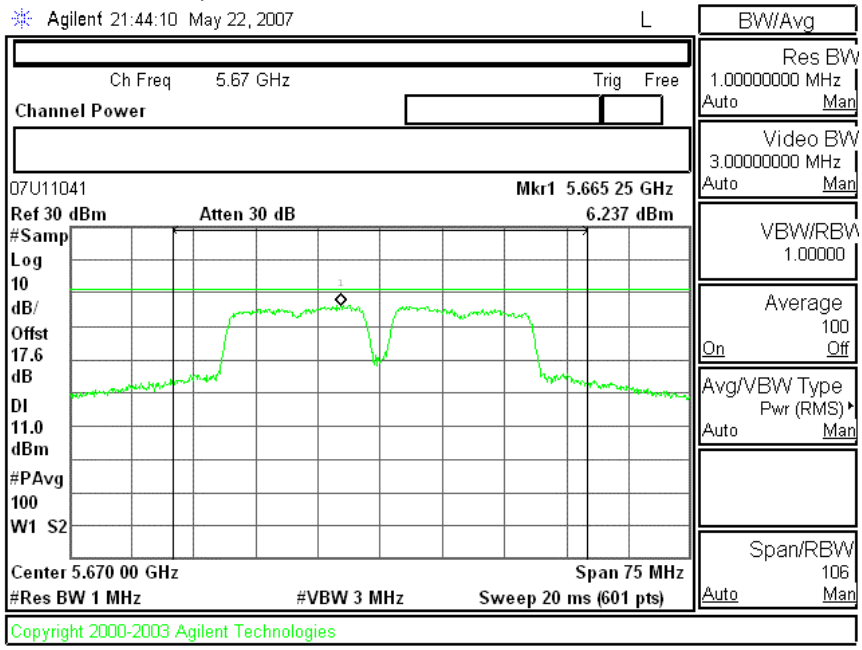
PPSD HIGH CH, 5670 MHz



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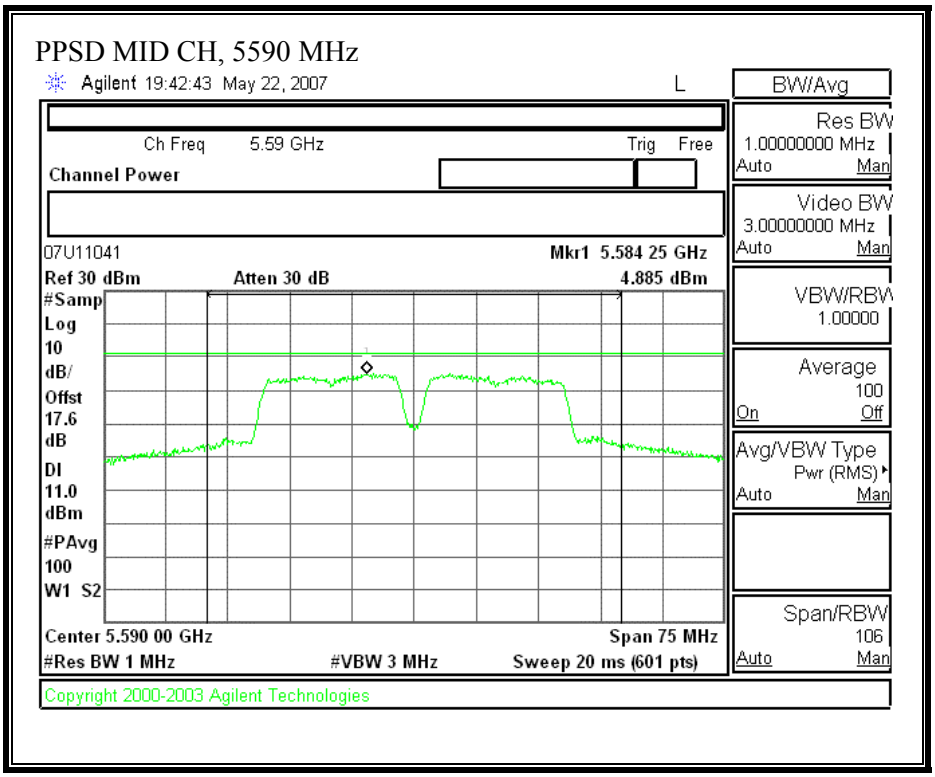
PEAK POWER SPECTRAL DENSITY (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)



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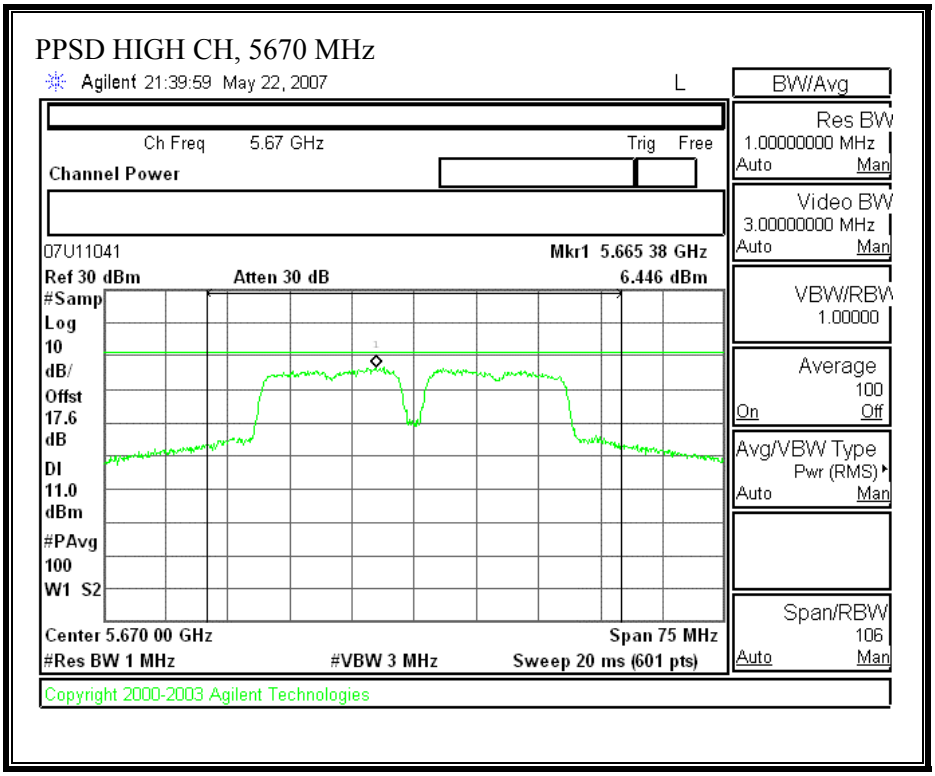
PPSD HIGH CH, 5670 MHz



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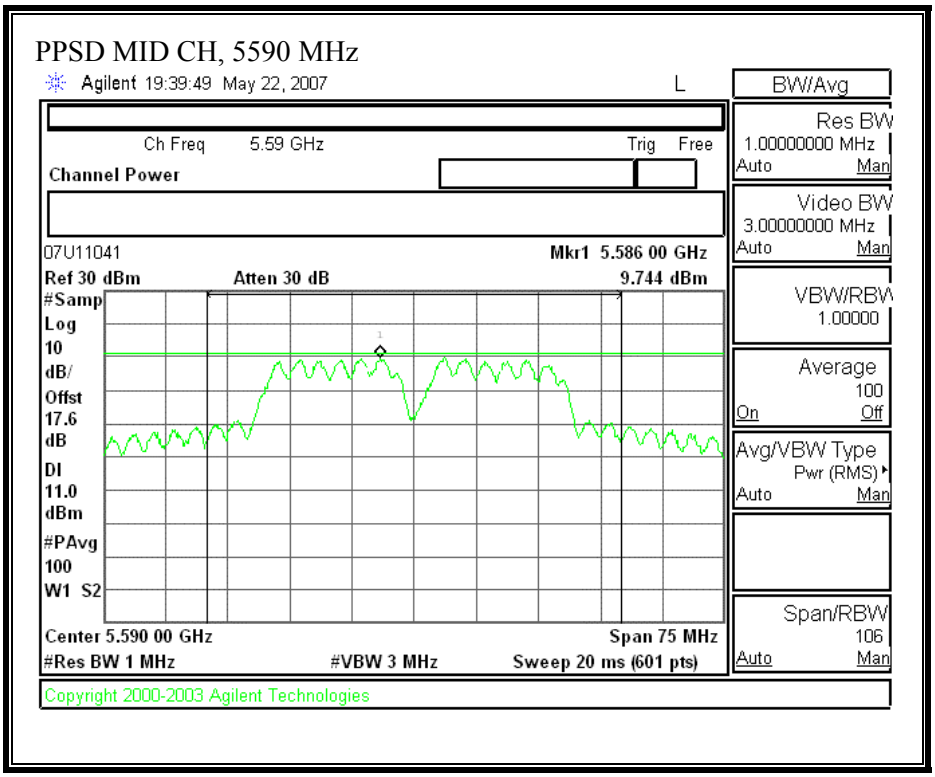
PEAK POWER SPECTRAL DENSITY (802.11 - 40 MHz TX BANDWIDTH – COMBINER)



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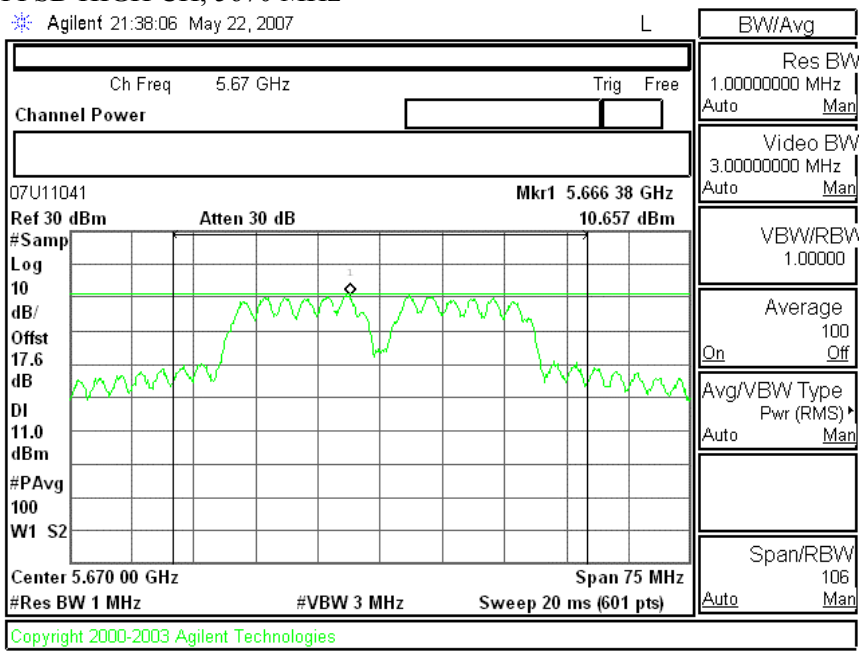
PPSD HIGH CH, 5670 MHz



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7.4.5. PEAK EXCURSION

LIMIT

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

TEST PROCEDURE

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

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

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RESULTS

No non-compliance noted:

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

802.11n 20 MHz CDD MCS 0

20 MHz TX BANDWIDTH - CHAIN 0

Channel	Frequency (MHz)	Peak Excursion Chain 0 (dB)	Limit (dB)	Margin (dB)
Low	5500	9.860	13	-3.14
Middle	5600	10.720	13	-2.28
High	5700	9.960	13	-3.04

20 MHz TX BANDWIDTH - CHAIN 1

Channel	Frequency (MHz)	Peak Excursion Chain 1 (dB)	Limit (dB)	Margin (dB)
Low	5500	10.530	13	-2.47
Middle	5600	9.370	13	-3.63
High	5700	10.460	13	-2.54

802.11n 40 MHz CDD MCS 32

40 MHz TX BANDWIDTH - CHAIN 0

Channel	Frequency (MHz)	Peak Excursion Chain 0 (dB)	Limit (dB)	Margin (dB)
Low	5510	10.310	13	-2.69
Middle	5590	8.620	13	-4.38
High	5670	10.270	13	-2.73

40 MHz TX BANDWIDTH - CHAIN 1

Channel	Frequency (MHz)	Peak Excursion Chain 1 (dB)	Limit (dB)	Margin (dB)
Low	5510	9.370	13	-3.63
Middle	5590	10.070	13	-2.93
High	5670	10.090	13	-2.91

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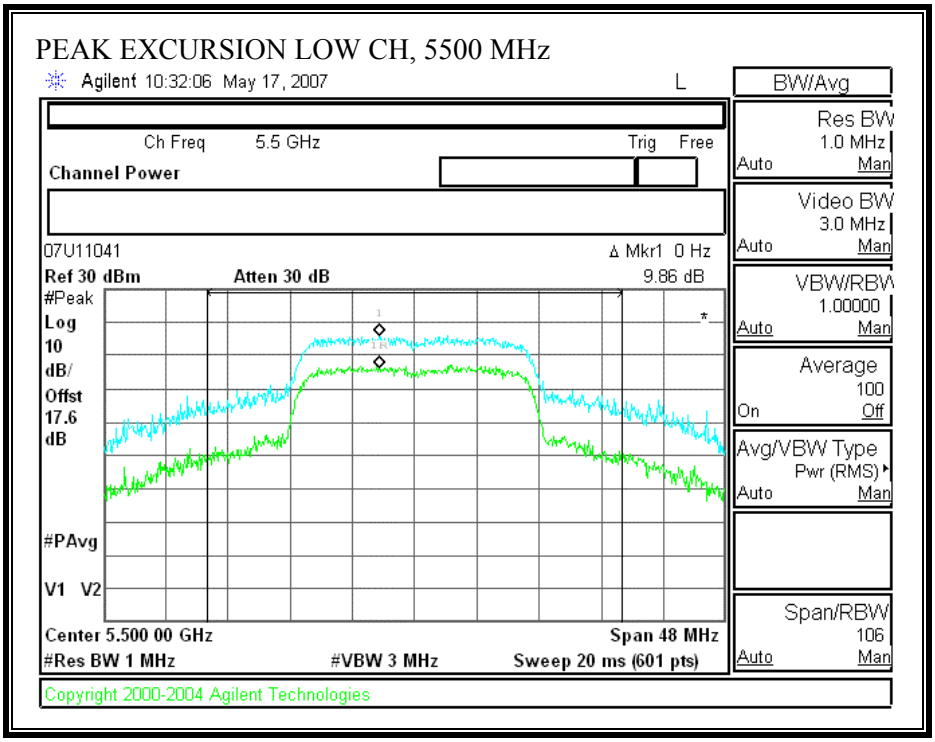
802.11n 20 MHz CDD MCS 0

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



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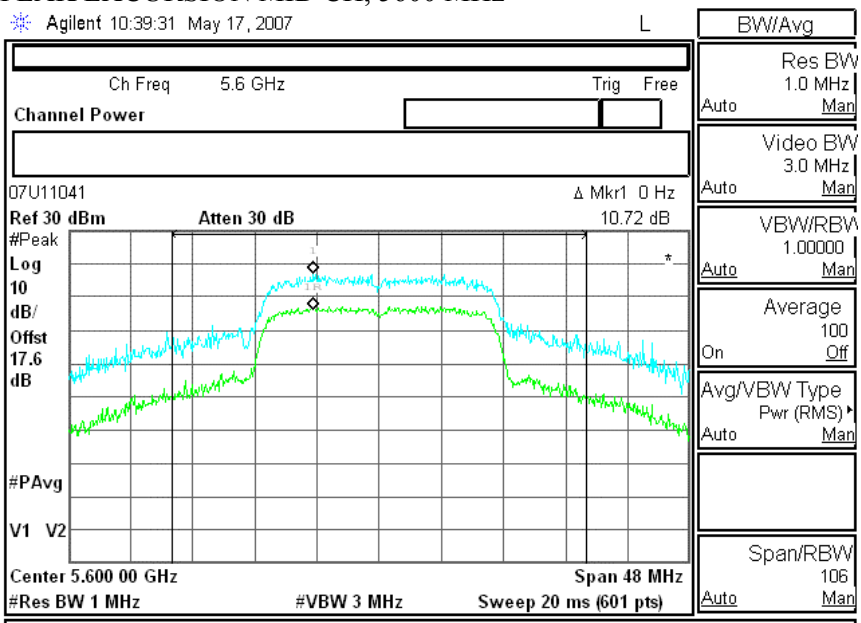
PEAK EXCURSION MID CH, 5600 MHz



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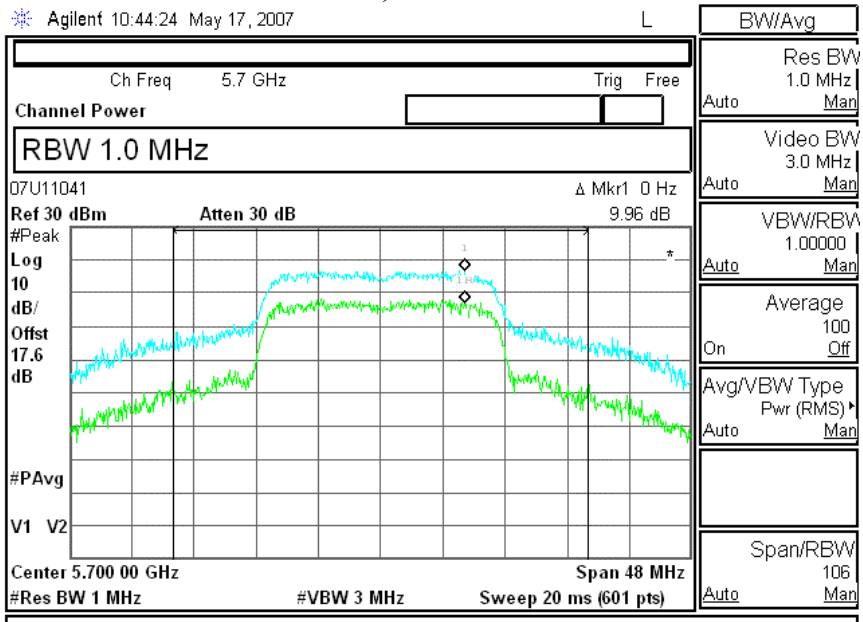
PEAK EXCURSION HIGH CH, 5700 MHz



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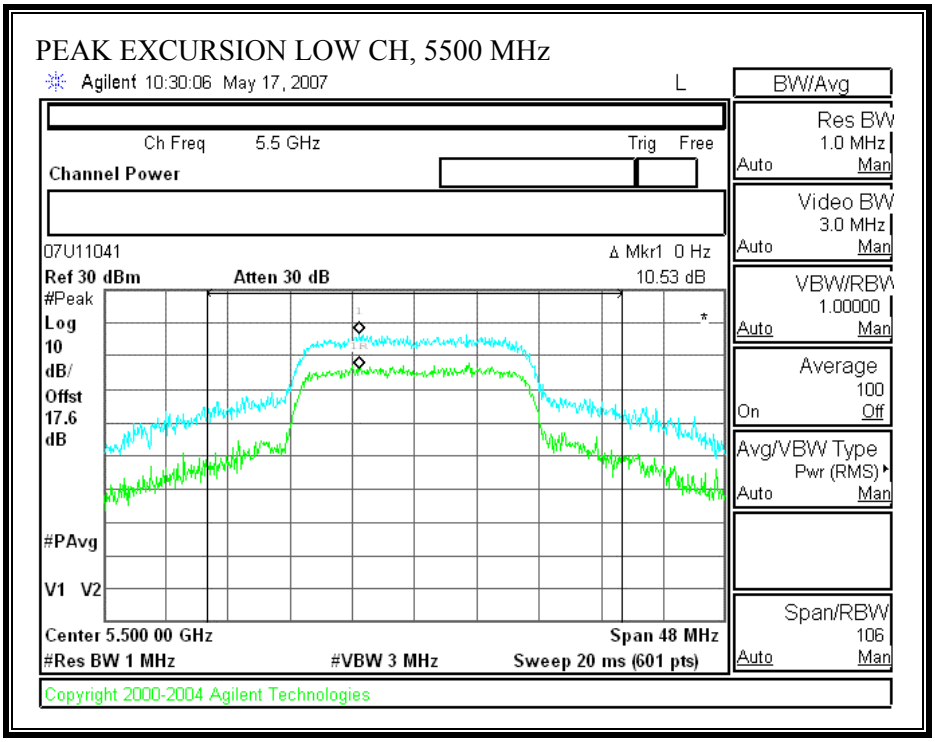
PEAK EXCURSION (802.11 - 20 MHz TX BANDWIDTH – CHAIN 1)



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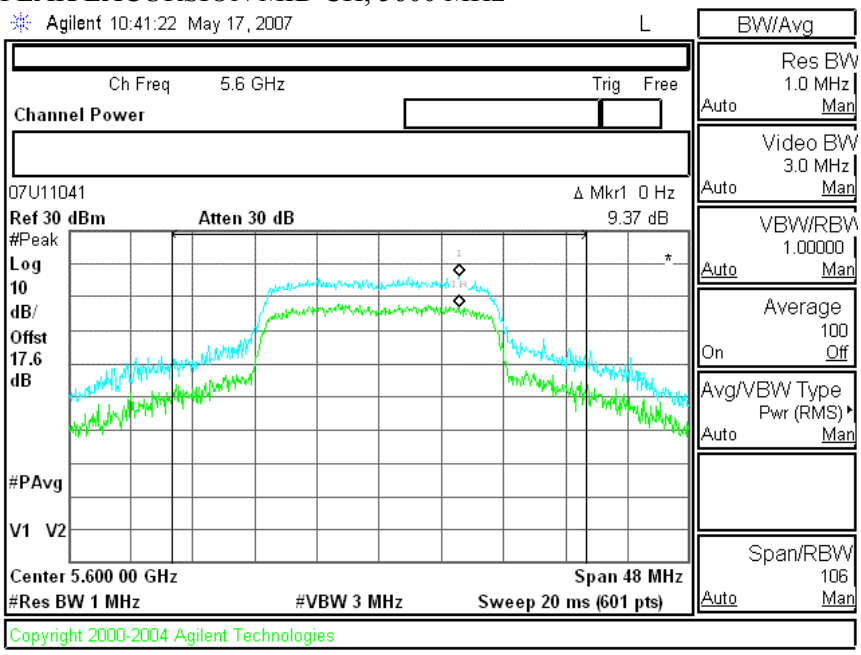
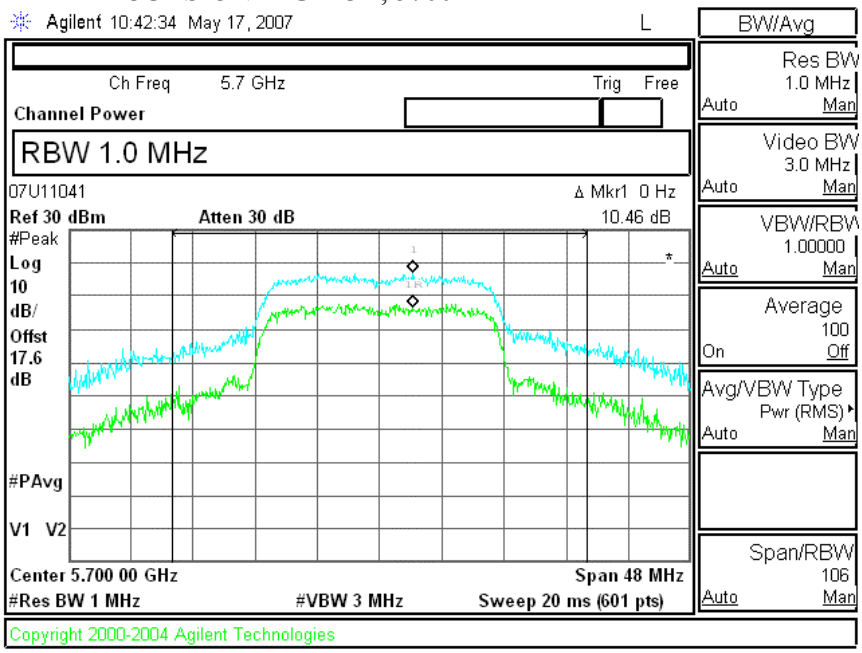
PEAK EXCURSION MID CH, 5600 MHz



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

PEAK EXCURSION HIGH CH, 5700 MHz



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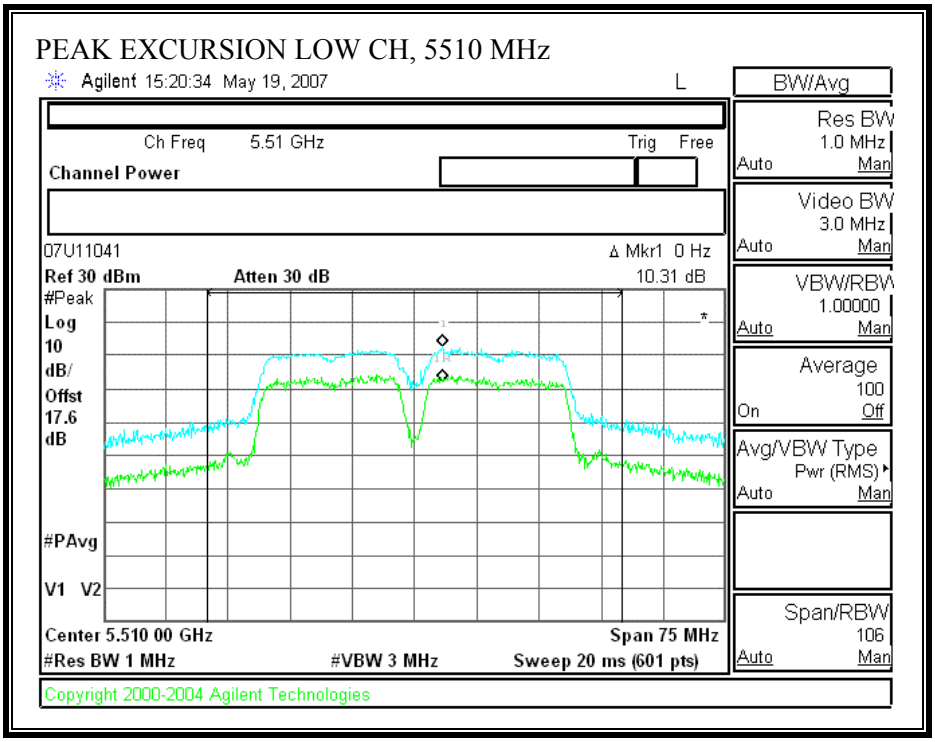
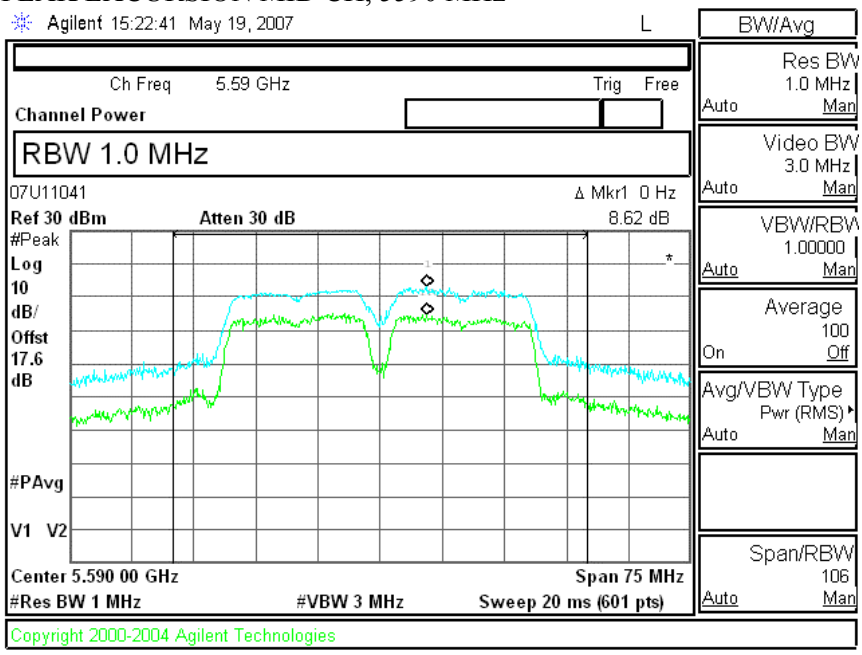
802.11n 40 MHz CDD MCS 32

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



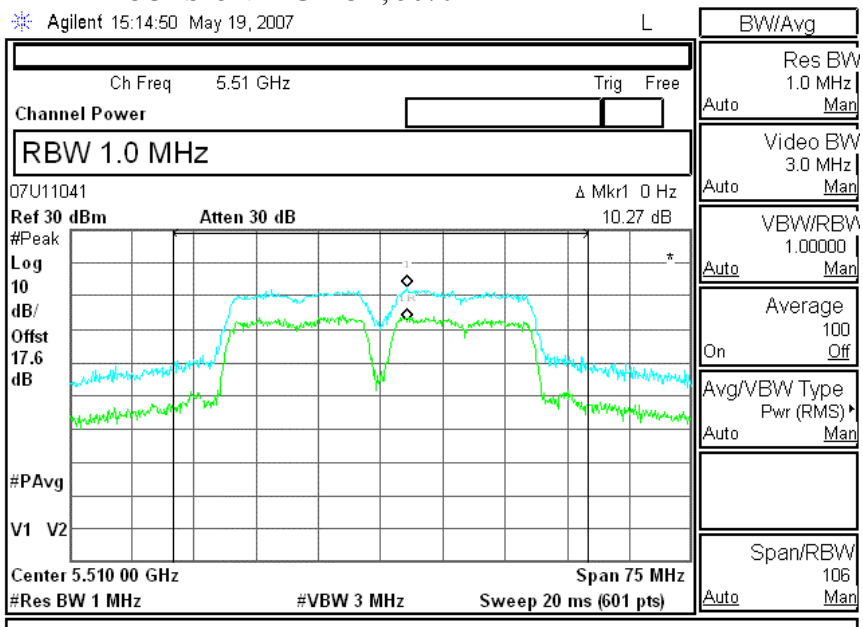
This report shall not be reproduced except in full, without the written approval of CCS.

PEAK EXCURSION MID CH, 5590 MHz



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

PEAK EXCURSION HIGH CH, 5670 MHz



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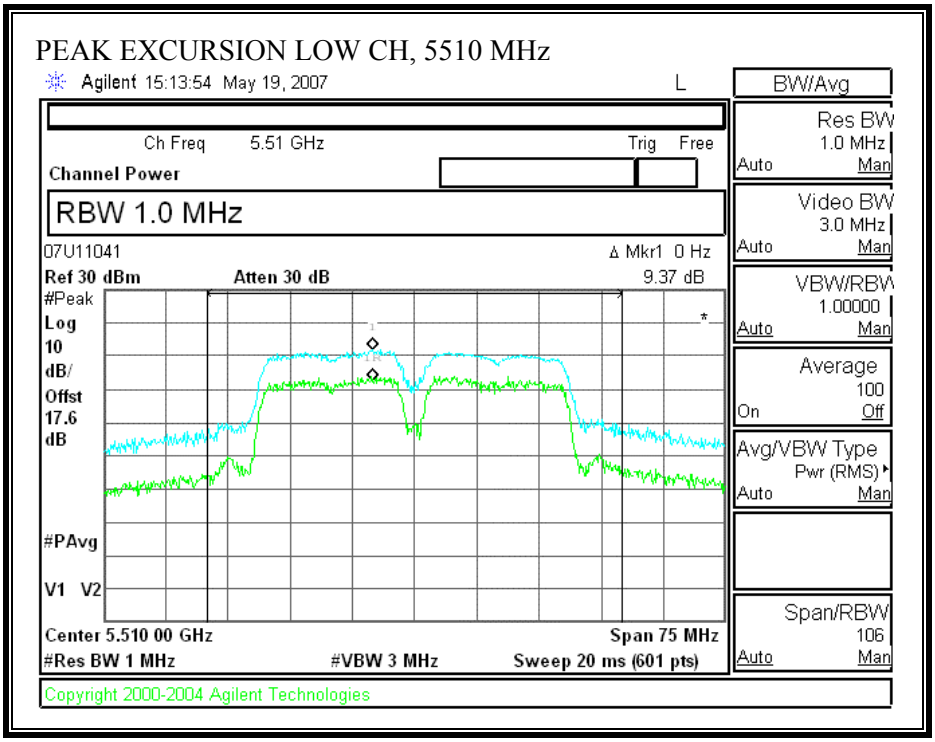
PEAK EXCURSION (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)



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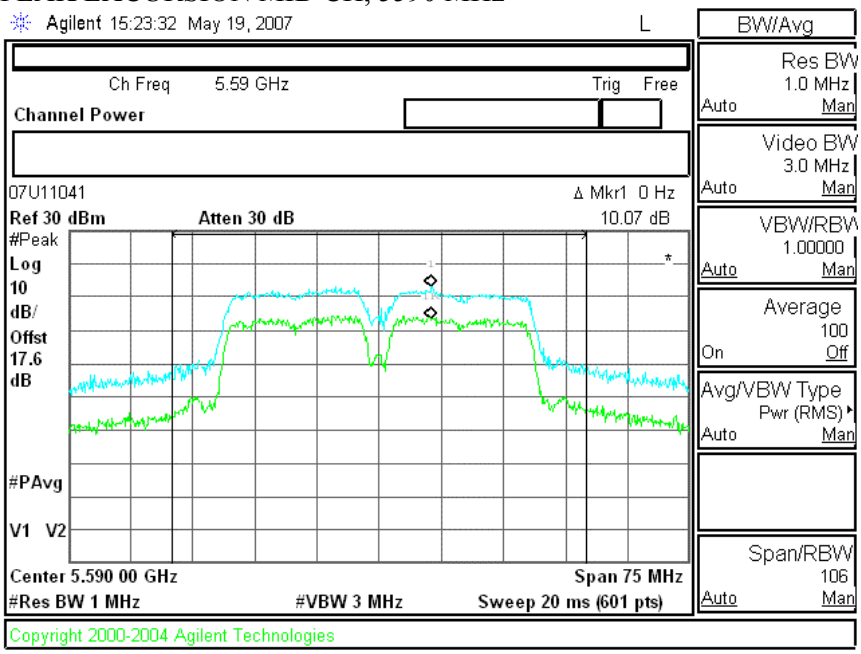
PEAK EXCURSION MID CH, 5590 MHz



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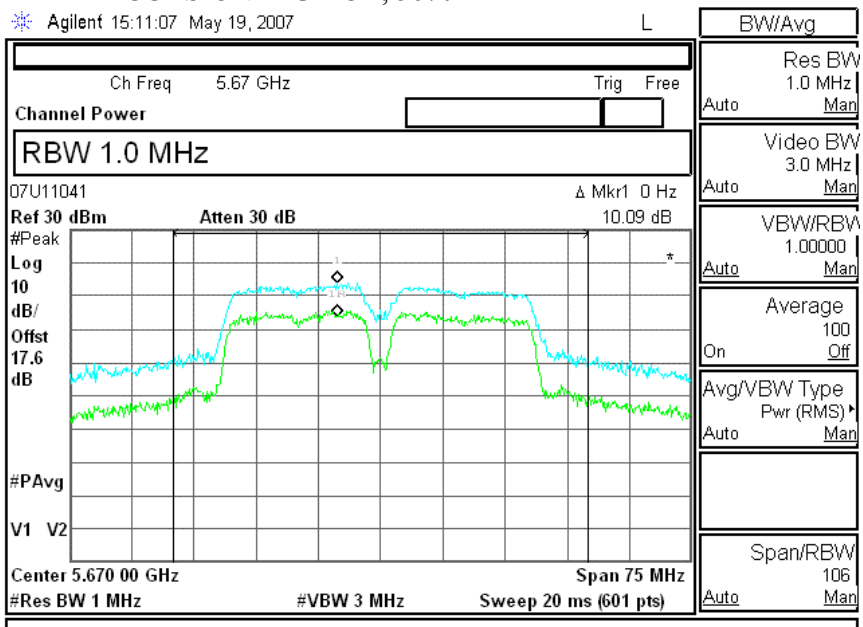
PEAK EXCURSION HIGH CH, 5670 MHz



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7.4.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

§15.407 (b) (3) For transmitters operating in the 5.47–5.725 GHz band: all emissions outside of the 5.47–5.725 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.

RESULTS

No non-compliance noted:

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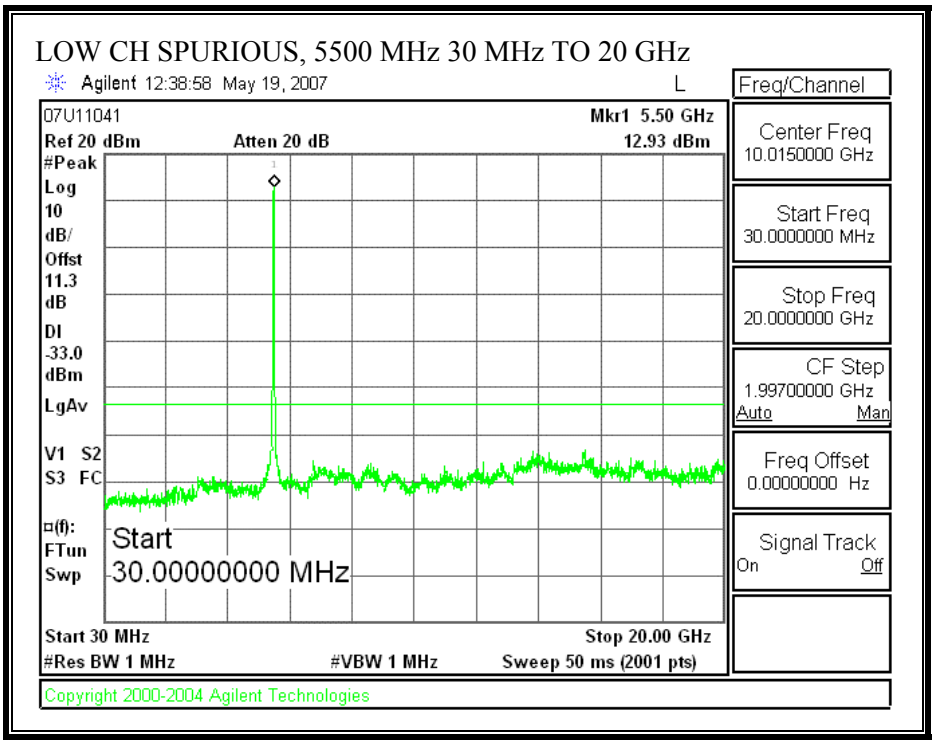
802.11a CDD is covered by worst case 802.11n 20 MHz CDD MCS 0

802.11n 20 MHz CDD MCS 0

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



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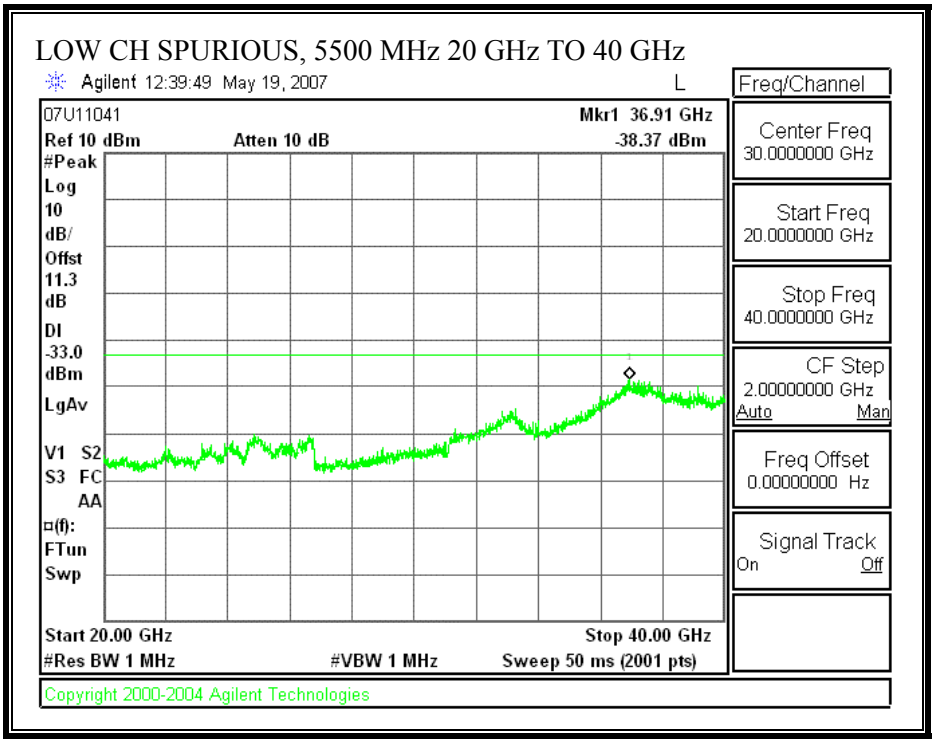
LOW CH SPURIOUS, 5500 MHz 20 GHz TO 40 GHz



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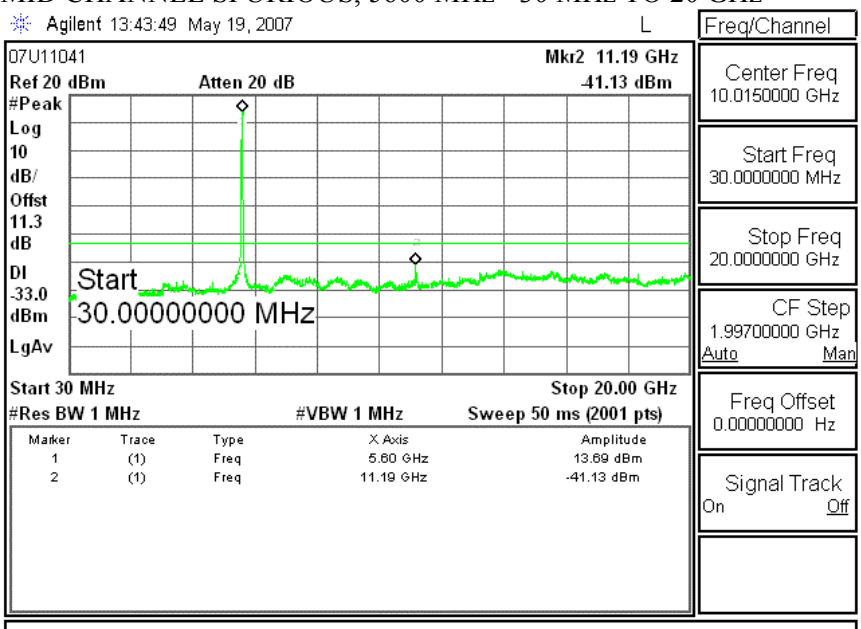
MID CHANNEL SPURIOUS, 5600 MHz - 30 MHz TO 20 GHz



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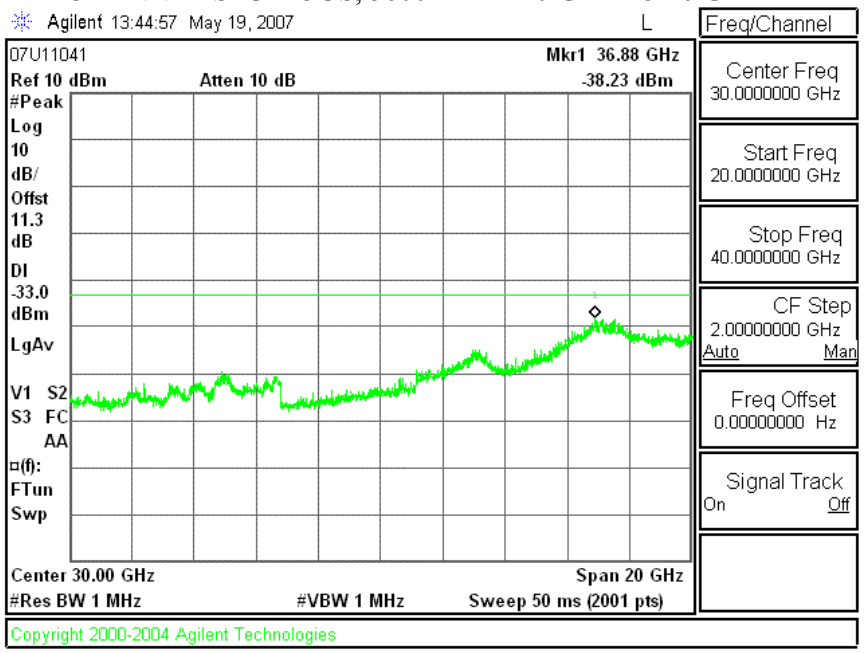
MID CHANNEL SPURIOUS, 5600 MHz - 20 GHz TO 40 GHz



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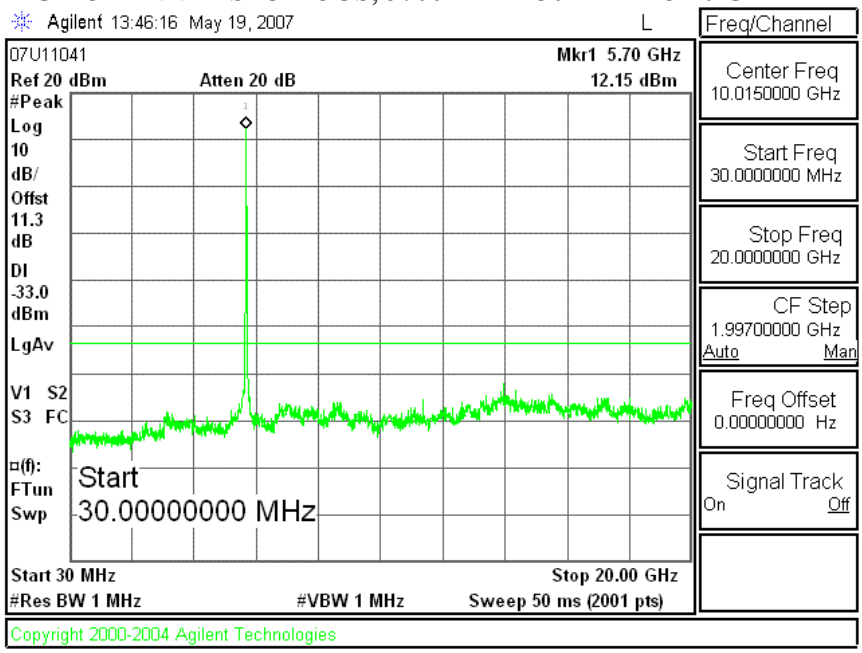
HIGH CHANNEL SPURIOUS, 5700 MHz - 30 MHz TO 20 GHz



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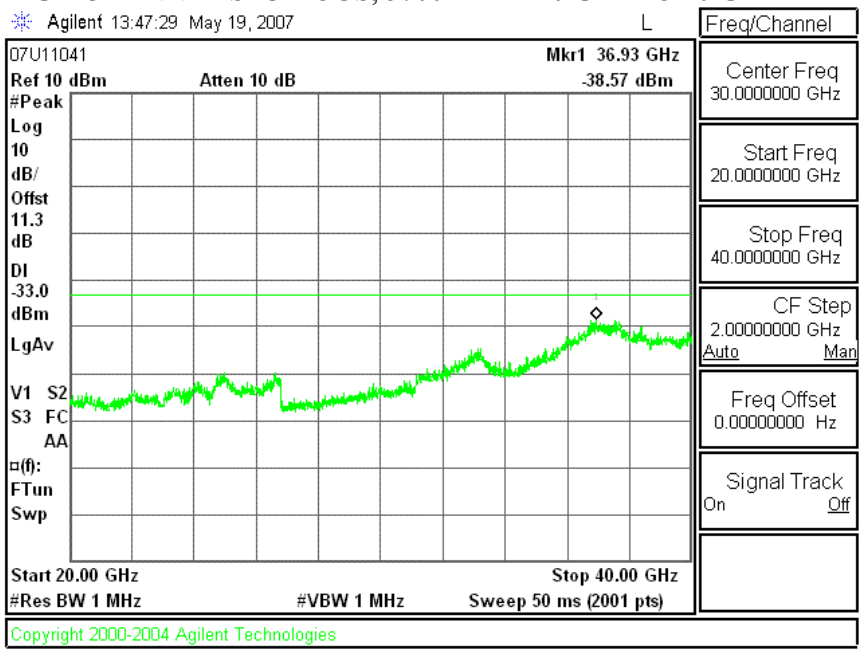
HIGH CHANNEL SPURIOUS, 5700 MHz - 20 GHz TO 40 GHz



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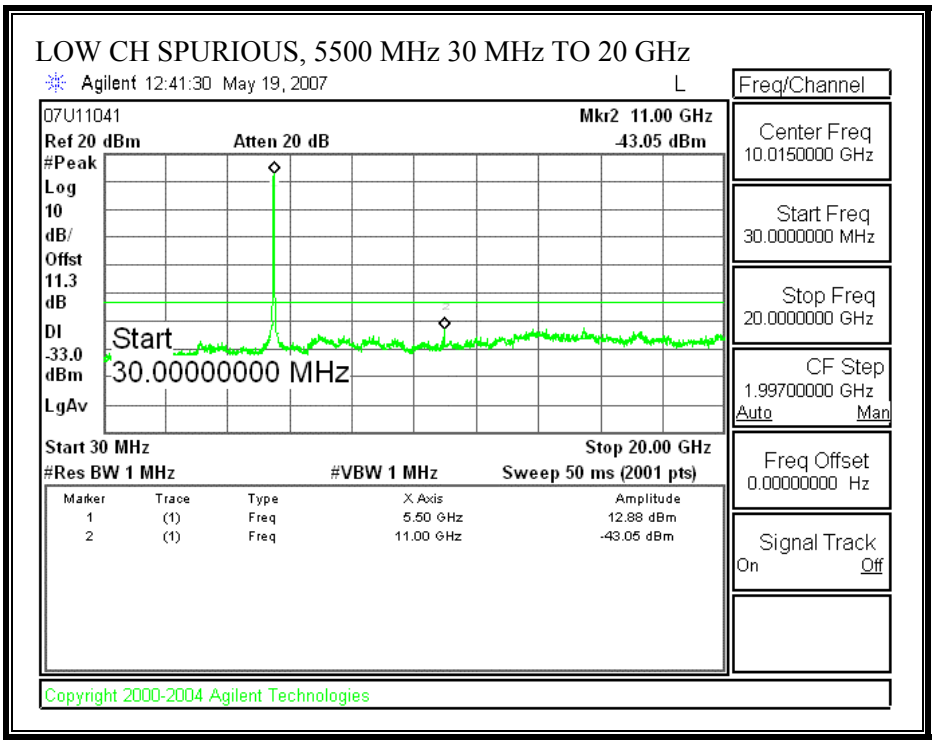
SPURIOUS EMISSIONS - 802.11a -20 MHz TX BANDWIDTH - CHAIN 1



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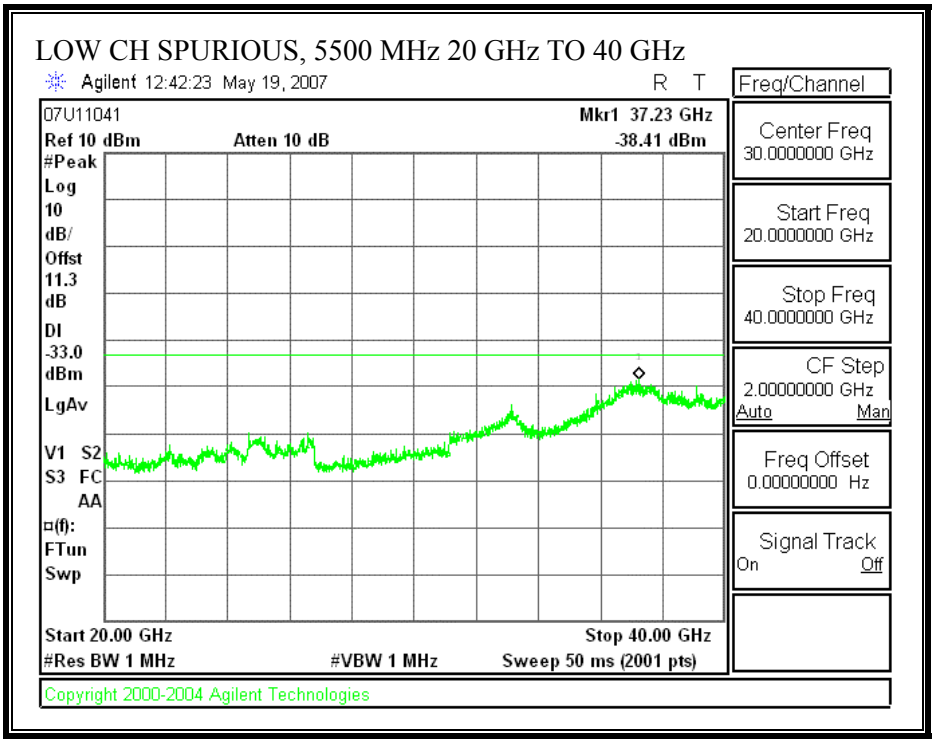
LOW CH SPURIOUS, 5500 MHz 20 GHz TO 40 GHz



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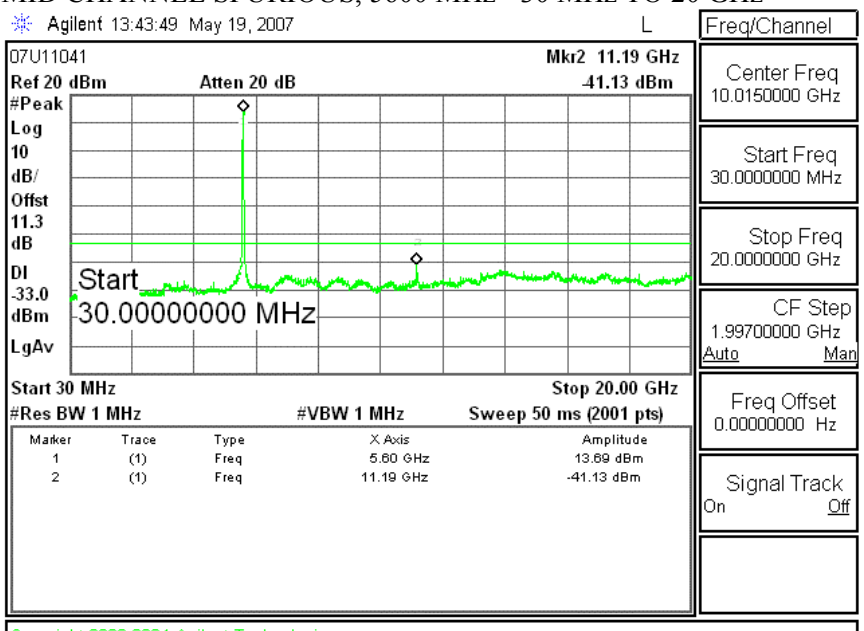
MID CHANNEL SPURIOUS, 5600 MHz - 30 MHz TO 20 GHz



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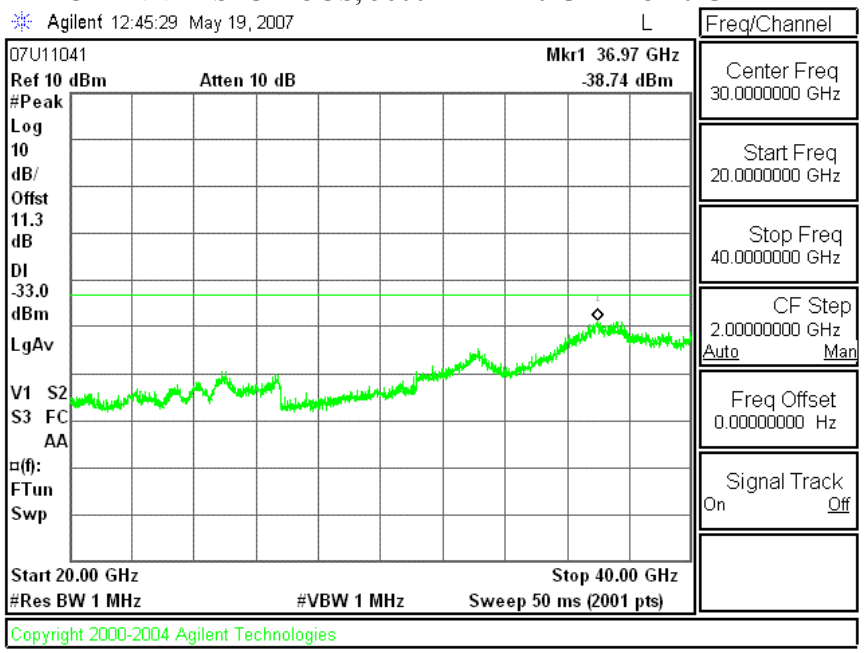
MID CHANNEL SPURIOUS, 5600 MHz - 20 GHz TO 40 GHz



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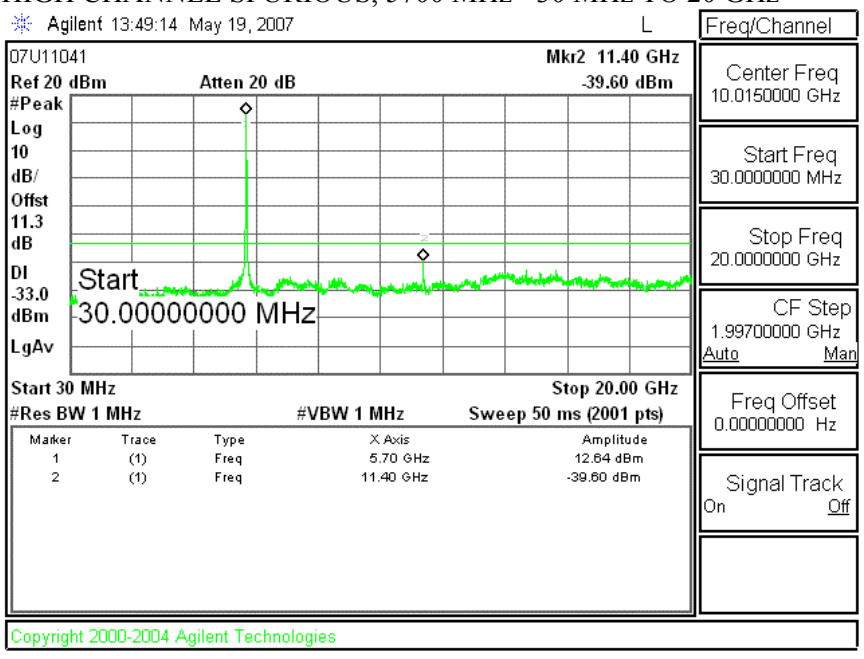
HIGH CHANNEL SPURIOUS, 5700 MHz - 30 MHz TO 20 GHz



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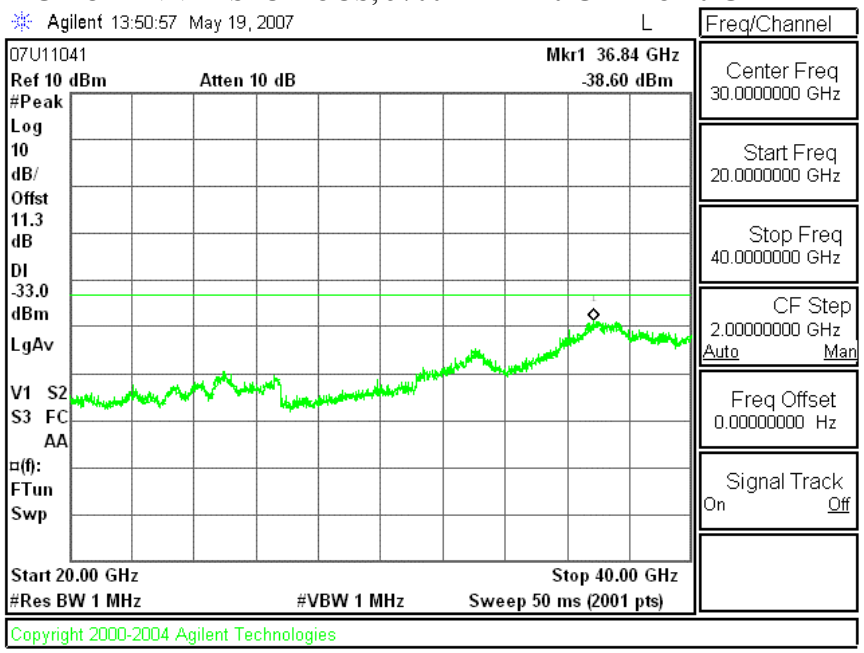
HIGH CHANNEL SPURIOUS, 5700 MHz - 20 GHz TO 40 GHz



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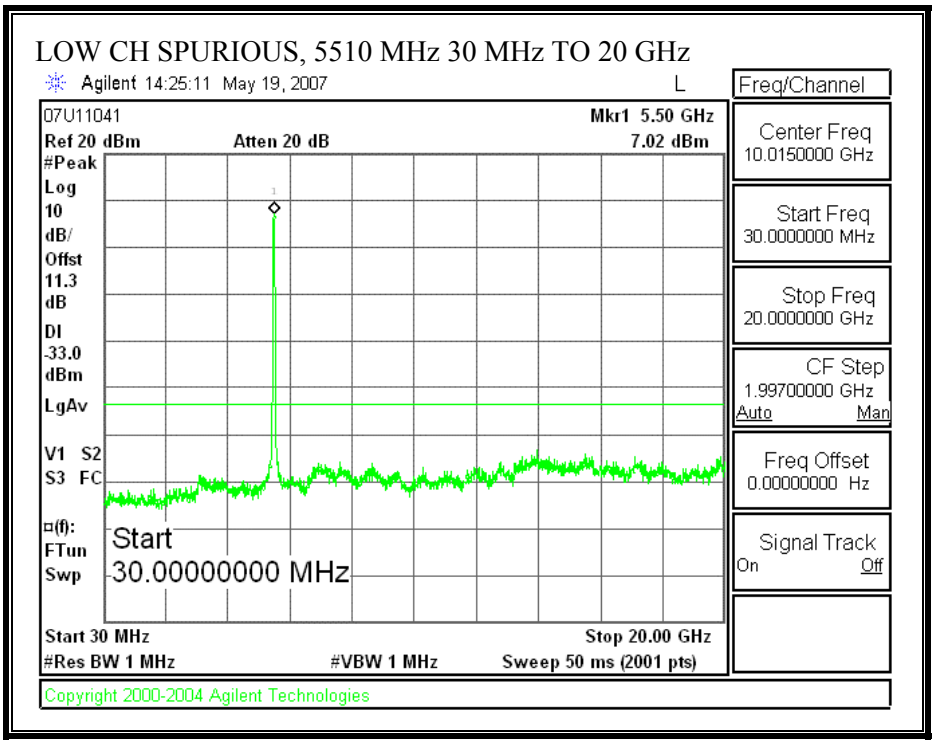
802.11n 40 MHz CDD MCS 32

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



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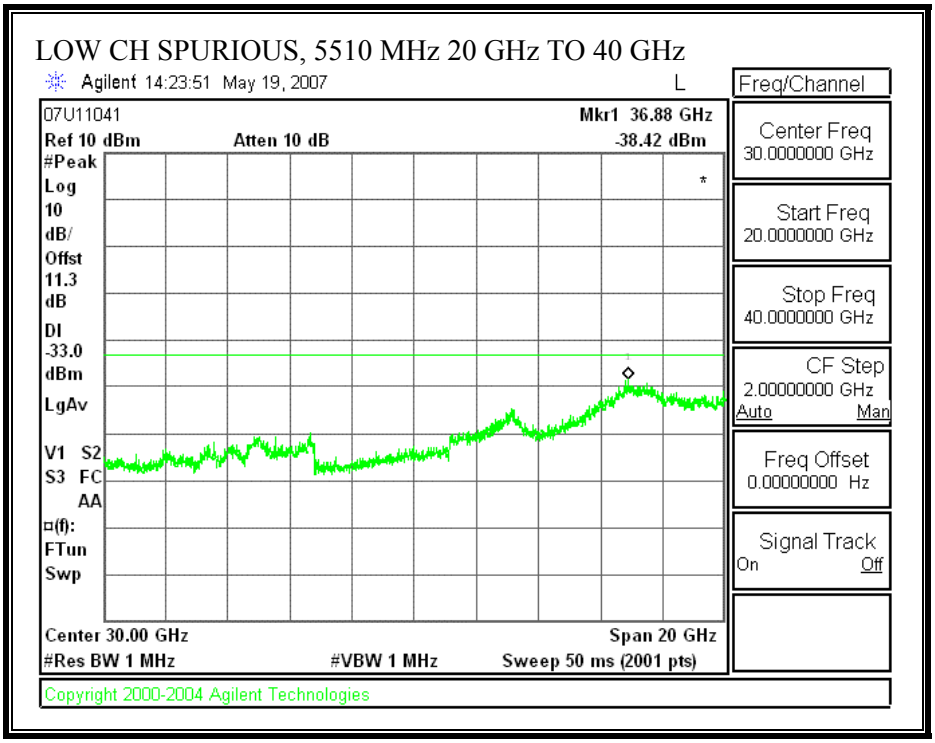
LOW CH SPURIOUS, 5510 MHz 20 GHz TO 40 GHz



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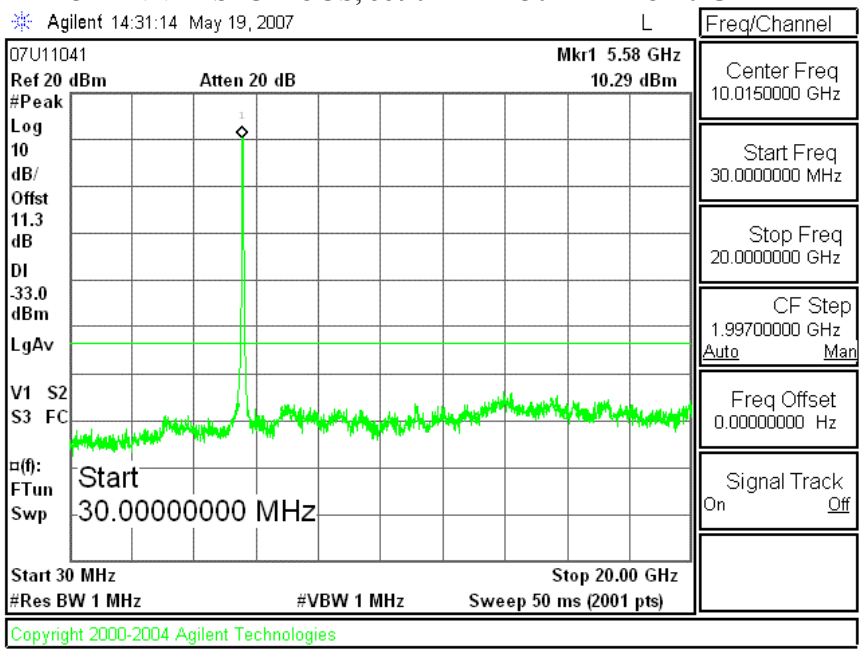
MID CHANNEL SPURIOUS, 5590 MHz - 30 MHz TO 20 GHz



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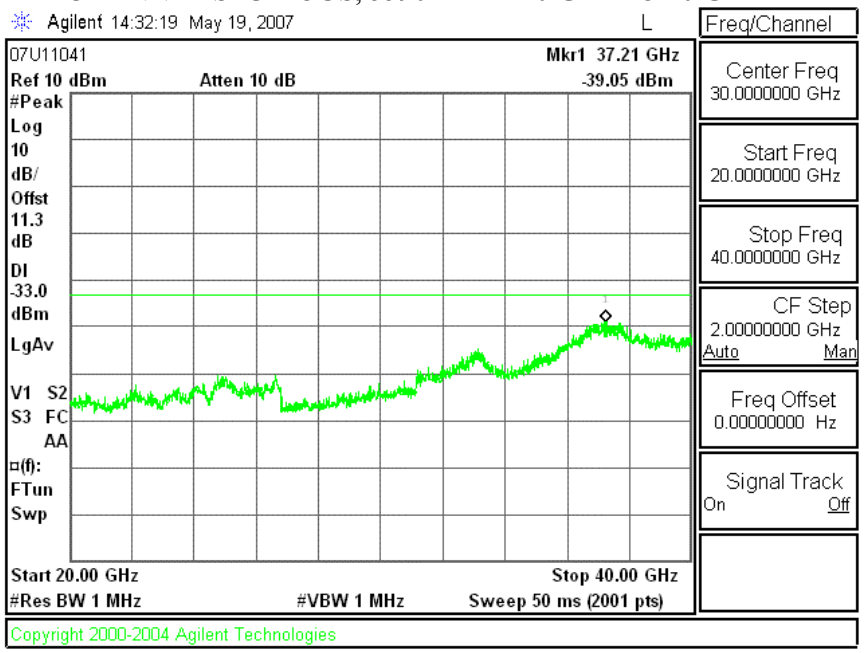
MID CHANNEL SPURIOUS, 5590 MHz - 20 GHz TO 40 GHz



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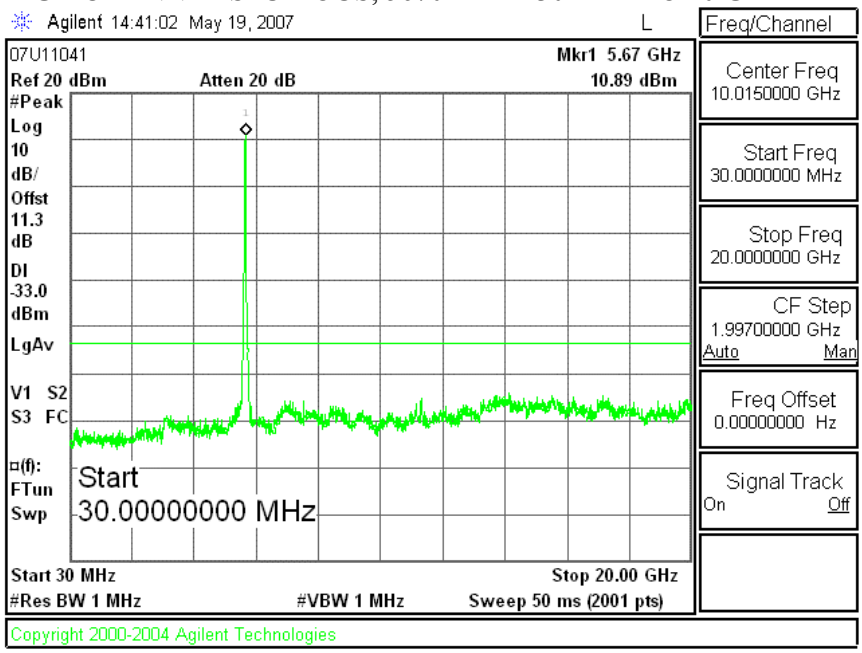
HIGH CHANNEL SPURIOUS, 5670 MHz - 30 MHz TO 20 GHz



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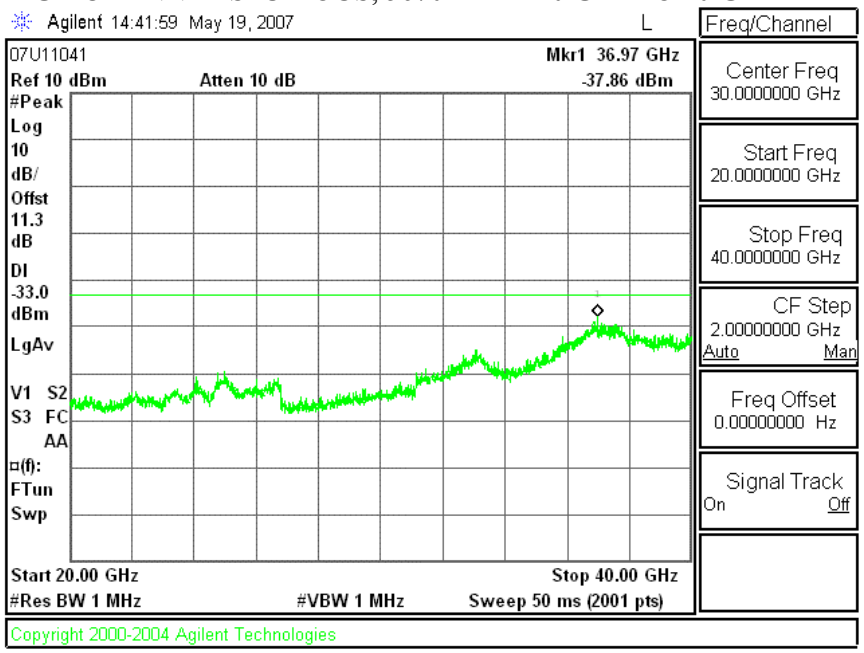
HIGH CHANNEL SPURIOUS, 5670 MHz - 20 GHz TO 40 GHz



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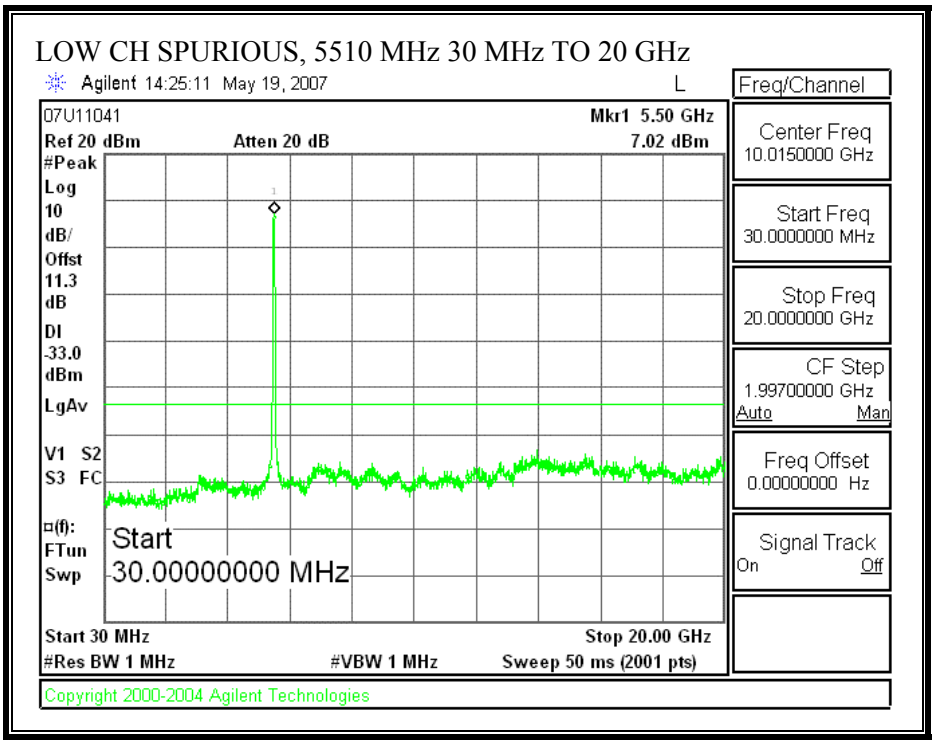
SPURIOUS EMISSIONS - 802.11a -40 MHz TX BANDWIDTH - CHAIN 1



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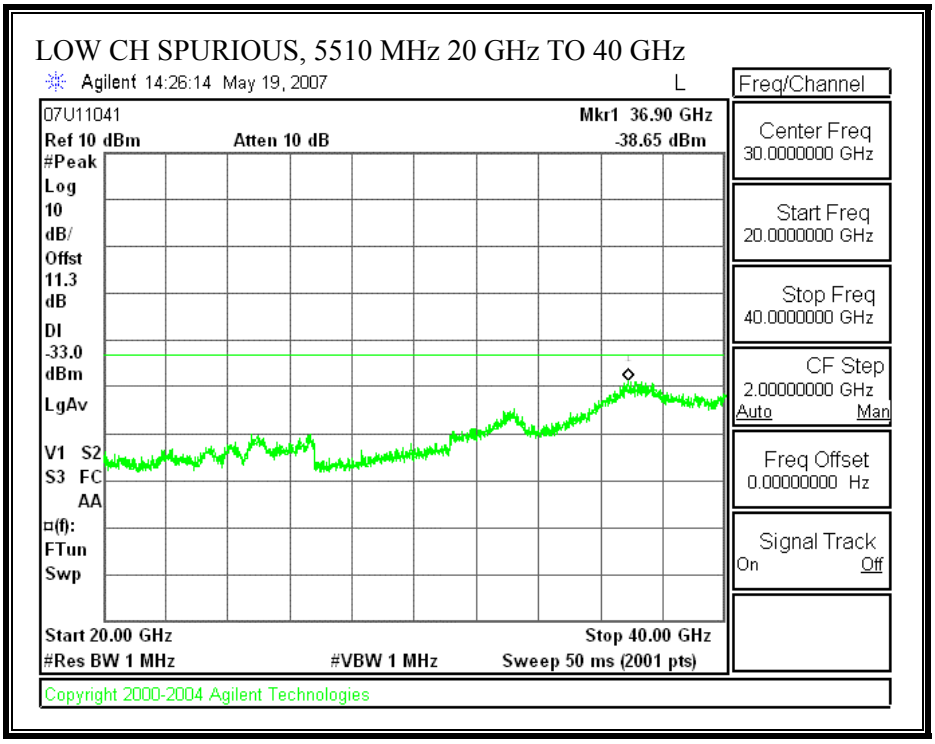
LOW CH SPURIOUS, 5510 MHz 20 GHz TO 40 GHz



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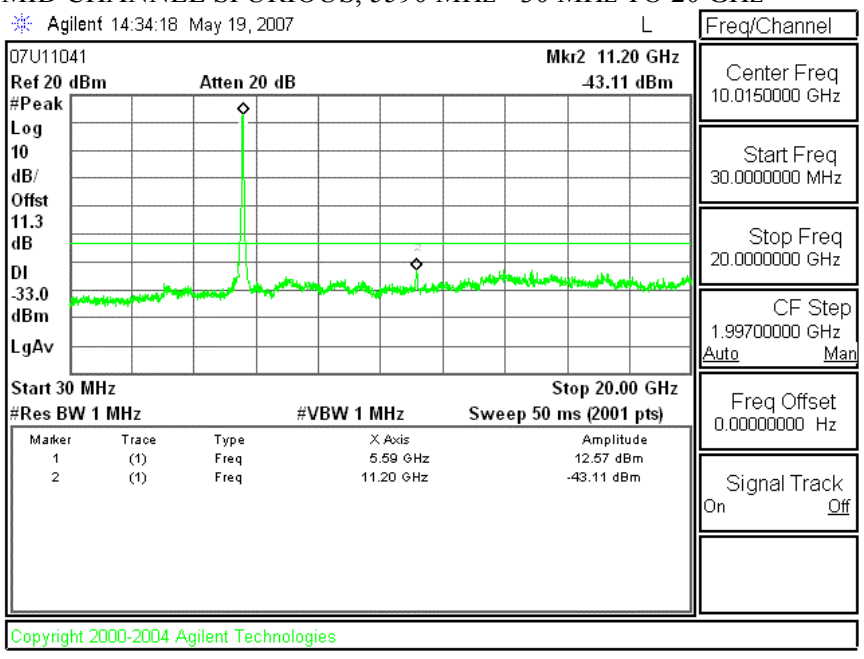
MID CHANNEL SPURIOUS, 5590 MHz - 30 MHz TO 20 GHz



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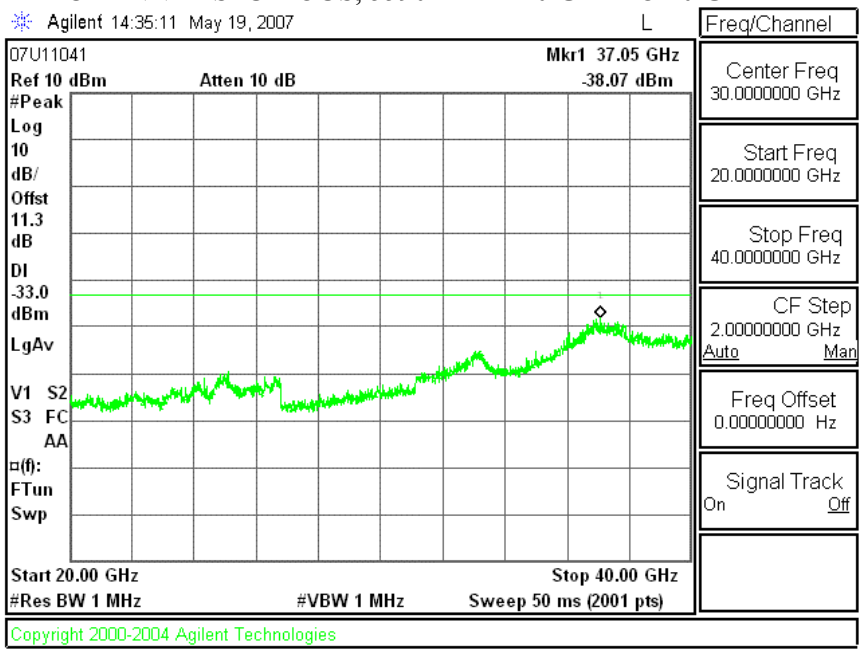
MID CHANNEL SPURIOUS, 5590 MHz - 20 GHz TO 40 GHz



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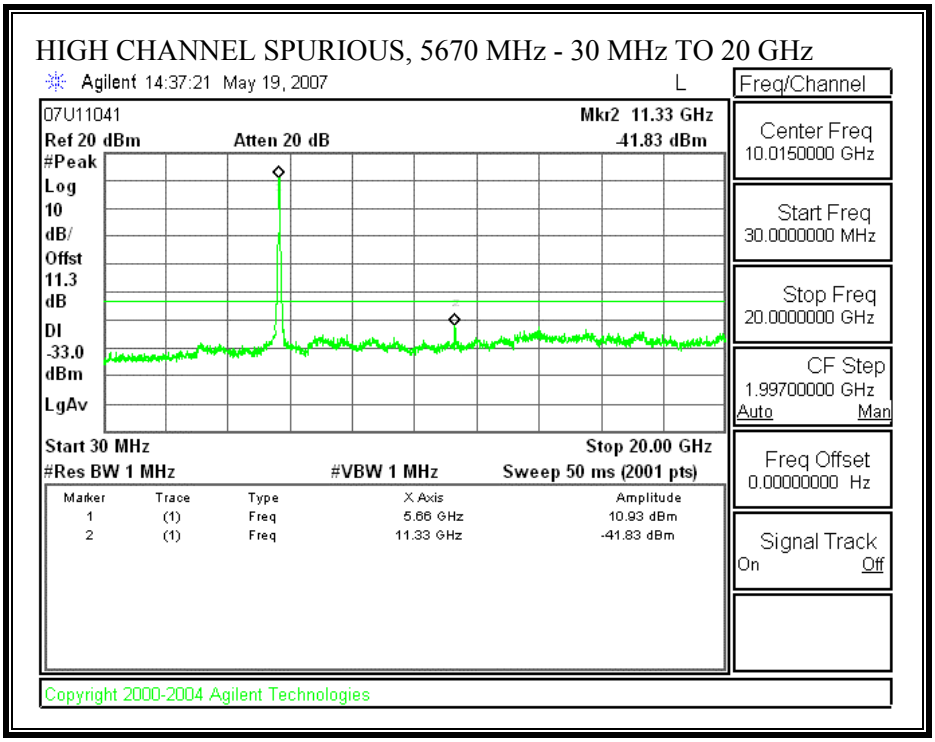

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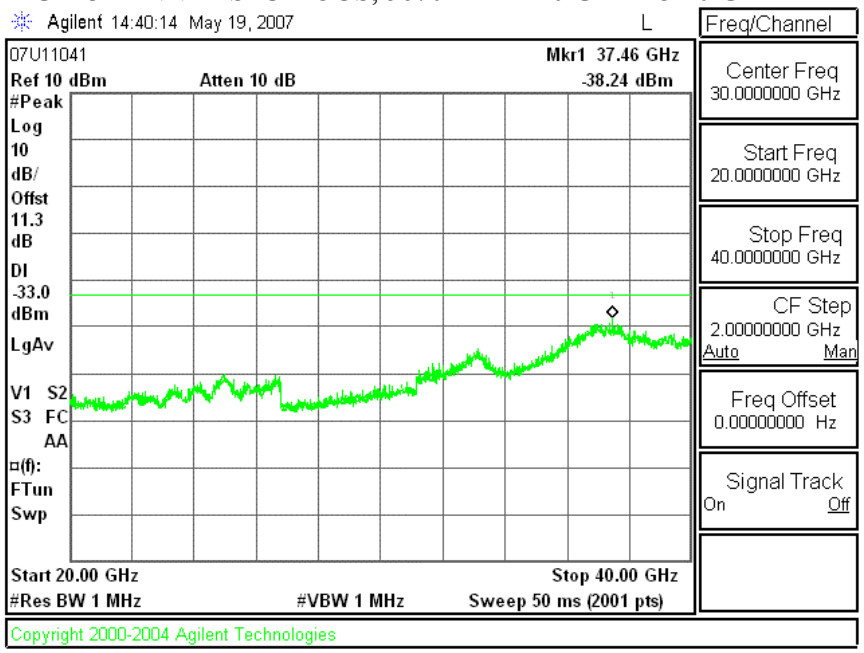
HIGH CHANNEL SPURIOUS, 5670 MHz - 20 GHz TO 40 GHz



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7.5. RADIATED EMISSIONS

7.5.1. TRANSMITTER RADIATED SPURIOUS EMISSIONS

LIMITS

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

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

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

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

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

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

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

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

TEST PROCEDURE

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

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

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

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each 5 GHz band.

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

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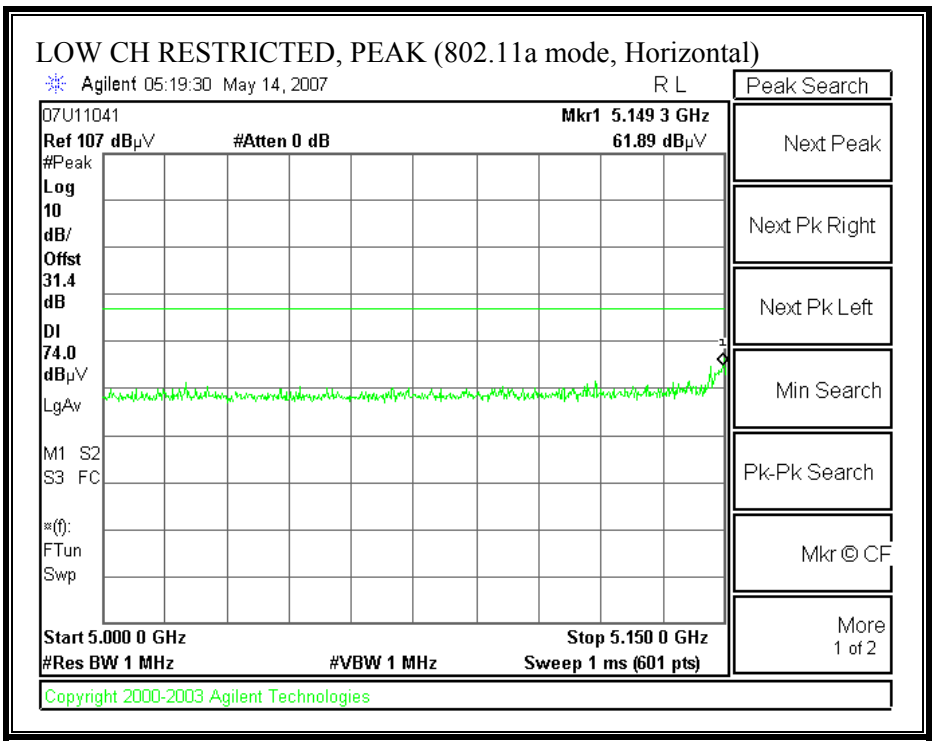
LEGACY MODE

7.5.2. TRANSMITTER ABOVE 1 GHz FOR 5150 TO 5350 MHz BAND

802.11a MODE

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



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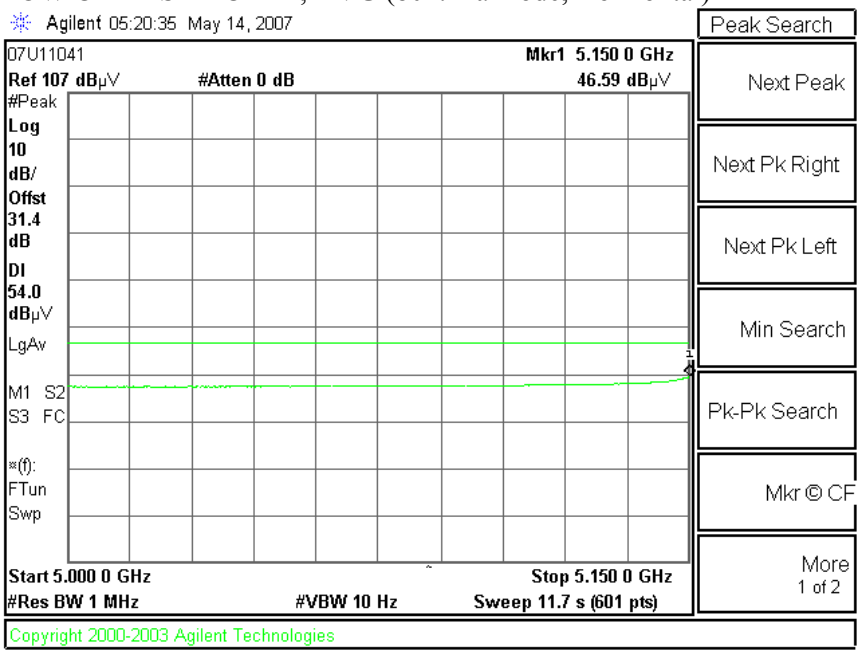
LOW CH RESTRICTED, AVG (802.11a mode, Horizontal)



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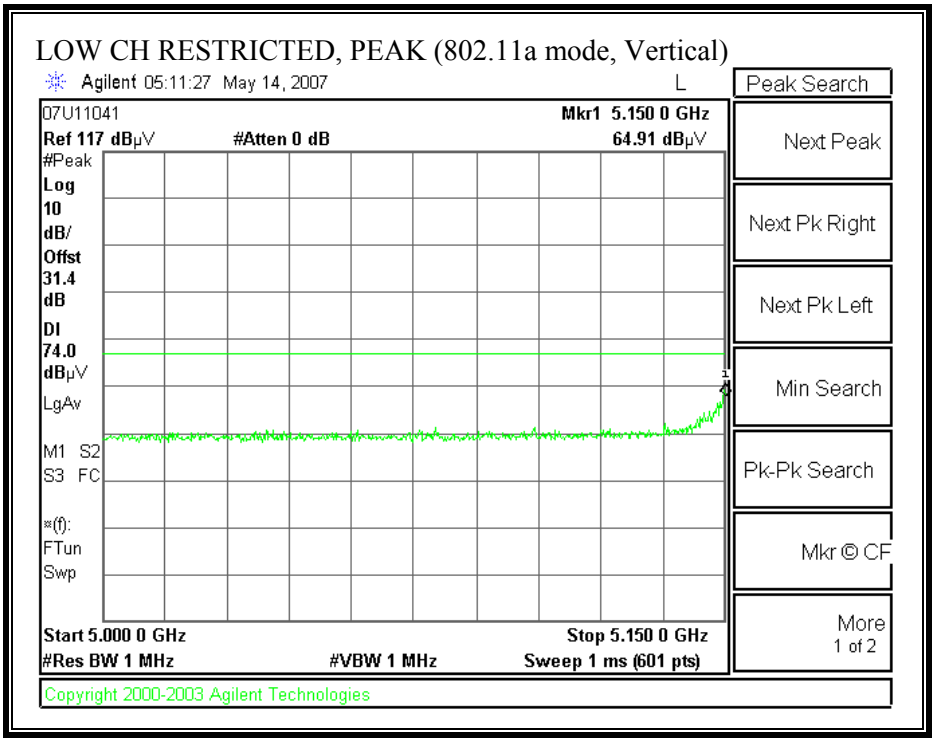
RESTRICTED BANDEDGE (802.11a MODE, LOW CHANNEL, 5180 MHz - VERTICAL)



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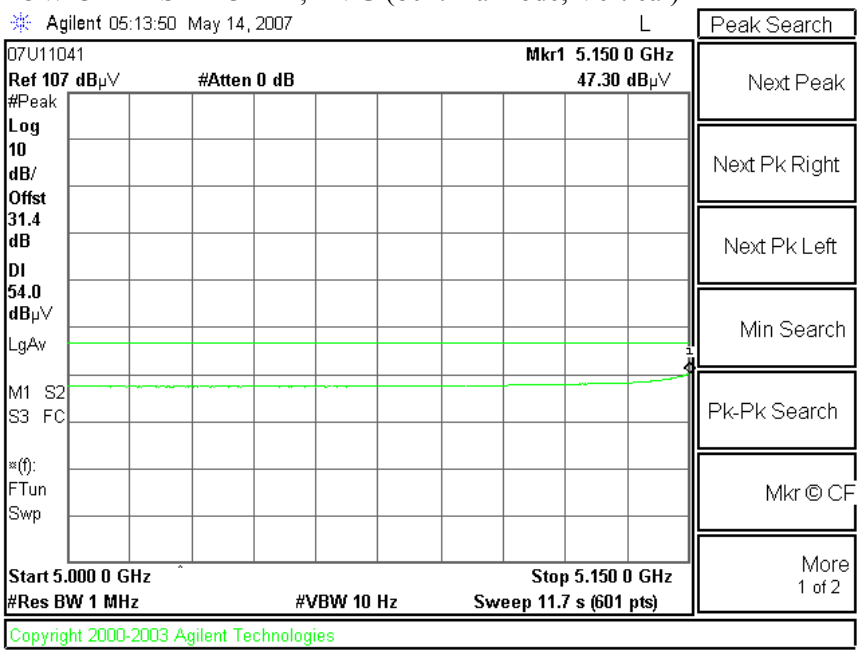
LOW CH RESTRICTED, AVG (802.11a mode, Vertical)



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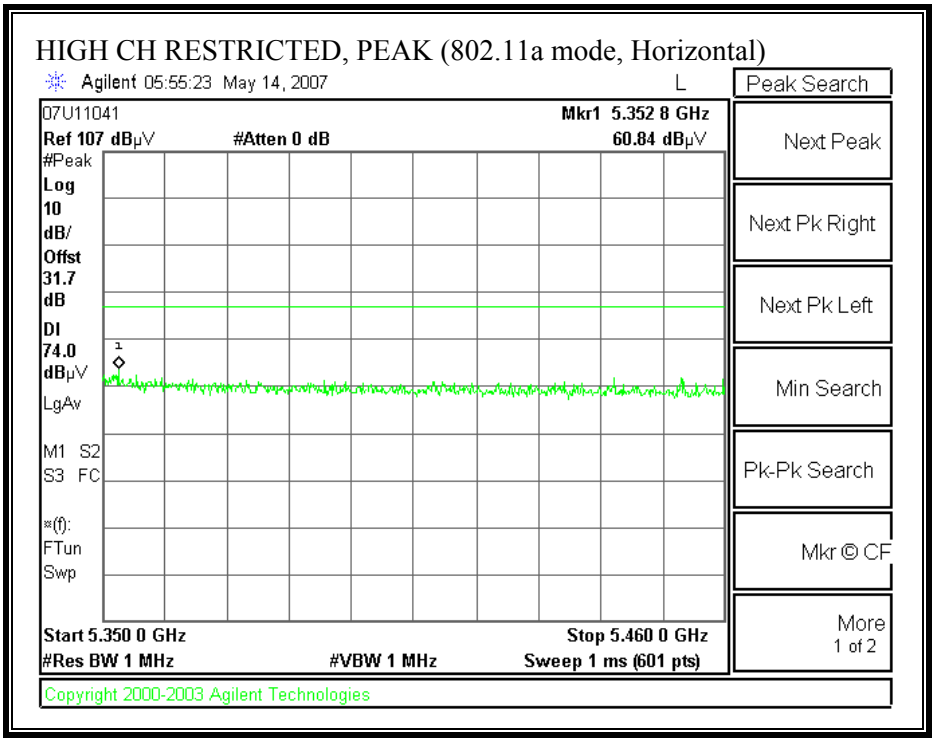
RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5300 MHz - HORIZONTAL)



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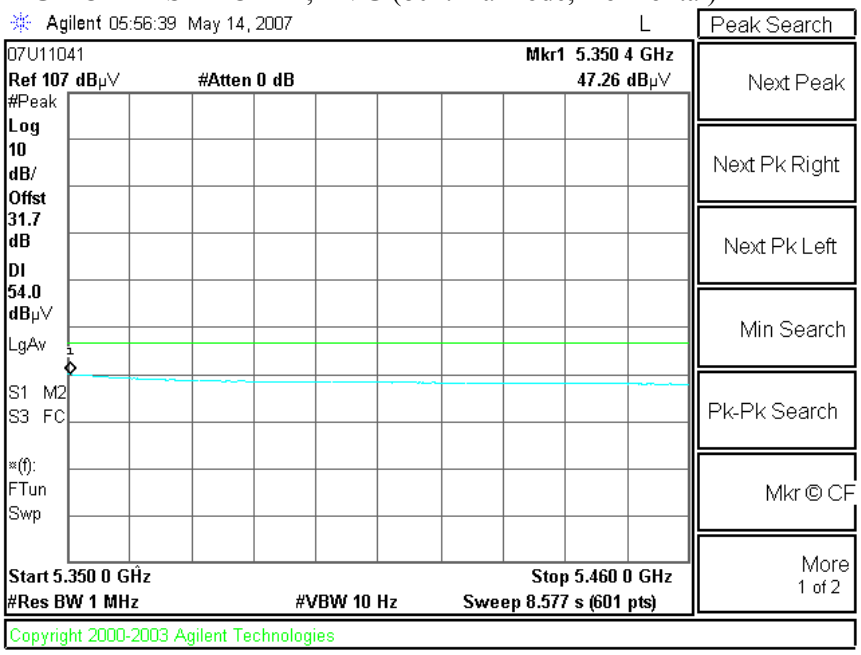
HIGH CH RESTRICTED, AVG (802.11a mode, Horizontal)



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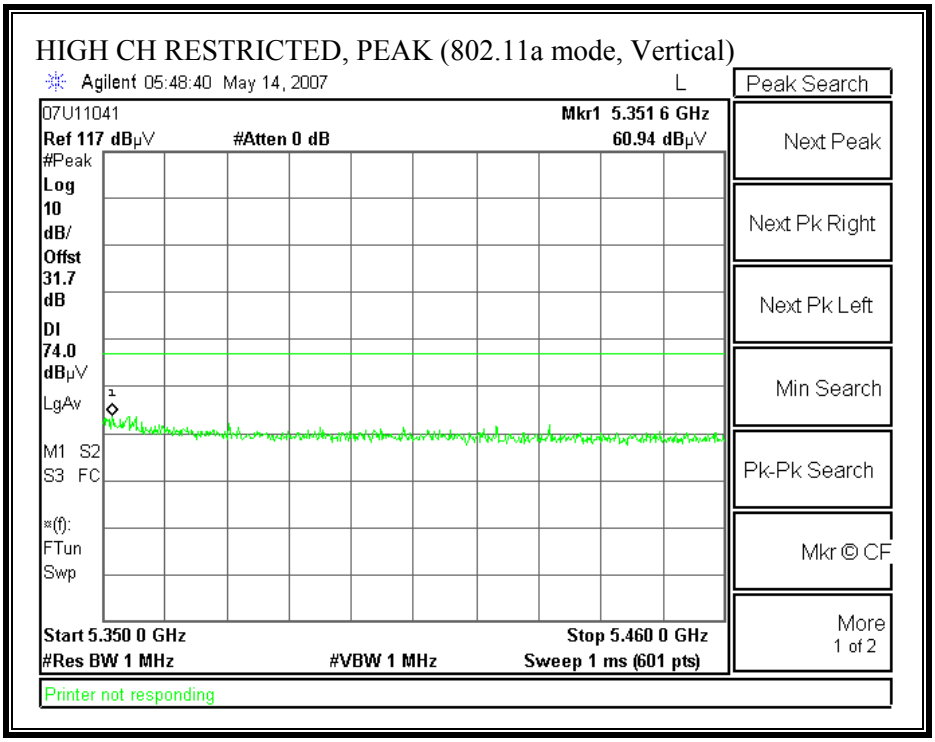
RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5300 MHz - VERTICAL)



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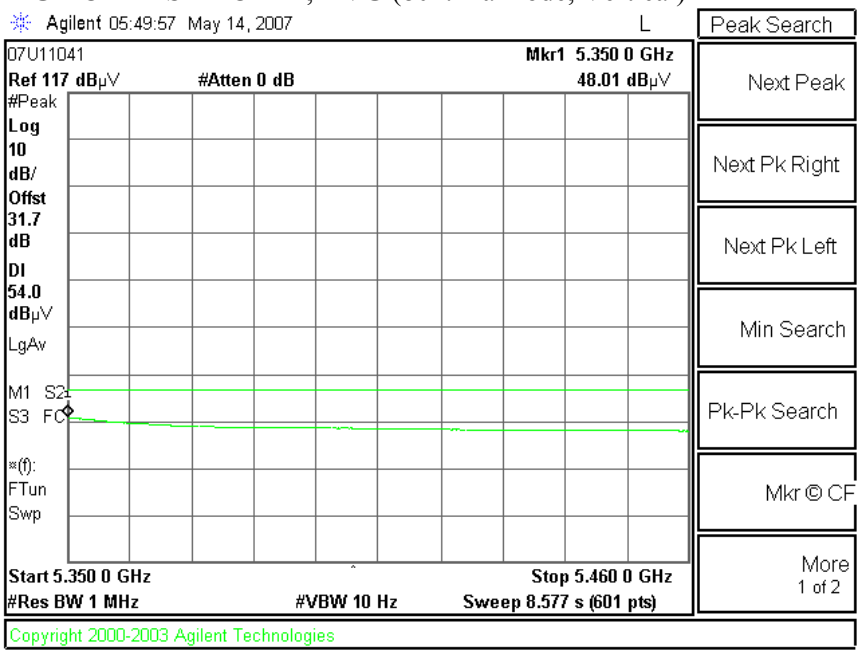
HIGH CH RESTRICTED, AVG (802.11a mode, Vertical)



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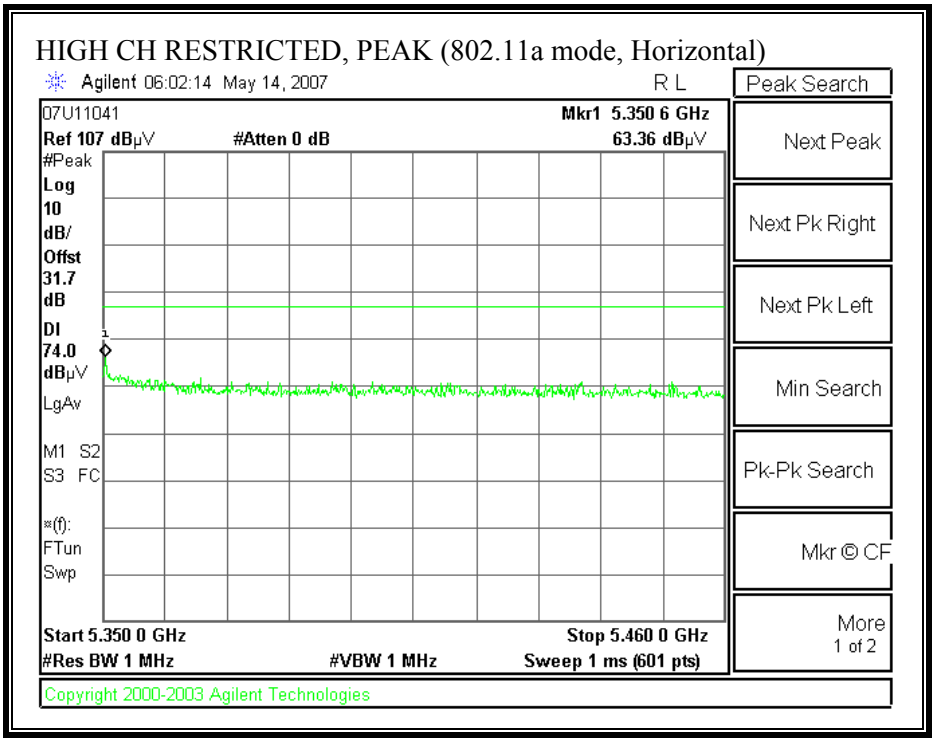
RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5320 MHz - HORIZONTAL)



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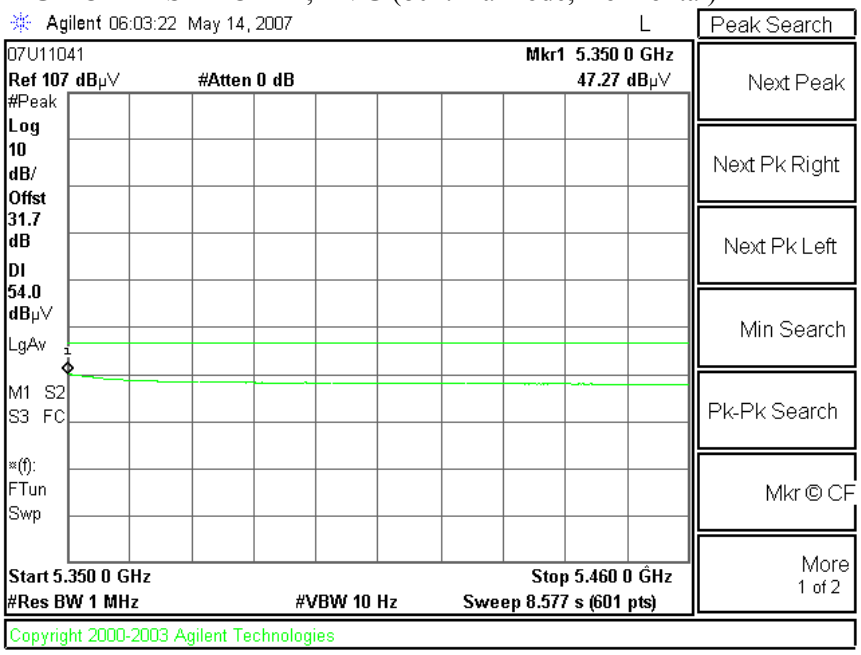
HIGH CH RESTRICTED, AVG (802.11a mode, Horizontal)



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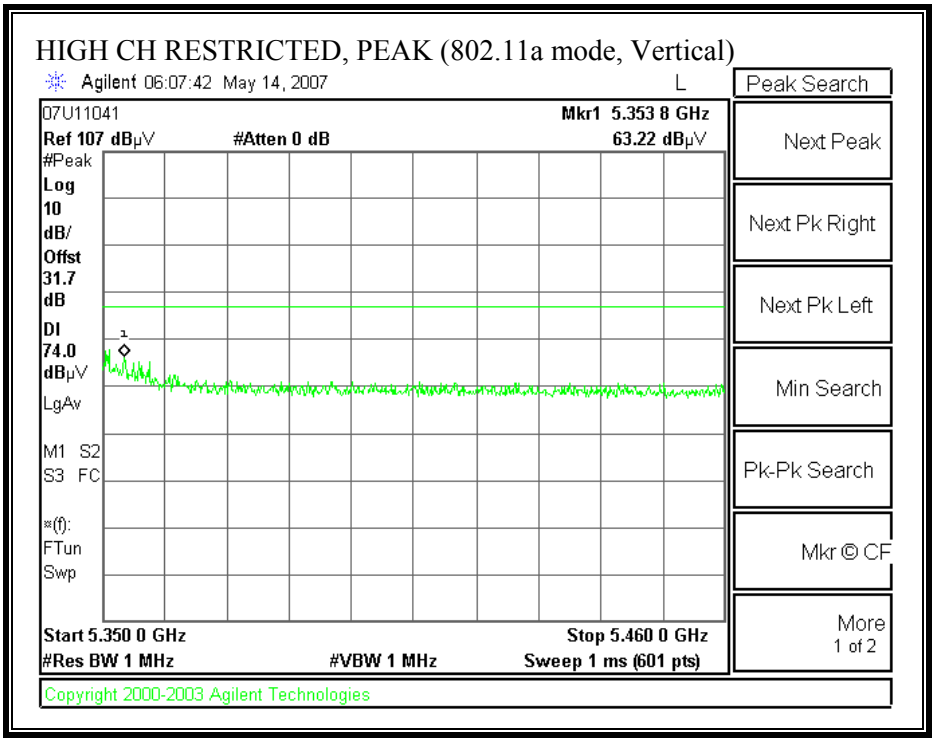
RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5320 MHz - VERTICAL)



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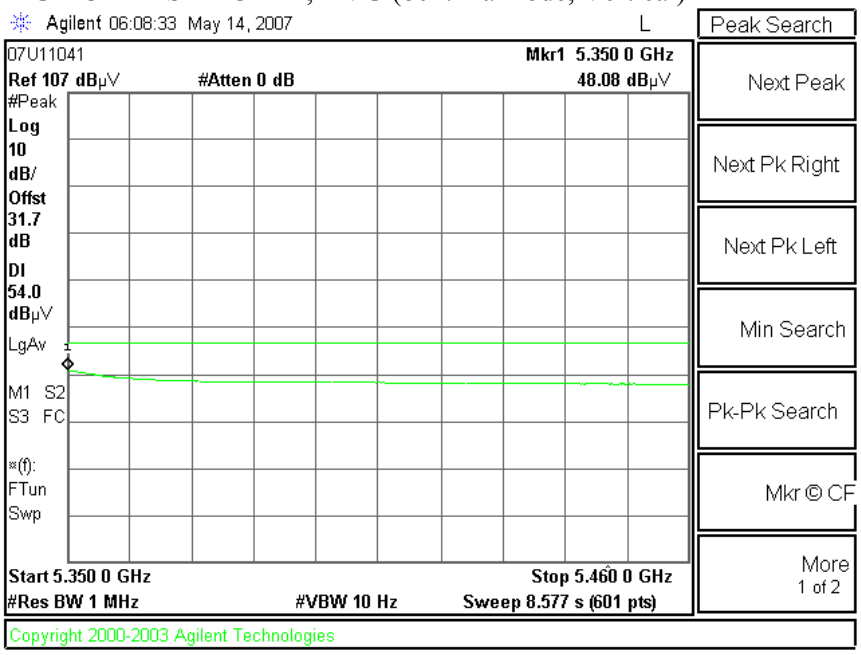
HIGH CH RESTRICTED, AVG (802.11a mode, Vertical)



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802.11a MODE

HARMONICS AND SPURIOUS EMISSIONS (802.11a MODE)

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company:	Broadcom
Project #:	07U11041
Date:	5/16/2007
Test Engineer:	Mengistu Mekuria
Configuration:	EUT Only
Mode:	Transmit, 11a mode 5.2GHz (Legacy)

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T120; S/N: 29310 @3m	T144 Miteq 3008A00931		T125; ARA 18-26GHz; S/N:1007	FCC 15.209

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
		A-5m Chamber	HPF_7.6GHz	

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
CH. 36 (5180MHz)															
10.360	3.0	47.3	33.9	37.5	10.4	-36.8	0.0	0.8	59.2	45.8	74	54	-14.8	-8.2	H
15.540	3.0	41.5	28.7	39.0	12.7	-34.8	0.0	0.7	59.0	46.2	74	54	-15.0	-7.8	H
10.360	3.0	46.0	32.8	37.5	10.4	-36.8	0.0	0.8	57.9	44.7	74	54	-16.1	-9.3	V
15.540	3.0	41.6	28.6	39.0	12.7	-34.8	0.0	0.7	59.1	46.2	74	54	-14.9	-7.8	V
CH. 52 (5260MHz)															
10.520	3.0	47.7	35.1	37.5	10.6	-36.7	0.0	0.8	59.9	47.3	74	54	-14.1	-6.7	H
15.780	3.0	42.4	29.0	39.1	12.8	-34.6	0.0	0.7	60.4	47.0	74	54	-13.6	-7.0	H
10.520	3.0	43.9	32.5	37.5	10.6	-36.7	0.0	0.8	56.1	44.7	74	54	-17.9	-9.3	V
15.780	3.0	41.5	27.5	39.1	12.8	-34.6	0.0	0.7	59.5	45.5	74	54	-14.5	-8.5	V
CH. 64 (5320MHz)															
10.640	3.0	46.6	33.3	37.5	10.7	-36.6	0.0	0.8	59.0	45.8	74	54	-15.0	-8.2	H
15.960	3.0	41.3	28.5	39.3	12.8	-34.5	0.0	0.7	59.6	46.8	74	54	-14.4	-7.2	H
10.640	3.0	44.0	31.8	37.5	10.7	-36.6	0.0	0.8	56.4	44.2	74	54	-17.6	-9.8	V
15.960	3.0	41.0	28.5	39.3	12.8	-34.5	0.0	0.7	59.3	46.8	74	54	-14.7	-7.2	V
Note: No other emission were detected above noise floor.															

Rev. 4.12.7

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		

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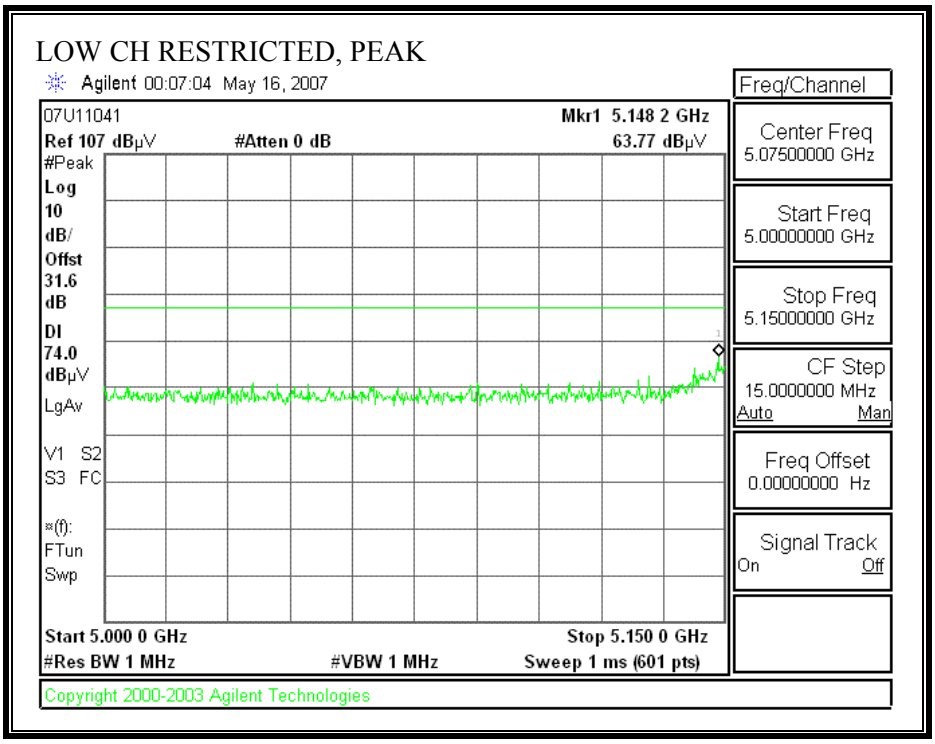
802.11n 40 MHz SISO MODE

RESTRICTED BANDEDGE (802.11n 40 MHz SIS0 MODE)

LOW CHANNEL, 5190 MHz - HORIZONTAL)



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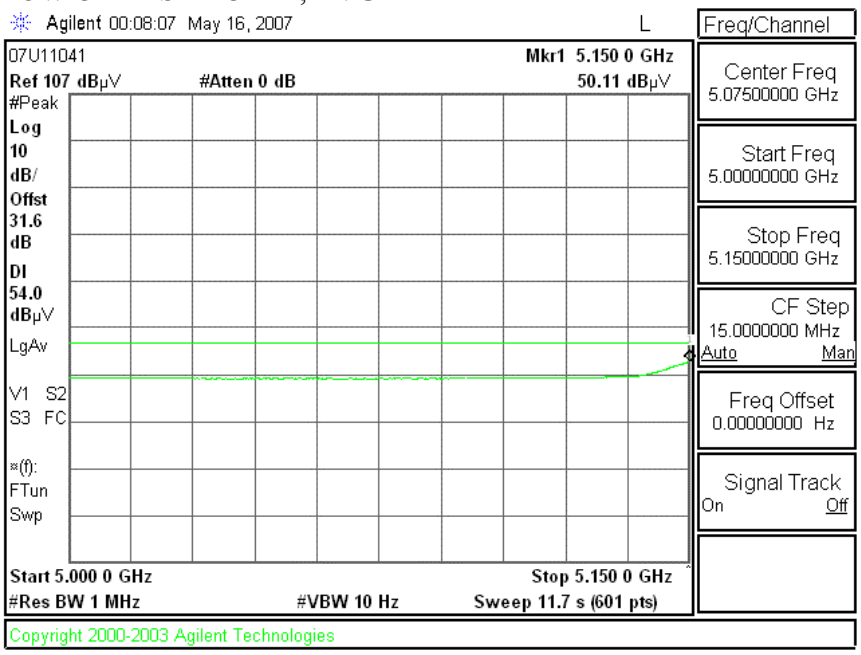
LOW CH RESTRICTED, AVG



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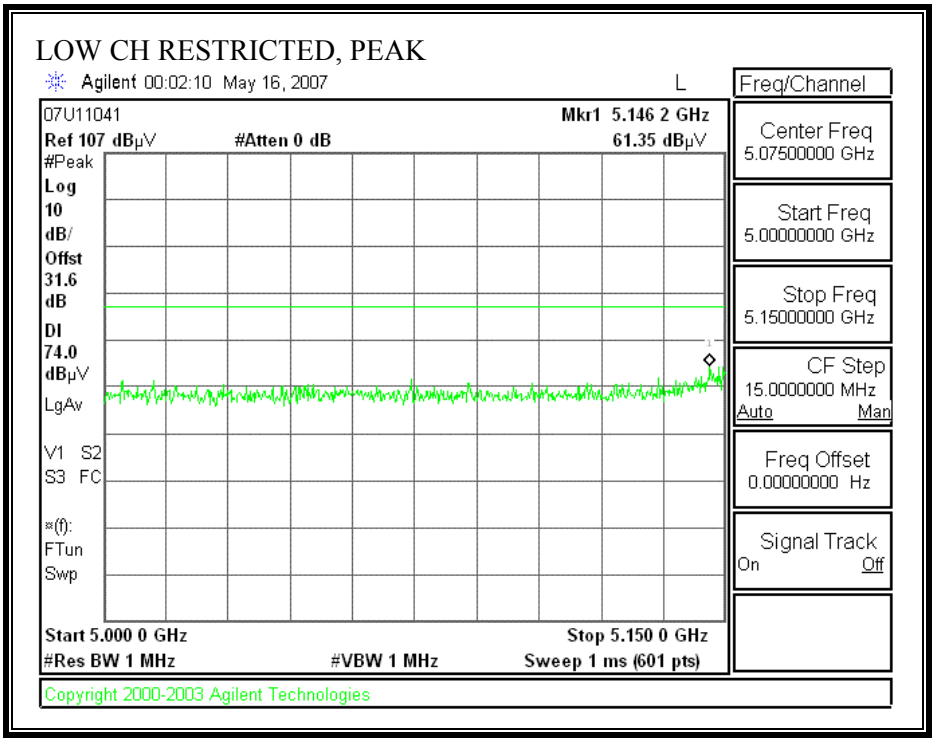
LOW CHANNEL, 5190 MHz - VERTICAL)



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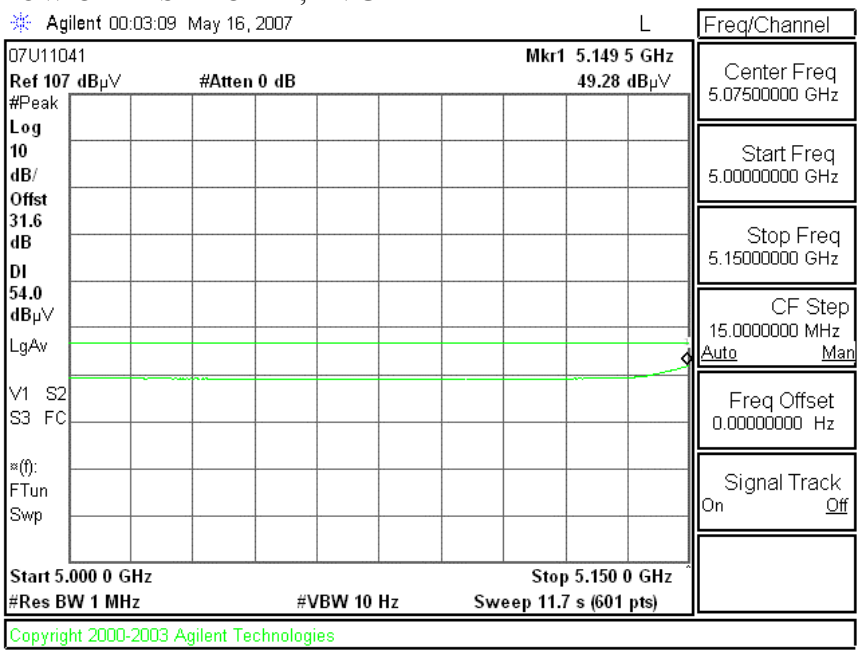
LOW CH RESTRICTED, AVG



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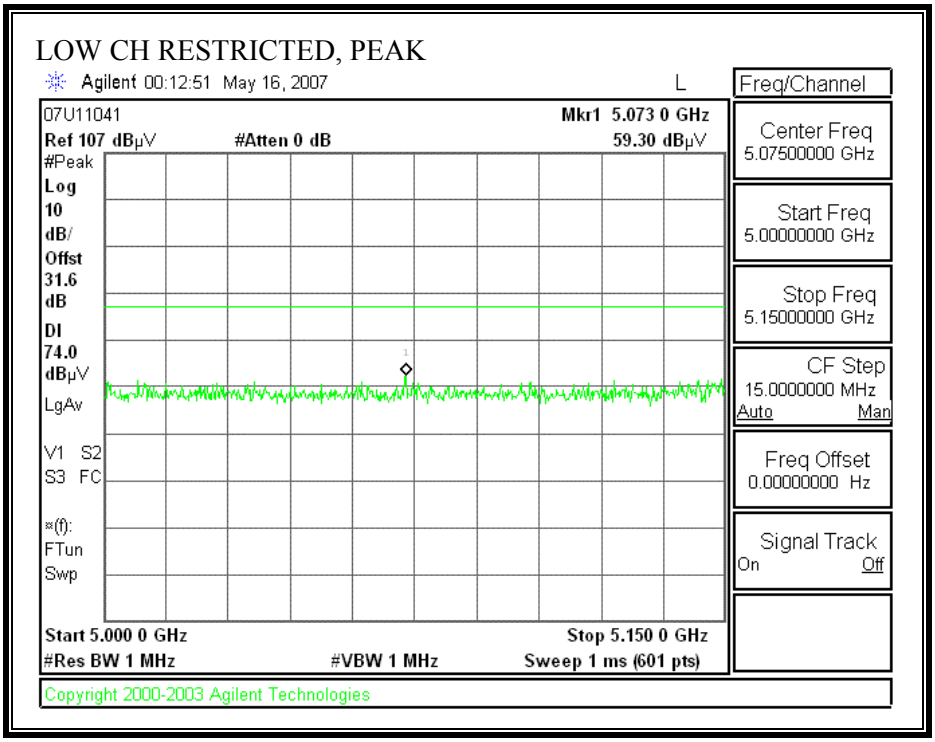
LOW CHANNEL, 5230 MHz - HORIZONTAL)



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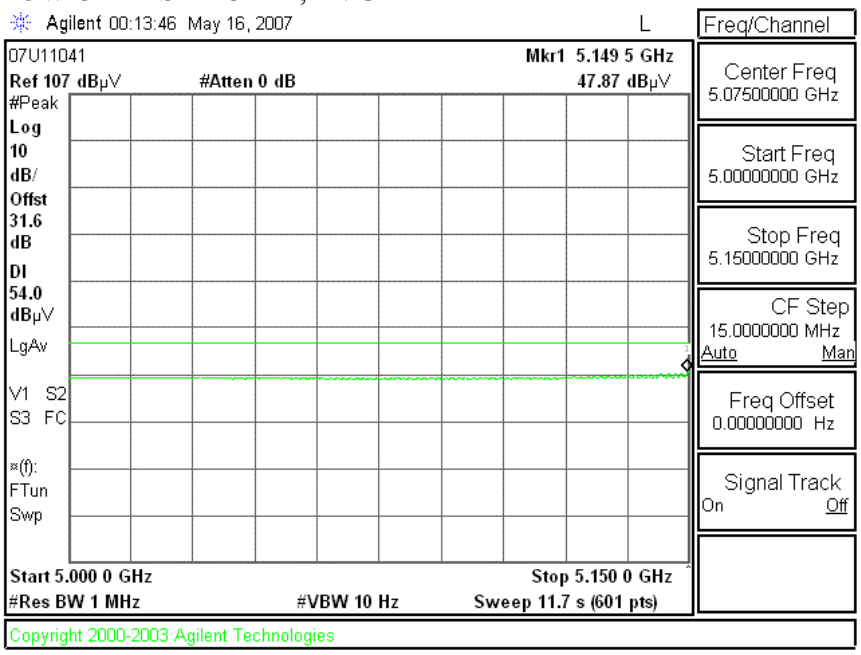
LOW CH RESTRICTED, AVG



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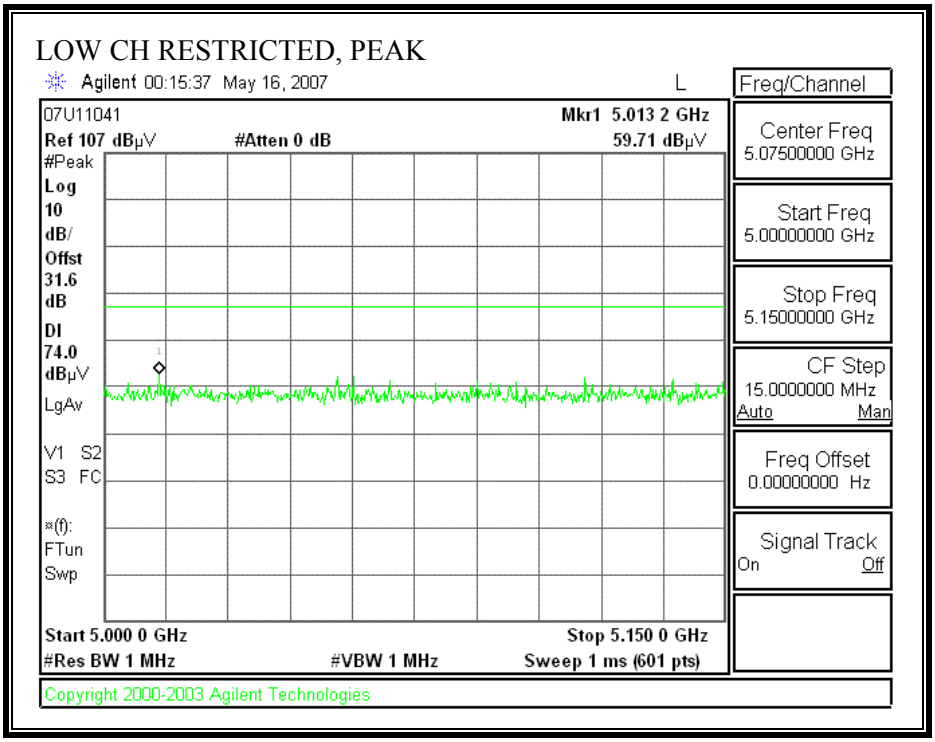
LOW CHANNEL, 5230 MHz - VERTICAL)



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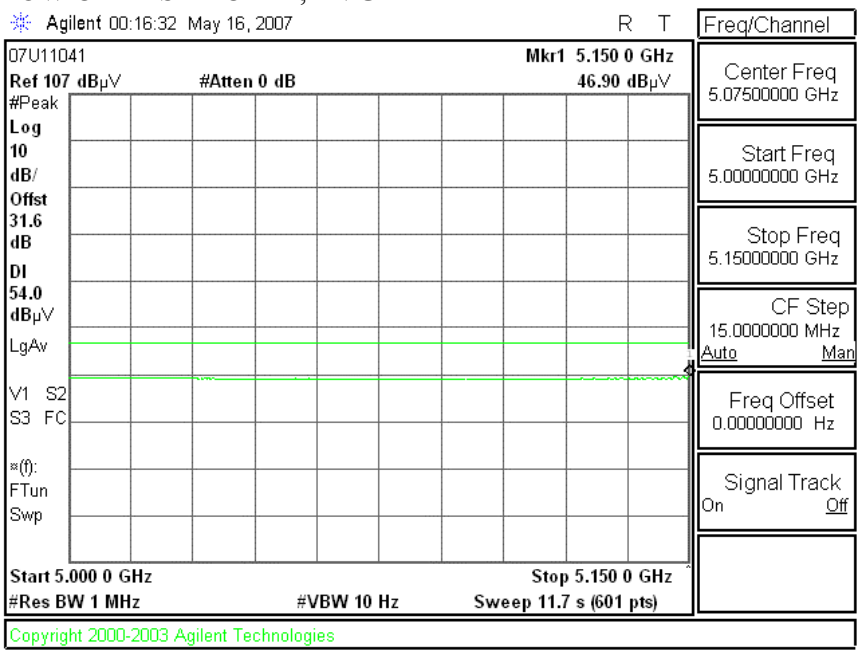
LOW CH RESTRICTED, AVG



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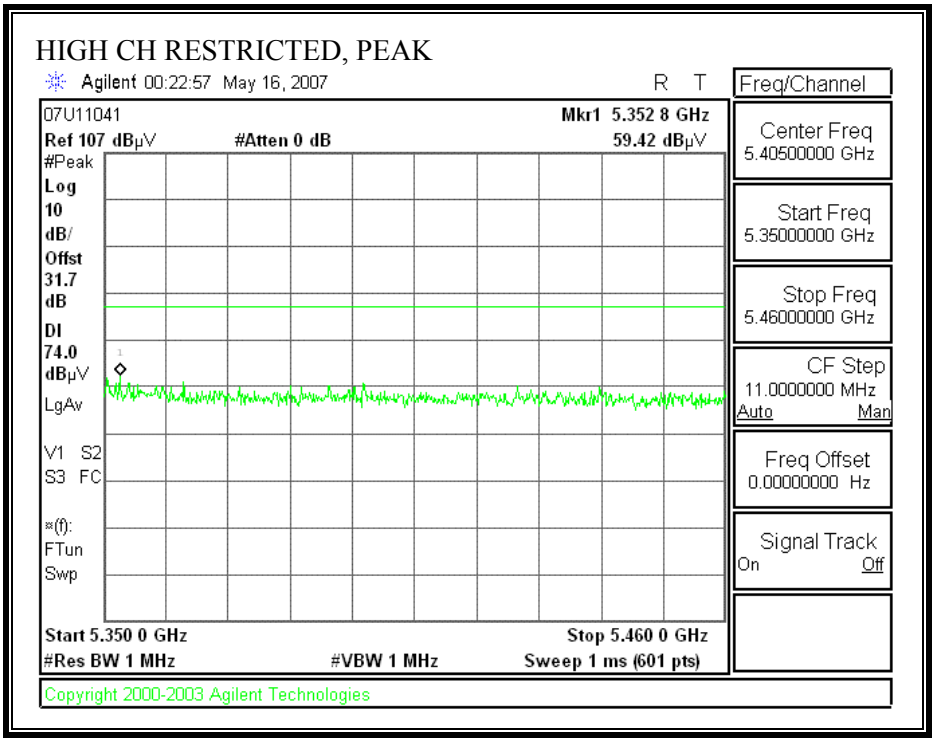
HIGH CHANNEL, 5310 MHz - HORIZONTAL)



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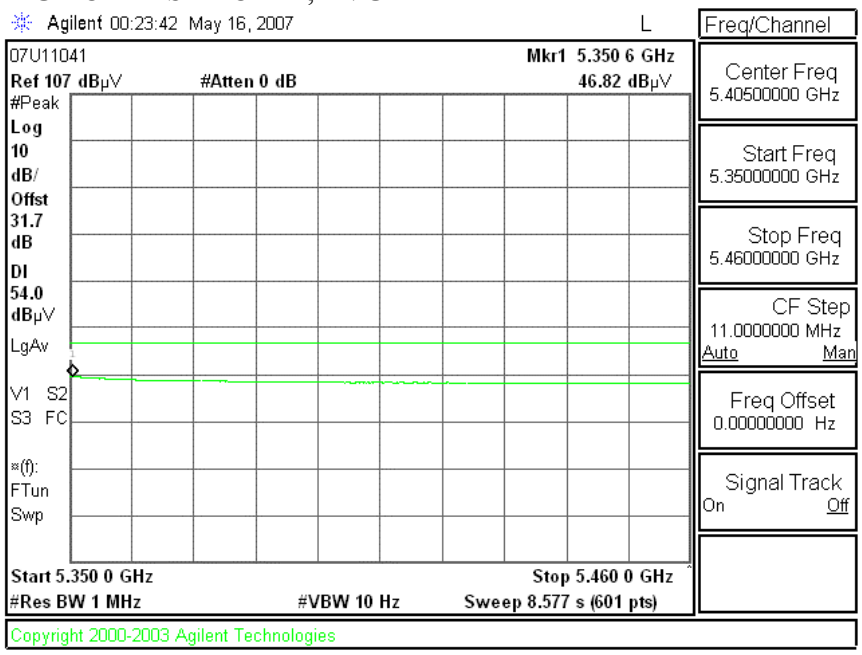
HIGH CH RESTRICTED, AVG



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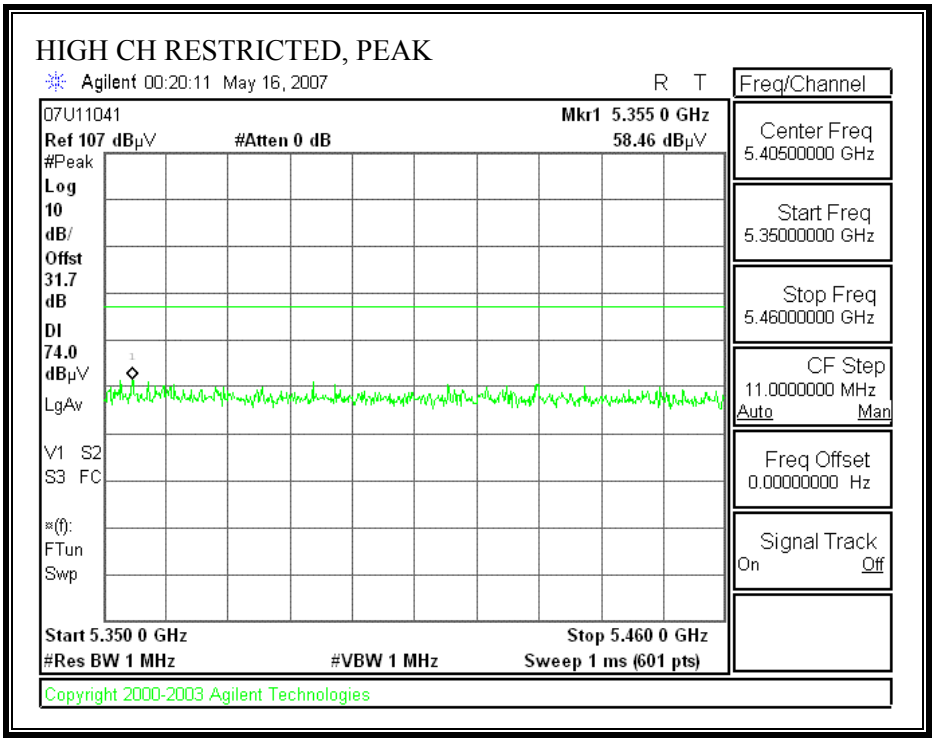
HIGH CHANNEL, 5310 MHz - VERTICAL)



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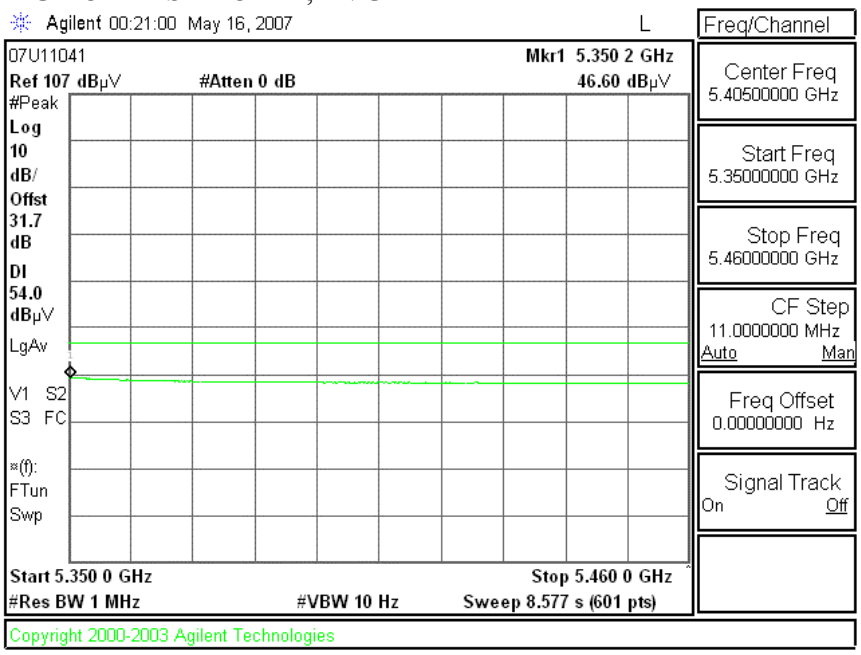
HIGH CH RESTRICTED, AVG



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802.11n 40 MHz SISO MODE

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

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Broadcom
Project #: 07U11041
Date: 5/15/2007
Test Engineer: Mengistu Mekuria
Configuration: EUT Only
Mode: Transmit, 11n mode 5.2GHz (40MHz SISO)

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T120; S/N: 29310 @3m	T144 Miteq 3008A00931		T125; ARA 18-26GHz; S/N:1007	FCC 15.209

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
		A-5m Chamber	HPF_7.6GHz	

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
CH. 38 (5190MHz)															
10.380	3.0	58.4	36.9	37.5	10.5	-36.8	0.0	0.8	70.3	48.9	74	54	-3.7	-5.1	H
15.570	3.0	47.1	31.6	39.0	12.7	-34.8	0.0	0.7	64.7	49.1	74	54	-9.3	-4.9	H
10.380	3.0	54.4	36.1	37.5	10.5	-36.8	0.0	0.8	66.4	48.0	74	54	-7.6	-6.0	V
15.570	3.0	43.7	30.5	39.0	12.7	-34.8	0.0	0.7	61.3	48.1	74	54	-12.7	-5.9	V
CH. 54 (5270MHz)															
10.540	3.0	61.5	37.2	37.5	10.6	-36.7	0.0	0.8	73.7	49.4	74	54	-0.3	-4.6	H
15.810	3.0	48.0	31.7	39.2	12.8	-34.6	0.0	0.7	66.1	49.7	74	54	-7.9	-4.3	H
10.540	3.0	56.5	36.5	37.5	10.6	-36.7	0.0	0.8	68.7	48.7	74	54	-5.3	-5.3	V
15.810	3.0	43.3	30.0	39.2	12.8	-34.6	0.0	0.7	61.4	48.0	74	54	-12.6	-6.0	V
CH. 62 (5310MHz)															
10.640	3.0	60.4	36.3	37.5	10.7	-36.6	0.0	0.8	72.8	48.7	74	54	-1.2	-5.3	H
15.960	3.0	42.9	30.1	39.3	12.8	-34.5	0.0	0.7	61.2	48.4	74	54	-12.8	-5.6	H
10.640	3.0	52.8	32.1	37.5	10.7	-36.6	0.0	0.8	65.2	44.5	74	54	-8.8	-9.5	V
15.960	3.0	42.5	30.1	39.3	12.8	-34.5	0.0	0.7	60.8	48.4	74	54	-13.2	-5.6	V

Note: No other emission were detected above noise floor.

Rev. 4.12.7

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		

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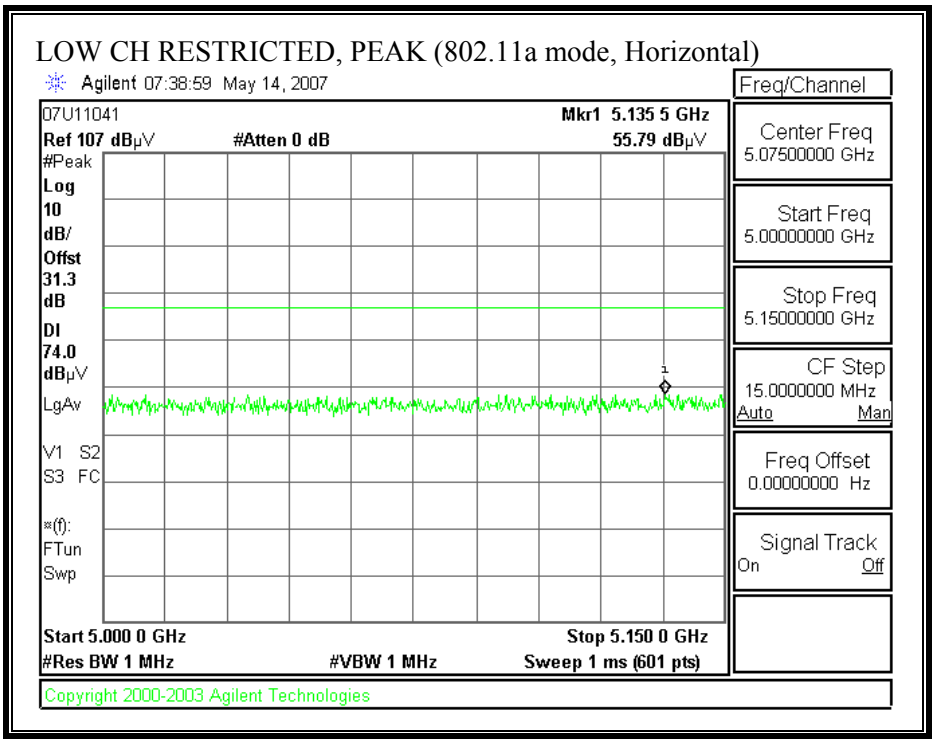
MIMO MODE

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

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

802.11n 20 MHz CDD MCS 0

RESTRICTED BANDEDGE (LOW CHANNEL, 5180 MHz - HORIZONTAL)



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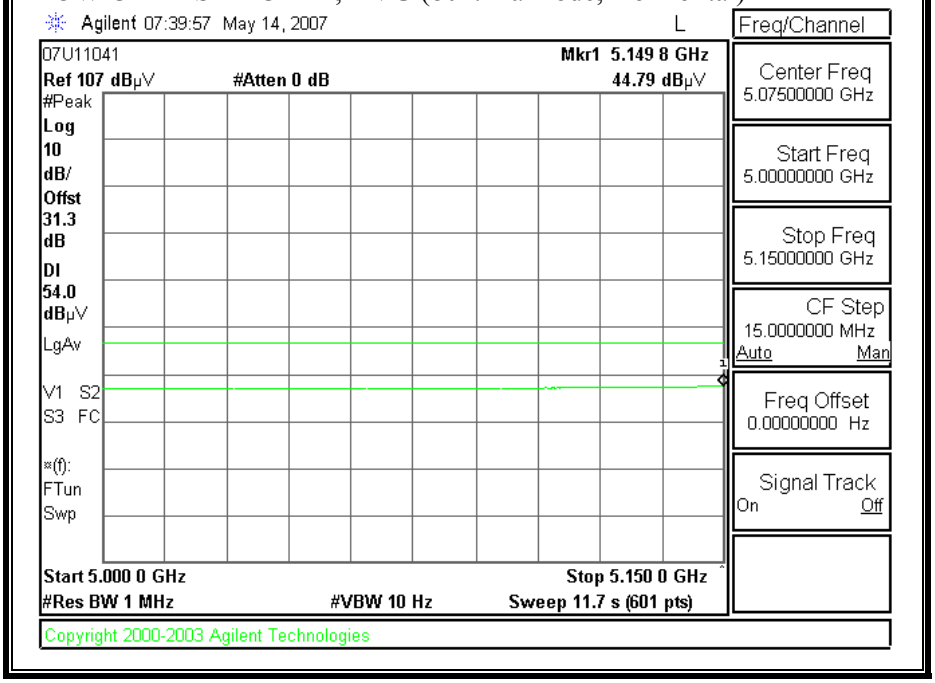
LOW CH RESTRICTED, AVG (802.11a mode, Horizontal)



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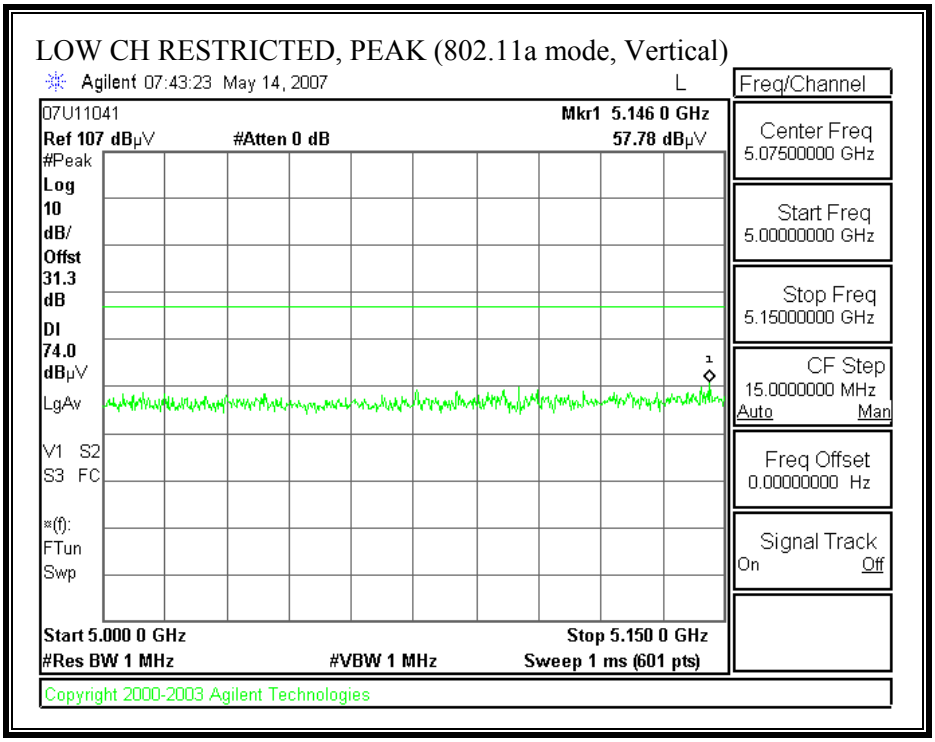
RESTRICTED BANDEDGE (802.11a MODE, LOW CHANNEL, 5180 MHz - VERTICAL)



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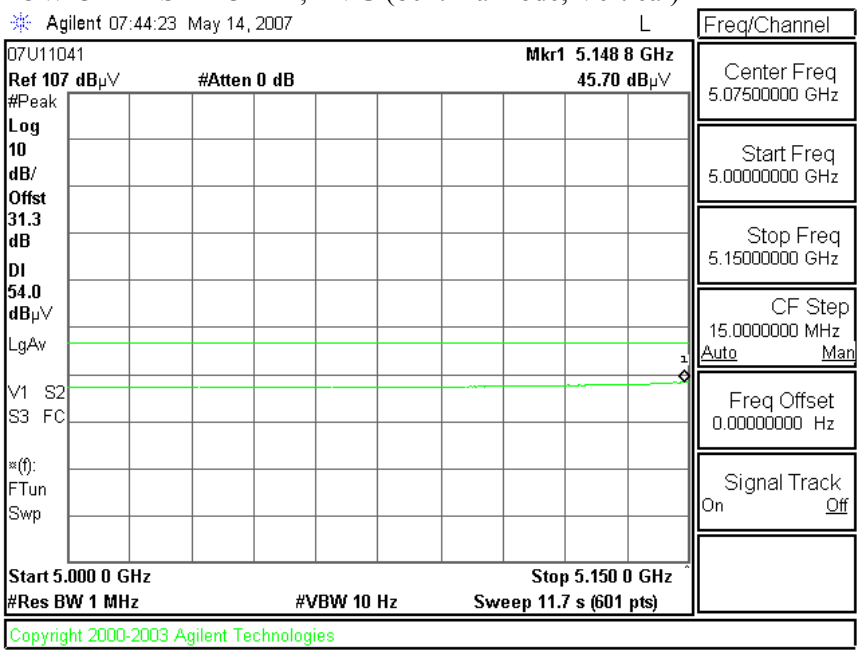
LOW CH RESTRICTED, AVG (802.11a mode, Vertical)



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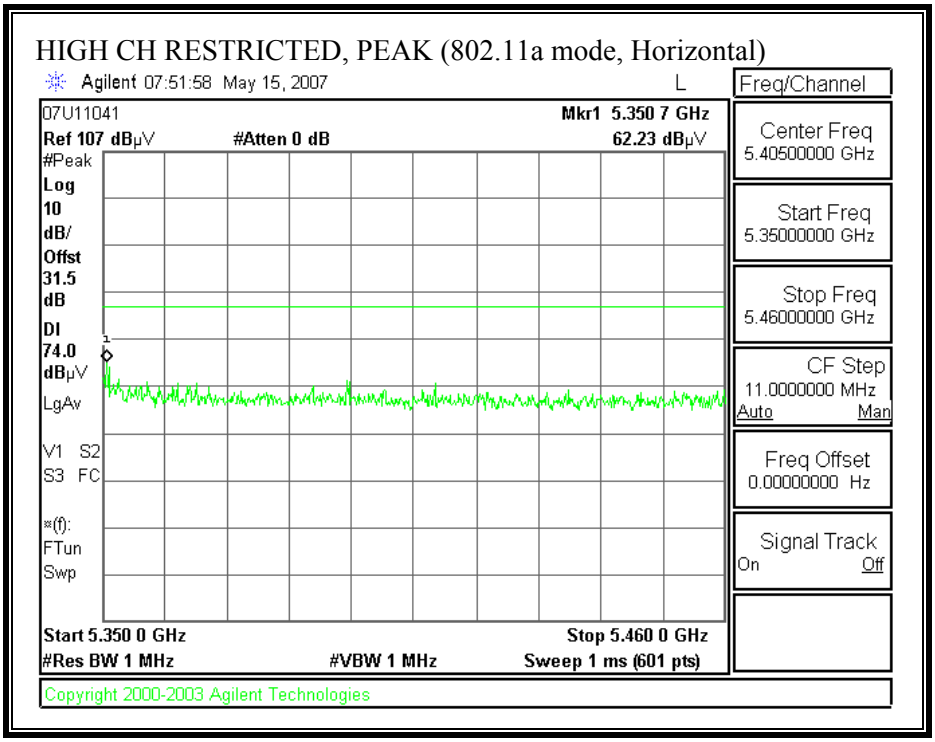
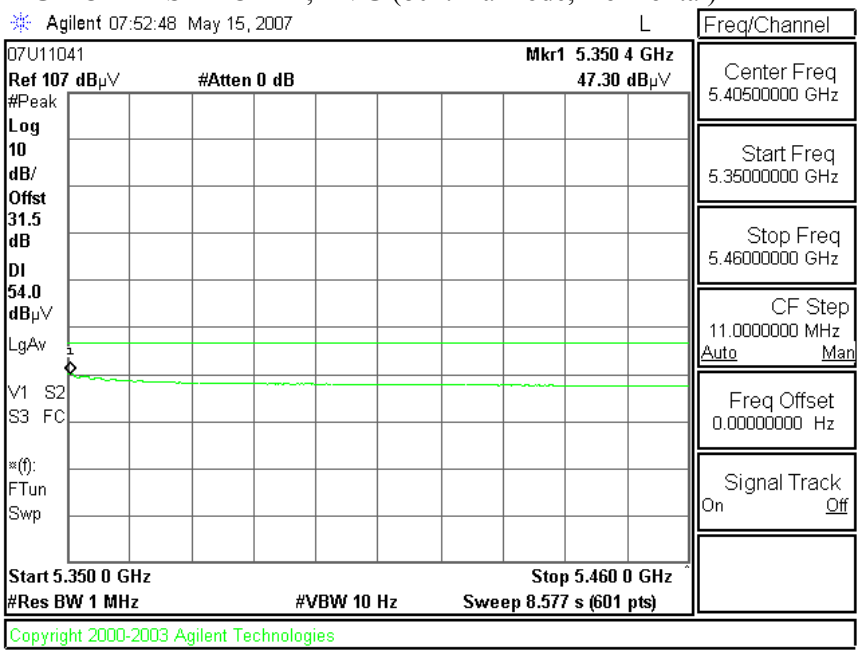
RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5320 MHz - HORIZONTAL)



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

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



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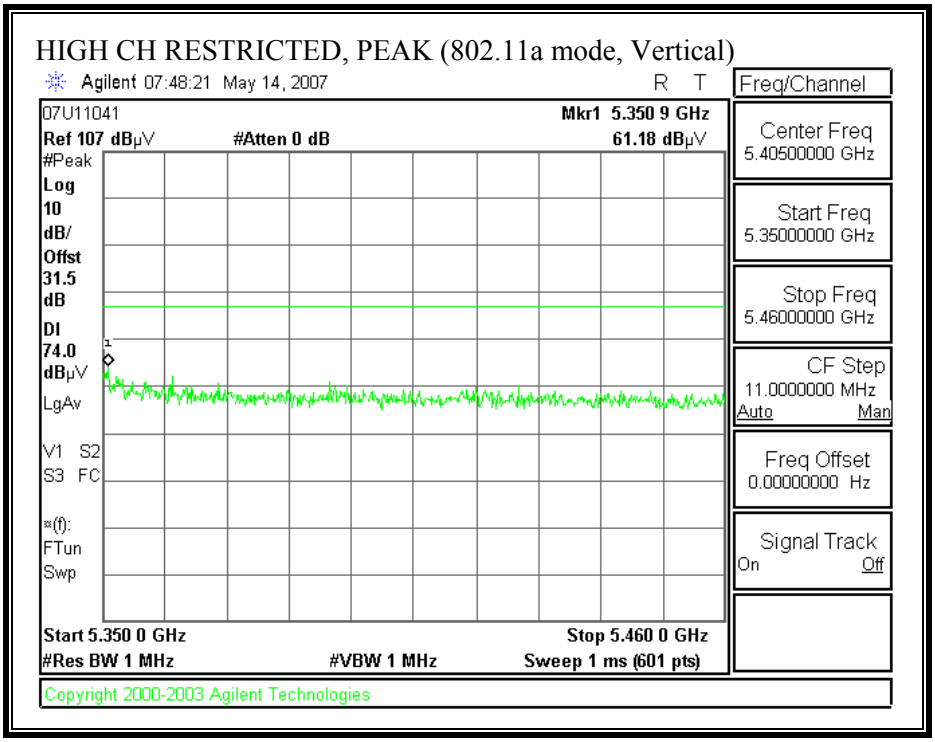
RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5320 MHz - VERTICAL)



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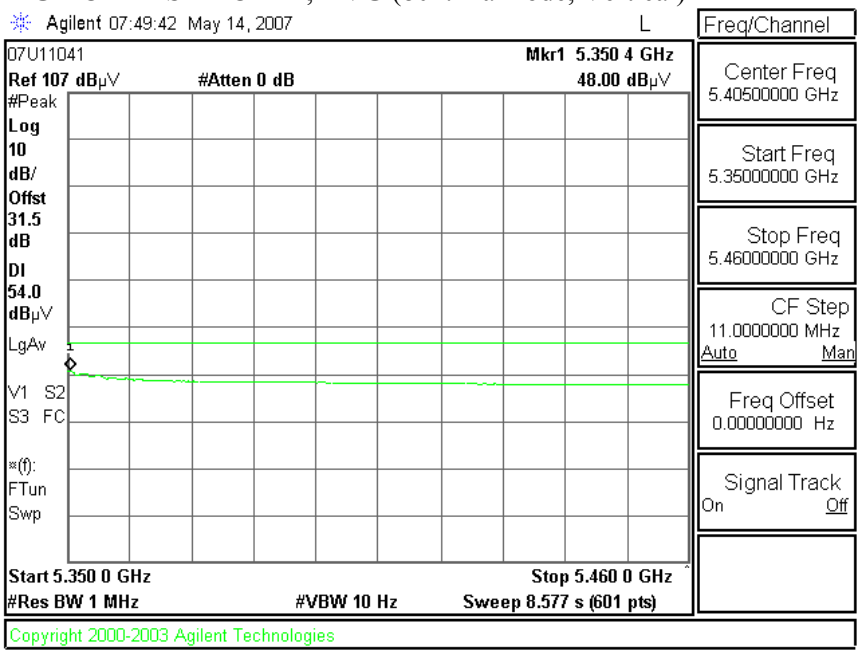
HIGH CH RESTRICTED, AVG (802.11a mode, Vertical)



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

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Broadcom
Project #: 07U11041
Date: 5/16/2007
Test Engineer: Mengistu Mekuria
Configuration: EUT Only
Mode: Transmit, 11n mode 5.2GHz (20MHz MIMO)

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T34 HP 8449B		T125; ARA 18-26GHz; S/N:1007	FCC 15.205

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
		B-5m Chamber	HPF_7.6GHz	

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
CH. 36 (5180MHz)															
15.540	3.0	41.7	28.6	38.1	12.9	-32.2	0.0	0.7	61.2	48.1	74	54	-12.8	-5.9	H
15.540	3.0	42.0	28.5	38.1	12.9	-32.2	0.0	0.7	61.5	48.0	74	54	-12.5	-6.0	V
CH. 52 (5260MHz)															
15.620	3.0	42.1	28.7	37.9	12.9	-32.2	0.0	0.7	61.4	48.1	74	54	-12.6	-5.9	H
15.620	3.0	41.6	28.7	37.9	12.9	-32.2	0.0	0.7	60.9	48.1	74	54	-13.1	-5.9	V
CH. 64 (5320MHz)															
10.640	3.0	42.4	29.9	37.1	11.0	-32.6	0.0	0.8	58.6	46.1	74	54	-15.4	-7.9	H
15.960	3.0	41.1	28.3	37.1	13.1	-32.1	0.0	0.7	59.8	47.0	74	54	-14.2	-7.0	H
10.640	3.0	43.0	30.4	37.1	11.0	-32.6	0.0	0.8	59.2	46.6	74	54	-14.8	-7.4	V
15.960	3.0	41.3	28.2	37.1	13.1	-32.1	0.0	0.7	60.0	47.0	74	54	-14.0	-7.0	V
Note: No other emission were detected above noise floor.															

Rev. 4.12.7

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		

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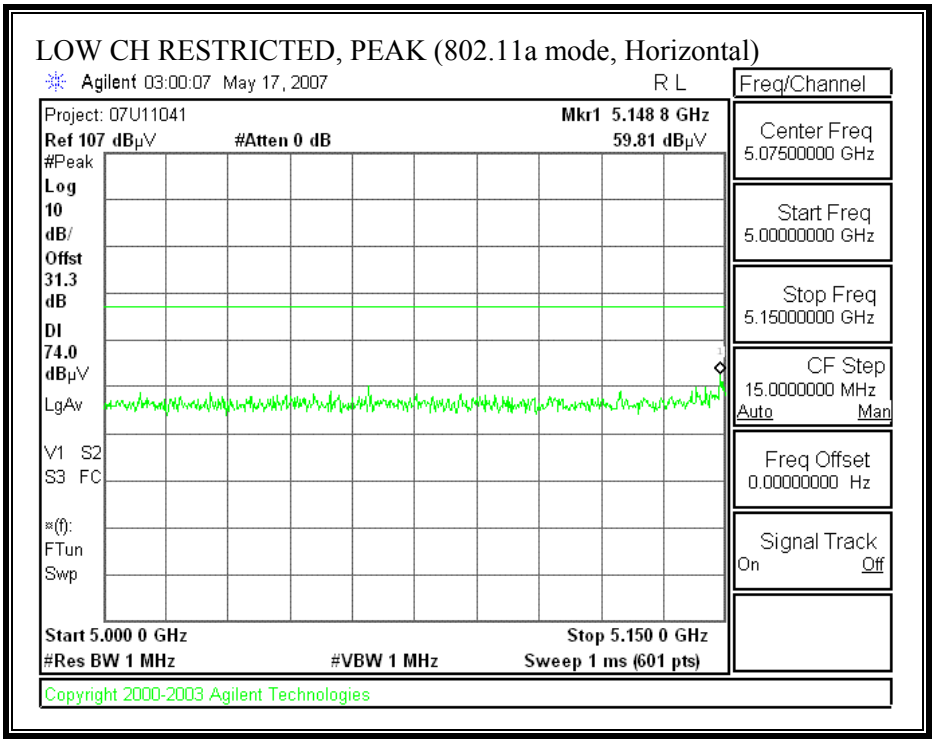
802.11n 40 MHz CDD MCS 32

RESTRICTED BANDEDGE (LOW CHANNEL, 5190 MHz - HORIZONTAL)



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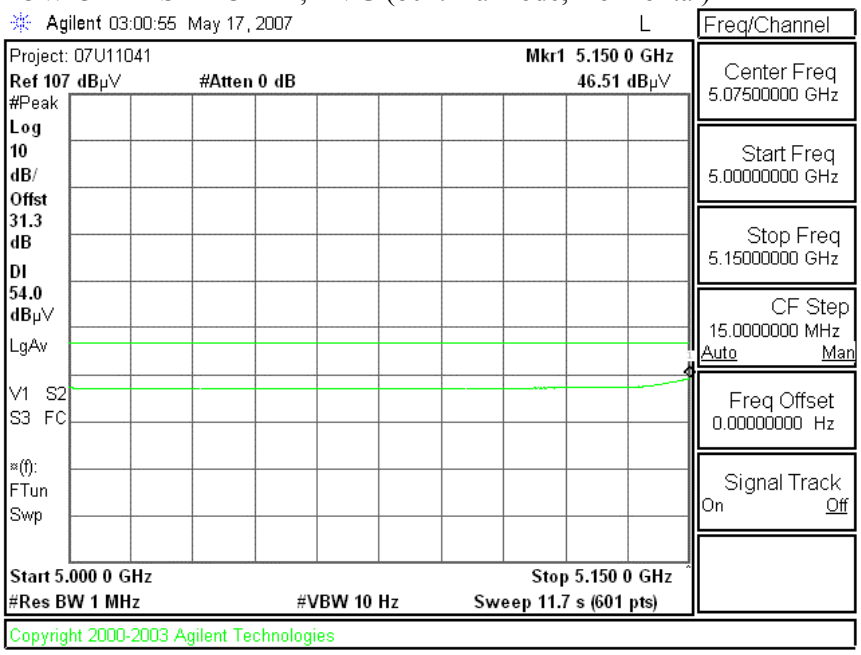
LOW CH RESTRICTED, AVG (802.11a mode, Horizontal)



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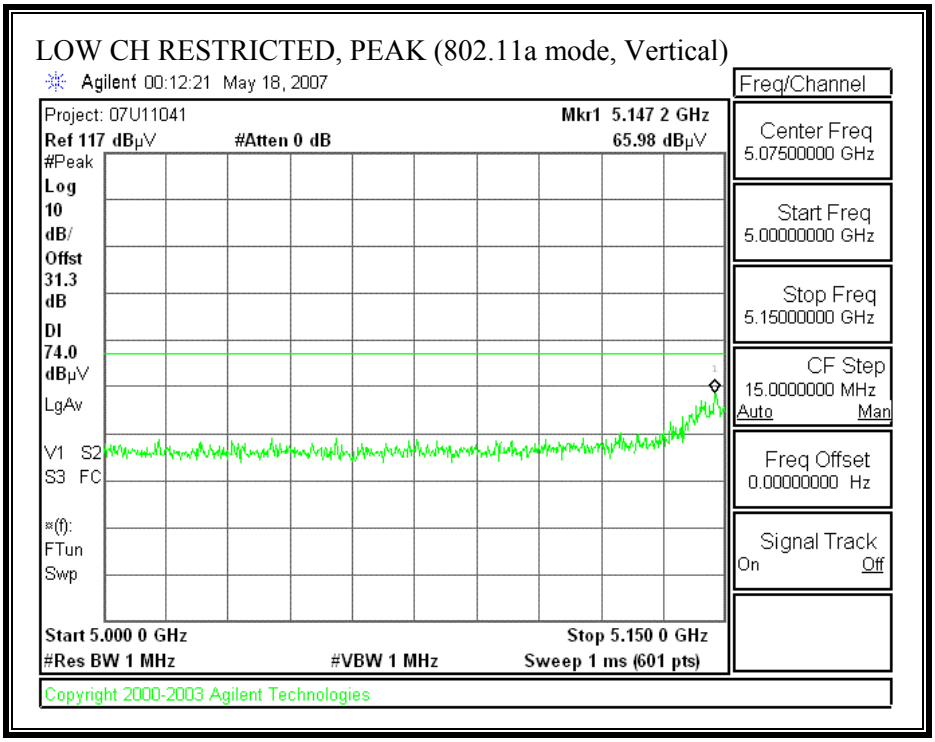
RESTRICTED BANDEDGE (802.11a MODE, LOW CHANNEL, 5190 MHz - VERTICAL)



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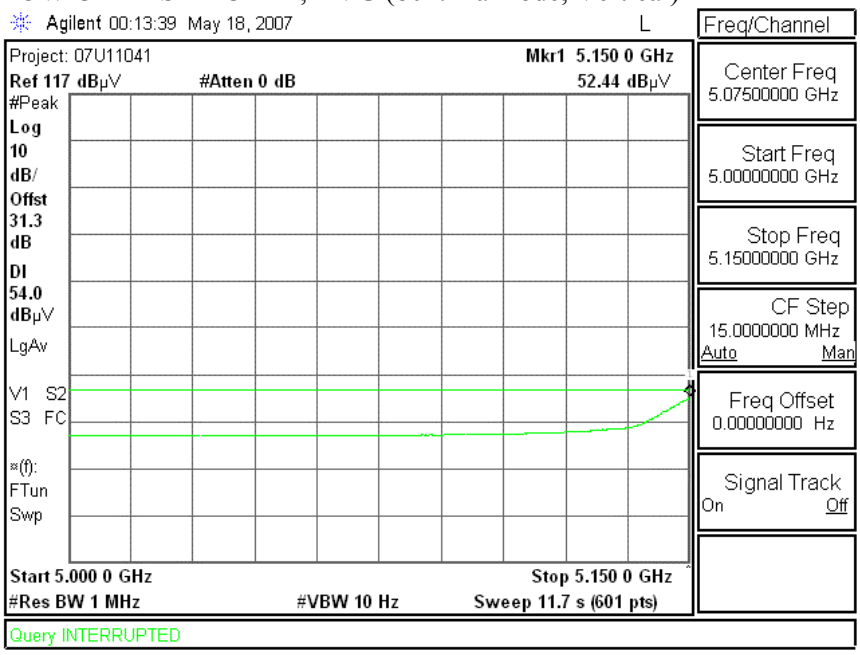
LOW CH RESTRICTED, AVG (802.11a mode, Vertical)



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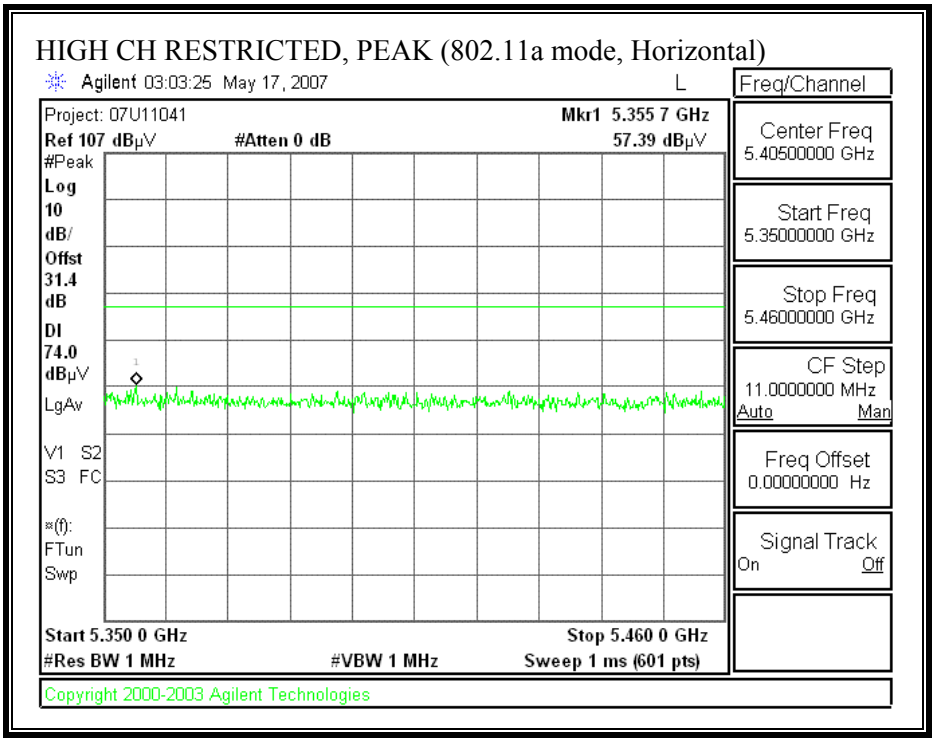
RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5310 MHz - HORIZONTAL)



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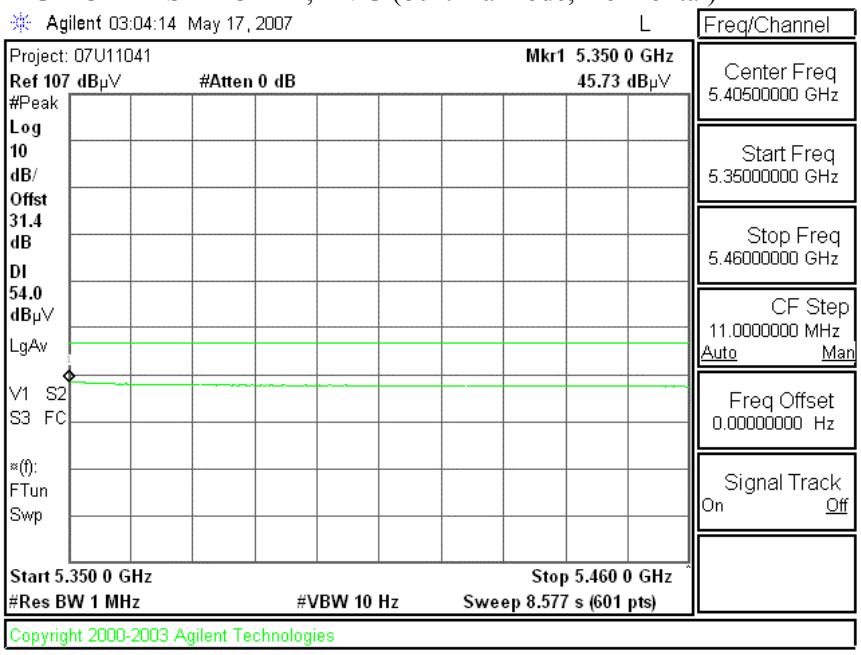
HIGH CH RESTRICTED, AVG (802.11a mode, Horizontal)



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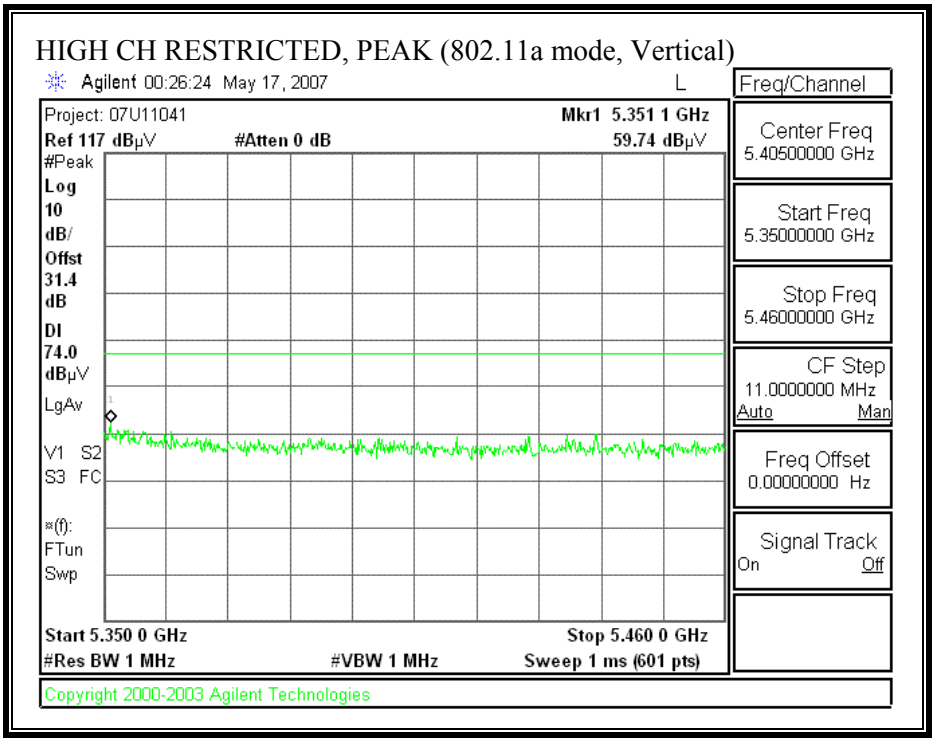
RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5310 MHz - VERTICAL)



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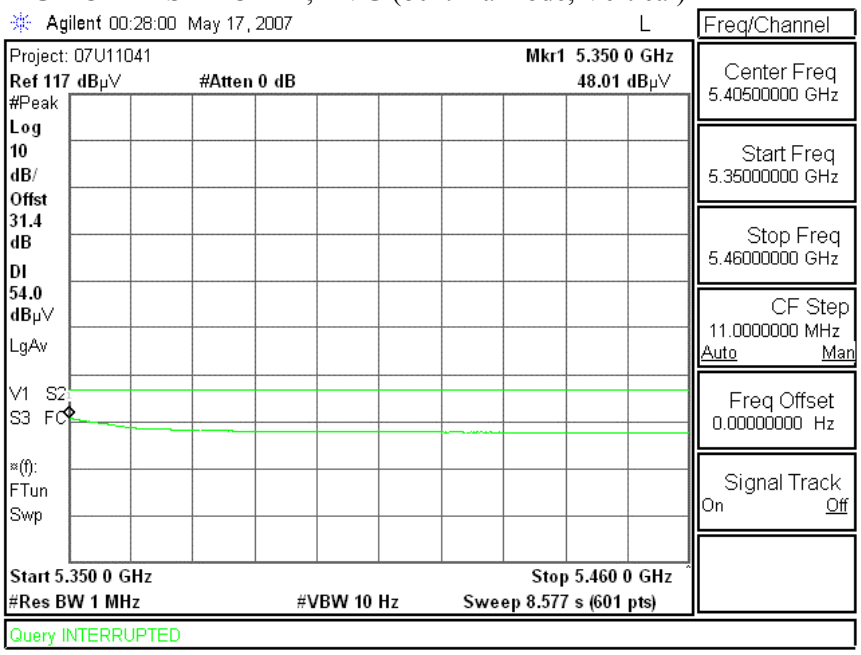
HIGH CH RESTRICTED, AVG (802.11a mode, Vertical)



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802.11n 40 MHz CDD MCS 32

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

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company:	Broadcom
Project #:	07U11041
Date:	5/16/2007
Test Engineer:	Mengistu Mekuria
Configuration:	EUT Only
Mode:	Transmit, 11n mode 5.2GHz (40MHz MCS32 MIMO)

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T120; S/N: 29310 @3m	T144 Miteq 3008A00931		T125; ARA 18-26GHz; S/N:1007	FCC 15.209

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
		A-5m Chamber	HPF_7.6GHz	

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
CH. 38 (5190MHz)															
10.380	3.0	41.7	29.6	37.5	10.5	-36.8	0.0	0.8	53.6	41.5	74	54	-20.4	-12.5	H
15.570	3.0	41.8	28.9	39.0	12.7	-34.8	0.0	0.7	59.4	46.5	74	54	-14.6	-7.5	H
10.380	3.0	42.8	30.0	37.5	10.5	-36.8	0.0	0.8	54.7	41.9	74	54	-19.3	-12.1	V
15.570	3.0	41.3	28.5	39.0	12.7	-34.8	0.0	0.7	58.9	46.1	74	54	-15.1	-7.9	V
CH. 54 (5270MHz)															
10.540	3.0	41.6	28.5	37.5	10.6	-36.7	0.0	0.8	53.8	40.7	74	54	-20.2	-13.3	H
15.810	3.0	41.2	28.5	39.2	12.8	-34.6	0.0	0.7	59.2	46.5	74	54	-14.8	-7.5	H
10.540	3.0	42.8	31.1	37.5	10.6	-36.7	0.0	0.8	55.0	43.4	74	54	-19.0	-10.6	V
15.810	3.0	40.9	28.6	39.2	12.8	-34.6	0.0	0.7	59.0	46.6	74	54	-15.0	-7.4	V
CH. 62 (5310MHz)															
10.620	3.0	40.1	29.5	37.5	10.7	-36.6	0.0	0.8	52.5	41.8	74	54	-21.5	-12.2	H
15.960	3.0	41.0	28.4	39.3	12.8	-34.5	0.0	0.7	59.3	46.7	74	54	-14.7	-7.3	H
10.640	3.0	41.6	29.3	37.5	10.7	-36.6	0.0	0.8	54.0	41.7	74	54	-20.0	-12.3	V
15.960	3.0	41.6	29.4	39.3	12.8	-34.5	0.0	0.7	59.9	47.7	74	54	-14.1	-6.3	V
Note: No other emission were detected above noise floor.															

Rev. 4.12.7

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		

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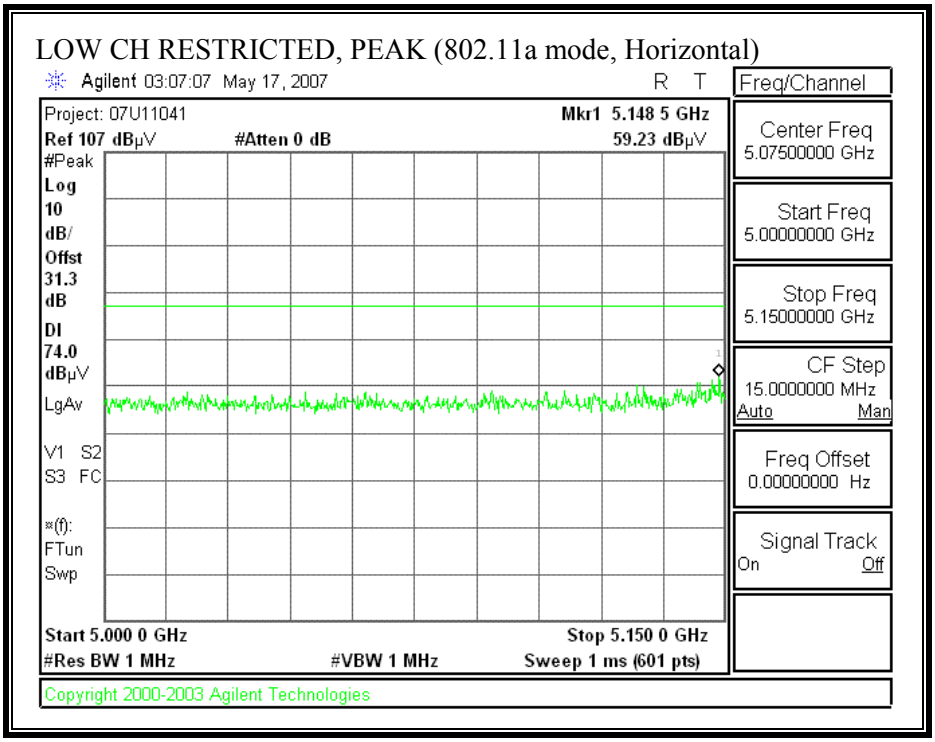
802.11n 40 MHz SDM MCS 15

RESTRICTED BANDEDGE (LOW CHANNEL, 5190 MHz - HORIZONTAL)



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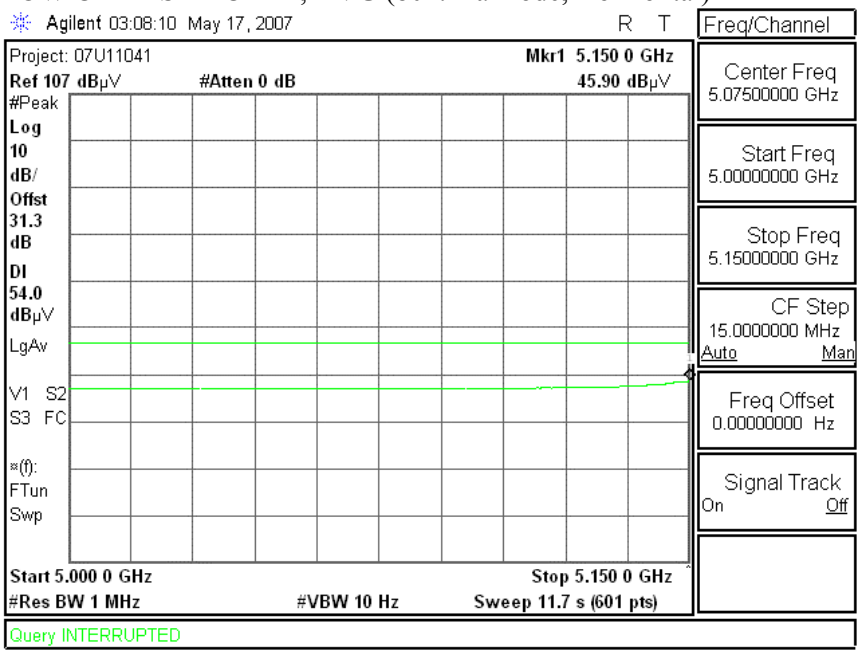
LOW CH RESTRICTED, AVG (802.11a mode, Horizontal)



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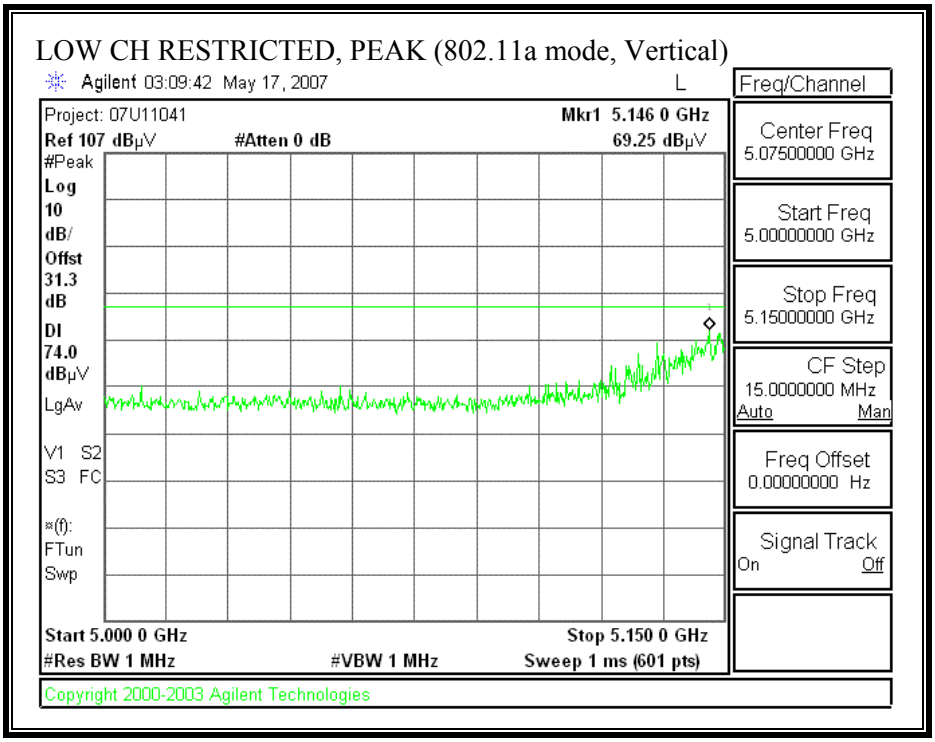
RESTRICTED BANDEDGE (802.11a MODE, LOW CHANNEL, 5190 MHz - VERTICAL)



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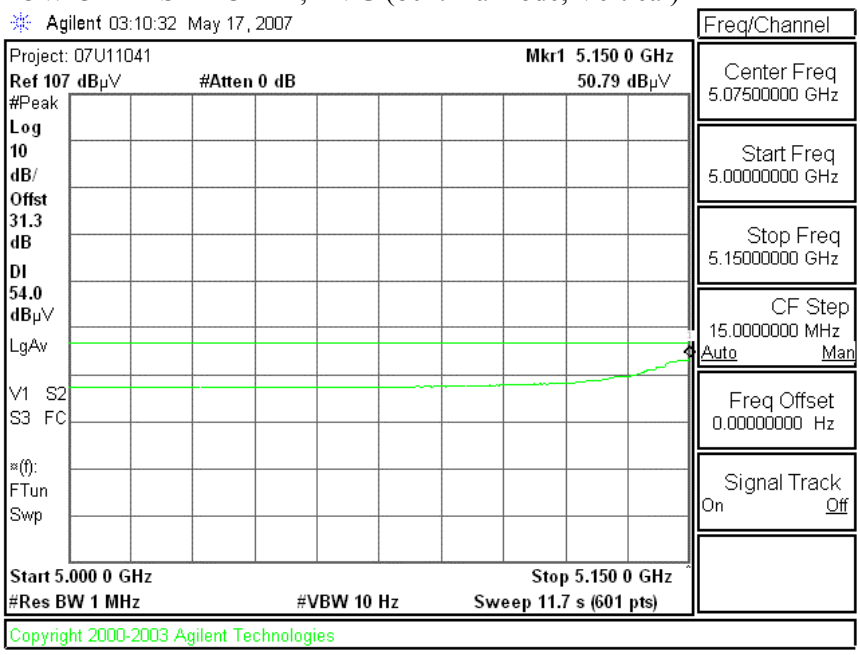
LOW CH RESTRICTED, AVG (802.11a mode, Vertical)



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802.11n 40 MHz SDM MCS 15

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

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company:	Broadcom
Project #:	07U11041
Date:	5/16/2007
Test Engineer:	Mengistu Mekuria
Configuration:	EUT Only
Mode:	Transmit, 11n mode 5.2GHz (40MHz MCS15 MIMO)

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T120; S/N: 29310 @3m	T144 Miteq 3008A00931		T125; ARA 18-26GHz; S/N:1007	FCC 15.209

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
		A-5m Chamber	HPF_7.6GHz	

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
CH. 38 (5190MHz)															
10.380	3.0	42.5	30.1	37.5	10.5	-36.8	0.0	0.8	54.4	42.0	74	54	-19.6	-12.0	H
15.570	3.0	42.0	29.5	39.0	12.7	-34.8	0.0	0.7	59.6	47.1	74	54	-14.4	-6.9	H
10.380	3.0	42.6	30.5	37.5	10.5	-36.8	0.0	0.8	54.5	42.4	74	54	-19.5	-11.6	V
15.570	3.0	41.6	29.4	39.0	12.7	-34.8	0.0	0.7	59.2	47.0	74	54	-14.8	-7.0	V
CH. 54 (5270MHz)															
10.540	3.0	42.0	28.9	37.5	10.6	-36.7	0.0	0.8	54.2	41.1	74	54	-19.8	-12.9	H
15.810	3.0	41.6	29.5	39.2	12.8	-34.6	0.0	0.7	59.6	47.5	74	54	-14.4	-6.5	H
10.540	3.0	39.0	30.0	37.5	10.6	-36.7	0.0	0.8	51.2	42.2	74	54	-22.8	-11.8	V
15.810	3.0	39.0	28.0	39.2	12.8	-34.6	0.0	0.7	57.0	46.0	74	54	-17.0	-8.0	V
CH. 62 (5310MHz)															
10.620	3.0	42.0	28.5	37.5	10.7	-36.6	0.0	0.8	54.4	40.9	74	54	-19.6	-13.1	H
15.960	3.0	42.3	29.3	39.3	12.8	-34.5	0.0	0.7	60.6	47.6	74	54	-13.4	-6.4	H
10.640	3.0	43.2	30.0	37.5	10.7	-36.6	0.0	0.8	55.6	42.4	74	54	-18.4	-11.6	V
15.960	3.0	43.0	28.7	39.3	12.8	-34.5	0.0	0.7	61.3	47.0	74	54	-12.7	-7.0	V
Note: No other emission were detected above noise floor.															

Rev. 4.12.7

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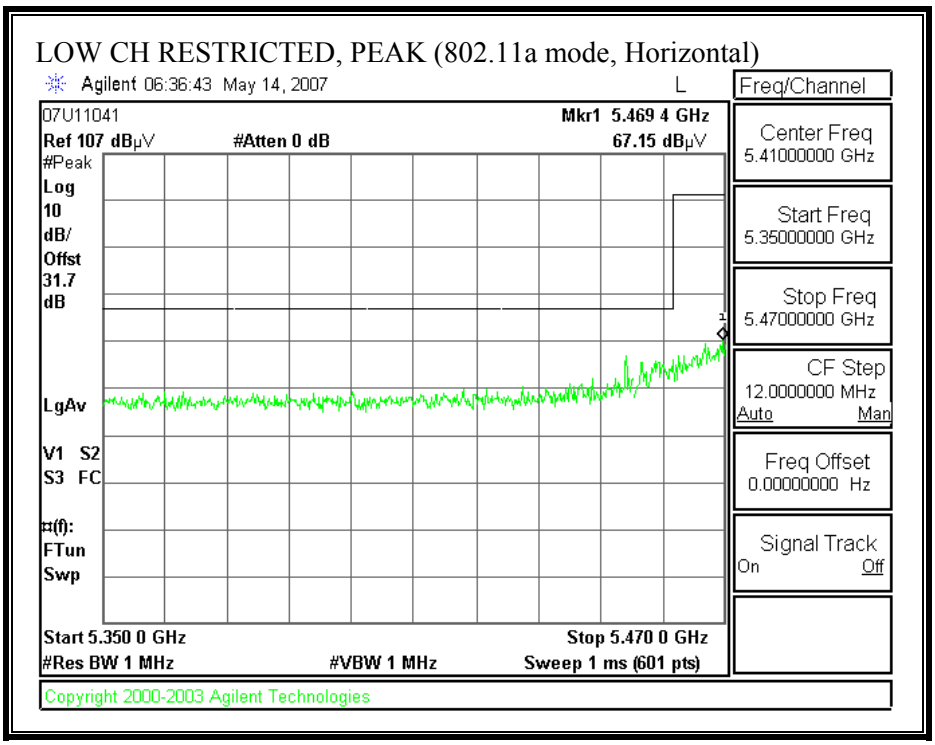
LEGACY MODE

7.5.4. TRANSMITTER ABOVE 1 GHz FOR 5470 TO 5725 MHz BAND

802.11a MODE

RESTRICTED BANDEDGE (802.11a MODE, LOW CHANNEL, 5500 MHz - HORIZONTAL)



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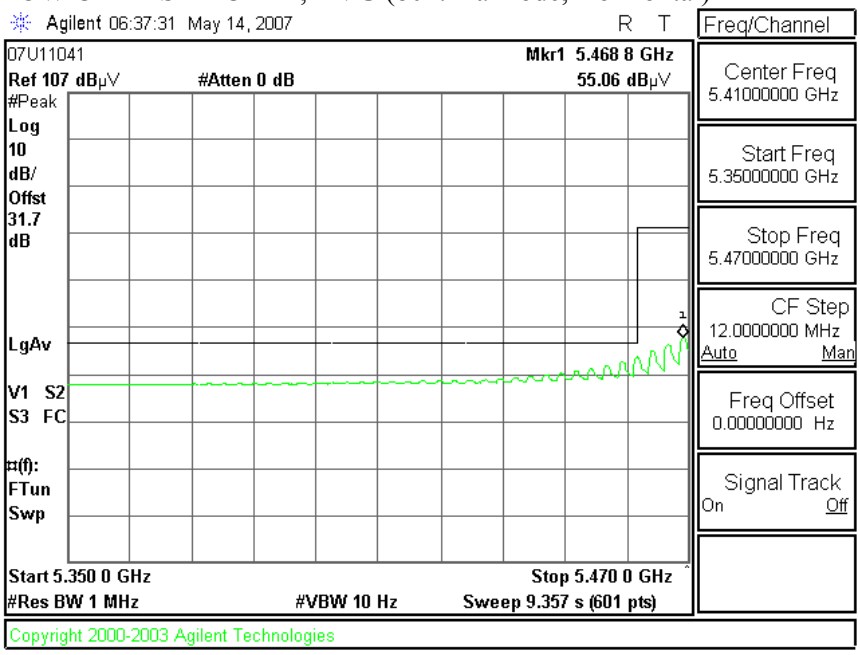
LOW CH RESTRICTED, AVG (802.11a mode, Horizontal)



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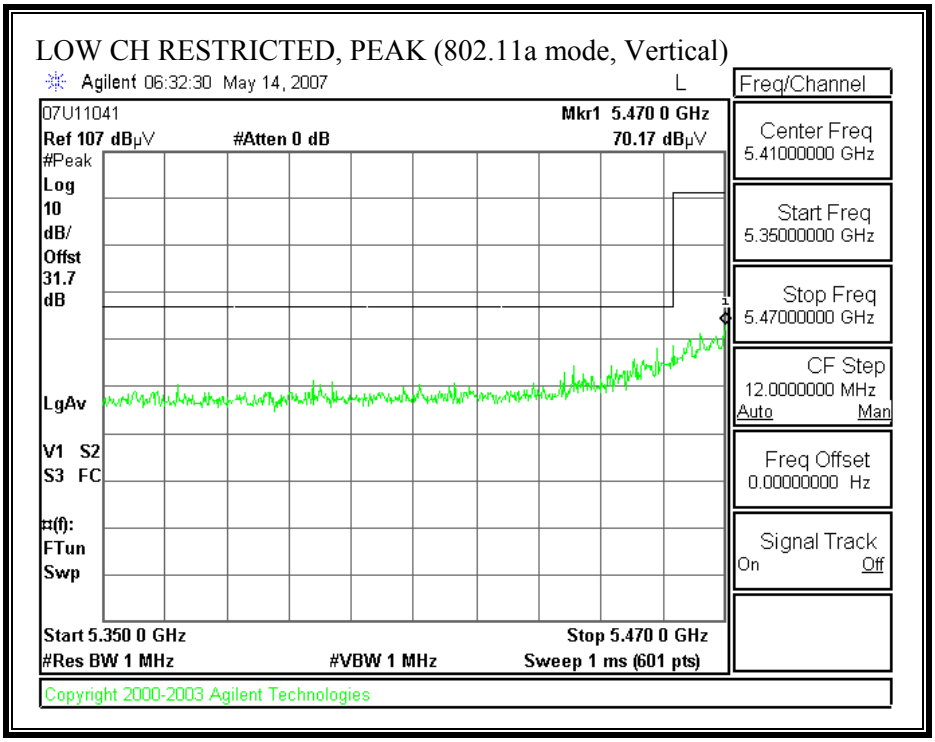
RESTRICTED BANDEDGE (802.11a MODE, LOW CHANNEL, 5500 MHz - VERTICAL)



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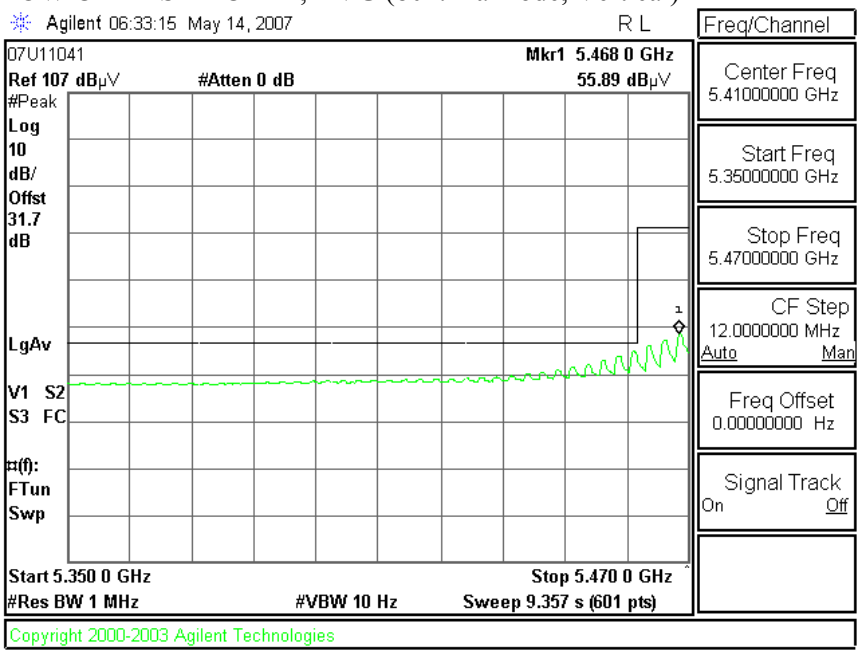
LOW CH RESTRICTED, AVG (802.11a mode, Vertical)



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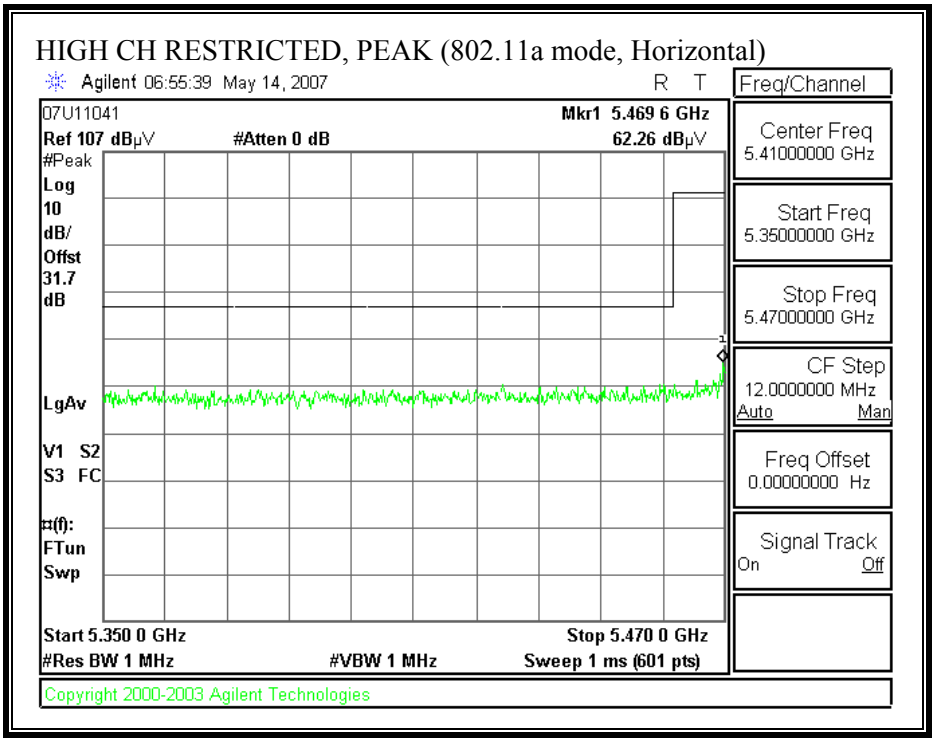
RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5520 MHz - HORIZONTAL)



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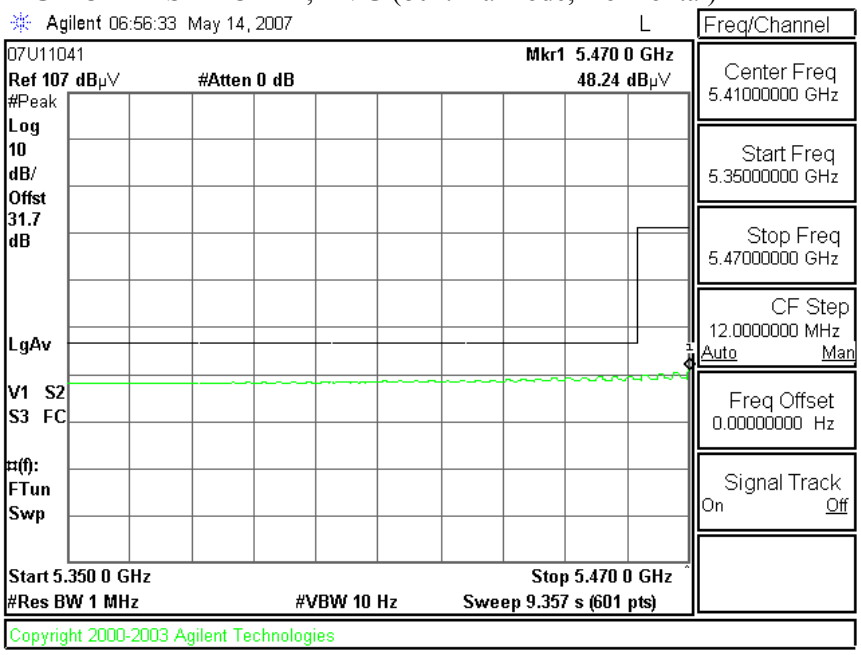
HIGH CH RESTRICTED, AVG (802.11a mode, Horizontal)



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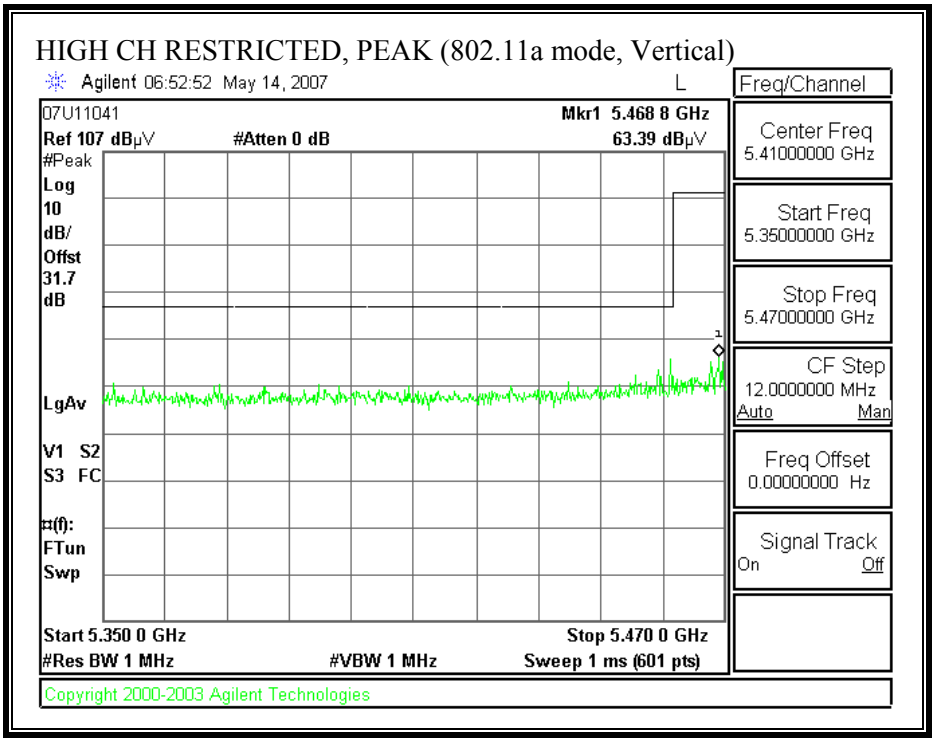
RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5520 MHz - VERTICAL)



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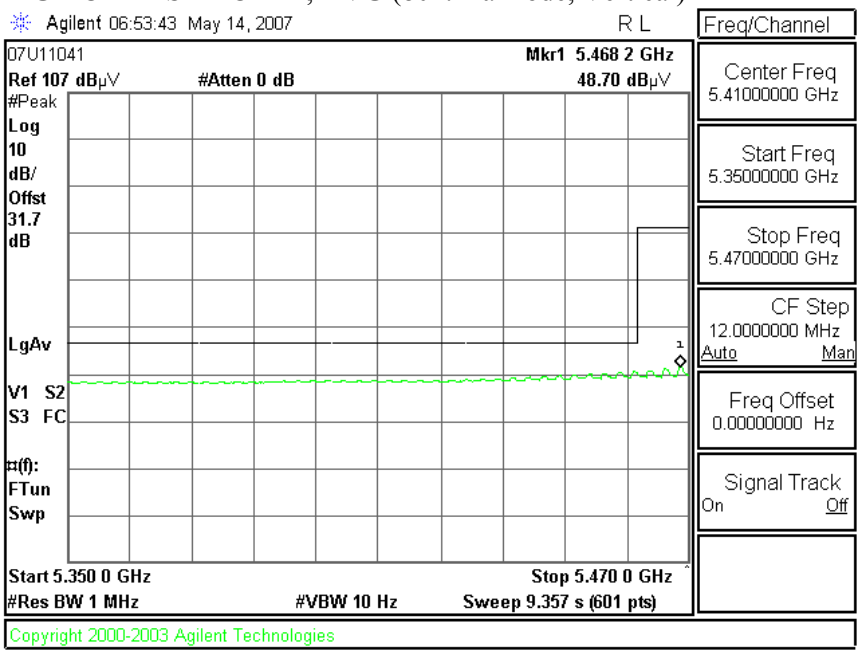
HIGH CH RESTRICTED, AVG (802.11a mode, Vertical)



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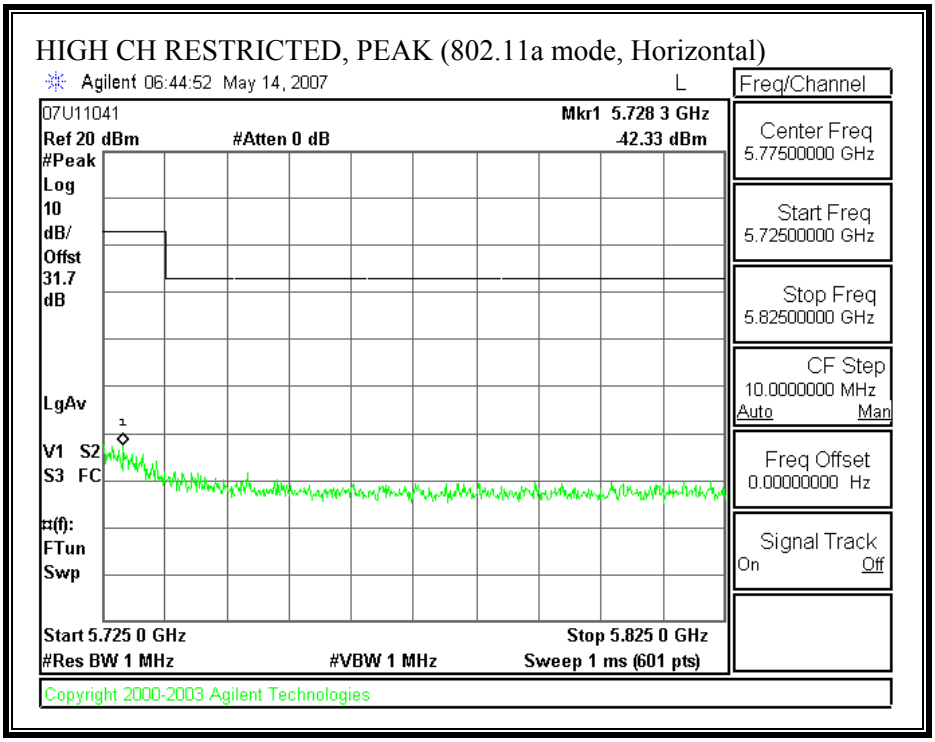
RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5700 MHz - HORIZONTAL)



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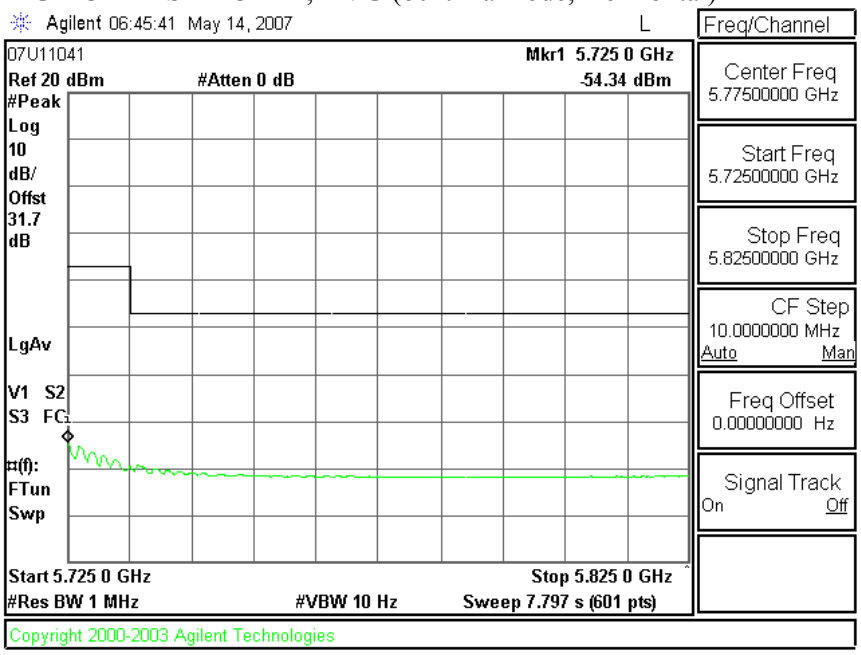
HIGH CH RESTRICTED, AVG (802.11a mode, Horizontal)



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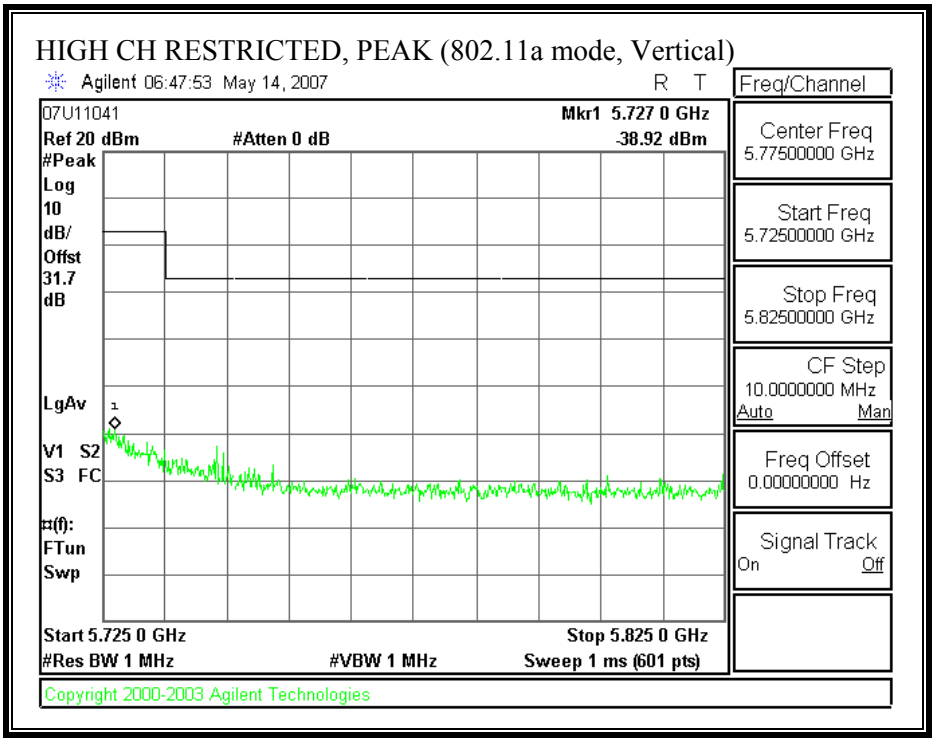
RESTRICTED BANDEDGE (802.11a MODE, HIGH CHANNEL, 5700 MHz - VERTICAL)



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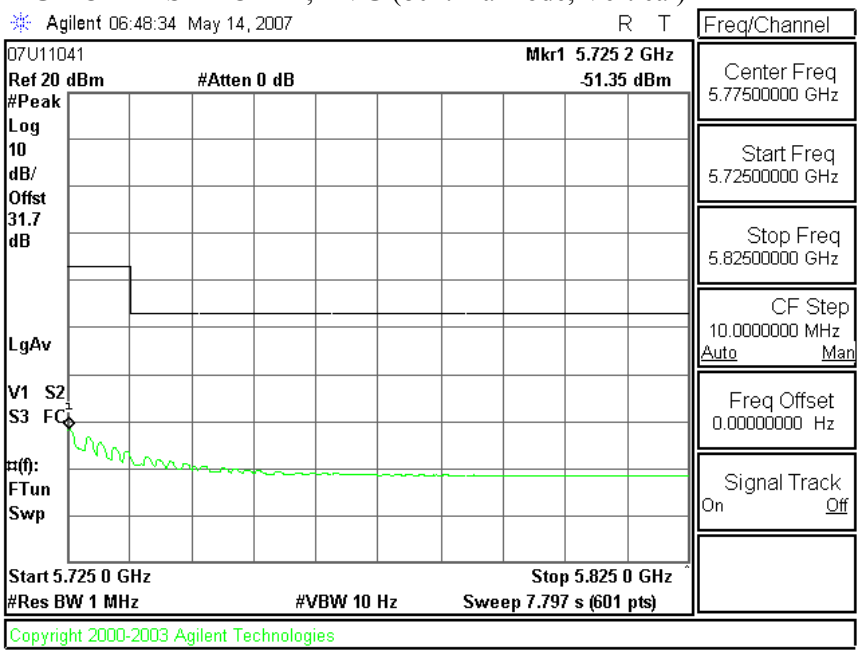
HIGH CH RESTRICTED, AVG (802.11a mode, Vertical)



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802.11a MODE

HARMONICS AND SPURIOUS EMISSIONS (802.11a MODE)

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Broadcom
Project #: 07U11041
Date: 5/16/2007
Test Engineer: Mengistu Mekuria
Configuration: EUT Only
Mode: Transmit, 11a mode 5.6GHz (Legacy)

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T120; S/N: 29310 @3m	T144 Miteq 3008A00931		T125; ARA 18-26GHz; S/N:1007	FCC 15.209

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
		A-5m Chamber	HPF_7.6GHz	

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
CH. 100 (5500MHz)															
11.000	3.0	44.6	30.5	37.5	11.1	-36.3	0.0	0.7	57.7	43.6	74	54	-16.3	-10.4	H
16.500	3.0	40.2	28.1	39.7	13.0	-34.1	0.0	0.7	59.5	47.4	74	54	-14.5	-6.6	H
11.000	3.0	42.7	29.7	37.5	11.1	-36.3	0.0	0.7	55.8	42.8	74	54	-18.2	-11.2	V
16.500	3.0	40.0	27.7	39.7	13.0	-34.1	0.0	0.7	59.4	47.0	74	54	-14.6	-7.0	V
CH. 120 (5600MHz)															
11.200	3.0	46.4	32.7	37.6	11.3	-36.1	0.0	0.7	59.9	46.2	74	54	-14.1	-7.8	H
16.800	3.0	40.7	27.7	39.9	13.1	-33.8	0.0	0.7	60.6	47.6	74	54	-13.4	-6.4	H
11.200	3.0	45.1	31.7	37.6	11.3	-36.1	0.0	0.7	58.6	45.1	74	54	-15.4	-8.9	V
16.800	3.0	40.1	28.3	39.9	13.1	-33.8	0.0	0.7	59.9	48.2	74	54	-14.1	-5.8	V
CH. 140 (5700MHz)															
11.400	3.0	48.1	33.8	37.6	11.5	-35.9	0.0	0.7	62.0	47.7	74	54	-12.0	-6.3	H
17.100	3.0	41.1	28.3	40.1	13.2	-33.7	0.0	0.7	61.4	48.6	74	54	-12.6	-5.4	H
11.400	3.0	45.0	31.8	37.6	11.5	-35.9	0.0	0.7	58.9	45.7	74	54	-15.1	-8.3	V
17.100	3.0	40.8	28.2	40.1	13.2	-33.7	0.0	0.7	61.1	48.5	74	54	-12.9	-5.5	V
Note: No other emission were detected above noise floor.															

Rev. 4.12.7

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		

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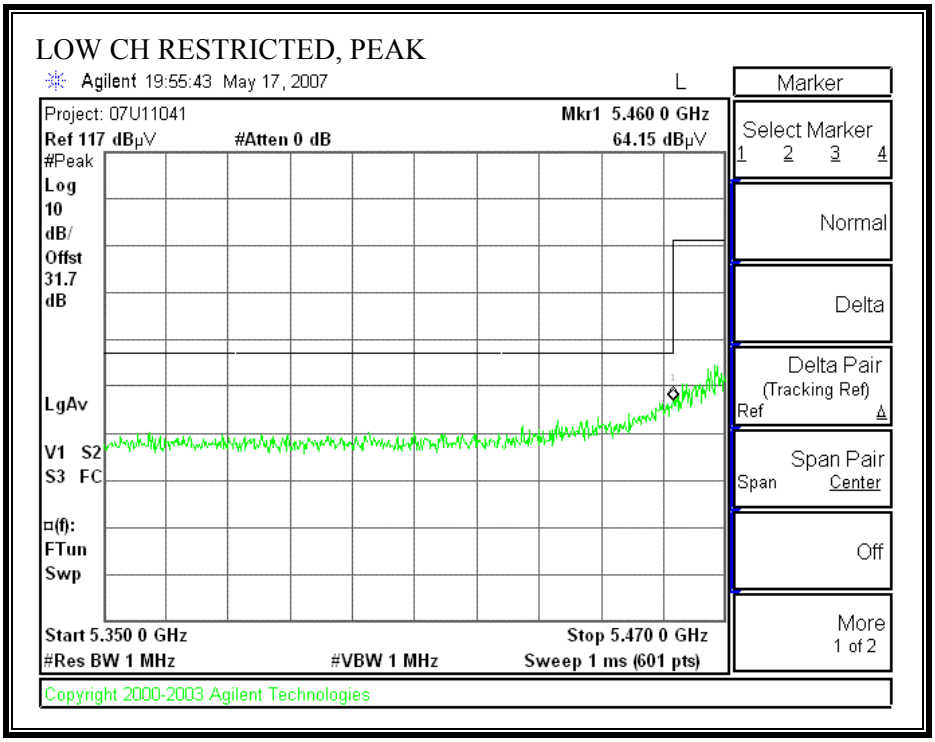
802.11n 40 MHz SISO MCS 32 MODE

RESTRICTED BANDEDGE, LOW CHANNEL, 5510 MHz - HORIZONTAL



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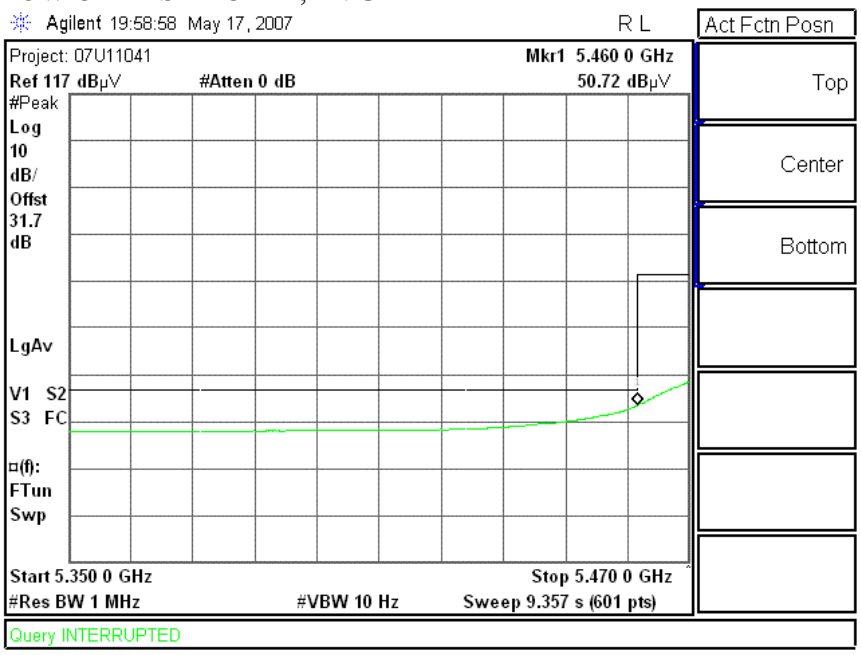
LOW CH RESTRICTED, AVG



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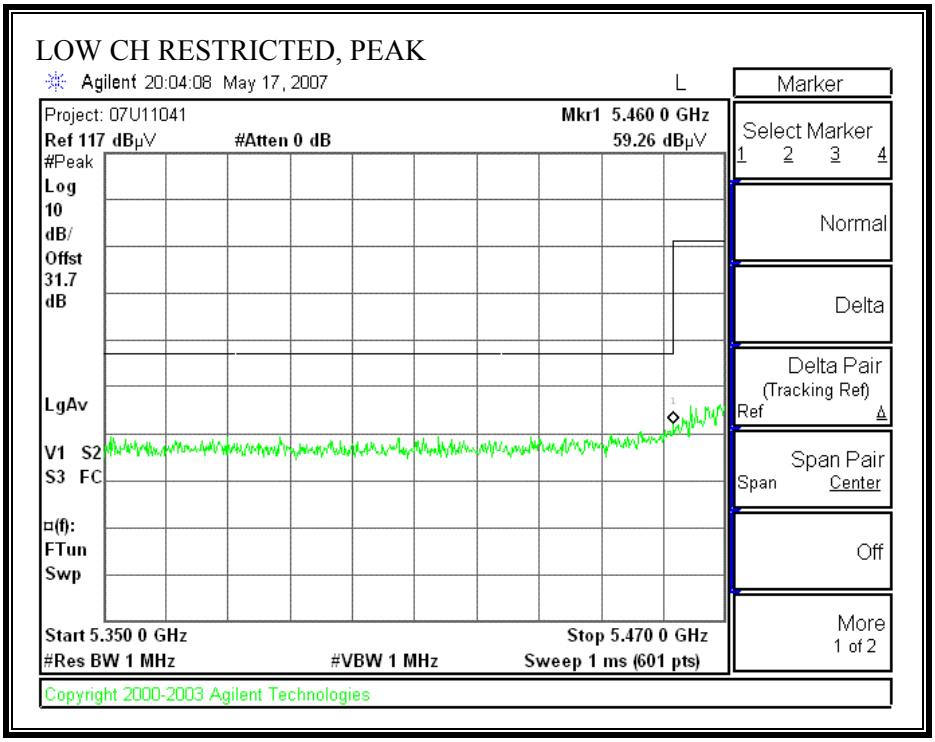
RESTRICTED BANDEDGE, LOW CHANNEL, 5510 MHz - VERTICAL



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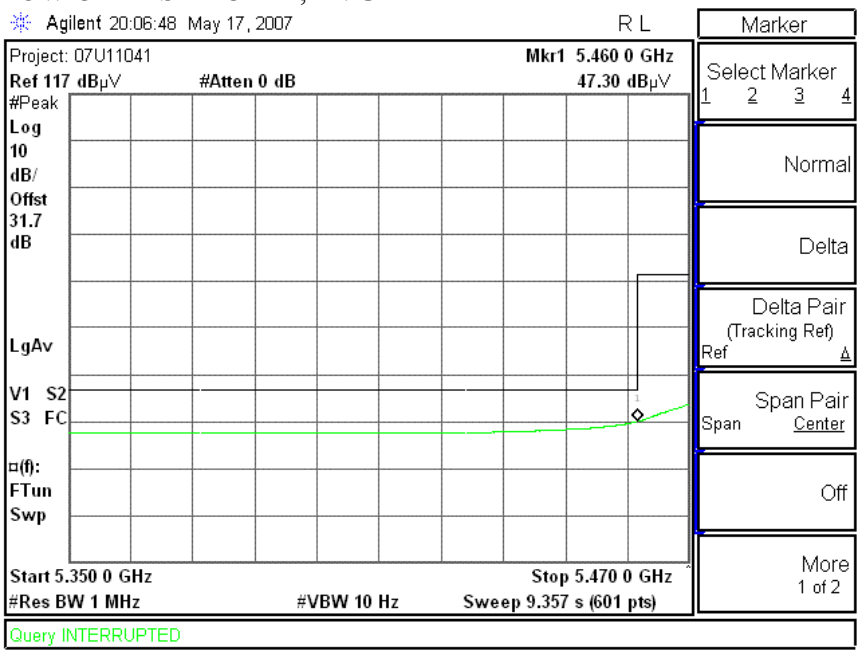
LOW CH RESTRICTED, AVG



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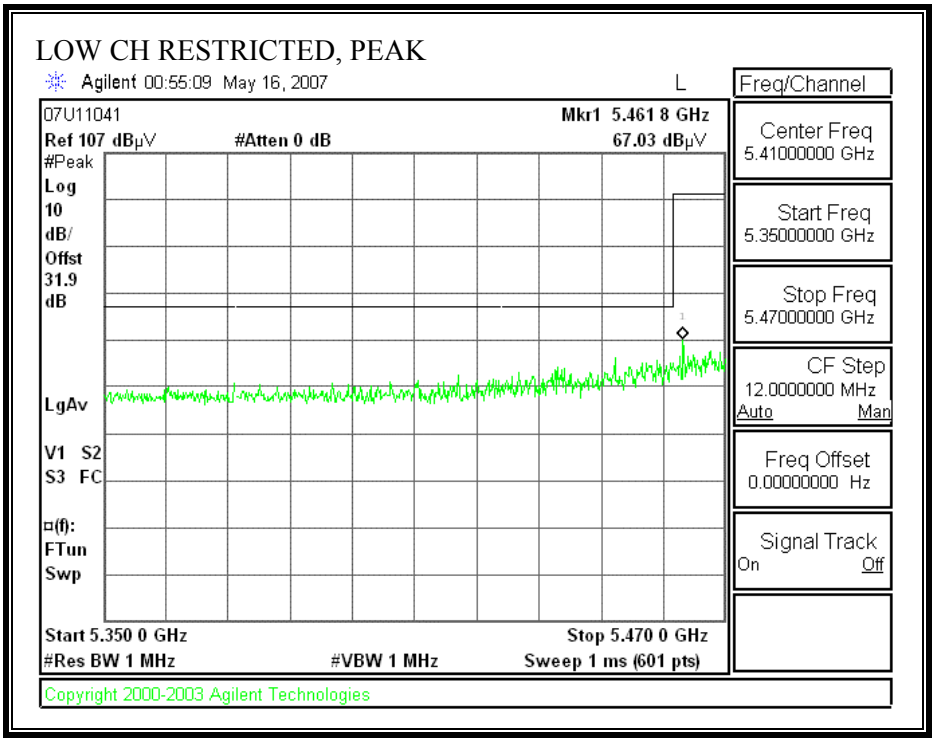
RESTRICTED BANDEDGE, LOW CHANNEL, 5550 MHz - HORIZONTAL



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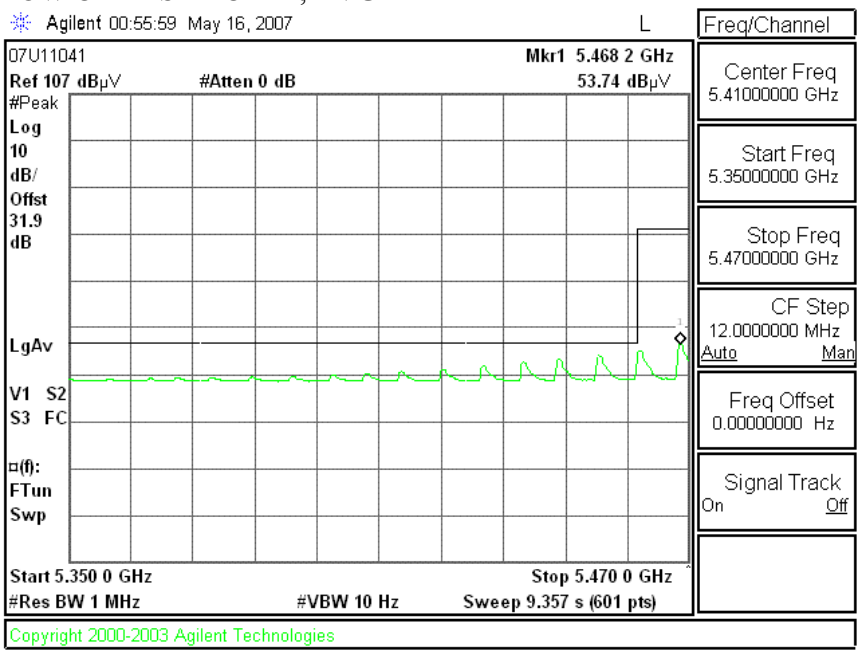
LOW CH RESTRICTED, AVG



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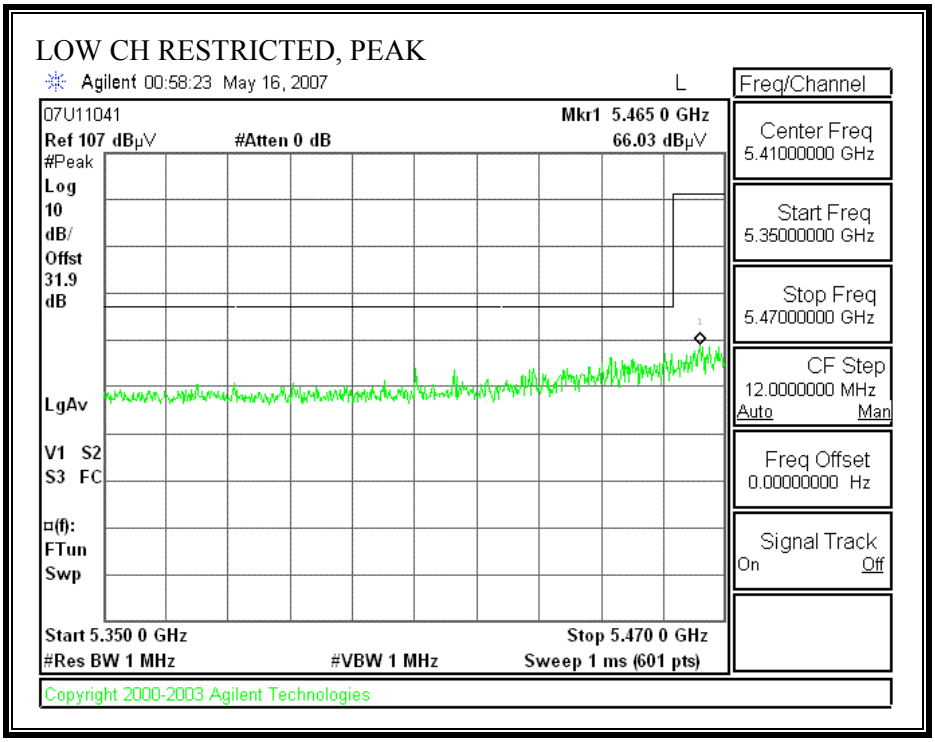
RESTRICTED BANDEDGE, LOW CHANNEL, 5550 MHz - VERTICAL



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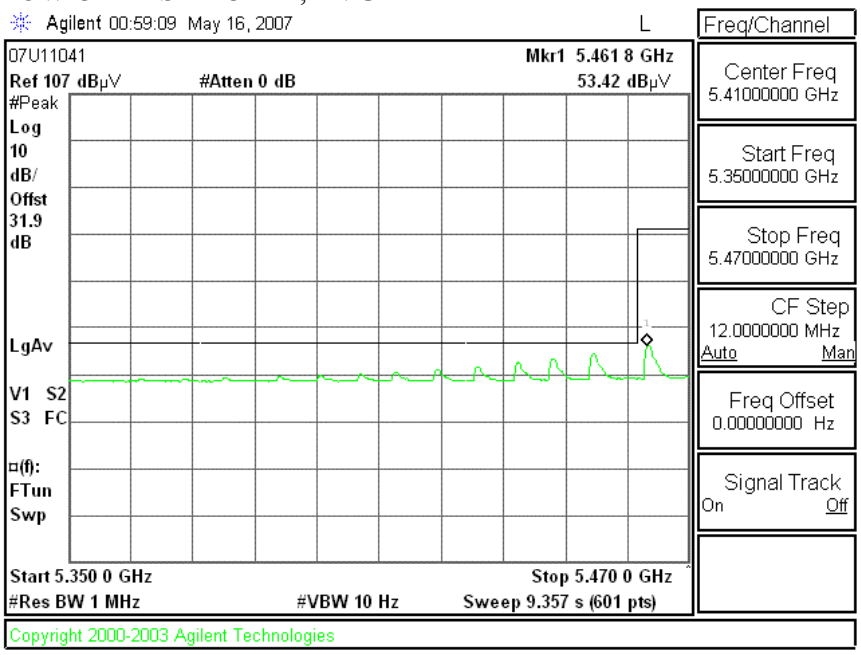
LOW CH RESTRICTED, AVG



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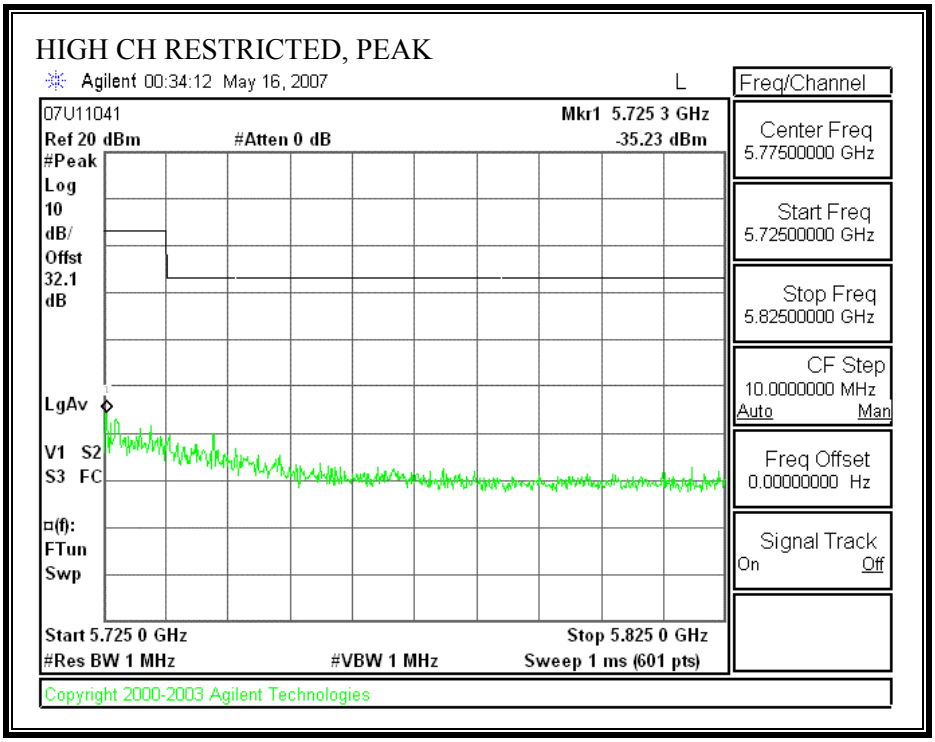
RESTRICTED BANDEDGE, HIGH CHANNEL, 5670 MHz - HORIZONTAL



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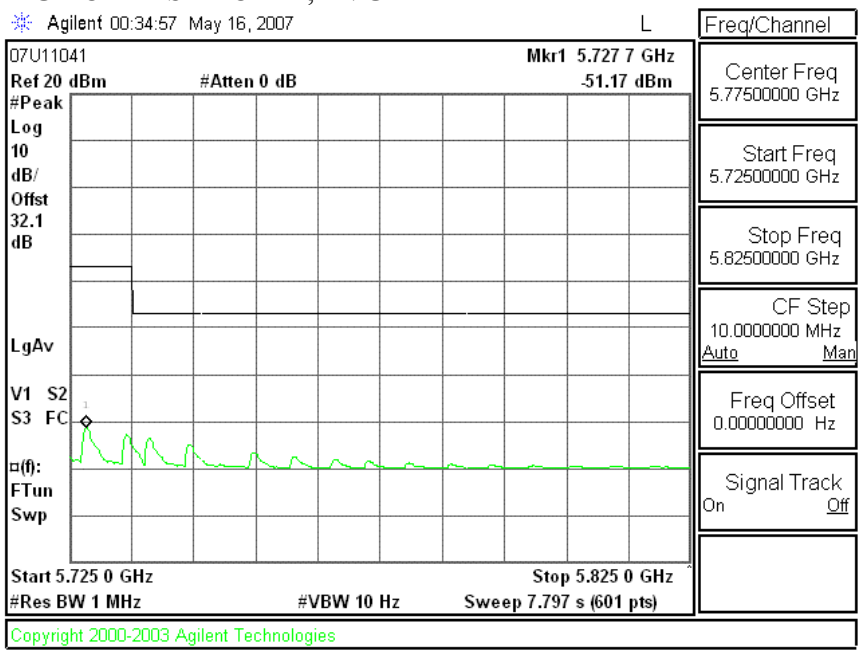
HIGH CH RESTRICTED, AVG



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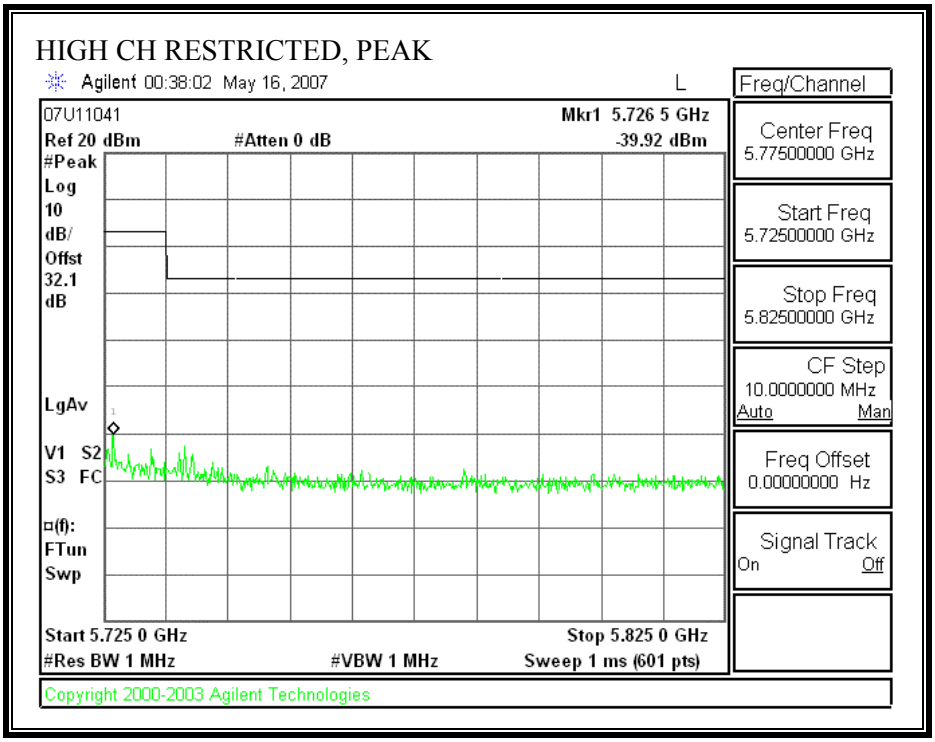
RESTRICTED BANDEDGE, HIGH CHANNEL, 5670 MHz - VERTICAL



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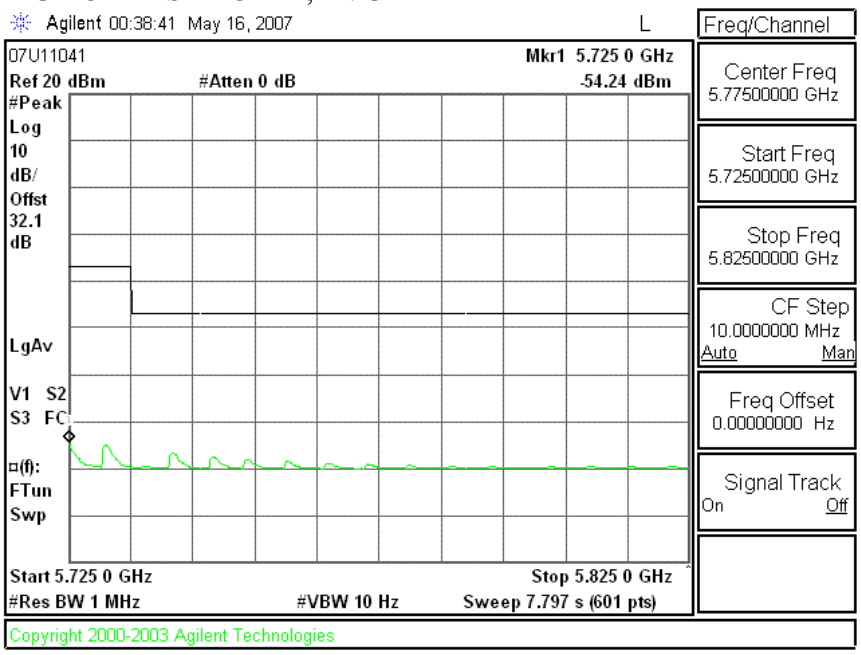
HIGH CH RESTRICTED, AVG



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802.11n 40 MHz SISO MODE

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

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company:	Broadcom
Project #:	07U11041
Date:	5/16/2007
Test Engineer:	Mengistu Mekuria
Configuration:	EUT Only
Mode:	Transmit, 11n mode 5.6GHz (40MHz SISO)

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T120; S/N: 29310 @3m	T144 Miteq 3008A00931		T125; ARA 18-26GHz; S/N:1007	FCC 15.209

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
		A-5m Chamber	HPF_7.6GHz	

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
CH. 102 (5510MHz)															
11.020	3.0	42.1	31.0	37.5	11.1	-36.3	0.0	0.7	55.2	44.1	74	54	-18.8	-9.9	H
16.530	3.0	40.8	29.1	39.7	13.0	-34.0	0.0	0.7	60.2	48.4	74	54	-13.8	-5.6	H
11.020	3.0	41.3	29.6	37.5	11.1	-36.3	0.0	0.7	54.4	42.7	74	54	-19.6	-11.3	V
16.530	3.0	41.9	28.4	39.7	13.0	-34.0	0.0	0.7	61.3	47.7	74	54	-12.7	-6.3	V
CH. 118 (5590MHz)															
11.180	3.0	41.8	29.9	37.6	11.3	-36.1	0.0	0.7	55.3	43.4	74	54	-18.7	-10.6	H
16.770	3.0	41.6	28.2	39.9	13.1	-33.8	0.0	0.7	61.4	48.0	74	54	-12.6	-6.0	H
11.180	3.0	42.0	31.2	37.6	11.3	-36.1	0.0	0.7	55.4	44.6	74	54	-18.6	-9.4	V
16.770	3.0	41.7	28.3	39.9	13.1	-33.8	0.0	0.7	61.5	48.1	74	54	-12.5	-5.9	V
CH. 134 (5670MHz)															
11.340	3.0	47.2	35.2	37.6	11.5	-36.0	0.0	0.7	61.0	48.9	74	54	-13.0	-5.1	H
17.010	3.0	40.2	27.9	40.0	13.2	-33.7	0.0	0.7	60.4	48.1	74	54	-13.6	-5.9	H
11.400	3.0	43.5	30.8	37.6	11.5	-35.9	0.0	0.7	57.4	44.7	74	54	-16.6	-9.3	V
17.010	3.0	41.3	28.4	40.0	13.2	-33.7	0.0	0.7	61.5	48.6	74	54	-12.5	-5.4	V
Note: No other emission were detected above noise floor.															

Rev. 4.12.7

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		

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MIMO MODE

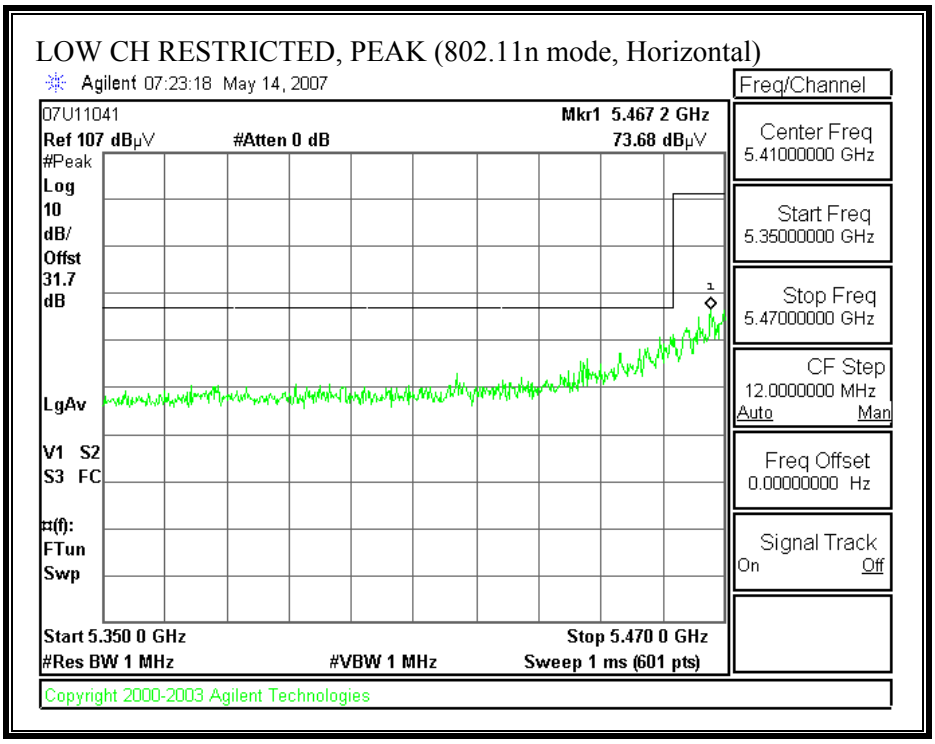
7.5.5. TRANSMITTER ABOVE 1 GHz FOR 5470 TO 5725 MHz BAND

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

802.11n 20 MHz CDD MCS 0

RESTRICTED BANDEDGE (LOW CHANNEL, 5500 MHz - HORIZONTAL)

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



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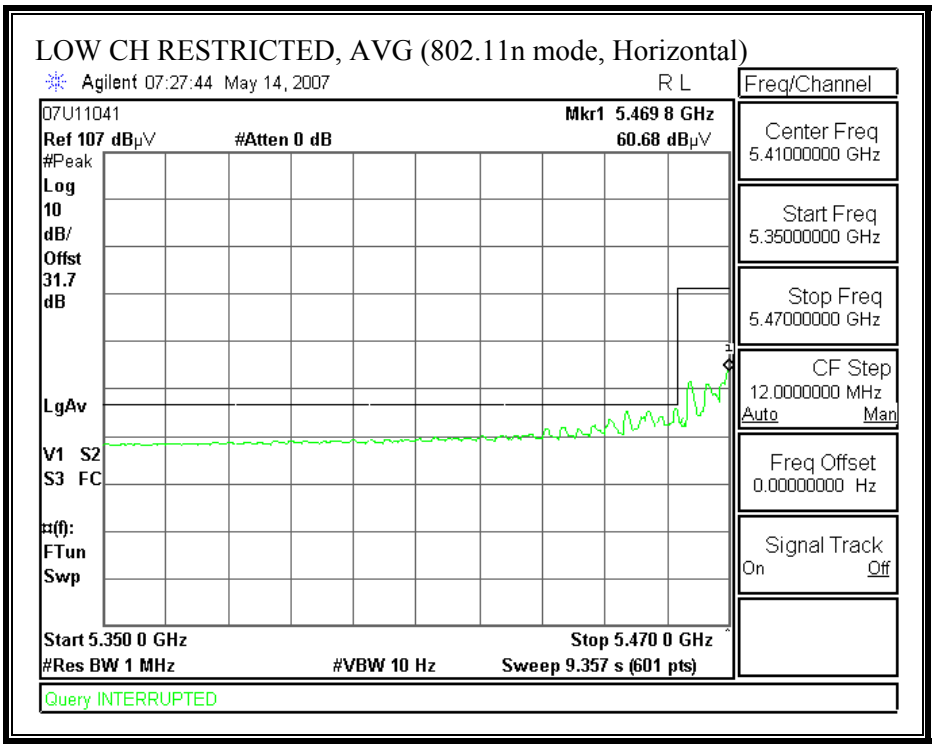
LOW CH RESTRICTED, AVG (802.11n mode, Horizontal)



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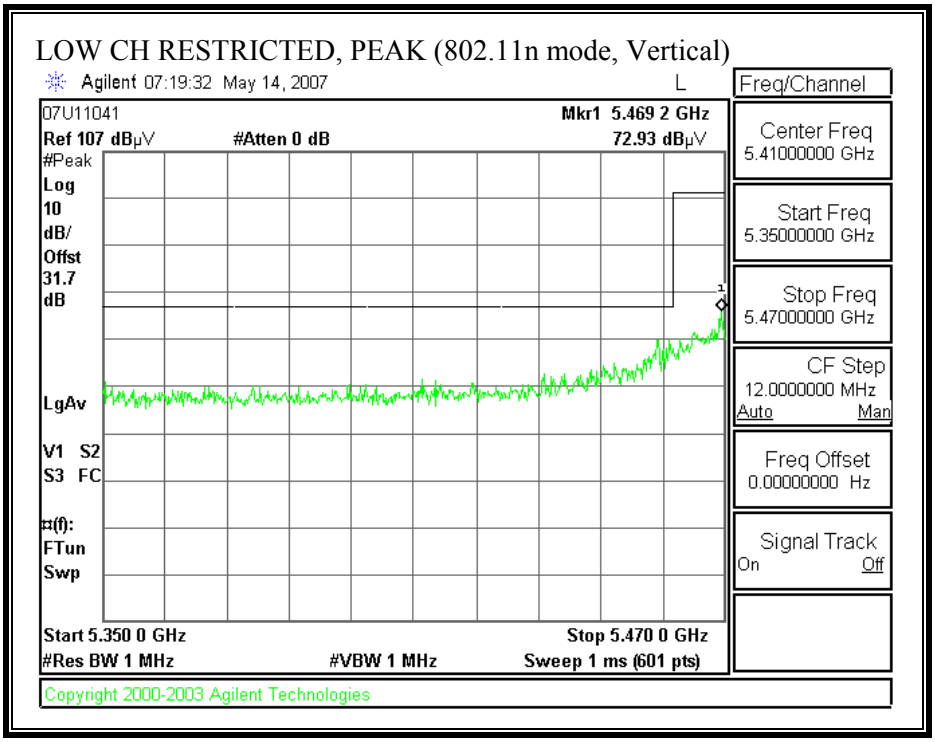
RESTRICTED BANDEDGE (802.11n MODE, LOW CHANNEL, 5500 MHz - VERTICAL)



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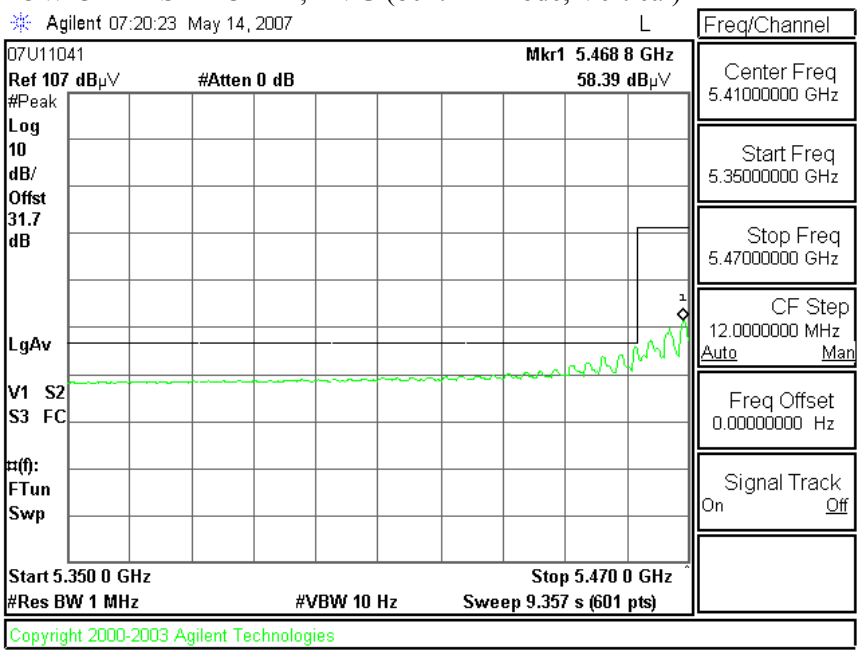
LOW CH RESTRICTED, AVG (802.11n mode, Vertical)



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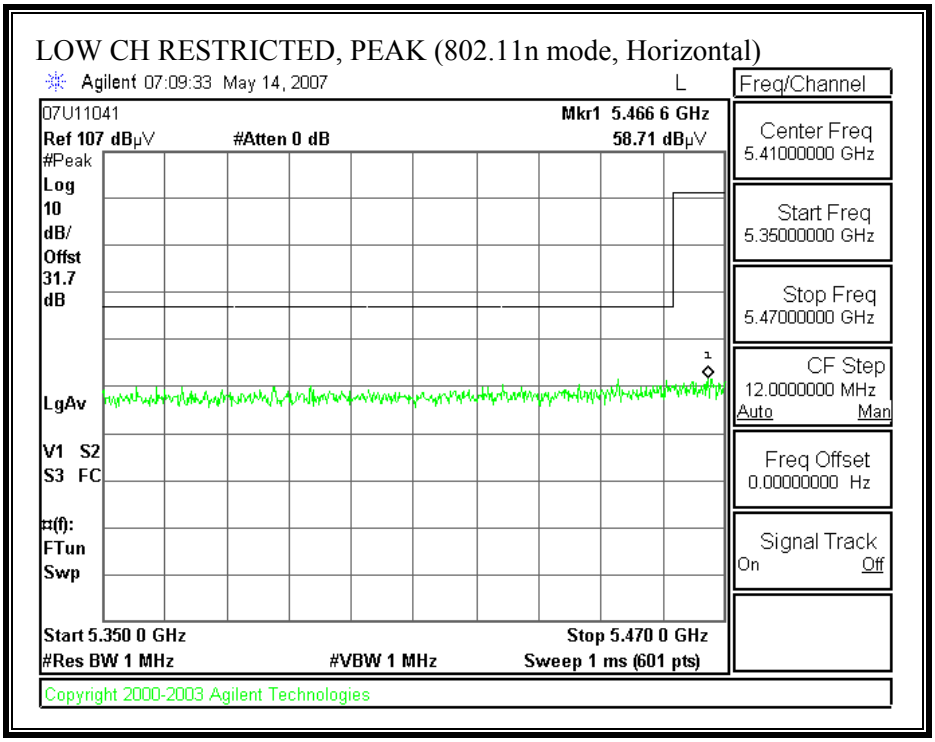
RESTRICTED BANDEDGE (LOW CHANNEL, 5520 MHz - HORIZONTAL)



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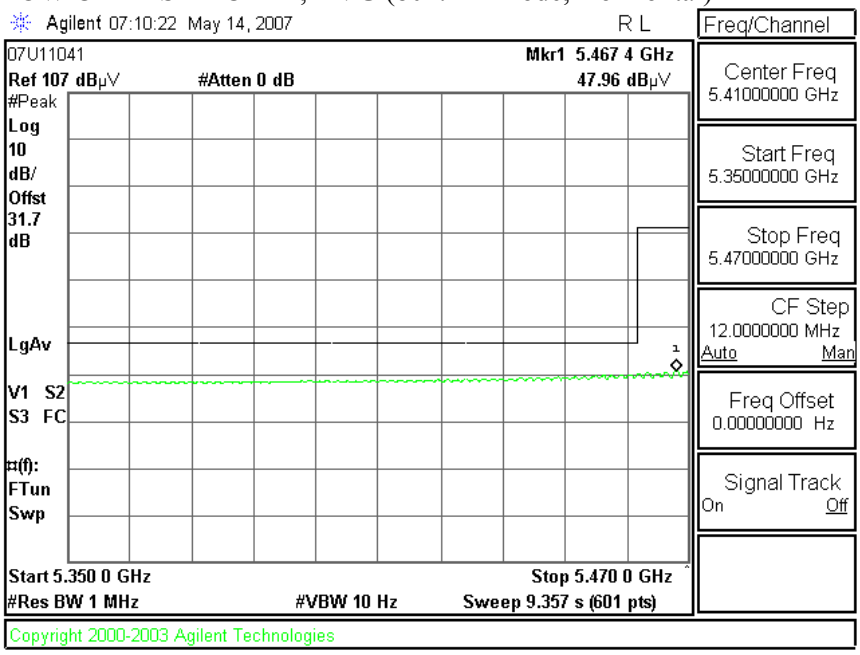
LOW CH RESTRICTED, AVG (802.11n mode, Horizontal)



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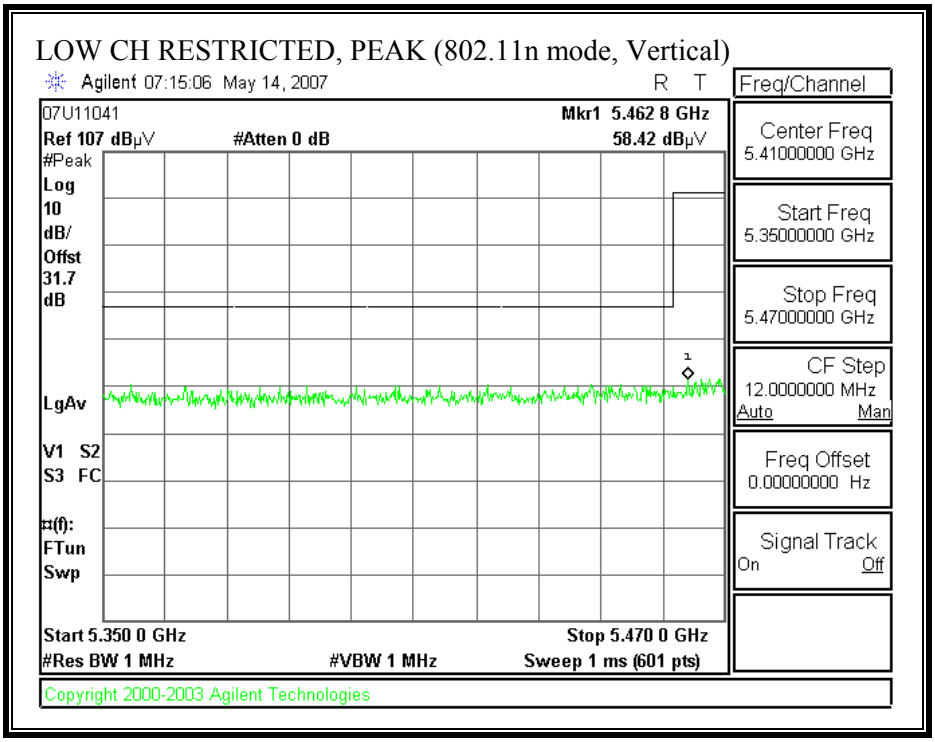
RESTRICTED BANDEDGE (802.11n MODE, LOW CHANNEL, 5520 MHz - VERTICAL)



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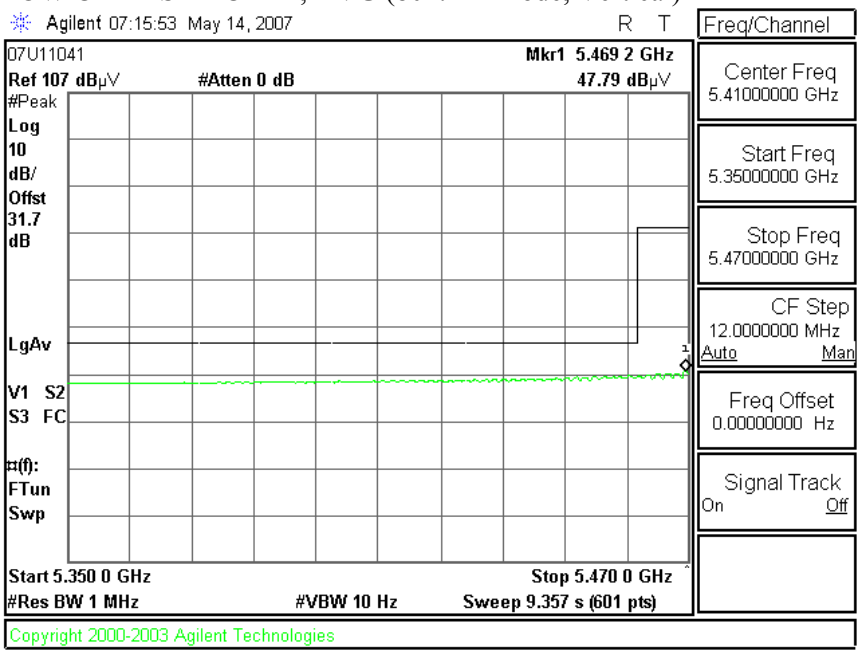
LOW CH RESTRICTED, AVG (802.11n mode, Vertical)



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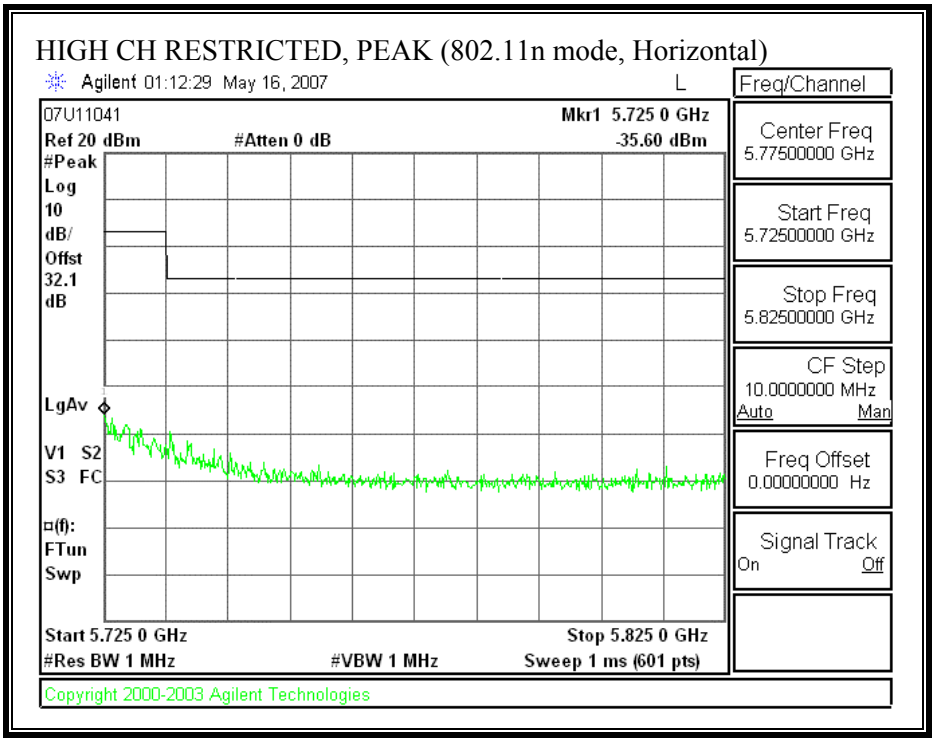
RESTRICTED BANDEDGE (802.11n MODE, HIGH CHANNEL, 5700 MHz - HORIZONTAL)



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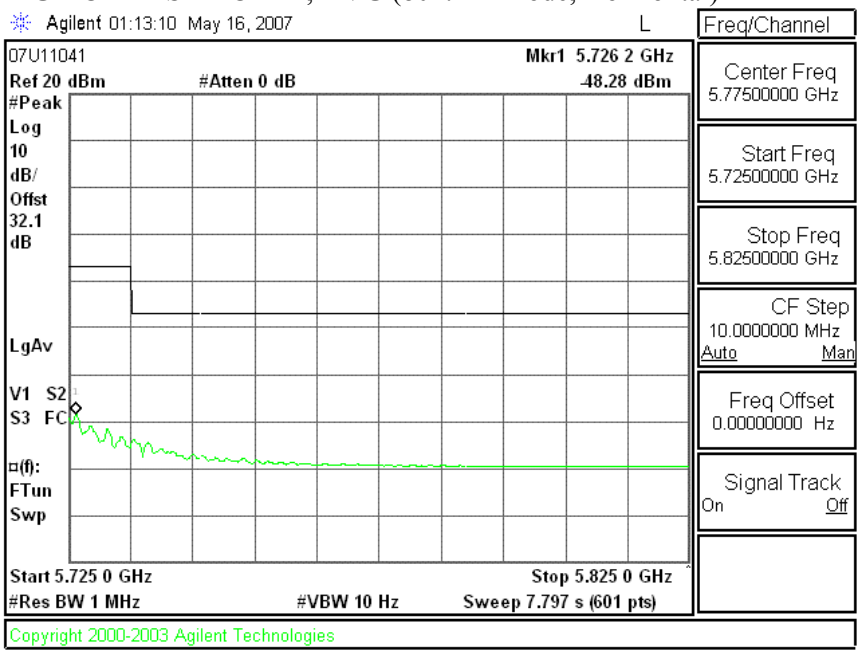
HIGH CH RESTRICTED, AVG (802.11n mode, Horizontal)



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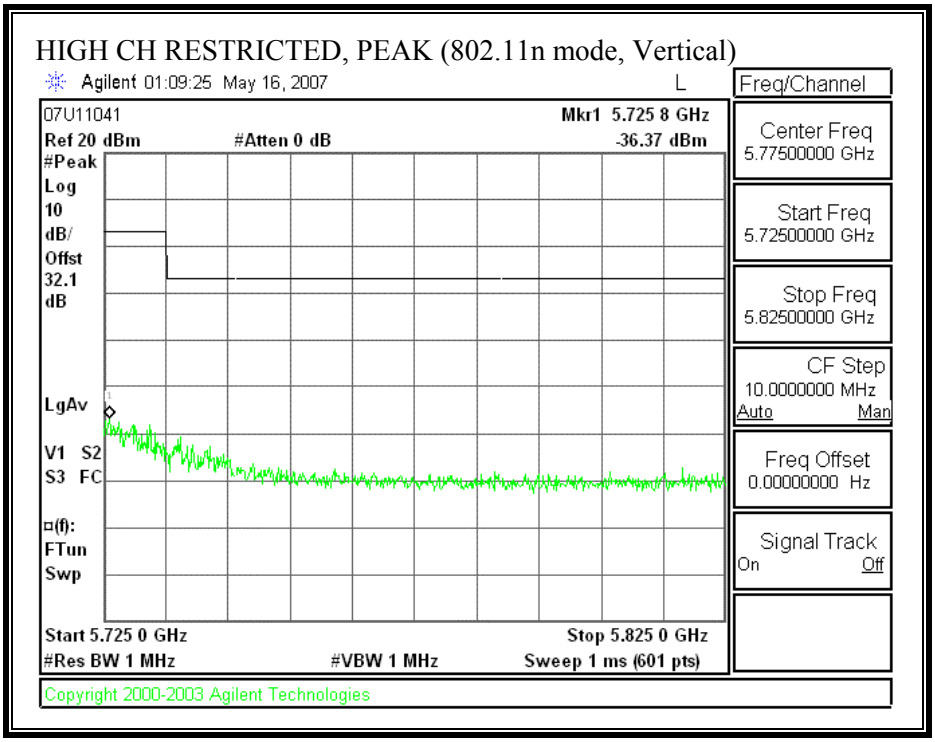
RESTRICTED BANDEDGE (802.11n MODE, HIGH CHANNEL, 5700 MHz - VERTICAL)



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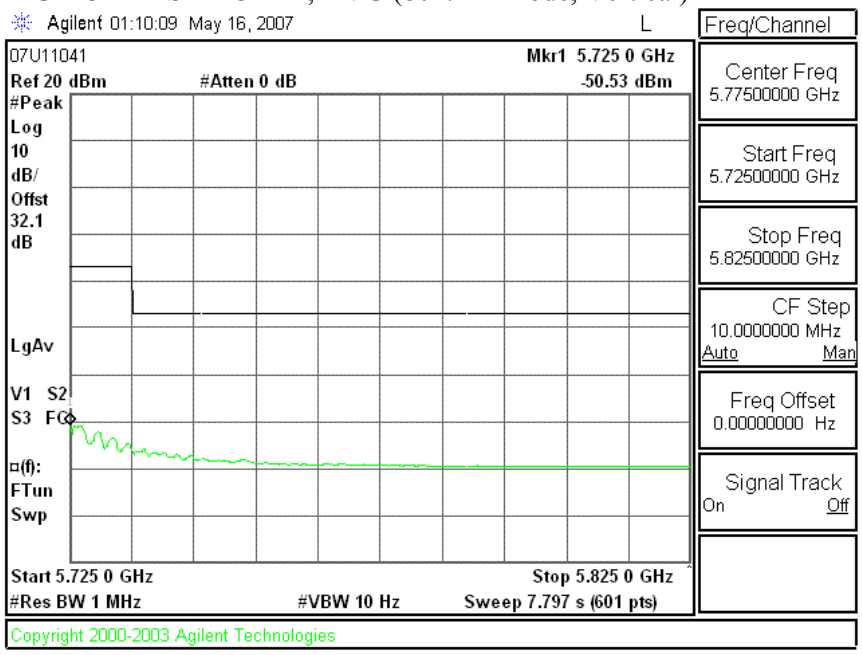
HIGH CH RESTRICTED, AVG (802.11n mode, Vertical)



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

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Broadcom
Project #: 07U11041
Date: 5/16/2007
Test Engineer: Mengistu Mekuria
Configuration: EUT Only
Mode: Transmit, 11n mode 5.6GHz (20MHz MIMO)

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T120; S/N: 29310 @3m	T144 Miteq 3008A00931		T125; ARA 18-26GHz; S/N:1007	FCC 15.209

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
		A-5m Chamber	HPF_7.6GHz	

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
CH. 100 (5500MHz)															
11.000	3.0	45.4	32.1	37.5	11.1	-36.3	0.0	0.7	58.5	45.2	74	54	-15.5	-8.8	H
16.500	3.0	41.9	28.9	39.7	13.0	-34.1	0.0	0.7	61.2	48.2	74	54	-12.8	-5.8	H
11.000	3.0	43.4	30.1	37.5	11.1	-36.3	0.0	0.7	56.5	43.1	74	54	-17.5	-10.9	V
16.500	3.0	41.0	28.2	39.7	13.0	-34.1	0.0	0.7	60.3	47.5	74	54	-13.7	-6.5	V
CH. 120 (5600MHz)															
11.200	3.0	47.5	34.3	37.6	11.3	-36.1	0.0	0.7	61.0	47.8	74	54	-13.0	-6.2	H
16.800	3.0	41.4	28.3	39.9	13.1	-33.8	0.0	0.7	61.3	48.1	74	54	-12.7	-5.9	H
11.200	3.0	45.2	31.4	37.6	11.3	-36.1	0.0	0.7	58.7	44.9	74	54	-15.3	-9.1	V
16.800	3.0	40.6	27.7	39.9	13.1	-33.8	0.0	0.7	60.5	47.6	74	54	-13.5	-6.4	V
CH. 140 (5700MHz)															
11.400	3.0	48.6	34.7	37.6	11.5	-35.9	0.0	0.7	62.5	48.6	74	54	-11.5	-5.4	H
11.400	3.0	41.0	28.5	37.6	11.5	-35.9	0.0	0.7	54.9	42.4	74	54	-19.1	-11.6	H
11.400	3.0	46.4	31.9	37.6	11.5	-35.9	0.0	0.7	60.3	45.8	74	54	-13.7	-8.2	V
11.400	3.0	41.3	28.0	37.6	11.5	-35.9	0.0	0.7	55.2	41.9	74	54	-18.8	-12.1	V
Note: No other emission were detected above noise floor.															

Rev. 4.12.7

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		

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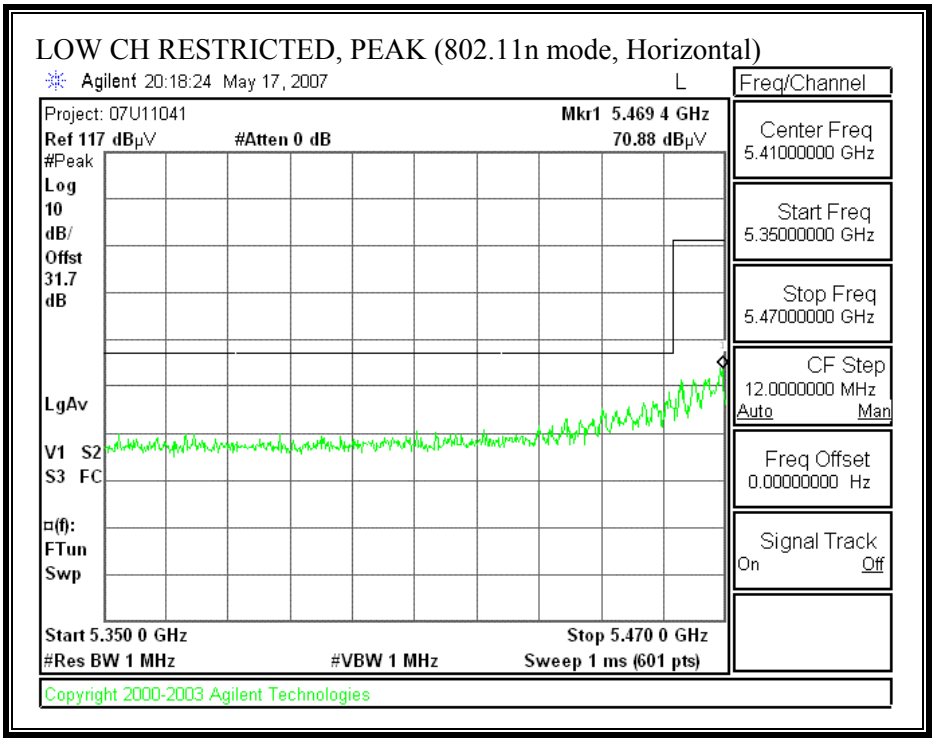
802.11n 40 MHz CDD MCS 32 MODE

RESTRICTED BANDEDGE (LOW CHANNEL, 5510 MHz - HORIZONTAL)



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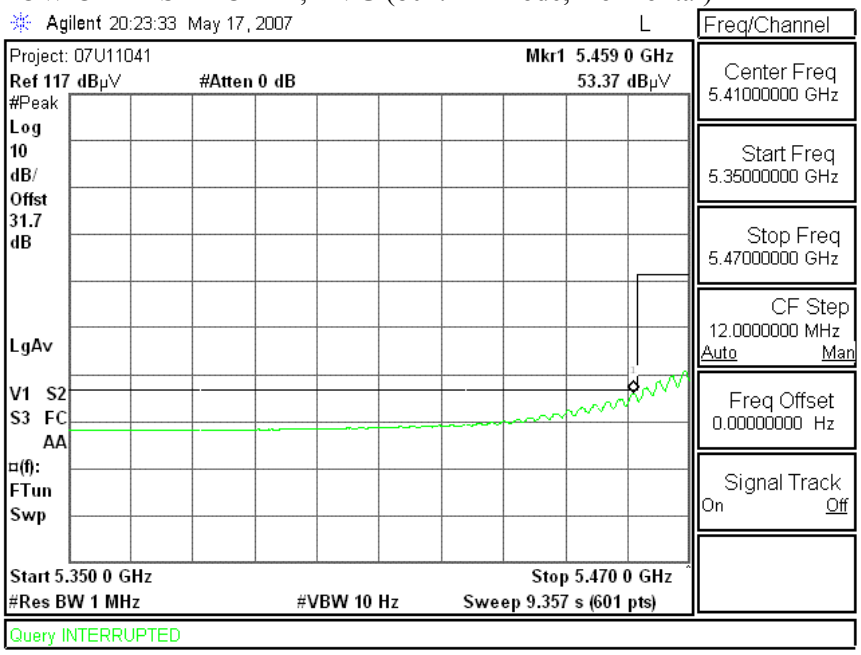
LOW CH RESTRICTED, AVG (802.11n mode, Horizontal)



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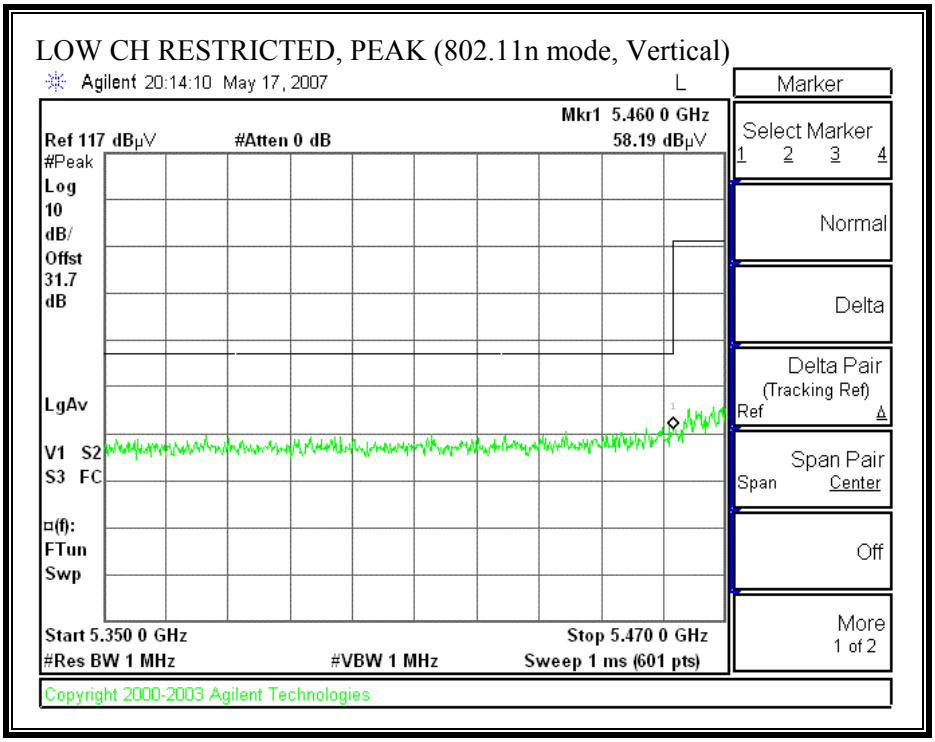
RESTRICTED BANDEDGE (802.11n MODE, LOW CHANNEL, 5510 MHz - VERTICAL)



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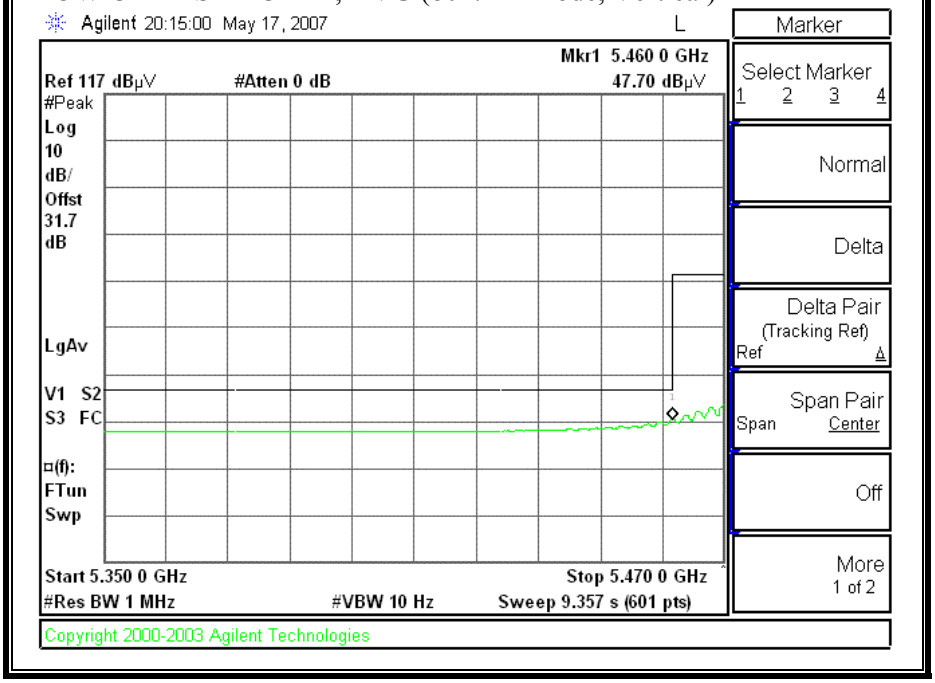
LOW CH RESTRICTED, AVG (802.11n mode, Vertical)



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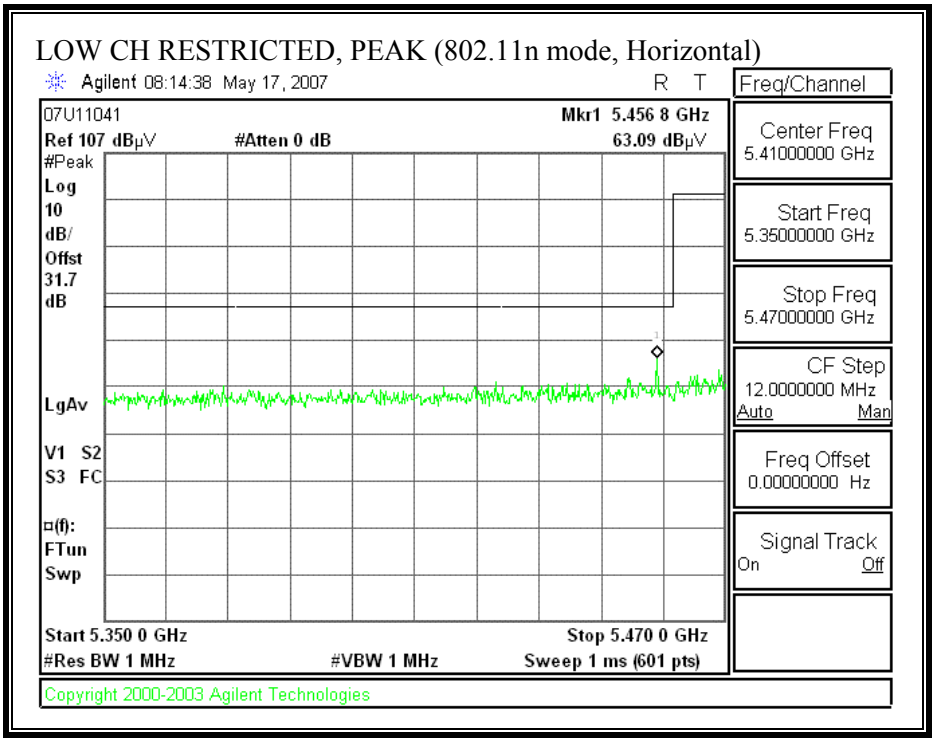
RESTRICTED BANDEDGE (LOW CHANNEL, 5550 MHz - HORIZONTAL)



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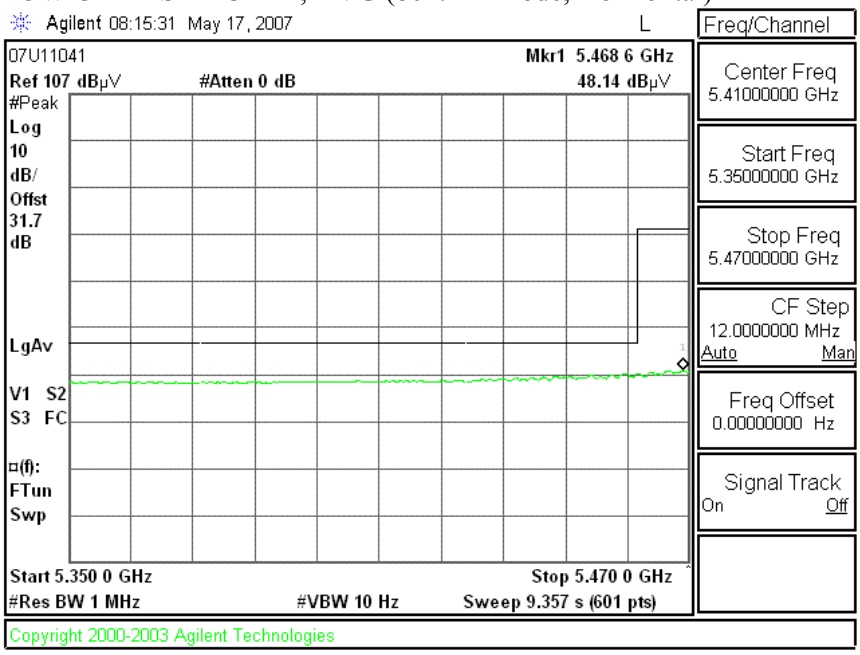
LOW CH RESTRICTED, AVG (802.11n mode, Horizontal)



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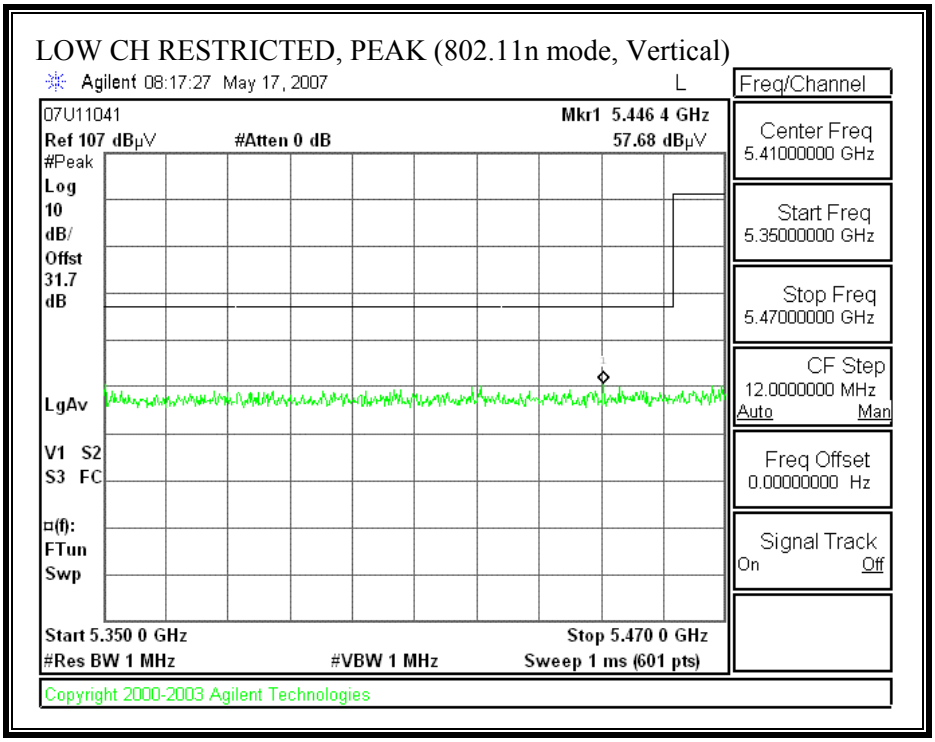
RESTRICTED BANDEDGE (802.11n MODE, LOW CHANNEL, 5550 MHz - VERTICAL)



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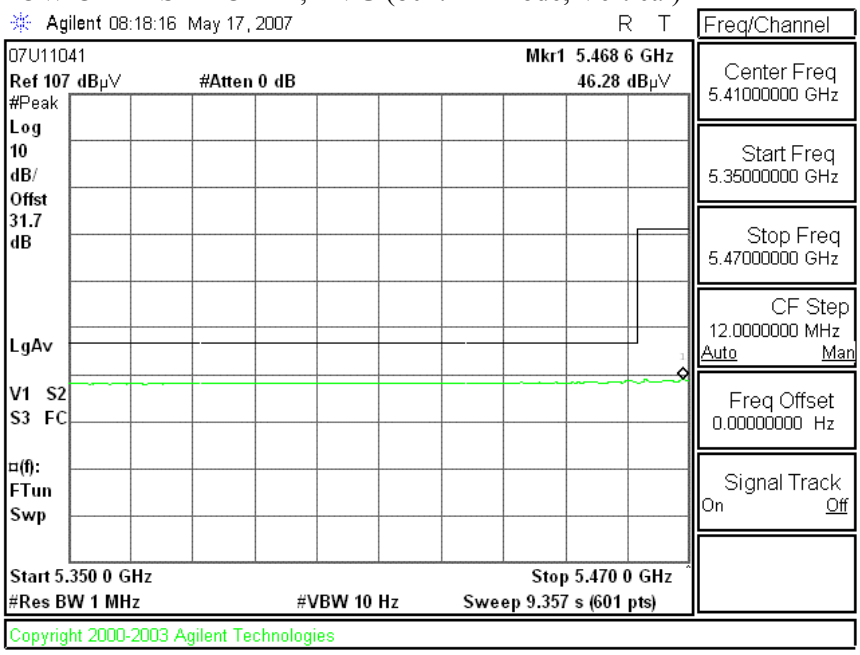
LOW CH RESTRICTED, AVG (802.11n mode, Vertical)



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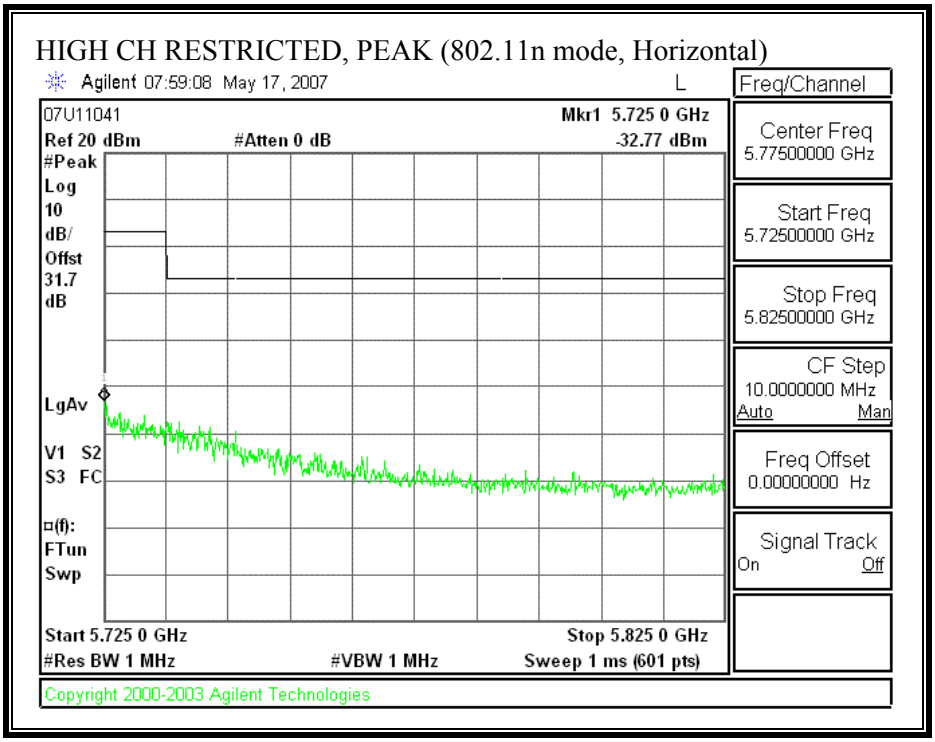
RESTRICTED BANDEDGE (802.11n MODE, HIGH CHANNEL, 5670 MHz - HORIZONTAL)



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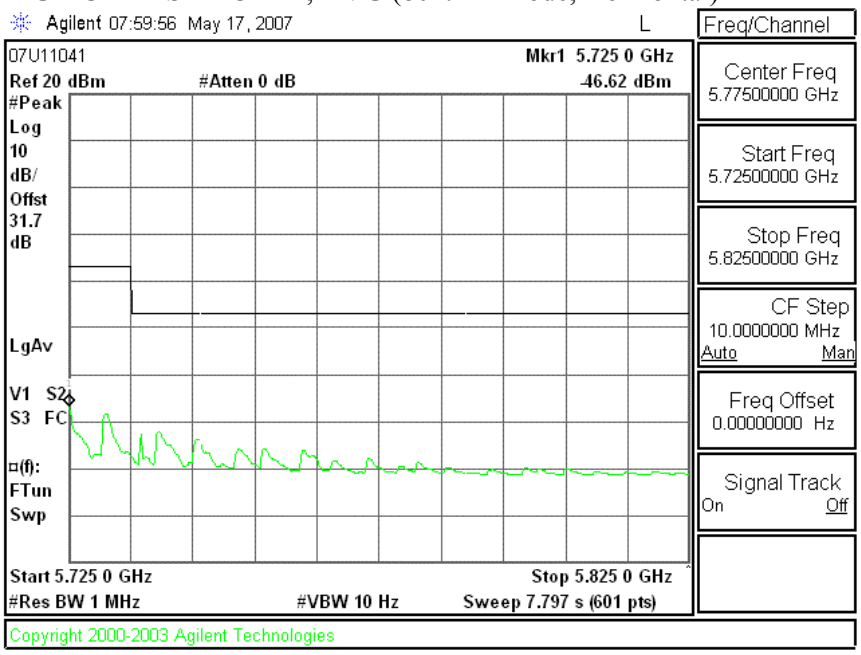
HIGH CH RESTRICTED, AVG (802.11n mode, Horizontal)



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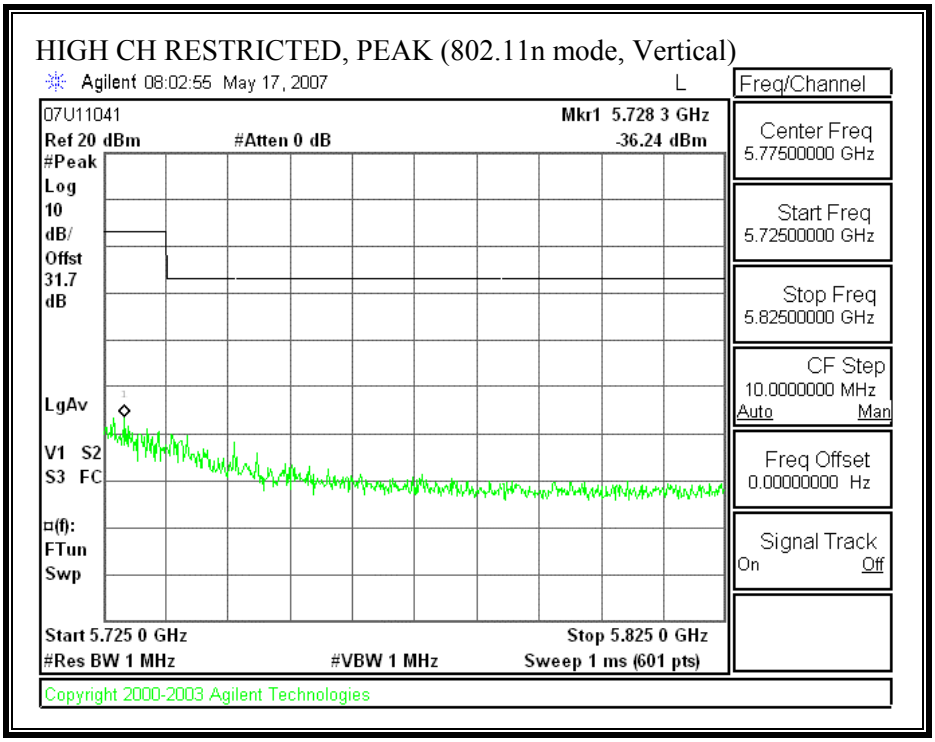
RESTRICTED BANDEDGE (802.11n MODE, HIGH CHANNEL, 5670 MHz - VERTICAL)



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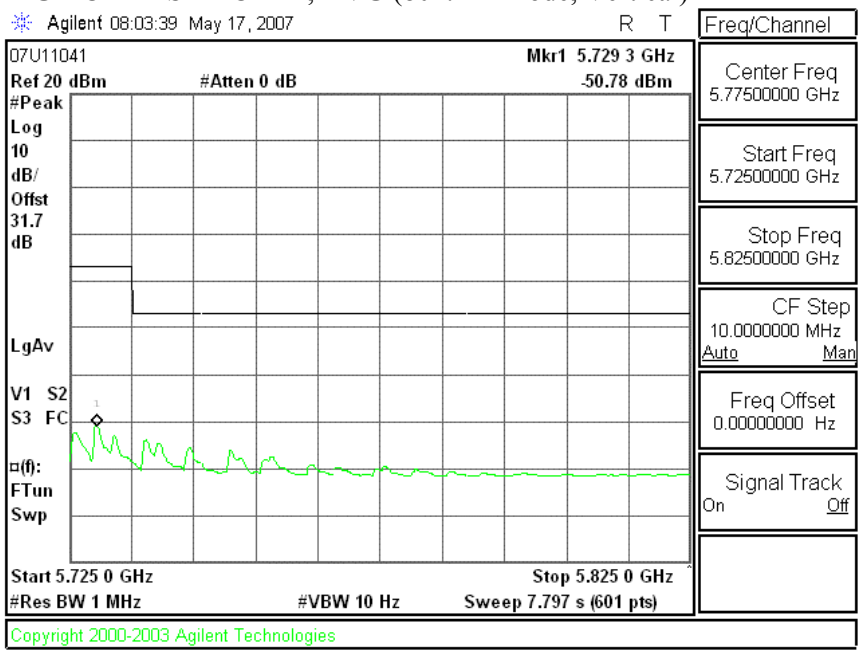
HIGH CH RESTRICTED, AVG (802.11n mode, Vertical)



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

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Broadcom
Project #: 07U11041
Date: 5/16/2007
Test Engineer: Mengistu Mekuria
Configuration: EUT Only
Mode: Transmit, 11n mode 5.6GHz (40MHz MCS32 MIMO)

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T120; S/N: 29310 @3m	T144 Miteq 3008A00931		T125; ARA 18-26GHz; S/N:1007	FCC 15.209

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
		A-5m Chamber	HPF_7.6GHz	

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
CH. 102 (5510MHz)															
11.020	3.0	46.6	34.9	37.5	11.1	-36.3	0.0	0.7	59.7	48.0	74	54	-14.3	-6.0	H
16.530	3.0	42.0	29.4	39.7	13.0	-34.0	0.0	0.7	61.4	48.8	74	54	-12.6	-5.2	H
11.020	3.0	44.2	32.6	37.5	11.1	-36.3	0.0	0.7	57.3	45.7	74	54	-16.7	-8.3	V
16.530	3.0	41.4	29.1	39.7	13.0	-34.0	0.0	0.7	60.7	48.5	74	54	-13.3	-5.5	V
CH. 118 (5590MHz)															
11.180	3.0	47.5	34.5	37.6	11.3	-36.1	0.0	0.7	60.9	48.0	74	54	-13.1	-6.0	H
16.770	3.0	41.4	28.9	39.9	13.1	-33.8	0.0	0.7	61.2	48.7	74	54	-12.8	-5.3	H
11.180	3.0	49.1	35.1	37.6	11.3	-36.1	0.0	0.7	62.6	48.6	74	54	-11.4	-5.4	V
16.770	3.0	41.3	28.1	39.9	13.1	-33.8	0.0	0.7	61.1	47.9	74	54	-12.9	-6.1	V
CH. 134 (5670MHz)															
11.340	3.0	48.5	37.0	37.6	11.5	-36.0	0.0	0.7	62.3	50.8	74	54	-11.7	-3.2	H
17.010	3.0	40.4	28.8	40.0	13.2	-33.7	0.0	0.7	60.6	49.1	74	54	-13.4	-4.9	H
11.400	3.0	47.0	35.1	37.6	11.5	-35.9	0.0	0.7	60.9	49.0	74	54	-13.1	-5.0	V
17.010	3.0	40.0	27.6	40.0	13.2	-33.7	0.0	0.7	60.2	47.9	74	54	-13.8	-6.1	V

Note: No other emission were detected above noise floor.

Rev. 4.12.7

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		

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ALL BANDS AND MODES

7.5.6. WORST-CASE RADIATED EMISSIONS BELOW 1 GHz

HORIZONTAL DATA

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

Data#: 36 File#: 07U11041 A.EMI Date: 05-18-2007 Time: 23:34:39

Condition: FCC CLASS-B HORIZONTAL
Test Operator:: Mengistu Mekuria
Project #: : 07U11041
Company: : Broadcom
Configuration:: EUT With Host Laptop
Mode : : Tx @ 5 GHz (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	198.780	59.80	-17.19	42.61	43.50	-0.89	Peak
2	246.310	60.30	-17.94	42.36	46.00	-3.64	Peak
3	282.200	61.70	-16.56	45.14	46.00	-0.86	Peak
4	599.390	53.50	-9.92	43.58	46.00	-2.42	Peak
5	633.340	50.70	-9.34	41.36	46.00	-4.64	Peak
6	697.360	51.40	-8.48	42.92	46.00	-3.08	Peak
7	800.180	48.20	-6.88	41.32	46.00	-4.68	Peak

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

VERTICAL DATA

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

Data#: 35 File#: 07U11041 A.EMI Date: 05-18-2007 Time: 23:33:09

Condition: FCC CLASS-B VERTICAL
Test Operator:: Mengistu Mekuria
Project #: : 07U11041
Company: : Broadcom
Configuration:: EUT With Host Laptop
Mode : : Tx @ 5 GHz (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	246.310	58.10	-17.94	40.16	46.00	-5.84	Peak
2	319.060	54.70	-15.33	39.37	46.00	-6.63	Peak
3	364.650	55.00	-14.11	40.89	46.00	-5.11	Peak
4	399.570	53.70	-13.47	40.23	46.00	-5.77	Peak
5	566.410	52.70	-10.35	42.35	46.00	-3.65	Peak
6	599.390	53.80	-9.92	43.88	46.00	-2.12	Peak
7	696.390	51.30	-8.54	42.76	46.00	-3.24	Peak
8	800.180	48.10	-6.88	41.22	46.00	-4.78	Peak

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7.6. POWERLINE CONDUCTED EMISSIONS

LIMIT

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

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

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

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

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

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

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

RESULTS

No non-compliance noted:

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5 GHz BAND

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	49.28	--	--	0.00	63.82	53.82	-14.54	-4.54	L1
3.94	31.52	--	--	0.00	56.00	46.00	-24.48	-14.48	L1
22.30	39.15	--	--	0.00	60.00	50.00	-20.85	-10.85	L1
0.20	49.52	--	--	0.00	63.82	53.82	-14.30	-4.30	L2
3.47	32.76	--	--	0.00	56.00	46.00	-23.24	-13.24	L2
22.18	39.78	--	--	0.00	60.00	50.00	-20.22	-10.22	L2
6 Worst Data									

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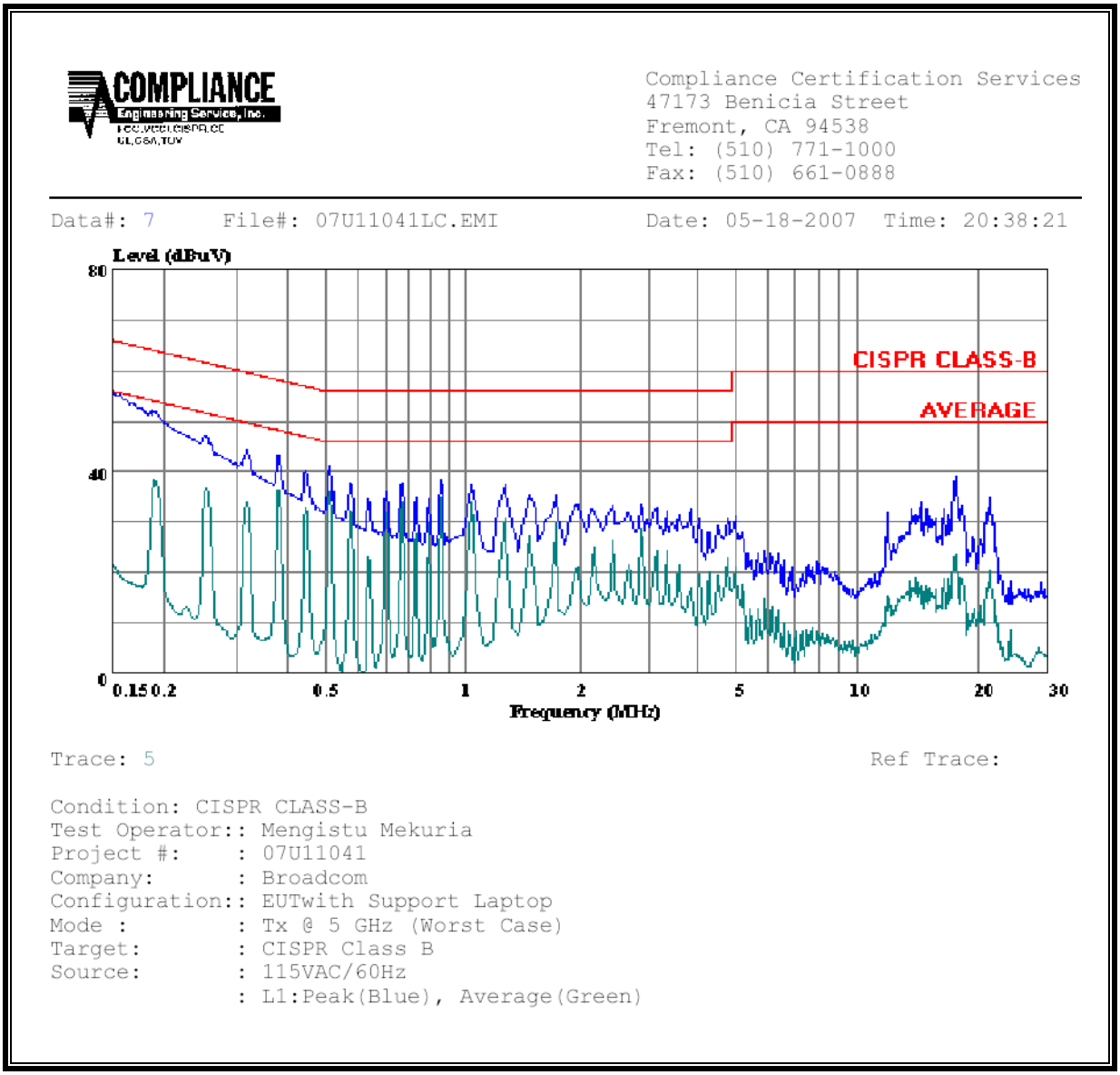
LINE 1 RESULTS



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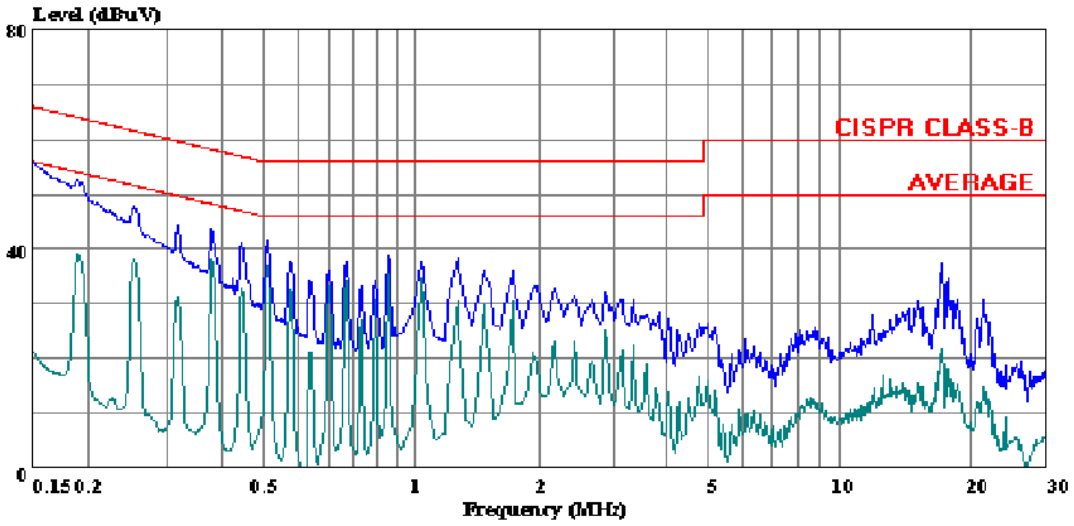
LINE 2 RESULTS

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

Data#: 14 File#: 07U11041LC.EMI Date: 05-18-2007 Time: 20:52:56



Trace: 12 Ref Trace:

Condition: CISPR CLASS-B
Test Operator:: Mengistu Mekuria
Project #: : 07U11041
Company: : Broadcom
Configuration:: EUTwith Support Laptop
Mode : : Tx @ 5 GHz (Worst Case)
Target: : CISPR Class B
Source: : 115VAC/60Hz
: L2:Peak(Blue), Average(Green)

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7.7. DYNAMIC FREQUENCY SELECTION

7.7.1. LIMITS

§15.407 (h) and FCC 06-96 APPENDIX "COMPLIANCE MEASUREMENT PROCEDURES FOR UNLICENSED-NATIONAL INFORMATION INFRASTRUCTURE DEVCIES OPERATING IN THE 5250-5350 MHz AND 5470-5725 MHz BANDS INCORPORATING DYNAMIC FREQUENCY SELECTION".

Table 1: Applicability of DFS requirements prior to use of a channel

Requirement	**Operational Mode**		
	Master	**Client (without radar detection)**	**Client (with radar detection)**
Non-Occupancy Period	Yes	Not required	Yes
DFS Detection Threshold	Yes	Not required	Yes
Channel Availability Check Time	Yes	Not required	Not required
Uniform Spreading	Yes	Not required	Not required

Table 2: Applicability of DFS requirements during normal operation

Requirement	**Operational Mode**		
	Master	**Client** (without DFS)	**Client** (with DFS)
DFS Detection Threshold	Yes	Not required	Yes
Channel Closing Transmission Time	Yes	Yes	Yes
Channel Move Time	Yes	Yes	Yes

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Table 3: Interference Threshold values, Master or Client incorporating In-Service Monitoring

Maximum Transmit Power	**Value (see note)**
≥ 200 milliwatt	-64 dBm
< 200 milliwatt	-62 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna Note 2: Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.	

Table 4: DFS Response requirement values

Parameter	**Value**
Non-occupancy period	30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds
Channel Closing Transmission Time	200 milliseconds + approx. 60 milliseconds over remaining 10 second period
The instant that the *Channel Move Time* and the *Channel Closing Transmission Time* begins is as follows: • For the Short pulse radar Test Signals this instant is the end of the *Burst*. • For the Frequency Hopping radar Test Signal, this instant is the end of the last radar burst generated. • For the Long Pulse radar Test Signal this instant is the end of the 12 second period defining the radar transmission. The Channel Closing Transmission Time is comprised of 200 milliseconds starting at the beginning of the Channel Move Time plus any additional intermittent control signals required to facilitate channel changes (an aggregate of approximately 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.	

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Table 5 – Short Pulse Radar Test Waveforms

Radar Type	Pulse Width (Microseconds)	PRI (Microseconds)	Pulses	Minimum Percentage of Successful Detection	Minimum Trials
1	1	1428	18	60%	30
2	1-5	150-230	23-29	60%	30
3	6-10	200-500	16-18	60%	30
4	11-20	200-500	12-16	60%	30
Aggregate (Radar Types 1-4)				80%	120

Table 6 – Long Pulse Radar Test Signal

Radar Waveform	Bursts	Pulses per Burst	Pulse Width (µsec)	Chirp Width (MHz)	PRI (µsec)	Minimum Percentage of Successful Detection	Minimum Trials
5	8-20	1-3	50-100	5-20	1000-2000	80%	30

Table 7 – Frequency Hopping Radar Test Signal

Radar Waveform	Pulse Width (µsec)	PRI (µsec)	Burst Length (ms)	Pulses per Hop	Hopping Rate (kHz)	Minimum Percentage of Successful Detection	Minimum Trials
6	1	333	300	9	.333	70%	30

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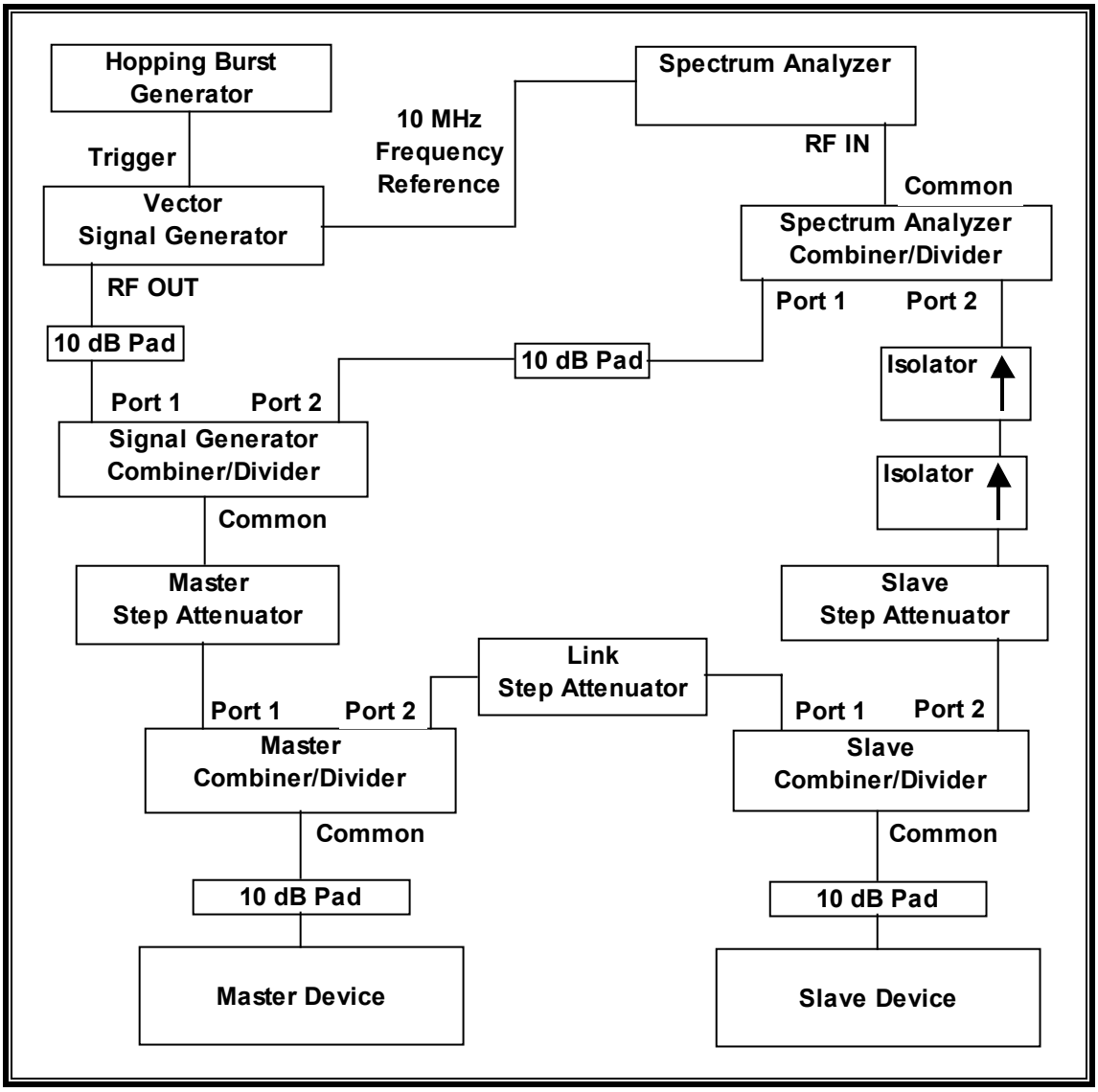
7.7.2. TEST AND MEASUREMENT SYSTEM

CONDUCTED METHOD SYSTEM BLOCK DIAGRAM



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SYSTEM OVERVIEW

The short pulse and long pulse signal generating system utilizes the NTIA software. The Vector Signal Generator has been validated by the NTIA. The hopping signal generating system utilizes the CCS simulated hopping method and system, which has been validated by the DoD, FCC and NTIA. The software selects waveform parameters from within the bounds of the signal type on a random basis using uniform distribution.

The short pulse types 2, 3 and 4, and the long pulse type 5 parameters are randomized at run-time.

The hopping type 6 pulse parameters are fixed while the hopping sequence is based on the August 2005 NTIA Hopping Frequency List. The initial starting point randomized at run-time and each subsequent starting point is incremented by 475. Each frequency in the 100-length segment is compared to the boundaries of the EUT Detection Bandwidth and the software creates a hopping burst pattern in accordance with Section 7.4.1.3 Method #2 Simulated Freqeuncy Hopping Radar Waveform Generating Subsystem of FCC 06-96 APPENDIX. The frequency of the signal generator is incremented in 1 MHz steps from F_L to F_H for each successive trial. This incremental sequence is repeated as required to generate a minimum of 30 total trials and to maintain a uniform frequency distribution over the entire Detection Bandwidth.

The signal monitoring equipment consists of a spectrum analyzer set to display 8001 bins on the horizontal axis. The time-domain resolution is 2 msec / bin with a 16 second sweep time, meeting the 10 second short pulse reporting criteria. The aggregate ON time is calculated by multiplying the number of bins above a threshold during a particular observation period by the dwell time per bin, with the analyzer set to peak detection and max hold.

Should multiple RF ports be utilized for the Master and/or Slave devices (for example, for diversity or MIMO implementations), additional combiner/dividers are inserted between the Master Combiner/Divider and the pad connected to the Master Device (and/or between the Slave Combiner/Divider and the pad connected to the Slave Device). Additional pads are utilized such that there is one pad at each RF port on each EUT.

SYSTEM CALIBRATION

A 50 ohm load is connected in place of the spectrum analyzer, and the spectrum analyzer is connected in place of the master device and the signal generator is set to CW mode. The amplitude of the signal generator is adjusted to yield a level of –64 dBm as measured on the spectrum analyzer.

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Without changing any of the instrument settings, the spectrum analyer is reconnected to the Common port of the Spectrum Analyzer Combiner/Divider. Measure the amplitude and calculate the difference from –64 dBm. Adjust the Reference Level Offset of the spectrum analyzer to this difference.

The spectrum analyzer displays the level of the signal generator as received at the antenna ports of the Master Device. The interference detection threshold may be varied from the calibrated value of –64 dBm and the spectrum analyzer will still indicate the level as received by the Master Device.

Set the signal generator to produce a radar waveform, trigger a burst manually and measure the level on the spectrum analyzer. Readjust the amplitude of the signal generator as required so that the peak level of the waveform is at a displayed level equal to the required or desired interference detection threshold. Separate signal generator amplitude settings are determined as required for each radar type.

ADJUSTMENT OF DISPLAYED TRAFFIC LEVEL

Establish a link between the Master and Slave, adjusting the Link Step Attenuator as needed to provide a suitable received level at the Master and Slave devices. Stream the video test file to generate WLAN traffic. Confirm that the WLAN traffic level, as displayed on the spectrum analyzer, is at lower amplitude than the radar detection threshold. For Master Device testing confirm that the displayed traffic does not include Slave Device traffic. For Slave Device testing confirm that the displayed traffic does not include Master Device traffic.

If a different setting of the Master Step Attenuator is required to meet the above conditions, perform a new System Calibration for the new Master Step Attenuator setting.

TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**Cal Due**
Spectrum Analyzer 3 Hz ~ 44 GHz	Agilent / HP	E4446A	US42070220	7/29/2007
Vector Signal Generator 250kHz-20GHz	Agilent / HP	E8267C	US43320336	11/2/2007
High Speed Digital I/O Card	National Instruments	PCI-6534	HA1612845	1/16/2008

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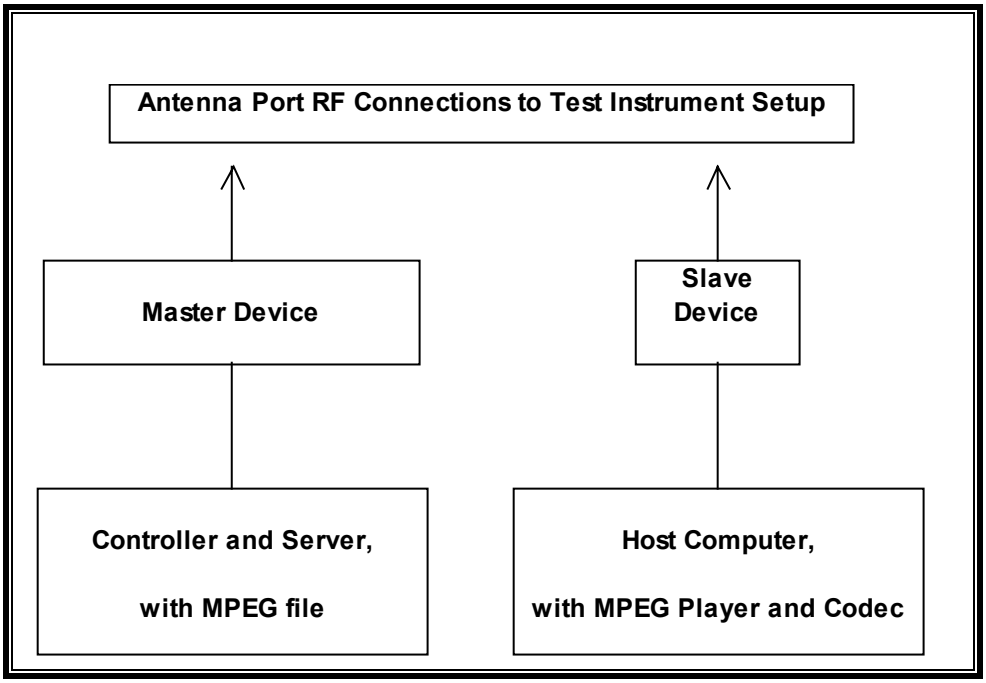
CONDUCTED METHOD EUT TEST SETUP



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SUPPORT EQUIPMENT

The following test and measurement equipment was utilized for the 20 MHz bandwidth DFS tests documented in this report:

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	DELL	Dell Inspiron 4150	CN-04P449-48643-2CH-2011	DoC
AC Adapter	DELL	ADP-70EB	TH-09364U-17971-248-8PDP	DoC
Laptop	Compaq	Presario 3000	CNU327025L	DoC
AC Adapter	Compaq	PA-1900-05H	3300371601	DoC
Access Point	CISCO	AIR-AP1242AG-A-K9	FTX1042B5E0	LDK102056
AC Adapter	Delta	ADP-18PB	PZT0628359656	DoC

The following test and measurement equipment was utilized for the 40 MHz bandwidth DFS tests documented in this report:

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop	HP	PA-1121-12HD	PPP017L	DoC
AC Adapter	HP	HP Pavilion zv6000	CND52904s1	DoC
Laptop	DELL	ADP-70EB	TH-09364U-17971-248-8PDP	DoC
AC Adapter	DELL	Dell Inspiron 4150	CN-04P449-48643-2CH-2011	DoC
Access Point	Broadcom	BCM94705LMP	Prototype	QDS-BRCM1025
AC Adapter	Bothhand	M1-10S05	R00031106975B	DoC

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7.7.3. DESCRIPTION OF EUT WITH RESPECT TO FCC 06-96 REQUIREMENTS

The EUT operates over the 5250-5350 MHz and 5470-5725 MHz ranges.

The EUT is a Slave Device without radar detection.

The highest power level within these bands is 27.58 dBm EIRP in the 5250-5350 MHz band and 29.75 dBm EIRP in the 5470-5725 MHz band.

The main antenna assembly utilized with the EUT has a gain of 6.23 dBi for the 5250-5350 MHz band and 6.02 dBi in the 5470-5725 MHz band. The aux antenna assembly utilized with the EUT has a gain of 5.02 dBi for the 5250-5350 MHz band and 5.44 dBi in the 5470-5725 MHz band.

All antennas are integral.

Two non-identical antennas are utilized to meet the MIMO transmit diversity operational requirements.

The EUT uses two transmitters, each connected to a 50-ohm coaxial antenna port. Both antenna ports are connected to the test system via a power divider to perform conducted tests.

WLAN traffic is generated by streaming the video file TestFile.mp2 “6 ½ Magic Hours” from the Master to the Slave in full motion video mode using the media player with the V2.61 Codec package.

TPC is required since the maximum EIRP is greater than 500 mW (27 dBm).

The EUT utilizes the 802.11a / 802.11Draft n architecture. Two nominal channel bandwidths, 20 MHz and 40 MHz, are implemented.

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DESCRIPTION OF TPC FUNCTION

The power level can be reduced to a conducted level of 15 dBm, which yields a maximum EIRP of 23.7 dBm, which is less than the 24 dBm EIRP limit for TPC level.

OVERVIEW OF MASTER DEVICE UTILIZED FOR 20 MHz BANDWIDTH TESTS WITH RESPECT TO §15.407 (h) REQUIREMENTS

The Master Device is a Cisco Access Point, FCC ID: LDK102056. The DFS software installed in the Master Device is revision 6.00.1. The minimum antenna gain for the Master Device is 3.5 dBi.

The rated output power of the Master unit is > 23dBm (EIRP). Therefore the required interference threshold level is –64 dBm. After correction for antenna gain and procedural adjustments, the required conducted threshold at the antenna port is –64 + 2 + 1 = -61 dBm.

The calibrated conducted DFS Detection Threshold level is set to –64 dBm. The tested level is lower than the required level hence it provides margin to the limit.

OVERVIEW OF MASTER DEVICE UTILIZED FOR 40 MHz BANDWIDTH TESTS WITH RESPECT TO §15.407 (h) REQUIREMENTS

The Master Device is a Broadcom Access Point, FCC ID: QDS-BRCM1025. The DFS software installed in the Master Device is revision PO_4_100_22_2. The minimum antenna gain for the Master Device is 3 dBi.

The rated output power of the Master unit is < 23 dBm (EIRP). Therefore the required interference threshold level is –62 dBm. After correction for antenna gain and procedural adjustments, the required conducted threshold at the antenna port is –62 + 3 + 1 = -58dBm.

The calibrated conducted DFS Detection Threshold level is set to –64 dBm. The tested level is lower than the required level hence it provides margin to the limit.

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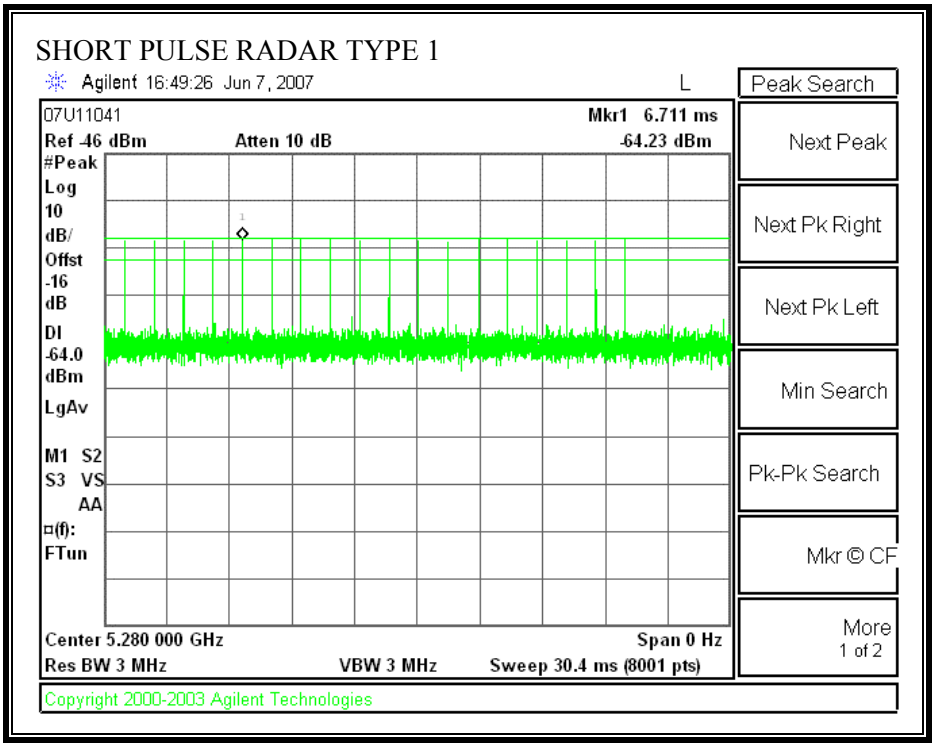
7.8. RESULTS FOR 20 MHz BANDWIDTH CONFIGURATION

7.8.1. TEST CHANNEL AND METHOD

All tests were performed at a channel center frequency of 5280 MHz. Measurements were performed using conducted test methods.

7.8.2. PLOTS OF RADAR WAVEFORM, AND WLAN TRAFFIC

PLOTS OF RADAR WAVEFORMS



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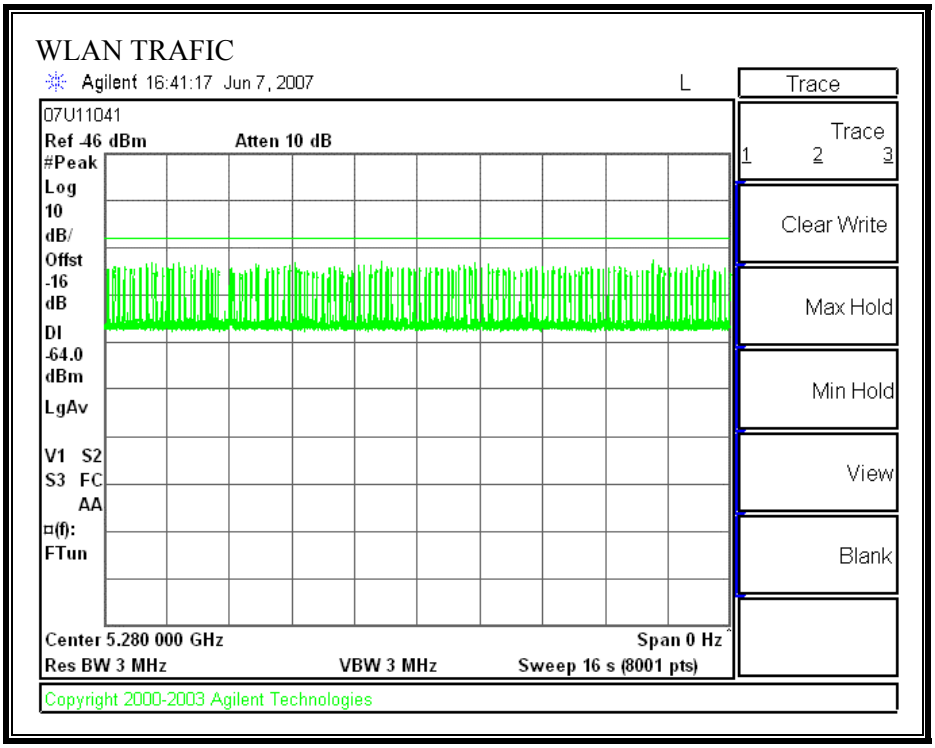
PLOT OF WLAN TRAFFIC FROM SLAVE



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7.8.3. CHANNEL MOVE TIME AND CHANNEL CLOSING TRANSMISSION TIME

REPORTING NOTES

The reference marker is set at the end of last radar pulse.

The delta marker is set at the end of the last WLAN transmission following the radar pulse. This delta is the channel move time.

The aggregate channel closing transmission time is calculated as follows:

Aggregate Transmission Time =
(Number of analyzer bins showing transmission) * (dwell time per bin)

The observation period over which the aggregate time is calculated
Begins at (Reference Marker + 200 msec)
and
Ends no earlier than (Reference Marker + 10 sec).

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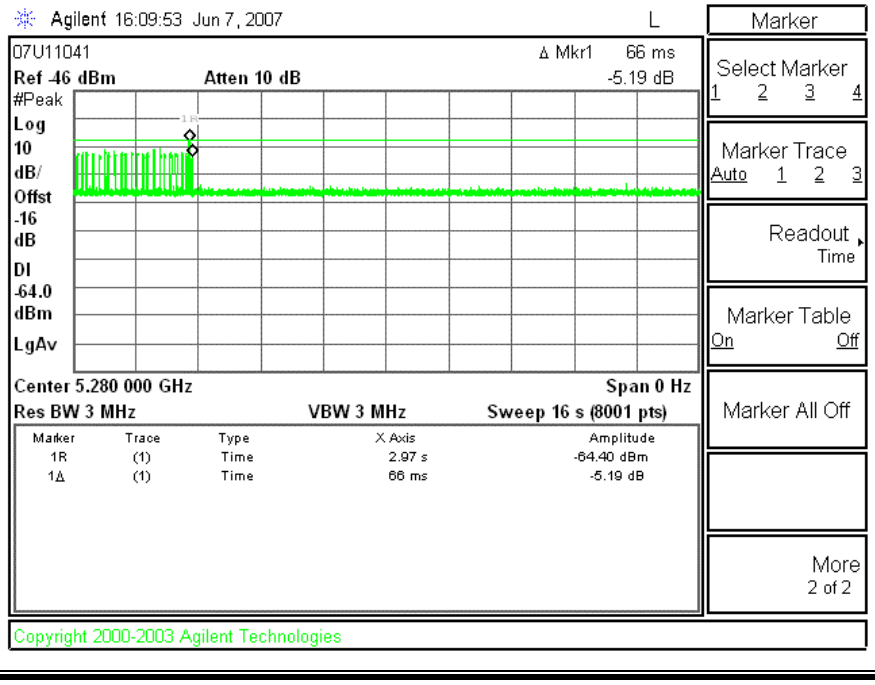
CHANNEL MOVE TIME RESULTS

No non-compliance noted:

Channel Move Time (s)	Limit (s)
0.066	10

MOVE TIME PLOT



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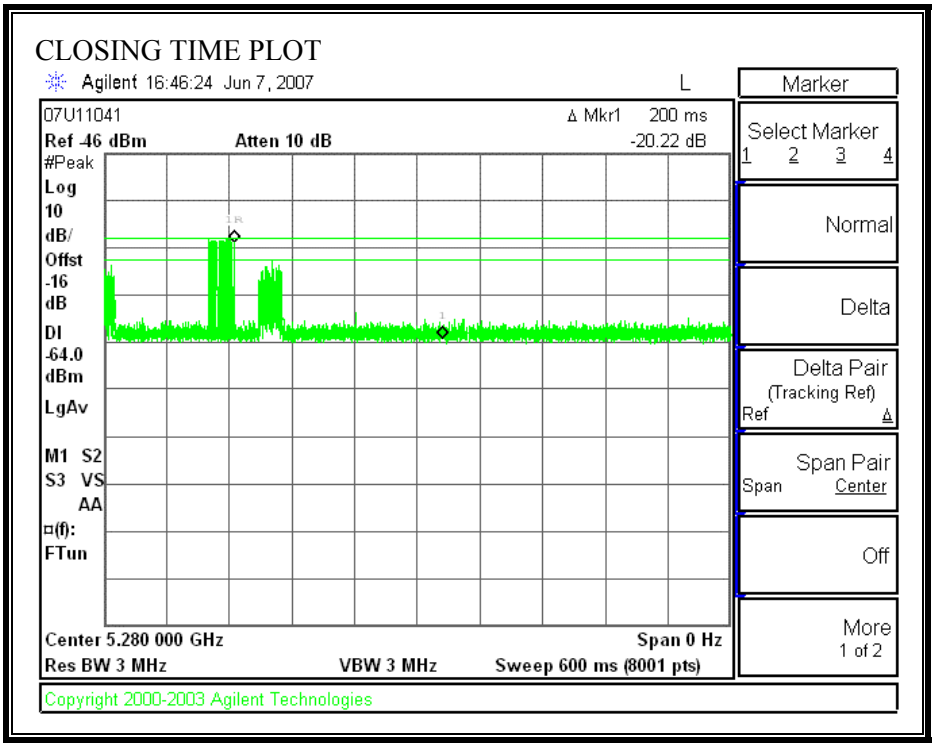
CHANNEL CLOSING TIME RESULTS



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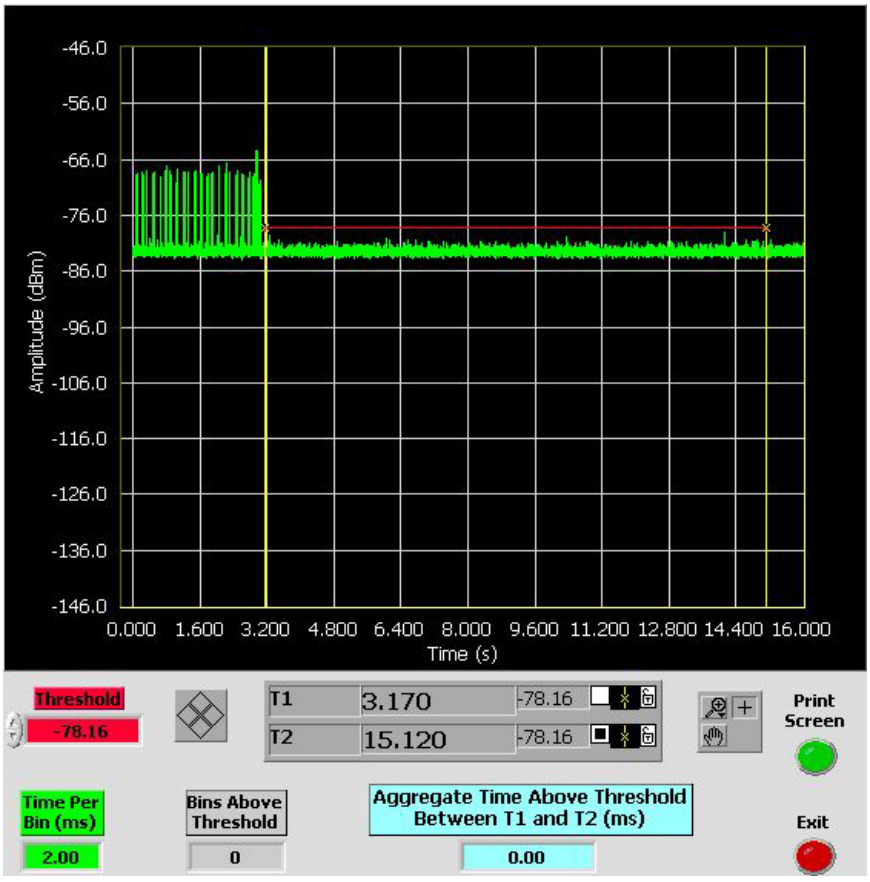
FCC AGGREGATE CHANNEL CLOSING TRANSMISSION TIME RESULTS

No non-compliance noted:

Aggregate Transmission Time (ms)	Limit (ms)	Margin (ms)
0.00	60	60.00

No transmissions are observed during the aggregate monitoring period.

FCC AGGREGATE CLOSING TIME PLOT



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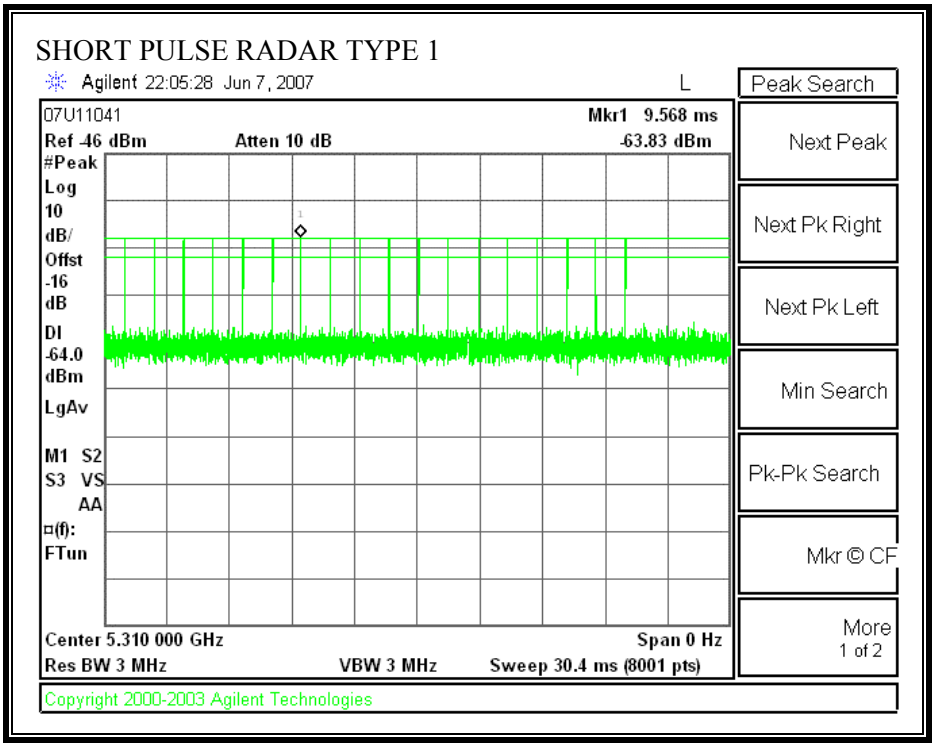
7.9. RESULTS FOR 40 MHz BANDWIDTH CONFIGURATION

7.9.1. TEST CHANNEL AND METHOD

All tests were performed at a channel center frequency of 5310 MHz. Measurements were performed using conducted test methods.

7.9.2. PLOTS OF RADAR WAVEFORM, AND WLAN TRAFFIC

PLOTS OF RADAR WAVEFORMS



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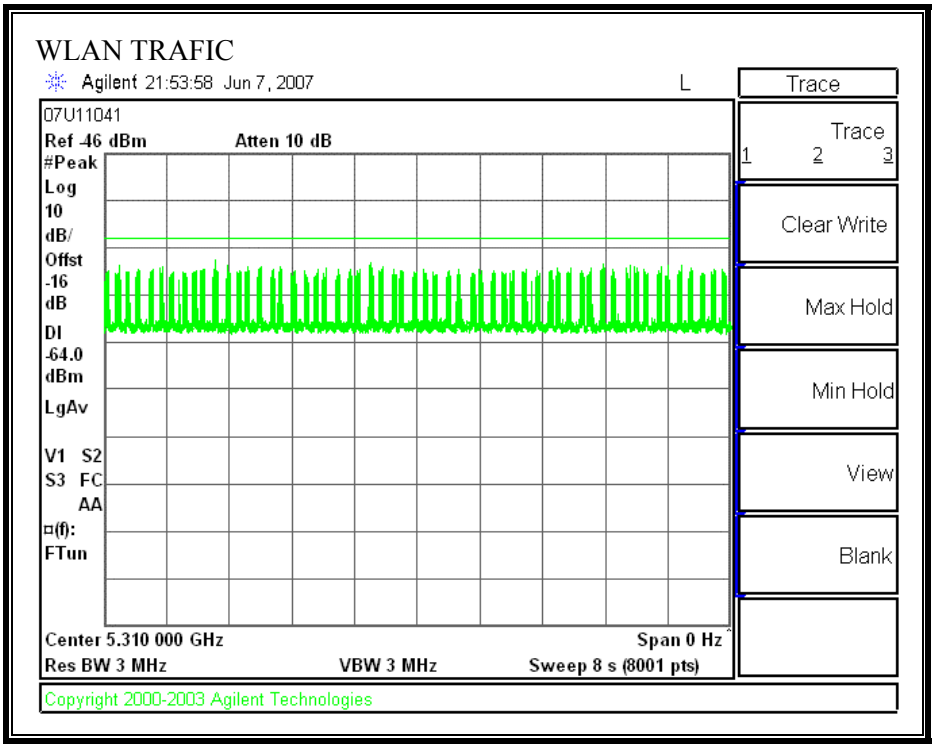
PLOT OF WLAN TRAFFIC FROM SLAVE



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7.9.3. CHANNEL MOVE TIME AND CHANNEL CLOSING TRANSMISSION TIME

REPORTING NOTES

The reference marker is set at the end of last radar pulse.

The delta marker is set at the end of the last WLAN transmission following the radar pulse. This delta is the channel move time.

The aggregate channel closing transmission time is calculated as follows:

Aggregate Transmission Time =
(Number of analyzer bins showing transmission) * (dwell time per bin)

The observation period over which the aggregate time is calculated
Begins at (Reference Marker + 200 msec)
and
Ends no earlier than (Reference Marker + 10 sec).

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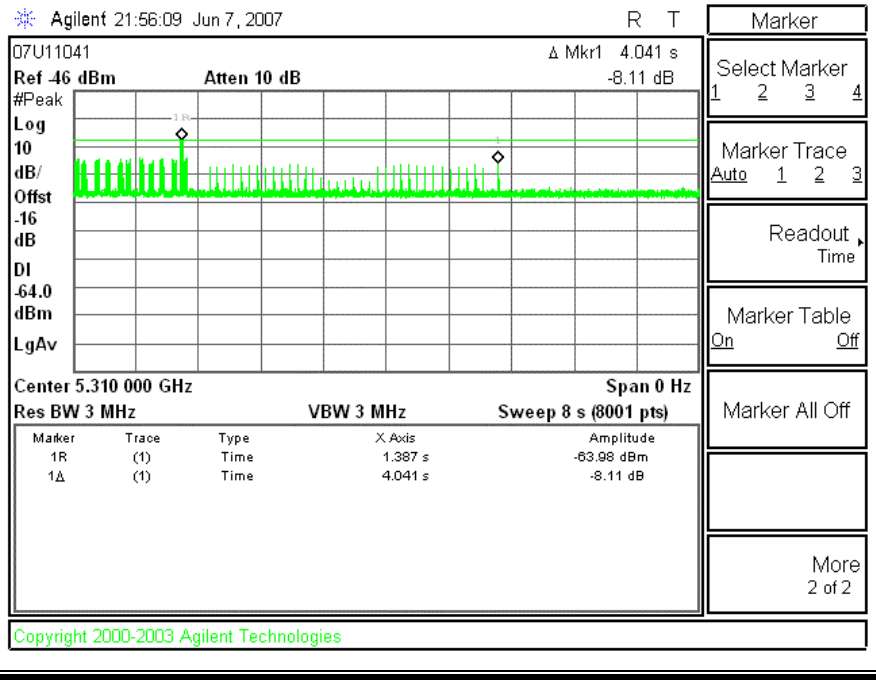
CHANNEL MOVE TIME RESULTS

No non-compliance noted:

Channel Move Time (s)	Limit (s)
4.041	10

MOVE TIME PLOT



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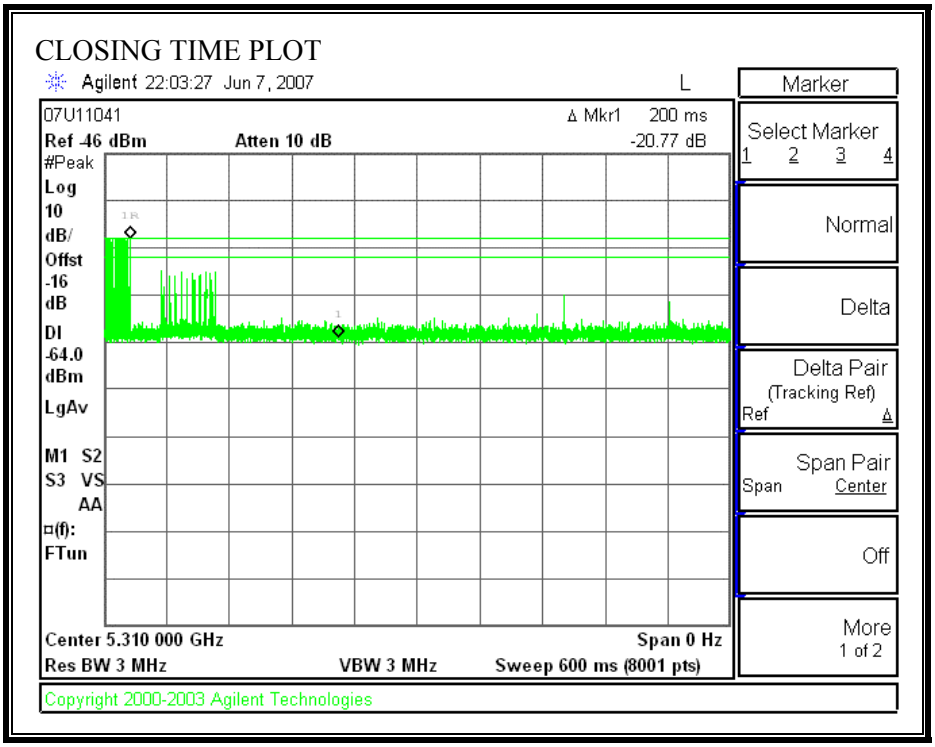
CHANNEL CLOSING TIME RESULTS



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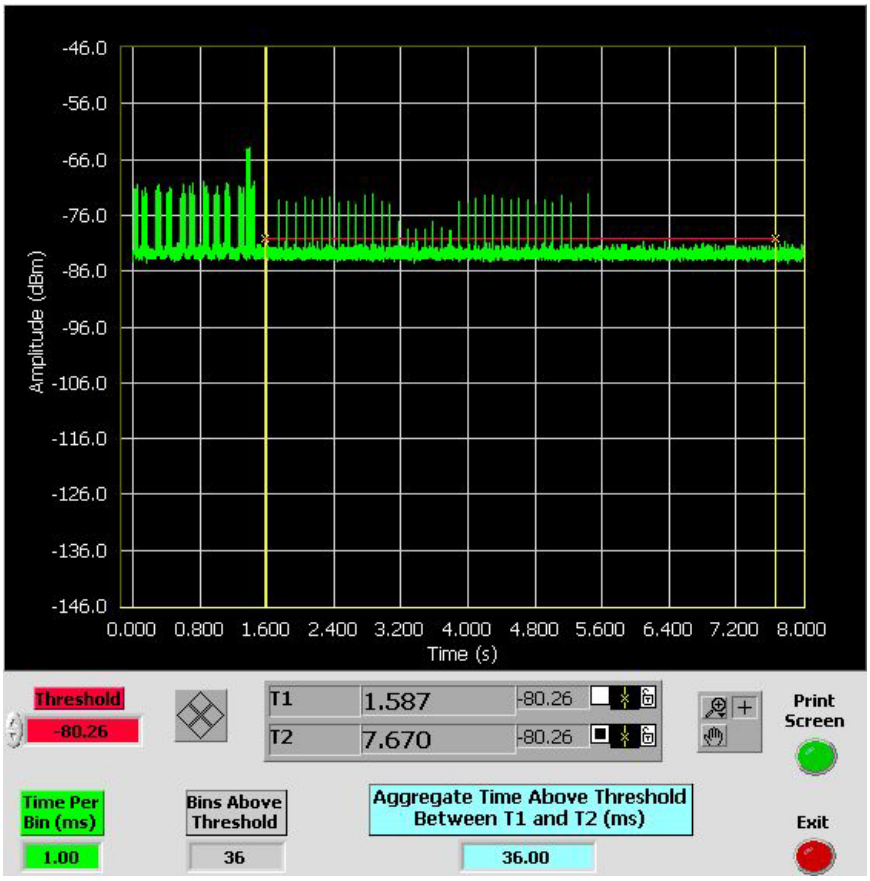
FCC AGGREGATE CHANNEL CLOSING TRANSMISSION TIME RESULTS

No non-compliance noted:

Aggregate Transmission Time (ms)	Limit (ms)	Margin (ms)
36.00	60	24.00

No transmissions are observed during the aggregate monitoring period.

FCC AGGREGATE CLOSING TIME PLOT



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