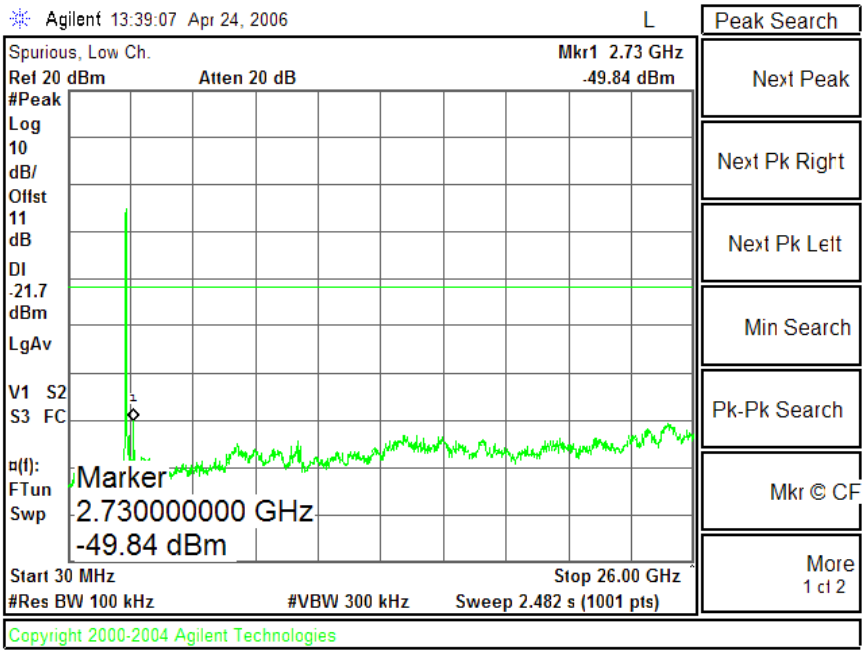
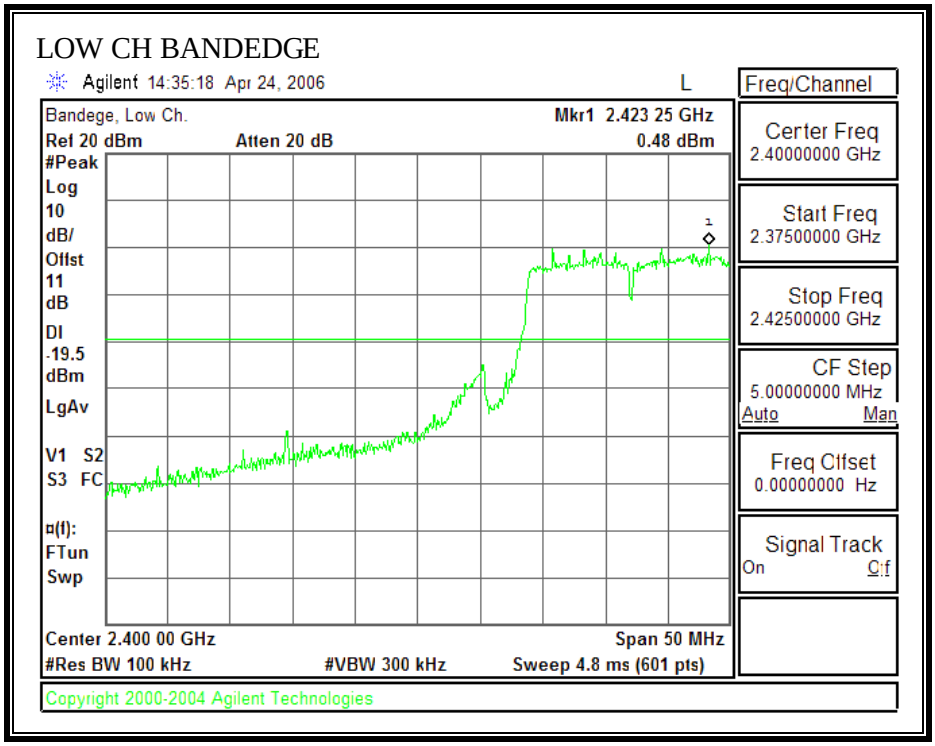
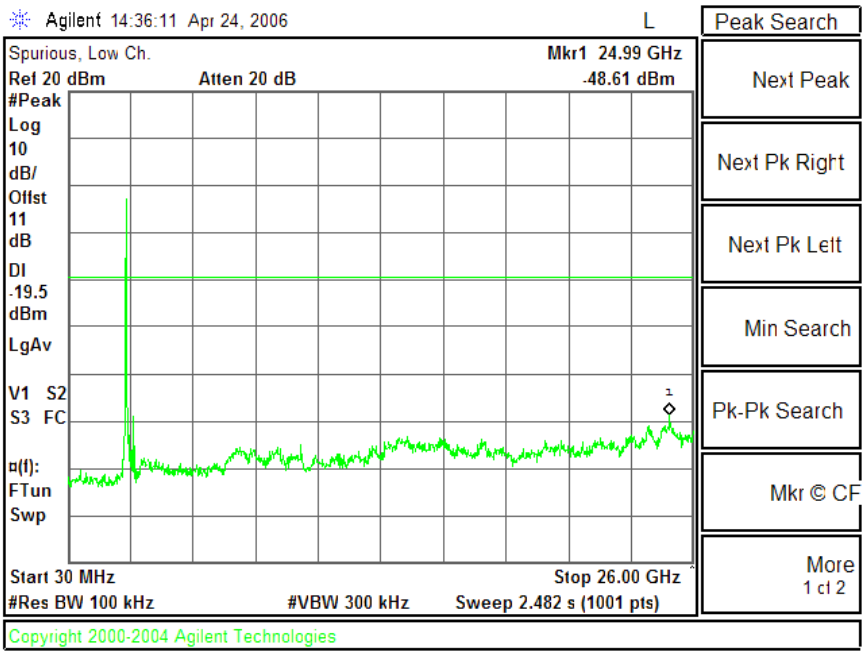
LOW CH SPURIOUS



LOW CH BANDEDGE, 2427 MHz

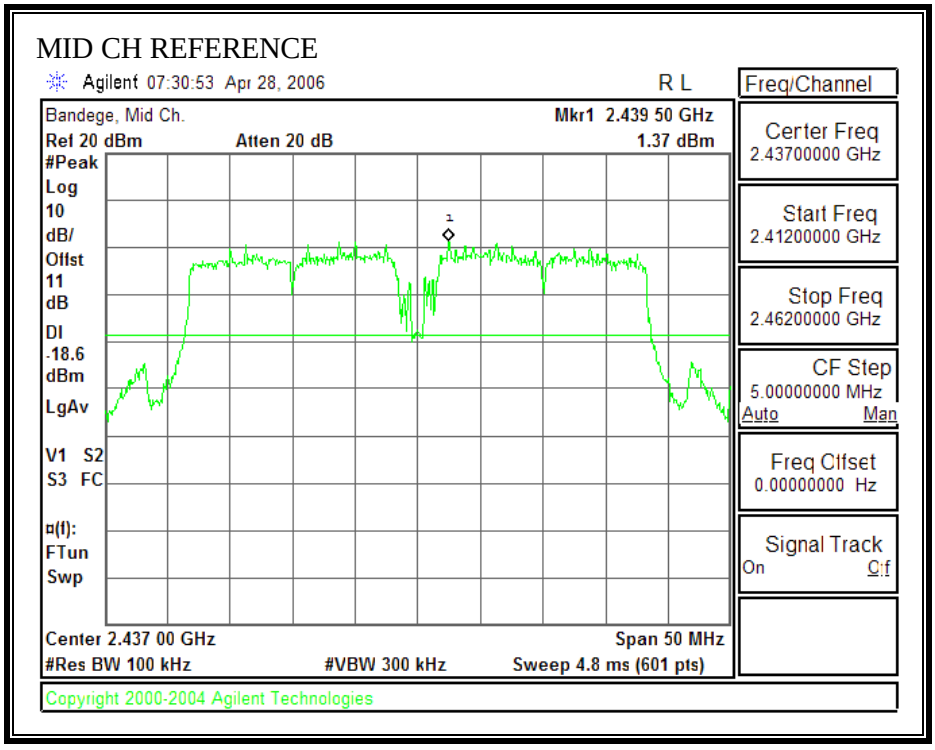


LOW CH SPURIOUS

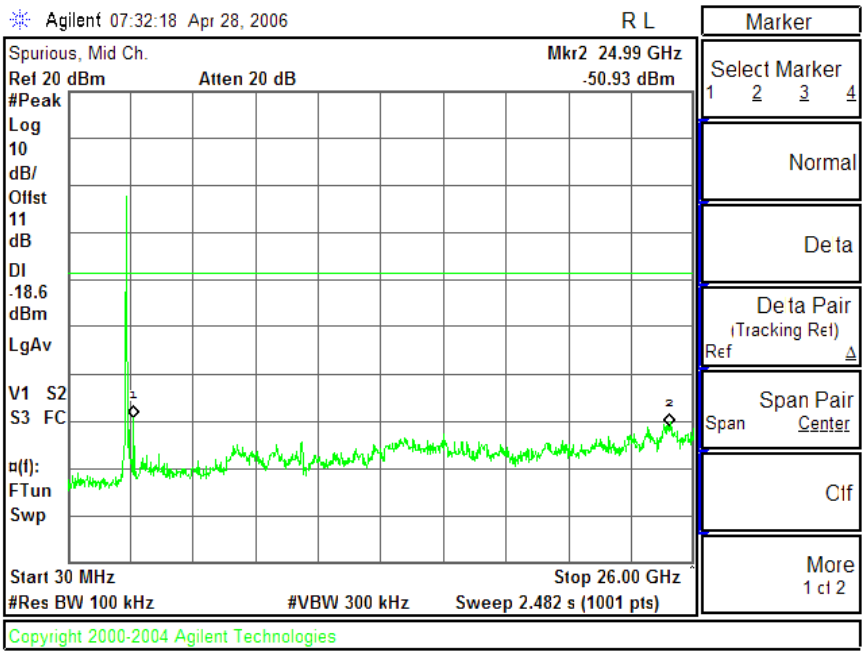


PURIOUS EMISSIONS, MIDDLE CHANNEL (802.11 - 20 MHz TX BANDWIDTH – CHAIN 0)

MID CH BANDEGE, 2437 MHz

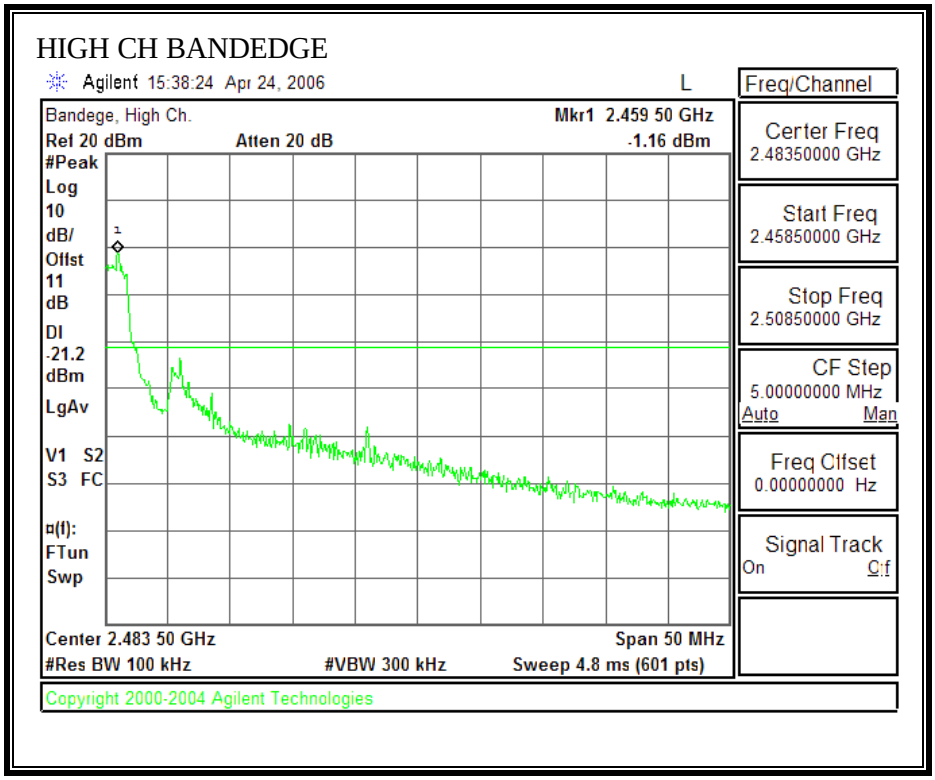


MID CH SPURIOUS

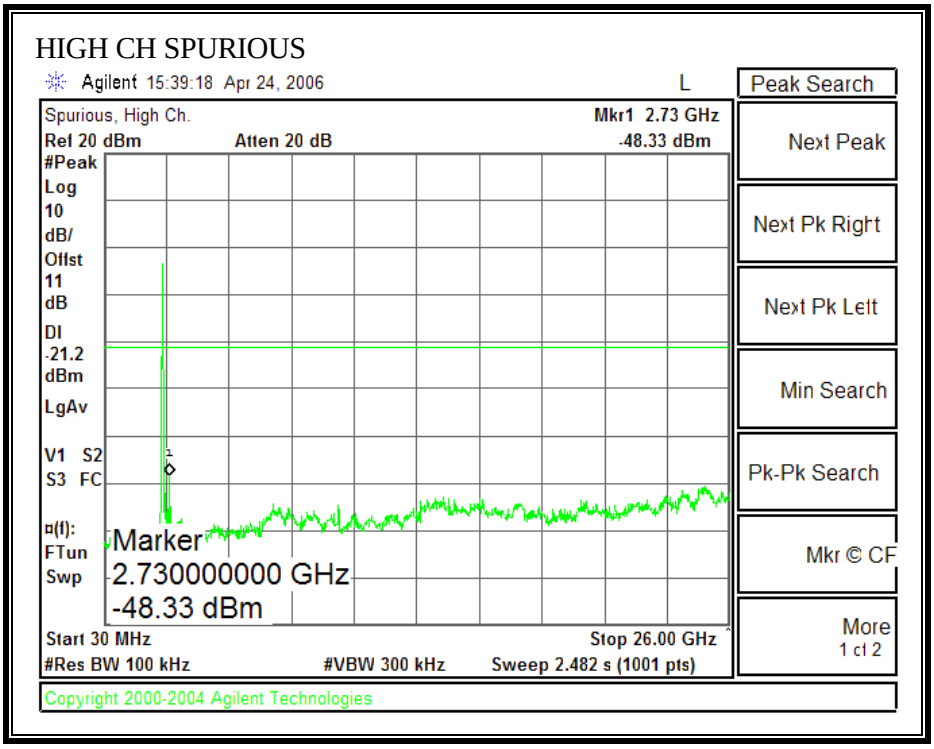


SPURIOUS EMISSIONS, HIGH CHANNEL (802.11 - 40 MHz TX BANDWIDTH – CHAIN 0)

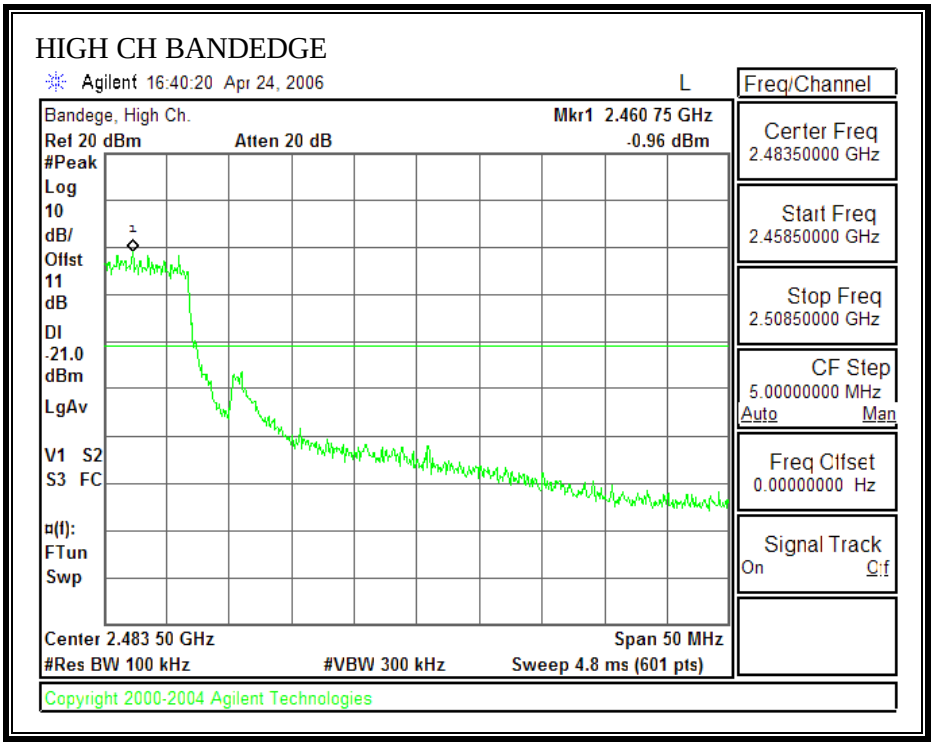
HIGH CH BANDEDGE, 2442 MHz



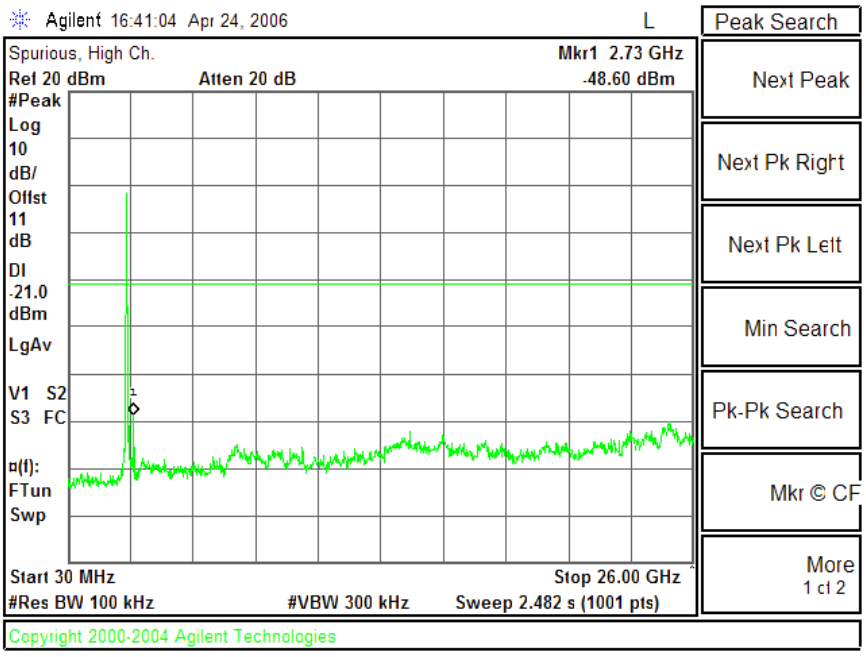
HIGH CH SPURIOUS



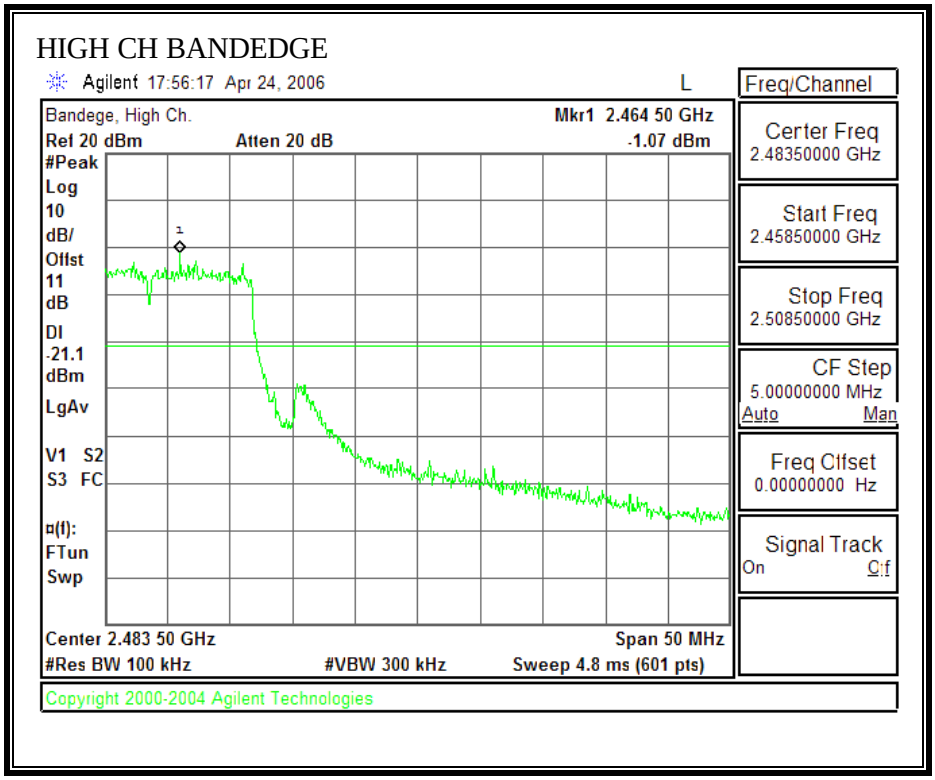
HIGH CH BANDEDGE, 2447 MHz



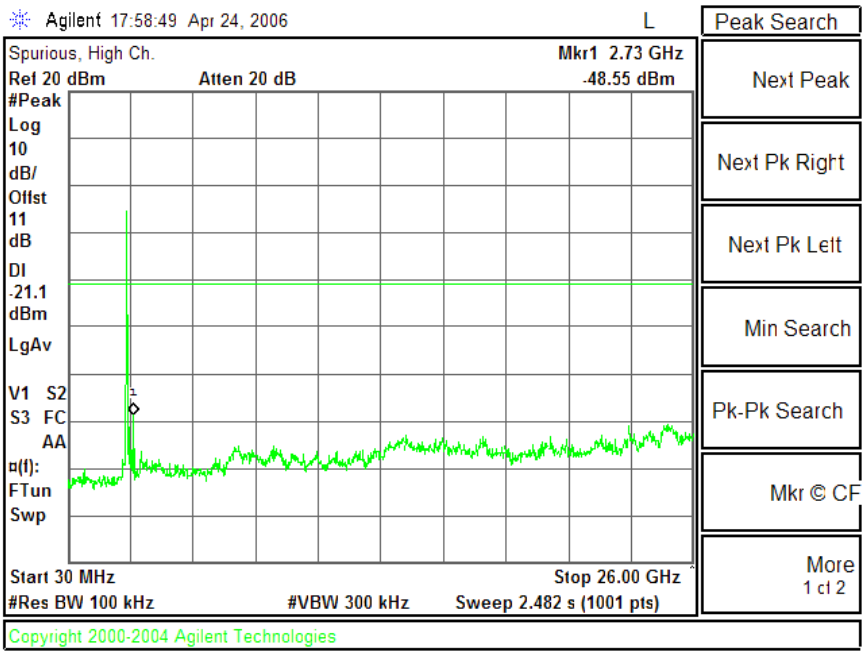
HIGH CH SPURIOUS



HIGH CH BANDEDGE, 2452 MHz

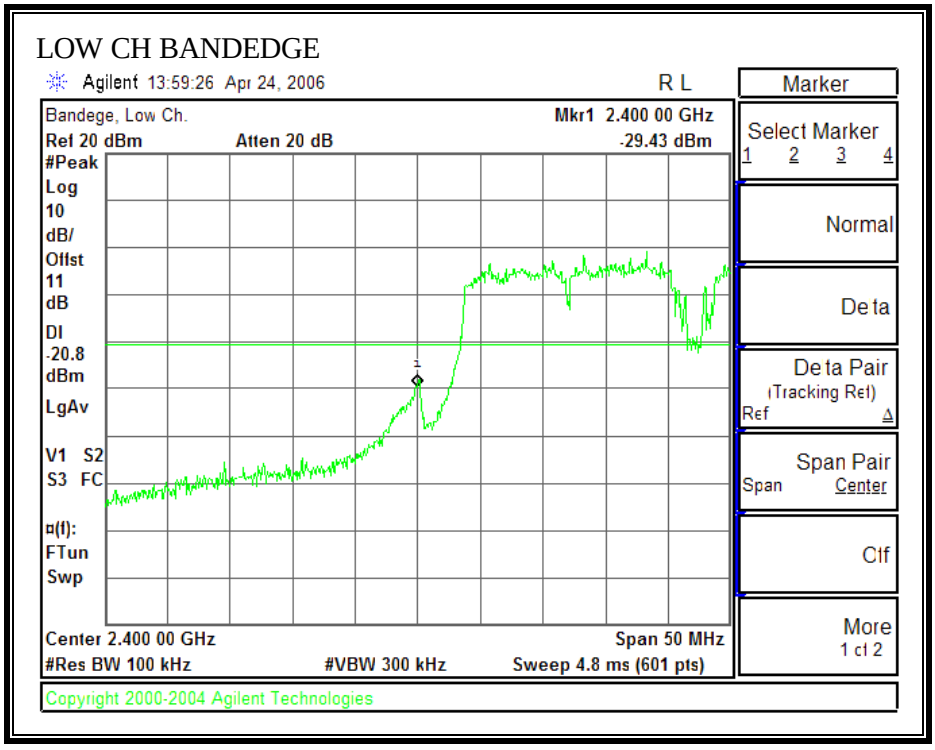


HIGH CH SPURIOUS

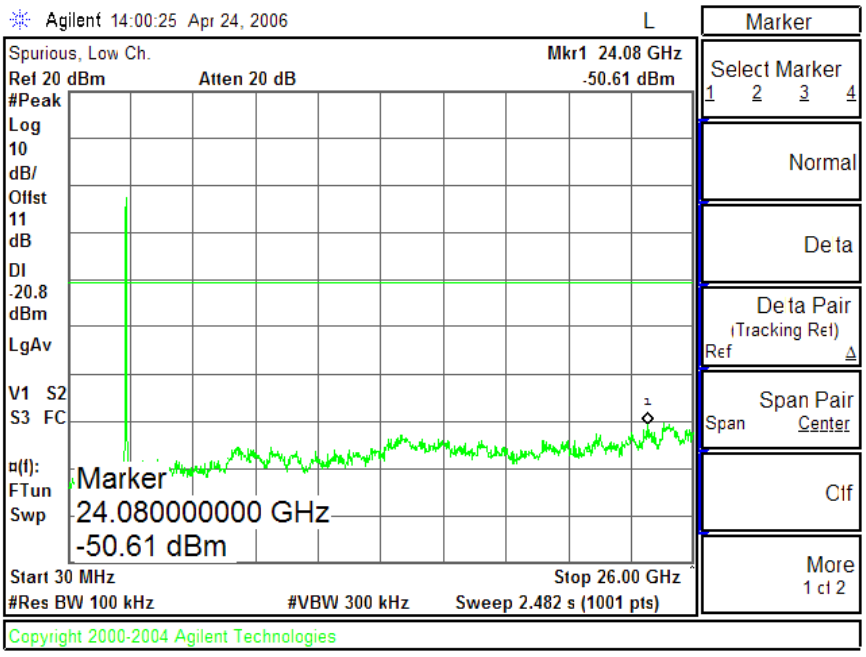


SPURIOUS EMISSIONS, LOW CHANNEL (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)

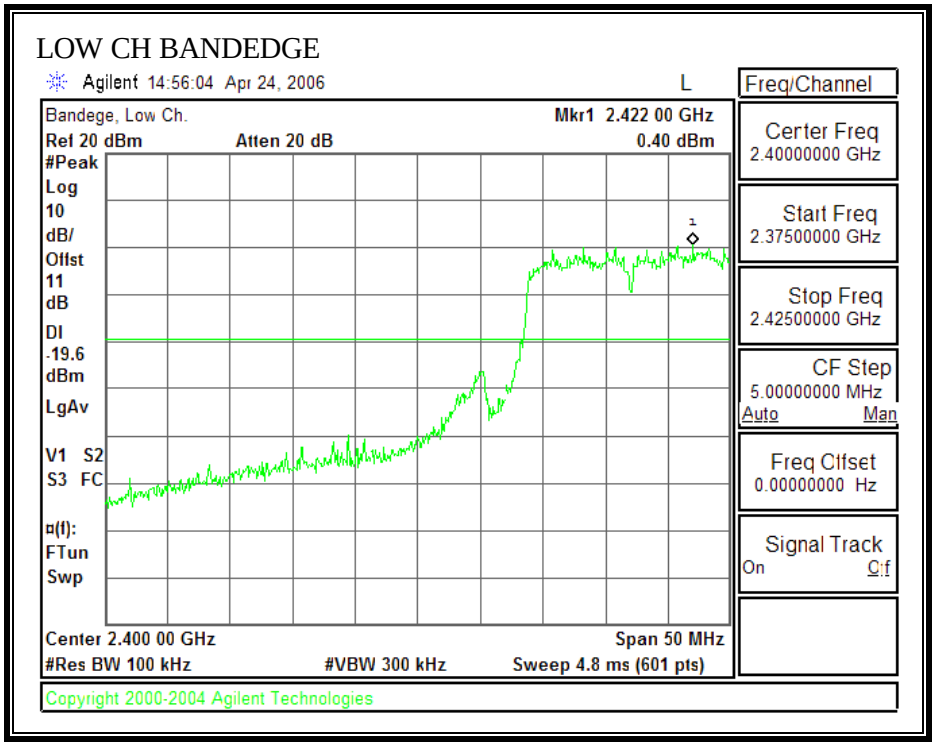
LOW CH BANDEDGE, 2422 MHz



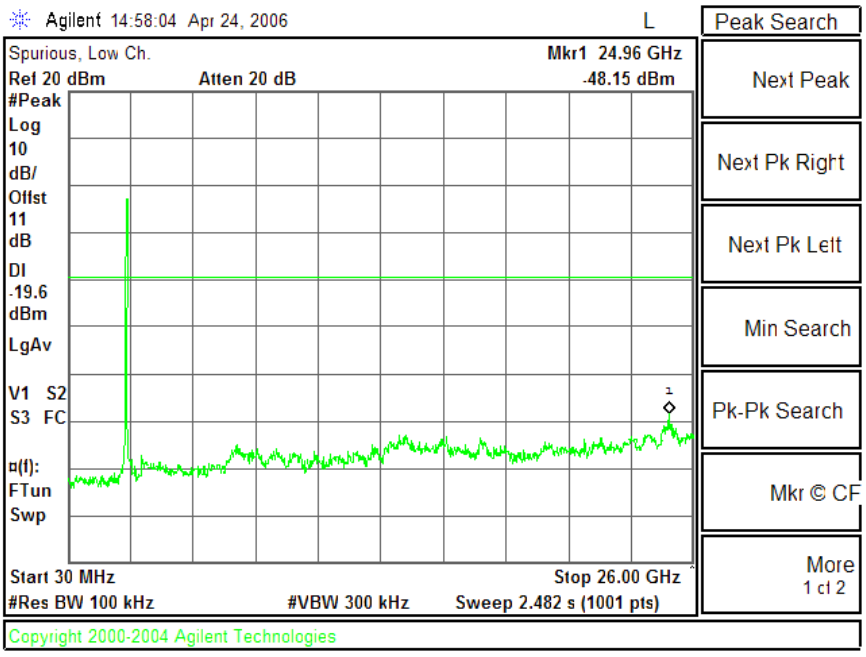
LOW CH SPURIOUS



LOW CH BANDEDGE, 2427 MHz

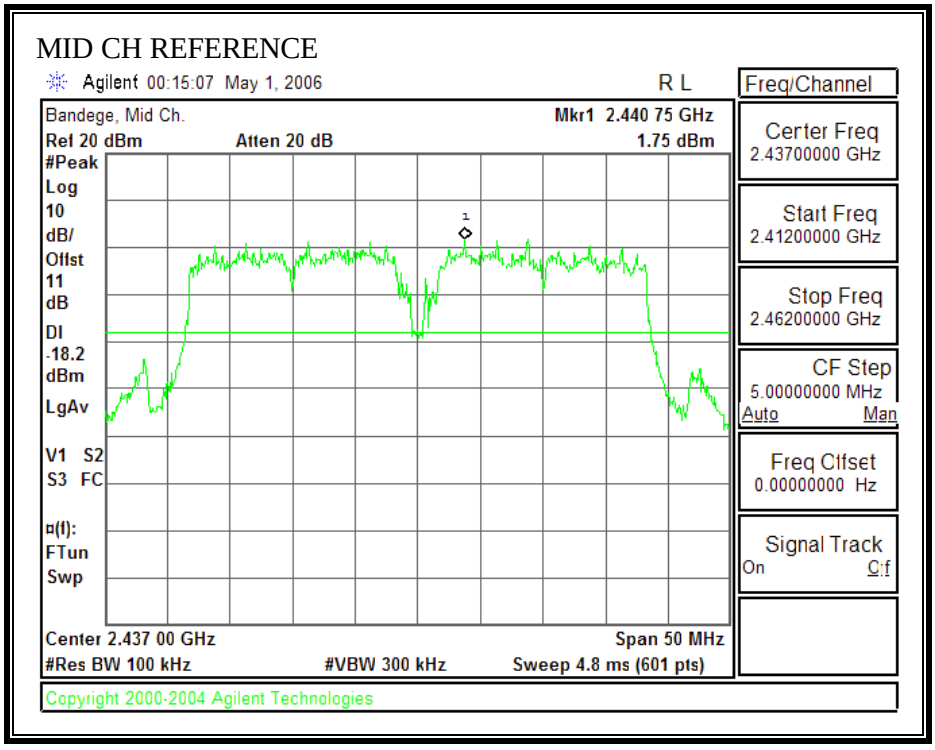


LOW CH SPURIOUS

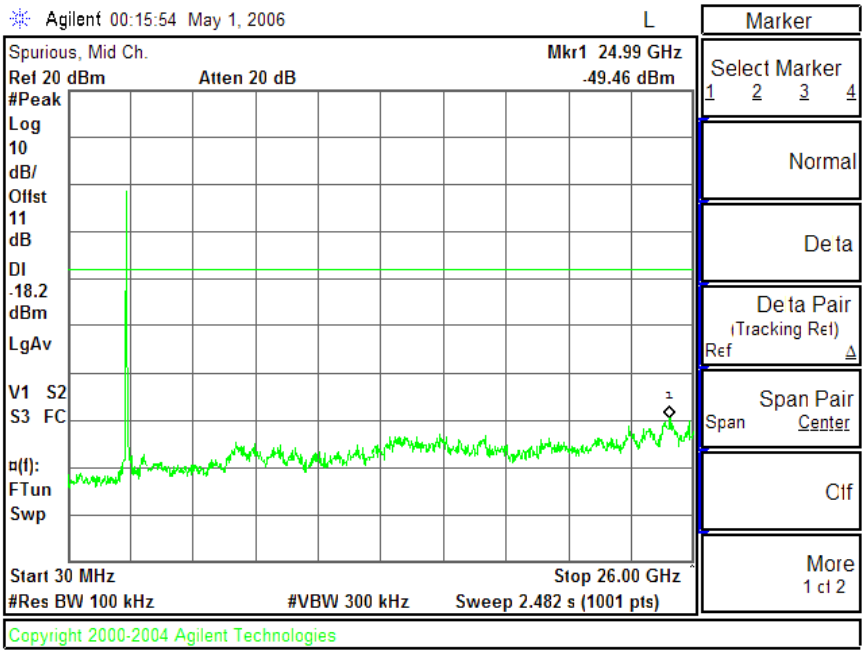


SPURIOUS EMISSIONS, MIDDLE CHANNEL (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)

MID CH BANDEGE, 2437 MHz

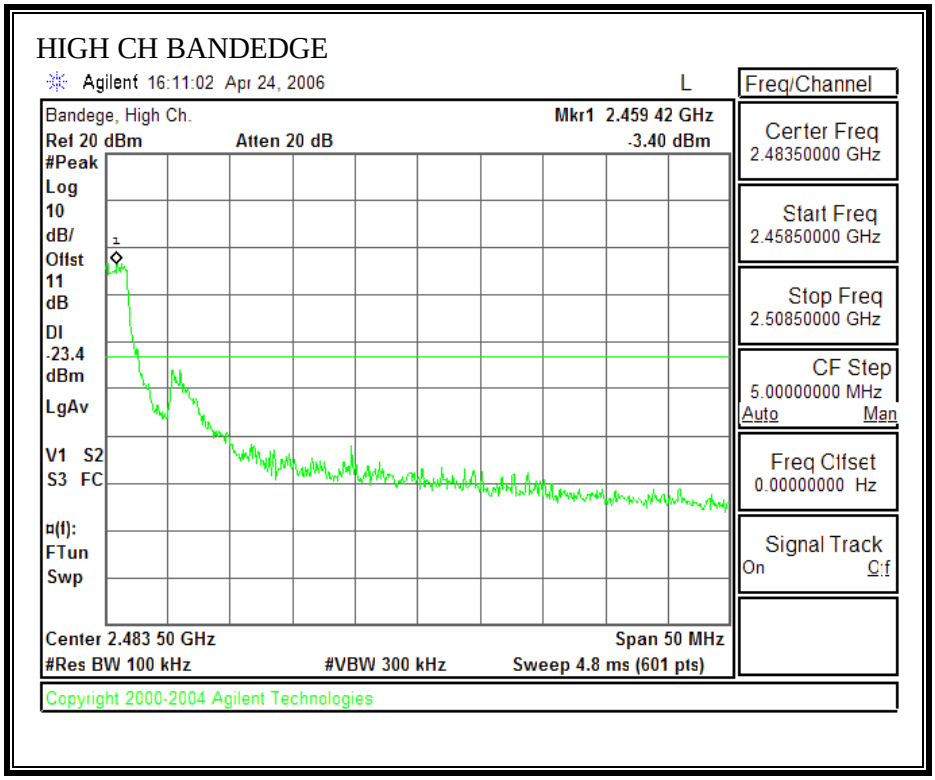


MID CH SPURIOUS

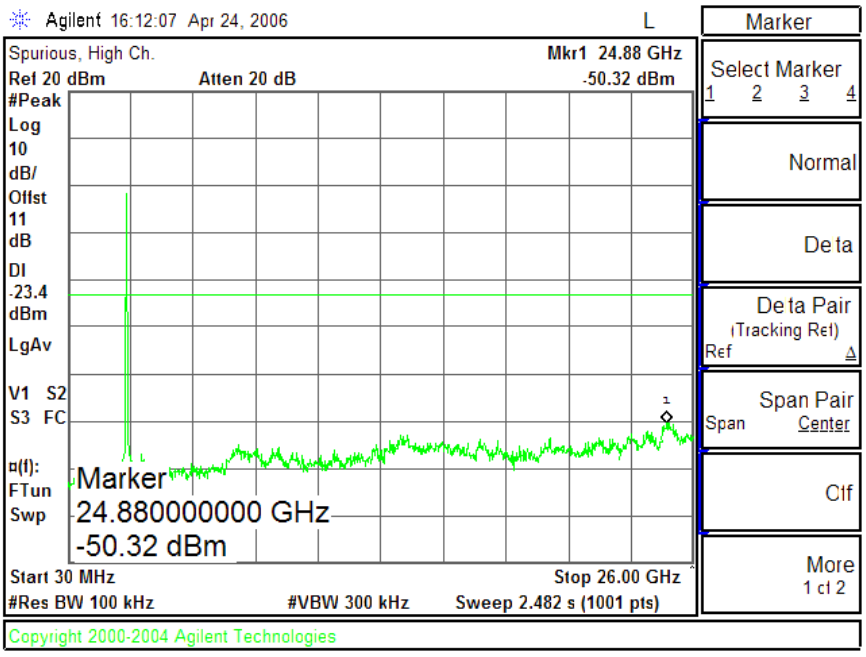


SPURIOUS EMISSIONS, HIGH CHANNEL (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)

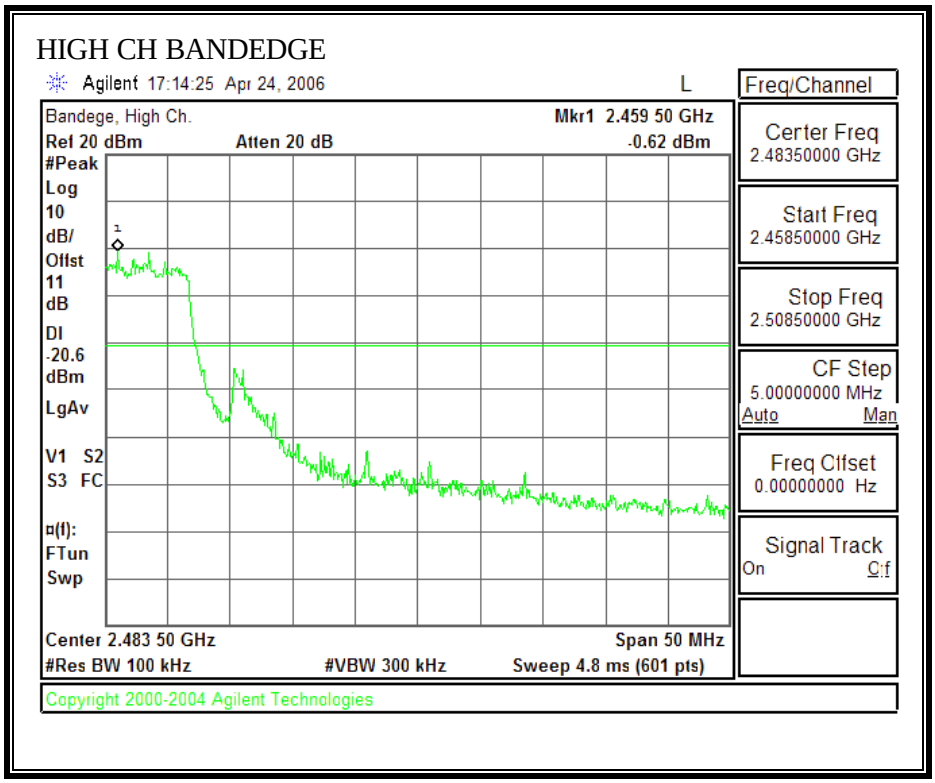
HIGH CH BANDEDGE, 2442 MHz



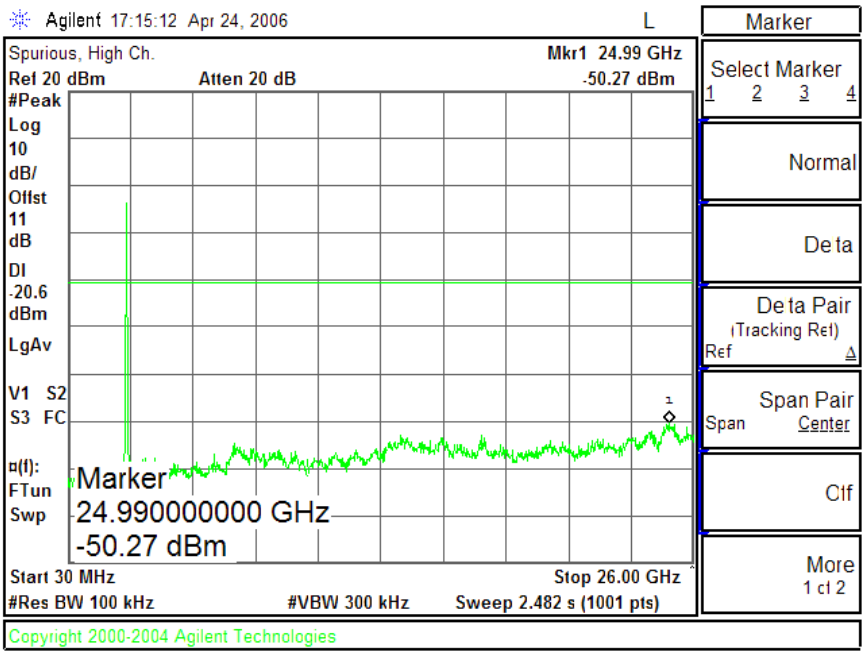
HIGH CH SPURIOUS



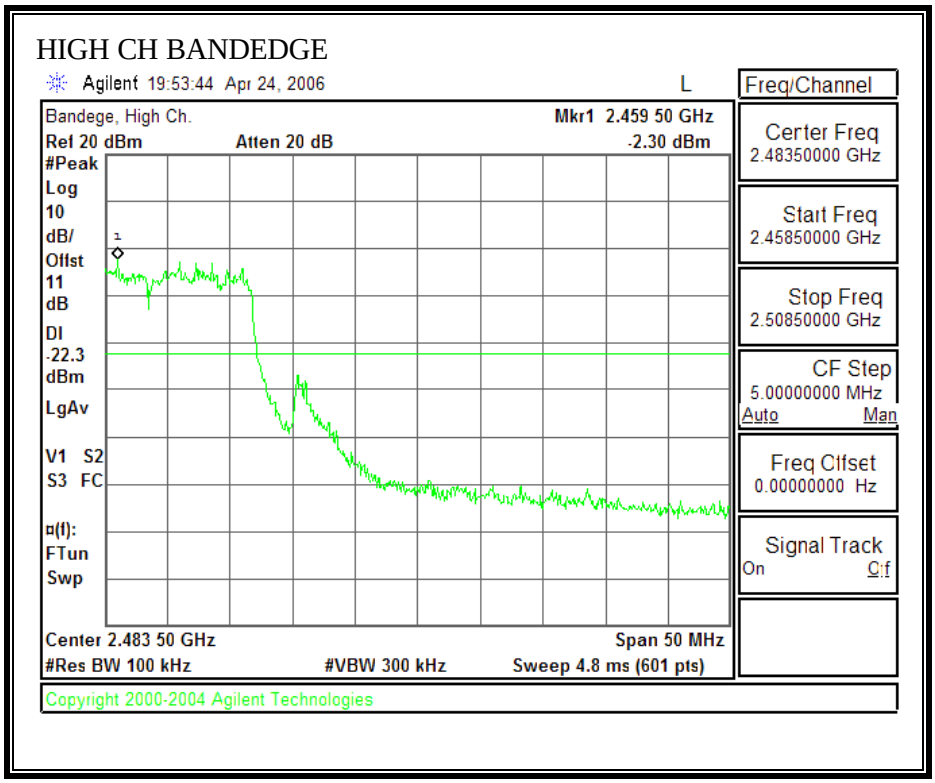
HIGH CH BANDEDGE, 2447 MHz



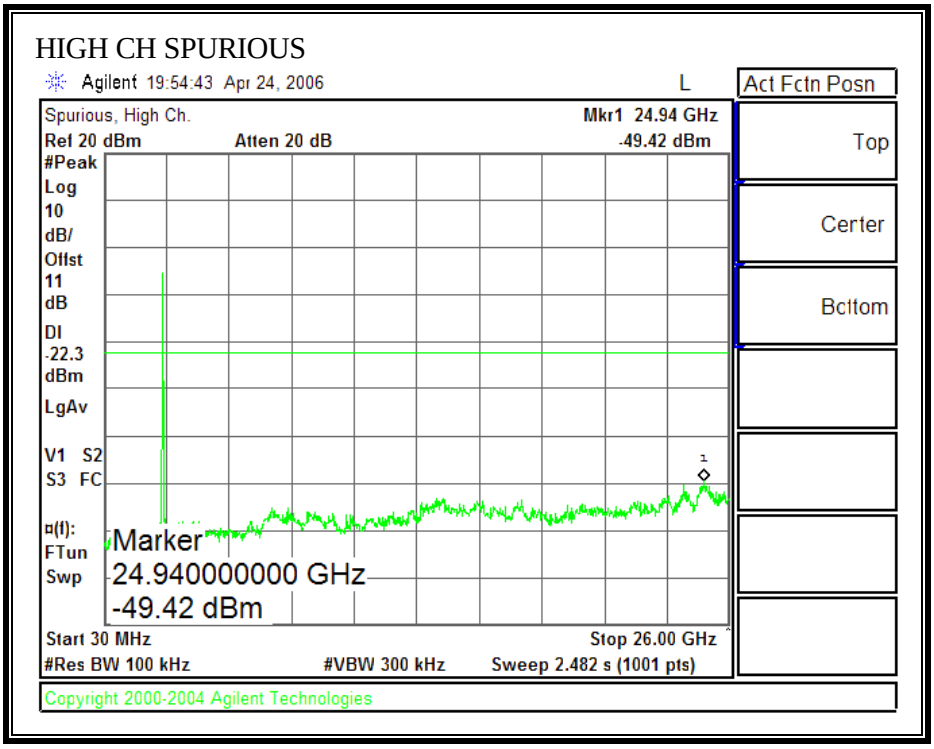
HIGH CH SPURIOUS



HIGH CH BANDEDGE, 2452 MHz



HIGH CH SPURIOUS



7.4. CHANNEL TESTS FOR THE 5725 TO 5850 MHz BAND

7.4.1. 6 dB BANDWIDTH

LIMIT

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

TEST PROCEDURE

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

RESULTS

No non-compliance noted:

6 dB BANDWIDTH

20 MHz Tx BANDWIDTH - CHAIN 0

Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	Minimum Limit (kHz)	Margin (kHz)
Low	5745	15670.00	500	15170
Middle	5785	16170.00	500	15670
High	5825	16000.00	500	15500

20 MHz Tx BANDWIDTH - CHAIN 1

Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	Minimum Limit (kHz)	Margin (kHz)
Low	5745	15670	500	15170
Middle	5785	16250	500	15750
High	5825	15670	500	15170

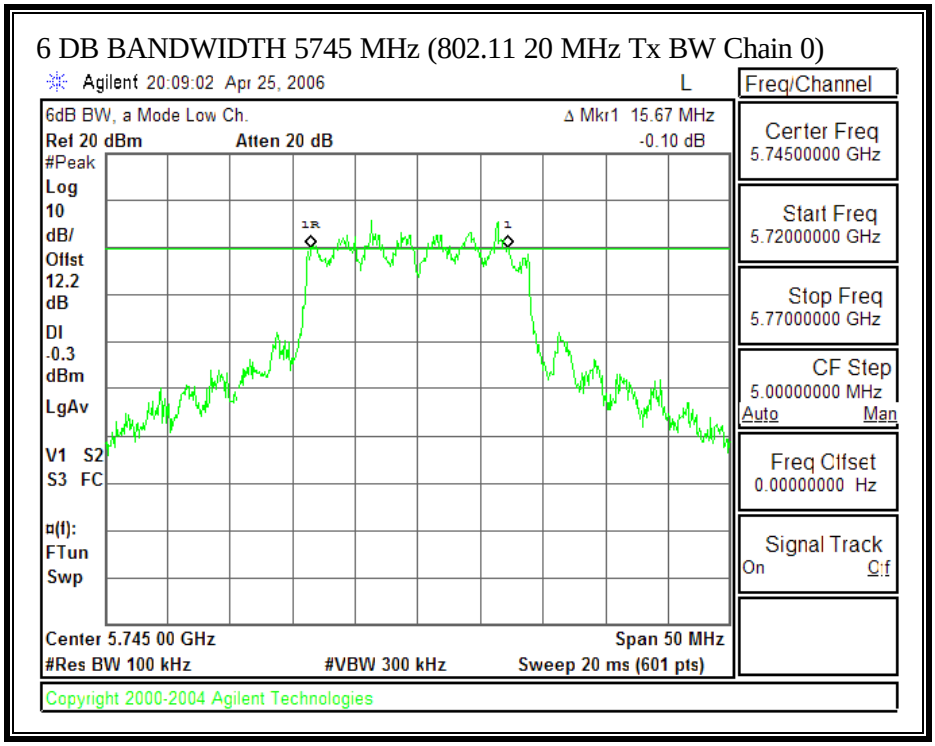
40 MHz Tz BANDWIDTH - CHAIN 0

Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	Minimum Limit (kHz)	Margin (kHz)
High	5755	35670	500	35170
High	5795	35670	500	35170

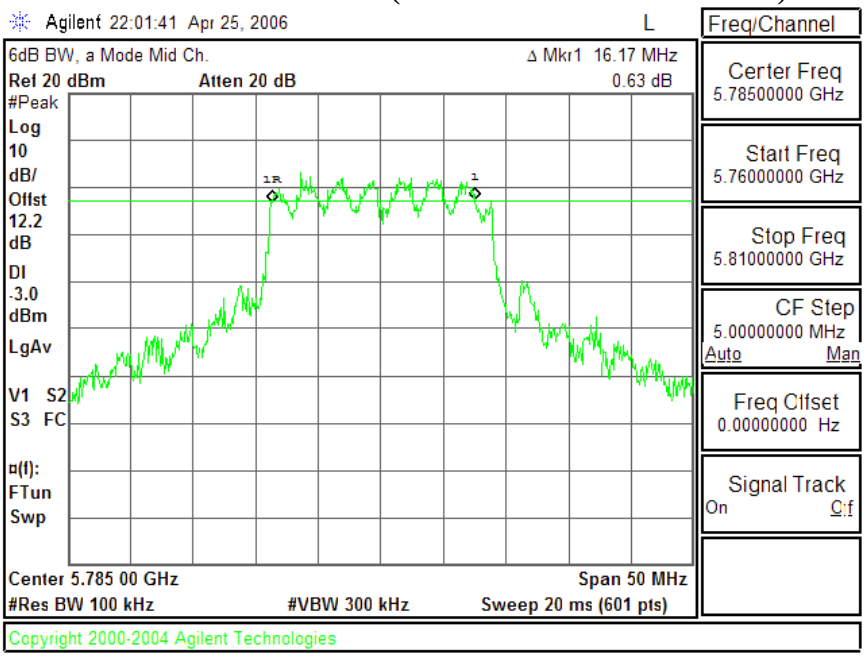
40 MHz Tx BANDWIDTH - CHAIN 1

Channel	Frequency (MHz)	6 dB Bandwidth (kHz)	Minimum Limit (kHz)	Margin (kHz)
High	5755	35080	500	34580
High	5795	35080	500	34580

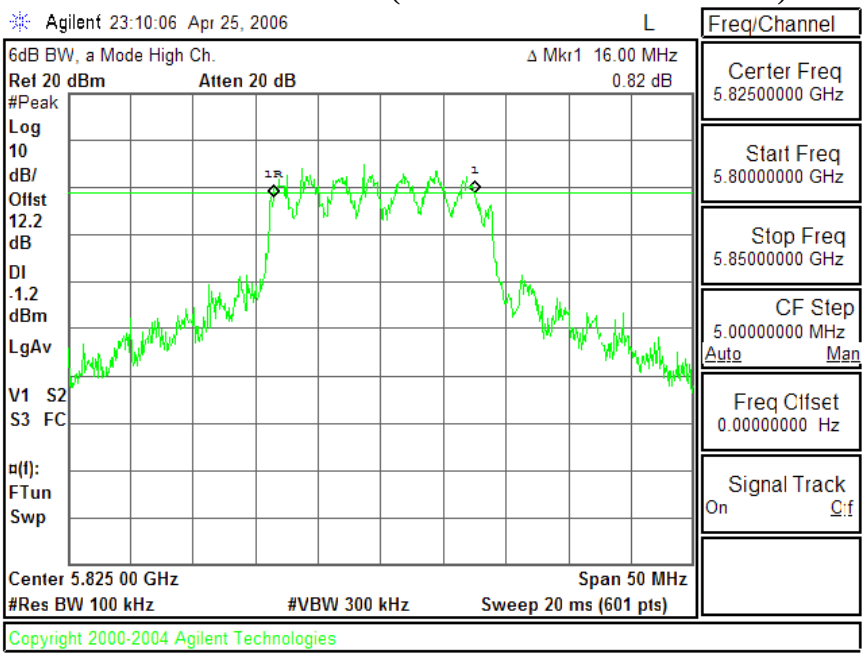
6 DB BANDWIDTH (802.11 - 20 MHz TX BANDWIDTH – CHAIN 0)



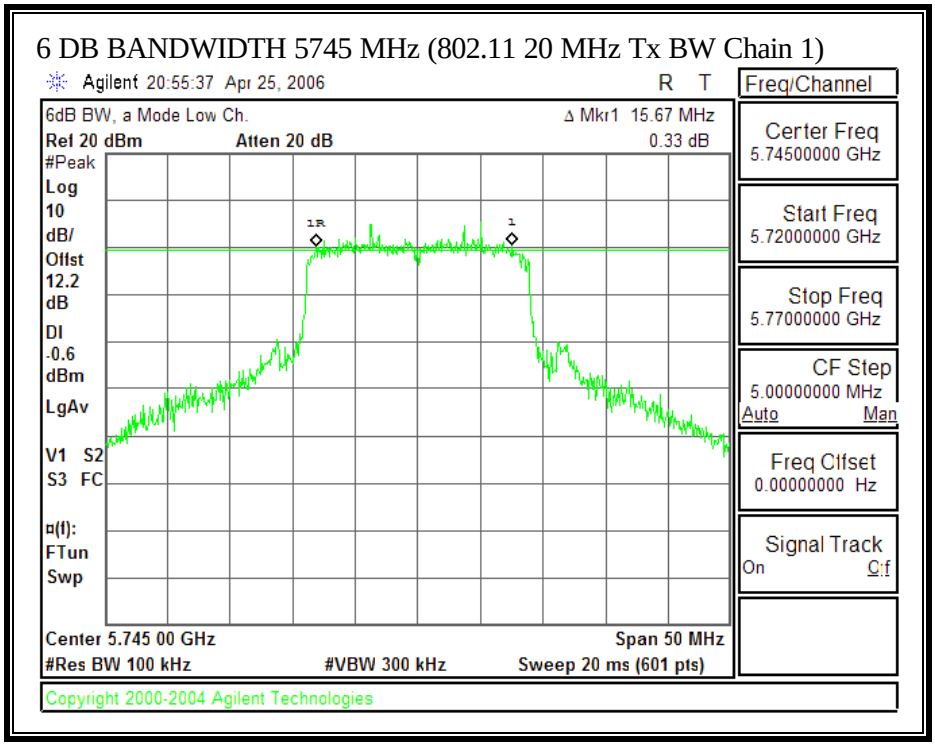
6 DB BANDWIDTH 5785 MHz (802.11 20 MHz Tx BW Chain 0)



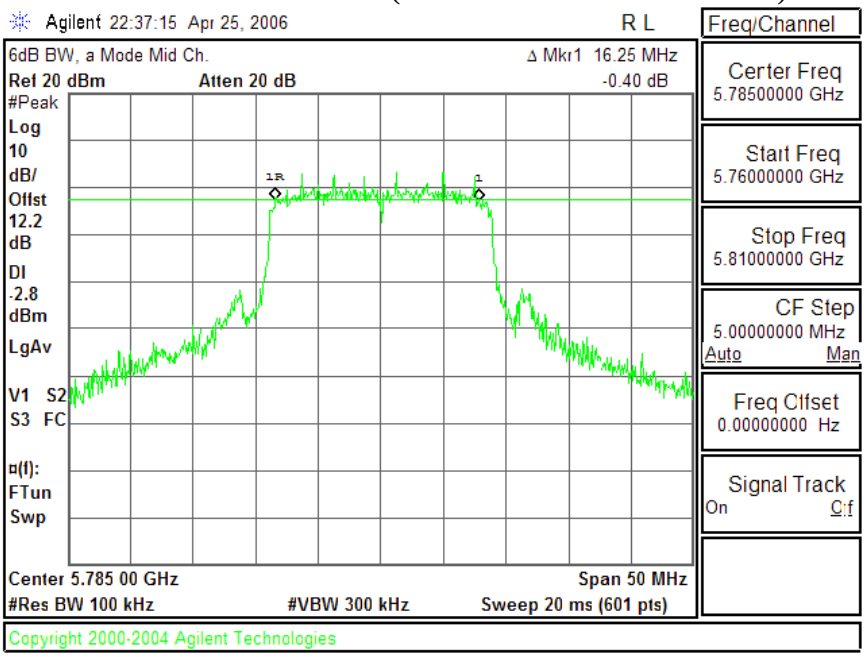
6 DB BANDWIDTH 5825 MHz (802.11 20 MHz Tx BW Chain 0)



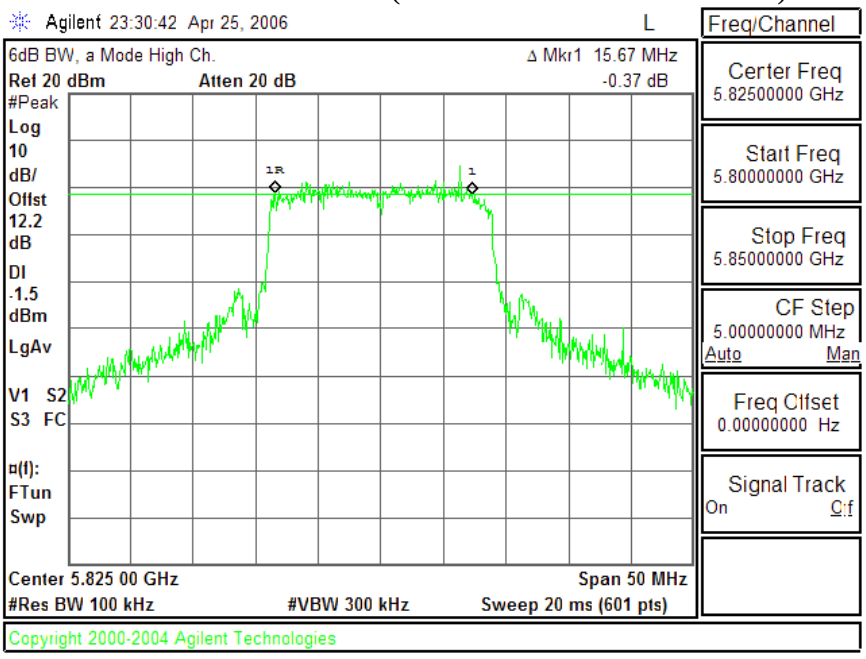
6 DB BANDWIDTH (802.11 - 20 MHz TX BANDWIDTH – CHAIN 1)



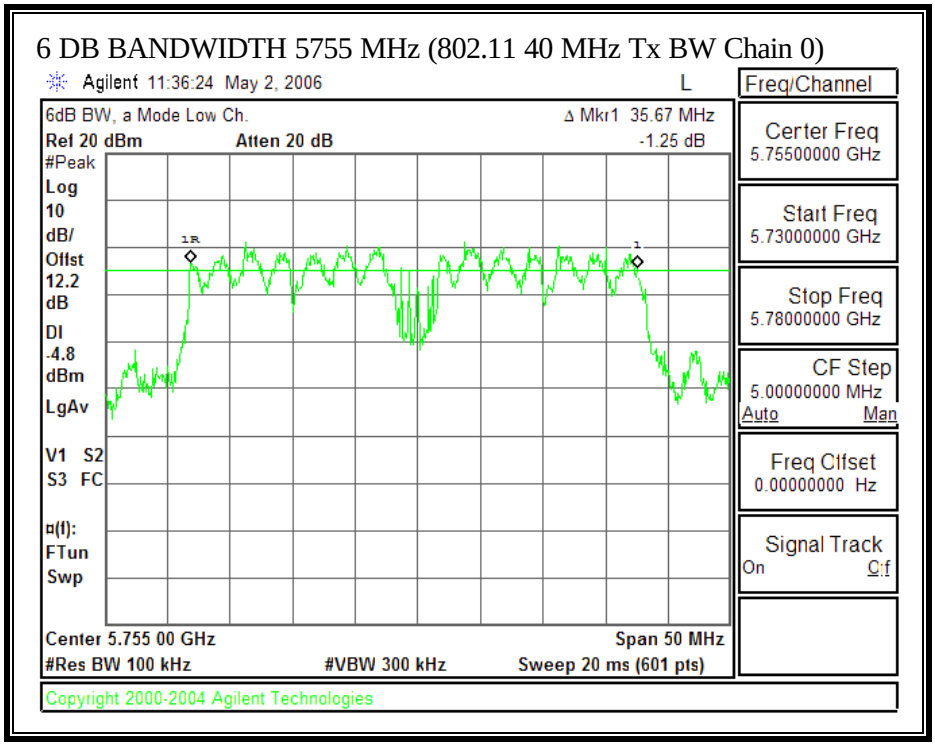
6 DB BANDWIDTH 5785 MHz (802.11 20 MHz Tx BW Chain 1)



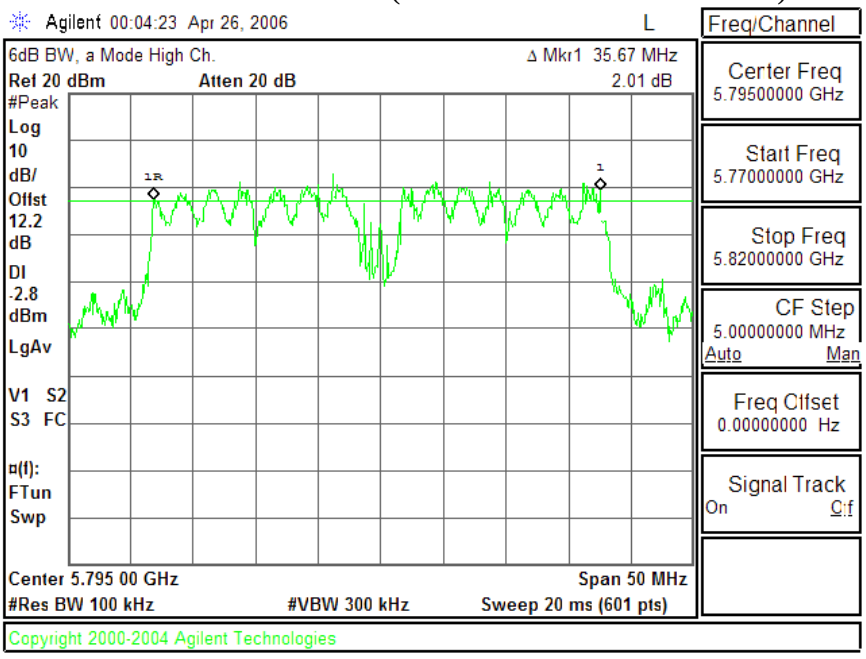
6 DB BANDWIDTH 5825 MHz (802.11 20 MHz Tx BW Chain 1)



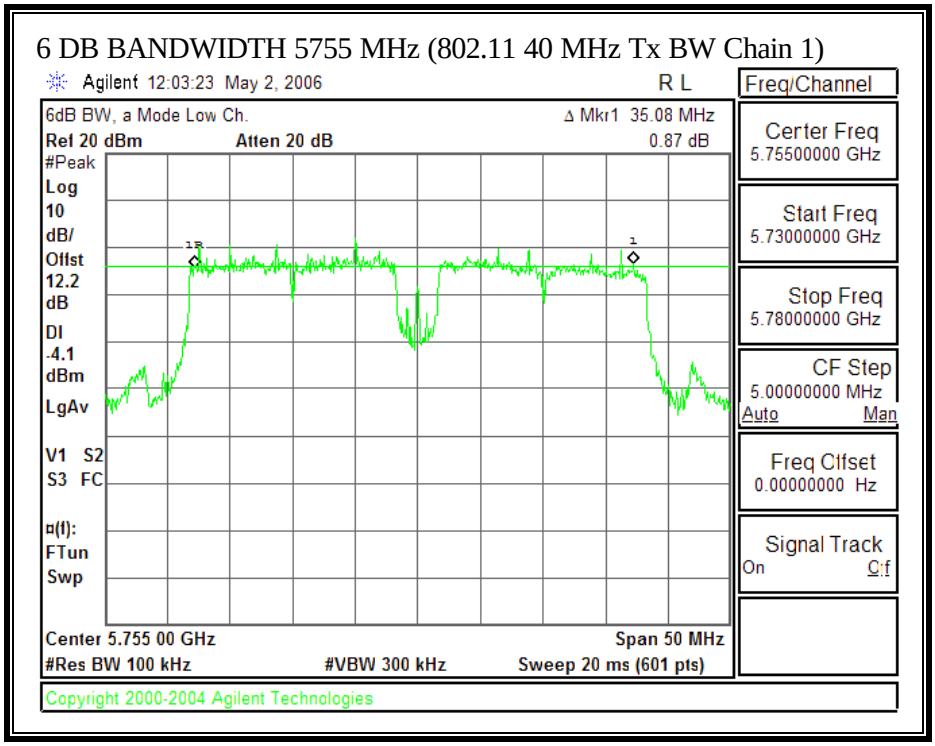
6 DB BANDWIDTH (802.11 - 40 MHz TX BANDWIDTH – CHAIN 0)



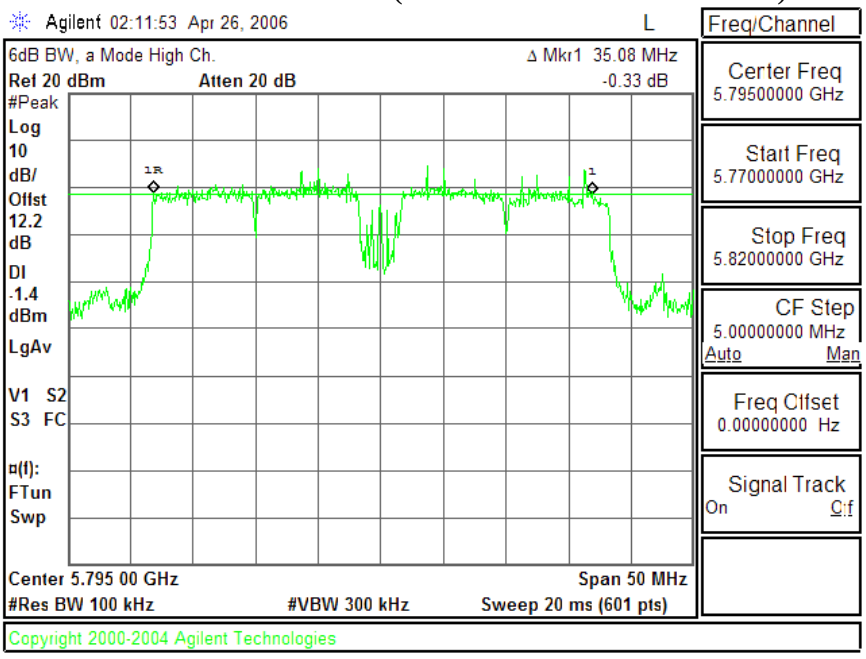
6 DB BANDWIDTH 5795 MHz (802.11 40 MHz Tx BW Chain 0)



6 DB BANDWIDTH (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)



6 DB BANDWIDTH 5795 MHz (802.11 40 MHz Tx BW Chain 1)



7.4.2. 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

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

RESULTS

No non-compliance noted:

99% BANDWIDTH

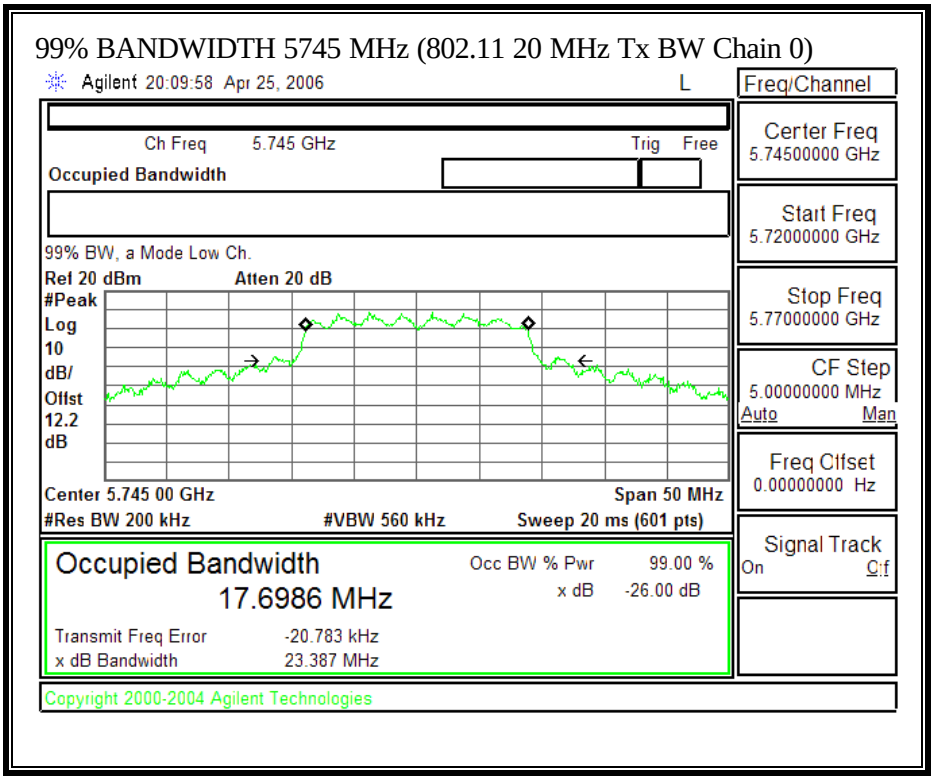
20MHz Tx Bandwidth

Channel	Frequency (MHz)	99% Bandwidth Chain 0 (MHz)	99% Bandwidth Chain 1 (MHz)
Low	5745	17.6986	17.5823
Middle	5785	17.6223	17.5532
High	5825	17.6619	17.5810

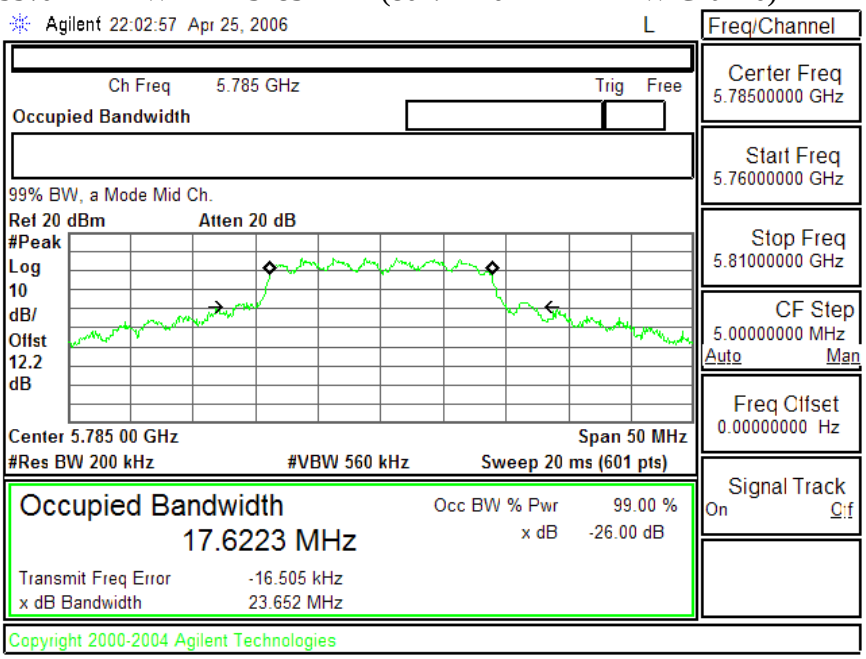
40MHz Tx Bandwidth

Channel	Frequency (MHz)	99% Bandwidth Chain 0 (MHz)	99% Bandwidth Chain 1 (MHz)
Low	5755	36.2790	36.2227
High	5795	36.3715	36.4722

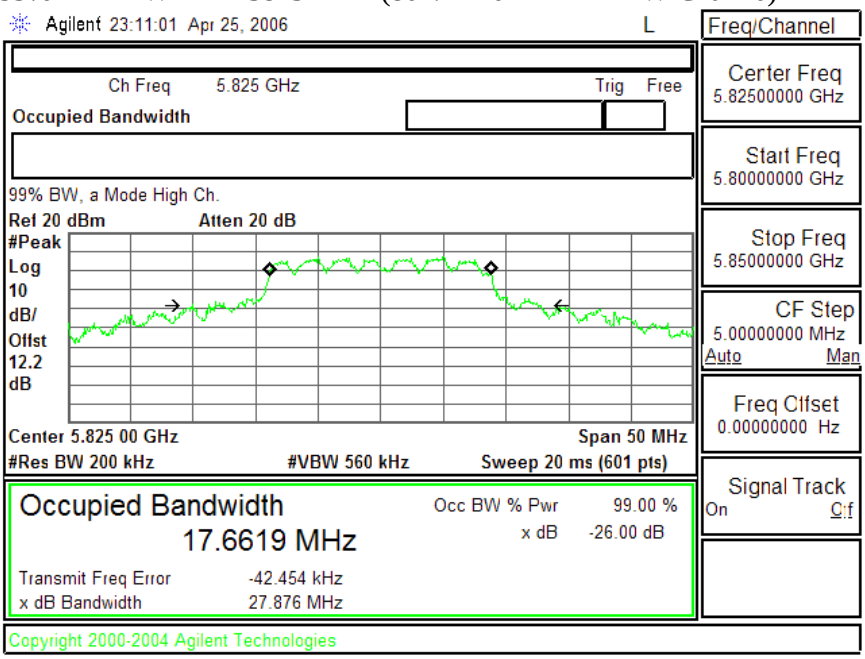
99% BANDWIDTH (802.11 - 20 MHz Tx BANDWIDTH – CHAIN 0)



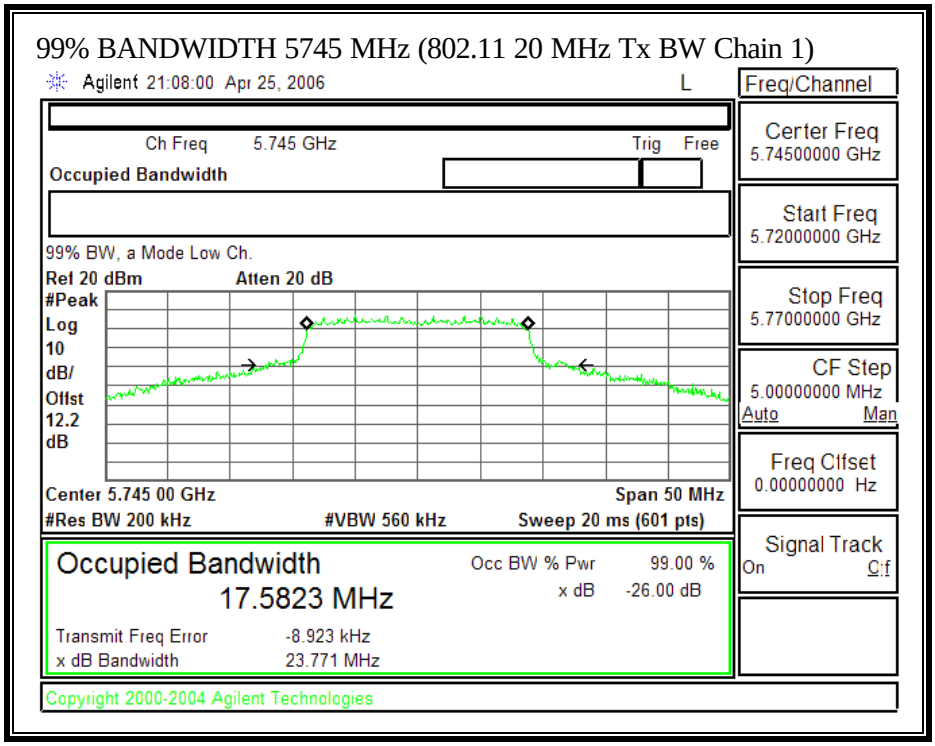
99% BANDWIDTH 5785 MHz (802.11 20 MHz Tx BW Chain 0)



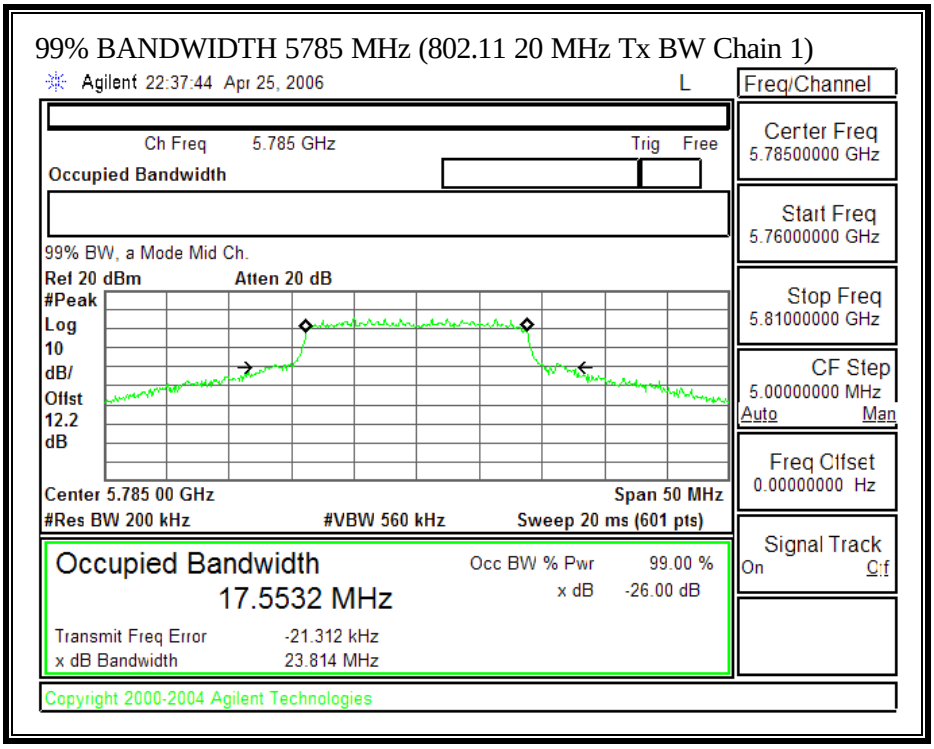
99% BANDWIDTH 5825 MHz (802.11 20 MHz Tx BW Chain 0)



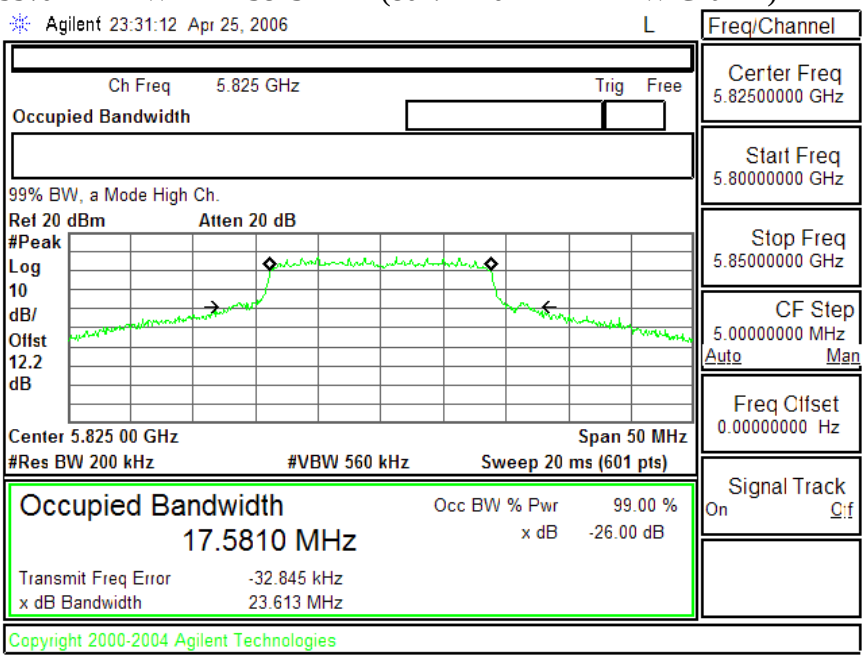
99% BANDWIDTH (802.11 - 20 MHz Tx BANDWIDTH – CHAIN 1)



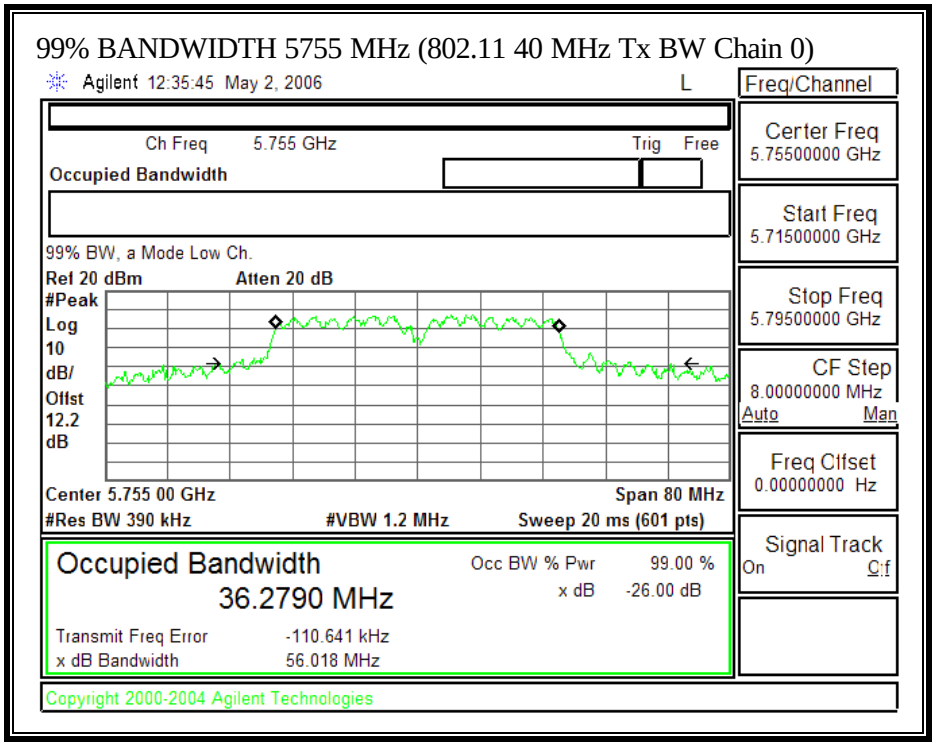
99% BANDWIDTH 5785 MHz (802.11 20 MHz Tx BW Chain 1)



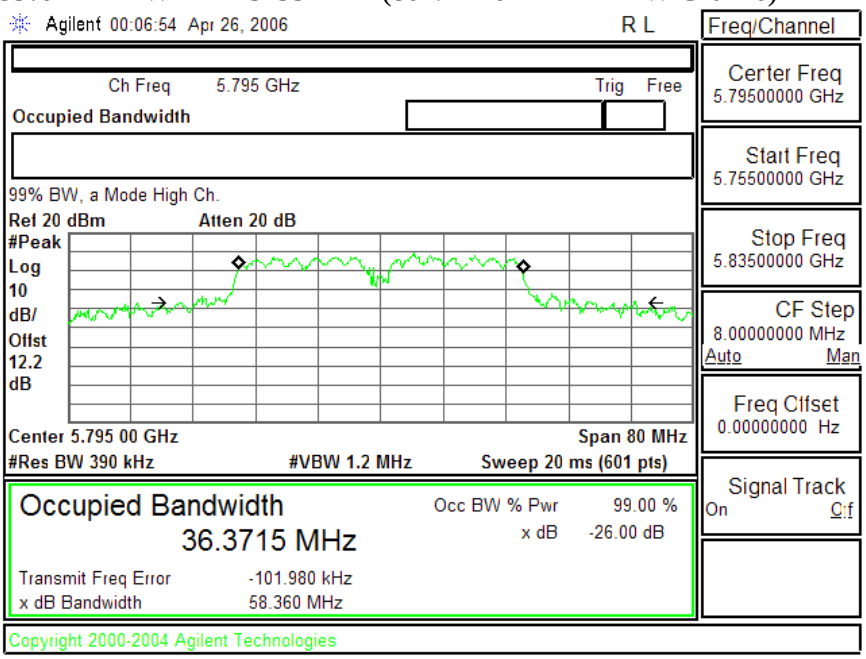
99% BANDWIDTH 5825 MHz (802.11 20 MHz Tx BW Chain 1)



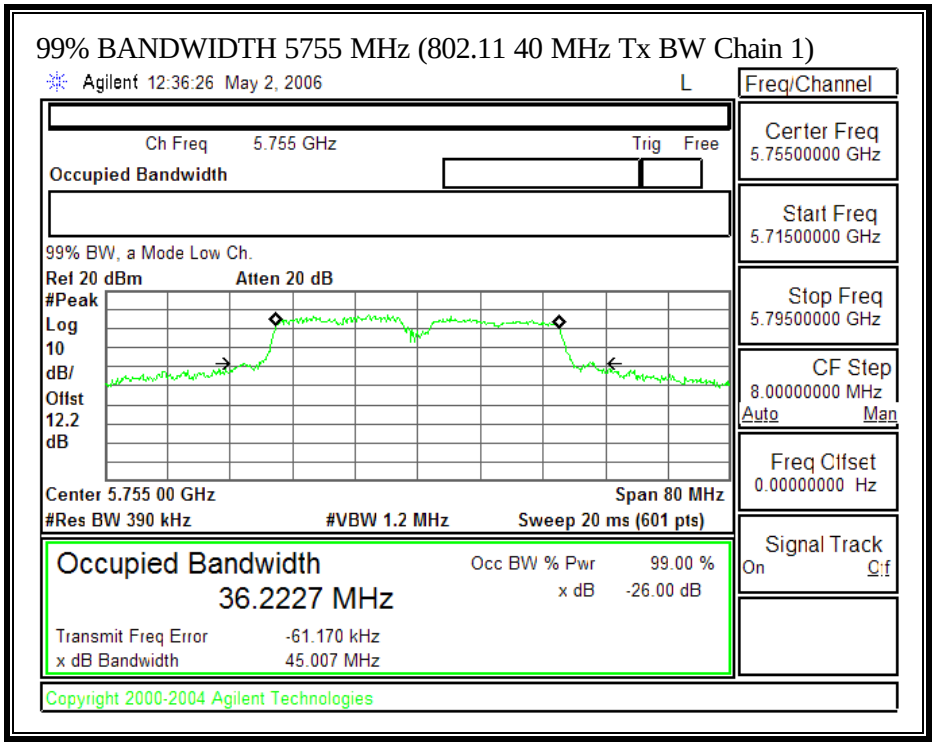
99% BANDWIDTH (802.11 - 40 MHz TX BANDWIDTH – CHAIN 0)



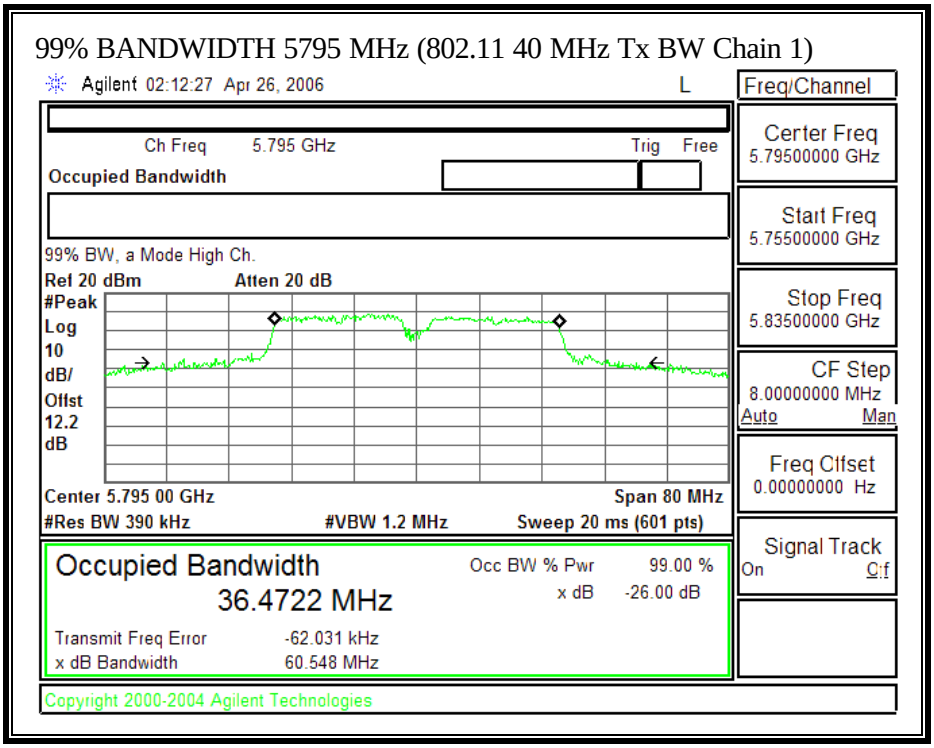
99% BANDWIDTH 5795 MHz (802.11 40 MHz Tx BW Chain 0)



99% BANDWIDTH (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)



99% BANDWIDTH 5795 MHz (802.11 40 MHz Tx BW Chain 1)



7.4.3. PEAK OUTPUT POWER

PEAK POWER LIMIT

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

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

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz , and 5725-5850 MHz bands: 1 watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

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

TEST PROCEDURE

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

RESULTS,

The maximum antenna gain is 6.2 dBi for other than fixed, point-to-point operations, therefore the limit is 29.8dBm.

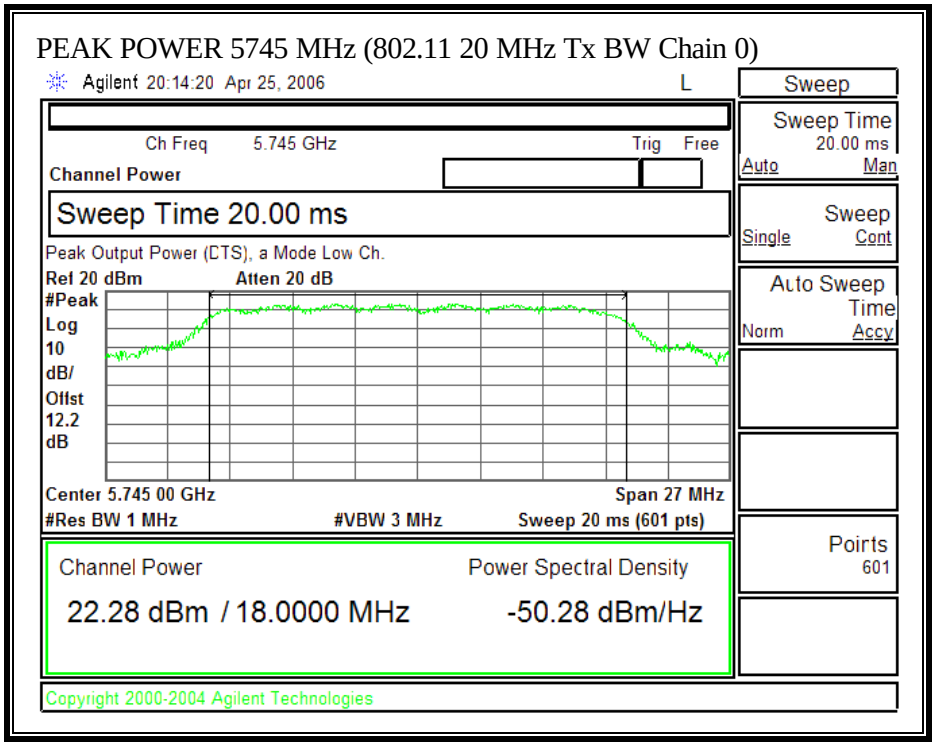
Total peak power calculation formula: 10 log (10^ (Pchain0 / 10) + 10^ (Pchain1 / 10))

Note: Pchain 0 and Pchain1 are in dBm

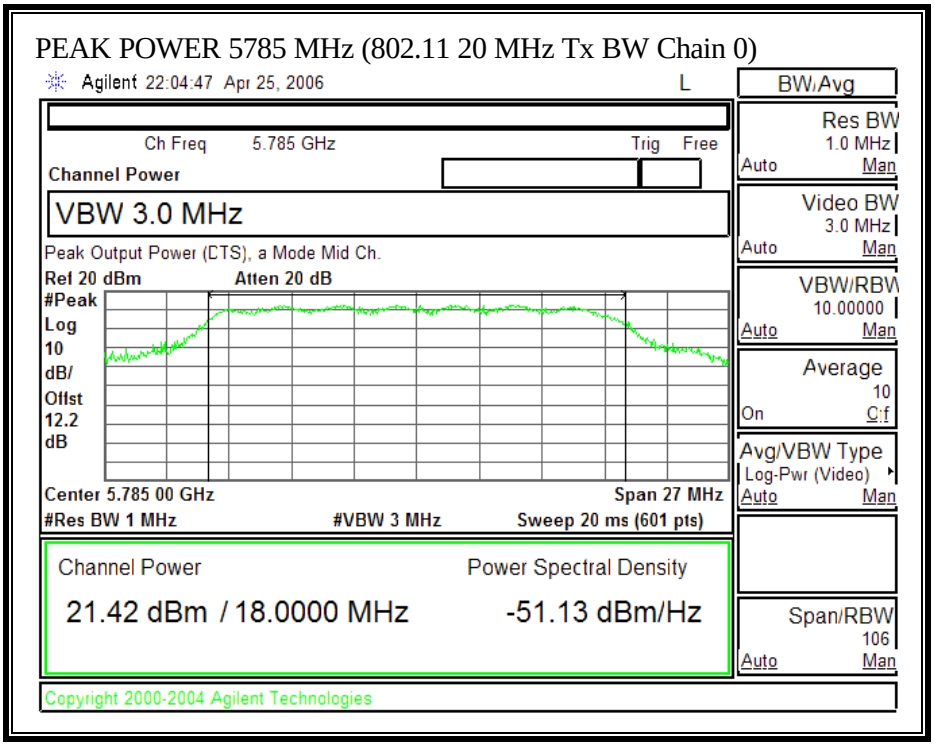
No non-compliance noted:

Channel	Frequency (MHz)	Peak Power Chain 0 (dBm)	Peak Power Chain 1 (dBm)	Peak Power Total (dBm)	Limit (dBm)	Margin (dB)
20 MHz TX BANDWIDTH						
Low	5745	22.28	22.11	25.21	29.8	-4.59
Middle	5785	21.42	21.52	24.48	29.8	-5.32
High	5825	22.17	22.56	25.38	29.8	-4.42
40 MHz TX BANDWIDTH						
Low	5755	21.42	21.54	24.49	29.8	-5.31
High	5795	22.41	23.66	26.09	29.8	-3.71

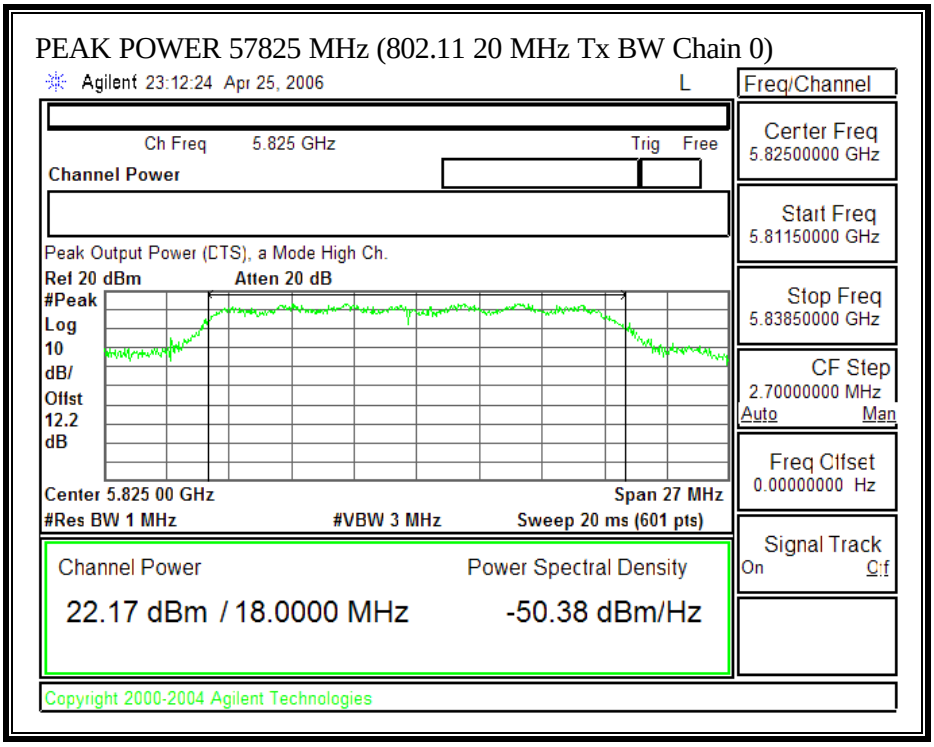
OUTPUT POWER (802.11 - 20 MHz TX BANDWIDTH – CHAIN 0)



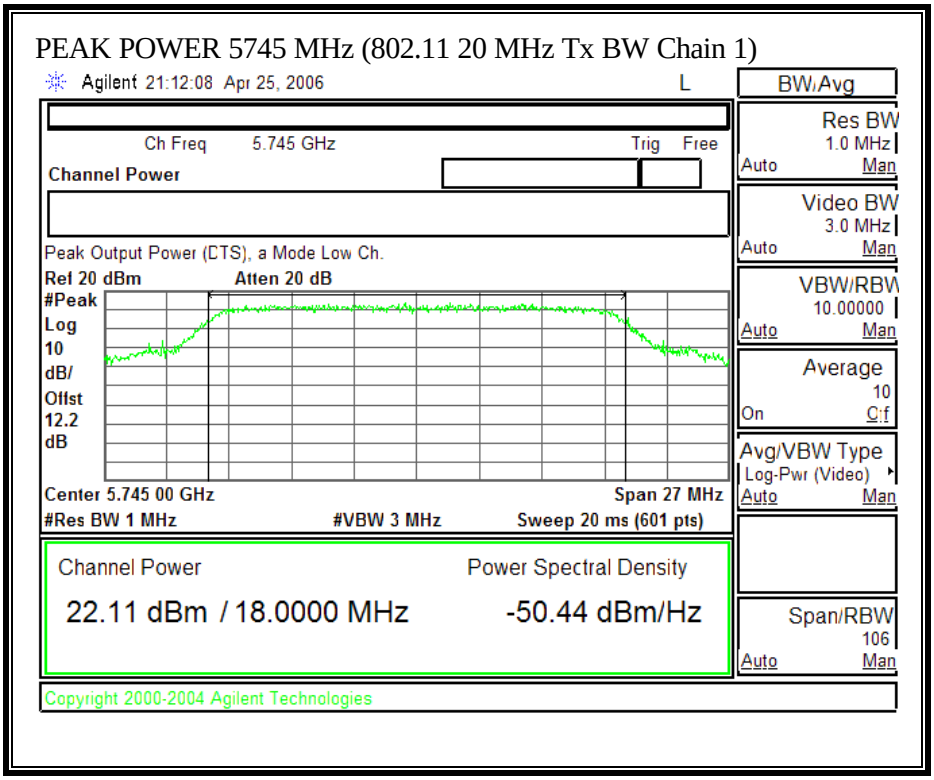
PEAK POWER 5785 MHz (802.11 20 MHz Tx BW Chain 0)



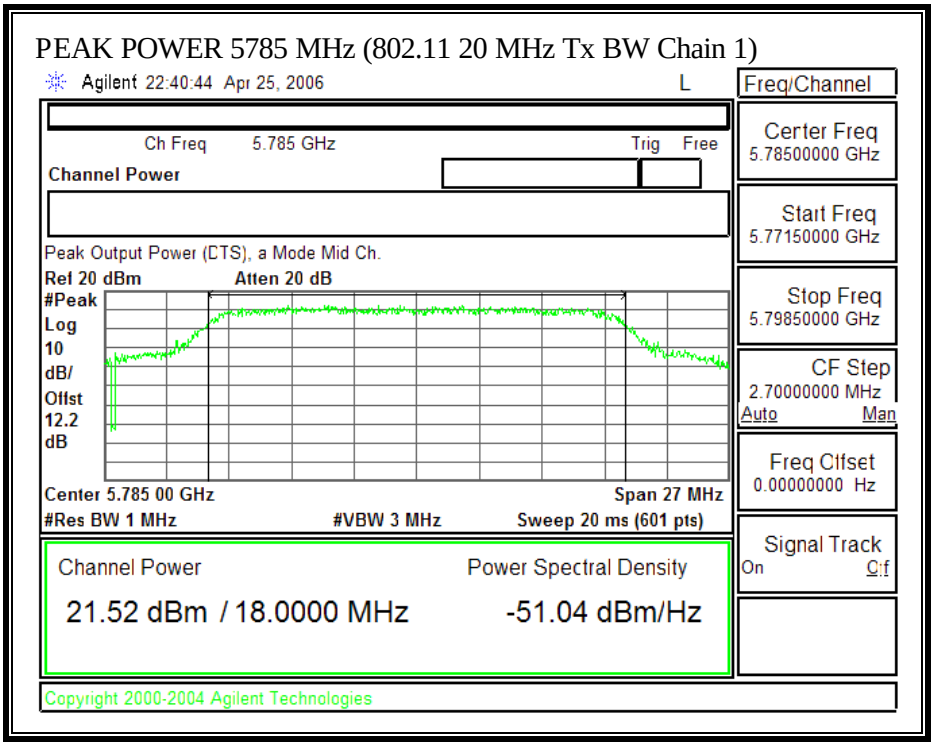
PEAK POWER 57825 MHz (802.11 20 MHz Tx BW Chain 0)



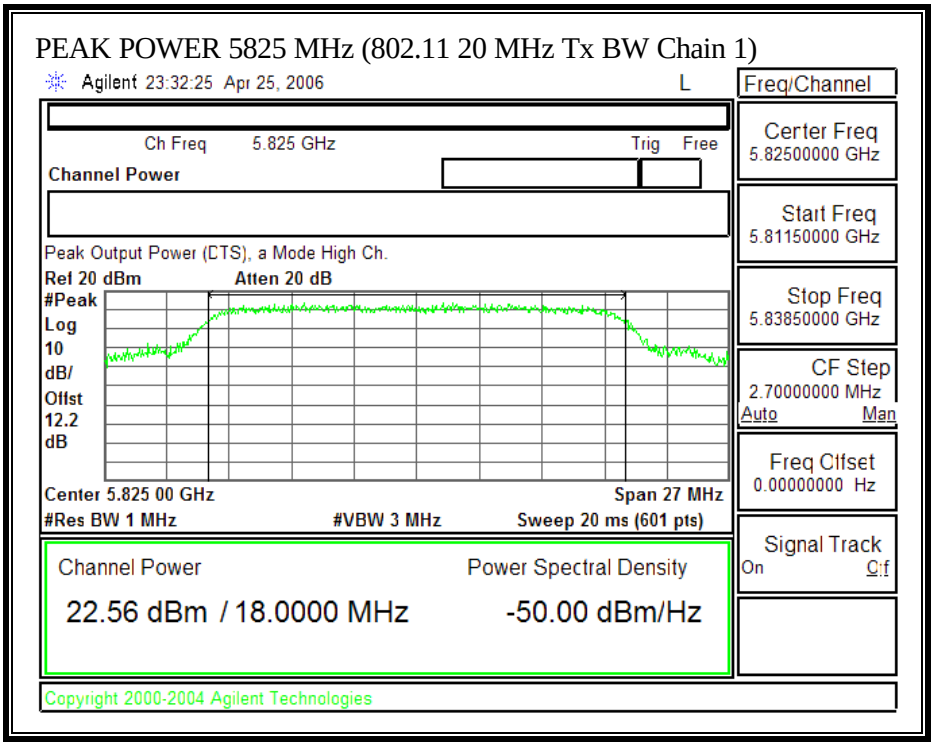
OUTPUT POWER (802.11 - 20 MHz TX BANDWIDTH – CHAIN 1)



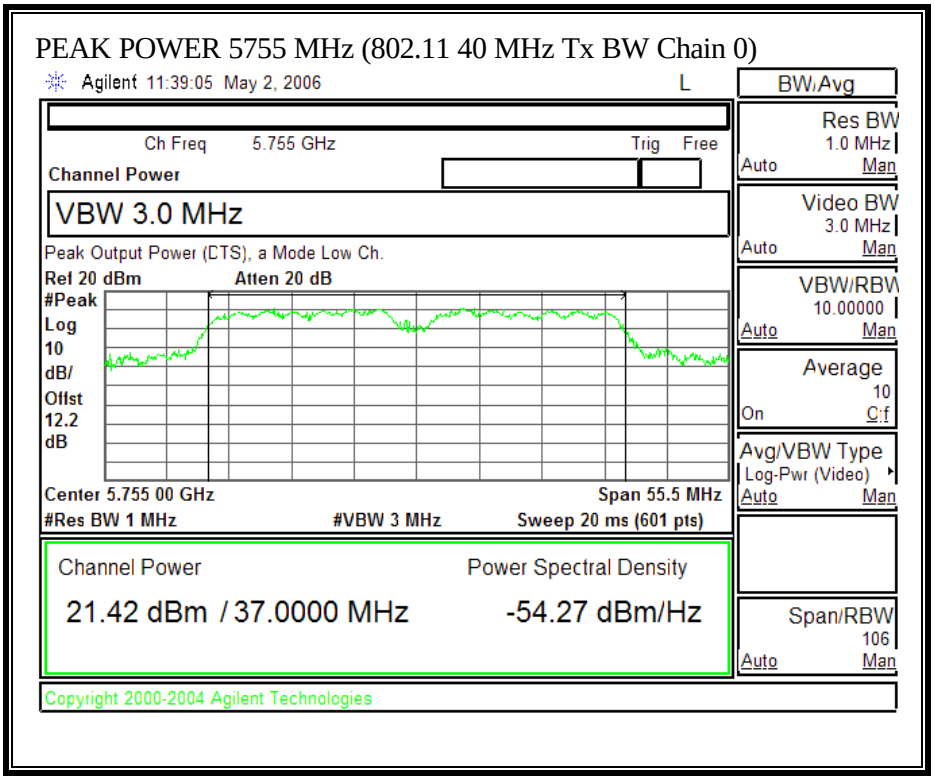
PEAK POWER 5785 MHz (802.11 20 MHz Tx BW Chain 1)



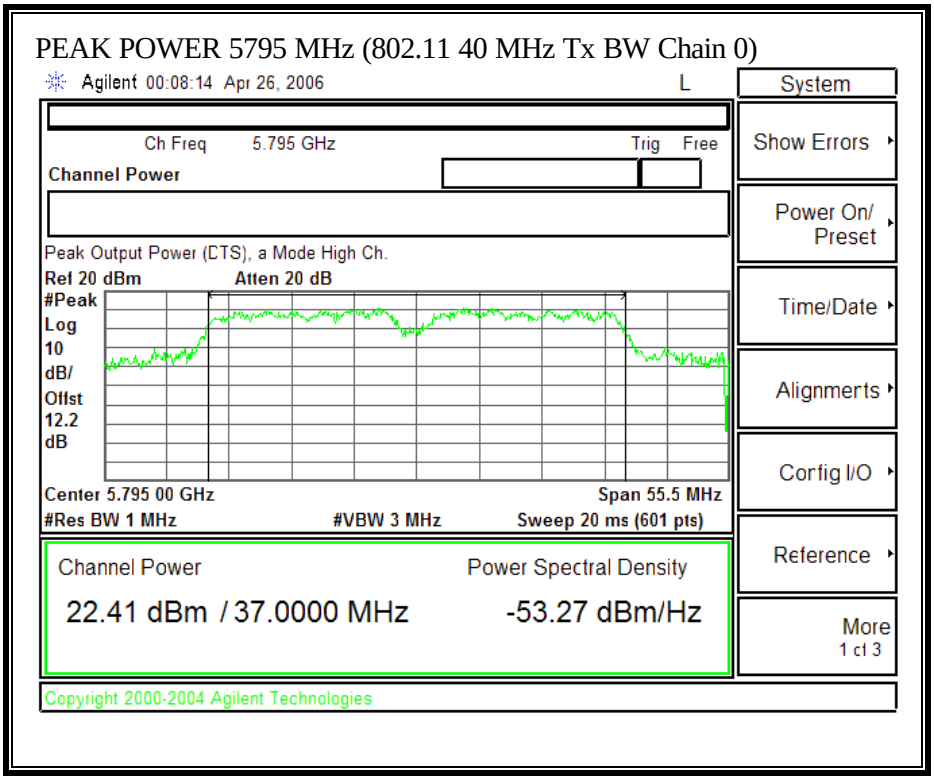
PEAK POWER 5825 MHz (802.11 20 MHz Tx BW Chain 1)



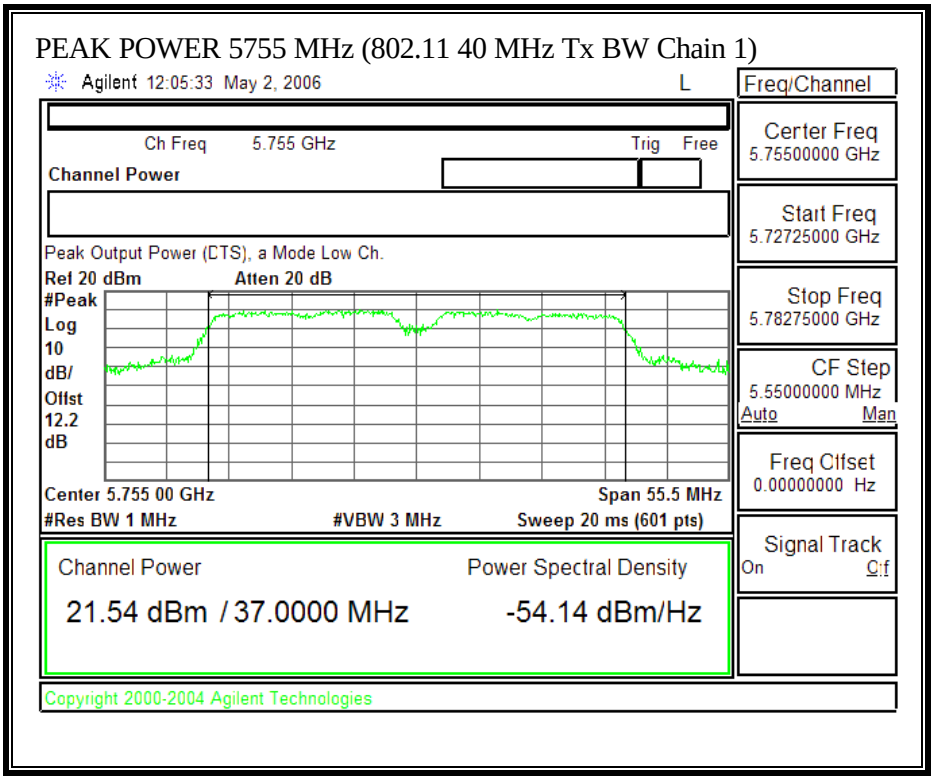
OUTPUT POWER (802.11 - 40 MHz TX BANDWIDTH – CHAIN 0)



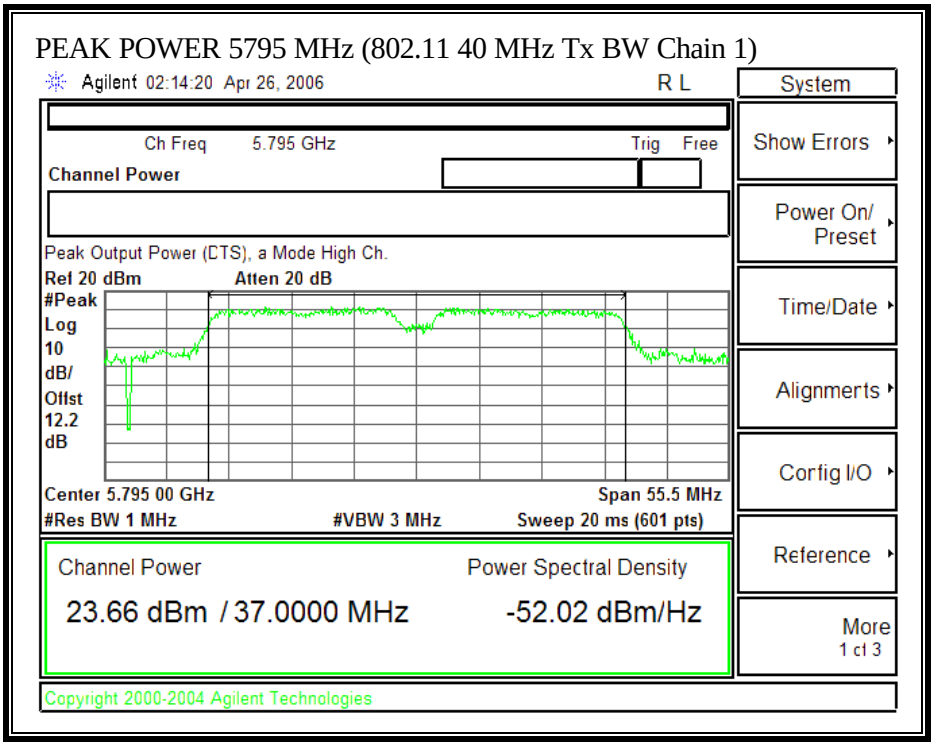
PEAK POWER 5795 MHz (802.11 40 MHz Tx BW Chain 0)



OUTPUT POWER (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)



PEAK POWER 5795 MHz (802.11 40 MHz Tx BW Chain 1)



7.4.4. MAXIMUM PERMISSIBLE EXPOSURE

LIMITS

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

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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

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

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

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

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

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

CALCULATIONS

Given

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

and

$S = E \wedge 2 / 3770$

where

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

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

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

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

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

yields

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

where

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

Substituting the logarithmic form of power and gain using:

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

yields

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

where

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

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

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

LIMITS

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

RESULTS

No non-compliance noted

Mode	MPE Distance (cm)	Peak Power Chain 0 (dBm)	Peak Power Chain 1 (dBm)	Total Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
20MHz TX BW	20.0	22.17	22.56	25.38	6.20	0.29
40MHz TX BW	20.0	22.41	23.66	26.09	6.20	0.34

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

7.4.5. AVERAGE POWER

AVERAGE POWER LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

No non-compliance noted:

The cable assembly insertion loss of 12.2 dB (including 10 dB pad and 2.2 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

20 MHz TX BANDWIDTH

Channel	Frequency (MHz)	Power Chain 0 (dBm)	Power Chain 1 (dBm)
149	5745	15.30	15.35
157	5785	15.24	15.30
165	5825	15.30	15.30

40 MHz TX BANDWIDTH

Channel	Frequency (MHz)	Power Chain 0 (dBm)	Power Chain 1 (dBm)
157	5795	15.30	15.40

7.4.6. PEAK POWER SPECTRAL DENSITY

LIMIT

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

TEST PROCEDURE

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

RESULTS

No non-compliance noted:

20 MHz TX BANDWIDTH

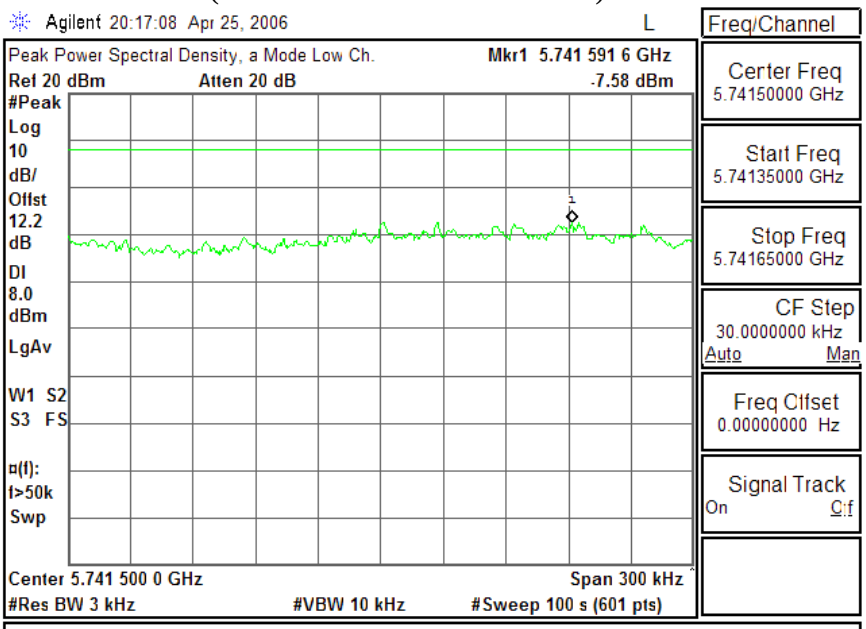
Channel	Frequency (MHz)	PPSD Chain 0 (dBm)	PPSD Chain 1 (dBm)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Low	5745	-7.58	-5.99	-3.70	8	-11.70
Middle	5785	-6.83	-6.27	-3.53	8	-11.53
High	5825	-6.70	-3.61	-1.88	8	-9.88

40 MHz TX BANDWIDTH

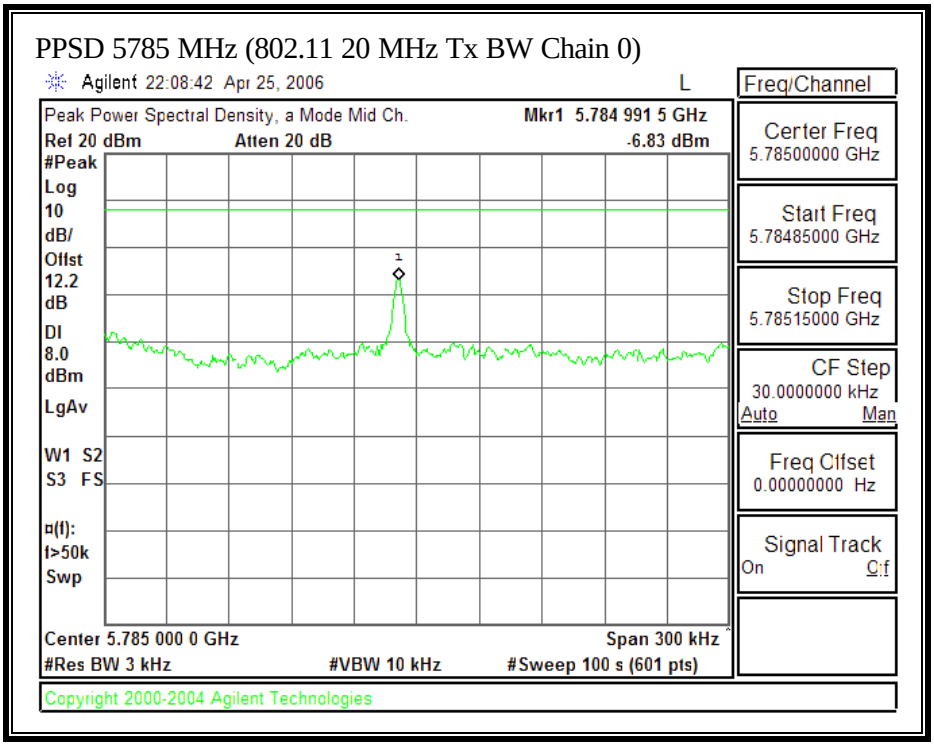
Channel	Frequency (MHz)	PPSD Chain 0 (dBm)	PPSD Chain 1 (dBm)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Low	5755	-9.26	-8.92	-6.08	8	-14.08
High	5795	-8.57	-5.57	-3.81	8	-11.81

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

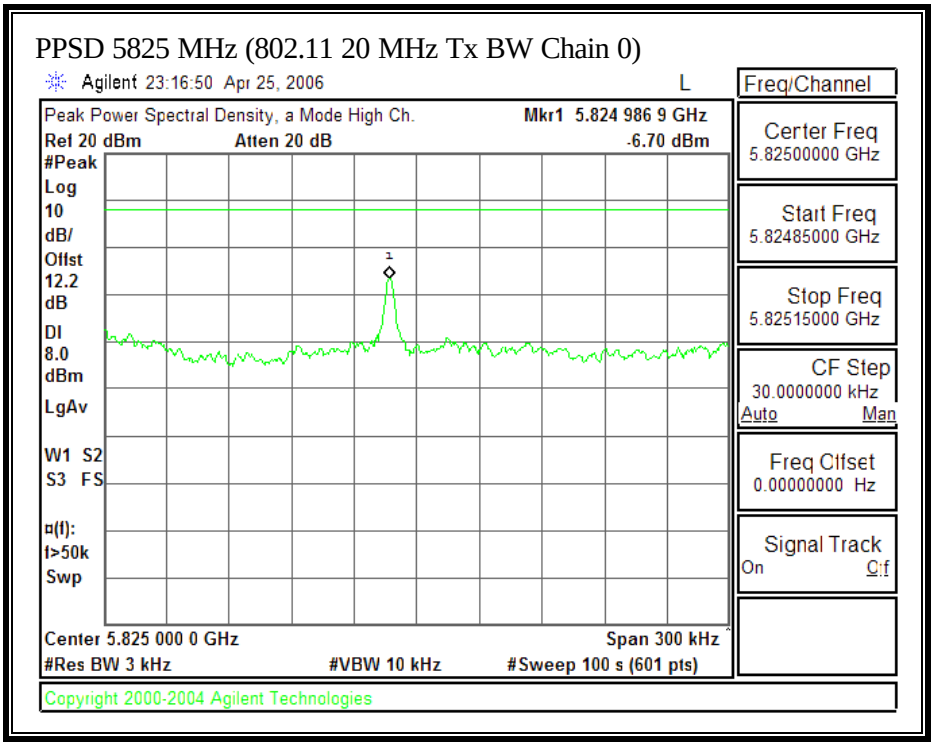
PPSD 5745 MHz (802.11 20 MHz Tx BW Chain 0)



PPSD 5785 MHz (802.11 20 MHz Tx BW Chain 0)

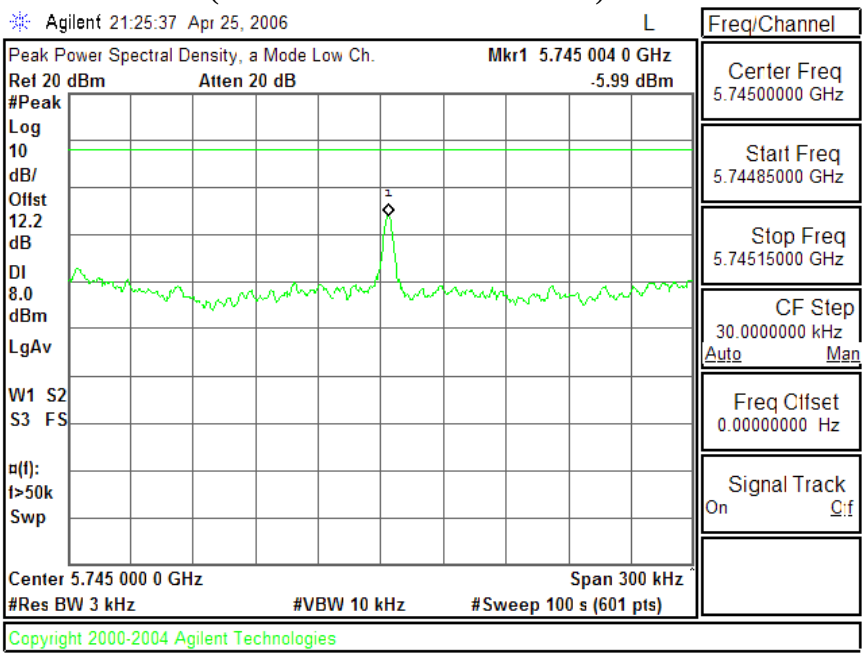


PPSD 5825 MHz (802.11 20 MHz Tx BW Chain 0)

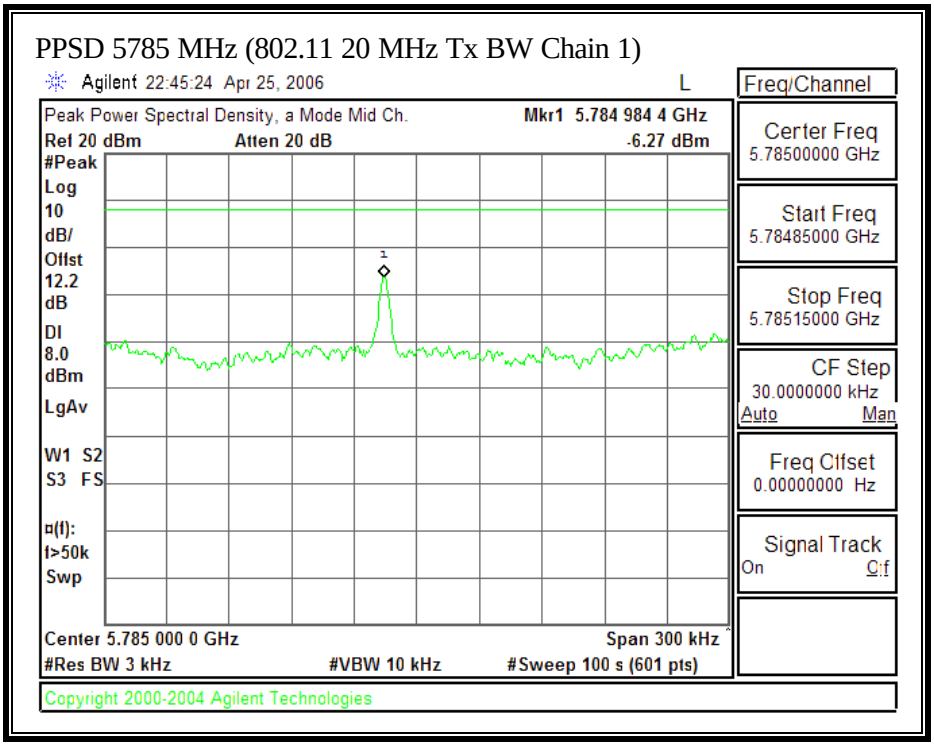


PEAK POWER SPECTRAL DENSITY (802.11 - 20 MHz TX BANDWIDTH – CHAIN 1)

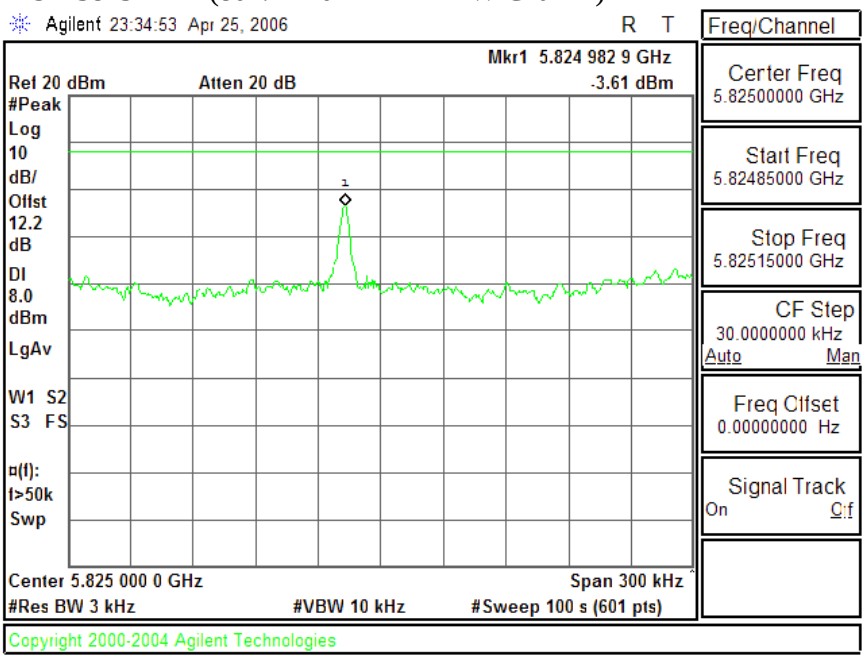
PPSD 5745 MHz (802.11 20 MHz Tx BW Chain 1)



PPSD 5785 MHz (802.11 20 MHz Tx BW Chain 1)

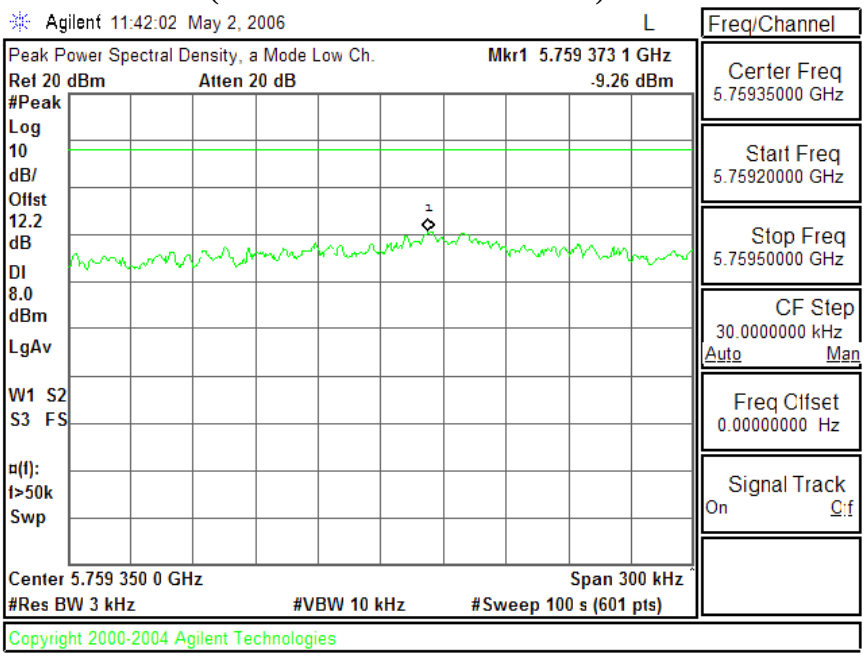


PPSD 5825 MHz (802.11 20 MHz Tx BW Chain 1)

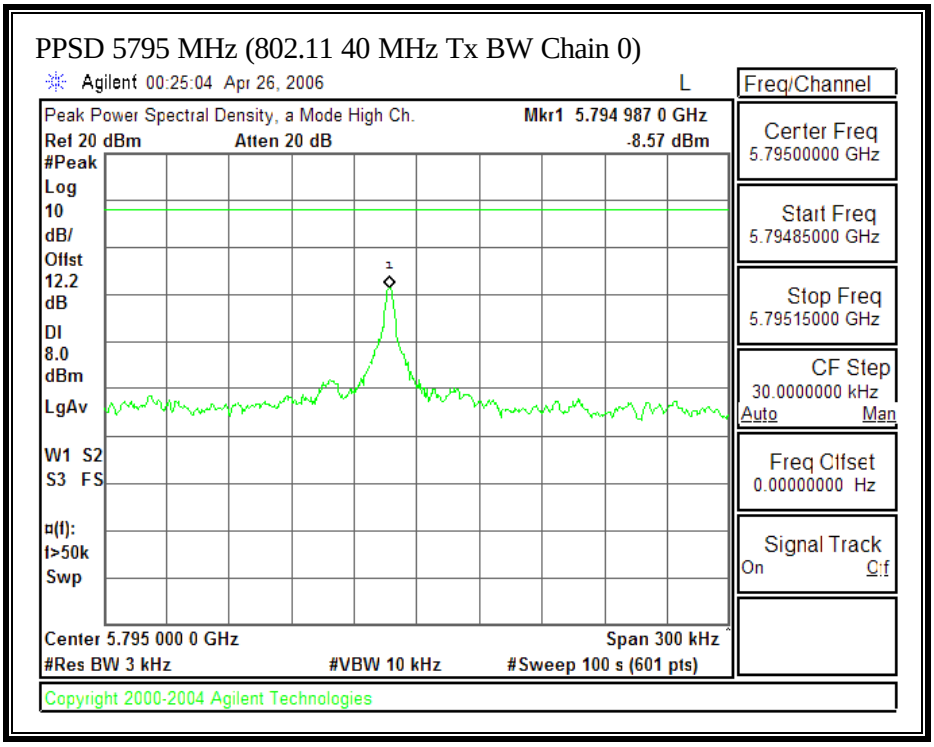


PEAK POWER SPECTRAL DENSITY (802.11 - 40 MHz TX BANDWIDTH – CHAIN 0)

PPSD 5755 MHz (802.11 40 MHz Tx BW Chain 0)

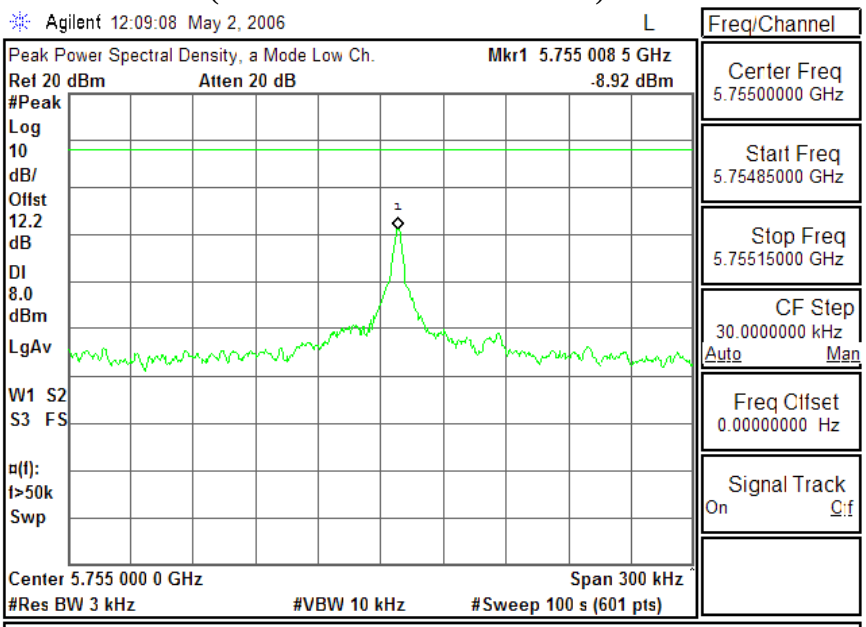


PPSD 5795 MHz (802.11 40 MHz Tx BW Chain 0)

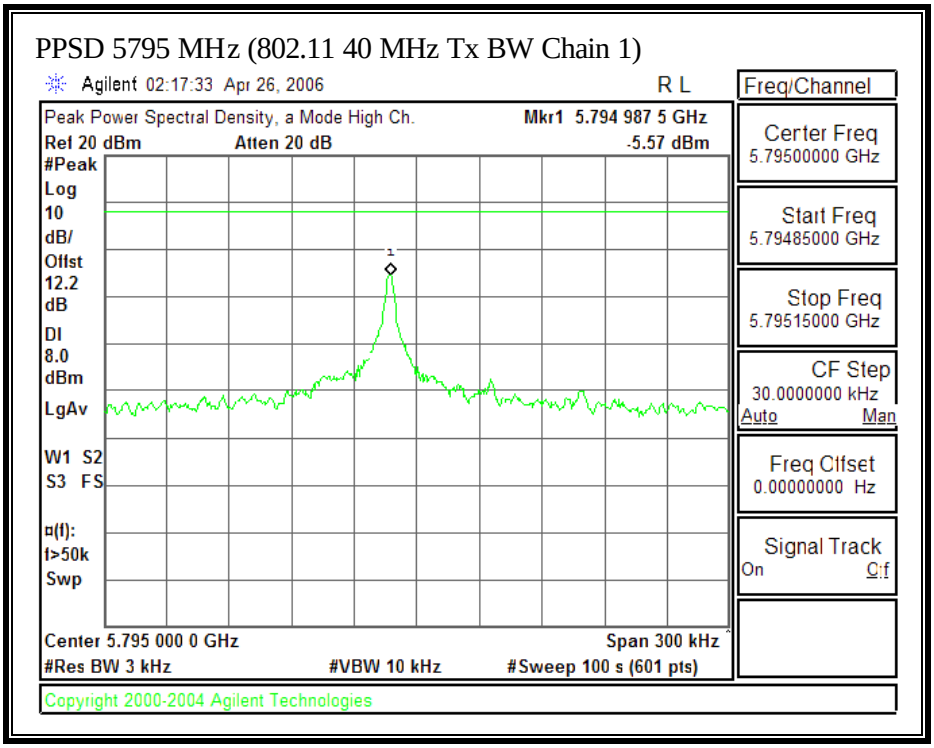


PEAK POWER SPECTRAL DENSITY (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)

PPSD 5755 MHz (802.11 40 MHz Tx BW Chain 1)



PPSD 5795 MHz (802.11 40 MHz Tx BW Chain 1)



7.4.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

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

Conducted power was measured based on the use of RMS averaging over a time interval, therefore the required attenuation is 30 dB.

TEST PROCEDURE

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

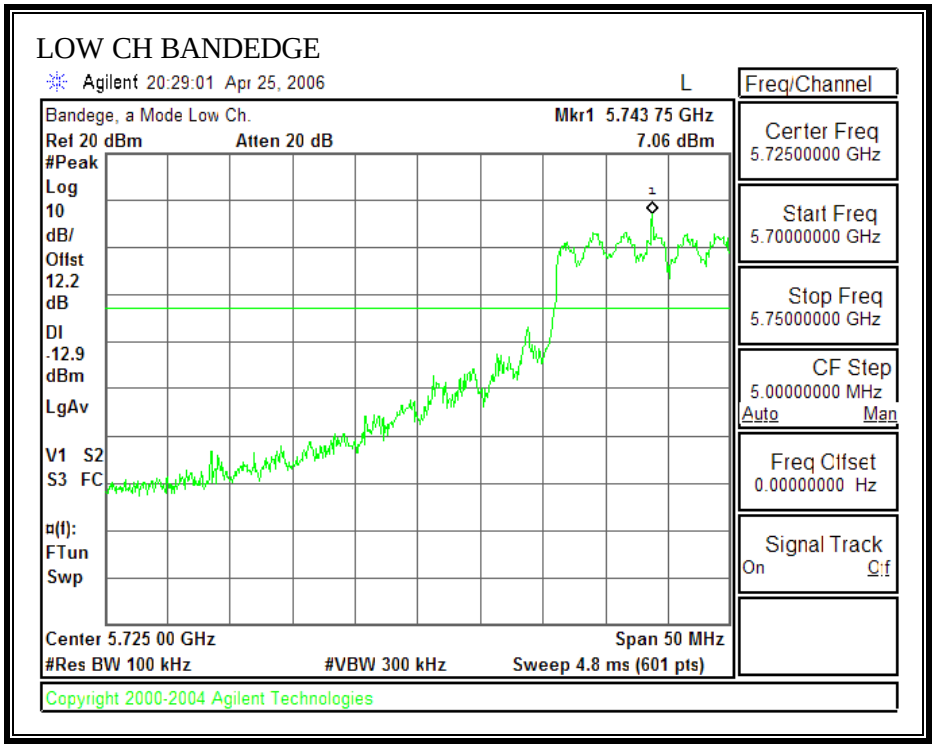
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

RESULTS

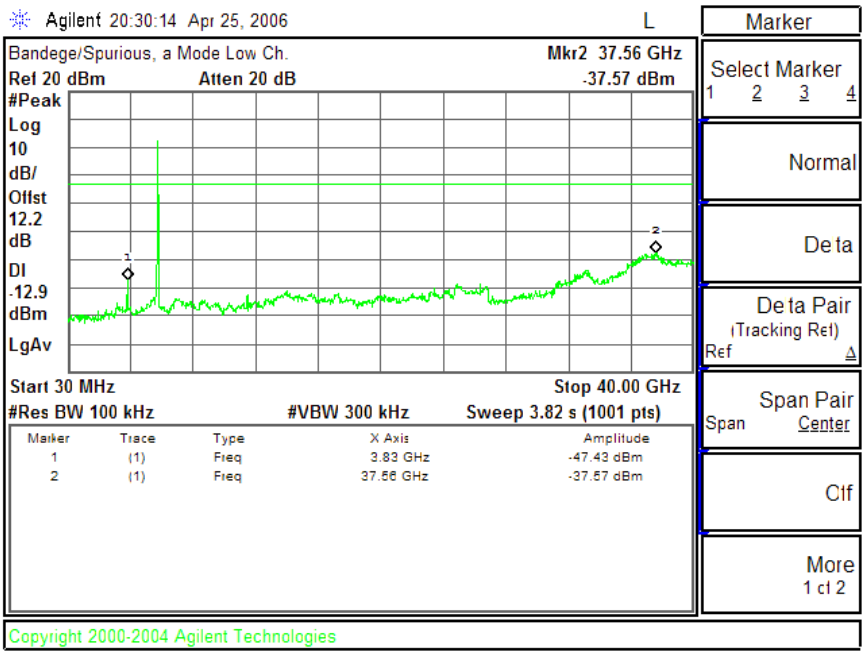
No non-compliance noted:

SPURIOUS EMISSIONS, LOW CHANNEL (802.11 - 20 MHz TX BANDWIDTH – CHAIN 0)

LOW CH BANDEDGE, 5745 MHz

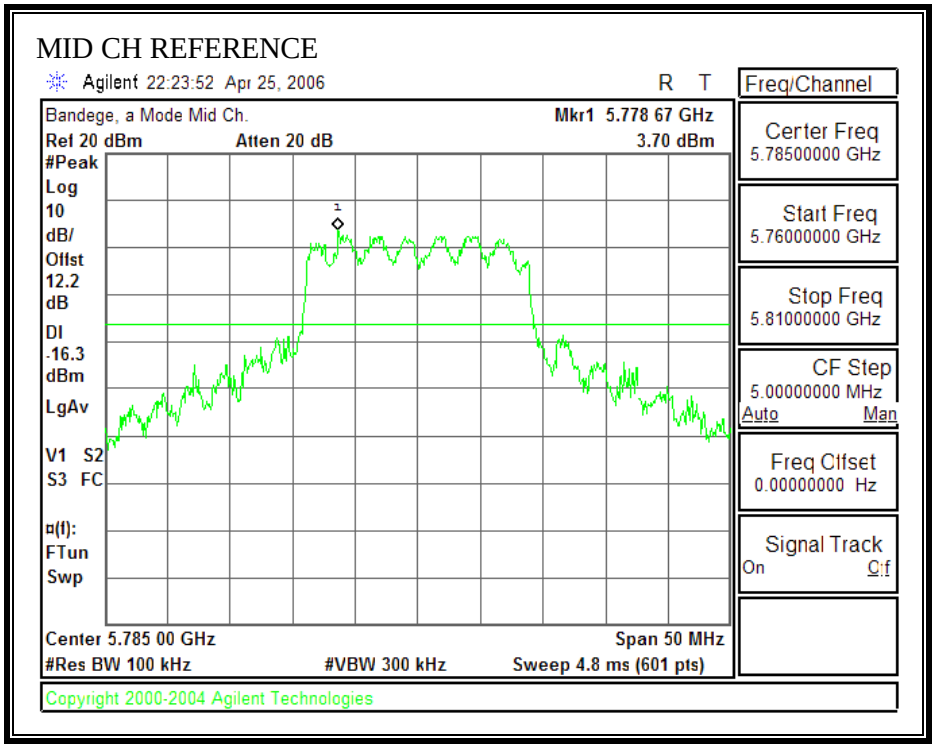


LOW CH SPURIOUS

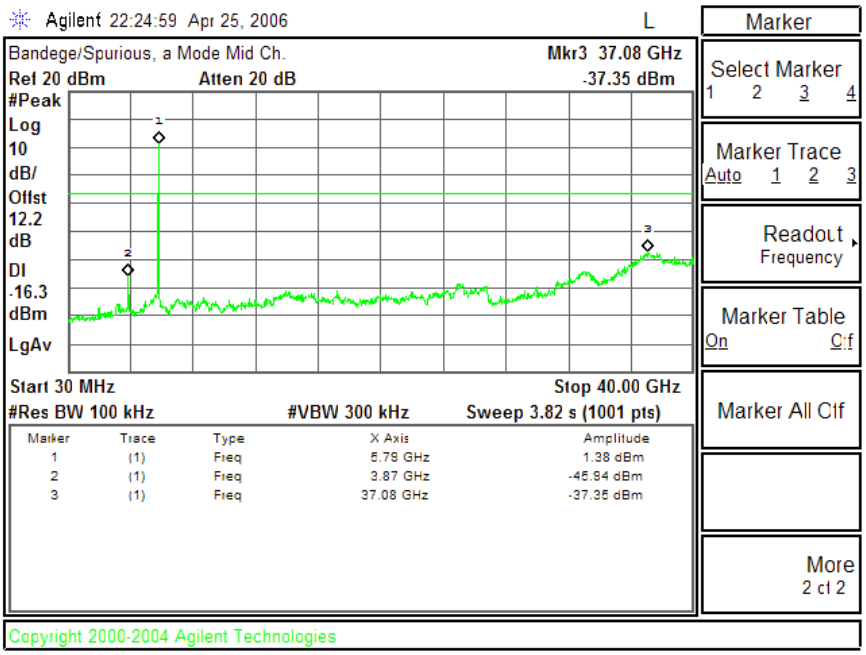


SPURIOUS EMISSIONS, MIDDLE CHANNEL (802.11 - 20 MHz TX BANDWIDTH – CHAIN 0)

MID CH BANDEGE, 5785 MHz

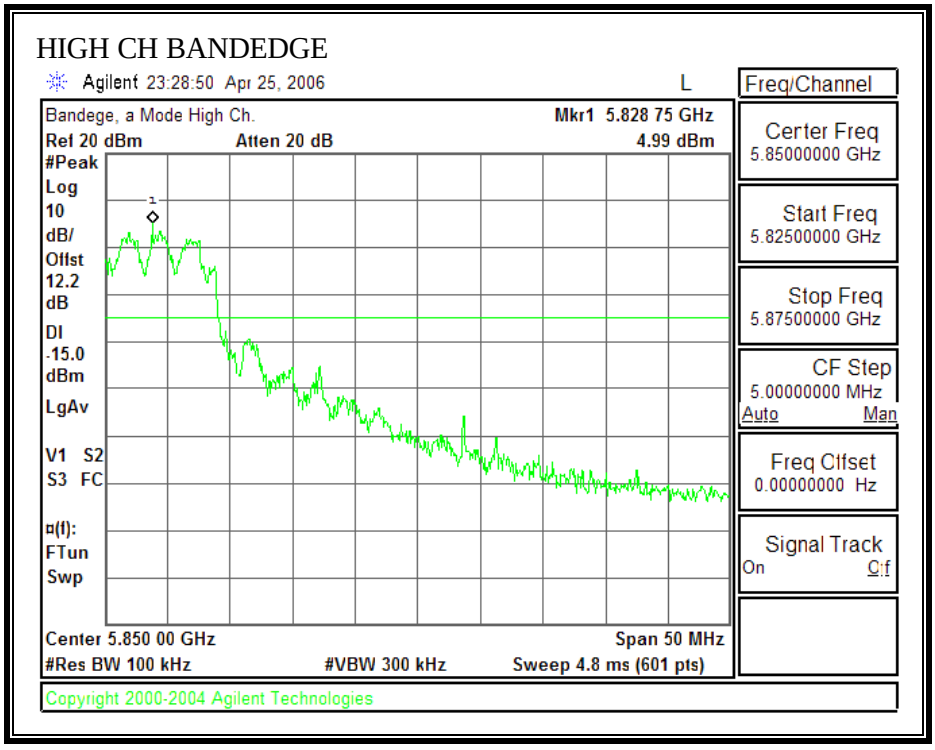


MID CH SPURIOUS

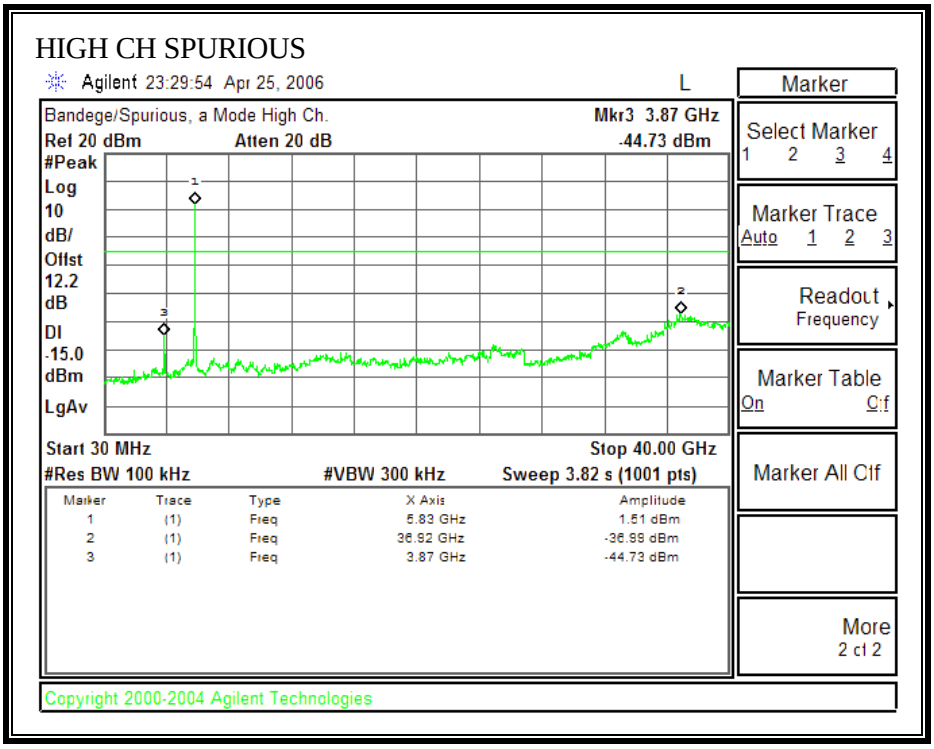


SPURIOUS EMISSIONS, HIGH CHANNEL (802.11 - 20 MHz TX BANDWIDTH – CHAIN 0)

HI CH BANDEDGE, 5825 MHz

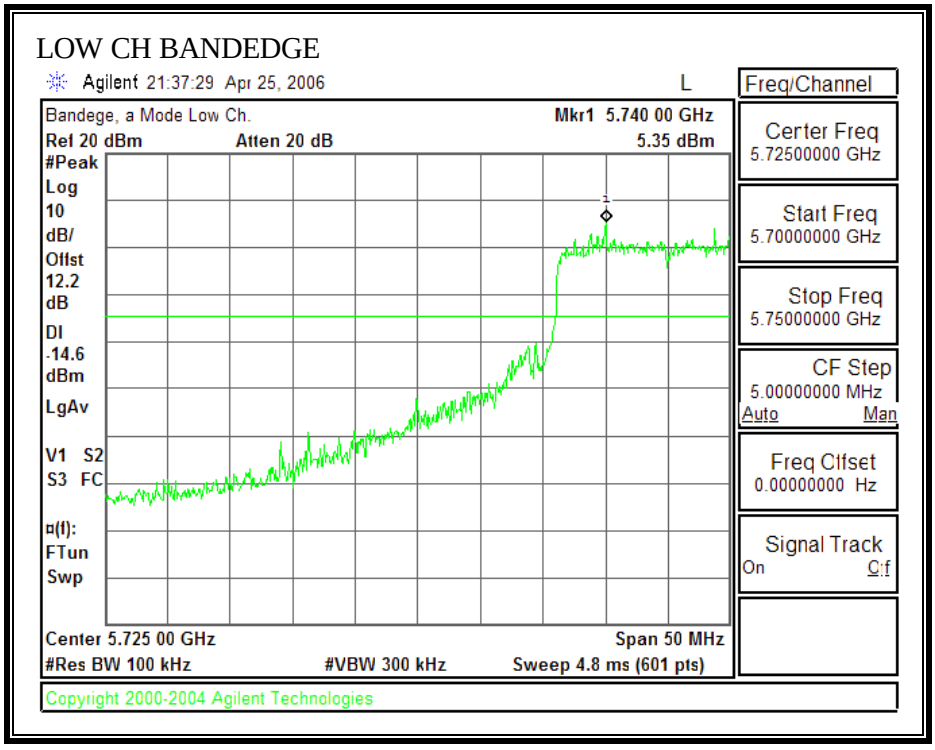


HIGH CH SPURIOUS

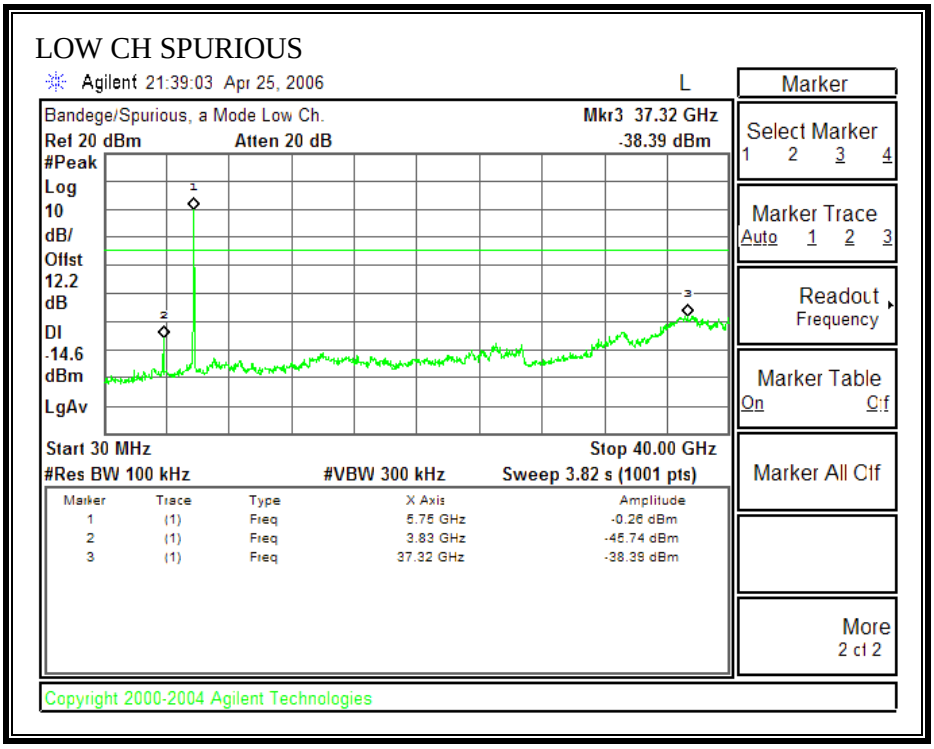


SPURIOUS EMISSIONS, LOW CHANNEL (802.11 - 20 MHz TX BANDWIDTH – CHAIN 1)

LOW CH BANDEDGE, 5745 MHz

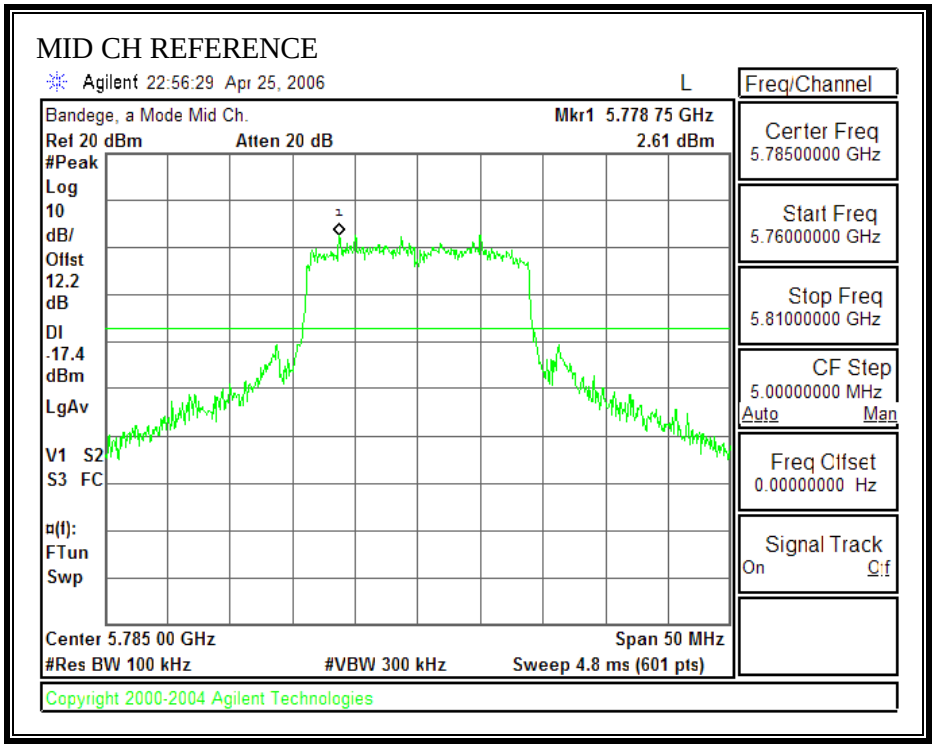


LOW CH SPURIOUS

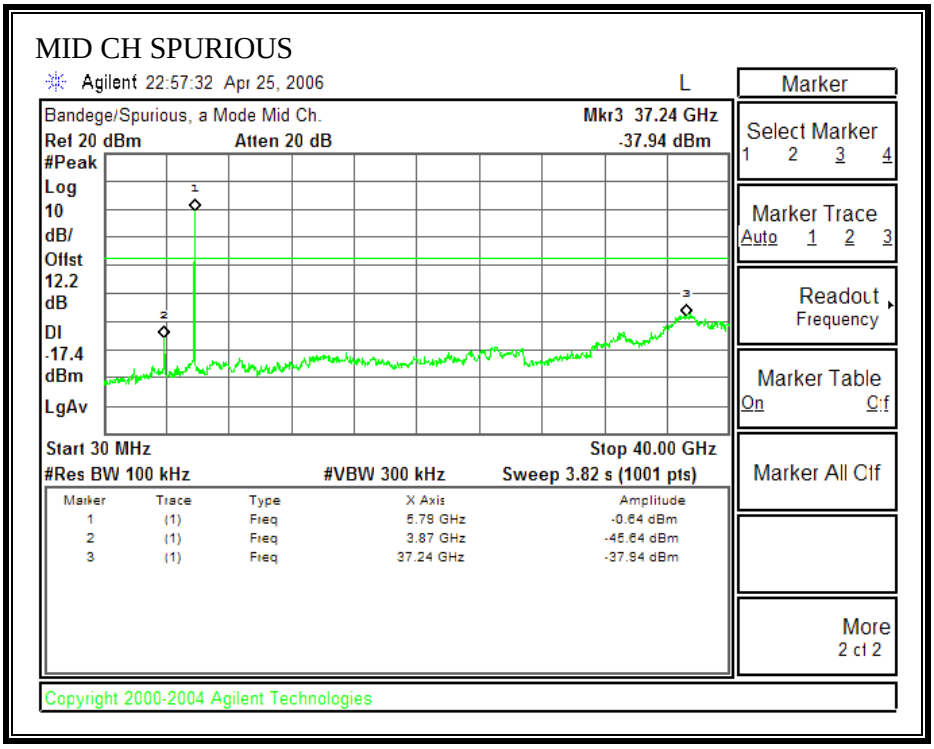


SPURIOUS EMISSIONS, MIDDLE CHANNEL (802.11 - 20 MHz TX BANDWIDTH – CHAIN 1)

MID CH BANDEGE, 5785 MHz

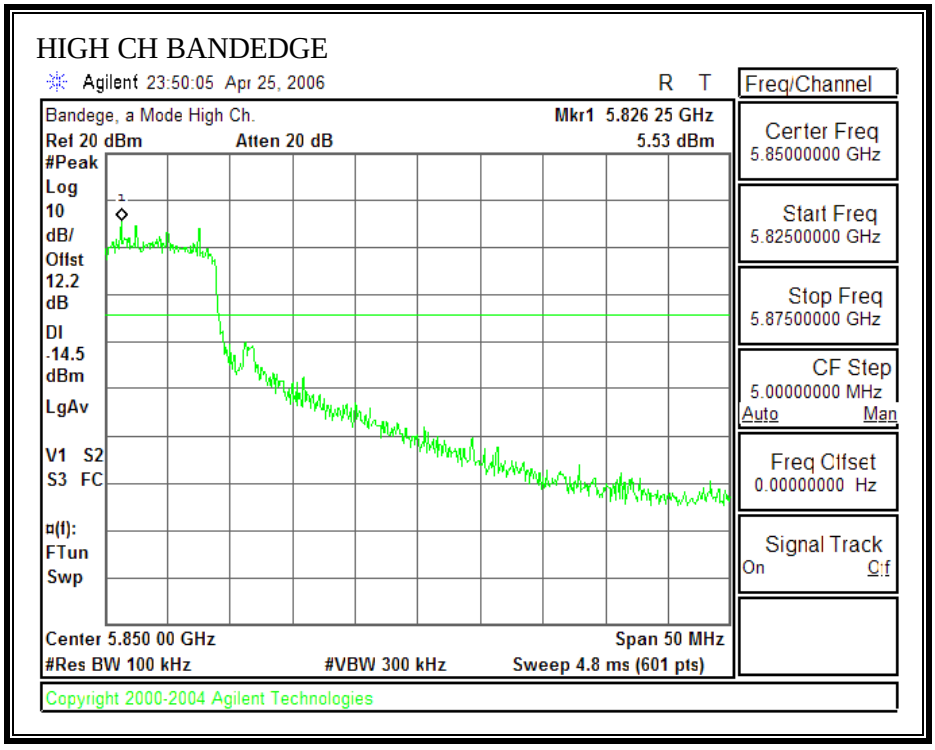


MID CH SPURIOUS

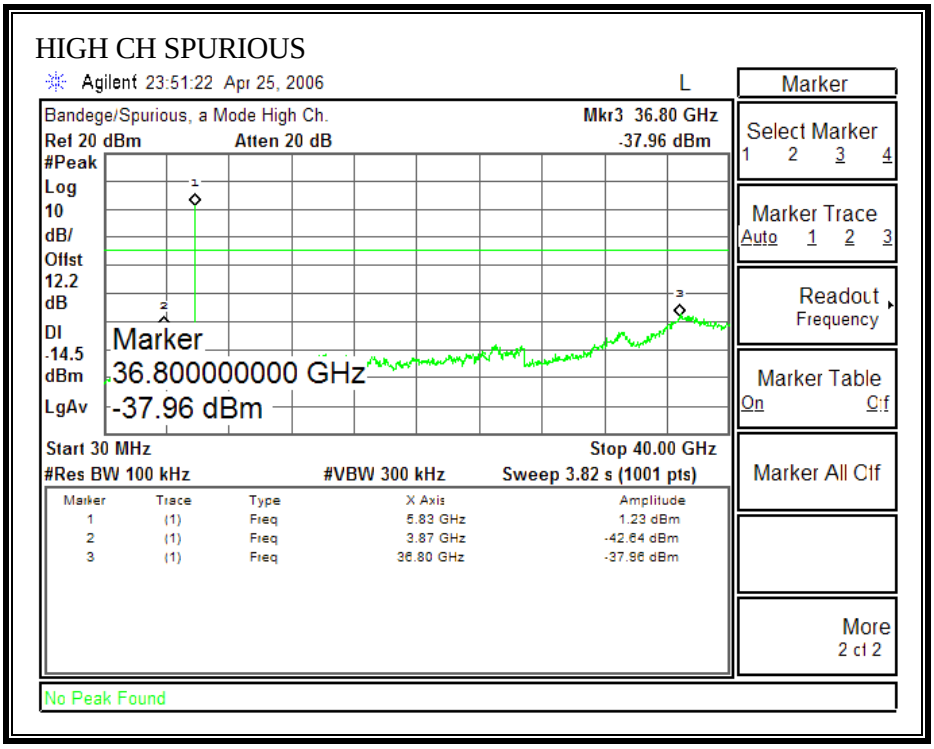


SPURIOUS EMISSIONS, HIGH CHANNEL (802.11 40 - MHz TX BANDWIDTH – CHAIN 1)

HI CH BANDEDGE, 5825 MHz

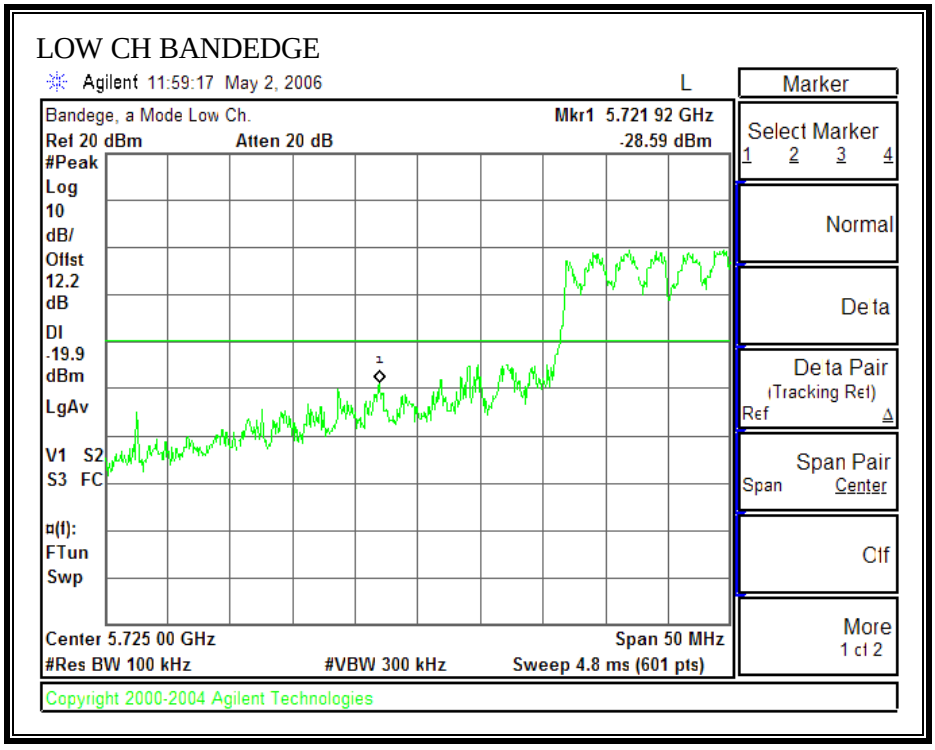


HIGH CH SPURIOUS

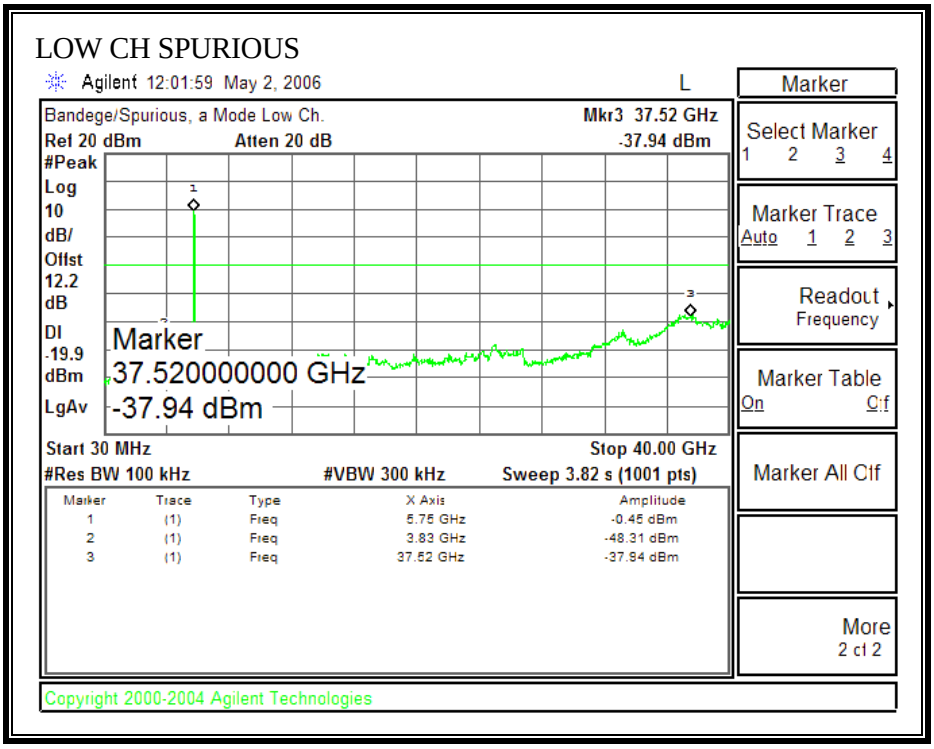


SPURIOUS EMISSIONS, HIGH CHANNEL (802.11 - 40 MHz TX BANDWIDTH – CHAIN 0)

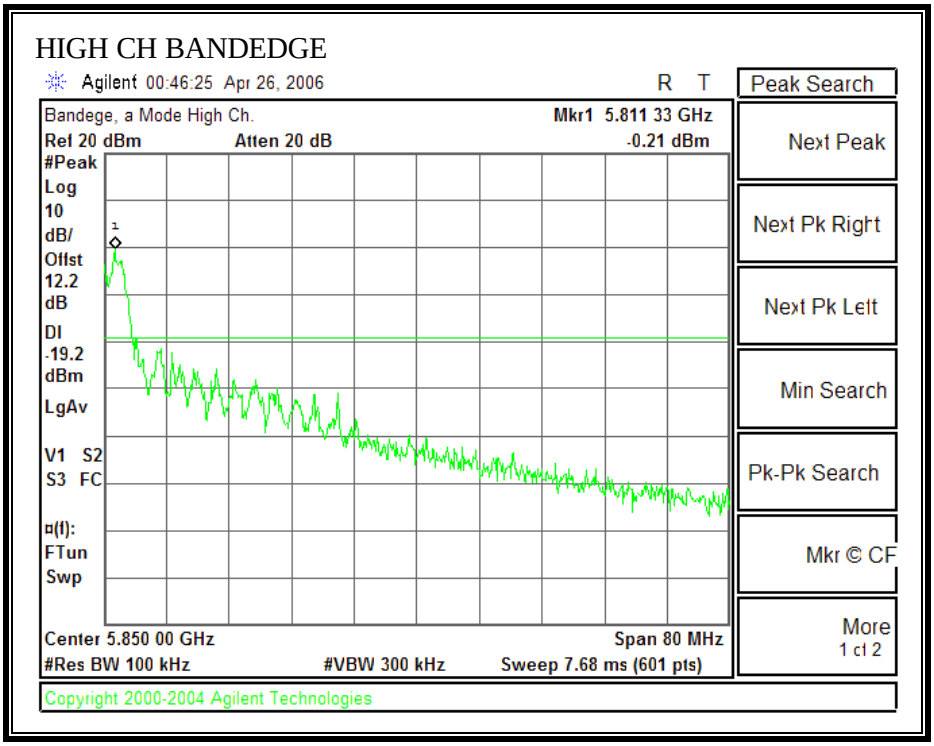
LOW CH BANDEDGE, 5755 MHz



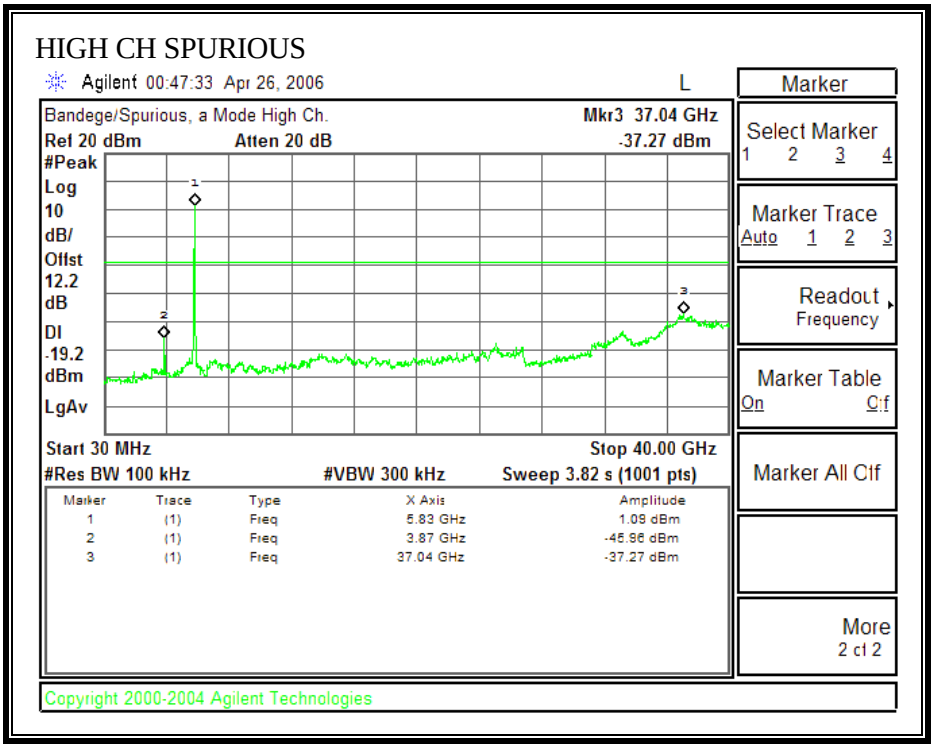
LOW CH SPURIOUS



HIGH CH BANDEDGE, 5795 MHz

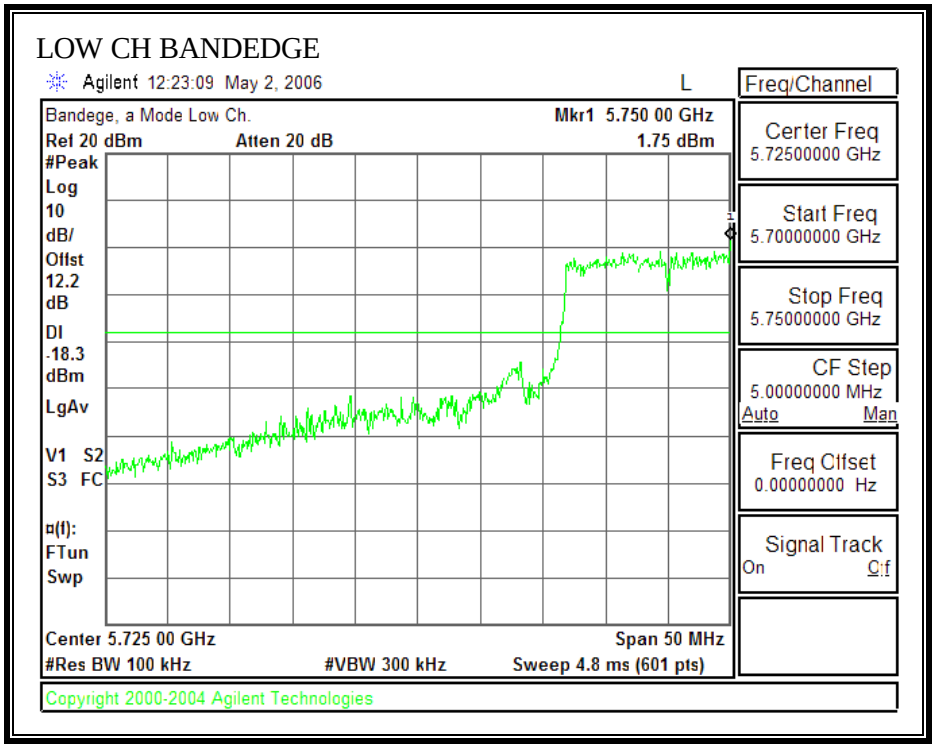


HIGH CH SPURIOUS

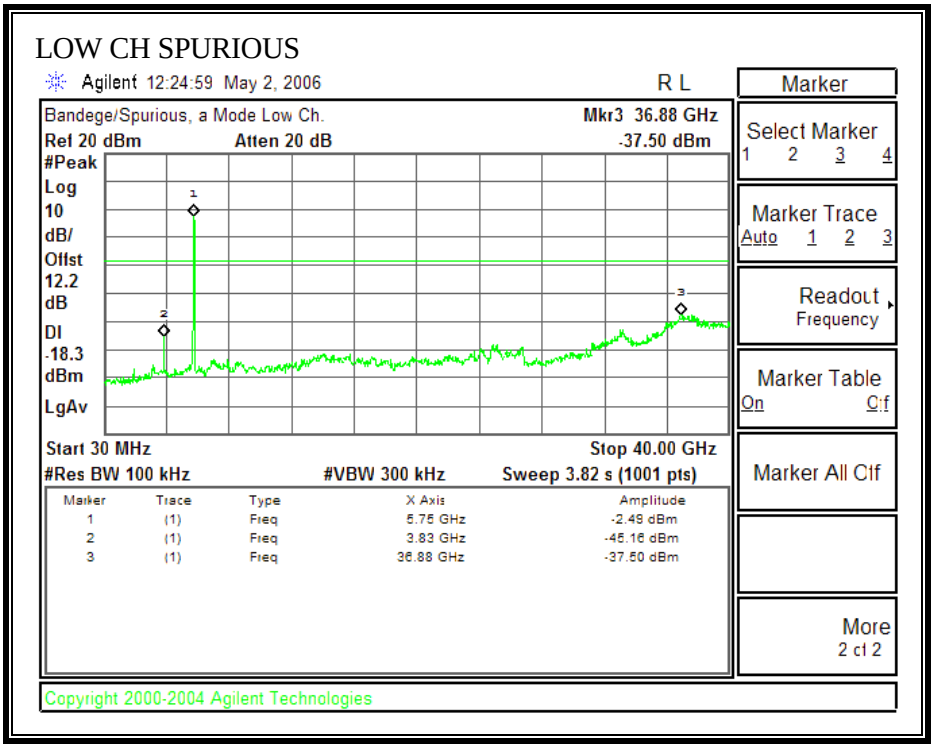


SPURIOUS EMISSIONS, HIGH CHANNEL (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)

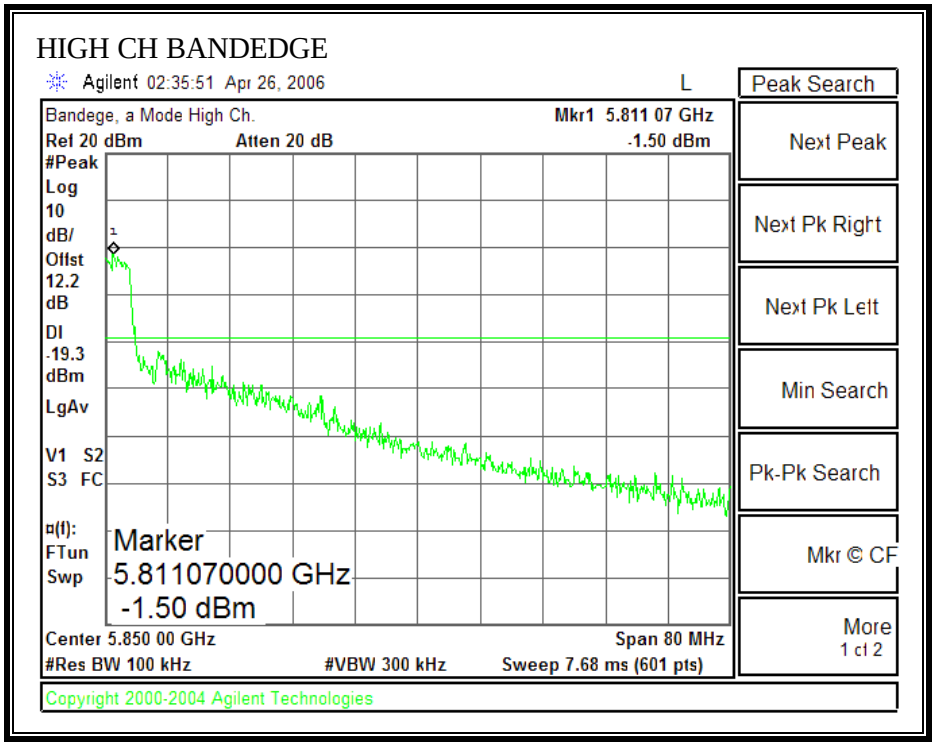
LOW CH BANDEDGE, 5755 MHz



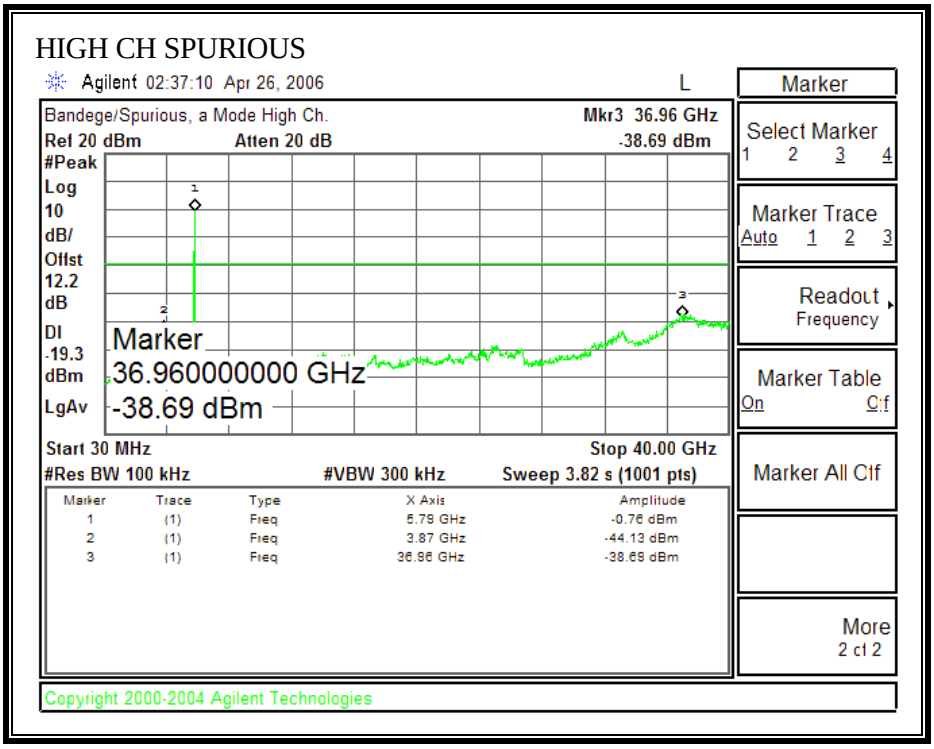
LOW CH SPURIOUS



HI CH BANDEDGE, 5795 MHz



HIGH CH SPURIOUS



FOXCONN, PCB ANTENNA

LEGACY MODE

7.5. CHANNEL TESTS FOR THE 2400 TO 2483.5 MHz BAND

7.5.1. PEAK OUTPUT POWER

PEAK POWER LIMIT

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

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

§15.247 (b) (4) Except as shown in paragraphs (b)(4) (i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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

TEST PROCEDURE

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

RESULTS

The maximum antenna gain is 2.15 dBi for other than fixed, point-to-point operations, therefore the limit is 30 dBm.

No non-compliance noted:

802.11b Mode

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
1	2412	22.32	30	-7.68
2	2417	23.19	30	-6.81
6	2437	23.01	30	-6.99
10	2457	22.56	30	-7.44
11	2462	18.34	30	-11.66

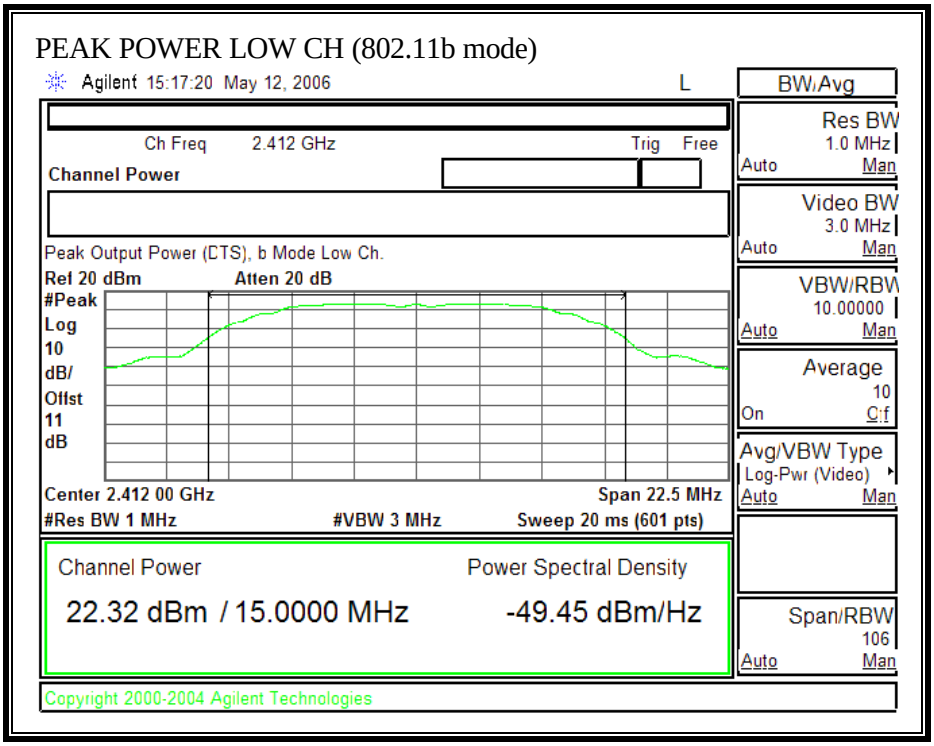
802.11g Mode

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
1	2412	23.15	30	-6.85
2	2417	24.29	30	-5.71
6	2437	24.27	30	-5.73
10	2457	24.40	30	-5.60
11	2462	22.10	30	-7.90

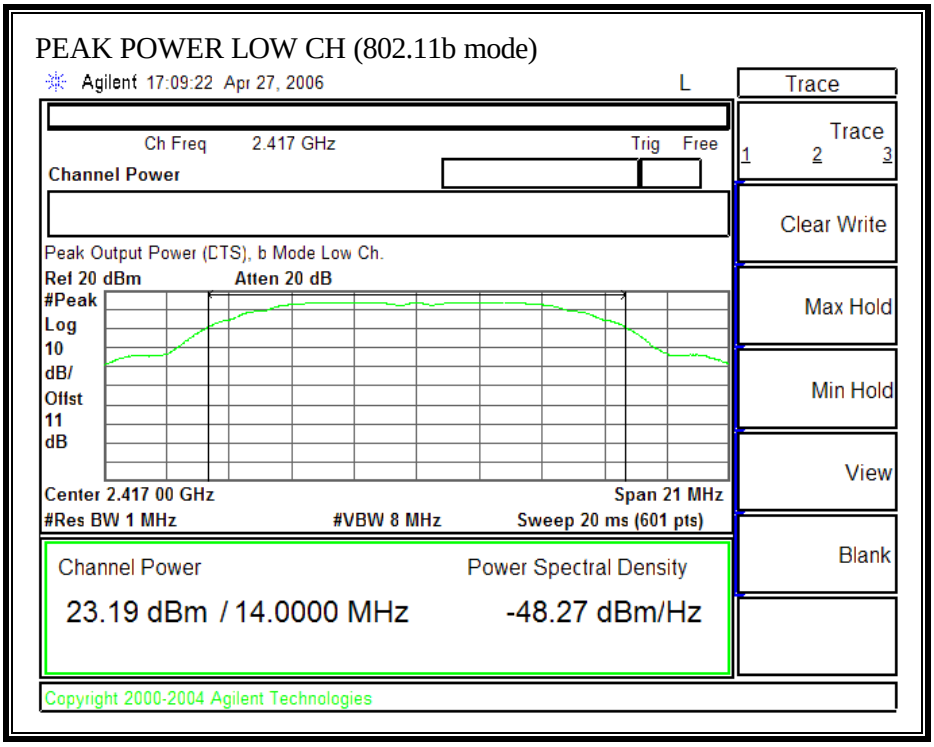
OUTPUT POWER (802.11b MODE)

CHANNEL 1, 2412 MHz

PEAK POWER LOW CH (802.11b mode)

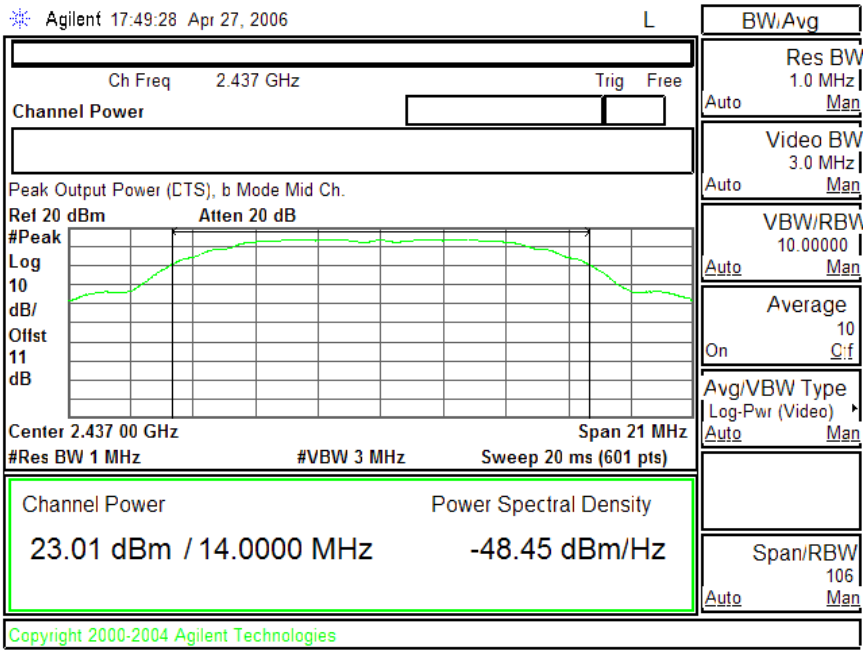


CHANNEL 2, 2417 MHz

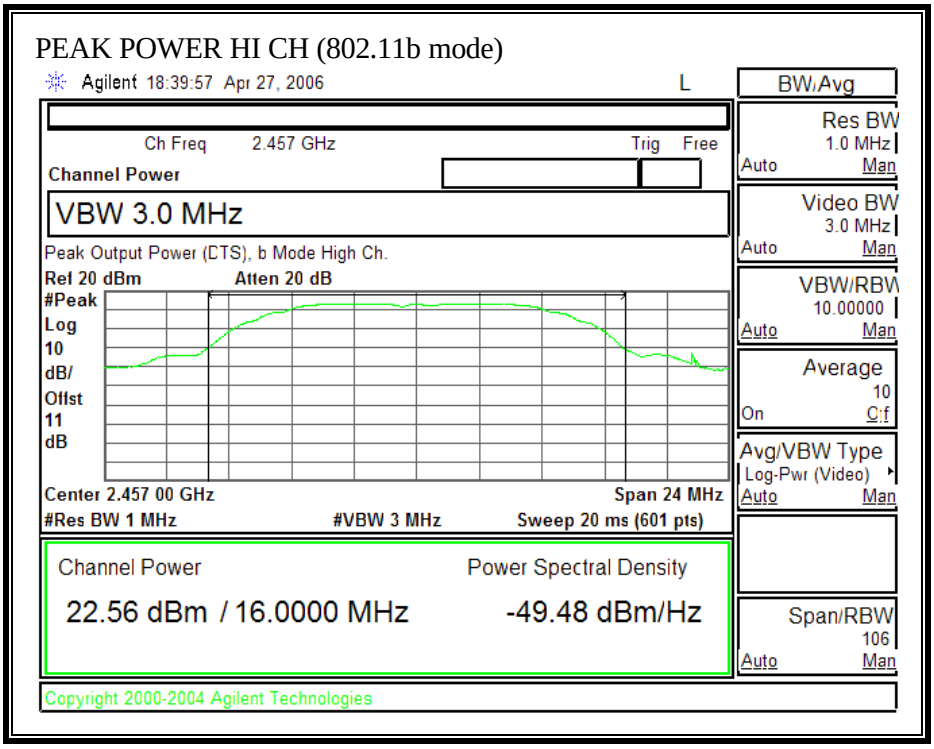


CHANNEL 2, 2437 MHz

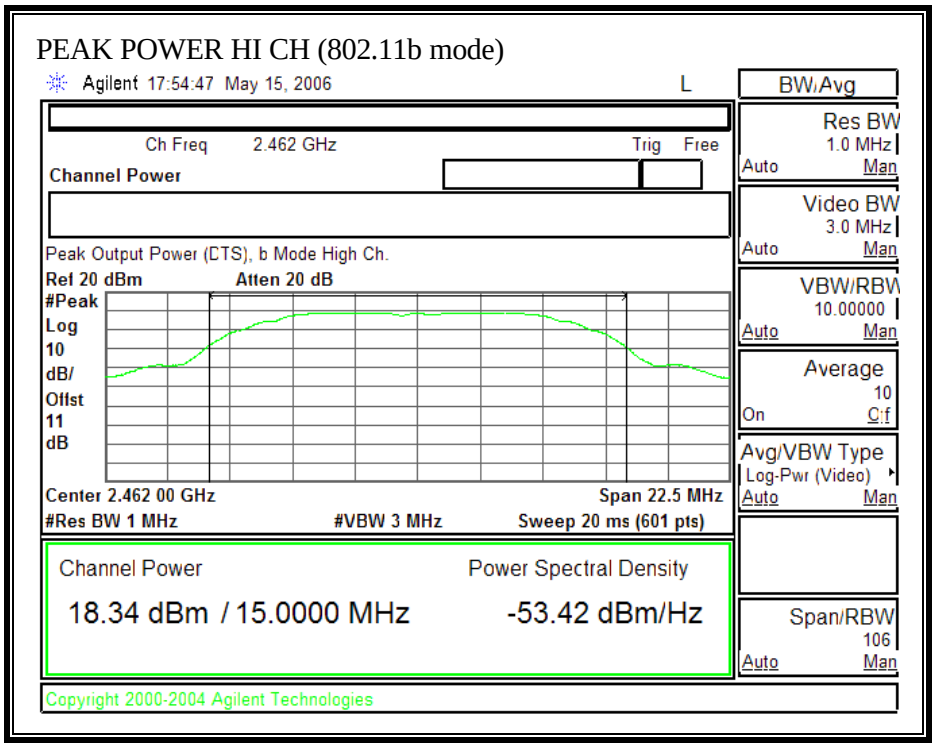
PEAK POWER MID CH (802.11b mode)



CHANNEL 10, 2457 MHz

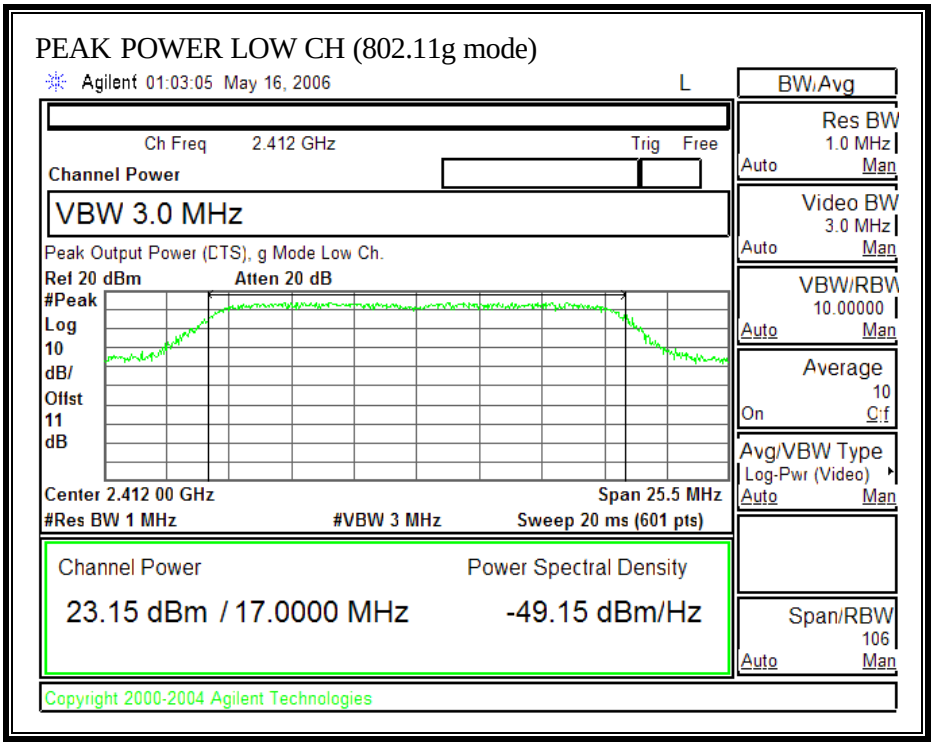


CHANNEL 11, 2462 MHz

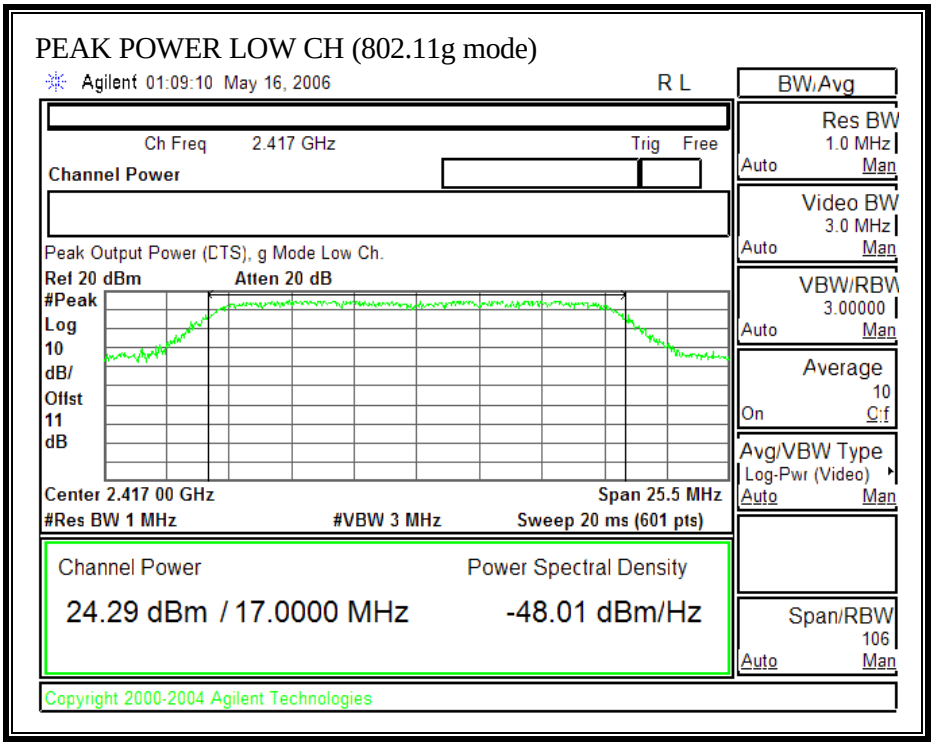


OUTPUT POWER (802.11g MODE)

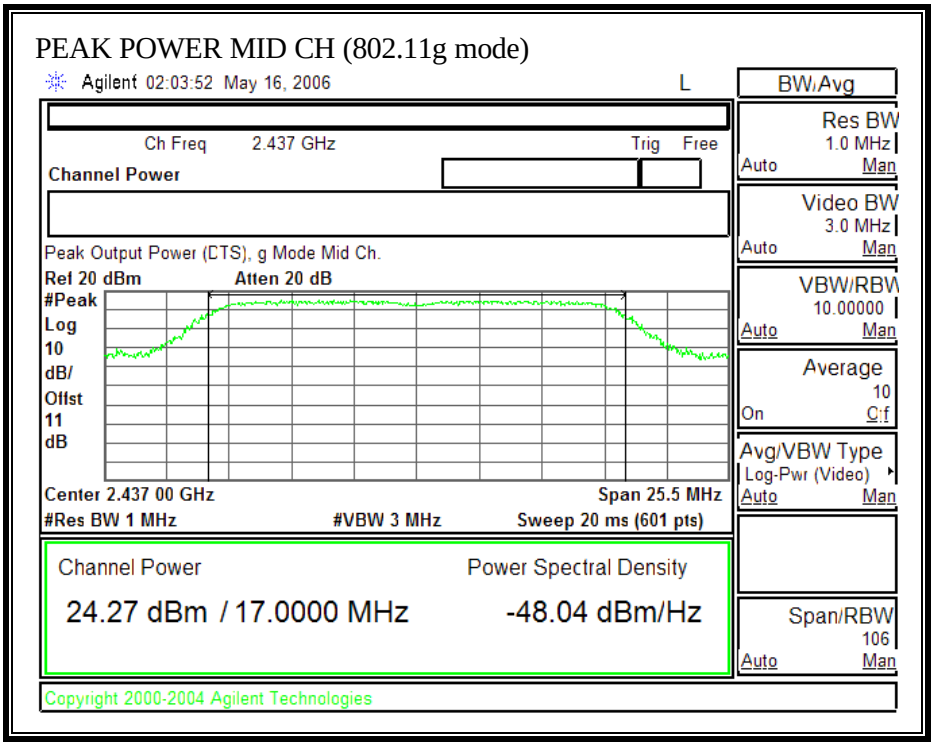
CHANNEL 1, 2412 MHz



CHANNEL 2, 2417 MHz

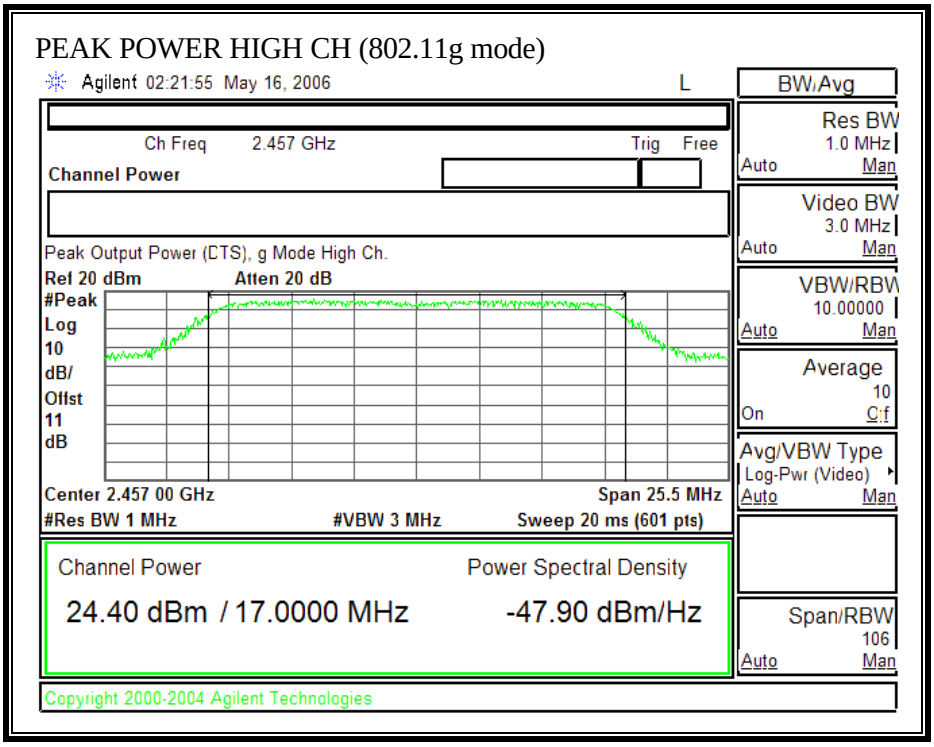


CHANNEL 6, 2437 MHz



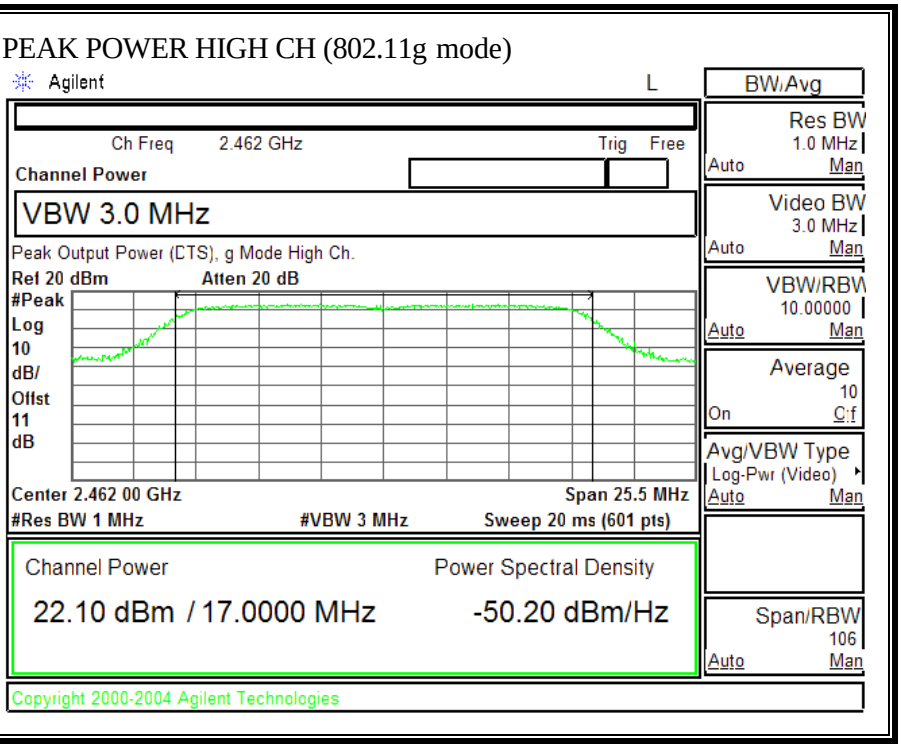
CHANNEL 10, 2457 MHz

PEAK POWER HIGH CH (802.11g mode)



CHANNEL 11, 2462 MHz

PEAK POWER HIGH CH (802.11g mode)



7.5.2. MAXIMUM PERMISSIBLE EXPOSURE

LIMITS

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

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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

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

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

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

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

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

CALCULATIONS

Given

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

and

$S = E \wedge 2 / 3770$

where

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

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

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

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

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

yields

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

where

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

Substituting the logarithmic form of power and gain using:

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

yields

$d = 0.282 * 10 \wedge ((P + G) / 20) / \sqrt{S}$ Equation (1)

where

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

Equation (1) and the measured peak power is used to calculate the MPE distance.

LIMITS

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

RESULTS

No non-compliance noted:

Mode	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
802.11b	20.0	23.19	2.15	0.07
802.11g	20.0	24.40	2.15	0.09

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

7.5.3. AVERAGE POWER

AVERAGE POWER LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

No non-compliance noted:

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

802.11b Mode

Channel	Frequency (MHz)	Power (dBm)
1	2412	18.90
2	2417	19.65
6	2437	19.56
10	2457	19.20
11	2462	17.60

802.11g Mode

Channel	Frequency (MHz)	Power (dBm)
1	2412	19.20
2	2417	19.10
6	2437	19.15
10	2457	19.30
11	2462	17.30

7.5.4. PEAK POWER SPECTRAL DENSITY

LIMIT

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

TEST PROCEDURE

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

RESULTS

No non-compliance noted:

802.11b Mode

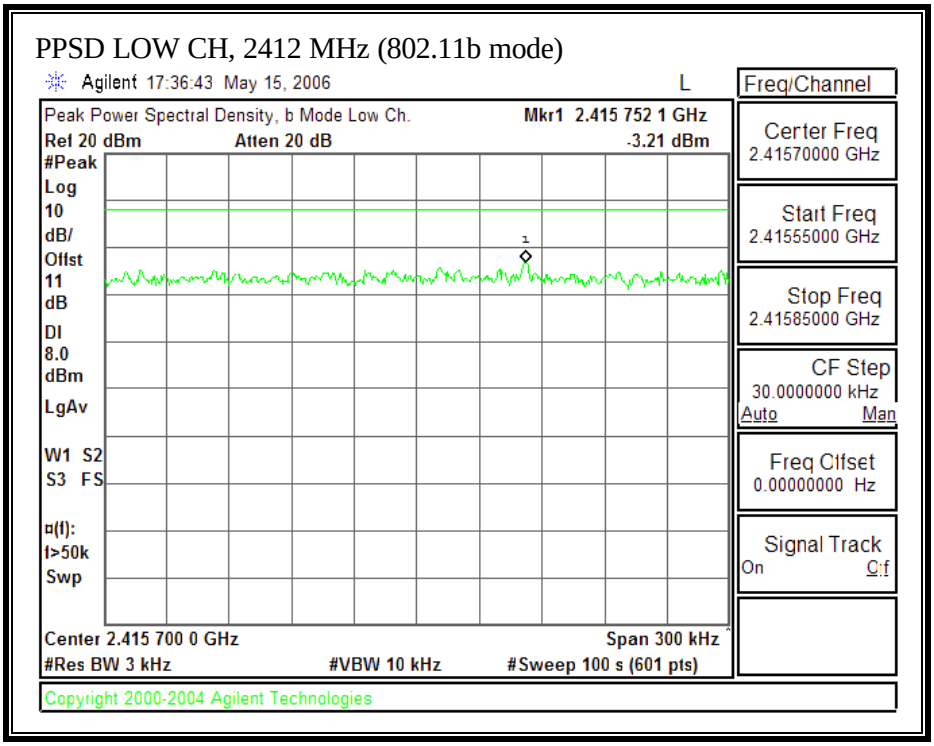
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-3.21	8	-11.21
Low	2417	-3.52	8	-11.52
Middle	2437	-2.01	8	-10.01
High	2457	-2.35	8	-10.35
High	2462	-6.59	8	-14.59

802.11g Mode

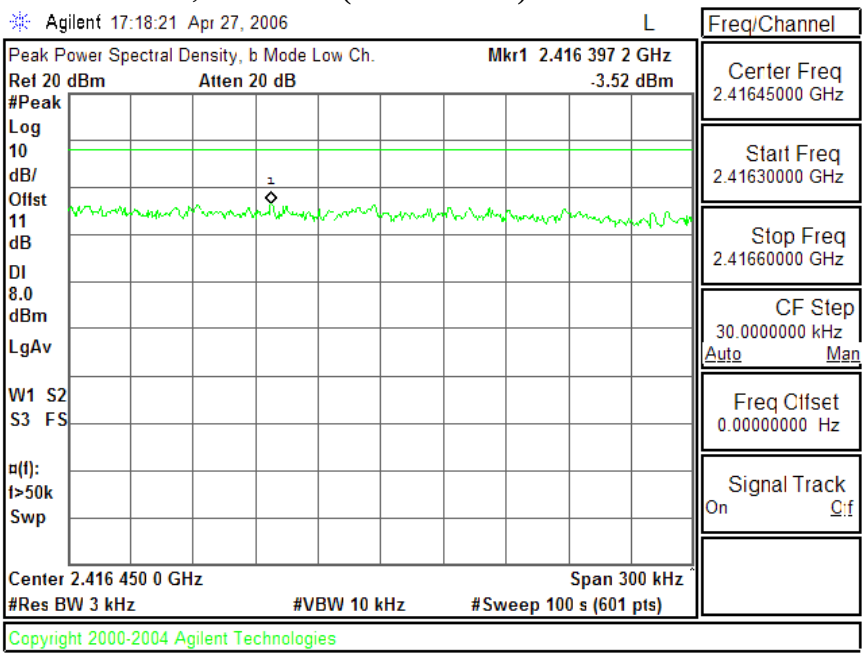
Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-9.41	8	-17.41
Low	2417	-7.61	8	-15.61
Middle	2437	-7.53	8	-15.53
High	2457	-6.38	8	-14.38
High	2462	-9.53	8	-17.53

PEAK POWER SPECTRAL DENSITY (802.11b MODE)

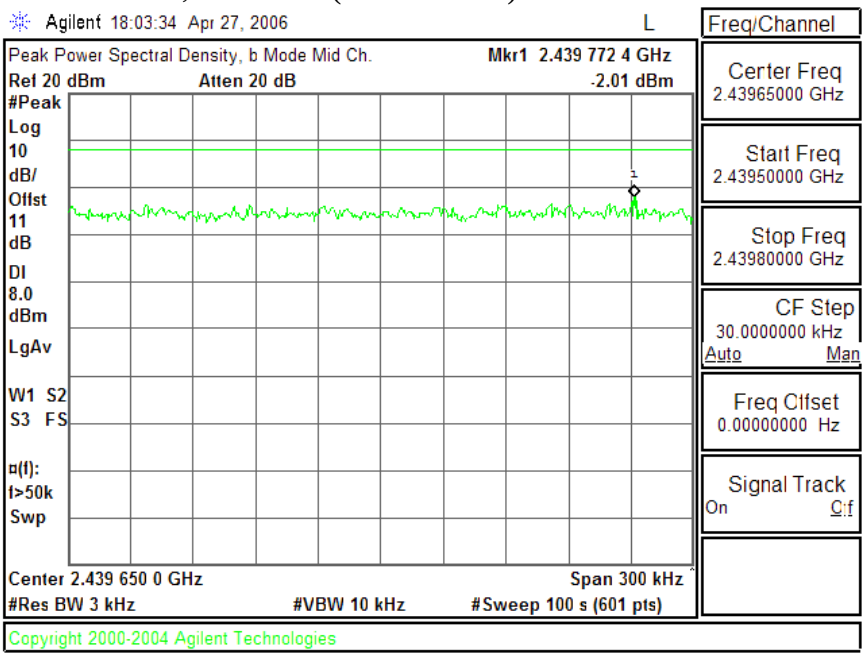
PPSD LOW CH, 2412 MHz (802.11b mode)



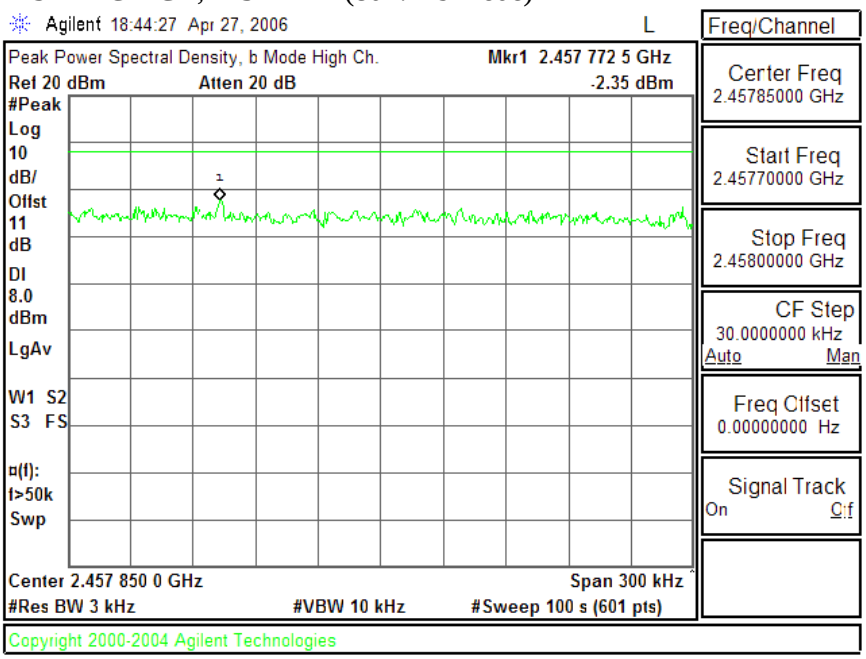
PPSD LOW CH, 2417 MHz (802.11b mode)



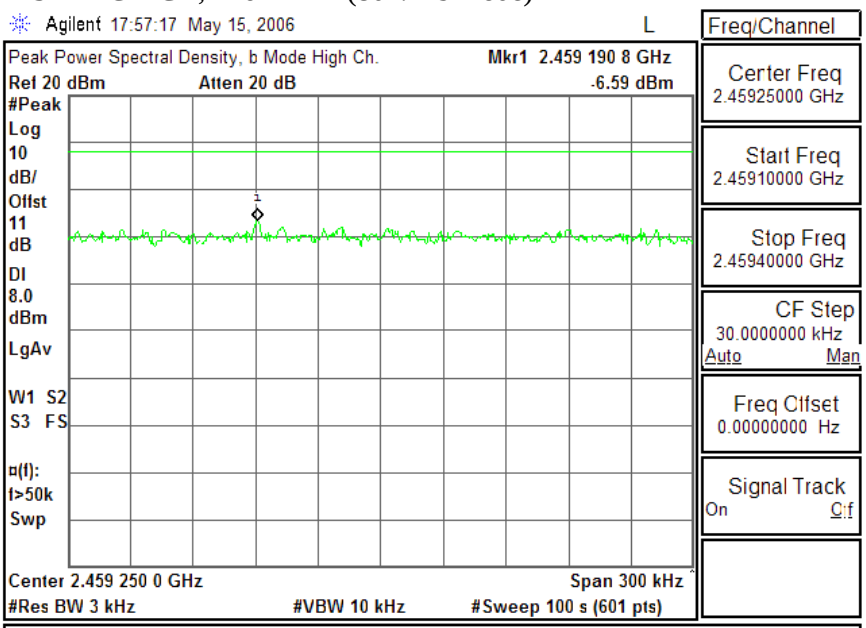
PPSD MID CH, 2437 MHz (802.11b mode)



PPSD HIGH CH, 2457 MHz (802.11b mode)

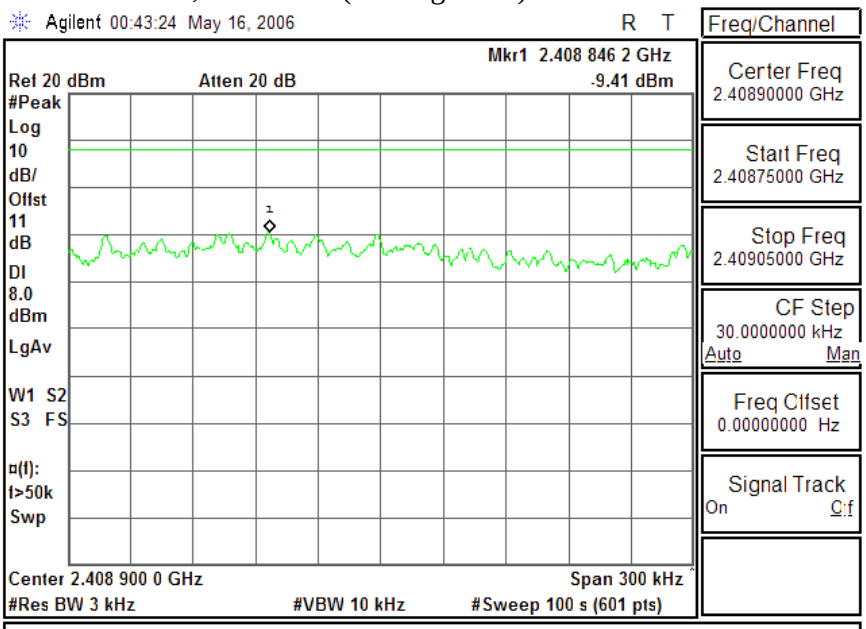


PPSD HIGH CH, 2462 MHz (802.11b mode)

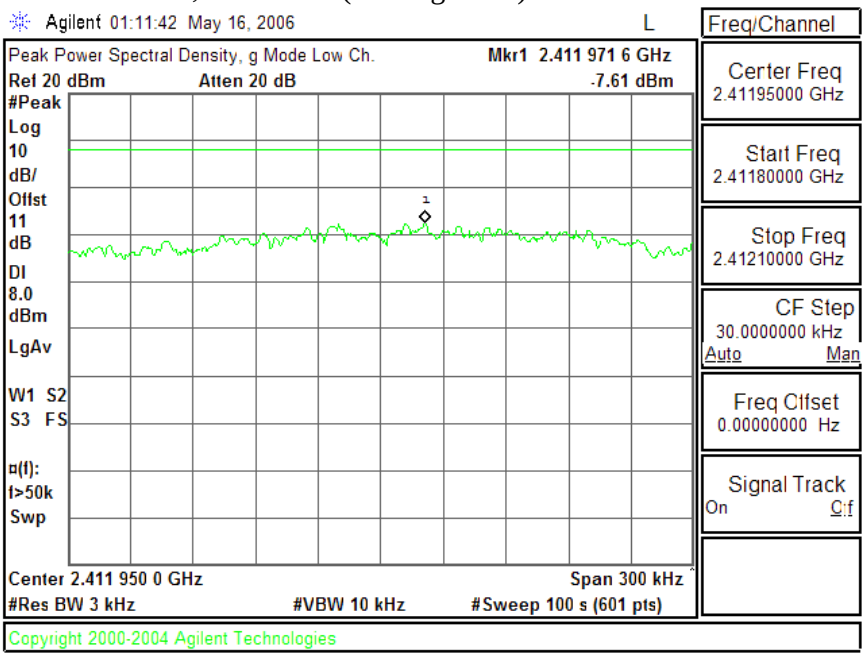


PEAK POWER SPECTRAL DENSITY (802.11g MODE)

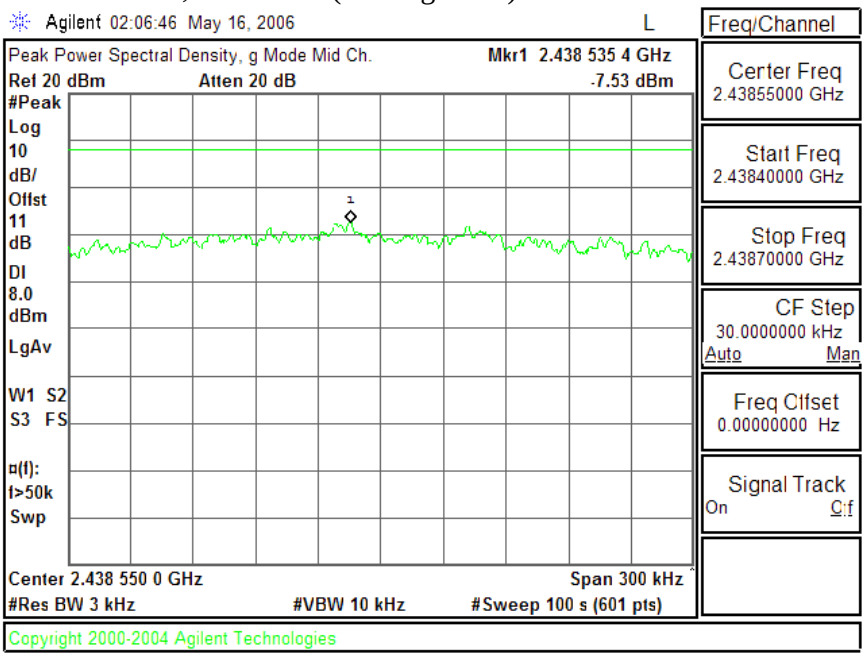
PPSD LOW CH, 2412 MHz (802.11g mode)



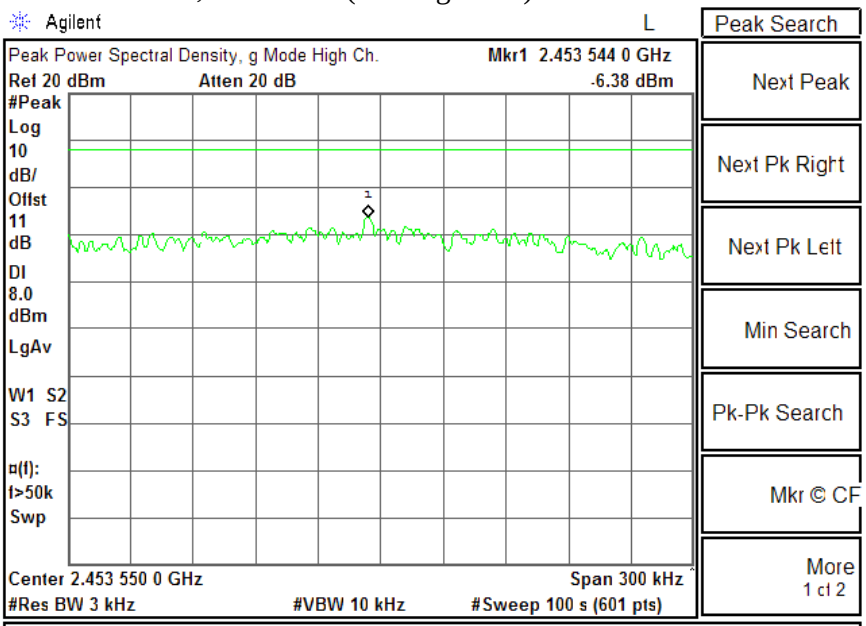
PPSD LOW CH, 2417 MHz (802.11g mode)



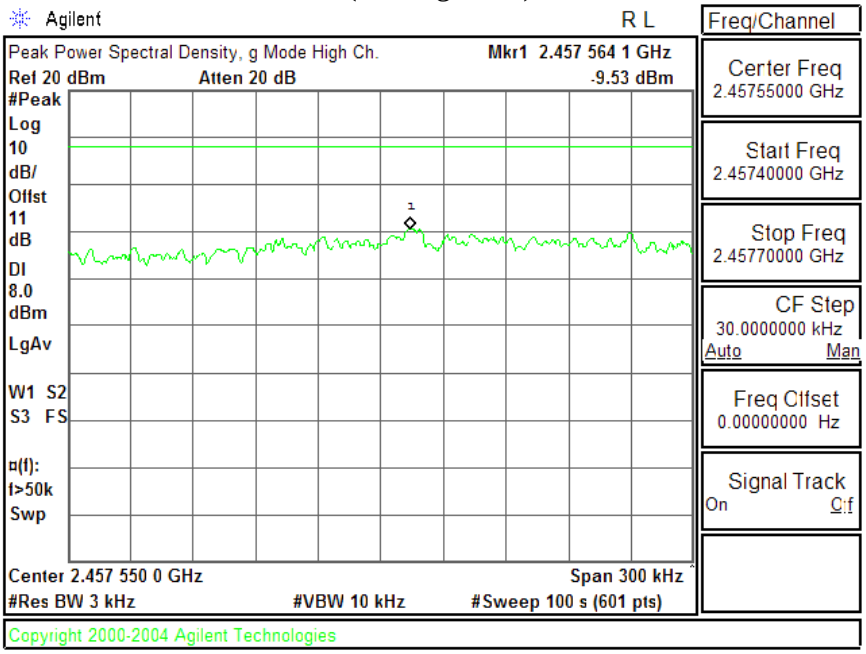
PPSD MID CH, 2437 MHz (802.11g mode)



PPSD HIGH CH, 2457 MHz (802.11g mode)



PPSD HIGH CH, 2462 MHz (802.11g mode)



7.6. CHANNEL TESTS FOR THE 5725 TO 5850 MHz BAND

Please refer to Hitachi Antenna RF conducted test section.

7.6.1. PEAK OUTPUT POWER

PEAK POWER LIMIT

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

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

§15.247 (b) (4) Except as shown in paragraphs (b)(3) (i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

§15.247 (b) (4) (ii) Systems operating in the 5725–5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

TEST PROCEDURE

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

RESULTS

The maximum antenna gain is 7.44 dBi for other than fixed, point-to-point operations, therefore the limit is 28.56dBm.

No non-compliance noted:

802.11a Mode

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	5745	24.23	28.56	-4.33
Middle	5785	24.13	28.56	-4.43
High	5825	23.82	28.56	-4.74

7.6.2. MAXIMUM PERMISSIBLE EXPOSURE

LIMITS

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

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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

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

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

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

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

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

CALCULATIONS

Given

E = √ (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 = √ ((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 * √ ((30 * (P / 1000) * G) / (3770 * S))
d = 0.282 * √ (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) / √ S Equation (1)

where

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

Equation (1) and the measured peak power is used to calculate the MPE distance.

LIMITS

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

RESULTS

No non-compliance noted:

Mode	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
802.11a	20.0	24.23	7.44	0.29

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.

MIMO MODE

7.7. CHANNEL TESTS FOR THE 2400 TO 2483.5 MHz BAND

7.7.1. PEAK OUTPUT POWER

PEAK POWER LIMIT

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

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

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz , and 5725-5850 MHz bands: 1 watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

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

TEST PROCEDURE

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

The test is performed in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005. The transmitter operates continuously therefore Power Output Option 2, Method # 1 is used.

RESULTS,

The maximum antenna gain is 2.15 dBi for other than fixed, point-to-point operations, therefore the limit is 30 dBm.

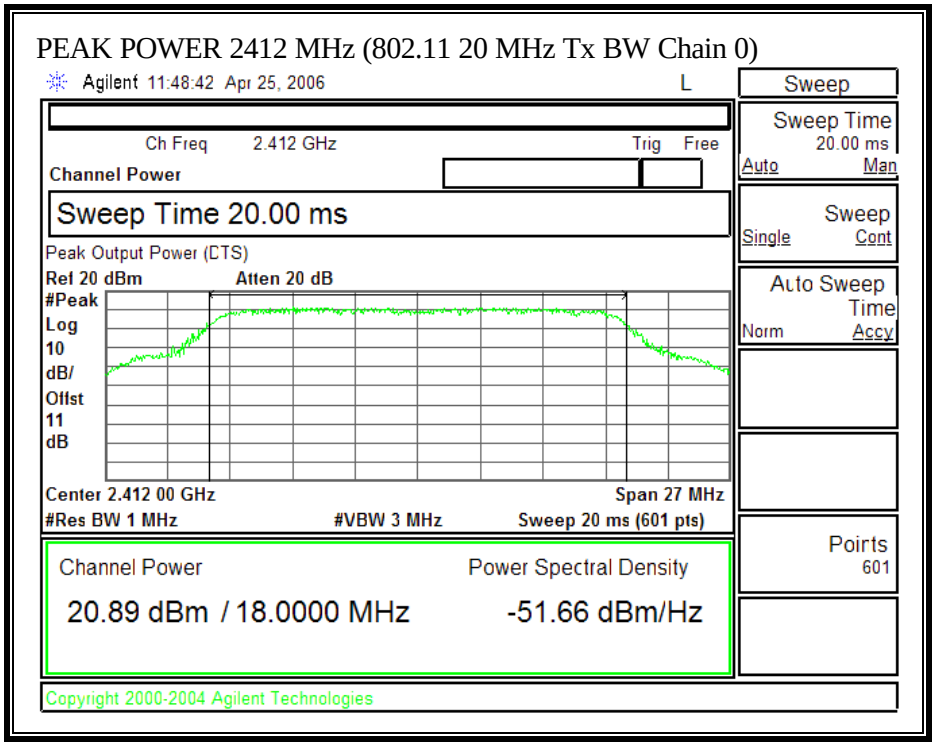
Total peak power calculation formula: 10 log (10^ (Pchain0 / 10) + 10^ (Pchain1 / 10))

Note: Pchain 0 and Pchain1 are in dBm

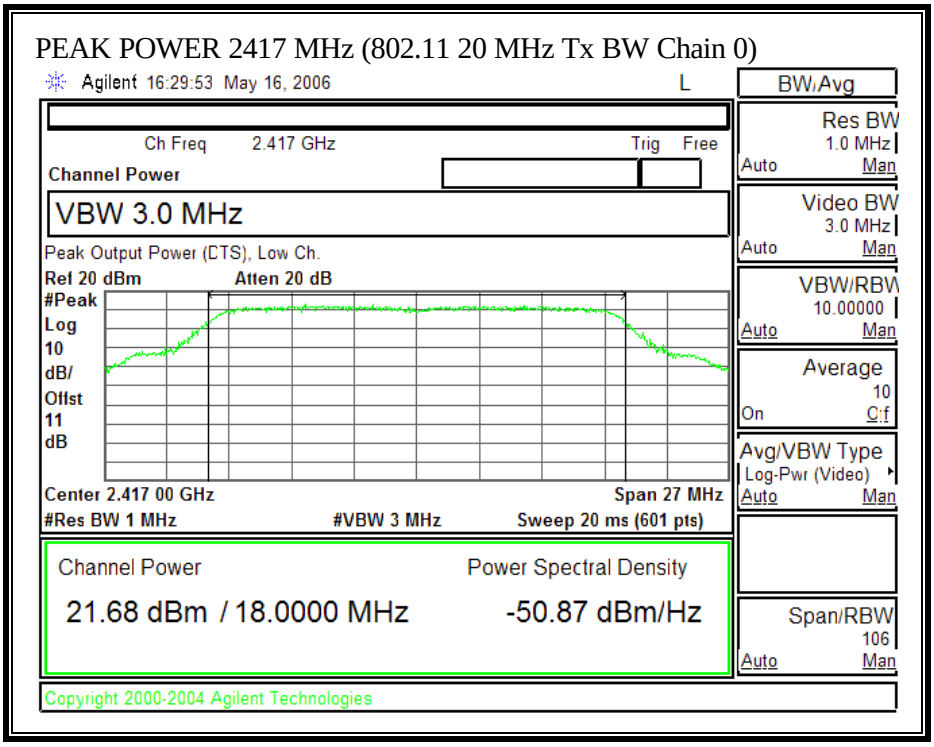
No non-compliance noted:

Channel	Frequency (MHz)	Peak Power Chain 0 (dBm)	Peak Power Chain 1 (dBm)	Peak Power Total (dBm)	Limit (dBm)	Margin (dB)
20 MHz TX BANDWIDTH						
Low	2412	20.89	20.91	23.91	30.0	-6.09
Low	2417	21.68	21.90	24.80	30.0	-5.20
Low	2422	21.62	21.98	24.81	30.0	-5.19
Middle	2437	21.26	22.03	24.67	30.0	-5.33
High	2457	21.32	21.96	24.66	30.0	-5.34
High	2462	20.16	20.74	23.47	30.0	-6.53
40 MHz TX BANDWIDTH						
Low	2422	19.17	18.85	22.02	30.0	-7.98
Low	2427	19.61	19.36	22.50	30.0	-7.50
Middle	2437	19.89	19.41	22.67	30.0	-7.33
High	2442	20.02	19.27	22.67	30.0	-7.33
High	2447	20.14	20.17	23.17	30.0	-6.83
High	2452	18.84	18.77	21.82	30.0	-8.18

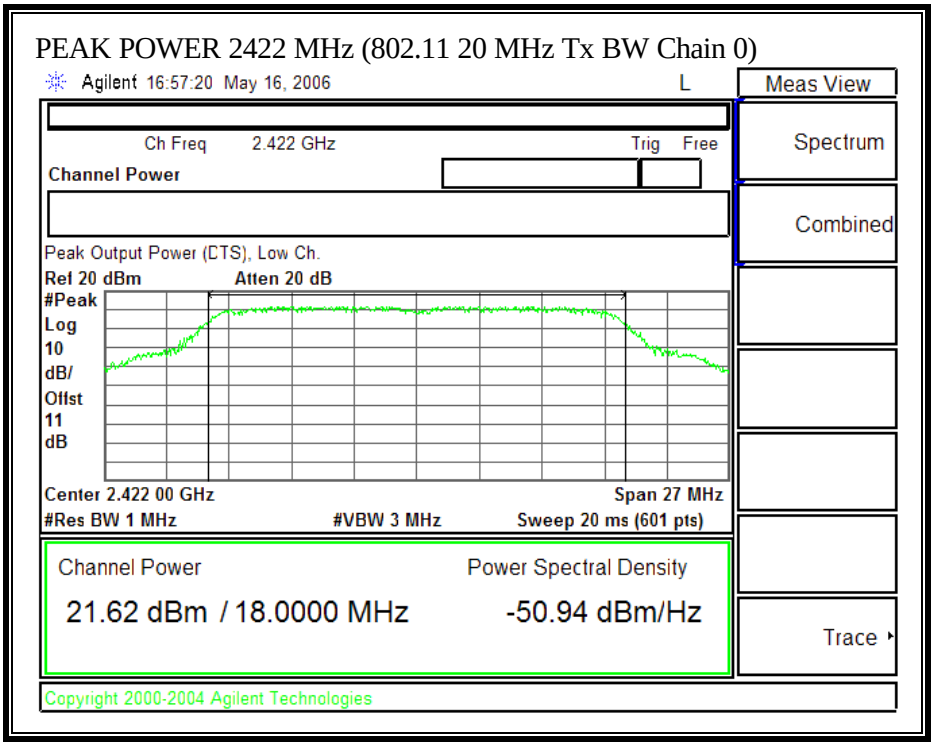
OUTPUT POWER (802.11 20 MHz TX BANDWIDTH – CHAIN 0)



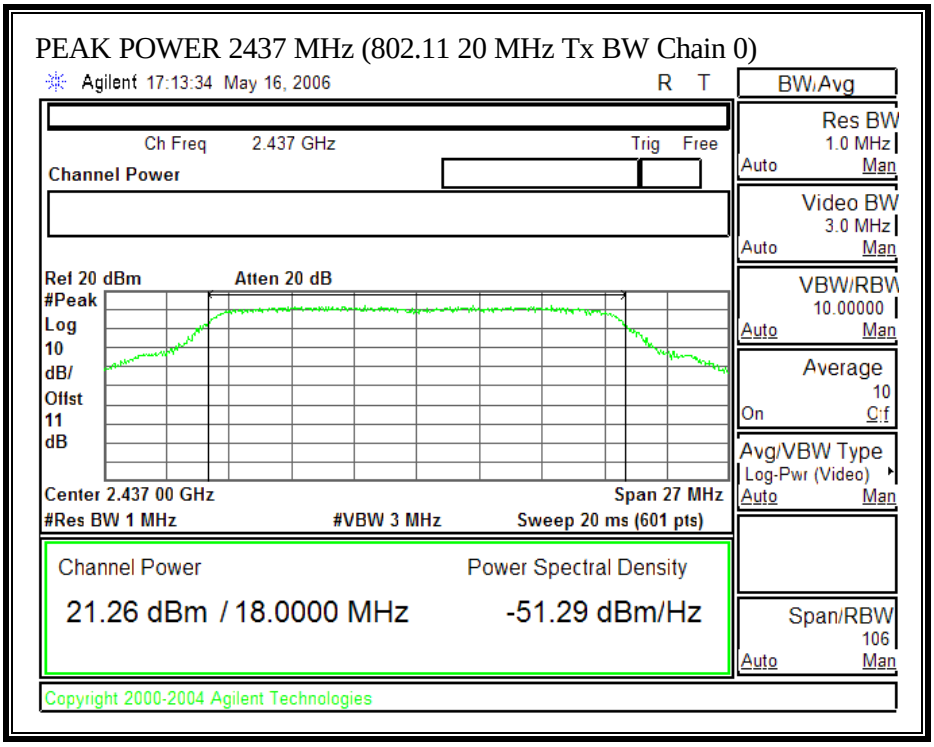
PEAK POWER 2417 MHz (802.11 20 MHz Tx BW Chain 0)



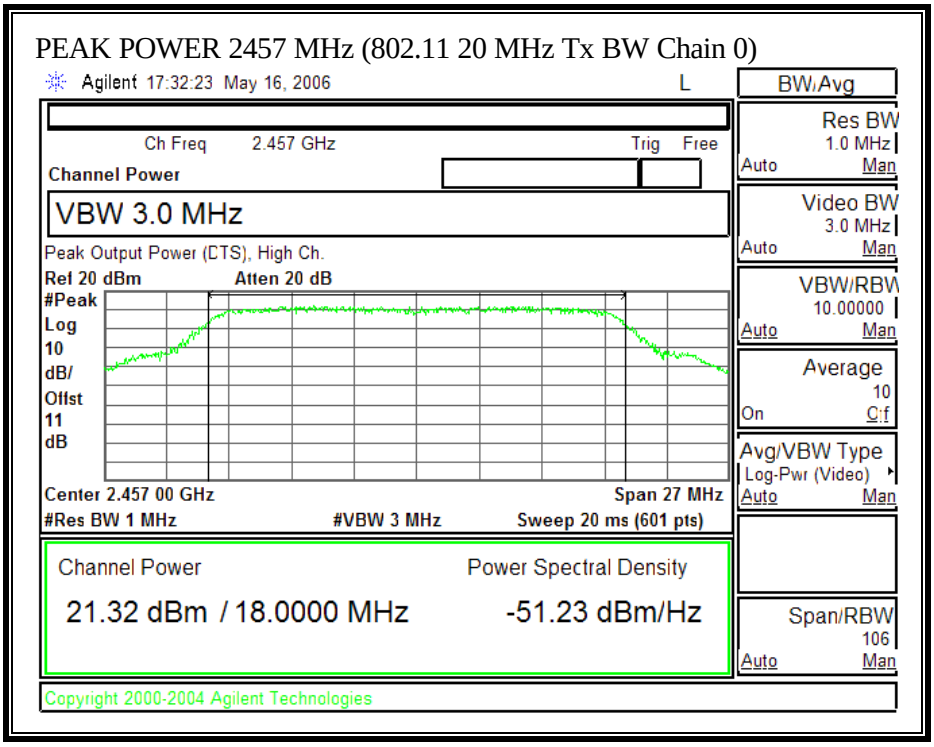
PEAK POWER 2422 MHz (802.11 20 MHz Tx BW Chain 0)



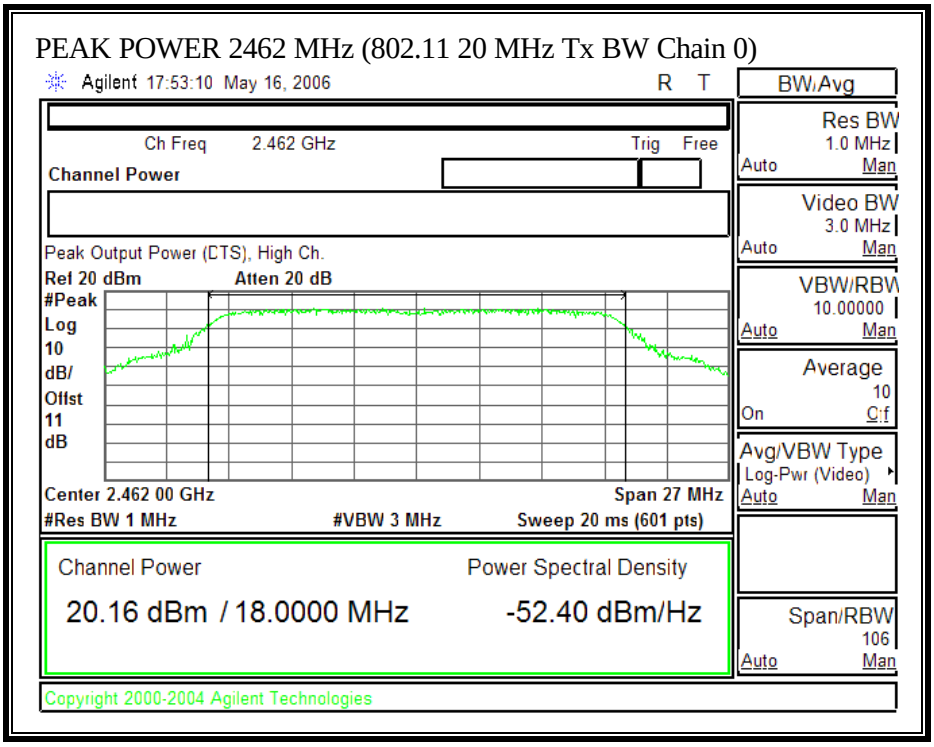
PEAK POWER 2437 MHz (802.11 20 MHz Tx BW Chain 0)



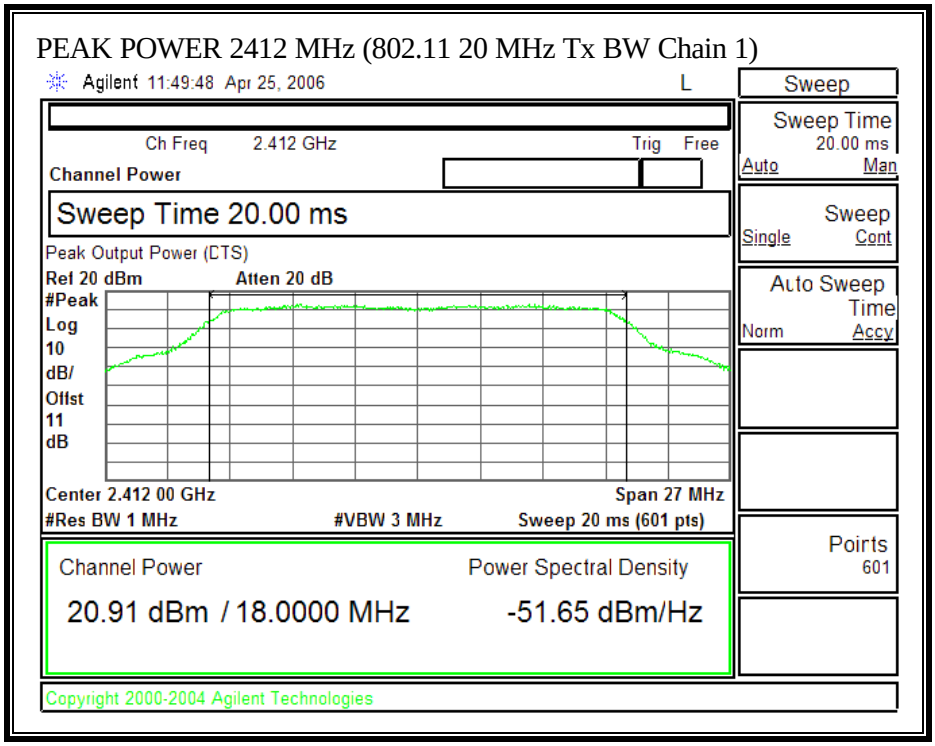
PEAK POWER 2457 MHz (802.11 20 MHz Tx BW Chain 0)



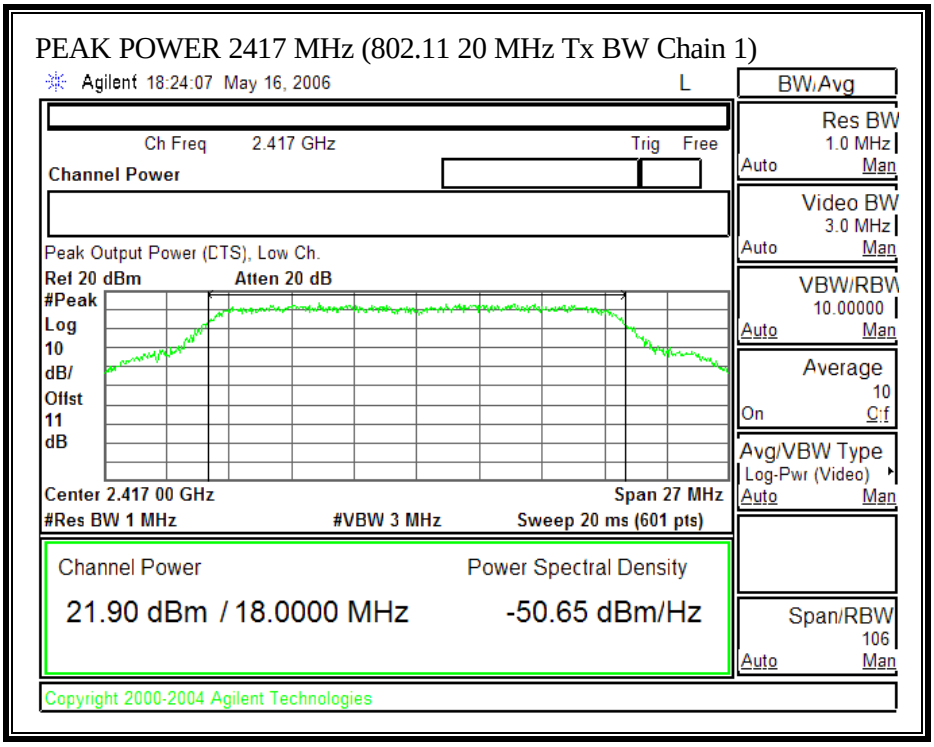
PEAK POWER 2462 MHz (802.11 20 MHz Tx BW Chain 0)



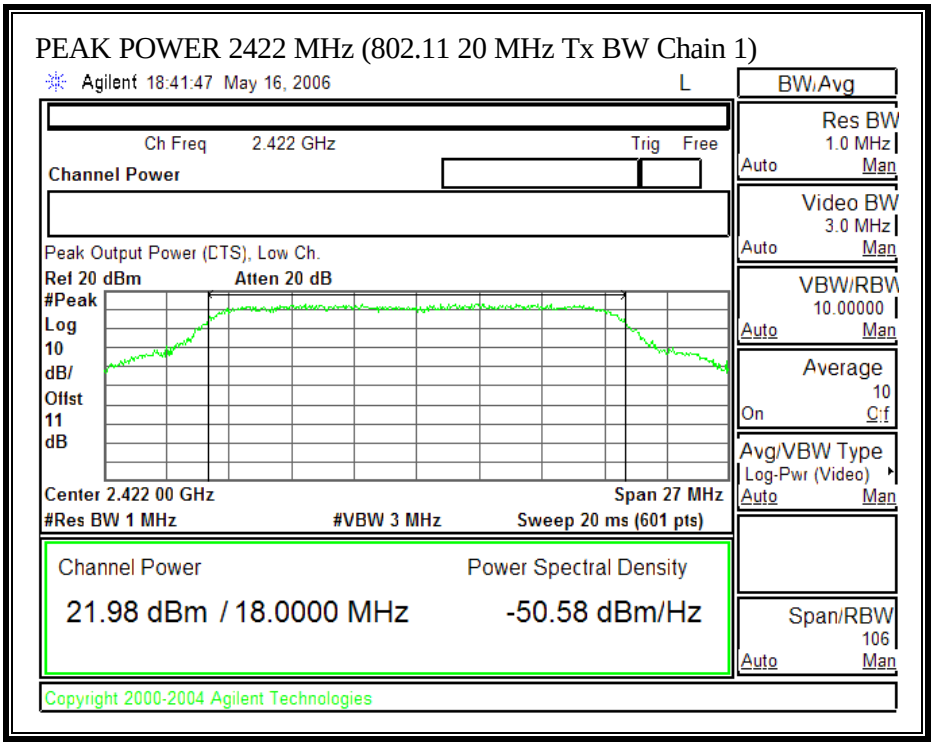
OUTPUT POWER (802.11 20 MHz TX BANDWIDTH – CHAIN 1)



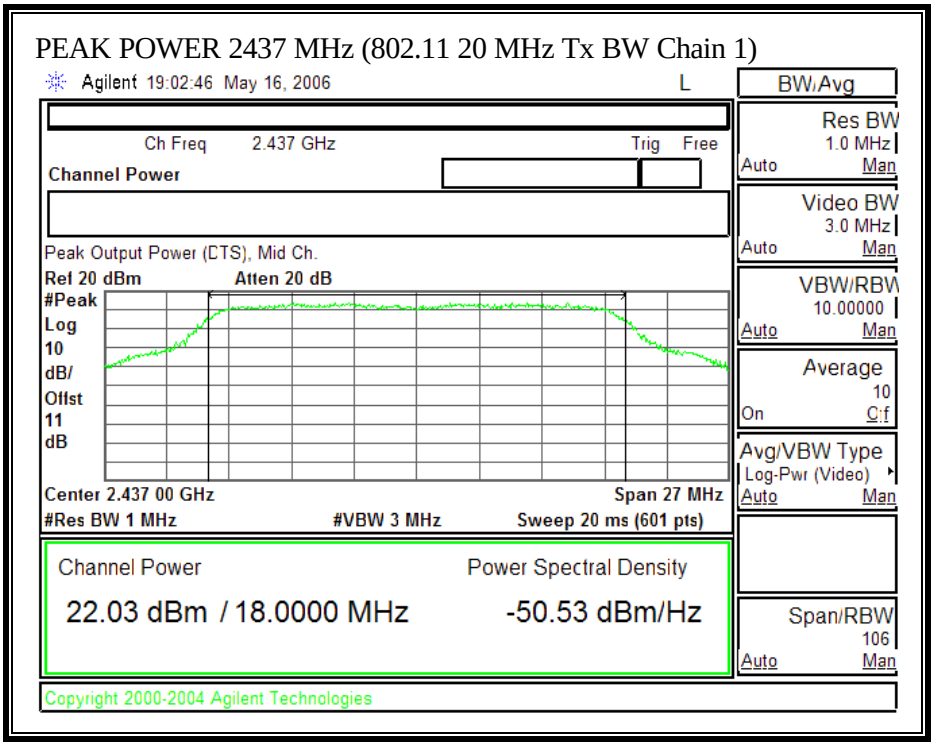
PEAK POWER 2417 MHz (802.11 20 MHz Tx BW Chain 1)



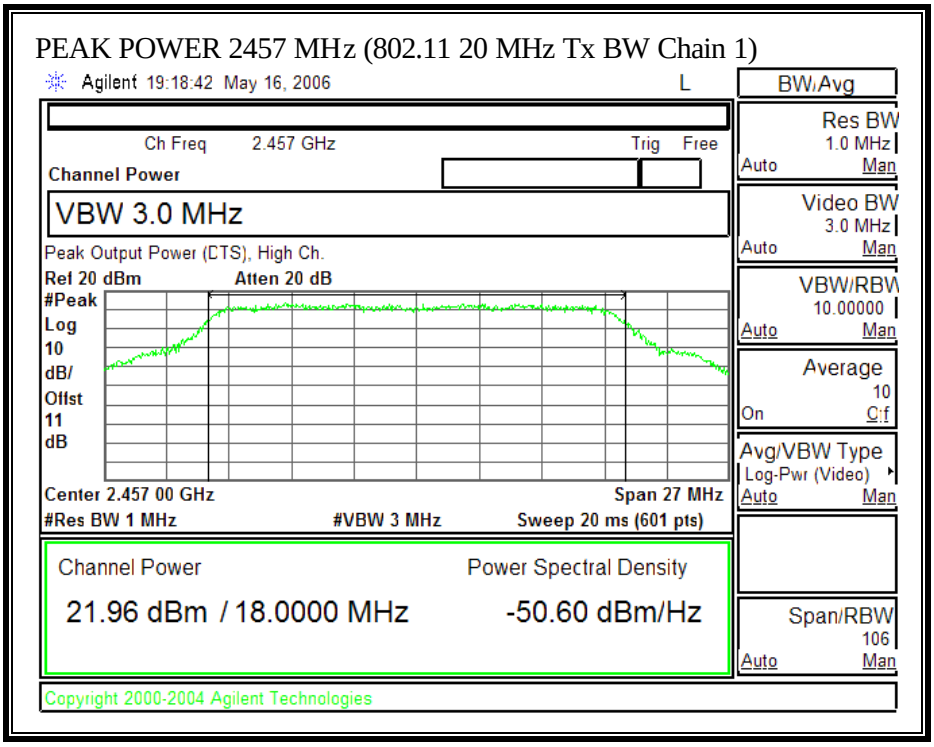
PEAK POWER 2422 MHz (802.11 20 MHz Tx BW Chain 1)



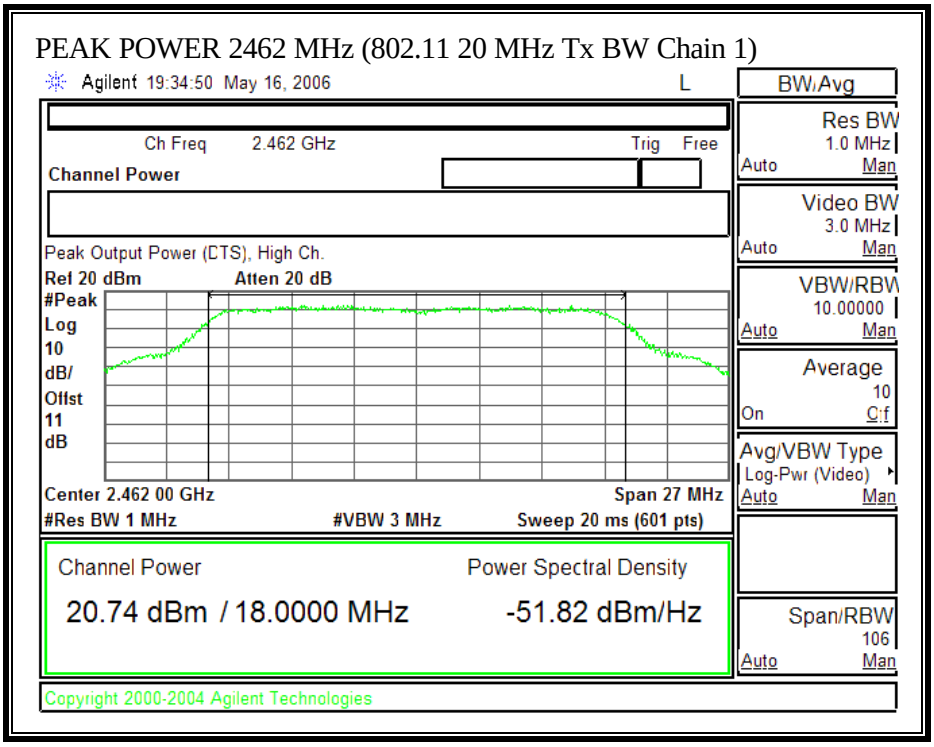
PEAK POWER 2437 MHz (802.11 20 MHz Tx BW Chain 1)



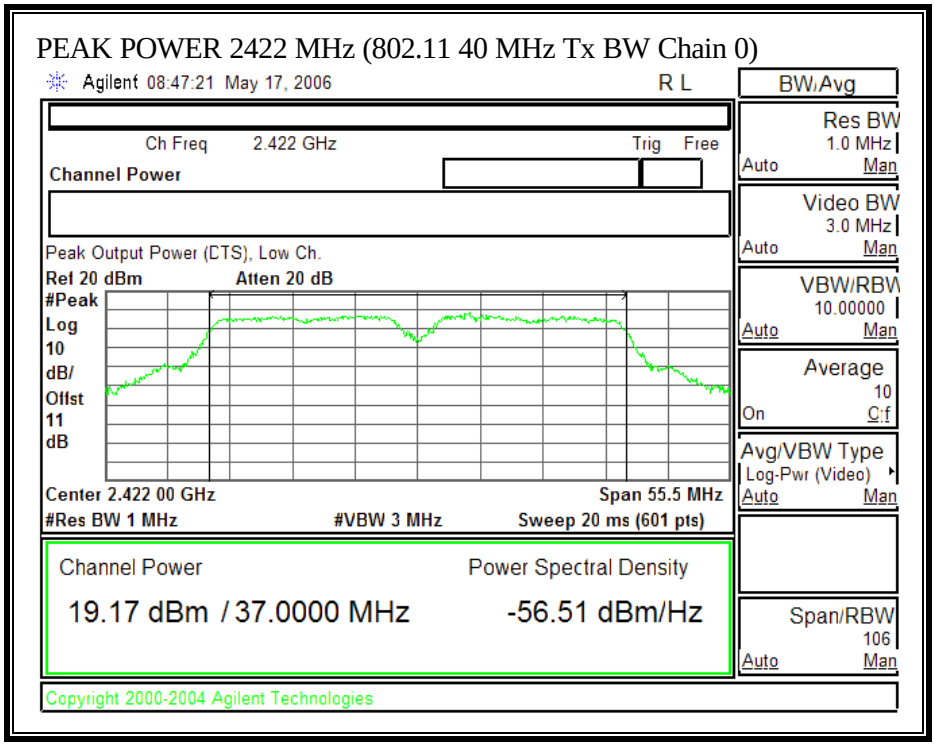
PEAK POWER 2457 MHz (802.11 20 MHz Tx BW Chain 1)



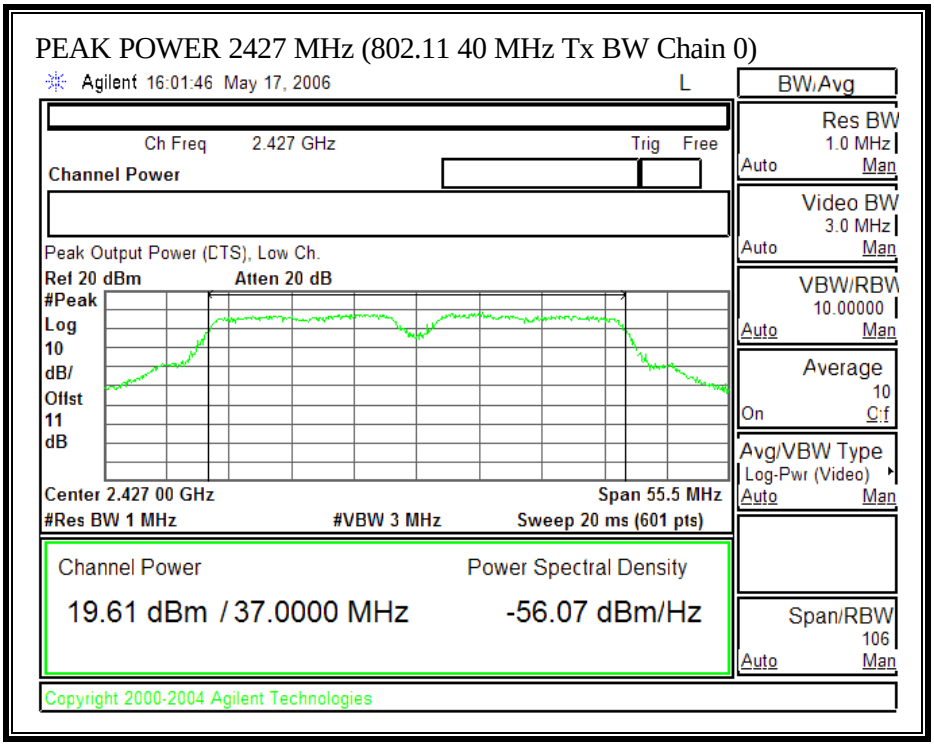
PEAK POWER 2462 MHz (802.11 20 MHz Tx BW Chain 1)



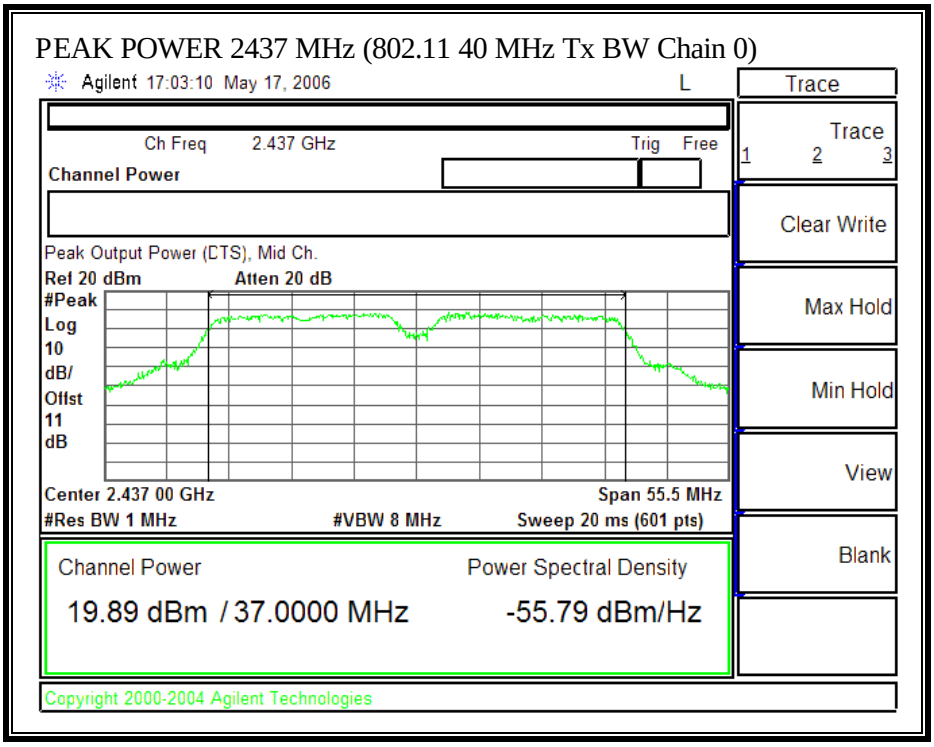
OUTPUT POWER (802.11 40 MHz TX BANDWIDTH – CHAIN 0)



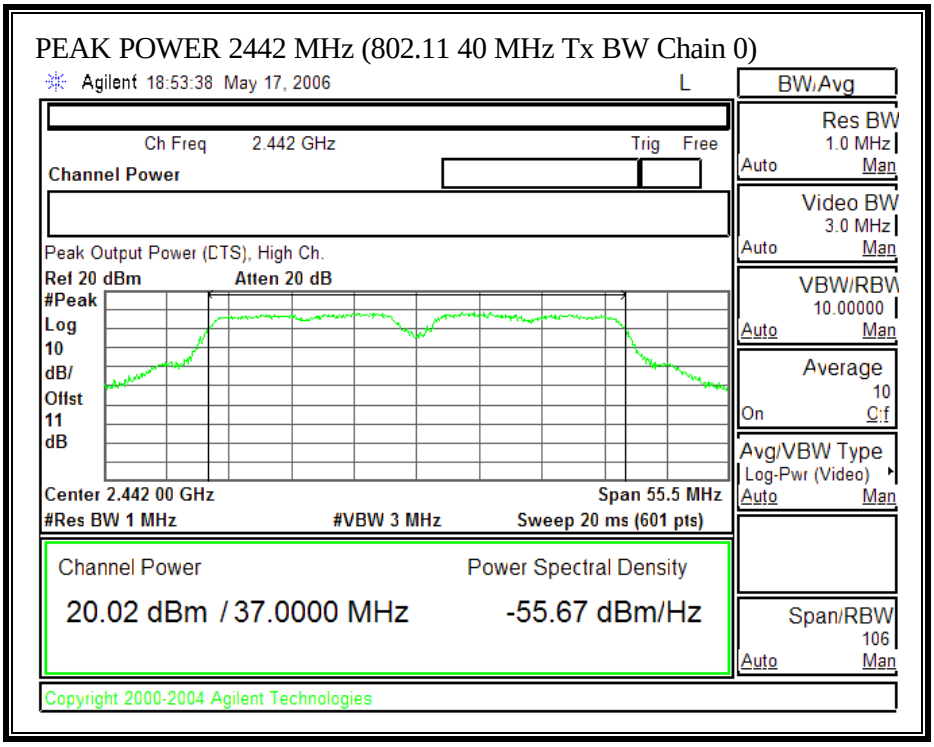
PEAK POWER 2427 MHz (802.11 40 MHz Tx BW Chain 0)



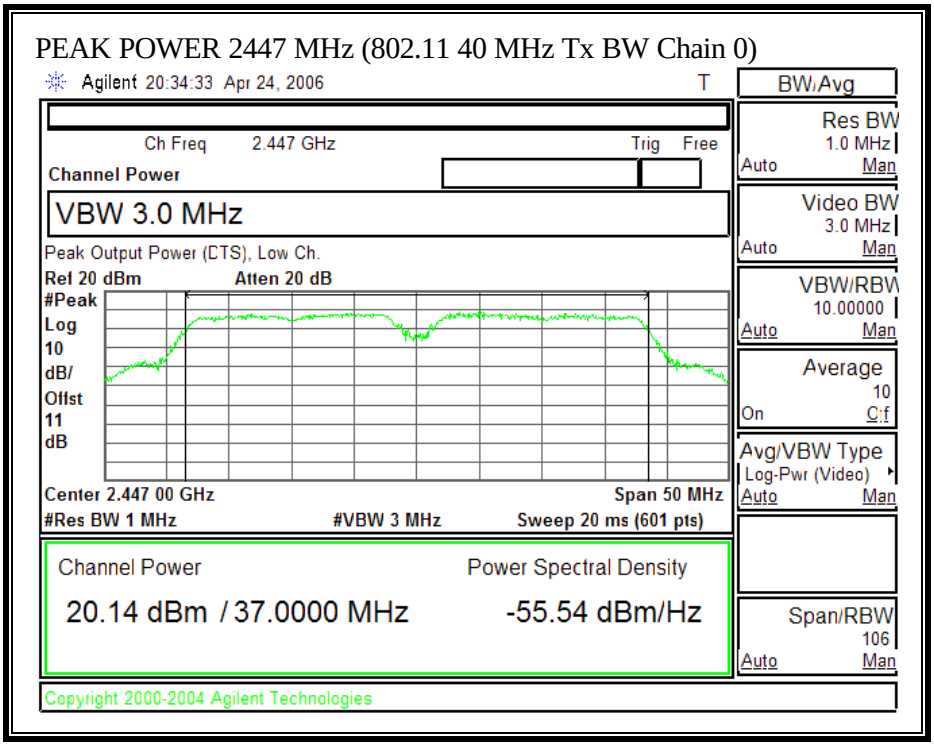
PEAK POWER 2437 MHz (802.11 40 MHz Tx BW Chain 0)



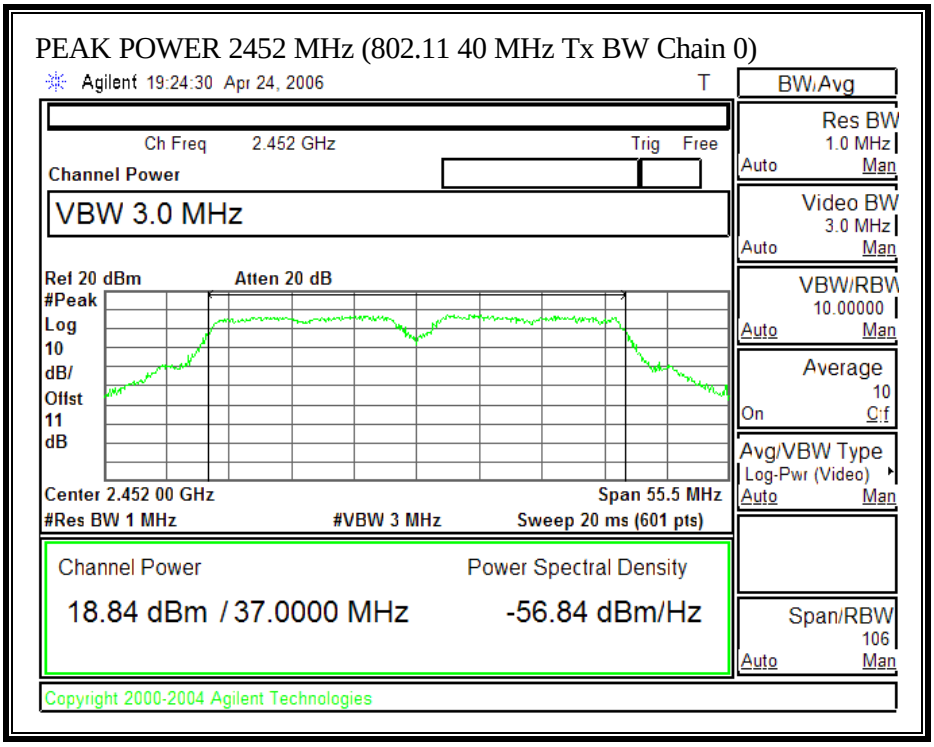
PEAK POWER 2442 MHz (802.11 40 MHz Tx BW Chain 0)



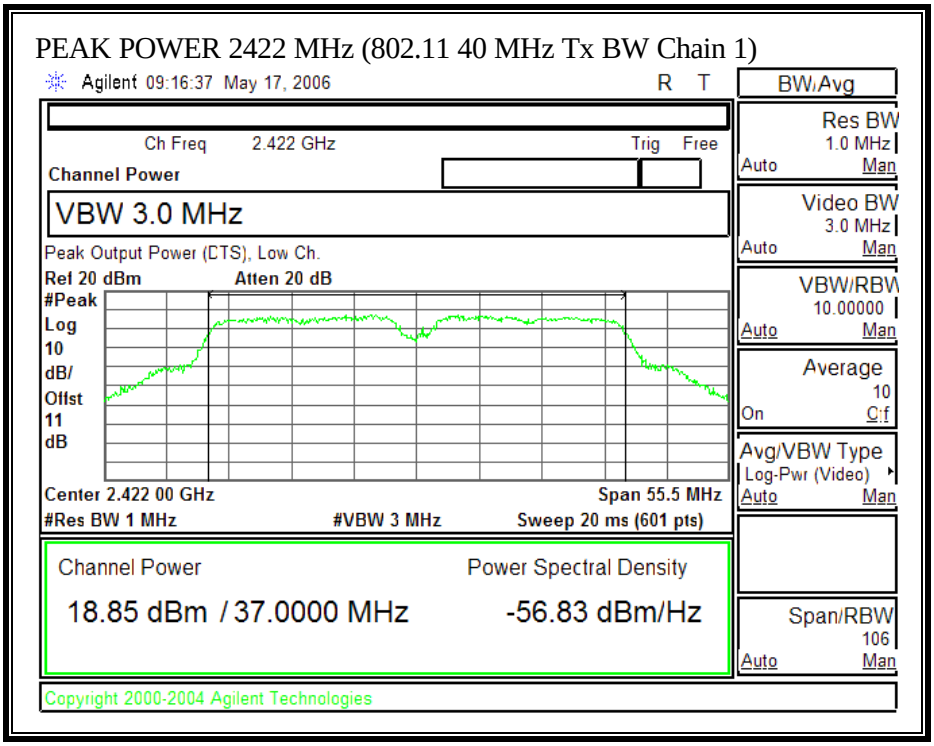
PEAK POWER 2447 MHz (802.11 40 MHz Tx BW Chain 0)



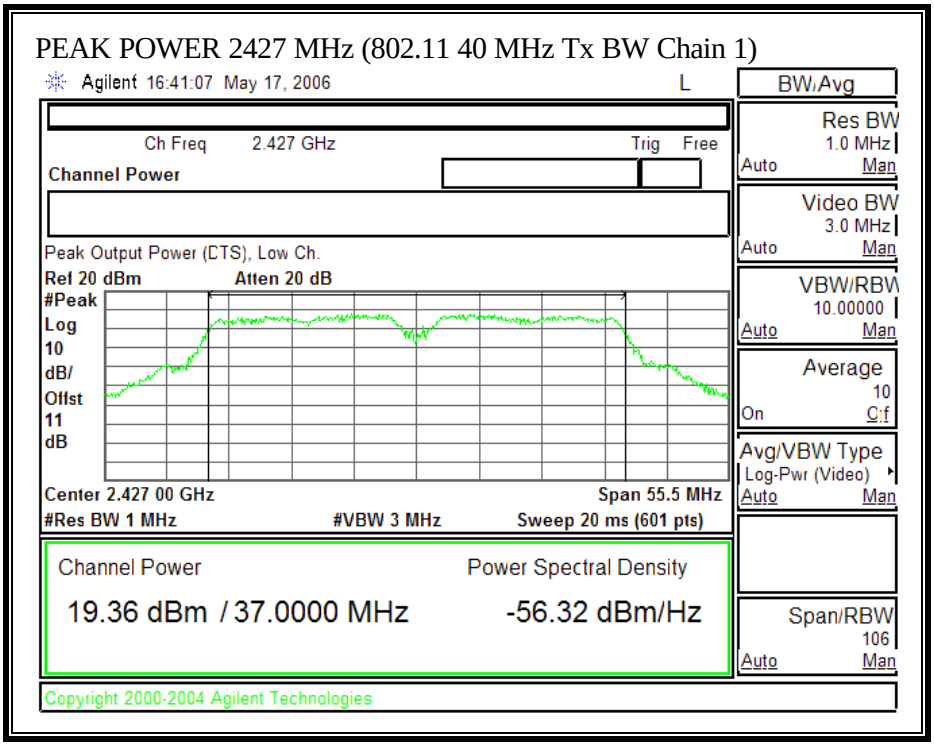
PEAK POWER 2452 MHz (802.11 40 MHz Tx BW Chain 0)



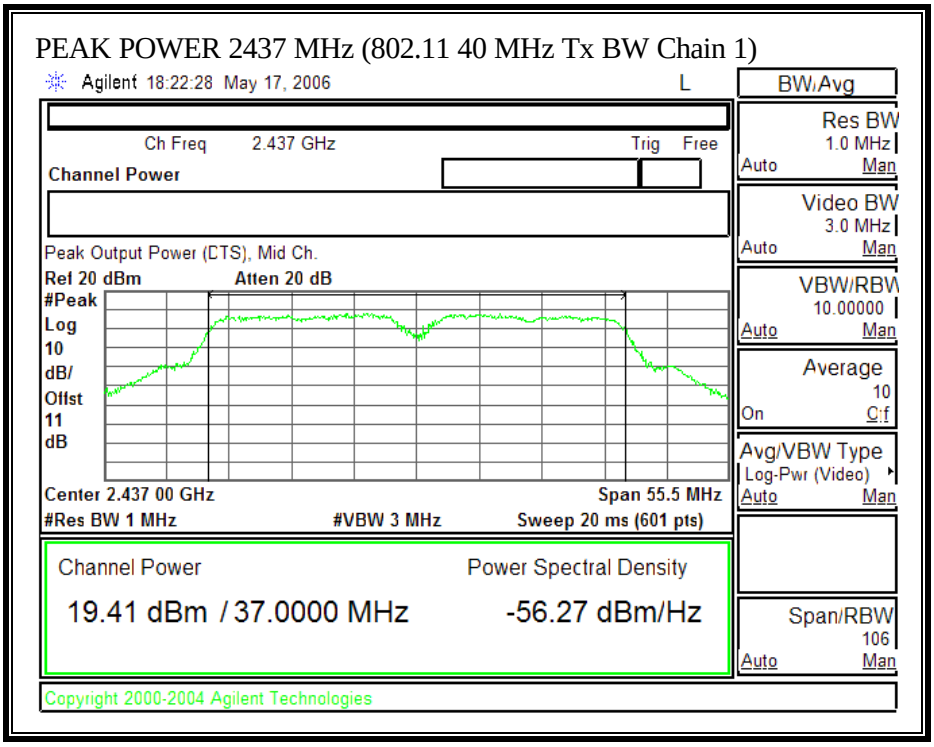
OUTPUT POWER (802.11 40 MHz TX BANDWIDTH – CHAIN 1)



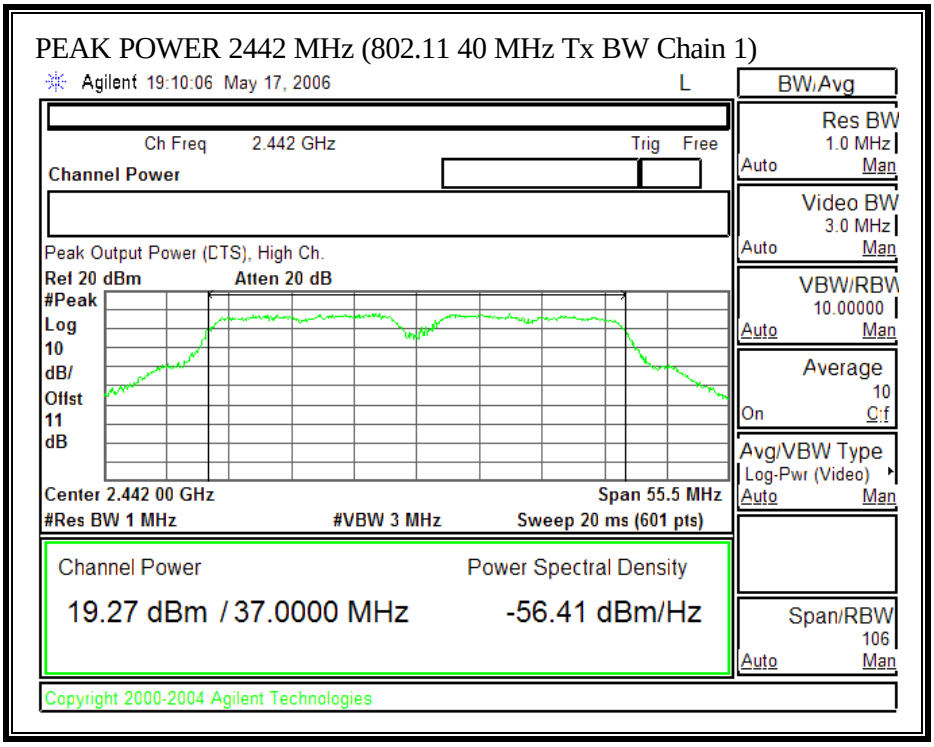
PEAK POWER 2427 MHz (802.11 40 MHz Tx BW Chain 1)



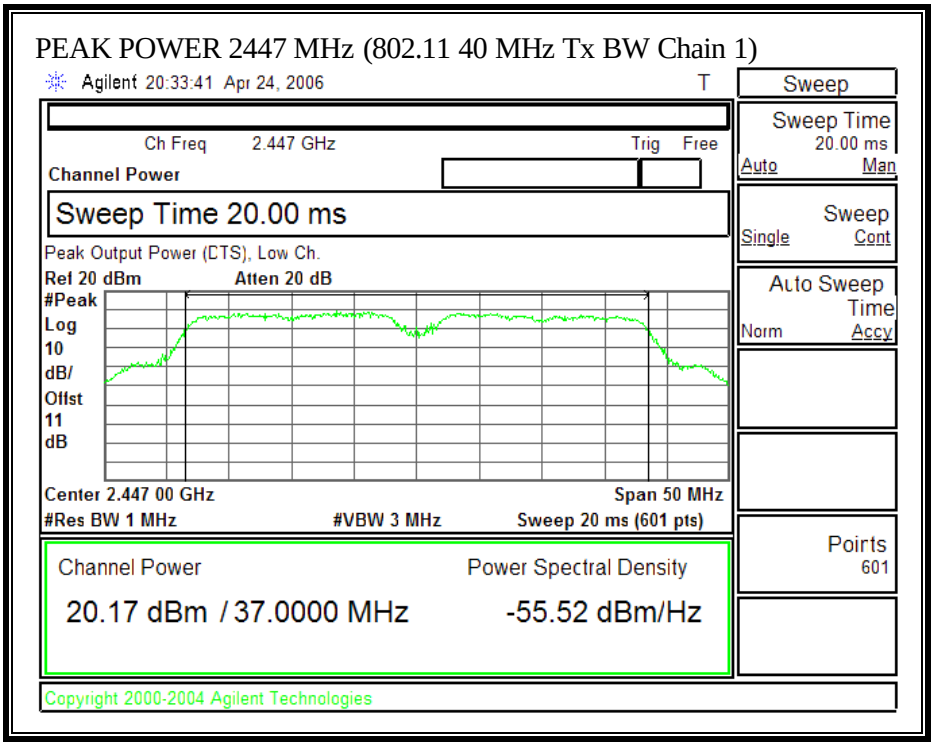
PEAK POWER 2437 MHz (802.11 40 MHz Tx BW Chain 1)



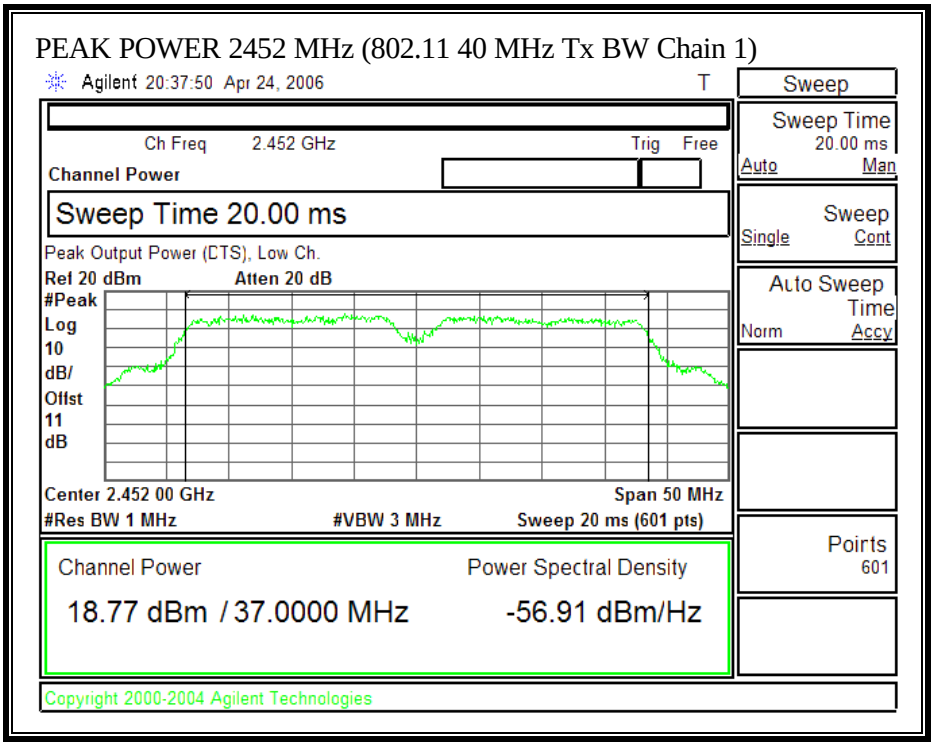
PEAK POWER 2442 MHz (802.11 40 MHz Tx BW Chain 1)



PEAK POWER 2447 MHz (802.11 40 MHz Tx BW Chain 1)



PEAK POWER 2452 MHz (802.11 40 MHz Tx BW Chain 1)



7.7.2. MAXIMUM PERMISSIBLE EXPOSURE

LIMITS

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

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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

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

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

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

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

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

CALCULATIONS

Given

E = √ (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 = √ ((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 * √ ((30 * (P / 1000) * G) / (3770 * S))
d = 0.282 * √ (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) / √ S

where

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

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

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

LIMITS

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

RESULTS

No non-compliance noted

Mode	MPE Distance (cm)	Peak Power Chain 0 (dBm)	Peak Power Chain 1 (dBm)	Total Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
20MHz TX BW	20.0	21.62	21.98	24.81	2.15	0.10
40MHz TX BW	20.0	20.14	20.17	23.17	2.15	0.07

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

7.7.3. AVERAGE POWER

AVERAGE POWER LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

No non-compliance noted:

The cable assembly insertion loss of 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

20 MHz TX BANDWIDTH

Channel	Frequency (MHz)	Power Chain 0 (dBm)	Power Chain 1 (dBm)
1	2412	14.40	14.35
2	2417	15.59	15.68
3	2422	15.61	15.65
6	2437	15.72	15.73
10	2457	15.60	15.66
11	2462	13.76	13.64

40 MHz TX BANDWIDTH

Channel	Frequency (MHz)	Power Chain 0 (dBm)	Power Chain 1 (dBm)
3	2422	12.60	12.70
4	2427	13.20	13.27
6	2437	13.38	13.20
7	2442	13.22	13.30
8	2447	13.60	13.70
9	2452	12.30	12.33

7.7.4. PEAK POWER SPECTRAL DENSITY

LIMIT

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

TEST PROCEDURE

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

RESULTS

No non-compliance noted:

20 MHz TX BANDWIDTH

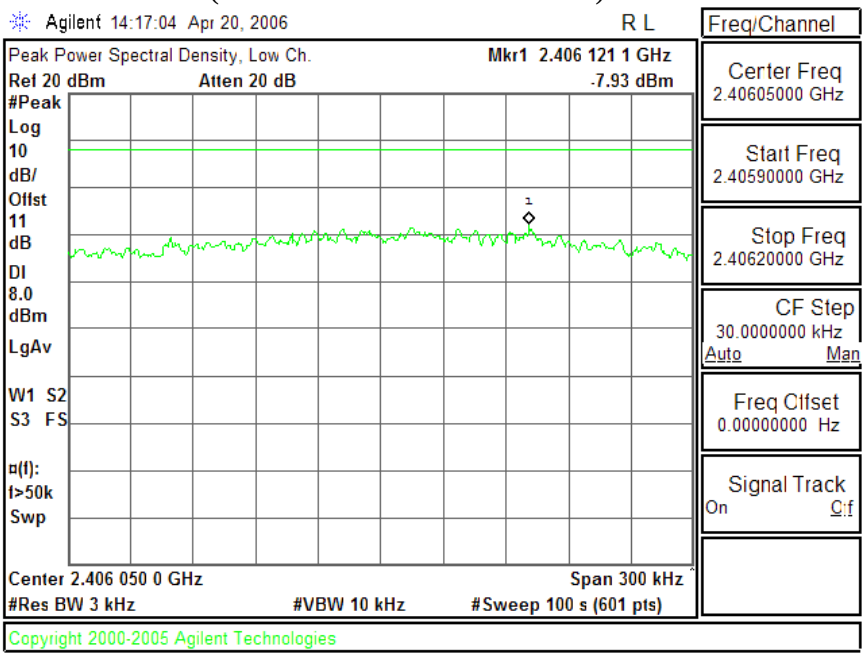
Channel	Frequency (MHz)	PPSD Chain 0 (dBm)	PPSD Chain 1 (dBm)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Low	2412	-7.93	-6.61	-4.21	8	-12.21
Low	2417	-9.39	-8.90	-6.13	8	-14.13
Low	2422	-10.08	-8.87	-6.42	8	-14.42
Middle	2437	-10.47	-8.69	-6.48	8	-14.48
High	2457	-10.55	-6.78	-5.26	8	-13.26
High	2462	-11.62	-9.98	-7.71	8	-15.71

40 MHz TX BANDWIDTH

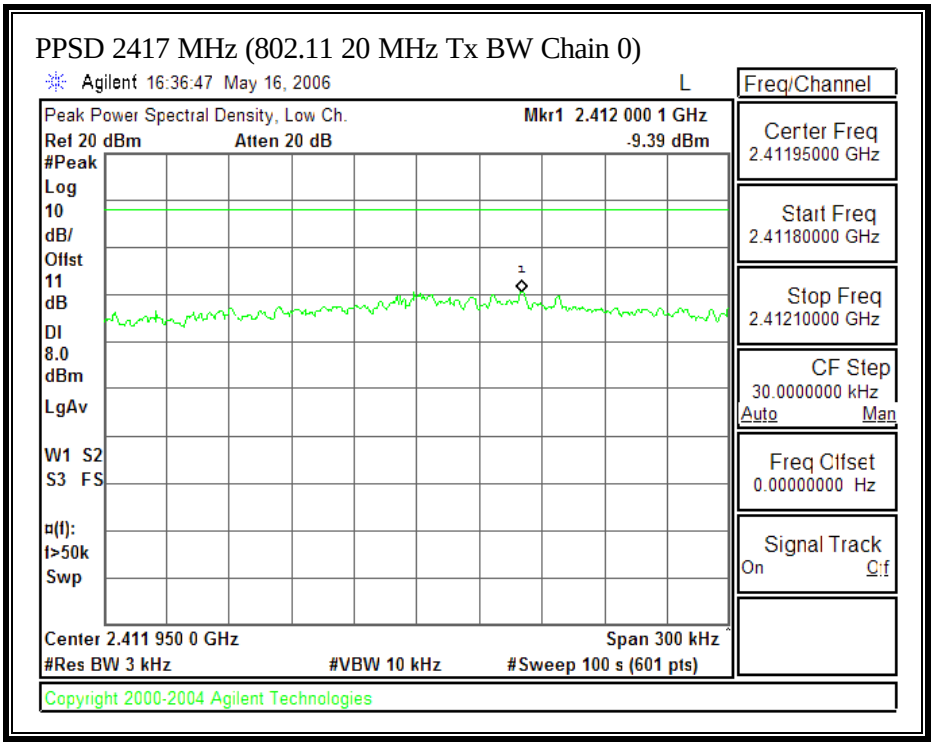
Channel	Frequency (MHz)	PPSD Chain 0 (dBm)	PPSD Chain 1 (dBm)	PPSD Total (dBm)	Limit (dBm)	Margin (dB)
Low	2422	-15.00	-13.40	-11.12	8	-19.12
Low	2427	-13.63	-13.56	-10.58	8	-18.58
Middle	2437	-13.85	-13.14	-10.47	8	-18.47
High	2442	-14.04	-14.71	-11.35	8	-19.35
High	2447	-13.58	-12.87	-10.20	8	-18.20
High	2452	-15.03	-14.11	-11.54	8	-19.54

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

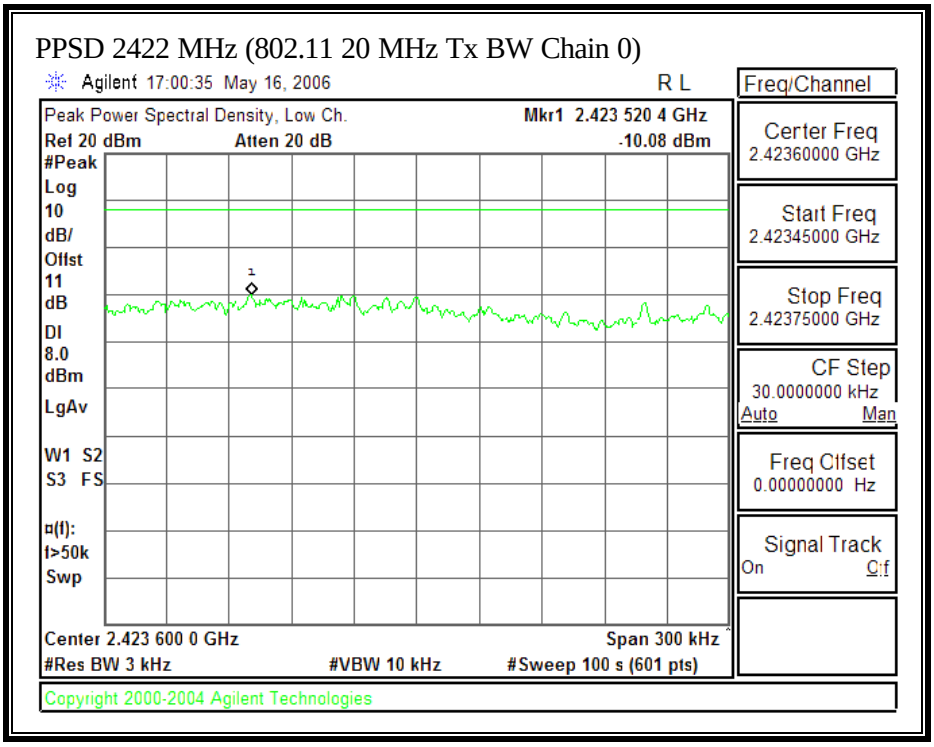
PPSD 2412 MHz (802.11 20 MHz Tx BW Chain 0)



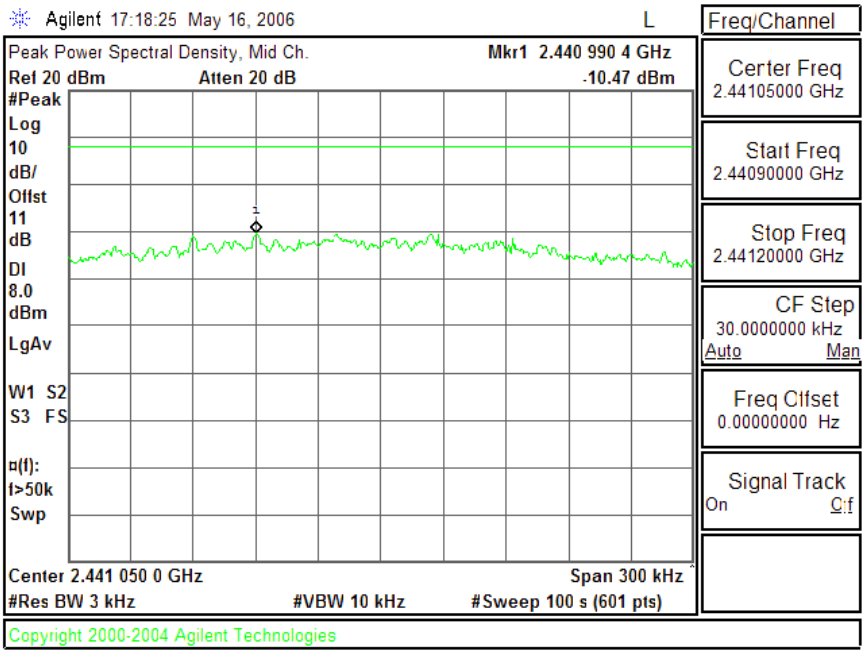
PPSD 2417 MHz (802.11 20 MHz Tx BW Chain 0)



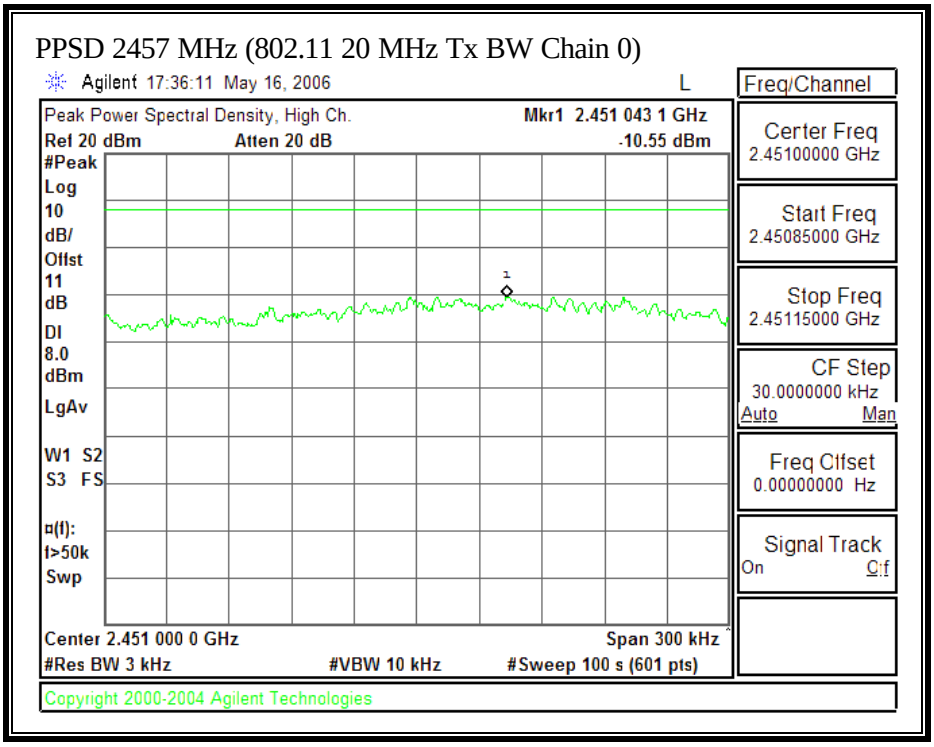
PPSD 2422 MHz (802.11 20 MHz Tx BW Chain 0)



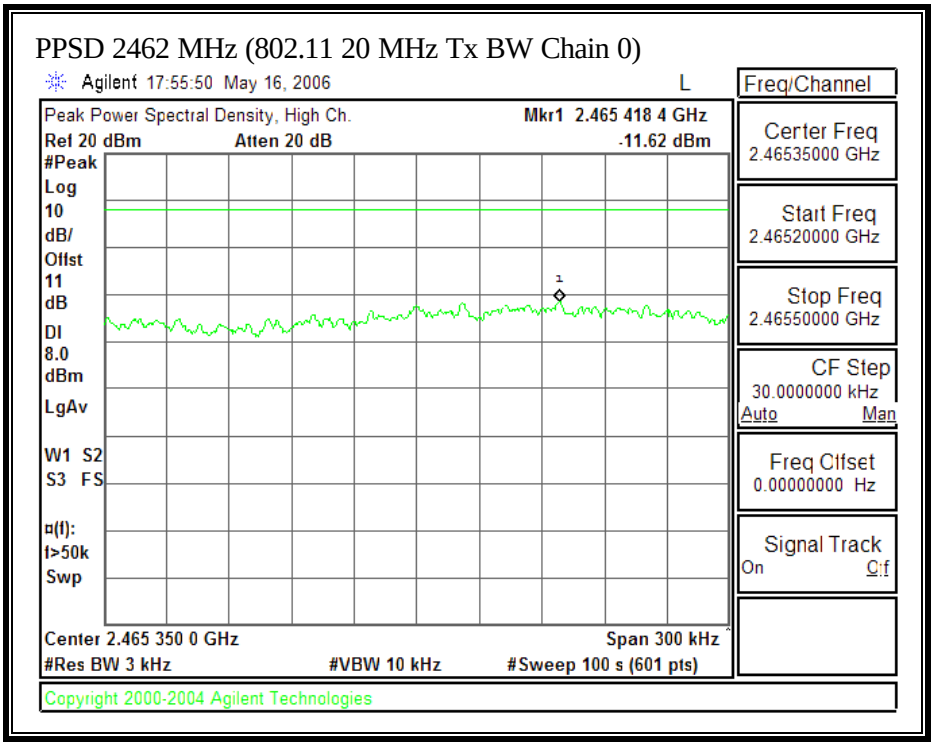
PPSD 2437 MHz (802.11 20 MHz Tx BW Chain 0)



PPSD 2457 MHz (802.11 20 MHz Tx BW Chain 0)

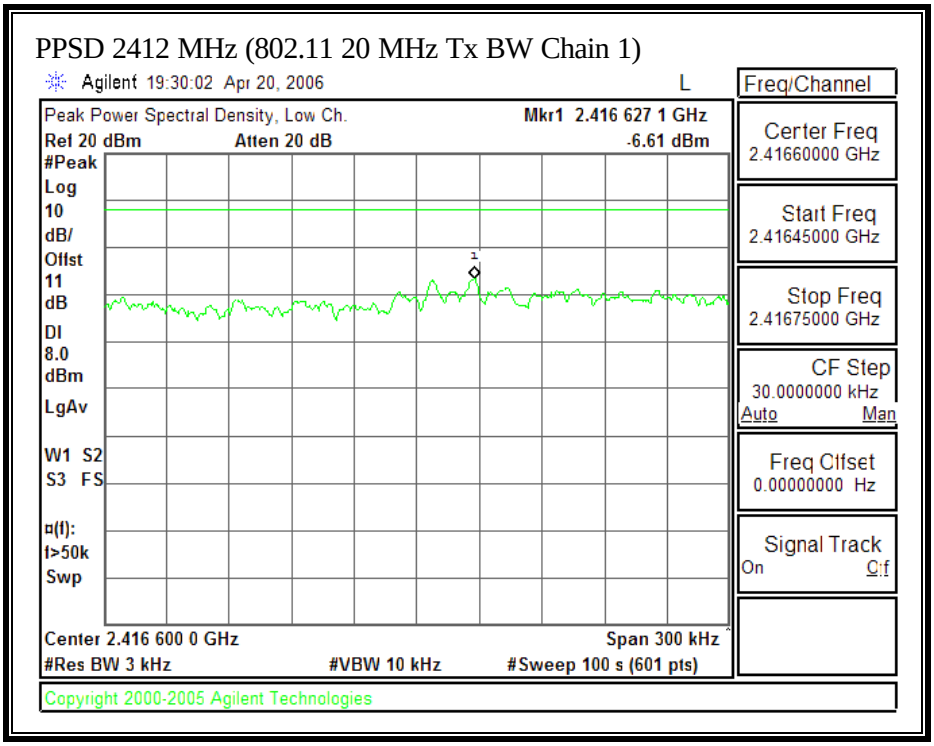


PPSD 2462 MHz (802.11 20 MHz Tx BW Chain 0)

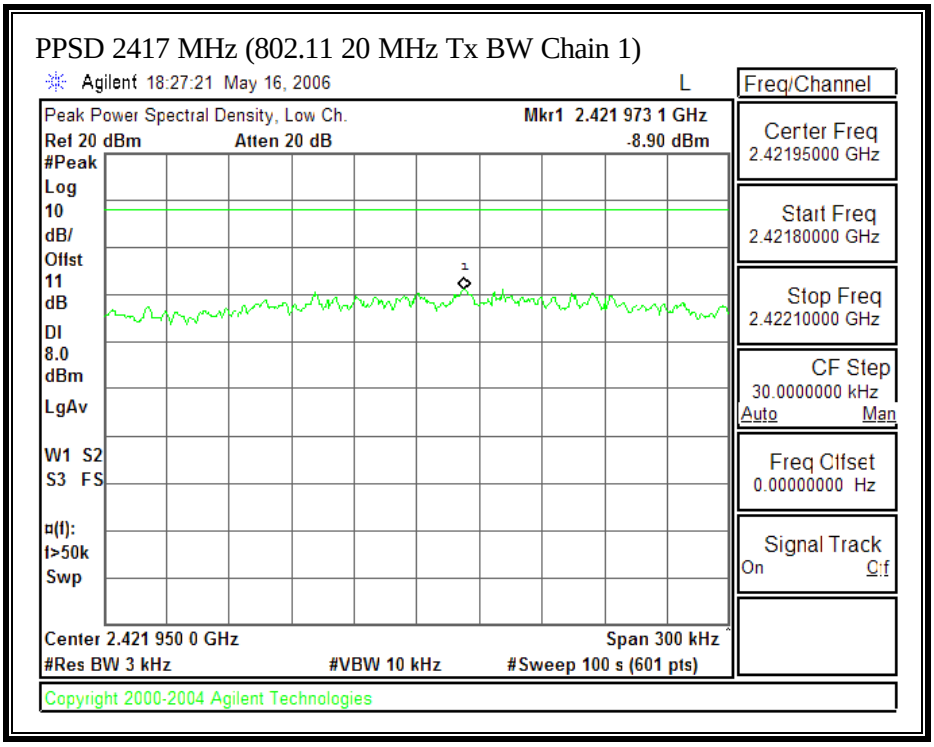


PEAK POWER SPECTRAL DENSITY (802.11 20 MHz TX BANDWIDTH – CHAIN 1)

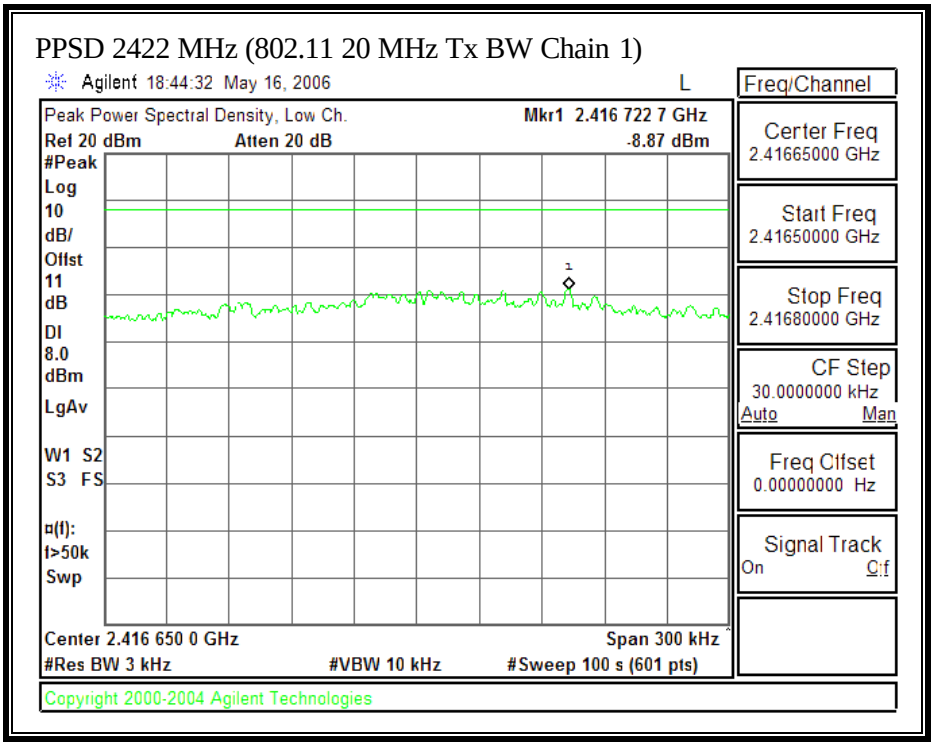
PPSD 2412 MHz (802.11 20 MHz Tx BW Chain 1)



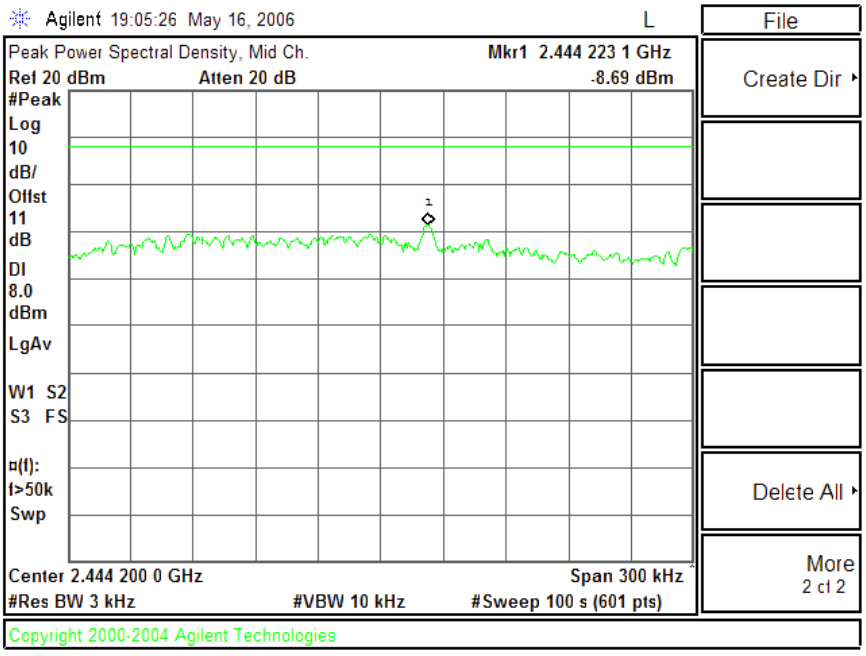
PPSD 2417 MHz (802.11 20 MHz Tx BW Chain 1)



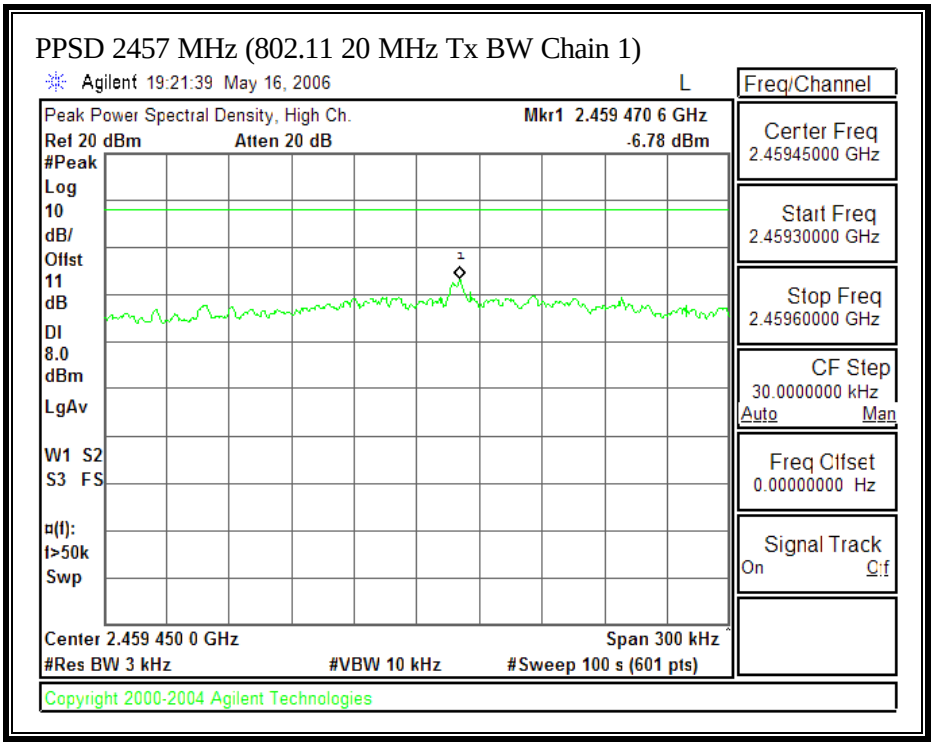
PPSD 2422 MHz (802.11 20 MHz Tx BW Chain 1)



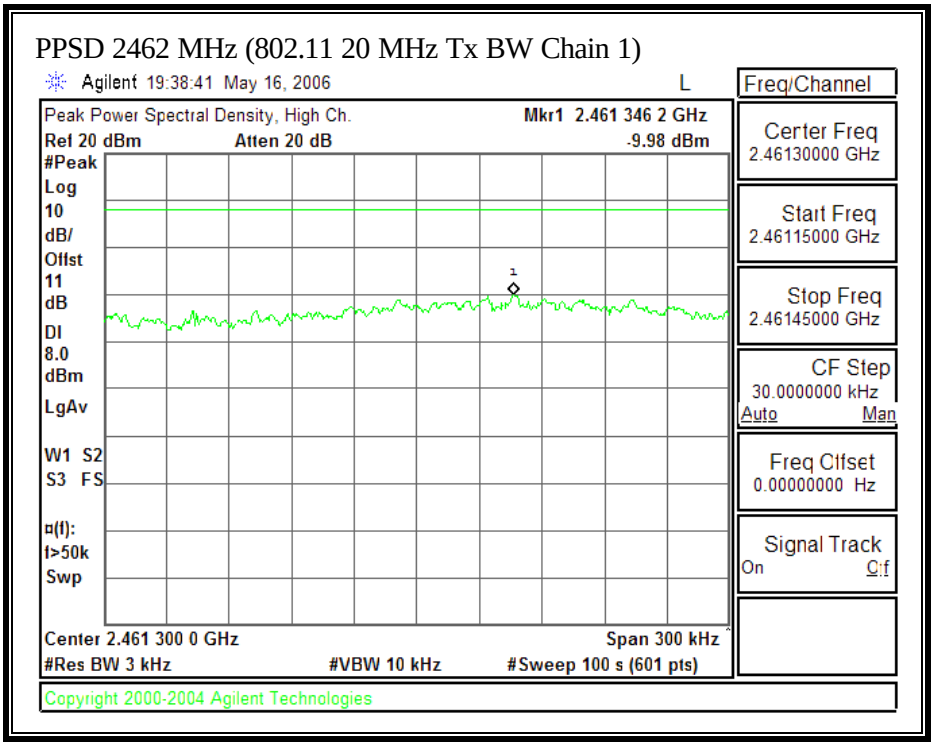
PPSD 2437 MHz (802.11 20 MHz Tx BW Chain 1)



PPSD 2457 MHz (802.11 20 MHz Tx BW Chain 1)

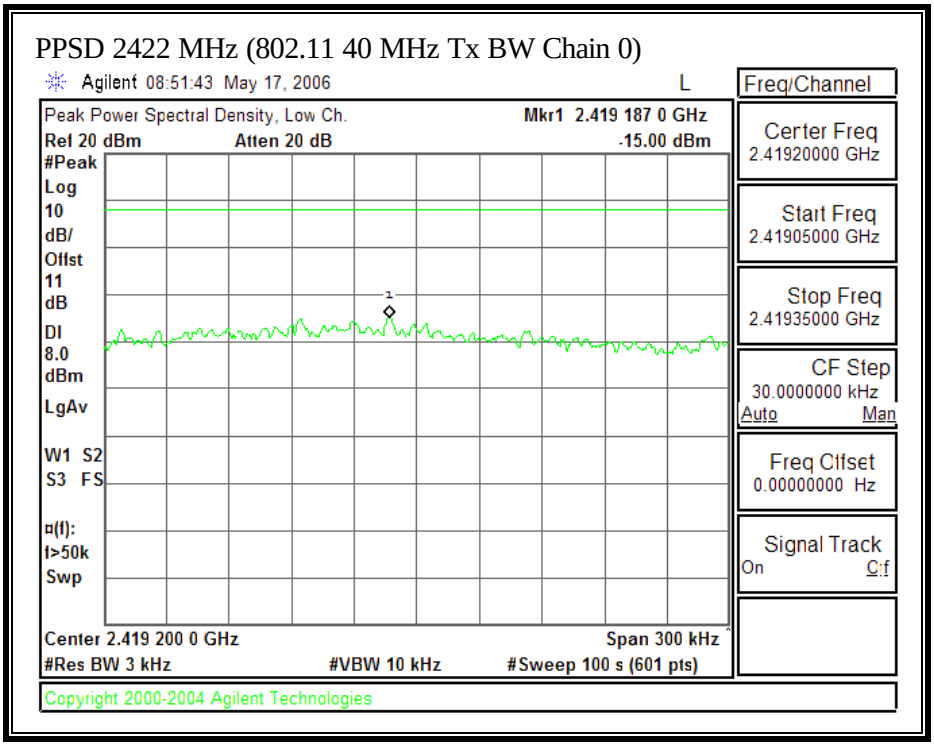


PPSD 2462 MHz (802.11 20 MHz Tx BW Chain 1)

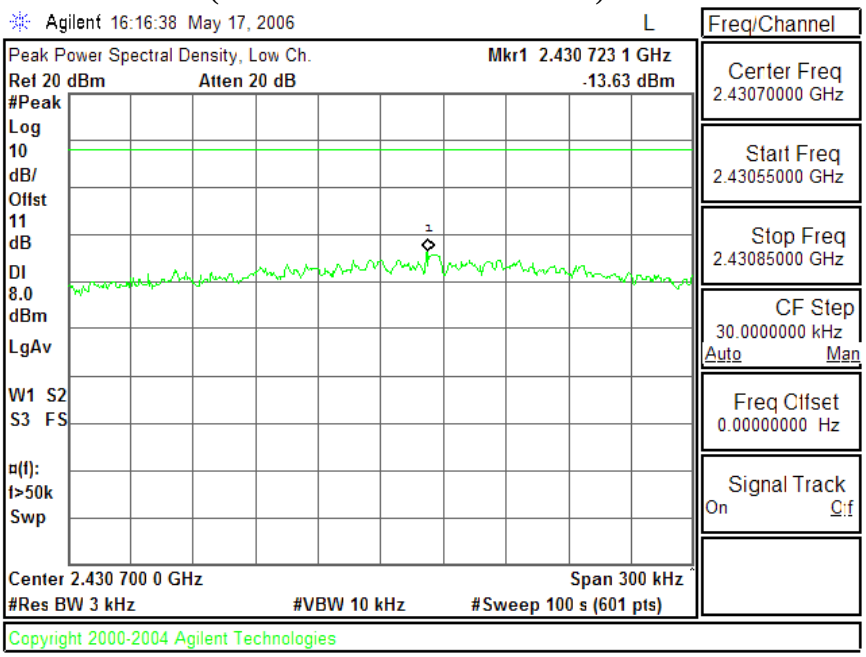


PEAK POWER SPECTRAL DENSITY (802.11 40 MHz TX BANDWIDTH – CHAIN 0)

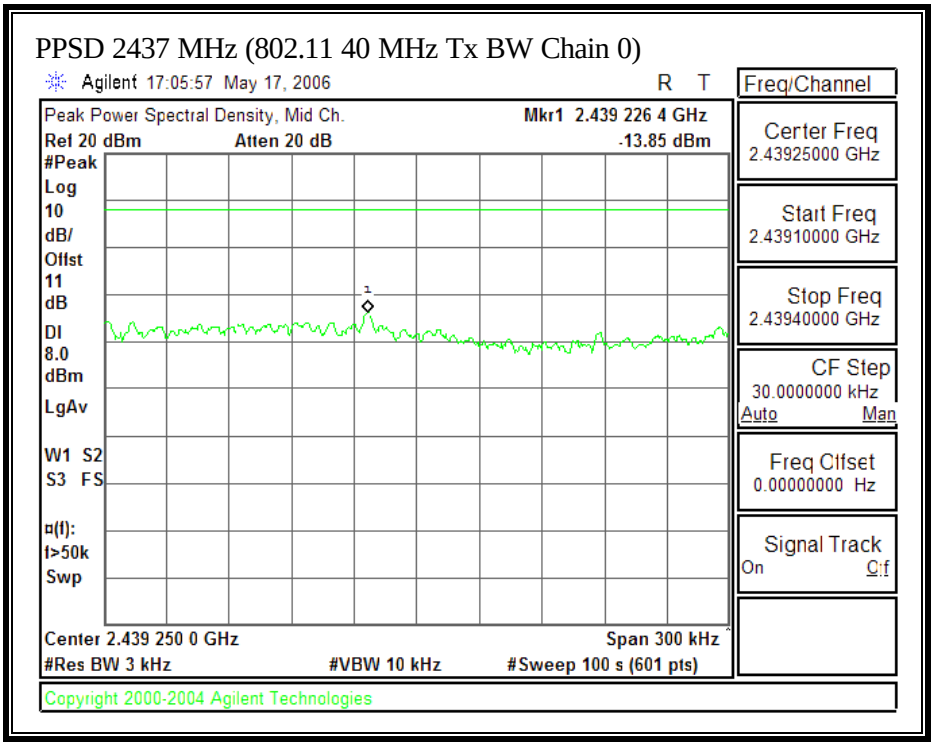
PPSD 2422 MHz (802.11 40 MHz Tx BW Chain 0)



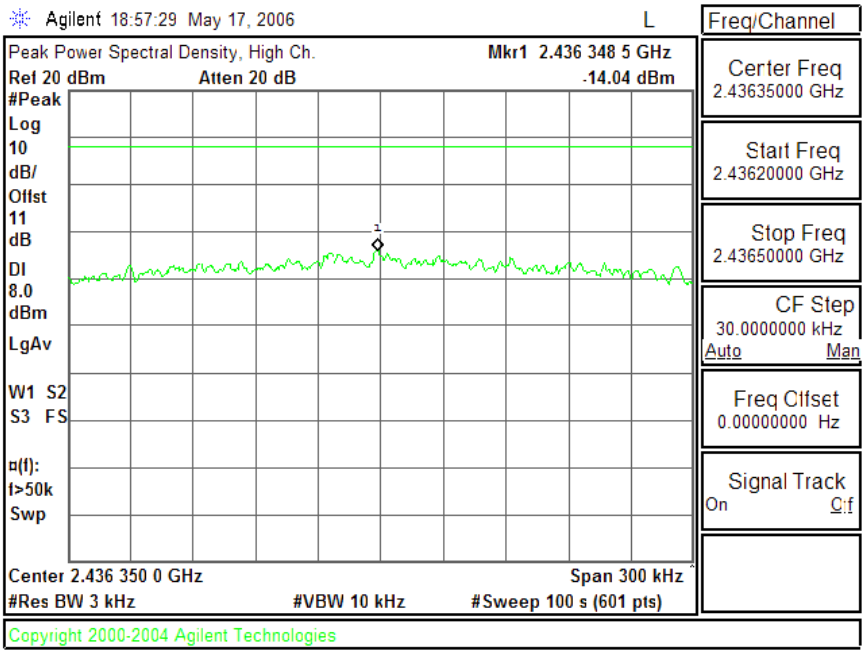
PPSD 2427 MHz (802.11 40 MHz Tx BW Chain 0)



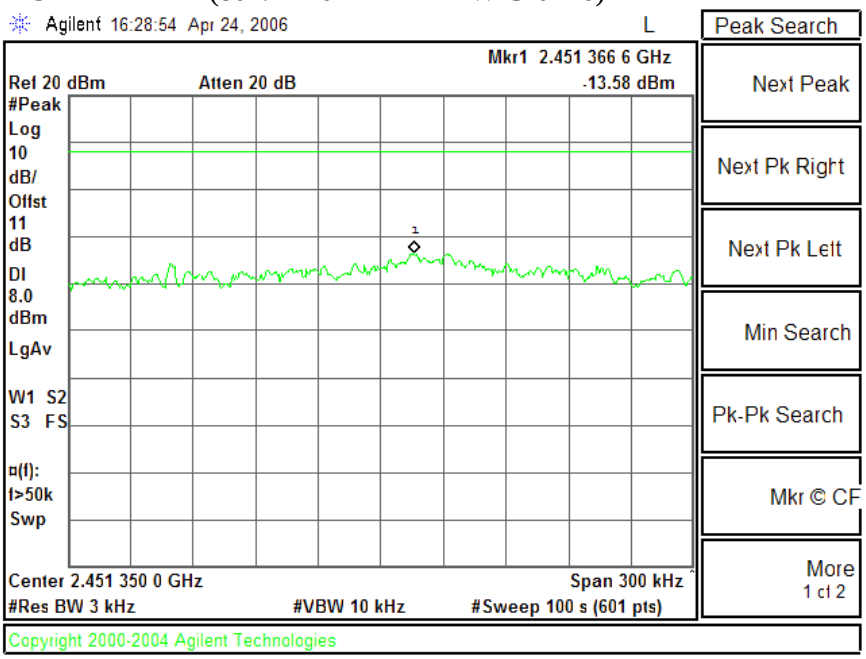
PPSD 2437 MHz (802.11 40 MHz Tx BW Chain 0)



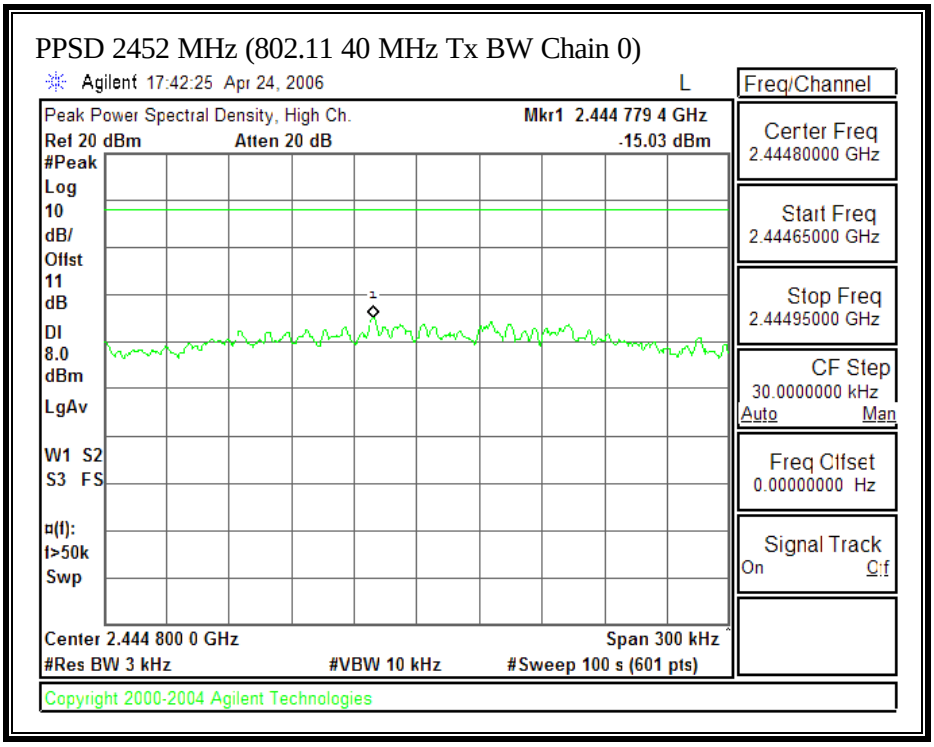
PPSD 2442 MHz (802.11 40 MHz Tx BW Chain 0)



PPSD 2447 MHz (802.11 40 MHz Tx BW Chain 0)

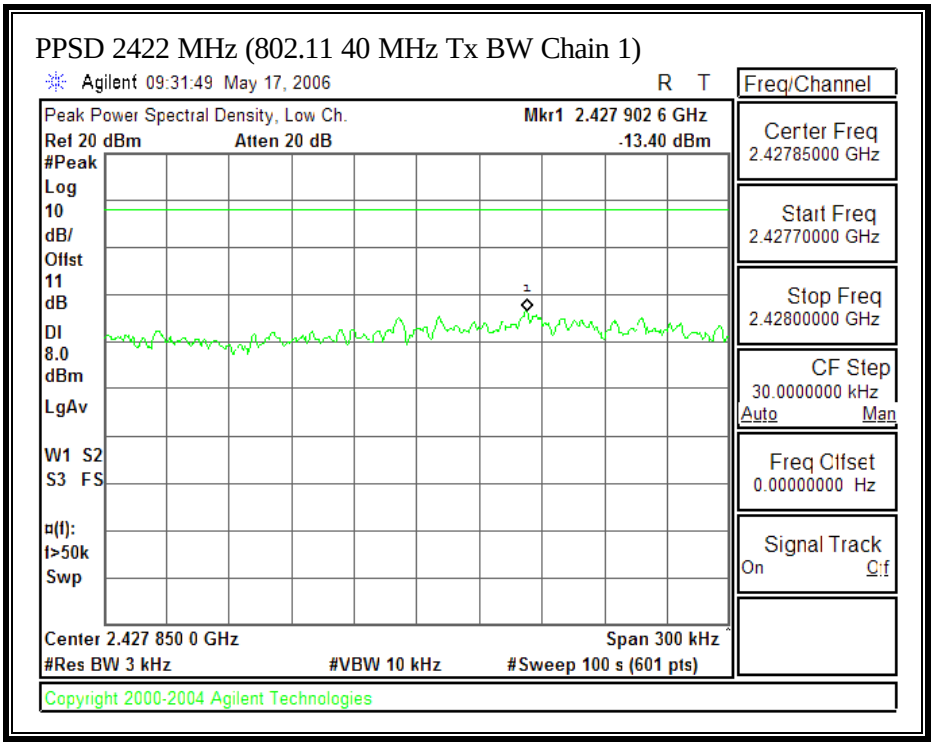


PPSD 2452 MHz (802.11 40 MHz Tx BW Chain 0)

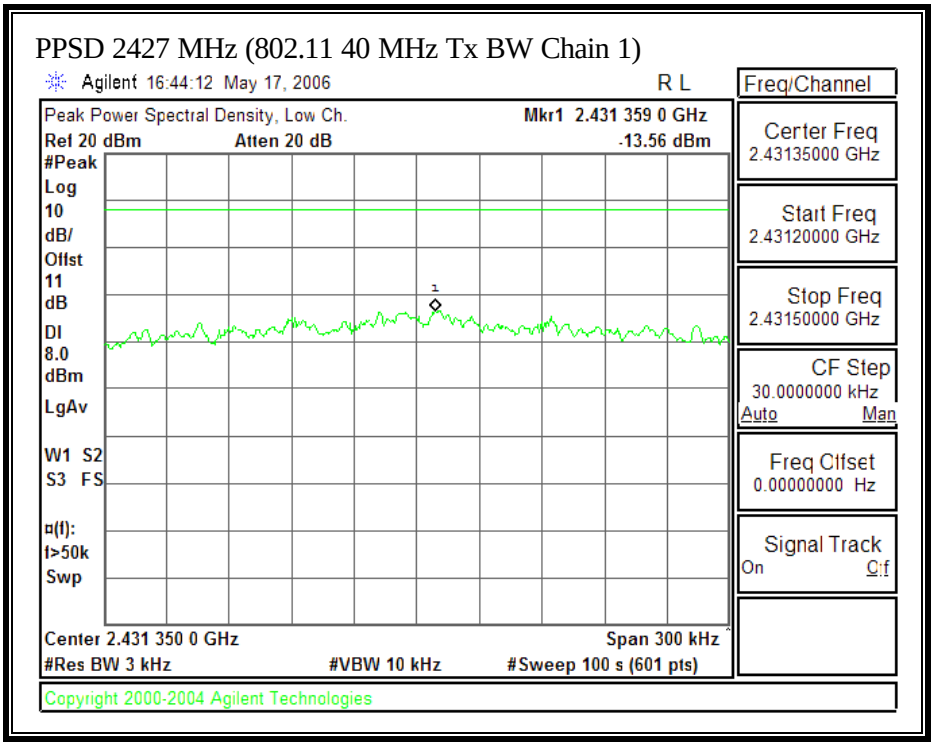


PEAK POWER SPECTRAL DENSITY (802.11 40 MHz TX BANDWIDTH – CHAIN 1)

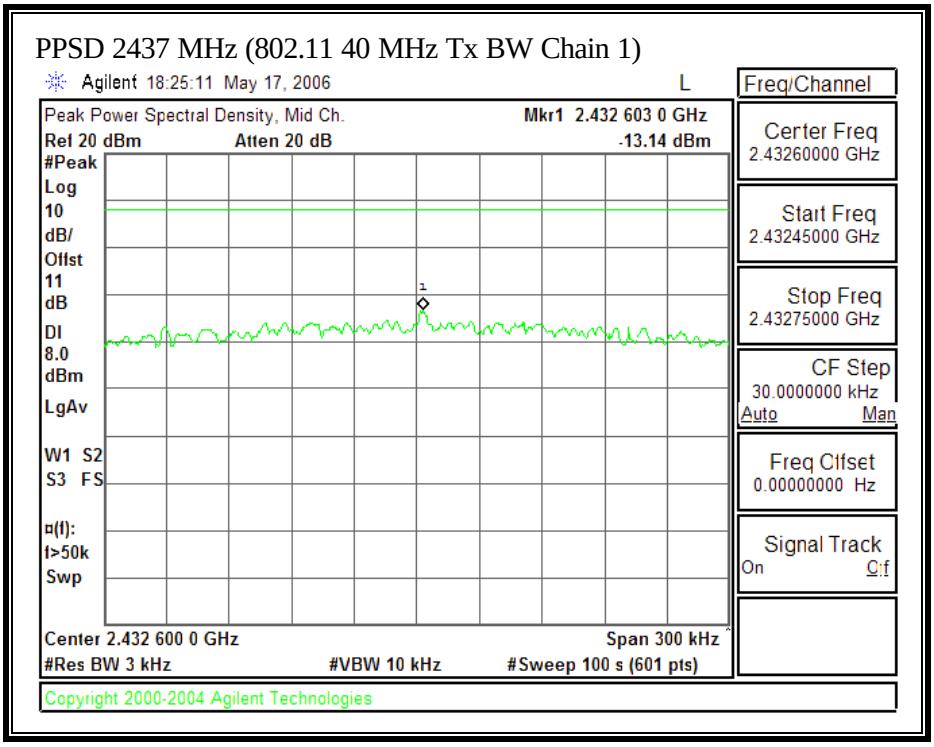
PPSD 2422 MHz (802.11 40 MHz Tx BW Chain 1)



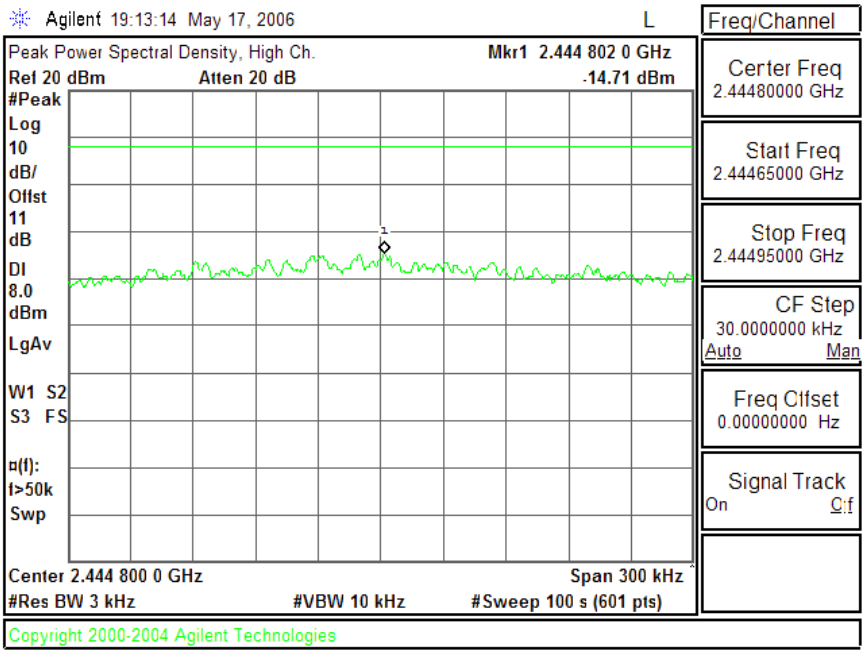
PPSD 2427 MHz (802.11 40 MHz Tx BW Chain 1)



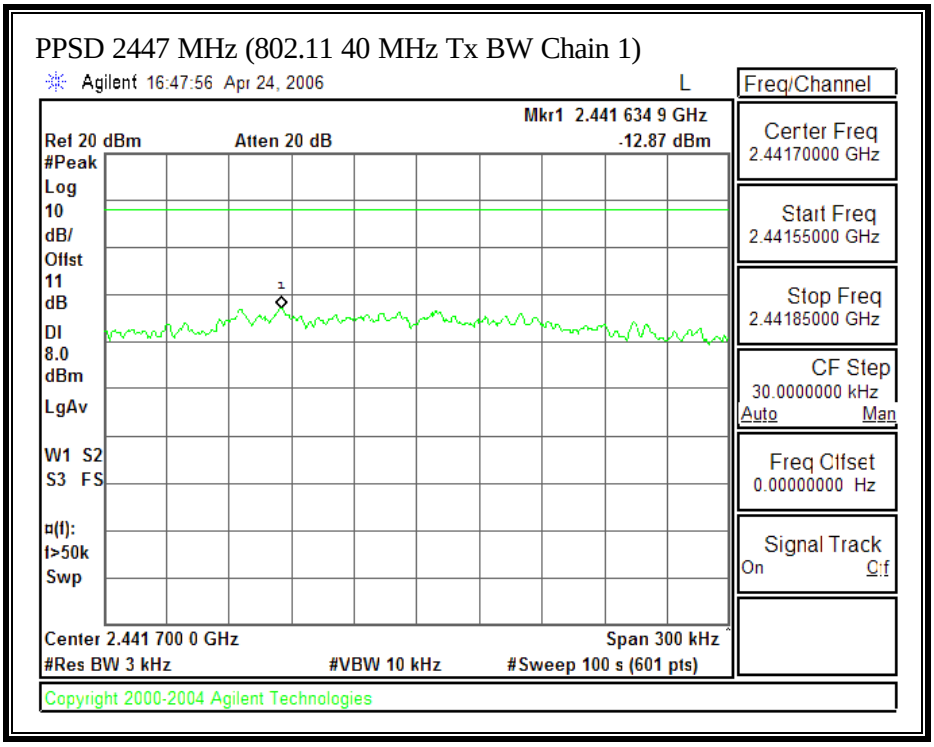
PPSD 2437 MHz (802.11 40 MHz Tx BW Chain 1)



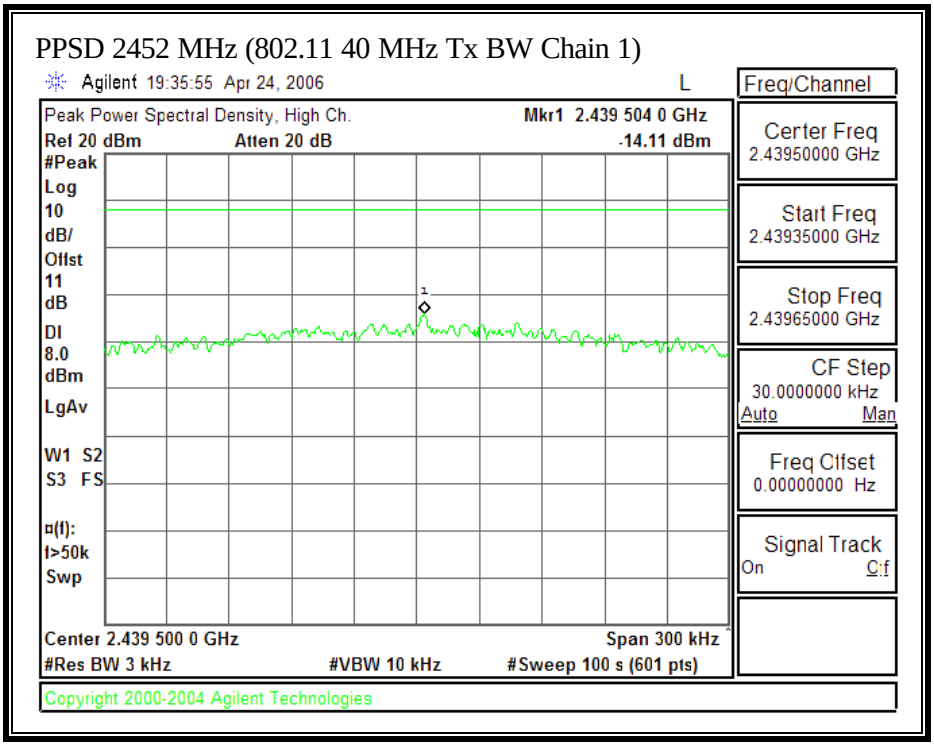
PPSD 2442 MHz (802.11 40 MHz Tx BW Chain 1)



PPSD 2447 MHz (802.11 40 MHz Tx BW Chain 1)



PPSD 2452 MHz (802.11 40 MHz Tx BW Chain 1)



7.8. CHANNEL TESTS FOR THE 5725 TO 5850 MHz BAND

Please refer to Hitachi Antenna RF conducted test section.

7.8.1. PEAK OUTPUT POWER

PEAK POWER LIMIT

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

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

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz , and 5725-5850 MHz bands: 1 watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

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

TEST PROCEDURE

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

RESULTS,

The maximum antenna gain is 7.44 dBi for other than fixed, point-to-point operations, therefore the limit is 28.56dBm.

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

Note: Pchain 0 and Pchain1 are in dBm

No non-compliance noted:

Channel	Frequency (MHz)	Peak Power Chain 0 (dBm)	Peak Power Chain 1 (dBm)	Peak Power Total (dBm)	Limit (dBm)	Margin (dB)
20 MHz TX BANDWIDTH						
Low	5745	22.28	22.11	25.21	28.56	-3.35
Middle	5785	21.42	21.52	24.48	28.56	-4.08
High	5825	22.17	22.56	25.38	28.56	-3.18
40 MHz TX BANDWIDTH						
Low	5755	21.42	21.54	24.49	28.56	-4.07
High	5795	22.41	23.66	26.09	28.56	-2.47

7.8.2. MAXIMUM PERMISSIBLE EXPOSURE

LIMITS

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

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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

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

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

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

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

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

CALCULATIONS

Given

E = √ (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 = √ ((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 * √ ((30 * (P / 1000) * G) / (3770 * S))
d = 0.282 * √ (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) / √ S

where

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

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

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

LIMITS

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

RESULTS

No non-compliance noted

Mode	MPE Distance (cm)	Peak Power Chain 0 (dBm)	Peak Power Chain 1 (dBm)	Total Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
20MHz TX BW	20.0	22.17	22.56	25.38	7.44	0.38
40MHz TX BW	20.0	22.41	23.66	26.09	7.44	0.45

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.

PHYCOMP PCB ANTENNA

LEGACY MODE

7.9. CHANNEL TESTS FOR THE 2400 TO 2483.5 MHz BAND

Please refer to Hitachi Antenna RF conducted test section.

7.9.1. PEAK OUTPUT POWER

PEAK POWER LIMIT

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

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

§15.247 (b) (4) Except as shown in paragraphs (b)(4) (i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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

TEST PROCEDURE

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

RESULTS

The maximum antenna gain is 2.22dBi @ 2.4GHz for other than fixed, point-to-point operations, therefore the limit is still 30 dBm for 2.4GHz band.

No non-compliance noted:

802.11b Mode

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
1	2412	22.99	30	-7.01
2	2417	23.19	30	-6.81
6	2437	23.01	30	-6.99
10	2457	22.56	30	-7.44
11	2462	19.97	30	-10.03

802.11g Mode

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
1	2412	25.72	30	-4.28
2	2417	25.51	30	-4.49
6	2437	25.56	30	-4.44
10	2457	26.02	30	-3.98
11	2462	23.51	30	-6.49

7.9.2. MAXIMUM PERMISSIBLE EXPOSURE

LIMITS

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

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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

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

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

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

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

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

CALCULATIONS

Given

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

and

$S = E \wedge 2 / 3770$

where

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

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

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

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

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

yields

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

where

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

Substituting the logarithmic form of power and gain using:

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

yields

$d = 0.282 * 10 \wedge ((P + G) / 20) / \sqrt{S}$ Equation (1)

where

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

Equation (1) and the measured peak power is used to calculate the MPE distance.

LIMITS

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

RESULTS

No non-compliance noted:

Mode	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
802.11b	20.0	23.19	2.20	0.07
802.11g	20.0	26.02	2.20	0.13

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

7.10. CHANNEL TESTS FOR THE 5725 TO 5850 MHz BAND

Please refer to Hitachi Antenna RF conducted test section.

7.10.1. PEAK OUTPUT POWER

PEAK POWER LIMIT

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

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

§15.247 (b) (4) Except as shown in paragraphs (b)(3) (i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

§15.247 (b) (4) (ii) Systems operating in the 5725–5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

TEST PROCEDURE

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

RESULTS

The maximum antenna gain is 3.9 dBi for other than fixed, point-to-point operations, therefore the limit is still 30dBm.

No non-compliance noted:

802.11a Mode

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
Low	5745	24.23	30.0	-5.77
Middle	5785	24.13	30.0	-5.87
High	5825	23.82	30.0	-6.18

7.10.2. MAXIMUM PERMISSIBLE EXPOSURE

LIMITS

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

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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

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

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

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

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

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

CALCULATIONS

Given

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

and

$S = E \wedge 2 / 3770$

where

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

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

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

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

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

yields

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

where

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

Substituting the logarithmic form of power and gain using:

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

yields

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

where

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

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

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

LIMITS

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

RESULTS

No non-compliance noted

Mode	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
802.11a	20.0	24.23	6.20	0.22

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.

MIMO MODE

7.11. CHANNEL TESTS FOR THE 2400 TO 2483.5 MHz BAND

Please refer to Hitachi Antenna RF conducted test section.

7.11.1. PEAK OUTPUT POWER

PEAK POWER LIMIT

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

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

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz , and 5725-5850 MHz bands: 1 watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

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

TEST PROCEDURE

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

The test is performed in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005. The transmitter operates continuously therefore Power Output Option 2, Method # 1 is used.

RESULTS,

The maximum antenna gain is 2.2 dBi for other than fixed, point-to-point operations, therefore the limit is 30 dBm.

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

Note: Pchain 0 and Pchain1 are in dBm

No non-compliance noted:

Channel	Frequency (MHz)	Peak Power Chain 0 (dBm)	Peak Power Chain 1 (dBm)	Peak Power Total (dBm)	Limit (dBm)	Margin (dB)
20 MHz TX BANDWIDTH						
Low	2412	20.89	20.91	23.91	30.0	-6.09
Low	2417	22.86	23.02	25.95	30.0	-4.05
Low	2422	23.40	23.28	26.35	30.0	-3.65
Middle	2437	23.95	23.82	26.90	30.0	-3.10
High	2457	23.60	23.63	26.63	30.0	-3.37
High	2462	21.07	21.18	24.14	30.0	-5.86
40 MHz TX BANDWIDTH						
Low	2422	19.48	19.56	22.53	30.0	-7.47
Low	2427	21.12	21.36	24.25	30.0	-5.75
Middle	2437	21.77	21.61	24.70	30.0	-5.30
High	2442	21.22	21.23	24.24	30.0	-5.76
High	2447	20.14	20.17	23.17	30.0	-6.83
High	2452	18.84	18.77	21.82	30.0	-8.18

7.11.2. MAXIMUM PERMISSIBLE EXPOSURE

LIMITS

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

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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

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

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

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

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

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

CALCULATIONS

Given

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

and

$S = E \wedge 2 / 3770$

where

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

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

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

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

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

yields

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

where

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

Substituting the logarithmic form of power and gain using:

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

yields

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

where

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

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

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

LIMITS

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

RESULTS

No non-compliance noted

Mode	MPE Distance (cm)	Peak Power Chain 0 (dBm)	Peak Power Chain 1 (dBm)	Total Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
20MHz TX BW	20.0	23.95	23.82	26.90	2.20	0.16
40MHz TX BW	20.0	21.77	21.61	24.70	2.20	0.10

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

7.12. CHANNEL TESTS FOR THE 5725 TO 5850 MHz BAND

Please refer to Hitachi Antenna RF conducted test section.

7.12.1. PEAK OUTPUT POWER

PEAK POWER LIMIT

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

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

§15.247 (b) (3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz , and 5725-5850 MHz bands: 1 watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

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

TEST PROCEDURE

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

RESULTS,

The maximum antenna gain is 3.9 dBi for other than fixed, point-to-point operations, therefore the limit is 30dBm.

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

Note: Pchain 0 and Pchain1 are in dBm

No non-compliance noted:

Channel	Frequency (MHz)	Peak Power Chain 0 (dBm)	Peak Power Chain 1 (dBm)	Peak Power Total (dBm)	Limit (dBm)	Margin (dB)
20 MHz TX BANDWIDTH						
Low	5745	22.28	22.11	25.21	30.0	-4.79
Middle	5785	21.42	21.52	24.48	30.0	-5.52
High	5825	22.17	22.56	25.38	30.0	-4.62
40 MHz TX BANDWIDTH						
Low	5755	21.42	21.54	24.49	30.0	-5.51
High	5795	22.41	23.66	26.09	30.0	-3.91

7.12.2. MAXIMUM PERMISSIBLE EXPOSURE

LIMITS

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

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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

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

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

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

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

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

CALCULATIONS

Given

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

and

$S = E \wedge 2 / 3770$

where

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

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

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

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

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

yields

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

where

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

Substituting the logarithmic form of power and gain using:

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

yields

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

where

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

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

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

LIMITS

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

RESULTS

No non-compliance noted

Mode	MPE Distance (cm)	Peak Power Chain 0 (dBm)	Peak Power Chain 1 (dBm)	Total Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)
20MHz TX BW	20.0	22.17	22.56	25.38	3.90	0.17
40MHz TX BW	20.0	22.41	23.66	26.09	3.90	0.20

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

7.13. RADIATED EMISSIONS

7.13.1. TRANSMITTER RADIATED SPURIOUS EMISSIONS

HITACHI, PIFA STAMPED METAL ANTENNA

LEGACY MODE

LIMITS

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

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

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

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

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

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

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

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

TEST PROCEDURE

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

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

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

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

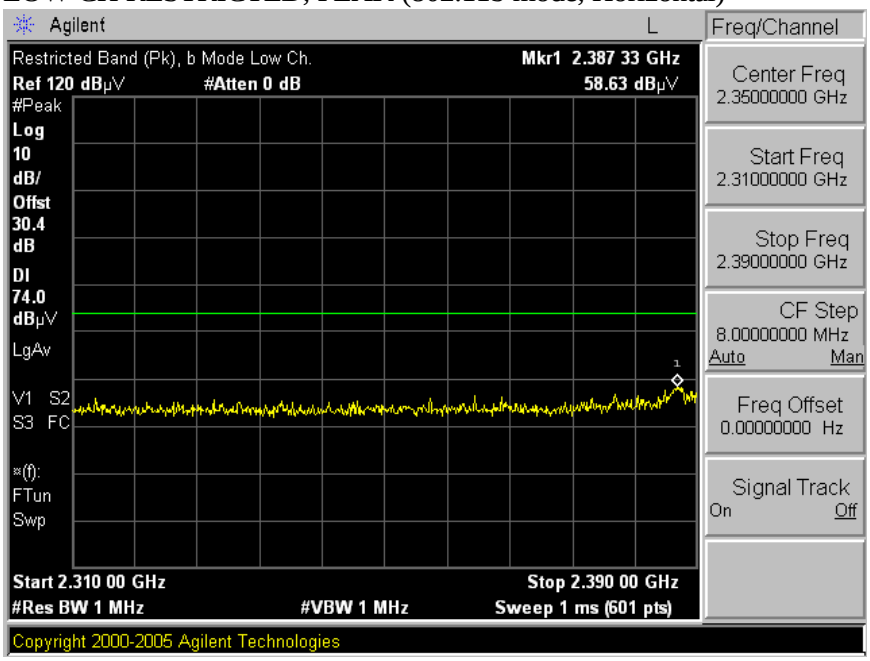
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each 5 GHz band.

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

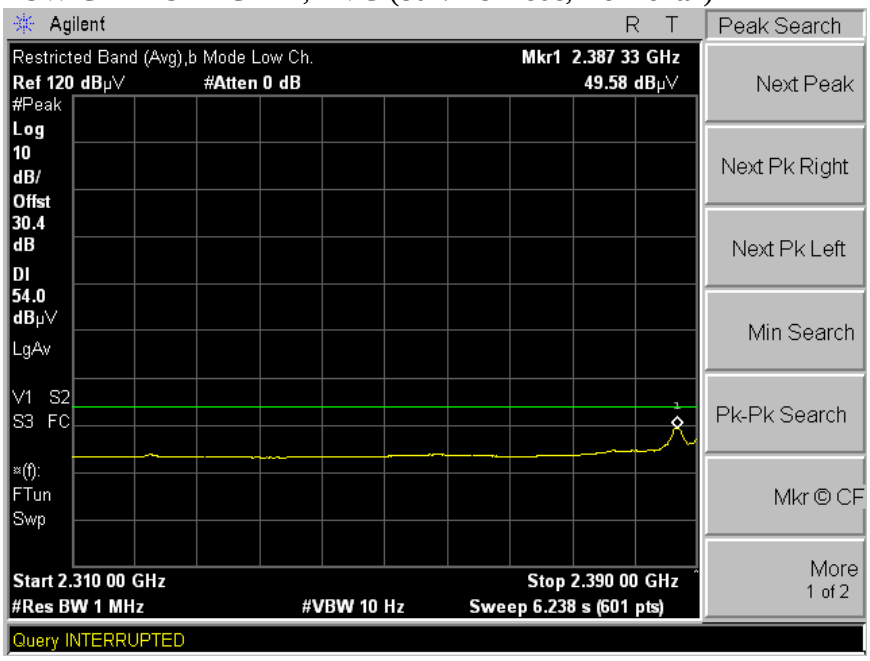
7.13.2. TRANSMITTER ABOVE 1 GHz FOR 2400 TO 2483.5 MHz BAND

RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, 2412 MHz, HORIZONTAL)

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

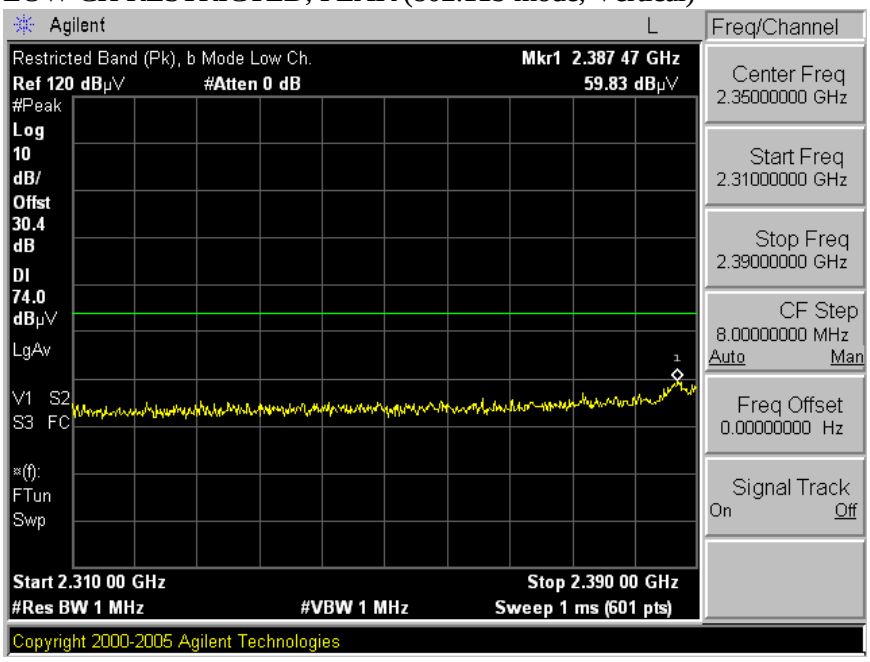


LOW CH RESTRICTED, AVG (802.11b mode, Horizontal)

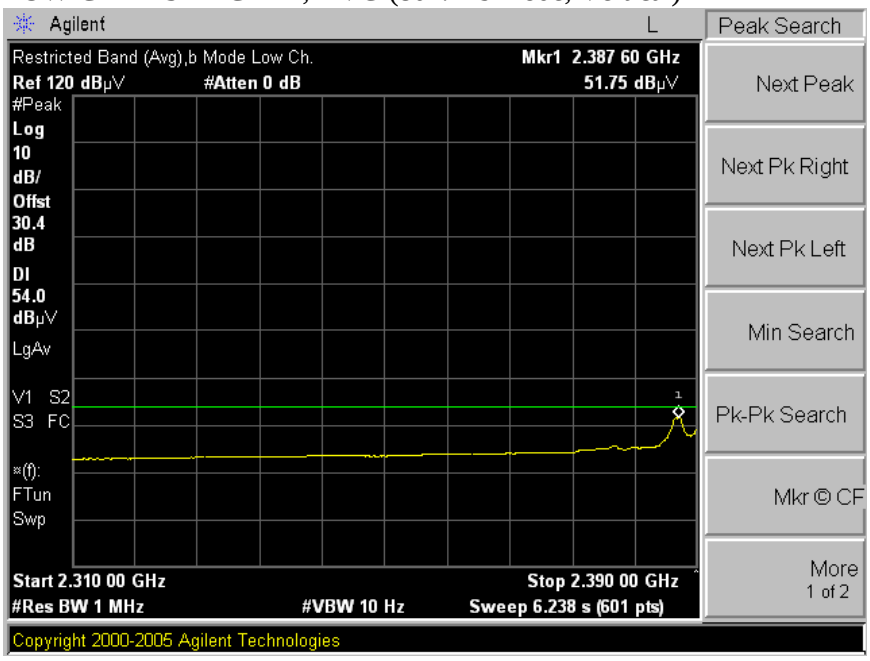


RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, 2412 MHz, VERTICAL)

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

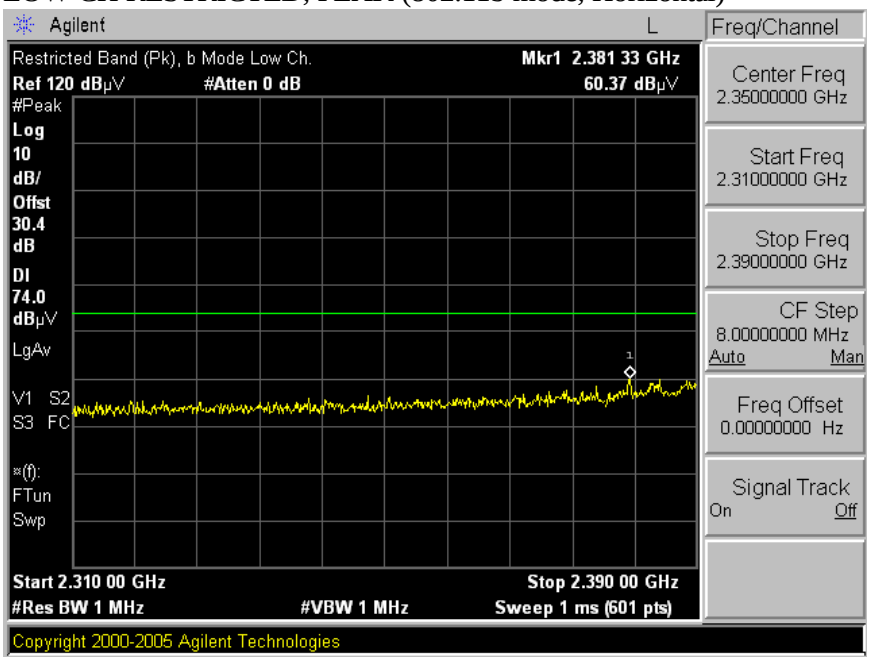


LOW CH RESTRICTED, AVG (802.11b mode, Vertical)

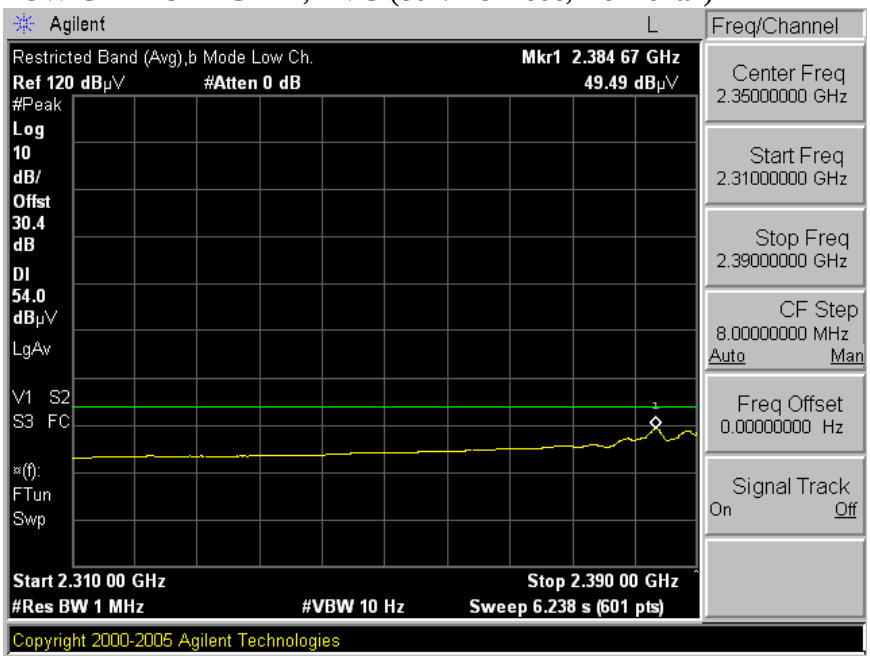


RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, 2417 MHz, HORIZONTAL)

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

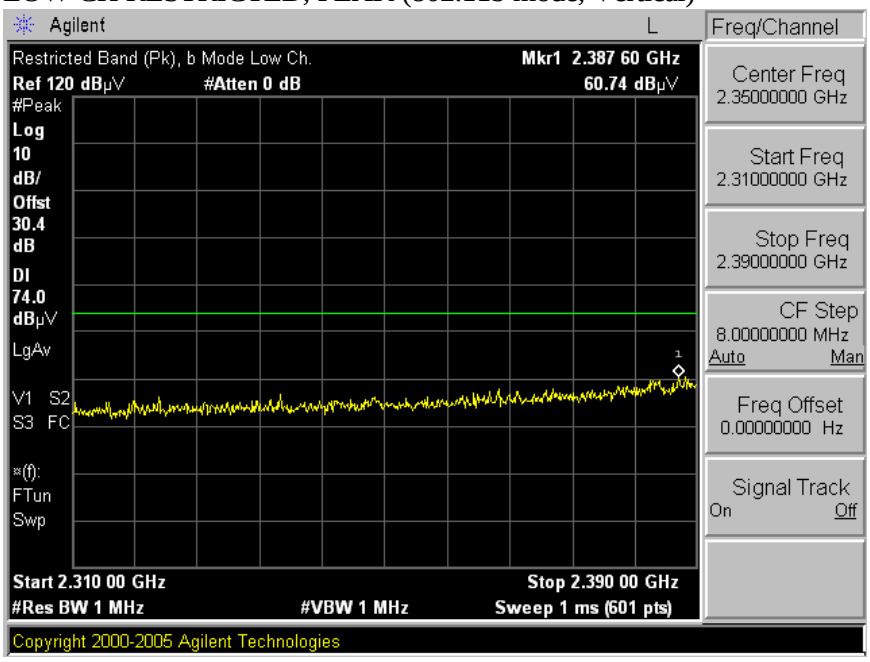


LOW CH RESTRICTED, AVG (802.11b mode, Horizontal)

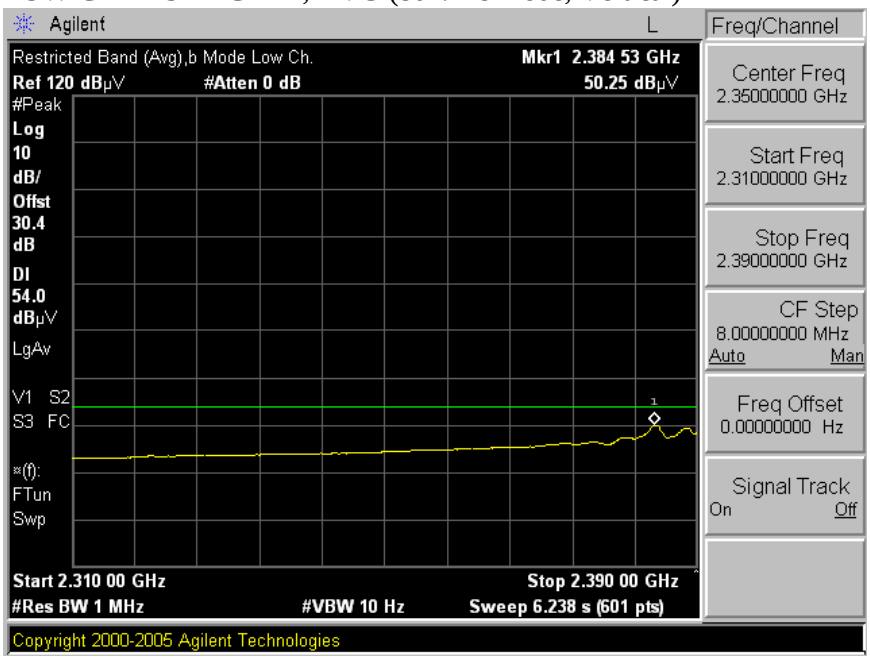


RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, 2417 MHz, VERTICAL)

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

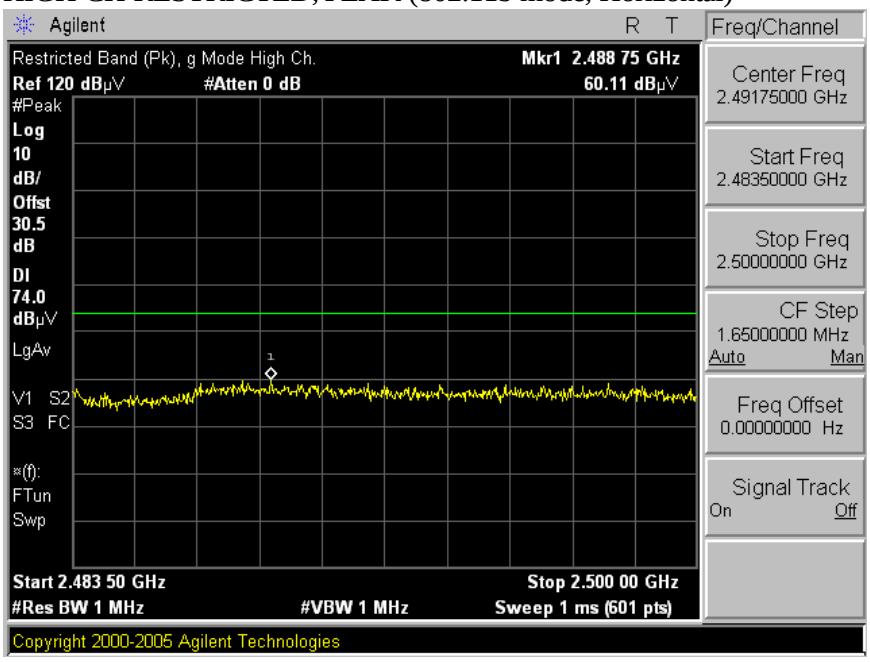


LOW CH RESTRICTED, AVG (802.11b mode, Vertical)

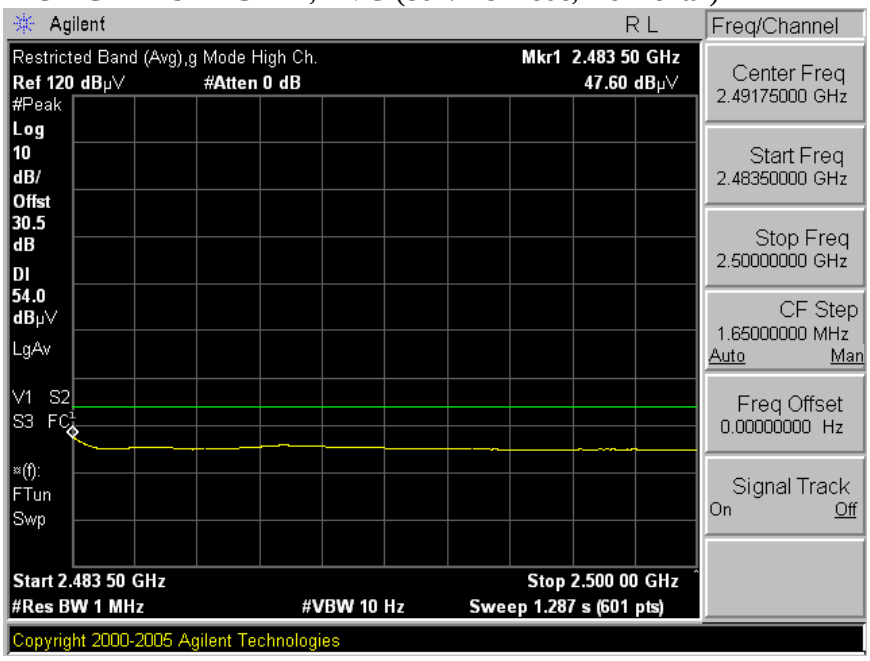


RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, 2457 MHz, HORIZONTAL)

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

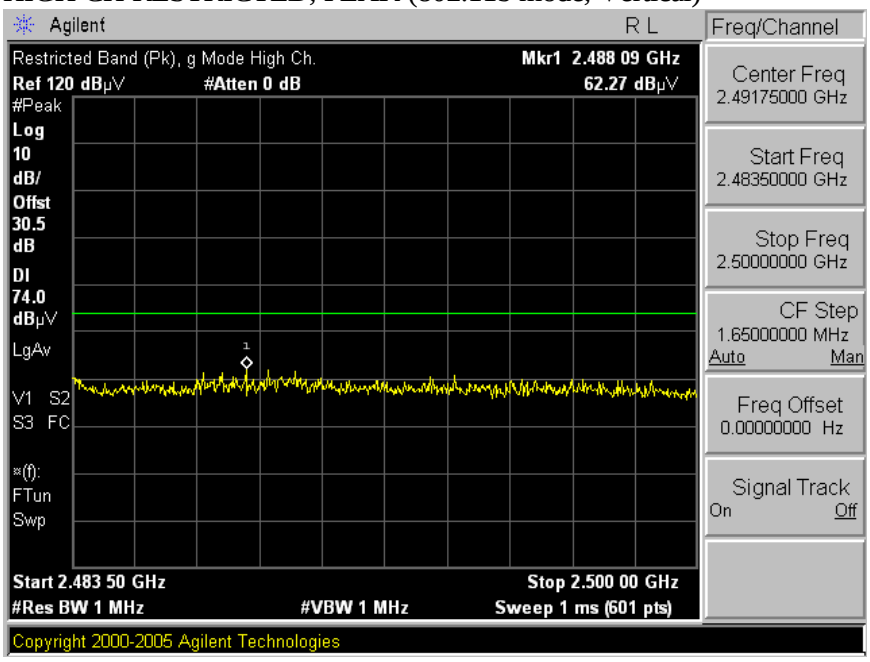


HIGH CH RESTRICTED, AVG (802.11b mode, Horizontal)

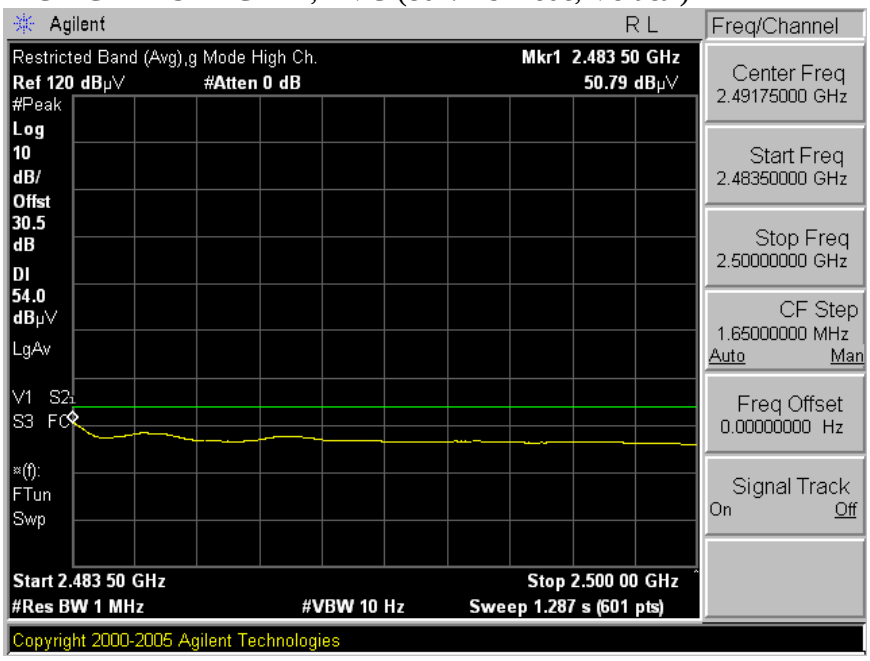


RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, 2457 MHz, VERTICAL)

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

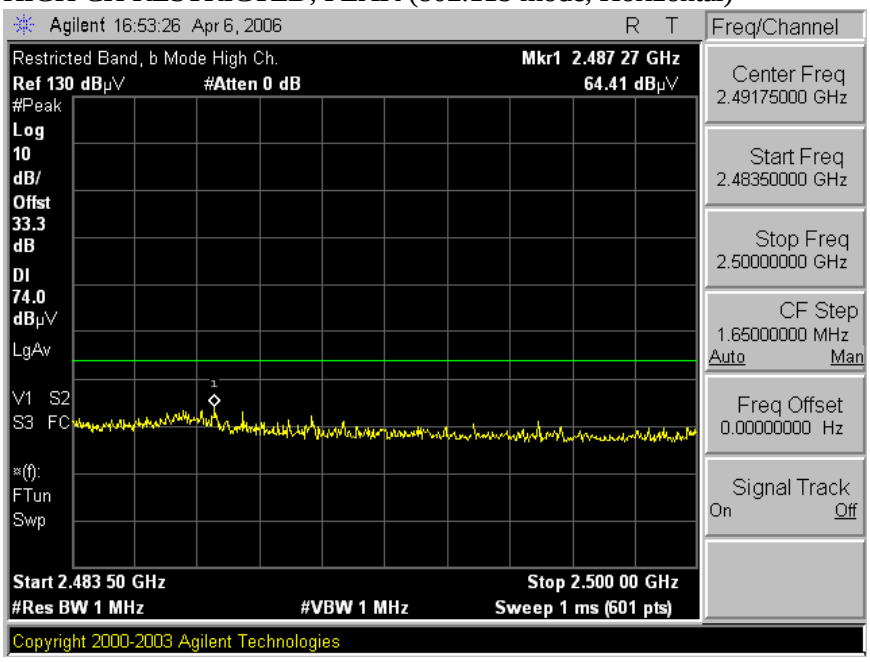


HIGH CH RESTRICTED, AVG (802.11b mode, Vertical)

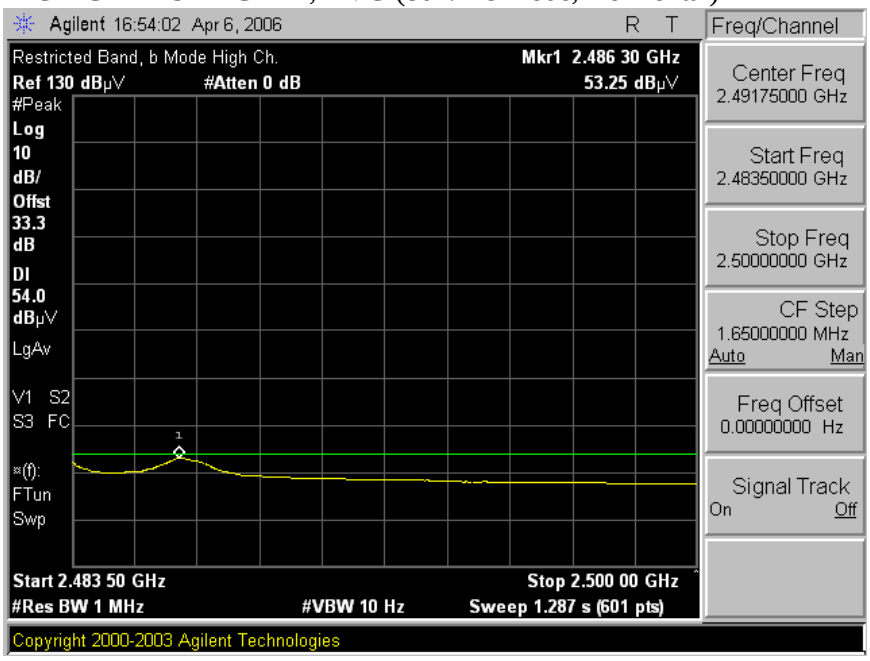


RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, 2462 MHz, HORIZONTAL)

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

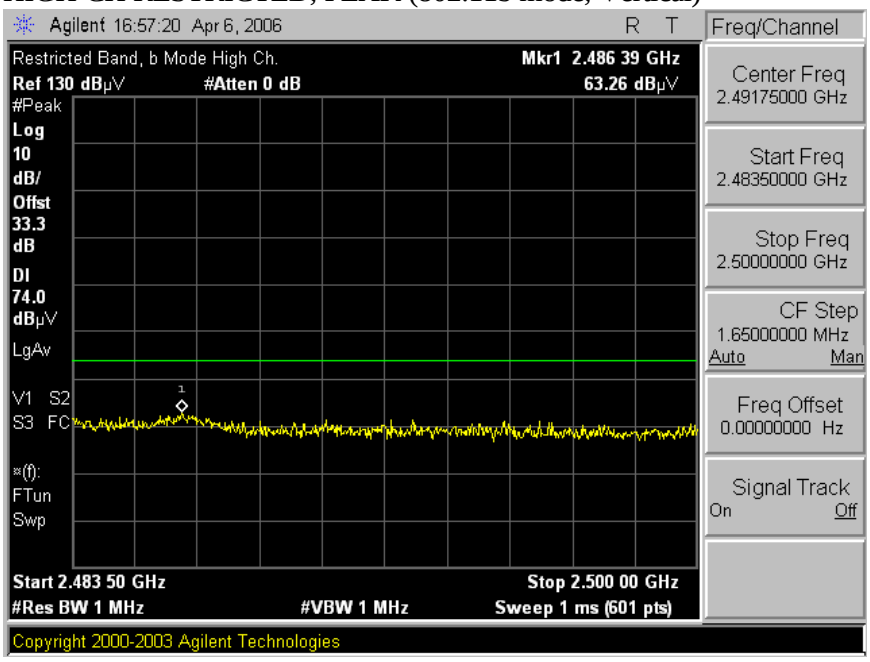


HIGH CH RESTRICTED, AVG (802.11b mode, Horizontal)

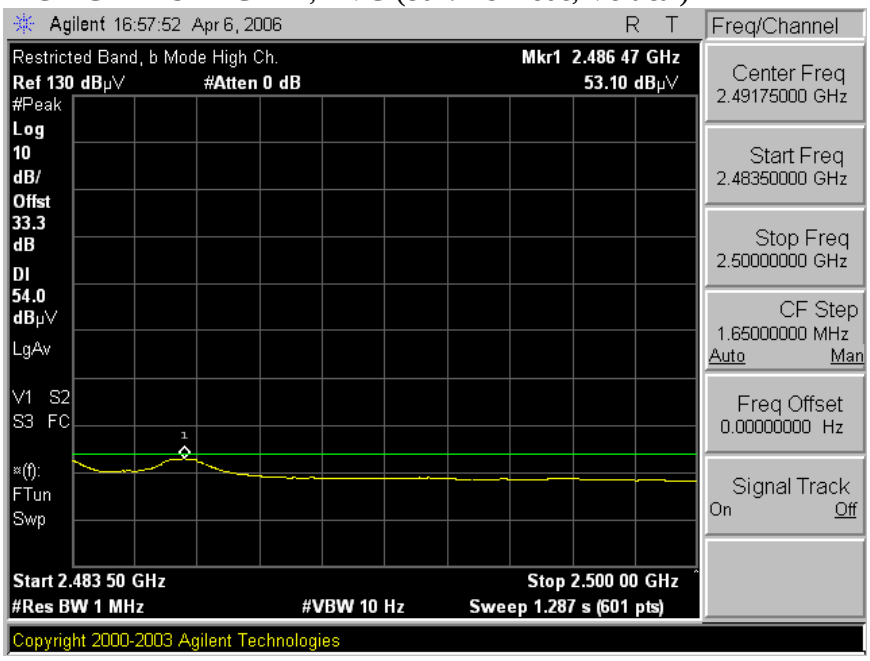


RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, 2462 MHz, VERTICAL)

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



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



HARMONICS AND SPURIOUS EMISSIONS (b MODE)

04/08/06 **High Frequency Measurement**
Compliance Certification Services, Morgan Hill Open Field Site

Test Engineer: Thanh Nguyen
Project #:06U10233-1
Company: BroadCom Corporation
EUT Description:802.11a/b/g Mini PCI card
EUT M/N: BCM94321MCAG Rev 3.0
EUT S/N: 107
Test Target: FCC Part15.247
Mode Of Operation:Tx b Mode
Average Power Meter: Low = 19 dBm, Mid = 19 dBm, High = 19dBm

Test Equipment:

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

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
Thanh 177079008		Thanh 208946003	HPF_4.0GHz	

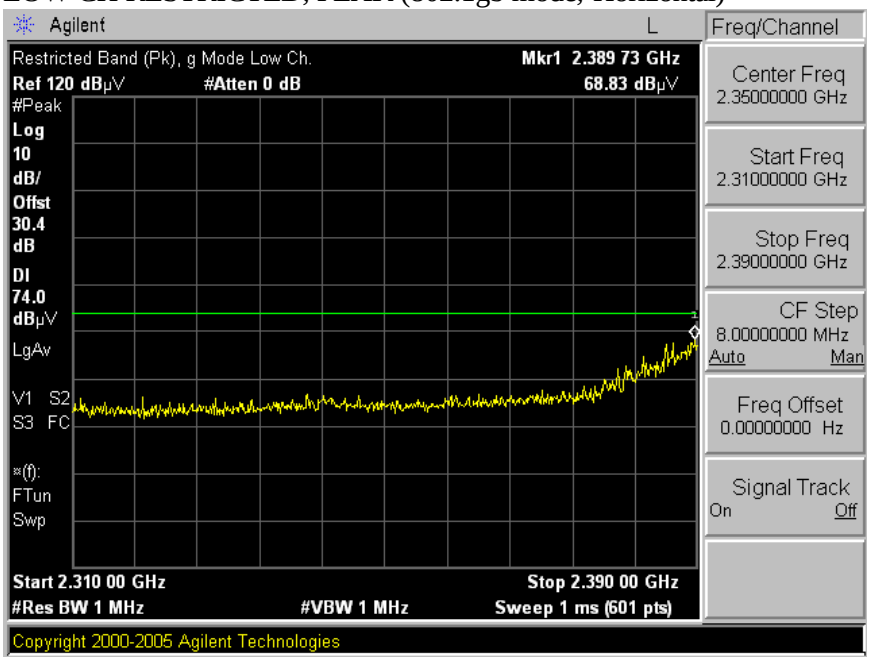
Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

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)
Harmonics Spurious															
Low Channel															
4.824	3.0	51.57	50.00	33.7	2.8	-34.8	0.0	0.6	53.8	52.3	74	54	-20.2	-1.7	V
4.824	3.0	52.84	50.78	33.7	2.8	-34.8	0.0	0.6	55.1	53.0	74	54	-18.9	-1.0	H
Mid Channel															
4.874	3.0	50.90	47.91	33.8	2.8	-34.8	0.0	0.6	53.3	50.3	74	54	-20.7	-3.7	V
7.311	3.0	42.41	42.37	35.5	3.3	-34.1	0.0	0.6	47.8	47.7	74	54	-26.2	-6.3	V
12.185	3.0	41.46	30.12	38.5	4.3	-32.5	0.0	0.9	52.7	41.4	74	54	-21.3	-12.6	V
4.874	3.0	52.55	50.61	33.8	2.8	-34.8	0.0	0.6	54.9	53.0	74	54	-19.1	-1.0	H
7.311	3.0	43.87	32.73	35.5	3.3	-34.1	0.0	0.6	49.2	38.1	74	54	-24.8	-15.9	H
12.185	3.0	43.10	30.34	38.5	4.3	-32.5	0.0	0.9	54.4	41.6	74	54	-19.6	-12.4	H
High Channel															
4.924	3.0	54.49	50.64	33.8	2.8	-34.8	0.0	0.6	56.9	53.1	74	54	-17.1	-0.9	V
7.386	3.0	44.49	34.63	35.6	3.3	-34.1	0.0	0.6	50.0	40.1	74	54	-24.0	-13.9	V
12.310	3.0	42.01	30.25	38.5	4.4	-32.5	0.0	0.9	53.3	41.6	74	54	-20.7	-12.4	V
4.924	3.0	52.50	50.81	33.8	2.8	-34.8	0.0	0.6	55.0	53.3	74	54	-19.0	-0.7	H
7.386	3.0	45.33	36.50	35.6	3.3	-34.1	0.0	0.6	50.8	42.0	74	54	-23.2	-12.0	H
12.310	3.0	45.24	36.27	38.5	4.4	-32.5	0.0	0.9	56.6	47.6	74	54	-17.4	-6.4	H
Spurious Emissions															
1.057	3.0	59.50	41.42	24.0	1.3	-38.2	0.0	0.0	46.6	28.6	74	54	-27.4	-25.4	V
1.065	3.0	58.76	42.25	24.1	1.3	-38.2	0.0	0.0	45.9	29.4	74	54	-28.1	-24.6	H
1.197	3.0	58.27	43.26	24.5	1.4	-38.0	0.0	0.0	46.2	31.2	74	54	-27.8	-22.8	H

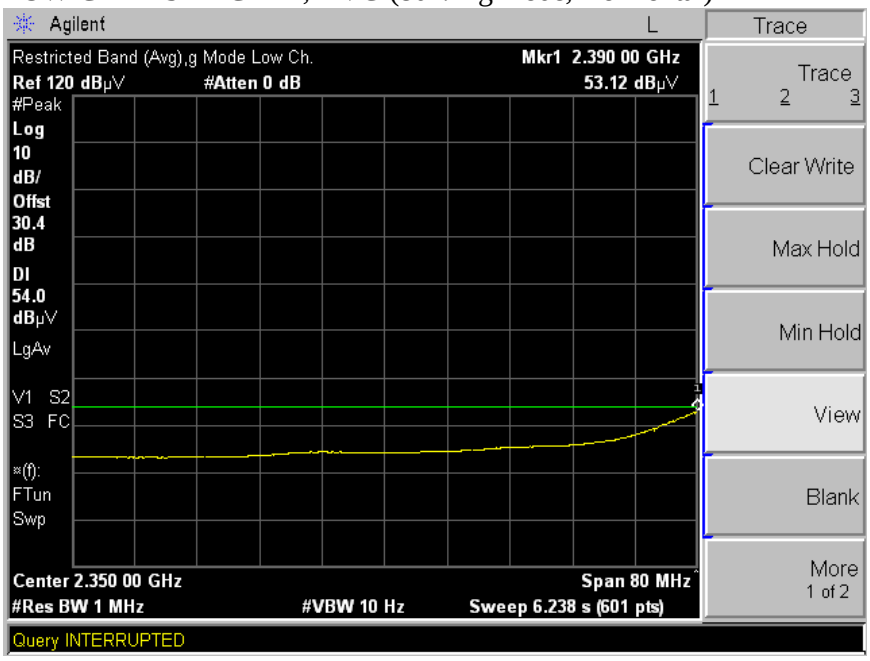
f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field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

RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, 2412 MHz, HORIZONTAL)

LOW CH RESTRICTED, PEAK (802.1gb mode, Horizontal)

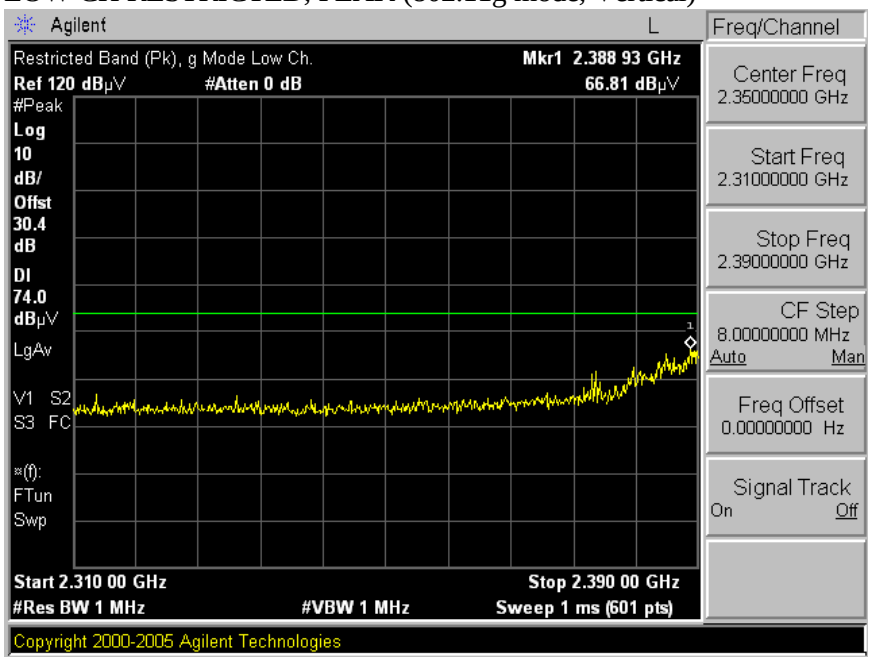


LOW CH RESTRICTED, AVG (802.11g mode, Horizontal)

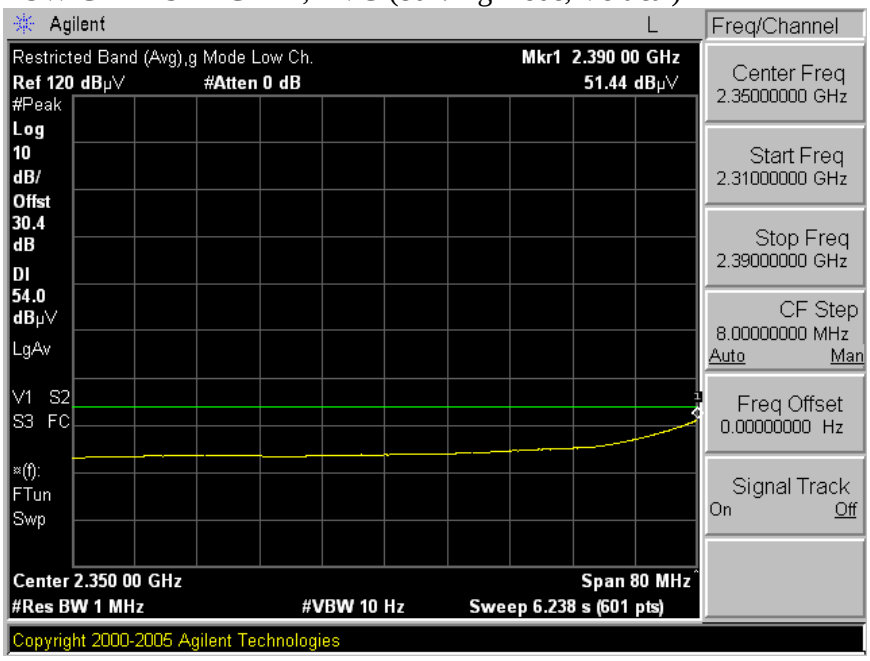


RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, 2412 MHz, VERTICAL)

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

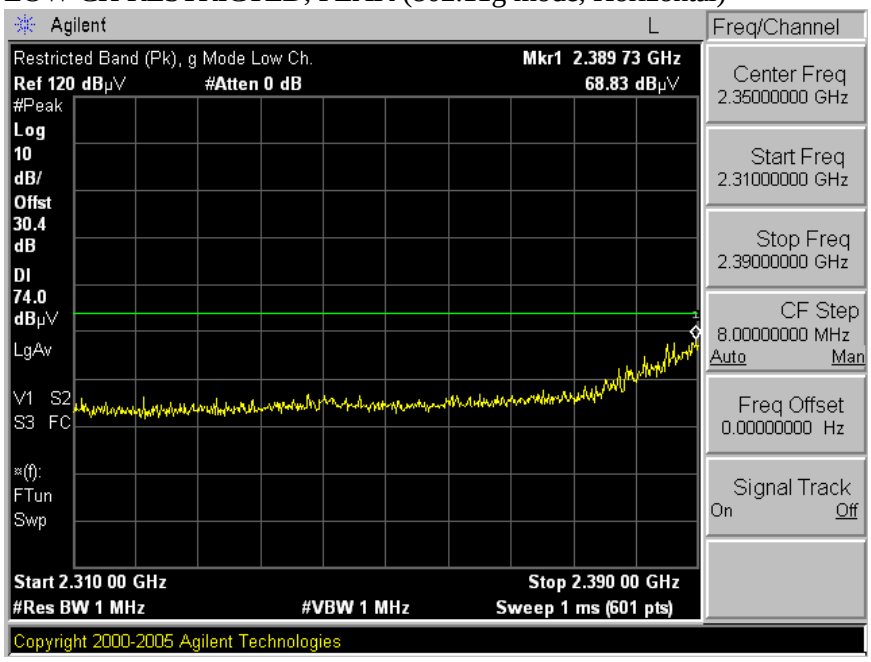


LOW CH RESTRICTED, AVG (802.11g mode, Vertical)

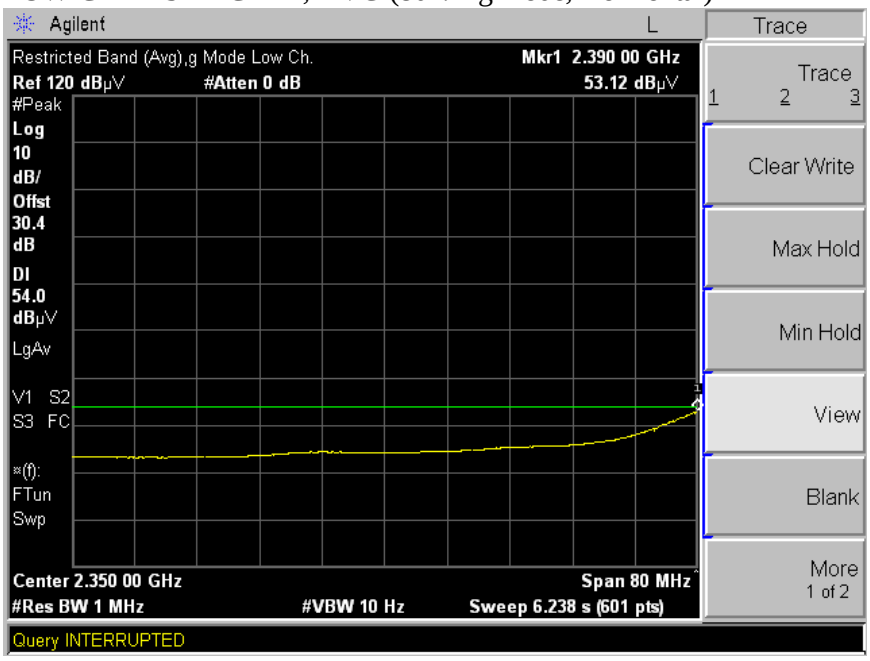


RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, 2417 MHz, HORIZONTAL)

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

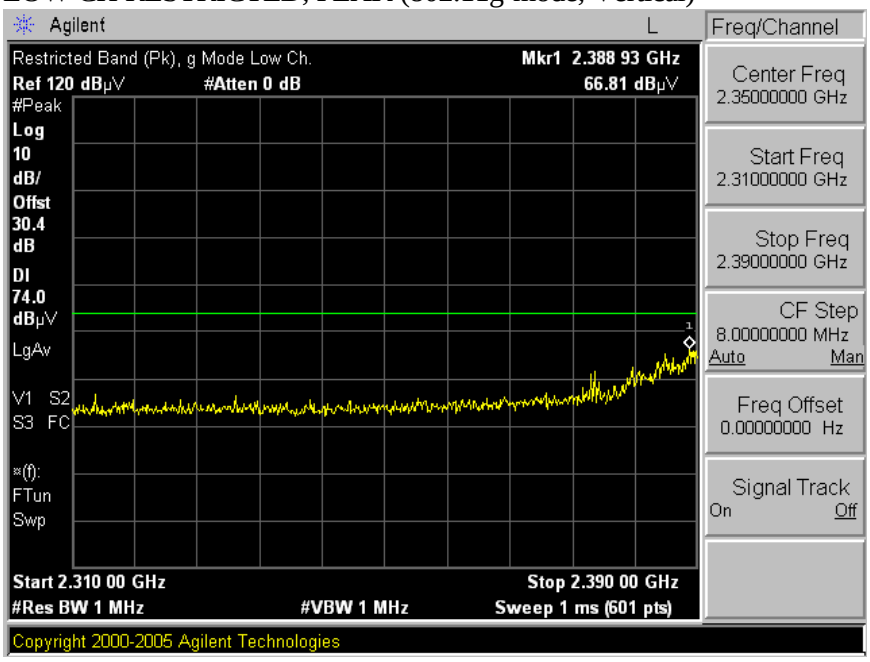


LOW CH RESTRICTED, AVG (802.11g mode, Horizontal)

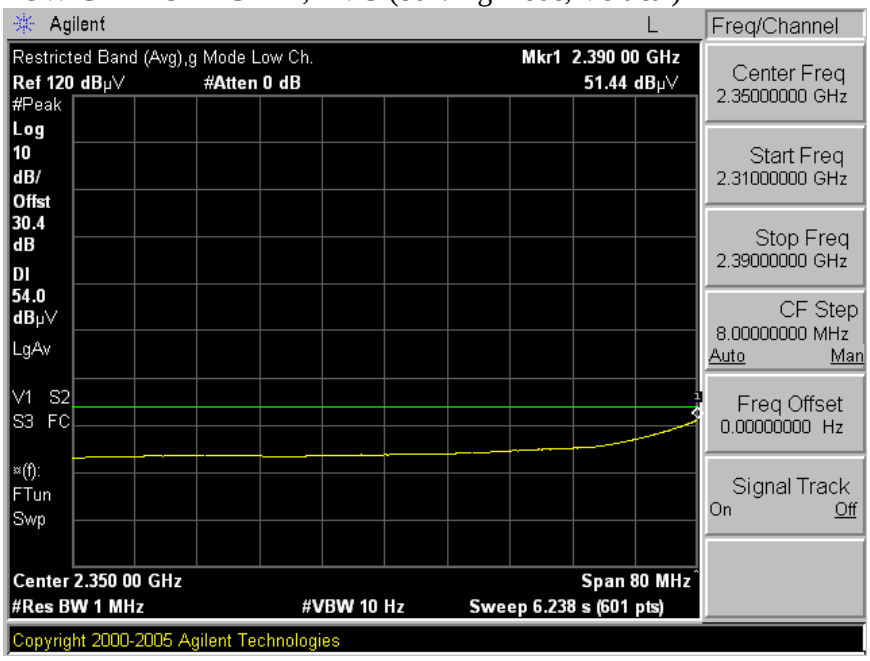


RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, 2417 MHz, VERTICAL)

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

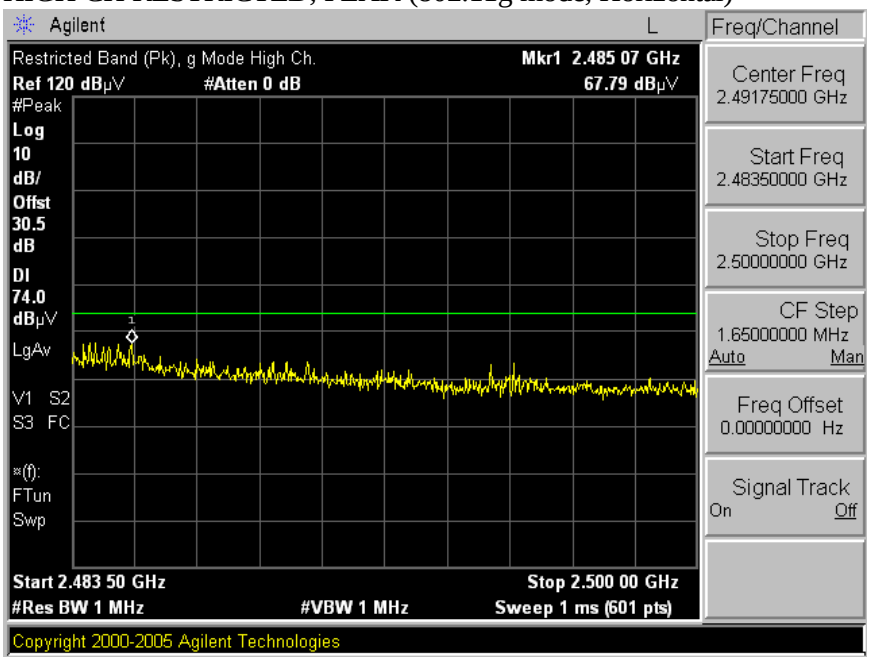


LOW CH RESTRICTED, AVG (802.11g mode, Vertical)

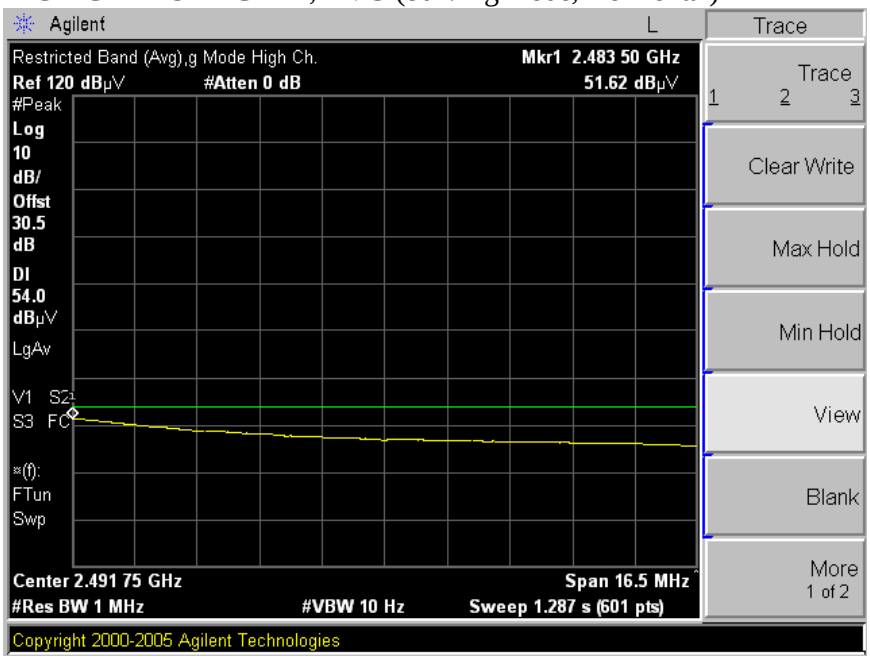


RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, 2457 MHz, HORIZONTAL)

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

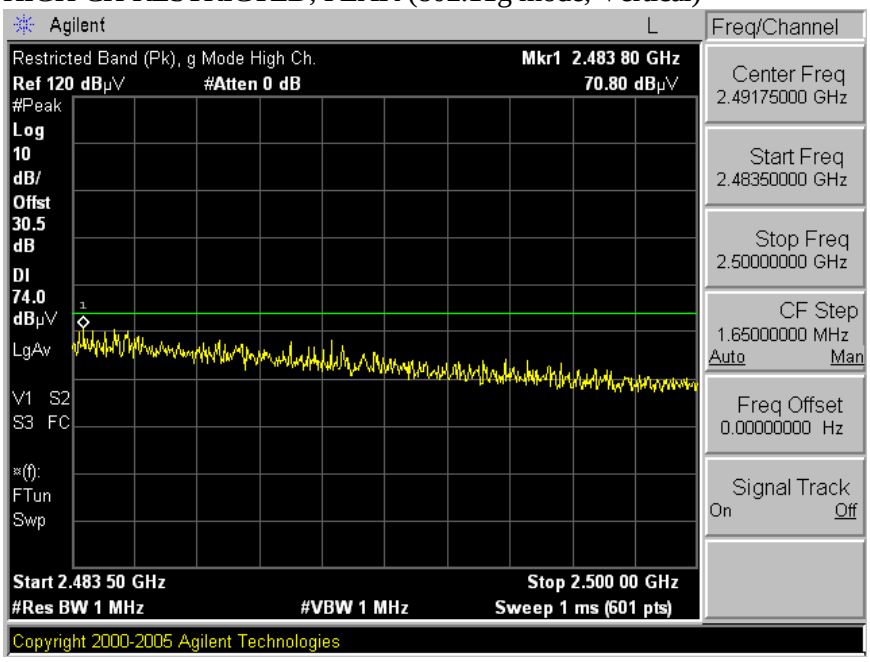


HIGH CH RESTRICTED, AVG (802.11g mode, Horizontal)

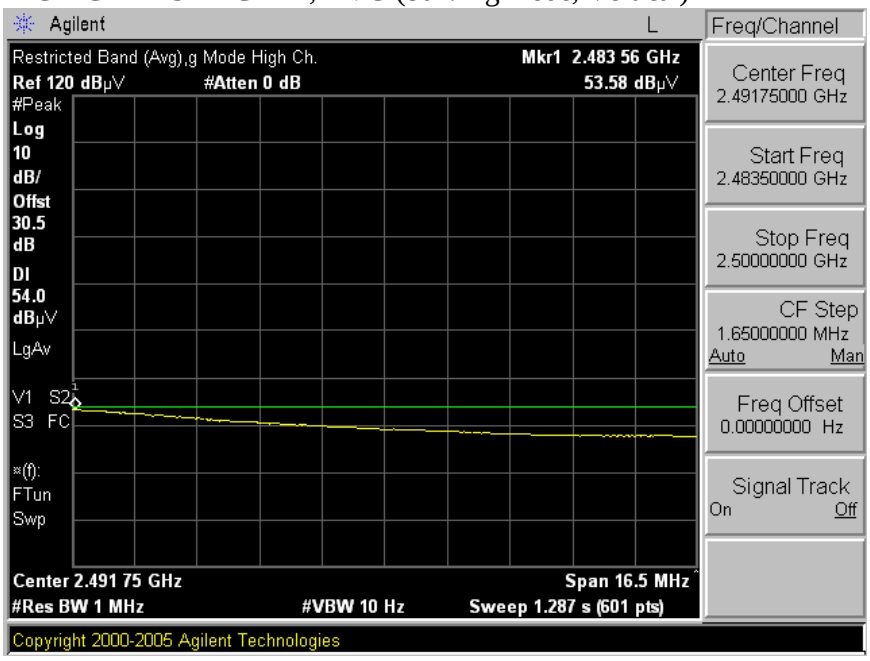


RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, 2457 MHz, VERTICAL)

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

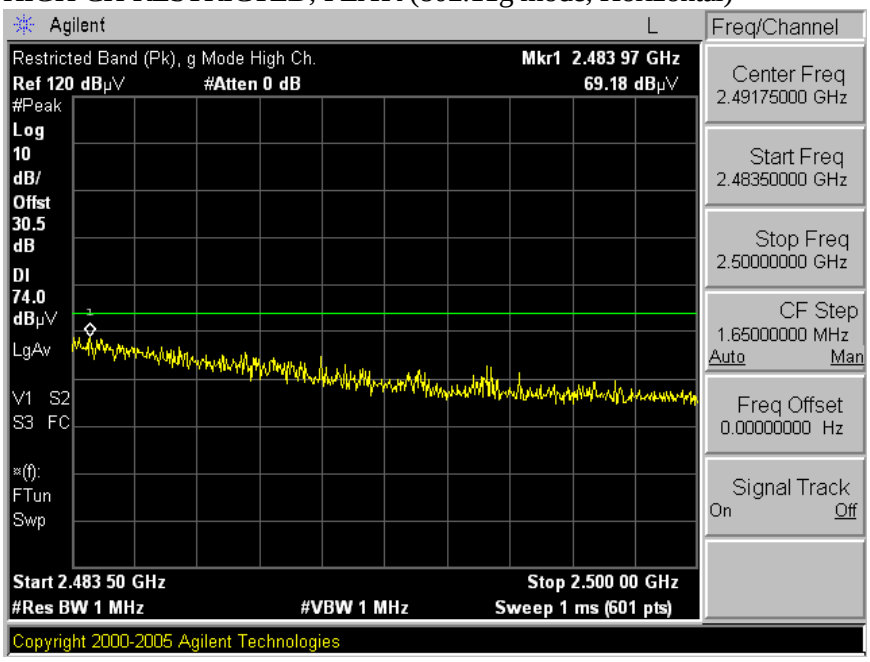


HIGH CH RESTRICTED, AVG (802.11g mode, Vertical)

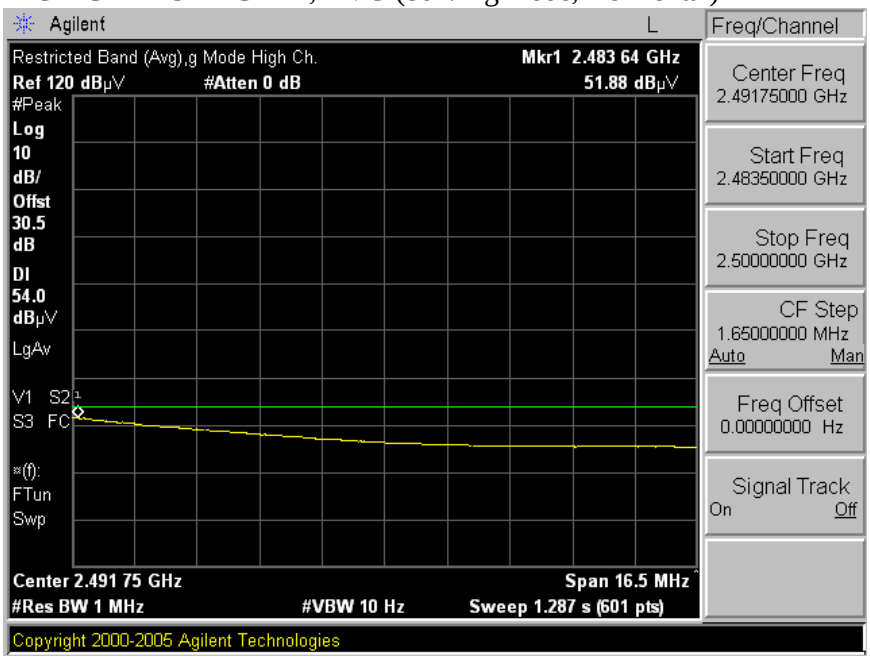


RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, 2462 MHz, HORIZONTAL)

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

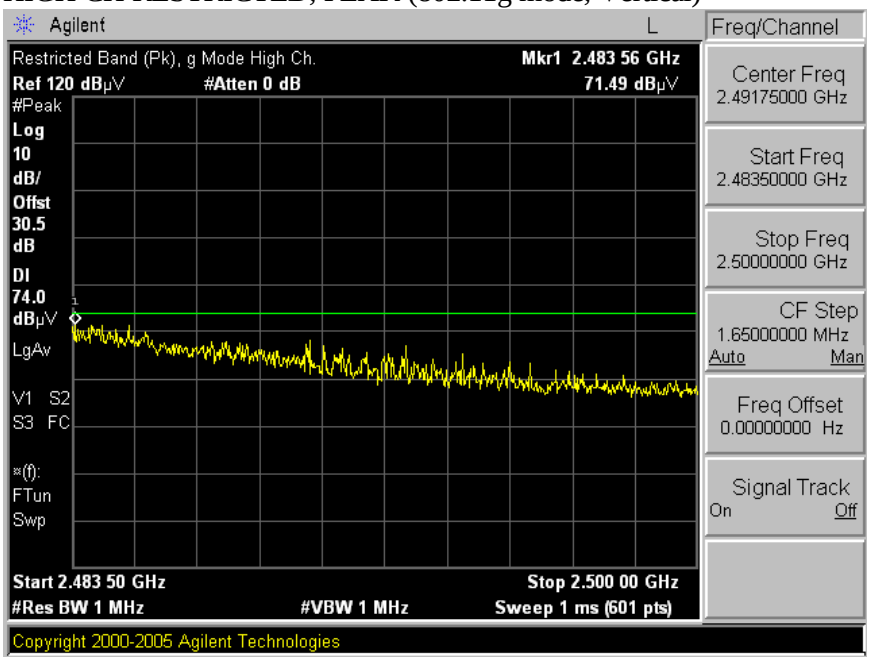


HIGH CH RESTRICTED, AVG (802.11g mode, Horizontal)

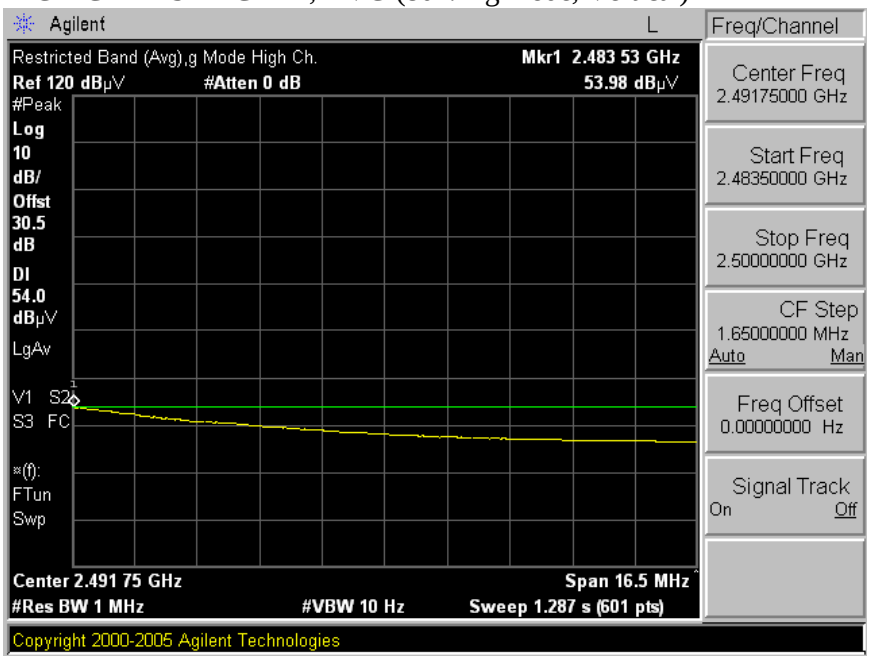


RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, 2462 MHz, VERTICAL)

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



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



HARMONICS AND SPURIOUS EMISSIONS (g MODE)

04/08/06 **High Frequency Measurement**
Compliance Certification Services, Morgan Hill Open Field Site

Test Engineer: Thanh Nguyen
Project #:06U10233-1
Company: BroadCom Corporation
EUT Description:802.11a/b/g Mini PCI card
EUT M/N: BCM94321MCAG Rev 3.0
EUT S/N: 107
Test Target: FCC Part15.247
Mode Of Operation:Tx g Mode
Average Power Meter: Low = 19 dBm, Mid = 19 dBm, High = 19 dBm

Test Equipment:

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

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
Thanh 177079008		Thanh 208946003	HPF_4.0GHz	

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)
Harmonics Spurious															
Low Channel															
4.824	3.0	47.12	37.62	33.7	2.8	-34.3	0.0	0.6	49.4	39.9	74	54	-24.6	-14.1	V
12.060	3.0	42.93	30.46	38.5	4.3	-32.5	0.0	0.9	54.2	41.7	74	54	-19.8	-12.3	Noise floor
4.824	3.0	50.03	45.38	33.7	2.8	-34.3	0.0	0.6	52.3	47.6	74	54	-21.7	-6.4	H
12.060	3.0	43.90	31.50	38.5	4.3	-32.5	0.0	0.9	55.1	42.7	74	54	-18.9	-11.3	Noise floor
Mid Channel															
4.870	3.0	53.69	40.72	33.8	2.8	-34.3	0.0	0.6	56.0	43.1	74	54	-18.0	-10.9	V
7.311	3.0	43.56	30.79	35.5	3.3	-34.1	0.0	0.6	48.9	36.2	74	54	-25.1	-17.8	V
12.185	3.0	52.01	30.26	38.5	4.3	-32.5	0.0	0.9	63.3	41.5	74	54	-10.7	-12.5	Noise floor
4.874	3.0	54.34	50.14	33.8	2.8	-34.3	0.0	0.6	56.7	52.5	74	54	-17.3	-1.5	H
7.311	3.0	44.66	31.71	35.5	3.3	-34.1	0.0	0.6	50.0	37.1	74	54	-24.0	-16.9	H
12.185	3.0	42.27	30.26	38.5	4.3	-32.5	0.0	0.9	53.5	41.5	74	54	-20.5	-12.5	Noise floor
High Channel															
4.924	3.0	50.50	39.21	33.8	2.8	-34.3	0.0	0.6	53.0	41.7	74	54	-21.0	-12.3	V
7.386	3.0	46.09	33.79	35.6	3.3	-34.1	0.0	0.6	51.6	39.3	74	54	-22.4	-14.7	V
12.310	3.0	42.41	30.23	38.5	4.4	-32.5	0.0	0.9	53.7	41.5	74	54	-20.3	-12.5	Noise floor
4.924	3.0	55.39	50.09	33.8	2.8	-34.3	0.0	0.6	57.8	52.5	74	54	-16.2	-1.5	H
7.386	3.0	50.74	35.53	35.6	3.3	-34.1	0.0	0.6	56.2	41.0	74	54	-17.8	-13.0	H
12.310	3.0	43.21	30.27	38.5	4.4	-32.5	0.0	0.9	54.5	41.6	74	54	-19.5	-12.4	Noise floor
Spurious Emissions															
1.057	3.0	60.01	43.42	24.0	1.3	-38.2	0.0	0.0	47.2	30.6	74	54	-26.8	-23.4	V
1.065	3.0	59.42	43.30	24.1	1.3	-38.2	0.0	0.0	46.6	30.5	74	54	-27.4	-23.5	H
1.195	3.0	39.94	56.81	24.5	1.4	-38.0	0.0	0.0	27.8	44.7	74	54	-46.2	-9.3	H

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

7.13.3. TRANSMITTER ABOVE 1 GHz FOR 5725 TO 5850 MHz BAND

HARMONICS AND SPURIOUS EMISSIONS (802.11a MODE)

04/08/06 **High Frequency Measurement**
Compliance Certification Services, Morgan Hill Open Field Site

Test Engineer: Thanh Nguyen
Project #:06U10233-1
Company: BroadCom Corporation
EUT Description:2x2 Dual Band MIMO Device
EUT M/N: BCM94321MCAG Rev 3.0
EUT S/N: 107
Test Target: FCC Part15.247
Mode Of Operation: Tx 5.8 GHz
Average Power Meter: Low = 17.5 dBm, Mid = 17.5 dBm, High = 17.5 dBm

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T34 HP 8449B			FCC 15.209

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
Thanh 177079008		Thanh 208946003	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)
Low 5745MHz															
11.490	3.0	47.0	34.3	38.3	4.2	-32.5	0.0	0.7	57.7	45.0	74	54	-16.3	-9.0	V
17.235	3.0	42.3	30.4	42.4	5.2	-32.0	0.0	0.6	58.4	46.6	74	54	-15.6	-7.4	V
11.490	3.0	54.1	37.8	38.3	4.2	-32.5	0.0	0.7	64.7	48.5	74	54	-9.3	-5.5	H
17.235	3.0	42.9	30.2	42.4	5.2	-32.0	0.0	0.6	59.1	46.4	74	54	-14.9	-7.6	H
Tx Mid Ch 5785MHz															
11.570	3.0	51.7	35.9	38.3	4.2	-32.5	0.0	0.7	62.4	46.6	74	54	-11.6	-7.4	H
17.355	3.0	41.7	30.3	43.0	5.2	-32.1	0.0	0.6	58.5	47.1	74	54	-15.5	-6.9	H
11.570	3.0	47.6	32.5	38.3	4.2	-32.5	0.0	0.7	58.3	43.2	74	54	-15.7	-10.8	V
17.355	3.0	43.0	30.4	43.0	5.2	-32.1	0.0	0.6	59.9	47.2	74	54	-14.1	-6.8	V
Tx High Ch 5825MHz															
11.650	3.0	49.3	33.8	38.5	4.8	-32.5	0.0	0.7	60.8	45.3	74	54	-13.2	-8.7	H
11.650	3.0	48.8	34.4	38.5	4.8	-32.5	0.0	0.7	60.4	45.9	74	54	-13.6	-8.1	V
17.475	3.0	45.3	31.4	42.2	6.3	-32.1	0.0	0.6	62.3	48.3	74	54	-11.7	-5.7	V
17.475	3.0	44.9	31.4	42.2	6.3	-32.1	0.0	0.6	61.9	48.4	74	54	-12.1	-5.6	H
23.300	3.0	46.1	32.9	33.7	7.4	-32.8	0.0	0.0	54.4	41.2	74	54	-19.6	-12.8	H
23.300	3.0	45.9	33.0	33.7	7.4	-32.8	0.0	0.0	54.1	41.3	74	54	-19.9	-12.7	V

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

7.13.4. WORST-CASE RADIATED EMISSIONS BELOW 1 GHz

2.4 GHz BAND

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

HORIZONTAL

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

Data#: 28 File#: 30-1000.EMI Date: 04-22-2006 Time: 12:42:47
Audix ATC

Condition: FCC CLASS-B HORIZONTAL
Test Operator : Vien Tran
Project # : 06U10233
Company : Broadcom
EUT : 2x2 Dual Band MIMO Device
Model No : BCM94321MCAG Rev. 3
S/N : 107
Configuration : EUT and Laptop
Mode of operation: Tx 2.4 GHz Band Legacy_Worst Case

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	30.000	9.60	20.45	30.05	40.00	-9.95	Peak
2	124.090	21.23	15.23	36.46	43.50	-7.04	Peak
3	218.180	25.28	12.51	37.79	46.00	-8.21	Peak
4	288.990	26.18	15.26	41.44	46.00	-4.56	Peak
5	575.140	20.40	21.20	41.60	46.00	-4.40	Peak
6	643.040	19.09	22.23	41.32	46.00	-4.68	Peak

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

VERTICAL

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

Data#: 32 File#: 30-1000.emi Date: 04-22-2006 Time: 13:02:07
Audix ATC

Condition: FCC CLASS-B VERTICAL
Test Operator : Vien Tran
Project # : 06U10233
Company : Broadcom
EUT : 2x2 Dual Band MIMO Device
Model No : BCM94321MCAG Rev. 3
S/N : 107
Configuration : EUT and Laptop
Mode of operation: Tx 2.4 GHz Band Legacy_Worst Case

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	62.980	23.53	8.90	32.43	40.00	-7.57	Peak
2	133.790	20.00	15.02	35.02	43.50	-8.48	Peak
3	271.530	18.83	14.65	33.48	46.00	-12.52	Peak
4	506.270	21.82	20.29	42.11	46.00	-3.89	Peak
5	574.170	19.01	21.18	40.18	46.00	-5.82	Peak
6	643.040	18.26	22.23	40.49	46.00	-5.51	Peak