FCC CFR47 CERTIFICATION
CLASS II PERMISSIVE CHANGE
TEST REPORT

FOR

BROADCOM 802.11ag /DRAFT 802.11n
WIRELESS LAN PCI-E MINI CARD

MODEL NUMBER: BCM94321MC

FCC ID: QDS-BRCM1022

REPORT NUMBER: 06U10579-1B

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	BROADCOM CORP. 190 MATHILDA PLACE SUNNYVALE, CA 94086, USA
EUT DESCRIPTION:	BROADCOM 802.11 AG /DRAFT 802.11n WIRELESS LAN PCI-E MINI CARD
MODEL:	BCM94321MC
SERIAL NUMBER:	944 & 976
DATE TESTED:	SEPTEMBER 13 - 29, 2006

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC PART 15 SUBPART C	NO NON-COMPLIANCE NOTED

Compliance Certification Services, Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:

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EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

Tested By:

VIEN TRAN
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

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2. TEST METHODOLOGY

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

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

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

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

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

4.2. MEASUREMENT UNCERTAINTY

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

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

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

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is an 802.11n MIMO transceiver chipset and manufactured by Broadcom Corp.
The chipset is installed on a Mini PCI–E card, model number BCM94321MC.

5.2. CLASS II PERMISSIVE CHANGE DESCRIPTION

The major change filed under this application is:

1. The 5GHz power amp has been modified from a SIGE to a Skyworks model and the associated layout and filter circuitry is slightly different. The power levels of the BCM94321MC with new PA will be identical to those in the original filing, as detailed in the operational description.

2. The top metal shield is modified to offer improved EMC suppression.

5.3. TEST RESULT CONCLUSIONS

The worst-case data rates in each mode is based on the investigations by measuring the PSD, peak power, average power on conducted emissions, bandedge and 2nd harmonic (5GHz only) on radiated emissions across all the data rates, bandwidths, modulations and spatial stream modes.

For the Legacy Mode, the worst case is 1Mb/s @ 11b mode & 6Mb/s @ 11g mode.
For MCS Index and MIMO operation modes covered under this evaluation it was determined that MCS Index 0 is worst case for all testing performed at 20MHz (including Band-edge, Emissions testing, PSD).
MCS Index 32 is worst case for 40MHz mode.
Both MCS 0 and MCS 32 were set to CDD mode.

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5.4. MAXIMUM OUTPUT POWER

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

LEGACY MODE

2400 to 2483.5 MHz Authorized Band

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2412 - 2462	802.11b	23.31	214.29

2400 to 2483.5 MHz Authorized Band

Frequency Range (MHz)	Mode	Peak Power Chain 0 (dBm)	Peak Power Chain 1 (dBm)	Total Peak Power (dBm)	Output (mW)
2412 - 2462	802.11g	25.78	25.74	28.77	753.42

5725 to 5850 MHz Authorized Band

Frequency Range (MHz)	Mode	Peak Power Chain 0 (dBm)	Peak Power Chain 1 (dBm)	Total Peak Power (dBm)	Output (mW)
5745 - 5825	802.11a	24.61	24.18	27.41	550.89

MIMO MODE

2400 to 2483.5 MHz Authorized Band

Frequency Range (MHz)	Mode	Peak Chain 0 (dBm)	Peak Chain 1 (dBm)	Total Peak Power (dBm)	Output (mW)
2412 - 2462	20 MHz BANDWIDTH	23.31	23.52	26.43	439.19
2422 - 2452	40 MHz BANDWIDTH	21.29	21.35	24.33	271.04

5725 to 5850 MHz Authorized Band

Frequency Range (MHz)	Mode	Peak Chain 0 (dBm)	Peak Chain 1 (dBm)	Total Peak Power (dBm)	Output (mW)
5745 - 5825	20 MHz BANDWIDTH	22.00	21.97	25.00	315.89
5755 - 5795	40 MHz BANDWIDTH	22.62	22.69	25.67	368.59

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5.5. DESCRIPTION OF AVAILABLE ANTENNAS

The EUT has 2 Tx/Rx antennas that are automatically selected for use as per the MCS index and STF mode selections.

The radio utilizes an integral antenna for diversity, with a maximum gain as below:

Hitachi Antenna:
Main Antenna: 1.7 dBi @2.4 GHz; Aux antenna: 3.9 dBi @2.4 GHz
Main Antenna: 3.5 dBi @5.3 GHz; Aux antenna: 5.6 dBi @ 5.3 GHz.
Main Antenna: 4.2 dBi @5.8 GHz; Aux antenna: 6.2 dBi @5.8 GHz.

5.6. SOFTWARE AND FIRMWARE

The EUT was tested in the following manner:
- "epi_ttcp.exe" was used to transmit UDP packets to a broadcast IP address (192.168.66.255) – i.e. no ACK required. This test mode sends a continuous packetized data stream with duty cycles that vary dependant upon data rate/MCS Index selected.
- "wl ampdu" and "frameburst" were enabled to ensure worst case data packet transfer and duty cycle.
- Worst case packet length have also been used to ensure max duty cycle

5.7. CONFIGURATION AND MODE

Operating modes were changed directly in software with no other changes to the set up. Power levels were verified across all the MCS Index at the start of test and as required throughout testing.

Prior to each test a power meter was used to tune the gated average power within a Tx packet. The channel gates on the meter were set to ensure that, at the time of recording, only packet power was captured without including duty cycle off time.

Power was tuned for different modes, channels and antennas based on the power tuning table contained in the Operational Description submitted under the same filing.

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5.8. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Laptop PC	Dell	Inspiron 0000	CN-901014-70166-57K-01JT	DOC
AC Adapter	Dell	PA-1600-06D1	F9710	DOC

I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	AC	1	AC	Unshielded	1.2 m	N/A
2	DC	1	DC	Unshielded	1.2 m	N/A

TEST SETUP

The EUT is installed in a host laptop computer via Express card to MiniPCI-E adapter boards during the tests. Test software exercised the radio card.

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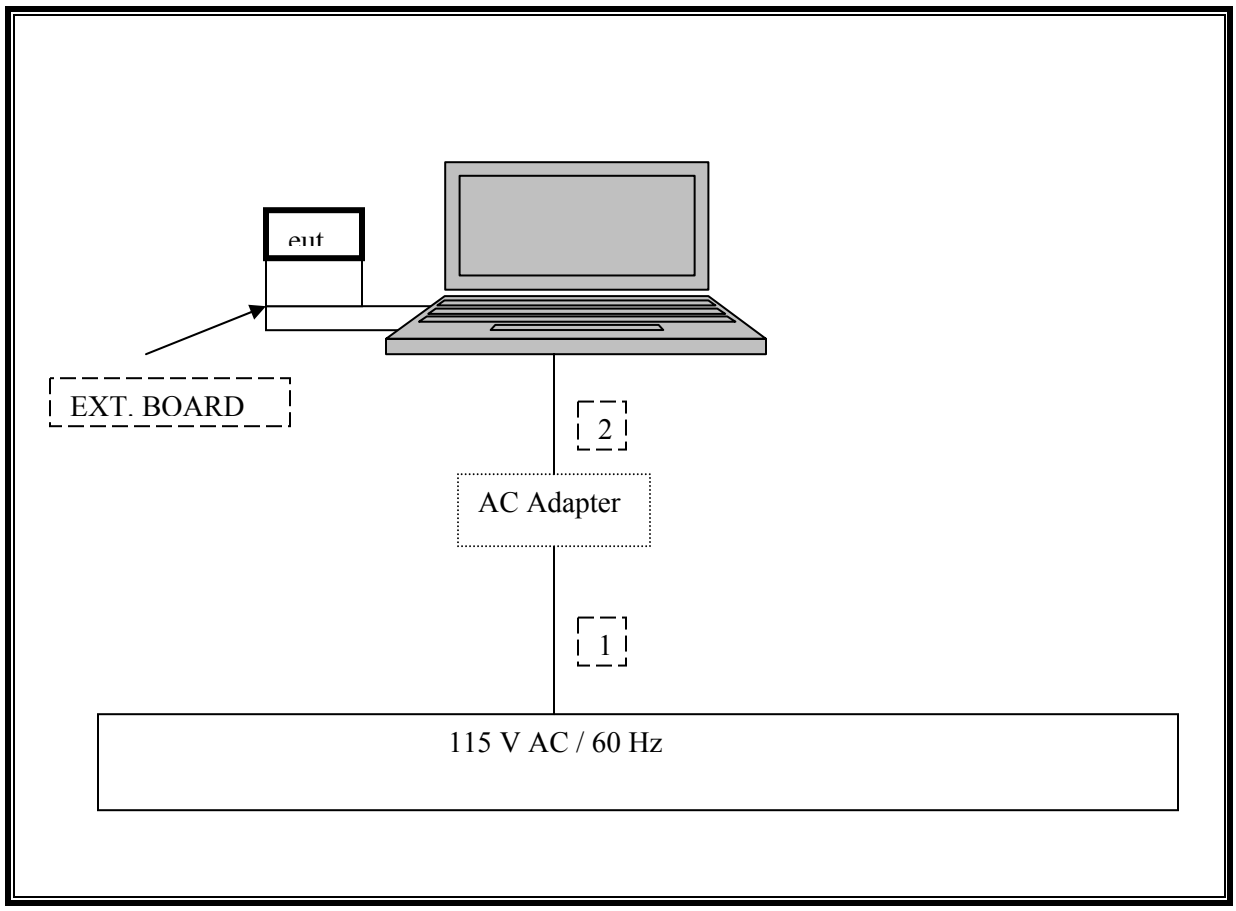
SETUP DIAGRAM



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6. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**Cal Due**
Spectrum Analyzer 3 Hz ~ 44 GHz	Agilent / HP	E4446A	US42510266	10/19/2006
Antenna, Horn 1 ~ 18 GHz	EMCO	3115	2238	4/22/2007
Preamplifier, 1 ~ 26.5 GHz	Agilent / HP	8449B	3008A00561	10/3/2007
Preamplifier, 26 ~ 40 GHz	Miteq	NSP4000-SP2	924343	8/18/2007
LISN, 10 kHz ~ 30 MHz	FCC	LISN-50/250-25-2	2023	8/30/2007
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-BNC	8379443	8/30/2007
EMI Test Receiver	R & S	ESHS 20	827129/006	11/3/2006
AC Power Source, 10 kVA	ACS	AFC-10K-AFC-2	J1568	CNR
EMI Receiver, 9 kHz ~ 2.9 GHz	Agilent / HP	8542E	3942A00286	2/4/2007
RF Filter Section	Agilent / HP	85420E	3705A00256	2/4/2007
Antenna, Bilog 30 MHz ~ 2 Ghz	Sunol Sciences	JB1	A121003	3/3/2007
4.0 High Pass Filter	Micro Tronics	HPM13351	3	N/A
2.4 - 2.5 Band Reject Filter	Micro Tronics	N/A	1	N/A
2.0 - 4.2 GHz Combiner	Mini-Circuits	ZA4PD-4	SF380100518	N/A
4.6 - 5.8 GHz Combiner	Mini-Circuits	ZB4PD1-5.8	SN649900514	N/A
Peak Power Meter	Agilent / HP	E4416A	GB41291160	12/2/2007
Antenna, Horn 26 ~ 40 GHz	ARA	MWH-2640/B	1029	4/13/2007
4.0 GHz High Pass Filter	Micro Tronics	HPM13351	3	N/A
2.4 - 2.5 Reject Filter	Micro Tronics	BRM50702	3	N/A
7.6 GHz High Pass Filter	Micro Tronics	HPM13350	1	N/A
5.75 - 5.8 Reject Filter	Micro Tronics	BRC13192	2	N/A

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7. LIMITS AND RESULT

LEGACY MODE

7.1. CHANNEL TESTS FOR THE 2400 TO 2483.5 MHz BAND

7.1.1. 6 dB BANDWIDTH

LIMIT

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

TEST PROCEDURE

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

RESULTS

Same as previous CCS report # 06U10233-1C.

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7.1.2. 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

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

RESULTS

Same as previous CCS report # 06U10233-1C.

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7.1.3. 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) (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.

Following formula to calculate the array gain:

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

2.4GHz band: 5.948 dBi
5.8GHz band: 8.084 dBi

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RESULTS

The maximum antenna gain is < 6dBi @ 2.4GHz for other than fixed, point-to-point operations, therefore the limit is still 30 dBm for 2.4GHz band.

Spot check worst case base on CCS previous report # 06U10233-1C.

802.11b Mode

Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin (dB)
2	2417	23.31	30	-6.69

802.11g Mode

Channel	Frequency (MHz)	Peak Power Chain0 (dBm)	Peak Power Chain1 (dBm)	Total (dBm)	Limit (dBm)	Margin (dB)
1	2412	25.78	25.74	28.77	30	-1.23
10	2457	25.70	25.69	28.71	30	-1.29

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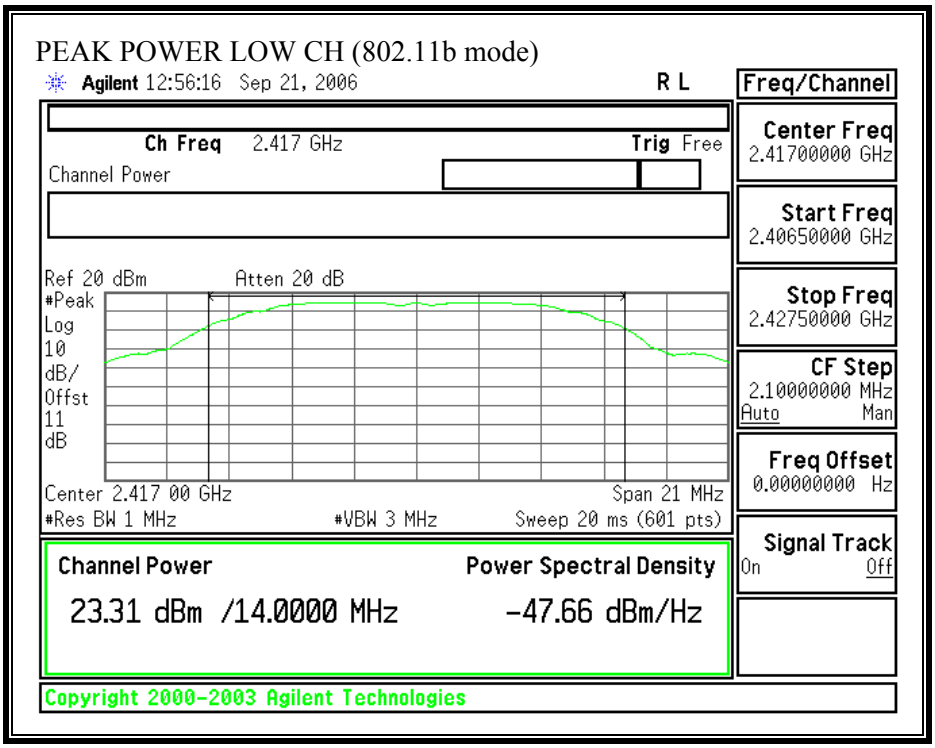
OUTPUT POWER (802.11b MODE)

CHANNEL 2, 2417 MHz



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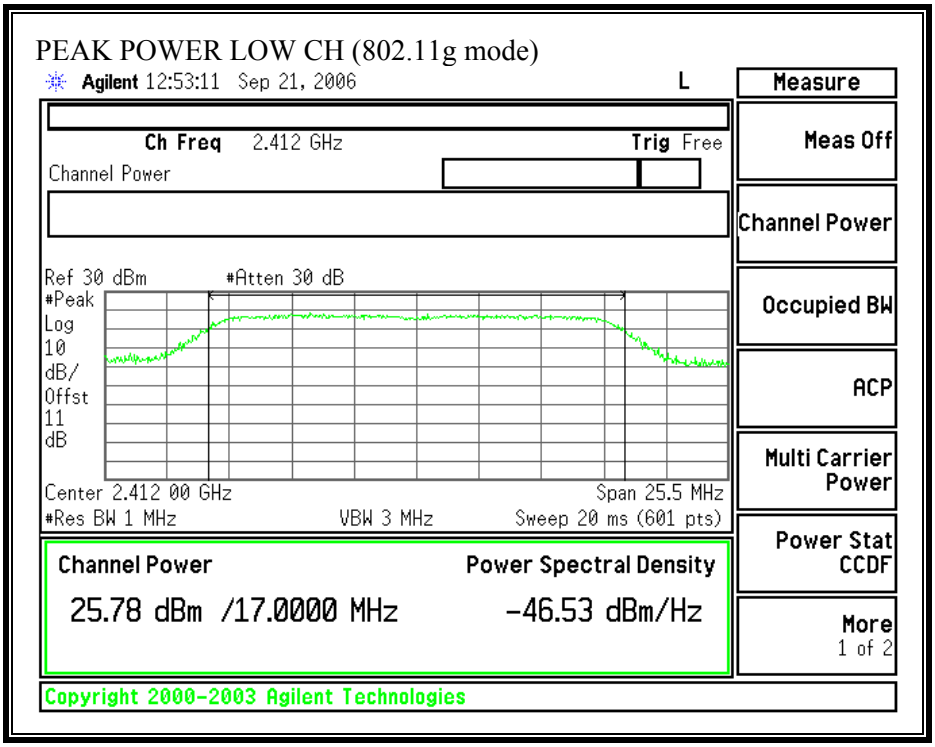
OUTPUT POWER (802.11g MODE) (Chain0)

CHANNEL 1, 2412 MHz



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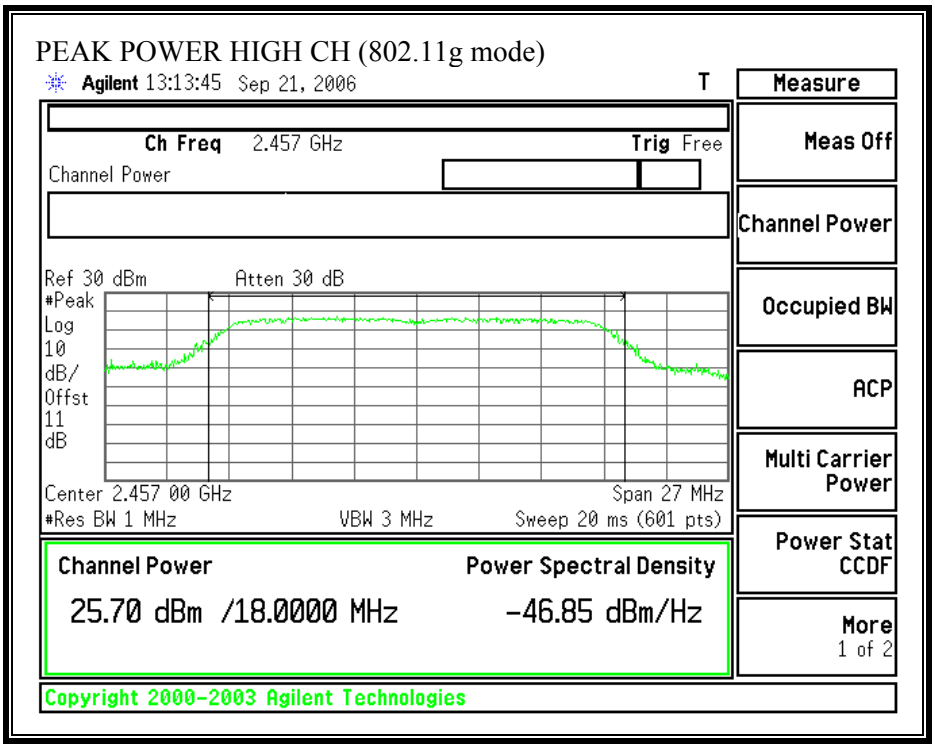
CHANNEL 10, 2457 MHz



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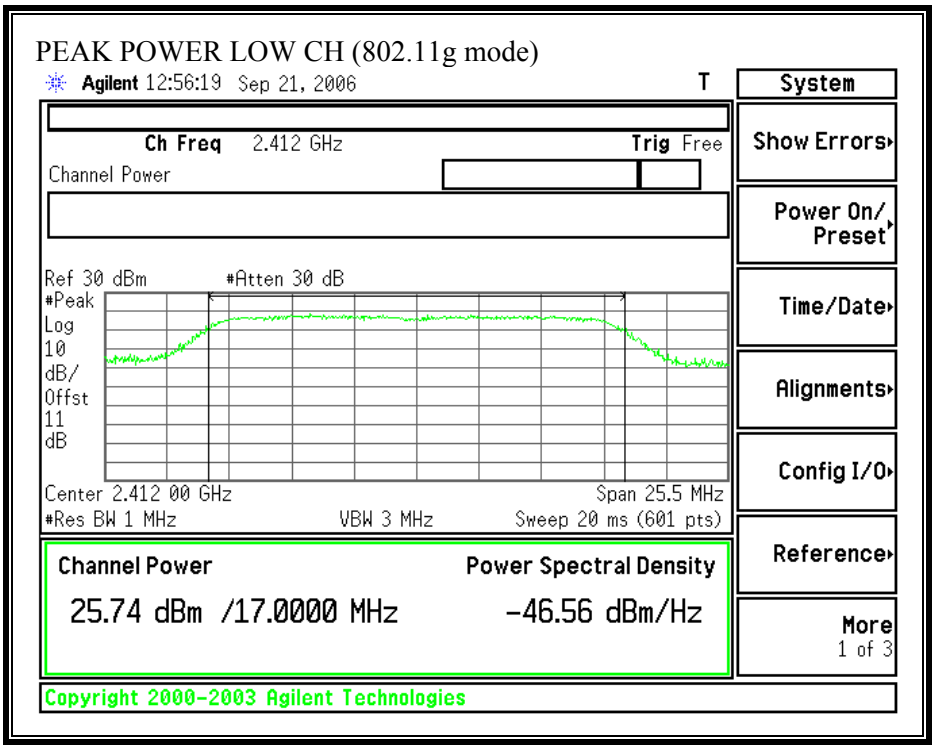
OUTPUT POWER (802.11g MODE) (Chain1)

CHANNEL 1, 2412 MHz CHAIN 1



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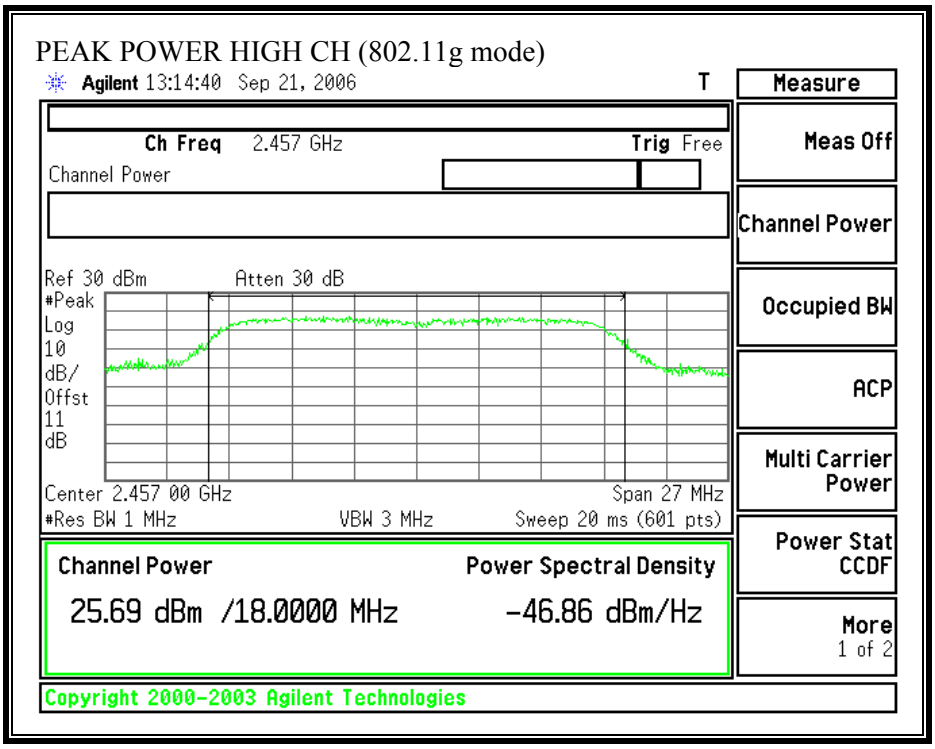
CHANNEL 10, 2457 MHz



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7.1.4. 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.

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CALCULATIONS

Given

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

and

$S = E ^ 2 / 3770$

where

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

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

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

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

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

yields

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

where

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

Substituting the logarithmic form of power and gain using:

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

yields

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

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LIMITS

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

RESULTS

No non-compliance noted:

Mode	MPE Distance (cm)	Peak Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^
802.11b	20.0	23.81	3.90	0.12

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)
802.11g	20.0	26.02	25.41	28.74	5.95	0.58

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

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7.1.5. 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 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)	Average Power (dBm)
1	2412	19.12
2	2417	19.22
6	2437	19.32
10	2457	19.20
11	2462	16.62

802.11g Mode

Channel	Frequency (MHz)	Average Power (dBm)	Average Power (dBm)
1	2412	17.54	17.61
2	2417	19.22	19.24
6	2437	19.35	19.11
10	2457	19.20	19.10
11	2462	16.51	16.64

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7.1.6. 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 8dBm 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

Same as previous CCS report # 06U10233-1C.

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7.1.7. 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)).

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

Spot check worst case base on previous CCS report # 06U10233-1C.

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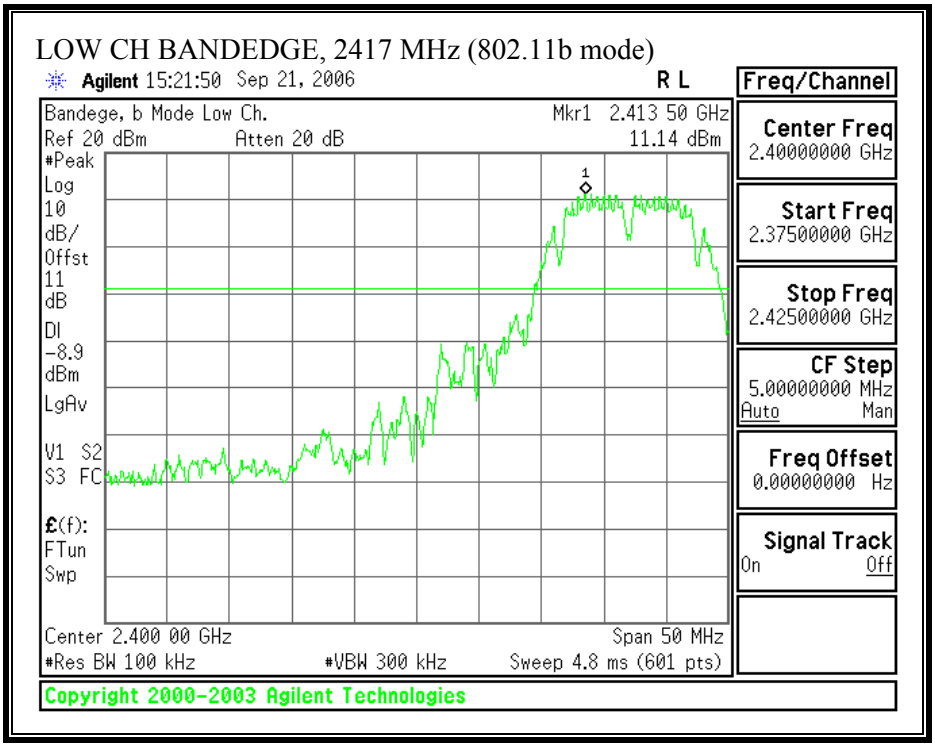
SPURIOUS EMISSIONS, LOW CHANNEL (802.11b MODE)



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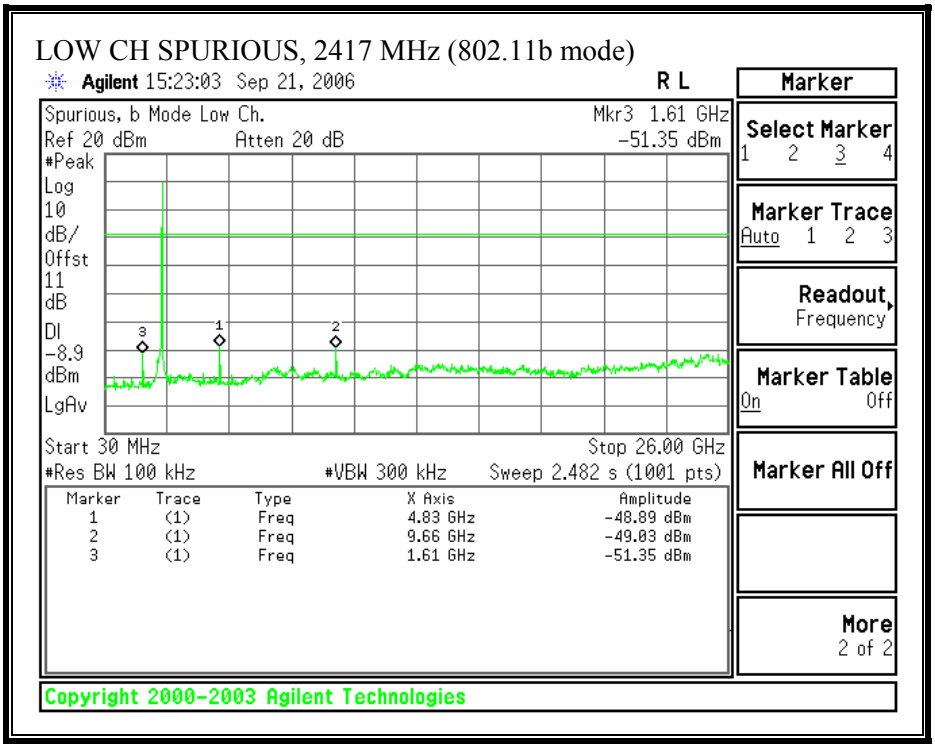
LOW CH SPURIOUS, 2417 MHz (802.11b mode)



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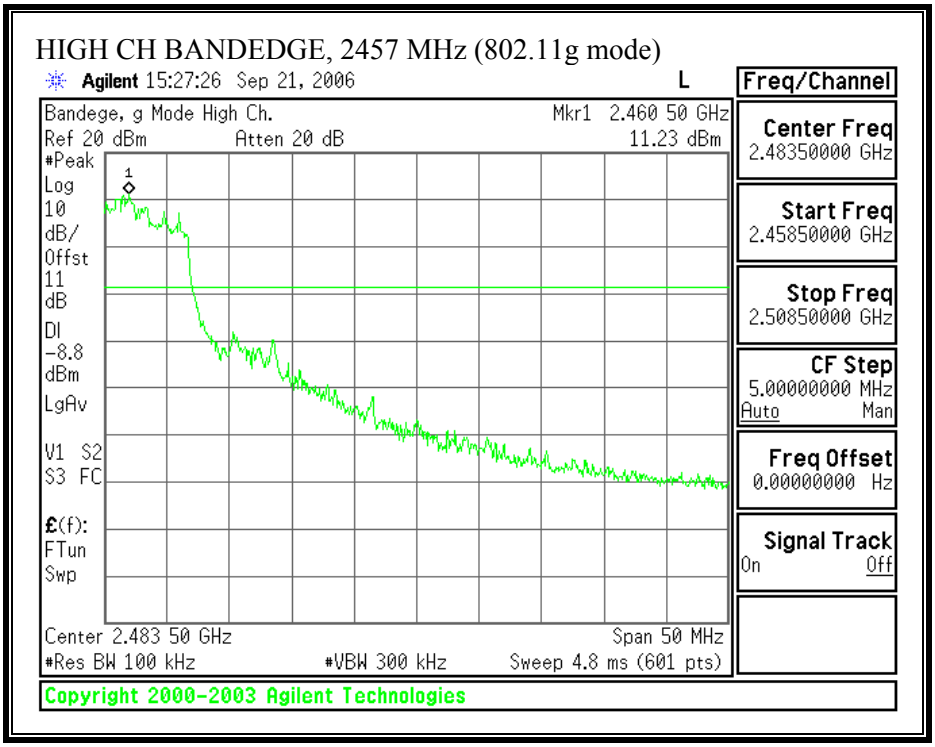
SPURIOUS EMISSIONS, HIGH CHANNEL (802.11g MODE)



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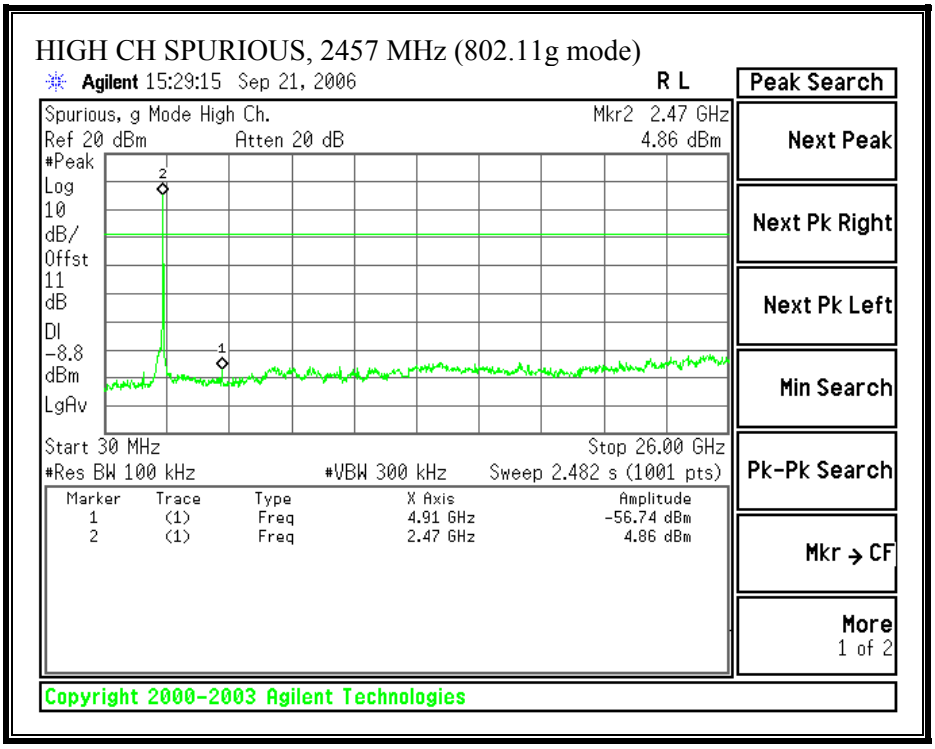
HIGH CH SPURIOUS, 2457 MHz (802.11g mode)



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7.2. CHANNEL TESTS FOR THE 5725 TO 5850 MHz BAND

7.2.1. 6 dB BANDWIDTH

LIMIT

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

TEST PROCEDURE

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

RESULTS

Same as previous CCS report # 06U10233-1C.

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7.2.2. 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

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

RESULTS

Same as previous CCS report # 06U10233-1C.

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7.2.3. 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) (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.

Following formula to calculate the array gain:

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

2.4GHz band: 5.948 dBi
5.8GHz band: 8.084 dBi

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RESULTS

The maximum antenna gain is 8.084 dBi for other than fixed, point-to-point operations, therefore the limit is 27.916dBm.

Spot check worst case base on CCS previous report # 06U10233-1C.

802.11a Mode

Channel	Frequency (MHz)	Peak Power Chain0 (dBm)	Peak Power Chain1 (dBm)	Total (dBm)	Limit (dBm)	Margin (dB)
Low	5745	24.61	24.18	27.4	27.9	-0.51

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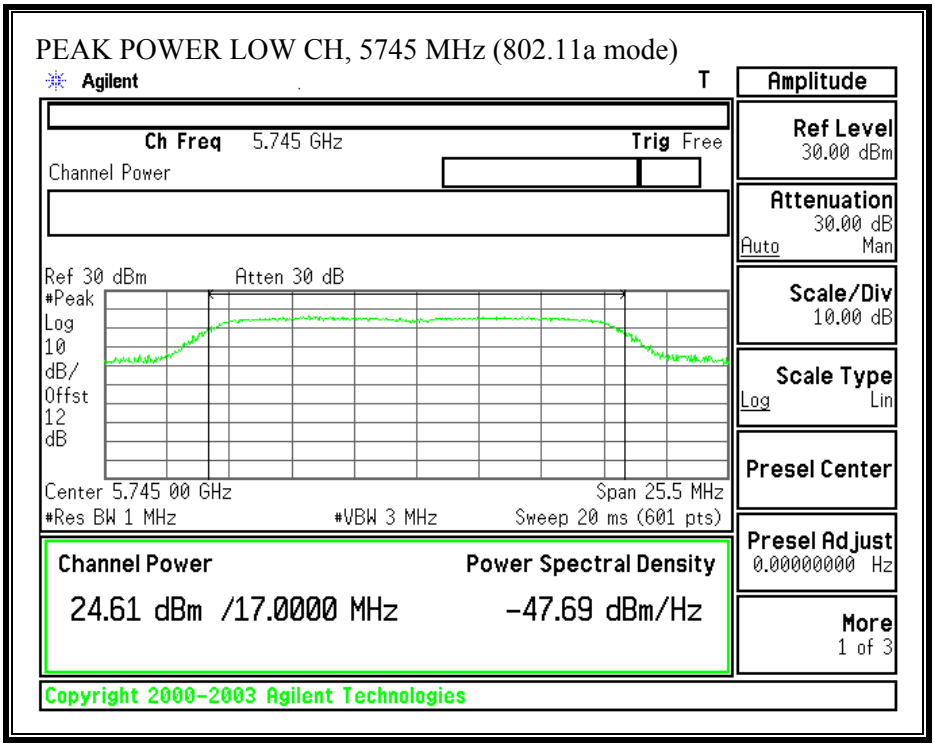
OUTPUT POWER (802.11a MODE) (Chain0)

PEAK POWER LOW CH, 5745 MHz (802.11a mode)



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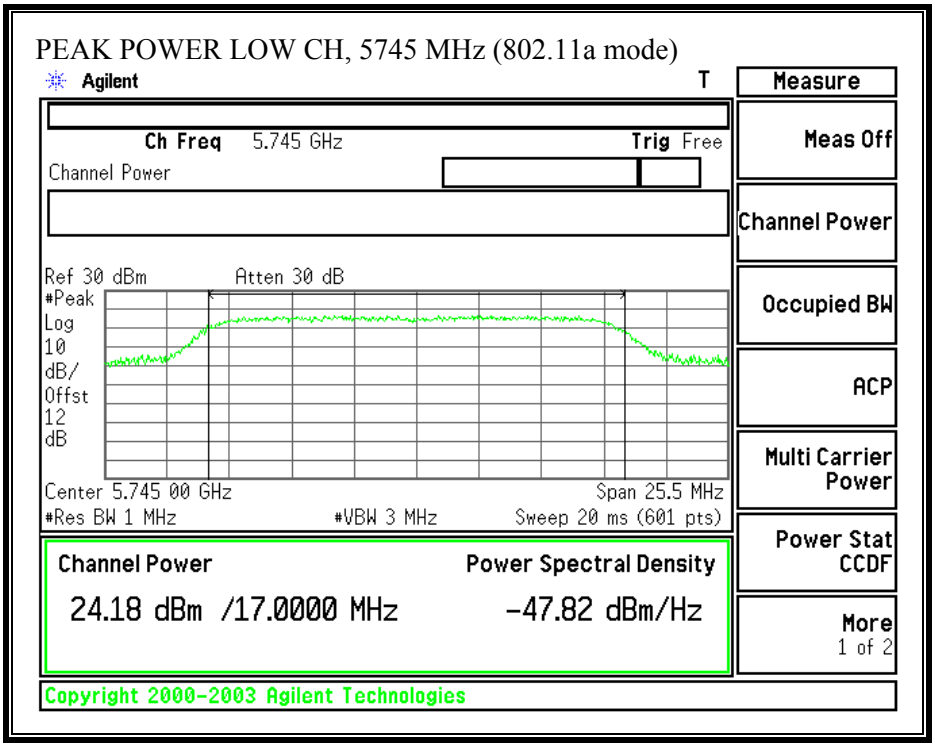
OUTPUT POWER (802.11a MODE) (Chain1)

PEAK POWER LOW CH, 5745 MHz (802.11a mode)



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7.2.4. 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.

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CALCULATIONS

Given

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

and

$S = E ^ 2 / 3770$

where

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

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

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

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

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

yields

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

where

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

Substituting the logarithmic form of power and gain using:

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

yields

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

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LIMITS

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

RESULTS

Spot check worst case base on CCS previous report # 06U10233-1C.

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)
802.11a	20.0	24.61	24.48	27.56	8.08	0.73

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

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7.2.5. 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.

802.11a Mode

Channel	Frequency (MHz)	Average Power Chain 0 (dBm)	Average Power Chain 1 (dBm)
Low	5745	17.63	17.49
Middle	5785	17.73	17.67
High	5825	17.55	17.45

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7.2.6. 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 8dBm 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

Spot check worst case base on CCS previous report # 06U10233-1C.

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7.2.7. 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)).

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 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

RESULTS

Spot check worst case base on CCS previous report # 06U10233-1C.

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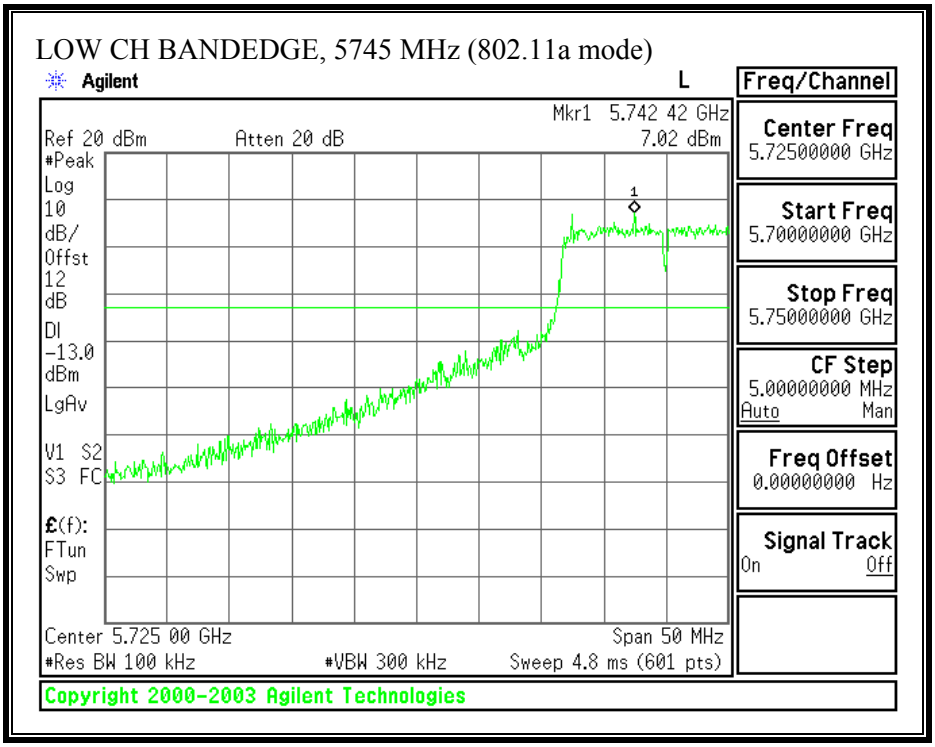
SPURIOUS EMISSIONS, LOW CHANNEL (802.11a MODE)



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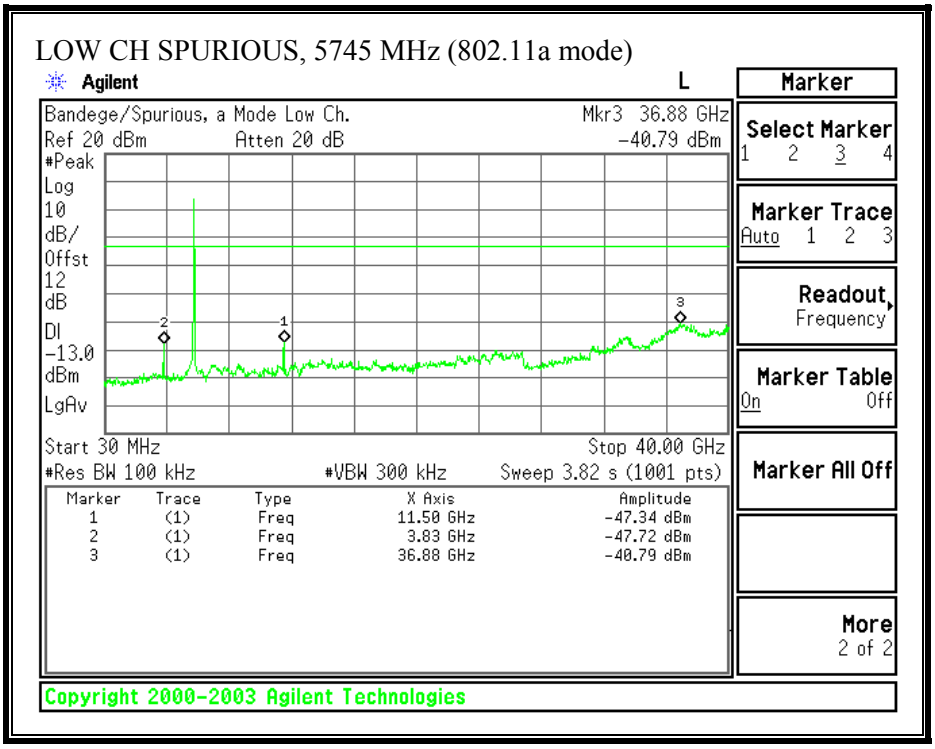
LOW CH SPURIOUS, 5745 MHz (802.11a mode)



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MIMO MODE

7.3. CHANNEL TESTS FOR THE 2400 TO 2483.5 MHz BAND

7.3.1. 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

Same as previous CCS report # 06U10233-1C.

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7.3.2. 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

Same as previous CCS report # 06U10233-1C.

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7.3.3. 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.

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.

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RESULTS,

The maximum antenna gain is < 6dBi 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

Spot check worst case base on CCS previous report # 06U10233-1C.

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	2417	23.31	23.52	26.43	30.0	-3.57
40 MHz TX BANDWIDTH						
High	2442	21.29	21.35	24.33	30.0	-5.67

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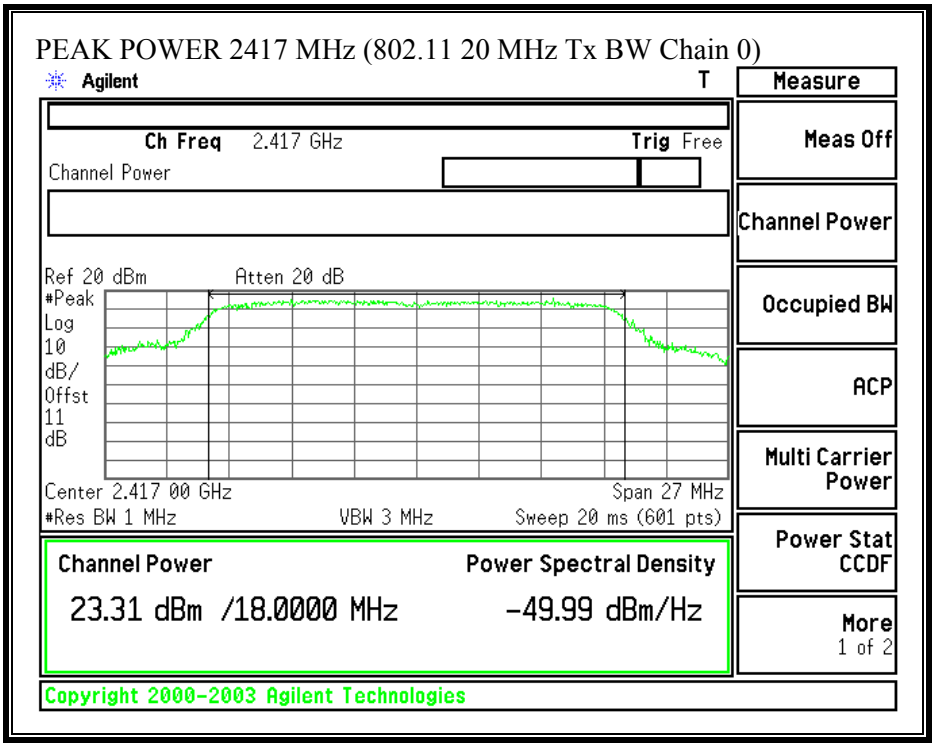
OUTPUT POWER (802.11 - 20 MHz TX BANDWIDTH – CHAIN 0)

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



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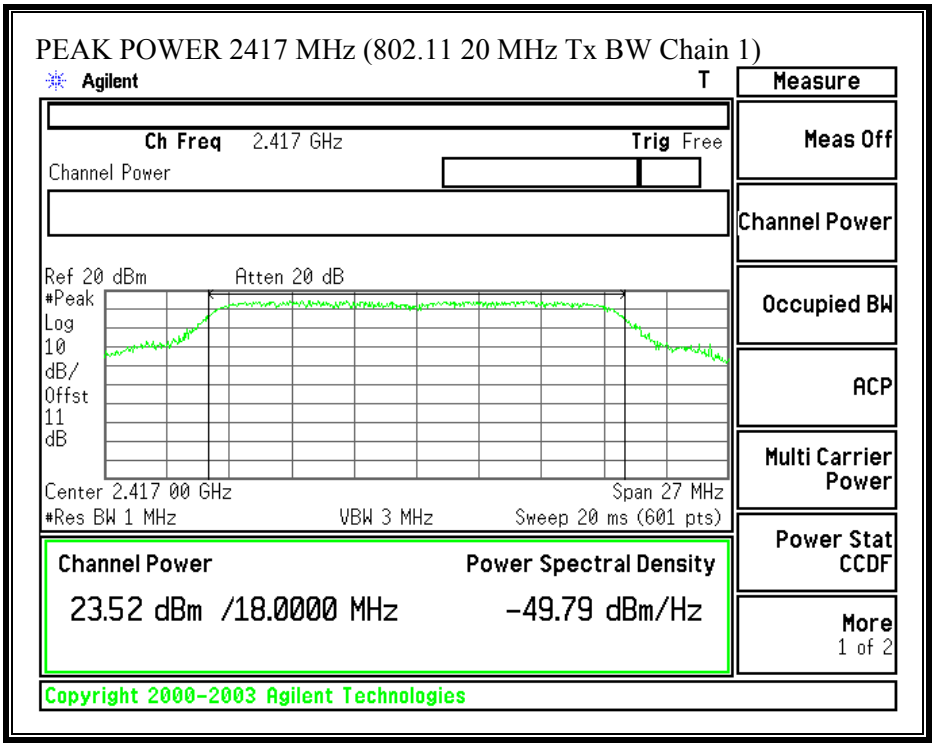
OUTPUT POWER (802.11 - 20 MHz TX BANDWIDTH – CHAIN 1)

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



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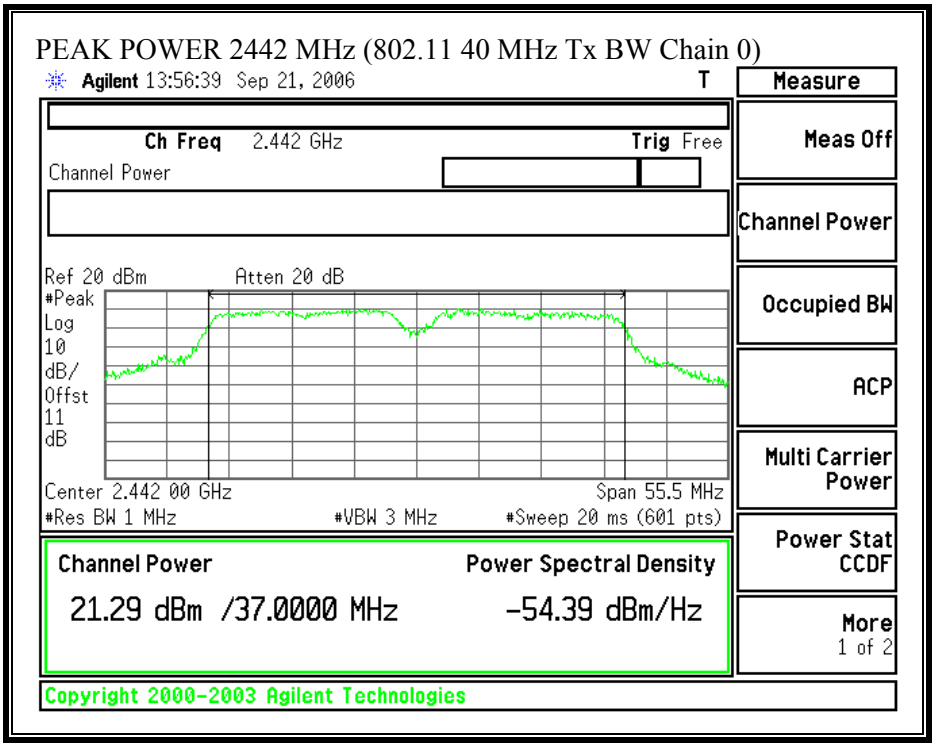
OUTPUT POWER (802.11 - 40 MHz TX BANDWIDTH – CHAIN 0)



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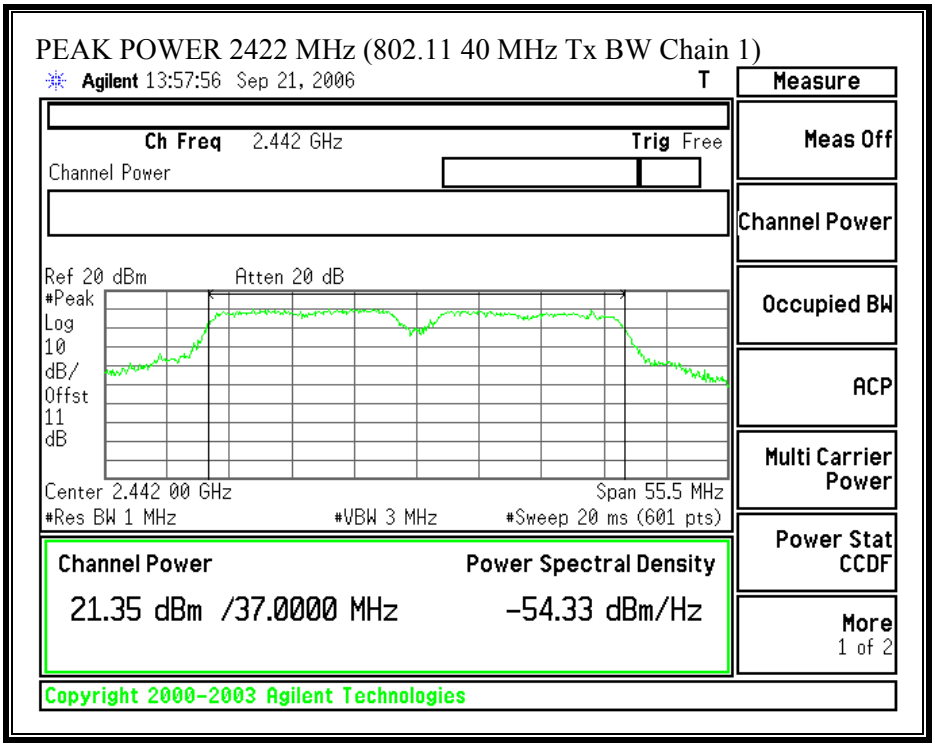
OUTPUT POWER (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)



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7.3.4. 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.

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CALCULATIONS

Given

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

and

$S = E ^ 2 / 3770$

where

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

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

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

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

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

yields

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

where

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

Substituting the logarithmic form of power and gain using:

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

yields

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

where

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

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

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

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LIMITS

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

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	3.90	0.24
40MHz TX BW	20.0	21.77	21.61	24.70	3.90	0.14

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

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7.3.5. 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 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	14.22	14.31
2	2417	16.11	16.23
6	2437	16.24	16.23
10	2457	16.32	16.21
11	2462	14.12	14.15

40 MHz TX BANDWIDTH

Channel	Frequency (MHz)	Power Chain 0 (dBm)	Power Chain 1 (dBm)
3	2422	13.18	13.32
4	2427	14.32	14.31
6	2437	14.26	14.39
7	2442	14.40	14.30
9	2452	12.27	12.33

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7.3.6. 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.

Same as previous CCS report # 06U10233-1C.

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7.3.7. 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

Same as previous CCS report # 06U10233-1C.

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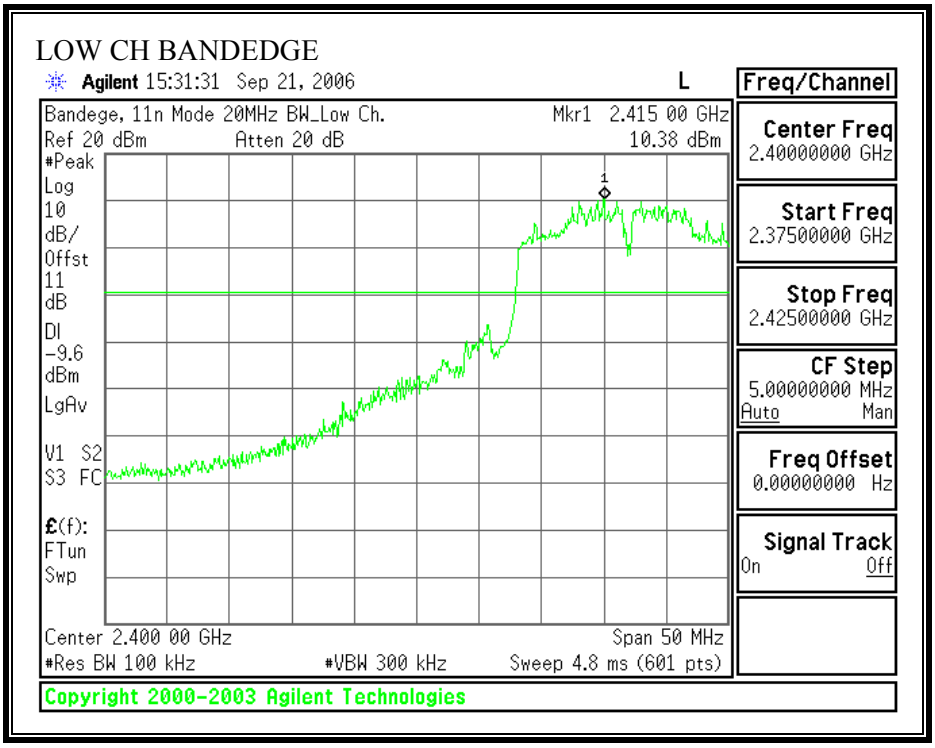
SPURIOUS EMISSIONS, LOW CHANNEL (802.11 - 20 MHz TX BANDWIDTH)

LOW CH BANDEDGE, 2417 MHz



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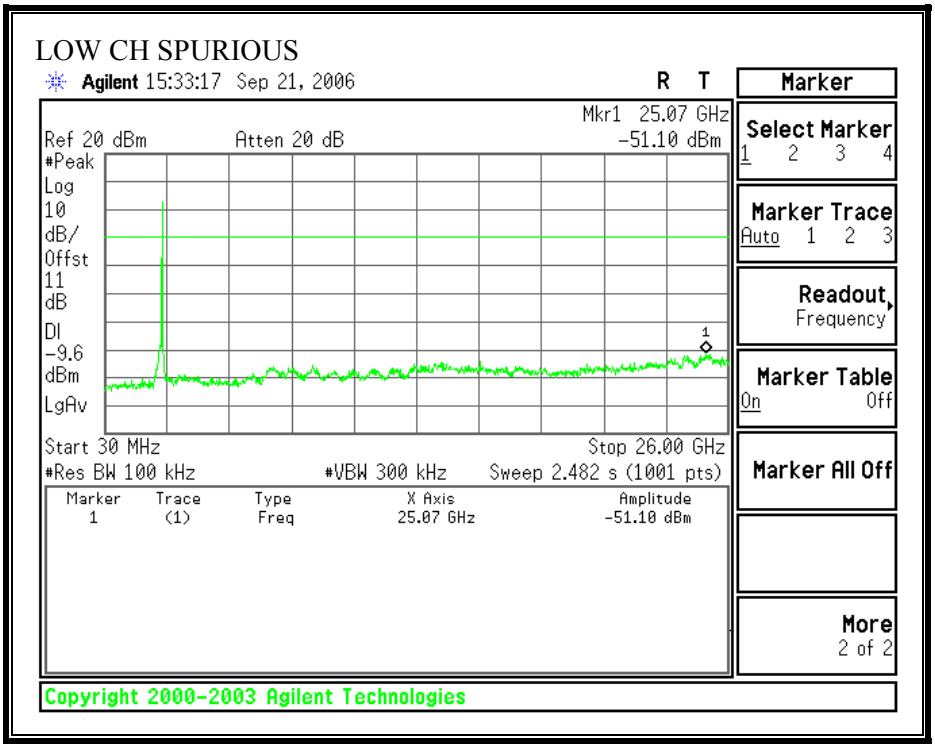

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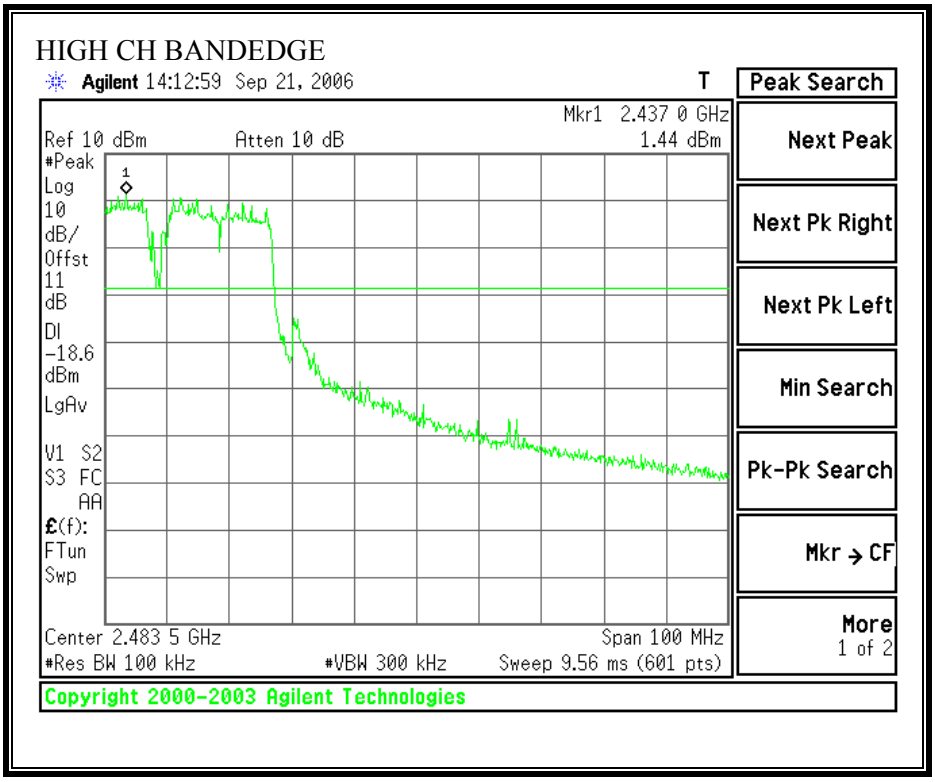
SPURIOUS EMISSIONS, HIGH CHANNEL (802.11 - 40 MHz TX BANDWIDTH)

HIGH CH BANDEDGE, 2442 MHz



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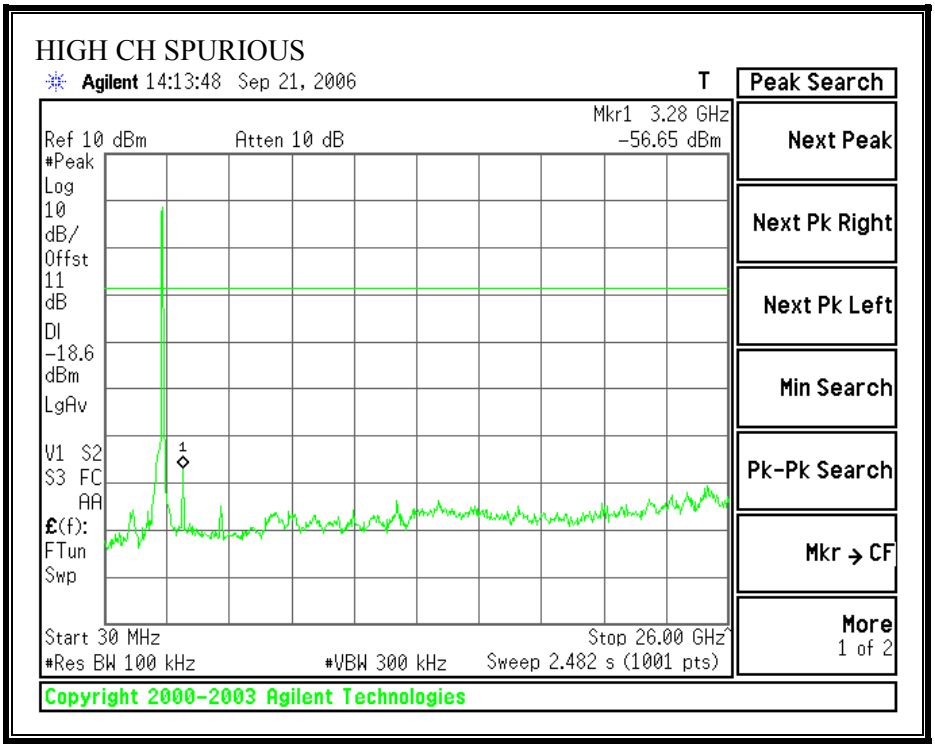
HIGH CH SPURIOUS



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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

Same as previous CCS report # 06U10233-1C.

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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

Same as previous CCS report # 06U10233-1C.

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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.

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RESULTS,

The maximum antenna gain is < 6dBi 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

Spot check worst case base on CCS previous report # 06U10233-1C.

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						
High	5825	22.00	21.97	25.00	30.0	-5.00
40 MHz TX BANDWIDTH						
High	5795	22.62	22.69	25.67	30.0	-4.33

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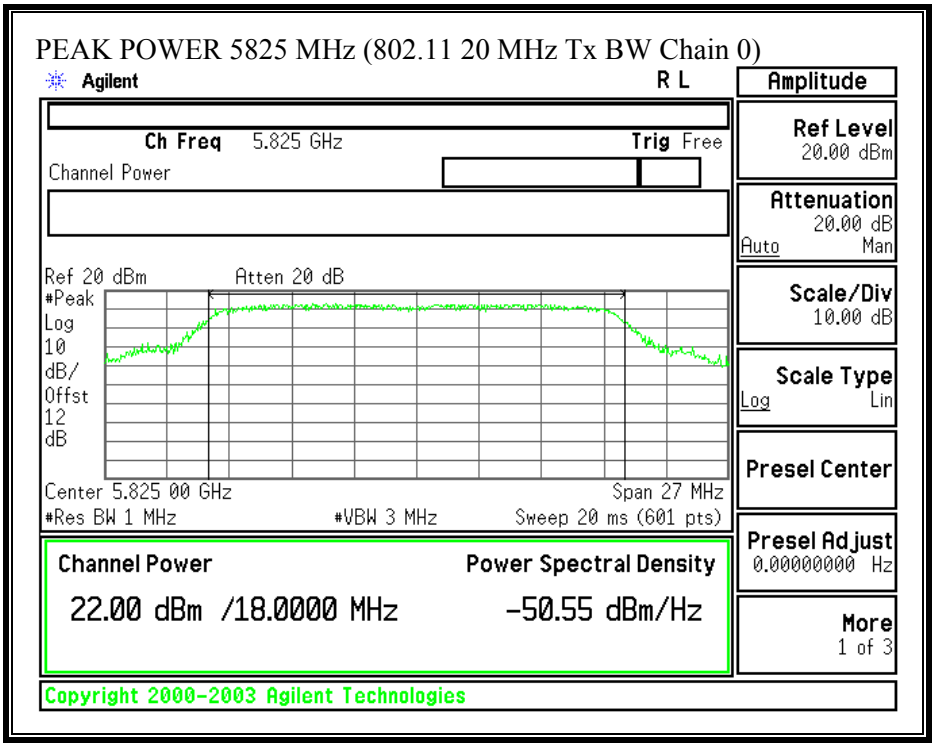
OUTPUT POWER (802.11 - 20 MHz TX BANDWIDTH – CHAIN 0)



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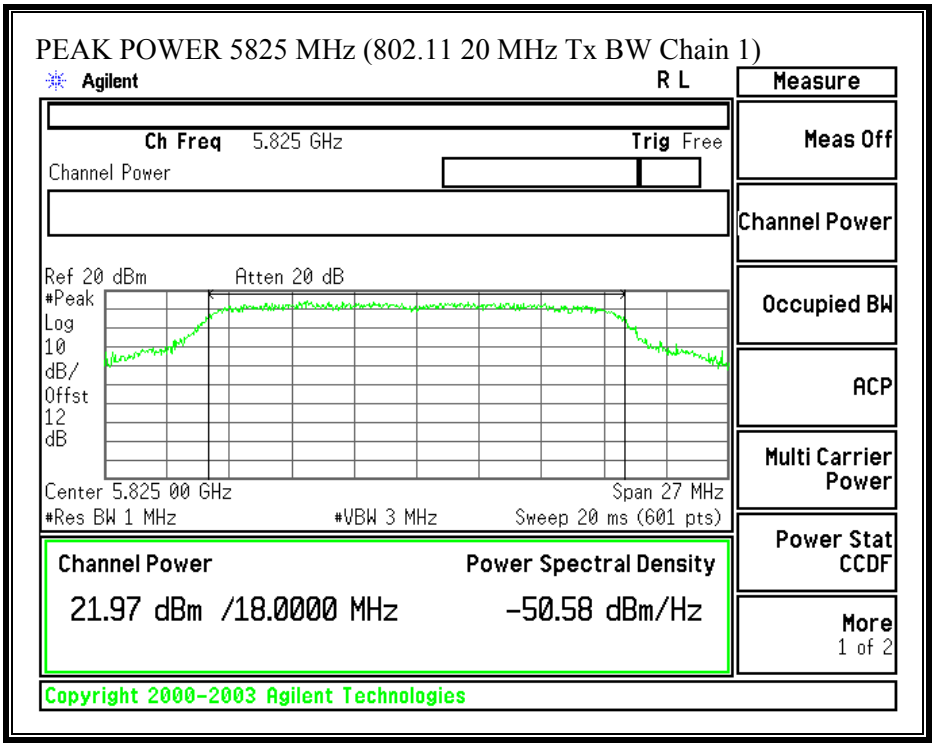
OUTPUT POWER (802.11 - 20 MHz TX BANDWIDTH – CHAIN 1)

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



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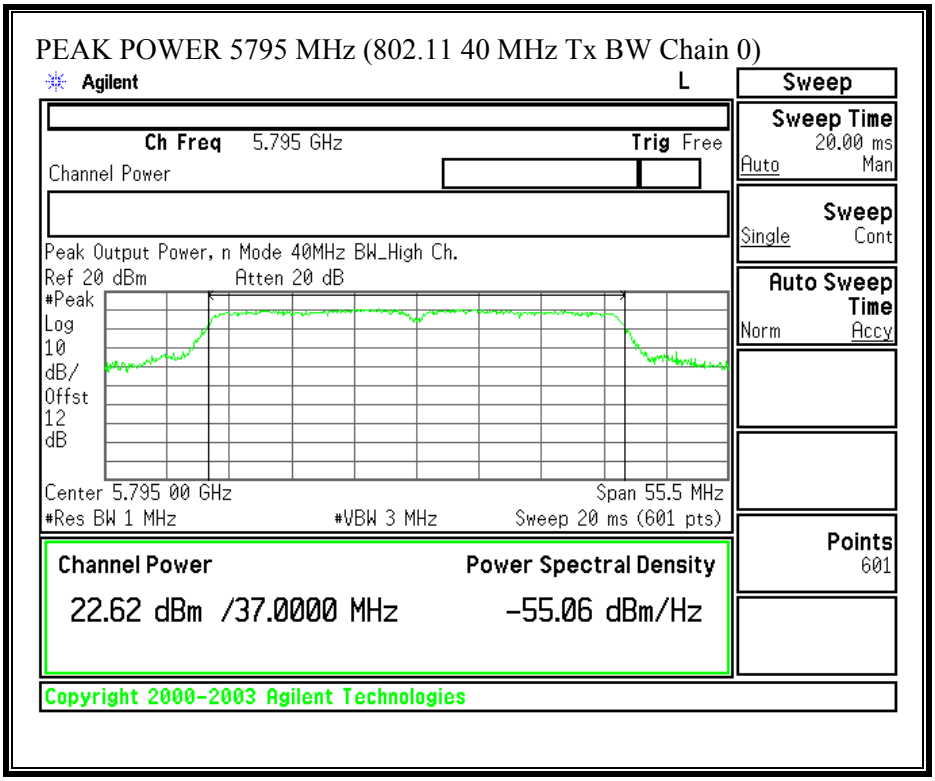
OUTPUT POWER (802.11 - 40 MHz TX BANDWIDTH – CHAIN 0)

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



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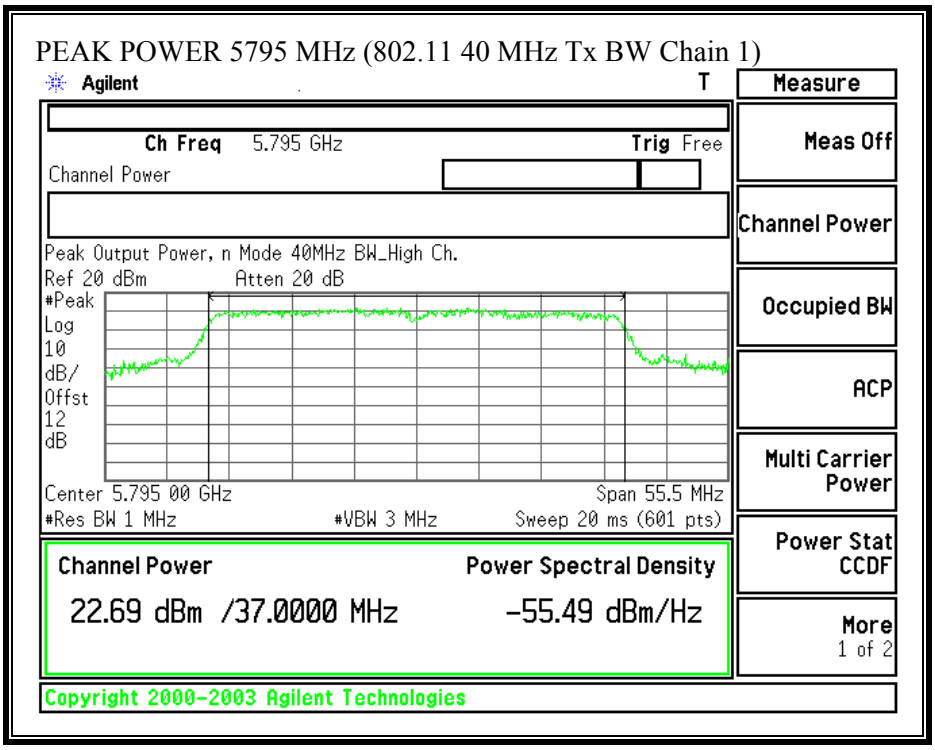
OUTPUT POWER (802.11 - 40 MHz TX BANDWIDTH – CHAIN 1)



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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.

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CALCULATIONS

Given

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

and

$S = E ^ 2 / 3770$

where

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

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

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

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

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

yields

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

where

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

Substituting the logarithmic form of power and gain using:

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

yields

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

where

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

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

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

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LIMITS

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

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	5.80	0.26
40MHz TX BW	20.0	22.41	23.66	26.09	5.80	0.31

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

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7.4.5. 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	15.34	15.23
157	5785	15.44	15.43
165	5825	15.34	15.37

40 MHz TX BANDWIDTH

Channel	Frequency (MHz)	Power Chain 0 (dBm)	Power Chain 1 (dBm)
159	5795	15.21	15.27

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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

Same as previous CCS report # 06U10233-1C.

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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:

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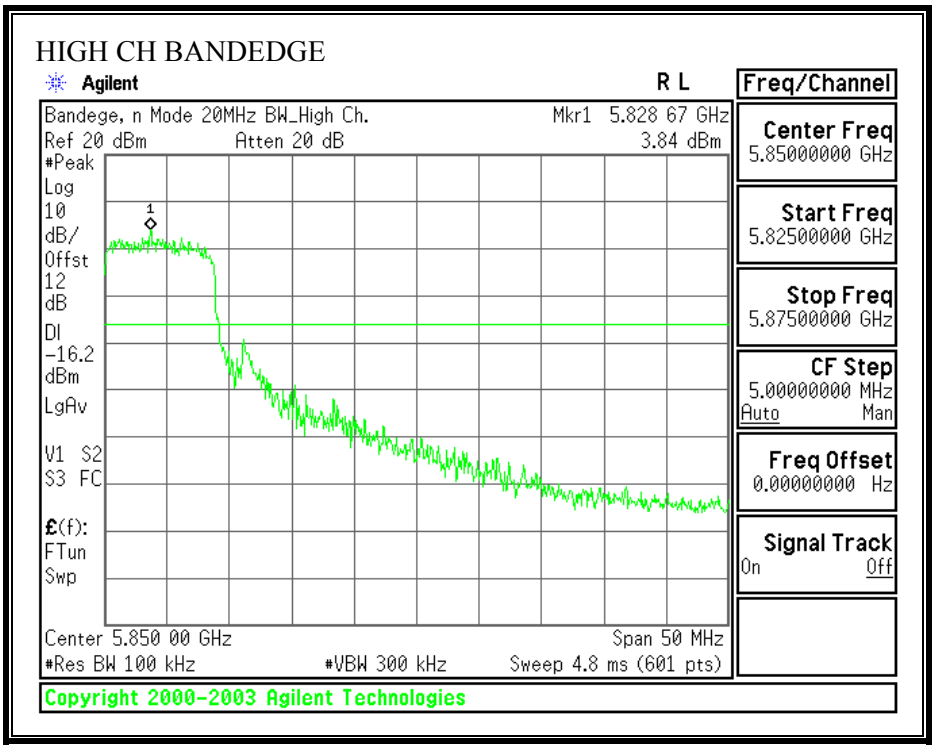
SPURIOUS EMISSIONS, HIGH CHANNEL (802.11 - 20 MHz TX BANDWIDTH)

HI CH BANDEDGE, 5825 MHz



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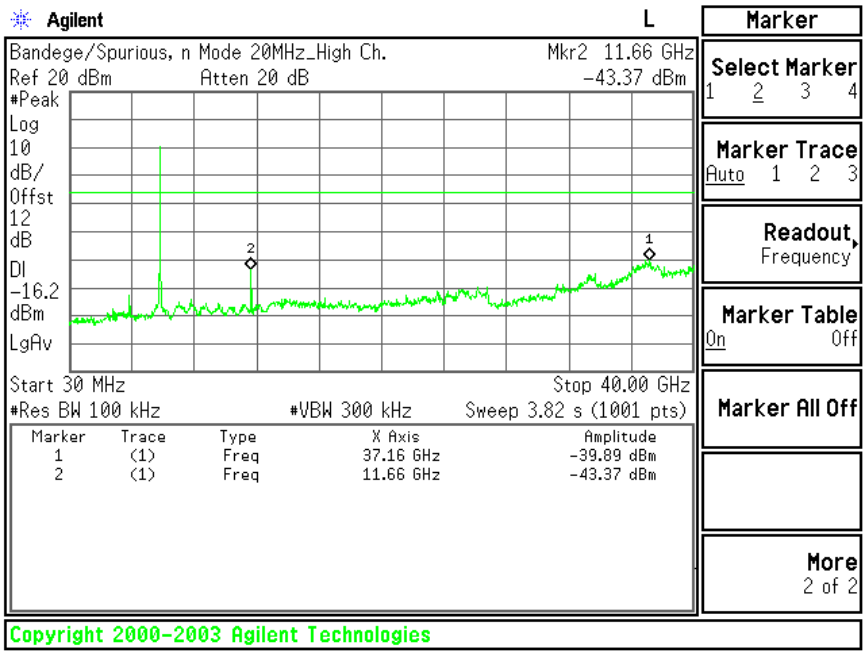
HIGH CH SPURIOUS



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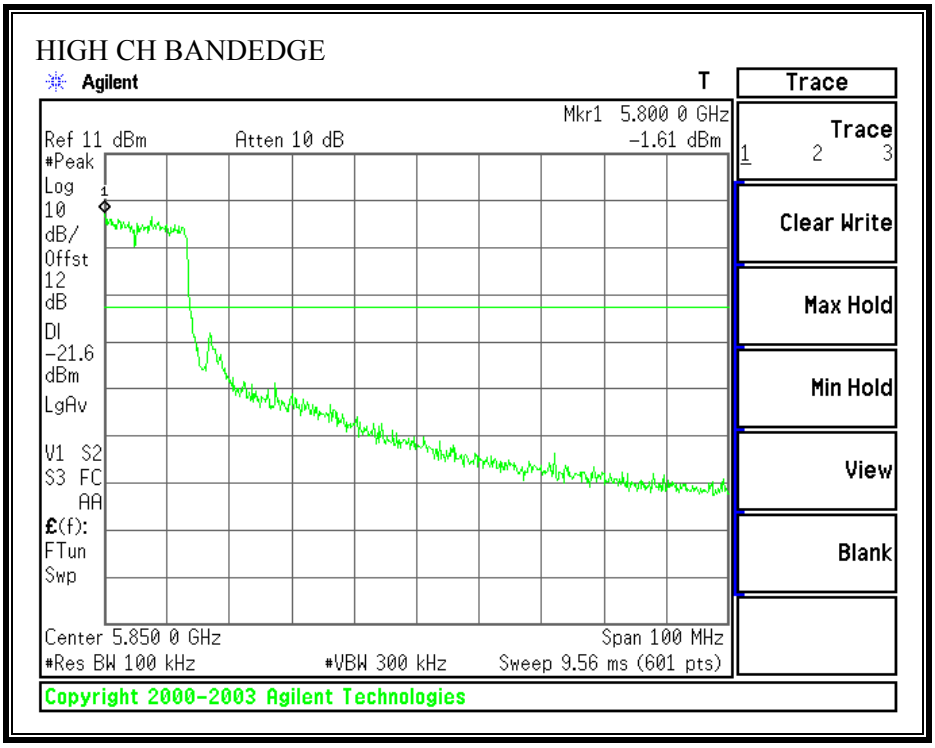
SPURIOUS EMISSIONS, HIGH CHANNEL (802.11 - 40 MHz TX BANDWIDTH)

HIGH CH BANDEDGE, 5795 MHz



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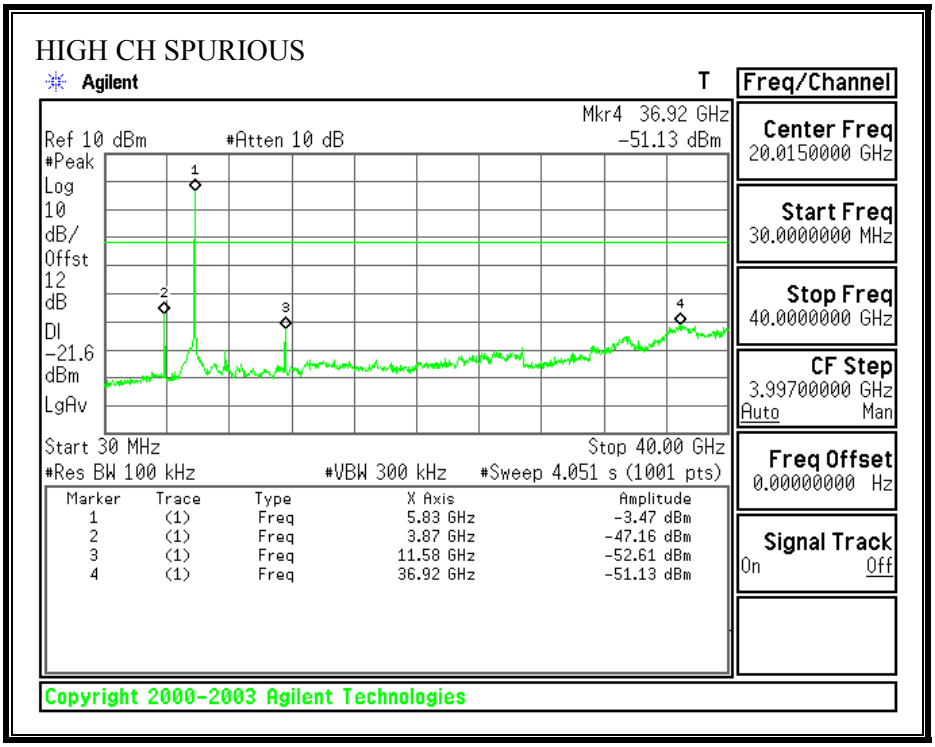
HIGH CH SPURIOUS



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7.5. RADIATED EMISSIONS

7.5.1. TRANSMITTER RADIATED SPURIOUS EMISSIONS

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.

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

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

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

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

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TEST PROCEDURE

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

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

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

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

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

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

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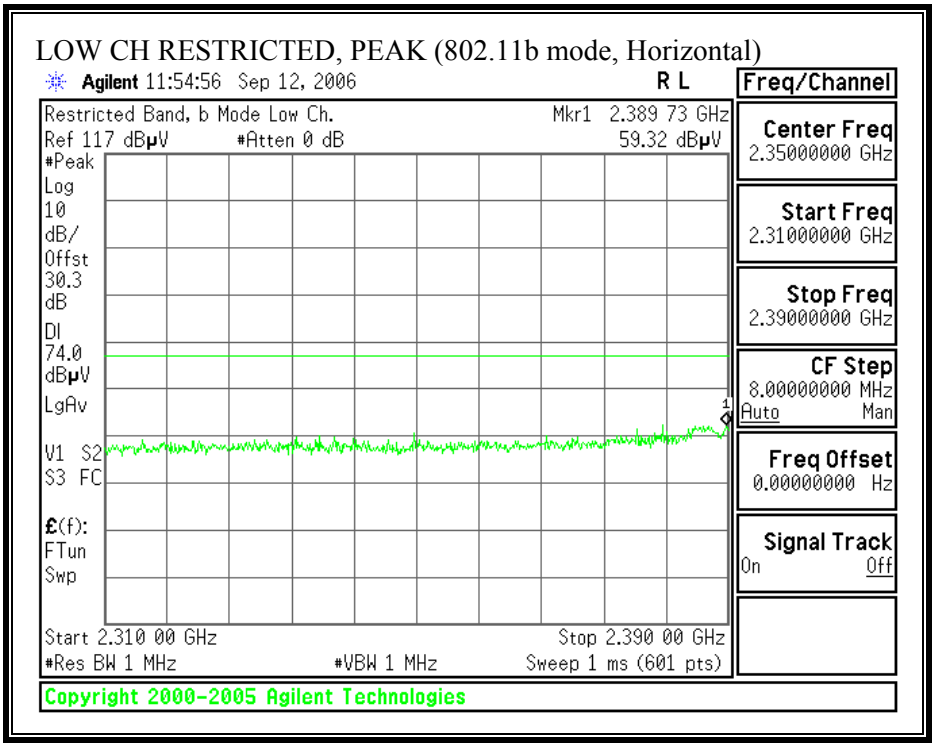
7.5.2. TRANSMITTER ABOVE 1 GHz FOR 2400 TO 2483.5 MHz BAND

11b MODE

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

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



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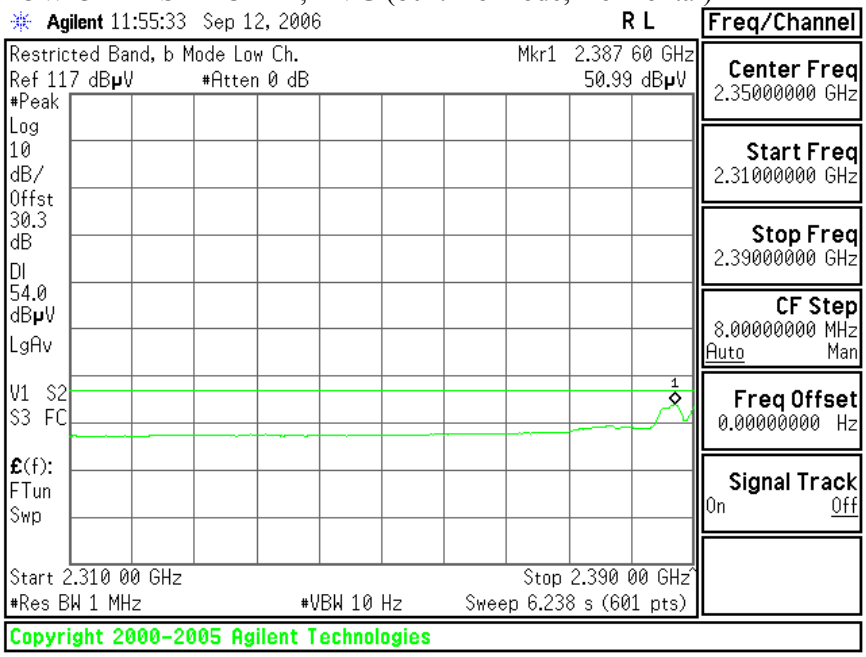
LOW CH RESTRICTED, AVG (802.11b mode, Horizontal)



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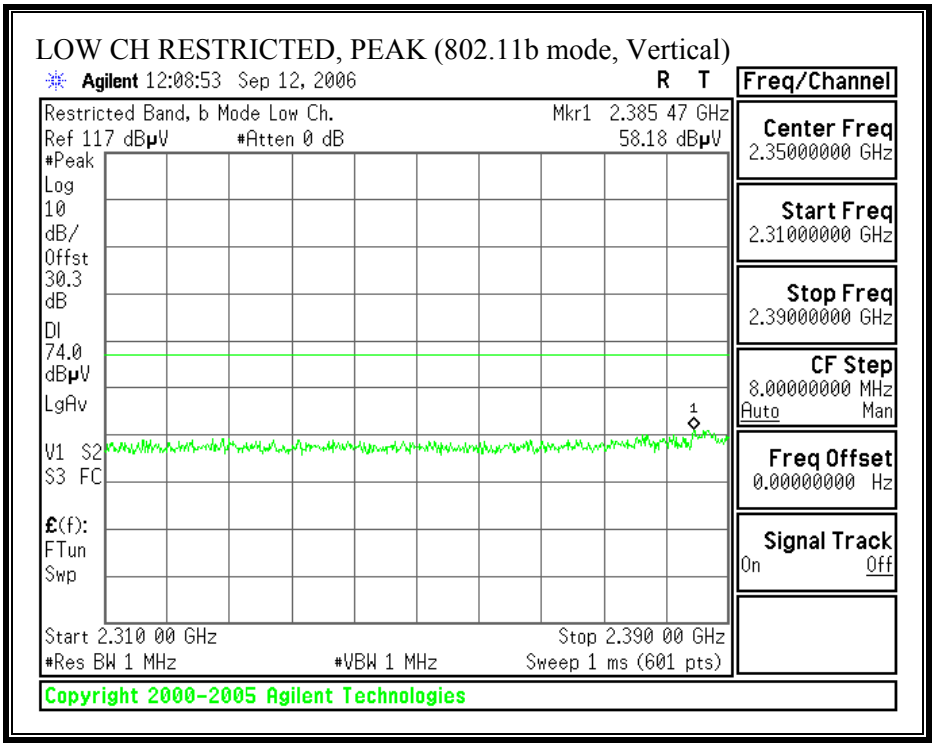
RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, 2412 MHz, VERTICAL)



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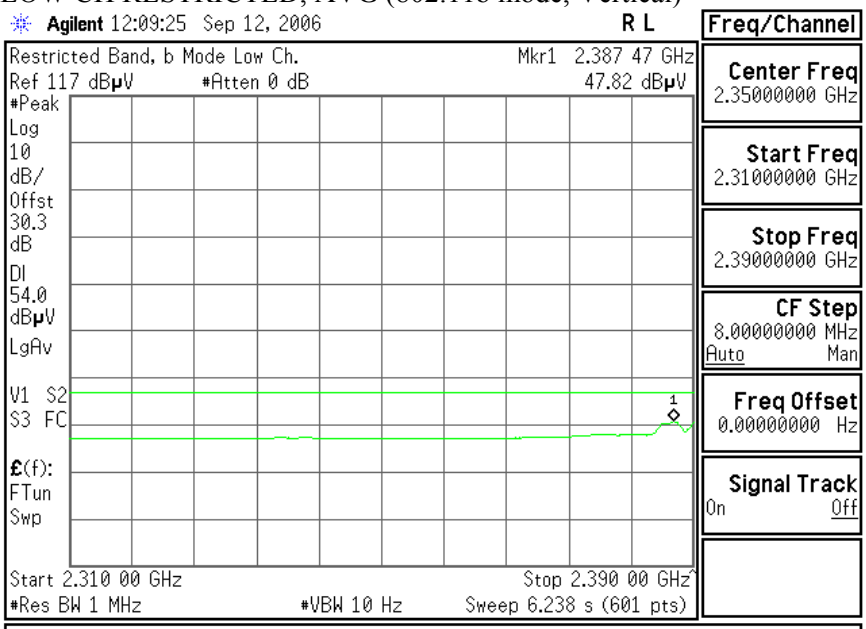
LOW CH RESTRICTED, AVG (802.11b mode, Vertical)



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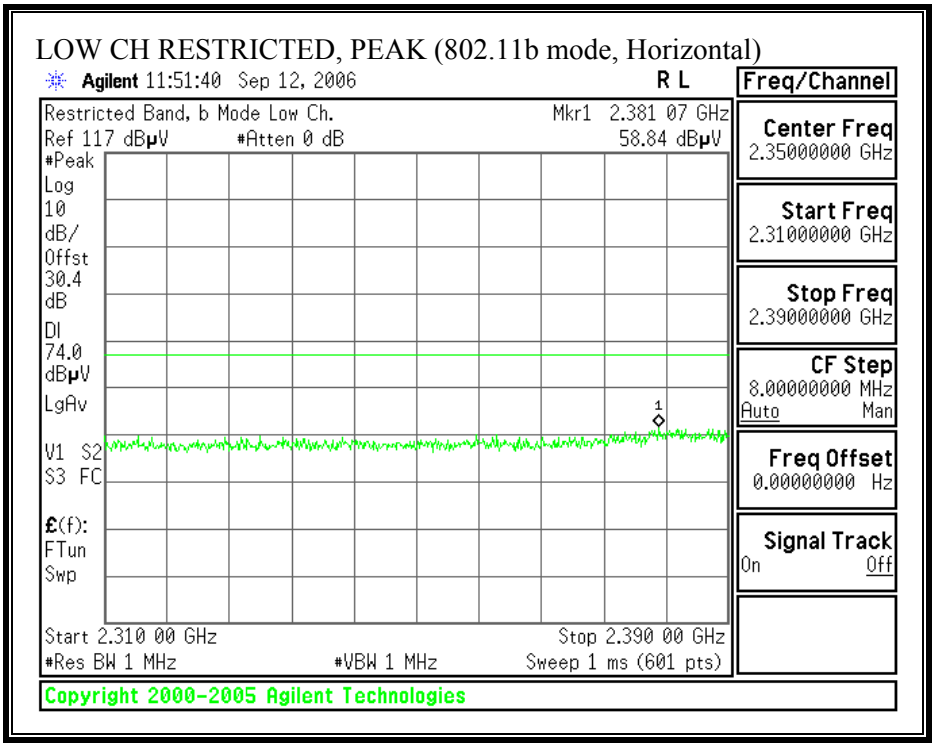
RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, 2417 MHz, HORIZONTAL)



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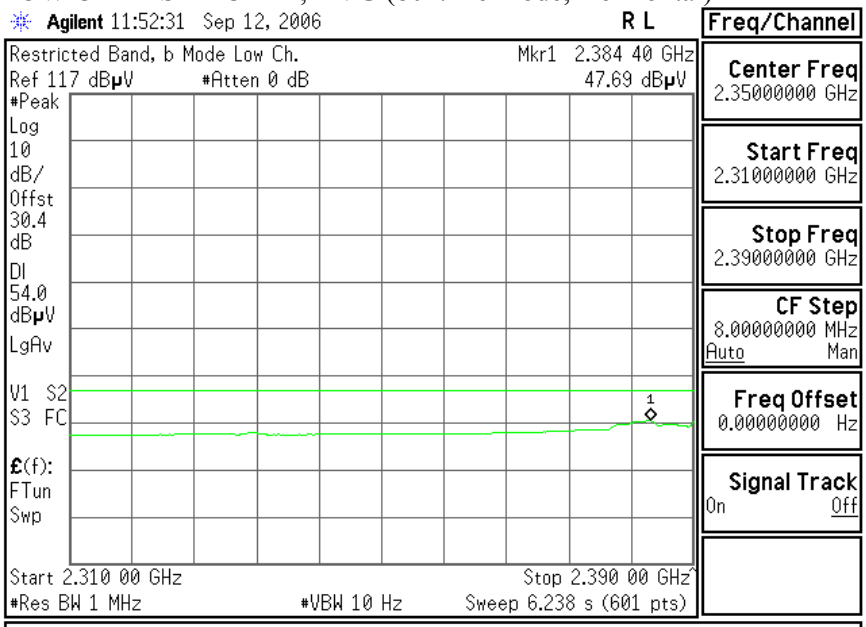
LOW CH RESTRICTED, AVG (802.11b mode, Horizontal)



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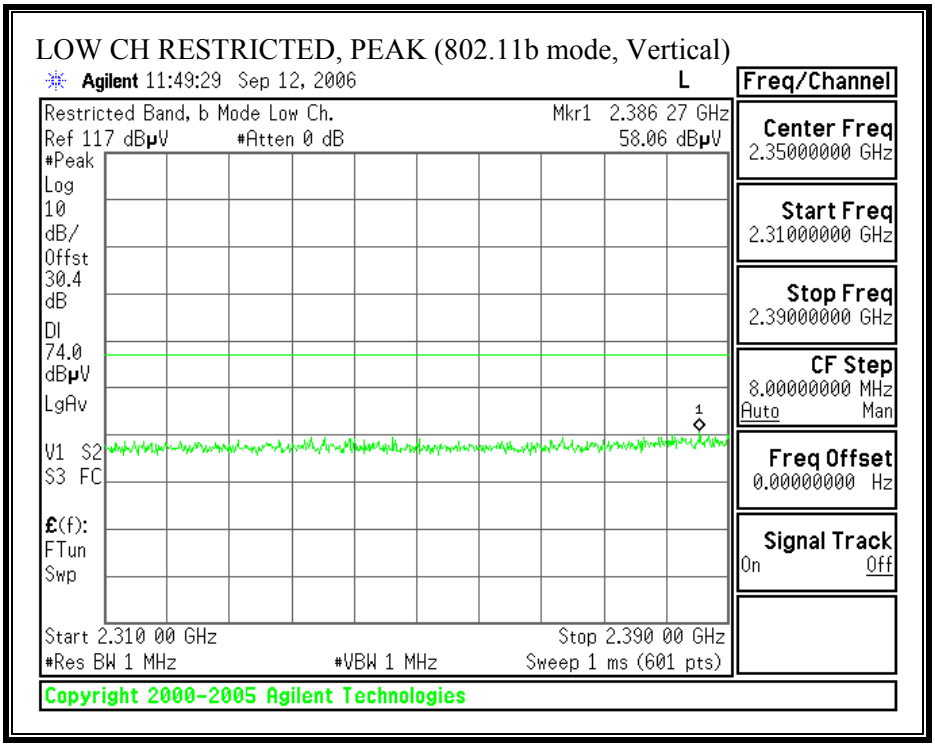
RESTRICTED BANDEDGE (b MODE, LOW CHANNEL, 2417 MHz, VERTICAL)



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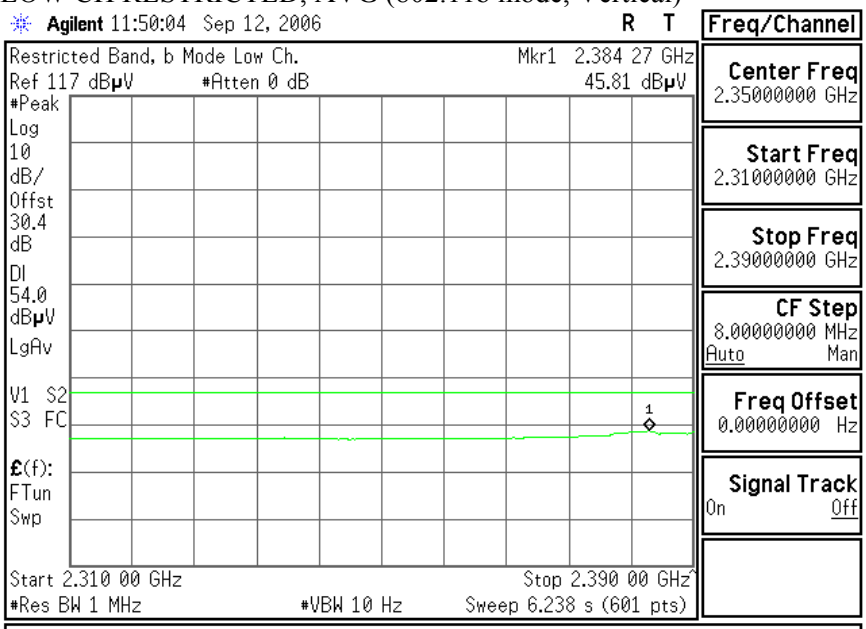
LOW CH RESTRICTED, AVG (802.11b mode, Vertical)



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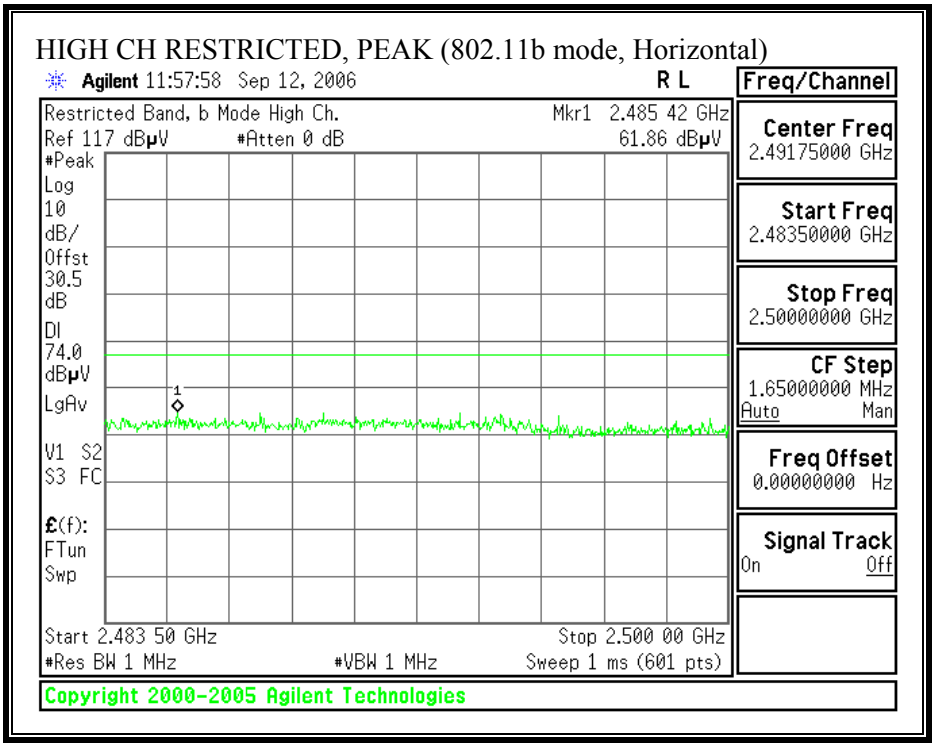
RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, 2457 MHz, HORIZONTAL)



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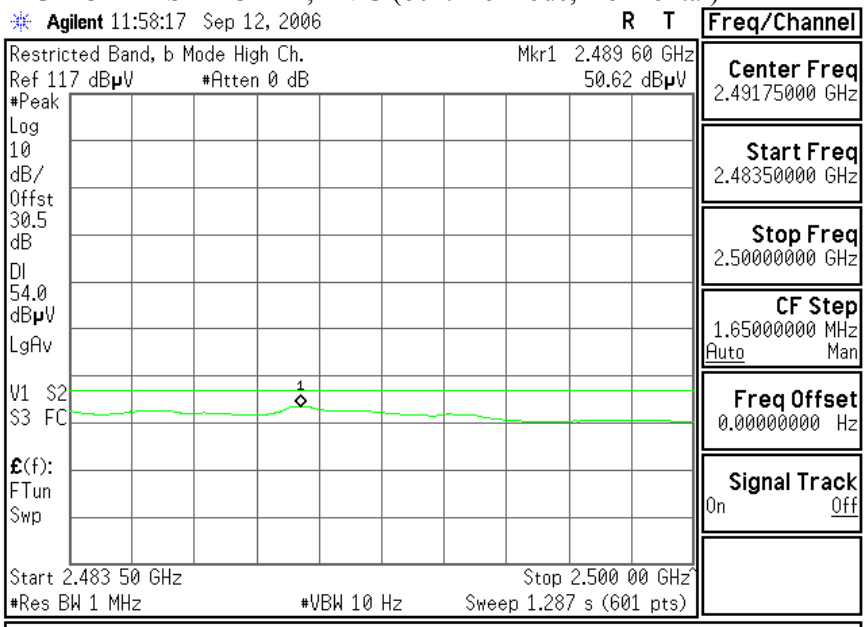
HIGH CH RESTRICTED, AVG (802.11b mode, Horizontal)



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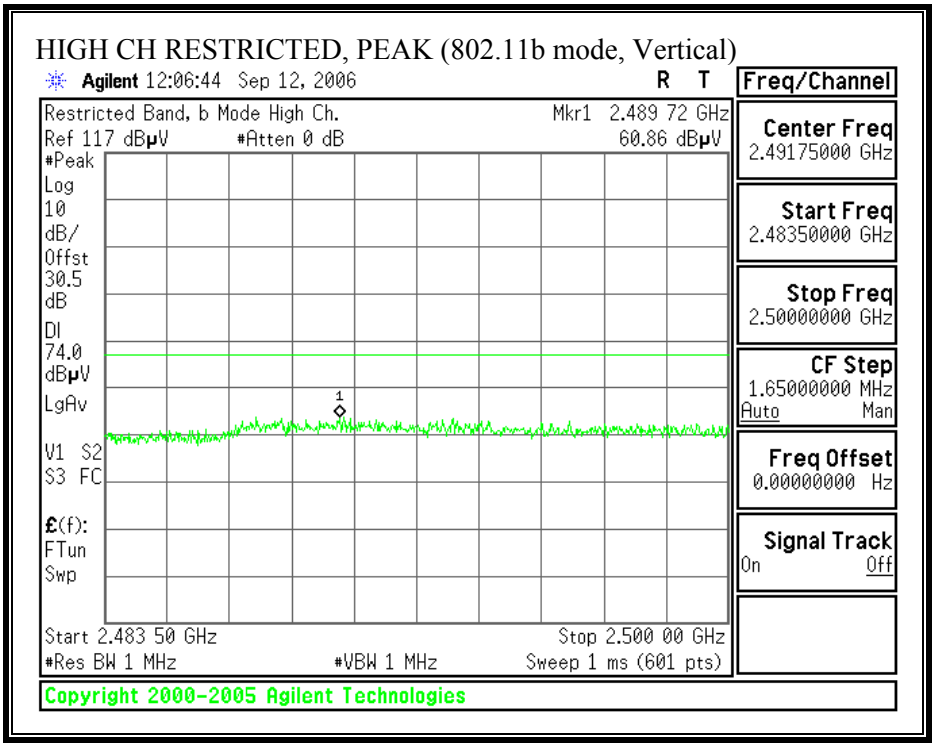
RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, 2457 MHz, VERTICAL)



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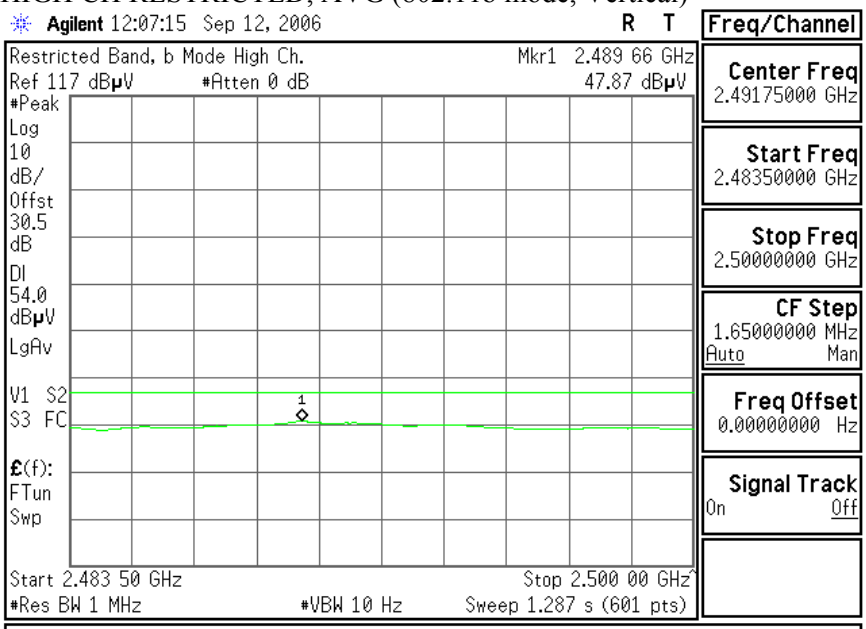
HIGH CH RESTRICTED, AVG (802.11b mode, Vertical)



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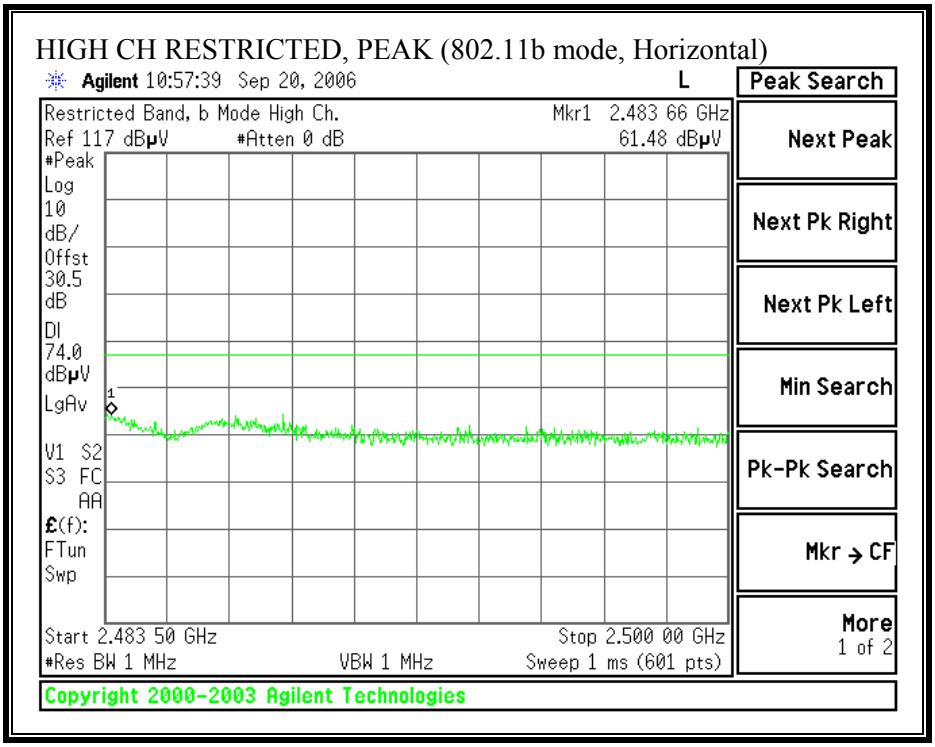
RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, 2462 MHz, HORIZONTAL)



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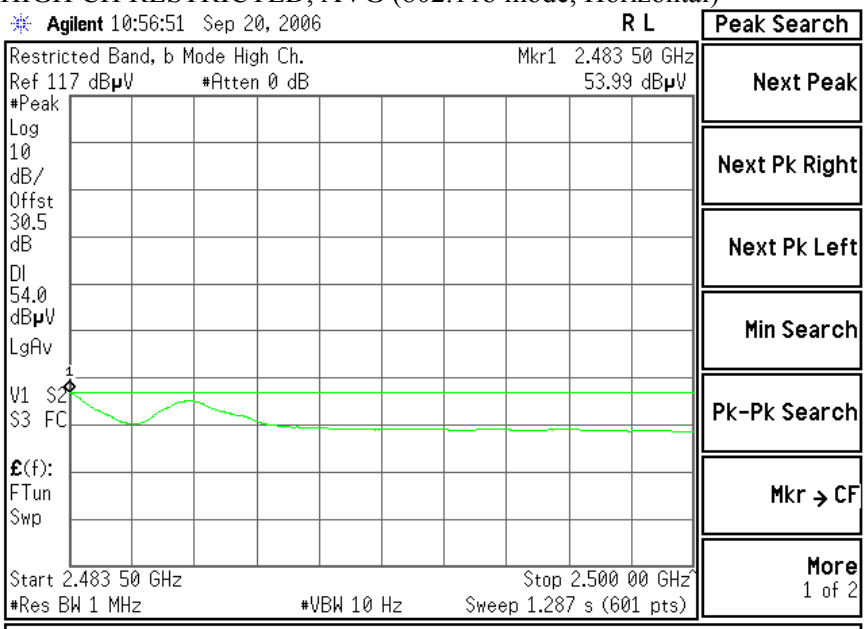
HIGH CH RESTRICTED, AVG (802.11b mode, Horizontal)



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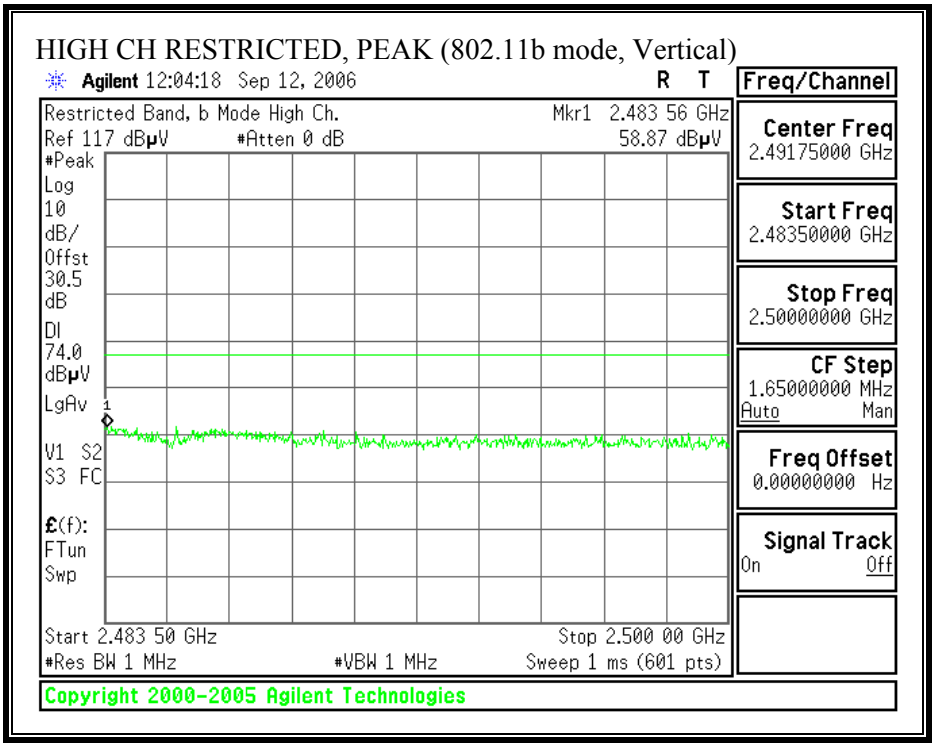
RESTRICTED BANDEDGE (b MODE, HIGH CHANNEL, 2462 MHz, VERTICAL)



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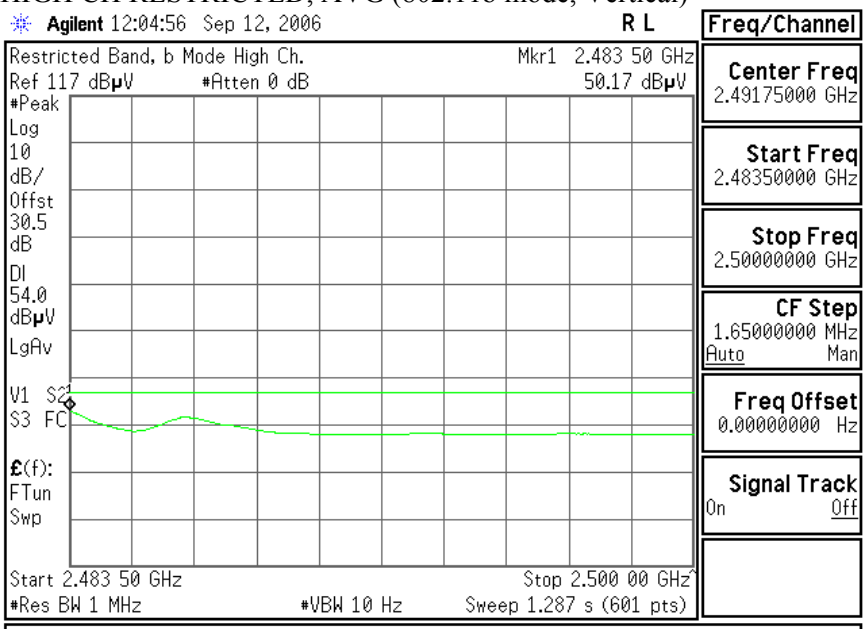
HIGH CH RESTRICTED, AVG (802.11b mode, Vertical)



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HARMONICS AND SPURIOUS EMISSIONS (b MODE)

High Frequency Measurement
Compliance Certification Services, Morgan Hill Open Field Site

Company: Broadcom
Project #: 06U10579
Date: 09/12/06
Test Engineer: Vien Tran
Configuration: EUT & Antenna
Mode: Tx 11b

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T145 Agilent 3008A0056			FCC 15.205

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter
	Vien 187215002	Vien 197209005	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)
Low Channel, 2412 MHz															
4.824	3.0	49.0	44.9	33.0	2.9	-34.8	0.0	0.6	50.7	46.6	74	54	-23.3	-7.4	H
4.824	3.0	48.9	43.4	33.0	2.9	-34.8	0.0	0.6	50.6	45.1	74	54	-23.4	-8.9	V
Mid Channel, 2437 MHz															
4.874	3.0	51.1	48.9	33.1	3.0	-34.9	0.0	0.6	52.9	50.7	74	54	-21.1	-3.3	H
7.311	3.0	43.9	31.8	35.5	4.2	-34.7	0.0	0.6	49.5	37.4	74	54	-24.5	-16.6	H
4.874	3.0	50.4	47.2	33.1	3.0	-34.9	0.0	0.6	52.2	49.0	74	54	-21.8	-5.0	V
7.311	3.0	44.5	32.2	35.5	4.2	-34.7	0.0	0.6	50.1	37.8	74	54	-23.9	-16.2	V
High Channel, 2462 MHz															
4.924	3.0	54.1	51.6	33.1	3.1	-34.9	0.0	0.6	56.0	53.5	74	54	-18.0	-0.5	H
7.386	3.0	43.7	32.9	35.6	4.2	-34.6	0.0	0.6	49.5	38.7	74	54	-24.5	-15.3	H
4.924	3.0	50.2	46.9	33.1	3.1	-34.9	0.0	0.6	52.1	48.8	74	54	-21.9	-5.2	V
7.386	3.0	44.2	32.6	35.6	4.2	-34.6	0.0	0.6	50.0	38.4	74	54	-24.0	-15.6	V
	No other emissions were detected above system noise floor														

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

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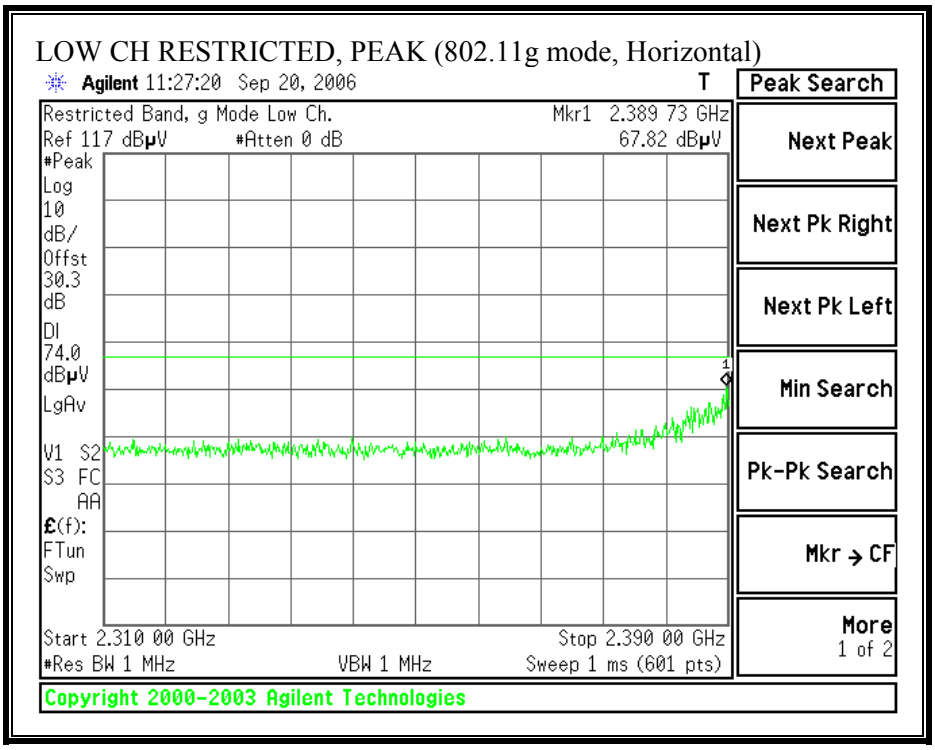
11g MODE

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



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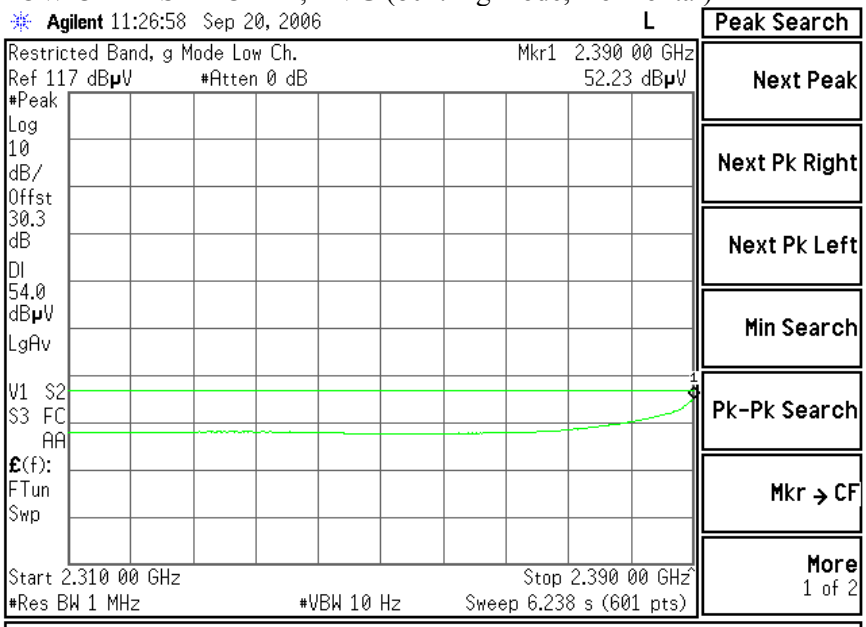
LOW CH RESTRICTED, AVG (802.11g mode, Horizontal)



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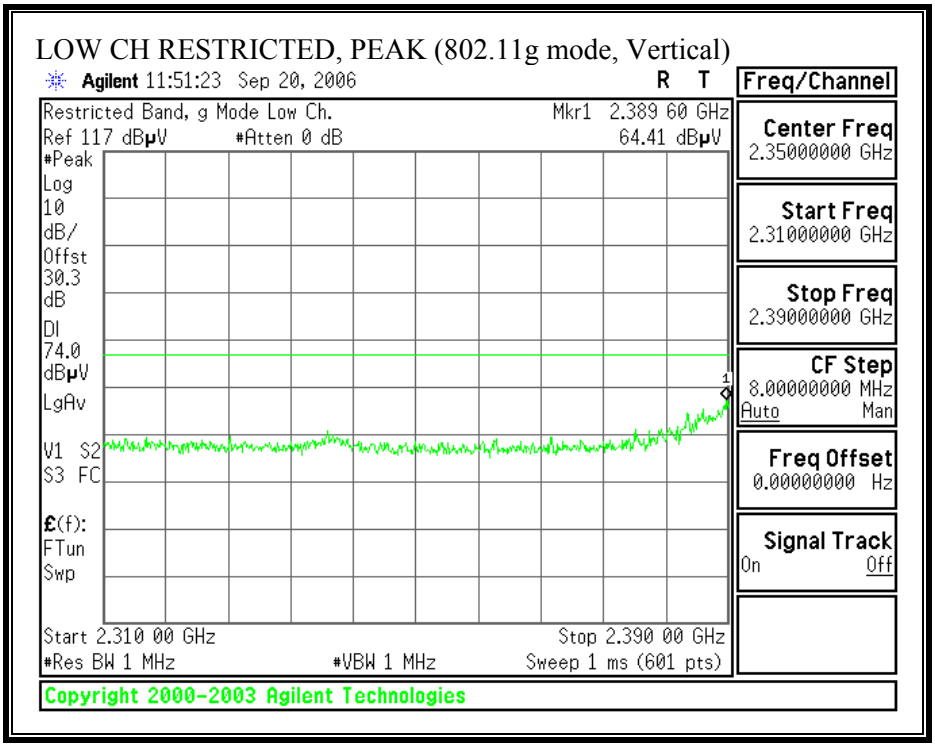
RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, 2412 MHz, VERTICAL)



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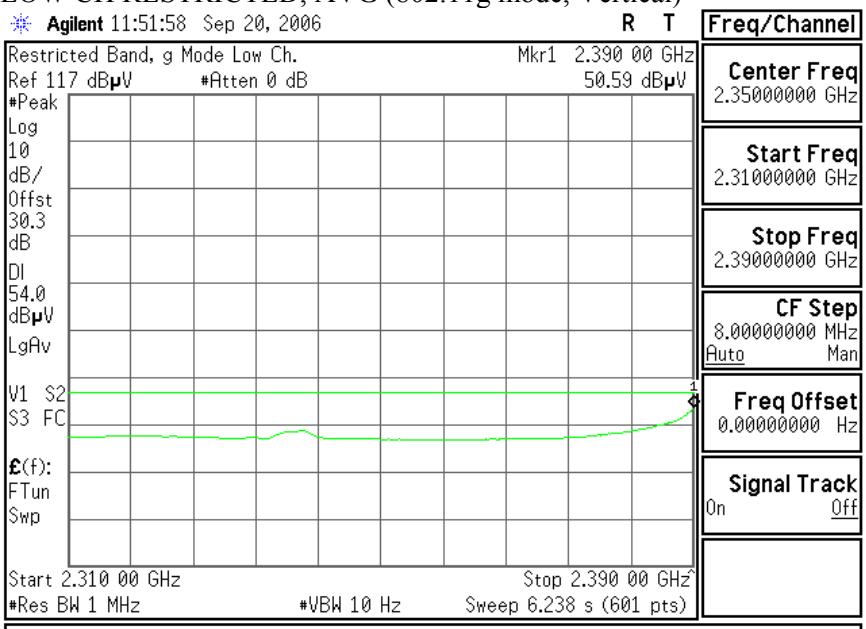
LOW CH RESTRICTED, AVG (802.11g mode, Vertical)



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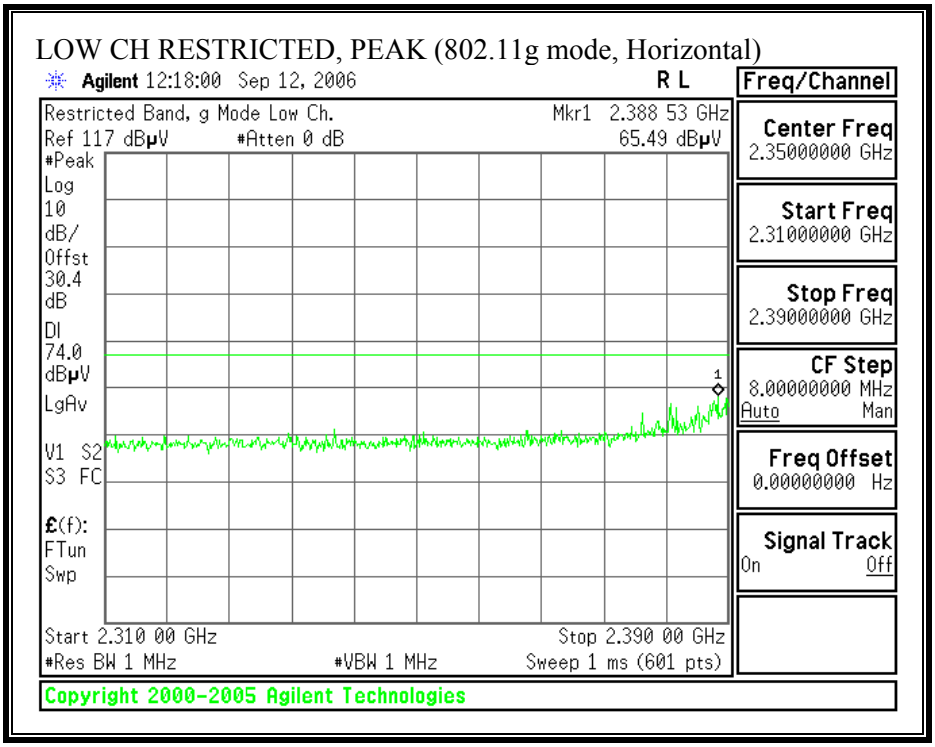
RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, 2417 MHz, HORIZONTAL)



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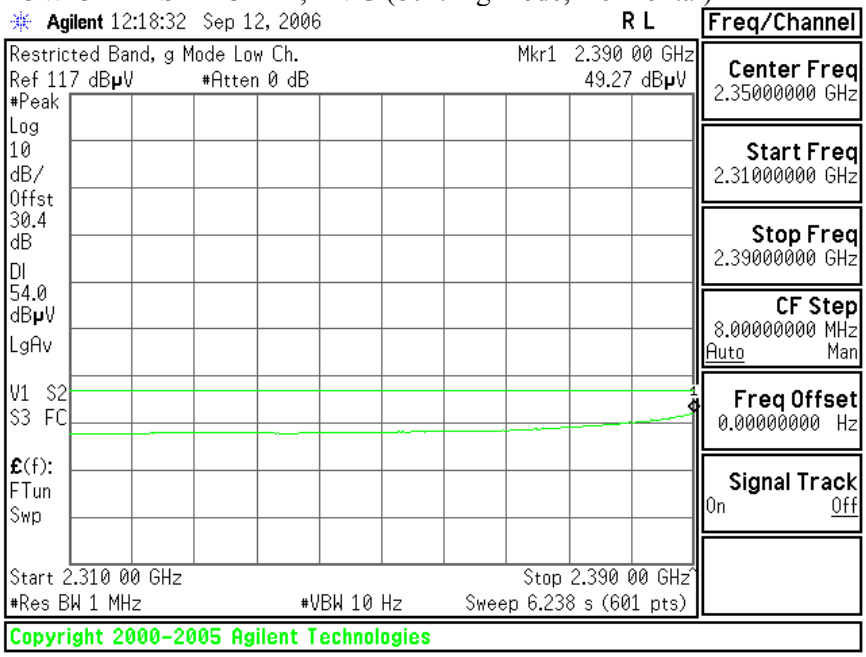
LOW CH RESTRICTED, AVG (802.11g mode, Horizontal)



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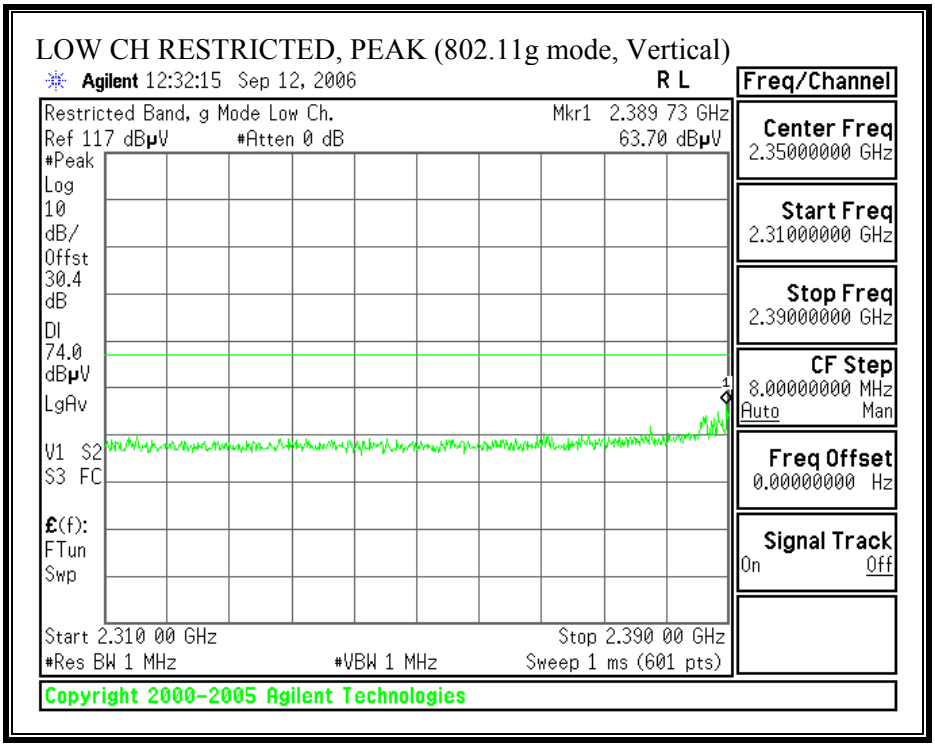
RESTRICTED BANDEDGE (g MODE, LOW CHANNEL, 2417 MHz, VERTICAL)



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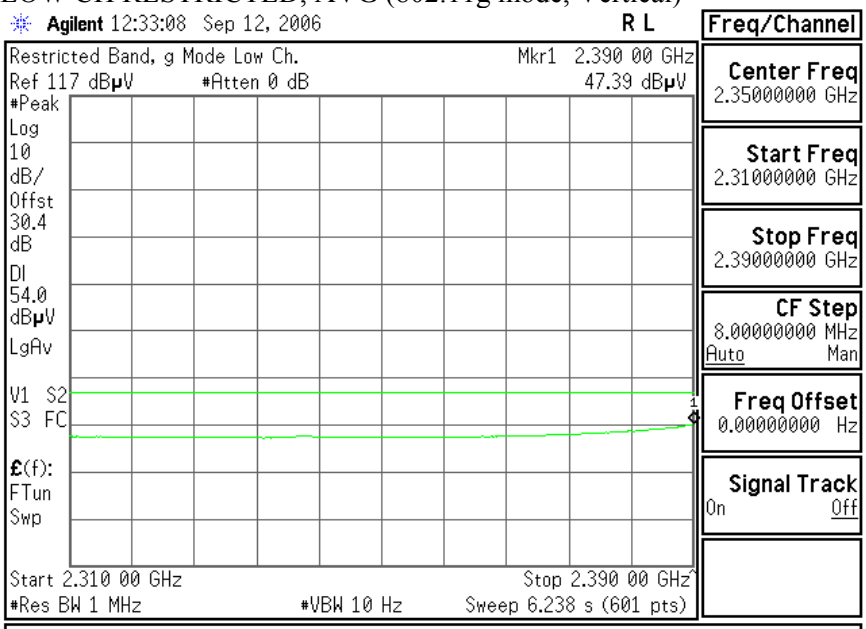
LOW CH RESTRICTED, AVG (802.11g mode, Vertical)



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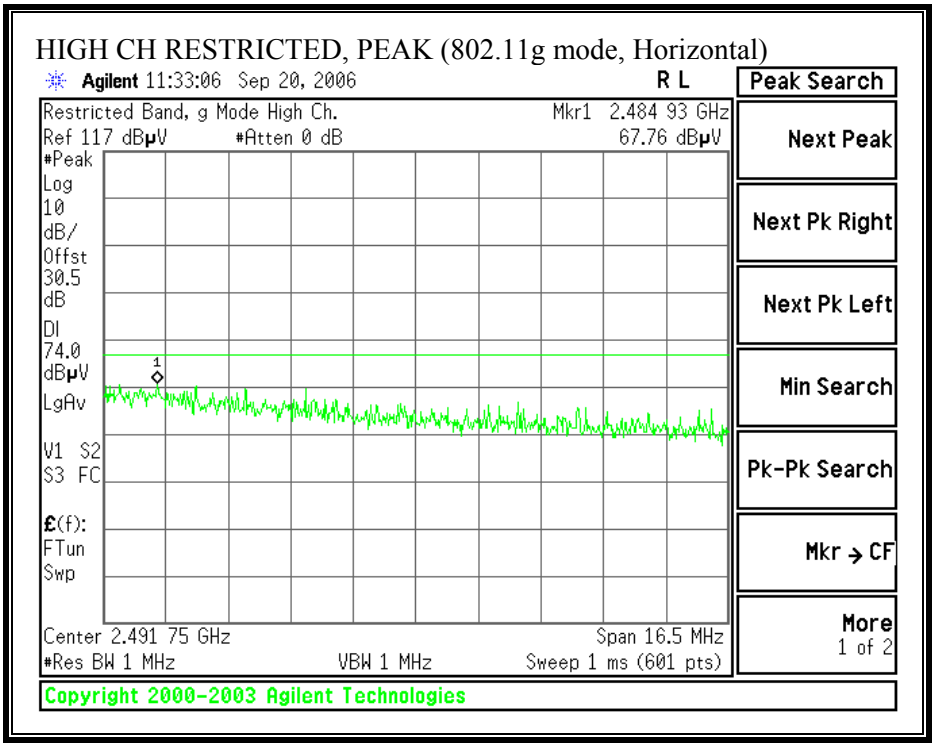
RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, 2457 MHz, HORIZONTAL)



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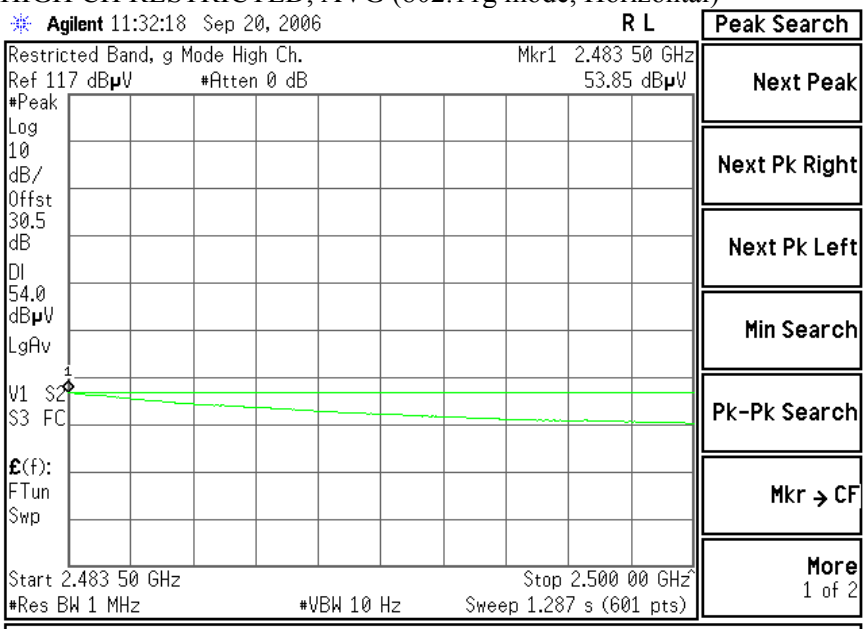
HIGH CH RESTRICTED, AVG (802.11g mode, Horizontal)



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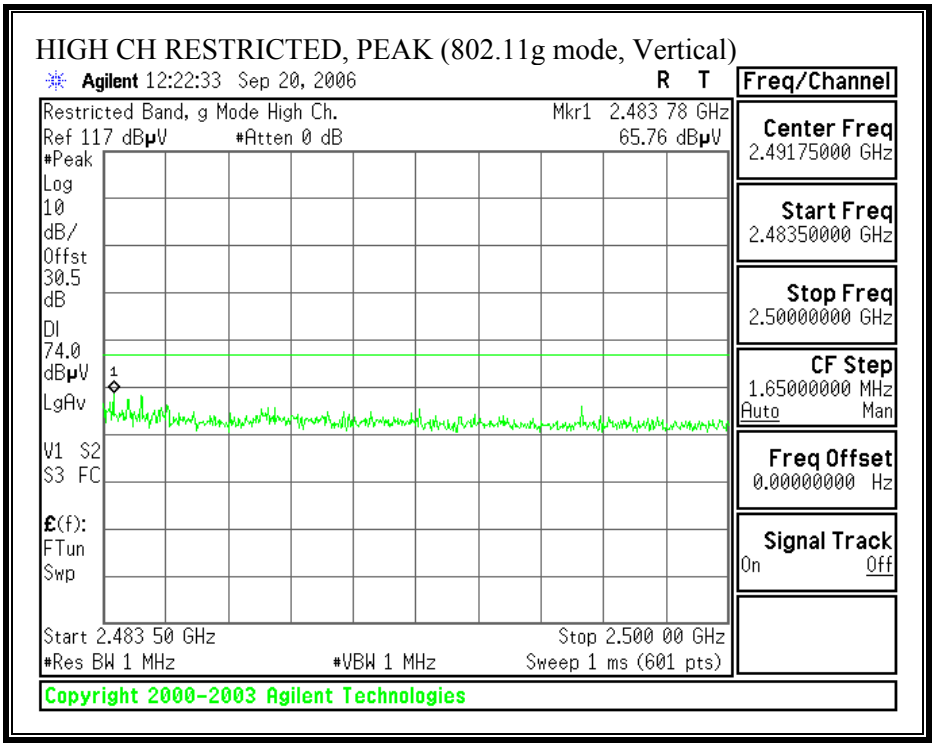
RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, 2457 MHz, VERTICAL)



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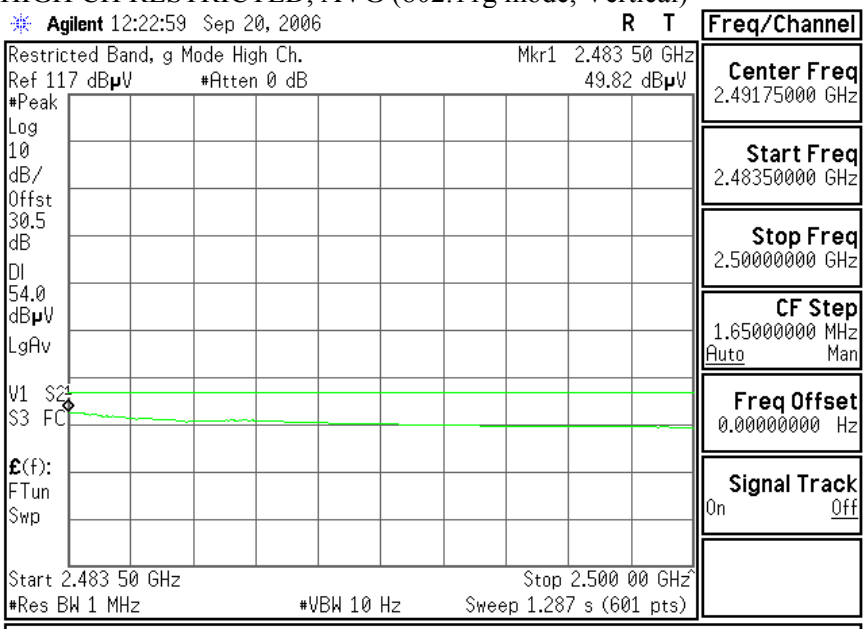
HIGH CH RESTRICTED, AVG (802.11g mode, Vertical)



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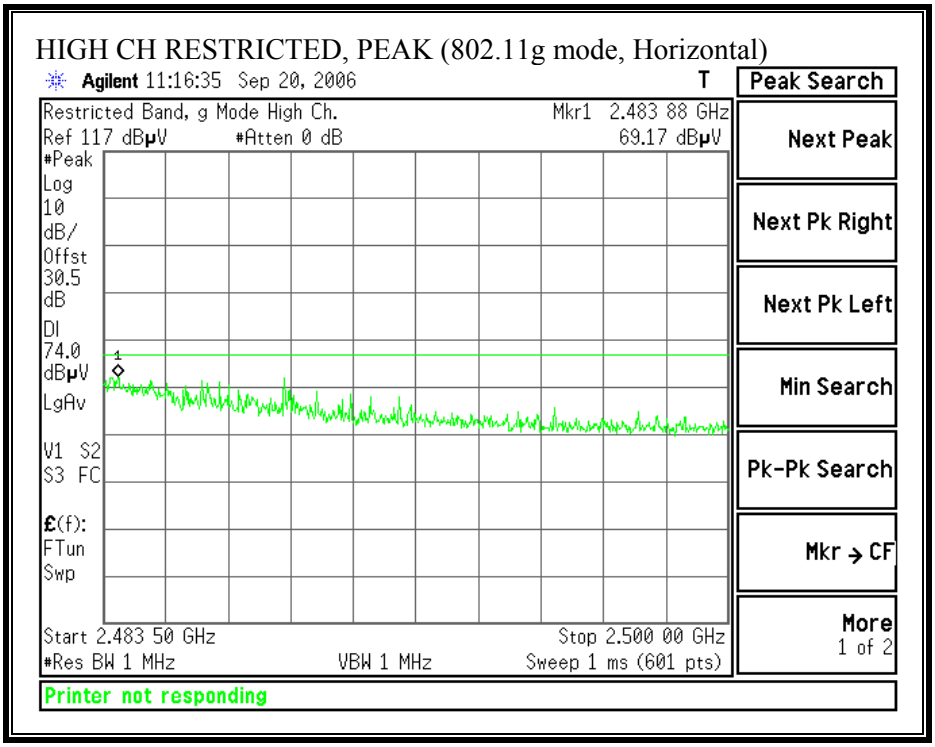
RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, 2462 MHz, HORIZONTAL)



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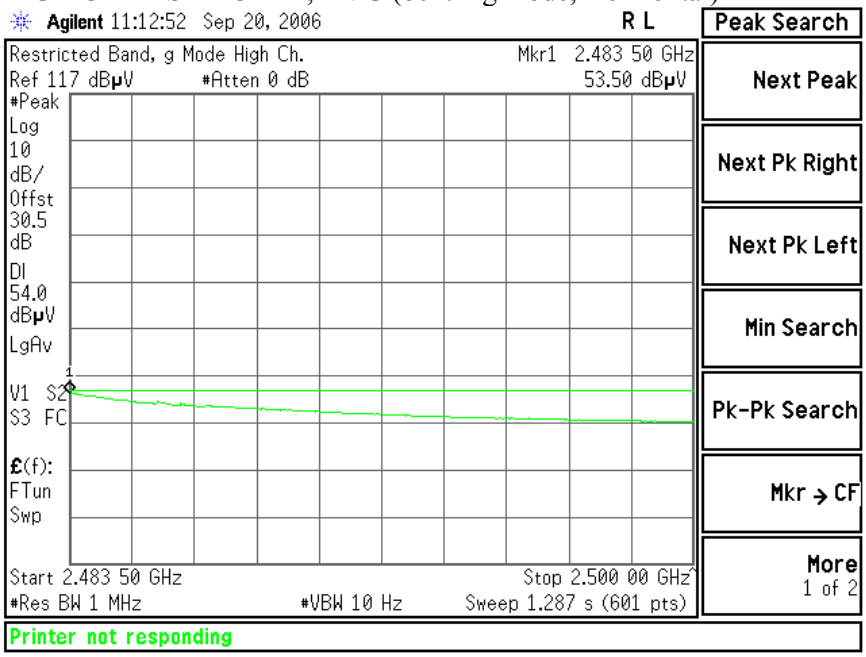
HIGH CH RESTRICTED, AVG (802.11g mode, Horizontal)



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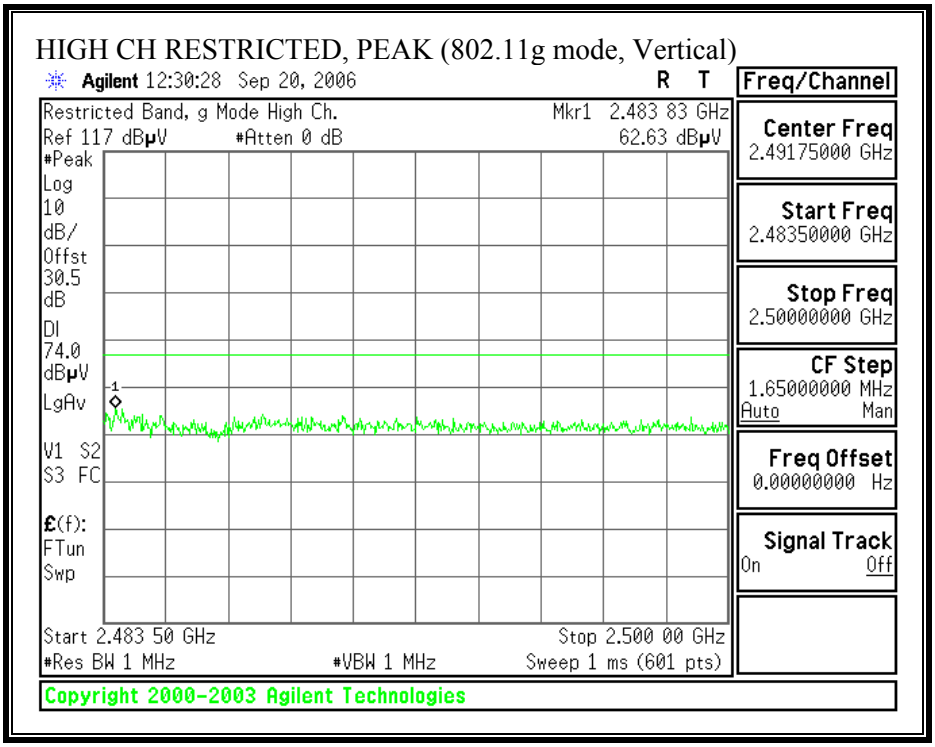
RESTRICTED BANDEDGE (g MODE, HIGH CHANNEL, 2462 MHz, VERTICAL)



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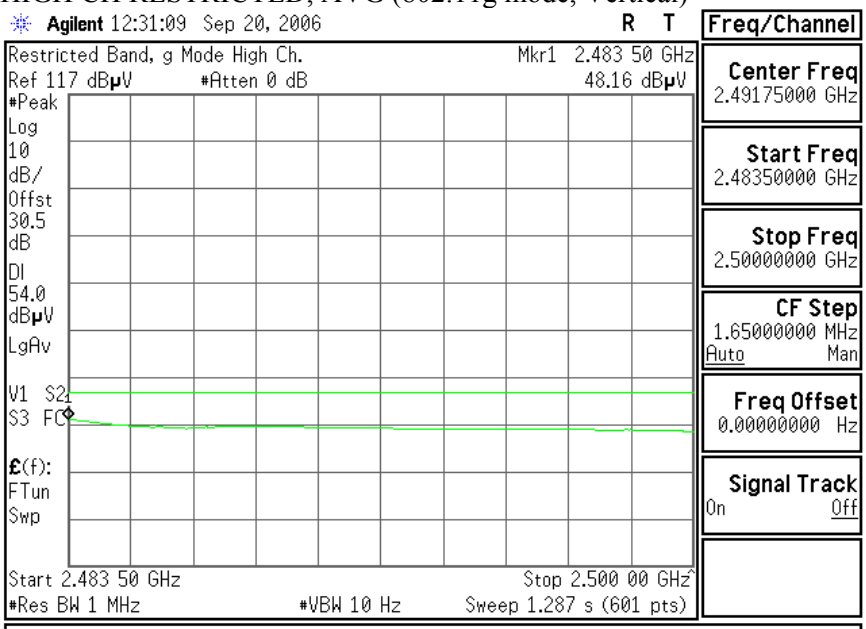
HIGH CH RESTRICTED, AVG (802.11g mode, Vertical)



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HARMONICS AND SPURIOUS EMISSIONS (g MODE)

High Frequency Measurement
Compliance Certification Services, Morgan Hill Open Field Site

Company: Broadcom
Project #: 06U10579
Date: 09/18/06
Test Engineer: Vien Tran
Configuration: EUT & Antenna
Mode: Tx 11g

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
	Vien 187215002	Vien 197209005	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)
Low Channel, 2412 MHz															
4.824	3.0	51.8	38.3	33.3	2.9	-34.8	0.0	0.6	53.8	40.3	74	54	-20.2	-13.7	H
4.824	3.0	51.3	37.6	33.3	2.9	-34.8	0.0	0.6	53.3	39.6	74	54	-20.7	-14.4	V
Mid Channel, 2437 MHz															
4.874	3.0	56.3	40.3	33.4	3.0	-34.8	0.0	0.6	58.4	42.4	74	54	-15.6	-11.6	H
7.311	3.0	48.0	34.9	35.0	4.2	-34.1	0.0	0.6	53.7	40.6	74	54	-20.3	-13.4	H
4.874	3.0	55.5	39.6	33.4	3.0	-34.8	0.0	0.6	57.6	41.7	74	54	-16.4	-12.3	V
7.311	3.0	45.5	35.1	35.0	4.2	-34.1	0.0	0.6	51.2	40.8	74	54	-22.8	-13.2	V
High Channel, 2462 MHz															
4.924	3.0	57.3	40.2	33.4	3.1	-34.8	0.0	0.6	59.6	42.5	74	54	-14.4	-11.5	H
7.386	3.0	47.3	34.7	35.0	4.2	-34.1	0.0	0.6	53.1	40.5	74	54	-20.9	-13.5	H
4.924	3.0	55.7	38.7	33.4	3.1	-34.8	0.0	0.6	58.0	41.0	74	54	-16.0	-13.0	V
7.386	3.0	47.7	35.8	35.0	4.2	-34.1	0.0	0.6	53.5	41.6	74	54	-20.5	-12.4	V
	No other emissions were detected above system noise floor														

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

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

HARMONICS AND SPURIOUS EMISSIONS (802.11a MODE)

High Frequency Measurement
Compliance Certification Services, Morgan Hill Open Field Site

Company: Broadcom
Project #: 06U10579
Date: 09/18/06
Test Engineer: Vien Tran
Configuration: EUT & Antenna
Mode: Tx 11a

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
	Vien 187215002	Vien 197209005	HPF_7.6GHz	

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
CH 149, 5745 MHz															
11.490	3.0	53.9	41.6	37.5	4.8	-32.5	0.0	0.7	64.3	52.0	74	54	-9.7	-2.0	H
11.490	3.0	51.5	39.2	37.5	4.8	-32.5	0.0	0.7	61.9	49.6	74	54	-12.1	-4.4	V
CH 157, 5785 MHz															
11.570	3.0	54.8	41.9	37.5	4.8	-32.5	0.0	0.7	65.3	52.4	74	54	-8.7	-1.6	H
11.570	3.0	52.9	40.0	37.5	4.8	-32.5	0.0	0.7	63.4	50.5	74	54	-10.6	-3.5	V
CH 165, 5825 MHz															
11.650	3.0	54.4	41.7	37.5	4.8	-32.5	0.0	0.7	64.9	52.2	74	54	-9.1	-1.8	H
11.650	3.0	51.7	39.1	37.5	4.8	-32.5	0.0	0.7	62.2	49.6	74	54	-11.8	-4.4	V
			No other emissions were detected above system noise floor												

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

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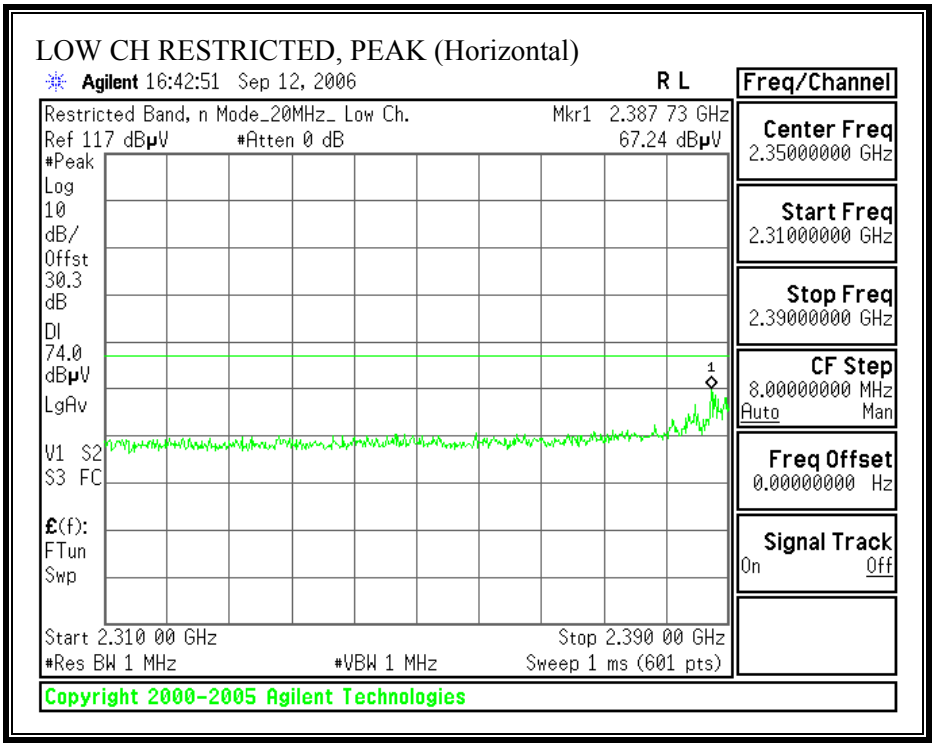
MIMO MODE

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

20 MHz TX BANDWIDTH

RESTRICTED BANDEDGE (LOW CHANNEL, 2412 MHz, HORIZONTAL)



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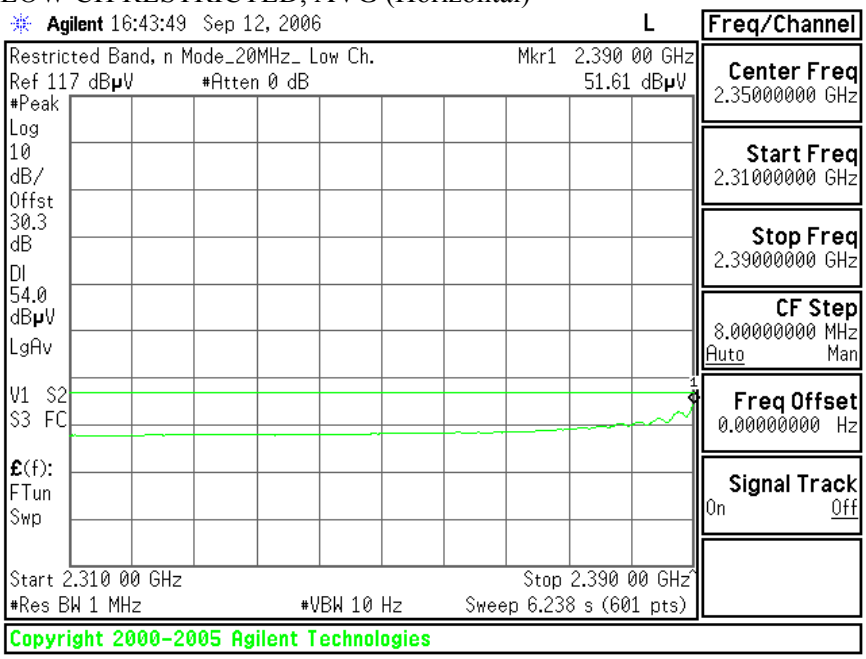
LOW CH RESTRICTED, AVG (Horizontal)



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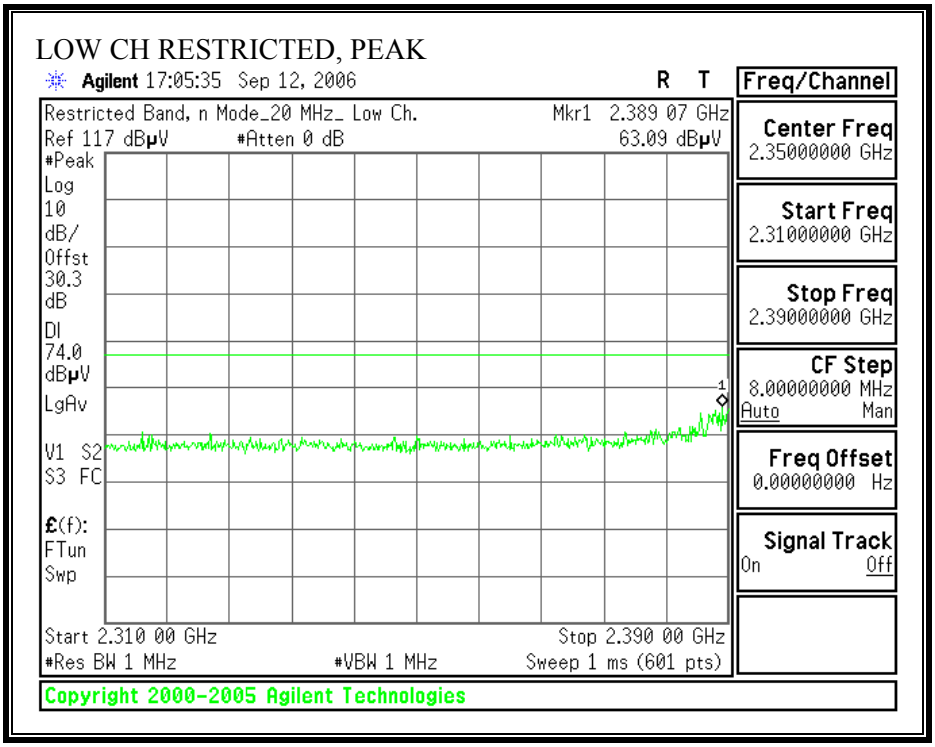
RESTRICTED BANDEDGE (LOW CHANNEL, 2412 MHz, VERTICAL)



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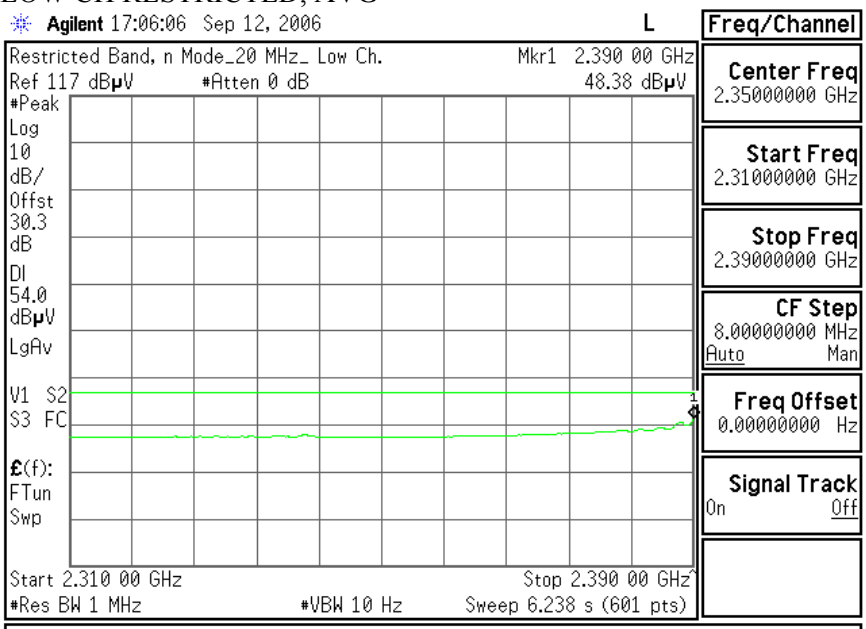
LOW CH RESTRICTED, AVG



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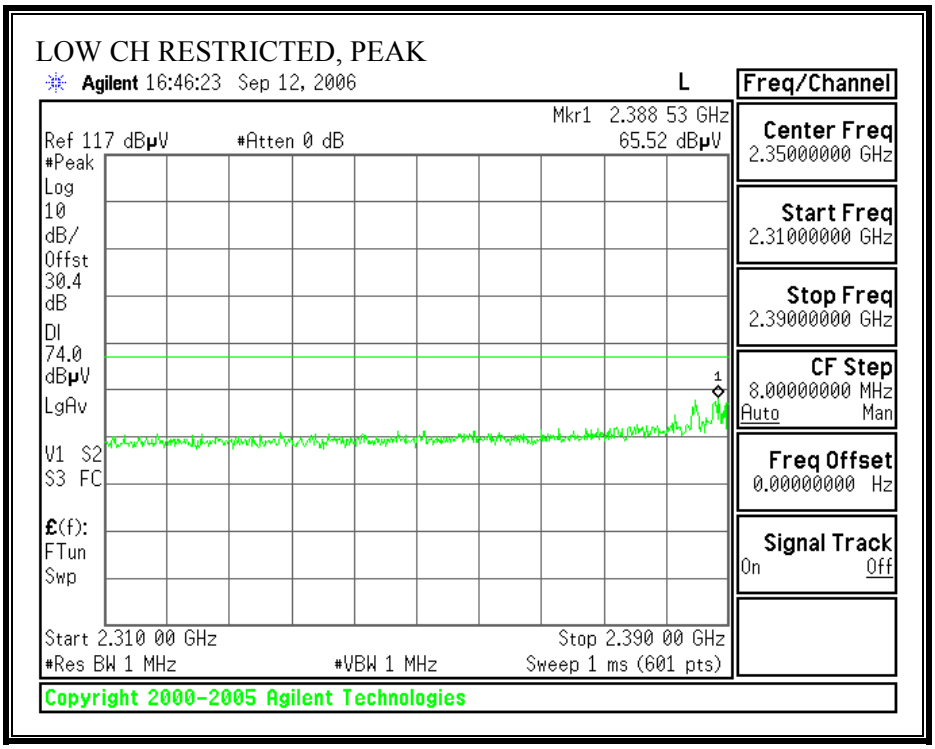
RESTRICTED BANDEDGE (LOW CHANNEL, 2417 MHz, HORIZONTAL)



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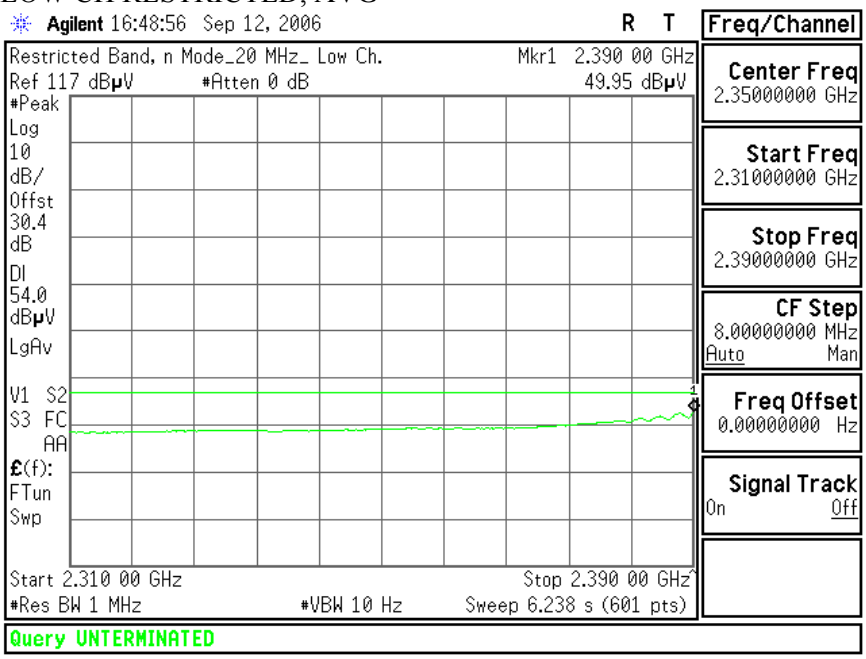
LOW CH RESTRICTED, AVG



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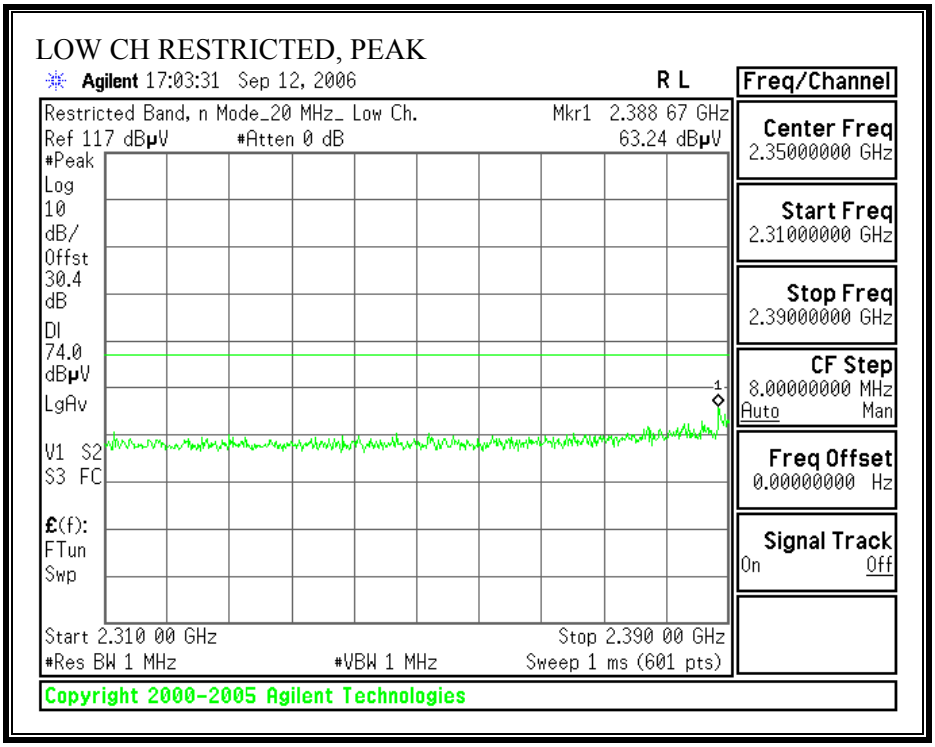
RESTRICTED BANDEDGE (LOW CHANNEL, 2417 MHz, VERTICAL)



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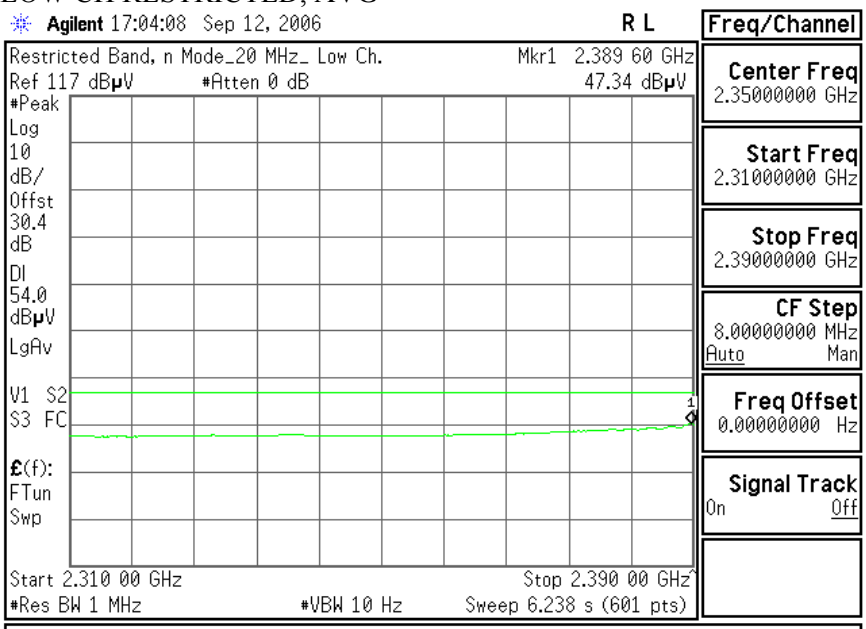
LOW CH RESTRICTED, AVG



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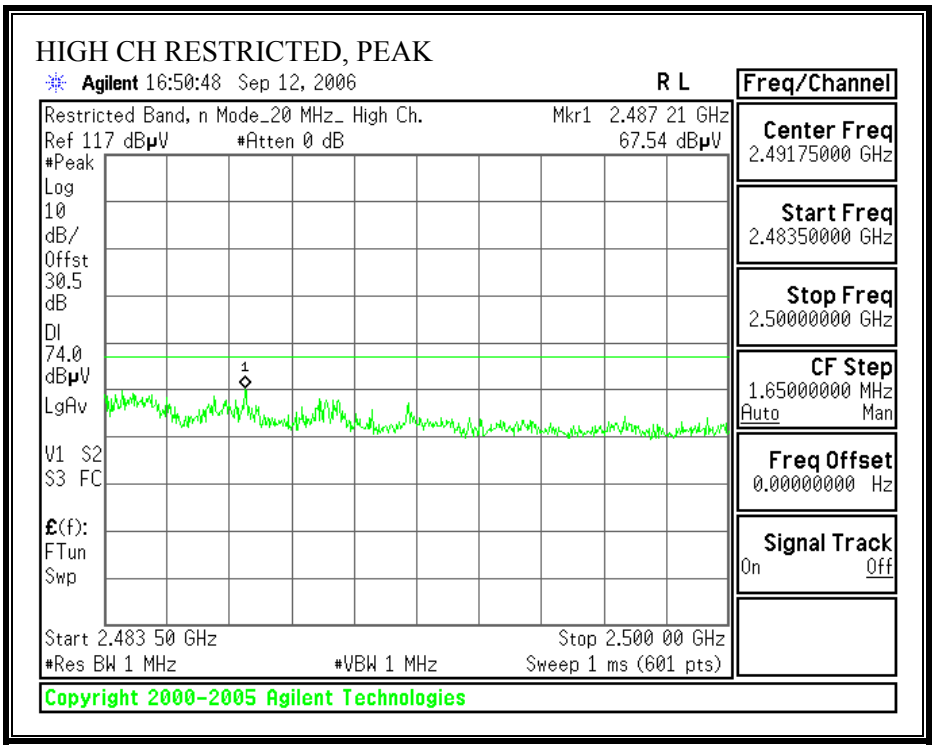
RESTRICTED BANDEDGE (HIGHCHANNEL, 2457 MHz, HORIZONTAL)



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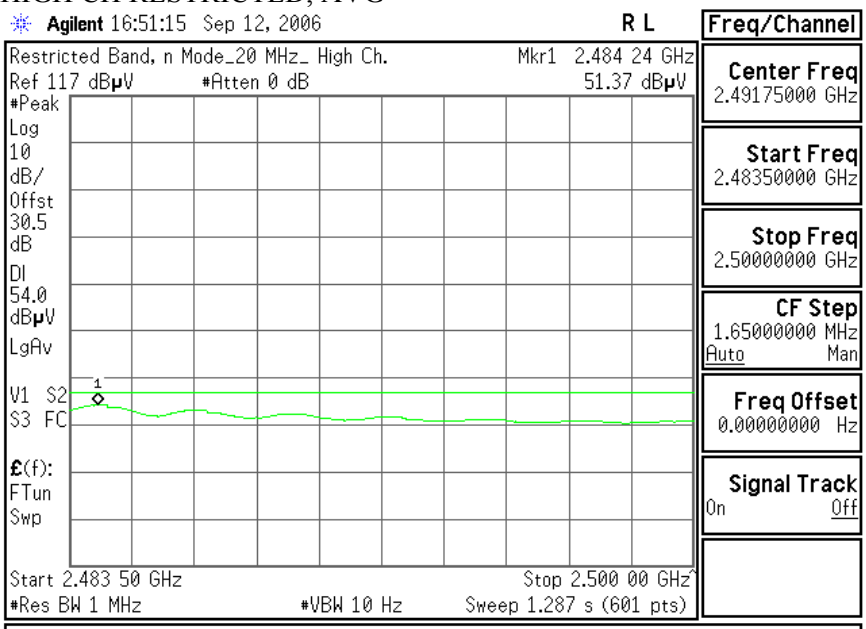
HIGH CH RESTRICTED, AVG



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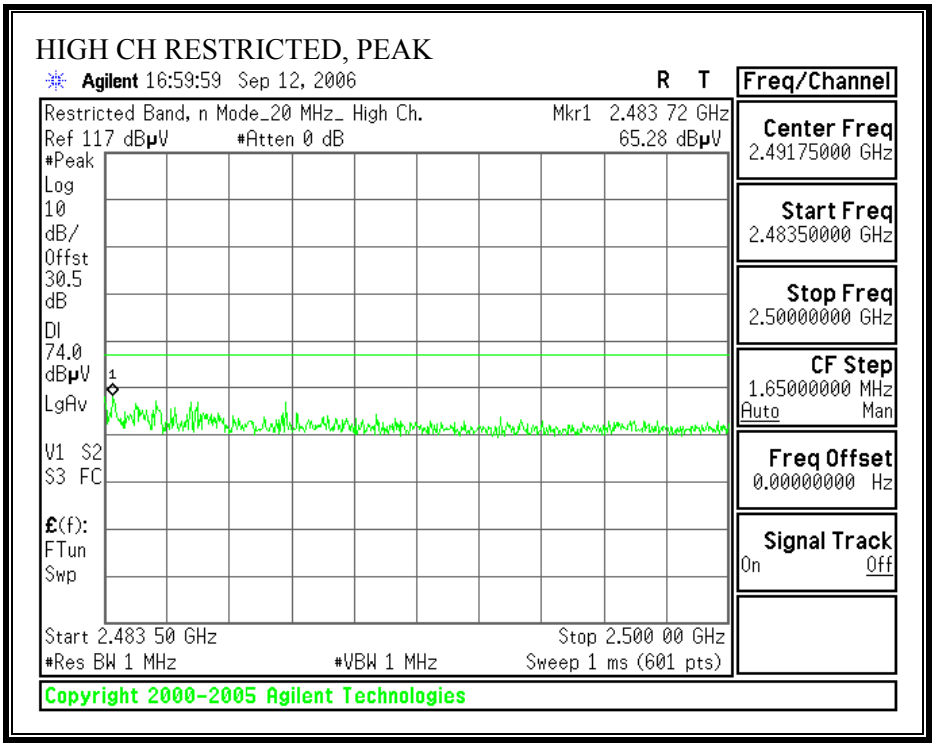
RESTRICTED BANDEDGE (HIGH CHANNEL, 2457 MHz, VERTICAL)



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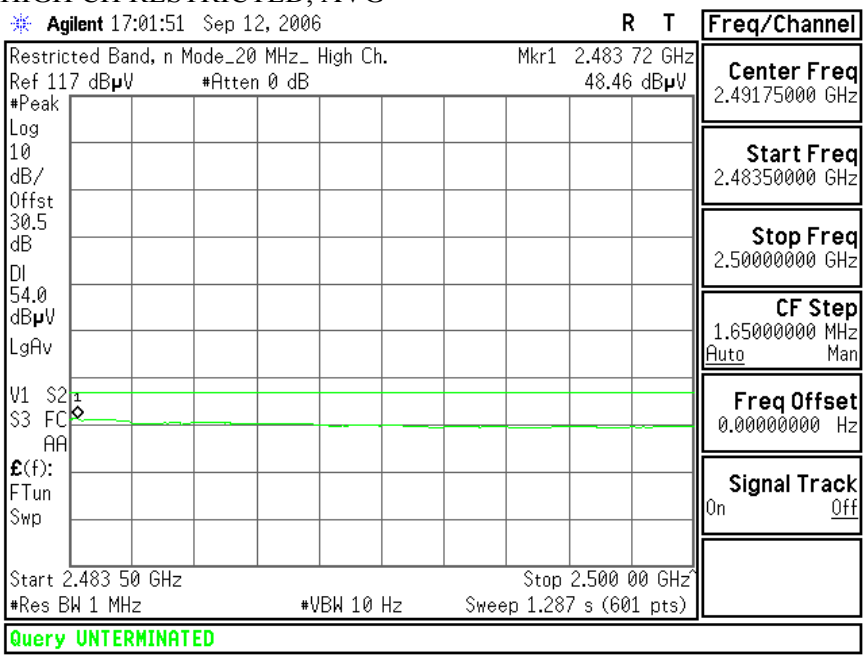
HIGH CH RESTRICTED, AVG



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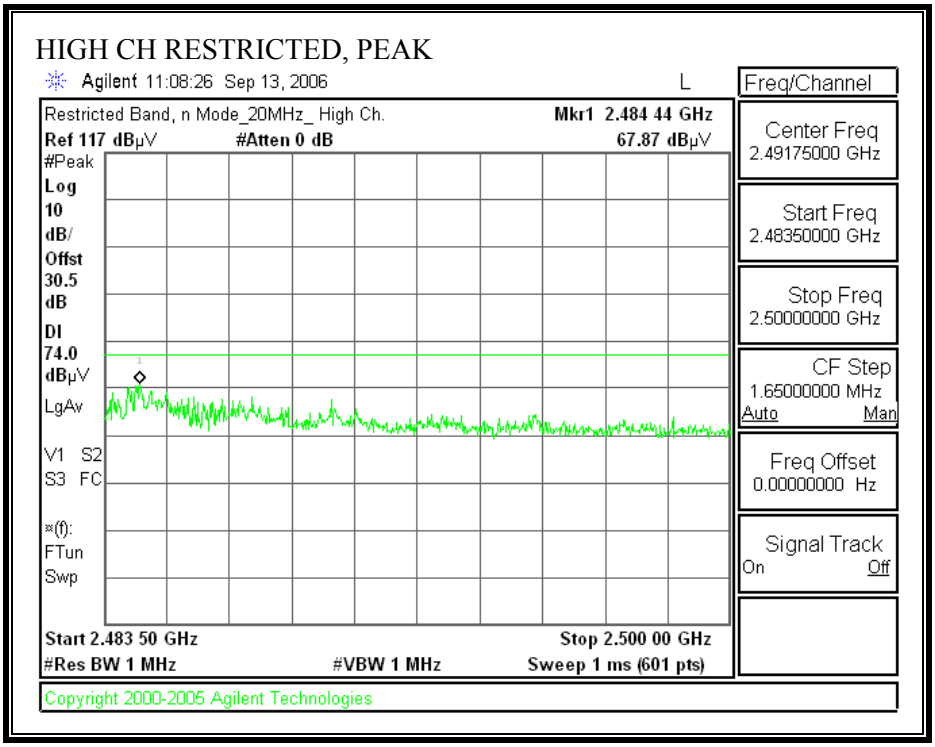
RESTRICTED BANDEDGE (HIGH CHANNEL, 2462 MHz, HORIZONTAL)



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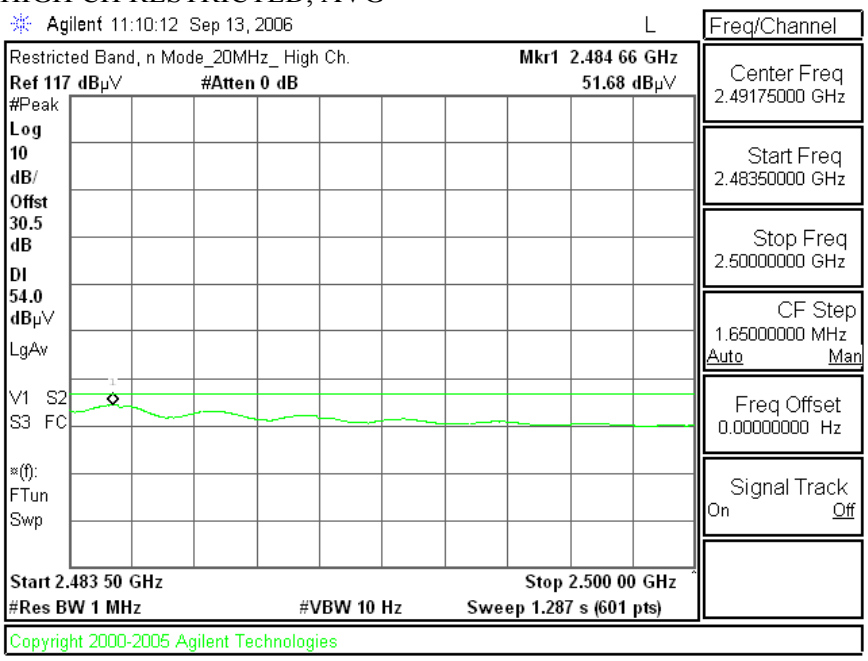
HIGH CH RESTRICTED, AVG



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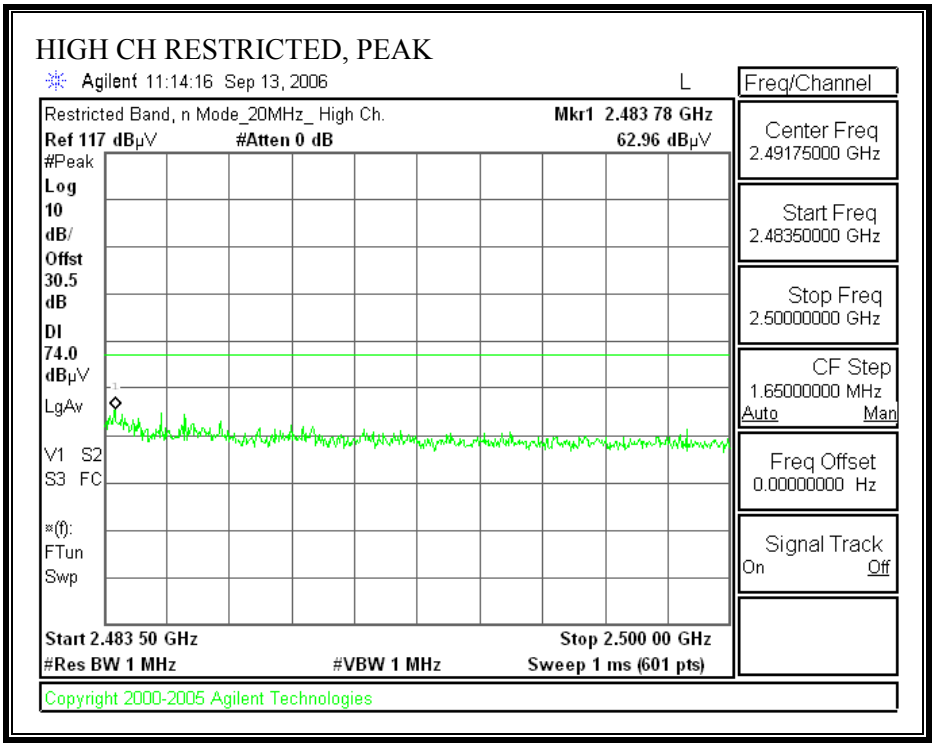
RESTRICTED BANDEDGE (HIGH CHANNEL, 2462 MHz, VERTICAL)



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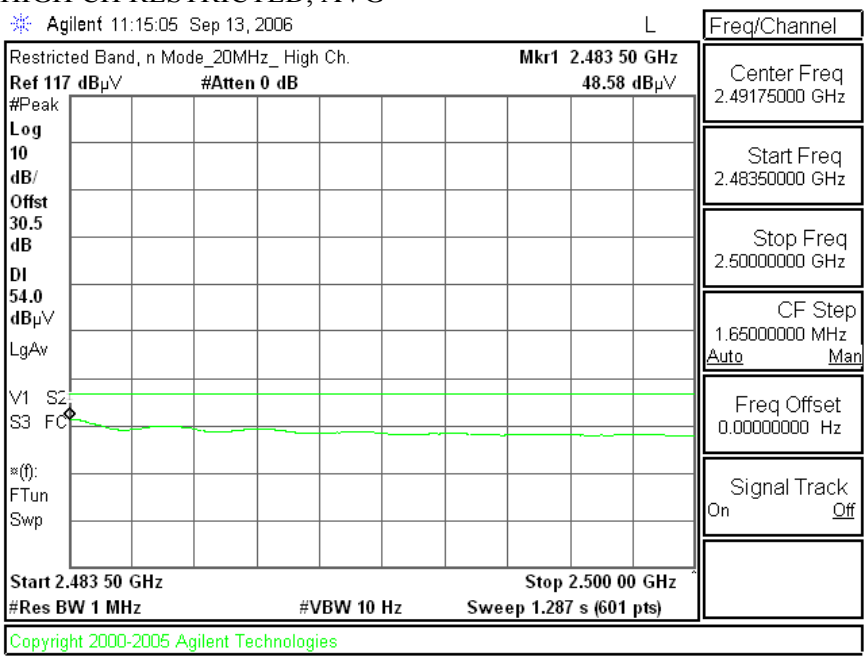
HIGH CH RESTRICTED, AVG



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HARMONICS AND SPURIOUS EMISSIONS – 20 MHz TX BANDWIDTH

High Frequency Measurement
Compliance Certification Services, Morgan Hill Open Field Site

Company: Broadcom
Project #: 06U10579
Date: 09/16/06
Test Engineer: Vien Tran
Configuration: EUT & Antenna
Mode: Tx 2.4 GHz Band_11n 20 MHz

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
	Vien 187215002	Vien 197209005	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)
LOW CH, 2412 MHz															
4.824	3.0	50.0	37.1	33.3	2.9	-34.8	0.0	0.6	52.0	39.1	74	54	-22.0	-14.9	H
4.824	3.0	46.5	33.9	33.3	2.9	-34.8	0.0	0.6	48.5	35.9	74	54	-25.5	-18.1	V
MID CH , 2437 MHz															
4.874	3.0	51.7	37.0	33.4	3.0	-34.8	0.0	0.6	53.8	39.1	74	54	-20.2	-14.9	H
4.874	3.0	49.5	35.8	33.4	3.0	-34.8	0.0	0.6	51.6	37.9	74	54	-22.4	-16.1	V
HI CH, 2462 MHz															
4.924	3.0	51.8	37.9	33.4	3.1	-34.8	0.0	0.6	54.0	40.1	74	54	-20.0	-13.9	H
7.386	3.0	50.4	33.4	35.0	4.2	-34.1	0.0	0.6	56.1	39.2	74	54	-17.9	-14.8	H
4.924	3.0	49.9	36.4	33.4	3.1	-34.8	0.0	0.6	52.1	38.7	74	54	-21.9	-15.3	V
7.386	3.0	49.5	33.3	35.0	4.2	-34.1	0.0	0.6	55.2	39.1	74	54	-18.8	-14.9	V

Note: No other emissions were detected above the system noise floor

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

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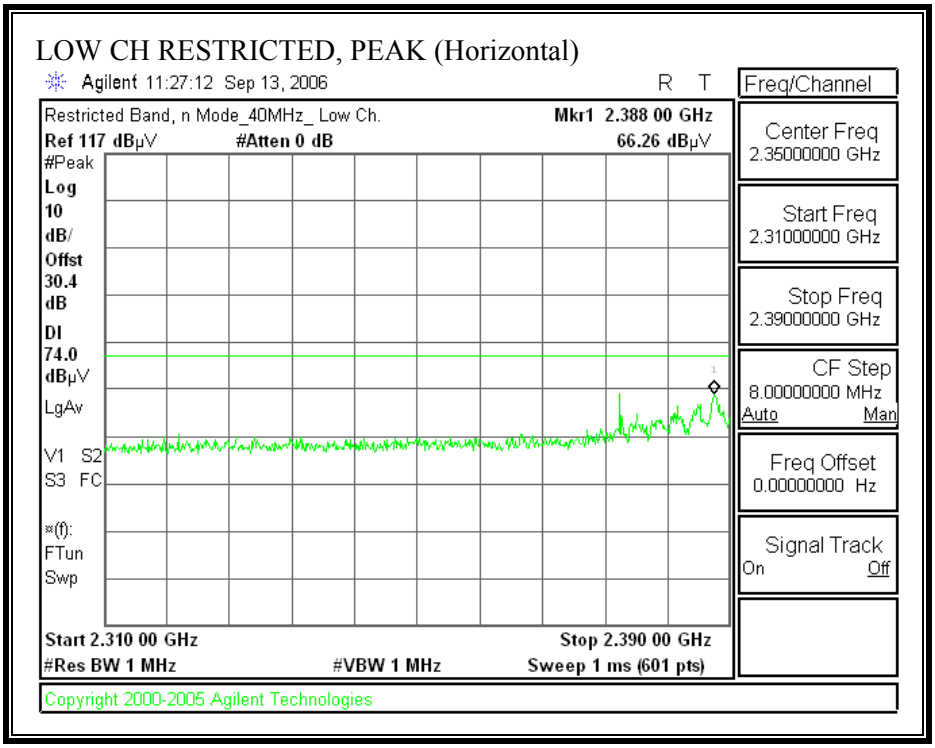
40 MHz TX BANDWIDTH

RESTRICTED BANDEDGE (LOW CHANNEL, 2422 MHz, HORIZONTAL)



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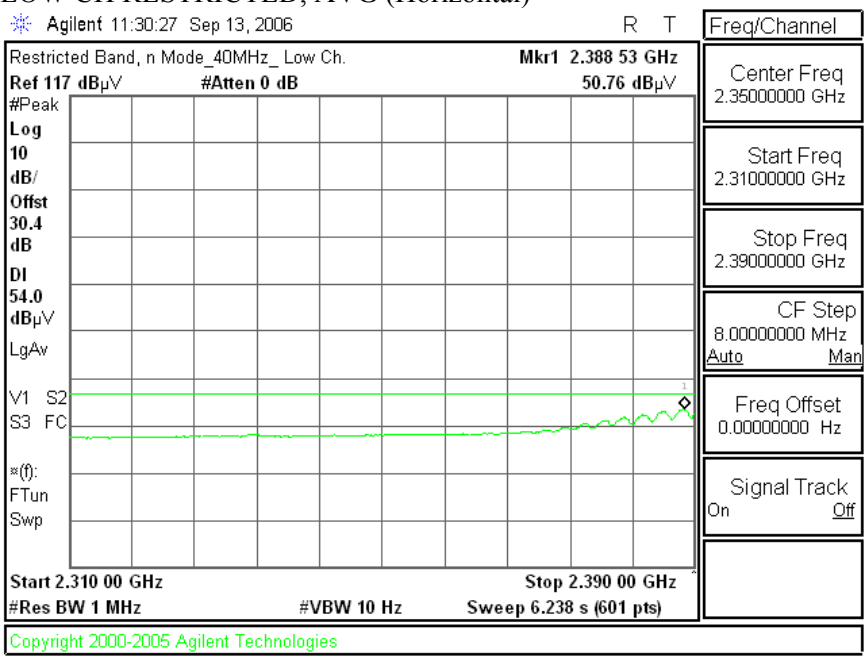
LOW CH RESTRICTED, AVG (Horizontal)



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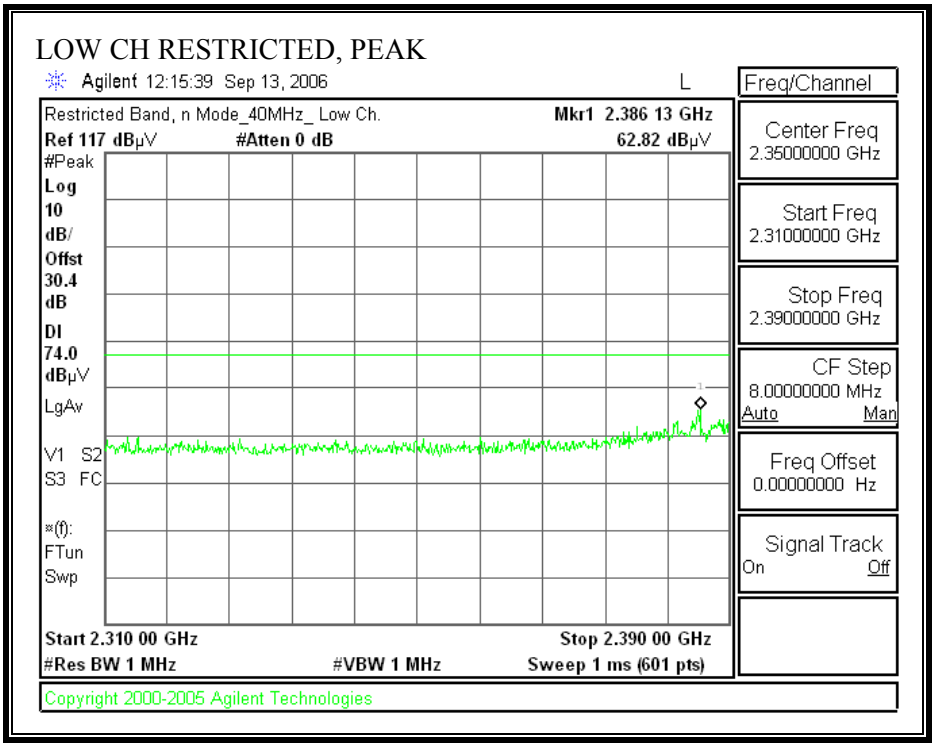
RESTRICTED BANDEDGE (LOW CHANNEL, 2422 MHz, VERTICAL)



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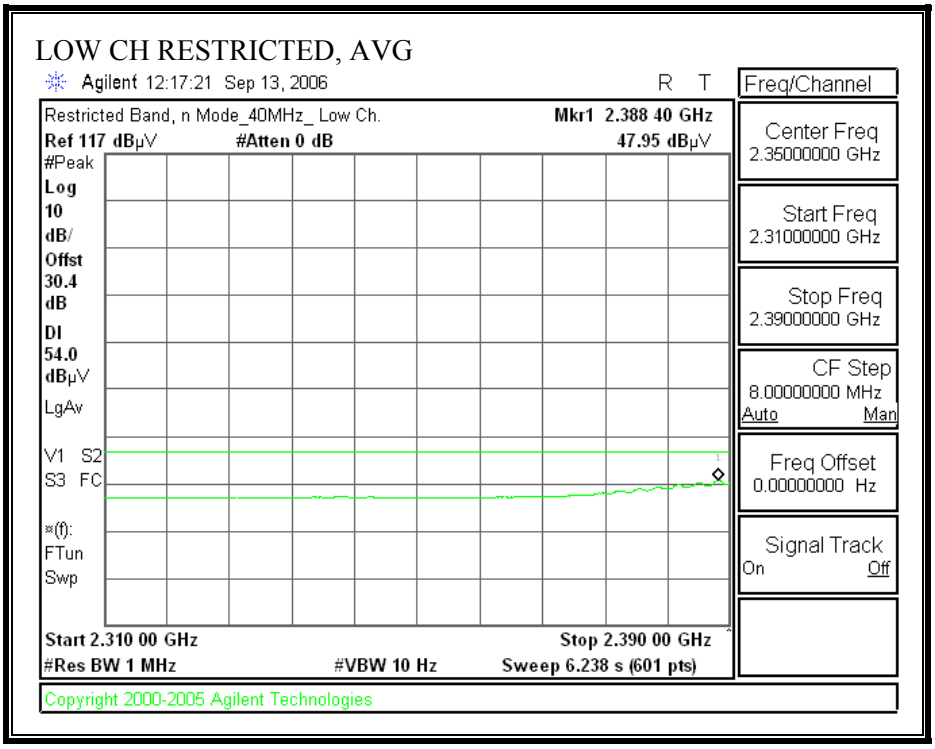
LOW CH RESTRICTED, AVG



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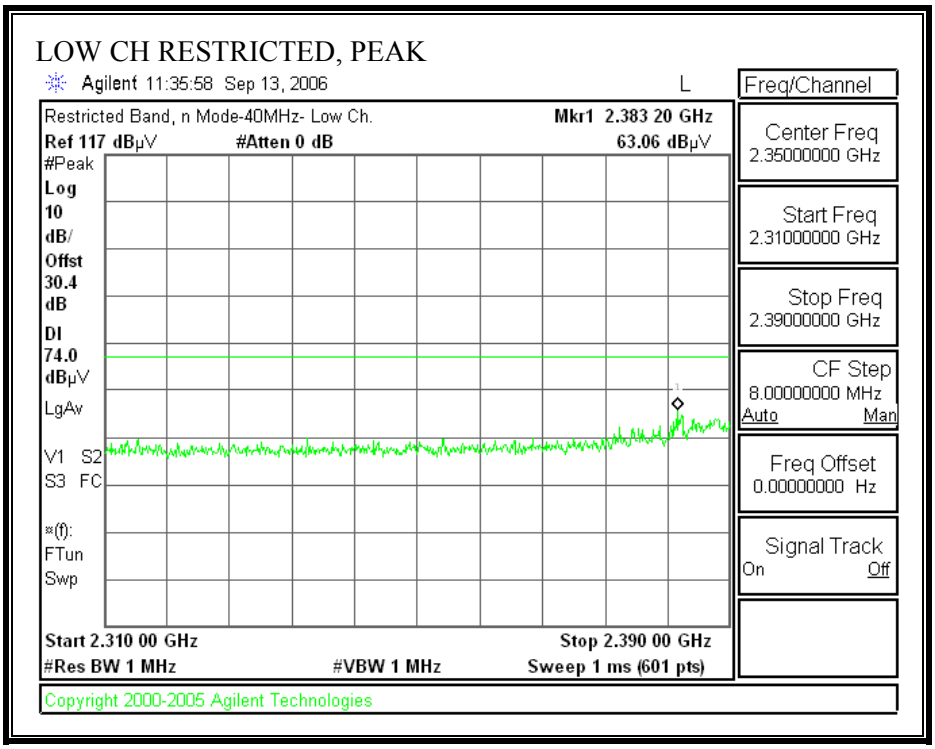
RESTRICTED BANDEDGE (LOW CHANNEL, 2427 MHz, HORIZONTAL)



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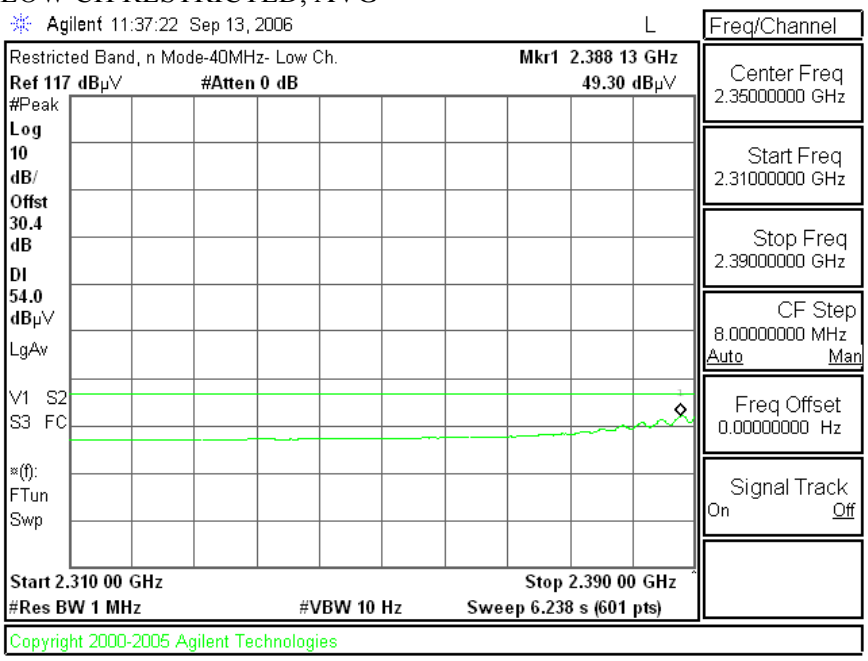
LOW CH RESTRICTED, AVG



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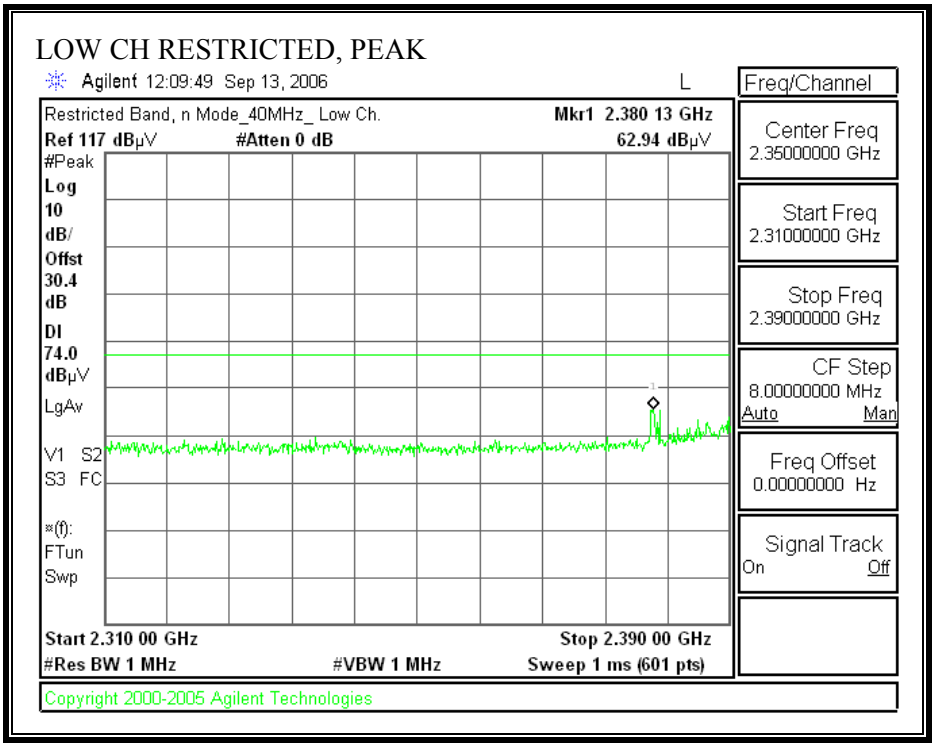
RESTRICTED BANDEDGE (LOW CHANNEL, 2427 MHz, VERTICAL)



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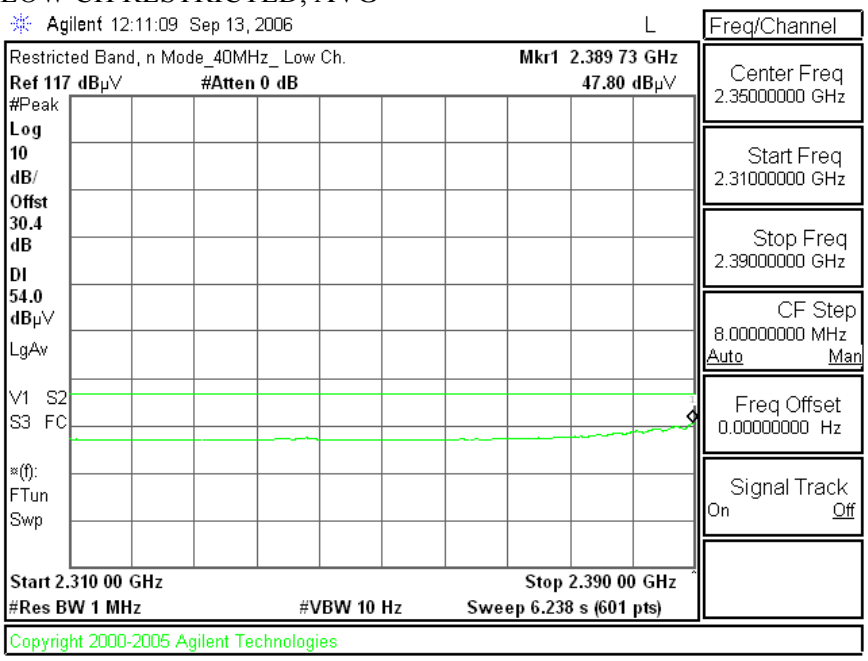
LOW CH RESTRICTED, AVG



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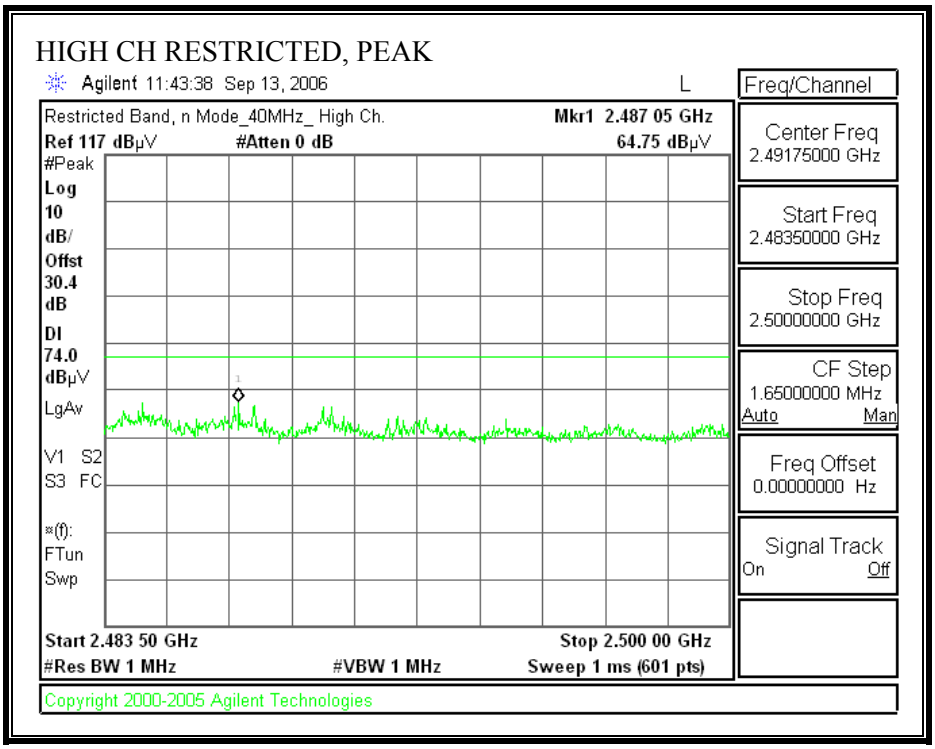
RESTRICTED BANDEDGE (HIGHCHANNEL, 2442 MHz, HORIZONTAL)



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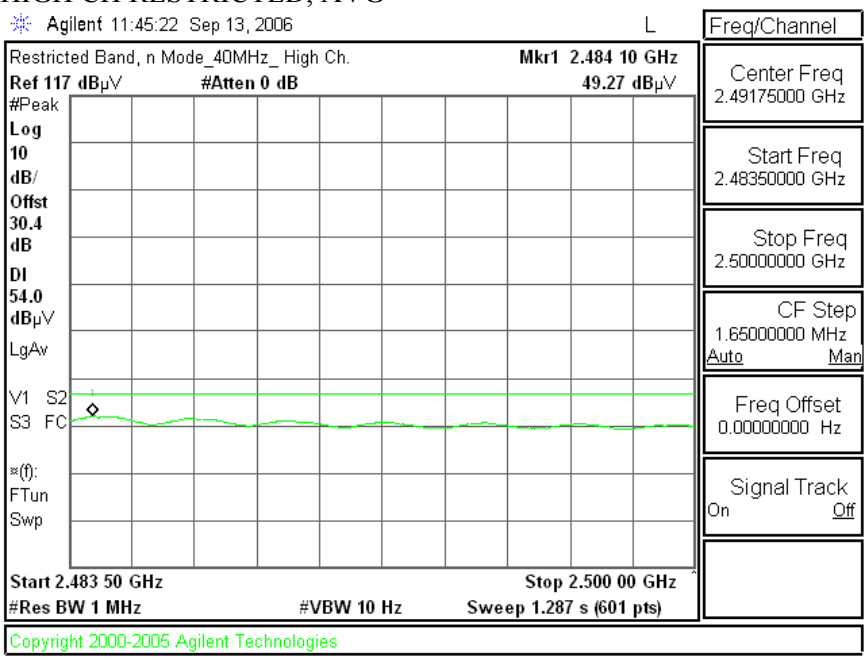
HIGH CH RESTRICTED, AVG



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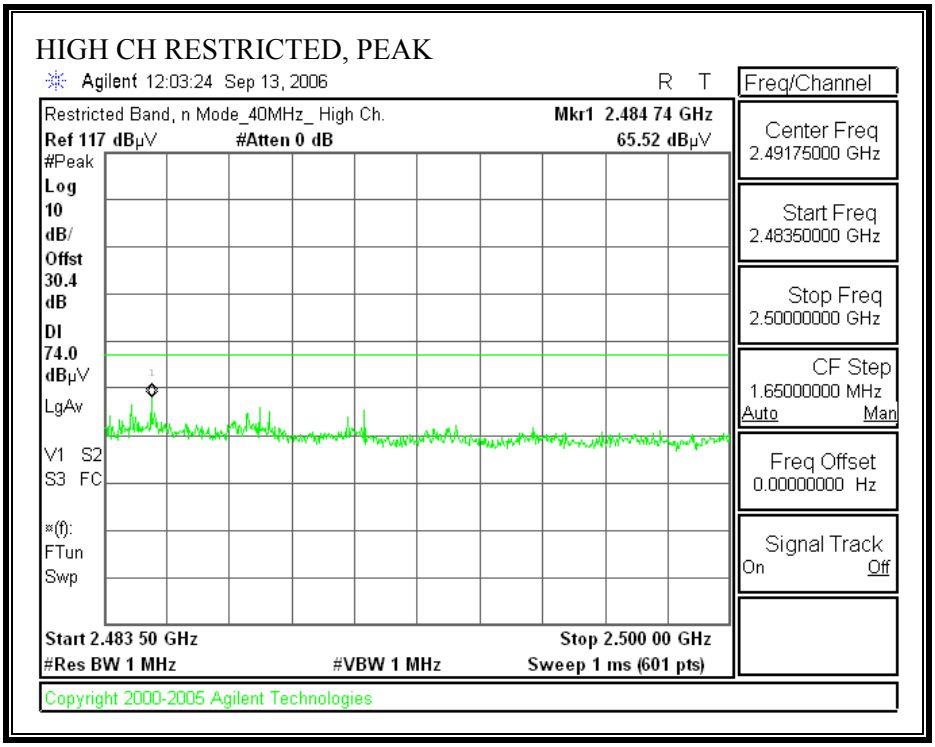
RESTRICTED BANDEDGE (HIGH CHANNEL, 2442 MHz, VERTICAL)



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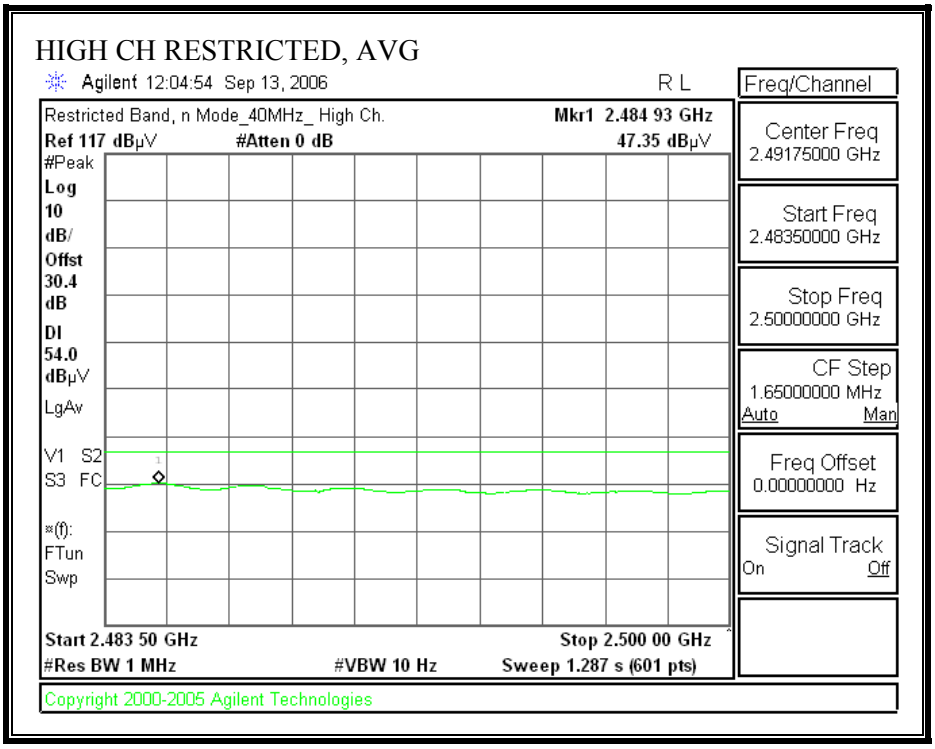
HIGH CH RESTRICTED, AVG



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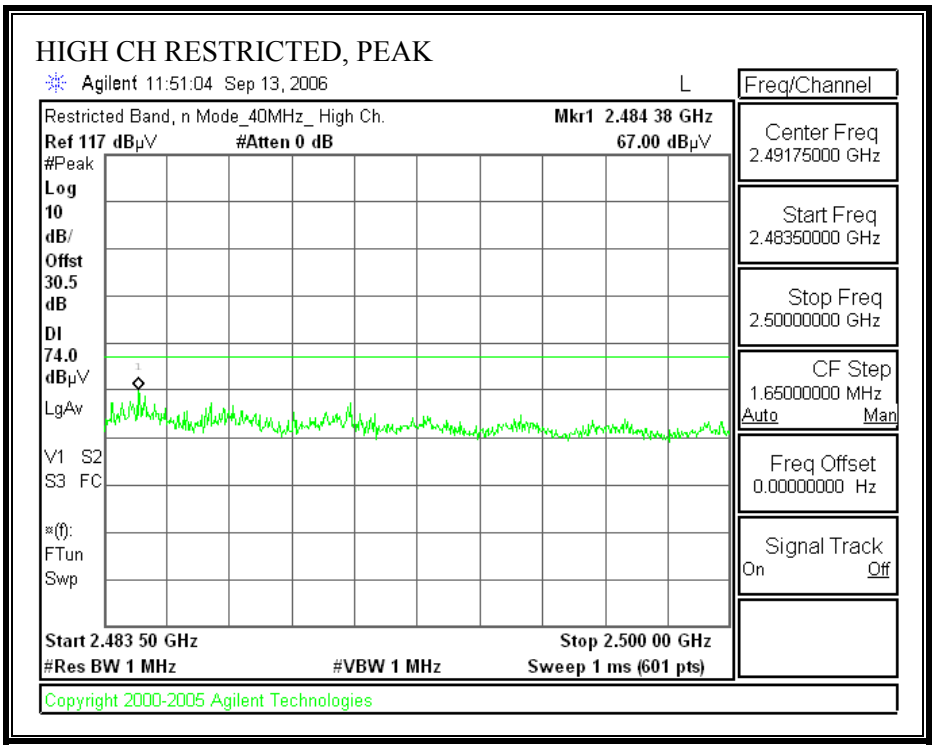
RESTRICTED BANDEDGE (HIGH CHANNEL, 2452 MHz, HORIZONTAL)



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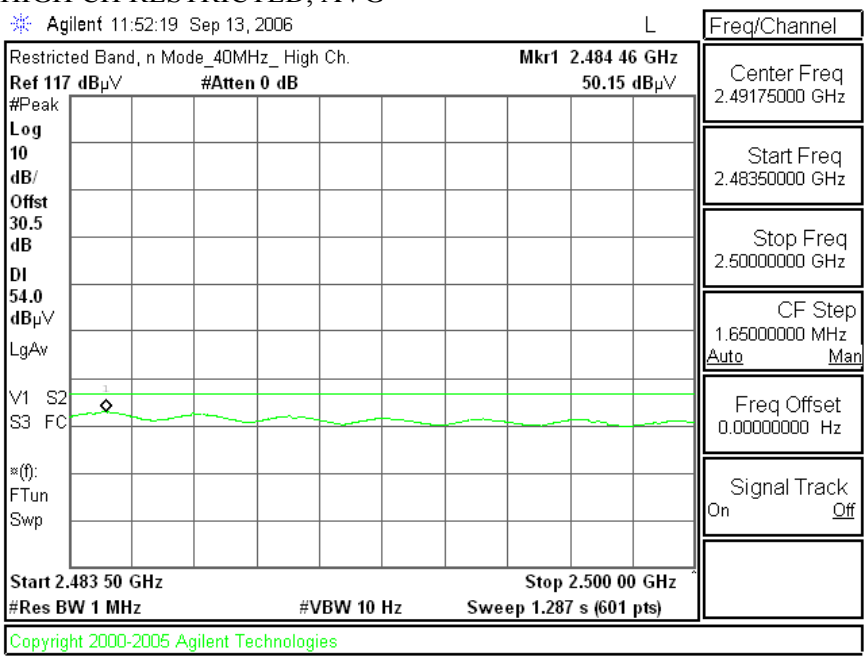
HIGH CH RESTRICTED, AVG



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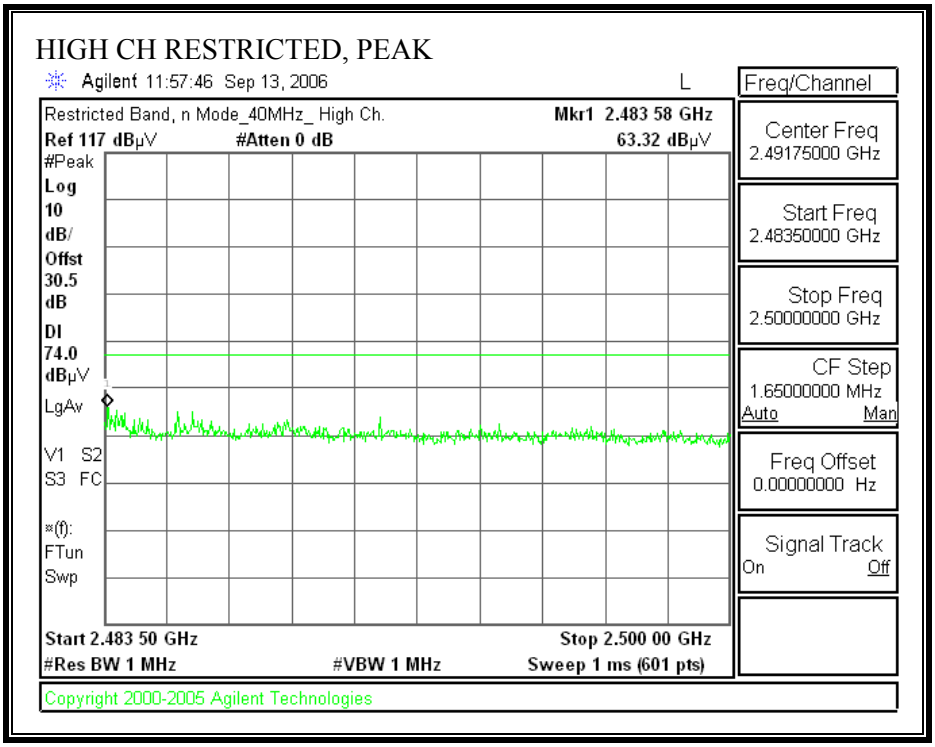
RESTRICTED BANDEDGE (HIGH CHANNEL, 2452 MHz, VERTICAL)



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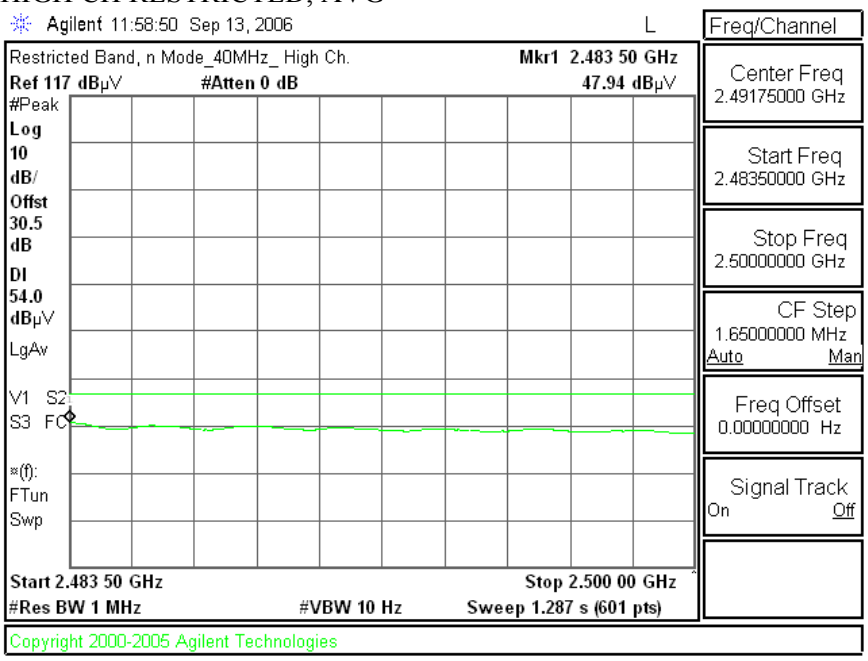
HIGH CH RESTRICTED, AVG



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HARMONICS AND SPURIOUS EMISSIONS – 40 MHz TX BANDWIDTH

High Frequency Measurement
Compliance Certification Services, Morgan Hill Open Field Site

Company: Broadcom
Project #: 06U10579
Date: 09/16/06
Test Engineer: Vien Tran
Configuration: EUT & Antenna
Mode: Tx_2.4 GHz Band_11n 40 MHz

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
	Vien 187215002	Vien 197209005	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)
LOW CH, 2422 MHz															
4.844	3.0	45.0	33.1	33.3	3.0	-34.8	0.0	0.6	47.1	35.2	74	54	-26.9	-18.8	H
4.844	3.0	42.2	31.4	33.3	3.0	-34.8	0.0	0.6	44.3	33.5	74	54	-29.7	-20.5	V
MID CH , 2437 MHz															
4.874	3.0	45.4	33.7	33.4	3.0	-34.8	0.0	0.6	47.6	35.9	74	54	-26.4	-18.1	H
4.874	3.0	44.3	33.0	33.4	3.0	-34.8	0.0	0.6	46.5	35.2	74	54	-27.5	-18.8	V
HI CH, 2452 MHz															
4.904	3.0	44.8	32.9	33.4	3.0	-34.8	0.0	0.6	47.1	35.2	74	54	-26.9	-18.8	H
4.904	3.0	44.0	32.0	33.4	3.0	-34.8	0.0	0.6	46.3	34.3	74	54	-27.7	-19.7	V

Note: No other emissions were detected above the system noise floor

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

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

HARMONICS AND SPURIOUS EMISSIONS – 20 MHz TX BANDWIDTH

High Frequency Measurement
Compliance Certification Services, Morgan Hill Open Field Site

Company: Broadcom
Project #: 06U10579
Date: 09/18/06
Test Engineer: Vien Tran
Configuration: EUT & Antenna
Mode: Tx 11a 5.8 GHz Band_11n 20 MHz Bandwidth

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
	Vien 187215002	Vien 197209005	HPF_7.6GHz	

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
CH 149, 5745 MHz															
11.490	3.0	53.4	41.8	37.5	4.8	-32.5	0.0	0.7	63.8	52.2	74	54	-10.2	-1.8	H
11.490	3.0	51.8	40.2	37.5	4.8	-32.5	0.0	0.7	62.2	50.6	74	54	-11.8	-3.4	V
CH 157, 5785 MHz															
11.570	3.0	54.2	42.1	37.5	4.8	-32.5	0.0	0.7	64.7	52.6	74	54	-9.3	-1.4	H
11.570	3.0	51.3	39.8	37.5	4.8	-32.5	0.0	0.7	61.8	50.3	74	54	-12.2	-3.7	V
CH 165, 5825 MHz															
11.650	3.0	53.5	41.4	37.5	4.8	-32.5	0.0	0.7	64.0	51.9	74	54	-10.0	-2.1	H
11.650	3.0	51.0	39.1	37.5	4.8	-32.5	0.0	0.7	61.5	49.6	74	54	-12.5	-4.4	V
			No other emissions were detected above system noise floor												

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

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HARMONICS AND SPURIOUS EMISSIONS – 40 MHz TX BANDWIDTH

High Frequency Measurement
Compliance Certification Services, Morgan Hill Open Field Site

Company: Broadcom
Project #: 06U10579
Date: 09/18/06
Test Engineer: Vien Tran
Configuration: EUT & Antenna
Mode: Tx 11a 5.8 GHz Band_11n 40 MHz Bandwidth

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
	Vien 187215002	Vien 197209005	HPF_7.6GHz	

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

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
CH 151, 5755 MHz															
11.510	3.0	50.0	39.6	37.5	4.8	-32.5	0.0	0.7	60.4	50.0	74	54	-13.6	-4.0	H
11.510	3.0	47.9	35.8	37.5	4.8	-32.5	0.0	0.7	58.3	46.2	74	54	-15.7	-7.8	V
CH 159, 5795 MHz															
11.650	3.0	49.4	39.2	37.5	4.8	-32.5	0.0	0.7	59.9	49.7	74	54	-14.1	-4.3	H
11.650	3.0	46.6	35.6	37.5	4.8	-32.5	0.0	0.7	57.1	46.1	74	54	-16.9	-7.9	V
			No other emissions were detected above system noise floor												

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

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7.5.6. WORST-CASE RADIATED EMISSIONS BELOW 1 GHz

Spot check worst case base on CCS previous report # 06U10233-1C.

5 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#: 10 File#: 06u10579.EMI Date: 09-29-2006 Time: 14:27:42
Audix ATC

Condition: FCC CLASS-B HORIZONTAL
Test Operator:: Vien Tran
Company: : Broadcom
Project #: : 06U10579
Configuration:: EUT, Laptop, Antenna
Mode of Oper.:: Tx on_5 GHz Band
Target: : FCC Class B
EUT S/N: : 944
Notes: :

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	101.780	30.86	11.77	42.63	43.50	-0.87	Peak
2	164.830	28.66	13.61	42.27	43.50	-1.23	Peak
3	213.330	26.09	12.71	38.80	43.50	-4.70	Peak
4	286.080	22.63	15.16	37.79	46.00	-8.21	Peak
5	434.490	21.27	18.84	40.11	46.00	-5.89	Peak
6	567.380	20.71	21.12	41.83	46.00	-4.17	Peak

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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#: 12 File#: 06u10579.EMI Date: 09-29-2006 Time: 14:41:21
Audix ATC

Condition: FCC CLASS-B VERTICAL
Test Operator:: Vien Tran
Company: : Broadcom
Project #: : 06U10579
Configuration:: EUT, Laptop, Antenna
Mode of Oper.:: Tx on_5 GHz Band
Target: : FCC Class B
EUT S/N: : 944
Notes: :

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	101.780	28.68	11.77	40.45	43.50	-3.05	Peak
2	164.830	25.61	13.61	39.22	43.50	-4.28	Peak
3	201.690	22.74	14.32	37.06	43.50	-6.44	Peak
4	242.430	20.89	13.63	34.52	46.00	-11.48	Peak
5	397.630	19.15	17.99	37.14	46.00	-8.86	Peak
6	473.290	22.32	19.71	42.03	46.00	-3.97	Peak

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7.6. POWERLINE CONDUCTED EMISSIONS

LIMIT

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

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

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

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

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

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

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

RESULTS

Spot check worst case base on CCS previous report # 06U10233-1C.

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5 GHz Band

6 WORST EMISSIONS

CONDUCTED EMISSIONS DATA (115VAC 60Hz)

Freq.	Reading			Closs	Limit	FCC_B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.17	55.96	--	41.40	0.00	65.21	55.21	-9.25	-13.81	L1
0.22	48.16	--	30.96	0.00	62.82	52.82	-14.66	-21.86	L1
0.34	38.90	--	27.89	0.00	59.20	49.20	-20.30	-21.31	L1
0.17	53.80	--	39.86	0.00	65.21	55.21	-11.41	-15.35	L2
0.22	45.50	--	30.20	0.00	62.82	52.82	-17.32	-22.62	L2
0.34	38.28	--	36.32	0.00	59.20	49.20	-20.92	-12.88	L2
6 Worst Data									

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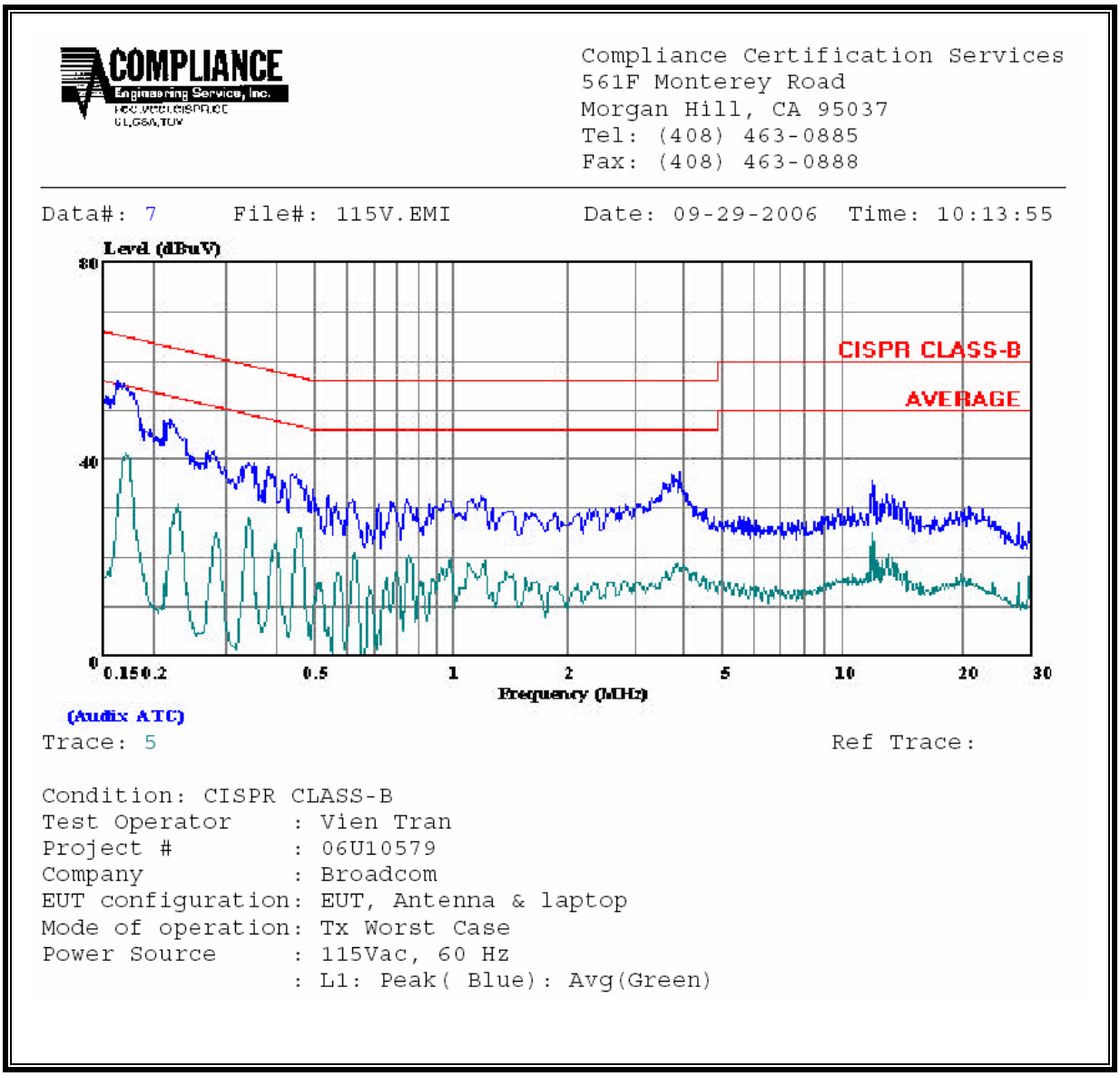
LINE 1 AND LINE 2 RESULTS (11g mode)



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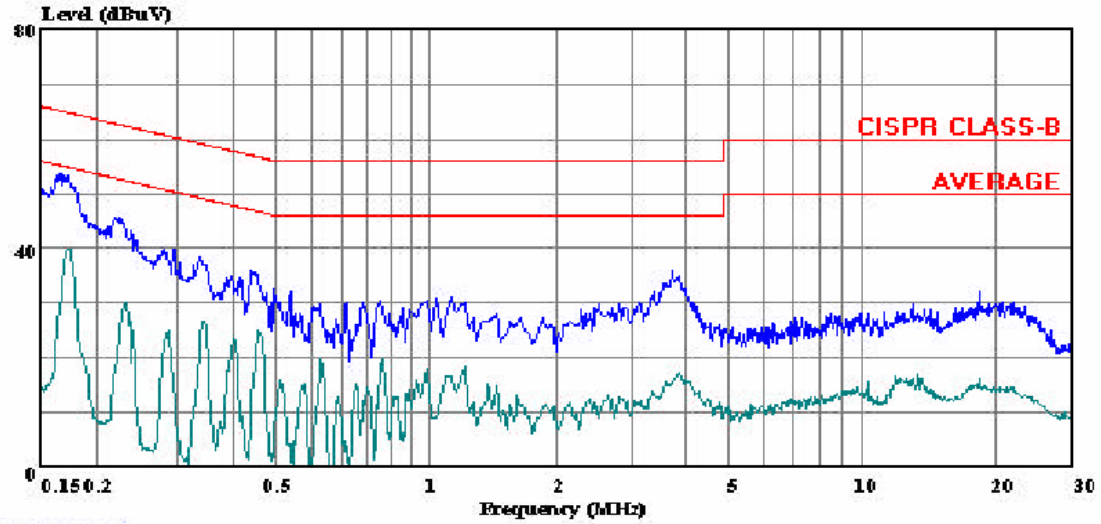
LINE 1 AND LINE 2 RESULTS (11a, 5.8 GHz mode)

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

Data#: 14 File#: 115V.EMI Date: 09-29-2006 Time: 10:29:40



(Audix ATC)
Trace: 12 Ref Trace:

Condition: CISPR CLASS-B
Test Operator : Vien Tran
Project # : 06U10579
Company : Broadcom
EUT configuration: EUT, Antenna & laptop
Mode of operation: Tx Worst Case
Power Source : 115Vac, 60 Hz
: L2: Peak(Blue): Avg(Green)

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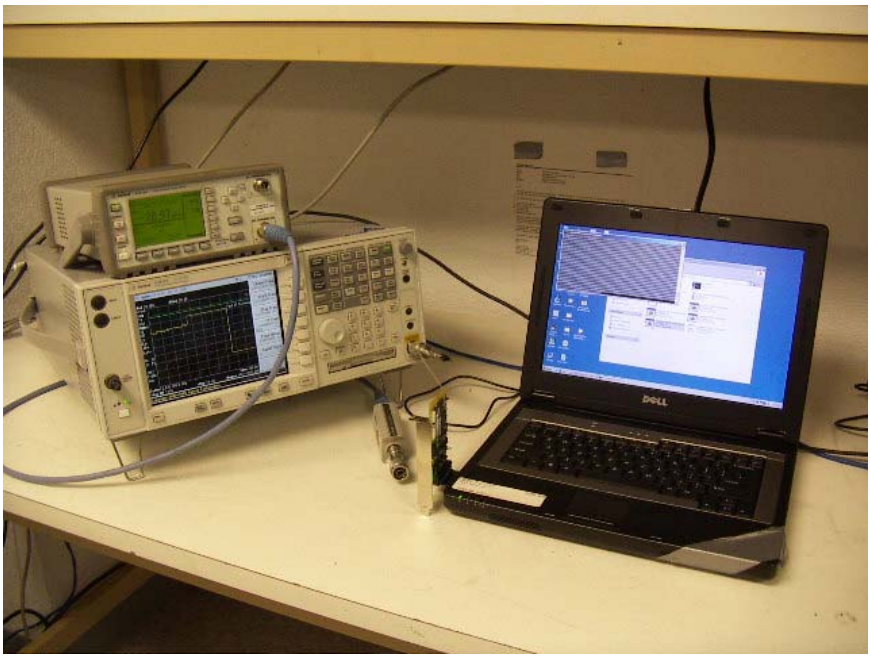
8. SETUP PHOTOS

ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP

ANTENNA PORT CONDUCTED PHOTO



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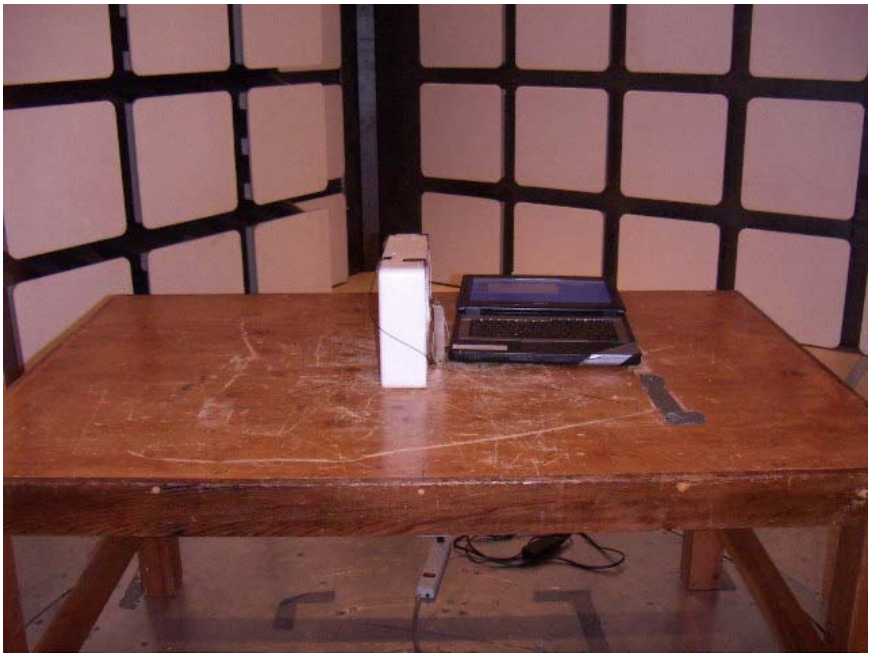
RADIATED RF MEASUREMENT SETUP

RADIATED FRONT PHOTO



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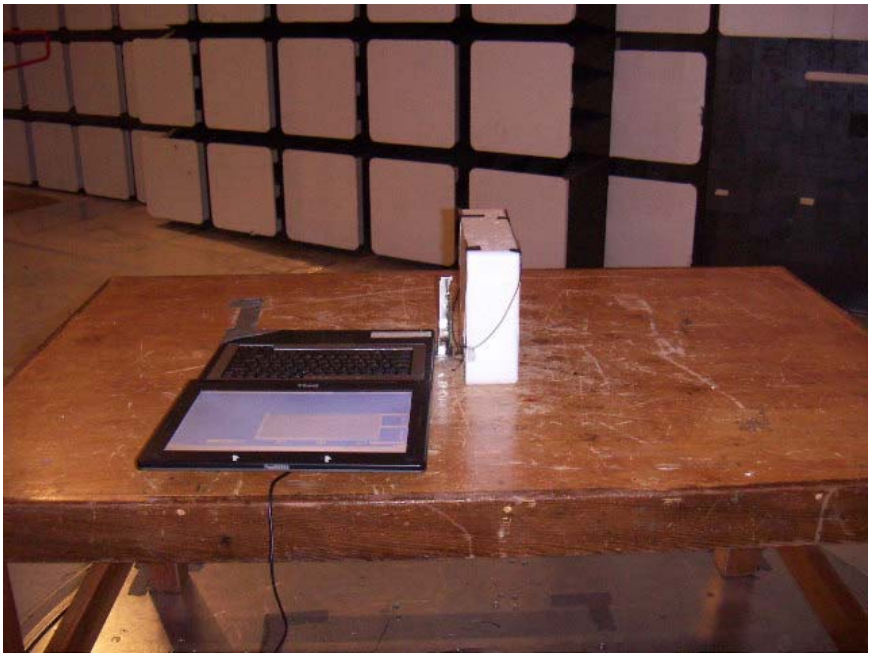
RADIATED BACK PHOTO



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RADIATED SIDE PHOTO

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POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP

LINE CONDUCTED FRONT PHOTO

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LINE CONDUCTED BACK PHOTO

END OF REPORT

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