



**FCC CFR47 PART 15 SUBPART C  
INDUSTRY CANADA RSS-210 ISSUE 7**

**CERTIFICATION TEST REPORT**

**FOR**

**802.11g / Draft 802.11n WLAN + BLUETOOTH PCI-E MINICARD**

**MODEL NUMBER: BCM94313HMGB**

**FCC ID: QDS-BRCM1051**

**IC: 4324A-BRCM1051**

**REPORT NUMBER: 09U12871-1, Revision A**

**ISSUE DATE: NOVEMBER 09, 2009**

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**NVLAP LAB CODE 200065-0**

Revision History

Rev.	Issue Date	Revisions	Revised By
--	10/27/09	Initial Issue	T. Chan
A	11/09/09	Addressed TCB Question on Dwell Time	T. Chan

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## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** BROADCOM CORPORATION  
190 MATHILDA PLACE  
SUNNYVALE, CA 94086, USA

**EUT DESCRIPTION:** 802.11g / Draft 802.11n WLAN + Bluetooth PCI-E Minicard

**MODEL:** BCM94313HMGB

**SERIAL NUMBER:** 110 (P202)

**DATE TESTED:** OCTOBER 21 - 23, 2009

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-210 Issue 7 Annex 8	Pass
INDUSTRY CANADA RSS-GEN Issue 2	Pass

Compliance Certification Services, Inc. (CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by CCS based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by CCS will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For CCS By:

Tested By:



THU CHAN  
EMC MANAGER  
COMPLIANCE CERTIFICATION SERVICES



VIEN TRAN  
EMC ENGINEER  
COMPLIANCE CERTIFICATION SERVICES

## 2. TEST METHODOLOGY

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

## 3. FACILITIES AND ACCREDITATION

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

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

## 4. CALIBRATION AND UNCERTAINTY

### 4.1. MEASURING INSTRUMENT CALIBRATION

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

### 4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamplifier Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

### 4.3. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.52 dB
Radiated Disturbance, 30 to 1000 MHz	4.94 dB

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

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is an 802.11g / Draft 802.11n WLAN + Bluetooth PCI-E Minicard.

The radio module is manufactured by Broadcom.

### 5.2. MAXIMUM OUTPUT POWER

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

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402 - 2480	Basic GFSK	1.97	1.57
2402 - 2480	Enhanced 8PSK	4.46	2.79

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an antenna with a maximum gain of 3.9dBi.

### 5.4. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Broadcom BCM2070 Bluetooth 2.1+EDR USB Device, rev. 5.5.0.4600.

The test utility software used during testing was Blue Tool, rev. 1.2.4.3.

### 5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Lenovo	4446	R8-CAC56 09/08	DoC
AC Adapter	Lenovo	ADP 65YB B	N/A	N/A
Adapter Board	Broadcom	BCRM943224PCIEBTAD	1261490	N/A

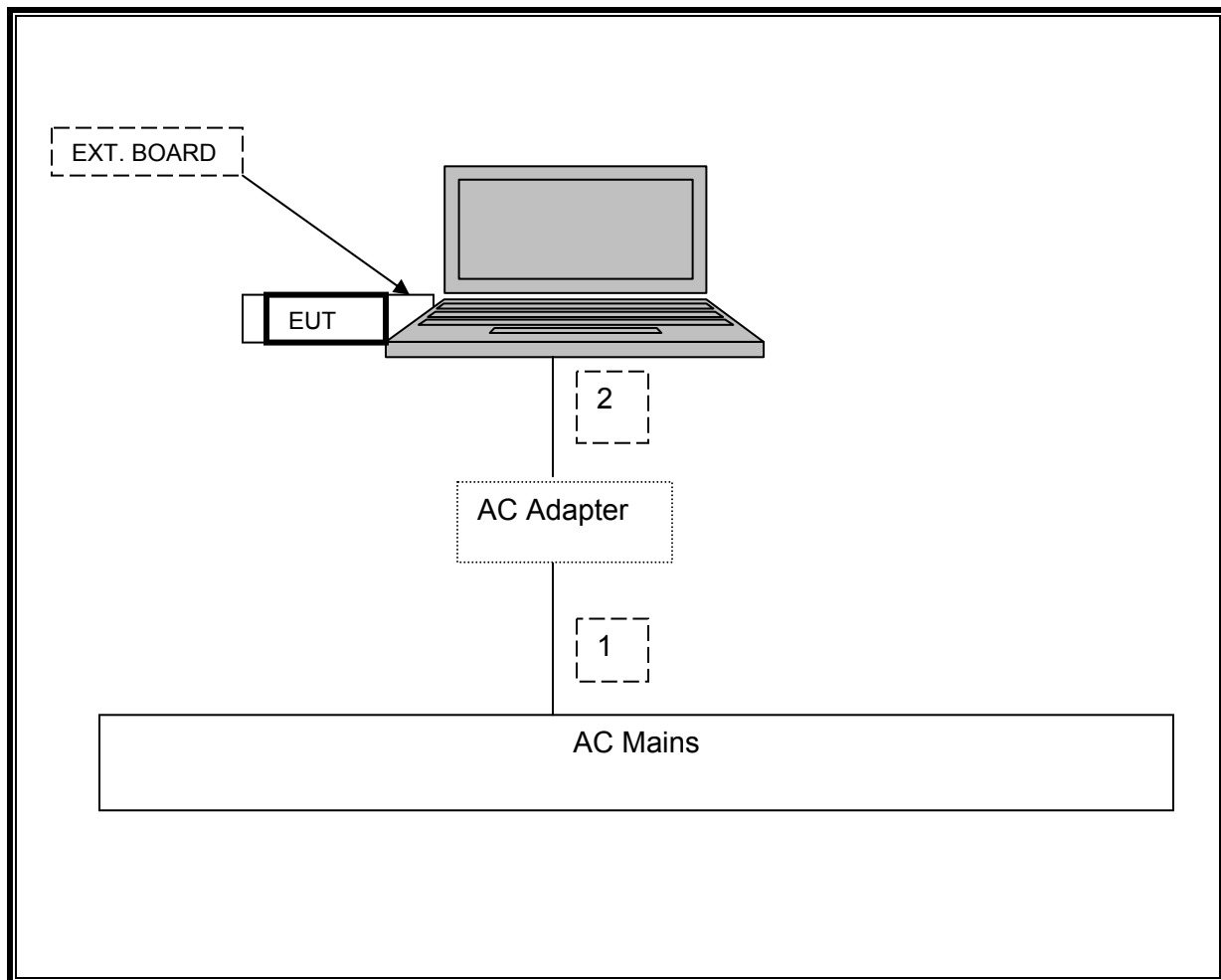
### I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	AC	Unshielded	1.8m	N/A
2	DC	1	DC	Unshielded	1.8m	Ferrite at laptop's end

### TEST SETUP

The EUT is connected to a host laptop computer via Express card to MiniPCI-E adapter board with USB cable during the test. Test software exercised the radio card.

**SETUP DIAGRAM**



## 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	Asset	Cal Due
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01069	01/05/10
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01011	01/14/10
Antenna, Horn, 18 GHz	EMCO	3115	C00945	04/22/10
Antenna, Horn, 26.5 GHz	ARA	MVH-1826/B	C00589	11/28/09
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	03/31/10
Preamplifier, 1-26GHz	Agilent / HP	8449B	C01052	07/05/10
Peak Power Meter	Boonton	4541	C01186	01/19/10
Peak Power Sensor	Boonton	4541	C01189	01/15/10
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	10/29/09
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	02/06/10

## 7. ANTENNA PORT TEST RESULTS

### 7.1. BASIC DATA RATE GFSK MODULATION

#### 7.1.1. 99% BANDWIDTH

##### LIMIT

None; for reporting purposes only.

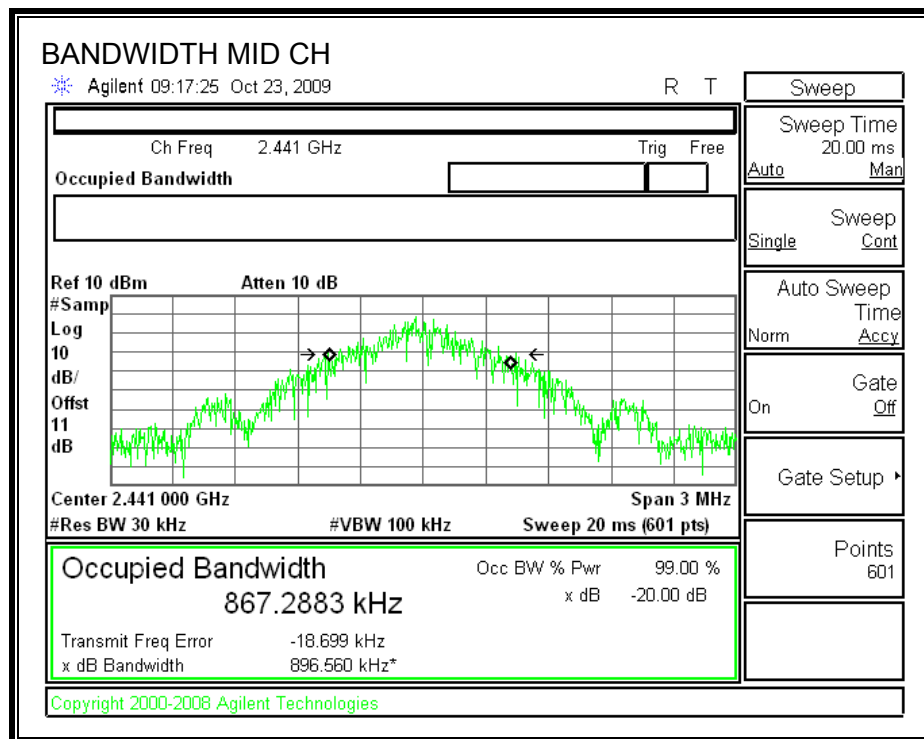
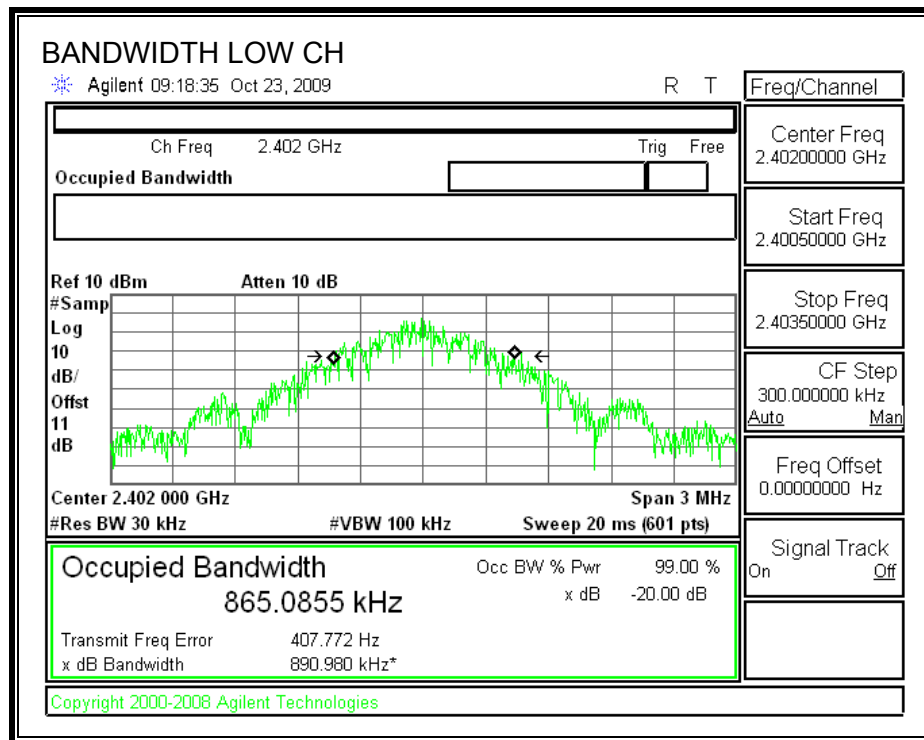
##### TEST PROCEDURE

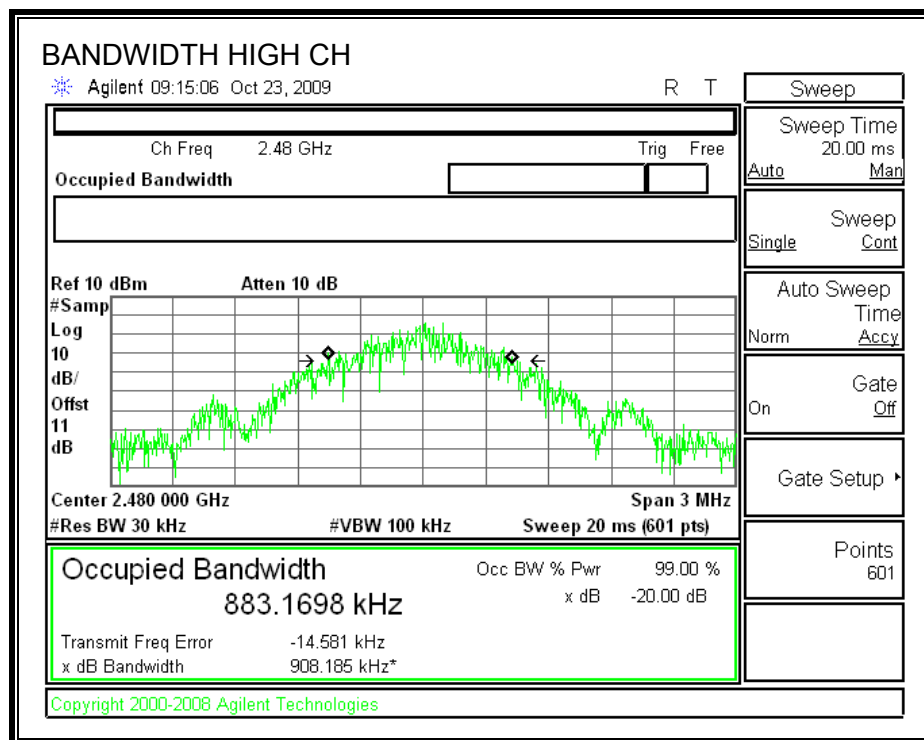
The transmitter output is connected to a spectrum analyzer. The RBW is set to  $\geq 1\%$  of the 99% bandwidth. The VBW is set to  $\geq$  RBW. The sweep time is coupled.

##### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (kHz)
Low	2402	865.0855
Middle	2441	867.2883
High	2480	883.1698

# 99% BANDWIDTH





### 7.1.2. 20 dB BANDWIDTH

#### LIMIT

None; for reporting purposes only.

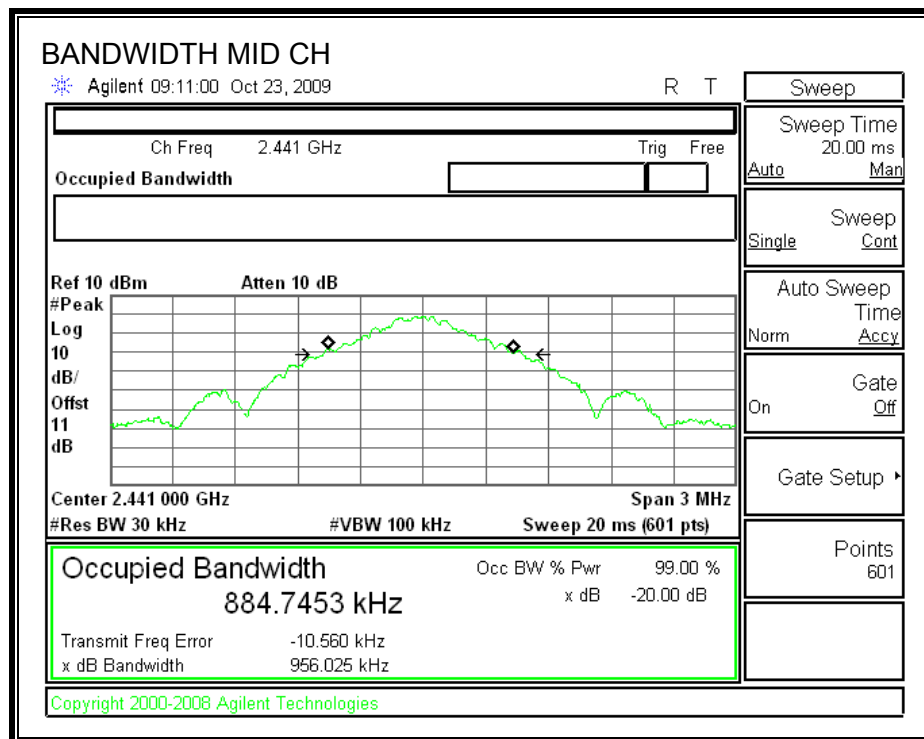
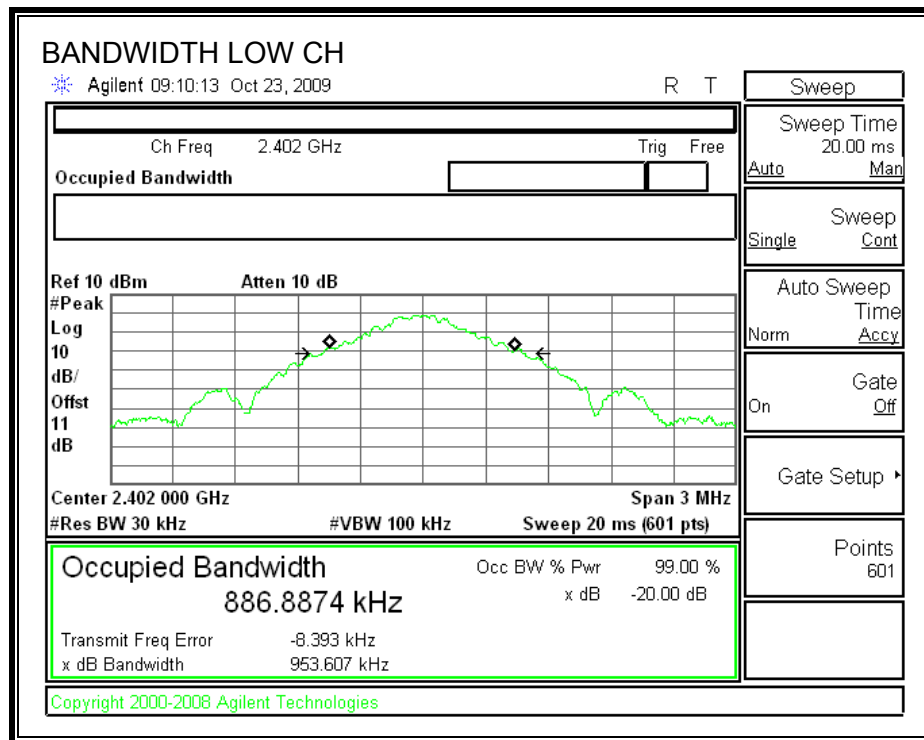
#### TEST PROCEDURE

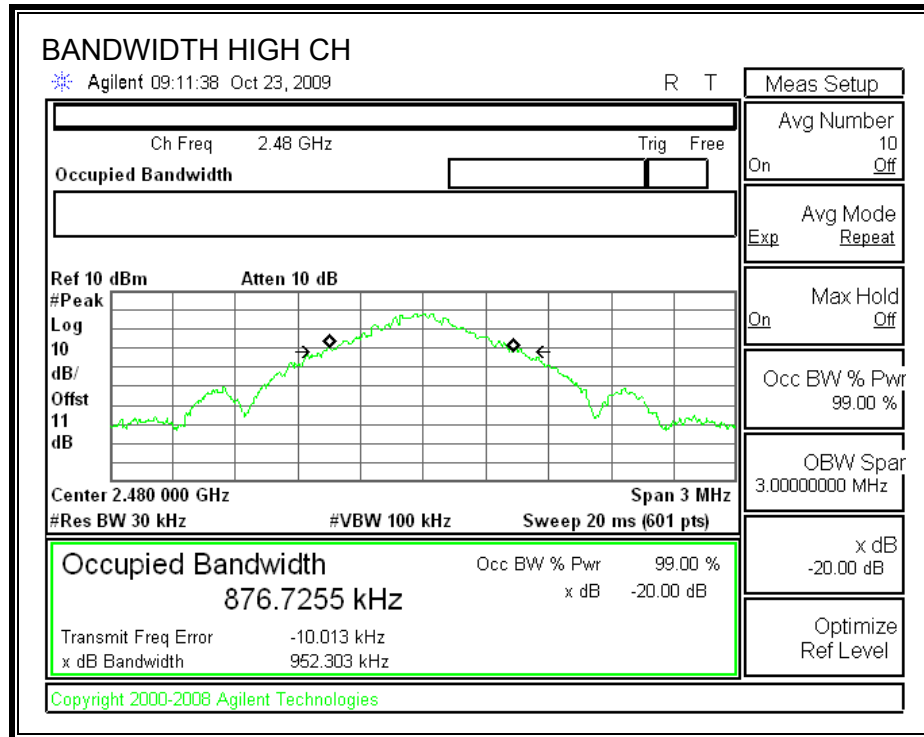
The transmitter output is connected to a spectrum analyzer. The RBW is set to  $\geq 1\%$  of the 20 dB bandwidth. The VBW is set to  $\geq$  RBW. The sweep time is coupled.

#### RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)
Low	2402	953.607
Middle	2441	956.025
High	2480	952.303

## 20 dB BANDWIDTH





### 7.1.3. HOPPING FREQUENCY SEPARATION

#### LIMIT

FCC §15.247 (a) (1)

IC RSS-210 A8.1 (b)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

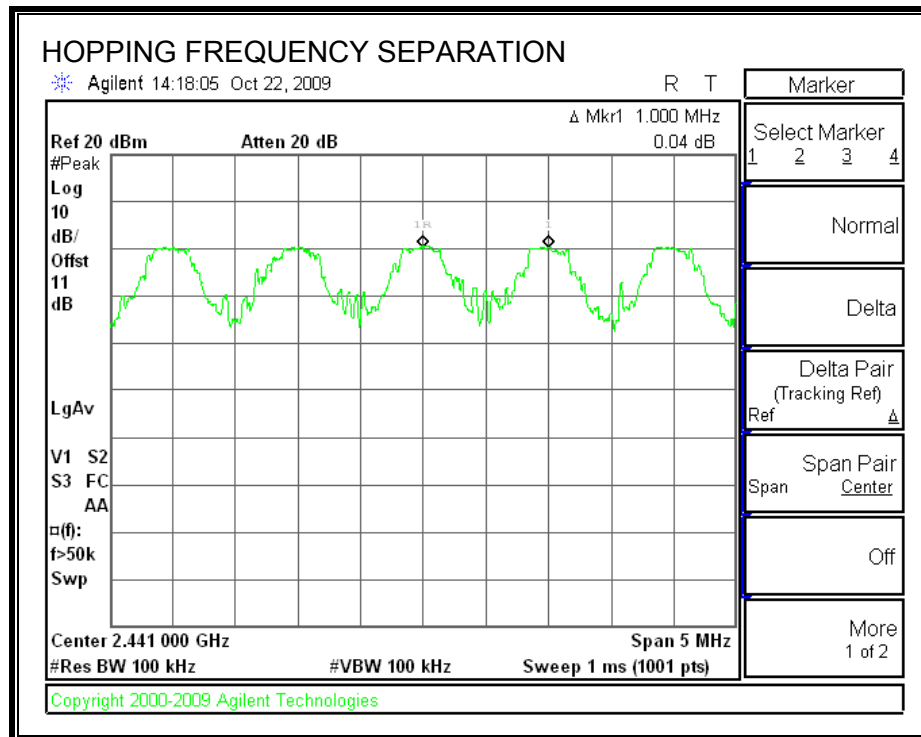
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

#### TEST PROCEDURE

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

#### RESULTS

##### HOPPING FREQUENCY SEPARATION



#### **7.1.4. NUMBER OF HOPPING CHANNELS**

##### **LIMIT**

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

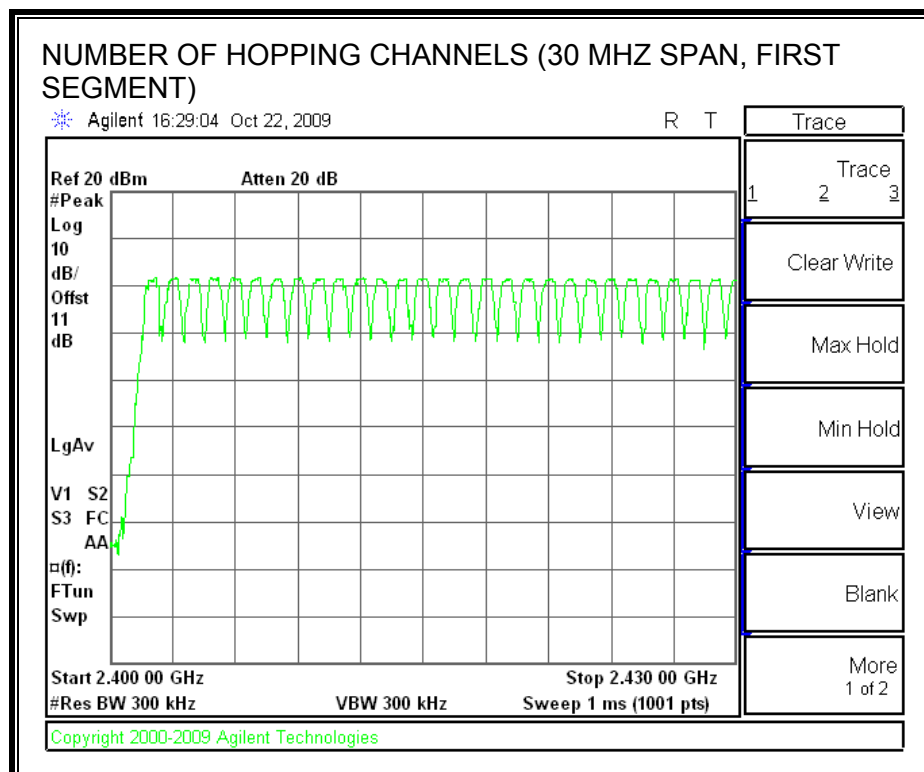
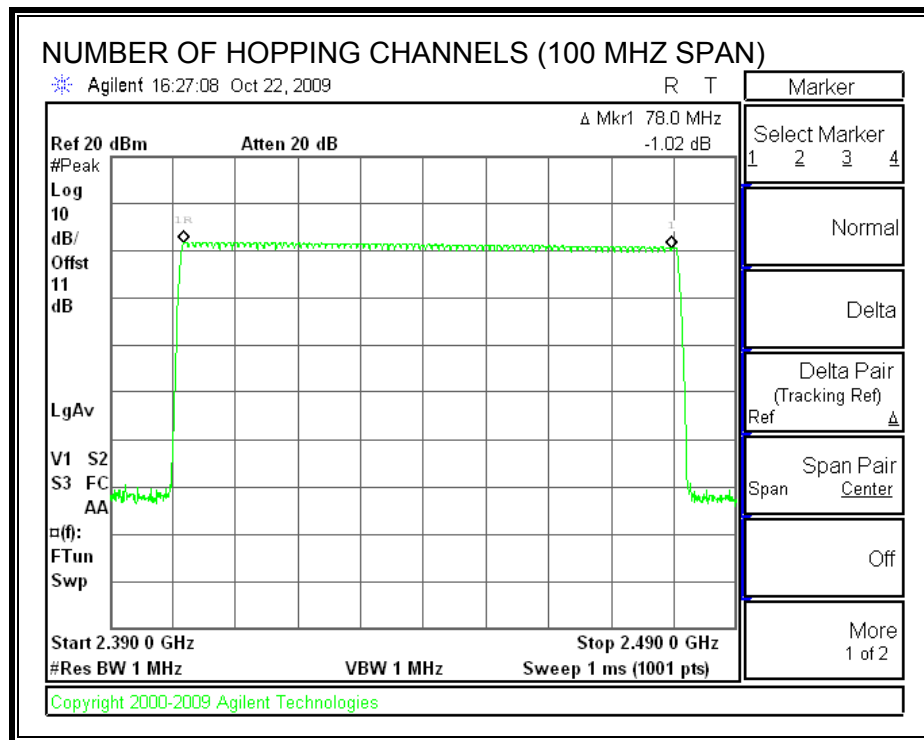
##### **TEST PROCEDURE**

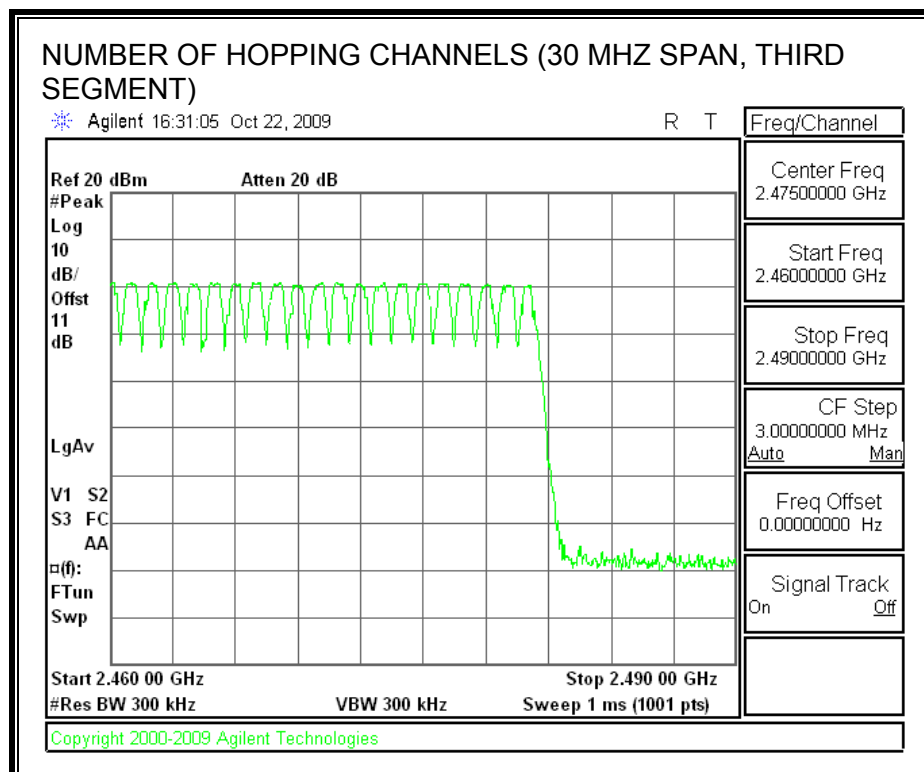
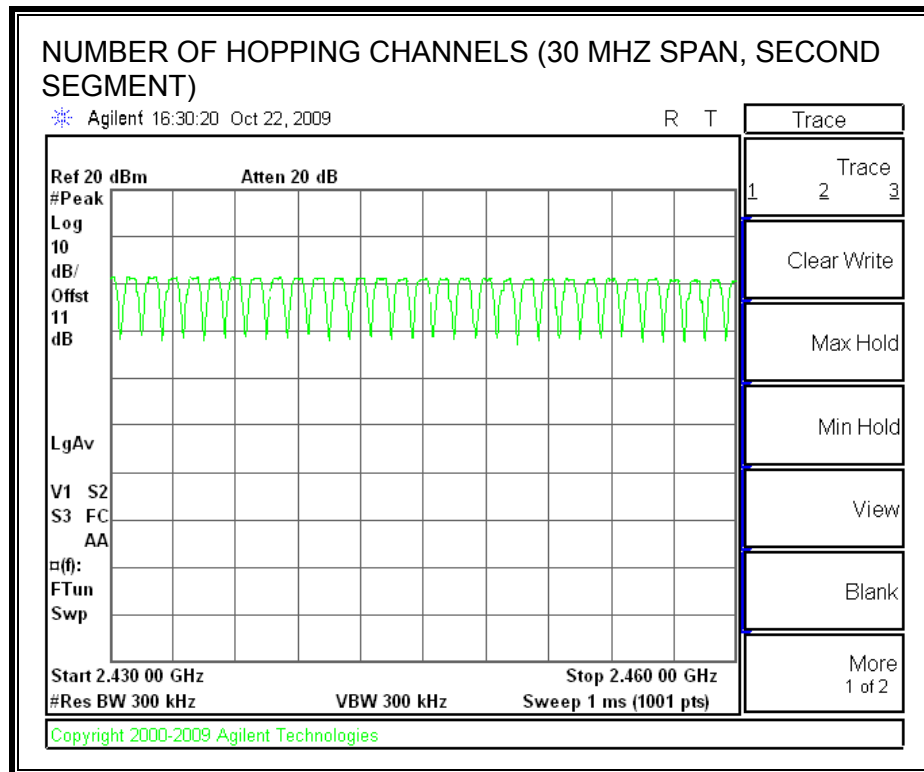
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

##### **RESULTS**

79 Channels observed.

## NUMBER OF HOPPING CHANNELS





### 7.1.5. AVERAGE TIME OF OCCUPANCY

#### LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

#### TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 31.6 second period (79 channels \* 0.4 s) is equal to  $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$ .

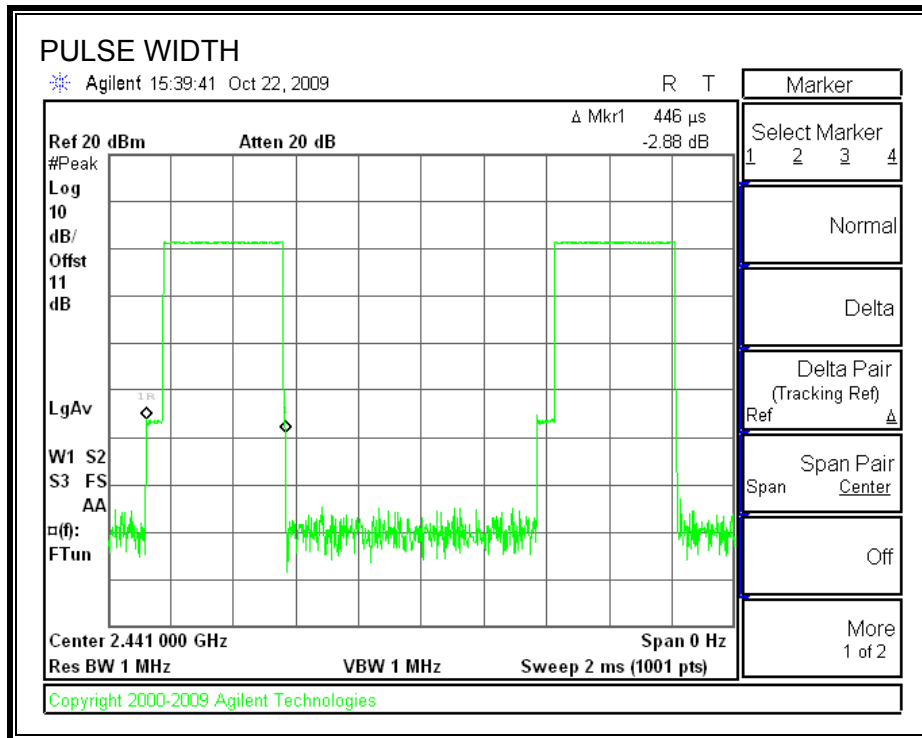
#### RESULTS

GFSK Mode

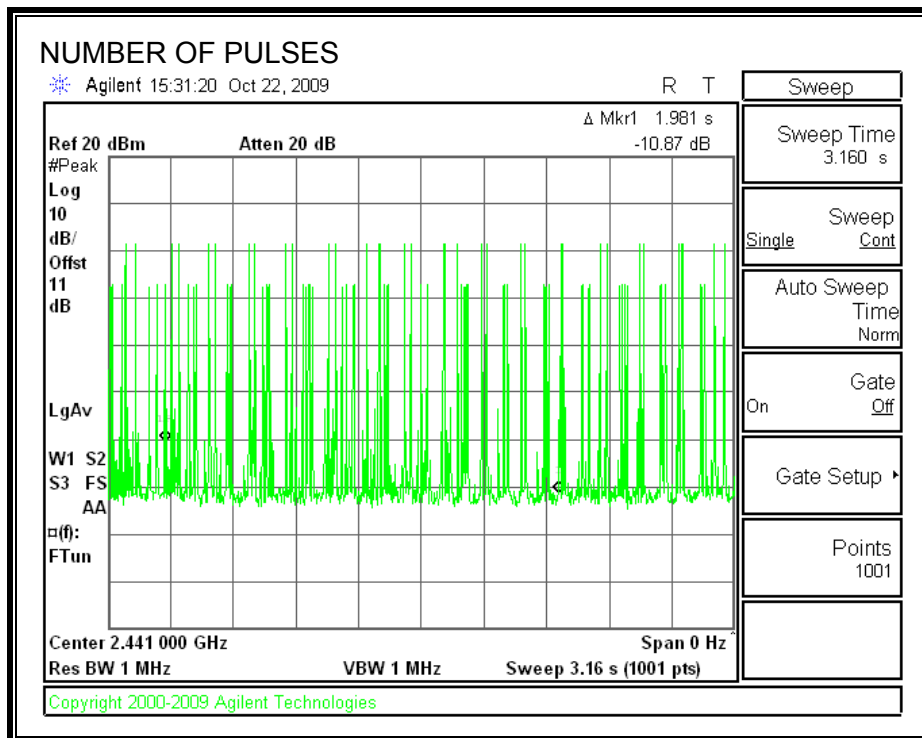
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.446	32	0.143	0.4	0.257
DH3	1.700	20	0.340	0.4	0.060
DH5	2.947	12	0.354	0.4	0.046

**DH1**

**PULSE WIDTH**

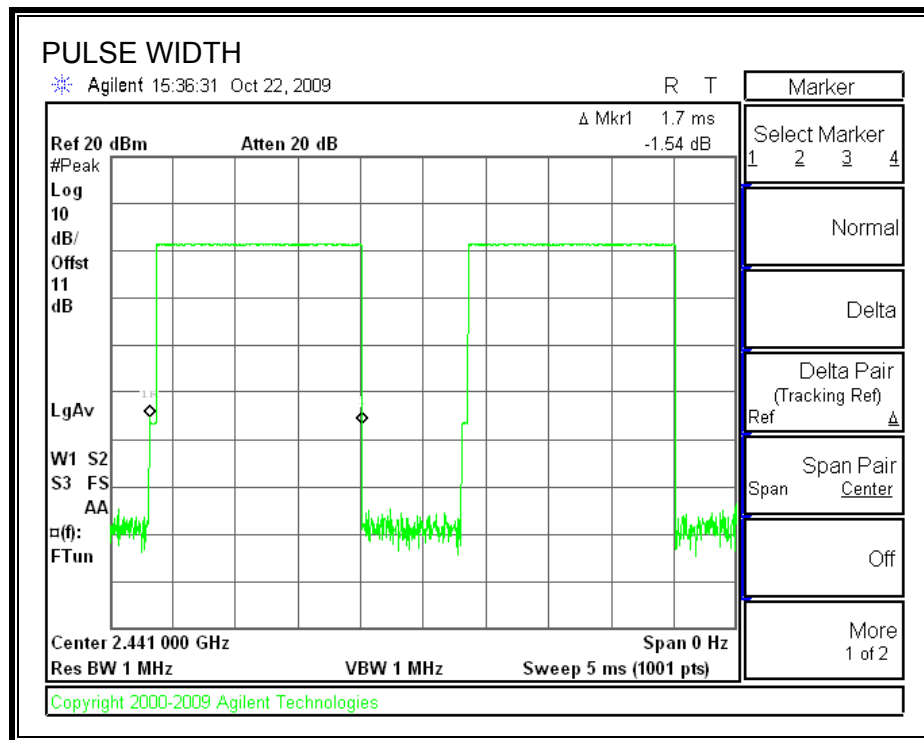


**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD**

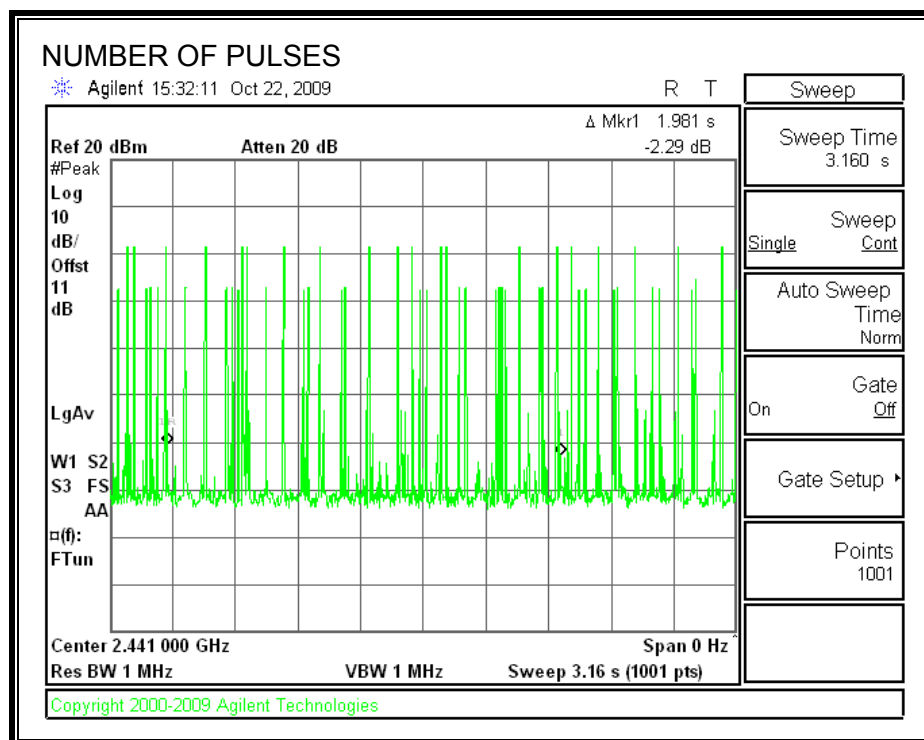


**DH3**

**PULSE WIDTH**

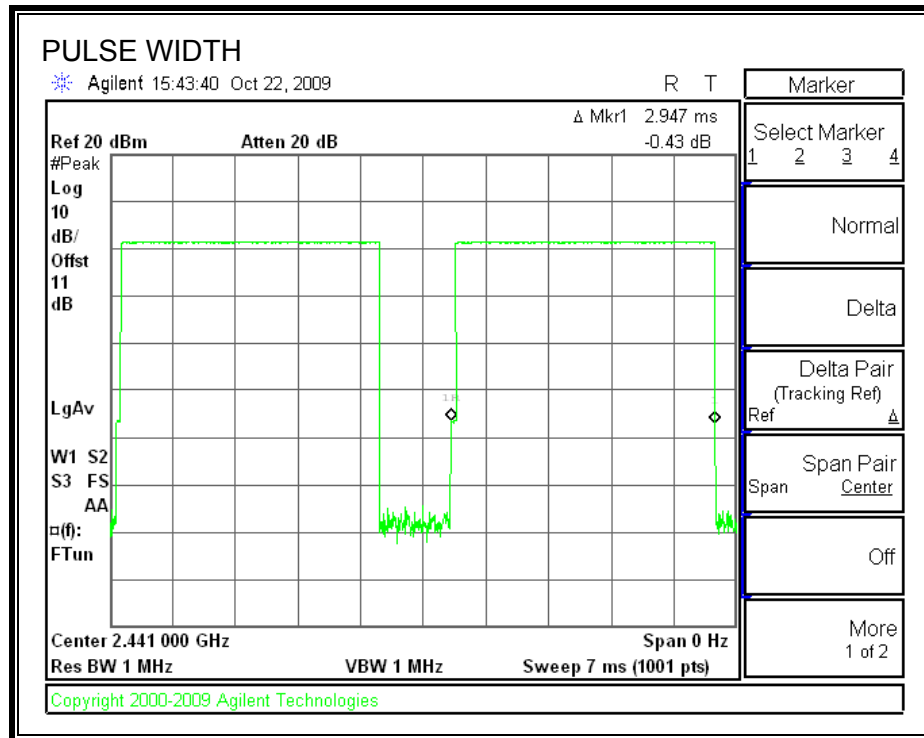


**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD**

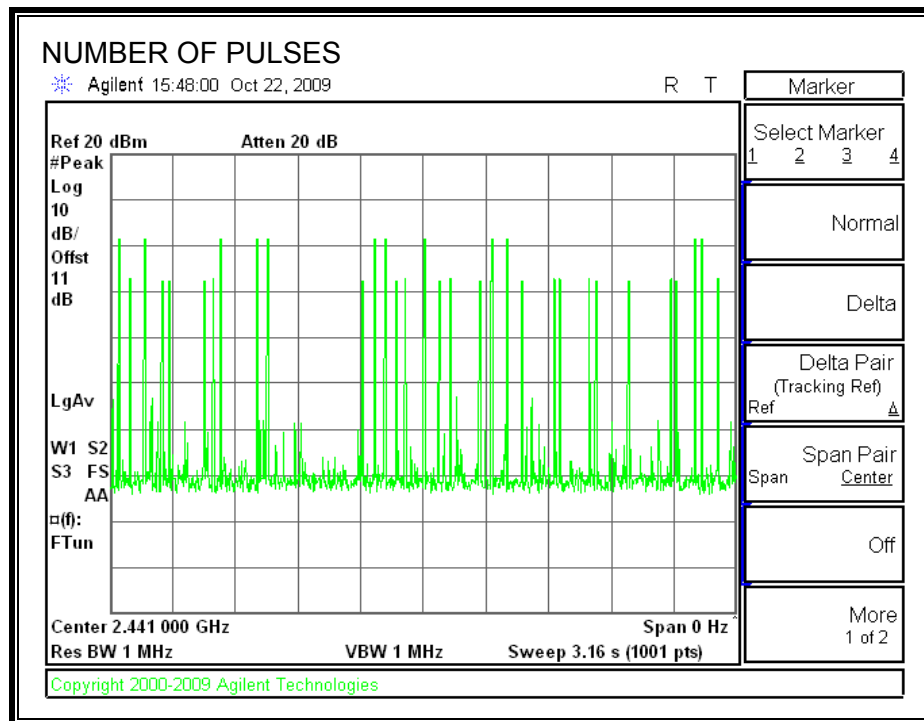


**DH5**

**PULSE WIDTH**



**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD**



## 7.1.6. OUTPUT POWER

### LIMIT

§15.247 (b) (1)

RSS-210 Issue 7 Clause A8.4

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

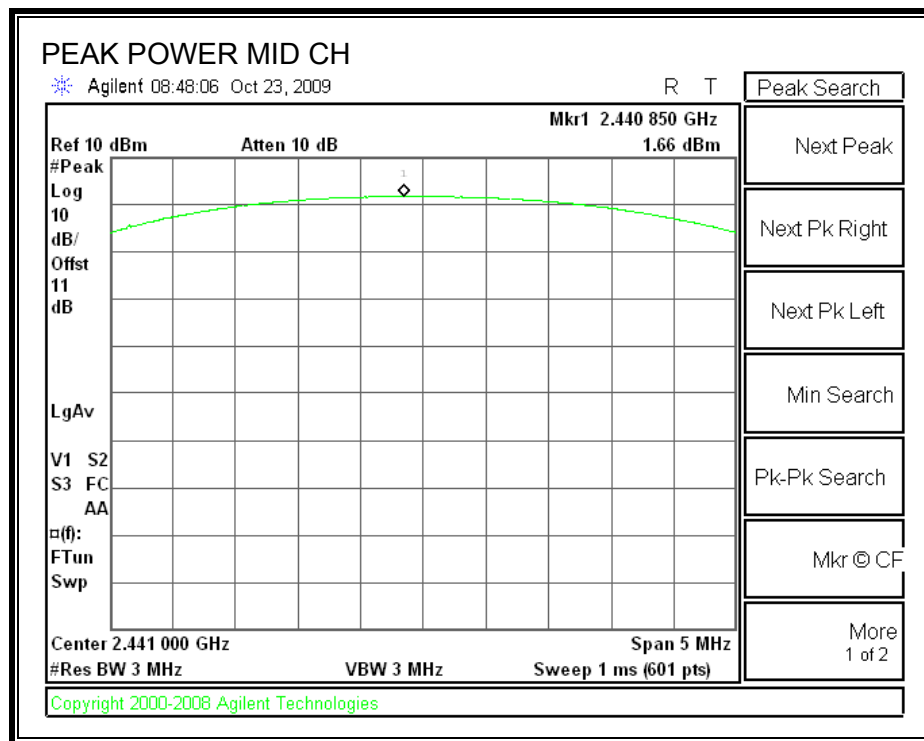
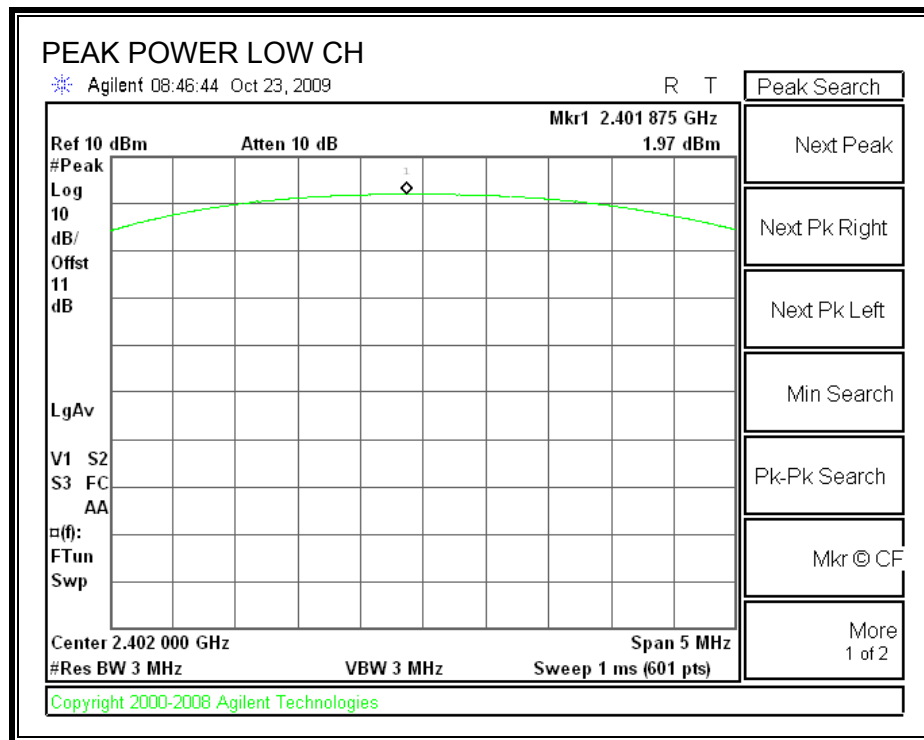
### TEST PROCEDURE

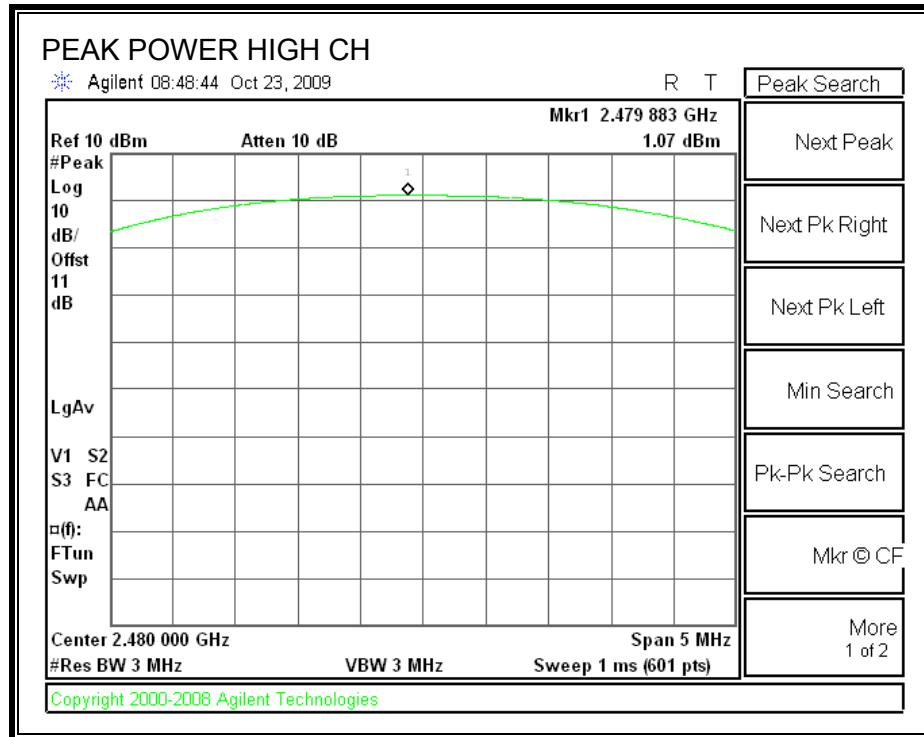
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

### RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	1.97	30	-28.03
Middle	2441	1.66	30	-28.34
High	2480	1.07	30	-28.93

## OUTPUT POWER





### **7.1.7. CONDUCTED SPURIOUS EMISSIONS**

#### **LIMITS**

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

#### **TEST PROCEDURE**

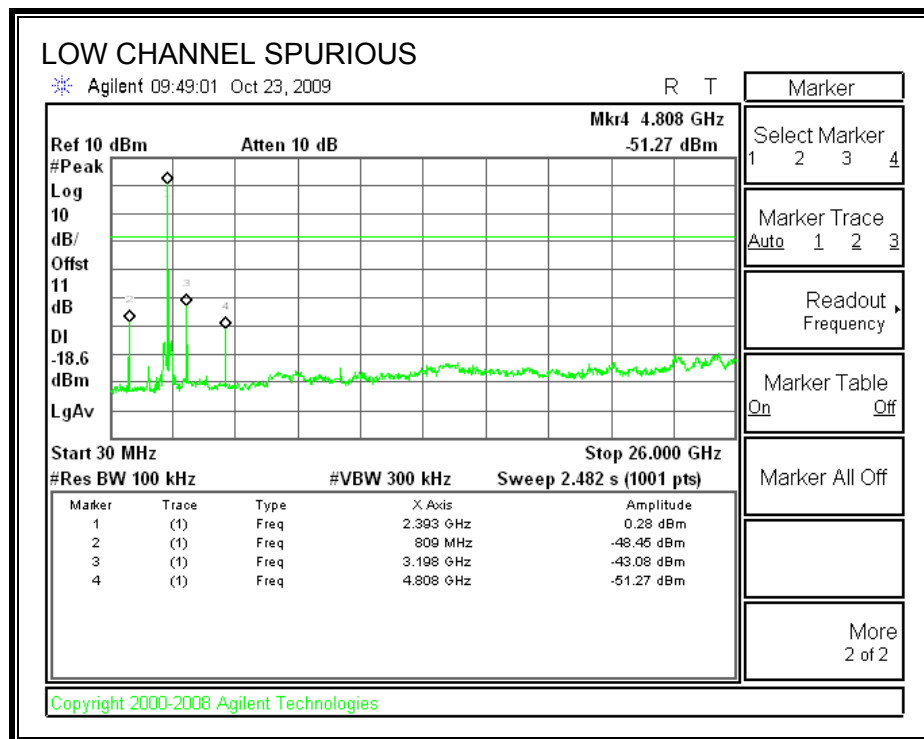
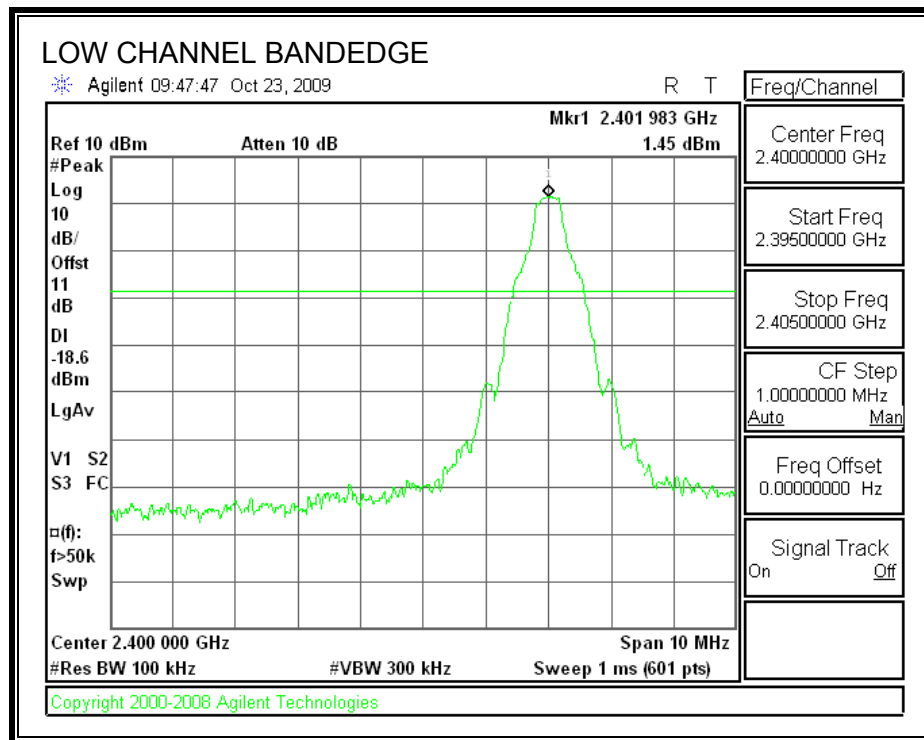
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

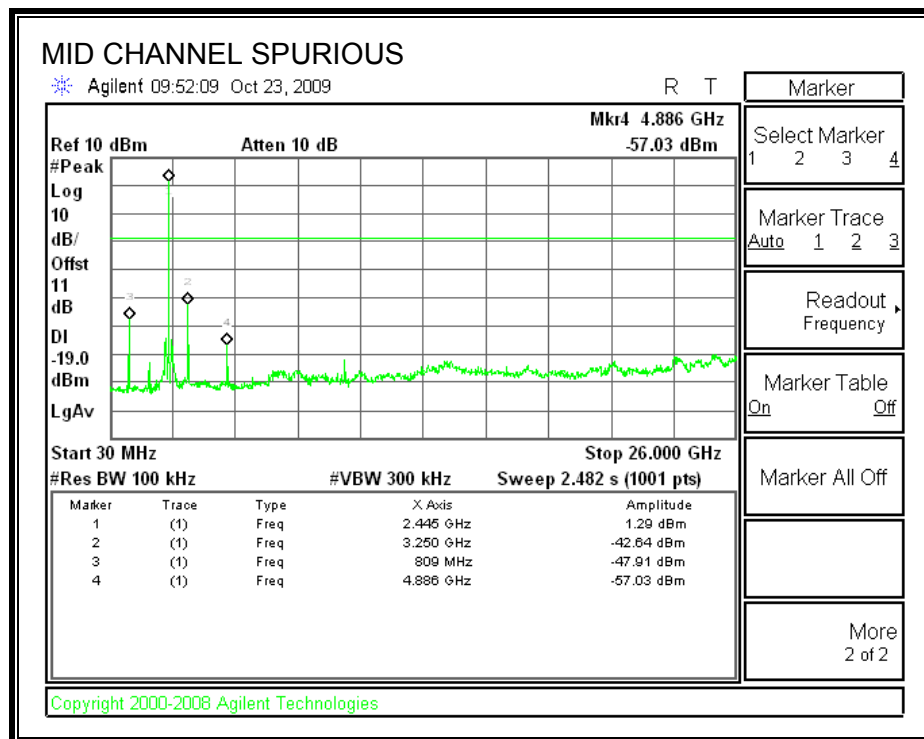
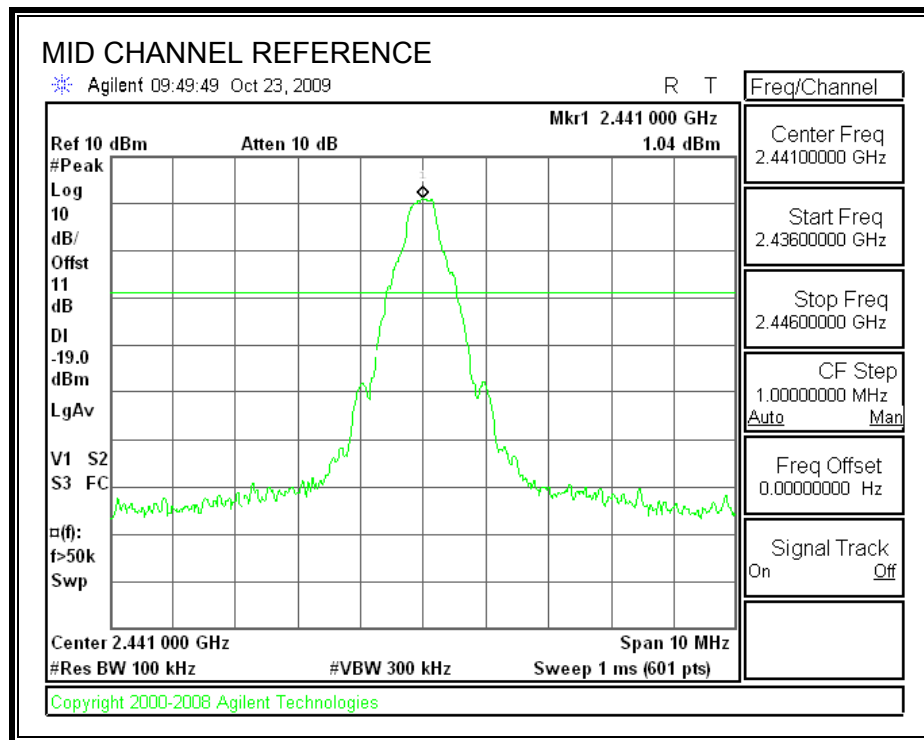
The band edges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

#### **RESULTS**

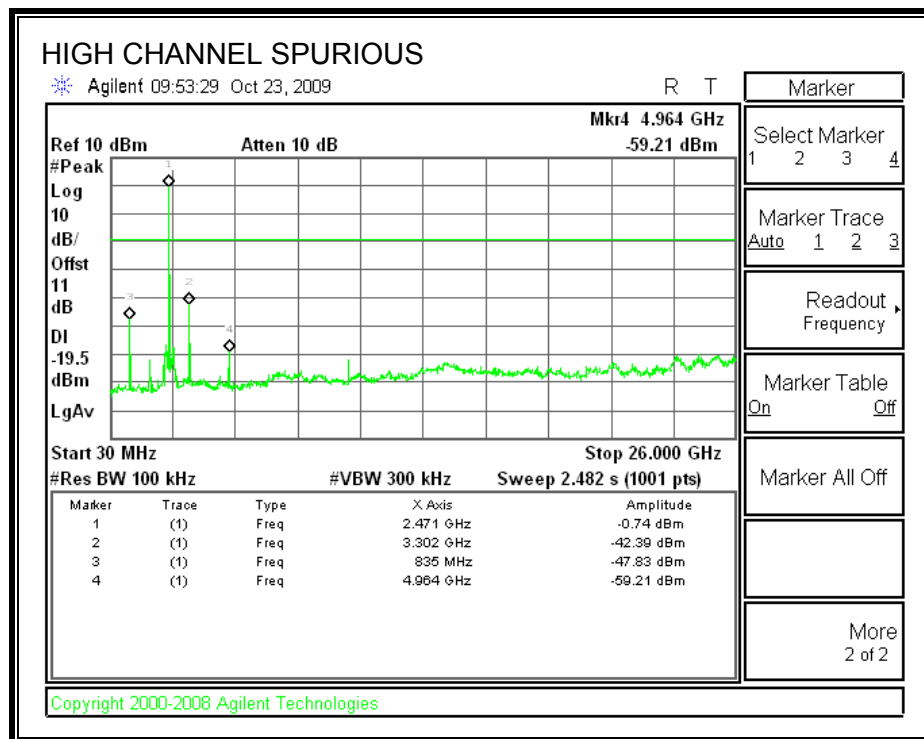
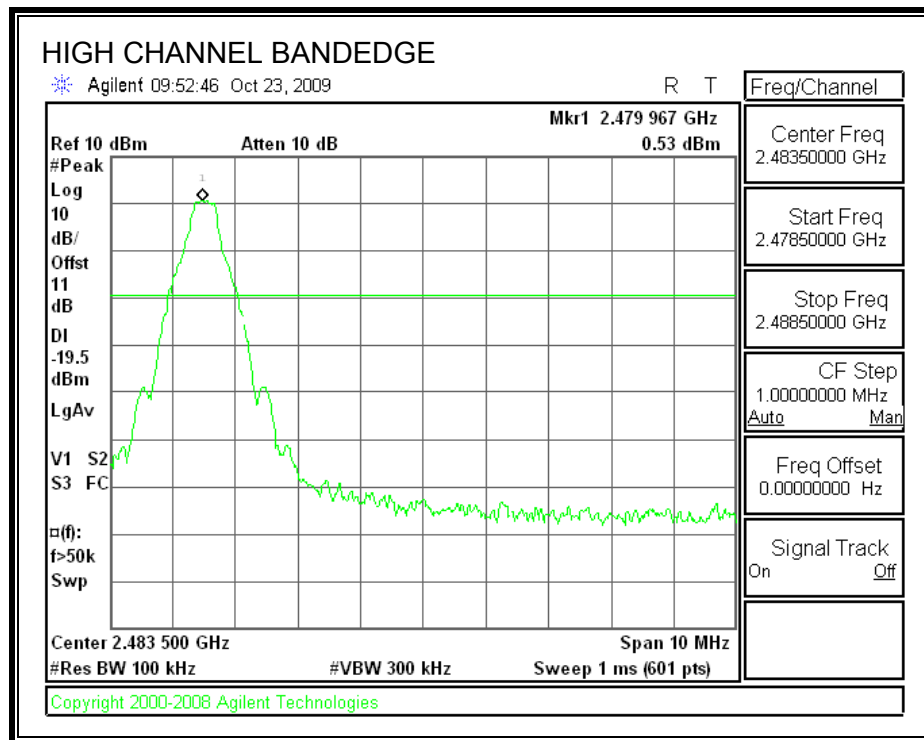
## SPURIOUS EMISSIONS, LOW CHANNEL



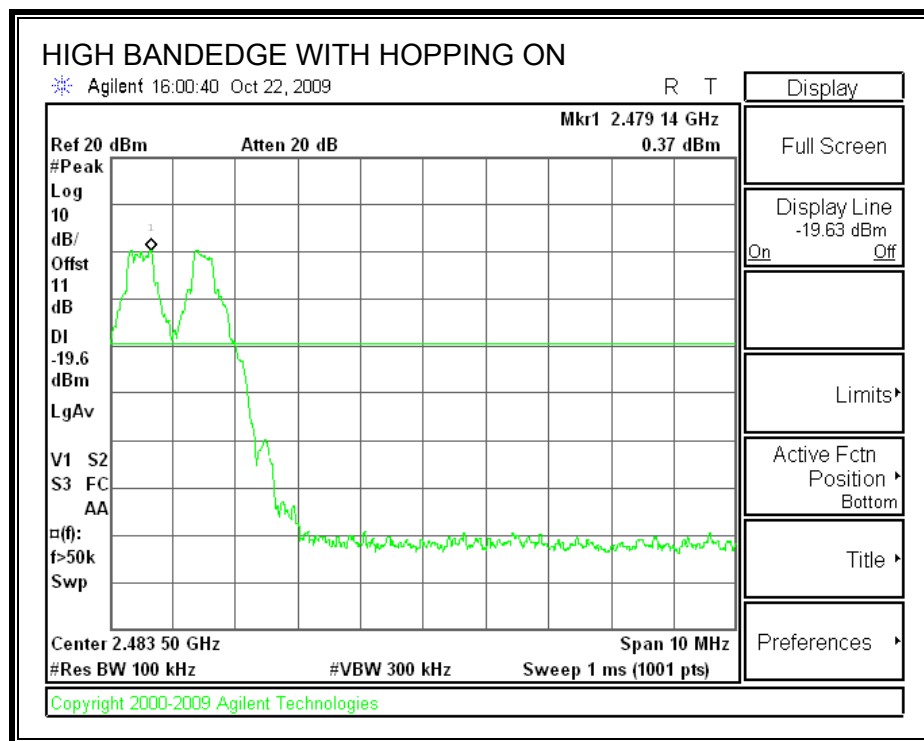
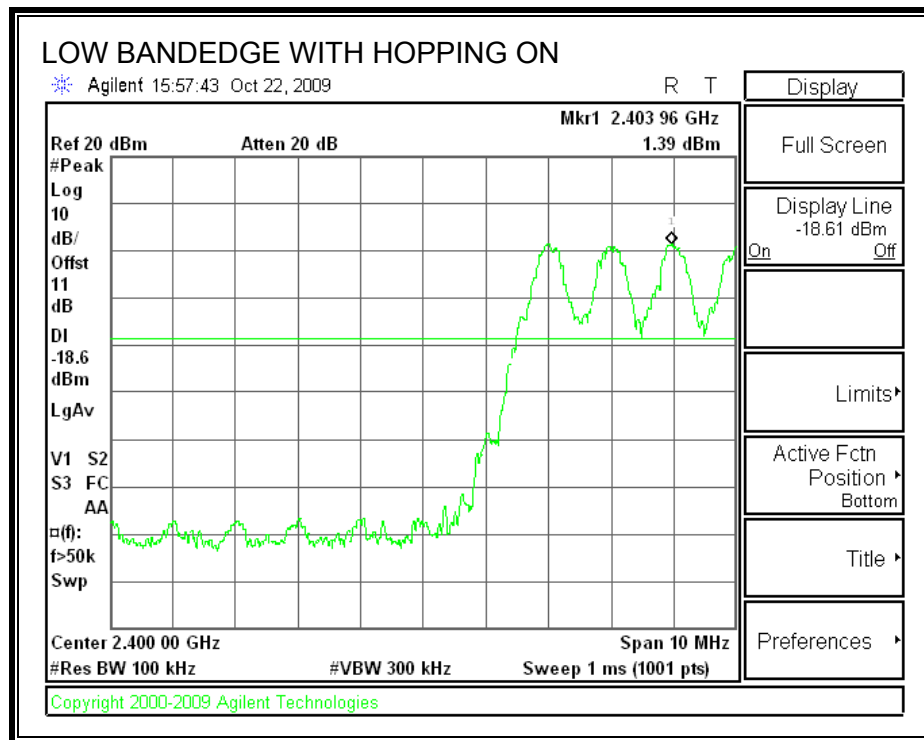
## SPURIOUS EMISSIONS, MID CHANNEL



## SPURIOUS EMISSIONS, HIGH CHANNEL



# SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



## 7.2. ENHANCED DATA RATE 8PSK MODULATION

### 7.2.1. 99% BANDWIDTH

#### LIMIT

None; for reporting purposes only.

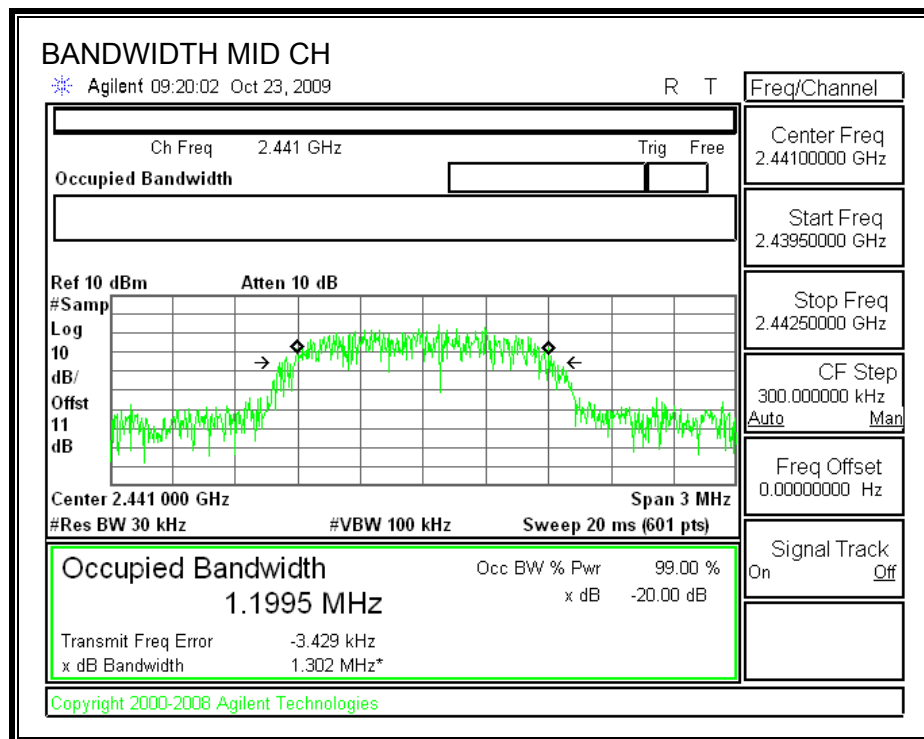
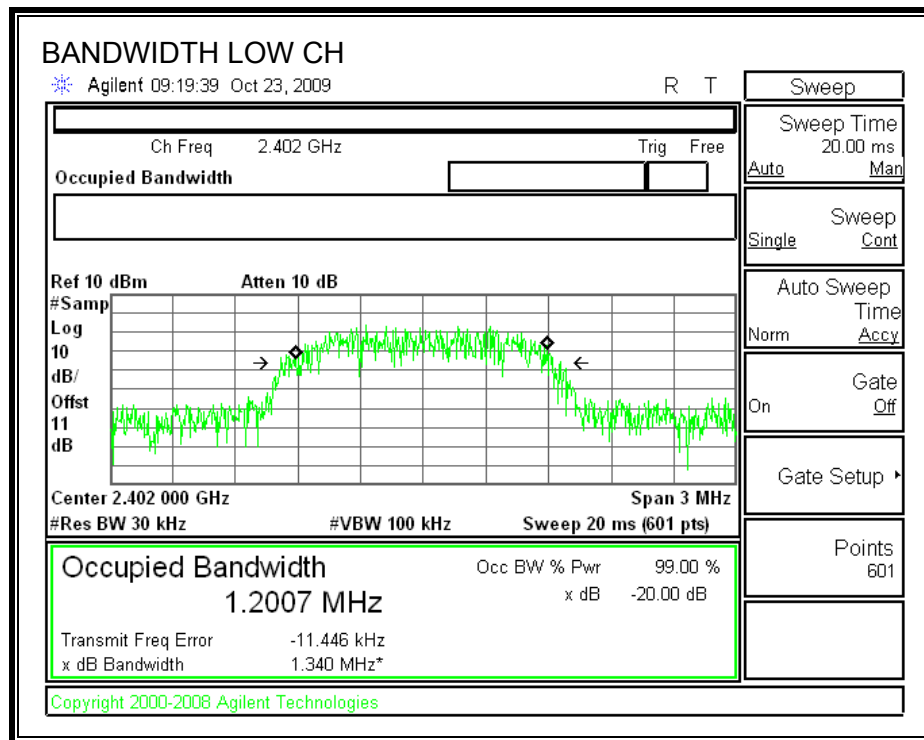
#### TEST PROCEDURE

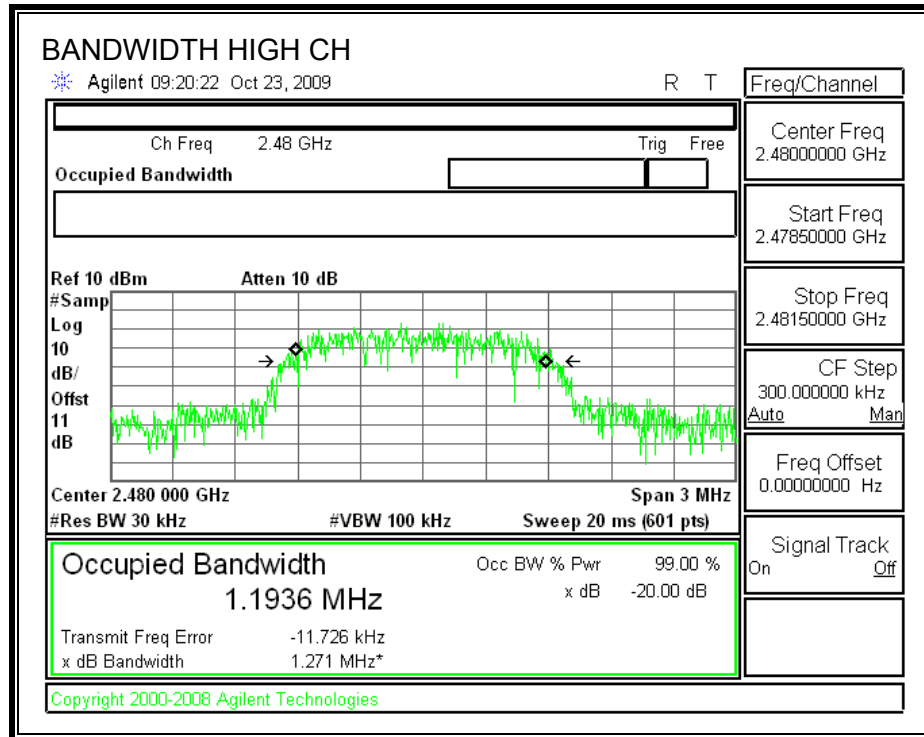
The transmitter output is connected to a spectrum analyzer. The RBW is set to  $\geq 1\%$  of the 99% bandwidth. The VBW is set to  $\geq$  RBW. The sweep time is coupled.

#### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.2007
Middle	2441	1.1995
High	2480	1.1936

## 99% BANDWIDTH





## 7.2.2. 20dB BANDWIDTH

### LIMIT

None; for reporting purposes only.

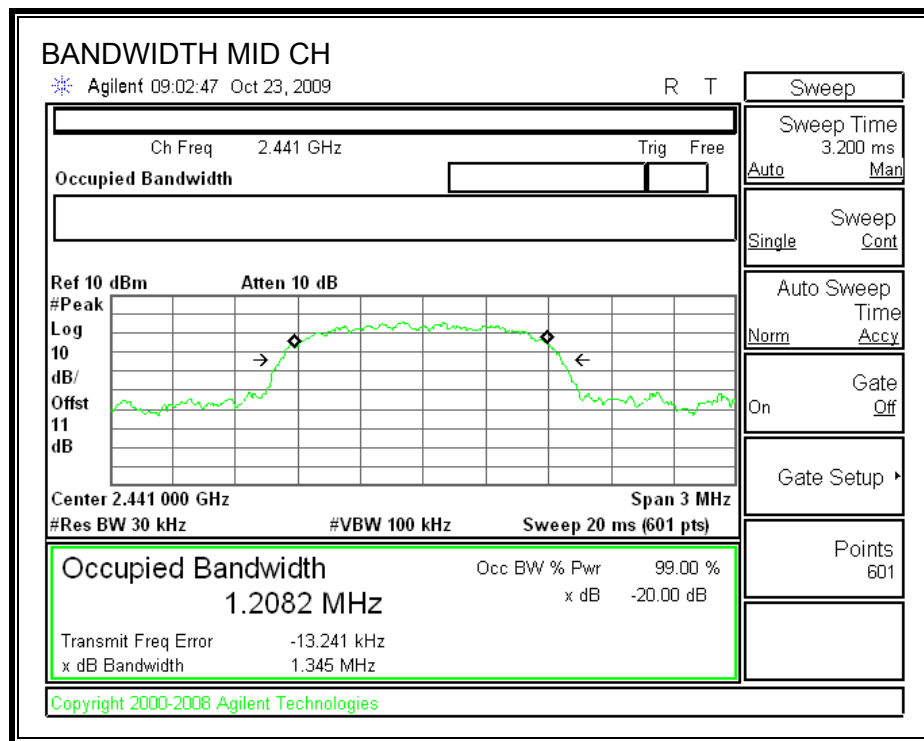
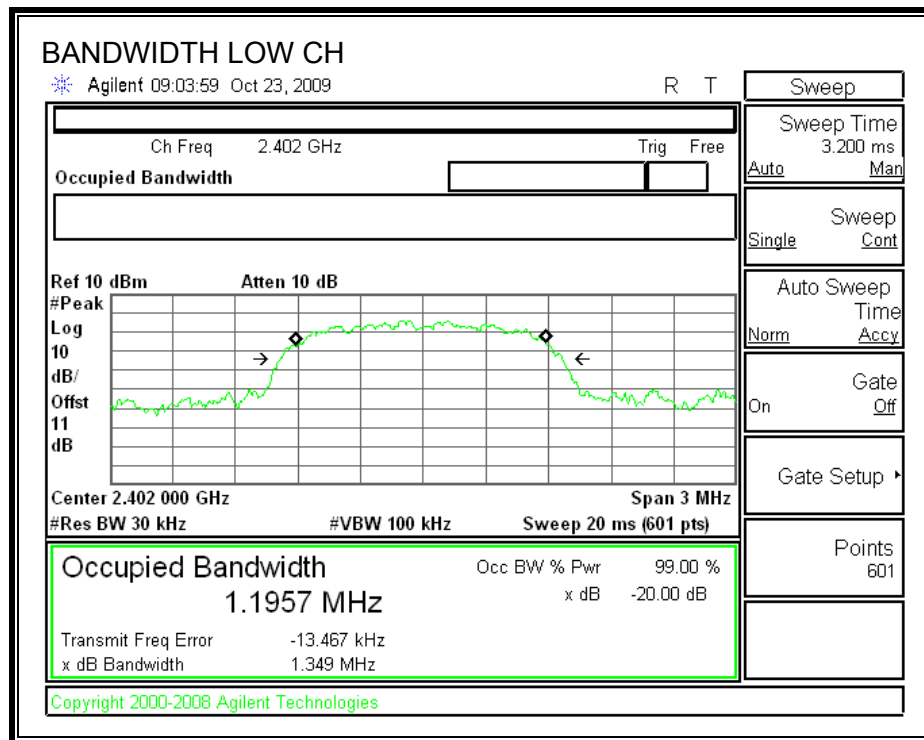
### TEST PROCEDURE

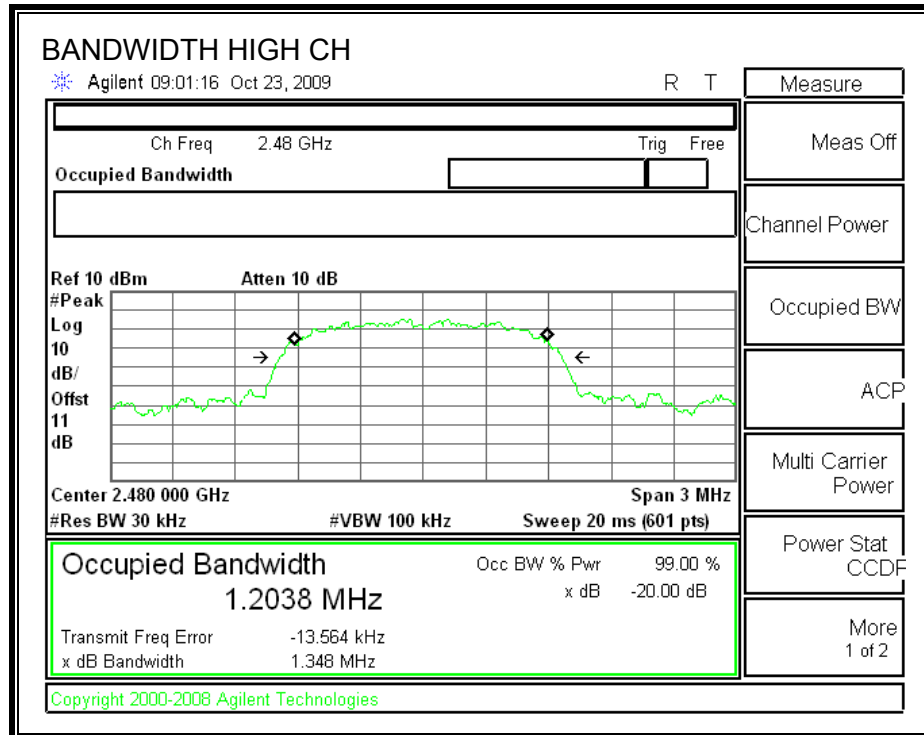
The transmitter output is connected to a spectrum analyzer. The RBW is set to  $\geq 1\%$  of the 20dB bandwidth. The VBW is set to  $\geq$  RBW. The sweep time is coupled.

### RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	2402	1.349
Middle	2441	1.345
High	2480	1.348

## 20 dB BANDWIDTH





### 7.2.3. HOPPING FREQUENCY SEPARATION

#### LIMIT

FCC §15.247 (a) (1)

IC RSS-210 A8.1 (b)

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

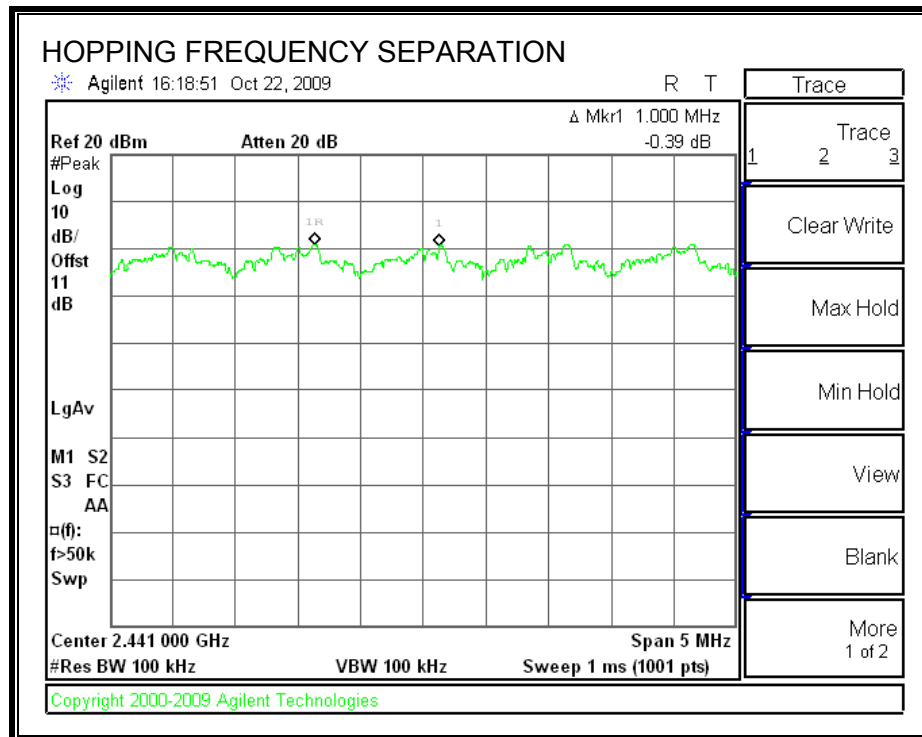
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

#### TEST PROCEDURE

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

#### RESULTS

##### HOPPING FREQUENCY SEPARATION



## **7.2.4. NUMBER OF HOPPING CHANNELS**

### **LIMIT**

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

Frequency hopping systems in the 2400 – 2483.5 MHz band shall use at least 15 non-overlapping channels.

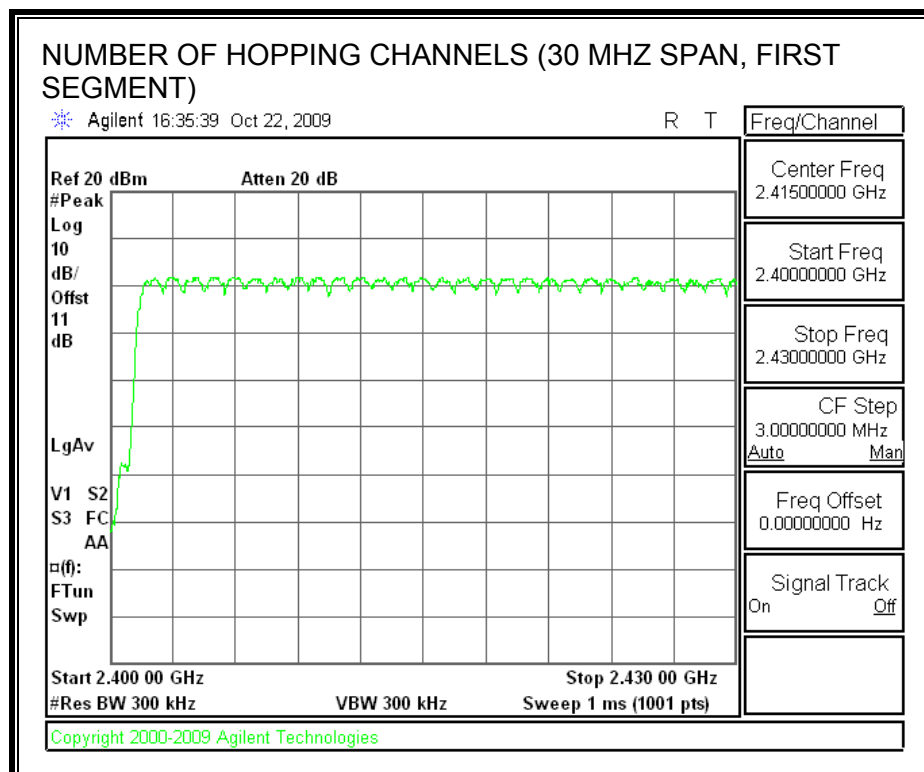
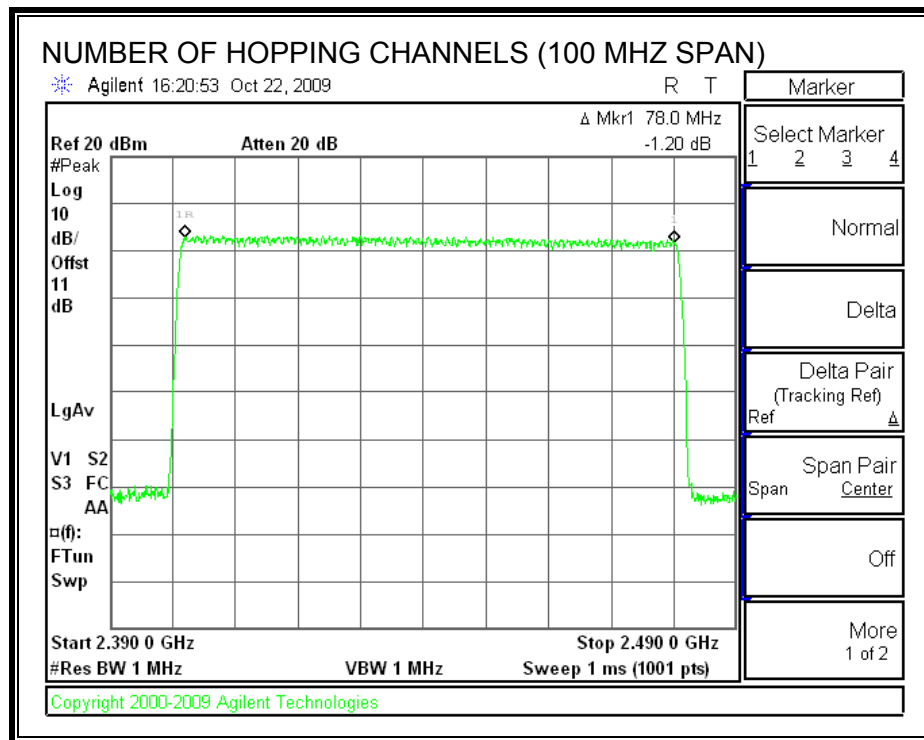
### **TEST PROCEDURE**

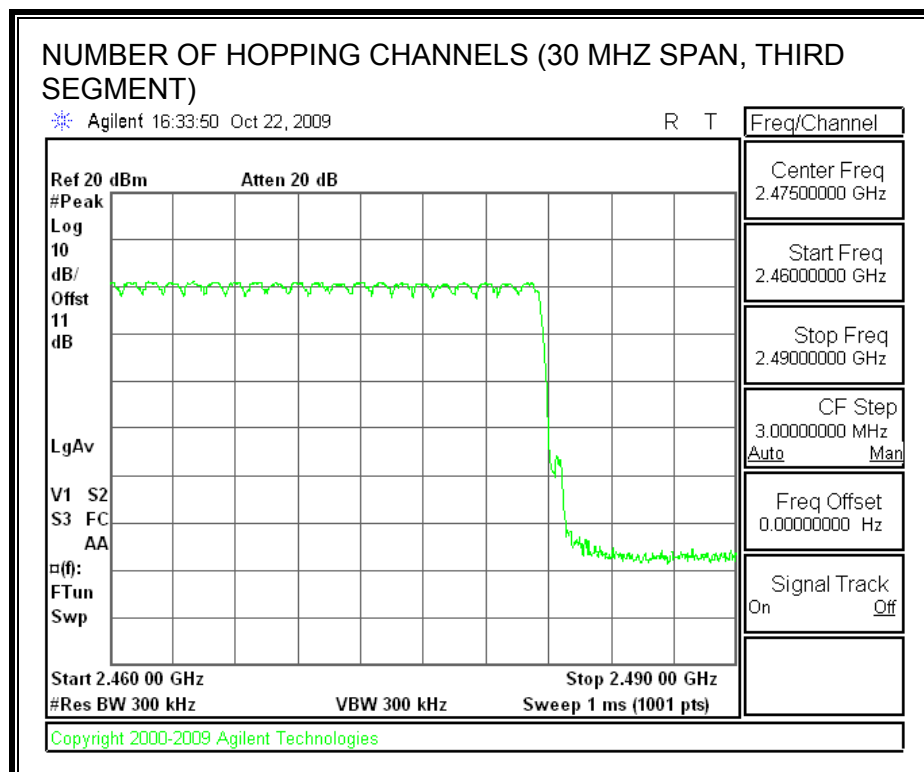
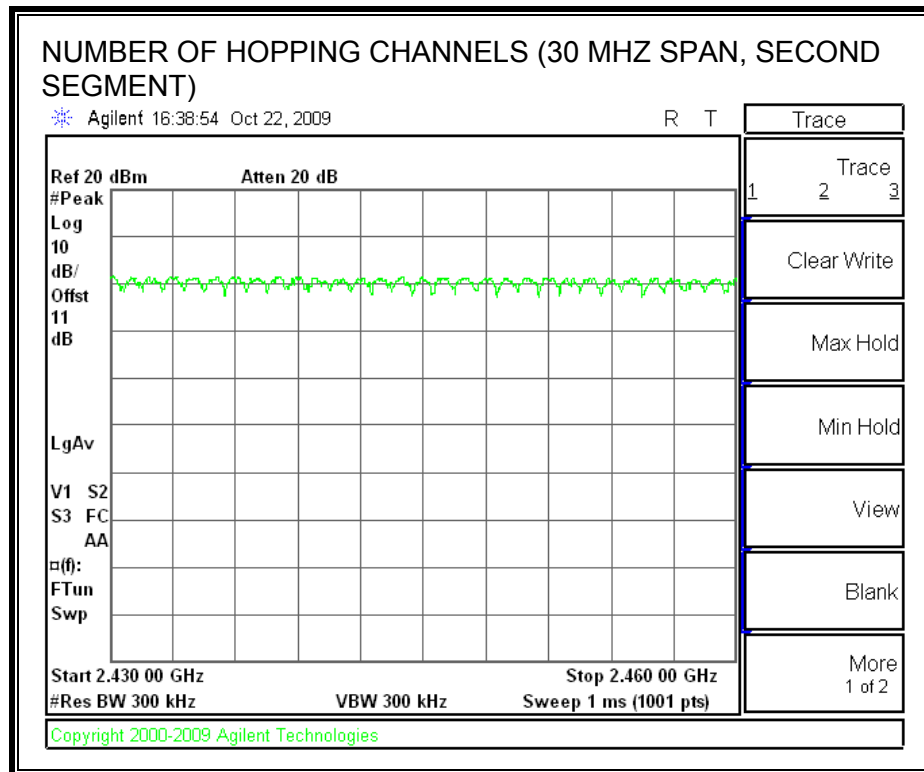
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

### **RESULTS**

79 Channels observed.

## NUMBER OF HOPPING CHANNELS





## 7.2.5. AVERAGE TIME OF OCCUPANCY

### LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

### TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 31.6 second period (79 channels \* 0.4 s) is equal to  $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$ .

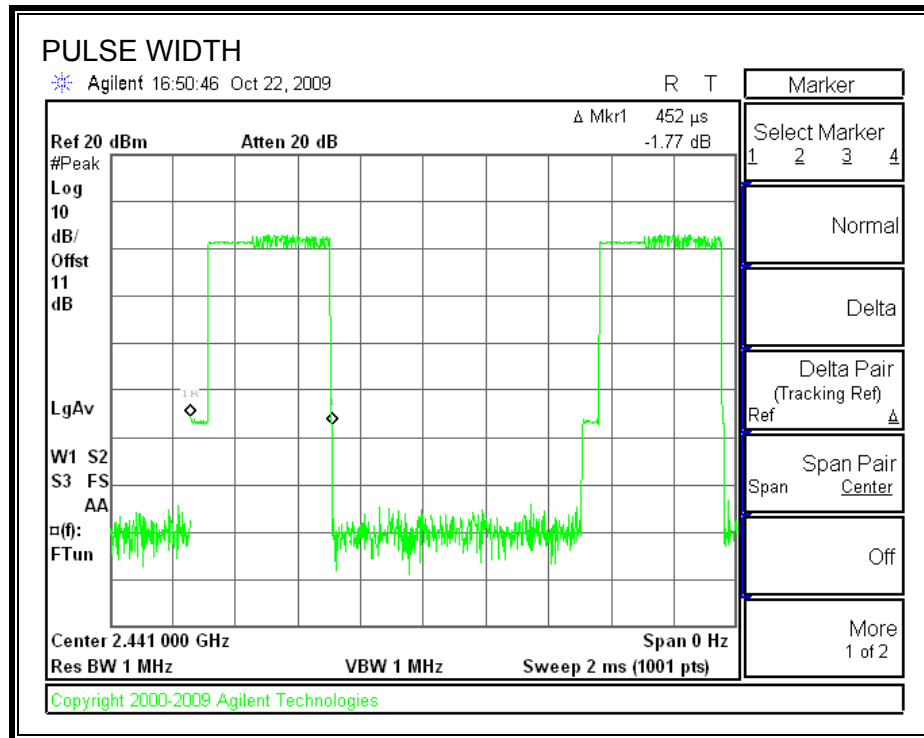
### RESULTS

#### 8PSK Mode

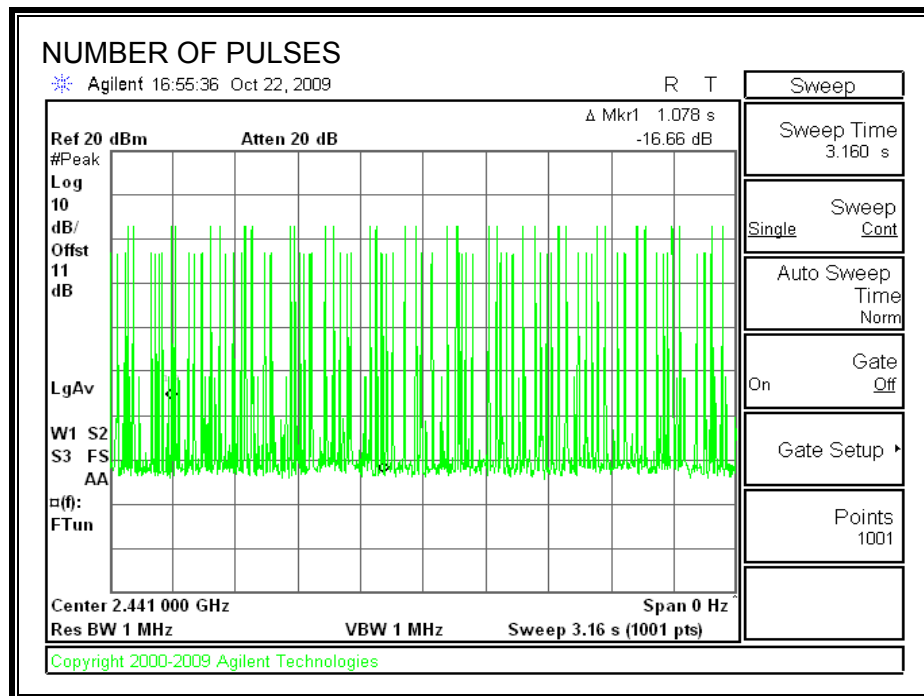
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
DH1	0.452	34	0.154	0.4	0.246
DH3	1.705	18	0.307	0.4	0.093
DH5	2.955	11	0.325	0.4	0.075

## DH1

### PULSE WIDTH

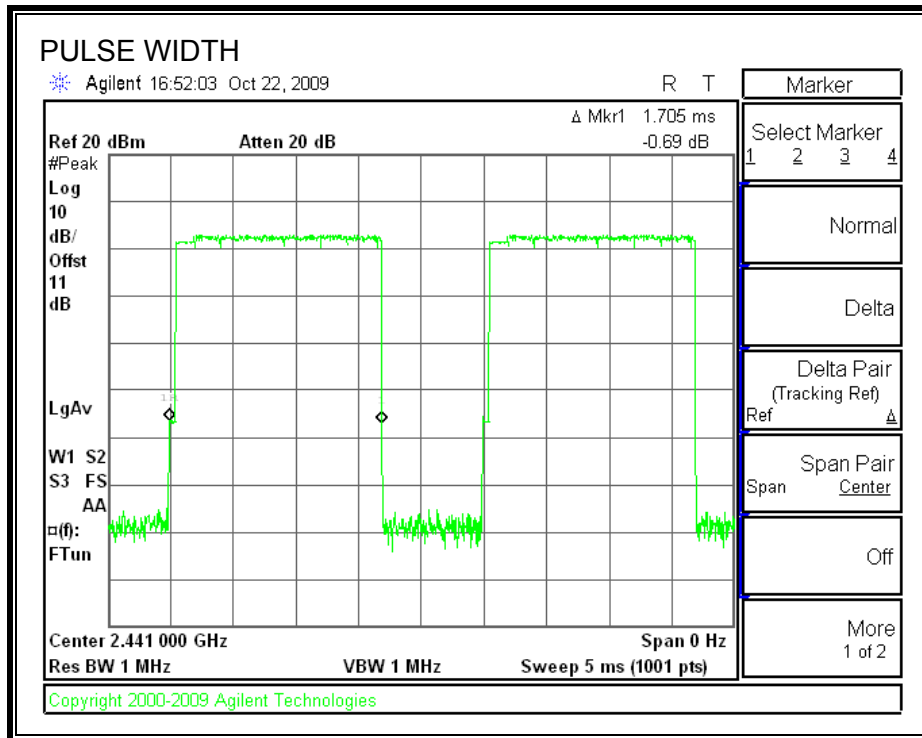


### NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD

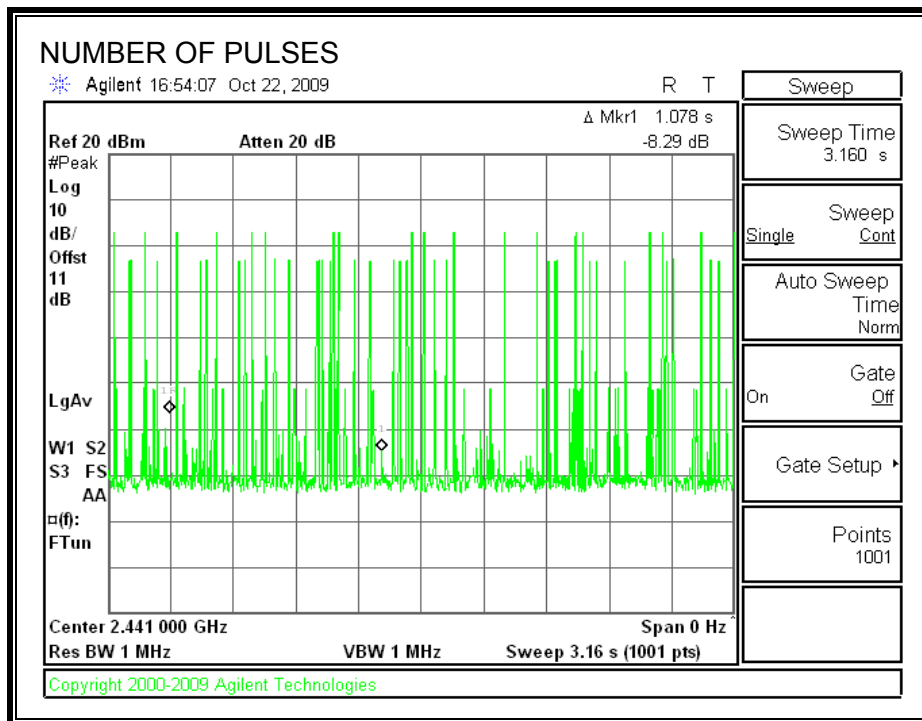


**DH3**

**PULSE WIDTH**

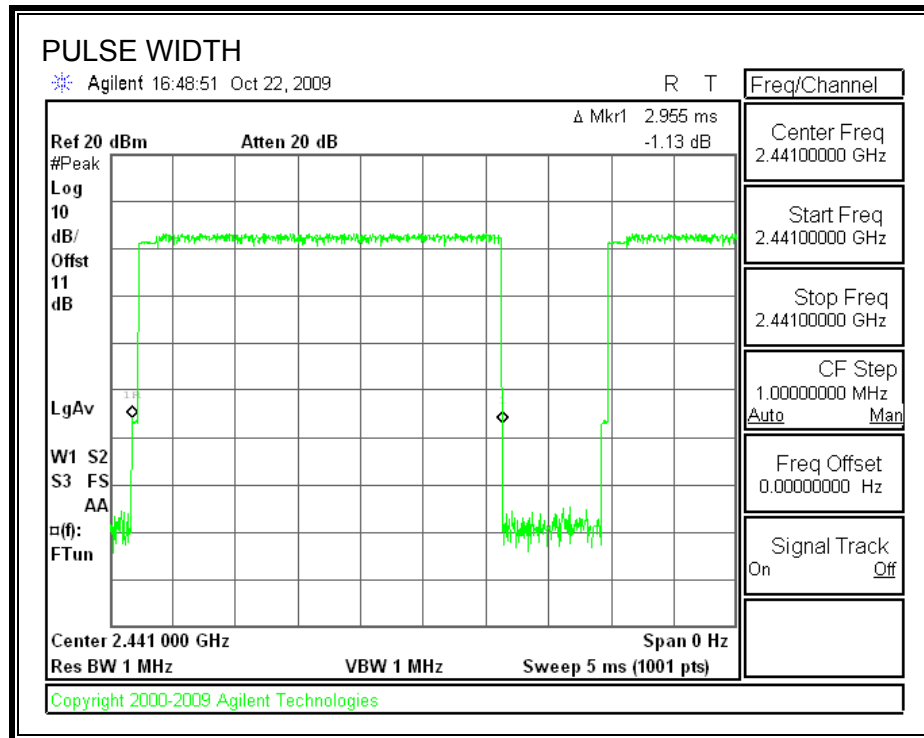


**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD**

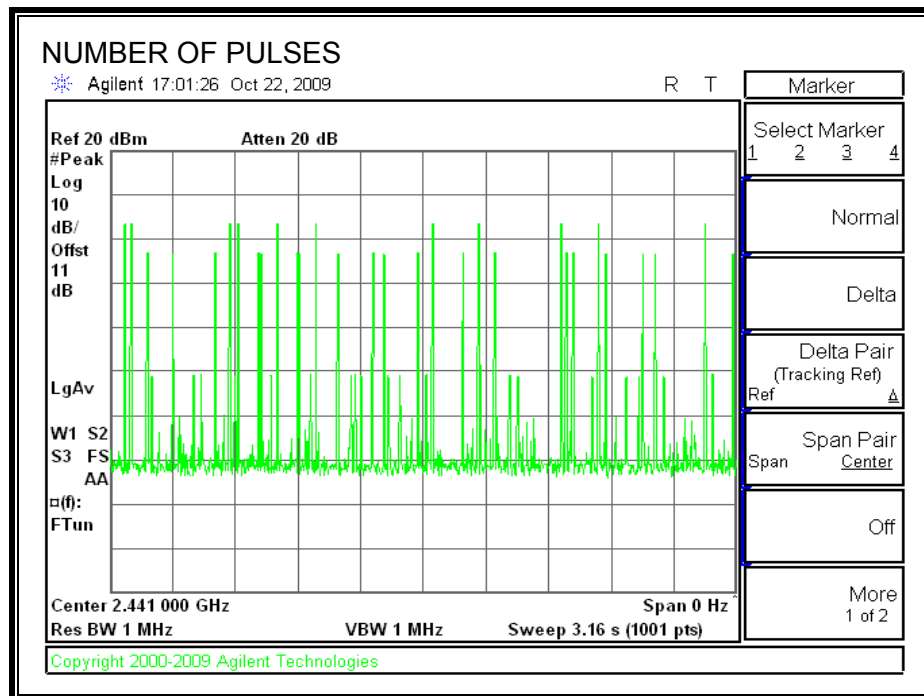


**DH5**

**PULSE WIDTH**



**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD**



## 7.2.6. OUTPUT POWER

### LIMIT

§15.247 (b) (1)

RSS-210 Issue 7 Clause A8.4

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm.

Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

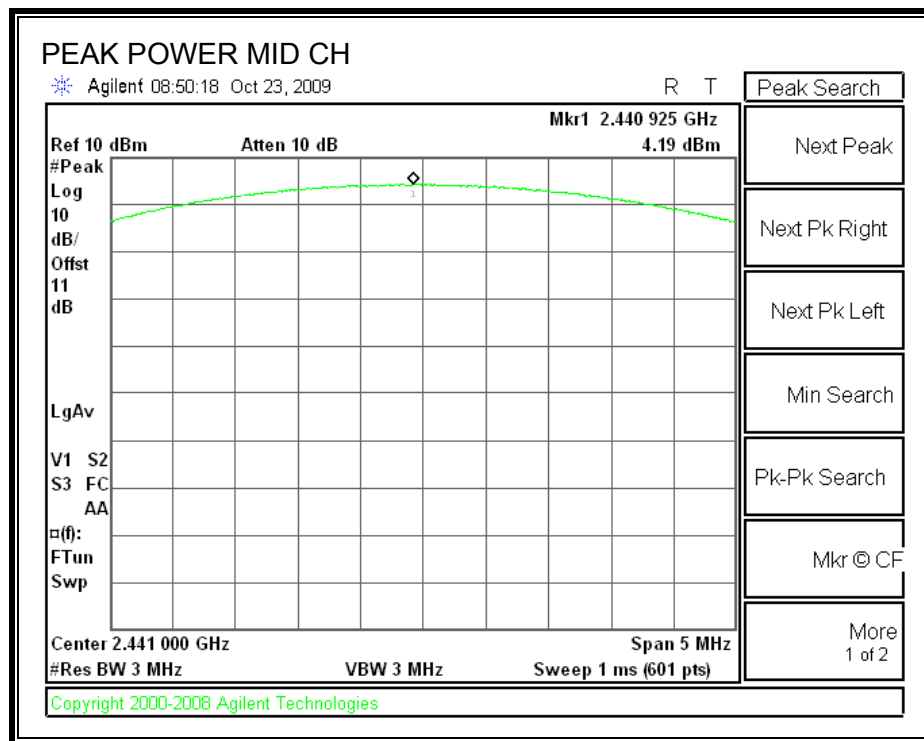
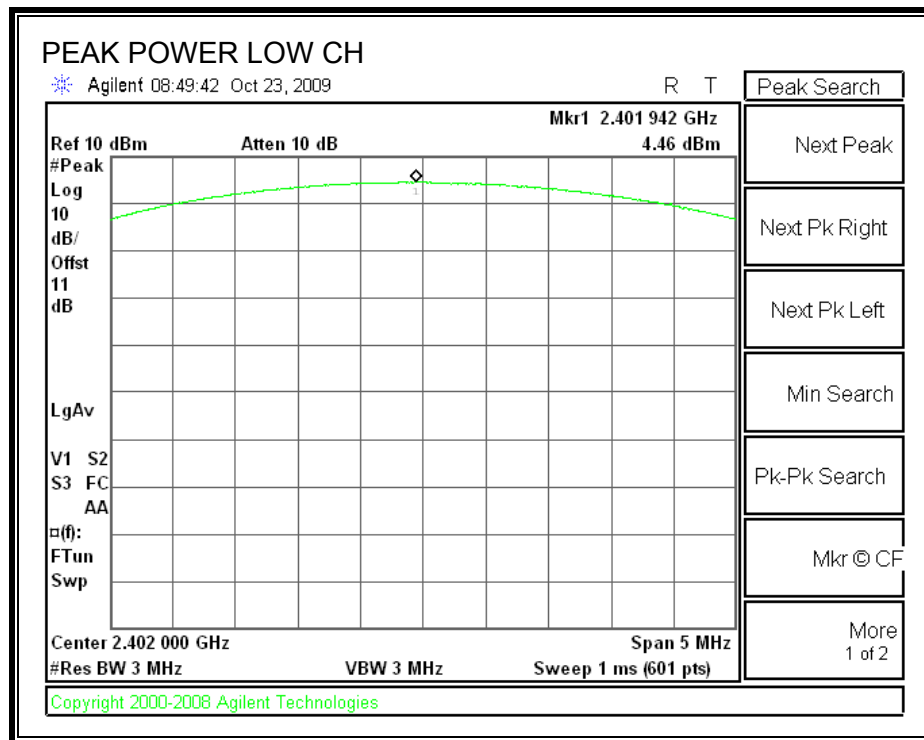
### TEST PROCEDURE

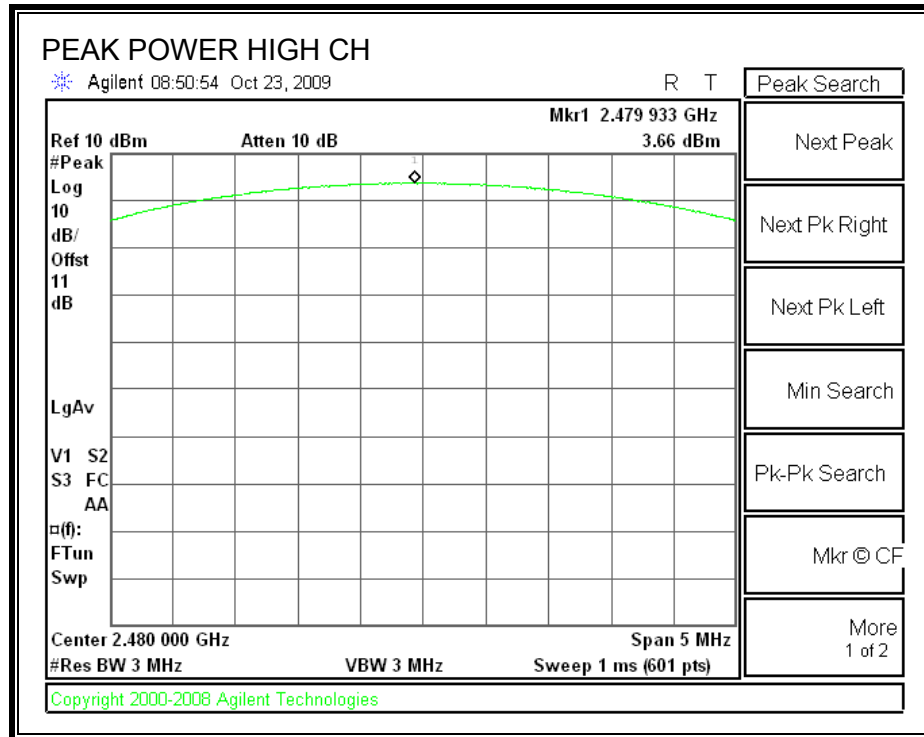
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

### RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	4.46	20.97	-16.51
Middle	2441	4.19	20.97	-16.78
High	2480	3.66	20.97	-17.31

## OUTPUT POWER





## **7.2.7. CONDUCTED SPURIOUS EMISSIONS**

### **LIMITS**

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

### **TEST PROCEDURE**

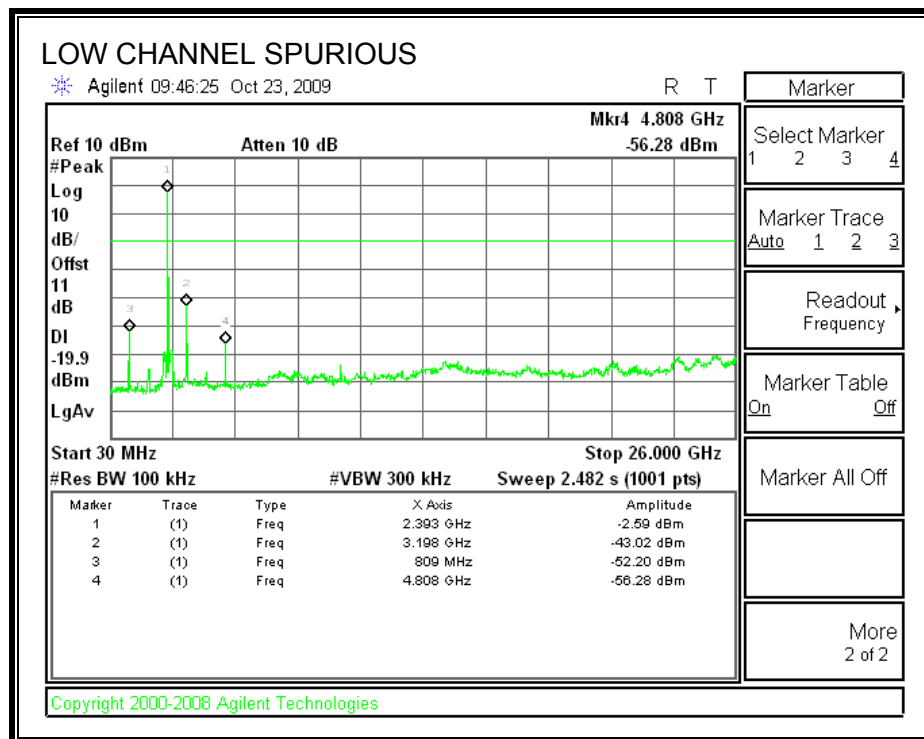
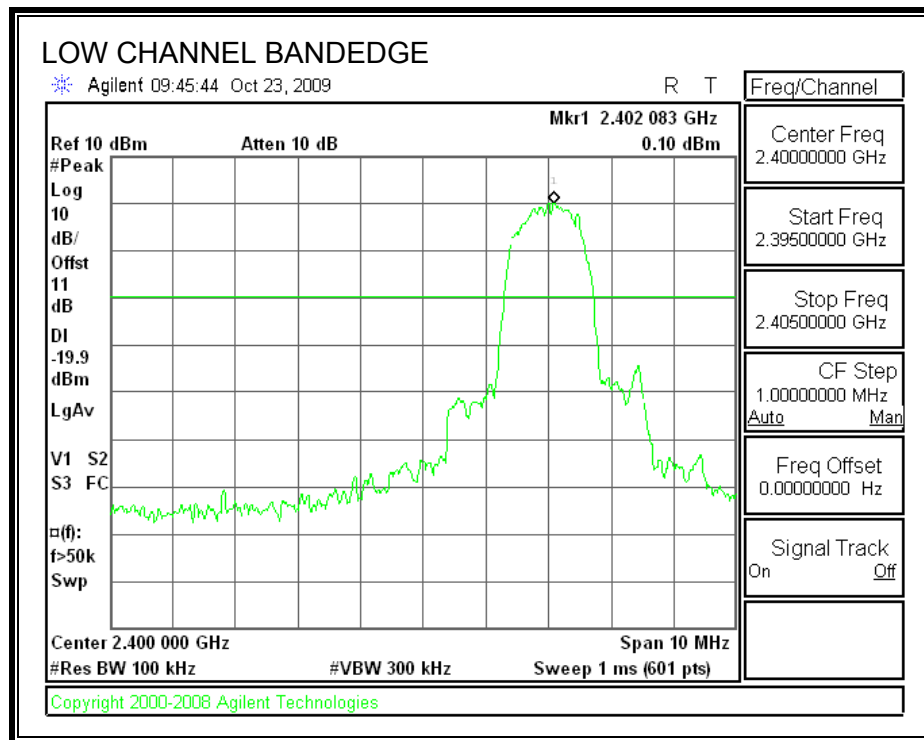
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

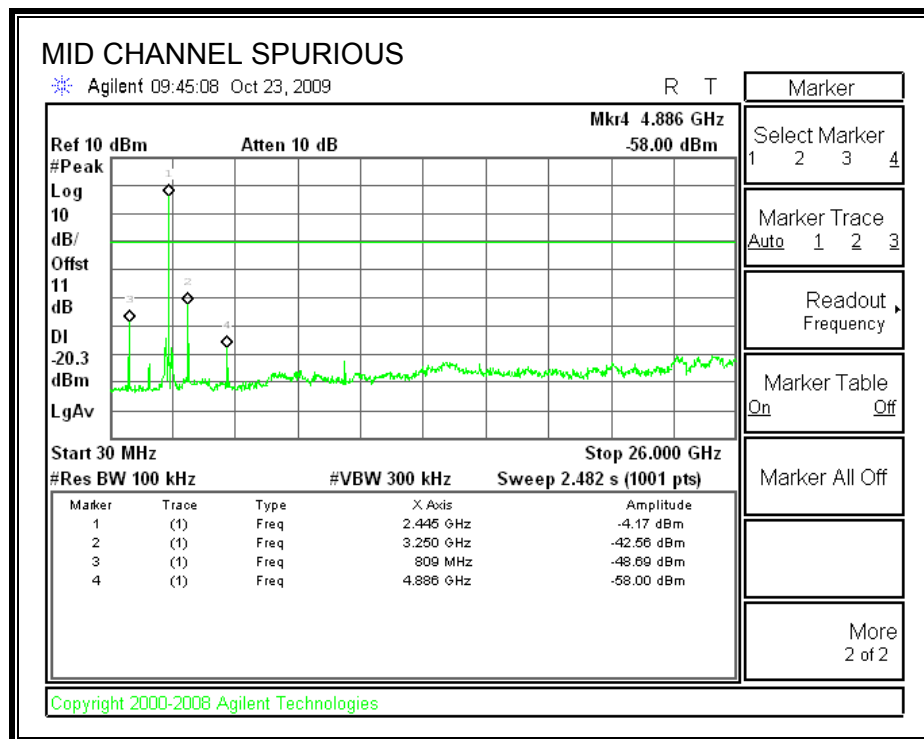
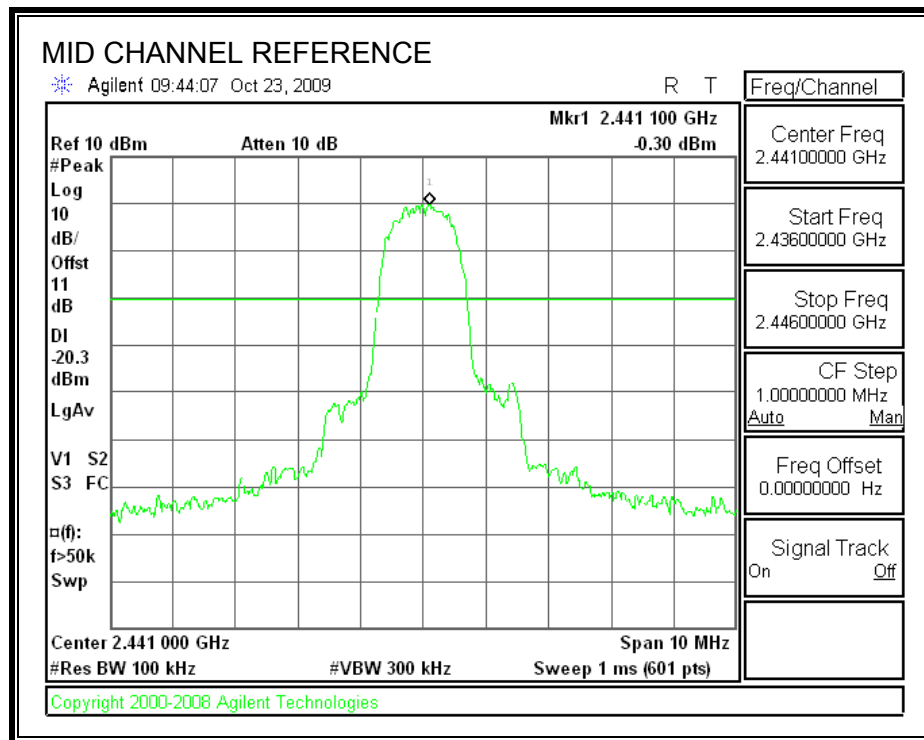
The band edges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

### **RESULTS**

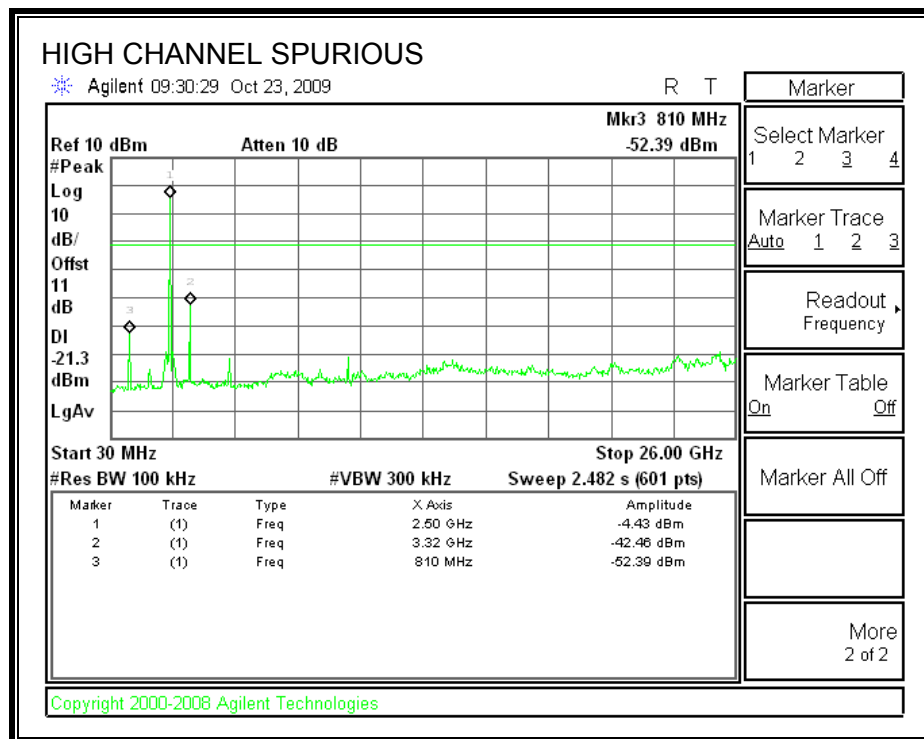
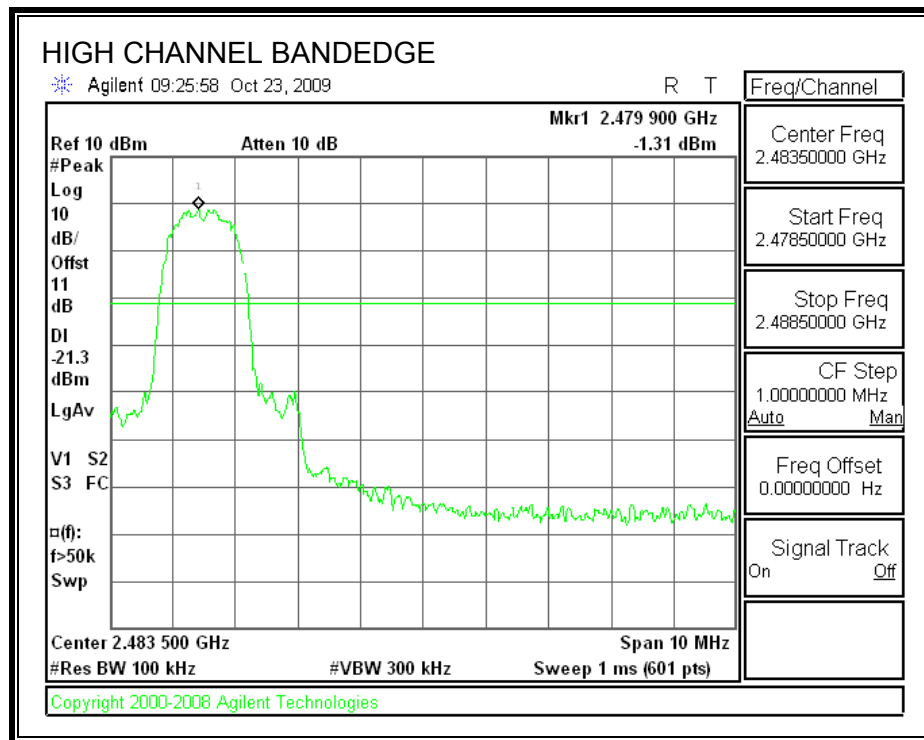
# **SPURIOUS EMISSIONS, LOW CHANNEL**



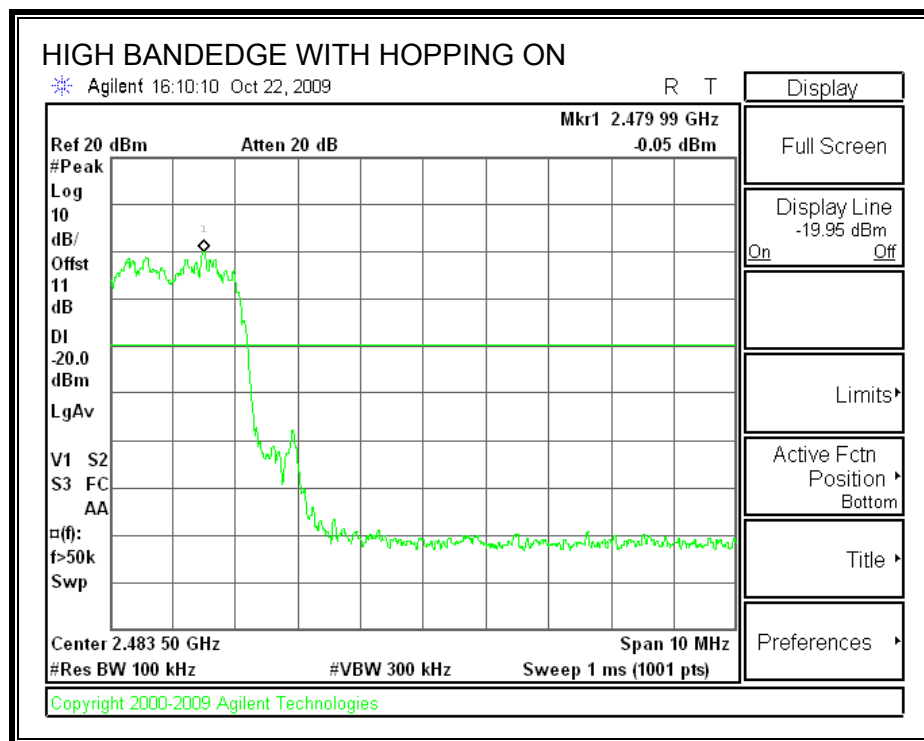
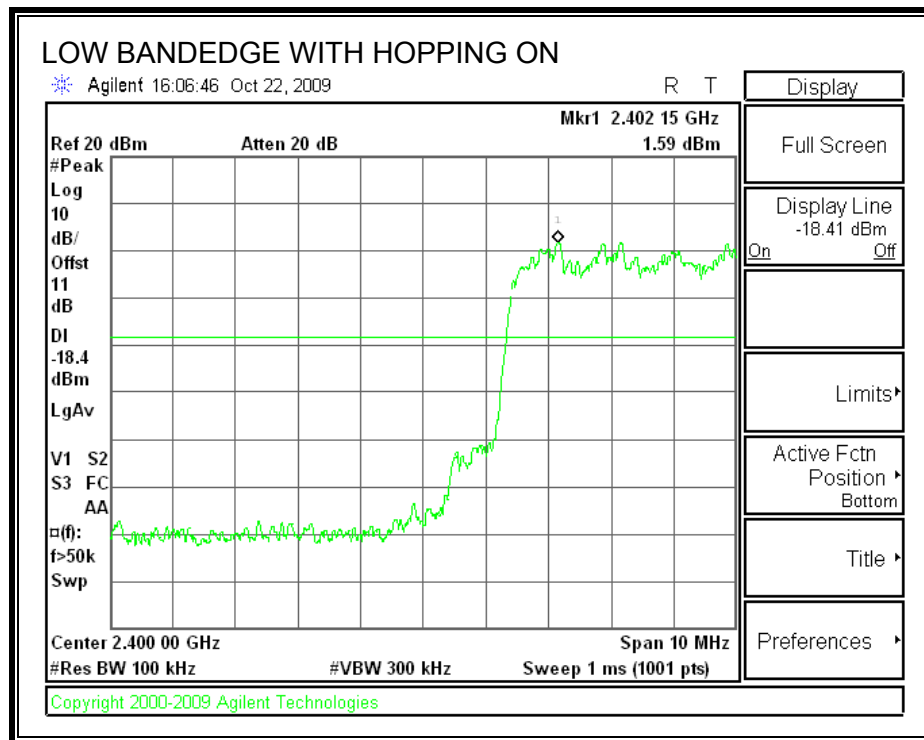
## SPURIOUS EMISSIONS, MID CHANNEL



## SPURIOUS EMISSIONS, HIGH CHANNEL



# SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



## 8. RADIATED TEST RESULTS

### 8.1. LIMITS AND PROCEDURE

#### LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

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

#### TEST PROCEDURE

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

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

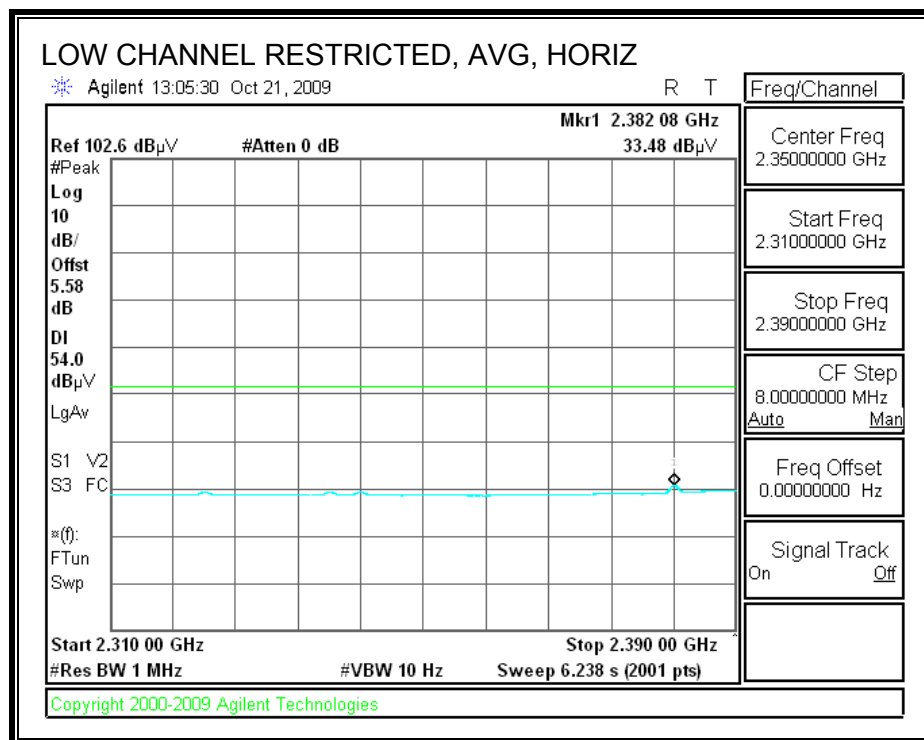
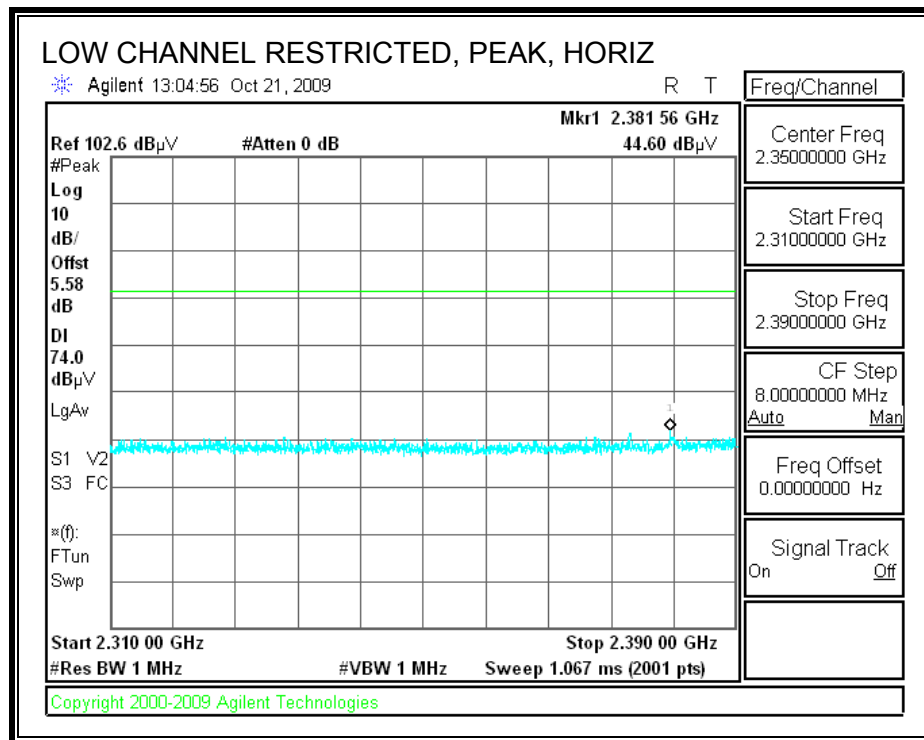
For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, and then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

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.

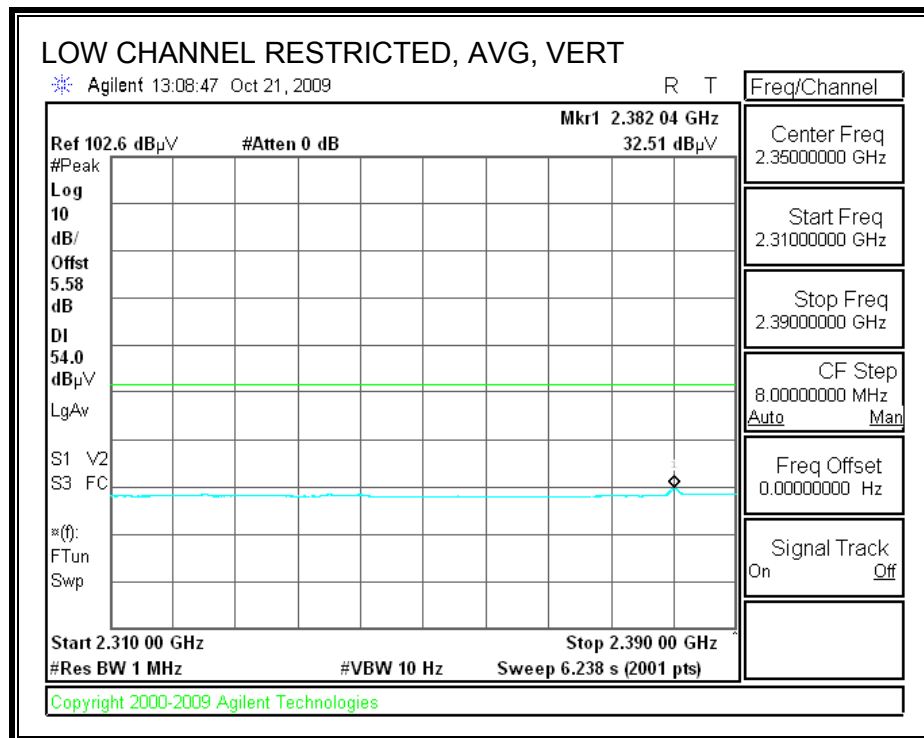
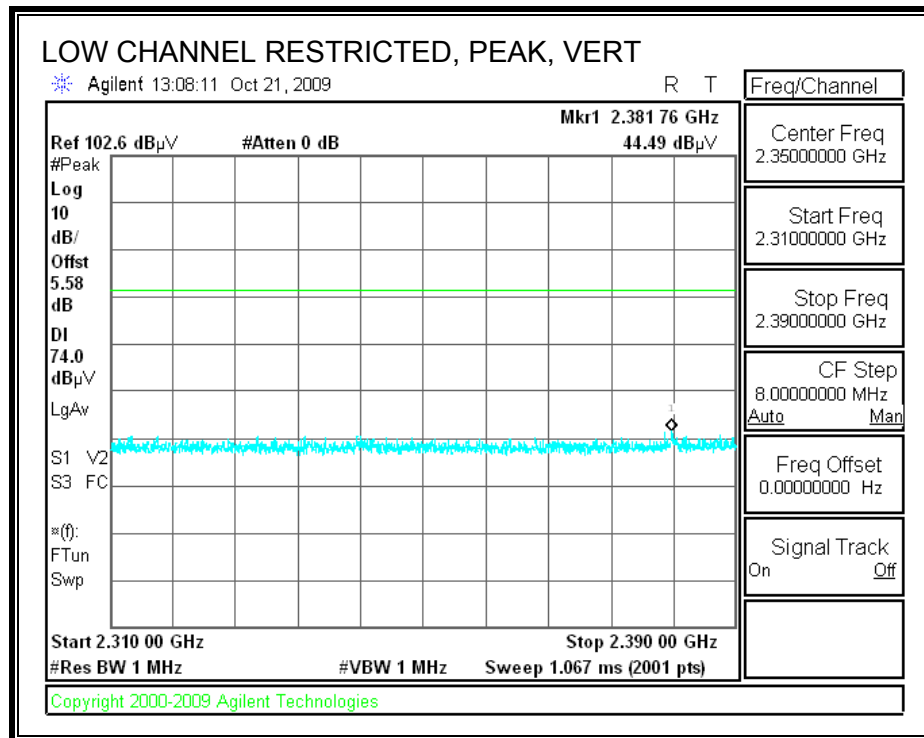
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

### 8.1.1. BASIC DATA RATE GFSK MODULATION

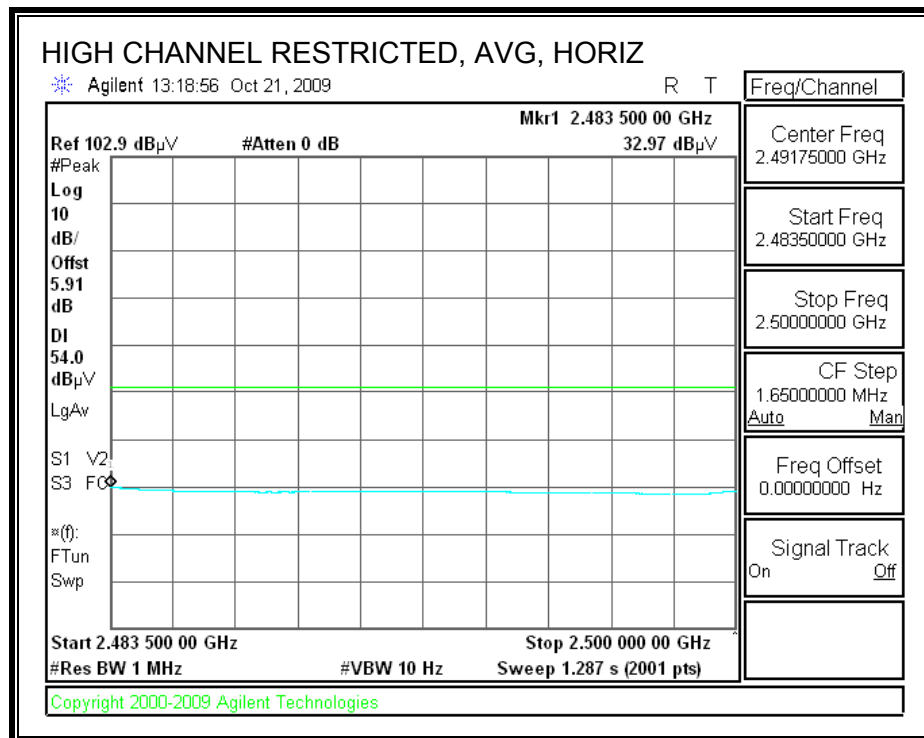
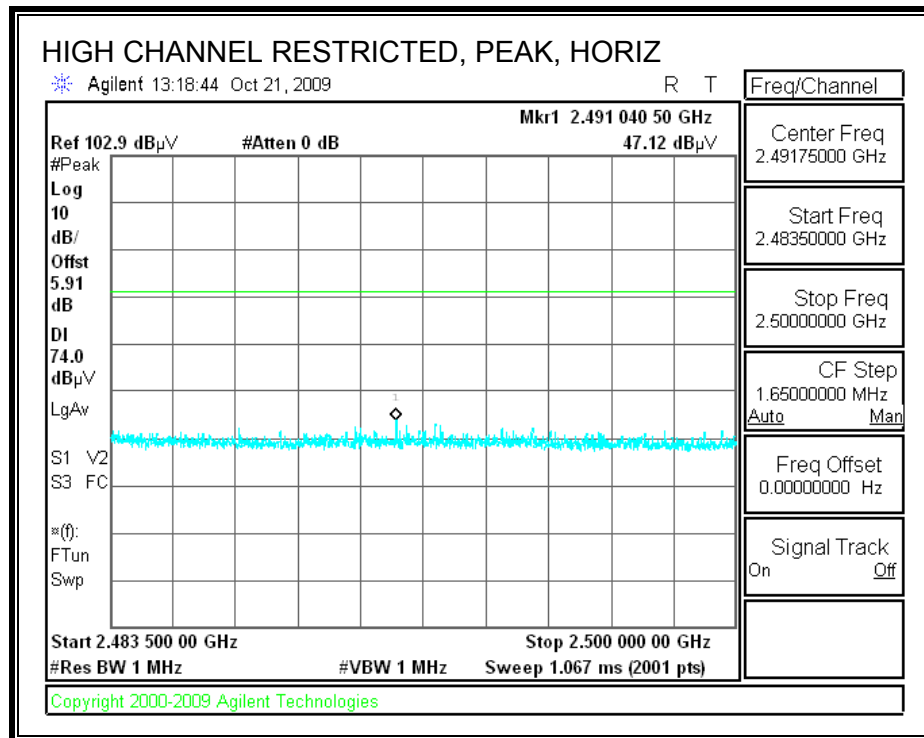
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



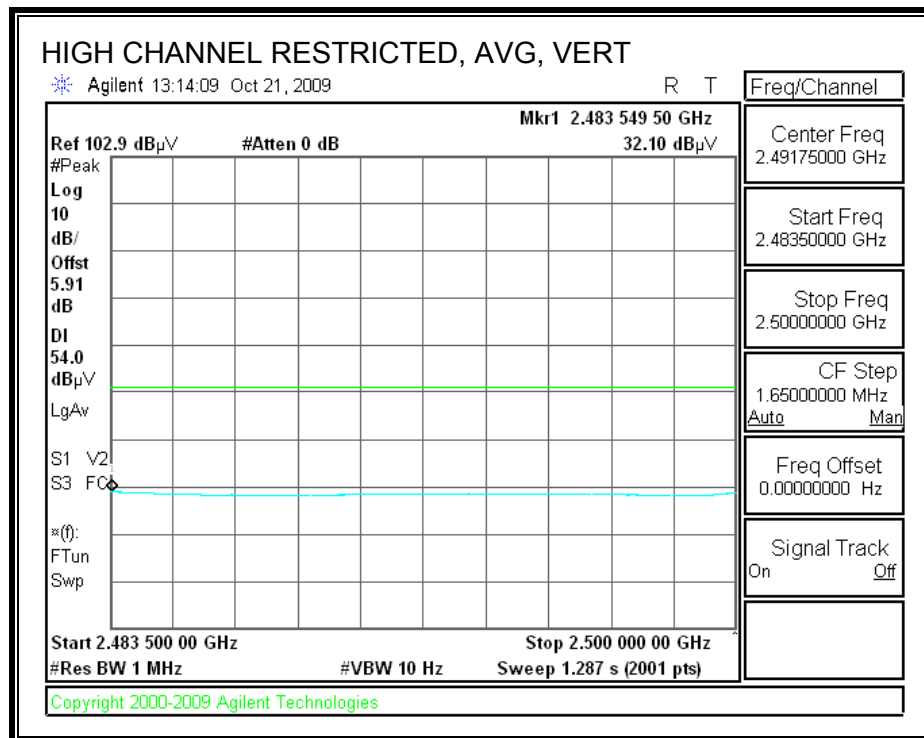
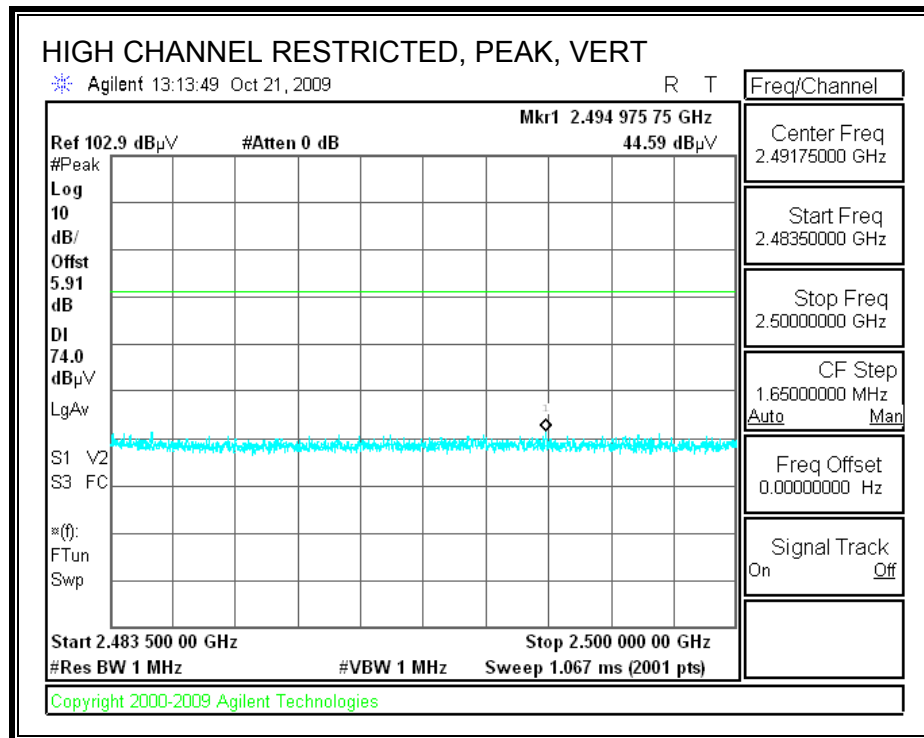
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**



**RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**



## HARMONICS AND SPURIOUS EMISSIONS

### High Frequency Measurement Compliance Certification Services, Fremont 3m Chamber

Test Engr: Vien Tran  
Date: 10/21/09  
Project #: 09U12871  
Company: Broadcom  
EUT Description: 802.g/Draft 802.11n WLAN + BT PCI-E MINICARD  
EUT M/N: BCM94343HMGB  
Test Target: FCC Class B  
Mode Oper: Tx GFSK Mode\_Harmonic

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

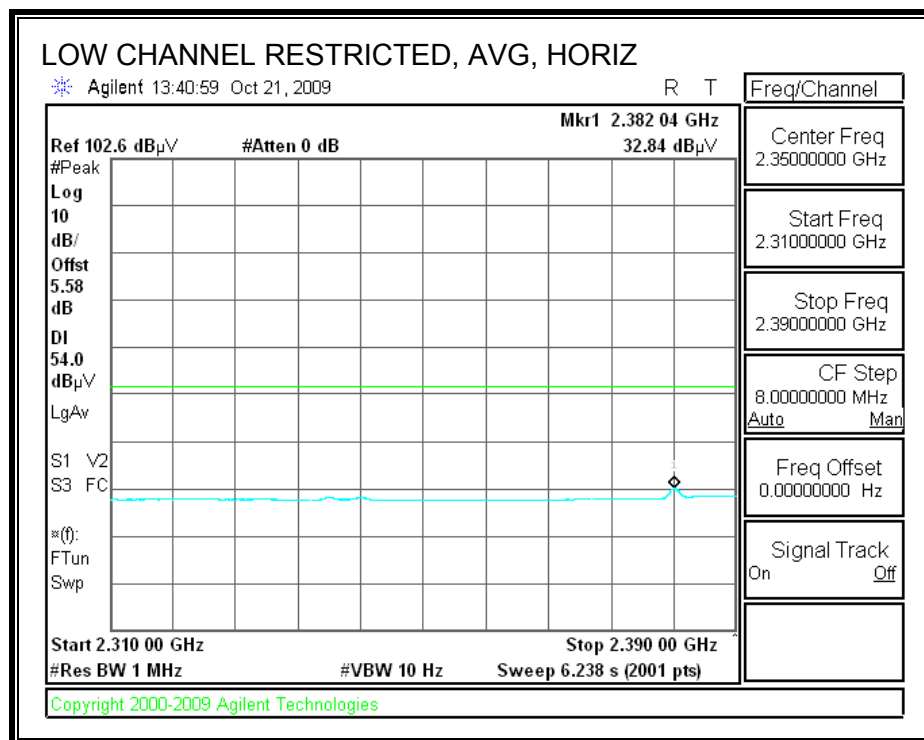
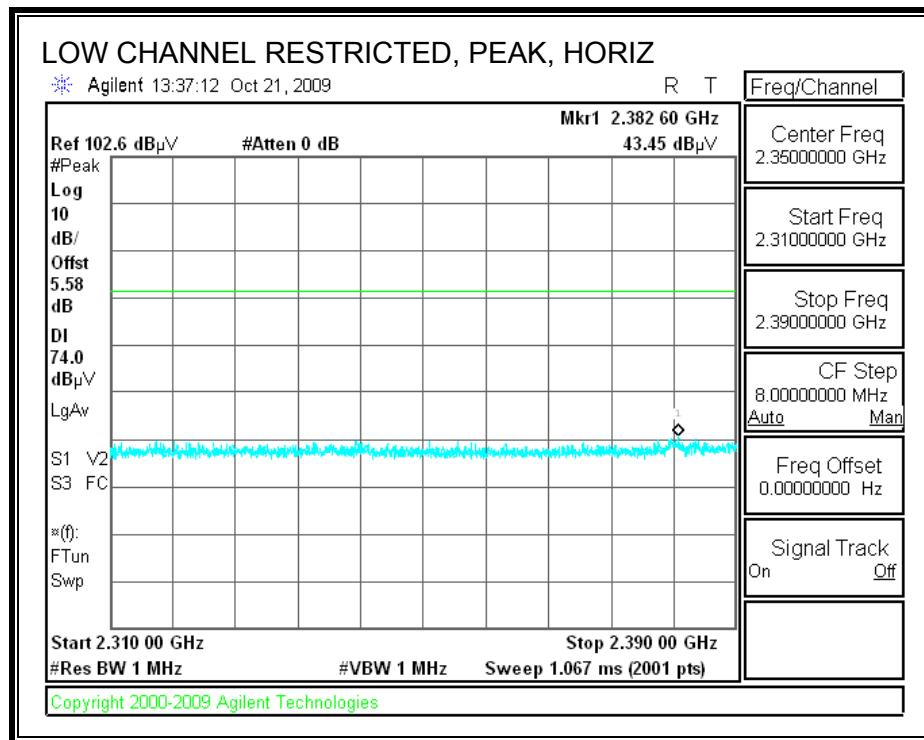
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fldr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol V/H	Det. P/A/QP	Ant.High cm	Table Angle Degree	Notes
<b>LOW CHANNEL, 2402MHz</b>															
4.804	3.0	39.5	32.7	5.8	-34.8	0.0	0.0	43.1	74.0	-30.9	V	P	100.0	112.0	
4.804	3.0	34.8	32.7	5.8	-34.8	0.0	0.0	38.4	54.0	-15.6	V	A	100.0	112.0	
4.804	3.0	38.9	32.7	5.8	-34.8	0.0	0.0	42.5	74.0	-31.5	H	P	99.0	108.0	
4.804	3.0	34.8	32.7	5.8	-34.8	0.0	0.0	38.4	54.0	-15.6	H	A	99.0	108.0	
<b>MID CHANNEL, 2441MHz</b>															
4.882	3.0	37.5	32.7	5.8	-34.8	0.0	0.0	41.2	74.0	-32.8	V	P	100.0	230.0	
4.882	3.0	32.2	32.7	5.8	-34.8	0.0	0.0	35.9	54.0	-18.1	V	A	100.0	230.0	
7.323	3.0	34.0	35.5	7.3	-34.1	0.0	0.0	42.7	74.0	-31.3	V	P	100.0	33.0	
7.323	3.0	20.6	35.5	7.3	-34.1	0.0	0.0	29.3	54.0	-24.7	V	A	100.0	33.0	
4.882	3.0	35.8	32.7	5.8	-34.8	0.0	0.0	39.6	74.0	-34.4	H	P	100.0	120.0	
4.882	3.0	29.5	32.7	5.8	-34.8	0.0	0.0	33.2	54.0	-20.8	H	A	100.0	120.0	
7.323	3.0	33.6	35.5	7.3	-34.1	0.0	0.0	42.3	74.0	-31.7	H	P	151.0	238.0	
7.323	3.0	20.7	35.5	7.3	-34.1	0.0	0.0	29.3	54.0	-24.7	H	A	151.0	238.0	
<b>HIGH CHANNEL, 2480MHz</b>															
4.960	3.0	35.9	32.8	5.9	-34.8	0.0	0.0	39.7	74.0	-34.3	V	P	132.0	231.0	
4.960	3.0	30.2	32.8	5.9	-34.8	0.0	0.0	34.0	54.0	-20.0	V	A	132.0	231.0	
7.440	3.0	32.7	35.6	7.3	-34.1	0.0	0.0	41.6	74.0	-32.4	V	P	142.0	33.0	
7.440	3.0	20.4	35.6	7.3	-34.1	0.0	0.0	29.3	54.0	-24.7	V	A	142.0	33.0	
4.960	3.0	35.1	32.8	5.9	-34.8	0.0	0.0	39.0	74.0	-35.0	H	P	100.0	240.0	
4.960	3.0	27.8	32.8	5.9	-34.8	0.0	0.0	31.7	54.0	-22.3	H	A	100.0	240.0	
7.440	3.0	32.8	35.6	7.3	-34.1	0.0	0.0	41.7	74.0	-32.3	H	P	99.0	239.0	
7.440	3.0	20.3	35.6	7.3	-34.1	0.0	0.0	29.2	54.0	-24.8	H	A	99.0	239.0	

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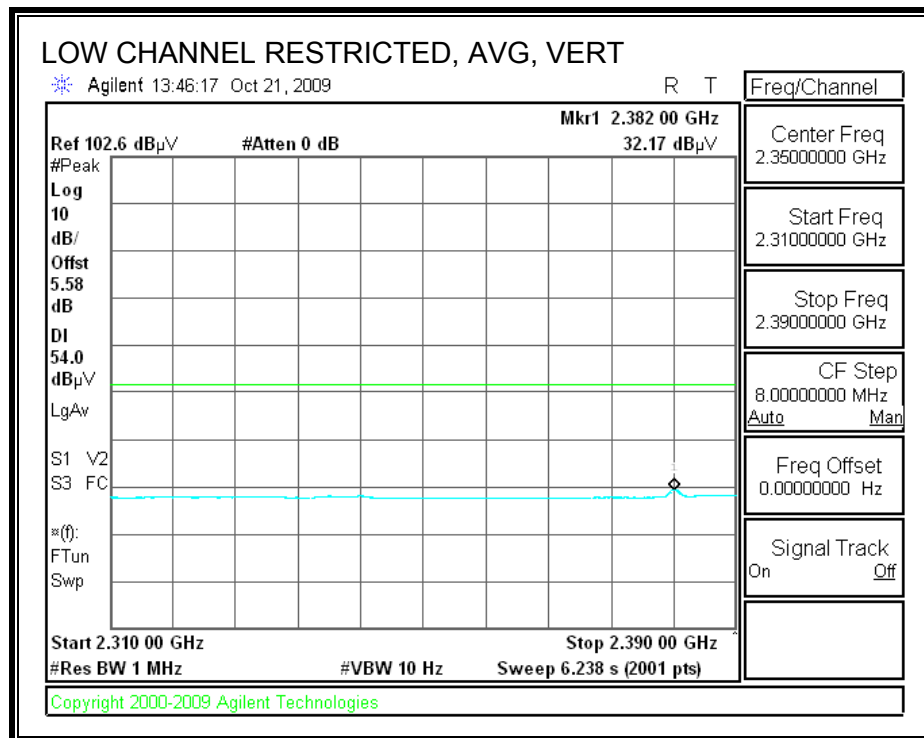
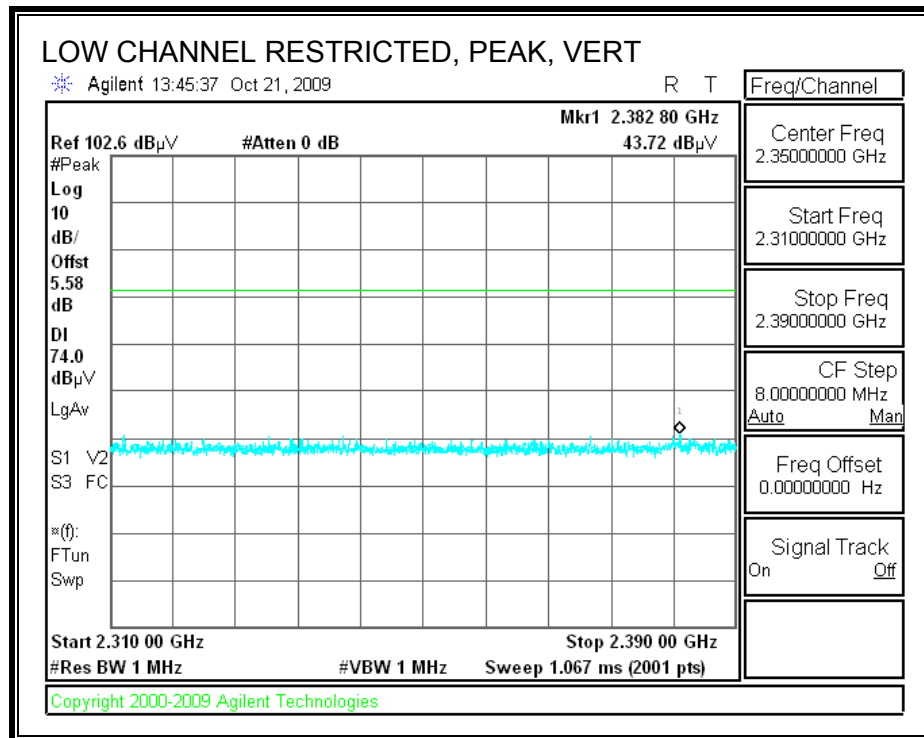
Note: No other emissions were detected above the system noise floor.

## 8.1.2. ENHANCED DATA RATE 8PSK MODULATION

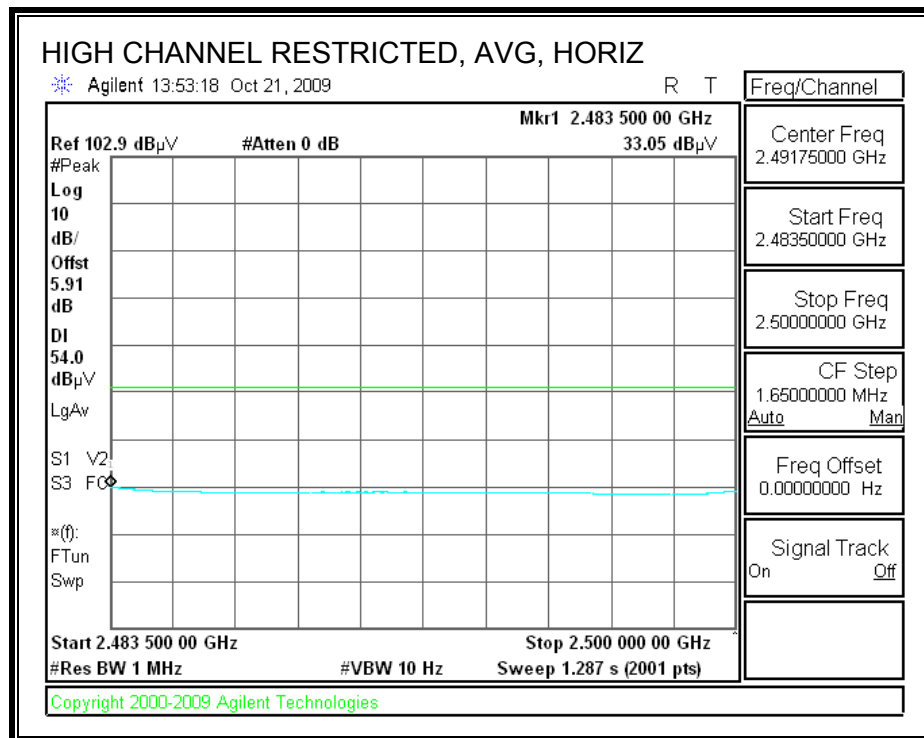
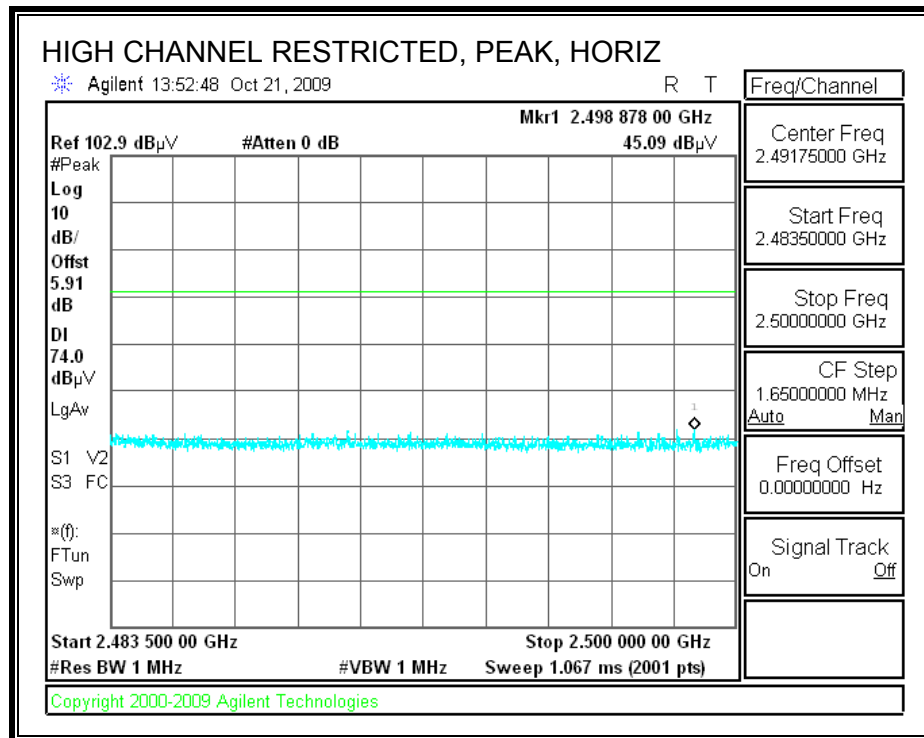
### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



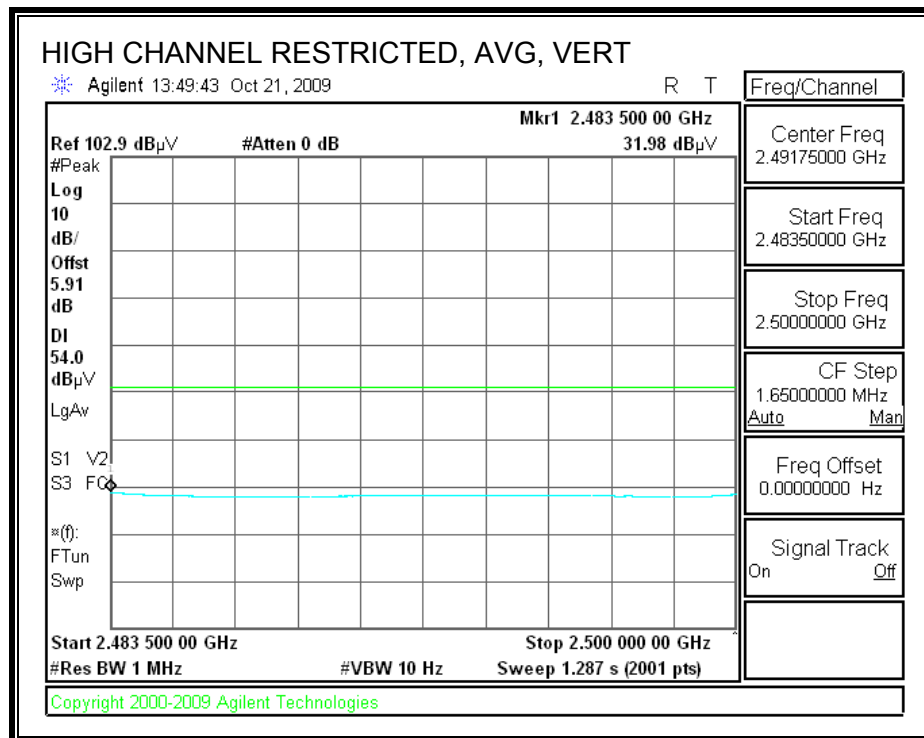
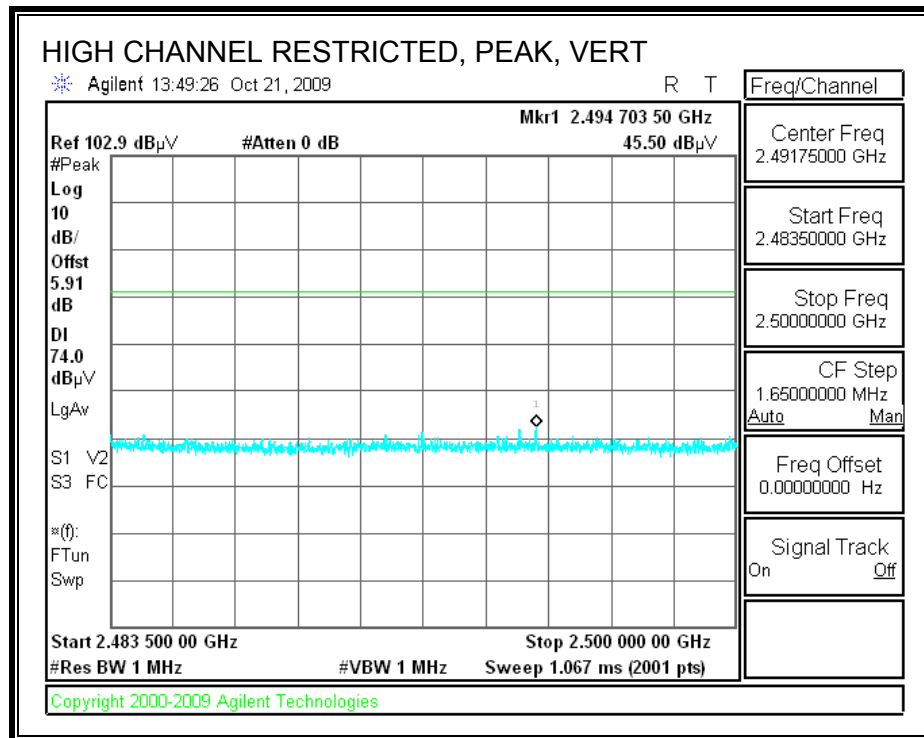
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**



**RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**



## HARMONICS AND SPURIOUS EMISSIONS

### High Frequency Measurement Compliance Certification Services, Fremont 3m Chamber

Test Engr: Vien Tran  
Date: 10/17/08  
Project #: 09U12871  
Company: Broadcom  
EUT Description: 802.g/Draft 802.11n WLAN + BT PCI-E MINICARD  
EUT M/N: BCM94343HMGB  
Test Target: FCC Class B  
Mode Oper: Tx 8PSK Mode\_Harmonic

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

f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fldr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol V/H	Det. P/A/QP	Ant.High cm	Table Angle Degree	Notes
<b>8PSK 2402MHz</b>															
4.804	3.0	41.9	32.7	5.8	-34.8	0.0	0.0	45.5	74.0	-28.5	V	P	99.0	109.0	
4.804	3.0	33.7	32.7	5.8	-34.8	0.0	0.0	37.3	54.0	-16.7	V	A	99.0	109.0	
4.804	3.0	40.8	32.7	5.8	-34.8	0.0	0.0	44.4	74.0	-29.6	H	P	99.0	108.0	
4.804	3.0	33.4	32.7	5.8	-34.8	0.0	0.0	37.0	54.0	-17.0	H	A	99.0	108.0	
<b>8PSK 2441MHz</b>															
4.882	3.0	37.2	32.7	5.8	-34.8	0.0	0.0	40.9	74.0	-33.1	V	P	100.0	231.0	
4.882	3.0	29.6	32.7	5.8	-34.8	0.0	0.0	33.3	54.0	-20.7	V	A	100.0	231.0	
7.323	3.0	32.5	35.5	7.3	-34.1	0.0	0.0	41.2	74.0	-32.8	V	P	100.0	36.0	
7.323	3.0	20.2	35.5	7.3	-34.1	0.0	0.0	28.8	54.0	-25.2	V	A	100.0	36.0	
4.882	3.0	35.9	32.7	5.8	-34.8	0.0	0.0	39.6	74.0	-34.4	H	P	100.0	122.0	
4.882	3.0	27.7	32.7	5.8	-34.8	0.0	0.0	31.4	54.0	-22.6	H	A	100.0	122.0	
7.323	3.0	32.7	35.5	7.3	-34.1	0.0	0.0	41.3	74.0	-32.7	H	P	100.0	203.0	
7.323	3.0	20.5	35.5	7.3	-34.1	0.0	0.0	29.1	54.0	-24.9	H	A	100.0	203.0	
<b>8PSK 2480MHz</b>															
4.960	3.0	34.4	32.8	5.9	-34.8	0.0	0.0	38.3	74.0	-35.7	V	P	101.0	230.0	
4.960	3.0	27.1	32.8	5.9	-34.8	0.0	0.0	31.0	54.0	-23.0	V	A	101.0	230.0	
7.440	3.0	33.0	35.6	7.3	-34.1	0.0	0.0	41.8	74.0	-32.2	V	P	100.0	230.0	
7.440	3.0	20.5	35.6	7.3	-34.1	0.0	0.0	29.4	54.0	-24.6	V	A	100.0	230.0	
4.960	3.0	34.1	32.8	5.9	-34.8	0.0	0.0	38.0	74.0	-36.0	H	P	100.0	237.0	
4.960	3.0	25.4	32.8	5.9	-34.8	0.0	0.0	29.3	54.0	-24.7	H	A	100.0	237.0	
7.440	3.0	32.5	35.6	7.3	-34.1	0.0	0.0	41.4	74.0	-32.6	H	P	125.0	252.0	
7.440	3.0	20.0	35.6	7.3	-34.1	0.0	0.0	28.9	54.0	-25.1	H	A	125.0	252.0	

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

## 8.2. RECEIVER ABOVE 1 GHz

High Frequency Measurement																	
Compliance Certification Services, Fremont 3m Chamber																	
Company:		Broadcom															
Project #:		09U12871															
Date:		10/21/09															
Test Engineer:		Vien Tran															
Configuration:		EUT / Laptop															
Mode:		Rx Mode_Worst-Case															
Test Equipment:																	
Horn 1-18GHz				Pre-amplifier 1-26GHz				Pre-amplifier 26-40GHz				Horn > 18GHz				Limit	
T60; S/N: 2238 @3m				T34 HP 8449B												FCC 15.209	
Hi Frequency Cables																	
3' cable 22807700				12' cable 22807600				20' cable 22807500				HPF				Reject Filter	
3' cable 22807700				12' cable 22807600				20' cable 22807500									
<div style="display: flex; justify-content: space-between;"> <div> <b>Peak Measurements</b>  RBW=VBW=1MHz  <b>Average Measurements</b>  RBW=1MHz ; VBW=10Hz </div> </div>																	
f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filt dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)		
1.040	3.0	52.5	48.5	24.6	2.4	-38.2	0.0	0.0	41.3	37.3	74	54	-32.7	-16.7	H		
1.196	3.0	53.3	36.3	25.1	2.6	-38.0	0.0	0.0	43.0	26.0	74	54	-31.0	-28.0	H		
1.600	3.0	48.0	32.6	26.5	3.0	-37.4	0.0	0.0	40.1	24.7	74	54	-33.9	-29.3	H		
3.167	3.0	45.4	39.9	30.1	4.5	-35.7	0.0	0.0	44.2	38.7	74	54	-29.8	-15.3	H		
1.040	3.0	51.5	45.5	24.6	2.4	-38.2	0.0	0.0	40.3	34.3	74	54	-33.7	-19.7	V		
1.965	3.0	51.9	37.8	27.7	3.4	-36.9	0.0	0.0	46.1	32.0	74	54	-27.9	-22.0	V		
1.600	3.0	48.7	34.6	26.5	3.0	-37.4	0.0	0.0	40.8	26.7	74	54	-33.2	-27.3	V		
3.167	3.0	44.4	39.3	30.1	4.5	-35.7	0.0	0.0	43.2	38.1	74	54	-30.8	-15.9	V		
<div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div> f      Measurement Frequency  Dist   Distance to Antenna  Read   Analyzer Reading  AF      Antenna Factor  CL      Cable Loss </div> <div> Amp    Preamp Gain  D Corr   Distance Correct to 3 meters  Avg     Average Field Strength @ 3 m  Peak    Calculated Peak Field Strength  HPF     High Pass Filter </div> <div> Avg Lim   Average Field Strength Limit  Pk Lim    Peak Field Strength Limit  Avg Mar   Margin vs. Average Limit  Pk Mar    Margin vs. Peak Limit </div> </div>																	

### 8.3. WORST-CASE BELOW 1 GHz

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

##### HORIZONTAL AND VERTICAL DATA

###### High Frequency Measurement

Compliance Certification Services, Fremont 3m Chamber

Test Engr: Vien Tran  
Date: 10/21/09  
Project #: 09U12871  
Company: Broadcom  
EUT Description: 802.g/Draft 802.11n WLAN + BT PCI-E MINICARD  
EUT M/N: BCM94343HMGB  
Test Target: FCC Class B  
Mode Oper: Tx Below 1GHz \_ Worst-Case

f	Measurement Frequency	Amp	Preamp Gain	Margin	Margin vs. Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		
Read	Analyzer Reading	Filter	Filter Insert Loss		
AF	Antenna Factor	Corr.	Calculated Field Strength		
CL	Cable Loss	Limit	Field Strength Limit		

f MHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filter dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol V/H	Det. P/A/QP	Notes
<b>Vertical</b>													
99.963	3.0	50.9	9.3	0.8	28.2	0.0	0.0	32.8	43.5	-10.7	V	EP	
300.011	3.0	49.4	13.5	1.5	27.4	0.0	0.0	37.0	46.0	-9.0	V	EP	
480.019	3.0	49.3	16.5	1.9	28.5	0.0	0.0	39.2	46.0	-6.8	V	EP	
619.944	3.0	45.7	18.5	2.2	28.6	0.0	0.0	37.9	46.0	-8.1	V	EP	
996.040	3.0	38.8	22.7	2.9	27.6	0.0	0.0	36.8	54.0	-17.2	V	EP	
<b>Horizontal</b>													
199.807	3.0	52.1	11.9	1.2	27.4	0.0	0.0	37.8	43.5	-5.7	H	EP	
299.771	3.0	53.6	13.5	1.5	27.4	0.0	0.0	41.2	46.0	-4.8	H	EP	
399.615	3.0	49.1	15.0	1.7	28.0	0.0	0.0	37.9	46.0	-8.1	H	EP	
619.944	3.0	47.1	18.5	2.2	28.6	0.0	0.0	39.3	46.0	-6.7	H	EP	
979.959	3.0	42.0	22.6	2.9	27.6	0.0	0.0	39.8	54.0	-14.2	H	EP	

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

## 9. AC POWER LINE CONDUCTED EMISSIONS

### LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

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

<sup>\*</sup> 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 receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

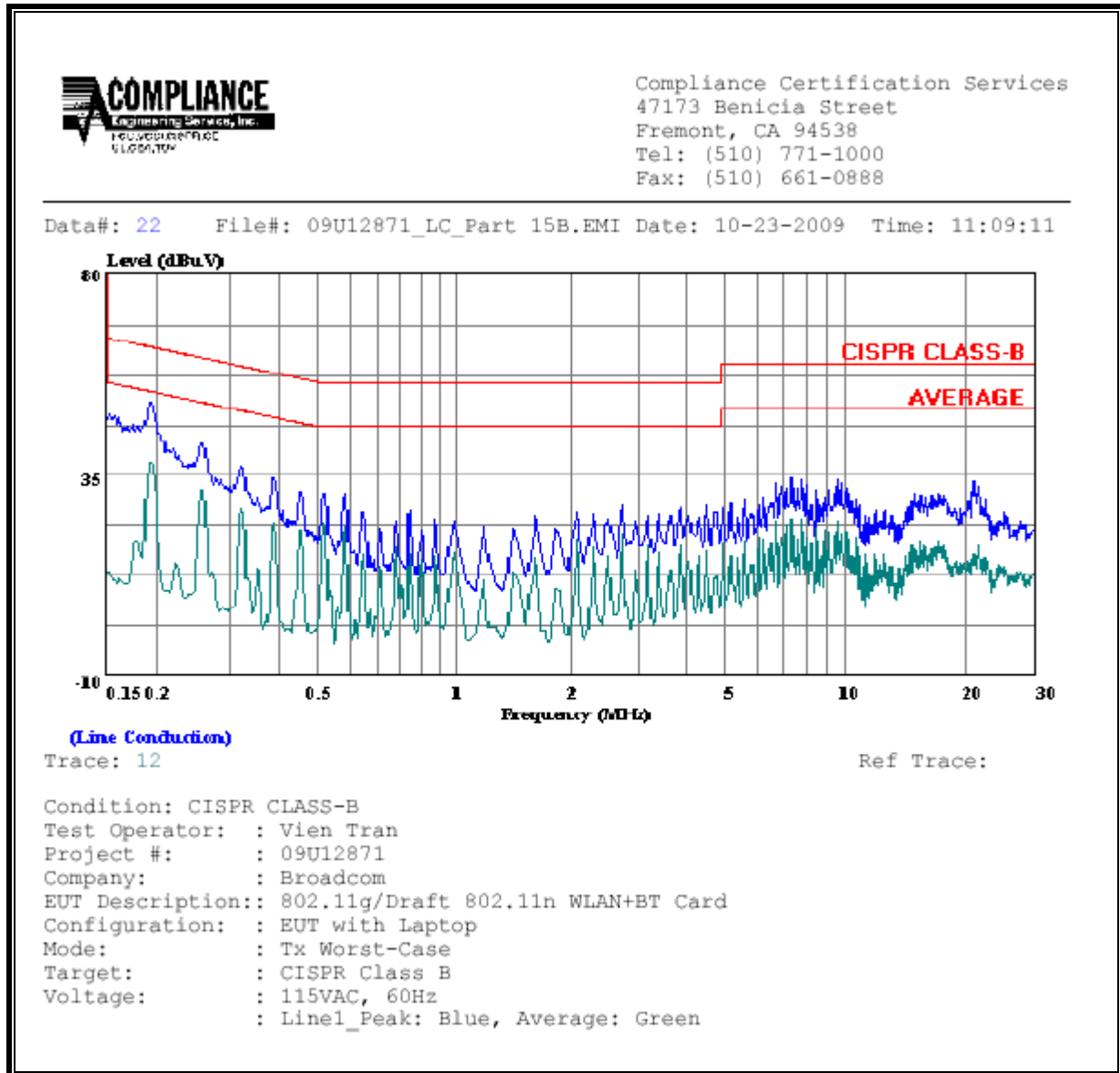
Line conducted data is recorded for both NEUTRAL and HOT lines.

### RESULTS

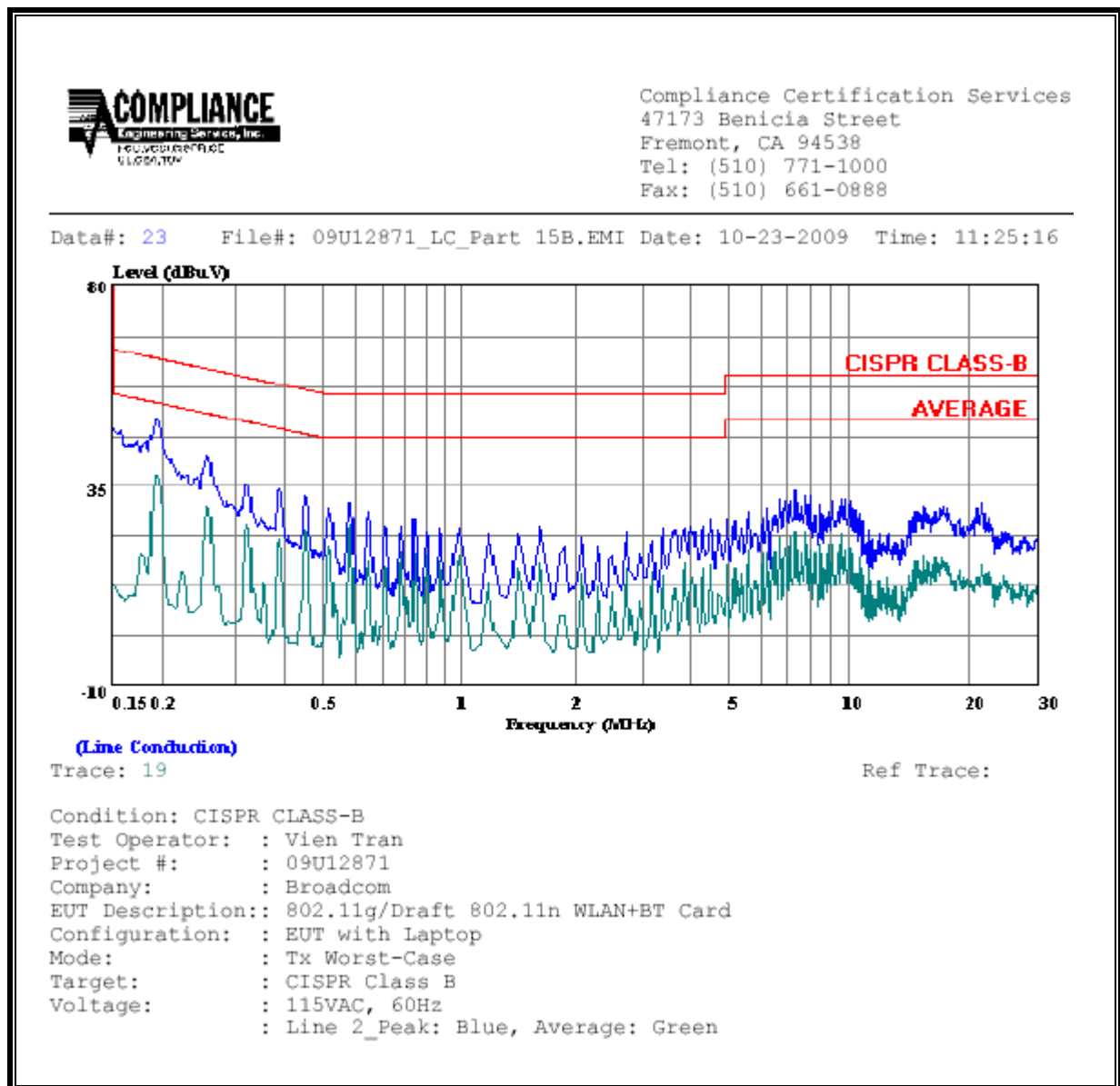
## 6 WORST EMISSIONS

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
0.19	51.43	--	38.09	0.00	63.91	53.91	-12.48	-15.82	L1
0.59	30.76	--	26.20	0.00	56.00	46.00	-25.24	-19.80	L1
9.65	34.07	--	24.65	0.00	60.00	50.00	-25.93	-25.35	L1
0.19	50.30	--	37.63	0.00	63.91	53.91	-13.61	-16.28	L2
0.59	31.13	--	25.33	0.00	56.00	46.00	-24.87	-20.67	L2
9.65	33.99	--	22.70	0.00	60.00	50.00	-26.01	-27.30	L2
6 Worst Data									

## LINE 1 RESULTS



## LINE 2 RESULTS



## 10. MAXIMUM PERMISSIBLE EXPOSURE

### FCC RULES

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

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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

f = frequency in MHz

\* = Plane-wave equivalent power density

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

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

## IC RULES

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

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

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

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

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

## **EQUATIONS**

Power density is given by:

$$S = \text{EIRP} / (4 * \pi * D^2)$$

where

S = Power density in W/m<sup>2</sup>

EIRP = Equivalent Isotropic Radiated Power in W

D = Separation distance in m

Power density in units of W/m<sup>2</sup> is converted to units of mW/cm<sup>2</sup> by dividing by 10.

Distance is given by:

$$D = \text{SQRT} (\text{EIRP} / (4 * \pi * S))$$

where

D = Separation distance in m

EIRP = Equivalent Isotropic Radiated Power in W

S = Power density in W/m<sup>2</sup>

For multiple colocated transmitters operating simultaneously in frequency bands where the limit is identical, the total power density is calculated using the total EIRP obtained by summing the Power \* Gain product (in linear units) of each transmitter.

$$\text{Total EIRP} = (P_1 * G_1) + (P_2 * G_2) + \dots + (P_n * G_n)$$

where

P<sub>x</sub> = Power of transmitter x

G<sub>x</sub> = Numeric gain of antenna x

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

## **LIMITS**

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

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

## **RESULTS**

Band	Mode	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	IC Power Density (W/m <sup>2</sup> )	FCC Power Density (mW/cm <sup>2</sup> )
2.4 GHz	Bluetooth	0.20	4.46	3.90	0.01	0.001