



**FCC CFR47 PART 15 SUBPART C  
INDUSTRY CANADA RSS-210 ISSUE 8**

**CERTIFICATION TEST REPORT**

**FOR**

**WIRELESS COMMUNICATION DEVICE**

**MODEL NUMBER: BCM94319SDHMB**

**FCC ID: QDS-BRCM1057  
IC: 4324A- BRCM1057**

**REPORT NUMBER: 11U13694-3**

**ISSUE DATE: MARCH 24, 2011**

*Prepared for*  
**BROADCOM CORPORATION  
190 MATHILDA PLACE  
SUNNYVALE, CA 94086, U.S.A.**

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



**NVLAP LAB CODE 200065-0**

Revision History

Rev.	Issue Date	Revisions	Revised By
--	03/24/2011	Initial Issue	T. Chan

## TABLE OF CONTENTS

<b>1. ATTESTATION OF TEST RESULTS</b>	<b>5</b>
<b>2. TEST METHODOLOGY</b>	<b>6</b>
<b>3. FACILITIES AND ACCREDITATION</b>	<b>6</b>
<b>4. CALIBRATION AND UNCERTAINTY</b>	<b>6</b>
4.1. MEASURING INSTRUMENT CALIBRATION	6
4.2. SAMPLE CALCULATION	6
4.3. MEASUREMENT UNCERTAINTY	6
<b>5. EQUIPMENT UNDER TEST</b>	<b>7</b>
5.1. DESCRIPTION OF EUT	7
5.2. MAXIMUM OUTPUT POWER	7
5.3. DESCRIPTION OF AVAILABLE ANTENNAS	7
5.4. SOFTWARE AND FIRMWARE	7
5.5. WORST-CASE CONFIGURATION AND MODE	7
5.6. DESCRIPTION OF TEST SETUP	8
<b>6. TEST AND MEASUREMENT EQUIPMENT</b>	<b>12</b>
<b>7. ANTENNA PORT TEST RESULTS</b>	<b>13</b>
7.1. BASIC DATA RATE GFSK MODULATION	13
7.1.1. 20 dB AND 99% BANDWIDTH	13
7.1.2. HOPPING FREQUENCY SEPARATION	20
7.1.3. NUMBER OF HOPPING CHANNELS	22
7.1.4. AVERAGE TIME OF OCCUPANCY	27
7.1.5. OUTPUT POWER	34
7.1.6. CONDUCTED SPURIOUS EMISSIONS	38
7.2. ENHANCED DATA RATE 8PSK MODULATION	47
7.2.1. 20 dB AND 99% BANDWIDTH	47
7.2.2. HOPPING FREQUENCY SEPARATION	54
7.2.3. NUMBER OF HOPPING CHANNELS	56
7.2.4. AVERAGE TIME OF OCCUPANCY	61
7.2.5. OUTPUT POWER	68
7.2.6. CONDUCTED SPURIOUS EMISSIONS	72
7.3. BLE BASIC DATA RATE GFSK MODULATION	81
7.3.1. 20 dB AND 99% BANDWIDTH	81
7.3.2. HOPPING FREQUENCY SEPARATION	88
7.3.3. NUMBER OF HOPPING CHANNELS	90
7.3.4. AVERAGE TIME OF OCCUPANCY	95
7.3.5. OUTPUT POWER	98
7.3.6. CONDUCTED SPURIOUS EMISSIONS	102
<b>8. RADIATED TEST RESULTS</b>	<b>111</b>

8.1.	<i>LIMITS AND PROCEDURE</i> .....	111
8.2.	<i>TRANSMITTER ABOVE 1 GHz</i> .....	112
8.2.1.	BASIC DATA RATE GFSK MODULATION.....	112
8.2.2.	ENHANCED DATA RATE 8PSK MODULATION .....	121
8.2.3.	LE (LOW ENERGY) GFSK MODULATION.....	130
8.3.	<i>RECEIVER ABOVE 1 GHz</i> .....	139
8.4.	<i>WORST-CASE BELOW 1 GHz</i> .....	140
9.	<b>AC POWER LINE CONDUCTED EMISSIONS</b> .....	141
10.	<b>MAXIMUM PERMISSIBLE EXPOSURE</b> .....	145
11.	<b>SETUP PHOTOS</b> .....	148

## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** BROADCOM CORPORATION  
190 MATHILDA PLACE  
SUNNYVALE, CA 94086, U.S.A.

**EUT DESCRIPTION:** WIRELESS COMMUNICATION DEVICE

**MODEL:** BCM94319SDHMB

**SERIAL NUMBER:** 005

**DATE TESTED:** MARCH 18 to 23, 2011

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-210 Issue 8 Annex 8	Pass
INDUSTRY CANADA RSS-GEN Issue 3	Pass

Compliance Certification Services, Inc. (ULCCS) 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 UL 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.

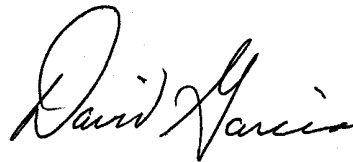
**Note:** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL 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 UL CCS By:

Tested By:



THU CHAN  
ENGINEERING MANAGER  
UL CCS



DAVID GARCIA  
EMC ENGINEER  
UL CCS

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 3, and RSS-210 Issue 8.

## 3. FACILITIES AND ACCREDITATION

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

UL 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 a wireless communication device

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	-2.40	0.58
2402 - 2480	Enhanced 8PSK	1.05	1.27
2402 - 2480	Low Energy BLE	-2.08	0.62

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an 802.11bgn WLAN antenna, with a maximum gain of 3.9dBi.

### 5.4. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Broadcom Bluetooth 4.0 + HS USB, rev. 5.6.0.3200.

The test utility software used during testing was Bluetool, ver. 1.4.3.0 and BCM\_BTDL, ver 1.8.17.

### 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

### **FOR GFSK, 8PSK MODES; Hopping ON & OFF and LE MODE; Hopping OFF**

#### **SUPPORT EQUIPMENT**

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Dell	Inspiron 0000	N/A	DoC
AC Adapter	Dell	ADP-90AH B	CN-0C8023-48661-5C9-G7X3	DoC
Adapter Board	AzureWave	1124 TEST BOARD I3	063EB	N/A
USB Cable	N/A	N/A	N/A	N/A

#### **I/O CABLES**

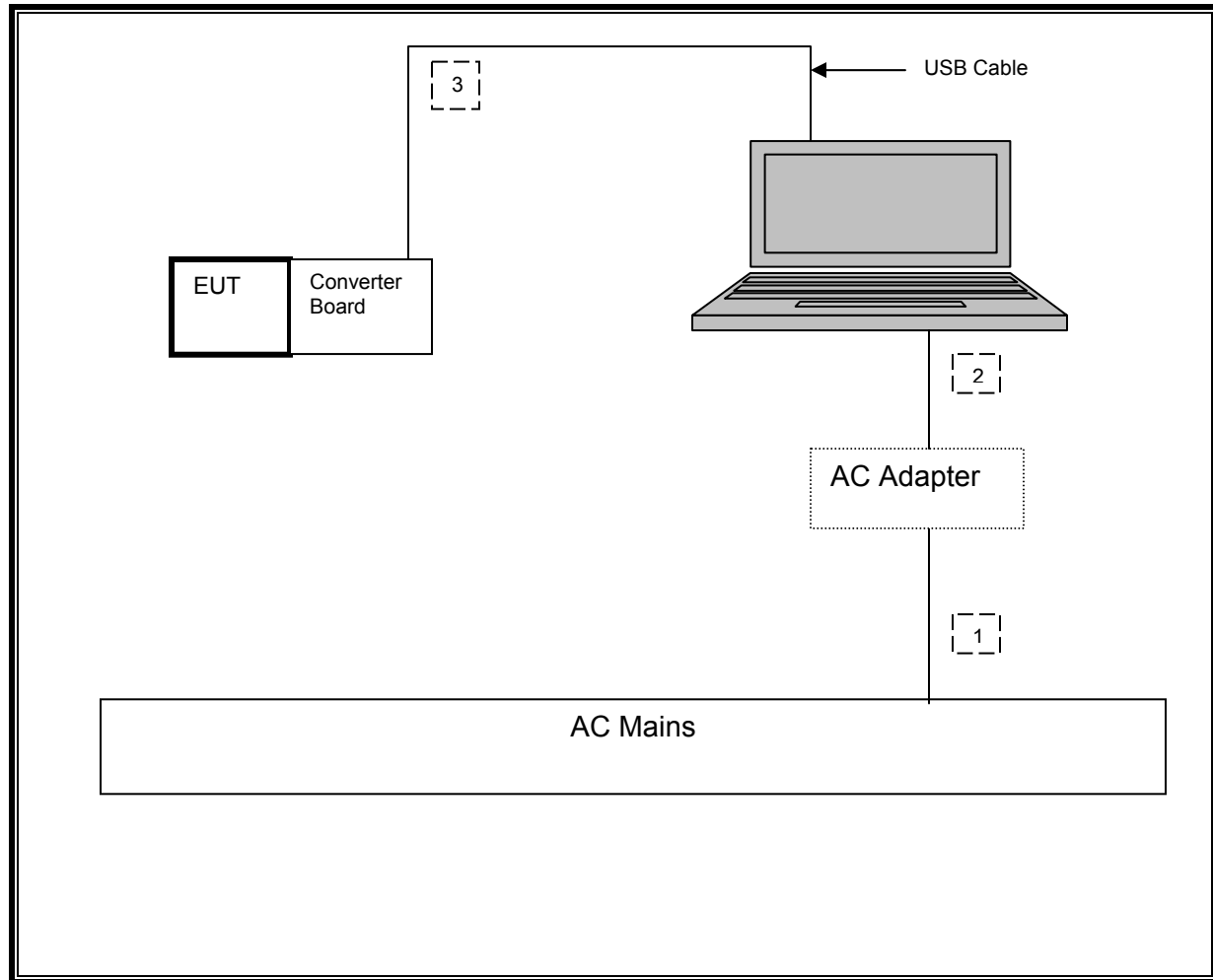
I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	US 115V	Shielded	1.5m	NA
2	DC	1	DC	Un-shielded	1.5m	Ferrite at laptop's end
3	USB	1	USB	Un-shielded	1.0m	NA

#### **TEST SETUP**

The EUT was tested as an external module that installed on a converter board connected to a host Laptop PC USB cable.



**SETUP DIAGRAM**



**FOR LE MODE; Hopping ON**

**SUPPORT EQUIPMENT**

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Dell	Inspiron	F14	DoC
AC Adapter	Dell	ADP-90AH B	CN-0C8023-48661-5C9-G7X3	DoC
Laptop	Dell	WD416	33	DoC
AC Adapter	Dell	PA-1600-06D1	CN-0F9710-71615-56H-510D	DoC
Adapter Board	AzureWave	1124 TEST BOARD I3	063EB	N/A
Adapter Board	AzureWave	1124 TEST BOARD I3	076EA	N/A

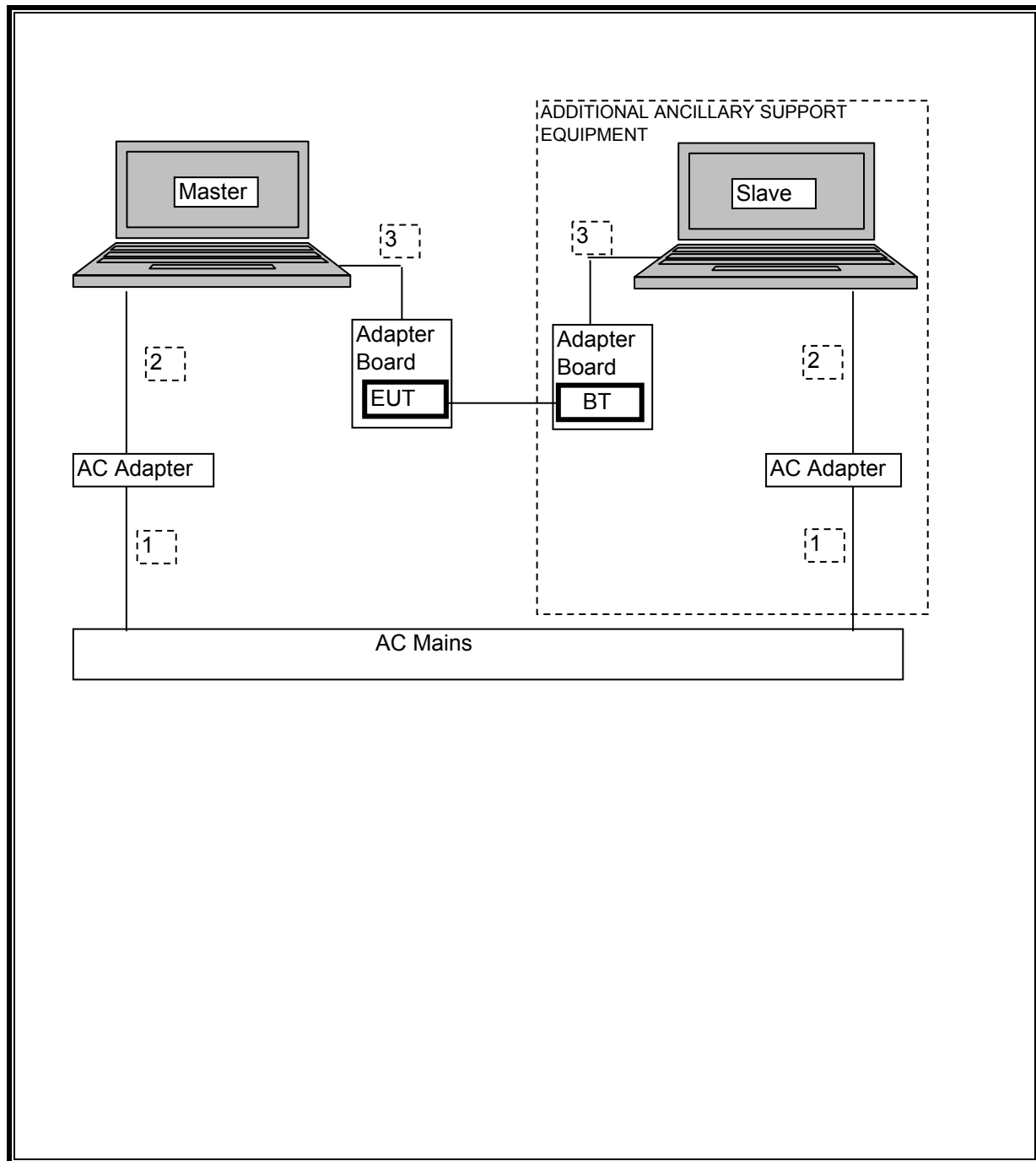
**I/O CABLES**

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	US 115V	Shielded	1.5m	NA
2	DC	1	DC	Un-shielded	1.5m	Ferrite at laptop's end
3	USB	1	USB	Un-shielded	1.0m	NA

**TEST SETUP**

The EUT was tested as an external module that installed on a converter board connected to a host Laptop PC USB cable.

**SETUP DIAGRAM FOR TESTS**



## 6. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST				
Description	Manufacturer	Model	Asset	Cal Due
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C00996	10/29/11
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01171	07/14/11
Antenna, Horn, 18 GHz	EMCO	3115	C00872	07/29/11
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00980	07/29/11
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00778	01/26/12
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C00749	08/04/11
Peak Power Meter	Agilent / HP	E9327A	C00964	12/04/11
Peak Power Sensor	Agilent / HP	E4416A	C00963	12/04/11
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRM50702	N02685	CNR
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	11/06/10
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	05/06/11

## 7. ANTENNA PORT TEST RESULTS

### 7.1. BASIC DATA RATE GFSK MODULATION

#### 7.1.1. 20 dB AND 99% BANDWIDTH

##### LIMIT

None; for reporting purposes only.

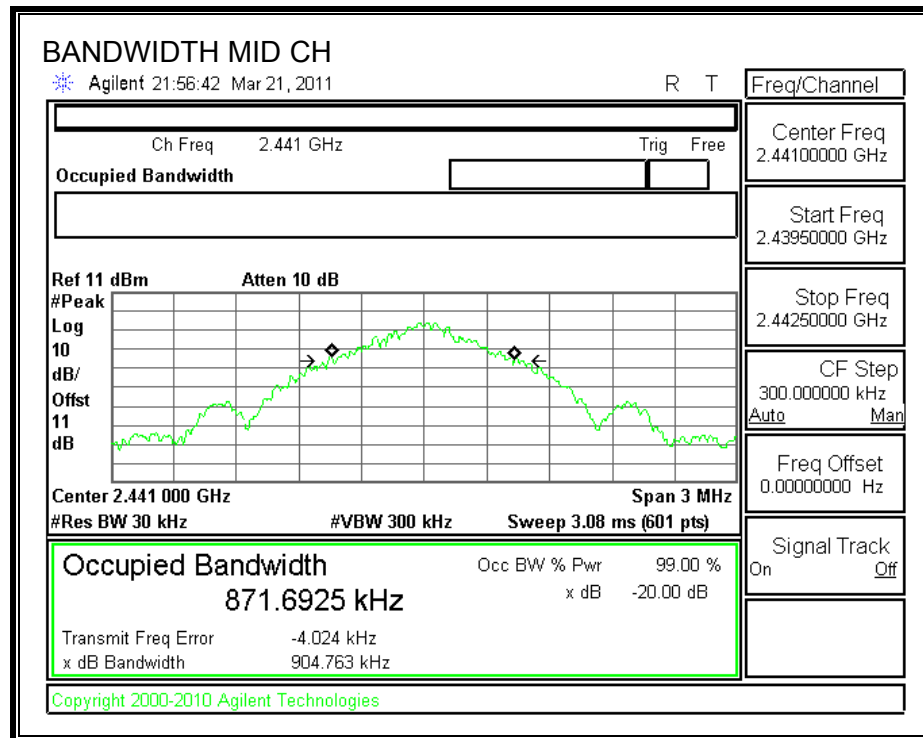
##### TEST PROCEDURE

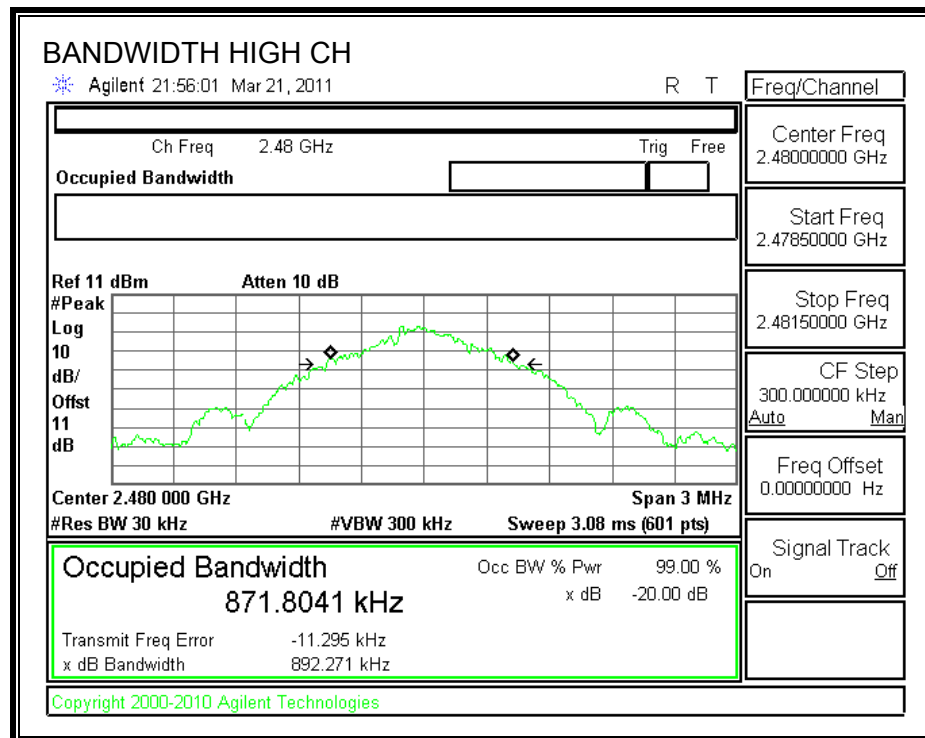
The transmitter output is connected to a spectrum analyzer. The RBW is set to  $\geq 1\%$  of the 20 dB bandwidth. The VBW is set to  $\geq$  RBW. The sweep time is coupled.

##### RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	930.777	880.4769
Middle	2441	904.763	864.9882
High	2480	892.271	865.3787

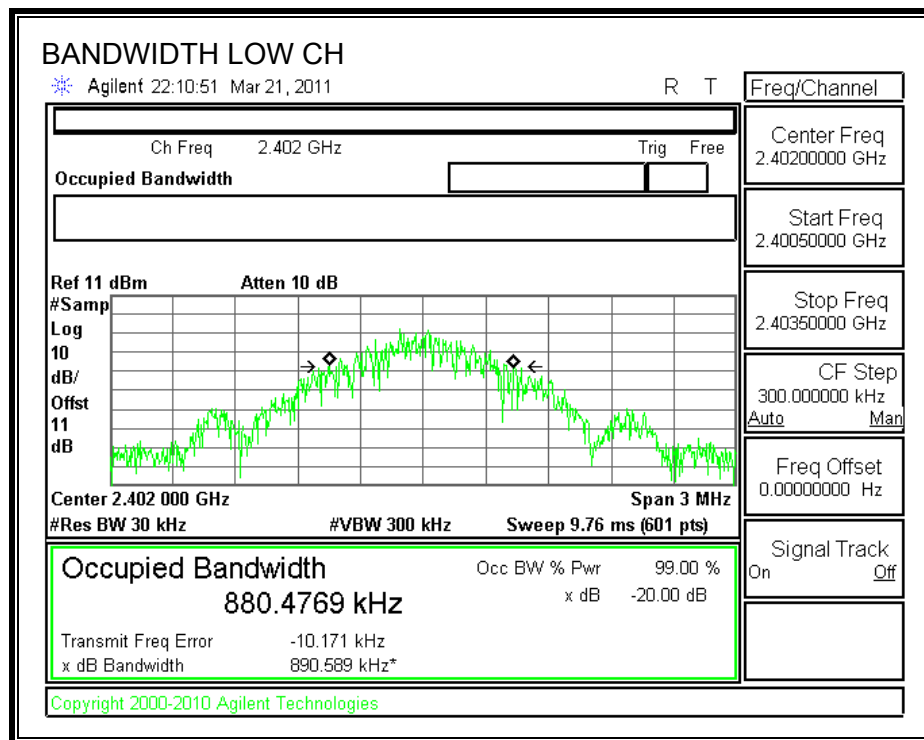


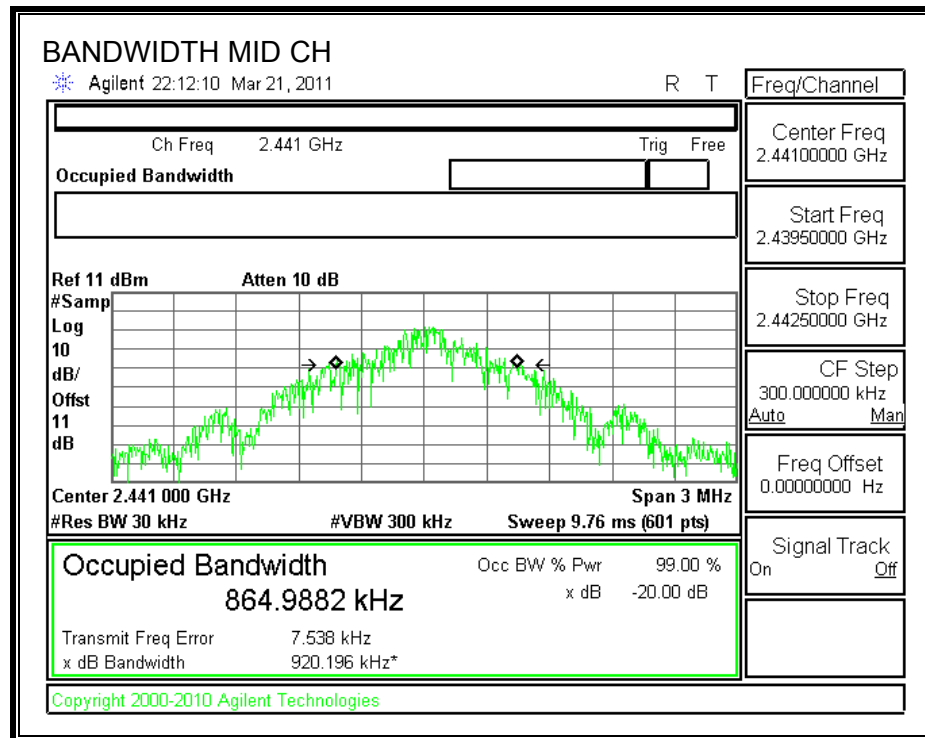


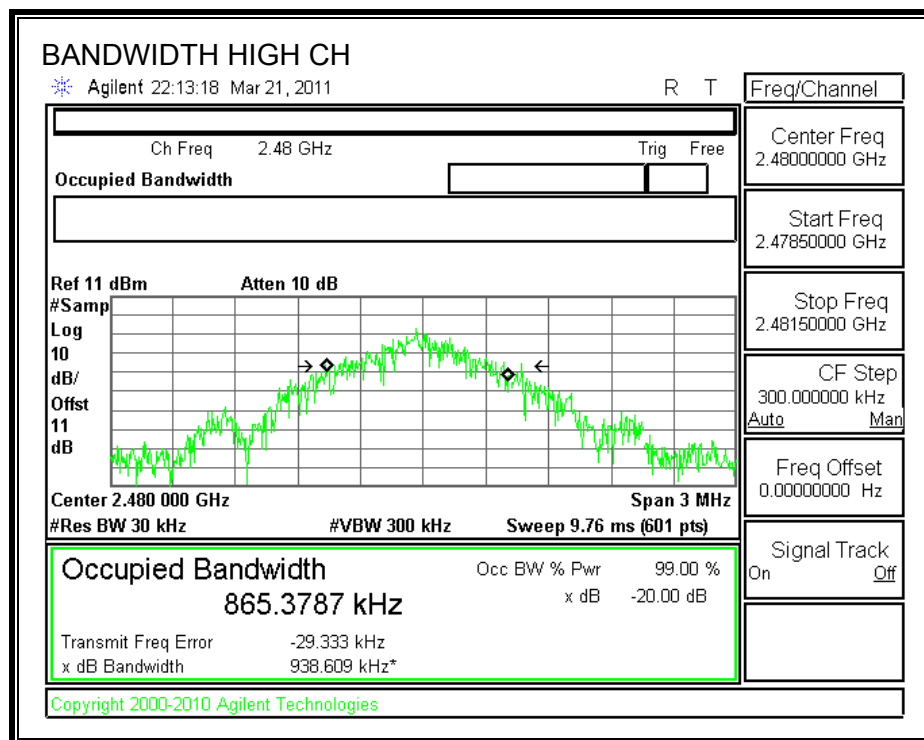




**99% BANDWIDTH**







## **7.1.2. 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.

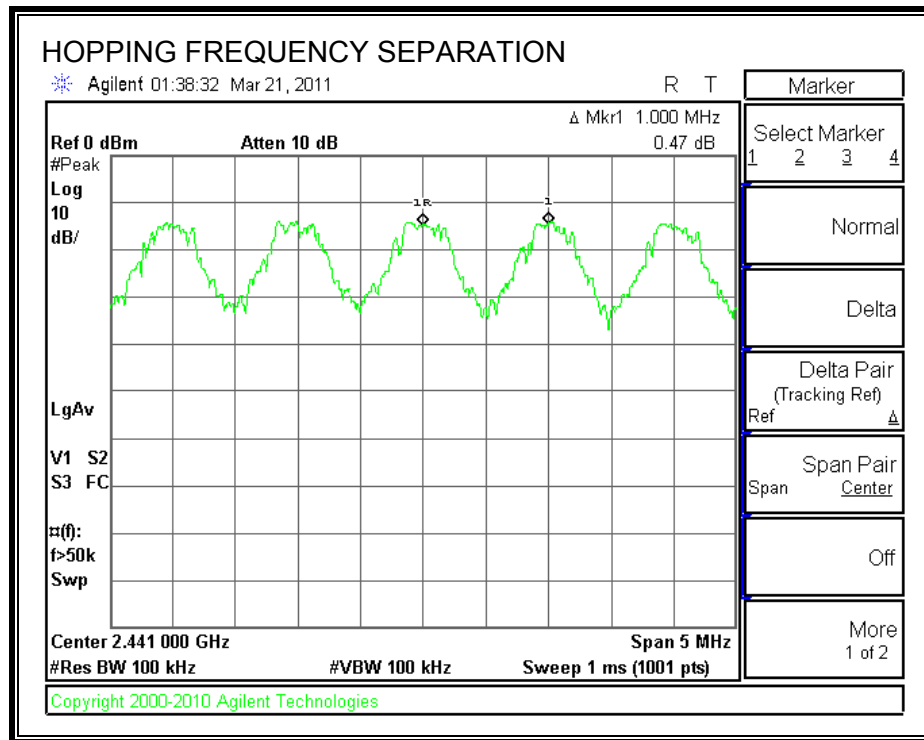
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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



### **7.1.3. 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.

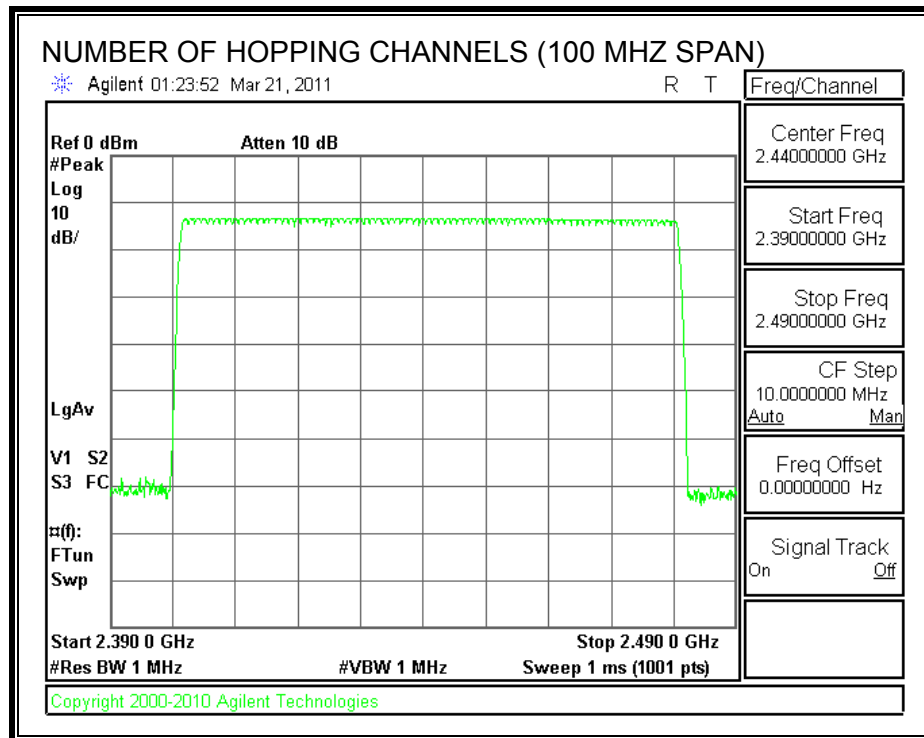
#### **TEST PROCEDURE**

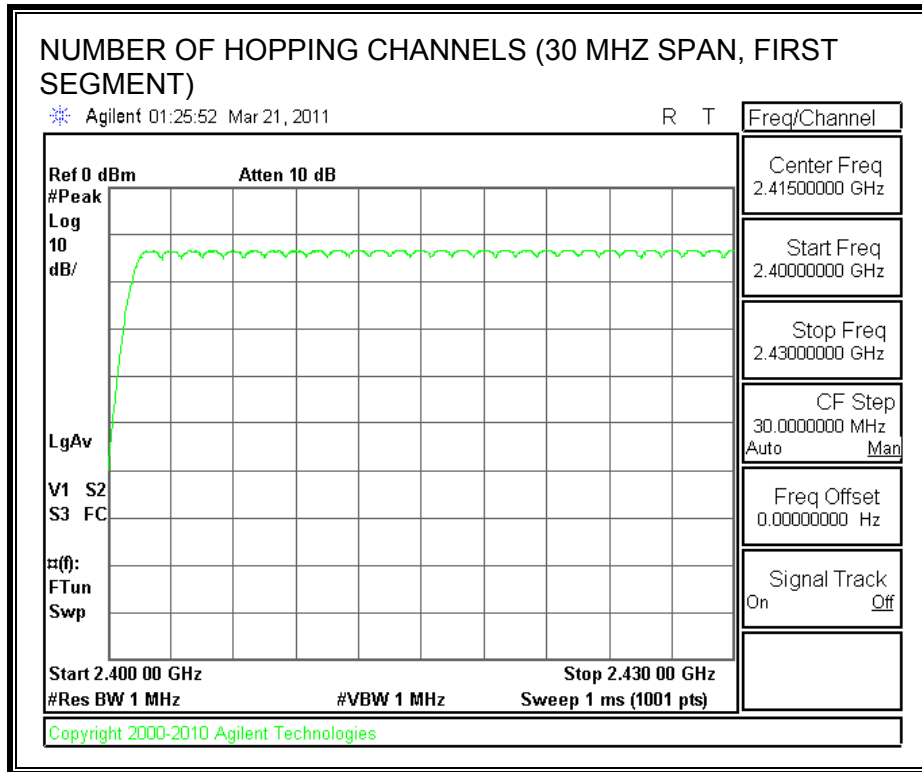
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

#### **RESULTS**

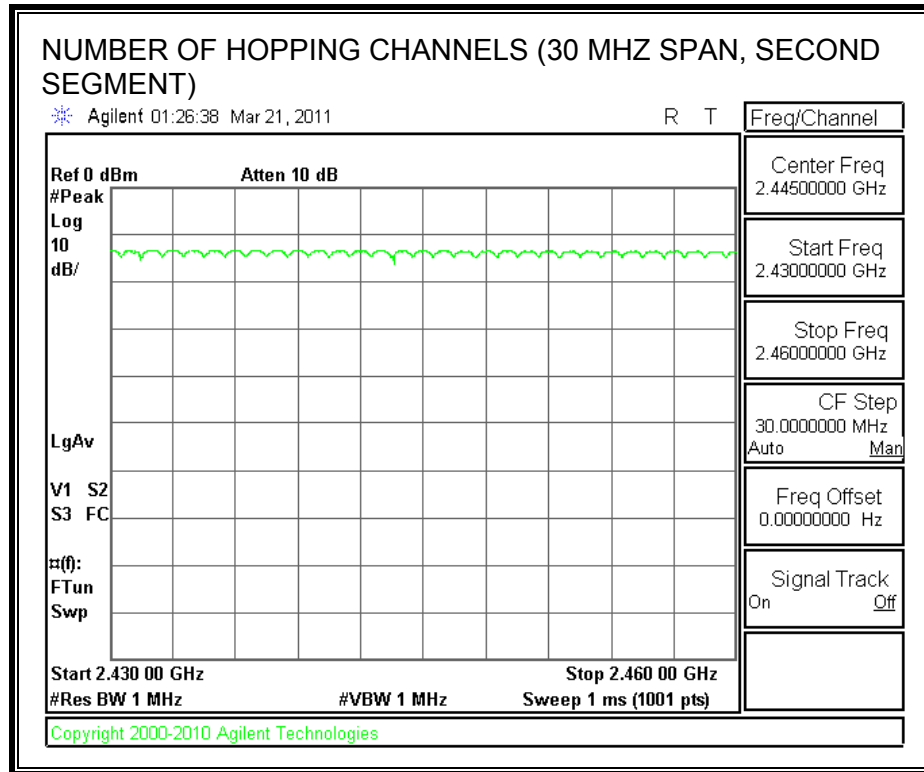
79 Channels observed.

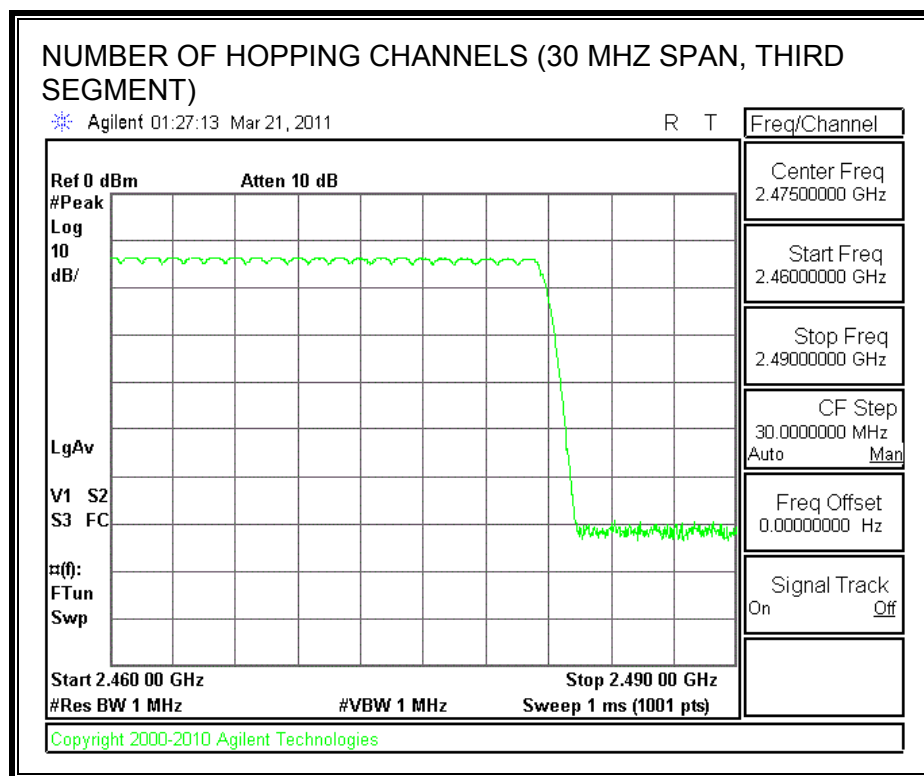
**NUMBER OF HOPPING CHANNELS**











#### 7.1.4. 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  $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$ .

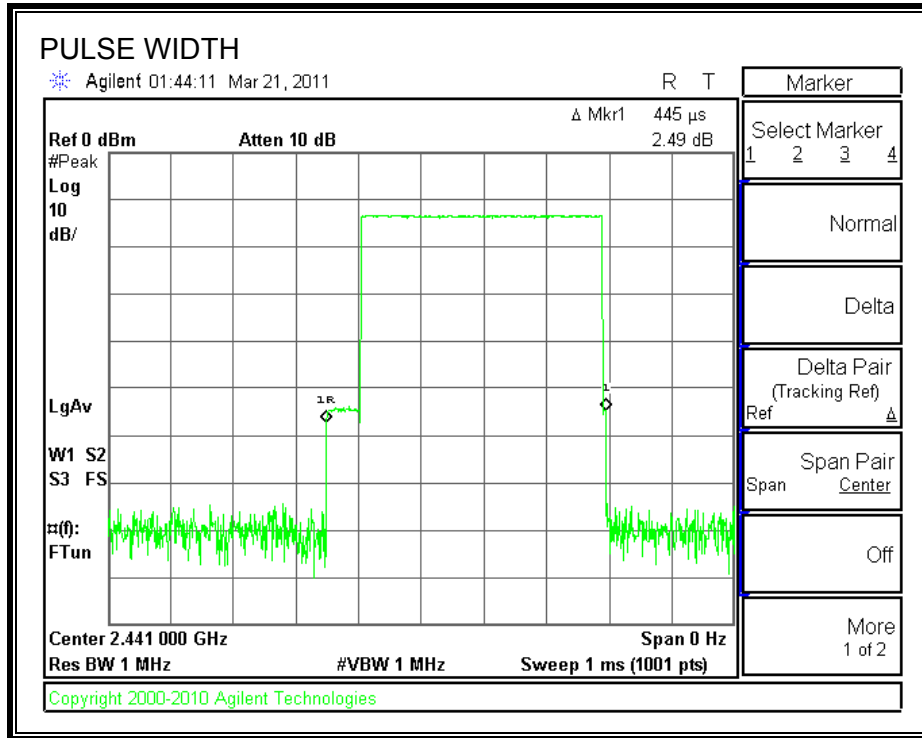
##### RESULTS

###### GFSK Mode

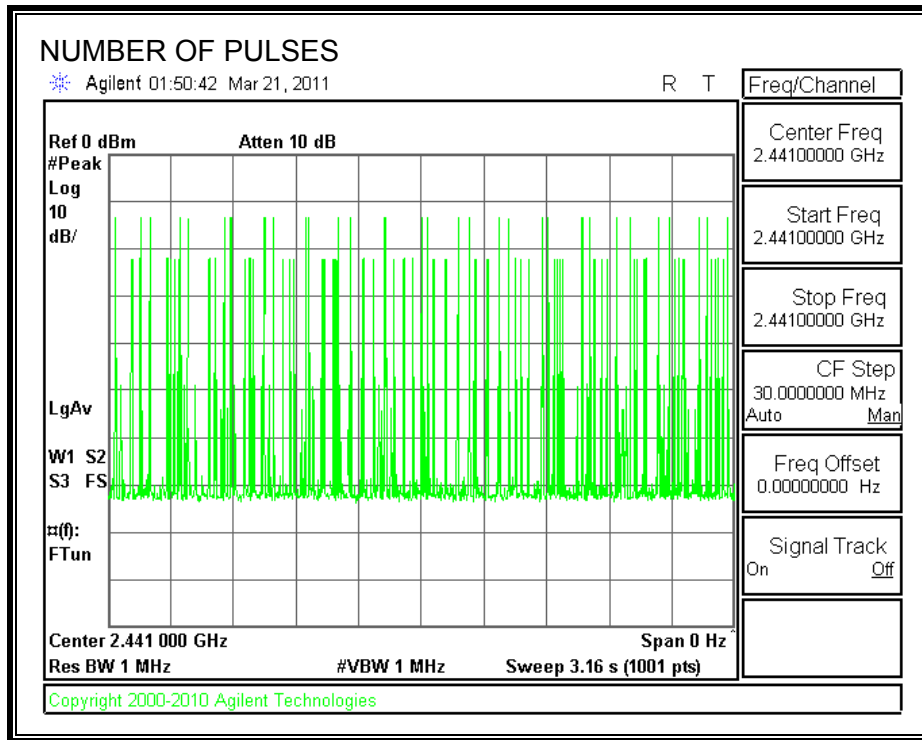
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.445	31	0.138	0.4	0.262
DH3	1.7	15	0.255	0.4	0.145
DH5	2.93	11	0.322	0.4	0.078

**DH1**

**PULSE WIDTH**

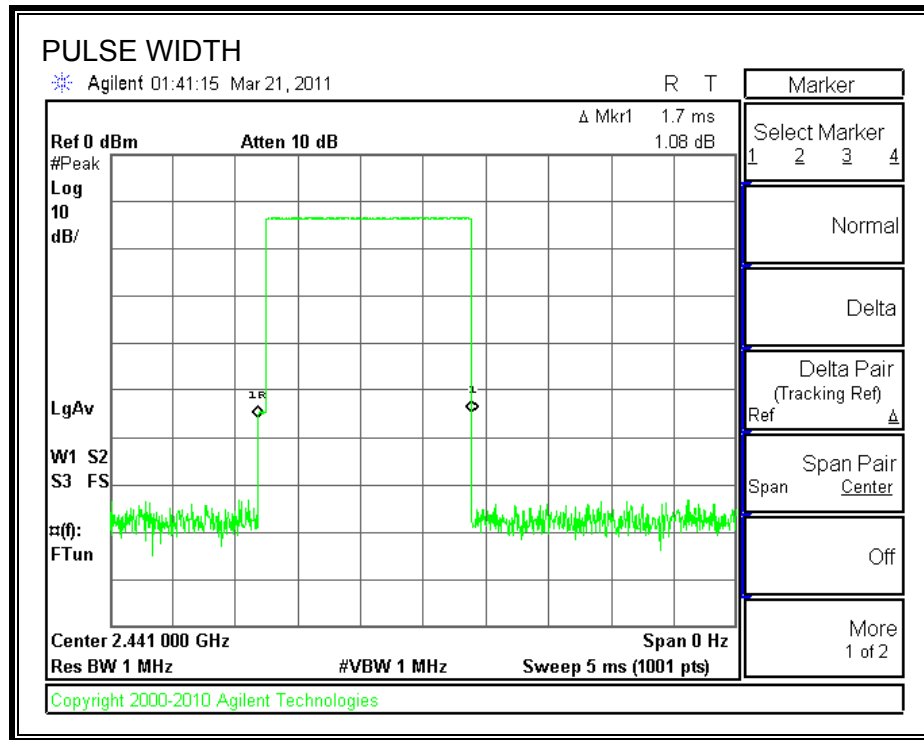


**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD**

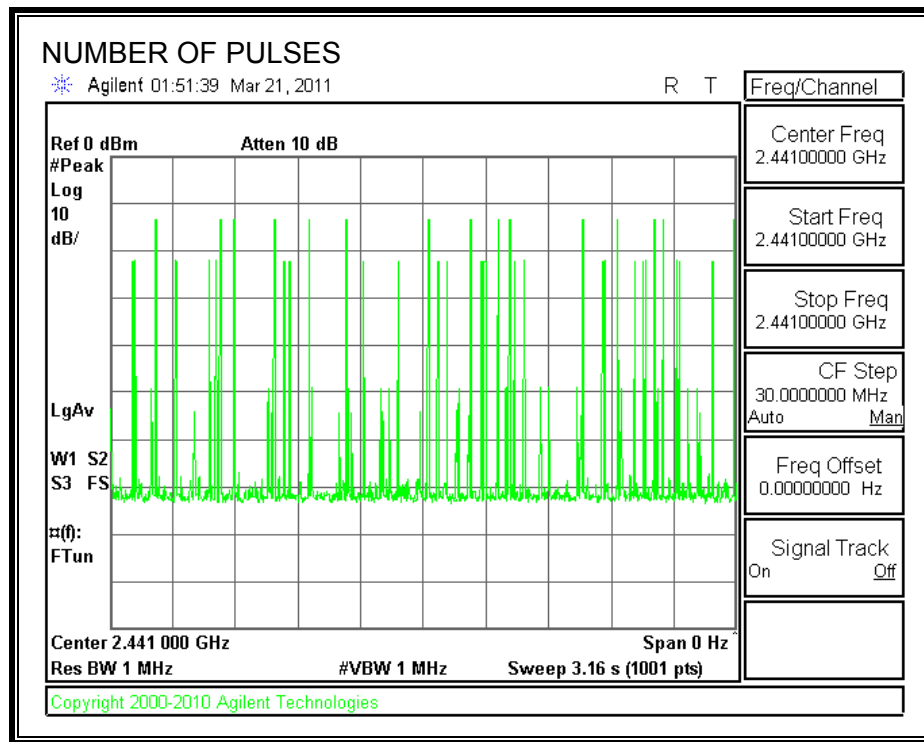


### DH3

### PULSE WIDTH

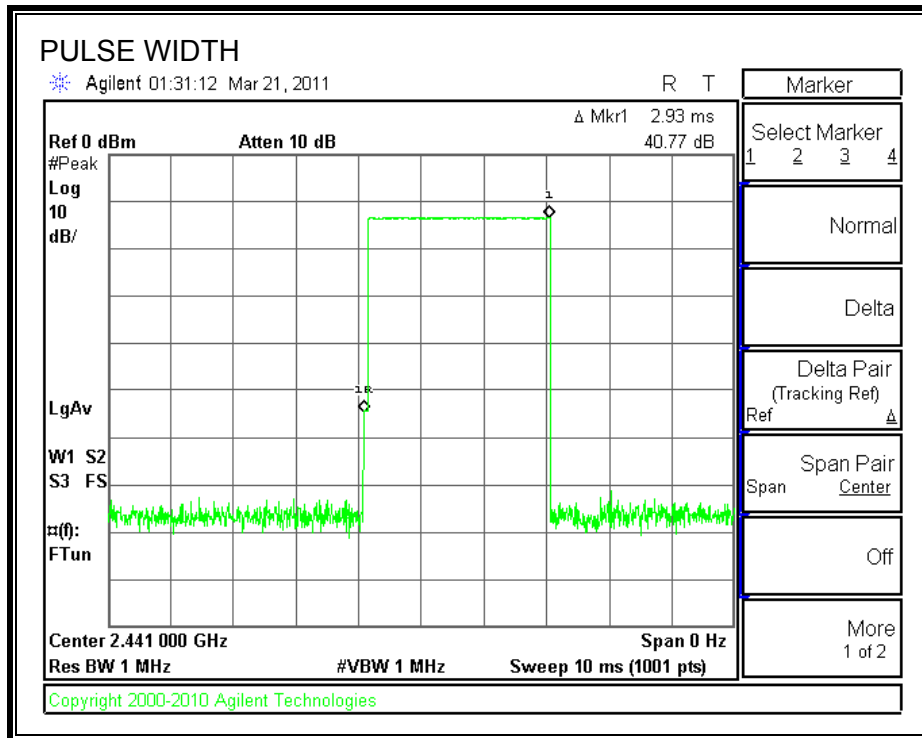


**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD**



**DH5**

**PULSE WIDTH**







### 7.1.5. 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.

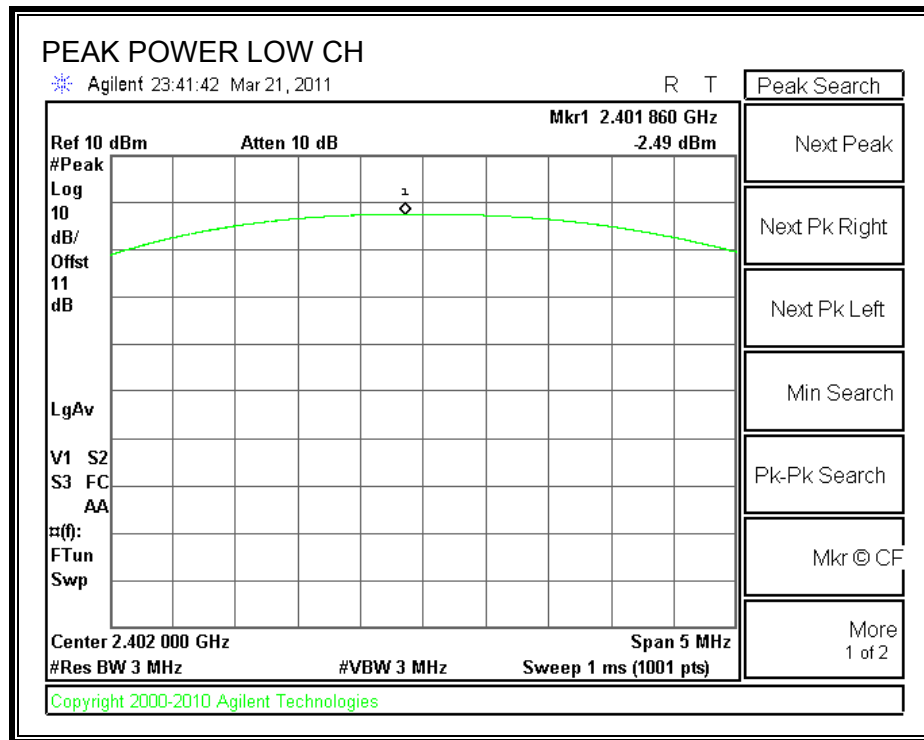
#### TEST PROCEDURE

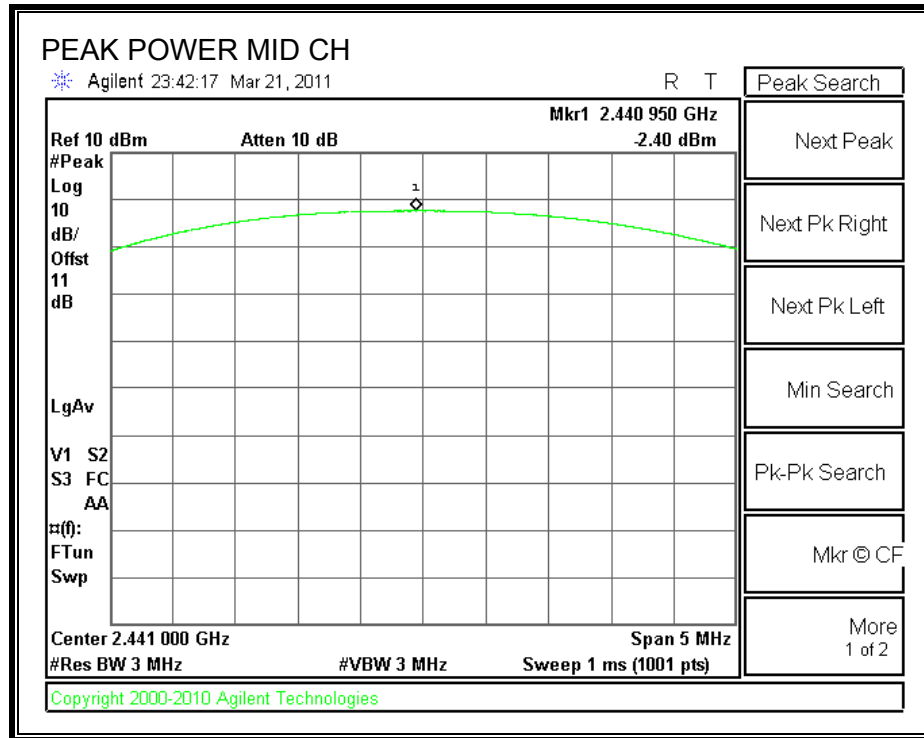
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

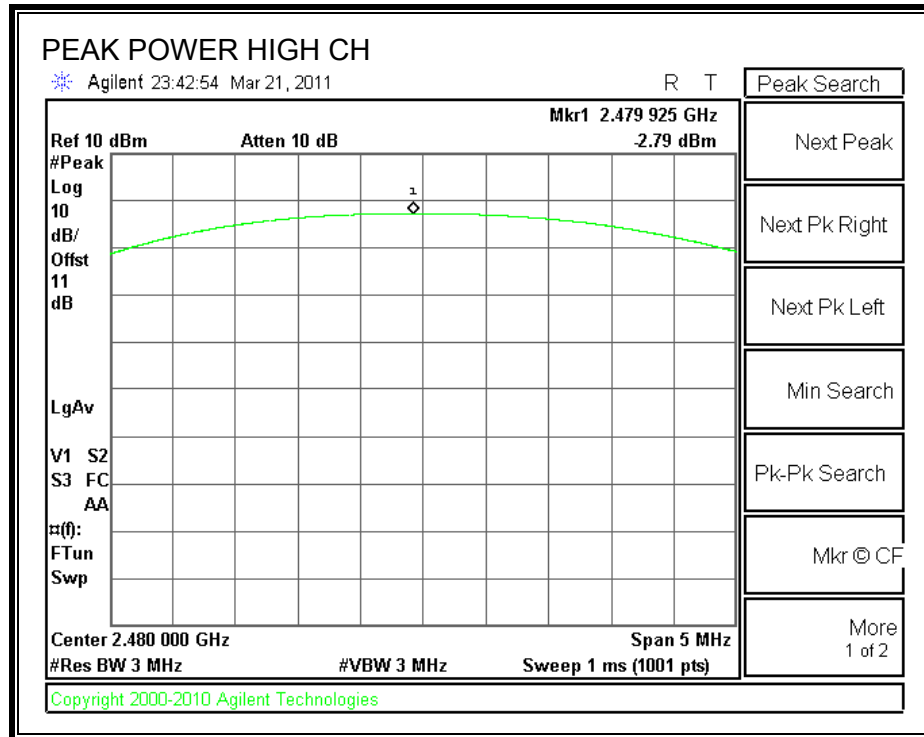
#### RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-2.49	30	-32.49
Middle	2441	-2.40	30	-32.40
High	2480	-2.79	30	-32.79

## OUTPUT POWER







## **7.1.6. CONDUCTED SPURIOUS EMISSIONS**

### **LIMITS**

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

### **TEST PROCEDURE**

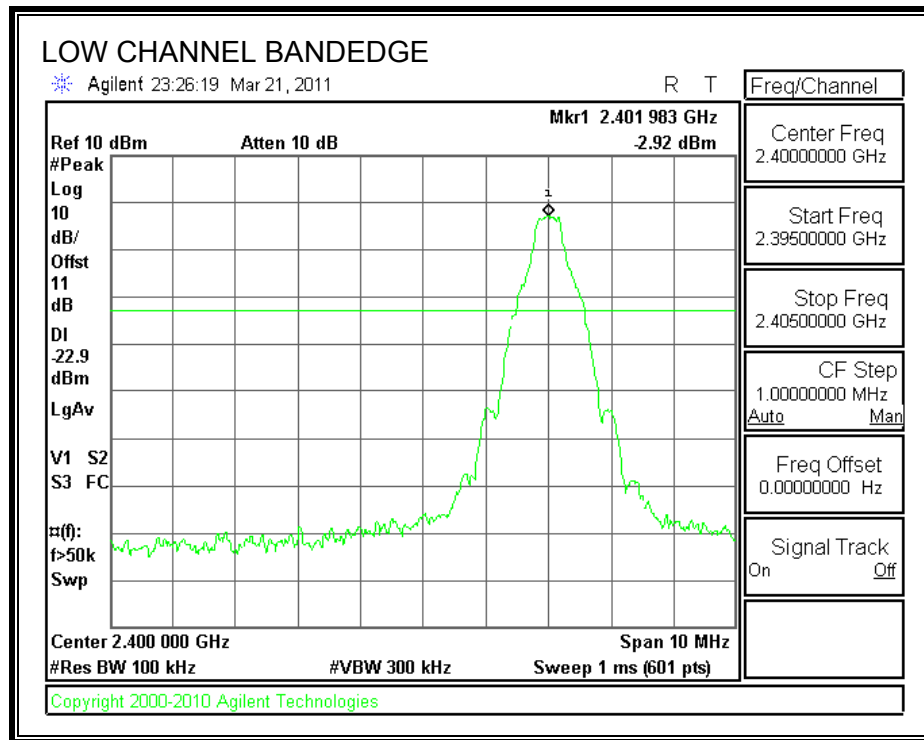
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

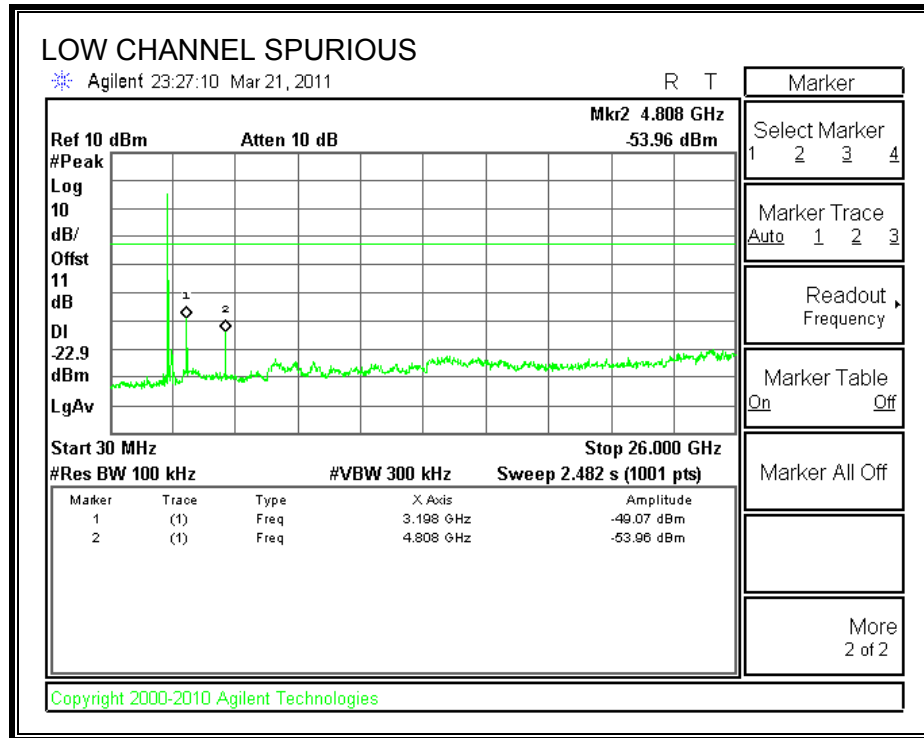
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

### **RESULTS**

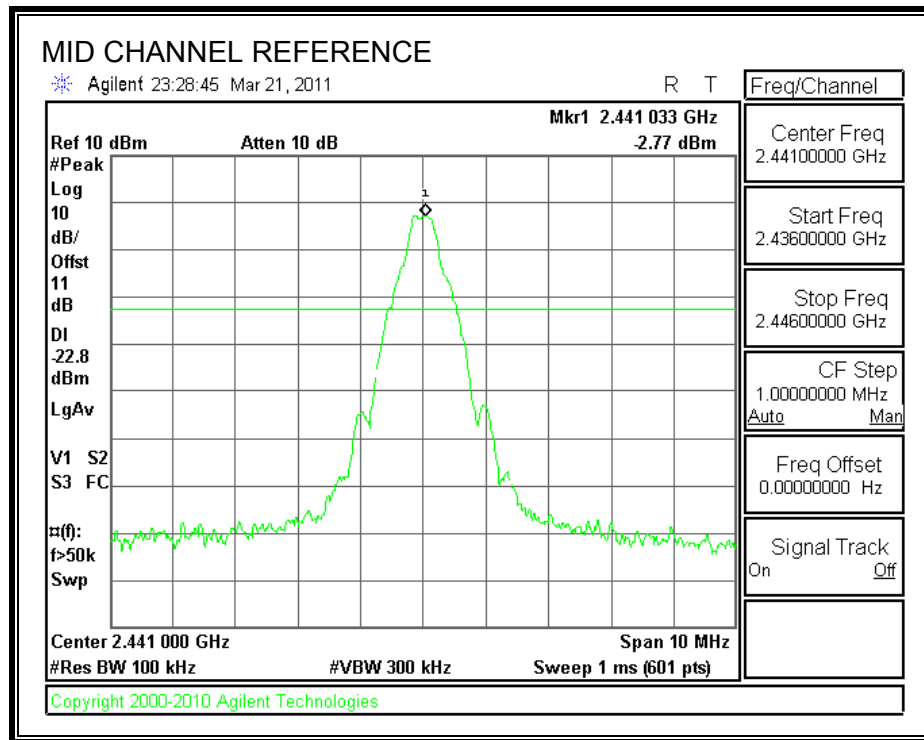
**SPURIOUS EMISSIONS, LOW CHANNEL**

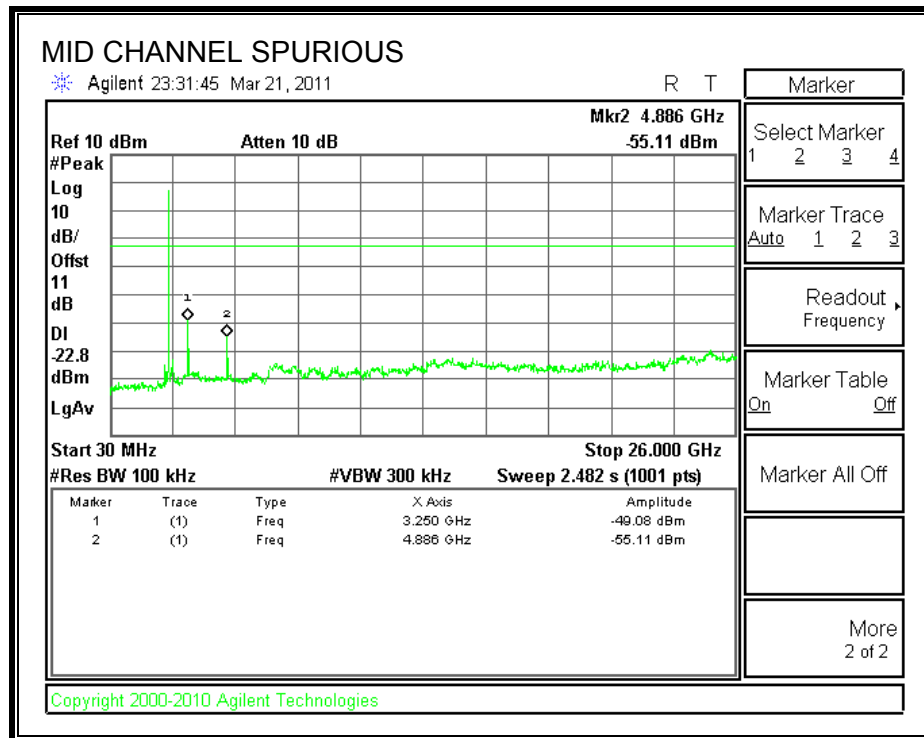




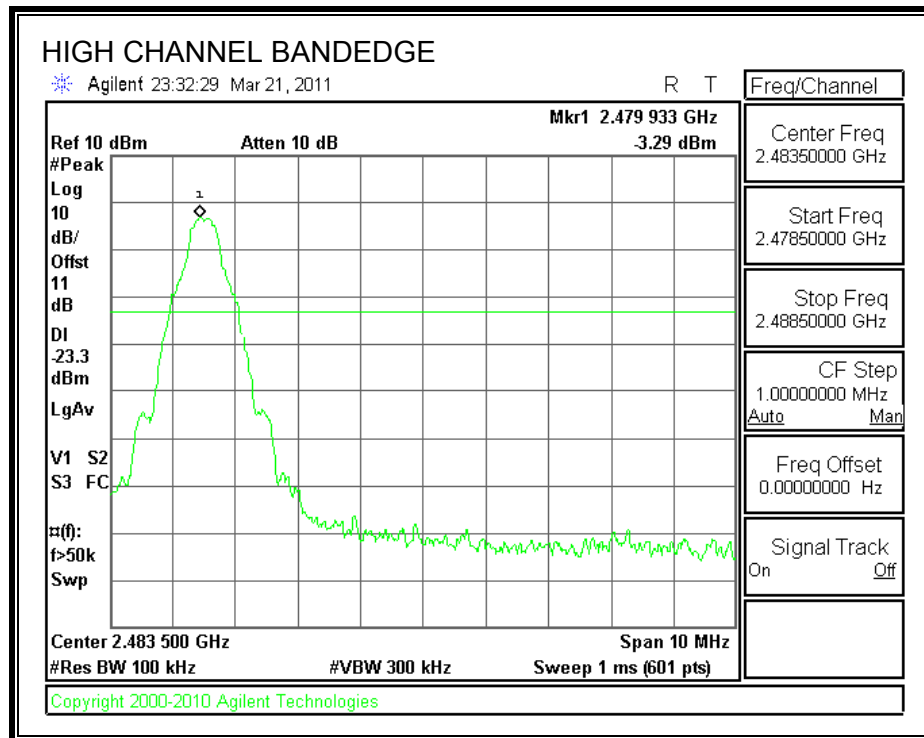


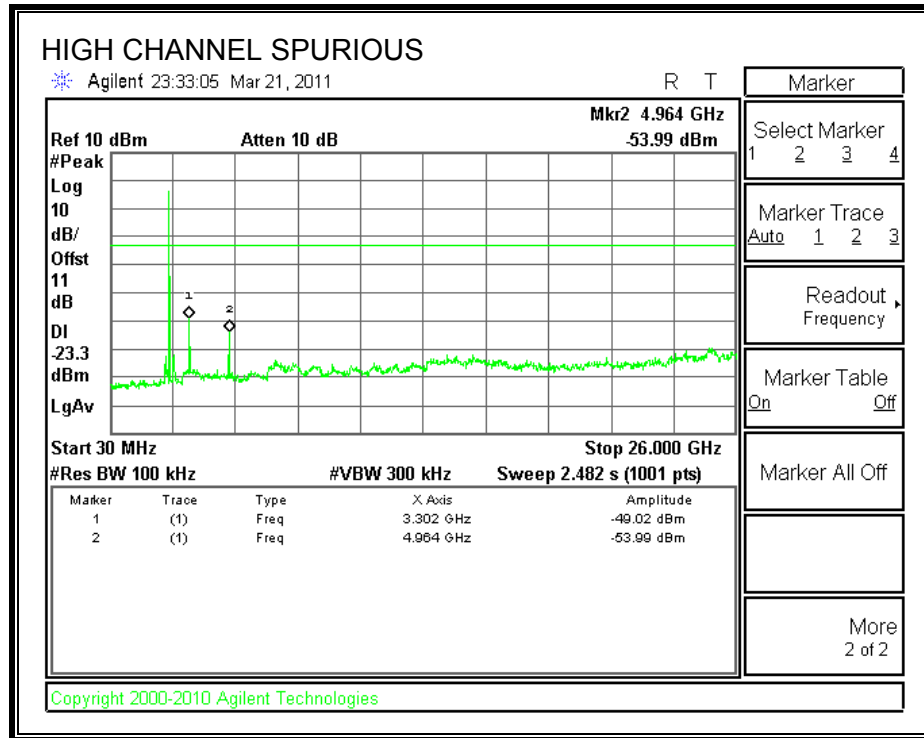
**SPURIOUS EMISSIONS, MID CHANNEL**



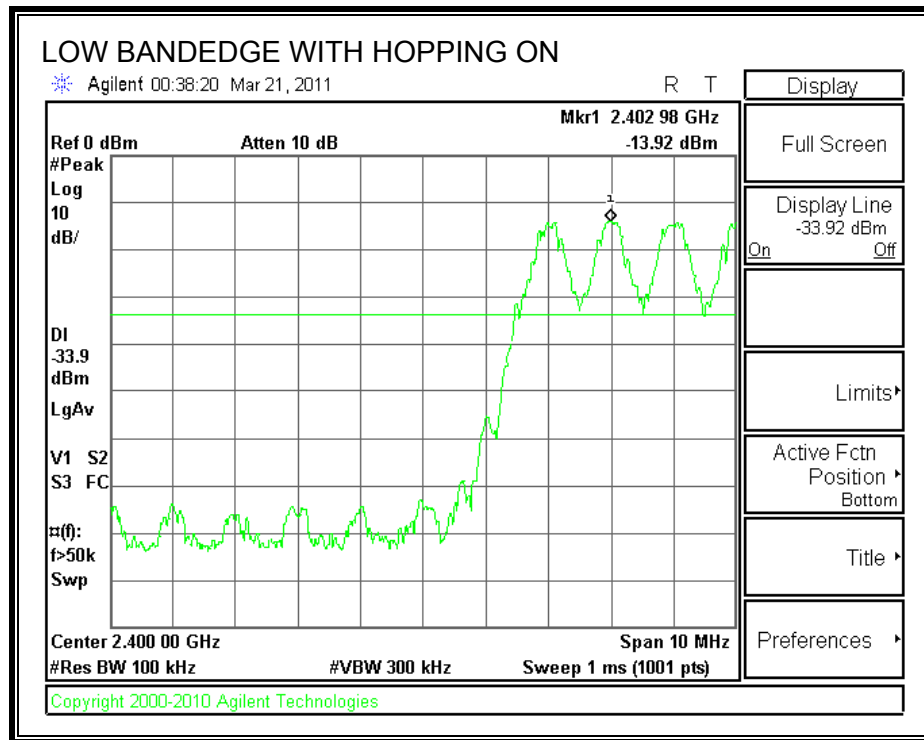


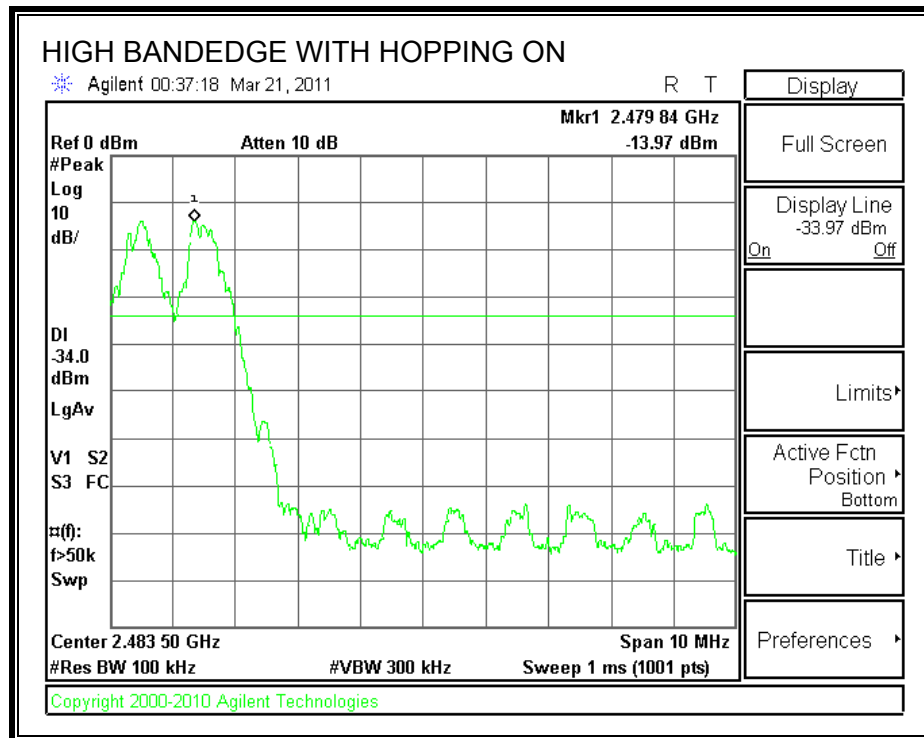
**SPURIOUS EMISSIONS, HIGH CHANNEL**





**SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON**





## 7.2. ENHANCED DATA RATE 8PSK MODULATION

### 7.2.1. 20 dB AND 99% BANDWIDTH

#### LIMIT

None; for reporting purposes only.

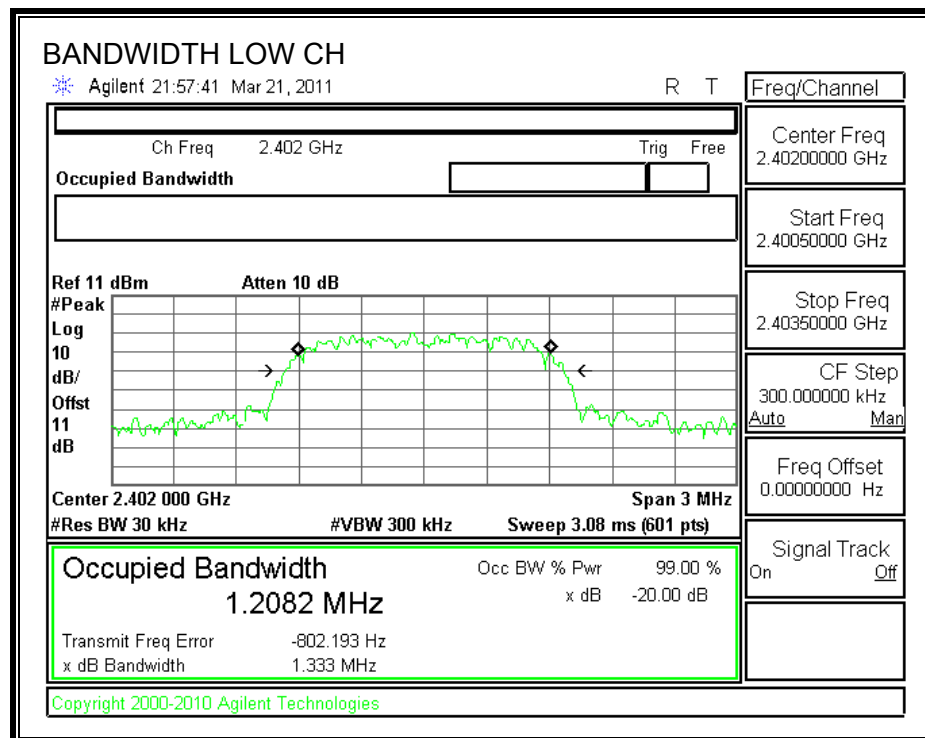
#### TEST PROCEDURE

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

#### RESULTS

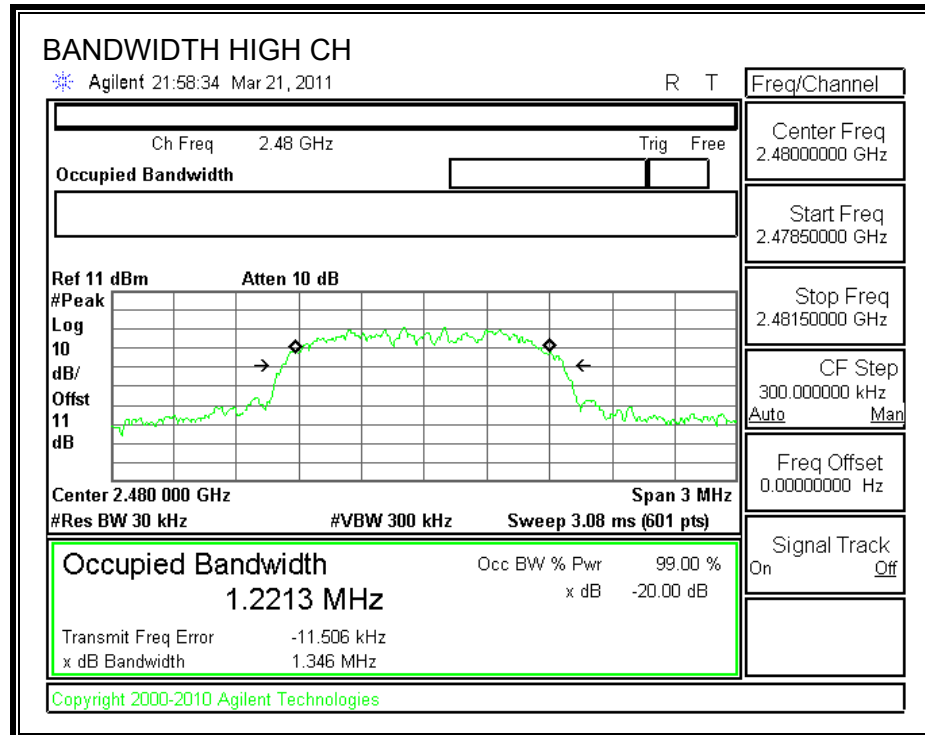
Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	1333	1201.0
Middle	2441	1327	1204.1
High	2480	1346	1223.1

## 20 dB BANDWIDTH

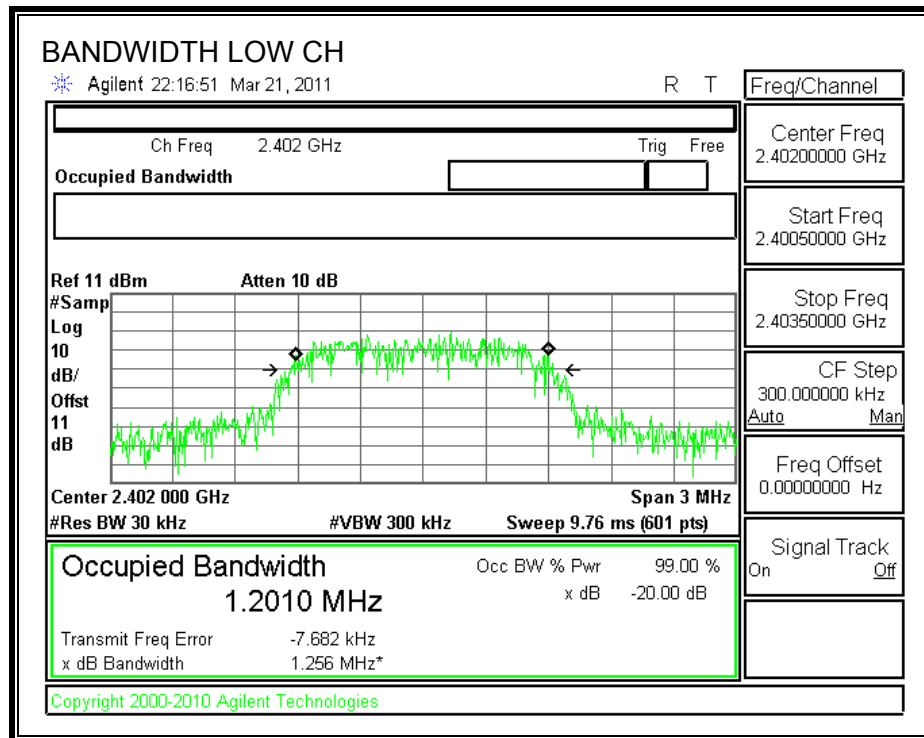


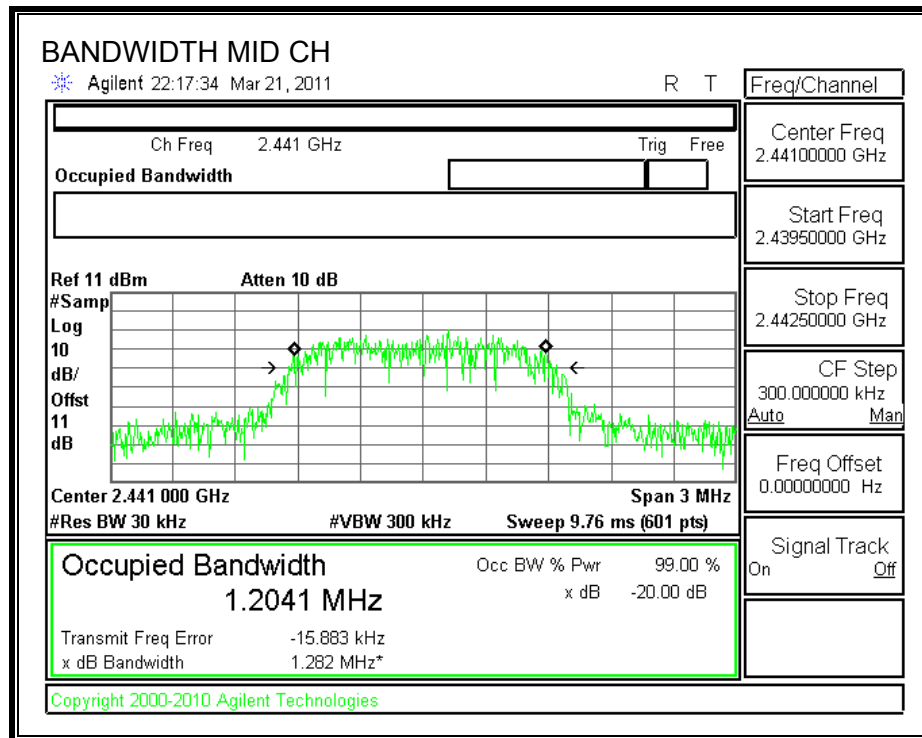


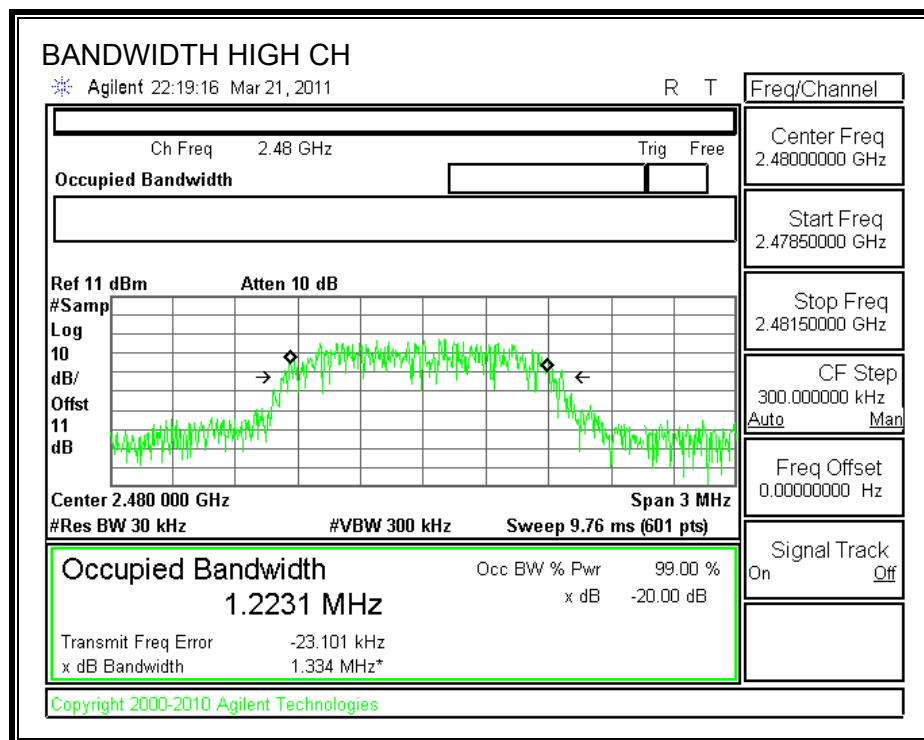




**99% BANDWIDTH**







## **7.2.2. 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.

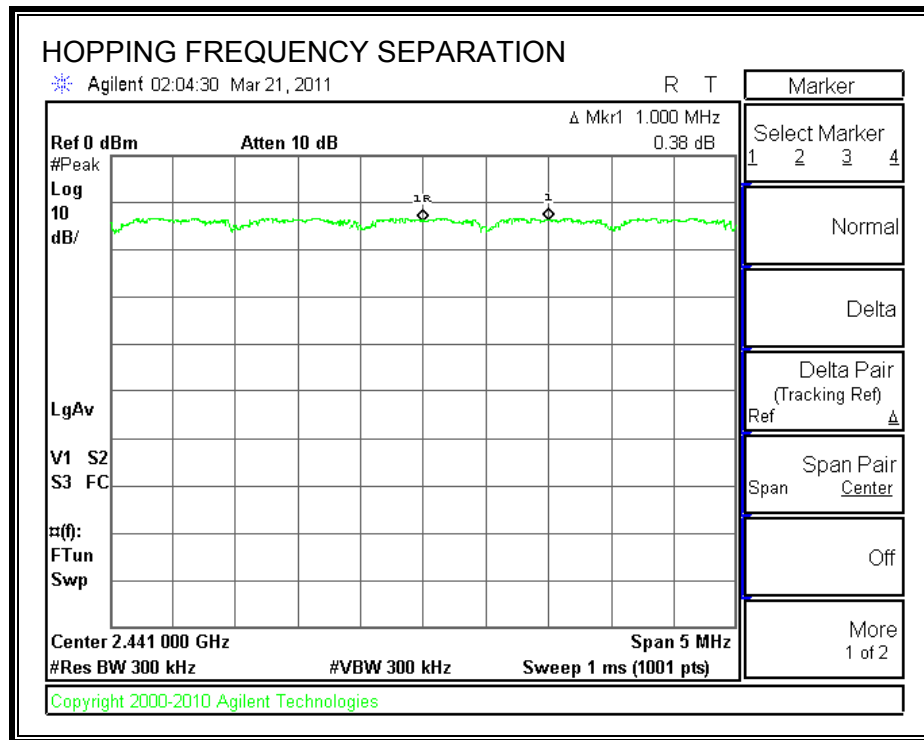
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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



### **7.2.3. 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**

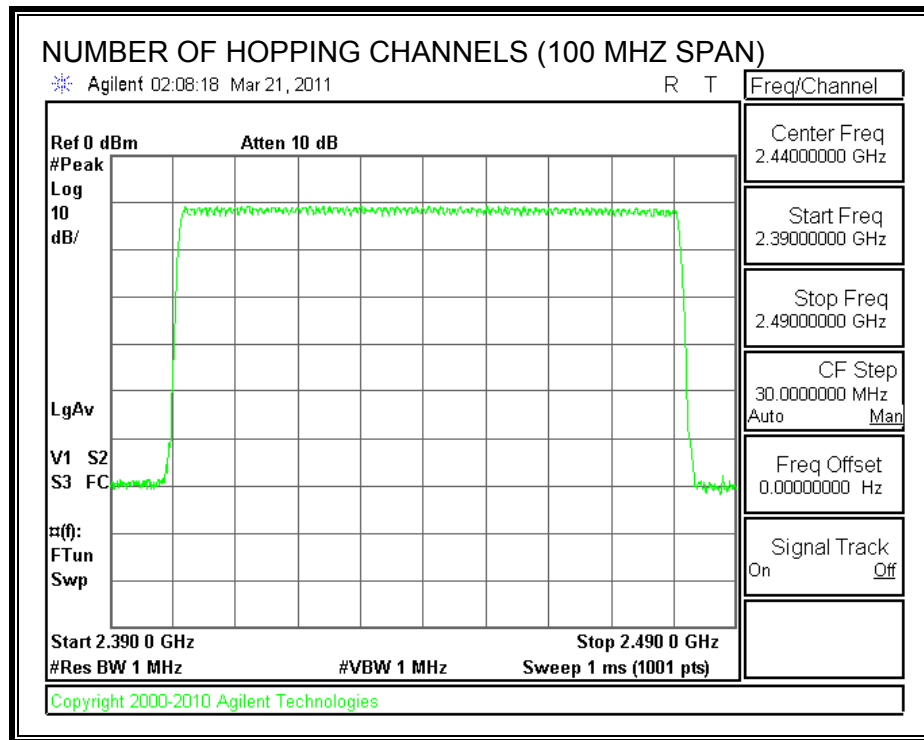
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

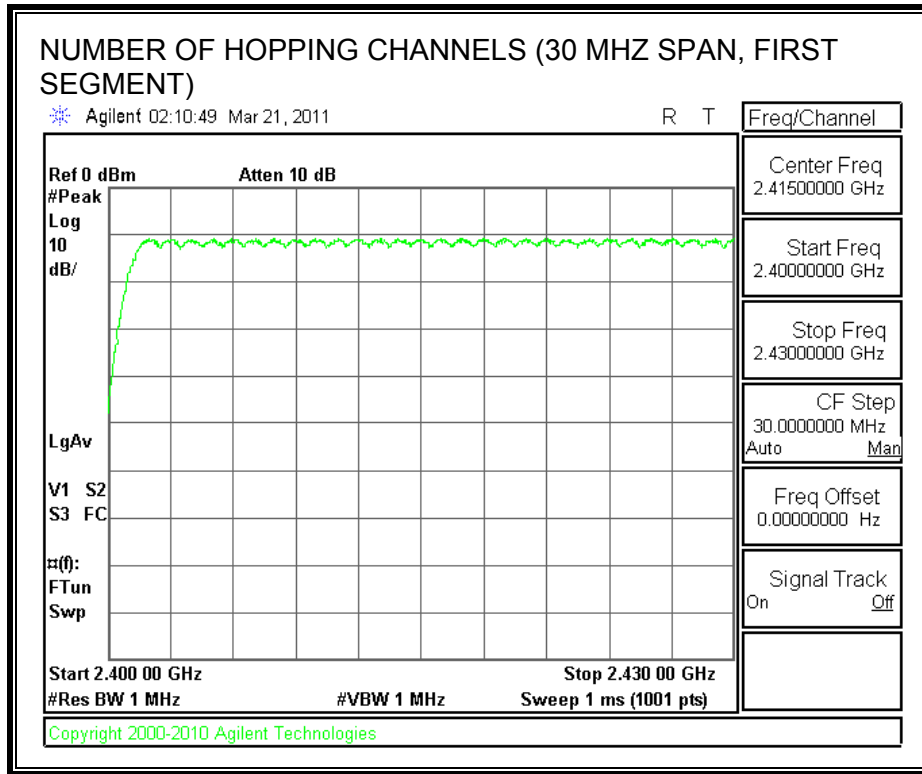
#### **RESULTS**

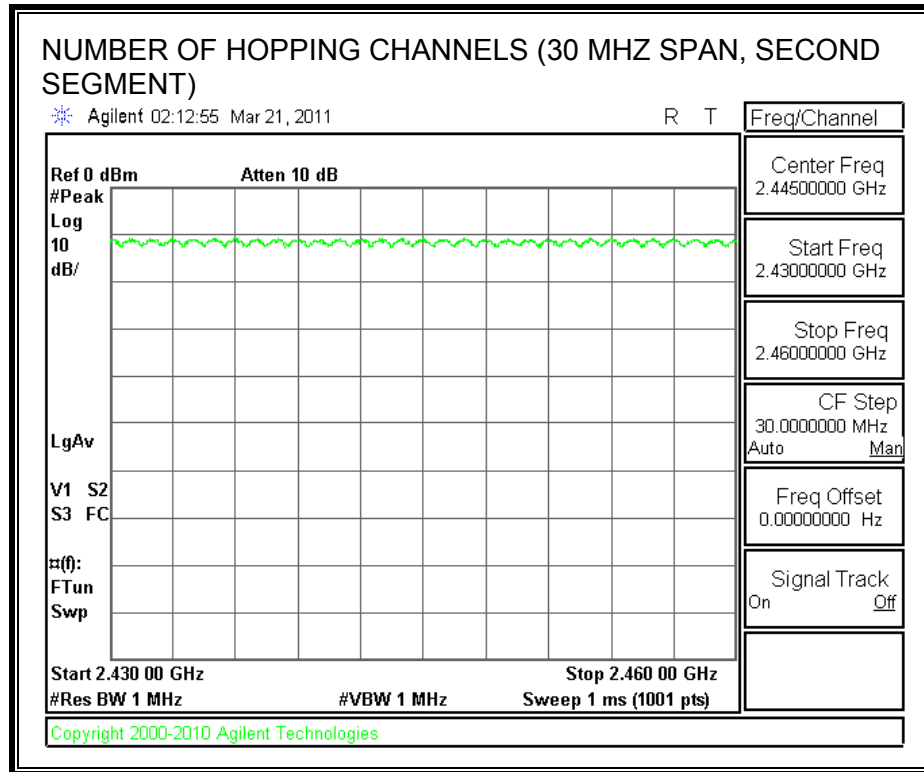
79 Channels observed.

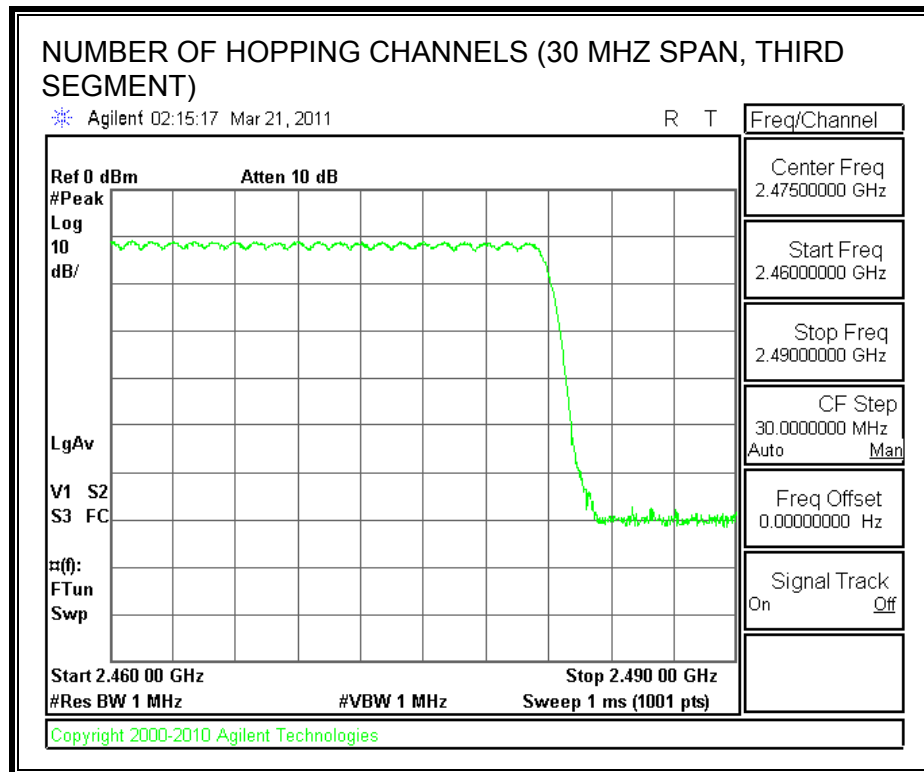


**NUMBER OF HOPPING CHANNELS**









## 7.2.4. 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  $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$ .

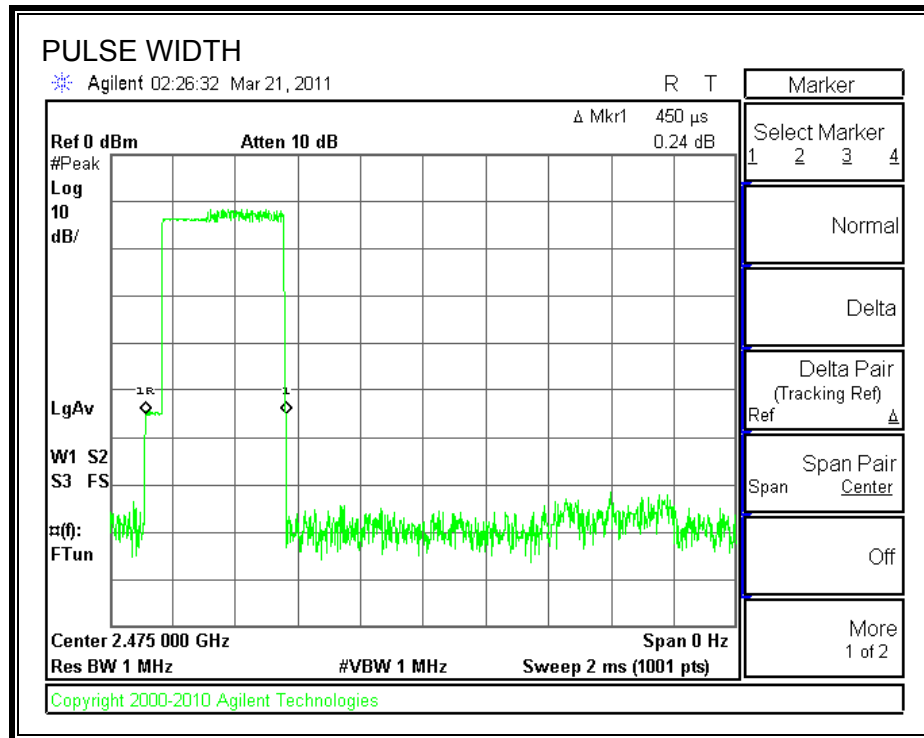
### RESULTS

#### 8PSK Mode

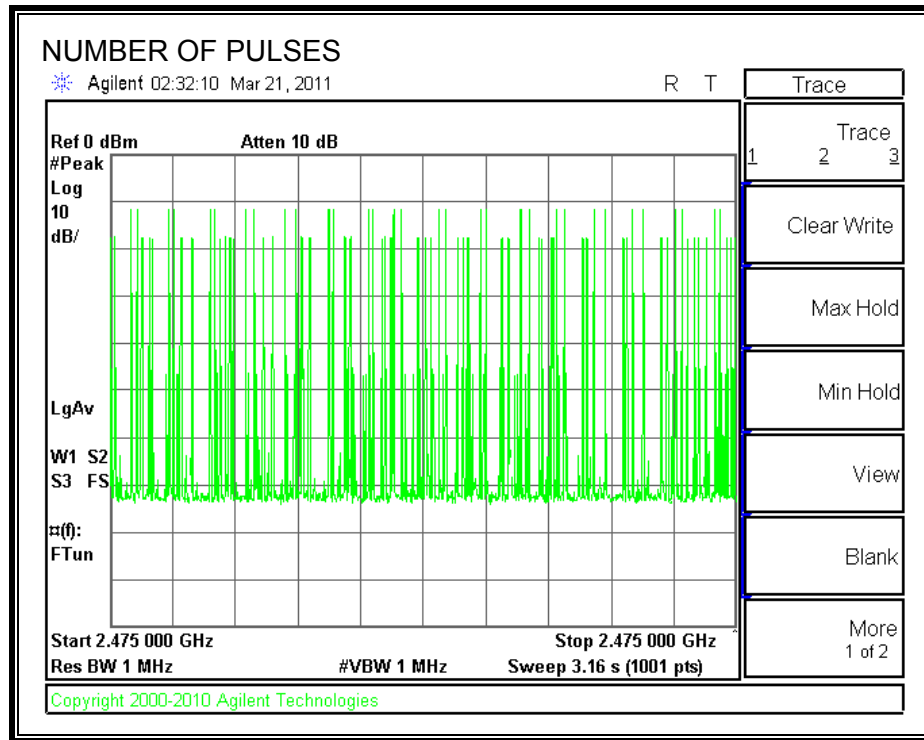
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.45	32	0.144	0.4	0.256
DH3	1.7	15	0.255	0.4	0.145
DH5	2.94	11	0.323	0.4	0.077

**DH1**

**PULSE WIDTH**

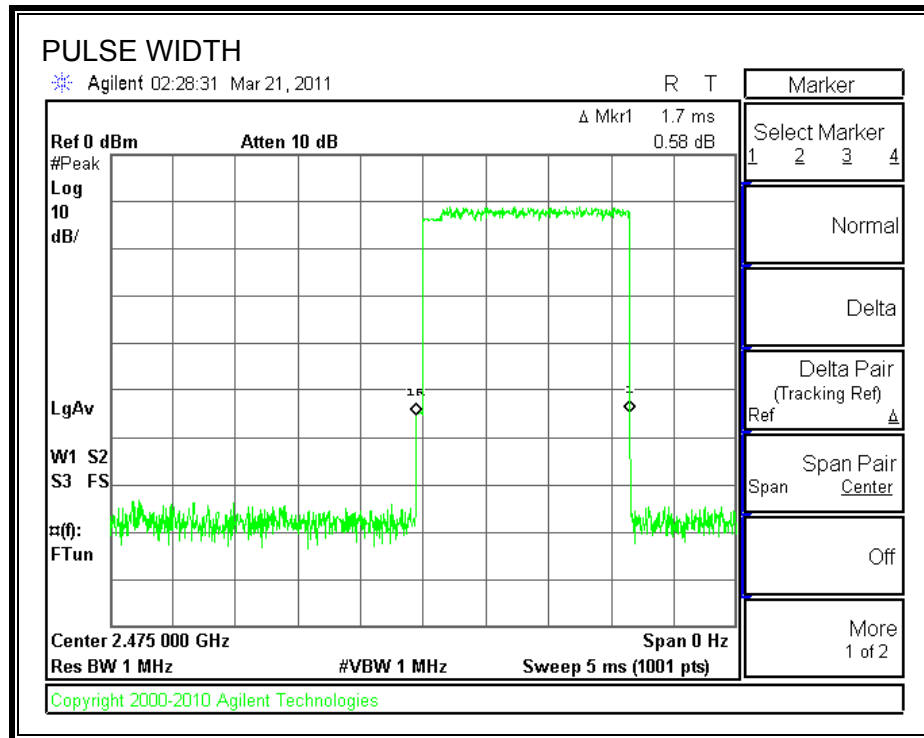


**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD**



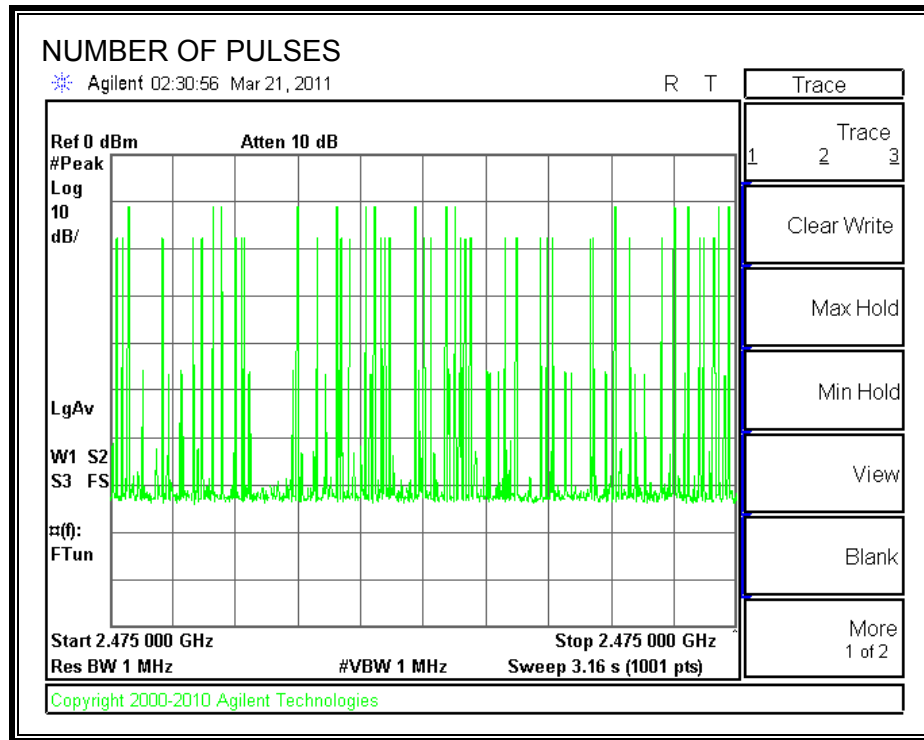
**DH3**

**PULSE WIDTH**



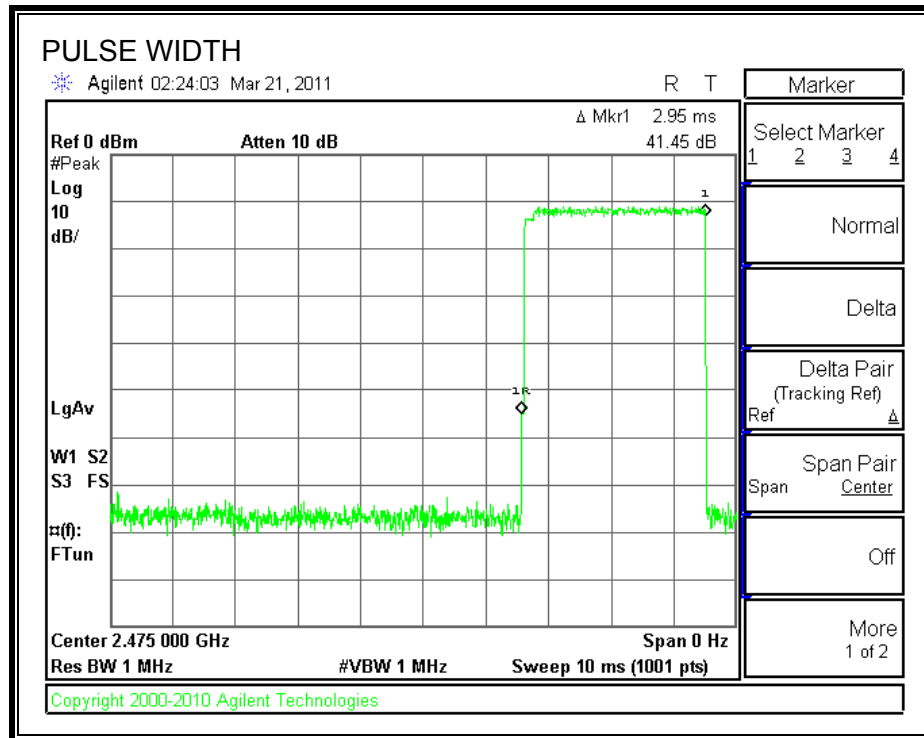


**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD**

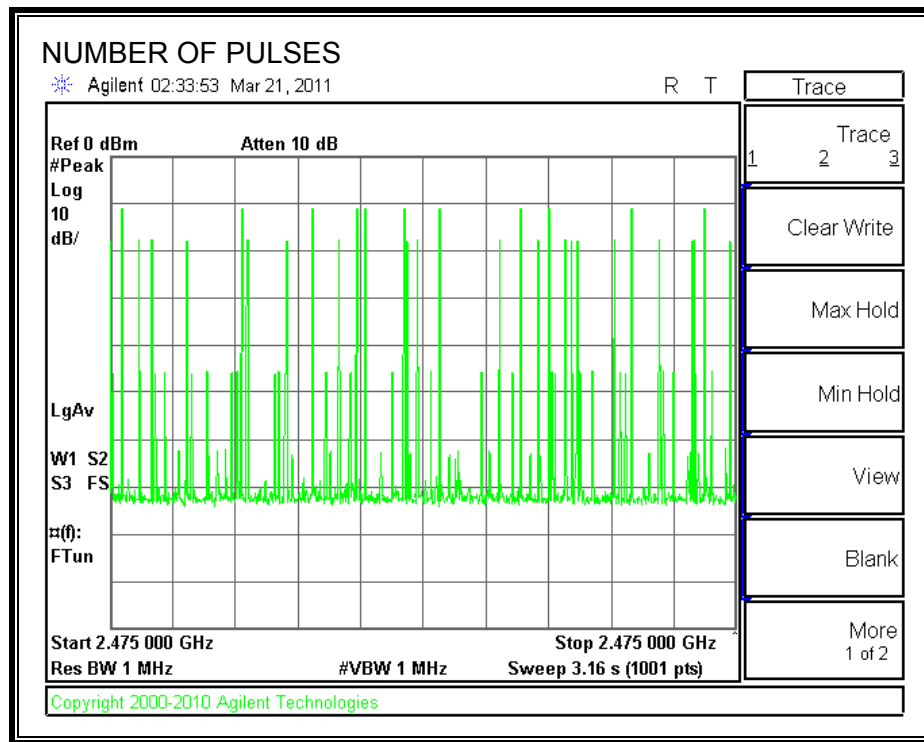


**DH5**

**PULSE WIDTH**



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



## 7.2.5. 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.

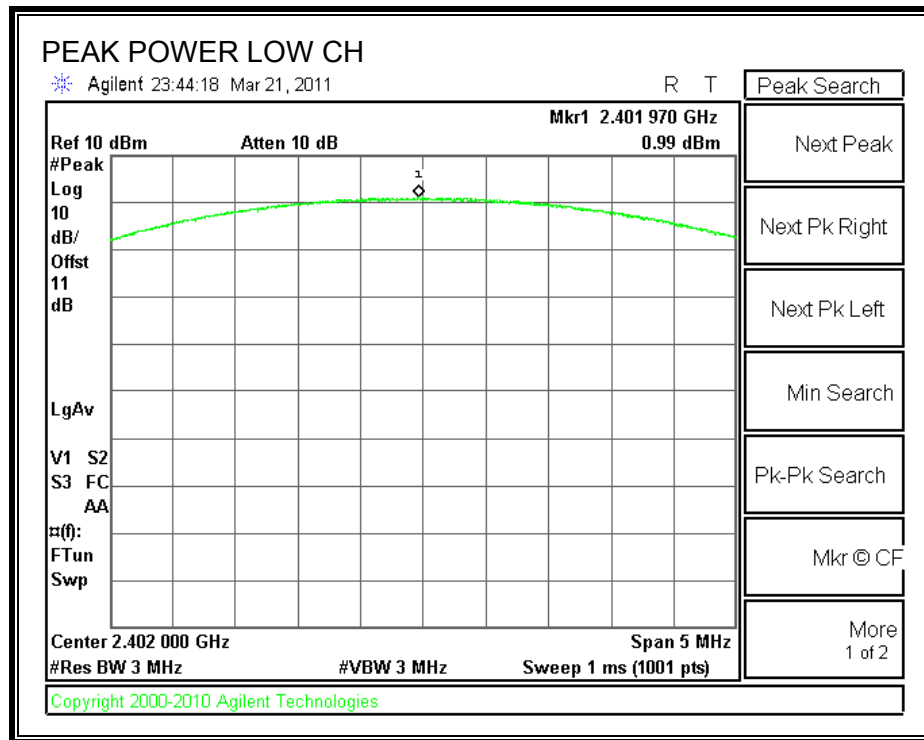
### TEST PROCEDURE

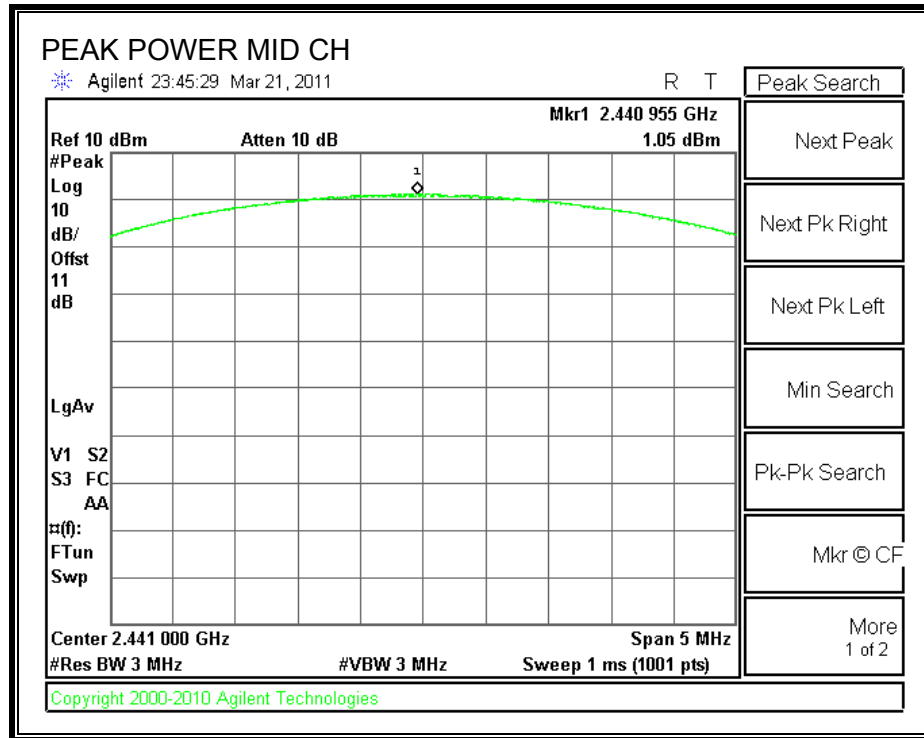
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

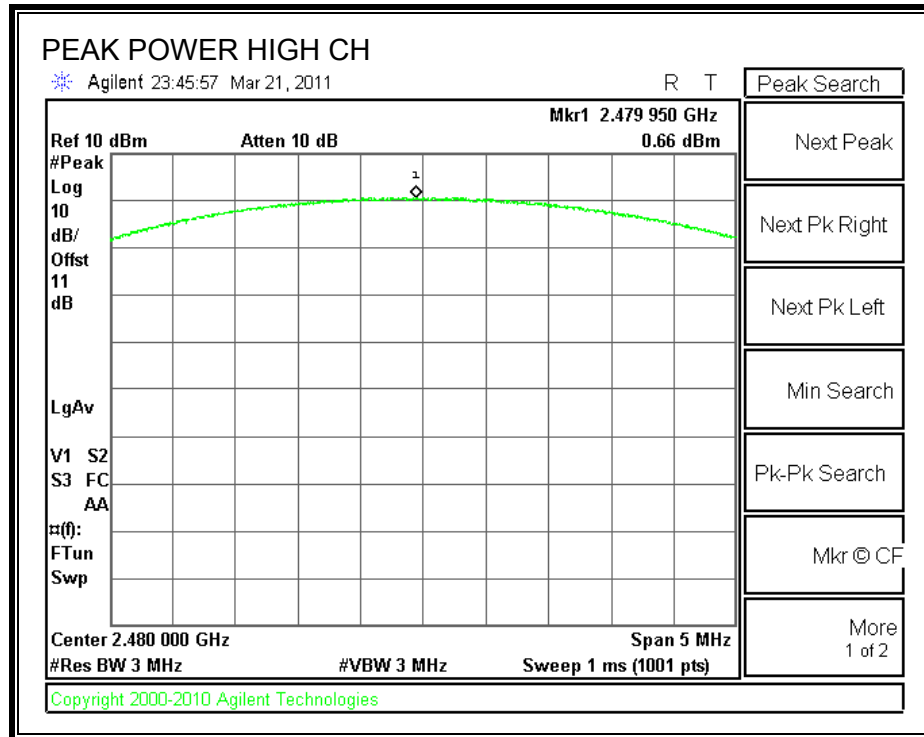
### RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	0.99	30	-29.01
Middle	2441	1.05	30	-28.95
High	2480	0.66	30	-29.34

## OUTPUT POWER







## **7.2.6. 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.

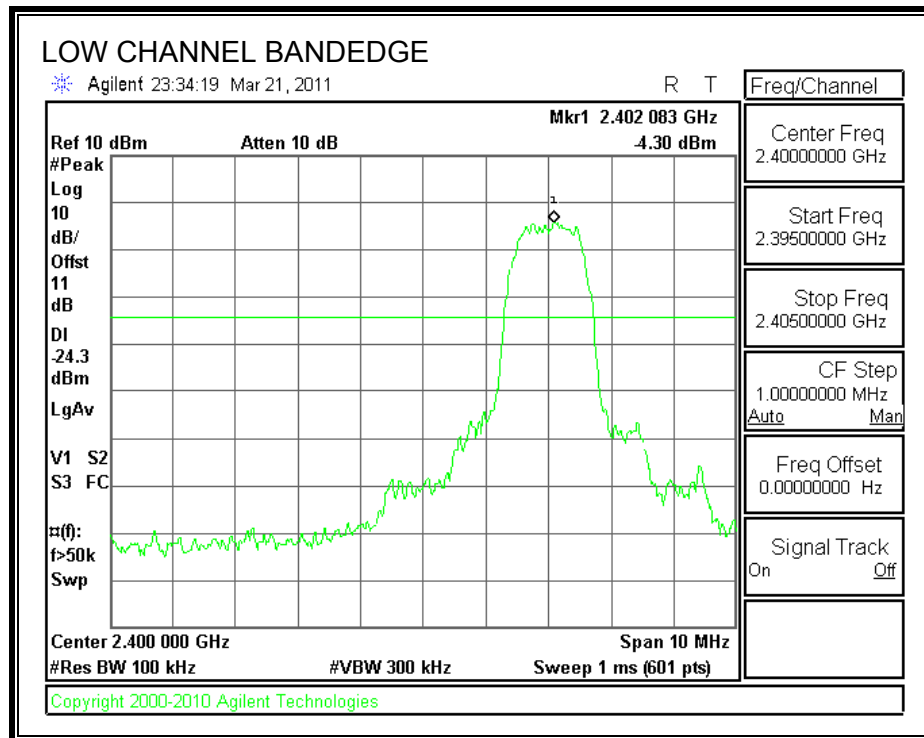
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

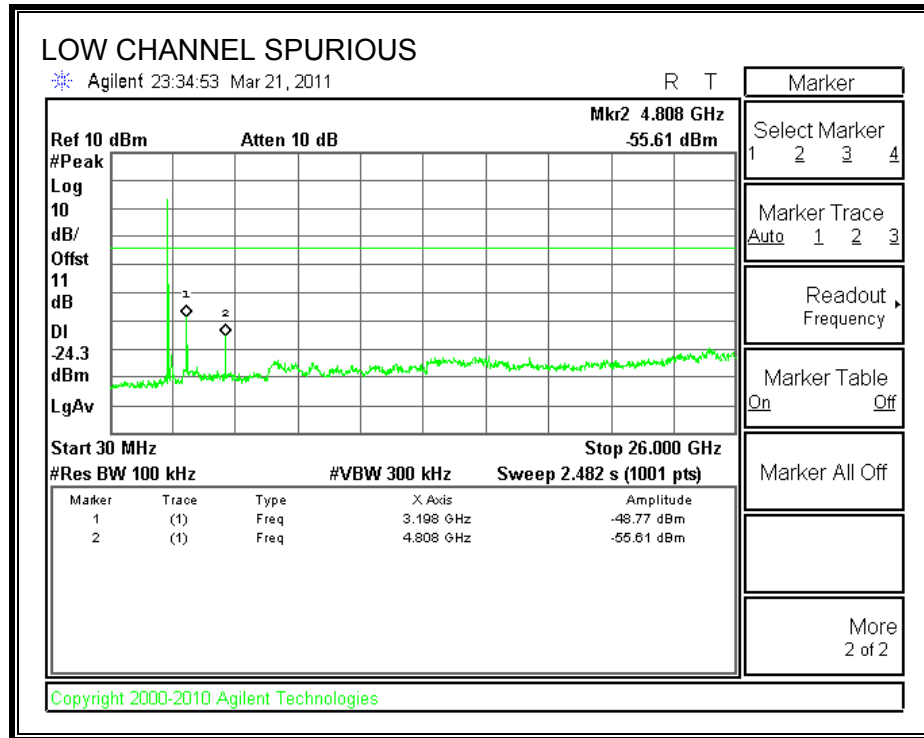
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

### **RESULTS**

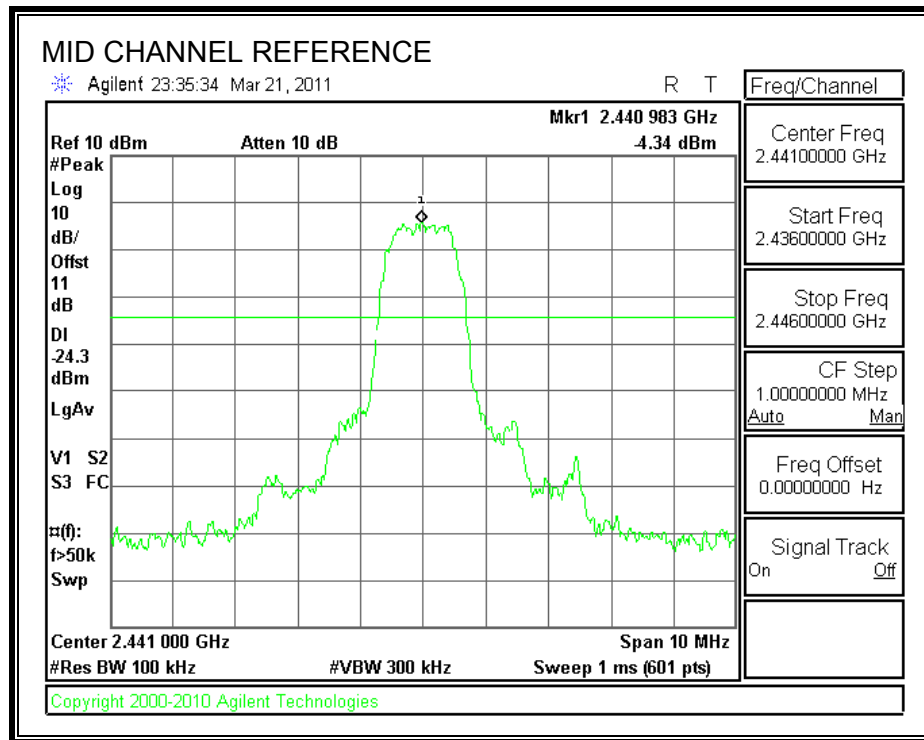


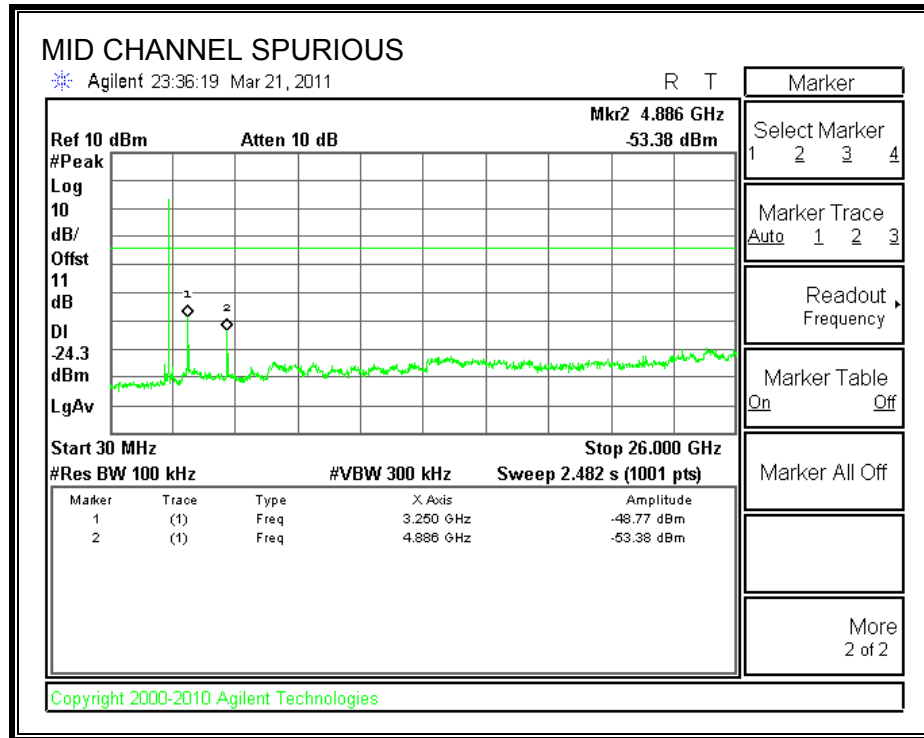
**SPURIOUS EMISSIONS, LOW CHANNEL**



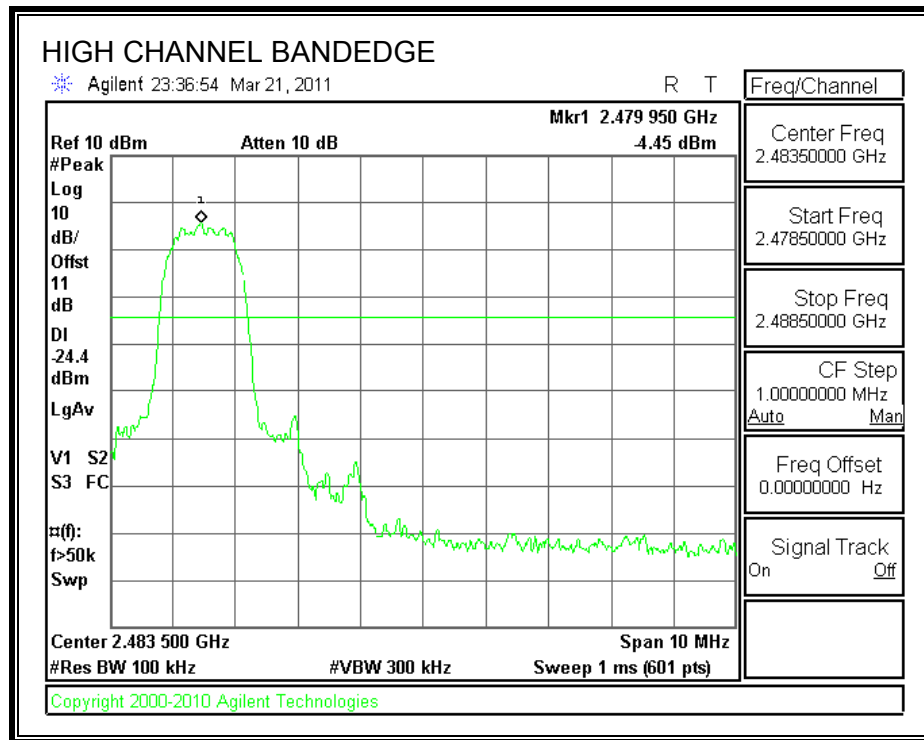


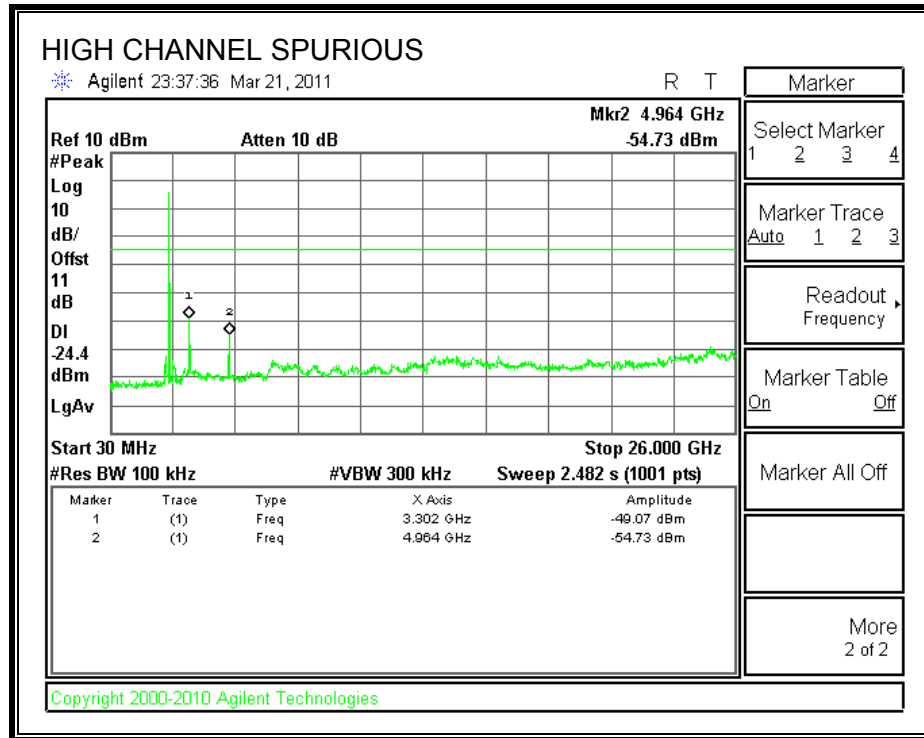
**SPURIOUS EMISSIONS, MID CHANNEL**



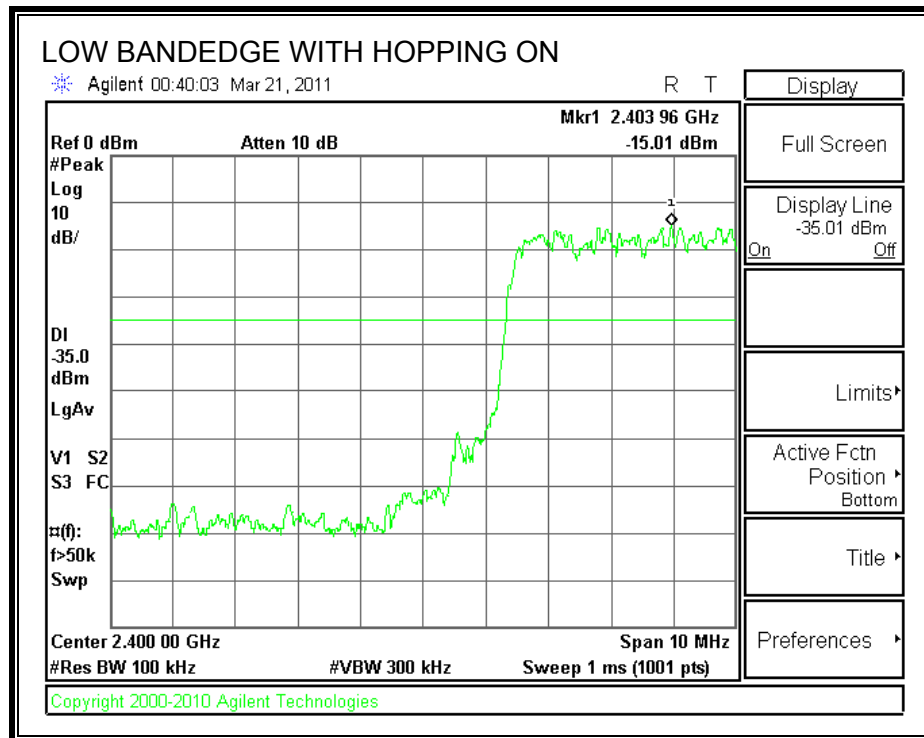


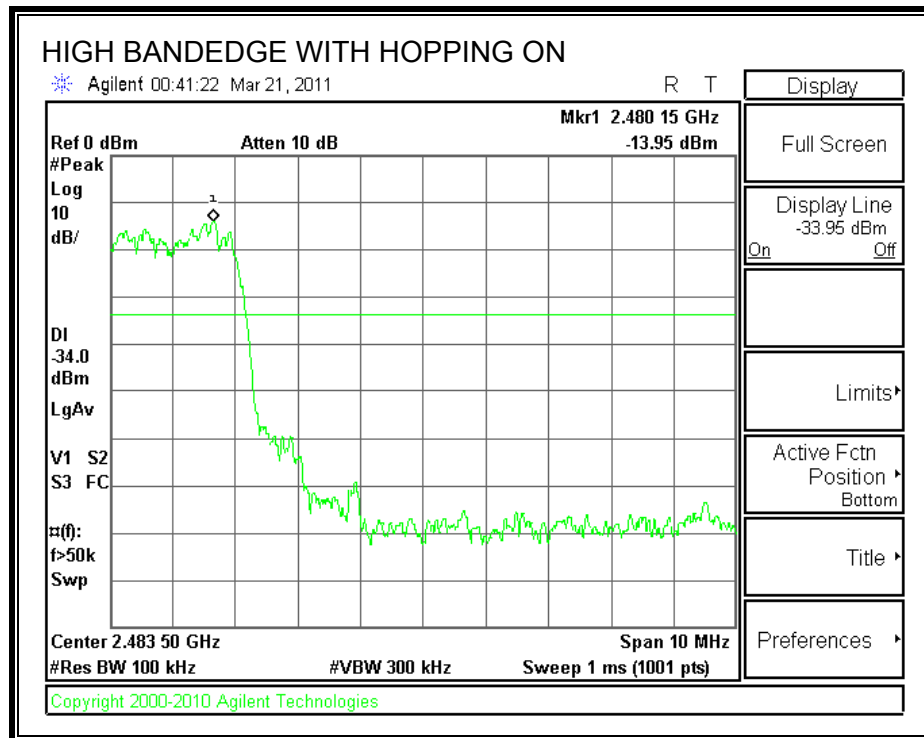
**SPURIOUS EMISSIONS, HIGH CHANNEL**





**SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON**







### 7.3. BLE BASIC DATA RATE GFSK MODULATION

#### 7.3.1. 20 dB AND 99% BANDWIDTH

##### LIMIT

None; for reporting purposes only.

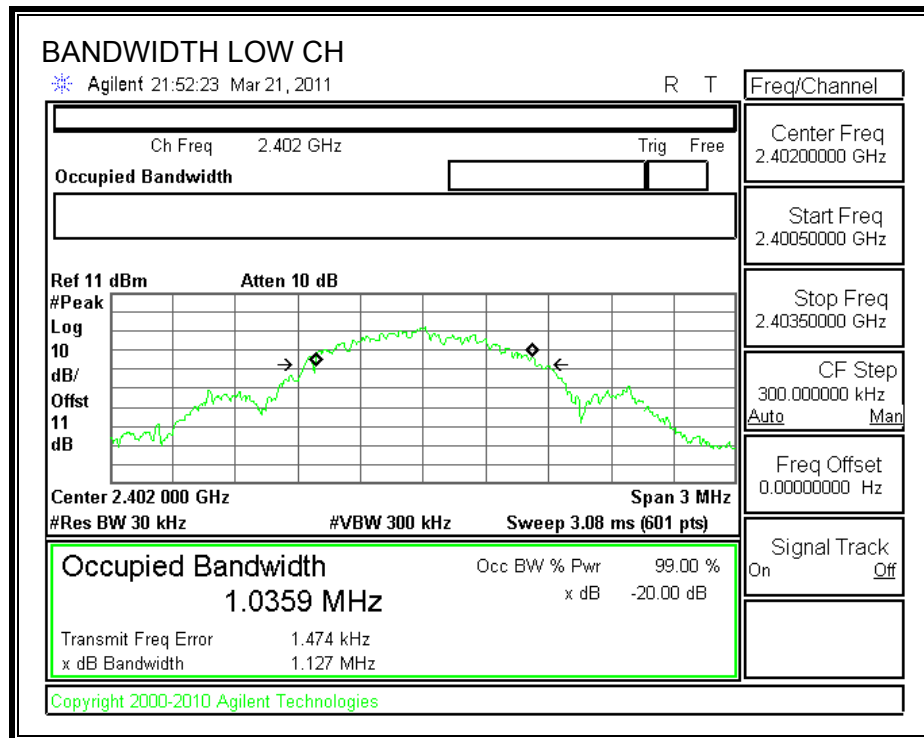
##### TEST PROCEDURE

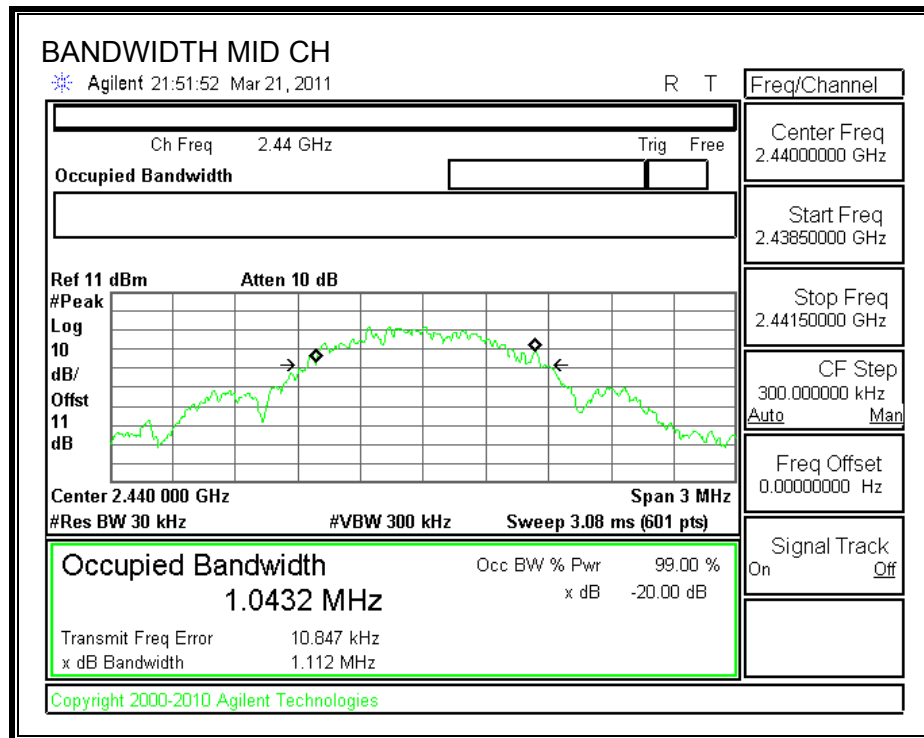
The transmitter output is connected to a spectrum analyzer. The RBW is set to  $\geq 1\%$  of the 20 dB bandwidth. The VBW is set to  $\geq$  RBW. The sweep time is coupled.

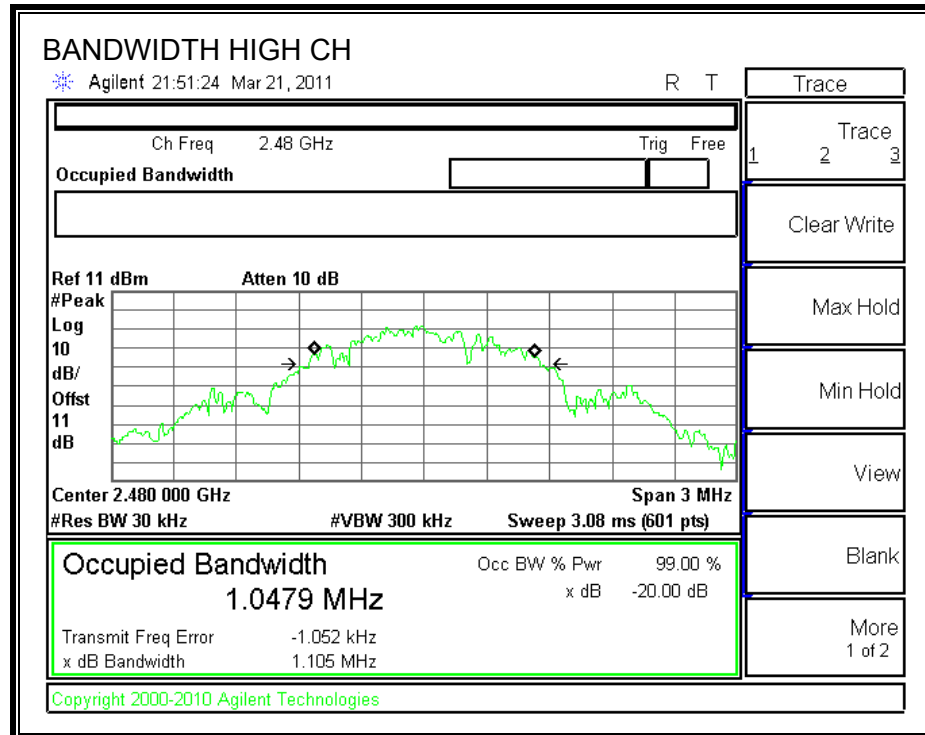
##### RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	1127.0	1028.1
Middle	2440	1112.0	979.5
High	2480	1105.0	1016.1

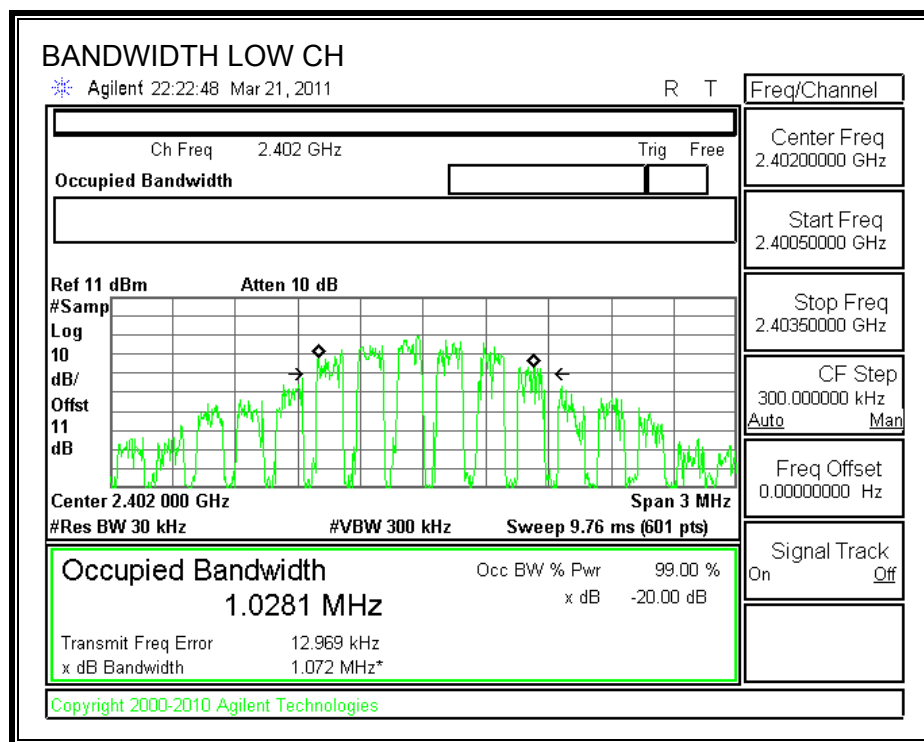
**20 dB BANDWIDTH**

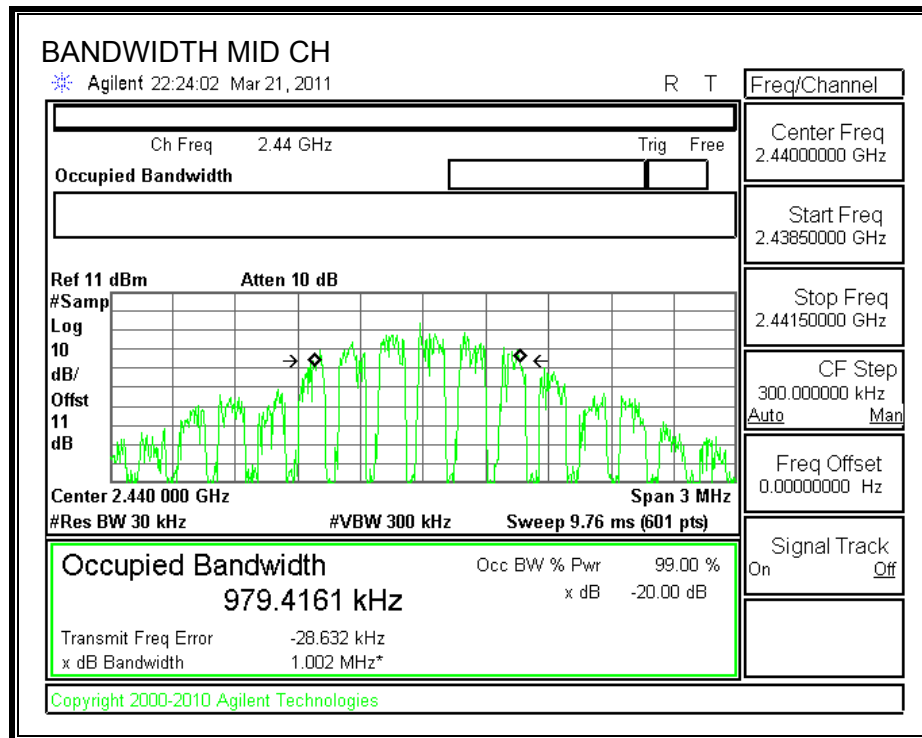


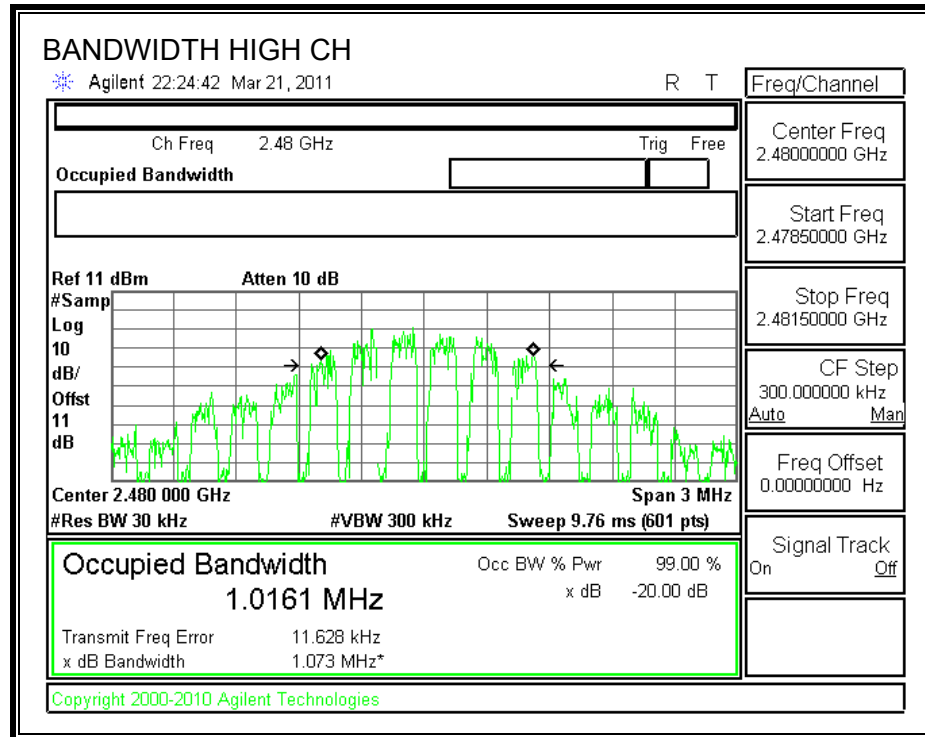




**99% BANDWIDTH**







### **7.3.2. 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.

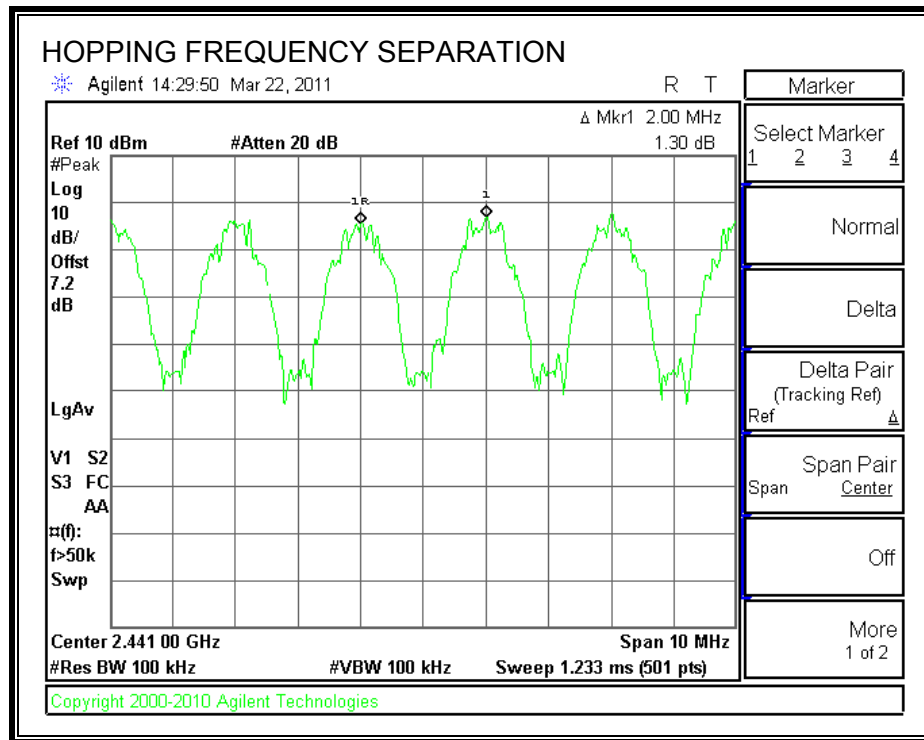
#### **TEST PROCEDURE**

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



### **7.3.3. 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.

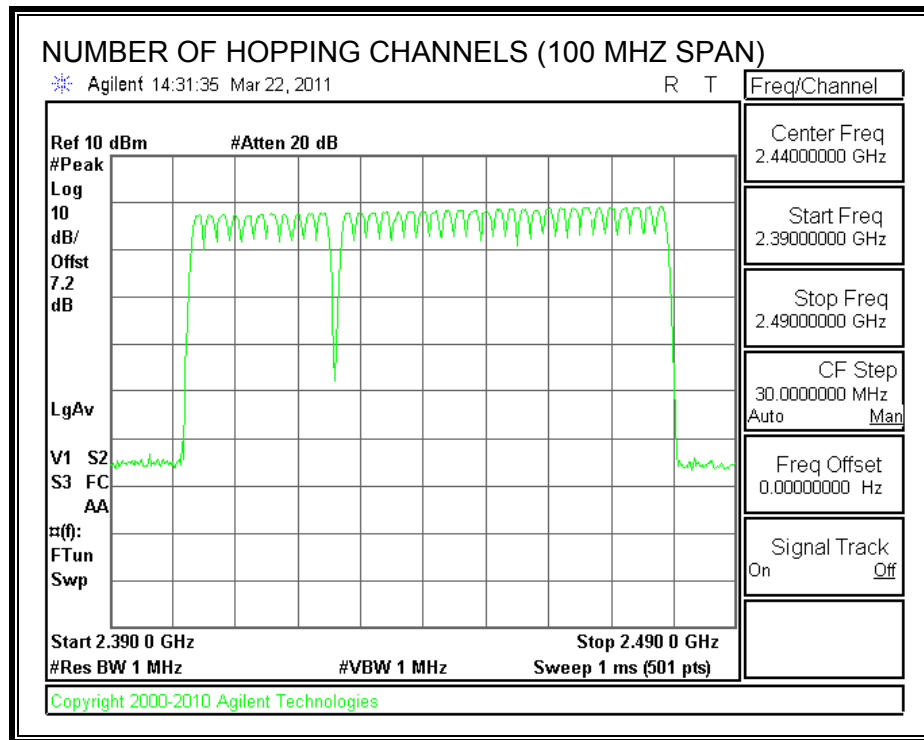
#### **TEST PROCEDURE**

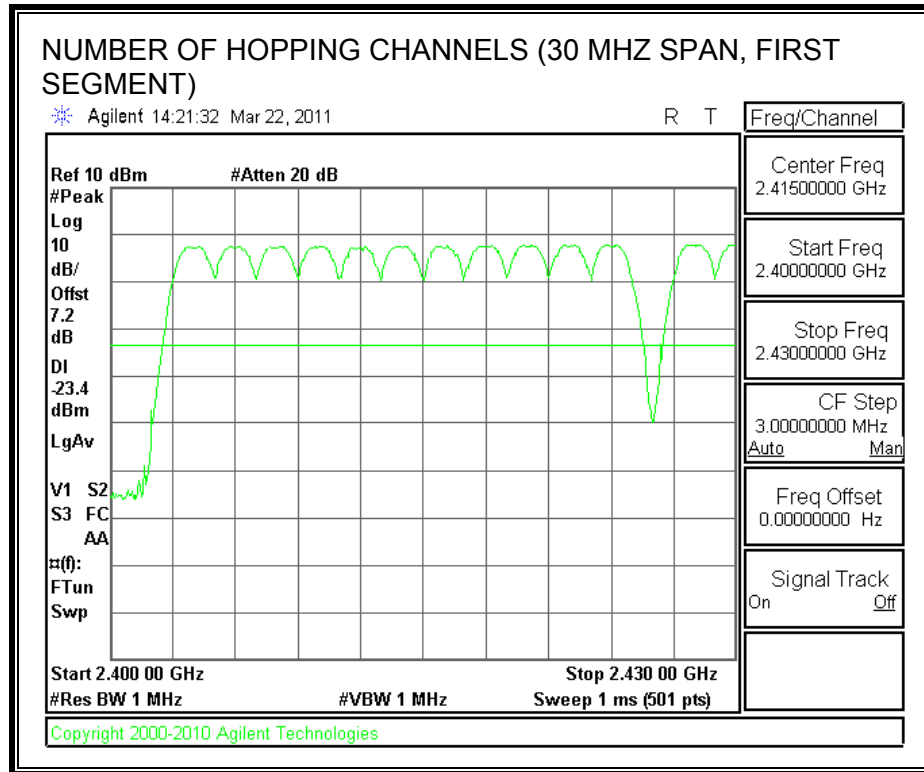
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

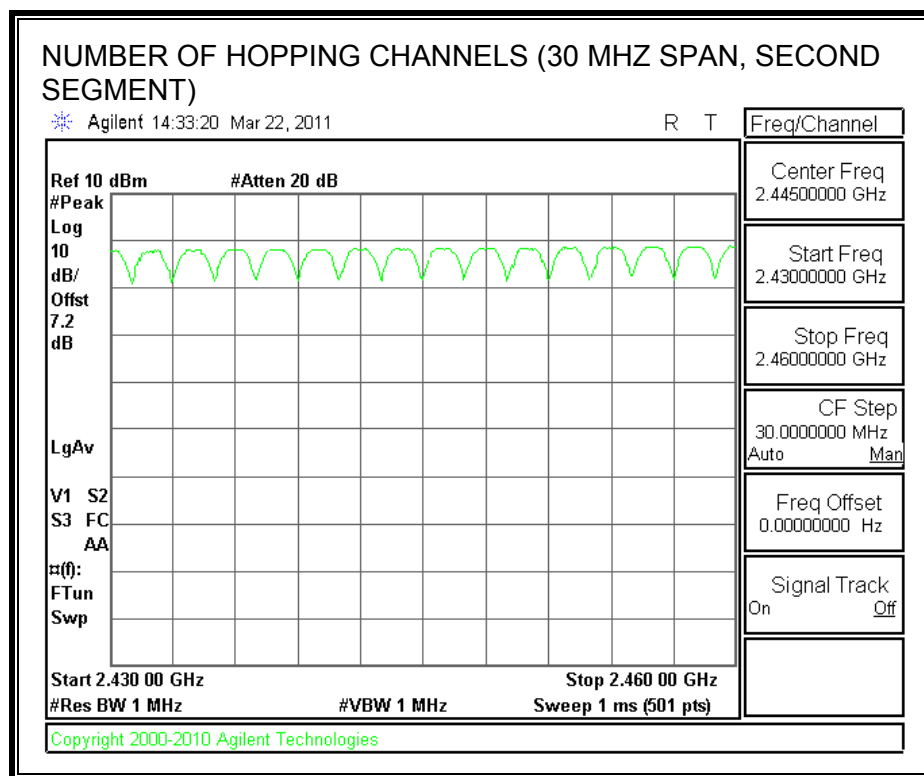
#### **RESULTS**

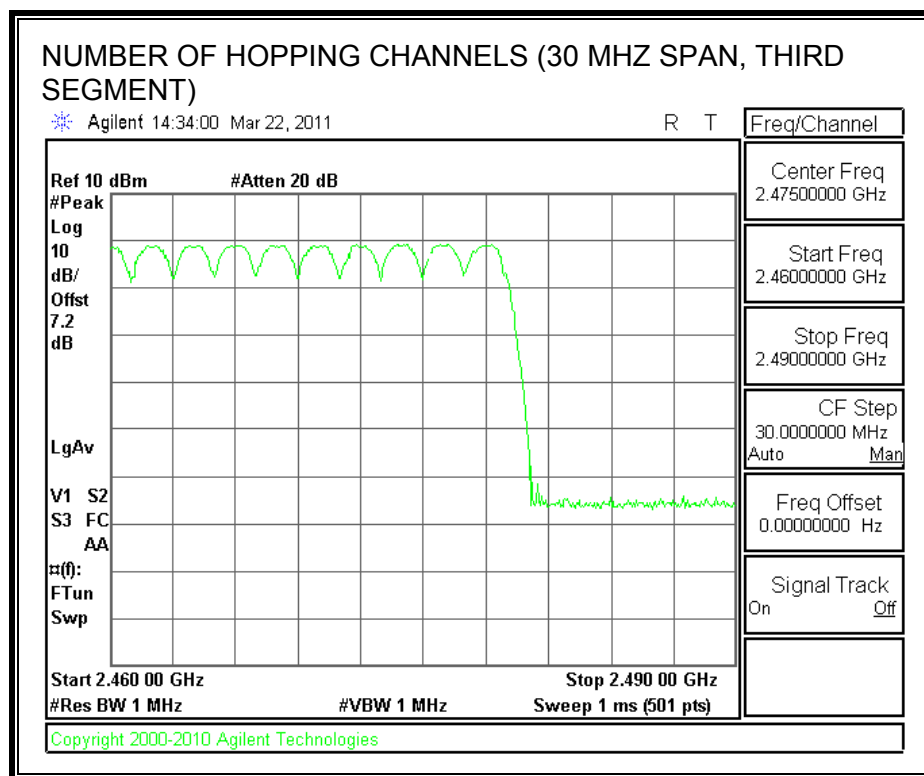
37 channels observation, please see advertising channels for 2402, 2426, and 2480MHz explanation in separated document.

# NUMBER OF HOPPING CHANNELS









### 7.3.4. 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

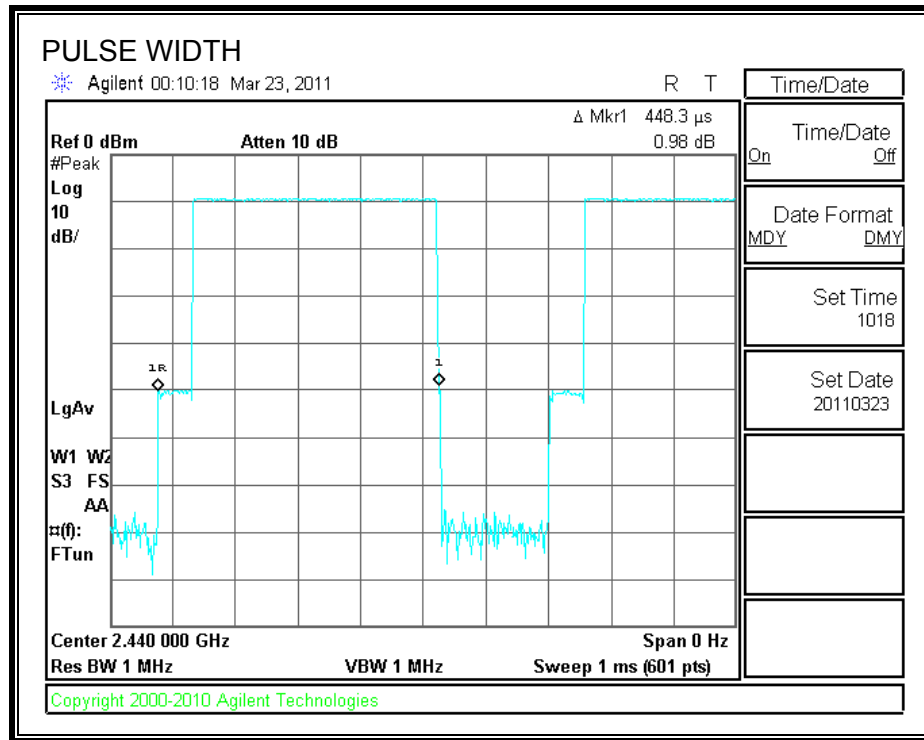
The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 1.60 second scan, to enable resolution of each occurrence.

The average time of occupancy in the specified 1.60 second period (40 channels \* 0.4 s) is equal to  $10 * (\# \text{ of pulses in } 1.60 \text{ s}) * \text{pulse width}$ .

#### RESULTS

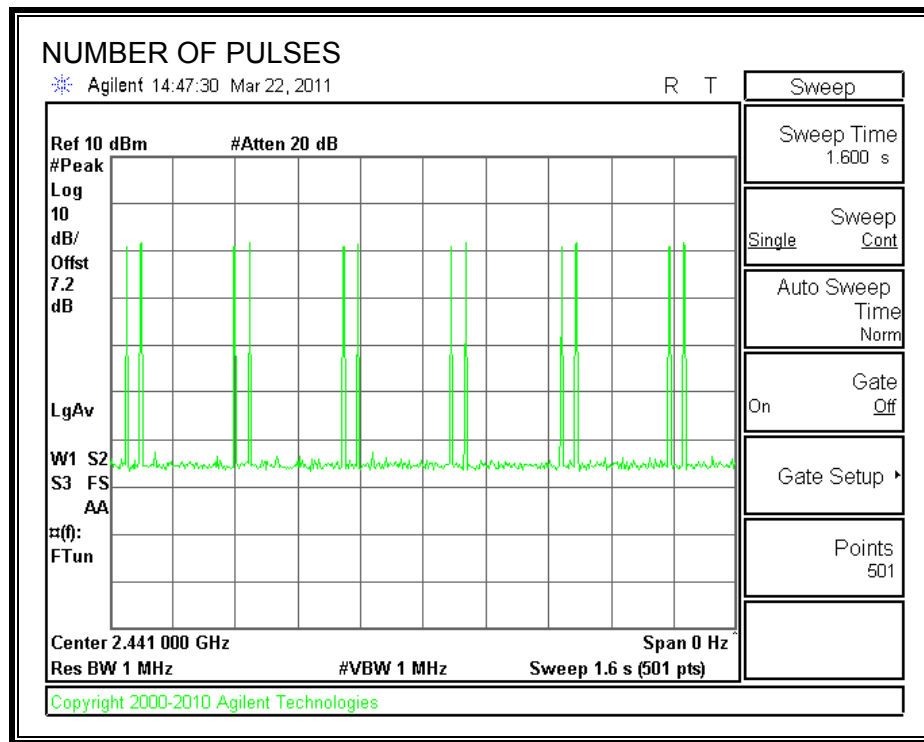
Pulse Width (msec)	Number of Pulses in 1.6 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
0.4483	12	0.054	0.4	0.346

## PULSE WIDTH





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



### 7.3.5. 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.

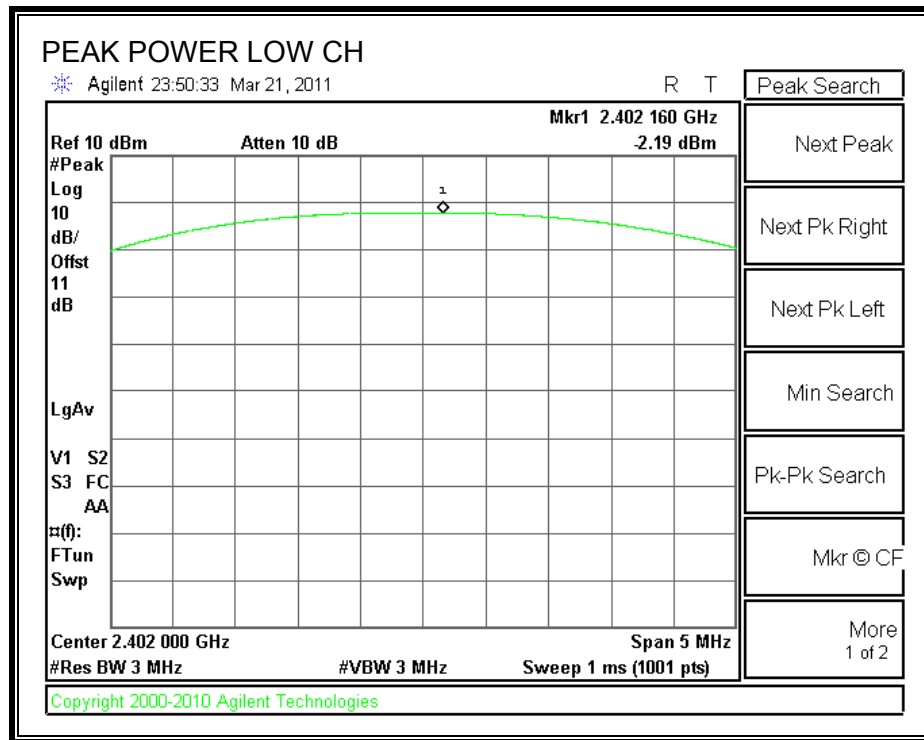
#### TEST PROCEDURE

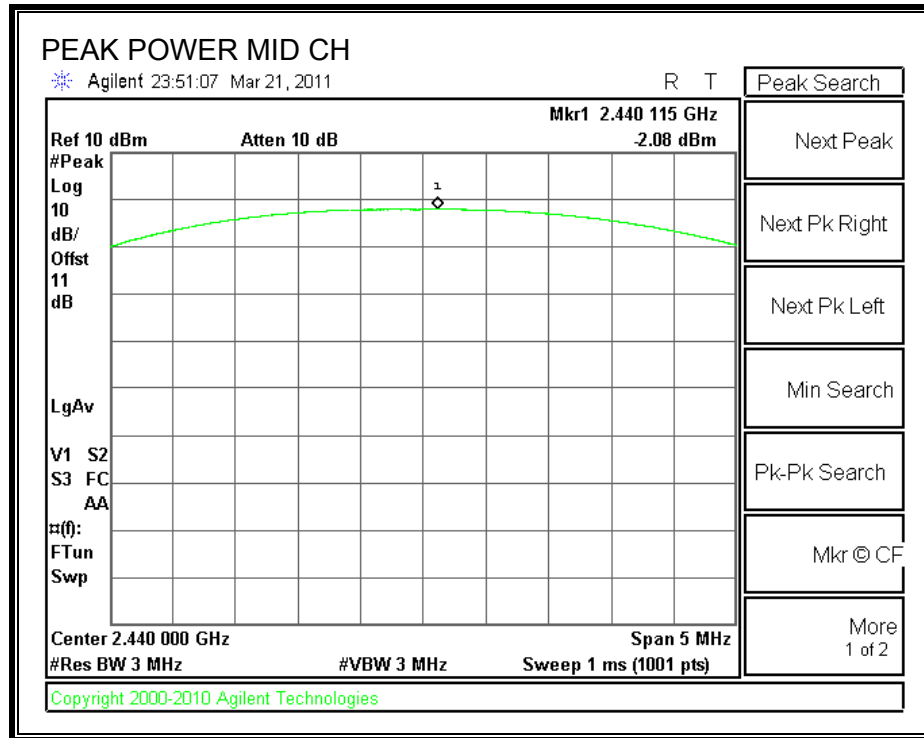
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

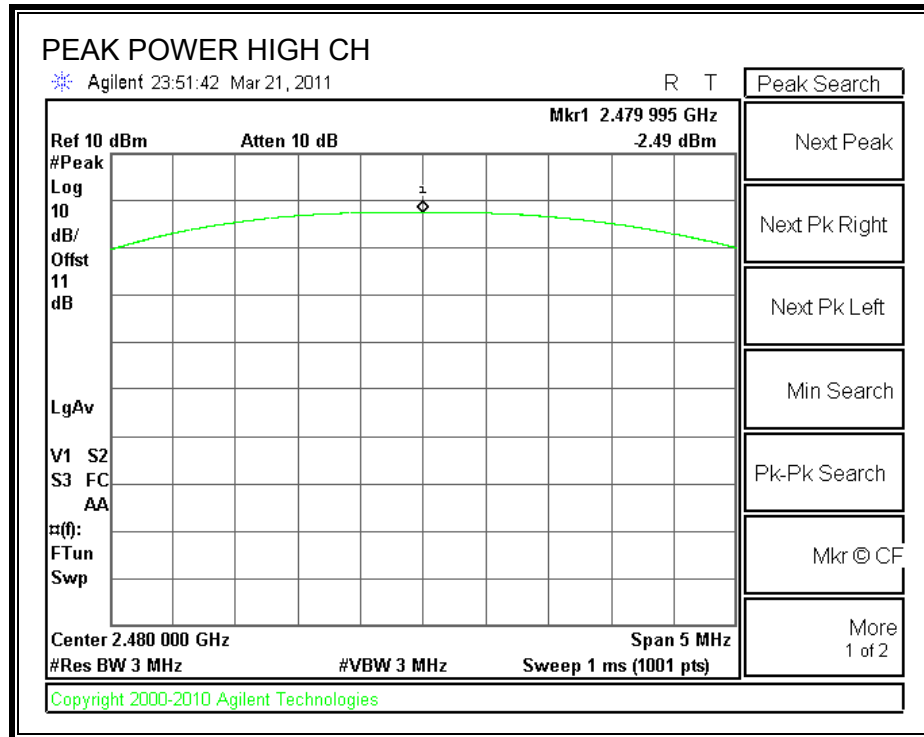
#### RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-2.19	30	-32.19
Middle	2440	-2.08	30	-32.08
High	2480	-2.49	30	-32.49

## OUTPUT POWER







### **7.3.6. CONDUCTED SPURIOUS EMISSIONS**

#### **LIMITS**

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

#### **TEST PROCEDURE**

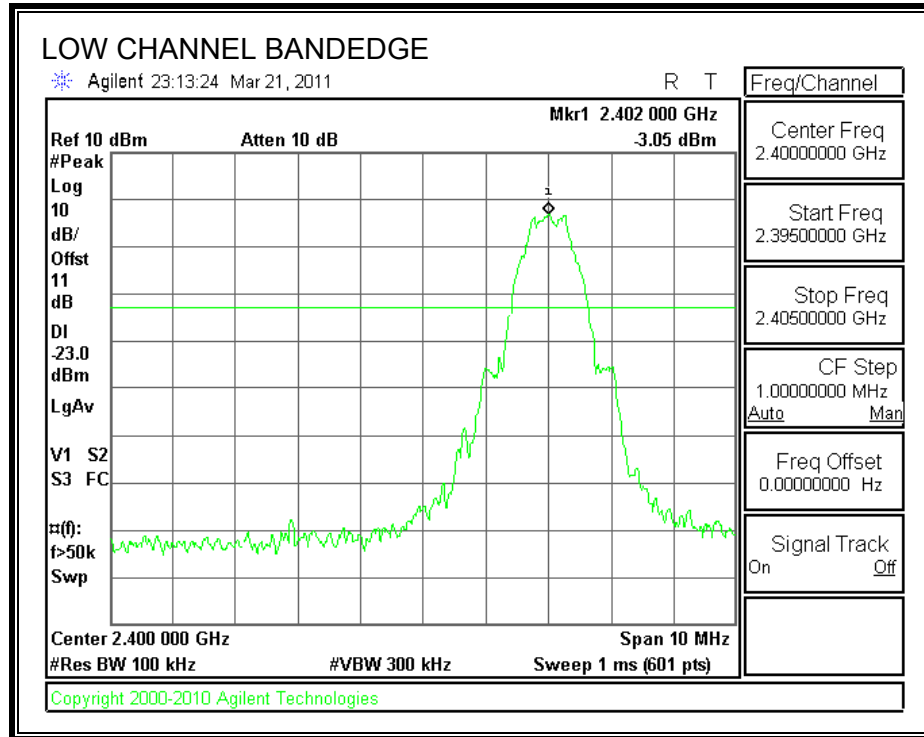
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

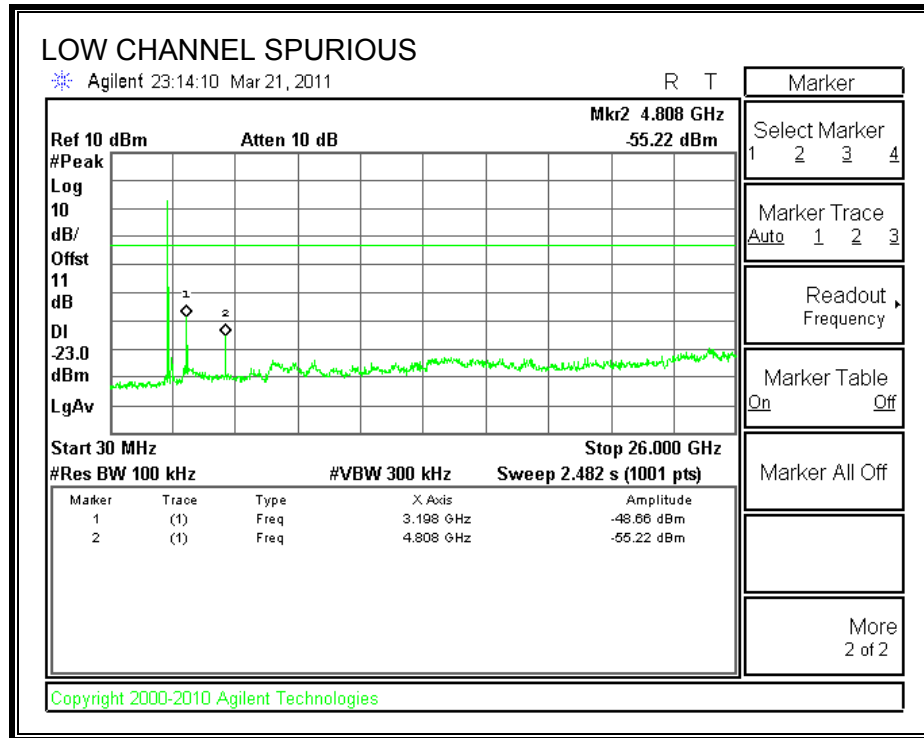
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

#### **RESULTS**

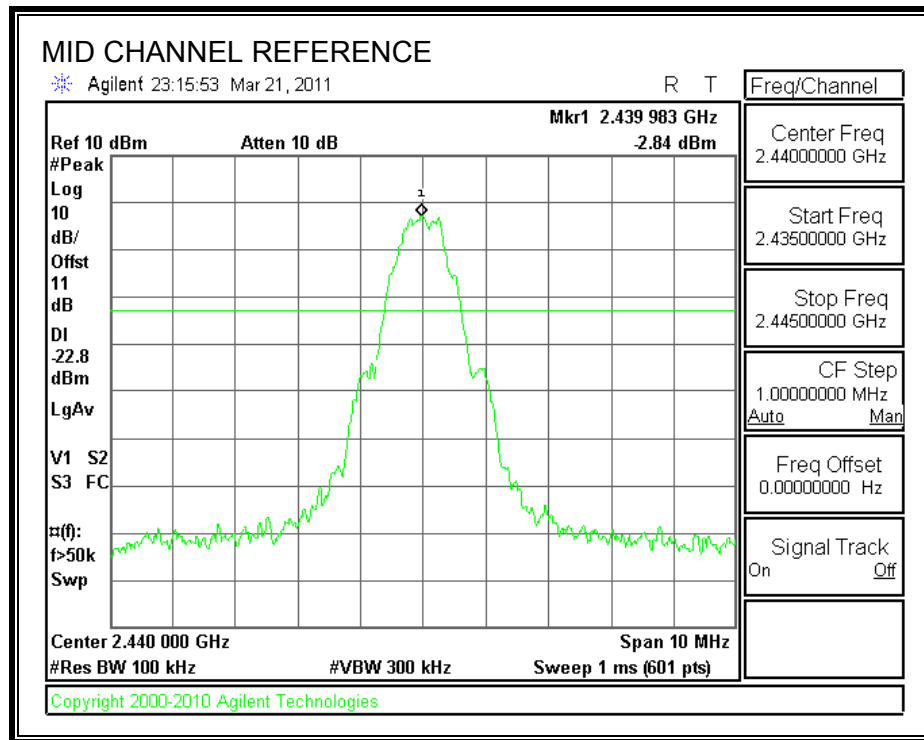
**SPURIOUS EMISSIONS, LOW CHANNEL**

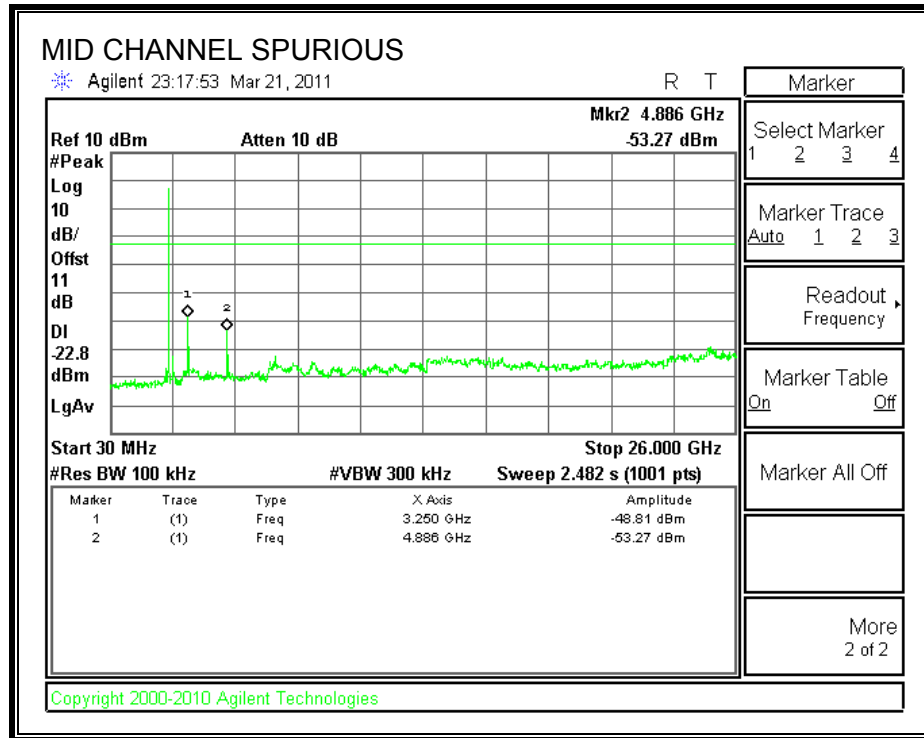




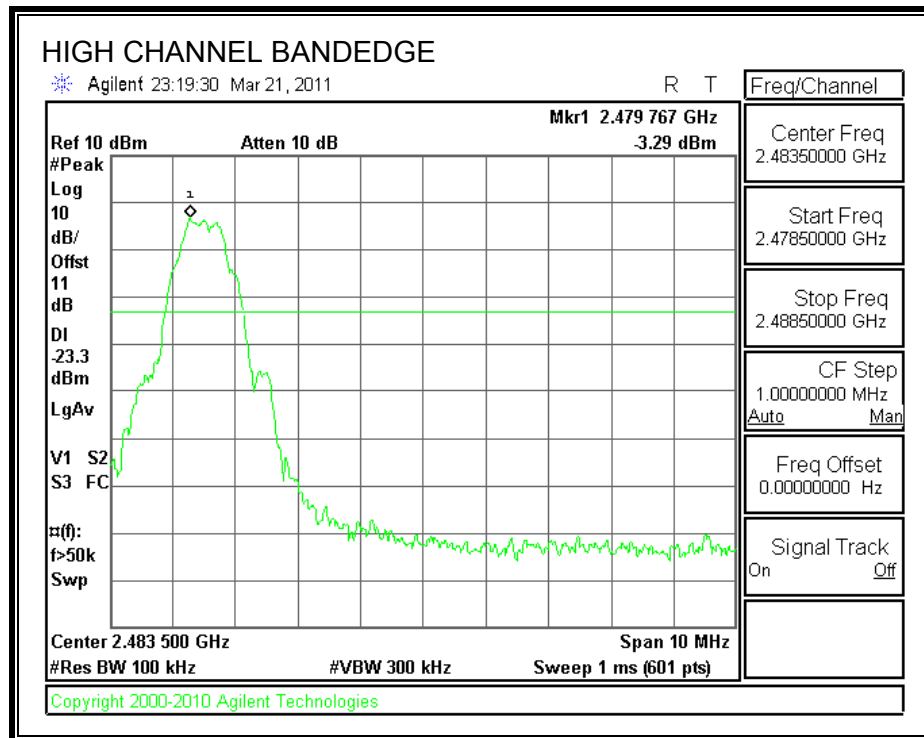


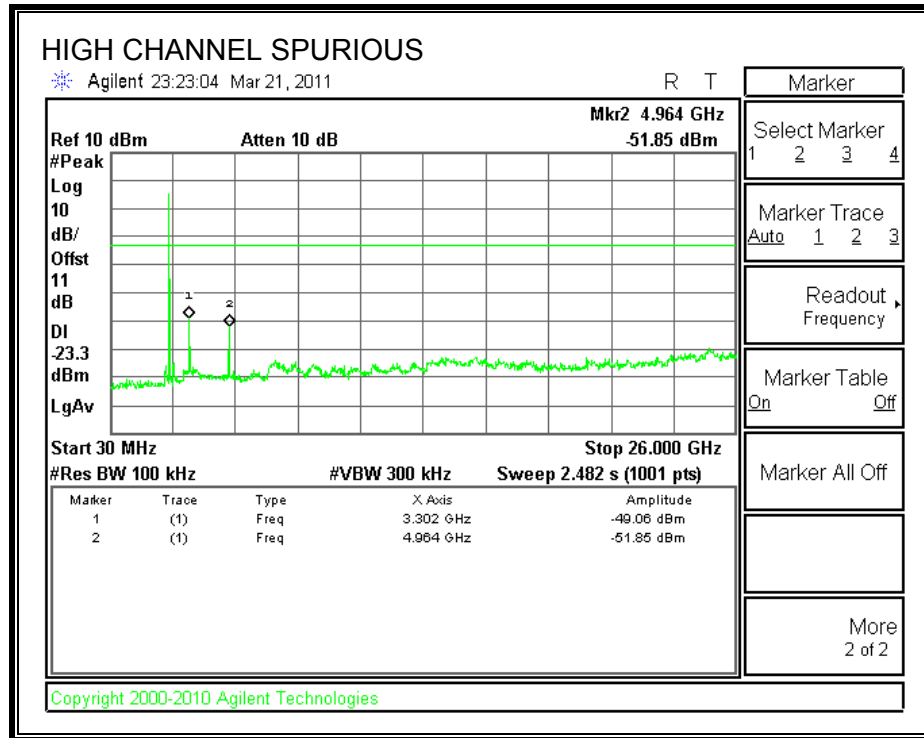
**SPURIOUS EMISSIONS, MID CHANNEL**



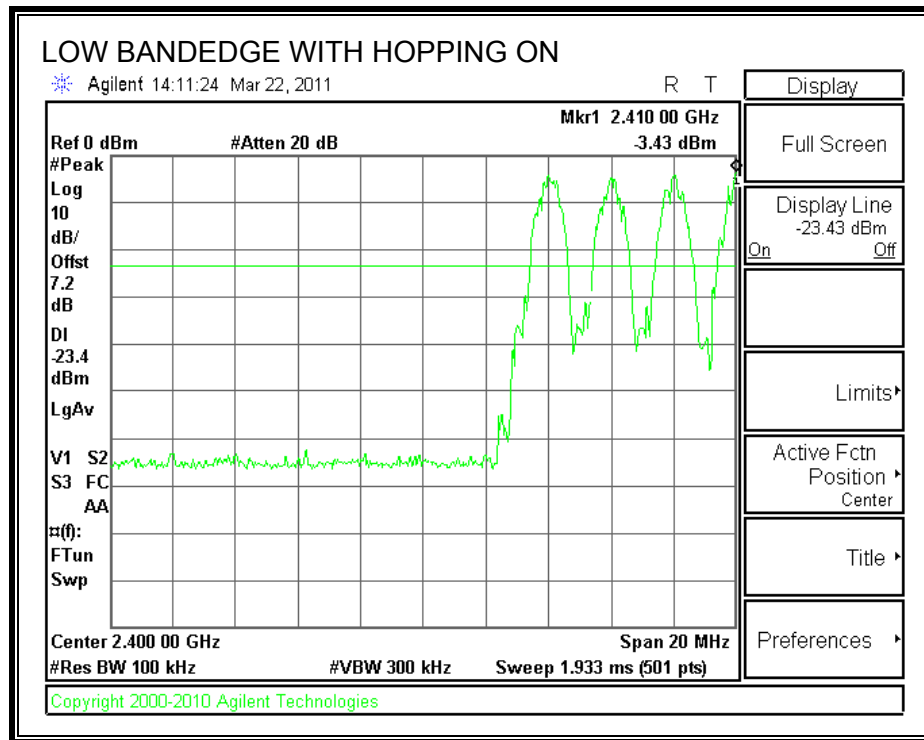


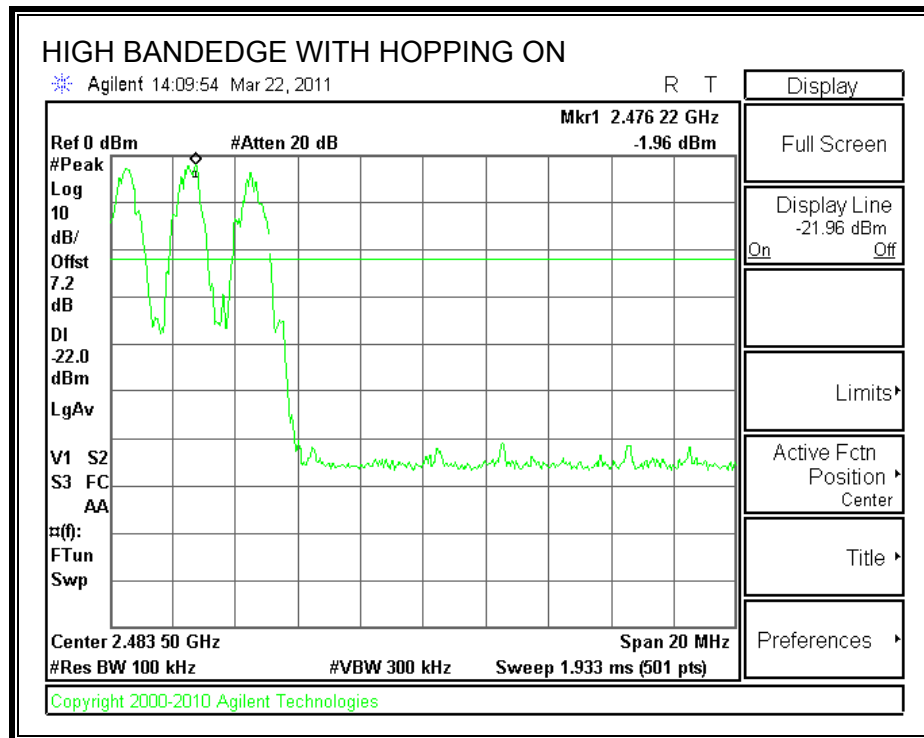
**SPURIOUS EMISSIONS, HIGH CHANNEL**





**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, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

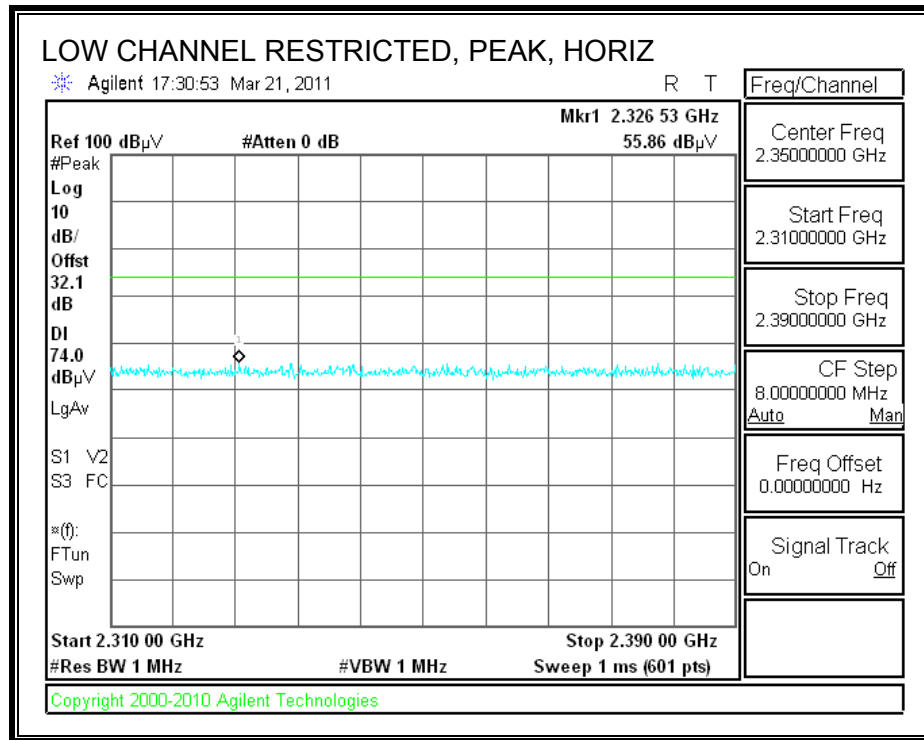
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

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.

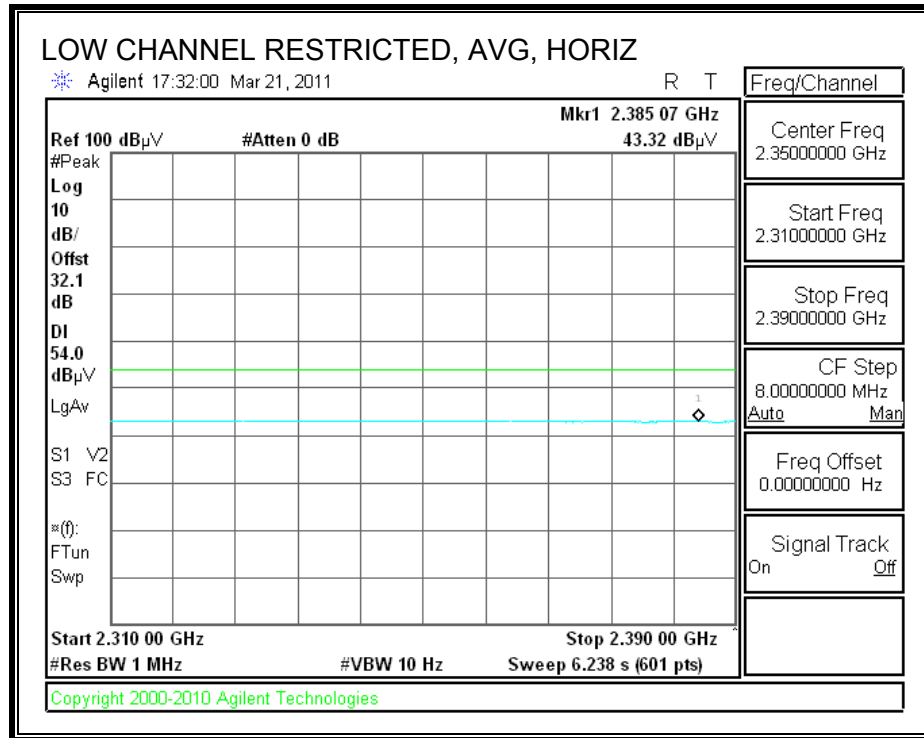
## 8.2. TRANSMITTER ABOVE 1 GHz

### 8.2.1. BASIC DATA RATE GFSK MODULATION

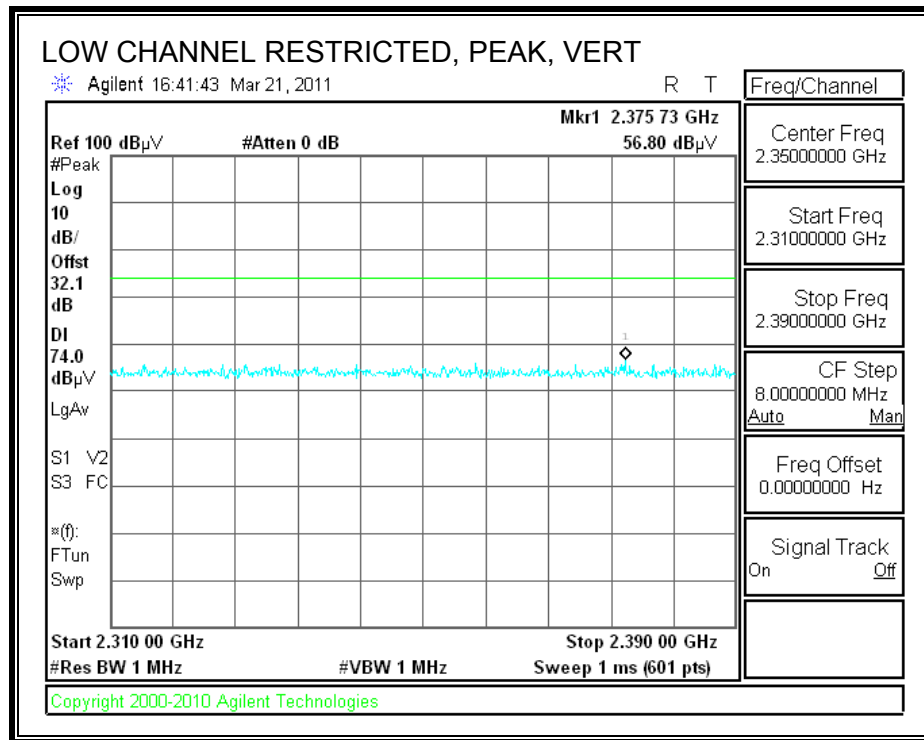
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

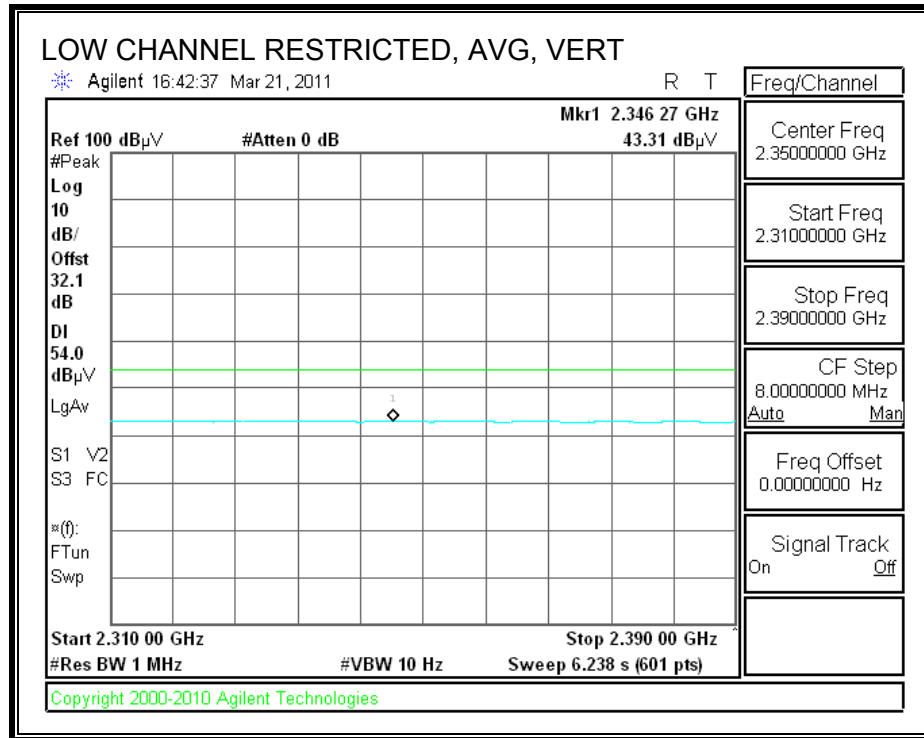




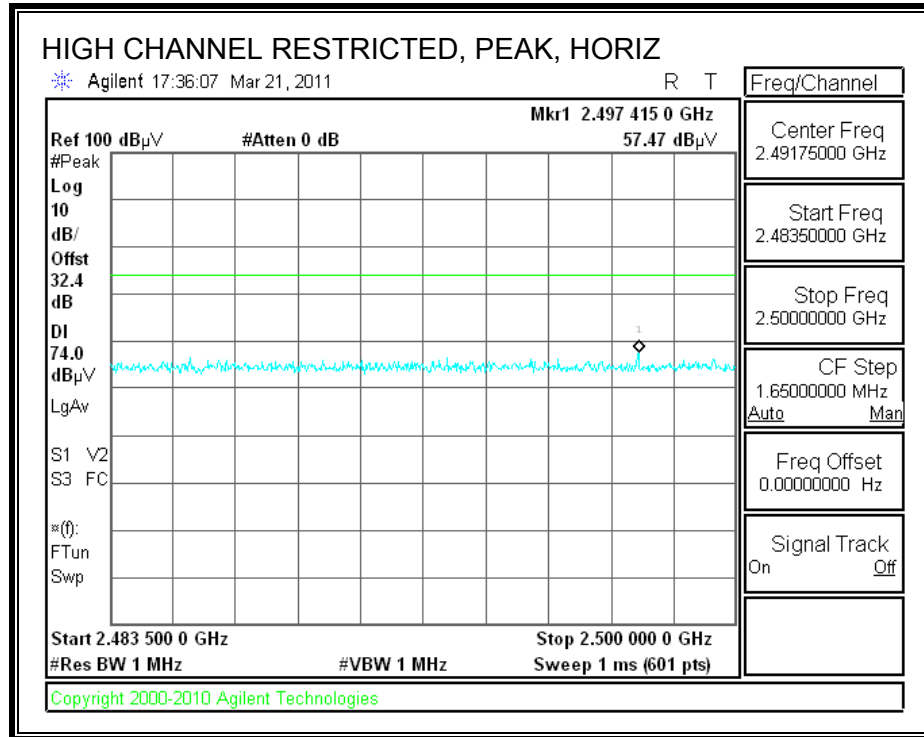


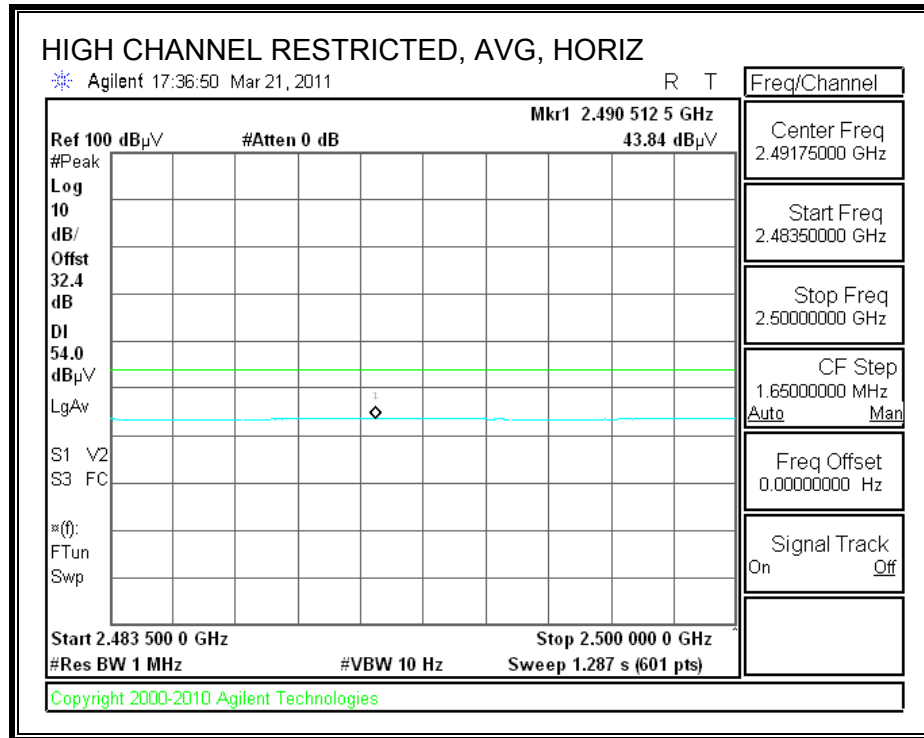
**RESTRICTED BANDEGE (LOW CHANNEL, VERTICAL)**



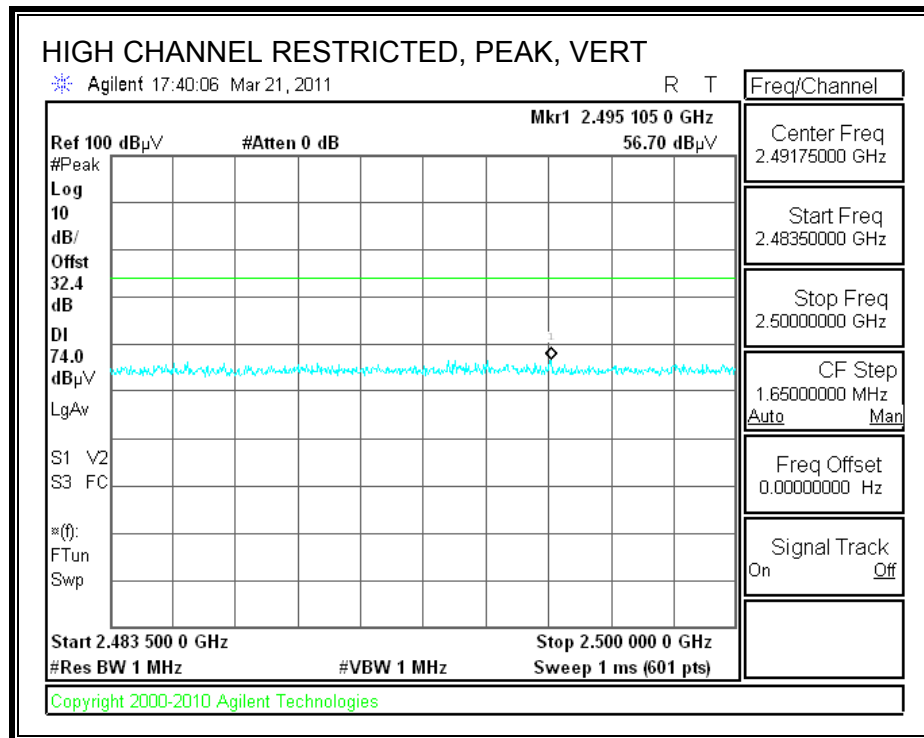


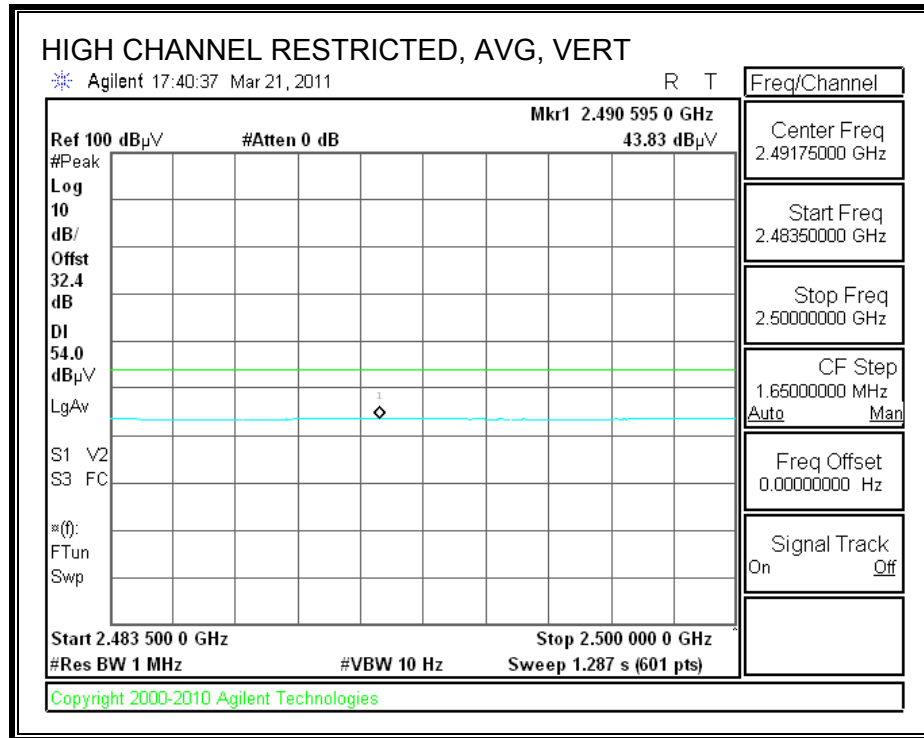
**RESTRICTED BANEDGE (HIGH CHANNEL, HORIZONTAL)**





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





## HARMONICS AND SPURIOUS EMISSIONS

### High Frequency Measurement Compliance Certification Services, Fremont 5m Chamber

Test Engr: David Garcia  
Date: 03/22/11  
Project #: 11U13694  
Company: Broadcom  
Test Target: FCC 15.205  
Mode Oper: Tx, GFSK Mode

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	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
<b>Low Channel: 2402 MHz</b>													
4.804	3.0	48.0	33.0	5.8	-36.5	0.0	0.5	50.9	74.0	-23.1	H	P	
4.804	3.0	44.6	33.0	5.8	-36.5	0.0	0.5	47.4	54.0	-6.6	H	A	
12.010	3.0	35.3	39.0	9.7	-35.4	0.0	0.8	49.4	74.0	-24.6	H	P	
12.010	3.0	23.3	39.0	9.7	-35.4	0.0	0.8	37.4	54.0	-16.6	H	A	
4.804	3.0	46.2	33.0	5.8	-36.5	0.0	0.5	49.0	74.0	-25.0	V	P	
4.804	3.0	42.1	33.0	5.8	-36.5	0.0	0.5	45.0	54.0	-9.0	V	A	
<b>Mid Channel: 2441 MHz</b>													
4.882	3.0	46.2	33.1	5.8	-36.5	0.0	0.5	49.2	74.0	-24.8	H	P	
4.882	3.0	43.0	33.1	5.8	-36.5	0.0	0.5	46.0	54.0	-8.0	H	A	
7.323	3.0	37.0	35.3	7.3	-36.2	0.0	0.5	43.9	74.0	-30.1	H	P	
7.323	3.0	25.0	35.3	7.3	-36.2	0.0	0.5	31.9	54.0	-22.1	H	A	
4.882	3.0	45.7	33.1	5.8	-36.5	0.0	0.5	48.7	74.0	-25.3	V	P	
4.882	3.0	41.8	33.1	5.8	-36.5	0.0	0.5	44.8	54.0	-9.2	V	A	
7.323	3.0	38.1	35.3	7.3	-36.2	0.0	0.5	44.9	74.0	-29.1	V	P	
7.323	3.0	25.1	35.3	7.3	-36.2	0.0	0.5	31.9	54.0	-22.1	V	A	
<b>High Channel: 2480 MHz</b>													
4.960	3.0	47.3	33.2	5.9	-36.5	0.0	0.5	50.5	74.0	-23.5	H	P	
4.960	3.0	44.2	33.2	5.9	-36.5	0.0	0.5	47.4	54.0	-6.6	H	A	
7.440	3.0	36.6	35.5	7.3	-36.2	0.0	0.5	43.7	74.0	-30.3	H	P	
7.440	3.0	24.6	35.5	7.3	-36.2	0.0	0.5	31.7	54.0	-22.3	H	A	
4.960	3.0	45.6	33.2	5.9	-36.5	0.0	0.5	48.7	74.0	-25.3	V	P	
4.960	3.0	41.2	33.2	5.9	-36.5	0.0	0.5	44.4	54.0	-9.6	V	A	
7.440	3.0	37.3	35.5	7.3	-36.2	0.0	0.5	44.5	74.0	-29.5	V	P	
7.440	3.0	24.5	35.5	7.3	-36.2	0.0	0.5	31.7	54.0	-22.3	V	A	

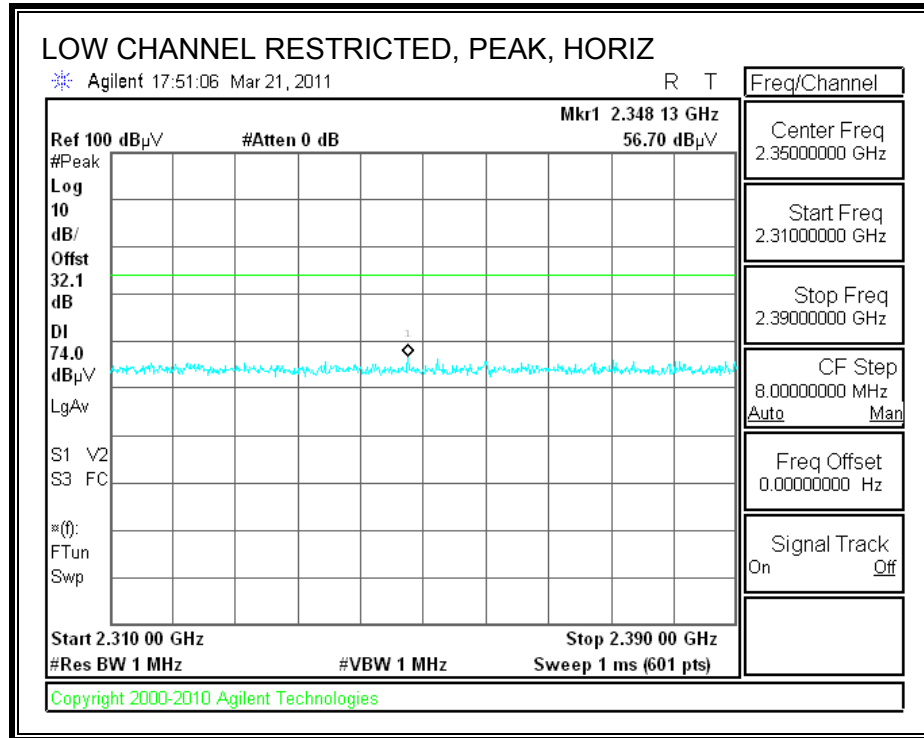
Rev. 4.1.2.7

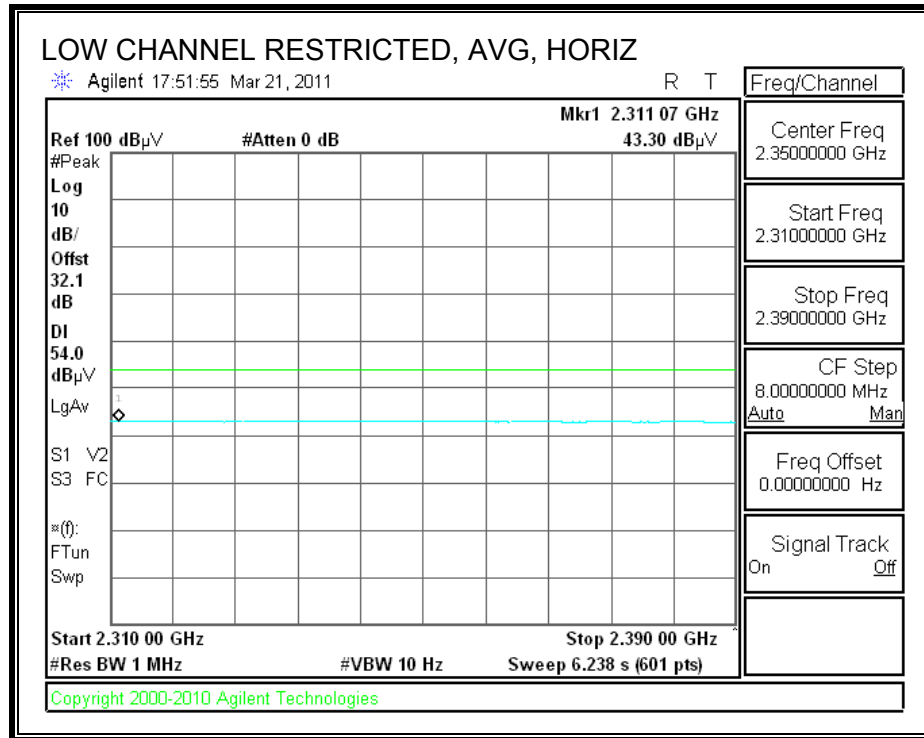
Note: No other emissions were detected above the system noise floor.



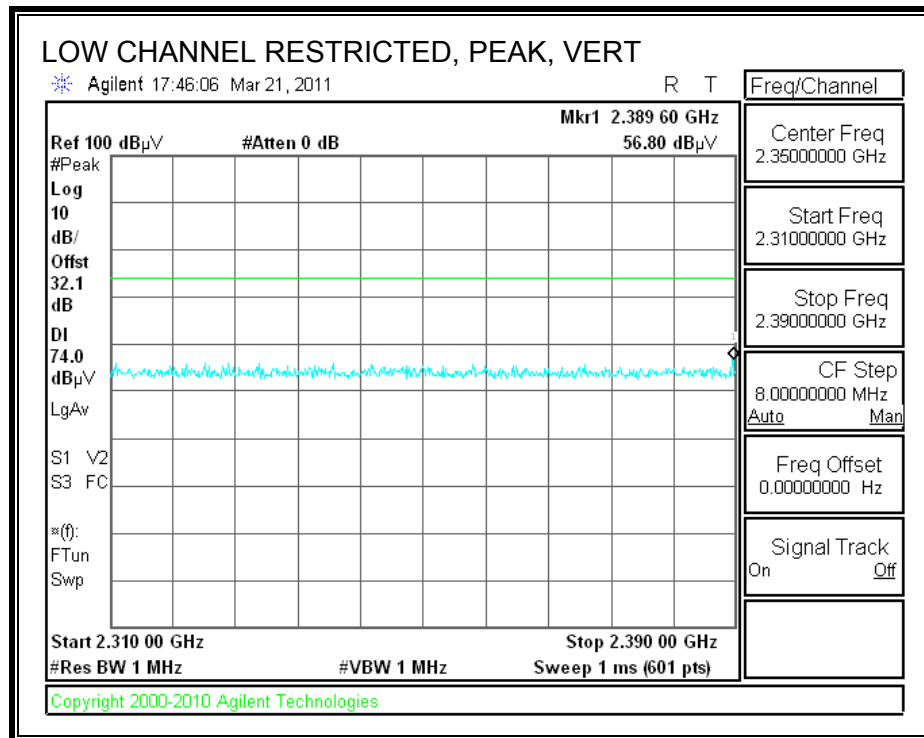
## 8.2.2. ENHANCED DATA RATE 8PSK MODULATION

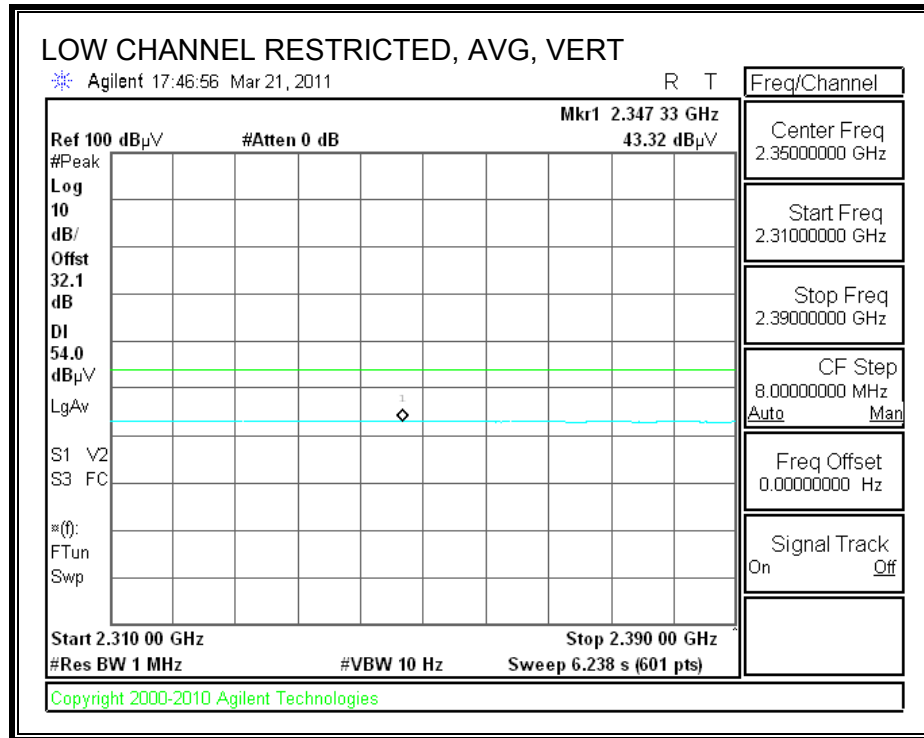
### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



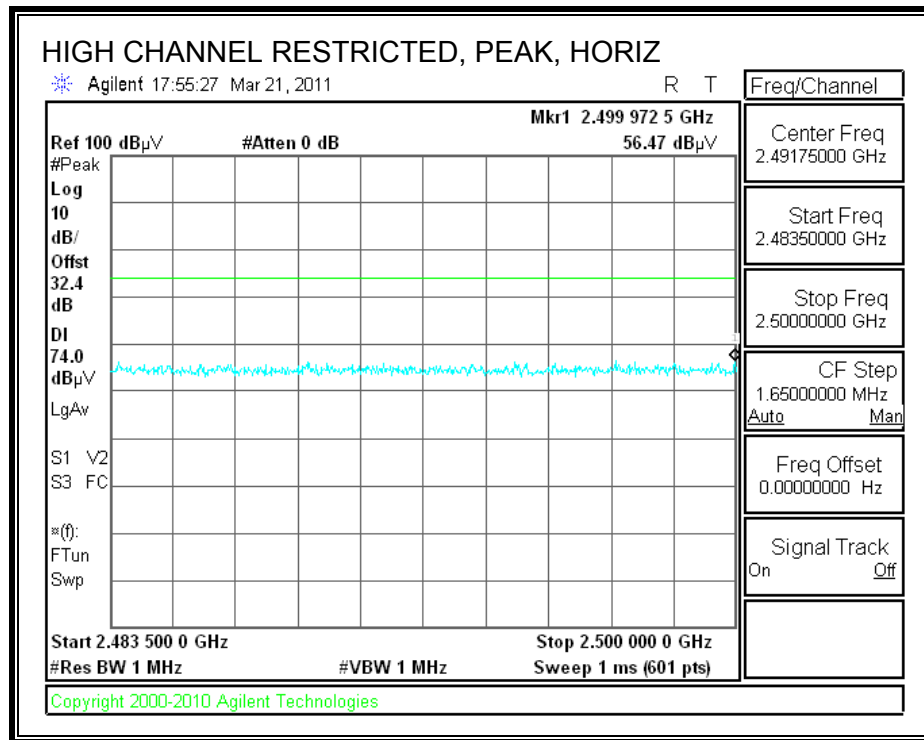


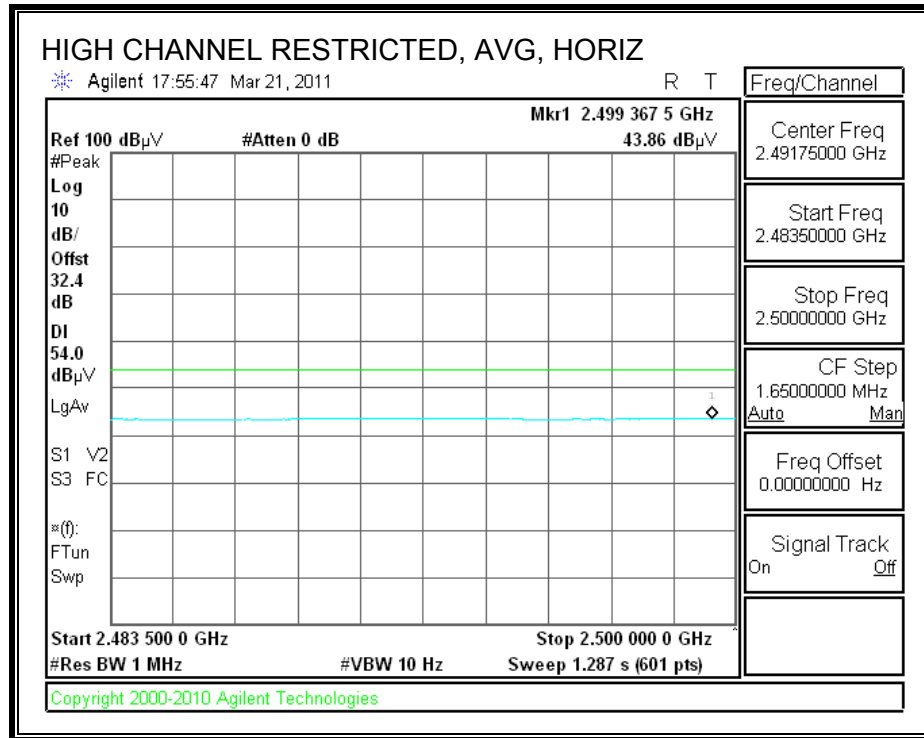
**RESTRICTED BANDEGE (LOW CHANNEL, VERTICAL)**



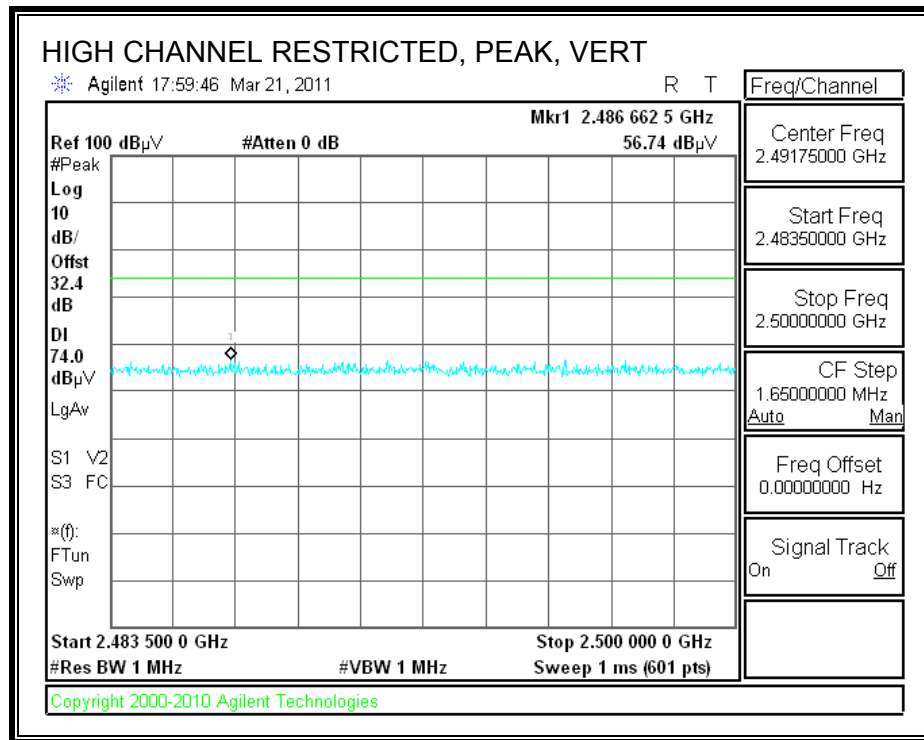


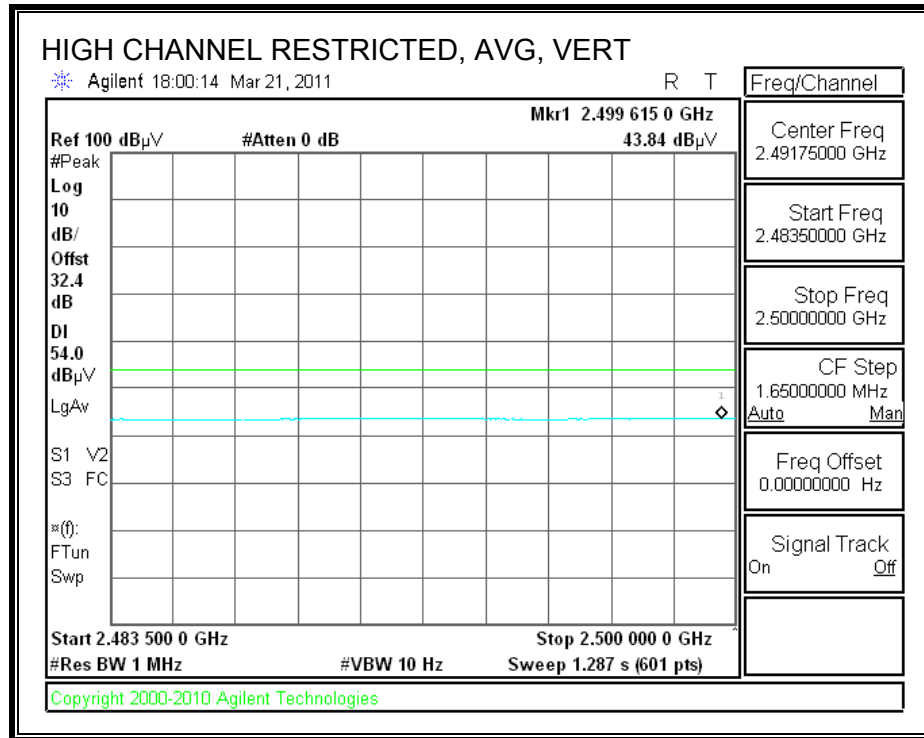
**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**





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







## HARMONICS AND SPURIOUS EMISSIONS

### High Frequency Measurement Compliance Certification Services, Fremont 5m Chamber

Test Engr: David Garcia  
Date: 03/22/11  
Project #: 11U13694  
Company: Broadcom  
Test Target: FCC 15.205  
Mode Oper: Tx, 8PSK Mode

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

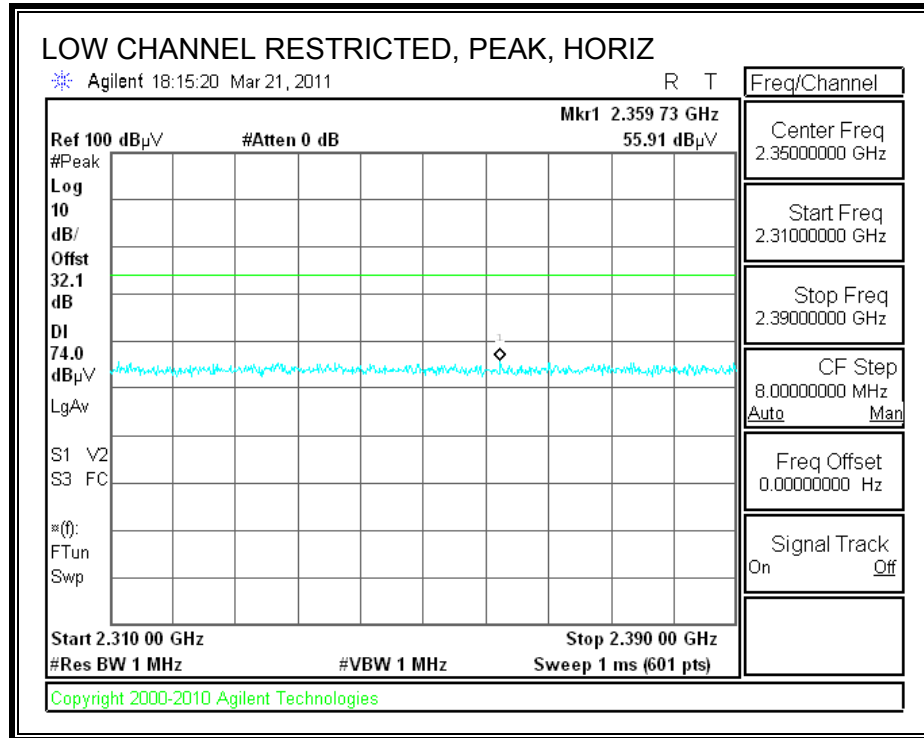
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
<b>Low Channel: 2402 MHz</b>													
4.804	3.0	50.6	33.0	5.8	-36.5	0.0	0.5	53.5	74.0	-20.5	H	P	
4.804	3.0	43.5	33.0	5.8	-36.5	0.0	0.5	46.3	54.0	-7.7	H	A	
4.804	3.0	48.0	33.0	5.8	-36.5	0.0	0.5	50.8	74.0	-23.2	V	P	
4.804	3.0	41.0	33.0	5.8	-36.5	0.0	0.5	43.8	54.0	-10.2	V	A	
<b>Mid Channel: 2441 MHz</b>													
4.882	3.0	48.9	33.1	5.8	-36.5	0.0	0.5	51.9	74.0	-22.1	H	P	
4.882	3.0	41.6	33.1	5.8	-36.5	0.0	0.5	44.6	54.0	-9.4	H	A	
7.323	3.0	37.1	35.3	7.3	-36.2	0.0	0.5	44.0	74.0	-30.0	H	P	
7.323	3.0	25.0	35.3	7.3	-36.2	0.0	0.5	31.9	54.0	-22.1	H	A	
4.882	3.0	47.1	33.1	5.8	-36.5	0.0	0.5	50.1	74.0	-23.9	V	P	
4.882	3.0	40.1	33.1	5.8	-36.5	0.0	0.5	43.1	54.0	-10.9	V	A	
7.323	3.0	37.4	35.3	7.3	-36.2	0.0	0.5	44.3	74.0	-29.7	V	P	
7.323	3.0	25.0	35.3	7.3	-36.2	0.0	0.5	31.9	54.0	-22.1	V	A	
<b>High Channel: 2480 MHz</b>													
4.960	3.0	50.1	33.2	5.9	-36.5	0.0	0.5	53.2	74.0	-20.8	H	P	
4.960	3.0	43.2	33.2	5.9	-36.5	0.0	0.5	46.4	54.0	-7.6	H	A	
7.440	3.0	36.7	35.5	7.3	-36.2	0.0	0.5	43.8	74.0	-30.2	H	P	
7.440	3.0	24.5	35.5	7.3	-36.2	0.0	0.5	31.7	54.0	-22.3	H	A	
4.960	3.0	47.4	33.2	5.9	-36.5	0.0	0.5	50.6	74.0	-23.4	V	P	
4.960	3.0	40.8	33.2	5.9	-36.5	0.0	0.5	43.9	54.0	-10.1	V	A	
7.440	3.0	37.3	35.5	7.3	-36.2	0.0	0.5	44.5	74.0	-29.5	V	P	
7.440	3.0	24.6	35.5	7.3	-36.2	0.0	0.5	31.7	54.0	-22.3	V	A	

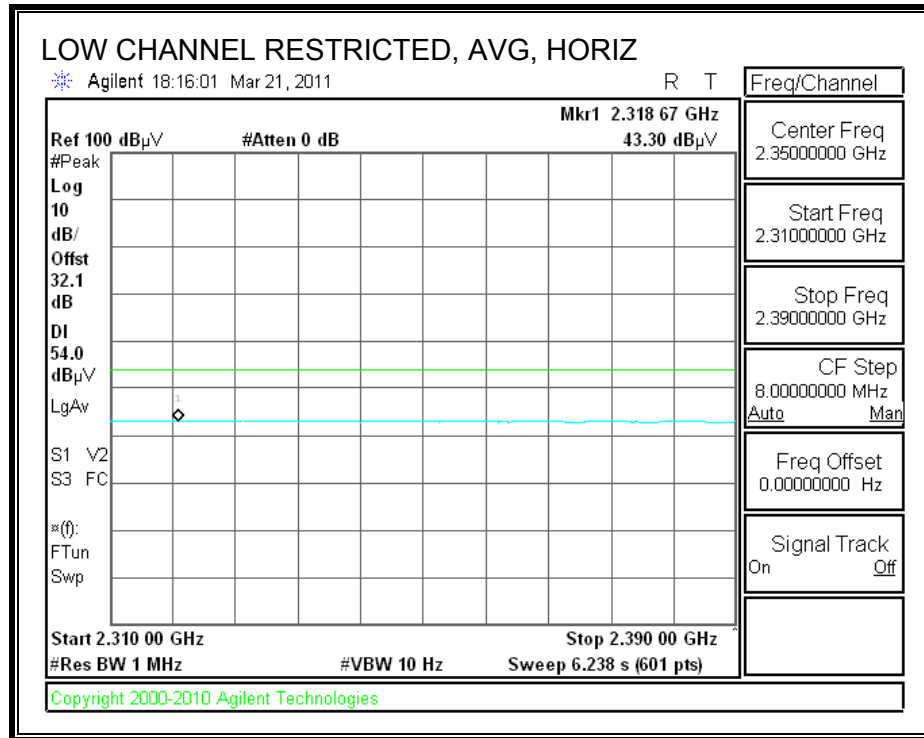
Rev. 4.1.2.7

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

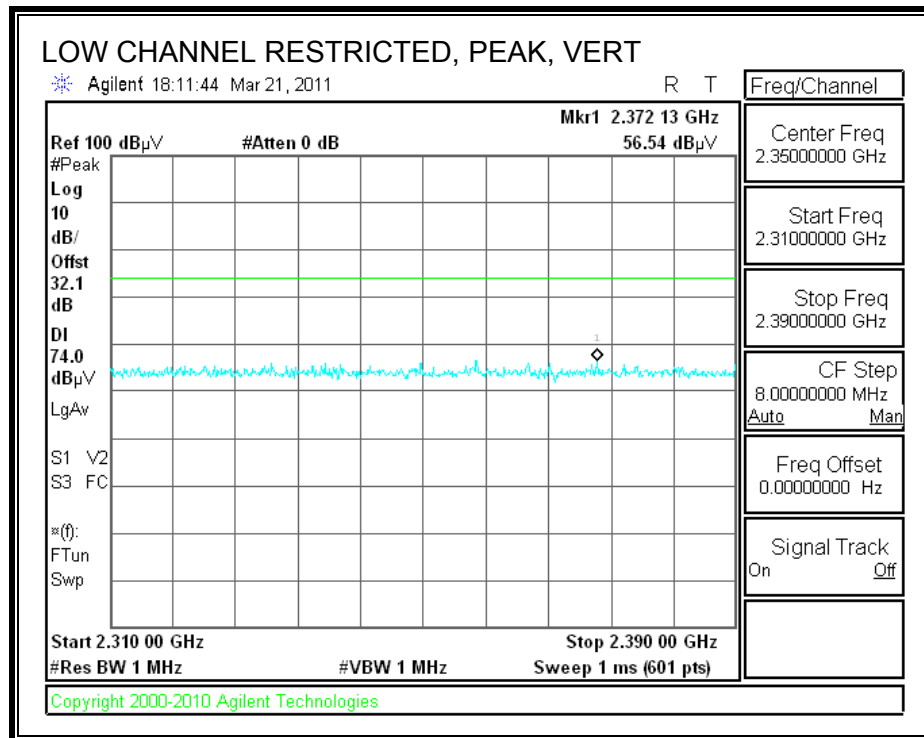
### 8.2.3. LE (LOW ENERGY) GFSK MODULATION

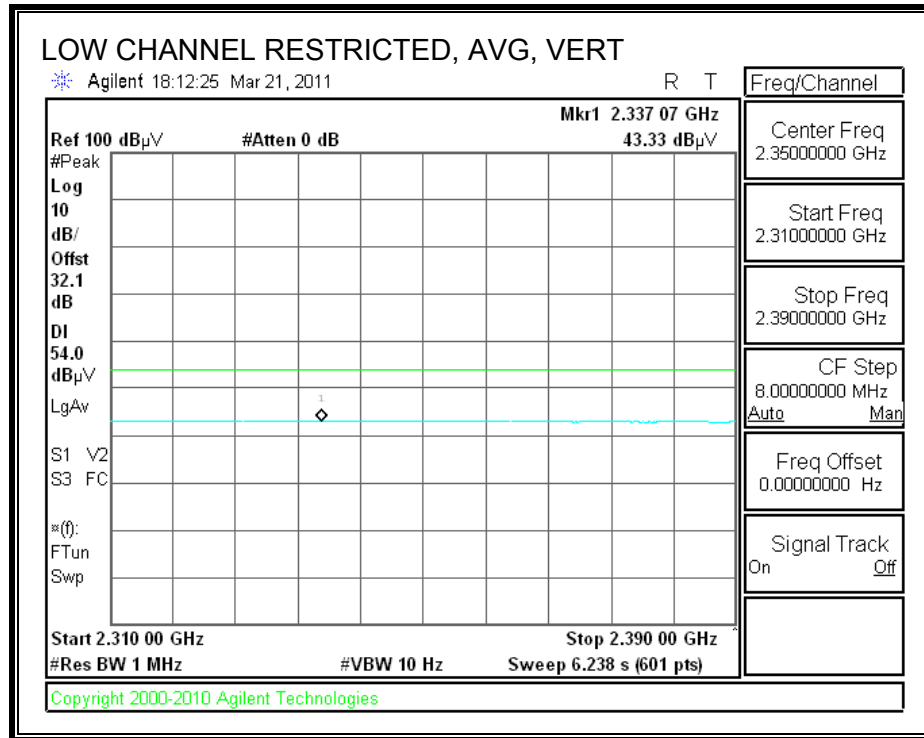
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



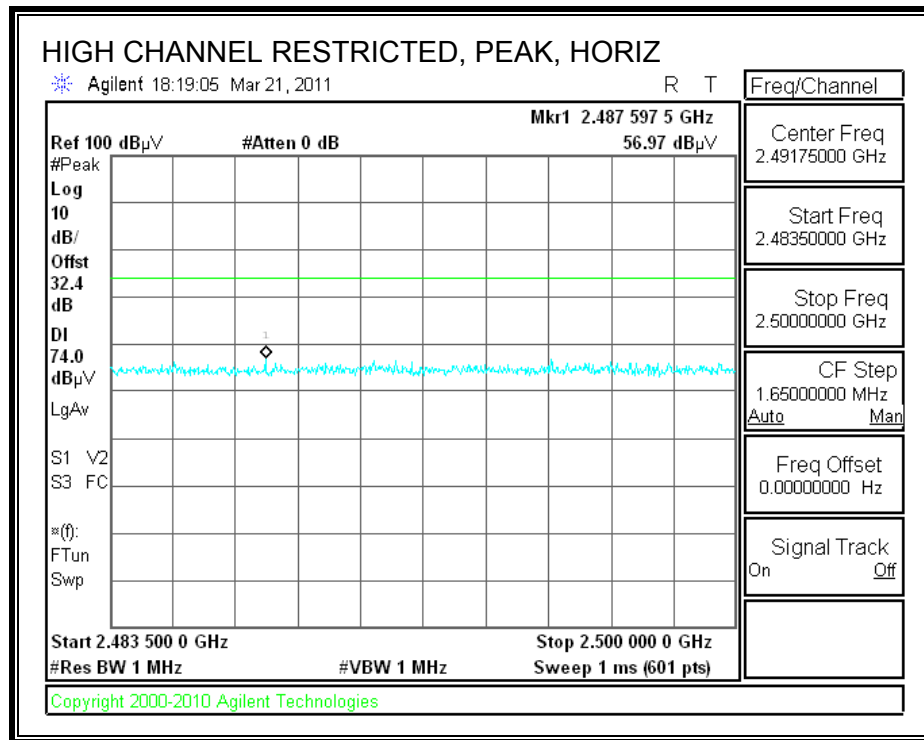


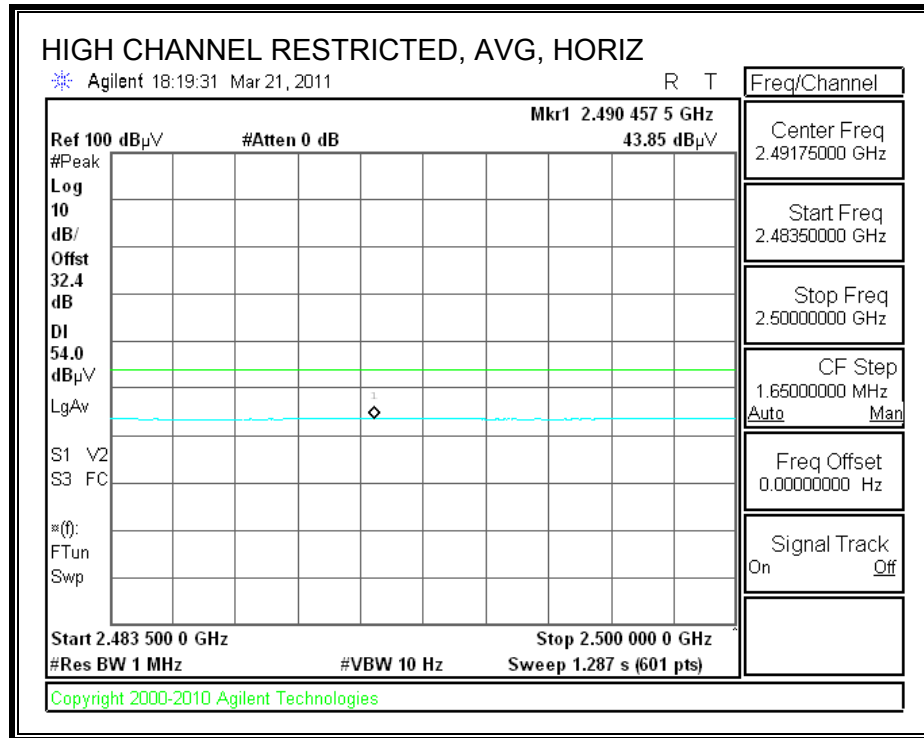
**RESTRICTED BANEDGE (LOW CHANNEL, VERTICAL)**



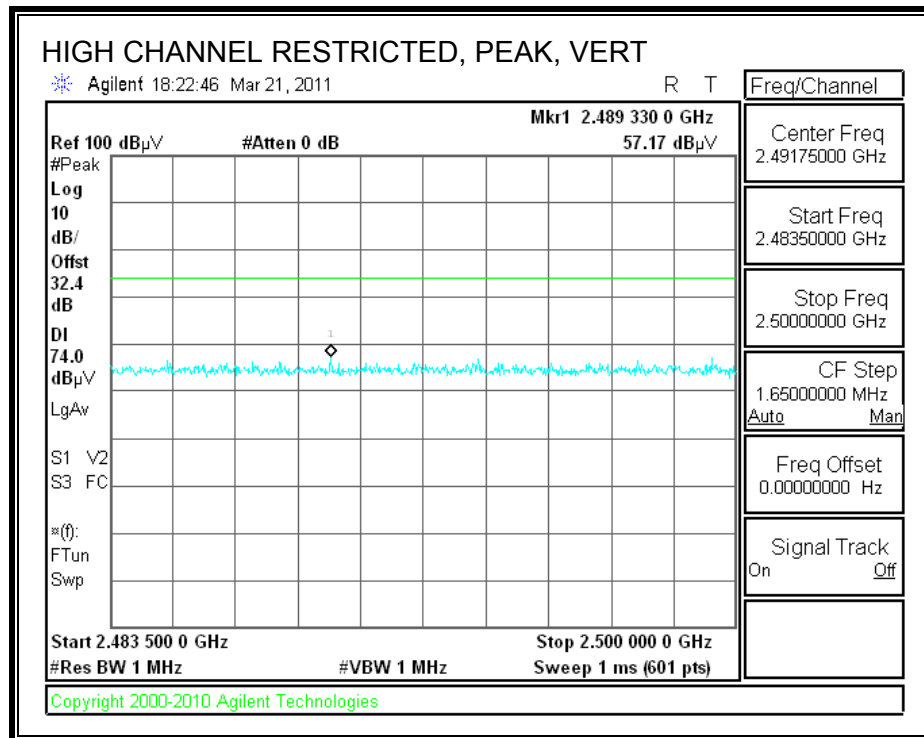


**RESTRICTED BANEDGE (HIGH CHANNEL, HORIZONTAL)**

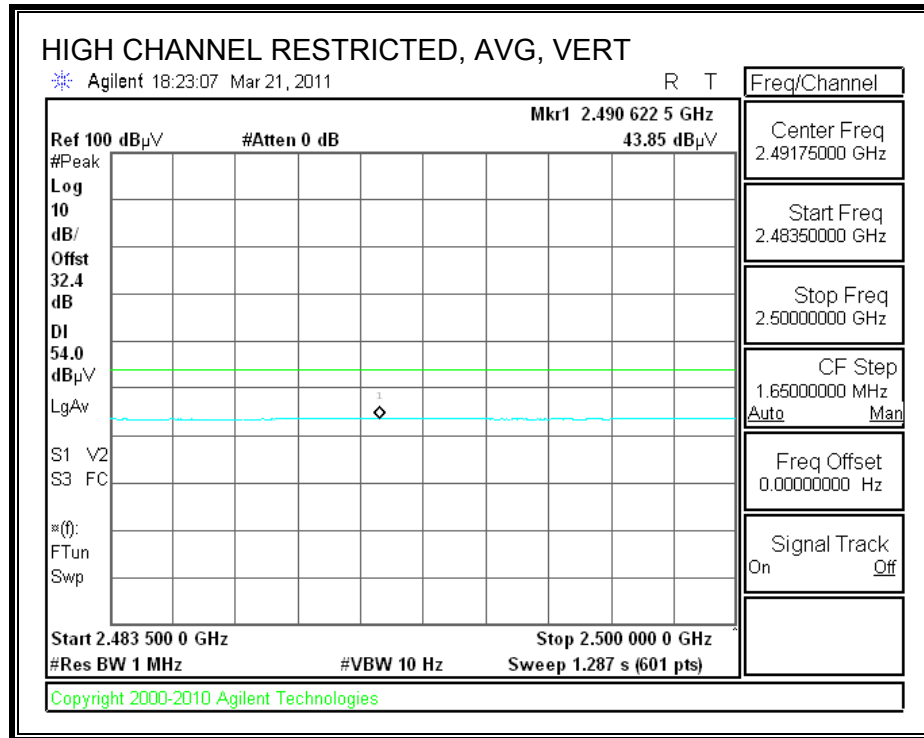




**RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**







## HARMONICS AND SPURIOUS EMISSIONS

### High Frequency Measurement

Compliance Certification Services, Fremont 5m Chamber

Test Engr: David Garcia  
Date: 03/21/11  
Project #: 11U13694  
Company: Broadcom  
Test Target: FCC 15.205  
Mode Oper: Tx, BLE Mode

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	Filtr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
<b>Low Channel: 2402 MHz</b>													
4.804	3.0	48.6	33.0	5.8	-36.5	0.0	0.5	51.5	74.0	-22.5	H	P	
4.804	3.0	37.5	33.0	5.8	-36.5	0.0	0.5	40.4	54.0	-13.6	H	A	
4.804	3.0	46.1	33.0	5.8	-36.5	0.0	0.5	49.0	74.0	-25.0	V	P	
4.804	3.0	35.5	33.0	5.8	-36.5	0.0	0.5	38.4	54.0	-15.6	V	A	
<b>Mid Channel: 2440 MHz</b>													
4.880	3.0	37.2	33.1	5.8	-36.5	0.0	0.5	40.2	74.0	-33.8	H	P	
4.880	3.0	25.2	33.1	5.8	-36.5	0.0	0.5	28.2	54.0	-25.8	H	A	
7.320	3.0	37.6	35.3	7.3	-36.2	0.0	0.5	44.4	74.0	-29.6	H	P	
7.320	3.0	25.1	35.3	7.3	-36.2	0.0	0.5	32.0	54.0	-22.0	H	A	
4.880	3.0	37.9	33.1	5.8	-36.5	0.0	0.5	40.9	74.0	-33.1	V	P	
4.880	3.0	25.2	33.1	5.8	-36.5	0.0	0.5	28.2	54.0	-25.8	V	A	
7.320	3.0	37.1	35.3	7.3	-36.2	0.0	0.5	44.0	74.0	-30.0	V	P	
7.320	3.0	25.1	35.3	7.3	-36.2	0.0	0.5	32.0	54.0	-22.0	V	A	
<b>High Channel: 2480 MHz</b>													
4.960	3.0	37.4	33.2	5.9	-36.5	0.0	0.5	40.5	74.0	-33.5	H	P	
4.960	3.0	24.9	33.2	5.9	-36.5	0.0	0.5	28.1	54.0	-25.9	H	A	
7.440	3.0	37.4	35.5	7.3	-36.2	0.0	0.5	44.6	74.0	-29.4	H	P	
7.440	3.0	24.6	35.5	7.3	-36.2	0.0	0.5	31.7	54.0	-22.3	H	A	
4.960	3.0	37.0	33.2	5.9	-36.5	0.0	0.5	40.2	74.0	-33.8	V	P	
4.960	3.0	24.9	33.2	5.9	-36.5	0.0	0.5	28.1	54.0	-25.9	V	A	
7.440	3.0	37.0	35.5	7.3	-36.2	0.0	0.5	44.1	74.0	-29.9	V	P	
7.440	3.0	24.6	35.5	7.3	-36.2	0.0	0.5	31.7	54.0	-22.3	V	A	

Rev. 4.1.2.7

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

### 8.3. RECEIVER ABOVE 1 GHz

High Frequency Measurement																	
Compliance Certification Services, Fremont 5m Chamber																	
Company:		Broadcom															
Project #:		11U13694															
Date:		3/22/2011															
Test Engineer:		David Garcia															
Configuration:		EUT, Laptop PC and antenna															
Mode:		Receive															
Test Equipment:																	
Horn 1-18GHz				Pre-amplifier 1-26GHz				Pre-amplifier 26-40GHz				Horn > 18GHz				Limit	
T73; S/N: 6717 @3m				T144 Miteq 3008A00931				T88 Miteq 26-40GHz				T125; ARA 18-26GHz; S/N:1007				RX RSS 210	
Hi Frequency Cables																	
3' cable 22807700				12' cable 22807600				20' cable 22807500				HPF		Reject Filter		Peak Measurements RBW=VBW=1MHz	
3' cable 22807700				12' cable 22807600				20' cable 22807500								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	Filtr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)		
1.193	3.0	57.0	56.4	24.5	2.6	-39.2	0.0	0.0	44.9	44.3	74	54	-29.1	-9.7	H		
1.857	3.0	55.4	53.5	26.7	3.3	-38.3	0.0	0.0	47.1	45.2	74	54	-26.9	-8.8	H		
2.120	3.0	50.2	48.8	27.5	3.6	-37.9	0.0	0.0	43.4	42.0	74	54	-30.6	-12.0	H		
1.195	3.0	58.3	54.7	24.5	2.6	-39.2	0.0	0.0	46.2	42.6	74	54	-27.8	-11.4	V		
1.325	3.0	58.0	56.2	24.9	2.7	-39.0	0.0	0.0	46.7	44.9	74	54	-27.3	-9.1	V		
2.385	3.0	57.5	53.2	28.2	3.8	-37.5	0.0	0.0	52.0	47.7	74	54	-22.0	-6.3	V		
Rev. 07.22.09																	
f	Measurement Frequency					Amp	Preamp Gain					Avg Lim	Average Field Strength Limit				
Dist	Distance to Antenna					D Corr	Distance Correct to 3 meters					Pk Lim	Peak Field Strength Limit				
Read	Analyzer Reading					Avg	Average Field Strength @ 3 m					Avg Mar	Margin vs. Average Limit				
AF	Antenna Factor					Peak	Calculated Peak Field Strength					Pk Mar	Margin vs. Peak Limit				
CL	Cable Loss					HPF	High Pass Filter										

## 8.4. WORST-CASE BELOW 1 GHz

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

#### DATA

30-1000MHz Frequency Measurement

Compliance Certification Services, Fremont 5m Chamber

Test Engr: David Garcia  
Date: 03/22/11  
Project #: 11U13694  
Company: Broadcom  
Test Target: FCC Class B  
Mode Oper: Tx (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	Pad dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
111.243	3.0	48.9	12.0	1.0	28.3	0.0	0.0	33.6	43.5	-9.9	H	QP	
120.124	3.0	44.2	13.6	1.0	28.3	0.0	0.0	30.6	43.5	-12.9	H	QP	
211.928	3.0	49.3	12.0	1.3	28.2	0.0	0.0	34.3	43.5	-9.2	H	QP	
456.018	3.0	49.3	15.9	1.9	27.9	0.0	0.0	39.3	46.0	-6.7	H	P	
133.204	3.0	51.9	13.4	1.1	28.3	0.0	0.0	38.2	43.5	-5.3	V	P	
168.006	3.0	52.9	11.0	1.2	28.2	0.0	0.0	36.8	43.5	-6.7	V	P	
397.575	3.0	45.1	14.9	1.8	28.1	0.0	0.0	33.7	46.0	-12.4	V	P	
468.018	3.0	43.8	16.2	2.0	27.9	0.0	0.0	34.0	46.0	-12.0	V	P	

Rev. 1.27.09

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.

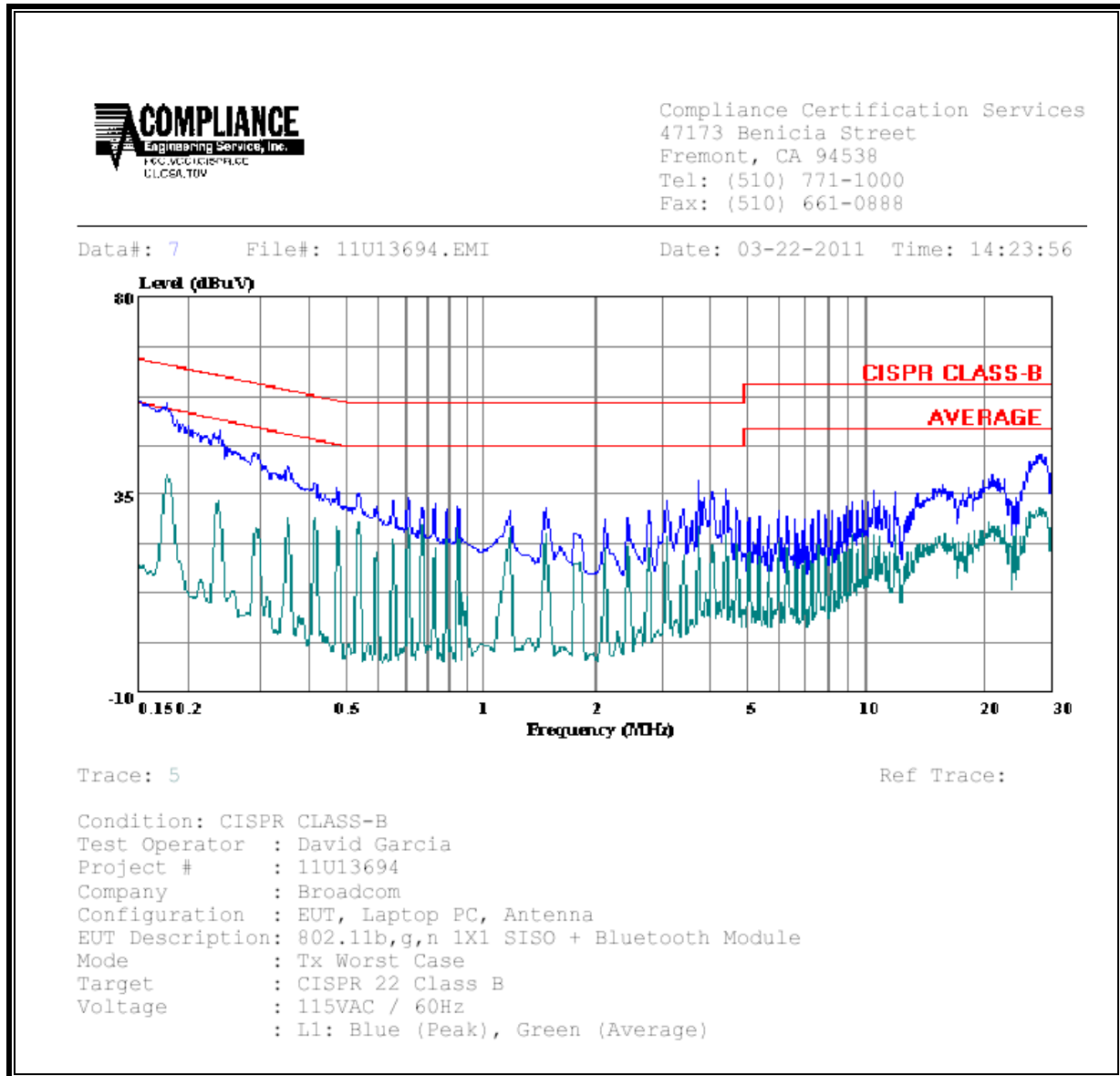
Line conducted data is recorded for both NEUTRAL and HOT lines.

### RESULTS

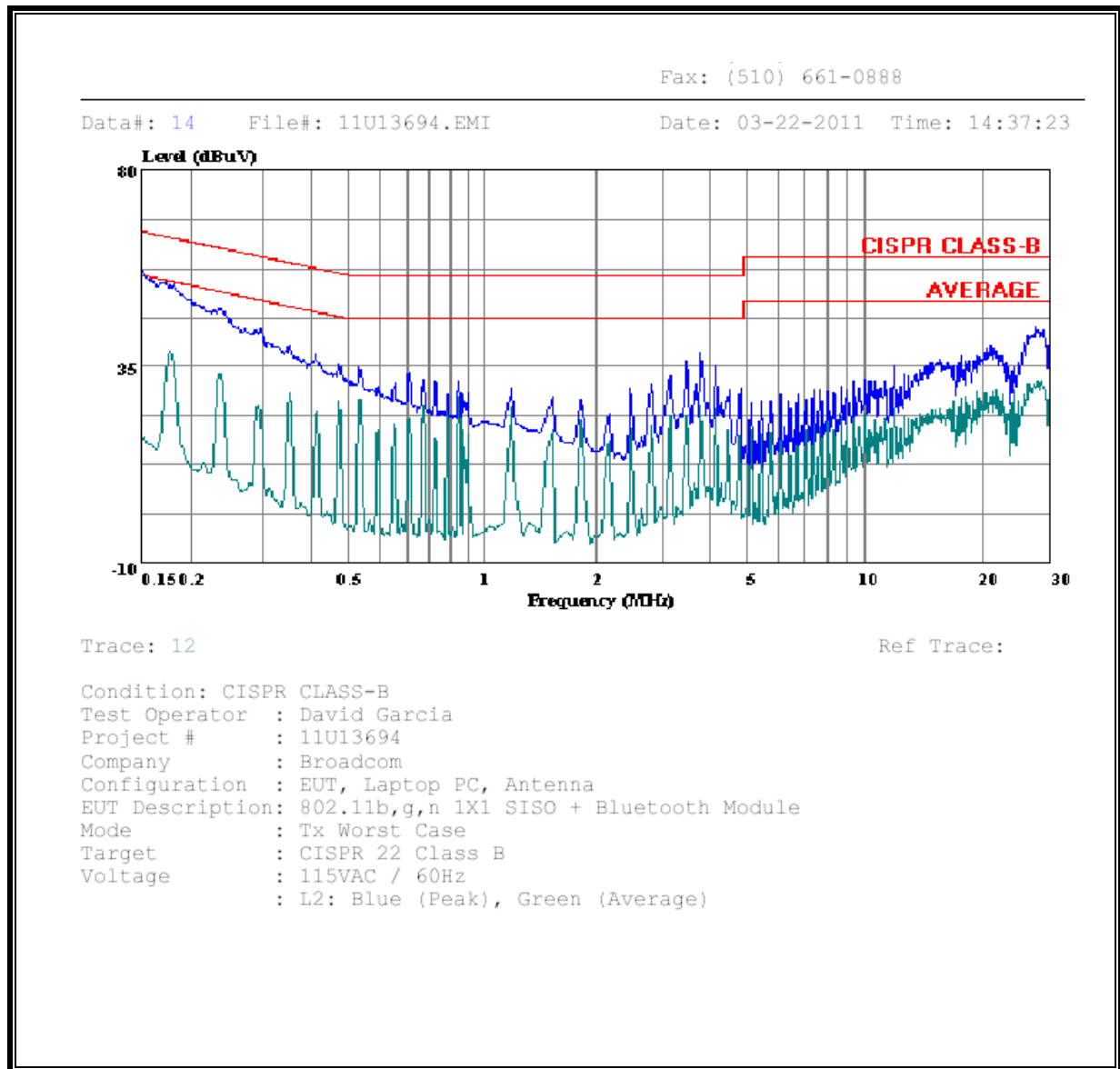
## 6 WORST EMISSIONS

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Closs	Limit	EN B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.15	55.63	--	18.73	0.00	65.84	55.84	-10.21	-37.11	L1
0.18	55.73	--	39.49	0.00	64.67	54.67	-8.94	-15.18	L1
27.86	44.13	--	31.60	0.00	60.00	50.00	-15.87	-18.40	L1
0.15	56.84	--	18.66	0.00	66.00	56.00	-9.16	-37.34	L2
0.18	53.95	--	38.77	0.00	64.49	54.49	-10.54	-15.72	L2
27.42	53.98	--	43.98	0.00	60.00	50.00	-6.02	-6.02	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	$280/f$	$2.19/f$		6
10–30	28	$2.19/f$		6
30–300	28	0.073	2*	6
300–1 500	$1.585f^{0.5}$	$0.0042f^{0.5}$	$f/150$	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	$616\,000/f^{1.2}$
150 000–300 000	$0.158f^{0.5}$	$4.21 \times 10^{-4}f^{0.5}$	$6.67 \times 10^{-5}f$	$616\,000/f^{1.2}$

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

**Notes:** 1. Frequency,  $f$ , is in MHz.  
2. A power density of 10 W/m<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.

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	1.05	3.90	0.01	0.001