



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

**CERTIFICATION TEST REPORT**

**FOR**

**The Apple iPad is a tablet device with multimedia functions (music, application support, and video), 802.11a/b/g/n radio, and Bluetooth radio functions**

**MODEL NUMBER: A1432, A1454, & A1455\***

**FCC ID: BCGA1432  
IC: 579C-A1432**

**REPORT NUMBER: 12U14526-3, Revision A**

**ISSUE DATE: OCTOBER 03, 2012**

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\*Models differences are detailed within the body of this report



**NVLAP LAB CODE 200065-0**

Revision History

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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** APPLE, INC.  
1 INFINITE LOOP  
CUPERTINO, CA 95014, U.S.A.

**EUT DESCRIPTION:** The Apple iPad is a tablet device with multimedia functions (music, application support, and video), 802.11a/b/g/n radio, and Bluetooth radio functions

**MODEL:** A1432, A1454, & A1455

**SERIAL NUMBER:** 20558

**DATE TESTED:** AUGUST 03-13, 2012

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

UL 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 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.

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EMC ENGINEER  
UL CCS

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2003, 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:

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

### 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 iPad tablet device with iPod functions (music, application support, and video), 802.11a/b/g/n radio, and Bluetooth radio functions.

### 5.2. DESCRIPTION OF MODELS DIFFERENCES

FCC ID: BCGA1432  
IC ID: 579C-A1432  
Model #: A1432

Model A1432, is a tablet with multimedia functions (music, application support, and video)IEEE 802.11a/b/g/n radio and Bluetooth radio. The rechargeable battery is not user accessible.

FCC ID: BCGA1454  
IC ID: 579C-A1454  
Model #: A1454

Model A1454 is a tablet with multimedia functions (music, application support, and video), cellular GSM/GPRS/EGPRS/WCDMA/HSPA+/DC-HSDPA/LTE radio, IEEE 802.11a/b/g/n and Bluetooth radio. The rechargeable battery is not user accessible.

FCC ID: BCGA1455  
IC ID: 579C-A1455  
Model #: A1455

Model A1455, is a tablet with multimedia functions (music, application support, and video), cellular GSM/GPRS/EGPRS/WCDMA/HSPA+/DC-HSDPA/CDMA1xRTT/ EV-DO Rev 0, A, B / LTE radio, IEEE 802.11a/b/g/n radio and Bluetooth radio. The rechargeable battery is not user accessible.

### 5.3. 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	12.17	16.48
2402 - 2480	Enhanced 8PSK	11.06	12.76

#### 5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PIFA antenna, with a maximum gain as shown below:

<i>Frequency Band (GHz)</i>	<i>Antenna Gain (dBi)</i>
2.4-2.4835	1.41
5.15-5.25	4.70
5.25-5.35	5.08
5.5-5.7	5.42
5.725-5.85	5.27

#### 5.5. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was 10A378

The EUT driver software installed during testing was Broadcom\_Rel\_6\_10\_56\_166

The EUT is also linked in Bluetooth Enable Test mode with Rohde & Schwarz CBT Test box.



## 5.6. WORST-CASE CONFIGURATION AND MODE

Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

For the fundamental investigation, since the EUT is a portable device that has three orientations; X, Y and Z orientations have been investigated, also with AC/DC adapter, and earphone, and the worst case was found to be at X orientation without AC adapter and earphone.

For 2.4 GHz band, an investigation of the fundamental frequency on both Ant0 and Ant1 ports showed that Ant0 is worst-case; therefore, all final radiated testing was performed using Ant0.

For 5 GHz bands, an investigation of the fundamental frequency on both Ant0 and Ant1 ports showed that Ant1 is worst-case; therefore, all final radiated testing was performed using Ant1.

## 5.7. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

Support Equipment List			
Description	Manufacturer	Model	Serial Number
AC Adapter	Apple	A1344	NA
Laptop PC	Apple	MacBook Pro	NA
Directional Coupler	RF-Lambda	RFDC5M06G15	NA
Headset	Apple	NA	NA

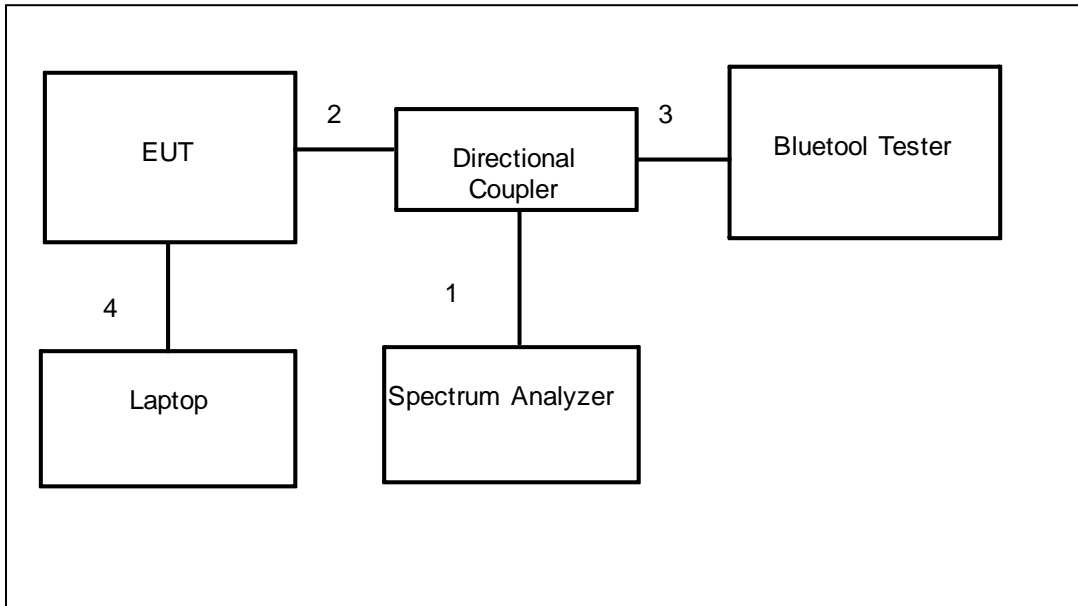
### I/O CABLES (Conducted Setup)

Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	In/Out	1	SMA	Shielded	0.2m	NA
2	In/Out	1	SMA	Shielded	0.6m	NA
3	Antenna Port	1	SMA	Shielded	0.1m	NA
4	Laptop	1	USB	Un-Shielded	1m	NA

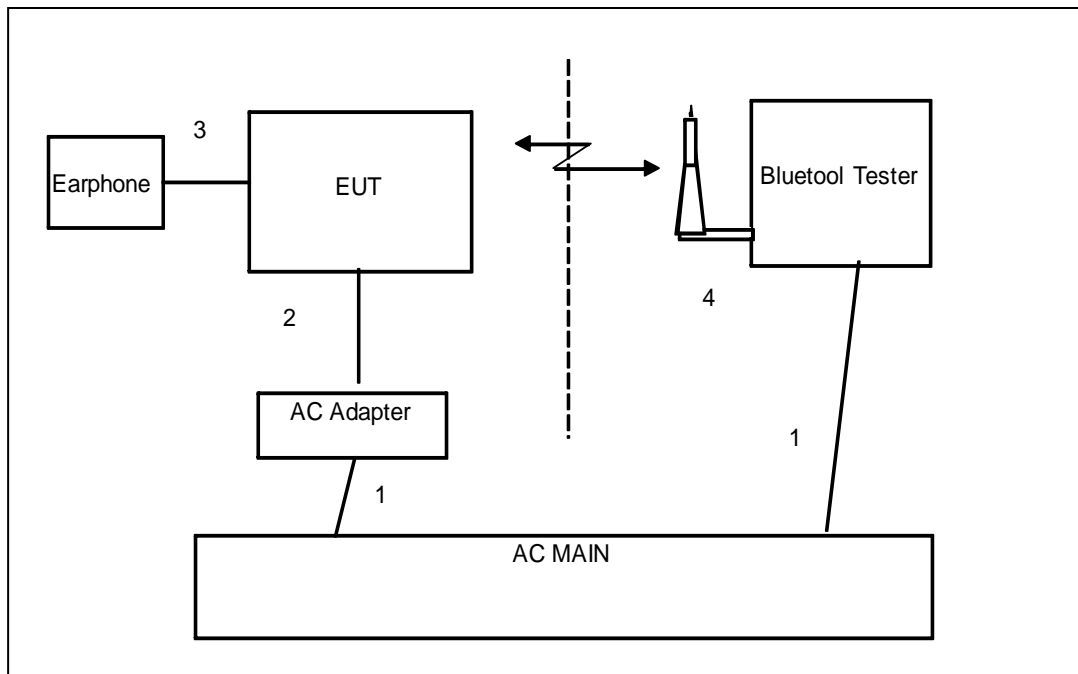
### I/O CABLES (Radiated Setup)

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	US115VAC	Un-Shielded	2m	NA
2	DC	1	DC	Un-Shielded	1m	NA
3	Jack	1	Earphone	Shielded	0.5m	NA
4	Antenna Port	1	Horn	Un-shielded	2m	NA

**SETUP DIAGRAM FOR CONDUCTED TESTS**



**SETUP DIAGRAM FOR CONDUCTED 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
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	07/14/13
Antenna, Horn, 18 GHz	EMCO	3115	C00945	06/29/13
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00580	11/11/12
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01016	07/12/13
Horn Antenna, 26.5 GHz	ARA	MWH-1826/B	C00589	07/28/13
Horn Antenna, 40 GHz	ARA	MWH-2640/B	C00981	05/10/13
Preamplifier, 40 GHz	Miteq	NSP4000-SP2	C00990	03/14/13
Reject Filter, 2.0-2.9 GHz	Micro-Tronics	BRM50702	N02684	CNR
High Pass Filter, 7.6 GHz	Micro-Tronics	HPM13195	N02682	CNR
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01159	04/09/13
CBT Bluetooth tester	Rohde Schwarz	CBT	10090	05/15/2013
Reject Filter, 5.725-5.825 GHz	Micro-Tronics	BRC13192	N02676	CNR
Reject Filter, 2.4-2.5 GHz	Micro-Tronics	BRM50702	N02685	CNR
Highpass Filter, 7.6 GHz	Micro-Tronics	HPM13195	N02682	CNR
EMI Test Receiver, 30MHz	R & S	ESHS 20	N02396	08/19/13
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	12/13/12

## 7. ANTENNA PORT TEST RESULTS

### 7.1. BASIC DATA RATE GFSK MODULATION

#### 7.1.1. 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.

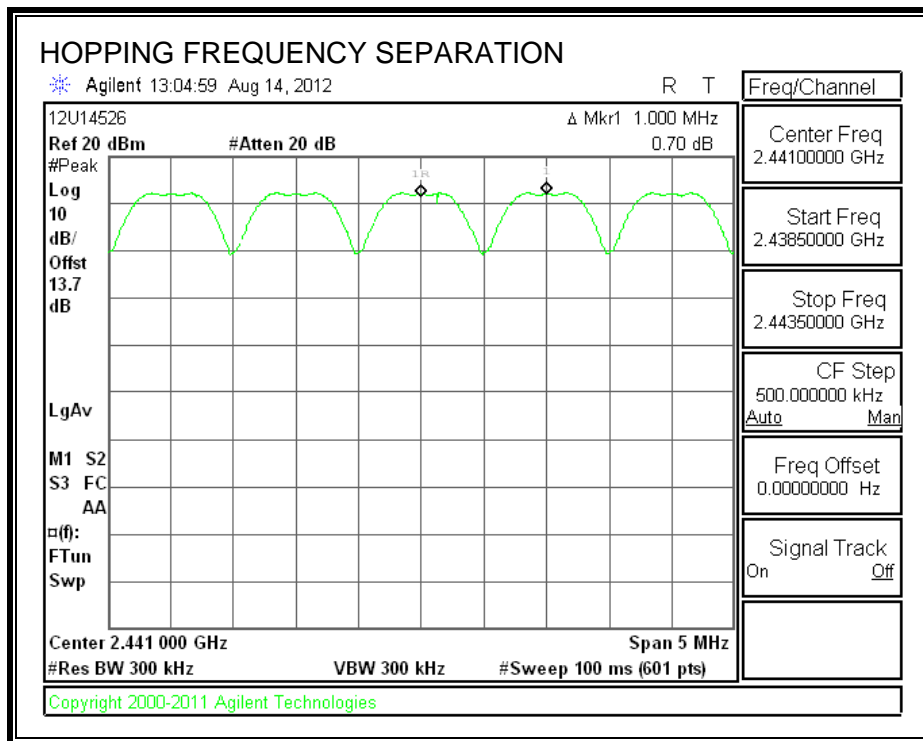
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

##### TEST PROCEDURE

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

**RESULTS**

**HOPPING FREQUENCY SEPARATION**



## 7.1.2. 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

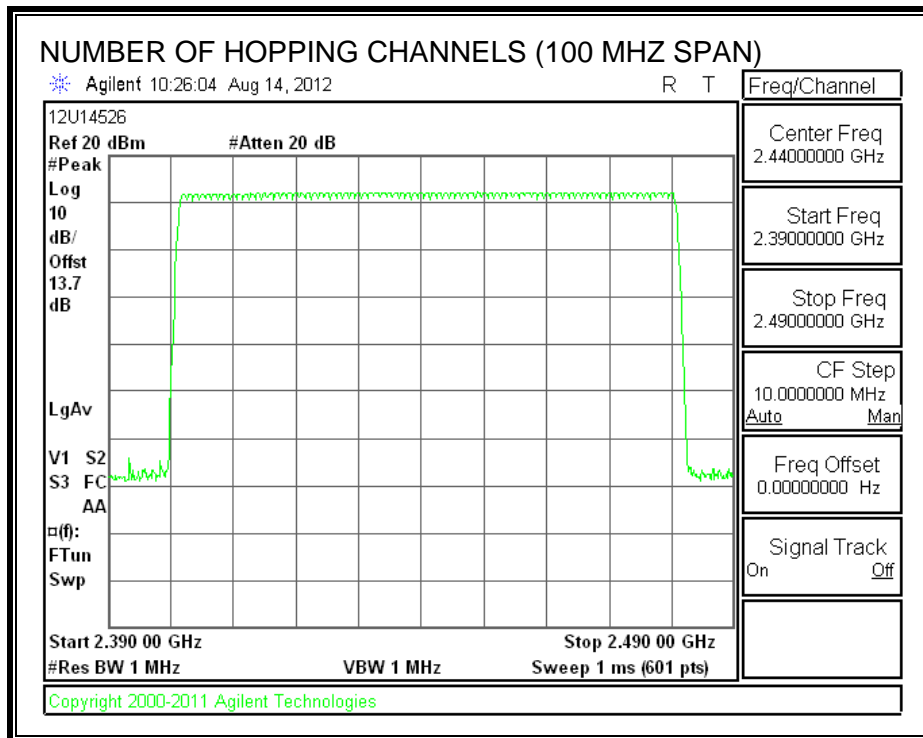
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

### RESULTS

Normal Mode: 79 Channels observed.

AFH mode supports 15 channels.

**NUMBER OF HOPPING CHANNELS**











### 7.1.3. 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.

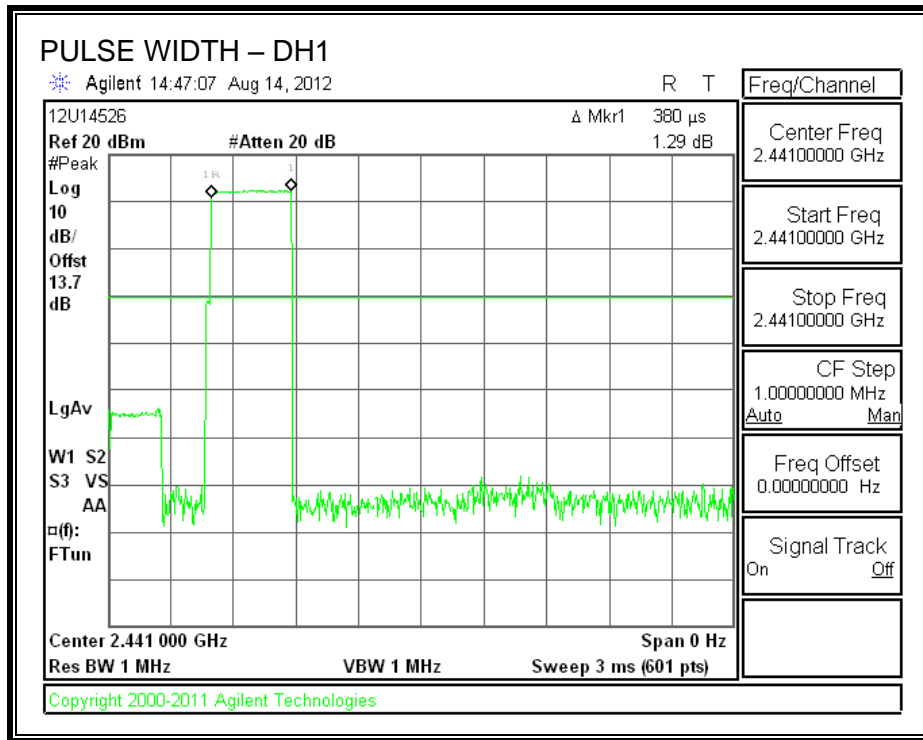
The average time of occupancy in the specified 31.6 second period (79 channels \* 0.4 s) is equal to  $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{ pulse width}$ .

For AFH mode, the average time of occupancy in the specified 8 second period (20 channels \* 0.4 seconds) is equal to  $10 * (\# \text{ of pulses in } 0.8 \text{ s}) * \text{ pulse width}$ .

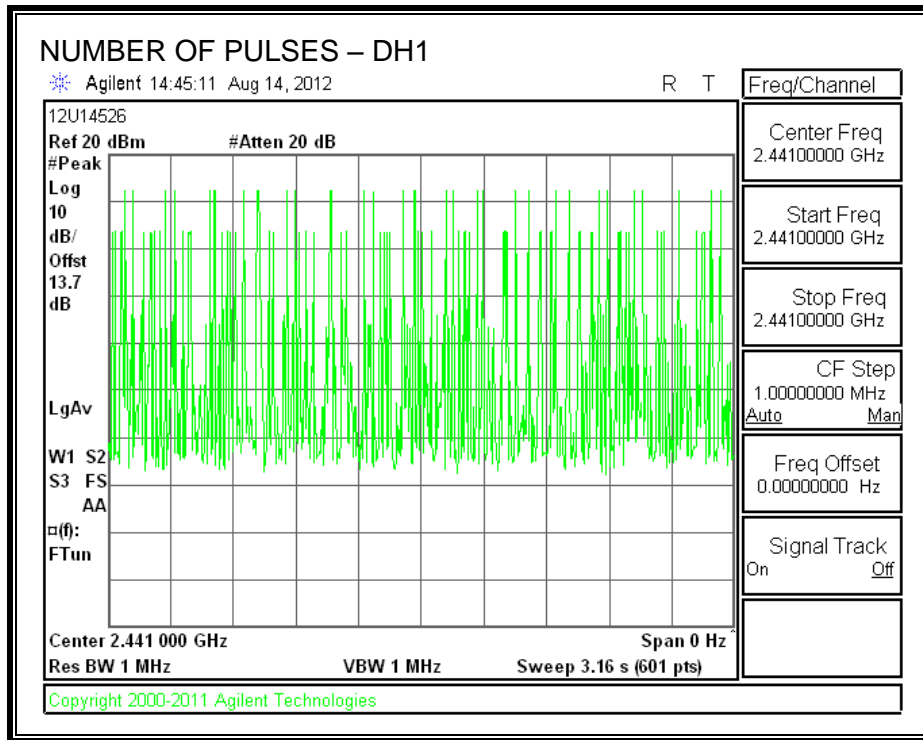
#### RESULTS

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK Normal Mode					
DH1	0.38	31	0.118	0.4	-0.282
DH3	1.64	15	0.246	0.4	-0.154
DH5	2.883	9	0.259	0.4	-0.141

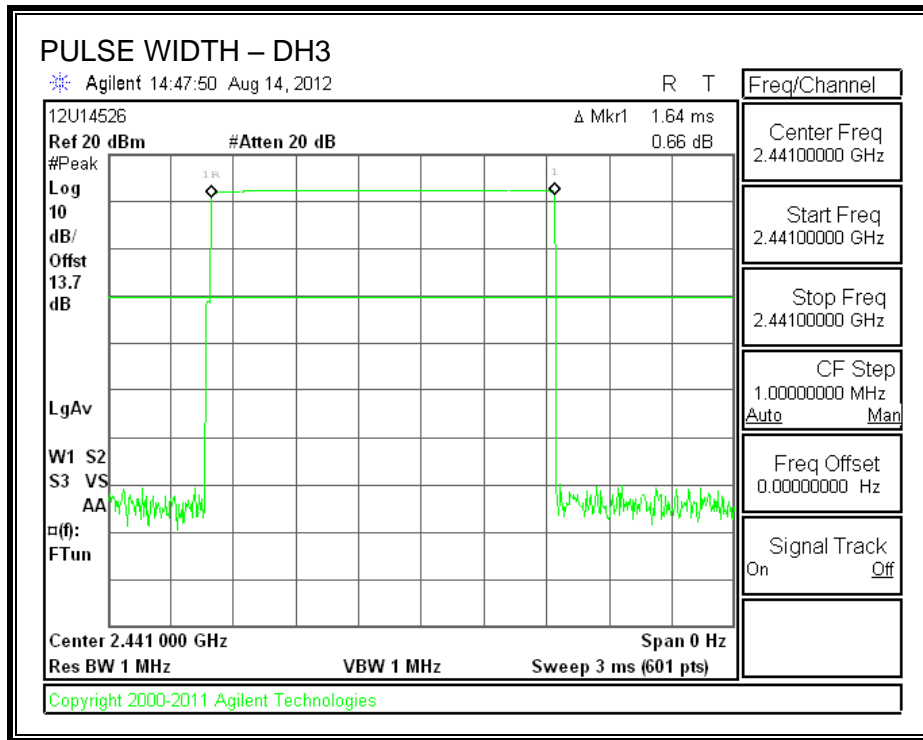
**PULSE WIDTH - DH1**



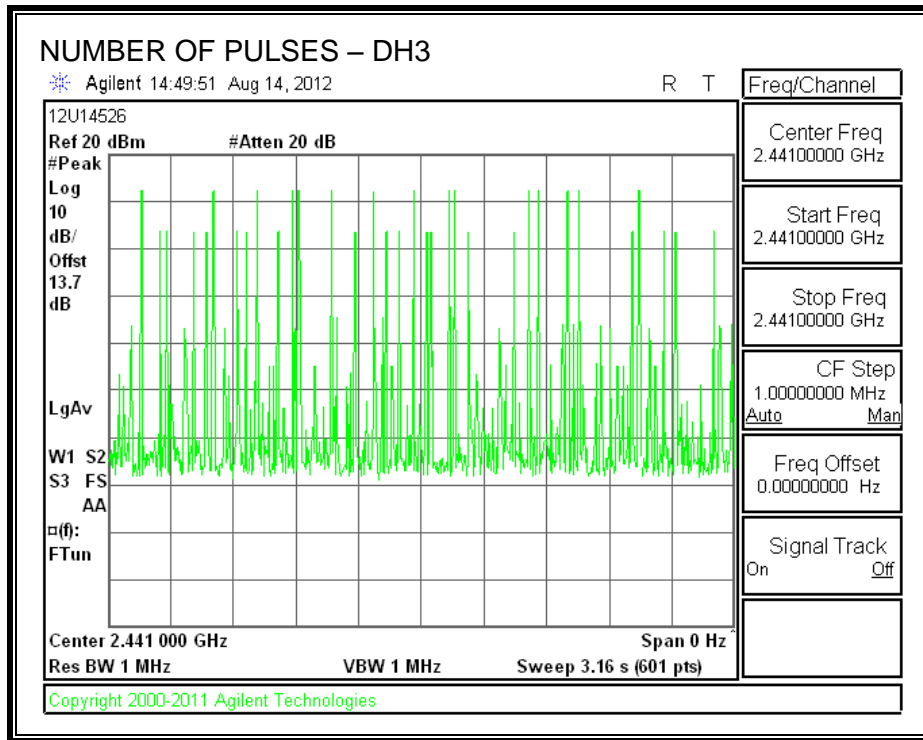
**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1**



**PULSE WIDTH – DH3**

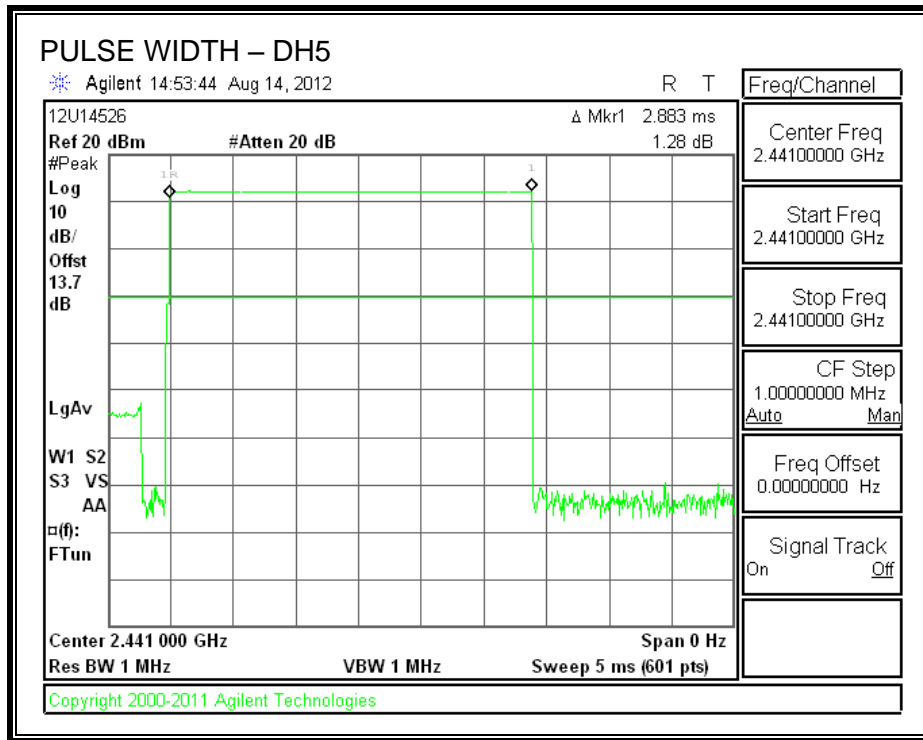


**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3**

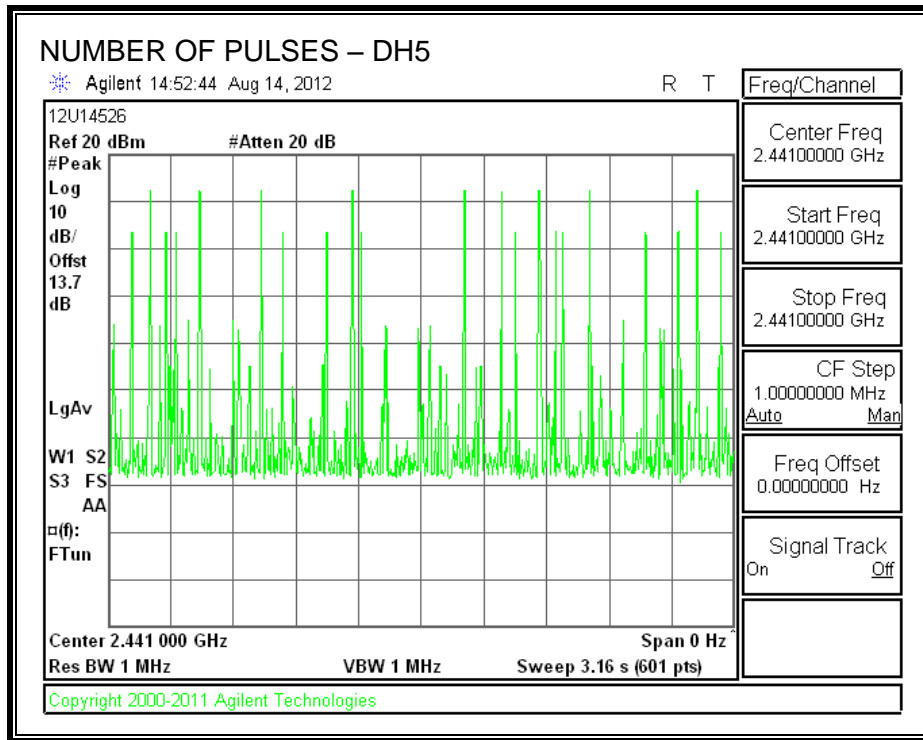




**PULSE WIDTH – DH5**



**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5**



### 7.1.4. 20 dB AND 99% BANDWIDTH

#### LIMIT

None; for reporting purposes only.

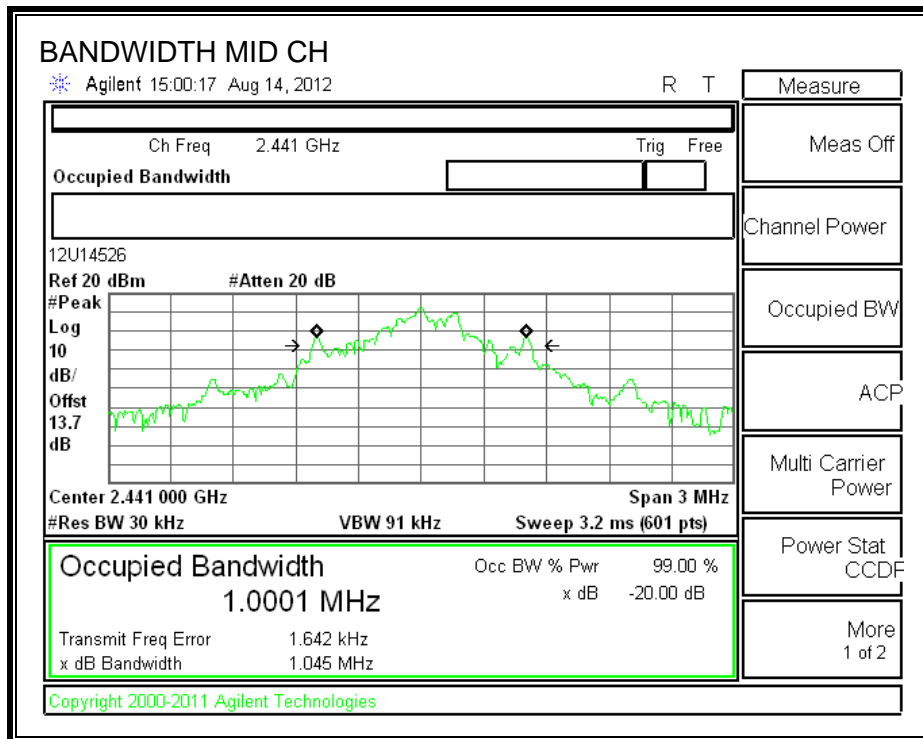
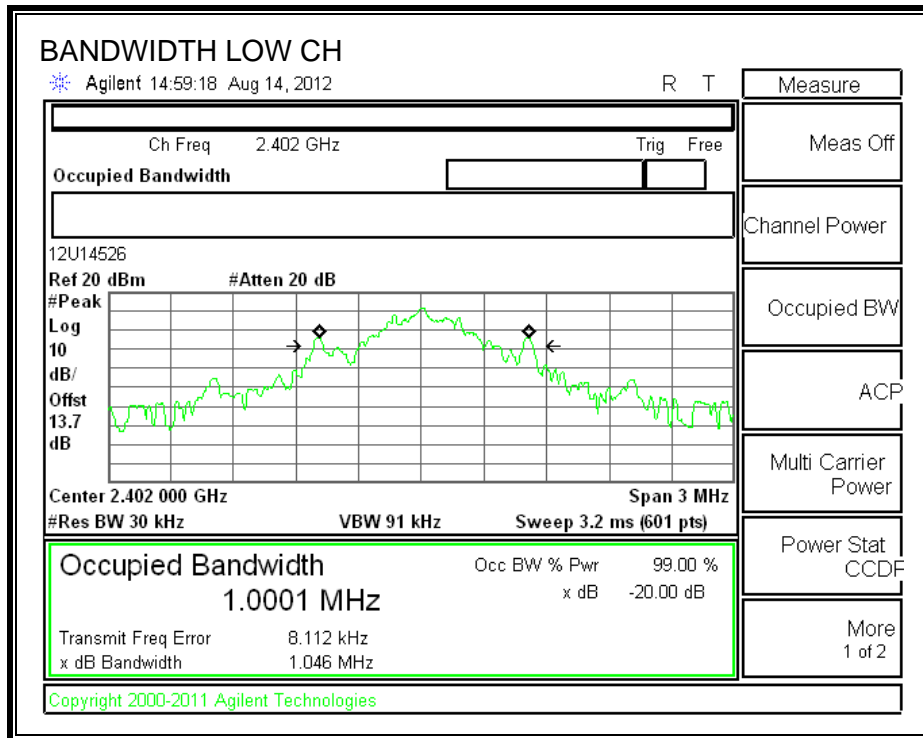
#### TEST PROCEDURE

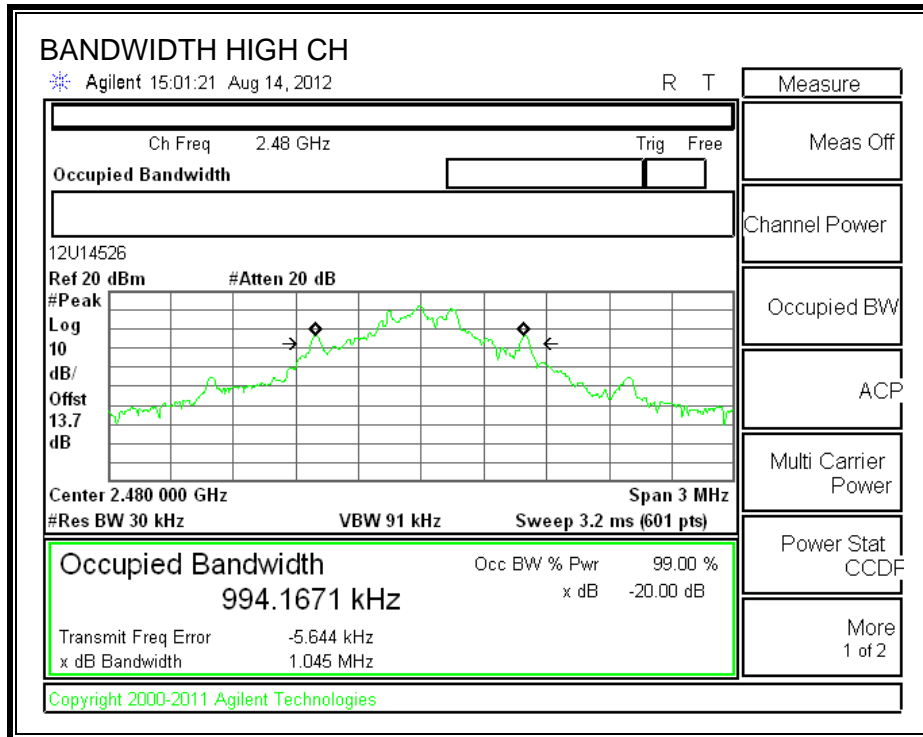
The transmitter output is connected to a spectrum analyzer. The RBW is set to  $\geq 1\%$  of the 20 dB bandwidth. The VBW is set to  $\geq$  RBW. The sweep time is coupled.

#### RESULTS

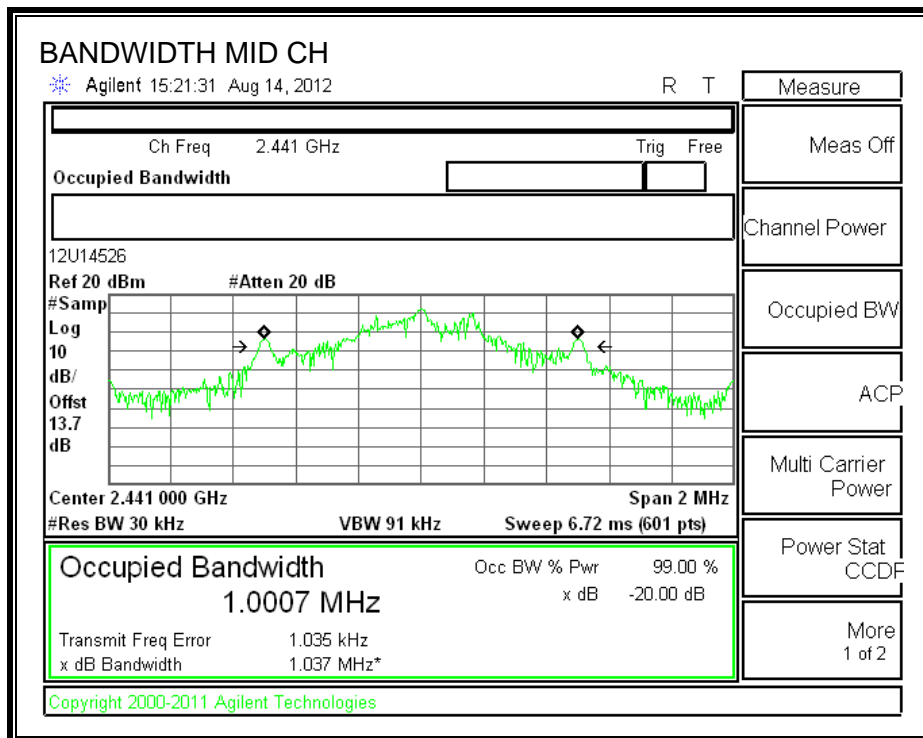
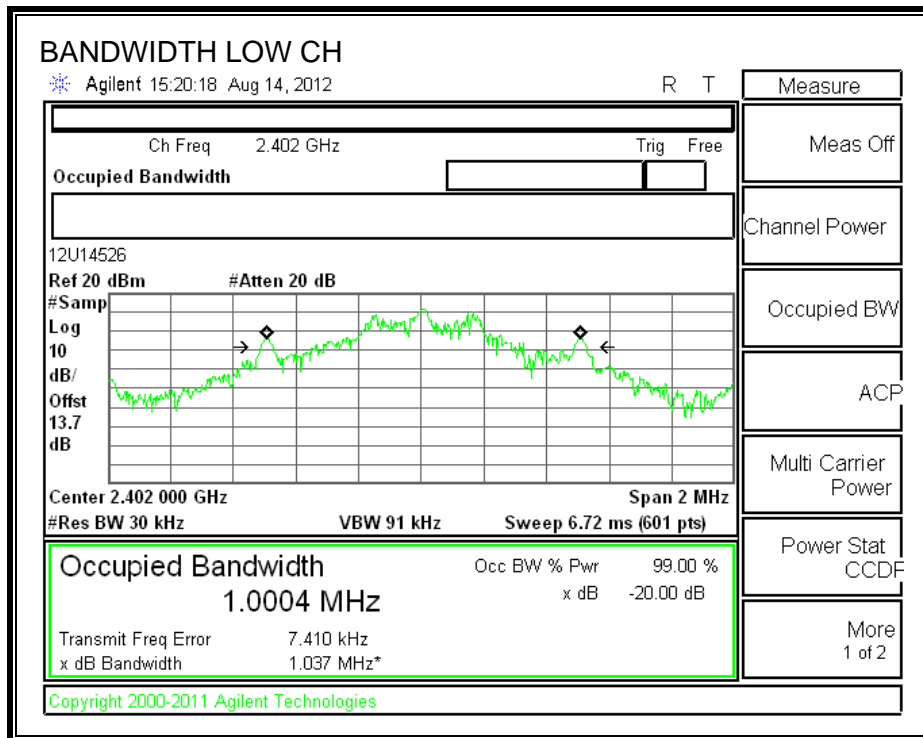
Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	1046	1000.4
Middle	2441	1045	1000.7
High	2480	1045	1004.1

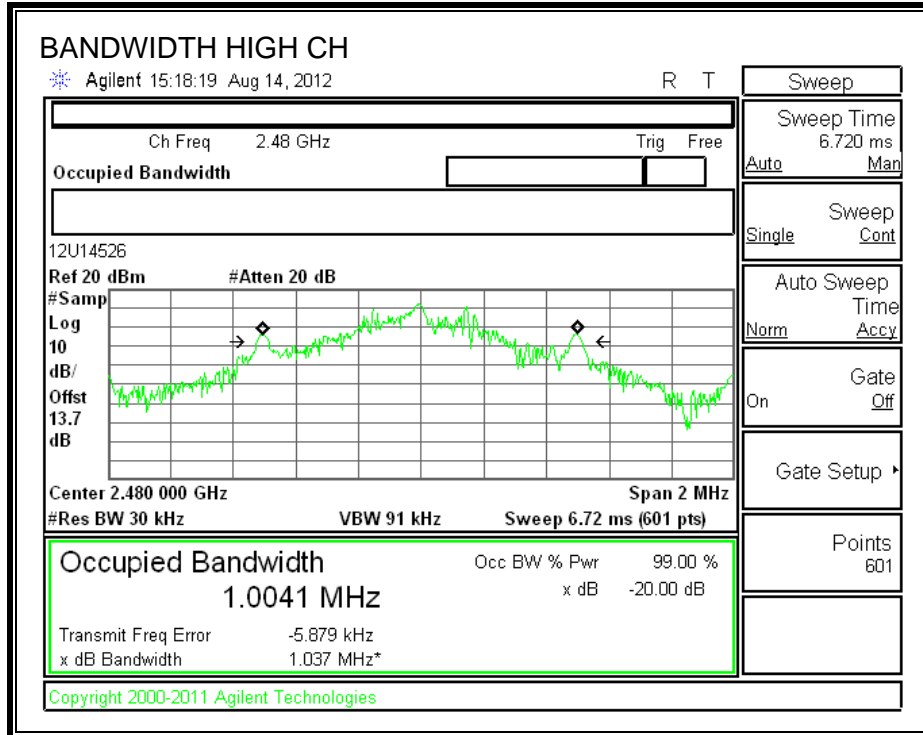
**20 dB BANDWIDTH**





**99% BANDWIDTH**





### 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 20.97 dBm.

#### TEST PROCEDURE

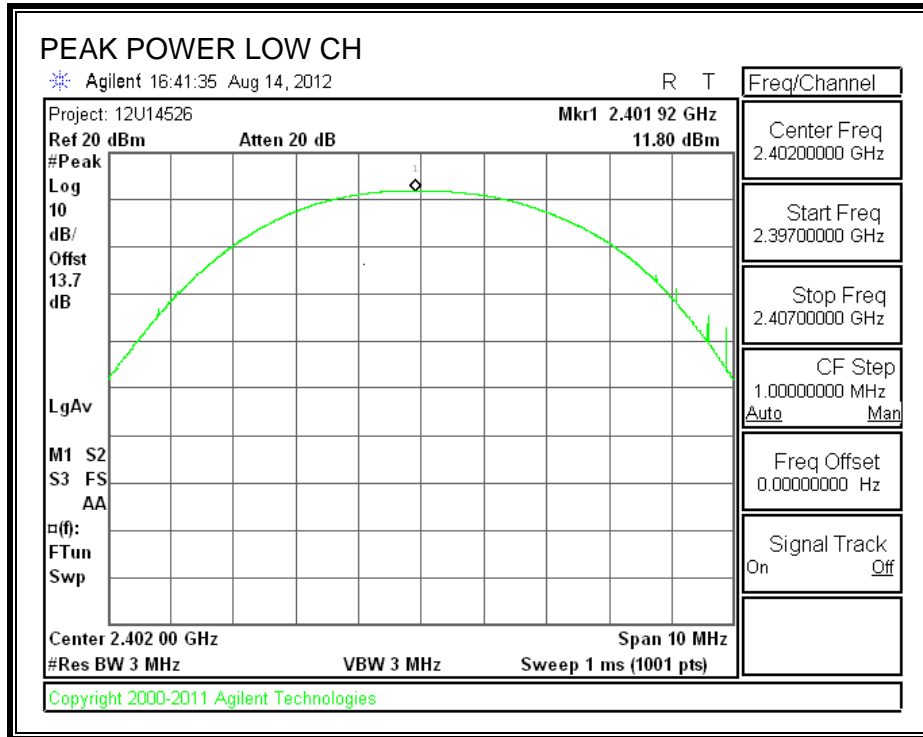
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

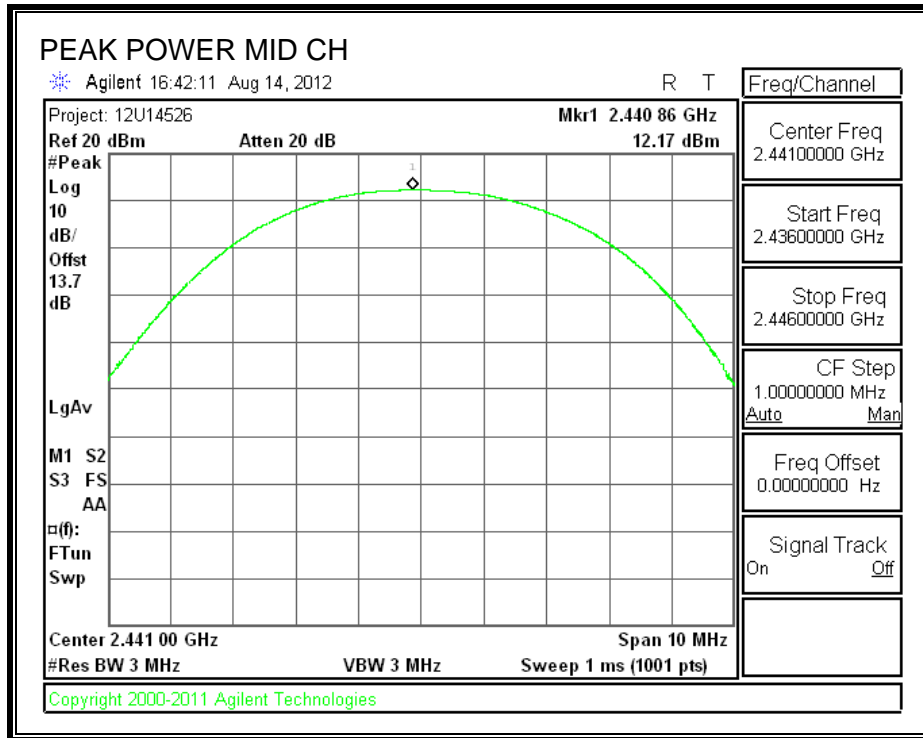
#### RESULTS

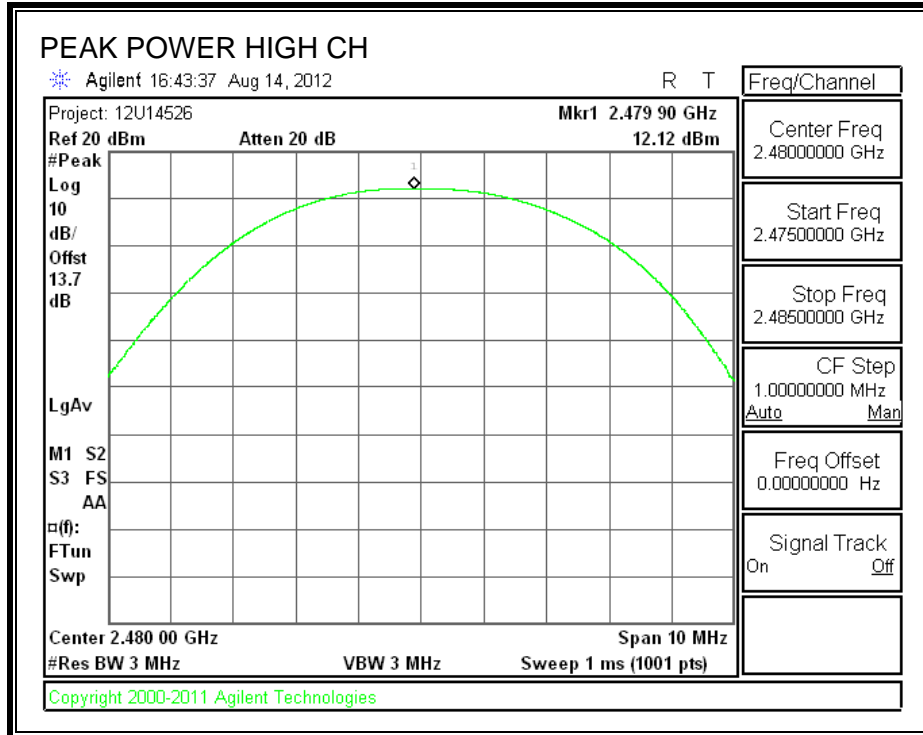
Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	11.80	20.97	-9.17
Middle	2441	12.17	20.97	-8.80
High	2480	12.12	20.97	-8.85



**OUTPUT POWER**







### 7.1.6. AVERAGE POWER

#### LIMIT

None; for reporting purposes only.

#### TEST PROCEDURE

The transmitter output is connected to a power meter.

#### RESULTS

The cable assembly insertion loss of 13.9 dB (including 12. dB pad and 1.9 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	11.40
Middle	2441	11.80
High	2480	11.90

## 7.1.7. CONDUCTED SPURIOUS EMISSIONS

### LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

### TEST PROCEDURE

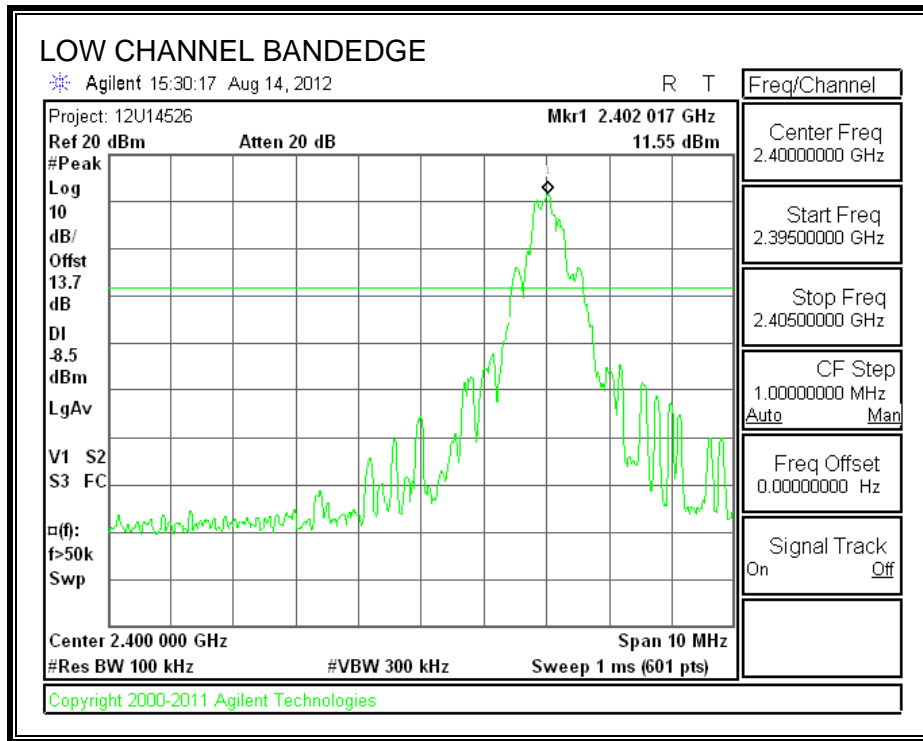
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

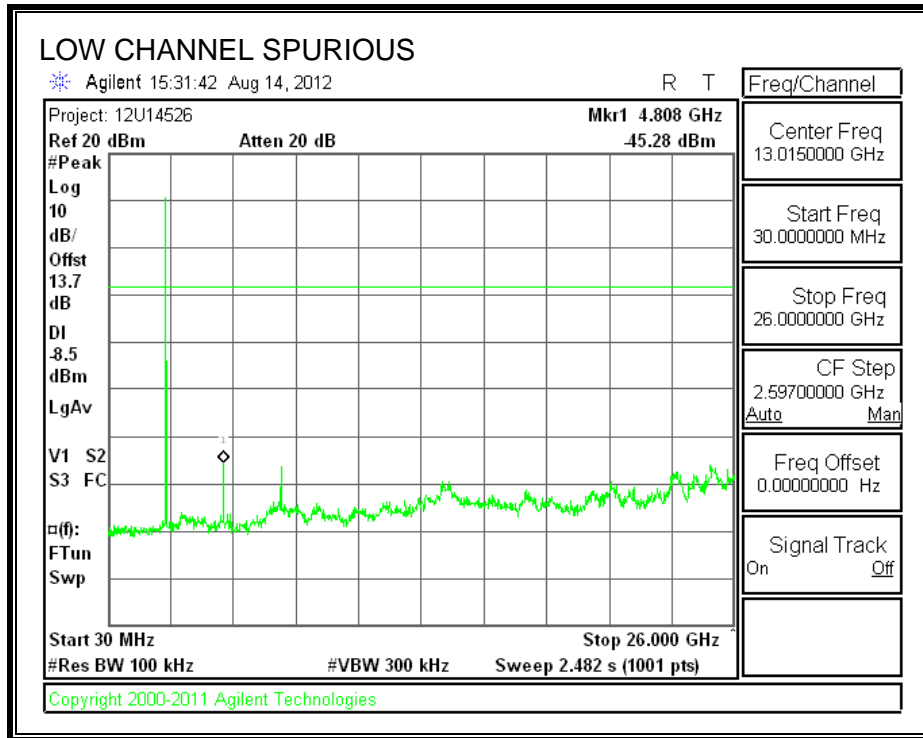
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

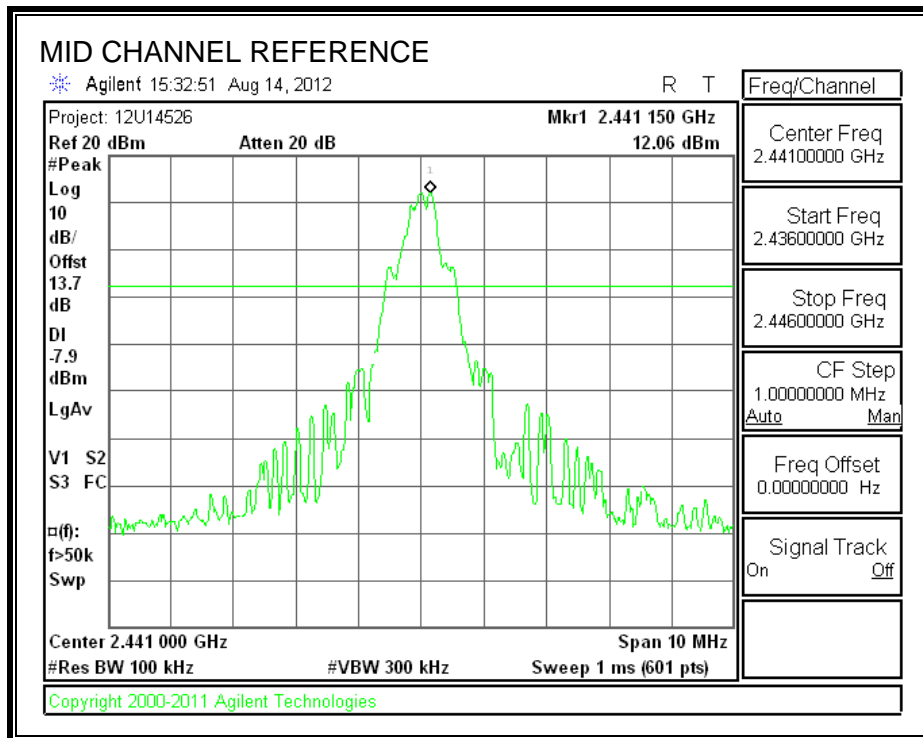
**RESULTS**

**SPURIOUS EMISSIONS, LOW CHANNEL**

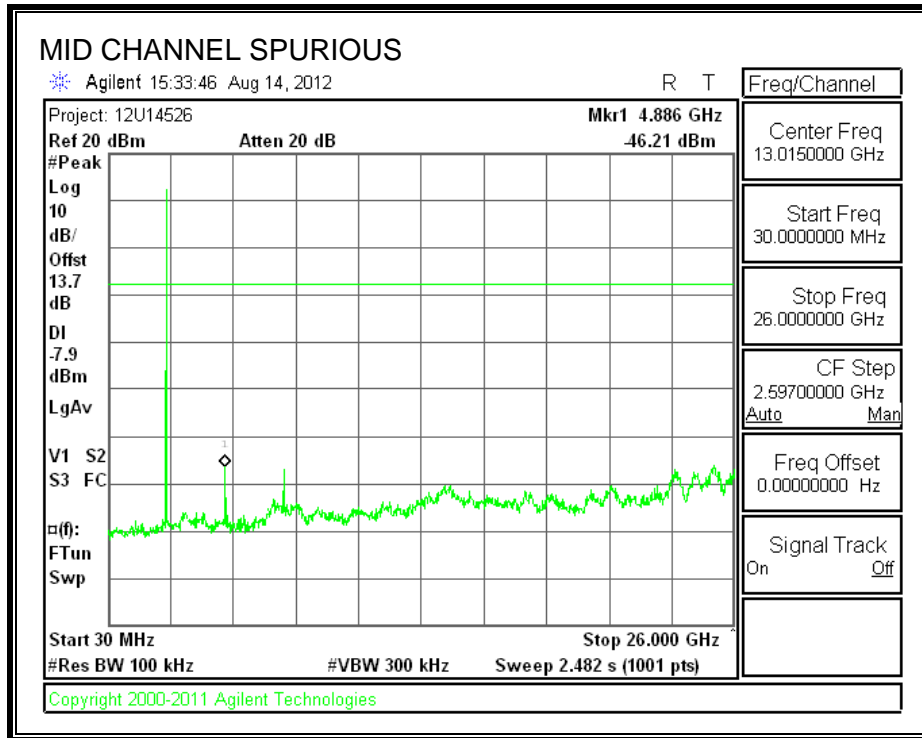




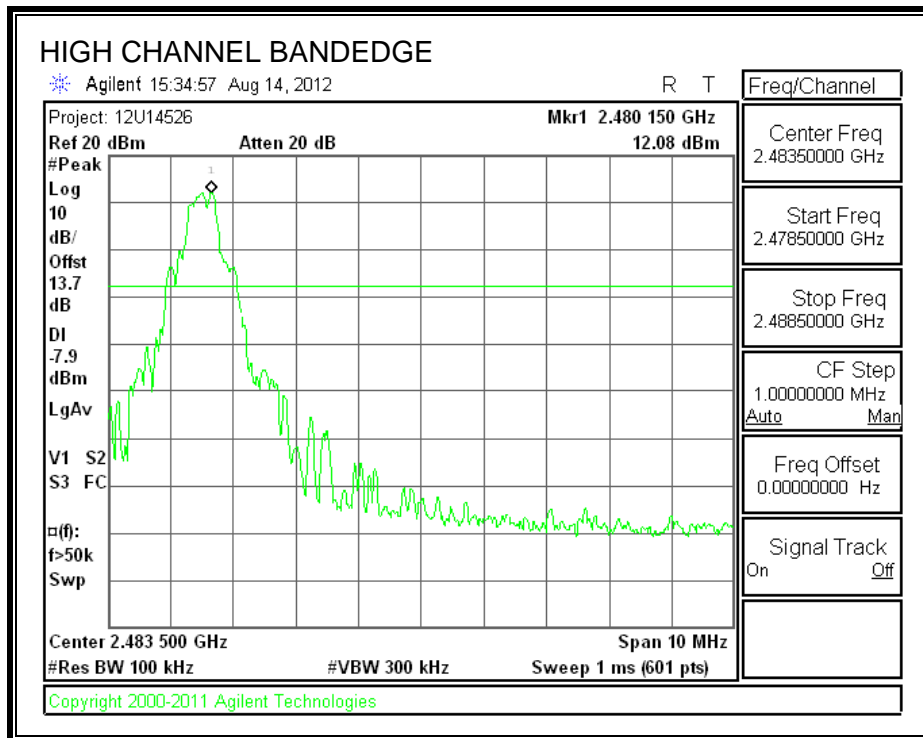
**SPURIOUS EMISSIONS, MID CHANNEL**

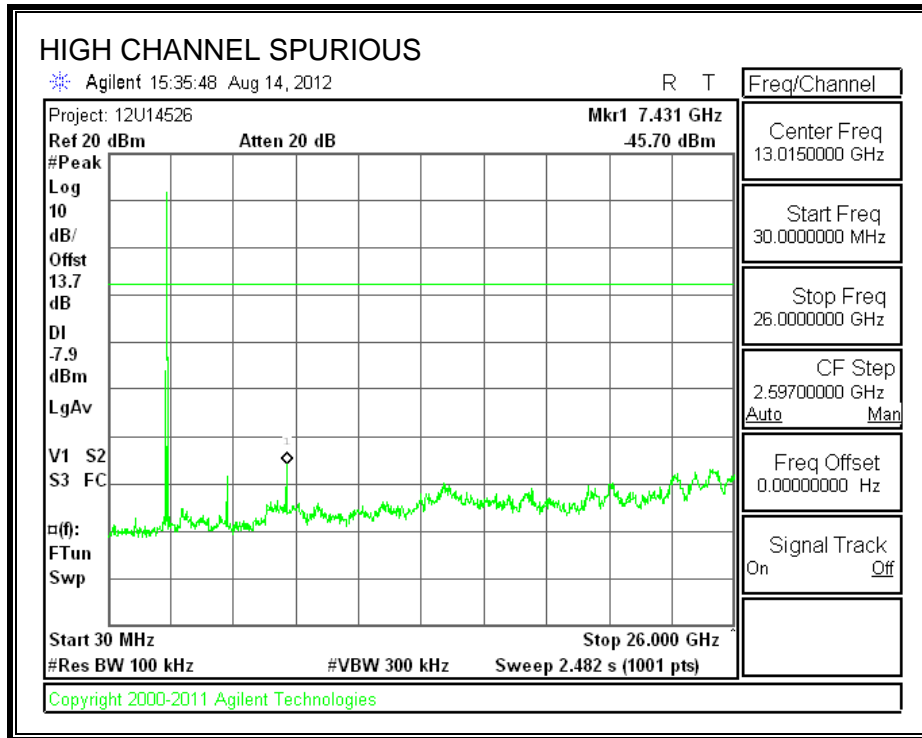




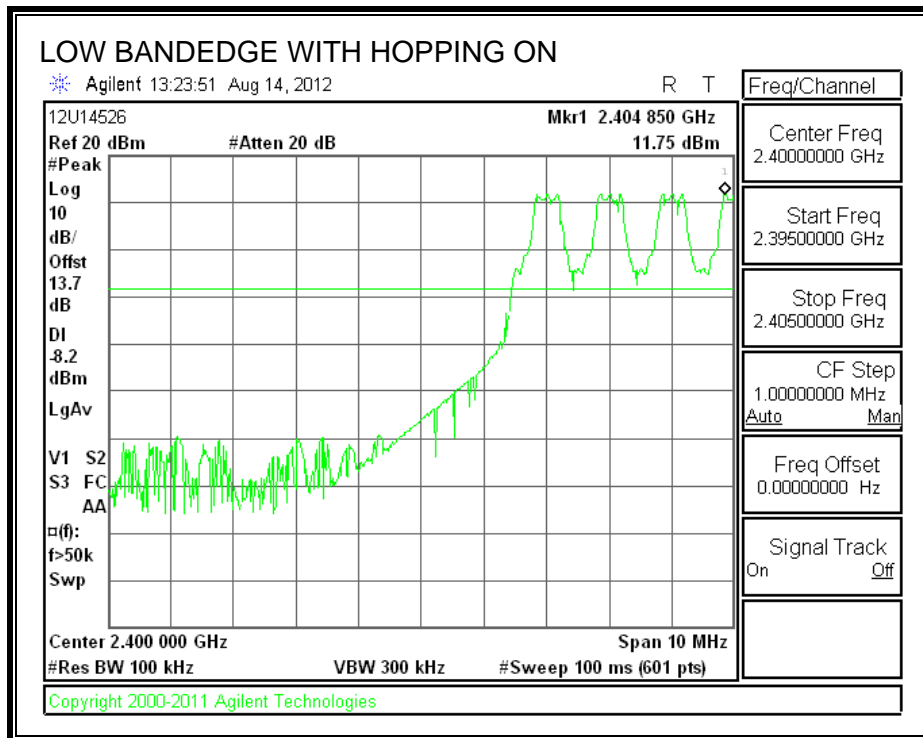


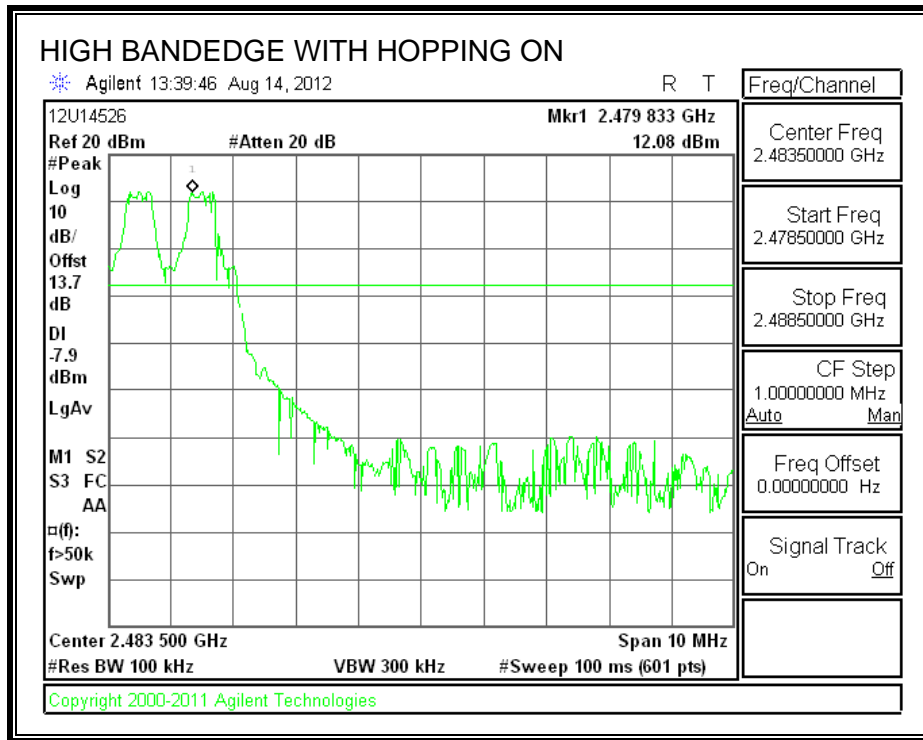
**SPURIOUS EMISSIONS, HIGH CHANNEL**





**SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON**





## 7.2. ENHANCED DATA RATE QPSK MODULATION

### 7.2.1. 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.

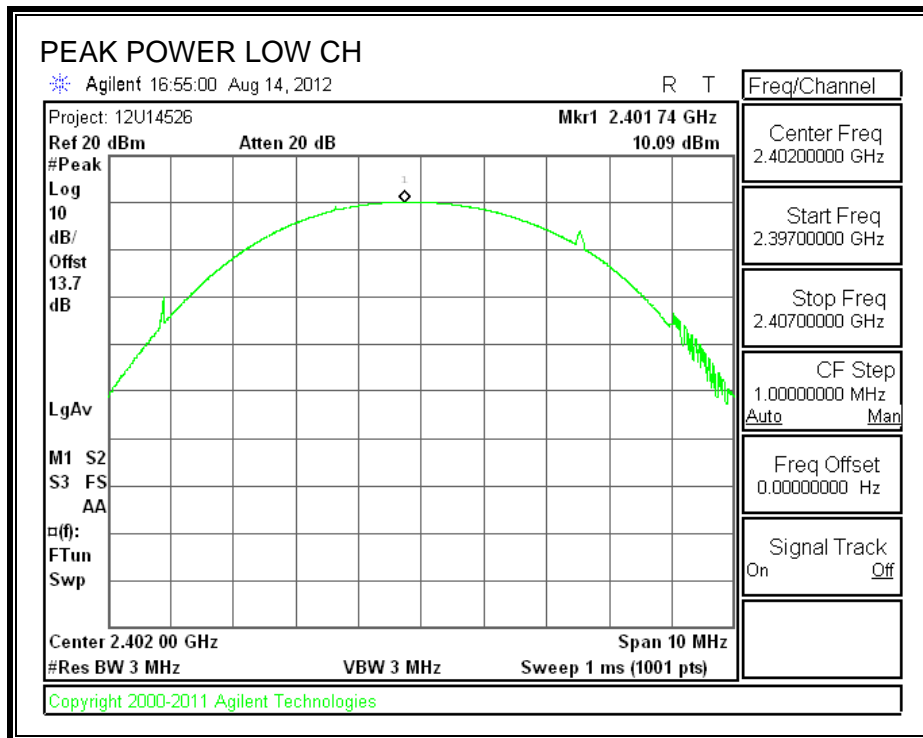
#### TEST PROCEDURE

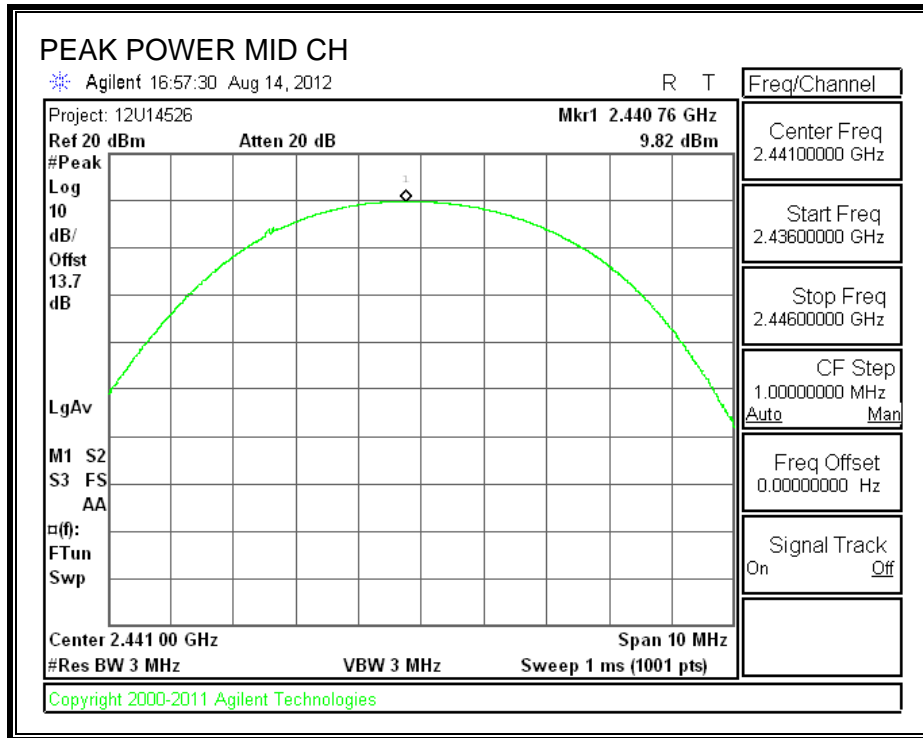
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

#### RESULTS

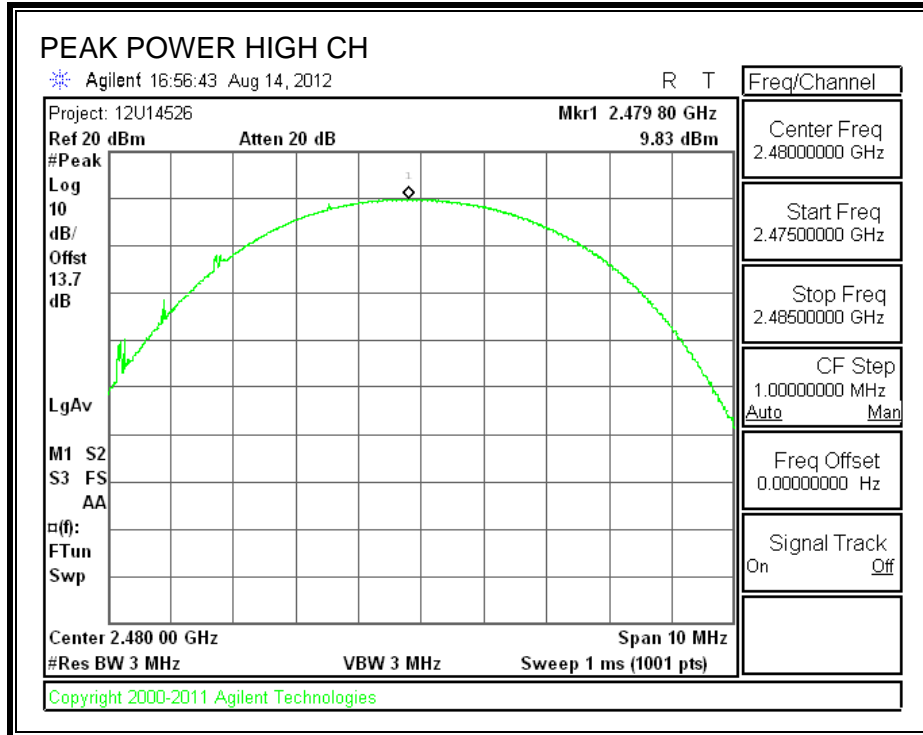
Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	10.09	30	-19.91
Middle	2441	9.82	30	-20.18
High	2480	9.83	30	-20.17

**OUTPUT POWER**









## 7.2.2. AVERAGE POWER

### LIMIT

None; for reporting purposes only.

### TEST PROCEDURE

The transmitter output is connected to a power meter.

### RESULTS

The cable assembly insertion loss of 13.9 dB (including 12. dB pad and 1.9 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	9.50
Middle	2441	9.30
High	2480	9.40

### **7.3. ENHANCED DATA RATE 8PSK MODULATION**

#### **7.3.1. 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.

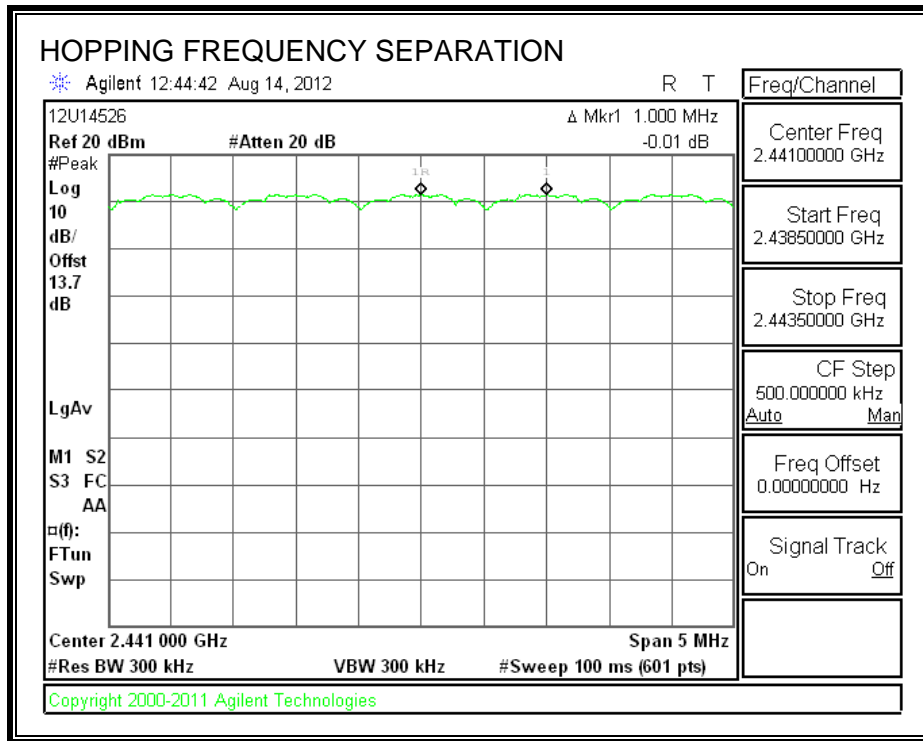
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

##### **TEST PROCEDURE**

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

**RESULTS**

**HOPPING FREQUENCY SEPARATION**



### **7.3.2. 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**

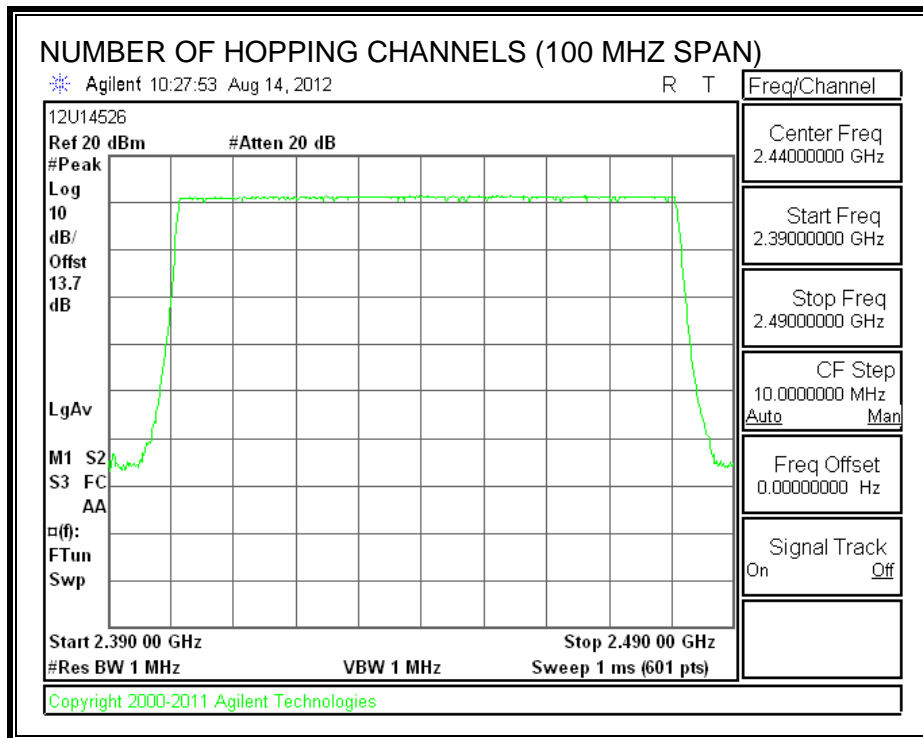
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

#### **RESULTS**

Normal Mode: 79 Channels observed.

AFH mode supports 15 channels.

**NUMBER OF HOPPING CHANNELS**











### 7.3.3. 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  $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{ pulse width}$ .

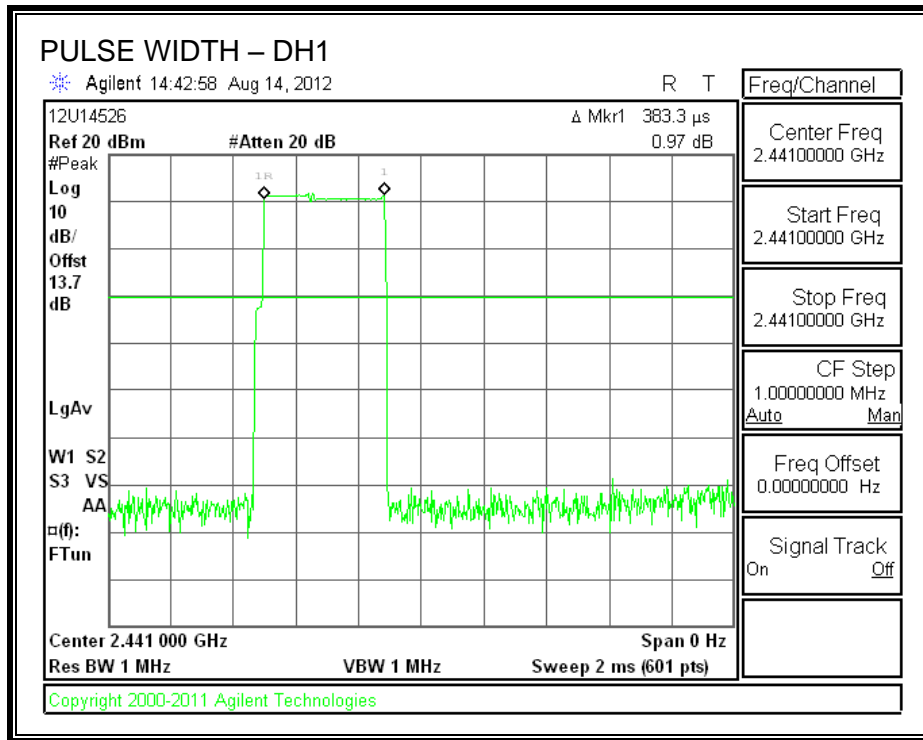
#### RESULTS

Time Of Occupancy =  $10 * xx \text{ pulses} * yy \text{ msec} = zz \text{ msec}$

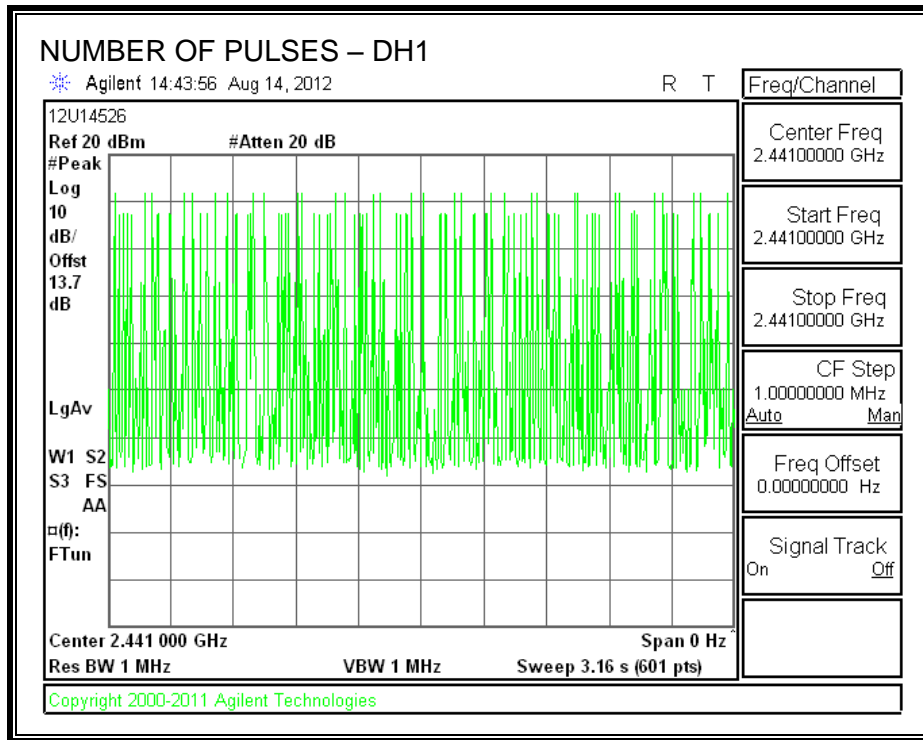
#### 8PSK (EDR) Mode

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.3833	32	0.123	0.4	-0.277
DH3	1.642	14	0.230	0.4	-0.170
DH5	2.883	7	0.202	0.4	-0.198

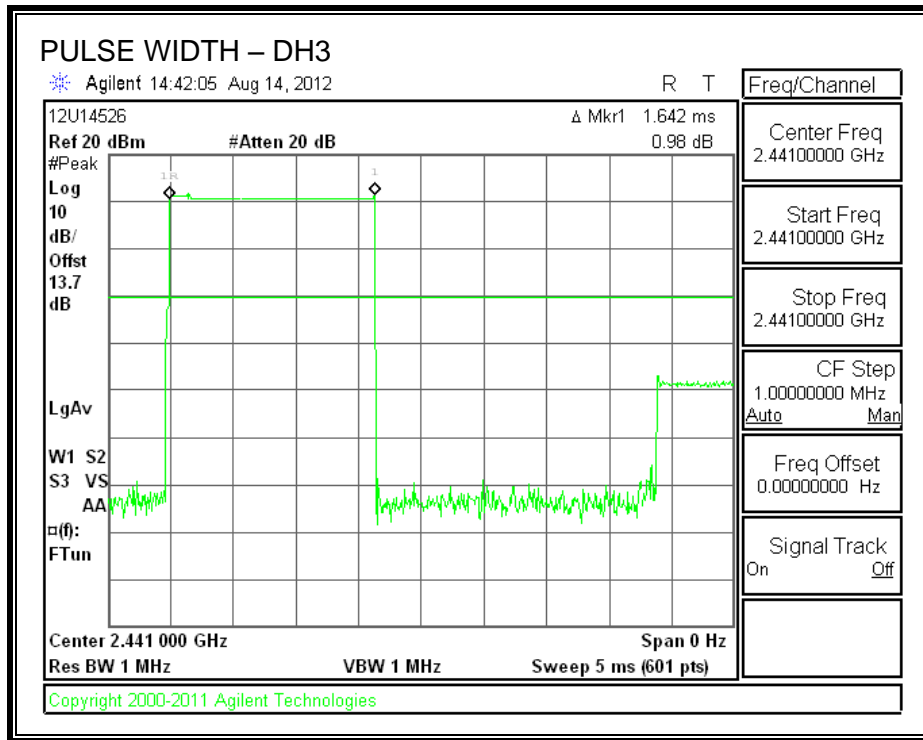
**PULSE WIDTH - DH1**



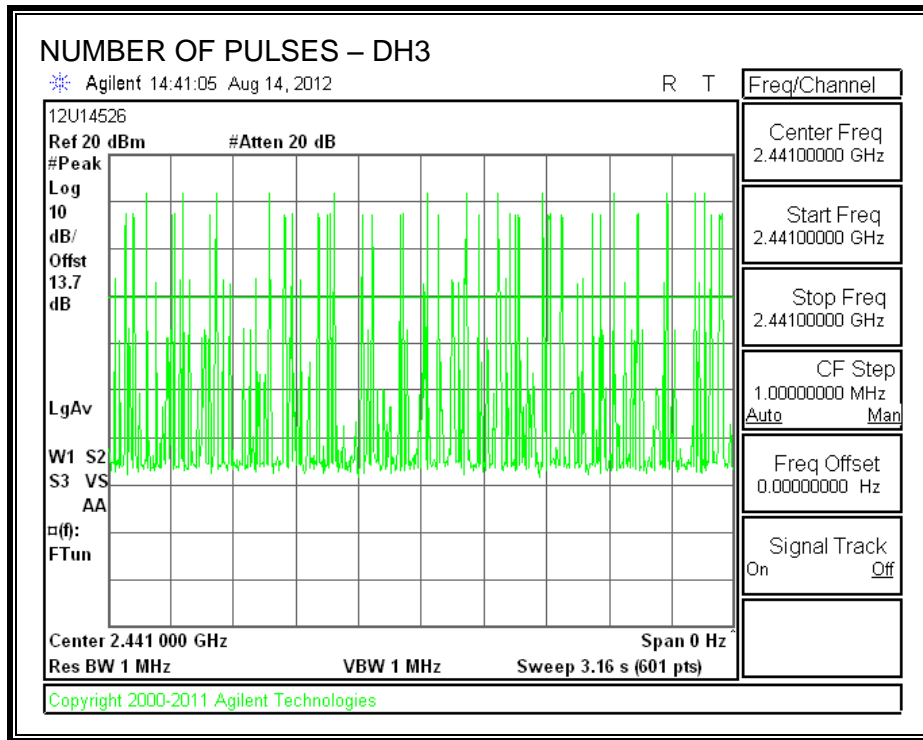
**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1**



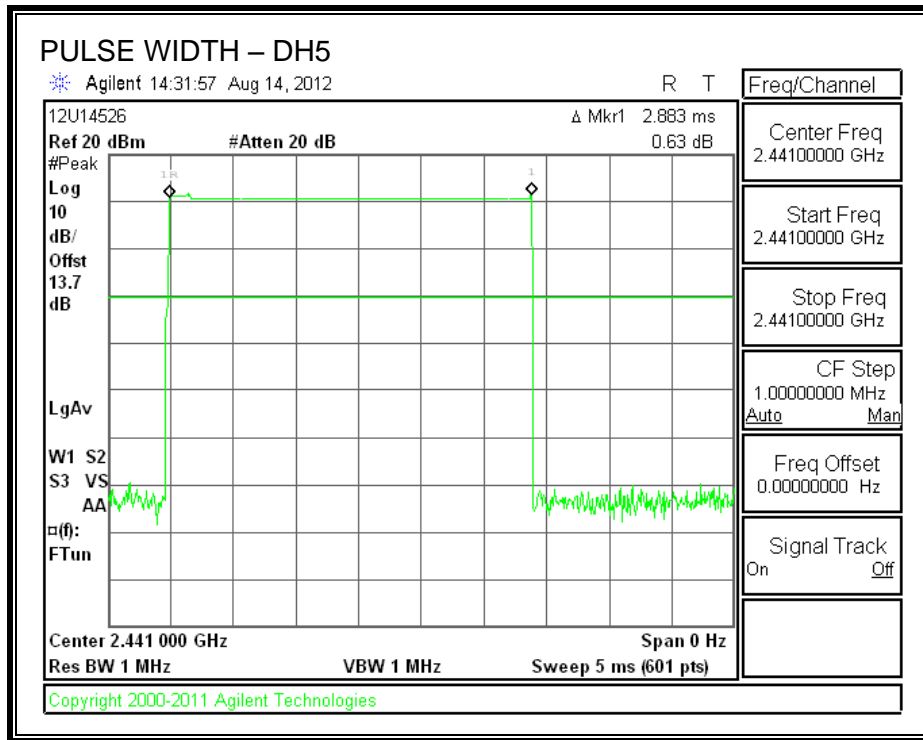
**PULSE WIDTH – DH3**



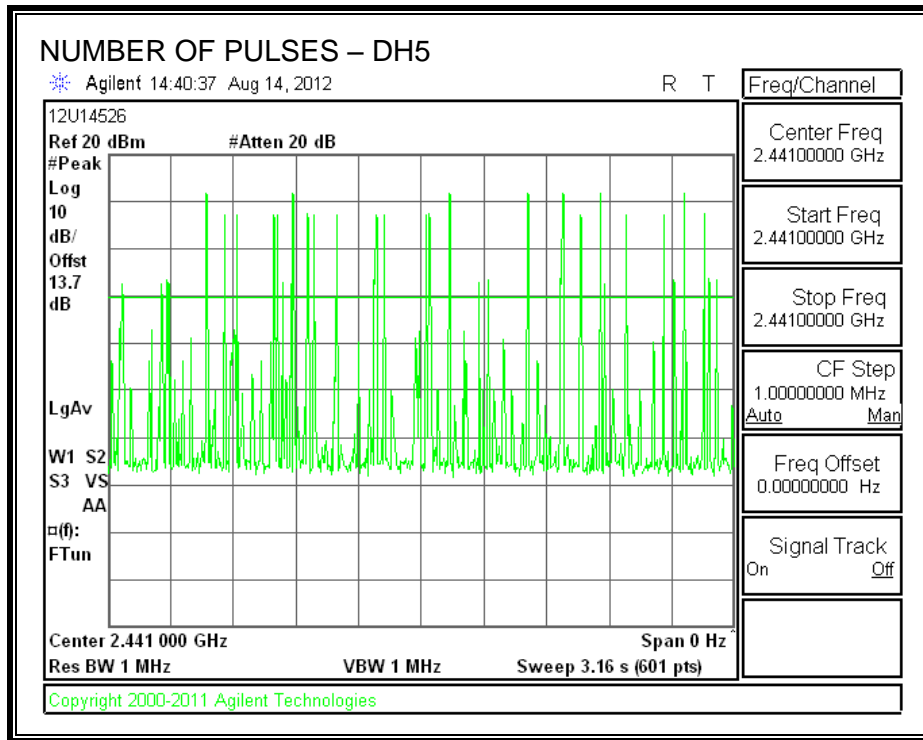
**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3**



**PULSE WIDTH – DH5**



**NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5**





### 7.3.4. 20 dB AND 99% BANDWIDTH

#### LIMIT

None; for reporting purposes only.

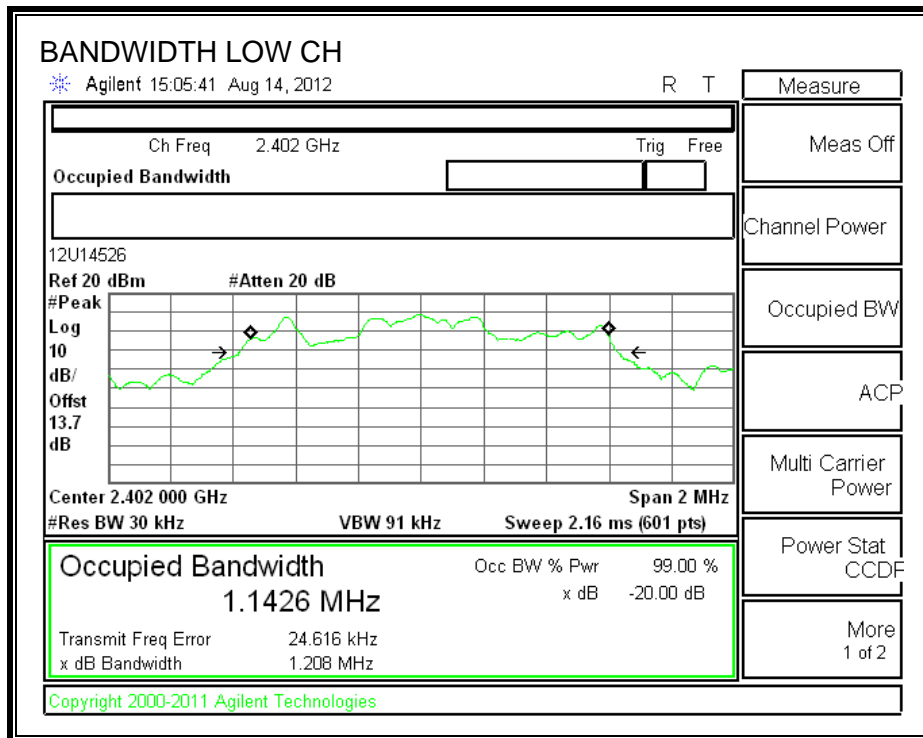
#### TEST PROCEDURE

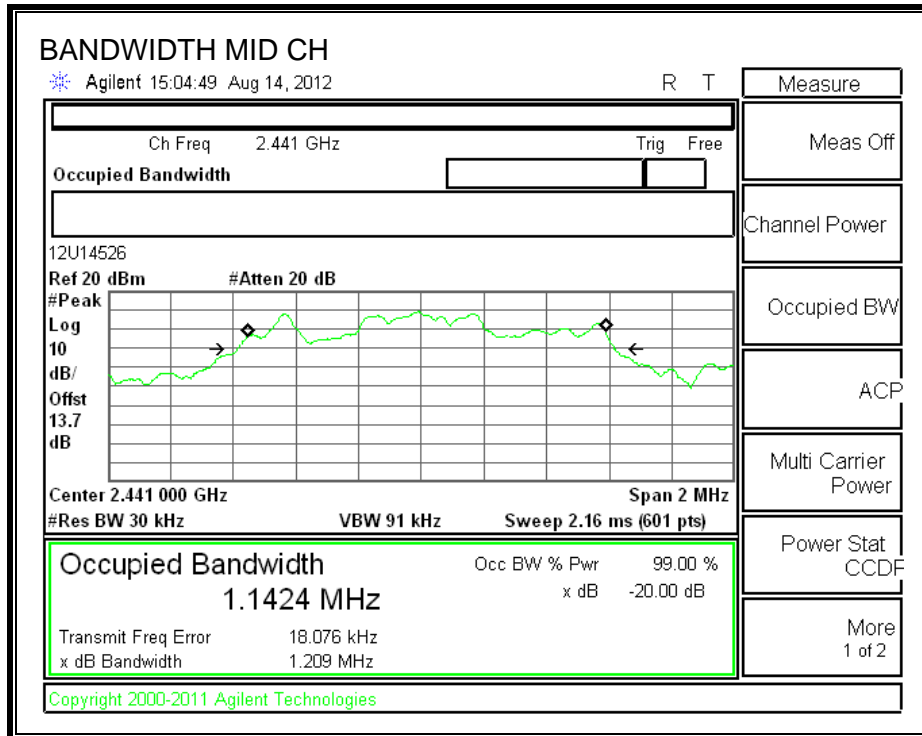
The transmitter output is connected to a spectrum analyzer. The RBW is set to  $\geq 1\%$  of the 20 dB bandwidth. The VBW is set to  $\geq$  RBW. The sweep time is coupled.

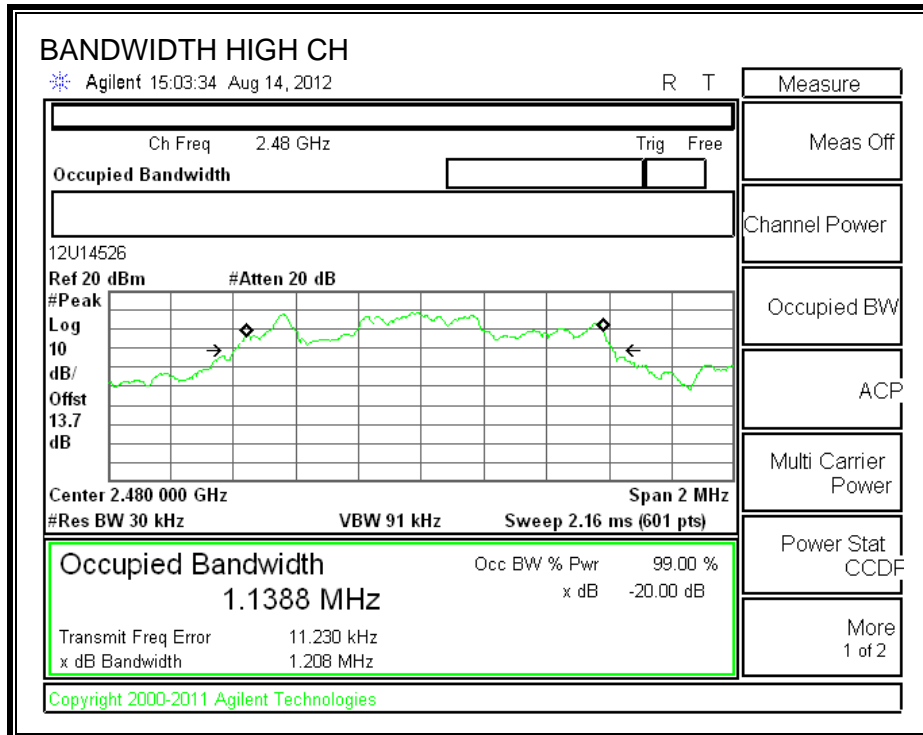
#### RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	1208	1127.3
Middle	2441	1209	1097.9
High	2480	1208	1124.5

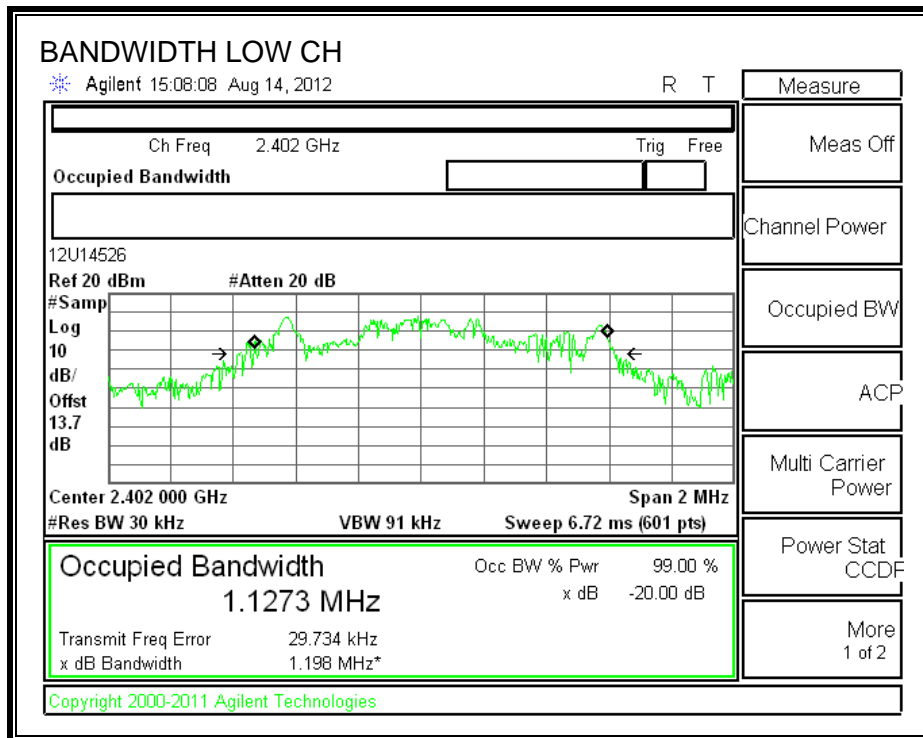
**20 dB BANDWIDTH**

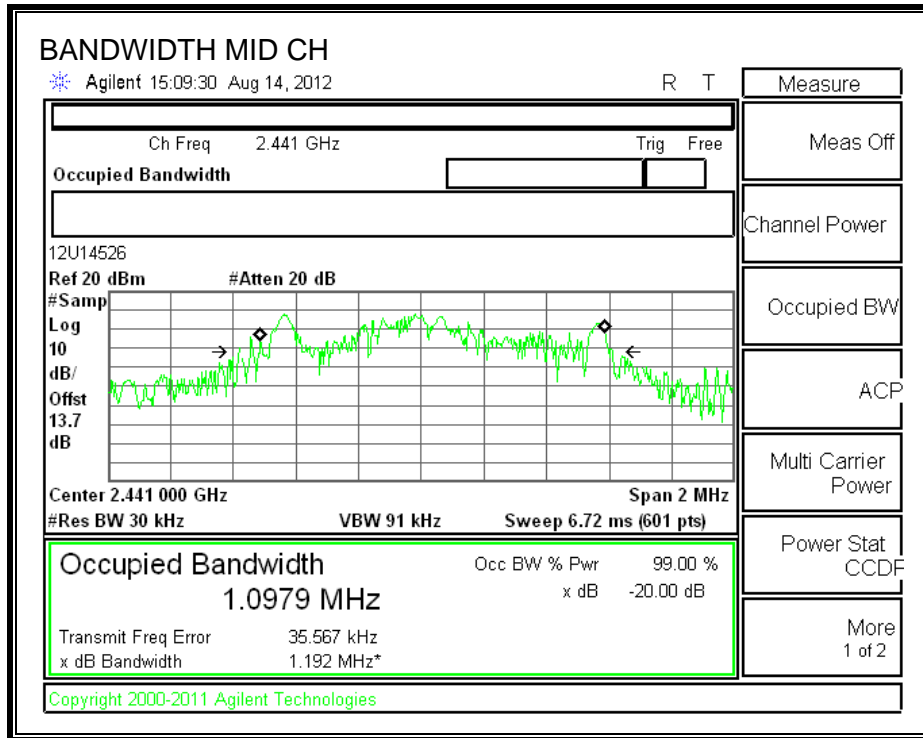


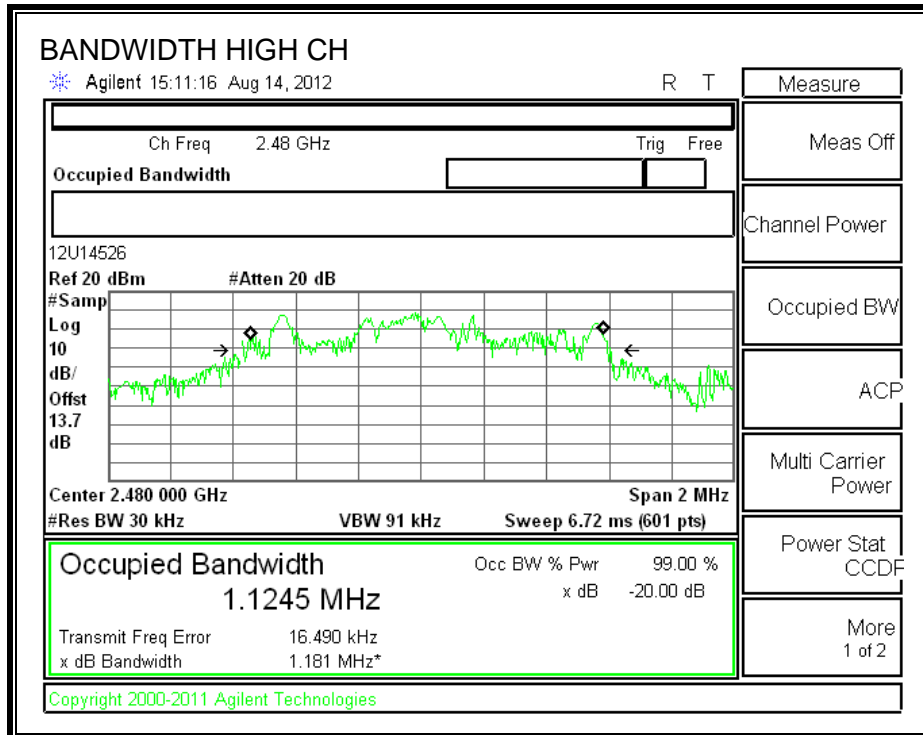




**99% BANDWIDTH**







### 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

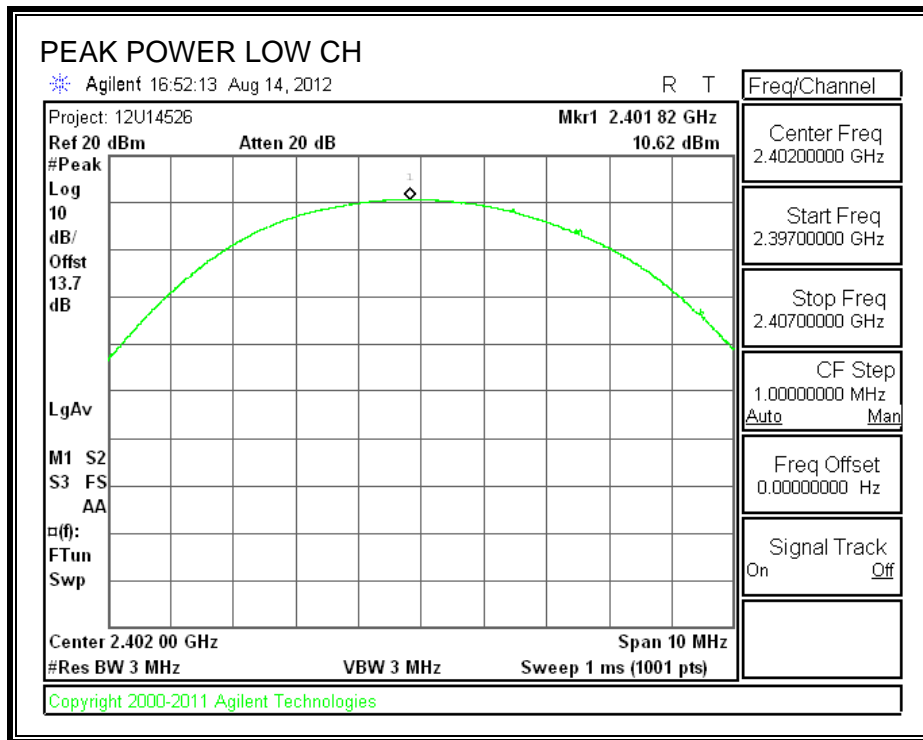
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

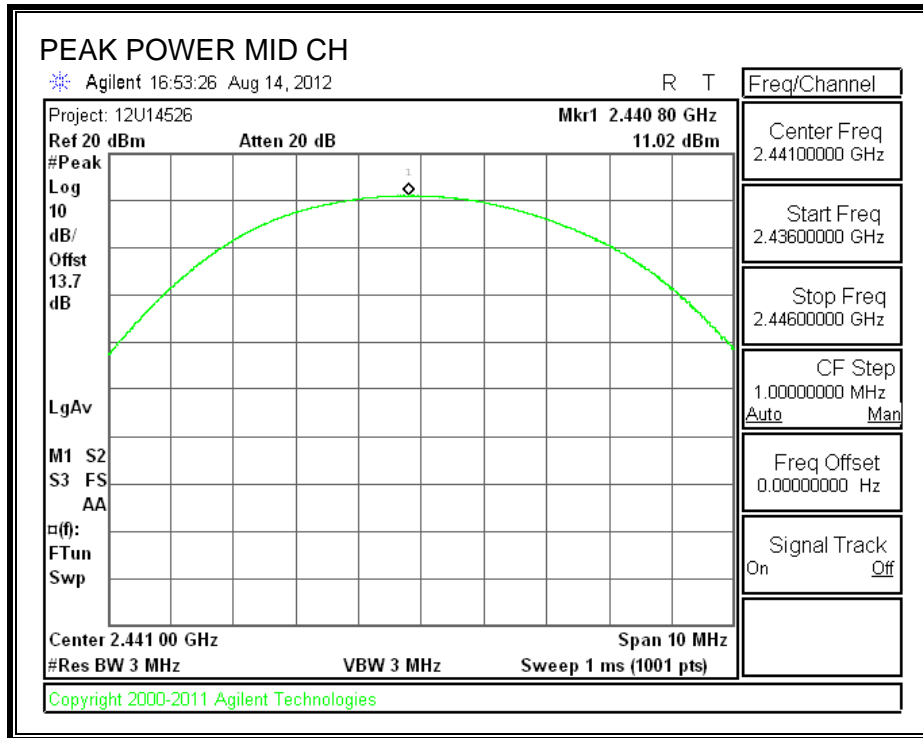
#### RESULTS

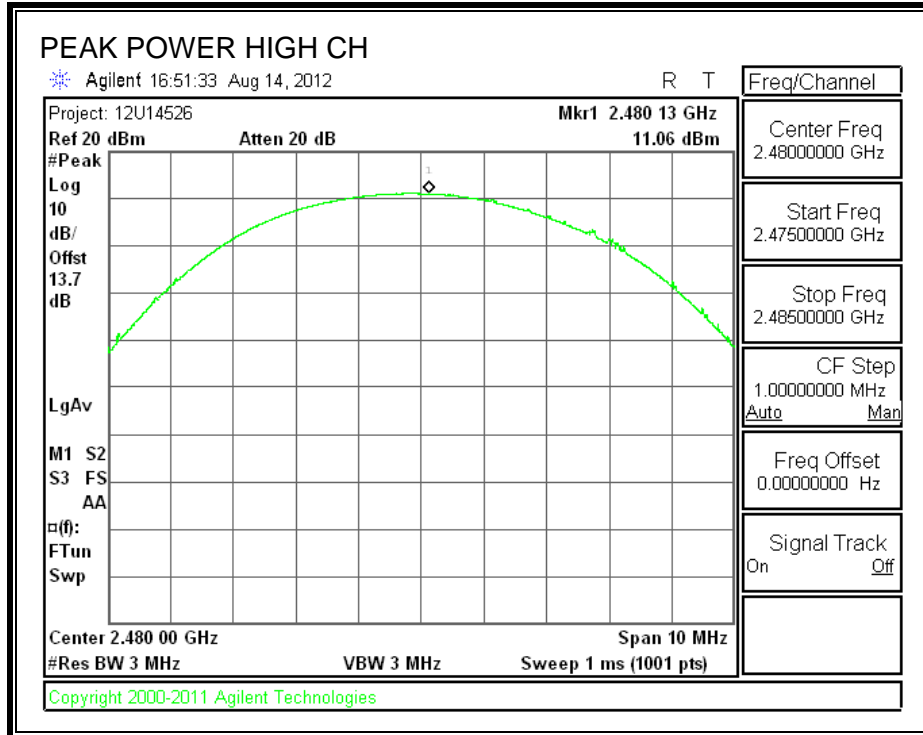
Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	10.62	20.97	-10.35
Middle	2441	11.02	20.97	-9.95
High	2480	11.06	20.97	-9.91



**OUTPUT POWER**







### 7.3.6. AVERAGE POWER

#### LIMIT

None; for reporting purposes only.

#### TEST PROCEDURE

The transmitter output is connected to a Bluetooth Tester.

#### RESULTS

The cable assembly insertion loss of 13.9 dB (including 12.5 dB pad and 1.4 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	9.00
Middle	2441	9.50
High	2480	9.50

### **7.3.7. CONDUCTED SPURIOUS EMISSIONS**

#### **LIMITS**

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

#### **TEST PROCEDURE**

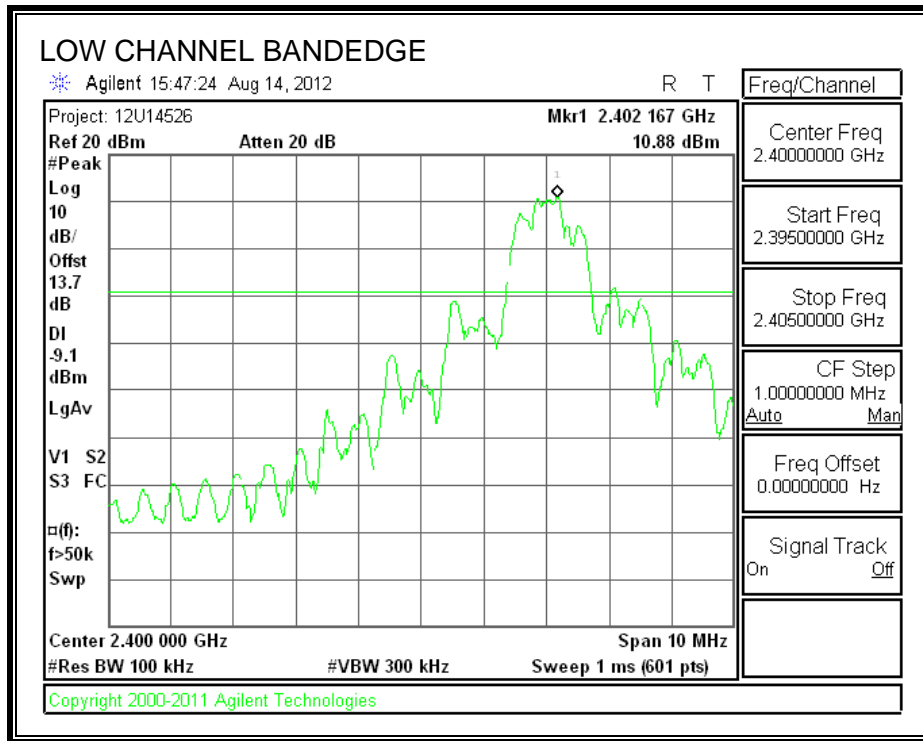
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

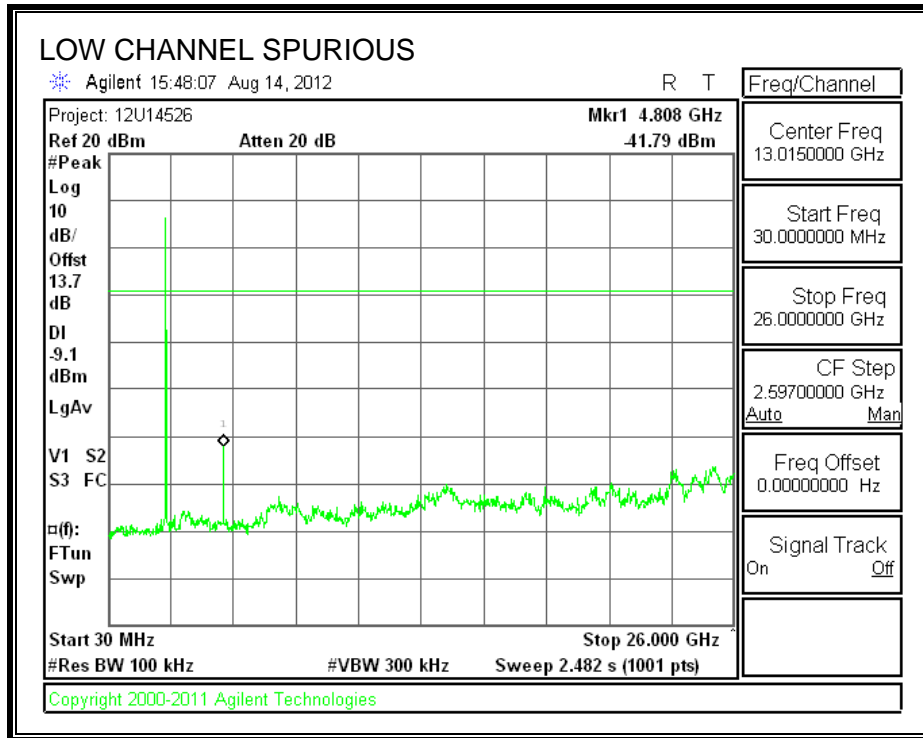
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

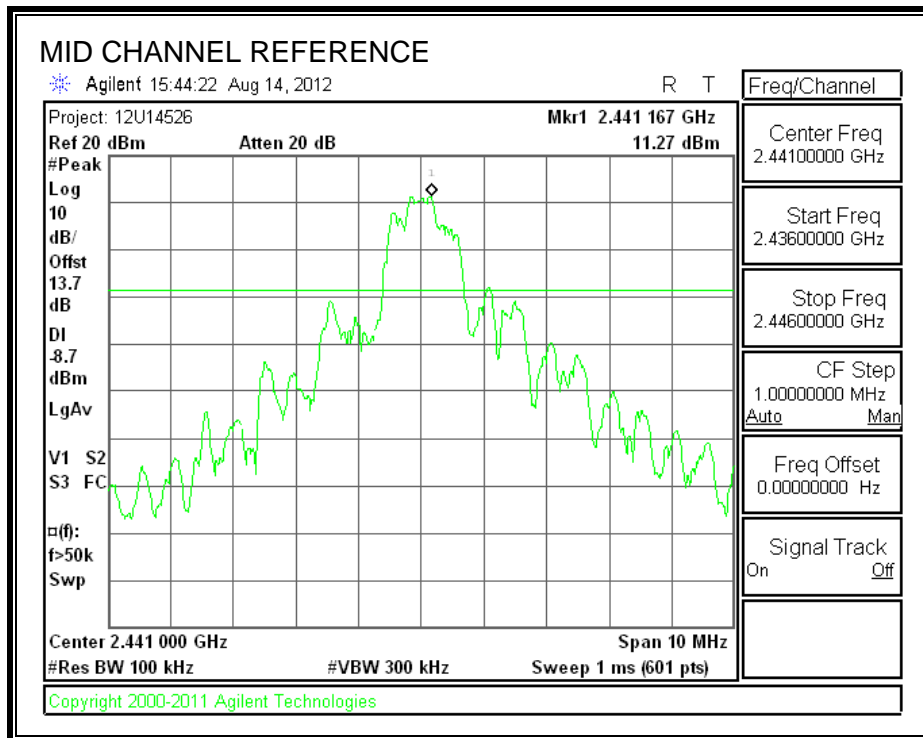
**RESULTS**

**SPURIOUS EMISSIONS, LOW CHANNEL**

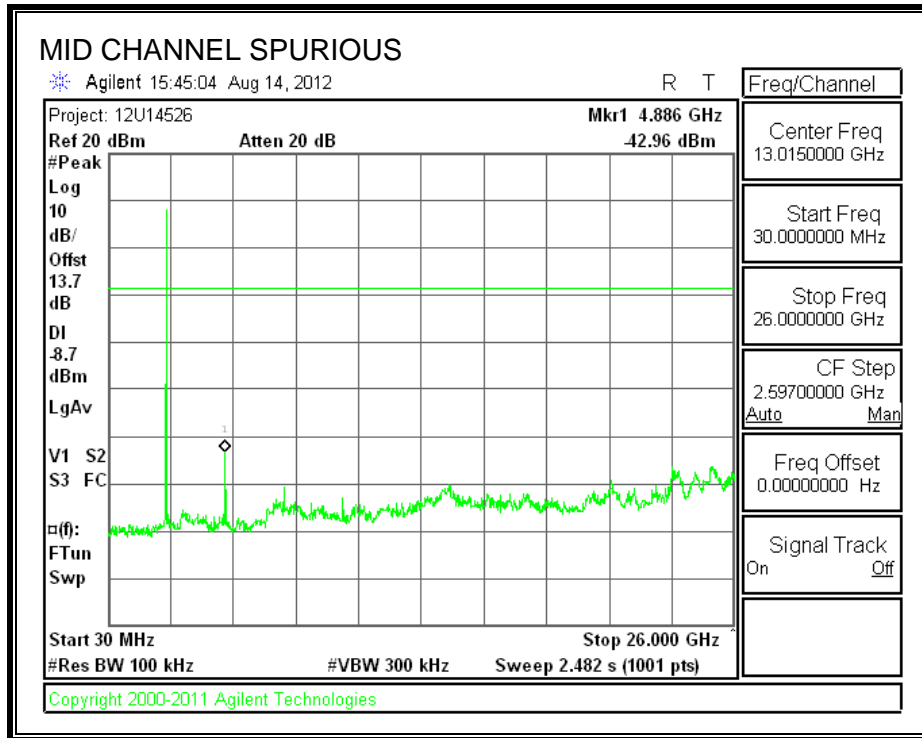




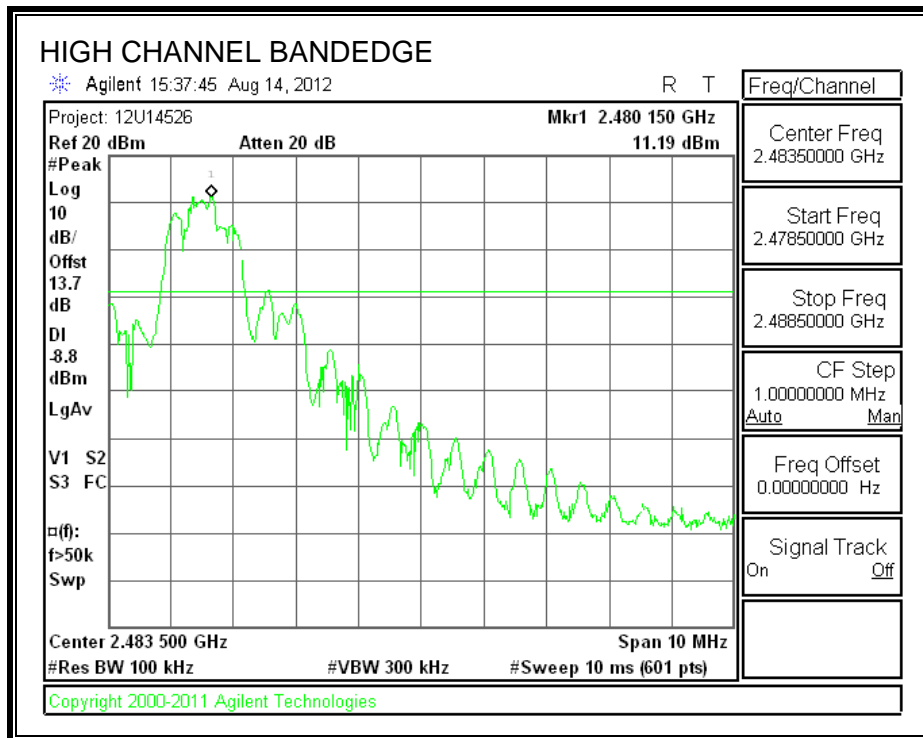
**SPURIOUS EMISSIONS, MID CHANNEL**

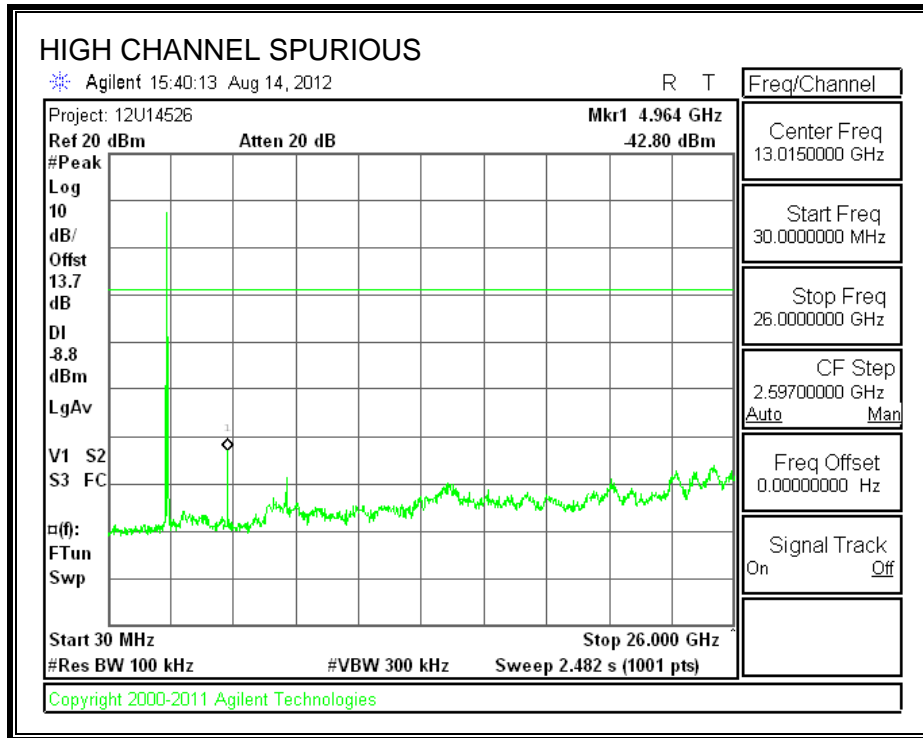




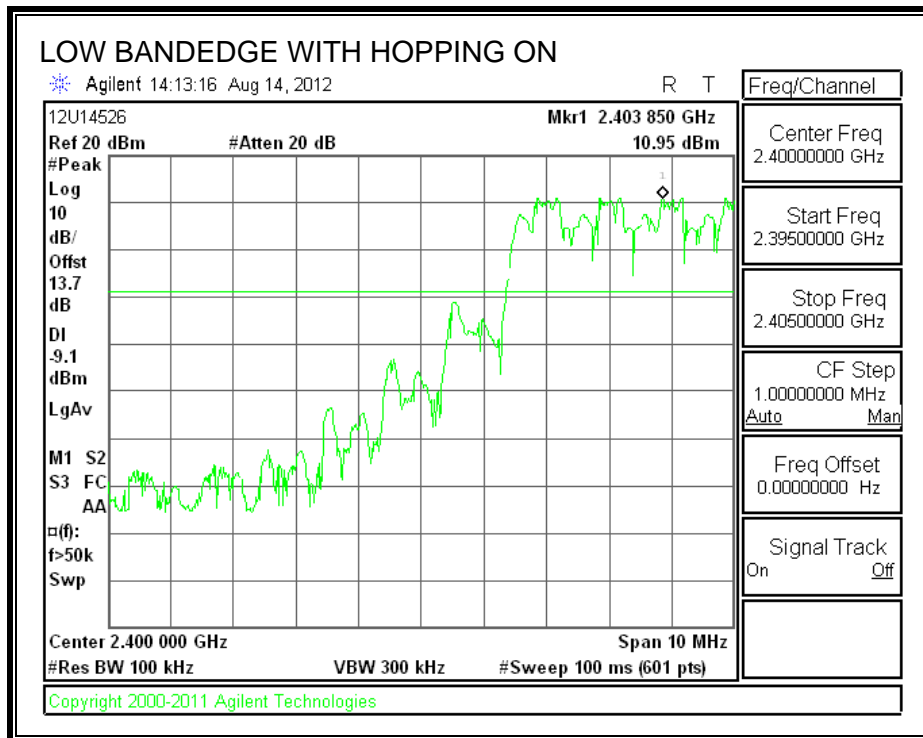


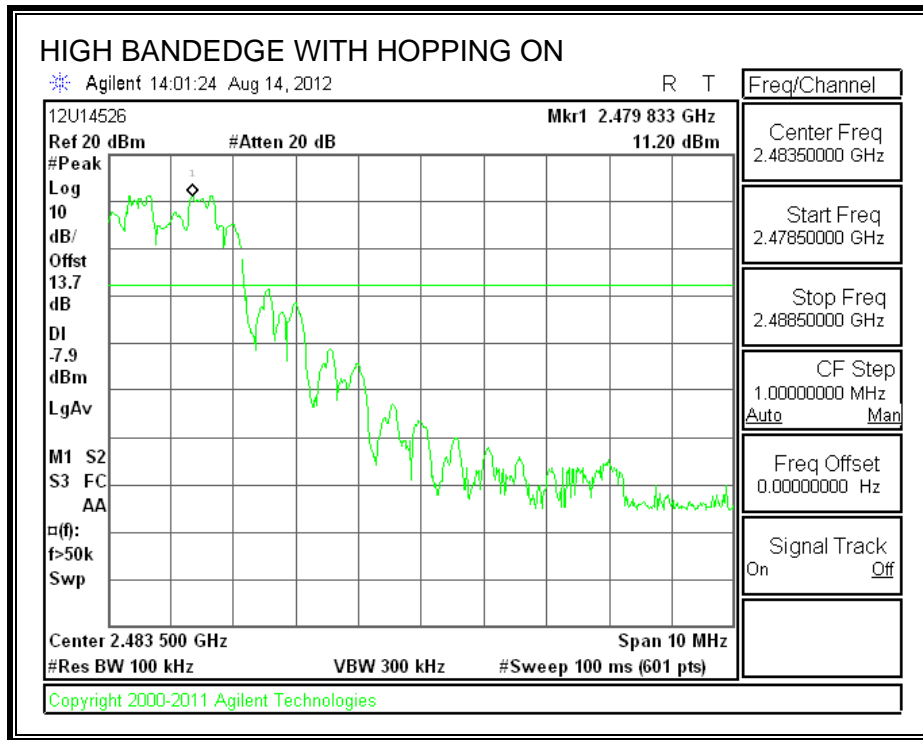
**SPURIOUS EMISSIONS, HIGH CHANNEL**





**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.

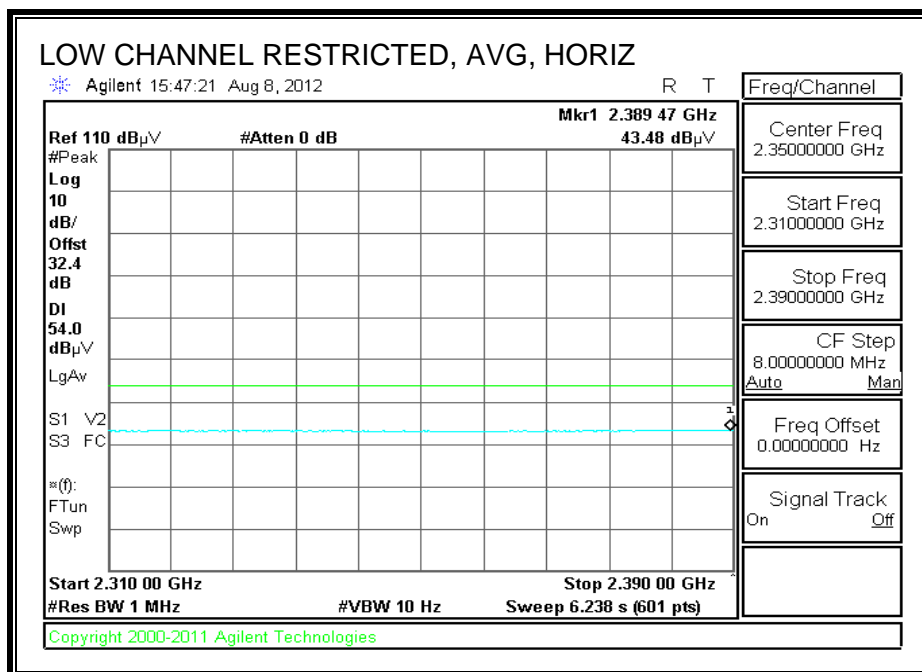
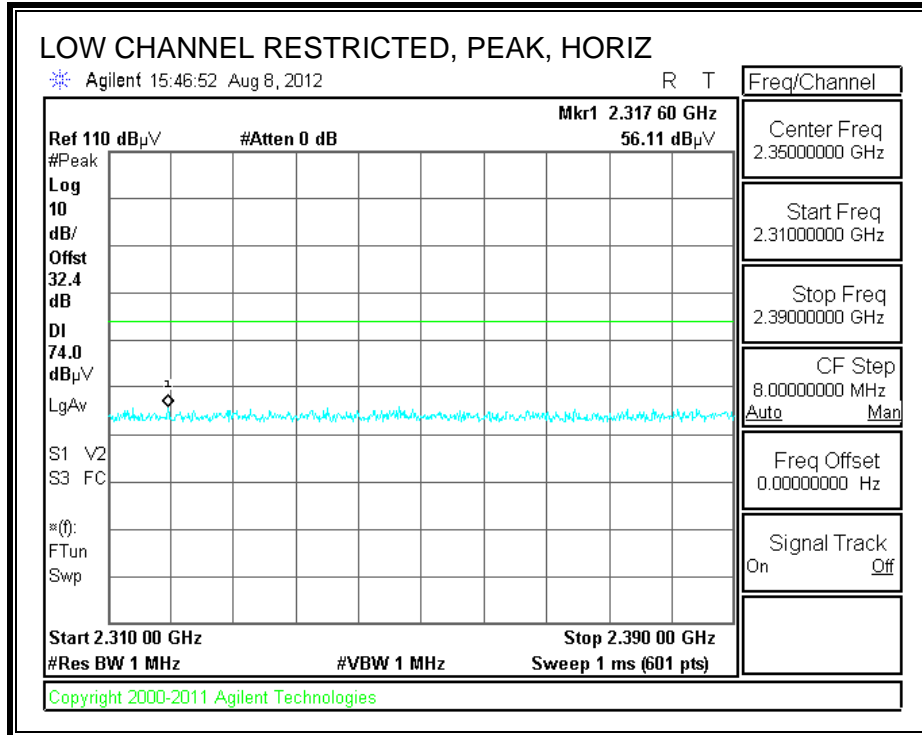
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

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.

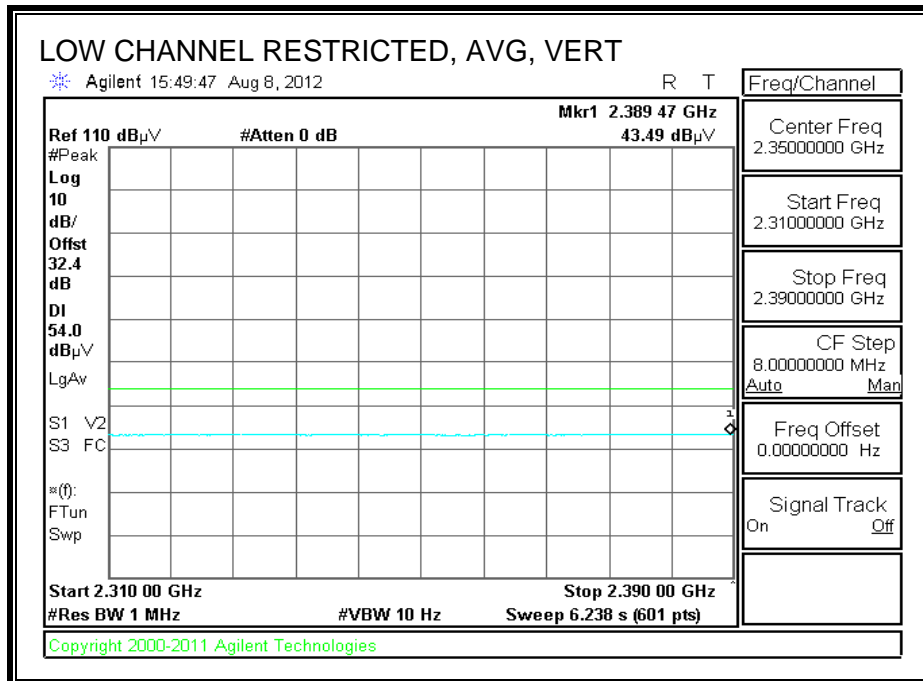
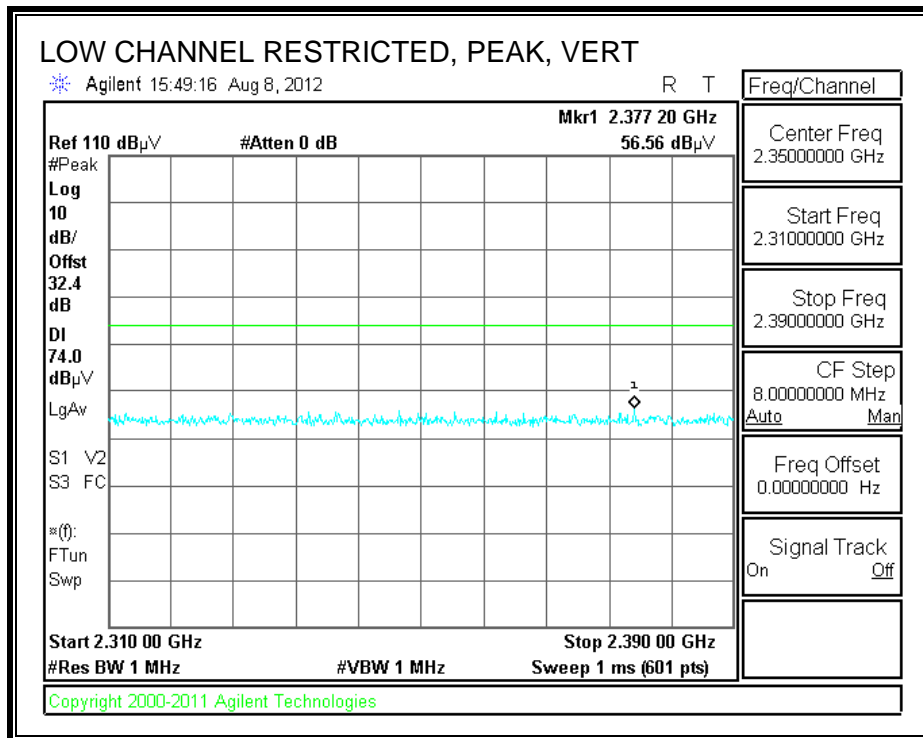
## 8.2. TRANSMITTER ABOVE 1 GHz

### 8.2.1. BASIC DATA RATE GFSK MODULATION

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

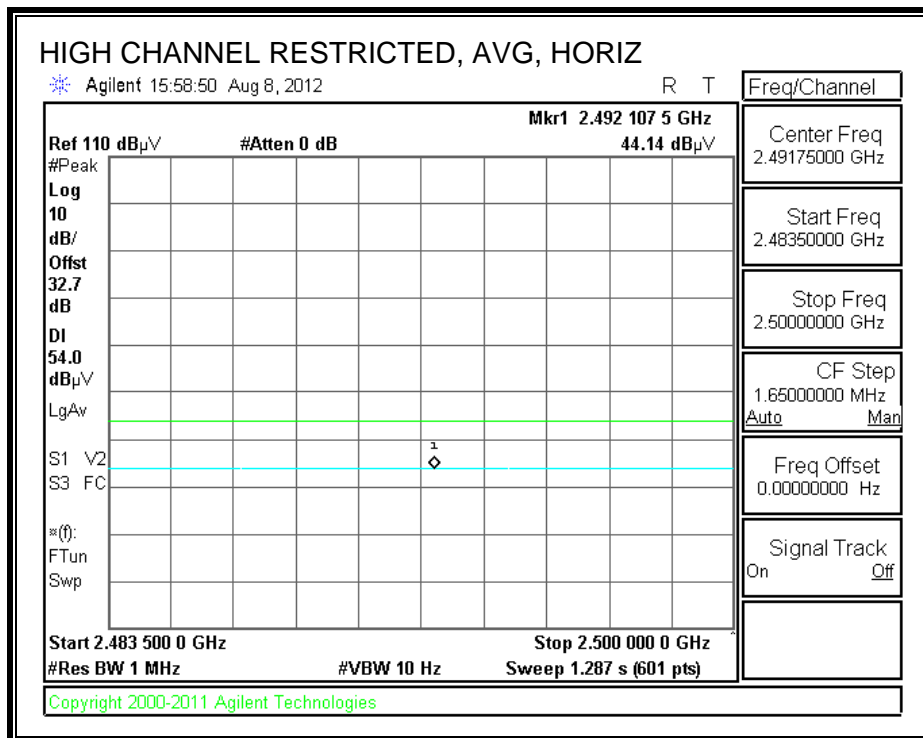
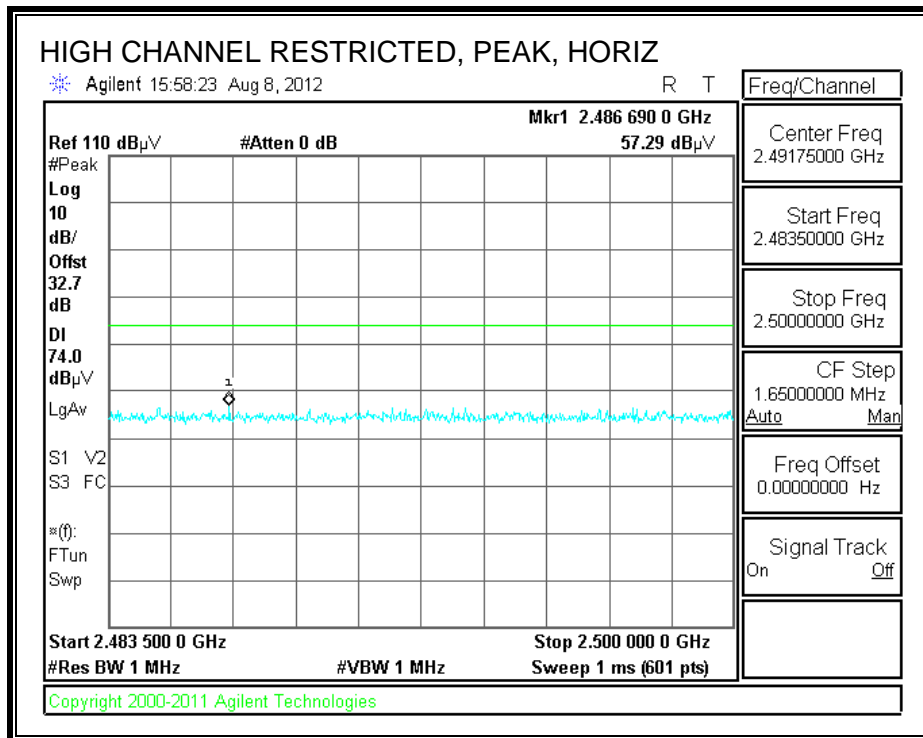


**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**

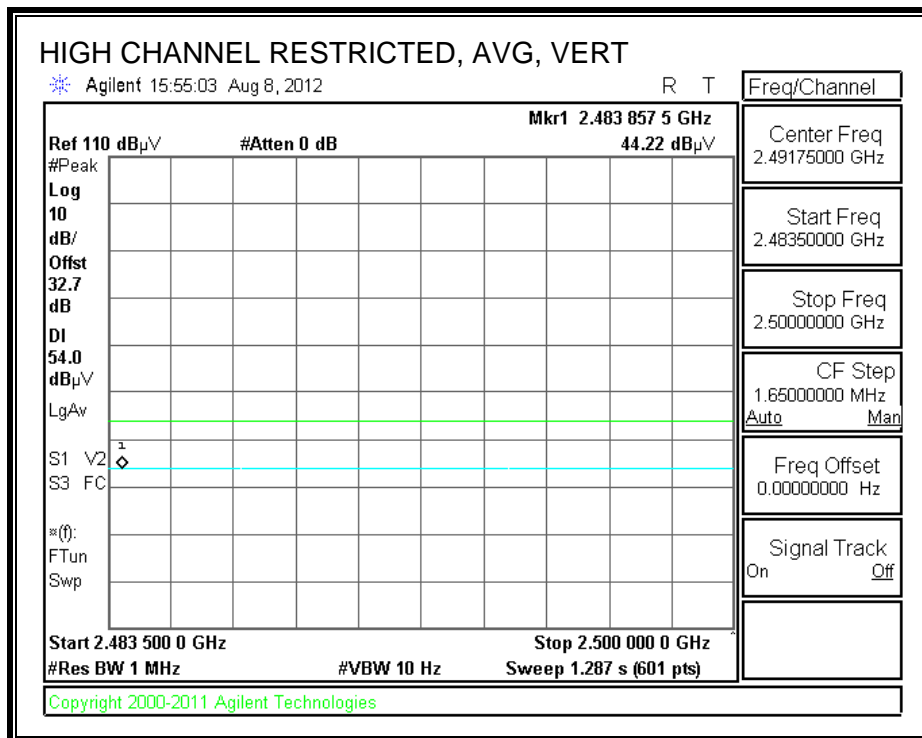
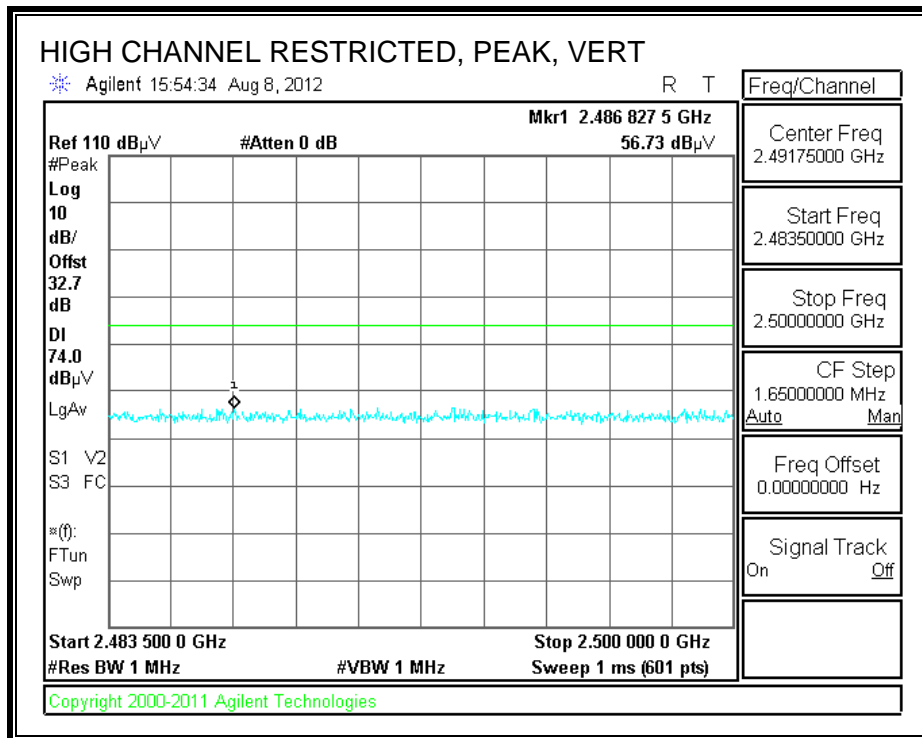




**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**



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

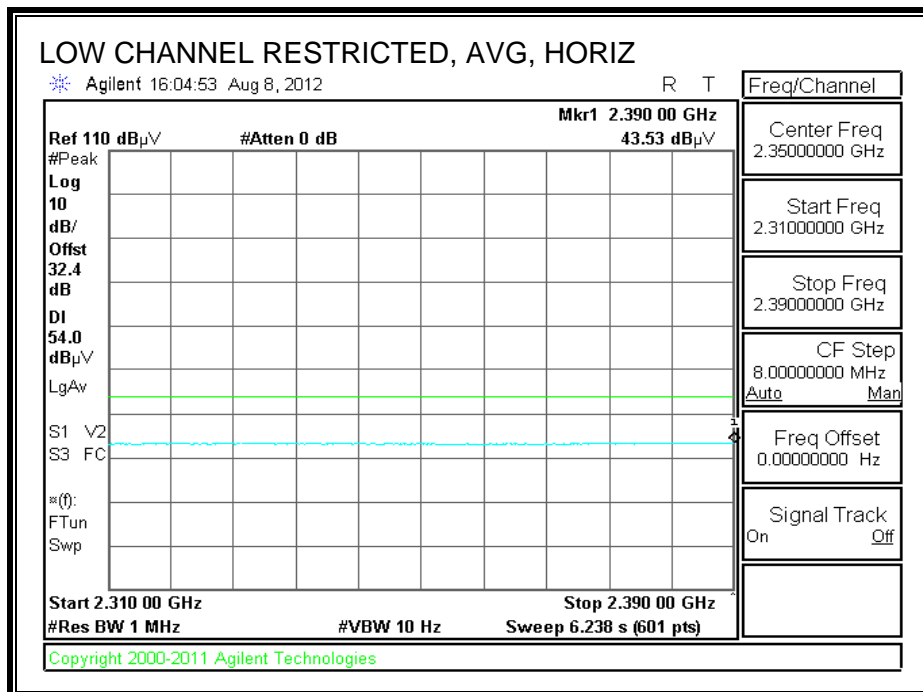
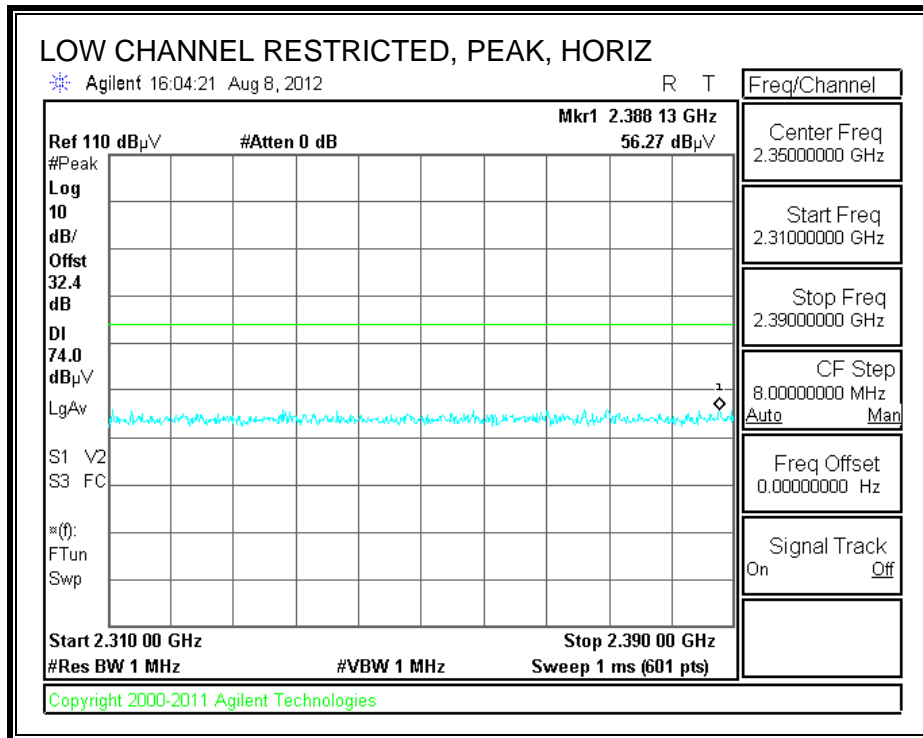


**HARMONICS AND SPURIOUS EMISSIONS**

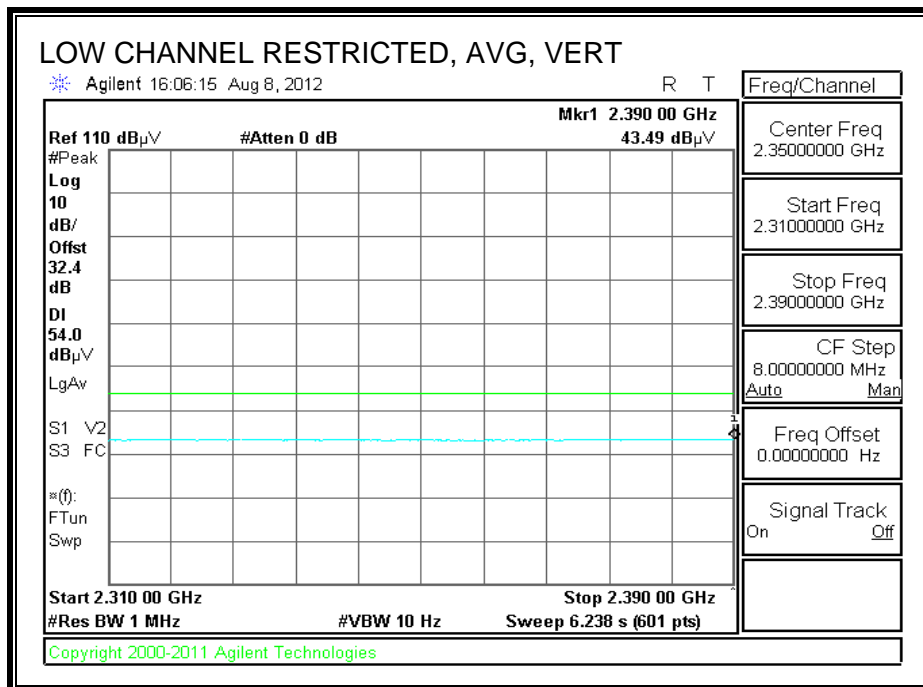
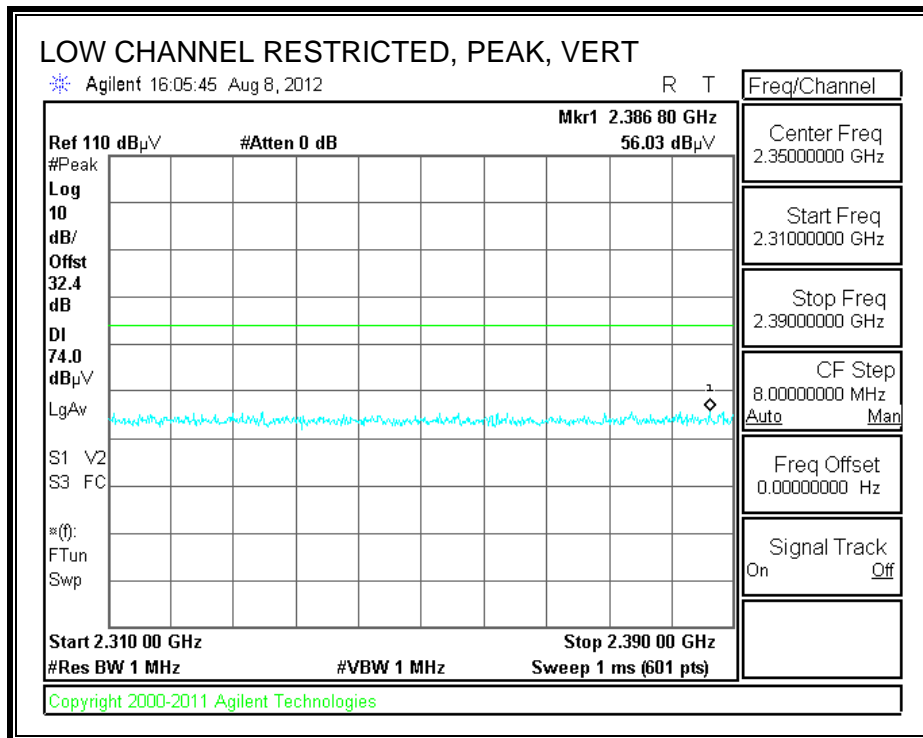
High Frequency Measurement													
Compliance Certification Services, Fremont 5m Chamber													
Test Engr:		Chin Pang											
Date:		08/08/12											
Project #:		12U14526											
Company:		Apple											
Test Target:		FCC 15.247											
Mode Oper:		GFSK, TX											
f	Measurement 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	Dist	Read	AF	CL	Amp	D Corr	Fldr	Corr.	Limit	Margin	Ant. Pol.	Det.	Notes
GHz	(m)	dBuV	dB/m	dB	dB	dB	dB	dB	dBuV/m	dBuV/m	dB	V/H	P/A/QP
<b>Low Ch, 2402MHz</b>													
4.804	3.0	45.9	33.4	6.3	-35.5	0.0	0.0	50.1	74.0	-23.9	V	P	
4.804	3.0	34.3	33.4	6.3	-35.5	0.0	0.0	38.5	54.0	-15.5	V	A	
4.804	3.0	42.7	33.4	6.3	-35.5	0.0	0.0	46.9	74.0	-27.1	H	P	
4.804	3.0	31.6	33.4	6.3	-35.5	0.0	0.0	35.8	54.0	-18.2	H	A	
<b>Mid Ch, 2441MHz</b>													
4.882	3.0	46.0	33.5	6.3	-35.5	0.0	0.0	50.3	74.0	-23.7	V	P	
4.882	3.0	34.3	33.5	6.3	-35.5	0.0	0.0	38.6	54.0	-15.4	V	A	
7.323	3.0	49.6	35.7	8.5	-35.4	0.0	0.0	58.5	74.0	-15.5	V	P	
7.323	3.0	36.0	35.7	8.5	-35.4	0.0	0.0	44.9	54.0	-9.1	V	A	
4.882	3.0	45.1	33.5	6.3	-35.5	0.0	0.0	49.4	74.0	-24.6	H	P	
4.882	3.0	33.8	33.5	6.3	-35.5	0.0	0.0	38.1	54.0	-15.9	H	A	
7.323	3.0	46.9	35.7	8.5	-35.4	0.0	0.0	55.7	74.0	-18.3	H	P	
7.323	3.0	34.3	35.7	8.5	-35.4	0.0	0.0	43.1	54.0	-10.9	H	A	
<b>High Ch, 2480MHz</b>													
4.960	3.0	48.7	33.6	6.4	-35.5	0.0	0.0	53.2	74.0	-20.8	V	P	
4.960	3.0	35.7	33.6	6.4	-35.5	0.0	0.0	40.2	54.0	-13.8	V	A	
7.440	3.0	47.6	35.9	8.5	-35.5	0.0	0.0	56.6	74.0	-17.4	V	P	
7.440	3.0	34.5	35.9	8.5	-35.5	0.0	0.0	43.5	54.0	-10.5	V	A	
4.960	3.0	47.6	33.6	6.4	-35.5	0.0	0.0	52.1	74.0	-21.9	H	P	
4.960	3.0	35.2	33.6	6.4	-35.5	0.0	0.0	39.7	54.0	-14.3	H	A	
7.440	3.0	44.2	35.9	8.5	-35.5	0.0	0.0	53.2	74.0	-20.8	H	P	
7.440	3.0	32.6	35.9	8.5	-35.5	0.0	0.0	41.6	54.0	-12.4	H	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

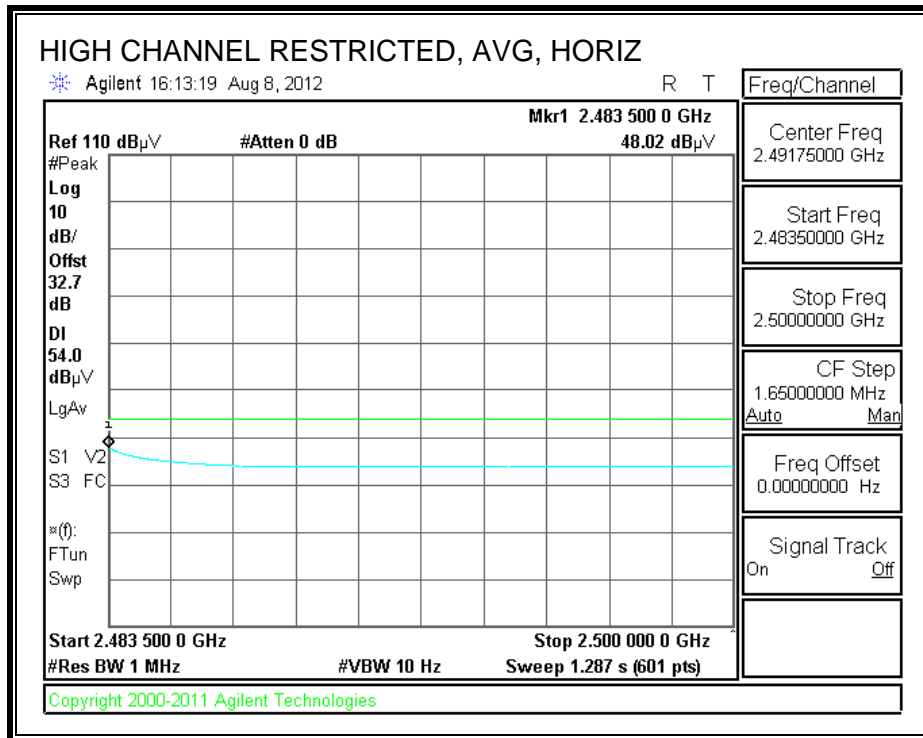
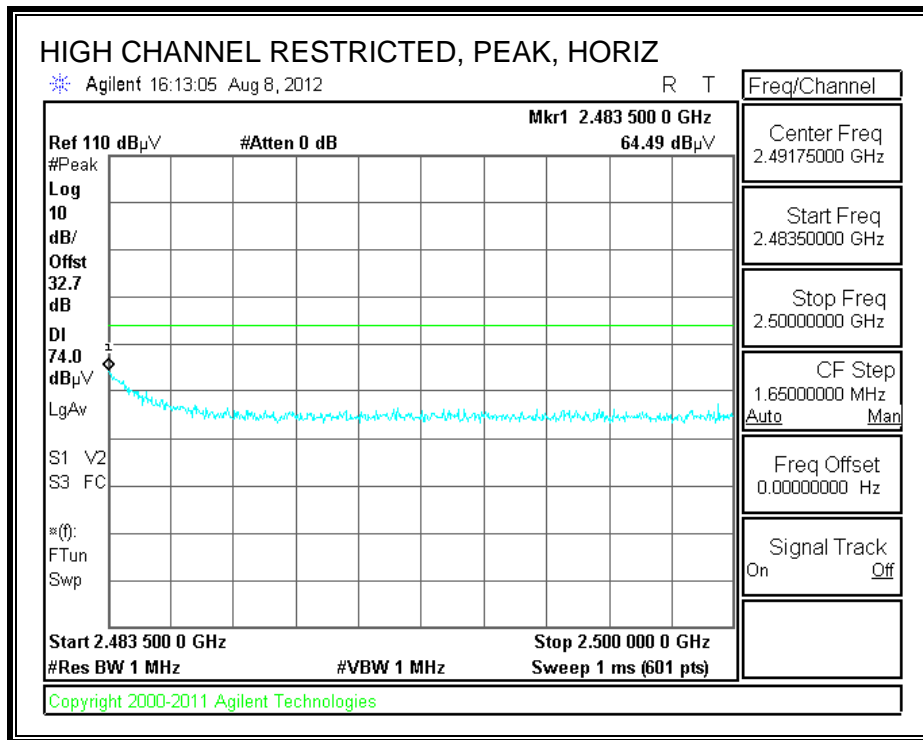
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



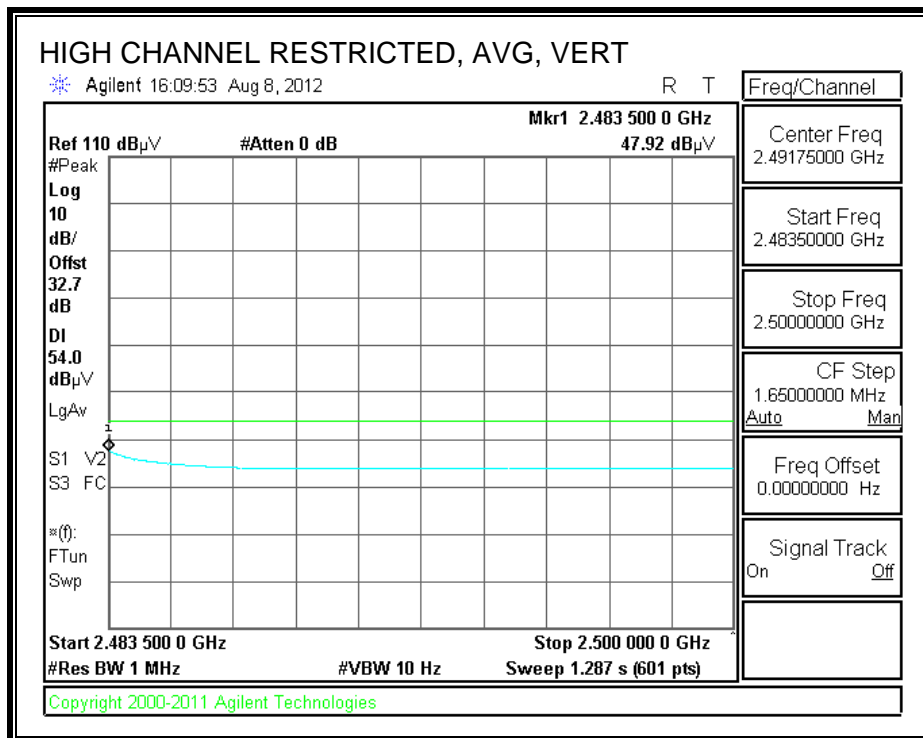
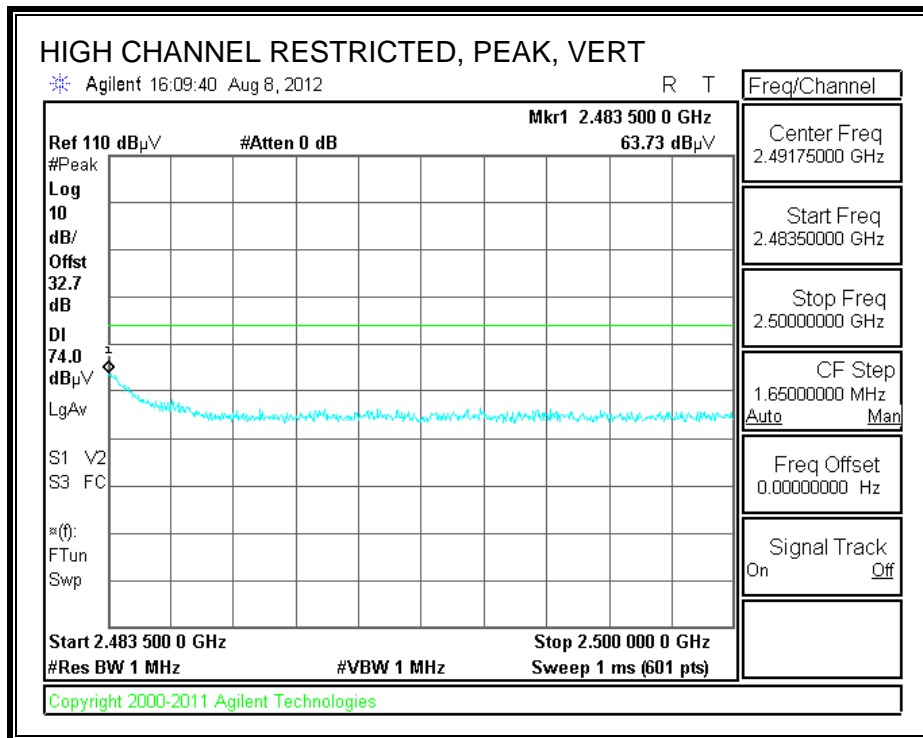
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**



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



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



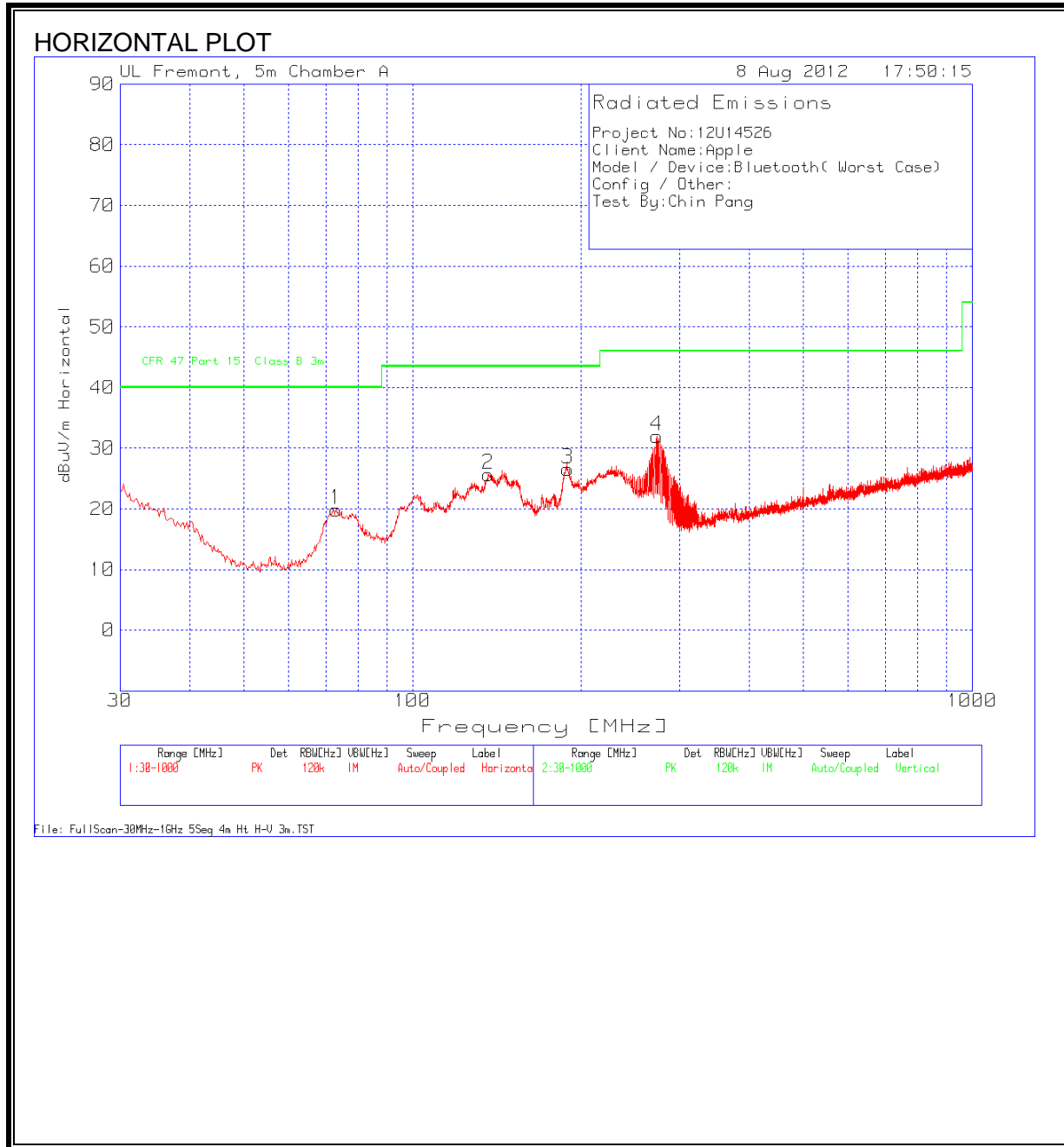
**HARMONICS AND SPURIOUS EMISSIONS**

High Frequency Measurement													
Compliance Certification Services, Fremont 5m Chamber													
Test Engr:		Chin Pang											
Date:		08/08/12											
Project #:		12U14526											
Company:		Apple											
Test Target:		FCC 15.247											
Mode Oper:		8PSK, TX											
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	Dist	Read	AF	CL	Amp	D Corr	Fltr	Corr.	Limit	Margin	Ant. Pol.	Det.	Notes
GHz	(m)	dBuV	dB/m	dB	dB	dB	dB	dBuV/m	dBuV/m	dB	V/H	P/A/QP	
<b>Low Ch, 2402MHz</b>													
4.804	3.0	42.3	33.4	6.3	-35.5	0.0	0.0	46.5	74.0	-27.5	V	P	
4.804	3.0	31.3	33.4	6.3	-35.5	0.0	0.0	35.4	54.0	-18.6	V	A	
4.804	3.0	43.9	33.4	6.3	-35.5	0.0	0.0	48.0	74.0	-26.0	H	P	
4.804	3.0	32.1	33.4	6.3	-35.5	0.0	0.0	36.3	54.0	-17.7	H	A	
<b>Mid Ch, 2441MHz</b>													
4.882	3.0	45.6	33.5	6.3	-35.5	0.0	0.0	49.9	74.0	-24.1	V	P	
4.882	3.0	33.0	33.5	6.3	-35.5	0.0	0.0	37.3	54.0	-16.7	V	A	
7.323	3.0	48.3	35.7	8.5	-35.4	0.0	0.0	57.1	74.0	-16.9	V	P	
7.323	3.0	33.2	35.7	8.5	-35.4	0.0	0.0	42.0	54.0	-12.0	V	A	
4.882	3.0	40.9	33.5	6.3	-35.5	0.0	0.0	45.2	74.0	-28.8	H	P	
4.882	3.0	29.8	33.5	6.3	-35.5	0.0	0.0	34.1	54.0	-19.9	H	A	
7.323	3.0	43.4	35.7	8.5	-35.4	0.0	0.0	52.2	74.0	-21.8	H	P	
7.323	3.0	30.8	35.7	8.5	-35.4	0.0	0.0	39.6	54.0	-14.4	H	A	
<b>High Ch, 2480MHz</b>													
4.960	3.0	45.3	33.6	6.4	-35.5	0.0	0.0	49.8	74.0	-24.2	V	P	
4.960	3.0	32.8	33.6	6.4	-35.5	0.0	0.0	37.3	54.0	-16.7	V	A	
7.440	3.0	45.6	35.9	8.5	-35.5	0.0	0.0	54.6	74.0	-19.4	V	P	
7.440	3.0	31.5	35.9	8.5	-35.5	0.0	0.0	40.5	54.0	-13.5	V	A	
4.960	3.0	41.2	33.6	6.4	-35.5	0.0	0.0	45.6	74.0	-28.4	H	P	
4.960	3.0	34.3	33.6	6.4	-35.5	0.0	0.0	38.8	54.0	-15.2	H	A	
7.440	3.0	41.6	35.9	8.5	-35.5	0.0	0.0	50.6	74.0	-23.4	H	P	
7.440	3.0	29.4	35.9	8.5	-35.5	0.0	0.0	38.4	54.0	-15.6	H	A	
Rev. 4.1.2.7													
Note: No other emissions were detected above the system noise floor.													

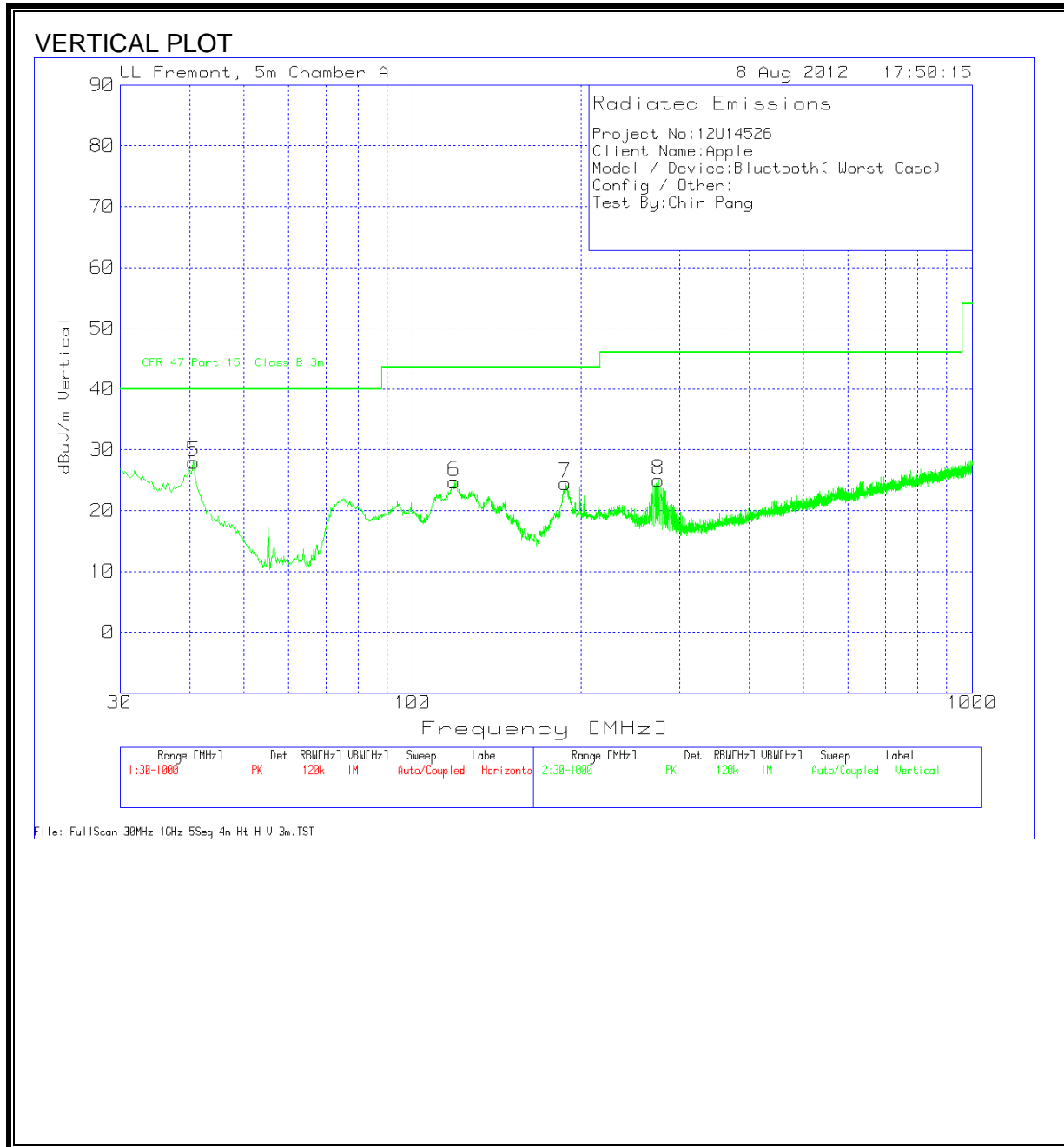


### 8.3. WORST-CASE BELOW 1 GHz

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



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



HORIZONTAL AND VERTICAL DATA

Project No:12U14526								
Client Name:Apple								
Model / Device:Bluetooth( Worst Case)								
Config / Other:								
Test By:Chin Pang								
Horizontal 30 - 1000MHz								
Frequency	Reading	Detector	25MHz-1GHz	T243 Sunol	dBuV/m	CFR 47 Part 15	Margin	Polarity
73.0336	38.91	PK	-27.1	8.1	19.91	40	-20.09	Horz
136.6147	39.34	PK	-26.7	13	25.64	43.5	-17.86	Horz
189.3405	41.57	PK	-26.3	11.3	26.57	43.5	-16.93	Horz
273.0815	44.69	PK	-25.9	13.2	31.99	46	-14.01	Horz
Vertical 30 - 1000MHz								
Frequency	Reading	Detector	25MHz-1GHz	T243 Sunol	dBuV/m	CFR 47 Part 15	Margin	Polarity
40.6615	41.74	PK	-27.3	13.5	27.94	40	-12.06	Vert
118.781	37.53	PK	-26.7	13.9	24.73	43.5	-18.77	Vert
187.5959	39.46	PK	-26.3	11.3	24.46	43.5	-19.04	Vert
275.02	37.57	PK	-25.9	13.3	24.97	46	-21.03	Vert

## 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*	56 to 46*
0.5-5	56	46
5-30	60	50

\*Decreases with the logarithm of the frequency.

### TEST PROCEDURE

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

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

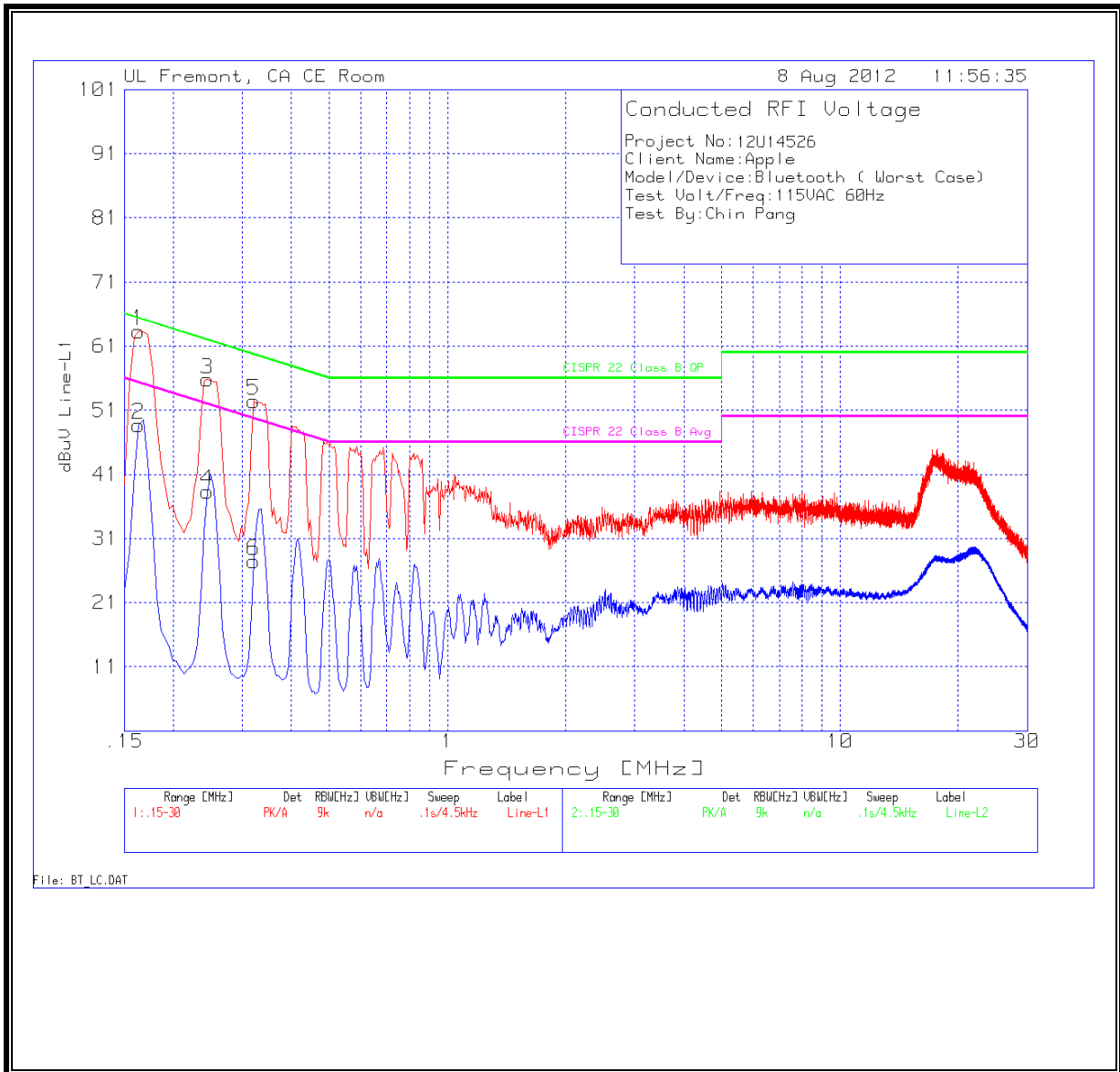
Line conducted data is recorded for both NEUTRAL and HOT lines.

**RESULTS**

**6 WORST EMISSIONS**

Project No:12U14526									
Client Name:Apple									
Model/Device:Bluetooth ( Worst Case)									
Test Volt/Freq:115VAC 60Hz									
Test By:Chin Pang									
Line-L1 .15 - 30MHz									
Test Freq	Meter Res	Detector	T24 IL L1.T	LC Cables	dBuV	CISPR 22 C Margin	CISPR 22 C Margin	CISPR 22 C Margin	CISPR 22 C Margin
0.1635	63.18	PK	0.1	0	63.28	65.3	-2.02	-	-
0.1635	48.55	Av	0.1	0	48.65	-	-	55.3	-6.65
0.2445	55.66	PK	0.1	0	55.76	61.9	-6.14	-	-
0.2445	38.3	Av	0.1	0	38.4	-	-	51.9	-13.5
0.321	52.32	PK	0.1	0	52.42	59.7	-7.28	-	-
0.321	27.33	Av	0.1	0	27.43	-	-	49.7	-22.27
Line-L2 .15 - 30MHz									
Test Freq	Meter Res	Detector	T24 IL L2.T	LC Cables	dBuV	CISPR 22 C Margin	CISPR 22 C Margin	CISPR 22 C Margin	CISPR 22 C Margin
0.159	53.36	PK	0.1	0	53.46	65.5	-12.04	-	-
0.159	40.25	Av	0.1	0	40.35	-	-	55.5	-15.15
0.2355	45.9	PK	0.1	0	46	62.3	-16.3	-	-
0.2355	28.74	Av	0.1	0	28.84	-	-	52.3	-23.46
0.312	43.07	PK	0.1	0	43.17	59.9	-16.73	-	-
0.312	23.15	Av	0.1	0	23.25	-	-	49.9	-26.65

**LINE 1 RESULTS**



**LINE 2 RESULTS**

