



**FCC 47 CFR PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 8**

CERTIFICATION TEST REPORT

FOR

HANDHELD COMPUTING DEVICE

MODEL NUMBER: 1573

FCC ID: C3K1573

IC: 3048A-1573

REPORT NUMBER: 13U15414-15A

ISSUE DATE: FEBRUARY 11, 2014

Prepared for

**MICROSOFT CORPORATION
ONE MICROSOFT WAY
REDMOND, WA 98052, U.S.A.**

Prepared by

**UL VERIFICATION SERVICES INC.
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888**



NVLAP LAB CODE 200065-0

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
-	11/10/13	Initial Issue	T. LEE
A	02/11/14	Update sections 8.1.4 and 8.2.4 with AFH calculation tables.	D. Garcia

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS	5
2. TEST METHODOLOGY	6
3. FACILITIES AND ACCREDITATION	6
4. CALIBRATION AND UNCERTAINTY	6
4.1. <i>MEASURING INSTRUMENT CALIBRATION</i>	<i>6</i>
4.2. <i>SAMPLE CALCULATION</i>	<i>6</i>
4.3. <i>MEASUREMENT UNCERTAINTY.....</i>	<i>6</i>
5. EQUIPMENT UNDER TEST	7
5.1. <i>DESCRIPTION OF EUT</i>	<i>7</i>
5.2. <i>MAXIMUM OUTPUT POWER.....</i>	<i>7</i>
5.3. <i>DESCRIPTION OF AVAILABLE ANTENNAS</i>	<i>7</i>
5.4. <i>SOFTWARE AND FIRMWARE.....</i>	<i>7</i>
5.5. <i>WORST-CASE CONFIGURATION AND MODE.....</i>	<i>8</i>
5.6. <i>DESCRIPTION OF TEST SETUP.....</i>	<i>9</i>
6. TEST AND MEASUREMENT EQUIPMENT	11
7. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS	12
7.1.1. <i>ON TIME AND DUTY CYCLE RESULTS.....</i>	<i>12</i>
8. ANTENNA PORT TEST RESULTS	13
8.1. <i>BASIC DATA RATE GFSK MODULATION.....</i>	<i>13</i>
8.1.1. <i>20 dB AND 99% BANDWIDTH</i>	<i>13</i>
8.1.2. <i>HOPPING FREQUENCY SEPARATION</i>	<i>18</i>
8.1.3. <i>NUMBER OF HOPPING CHANNELS.....</i>	<i>20</i>
8.1.4. <i>AVERAGE TIME OF OCCUPANCY</i>	<i>24</i>
8.1.5. <i>OUTPUT POWER</i>	<i>28</i>
8.1.6. <i>AVERAGE POWER.....</i>	<i>31</i>
8.1.7. <i>CONDUCTED SPURIOUS EMISSIONS.....</i>	<i>32</i>
8.2. <i>ENHANCED DATA RATE 8PSK MODULATION</i>	<i>37</i>
8.2.1. <i>20 dB AND 99% BANDWIDTH</i>	<i>37</i>
8.2.2. <i>HOPPING FREQUENCY SEPARATION</i>	<i>42</i>
8.2.3. <i>NUMBER OF HOPPING CHANNELS.....</i>	<i>44</i>
8.2.4. <i>AVERAGE TIME OF OCCUPANCY</i>	<i>47</i>
8.2.5. <i>OUTPUT POWER</i>	<i>52</i>
8.2.6. <i>AVERAGE POWER.....</i>	<i>55</i>
8.2.7. <i>CONDUCTED SPURIOUS EMISSIONS.....</i>	<i>56</i>
9. RADIATED TEST RESULTS.....	61
9.1. <i>LIMITS AND PROCEDURE.....</i>	<i>61</i>

9.2.	TRANSMITTER ABOVE 1 GHz.....	62
9.2.1.	BASIC DATA RATE GFSK MODULATION.....	62
9.2.2.	ENHANCED DATA RATE 8PSK MODULATION.....	73
9.3.	WORST-CASE BELOW 1 GHz.....	83
10.	AC POWER LINE CONDUCTED EMISSIONS	85
11.	SETUP PHOTOS	89

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: MICROSOFT CORPORATION
ONE MICROSOFT WAY
REDMOND, WA 98052, U.S.A.

EUT DESCRIPTION: HANDHELD COMPUTING DEVICE WITH 802.11 A/B/G/N WLAN
AND BLUETOOTH RADIOS

MODEL: 1573

SERIAL NUMBER: 001925433252

DATE TESTED: OCTOBER 23, 2013 – OCTOBER 29, 2013

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 Verification Services Inc. 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 Verification Services Inc. 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 Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. 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 Verification Services Inc. By:

Tested By:



TIMOTHY LEE
WISE PROGRAM MANAGER
UL Verification Services Inc.

Joe Vang
EMC ENGINEER
UL Verification Services Inc.

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 Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsenc.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 hand held computing device with 802.11 a/b/g/n WLAN and Bluetooth radios.

The unit supports AFH mode. The manufacturer attested the following.

- It is in compliance with Bluetooth Specification 1.2 or later specification.
- The number of hopping channels in AFH mode is 20 channels
- The output power does not transmit over 125 mW
- The channel separation is based upon 2/3 of 20 dB channel bandwidth

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	8.93	7.82
2402 - 2480	Enhanced 8PSK	7.36	5.45

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PIFA antenna, with a maximum gain of 3.1 dBi.

5.4. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Window RT 8.1 Preview Build 943

The test utility software used during testing was Laptool 189.1.0.9.0\ WIFI Tool.exe

5.5. 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.

The fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z, it was determined that Z orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in Z orientation.

Conducted measurement was conducted on Model 1572 under FCC ID C3K1572. Model 1572 are identical to Model 1573 except Model 1573 includes the WWAN radio.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
USB Ethernet Adaptor	CISCO	USB 300M	CU90MC02233	DoC
Laptop	Lenovo	L420	7854CT0	DoC
AC Adaptor (laptop)	Lenovo	92P1156	111S92P1156ZDXN272091	N/A

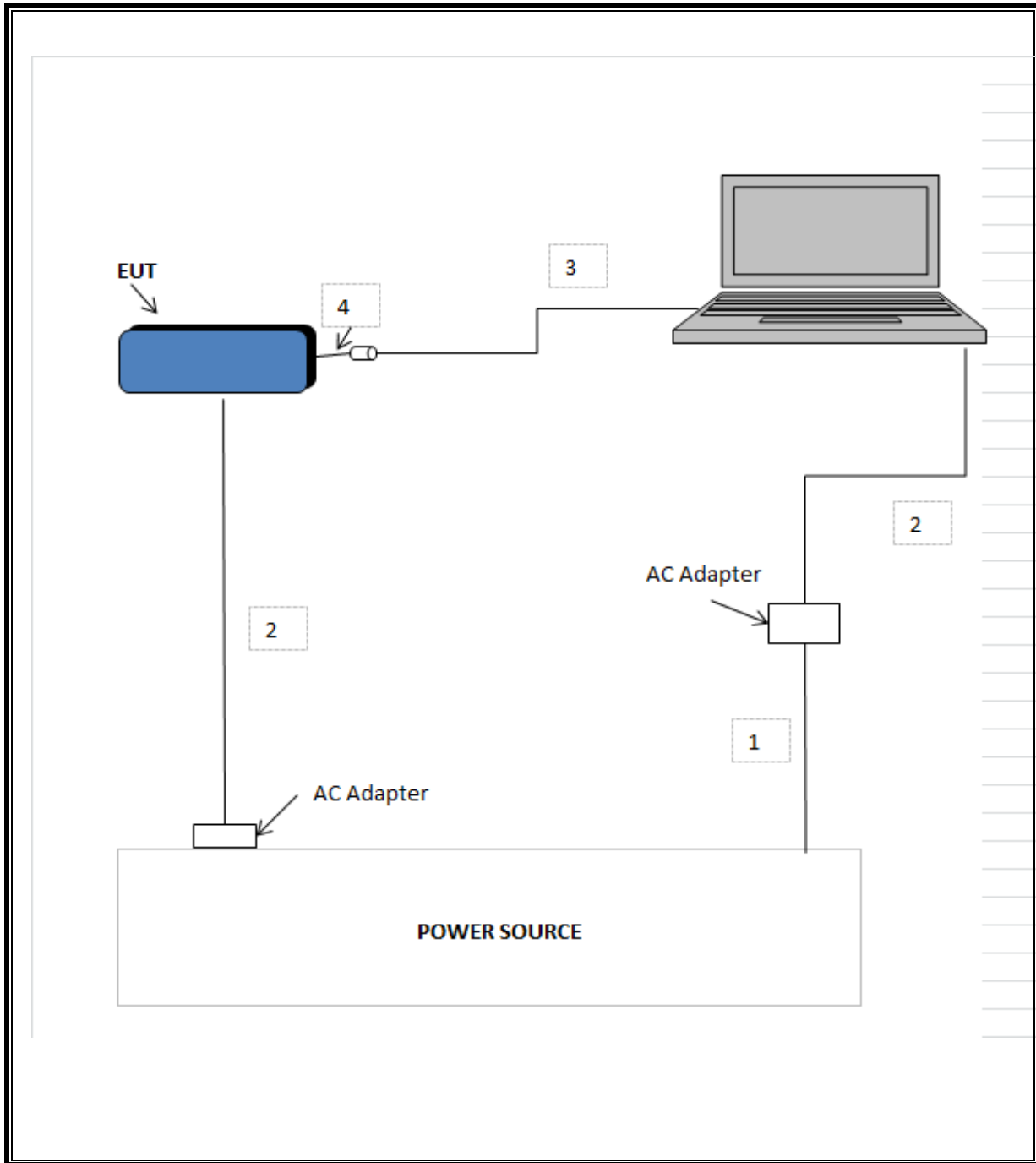
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	AC	Unshielded	1.8	AC adapter
2	USB	1	USB	Unshielded	0.1	USB to Ethernet adapter
3	DC	1	DC	Unshielded	1.8	
4	Ethernet	1	RJ 45	Unshielded	7.62	Connects to USB adapter

TEST SETUP

The EUT is a standalone wireless handheld computing device. Test software exercised the wireless module installed within the device under test.

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 Date	Cal Due
Bilog 30-1000MHz	Sunol	JB1	C01011	02/07/12	03/28/14
LISN, 30 MHz	FCC	LISN-50/250-25-	N02625	01/14/13	01/14/14
Power meter	Agilent	N119A	T198	06/25/12	12/13/13
Power Sensor	Agilent	E9323A	T397	06/26/12	04/02/14
Spectrum Analyzer, 26 GHz	Agilent / HP	E4440A	C01176	10/21/12	12/13/13
Spectrum Analyzer	Agilent	N9030A	F00128	2/22/2013	2/22/2014
Horn Antenna, 1-18GHz	ETS Lindgren	3117	F00133	2/19/2013	2/19/2014
Antenna, Biconolog, 30MHz-1	Sunol Sciences	JB3	F00168	3/7/2013	3/7/2014
High Pass Filter, fc: 3.0GHz, 50	Micro-Tronics	HPM17543	F00180	8/24/2013	8/24/2014
Low Pass Filter, fc: 5GHz, 50 O	Micro-Tronics	LPS17541	F00174	8/24/2013	8/24/2014
RF PreAmplifier, 1-18GHz	Miteq	To Be Determine	F00353	8/24/2013	8/24/2014
Amplifier	Sonoma	310	F00008	11/6/2012	11/6/2013

7. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

LIMITS

None; for reporting purposes only.

PROCEDURE

KDB 789033 Zero-Span Spectrum Analyzer Method.

7.1.1. ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/T Minimum VBW (kHz)
GFSK	2.884	3.751	0.769	76.9%	1.14	0.347
8PSK	2.869	3.751	0.765	76.5%	1.16	0.349

8. ANTENNA PORT TEST RESULTS

8.1. BASIC DATA RATE GFSK MODULATION

8.1.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

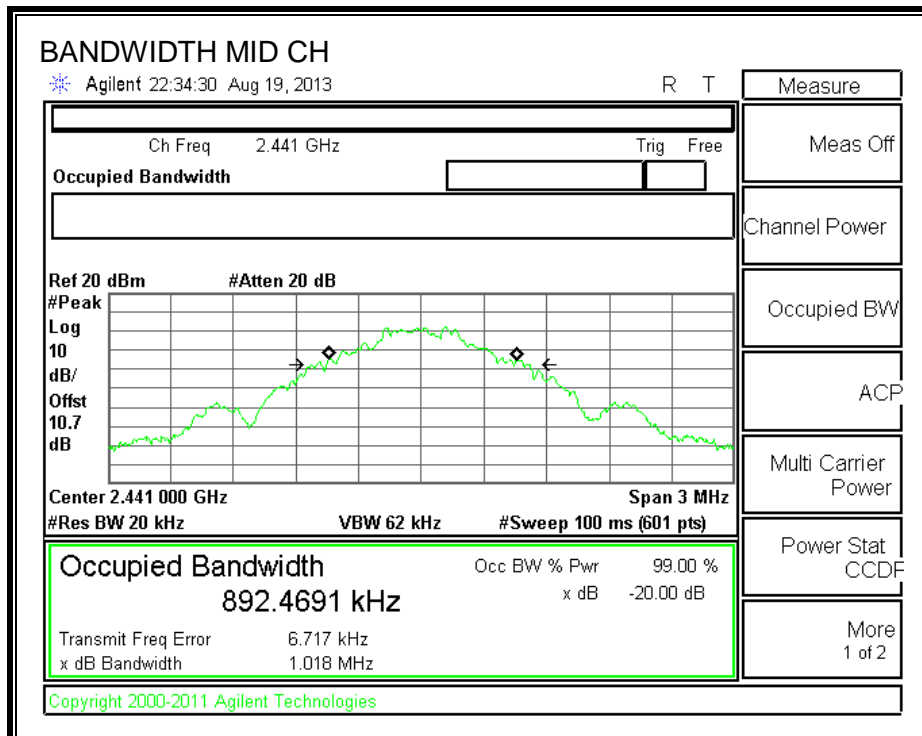
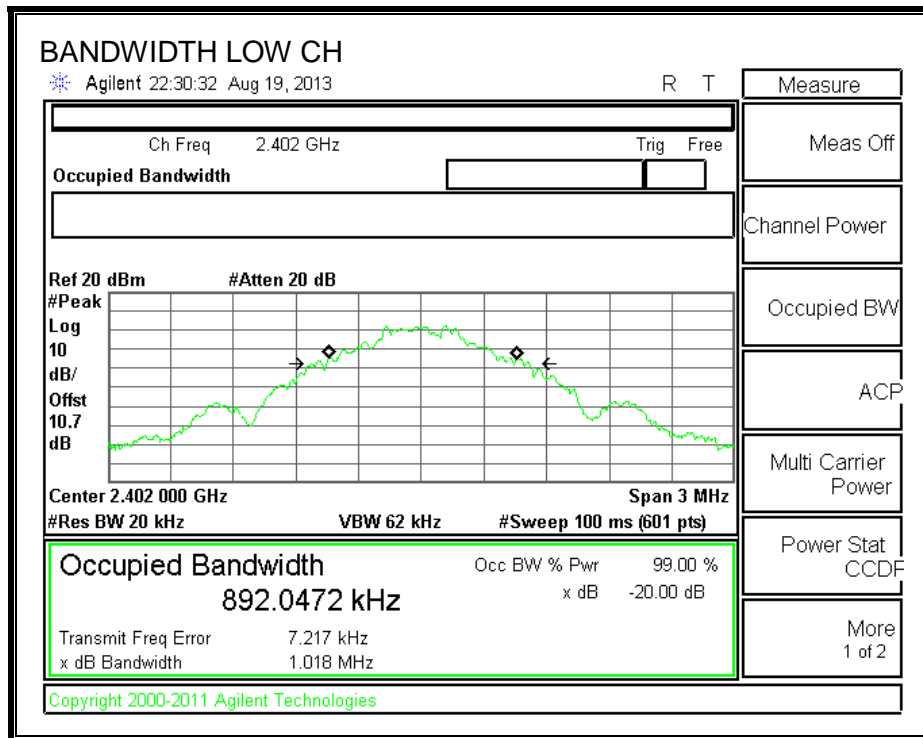
TEST PROCEDURE

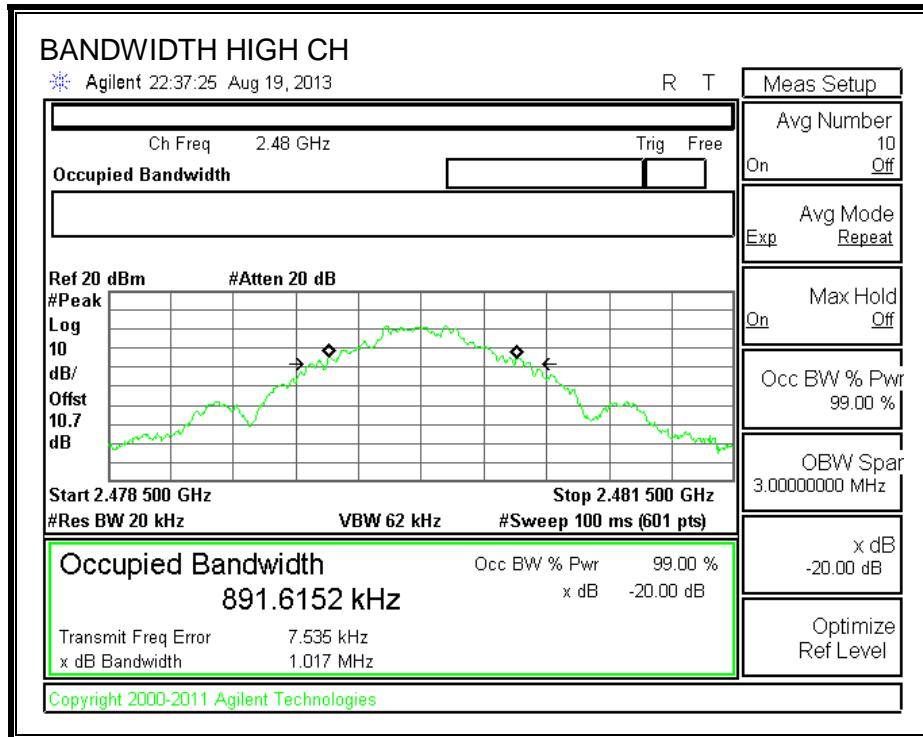
The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to \geq RBW. The sweep time is coupled.

RESULTS

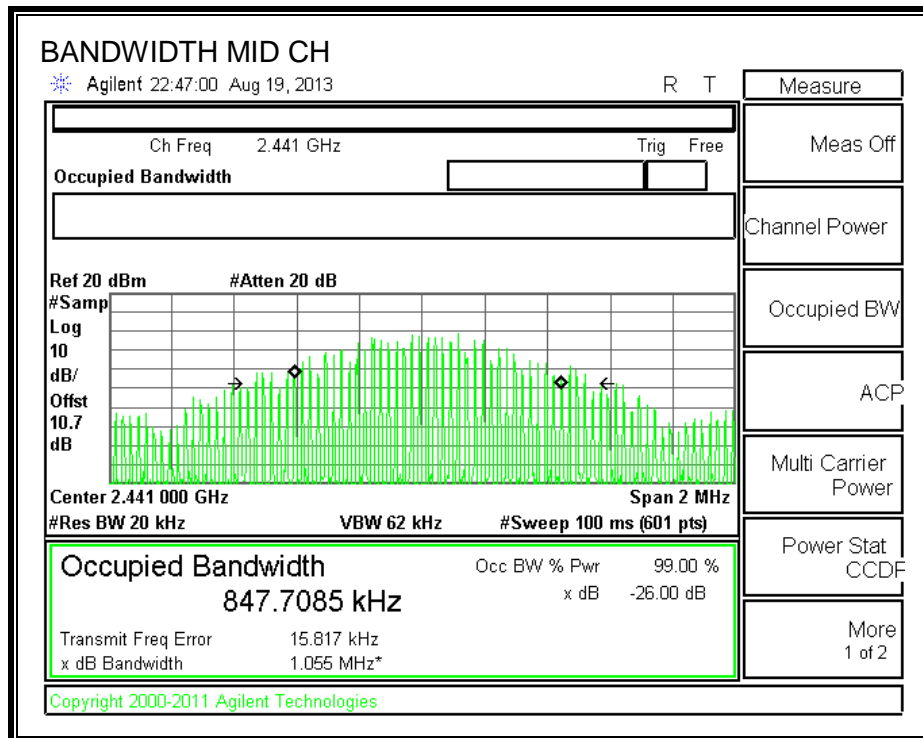
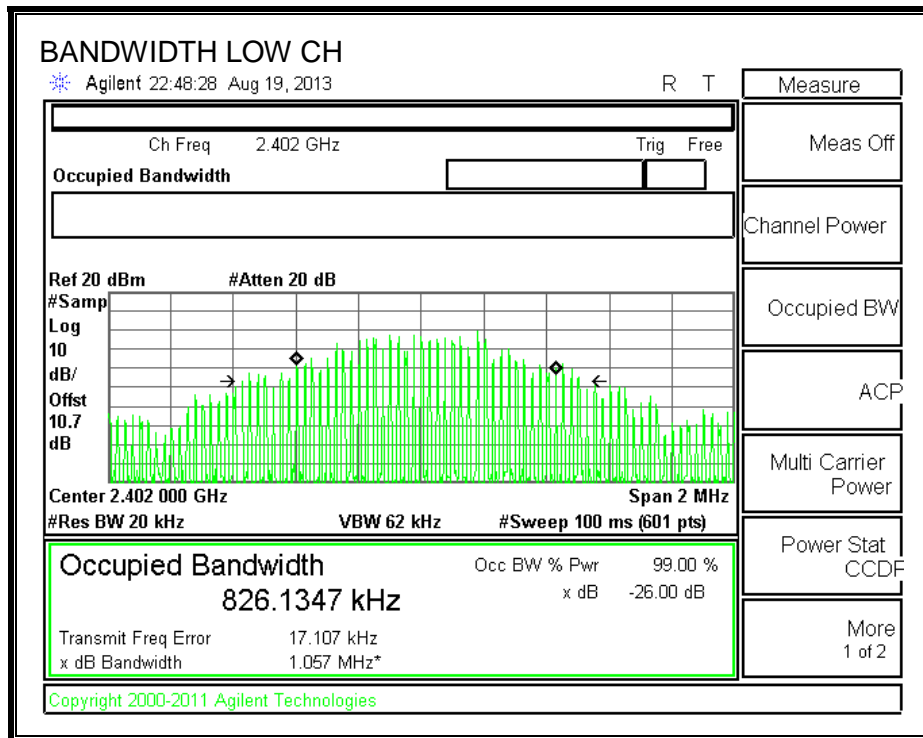
Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	1.018	826.1347
Middle	2441	1.018	847.7085
High	2480	1.017	826.4963

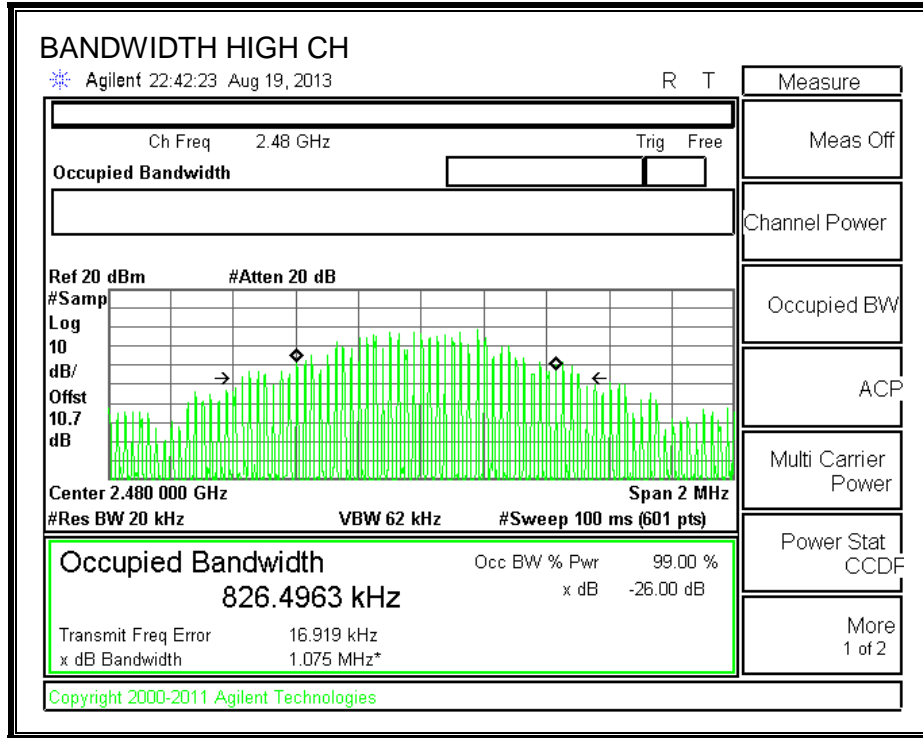
20 dB BANDWIDTH





99% BANDWIDTH





8.1.2. 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.

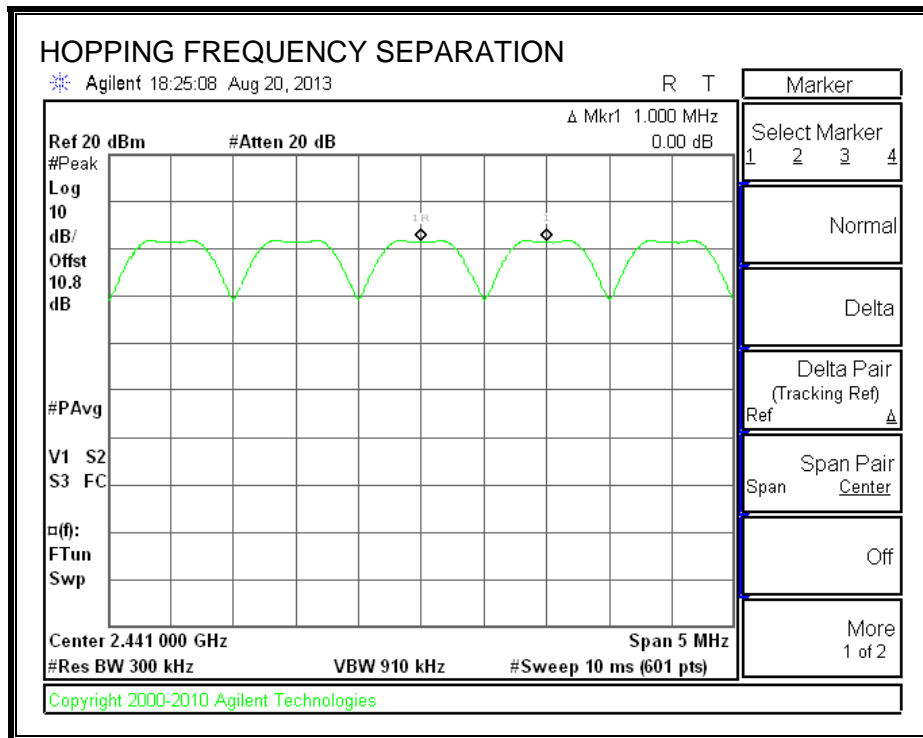
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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



8.1.3. 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.

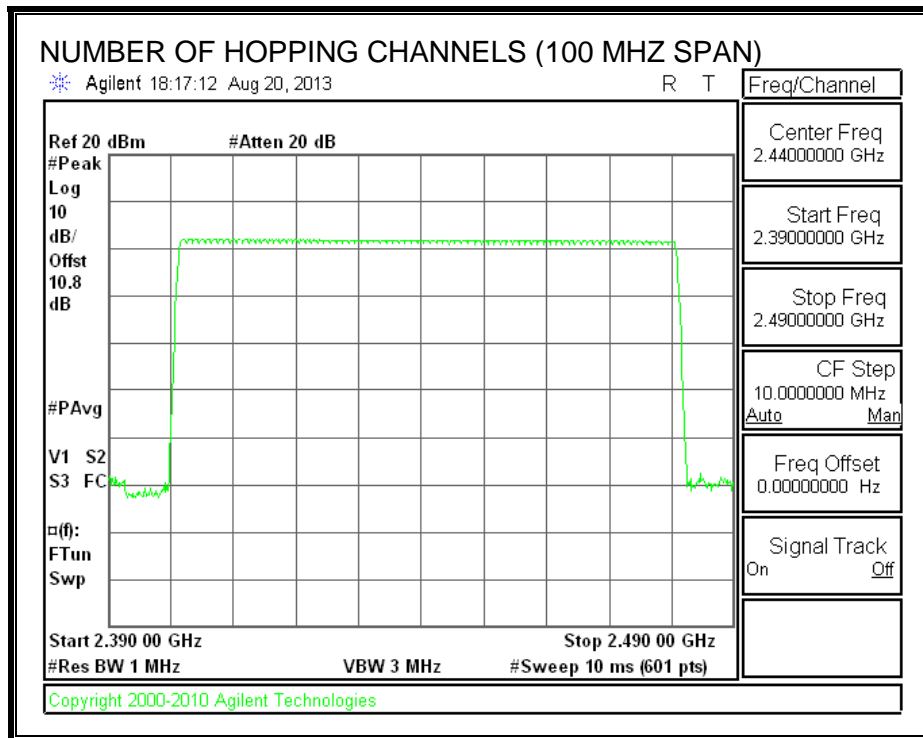
TEST PROCEDURE

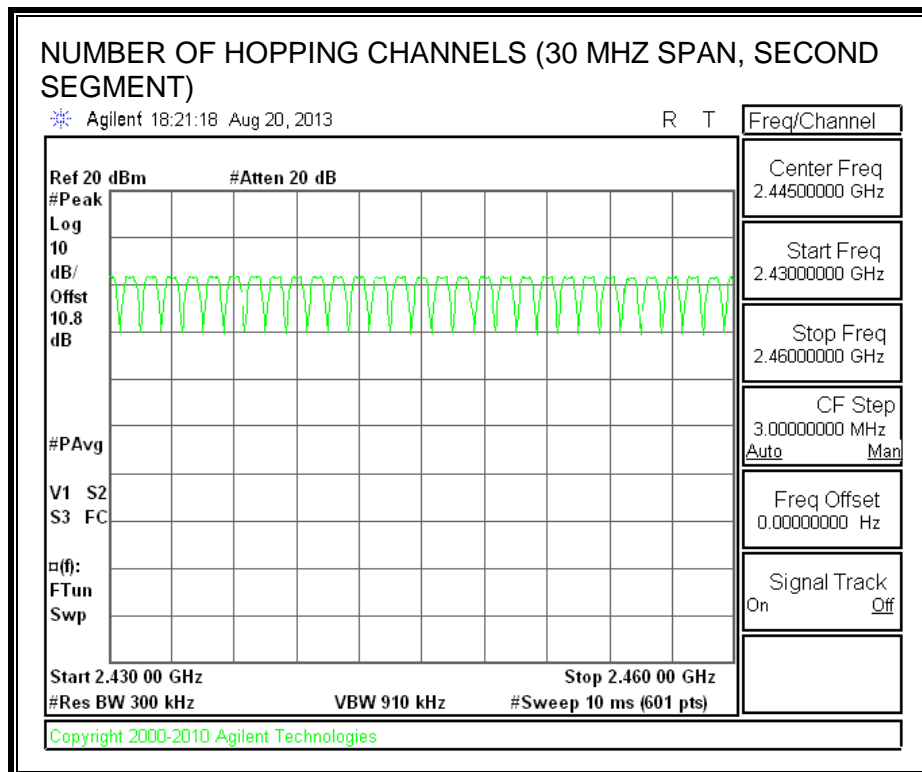
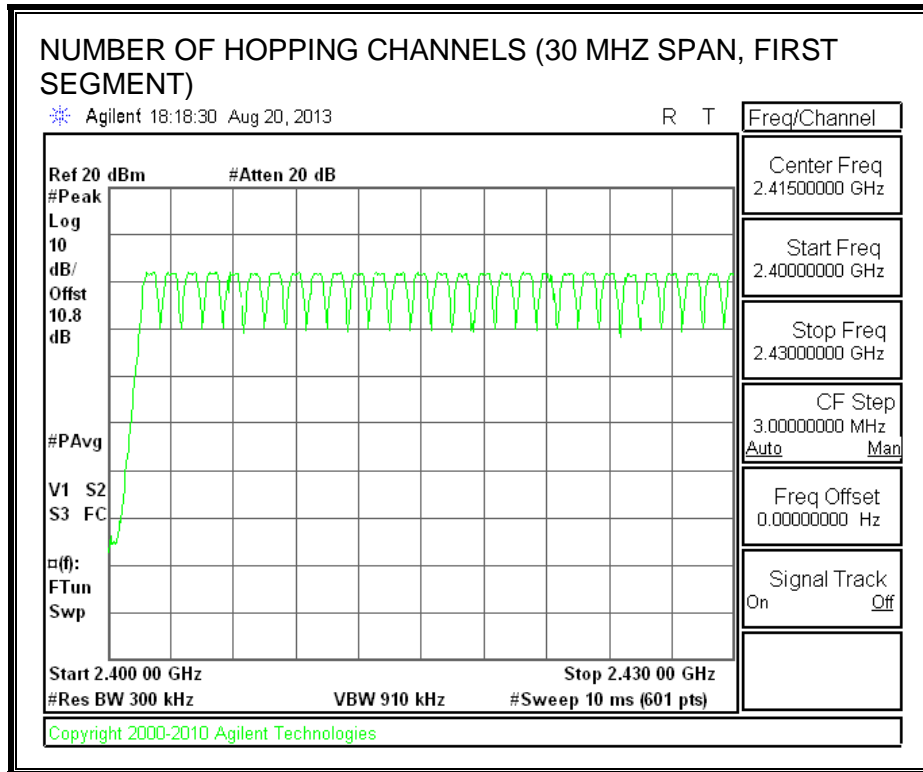
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

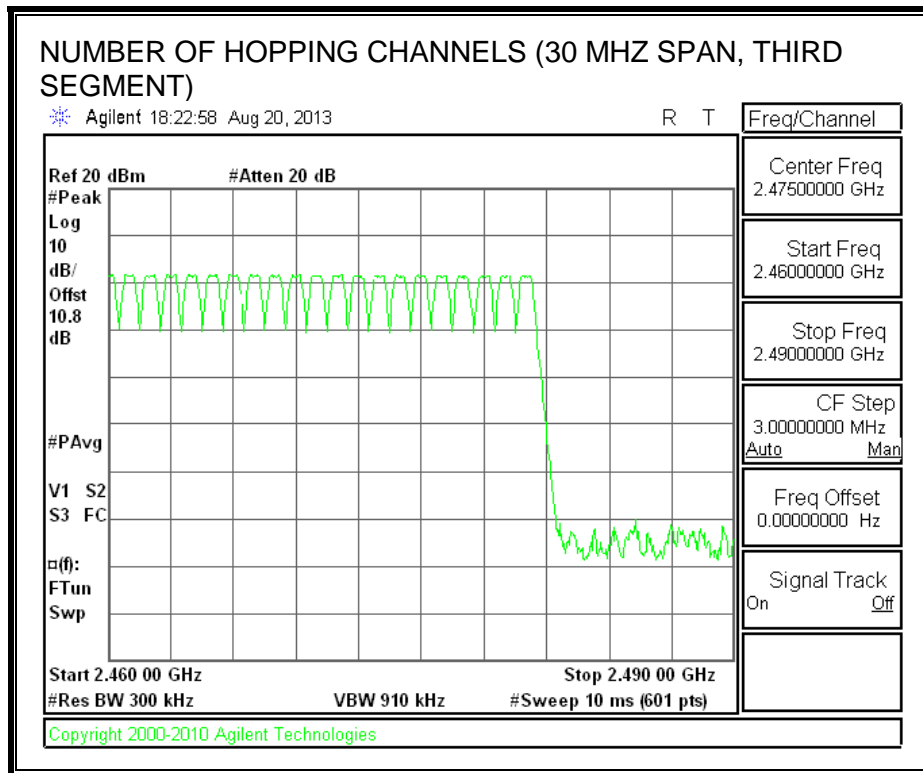
RESULTS

Normal Mode: 79 Channels observed.

NUMBER OF HOPPING CHANNELS







8.1.4. 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 $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{ pulse width}$.

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

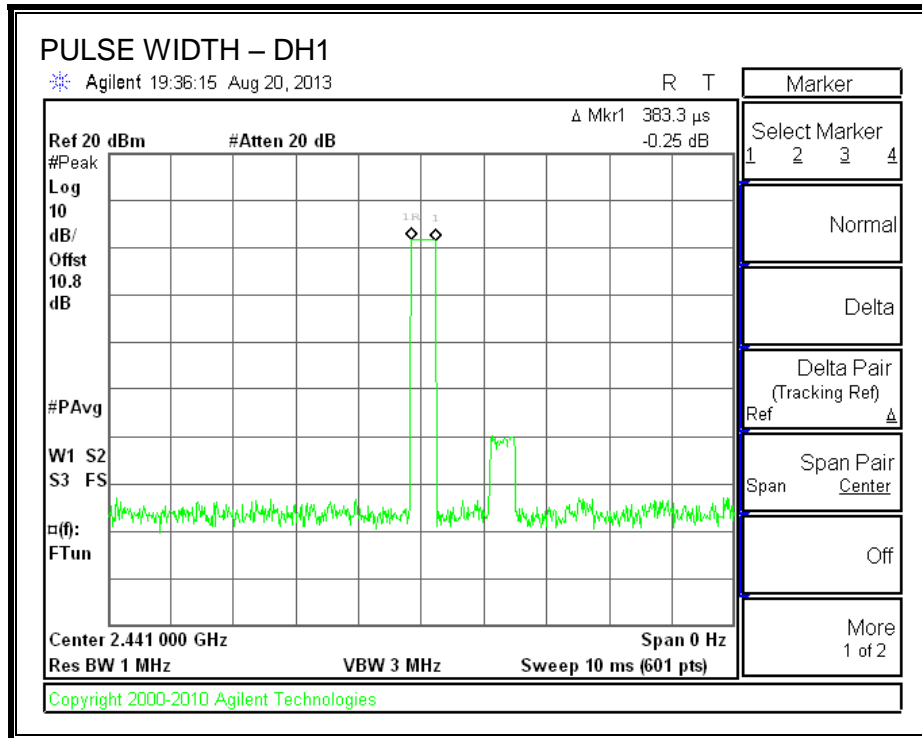
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK Normal Mode					
DH1	0.3833	32	0.123	0.4	-0.277
DH3	1.617	16	0.259	0.4	-0.141
DH5	2.833	10	0.283	0.4	-0.117

AFH Calculations

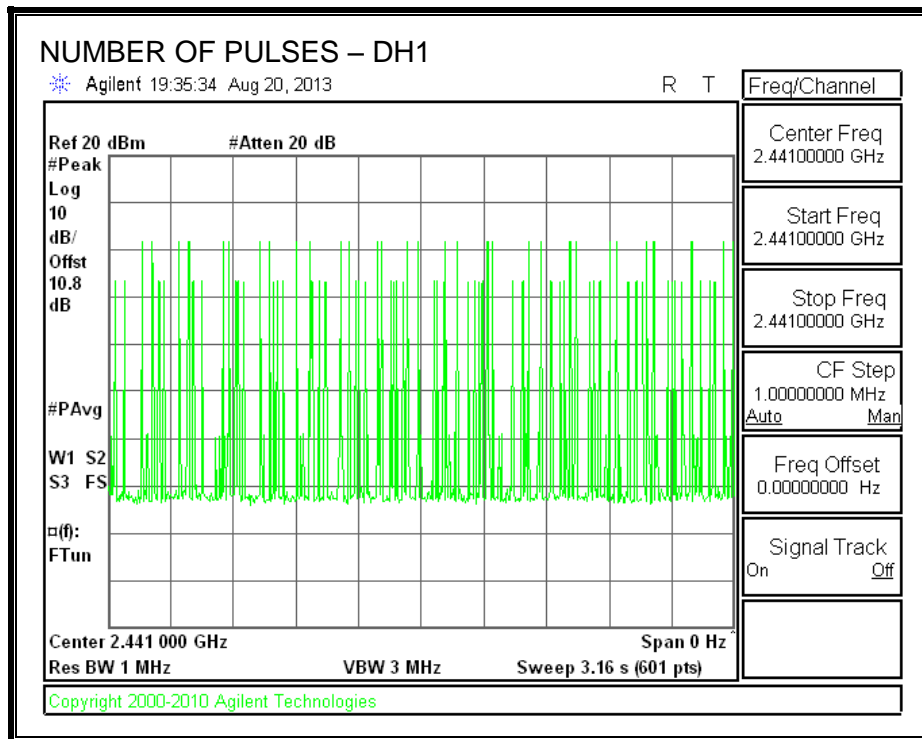
DH Packet	Pulse Width (msec)	Number of Pulses in 8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
GFSK Normal Mode					
DH1	0.3833	8	0.031	0.8	-0.769
DH3	1.617	4	0.065	0.8	-0.735
DH5	2.833	3	0.072	0.8	-0.728

AFH # of pulses calculation formula: $(8 * (\# \text{ of pulses in normal hopping} / 3.16)) / 10$

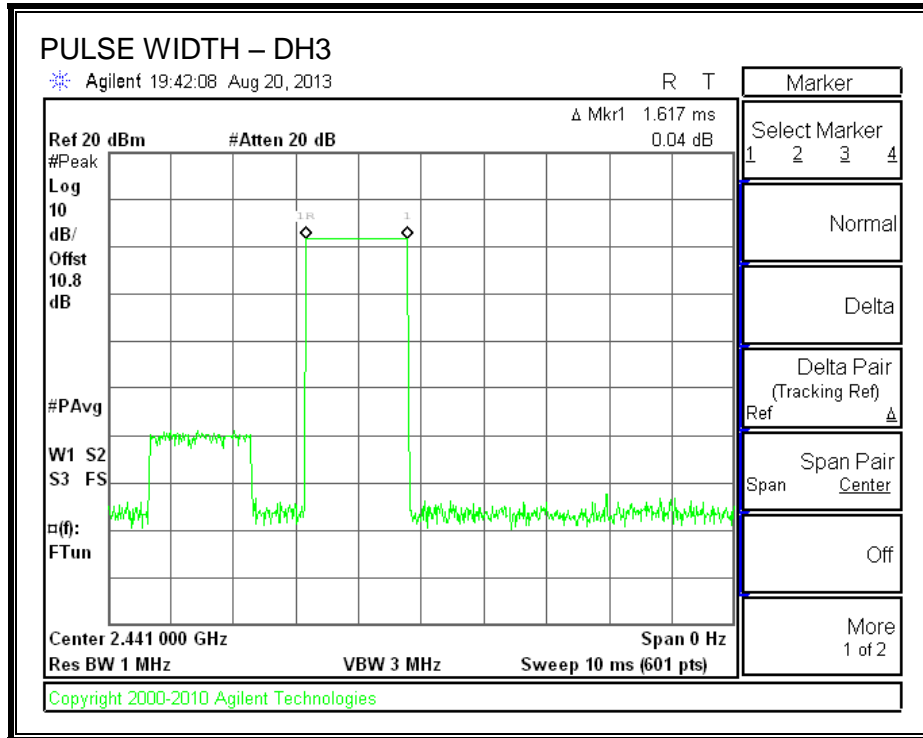
PULSE WIDTH - DH1



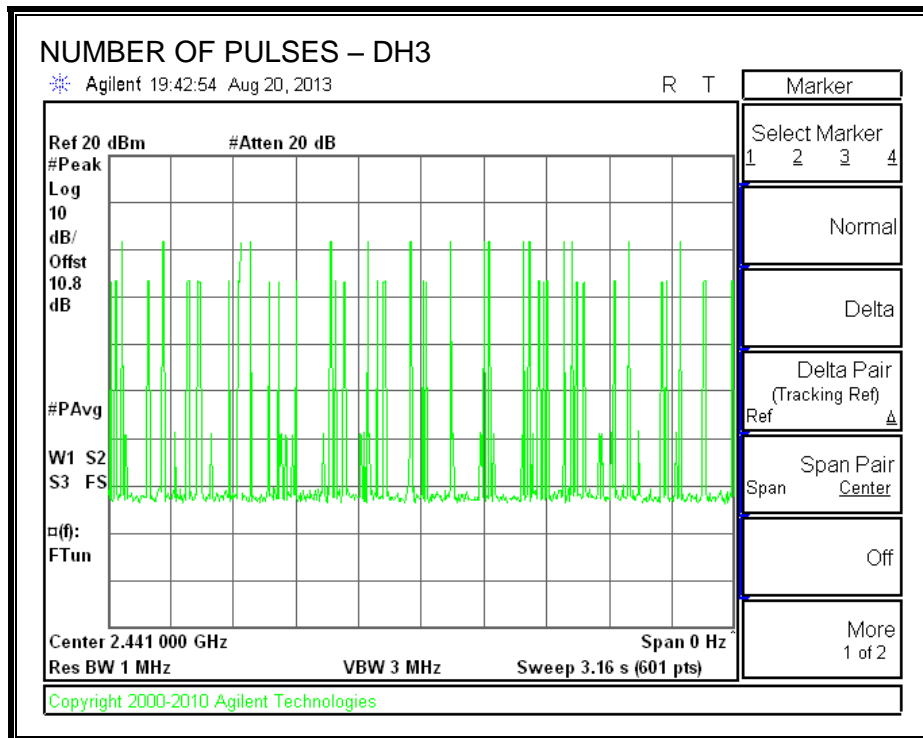
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH1



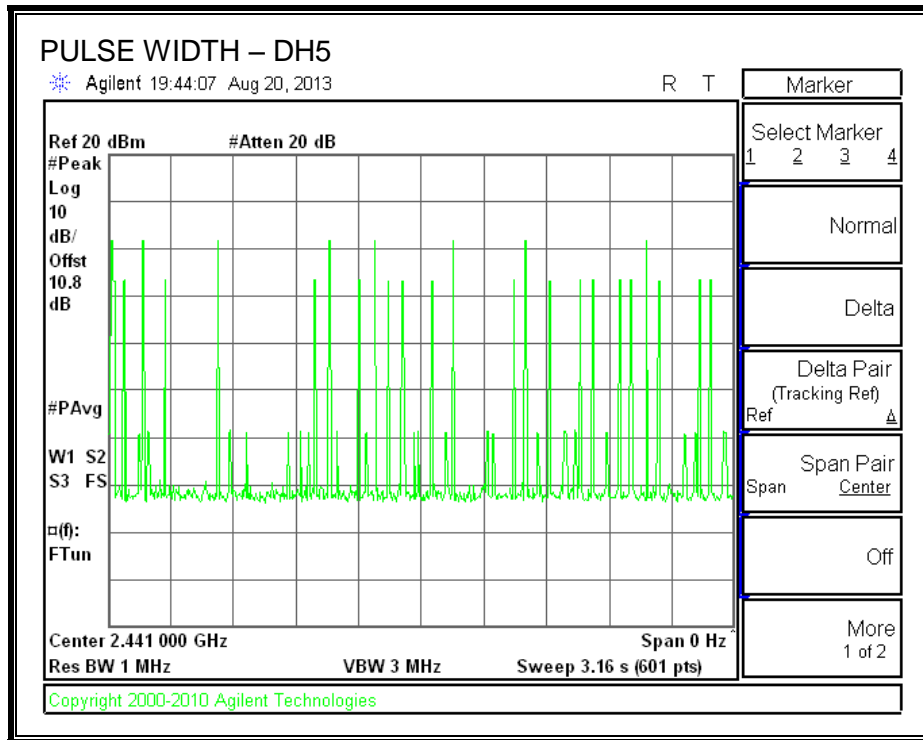
PULSE WIDTH – DH3



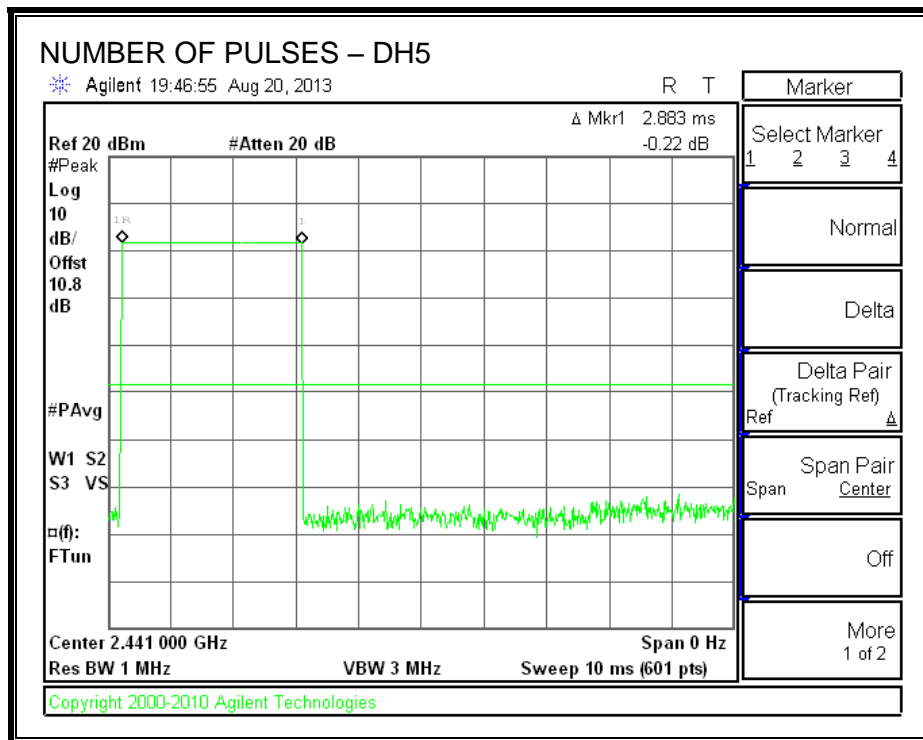
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5



8.1.5. 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.

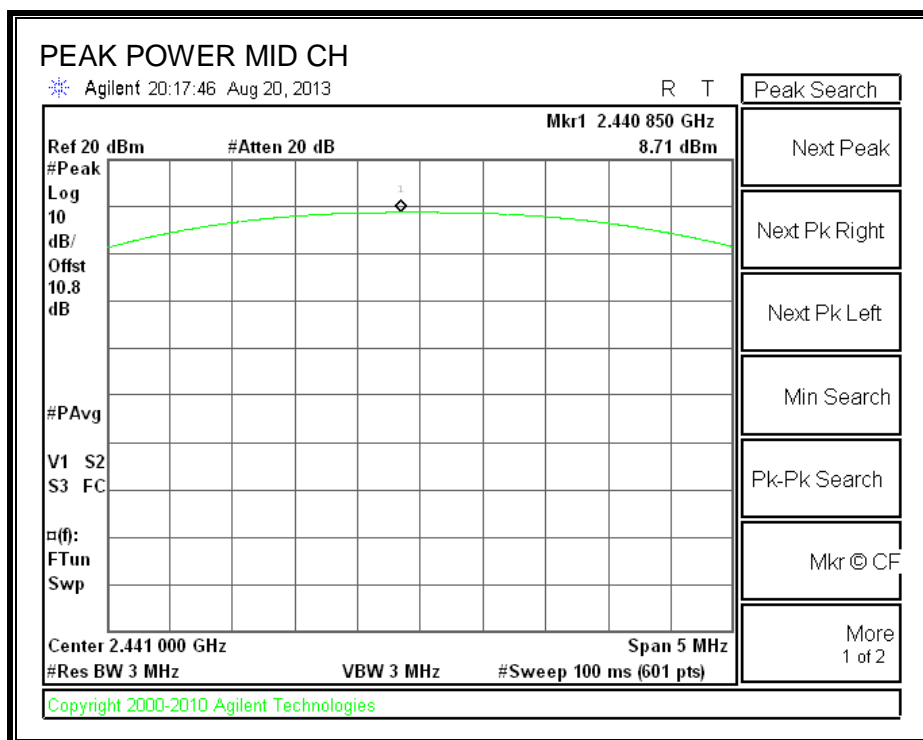
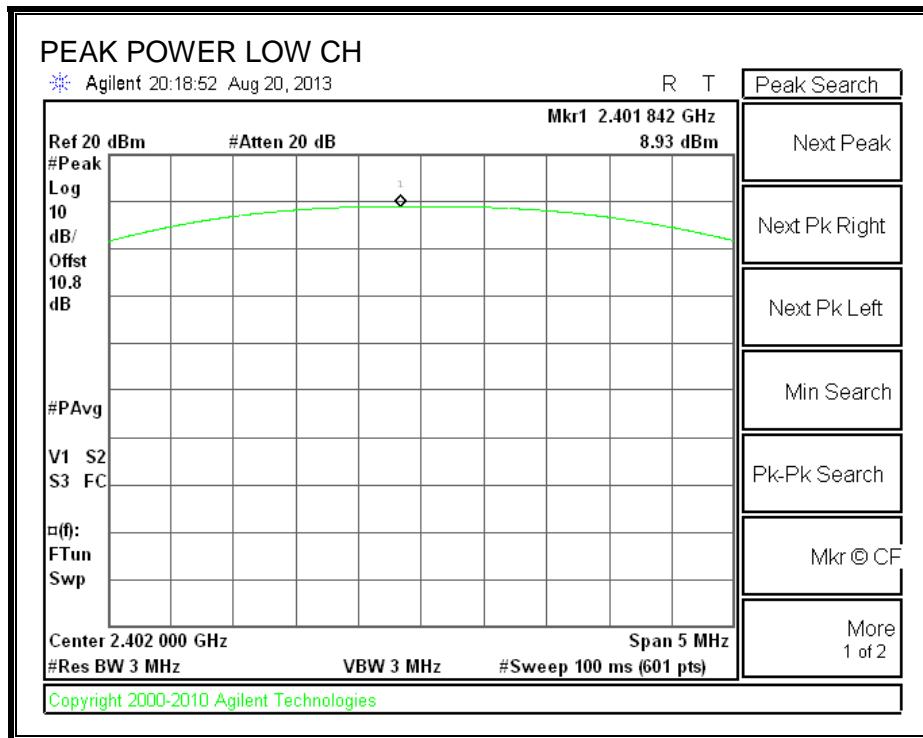
TEST PROCEDURE

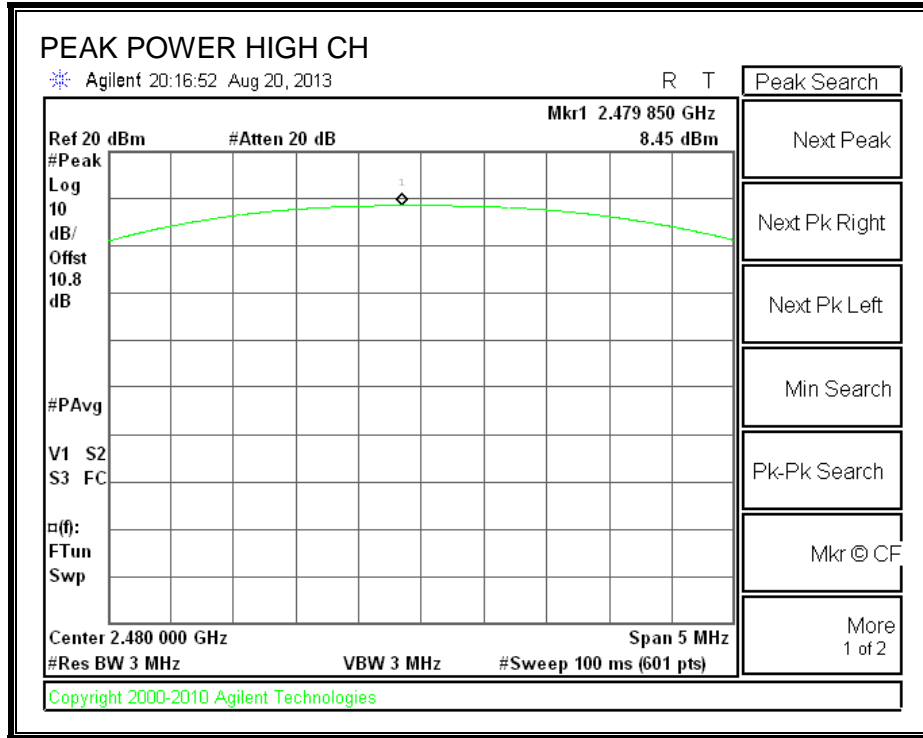
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	8.93	30	-21.07
Middle	2441	8.71	30	-21.29
High	2480	8.45	30	-21.55

OUTPUT POWER





8.1.6. 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 10.75dB (including 10 dB pad and .75dB 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	7.62
Middle	2441	7.45
High	2480	7.18

8.1.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

TEST PROCEDURE

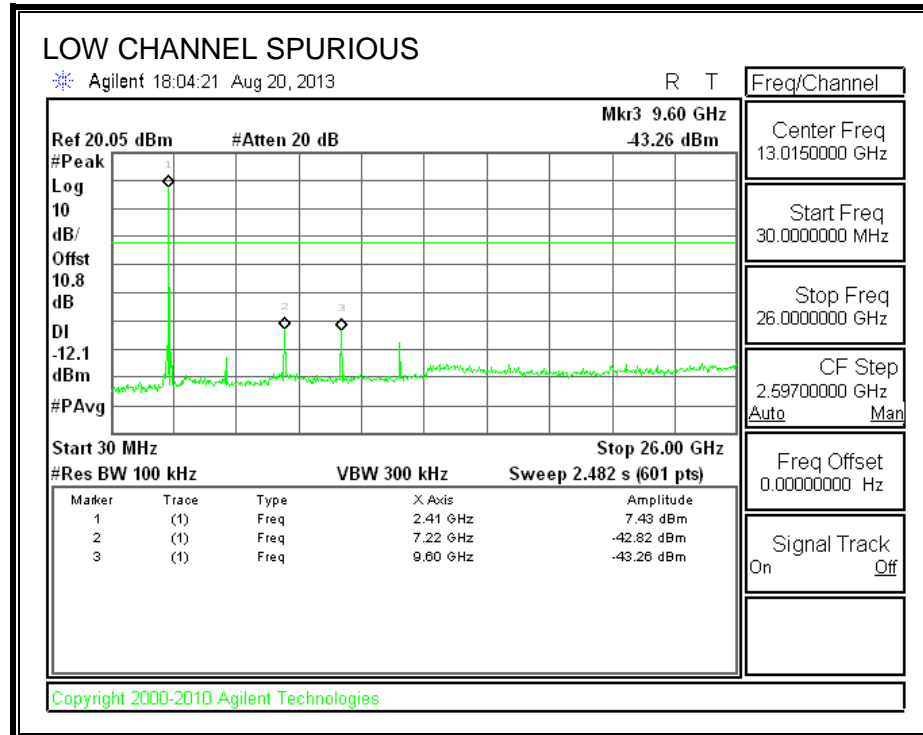
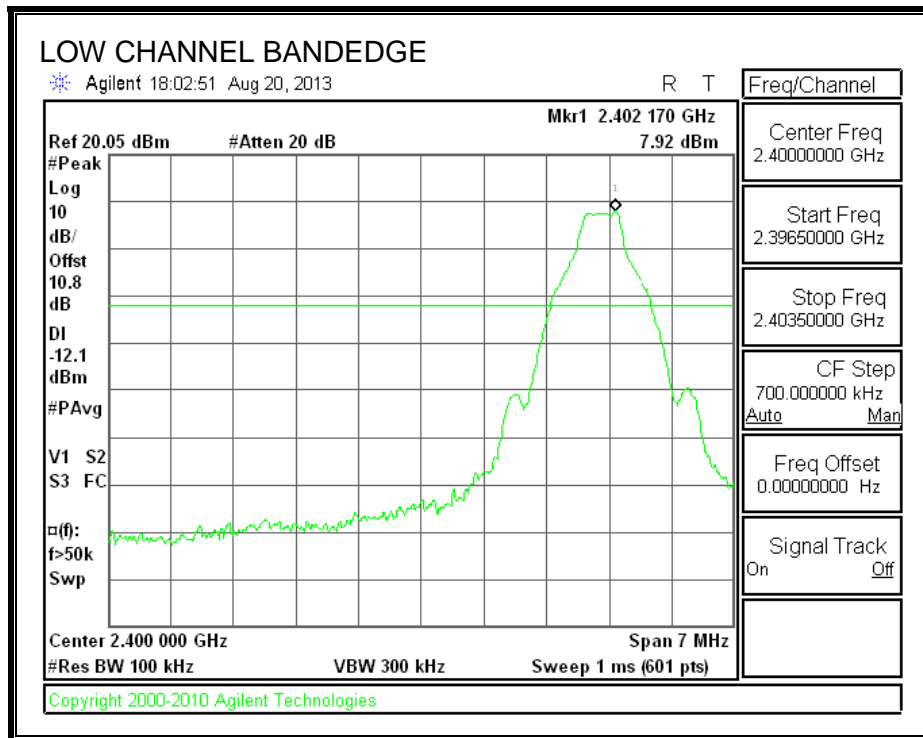
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

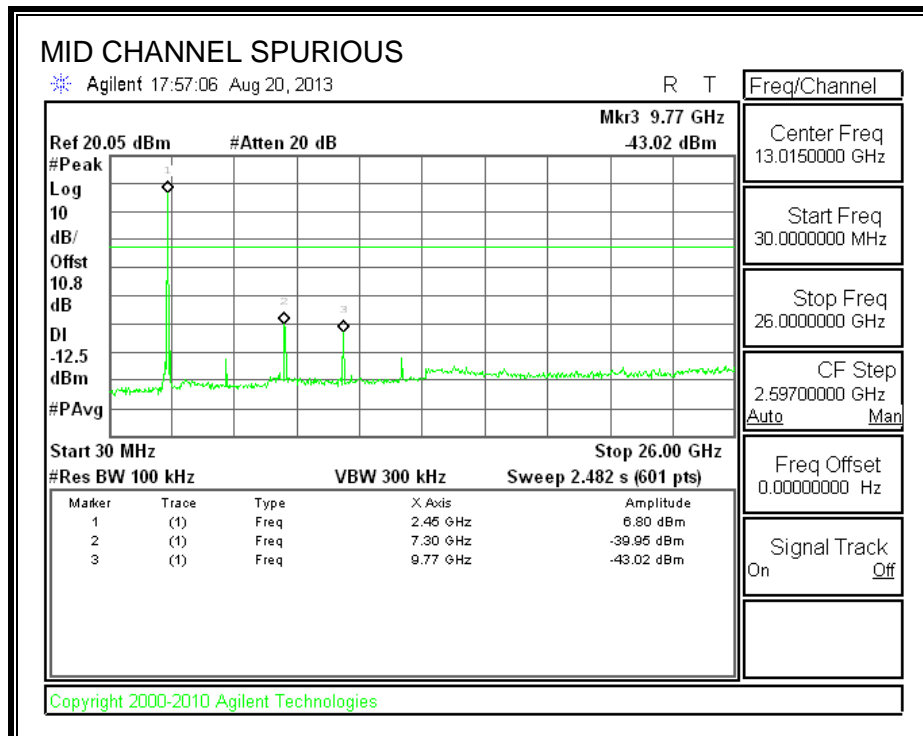
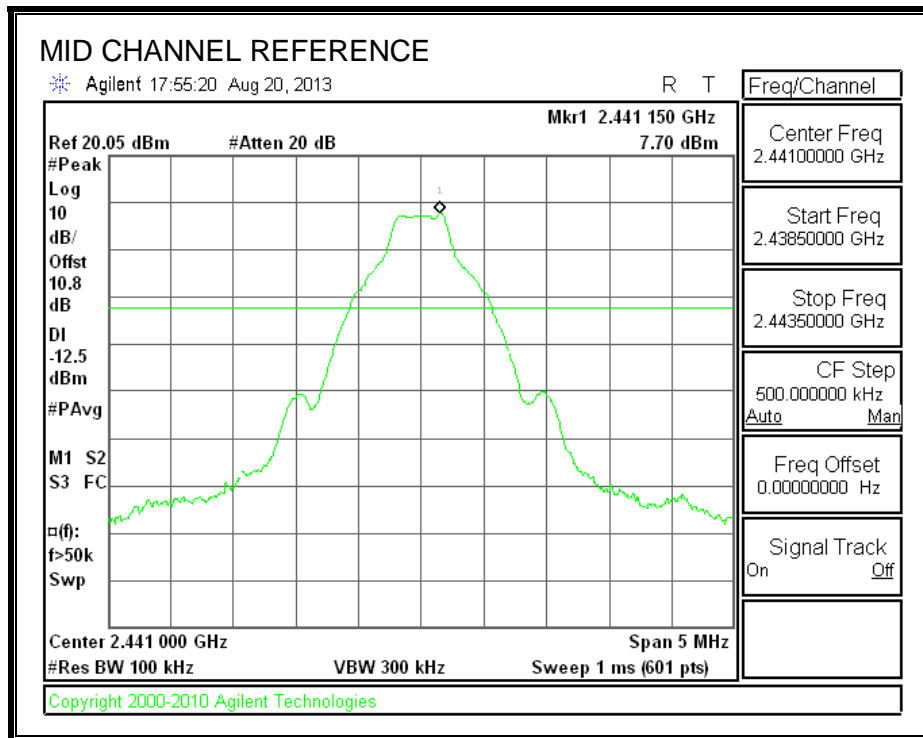
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

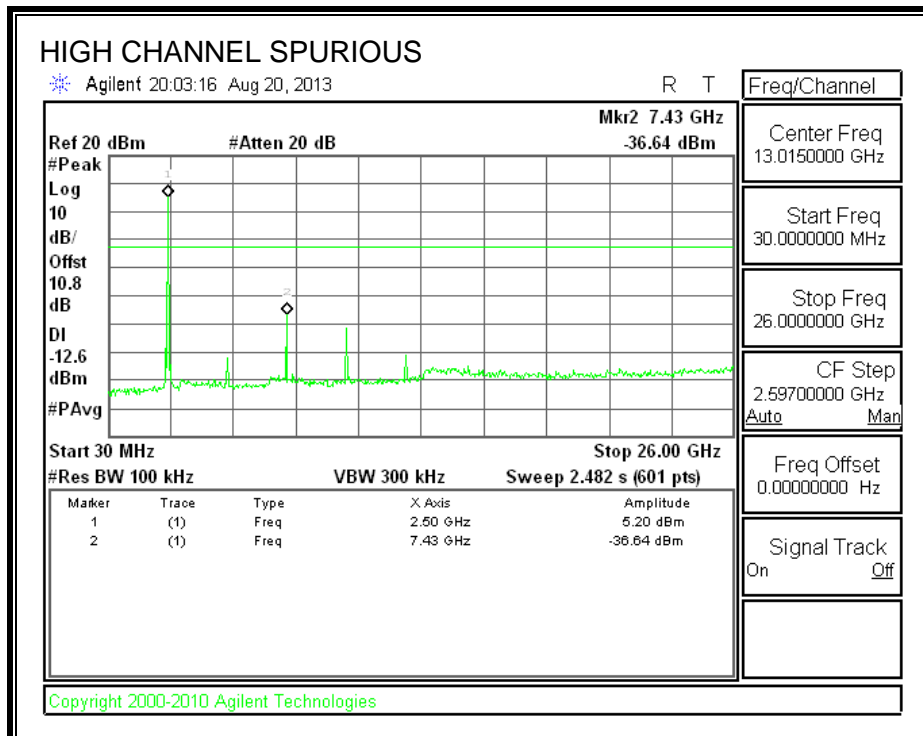
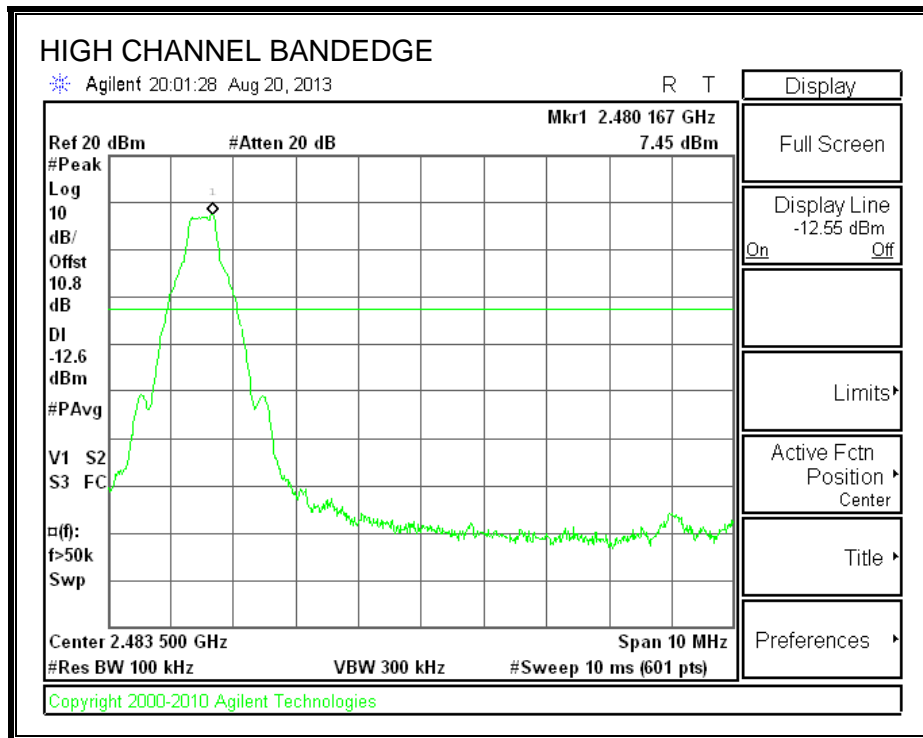
SPURIOUS EMISSIONS, LOW CHANNEL



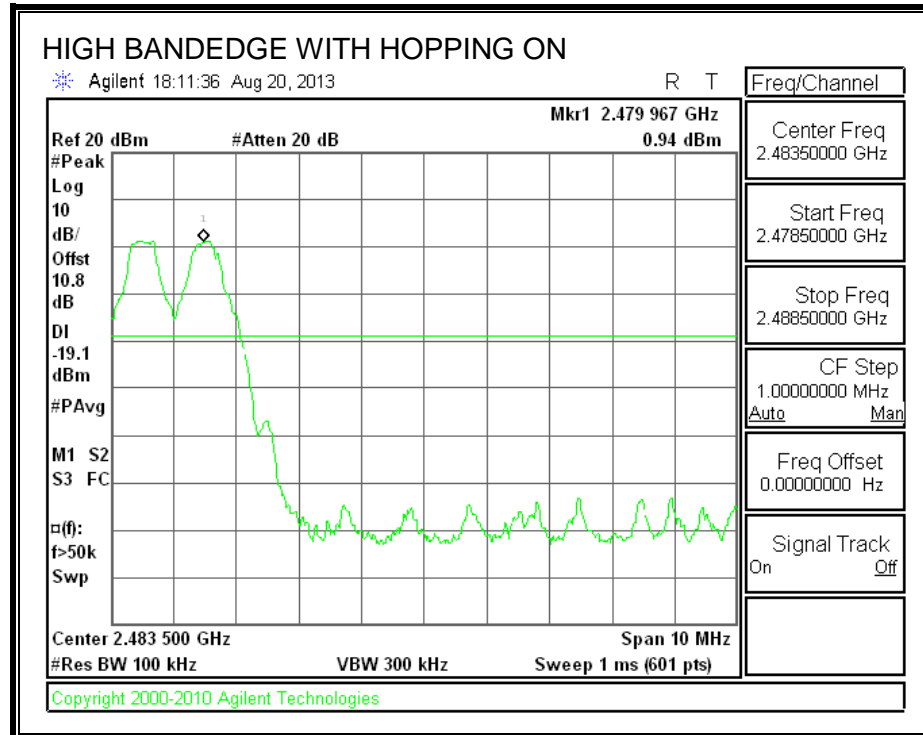
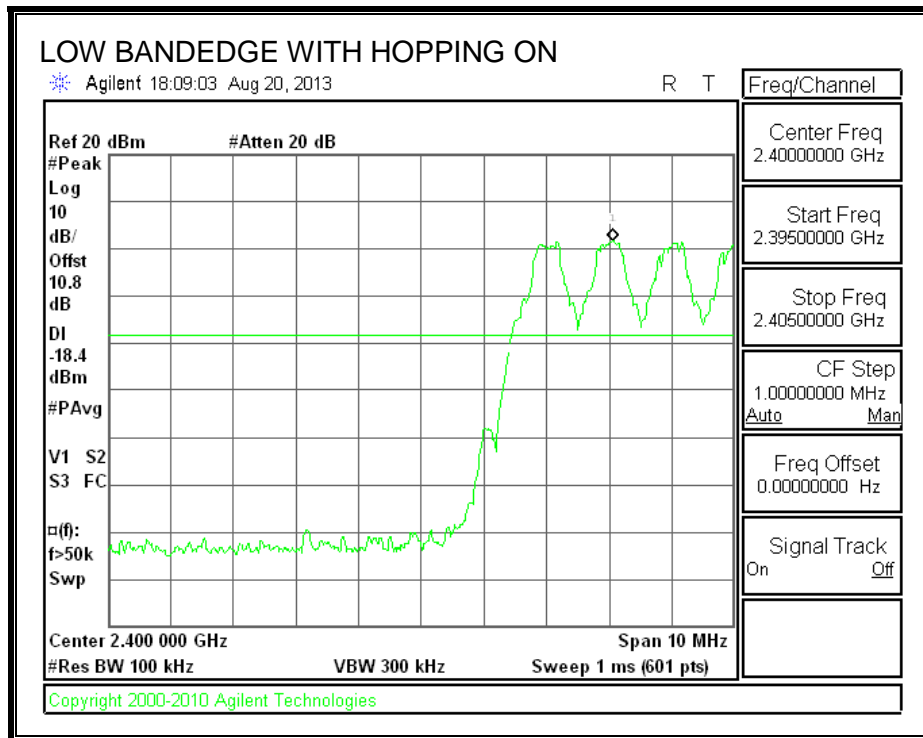
SPURIOUS EMISSIONS, MID CHANNEL



SPURIOUS EMISSIONS, HIGH CHANNEL



SPURIOUS BANDEGE EMISSIONS WITH HOPPING ON



8.2. ENHANCED DATA RATE 8PSK MODULATION

8.2.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

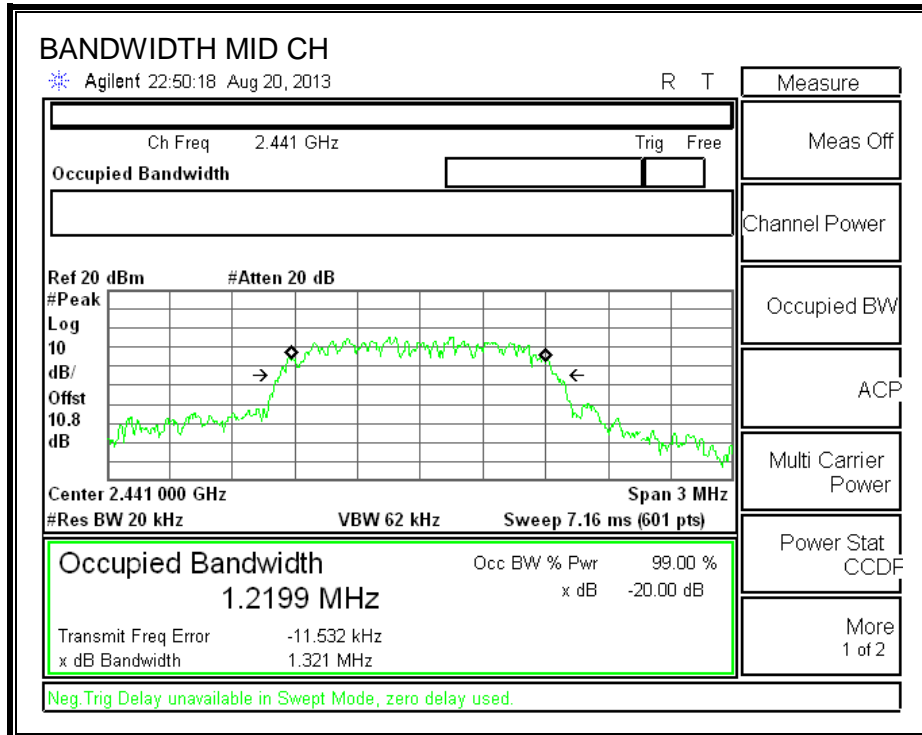
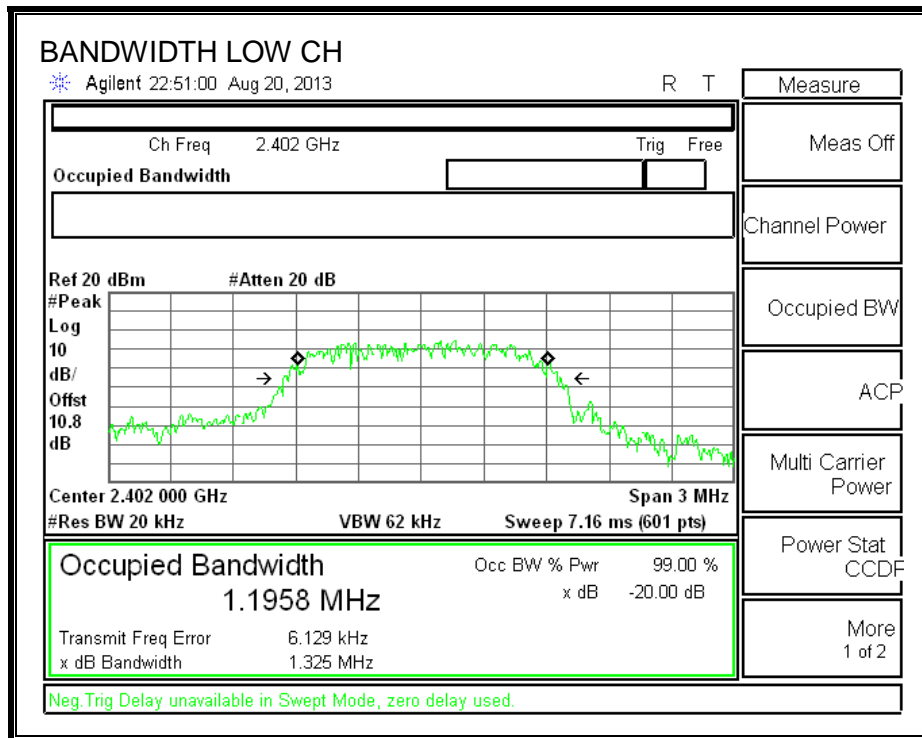
TEST PROCEDURE

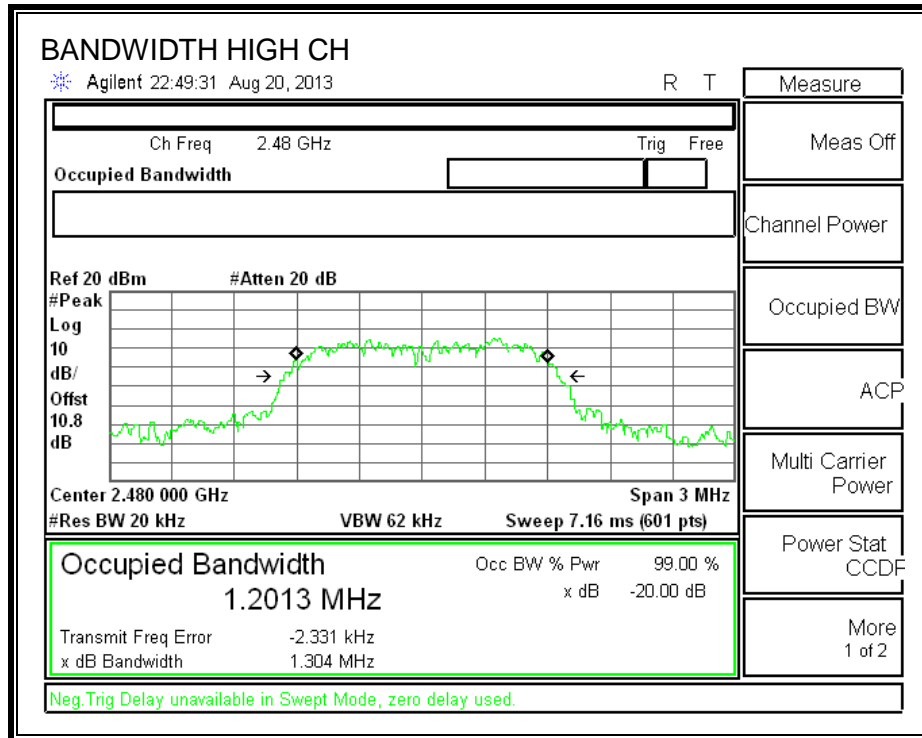
The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to \geq RBW. The sweep time is coupled.

RESULTS

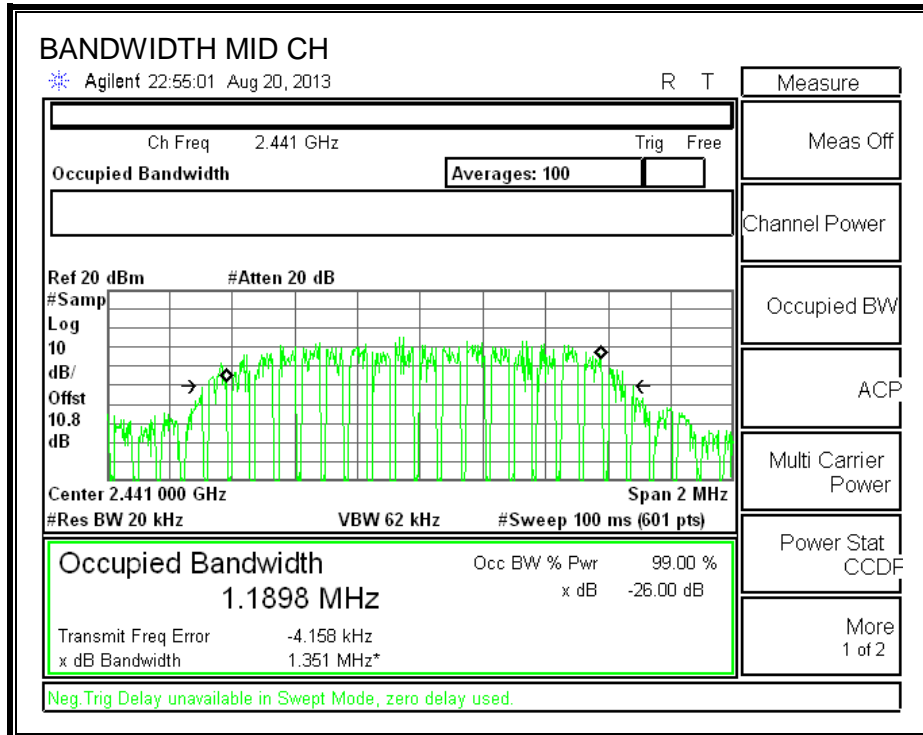
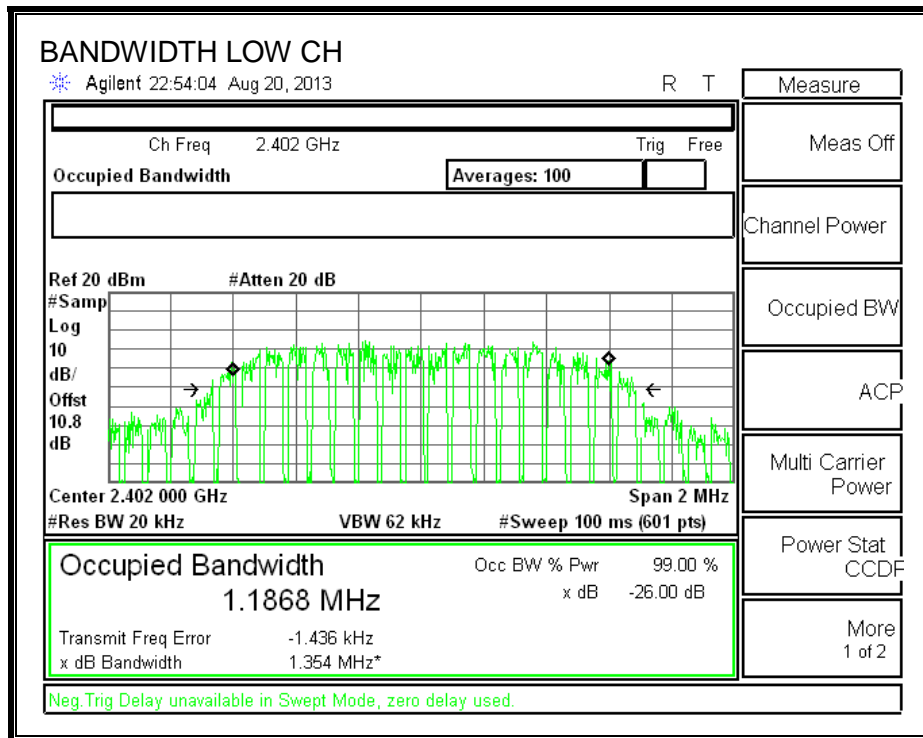
Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	1325	1186.8
Middle	2441	1321	1189.8
High	2480	1304	1216.2

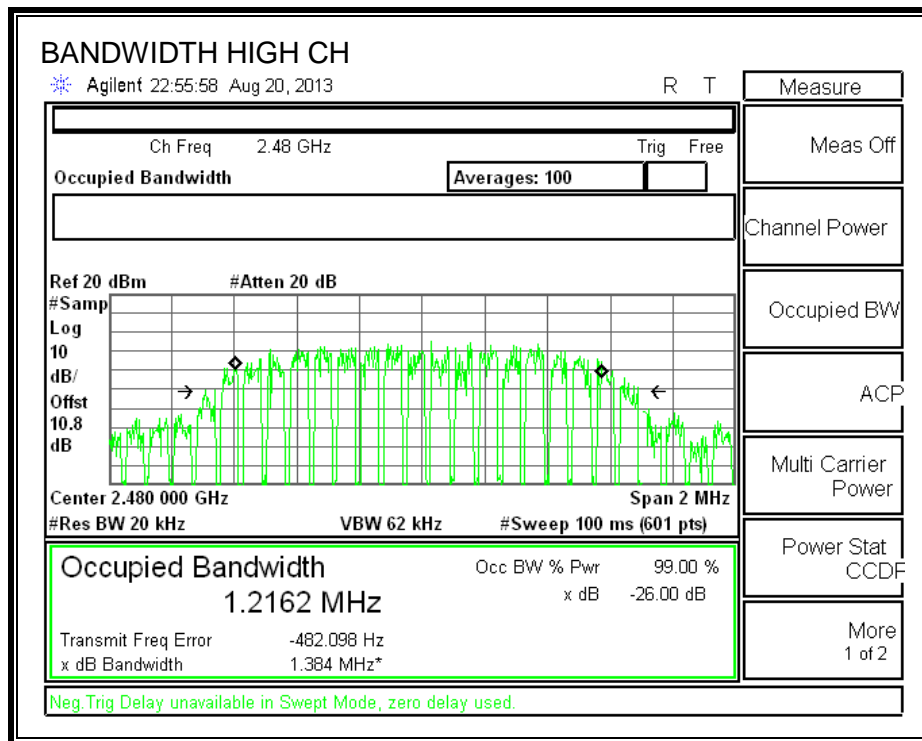
20 dB BANDWIDTH





99% BANDWIDTH





8.2.2. 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.

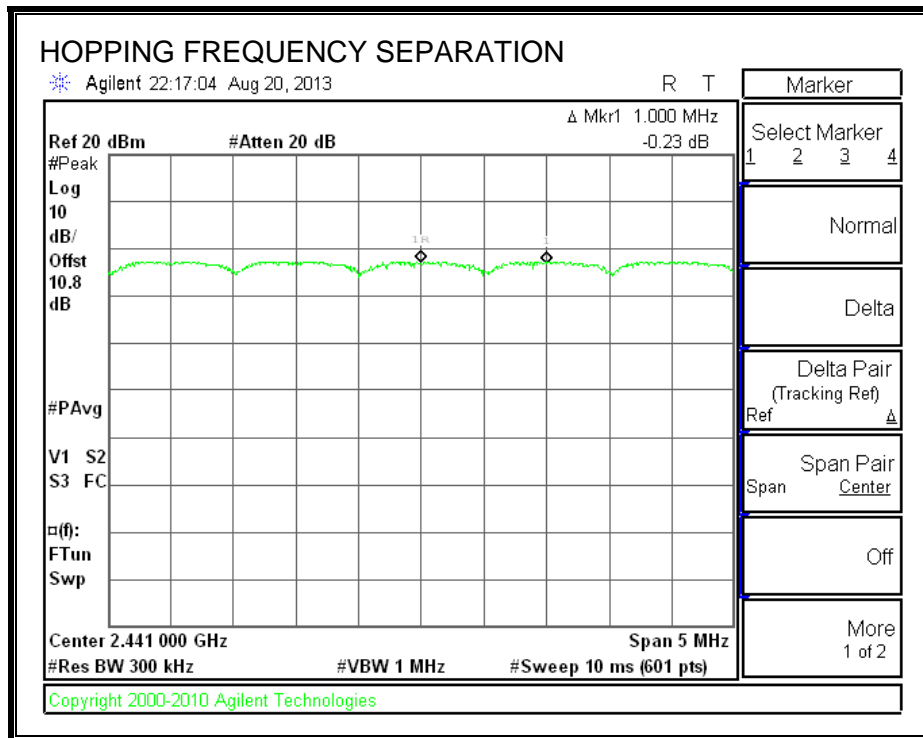
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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



8.2.3. 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.

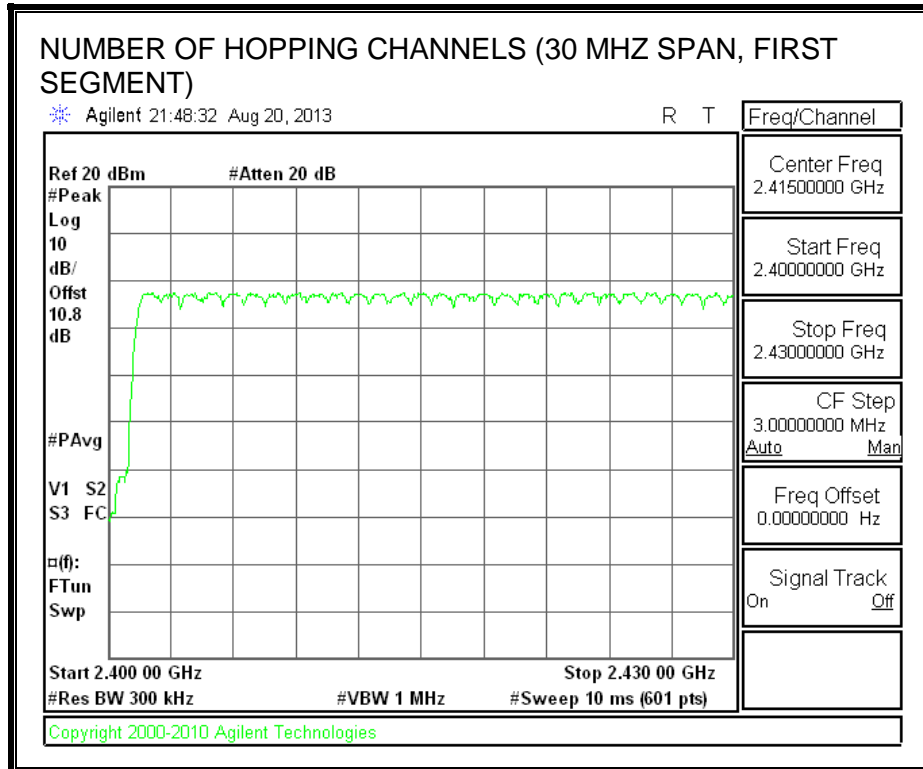
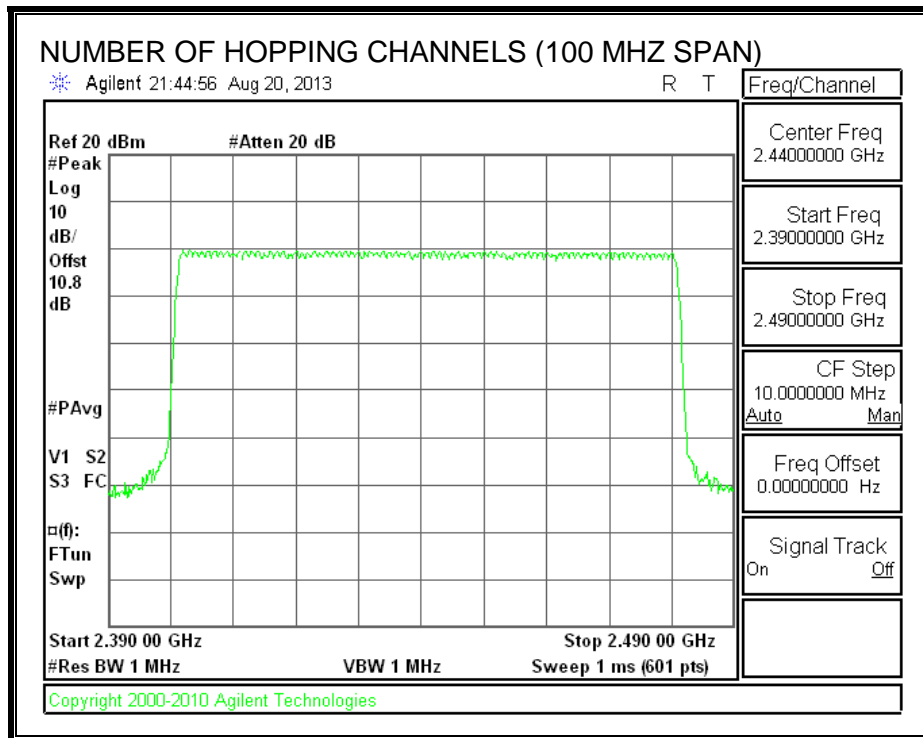
TEST PROCEDURE

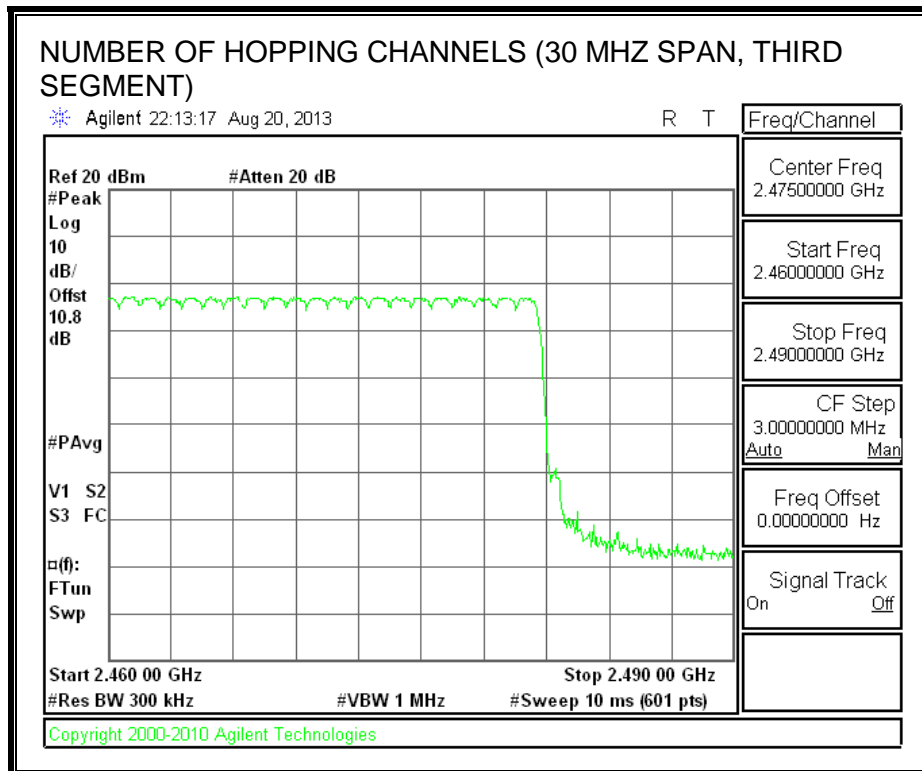
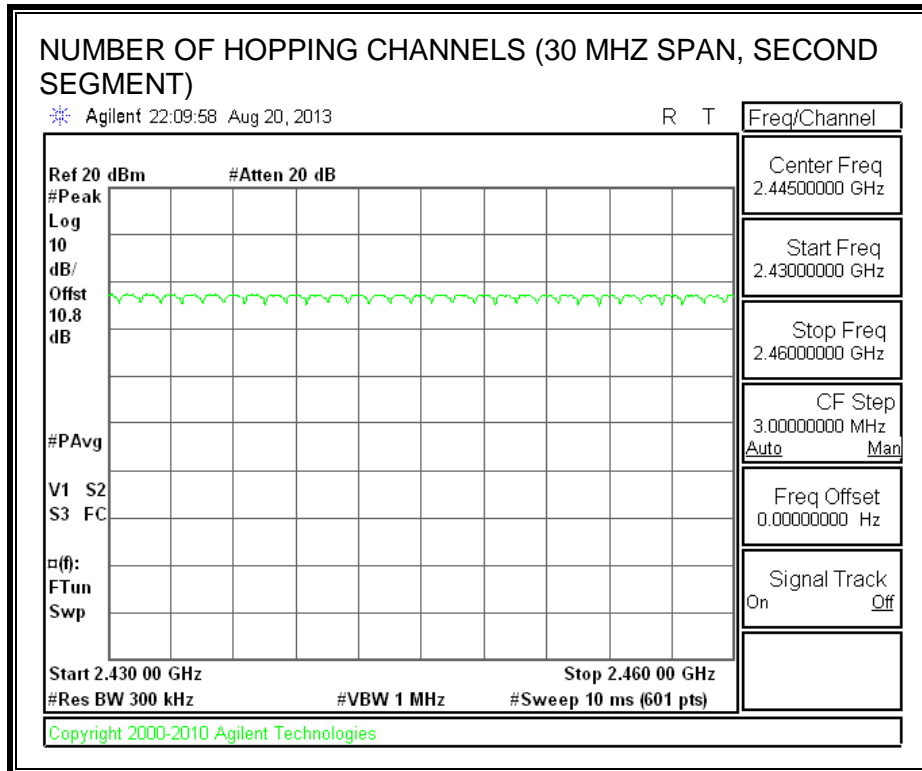
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

Normal Mode: 79 Channels observed.

NUMBER OF HOPPING CHANNELS





8.2.4. 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 * (# of pulses in 3.16 s) * 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 * (# of pulses in 0.8 s) * pulse width.

RESULTS

Time Of Occupancy = 10 * xx pulses * yy msec = zz msec

8PSK (EDR) Mode

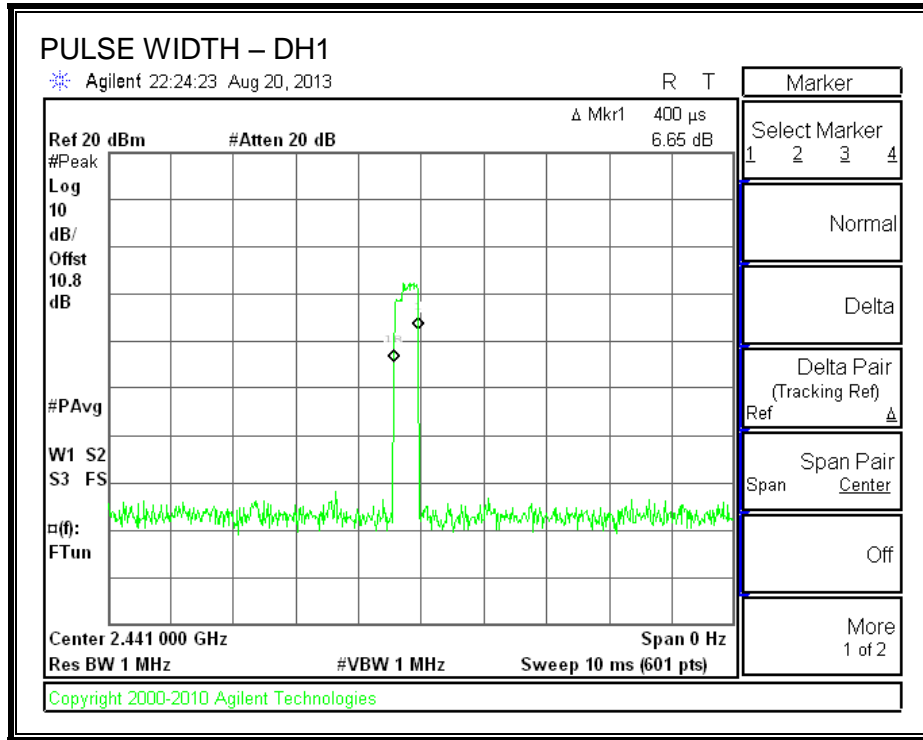
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.40	33	0.132	0.4	-0.268
DH3	1.63	14	0.229	0.4	-0.171
DH5	2.86	10	0.286	0.4	-0.114

AFH Calculations

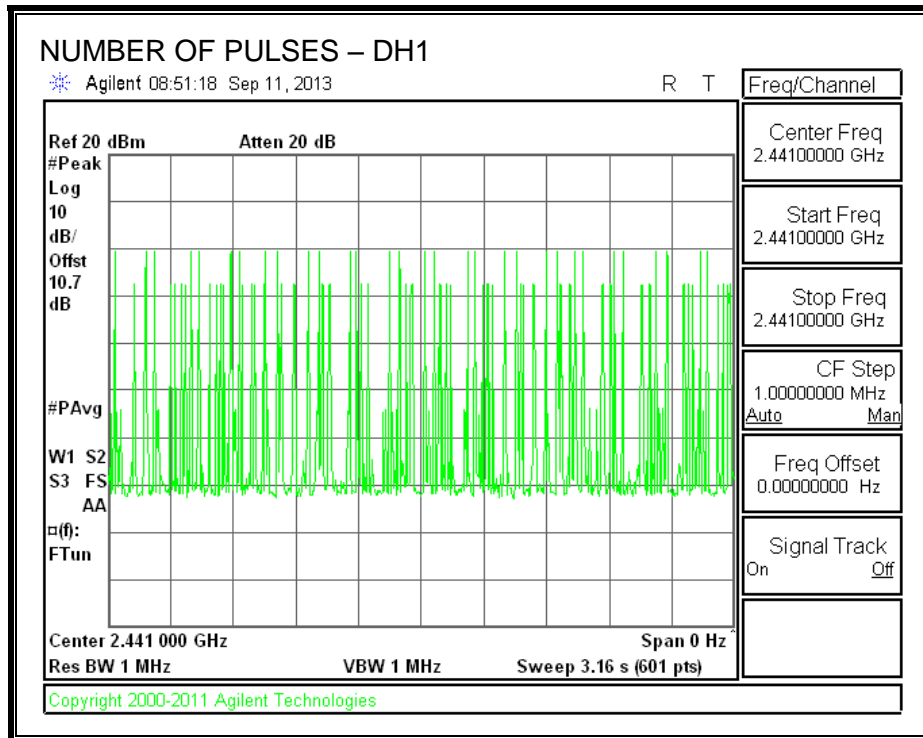
DH Packet	Pulse Width (msec)	Number of Pulses in 8 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
8PSK Normal Mode					
DH1	0.3833	8	0.032	0.8	-0.768
DH3	1.617	4	0.057	0.8	-0.743
DH5	2.833	3	0.072	0.8	-0.728

AFH # of pulses calculation formula: $(8 * (\# \text{ of pulses in normal hopping} / 3.16) / 10)$

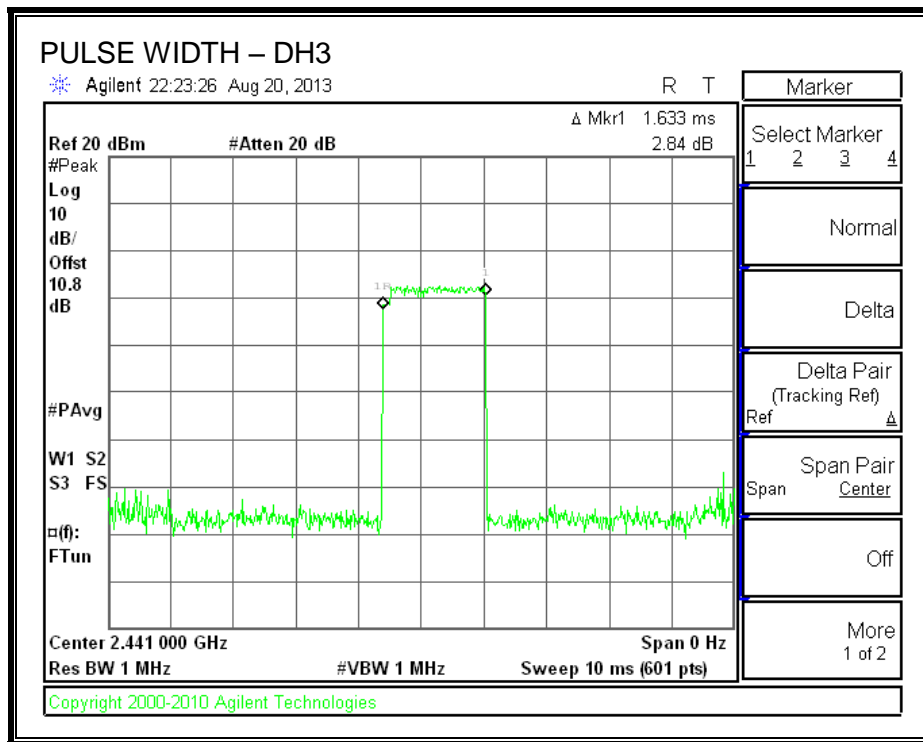
PULSE WIDTH - DH1



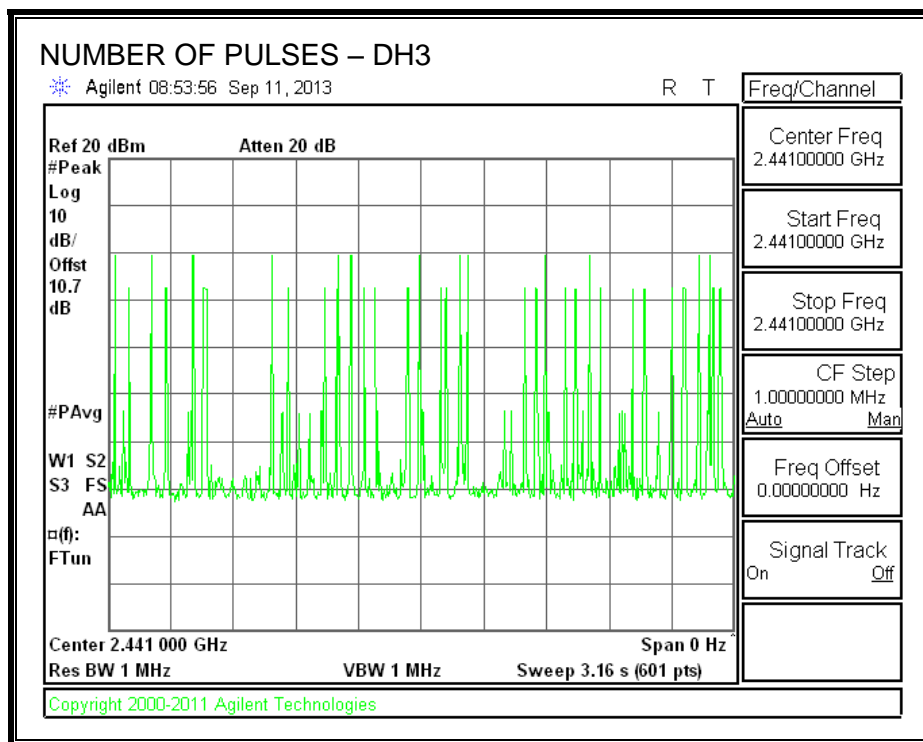
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD - DH1



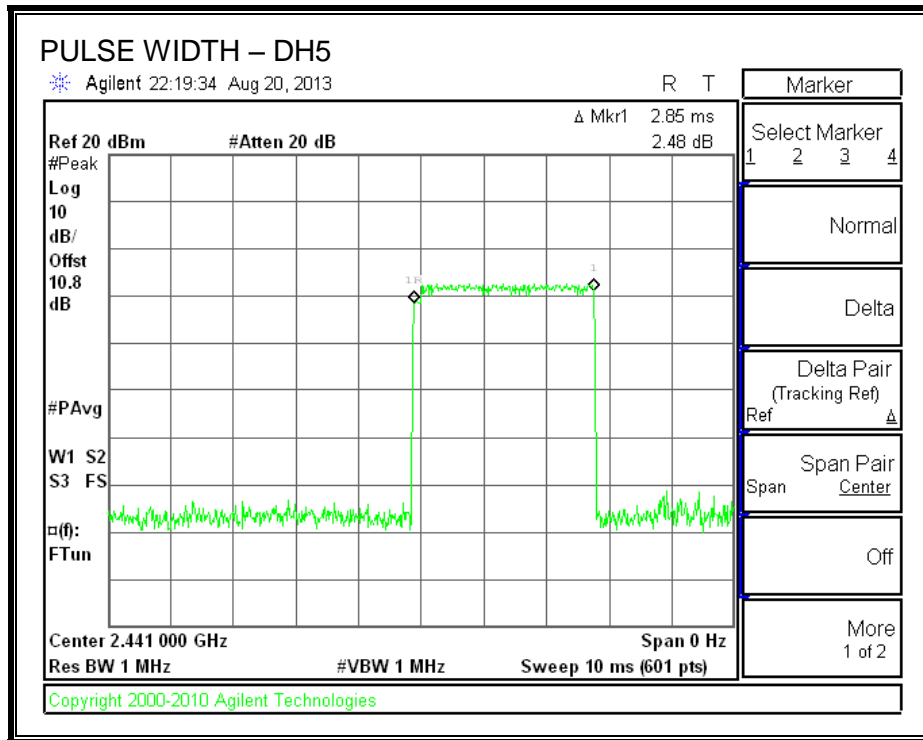
PULSE WIDTH – DH3



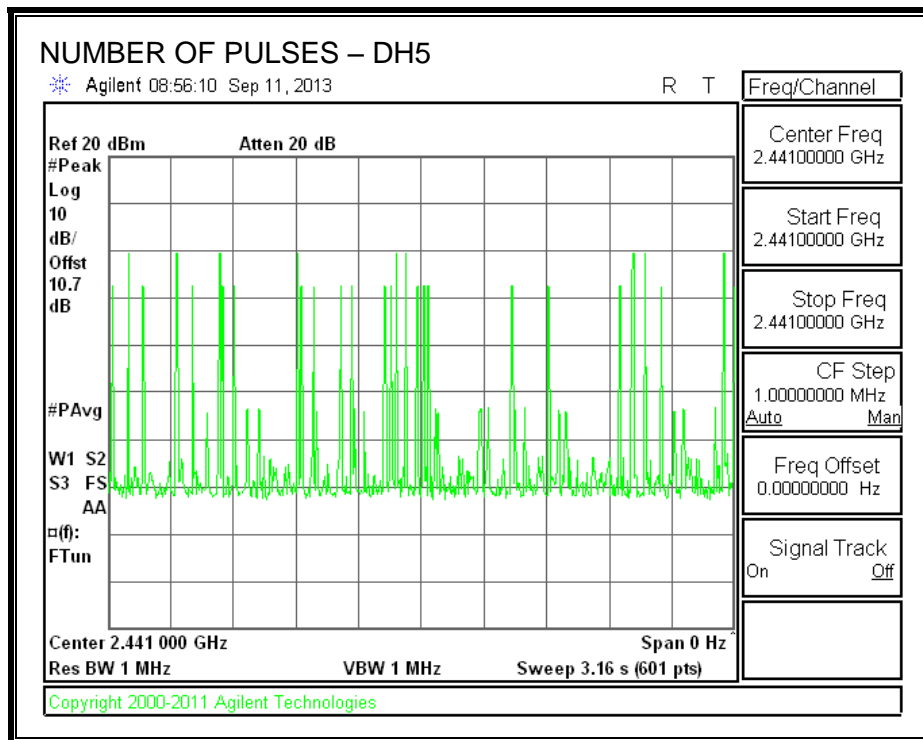
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5



8.2.5. 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.

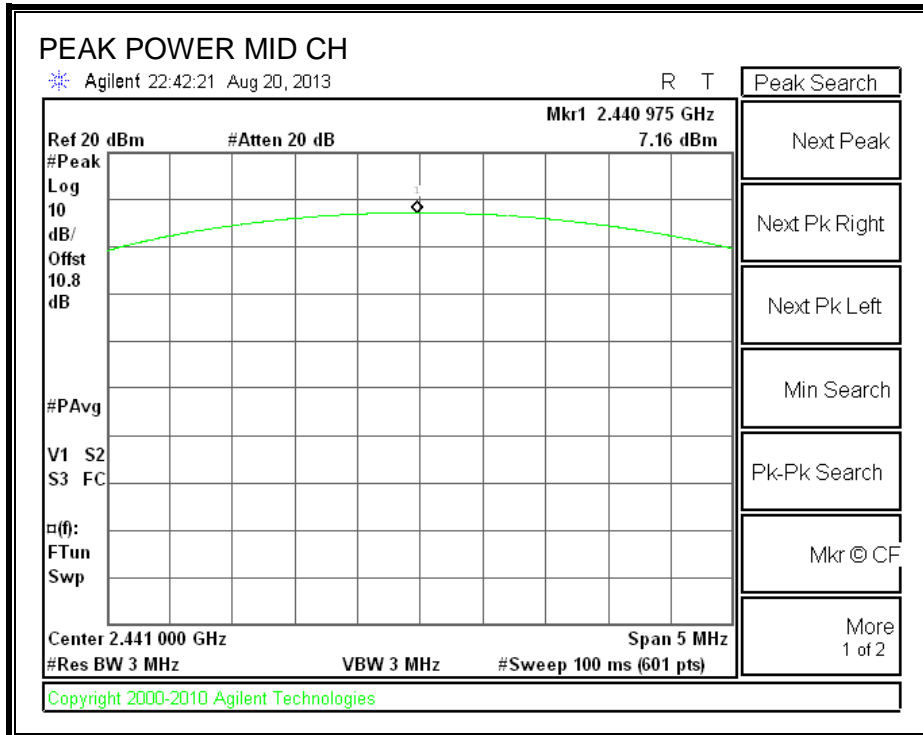
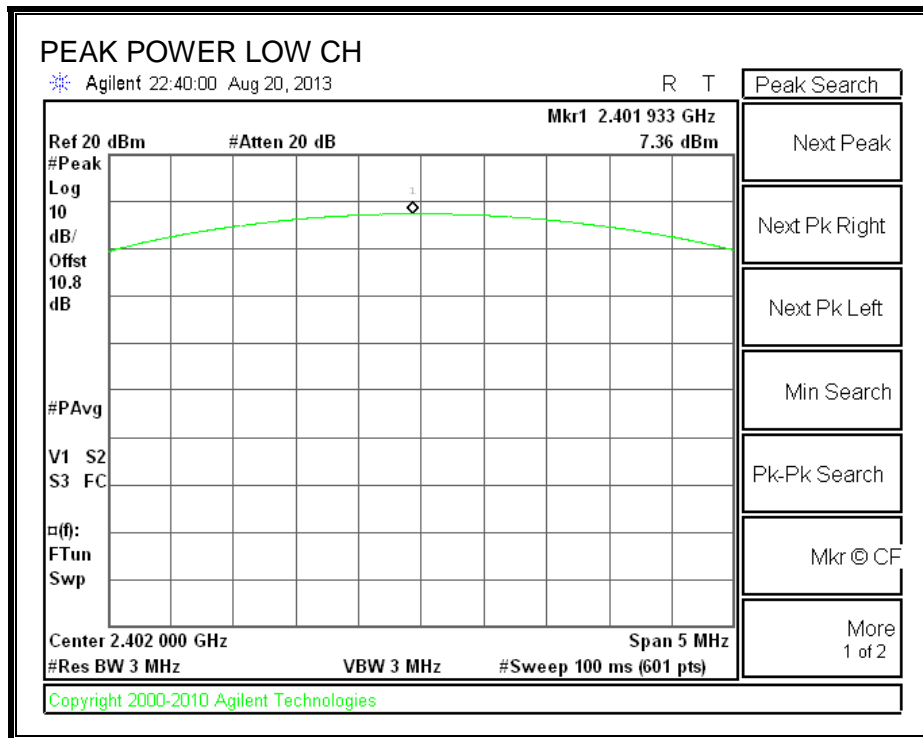
TEST PROCEDURE

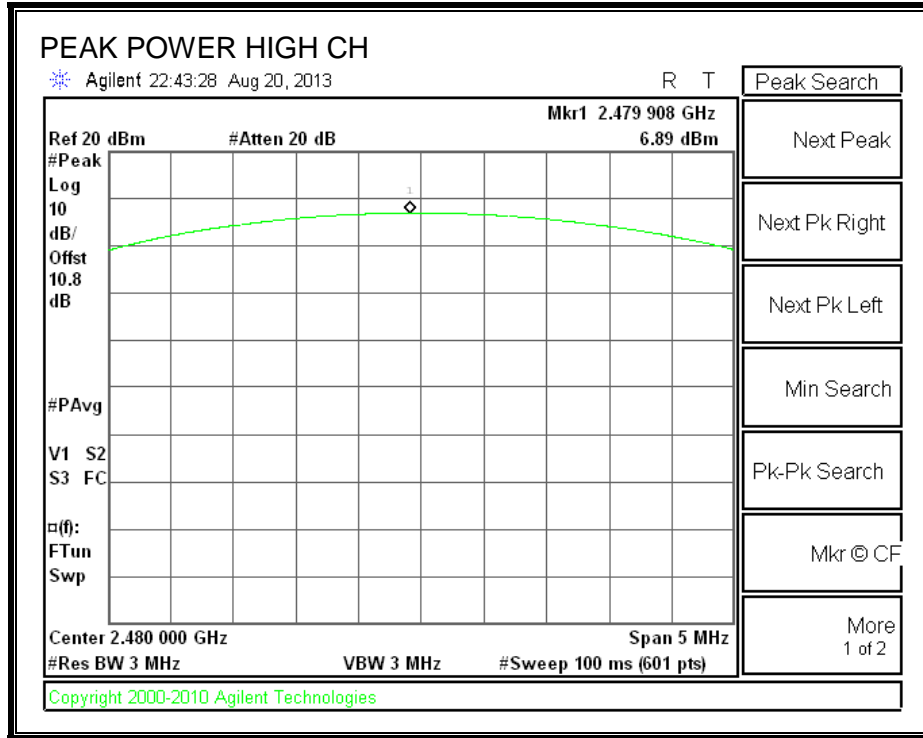
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	7.36	30	-22.64
Middle	2441	7.16	30	-22.84
High	2480	6.89	30	-23.11

OUTPUT POWER





8.2.6. 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 10.8dB (including 10 dB pad and .75dB 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	4.11
Middle	2441	3.92
High	2480	3.68

8.2.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

TEST PROCEDURE

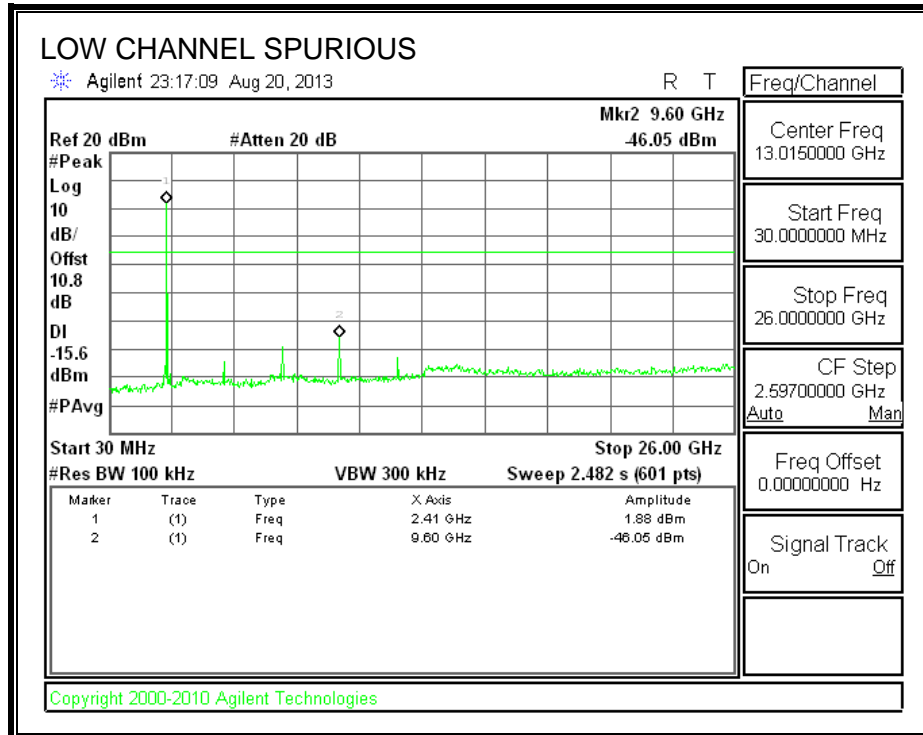
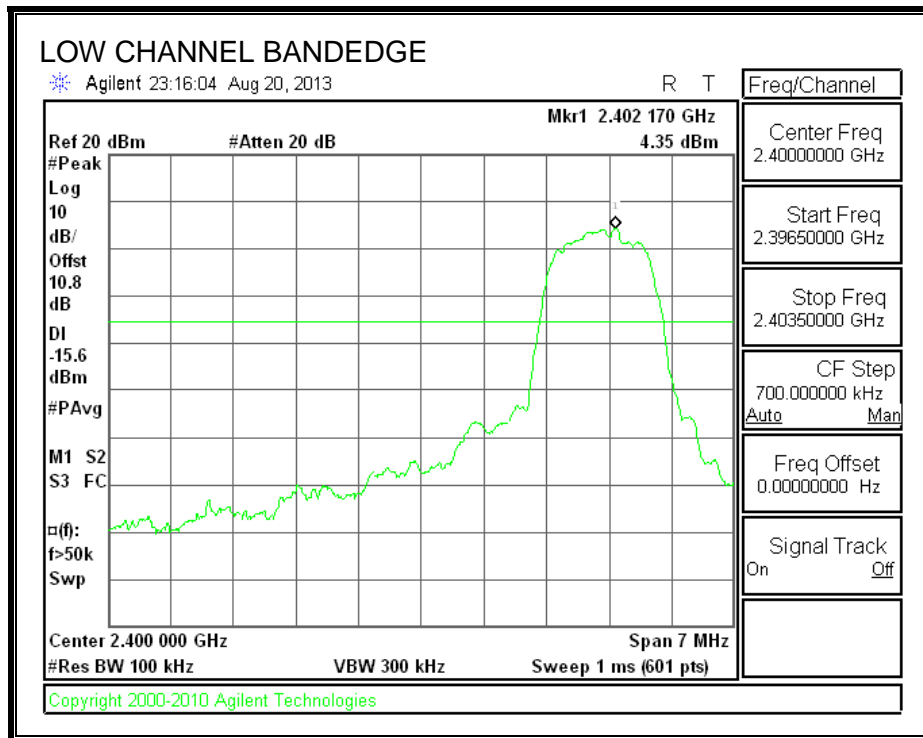
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

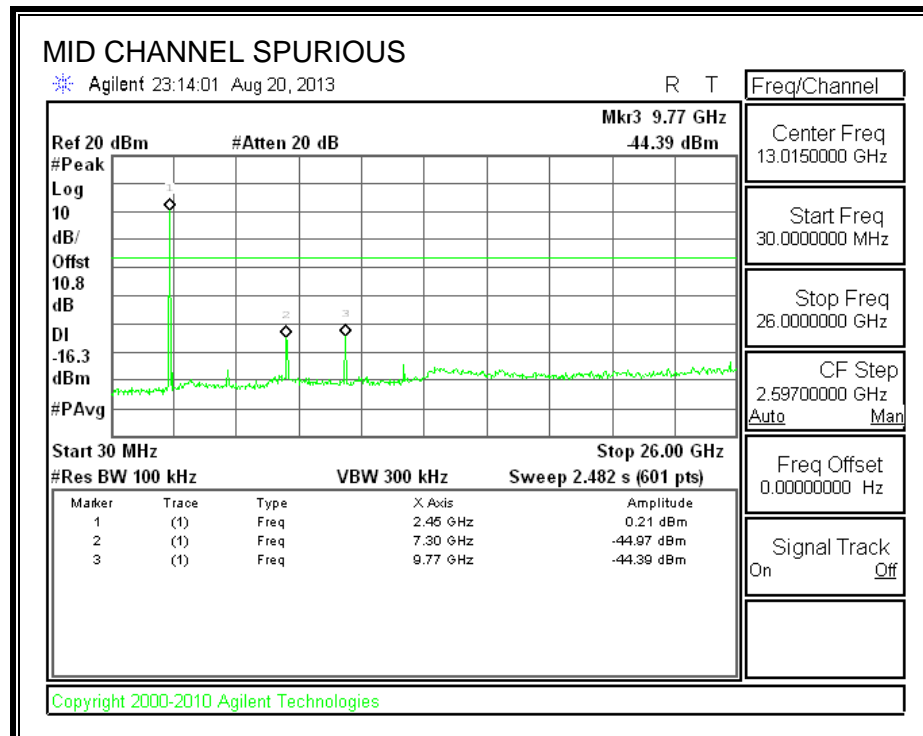
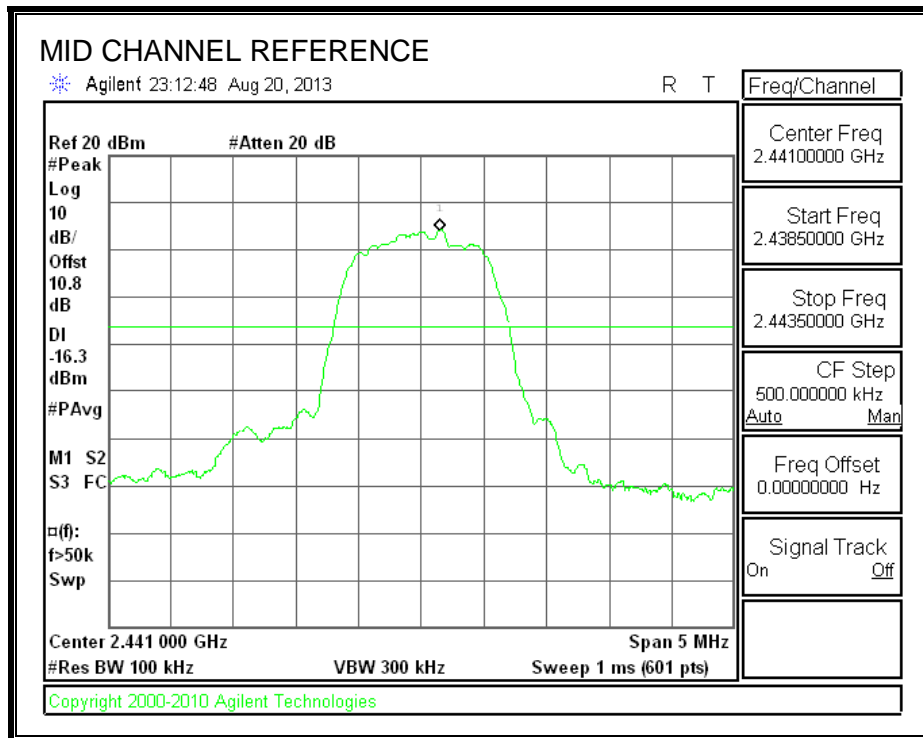
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

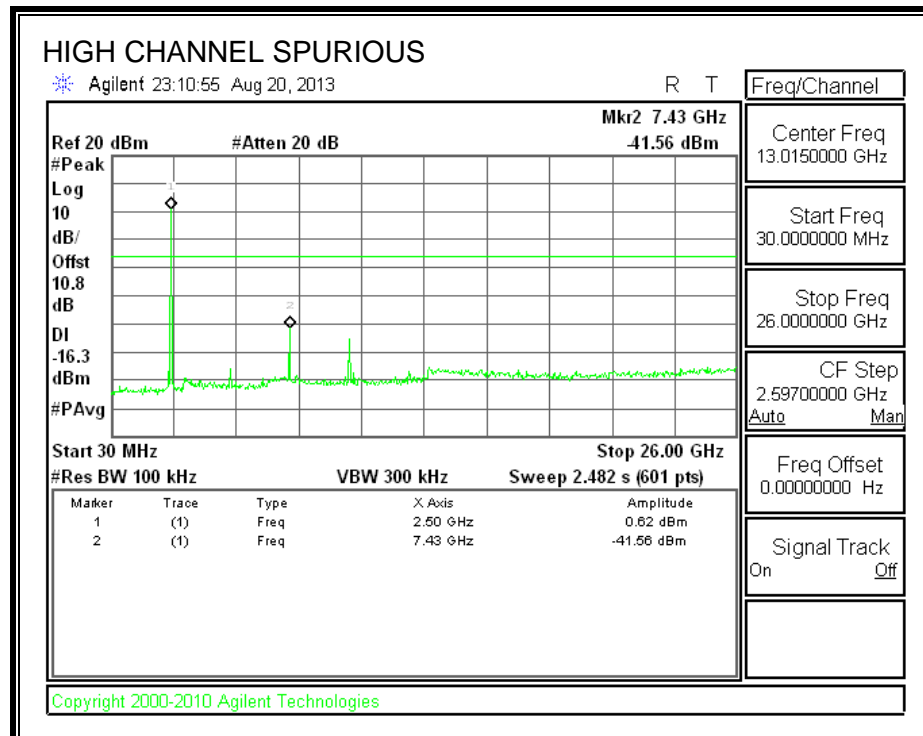
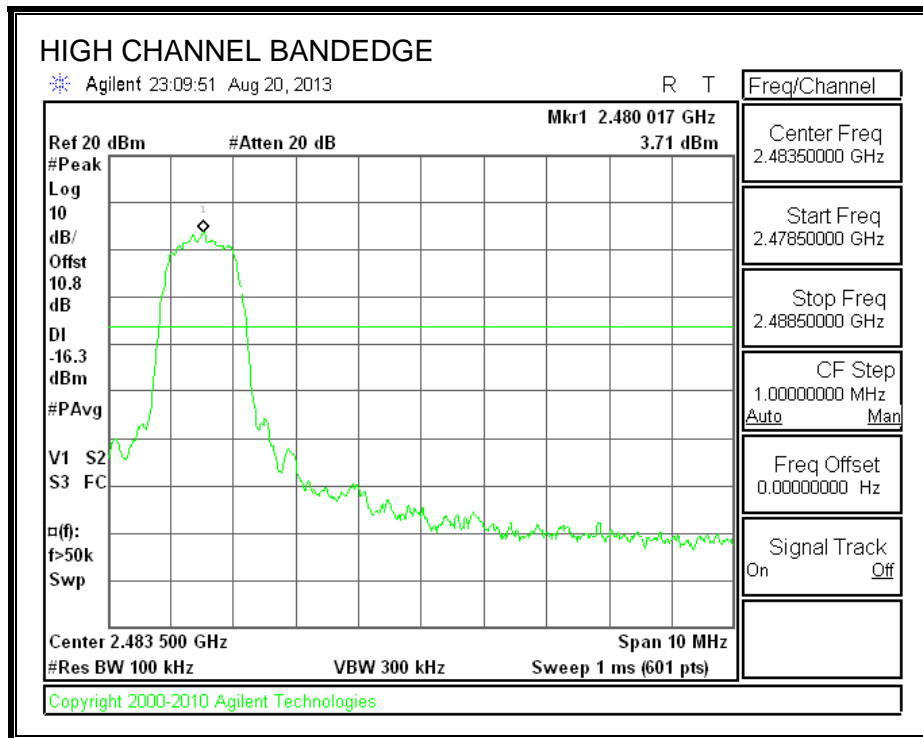
SPURIOUS EMISSIONS, LOW CHANNEL



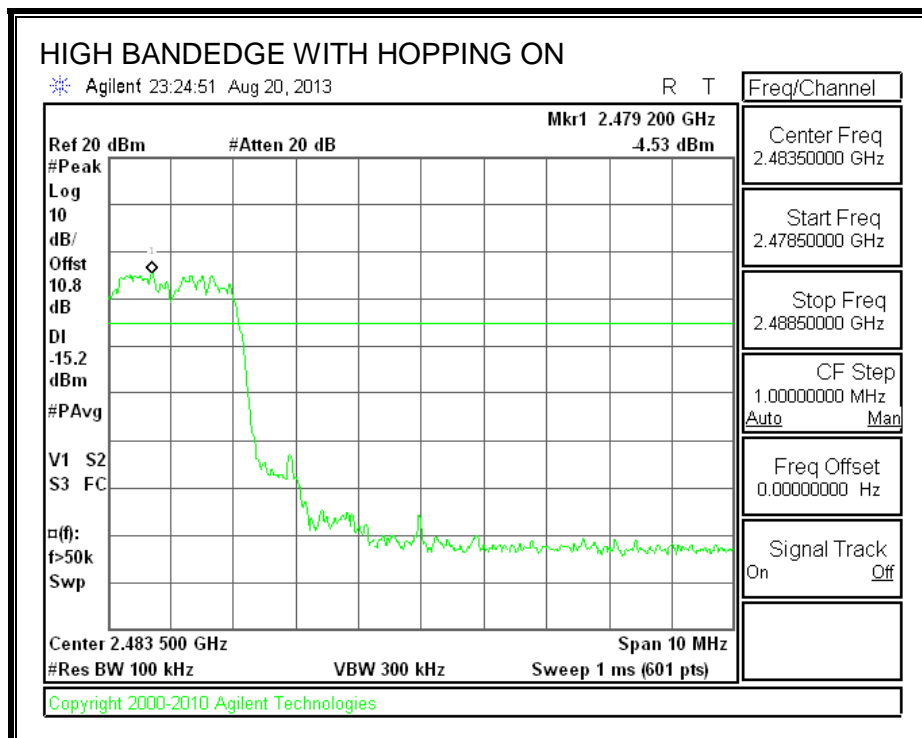
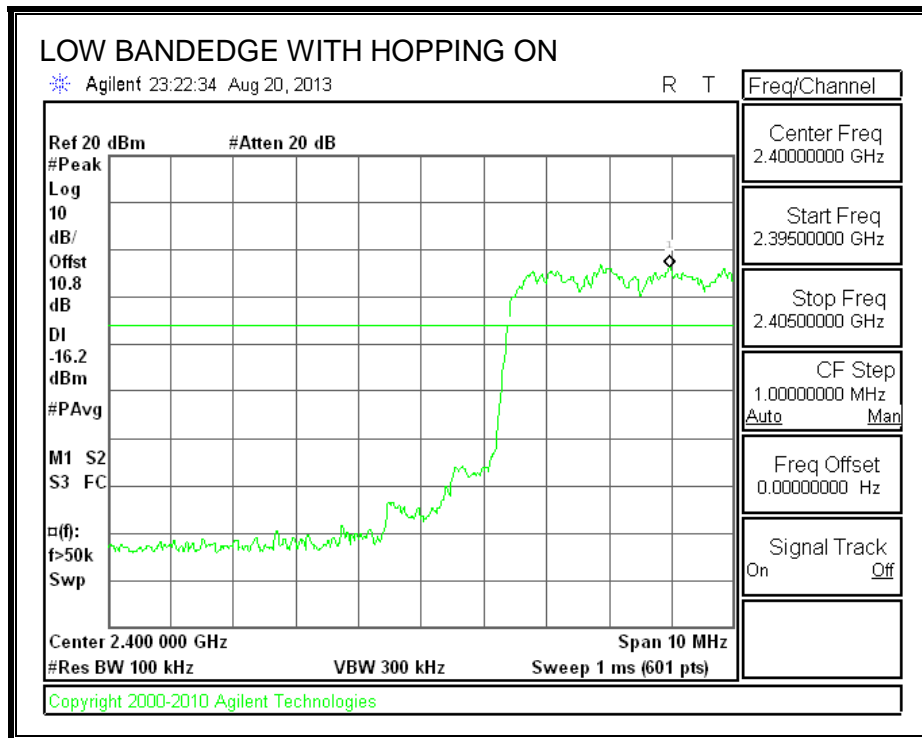
SPURIOUS EMISSIONS, MID CHANNEL



SPURIOUS EMISSIONS, HIGH CHANNEL



SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



9. RADIATED TEST RESULTS

9.1. 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 3 MHz for peak measurements and reduced video bandwidth technique for average measurements. The analyzer is set to power averaging mode for average measurements.

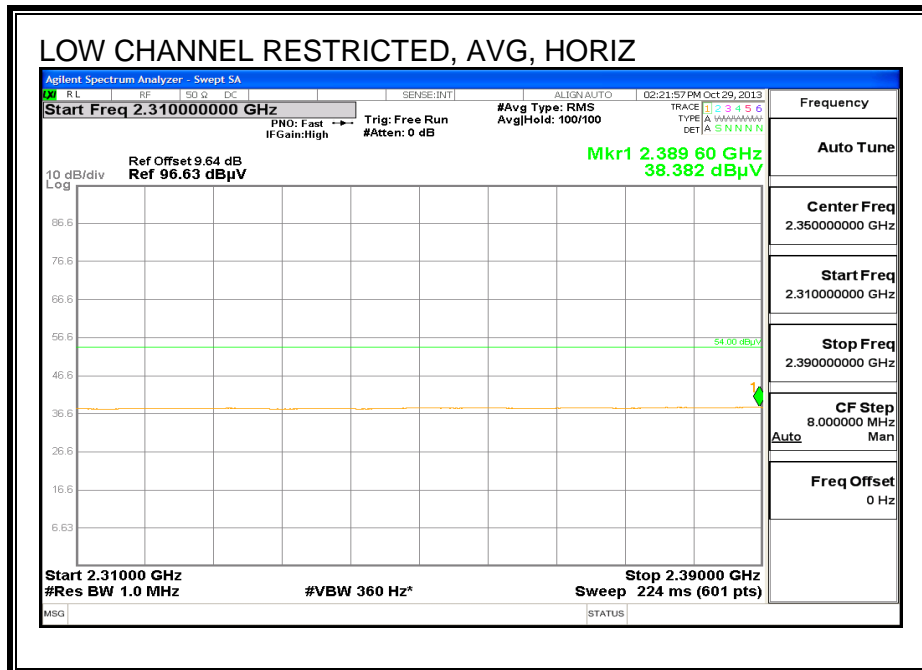
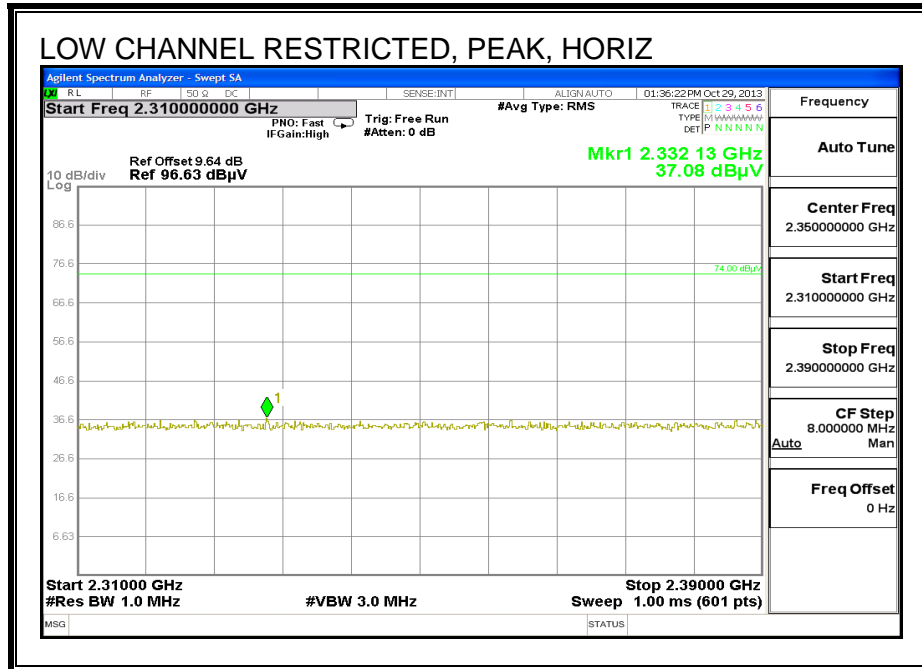
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

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.

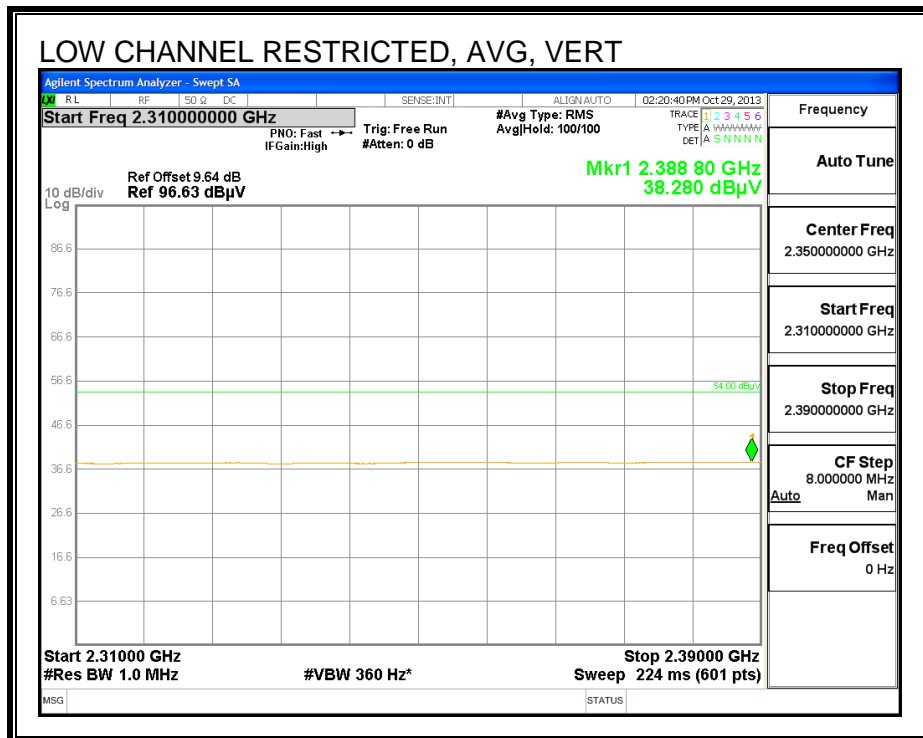
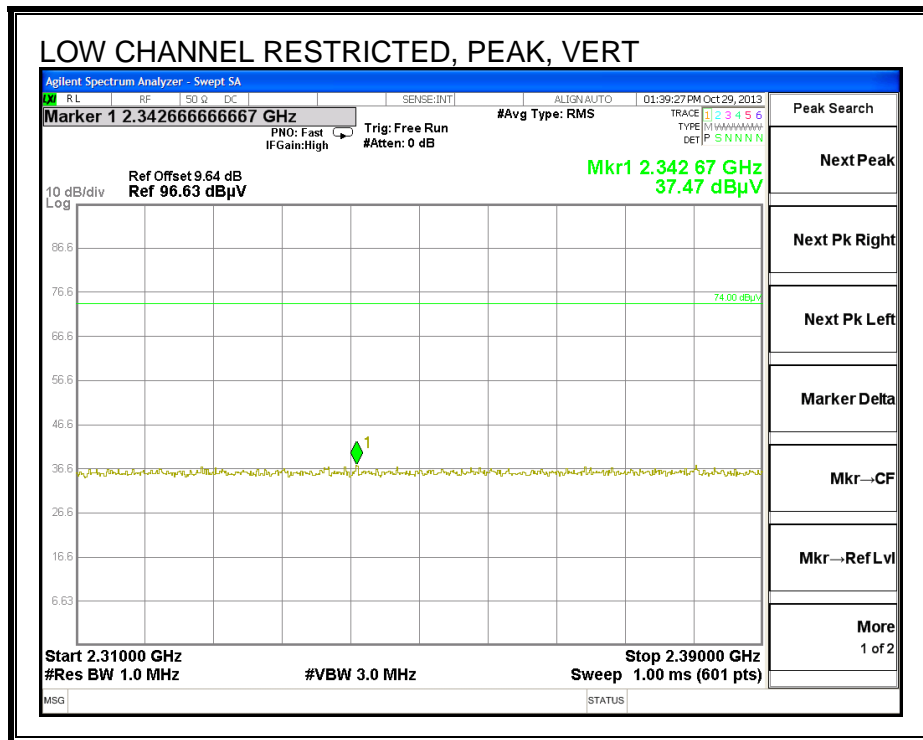
9.2. TRANSMITTER ABOVE 1 GHz

9.2.1. BASIC DATA RATE GFSK MODULATION

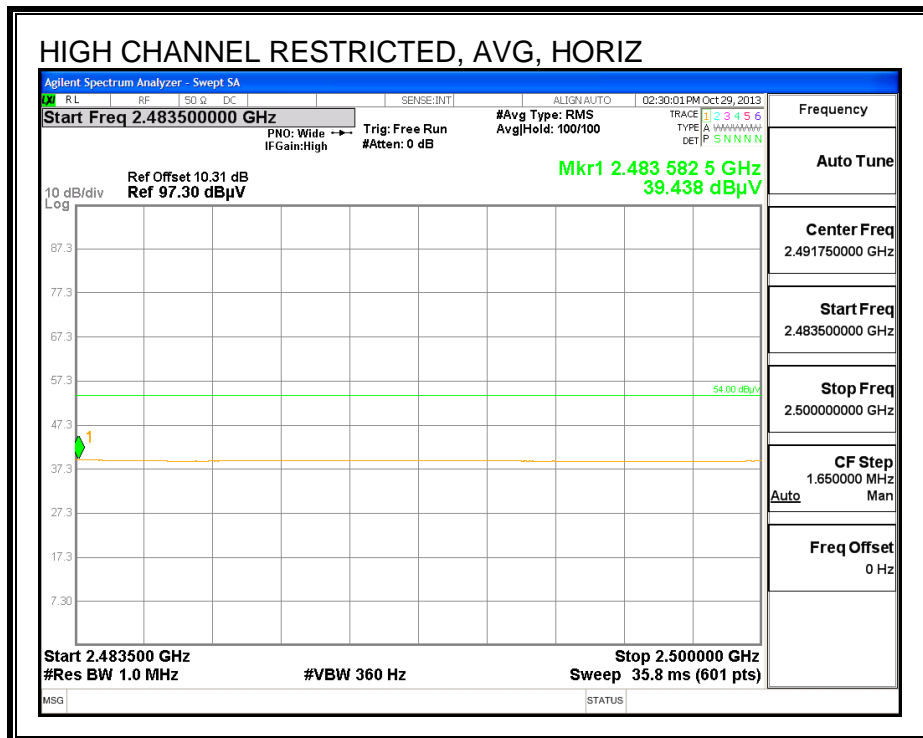
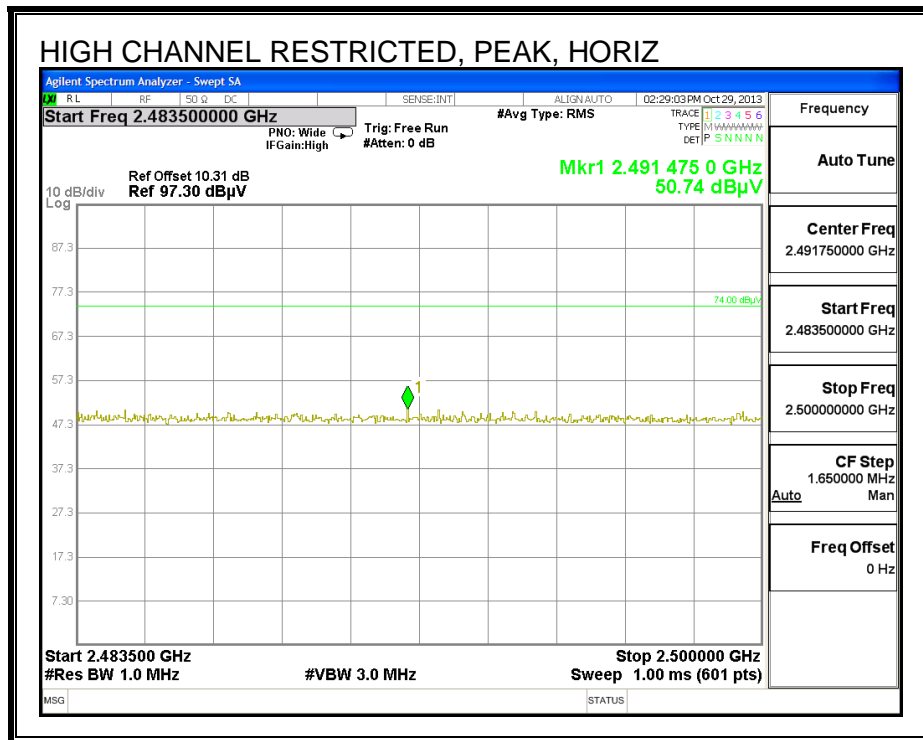
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



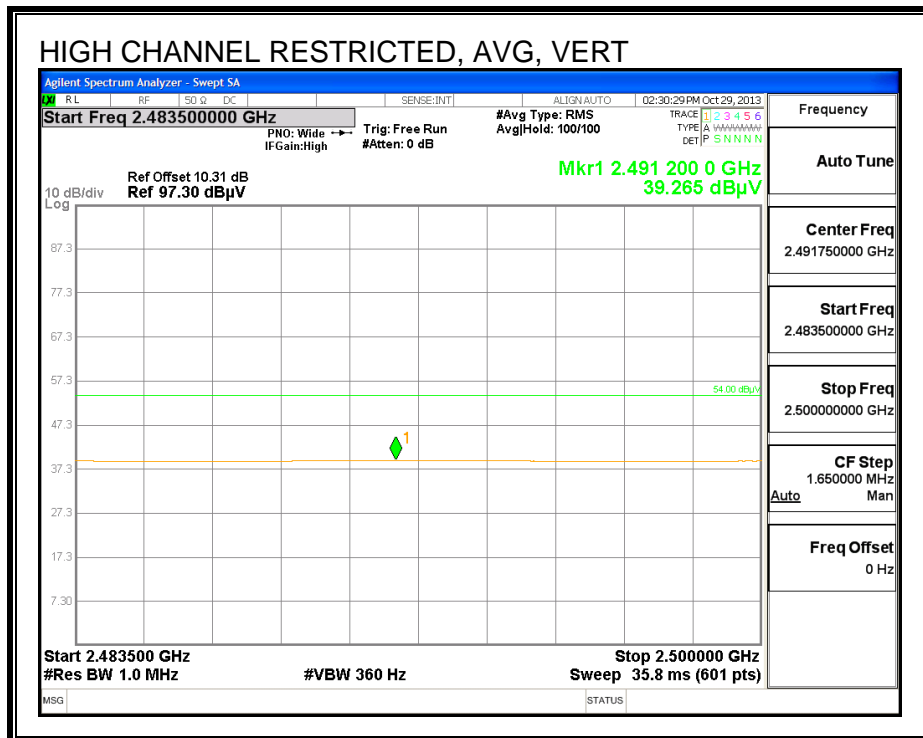
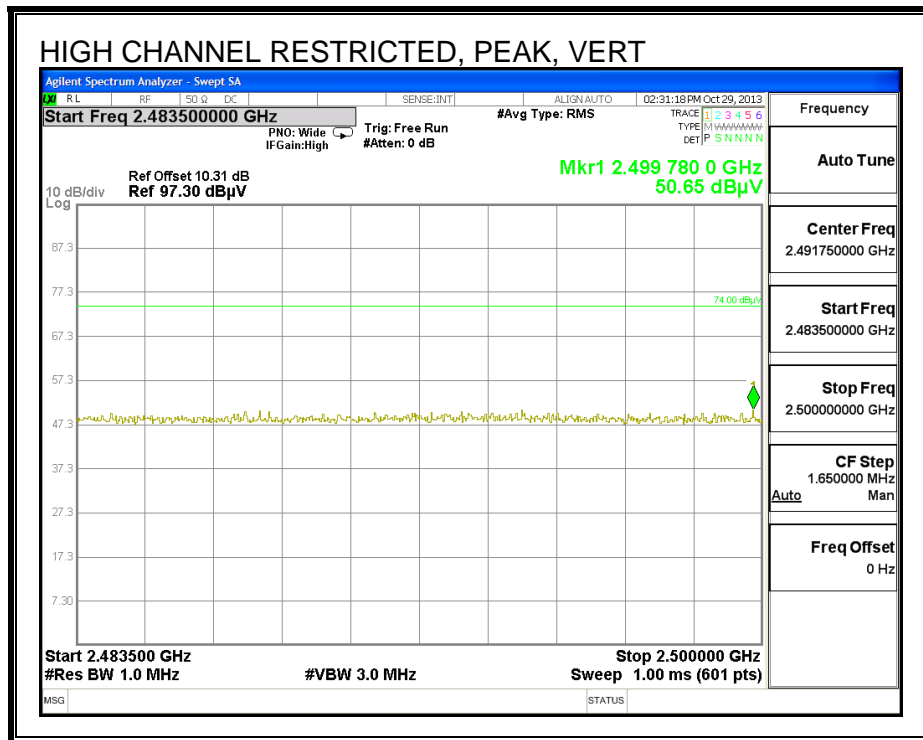
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)

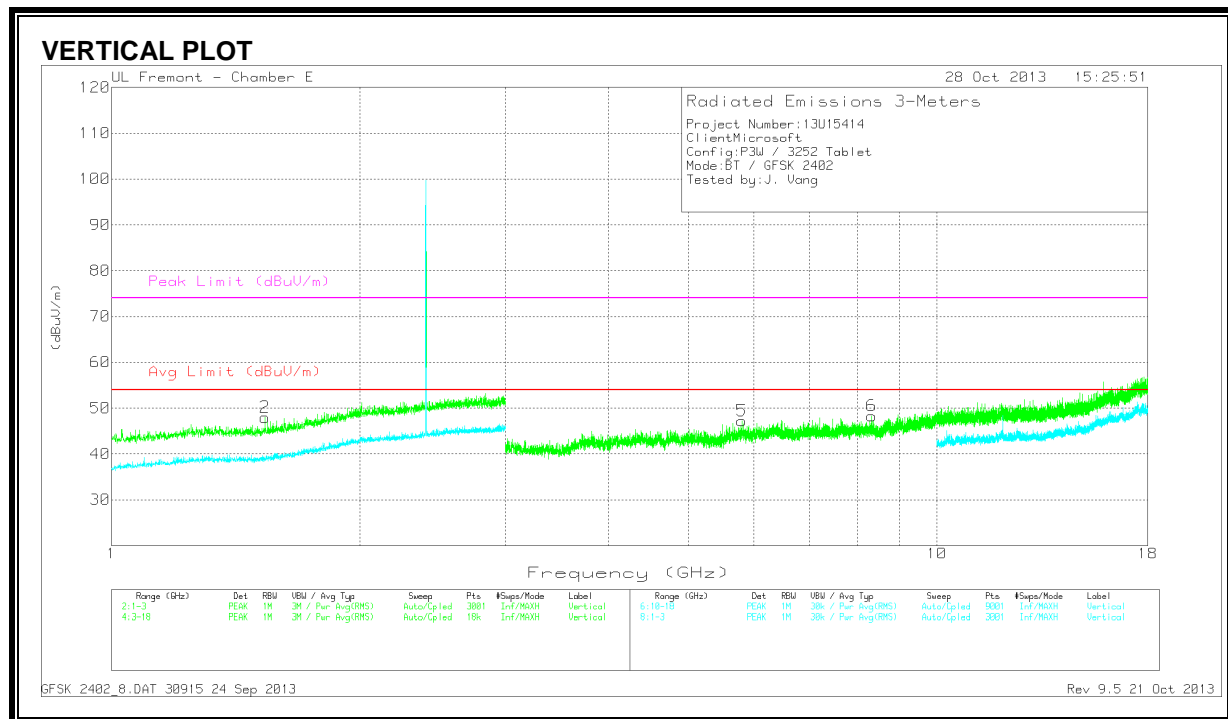
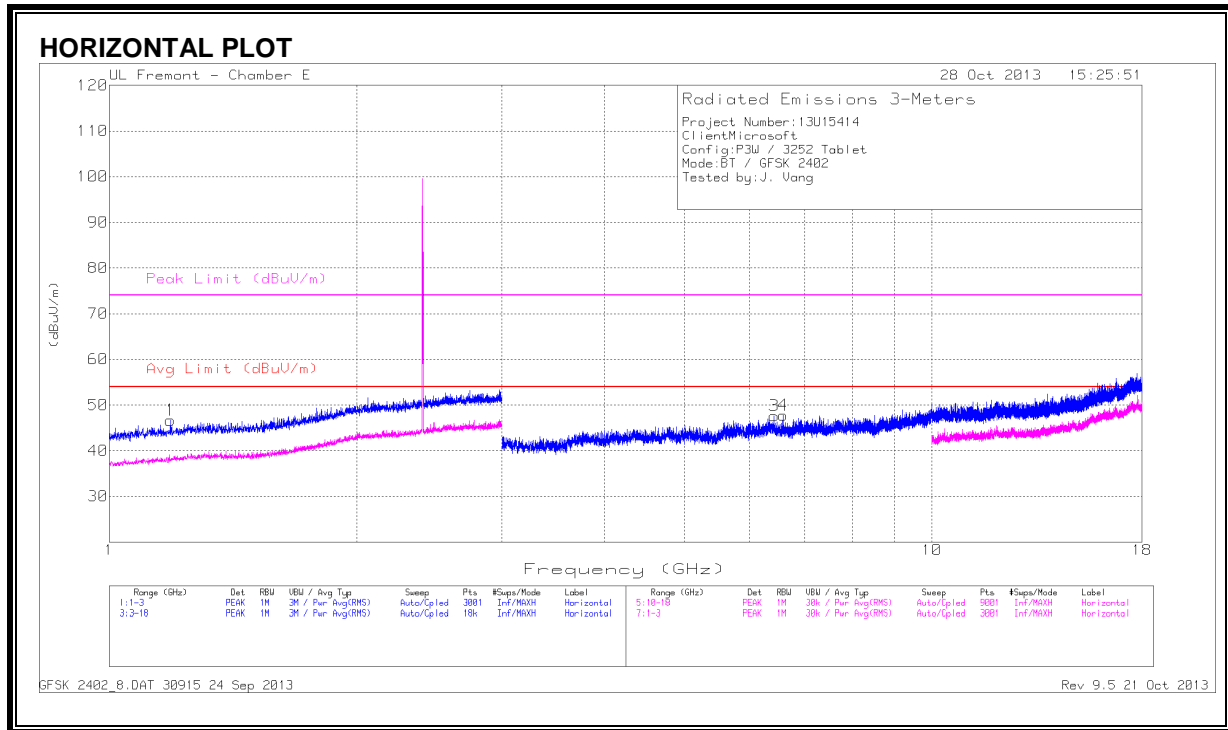


RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



HARMONICS AND SPURIOUS EMISSIONS

GFSK, LOW CHANNEL, 2402 MHz



HORIZONTAL AND VERTICAL DATA

Radiated Emissions

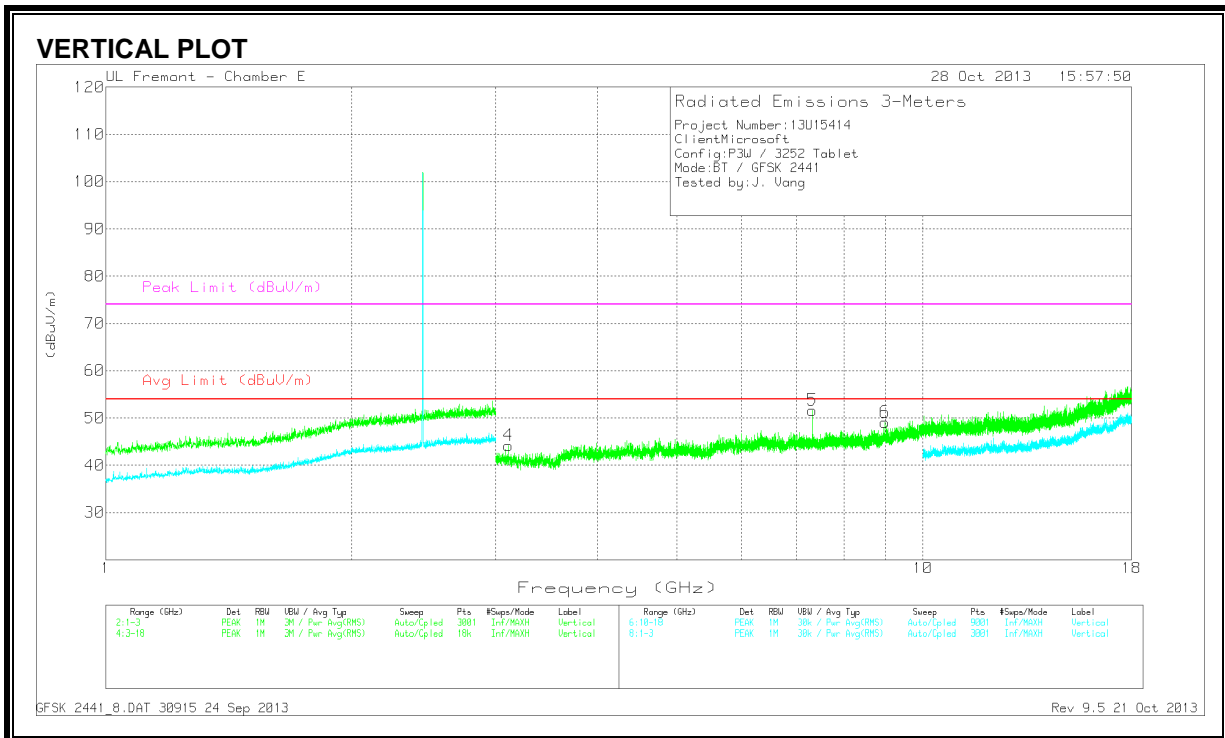
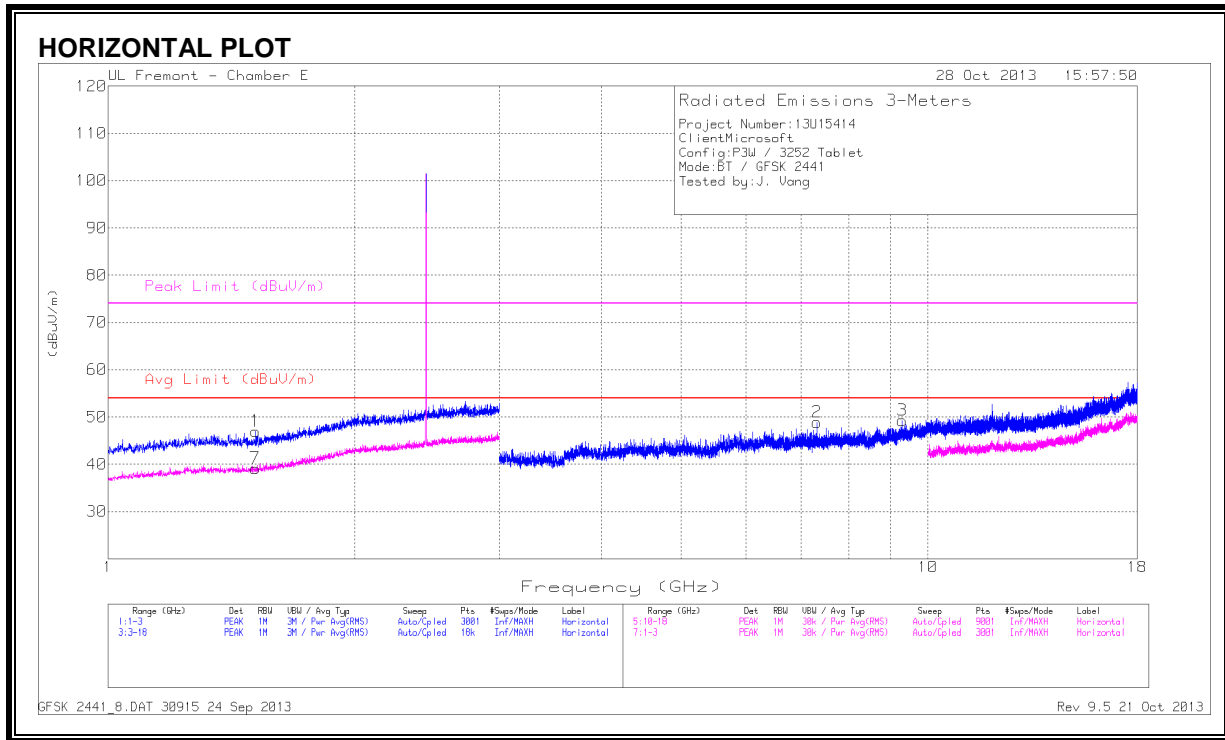
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/10dB Pad	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.187	45.46	PK	28.9	-27.7	46.66	53.97	-7.31	74	-27.34	0-360	199	H
2	1.535	45.47	PK	29	-26.5	47.97	53.97	-6	74	-26.03	0-360	100	V
7	1.183	37.98	Avg	28.9	-27.8	39.08	53.97	-14.89	-	-	0-360	199	H
8	1.525	37.15	Avg	29	-26.5	39.65	53.97	-14.32	-	-	0-360	199	V

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/3GHz HPF	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	6.429	41.16	PK	35.8	-29.3	47.66	53.97	-6.31	74	-26.34	0-360	199	H
4	6.596	40.65	PK	35.8	-28.7	47.75	53.97	-6.22	74	-26.25	0-360	199	H
5	5.802	41.74	PK	35.5	-30	47.24	53.97	-6.73	74	-26.76	0-360	100	V
6	8.336	38.82	PK	36.2	-26.7	48.32	53.97	-5.65	74	-25.68	0-360	100	V

PK - Peak detector

Av - average detection

GFSK, MID CHANNEL, 2441 MHz



HORIZONTAL AND VERTICAL DATA

Radiated Emissions

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/10dB Pad	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	1.513	44.57	PK	28.9	-26.5	46.97	53.97	-7	74	-27.03	0-360	199	H
7	1.512	36.72	Avg	28.9	-26.5	39.12	53.97	-14.85	-	-	0-360	199	H

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/3GHz HPF	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	7.323	40.98	PK	36	-28.1	48.88	53.97	-5.09	74	-25.12	0-360	199	H
3	9.305	37.37	PK	37.2	-25.3	49.27	53.97	-4.7	74	-24.73	0-360	199	H
4	3.112	42.18	PK	33.3	-31.3	44.18	53.97	-9.79	74	-29.82	0-360	100	V
5	7.324	43.73	PK	36	-28.1	51.63	53.97	-2.34	74	-22.37	0-360	200	V
6	8.984	37.78	PK	36.8	-25.5	49.08	53.97	-4.89	74	-24.92	0-360	100	V

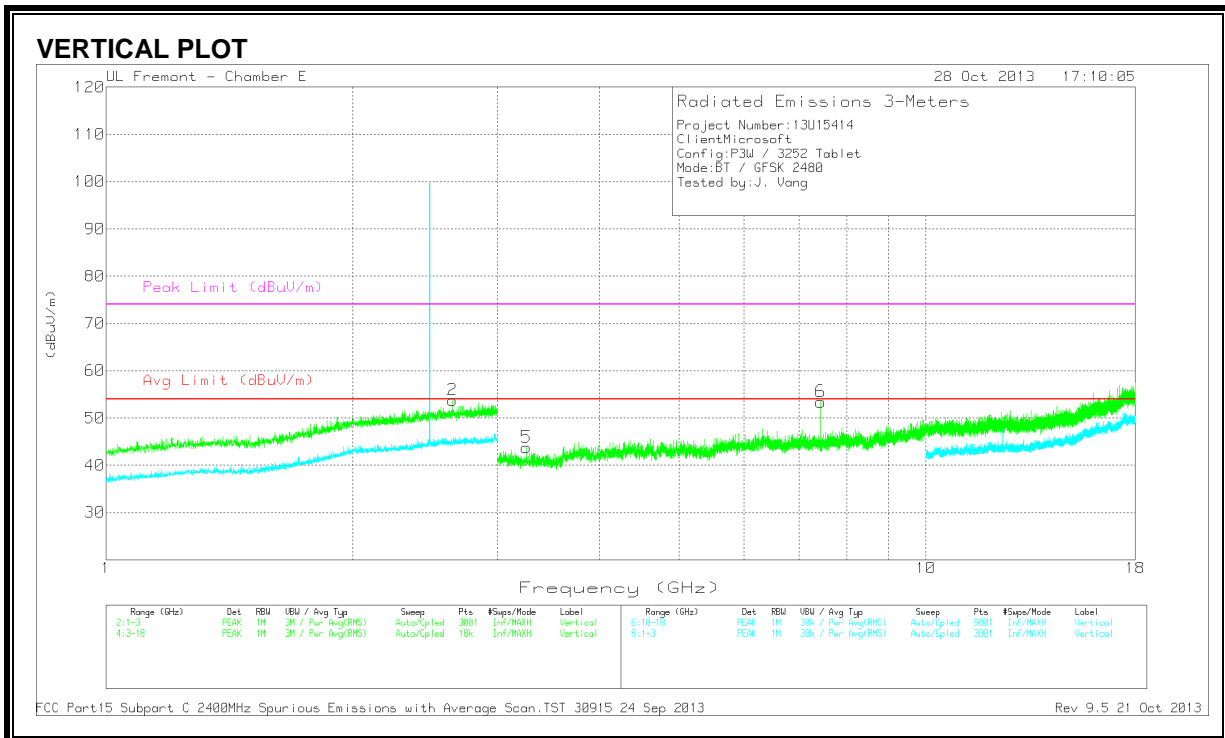
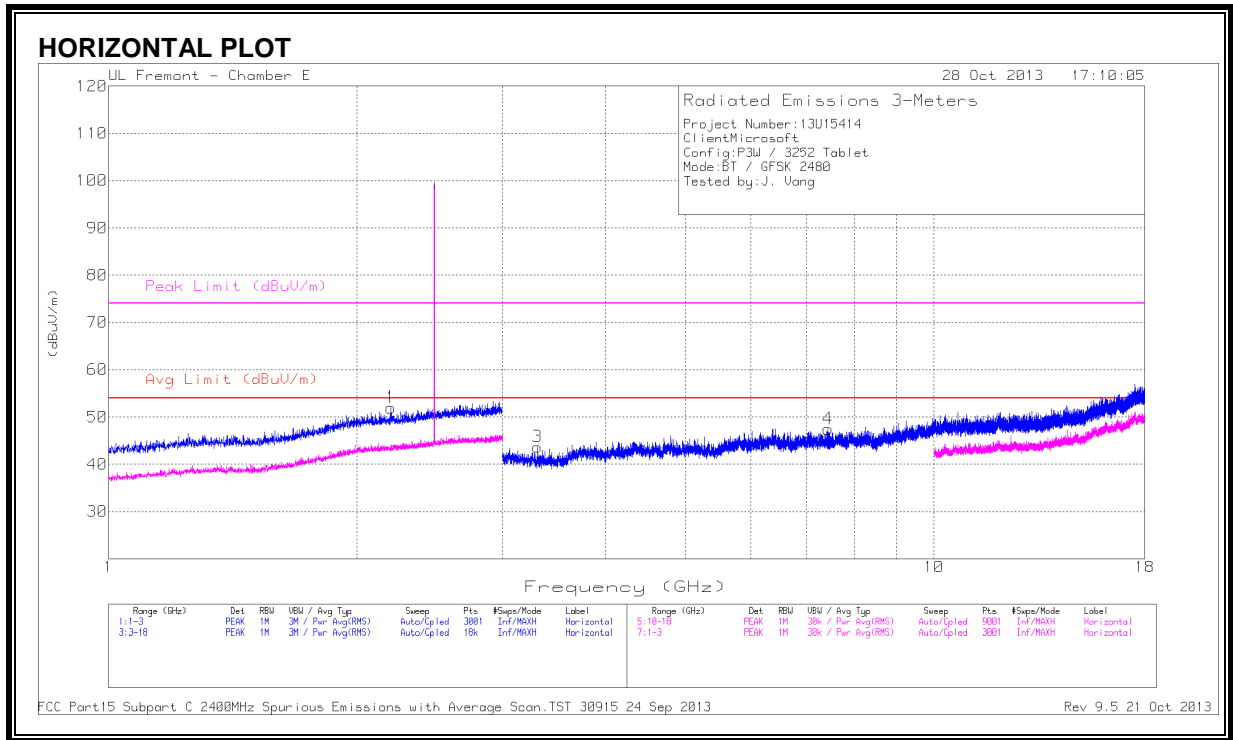
Avg - Video bandwidth < Resolution bandwidth

PK - Peak detector

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl /3GHz HPF	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
7.323	28.82	Av	36	-28.1	36.72	53.97	-17.25	-	-	335	384	H
9.302	22.28	Av	37.2	-25.3	34.18	53.97	-19.79	-	-	0	301	H
7.323	25.93	Av	36	-28.1	33.83	53.97	-20.14	-	-	79	247	V
8.983	22.76	Av	36.8	-25.5	34.06	53.97	-19.91	-	-	345	367	V

Av - average detection

GFSK, HIGH CHANNEL, 2480 MHz



HORIZONTAL AND VERTICAL DATA

Radiated Emissions

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/10dB Pad	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	2.197	44.95	PK	32.3	-25.3	51.95	53.97	-2.02	74	-22.05	0-360	199	H
2	2.645	44.98	PK	33	-24.2	53.78	53.97	-1.19	74	-20.22	0-360	199	V
7	2.202	37.17	Avg	32.3	-25.3	44.17	53.97	-9.8	-	-	0-360	199	H
8	2.663	37.25	Avg	33	-24.2	46.05	53.97	-7.92	-	-	0-360	199	V

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/3GHz HPF	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
3	3.308	42.18	PK	33.3	-31.8	43.68	53.97	-10.29	74	-30.32	0-360	100	H
4	7.441	40.15	PK	36.1	-28.8	47.45	53.97	-6.52	74	-26.55	0-360	100	H
5	3.256	42.46	PK	33.4	-32.1	43.76	53.97	-10.21	74	-30.24	0-360	200	V
6	7.441	46.11	PK	36.1	-28.8	53.41	53.97	-56	74	-20.59	0-360	100	V

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/3GHz HPF	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
7.44	32.7	Av	36.1	-28.8	40	53.97	-13.97	-	-	355	222	V

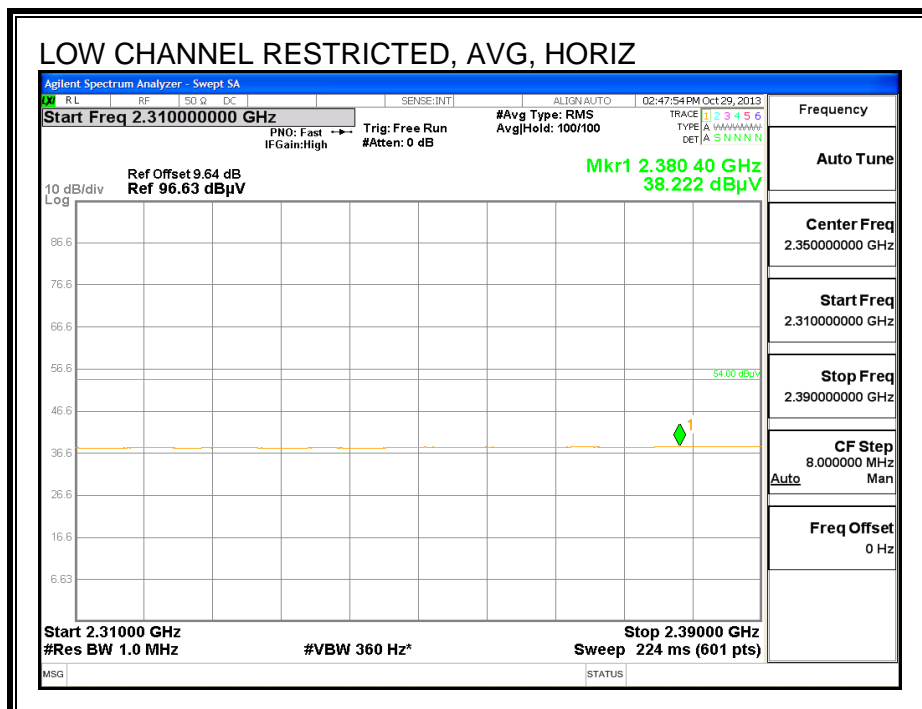
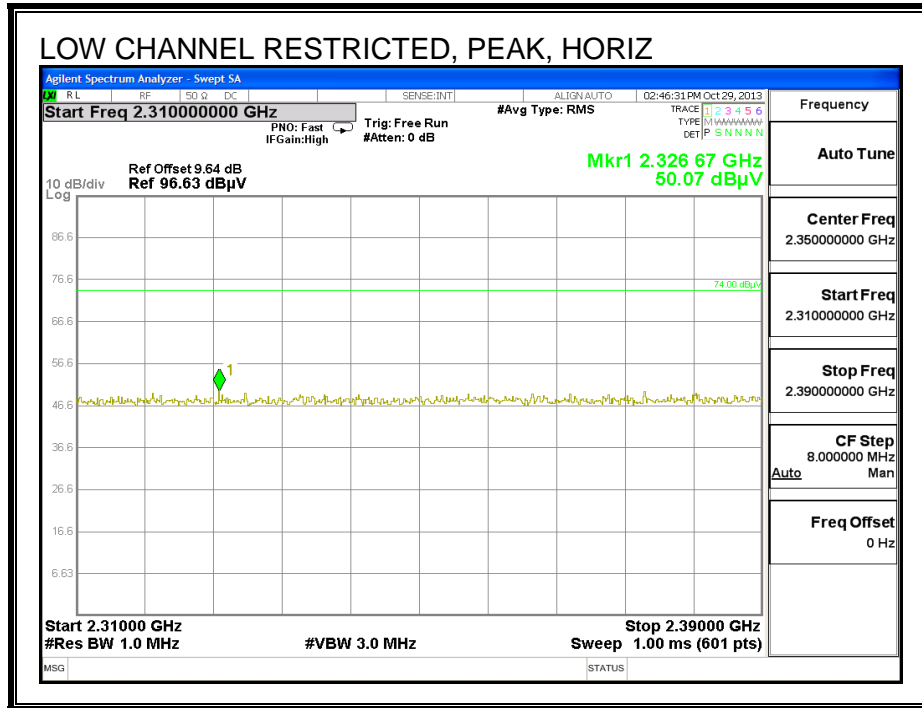
PK - Peak detector

Avg - Video bandwidth < Resolution bandwidth

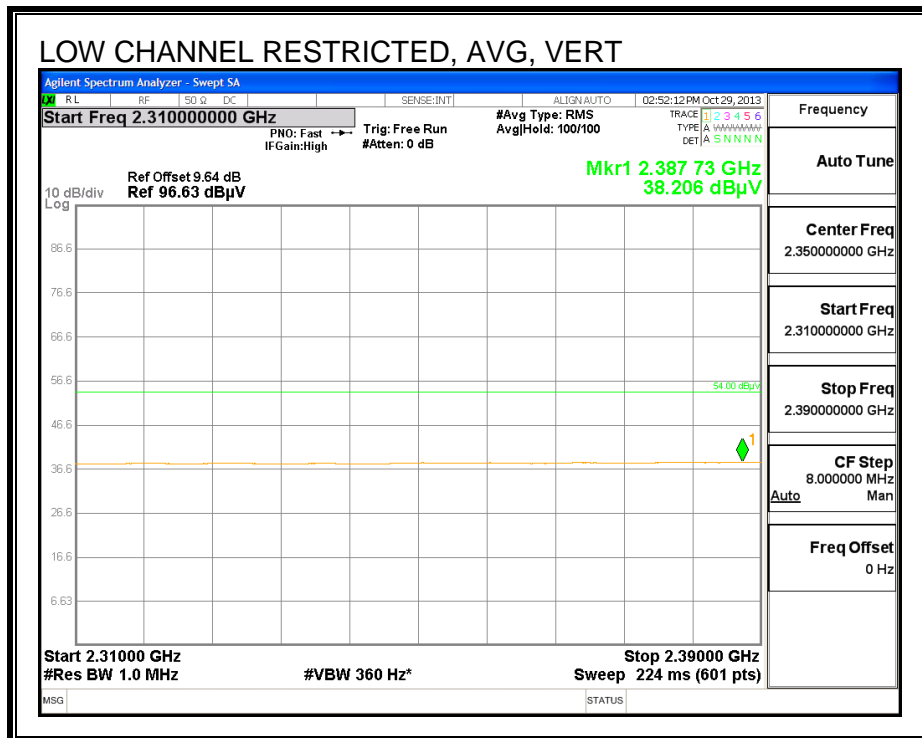
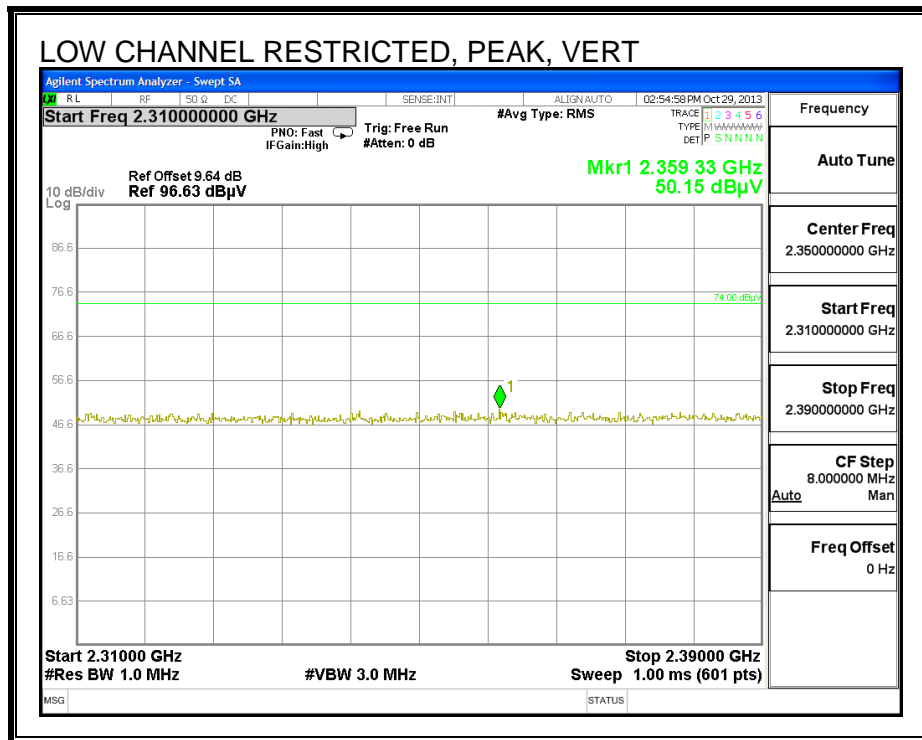
Av - average detection

9.2.2. ENHANCED DATA RATE 8PSK MODULATION

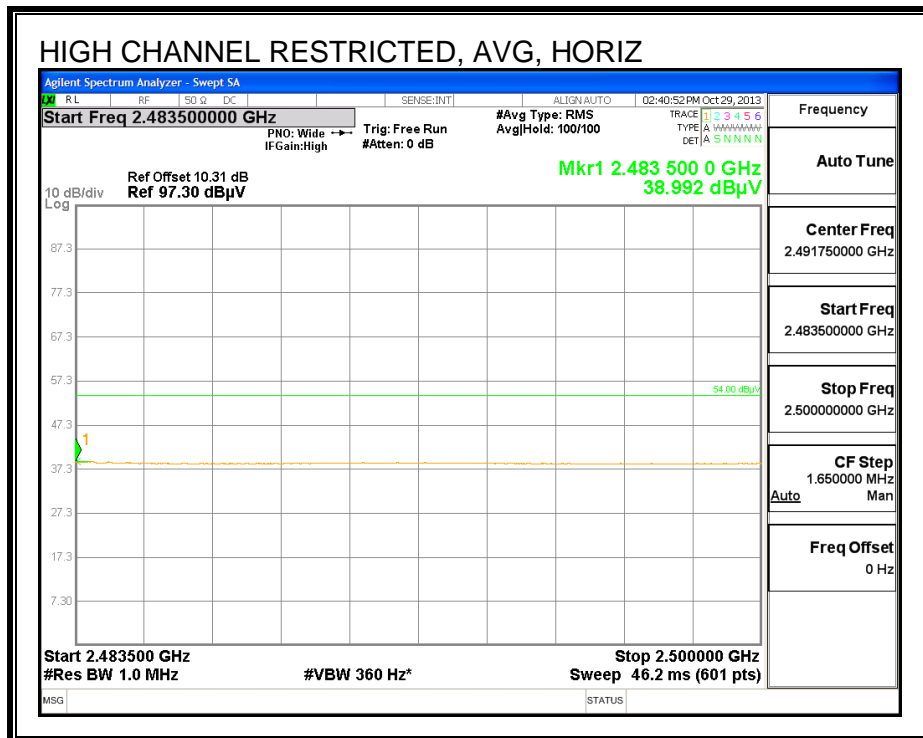
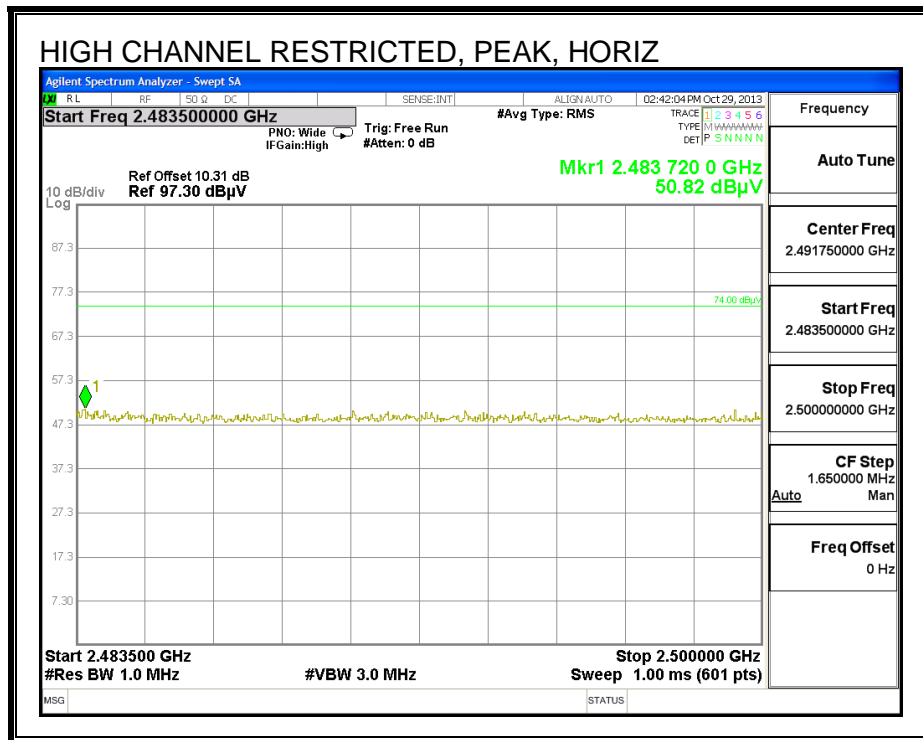
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



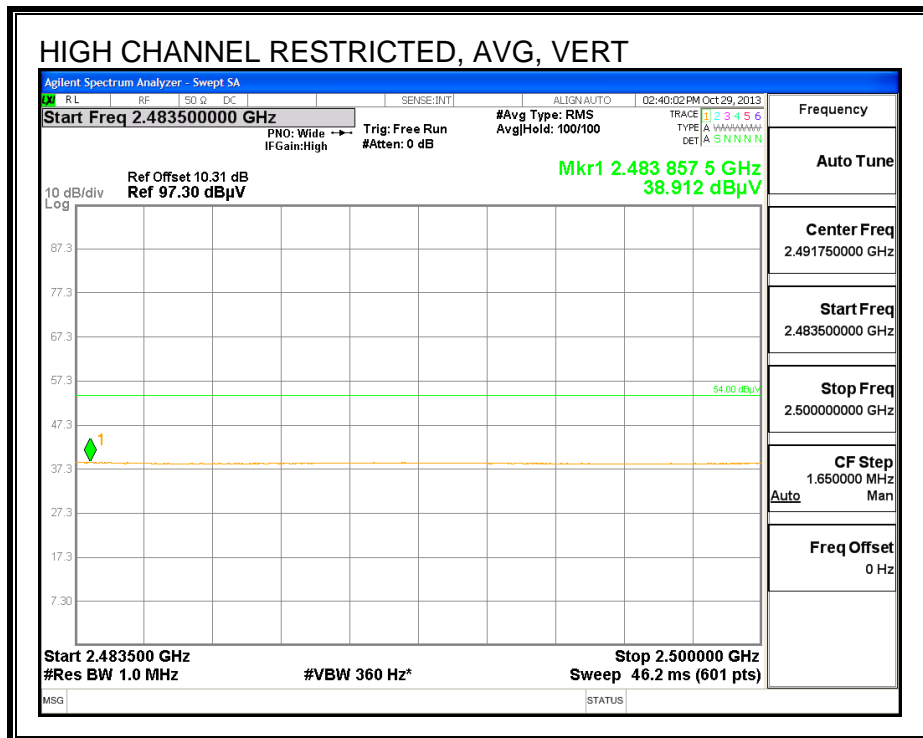
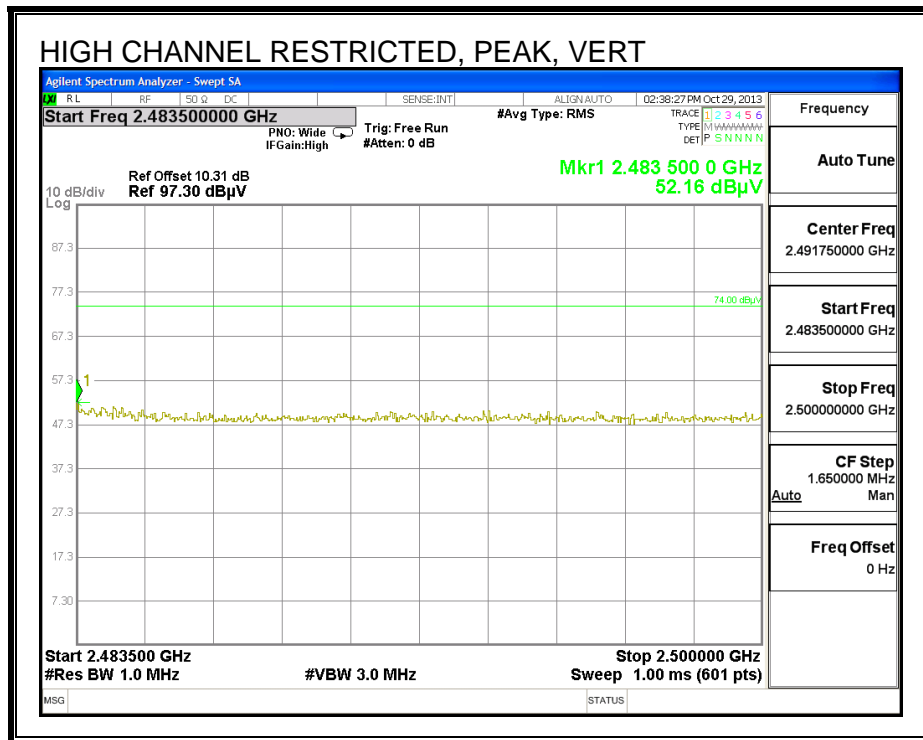
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)

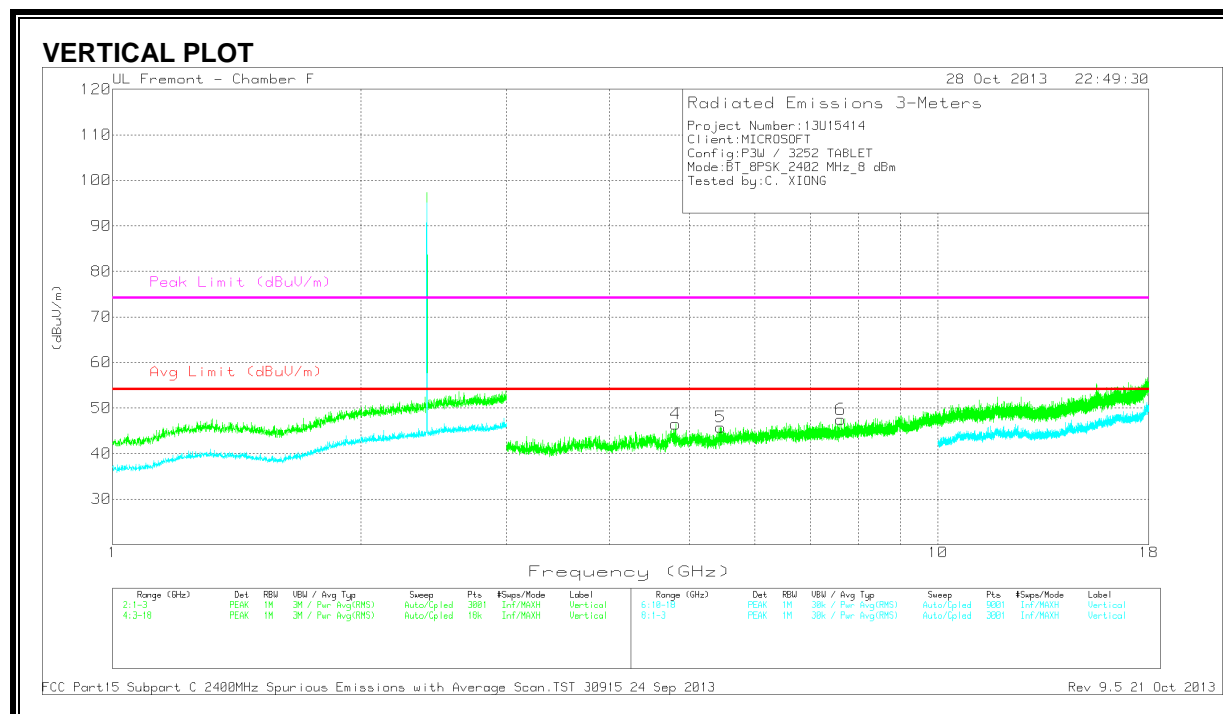
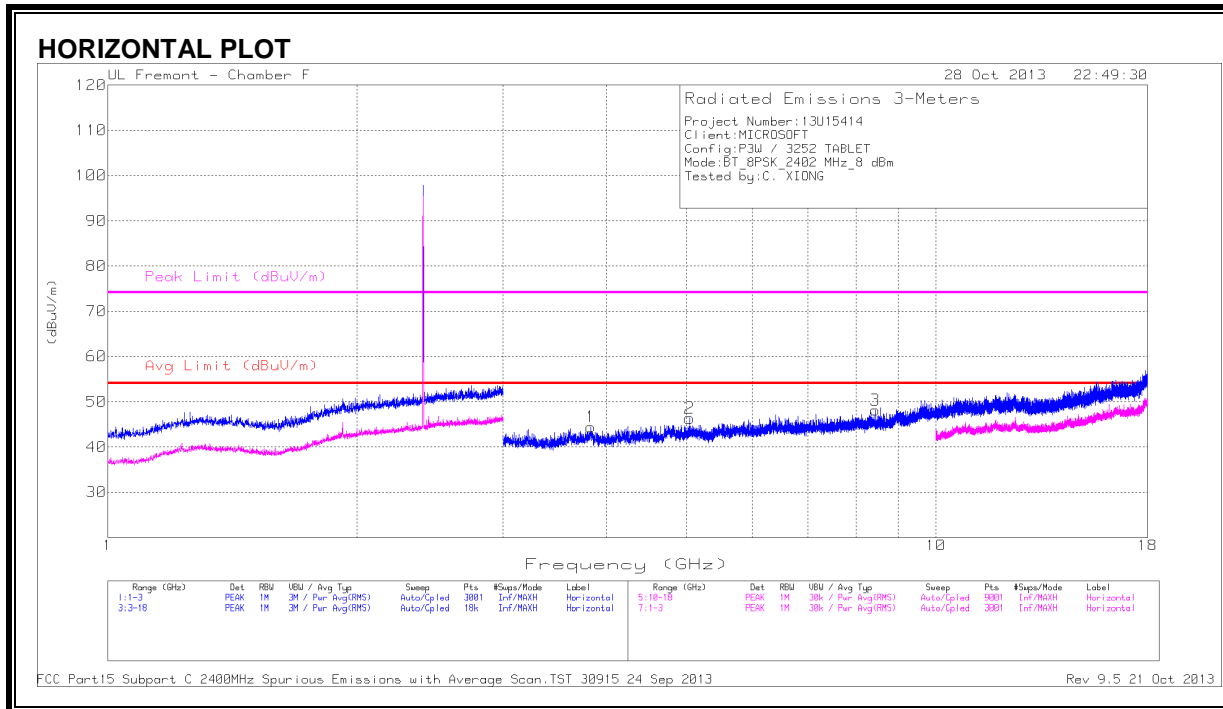


RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



HARMONICS AND SPURIOUS EMISSIONS

8PSK, LOW CHANNEL, 2402 MHz



HORIZONTAL AND VERTICAL DATA

Radiated Emissions

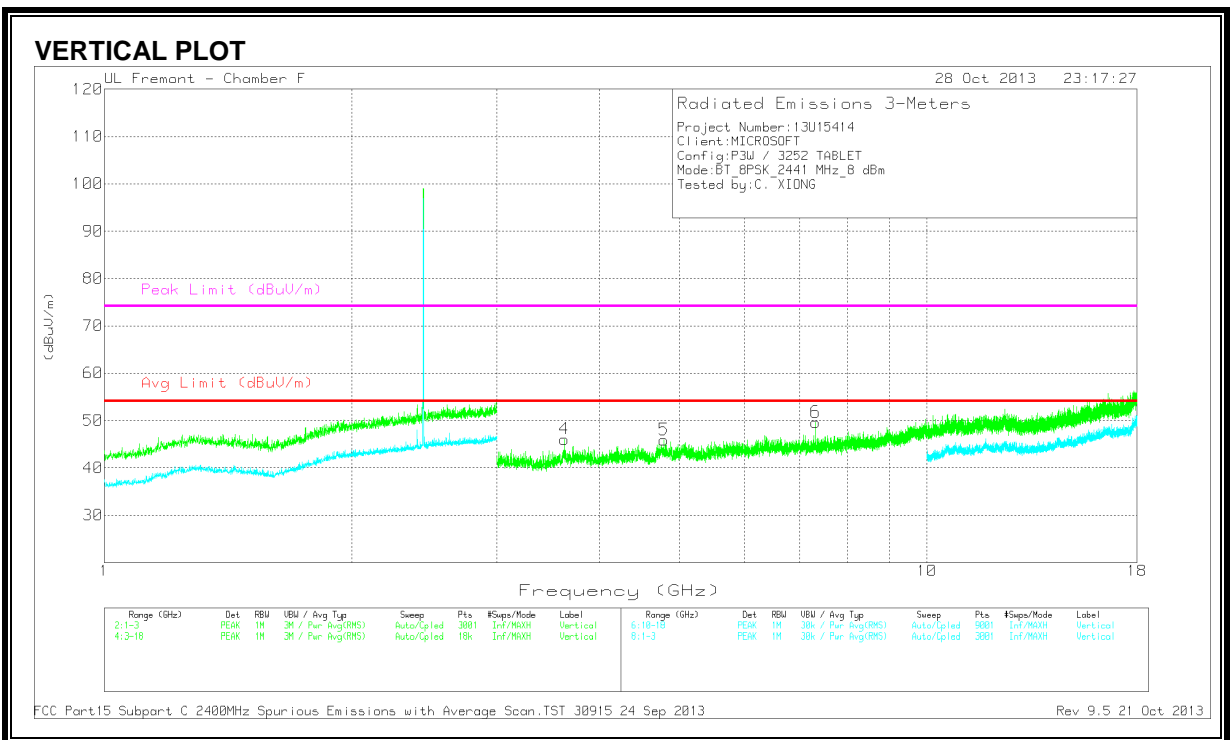
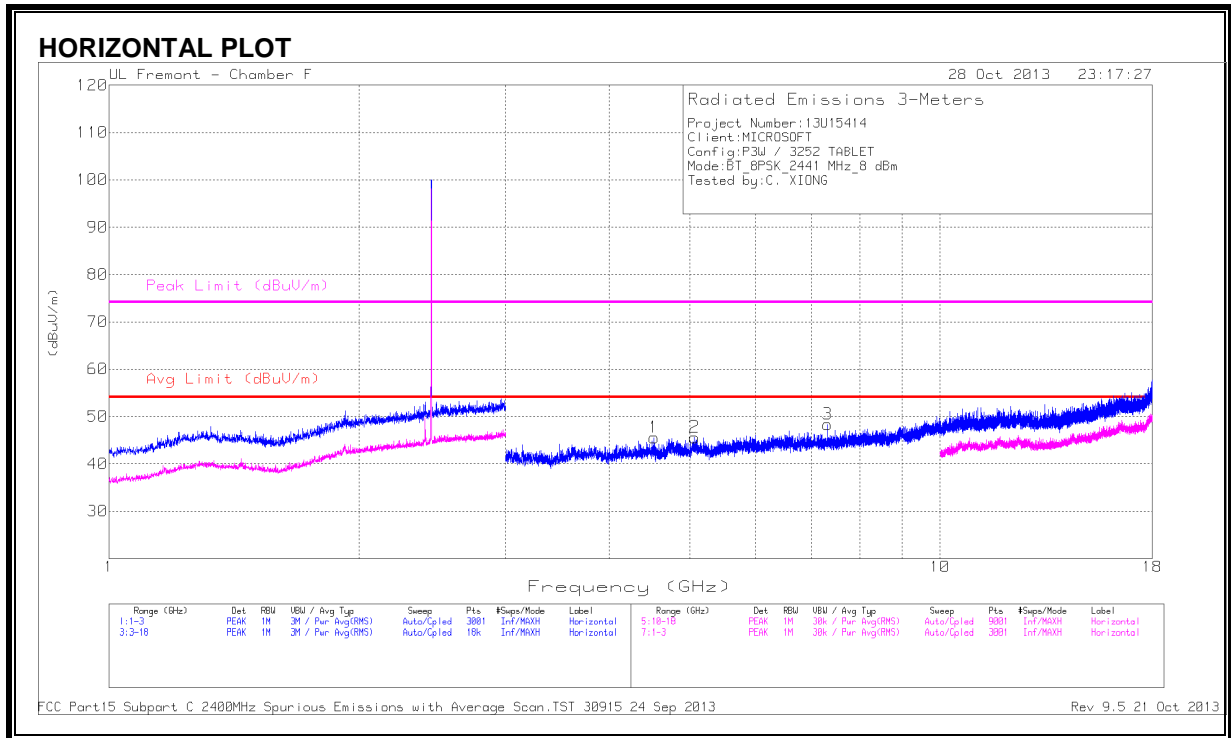
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cb/3GHz HPF	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	3.828	39.46	PK	33.6	-28.6	44.46	53.97	-9.51	74	-29.54	0-360	199	H
2	5.039	39.88	PK	34.1	-27.6	46.38	53.97	-7.59	74	-27.62	0-360	100	H
3	8.443	37.07	PK	36	-24.9	48.17	53.97	-5.8	74	-25.83	0-360	100	H
4	4.81	39.71	PK	34.1	-27.3	46.51	53.97	-7.46	74	-27.49	0-360	101	V
5	5.452	38.71	PK	34.7	-27.6	45.81	53.97	-8.16	74	-28.19	0-360	101	V
6	7.626	37.3	PK	35.9	-25.7	47.5	53.97	-6.47	74	-26.5	0-360	101	V

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cb/3GHz HPF	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
8.448	23.92	VB1T	36	-24.9	35.02	53.97	-18.95	-	-38.98	-	125	H

PK - Peak detector

VB 1/T - FHSS Method: Reduced Video Bandwidth

8PSK, MID CHANNEL, 2441 MHz



HORIZONTAL AND VERTICAL DATA

Radiated Emissions

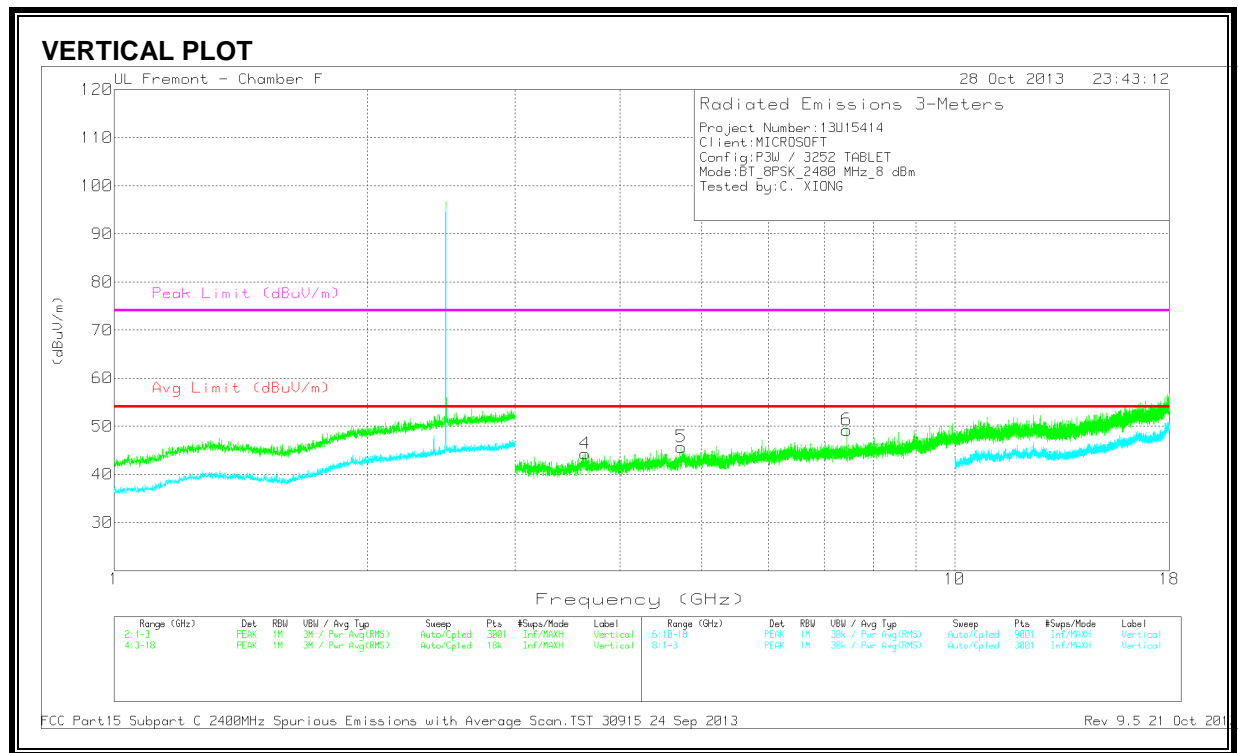
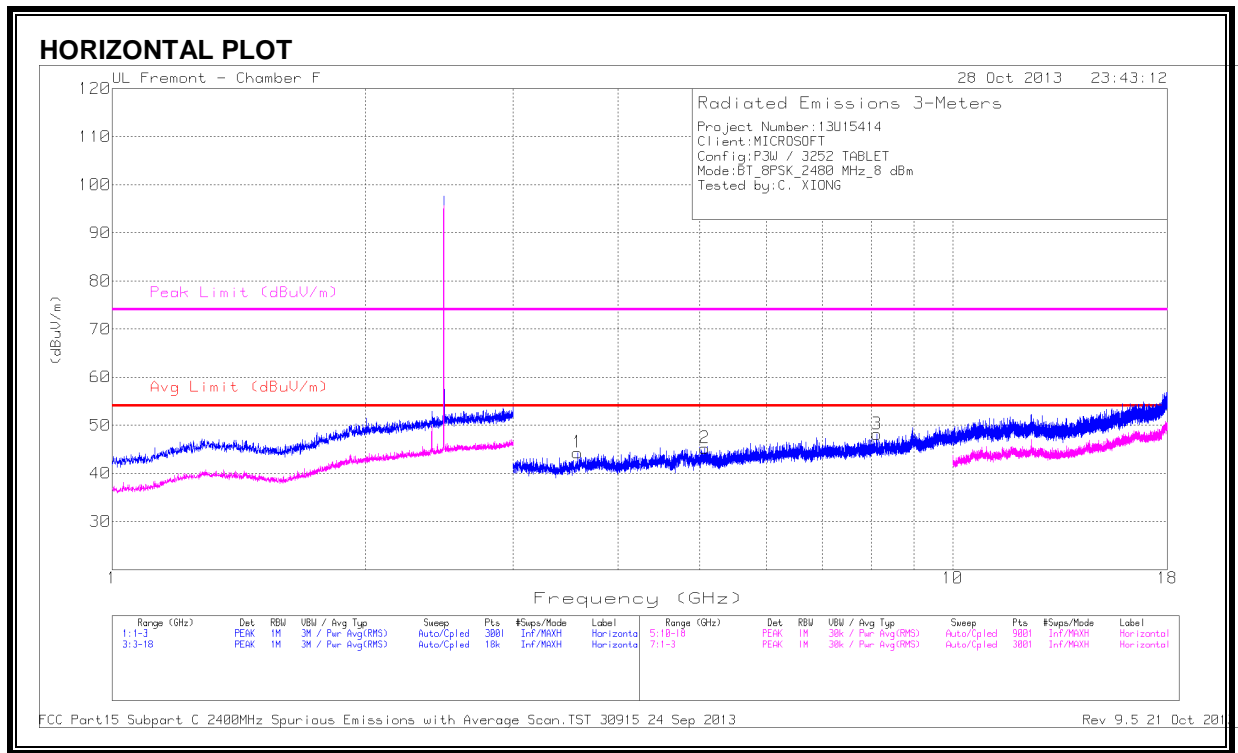
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cb/3GHz HPF	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	4.527	39.25	PK	34	-27.7	45.55	53.97	-8.42	74	-28.45	0-360	199	H
2	5.062	38.58	PK	34.1	-27.1	45.58	53.97	-8.39	74	-28.42	0-360	199	H
3	7.322	39.44	PK	35.7	-26.8	48.34	53.97	-5.63	74	-25.66	0-360	199	H
4	3.625	41.57	PK	33.7	-29.2	46.07	53.97	-7.9	74	-27.93	0-360	101	V
5	4.789	39.6	PK	34.1	-27.8	45.9	53.97	-8.07	74	-28.1	0-360	200	V
6	7.323	40.72	PK	35.7	-26.8	49.62	53.97	-4.35	74	-24.38	0-360	101	V

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cb/3GHz HPF	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
7.323	27.73	VB1T	35.7	-26.8	36.63	53.97	-17.34	-	-	329	160	H
7.323	33.6	VB1T	35.7	-26.8	42.5	53.97	-11.47	-	-	0	305	V

PK - Peak detector

VB 1/T - FHSS Method: Reduced Video Bandwidth

8PSK, HIGH CHANNEL, 2480 MHz



HORIZONTAL AND VERTICAL DATA

Radiated Emissions

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cb/3GHz HPF	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	3.579	39.42	PK	33.6	-28.7	44.32	53.97	-9.65	74	-29.68	0-360	100	H
2	5.072	38.21	PK	34.1	-27.1	45.21	53.97	-8.76	74	-28.79	0-360	199	H
3	8.124	37.76	PK	36	-25.6	48.16	53.97	-5.81	74	-25.84	0-360	199	H
4	3.633	39.99	PK	33.7	-29.4	44.29	53.97	-9.68	74	-29.71	0-360	201	V
5	4.727	40.27	PK	34.1	-28.7	45.67	53.97	-8.3	74	-28.33	0-360	201	V
6	7.44	39.62	PK	35.8	-26.2	49.22	53.97	-4.75	74	-24.78	0-360	101	V

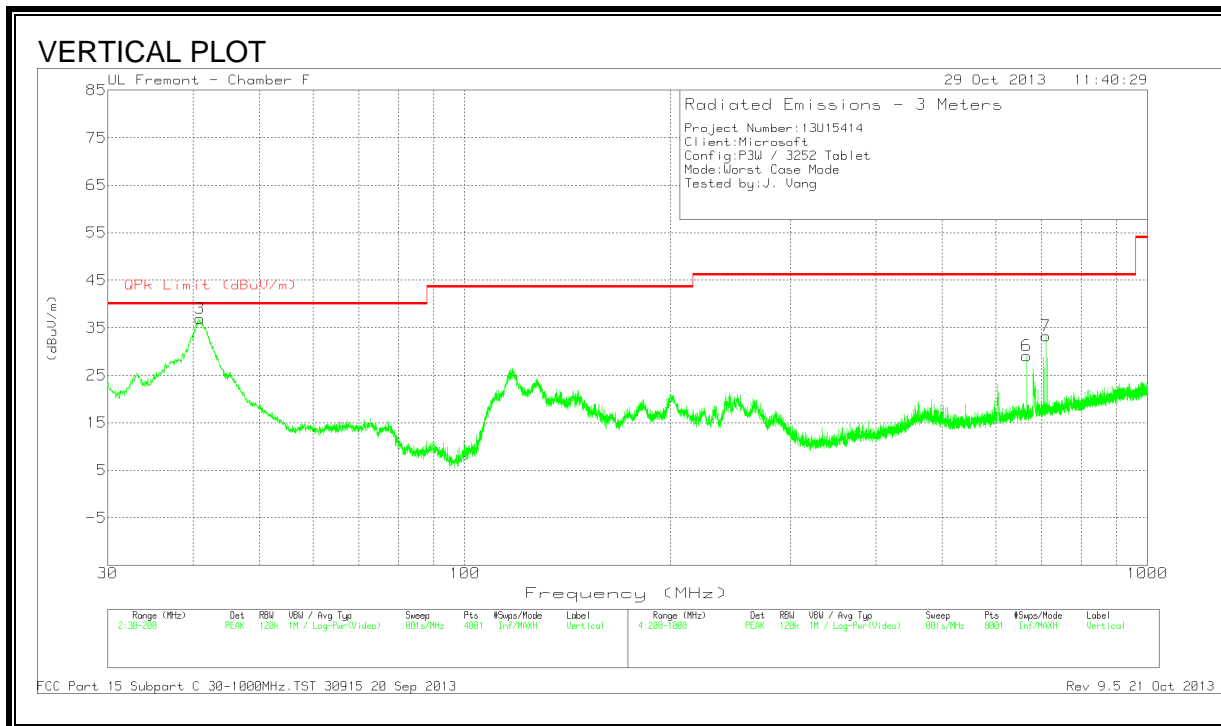
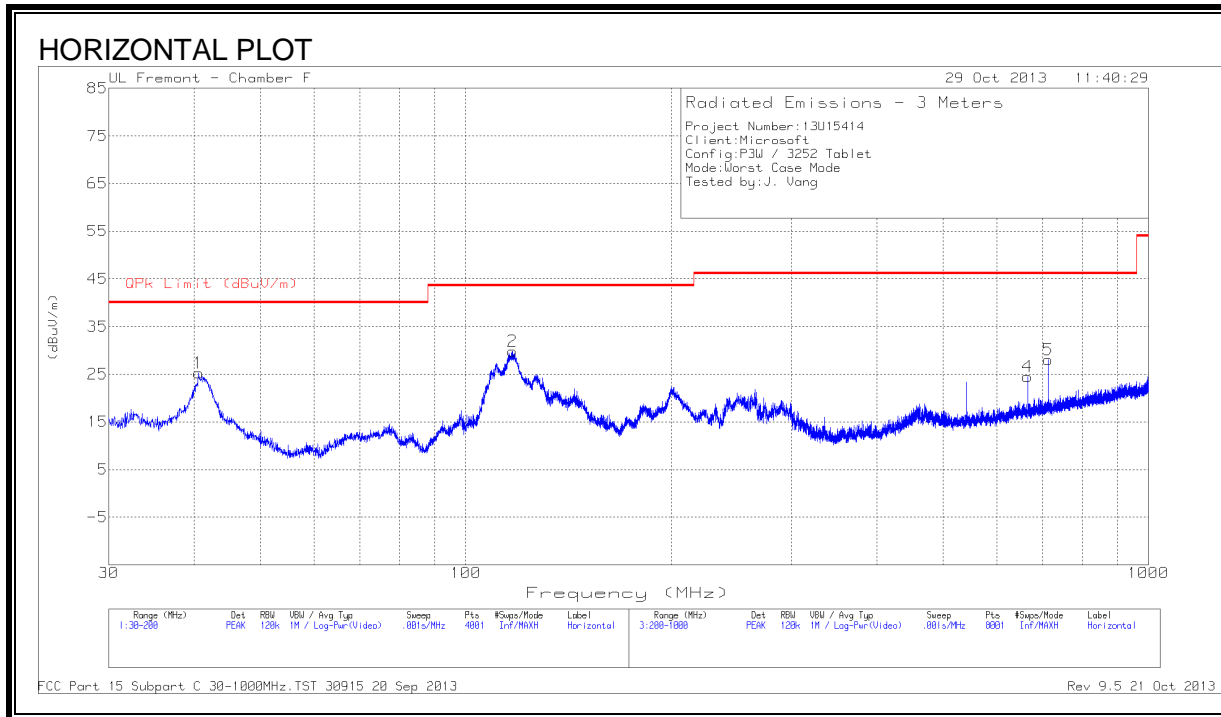
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T120 (dB/m)	Amp/Cb/3GHz HPF	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
8.124	24.76	VB1T	36	-25.6	35.16	53.97	-18.81	-	-	152	230	H
7.44	33.54	VB1T	35.8	-26.2	43.14	53.97	-10.83	-	-	21	284	V

PK - Peak detector

VB 1/T - FHSS Method: Reduced Video Bandwidth

9.3. WORST-CASE BELOW 1 GHz

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



HORIZONTAL AND VERTICAL DATA

Radiated Emissions

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T122 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	40.625	43.86	PK	13.4	-32	25.26	40	-14.74	0-360	300	H
2	117.1675	47.51	PK	13.8	-31.5	29.81	43.52	-13.71	0-360	300	H
3	40.9225	55.76	PK	13.2	-32	36.96	40	-3.04	0-360	100	V
4	665.1	34.7	PK	19.8	-30	24.5	46.02	-21.52	0-360	400	H
5	713.3	37.46	PK	20.4	-29.8	28.06	46.02	-17.96	0-360	100	H
6	665.1	39.29	PK	19.8	-30	29.09	46.02	-16.93	0-360	100	V
7	710.2	42.78	PK	20.4	-29.9	33.28	46.02	-12.74	0-360	100	V

Frequency (MHz)	Meter Reading (dBuV)	Det	AF T122 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
41.0121	50.75	QP	13.1	-32	31.85	40	-8.15	119	166	V

PK - Peak detector

QP - Quasi-Peak detector

10. 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

Line-L1 .15 - 30MHz

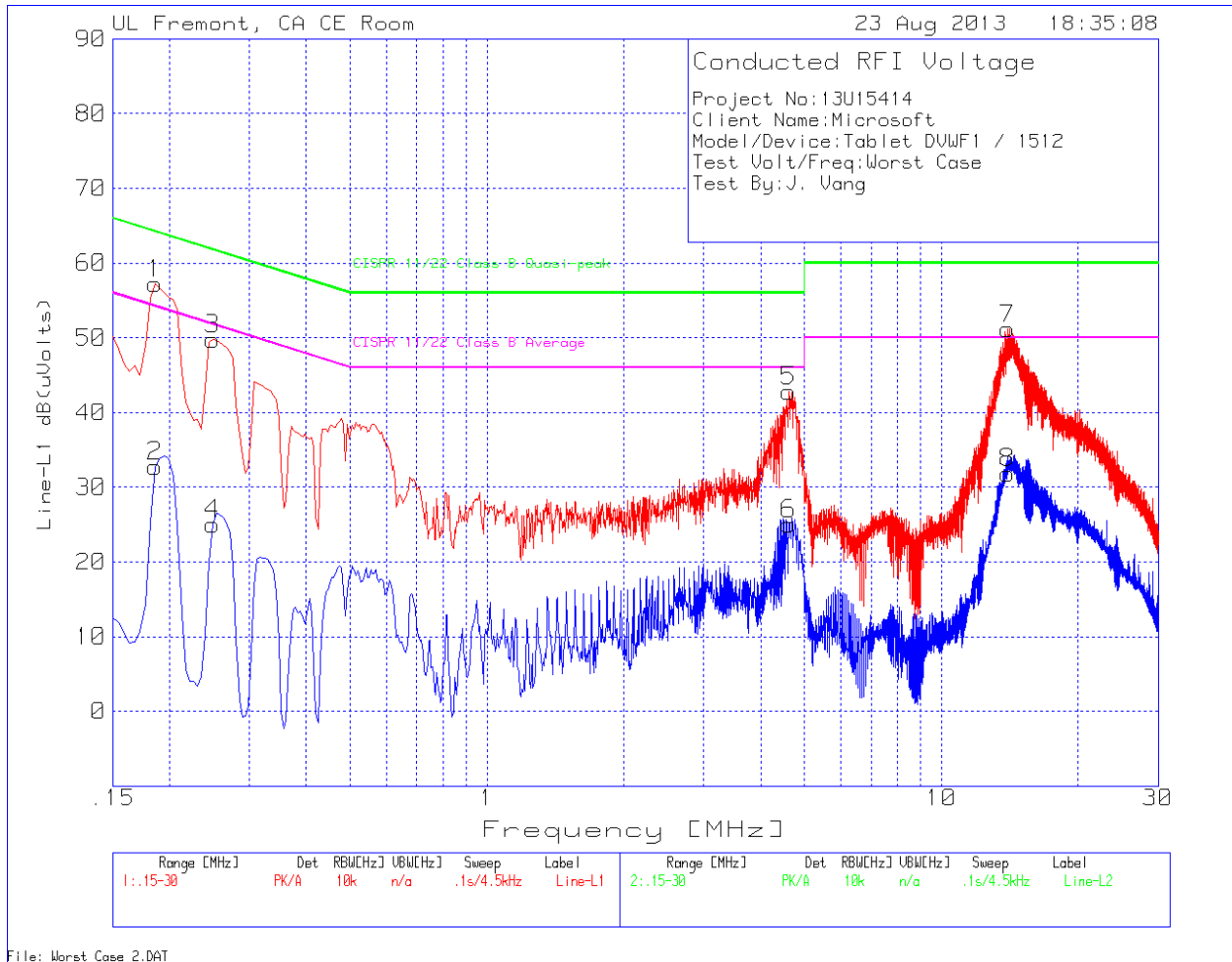
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L1 (dB)	LC Cables 1&3 (dB)	Corrected Reading dB(uVolts)	CISPR 11/22 Class B Quasi-peak	Margin to Limit (dB)	CISPR 11/22 Class B Average	Margin to Limit (dB)
1	.186	57.09	PK	.1	0	57.19	64.2	-7.01	-	-
2	.186	32.63	Av	.1	0	32.73	-	-	54.2	-21.47
3	.249	49.72	PK	.1	0	49.82	61.8	-11.98	-	-
4	.249	24.89	Av	.1	0	24.99	-	-	51.8	-26.81
5	4.623	42.61	PK	.1	.1	42.81	56	-13.19	-	-
6	4.623	24.77	Av	.1	.1	24.97	-	-	46	-21.03
7	14.0145	50.73	PK	.2	.2	51.13	60	-8.87	-	-
8	14.0145	31.43	Av	.2	.2	31.83	-	-	50	-18.17

Line-L2 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L2 (dB)	LC Cables 2&3 (dB)	Corrected Reading dB(uVolts)	CISPR 11/22 Class B Quasi-peak	Margin to Limit (dB)	CISPR 11/22 Class B Average	Margin to Limit (dB)
9	.186	57.51	PK	.1	0	57.61	64.2	-6.59	-	-
10	.186	33.68	Av	.1	0	33.78	-	-	54.2	-20.42
11	.249	49.88	PK	.1	0	49.98	61.8	-11.82	-	-
12	.249	26.27	Av	.1	0	26.37	-	-	51.8	-25.43
13	4.6905	41.47	PK	.1	.1	41.67	56	-14.33	-	-
14	4.6905	22.75	Av	.1	.1	22.95	-	-	46	-23.05
15	14.0055	49.21	PK	.2	.2	49.61	60	-10.39	-	-
16	14.0055	30.18	Av	.2	.2	30.58	-	-	50	-19.42

PK - Peak detector
 Av - average detection

LINE 1 RESULTS



LINE 2 RESULTS

