



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

CERTIFICATION TEST REPORT

FOR

TABLET DEVICE

MODEL NUMBER: A1599

FCC ID: BCGA1599

IC: 579C-A1599

REPORT NUMBER: 14U17895-E5 Revision B

ISSUE DATE: SEPTEMBER 3, 2014

Prepared for
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--	8/11/14	Initial Issue	F. de Anda
A	8/28/14	Updated section 9.2.6	F. de Anda
B	9/03/14	Updated section 5.5	F. de Anda

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. MEASURING INSTRUMENT CALIBRATION	6
4.2. SAMPLE CALCULATION	6
4.3. MEASUREMENT UNCERTAINTY.....	6
5. EQUIPMENT UNDER TEST	7
5.1. DESCRIPTION OF EUT	7
5.2. MAXIMUM OUTPUT POWER.....	7
5.3. DESCRIPTION OF AVAILABLE ANTENNAS	7
5.4. SOFTWARE AND FIRMWARE.....	7
5.5. WORST-CASE CONFIGURATION AND MODE.....	8
5.6. DESCRIPTION OF TEST SETUP.....	9
6. TEST AND MEASUREMENT EQUIPMENT	13
7. MEASUREMENT METHODS	14
8. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS	15
8.1. ON TIME AND DUTY CYCLE RESULTS.....	15
9. ANTENNA PORT TEST RESULTS	17
9.1. BASIC DATA RATE GFSK MODULATION.....	17
9.1.1. 20 dB AND 99% BANDWIDTH	17
9.1.2. HOPPING FREQUENCY SEPARATION	20
9.1.3. NUMBER OF HOPPING CHANNELS.....	22
9.1.4. AVERAGE TIME OF OCCUPANCY	25
9.1.5. AVERAGE POWER.....	29
9.1.6. OUTPUT POWER	30
9.1.7. CONDUCTED SPURIOUS EMISSIONS.....	33
9.2. ENHANCED DATA RATE 8PSK MODULATION	38
9.2.1. 20 dB AND 99% BANDWIDTH	38
9.2.2. HOPPING FREQUENCY SEPARATION	41
9.2.3. NUMBER OF HOPPING CHANNELS.....	43
9.2.4. AVERAGE TIME OF OCCUPANCY	46
9.2.5. AVERAGE POWER.....	50
9.2.6. OUTPUT POWER	51
9.2.7. CONDUCTED SPURIOUS EMISSIONS.....	54
10. RADIATED TEST RESULTS.....	59

10.1.	LIMITS AND PROCEDURE.....	59
10.2.	TRANSMITTER ABOVE 1GHz.....	60
10.2.1.	BASIC DATA RATE GFSK MODULATION	60
10.2.2.	ENHANCED DATA RATE 8PSK MODULATION.....	70
10.3.	WORST-CASE BELOW 1 GHz	80
10.4.	WORST-CASE ABOVE 18 GHz.....	82
11.	AC POWER LINE CONDUCTED EMISSIONS.....	83
12.	SETUP PHOTOS.....	87

1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: TABLET DEVICE

MODEL: A1599

SERIAL NUMBER: F4KMV00EG535

DATE TESTED: JULY 02 - JULY 11, 2014

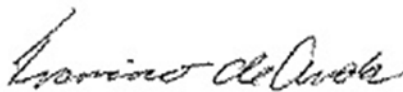
APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-210 Issue 8 Annex 8	Pass
INDUSTRY CANADA RSS-GEN Issue 3	Pass

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:



FRANCISCO DEANDA
PROJECT LEAD
UL Verification Services Inc.



JOE VANG
EMC TEST 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 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
☐ Chamber A	☐ Chamber D
☐ Chamber B	☒ Chamber E
☐ Chamber C	☐ Chamber F
	☒ Chamber G
	☒ Chamber H

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/standards/scopes/2000650.htm>.

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 tablet with IEEE 802.11a/b/g/n (MIMO 2x2) and Bluetooth radio. The rechargeable battery is not user accessible.

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	13.07	20.28
2402 - 2480	Enhanced 8PSK	12.58	18.11

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PiFA antenna, with a maximum gain of 0.81dBi.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was 12.1.729.874

The test utility software used during testing was Bluetool 1.8.5

5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case mode and channel used for 30-1000 MHz radiated and power line conducted emissions was including headset, AC charger and the mode and channel with the highest output power.

The EUT is a portable device that has three orientations; therefore X, Y and Z orientations have been investigated with AC adapter and Headset, and the worst case was found to be at Y (Landscape) position without AC adapter and headset.

Based on the manufacturer's attestation that the nominal output power is reduced as the data rate increases, the data rates tested represent the highest power and worst-case with respect to EMC performance.

Worst-case data rates were:

GFSK mode: DH1
8PSK mode: 3-DH5

DQPSK mode has been verified to have the lowest power.

There are two vendors of the WiFi/Bluetooth radio modules: variant 1 and variant 2. They have the same mechanical outline, same on board antenna, matching circuit, antenna structure and same specification. Baseline testing was performed on the two variants to determine the worst case on conducted power and radiated emissions.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
AC/DC adapter	Apple	A1357	N/A	NA
Earphone	Apple	NA	NA	NA
Laptop	Apple	A1278	C02HJ0A7DTY4	NA
DC power supply	Sorensen	XT 15-4	1319A02780	NA

I/O CABLES (CONDUCTED TEST)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Antenna	1	SMA	Un-Shielded	0.2	To spectrum Analyzer
2	USB	1	USB	Shielded	1	N/A
3	DC	1	DC	Un-shielded	0.8	N/A

I/O CABLES (RADIATED ABOVE 1 GHZ)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
None used						

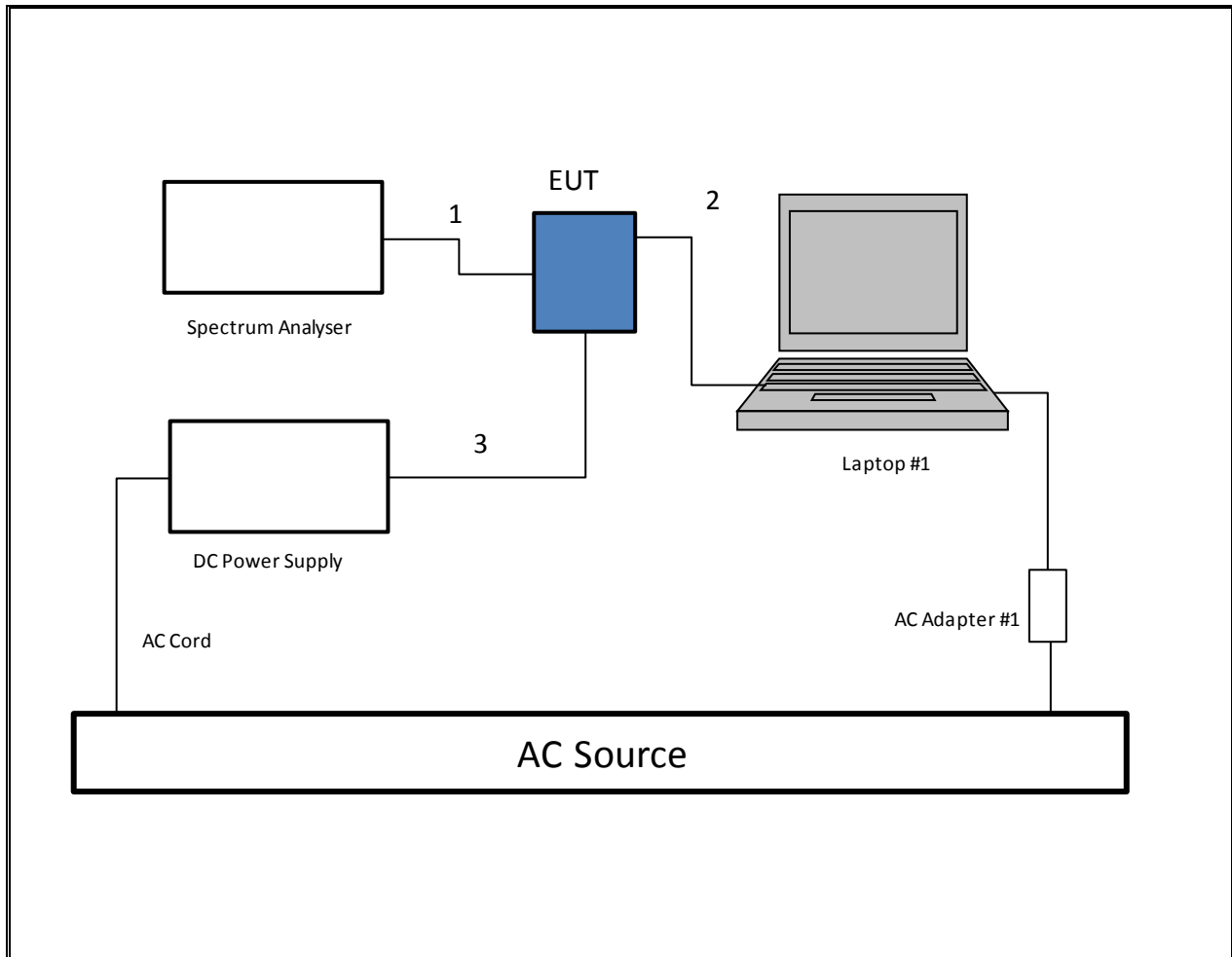
I/O CABLES (AC POWER CONDUCTED TEST and below 1 GHZ)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	US115	Un-Shielded	0.8	NA
2	DC	1	lightning	Un-Shielded	1	NA
3	Audio	1	Jack	Un-Shielded	0.5	NA

TEST SETUP- CONDUCTED PORT

The EUT was tested connected to a host Laptop via USB cable adapter and spectrum analyzer to antenna port. Test software exercised the EUT.

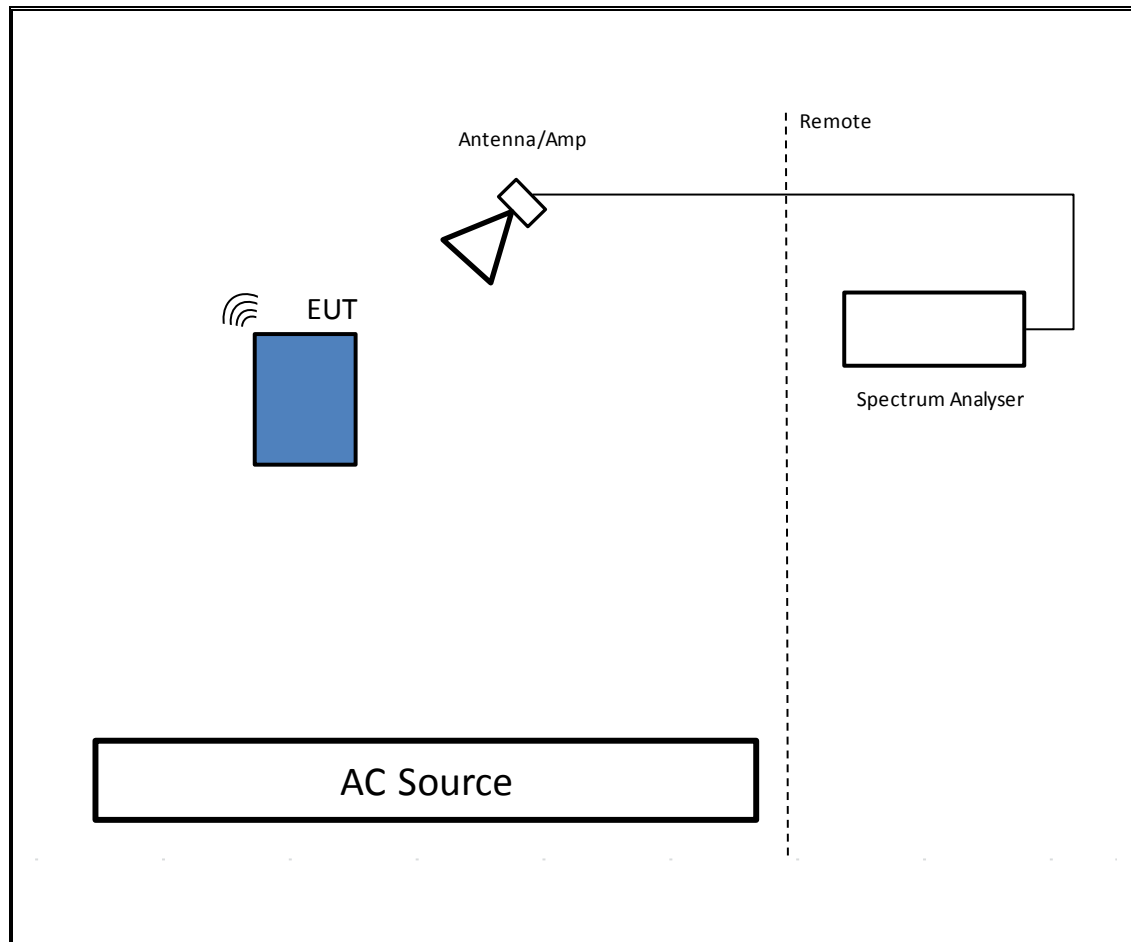
SETUP DIAGRAM



TEST SETUP- RADIATED-ABOVE 1 GHZ

The EUT was tested battery powered. Test software exercised the EUT.

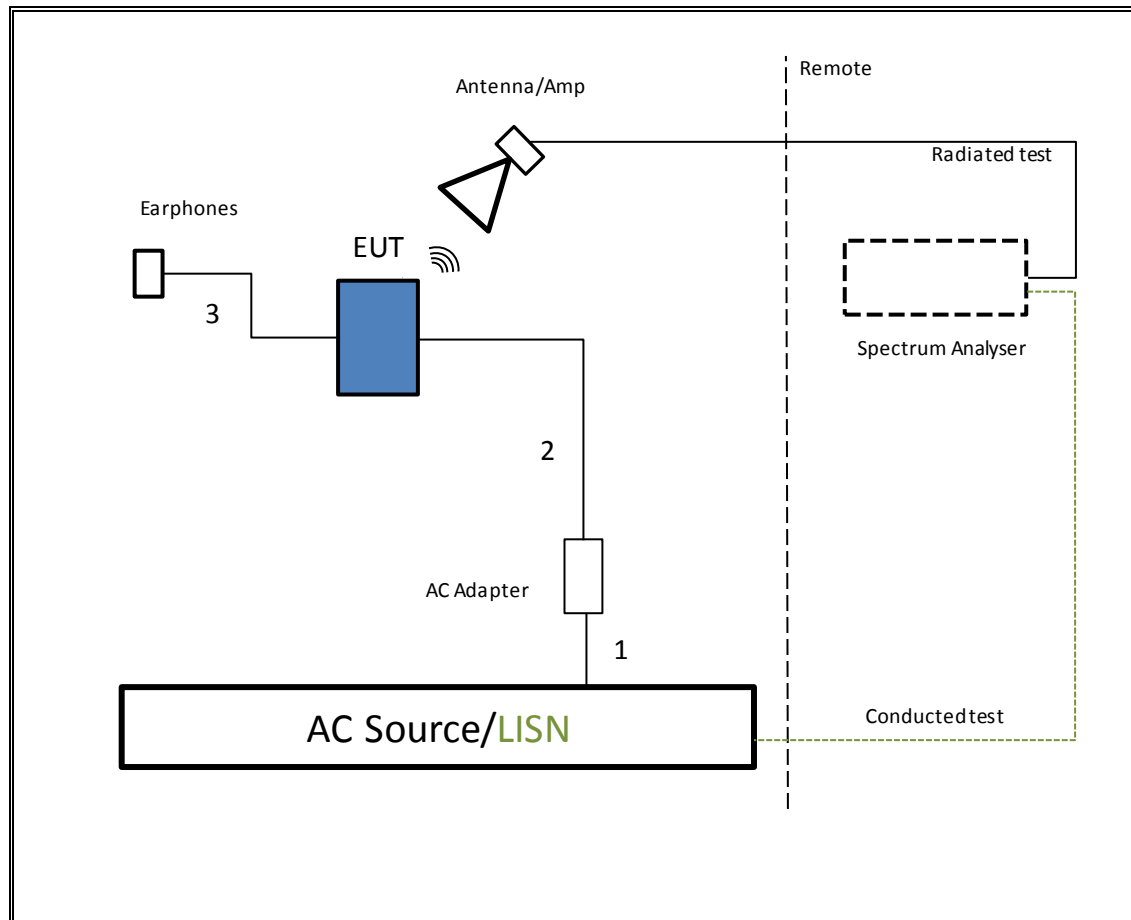
SETUP DIAGRAM



TEST SETUP- BELOW 1GHZ & AC LINE CONDUCTED TESTS

The EUT was tested with earphones connected and powered by AC adapter. Test software exercised the EUT.

SETUP DIAGRAM



6. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST				
Description	Manufacturer	Model	Asset	Cal Due
Spectrum Analyzer, PSA 3Hz to 26.5 GHz	Agilent	E4404B	C01179	03/21/15
Antenna, Horn, 18 GHz	ETS Lindgren	3117	F00131	02/18/15
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00589	11/26/14
Peak / Average Power Sensor	Agilent / HP	N1911A	F00153	03/06/15
Wideband Power Sensor	Agilent	N1921A	F00361	10/02/14
Peak Power Meter	Agilent / HP	E9323A	F00025	04/03/15
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	F00129	02/22/15
Spectrum Analyzer, 40 GHz	Agilent	8564E	C00951	07/29/14
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	F00168	03/28/15
Preamplifier, 1300 MHz	Sonoma	310	F00008	05/27/15
Preamplifier, 26.5 GHz	Agilent / HP	8449B	F00165	03/25/15
EMI Test Receiver, 9 kHz-7 GHz	R & S	ESCI 7	F00092	09/05/14
LISN, 30 MHz	FCC	LISN-50/250-25-2	C00626	01/14/15

7. MEASUREMENT METHODS

6 dB BW: KDB 558074 D01.

Output Power: KDB 558074 D01.

Power Spectral Density: KDB 558074 D01.

Out-of-band emissions in non-restricted bands: KDB 558074 D01.

Out-of-band emissions in restricted bands: KDB 558074 D01.

8. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

LIMITS

None; for reporting purposes only.

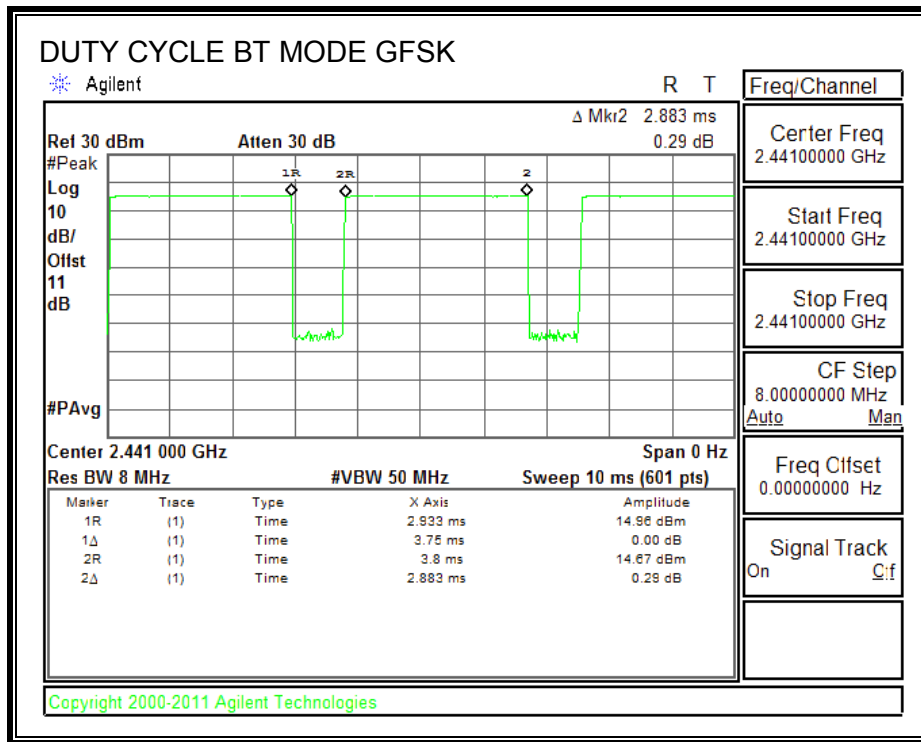
PROCEDURE

KDB 789033 Zero-Span Spectrum Analyzer Method.

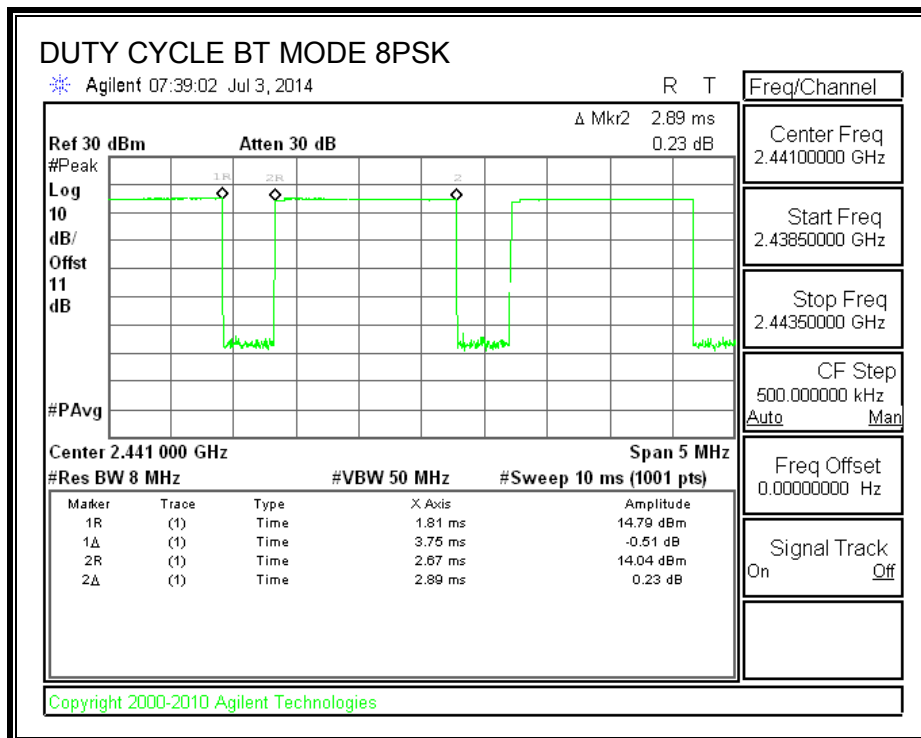
8.1. ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
GFSK	2.883	3.750	0.769	76.9%	1.142	0.347
8PSK	2.890	3.750	0.771	77.1%	1.131	0.346

DUTY CYCLE PLOTS



DUTY CYCLE PLOTS



9. ANTENNA PORT TEST RESULTS

9.1. BASIC DATA RATE GFSK MODULATION

9.1.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

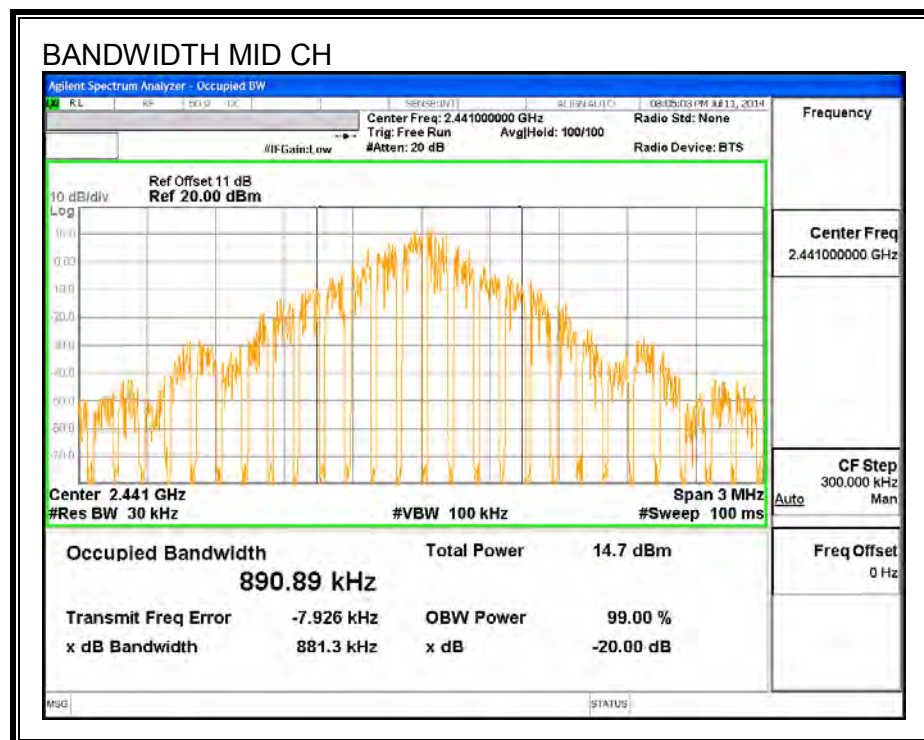
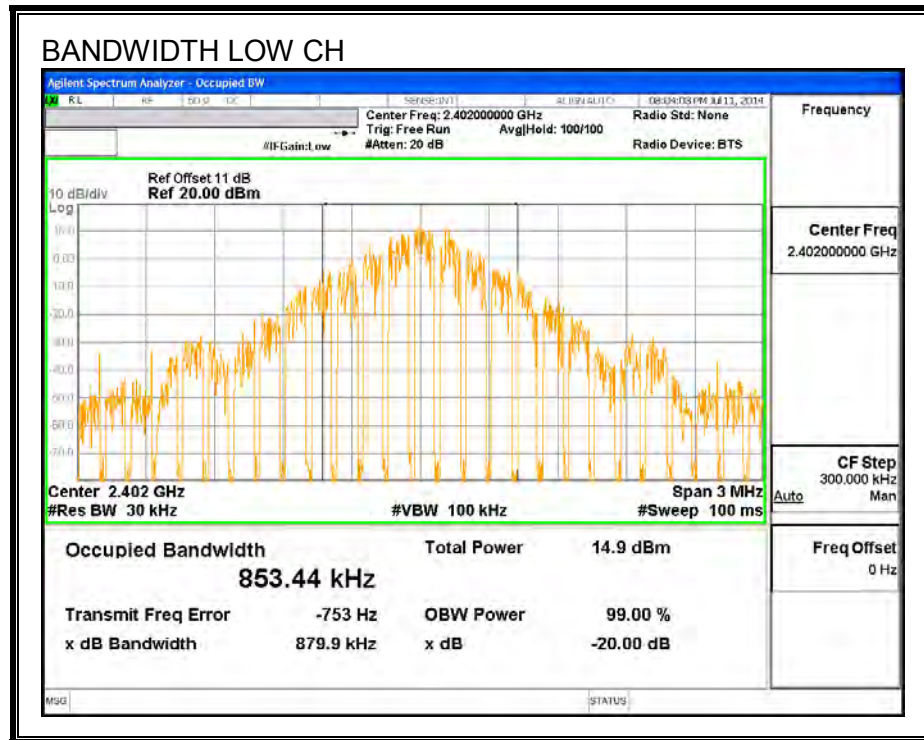
TEST PROCEDURE

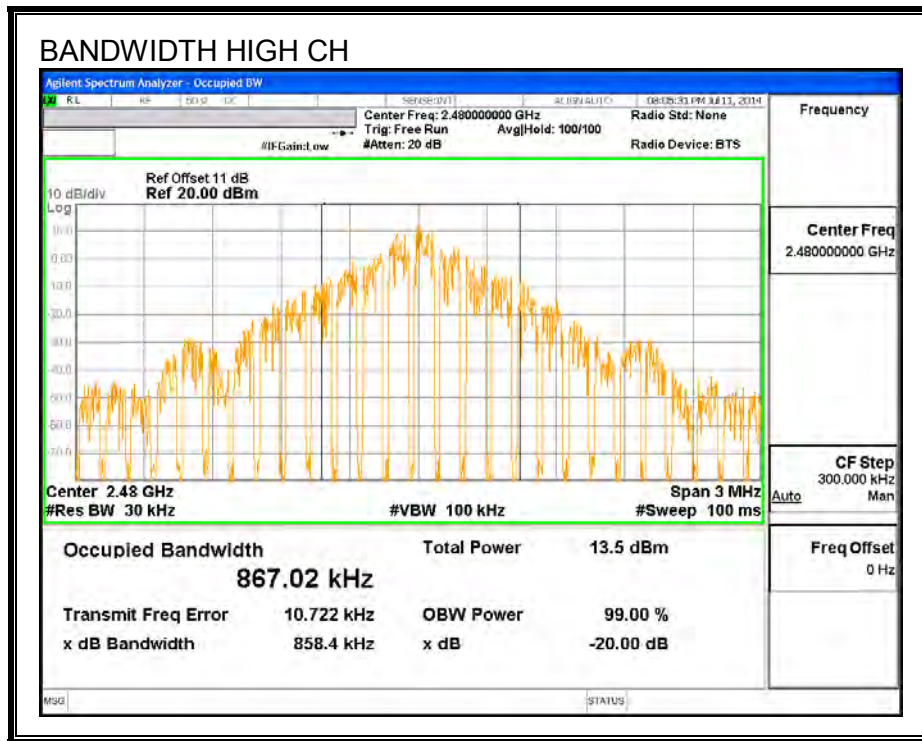
The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to $\geq$ RBW. The sweep time is coupled.

RESULTS

Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
2402	879.90	853.44
2441	881.30	890.89
2480	858.4	867.02

20 dB AND 99% BANDWIDTH





9.1.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

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.

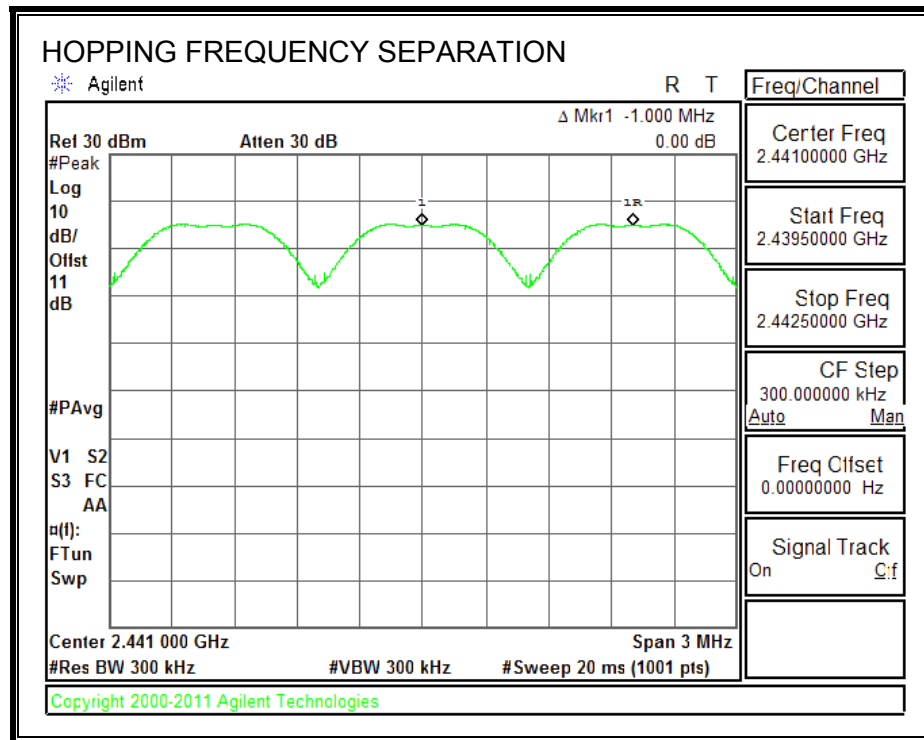
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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



9.1.3. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)

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

TEST PROCEDURE

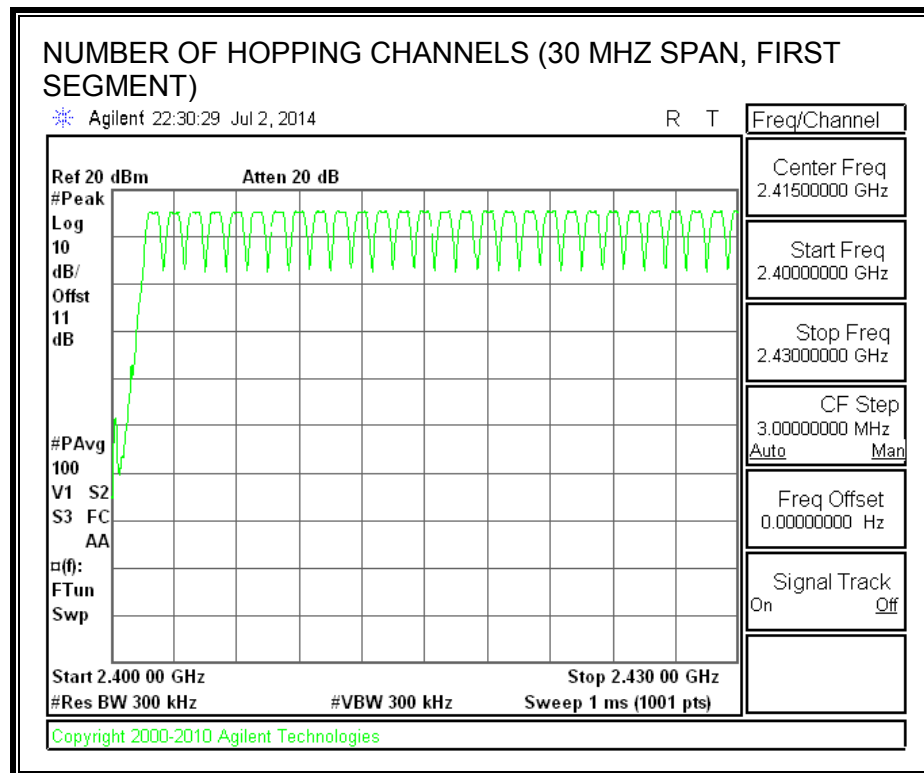
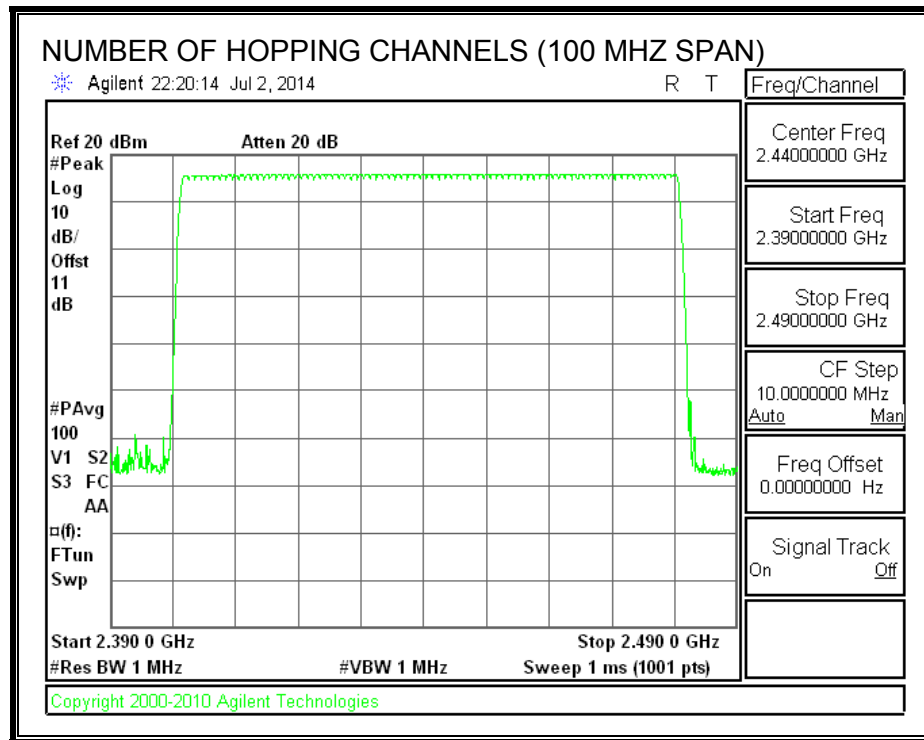
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

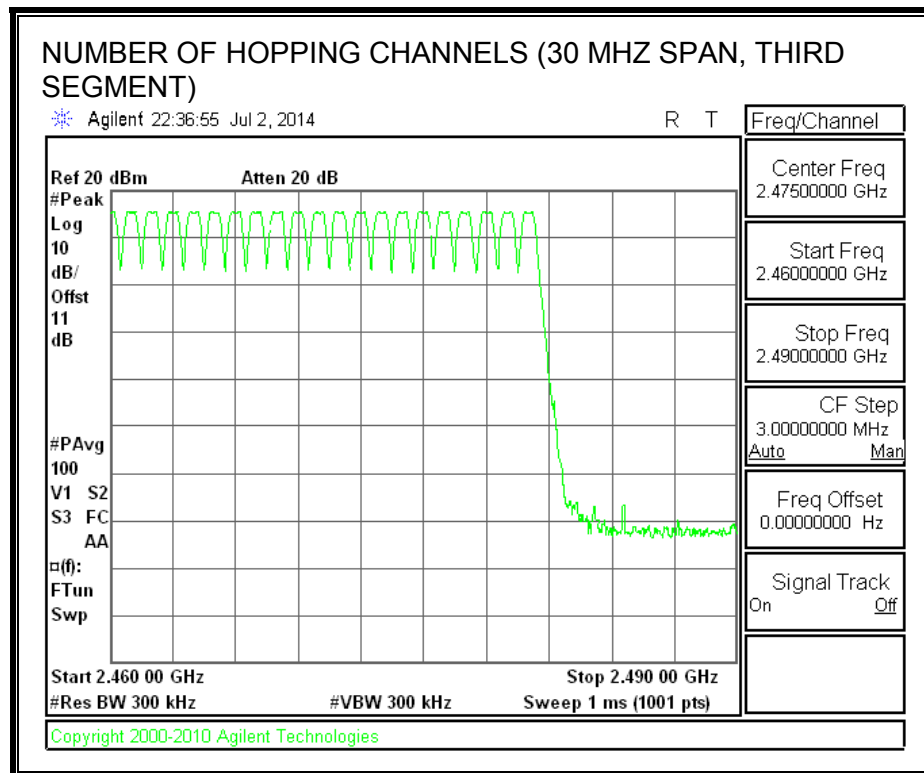
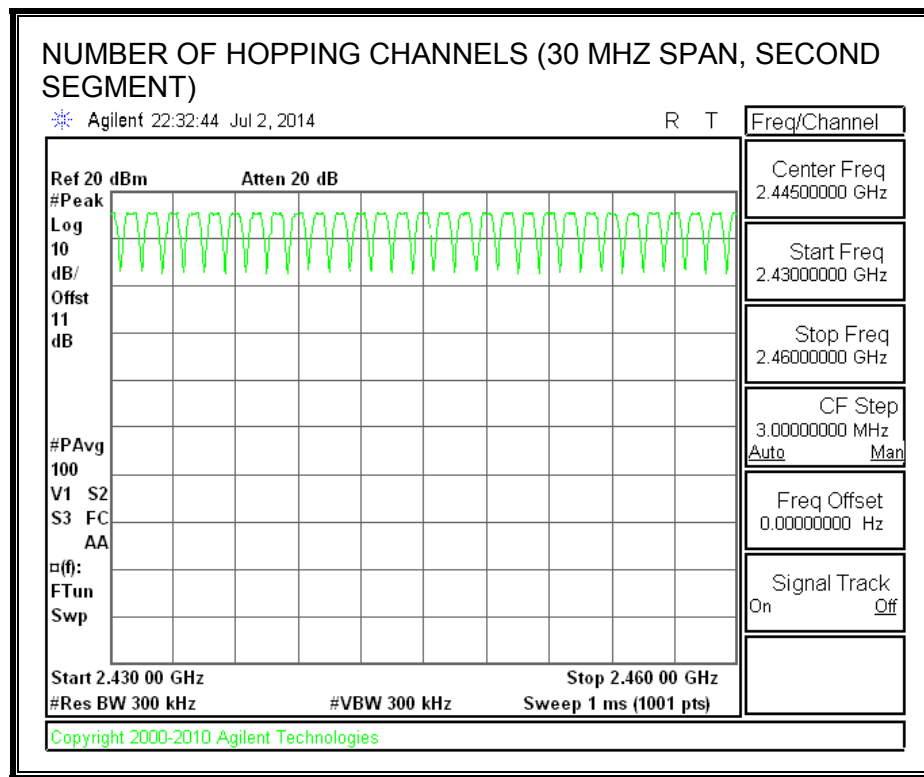
RESULTS

Normal Mode: 79 Channels observed.

.

NUMBER OF HOPPING CHANNELS





9.1.4. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)

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

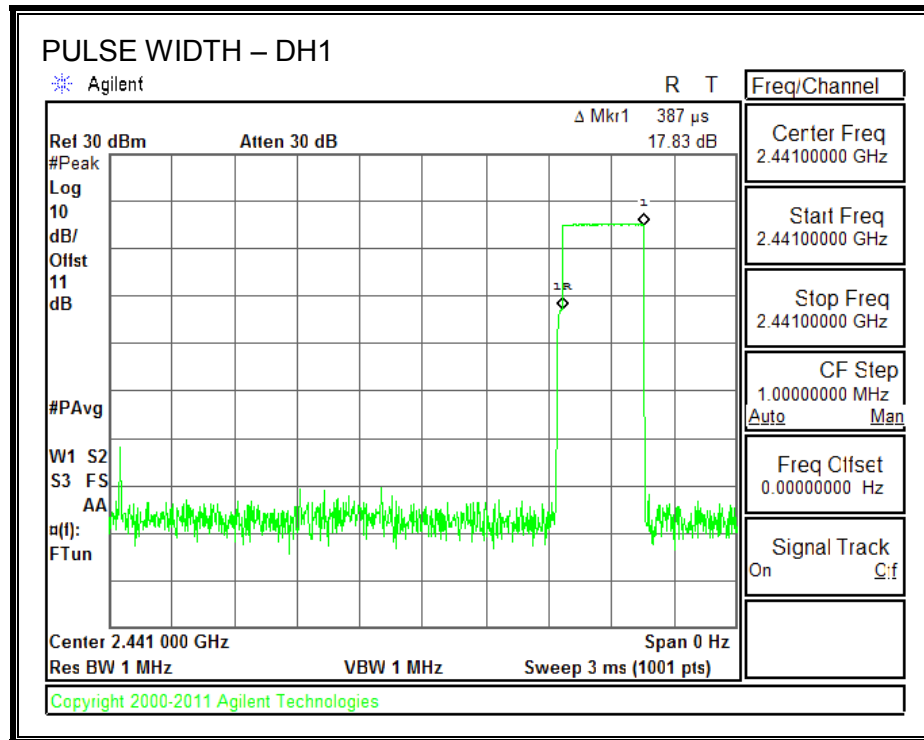
The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

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

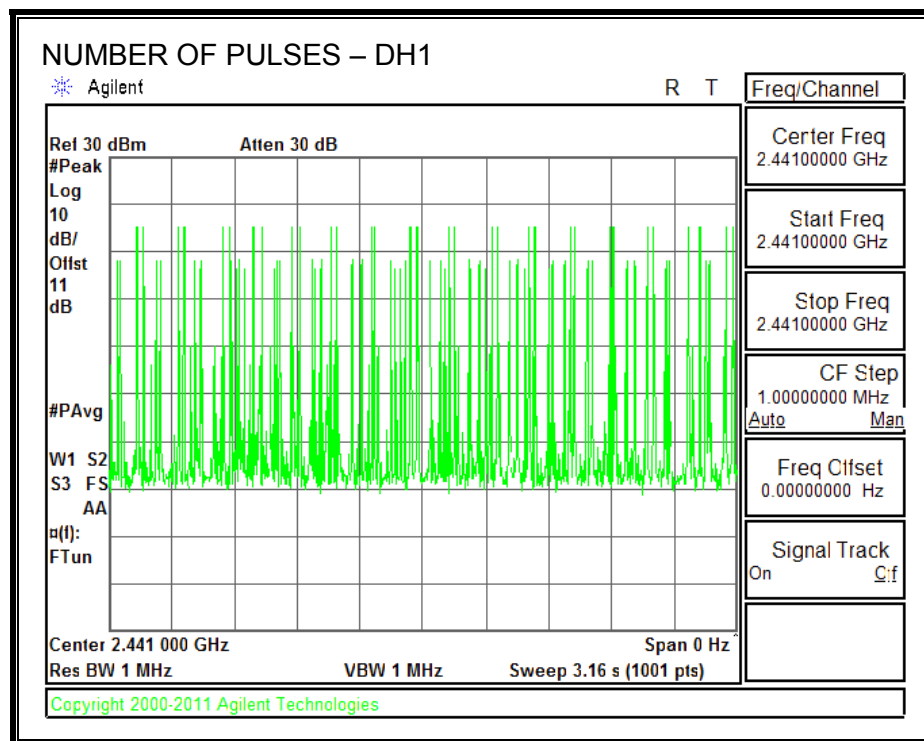
RESULTS

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	0.387	32	0.124	0.4	-0.276
DH3	1.64	14	0.230	0.4	-0.170
DH5	2.91	13	0.378	0.4	-0.022

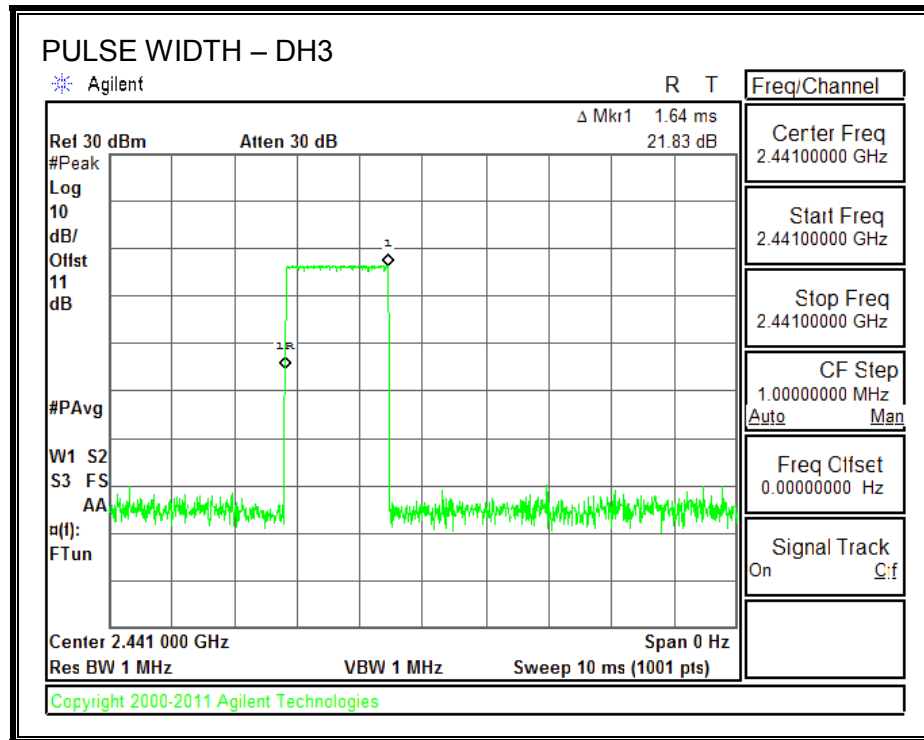
PULSE WIDTH - DH1



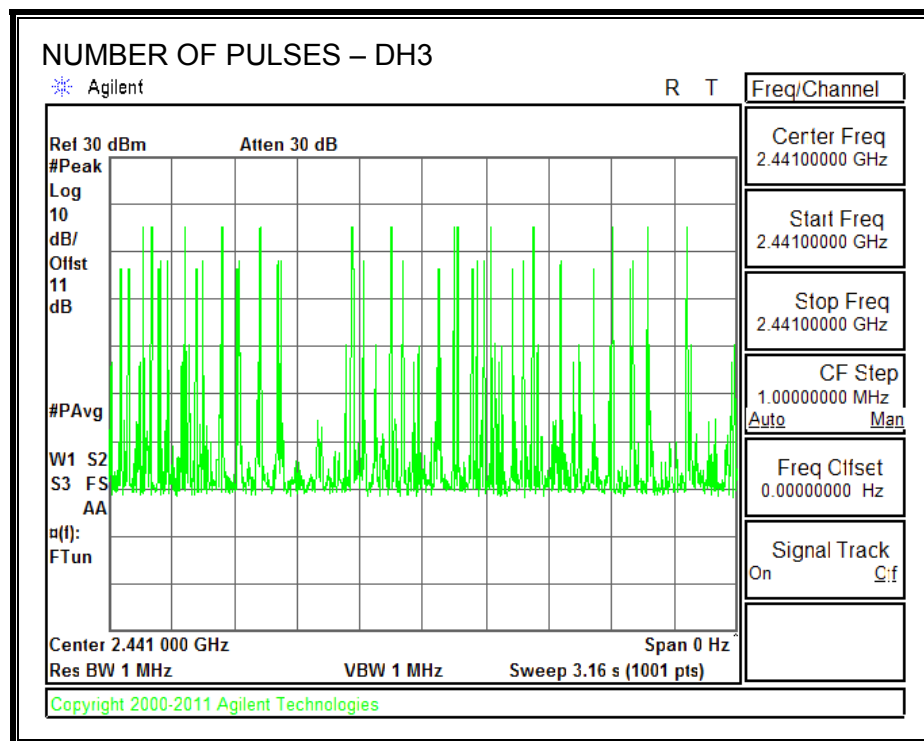
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



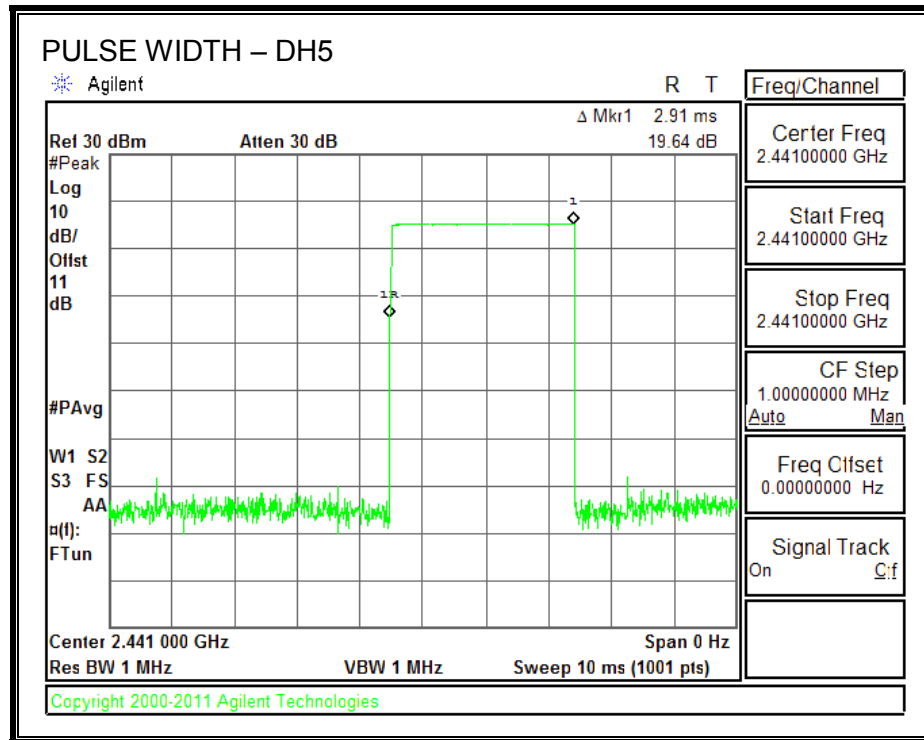
PULSE WIDTH – DH3



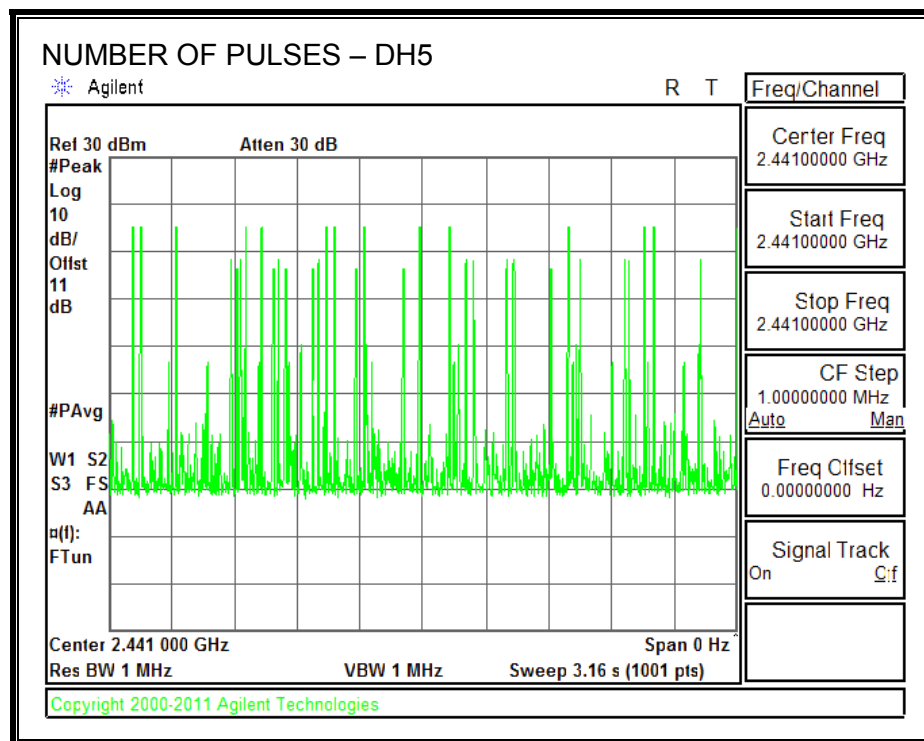
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5



9.1.5. 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 11 dB (including 10 dB pad and 1 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	12.28
Middle	2441	12.23
High	2480	11.90

9.1.6. OUTPUT POWER

LIMIT

§15.247 (b) (1)

The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm. Furthermore, if separation channel frequency is less 20 dB BW, then limit is 21 dBm.

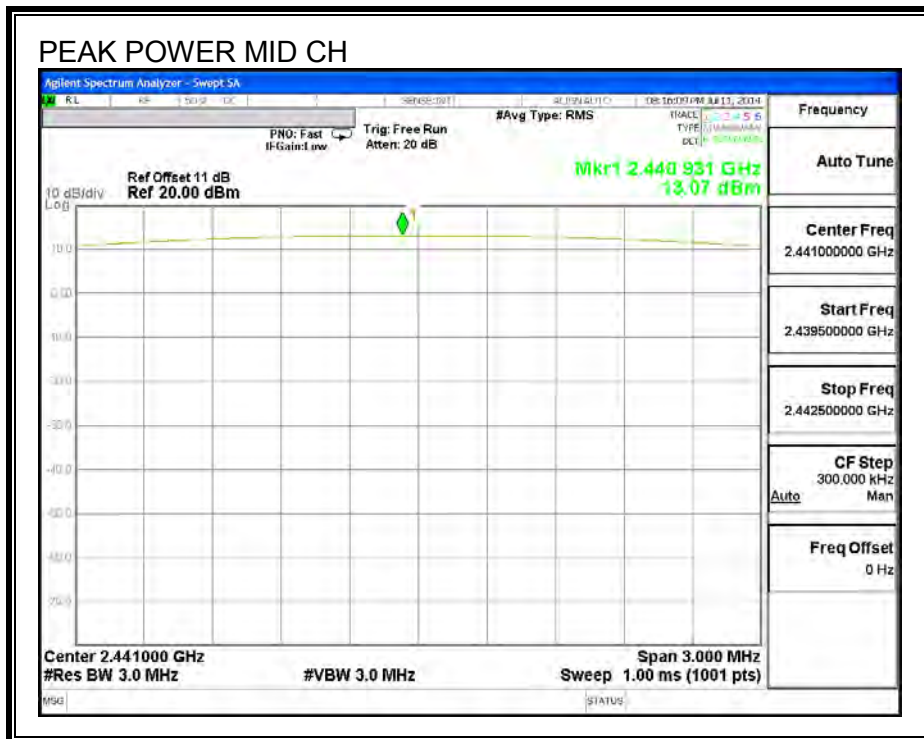
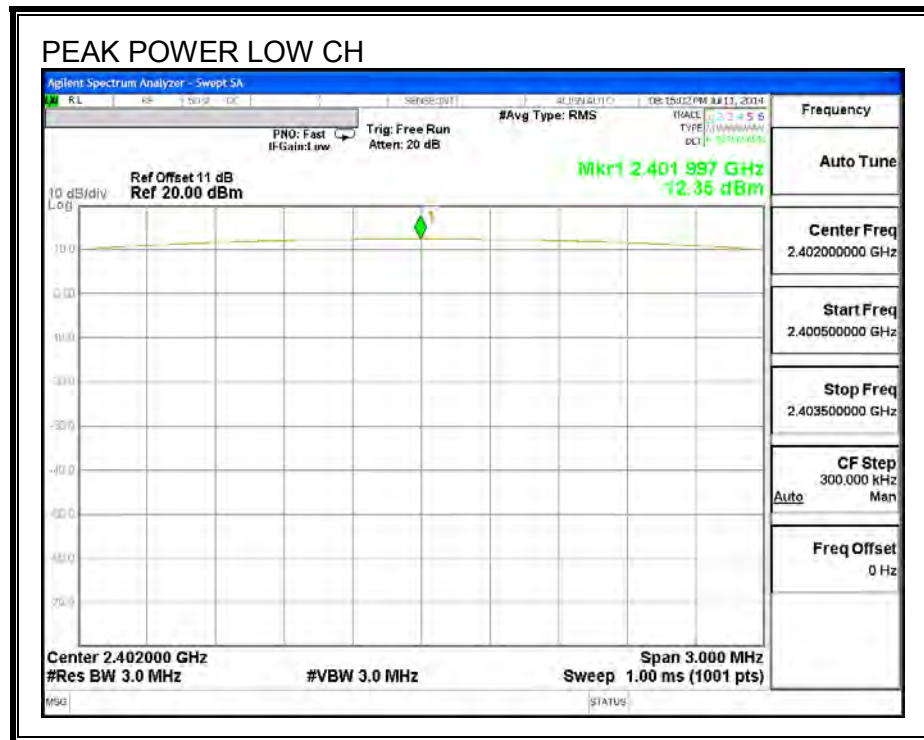
TEST PROCEDURE

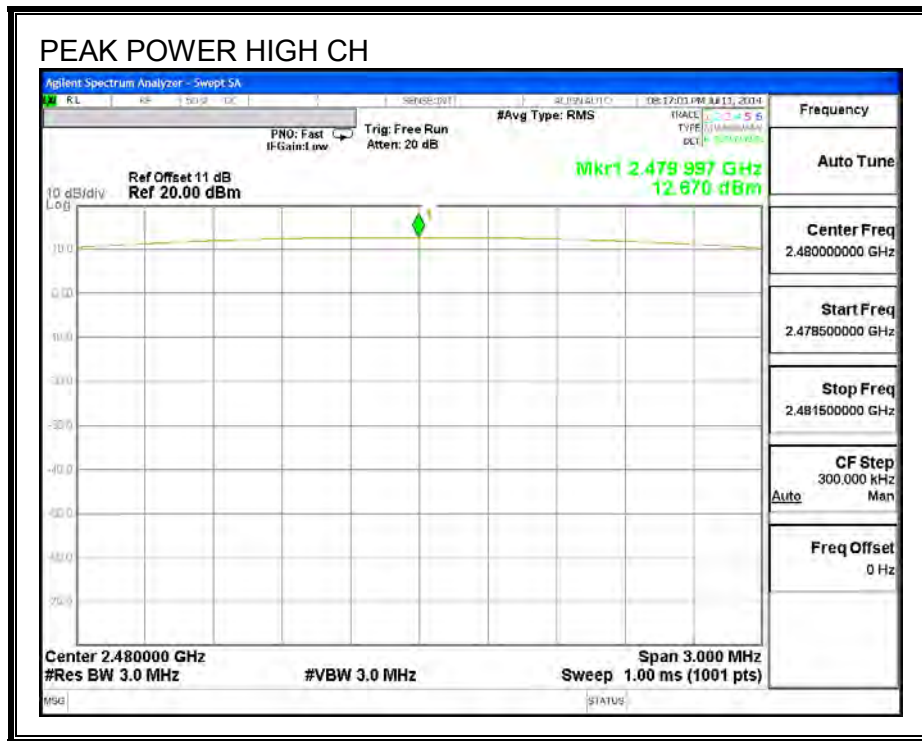
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.35	30	-17.65
Middle	2441	13.07	30	-16.93
High	2480	12.67	30	-17.33

OUTPUT POWER





9.1.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

Limit = -20 dBc

TEST PROCEDURE

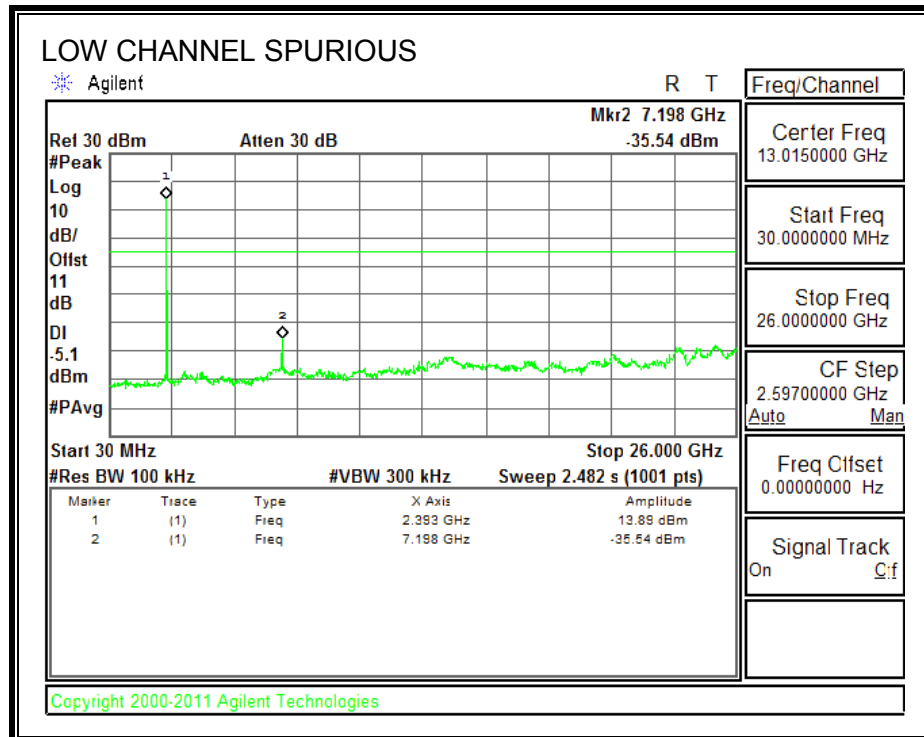
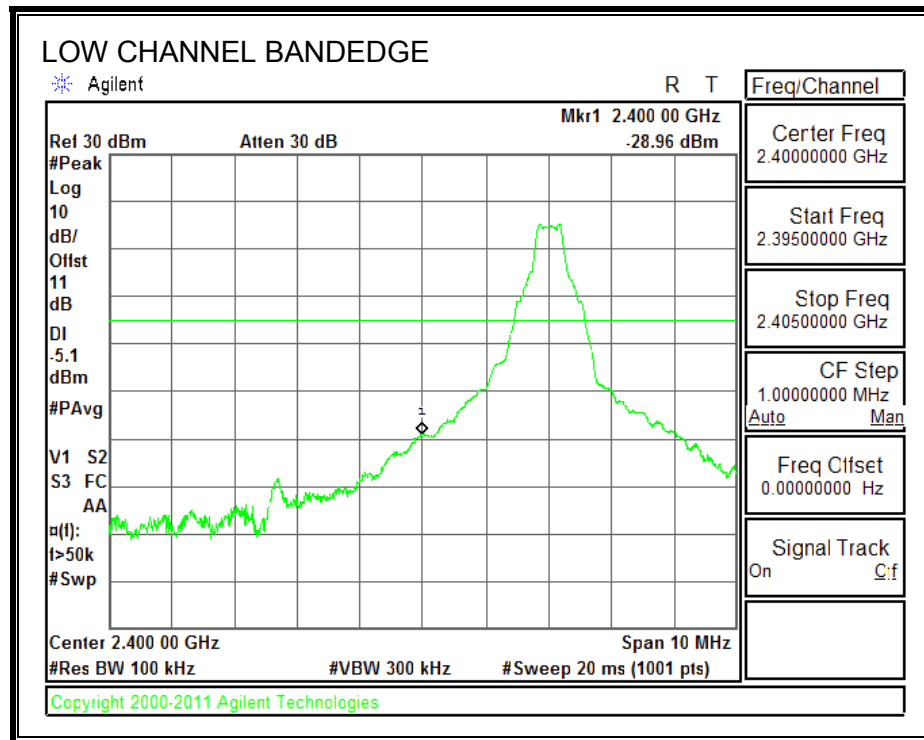
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

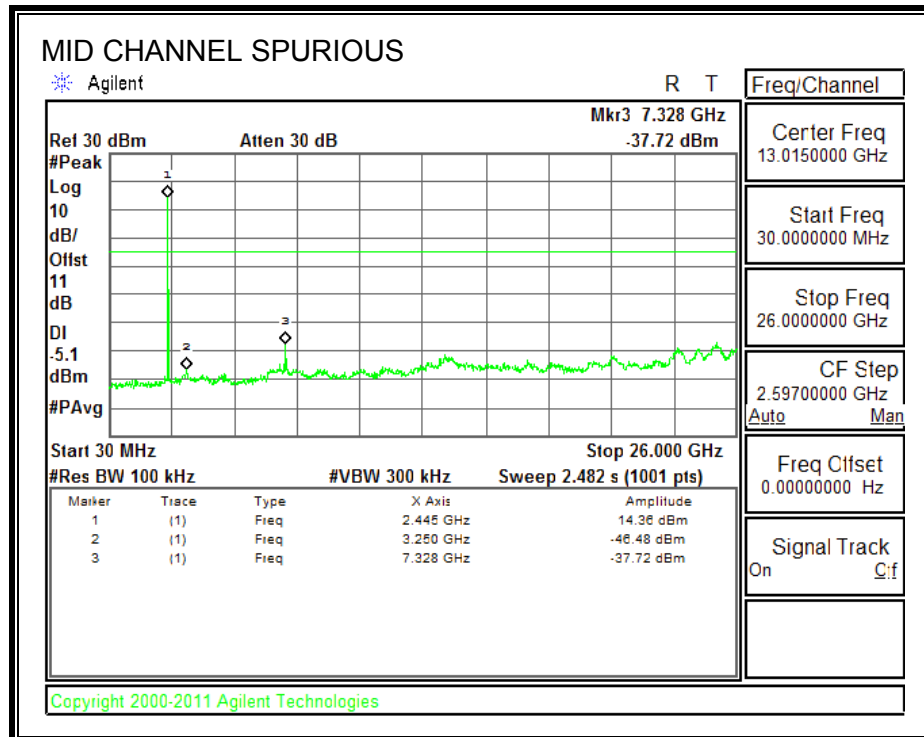
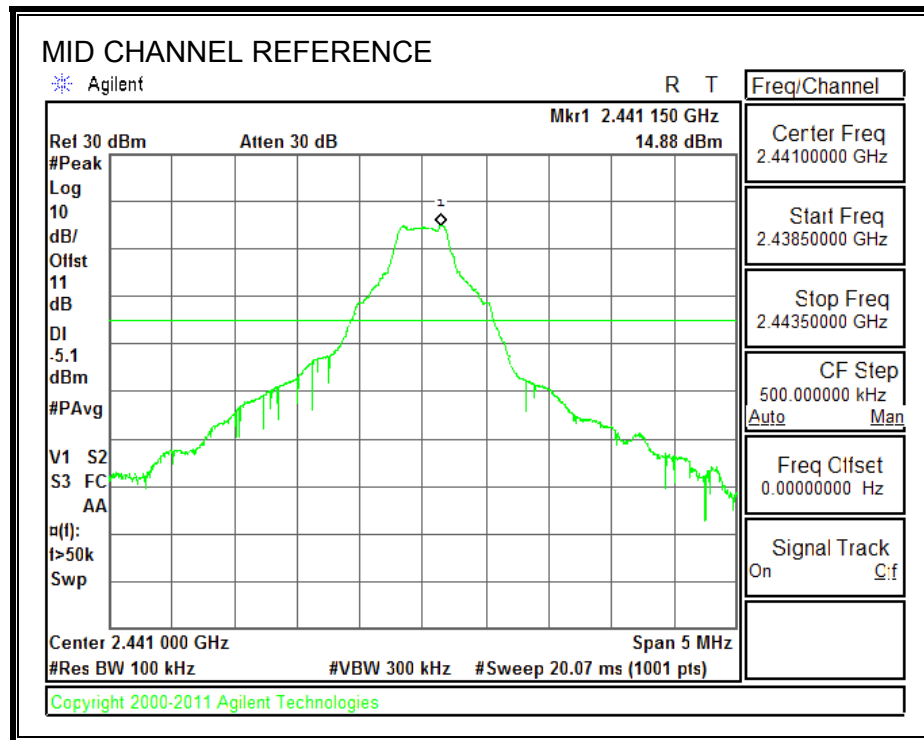
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

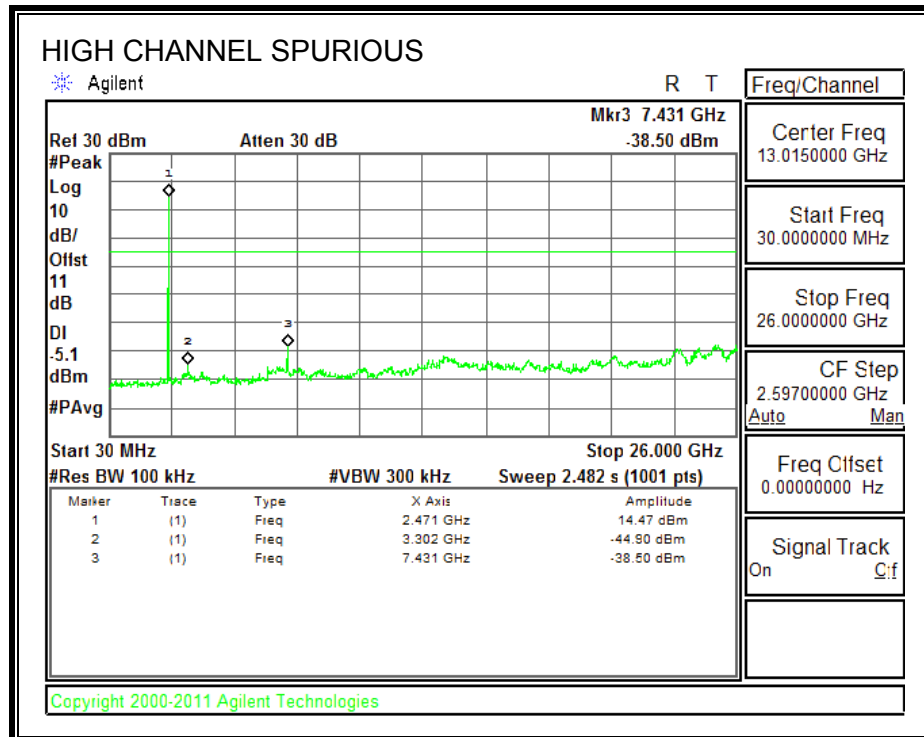
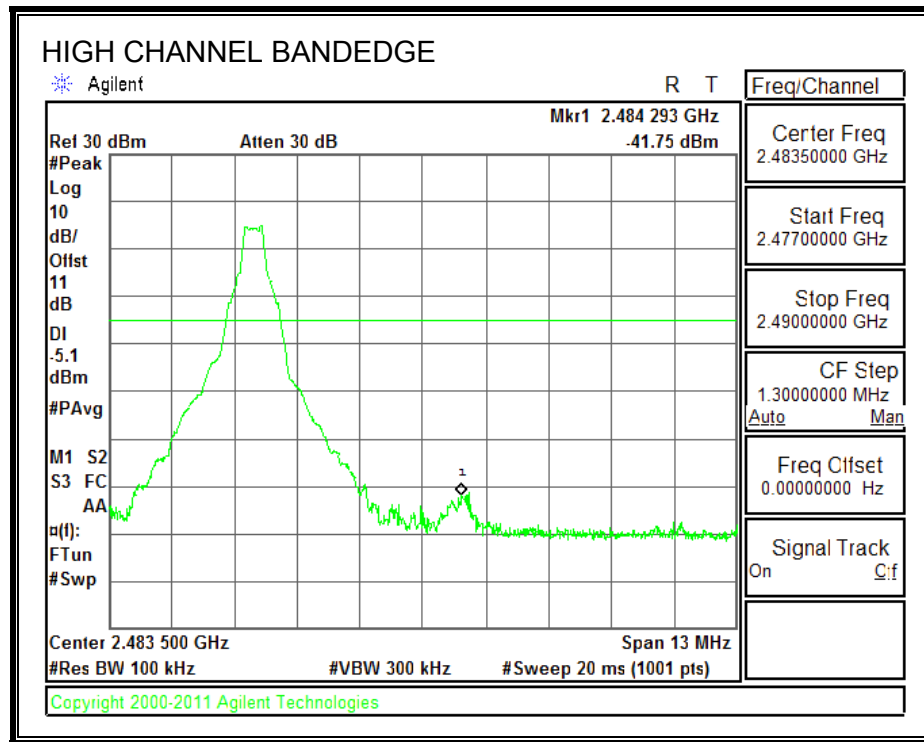
SPURIOUS EMISSIONS, LOW CHANNEL



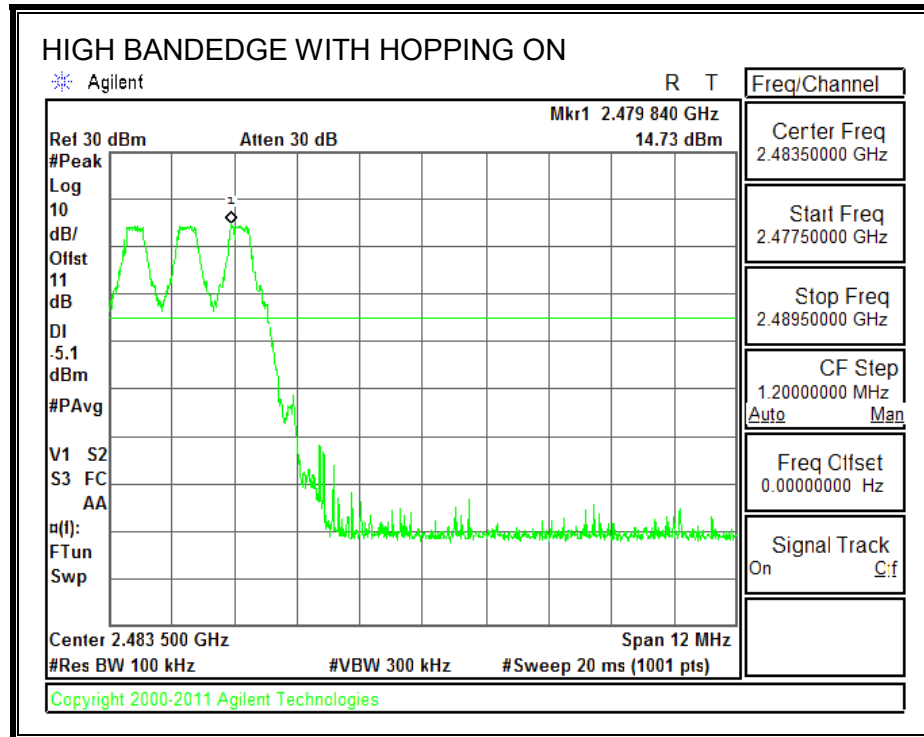
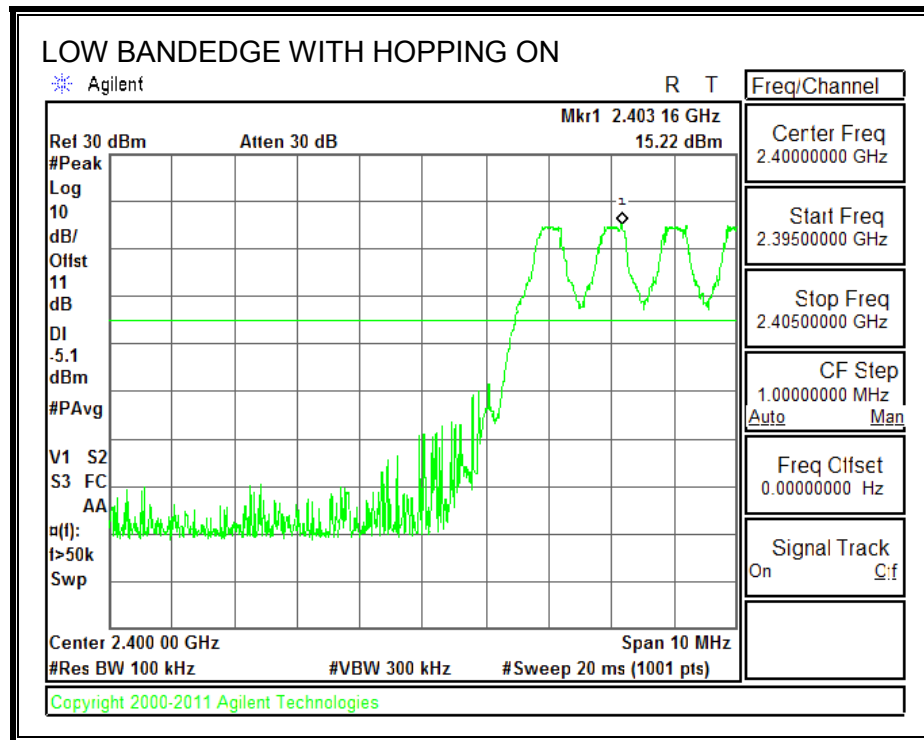
SPURIOUS EMISSIONS, MID CHANNEL



SPURIOUS EMISSIONS, HIGH CHANNEL



SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



9.2. ENHANCED DATA RATE 8PSK MODULATION

9.2.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

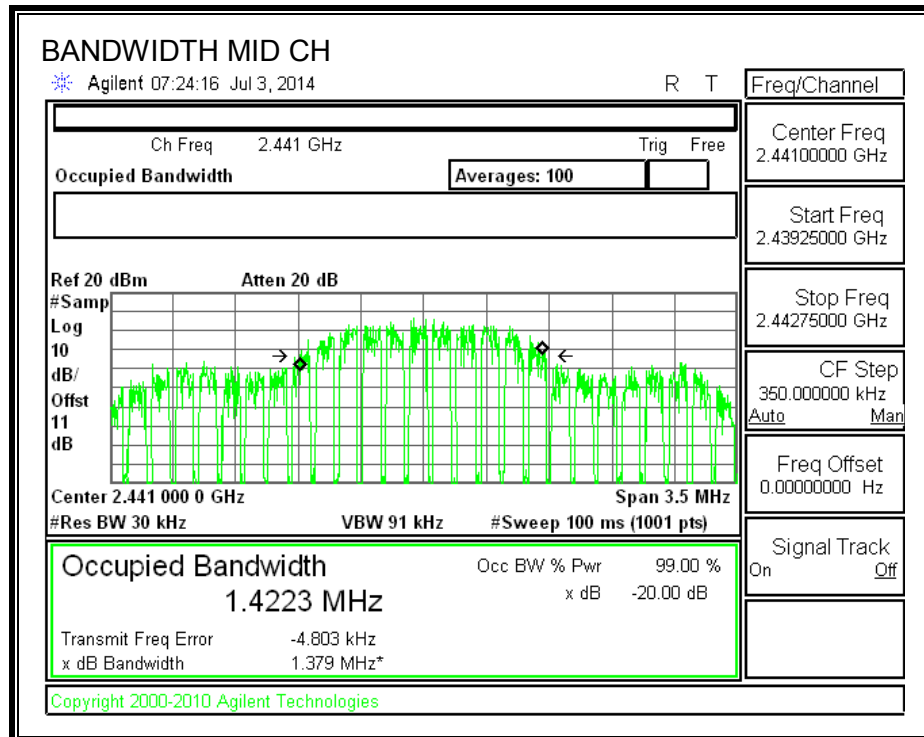
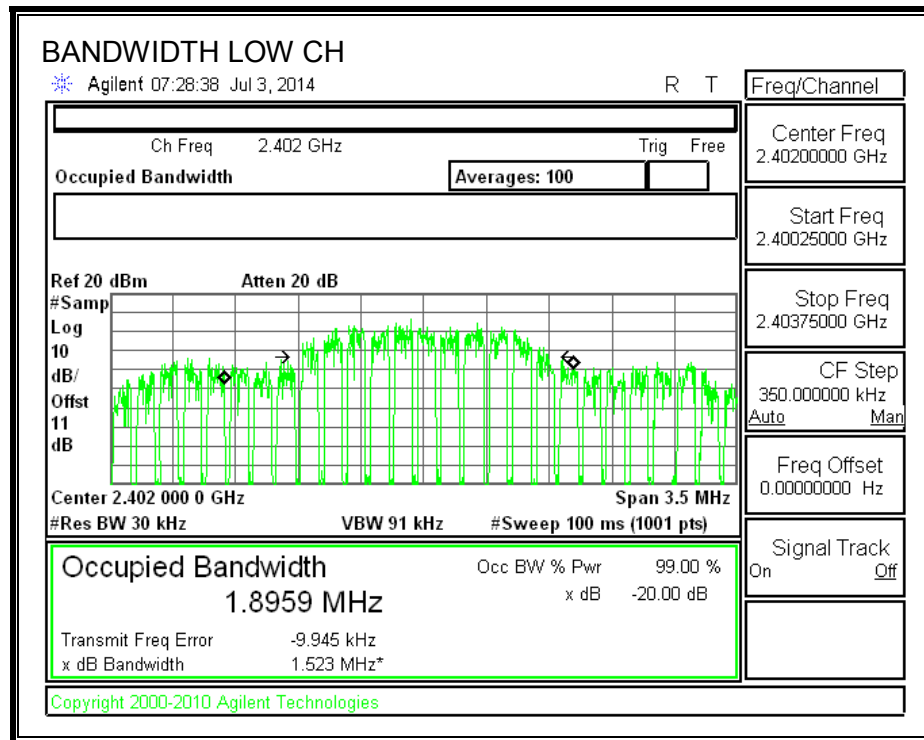
TEST PROCEDURE

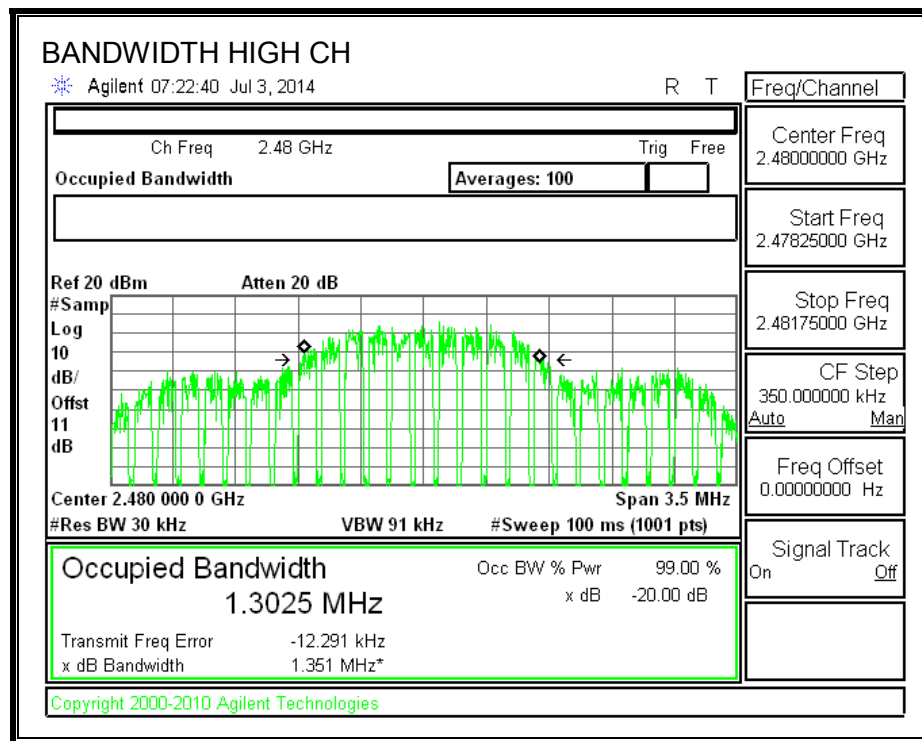
The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to $\geq$ RBW. The sweep time is coupled.

RESULTS

Frequency (MHz)	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)
2402	1.523	1.8959
2441	1.379	1.4223
2480	1.351	1.3025

20 dB AND 99% BANDWIDTH





9.2.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

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.

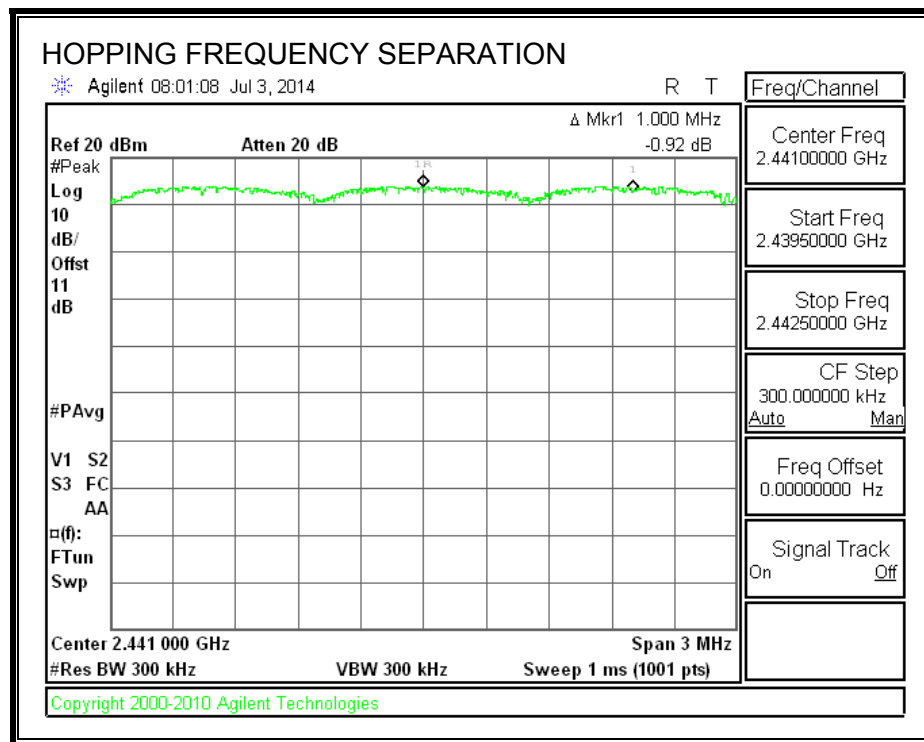
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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



9.2.3. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)

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

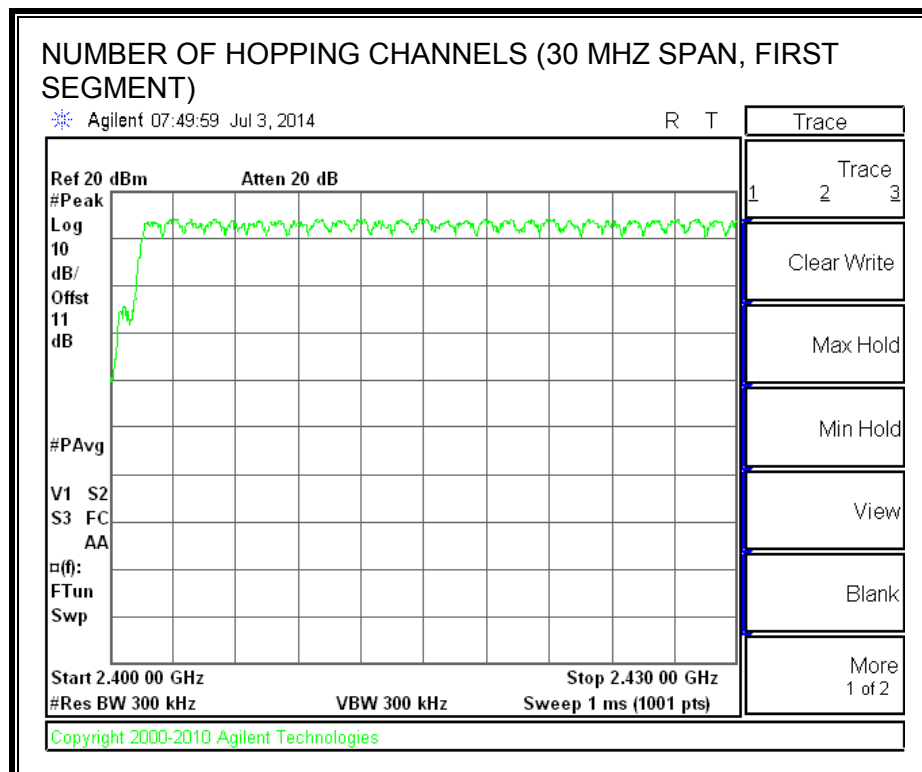
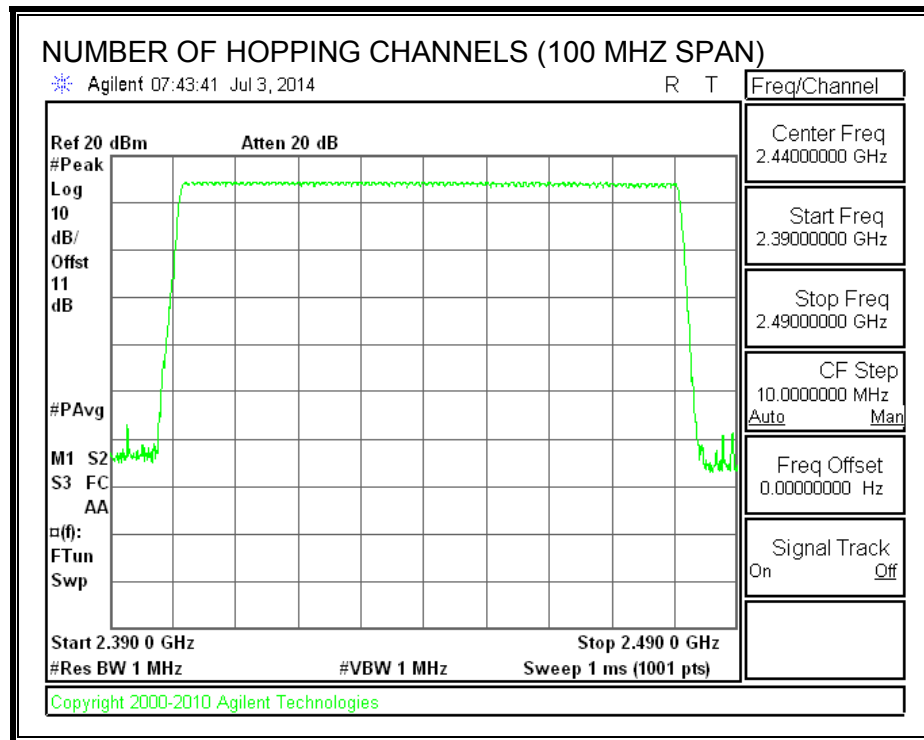
TEST PROCEDURE

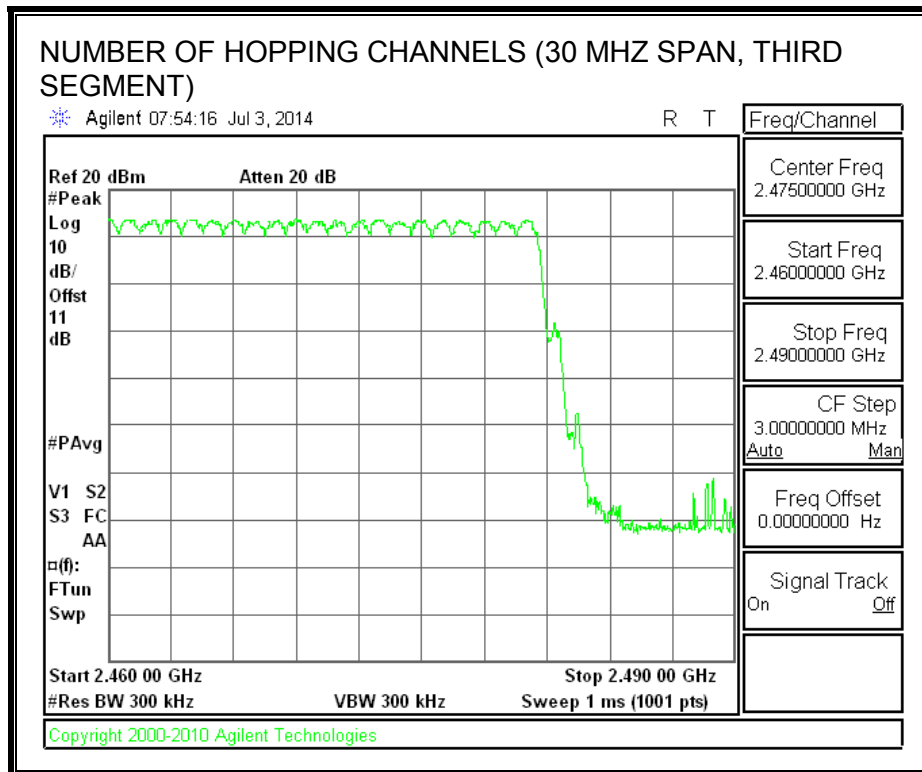
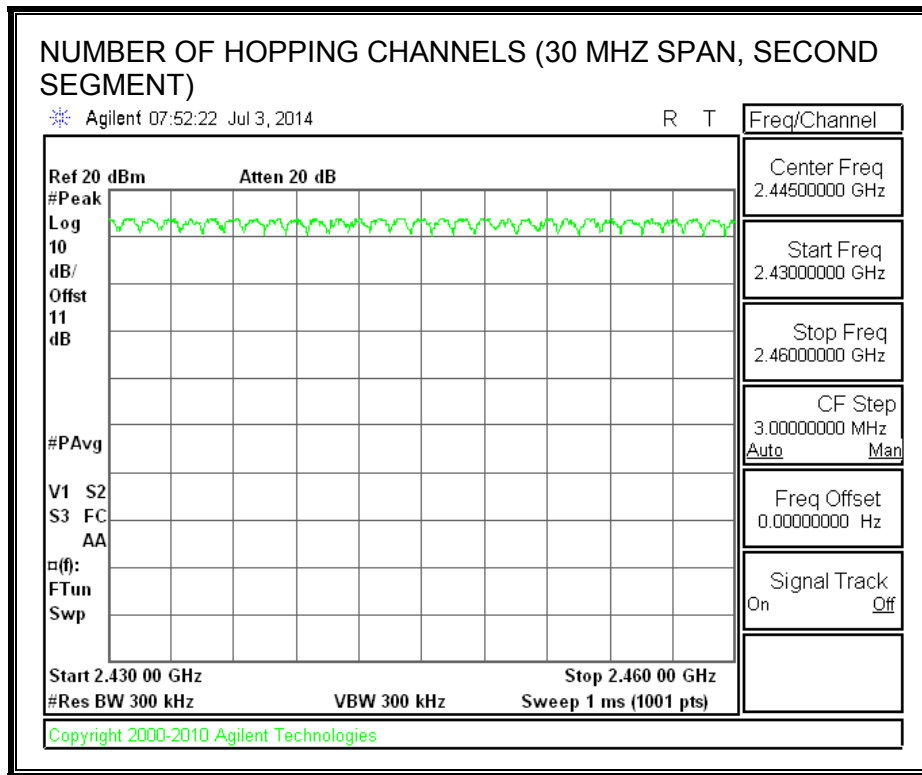
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

Normal Mode: 79 Channels observed.

NUMBER OF HOPPING CHANNELS





9.2.4. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)

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

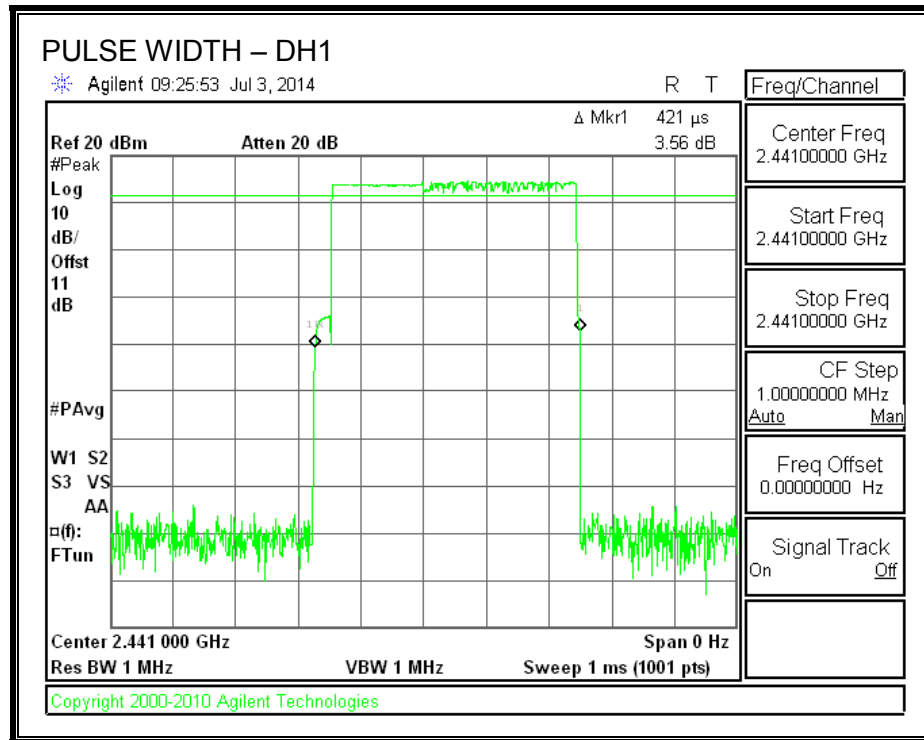
RESULTS

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

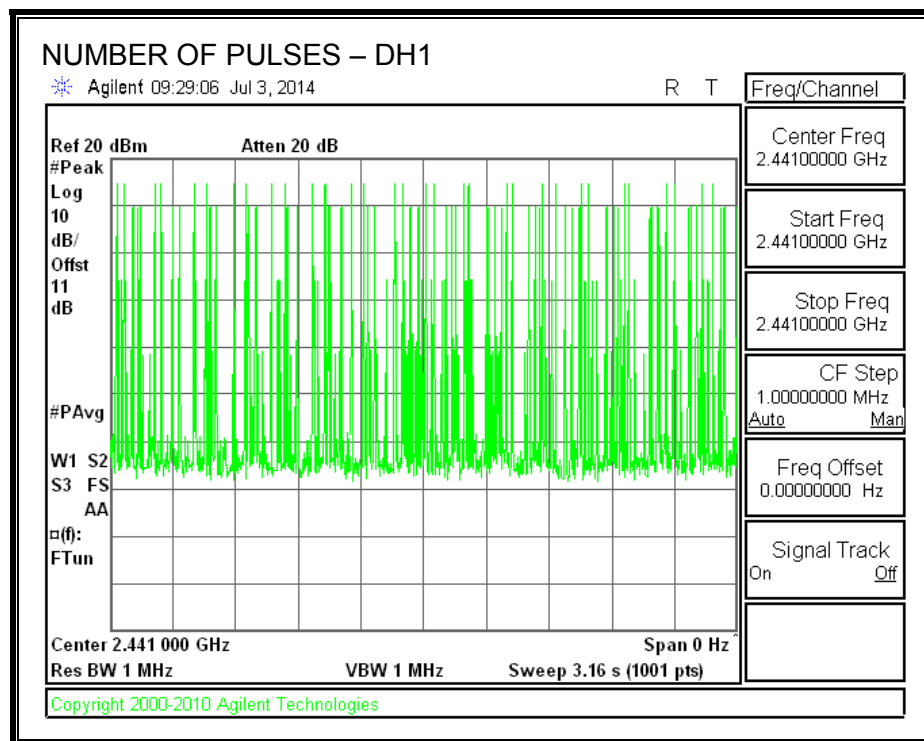
8PSK (EDR) Mode

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
3DH1	0.421	32	0.135	0.4	-0.265
3DH3	1.641	15	0.246	0.4	-0.154
3DH5	2.905	13	0.378	0.4	-0.022

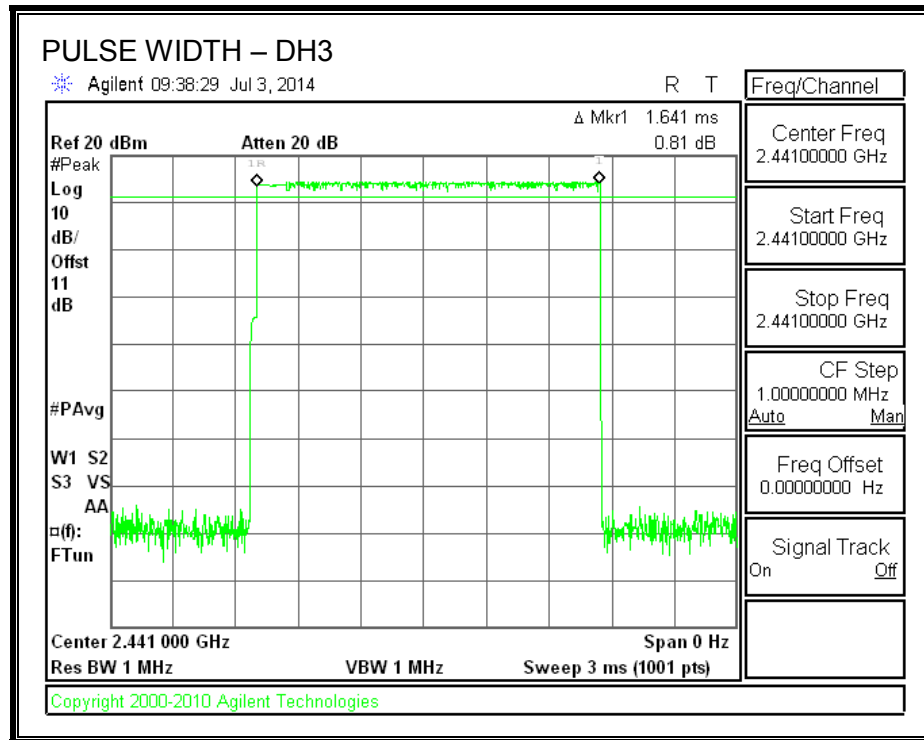
PULSE WIDTH - DH1



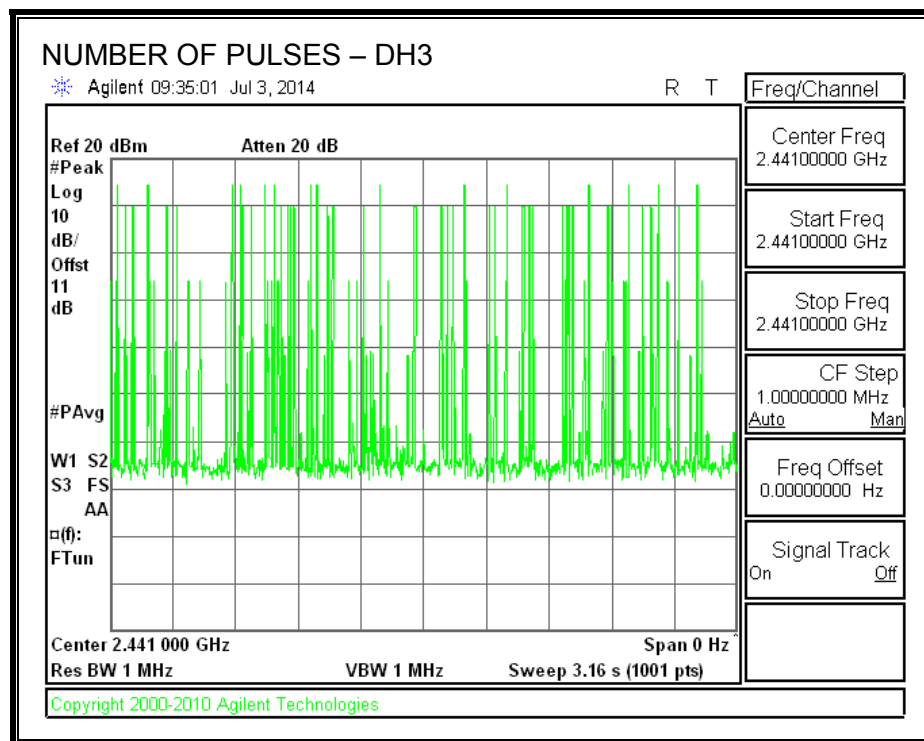
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



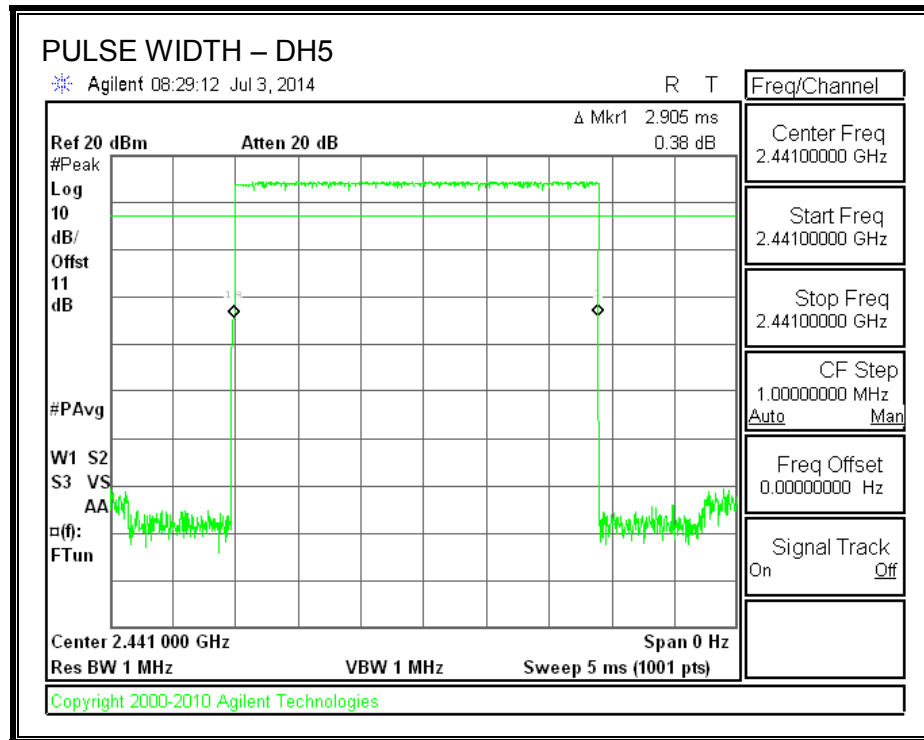
PULSE WIDTH – DH3



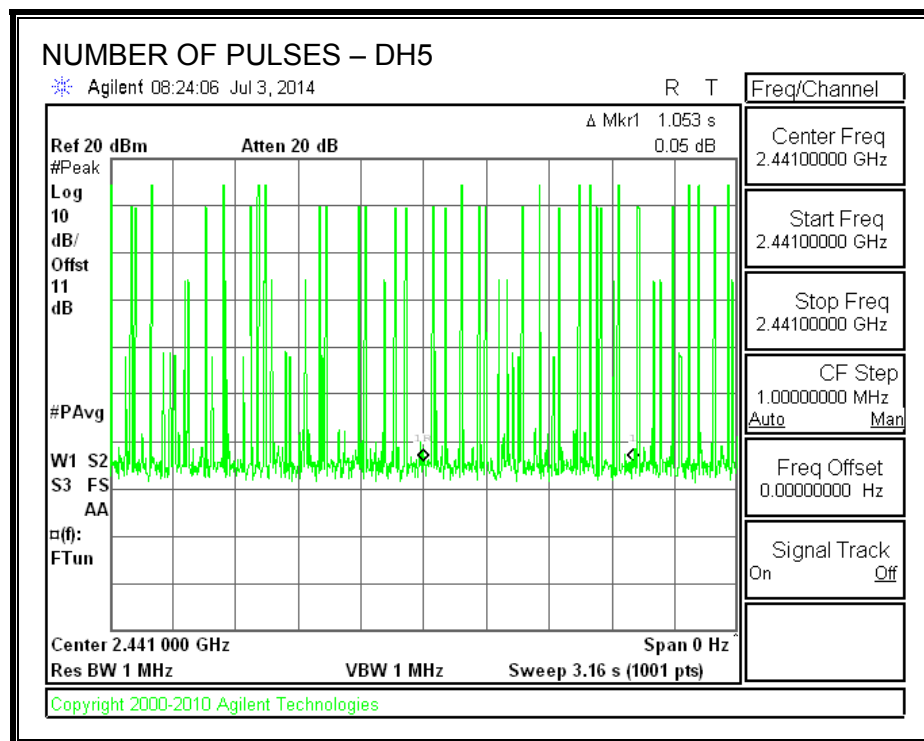
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5



9.2.5. 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 11.0 dB (including 10 dB pad and 1.0 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	9.53
Middle	2441	9.88
High	2480	9.77

9.2.6. OUTPUT POWER

LIMIT

§15.247 (b) (1)

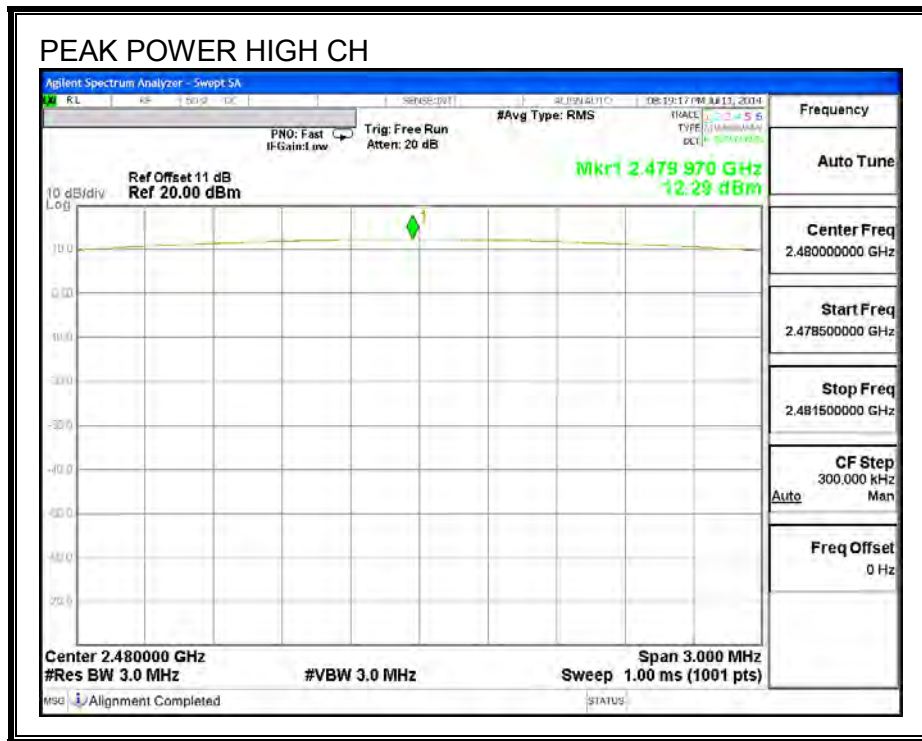
The maximum antenna gain is less than 6 dBi, therefore the limit is 30 dBm. Furthermore, if separation channel frequency is less 20 dB BW, then limit is 21 dBm.

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	12.44	21	-8.53
Middle	2441	12.58	21	-8.42
High	2480	12.29	21	-8.71



9.2.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

Limit = -20 dBc

TEST PROCEDURE

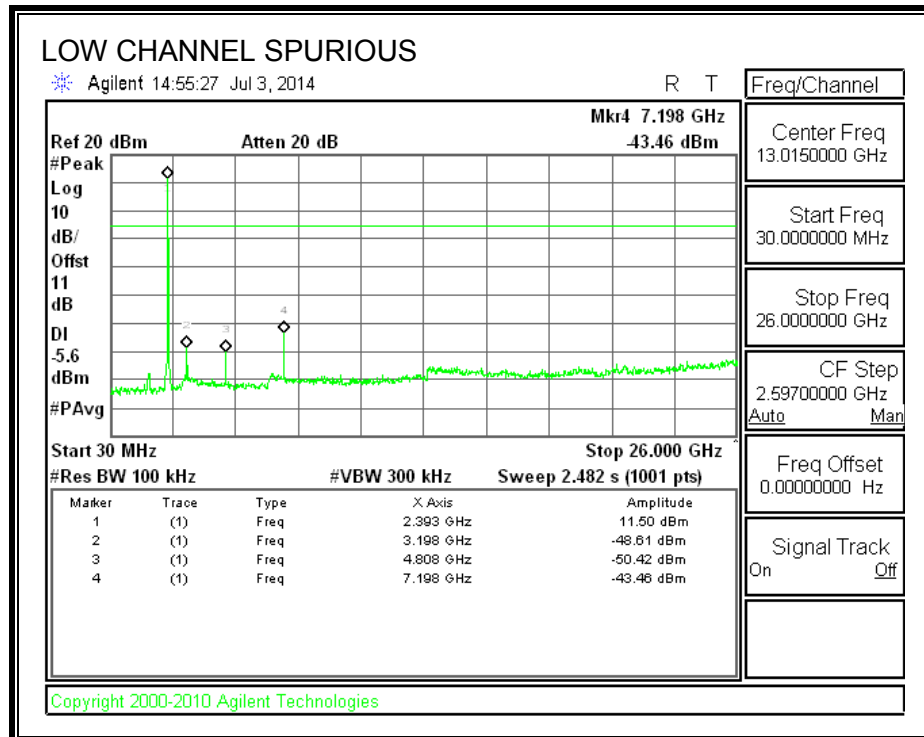
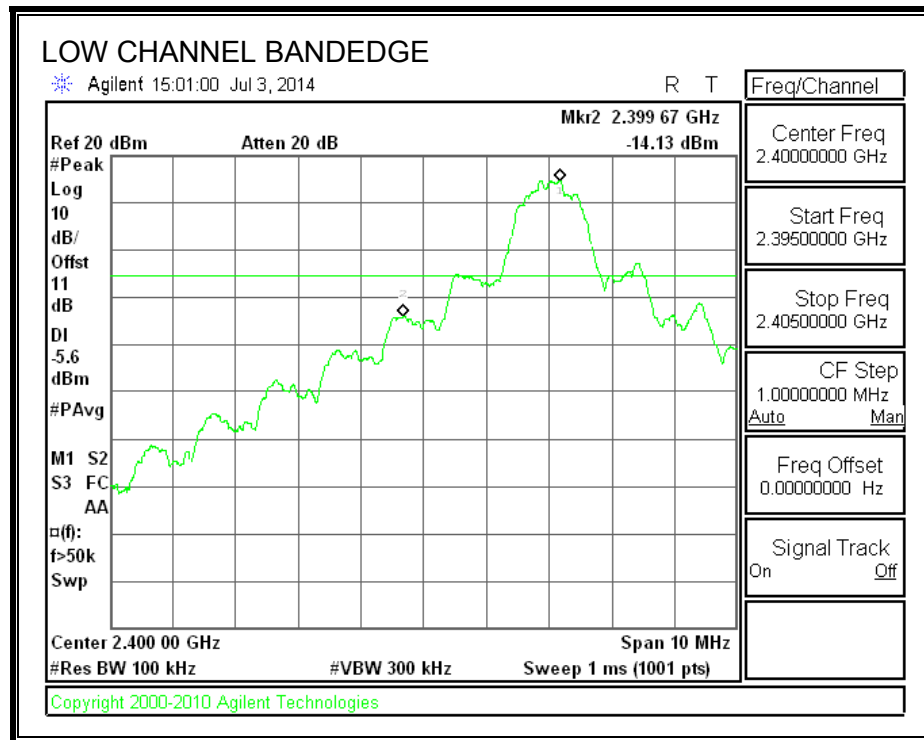
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

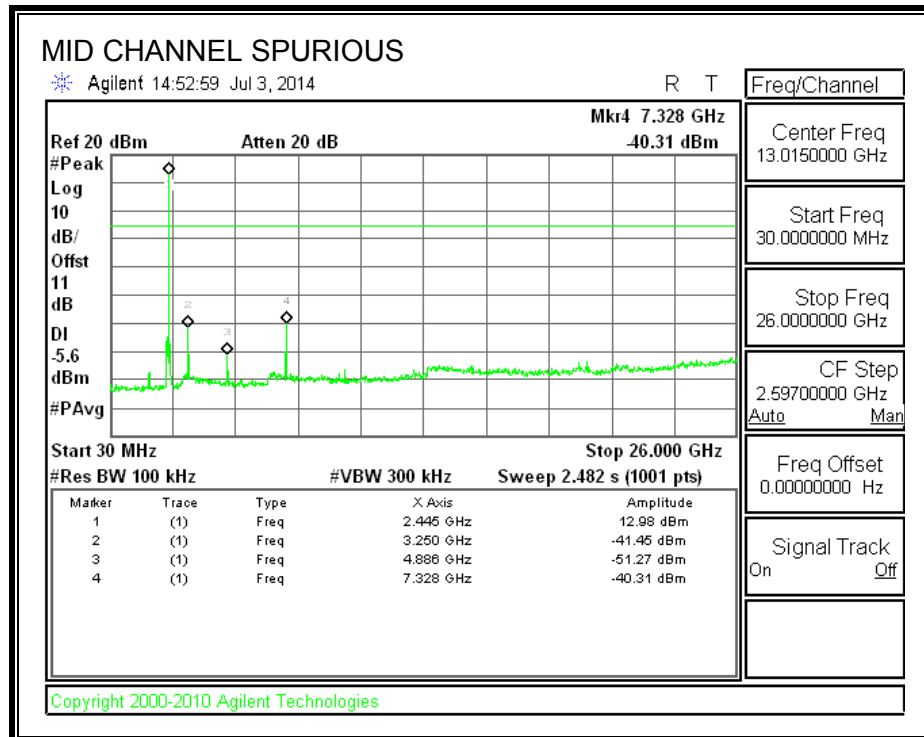
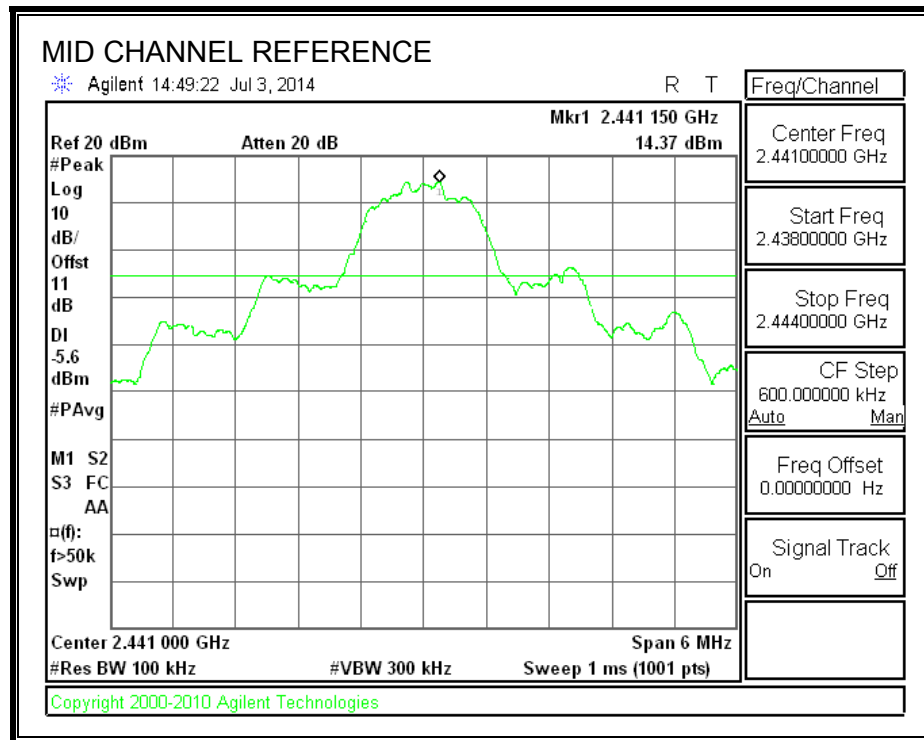
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

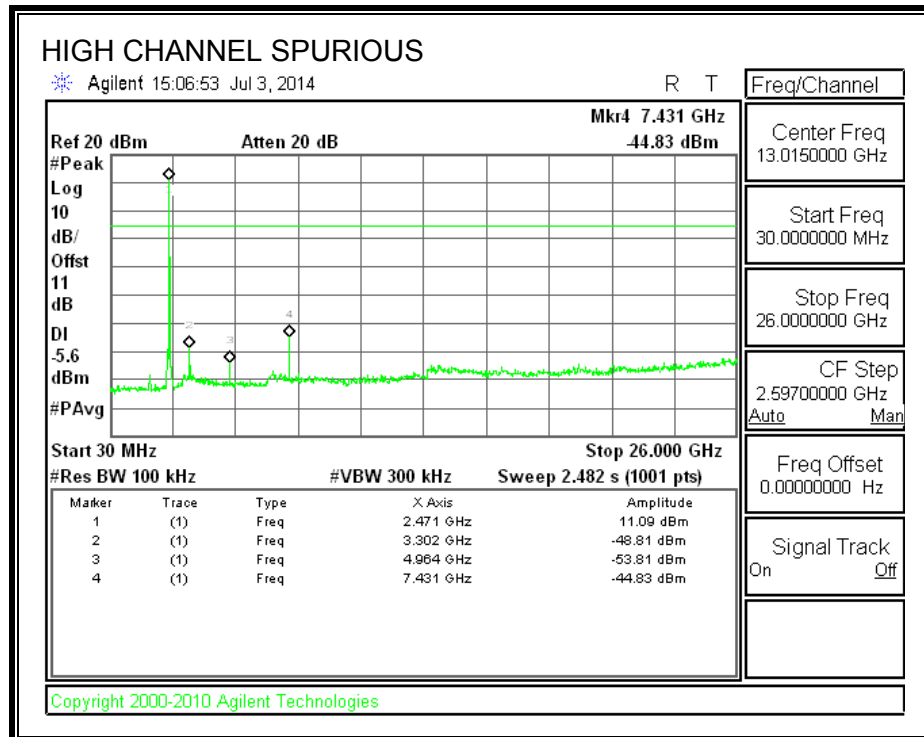
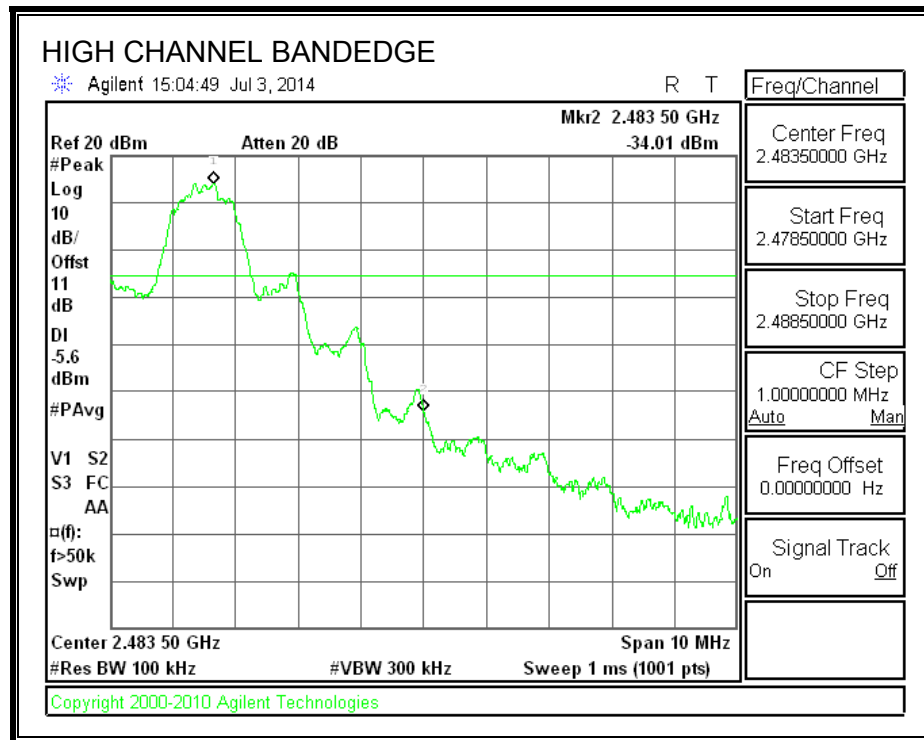
SPURIOUS EMISSIONS, LOW CHANNEL



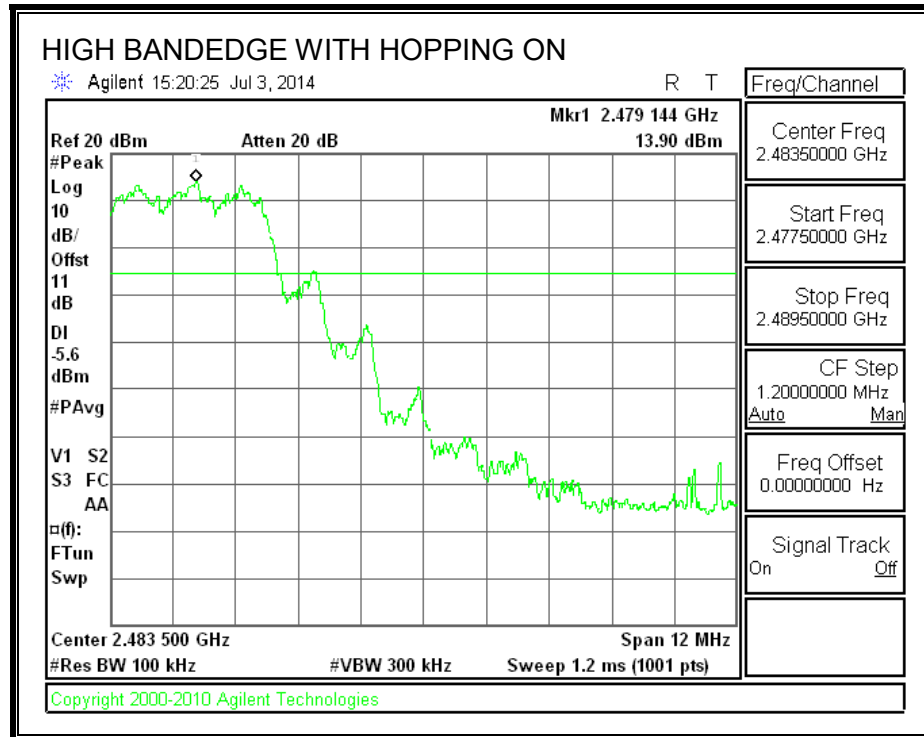
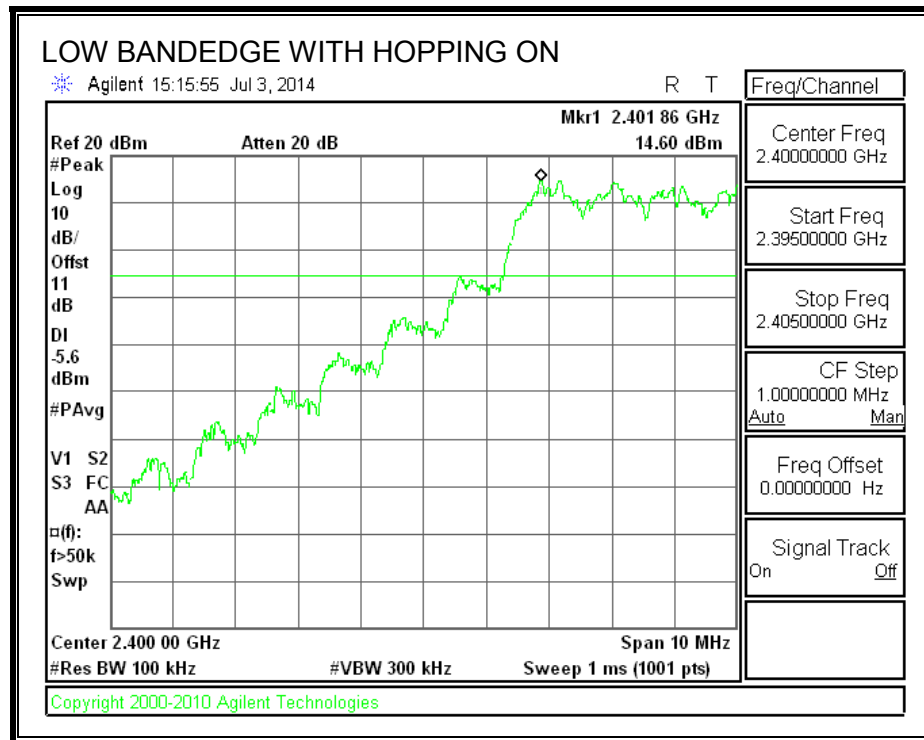
SPURIOUS EMISSIONS, MID CHANNEL



SPURIOUS EMISSIONS, HIGH CHANNEL



SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



10. RADIATED TEST RESULTS

10.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

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 10 Hz for average measurements.

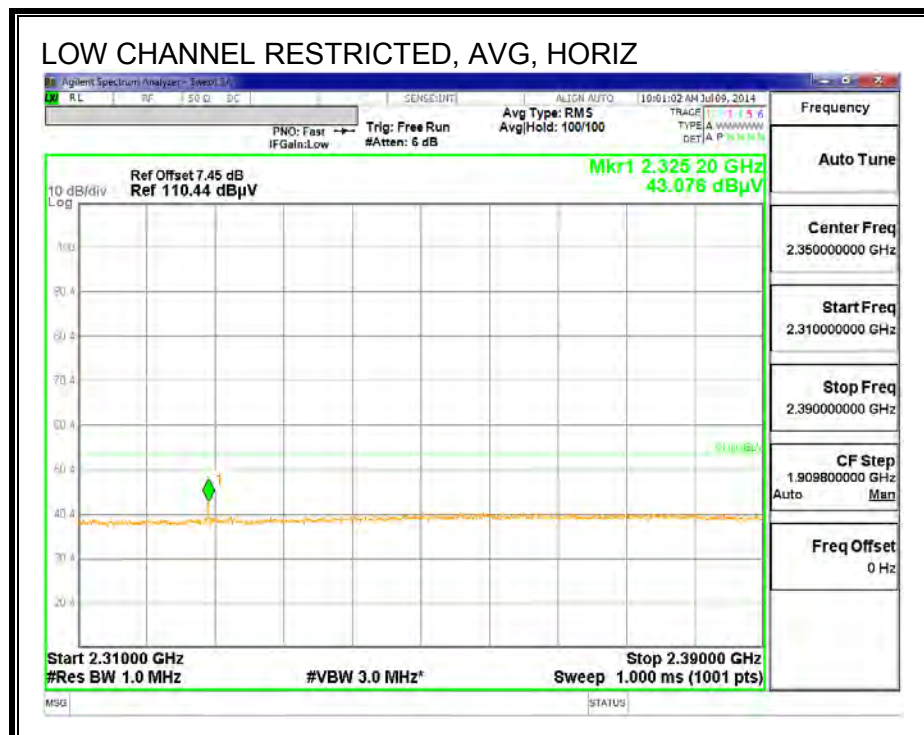
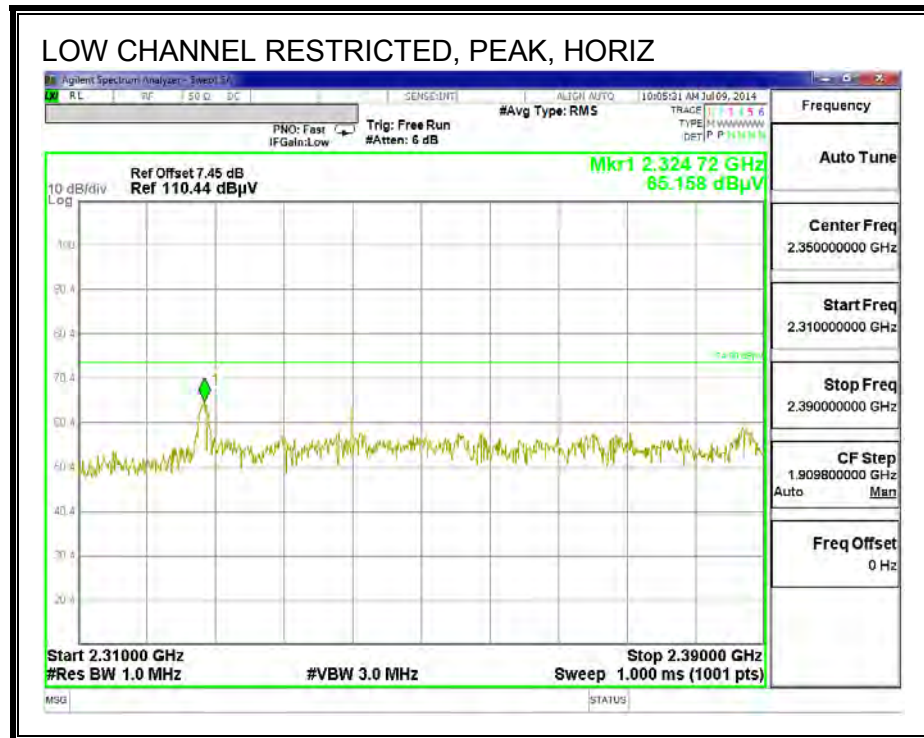
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

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.

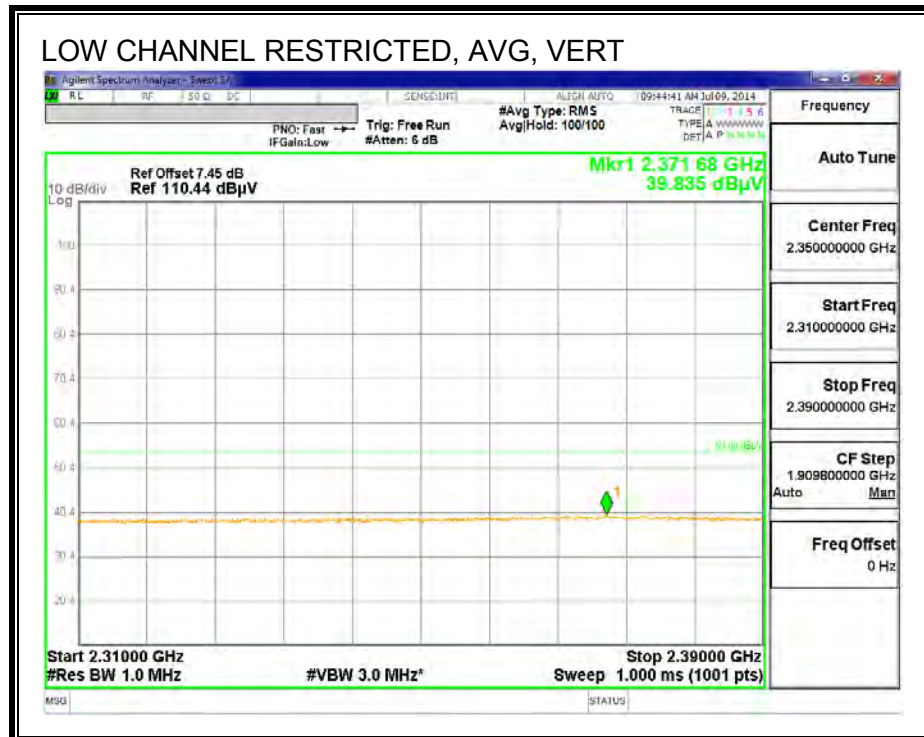
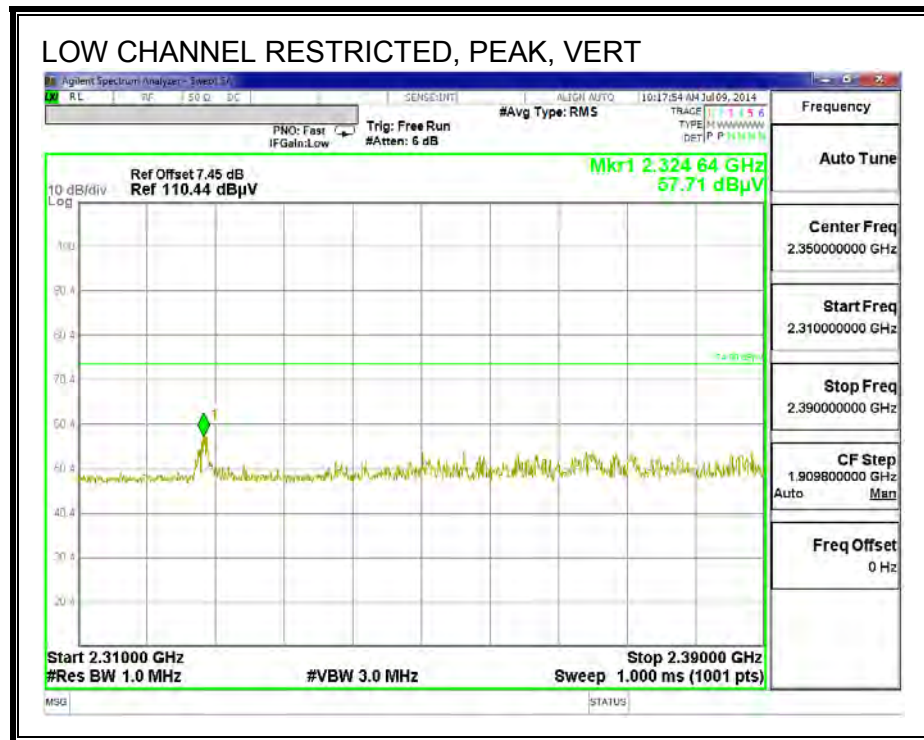
10.2. TRANSMITTER ABOVE 1GHz

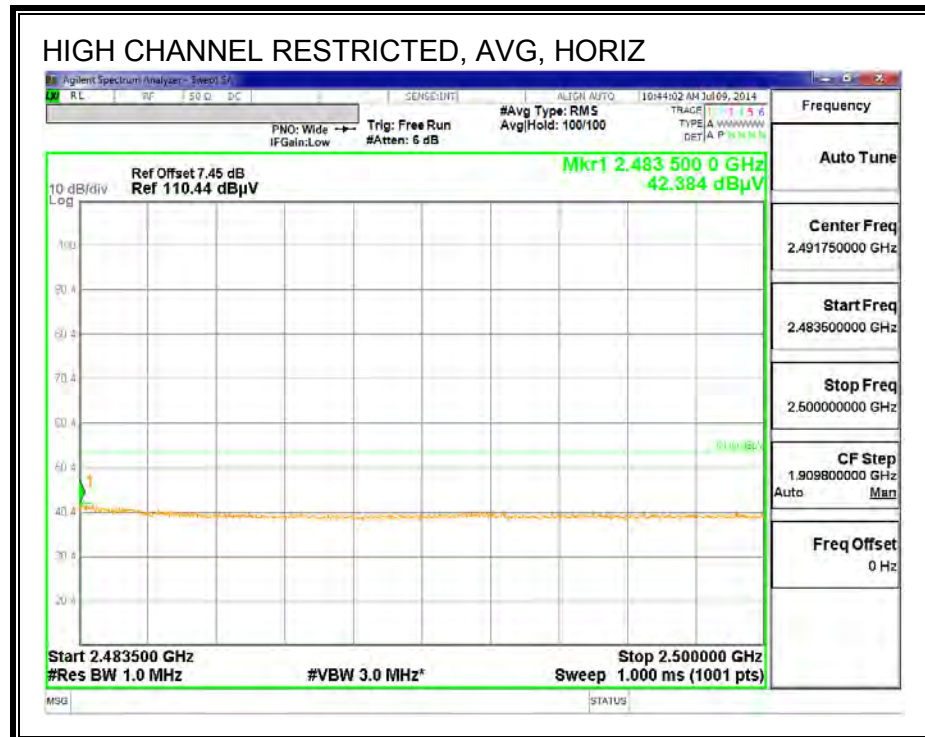
10.2.1. BASIC DATA RATE GFSK MODULATION

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

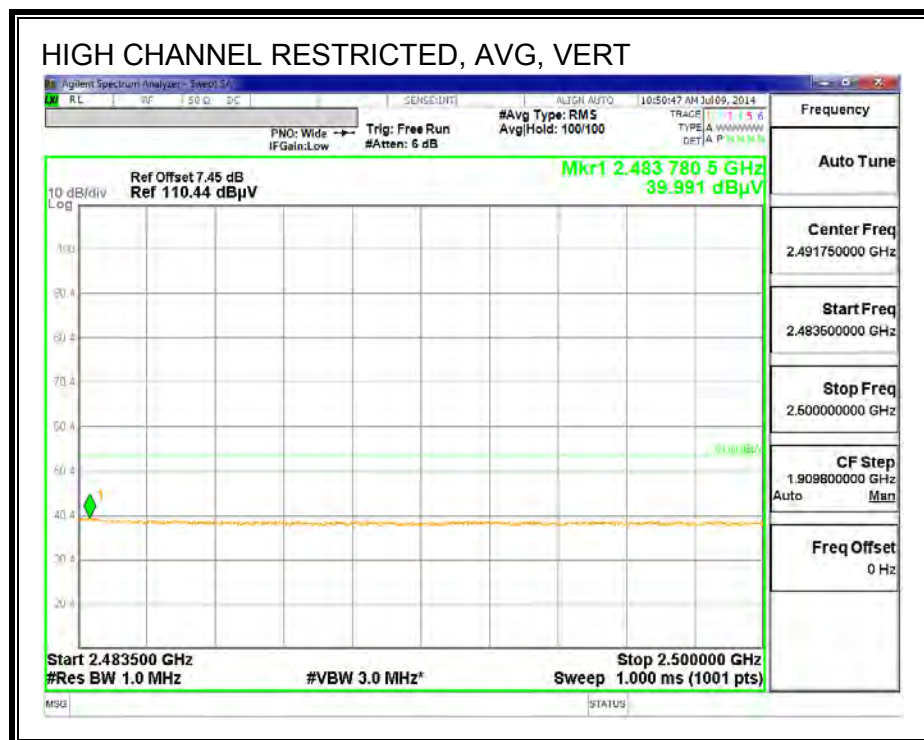
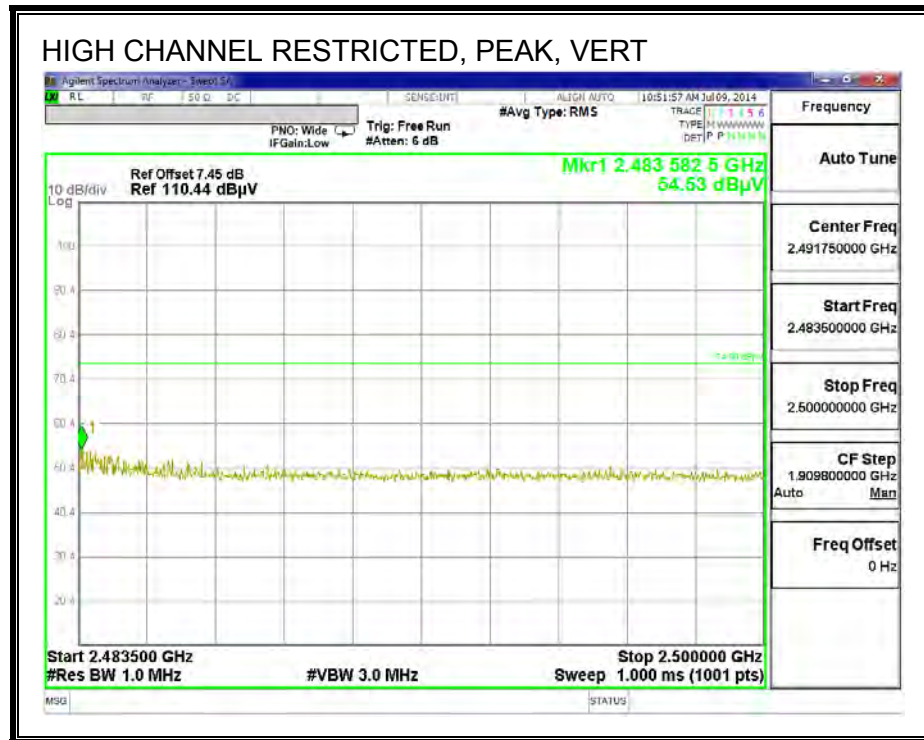


RESTRICTED BANEDGE (LOW CHANNEL, VERTICAL)



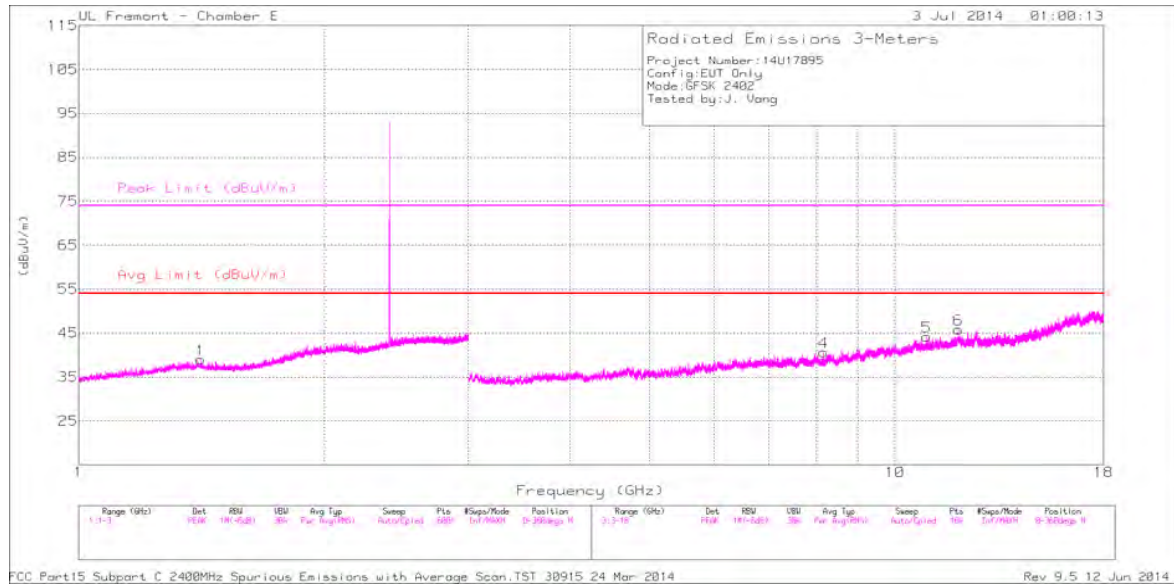


RESTRICTED BANEDGE (HIGH CHANNEL, VERTICAL)

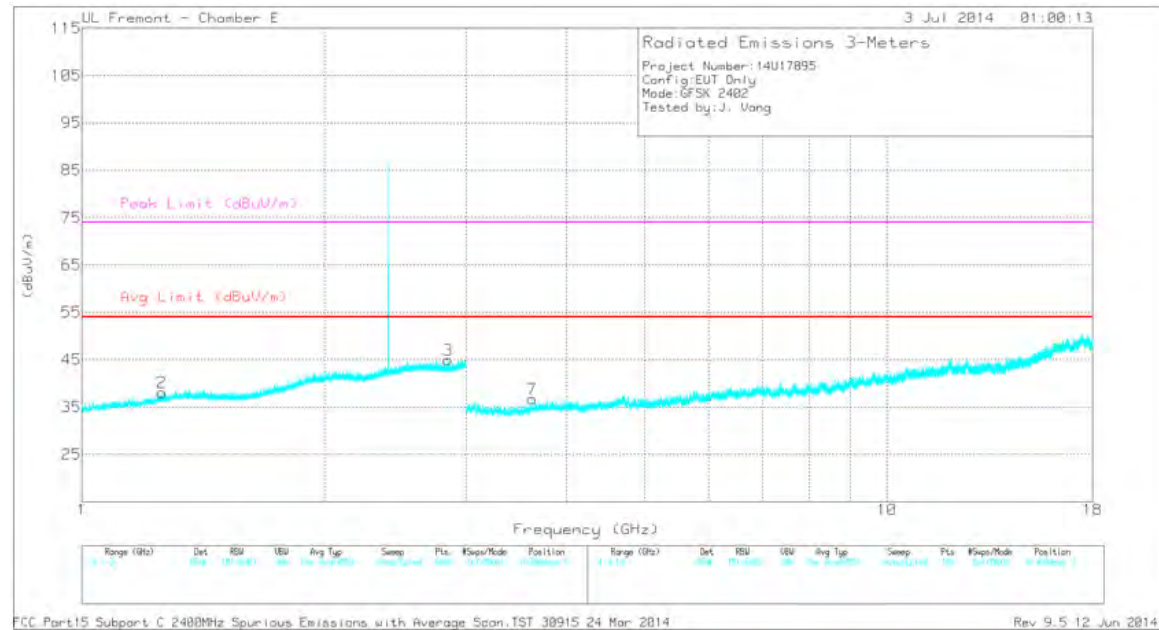


LOW CHANNEL HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL PLOT



LOW CHANNEL VERTICAL PLOT



DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.411	38.04	PK3	28.8	-26.4	0	40.44	-	-	74	-33.56	229	119	H
	* 1.41	31.03	VB10	28.8	-26.4	0	33.43	54	-20.57	-	-	229	119	H
2	* 1.258	39.62	PK3	28.6	-27.2	0	41.02	-	-	74	-32.98	359	196	V
	* 1.257	31.26	VB10	28.6	-27.2	0	32.66	54	-21.34	-	-	359	196	V
3	* 2.849	39.2	PK3	32.4	-24.1	0	47.5	-	-	74	-26.5	77	265	V
	* 2.849	30.55	VB10	32.4	-24.1	0	38.85	54	-15.15	-	-	77	265	V
4	* 8.174	33.86	PK3	35.9	-28	0	41.76	-	-	74	-32.24	98	375	H
	* 8.172	26.44	VB10	35.9	-27.9	0	34.44	54	-19.56	-	-	98	375	H
5	* 10.926	31	PK3	37.9	-23.8	0	45.1	-	-	74	-28.9	121	212	H
	* 10.926	24.2	VB10	37.9	-23.8	0	38.3	54	-15.7	-	-	121	212	H
6	* 11.958	32.61	PK3	38.6	-22.4	0	48.81	-	-	74	-25.19	106	187	H
	* 11.958	23.56	VB10	38.6	-22.4	0	39.76	54	-14.24	-	-	106	187	H
7	* 3.623	37.37	PK3	33.2	-31.8	0	38.77	-	-	74	-35.23	205	210	V
	* 3.623	29.46	VB10	33.2	-31.8	0	30.86	54	-23.14	-	-	205	210	V

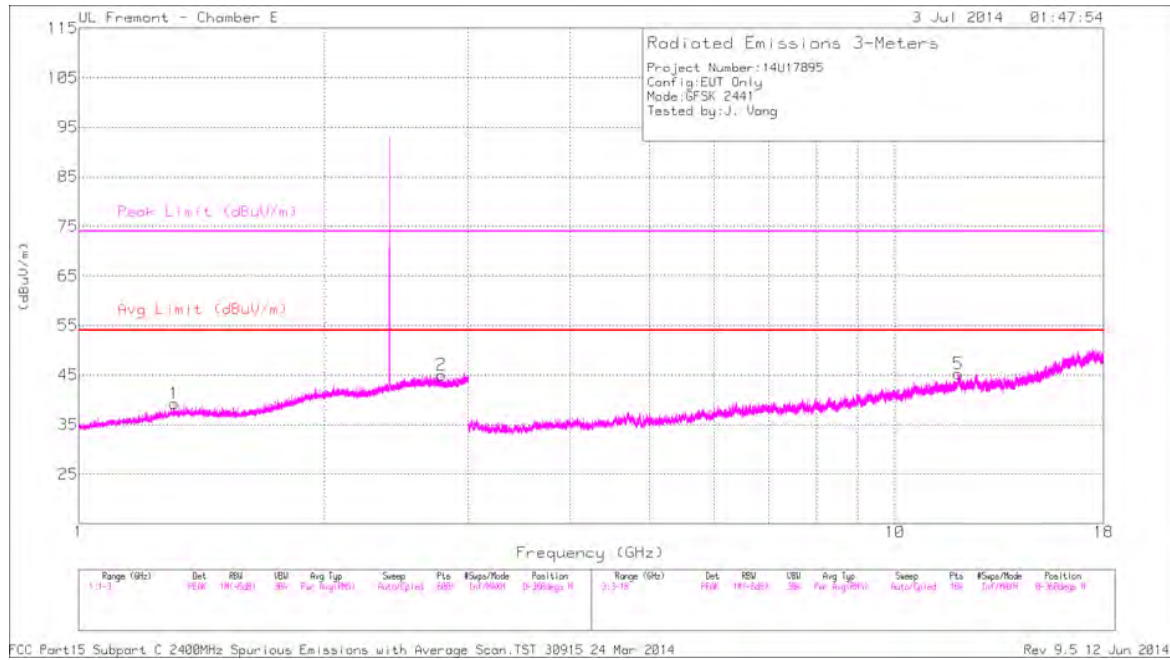
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK3 - FHSS Method: Maximum Peak

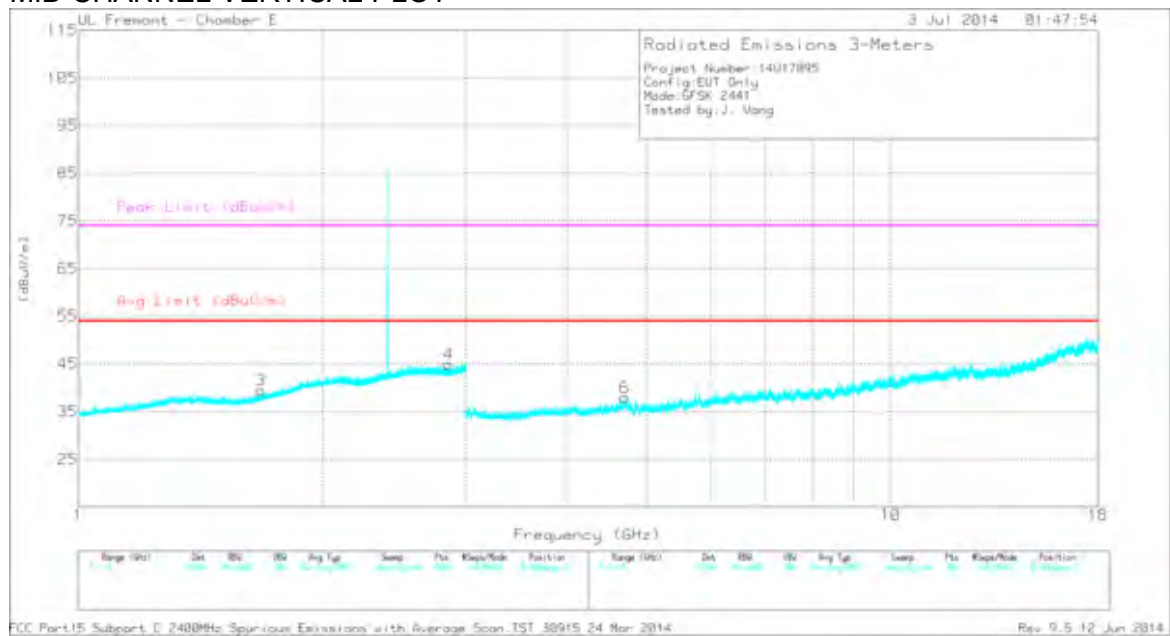
VB10Hz - FHSS Method: 10Hz Video Bandwidth

MID CHANNEL HARMONICS AND SPURIOUS EMISSIONS

MID CHANNEL HORIZONTAL PLOT



MID CHANNEL VERTICAL PLOT



DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/Filtr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.309	39.58	PK3	29	-26.9	0	41.68	-	-	74	-32.32	282	138	H
	* 1.308	31.33	VB10	29	-26.9	0	33.43	54	-20.57	-	-	282	138	H
2	* 2.779	38.92	PK3	32.4	-24	0	47.32	-	-	74	-26.68	33	358	H
	* 2.779	30.77	VB10	32.4	-24	0	39.17	54	-14.83	-	-	33	358	H
3	* 1.677	38.51	PK3	29	-26.3	0	41.21	-	-	74	-32.79	284	219	V
	* 1.679	30.92	VB10	29	-26.3	0	33.62	54	-20.38	-	-	284	219	V
4	* 2.854	38.14	PK3	32.4	-24.1	0	46.44	-	-	74	-27.56	234	106	V
	* 2.854	30.56	VB10	32.4	-24.1	0	38.86	54	-15.14	-	-	234	106	V
5	* 11.949	30.63	PK3	38.6	-22.2	0	47.03	-	-	74	-26.97	285	328	H
	* 11.95	23.5	VB10	38.6	-22.2	0	39.9	54	-14.1	-	-	285	328	H
6	* 4.708	36.39	PK3	34.2	-30.5	0	40.09	-	-	74	-33.91	38	103	V
	* 4.71	29.43	VB10	34.2	-30.5	0	33.13	54	-20.87	-	-	38	103	V

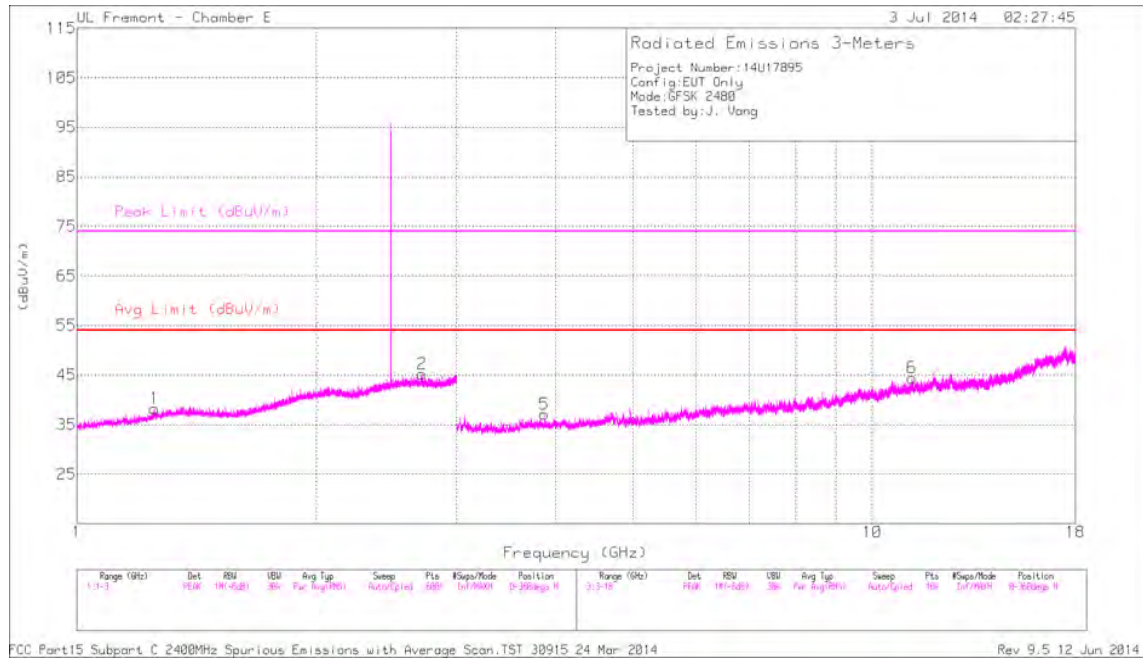
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK3 - FHSS Method: Maximum Peak

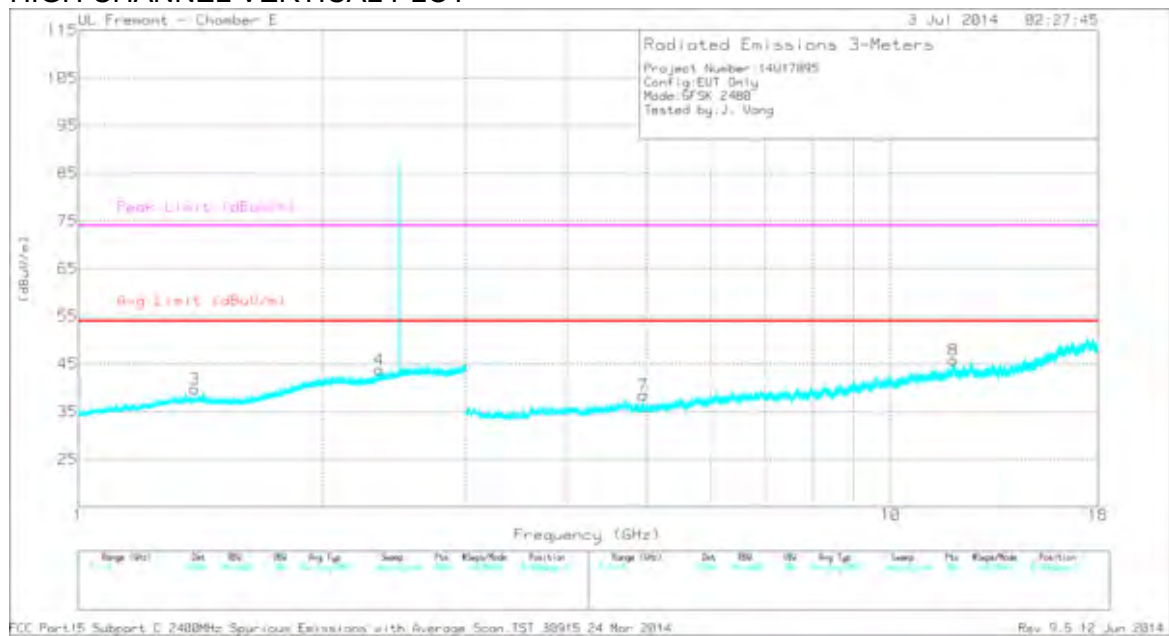
VB10Hz - FHSS Method: 10Hz Video Bandwidth

HIGH CHANNEL HARMONICS AND SPURIOUS EMISSIONS

HIGH CHANNEL HORIZONTAL PLOT



HIGH CHANNEL VERTICAL PLOT



DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cb/Filtr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.252	38.45	PK3	28.5	-27.2	0	39.75	-	-	74	-34.25	153	227	H
	* 1.252	31.26	VB10	28.5	-27.2	0	32.56	54	-21.44	-	-	153	227	H
2	* 2.716	37.35	PK3	32.5	-23.9	0	45.95	-	-	74	-28.05	258	357	H
	* 2.717	30.45	VB10	32.5	-23.9	0	39.05	54	-14.95	-	-	258	357	H
3	* 1.391	38.66	PK3	28.9	-26.5	0	41.06	-	-	74	-32.94	234	326	V
	* 1.392	30.81	VB10	28.9	-26.4	0	33.31	54	-20.69	-	-	234	326	V
4	* 2.345	37.49	PK3	31.7	-24.7	0	44.49	-	-	74	-29.51	19	163	V
	* 2.345	30.71	VB10	31.7	-24.7	0	37.71	54	-16.29	-	-	19	163	V
5	* 3.871	36.24	PK3	33.5	-31.7	0	38.04	-	-	74	-35.96	20	381	H
	* 3.872	29.22	VB10	33.5	-31.7	0	31.02	54	-22.98	-	-	20	381	H
6	* 11.215	31.03	PK3	37.9	-23.5	0	45.43	-	-	74	-28.57	60	265	H
	* 11.216	23.94	VB10	37.9	-23.5	0	38.34	54	-15.66	-	-	60	265	H
7	* 4.96	37.73	PK3	34.1	-30.2	0	41.63	-	-	74	-32.37	328	187	V
	* 4.96	31.43	VB10	34.1	-30.2	0	35.33	54	-18.67	-	-	328	187	V
8	* 11.944	30.33	PK3	38.6	-22.1	0	46.83	-	-	74	-27.17	114	265	V
	* 11.944	23.47	VB10	38.6	-22.1	0	39.97	54	-14.03	-	-	114	265	V

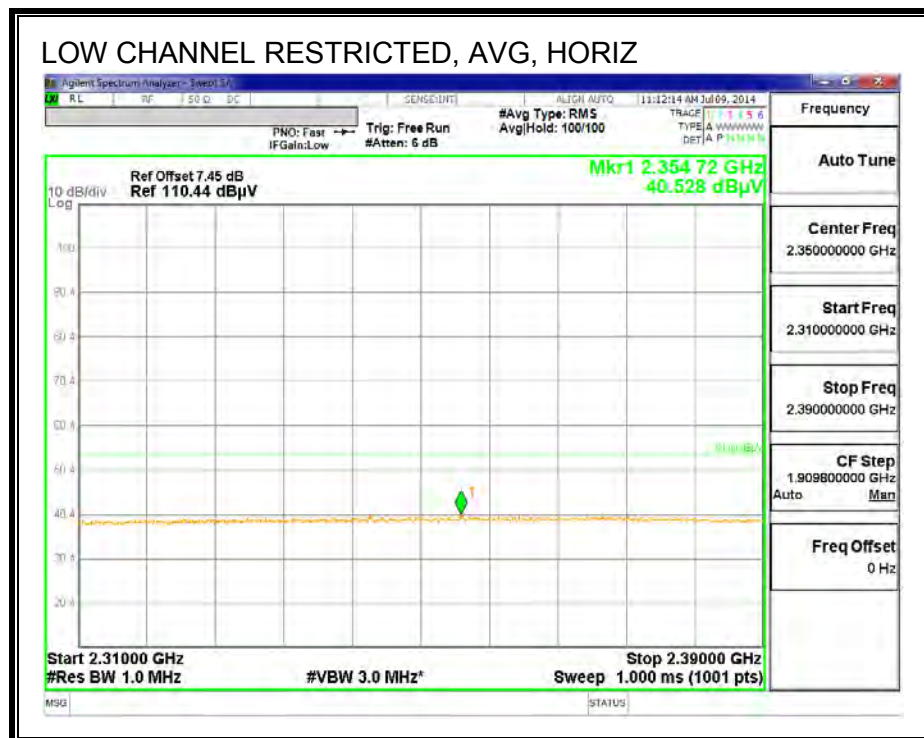
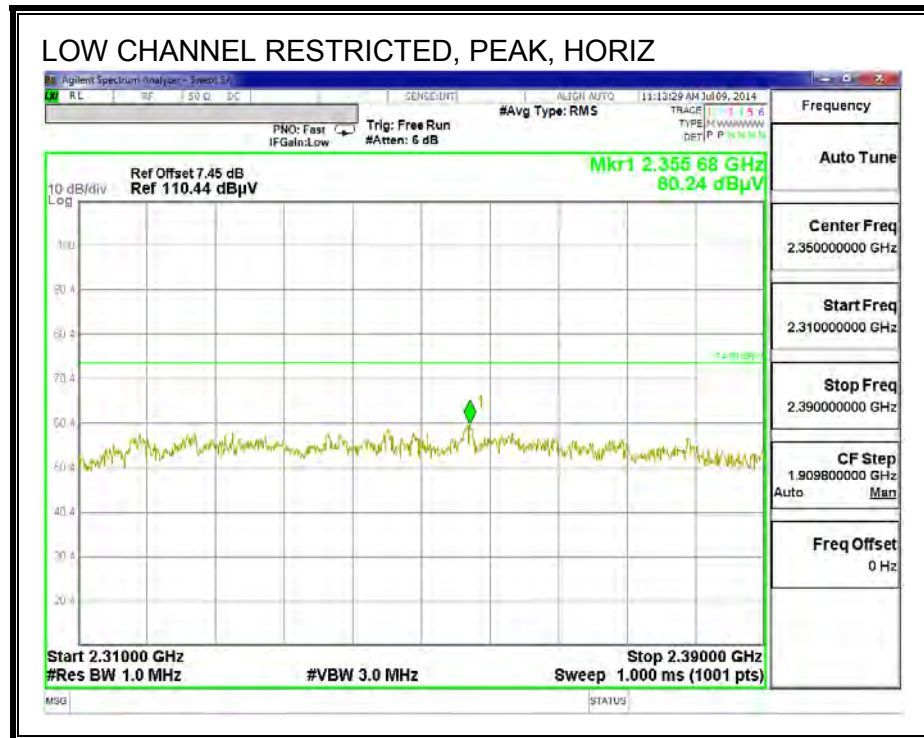
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK3 - FHSS Method: Maximum Peak

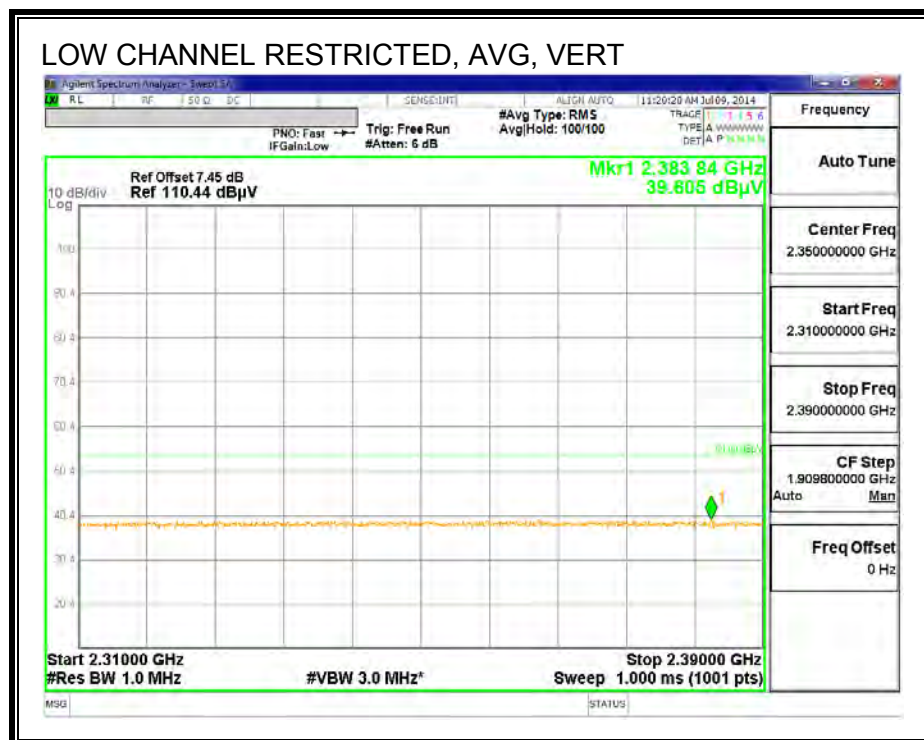
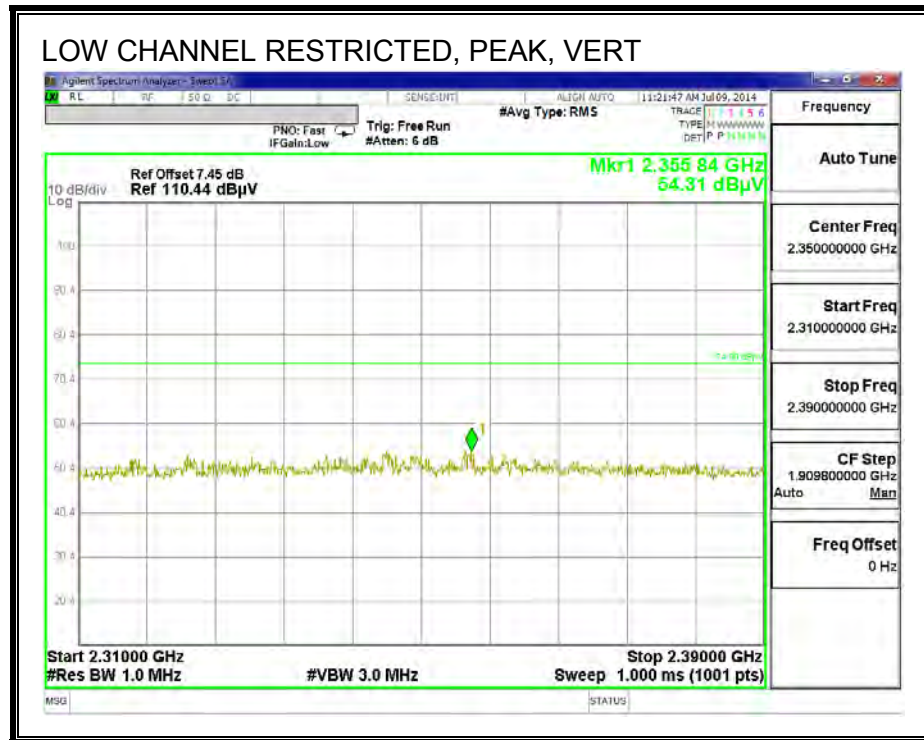
VB10Hz - FHSS Method: 10Hz Video Bandwidth

10.2.2. ENHANCED DATA RATE 8PSK MODULATION

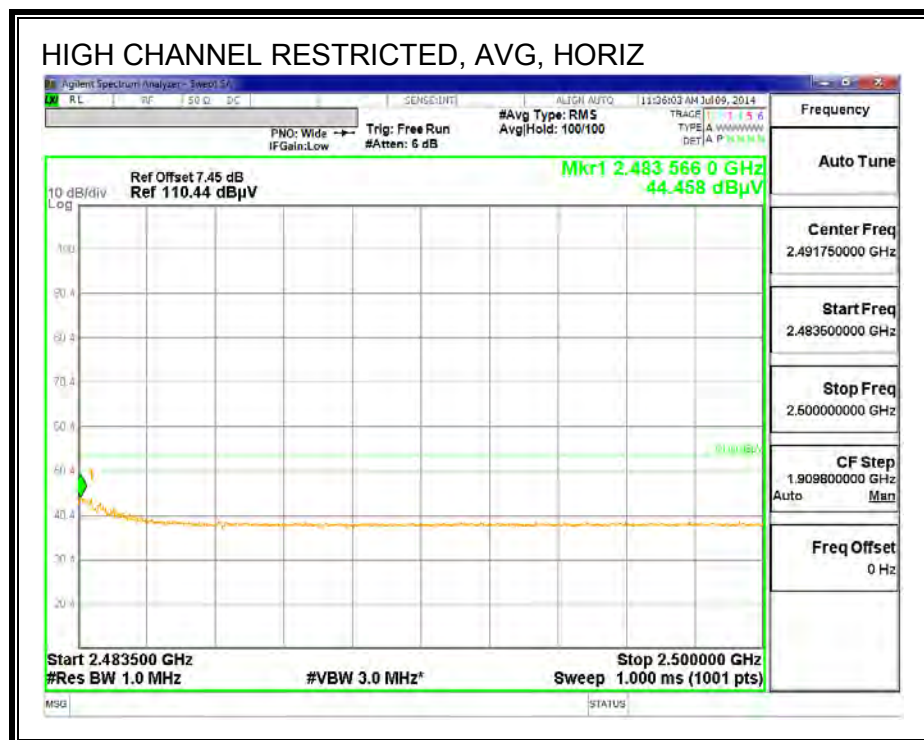
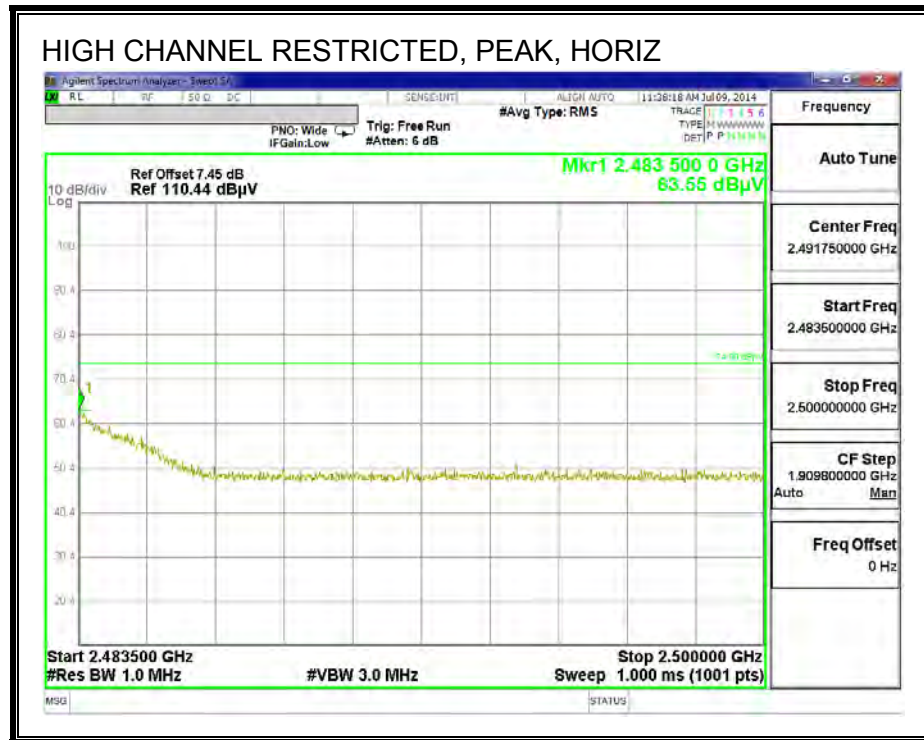
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



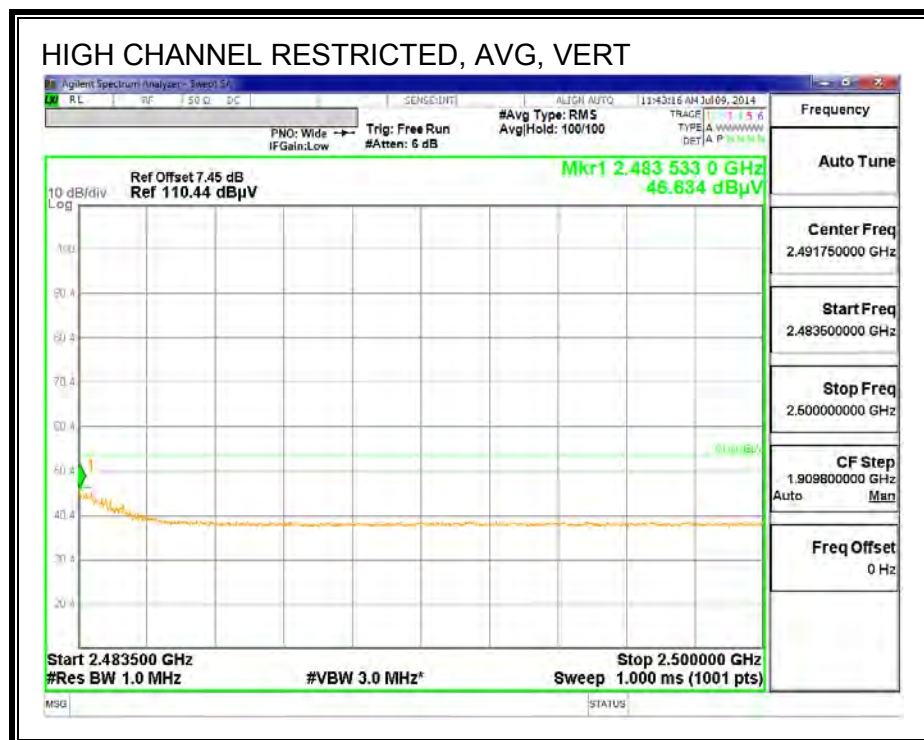
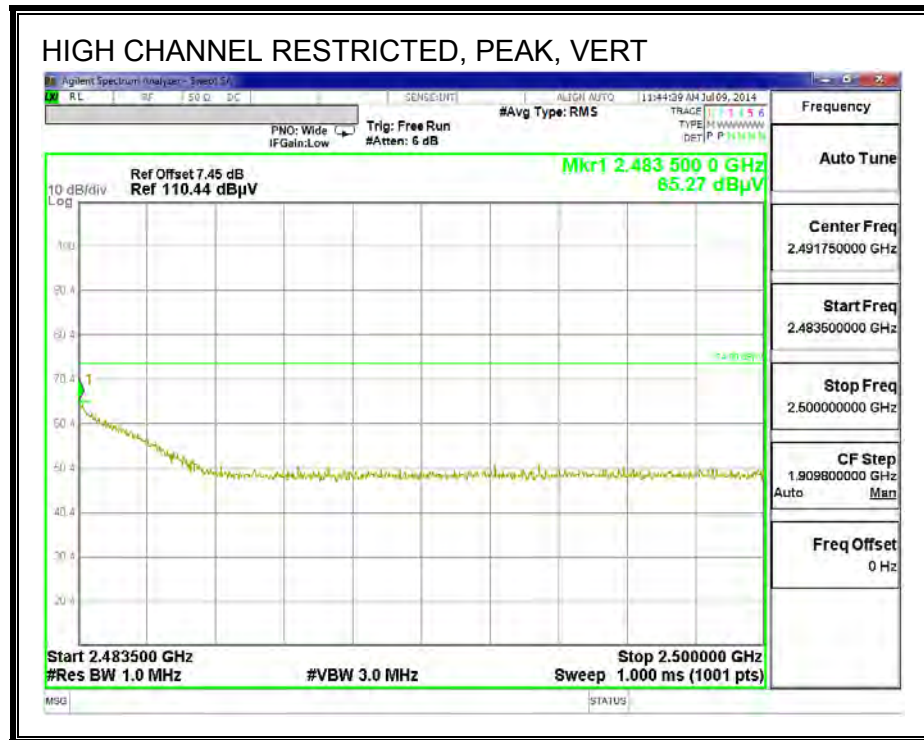
RESTRICTED BANEDGE (LOW CHANNEL, VERTICAL)



RESTRICTED BANEDGE (HIGH CHANNEL, HORIZONTAL)

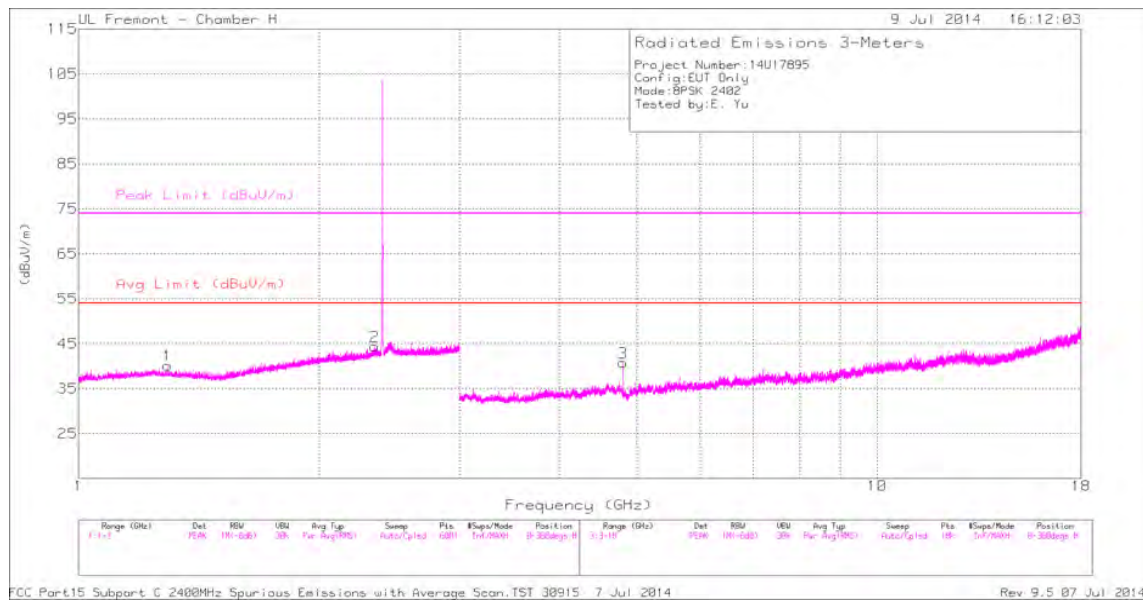


RESTRICTED BANEDGE (HIGH CHANNEL, VERTICAL)

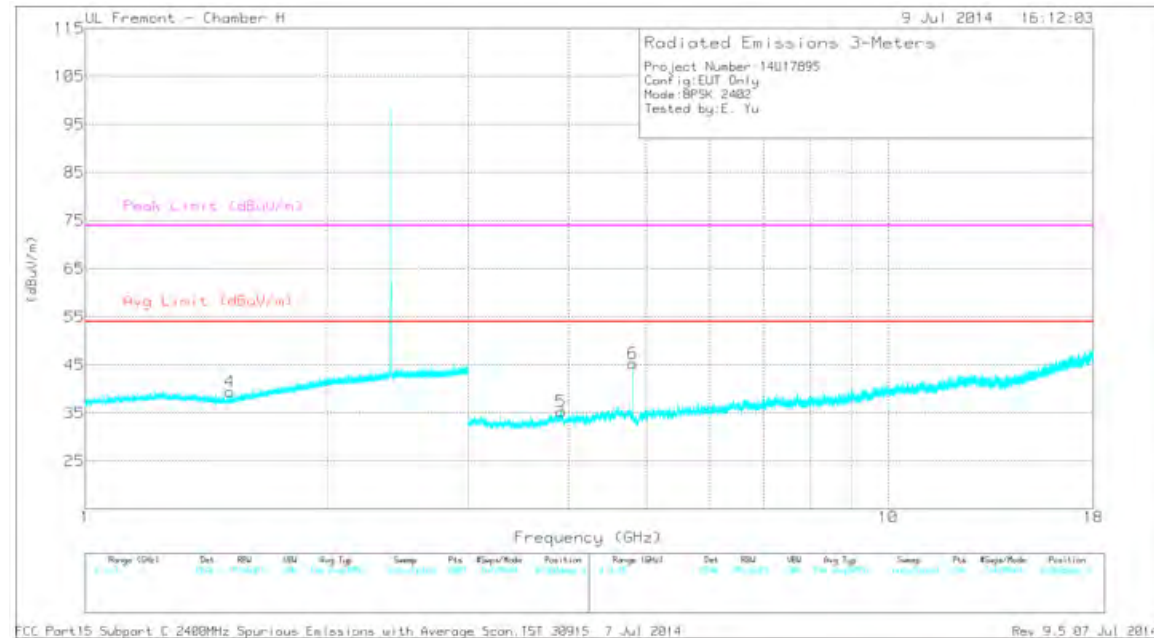


LOW CHANNEL HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL PLOT



LOW CHANNEL VERTICAL PLOT



DATA

Trace Markers

Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T863 (dB/m)	Amp/Cbl/ Ftr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.291	43.65	PK3	28.8	-25.8	46.65	-	-	74	-27.35	316	108	H
	* 1.294	31.21	VB1T	28.8	-25.8	34.21	54	-19.79	-	-	316	108	H
2	* 2.35	43.73	PK3	31.9	-24.6	51.03	-	-	74	-22.97	284	132	H
	* 2.35	30.82	VB1T	31.9	-24.6	38.12	54	-15.88	-	-	284	132	H
4	* 1.515	43.85	PK3	27.8	-25.4	46.25	-	-	74	-27.75	296	149	V
	* 1.512	30.84	VB1T	27.8	-25.4	33.24	54	-20.76	-	-	296	149	V
3	* 4.804	48.03	PK3	34.3	-32.5	49.83	-	-	74	-24.17	216	256	H
	* 4.804	40.89	VB1T	34.3	-32.5	42.69	54	-11.31	-	-	216	256	H
5	* 3.913	42.51	PK3	33.4	-33	42.91	-	-	74	-31.09	197	228	V
	* 3.915	29.9	VB1T	33.4	-33	30.3	54	-23.7	-	-	197	228	V
6	* 4.804	49.61	PK3	34.3	-32.5	51.41	-	-	74	-22.59	176	202	V
	* 4.804	43.05	VB1T	34.3	-32.5	44.85	54	-9.15	-	-	176	202	V

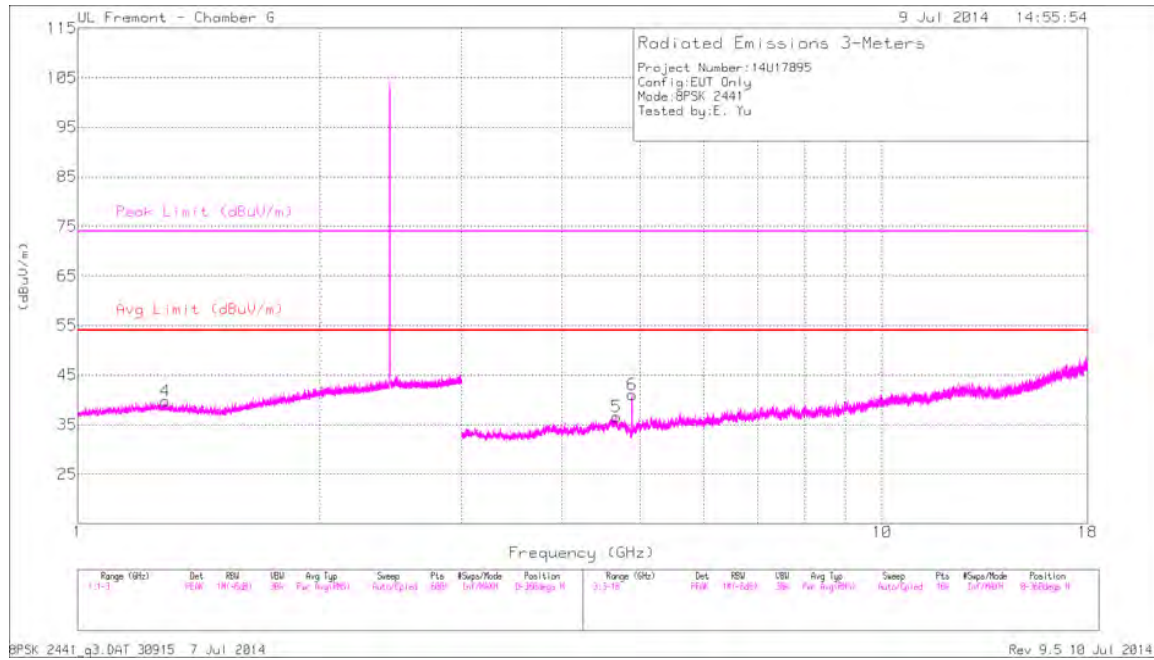
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK3 - FHSS Method: Maximum Peak

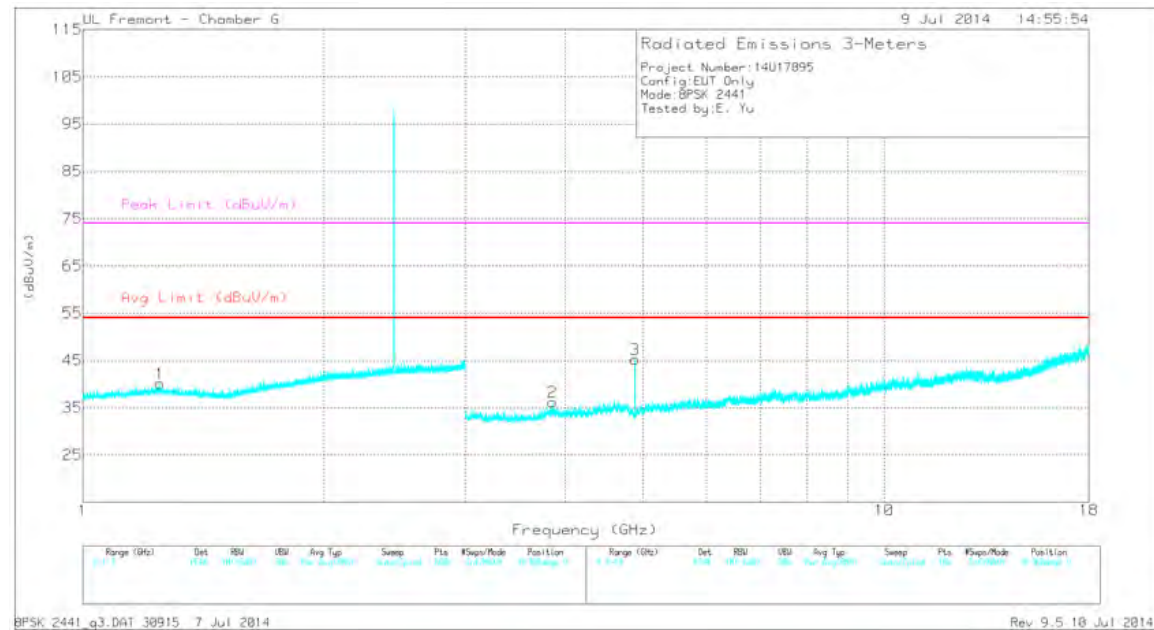
VB1T - FHSS Method: VB=1/Ton, Voltage Averaging Max Hold where: Ton is the duration of the packet

MID CHANNEL HARMONICS AND SPURIOUS EMISSIONS

MID CHANNEL HORIZONTAL PLOT



MID CHANNEL VERTICAL PLOT



DATA

Trace Markers

Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T863 (dB/m)	Amp/Cbl/ Fitr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	* 1.283	44.06	PK3	28.8	-25.9	46.96	-	-	74	-27.04	48	124	H
	* 1.286	31.06	VB10	28.8	-25.9	33.96	54	-20.04	-	-	48	124	H
5	* 1.249	44.39	PK3	29	-25.9	47.49	-	-	74	-26.51	131	226	V
	* 1.247	31.11	VB10	29	-25.9	34.21	54	-19.79	-	-	131	226	V
6	* 4.673	41.78	PK3	34.2	-31.9	44.08	-	-	74	-29.92	178	235	H
	* 4.674	29.02	VB10	34.2	-31.9	31.32	54	-22.68	-	-	178	235	H
1	* 4.884	47.5	PK3	34.3	-32	49.8	-	-	74	-24.2	218	278	H
	* 4.884	39.46	VB10	34.3	-32	41.76	54	-12.24	-	-	218	278	H
2	* 3.854	42.24	PK3	33.3	-32.4	43.14	-	-	74	-30.86	100	221	V
	* 3.855	29.51	VB10	33.3	-32.4	30.41	54	-23.59	-	-	100	221	V
3	* 4.884	48.64	PK3	34.3	-32	50.94	-	-	74	-23.06	184	241	V
	* 4.884	40.81	VB10	34.3	-32	43.11	54	-10.89	-	-	184	241	V

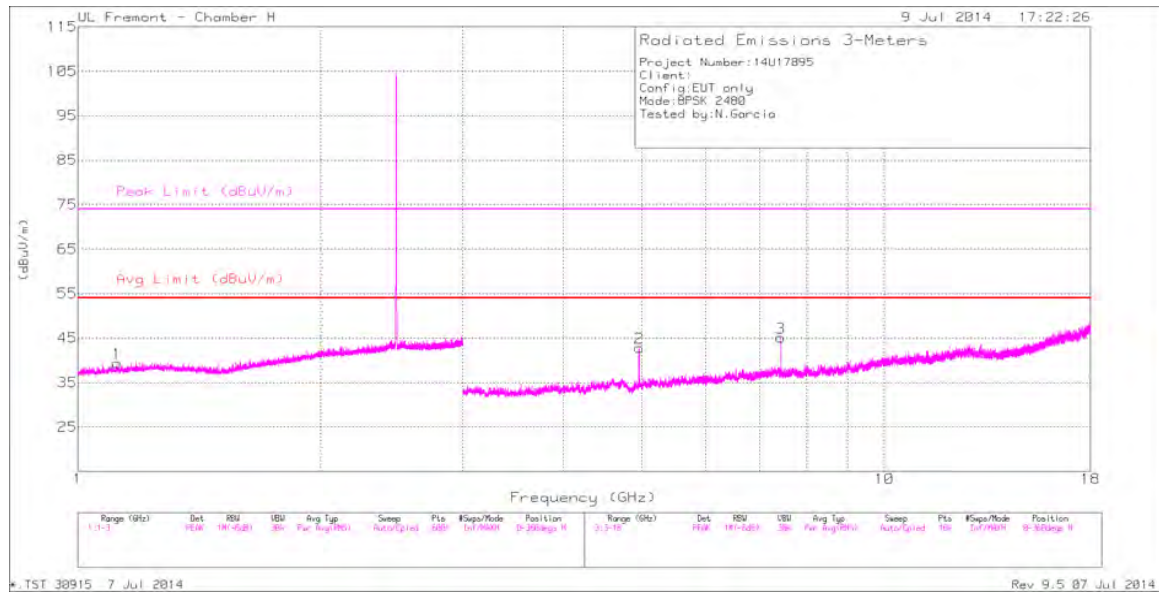
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK3 - FHSS Method: Maximum Peak

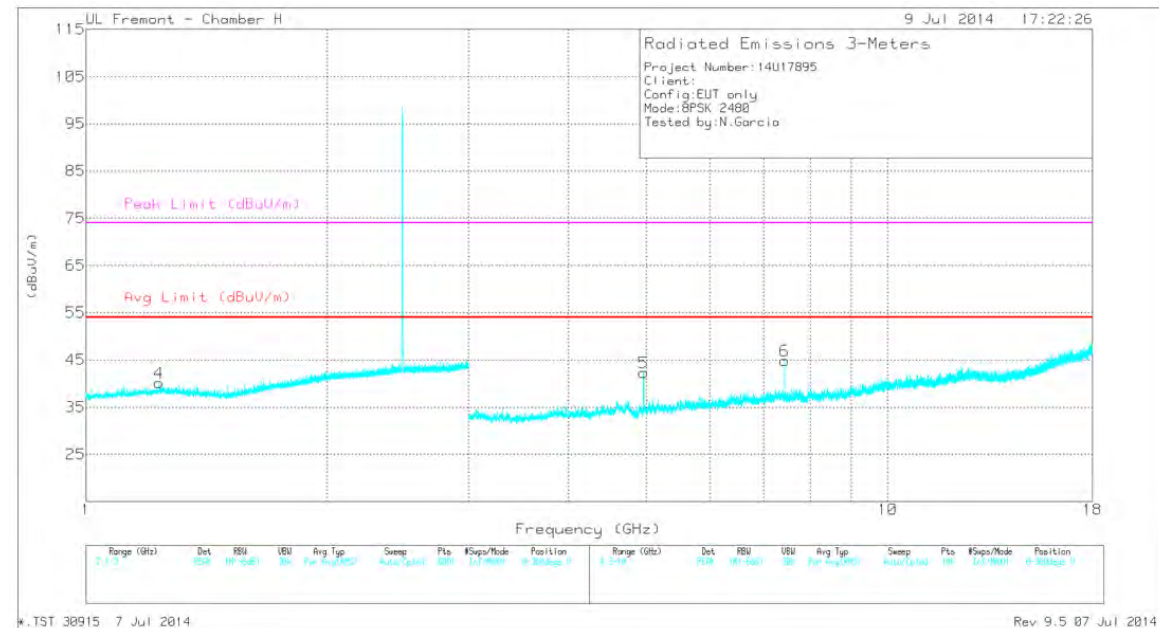
VB10Hz - FHSS Method: 10Hz Video Bandwidth

HIGH CHANNEL HARMONICS AND SPURIOUS EMISSIONS

HIGH CHANNEL HORIZONTAL PLOT



HIGH CHANNEL VERTICAL PLOT



DATA

Trace Markers

Markers	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T863 (dB/m)	Amp/Cbl/ Fitr/Pad (dB)	DC Corr (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 1.119	44.2	PK3	28.3	-25.8	0	46.7	-	-	74	-27.3	2	202	H
	* 1.12	31.41	VB1T	28.3	-25.8	0	33.91	54	-20.09	-	-	2	202	H
4	* 1.234	44.31	PK3	28.9	-25.9	0	47.31	-	-	74	-26.69	45	156	V
	* 1.234	31.59	VB1T	28.9	-25.9	0	34.59	54	-19.41	-	-	45	156	V
2	* 4.96	46.73	PK3	34.3	-31.8	0	49.23	-	-	74	-24.77	198	306	H
	* 4.96	39.89	VB1T	34.3	-31.8	0	42.39	54	-11.61	-	-	198	306	H
3	* 7.44	45.99	PK3	36.1	-29.3	0	52.79	-	-	74	-21.21	245	202	H
	* 7.44	37.19	VB1T	36.1	-29.3	0	43.99	54	-10.01	-	-	245	202	H
5	* 4.959	45.77	PK3	34.3	-31.8	0	48.27	-	-	74	-25.73	153	157	V
	* 4.96	38.74	VB1T	34.3	-31.8	0	41.24	54	-12.76	-	-	153	157	V
6	* 7.44	45.88	PK3	36.1	-29.3	0	52.68	-	-	74	-21.32	19	382	V
	* 7.44	37.08	VB1T	36.1	-29.3	0	43.88	54	-10.12	-	-	19	382	V

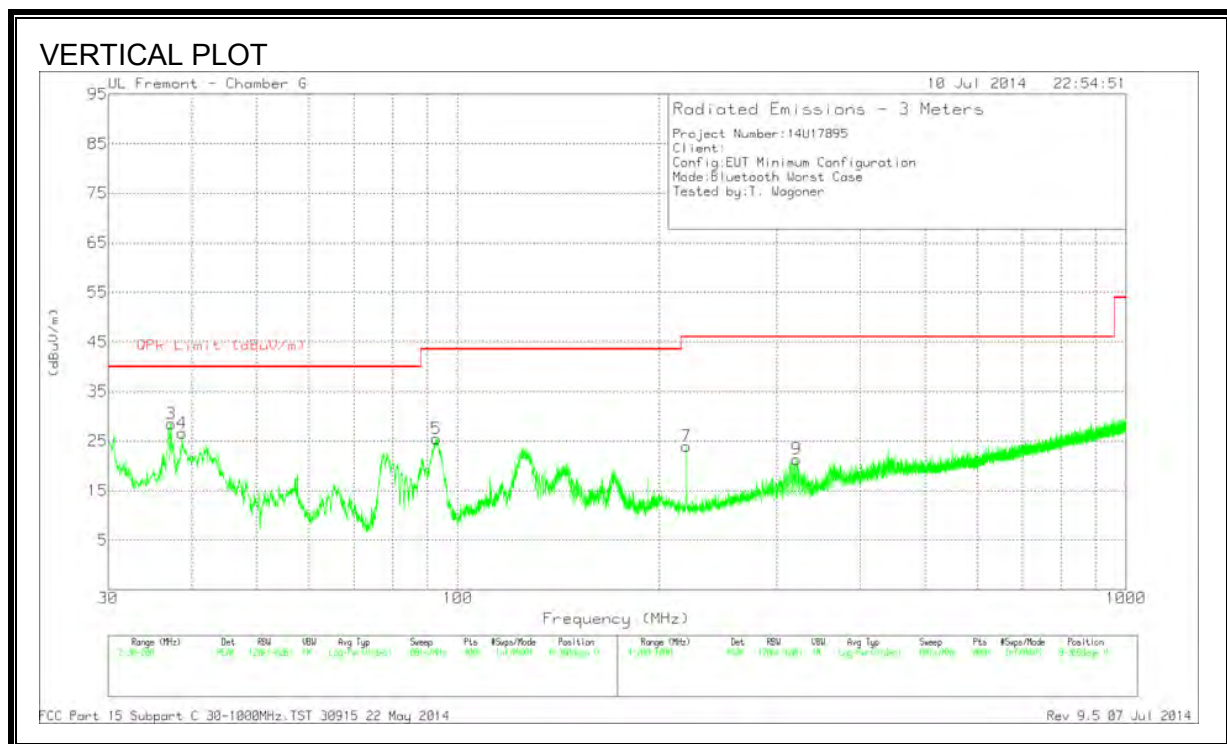
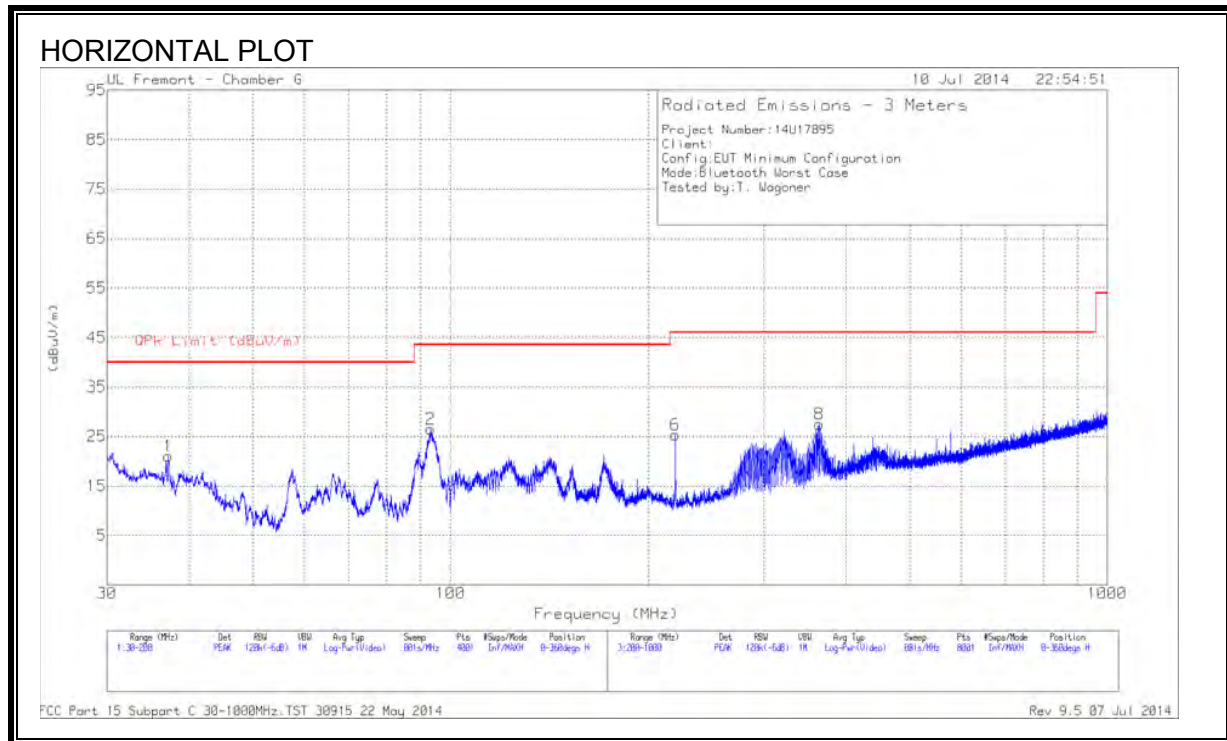
* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK3 - FHSS Method: Maximum Peak

VB1T - FHSS Method: VB=1/Ton, Voltage Averaging Max Hold where: Ton is the duration of the packet

10.3. WORST-CASE BELOW 1 GHz

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



DATA

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Hybrid	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	37.1825	32.74	PK	19.2	-30.9	21.04	40	-18.96	0-360	301	H
3	37.2675	40.28	PK	19.1	-30.9	28.48	40	-11.52	0-360	100	V
4	38.7125	39.44	PK	18.1	-30.9	26.64	40	-13.36	0-360	100	V
5	92.985	44.32	PK	11.2	-30.1	25.42	43.52	-18.1	0-360	100	V
2	93.3675	45.35	PK	11.3	-30.2	26.45	43.52	-17.07	0-360	201	H
6	219.9	40.94	PK	13.5	-29.1	25.34	46.02	-20.68	0-360	100	H
7	219.9	39.56	PK	13.5	-29.1	23.96	46.02	-22.06	0-360	100	V
9	321.6	32.85	PK	16.8	-28.3	21.35	46.02	-24.67	0-360	100	V
8	364	38.04	PK	17.6	-28.1	27.54	46.02	-18.48	0-360	100	H

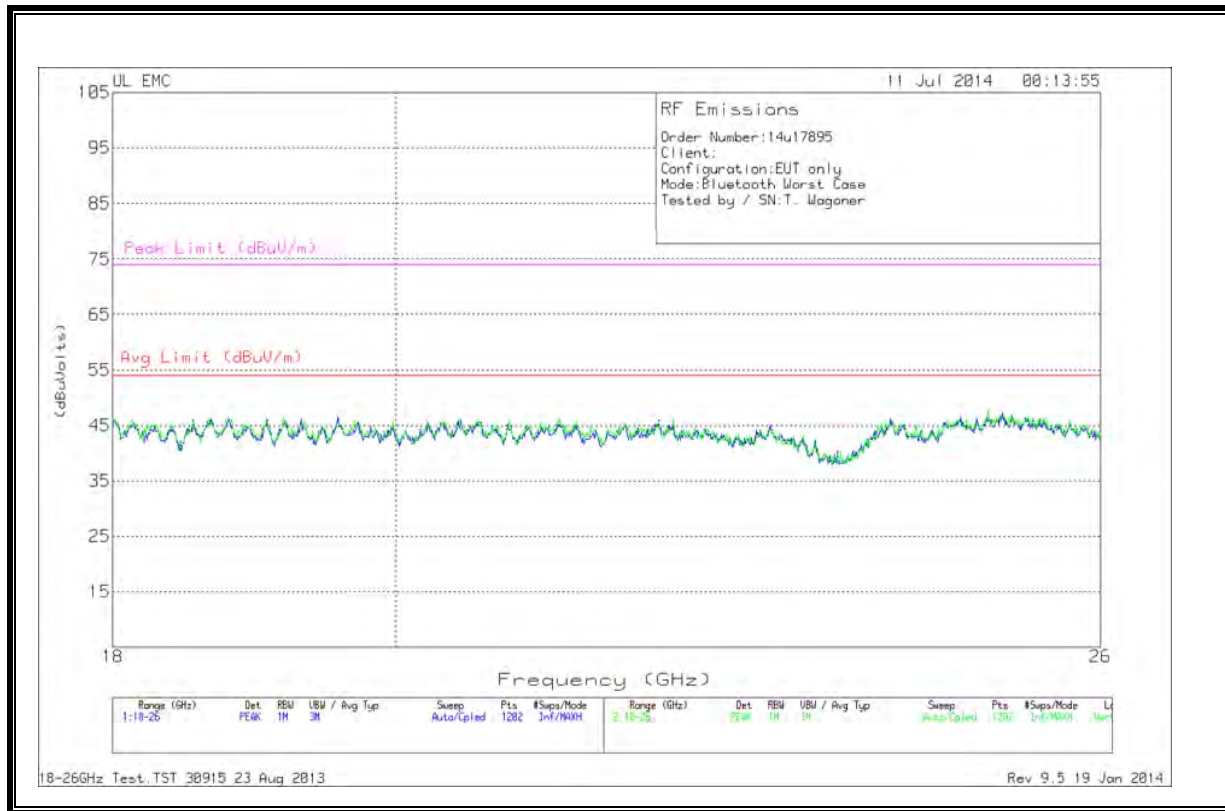
PK - Peak detector

FCC Part 15 Subpart C 30-1000MHz.TST 30915 22 May 2014

Rev 9.5 07 Jul 2014

10.4. WORST-CASE ABOVE 18 GHz

SPURIOUS EMISSIONS 18 TO 26 GHz (WORST-CASE CONFIGURATION, HORIZONTAL & VERTICAL)



Note: GFSK, highest power mode used for test.

11. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

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

LINE 1 RESULTS

Trace Markers										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L1 (dB)	LC Cables 1&3 (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	Margin to Limit (dB)	CFR 47 Part 15 Class B Avg	Margin to Limit (dB)
1	.15	45.74	PK	1.4	0	47.14	66	-18.86	--	--
2	.15	40.06	Av	1.4	0	41.46	--	--	56	-14.54
3	.1995	41.75	PK	.9	0	42.65	63.6	-20.95	--	--
4	.1995	33.88	Av	.9	0	34.78	--	--	53.6	-18.82
5	.249	37.23	PK	.7	0	37.93	61.8	-23.87	--	--
6	.249	29.69	Av	.7	0	30.39	--	--	51.8	-21.41
7	.2985	37	PK	.6	0	37.6	60.3	-22.7	--	--
8	.2985	28.56	Av	.6	0	29.16	--	--	50.3	-21.14
9	.5865	38.76	PK	.3	0	39.06	56	-16.94	--	--
10	.5865	26.63	Av	.3	0	26.93	--	--	46	-19.07
11	7.215	32.29	PK	.2	.1	32.59	60	-27.41	--	--
12	7.215	21.22	Av	.2	.1	21.52	--	--	50	-28.48

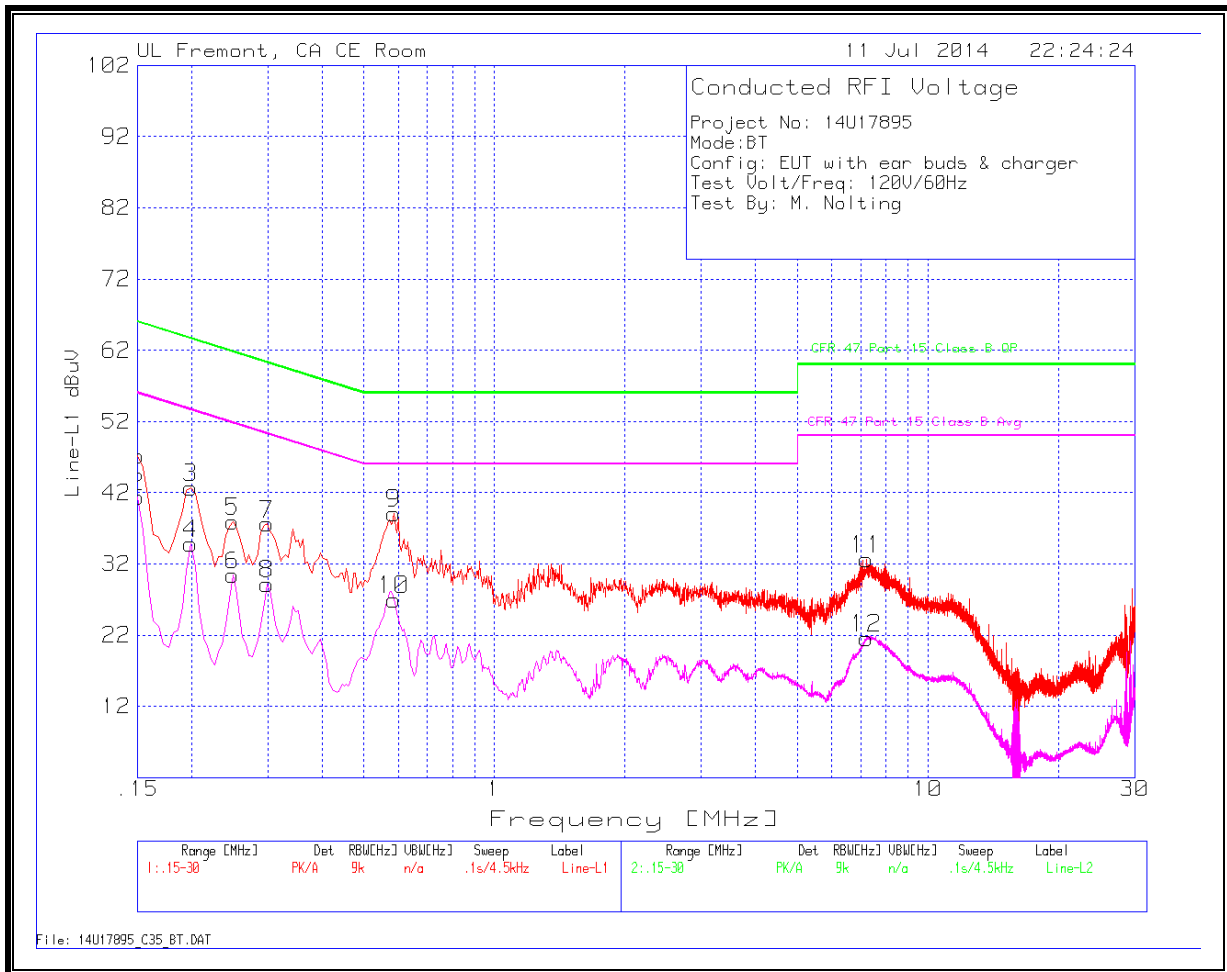
PK - Peak detector; Av - average detection

LINE 2 RESULTS

Trace Markers										
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L2 (dB)	LC Cables 2&3 (dB)	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	Margin to Limit (dB)	CFR 47 Part 15 Class B Avg	Margin to Limit (dB)
13	.2085	50.6	PK	1	0	51.6	63.3	-11.7	--	--
14	.2085	31.23	Av	1	0	32.23	--	--	53.3	-21.07
15	.3165	42.73	PK	.6	0	43.33	59.8	-16.47	--	--
16	.3165	26.53	Av	.6	0	27.13	--	--	49.8	-22.67
17	.501	40.1	PK	.4	0	40.5	56	-15.5	--	--
18	.501	23.53	Av	.4	0	23.93	--	--	46	-22.07
19	.618	38.8	PK	.3	0	39.1	56	-16.9	--	--
20	.618	21.06	Av	.3	0	21.36	--	--	46	-24.64
21	.8385	36.51	PK	.3	.1	36.91	56	-19.09	--	--
22	.8385	19.25	Av	.3	.1	19.65	--	--	46	-26.35
23	7.305	36.15	PK	.2	.1	36.45	60	-23.55	--	--
24	7.305	24.73	Av	.2	.1	25.03	--	--	50	-24.97

PK - Peak detector; Av - average detection

LINE 1 PLOT



LINE 2 PLOT

