



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

CERTIFICATION TEST REPORT

FOR

Tablet with IEEE 802.11a/b/g/n (MIMO 2X2) and BLUETOOTH RADIO

MODEL NUMBER: A1489

**FCC ID: BCGA1489
IC: 579C-A1489**

REPORT NUMBER: 13U15668-3

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Prepared for
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1 INFINITE LOOP
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NVLAP LAB CODE 200065-0

Revision History

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1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: The Apple iPad is a Tablet with IEEE 802.11a/b/g/n (MIMO 2x2) and Bluetooth radio

MODEL: A1489

SERIAL NUMBER: DLXL2010FN8M

DATE TESTED: AUGUST 21 - SEPTEMBER 09, 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:



THU CHAN
WiSE Operations Manager
UL Verification Services Inc.

Oliver Su
WiSE Senior 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.

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
<input type="checkbox"/> Chamber A	<input type="checkbox"/> Chamber D
<input type="checkbox"/> Chamber B	<input checked="" type="checkbox"/> Chamber E
<input type="checkbox"/> Chamber C	<input checked="" type="checkbox"/> Chamber F

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

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

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

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

4.3. MEASUREMENT UNCERTAINTY

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

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

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The Apple iPad is a tablet with IEEE 802.11a/b/g/n (MIMO 2x2) and bluetooth radio.

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	12.98	19.86
2402 - 2480	Enhanced 8PSK	12.13	16.33

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PiFA antenna, with a maximum gain as below table.

Frequency (MHz)	Antenna Gain (dBi)
2402 -2480	0.81

5.4. SOFTWARE AND FIRMWARE

Firmware installed in the EUT during testing was Broadcom Bluetooth 1.5.6.2.

5.5. WORST-CASE CONFIGURATION AND MODE

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

Worst-case data rates from the base line scans of output powers were:

GFSK: 1Mbps

8PSK: 3Mbps

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.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
AC/DC Adapter	Apple	A1357	A/12981EA	DoC
Earphone	Apple	NA	NA	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	0.1m	To Spectrum Analyzer

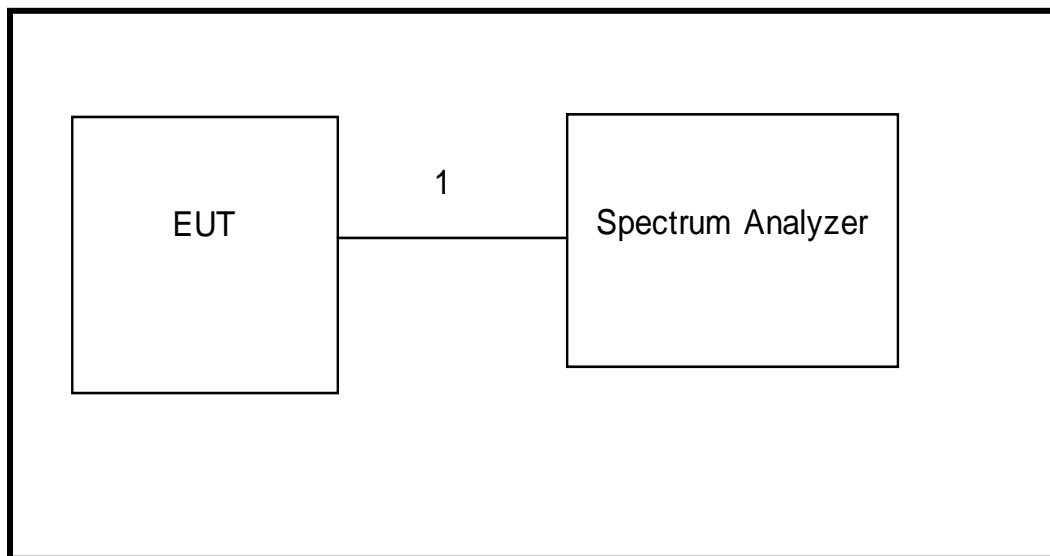
I/O CABLES (RADIATED TEST)

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Audio	1	Jack	Un-Shielded	0.5m	NA

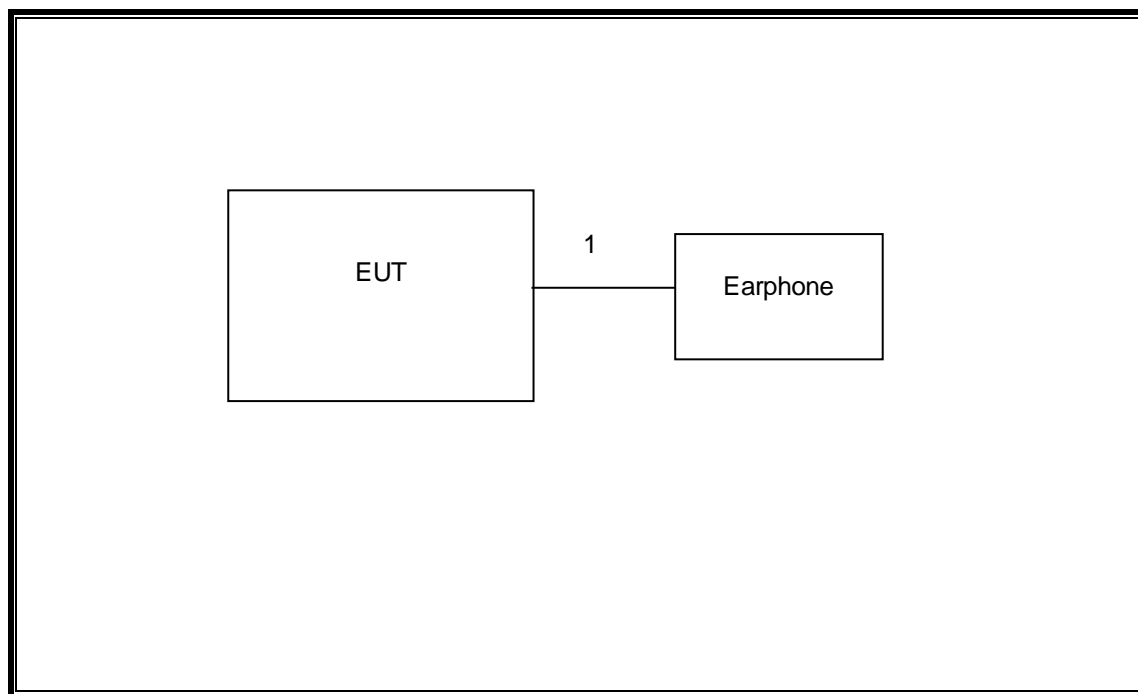
I/O CABLES (AC POWER CONDUCTED TEST)

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

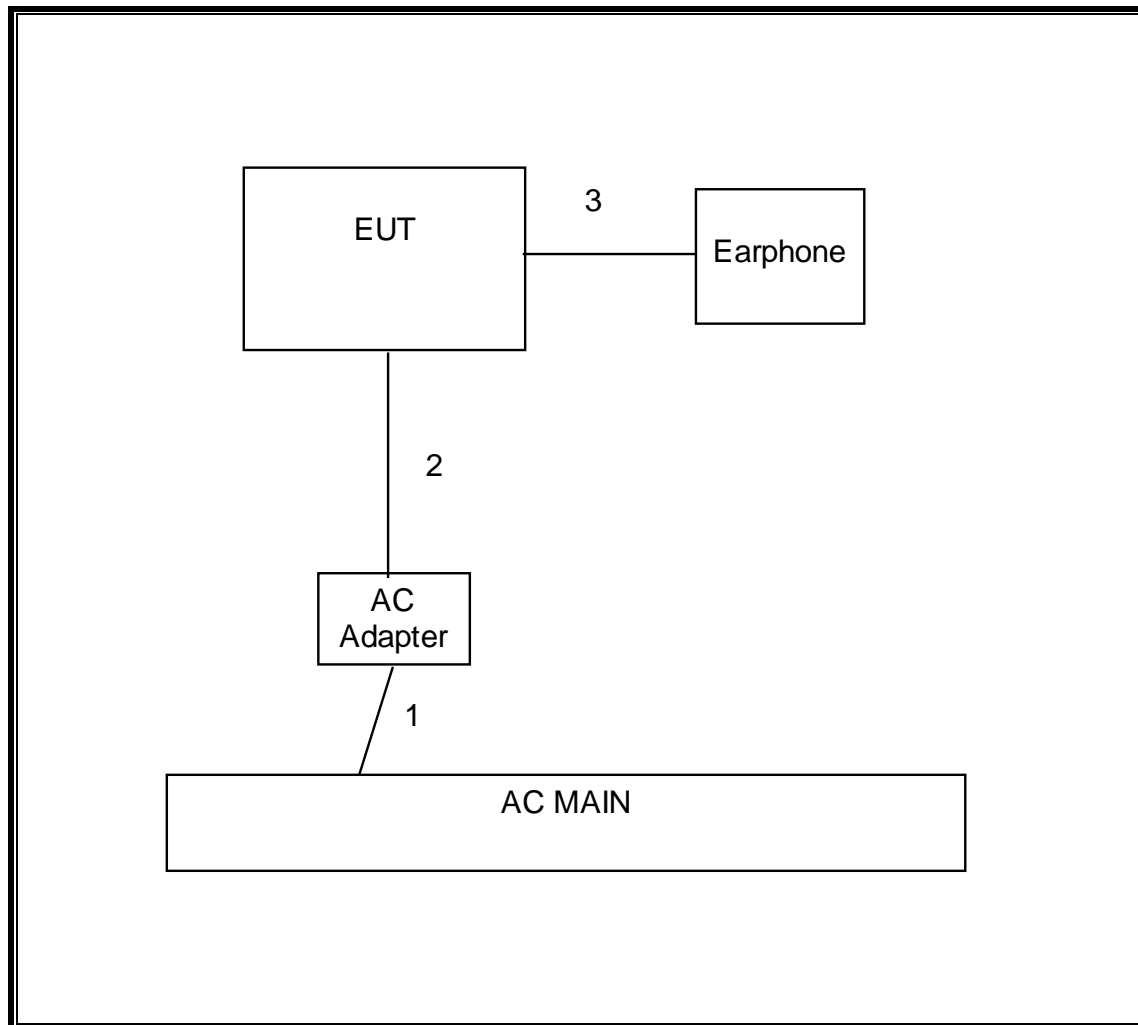
SETUP DIAGRAM FOR CONDUCTED TESTS



SETUP DIAGRAM FOR RADIATED TESTS



SETUP DIAGRAM FOR BELOW 1GHZ & AC POWER CONDUCTED TESTS



6. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST				
Description	Manufacturer	Model	Asset	Cal Due
Antenna, Horn, 18 GHz	ETS Lindgren	3117	F00131	02/19/14
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00589	04/28/14
Peak / Average Power Sensor	Agilent / HP	N1911A	F00153	04/05/14
Peak Power Meter	Agilent / HP	E9323A	F00025	04/03/14
Spectrum Analyzer, 44 GHz	Agilent / HP	N9030A	F00126	02/22/14
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	F00168	03/07/14
Preamplifier, 1300 MHz	Sonoma	310	F00008	11/06/13
Preamplifier, 26.5 GHz	Agilent / HP	8449B	F00165	03/18/14
EMI Test Receiver, 9 kHz-7 GHz	R & S	ESHS20	N02396	08/15/14
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	04/17/14

7. ANTENNA PORT TEST RESULTS

7.1. BASIC DATA RATE GFSK MODULATION

7.1.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

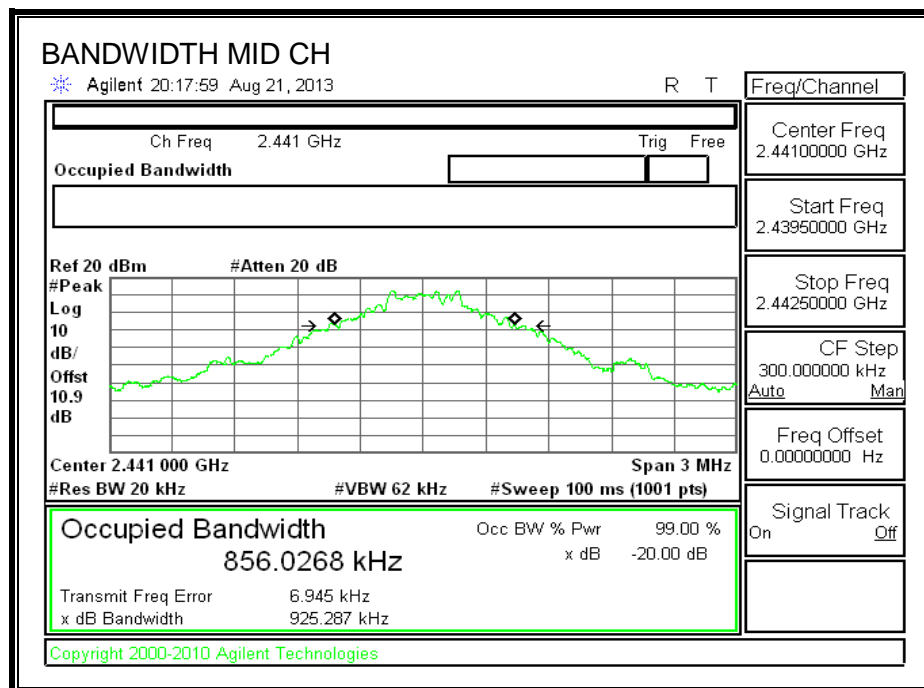
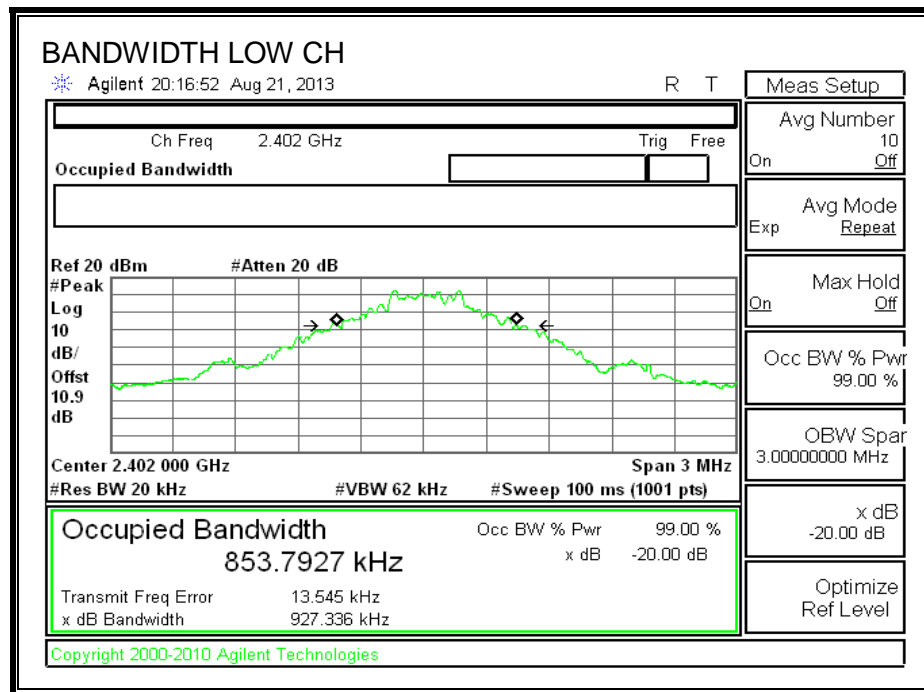
The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to \geq RBW. The sweep time is coupled.

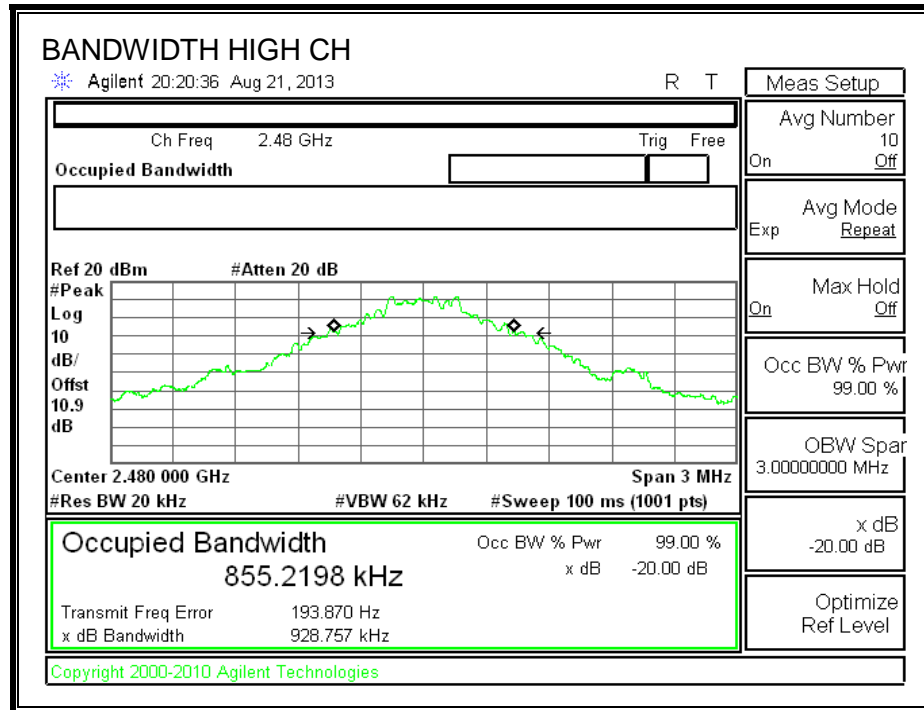
RESULTS

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	10.34
Middle	2441	10.82
High	2480	10.61

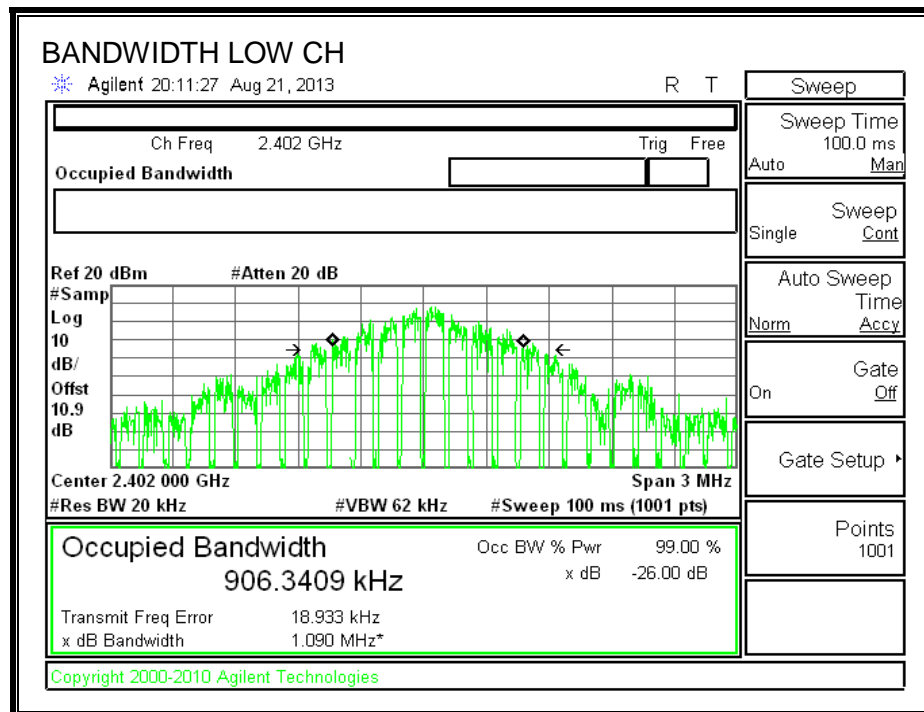
20 dB AND 99% BANDWIDTH

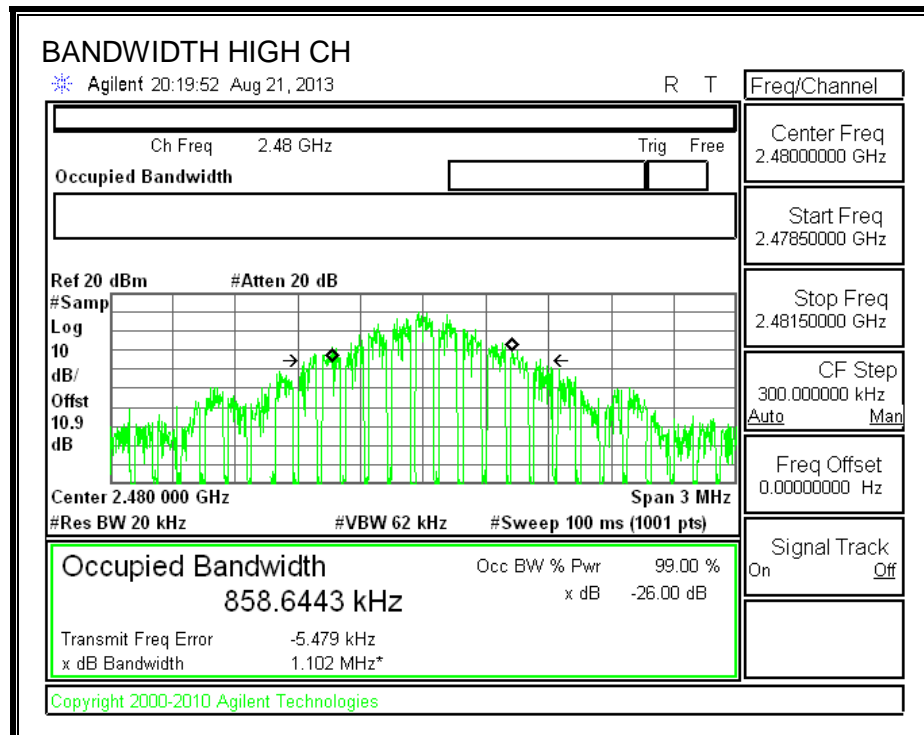
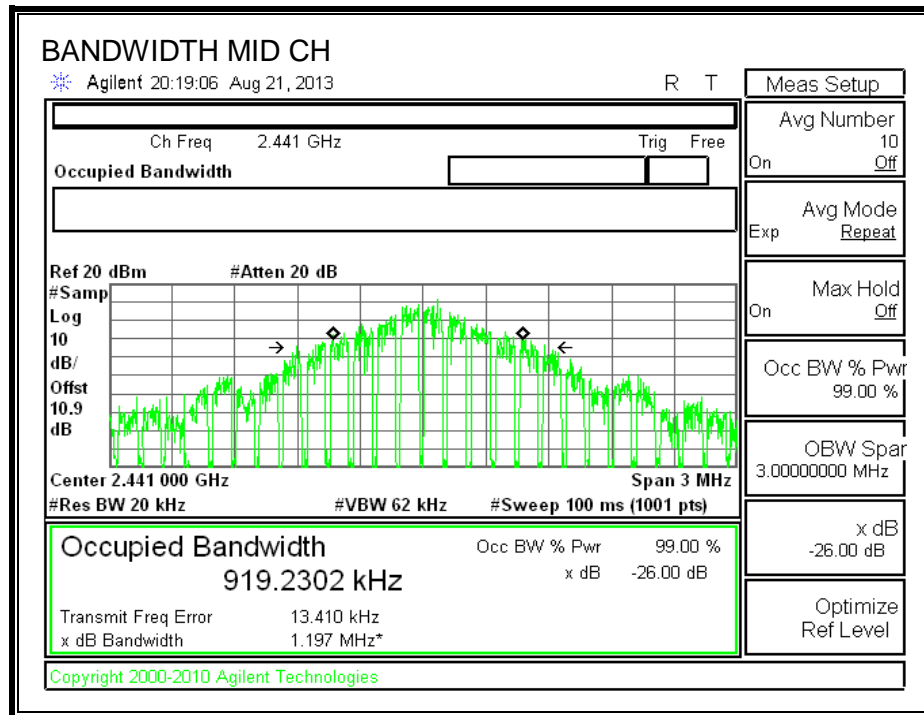
20 dB BANDWIDTH





99% BANDWIDTH





7.1.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

IC RSS-210 A8.1 (b)

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

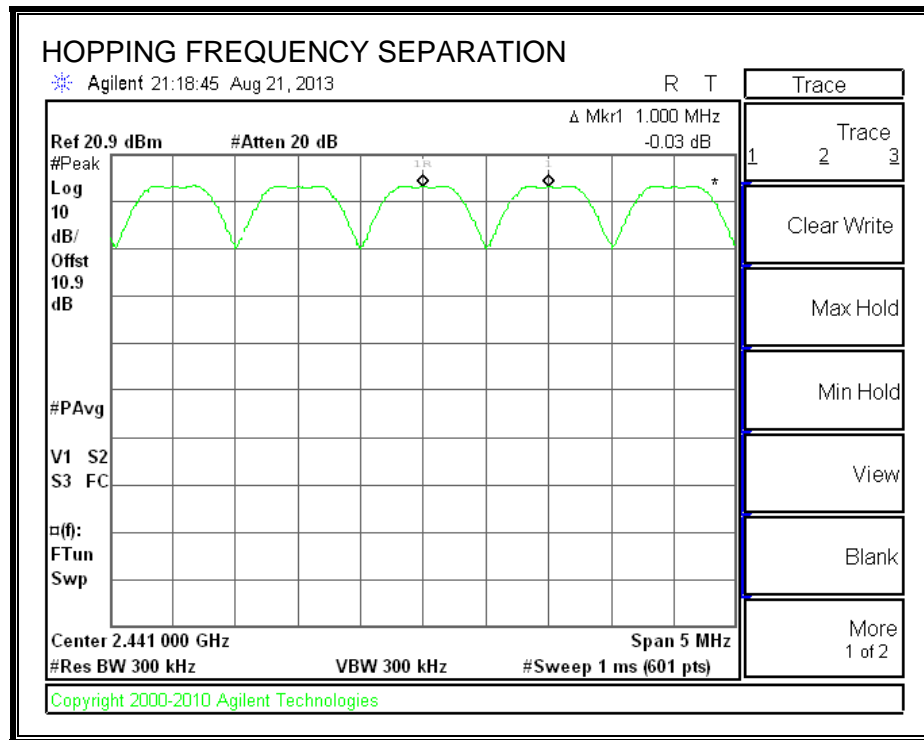
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

TEST PROCEDURE

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

RESULTS

HOPPING FREQUENCY SEPARATION



7.1.3. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

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

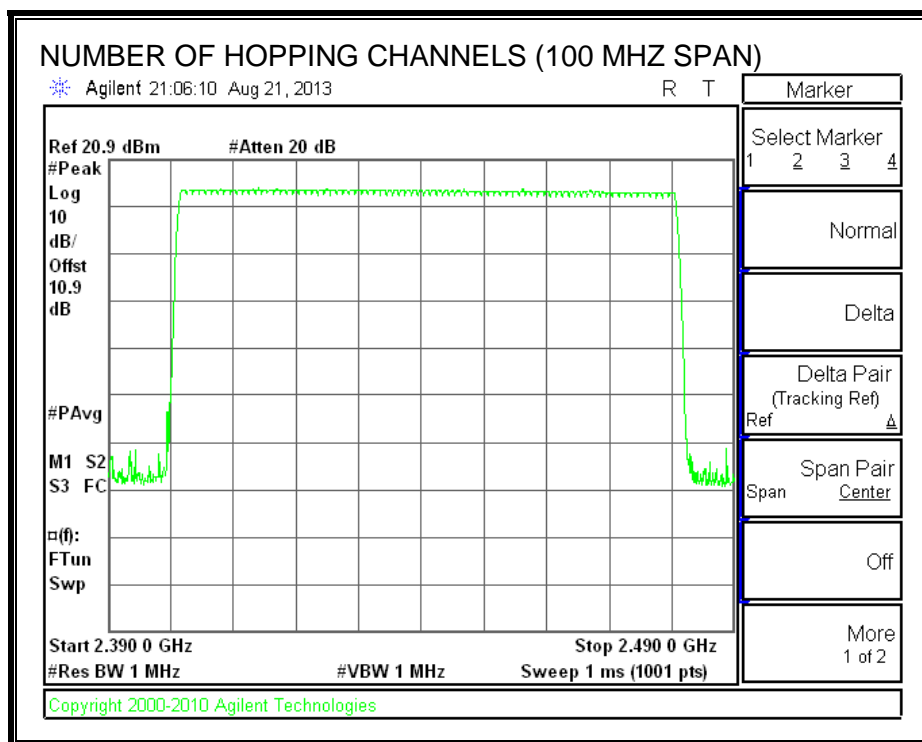
TEST PROCEDURE

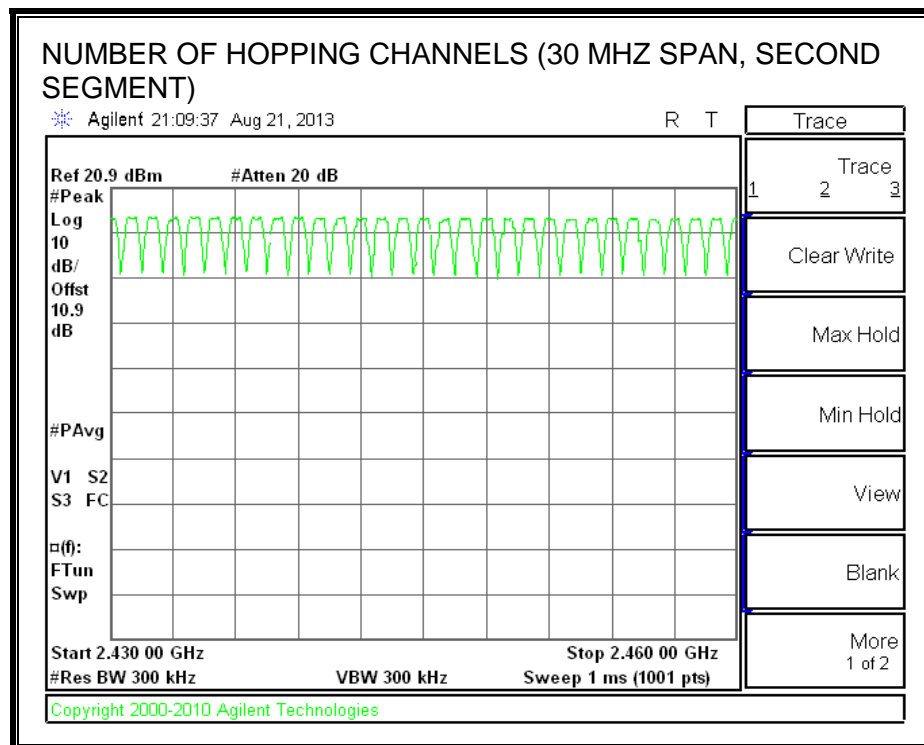
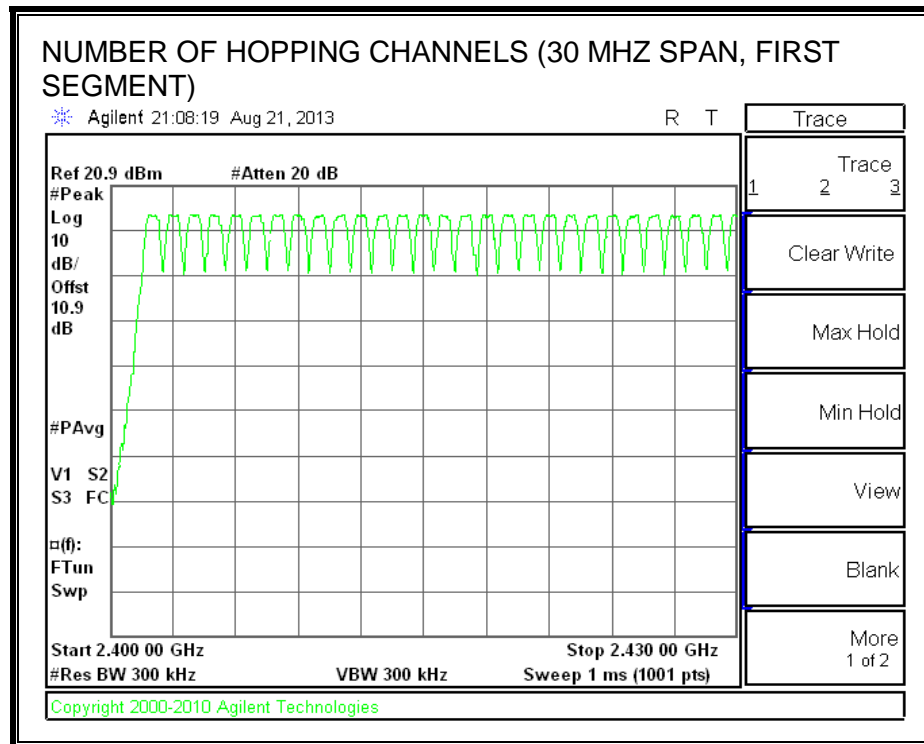
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

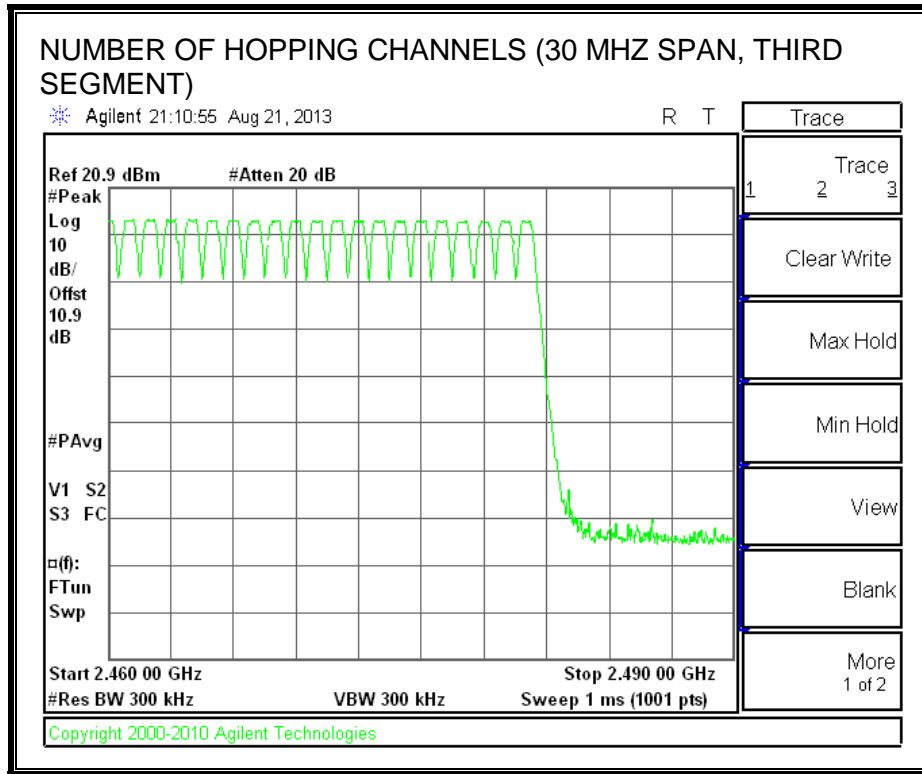
RESULTS

Normal Mode: 79 Channels observed.

NUMBER OF HOPPING CHANNELS







7.1.4. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

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

TEST PROCEDURE

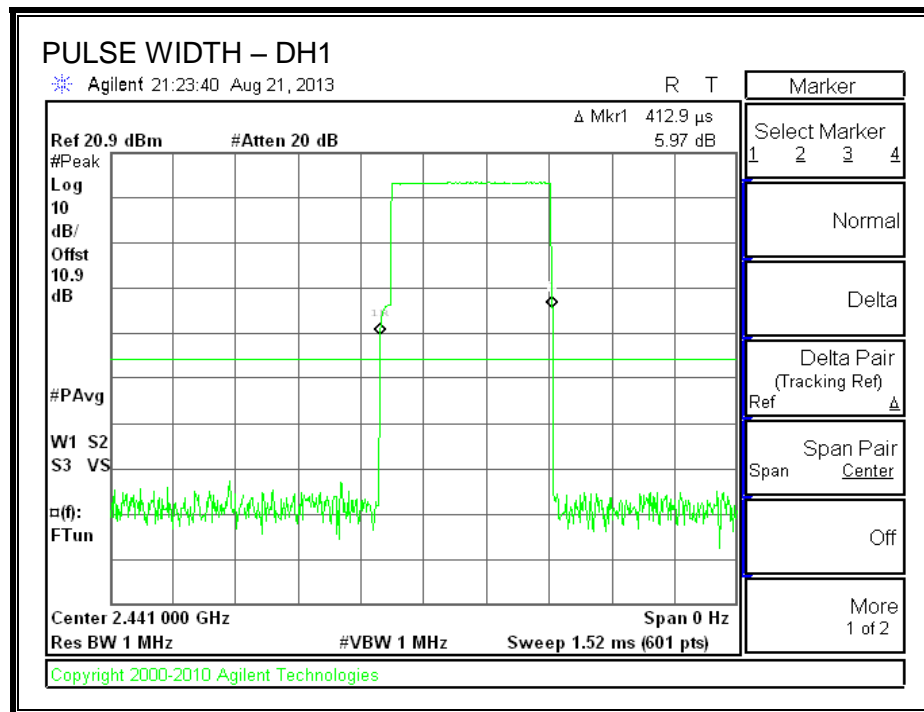
The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

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

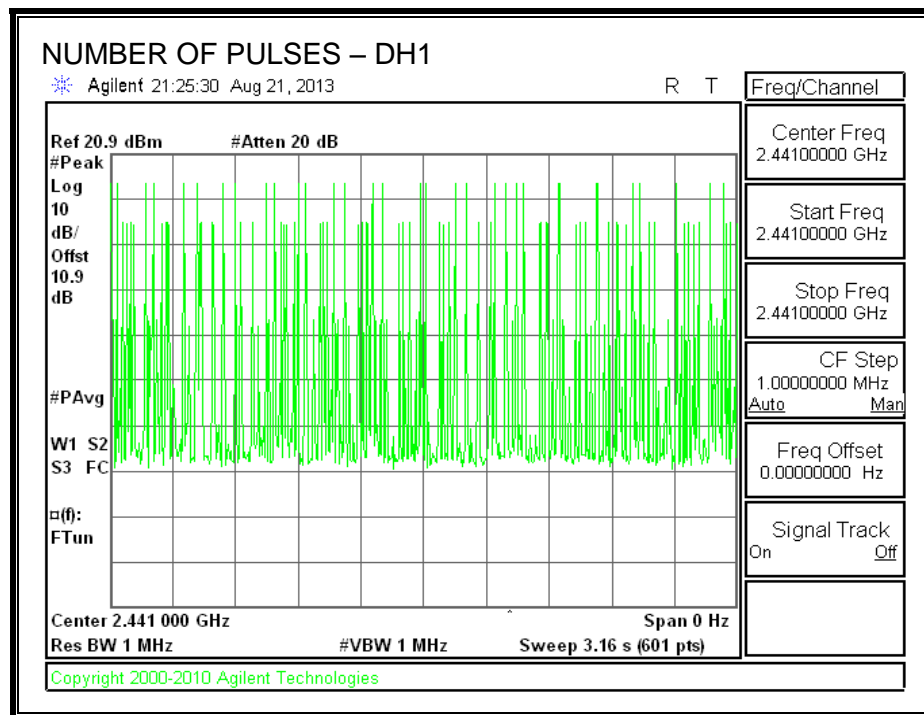
RESULTS

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	0.4129	31	0.128	0.4	-0.272
DH3	1.675	19	0.318	0.4	-0.082
DH5	2.92	13	0.380	0.4	-0.020

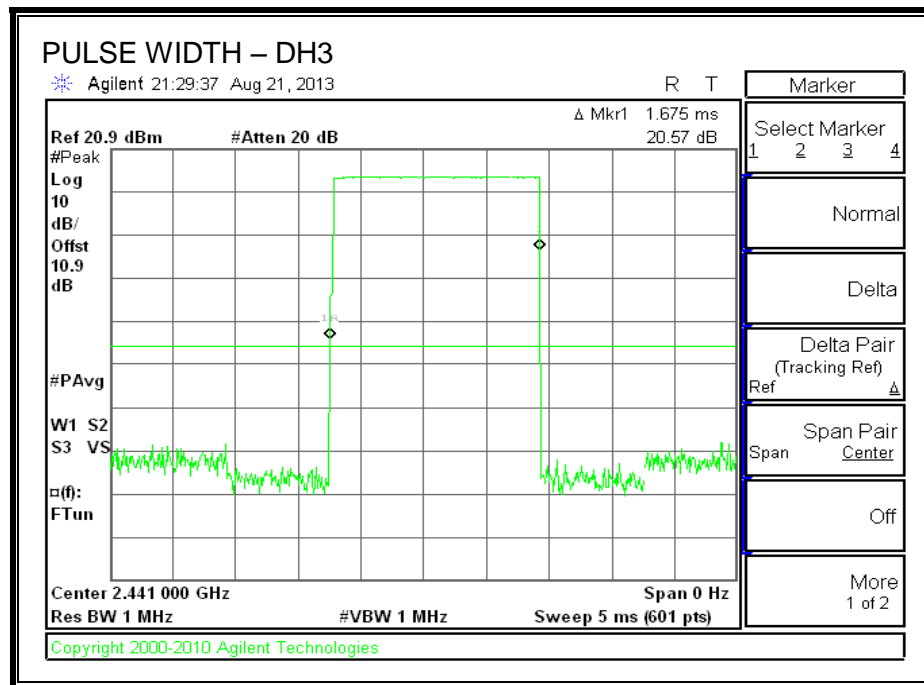
PULSE WIDTH - DH1



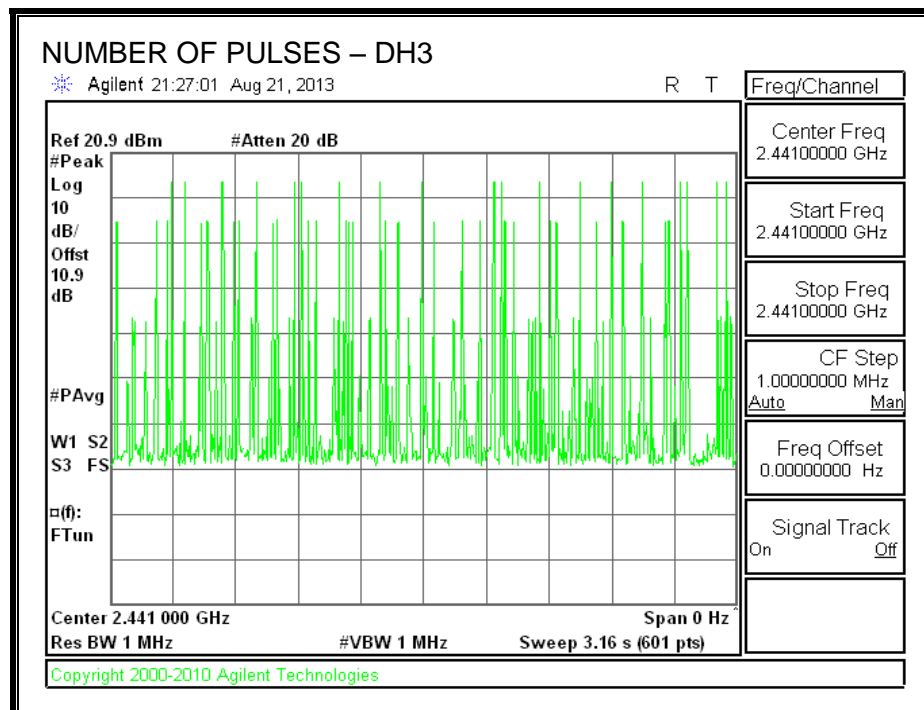
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



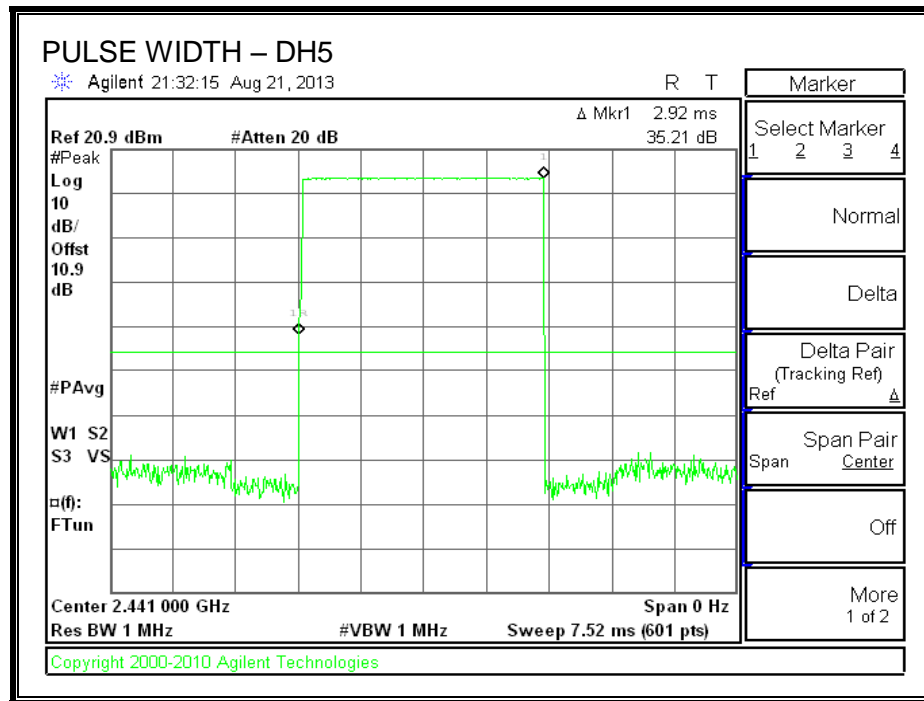
PULSE WIDTH – DH3



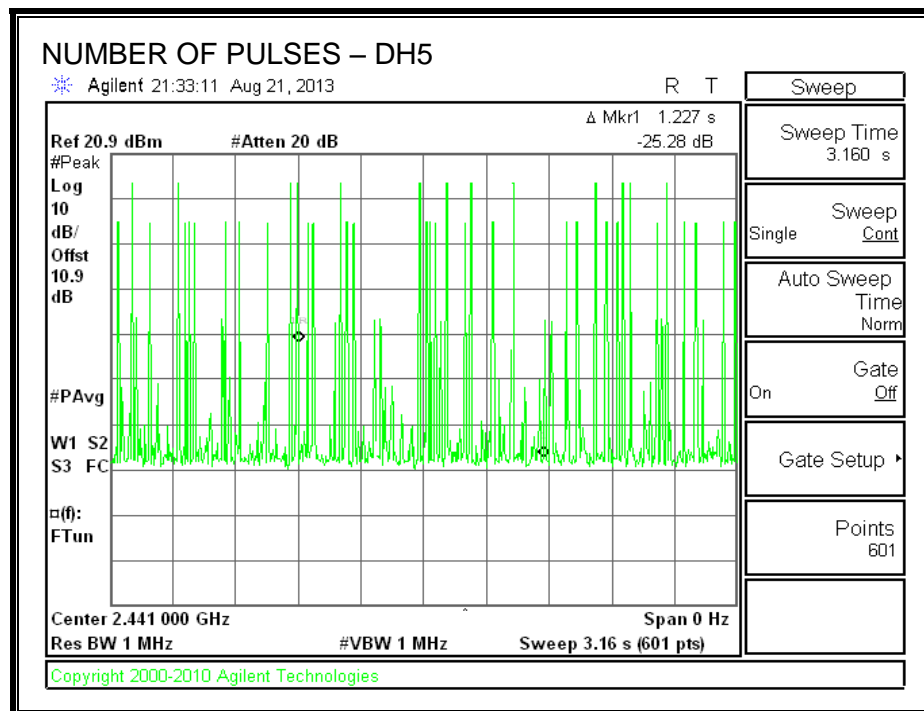
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5



7.1.5. 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.

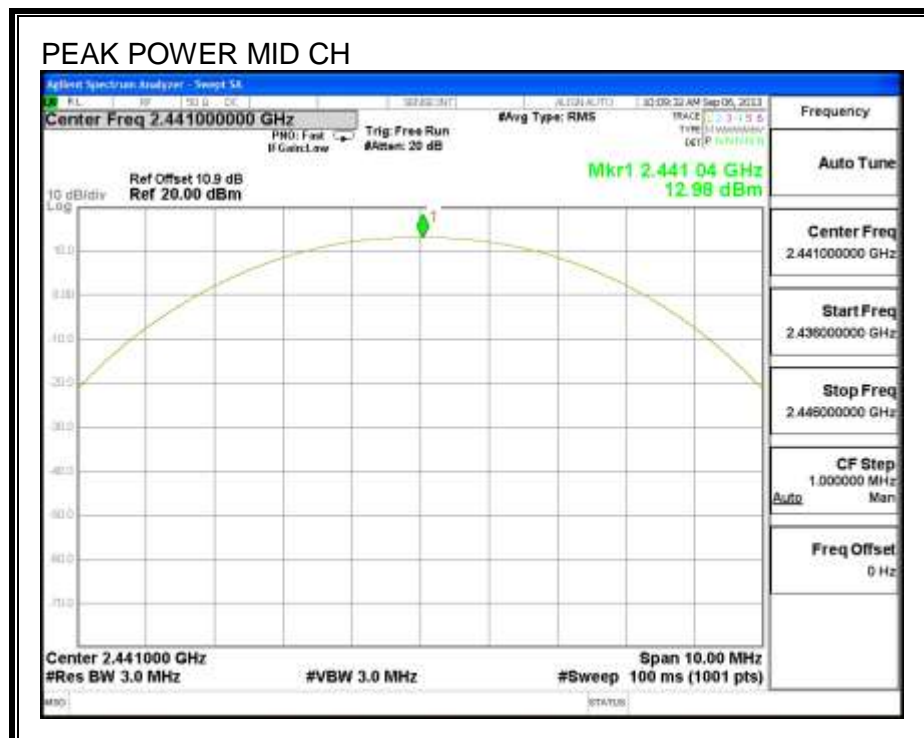
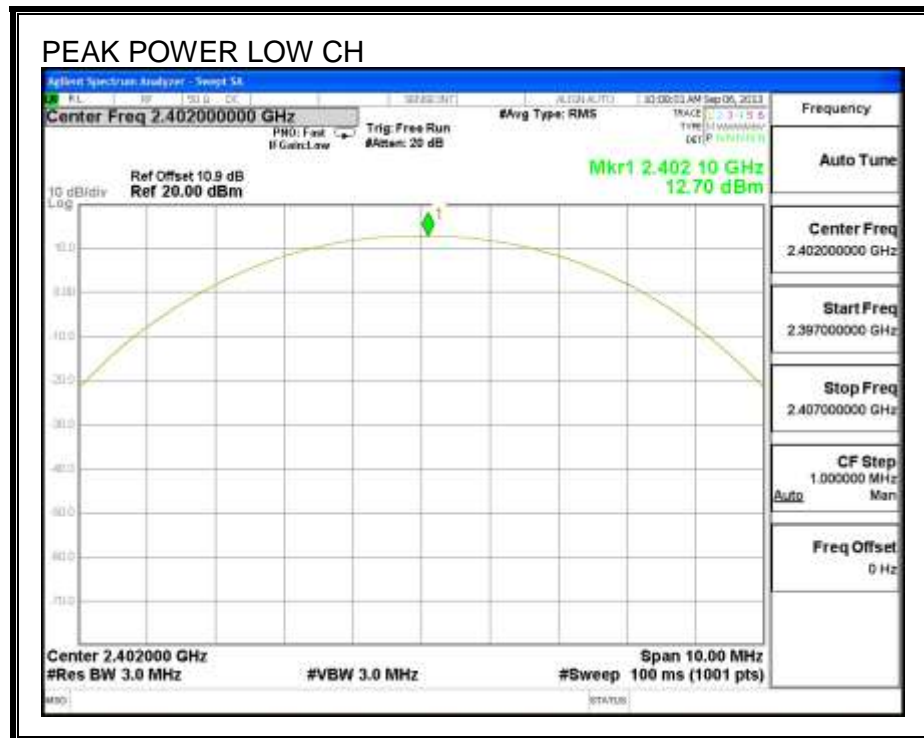
TEST PROCEDURE

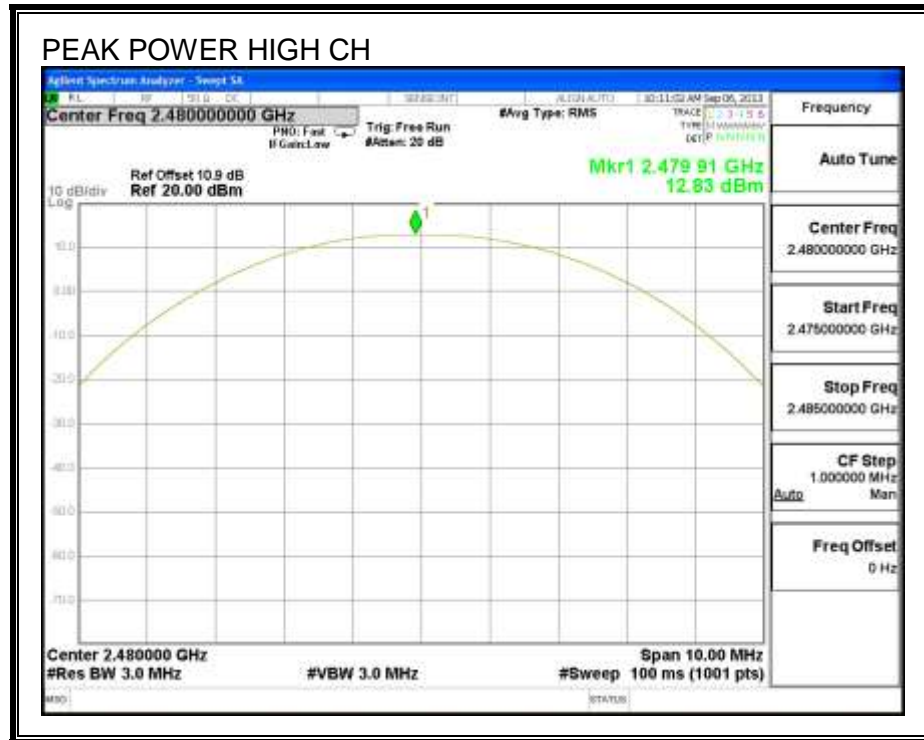
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.70	30	-17.30
Middle	2441	12.98	30	-17.02
High	2480	12.83	30	-17.17

OUTPUT POWER





7.1.6. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 10.9 dB (including 10 dB pad and 0.9 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	11.69
Middle	2441	11.80
High	2480	11.75

7.1.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

TEST PROCEDURE

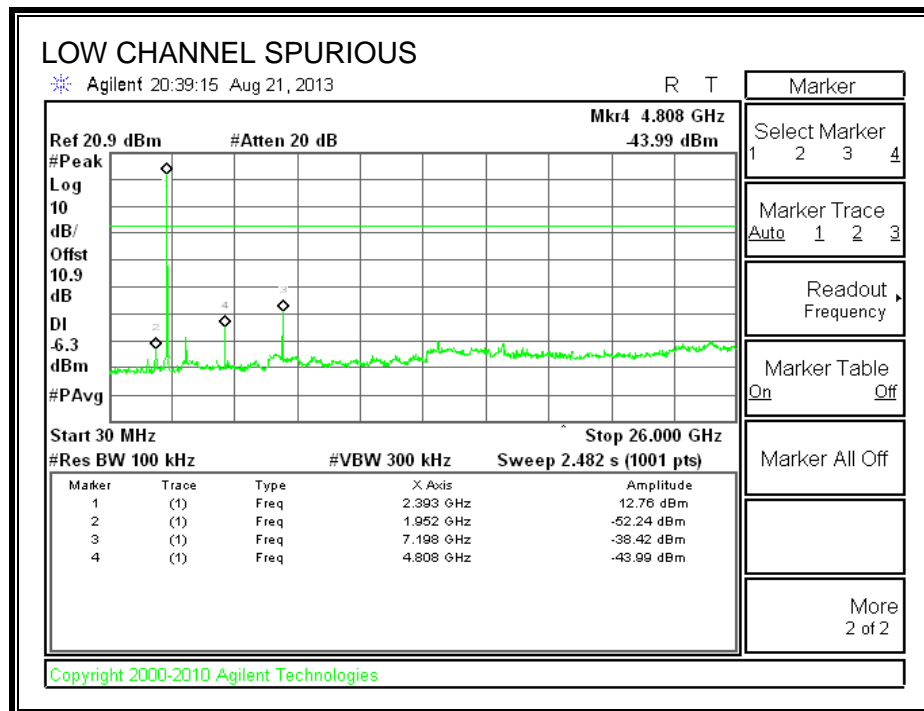
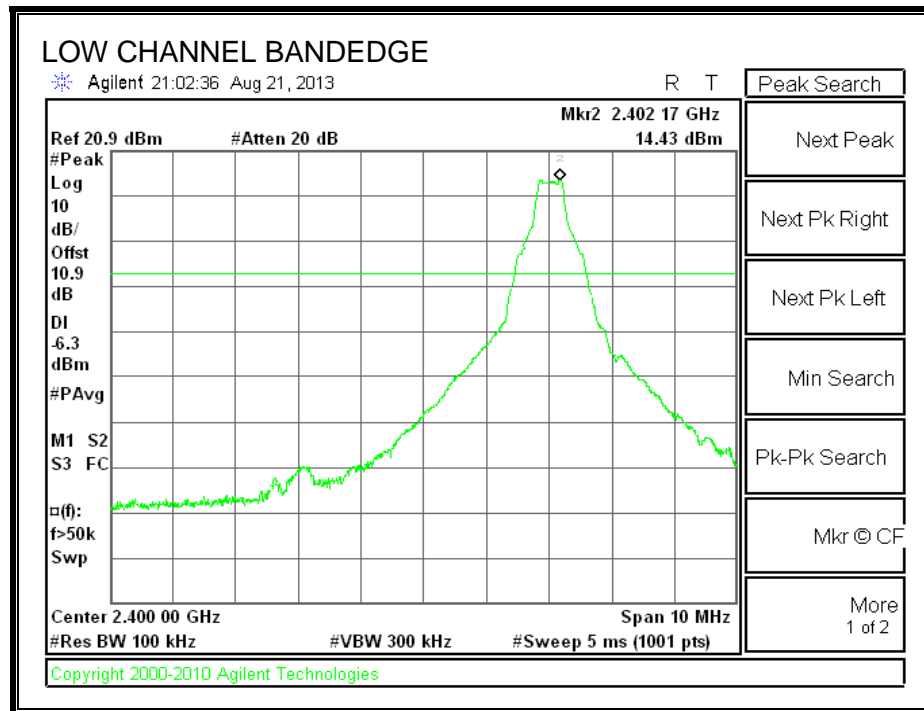
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

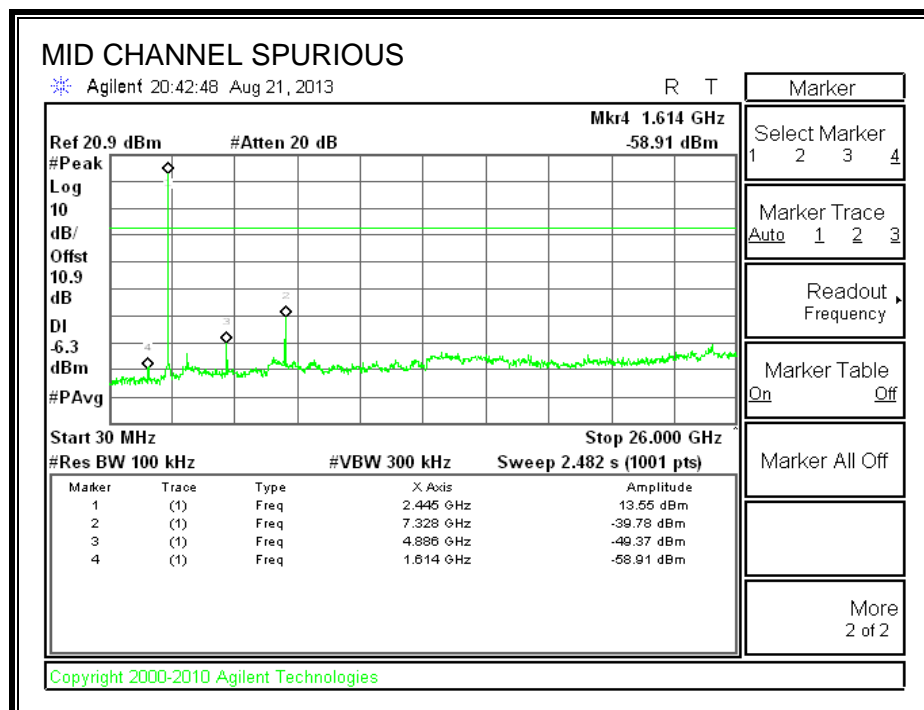
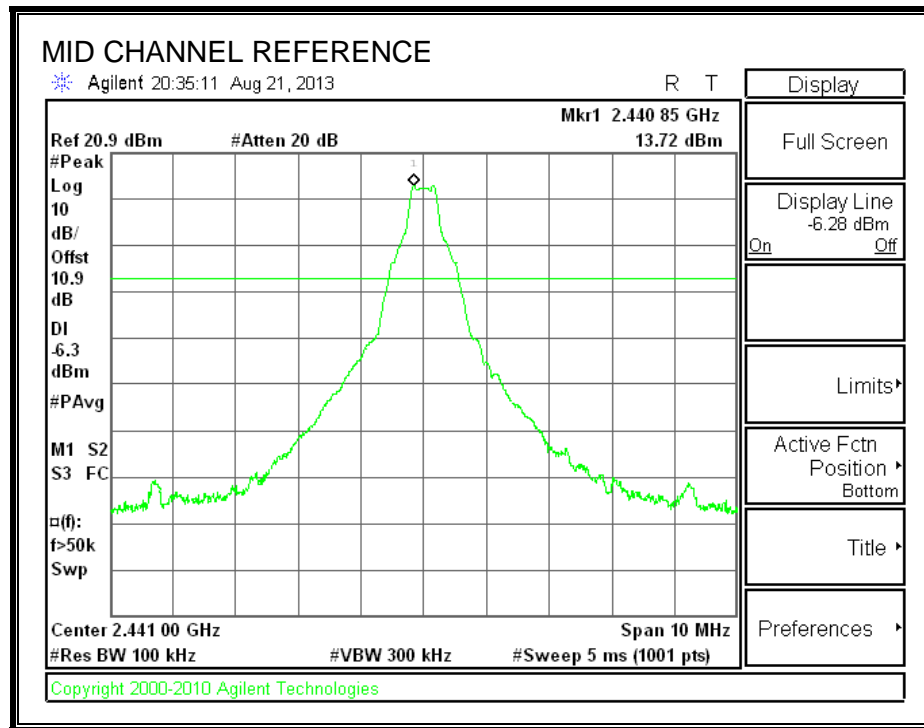
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

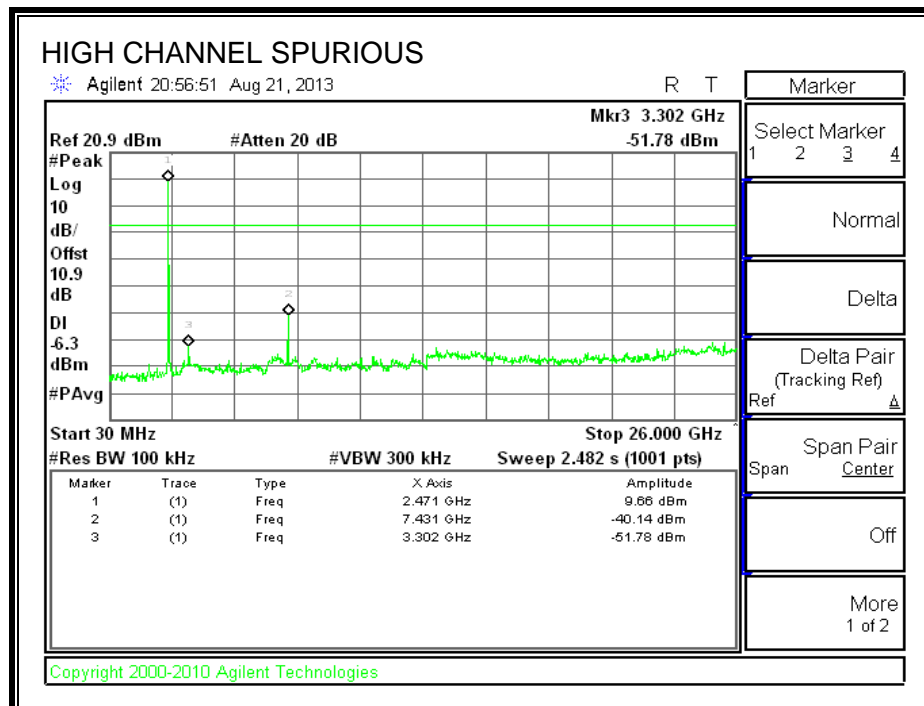
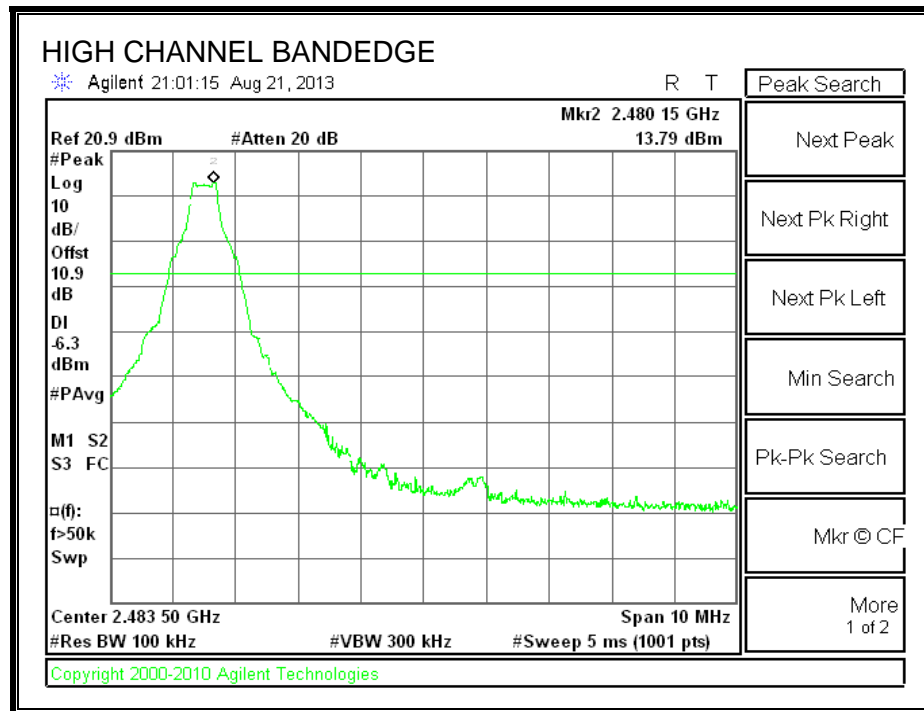
SPURIOUS EMISSIONS, LOW CHANNEL



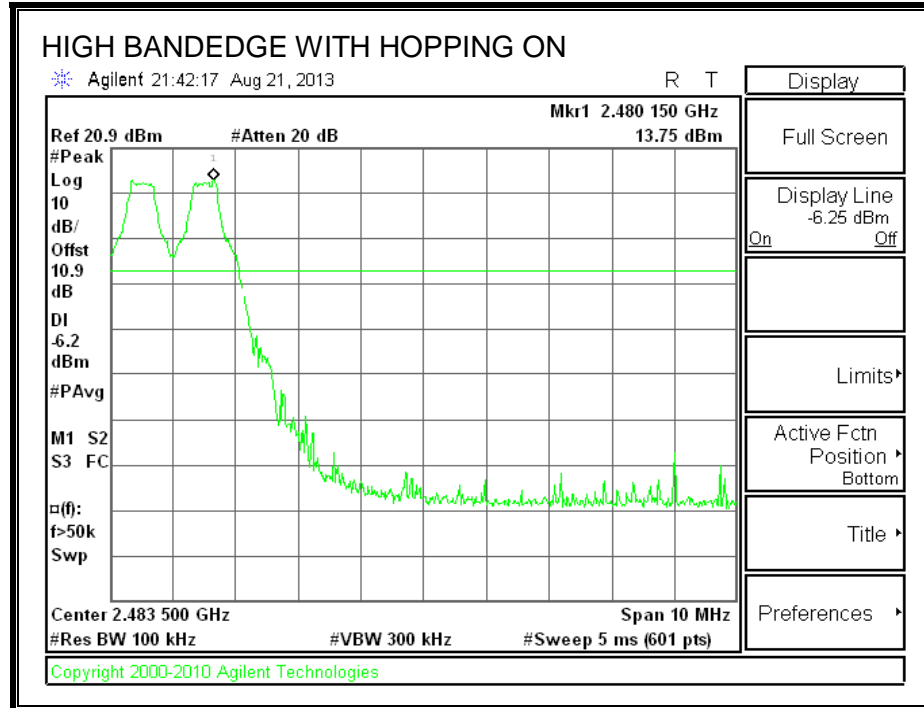
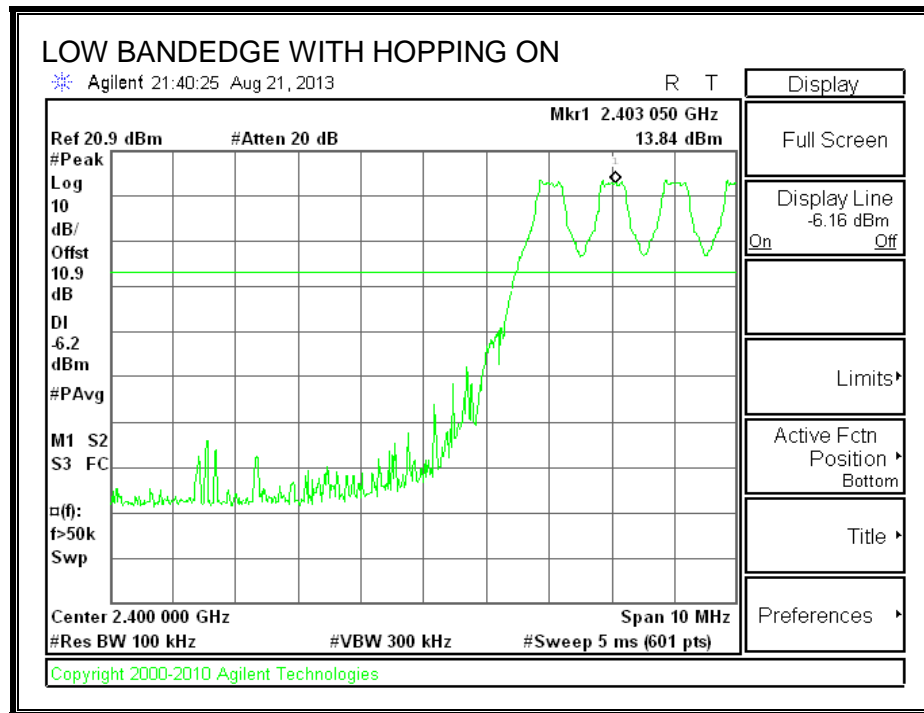
SPURIOUS EMISSIONS, MID CHANNEL



SPURIOUS EMISSIONS, HIGH CHANNEL



SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



7.2. ENHANCED DATA RATE QPSK MODULATION

7.2.1. OUTPUT POWER

LIMIT

§15.247 (b) (1)

RSS-210 Issue 7 Clause A8.4

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

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

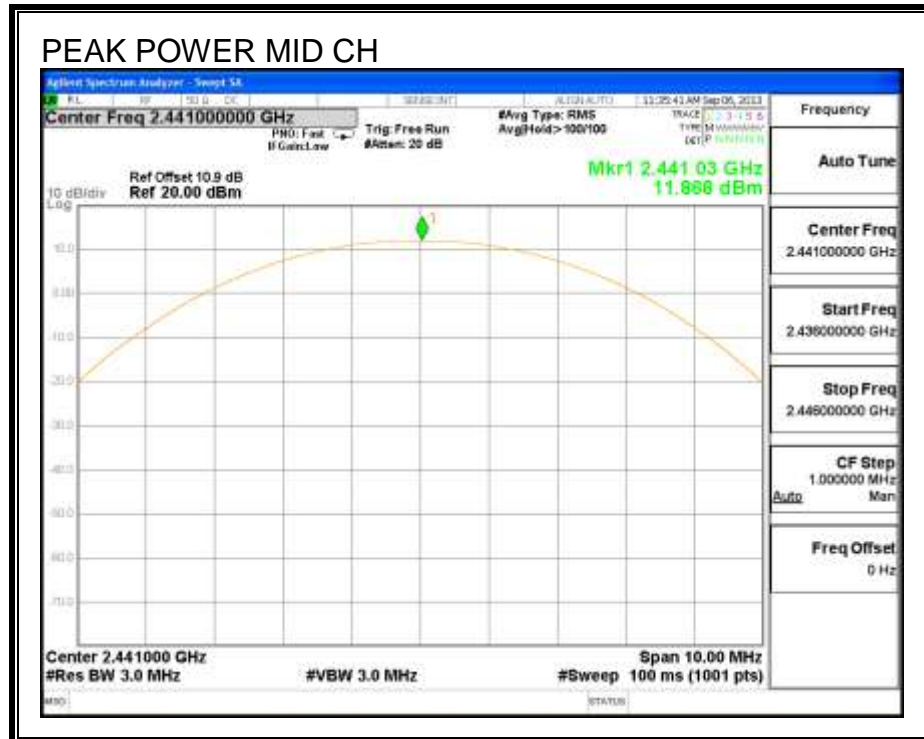
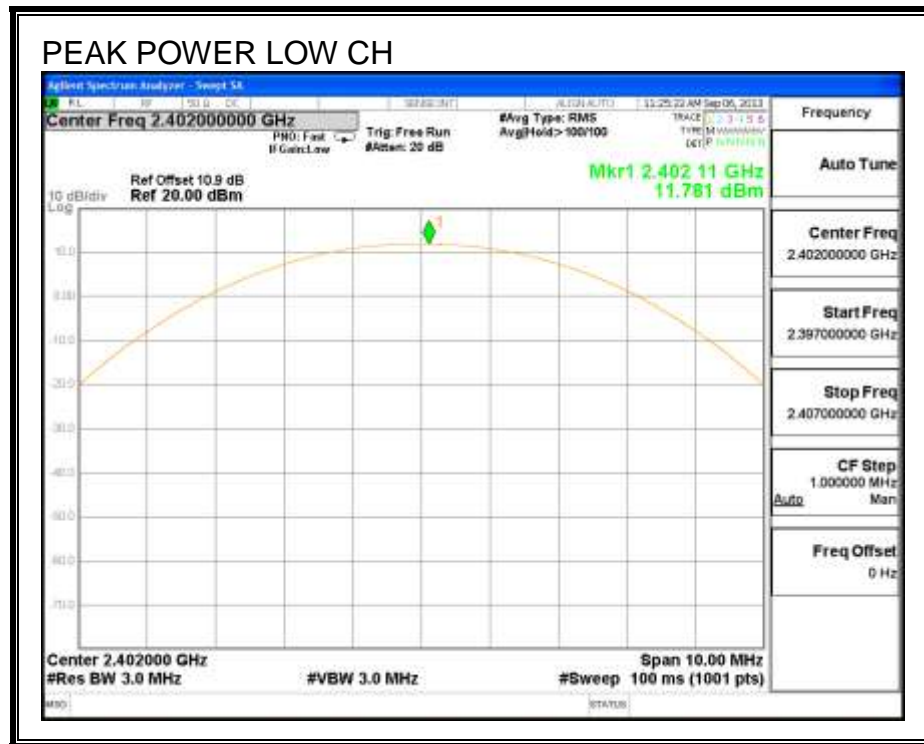
TEST PROCEDURE

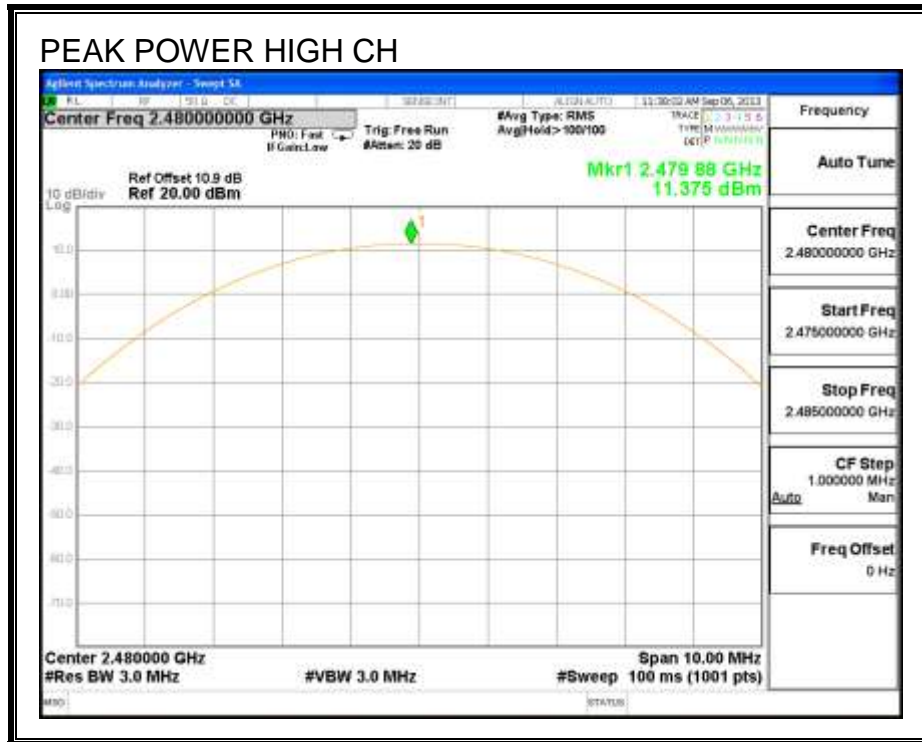
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	11.78	20.97	-9.19
Middle	2441	11.87	20.97	-9.10
High	2480	11.38	20.97	-9.59

OUTPUT POWER





7.2.2. AVERAGE POWER

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 10.9 dB (including 10 dB pad and 0.9 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	9.30
Middle	2441	10.00
High	2480	9.90

7.3. ENHANCED DATA RATE 8PSK MODULATION

7.3.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

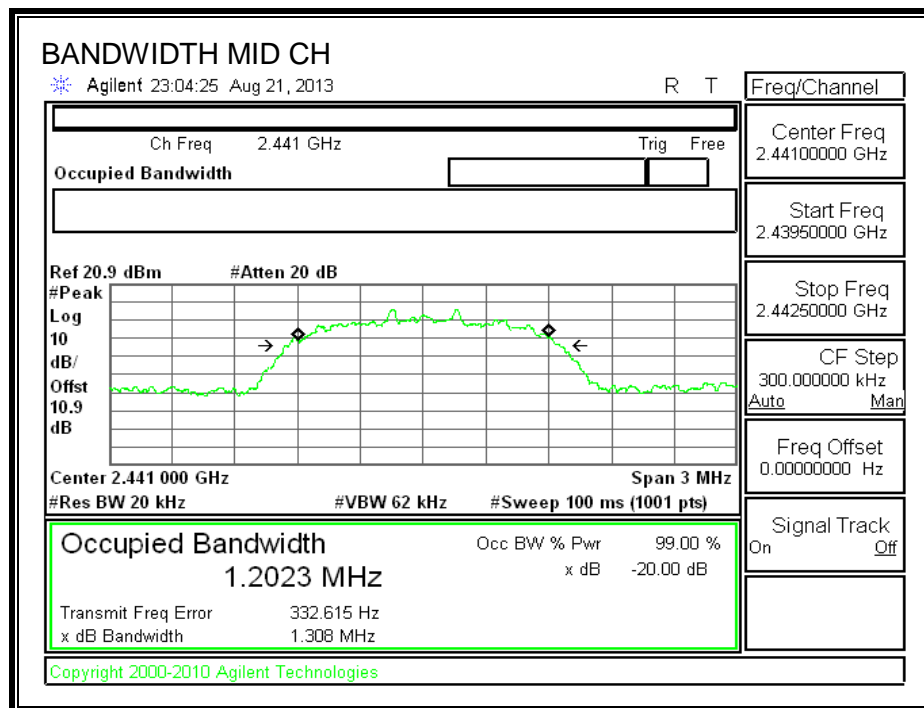
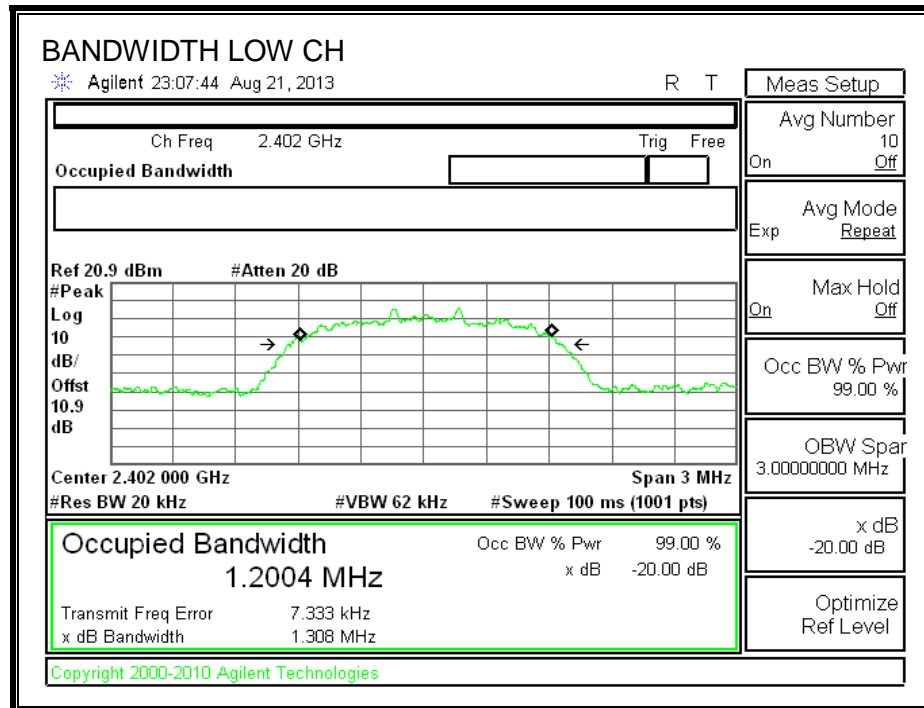
The transmitter output is connected to a spectrum analyzer. The RBW is set to $\geq 1\%$ of the 20 dB bandwidth. The VBW is set to \geq RBW. The sweep time is coupled.

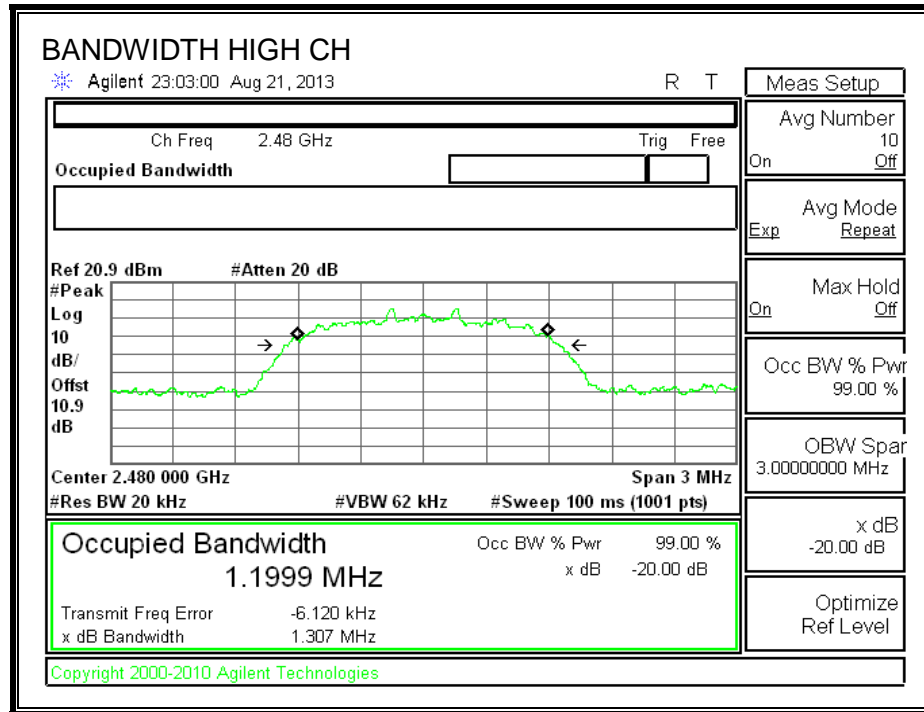
RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	1308	1226.6
Middle	2441	1308	1228.0
High	2480	1307	1236.3

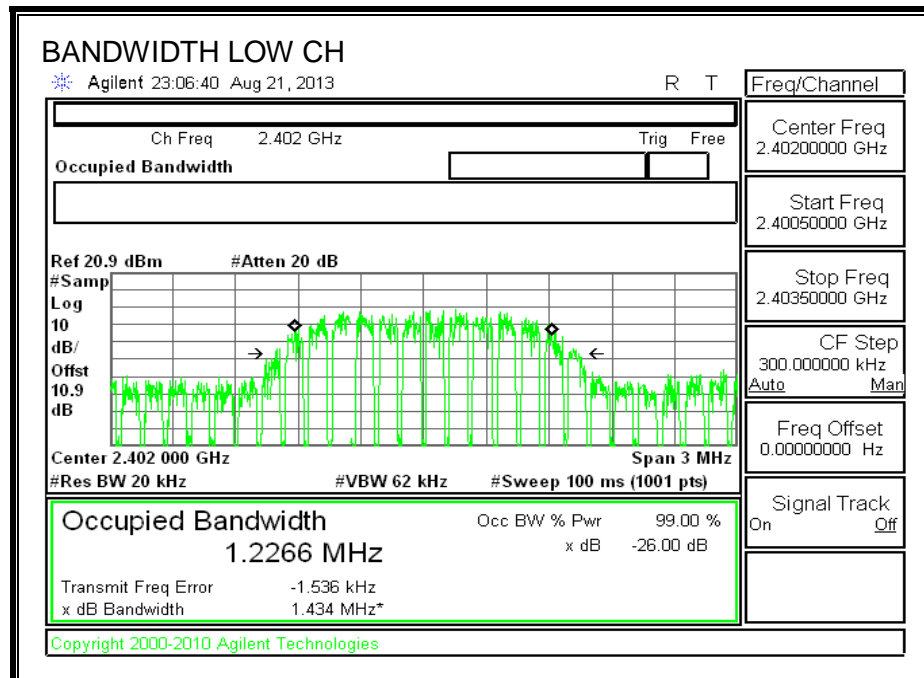
20 dB AND 99% BANDWIDTH

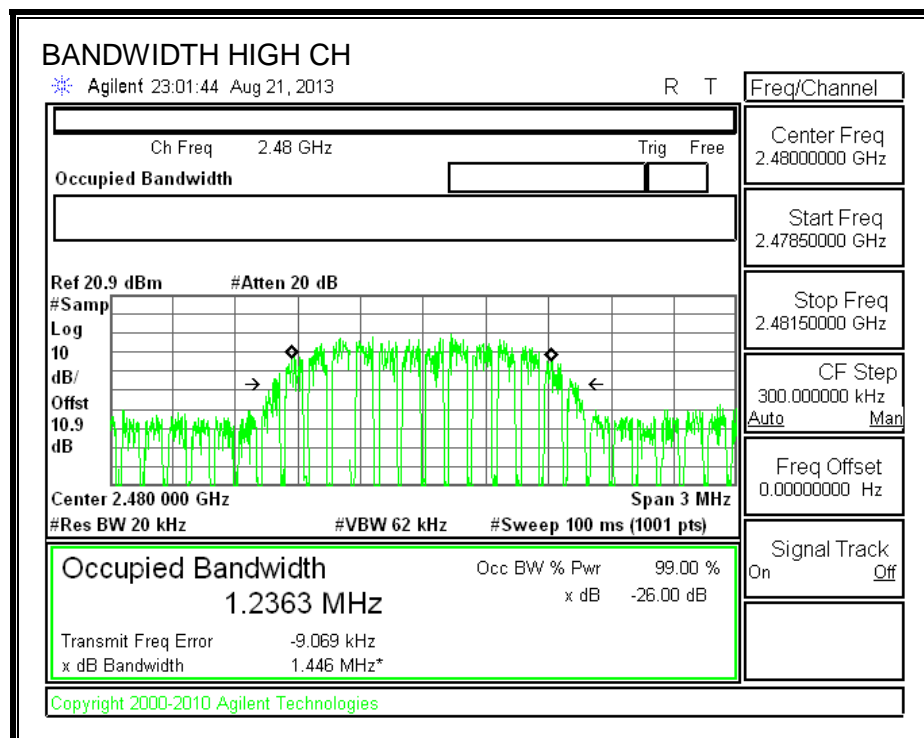
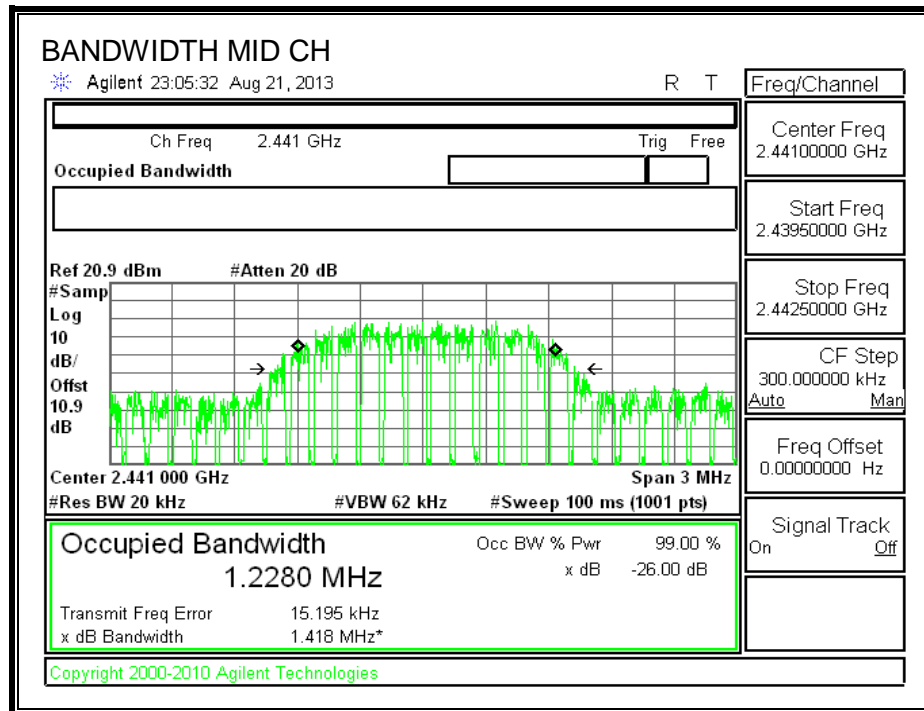
20 dB BANDWIDTH





99% BANDWIDTH





7.3.2. HOPPING FREQUENCY SEPARATION

LIMIT

FCC §15.247 (a) (1)

IC RSS-210 A8.1 (b)

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

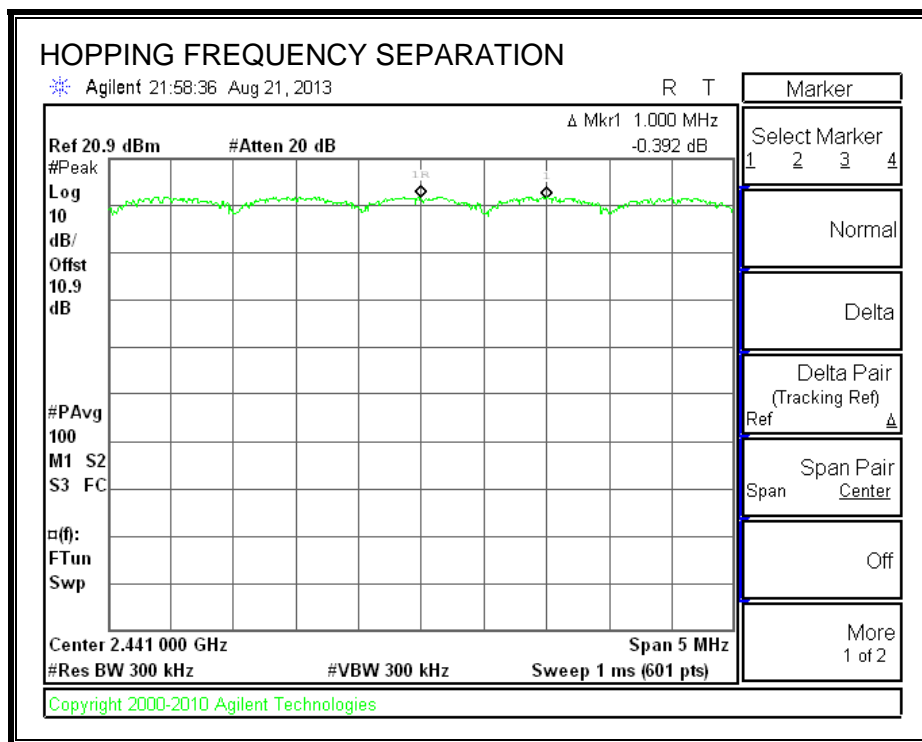
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

TEST PROCEDURE

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

RESULTS

HOPPING FREQUENCY SEPARATION



7.3.3. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

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

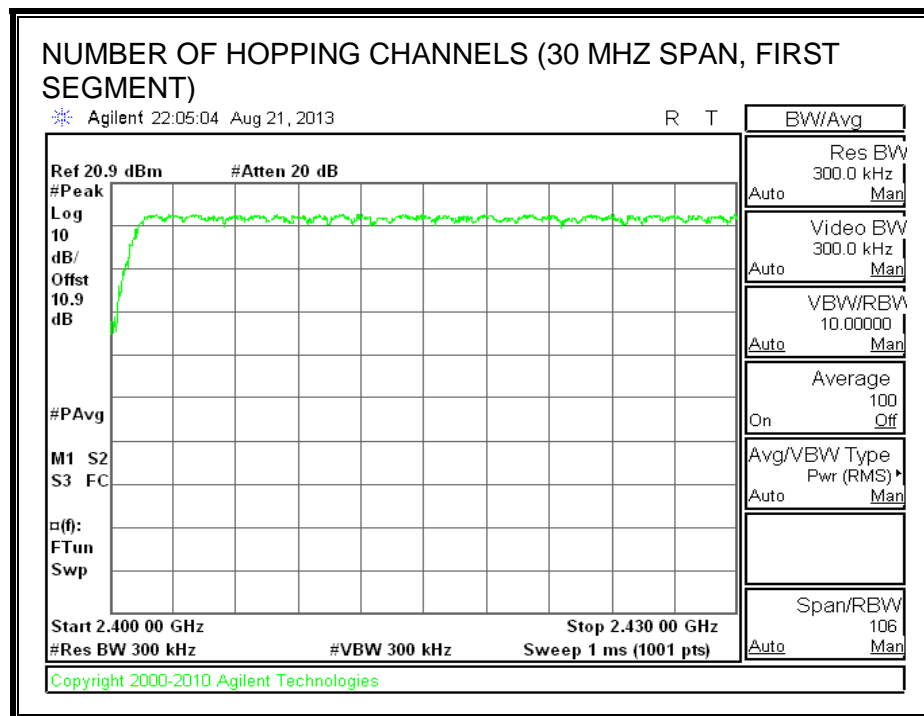
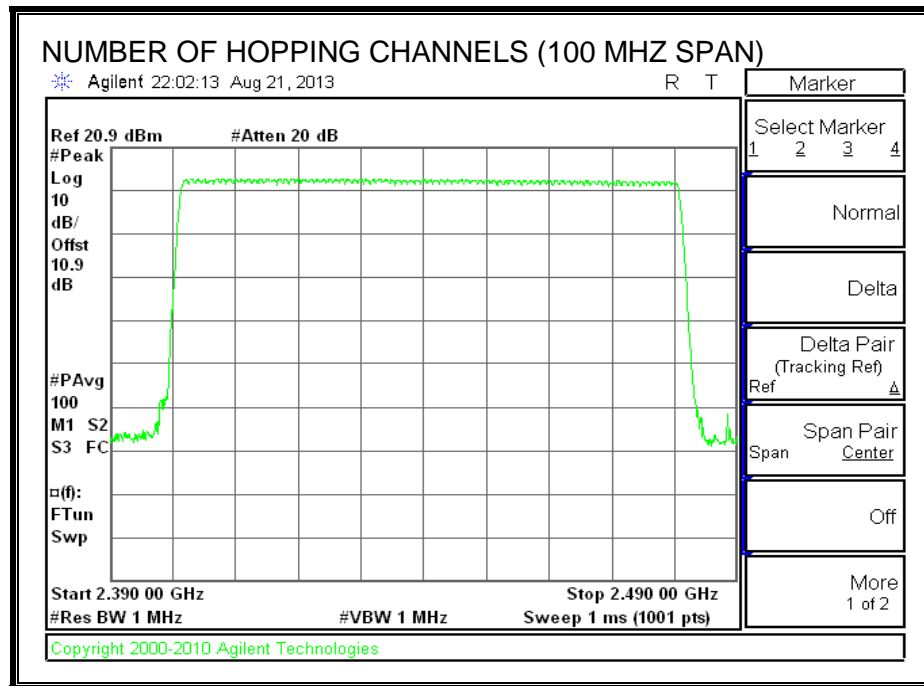
TEST PROCEDURE

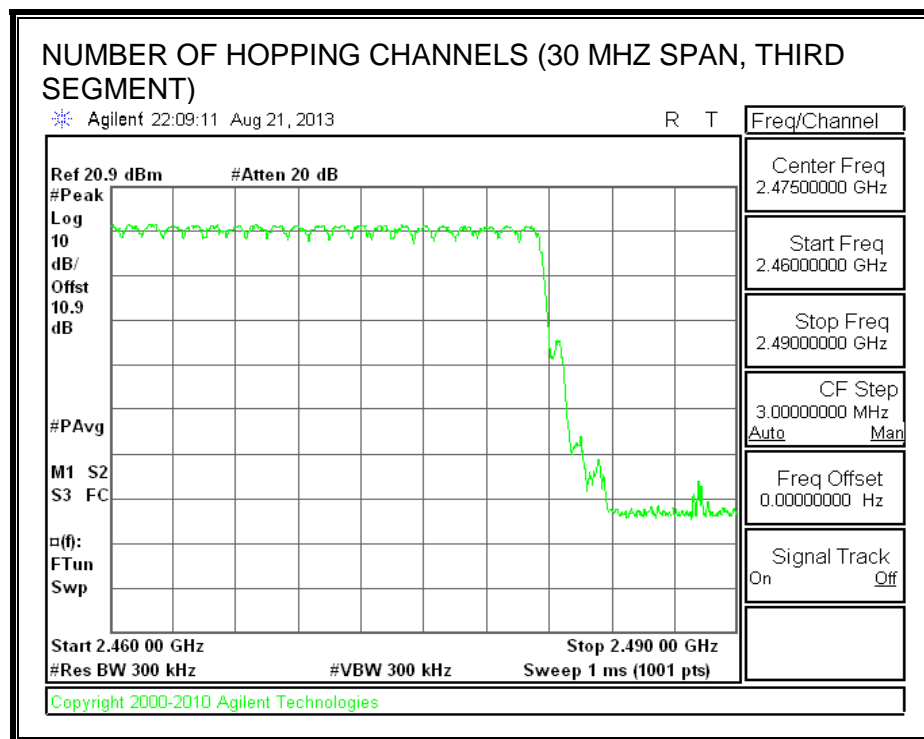
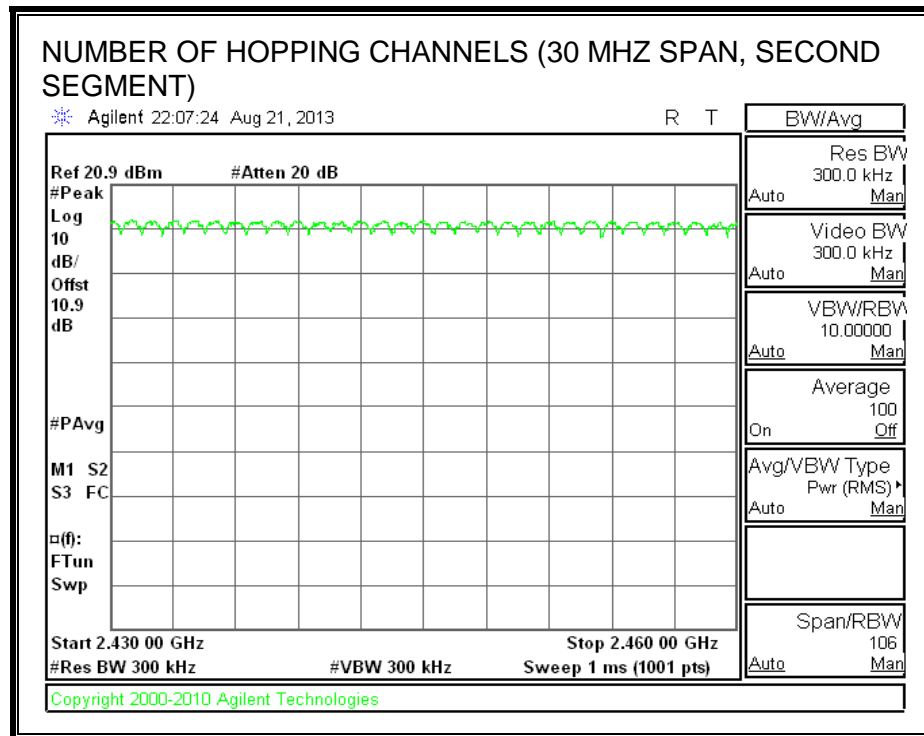
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

RESULTS

Normal Mode: 79 Channels observed.

NUMBER OF HOPPING CHANNELS





7.3.4. AVERAGE TIME OF OCCUPANCY

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

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

TEST PROCEDURE

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

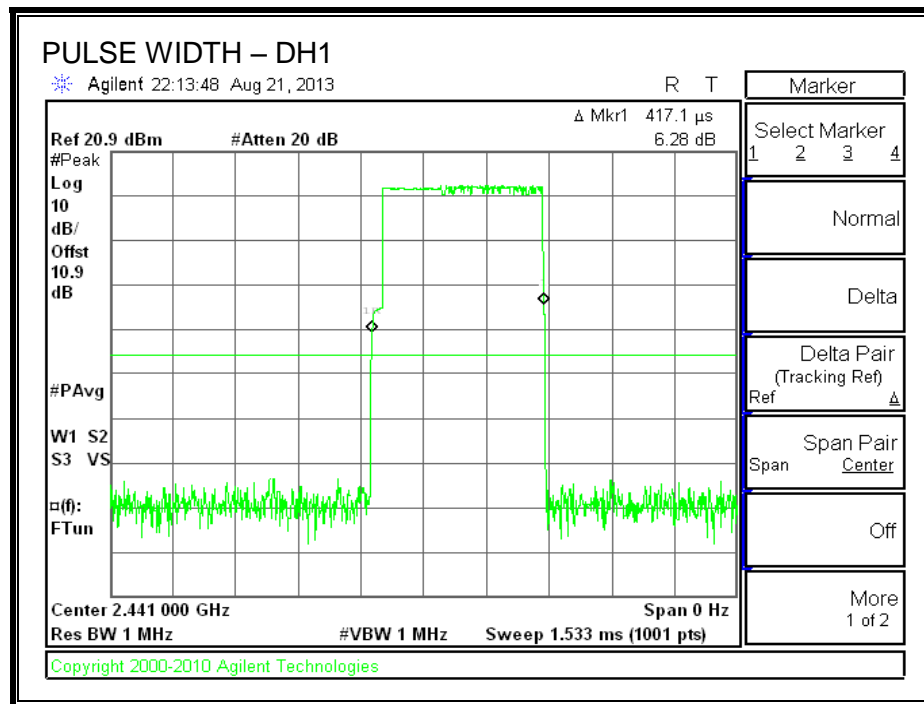
The average time of occupancy in the specified 31.6 second period (79 channels * 0.4 s) is equal to $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$.

RESULTS

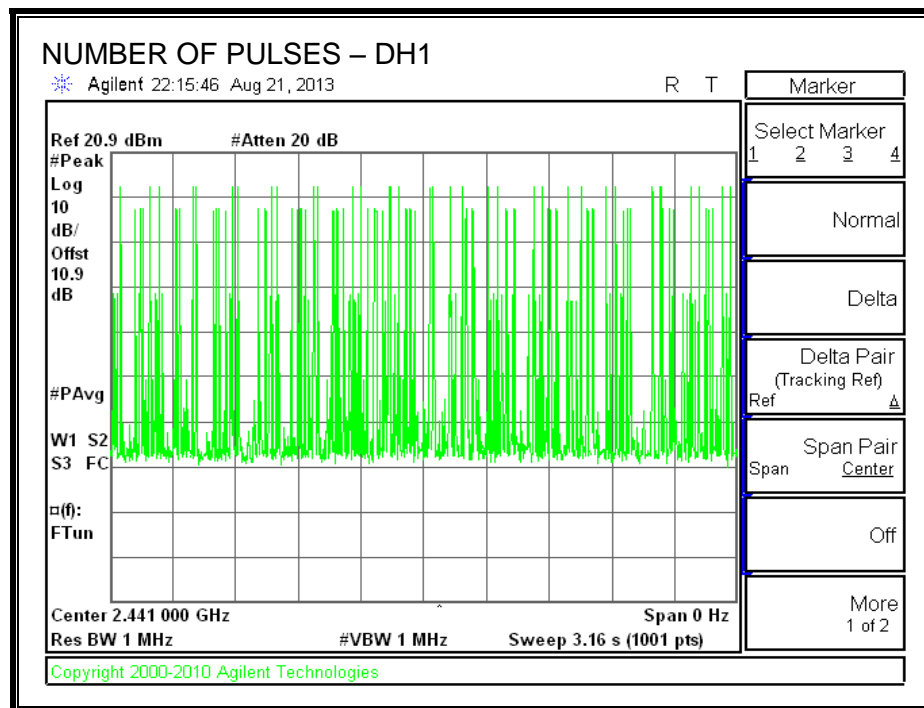
8PSK (EDR) Mode

DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
DH1	0.4171	31	0.129	0.4	-0.271
DH3	1.675	17	0.285	0.4	-0.115
DH5	2.923	12	0.351	0.4	-0.049

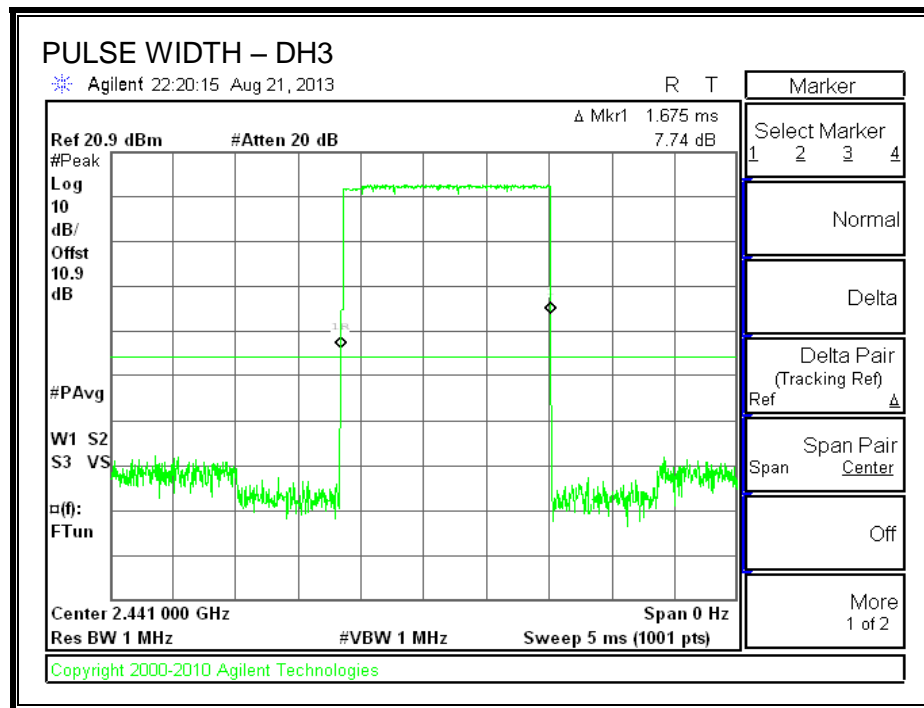
PULSE WIDTH - DH1



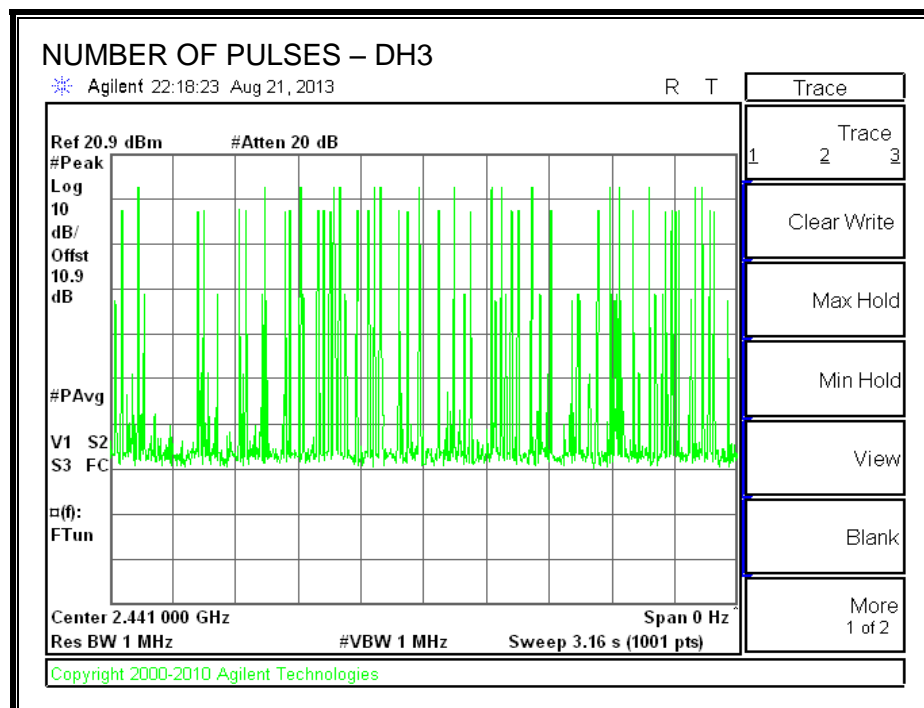
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH1



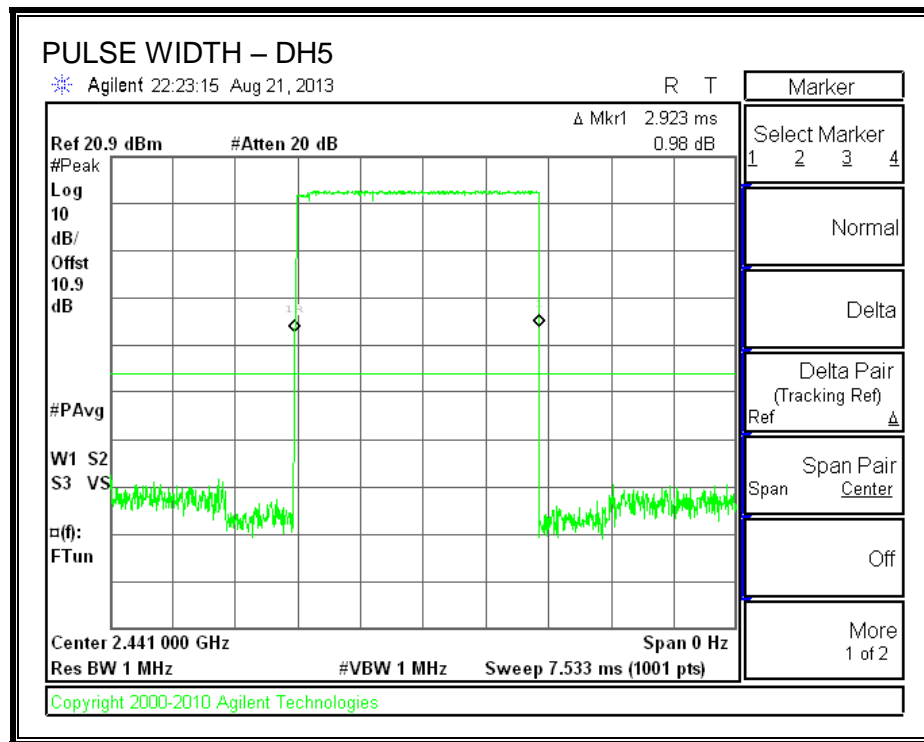
PULSE WIDTH – DH3



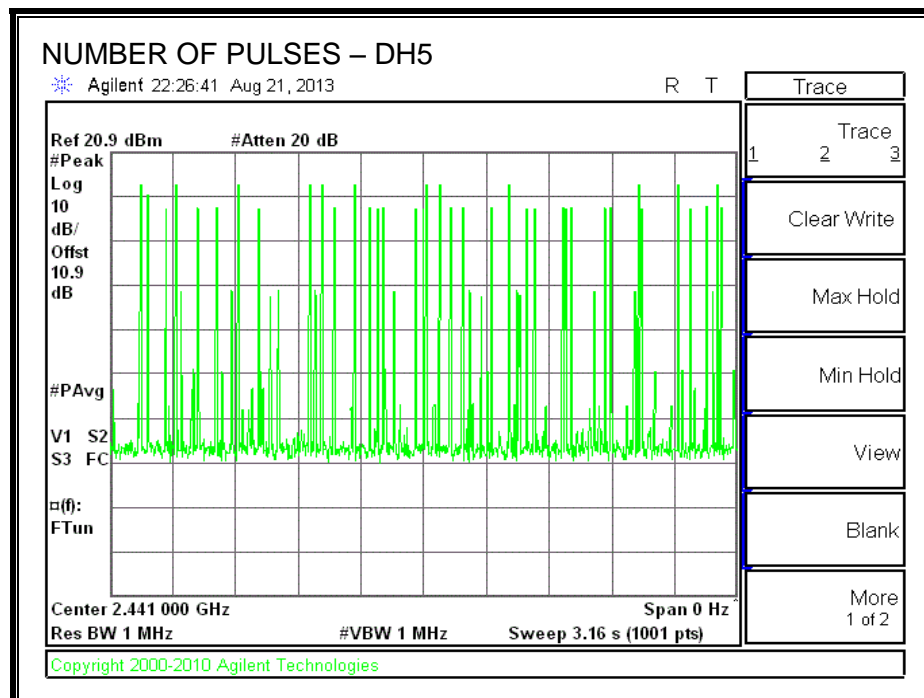
NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH3



PULSE WIDTH – DH5



NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD – DH5



7.3.5. 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.

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

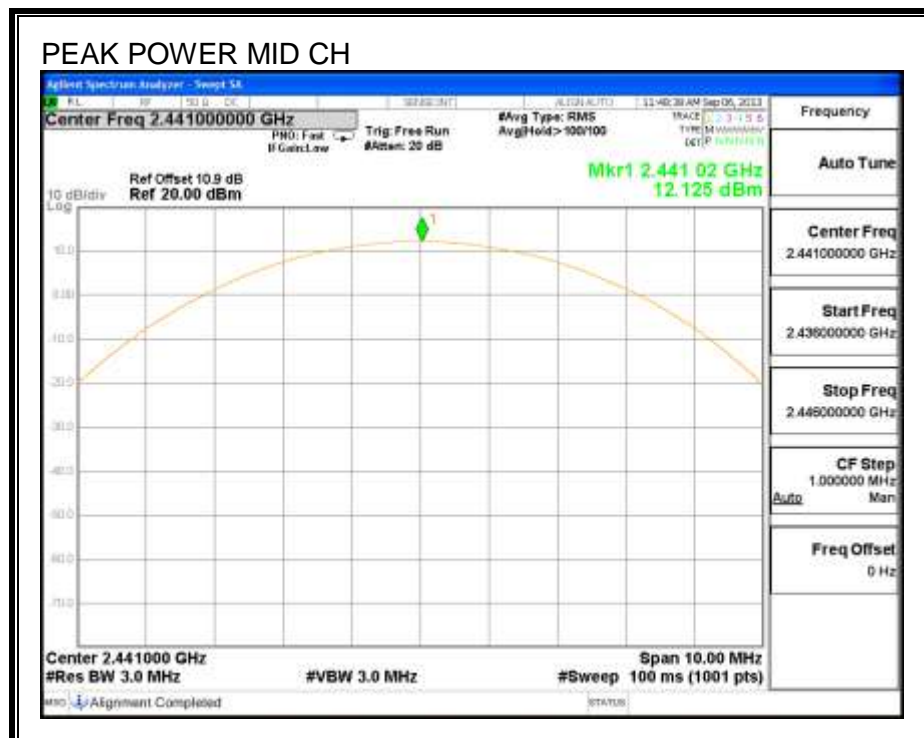
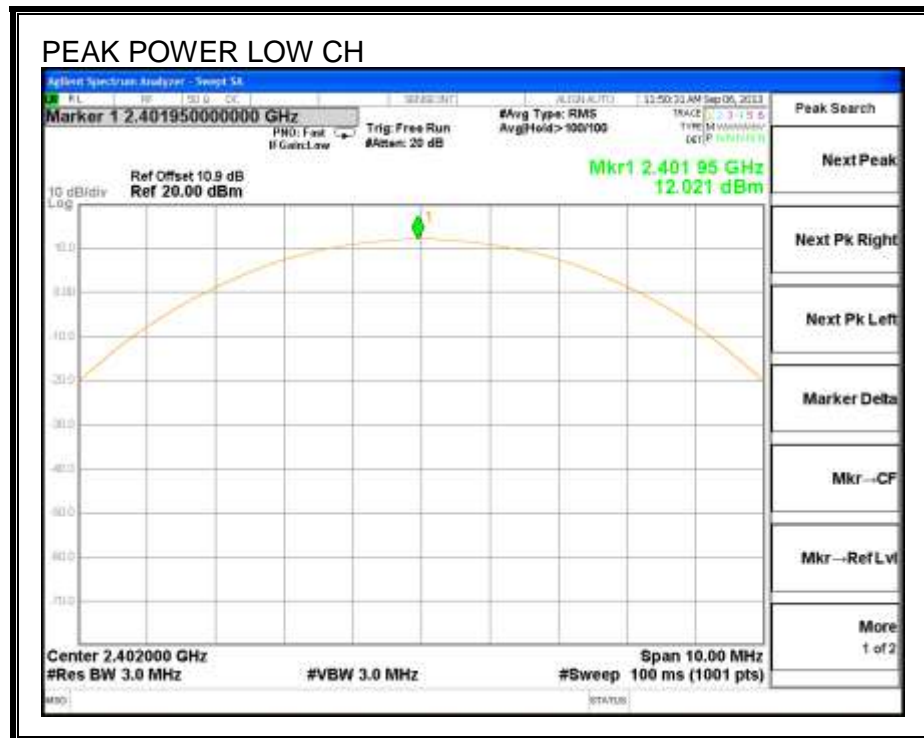
TEST PROCEDURE

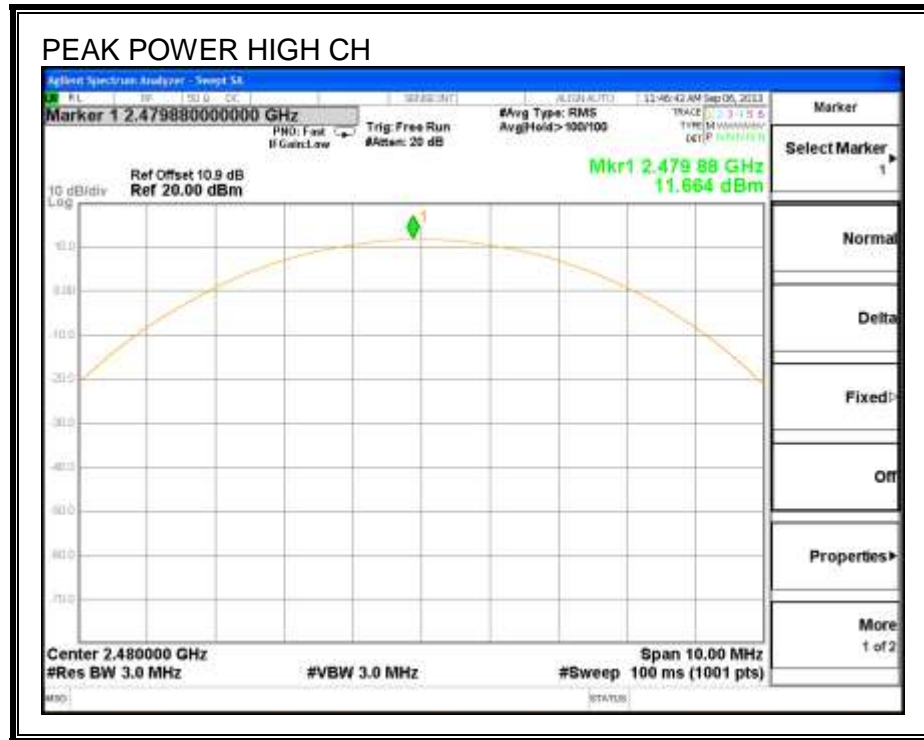
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	12.02	20.97	-8.95
Middle	2441	12.13	20.97	-8.84
High	2480	11.66	20.97	-9.31

OUTPUT POWER





7.3.6. 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 10.9 dB (including 10 dB pad and 0.9 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	9.91
Middle	2441	10.00
High	2480	9.80

7.3.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

TEST PROCEDURE

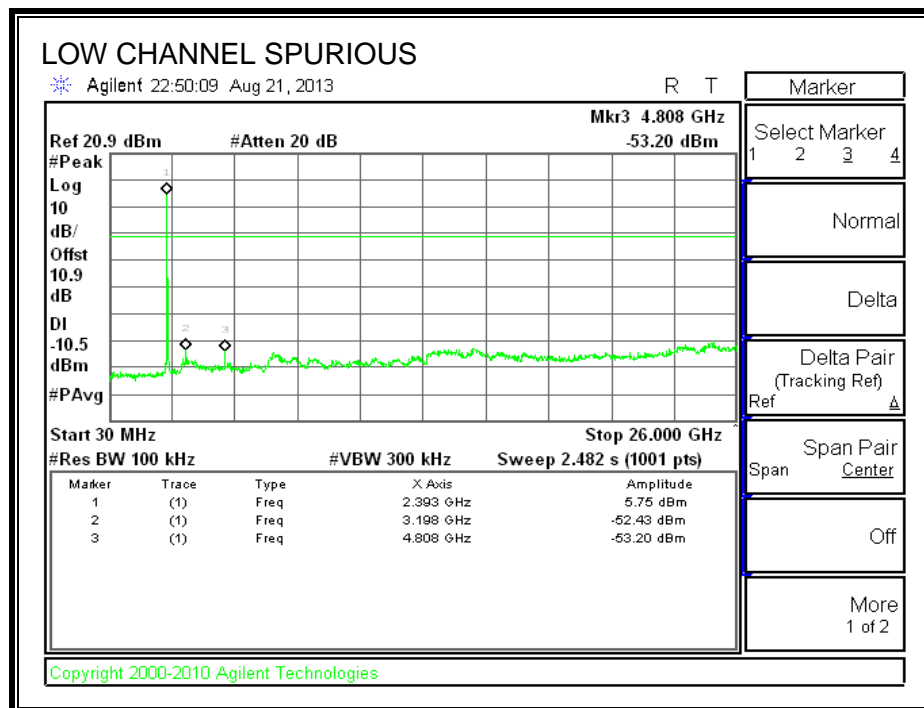
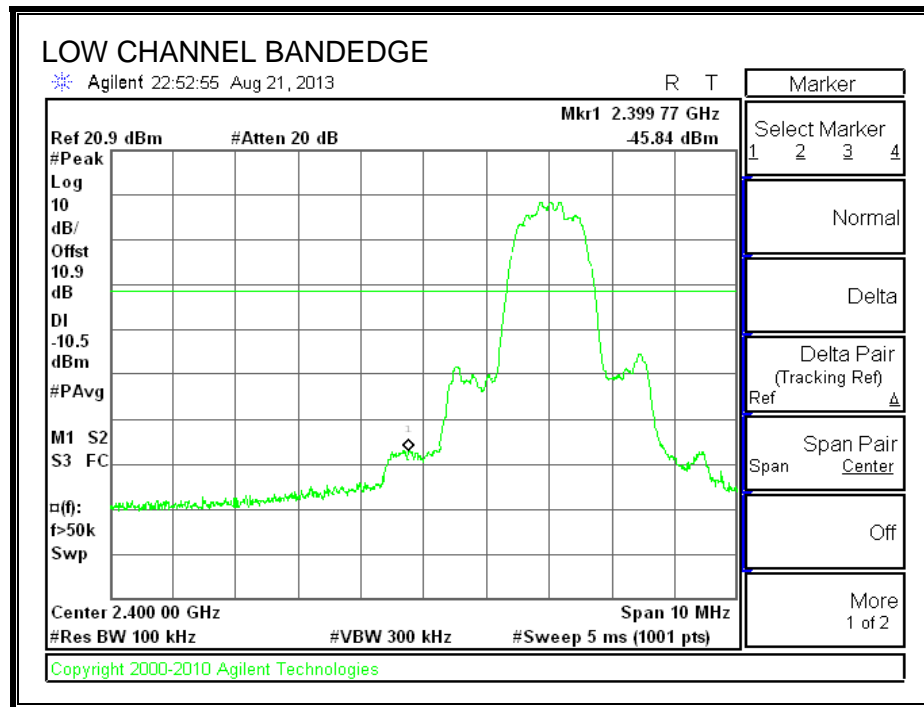
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

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

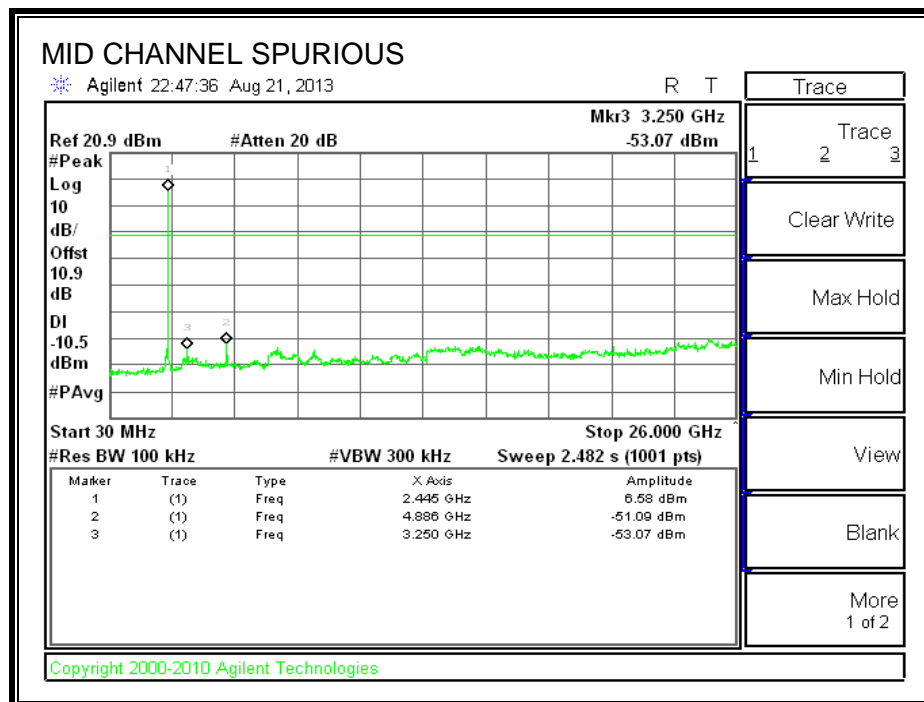
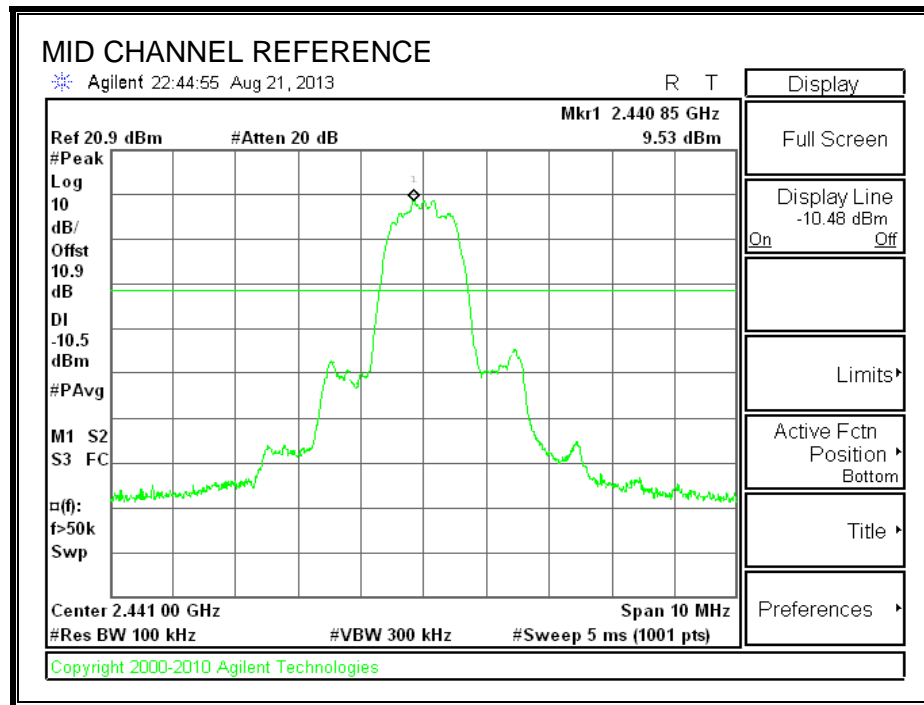
The bandedges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

RESULTS

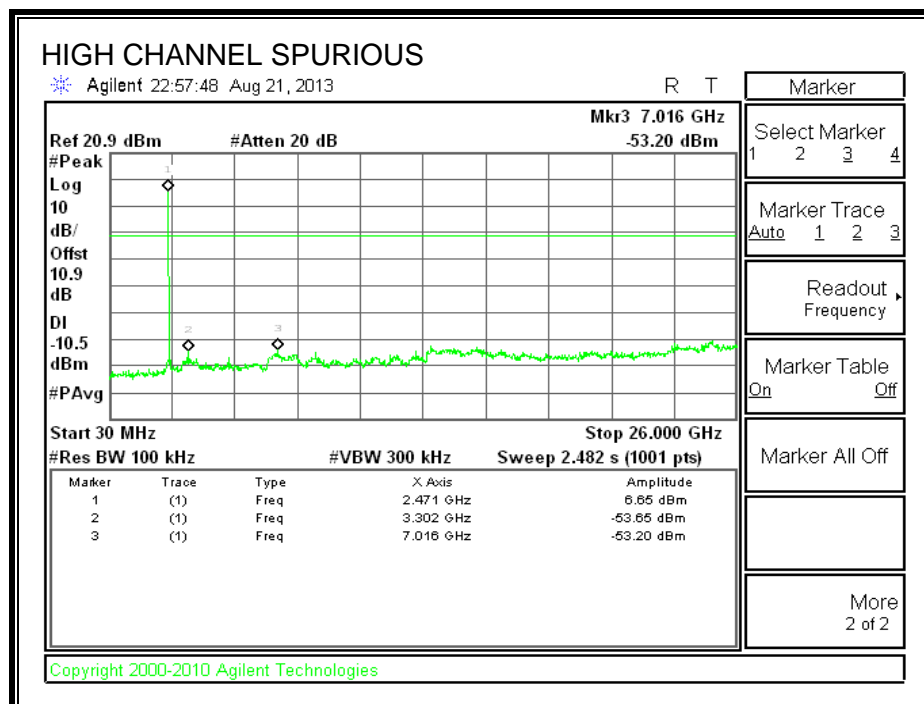
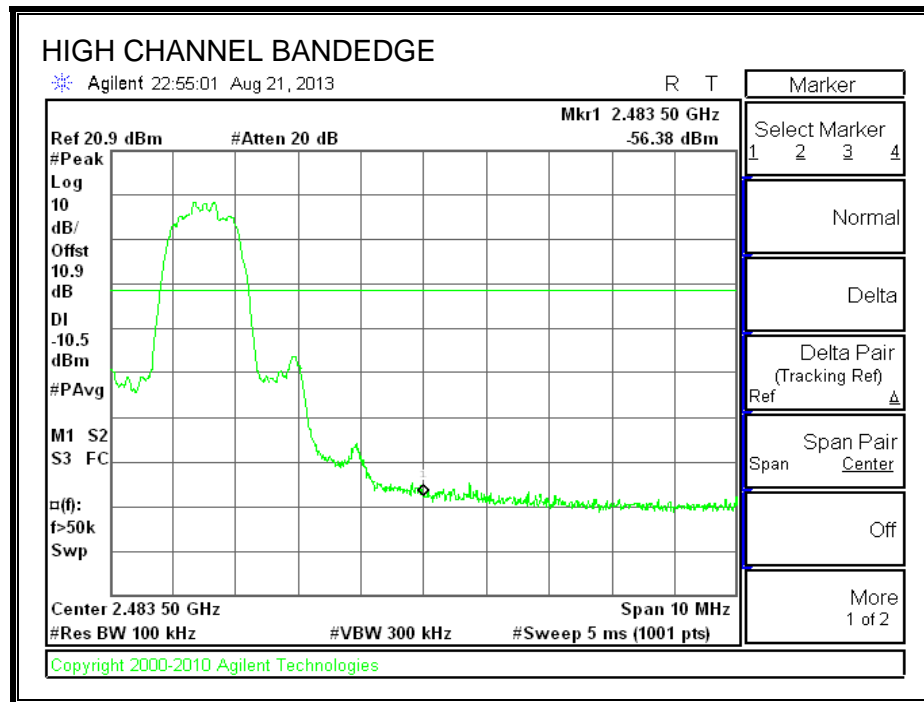
SPURIOUS EMISSIONS, LOW CHANNEL



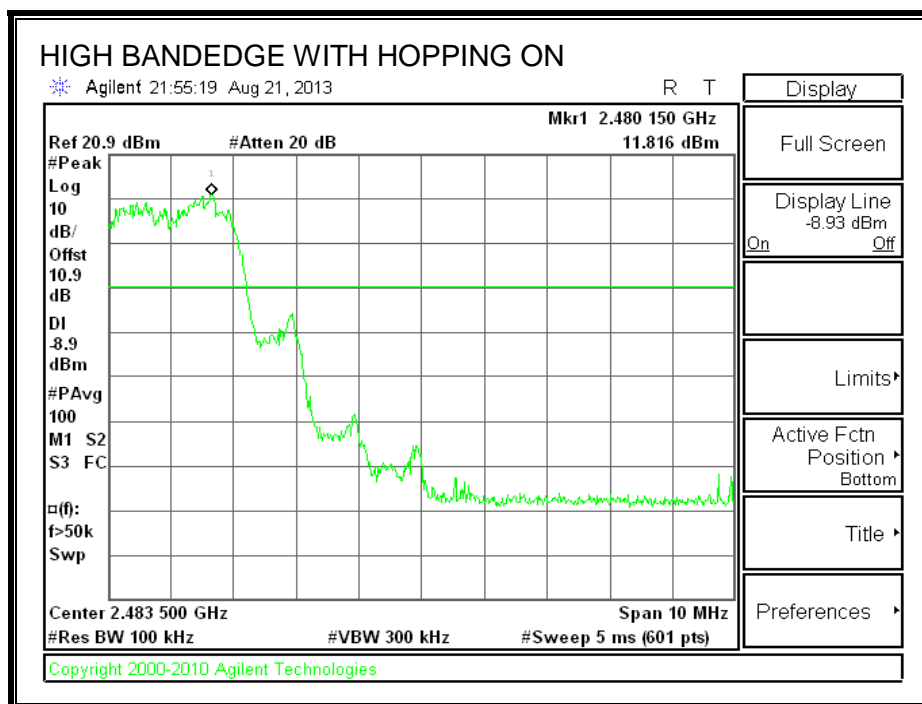
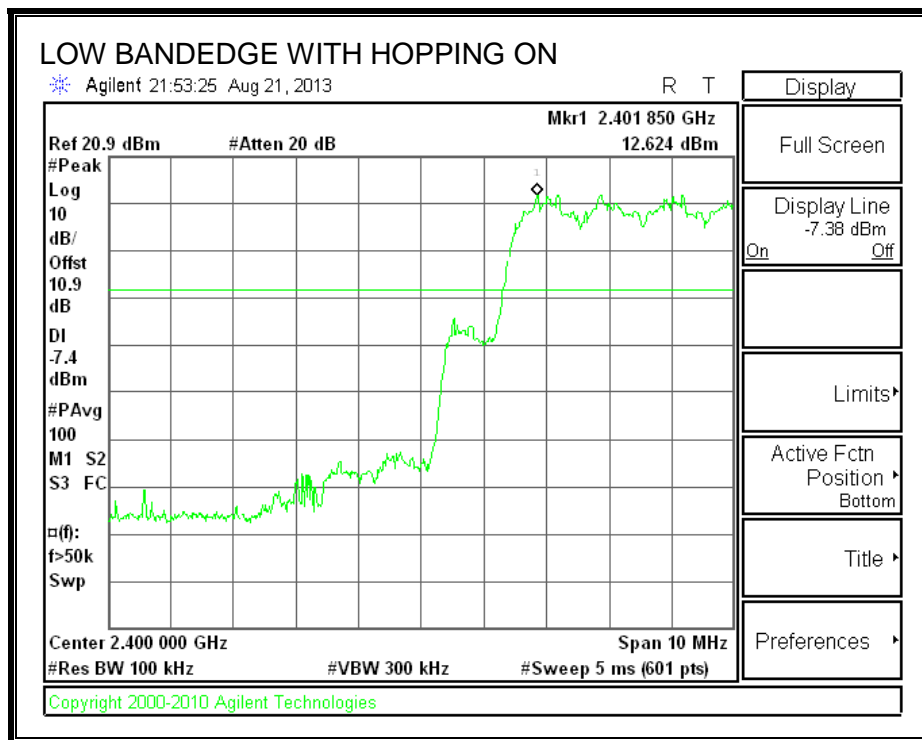
SPURIOUS EMISSIONS, MID CHANNEL



SPURIOUS EMISSIONS, HIGH CHANNEL



SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

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

TEST PROCEDURE

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

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

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

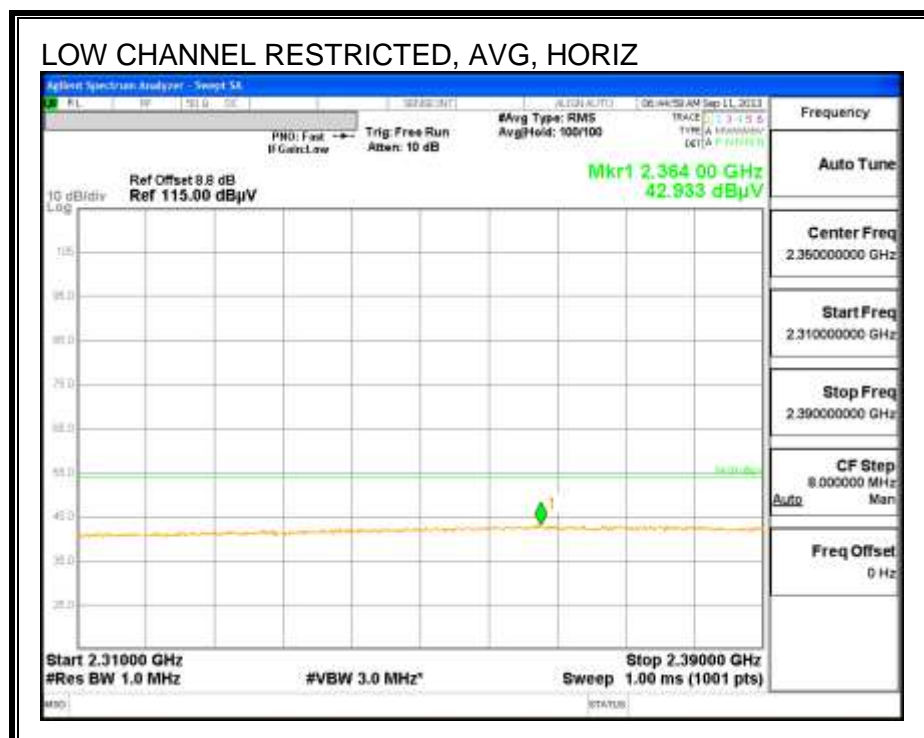
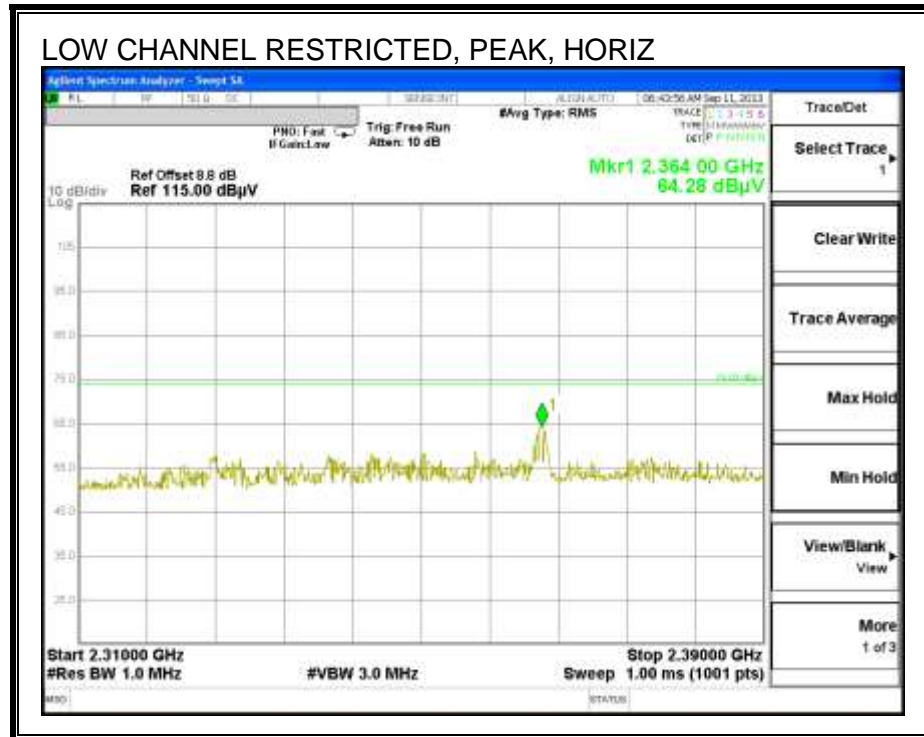
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

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

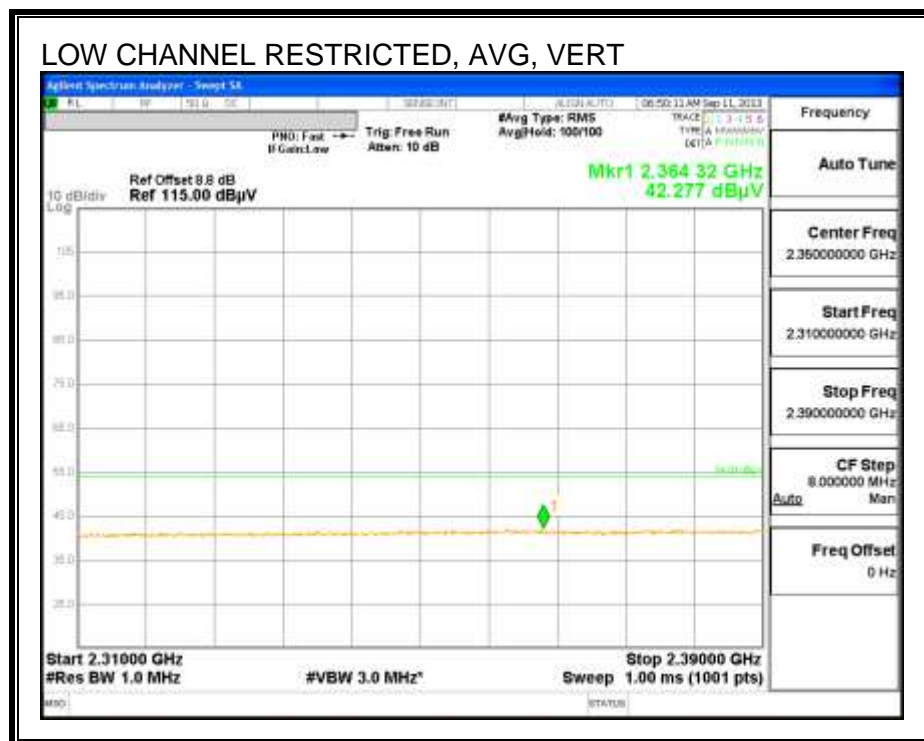
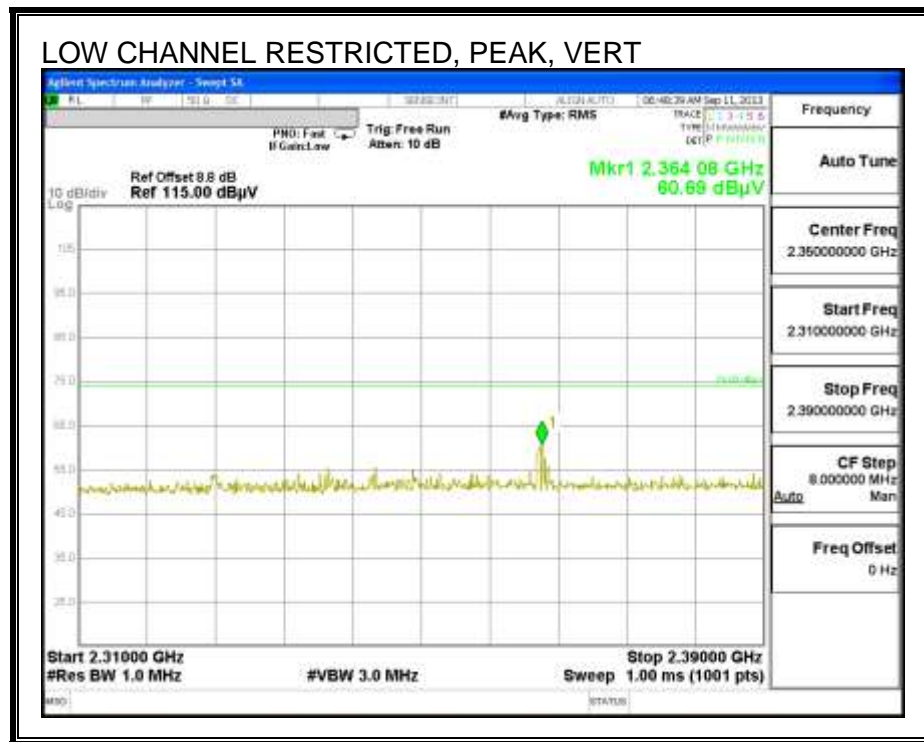
8.2. TRANSMITTER ABOVE 1 GHz

8.2.1. BASIC DATA RATE GFSK MODULATION

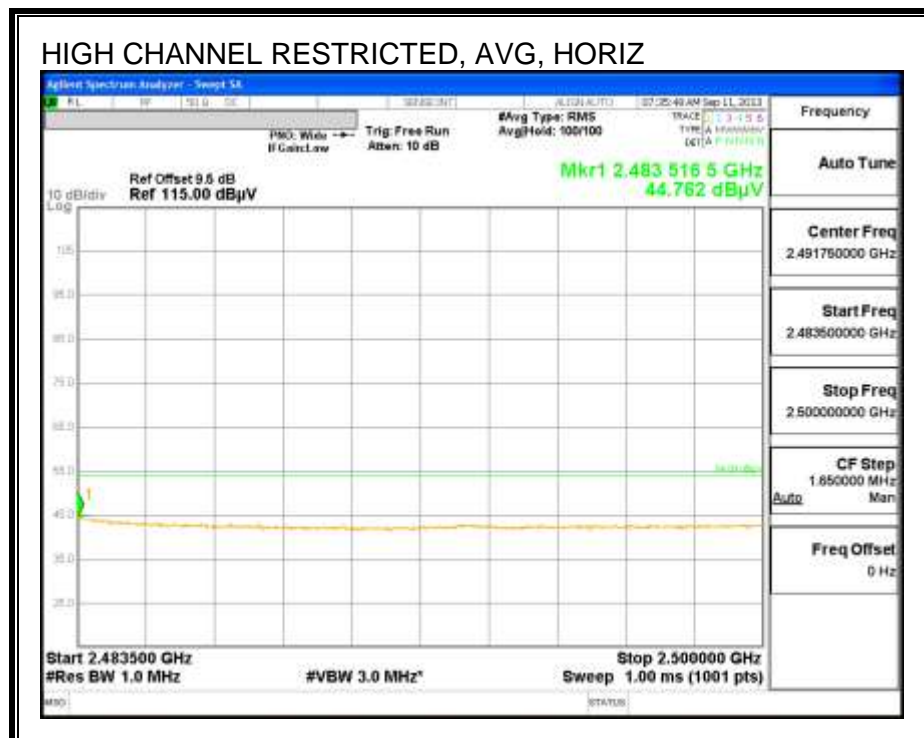
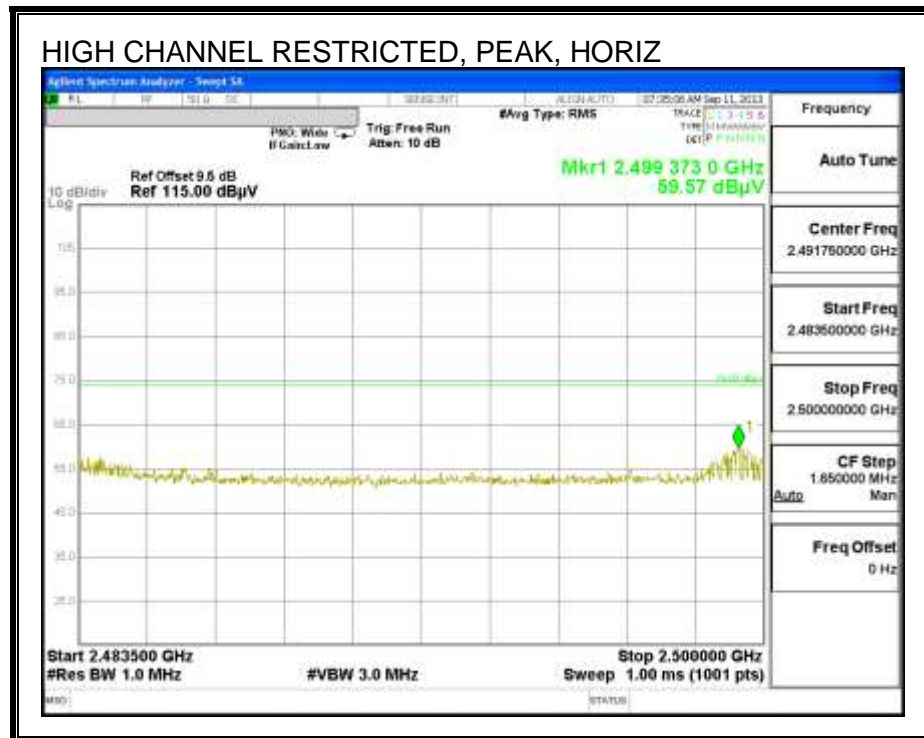
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



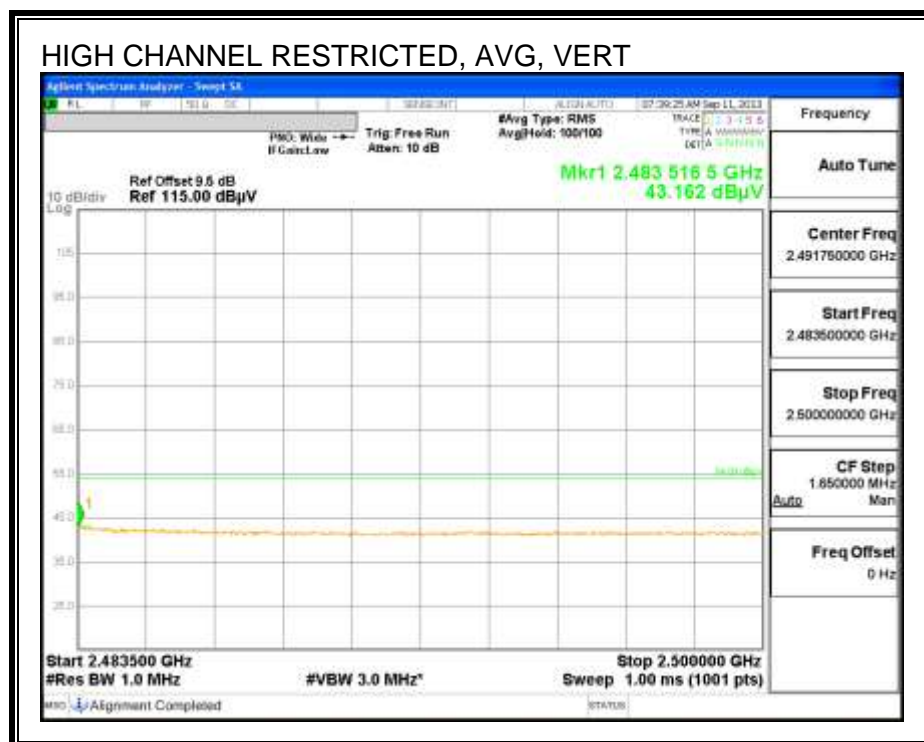
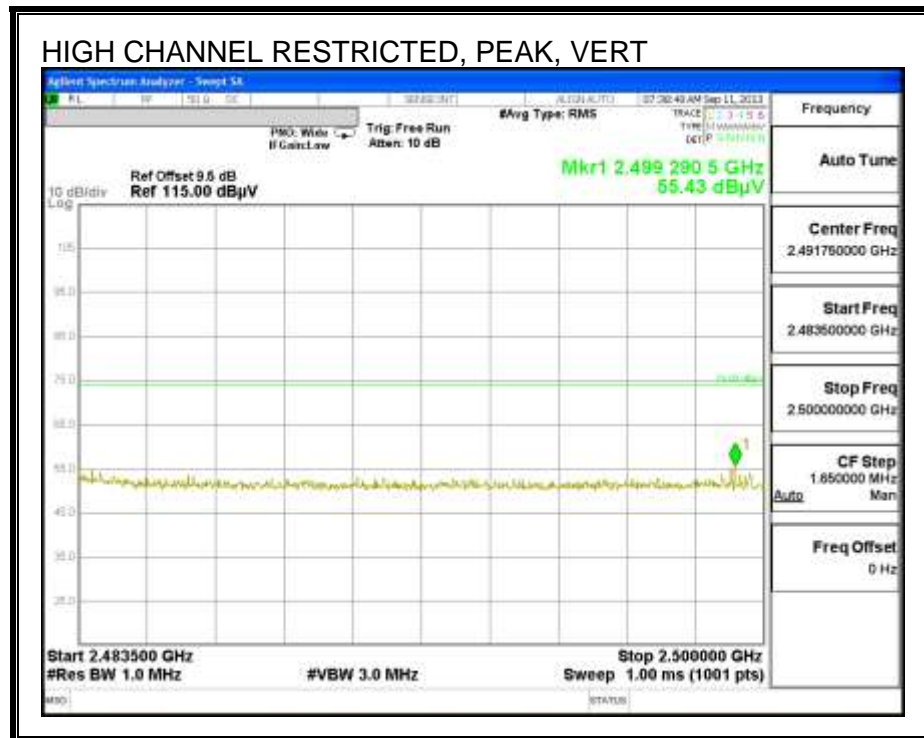
RESTRICTED BANEDGE (LOW CHANNEL, VERTICAL)



RESTRICTED BANEDGE (HIGH CHANNEL, HORIZONTAL)

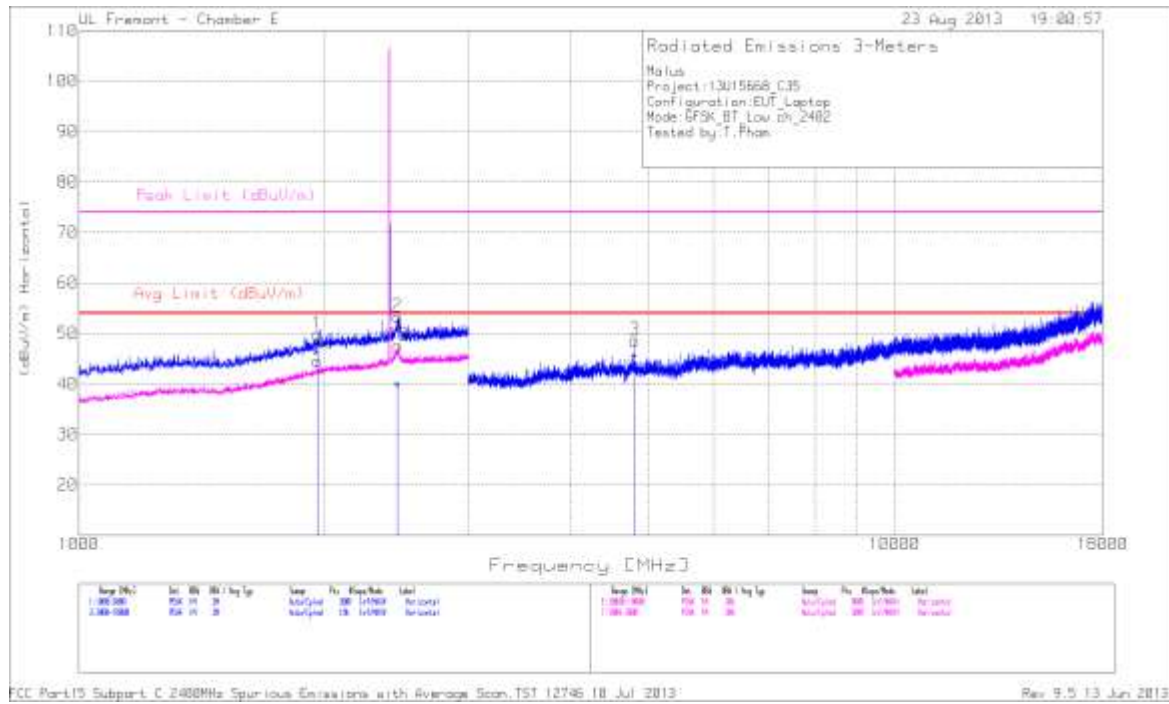


RESTRICTED BANEDGE (HIGH CHANNEL, VERTICAL)

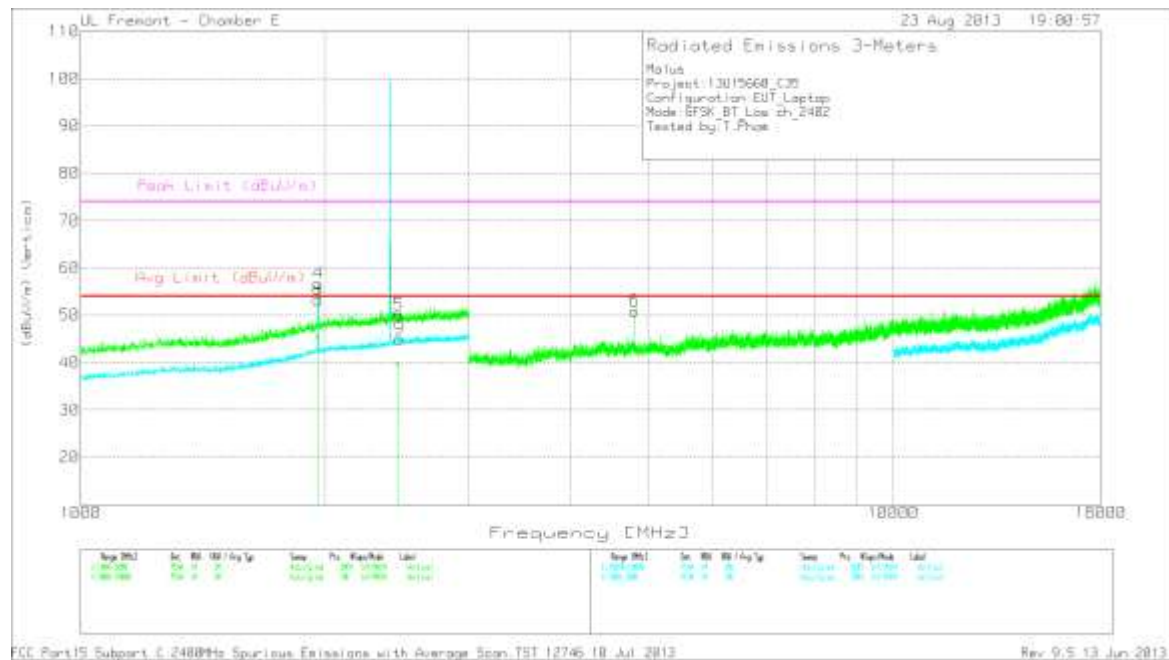


HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL



LOW CHANNEL VERTICAL



DATA

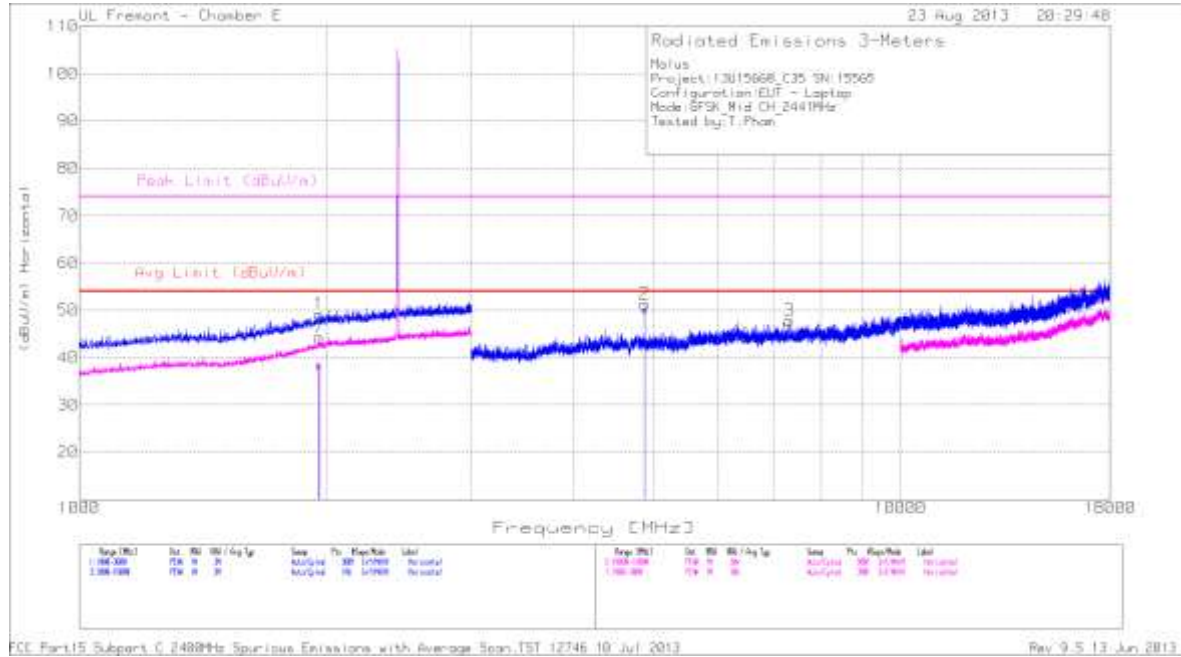
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/ 10dB Pad	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Height (cm)	Polarity
1	1.96	43.63	PK	31.8	-25.6	49.83	53.97	-4.14	74	-24.17	100	H
2	2.459	45.32	PK	32.7	-24.7	53.32	53.97	-.65	74	-20.68	100	H
3	4.804	45.31	PK	34.4	-31.1	48.61	53.97	-5.36	74	-25.39	100	H
4	1.959	50.45	PK	31.8	-25.6	56.65	-	-	74	-17.35	199	V
8	1.96	47.07	PK (VB)	31.8	-25.6	53.27	53.97	-.7	-	-	199	V
5	2.463	42.07	PK	32.7	-24.7	50.07	-	-	74	-23.93	101	V
9	2.467	37.03	PK (VB)	32.7	-24.7	45.03	53.97	-	-	-28.97	199	V
6	4.805	47.61	PK	34.4	-31.1	50.91	53.97	-3.06	74	-23.09	199	V
7	1.959	38.38	PK	31.8	-25.6	44.58	53.97	-9.39	74	-29.42	100	H
10	2.463	39.61	PK	32.7	-24.7	47.61	53.97	-6.36	74	-26.39	100	H

PK - Peak detector

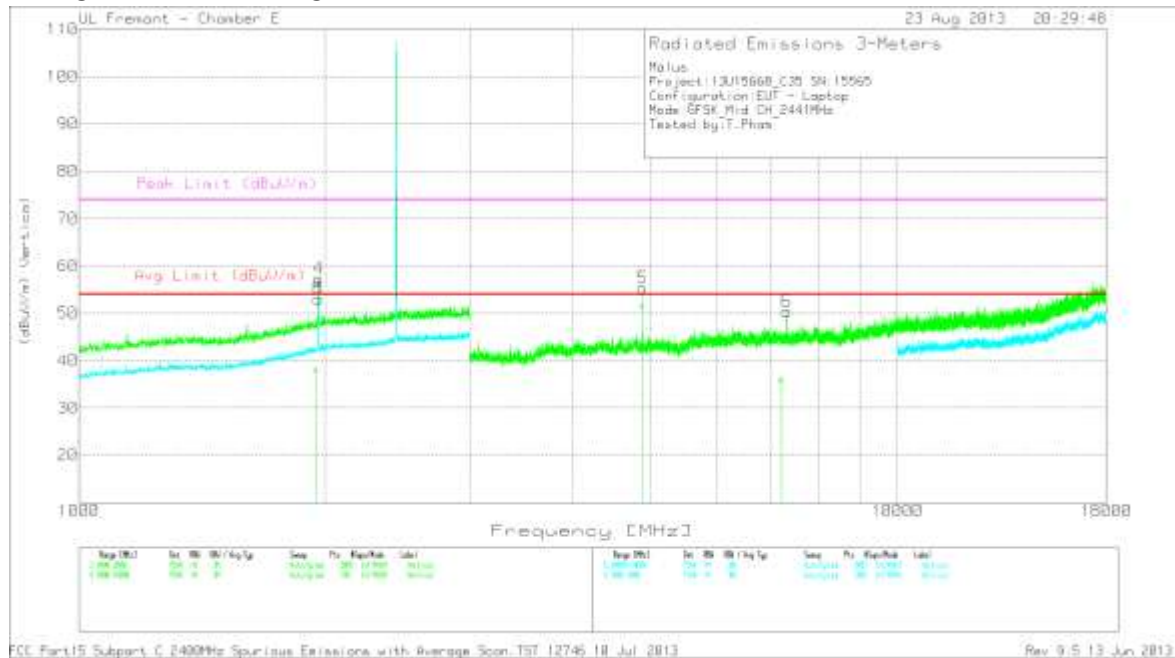
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/ 10dB Pad	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1.96	40.07	VB1	31.8	-25.6	46.27	53.97	-7.7	-	-	228	344	H
2.459	31.93	VB1	32.7	-24.7	39.93	53.97	-14.04	-	-	61	165	H
4.804	42.22	VB1	34.4	-31.1	45.52	53.97	-8.45	-	-	275	169	H
1.96	39.2	VB1	31.8	-25.6	45.4	53.97	-8.57	-	-	132	244	H
2.455	31.94	VB1	32.6	-24.8	39.74	53.97	-14.23	-	-	0	244	V

VB1 - KDB 789033 v01r02 Method: VB Alternative Reduced Video

MID CHANNEL HORIZONTAL



MID CHANNEL VERTICAL



DATA

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)	Height (cm)	Polarity
1	1.959	43.02	PK	31.8	-25.6	49.22	-	-	74	-24.78	100	H
7	1.96	38	PK (VB)	31.8	-25.6	44.2	53.97	-9.77	-	--	100	H
2	4.883	47.89	PK	34.4	-31	51.29	53.97	-2.68	74	-22.71	199	H
3	7.324	39.78	PK	36	-28	47.78	53.97	-6.19	74	-26.22	199	H

PK - Peak detector

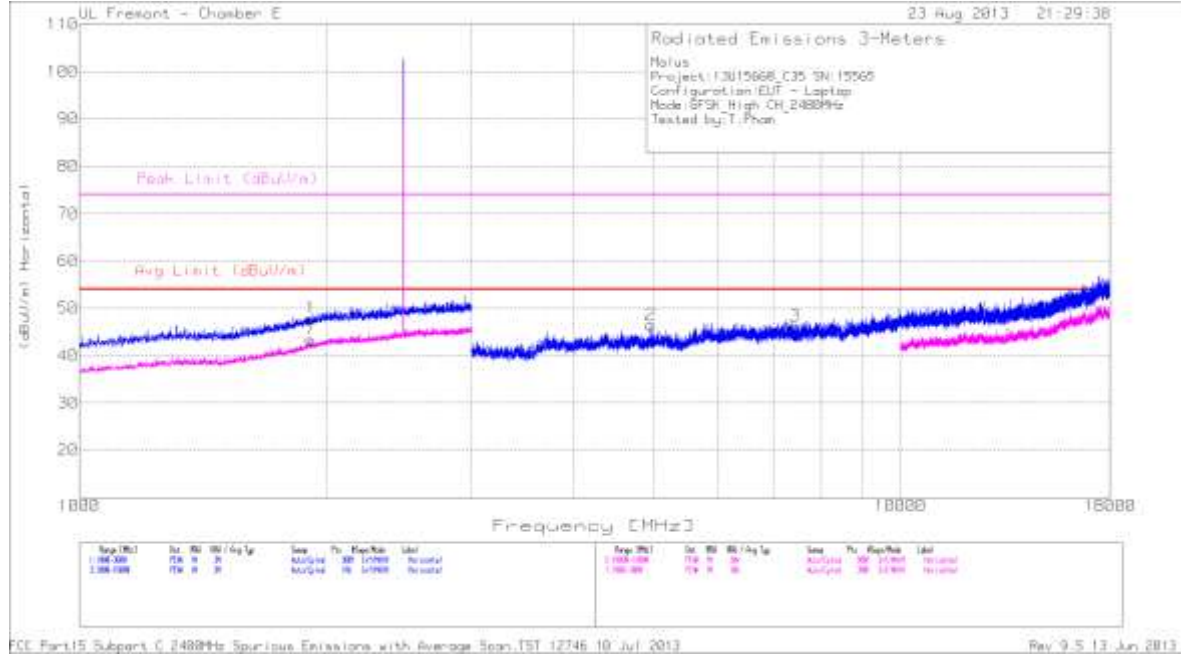
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/ 3GHz HPF	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Height (cm)	Polarity
4	1.961	51.11	PK	31.8	-25.6	57.31	-	-	74	-16.69	199	V
8	1.96	46.87	PK (VB)	31.8	-25.6	53.07	53.97	-.9	-	-	199	V
5	4.882	51.85	PK	34.4	-31	55.25	-	-	74	-18.75	199	V
6	7.324	42.35	PK	36	-28	50.35	53.97	-3.62	74	-23.65	199	V

PK - Peak detector

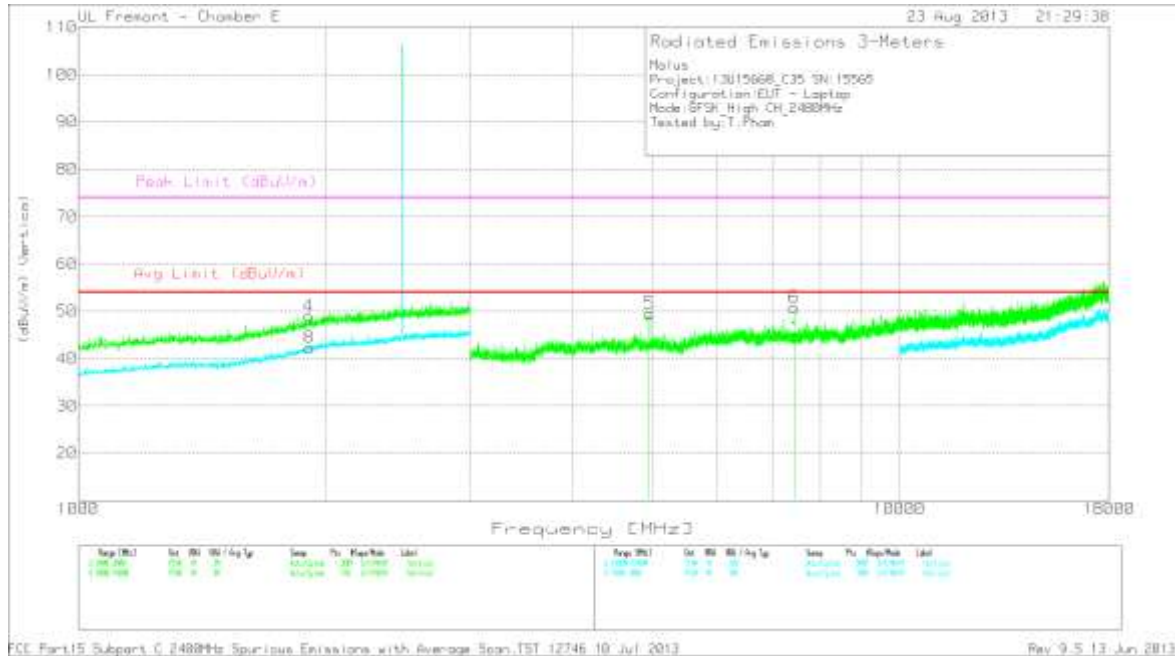
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/ 10dB Pad	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1.96	31.74	VB1	31.8	-25.6	37.94	53.97	-16.03	-	-	273	287	H
1.95	31.78	VB1	31.8	-25.6	37.98	53.97	-15.99	-	-	104	244	V
1.957	32.28	VB1	31.8	-25.6	38.48	53.97	-15.49	-	-	45	320	V
4.882	46.35	VB1	34.4	-31	49.75	53.97	-4.22	-	-	56	370	H
4.882	48.04	VB1	34.4	-31	51.44	53.97	-2.53	-	-	262	187	V
7.215	28.51	VB1	36	-28.7	35.81	53.97	-18.16	-	-	273	370	V

VB1 - KDB 789033 v01r02 Method: VB Alternative Reduced Video

HIGH CHANNEL HORIZONTAL



HIGH CHANNEL VERTICAL



DATA

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)	Height (cm)	Polarity
1	1.914	42.09	PK	31.5	-25.7	47.89	-	-	74	-26.11	100	H
7	1.912	37.47	PK (VB)	31.5	-25.6	43.37	53.97	-10.6	-	-	100	H
2	4.962	43.09	PK	34.4	-31.1	46.39	53.97	-7.58	74	-27.61	199	H
3	7.441	38.95	PK	36.1	-28.8	46.25	53.97	-7.72	74	-27.75	199	H

PK - Peak detector

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)	Height (cm)	Polarity
4	1.908	43.01	PK	31.5	-25.6	48.91	-	-	74	-25.09	100	V
8	1.911	36.4	PK (VB)	31.5	-25.6	42.3	53.97	-11.67	-	-	100	V
5	4.961	46.15	PK	34.4	-31.1	49.45	53.97	-4.52	74	-24.55	199	V
6	7.441	43.51	PK	36.1	-28.8	50.81	53.97	-3.16	74	-23.19	199	V

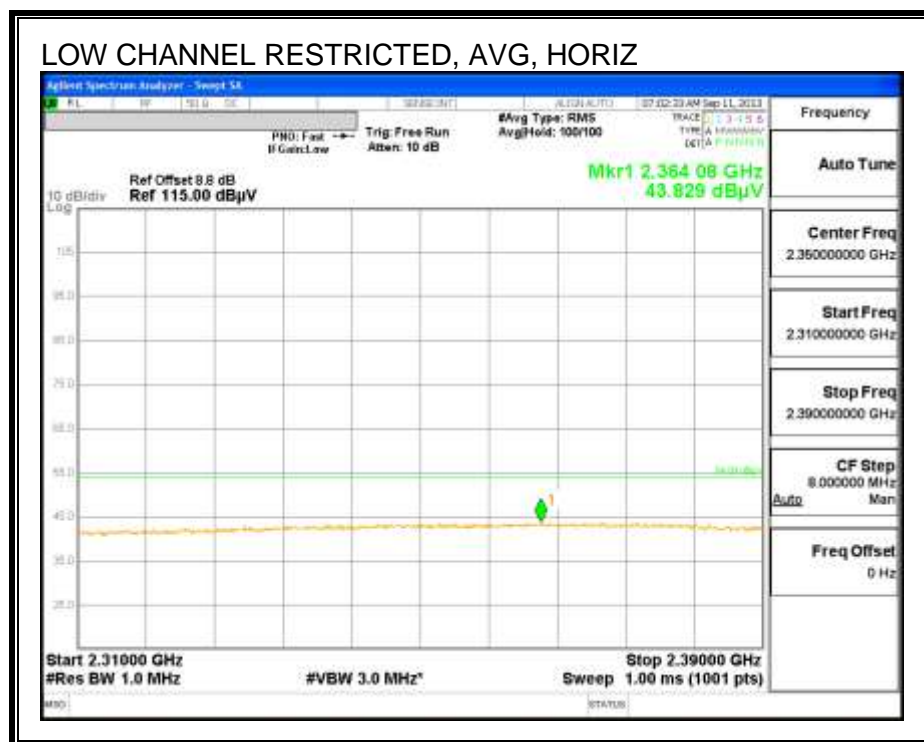
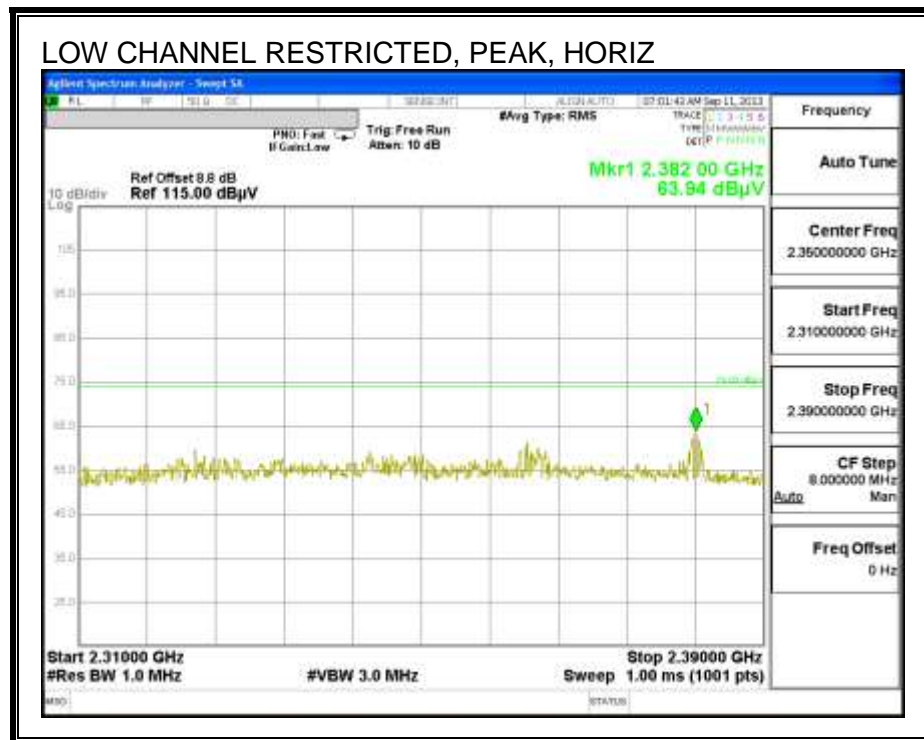
PK - Peak detector

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
4.96	45.12	VB1	34.4	-31	48.52	53.97	-6.45	-	-	261	215	V
7.44	40.37	VB1	36.1	-28.8	47.67	53.97	-6.3	-	-	350	215	V

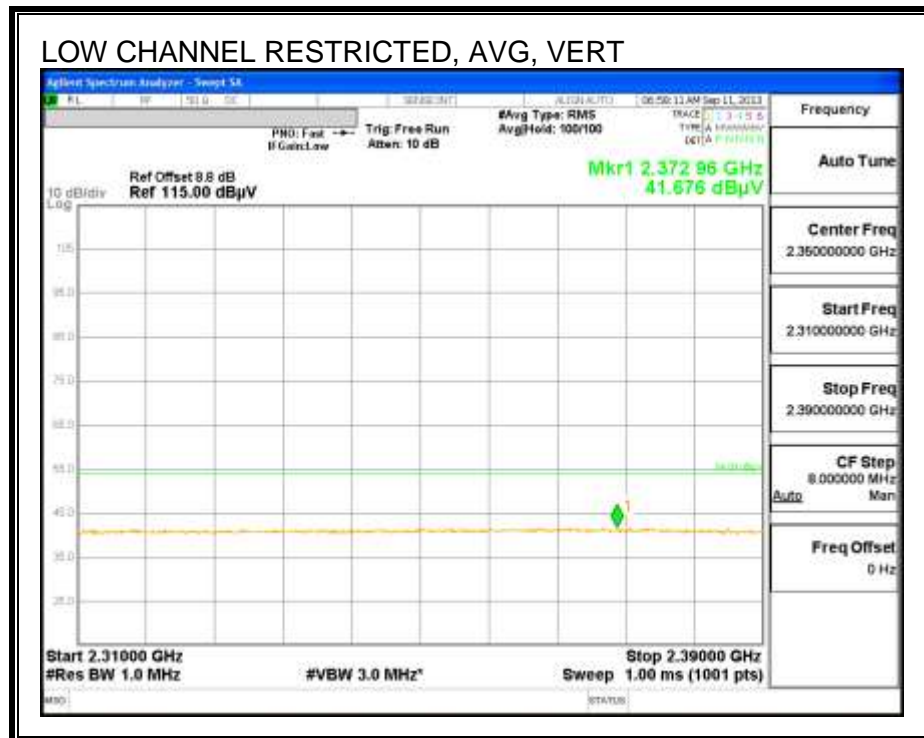
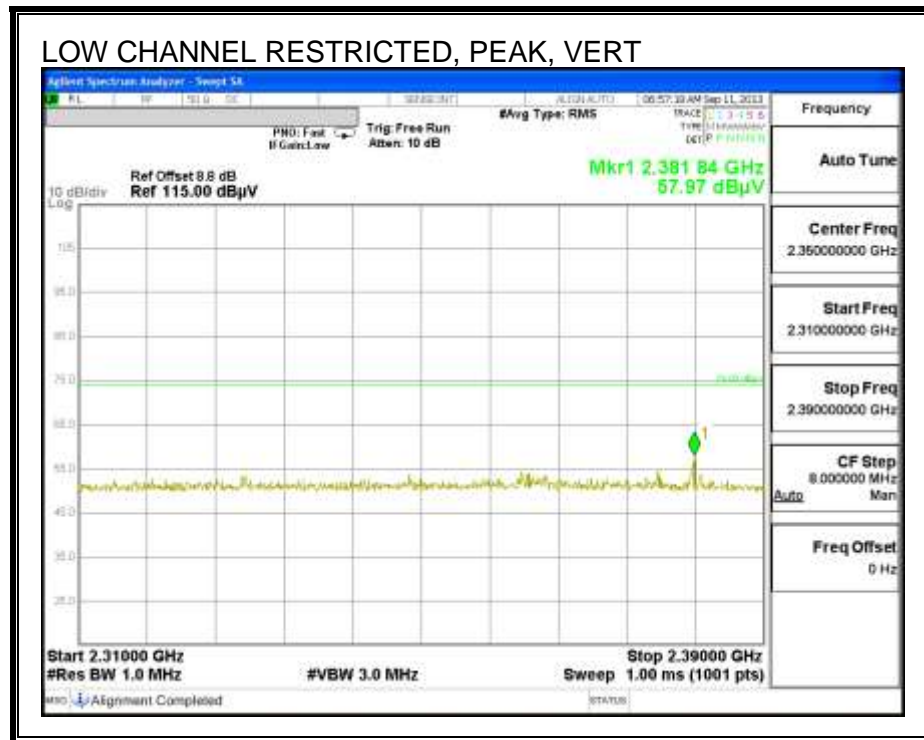
VB1 - KDB 789033 v01r02 Method: VB Alternative Reduced Video

8.2.2. ENHANCED DATA RATE 8PSK MODULATION

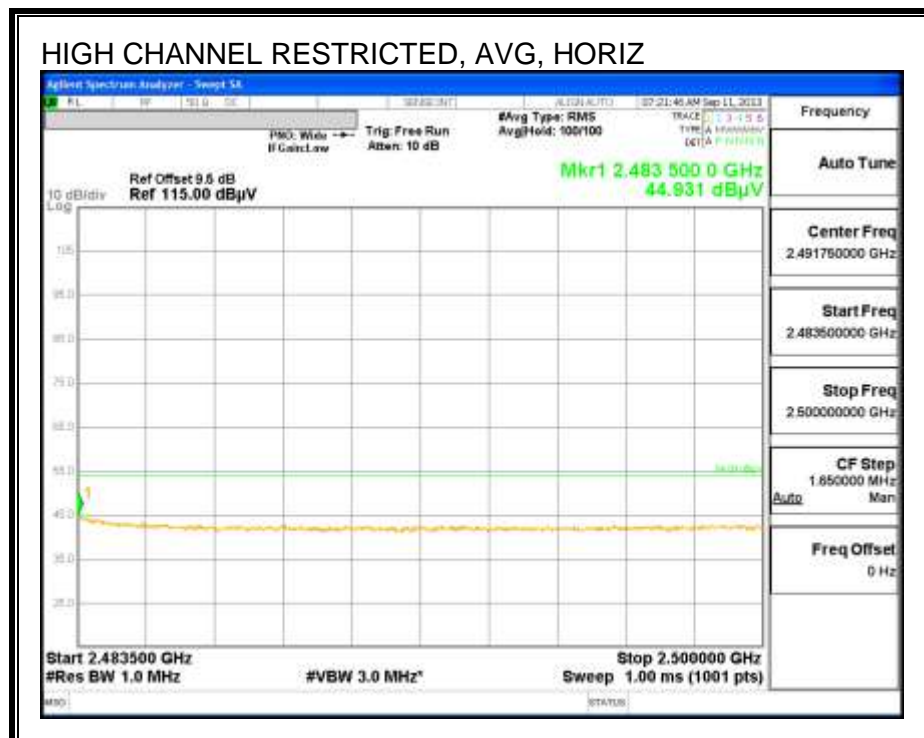
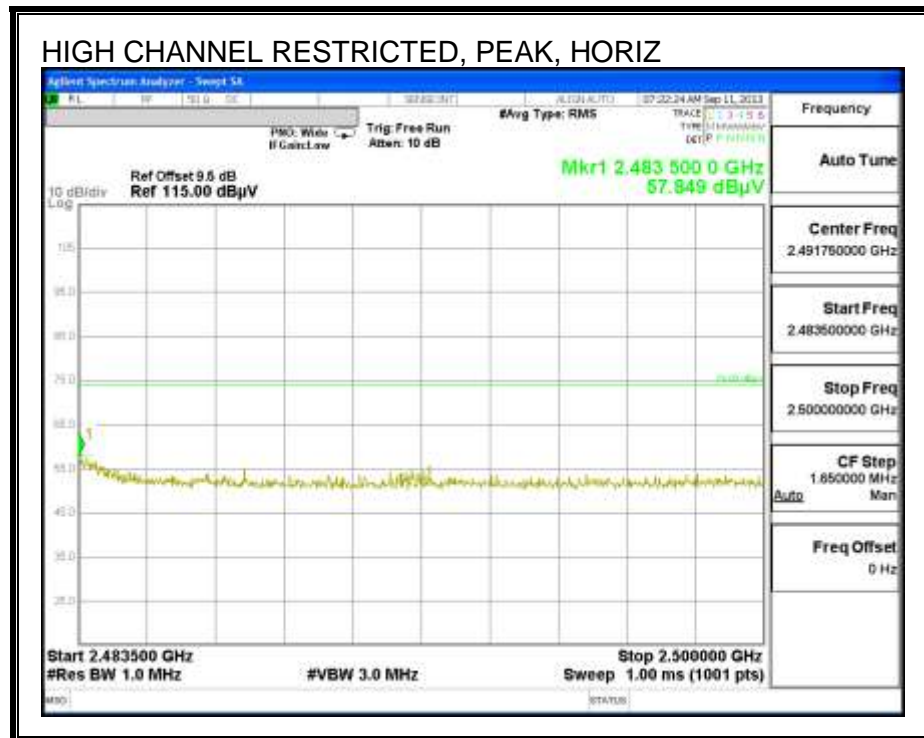
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



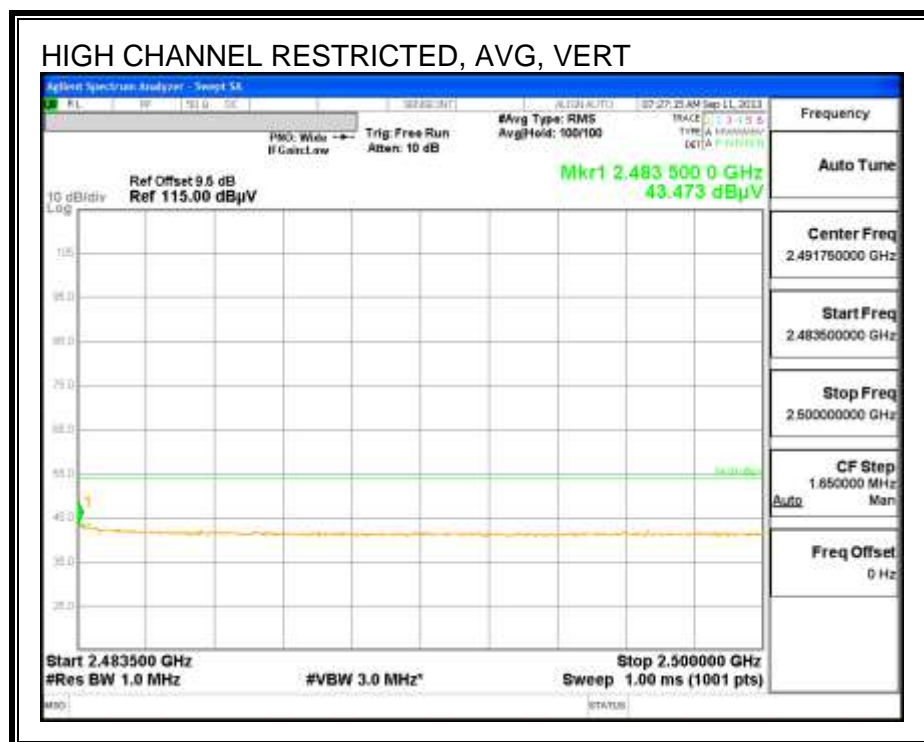
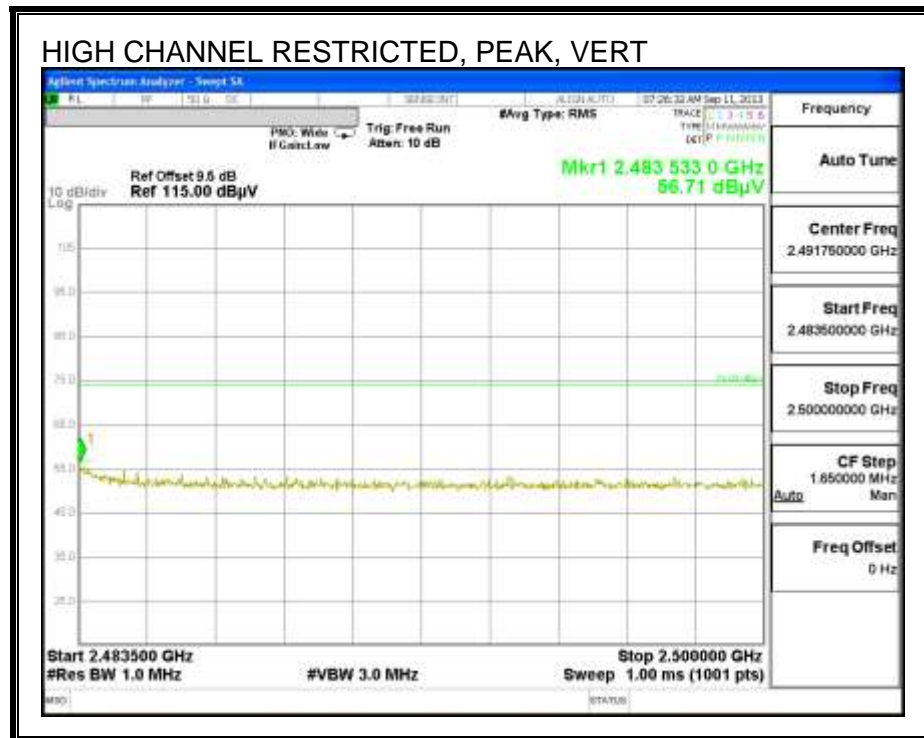
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



RESTRICTED BANEDGE (HIGH CHANNEL, HORIZONTAL)

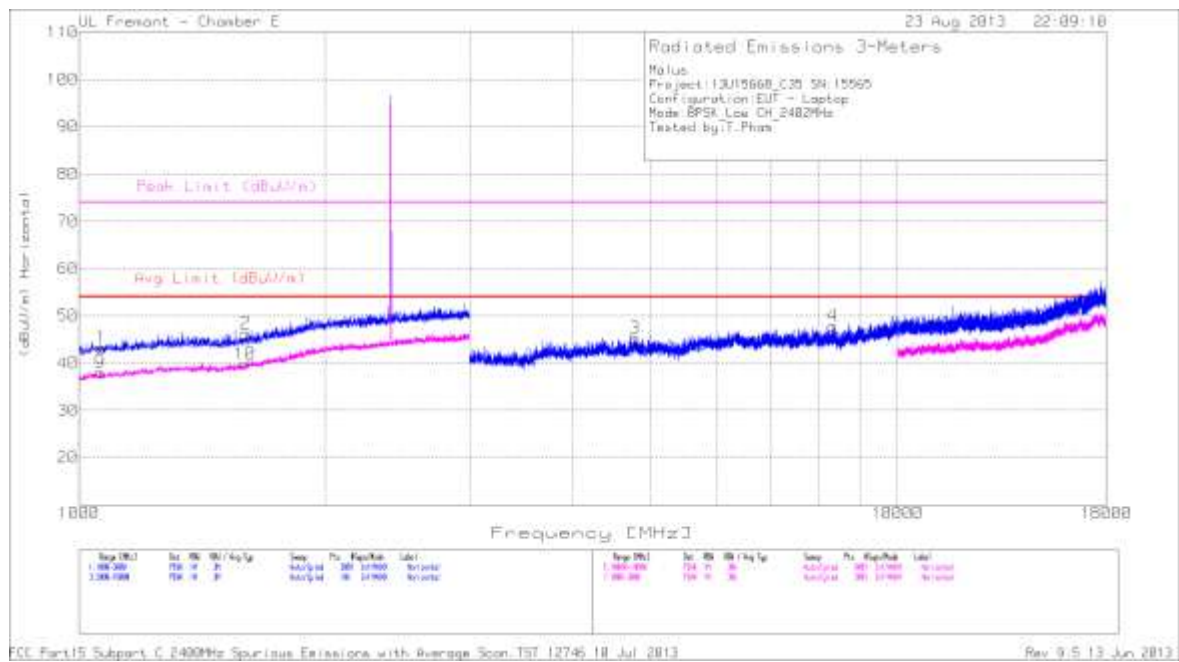


RESTRICTED BANEDGE (HIGH CHANNEL, VERTICAL)

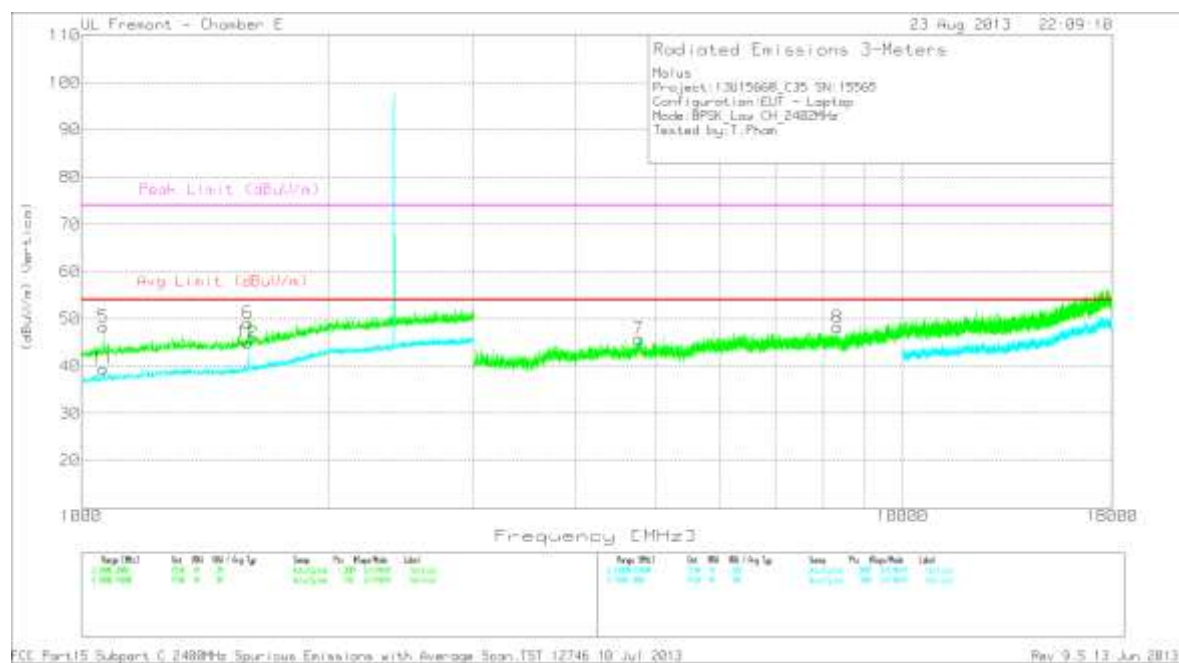


HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL HORIZONTAL



LOW CHANNEL VERTICAL

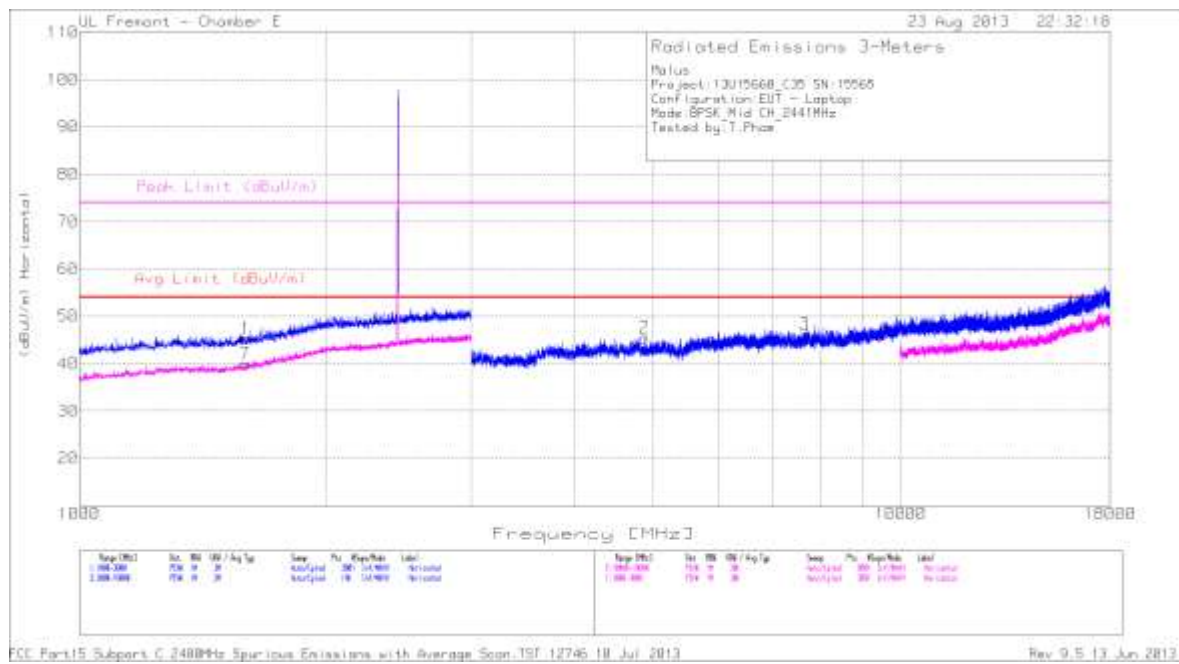


DATA

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)	Height (cm)	Polarity
1	1.064	42.9	PK	28.4	-28.1	43.2	-	-	74	-30.8	100	H
9	1.061	37.66	PK (VB)	28.4	-28.1	37.96	53.97	-16.01	-	-	199	H
2	1.599	43.34	PK	29.5	-26.6	46.24	-	-	74	-27.76	199	H
10	1.594	37	PK (VB)	29.4	-26.6	39.8	53.97	-14.17	-	-	199	H
3	4.781	41.69	PK	34.4	-30.8	45.29	53.97	-8.68	74	-28.71	199	H
4	8.334	38.47	PK	36.2	-26.8	47.87	53.97	-6.1	74	-26.13	199	H
5	1.064	47.95	PK	28.4	-28.1	48.25	-	-	74	-25.75	100	V
11	1.063	39.1	PK (VB)	28.4	-28.1	39.4	53.97	-14.57	-	-	100	V
6	1.597	46.25	PK	29.5	-26.6	49.15	-	-	74	-24.85	100	V
12	1.595	42.17	PK (VB)	29.4	-26.6	44.97	53.97	-9	-	-	100	V
7	4.771	42.12	PK	34.4	-30.7	45.82	53.97	-8.15	74	-28.18	100	V
8	8.331	38.79	PK	36.2	-26.8	48.19	53.97	-6.01	74	-25.81	100	V

PK - Peak detector

MID CHANNEL HORIZONTAL



MID CHANNEL VERTICAL

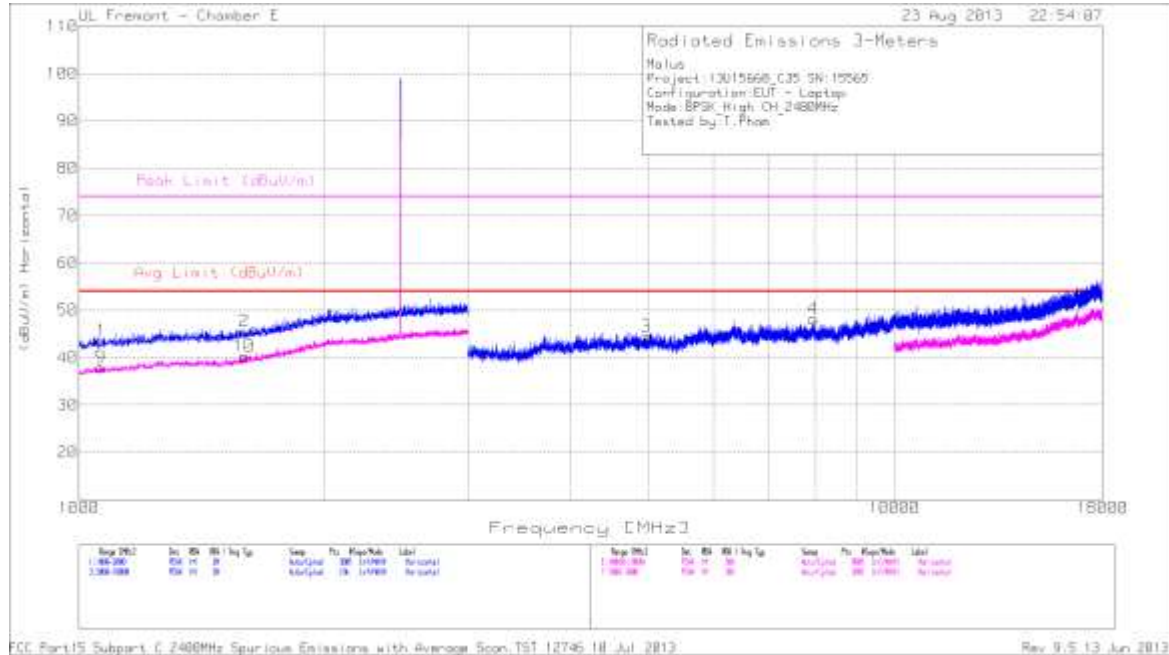


DATA

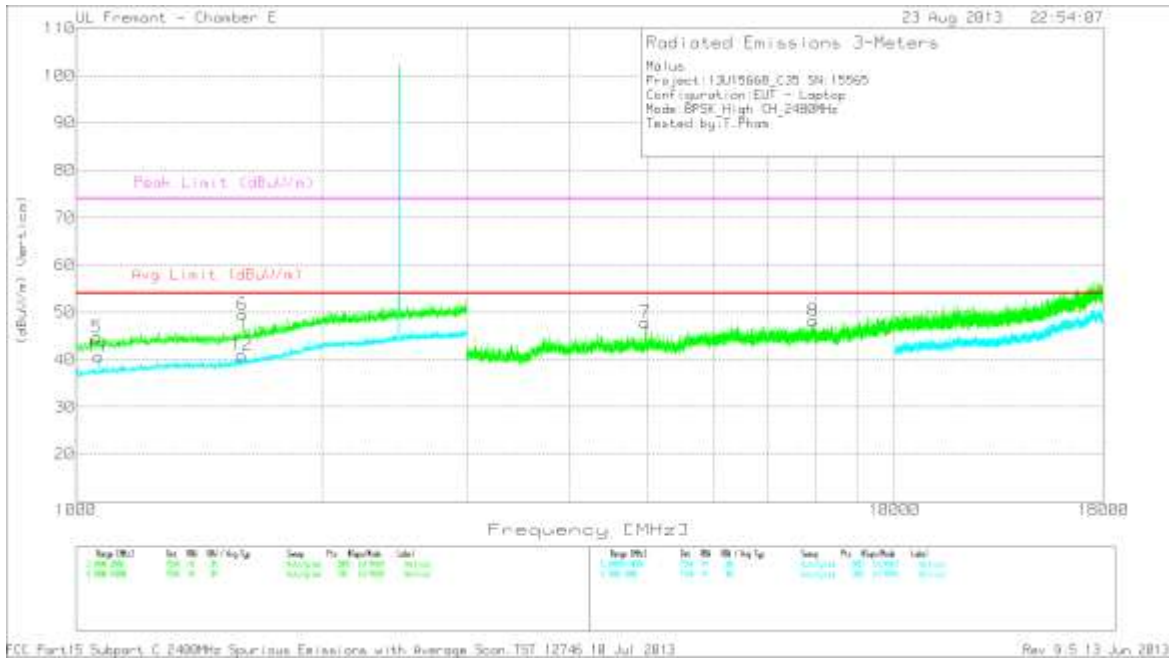
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T346 (dB/m)	Amp/Cbl/ 10dB Pad	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Height (cm)	Polarity
1	1.595	42.39	PK	29.4	-26.6	45.19	-	-	74	-28.81	199	H
7	1.592	37.03	PK (VB)	29.4	-26.6	39.83	53.97	-14.14	-	-	100	H
2	4.882	42.05	PK	34.4	-31	45.45	53.97	-8.52	74	-28.55	199	H
3	7.637	37.58	PK	36.2	-27.5	46.28	53.97	-7.69	74	-27.72	199	H
4	1.587	43.22	PK	29.4	-26.7	45.92	-	-	74	-28.08	199	V
8	1.594	41.69	PK (VB)	29.4	-26.6	44.49	53.97	-9.48	-	-	199	V
5	4.883	43.15	PK	34.4	-31	46.55	53.97	-7.42	74	-27.45	199	V
6	7.628	39.44	PK	36.2	-27.4	48.24	53.97	-6.03	74	-25.76	101	V

PK - Peak detector

HIGH CHANNEL HORIZONTAL



HIGH CHANNEL VERTICAL



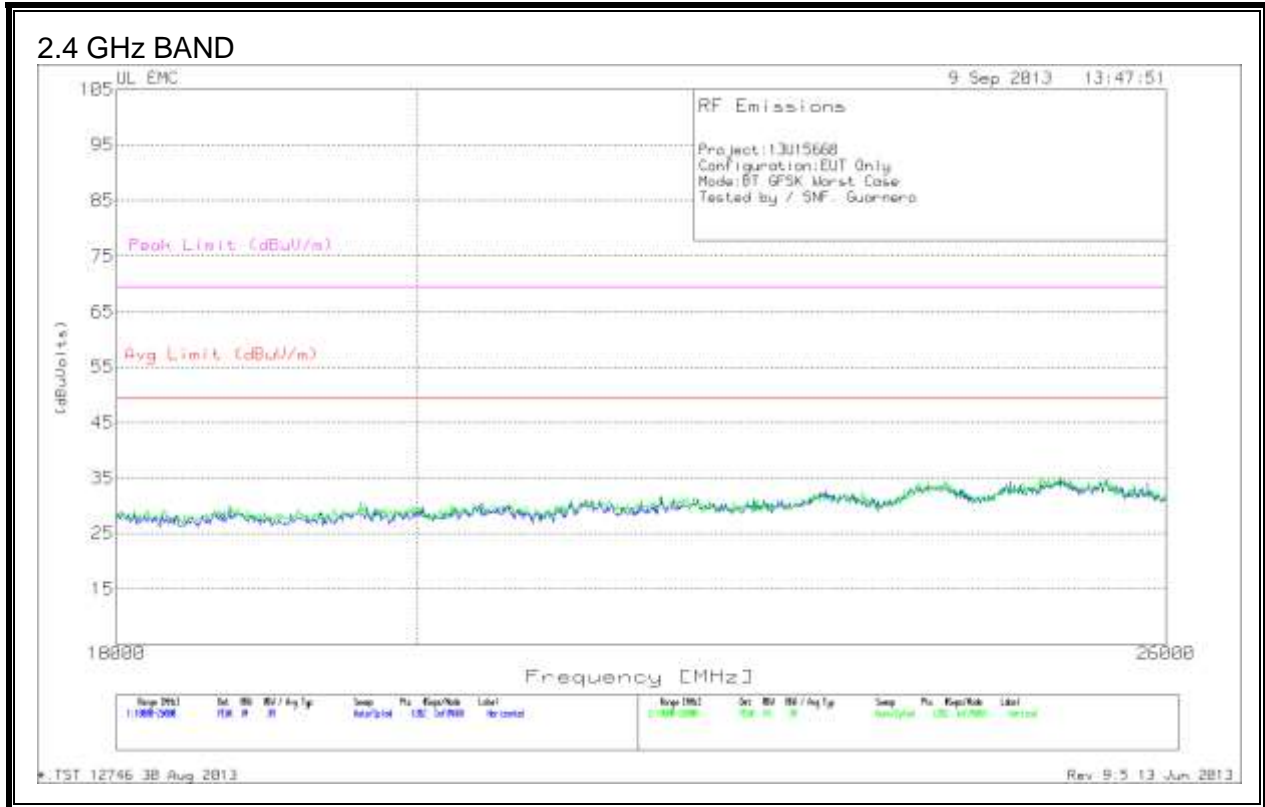
DATA

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)	Height (cm)	Polarity
1	1.065	43.25	PK	28.4	-28.1	43.55	-	--	74	-30.45	99	H
9	1.063	37.61	PK (VB)	28.4	-28.1	37.91	53.97	-16.06	-	-	100	H
2	1.596	42.59	PK	29.5	-26.6	45.49	-	-	74	-28.51	199	H
10	1.595	37.4	PK (VB)	29.4	-26.6	40.2	53.97	-13.77	-	-	100	H
3	4.961	41.11	PK	34.4	-31.1	44.41	53.97	-9.56	74	-29.59	199	H
4	7.957	37.99	PK	36.2	-26.3	47.89	53.97	-6.01	74	-25.84	100	H
5	1.061	44.36	PK	28.4	-28.1	44.66	-	-	74	-29.34	199	V
11	1.065	40.38	PK (VB)	28.4	-28.1	40.68	53.97	-13.29	-	-	199	V
6	1.598	45.12	PK	29.5	-26.6	48.02	-	-	74	-24.5	199	V
12	1.594	38.1	PK (VB)	29.4	-26.6	40.9	53.97	-13.07	-	-	199	V
7	4.961	44.49	PK	34.4	-31.1	47.79	53.97	-6.18	74	-26.21	199	V
8	7.956	38.1	PK	36.2	-26.3	48.01	53.97	-5.97	74	-25.82	199	V

PK - Peak detector

8.3. WORST-CASE ABOVE 18 GHz

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

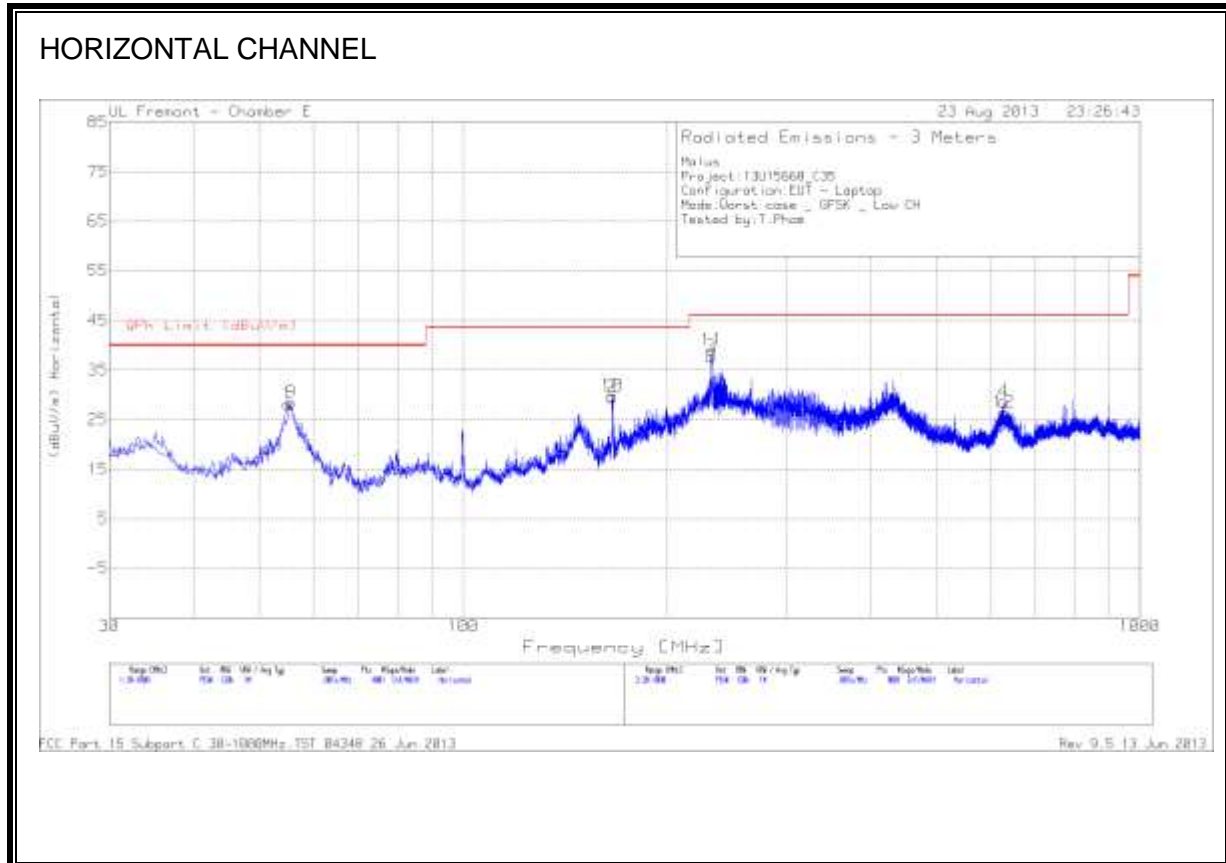


Note: There were no emissions detected above system noise floor.

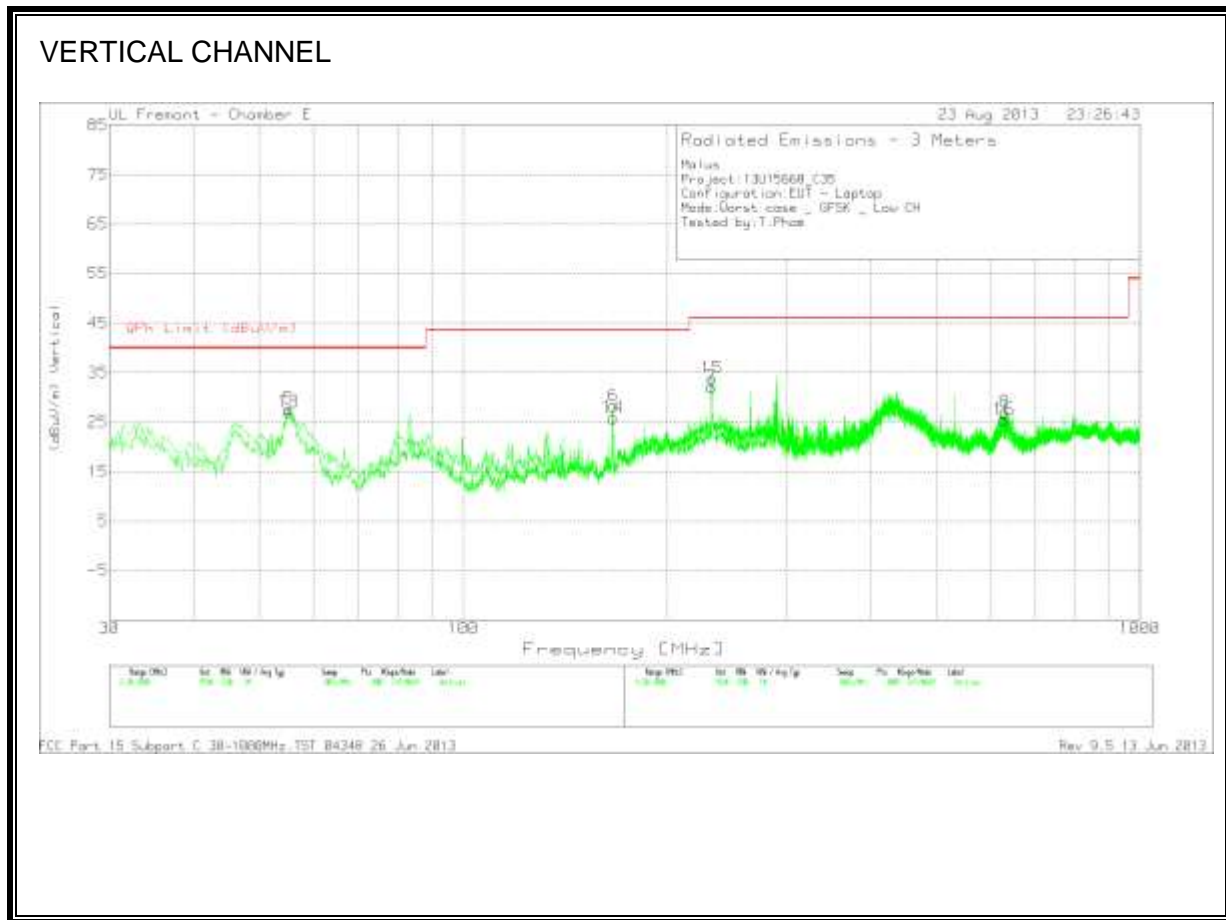
8.4. WORST-CASE BELOW 1 GHz

BLUETOOTH

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



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



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

WORST CASE CHANNEL DATA

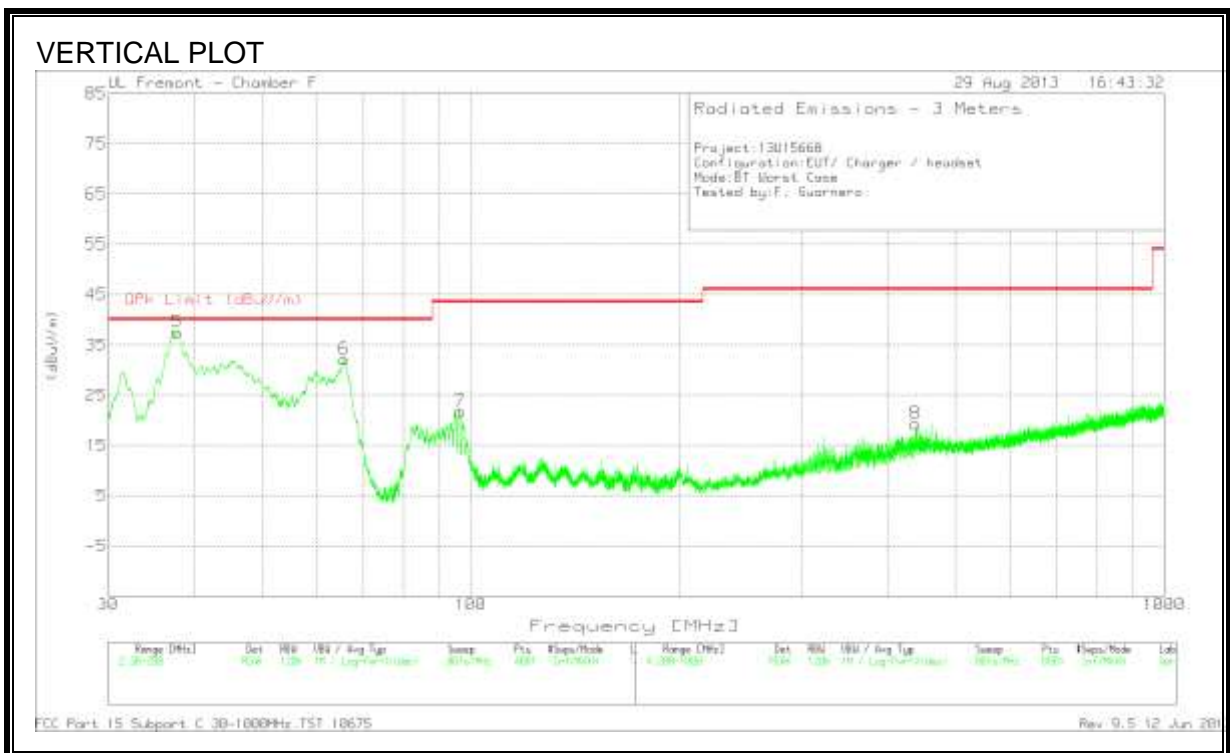
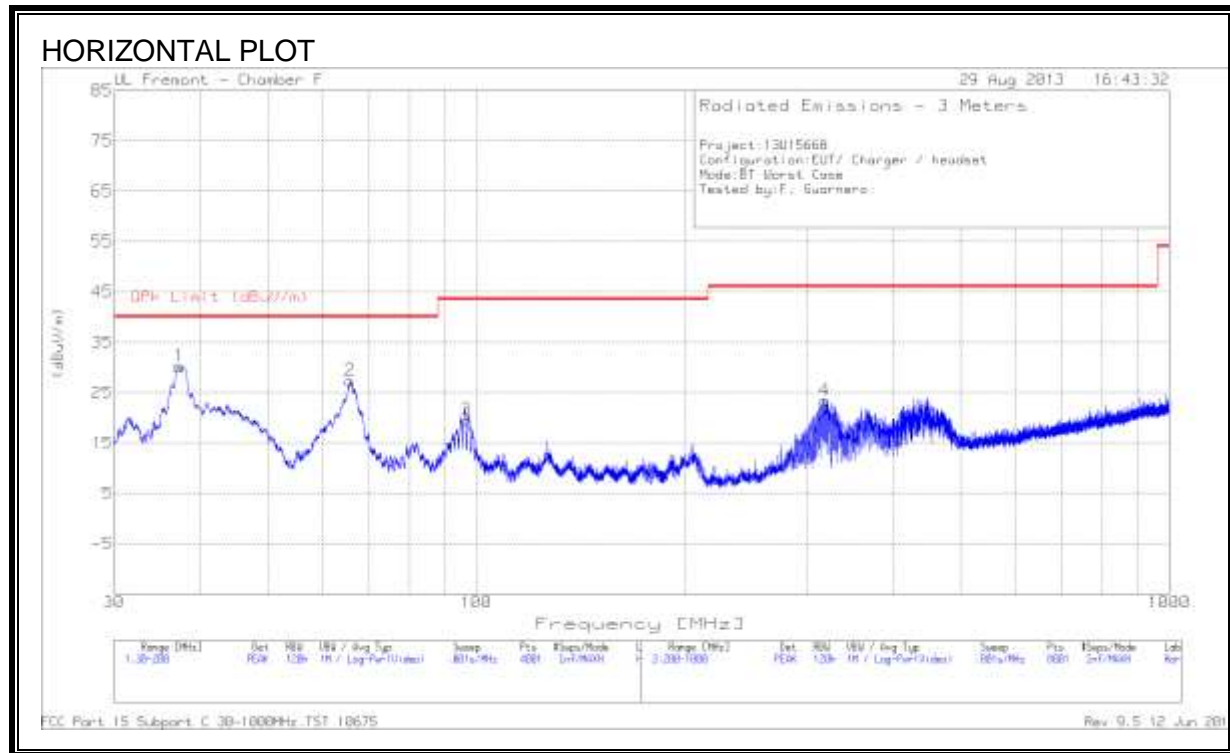
Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T408 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Height (cm)	Polarity
1	54.9775	48.86	PK	7.1	-27.8	28.16	40	-11.84	400	H
2	166.0425	45.22	PK	11.9	-27.6	29.52	43.52	-14	200	H
3	232.4875	52.7	PK	11.2	-26.2	37.7	46.02	-8.32	98	H
4	628.975	36.35	PK	19.1	-26.8	28.65	46.02	-17.37	98	H
5	55.22	48.39	PK	7.1	-27.8	27.69	40	-12.31	100	V
6	166.5275	44.03	PK	11.8	-27.6	28.23	43.52	-15.29	100	V
7	232.4875	47.1	PK	11.2	-26.2	32.1	46.02	-13.92	100	V
8	631.1575	34.8	PK	19.1	-26.9	27	46.02	-19.02	100	V
9	55.705	49.18	PK	7.1	-27.8	28.48	40	-11.52	400	H
10	166.0425	45.52	PK	11.9	-27.6	29.82	43.52	-13.7	200	H
11	233.0938	53.93	PK	11.3	-26.2	39.03	46.02	-6.99	99	H
12	628.7325	34.07	PK	19.2	-26.8	26.47	46.02	-19.55	99	H
13	55.22	47.72	PK	7.1	-27.8	27.02	40	-12.98	199	V
14	166.5275	41.65	PK	11.8	-27.6	25.85	43.52	-17.67	300	V
15	233.0938	48.82	PK	11.3	-26.2	33.92	46.02	-12.1	199	V
16	628.49	33.06	PK	19.2	-26.8	25.46	46.02	-20.56	199	V

PK - Peak detector

FCC Part 15 Subpart C 30-1000MHz.TST 04348 26 Jun 2013Rev 9.5 13 Jun 2013

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



Trace Markers

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	37.2675	46.3	PK	15.9	-32	30.2	40	-9.8	0-360	300	H
2	65.785	51.2	PK	7.9	-31.8	27.3	40	-12.7	0-360	300	H
3	96.64	41.76	PK	9.5	-31.7	19.56	43.52	-23.96	0-360	200	H
4	318.6	40.17	PK	13.9	-30.7	23.37	46.02	-22.65	0-360	100	H
5	37.735	53.93	PK	15.6	-32	37.53	40	-2.47	0-360	100	V
6	65.6575	56.07	PK	7.9	-31.8	32.17	40	-7.83	0-360	100	V
7	96.5125	43.91	PK	9.5	-31.7	21.71	43.52	-21.81	0-360	100	V
8	437.9	33.02	PK	16.7	-30.4	19.32	46.02	-26.7	0-360	200	V

PK - Peak detector

Radiated Emissions

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
37.8737	51.21	QP	15.5	-32	34.71	40	-5.29	146	112	V

QP - Quasi-Peak detector

FCC Part 15 Subpart C 30-1000MHz.TST 10675 Rev 9.5 12 Jun 2013

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

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

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

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

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

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

RESULTS

6 WORST EMISSIONS

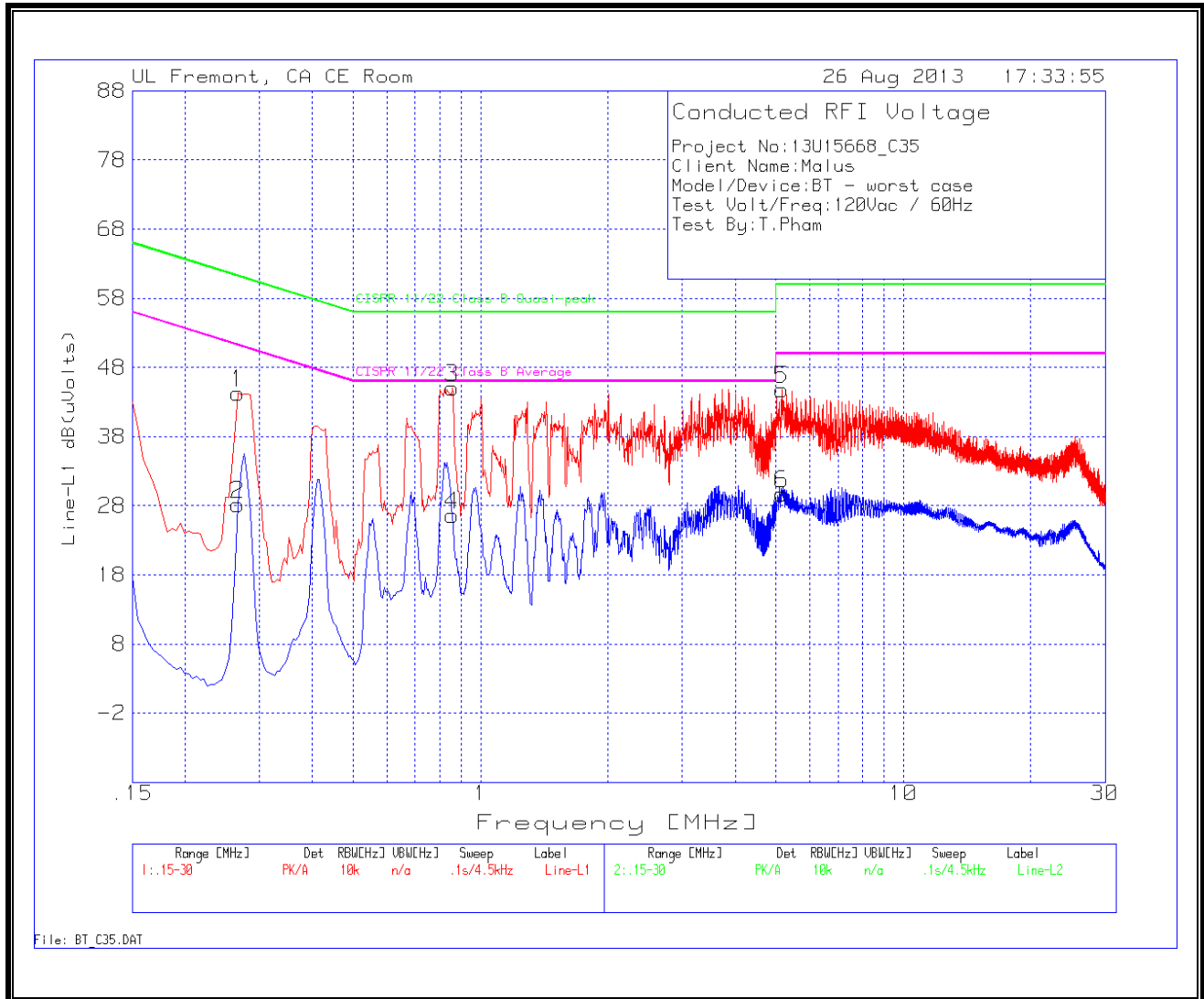
Line-L1 .15 - 30MHz

Trace Markers

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	.267	44.15	PK	.1	0	44.25	61.2	-16.95	-	-
2	.267	28.08	Av	.1	0	28.18	-	-	51.2	-23.02
3	.8565	44.96	PK	.1	0	45.06	56	-10.94	-	-
4	.8565	26.57	Av	.1	0	26.67	-	-	46	-19.33
5	5.154	44.56	PK	.1	.1	44.76	60	-15.24	-	-
6	5.154	29.56	Av	.1	.1	29.76	-	-	50	-20.24

PK - Peak detector
Av - average detection

LINE 1 RESULTS



6 WORST EMISSIONS

Line-L2 .15 - 30MHz

Trace Markers

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)
7	.2715	46.13	PK	.1	0	46.23	61.1	-14.87	-	-
8	.2715	33.33	Av	.1	0	33.43	-	-	51.1	-17.67
9	.9645	44.2	PK	.1	0	44.3	56	-11.7	-	-
10	.9645	31.88	Av	.1	0	31.98	-	-	46	-14.02
11	5.0145	42.47	PK	.1	.1	42.67	60	-17.33	-	-
12	5.0145	28.06	Av	.1	.1	28.26	-	-	50	-21.74

PK - Peak detector
Av - average detection

