FCC CFR47 PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 8
CERTIFICATION TEST REPORT

FOR

Accessory Wireless Controller

MODEL NUMBER: 1546

FCC ID: C3K1546
IC: 3048A-1546

REPORT NUMBER: 12U14344-1, Revision D

ISSUE DATE: June 1, 2012

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

Prepared by
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	05/10/12	Initial Issue	T.LEE
A	05/29/12	Added Duty Cycle	T. LEE
B	05/29/12	Updated report to maintain product confidentiality	A. Zaffar
C	06/01/12	Corrected Duty Cycle	T. LEE
D	06/01/12	Corrected Harmonic with Duty Cycle	T. LEE

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1. ATTESTATION OF TEST RESULTS

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

EUT DESCRIPTION: Accessory Wireless Controller

MODEL: 1546

SERIAL NUMBER: Standard Non-metallic Enclosure:
EV2 103(Conducted) & EV2 229(Radiated)
Metallic Artwork Enclosure: EV2B(Radiated)

DATE TESTED: April 18 – May 10, 2012

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

Compliance Certification Services (UL CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL CCS based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL CCS will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For UL CCS By:

TIMOTHY K. LEE
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UL CCS

Tested By:

VIEN TRAN / DENNIS HUANG
EMC TECHNICIAN / ENGINEER
UL CCS

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2009, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 2, and RSS-210 Issue 7.

3. FACILITIES AND ACCREDITATION

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

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

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

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

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

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 frequency hopping transceiver host. EUT is using the propitiatory communication protocol to interact with a console. Propitiatory communication protocol is detailed in the theory of operation.

The radio module is manufactured by Microsoft, Model 1546.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Output Power (dBm)	Output Power (mW)
2402 - 2482	3.80	2.40

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an inverted-F antenna, which is soldered to the printed circuit board. This antenna has a maximum gain of -0.2 dBi.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was Radon EEprom, rev. 0410 for Normal Plastic Cover and Radon EEprom, rev. 0452 for Metallic Cover.

The EUT driver software installed in the host laptop support equipment during testing was FPM Driver, rev. 8.1.0.0.

The test utility software used during testing was Wireless Device Test Ver. 113 and ACCUsbUartTestTool Ver. 1-21-2012. Product firmware version: 4.10

5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power.

The worst-case channel is determined as the channel with the highest output power. The highest measured output power was at 2442 MHz.

The EUT is a portable device that has three orientations; therefore X, Y, and Z orientations have been investigated. The worst case was found to be Y orientation.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Lenovo	L420	LR-78PNB	DoC
AC Adaptor	Lenovo	42T4418	11S42T14418ZiZGW13PA94	DoC
USB Jump cable	Microsoft	EV3C-0007	6/24/2005	N/A
Interface Cable and PCB	Boron	MCS015	EV2C-IB039	N/A

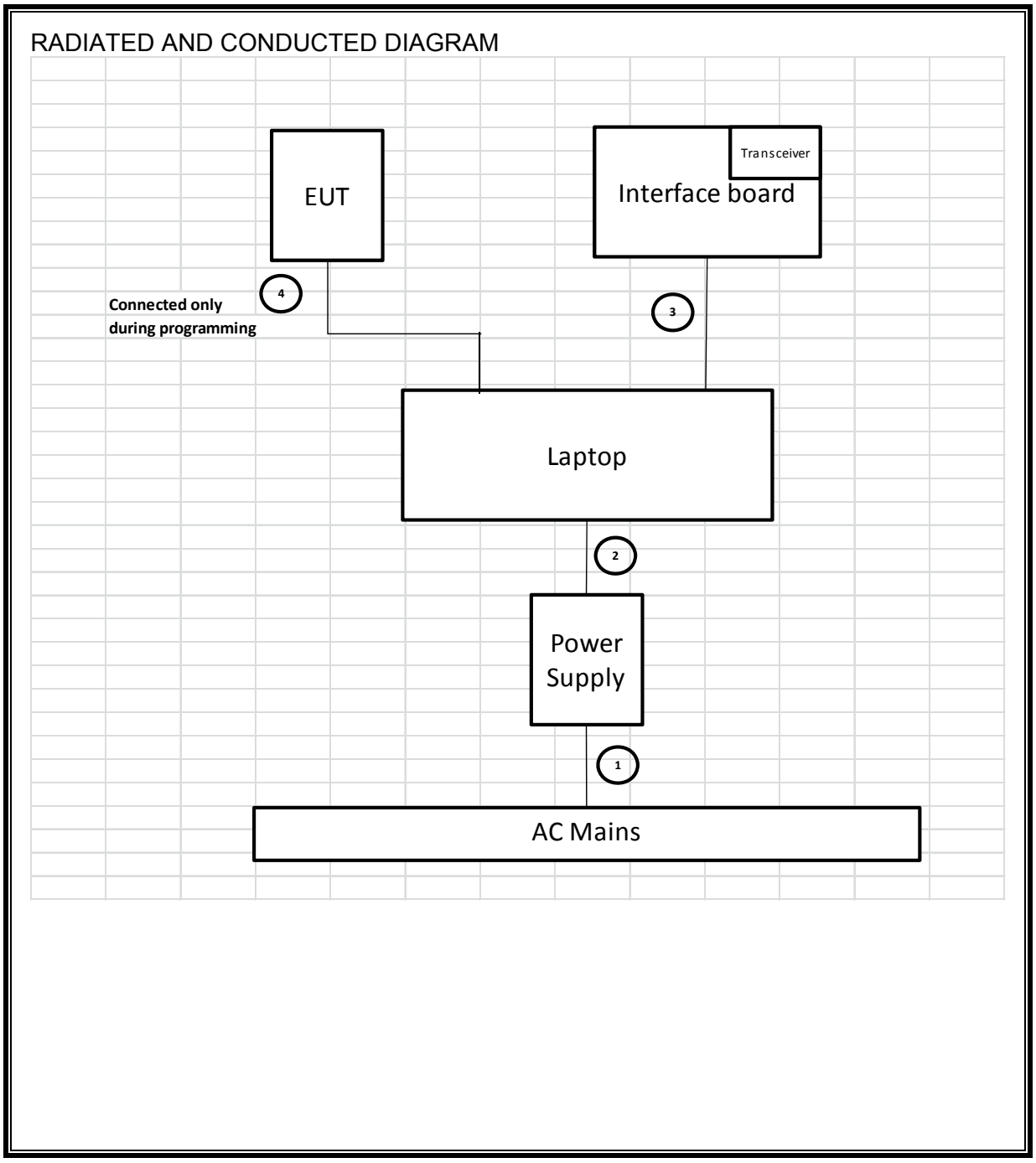
I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identic Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	US 115V	Un-shielded	0.9m	none
2	DC	1	DC	Shielded	1.8m	Ferrite
3	USB	1	I/O	Shielded	0.5m	none
4	USB	1	I/O	Shielded	2.8m	Ferrite

TEST SETUP

The EUT is tested as stand-alone unit.

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

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

TEST EQUIPMENT LIST					
Description	**Manufacturer**	**Model**	**Asset**	**Cal Date**	**Cal Due**
Peak Power Meter	Agilent / HP	E4416A	C00963	12/13/11	12/13/13
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C00996	05/04/11	05/04/12
Antenna, Horn, 18 GHz	EMCO	3115	C00872	09/20/11	09/20/12
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C00749	07/18/11	07/18/12
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01012	09/02/11	09/02/12
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00558	11/11/11	11/11/12
Antenna, Bilog, 30MHz-1 GHz	Sunol Sciences	JB1	C01171	01/26/12	01/26/13

7. ANTENNA PORT TEST RESULTS

7.1.1. 20 dB AND 99% BANDWIDTH

LIMIT

None; for reporting purposes only.

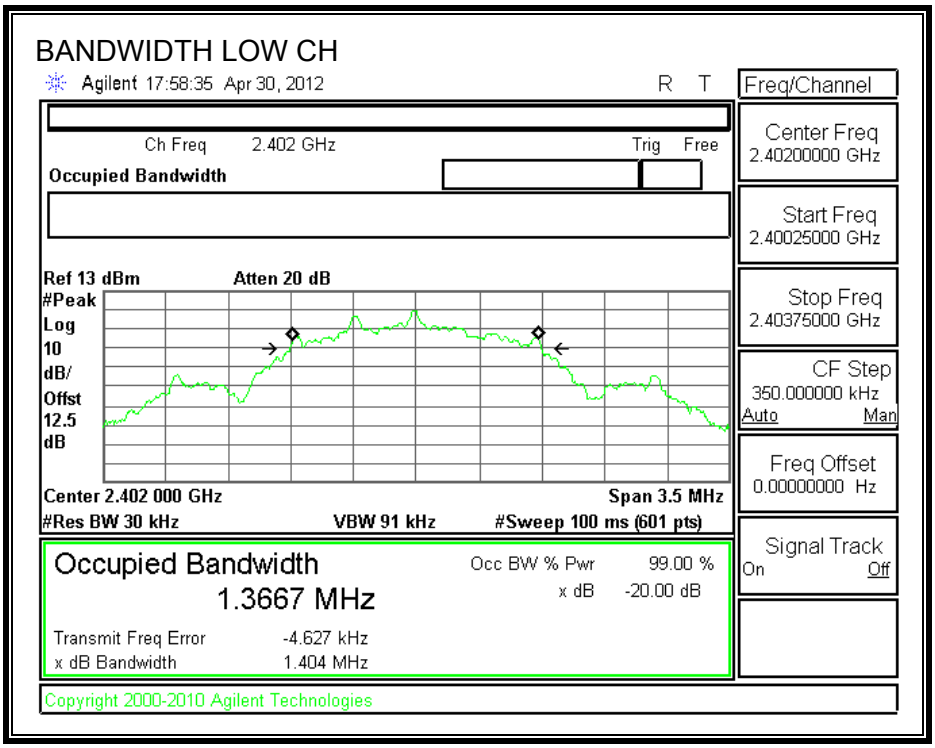
TEST PROCEDURE

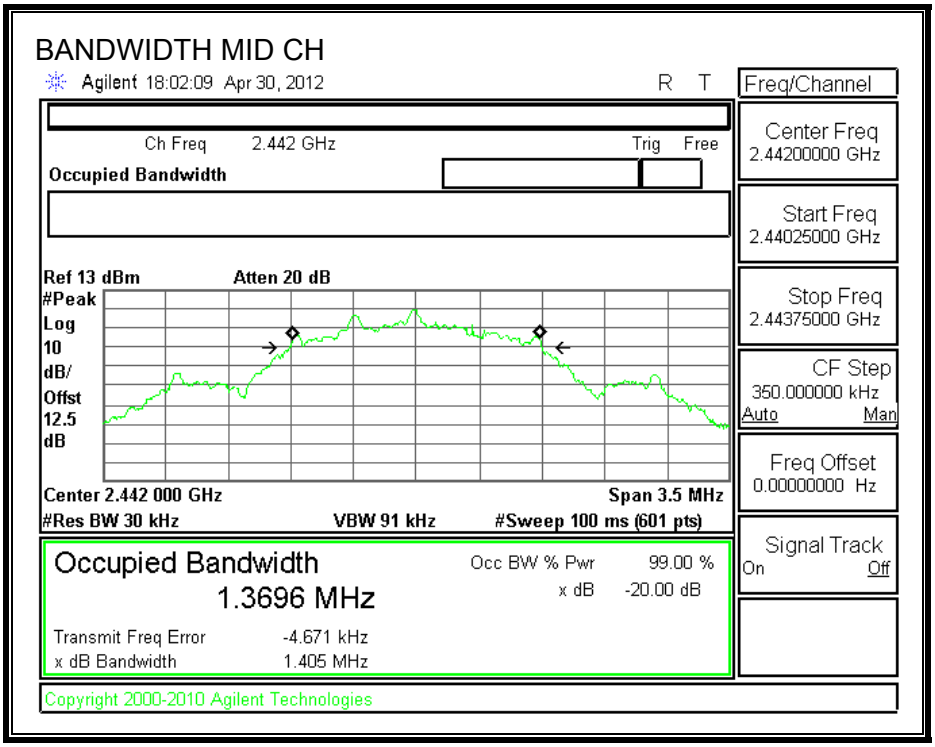
The transmitter output is connected to a spectrum analyzer. The RBW is set to ≥ 1% of the 20 dB bandwidth. The VBW is set to ≥ RBW. The sweep time is coupled.

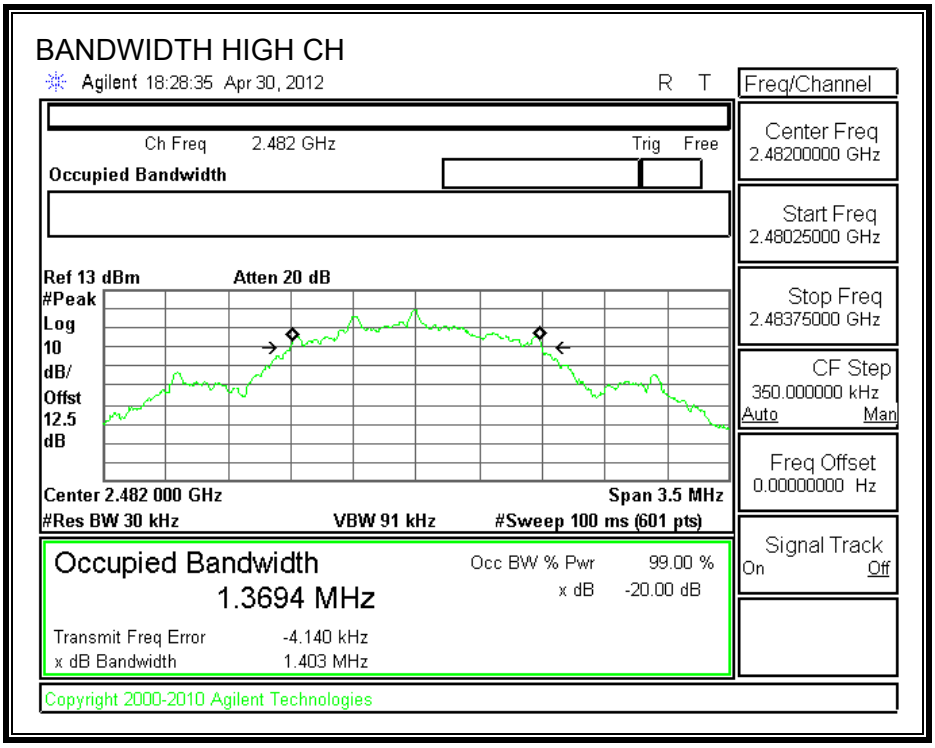
RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	1404	1265
Middle	2442	1405	1290.7
High	2482	1403	1361

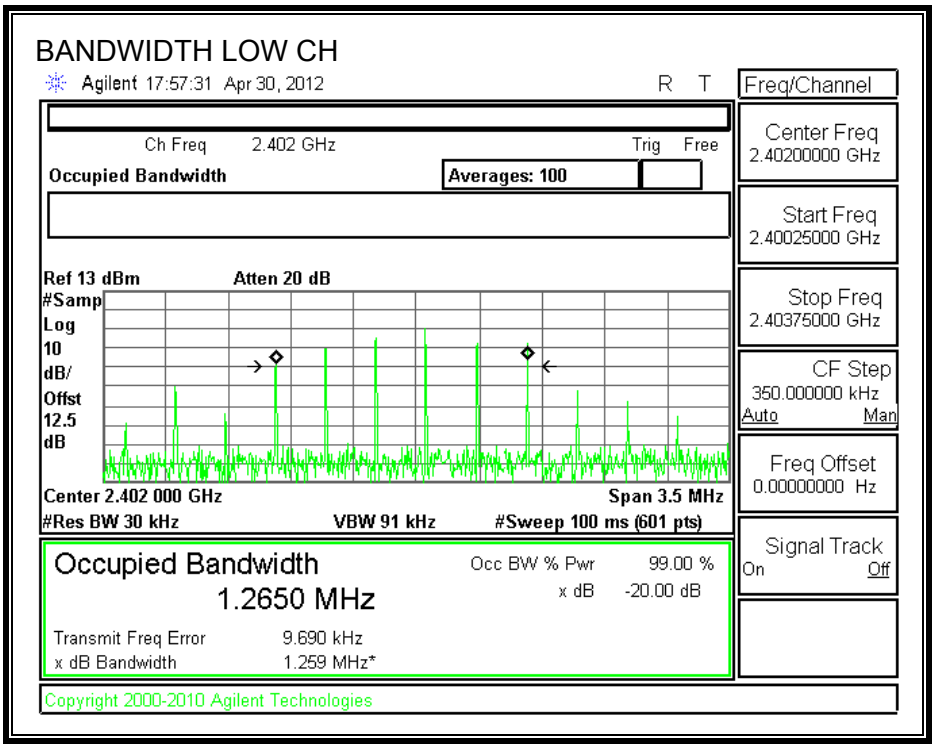
20 dB BANDWIDTH

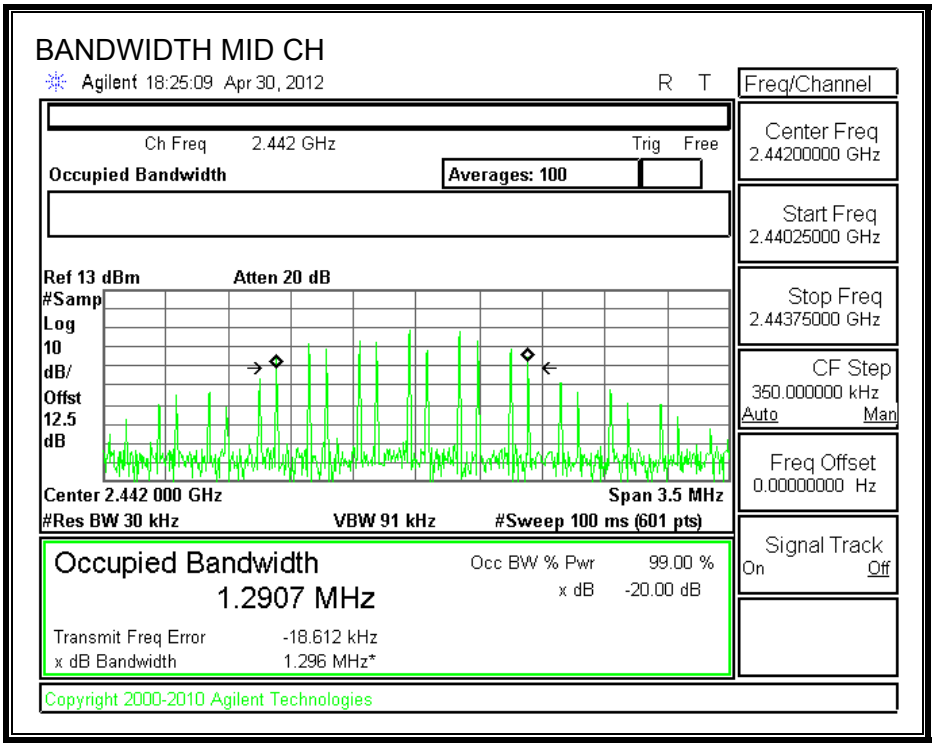


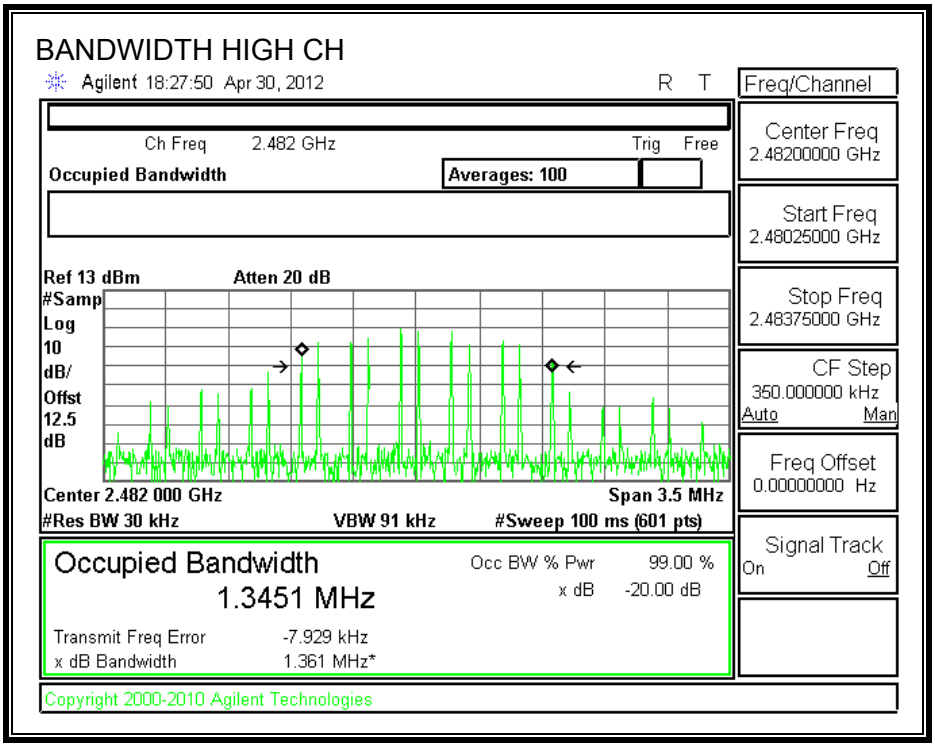




99% BANDWIDTH







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 hoping channel, whichever is greater.

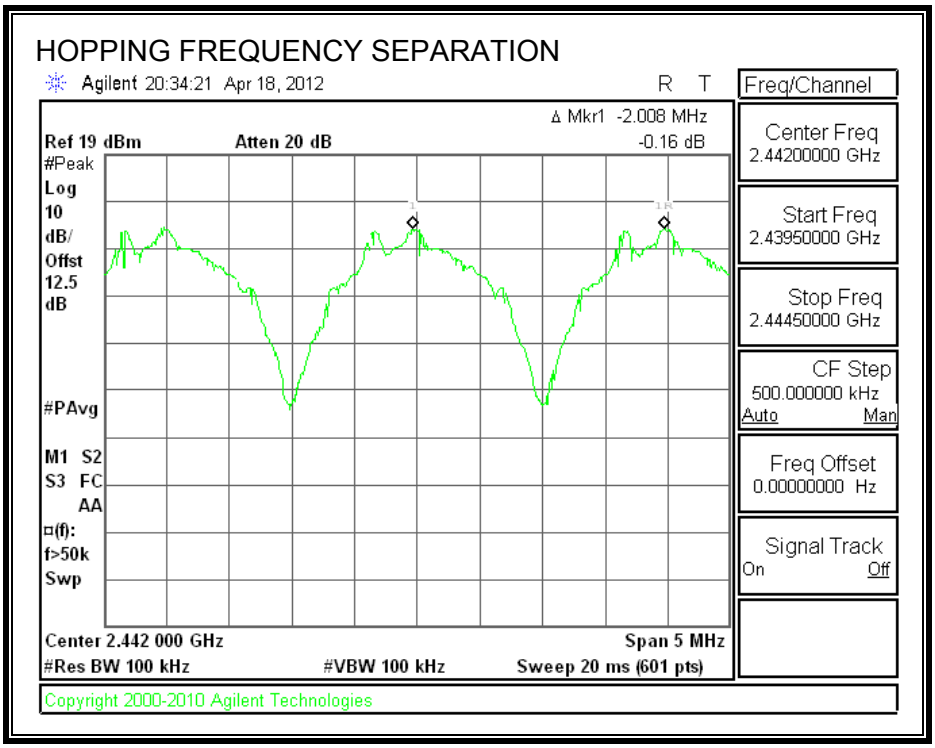
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 100 kHz. The sweep time is coupled.

RESULTS

HOPPING FREQUENCY SEPARATION



7.1.3. NUMBER OF HOPPING CHANNELS

LIMIT

FCC §15.247 (a) (1) (iii)

IC RSS-210 A8.1 (d)

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

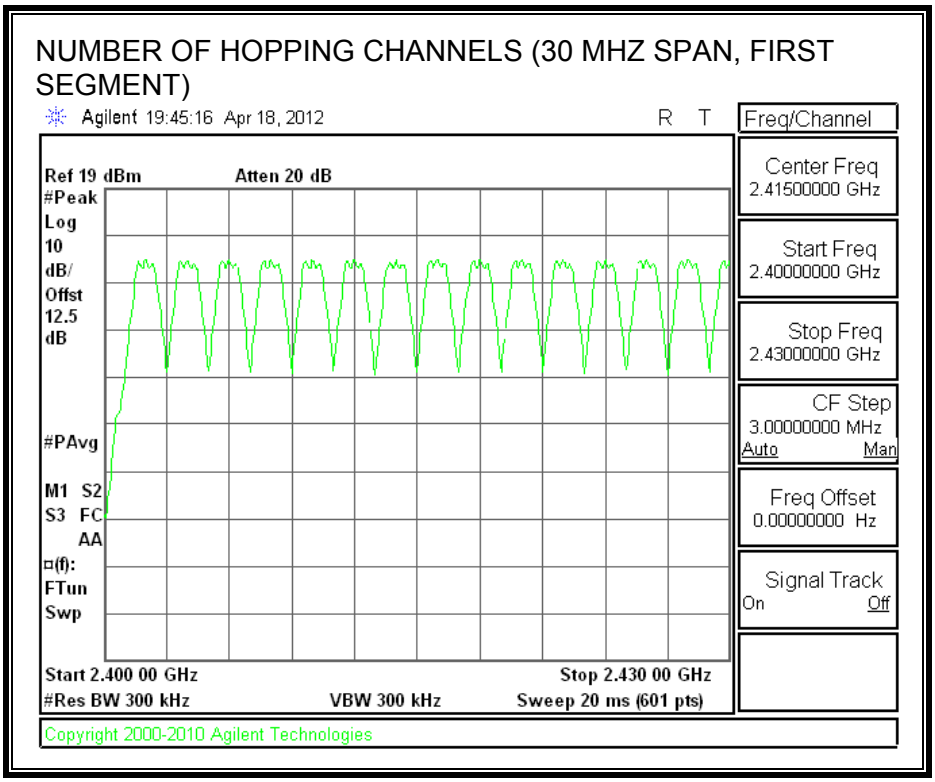
TEST PROCEDURE

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

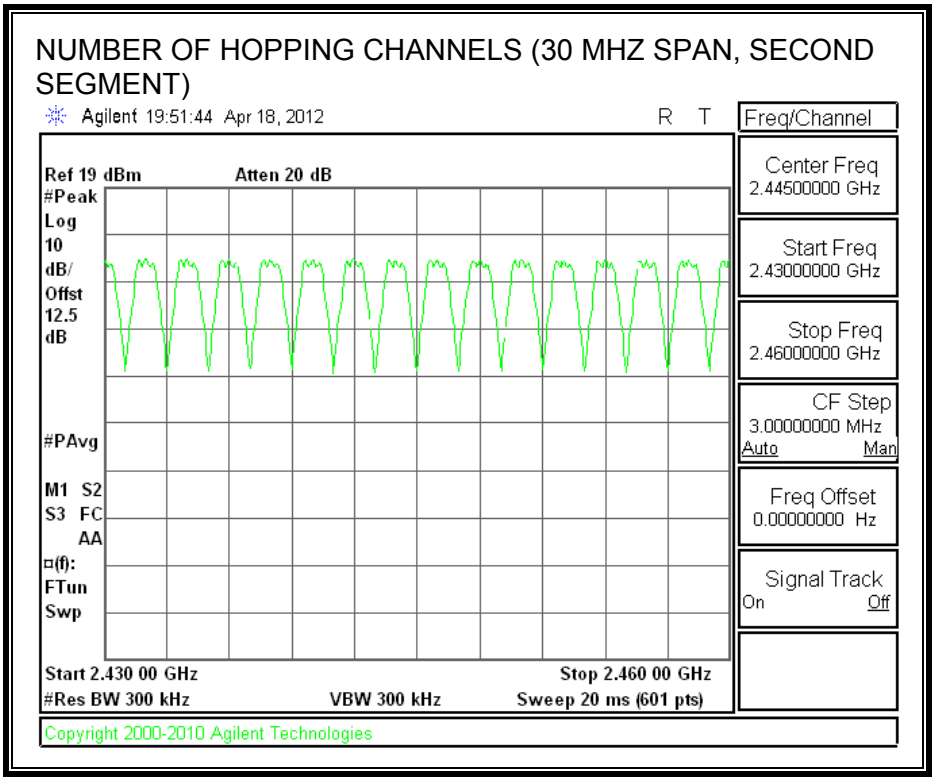
RESULTS

41 Channels observed.

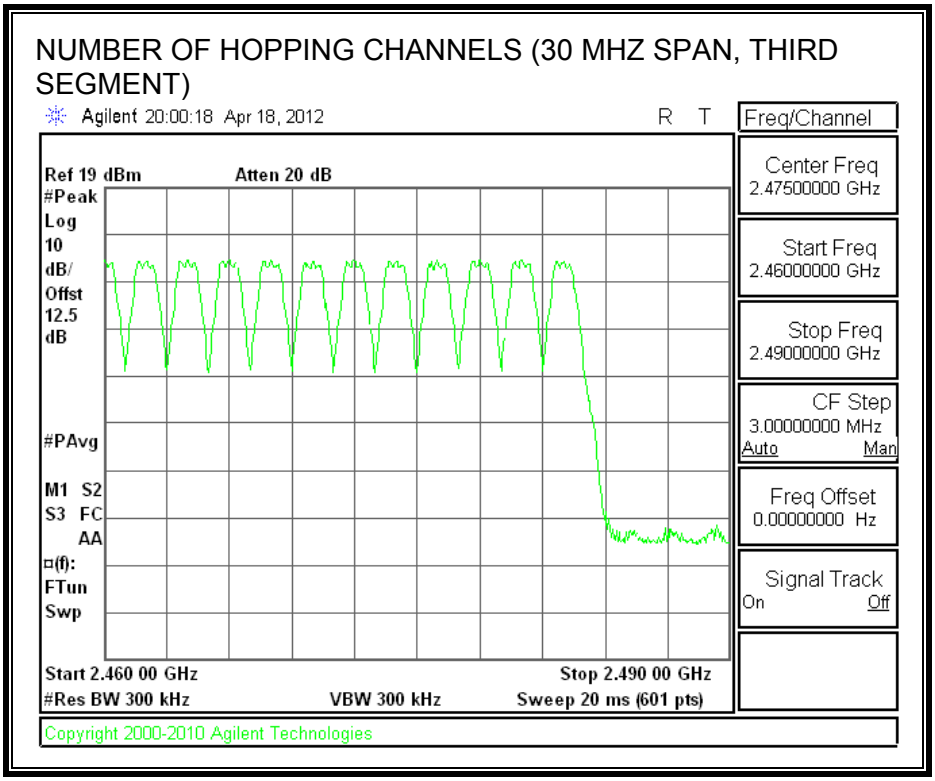
NUMBER OF HOPPING CHANNELS



NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, SECOND SEGMENT)



NUMBER OF HOPPING CHANNELS (30 MHZ SPAN, THIRD SEGMENT)



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 1.64 second scan, to enable resolution of each occurrence.

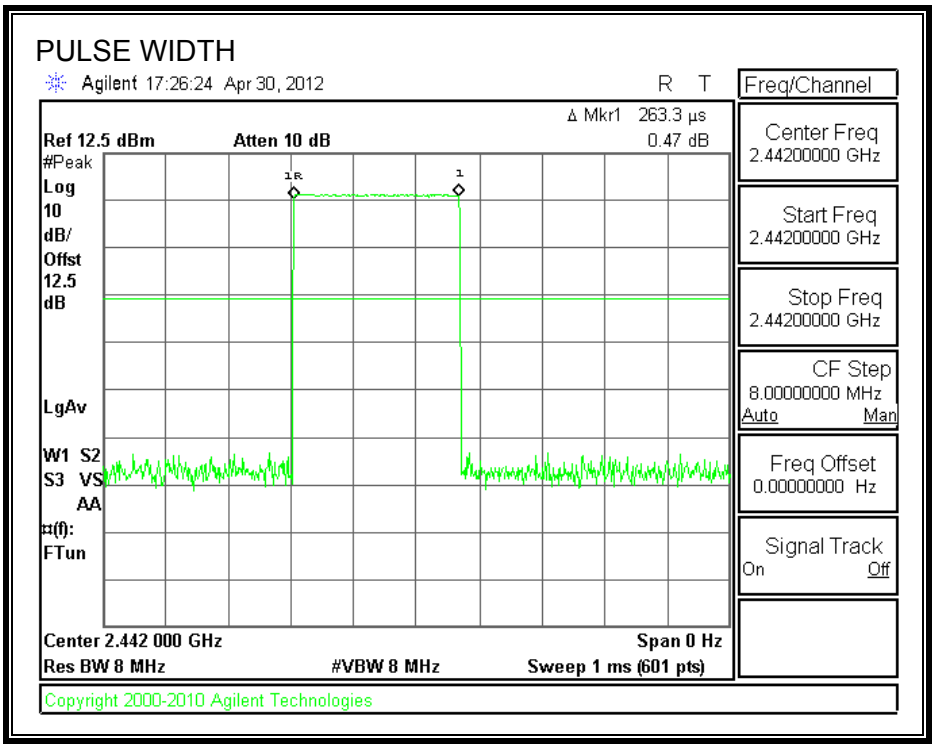
The average time of occupancy in the specified 16.4 second period (41 channels * 0.4 s) is equal to 10 * (# of pulses in 1.64 s) * pulse width.

RESULTS

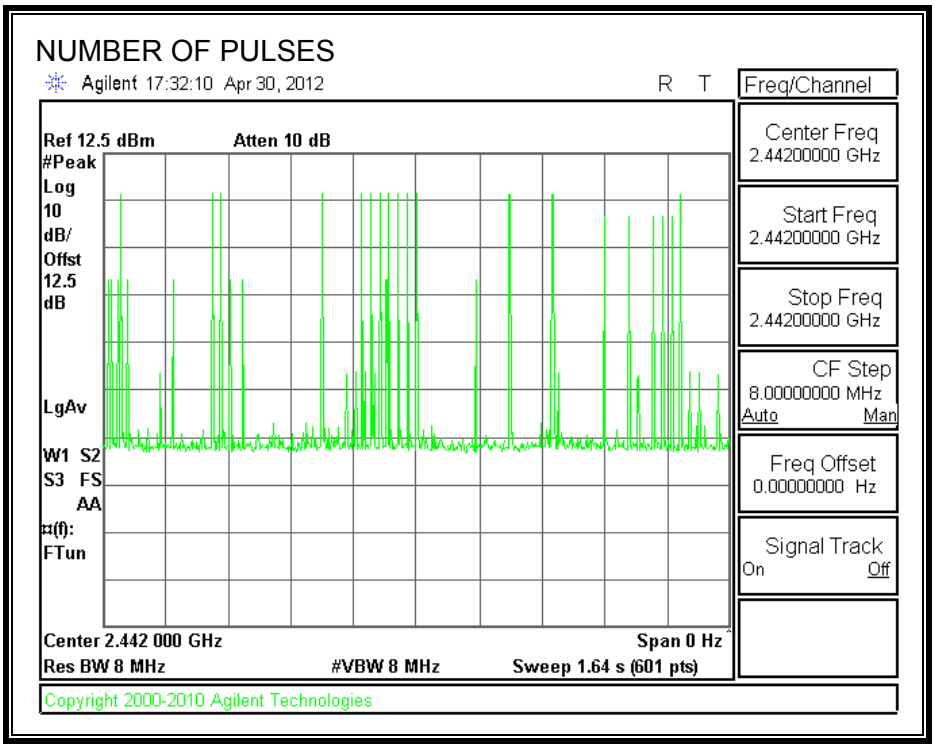
Time Of Occupancy = 10 * 21 pulses * 0.2633 msec = 55 msec

Pulse Width (msec)	Number of Pulses in 1.64 seconds	Average Time of (sec)	Limit (sec)	Margin (sec)
0.2633	21	0.055	0.4	-0.345

PULSE WIDTH



NUMBER OF PULSES IN 1.64 SECOND OBSERVATION PERIOD



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.

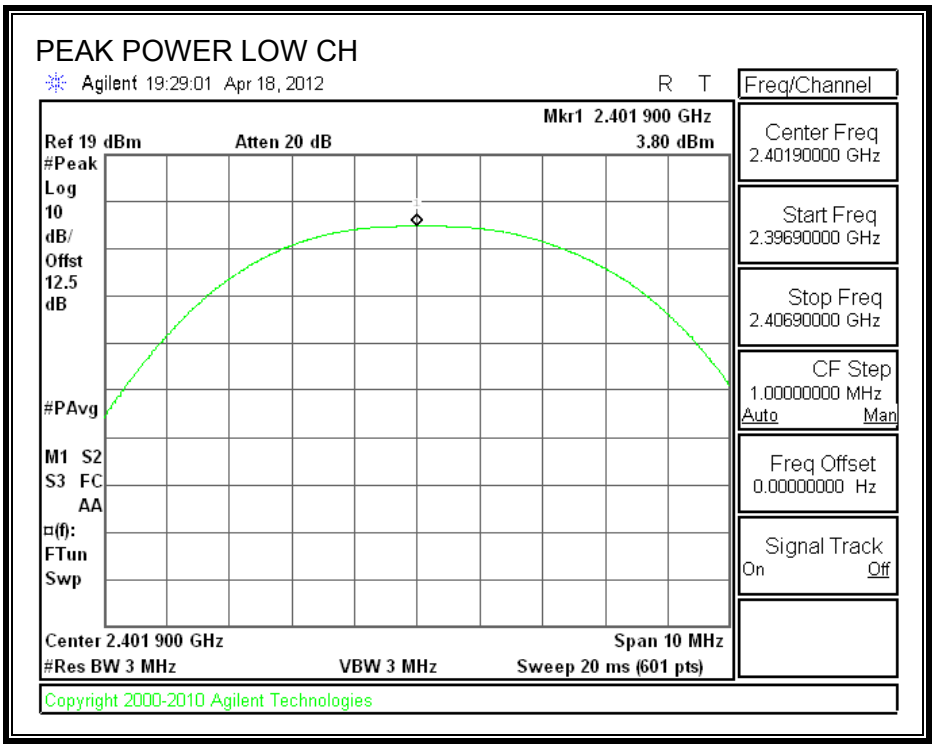
TEST PROCEDURE

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.

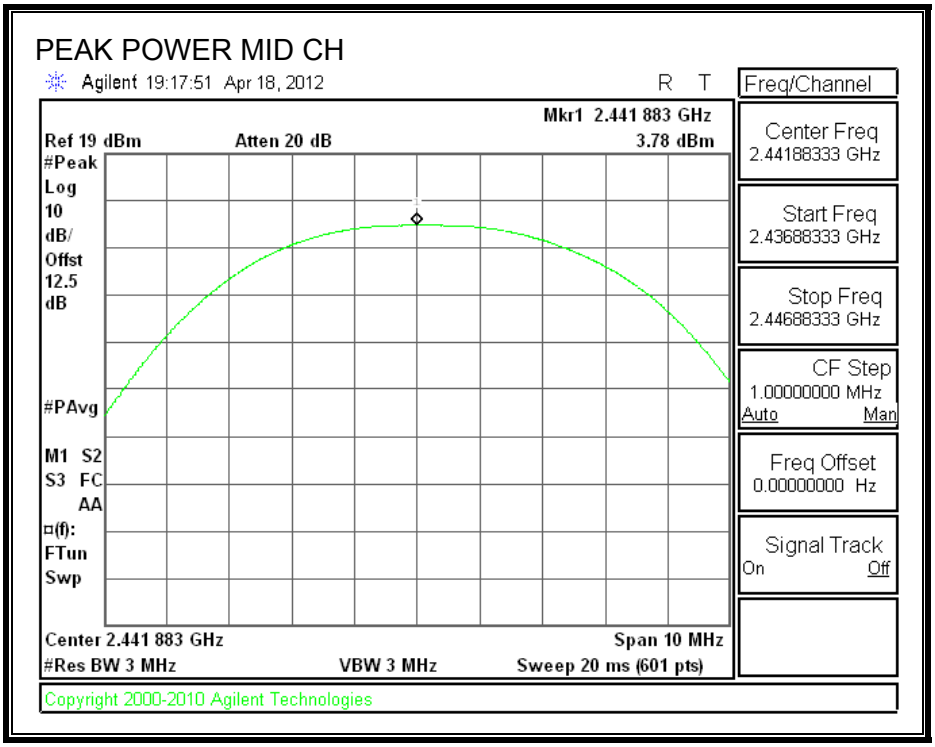
RESULTS

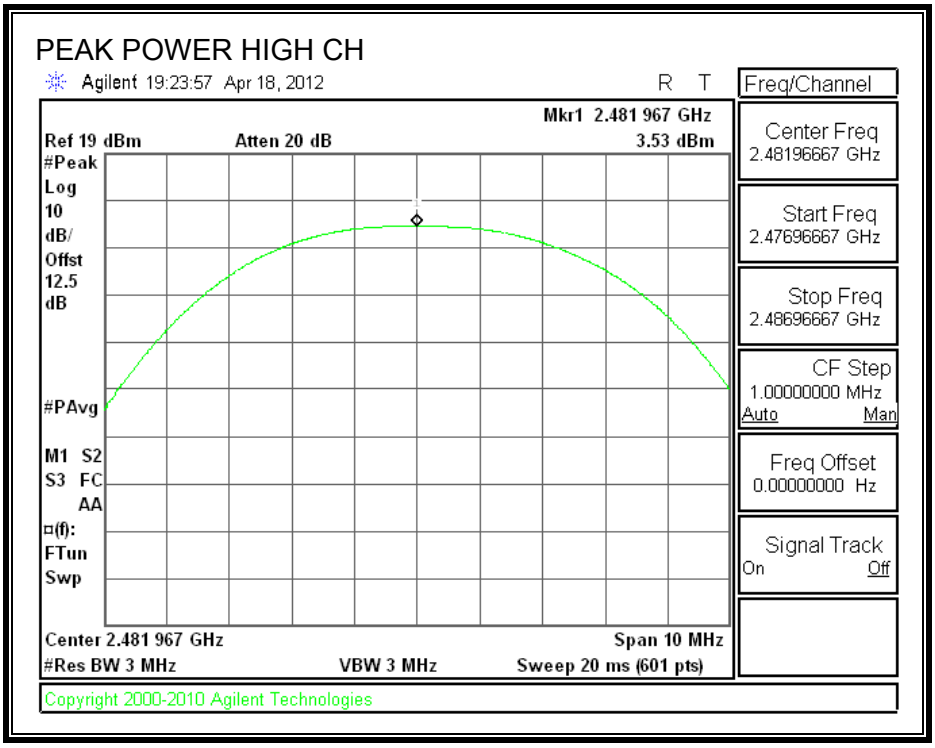
Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	3.80	30	-26.20
Middle	2442	3.78	30	-26.22
High	2482	3.53	30	-26.47

OUTPUT POWER



PEAK POWER MID CH





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 12.5 dB (including 2.5 dB cable loss) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Average Power (dBm)
Low	2402	-10.98
Middle	2442	-10.71
High	2482	-11.18

7.1.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

TEST PROCEDURE

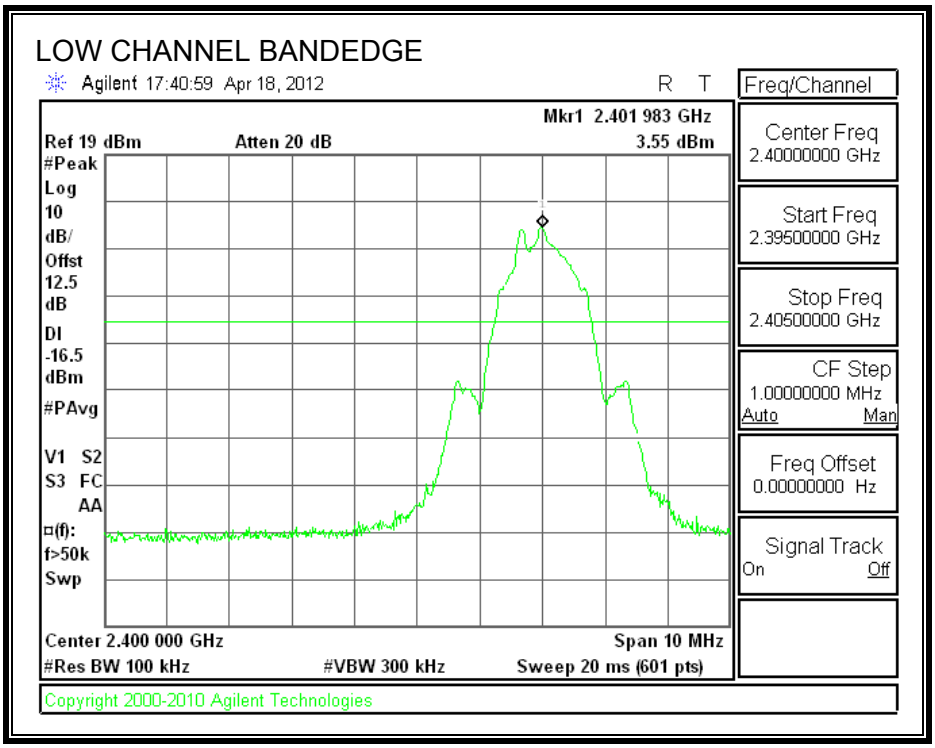
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

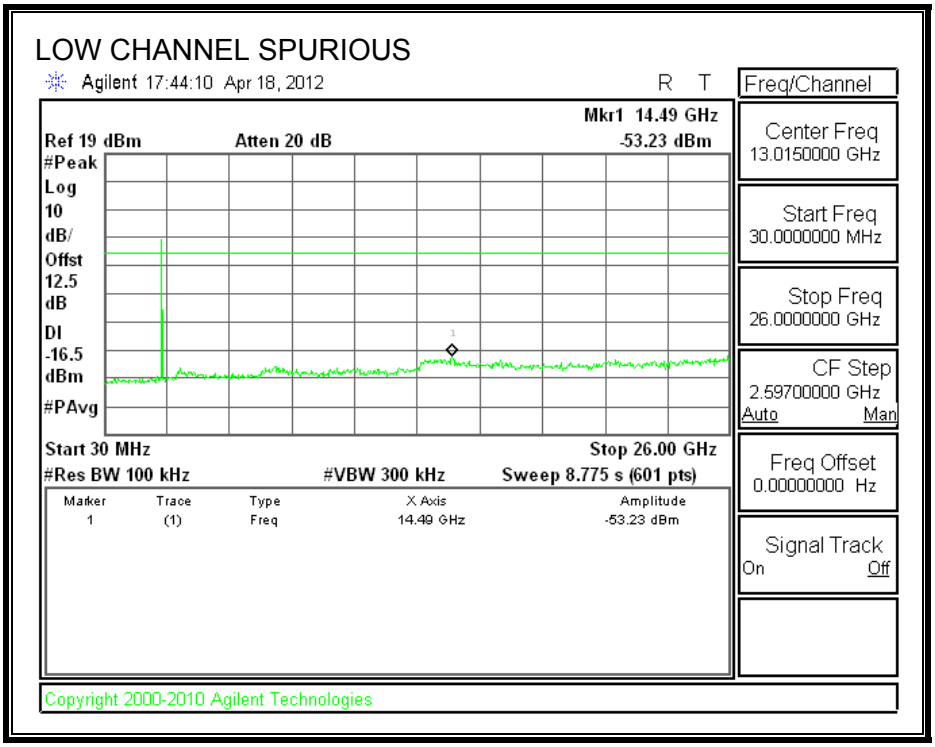
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

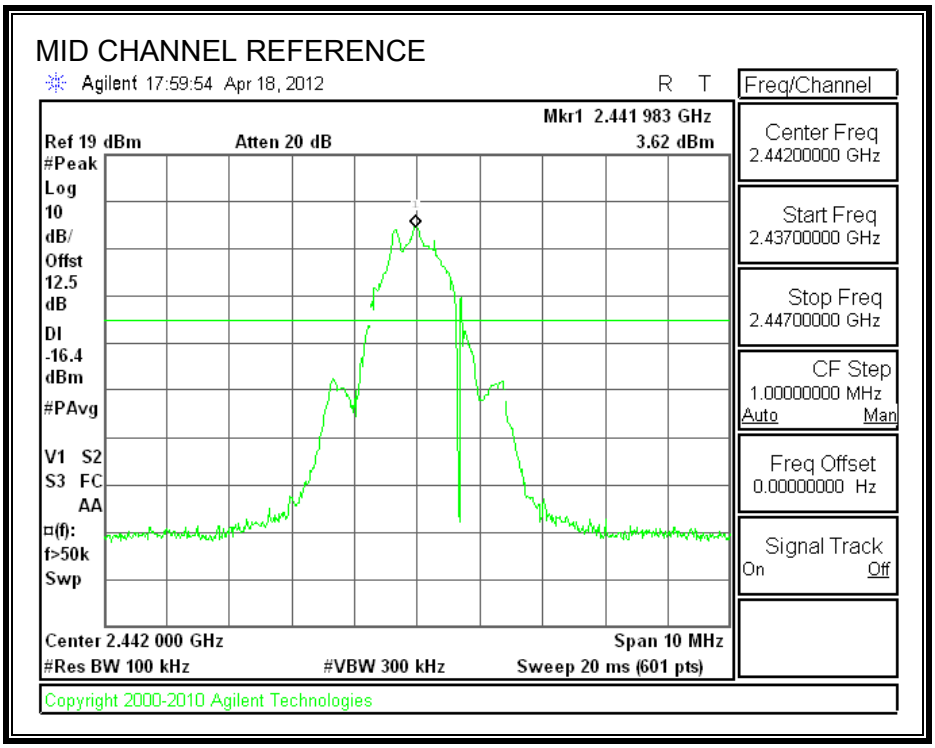
RESULTS

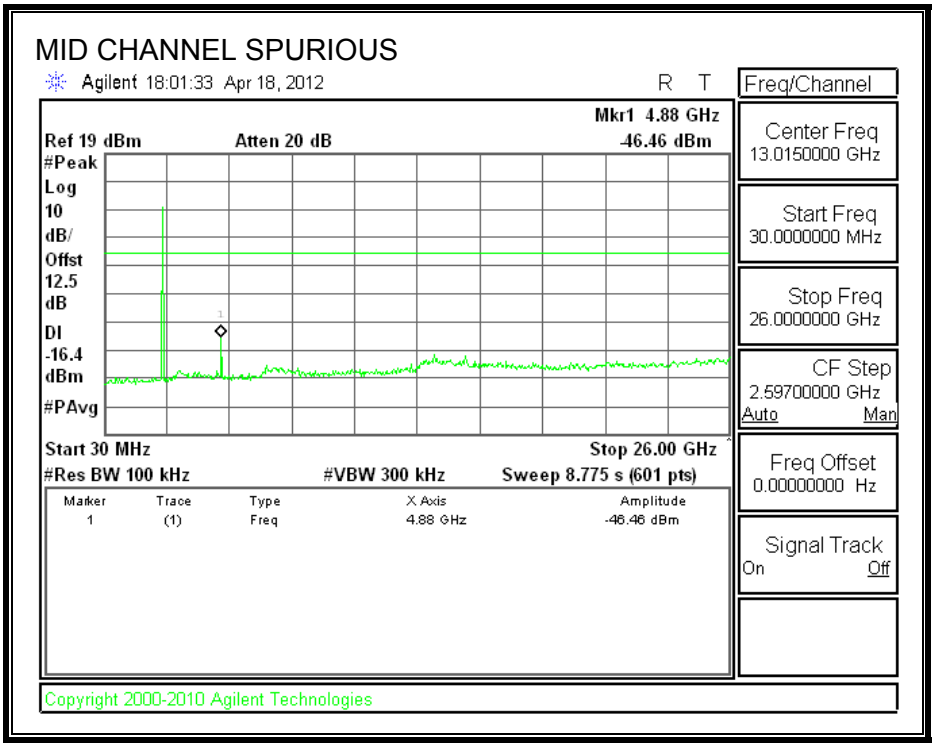
SPURIOUS EMISSIONS, LOW CHANNEL



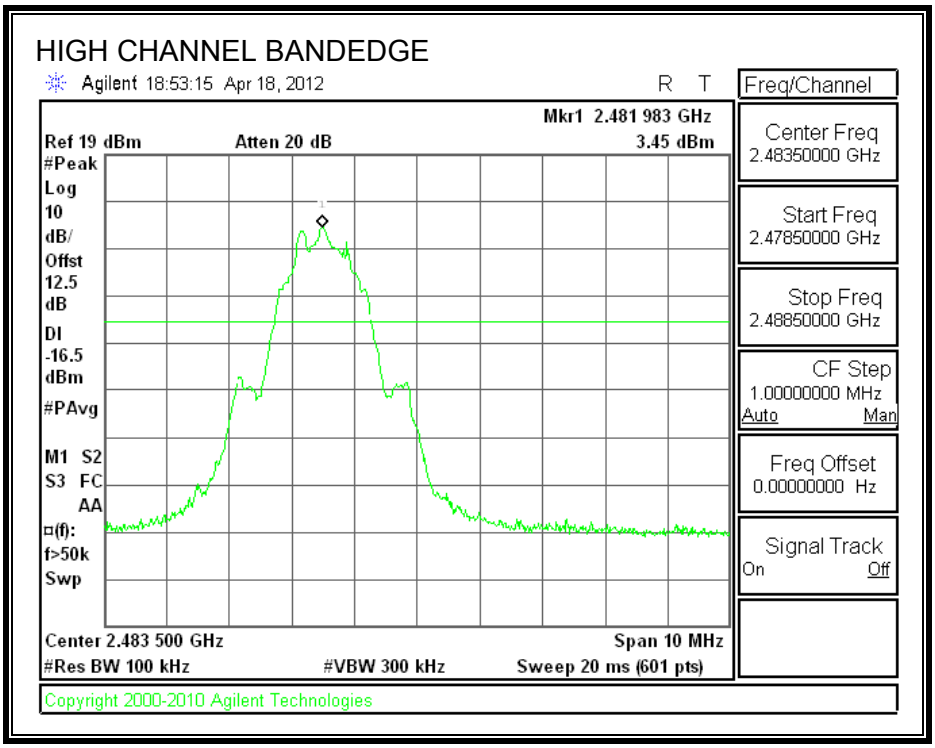


SPURIOUS EMISSIONS, MID CHANNEL

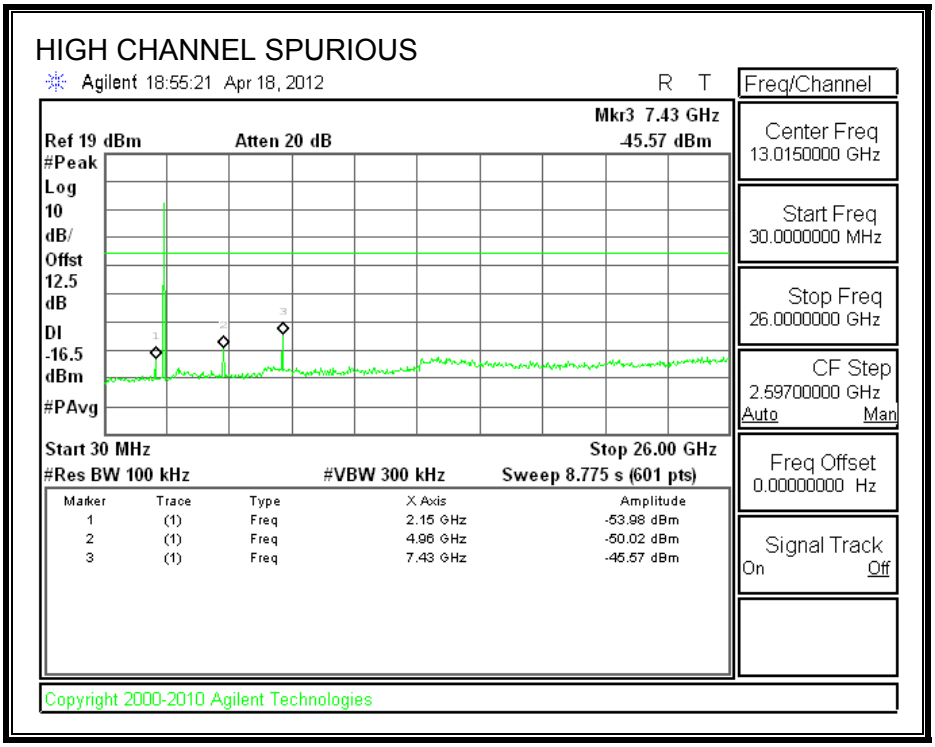




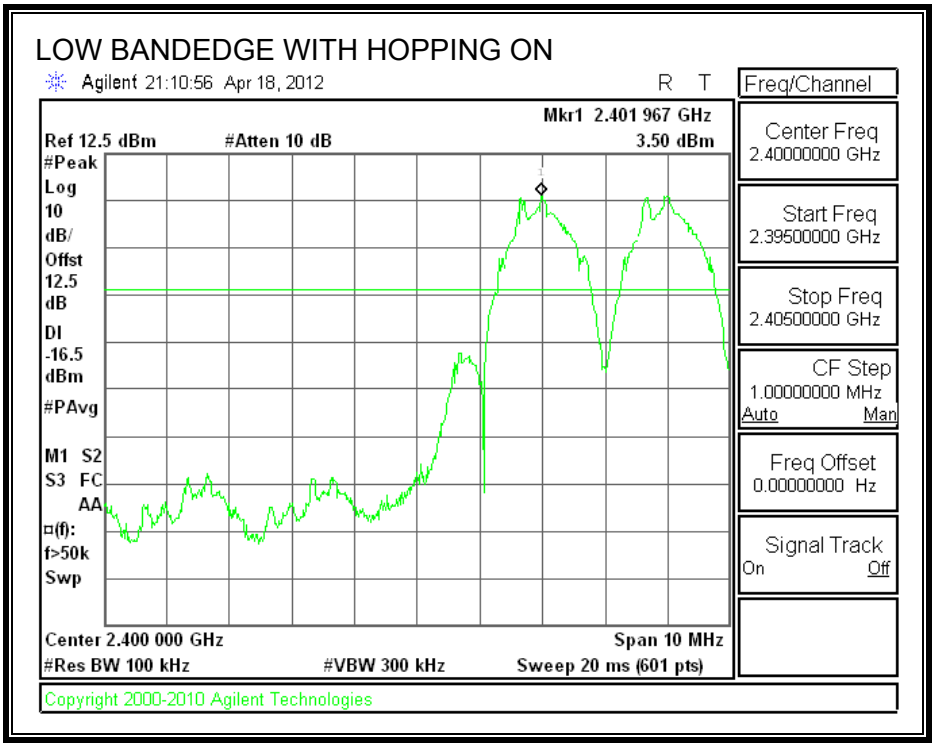
SPURIOUS EMISSIONS, HIGH CHANNEL

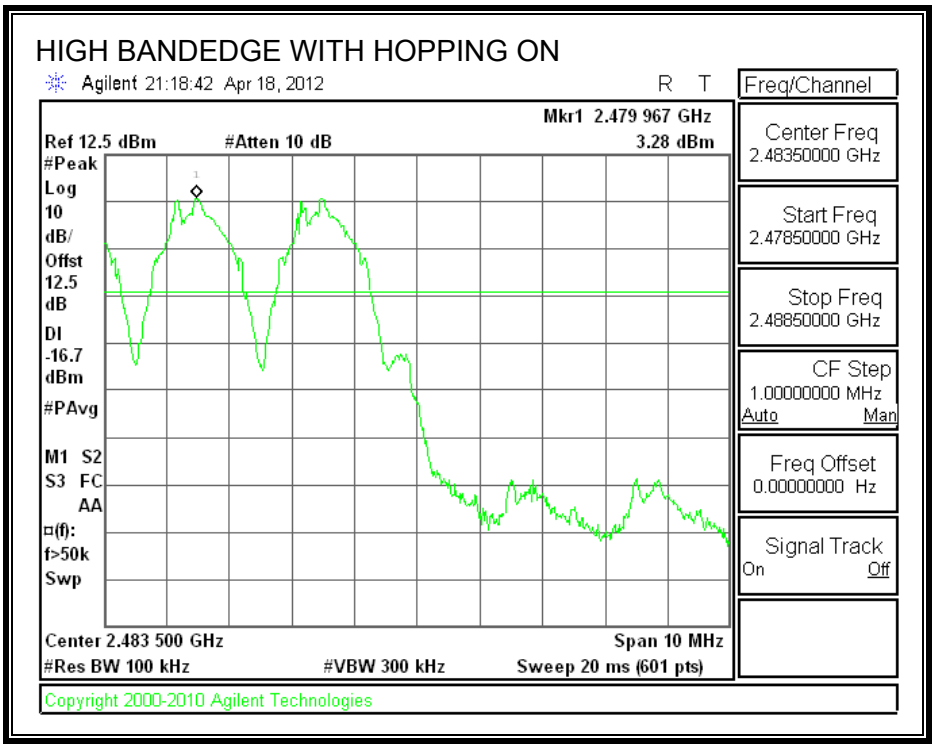


HIGH CHANNEL SPURIOUS



SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON





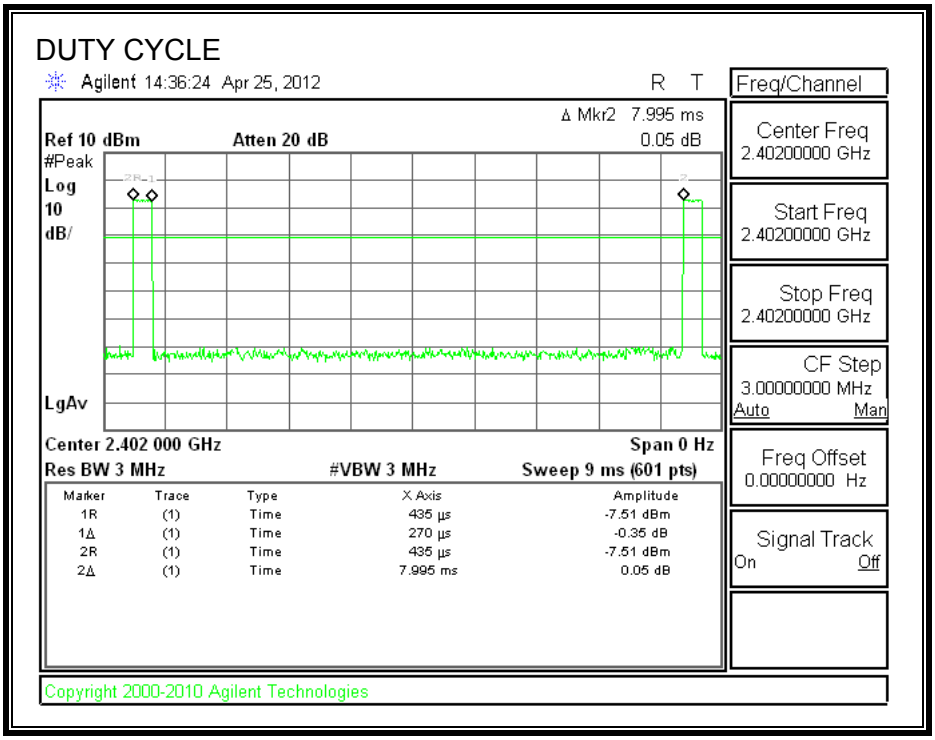
7.1.8. DUTY CYCLE

LIMITS

None; for reporting purposes only.

RESULTS

Mode	Tx on (usec)	Tx on + Tx off (usec)	Duty Cycle (%)	Correction Factor (dB)
FHSS	270	7995	3.38	14.71



8. RADIATED TEST RESULTS

LIMITS AND PROCEDURE

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.

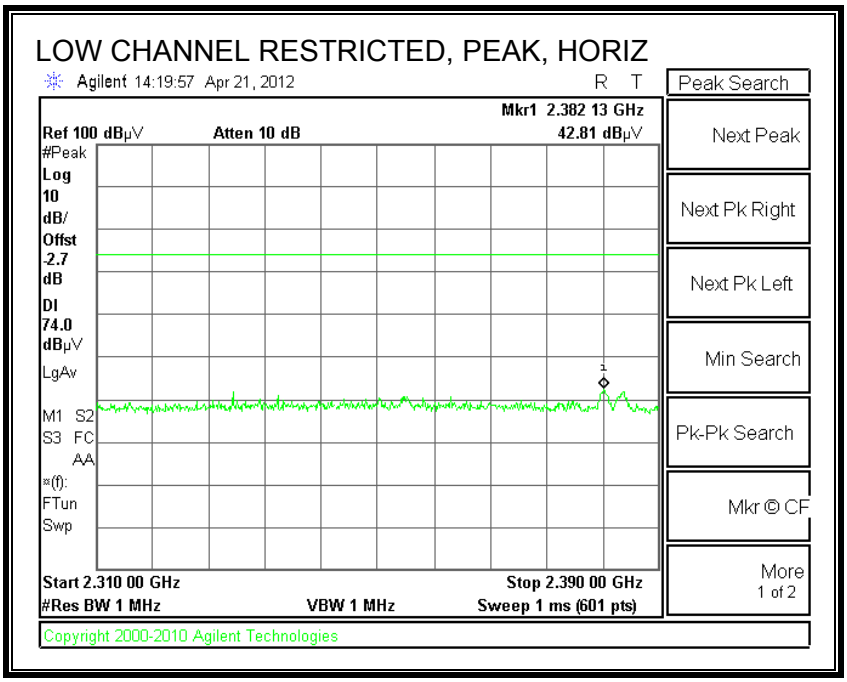
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

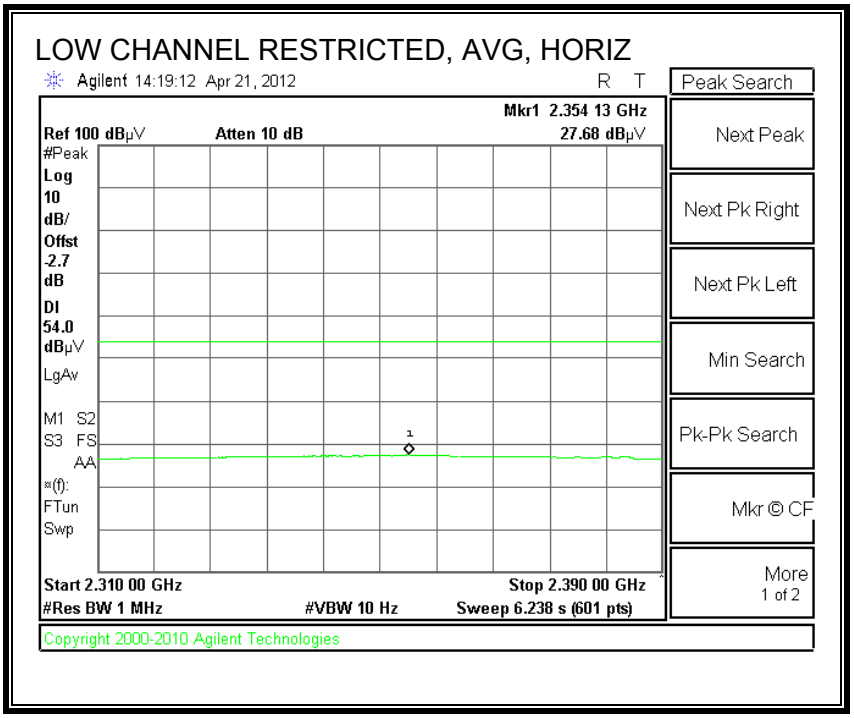
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

8.1. Standard Non-metallic Enclosure

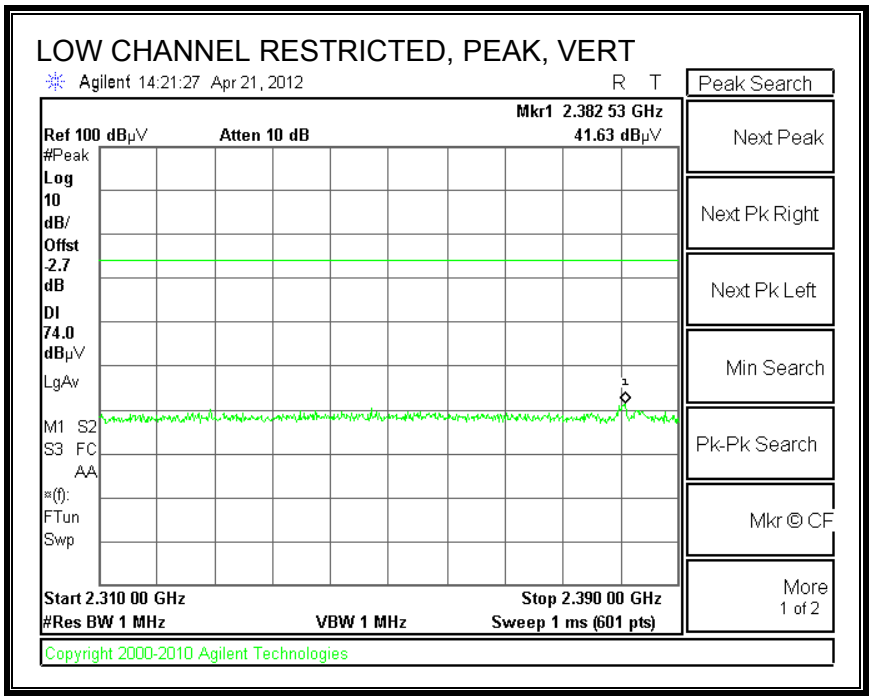
8.1.1. TRANSMITTER ABOVE 1 GHz

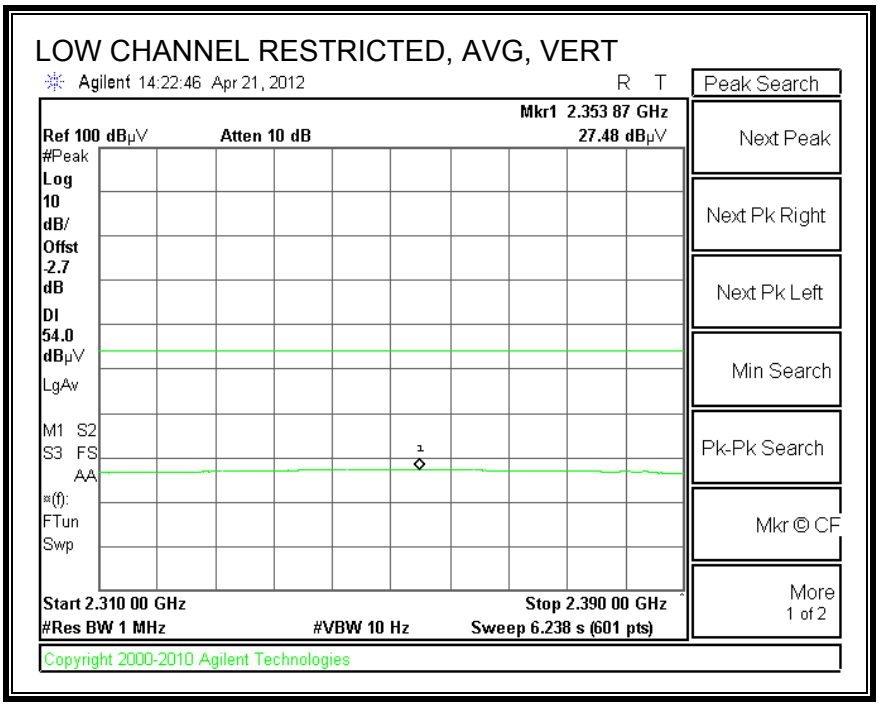
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





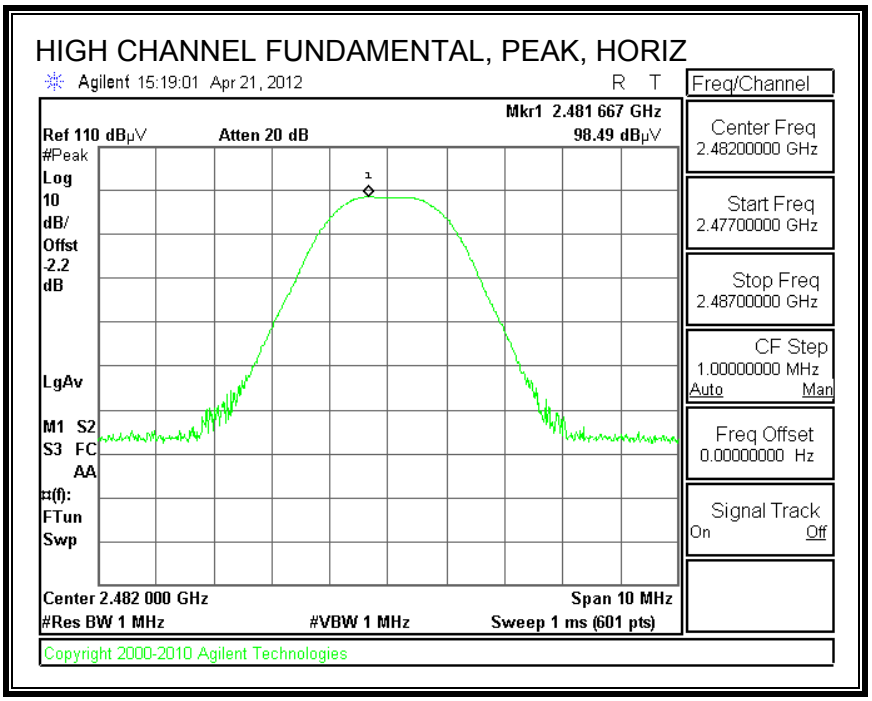
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



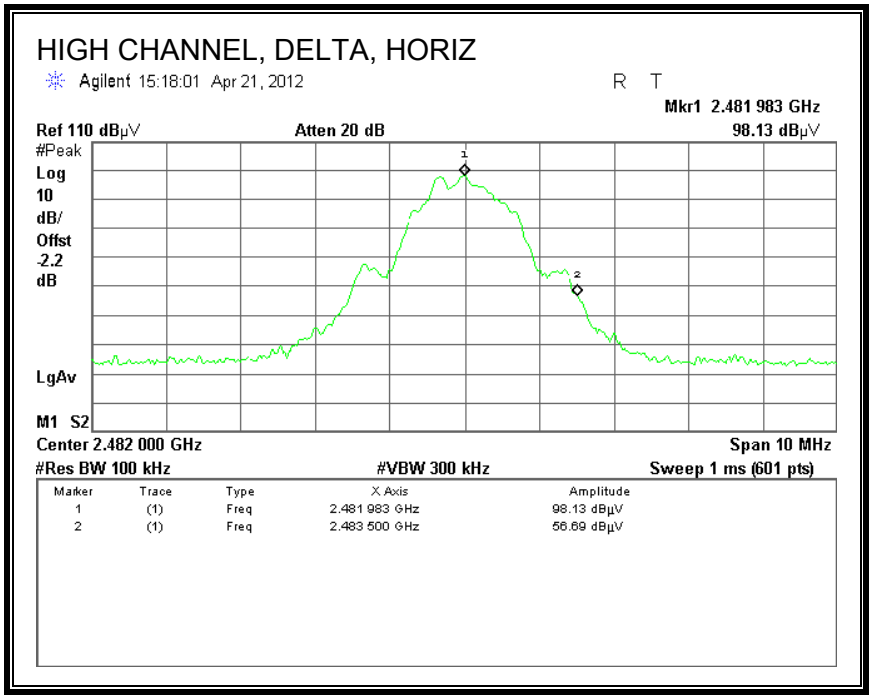


RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL) (Marker Delta Method)

Fundamental Peak Power = 98.49dBuV



Delta from Marker Peak to Highest Marker in Restricted Band = 41.44dB



CALCULATION

_ Peak Reading = Fundamental Peak Field Strength - Delta

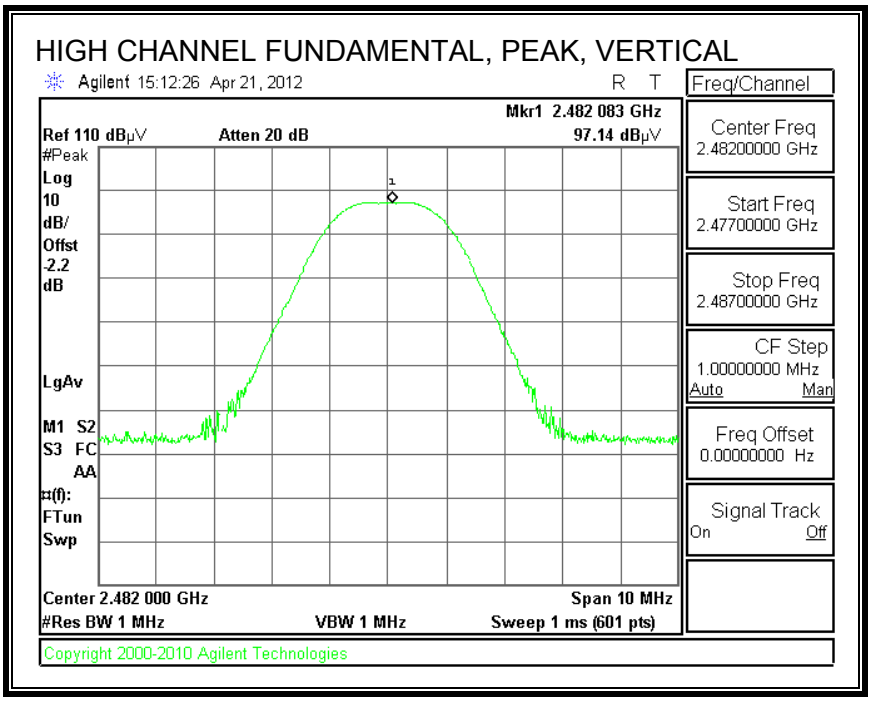
_Peak Margin = Peak Reading - 74

			Fundamental (dBuV/m)		Reading (dBuV/m)		Limit (dBuV/m)		Margin (dBuV/m)	
	Delta (dB)	Horn Antenna	Peak	AVG	Peak	AVG	Peak	AVG	Peak	AVG
High Ch, 2482MHz	41.44	Horizontal	98.49	N/A	57.05	42.34	74	54	-16.95	-11.66

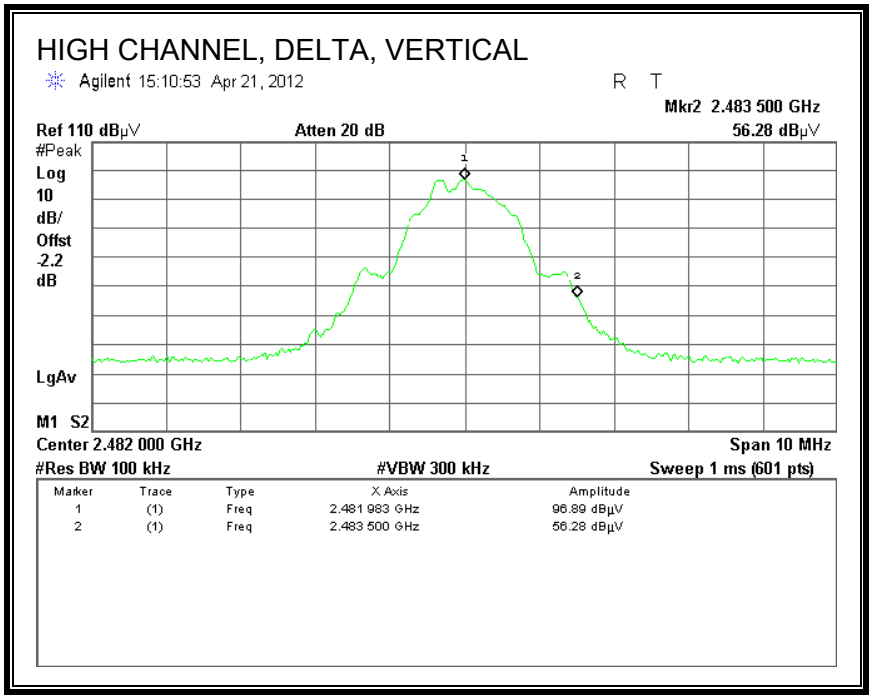
AVG Power = Peak Reading – Duty Cycle
= 57.05 dBuV/m - 14.71dBuV/m
= 42.34 dBuV/m

RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)

Fundamental Peak Power = 97.14dBuV



Delta from Marker Peak to Highest Marker in Restricted Band = 40.61



CALCULATION

_ Peak Reading = Fundamental Peak Field Strength - Delta

_Peak Margin = Peak Reading - 74

			Fundamental (dBuV/m)		Reading (dBuV/m)		Limit (dBuV/m)		Margin (dBuV/m)	
	Delta (dB)	Horn Antenna	Peak	AVG	Peak	AVG	Peak	AVG	Peak	AVG
High Ch, 2482MHz	40.61	Vertical	97.14	N/A	56.53	41.82	74	54	-17.47	-12.18

AVG Power = Peak Reading – Duty Cycle
= 56.53 dBuV/m - 14.71dBuV/m
= 41.82 dBuV/m

HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 3m Chamber

Company:	Dennis Huang
Project #:	12U14344
Date:	4/21/2012
Test Engineer:	Microsoft
Configuration:	15.247 Worst Case Test
Mode:	Tx Mode

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T34 HP 8449B			FCC 15.205

Hi Frequency Cables

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter
3' cable 22807700	12' cable 22807600	20' cable 22807500		R_001

Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
Low Channel - 2402MHz															V
4.804	3.0	56.0	26.8	33.1	6.8	-34.1	0.0	0.0	61.8	47.1	74	54	-12.2	-6.9	V
4.804	3.0	59.3	25.5	33.1	6.8	-34.1	0.0	0.0	65.1	50.4	74	54	-8.9	-3.6	H
Mid Channel - 2442MHz															V
4.884	3.0	57.0	26.9	33.2	6.8	-34.0	0.0	0.0	63.0	48.3	74	54	-11.0	-5.7	V
7.326	3.0	53.8	24.0	36.3	9.1	-33.1	0.0	0.0	66.1	51.4	74	54	-7.9	-2.6	V
4.884	3.0	58.4	25.9	33.2	6.8	-34.0	0.0	0.0	64.4	49.7	74	54	-9.6	-4.3	H
7.326	3.0	47.3	23.6	36.3	9.1	-33.1	0.0	0.0	59.6	44.9	74	54	-14.4	-9.1	H
High Channel - 2482MHz															V
4.964	3.0	56.6	29.2	33.2	6.9	-34.0	0.0	0.0	62.7	48.0	74	54	-11.3	-6.0	V
7.446	3.0	50.5	29.4	36.5	9.1	-33.0	0.0	0.0	63.1	48.4	74	54	-10.9	-5.6	V
4.964	3.0	59.2	28.4	33.2	6.9	-34.0	0.0	0.0	65.3	50.6	74	54	-8.7	-3.4	H
7.446	3.0	47.6	28.8	36.5	9.1	-33.0	0.0	0.0	60.2	45.5	74	54	-13.8	-8.5	H

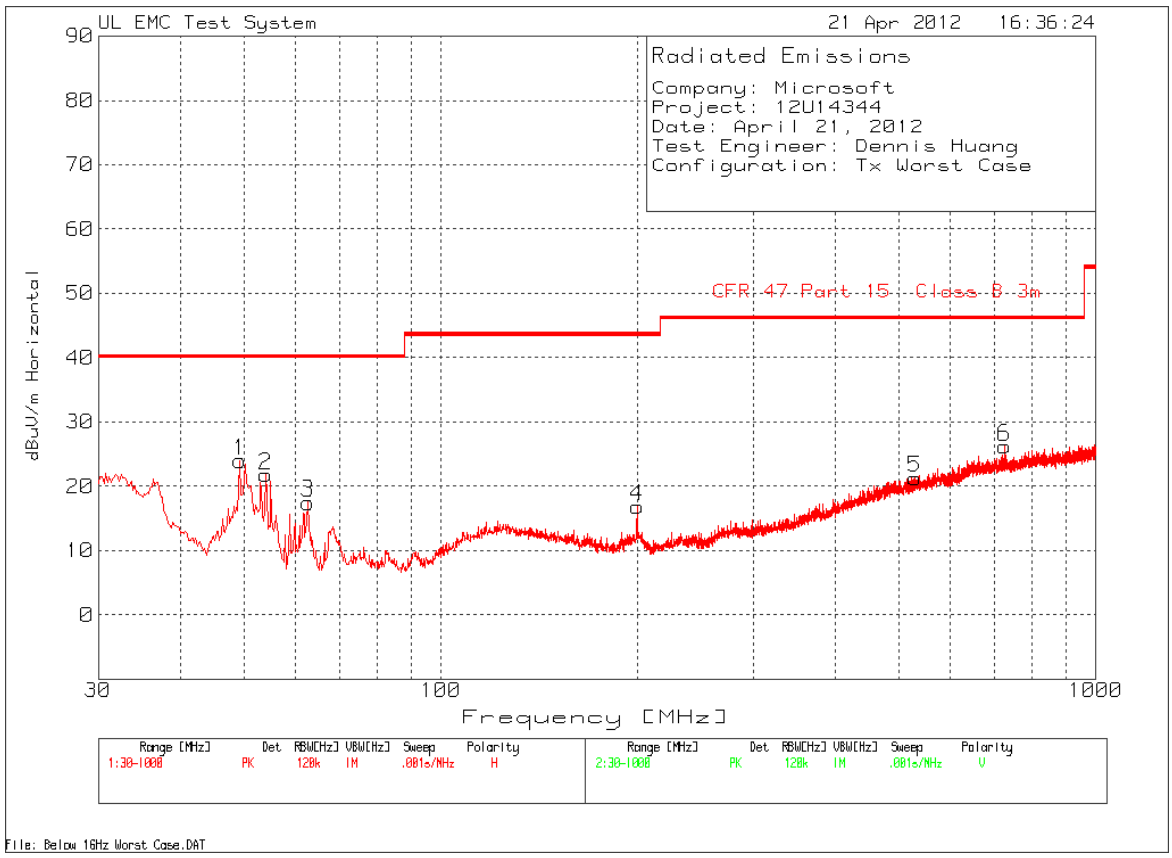
Rev. 11.10.11

f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

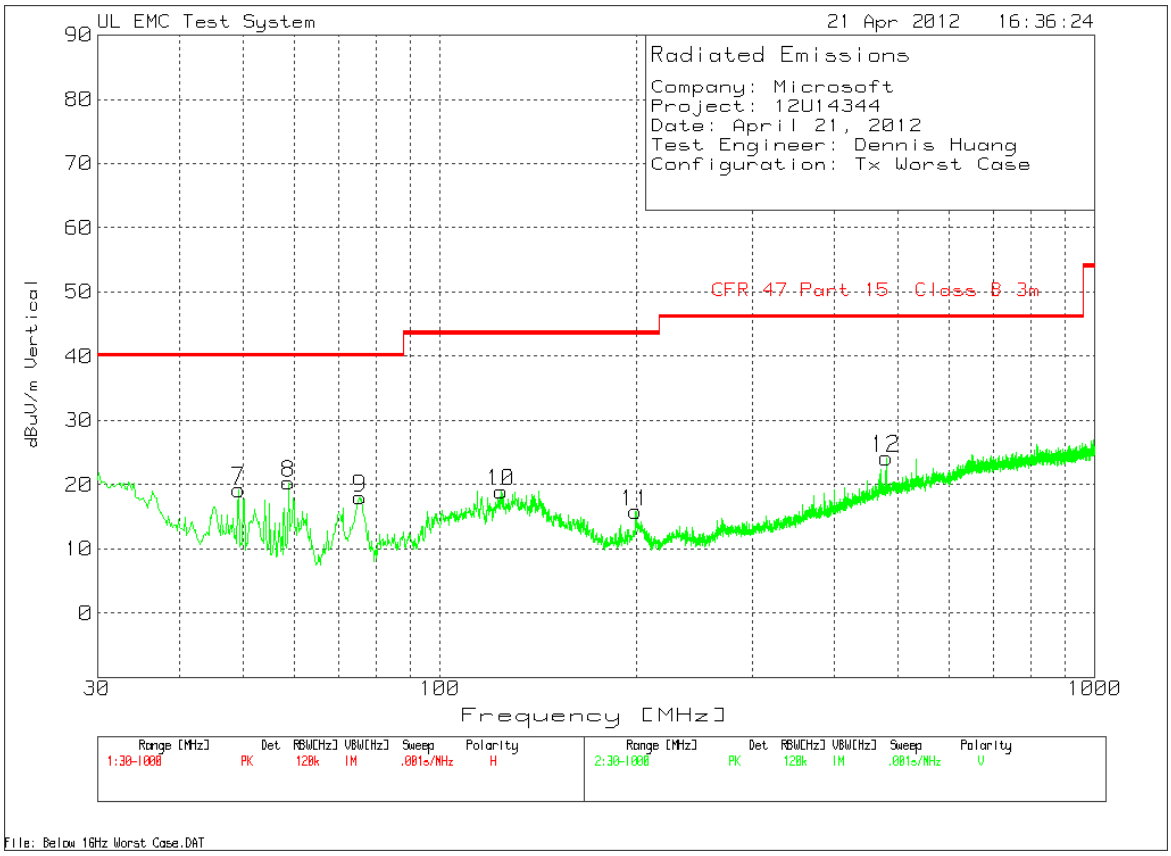
8.1.2. WORST-CASE BELOW 1 GHz

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

HORIZONTAL PLOT



VERTICAL PLOT



HORIZONTAL AND VERTICAL DATA

Company: Microsoft
Project: 12U14344
Date: April 21, 2012
Test Engineer: Dennis Huang
Configuration: Tx Worst Case

Test Frequency	Raw Reading (dBuV/m)	Detector	Amplifier + Cable Loss [dB]	Bilog Antenna Loss [dB]	Corrected Reading (dBuV/m)	Part 15 Class B Limit (dBuV/m)	Margin	Antenna Height [cm]	Polarity
49.3845	43.2	PK	-27.3	8.1	24	40	-16	201	Horz
54.0368	42.07	PK	-27.3	7	21.77	40	-18.23	400	Horz
62.7598	37.19	PK	-27.2	7.5	17.49	40	-22.51	201	Horz
199.6143	30.89	PK	-26.2	12.2	16.89	43.5	-26.61	100	Horz
530.1199	27.91	PK	-24.6	18	21.31	46	-24.69	400	Horz
725.7094	29.1	PK	-23.3	20.4	26.2	46	-19.8	100	Horz

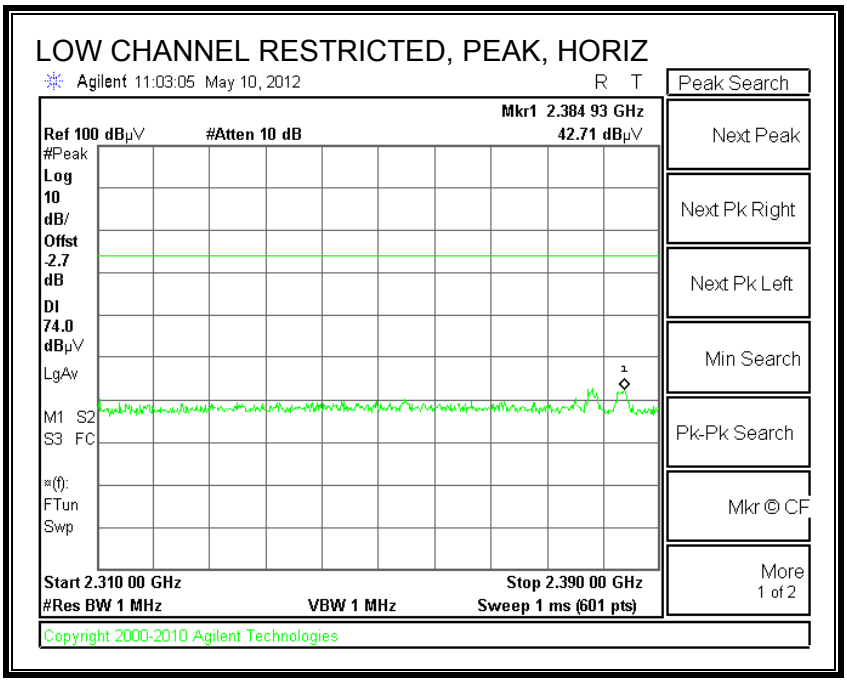
Test Frequency	Raw Reading (dBuV/m)	Detector	Amplifier + Cable Loss [dB]	Bilog Antenna Loss [dB]	Corrected Reading (dBuV/m)	Part 15 Class B Limit (dBuV/m)	Margin	Ant Height [cm]	Polarity
49.3845	38.46	PK	-27.3	8.1	19.26	40	-20.74	101	Vert
58.689	40.44	PK	-27.2	7.1	20.34	40	-19.66	201	Vert
75.5536	37.04	PK	-27.1	8.1	18.04	40	-21.96	201	Vert
124.0148	31.65	PK	-26.7	14	18.95	43.5	-24.55	101	Vert
199.0328	29.95	PK	-26.2	12.1	15.85	43.5	-27.65	201	Vert
480.4956	31.53	PK	-25	17.7	24.23	46	-21.77	101	Vert

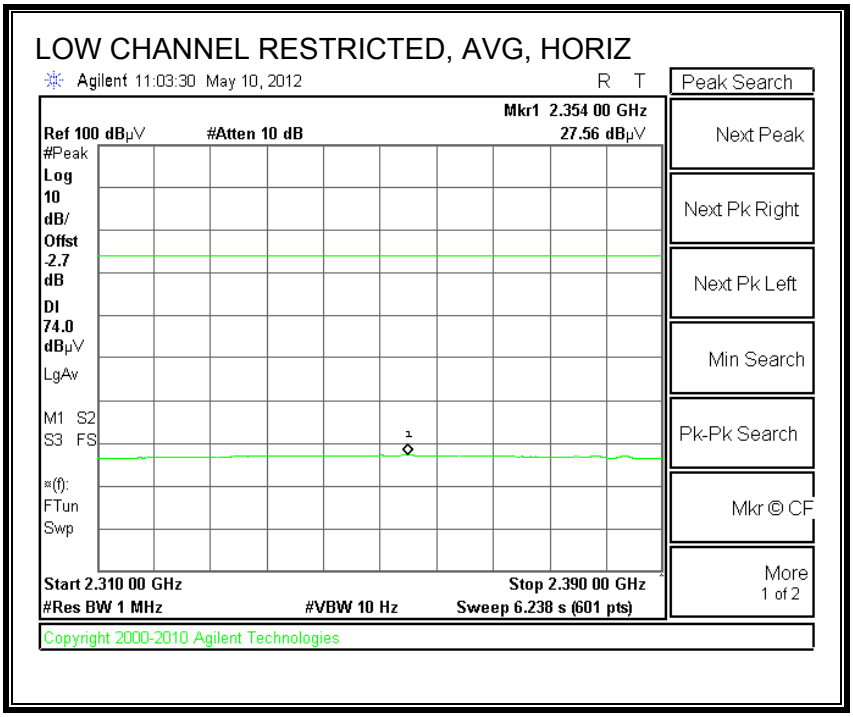
PK - Peak detector
QP - Quasi-Peak detector
LnAv - Linear Average detector
LgAv - Log Average detector
Av - Average detector
CAV - CISPR Average detector
RMS - RMS detection
CRMS - CISPR RMS detection
Text File: below 1ghz.TXT
File: below 1ghz.DAT

8.2. Metallic Artwork Enclosure

8.2.1. TRANSMITTER ABOVE 1 GHz

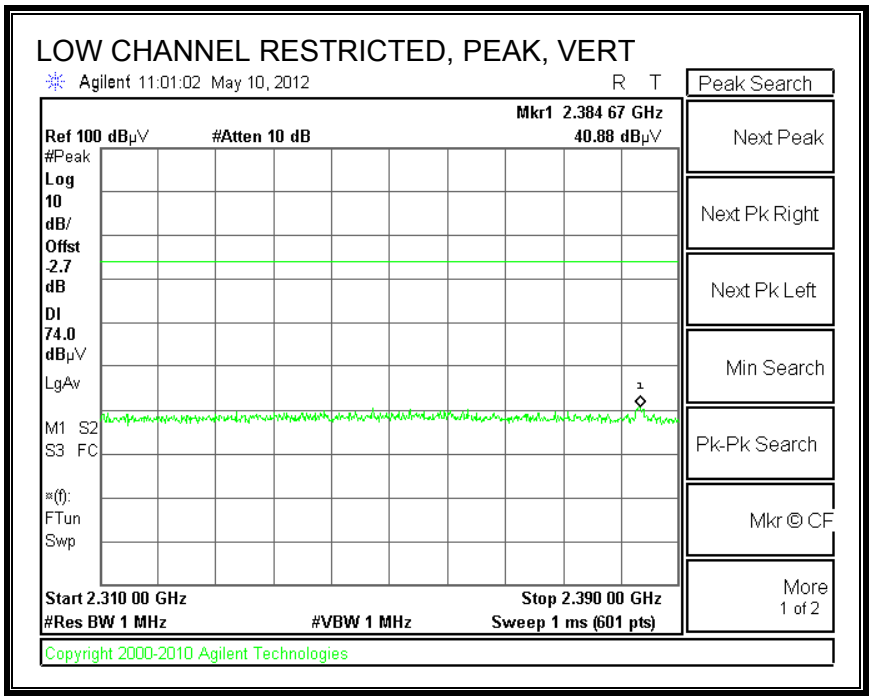
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

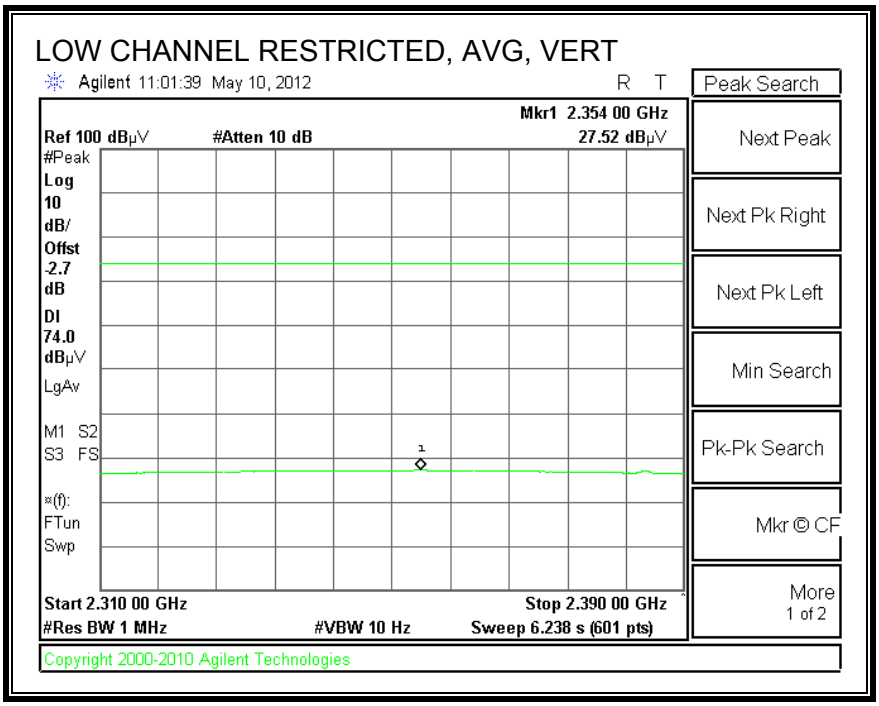




Limit for Average is at 54 dBuV/m. Limit line on graph does not depict the actual limit.

RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)

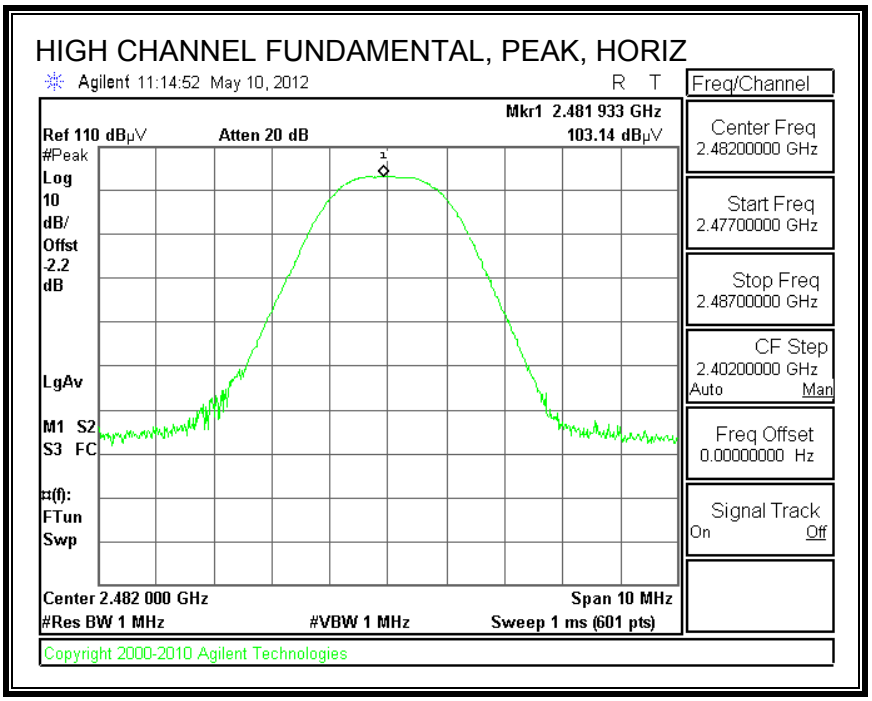




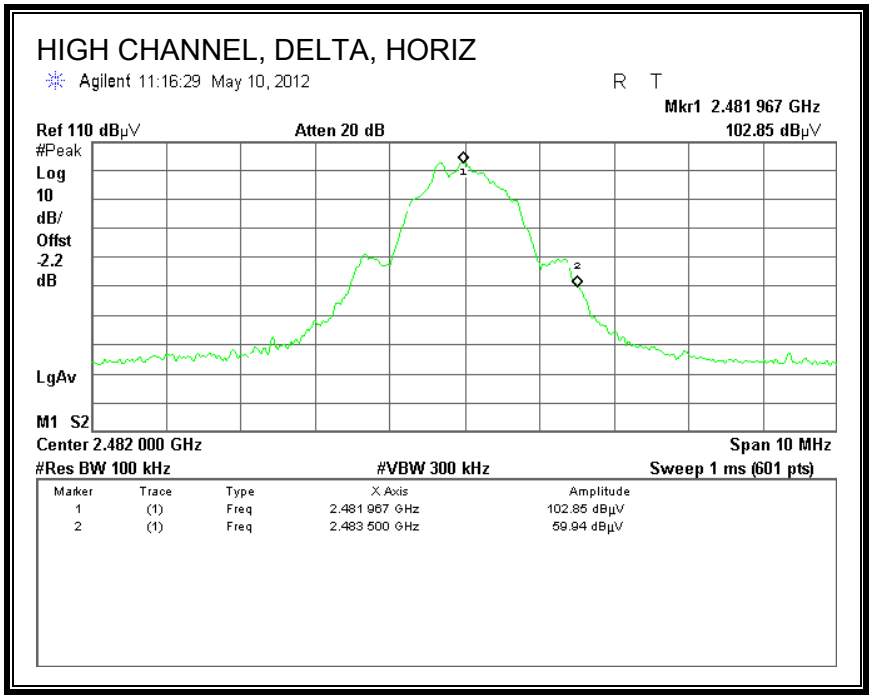
Limit for Average is at 54 dBuV/m. Limit line on graph does not depict the actual limit.

RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL) (Marker Delta Method)

Fundamental Peak Power = 103.14dBuV



Delta from Marker Peak to Highest Marker in Restricted Band = 42.91dB



CALCULATION

_ Peak Reading = Fundamental Peak Field Strength - Delta

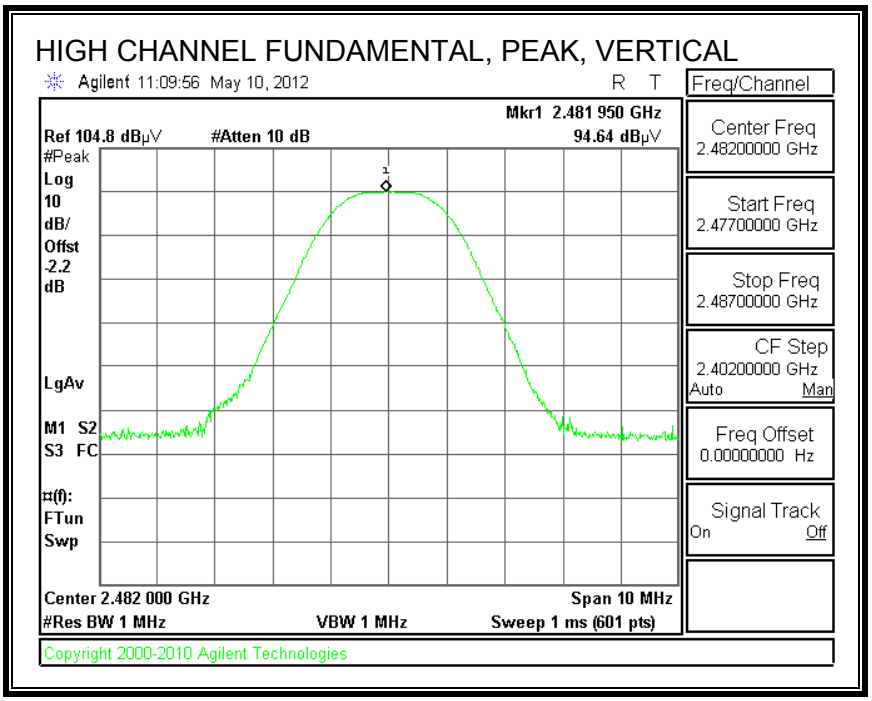
_Peak Margin = Peak Reading - 74

			Fundamental (dBuV/m)		Reading (dBuV/m)		Limit (dBuV/m)		Margin (dBuV/m)	
	Delta (dB)	Horn Antenna	Peak	AVG	Peak	AVG	Peak	AVG	Peak	AVG
High Ch, 2482MHz	42.91	Horizontal	103.14	N/A	60.23	45.52	74	54	-13.77	-8.48

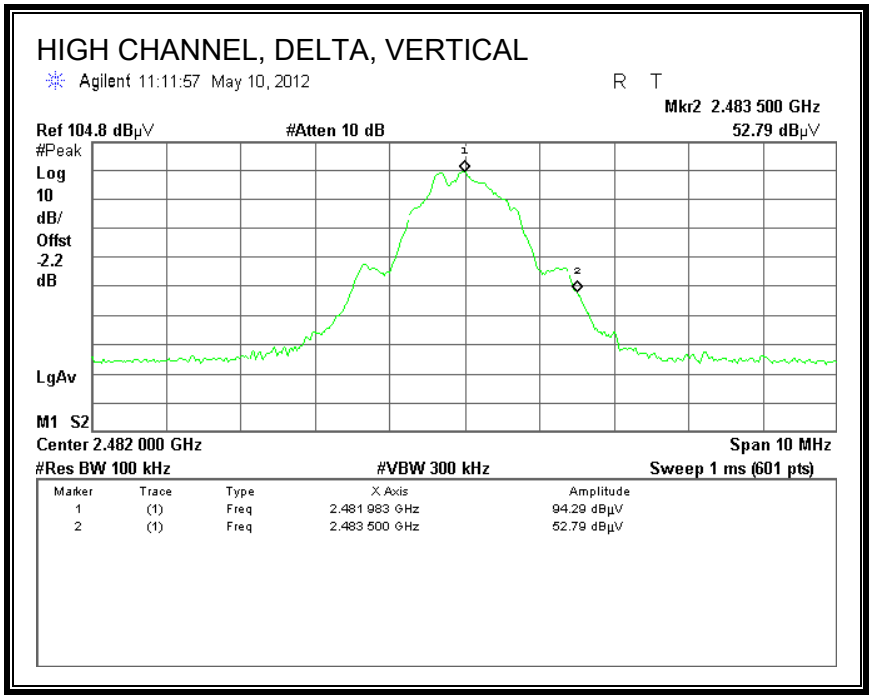
AVG Power = Peak Reading – Duty Cycle
= 60.23 dBuV/m - 14.71dBuV/m
= 45.52 dBuV/m

RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)

Fundamental Peak Power = 94.64dBuV



Delta from Marker Peak to Highest Marker in Restricted Band = 41.50



CALCULATION

_ Peak Reading = Fundamental Peak Field Strength - Delta

_Peak Margin = Peak Reading - 74

			Fundamental (dBuV/m)		Reading (dBuV/m)		Limit (dBuV/m)		Margin (dBuV/m)	
	Delta (dB)	Horn Antenna	Peak	AVG	Peak	AVG	Peak	AVG	Peak	AVG
High Ch, 2482MHz	41.5	Vertical	94.64	N/A	53.14	38.43	74	54	-20.86	-15.57

AVG Power = Peak Reading – Duty Cycle
= 53.14 dBuV/m - 14.71dBuV/m
= 38.43 dBuV/m

HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 3m Chamber

Company: Dennis Huang
Project #: 12U14344
Date: 5/10/2012
Test Engineer: Microsoft
Configuration: 15.247 Worst Case Test (Metallic Cover)
Mode: Tx Mode

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T60; S/N: 2238 @3m	T34 HP 8449B			FCC 15.205

Hi Frequency Cables

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter
3' cable 22807700	12' cable 22807600	20' cable 22807500		R_001

Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
Low Channel - 2402MHz															V
4.804	3.0	54.4	25.7	33.1	6.8	-34.1	0.0	0.0	60.2	45.5	74	54	-13.8	-8.5	V
4.804	3.0	57.0	25.8	33.1	6.8	-34.1	0.0	0.0	62.8	48.1	74	54	-11.2	-5.9	H
Mid Channel - 2442MHz															V
4.884	3.0	55.6	26.1	33.2	6.8	-34.0	0.0	0.0	61.6	46.9	74	54	-12.4	-7.1	V
7.326	3.0	52.1	24.0	36.3	9.1	-33.1	0.0	0.0	64.4	49.7	74	54	-9.6	-4.3	V
4.884	3.0	56.0	26.0	33.2	6.8	-34.0	0.0	0.0	62.0	47.3	74	54	-12.0	-6.7	H
7.326	3.0	46.1	23.6	36.3	9.1	-33.1	0.0	0.0	58.4	43.7	74	54	-15.6	-10.3	H
High Channel - 2482MHz															V
4.964	3.0	54.7	25.9	33.2	6.9	-34.0	0.0	0.0	60.8	46.1	74	54	-13.2	-7.9	V
7.446	3.0	52.6	24.4	36.5	9.1	-33.0	0.0	0.0	65.2	50.5	74	54	-8.8	-3.5	V
4.964	3.0	58.4	25.2	33.2	6.9	-34.0	0.0	0.0	64.5	49.8	74	54	-9.5	-4.2	H
7.446	3.0	46.9	23.9	36.5	9.1	-33.0	0.0	0.0	59.5	44.8	74	54	-14.5	-9.2	H

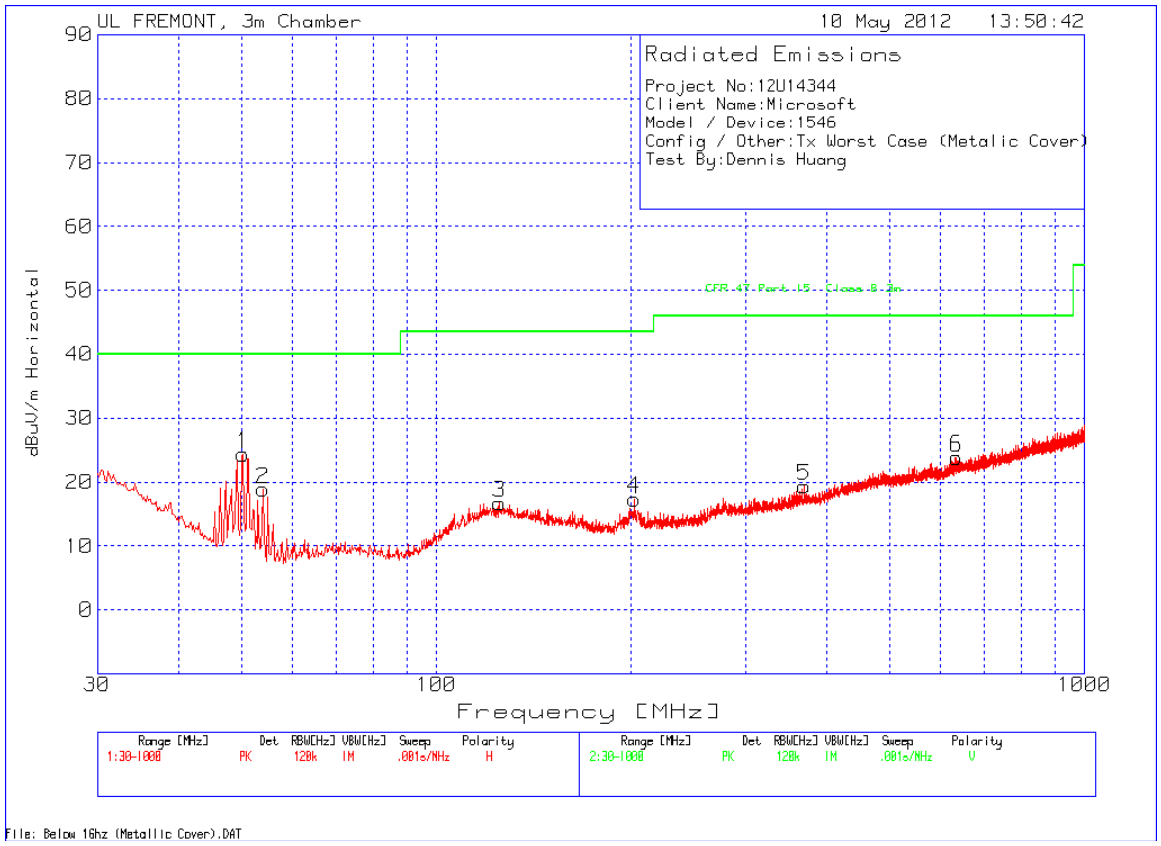
Rev. 11.10.11

f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

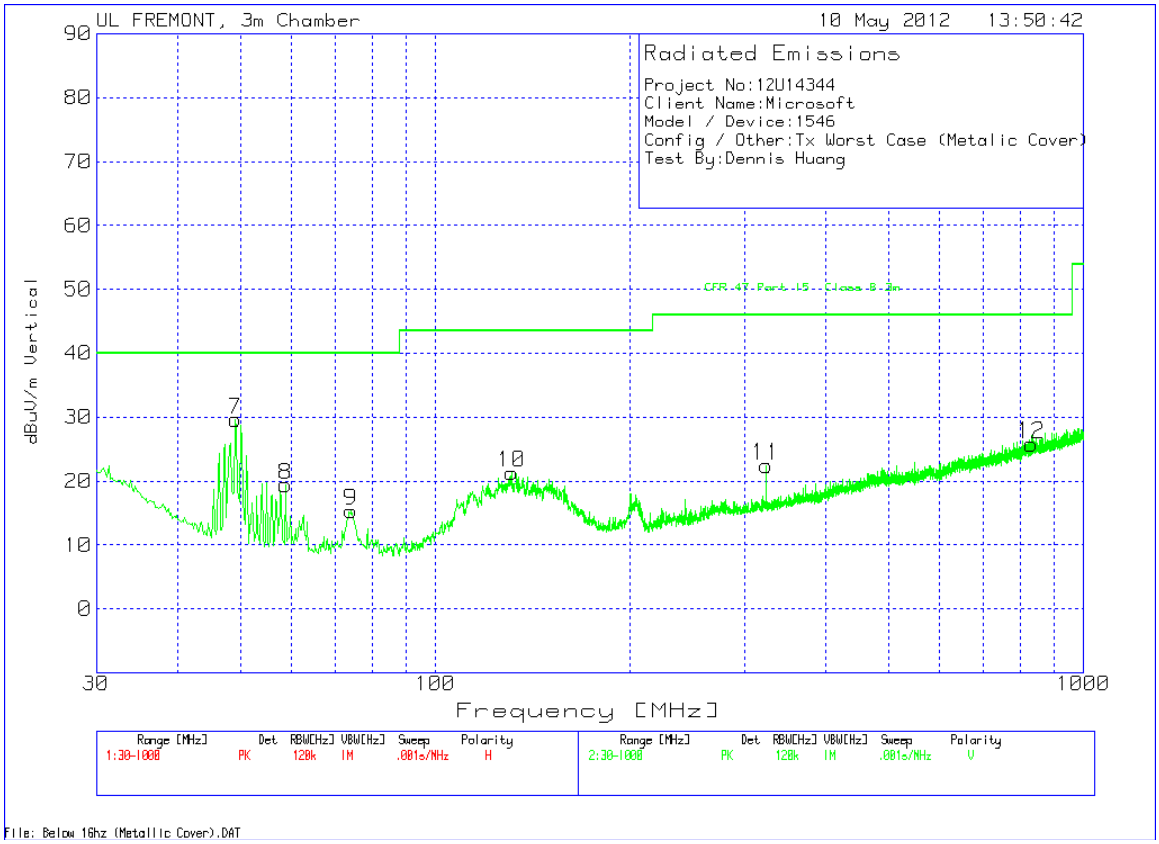
8.2.2. WORST-CASE BELOW 1 GHz

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

HORIZONTAL PLOT



VERTICAL PLOT



HORIZONTAL AND VERTICAL DATA

Company: Microsoft
Project: 12U14344
Date: May 10, 2012
Test Engineer: Dennis Huang
Configuration: Tx Worst Case (Metallic Cover)

Test Frequency	Raw Reading (dBuV/m)	Detector	Amplifier + Cable Loss [dB]	Bilog Antenna Loss [dB]	Corrected Reading (dBuV/m)	Part 15 Class B Limit (dBuV/m)	Margin	Antenna Height [cm]	Polarity
50.3537	43.87	PK	-27.3	7.8	24.37	40	-15.63	201	Horz
54.0368	39.1	PK	-27.2	7	18.9	40	-21.1	399	Horz
125.1779	29.21	PK	-26.5	14	16.71	43.5	-26.79	399	Horz
202.1343	31.26	PK	-25.8	11.9	17.36	43.5	-26.14	301	Horz
369.6163	29.86	PK	-25.5	15	19.36	46	-26.64	100	Horz
635.3777	29.77	PK	-25.5	19.6	23.87	46	-22.13	301	Horz

Test Frequency	Raw Reading (dBuV/m)	Detector	Amplifier + Cable Loss [dB]	Bilog Antenna Loss [dB]	Corrected Reading (dBuV/m)	Part 15 Class B Limit (dBuV/m)	Margin	Ant Height [cm]	Polarity
49.1906	48.74	PK	-27.3	8.2	29.64	40	-10.36	101	Vert
58.689	39.51	PK	-27.2	7.1	19.41	40	-20.59	201	Vert
74.1966	34.25	PK	-27.1	8.2	15.35	40	-24.65	101	Vert
131.1871	34.19	PK	-26.5	13.6	21.29	43.5	-22.21	101	Vert
324.0628	33.96	PK	-25.3	13.8	22.46	46	-23.54	201	Vert
831.3549	28.58	PK	-24.4	21.6	25.78	46	-20.22	101	Vert

PK - Peak detector
QP - Quasi-Peak detector
LnAv - Linear Average detector
LgAv - Log Average detector
Av - Average detector
CAV - CISPR Average detector
RMS - RMS detection
CRMS - CISPR RMS detection
Text File: Below 1Ghz (Metallic Cover).TXT
File: Below 1Ghz (Metallic Cover).DAT

9. MAXIMUM PERMISSIBLE EXPOSURE

FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*($900/f^2$)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

IC RULES

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

Table 5
Exposure Limits for Persons Not Classed As RF and Microwave Exposed Workers (Including the General Public)

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m^2)	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	$280/f$	$2.19/f$		6
10–30	28	$2.19/f$		6
30–300	28	0.073	2*	6
300–1 500	$1.585f^{0.5}$	$0.0042f^{0.5}$	$f/150$	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	$616\,000/f^{1.2}$
150 000–300 000	$0.158f^{0.5}$	$4.21 \times 10^{-4}f^{0.5}$	$6.67 \times 10^{-5}f$	$616\,000/f^{1.2}$

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

Notes: 1. Frequency, f, is in MHz.
2. A power density of 10 W/m^2 is equivalent to 1 mW/cm^2.
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

EQUATIONS

Power density is given by:

S = EIRP / (4 * Pi * D^2)

where

S = Power density in W/m^2
EIRP = Equivalent Isotropic Radiated Power in W
D = Separation distance in m

Power density in units of W/m^2 is converted to units of mWc/m^2 by dividing by 10.

Distance is given by:

D = SQRT (EIRP / (4 * Pi * S))

where

D = Separation distance in m
EIRP = Equivalent Isotropic Radiated Power in W
S = Power density in W/m^2

For multiple colocated transmitters operating simultaneously in frequency bands where the limit is identical, the total power density is calculated using the total EIRP obtained by summing the Power * Gain product (in linear units) of each transmitter.

Total EIRP = (P1 * G1) + (P2 * G2) + ... + (Pn * Pn)

where

Px = Power of transmitter x
Gx = Numeric gain of antenna x

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

LIMITS

From FCC §1.1310 Table 1 (B), the maximum value of S = 1.0 mW/cm^2

From IC Safety Code 6, Section 2.2 Table 5 Column 4, S = 10 W/m^2

RESULTS

Band	Mode	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	IC Power Density (W/m^2)	FCC Power Density (mW/cm^2)
2.4 GHz	FHSS	0.20	11.18	-0.20	0.0249	0.00249