



**FCC CFR47 PART 15 SUBPART C  
INDUSTRY CANADA RSS-210 ISSUE 7**

**CERTIFICATION TEST REPORT**

**FOR**

**Wii Remote**

**MODEL NUMBER: RVL-003**

**FCC ID: CWTSBCN1001  
IC: 1788F-SBCN1001**

**REPORT NUMBER: 08J11856-1**

**ISSUE DATE: JUNE 06, 2008**

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**NVLAP LAB CODE 200065-0**

Revision History

<u>Rev.</u>	<u>Issue Date</u>	<u>Revisions</u>	<u>Revised By</u>
--	06/06/2008	Initial Issue	T. Chan

## TABLE OF CONTENTS

<b>1. ATTESTATION OF TEST RESULTS</b>	<b>4</b>
<b>2. TEST METHODOLOGY</b>	<b>5</b>
<b>3. FACILITIES AND ACCREDITATION</b>	<b>5</b>
<b>4. CALIBRATION AND UNCERTAINTY</b>	<b>5</b>
4.1. MEASURING INSTRUMENT CALIBRATION	5
4.2. MEASUREMENT UNCERTAINTY	5
<b>5. EQUIPMENT UNDER TEST</b>	<b>6</b>
5.1. DESCRIPTION OF EUT	6
5.2. MAXIMUM OUTPUT POWER	6
5.3. DESCRIPTION OF AVAILABLE ANTENNAS	6
5.4. SOFTWARE AND FIRMWARE	6
5.5. WORST-CASE CONFIGURATION AND MODE	6
5.6. DESCRIPTION OF TEST SETUP	7
<b>6. TEST AND MEASUREMENT EQUIPMENT</b>	<b>9</b>
<b>7. ANTENNA PORT TEST RESULTS</b>	<b>10</b>
7.1.1. 20 dB AND 99% BANDWIDTH	10
7.1.2. HOPPING FREQUENCY SEPARATION	14
7.1.3. NUMBER OF HOPPING CHANNELS	16
7.1.4. AVERAGE TIME OF OCCUPANCY	21
7.1.5. OUTPUT POWER	28
7.1.6. AVERAGE POWER	32
7.1.7. CONDUCTED SPURIOUS EMISSIONS	33
<b>8. RADIATED TEST RESULTS</b>	<b>42</b>
8.1. LIMITS AND PROCEDURE	42
8.1.1. TRANSMITTER ABOVE 1 GHz	43
8.1.2. RECEIVER ABOVE 1 GHz	52
8.1.3. WORST-CASE BELOW 1 GHz	53
<b>9. MAXIMUM PERMISSIBLE EXPOSURE</b>	<b>57</b>
<b>10. SETUP PHOTOS</b>	<b>61</b>

# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** ALPS ELECTRIC CO., LTD  
1-7 YUKIGAYA-OTSUKAMACHI OTA-KU  
OTA-KU, TOKYO, 145-8501, JAPAN

**EUT DESCRIPTION:** Wii Remote

**MODEL:** RVL-003

**SERIAL NUMBER:** N/A

**VERSION NUMBER:** X3

**DATE TESTED:** JUNE 02 - 05, 2008

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-210 Issue 7 Annex 8	Pass
INDUSTRY CANADA RSS-GEN Issue 2	Pass

Compliance Certification Services, Inc. (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 CCS based on interpretations and/or observations of test results. 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 CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by CCS will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:

Tested By:



THU CHAN  
EMC SUPERVISOR  
COMPLIANCE CERTIFICATION SERVICES

CAN CHUNG  
EMC ENGINEER  
COMPLIANCE CERTIFICATION SERVICES

## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, 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.

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. MEASUREMENT UNCERTAINTY

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

PARAMETER	UNCERTAINTY
Power Line Conducted Emission	+/- 2.3 dB
Radiated Emission	+/- 3.4 dB

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

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is a Wii Remote, which manufactured by Alps Electric Co., Ltd.

### 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	1.88	1.54

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a PWB Printed antenna, with a maximum gain of -1.78 dBi.

### 5.4. SOFTWARE AND FIRMWARE

The firmware and Utility software installed in the EUT during testing was Bluetooth HCI command.

### 5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case data rate for each mode is determined to be as follows, based on input from the manufacturer of the radio.

All final tests in the GFSK mode were made at 1 Mb/s.

For radiated emissions below 1 GHz the worst-case configuration is determined to be the mode and channel with the highest output power.

EUT has been evaluated at X, Y, and Z-axis. The highest measured output power was at X-axis.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	HP	HP Pavilion dv 1000	CNF62007RV	DoC
AC Adapter	HP	PPP009H	F3-06072698200B	DoC
NUNCYAKU	Nintendo	RVL-004	NA	DoC
Test Jig	Alps	NA	NA	N/A
Test jig AC/Dc Adapter	Alps	GP05-US0510	NA	DoC

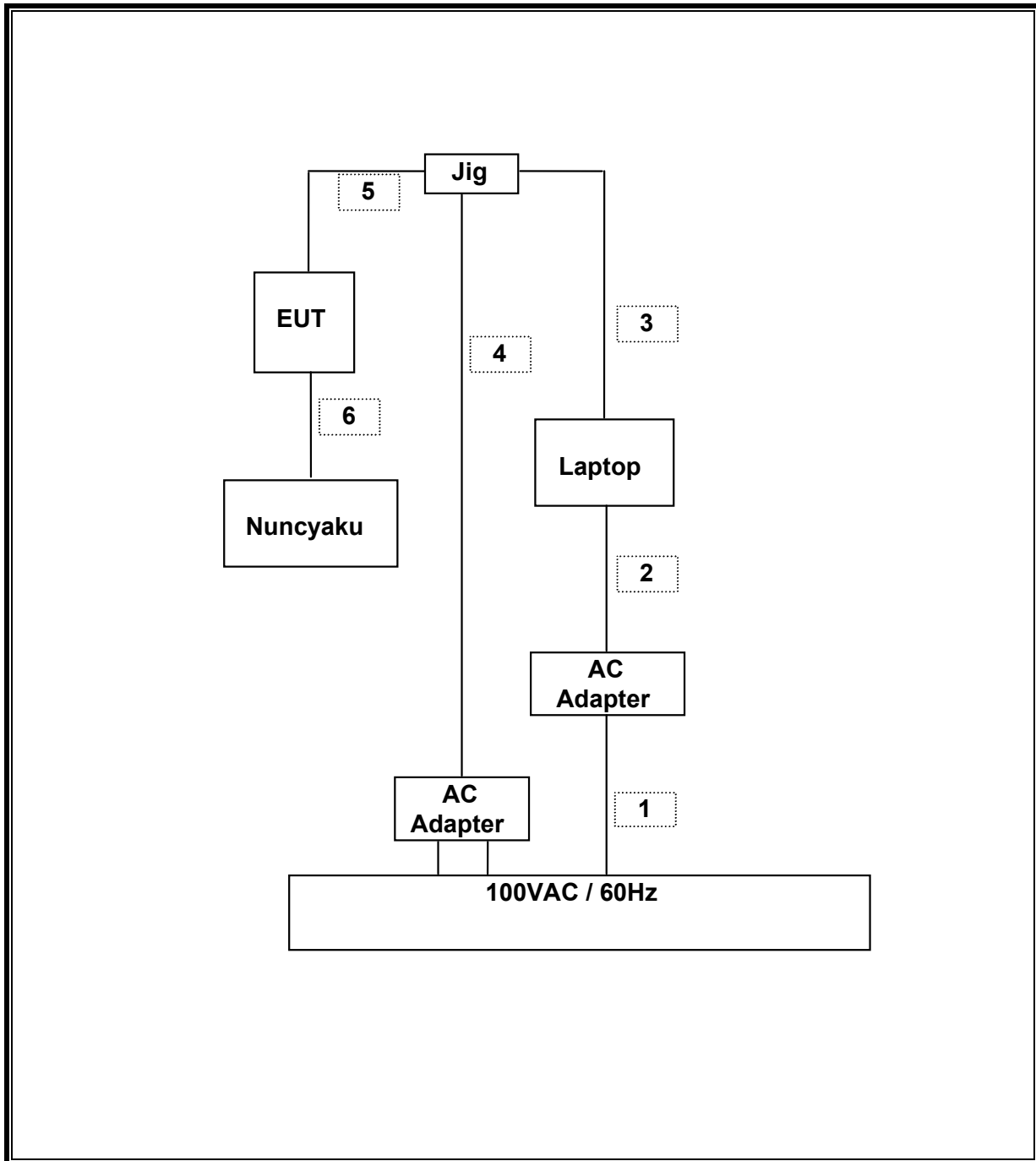
### I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	1	US 115V	Un-shielded	2m	
2	DC	1	DC	Un-shielded	2m	
3	Serial	1	DB9	Shielded	1m	
4	DC	1	DC	Un-shielded	2m	
5	10 Pins Connector	1	Wii Remote	Un-shielded	0.1m	
6	USB	1	Nuncyaku	Un-shielded	0.8m	

### TEST SETUP

The EUT is connected to a jig and Laptop during the tests. Test software exercises the EUT.

**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 Due
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01011	09/28/08
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01012	03/03/09
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C00749	09/27/08
Antenna, Horn, 18 GHz	ETS	3117	C01005	04/22/09
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	03/31/09
Peak Power Meter	Agilent / HP	E4416A	C00963	12/04/09
Peak / Average Power Sensor	Agilent / HP	E9327A	C00964	12/07/09
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01069	10/08/09
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C00749	09/27/08
Antenna, Horn, 18 GHz	EMCO	3115	C00872	04/22/09
Communication Test Set	R & S	CMU 200	C00944	12/26/09

## 7. ANTENNA PORT TEST RESULTS

### 7.1.1. 20 dB AND 99% BANDWIDTH

#### LIMIT

None; for reporting purposes only.

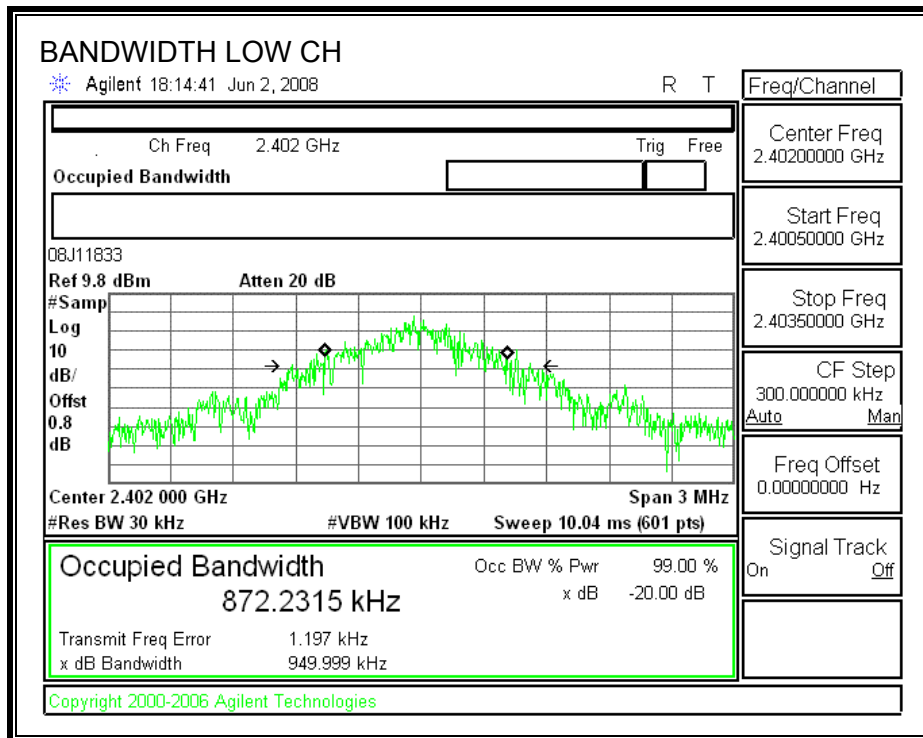
#### TEST PROCEDURE

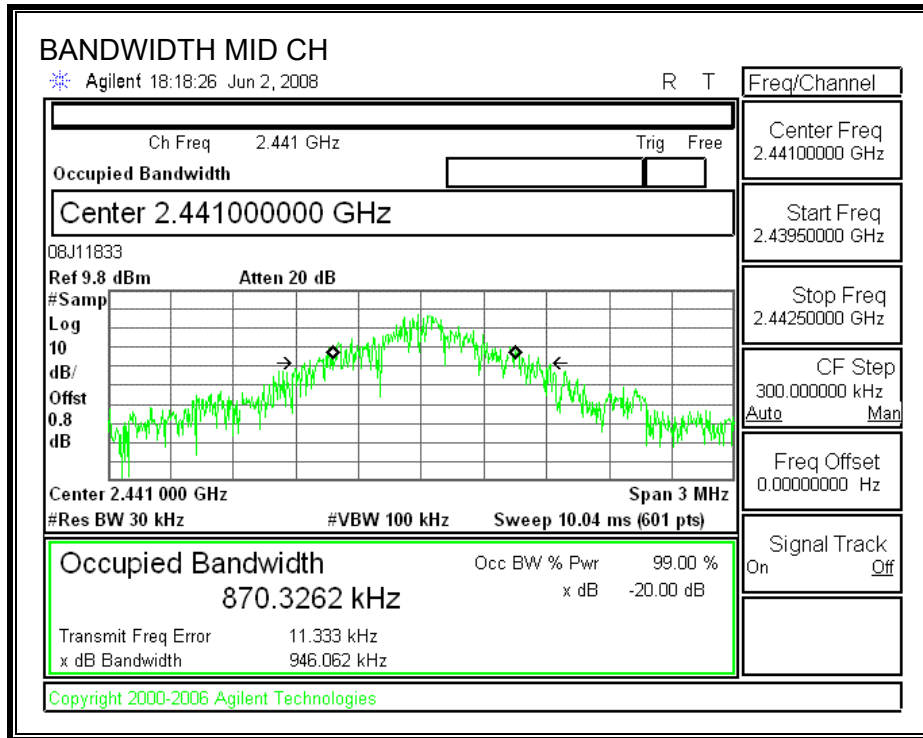
The transmitter output is connected to a spectrum analyzer. The RBW is set to  $\geq 1\%$  of the 20 dB bandwidth. The VBW is set to  $\geq$  RBW. The sweep time is coupled.

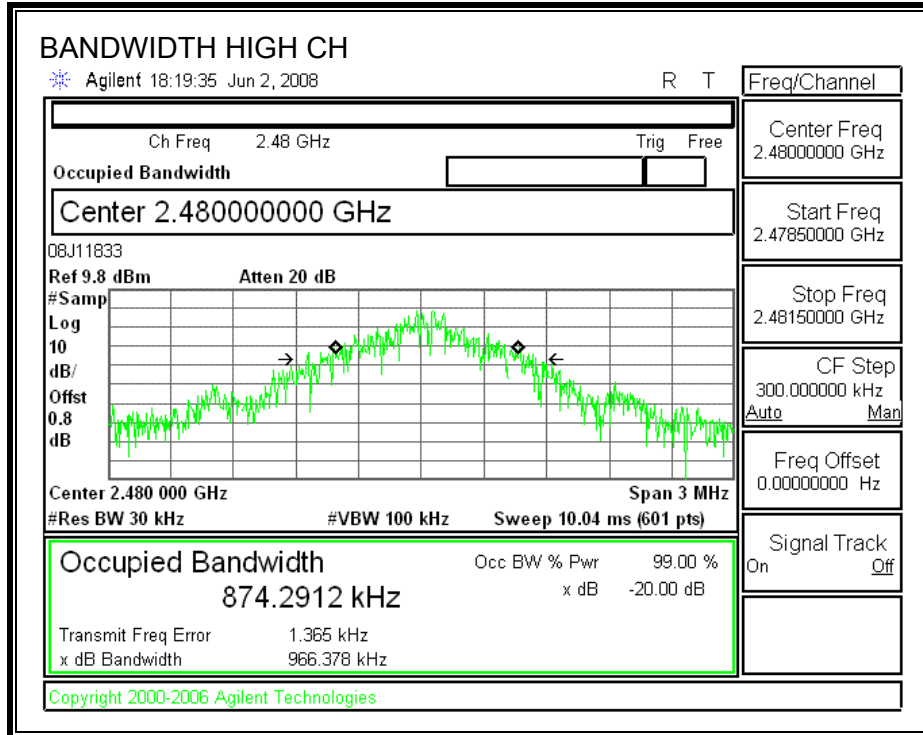
#### RESULTS

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	99% Bandwidth (kHz)
Low	2402	949.999	872.2315
Middle	2441	946.062	870.3262
High	2480	966.378	874.2912

**20dB & 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.

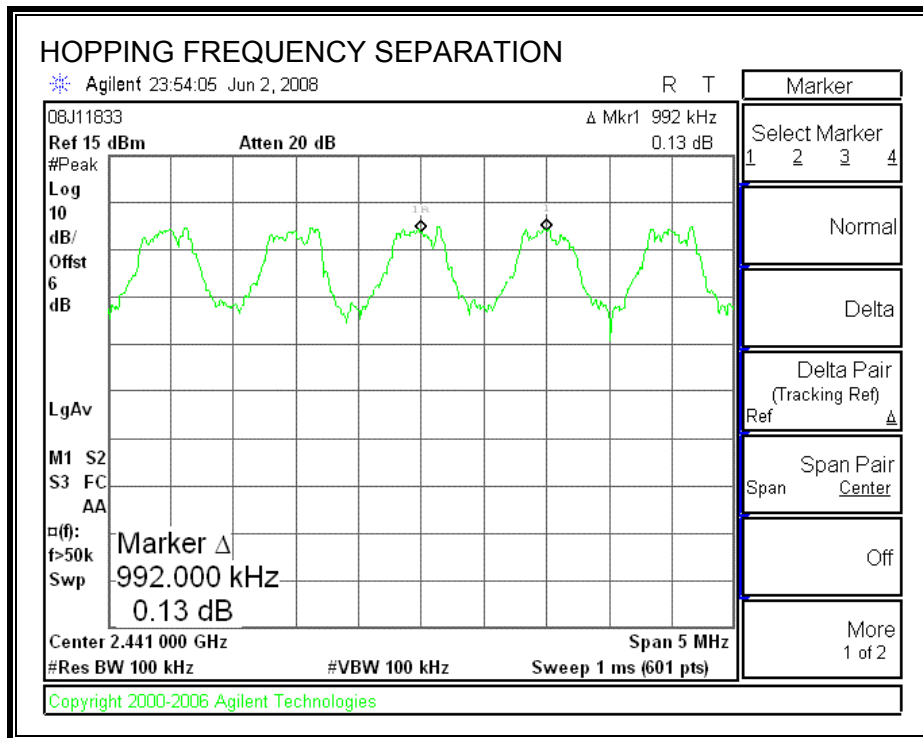
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

### TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The RBW is set to 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**

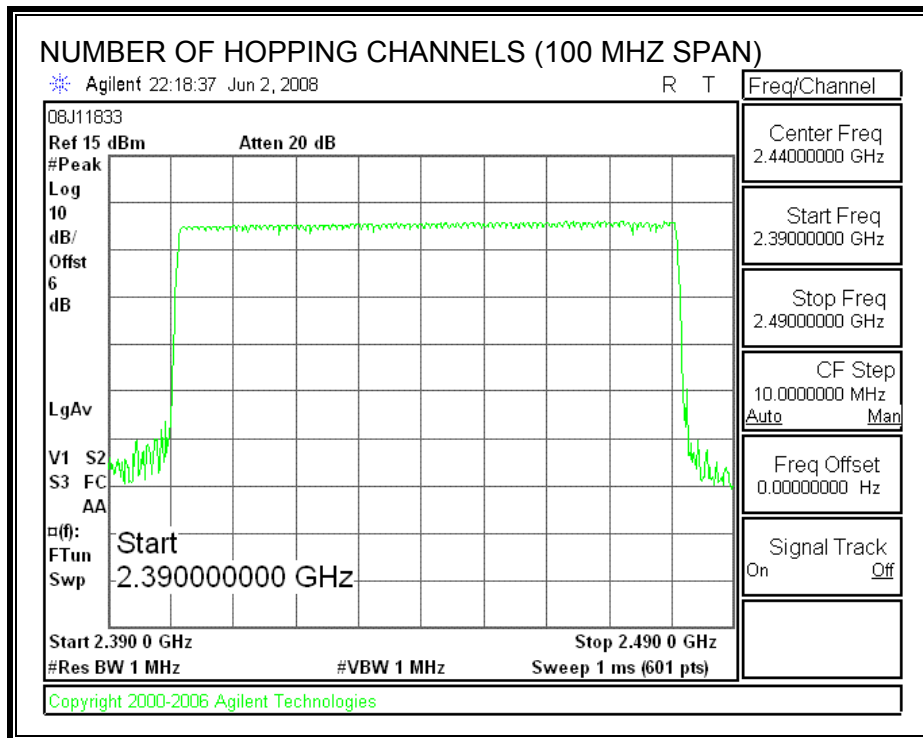
The transmitter output is connected to a spectrum analyzer. The span is set to cover the entire authorized band, in either a single sweep or in multiple contiguous sweeps. The RBW is set to a maximum of 1 % of the span. The analyzer is set to Max Hold.

#### **RESULTS**

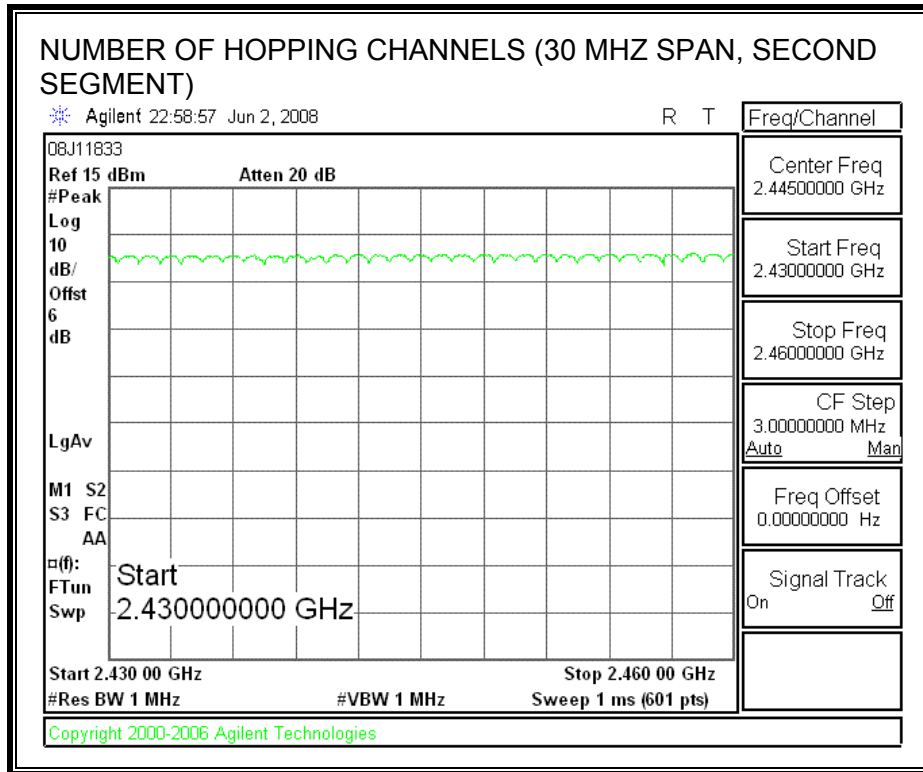
79 Channels observed.

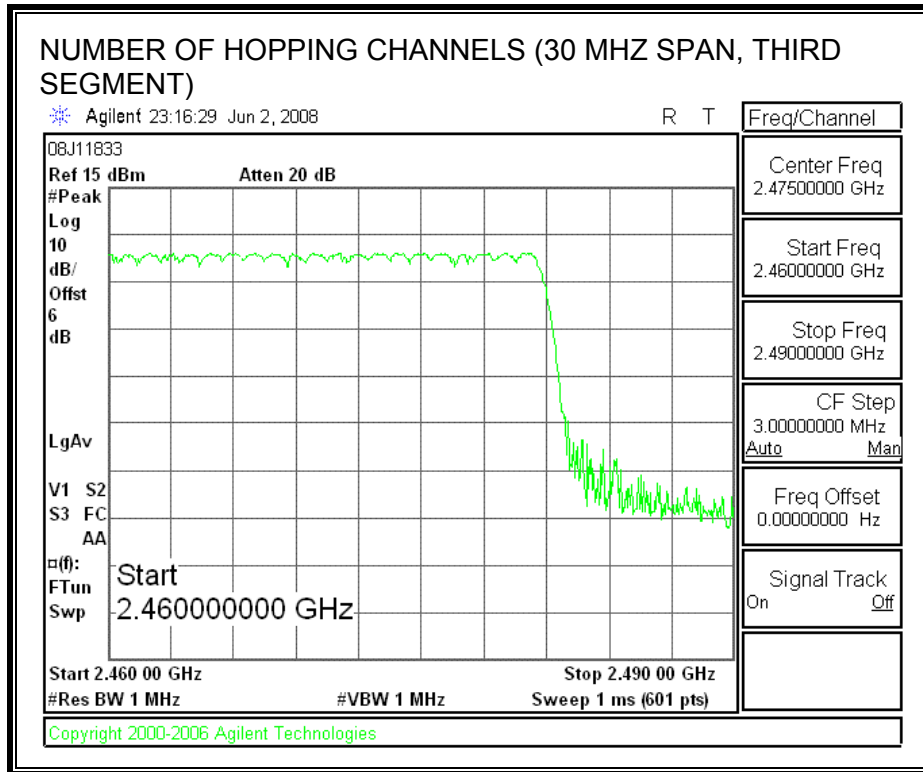


**NUMBER OF HOPPING CHANNELS**









**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**

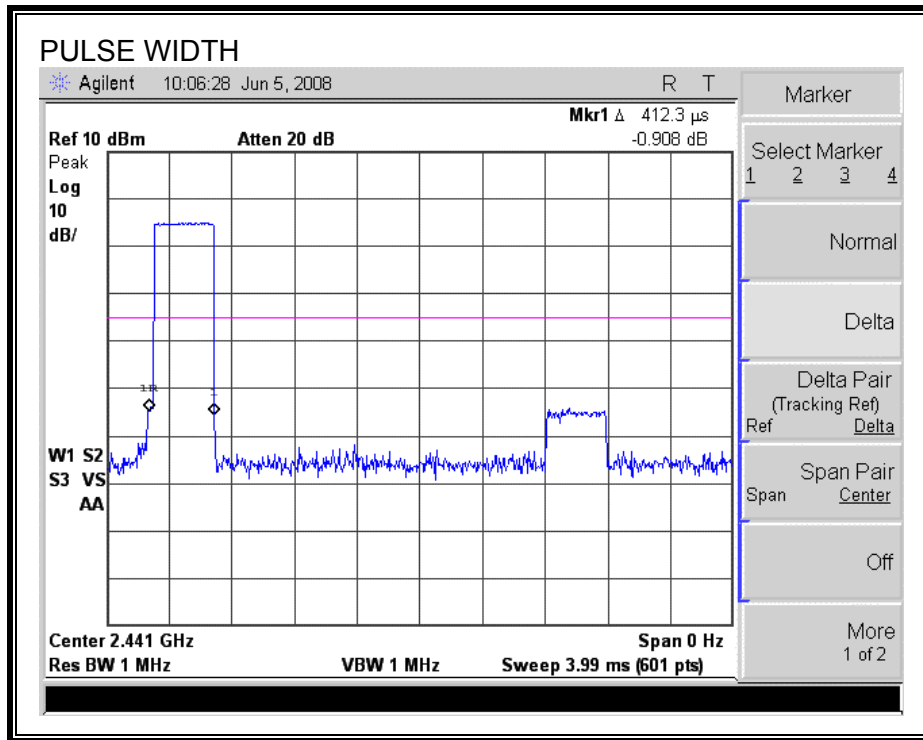
The transmitter output is connected to a spectrum analyzer. The span is set to 0 Hz, centered on a single, selected hopping channel. The width of a single pulse is measured in a fast scan. The number of pulses is measured in a 3.16 second scan, to enable resolution of each occurrence.

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

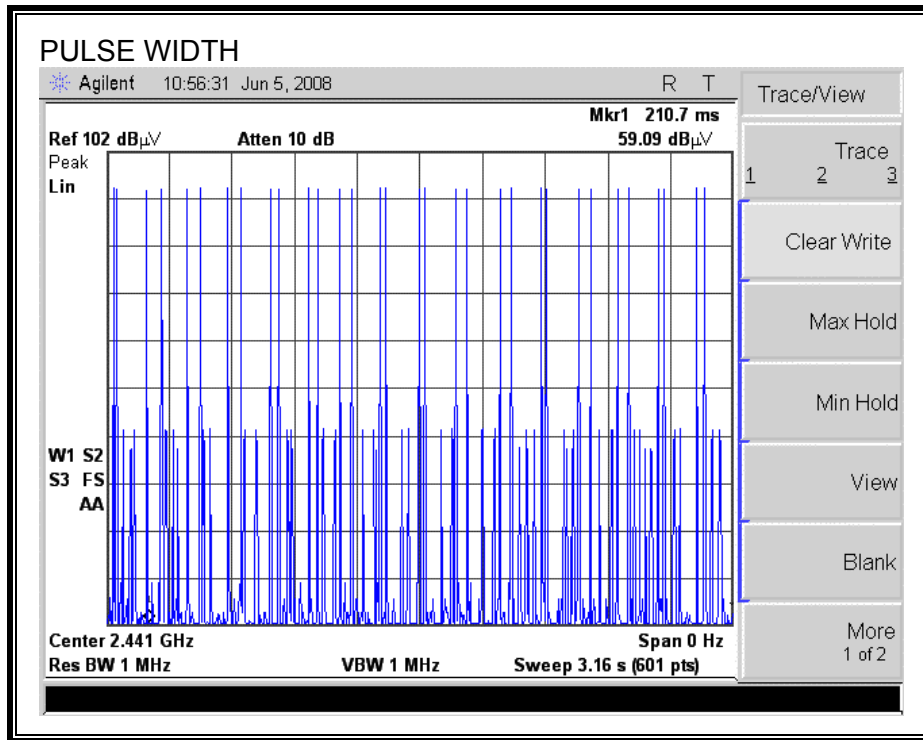
DH Packet	Pulse Width (msec)	Number of Pulses in 3.16 seconds	Average Time of Occupancy (sec)	Limit (sec)	Margin (sec)
1	0.412	32	0.132	0.4	0.268
3	1.669	19	0.317	0.4	0.083
5	2.913	12	0.350	0.4	0.050

**RESULTS**

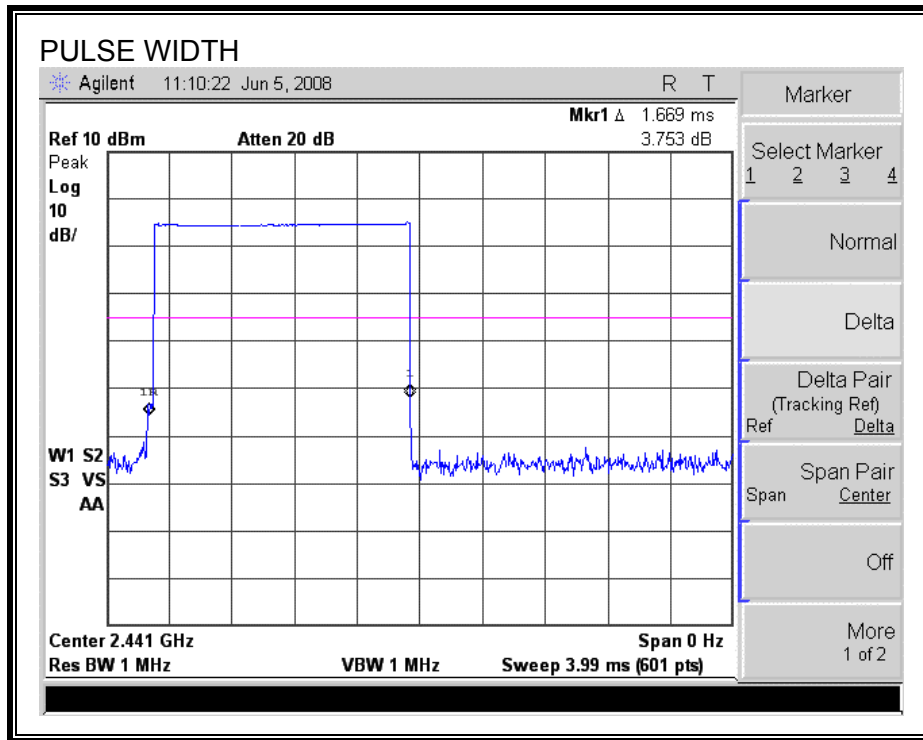
**DH1 PULSE WIDTH**



**DH1 PULSE WIDTH**

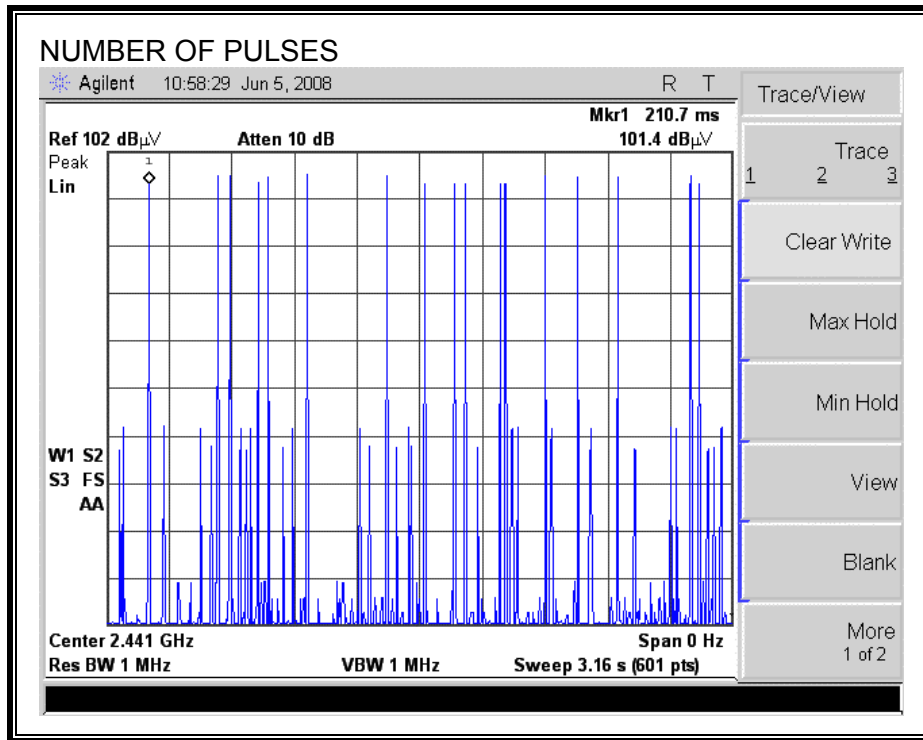


**DH3 PULSE WIDTH**

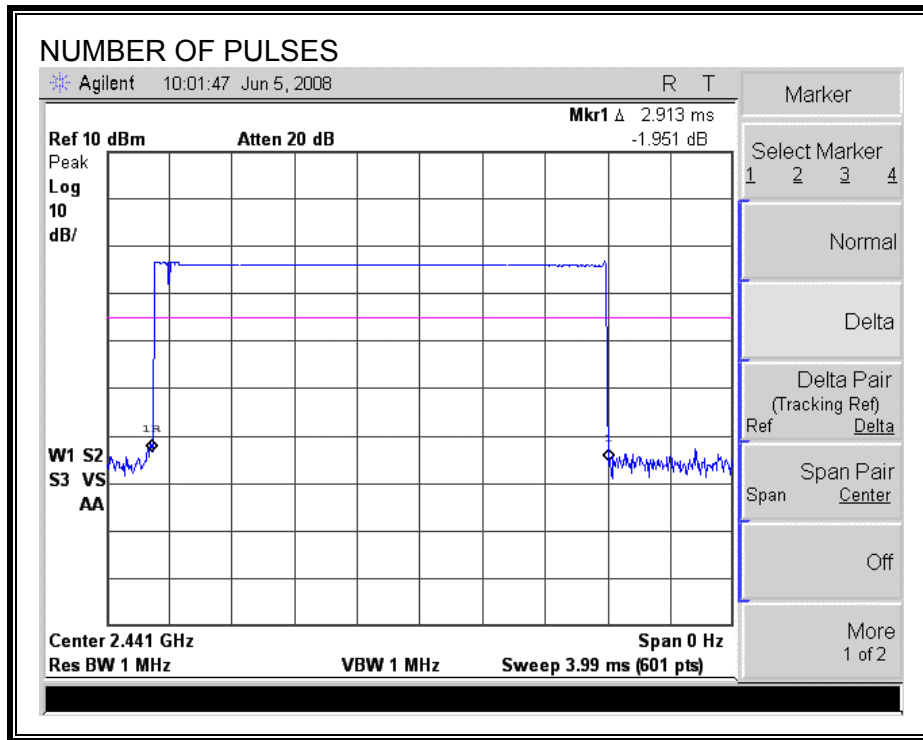




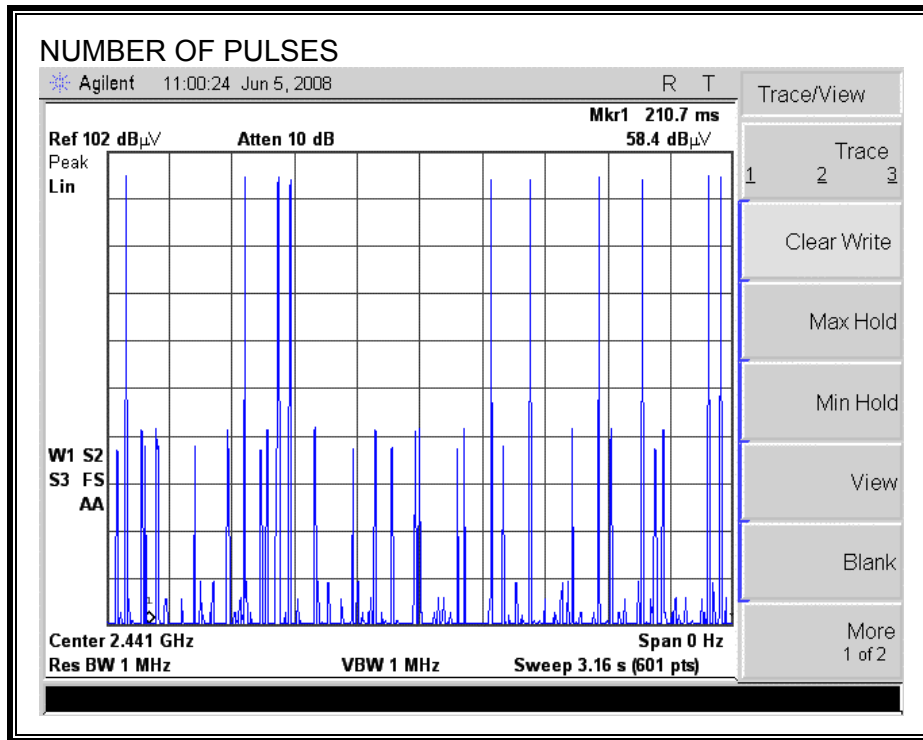
**DH3 NUMBER OF PULSES IN 3.16 SECOND OBSERVATION PERIOD**



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



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



### 7.1.5. OUTPUT POWER

#### LIMIT

§15.247 (b) (1)

RSS-210 Issue 7 Clause A8.4

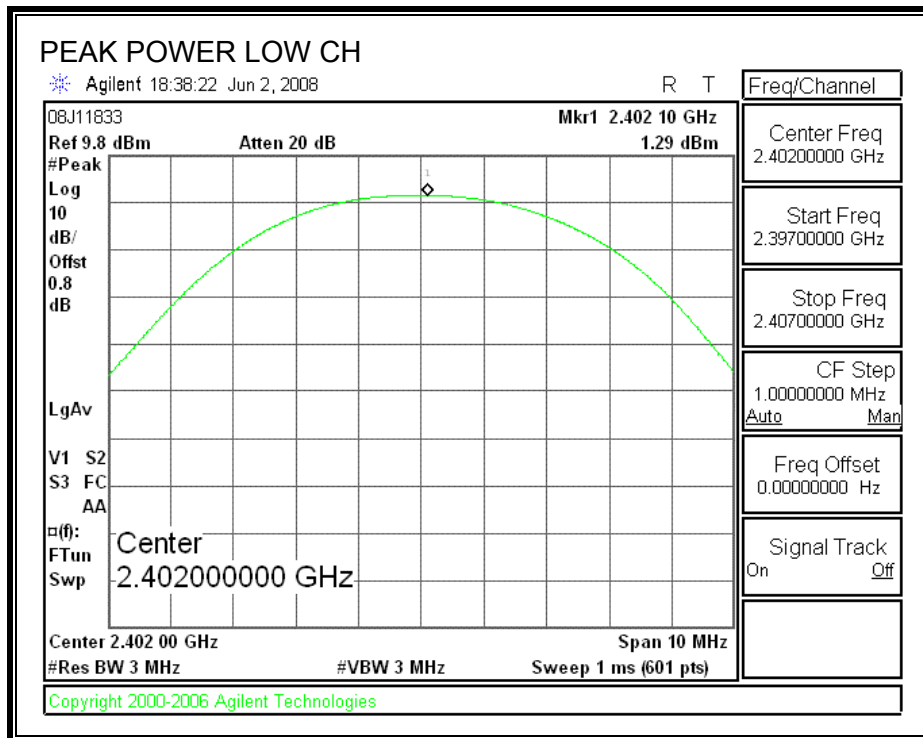
#### TEST PROCEDURE

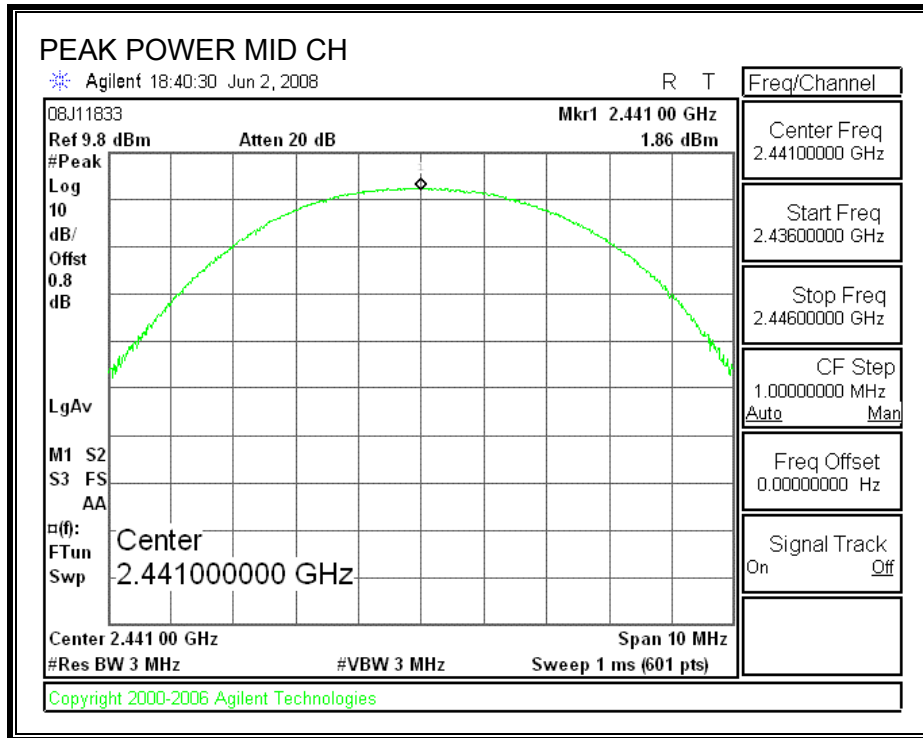
The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

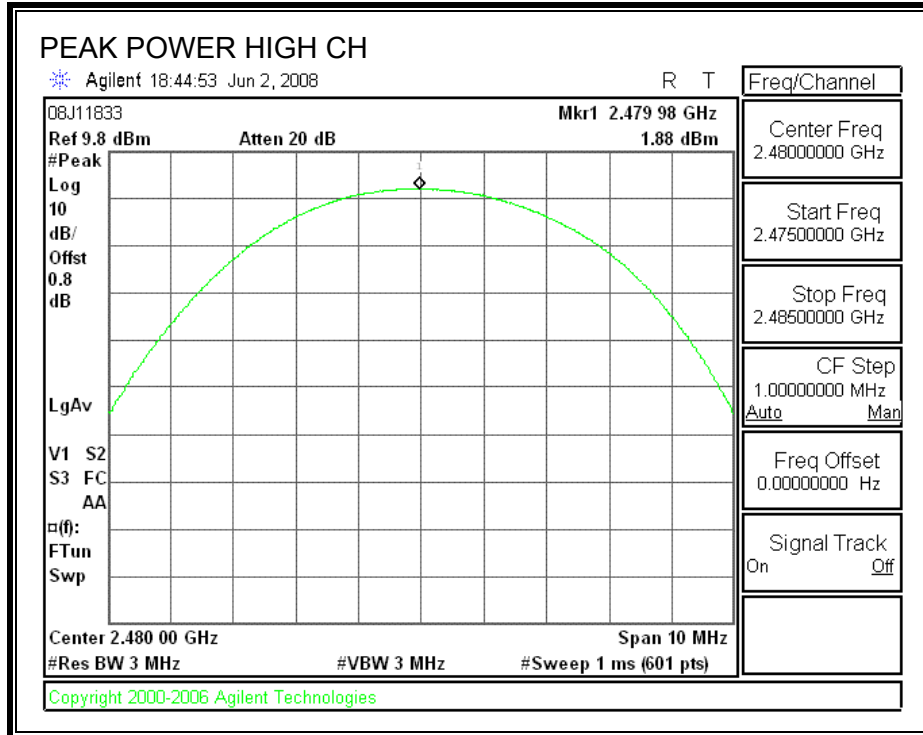
#### RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	1.29	30	-28.71
Middle	2441	1.86	30	-28.14
High	2480	1.88	30	-28.12

**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 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	-0.65
Middle	2441	0.15
High	2480	0.43



## **7.1.7. CONDUCTED SPURIOUS EMISSIONS**

### **LIMITS**

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

### **TEST PROCEDURE**

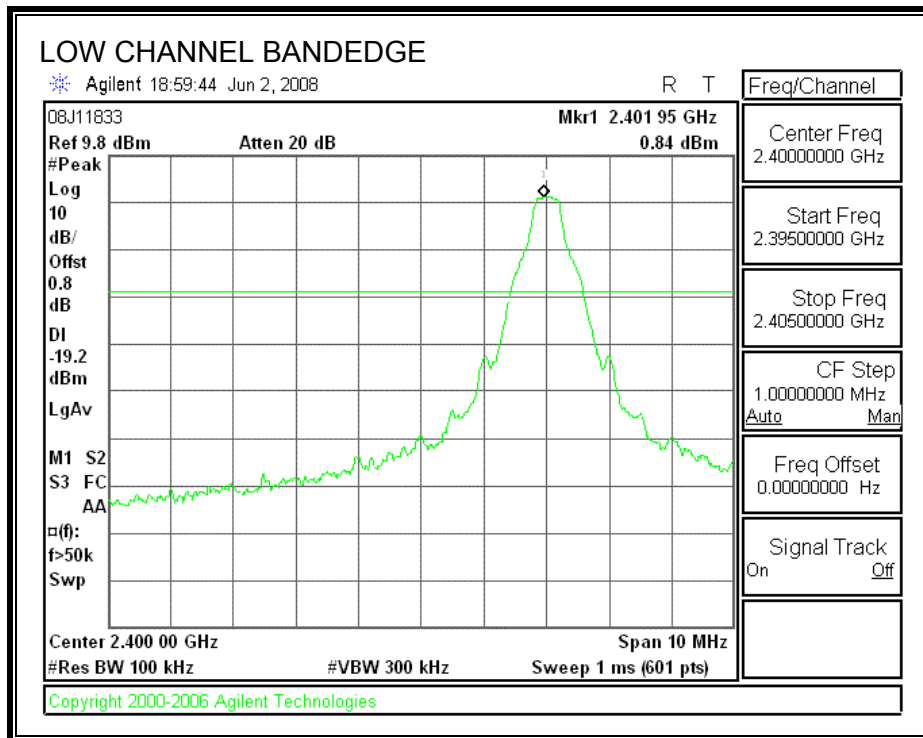
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

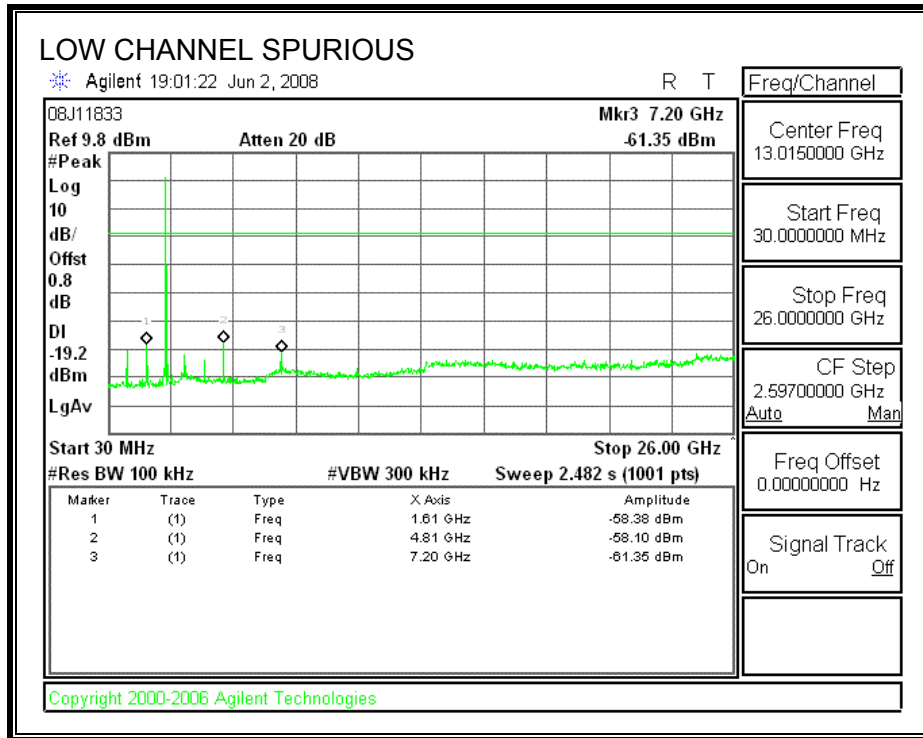
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

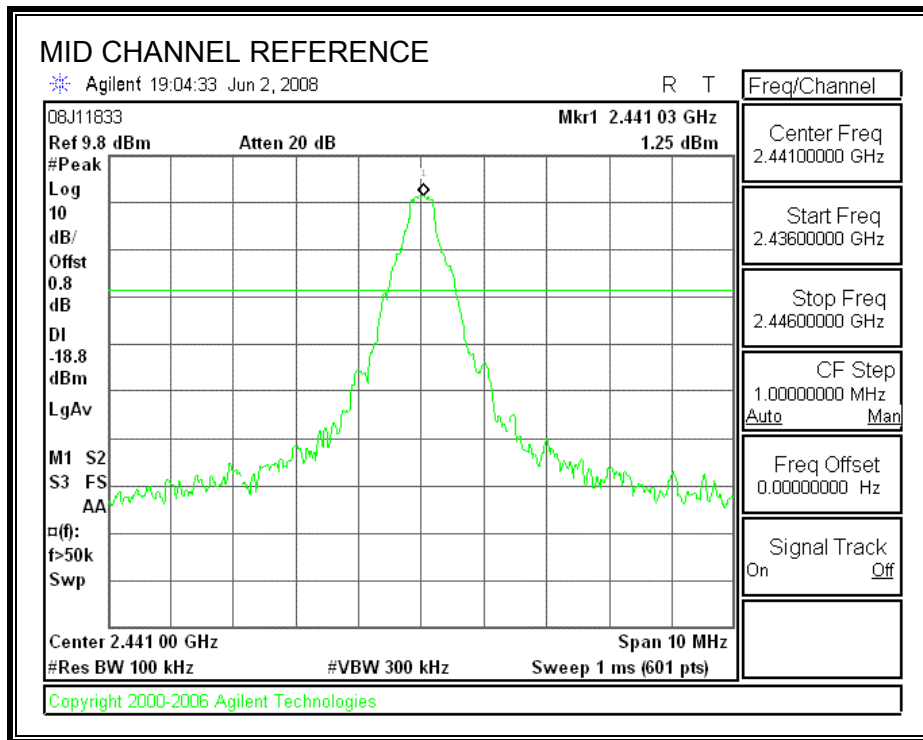
### **RESULTS**

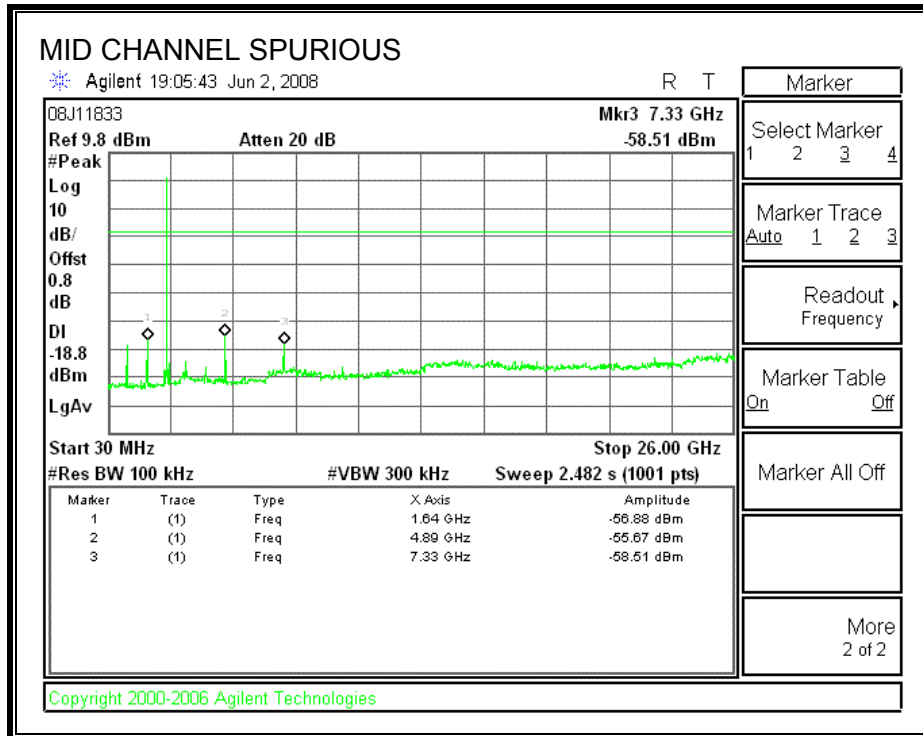
**SPURIOUS EMISSIONS, LOW CHANNEL**



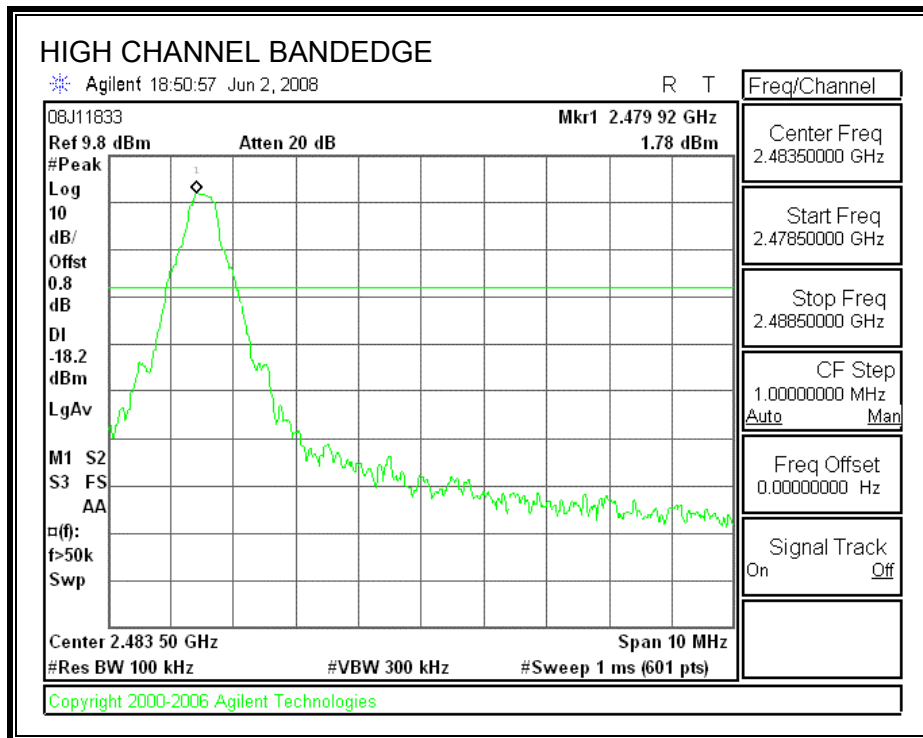


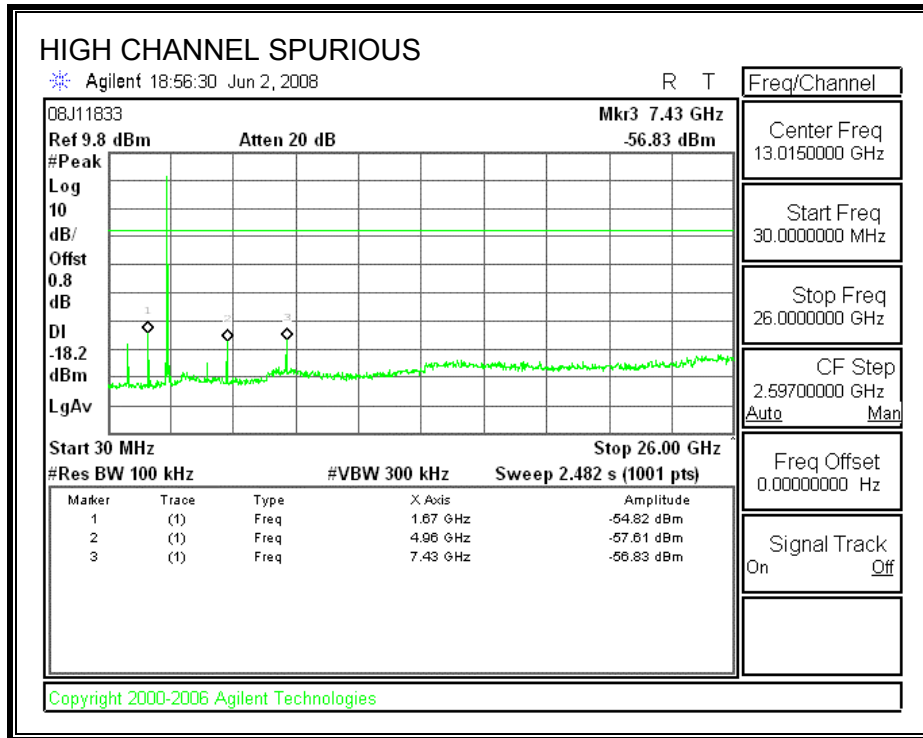
**SPURIOUS EMISSIONS, MID CHANNEL**



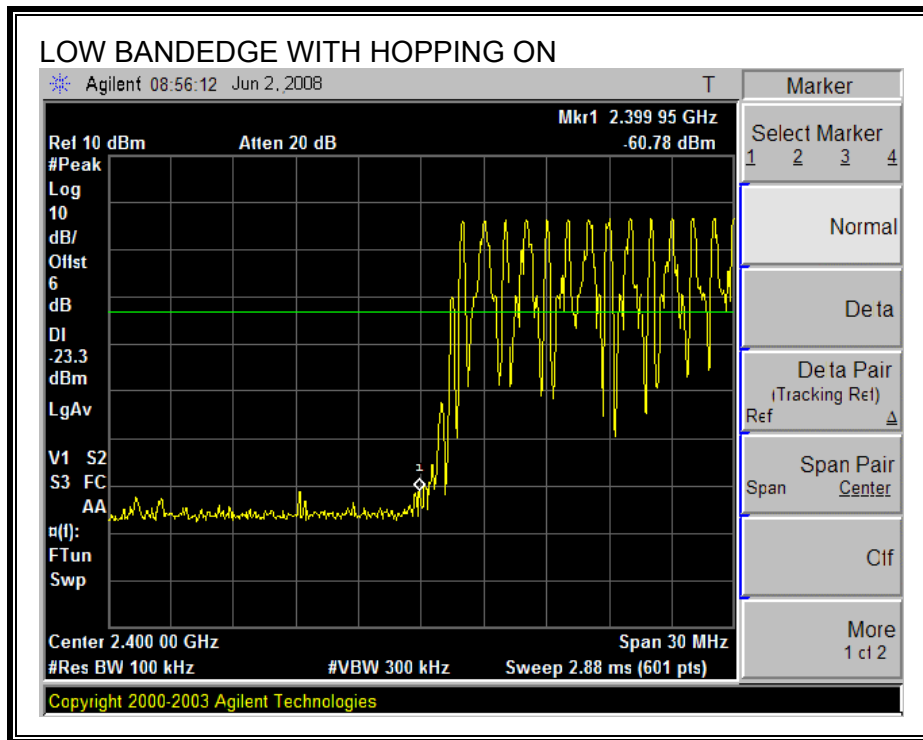


**SPURIOUS EMISSIONS, HIGH CHANNEL**

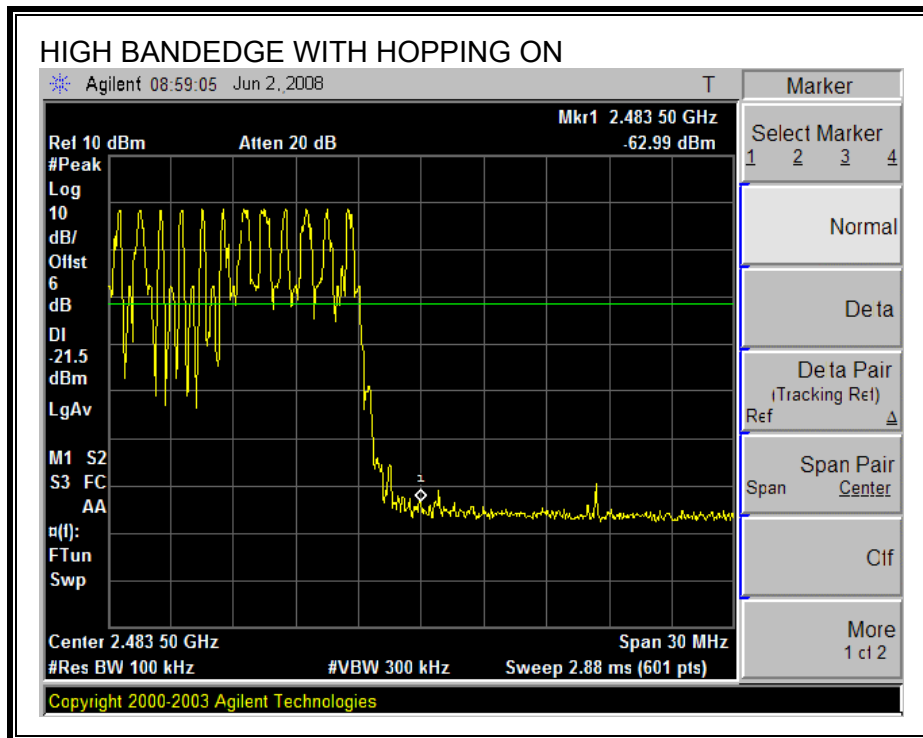




**SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON**







## 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.

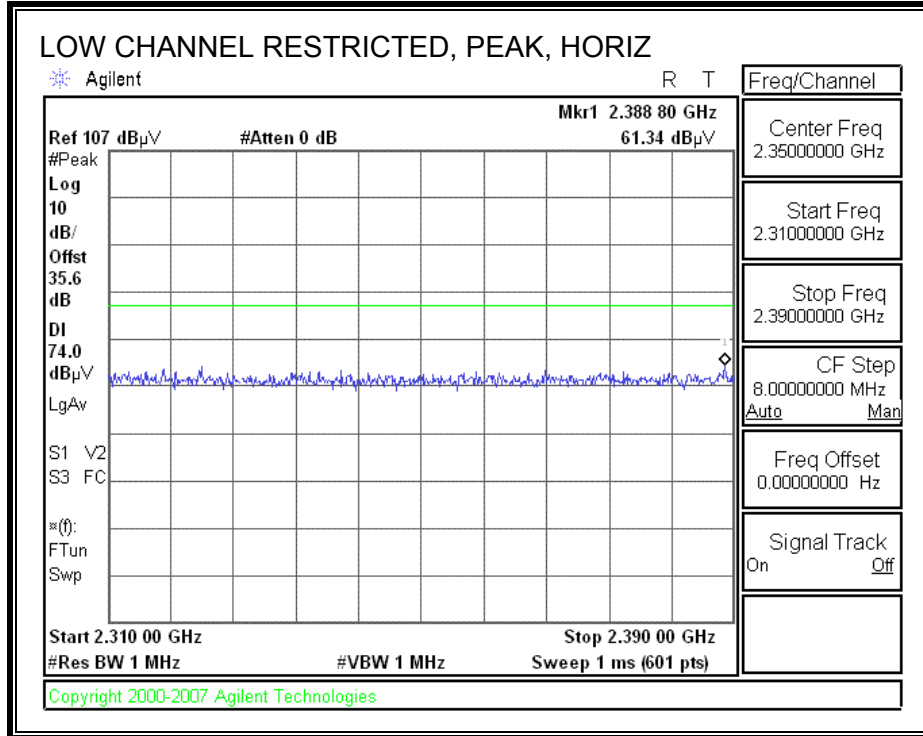
For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

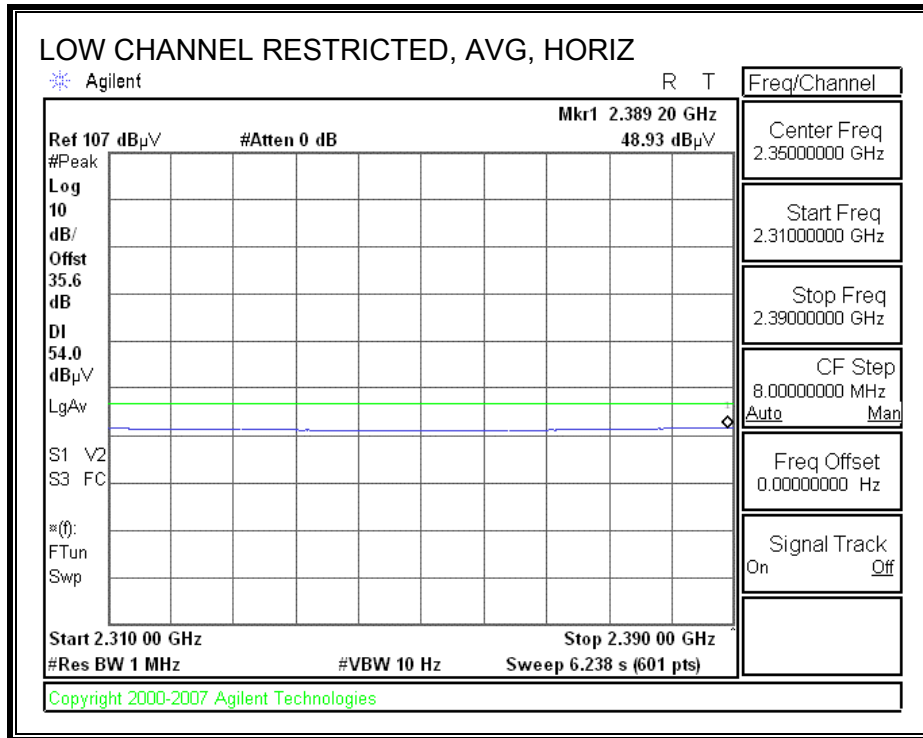
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

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.

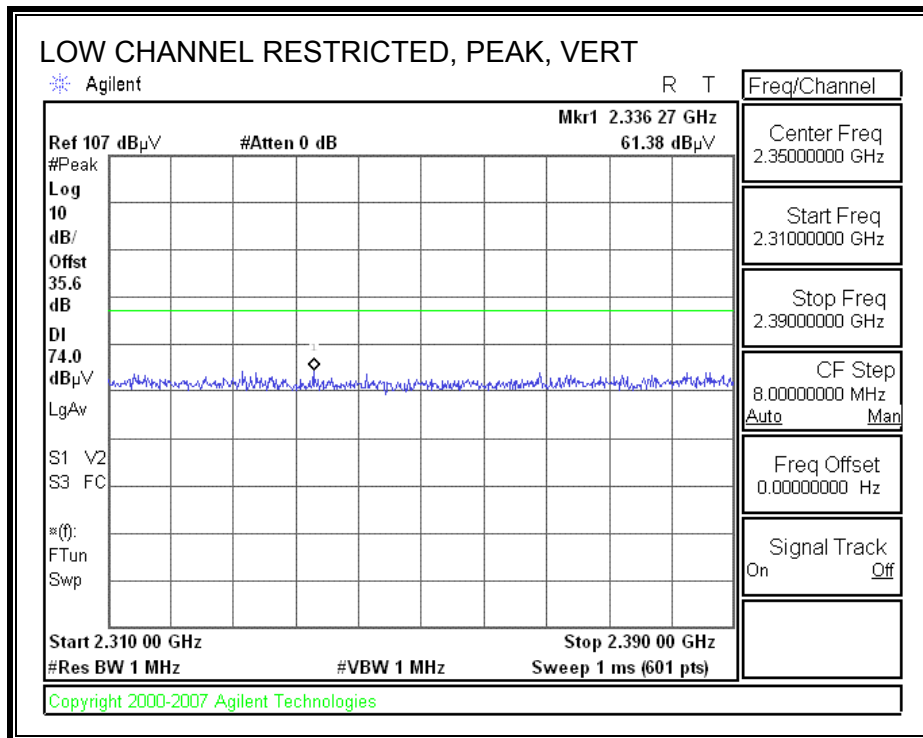
### 8.1.1. TRANSMITTER ABOVE 1 GHz

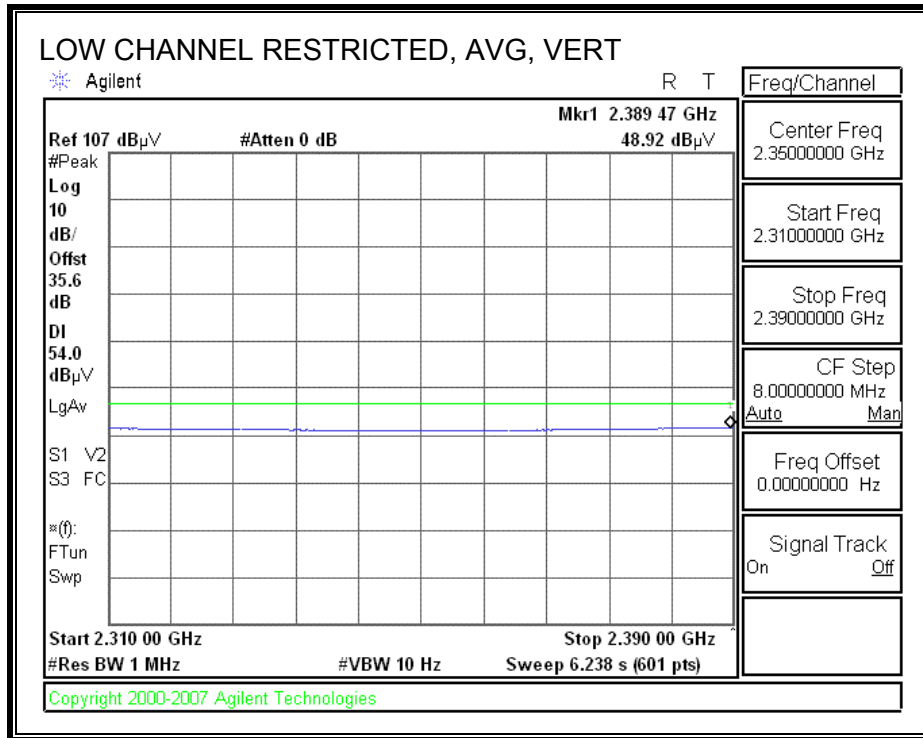
#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



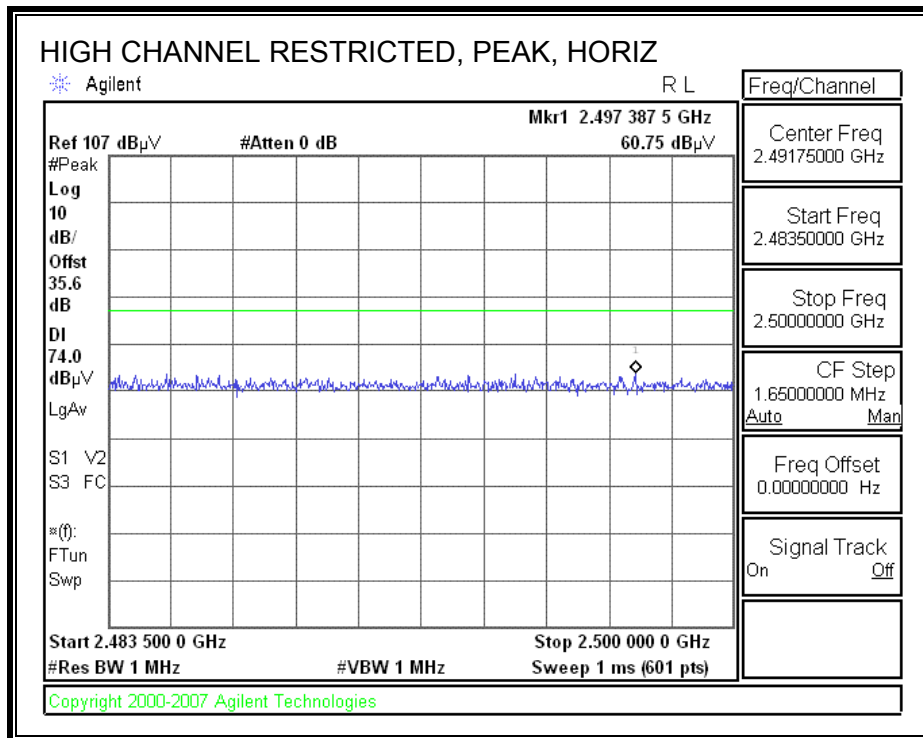


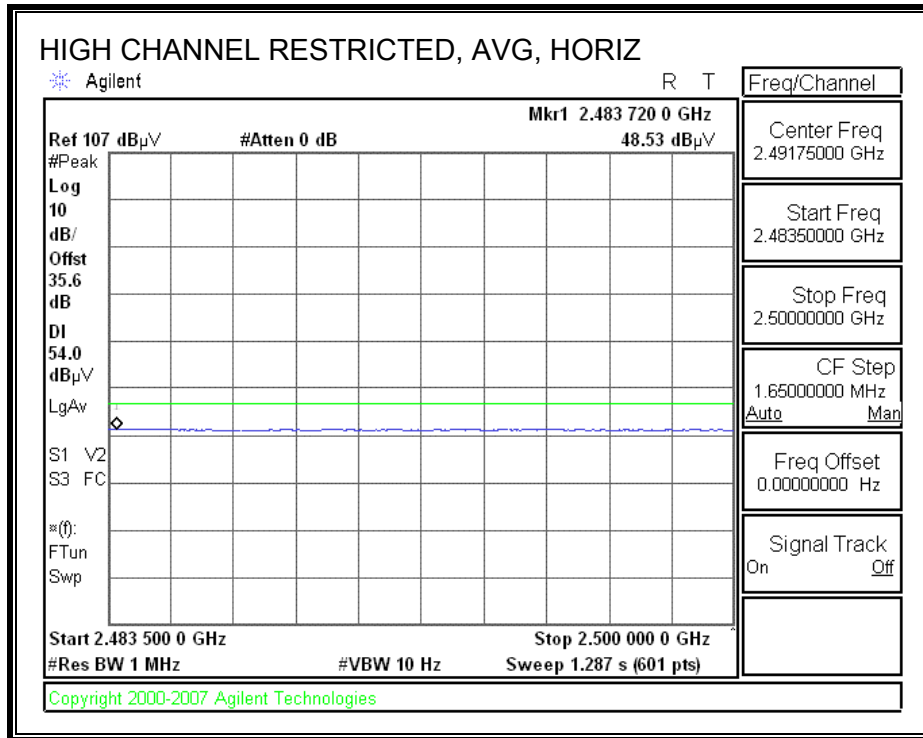
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**





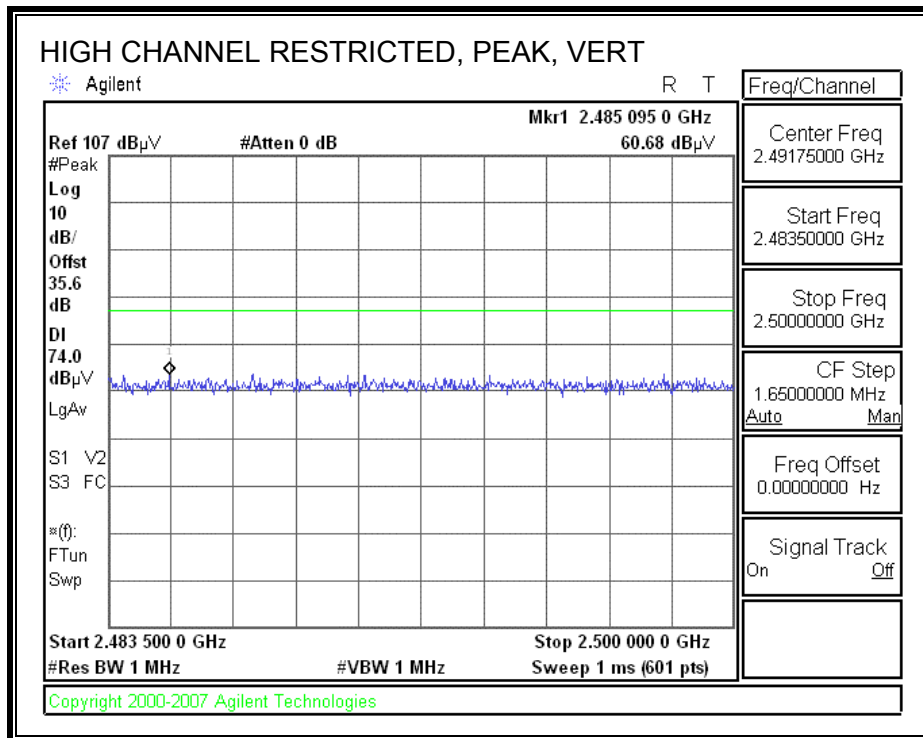
**RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)**

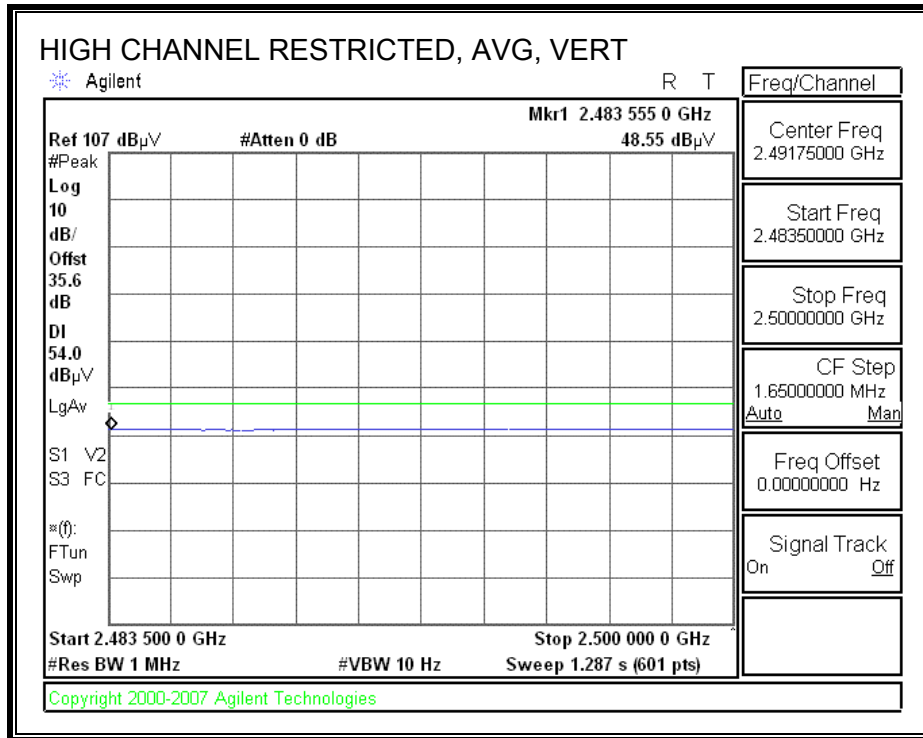






**RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)**





**HARMONICS AND SPURIOUS EMISSIONS**

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 5m Chamber

Company: ALPS  
 Project #: 08J11833  
 Date: 6/2/2008  
 Test Engineer: Yobi Zhou  
 Configuration: EUT / Laptop  
 Mode: TX

**Test Equipment:**

Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
T120; S/N: 29310 @3m	T34 HP 8449B			FCC 15.205

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter	Peak Measurements RBW=VBW=1MHz
		B-5m Chamber		R_001	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)
<b>Low Chan</b>															
4.804	3.0	38.0	27.9	32.3	7.1	-34.8	0.0	0.0	42.6	32.4	74	54	-31.4	-21.6	H
12.010	3.0	34.0	21.9	36.5	12.4	-32.5	0.0	0.0	50.4	38.3	74	54	-23.6	-15.7	H
4.804	3.0	40.9	34.2	32.3	7.1	-34.8	0.0	0.0	45.4	38.7	74	54	-28.6	-15.3	V
12.010	3.0	34.0	22.0	36.5	12.4	-32.5	0.0	0.0	50.4	38.4	74	54	-23.6	-15.6	V
<b>Mid Chan</b>															
4.882	3.0	38.0	28.9	32.3	7.2	-34.8	0.0	0.0	42.7	33.6	74	54	-31.3	-20.4	H
7.323	3.0	36.5	24.9	34.1	8.7	-34.1	0.0	0.0	45.2	33.6	74	54	-28.8	-20.4	H
12.205	3.0	33.2	21.7	36.7	12.4	-32.5	0.0	0.0	49.8	38.3	74	54	-24.2	-15.7	H
4.882	3.0	42.6	37.3	32.3	7.2	-34.8	0.0	0.0	47.2	41.9	74	54	-26.8	-12.1	V
7.323	3.0	35.3	23.5	34.1	8.7	-34.1	0.0	0.0	44.0	32.2	74	54	-30.0	-21.8	V
12.205	3.0	34.2	21.7	36.7	12.4	-32.5	0.0	0.0	50.8	38.3	74	54	-23.2	-15.7	V
<b>High Chan</b>															
4.960	3.0	37.2	27.4	32.4	7.2	-34.8	0.0	0.0	42.0	32.2	74	54	-32.0	-21.8	H
7.440	3.0	37.8	28.7	34.1	8.7	-34.1	0.0	0.0	46.5	37.4	74	54	-27.5	-16.6	H
12.400	3.0	34.0	21.9	36.8	12.4	-32.5	0.0	0.0	50.8	38.6	74	54	-23.2	-15.4	H
4.960	3.0	39.9	33.9	32.4	7.2	-34.8	0.0	0.0	44.7	38.7	74	54	-29.3	-15.3	V
7.440	3.0	36.1	24.9	34.1	8.7	-34.1	0.0	0.0	44.8	33.7	74	54	-29.2	-20.3	V
12.400	3.0	35.0	22.0	36.8	12.4	-32.5	0.0	0.0	51.8	38.8	74	54	-22.2	-15.2	V

Rev. 412.7

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. RECEIVER ABOVE 1 GHz

**High Frequency Measurement**  
 Compliance Certification Services, Fremont 5m Chamber

Company: Alps  
 Project #: 08J11833  
 Date: May 30, 2008  
 Test Engineer: Yobi Zhou  
 Configuration: EUT w/ Laptop  
 Mode: Rx On

**Test Equipment:**

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931			FCC 15.209

Hi Frequency Cables

2 foot cable	3 foot cable	12 foot cable	HPF	Reject Filter	Peak Measurements RBW=VBW=1MHz
		6-5m Chamber			Average Measurements RBW=1MHz ; VBW=10Hz

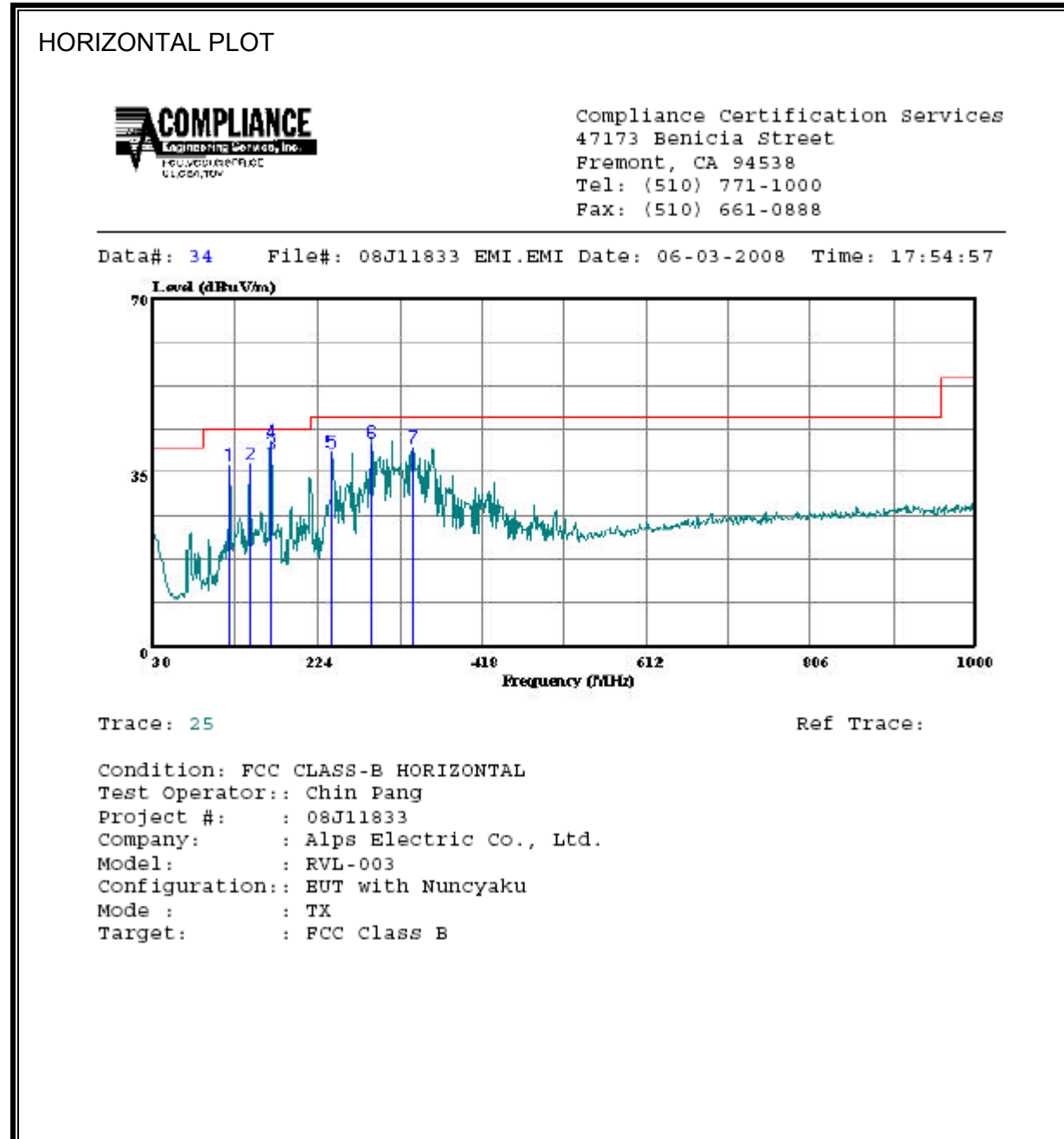
f	Dist	Read Pk	Read Avg.	AF	CL	Amp	D Corr	Ftr	Peak	Avg	Pk Lim	Avg Lim	Pk Mar	Avg Mar	Notes
GHz	(m)	dBuV	dBuV	dB/m	dB	dB	dB	dB	dBuV/m	dBuV/m	dBuV/m	dBuV/m	dB	dB	(V/H)
1.330	3.0	49.3	35.8	26.6	3.7	-39.0	0.0	0.0	40.5	27.0	74	54	-33.5	-27.0	V
1.663	3.0	48.5	36.0	27.5	4.1	-38.5	0.0	0.0	41.5	29.0	74	54	-32.5	-25.0	V
1.997	3.0	46.7	36.0	28.4	4.5	-38.1	0.0	0.0	41.5	30.8	74	54	-32.5	-23.2	V
1.200	3.0	47.8	36.4	26.2	3.5	-39.2	0.0	0.0	38.3	26.9	74	54	-35.7	-27.1	H
1.330	3.0	47.0	36.0	26.6	3.7	-39.0	0.0	0.0	38.2	27.2	74	54	-35.8	-26.8	H
1.663	3.0	45.0	35.5	27.5	4.1	-38.5	0.0	0.0	38.0	28.5	74	54	-36.0	-25.5	H

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		

### 8.1.3. WORST-CASE BELOW 1 GHz

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



HORIZONTAL DATA

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	120.210	49.33	-12.84	36.50	43.50	-7.00	Peak
2	144.460	49.67	-13.09	36.57	43.50	-6.93	Peak
3	168.700	53.16	-14.52	38.64	43.50	-4.86	QP
4	168.710	55.33	-14.12	41.21	43.50	-2.29	Peak
5	239.520	53.17	-14.08	39.09	46.00	-6.91	Peak
6	288.020	53.17	-12.19	40.97	46.00	-5.03	Peak
7	336.520	50.83	-10.77	40.06	46.00	-5.94	Peak

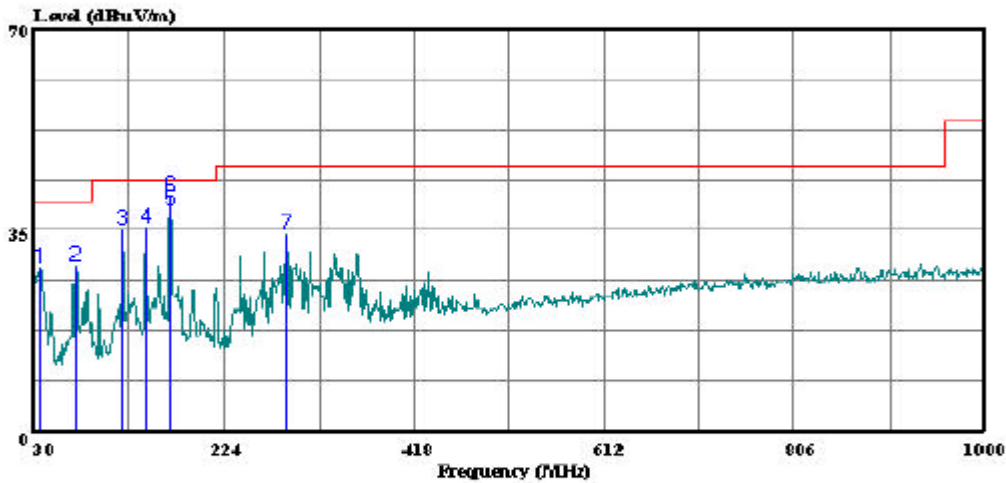
**SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)**

VERTICAL PLOT



Compliance Certification Services  
47173 Benicia Street  
Fremont, CA 94538  
Tel: (510) 771-1000  
Fax: (510) 661-0888

Data#: 35 File#: 08J11833 EMI.EMI Date: 06-03-2008 Time: 17:59:10



Trace: 27

Ref Trace:

Condition: FCC CLASS-B VERTICAL  
Test Operator:: Chin Pang  
Project #: : 08J11833  
Company: : Alps Electric Co., Ltd.  
Model: : RVL-003  
Configuration:: BUT with Nuncyaku  
Mode : : TX  
Target: : FCC Class B

VERTICAL DATA

Page: 1

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB	
1	35.820	36.66	-8.27	28.40	40.00	-11.60	Peak
2	71.710	47.33	-18.69	28.65	40.00	-11.35	Peak
3	120.210	48.00	-12.84	35.16	43.50	-8.34	Peak
4	144.460	48.67	-13.09	35.57	43.50	-7.93	Peak
5	168.710	53.09	-14.58	38.51	43.50	-4.99	QP
6	168.710	55.17	-14.12	41.04	43.50	-2.46	Peak
7	288.020	46.33	-12.19	34.14	46.00	-11.86	Peak



## 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 <sup>2</sup> )	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 <sup>2</sup> )	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 <sup>2</sup> )	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 <sup>2</sup> )	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 <sup>2</sup> )	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	280/ <i>f</i>	2.19/ <i>f</i>		6
10–30	28	2.19/ <i>f</i>		6
30–300	28	0.073	2*	6
300–1 500	1.585 <i>f</i> <sup>0.5</sup>	0.0042 <i>f</i> <sup>0.5</sup>	<i>f</i> /150	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	616 000 / <i>f</i> <sup>1.2</sup>
150 000–300 000	0.158 <i>f</i> <sup>0.5</sup>	4.21 x 10 <sup>-4</sup> <i>f</i> <sup>0.5</sup>	6.67 x 10 <sup>-5</sup> <i>f</i>	616 000 / <i>f</i> <sup>1.2</sup>

\* 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<sup>2</sup> is equivalent to 1 mW/cm<sup>2</sup>.
  3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

## CALCULATIONS

Given

$$E = \sqrt{(30 * P * G) / d}$$

and

$$S = E^2 / 3770$$

where

E = Field Strength in Volts/meter

P = Power in Watts

G = Numeric antenna gain

d = Distance in meters

S = Power Density in milliwatts/square centimeter

Combining equations, rearranging the terms to express the distance as a function of the remaining variables, changing to units of Power to mW and Distance to cm, and substituting the logarithmic form of power and gain yields:

$$d = 0.282 * 10^{((P + G) / 20)} / \sqrt{S}$$

where

d = MPE distance in cm

P = Power in dBm

G = Antenna Gain in dBi

S = Power Density Limit in mW/cm<sup>2</sup>

Rearranging terms to calculate the power density at a specific distance yields

$$S = 0.0795 * 10^{((P + G) / 10)} / (d^2)$$

The power density in units of mW/cm<sup>2</sup> is converted to units of W/m<sup>2</sup> by multiplying by a factor of 10.

**LIMITS**

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

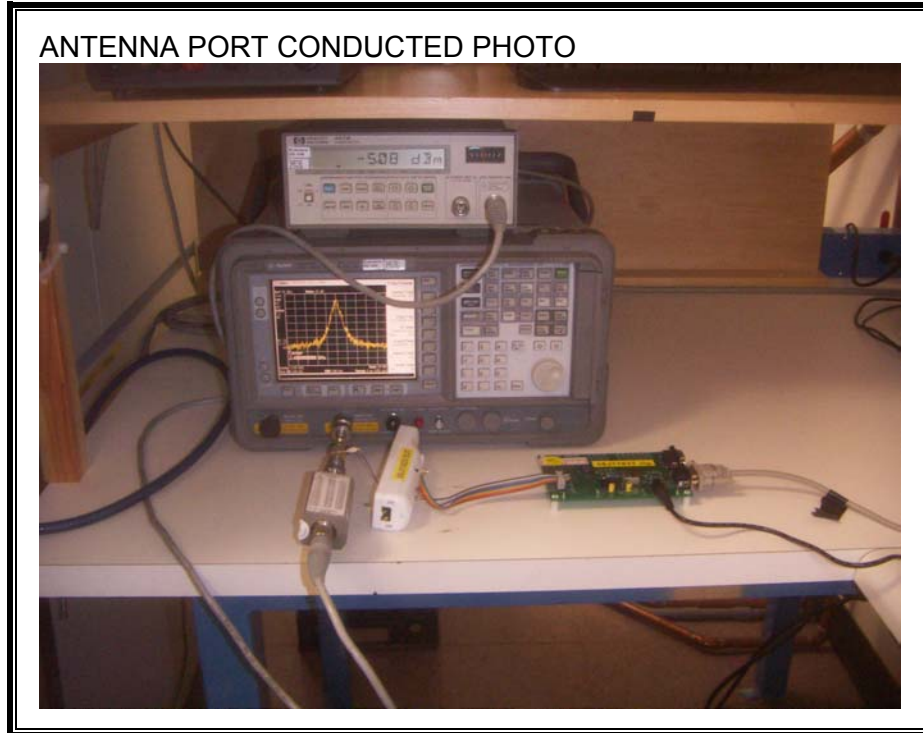
From IC Safety Code 6, Section 2.2 Table 5 Column 4,  $S = 10 \text{ W/m}^2$

**RESULTS**

Mode	Band	MPE Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	FCC Power Density (mW/cm <sup>2</sup> )	IC Power Density (W/m <sup>2</sup> )
Bluetooth	2.4 GHz	20.0	1.88	-1.78	0.0002	0.002

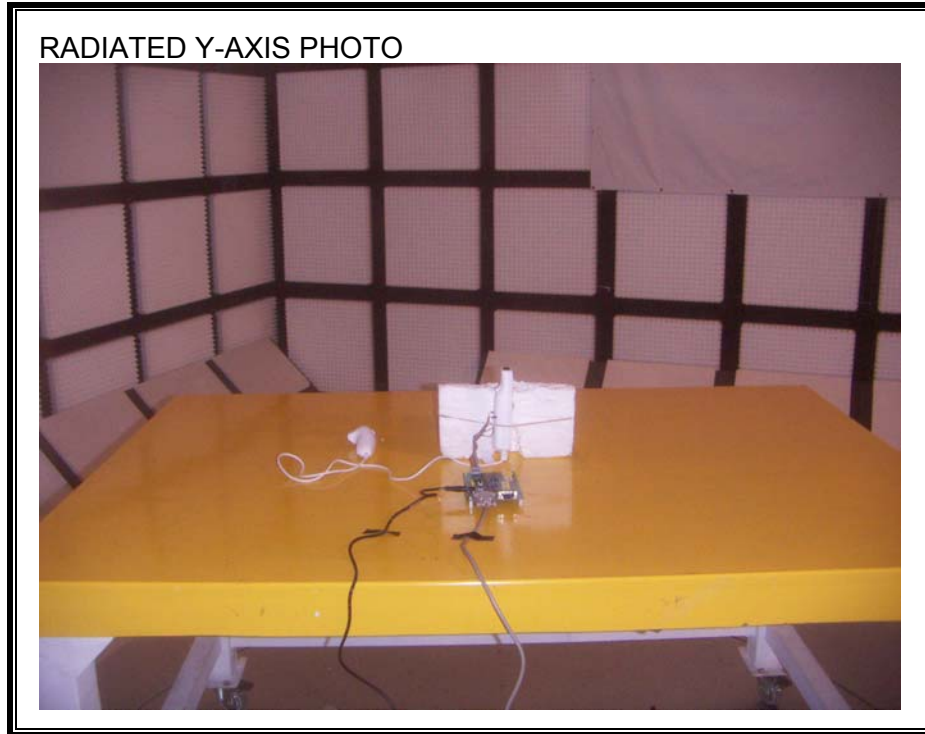
## 10. SETUP PHOTOS

### ANTENNA PORT CONDUCTED RF MEASUREMENT SETUP



**RADIATED RF MEASUREMENT SETUP**







**END OF REPORT**