



**FCC CFR47 PART 15 SUBPART C  
INDUSTRY CANADA RSS-210 ISSUE 7  
INDUSTRY CANADA RSS-GEN Issue 2**

**CERTIFICATION TEST REPORT**

**FOR**

**BLUETOOTH DEVICE**

**MODEL NUMBER: A1339**

**FCC ID: BCGA1339  
IC: 579C-A1339**

**REPORT NUMBER: 09U12780-3, Revision A**

**ISSUE DATE: OCTOBER 7, 2009**

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**NVLAP LAB CODE 200065-0**

Revision History

| Rev. | Issue Date | Revisions   | Revised By |
|------|------------|---|------------|
| --   | 10/01/09   | Initial Issue   | F. Ibrahim |
| A    | 10/07/09   | Updated the MPE section and edited some formatting in the report. | F. Ibrahim |

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## 1. ATTESTATION OF TEST RESULTS

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

**EUT DESCRIPTION:** Bluetooth Device

**MODEL:** A1339

**SERIAL NUMBER:** PT469055

**DATE TESTED:** September 22-28, 2009

| 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. 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 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. 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 CCS By:



FRANK IBRAHIM  
EMC SUPERVISOR  
COMPLIANCE CERTIFICATION SERVICES

Tested By:



TOM CHEN  
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. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

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

### 4.3. MEASUREMENT UNCERTAINTY

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

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

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

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is a Bluetooth device.

### 5.2. MAXIMUM OUTPUT POWER

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

| Frequency Range<br>(MHz) | Mode       | Output Power<br>(dBm) | Output Power<br>(mW) |
|--------------------------|------------|-----------------------|----------------------|
| 2402 - 2480              | Basic GFSK | -1.56                 | 0.70                 |

### 5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a slot antenna, with a maximum gain of 4.57 dBi.

### 5.4. SOFTWARE AND FIRMWARE

The driver version in the host support is Version 1.9.5f4

The test utility software used during testing is NemoBlue Version 1.22

### 5.5. WORST-CASE CONFIGURATION AND MODE

The EUT only has one mode of operation (basic GFSK modulation). EUT was setup as a desktop unit, a laptop PC was used to control the selection of channels and power.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

| PERIPHERAL SUPPORT EQUIPMENT LIST |              |            |               |
|-----------------------------------|--------------|------------|---------------|
| Description                       | Manufacturer | Model      | Serial Number |
| Laptop PC                         | Apple Inc.   | Macbook    | PT371797      |
| AC adapter                        | Apple Inc.   | PSCV600119 | NA            |

### SUPPORT EQUIPMENT

Laptop PC was used to control the radio, but it was outside the test area, so the EUT was a stand-alone EUT.

### SETUP DIAGRAM FOR TESTS

Stand-alone EUT.

## 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  |
| Spectrum Analyzer, 26.5 GHz | Agilent / HP   | E4407B | C01098 | 11/07/08 | 02/07/10 |
| Preamplifier, 26.5 GHz      | Agilent / HP   | 8449B  | C00749 | 12/01/08 | 12/01/09 |
| Horn Antenna                | EMCO           | 3115   | C00872 | 01/29/09 | 01/29/10 |
| Spectrum Analyzer, 44 GHz   | Agilent / HP   | E4446A | C01159 | 11/07/08 | 02/07/10 |
| Power Meter                 | Agilent / HP   | 437B   | N02778 | 11/04/08 | 08/04/10 |
| Antenna, Bilog, 2 GHz       | Sunol Sciences | JB1    | C01011 | 01/14/09 | 01/14/10 |
| Power Sensor, 18 GHz        | Agilent / HP   | 8481A  | N02784 | 04/22/08 | 10/22/09 |
| Antenna, Bilog, 2 GHz       | Sunol Sciences | JB1    | C01011 | 01/14/09 | 01/14/10 |
| Antenna, Horn, 26.5 GHz     | ARA            | SWH-28 | C01015 | 09/29/07 | 11/29/09 |



## 7. ANTENNA PORT TEST RESULTS (GFSK MODULATION)

### 7.1. 20 dB AND 99% BANDWIDTH

#### LIMIT

None; for reporting purposes only.

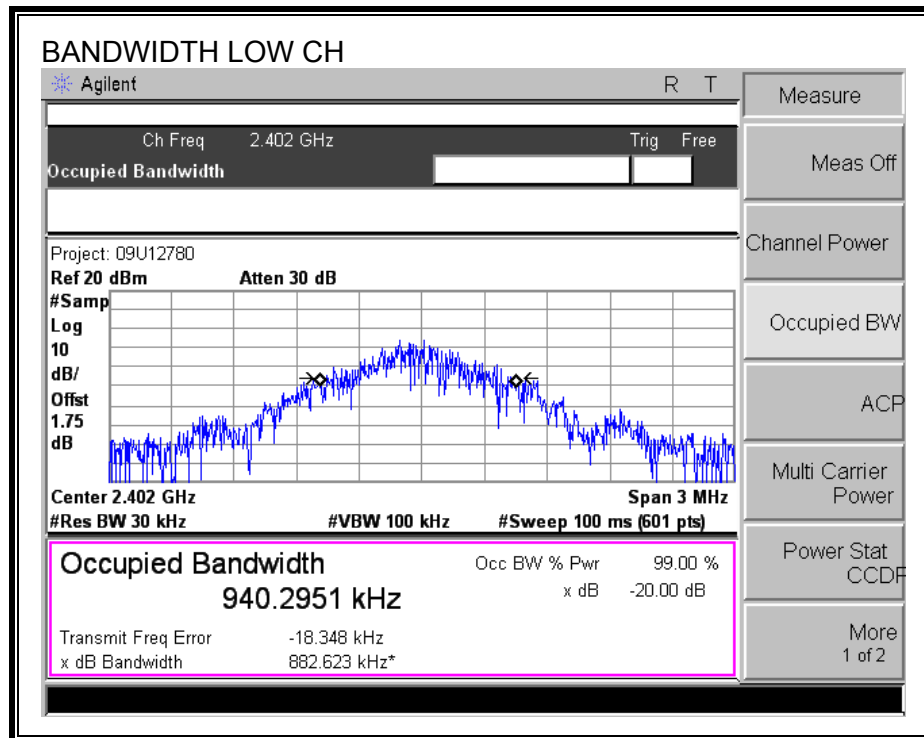
#### TEST PROCEDURE

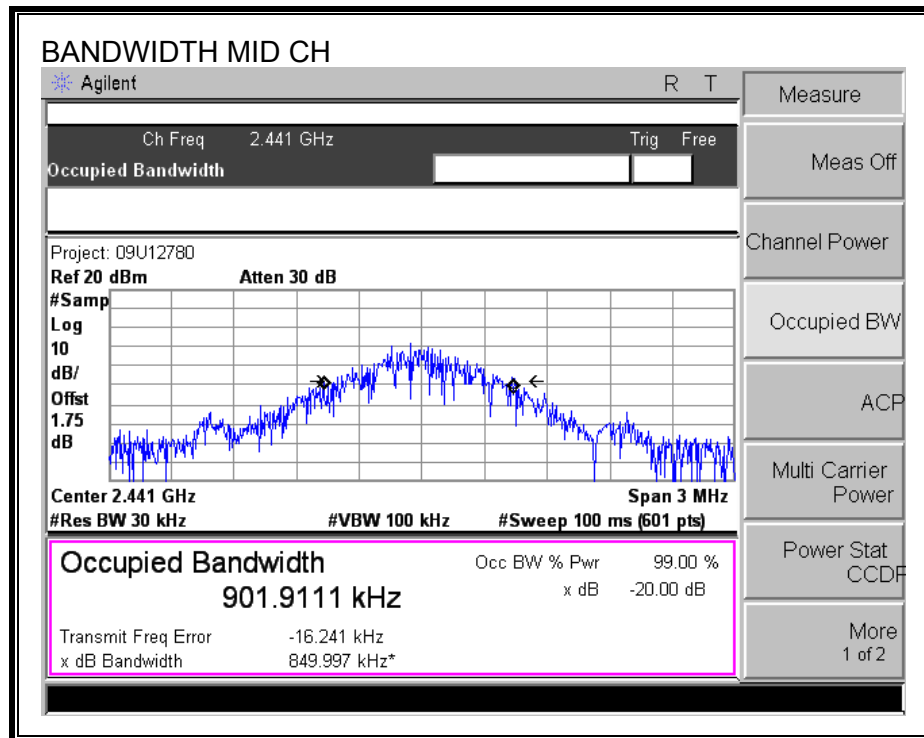
The transmitter output is connected to a spectrum analyzer. The RBW is set to  $\geq 1\%$  of the 20 dB bandwidth. The VBW is set to  $\geq$  RBW. The sweep time is coupled.

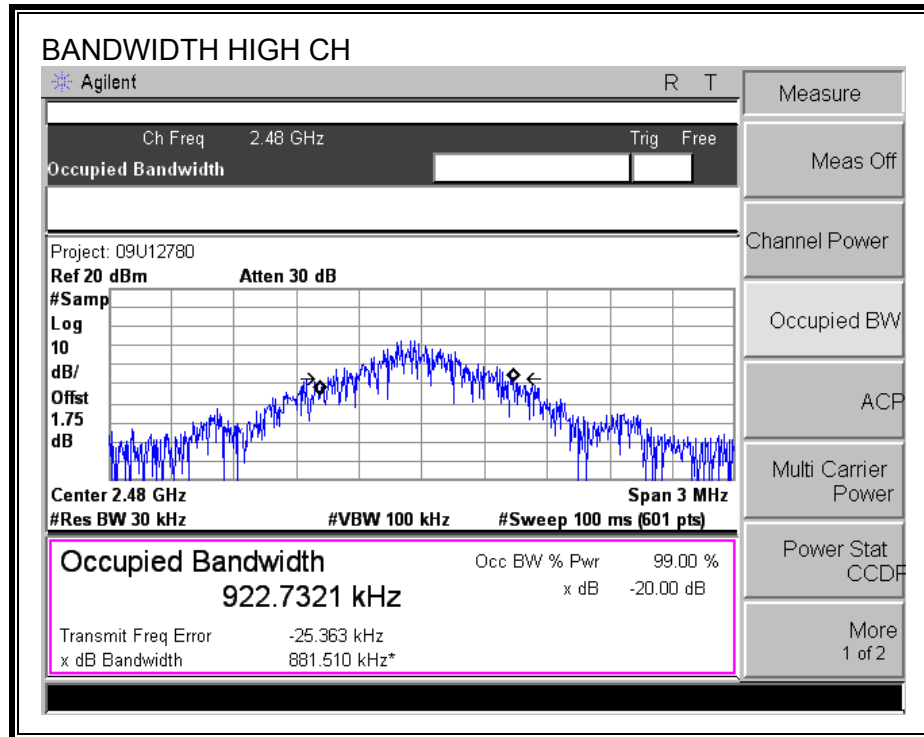
#### RESULTS

| Channel | Frequency<br>(MHz) | 20 dB Bandwidth<br>(kHz) | 99% Bandwidth<br>(kHz) |
|---------|--------------------|--------------------------|------------------------|
| Low     | 2402               | 882.623                  | 940.295                |
| Middle  | 2441               | 849.997                  | 901.911                |
| High    | 2480               | 881.51                   | 922.732                |

**20 dB AND 99% BANDWIDTH**







## **7.2. 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.

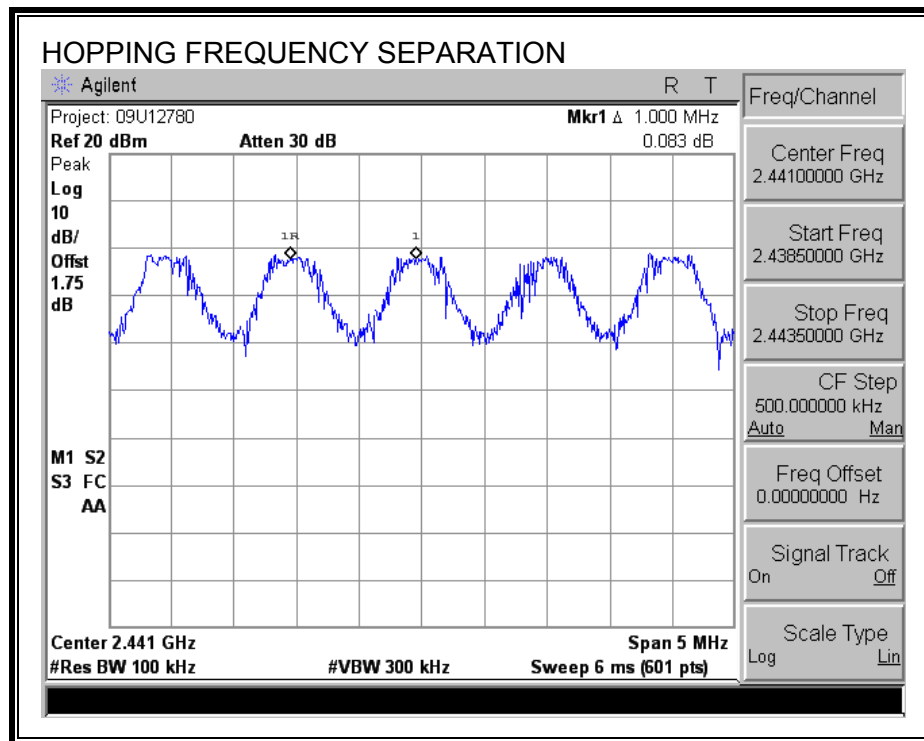
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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



### **7.3. 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.

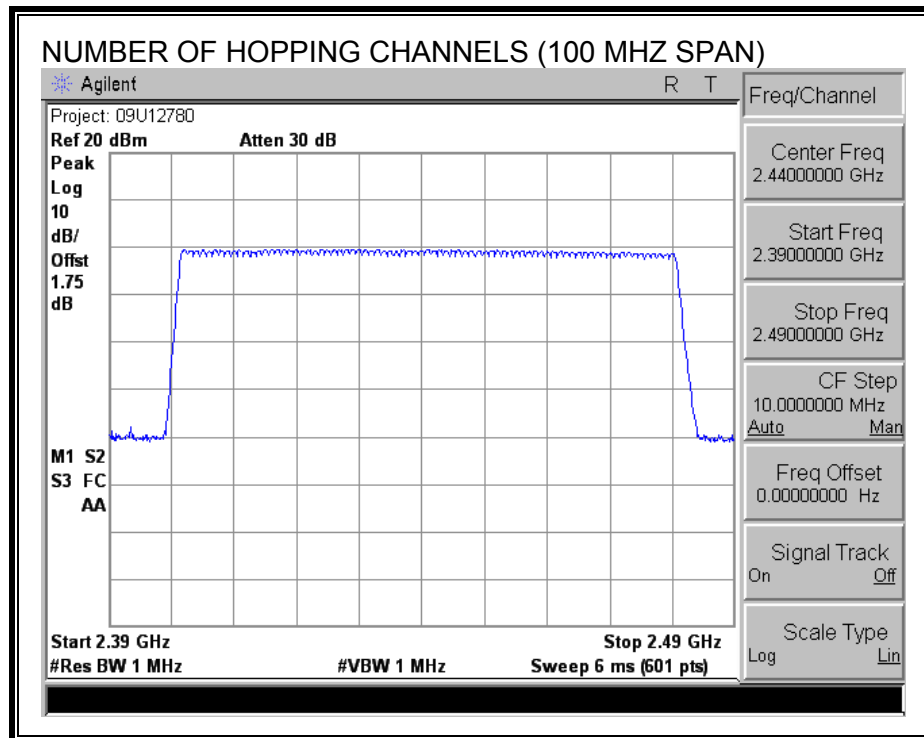
#### **TEST PROCEDURE**

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.

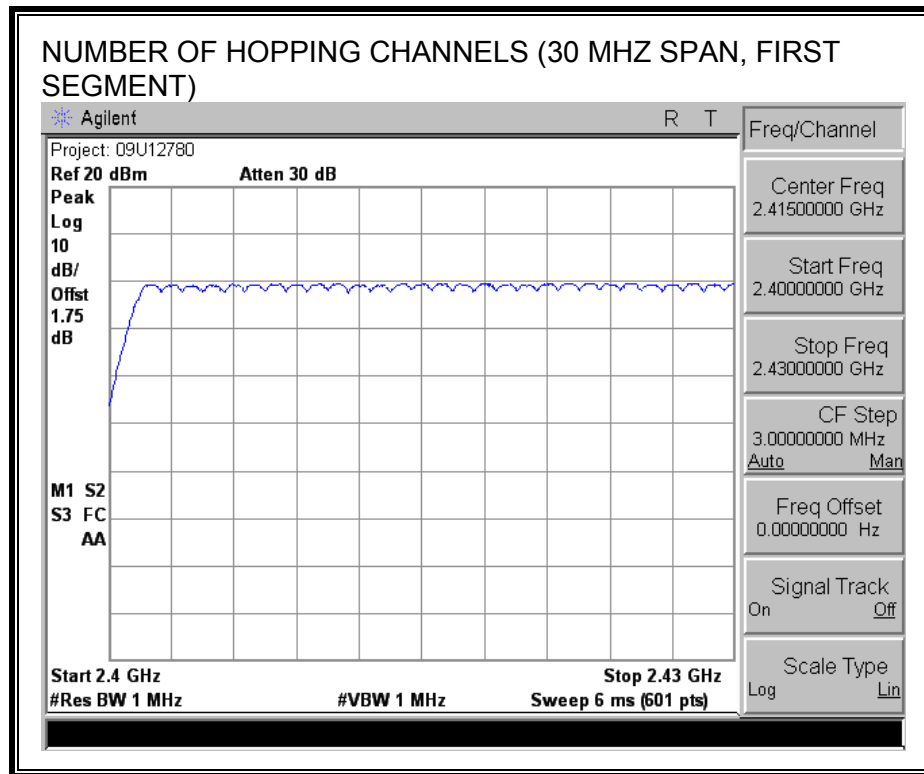
#### **RESULTS**

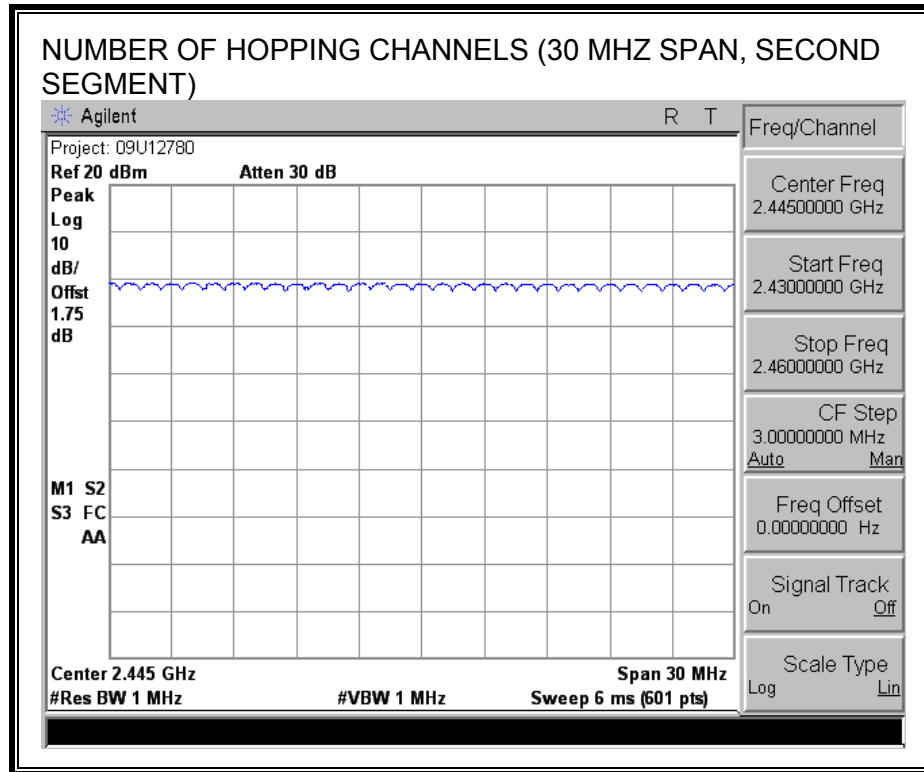
79 Channels observed.

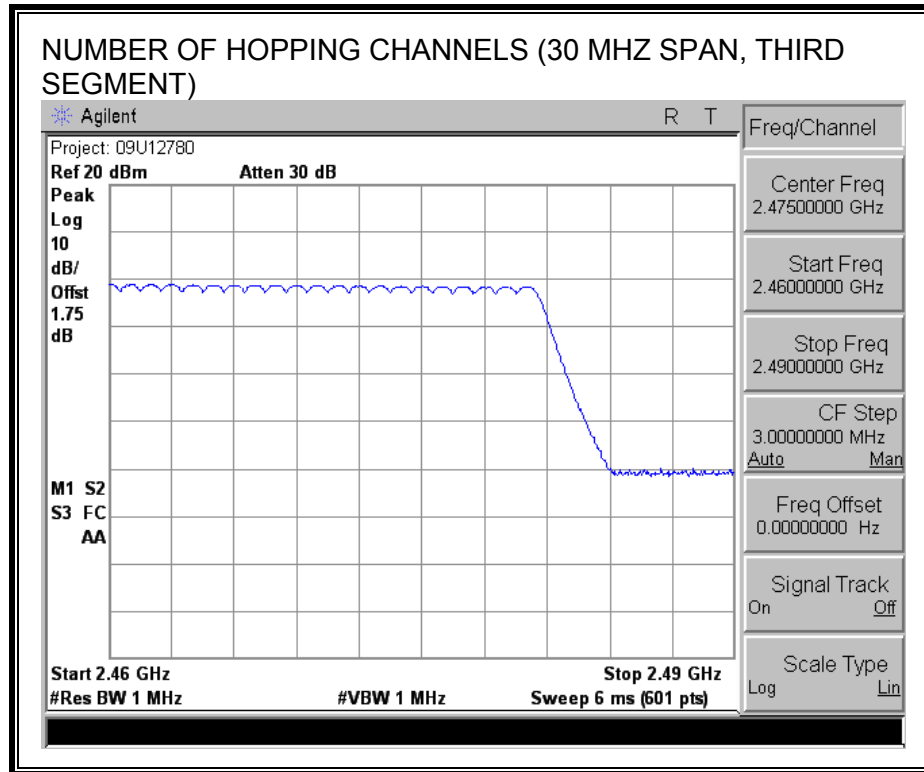
## NUMBER OF HOPPING CHANNELS











## 7.4. 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  $10 * (\# \text{ of pulses in } 3.16 \text{ s}) * \text{pulse width}$ .

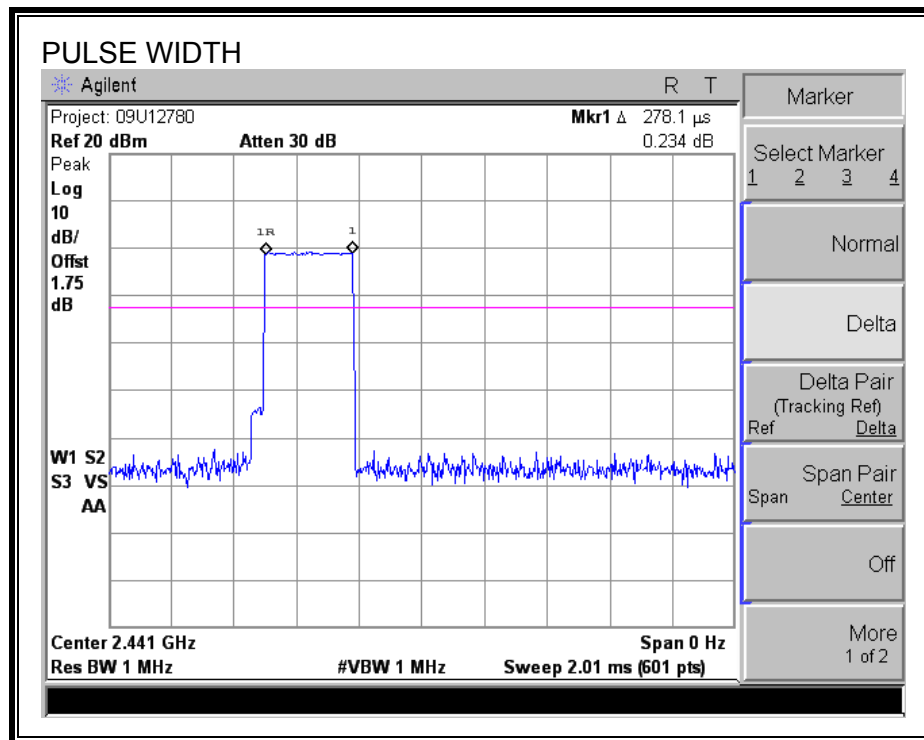
### RESULTS

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

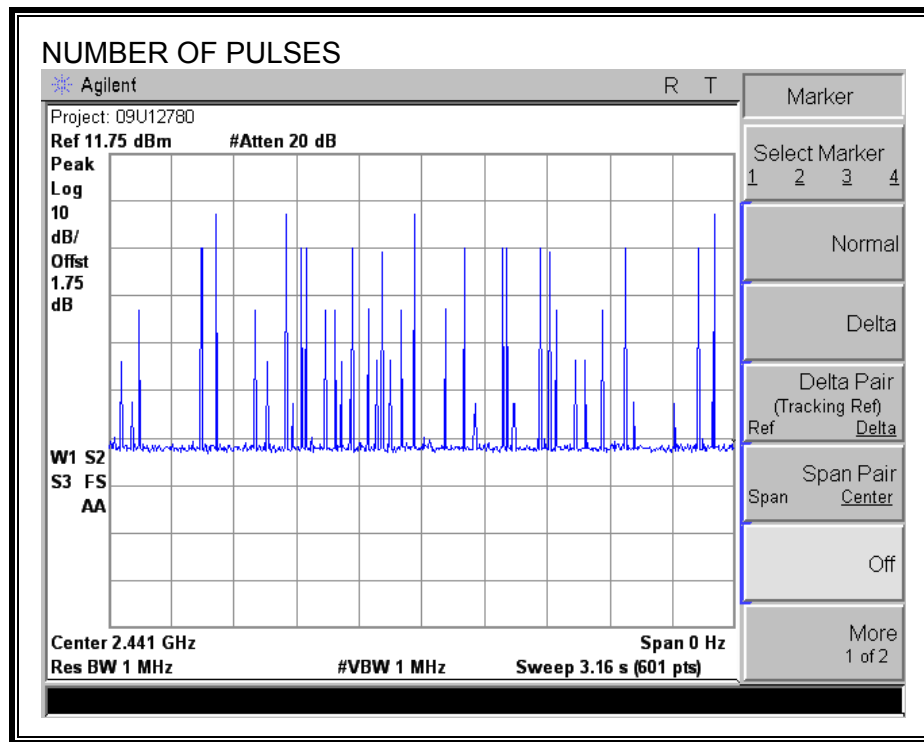
#### GFSK Mode

| DH Packet | Pulse Width (msec) | Number of Pulses in 3.16 seconds | Average Time of (sec) | Limit (sec) | Margin (sec) |
|-----------|--------------------|----------------------------------|-----------------------|-------------|--------------|
| DH1       | 0.2781             | 37                               | 0.103                 | 0.4         | 0.297        |

## PULSE WIDTH



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



## 7.5. 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.

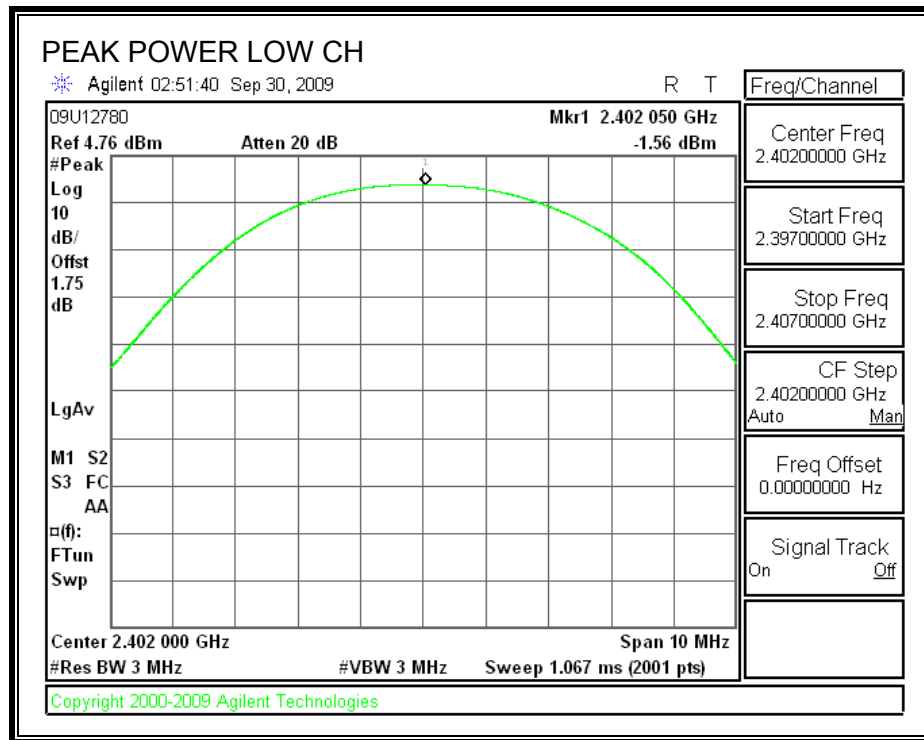
### TEST PROCEDURE

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.

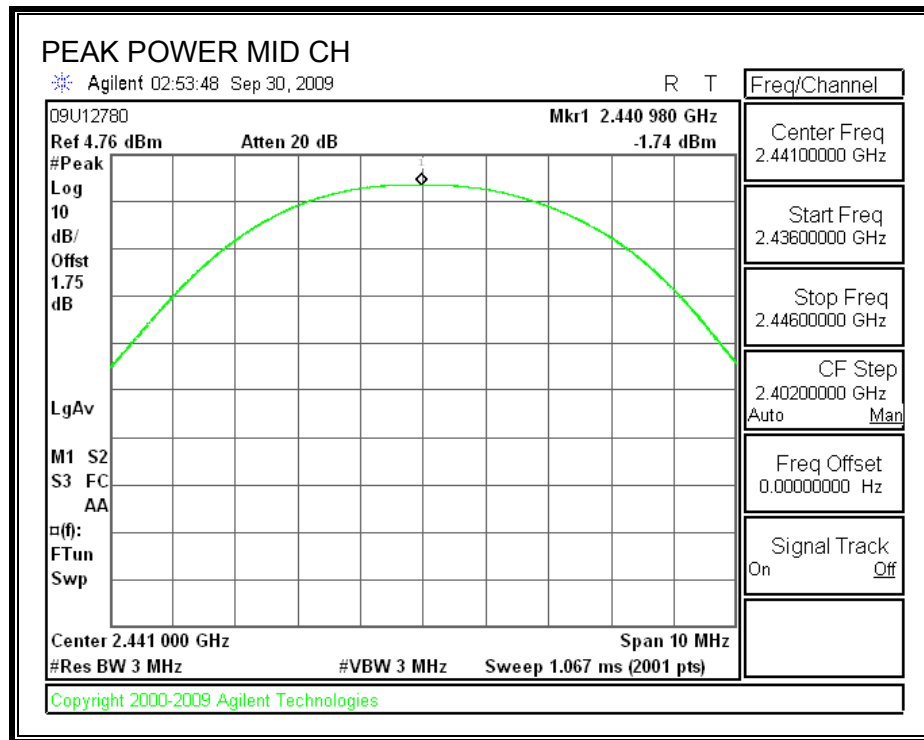
### RESULTS

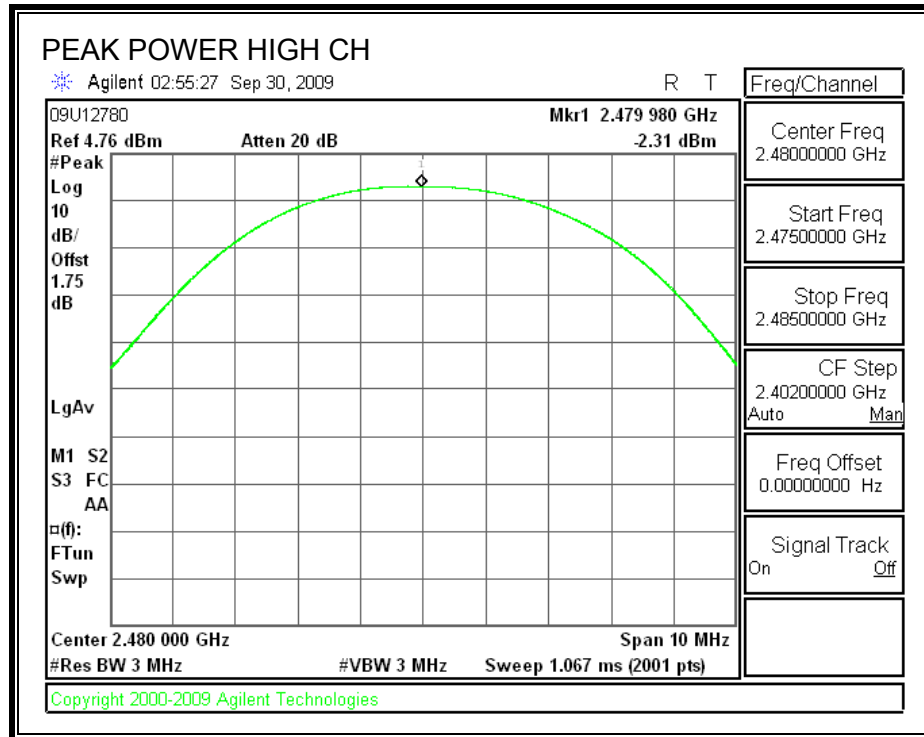
| Channel | Frequency<br>(MHz) | Output Power<br>(dBm) | Limit<br>(dBm) | Margin<br>(dB) |
|---------|--------------------|-----------------------|----------------|----------------|
| Low     | 2402               | -1.560                | 30             | -31.56         |
| Middle  | 2441               | -1.740                | 30             | -31.74         |
| High    | 2480               | -2.310                | 30             | -32.31         |

## OUTPUT POWER









## **7.6. CONDUCTED SPURIOUS EMISSIONS**

### **LIMITS**

FCC §15.247 (d)

IC RSS-210 A8.5

Limit = -20 dBc

### **TEST PROCEDURE**

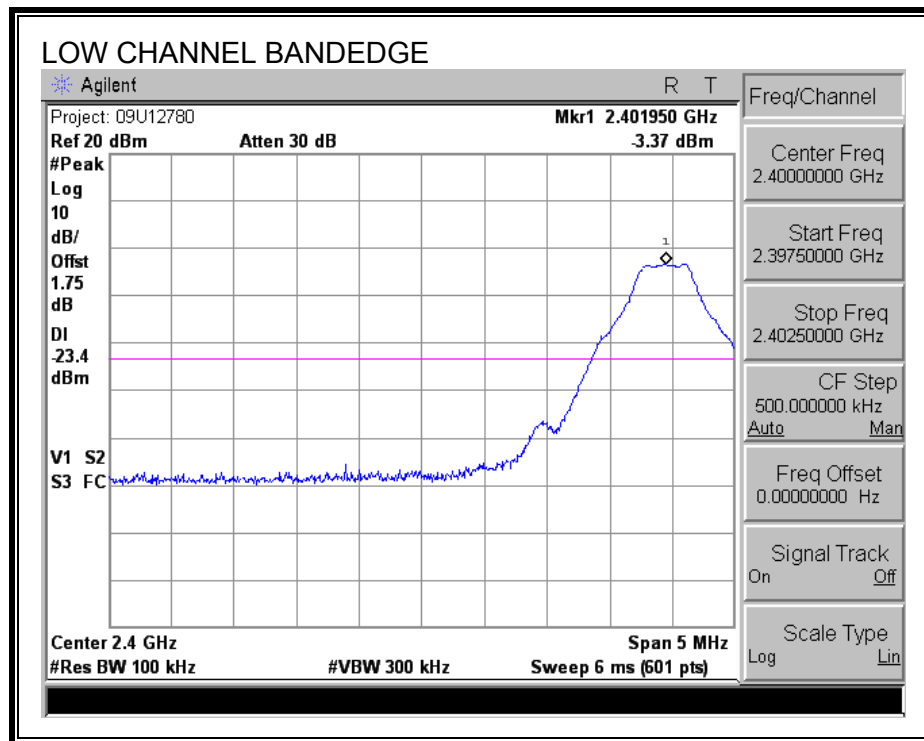
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

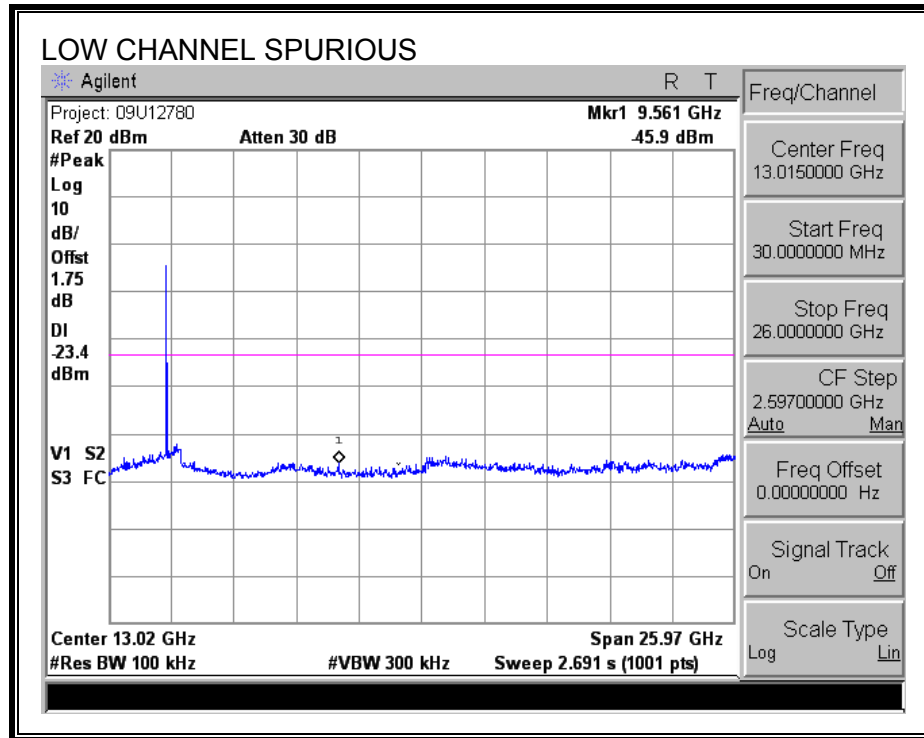
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

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

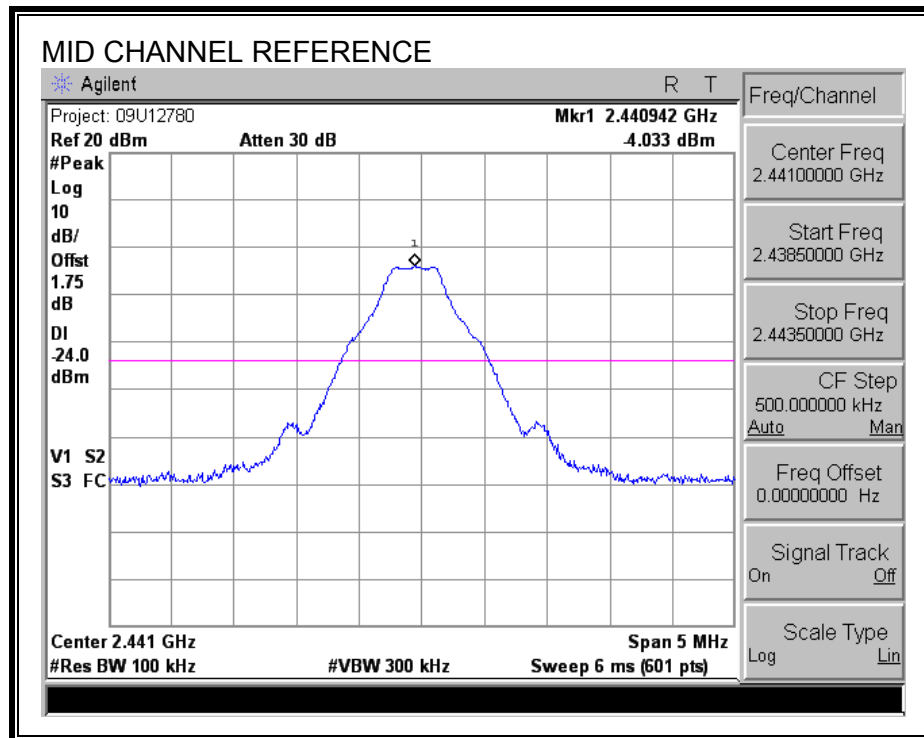
## RESULTS

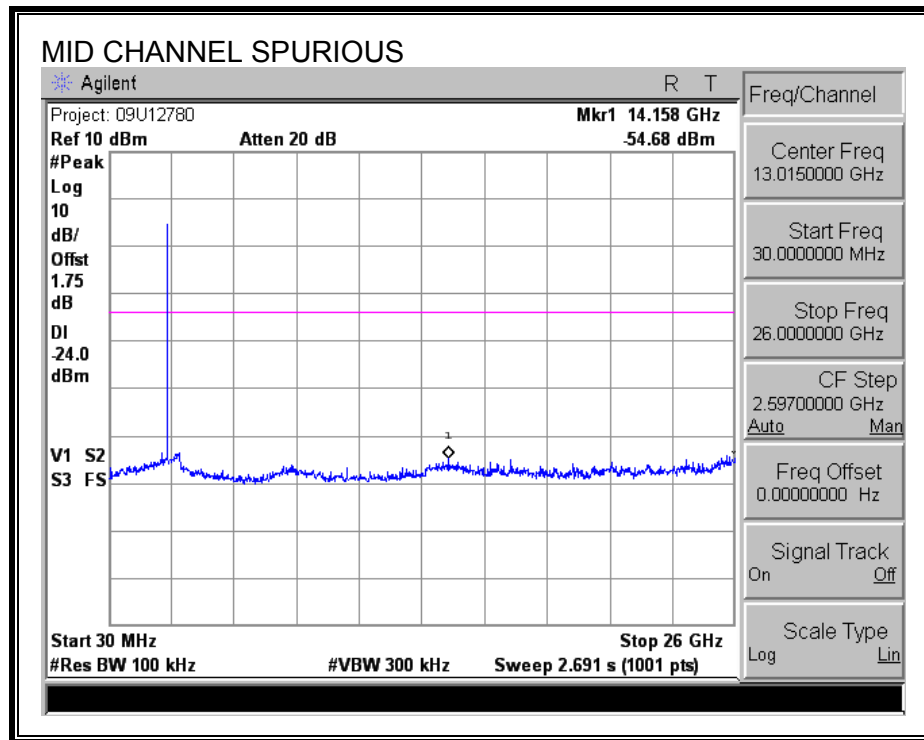
### SPURIOUS EMISSIONS, LOW CHANNEL



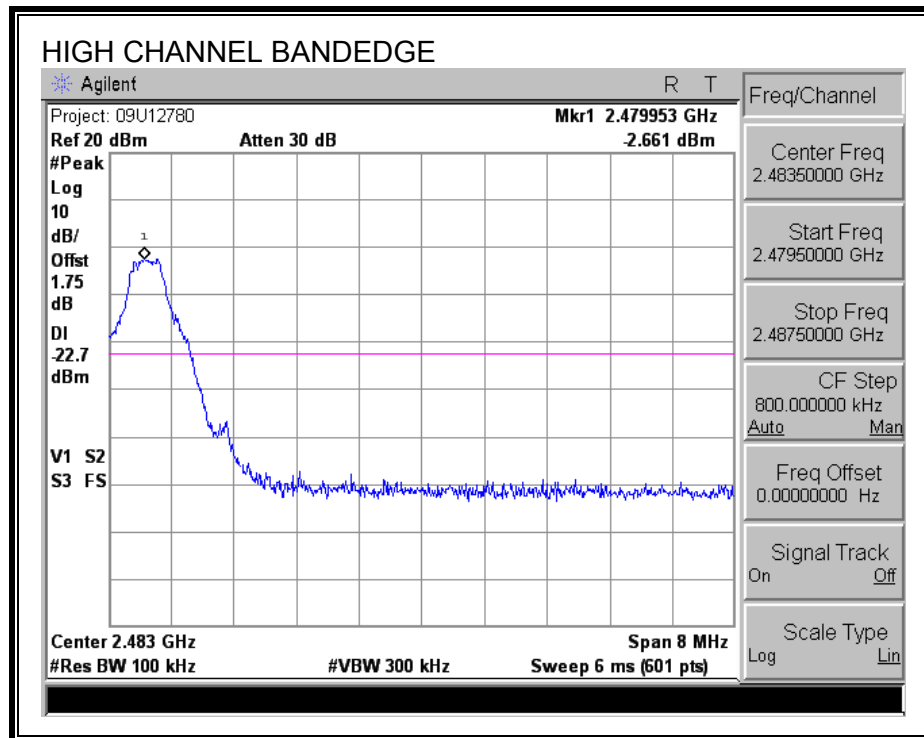


**SPURIOUS EMISSIONS, MID CHANNEL**

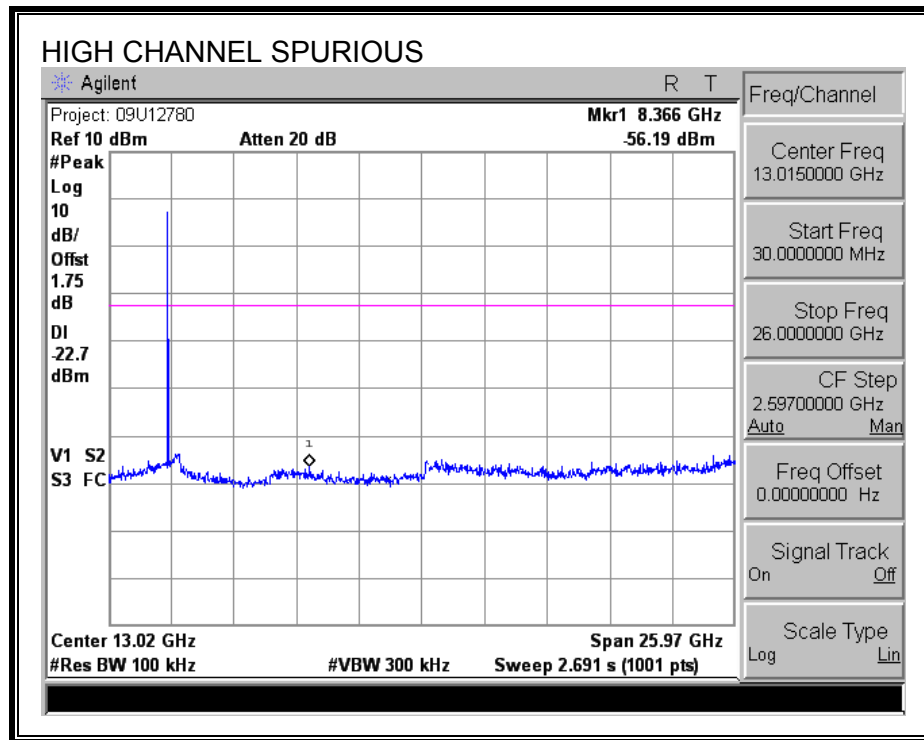




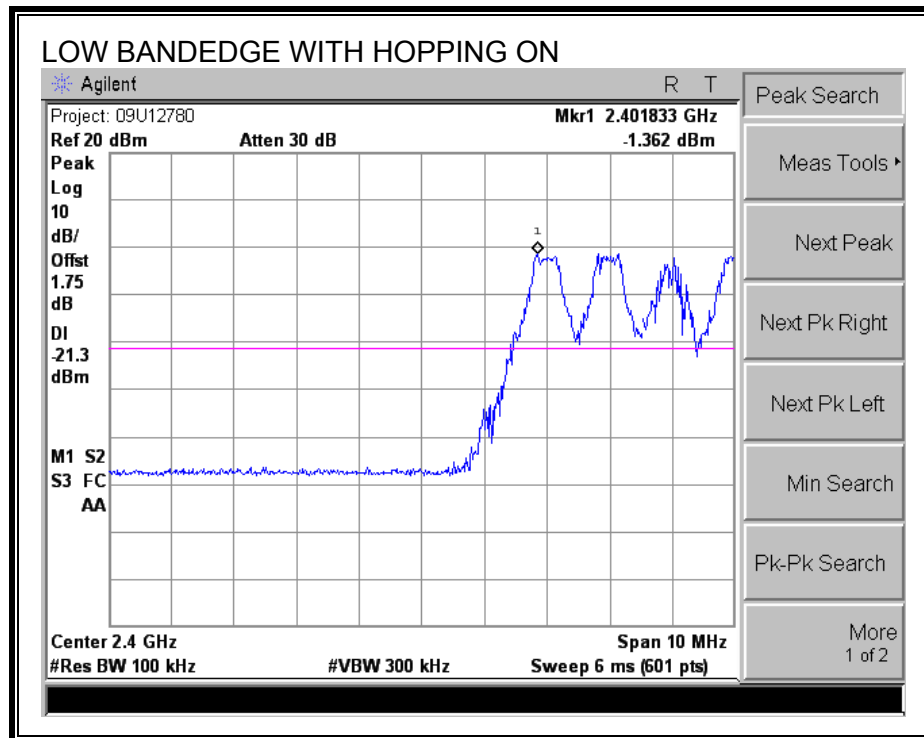
**SPURIOUS EMISSIONS, HIGH CHANNEL**

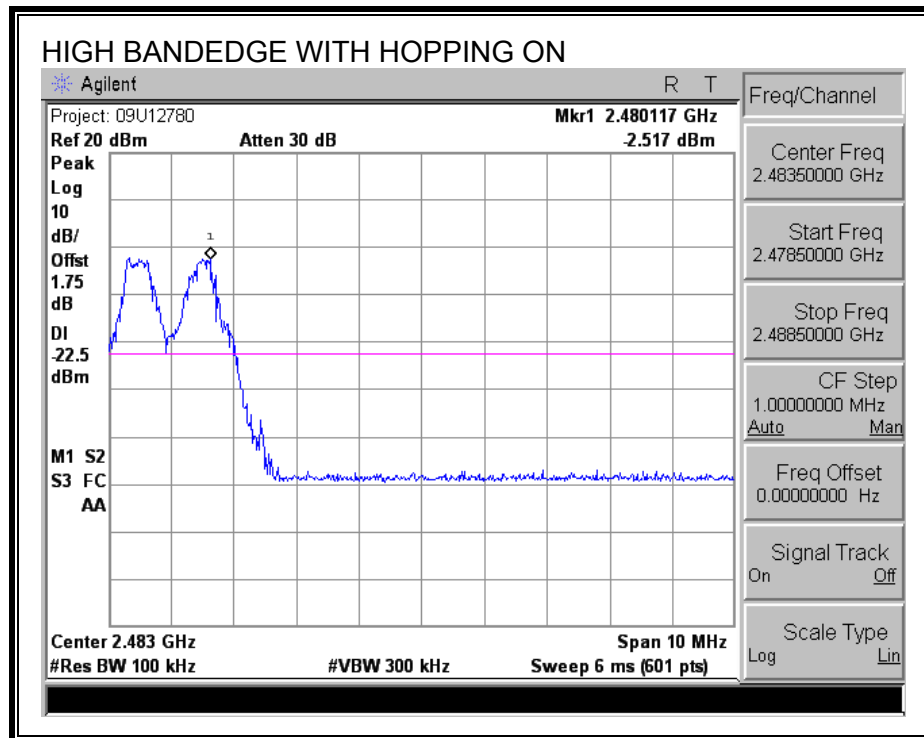






**SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON**





## 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.

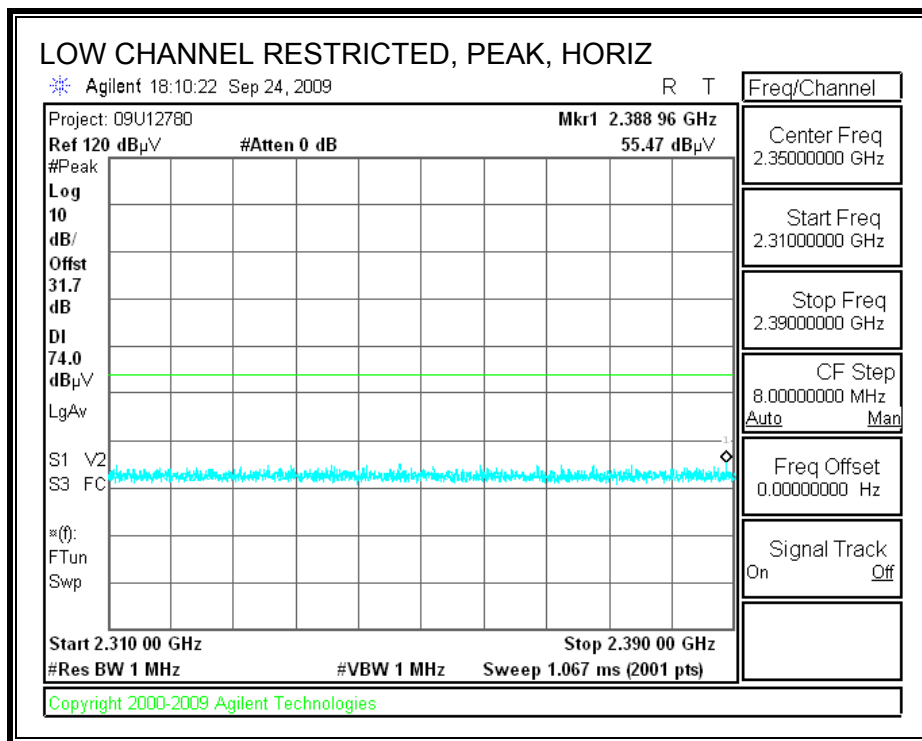
For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

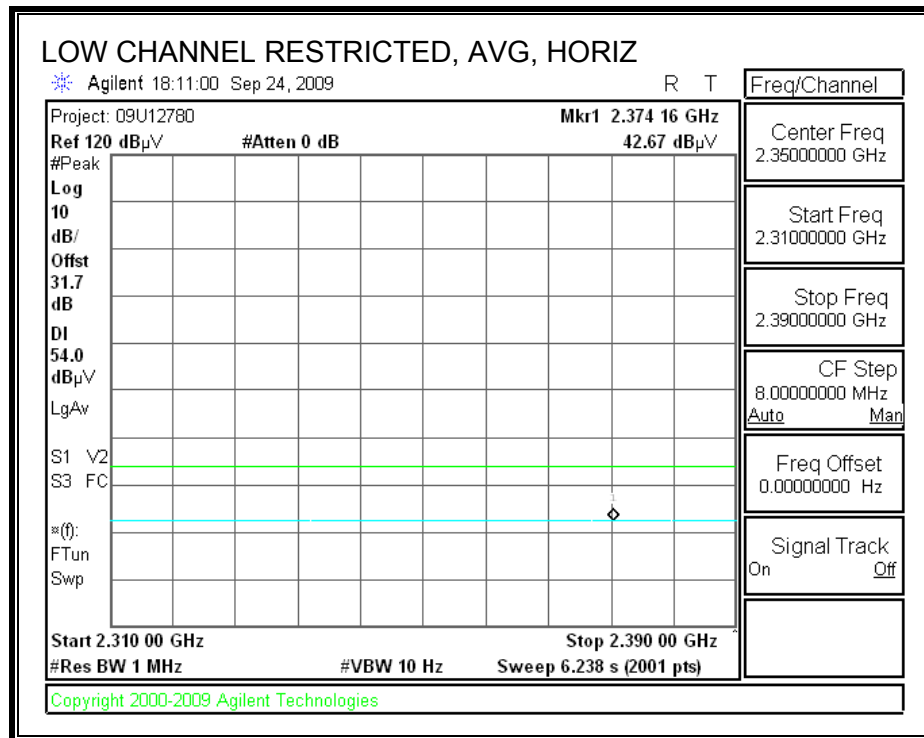
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

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.

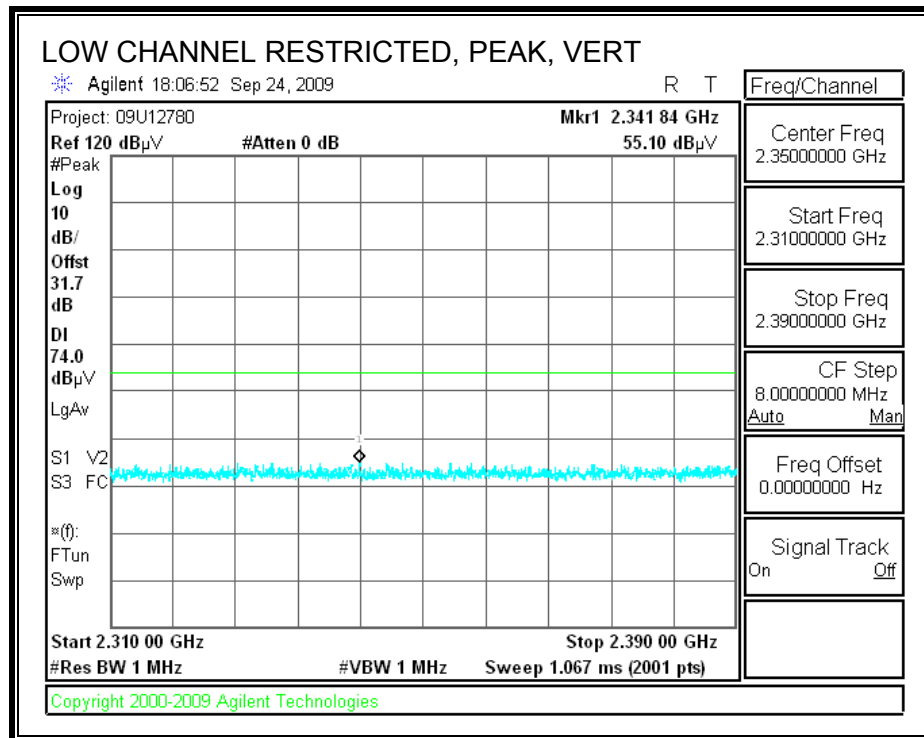
## 8.2. TRANSMITTER ABOVE 1 GHz

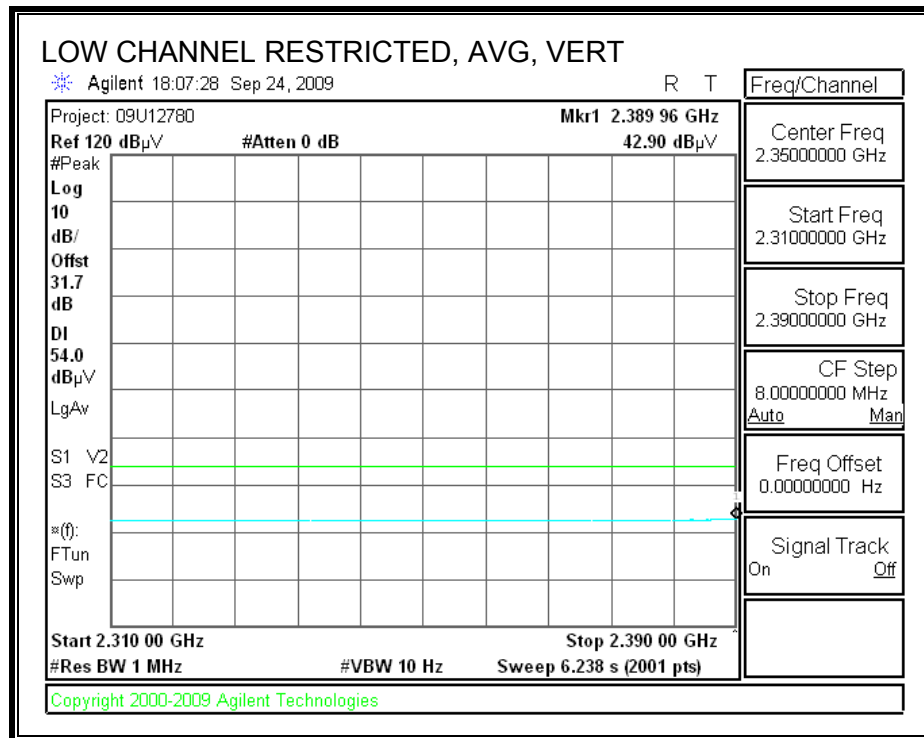
### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)





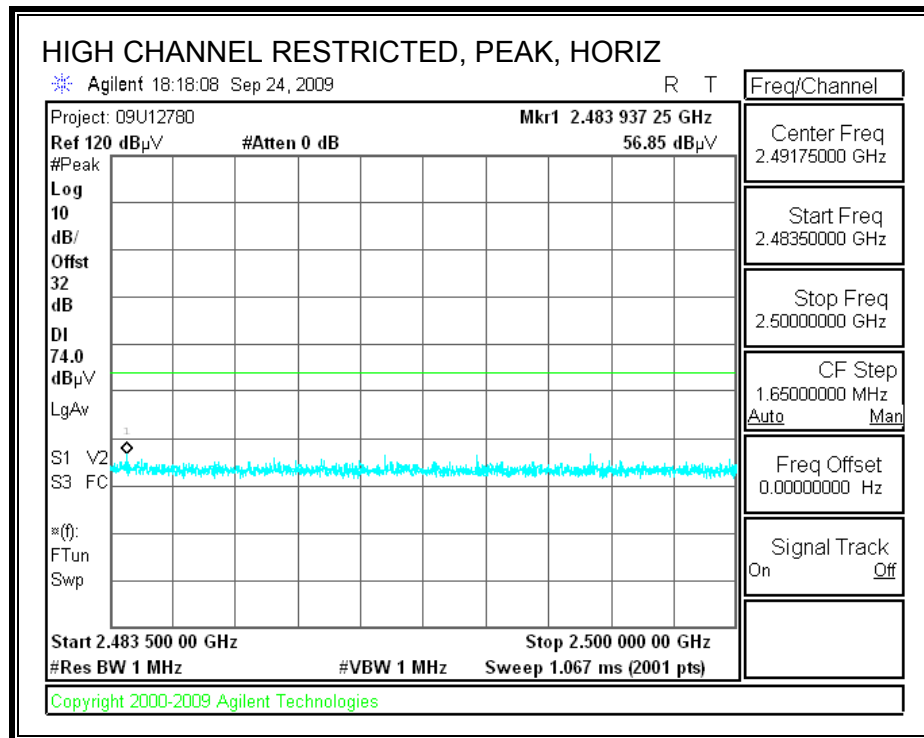
**RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)**

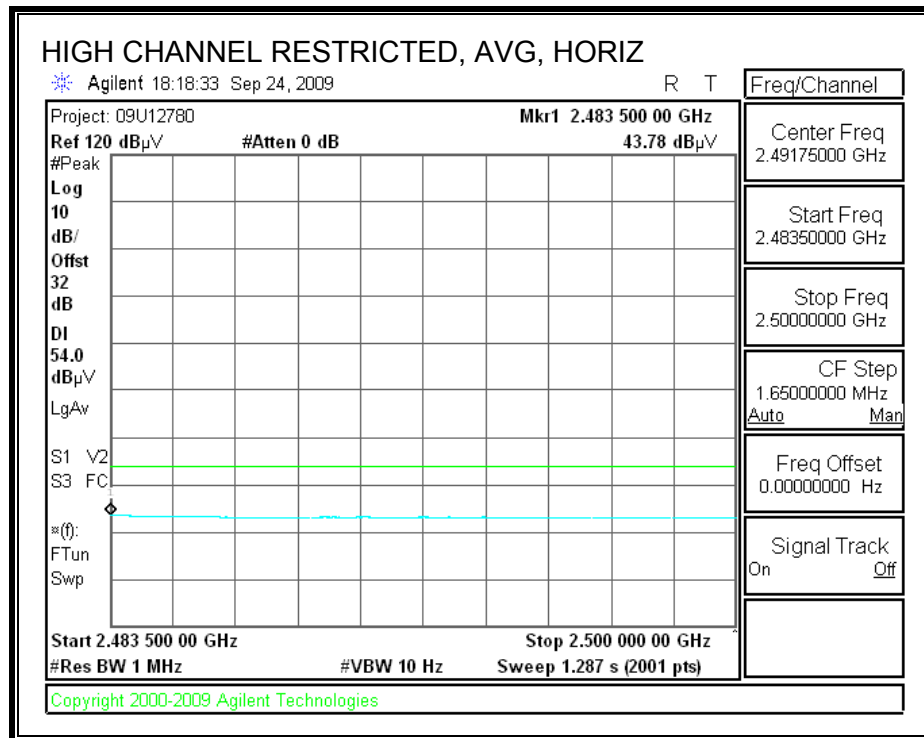




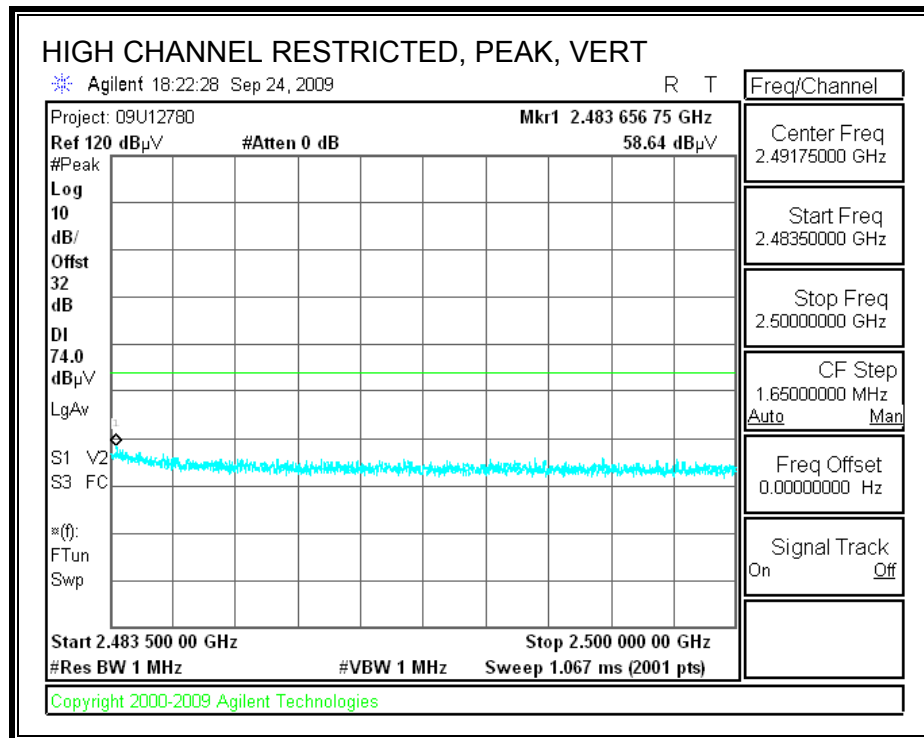


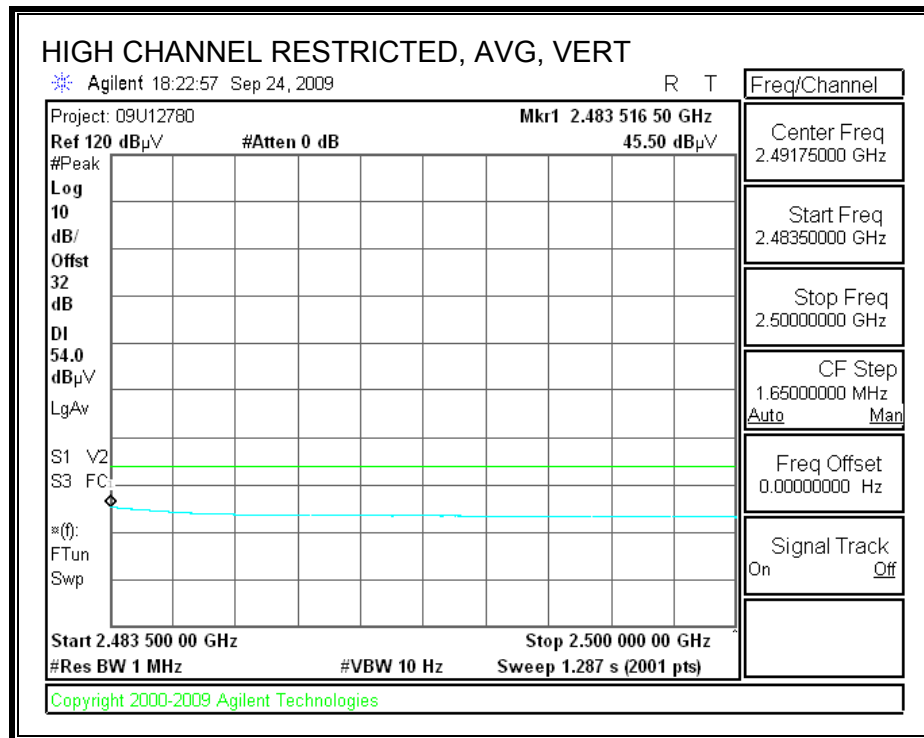
**RESTRICTED BANEDGE (HIGH CHANNEL, HORIZONTAL)**





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





# **HARMONICS AND SPURIOUS EMISSIONS**

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

Test Engr: Tom Chen  
Date: 09/24/09  
Project #: 09U12780  
Company: Apple Inc.  
EUT Description: Bluetooth Trackpad  
EUT M/N: EUT only  
Test Target: FCC Class B  
Mode Oper: Continuous TX

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

| f<br>GHz                     | Dist<br>(m) | Read<br>dBuV | AF<br>dB/m | CL<br>dB | Amp<br>dB | D Corr<br>dB | Fltr<br>dB | Corr.<br>dBuV/m | Limit<br>dBuV/m | Margin<br>dB | Ant. Pol<br>V/H | Det<br>P/A/QP | Ant. High<br>cm | Table Angle<br>Degree | Notes      |
|------------------------------|-------------|--------------|------------|----------|-----------|--------------|------------|-----------------|-----------------|--------------|-----------------|---------------|-----------------|-----------------------|------------|
| <b>2402 MHz Low Channel</b>  |             |              |            |          |           |              |            |                 |                 |              |                 |               |                 |                       |            |
| 4.804                        | 3.0         | 40.2         | 33.0       | 5.8      | -36.5     | 0.0          | 0.0        | 42.6            | 74.0            | -31.4        | V               | P             | 100.9           | 243.1                 | Vertical   |
| 4.804                        | 3.0         | 32.0         | 33.0       | 5.8      | -36.5     | 0.0          | 0.0        | 34.3            | 54.0            | -19.7        | V               | A             | 100.9           | 243.1                 | Vertical   |
| 7.206                        | 3.0         | 38.0         | 35.1       | 7.2      | -36.2     | 0.0          | 0.0        | 44.2            | 74.0            | -29.8        | V               | P             | 100.9           | 243.1                 | Vertical   |
| 7.206                        | 3.0         | 25.5         | 35.1       | 7.2      | -36.2     | 0.0          | 0.0        | 31.6            | 54.0            | -22.4        | V               | A             | 100.9           | 243.1                 | Vertical   |
| 4.804                        | 3.0         | 39.0         | 33.0       | 5.8      | -36.5     | 0.0          | 0.0        | 41.3            | 74.0            | -32.7        | H               | P             | 105.4           | 220.7                 | Horizontal |
| 4.804                        | 3.0         | 26.4         | 33.0       | 5.8      | -36.5     | 0.0          | 0.0        | 28.7            | 54.0            | -25.3        | H               | A             | 105.4           | 220.7                 | Horizontal |
| 7.206                        | 3.0         | 37.8         | 35.1       | 7.2      | -36.2     | 0.0          | 0.0        | 43.9            | 74.0            | -30.1        | H               | P             | 105.4           | 220.7                 | Horizontal |
| 7.206                        | 3.0         | 25.4         | 35.1       | 7.2      | -36.2     | 0.0          | 0.0        | 31.5            | 54.0            | -22.5        | H               | A             | 105.4           | 220.7                 | Horizontal |
| <b>2441 MHz Mid Channel</b>  |             |              |            |          |           |              |            |                 |                 |              |                 |               |                 |                       |            |
| 4.882                        | 3.0         | 38.2         | 33.1       | 5.8      | -36.5     | 0.0          | 0.0        | 40.7            | 74.0            | -33.3        | H               | P             | 105.4           | 220.7                 | Horizontal |
| 4.882                        | 3.0         | 26.0         | 33.1       | 5.8      | -36.5     | 0.0          | 0.0        | 28.4            | 54.0            | -25.6        | H               | A             | 105.4           | 220.7                 | Horizontal |
| 7.323                        | 3.0         | 38.2         | 35.3       | 7.3      | -36.2     | 0.0          | 0.0        | 44.6            | 74.0            | -29.4        | H               | P             | 105.4           | 220.7                 | Horizontal |
| 7.323                        | 3.0         | 25.4         | 35.3       | 7.3      | -36.2     | 0.0          | 0.0        | 31.7            | 54.0            | -22.3        | H               | A             | 105.4           | 220.7                 | Horizontal |
| 4.882                        | 3.0         | 41.7         | 33.1       | 5.8      | -36.5     | 0.0          | 0.0        | 44.2            | 74.0            | -29.8        | V               | P             | 100.0           | 237.7                 | Vertical   |
| 4.882                        | 3.0         | 32.8         | 33.1       | 5.8      | -36.5     | 0.0          | 0.0        | 35.3            | 54.0            | -18.7        | V               | A             | 100.0           | 237.7                 | Vertical   |
| 7.323                        | 3.0         | 38.5         | 35.3       | 7.3      | -36.2     | 0.0          | 0.0        | 44.9            | 74.0            | -29.1        | V               | P             | 100.0           | 237.7                 | Vertical   |
| 7.323                        | 3.0         | 25.4         | 35.3       | 7.3      | -36.2     | 0.0          | 0.0        | 31.8            | 54.0            | -22.2        | V               | A             | 100.0           | 237.7                 | Vertical   |
| <b>2480 MHz High Channel</b> |             |              |            |          |           |              |            |                 |                 |              |                 |               |                 |                       |            |
| 4.960                        | 3.0         | 40.6         | 33.2       | 5.9      | -36.5     | 0.0          | 0.0        | 43.3            | 74.0            | -30.7        | V               | P             | 100.0           | 281.4                 | Vertical   |
| 4.960                        | 3.0         | 33.3         | 33.2       | 5.9      | -36.5     | 0.0          | 0.0        | 35.9            | 54.0            | -18.1        | V               | A             | 100.0           | 281.4                 | Vertical   |
| 7.440                        | 3.0         | 39.0         | 35.5       | 7.3      | -36.2     | 0.0          | 0.0        | 45.6            | 74.0            | -28.4        | V               | P             | 100.0           | 281.4                 | Vertical   |
| 7.440                        | 3.0         | 25.0         | 35.5       | 7.3      | -36.2     | 0.0          | 0.0        | 31.7            | 54.0            | -22.3        | V               | A             | 100.0           | 281.4                 | Vertical   |
| 4.960                        | 3.0         | 39.1         | 33.2       | 5.9      | -36.5     | 0.0          | 0.0        | 41.7            | 74.0            | -32.3        | H               | P             | 100.0           | 294.0                 | Horizontal |
| 4.960                        | 3.0         | 27.4         | 33.2       | 5.9      | -36.5     | 0.0          | 0.0        | 30.1            | 54.0            | -23.9        | H               | A             | 100.0           | 294.0                 | Horizontal |
| 7.440                        | 3.0         | 37.5         | 35.5       | 7.3      | -36.2     | 0.0          | 0.0        | 44.1            | 74.0            | -29.9        | H               | P             | 100.0           | 294.0                 | Horizontal |
| 7.440                        | 3.0         | 24.9         | 35.5       | 7.3      | -36.2     | 0.0          | 0.0        | 31.6            | 54.0            | -22.4        | H               | A             | 100.0           | 294.0                 | Horizontal |

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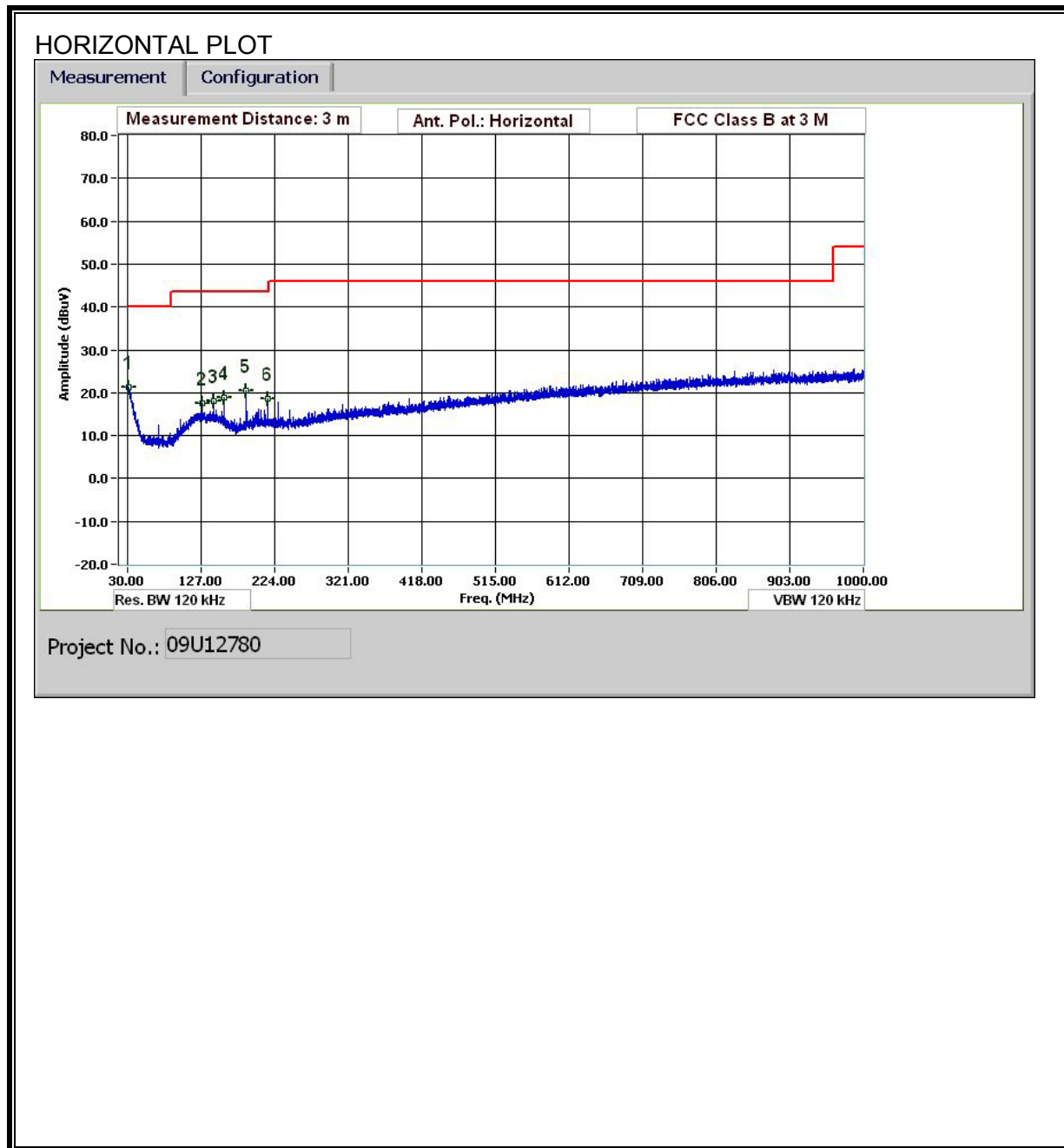
Note: No other emissions were detected above the system noise floor.

### 8.3. RECEIVER ABOVE 1 GHz

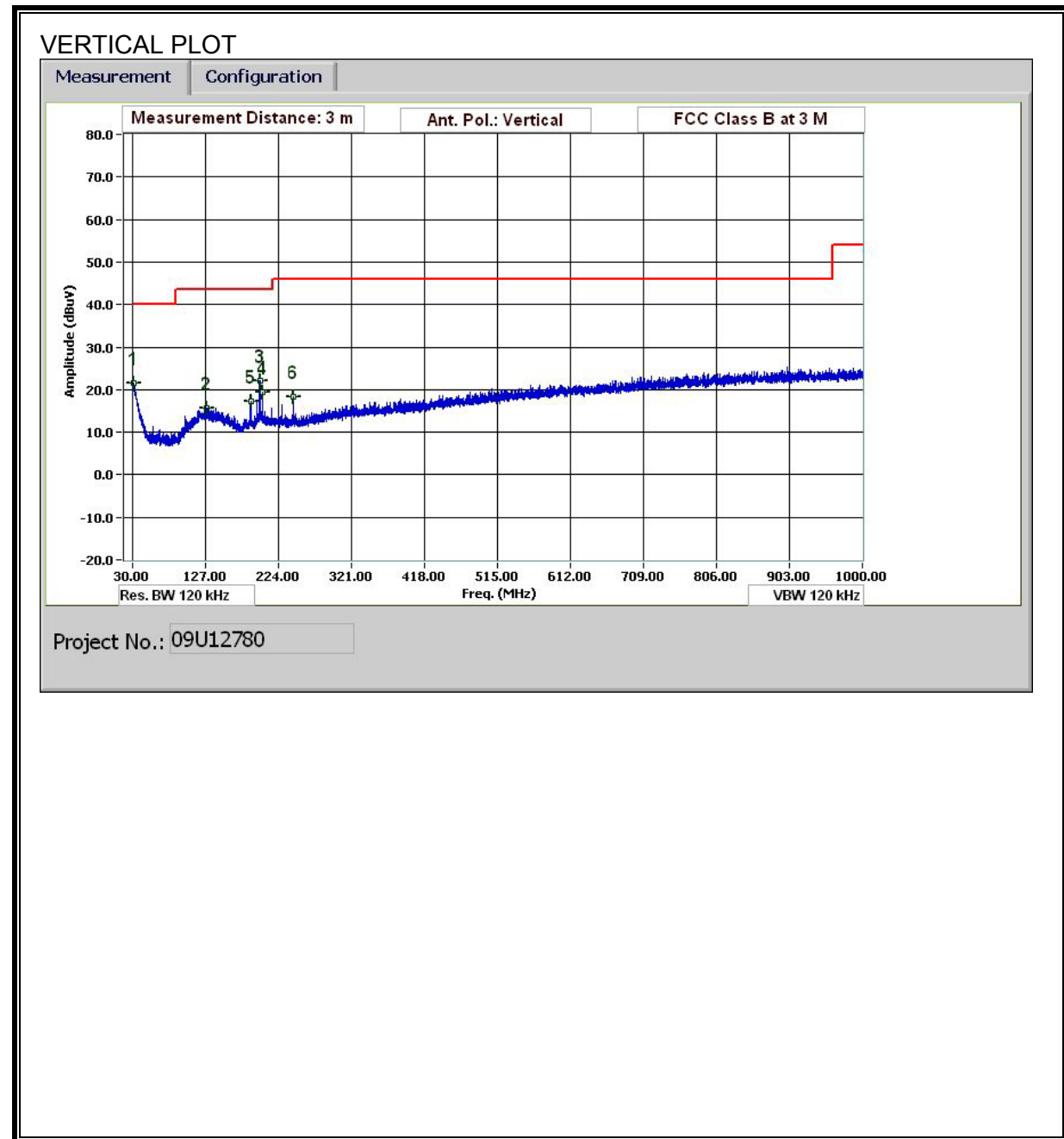
| High Frequency Measurement  |                       |                 |                   |                       |          |           |                                |                        |                |               |                  |                   |                              |               |                |   |  |
|---|-----------------------|-----------------|-------------------|-----------------------|----------|-----------|--------------------------------|------------------------|----------------|---------------|------------------|-------------------|------------------------------|---------------|----------------|---|--|
| Compliance Certification Services, Fremont 5m Chamber                       |                       |                 |                   |                       |          |           |                                |                        |                |               |                  |                   |                              |               |                |   |  |
| Company:  |                       | Apple Inc.      |                   |                       |          |           |                                |                        |                |               |                  |                   |                              |               |                |   |  |
| Project #:  |                       | 09U12780        |                   |                       |          |           |                                |                        |                |               |                  |                   |                              |               |                |   |  |
| Date:   |                       | 9/25/2009       |                   |                       |          |           |                                |                        |                |               |                  |                   |                              |               |                |   |  |
| Test Engineer:  |                       | Tom Chen        |                   |                       |          |           |                                |                        |                |               |                  |                   |                              |               |                |   |  |
| Configuration:  |                       | EUT only        |                   |                       |          |           |                                |                        |                |               |                  |                   |                              |               |                |   |  |
| Mode:   |                       | Standby mode    |                   |                       |          |           |                                |                        |                |               |                  |                   |                              |               |                |   |  |
| <b>Test Equipment:</b>  |                       |                 |                   |                       |          |           |                                |                        |                |               |                  |                   |                              |               |                |   |  |
| Horn 1-18GHz  |                       |                 |                   | Pre-amplifier 1-26GHz |          |           |                                | Pre-amplifier 26-40GHz |                |               |                  | Horn > 18GHz      |                              |               |                | Limit                                       |  |
| T73; S/N: 6717 @3m  |                       |                 |                   | T144 Miteq 3008A00931 |          |           |                                |                        |                |               |                  |                   |                              |               |                | RX RSS 210                                  |  |
| Hi Frequency Cables   |                       |                 |                   |                       |          |           |                                |                        |                |               |                  |                   |                              |               |                |   |  |
| 3' cable 22807700   |                       |                 |                   | 12' cable 22807600    |          |           |                                | 20' cable 22807500     |                |               |                  | HPF               |                              | Reject Filter |                | Peak Measurements<br>RBW=VBW=1MHz           |  |
| 3' cable 22807700   |                       |                 |                   | 12' cable 22807600    |          |           |                                | 20' cable 22807500     |                |               |                  |                   |                              |               |                | Average Measurements<br>RBW=1MHz ; VBW=10Hz |  |
| f<br>GHz  | Dist<br>(m)           | Read Pk<br>dBuV | Read Avg.<br>dBuV | AF<br>dB/m            | CL<br>dB | Amp<br>dB | D Corr<br>dB                   | Ftr<br>dB              | Peak<br>dBuV/m | Avg<br>dBuV/m | Pk Lim<br>dBuV/m | Avg Lim<br>dBuV/m | Pk Mar<br>dB                 | Avg Mar<br>dB | Notes<br>(V/H) |   |  |
| 1.015   | 3.0                   | 48.5            | 38.0              | 23.9                  | 2.4      | -39.5     | 0.0                            | 0.0                    | 35.3           | 24.8          | 74               | 54                | -38.7                        | -29.2         | V              |   |  |
| 1.405   | 3.0                   | 47.0            | 36.5              | 25.2                  | 2.8      | -38.9     | 0.0                            | 0.0                    | 36.1           | 25.6          | 74               | 54                | -37.9                        | -28.4         | V              |   |  |
| 3.820   | 3.0                   | 44.3            | 33.8              | 31.9                  | 5.0      | -36.7     | 0.0                            | 0.0                    | 44.4           | 33.9          | 74               | 54                | -29.6                        | -20.1         | V              |   |  |
| 6.565   | 3.0                   | 41.2            | 30.7              | 34.5                  | 6.8      | -36.3     | 0.0                            | 0.0                    | 46.2           | 35.7          | 74               | 54                | -27.8                        | -18.3         | V              |   |  |
| 1.090   | 3.0                   | 47.1            | 36.6              | 24.2                  | 2.5      | -39.4     | 0.0                            | 0.0                    | 34.4           | 23.9          | 74               | 54                | -39.6                        | -30.1         | H              |   |  |
| 2.500   | 3.0                   | 44.2            | 33.7              | 28.5                  | 3.9      | -37.5     | 0.0                            | 0.0                    | 39.1           | 28.6          | 74               | 54                | -34.9                        | -25.4         | H              |   |  |
| 3.370   | 3.0                   | 45.4            | 34.9              | 30.8                  | 4.7      | -37.1     | 0.0                            | 0.0                    | 43.8           | 33.3          | 74               | 54                | -30.2                        | -20.7         | H              |   |  |
| 4.420   | 3.0                   | 44.1            | 33.6              | 32.7                  | 5.5      | -36.5     | 0.0                            | 0.0                    | 45.7           | 35.2          | 74               | 54                | -28.3                        | -18.8         | H              |   |  |
| <b>Note: No other emissions were detected above the system noise floor.</b> |                       |                 |                   |                       |          |           |                                |                        |                |               |                  |                   |                              |               |                |   |  |
| Rev. 11.10.08   |                       |                 |                   |                       |          |           |                                |                        |                |               |                  |                   |                              |               |                |   |  |
| 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               |                        |                |               |                  |                   |                              |               |                |   |  |

## 8.4. WORST-CASE BELOW 1 GHz

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



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





## HORIZONTAL AND VERTICAL DATA

30-1000MHz Frequency Measurement  
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Tom Chen

Date: 09/25/09

Project #: 09U12780

Company: Apple Inc.

EUT Description: Bluetooth Trackpad

EUT M/N: EUT only

Test Target: FCC Class B

Mode Oper: TX mode

|      |                       |        |                              |        |                  |
|------|-----------------------|--------|------------------------------|--------|------------------|
| f    | Measurement Frequency | Amp    | Preamp Gain                  | Margin | Margin vs. Limit |
| Dist | Distance to Antenna   | D Corr | Distance Correct to 3 meters |        |                  |
| Read | Analyzer Reading      | Filter | Filter Insert Loss           |        |                  |
| AF   | Antenna Factor        | Corr   | Calculated Field Strength    |        |                  |
| CL   | Cable Loss            | Limit  | Field Strength Limit         |        |                  |

| f<br>MHz | Dist<br>(m) | Read<br>dBuV | AF<br>dB/m | CL<br>dB | Amp<br>dB | D Corr<br>dB | Filter<br>dB | Corr.<br>dBuV/m | Limit<br>dBuV/m | Margin<br>dB | Ant. Pol.<br>V/H | Det.<br>P/A/QP | Ant. High<br>cm | Table Angle<br>Degree | Notes |
|----------|-------------|--------------|------------|----------|-----------|--------------|--------------|-----------------|-----------------|--------------|------------------|----------------|-----------------|-----------------------|-------|
| 32.160   | 3.0         | 30.3         | 19.2       | 0.5      | 28.4      | 0.0          | 0.0          | 21.5            | 40.0            | -18.5        | V                | EP             | 100.0           | 0 - 360               |       |
| 128.164  | 3.0         | 29.2         | 13.6       | 1.1      | 28.3      | 0.0          | 0.0          | 15.6            | 43.5            | -27.9        | V                | EP             | 100.0           | 0 - 360               |       |
| 188.047  | 3.0         | 33.1         | 11.3       | 1.2      | 28.2      | 0.0          | 0.0          | 17.4            | 43.5            | -26.1        | V                | EP             | 100.0           | 0 - 360               |       |
| 199.087  | 3.0         | 37.0         | 11.9       | 1.2      | 28.2      | 0.0          | 0.0          | 22.0            | 43.5            | -21.5        | V                | EP             | 100.0           | 0 - 360               |       |
| 202.807  | 3.0         | 34.5         | 12.0       | 1.3      | 28.2      | 0.0          | 0.0          | 19.5            | 43.5            | -24.0        | V                | EP             | 100.0           | 0 - 360               |       |
| 243.369  | 3.0         | 33.4         | 11.8       | 1.3      | 28.2      | 0.0          | 0.0          | 18.4            | 46.0            | -27.6        | V                | EP             | 100.0           | 0 - 360               |       |
| 31.800   | 3.0         | 29.7         | 19.3       | 0.5      | 28.4      | 0.0          | 0.0          | 21.2            | 40.0            | -18.8        | H                | EP             | 100.0           | 0 - 360               |       |
| 128.884  | 3.0         | 31.1         | 13.6       | 1.1      | 28.3      | 0.0          | 0.0          | 17.4            | 43.5            | -26.1        | H                | EP             | 100.0           | 0 - 360               |       |
| 143.165  | 3.0         | 32.3         | 13.1       | 1.1      | 28.3      | 0.0          | 0.0          | 18.2            | 43.5            | -25.3        | H                | EP             | 100.0           | 0 - 360               |       |
| 157.445  | 3.0         | 34.0         | 11.9       | 1.1      | 28.3      | 0.0          | 0.0          | 18.8            | 43.5            | -24.7        | H                | EP             | 100.0           | 0 - 360               |       |
| 186.126  | 3.0         | 36.3         | 11.3       | 1.2      | 28.2      | 0.0          | 0.0          | 20.5            | 43.5            | -23.0        | H                | EP             | 100.0           | 0 - 360               |       |
| 214.808  | 3.0         | 33.6         | 11.9       | 1.3      | 28.2      | 0.0          | 0.0          | 18.6            | 43.5            | -24.9        | H                | EP             | 100.0           | 0 - 360               |       |

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Note: No other emissions were detected above the system noise floor.

## 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<br>Frequency<br>(MHz) | 2<br>Electric Field<br>Strength; rms<br>(V/m) | 3<br>Magnetic Field<br>Strength; rms<br>(A/m) | 4<br>Power<br>Density<br>(W/m <sup>2</sup> ) | 5<br>Averaging<br>Time<br>(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<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).

## **EQUATIONS**

Power density is given by:

$$S = \text{EIRP} / (4 * \text{Pi} * D^2)$$

where

S = Power density in W/m<sup>2</sup>

EIRP = Equivalent Isotropic Radiated Power in W

D = Separation distance in m

Power density in units of W/m<sup>2</sup> is converted to units of mW/cm<sup>2</sup> by dividing by 10.

Distance is given by:

$$D = \text{SQRT} (\text{EIRP} / (4 * \text{Pi} * S))$$

where

D = Separation distance in m

EIRP = Equivalent Isotropic Radiated Power in W

S = Power density in W/m<sup>2</sup>

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<sup>2</sup>

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

## **RESULTS**

(MPE distance equals 20 cm)

| Band    | Mode      | Separation Distance (m) | Output Power (dBm) | Antenna Gain (dBi) | IC Power Density (W/m <sup>2</sup> ) | FCC Power Density (mW/cm <sup>2</sup> ) |
|---------|-----------|-------------------------|--------------------|--------------------|--------------------------------------|---|
| 2.4 GHz | Bluetooth | 0.20                    | -1.56              | 4.57               | 0.00398                              | 0.00040                                 |