Engineering and Testing for EMC and Safety Compliance

Certification Application Report
FCC Part 15.247 & Industry Canada RSS-210

Test Lab:	Applicant:
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FCC ID/ IC:	U48-EI0001 6999A-EI0001	**Test Report Date:**	May 15, 2007
Platform:	N/A	**RTL Work Order Number:**	2007137
Model Name/ Model Number:	Icon/EI-30 Icon Braille/EIB-30 Braille+/IBP-30	**RTL Quote Number:**	QRTL07-070

American National Standard Institute:	ANSI C63.4-2003: Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
FCC Classification:	DTS – Part 15 Digital Transmission System DSS – Part 15 Spread Spectrum Transmitter
FCC Rule Part(s) and Guidance:	FCC Rules Part 15.247: Operation within the bands 920-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz Direct Sequence System, October 1, 2006, DA 00-705, 97-114, and Measurement of Digital Transmission Systems Operating under Section 15.247 March 23, 2005
Industry Canada:	RSS-210, Issue 6 September 2005: Low Power License-Exempt Communications Devices
Digital Interface Information	Digital Interface was found to be compliant

Frequency Range (MHz)	Output Power (W)	Frequency Tolerance	Emission Designator
2412-2462	0.089*	N/A	9M90G7D
2402-2480	0.00007*	N/A	1M00FXD

** reported power is peak conducted power*

I, the undersigned, hereby declare that the equipment tested and referenced in this report conforms to the identified standard(s) as described in this test report. No modifications were made to the equipment during testing in order to achieve compliance with these standards. Furthermore, there was no deviation from, additions to, or exclusions from, the applicable parts of FCC Part 2, FCC Part 15, ANSI C63.4, and Industry Canada RSS-210.

Signature: _____ Date: May 15, 2007

Typed/Printed Name: Desmond A. Fraser Position: President

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1 General Information

1.1 Scope

Applicable Standards:

- FCC Rules Part 15.247 (10-01-06): Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz.
- Industry Canada RSS-210 (Issue 6 September 2005): Low Power License-Exempt Communications Devices

1.2 Description of EUT

Equipment Under Test	PDA
Model Names/Numbers	Icon/EI-30, Icon Braille/EIB-30 and Braille+/IBP-30
Power Supply	3.7 VDC battery
Modulation Type	DSSS, FHSS
Frequency Range	2412-2462 MHz and 2402-2480
Antenna Connector Type	w.fl on DSSS and none on Bluetooth
Antenna Types	SMD

Three model types are included in this application. The three models are electrically identical. The Icon Braille/EIB-30 is a modified keypad version of the Icon/EI-30, and the Icon Braille+/IBP-30 is a re-branded version of the Icon Braille/EIB-30.

The EUT contains both a WiFi transmitter operating between 2412 and 2462 MHz and a Bluetooth module operating between 2402 and 2480 MHz.

1.3 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located at 360 Herndon Parkway, Suite 1400, Herndon, Virginia 20170. This site has been fully described in a report and approved by the Federal Communications Commission to perform AC line conducted and radiated emissions testing (ANSI C63.4 2003).

1.4 Related Submittal(s)/Grant(s)

This is an original FCC certification application for LevelStar, LLC Model Numbers EI-30, and EIB-30 and IBP-30; FCC ID: U48-EI0001, and an original IC Family Certification for IC: 6999A-EI0001 that includes these models.

1.5 Modifications

The dielectric filter was temporarily removed from the DSSS radio at the antenna port to accomplish a direct path to the w.fl. connector thus enabling a measurement of conducted power, but all other tests were conducted with the filter intact.

2 Test Information

2.1 Description of Test Modes

In accordance with FCC 15.31(m), and because the EUT utilizes an operating band greater than 10 MHz, the frequencies in Tables 2-1 and 2-2 were tested.

Table 2-1: Channels Tested - DSSS

Channel	Frequency
1	2412
6	2436
11	2462

Table 2-2: Channels Tested - Bluetooth

Channel	Frequency
2	2402
39	2439
79	2479

2.2 Exercising the EUT

The EUT was tested in all three orthogonal planes in order to determine worst-case emissions. The EUT was provided with software to continuously transmit during testing. The carrier was also checked to verify that information was being transmitted. There were no deviations from the test standard(s) and/or methods. The test results reported relate only to the item tested.

2.3 Test Result Summary

Table 2-3: Test Result Summary – FCC Part 15, Subpart C (Section 15.247)

Standard	Test	Pass/Fail or N/A
FCC 15.207	AC Power Conducted Emissions	Pass
FCC 15.209	Radiated Emissions	Pass
FCC 15.247(a)(2)	6 dB Bandwidth - DSSS	Pass
FCC 15.247(b)	Maximum Peak Power Output	Pass
FCC 15.247(d)	Antenna Conducted Spurious Emissions	Pass
FCC 15.247(e)	Power Spectral Density – DSSS	Pass
FCC 15.247(d)	Band Edge Measurement	Pass
FCC 15.247(a)(1)	Carrier Frequency Separation – Bluetooth	Pass
FCC 15.247(a)(1)(iii)	Hopping Characteristics – Bluetooth	Pass
FCC 15.247(a)(1)(iii)	Average Time of Occupancy - Bluetooth	Pass
FCC 15.247(a)(1)	20 dB Bandwidth – Bluetooth	Pass

2.4 Test System Details

The test samples were received on November 6, 2006 and March 28, 2007. The FCC identifiers for all applicable equipment, plus descriptions of all cables used in the tested system, are identified in the following table.

Table 2-4: Equipment Under Test

Part	Manufacturer	Model	Serial Number	FCC ID	Cable Description	RTL Bar Code
Icon PDA	LevelStar, LLC	EI-30	1IC01CD60004	U48-EI0001	N/A	17836
Icon Braille PDA	LevelStar, LLC	EIB-30	1IBP1CS60003	U48-EI0001	N/A	17837
Power Supply	Phihong	PSM11R-050	P60700528A4	N/A	N/A	17662
3.7V Battery	LevelStar, LLC	Li-1750-010	N/A	N/A	N/A	17838
3.7V Battery	LevelStar, LLC	Li-1750-010	6EBP19B60356	N/A	N/A	17839
Ear Buds	LevelStar, LLC	N/A	N/A	N/A	1 m Unshielded I/O	17664
Ear Buds	LevelStar, LLC	N/A	N/A	N/A	1 m Unshielded I/O	17663
USB Adapter	LevelStar, LLC	N/A	N/A	N/A	1 m Unshielded I/O	17660
Microphone	Sony	ECM-MS907	N/A	N/A	1 m Unshielded I/O	17656
USB Mini SD Card Adapter	IOGEAR	GFR2015DM	07685	N/A	N/A	17651

2.5 Configuration of Tested System

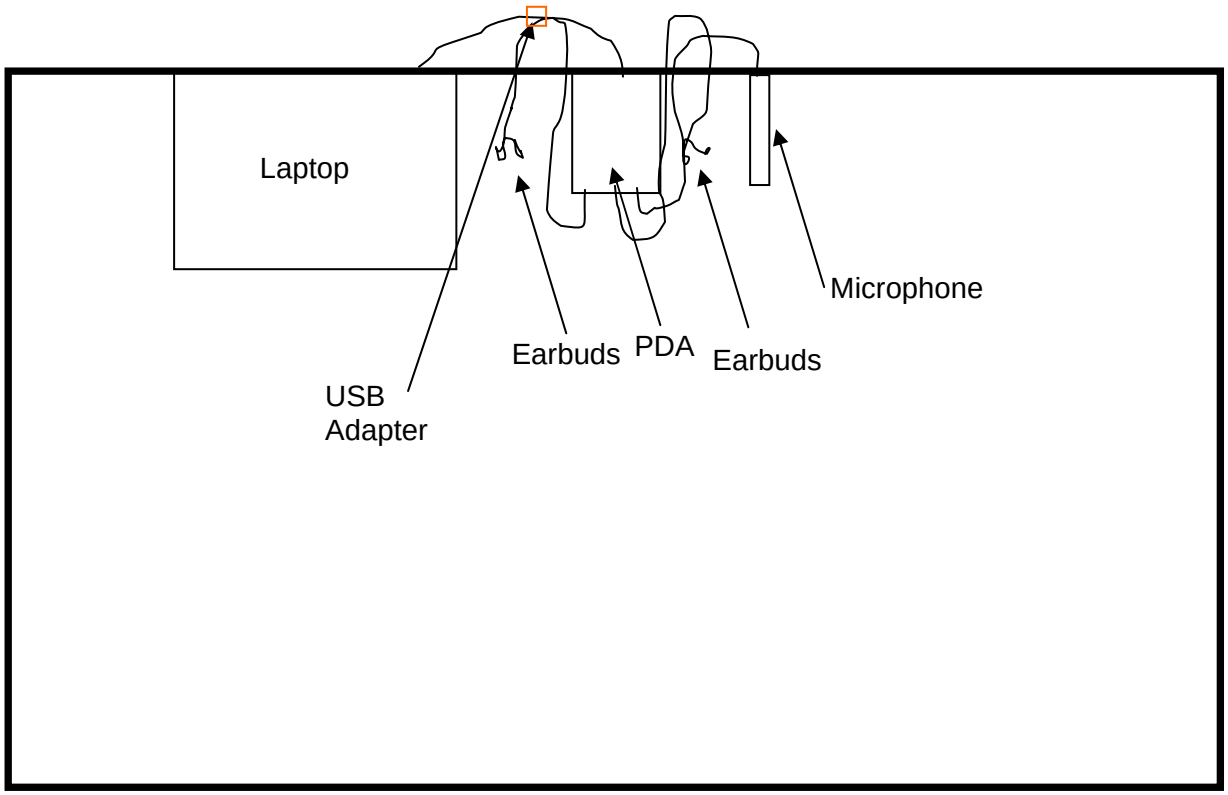


Figure 2-1: Configuration of System under Test

3 Peak Output Power - §15.247(b)(1); RSS-210 §A8.4

3.1 Power Output Test Procedure

A conducted power measurement of the EUT was taken using an Agilent 4416A EPM-P Series Power Meter with an E9323A Peak and Average Power Sensor.

Table 3-1: Power Output Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901184	Agilent Technologies	E4416A	EPM-P Power Meter, single channel	GB41050573	9/21/07
901356	Agilent Technologies	E9323A	Power Sensor	31764-264	9/21/07

3.2 Power Output Test Data

Table 3-2: Power Output Test Data - DSSS

Channel	Frequency (MHz)	Peak Power Conducted Output (dBm)*	Average Power Conducted Output (dBm)**
1	2412	19.5	17.4
6	2436	19.5	17.2
11	2462	19.4	17.1

** worst case power reported at 1 Mbps*
*** average power reported to compare with SAR testing, average power used per October 2006 guidance*

Table 3-3: Power Output Test Data - Bluetooth

Channel	Frequency (MHz)	Peak Power Conducted Output (dBm)
2	2402	-15.5
39	2436	-11.8
79	2462	-13.4

Test Personnel:

Daniel W. Baltzell		April 17, 2007
		November 8, 2006
Test Engineer	Signature	Dates Of Tests

4 Compliance with the Band Edge – FCC §15.247(d); RSS-210 §2.2

4.1 Band Edge Test Procedure

The transmitter output was connected to its appropriate antenna. Peak (1 MHz RBW/VBW) and average (1 MHz RBW/10 Hz VBW) radiated measurements were taken with a suitable span to encompass the peak of the fundamental. A delta measurement was performed from the highest peak in the restricted band to the peak of the fundamental, and subtracted from the field strength; the result was compared to the limit in the restricted band (54 dBuV/m).

Table 4-1: Band Edge Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	12/14/07
900878	Rhein Tech Labs	AM3-1197-0005	3 meter antenna mast, polarizing	Outdoor Range 1	Not Required
901426	Insulated Wire Inc.	KPS-1503-3600-KPS	RF cable, 30'	NA	12/5/07
901242	Rhein Tech Labs	WRT-000-0003	Wood rotating table	N/A	Not Required
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	5/20/07

4.2 Restricted Band Edge Test Results

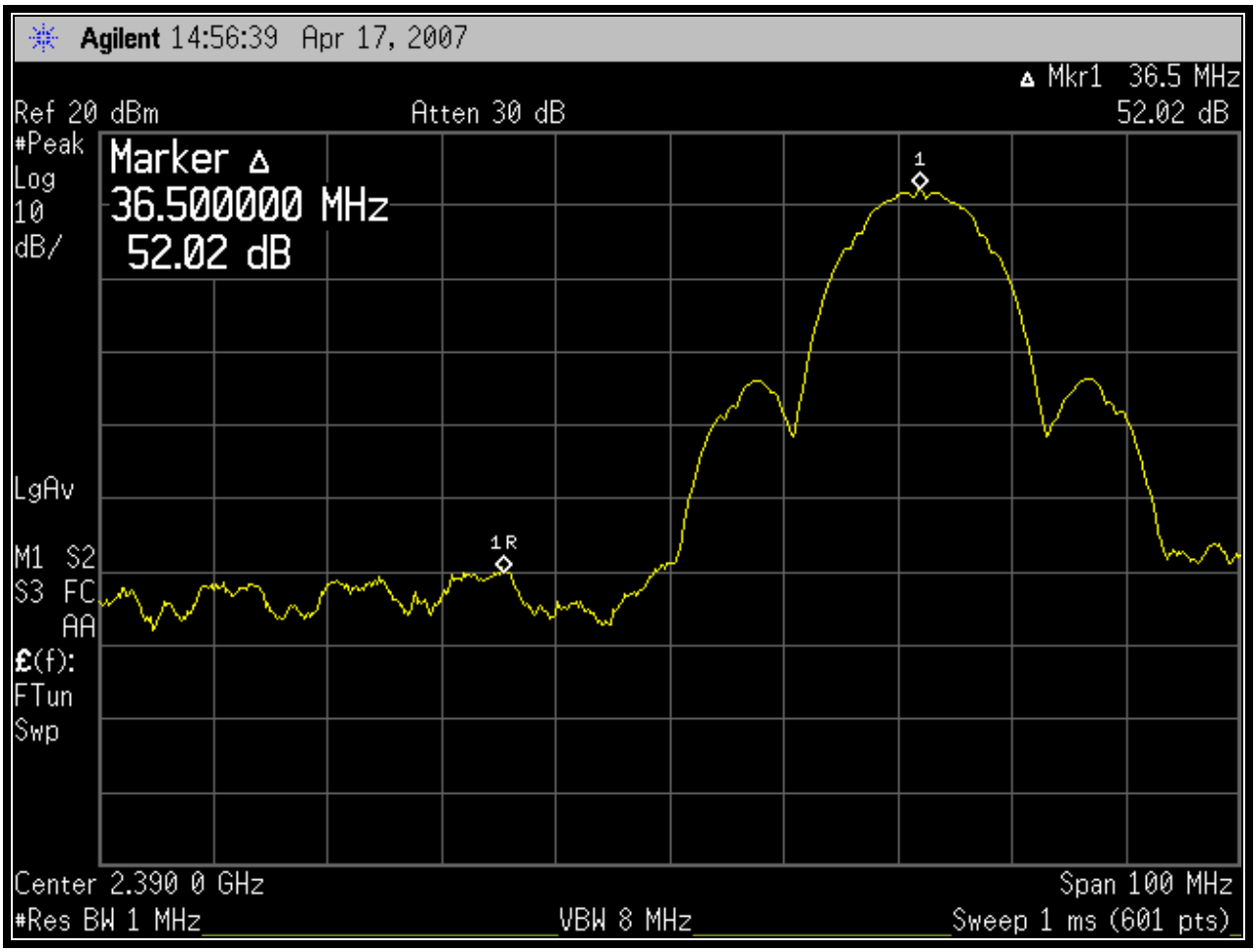
4.2.1 Calculation of Lower Band Edge DSSS

96.8 dBuV/m is the field strength measurement, from which the delta measurement of 52.0 dB is subtracted (reference plots), resulting in a level of 44.8 dB. This level has a margin of 9.2 dB below the limit of 54 dBuV/m.

Calculation: 96.8 dBuV/m – 52.0 dB – 54 dBuV/m = -9.2 dB

Peak Field Strength of Lower Band Edge (1 MHz RBW/1 MHz VBW) = 105.8 dBuV/m
Average Field Strength of Lower Band Edge (Pk less duty cycle -6.6 dB) = 96.8 dBuV/m
Delta measurement = 52.0 dB

Plot 4-1: Lower Band Edge: Channel 1 (TX Frequency: 2412 MHz); DSSS



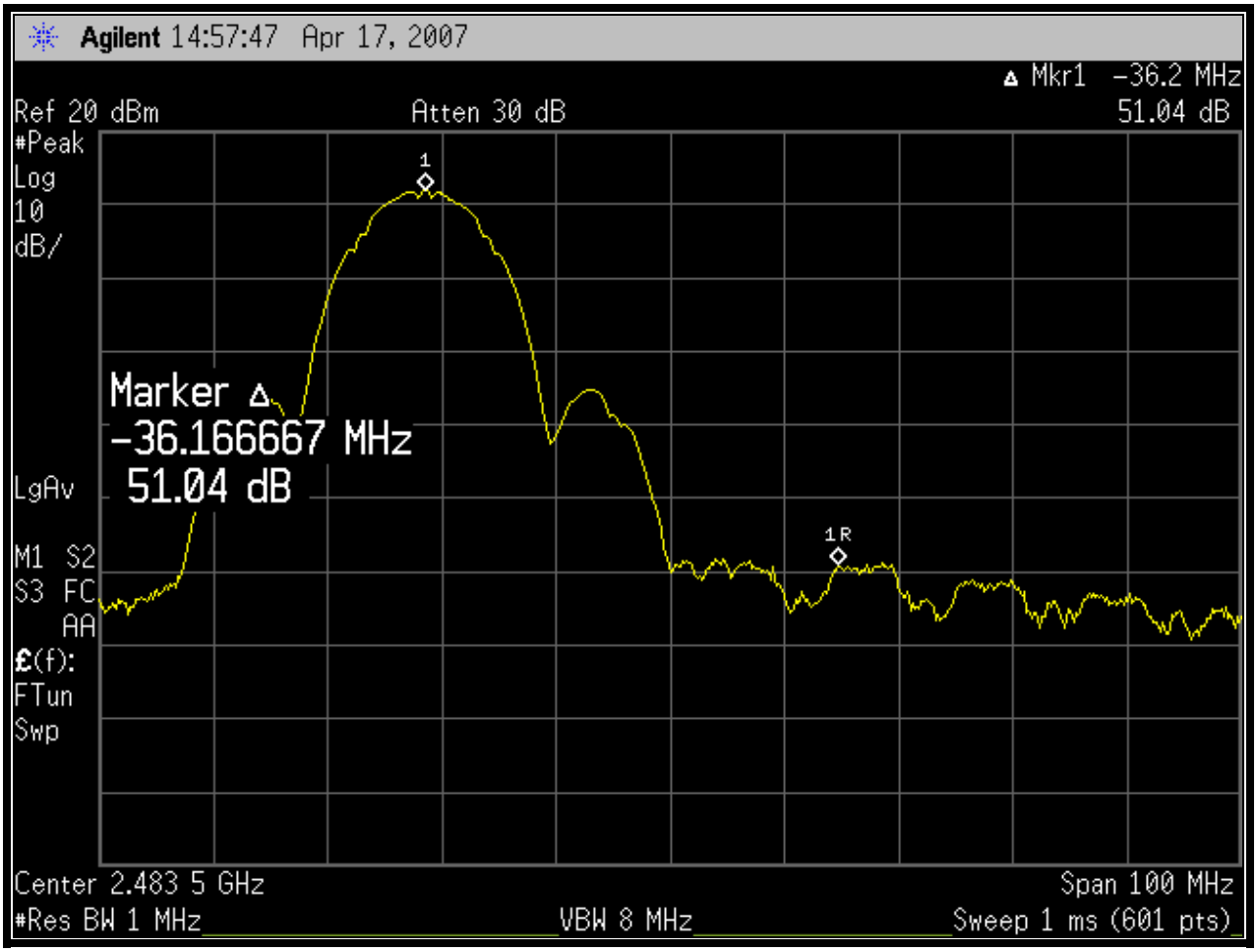
4.2.2 Calculation of Upper Band Edge DSSS

100.8 dBuV/m is the field strength measurement, from which the delta measurement of 51 dB is subtracted (reference plots), resulting in a level of 46.6 dB. This level has a margin of 7.4 dB below the limit of 54 dBuV/m.

Calculation: 100.8 dBuV/m – 51 dB – 54 dBuV/m = -4.2 dB

Peak Field Strength of Lower Band Edge (1 MHz RBW/1 MHz VBW) = 107.4 dBuV/m
Average Field Strength of Lower Band Edge (Pk less duty cycle -6.6 dB) =100.8 dBuV/m
Delta measurement = 51 dB

Plot 4-2: Upper Band Edge: Channel 11 (TX Frequency: 2462 MHz); DSSS



Test Personnel:

Daniel W. Baltzell	Daniel W. Baltzell	April 17, 2007
EMC Test Engineer	Signature	Date Of Test

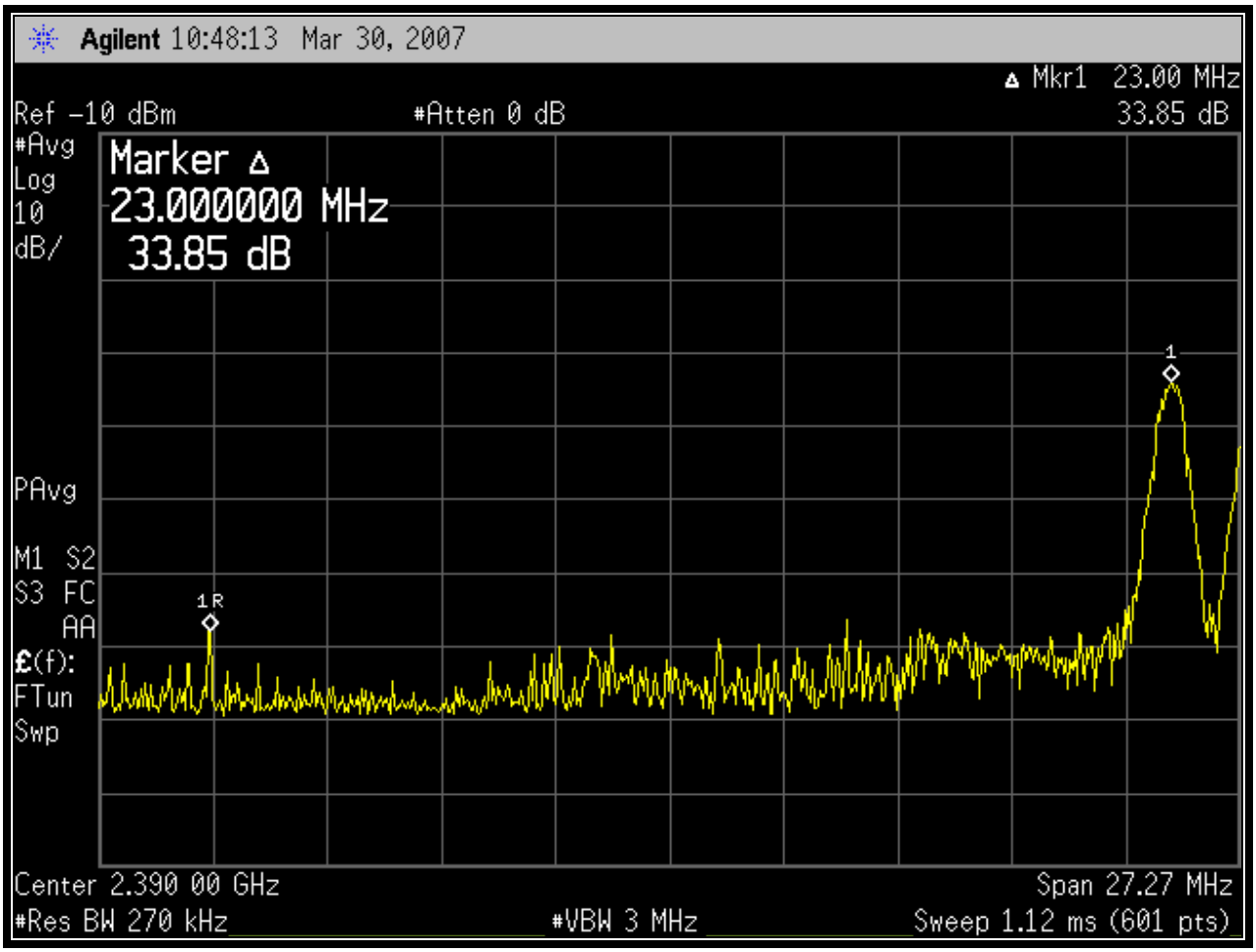
4.2.3 Calculation of Lower Band Edge Bluetooth

79.7 dBuV/m is the field strength measurement, from which the delta measurement of 33.9 dB is subtracted (reference plots), resulting in a level of 45.8 dB. This level has a margin of 8.2 dB below the limit of 54 dBuV/m.

Calculation: 79.7 dBuV/m – 33.9 dB – 54 dBuV/m = -8.2 dB

Peak Field Strength of Lower Band Edge (1 MHz RBW/1 MHz VBW) = 79.7 dBuV/m
Delta measurement = 33.9 dB
** note that a peak field strength is being compared to the average limit and is compliant*

Plot 4-3: Lower Band Edge: Channel 1 (TX Frequency: 2412 MHz); Bluetooth



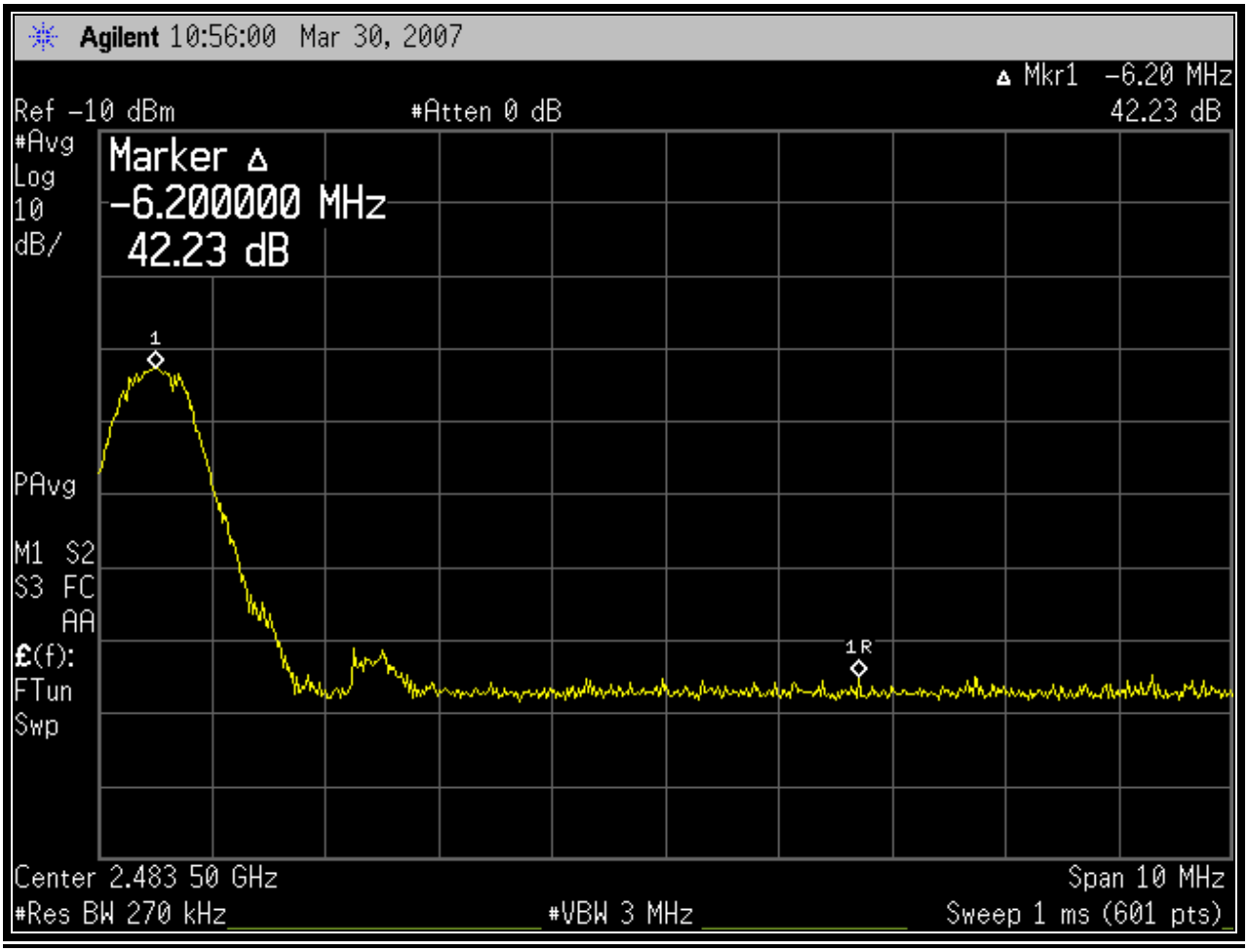
4.2.4 Calculation of Upper Band Edge Bluetooth

81.8 dBuV/m is the field strength measurement, from which the delta measurement of 42.2 dB is subtracted (reference plots), resulting in a level of 39.6 dB. This level has a margin of 14.4 dB below the limit of 54 dBuV/m.

Calculation: 81.8 dBuV/m – 42.2 dB – 54 dBuV/m = -14.4 dB

Peak Field Strength of Lower Band Edge (1 MHz RBW/1 MHz VBW) = 81.8 dBuV/m
Delta measurement = 42.2 dB
** note that a peak field strength is being compared to the average limit and is compliant*

Plot 4-4: Upper Band Edge: Channel 11 (TX Frequency: 2462 MHz); Bluetooth



Test Personnel:

Daniel W. Baltzell		March 30, 2007
EMC Test Engineer	Signature	Date Of Test

5 Antenna Conducted Spurious Emissions - §15.247(d); RSS-210 §A8.5

5.1 Antenna Conducted Spurious Emissions Test Procedures

Antenna conducted spurious emissions per FCC 15.247(c) were measured from the EUT antenna port using a 50 ohm spectrum analyzer with the resolution bandwidth set at 100 kHz, and the video bandwidth set at 1 MHz. The modulated carrier was identified at the following frequencies: 2412 MHz, 2436 MHz and 2462 MHz.

Table 5-1: Antenna Conducted Spurious Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	12/14/07

5.2 Antenna Conducted Spurious Emissions Test Results

Table 5-2: Antenna Conducted Spurious Emissions (2412 MHz)

Frequency (MHz)	Amplitude Measured (dBm)	Limit (20 dBc)	Margin (dB)
2412.0	7.7		Fundamental
4824.0	-27.4	-12.3	-15.1
7236.0	-39.3	-12.3	-27.0
9648.0	-41.9	-12.3	-29.6
12060.0	-74.9	-12.3	-62.6
14472.0	-57.6	-12.3	-45.3
16884.0	-74.8	-12.3	-62.5
19296.0	-70.5	-12.3	-58.2
21708.0	-72.5	-12.3	-60.2
24120.0	-67.6	-12.3	-55.3

Table 5-3: Antenna Conducted Spurious Emissions (2436 MHz)

Frequency (MHz)	Amplitude Measured (dBm)	Limit (20 dBc)	Margin (dB)
2436.0	8.4		Fundamental
4872.0	-27.7	-11.6	-16.1
7308.0	-39.5	-11.6	-27.9
9744.0	-42.9	-11.6	-31.3
12180.0	-76.5	-11.6	-64.9
14616.0	-56.7	-11.6	-45.1
17052.0	-73.2	-11.6	-61.6
19488.0	-69.2	-11.6	-57.6
21924.0	-72.9	-11.6	-61.3
24360.0	-72.9	-11.6	-61.3

Table 5-4: Antenna Conducted Spurious Emissions (2462 MHz)

Frequency (MHz)	Amplitude Measured (dBm)	Limit (20 dBc)	Margin (dB)
2462.0	8.7		Fundamental
4924.0	-27.5	-11.3	-16.2
7386.0	-38.8	-11.3	-27.5
9848.0	-42.1	-11.3	-30.8
12310.0	-77.6	-11.3	-66.3
14772.0	-56.4	-11.3	-45.1
17234.0	-72.8	-11.3	-61.5
19696.0	-68.0	-11.3	-56.7
22158.0	-72.3	-11.3	-61.0
24620.0	-71.9	-11.3	-60.6

Test Personnel:

Daniel W. Baltzell		April 17, 2007
EMC Test Engineer	Signature	Date Of Test

6 6 dB Bandwidth - §15.247(a)(2); RSS-210 §A8.2(1) - DSSS

6.1 6 dB Bandwidth Test Procedure – Minimum 6 dB Bandwidth

The minimum 6 dB bandwidths per FCC 15.247(a)(2) were measured using a 50 ohm spectrum analyzer with the resolution bandwidth set at 100 kHz, and the video bandwidth set at 1 MHz. The device was modulated. The minimum 6 dB bandwidths are presented below.

Table 6-1: 6 dB Bandwidth Test Equipment

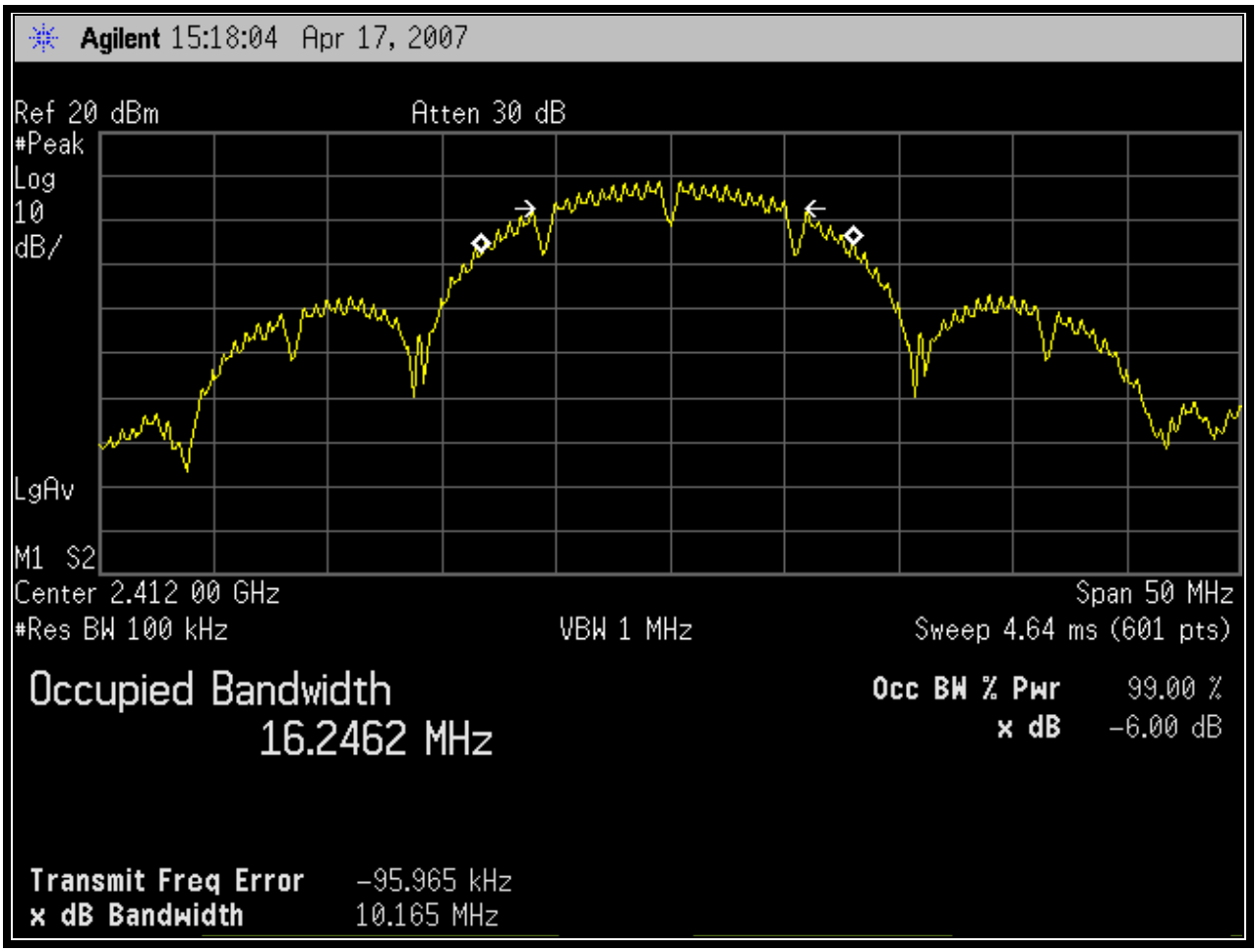
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz - 22 GHz)	3138A07771	9/13/07

6.2 6 db Bandwidth Test Results

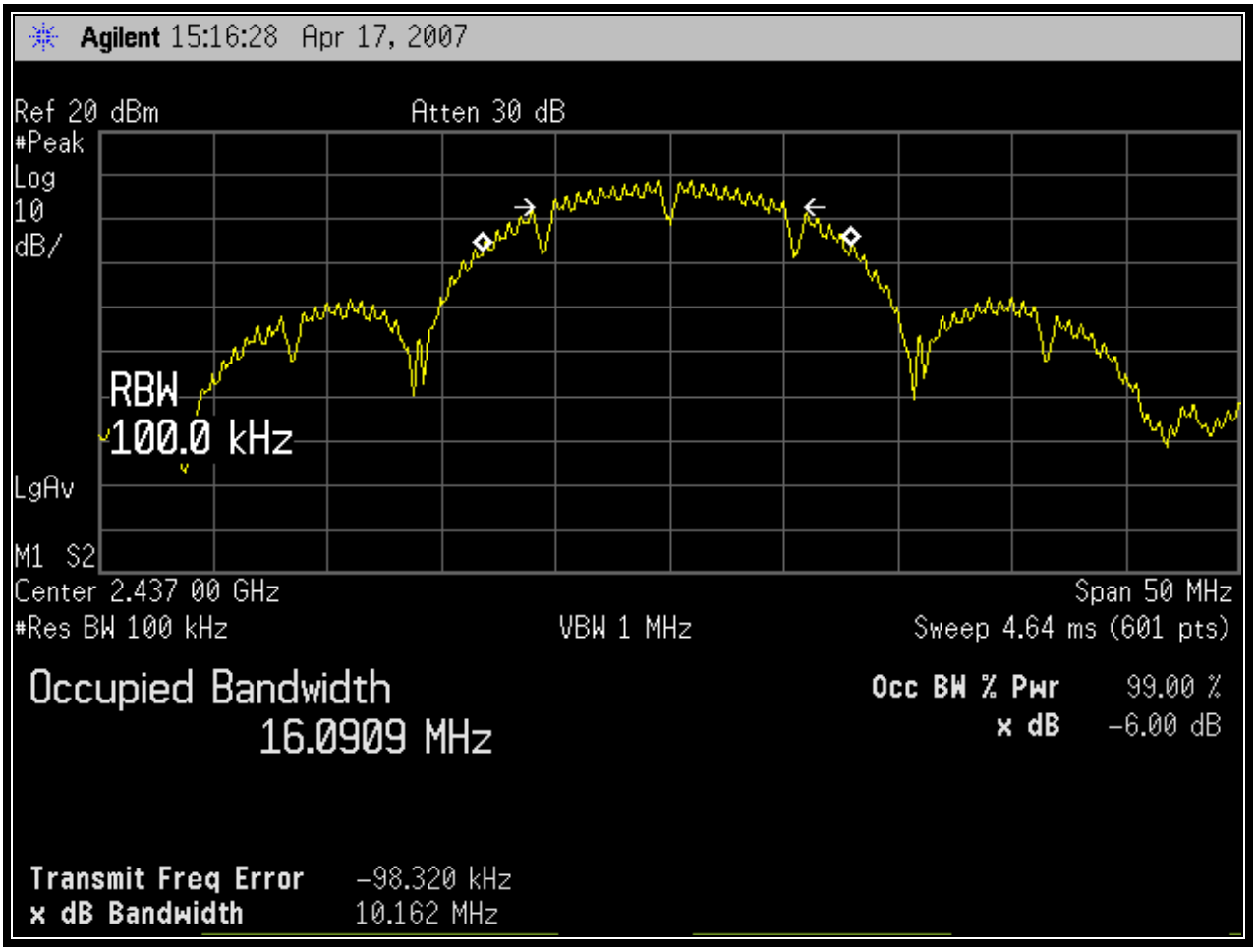
Table 6-2: 6 db Bandwidth Test Data

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass/Fail
0	2412	10.2	0.5	Pass
6	2437	10.2	0.5	Pass
15	2462	10.2	0.5	Pass

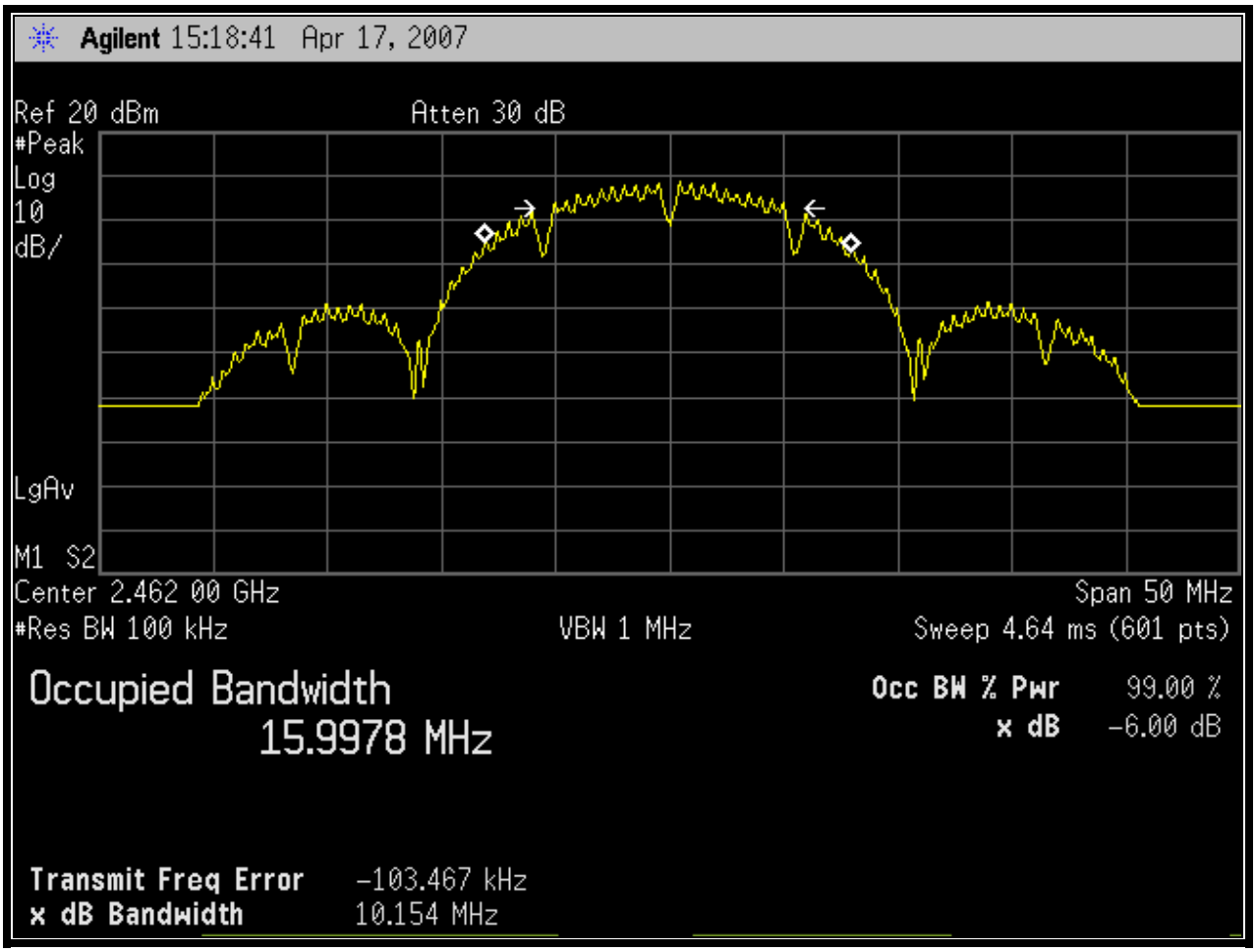
Plot 6-1: 6 dB Bandwidth Channel 1 (TX Frequency: 2412 MHz)



Plot 6-2: 6 dB Bandwidth Channel 6 (TX Frequency: 2436 MHz)



Plot 6-3: 6 dB Bandwidth Channel 11 (TX Frequency: 2462 MHz)



Test Personnel:

Daniel W. Baltzell		April 17, 2007
EMC Test Engineer	Signature	Date Of Test

7 Carrier Frequency Separation - §15.247(a)(1) ; RSS-210 §A8.1(2) - Bluetooth

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.

Table 7-1: Carrier Frequency Separation Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz - 22 GHz)	3138A07771	9/13/07

Measured frequency separation = 1.001 MHz

Plot 7-1: Carrier Frequency Separation

Test Personnel:

Daniel W. Baltzell	Daniel W. Baltzell	March 30, 2007
EMC Test Engineer	Signature	Date Of Test

8 20 dB Bandwidth Test Procedure – FCC §15.247(a)(1); IC RSS-210 §A8.1(1) - Bluetooth

The minimum 20 dB bandwidths per RSS-210 were measured using a 50 ohm spectrum analyzer. The carrier was adjusted on the analyzer so that it was displayed entirely on the spectrum analyzer. The sweep time was set to 10 seconds and allowed through several sweeps with the max hold function used in peak detector mode. The resolution bandwidth was set to 100 kHz, and the video bandwidth set at 300 kHz. The minimum 20 dB bandwidths were measured using the spectrum analyzer delta marker set 20 dB down from the peak of the carrier and modulated with a 2 Mbps data rate. The table below contains the bandwidth measurement results.

Table 8-1 20 dB Bandwidth Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	12/14/07

Table 8-2 Modulated Bandwidth Test Data

Minimum 20 dB bandwidths

Channel	20 dB Bandwidth (kHz)
2	820
40	860
80	805

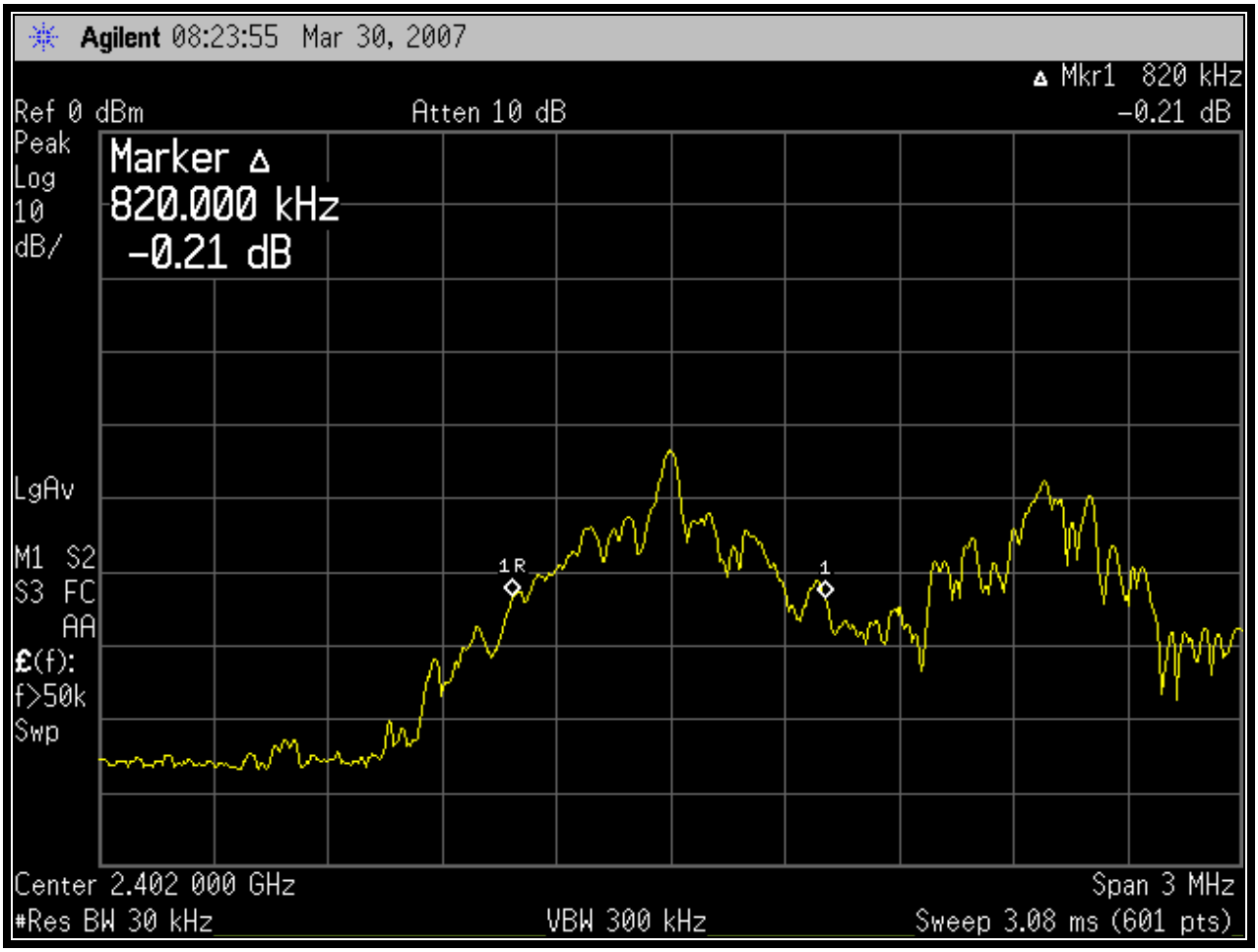
Test Personnel:

Daniel W. Baltzell		March 30, 2007
EMC Test Engineer	Signature	Date Of Test

20 dB Bandwidth Plots

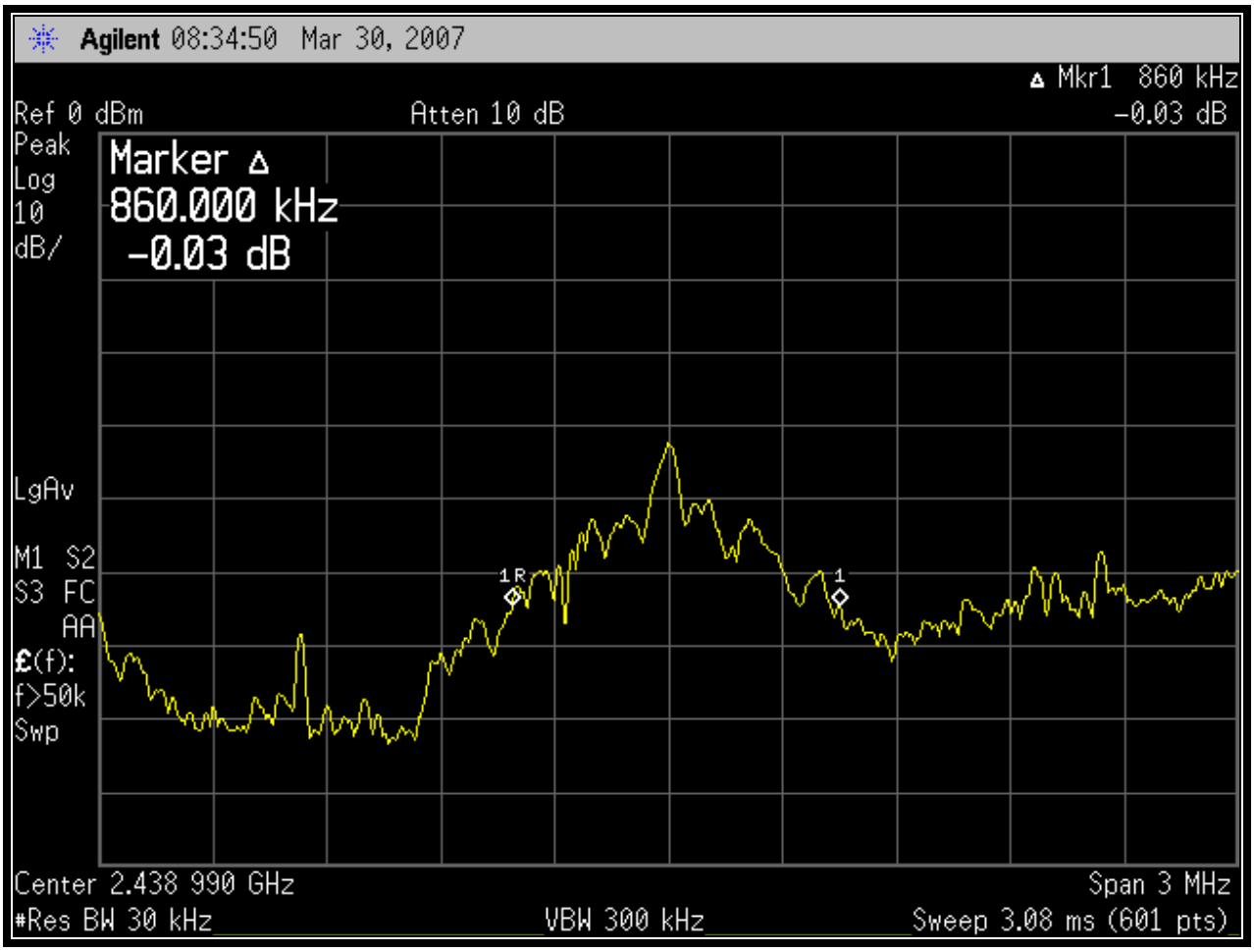
Channel:	2
Channel Frequency (MHz):	2402
Resolution Bandwidth (kHz):	30
Video Bandwidth (kHz):	300
Span (MHz):	3

Plot 8-1: 20 dB Bandwidth Channel 2



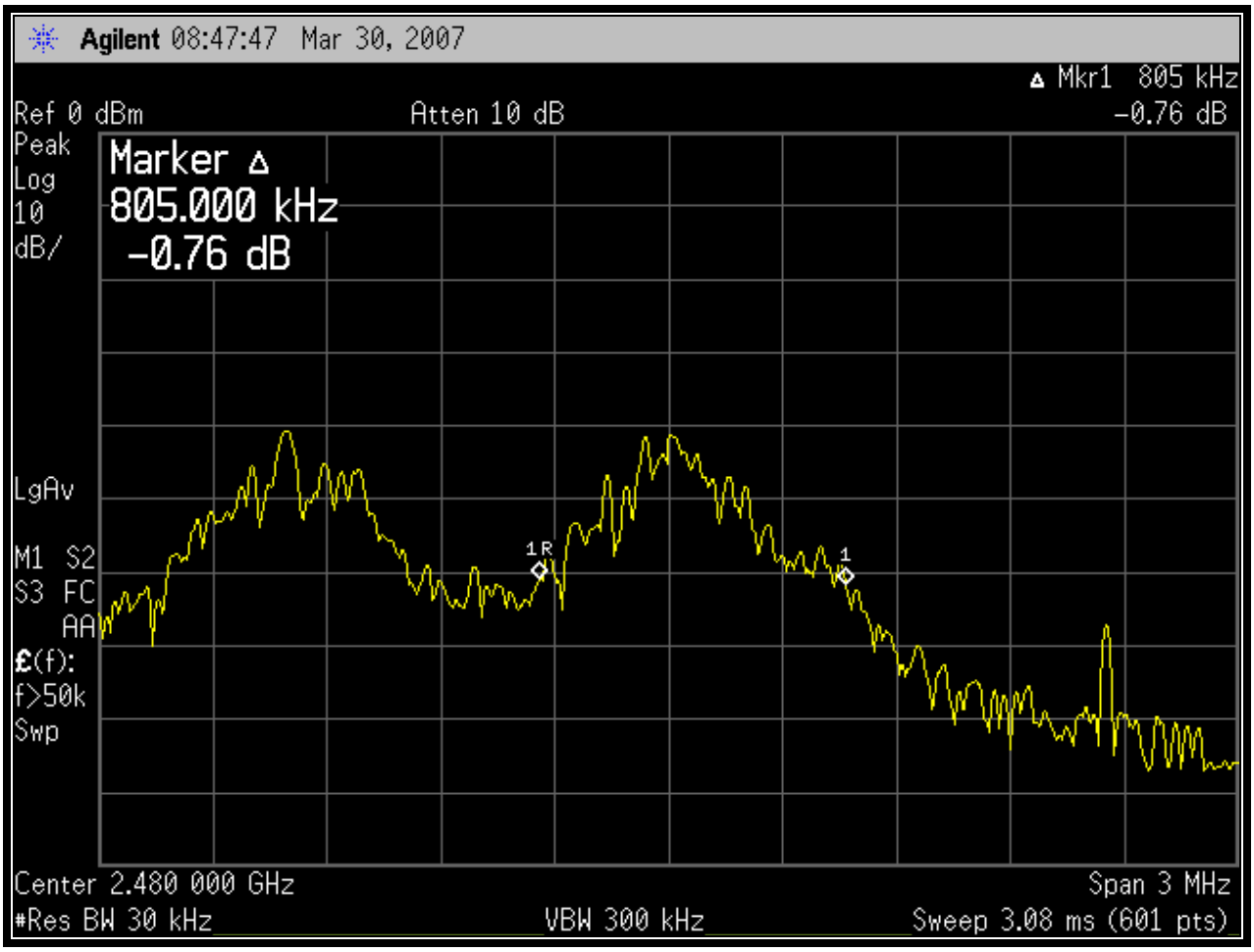
Channel:	40
Channel Frequency (MHz):	2439
Resolution Bandwidth (kHz):	30
Video Bandwidth (kHz):	300
Span (MHz):	3

Plot 8-2: 20 dB Bandwidth Channel 40



Channel:	80
Channel Frequency (MHz):	2480
Resolution Bandwidth (kHz):	30
Video Bandwidth (kHz):	300
Span (MHz):	3

Plot 8-3: 20 dB Bandwidth Channel 80



Test Personnel:

Daniel W. Baltzell	Daniel W. Baltzell	March 30, 2007
EMC Test Engineer	Signature	Date Of Test

9 Hopping Characteristics – FCC §15.247(a)(1)(iii); IC RSS-210 §A8.1(4) - Bluetooth

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. 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. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

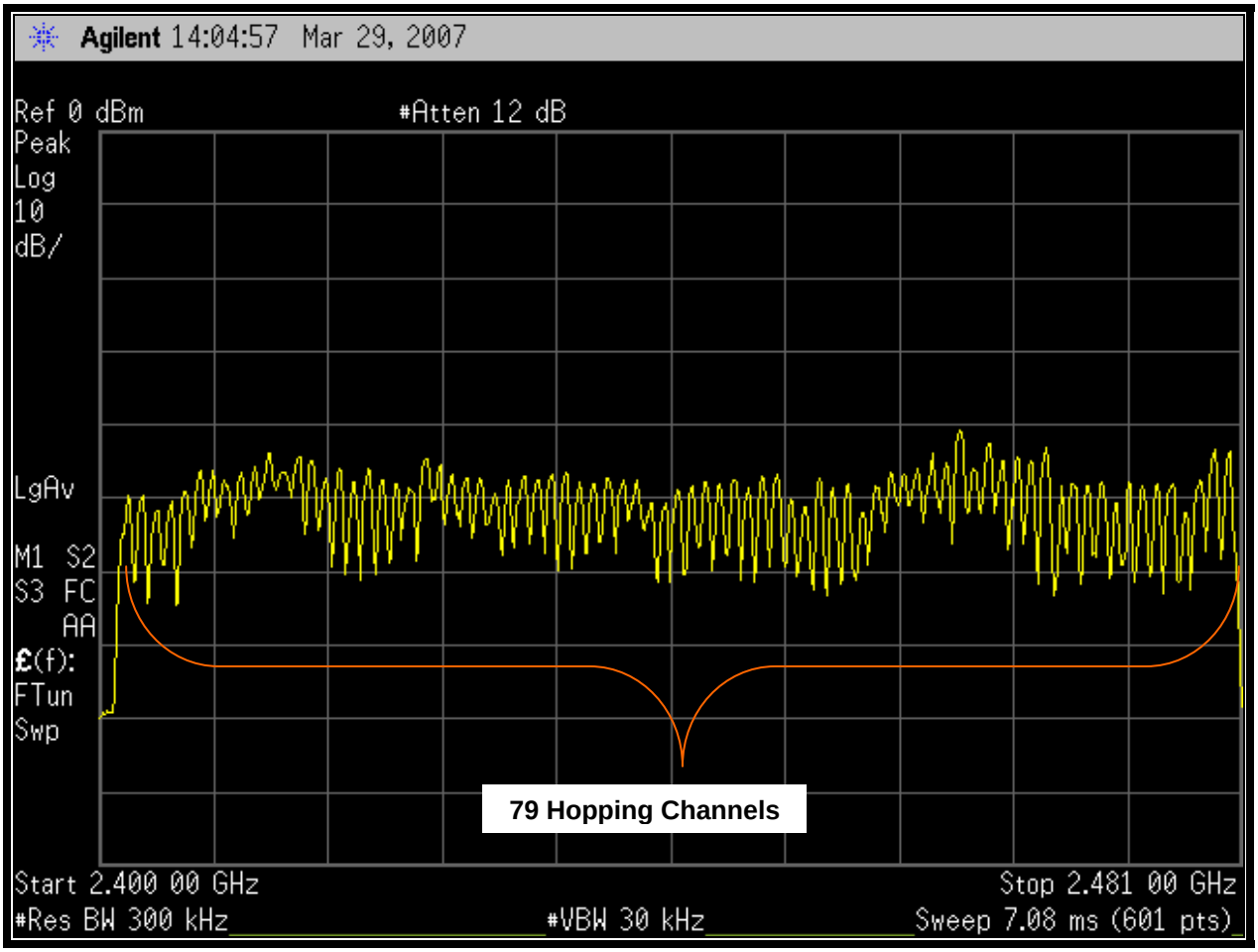
Table 9-1: Hopping Characteristics Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	12/14/07

9.1 Number of Hopping Frequencies

Measured number of hopping frequencies = 79

Plot 9-1: Number of Hopping Frequencies



9.2 Average Time of Occupancy

The spectrum analyzer sweep was set to video trigger, and a zero span until a pulse from the device under test was captured. The sweep was then set to single sweep for 400 ms, the number of pulses counted, and then interpolated to the required 31.6 s average time. The average time of occupancy on any channel shall not be greater than 0.4 s within a period of 0.4 s multiplied by the number of hopping channels employed.

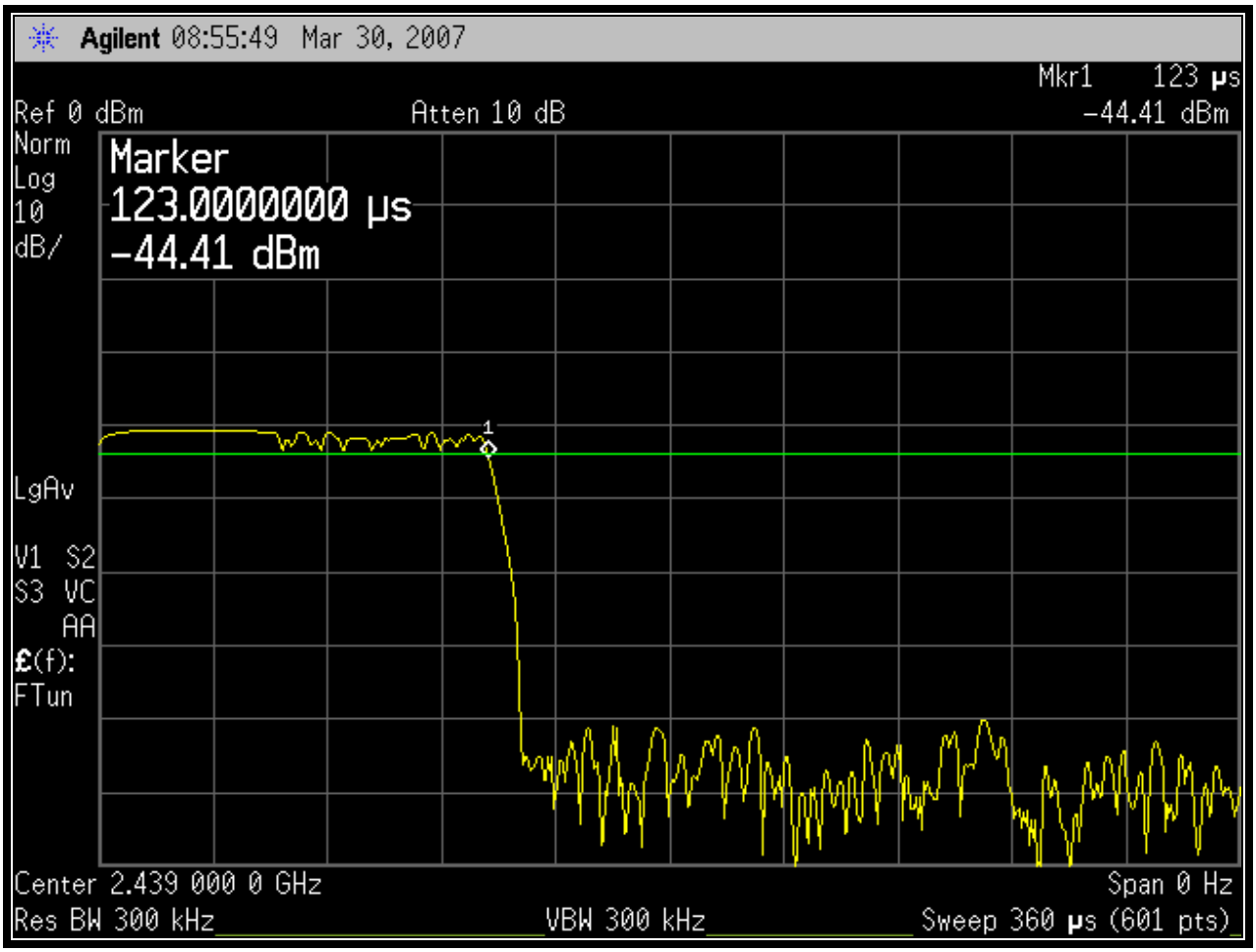
0.4 s x 79 channels = 31.6 s per channel

40 pulses in 0.4 s. or 31.6/0.4 * 40 = 3160 pulses in 31.6 s

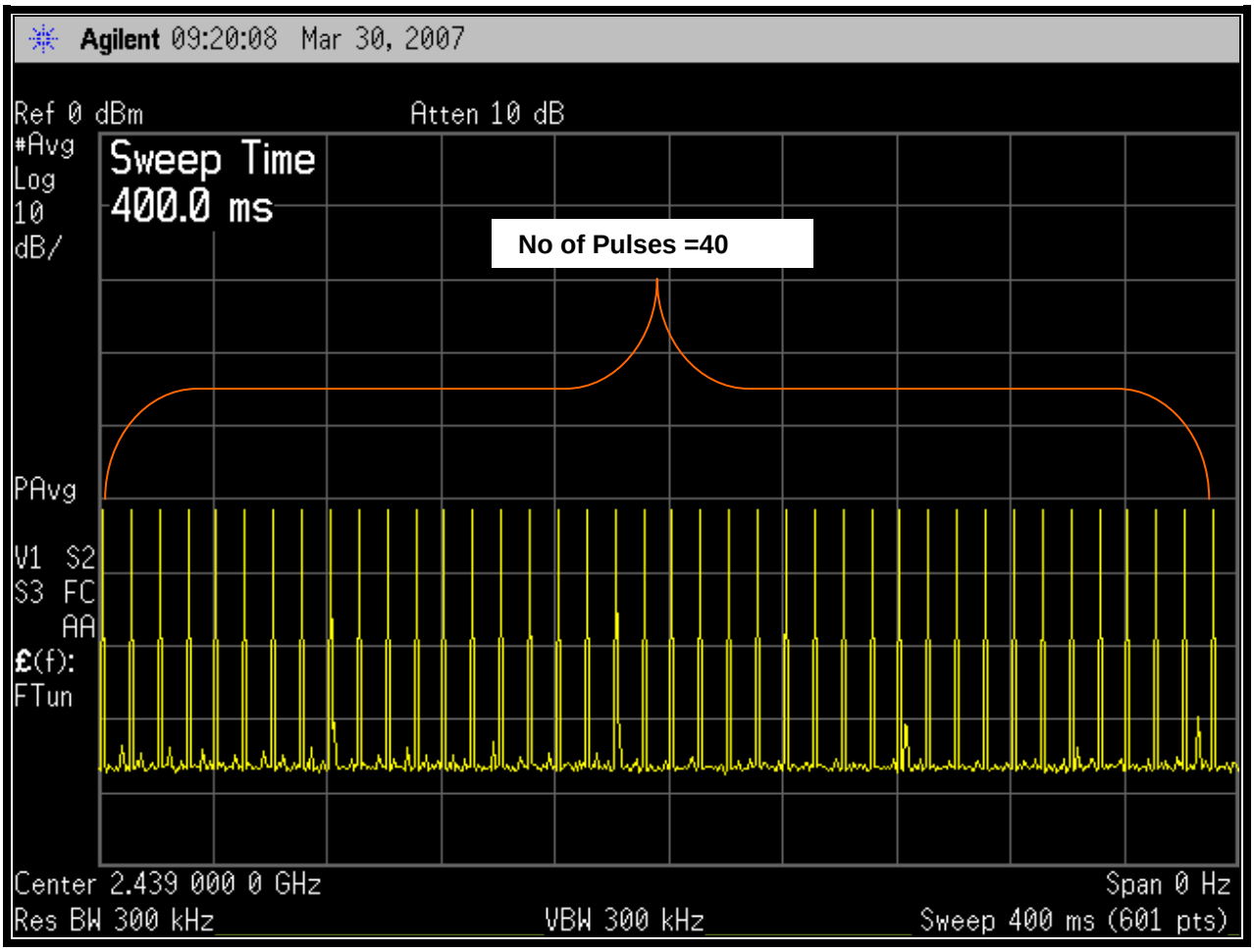
Dwell Time Measured = 123 µs

3160 pulses * 123 µs = 0.39 s occupancy in 31.6 s, which meets the criteria.

Plot 9-2: Time of Occupancy (Dwell Time)



Plot 9-3: Time of Occupancy (Dwell Time 400 mS Sweep)



Test Personnel:

Daniel W. Baltzell	Daniel W. Baltzell	March 29 & 30, 2007
EMC Test Engineer	Signature	Dates Of Tests

10 Power Spectral Density - §15.247(e); RSS-210 §A8.2(2) - DSSS

10.1 Power Spectral Density Test Procedure

The power spectral density per FCC 15.247(d) was measured using a 50 ohm spectrum analyzer with the resolution bandwidth set at 3 kHz, the video bandwidth set at 30 kHz, and the sweep time set at 500 seconds. The spectral lines were resolved for the modulated carriers at 2.412 GHz, 2.436 GHz, and 2.462 GHz respectively. These levels are below the +8 dBm limit. See the power spectral density table and plots.

Table 10-1: Power Spectral Density Test Equipment

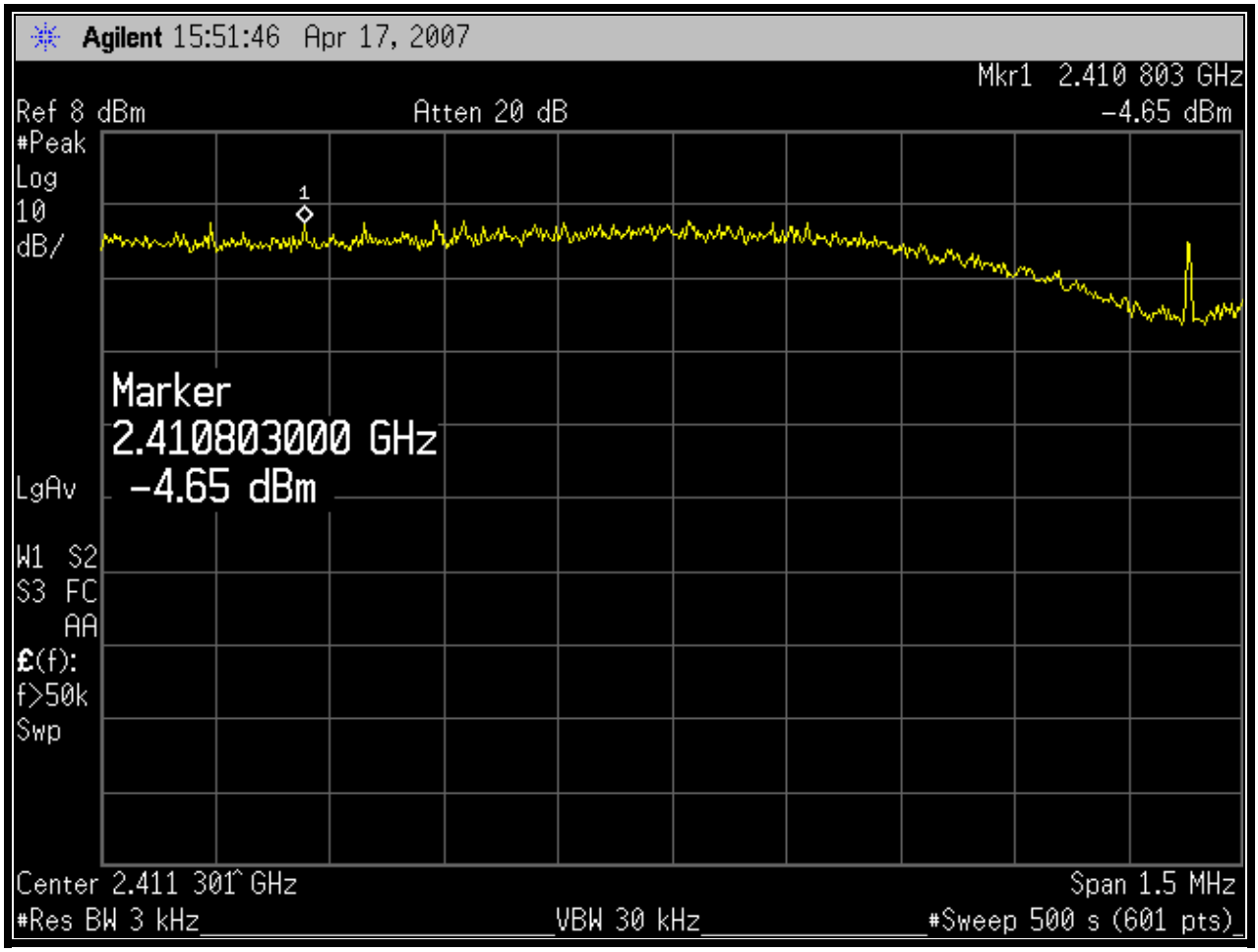
RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
901413	Agilent Technologies	E4448A	Spectrum Analyzer	US44020346	12/14/07

10.2 Power Spectral Density Test Data

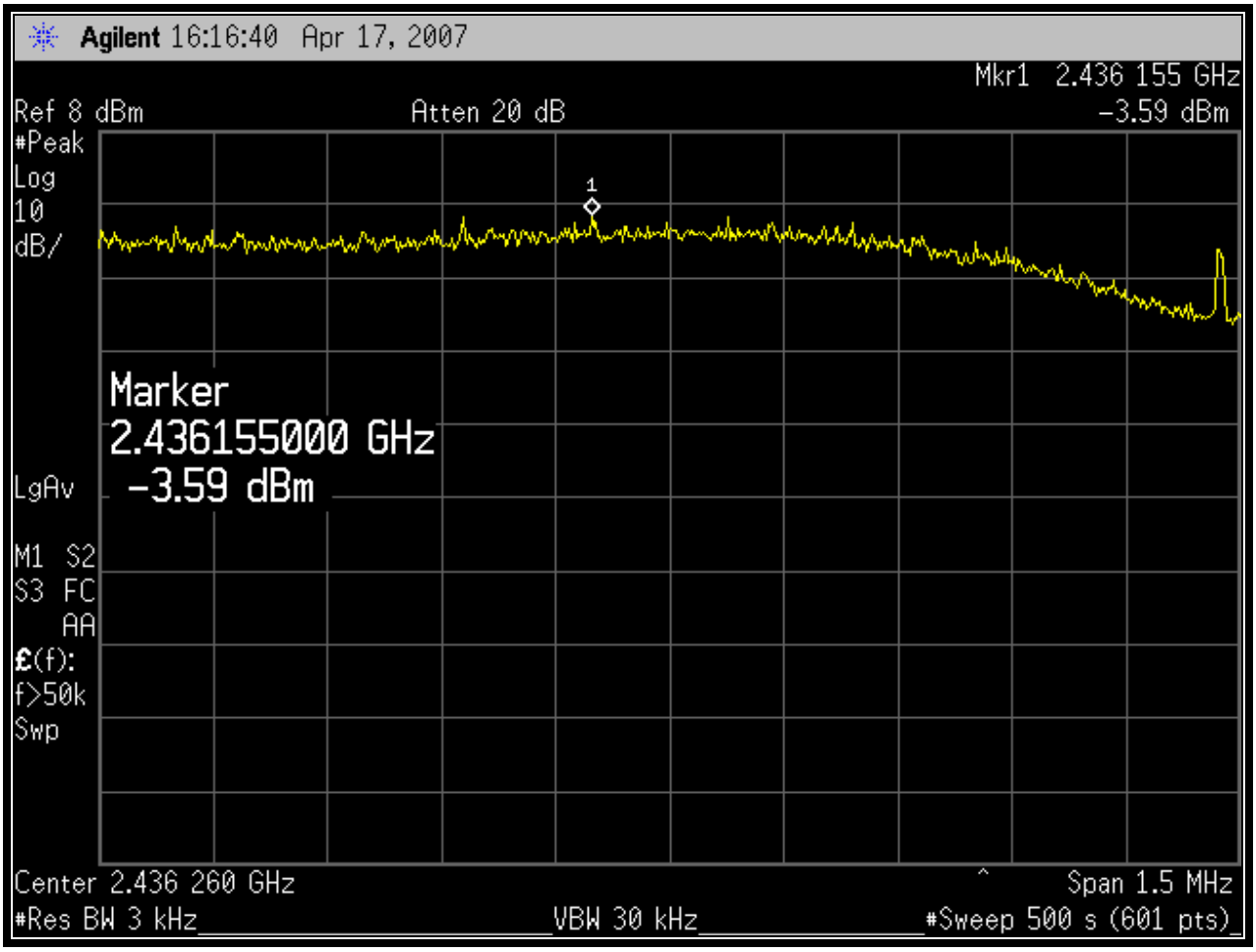
Table 10-2: Power Spectral Density Test Data

Channel	Frequency (MHz)	RF Power Level (dBm)	Maximum Limit +8dBm	Pass/Fail
1	2412	-4.7	8	Pass
6	2436	-3.6	8	Pass
11	2462	-4.4	8	Pass

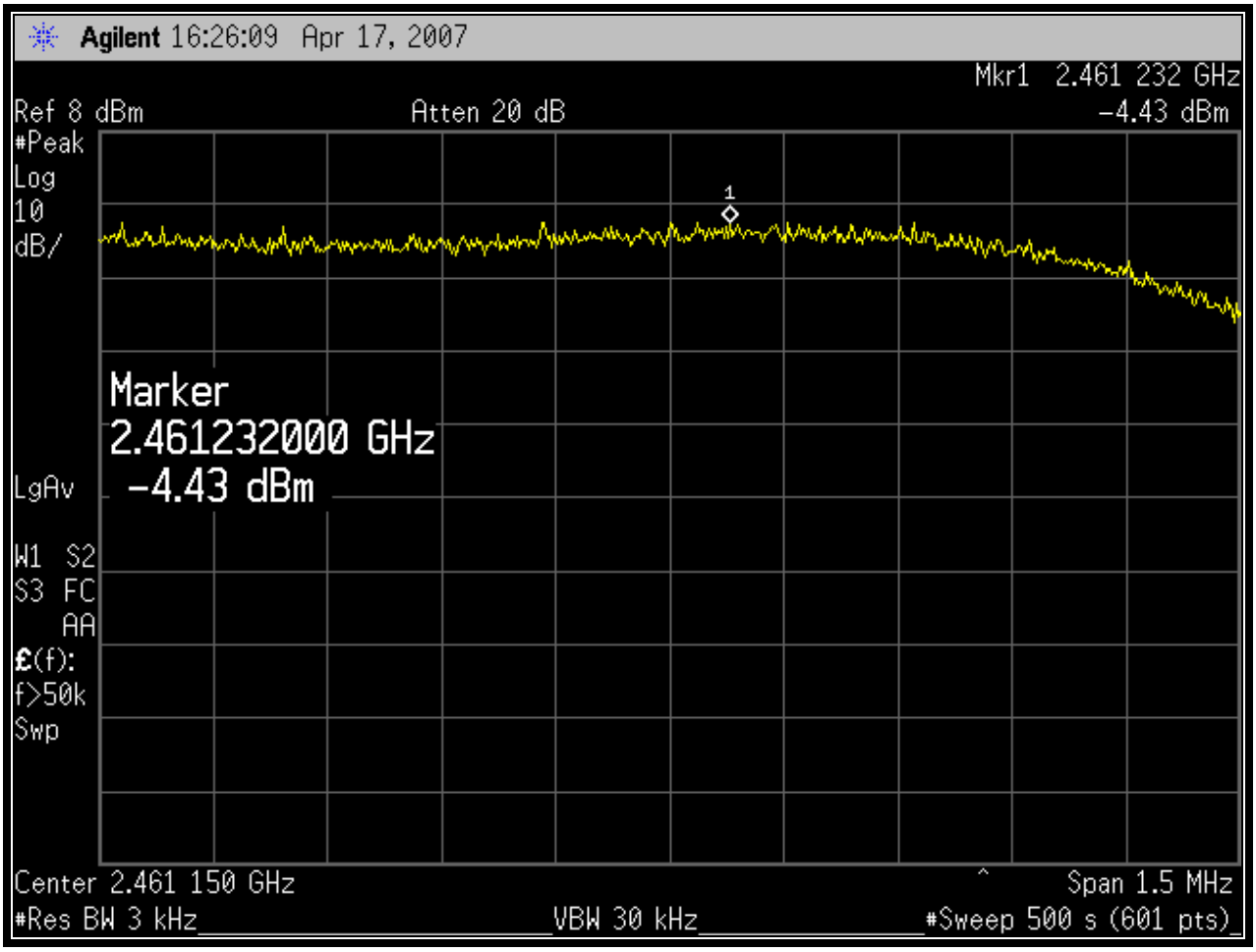
Plot 10-1: Power Spectral Density: Channel 1 (2412 MHz)



Plot 10-2: Power Spectral Density: Channel 6 (2436 MHz)



Plot 10-3: Power Spectral Density: Channel 11 (2462 MHz)



Test Personnel:

Daniel W. Baltzell	Daniel W. Baltzell	April 17, 2007
EMC Test Engineer	Signature	Date Of Test

11 Conducted Limits - §15.207; RSS-Gen

The conducted test was performed with the EUT exercised in center channel transmit and receive modes, and the emissions were scanned between 150 kHz to 30 MHz on the NEUTRAL SIDE and PHASE SIDE.

11.1 Limits of Conducted Emissions Measurement

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66-56	56-46
0.5-5.0	56	46
5.0-30.0	60	50

11.2 Conducted Emissions Measurement Test Procedure

The power line conducted emission measurements were performed in a Series 81 type shielded enclosure manufactured by Rayproof. The EUT was assembled on a wooden table 80 centimeters high. Power was fed to the EUT through a 50 ohm / 50 microhenry Line Impedance Stabilization Network (EUT LISN). The EUT LISN was fed power through an A.C. filter box on the outside of the shielded enclosure. The filter box and EUT LISN housing are bonded to the ground plane of the shielded enclosure. A second LISN, the peripheral LISN, provides isolation for the EUT test peripherals. This peripheral LISN was also fed A.C. power. A metal power outlet box, which is bonded to the ground plane and electrically connected to the peripheral LISN, powers the EUT host peripherals.

The spectrum analyzer was connected to the A.C. line through an isolation transformer. The 50 ohm output of the EUT LISN was connected to the spectrum analyzer input through a Solar high-pass filter. The filter is used to prevent overload of the spectrum analyzer from noise below 100 kHz. Conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or peak mode if applicable). The analyzer's 6 dB bandwidth was set to 9 kHz. No video filter less than 10 times the resolution bandwidth was used. Average measurements are performed in linear mode using a 10 kHz resolution bandwidth, a 1 Hz video bandwidth, and by increasing the sweep time in order to obtain a calibrated measurement. The emission spectrum was scanned from 150 kHz to 30 MHz. The highest emission amplitudes relative to the appropriate limit were measured and have been recorded in this report.

Note: Rhein Tech Laboratories, Inc. has implemented procedures to minimize errors that occur from test instruments, calibration, procedures, and test setups. Test instrument and calibration errors are documented from the manufacturer or calibration lab. Other errors have been defined and calculated within the Rhein Tech Quality Manual, Section 6.1. Rhein Tech implements the following procedures to minimize errors that may occur: yearly as well as daily calibration methods, technician training, and emphasis to employees on avoiding error.

Table 11-1: Conducted Line Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900968	Hewlett Packard	8567A	HP Spectrum Analyzer (10 KHz - 1.5 GHz)	2727A00535	8/14/07
900339	Hewlett Packard	85650A	Quasi-Peak Adapter (30 Hz - 1 GHz)	3145A01599	8/14/07
901084	AFJ International	LS16	16A LISN	16010020082	8/14/07

11.3 Conducted Line Emissions Test Data

Table 11-2: Conducted Emissions (Neutral Side); Transmit Mode

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)	AV Limit (dBuV)	AV Margin (dBuV)
0.165	Av	30.1	0.2	30.3			55.2	-24.9
0.165	Qp	49.6	0.2	49.8	65.2	-15.4		
0.241	Av	24.8	0.2	25.0			52.1	-27.1
0.241	Qp	46.1	0.2	46.3	62.1	-15.8		
0.303	Av	23.3	0.3	23.6			50.2	-26.6
0.303	Qp	42.1	0.3	42.4	60.2	-17.8		
0.356	Av	27.8	0.3	28.1			48.8	-20.7
0.356	Qp	44.8	0.3	45.1	58.8	-13.7		
0.648	Av	26.8	0.2	27.0			46.0	-19.0
0.648	Qp	43.0	0.2	43.2	56.0	-12.8		
1.067	Av	23.2	0.4	23.6			46.0	-22.4
1.067	Qp	38.5	0.4	38.9	56.0	-17.1		
5.094	Av	26.2	1.6	27.8			50.0	-22.2
5.094	Qp	40.9	1.6	42.5	60.0	-17.5		
24.060	Pk	43.9	2.8	46.7			50.0	-3.3

Table 11-3: Conducted Emissions (Phase Side); Transmit Mode

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)	AV Limit (dBuV)	AV Margin (dBuV)
0.194	Av	39.2	0.2	39.4			53.9	-14.5
0.194	Qp	49.9	0.2	50.1	63.9	-13.8		
0.259	Av	38.9	0.2	39.1			51.5	-12.4
0.259	Qp	50.2	0.2	50.4	61.5	-11.1		
0.324	Av	32.9	0.3	33.2			49.6	-16.4
0.324	Qp	44.6	0.3	44.9	59.6	-14.7		
0.668	Av	27.4	0.2	27.6			46.0	-18.4
0.668	Qp	43.7	0.2	43.9	56.0	-12.1		
5.560	Av	31.3	1.5	32.8			50.0	-17.2
5.560	Qp	42.7	1.5	44.2	60.0	-15.8		
23.780	Pk	44.1	2.8	46.9			50.0	-3.1

Table 11-4: Conducted Emissions (Neutral Side); Receive Mode

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)	AV Limit (dBuV)	AV Margin (dBuV)
0.195	Av	39.6	0.2	39.8			53.8	-14.0
0.195	Qp	52.1	0.2	52.3	63.8	-11.5		
0.293	Av	34.2	0.3	34.5			50.4	-15.9
0.293	Qp	48.0	0.3	48.3	60.4	-12.1		
0.391	Av	34.7	0.2	34.9			48.0	-13.1
0.391	Qp	49.2	0.2	49.4	58.0	-8.6		
0.683	Av	34.2	0.2	34.4			46.0	-11.6
0.683	Qp	49.8	0.2	50.0	56.0	-6.0		
5.209	Av	33.7	1.6	35.3			50.0	-14.7
5.209	Qp	49.4	1.6	51.0	60.0	-9.0		
23.250	Pk	44.5	2.9	47.4			50.0	-2.6

Table 11-5: Conducted Emissions (Phase Side); Receive Mode

Emission Frequency (MHz)	Test Detector	Analyzer Reading (dBuV)	Site Correction Factor (dB)	Emission Level (dBuV)	QP Limit (dBuV)	QP Margin (dBuV)	AV Limit (dBuV)	AV Margin (dBuV)
0.162	Av	29.4	0.2	29.6			55.4	-25.8
0.162	Qp	46.6	0.2	46.8	65.4	-18.6		
0.230	Av	31.3	0.2	31.5			52.4	-20.9
0.230	Qp	45.9	0.2	46.1	62.4	-16.3		
0.390	Av	29.5	0.2	29.7			48.1	-18.4
0.390	Qp	43.4	0.2	43.6	58.1	-14.5		
1.304	Av	28.3	0.6	28.9			46.0	-17.1
1.304	Qp	40.8	0.6	41.4	56.0	-14.6		
5.177	Av	26.4	1.6	28.0			50.0	-22.0
5.177	Qp	41.5	1.6	43.1	60.0	-16.9		
23.500	Pk	44.5	2.8	47.3			50.0	-2.7

Test Personnel:

Daniel W. Baltzell		November 9, 2006
EMC Test Engineer	Signature	Date Of Test

12 Radiated Emissions - §15.209; RSS-210 §A8.5 and RSS-Gen

12.1 Limits of Radiated Emissions Measurement

Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009-0.490	2400/f (kHz)	300
0.490-1.705	2400/f (kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

As shown in 15.35(b), for frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any circumstances of modulation.

12.2 Radiated Emissions Measurement Test Procedure

Before final measurements of radiated emissions were made on the open-field three/ten meter range, the EUT was scanned indoors at one and three meter distances. This was done in order to determine its emissions spectrum signature. The physical arrangement of the test system and associated cabling was varied in order to determine the effect on the EUT's emissions in amplitude, direction and frequency. This process was repeated during final radiated emissions measurements on the open-field range, at each frequency, in order to ensure that maximum emission amplitudes were attained.

Final radiated emissions measurements were made on the three/ten-meter, open-field test site. The EUT was placed on a nonconductive turntable 0.8 meters above the ground plane. The spectrum was examined from 9 kHz to the 10^{th} harmonic of the highest fundamental transmitter frequency (24.8 GHz).

At each frequency, the EUT was rotated 360°, and the antenna was raised and lowered from 1 to 4 meters in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations. For frequencies between 30 and 1000 MHz, the spectrum analyzer's 6 dB bandwidth was set to 120 kHz, and the analyzer was operated in the CISPR quasi-peak detection mode. For emissions above 1000 MHz, emissions are measured using the average detector function with a minimum resolution bandwidth of 1 MHz. No video filter less than 10 times the resolution bandwidth was used. The highest emission amplitudes relative to the appropriate limit were measured and recorded in this report.

Table 12-1: Radiated Emissions Test Equipment

RTL Asset #	Manufacturer	Model	Part Type	Serial Number	Calibration Due Date
900151	Rohde and Schwarz	HFH2-Z2	Antenna (Loop antenna, (9 kHz - 30 MHz)	827525/019	9/15/09
901364	MITEQ	JS4-00102600-41-5P	Amplifier, 15 V, 0.1-26 GHz, 28 dB gain, power 5 dB	N/A	3/12/08
900931	Hewlett Packard	8566B	Spectrum Analyzer (100 Hz - 22 GHz)	3138A07771	9/13/07
901281	Rhein Tech Labs	PR-1040	OATS 1 Preamplifier 40 dB (30 MHz – 2 GHz)	1004	1/19/08
900878	Rhein Tech Labs	AM3-1197-0005	3 meter antenna mast, polarizing	Outdoor Range 1	Not Required
901426	Insulated Wire Inc.	KPS-1503-3600-KPS	RF cable, 30'	NA	12/5/07
901425	Insulated Wire, Inc.	KPS-1503-2400-KPS	RF cable, 20'	NA	12/5/07
901242	Rhein Tech Labs	WRT-000-0003	Wood rotating table	N/A	Not Required
900772	EMCO	3161-02	Horn Antenna (2 - 4 GHz)	9804-1044	5/20/07
900321	EMCO	3161-03	Horn Antennas (4 - 8,2 GHz)	9508-1020	5/20/07
900323	EMCO	3160-7	Horn Antennas (8,2 - 12,4 GHz)	9605-1054	5/20/07
900356	EMCO	3160-08	Horn Antenna (12.4 - 18 GHz)	9607-1044	5/20/07
900325	EMCO	3160-9	Horn Antennas (18 - 26.5 GHz)	9605-1051	5/20/07
901218	EMCO	3301B	Horn Antenna (18 - 26.5 GHz)	960281-003	5/20/07
900392	Hewlett Packard	1197OK	Harmonic Mixer (18 – 26.5 GH)z	3525A00159	11/27/07

12.3 Radiated Emissions Test Results

12.3.1 Radiated Emissions – Digital Test Data

Table 12-2: Digital Radiated Emissions

Temperature: 68°F Humidity: 48%										
Emission Frequency (MHz)	Test Detector	Antenna Polarity (H/V)	Turntable Azimuth (deg)	Antenna Height (m)	Analyzer Reading (dBuV)	Site Correction Factor (dB/m)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Pass/ Fail
167.989	Qp	V	270	1.0	44.7	-18.3	26.4	43.5	-17.1	Pass
194.988	Qp	V	0	1.0	45.5	-18.4	27.1	43.5	-16.4	Pass
246.986	Qp	V	270	1.0	48.3	-15.2	33.1	46.0	-12.9	Pass
260.000	Qp	H	90	1.0	42.6	-13.7	28.9	46.0	-17.1	Pass
312.000	Qp	H	180	1.0	51.5	-13.1	38.4	46.0	-7.6	Pass
389.977	Qp	V	180	1.5	43.2	-10.5	32.7	46.0	-13.3	Pass
416.000	Qp	V	270	2.0	46.4	-9.1	37.3	46.0	-8.7	Pass
519.985	Qp	H	180	1.5	39.7	-7.4	32.3	46.0	-13.7	Pass

12.3.2 Radiated Emissions Harmonics/Spurious Test Data

Table 12-3: Radiated Emissions Harmonics/Spurious Channel 1 (TX Frequency: 2412 MHz) DSSS

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/VBW)	Average Analyzer Reading (dBuV) (1 MHz RBW/10 Hz VBW)	Site Correction Factor (dB/m)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
4824.0	33.9	28.7	0.5	29.2	54.0	-24.8
7236.0	44.9	37.1	3.3	40.4	76.8	-36.4
9648.0	39.0	29.3	8.4	37.7	76.8	-39.1
12060.0	36.0	24.5	11.3	35.8	54.0	-18.2
14472.0	40.7	27.5	15.3	42.8	54.0	-11.2
16884.0	40.6	26.5	16.3	42.8	76.8	-34.0

Table 12-4: Radiated Emissions Harmonics/Spurious Channel 6 (TX Frequency: 2436 MHz) DSSS

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/VBW)	Average Analyzer Reading (dBuV) (1 MHz RBW/10 Hz VBW)	Site Correction Factor (dB/m)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
4872.0	33.1	26.5	0.1	26.6	54.0	-27.4
7308.0	43.0	33.6	2.8	36.4	54.0	-17.6
9744.0	39.5	26.7	8.6	35.3	78.1	-42.8
12180.0	37.7	24.6	10.6	35.2	54.0	-18.8
14616.0	41.9	27.8	15.7	43.5	78.1	-34.6
17052.0	41.0	26.9	15.9	42.8	78.1	-35.3

Table 12-5: Radiated Emissions Harmonics/Spurious Channel 11 (TX Frequency: 2462 MHz) DSSS

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/VBW)	Average Analyzer Reading (dBuV) (1 MHz RBW/10 Hz VBW)	Site Correction Factor (dB/m)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
4924.0	31.5	22.6	0.4	23.0	54.0	-31.0
7386.0	42.8	32.7	4.0	36.7	54.0	-17.3
9848.0	40.4	27.3	9.3	36.6	77.6	-41.0
12310.0	38.7	24.7	10.2	34.9	54.0	-19.1
14772.0	41.6	27.7	14.7	42.4	77.6	-35.2
17234.0	40.9	27.1	16.2	43.3	77.6	-34.3

Table 12-6: Radiated Emissions Harmonics/Spurious Channel 2 (TX Frequency: 2402 MHz) Bluetooth

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/VBW)	Site Correction Factor (dB/m)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
4804.0	42.0	4.0	46.0	54.0	-8.0
7206.0	36.5	6.1	42.6	59.7	-17.1

Table 12-7: Radiated Emissions Harmonics/Spurious Channel 39 (TX Frequency: 2439 MHz) Bluetooth

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/VBW)	Site Correction Factor (dB/m)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
4878.0	41.2	4.0	45.2	54.0	-8.8
7317.0	37.6	6.1	43.7	54.0	-10.3

Table 12-8: Radiated Emissions Harmonics/Spurious Channel 79 (TX Frequency: 2479 MHz) Bluetooth

Emission Frequency (MHz)	Peak Analyzer Reading (dBuV) (1 MHz RBW/VBW)	Site Correction Factor (dB/m)	Average Emission Level (dBuV/m)	Average Limit (dBuV/m)	Average Margin (dB)
4958.0	42.6	4.2	46.8	54.0	-7.2
7437.0	35.5	6.8	42.3	54.0	-11.7

Test Personnel:

Daniel W. Baltzell		November 10, 2006 April 2 & 18, 2007
EMC Test Engineer	Signature	Dates Of Tests

13 Conclusion

The data in this measurement report shows that the EUT's as tested, LevelStar, LLC's Models EI-30 and EIB-30, FCC ID: U48-EI0001, IC: 6999A-EI0001, comply with all the applicable requirements of Parts 2 and 15 of the FCC Rules and Regulations, and Industry Canada RSS-210.