FCC PART 15 SUBPART C
TEST AND MEASUREMENT REPORT

For

SecureALL Corporation

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Mountain View, CA 94040, USA

FCC ID: Y29SA-PWR-C

Report Type:	**Product Type:**
Original Report	2.4 GHz Wireless Wall and Garage Reader

Prepared By: Ning Ma

Report Number: R1204302-247A FHSS

Report Date: 2012-07-05

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1204302-247 FHSS	Original Report	2012-06-13
1	R1204302-247A FHSS	Updated EUT photos	2012-07-05

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *SecureALL Corporation*, and their product model: *SA-PWR-C, FCC ID: Y29SA-PWR-C,* which will henceforth be referred to as the EUT (Equipment Under Test). The EUT is wall reader with DSSS and FHSSS transceiver. The EUT has a CBSA antenna, that is essentially one RF antenna with one common cavity and tow orthogonal slots for V-pol and H-pol, the antenna uses a metal skirt/plane to increase the front to back radiation ration and antenna gain. The PCB board has an RF switch to connect and excite only one slot at a time to produce either V-pol or H-pol. DSSS and FHSS can work at both sides.

1.2 Mechanical Description of EUT

The "EUT" measures approximately *12.7 cm (L) x 11.8 cm (W) x 10.8cm (H),* and weighs approximately *0.55k*g.

The test data gathered are from typical production sample provided by the manufacturer. Serial number: R1204301-2 assigned by BACL.

1.3 Objective

This report is prepared on behalf of *SecureALL Corporation* in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC Part 15.247 for Output Power, Antenna Requirements, 20 dB Bandwidth, Hopping channel number, Hopping channel separation, and Dwell time, 100 kHz Bandwidth of Band Edges, Conducted and Radiated Spurious Emissions.

1.4 Related Submittal(s)/Grant(s)

DTS submission with FCC ID: Y29SA-PWR-C.

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.4-2009, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR16-4-2:2003, The Treatment of Uncertainty in EMC Measurements, the values ranging from $\pm$2.0 dB for Conducted Emissions tests and $\pm$4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

1.7 Test Facility

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test site at BACL Corp. has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997, and Article 8 of the VCCI regulations on December 25, 1997. The test site also complies with the test methods and procedures set forth in CISPR 22:2008 §10.4 for measurements below 1 GHz and §10.6 for measurements above 1 GHz as well as ANSI C63.4-2003, ANSI C63.4-2009, TIA/EIA-603 & CISPR 24:2010.

The Federal Communications Commission and Voluntary Control Council for Interference have the reports on file and they are listed under FCC registration number: 90464 and VCCI Registration No.: A-0027. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL Corp. is an American Association for Laboratory Accreditation (A2LA) accredited laboratory (Lab Code 3297-02). The current scope of accreditations can be found at http://www.a2la.org/scopepdf/3297-02.pdf?CFID=1132286&CFTOKEN=e42a3240dac3f6ba-6DE17DCB-1851-9E57-477422F667031258&jsessionid=8430d44f1f47cf2996124343c704b367816b

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.4-2009.

The EUT was tested in a testing mode to represent worst-case results during the final qualification test.

2.2 EUT Exercise Software

The test utility used was RF Diagnostics Tool V2 was provided by client and was verified Ning Ma to comply with the standard requirements being tested against.

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Special Equipment

No special accessories were required, included, or intended for use with EUT during these tests.

2.5 Local Support Equipment

Manufacturer	Description	Model No.	Serial No.
-	-	-	-

2.6 EUT Internal Configuration Details

Manufacturers	Descriptions	Models	Serial Numbers
SecureAll	PCB Board 114	710-000114	-
SecureAll	CBSA Antenna	710-000109	-

2.7 External I/O Cabling List and AC Cord

Cable Description	Length (m)	From	To
RJ45	< 1m	Power and I/O Interface Box	EUT

2.8 Power Supply List and Details

Manufacturer	Description	Model	Serial Number
SecureAll	Power and I/O Interface Box	-	-
Triad	Power Supply	WSU240-0500	-

3 Summary of Test Results

Results reported relate only to the product tested.

FCC Rules	Description of Test	Results
§15.247(i), §2.1091	RF Exposure	Compliant
§15.203	Antenna Requirement	Compliant
§15.207(a)	AC Line Conducted Emissions	Compliant
§15.247(d)	Spurious Emissions at Antenna Port	Compliant
§15.205, §15.209, §15.247(d)	Restricted Bands, Radiated Spurious Emissions	Compliant
§15.247 (a)(2)	Hopping Channel Bandwidth	Compliant
§15.247(b)(3)	Maximum Peak Output Power	Compliant
§15.247(a) (1)	Hopping Channel Separation	Compliant
§15.247(a)(1)(iii)	Number of Hopping Channels	Compliant
§15.247(a)(1)(iii)	Dwell Time	Compliant
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliant

4 FCC §15.247 (i) & §2.1091 – RF Exposure

4.1 Applicable Standard

According to FCC §15.247(i), §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	30
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

4.2 MPE Prediction

Predication of MPE limit at a given distance, Equation from OET Bulletin 65, Edition 97-01

$$S = PG/4\ R^2$$

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

4.3 MPE Results

Maximum peak output power at antenna input terminal (dBm):	5.12
Maximum peak output power at antenna input terminal (mW):	3.25
Prediction distance (cm):	20
Prediction frequency (MHz):	2405
Maximum Antenna Gain, typical (dBi):	8
Maximum Antenna Gain (numeric):	6.31
Power density of prediction frequency at 20 cm (mW/cm^2):	0.004
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.004 mW/cm^2, limit is 1.0 mW/cm^2.

5 FCC §15.203 – Antenna Requirements

5.1 Applicable Standard

According to FCC §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

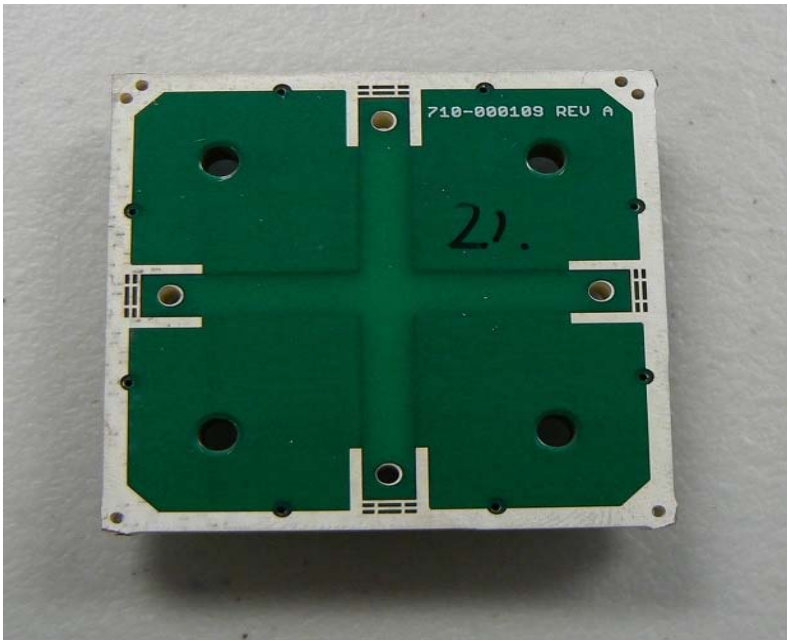
And according to FCC §15.247 (b) (4), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.2 Antenna List

Antenna Model	Antenna Gain (dBi)
CBSA Antenna – V Pol	8
CBSA Antenna – H Pol	8

5.3 Result

The EUT has maximum gain of 8 dBi antenna, which in accordance to sections FCC Part 15.203 is considered sufficient to comply with the provisions of these sections. The Max Power level need to reduce by 2 dB, please refer the Max power output section for more detail information.



EUT Antenna

6 FCC §15.207(a) – AC Line Conducted Emissions

6.1 Applicable Standard

As per FCC §15.207 Conducted limits:

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

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

** Decreases with the logarithm of the frequency.*

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.4-2009 measurement procedure. The specification used was FCC Part15.207 limits.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The AC/DC power adapter of the Supporting Laptop which connects the EUT was connected with LISN-1 which provided 120 V / 60 Hz AC power.

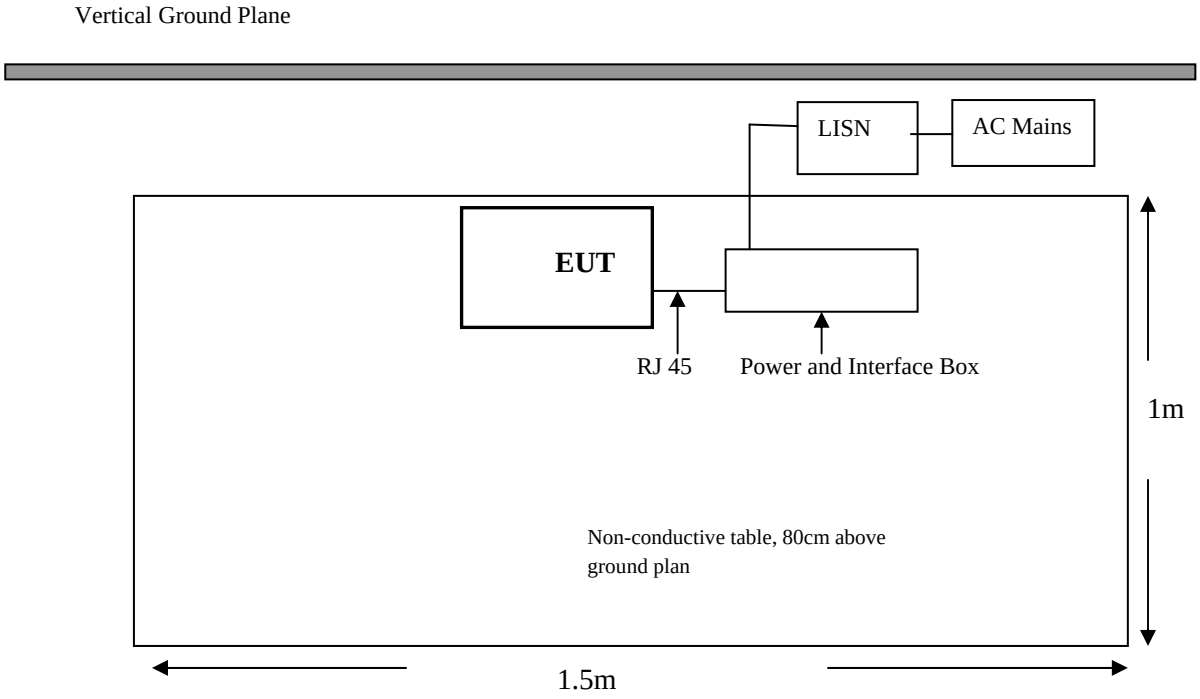
6.3 Test Procedure

During the conducted emissions test, the power cord of the EUT host system was connected to the mains outlet of the LISN-2.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the peak detection mode, quasi-peak and average. Quasi-Peak readings are distinguished with a “QP.” Average readings are distinguished with an “Ave”.

6.4 Test Setup Block Diagram



6.5 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Cable Loss (CL) plus the High Pass Filter/Attenuator value (HA) and subtracting the Amplifier Gain (Ga) to the indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + CL + HA – Ga

For example, a corrected amplitude (CA) of 36 dBuV = Indicated Amplitude reading (Ai) of 50.0 dBuV + Cable Loss (CL) 1.0 dB + High Pass Filter/Attenuator (IA) 5 dB - Amplifier Gain (Ga) 20 dB

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

Margin (dB) = Corrected Amplitude (dBuV) - Limit (dBuV)

6.6 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial No.	Calibration Dates
Solar Electronics	LISN	9252-R-24-BNC	511205	2011-06-25
TTE	Filter, High Pass	H9962-150K-50-21378	K7133	2011-06-10
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100338	2011-09-14

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

6.7 Test Environmental Conditions

Temperature:	20.57 °C
Relative Humidity:	36.77 %
ATM Pressure:	102.6 kPa

The testing was performed by Ning Ma on 2012-05-05 at 5 meter Chamber2.

6.8 Summary of Test Results

According to the recorded data in following table, the EUT complied with the FCC Part 15.207 standard's conducted emissions limits, with the margin reading of:

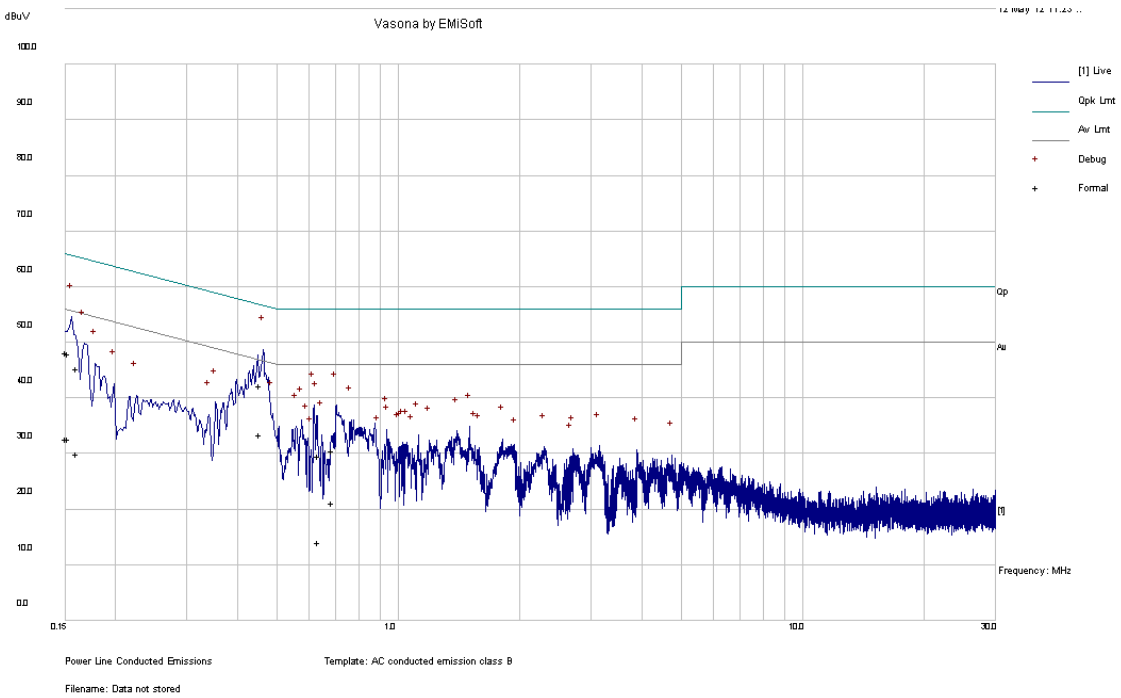
Worst Case: High Channel Transmitting Mode

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor (Line/Neutral)**	**Range (MHz)**
-13.40	0.456492	Line	0.15-30

6.9 Conducted Emissions Test Plots and Data

High channel (2405 MHz)

120 V, 60 Hz – Line



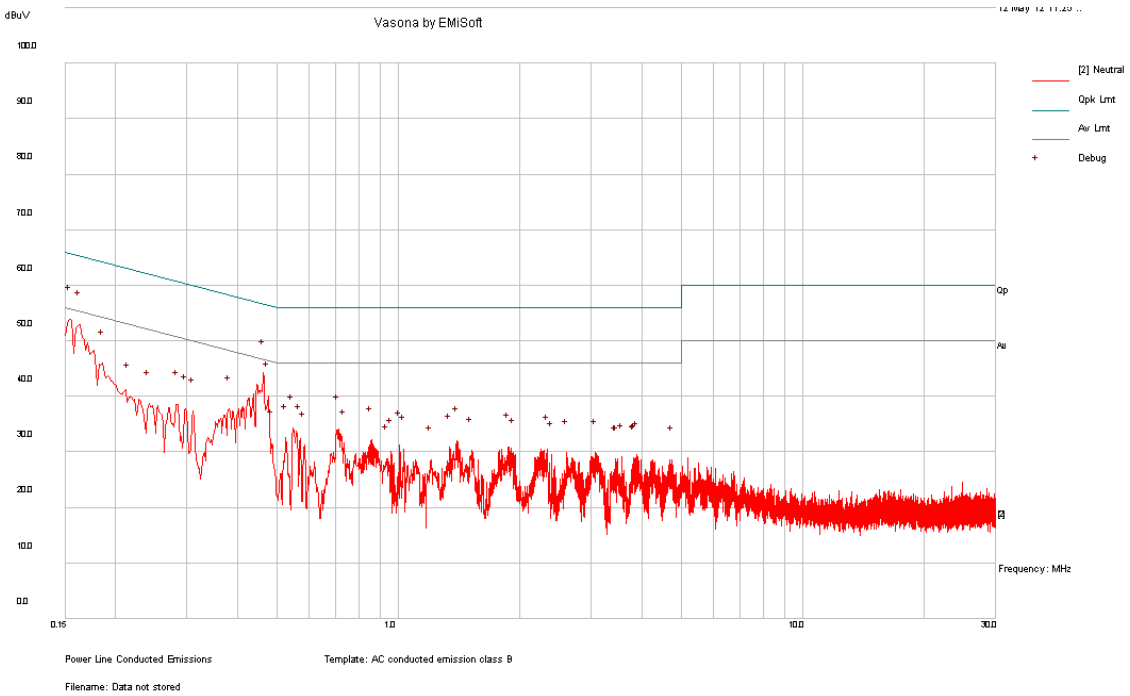
Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.456492	42.31	Line	56.76	-14.45
0.150986	48.2	Line	65.95	-17.75
0.152681	48.04	Line	65.85	-17.81
0.160253	45.41	Line	65.45	-20.04
0.688004	30.55	Line	56	-25.45
0.635323	29.69	Line	56	-26.31

Average Measurements

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.456492	33.35	Line	46.76	-13.40
0.152681	32.66	Line	55.85	-23.19
0.150986	32.74	Line	55.95	-23.21
0.688004	21.16	Line	46	-24.84
0.160253	30.08	Line	55.45	-25.37
0.635323	14.12	Line	46	-31.88

120 V, 60 Hz – Neutral



Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.152421	47.8	Neutral	65.87	-18.07
0.152291	47.7	Neutral	65.87	-18.17
0.463008	37.32	Neutral	56.64	-19.31
0.461487	37.14	Neutral	56.67	-19.53
0.168129	42.37	Neutral	65.05	-22.68
0.39808	30.31	Neutral	57.89	-27.59

Average Measurements

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.463008	27.34	Neutral	46.64	-19.30
0.461487	27.14	Neutral	46.67	-19.52
0.39808	19.38	Neutral	47.89	-28.51
0.152291	27.36	Neutral	55.87	-28.52
0.152421	27.25	Neutral	55.87	-28.62
0.168129	21.49	Neutral	55.05	-33.56

7 FCC §2.1051 & §15.247(d) – Spurious Emissions at Antenna Terminals

7.1 Applicable Standard

For FCC §15.247(d) in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

7.2 Measurement Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100 kHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

7.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-04-10

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

7.4 Test Environmental Conditions

Temperature:	23.7 °C
Relative Humidity:	41.2 %
ATM Pressure:	101.7 kPa

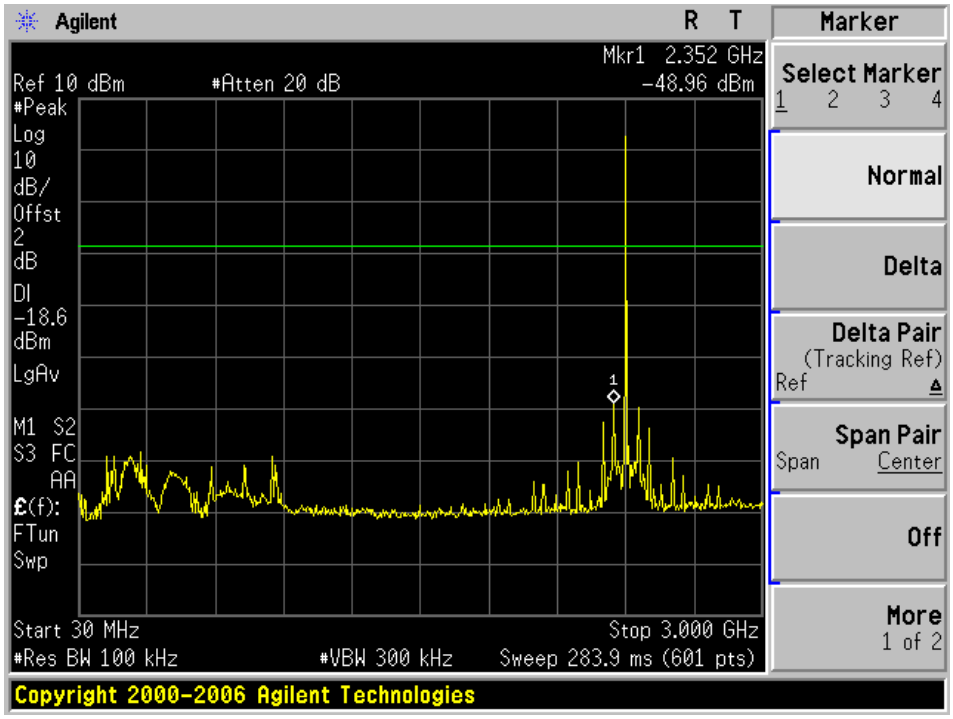
The testing was performed by Ning Ma on 2012-05-01.

7.5 Test Results

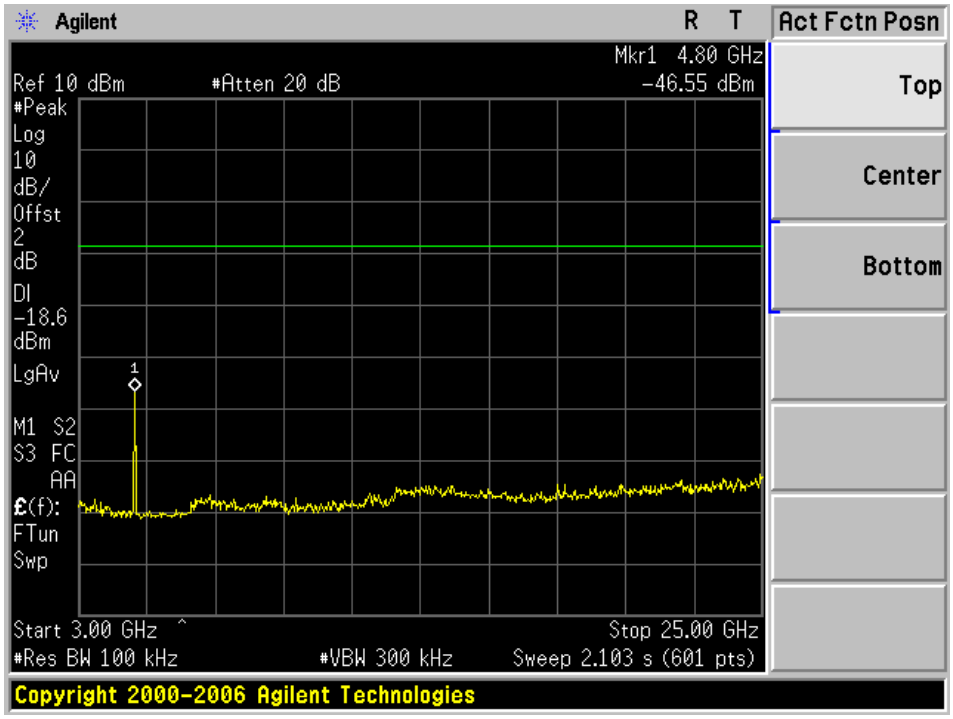
Please refer to following plots of spurious emissions.

Low Channel, 2405 MHz

Plot 1: 30 MHz – 3 GHz

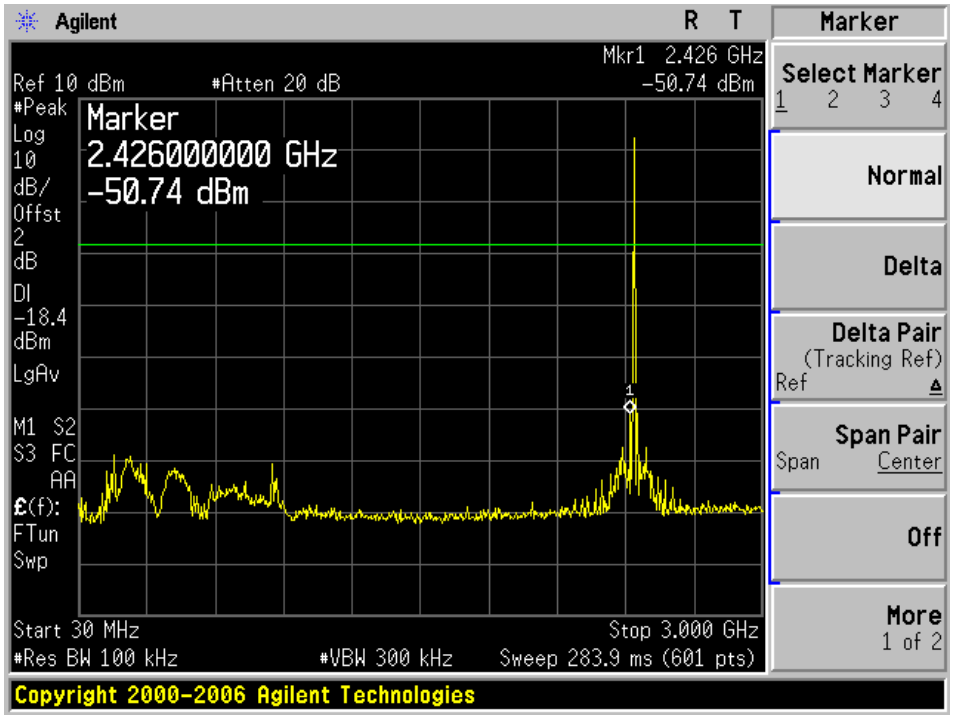


Plot 2: 3 GHz – 26 GHz

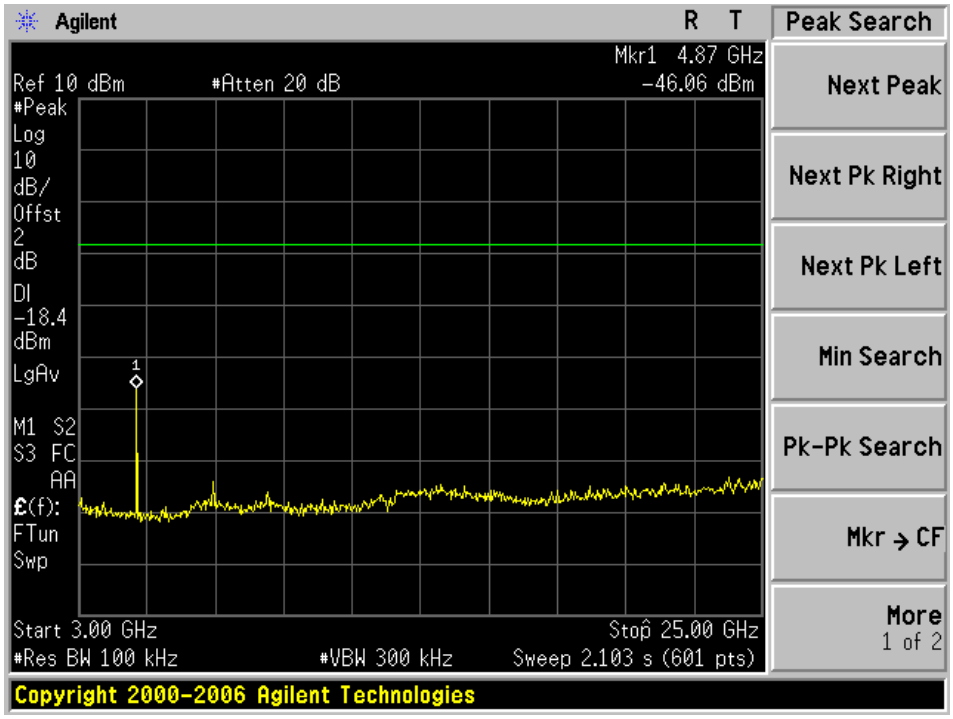


Middle Channel, 2440 MHz

Plot 1: 30 MHz – 3 GHz

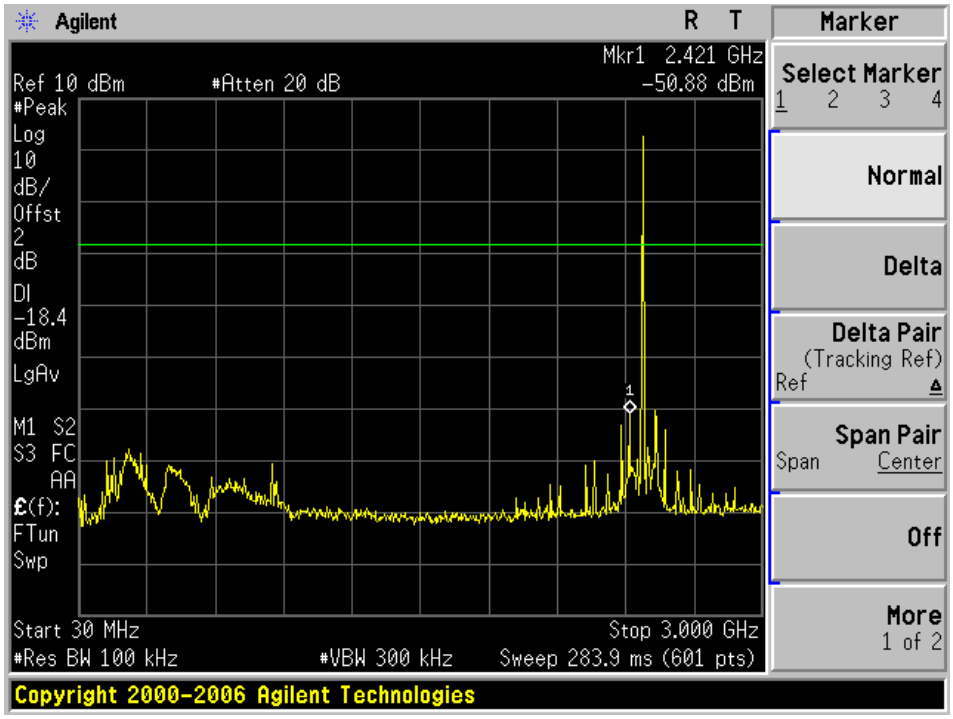


Plot 2: 3 GHz – 26 GHz

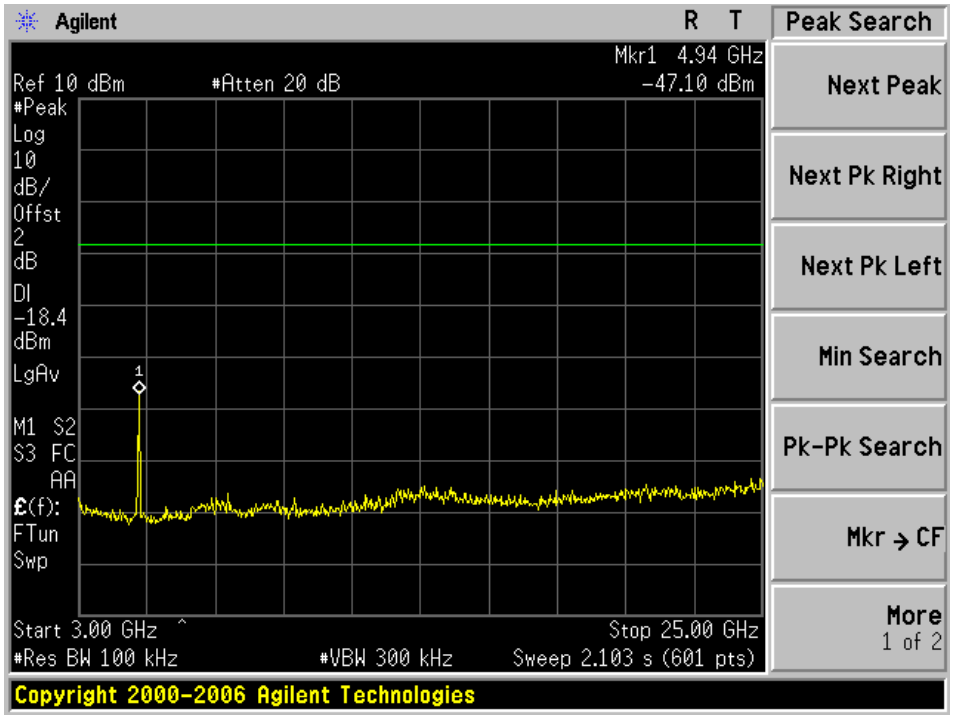


High Channel, 2475 MHz

Plot 1: 30 MHz – 3 GHz



Plot 2: 3 GHz – 26 GHz



8 FCC §15.205, §15.209 & §15.247(d) – Spurious Radiated Emissions

8.1 Applicable Standard

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/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

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110 0.495 – 0.505 2.1735 – 2.1905 4.125 – 4.128 4.17725 – 4.17775 4.20725 – 4.20775 6.215 – 6.218 6.26775 – 6.26825 6.31175 – 6.31225 8.291 – 8.294 8.362 – 8.366 8.37625 – 8.38675 8.41425 – 8.41475 12.29 – 12.293 12.51975 – 12.52025 12.57675 – 12.57725 13.36 – 13.41	16.42 – 16.423 16.69475 – 16.69525 25.5 – 25.67 37.5 – 38.25 73 – 74.6 74.8 – 75.2 108 – 121.94 123 – 138 149.9 – 150.05 156.52475 – 156.52525 156.7 – 156.9 162.0125 –167.17 167.72 – 173.2 240 – 285 322 – 335.4 399.9 – 410 608 – 614	960 – 1240 1300 – 1427 1435 – 1626.5 1645.5 – 1646.5 1660 – 1710 1718.8 – 1722.2 2200 – 2300 2310 – 2390 2483.5 – 2500 2690 – 2900 3260 – 3267 3.332 – 3.339 3 3458 – 3 358 3.600 – 4.400	4. 5 – 5. 15 5. 35 – 5. 46 7.25 – 7.75 8.025 – 8.5 9.0 – 9.2 9.3 – 9.5 10.6 – 12.7 13.25 – 13.4 14.47 – 14.5 15.35 – 16.2 17.7 – 21.4 22.01 – 23.12 23.6 – 24.0 31.2 – 31.8 36.43 – 36.5 Above 38.6

As per FCC §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c).

8.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.4-2009. The specification used was the FCC 15C and limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

8.3 Test Procedure

For the radiated emissions test, the EUT host, and all support equipment power cords was connected to the AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT is set 3 meter away from the testing antenna, which is varied from 1-4 meter, and the EUT is placed on a turntable, which is 0.8 meter above ground plane, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

8.4 Corrected Amplitude & Margin Calculation

The Corrected Amplitude (CA) is calculated by adding the Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) and subtracting the Amplifier Gain (Ga) to the indicated Amplitude (Ai) reading. The basic equation is as follows:

CA = Ai + AF + CL + Atten – Ga

For example, the Corrected Amplitude (CA) of 40.3 dBuV/m = indicated Amplitude reading (Ai) 32.5 dBuV + Antenna Factor (AF) 23.5dB + Cable Loss (CL) 3.7 dB + Attenuator (Atten) 10 dB - Amplifier Gain (Ga) 29.4 dB

The "**Margin**" column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the maximum limit. The equation for margin calculation is as follows:

Margin (dB) = Corrected Amplitude (dBuV/m) - Limit (dBuV/m)

8.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100338	2011-09-14
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-04-10
Sunol Science Corp	System Controller	SC99V	122303-1	N/R
Sunol Science Corp	Combination Antenna	JB3	A020106-2	2011-08-10
EMCO	Horn antenna	3115	9511-4627	2011-10-03
Hewlett Packard	Pre-amplifier	8447D	2944A06639	2011-06-09
Mini-Circuits	Pre-amplifier	ZVA-183-S	667400960	2011-05-08

Statement of Traceability: BACL attests that all calibrations have been performed per the A2LA requirements, traceable to NIST.

8.6 Test Environmental Conditions

Temperature:	22.7 °C
Relative Humidity:	43.6 %
ATM Pressure:	102.3 kPa

The testing was performed by Ning Ma on 2012-05-03 at 5m Chamber 3.

8.7 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Part 15C standard's radiated emissions limits, and had the worst margin of:

30-1000 MHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-7.22	320.015	Horizontal	30-1000 MHz

Above 1 GHz:

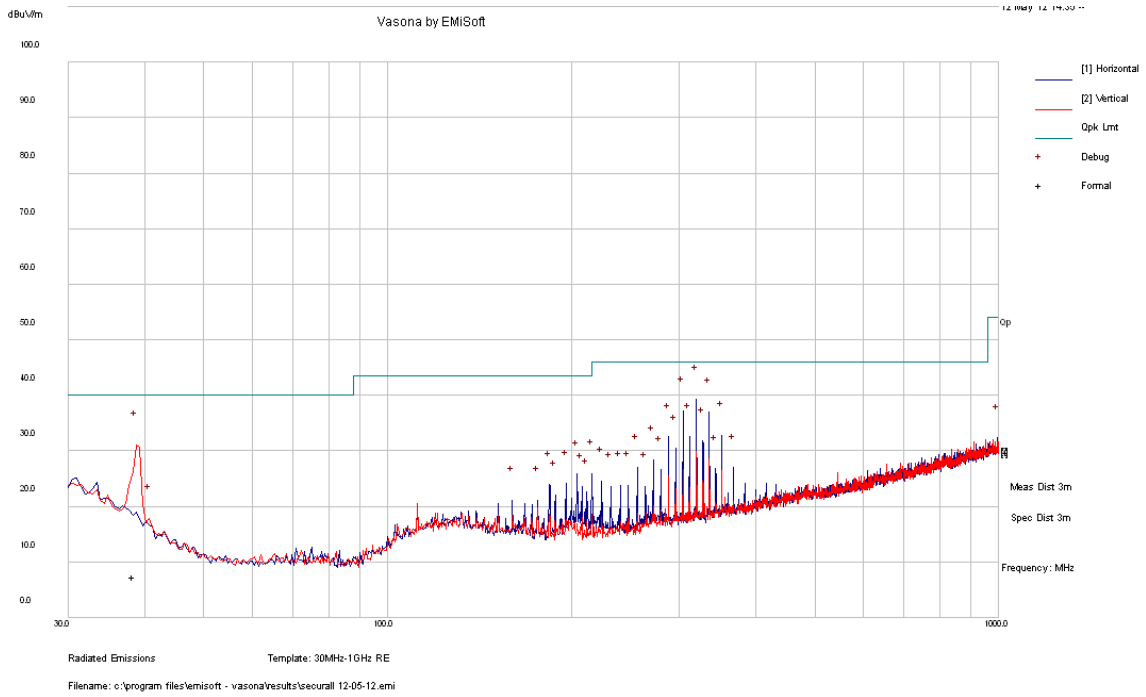
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-19.24	4958	Horizontal	Above 1 GHz

Please refer to the following table and plots for specific test result details

8.8 Radiated Emissions Test Result Data

1) Radiated Emission at 3 meters, 30 MHz – 1 GHz

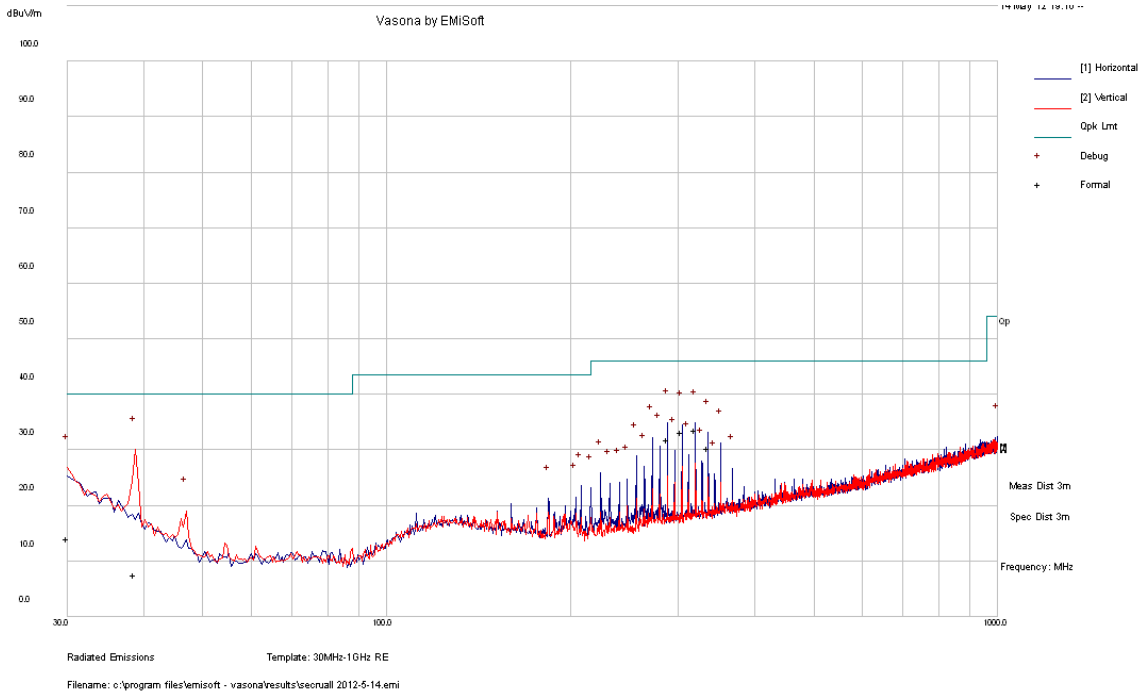
Worst Channel Low channel (2405 MHz) –Front Vertical Antenna



Quasi-Peak Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
320.015	38.78	99	H	81	46	-7.22
336.013	35.99	108	H	87	46	-10.01
312.0083	31.93	99	H	74	46	-14.07
304.0088	31.25	99	H	2	46	-14.75
352.0385	28.93	99	H	239	46	-17.07
38.788	7.64	155	V	185	40	-32.36

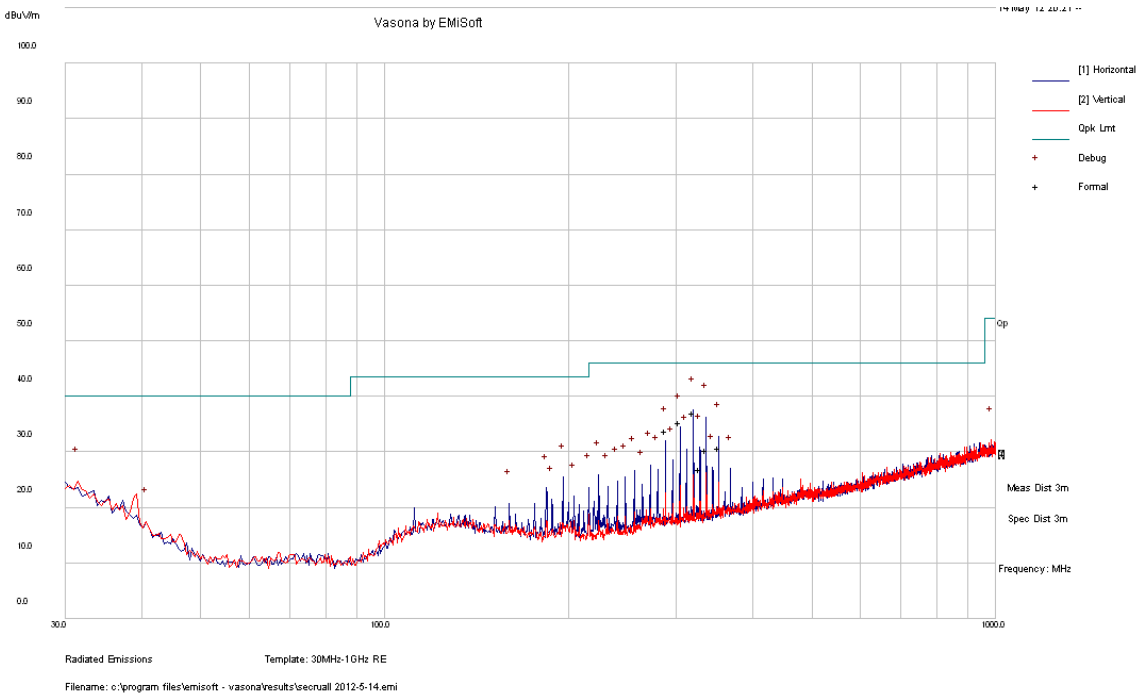
Worst Channel Low channel (2405 MHz) –Front Horizontal Antenna



Quasi-Peak Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
320.02	33.7	100	H	11	46	-12.30
304.0285	33.18	99	H	360	46	-12.82
288.0323	31.95	99	H	13	46	-14.05
336.0035	30.36	100	H	166	46	-15.64
30	14.09	99	V	47	40	-25.91
38.6255	7.49	99	V	7	40	-32.51

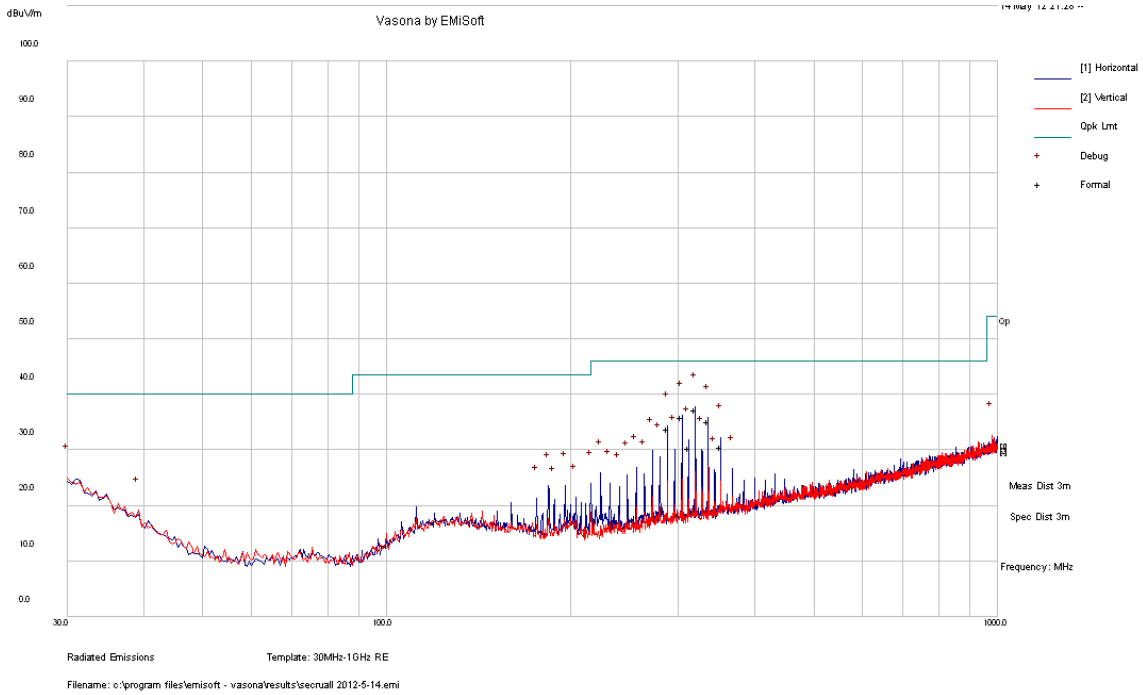
Worst Channel Low channel (2405 MHz) –Back Vertical Antenna



Quasi-Peak Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
320.0135	37.08	99	V	345	46	-8.92
304.0205	35.39	99	V	327	46	-10.61
287.9943	33.73	100	H	333	46	-12.27
351.9903	30.74	100	V	151	46	-15.26
336.0305	30.46	100	H	64	46	-15.54
328.019	26.95	99	H	93	46	-19.05

Worst Channel Low channel (2405 MHz) –Back Horizontal Antenna



Quasi-Peak Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
319.9958	37.29	99	H	351	46	-8.71
304.019	36	99	H	333	46	-10.00
336.1415	35.22	99	H	342	46	-10.78
288.0113	33.84	99	H	334	46	-12.16
352.039	30.6	99	H	152	46	-15.40
311.8983	30.36	100	H	321	46	-15.64

2) Radiated Emission at 3 meters, 1 – 25 GHz

Front Antenna

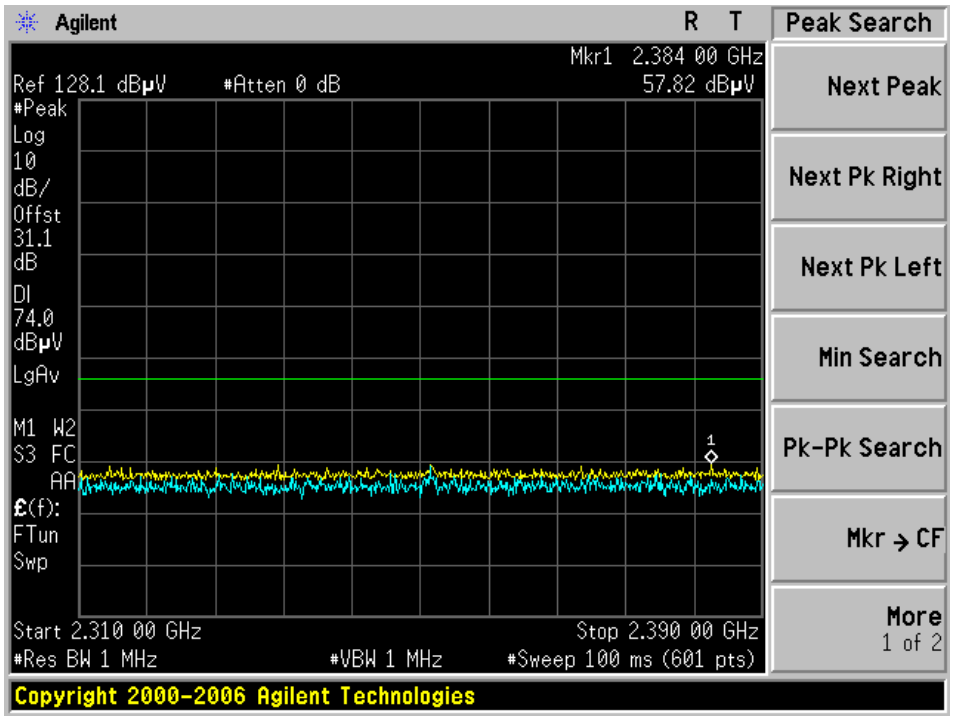
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	Part 15C		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2405 MHz, measured at 3 meters											
4810	43.97	151	103	H	32.629	4.56	27.71	53.449	74	-20.551	peak
4810	43.65	171	112	V	32.603	4.56	27.71	44.313	74	-29.687	peak
4810	26.07	151	103	H	32.629	4.56	27.71	35.549	54	-18.451	Ave
4810	27.02	171	112	V	32.603	4.56	27.71	27.683	54	-26.317	Ave
Middle channel 2440 MHz measured at 3 meters											
4880	44.31	149	100	H	32.8	4.54	36.5	45.15	74	-28.85	peak
4880	43.33	303	100	V	32.732	4.54	36.5	44.102	74	-29.898	peak
4880	24.74	149	100	H	32.8	4.54	36.5	25.58	54	-28.42	Ave
4880	22.65	303	100	V	32.732	4.54	36.5	23.422	54	-30.578	Ave
High channel 2479 MHz measured at 3 meters											
4958	40.93	172	127	H	32.8	4.52	27.71	50.54	74	-23.46	peak
4958	41.95	220	100	V	32.732	4.52	27.71	42.702	74	-31.298	peak
4958	19.87	172	127	H	32.8	4.52	27.71	29.48	54	-24.52	Ave
4958	20.81	220	100	V	32.732	4.52	27.71	21.562	54	-32.438	Ave

Back Antenna

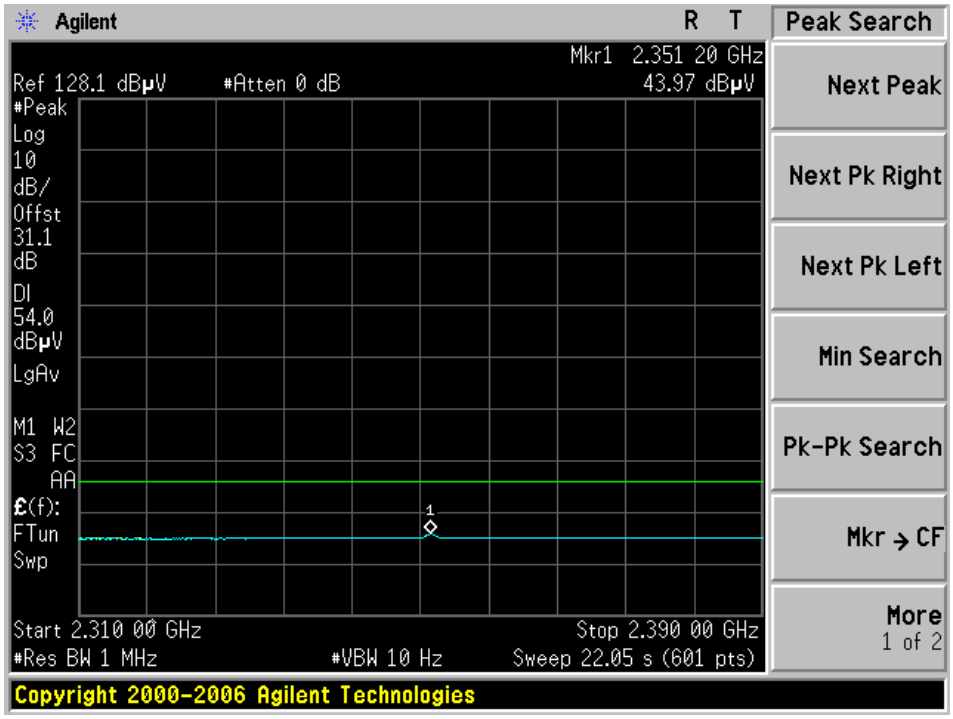
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	Part 15C		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2405 MHz, measured at 3 meters											
4810	41.54	292	112	H	32.629	4.56	27.71	51.019	74	-22.981	peak
4810	44.1	325	100	V	32.603	4.56	27.71	44.763	74	-29.237	peak
4810	22.21	292	112	H	32.629	4.56	27.71	31.689	54	-22.311	Ave
4810	22.12	325	100	V	32.603	4.56	27.71	22.783	54	-31.217	Ave
Middle channel 2440 MHz measured at 3 meters											
4880	45.2	332	112	H	32.8	4.54	36.5	46.04	74	-27.96	peak
4880	47.73	330	100	V	32.732	4.54	36.5	48.502	74	-25.498	peak
4880	20.54	332	112	H	32.8	4.54	36.5	21.38	54	-32.62	Ave
4880	24.21	330	100	V	32.732	4.54	36.5	24.982	54	-29.018	Ave
High channel 2479 MHz measured at 3 meters											
4958	45.15	302	117	H	32.8	4.52	27.71	54.76	74	-19.24	peak
4958	43.5	56	100	V	32.732	4.52	27.71	44.252	74	-29.748	peak
4958	21.31	302	117	H	32.8	4.52	27.71	30.92	54	-23.08	Ave
4958	20.17	56	100	V	32.732	4.52	27.71	20.922	54	-33.078	Ave

3) Restricted Band Emissions

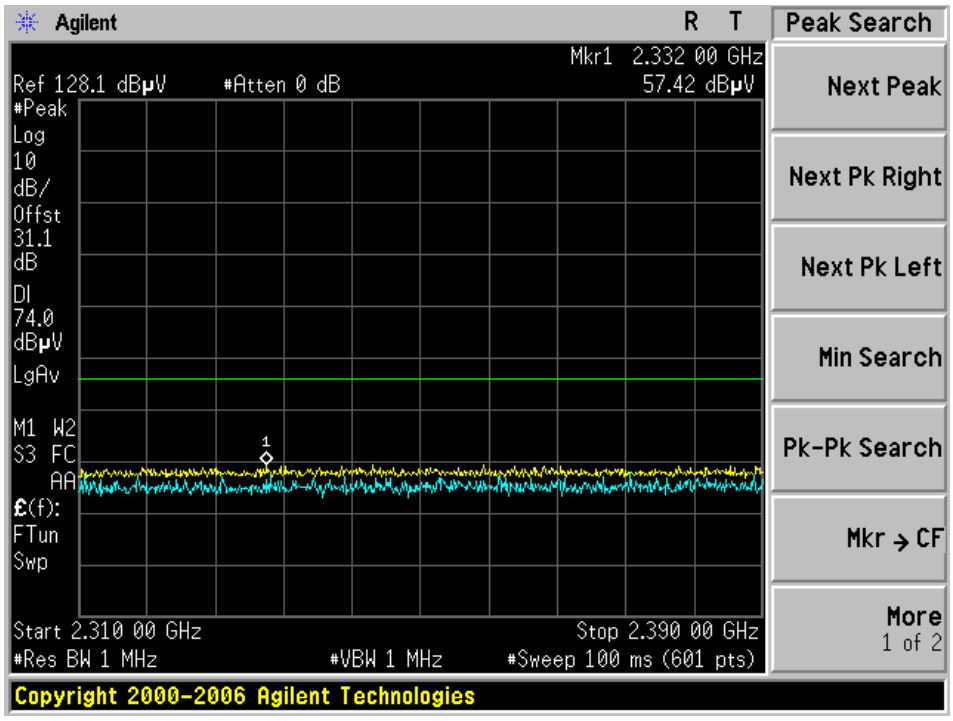
Front Vertical Antenna, Low channel, Vertical, Peak measurement



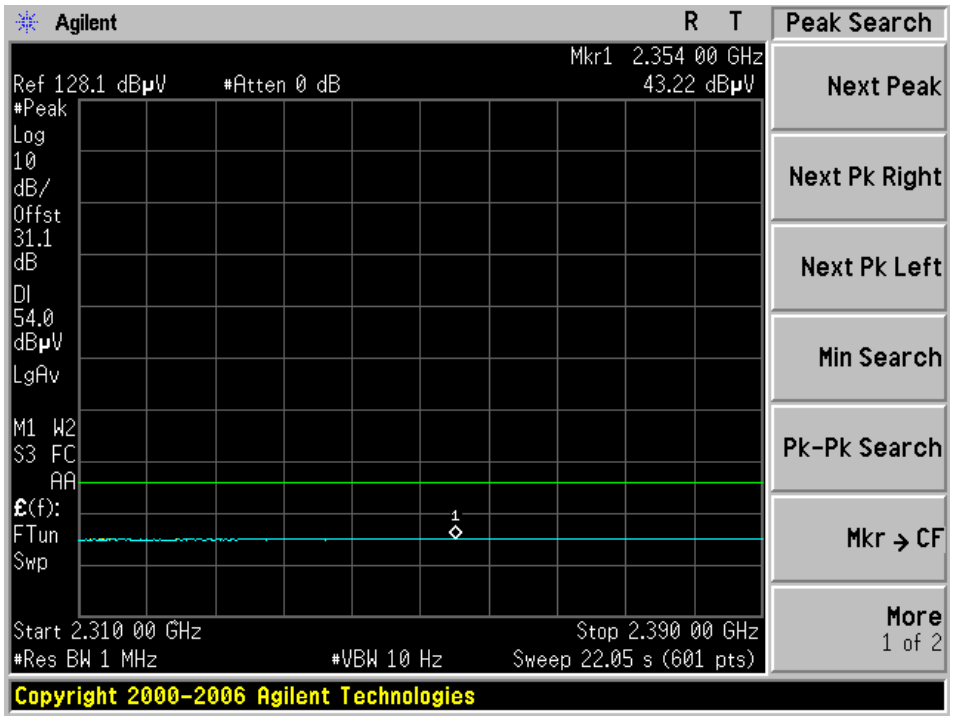
Front Vertical Antenna, Low channel, Vertical, Peak measurement



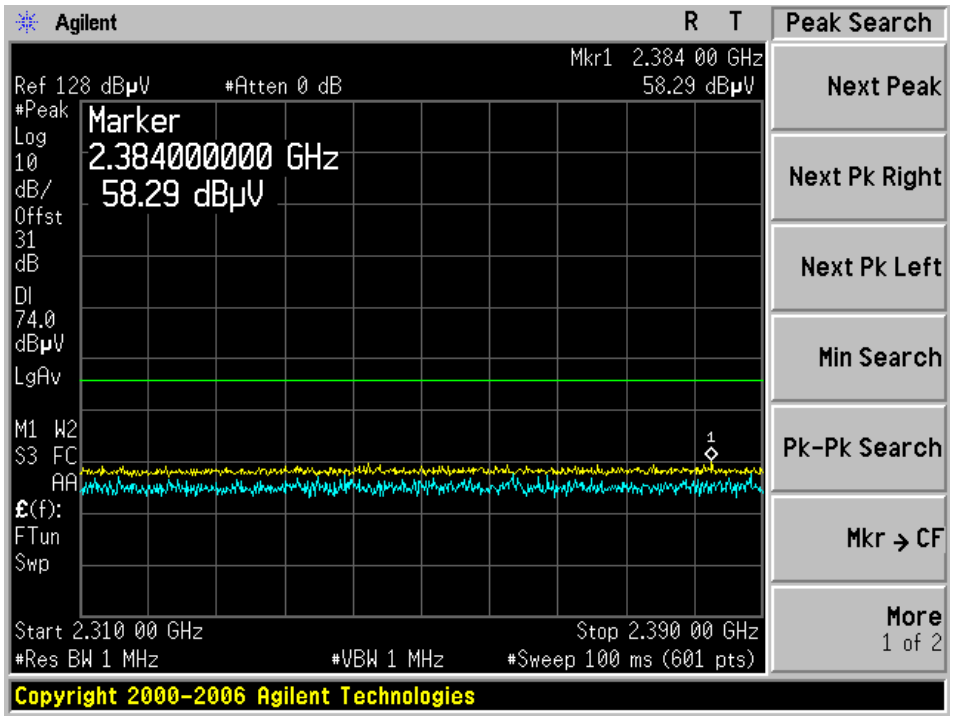
Front Horizontal Antenna, Low channel, Horizontal, Peak measurement



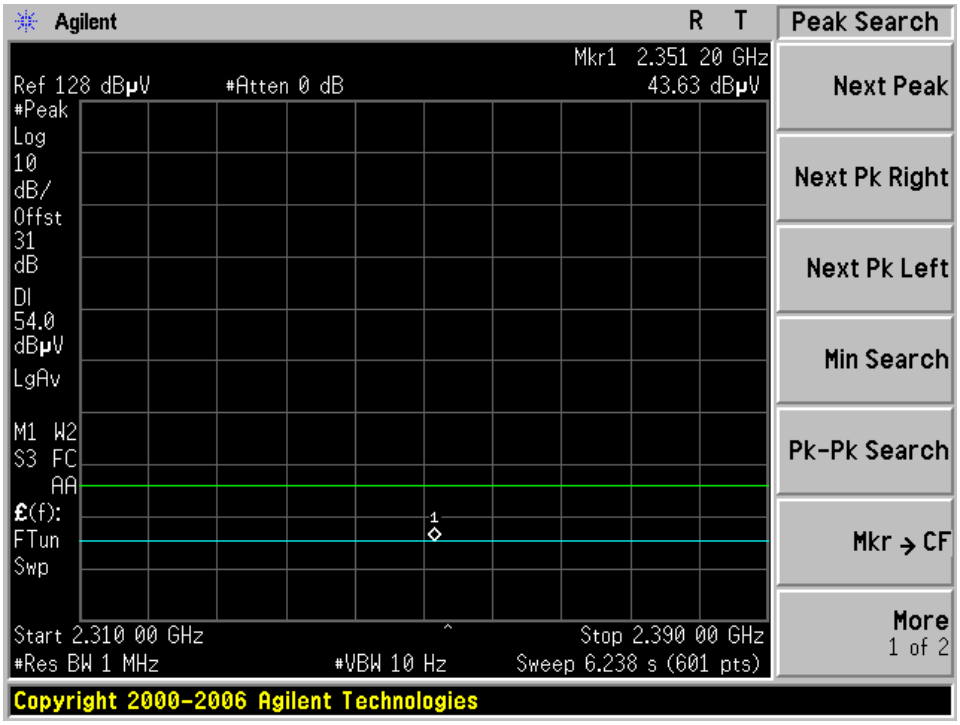
Front Horizontal Antenna, Low channel, Horizontal, Average measurement



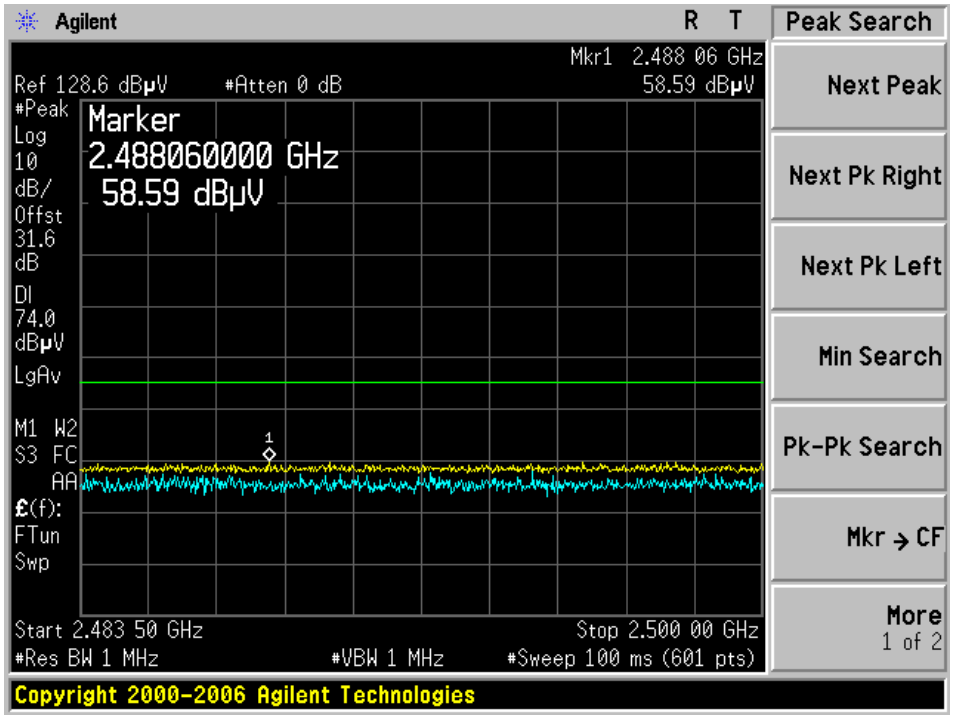
Front Vertical Antenna, High channel, Vertical, Peak measurement



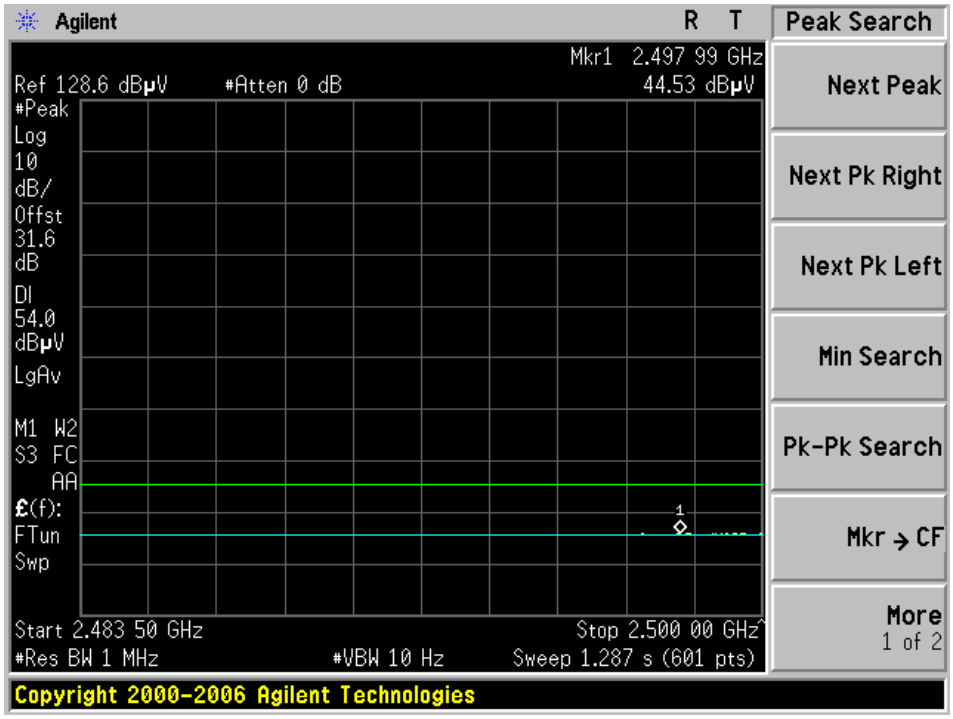
Front Vertical Antenna, High channel, Vertical, Average measurement



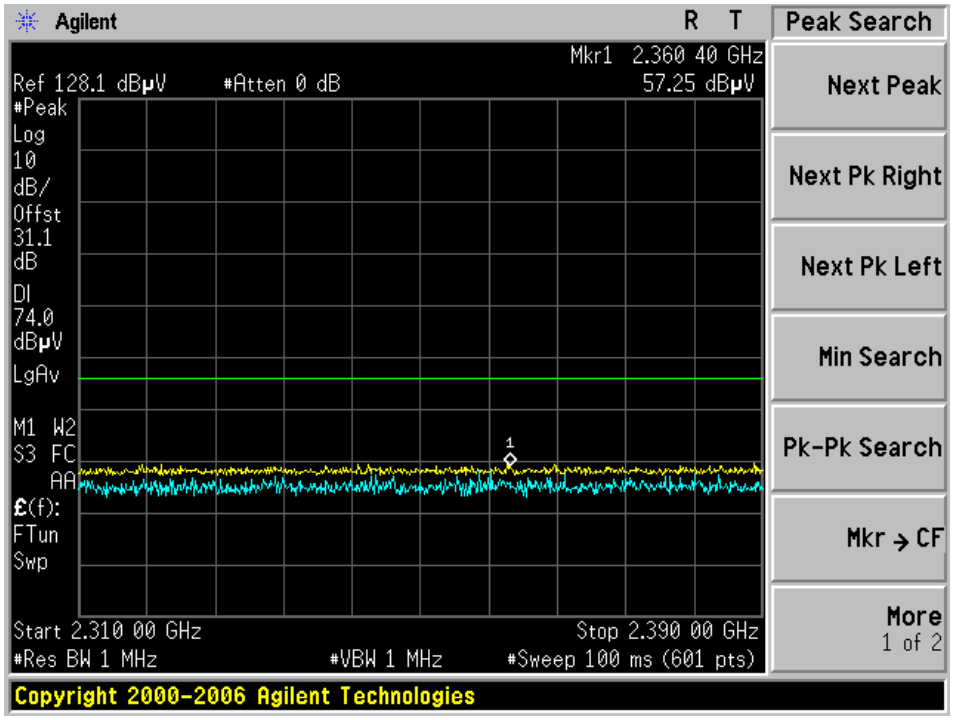
Front Horizontal Antenna, High channel, Horizontal, Peak measurement



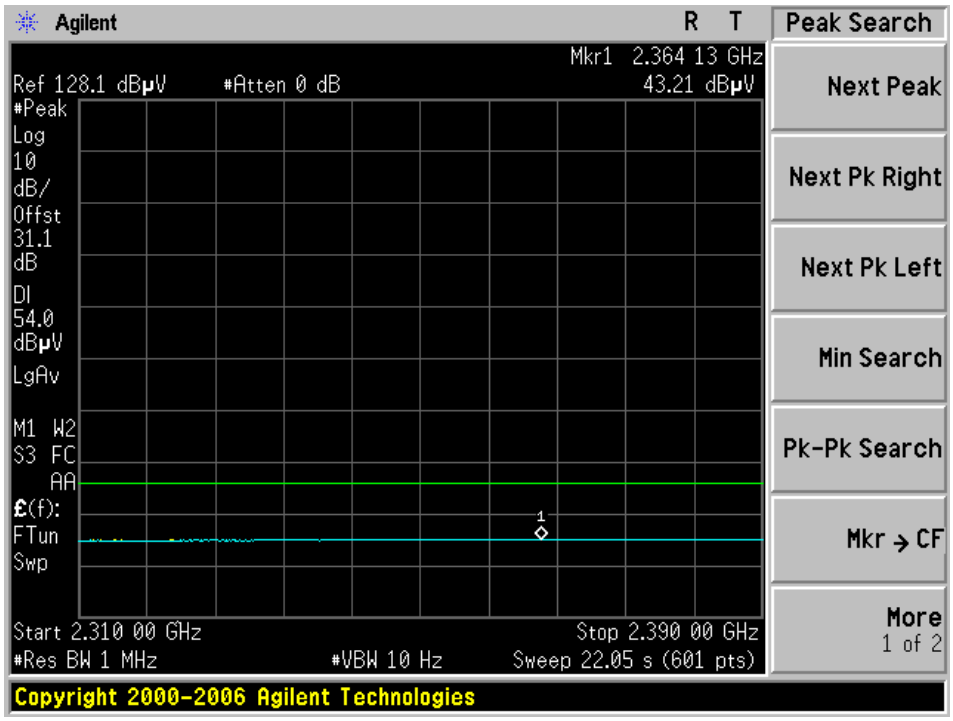
Front Horizontal Antenna, High channel, Horizontal, Average measurement



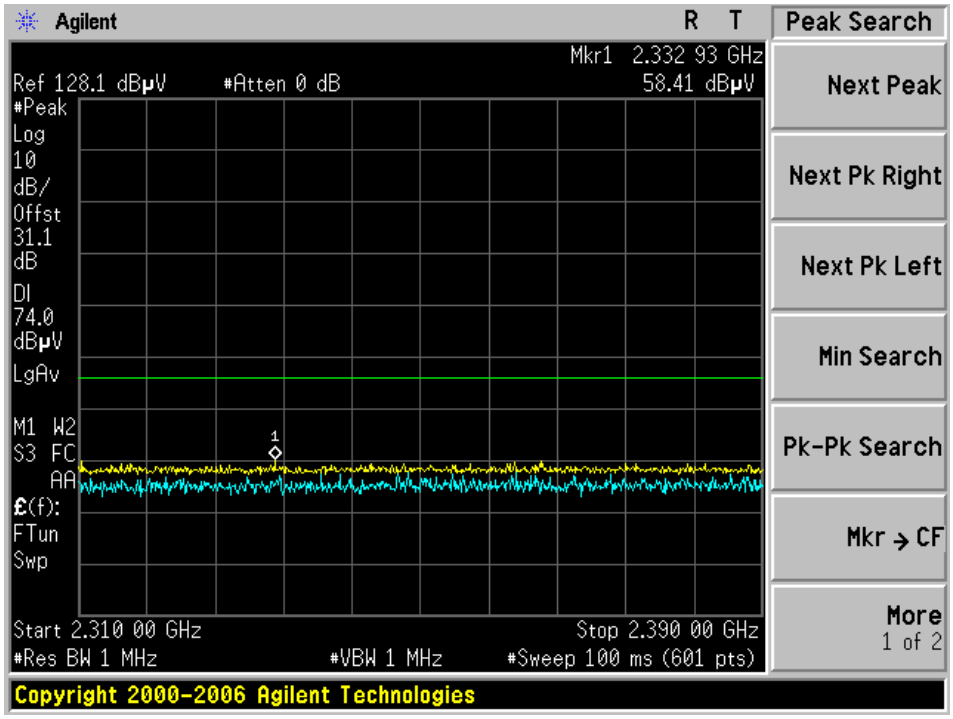
Back Vertical Antenna, Low channel, Vertical, Peak measurement



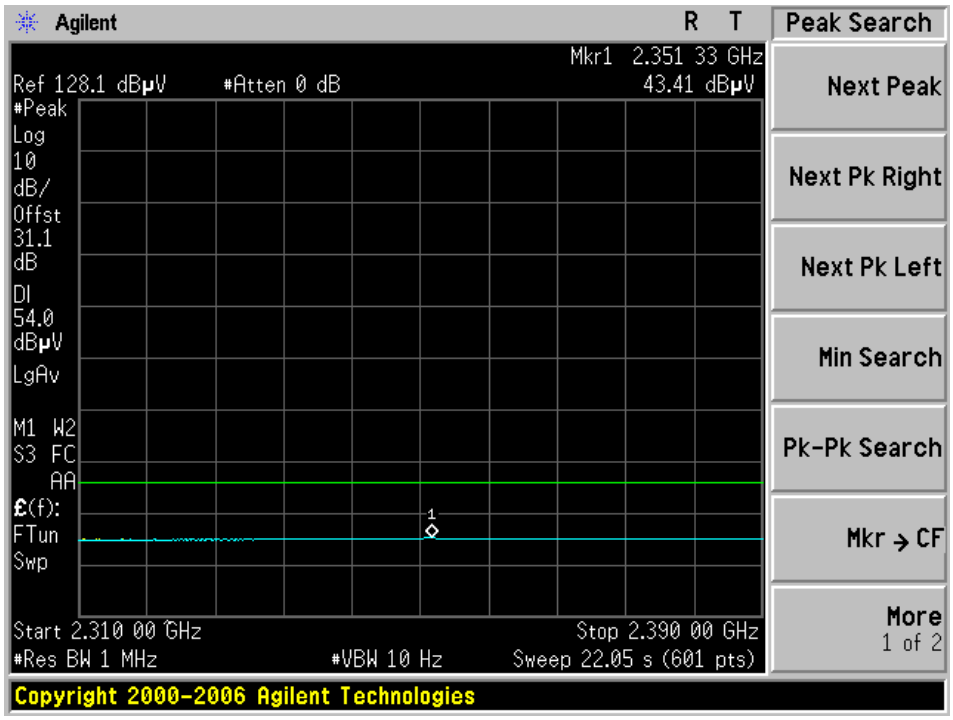
Back Vertical Antenna, Low channel, Vertical, Peak measurement



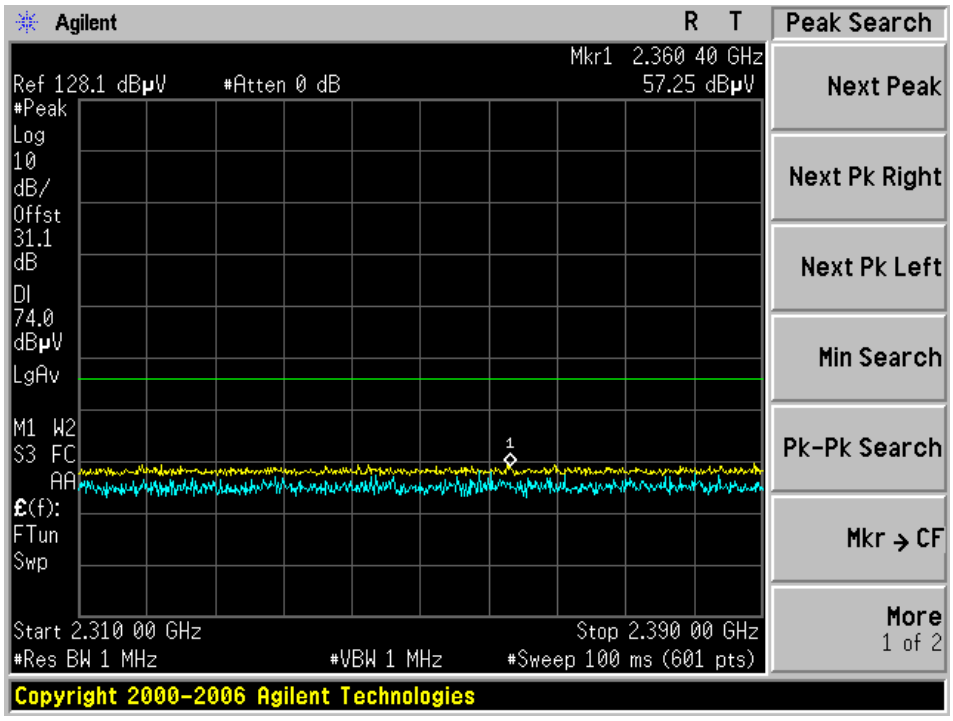
Back Horizontal Antenna, Low channel, Horizontal, Peak measurement



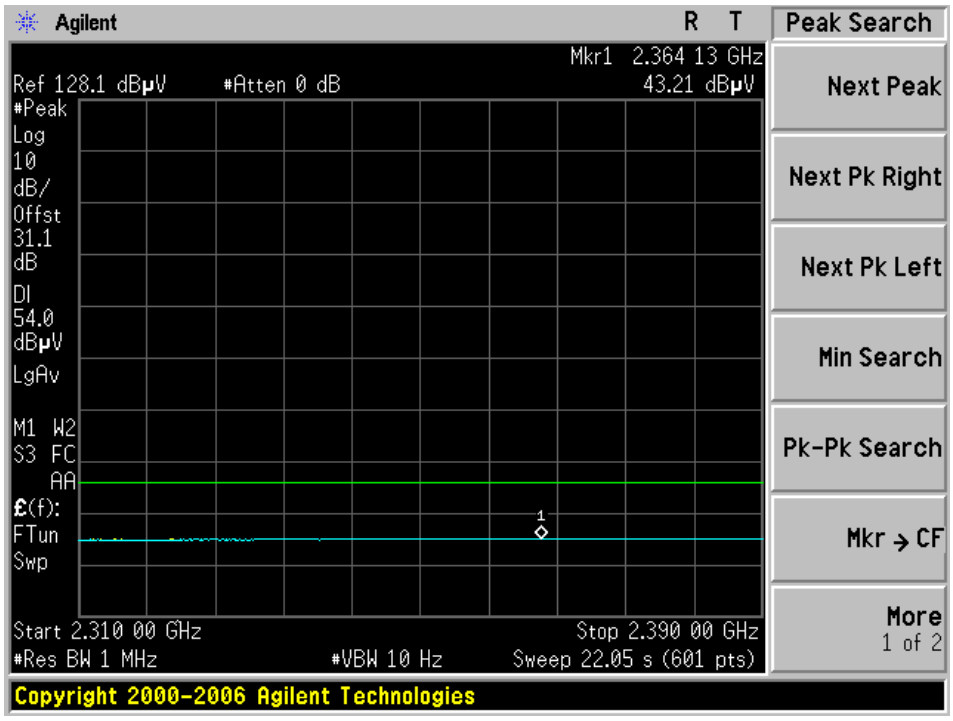
Back Horizontal Antenna, Low channel, Horizontal, Average measurement



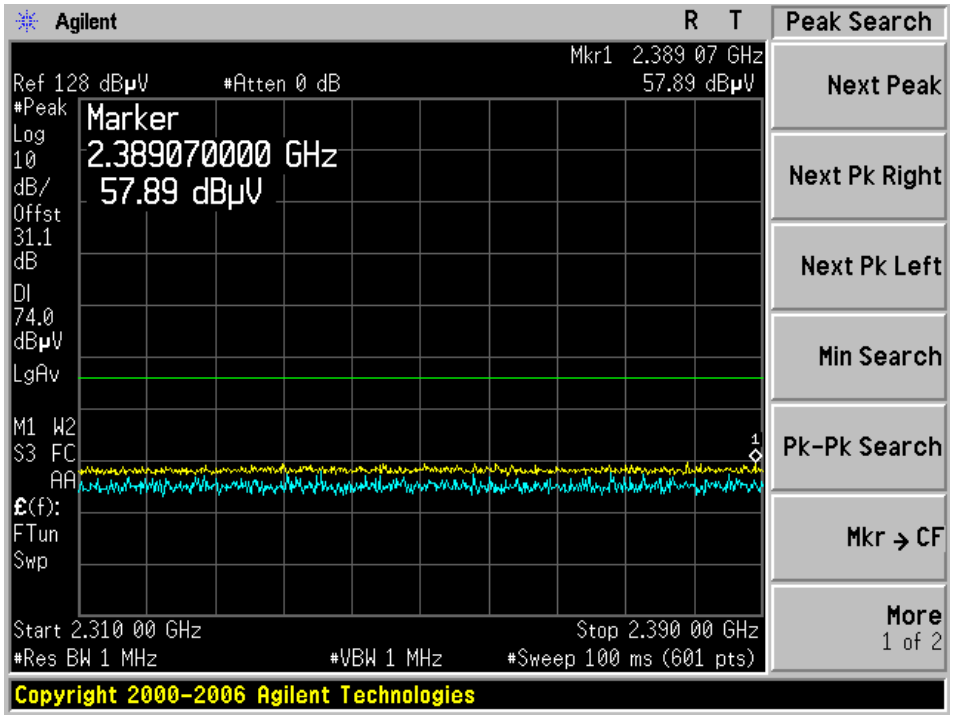
Back Vertical Antenna, High channel, Vertical, Peak measurement



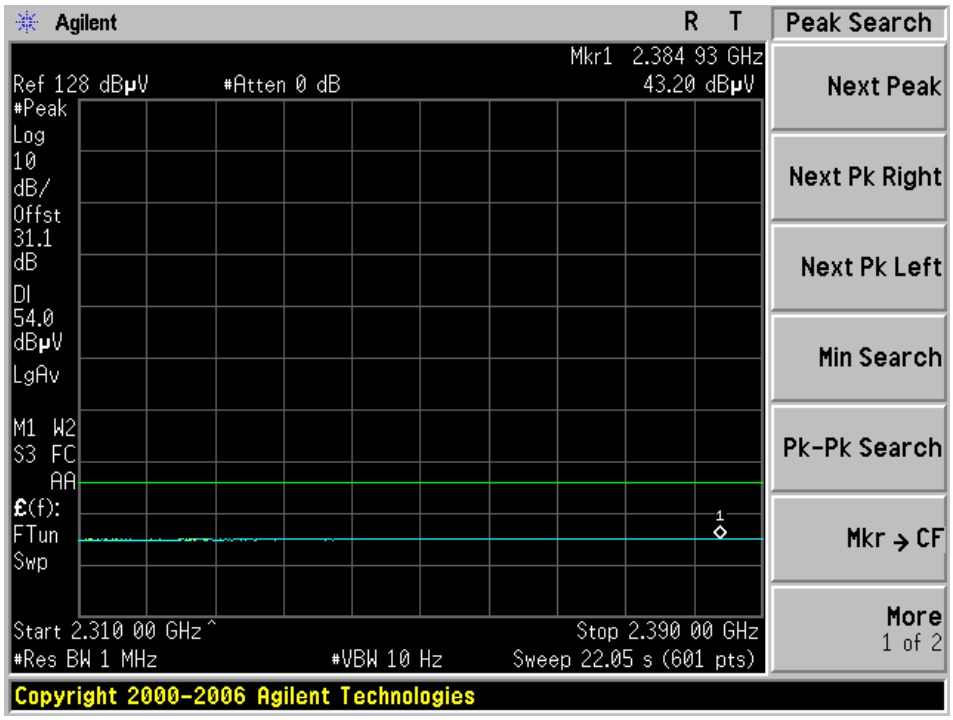
Back Vertical Antenna, High channel, Vertical, Average measurement



Back Horizontal Antenna, High channel, Horizontal, Peak measurement



Back Horizontal Antenna, High channel, Horizontal, Average measurement



9 FCC §15.247(a) (2) – Hopping Channel Bandwidth

9.1 Applicable Standard

According to FCC§15.247(a) (2), the maximum 20 dB bandwidth of the hopping channel shall be presented.

9.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emissions bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-04-10

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

9.4 Test Environmental Conditions

Temperature:	24.1 °C
Relative Humidity:	41.5 %
ATM Pressure:	102.3 kPa

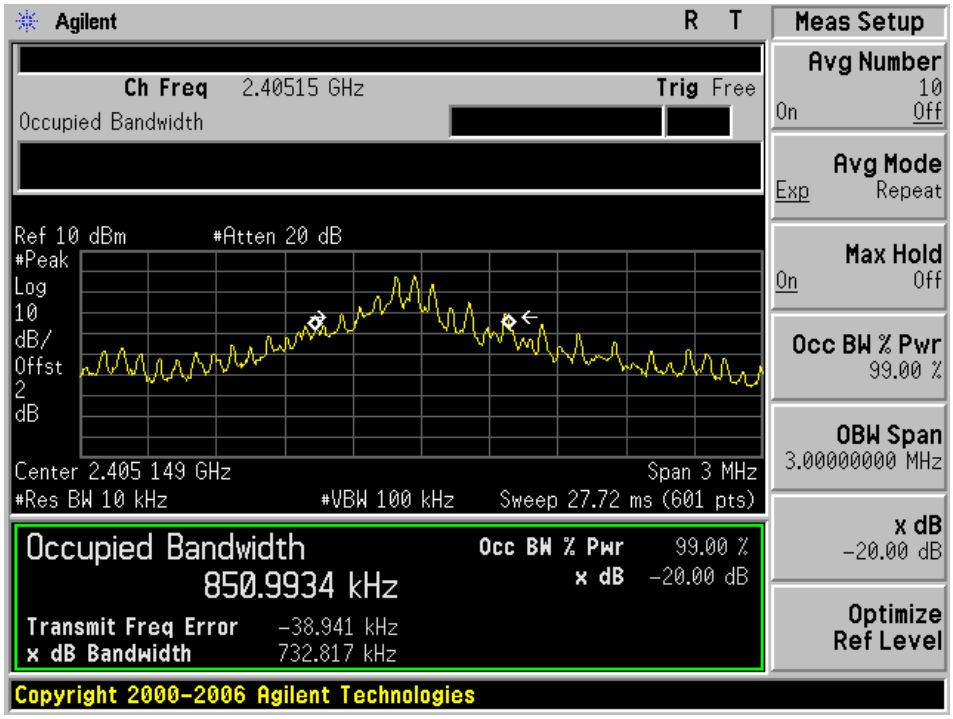
The testing was performed by Ning Ma on 2012-05-02.

9.5 Test Results

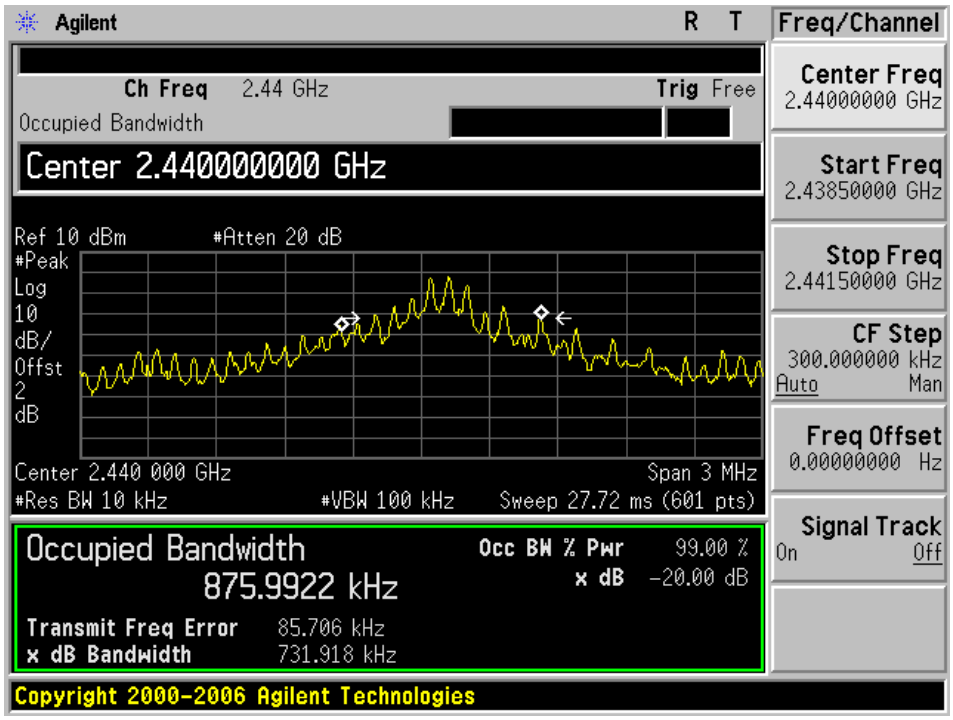
Channel	Frequency (MHz)	20 dB Channel Bandwidth (kHz)
Low	2405	732.817
Mid	2440	731.918
High	2479	505.913

Please refer to the following plots for detailed test results:

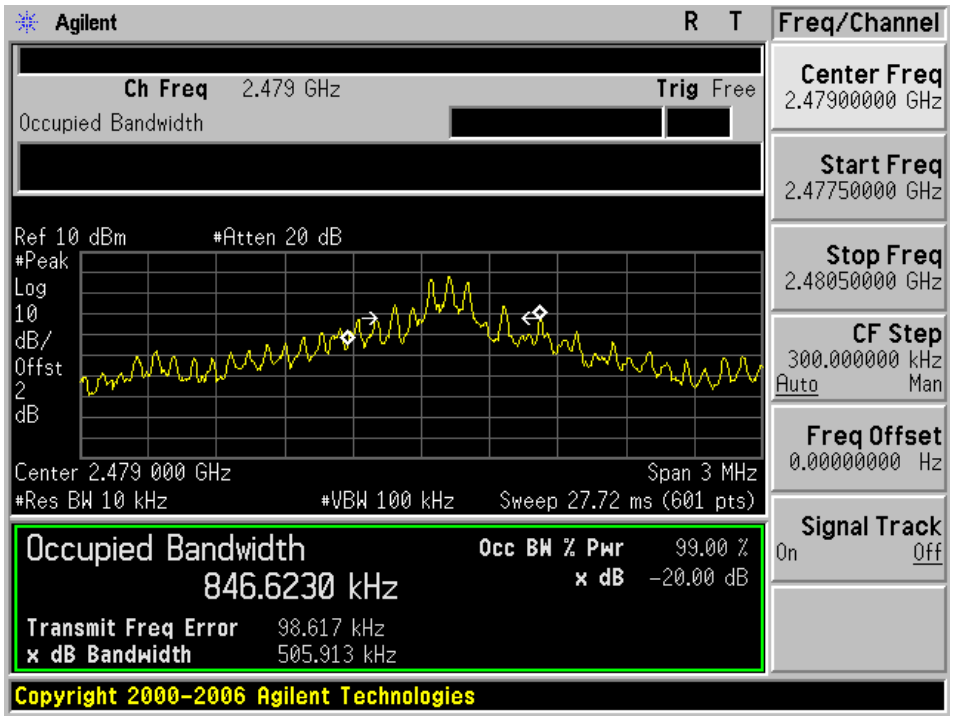
Low Channel



Middle Channel



High Channel



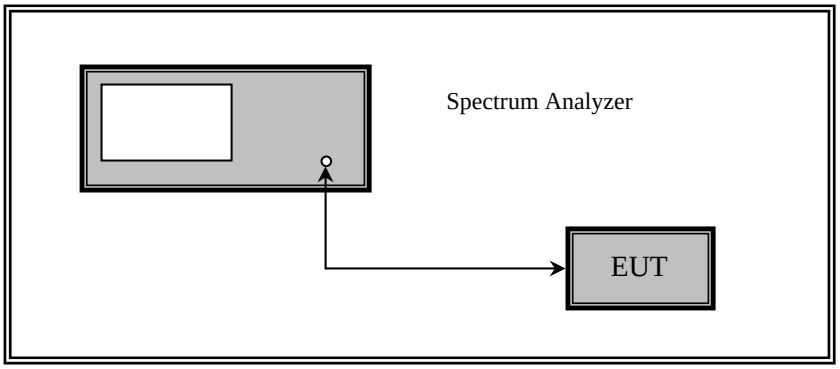
10 FCC §15.247(b) – Peak Output Power Measurement

10.1 Applicable Standard

According to FCC §15.247(b) (1), for frequency hopping systems in the 2400-2483.5MHz band employing at least 75 hopping channels, and all direct sequence systems, the maximum peak output power of the transmitter shall not exceed 1 Watt. For all other frequency hopping system in the 2400 – 2483.5 MHz band, the maximum peak output power of the transmitter shall not exceed 0.125 Watt.

10.2 Measurement Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to a spectrum analyzer.
3. Add a correction factor to the display.



10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-04-10

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

10.4 Test Environmental Conditions

Temperature:	24.1 °C
Relative Humidity:	41.5 %
ATM Pressure:	102.3 kPa

The testing was performed by Ning Ma on 2012-05-02.

10.5 Test Results

Channel	Frequency (MHz)	Max Peak Output Power		Limit (dBm)	Result
		(dBm)	(mw)		
Low	2405	5.12	3.25	19	Pass
Mid	2440	4.95	3.13	19	Pass
High	2479	4.96	3.13	19	Pass

Note: The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

As the Max power output limit is 21dBm, and the EUT antenna gain is 8dBi which exceed 2dB from 6dBi, according to this section, the Max power output limit will need to reduce by 2dBi which is 19dBm as the limit for this section.

11 FCC §15.247(d) – 100 kHz Bandwidth of Band Edges

11.1 Applicable Standard

According to FCC §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required.

11.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-04-10

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

11.4 Test Environmental Conditions

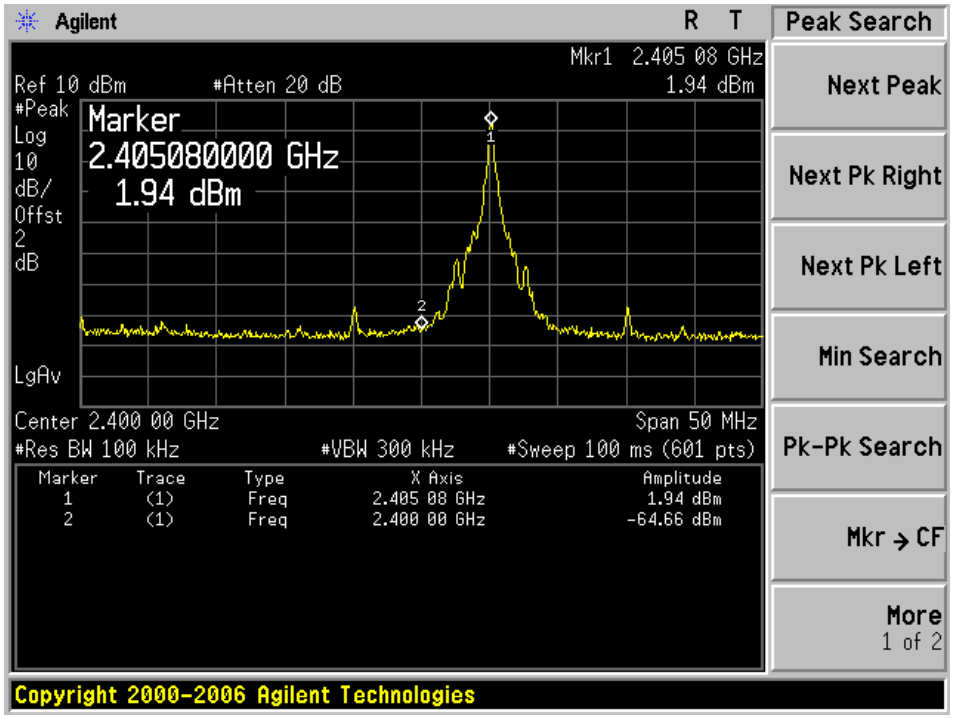
Temperature:	24.1 °C
Relative Humidity:	41.5 %
ATM Pressure:	102.3 kPa

The testing was performed by Ning Ma on 2012-05-02.

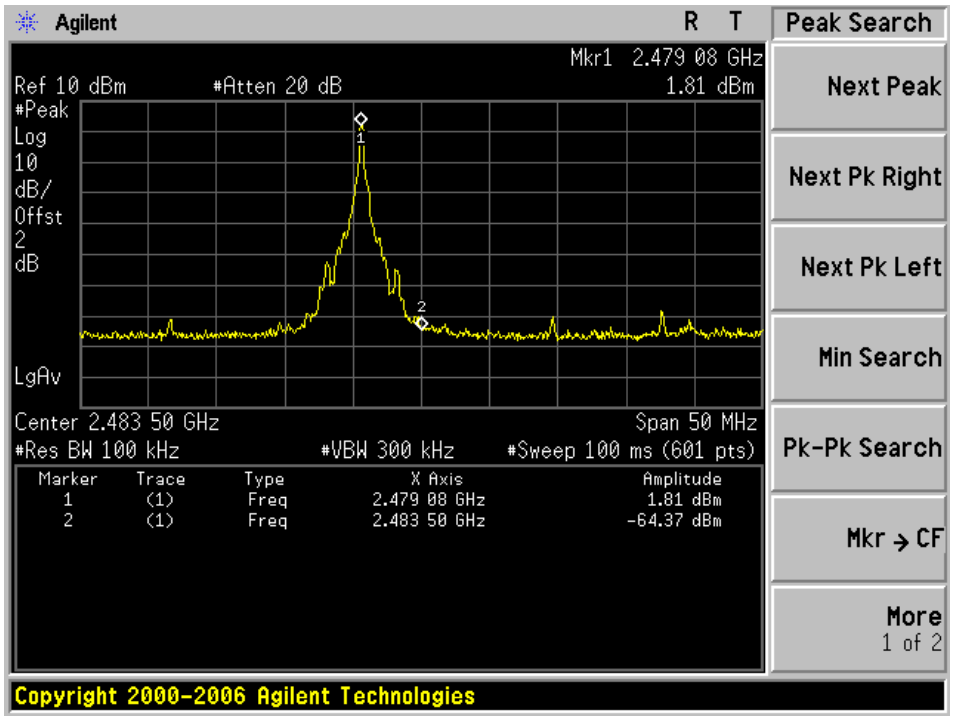
11.5 Test Results

Please refer to the following plots.

Band Edge: Lowest Channel



Band Edge: Highest Channel



12 FCC §15.247(a) (1) – Hopping Channel Separation

12.1 Applicable Standard

According to FCC §15.247(a)(1): 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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

12.2 Measurement Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on a bench without connection to measurement instrument Turn on the EUT and set it to any one convenient frequency within its operating range.
3. By using the Max-Hold function record the separation of two adjacent channels.
4. Measure the frequency difference of these two adjacent channels by SA MARK function, and then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

12.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-04-10

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

12.4 Test Environmental Conditions

Temperature:	24.1 °C
Relative Humidity:	41.5 %
ATM Pressure:	102.3 kPa

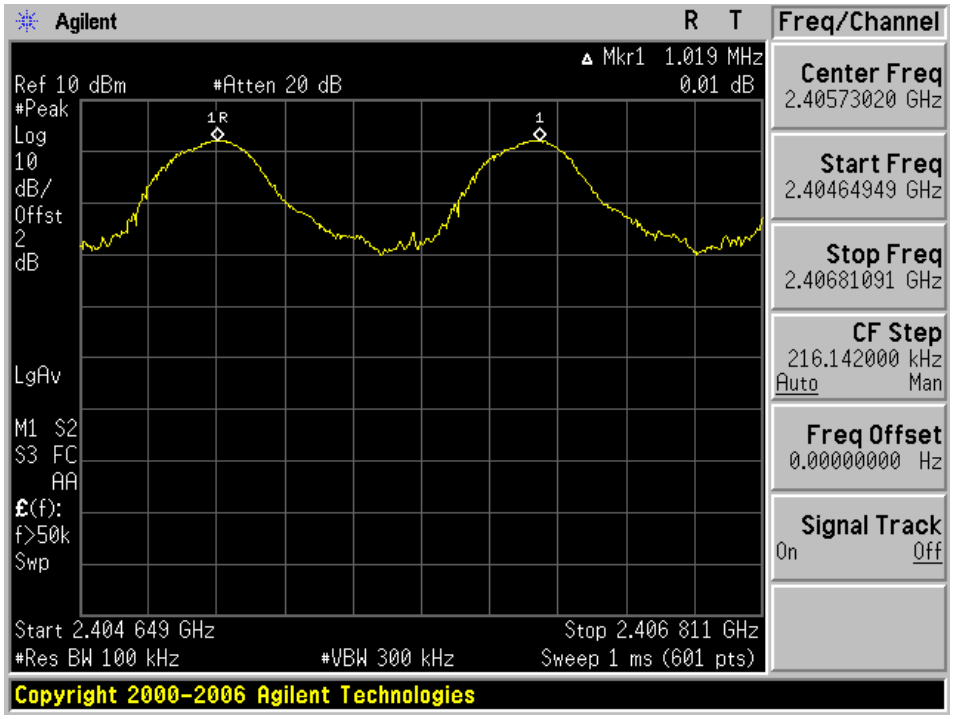
The testing was performed by Ning Ma on 2012-05-02.

12.5 Test Results

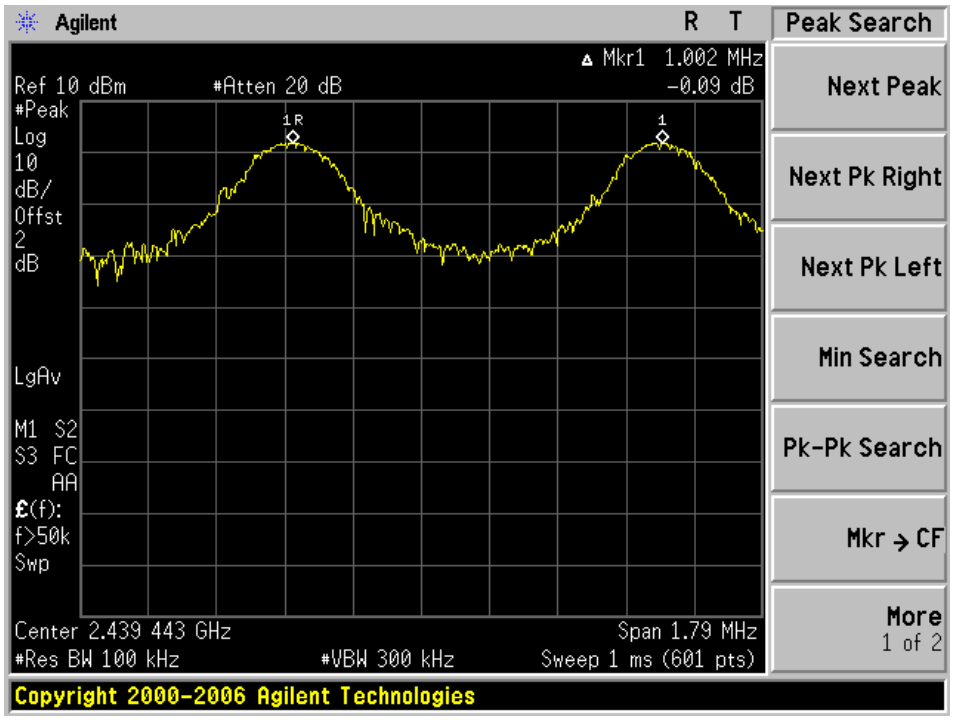
Channel	Frequency (MHz)	Channel Separation (kHz)	Limit > 2/3 20 dB OBW (kHz)
Low	2405	1019	488.5447
Mid	2440	1002	487.9453
High	2479	997	337.2753

Please refer to the following plots.

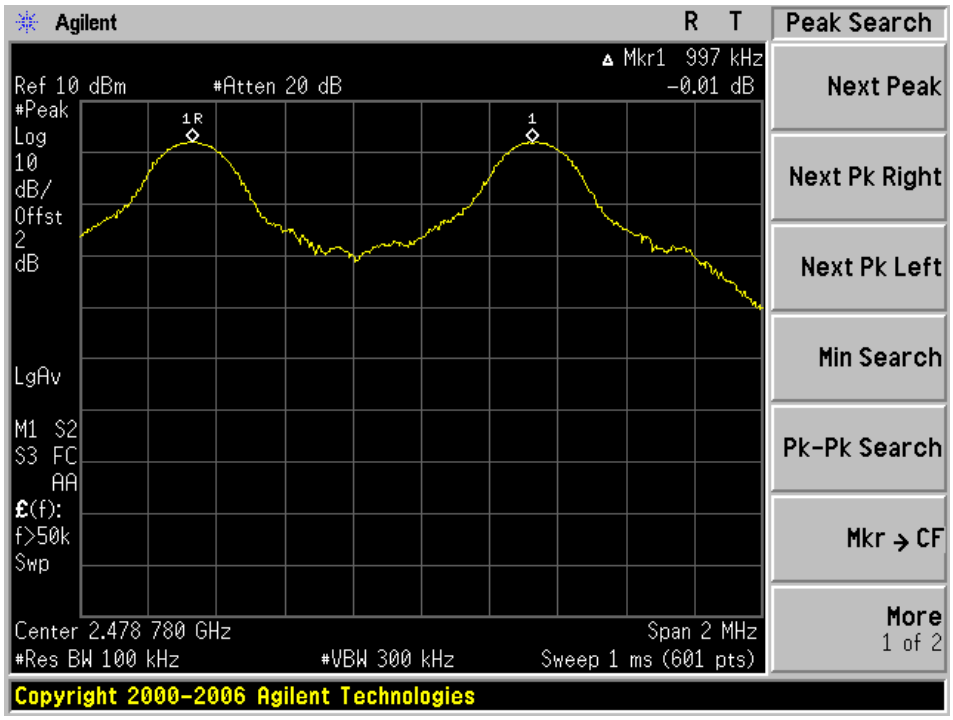
Low Channel



Middle Channel



High Channel



13 FCC §15.247(a) (1) (iii) – Number of Hopping Channels

13.1 Applicable Standard

According to FCC §15.247(a)(1)(iii), frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

13.2 Measurement Procedure

1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on the bench without connection to measurement instrument. Turn on the EUT and set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set the SA on Max-Hold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
4. Set the SA on View mode and then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

13.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-04-10

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

13.4 Test Environmental Conditions

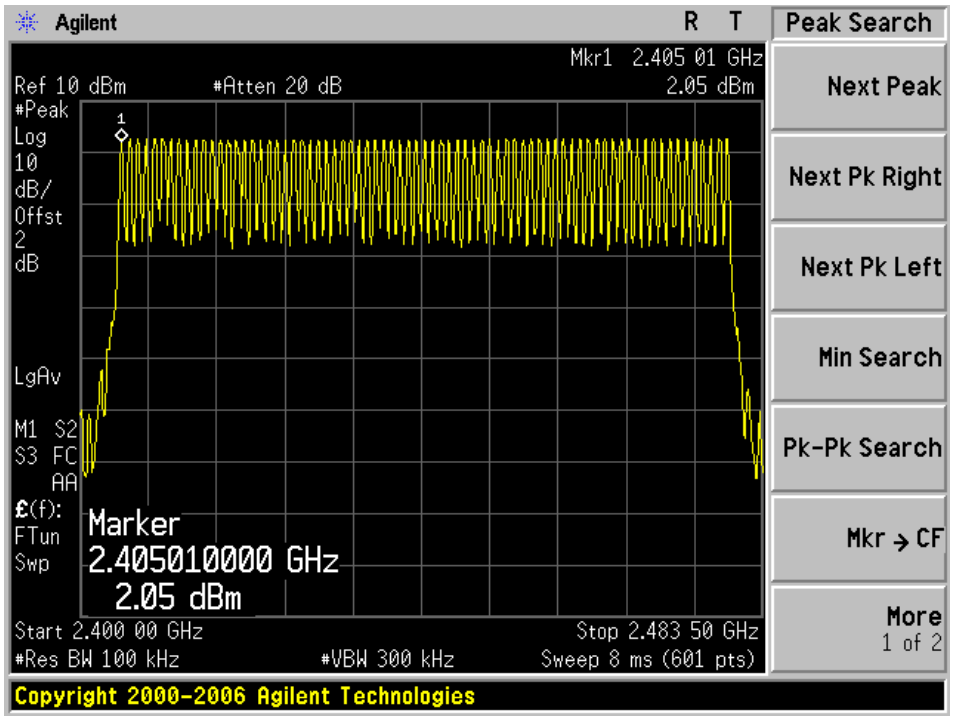
Temperature:	24.1 °C
Relative Humidity:	41.5 %
ATM Pressure:	102.3 kPa

The testing was performed by Ning Ma on 2012-05-02.

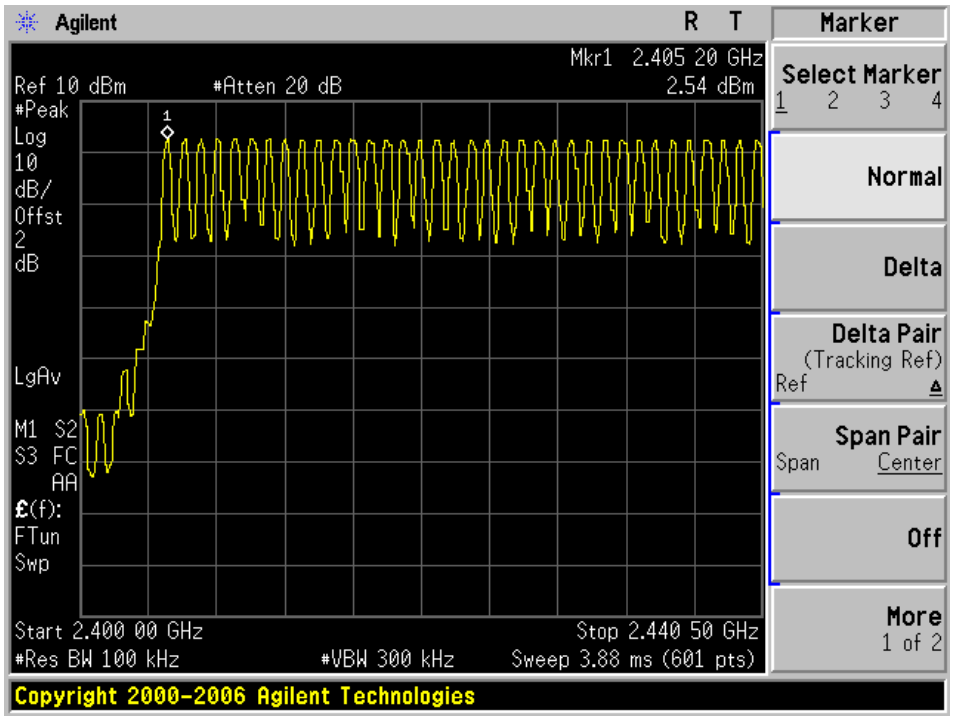
13.5 Test Results

Please refer to the following plots.

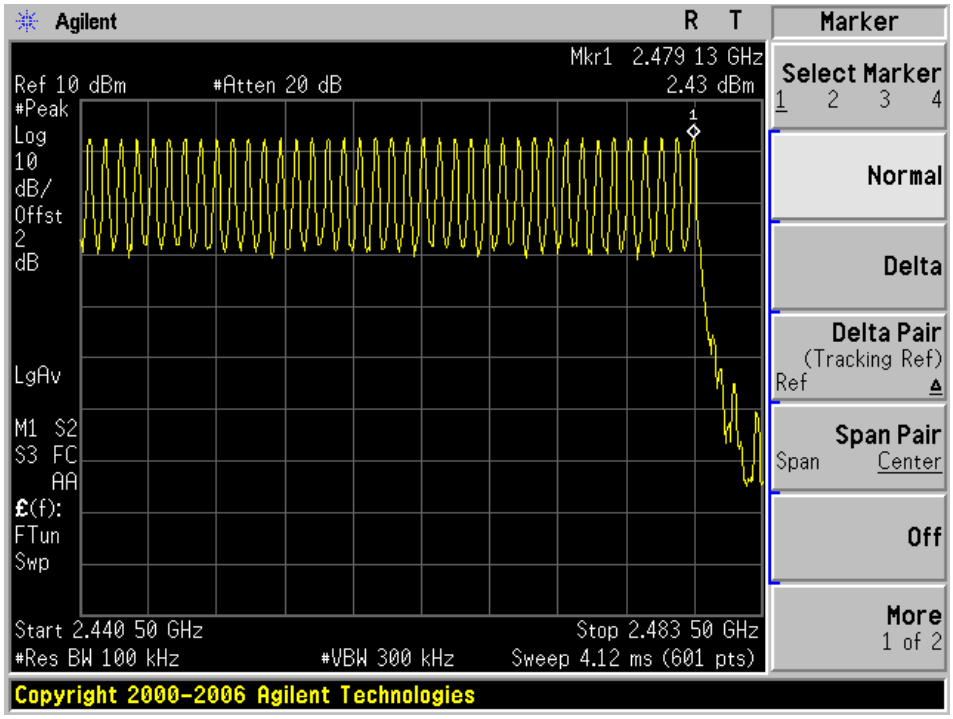
Hopping Channel Number: Total 75 Channels



36 Channels between 2400 to 2440.5 MHz



39 Channels between 2440.5 to 2483.5 MHz



14 FCC §15.247(a)(1)(iii) – Dwell Time

14.1 Applicable Standard

According to FCC §15.247 (a)(1)(iii), 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.

14.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
5. Repeat above procedures until all frequencies measured were complete.

14.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-04-10

Statement of Traceability: BACL Corp. attests that all calibrations have been performed per the A2LA requirements, traceable to the NIST.

14.4 Test Environmental Conditions

Temperature:	24.1 °C
Relative Humidity:	41.5 %
ATM Pressure:	102.3 kPa

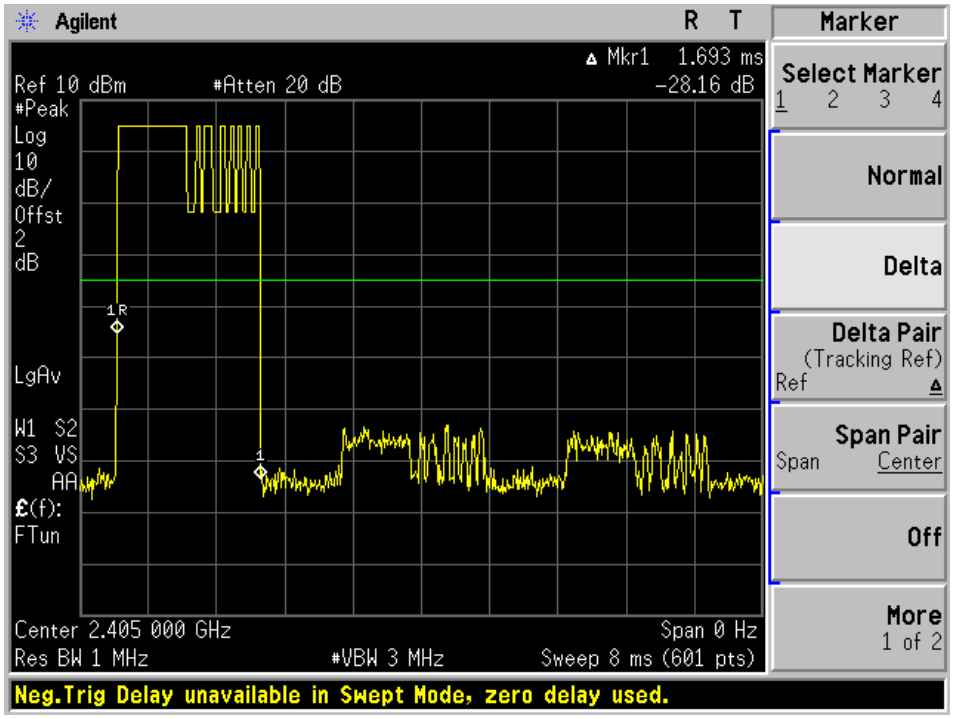
The testing was performed by Ning Ma on 2012-05-02.

14.5 Test Results

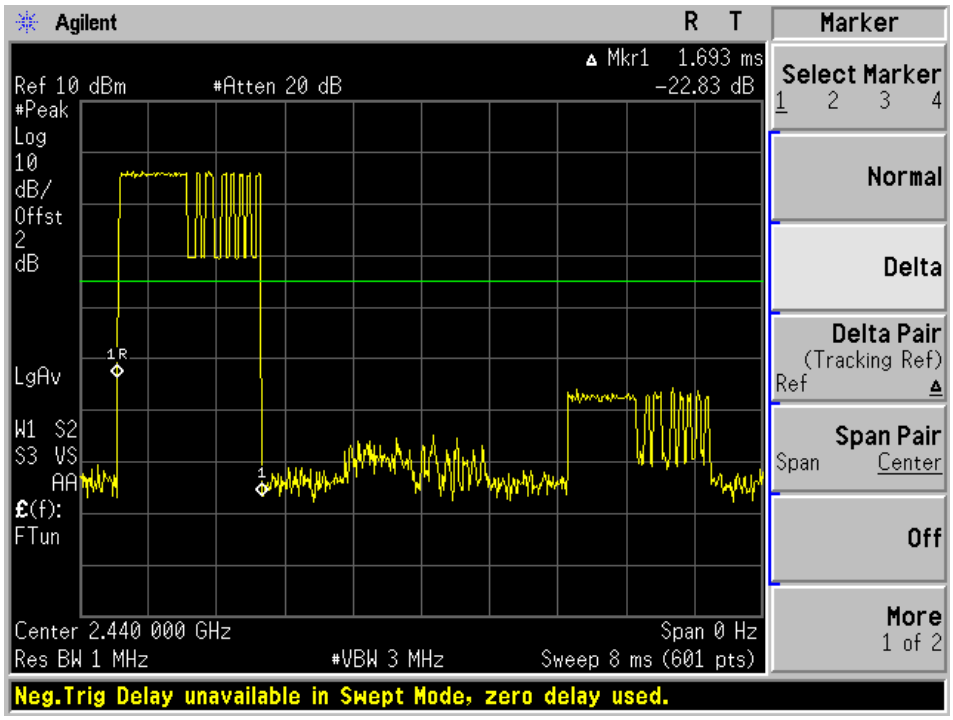
Channel	Frequency (MHz)	Pulse Width (ms)	Dwell Time (Sec.)	Limit (Sec.)	Results
Low	2405	1.63	0.0213	0.4	Compliant
Mid	2440	1.63	0.0213	0.4	Compliant
High	2479	1.63	0.0213	0.4	Compliant

Note: Dwell time = Pulse time*(hop rate/2/number of channels)*31.6 sec
Hop Rate = 60, Number of Channels = 75
Please refer the following plots.

Low Channel



Middle Channel



High Channel