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

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Report Number:	R1204302-247A DTS
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 DTS	Original Report	2012-06-13
1	R1204302-247A DTS	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 rules for Output Power, Antenna Requirements, 6 dB Bandwidth, and power spectral density, 100 kHz Bandwidth of Band Edges Measurement, Spurious Emissions, Conducted and Radiated Spurious Emissions.

1.4 Related Submittal(s)/Grant(s)

DSS 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)	6 dB Emission Bandwidth	Compliant
§15.247(b)(3)	Maximum Peak Output Power	Compliant
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliant
§15.247(e)	Power Spectral Density	Compliant

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

4.1 Applicable Standard

According to FCC §15.247(i) and §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

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

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):	5.01
Maximum peak output power at antenna input terminal (mW):	3.17
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 20.0 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.

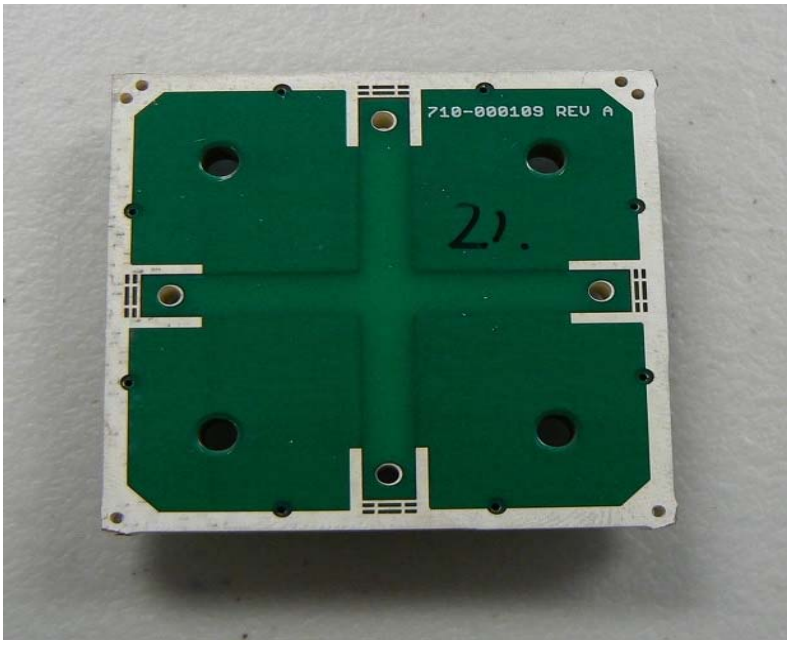
And according to FCC §15.247 (b) (4), if transmitting antennas of directional gain greater than 6 dBi are used the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

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 – AC Line Conducted Emissions

6.1 Applicable Standards

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 [1]	56 to 46 [1]
0.5-5	56	46
5-30	60	50

Note [1]: 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 §15.207 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 Supported Board was connected with LISN-1 which provided 120 V/60 Hz AC power.

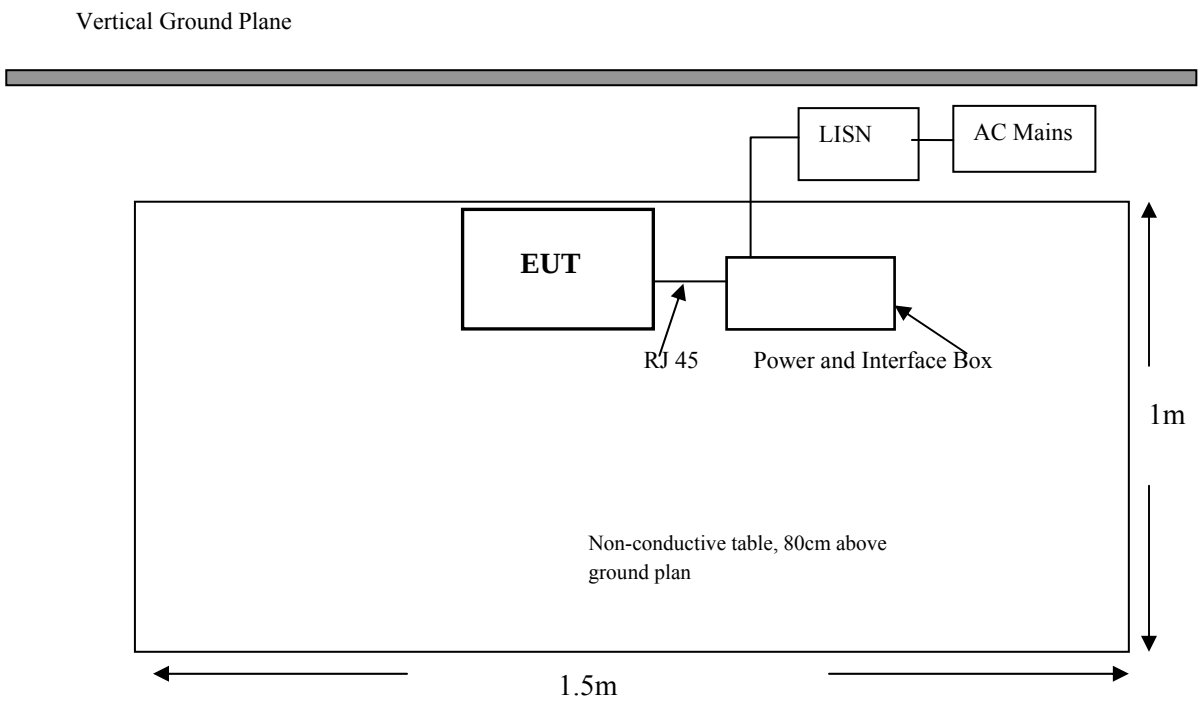
6.3 Test Procedure

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:

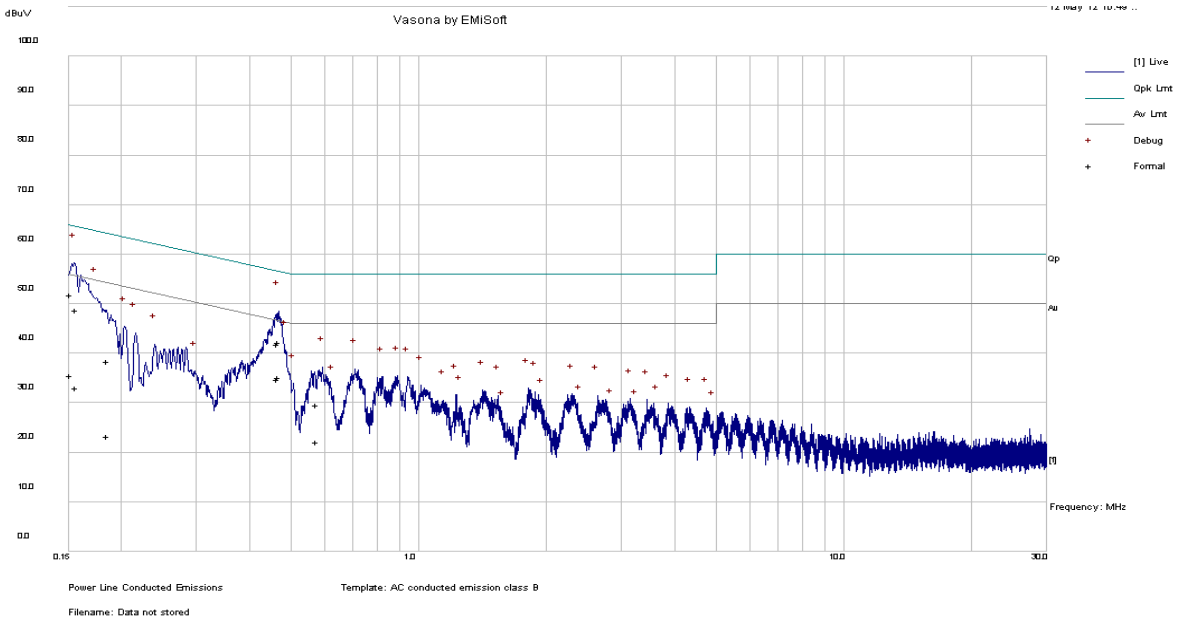
Worst Case: Low Channel Transmitting Mode

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-11.33	0.469896	Line	0.15-30

6.9 Conducted Emissions Test Plots and Data

Low channel

120 V, 60 Hz – Line



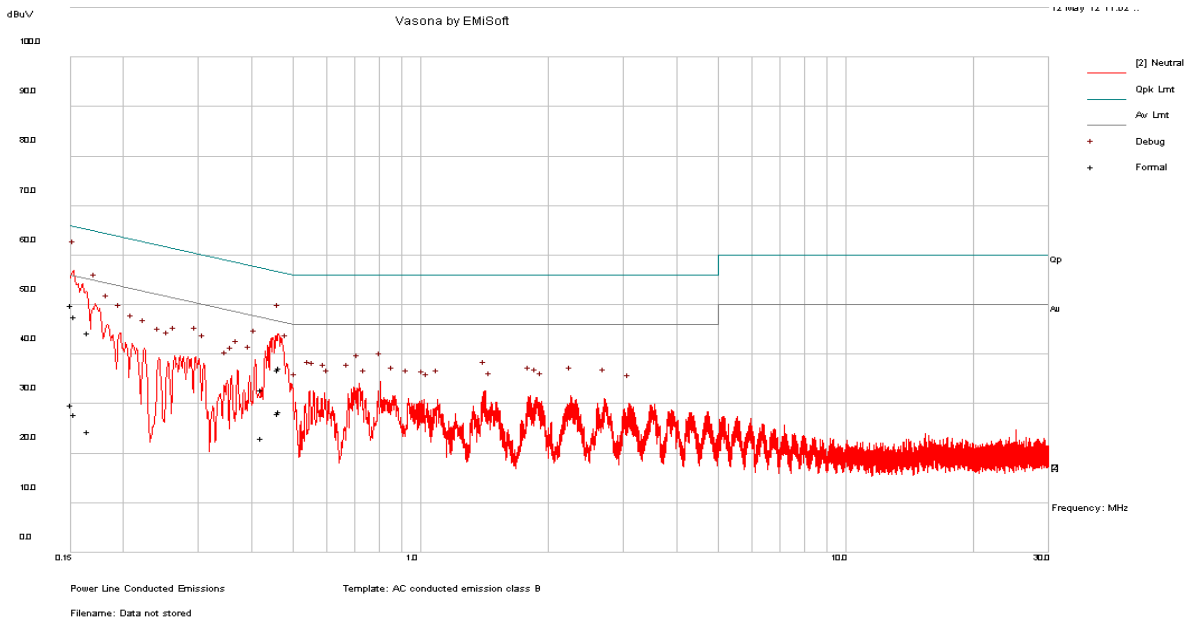
Quasi-Peak Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.151839	51.91	Line	65.9	-13.98
0.469896	42.25	Line	56.52	-14.27
0.46578	41.94	Line	56.59	-14.65
0.156492	48.81	Line	65.65	-16.84
0.185361	38.32	Line	64.24	-25.92
0.578343	29.62	Line	56	-26.38

Average Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.469896	35.19	Line	46.52	-11.33
0.46578	34.85	Line	46.59	-11.74
0.151839	35.58	Line	55.9	-20.32
0.156492	33.15	Line	55.65	-22.50
0.578343	22.21	Line	46	-23.79
0.185361	23.22	Line	54.24	-31.02

120 V, 60 Hz – Neutral



Quasi-Peak Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.150927	50.01	Neutral	65.95	-15.94
0.153729	47.59	Neutral	65.8	-18.21
0.465621	37.28	Neutral	56.59	-19.31
0.463884	36.93	Neutral	56.62	-19.70
0.165678	44.38	Neutral	65.17	-20.80
0.424176	32.86	Neutral	57.37	-24.51

Average Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.465621	28.51	Neutral	46.59	-18.08
0.463884	28.04	Neutral	46.62	-18.58
0.424176	23.16	Neutral	47.37	-24.21
0.150927	29.85	Neutral	55.95	-26.10
0.153729	27.84	Neutral	55.8	-27.96
0.165678	24.41	Neutral	55.17	-30.76

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 NVLAP requirements, traceable to the NIST.

7.4 Test Environmental Conditions

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

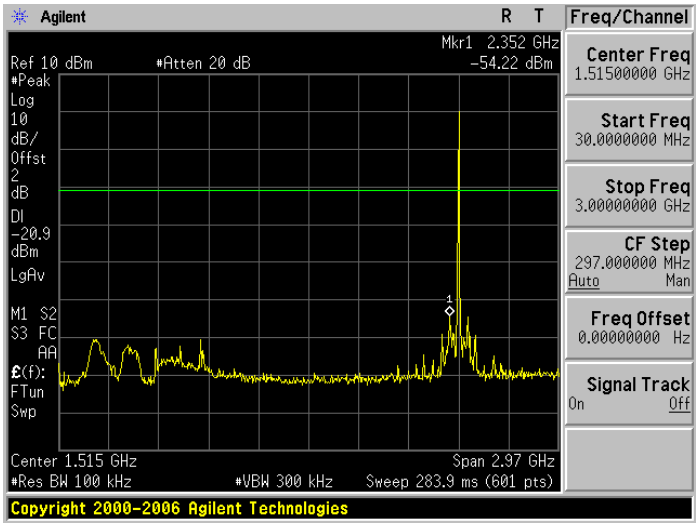
The testing was performed by Ning Ma on 2012-05-01.

7.5 Test Results

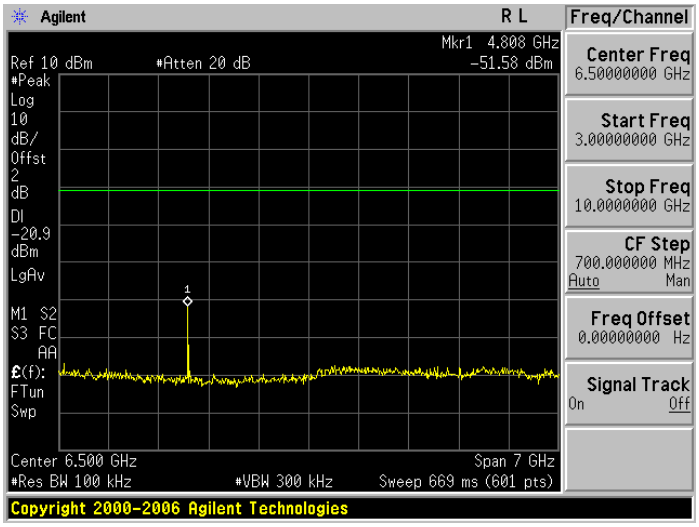
Please refer to following plots of spurious emissions.

Low Channel, 2405 MHz

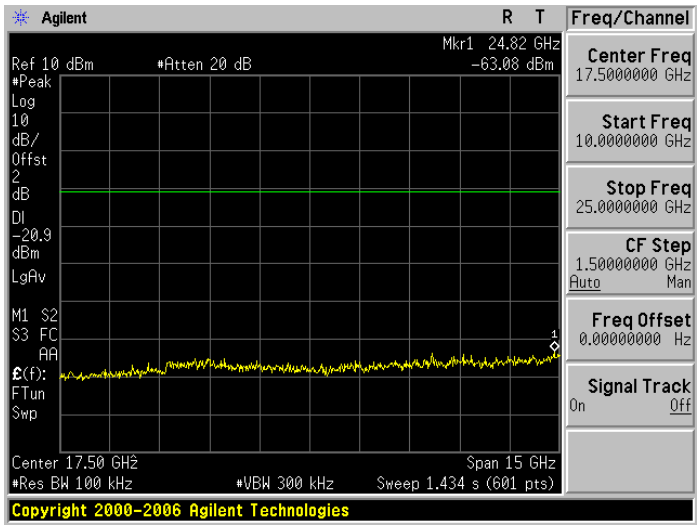
Plot: 30 MHz – 3 GHz



Plot: 3 GHz – 10 GHz

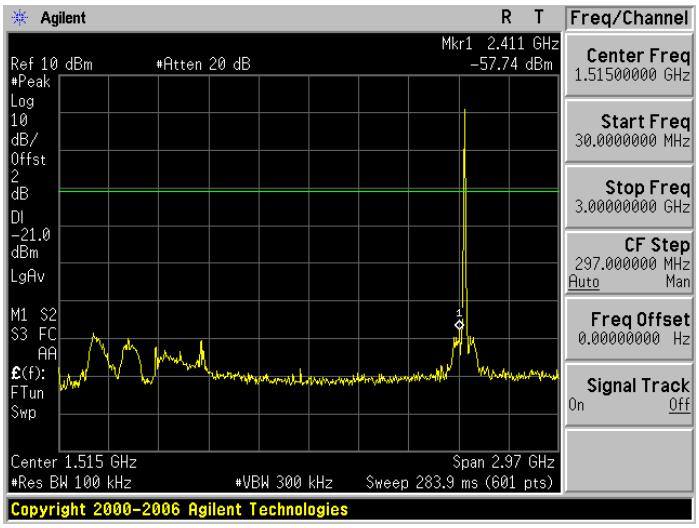


Plot: 10 GHz – 25 GHz

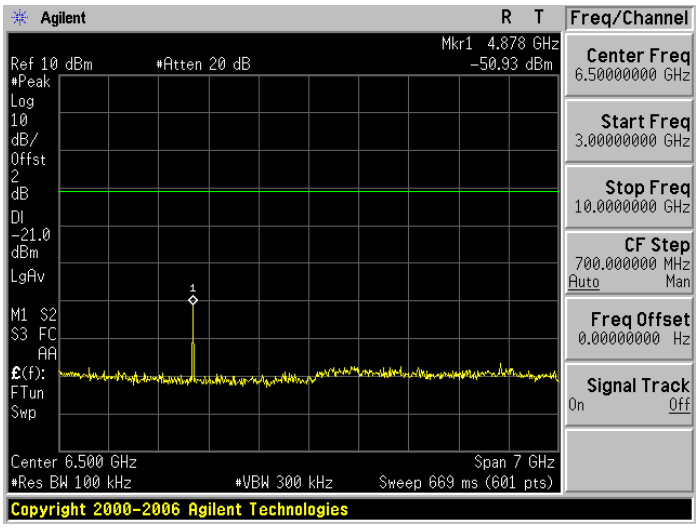


Middle Channel, 2440 MHz

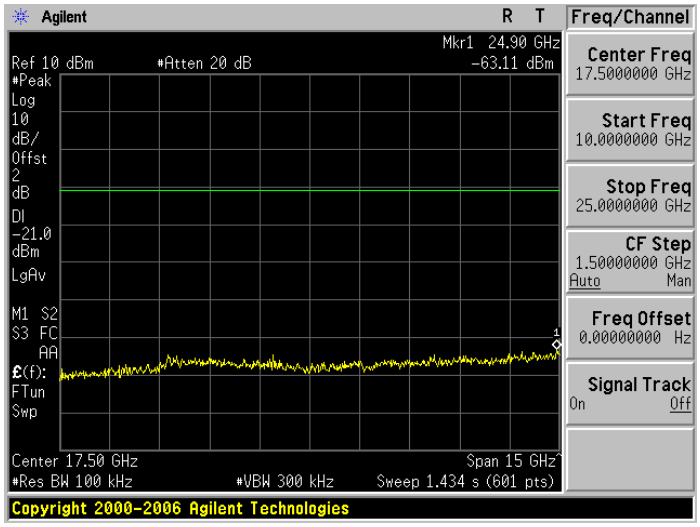
Plot: 30 MHz – 3 GHz



Plot: 3 GHz – 10 GHz

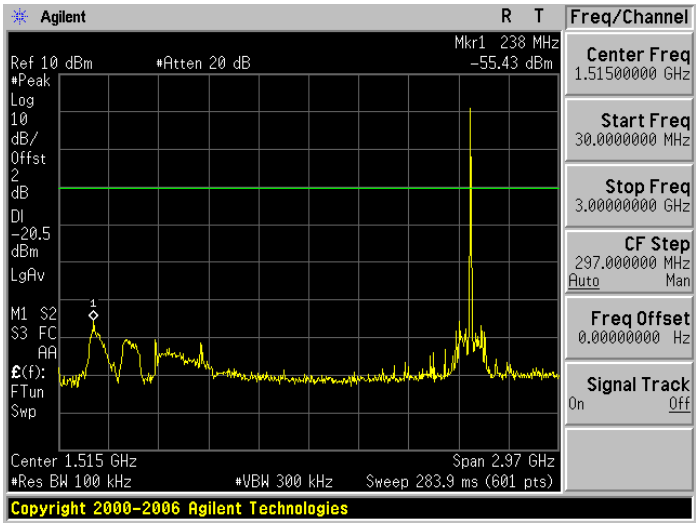


Plot: 10 GHz – 25 GHz

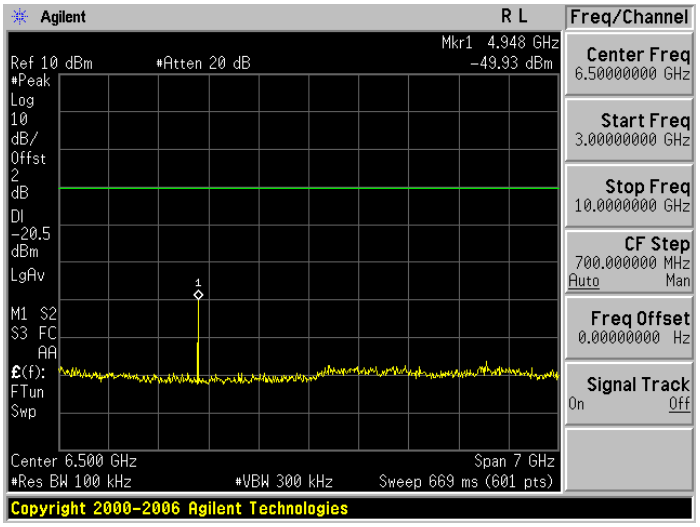


High Channel, 2475 MHz

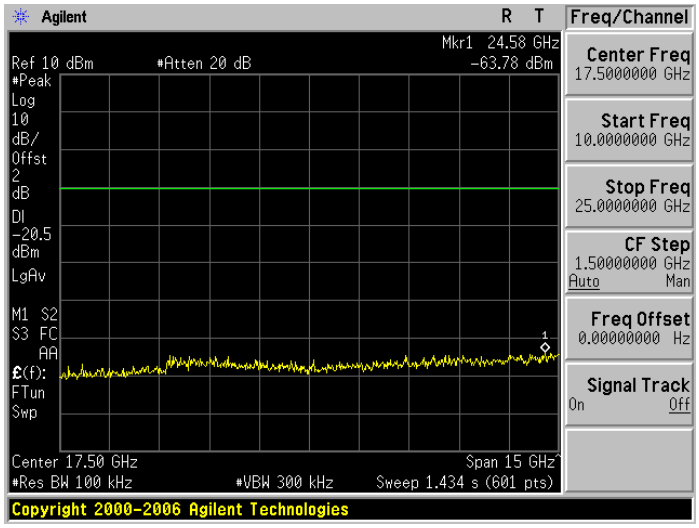
Plot: 30 MHz – 3 GHz



Plot: 3 GHz – 10 GHz



Plot: 10 GHz – 25 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) and RSS-210: 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	16.42 – 16.423	960 – 1240	4. 5 – 5. 15
0.495 – 0.505	16.69475 – 16.69525	1300 – 1427	5. 35 – 5. 46
2.1735 – 2.1905	25.5 – 25.67	1435 – 1626.5	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1645.5 – 1646.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1660 – 1710	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1718.8 – 1722.2	9.3 – 9.5
6.215 – 6.218	108 – 121.94	2200 – 2300	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2310 – 2390	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2483.5 – 2500	14.47 – 14.5
8.291 – 8.294	156.52475 – 156.52525	2690 – 2900	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	3260 – 3267	17.7 – 21.4
8.37625 – 8.38675	162.0125 –167.17	3.332 – 3.339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3 3458 – 3 358	23.6 – 24.0
12.29 – 12.293	240 – 285	3.600 – 4.400	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4		36.43 – 36.5
12.57675 – 12.57725	399.9 – 410		Above 38.6
13.36 – 13.41	608 – 614		

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 15 Subpart C limits.

The spacing between the peripherals was 3 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:

(1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
(2) 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 Title 47, 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)**	**Mode, Channel, Range**
-26.08	30	Vertical	30 MHz-1 GHz

1 – 25 GHz:

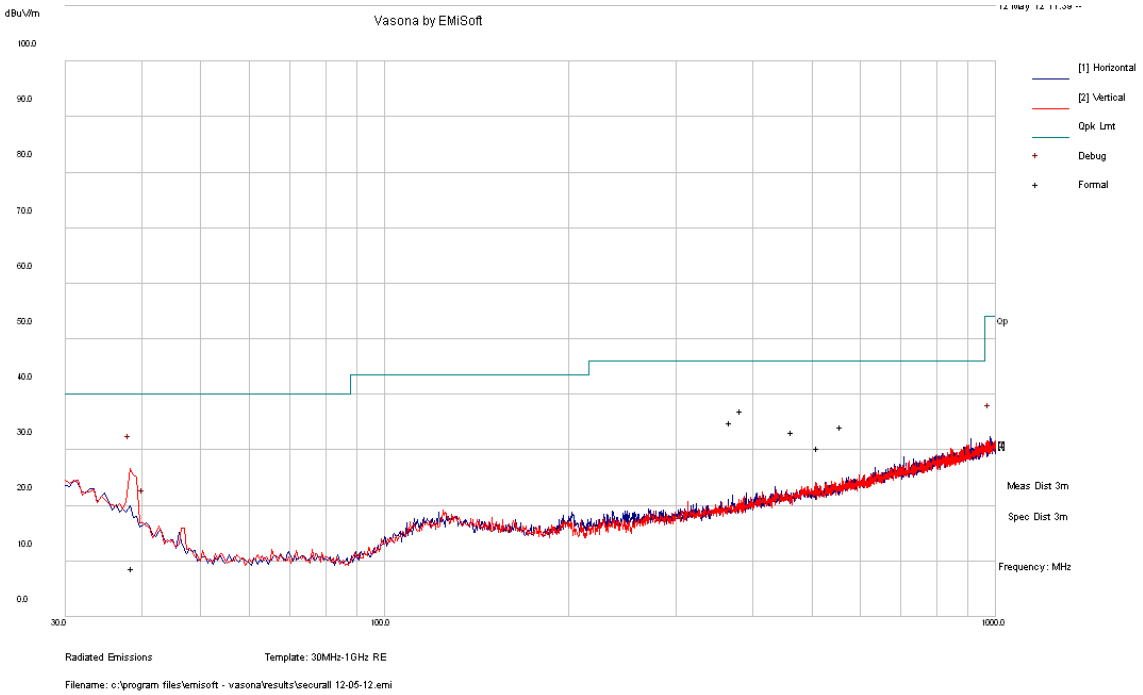
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Mode, Channel, Range**
-15.441	4810	Horizontal	Above 1 GHz

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

8.8 Radiated Emissions Test Data and Plots

1) 30 MHz – 1 GHz, Measured at 3 meters

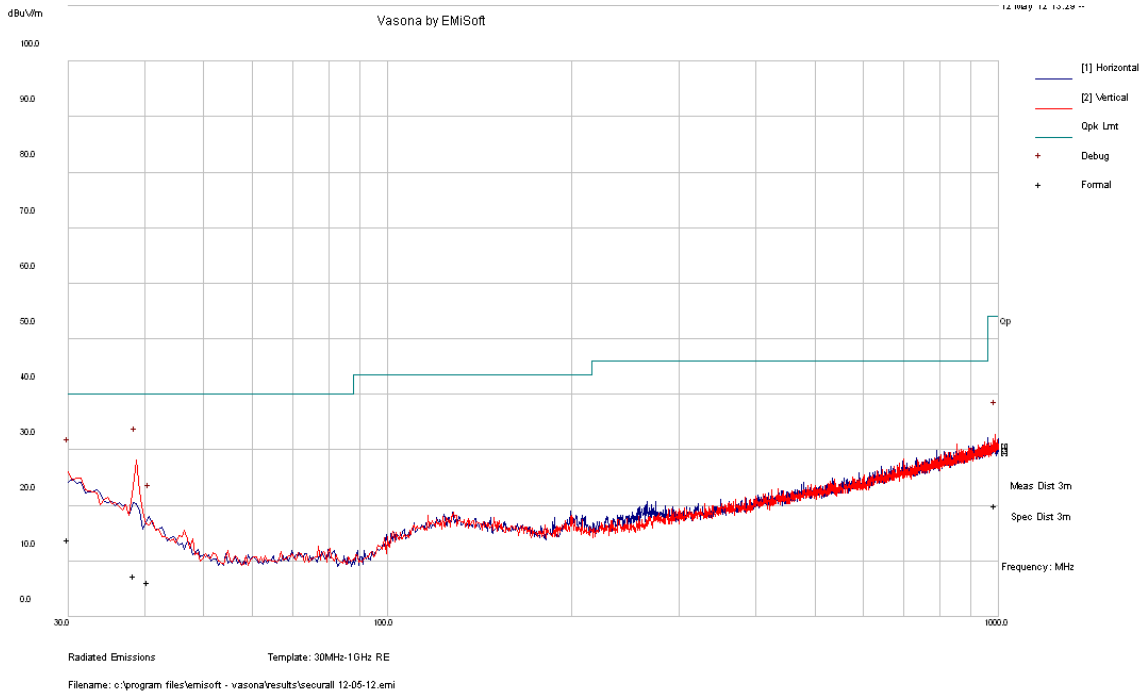
Worst Channel Low channel (2405 MHz) –Front Vertical Antenna



Quasi-Peak Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
38.2875	7.39	151	V	272	40	-32.61
39.762	6.14	154	V	144	40	-33.86
977.4948	19.88	109	H	39	54	-34.12

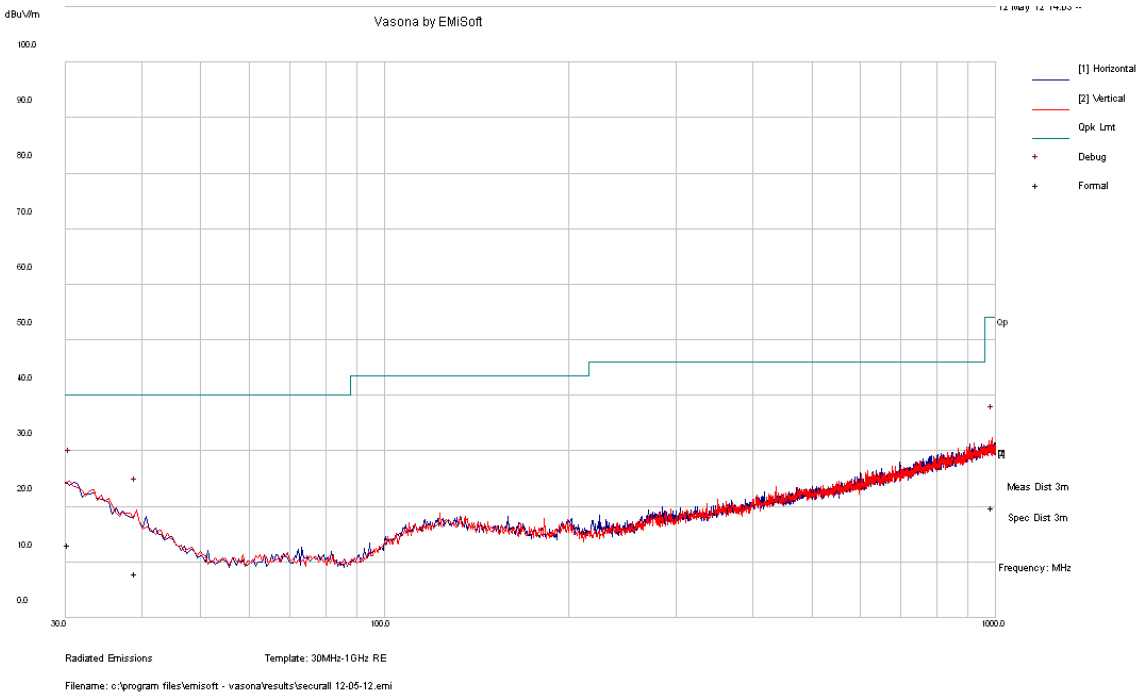
Worst Channel Middle channel (2405 MHz) – Front Horizontal Antenna



Quasi-Peak Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
30	13.92	202	V	354	40	-26.08
38.597	7.34	171	V	318	40	-32.66
40.522	6.19	172	V	280	40	-33.81
986.8298	19.94	109	V	53	54	-34.06

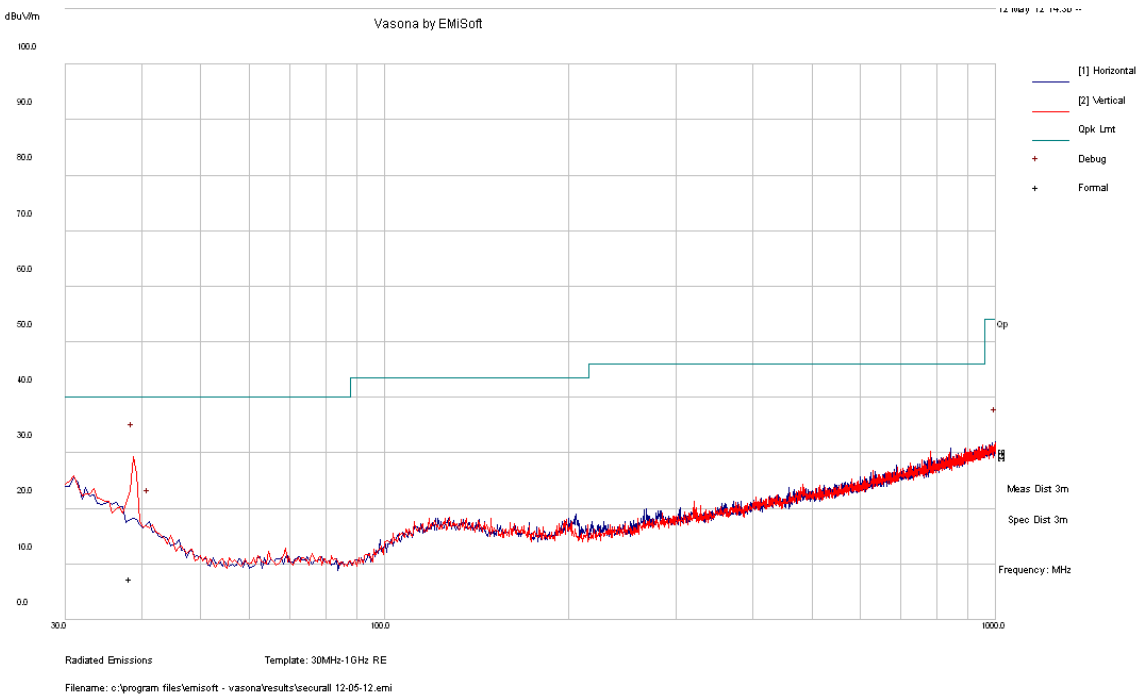
Worst Channel Low channel (2405 MHz) –Back Vertical Antenna



Quasi-Peak Measurements:

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
30.44325	13.2	187	V	285	40	-26.80
39.092	7.88	202	V	249	40	-32.12
986.1808	19.9	133	V	107	54	-34.10

Worst Channel Middle 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)
38.3815	7.38	199	V	172	40	-32.62

2) 1–25 GHz, Measured at 3 meters

Front Antenna

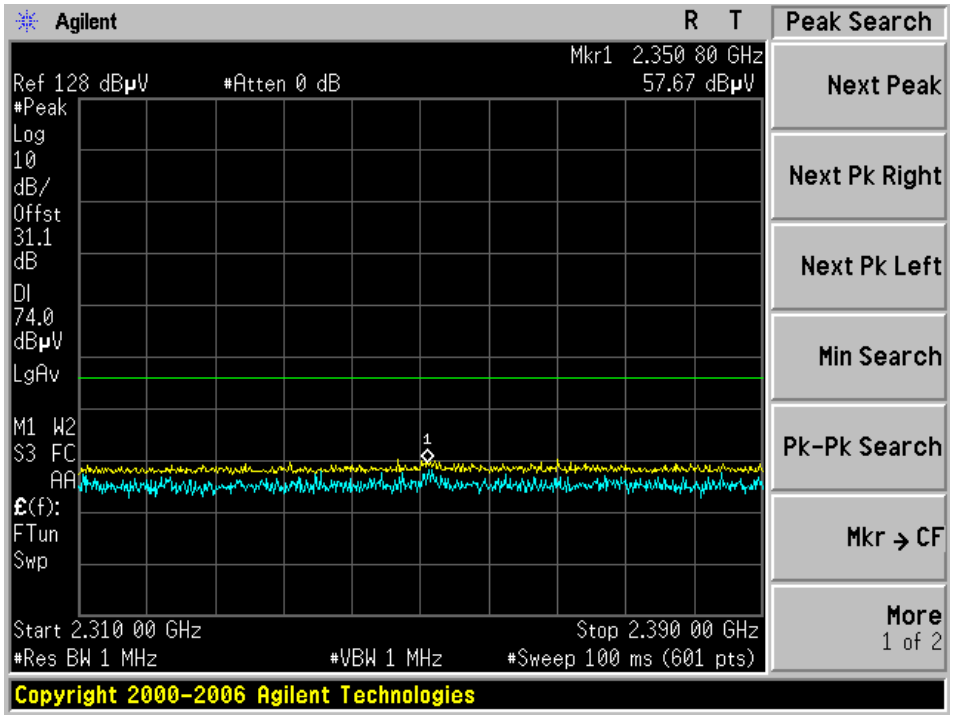
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2405 MHz, measured at 3 meters											
4810	36.7	118	116	H	32.629	4.56	27.71	46.179	74	-27.821	peak
4810	36.92	170	100	V	32.603	4.56	27.71	37.583	74	-36.417	peak
4810	28.42	118	116	H	32.629	4.56	27.71	37.899	54	-16.101	Ave
4810	28.71	170	100	V	32.603	4.56	27.71	29.373	54	-24.627	Ave
Middle Channel 2440 MHz, measured at 3 meters											
4880	39.46	111	122	H	32.8	4.54	36.5	40.3	74	-33.7	peak
4880	38.04	21	101	V	32.732	4.54	36.5	38.812	74	-35.188	peak
4880	31.33	111	122	H	32.8	4.54	36.5	32.17	54	-21.83	Ave
4880	29.11	21	101	V	32.732	4.54	36.5	29.882	54	-24.118	Ave
High Channel 2475 MHz, measured at 3 meters											
4950	33.65	23	106	H	32.8	4.52	27.71	43.26	74	-30.74	peak
4950	33.31	21	101	V	32.732	4.52	27.71	34.062	74	-39.938	peak
4950	24.28	23	106	H	32.8	4.52	27.71	33.89	54	-20.11	Ave
4950	22.94	21	101	V	32.732	4.52	27.71	23.692	54	-30.308	Ave

Back Antenna

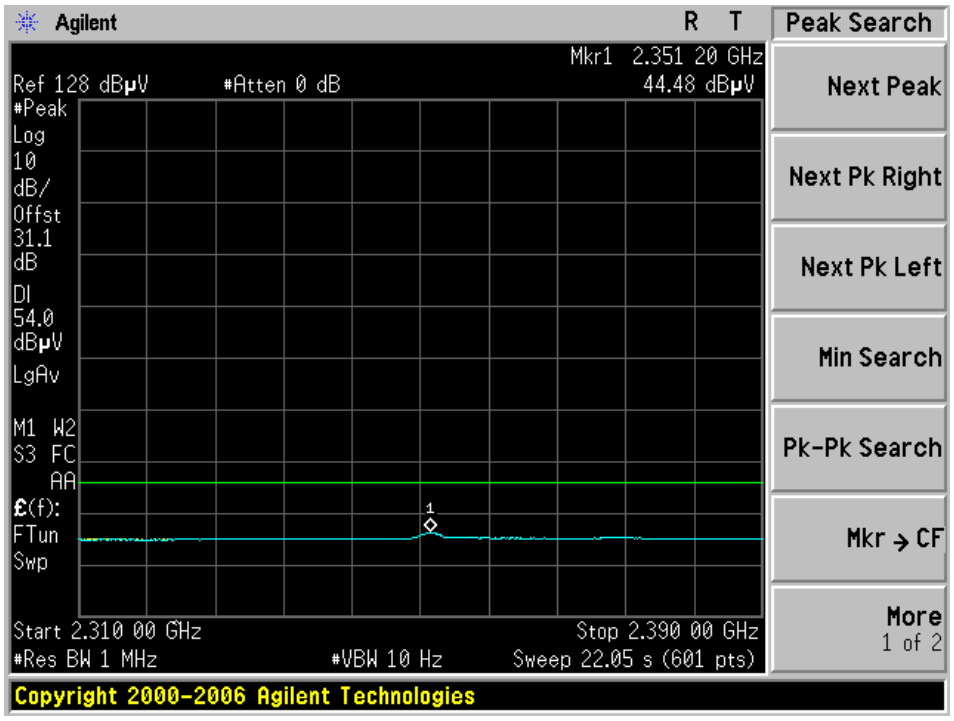
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 2405 MHz, measured at 3 meters											
4810	34.94	291	116	H	32.629	4.56	27.71	44.419	74	-29.581	peak
4810	36.82	332	101	V	32.603	4.56	27.71	37.483	74	-36.517	peak
4810	29.08	291	116	H	32.629	4.56	27.71	38.559	54	-15.441	Ave
4810	29.35	332	101	V	32.603	4.56	27.71	30.013	54	-23.987	Ave
Middle Channel 2440 MHz, measured at 3 meters											
4880	35.59	289	110	H	32.8	4.54	36.5	36.43	74	-37.57	peak
4880	34.1	324	100	V	32.732	4.54	36.5	34.872	74	-39.128	peak
4880	30.07	289	110	H	32.8	4.54	36.5	30.91	54	-23.09	Ave
4880	26.32	324	100	V	32.732	4.54	36.5	27.092	54	-26.908	Ave
High Channel 2475 MHz, measured at 3 meters											
4950	33.54	290	100	H	32.8	4.52	27.71	43.15	74	-30.85	peak
4950	31.79	338	100	V	32.732	4.52	27.71	32.542	74	-41.458	peak
4950	27.35	290	100	H	32.8	4.52	27.71	36.96	54	-17.04	Ave
4950	22.22	338	100	V	32.732	4.52	27.71	22.972	54	-31.028	Ave

3) Restricted Band Edge

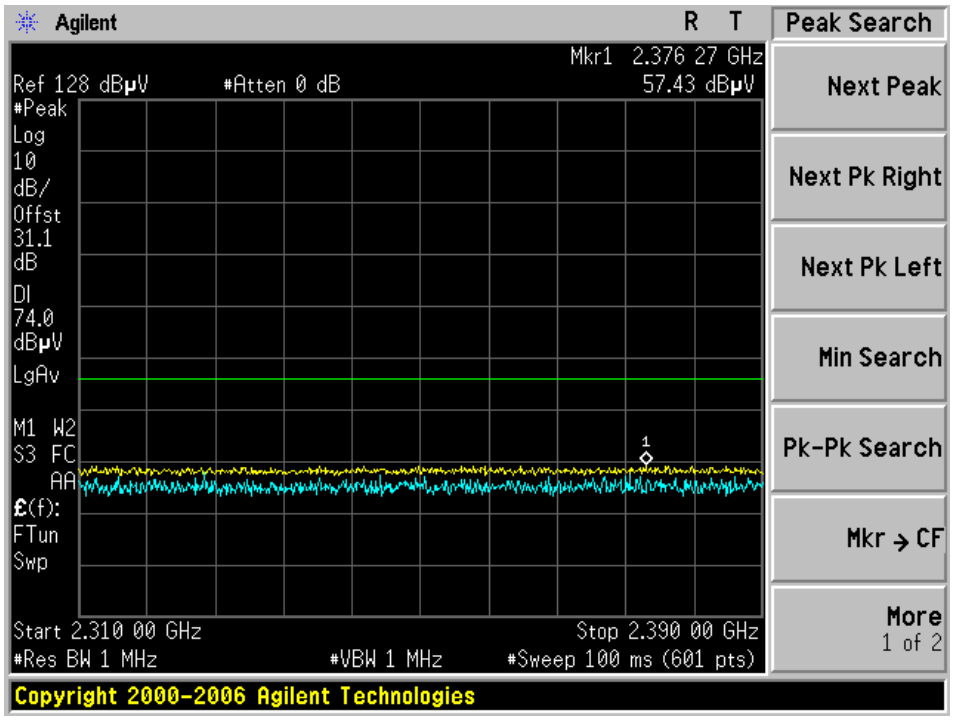
Front Vertical Antenna, Low channel, Vertical, Peak measurement



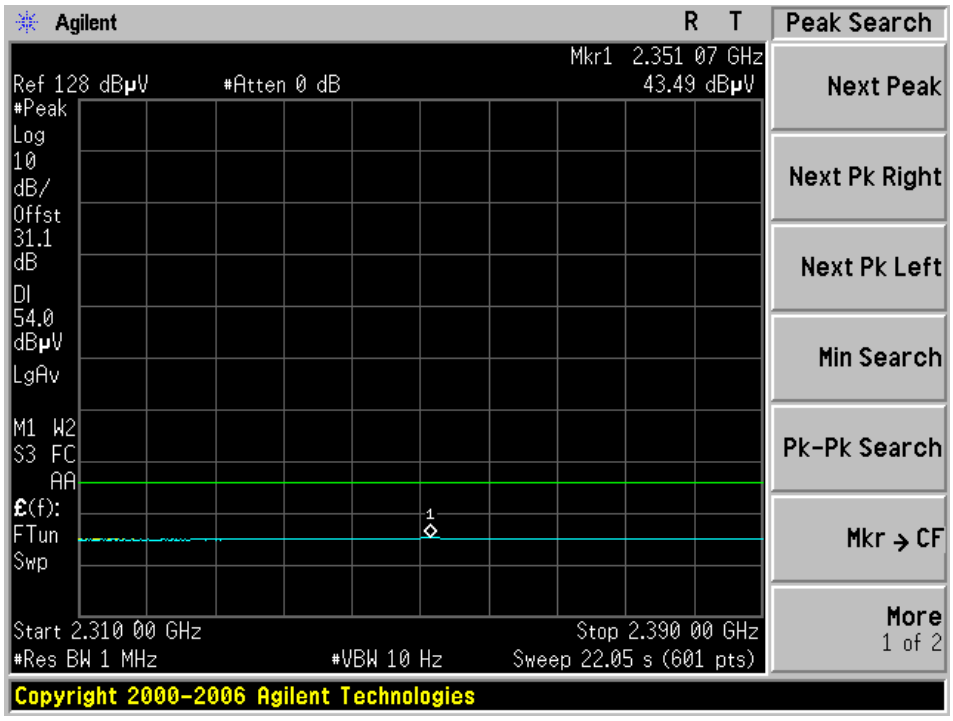
Front Vertical Antenna, Low channel, Vertical, Average measurement



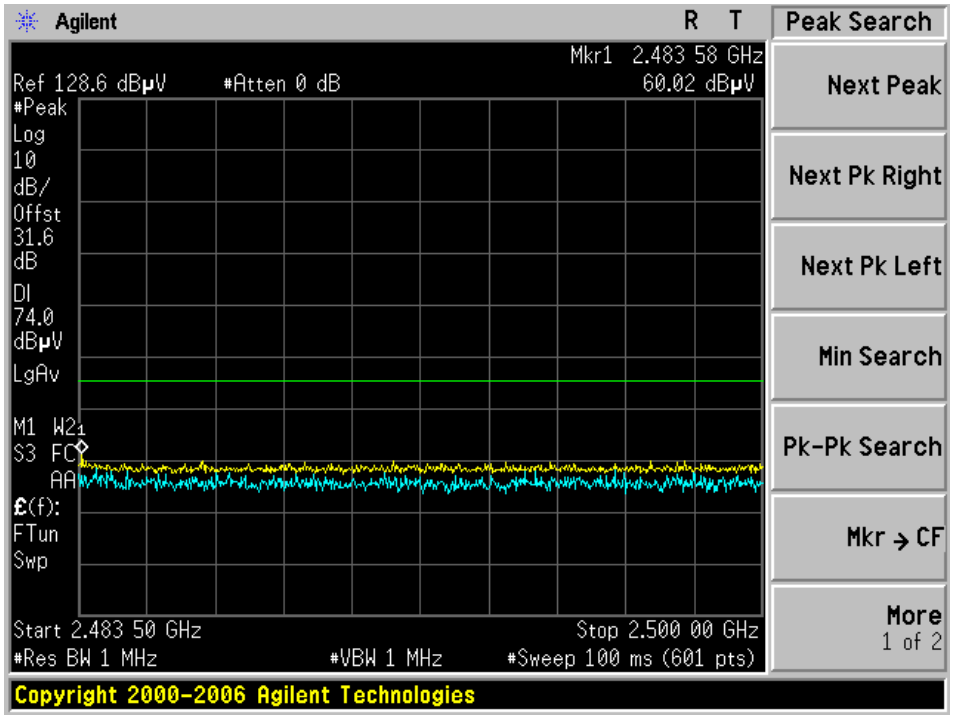
Front Horizontal Antenna, Low channel, Horizontal, Peak measurement



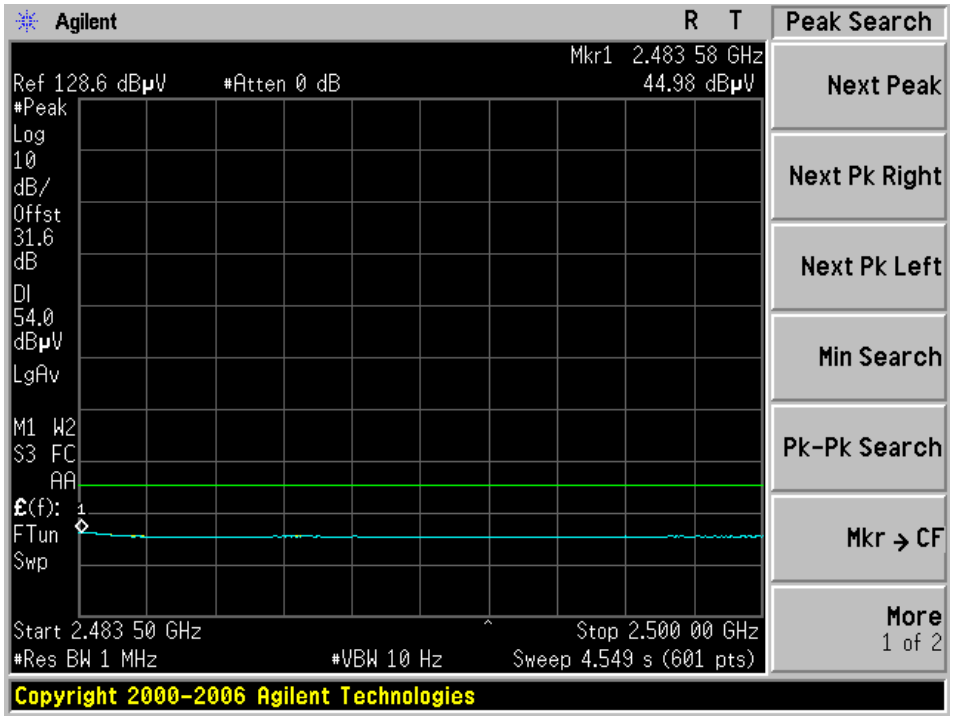
Front Horizontal Antenna, Low channel, Horizontal, Average measurement



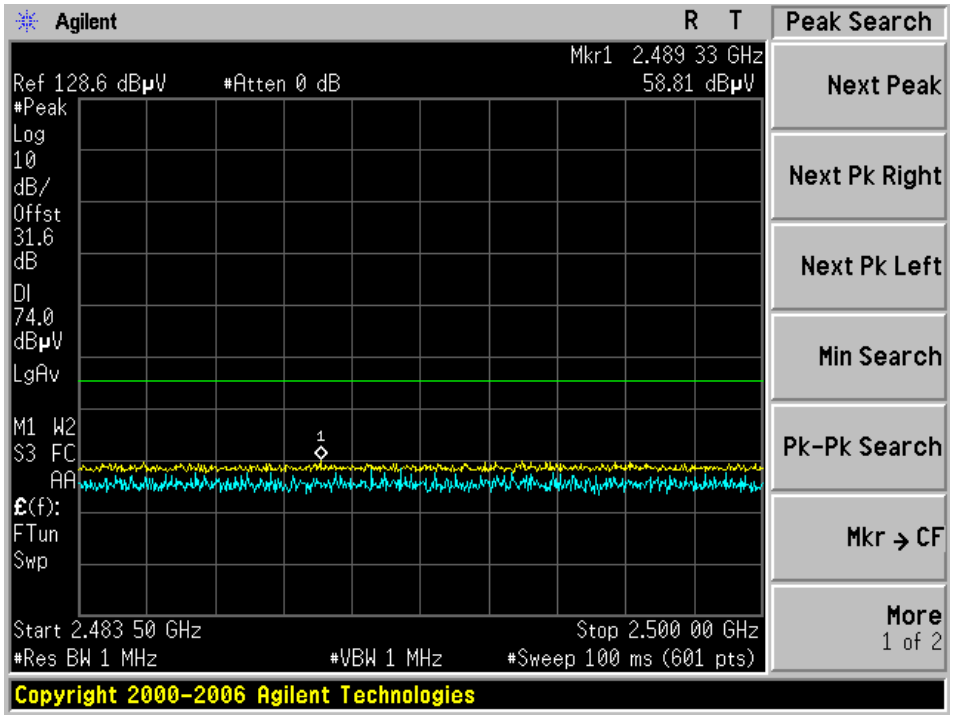
Front Vertical Antenna, High channel, Vertical, Peak measurement



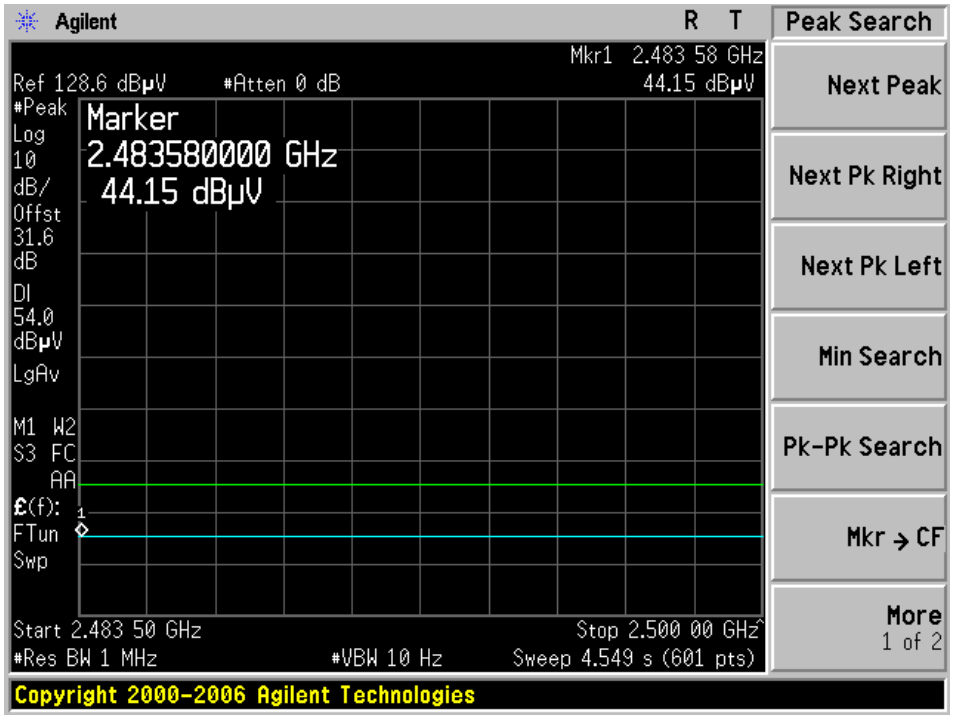
Front Vertical Antenna, High channel, Vertical, Average measurement



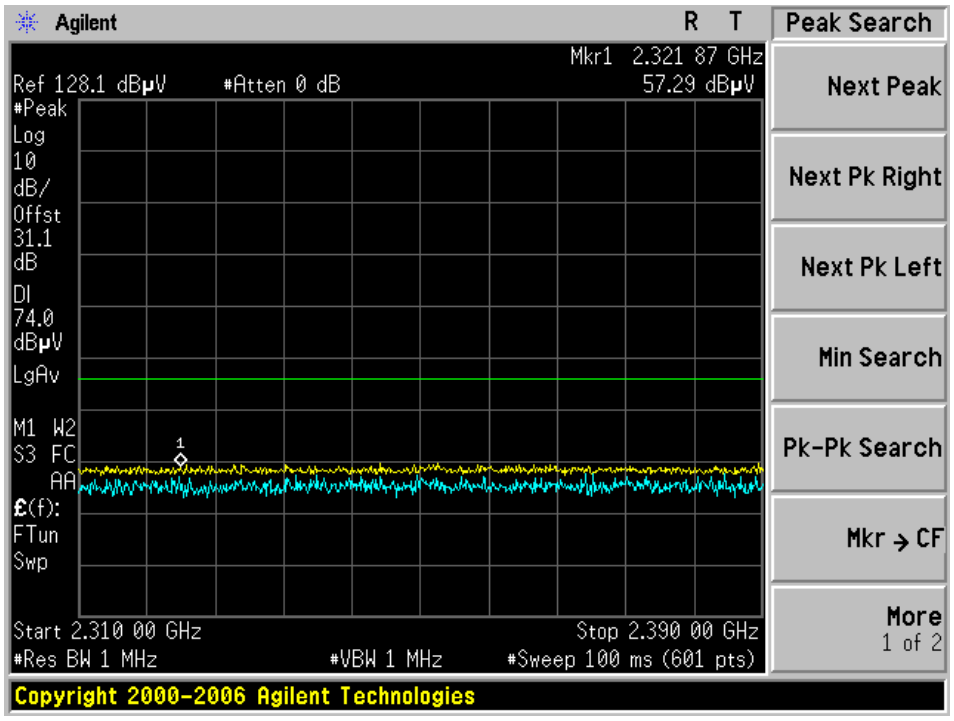
Front Horizontal Antenna, High channel, Horizontal, Peak measurement



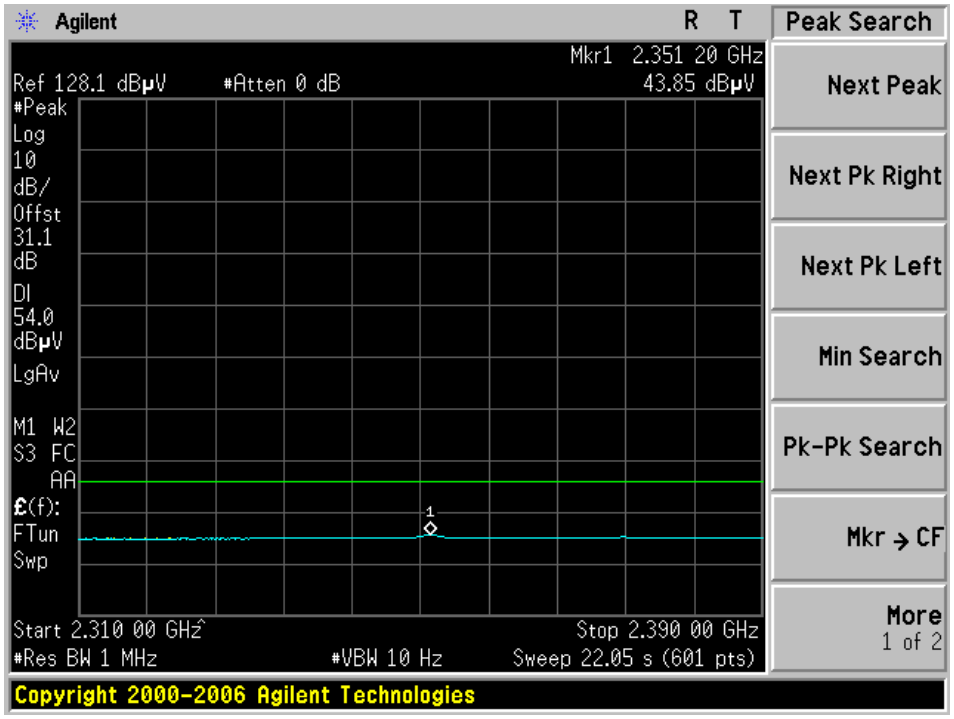
Front Horizontal Antenna, High channel, Horizontal, Average measurement



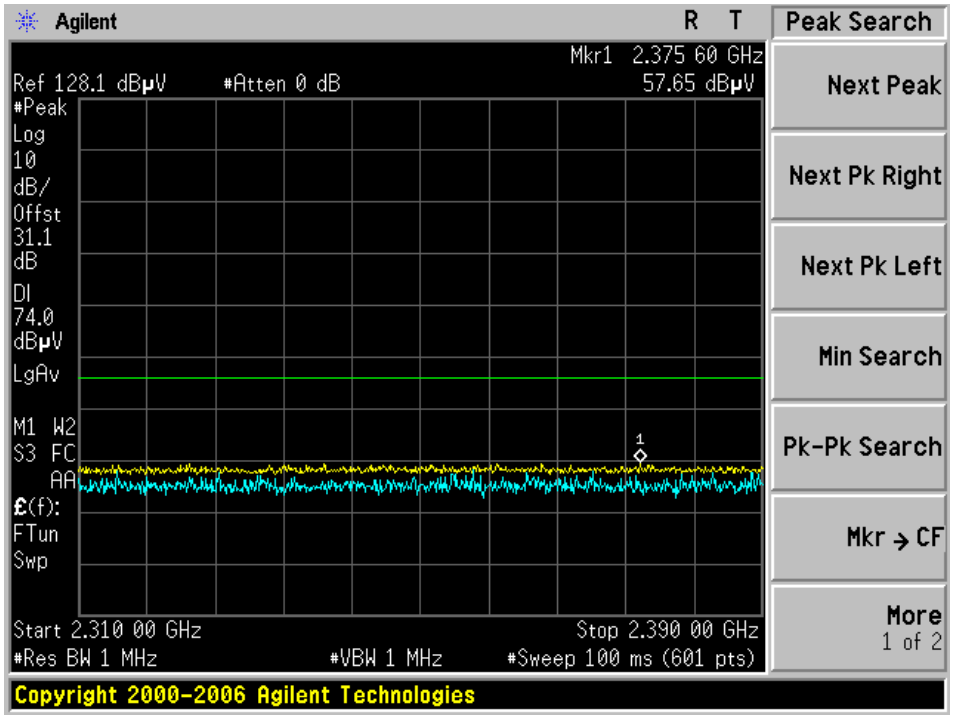
Back Vertical Antenna, Low channel, Vertical, Peak measurement



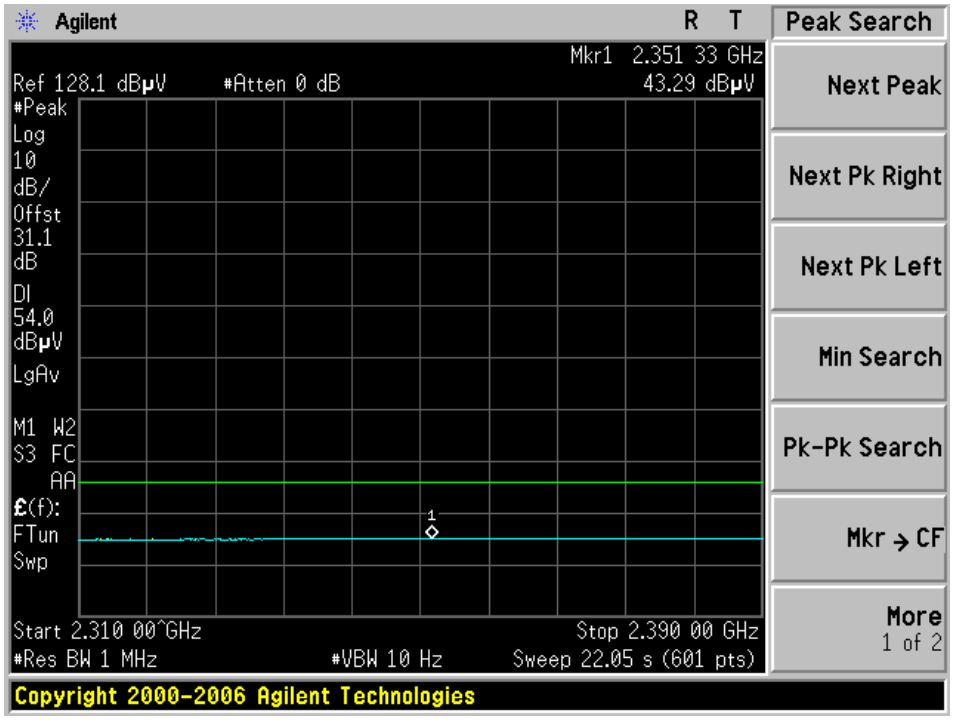
Back Vertical Antenna, Low channel, Vertical, Average measurement



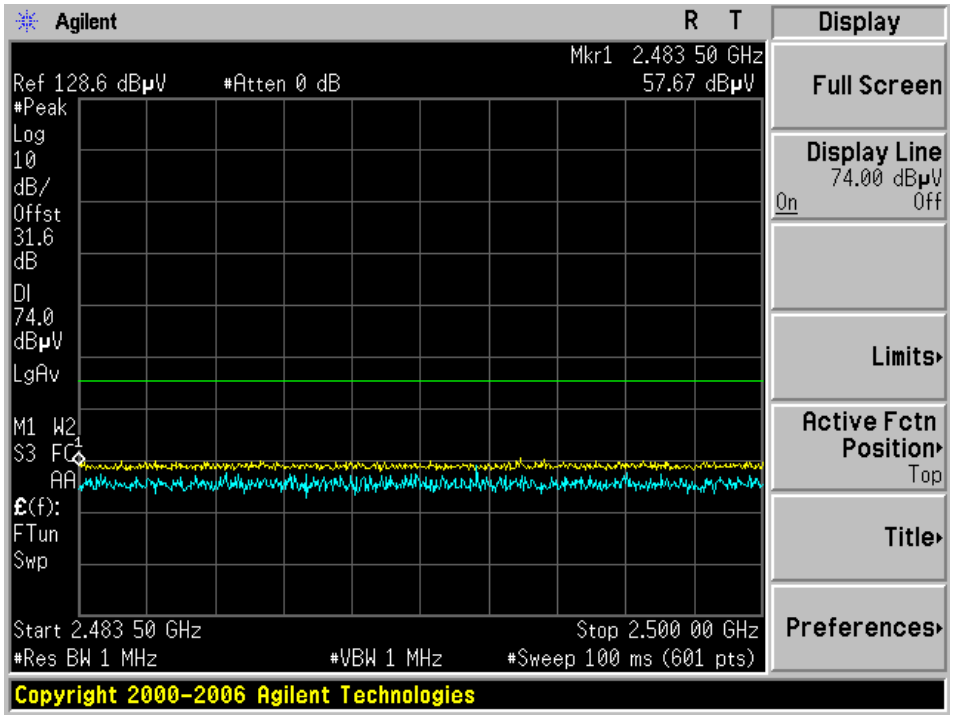
Back Horizontal Antenna, Low channel, Horizontal, Peak measurement



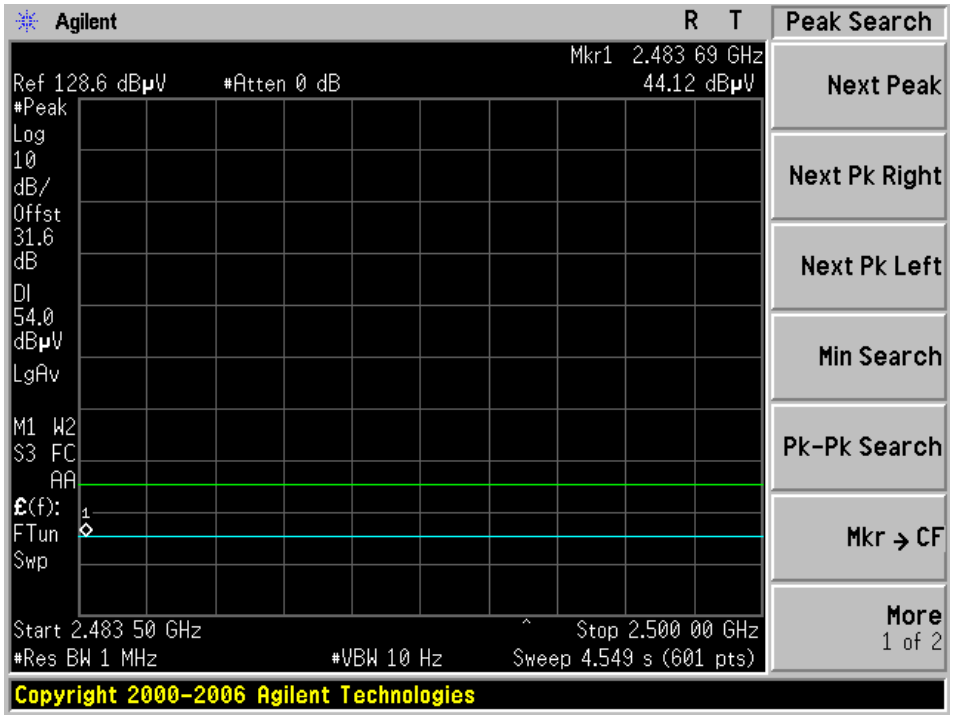
Back Horizontal Antenna, Low channel, Horizontal, Average measurement



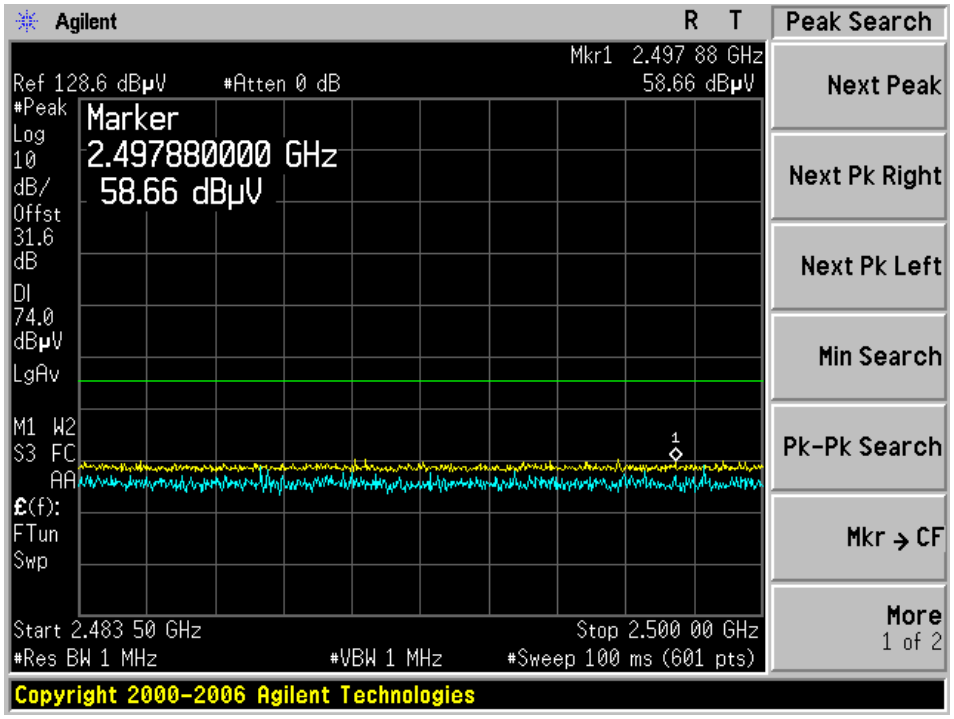
Back Vertical Antenna, High channel, Vertical, Peak measurement



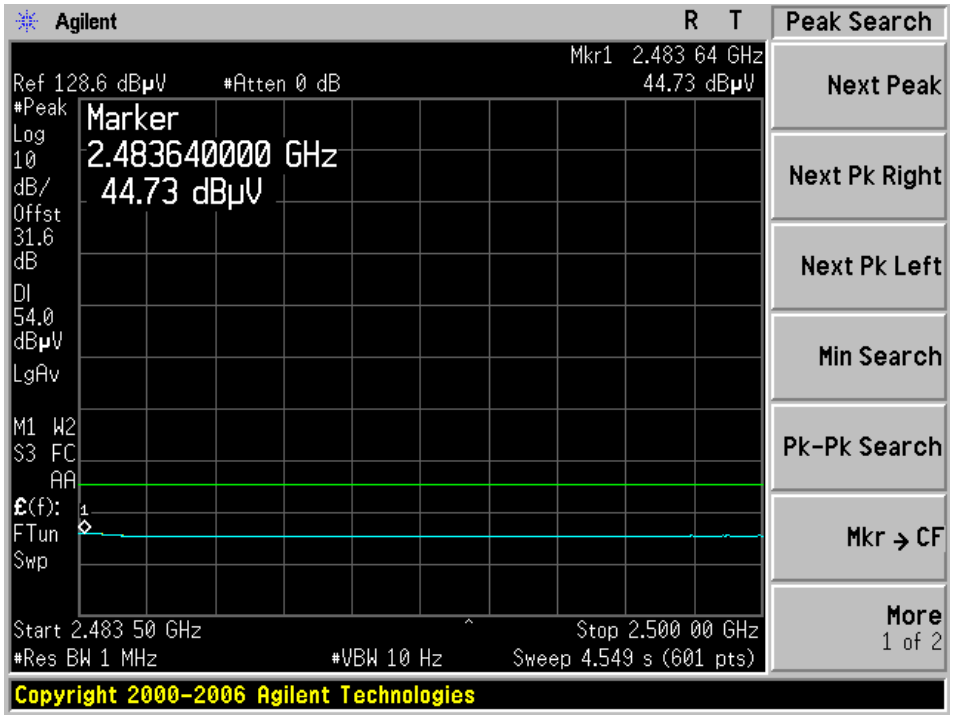
Back Vertical Antenna, High channel, Vertical, Average measurement



Back Horizontal Antenna, High channel, Horizontal, Peak measurement



Back Top Horizontal Antenna, High channel, Horizontal, Average measurement



9 FCC§15.247(a) (2) – 6 dB & 99% Emission Bandwidth

9.1 Applicable Standard

According to FCC §15.247(a)(2), systems using digital modulation techniques may operate in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz

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

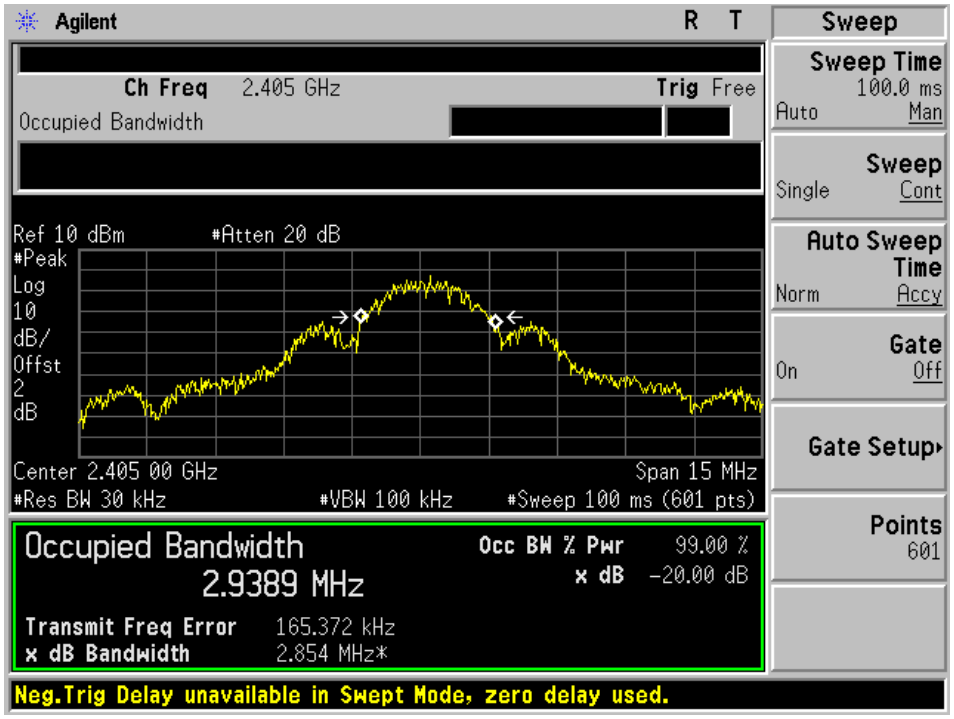
The testing was performed by Ning Ma on 2012-05-02.

9.5 Test Results

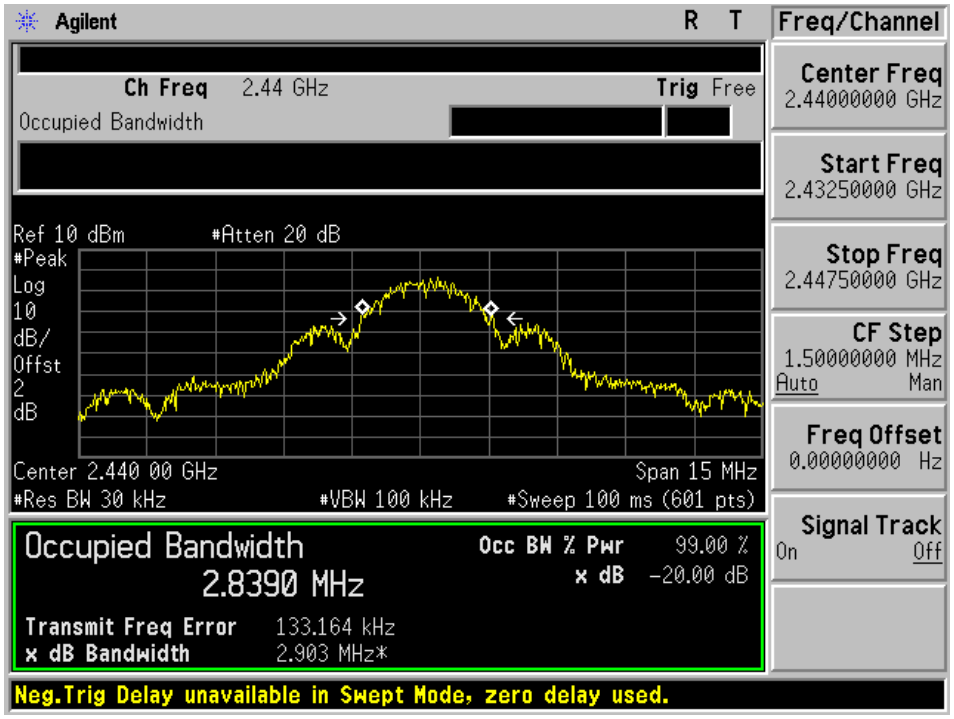
Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)	Limit (kHz)	Results
Low	2405	2.9389	2.854	> 500	Compliant
Middle	2440	2.8390	2.903	> 500	Compliant
High	2475	2.8835	2.881	> 500	Compliant

Please refer to the following plots for detailed test results

Low Channel 2405 MHz



Middle Channel 2440 MHz



High Channel 2475 MHz

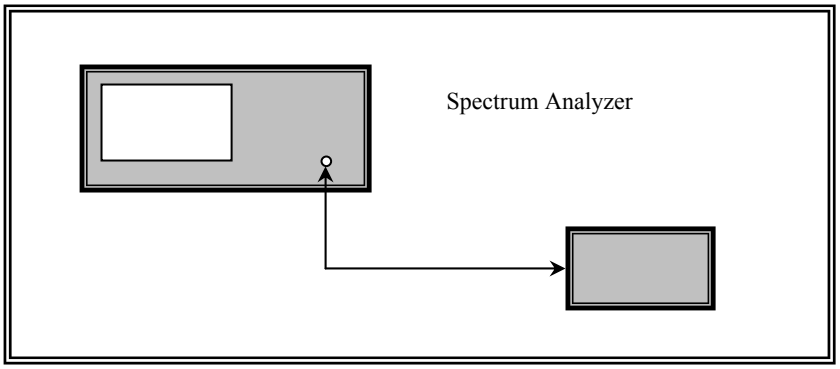
10 FCC §15.247(b) – Peak Output Power Measurement

10.1 Applicable Standard

According to FCC §15.247(b) for systems using digital modulation in the 902~928 MHz, 2400~2483.5 MHz, and 5725~5850 MHz bands: 1 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)	Conducted Output Power (dBm)	FCC Limit (dBm)	Margin (dB)
Low	2405	5.01	28	22.99
Middle	2440	4.82	28	23.18
High	2475	4.86	28	23.14

Note: Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

As the Max power output limit is 30dBm, and the EUT antenna gain is 8 dBi which exceed 2 dB from 6 dBi, according to this section, the Max power output limit will need to reduce by 2 dB which is 28 dBm 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 bands 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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emissions limits specified in §15.209(a) see §15.205(c).

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

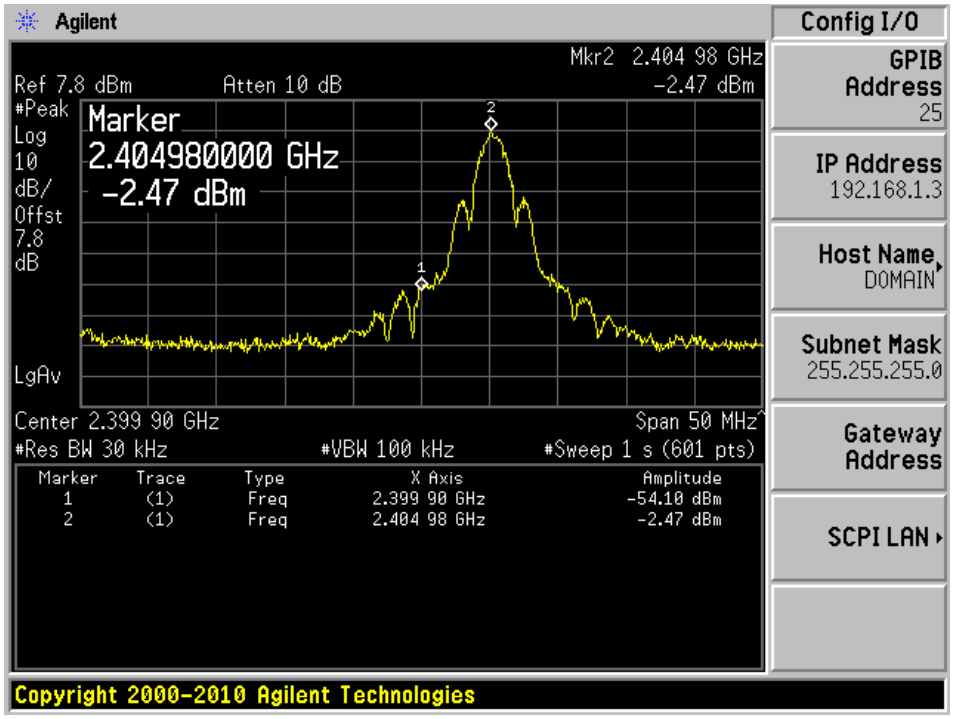
Temperature:	24.1 °C
Relative Humidity:	41.5 %
ATM Pressure:	102.3 kPa

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

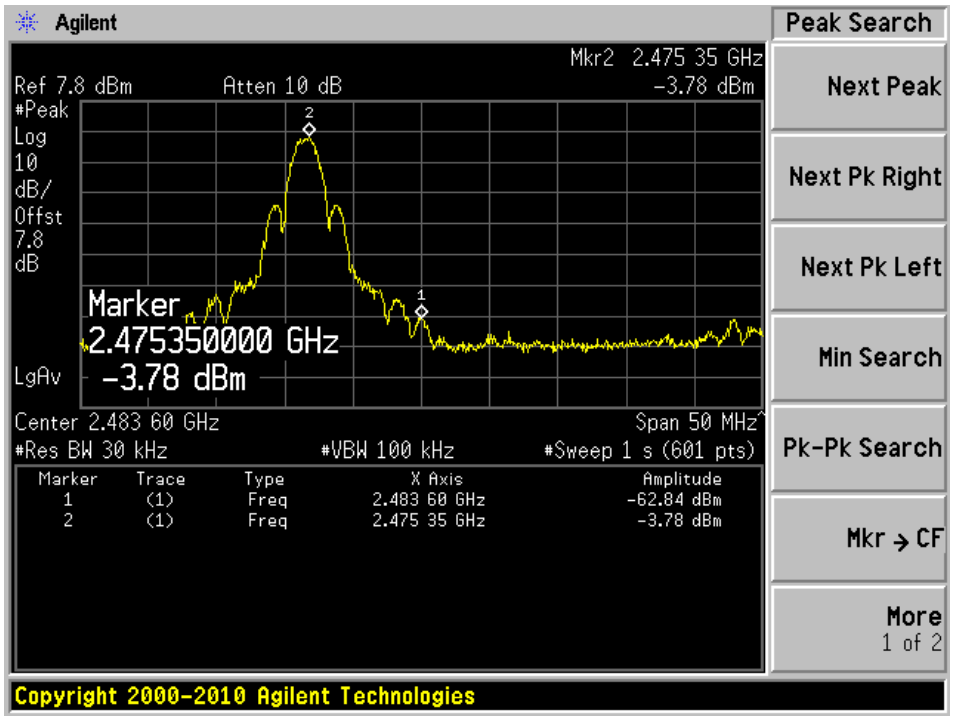
11.5 Test Results

Please refer to following pages for plots of band edge.

Low Channel Band Edge



High Channel Band Edge



12 FCC §15.247(e) – Power Spectral Density

12.1 Applicable Standard

According to FCC §15.247(e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

12.2 Measurement Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW = 100 kHz.
3. Set the VBW ≥ 300 kHz.
4. Set the span to 5-30 % greater than the EBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
10. Scale the observed power level to an equivalent value in 3 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where BWCF = 10log (3 kHz/100 kHz = -15.2 dB).
11. The resulting peak PSD level must be ≤ 8 dBm.

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.

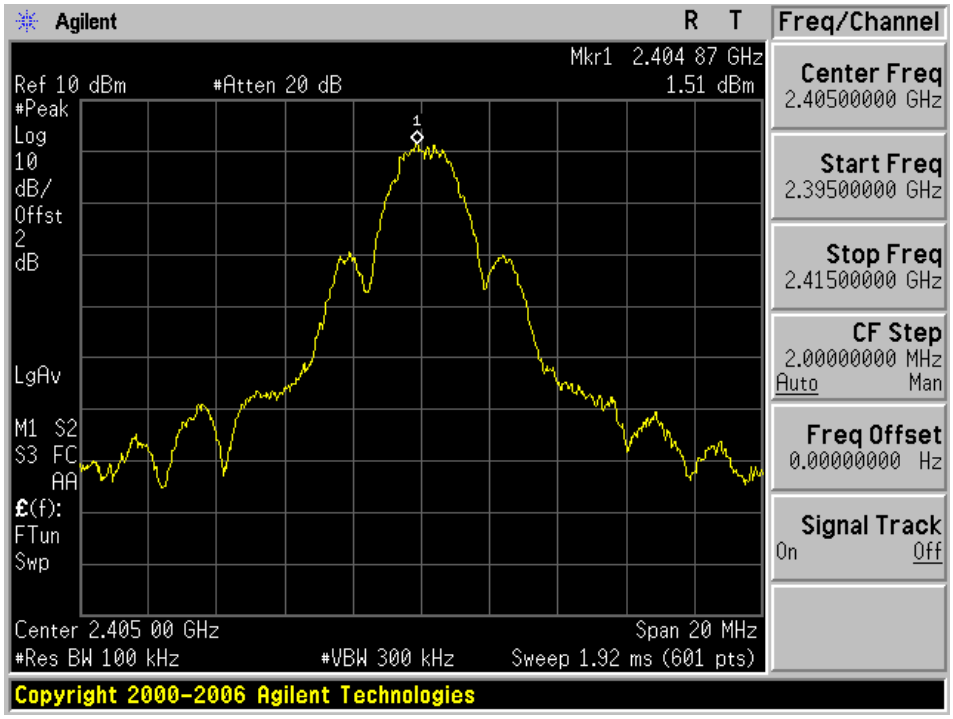
12.5 Test Results

All the data can be scaled to an equivalent value in 3 kHz by adjusting (reducing) the measured power by a bandwidth correction factor (BWCF) where BWCF=10log (3 kHz/100 kHz=-15.2 dB).

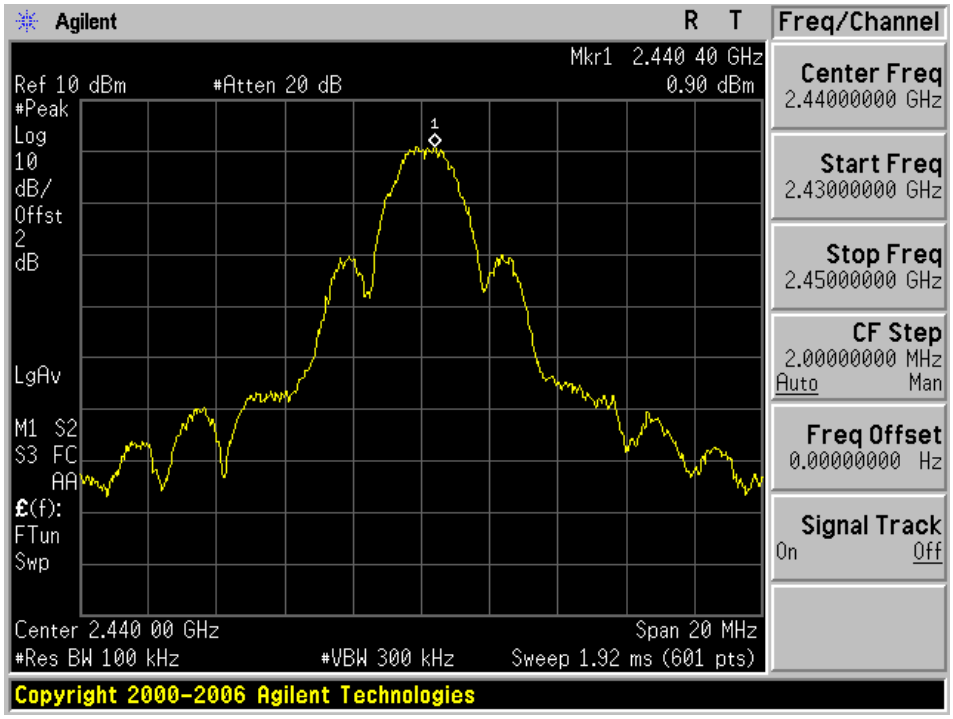
Channel	Frequency (MHz)	Power Spectral Density (dBm/100 kHz)	Corrected PSD (dBm)	FCC Limit (dBm/3 kHz)	Results
Low	2405	1.51	-13.51	8	Compliant
Mid	2440	0.90	-14.3	8	Compliant
High	2475	1.11	-14.09	8	Compliant

Please refer to the following plots for detailed test results:

Low Channel 2405 MHz



Middle Channel 2440 MHz



High Channel 2475 MHz