Lab Code: 200167-0

FCC PART 15.247

TEST AND MEASUREMENT REPORT

For

Cermetek Microelectronics, Inc.

374 Turquoise Street, Milpitas, CA 95035, USA

FCC ID: B46-CH4390
Model: CH4390

Report Type:	**Product Type:**
Original Report	900 MHz Embedded Wireless Sensor Module

Test Engineers:	Quinn Jiang
Report Number:	R1107052-247
Report Date:	2011-08-04
Reviewed By:	Victor Zhang EMC/RF Lead
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Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. This report **must not** be used by the customer to claim product certification, approval, or endorsement by NVLAP*, NIST, or any agency of the Federal Government.
* This report may contain data that are not covered by the NVLAP accreditation and are marked with an asterisk "*"

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1107052-247	Original Report	2011-08-04

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Cermetek Microelectronics Inc.*, and their product, FCC ID: B46-CH4390, model: CH4390, which will henceforth be referred to as the EUT "Equipment Under Test". The EUT is a 900 MHz Embedded Wireless Sensor Module.

1.2 Mechanical Description of EUT

The "EUT" measures approximately *50mm (L) x 20mm (W) x 5mm (H) and weights 0.02 (kg)*.

The test data gathered are from typical production sample, serial number: 0IEQT5, provided by the manufacturer.

1.3 Objective

This Type approval report is prepared on behalf of *Cermetek Microelectronics Inc.* in accordance with Part 2, Subpart J, Part 15, Subparts B and C of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC Part 15, Subpart B and C and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

1.4 Related Submittal(s)/Grant(s)

No Related Submittals.

1.5 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.4-2003, 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 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 NIS 81, The Treatment of Uncertainty in EMC Measurements, the values range from +2.0 for Conducted Emissions tests and +4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL.

Detailed instrumentation measurement uncertainties can be found in BACL report QAP-018.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

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 sites at BACL have been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has 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 facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission, Industry Canada, and Voluntary Control Council for Interference has the reports on file and is listed under FCC registration number: 90464, IC registration number: 3062A, and VCCI Registration Number: R-2463 and C-2698. The test site has been approved by the FCC, IC, and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The current scope of accreditations can be found at http://ts.nist.gov/Standards/scopes/2001670.htm

2 System Test Configuration

2.1 Justification

The EUT was configured for testing according to ANSI C63.4-2003.

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

2.2 EUT Exercise Software

The program, Hyper Terminal was used to control and configure the EUT for testing.

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Special Accessories

N/A

2.5 Local Support Equipment

Manufacturer	Description	Model No.	Serial No.
IBM	Laptop	T40	-
Dell	Laptop	Latitude D600	-

2.6 EUT Internal Configuration Details

Manufacturers	Descriptions	Models	Serial Numbers
Cermetek	Main PCB Board	CH4390 REV A	-

2.7 Interface Ports and Cabling

Cable Description	Length (m)	From	To
USB cable	< 1m	EUT	Laptop
RF cable	< 1m	EUT	PSA

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 Information	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 (a) §15.247 (d)	Restricted Bands, Radiated Spurious Emissions	Compliant
§15.247 (a)	20 dB Emission 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 Frequencies Used	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 Information

4.1 Applicable Standards

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):	24.91
Maximum peak output power at antenna input terminal (mW):	309.74
Prediction distance (cm):	20
Prediction frequency (MHz):	927.59
Maximum Antenna Gain, typical (dBi):	0
Maximum Antenna Gain (numeric):	1
Power density of prediction frequency at 20 cm (mW/cm^2):	0.062
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.62

The device meets FCC MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.062 mW/cm^2, limit is 0.62 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 Connector Construction

The EUT has one Transmitter/Receiver antenna with u.FL connector, The Transmitter antenna has a max gain of 0 dBi which fulfills the requirements of FCC §15.203.

Frequency Band (MHz)	Antenna Gain (dBi)
902-928	0

6 FCC §15.207 – AC Line Conducted Emissions

6.1 Applicable Standard

As per FCC §15.207, 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

1) Note: Decreases with the logarithm of the frequency.

6.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.4-2003 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.

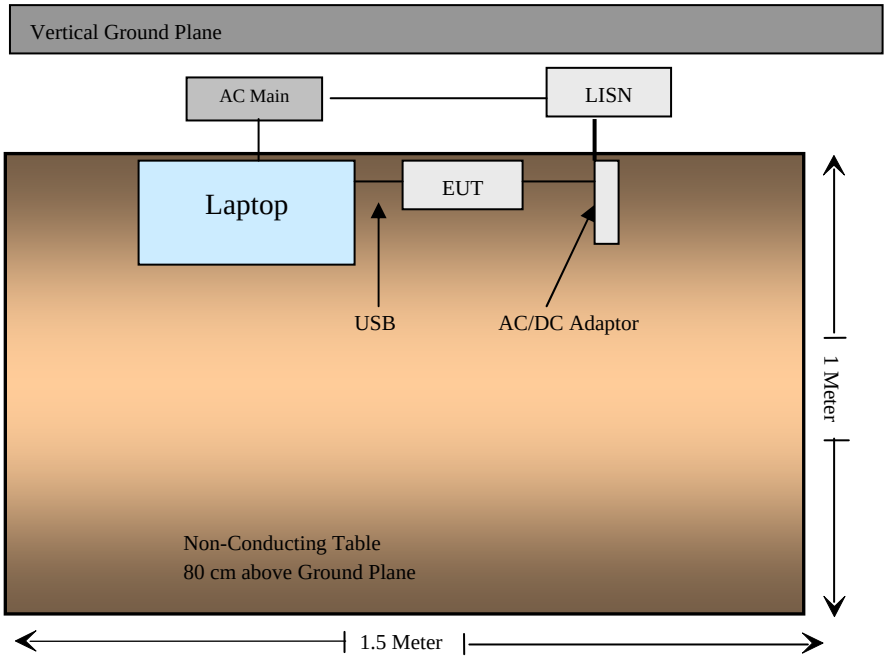
The AC/DC power adapter of the EUT was connected with LISN-1 which provided 120 V/60 Hz AC power.

6.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Due Date
Solar Electronics	LISN	9252-R-24-BNC	511205	2012-06-25
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2012-03-21

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

6.4 Test Setup Block Diagram



6.5 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".

6.6 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Cable Loss, and Attenuator Factor adding to the Indicated Reading. The basic equation is as follows:

Corrected Amplitude = Indicated Reading + Cable Loss + Attenuator Factor

For example, a Corrected Amplitude of 34.08 dBuV/m = Indicated Reading (23.85 dBuV) + Cable Factor (0.22 dB) + Attenuator Factor (10 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 = Corrected Amplitude - Limit

6.7 Test Environmental Conditions

Temperature:	21~24 °C
Relative Humidity:	38~45 %
ATM Pressure:	101.2-102 kPa

The testing was performed by Quinn Jiang on 07-01-2011 to 07-06-2011 in 5 meter chamber 3.

6.8 Summary of Test Results

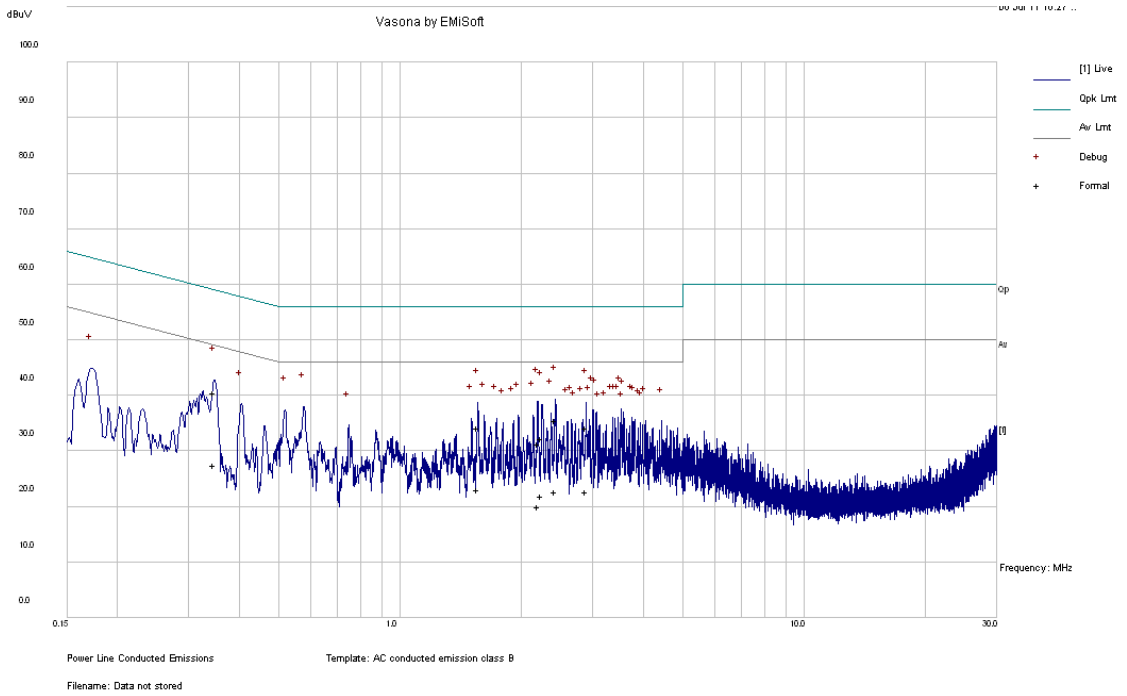
According to the recorded data in following table, the EUT complied with the FCC standard's conducted emissions limits, with the margin reading of:

Hopping Mode (902-928 MHz)

Connection: AC/DC adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor (Line/Neutral)**	**Range (MHz)**
-17.5	0.576792	Neutral	0.15 to 30

6.9 Conducted Emissions Test Plots and Data

120 V, 60 Hz – Line



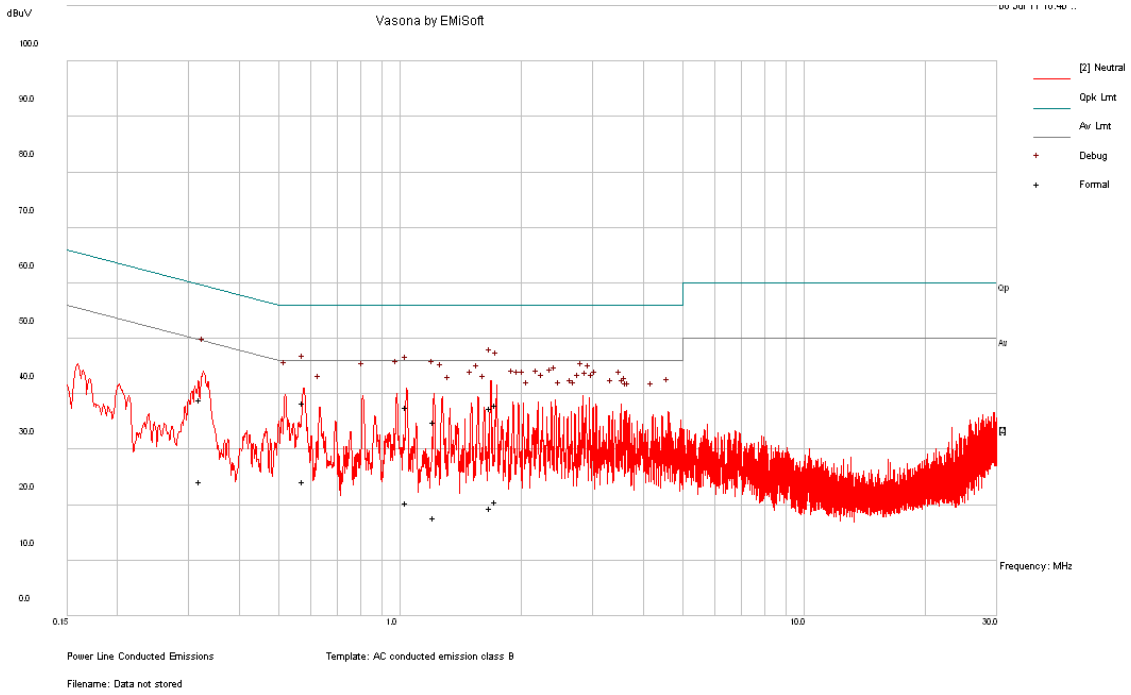
Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.346716	40.53	Line	59.04	-18.51
2.423665	35.59	Line	56	-20.41
1.559661	34.29	Line	56	-21.71
2.884068	34.12	Line	56	-21.88
2.246734	32.27	Line	56	-23.73
2.198471	31.37	Line	56	-24.63

Average Measurements

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.346716	27.45	Line	49.04	-21.59
1.559661	23.06	Line	46	-22.94
2.884068	22.8	Line	46	-23.20
2.423665	22.79	Line	46	-23.21
2.246734	21.97	Line	46	-24.03
2.198471	20.11	Line	46	-25.89

120 V, 60 Hz – Neutral



Quasi-Peak Measurements

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.576792	38.5	Neutral	56	-17.50
1.730886	38.12	Neutral	56	-17.88
1.036128	37.74	Neutral	56	-18.26
1.671453	37.49	Neutral	56	-18.51
0.321081	39.02	Neutral	59.68	-20.66
1.214814	34.98	Neutral	56	-21.02

Average Measurements

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
0.576792	24.31	Neutral	46	-21.69
1.730886	20.58	Neutral	46	-25.42
0.321081	24.17	Neutral	49.68	-25.51
1.036128	20.47	Neutral	46	-25.53
1.671453	19.51	Neutral	46	-26.49
1.214814	17.65	Neutral	46	-28.35

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

7.1 Applicable Standard

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.

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 Due Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-05-10

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

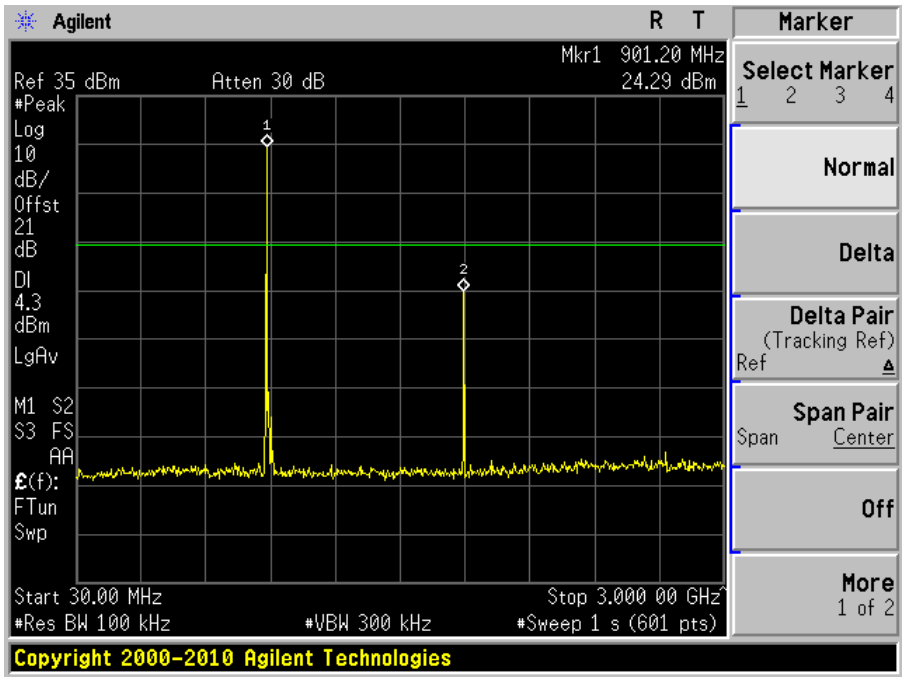
Temperature:	21~24 °C
Relative Humidity:	38~45 %
ATM Pressure:	101.2-102 kPa

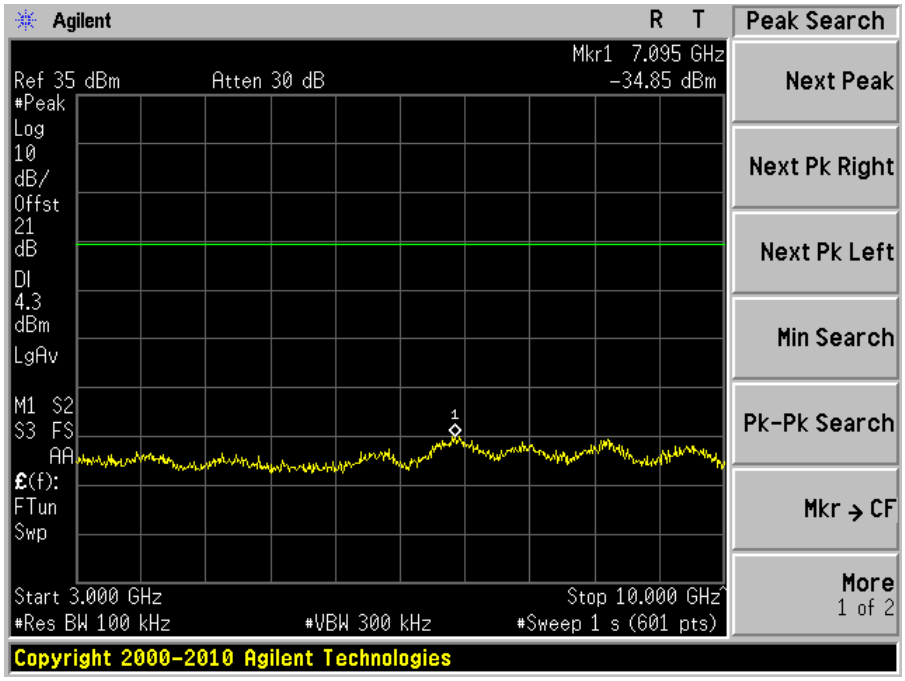
The testing was performed by Quinn Jiang on 07-01-2011 to 07-06-2011 in RF site.

7.5 Test Results

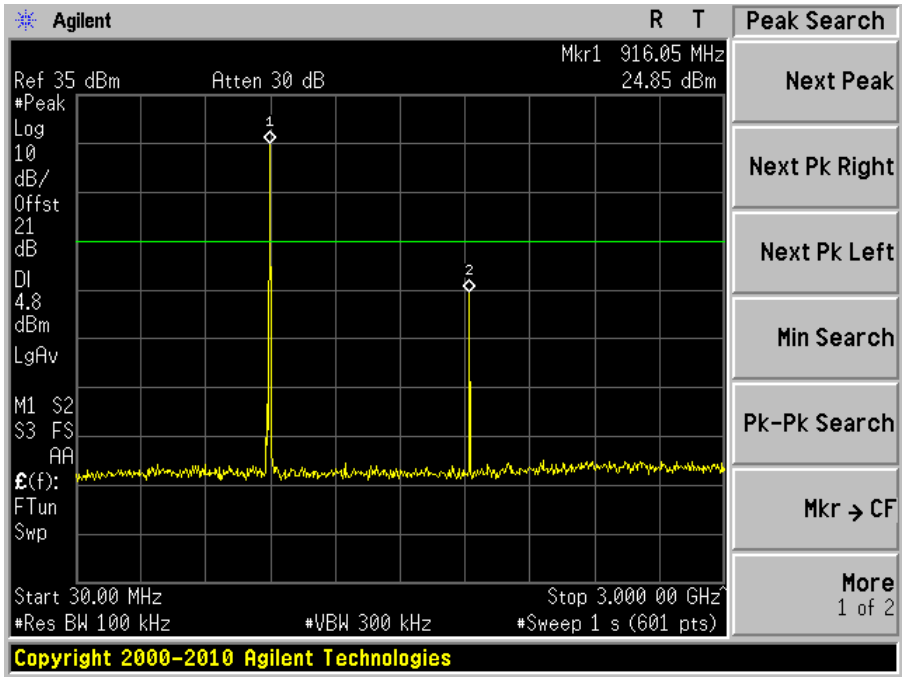
Please refer to following plots of spurious emissions.

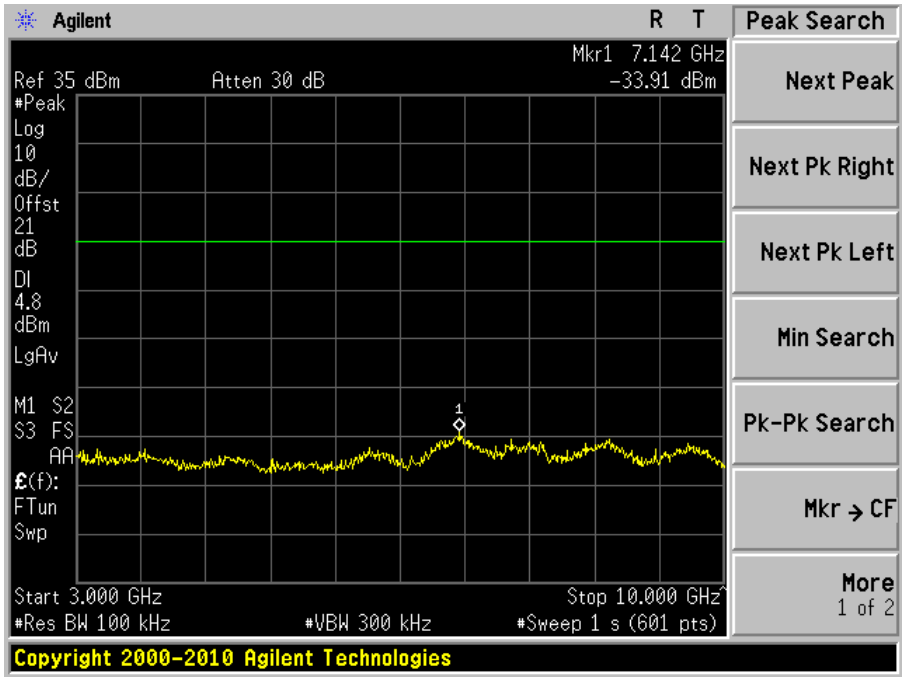
Low Channel 902.4 MHz



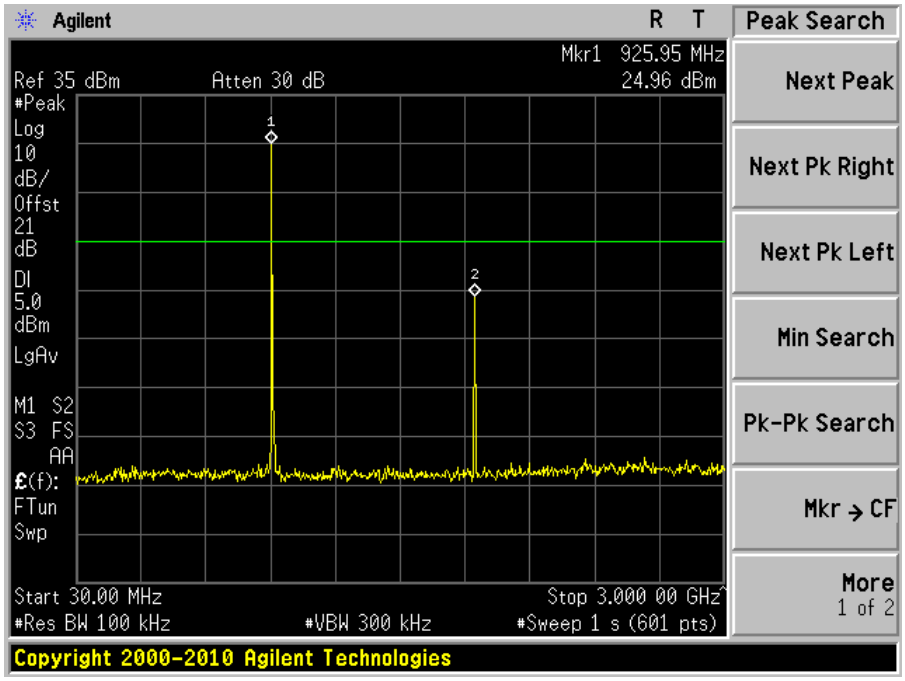


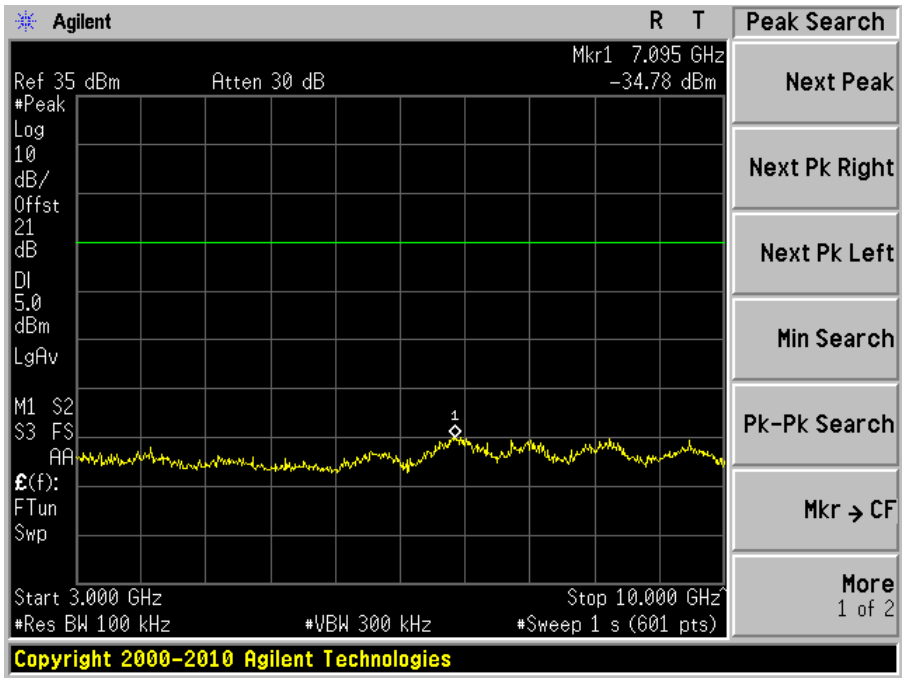
Middle Channel 914.8 MHz





High Channel 927.59 MHz





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[1]	3
88 - 216	150[1]	3
216 - 960	200[1]	3
Above 960	500	3

1) Note: 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 using the setup accordance with the ANSI C63.4-2003. The specification used was the FCC 15C 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:

(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 is calculated by adding the Cable Loss, and Attenuator Factor adding to the Indicated Reading. The basic equation is as follows:

Corrected Amplitude = Indicated Reading + Cable Loss + Attenuator Factor

For example, a Corrected Amplitude of 34.08 dBuV/m = Indicated Reading (23.85 dBuV) + Cable Factor (0.22 dB) + Attenuator Factor (10 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 = Corrected Amplitude - Limit

8.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Due Date
HP	Pre-amplifier	8449B	3147A00400	2012-02-03
Sunol Science Corp.	Combination Antenna	JB1 Antenna	A020106-1	2012-05-17
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-05-10
A. H. Systems	Antenna, Horn	DRG-118/A	1132	2011-11-29

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

8.6 Test Environmental Conditions

Temperature:	21~24 °C
Relative Humidity:	38~45 %
ATM Pressure:	101.2-102 kPa

The testing was performed by Quinn Jiang on 07-01-2011 to 07-06-2011 in 5 meter chamber 3.

8.7 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247 standard's radiated emissions limits, and had the worst margin of:

Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Channel, Range
30-1000 MHz			
-9.51	132.001	Horizontal	High, 30 MHz – 1GHz
Above 1 GHz			
-1.1	1829.5	Vertical	Middle, Above 1 GHz

8.8 Radiated Spurious Emissions Test Results

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

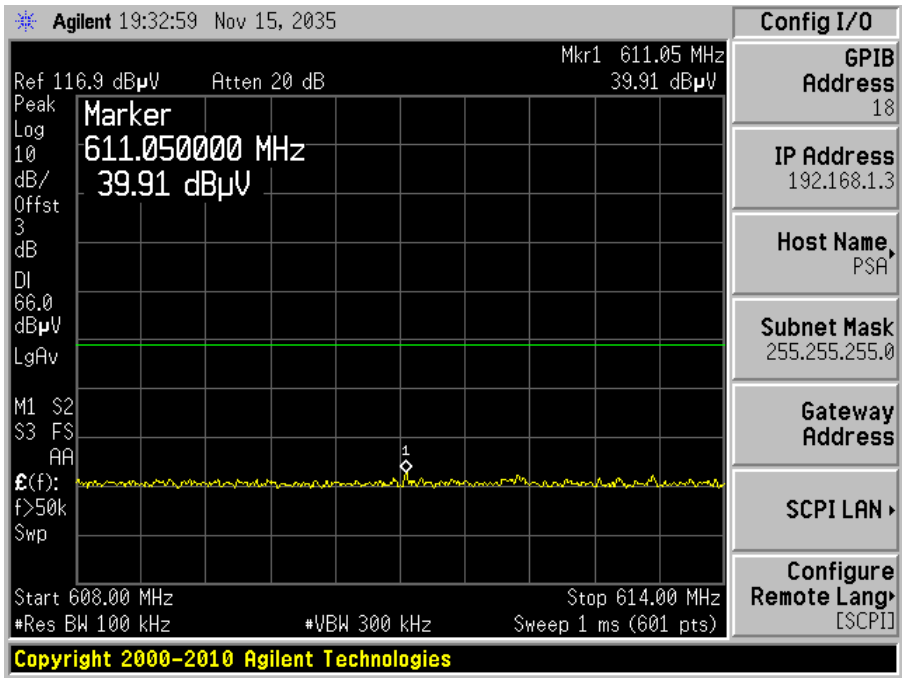
Frequency (MHz)	Corrected Amplitude (dBµV/m)	Test Antenna		Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
		Height (cm)	Polarity (H/V)			
132.001	33.99	239	H	261	43.5	-9.51
261.006	36.2	105	H	250	46	-9.80
38.04925	29.3	101	V	199	40	-10.70

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

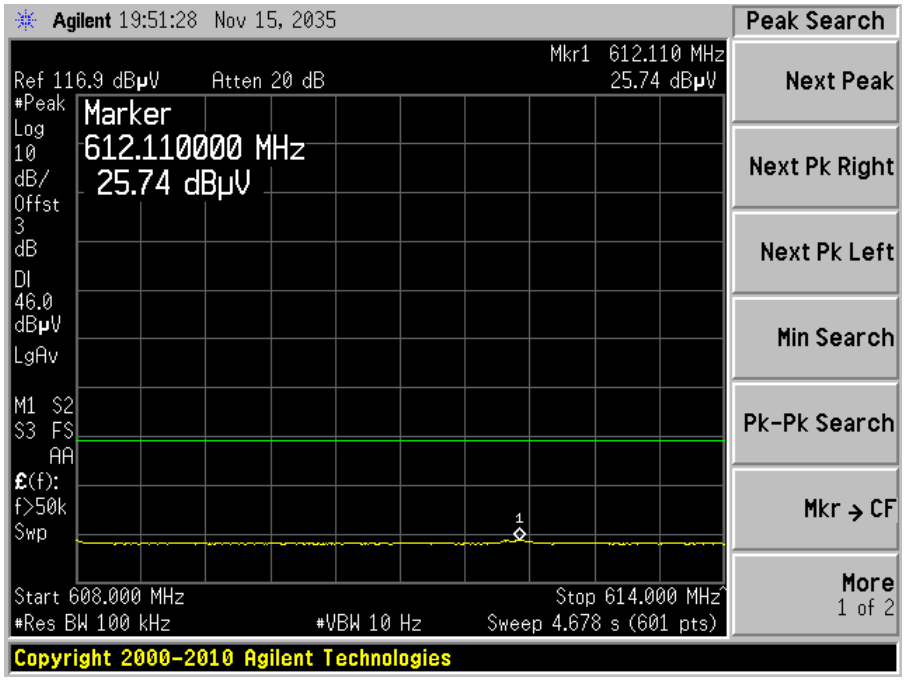
Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	Part 15C		Comments
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 902.4 MHz, measured at 3 meters											
1804.8	69.2	92	100	V	25.6	2.3	27.6	69.5	74	-4.50	Peak
1804.8	60.35	195	100	H	25.6	2.3	27.6	60.65	74	-13.35	Peak
1804.8	51.94	92	100	V	25.6	2.3	27.6	52.24	54	-1.76	Ave
1804.8	46.03	195	100	H	25.6	2.3	27.6	46.33	54	-7.67	Ave
Middle channel 914.8 MHz measured at 3 meters											
1829.5	70.29	104	100	V	25.6	2.3	27.6	70.59	74	-3.41	Peak
1829.5	61.9	116	100	H	25.6	2.3	27.6	62.2	74	-11.80	Peak
1829.5	52.6	104	100	V	25.6	2.3	27.6	52.9	54	-1.10	Ave
1829.5	47.35	116	100	H	25.6	2.3	27.6	47.65	54	-6.35	Ave
High channel 927.59 MHz measured at 3 meters											
1855.2	67.46	102	100	V	25.6	2.3	27.6	67.76	74	-6.24	Peak
1855.2	59.57	91	100	H	25.6	2.3	27.6	59.87	74	-14.13	Peak
1855.2	50.45	102	100	V	25.6	2.3	27.6	50.75	54	-3.25	Ave
1855.2	45.88	91	100	H	25.6	2.3	27.6	46.18	54	-7.82	Ave

Restricted Band Emissions

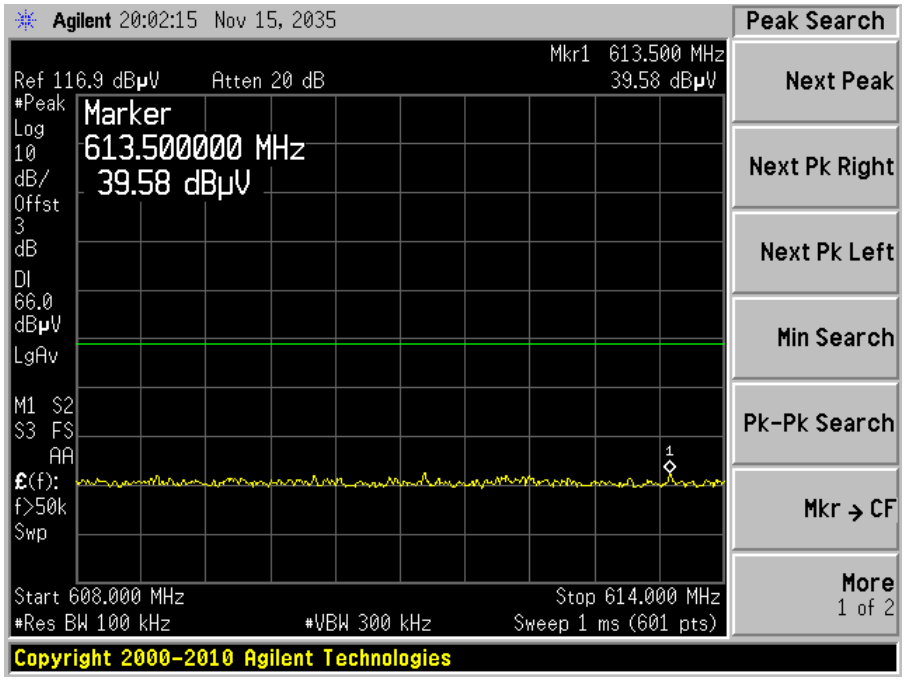
Lowest Channel at Horizontal, Peak



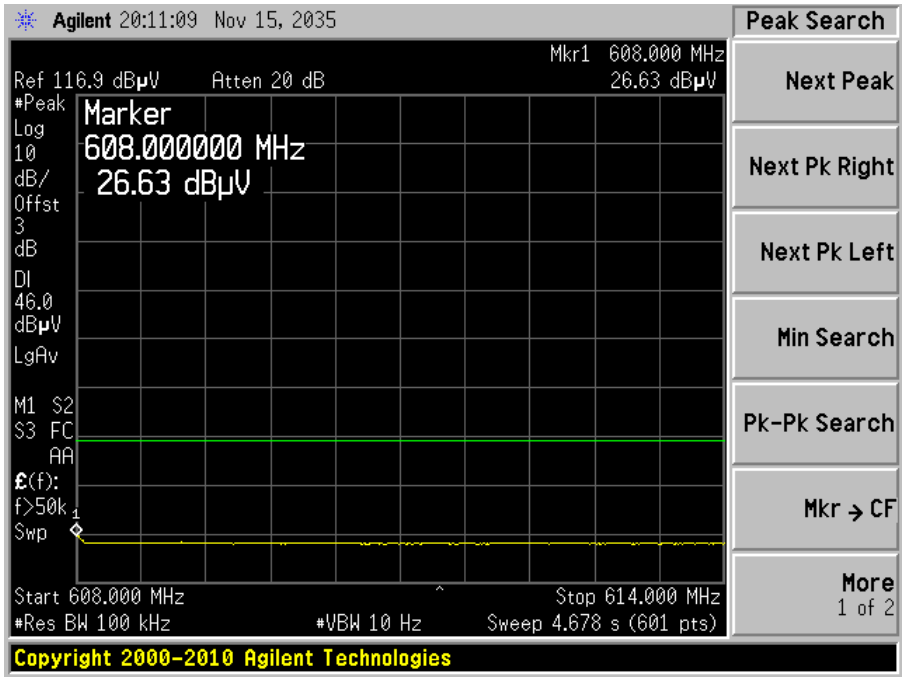
Lowest Channel at Horizontal, Average



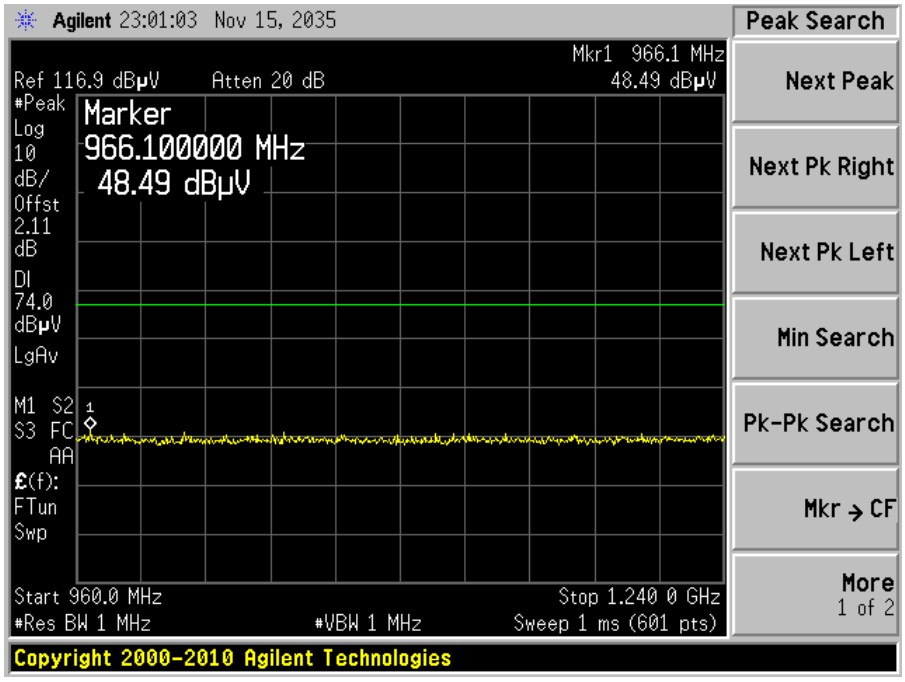
Lowest Channel at Vertical, Peak



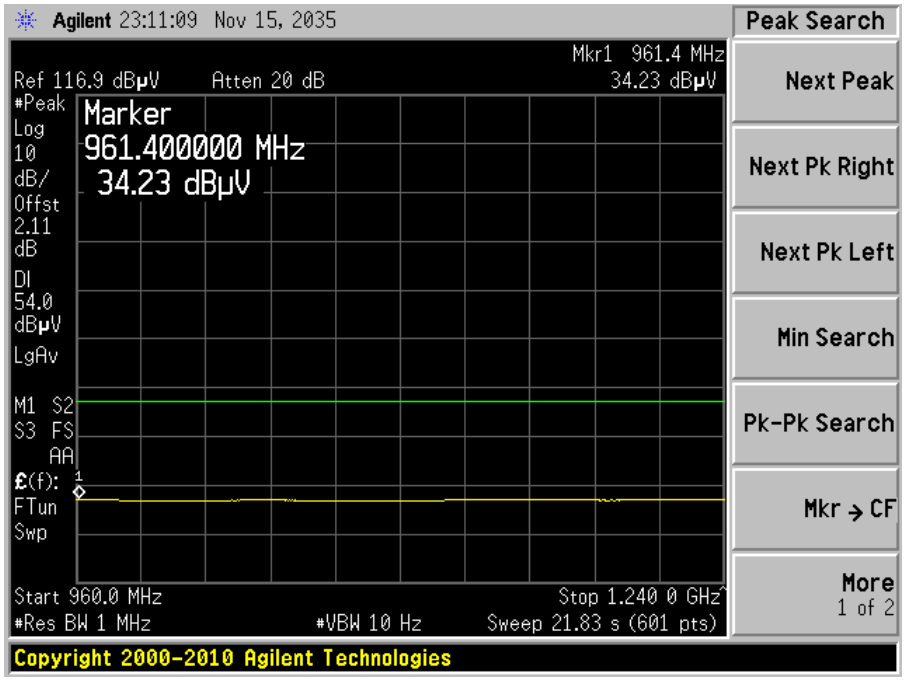
Lowest Channel at Vertical, Average



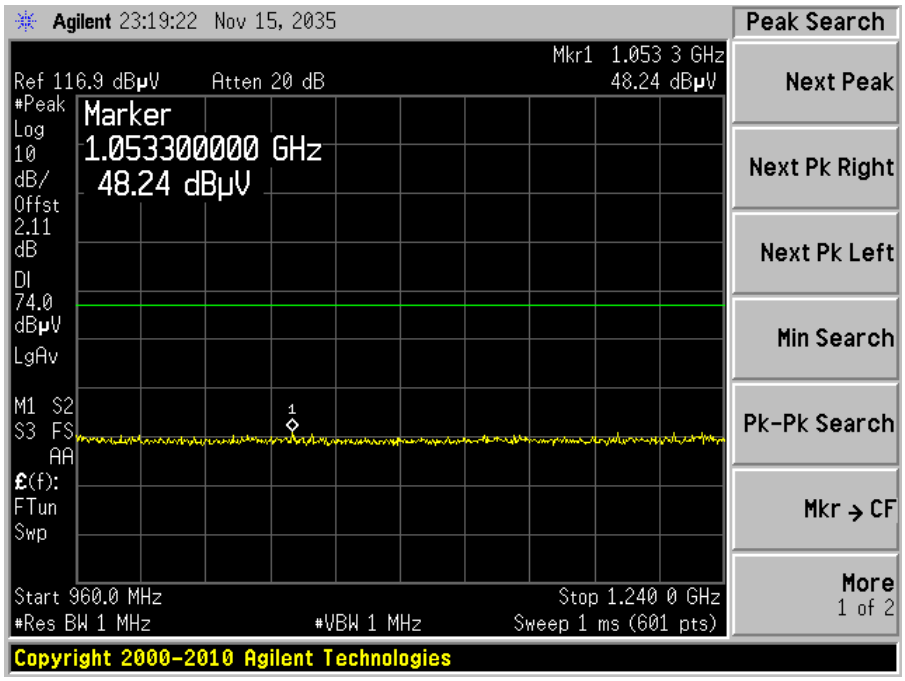
Highest Channel at Horizontal, Peak



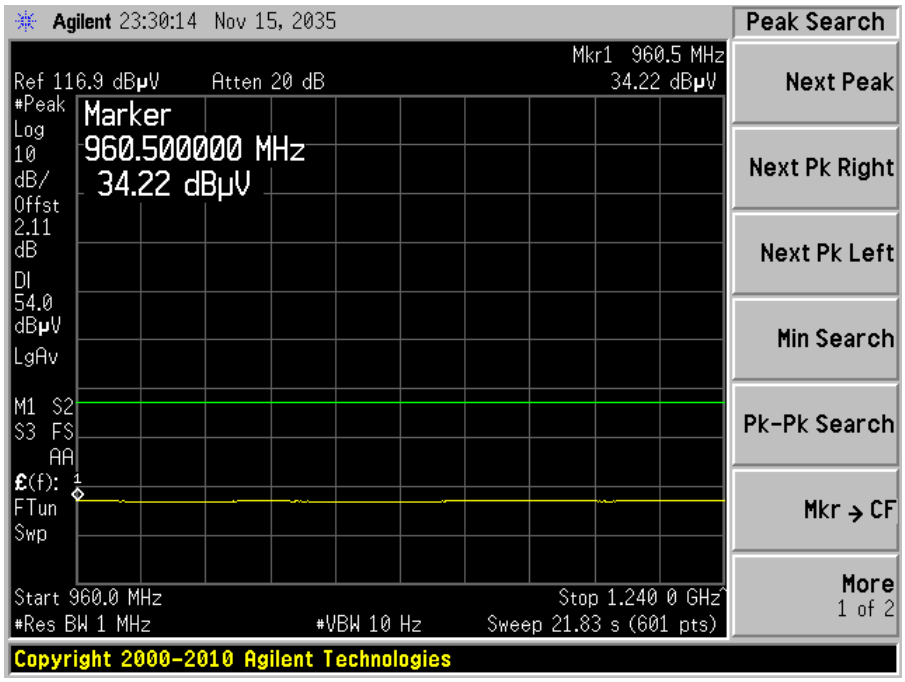
Highest Channel at Horizontal, Average



Highest Channel at Vertical, Peak



Highest Channel at Vertical, Average



9 FCC §15.247(a) – Emission Bandwidth

9.1 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.

According to FCC §15.247(a)(i), For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 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 20 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 Due Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-05-10

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

9.4 Test Environmental Conditions

Temperature:	21~24 °C
Relative Humidity:	38~45 %
ATM Pressure:	101.2-102 kPa

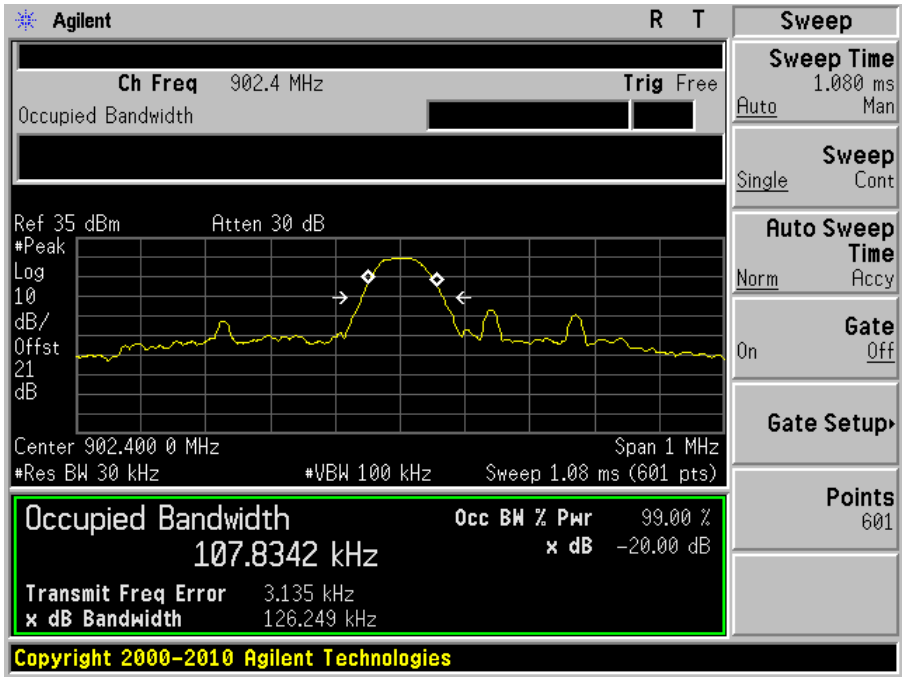
The testing was performed by Quinn Jiang on 07-01-2011 to 07-06-2011 in RF site.

9.5 Test Results

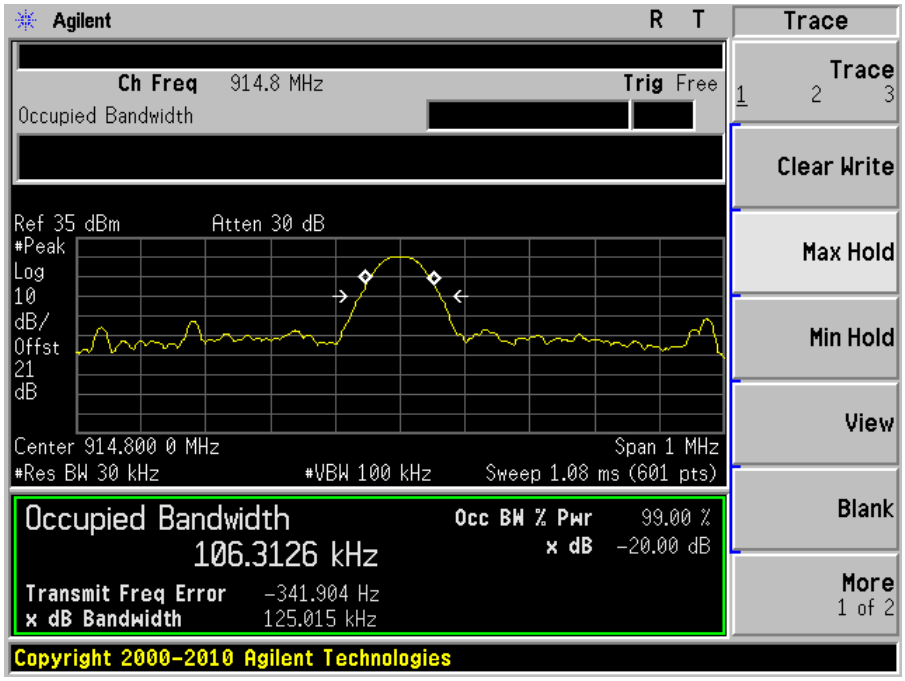
Channel	Frequency (MHz)	20 dB Emission Bandwidth (kHz)	99% Emission Bandwidth (kHz)	Limit (kHz)	Results
Low	902.4	126.249	107.8342	< 500	Compliant
Middle	914.8	125.015	106.3126	< 500	Compliant
High	927.59	125.211	107.0380	< 500	Compliant

Please refer to the following plots for detailed test results:

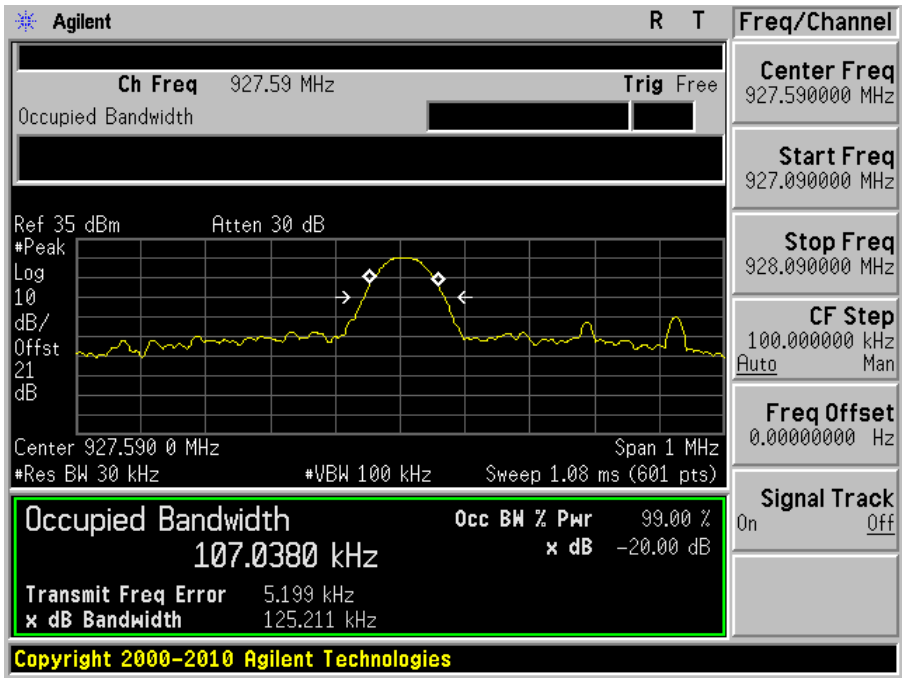
Low Channel 902.4 MHz



Middle Channel 914.8 MHz



High Channel 927.59 MHz



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

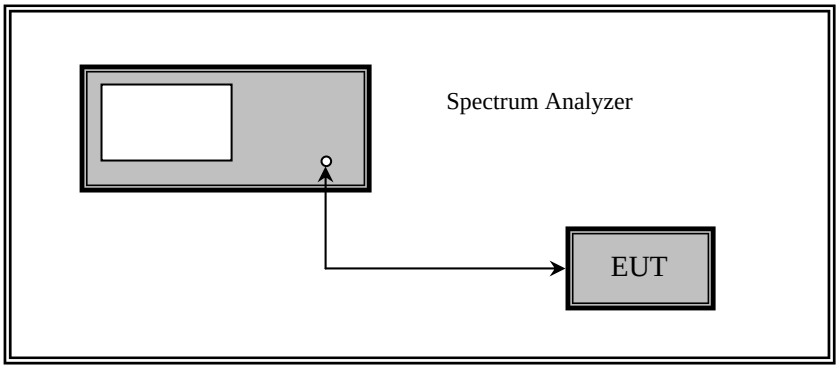
10.1 Applicable Standard

According to FCC §15.247(b)(3) for systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

For frequency hopping systems operating in the 902–928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

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 Due Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-05-10

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

10.4 Test Environmental Conditions

Temperature:	21~24 °C
Relative Humidity:	38~45 %
ATM Pressure:	101.2-102 kPa

The testing was performed by Quinn Jiang on 07-01-2011 to 07-06-2011 in RF site.

10.5 Test Results

Channel	Frequency (MHz)	Max Peak Output Power		Limit (mw)	Result
		(dBm)	(mw)		
Low	902.4	24.35	272.27	1000	Pass
Mid	914.8	24.85	305.49	1000	Pass
High	927.59	24.91	309.74	1000	Pass

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 Due Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-05-10

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

11.4 Test Environmental Conditions

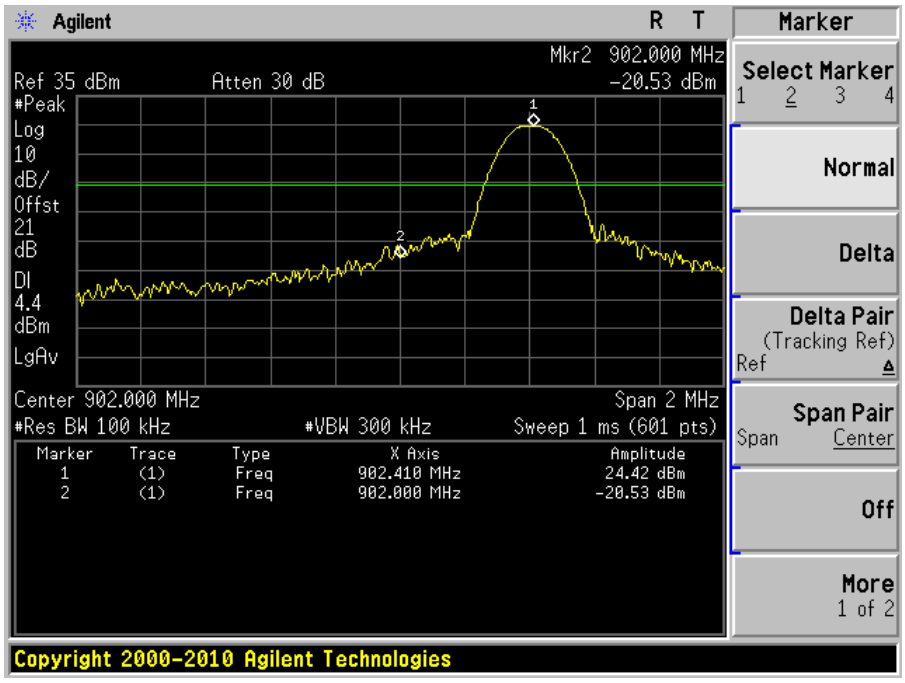
Temperature:	21~24 °C
Relative Humidity:	38~45 %
ATM Pressure:	101.2-102 kPa

The testing was performed by Quinn Jiang on 07-01-2011 to 07-06-2011 in RF site.

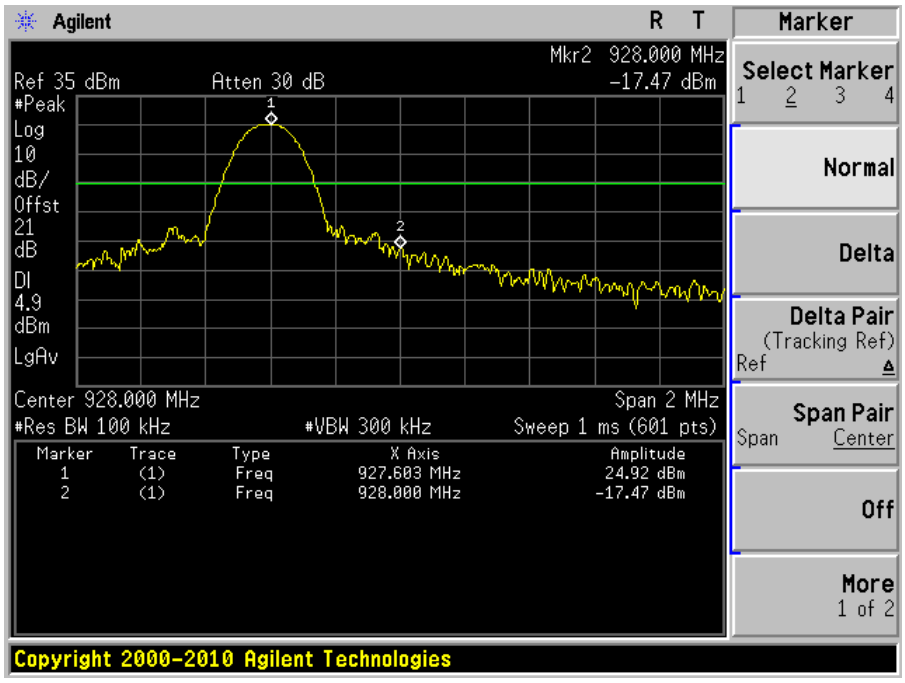
11.5 Test Results

Please refer to following pages for plots of band edge.

Low Band Edge



High Band Edge



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 250 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

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 Due Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-05-10

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

12.4 Test Environmental Conditions

Temperature:	21~24 °C
Relative Humidity:	38~45 %
ATM Pressure:	101.2-102 kPa

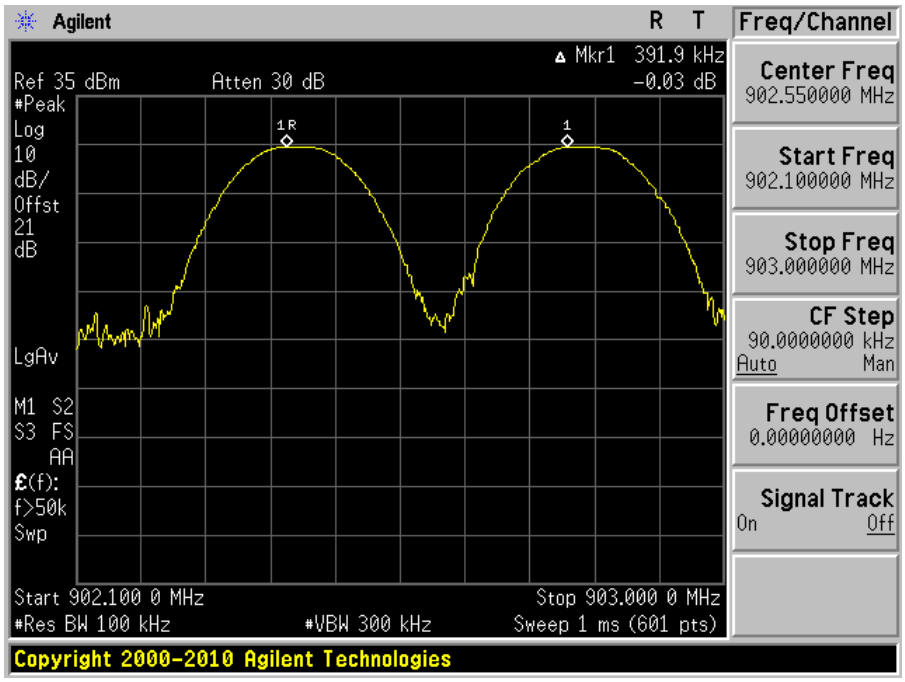
The testing was performed by Quinn Jiang on 07-01-2011 to 07-06-2011 in RF site.

12.5 Test Results

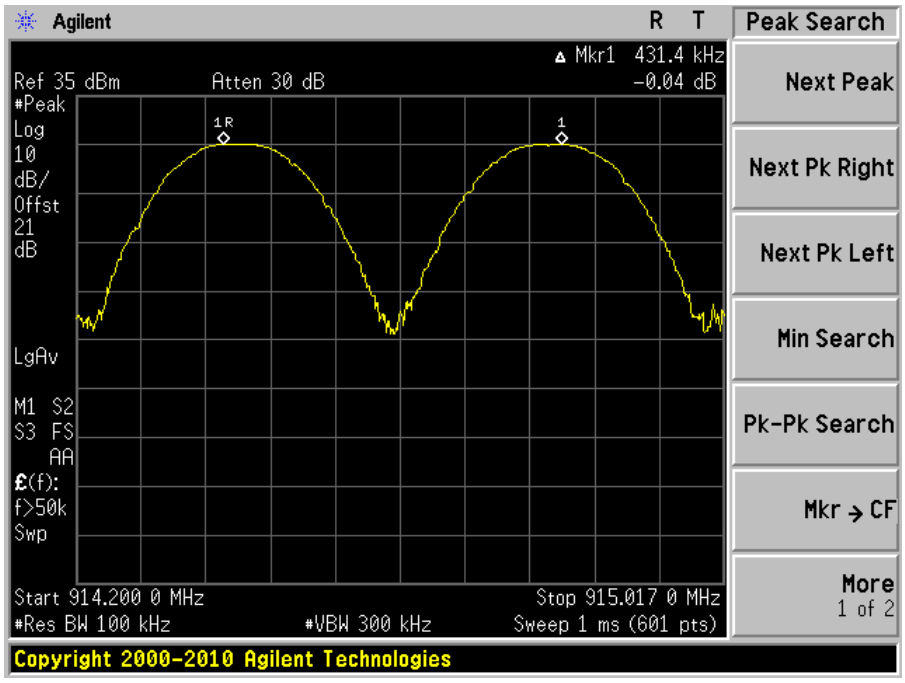
Channel	Frequency (MHz)	Channel Separation (kHz)	Limit > 20 dB OBW (kHz)
Low	902.4	391.9	126.249
Mid	914.8	431.4	125.015
High	927.59	432.7	125.211

Please refer to the following plots.

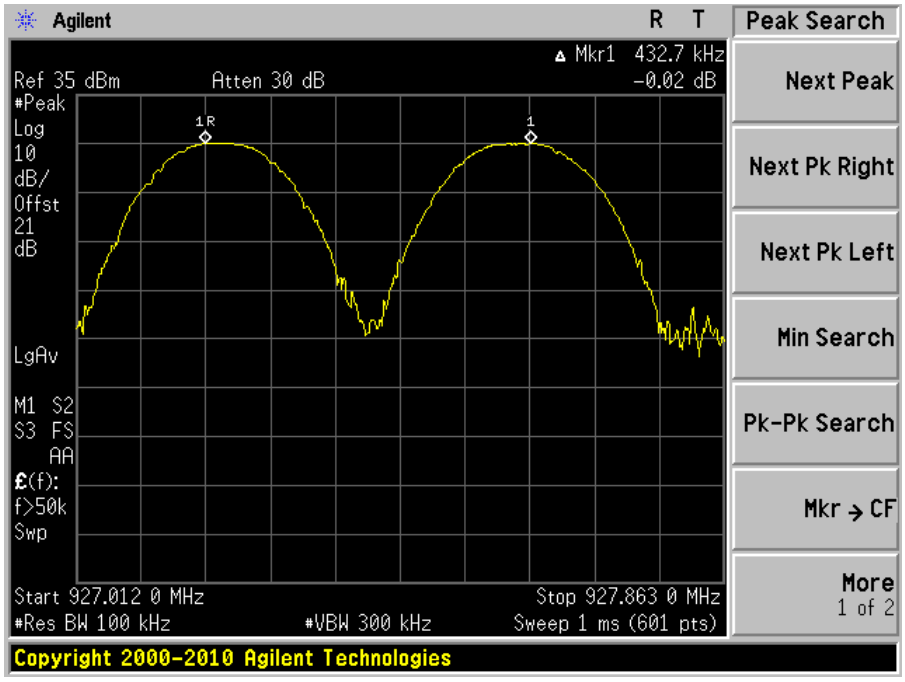
Low Channel



Middle Channel



High Channel



13 FCC §15.247(a) – Number of Hopping Frequencies Used

13.1 Applicable Standard

According to FCC §15.247(a)(1)(i), frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

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 Due Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-05-10

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

13.4 Test Environmental Conditions

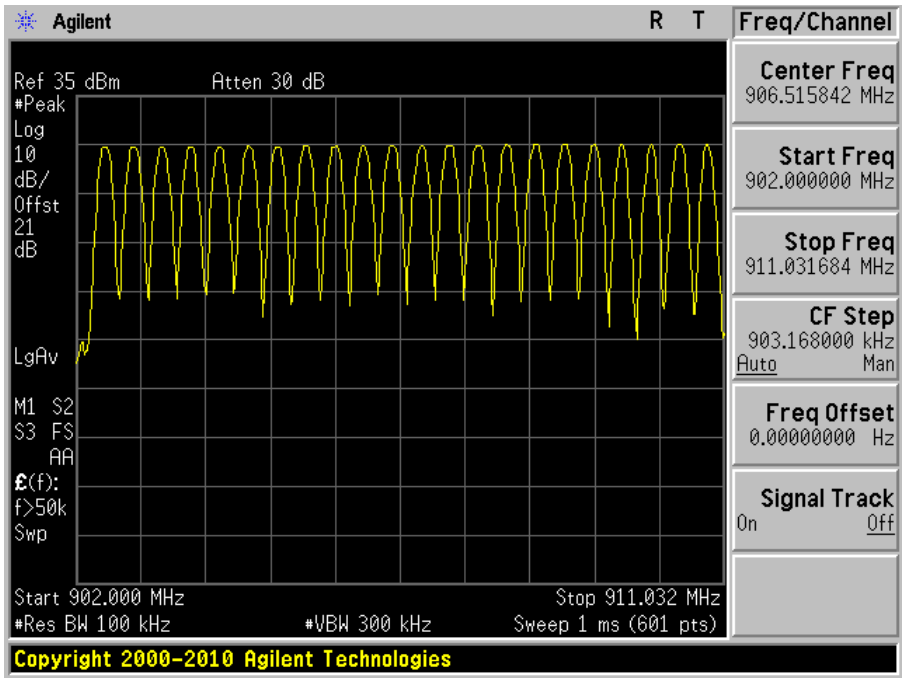
Temperature:	21~24 °C
Relative Humidity:	38~45 %
ATM Pressure:	101.2-102 kPa

The testing was performed by Quinn Jiang on 07-01-2011 to 07-06-2011 in RF site.

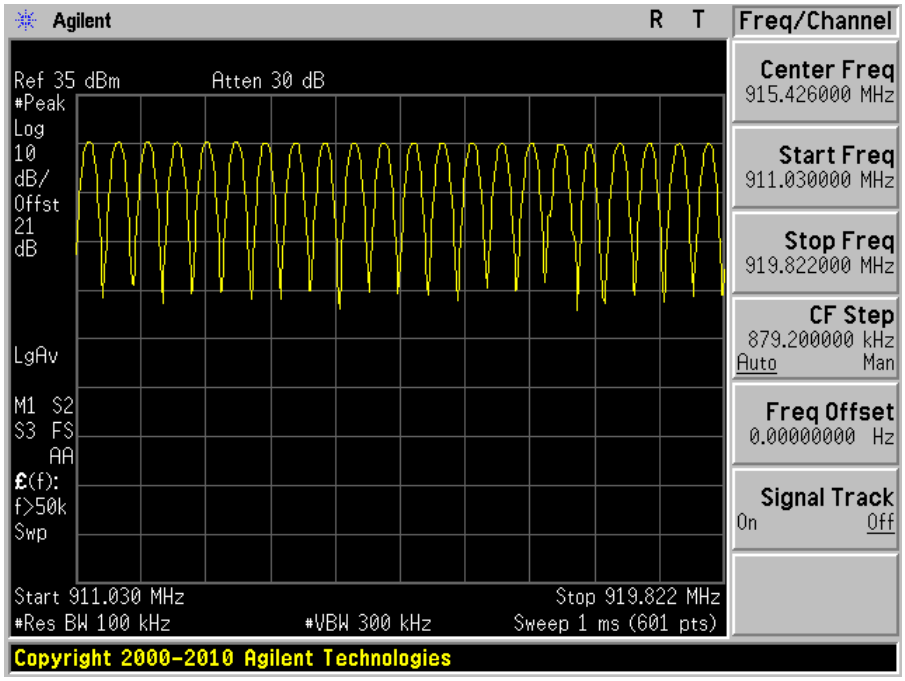
13.5 Test Results

64 channels, please refer to the following plots.

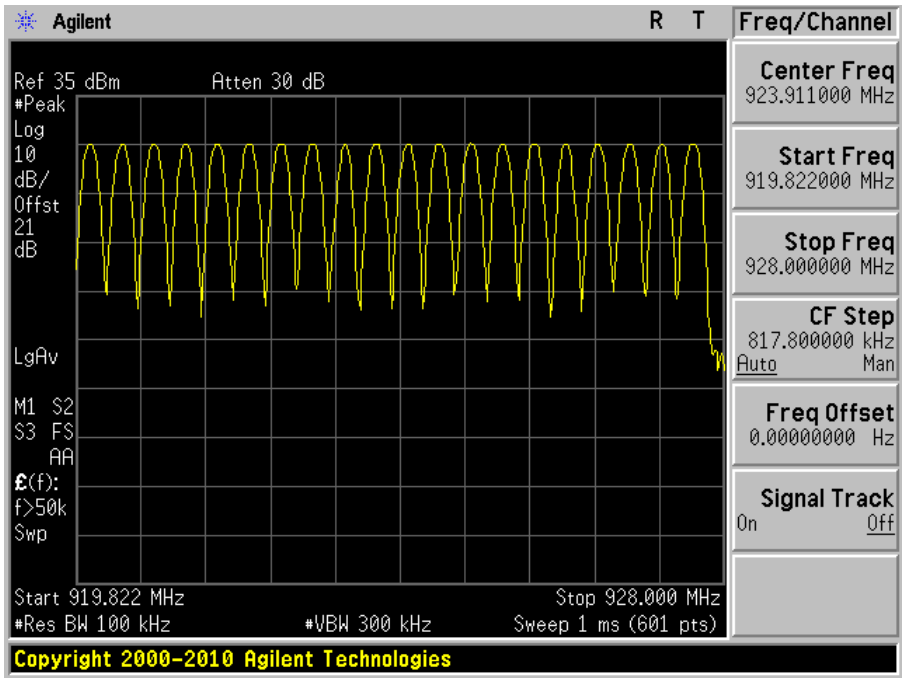
Hopping Channel Number



22 Channels between 902 to 911.032 MHz



22 Channels between 911.030 to 919.822 MHz



20 Channels between 919.822 to 928 MHz

14 FCC §15.247(a)(1)(i) - Dwell Time

14.1 Applicable Standard

According to FCC §15.247(a)(1)(i), frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

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 Due Date
Agilent	Spectrum Analyzer	E4440A	MY44303352	2012-05-10

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

14.4 Test Environmental Conditions

Temperature:	21~24 °C
Relative Humidity:	38~45 %
ATM Pressure:	101.2-102 kPa

The testing was performed by Quinn Jiang on 07-01-2011 to 07-06-2011 in RF site.

14.5 Test Results

Channel	Frequency (MHz)	Pulse Width (ms)	Dwell Time (Sec.)	Limit (Sec.)	Results
Low	902.4	14.44	0.023	0.4	Compliant
Mid	914.8	14.44	0.023	0.4	Compliant
High	927.59	14.44	0.023	0.4	Compliant

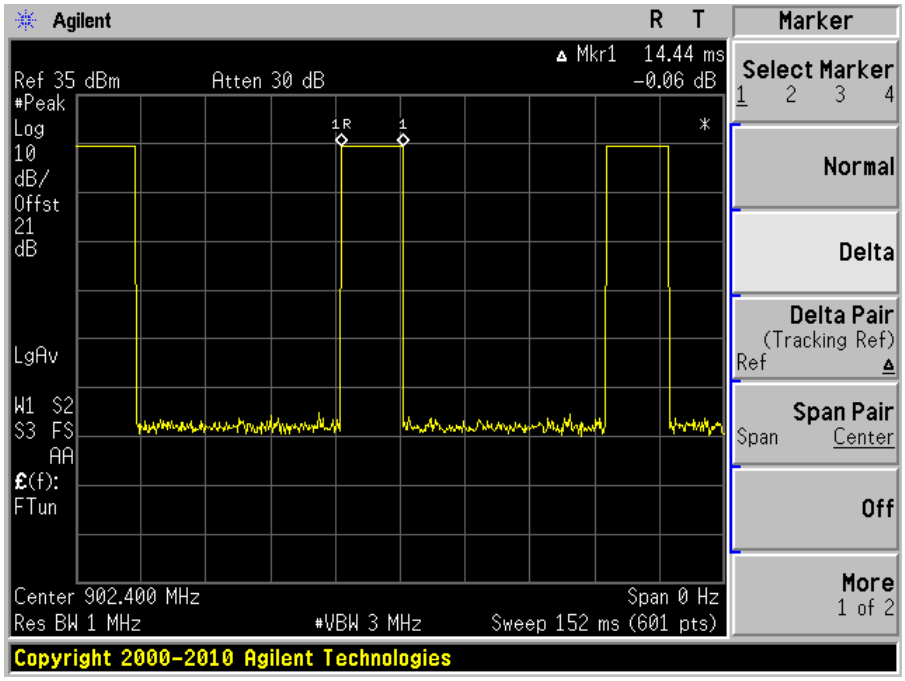
Note:

Dwell time = Pulse time*(hop rate/1/number of channels)*25.6 sec

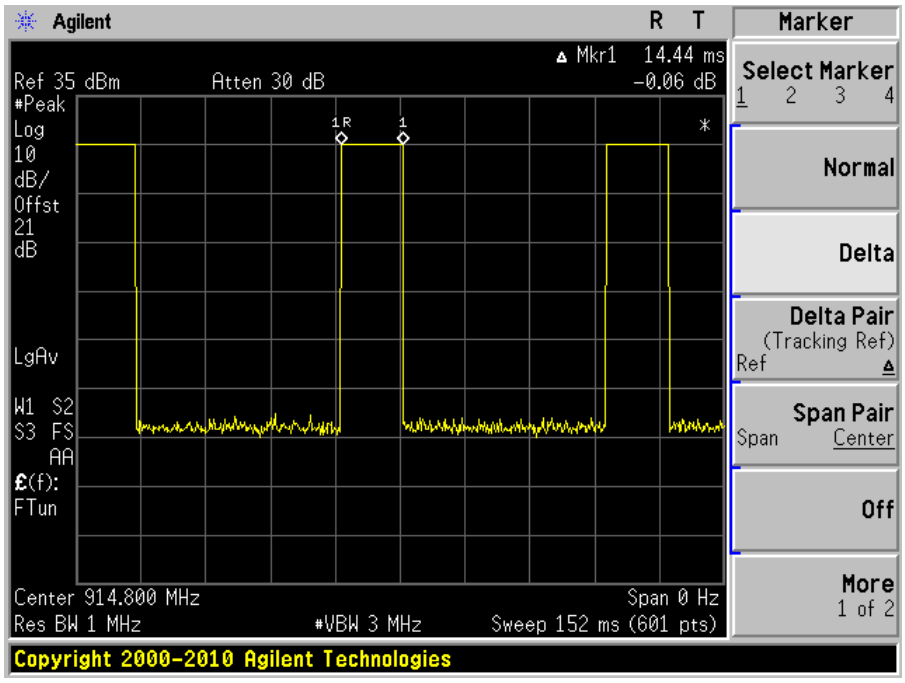
• Hop Rate = 4
• Number of Channels = 64

Please refer the following plots.

Low Channel



Middle Channel



High Channel