



FCC PART 15 SUBPART C IC RSS-210, ISSUE 8, DECEMBER 2010

TEST AND MEASUREMENT REPORT

For

Arrayent Inc.

1017 El Camino Real #417,
Redwood City, CA 94063, USA

**FCC ID: Y4B-MST-RFM
IC: 10122A-MSTRFM**

| | |
|---|--|
| Report Type: Original Report | Product Type: 900 MHz Transceiver Module |
| Prepared By: <u>Quinn Jiang</u>  | |
| Report Number: <u>R1205141-247</u> | |
| Report Date: <u>2012-07-12</u> | |
| Victor Zhang  | |
| Reviewed By: <u>EMC/RF Lead</u> | |
| Bay Area Compliance Laboratories Corp. 1274 Anvilwood Avenue Sunnyvale, CA 94089, USA Tel: (408) 732-9162 Fax: (408) 732-9164 | |

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 A2LA*, NIST, or any agency of the Federal Government.

* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk “*” (Rev.2)

TABLE OF CONTENTS

| | |
|---|-----------|
| 1 General Description..... | 5 |
| 1.1 Product Description for Equipment Under Test (EUT) | 5 |
| 1.2 Mechanical Description of EUT | 5 |
| 1.3 Objective..... | 5 |
| 1.4 Related Submittal(s)/Grant(s)..... | 5 |
| 1.5 Test Methodology | 5 |
| 1.6 Measurement Uncertainty..... | 5 |
| 1.7 Test Facility | 6 |
| 2 System Test Configuration..... | 7 |
| 2.1 Justification..... | 7 |
| 2.2 EUT Exercise Software | 7 |
| 2.3 Special Equipment..... | 7 |
| 2.4 Equipment Modifications | 7 |
| 2.5 Local Support Equipment | 7 |
| 2.6 EUT Internal Configuration Details | 7 |
| 2.7 Interface Ports and Cabling | 7 |
| 3 Summary of Test Results | 8 |
| 4 FCC §15.247 (i), §2.1091 & IC RSS-102 – RF Exposure..... | 9 |
| 4.1 Applicable Standard | 9 |
| 4.2 MPE Prediction..... | 10 |
| 4.3 MPE Results | 10 |
| 5 FCC §15.203 & IC RSS-Gen §7.1.2 – Antenna Requirements | 11 |
| 5.1 Applicable Standard | 11 |
| 5.2 Results | 11 |
| 6 FCC §15.207 & IC RSS-Gen §7.2.4 – AC Line Conducted Emissions..... | 12 |
| 6.1 Applicable Standards | 12 |
| 6.2 Test Setup | 12 |
| 6.3 Test Procedure | 12 |
| 6.4 Test Setup Block Diagram..... | 13 |
| 6.5 Corrected Amplitude & Margin Calculation | 13 |
| 6.6 Test Equipment List and Details..... | 14 |
| 6.7 Test Environmental Conditions | 14 |
| 6.8 Summary of Test Results..... | 14 |
| 6.9 Conducted Emissions Test Plots and Data..... | 15 |
| 7 FCC §2.1051, §15.247(d) & IC RSS-210 §A8.5 – Spurious Emissions at Antenna Terminals..... | 17 |
| 7.1 Applicable Standard | 17 |
| 7.2 Measurement Procedure | 17 |
| 7.3 Test Equipment List and Details..... | 17 |
| 7.4 Test Environmental Conditions | 17 |
| 7.5 Test Results | 17 |
| 8 FCC §15.205, §15.209 & §15.247(d) & IC RSS-210 §A8.5 – Spurious Radiated Emissions | 23 |
| 8.1 Applicable Standard | 23 |
| 8.2 Test Procedure | 24 |
| 8.3 Test Setup Block Diagram..... | 25 |
| 8.4 Corrected Amplitude & Margin Calculation | 25 |
| 8.5 Test Equipment List and Details..... | 26 |
| 8.6 Test Environmental Conditions | 26 |
| 8.7 Summary of Test Results..... | 26 |
| 8.8 Radiated Emissions Test Data and Plots..... | 27 |
| 9 FCC§15.247(a)(2) & IC RSS-210§A8.2 – 6 dB & 99% Emission Bandwidth | 30 |

| | | |
|-----------|---|-----------|
| 9.1 | Applicable Standard | 30 |
| 9.2 | Measurement Procedure | 30 |
| 9.3 | Test Equipment List and Details..... | 30 |
| 9.4 | Test Environmental Conditions | 30 |
| 9.5 | Test Results | 30 |
| 10 | FCC §15.247(b) & IC RSS-210 §A8.4 – Peak Output Power Measurement | 33 |
| 10.1 | Applicable Standard | 33 |
| 10.2 | Measurement Procedure | 33 |
| 10.3 | Test Equipment List and Details..... | 33 |
| 10.4 | Test Environmental Conditions | 33 |
| 10.5 | Test Results | 34 |
| 11 | FCC §15.247(d) & IC RSS-210 §A8.5 – 100 kHz Bandwidth of Band Edges..... | 36 |
| 11.1 | Applicable Standard | 36 |
| 11.2 | Measurement Procedure | 36 |
| 11.3 | Test Equipment List and Details..... | 36 |
| 11.4 | Test Environmental Conditions | 36 |
| 11.5 | Test Results | 37 |
| 12 | FCC §15.247(e) & IC RSS-210 §A8.2 (b) – Power Spectral Density | 38 |
| 12.1 | Applicable Standard | 38 |
| 12.2 | Measurement Procedure | 38 |
| 12.3 | Test Equipment List and Details..... | 38 |
| 12.4 | Test Environmental Conditions | 38 |
| 12.5 | Test Results | 39 |
| 13 | IC RSS-210 §2.3 & RSS-Gen §6.1 – Receiver Spurious Radiated Emissions..... | 41 |
| 13.1 | Applicable Standard | 41 |
| 13.2 | Test Setup Block Diagram..... | 41 |
| 13.3 | Test Procedure | 42 |
| 13.4 | Corrected Amplitude & Margin Calculation | 42 |
| 13.5 | Test Equipment Lists and Details | 42 |
| 13.6 | Test Environmental Conditions | 42 |
| 13.7 | Summary of Test Results..... | 43 |
| 13.8 | Test data and Plots..... | 43 |
| 14 | Exhibit A – FCC & IC Equipment Labeling Requirements | 44 |
| 14.1 | FCC ID Label Requirements | 44 |
| 14.2 | IC Label Requirements | 44 |
| 14.3 | FCC ID & IC Label Contents and Location on EUT..... | 45 |
| 15 | Exhibit B – Test Setup Photographs | 46 |
| 15.1 | AC Line Conducted Emission Front View | 46 |
| 15.2 | AC Line Conducted Emission Side View..... | 46 |
| 15.3 | TX Radiated Emission Front View at 3m..... | 47 |
| 15.4 | TX Radiated Emission below 1 GHz Rear View at 3m..... | 47 |
| 15.5 | TX Radiated Emission above 1 GHz Rear View at 3m..... | 48 |
| 15.6 | RX Radiated Emission Front View at 3m..... | 48 |
| 15.7 | RX Radiated Emission below 1 GHz Rear View at 3m | 49 |
| 15.8 | RX Radiated Emission above 1 GHz Rear View at 3m | 49 |
| 16 | Exhibit C – EUT Photographs..... | 50 |
| 16.1 | EUT – Top View | 50 |
| 16.2 | EUT – Bottom View | 50 |
| 16.3 | Support Equipment – Programming Board Top View..... | 51 |
| 16.4 | Support Equipment – Programming Board Bottom View | 51 |
| 16.5 | Support Equipment – CC Debugger View..... | 52 |
| 16.6 | Battery View..... | 52 |

DOCUMENT REVISION HISTORY

| Revision Number | Report Number | Description of Revision | Date of Revision |
|------------------------|----------------------|--------------------------------|-------------------------|
| 0 | R1205141-247 | Original Report | 2012-07-12 |

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Arrayent Inc.* and their product FCC ID: Y4B-MST-RFM, IC: 10122A-MSTRFM, model: *MST-RFM* or the “EUT” as referred on this report is 900 MHz transceiver module that operates at 902-928 MHz band.

1.2 Mechanical Description of EUT

The “EUT” measures approximately 3cm (L) x 2cm (W) x 0.5cm (H), and weighs approximately 2g.

The test data gathered are from typical production sample, serial number: 226330-IQ provided by the manufacturer.

1.3 Objective

This report is prepared on behalf of *Arrayent Inc.* in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commissions rules and IC RSS-210 Issue 8, Dec 2010.

The objective is to determine compliance with FCC Part 15.247 and IC RSS-210 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)

No Related Submittals.

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 ± 2.0 dB 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 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.

The worst-case data rates are determined to be as follows for each mode based upon investigation by measuring the average power, peak power and PPSD across all data rates bandwidths, and modulations.

2.2 EUT Exercise Software

The test utility used was Smart RF Flash Programmer (version 1.12.1) was provided by Arrayent Inc. and was verified Quinn Jiang to comply with the standard requirements being tested against.

2.3 Special Equipment

N/A

2.4 Equipment Modifications

N/A

2.5 Local Support Equipment

| Manufacturer | Description | Model No. | Serial No. |
|------------------|-------------------|---------------------|-------------------|
| IBM | Laptop | T40 | 00 0D 60 CE 91 C0 |
| Arrayent Inc | Programming Board | MST-PWM Programming | 227212-INT J |
| Texas Instrument | Debugger | CC Debugger Rev.1.0 | Z20100002C 09509 |

2.6 EUT Internal Configuration Details

NA: Only the module card was tested the s/n can be found in section 1.2.

2.7 Interface Ports and Cabling

| Cable Descriptions | Length (m) | From | To |
|--------------------|------------|-------------------|-------------|
| Interface Cable | <1 | Programming Board | CC Debugger |
| USB | <1 | CC Debugger | Laptop |

3 Summary of Test Results

Results reported relate only to the product tested.

| FCC & IC Rules | Description of Test | Results |
|--|--|-----------|
| FCC §15.247(i), §2.1091 IC RSS-102 | RF Exposure | Compliant |
| FCC §15.203 IC RSS-Gen §7.1.2 | Antenna Requirement | Compliant |
| FCC §15.207(a) IC RSS-Gen §7.2.4 | AC Line Conducted Emissions | Compliant |
| FCC §15.209 IC RSS-210 §A8.5 | Spurious Emissions at Antenna Port | Compliant |
| FCC §15.205 IC RSS-210 §2.2 | Restricted Bands | Compliant |
| FCC §15.209, §15.247 IC RSS-210 §A8.5 | Radiated Spurious Emissions | Compliant |
| FCC §15.247(a)(2) IC RSS-210 §A8.2 | 6 dB Emission Bandwidth | Compliant |
| FCC §15.247(b)(3) IC RSS-210 §A8.4 | Maximum Peak Output Power | Compliant |
| FCC §15.247(d) IC RSS-210 §A8.5 | 100 kHz Bandwidth of Frequency Band Edge | Compliant |
| FCC §15.247(e) IC RSS-210 §A8.2(b) | Power Spectral Density | Compliant |
| IC RSS-210 §2.3 & RSS-Gen §6.1 | Receiver Spurious Emission | Compliant |

4 FCC §15.247 (i), §2.1091 & IC RSS-102 – RF Exposure

4.1 Applicable Standard

According to FCC §15.247(i), §1.1307(b)(1) and §1.1310 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

Before equipment certification is granted, the procedure of IC RSS-102 must be followed concerning the exposure of humans to RF fields.

According to IC RSS-102 Issue 2 section 4.1, RF limits used for general public will be applied to the EUT.

| Frequency Range (MHz) | Electric Field (V/m rms) | Magnetic Field (A/m rms) | Power Density (W/m ²) | Time Averaging (min) |
|-----------------------|--------------------------|-------------------------------|-----------------------------------|---------------------------|
| 0.003 - 1 | 280 | 2.19 | - | 6 |
| 1 - 10 | 280 / f | 2.19 / f | - | 6 |
| 10 - 30 | 28 | 2.19 / f | - | 6 |
| 30 - 300 | 28 | 0.073 | 2* | 6 |
| 300 - 1 500 | 1.585 f ^{0.5} | 0.0042 f ^{0.5} | f / 150 | 6 |
| 1 500 - 15 000 | 61.4 | 0.163 | 10 | 6 |
| 15 000 - 150 000 | 61.4 | 0.163 | 10 | 616000 / f ^{1.2} |
| 150 000- 300 000 | 0.158 f ^{0.5} | 4.21 x 10 -4 f ^{0.5} | 6.67 x 10 ⁻⁵ f | 616000 / f ^{1.2} |

Note: f is frequency in MHz

* = Power density limit is applicable at frequencies greater than 100 MHz

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

| | |
|---|---------------|
| <u>Maximum peak output power at antenna input terminal (dBm):</u> | <u>8.95</u> |
| <u>Maximum peak output power at antenna input terminal (mW):</u> | <u>7.852</u> |
| <u>Prediction distance (cm):</u> | <u>20</u> |
| <u>Prediction frequency (MHz):</u> | <u>914.17</u> |
| <u>Maximum Antenna Gain, typical (dBi):</u> | <u>7.2</u> |
| <u>Maximum Antenna Gain (numeric):</u> | <u>5.25</u> |
| <u>Power density of prediction frequency at 20.0 cm (mW/cm²):</u> | <u>0.0082</u> |
| <u>Power density of prediction frequency at 20.0 cm (W/m²):</u> | <u>0.082</u> |
| <u>MPE limit for uncontrolled exposure at prediction frequency (mW/cm²):</u> | <u>0.609</u> |
| <u>MPE limit for uncontrolled exposure at prediction frequency (W/m²):</u> | <u>6.09</u> |

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.0082 mW/cm² (0.082 W/m²). Limit is 0.609 mW/cm² (6.09 W/m²).

5 FCC §15.203 & IC RSS-Gen §7.1.2 – 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.

According to IC RSS-Gen §7.1.2: Transmitter Antenna

A transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Testing shall be performed using the highest-gain antenna of each combination of transmitter and antenna type for which certification is being sought, with the transmitter output power set at the maximum level. Any antenna of the same type and having equal or lesser gain as an antenna that had been successfully tested for certification with the transmitter, will also be considered certified with the transmitter, and may be used and marketed with the transmitter. The manufacturer shall include with the application for certification a list of acceptable antenna types to be used with the transmitter.

When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer. Any antenna gain in excess of 6 dBi (6 dB above isotropic gain) shall be added to the measured RF output power before using the power limits specified in RSS-210 or RSS-310 for devices of RF output powers of 10 mW or less. For devices of output powers greater than 10 mW, except devices subject to RSS-210 Annex 8 (Frequency Hopping and Digital Modulation Systems Operating in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz Bands) or RSS-210 Annex 9 (Local Area Network Devices), the total antenna gain shall be added to the measured RF output power before using the specified power limits. For devices subject to RSS-210 Annex 8 or Annex 9, the antenna gain shall not be added.

5.2 Results

The EUT has an integral monopole antenna soldered to the PCB board with a maximum gain of 7.2 dBi, which is accordance to FCC Part 15.203 and IC RSS-Gen §7.1.2 and considered sufficient to comply with the provisions of these sections. Please refer to the EUT internal photos.

6 FCC §15.207 & IC RSS-Gen §7.2.4 – AC Line Conducted Emissions

6.1 Applicable Standards

As per FCC §15.207 and IC RSS-Gen §7.2.4 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 μ H/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 §15.207 and IC RSS-Gen §7.2.4 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.

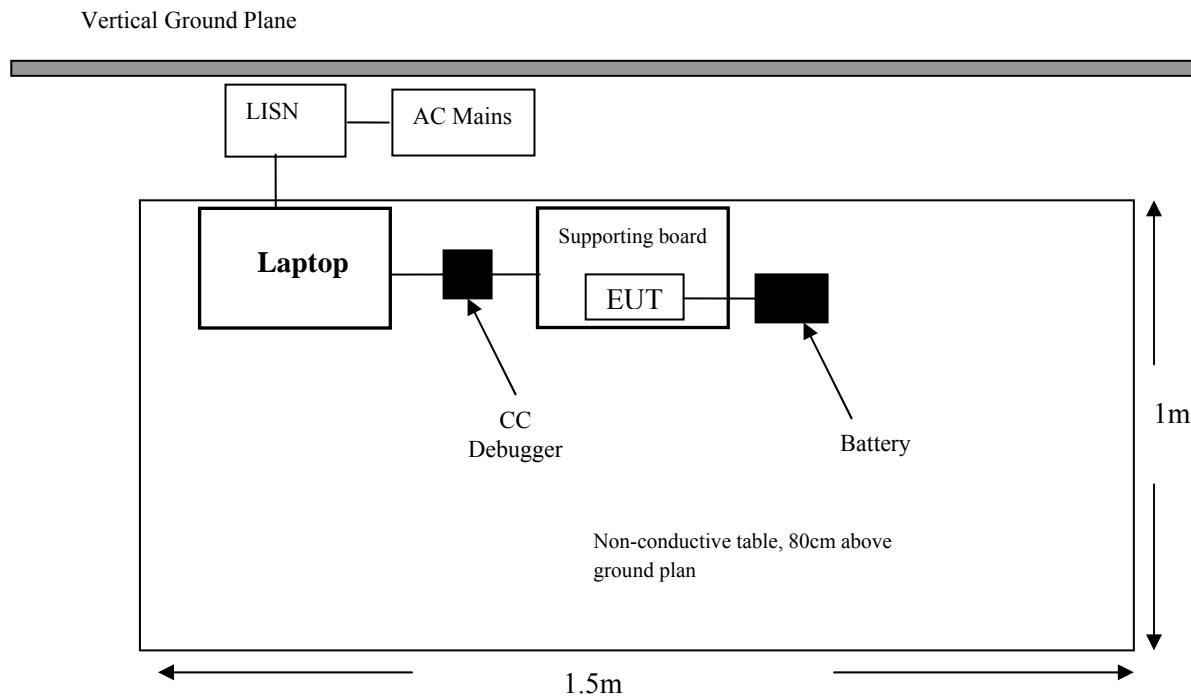
6.3 Test Procedure

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 Antenna Factor (AF), the Cable Loss (CL), the Attenuator Factor (Atten) to indicated Amplitude (Ai) reading. The basic equation is as follows:

$$CA = Ai + AF + CL + Atten$$

For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (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:

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

6.6 Test Equipment List and Details

| Manufacturers | Descriptions | Models | Serial Numbers | Calibration Dates |
|-------------------|-------------------|--------------------|----------------|-------------------|
| Solar Electronics | LISN | 9252-R-24-BNC | 511205 | 2011-06-25 |
| TTE | Filter, High Pass | H962-150k-50-21378 | K7133 | 2012-05-30 |
| 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: | 21.5 °C |
| Relative Humidity: | 42 % |
| ATM Pressure: | 102.2 kPa |

The testing was performed by Quinn Jiang on 2012-06-07 at Chamber³

6.8 Summary of Test Results

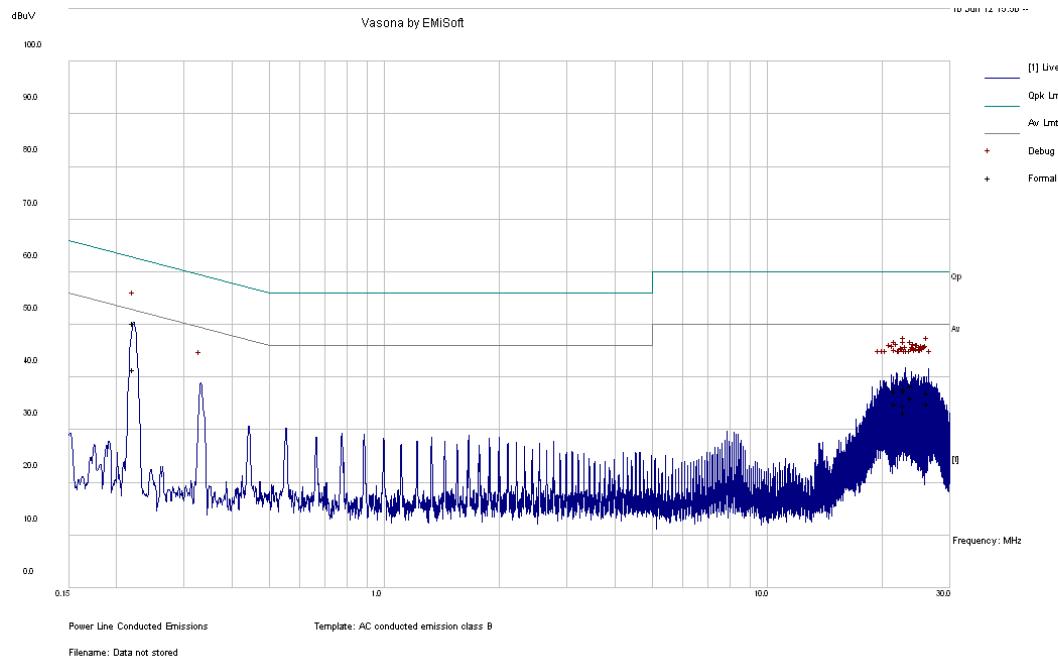
According to the recorded data in following table, the EUT complied with the FCC standard's conducted emissions limits, with the margin reading of:

| Connection: AC/DC adapter connected to 120 V/60 Hz, AC | | | |
|--|--------------------|----------------------------------|----------------|
| Margin (dB) | Frequency (MHz) | Conductor Mode (Line/Neutral) | Range (MHz) |
| -11.22 | 0.220905 | Line | 0.15-30 |

6.9 Conducted Emissions Test Plots and Data

Transmitting Mode the Worst Case: Middle channel

120 V, 60 Hz – Line

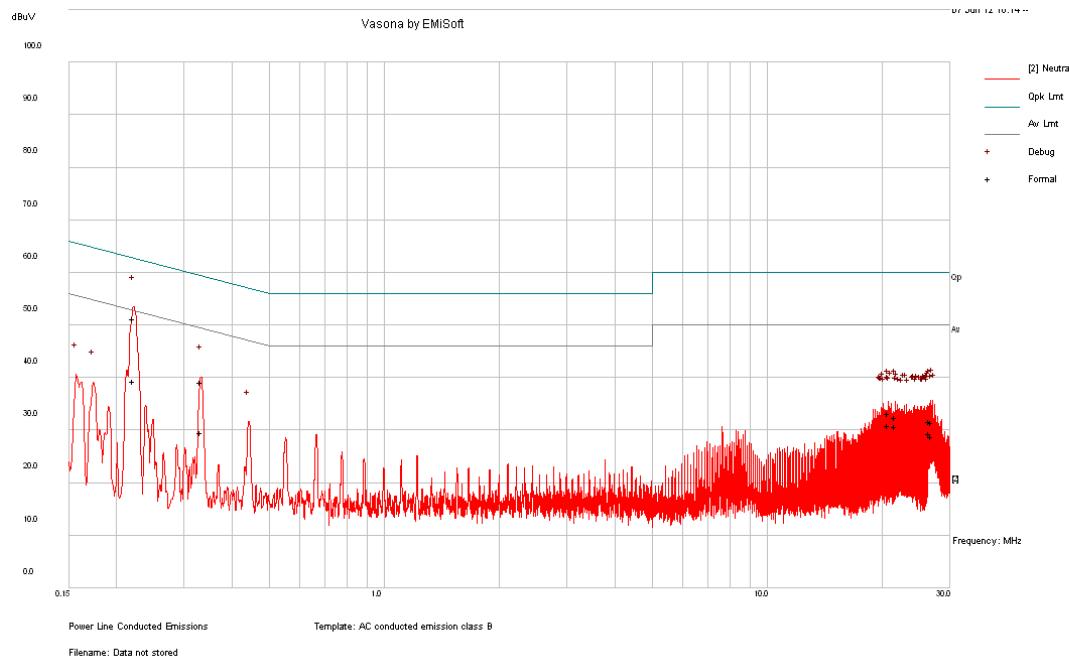


Quasi-Peak Measurements:

| Frequency (MHz) | Corrected Amplitude (dB μ V) | Conductor (Line/Neutral) | Limit (dB μ V) | Margin (dB) |
|-----------------|----------------------------------|--------------------------|--------------------|-------------|
| 0.220905 | 50.28 | Line | 62.78 | -12.51 |
| 23.76712 | 38.36 | Line | 60 | -21.64 |
| 22.77056 | 37.85 | Line | 60 | -22.15 |
| 21.66876 | 37.5 | Line | 60 | -22.50 |
| 22.88277 | 37.38 | Line | 60 | -22.62 |
| 26.31178 | 37.06 | Line | 60 | -22.94 |

Average Measurements:

| Frequency (MHz) | Corrected Amplitude (dB μ V) | Conductor (Line/Neutral) | Limit (dB μ V) | Margin (dB) |
|-----------------|----------------------------------|--------------------------|--------------------|-------------|
| 0.220905 | 41.57 | Line | 52.78 | -11.22 |
| 23.76712 | 36.16 | Line | 50 | -13.84 |
| 26.31178 | 35 | Line | 50 | -15.00 |
| 21.66876 | 34.89 | Line | 50 | -15.11 |
| 22.88277 | 34.55 | Line | 50 | -15.45 |
| 22.77056 | 33.15 | Line | 50 | -16.85 |

120 V, 60 Hz – Neutral**Quasi-Peak Measurements:**

| Frequency (MHz) | Corrected Amplitude (dB μ V) | Conductor (Line/Neutral) | Limit (dB μ V) | Margin (dB) |
|-----------------|----------------------------------|--------------------------|--------------------|-------------|
| 0.221769 | 51.25 | Neutral | 62.75 | -11.51 |
| 0.331503 | 39.16 | Neutral | 59.41 | -20.25 |
| 20.67426 | 33.25 | Neutral | 60 | -26.75 |
| 21.56031 | 32.54 | Neutral | 60 | -27.46 |
| 26.64302 | 31.76 | Neutral | 60 | -28.24 |
| 26.97441 | 31.43 | Neutral | 60 | -28.57 |

Average Measurements:

| Frequency (MHz) | Corrected Amplitude (dB μ V) | Conductor (Line/Neutral) | Limit (dB μ V) | Margin (dB) |
|-----------------|----------------------------------|--------------------------|--------------------|-------------|
| 0.221769 | 39.4 | Neutral | 52.75 | -13.35 |
| 20.67426 | 30.98 | Neutral | 50 | -19.02 |
| 21.56031 | 30.76 | Neutral | 50 | -19.24 |
| 0.331503 | 29.63 | Neutral | 49.41 | -19.78 |
| 26.64302 | 29.39 | Neutral | 50 | -20.61 |
| 26.97441 | 28.89 | Neutral | 50 | -21.11 |

7 FCC §2.1051, §15.247(d) & IC RSS-210 §A8.5 – Spurious Emissions at Antenna Terminals

7.1 Applicable Standard

For FCC §15.247(d) and IC RSS-210 §A8.5 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: | 102.2 kPa |

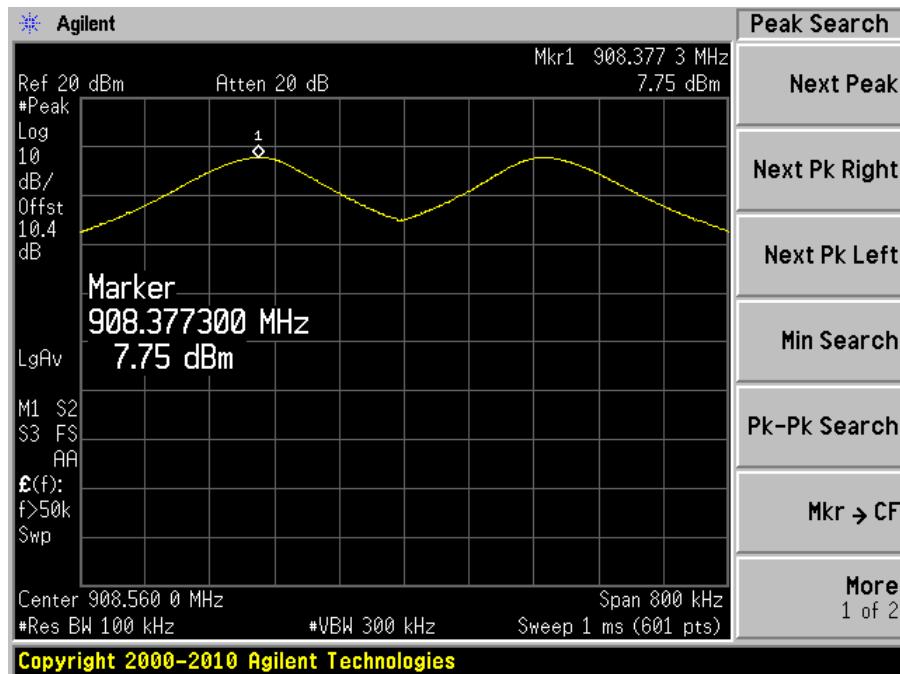
The testing was performed by Quinn Jiang on 2012-06-10 at the RF Site

7.5 Test Results

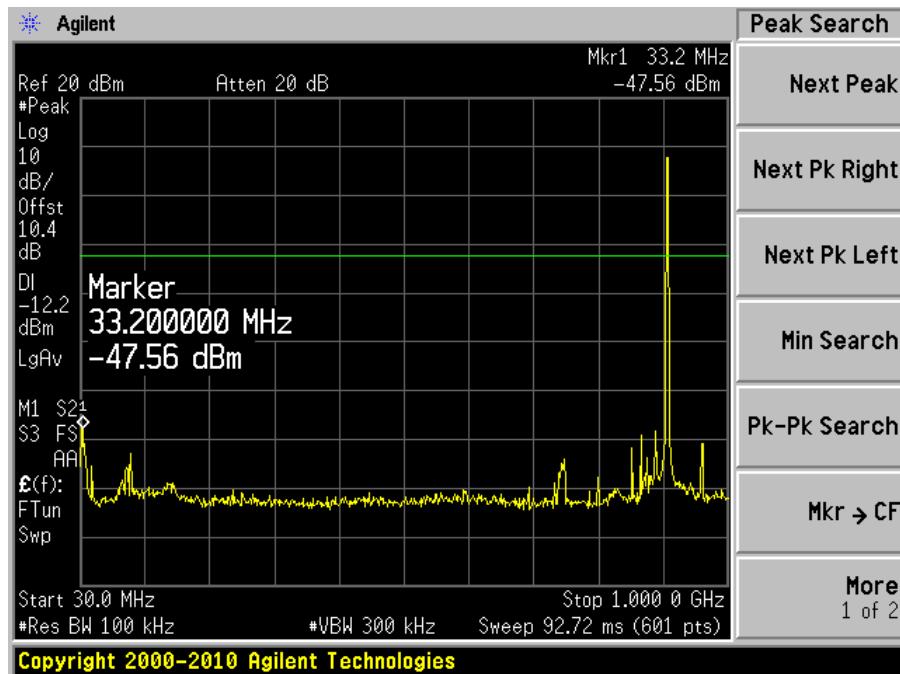
Please refer to following plots of spurious emissions.

Low Channel: 908.56 MHz

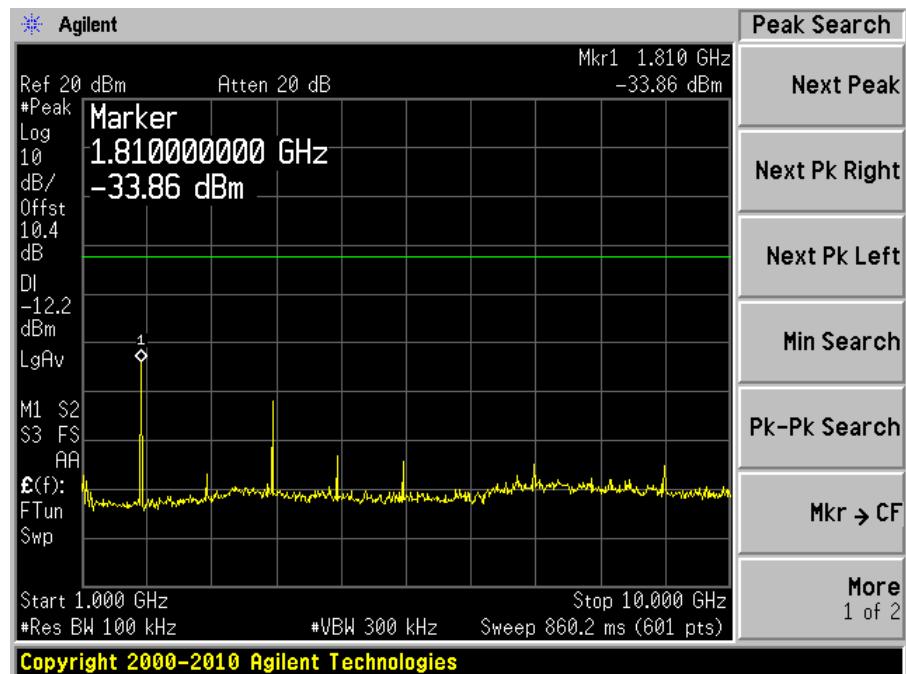
Plot: Reference Value



Plot: 30 MHz – 1GHz

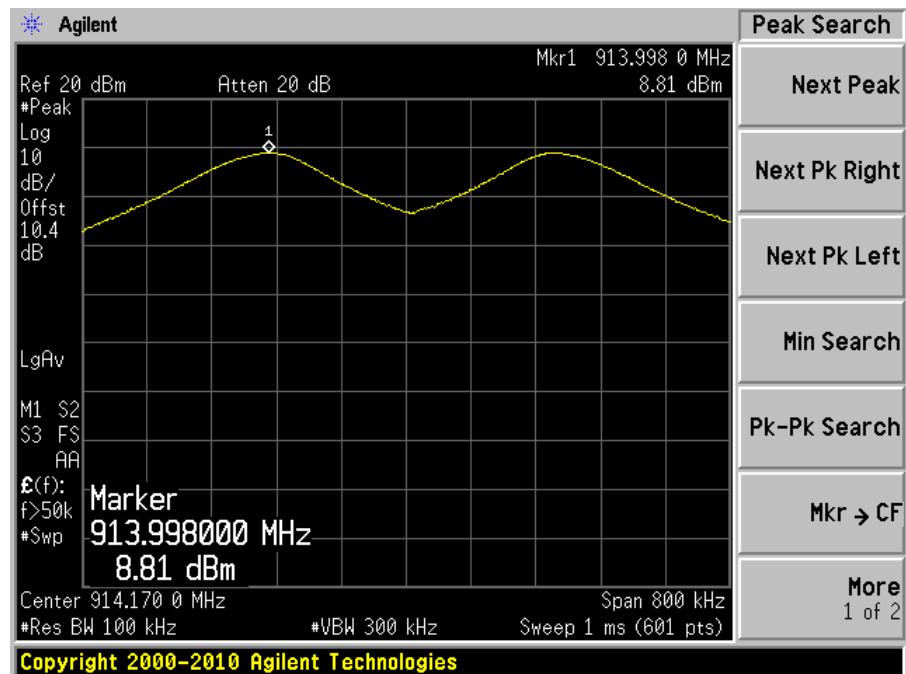


Plot: 1 – 10 GHz

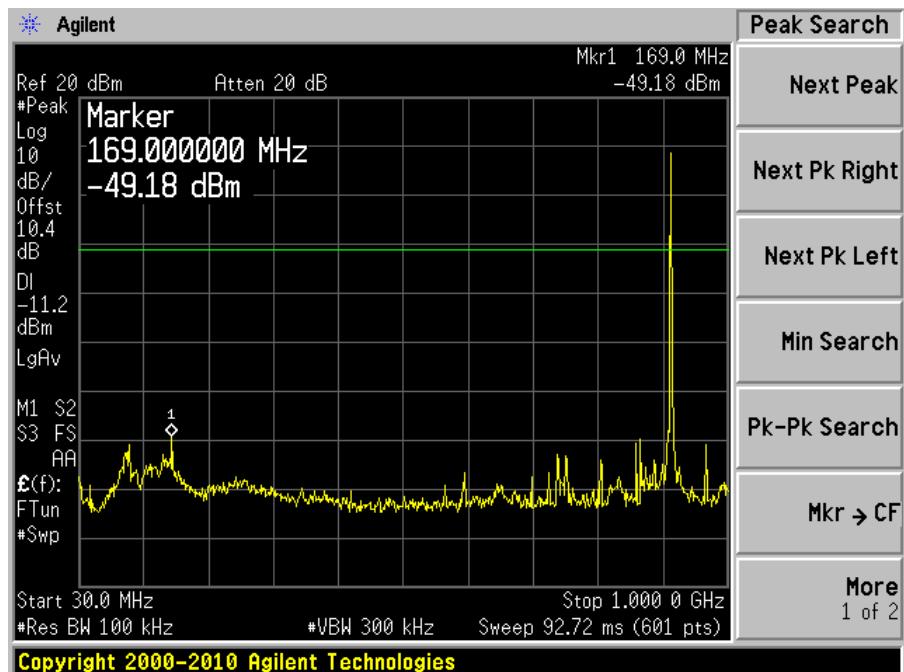


Middle Channel: 914.17 MHz

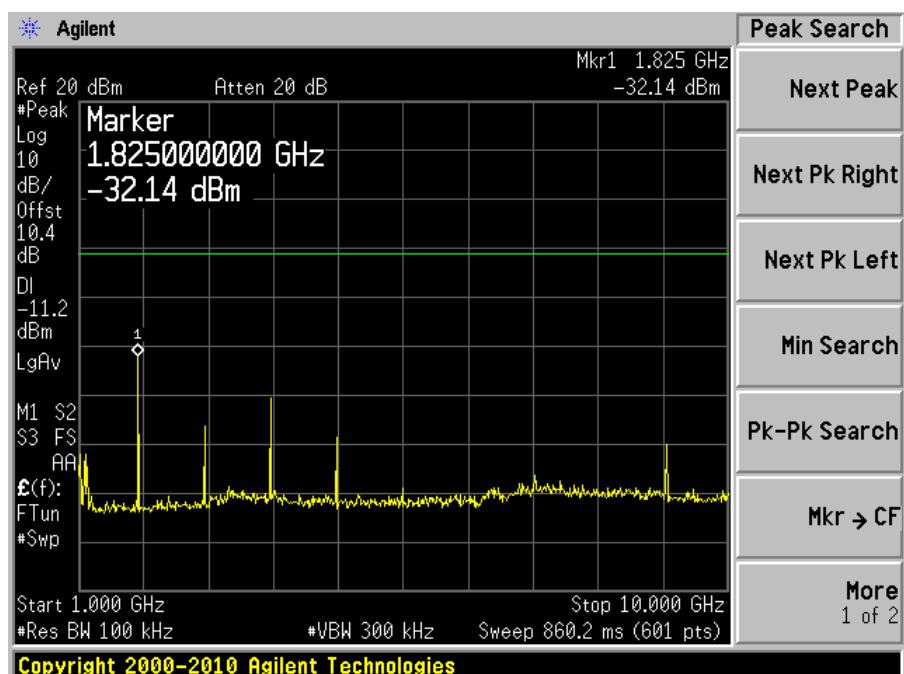
Plot: Reference Level



Plot: 30 MHz – 1 GHz

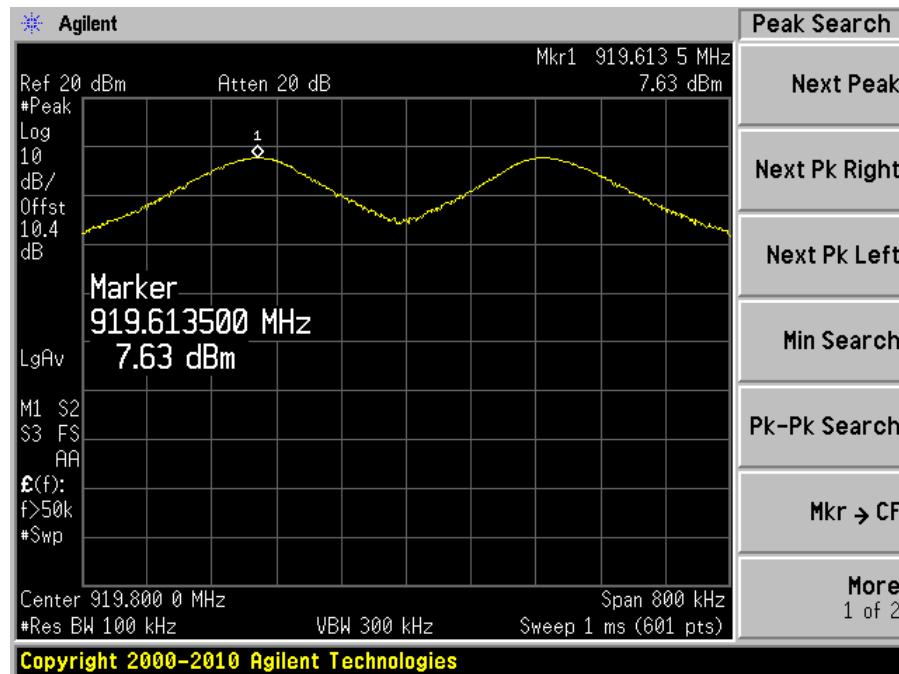


Plot: 1 – 10 GHz

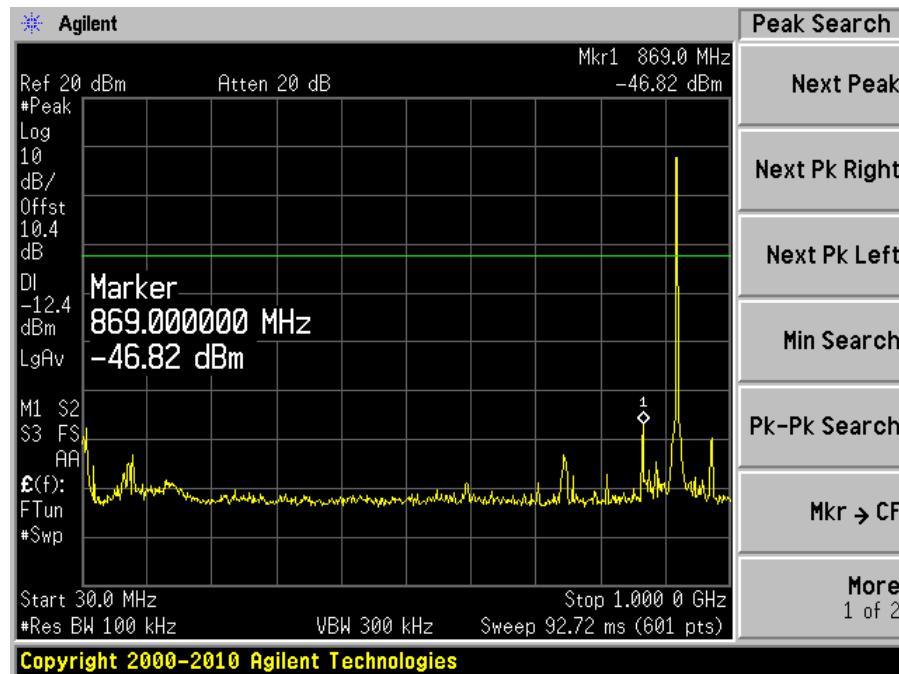


High Channel: 919.80 MHz

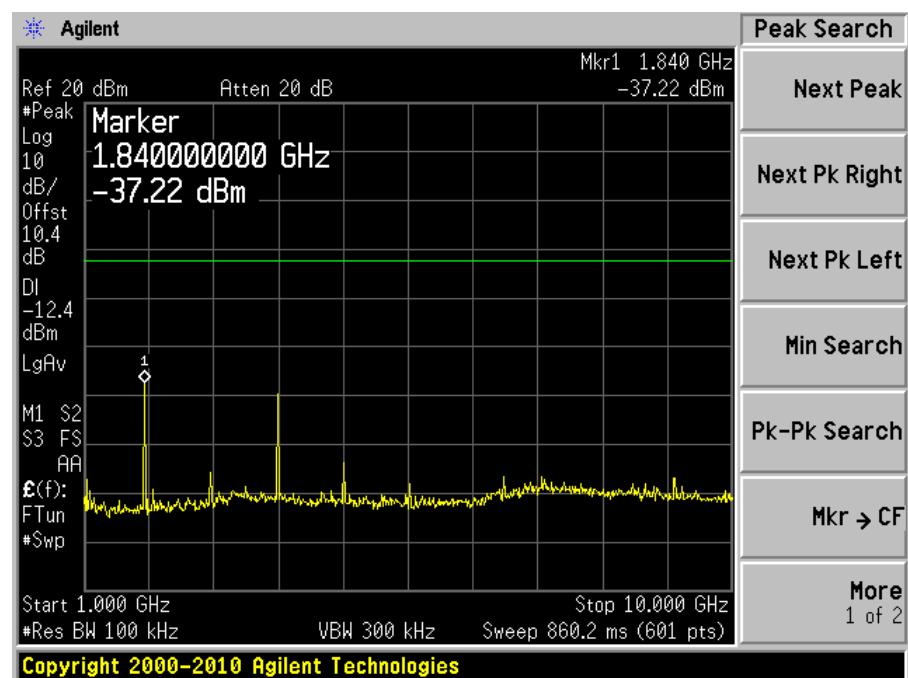
Plot: Reference Level



Plot: 30 MHz – 1 GHz



Plot: 1 – 10 GHz



8 FCC §15.205, §15.209 & §15.247(d) & IC RSS-210 §A8.5 – 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 – 2.2105 | 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)).

As per IC RSS-210 §A8.5, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section A8.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

8.2 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:

$$\text{RBW} = 100 \text{ kHz} / \text{VBW} = 300 \text{ kHz} / \text{Sweep} = \text{Auto}$$

Above 1000 MHz:

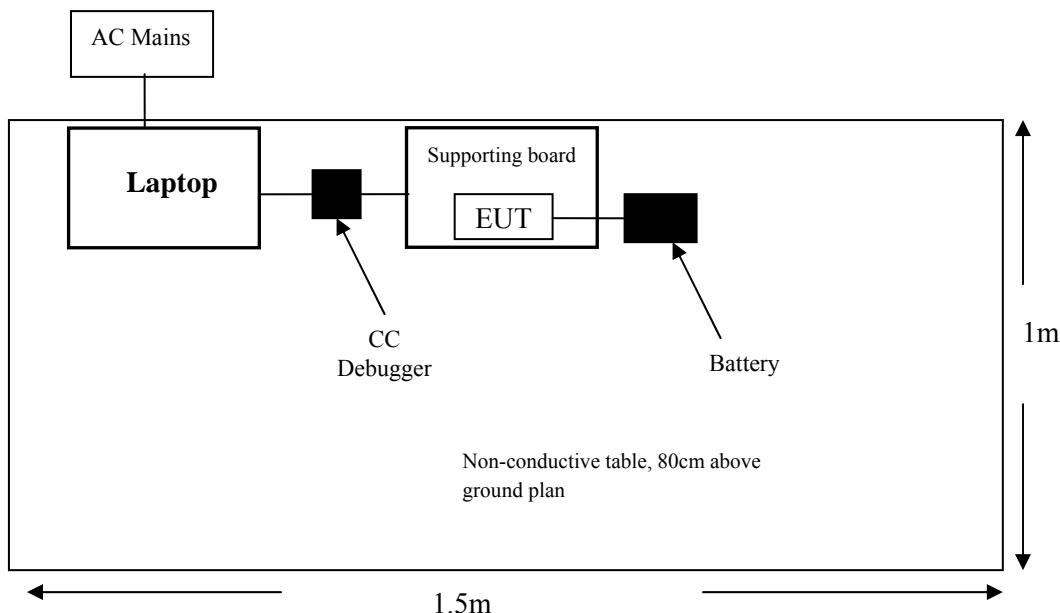
- (1) Peak: $\text{RBW} = 1\text{MHz} / \text{VBW} = 1\text{MHz} / \text{Sweep} = \text{Auto}$
- (2) Average: $\text{RBW} = 1\text{MHz} / \text{VBW} = 10\text{Hz} / \text{Sweep} = \text{Auto}$

8.3 Test Setup Block Diagram

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 and IC RSS-210 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.



8.4 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 indicated Amplitude (Ai) reading. The basic equation is as follows:

$$CA = Ai + AF + CL + Atten - Ga$$

For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (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:

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

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 | 570400946 | 2012-05-09 |

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 Quinn Jiang on 2012-06-05 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 and IC RSS-210 standard's radiated emissions limits, and had the worst margin of:

30 MHz – 10 GHz

| Mode: Transmitting | | | |
|---------------------------|----------------------------|---|---------------|
| Margin (dB) | Frequency (MHz) | Polarization (Horizontal/Vertical) | Range |
| -4.44 | 261.0005 | Vertical | 30 MHz -1 GHz |
| -1.800 | 3657 | Vertical | 1 – 10 GHz |

Please refer to the following table for test result details

8.8 Radiated Emissions Test Data and Plots

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

Quasi-Peak Measurements

| Frequency (MHz) | Corrected Amplitude (dB μ V/m) | Antenna Height (cm) | Antenna Polarity (H/V) | Turntable Azimuth (degrees) | Limit (dB μ V/m) | Margin (dB) |
|----------------------------|------------------------------------|---------------------|------------------------|-----------------------------|----------------------|-------------|
| Low Channel: 908.56 MHz | | | | | | |
| 261.0005 | 41.56 | 99 | V | 160 | 46 | -4.44 |
| 960.7463 | 41.08 | 116 | V | 102 | 54 | -12.92 |
| 326.2695 | 30.3 | 100 | V | 187 | 46 | -15.70 |
| 165.3963 | 24.28 | 108 | V | 313 | 43.5 | -19.22 |
| 402.9625 | 16.14 | 140 | V | 89 | 46 | -29.86 |
| 397.4118 | 15.22 | 189 | H | 87 | 46 | -30.78 |
| Middle Channel: 914.17 MHz | | | | | | |
| 261.013 | 38.37 | 100 | V | 170 | 46 | -7.63 |
| 966.3493 | 44.59 | 103 | V | 101 | 54 | -9.41 |
| 326.2405 | 30.56 | 101 | V | 172 | 46 | -15.44 |
| 130.5235 | 25.06 | 108 | V | 131 | 43.5 | -18.44 |
| 164.7315 | 22.9 | 132 | V | 276 | 43.5 | -20.60 |
| 991.9945 | 26.45 | 209 | V | 335 | 54 | -27.55 |
| High Channel: 919.8 MHz | | | | | | |
| 971.9803 | 44.66 | 99 | V | 360 | 54 | -9.34 |
| 260.9978 | 35.26 | 99 | V | 292 | 46 | -10.74 |
| 167.5645 | 23.04 | 226 | V | 360 | 43.5 | -20.46 |
| 326.2533 | 23.18 | 113 | V | 360 | 46 | -22.82 |
| 282.746 | 22.43 | 104 | V | 360 | 46 | -23.57 |
| 398.9235 | 19.52 | 268 | H | 360 | 46 | -26.48 |

2) 1-10 GHz, Measured at 3 meters

| Frequency (MHz) | S.A. Reading (dB μ V) | Turntable Azimuth (degrees) | Test Antenna | | | Cable Loss (dB) | Pre-Amp. (dB) | Cord. Reading (dB μ V/m) | FCC/IC | | Comments |
|---------------------------|---------------------------|-----------------------------|--------------|----------------|---------------|-----------------|---------------|------------------------------|----------------------|-------------|----------|
| | | | Height (cm) | Polarity (H/V) | Factor (dB/m) | | | | Limit (dB μ V/m) | Margin (dB) | |
| Low Channel 905.56 MHz | | | | | | | | | | | |
| 908.56 | 65.790 | 143 | 158 | H | 22.8 | 10.00 | 0.00 | 98.590 | n/a | n/a | Fun Peak |
| 908.56 | 66.39 | 295 | 131 | V | 22.8 | 10.00 | 0.00 | 99.190 | n/a | n/a | Fun Peak |
| 908.56 | 65.480 | 143 | 158 | H | 22.8 | 10.00 | 0.00 | 98.280 | n/a | n/a | Fun Ave |
| 908.56 | 66.090 | 295 | 131 | V | 22.8 | 10.00 | 0.00 | 98.890 | n/a | n/a | Fun Ave |
| 2726 | 41.060 | 69 | 100 | H | 28.6 | 4.40 | 27.83 | 46.201 | 74 | -27.799 | Peak |
| 2726 | 42.92 | 71 | 100 | V | 28.4 | 4.40 | 27.83 | 47.881 | 74 | -26.119 | Peak |
| 2726 | 33.810 | 69 | 100 | H | 28.6 | 4.40 | 27.83 | 38.951 | 54 | -15.049 | Ave |
| 2726 | 35.550 | 71 | 100 | V | 28.4 | 4.40 | 27.83 | 40.511 | 54 | -13.489 | Ave |
| 3635 | 48.460 | 43 | 100 | H | 30.9 | 4.62 | 27.95 | 55.995 | 74 | -18.005 | Peak |
| 3635 | 50.22 | 57 | 100 | V | 31.0 | 4.62 | 27.95 | 57.848 | 74 | -16.152 | Peak |
| 3635 | 39.700 | 43 | 100 | H | 30.9 | 4.62 | 27.95 | 47.235 | 54 | -6.765 | Ave |
| 3635 | 41.860 | 57 | 100 | V | 31.0 | 4.62 | 27.95 | 49.488 | 54 | -4.512 | Ave |
| 4542 | 41.500 | 45 | 100 | H | 32.0 | 5.10 | 27.8 | 50.760 | 74 | -23.240 | Peak |
| 4542 | 43.79 | 52 | 100 | V | 31.8 | 5.10 | 27.8 | 52.840 | 74 | -21.160 | Peak |
| 4542 | 28.990 | 45 | 100 | H | 32.0 | 5.10 | 27.8 | 38.250 | 54 | -15.750 | Ave |
| 4542 | 31.390 | 52 | 100 | V | 31.8 | 5.10 | 27.8 | 40.440 | 54 | -13.560 | Ave |
| Middle Channel 914.17 MHz | | | | | | | | | | | |
| 914.17 | 70.470 | 6 | 100 | H | 22.8 | 10.00 | 0.00 | 103.270 | n/a | n/a | Fun Peak |
| 914.17 | 74.11 | 178 | 123 | V | 22.8 | 10.00 | 0.00 | 106.910 | n/a | n/a | Fun Peak |
| 914.17 | 70.000 | 6 | 100 | H | 22.8 | 10.00 | 0.00 | 102.800 | n/a | n/a | Fun Ave |
| 914.17 | 72.870 | 178 | 123 | V | 22.8 | 10.00 | 0.00 | 105.670 | n/a | n/a | Fun Ave |
| 2742 | 50.010 | 69 | 100 | H | 28.6 | 4.40 | 27.83 | 55.151 | 74 | -18.849 | Peak |
| 2742 | 52.27 | 42 | 100 | V | 28.4 | 4.40 | 27.83 | 57.231 | 74 | -16.769 | Peak |
| 2742 | 44.381 | 69 | 100 | H | 28.6 | 4.40 | 27.83 | 49.522 | 54 | -4.478 | Ave |
| 2742 | 47.230 | 42 | 100 | V | 28.4 | 4.40 | 27.83 | 52.191 | 54 | -1.809 | Ave |
| 3657 | 49.770 | 42 | 100 | H | 31.5 | 4.62 | 27.95 | 57.923 | 74 | -16.077 | Peak |
| 3657 | 52.12 | 64 | 100 | V | 31.4 | 4.62 | 27.95 | 60.220 | 74 | -13.780 | Peak |
| 3657 | 41.390 | 42 | 100 | H | 31.5 | 4.62 | 27.95 | 49.543 | 54 | -4.457 | Ave |
| 3657 | 44.100 | 64 | 100 | V | 31.4 | 4.62 | 27.95 | 52.200 | 54 | -1.800 | Ave |
| 4570 | 44.610 | 45 | 100 | H | 32.0 | 5.10 | 27.8 | 53.930 | 74 | -20.070 | Peak |
| 4570 | 49.59 | 67 | 109 | V | 31.9 | 5.10 | 27.8 | 58.810 | 74 | -15.190 | Peak |
| 4570 | 32.510 | 45 | 100 | H | 32.0 | 5.10 | 27.8 | 41.830 | 54 | -12.170 | Ave |
| 4570 | 37.710 | 67 | 109 | V | 31.9 | 5.10 | 27.8 | 46.930 | 54 | -7.070 | Ave |

| Frequency (MHz) | S.A. Reading (dB μ V) | Turntable Azimuth (degrees) | Test Antenna | | | Cable Loss (dB) | Pre- Amp. (dB) | Cord. Reading (dB μ V/m) | FCC/IC | | Comments |
|-------------------------|---------------------------------|-----------------------------------|----------------|-------------------|------------------|-----------------------|----------------------|------------------------------------|-------------------------|----------------|----------|
| | | | Height (cm) | Polarity (H/V) | Factor (dB/m) | | | | Limit (dB μ V/m) | Margin (dB) | |
| High Channel 919.80 MHz | | | | | | | | | | | |
| 919.80 | 67.120 | 153 | 100 | H | 22.8 | 10.00 | 0.00 | 99.920 | n/a | n/a | Fun Peak |
| 919.80 | 66.93 | 315 | 100 | V | 22.8 | 10.00 | 0.00 | 99.730 | n/a | n/a | Fun Peak |
| 919.80 | 66.370 | 153 | 100 | H | 22.8 | 10.00 | 0.00 | 99.170 | n/a | n/a | Fun Ave |
| 919.80 | 66.560 | 315 | 100 | V | 22.8 | 10.00 | 0.00 | 99.360 | n/a | n/a | Fun Ave |
| 3680 | 47.750 | 63 | 100 | H | 31.5 | 4.62 | 27.95 | 55.903 | 74 | -18.097 | Peak |
| 3680 | 51.21 | 56 | 100 | V | 31.4 | 4.62 | 27.95 | 59.310 | 74 | -14.690 | Peak |
| 3680 | 38.650 | 63 | 100 | H | 31.5 | 4.62 | 27.95 | 46.803 | 54 | -7.197 | Ave |
| 3680 | 42.700 | 56 | 100 | V | 31.4 | 4.62 | 27.95 | 50.800 | 54 | -3.200 | Ave |
| 4598 | 40.200 | 53 | 100 | H | 32.0 | 5.10 | 27.8 | 49.520 | 74 | -24.480 | Peak |
| 4598 | 42.57 | 88 | 100 | V | 31.9 | 5.10 | 27.8 | 51.790 | 74 | -22.210 | Peak |
| 4598 | 27.850 | 53 | 100 | H | 32.0 | 5.10 | 27.8 | 37.170 | 54 | -16.830 | Ave |
| 4598 | 29.610 | 88 | 100 | V | 31.9 | 5.10 | 27.8 | 38.830 | 54 | -15.170 | Ave |

9 FCC§15.247(a)(2) & IC RSS-210§A8.2– 6 dB & 99% Emission Bandwidth

9.1 Applicable Standard

According to FCC §15.247(a)(2) and IC RSS-210 A8.2 (a), 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: | 23.7 °C |
| Relative Humidity: | 41.2 % |
| ATM Pressure: | 102.2 kPa |

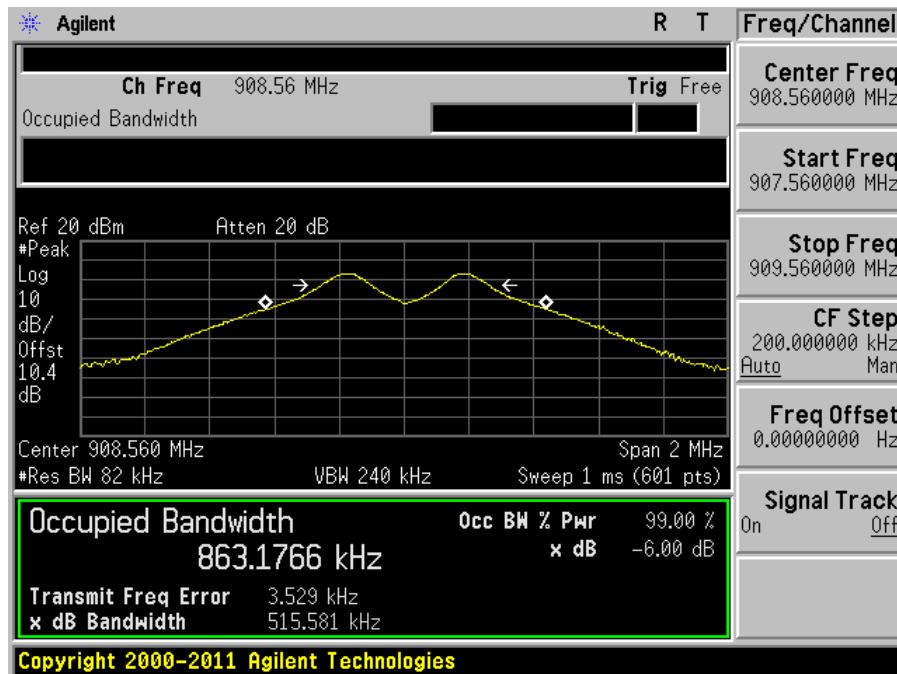
The testing was performed by Quinn Jiang on 2012-06-10 at the RF Site

9.5 Test Results

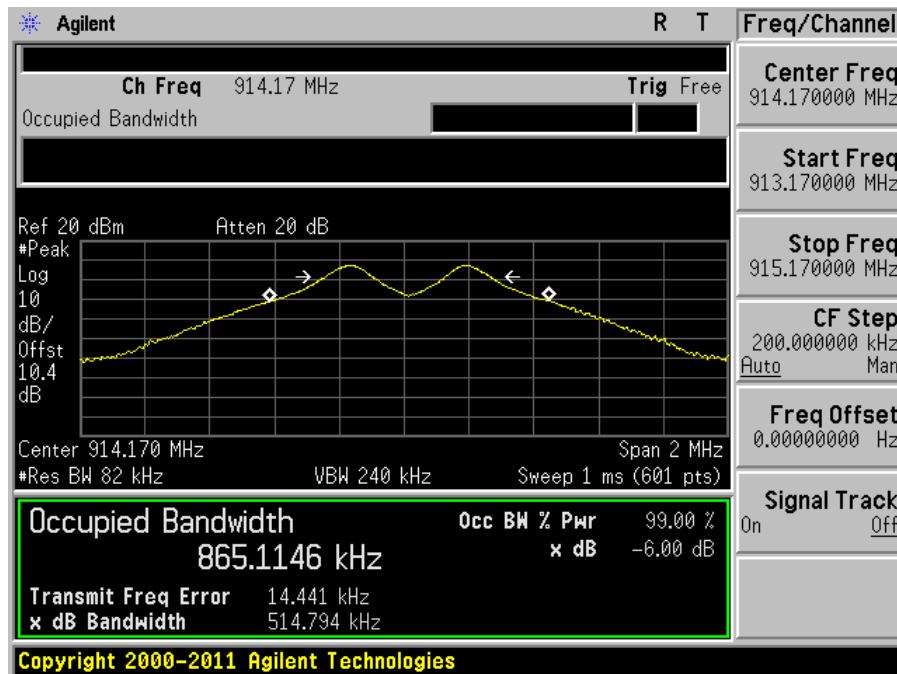
| Channel | Frequency (MHz) | 6 dB Emission Bandwidth (kHz) | 99% Emission Bandwidth (kHz) | Limit (kHz) | Results |
|---------|-----------------|-------------------------------|------------------------------|-------------|-----------|
| Low | 908.56 | 515.581 | 863.1766 | > 500 | Compliant |
| Middle | 914.17 | 514.794 | 865.1146 | > 500 | Compliant |
| High | 919.80 | 520.489 | 837.8574 | > 500 | Compliant |

Please refer to the following plots for detailed test results

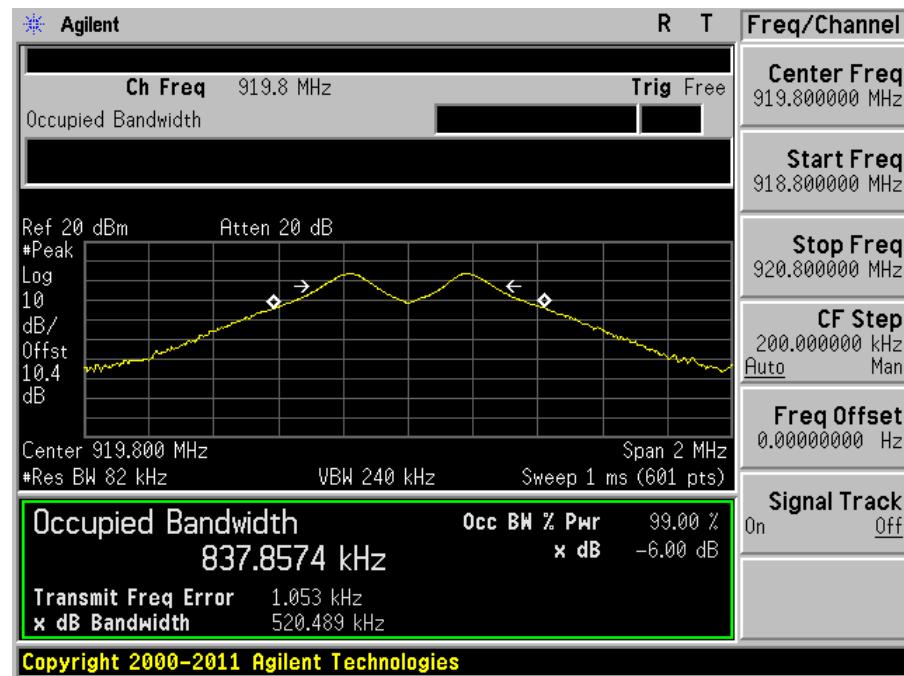
Low Channel: 908.56 MHz



Middle Channel: 914.17 MHz



High Channel: 919.80 MHz



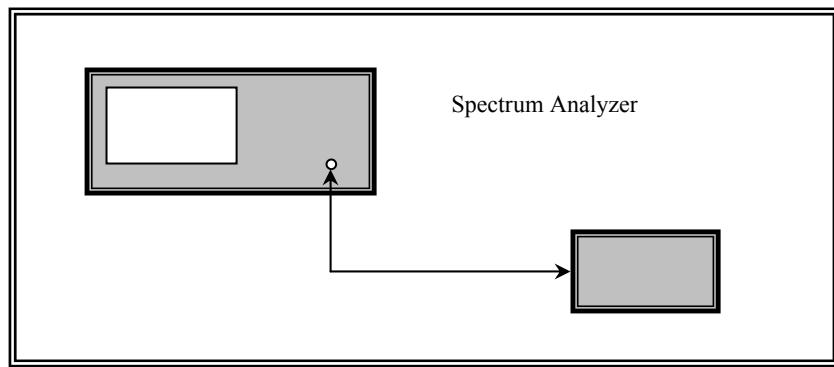
10 FCC §15.247(b) & IC RSS-210 §A8.4 – Peak Output Power Measurement

10.1 Applicable Standard

According to FCC §15.247(b) and IC RSS-210 §A8.4(4), 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

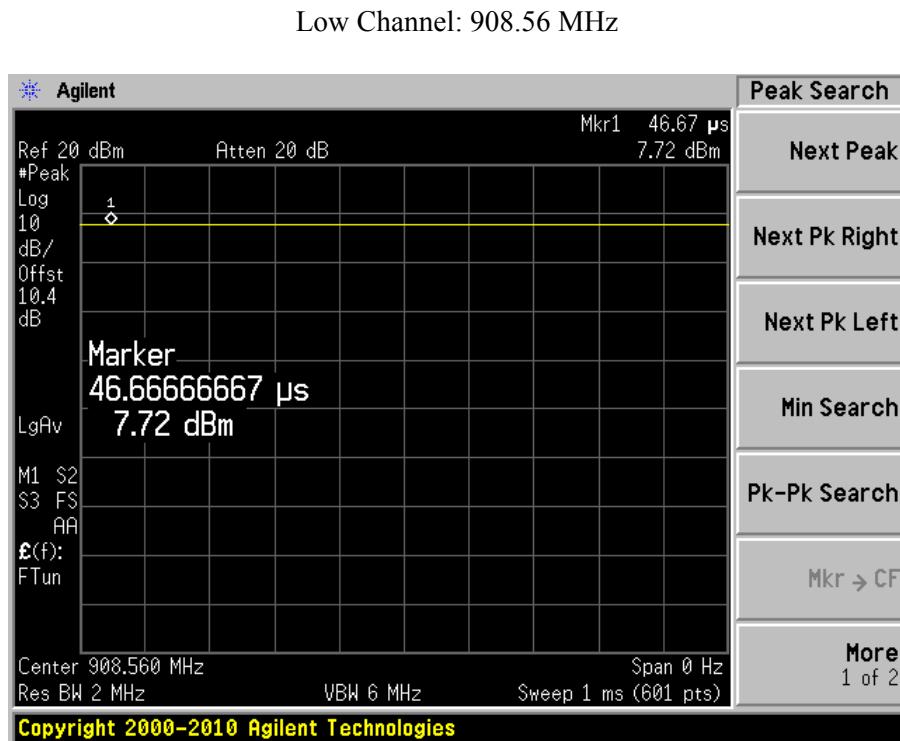
| | |
|---------------------------|-----------|
| Temperature: | 23.7 °C |
| Relative Humidity: | 41.2 % |
| ATM Pressure: | 102.2 kPa |

The testing was performed by Quinn Jiang on 2012-06-10 at the RF Site

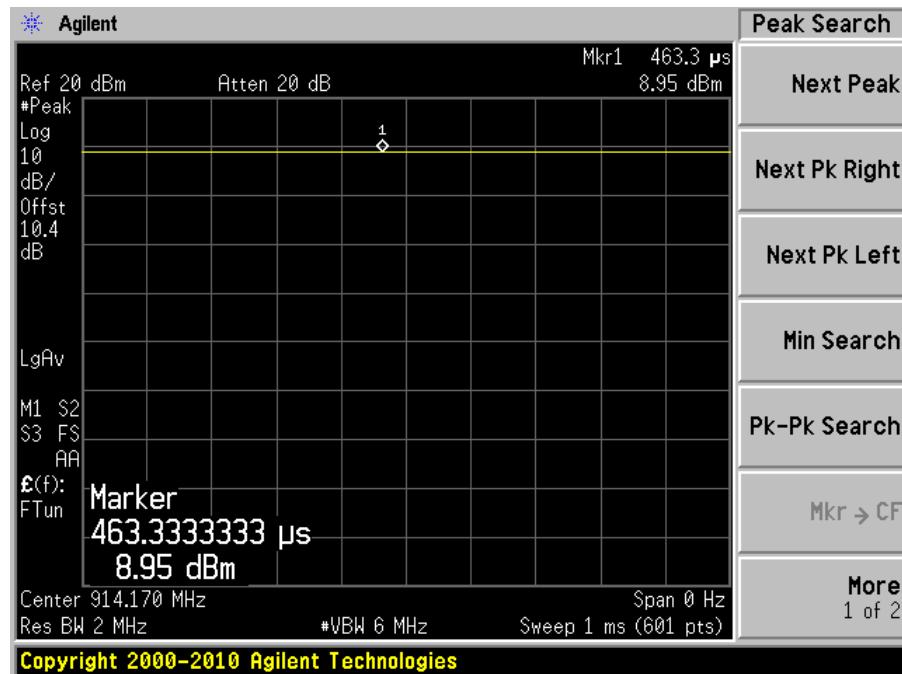
10.5 Test Results

| Channel | Frequency (MHz) | Conducted Output Power (dBm) | FCC/IC Limit (dBm) | Margin (dB) |
|---------|-----------------|------------------------------|--------------------|-------------|
| Low | 908.56 | 7.72 | 30 | -22.28 |
| Middle | 914.17 | 8.95 | 30 | -21.05 |
| High | 919.80 | 7.66 | 30 | -22.34 |

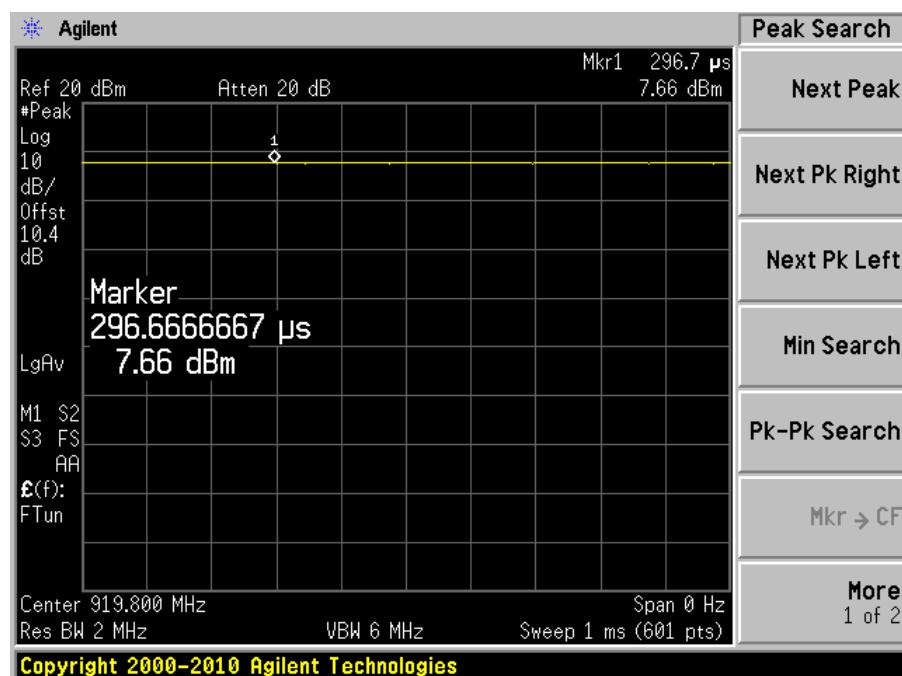
Please refer to the following plots.



Middle Channel: 914.17 MHz



High Channel: 919.80 MHz



11 FCC §15.247(d) & IC RSS-210 §A8.5 – 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).

According to IC Rss-210 §A8.5, in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced 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 section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 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

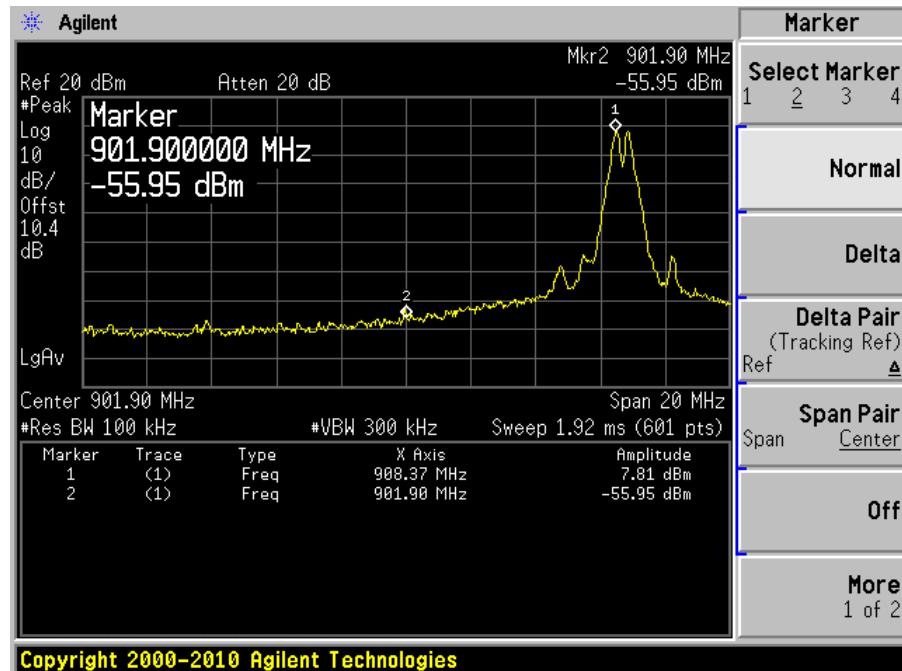
| | |
|---------------------------|-----------|
| Temperature: | 23.7 °C |
| Relative Humidity: | 41.2 % |
| ATM Pressure: | 102.2 kPa |

The testing was performed by Quinn Jiang on 2012-06-10 at the RF Site

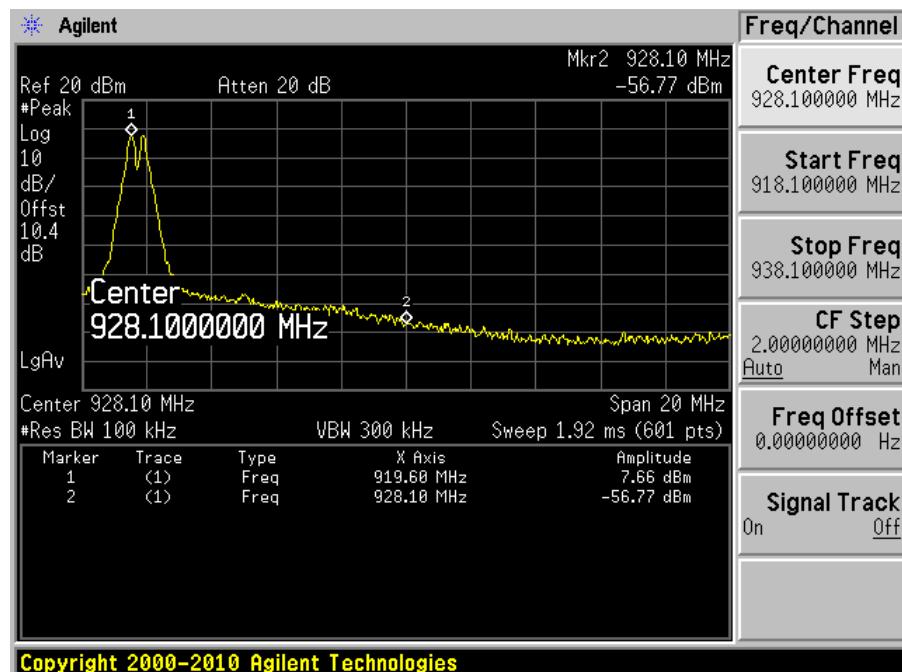
11.5 Test Results

Please refer to following pages for plots of band edge.

Low Channel Band Edge



High Channel Band Edge



12 FCC §15.247(e) & IC RSS-210 §A8.2 (b) – Power Spectral Density

12.1 Applicable Standard

According to FCC §15.247(e) and RSS-210 §A8.2 (b) , 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 \geq 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 = $10\log(3\text{ kHz}/100\text{ kHz}) = -15.2\text{ dB}$.
11. The resulting peak PSD level must be $\leq 8\text{ dBm}$.

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: | 23.7 °C |
| Relative Humidity: | 41.2 % |
| ATM Pressure: | 102.2 kPa |

The testing was performed by Quinn Jiang on 2012-06-10 at the RF Site

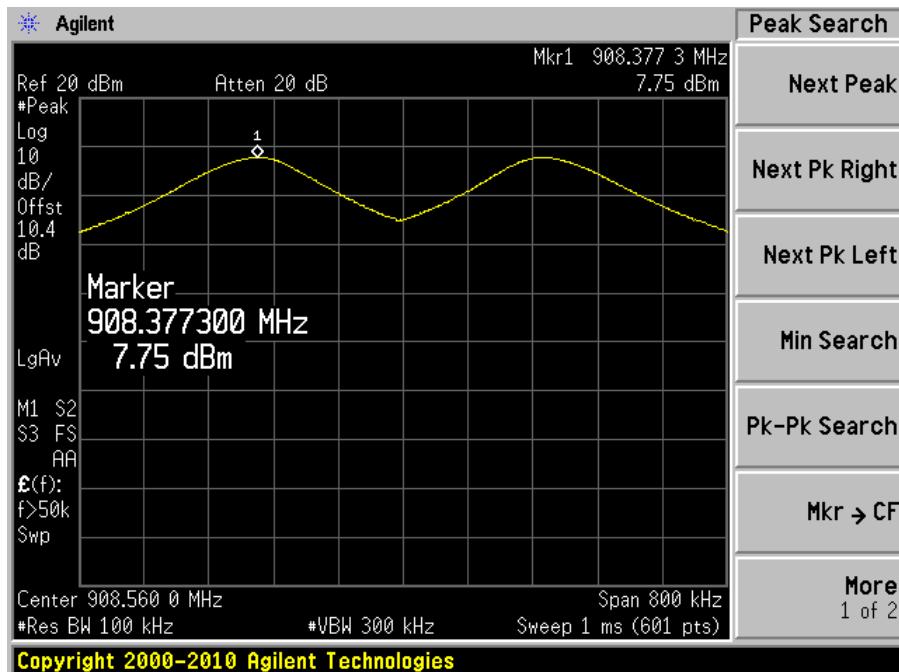
12.5 Test Results

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 $BWCF=10\log(3\text{ kHz}/100\text{ kHz})=-15.2\text{ dB}$.

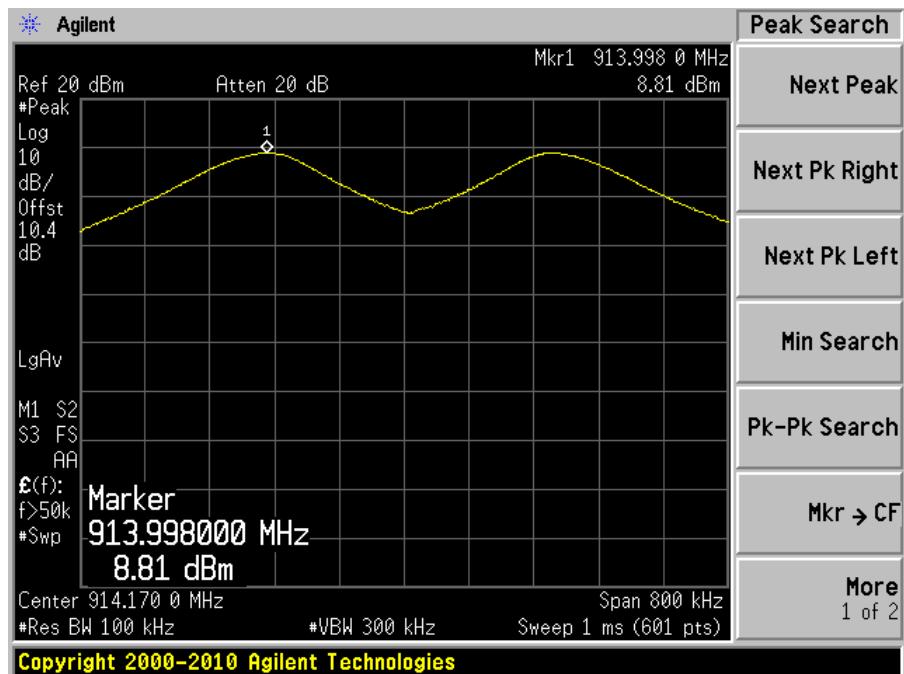
| Channel | Frequency (MHz) | Power Spectral Density (dBm/100 kHz) | Corrected PSD (dBm) | FCC/IC Limit (dBm/3 kHz) | Results |
|---------|-----------------|--------------------------------------|---------------------|--------------------------|-----------|
| Low | 908.56 | 7.75 | -7.45 | 8 | Compliant |
| Mid | 914.17 | 8.81 | -6.39 | 8 | Compliant |
| High | 919.80 | 7.63 | -7.57 | 8 | Compliant |

Please refer to the following plots for detailed test results:

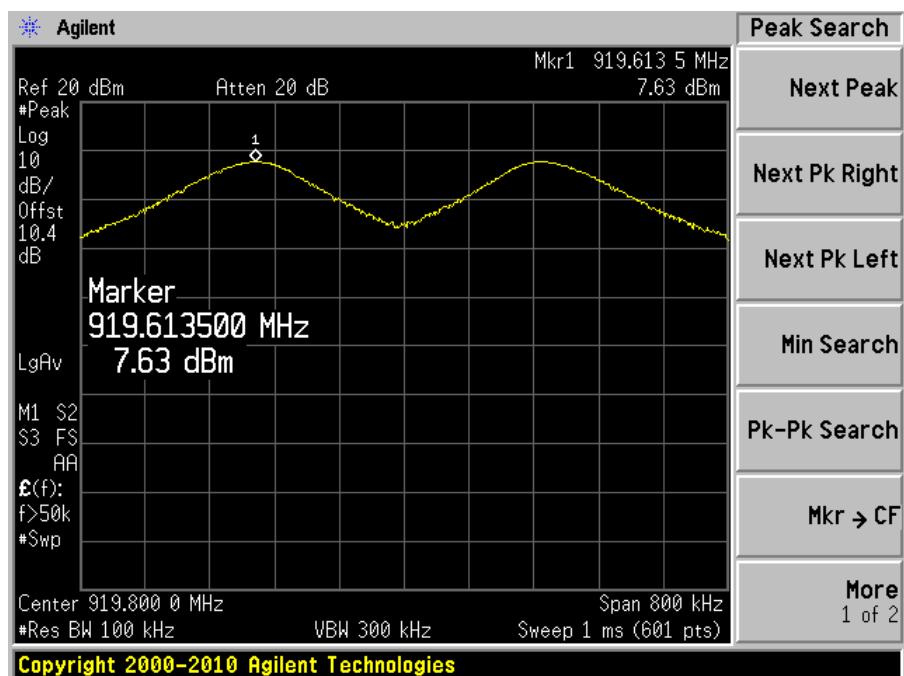
Low Channel: 908.56 MHz



Middle Channel: 914.17 MHz



High Channel: 919.80 MHz



13 IC RSS-210 §2.3 & RSS-Gen §6.1 – Receiver Spurious Radiated Emissions

13.1 Applicable Standard

According to IC RSS-Gen §4.10, the receiver shall be operated in the normal receive mode near the mid-point of the band over which the receiver is designed to operate.

Unless otherwise specified in the applicable RSS, the radiated emission measurement is the standard measurement method (with the device's antenna in place) to measure receiver spurious emissions.

Radiated emission measurements are to be performed using a calibrated open-area test site.

For either method, the search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tuneable or local oscillator frequency, whichever is the higher, without exceeding 40 GHz.

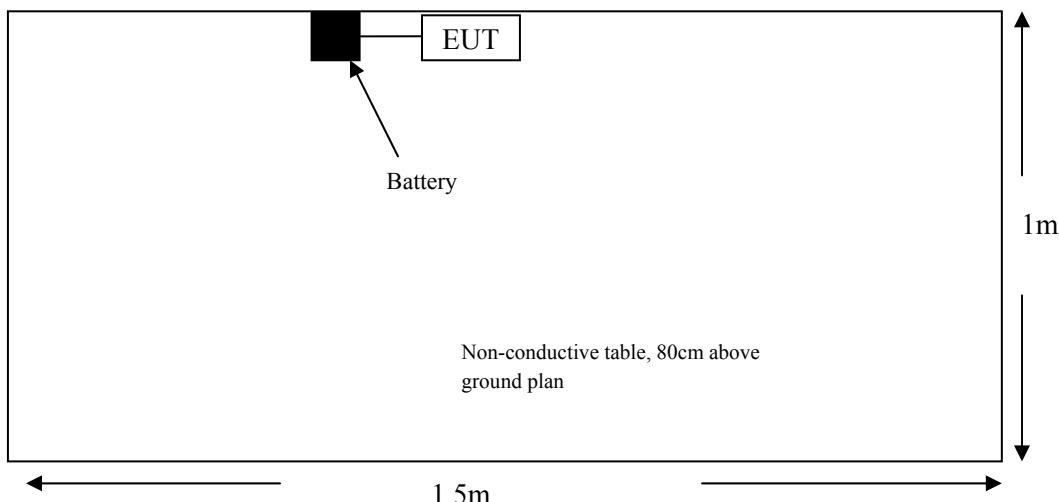
For emissions below 1 GHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector with the same measurement bandwidth as that for CISPR quasi-peak measurements. Above 1 GHz, measurements shall be performed using an average detector and a resolution bandwidth of 300 kHz to 1 MHz.

According to RSS-Gen §6.1, Table 2, the radiated limit of receiver spurious emissions

| Frequency (MHz) | Field Strength (Microvolts/m at 3 meters) |
|-----------------|---|
| 30-88 | 100 |
| 88-216 | 150 |
| 216-960 | 200 |
| Above 960 | 500 |

13.2 Test Setup Block Diagram

The radiated emissions tests were performed in the 3 meter chamber, using the setup in accordance with ANSI C63.4-2009.



13.3 Test Procedure

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT compliance is with all installation combinations.

13.4 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 indicated Amplitude (Ai) reading. The basic equation is as follows:

$$CA = Ai + AF + CL + Atten - Ga$$

For example, a corrected amplitude of 40.3 dBuV/m = Indicated Reading (32.5 dBuV) + Antenna Factor (+23.5dB) + Cable Loss (3.7 dB) + Attenuator (10 dB) - Amplifier Gain (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:

$$\text{Margin} = \text{Corrected Amplitude} - \text{Limit}$$

13.5 Test Equipment Lists 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 | 570400946 | 2012-05-09 |

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

13.6 Test Environmental Conditions

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

The testing was performed by Quinn Jiang on 2012-06-05 at 5m Chamber 3.

13.7 Summary of Test Results

According to the test data, the EUT complied with the with the RSS-210, with the closest margins from the limit listed below:

30 MHz – 10 GHz

| Mode: Receiving | | | |
|-----------------|--------------------|---------------------------------------|---------------|
| Margin (dB) | Frequency (MHz) | Polarization (Horizontal/Vertical) | Range |
| - | - | - | 30 MHz -1 GHz |
| - | - | - | 1 – 10 GHz |

Note: all emissions were on the noise floor/20 dB below the margin

13.8 Test data and Plots

1) 30-1000 MHz, Measured at 3 meters

Quasi-Peak Measurements

| Frequency (MHz) | Corrected Amplitude (dB μ V/m) | Antenna Height (cm) | Antenna Polarity (H/V) | Turntable Azimuth (degrees) | Limit (dB μ V/m) | Margin (dB) |
|--------------------|--|---------------------------|------------------------------|-----------------------------------|-------------------------|----------------|
| - | - | - | - | - | - | Note: |

2) Above 1 GHz Measured at 3 meters

| Frequency (MHz) | S.A. Reading (dB μ V) | Turntable Azimuth (degrees) | Test Antenna | | | Cable Loss (dB) | Pre- Amp. (dB) | Cord. Reading (dB μ V/m) | IC | | Comments |
|--------------------|---------------------------------|-----------------------------------|----------------|-------------------|------------------|-----------------------|----------------------|------------------------------------|-------------------------|----------------|----------|
| | | | Height (cm) | Polarity (H/V) | Factor (dB/m) | | | | Limit (dB μ V/m) | Margin (dB) | |
| - | - | - | - | - | - | - | - | - | - | - | Note |

Note: all emissions were on the noise floor/20 dB below the margin