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

TEST AND MEASUREMENT REPORT

For

Trimble Navigation Ltd.

935 Stewart Drive,

Sunnyvale, CA 94085, USA

FCC ID: JUP-9091191
IC: 1756A-9091191

Report Type:	**Product Type:**
Original Report	GNSS Receiver

Prepared By:	Chen Ge Test Engineer
Report Number:	R14073110-247 AC900
Report Date:	2014-12-12
Reviewed By:	Suhaila Khushzad Engineering Manager

Bay Area Compliance Laboratories Corp.
1274 Anvilwood Avenue,
Sunnyvale, CA 94089, USA
Tel: (408) 732-9162
Fax: (408) 732-9164

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R14073110-247 AC900	Initial	2014-12-12

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Trimble Navigation Ltd,* , and their product model: *R10*; *FCC ID: JUP-9091191*, and with *IC: 1756A-9091191* , or the "EUT" as referred to in this report. The EUT is a GNSS Receiver.

1.2 Mechanical Description of EUT

The EUT measures approximately 120 mm (W) x 120 mm (L) x 150 mm (H) and weighs 200 g.

The test data gathered are from typical production sample, S/N: 90911 provided by the customer.

1.3 Objective

This report is prepared on behalf of *Trimble Navigation Ltd.* in accordance with Part 2, Subpart J, and Part 15, Subparts B and C of the Federal Communication Commission's 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 AC Line Conducted Emissions, Output Power, Antenna Requirements, 6 dB Bandwidth, Power Spectral Density, 100 kHz Bandwidth of Band Edges Measurement, and Conducted and Radiated Spurious Emissions.

1.4 Related Submittal(s)/Grant(s)

N/A

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.

The following calculation follows the procedures as set forth in clause 7.2.3, ETSI TR 100 028-1 V1.4.1 (2001-12), the expression of Uncertainty in Radiated RF Testing is in accordance to ISO/IEC 17025 and TR 100 028-1 V1.4.1 (2001-12).

The expanded Measurement Uncertainty value having a confidence factor of 95%, is within a range of 5.48 dB.

This means that the value of conducted RF carrier power test will be within +/- 2.74 dB of the measuring radiated emissions power versus the expected value.

The expected value is defined as the power at the antenna of the Transmitter under Test.

1.7 Test Facility

Bay Area Compliance Laboratories Corp. (BACL) is:
1- An independent Commercial Test Laboratory accredited to **ISO 17025: 2005** by **A2LA**, in the fields of: Electromagnetic Compatibility & Telecommunications covering Emissions, Immunity, Radio, RF Exposure, Safety and Telecom. This includes NEBS (Network Equipment Building System), Wireless RF, Telecommunications Terminal Equipment (TTE); Network Equipment; Information Technology Equipment (ITE); Medical Electrical Equipment; Industrial, Commercial, and Medical Test Equipment; Professional Audio and Video Equipment; Electronic (Digital) Products; Industrial and Scientific Instruments; Cabled Distribution Systems and Energy Efficiency Lighting.

2- An ENERGY STAR Recognized Laboratory, for the LM80 Testing, a wide variety of Luminaires and Computers.

3- A NIST Designated Phase-I and Phase-II CAB including: ACMA (Australian Communication and Media Authority), BSMI (Bureau of Standards, Metrology and Inspection of Taiwan), IDA (Infocomm Development Authority of Singapore), IC(Industry Canada), Korea (Ministry of Communications Radio Research Laboratory), NCC (Formerly DGT; Directorate General of Telecommunication of Chinese Taipei) OFTA (Office of the Telecommunications Authority of Hong Kong), Vietnam, VCCI - Voluntary Control Council for Interference of Japan and a designated EU CAB (Conformity Assessment Body) (Notified Body) for the EMC and R&TTE Directives.

4- A Product Certification Body accredited to **ISO Guide 65: 1996** by **A2LA** to certify:
1- Unlicensed, Licensed radio frequency devices and Telephone Terminal Equipment for the FCC. Scope A1, A2, A3, A4, B1, B2, B3, B4 & C.
2. Radio Standards Specifications (RSS) in the Category I Equipment Standards List and All Broadcasting Technical Standards (BETS) in Category I Equipment Standards List for Industry Canada.
3. Radio Communication Equipment for Singapore.
4. Radio Equipment Specifications, GMDSS Marine Radio Equipment Specifications, and Fixed Network Equipment Specifications for Hong Kong.
5. Japan MIC Telecommunication Business Law (A1, A2) and Radio Law (B1, B2 and B3).
6. Audio/Video, Battery Charging Systems, Computers, Displays, Enterprise Servers, Imaging Equipment, Set-Top Boxes, Telephony, Televisions, Ceiling Fans, CFLs (Including GU24s),Decorative Light Strings, Integral LED Lamps, Luminaires, Residential Ventilating Fans.

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 C63.4-2009, 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 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 software used, Rajant BC, Commander v11.4.1, provided by the client and was verified by Chen Ge to comply with the standard requirements being tested against.

2.3 Special Equipment

There were no special accessories which were required, included, or intended for use with the EUT during these tests.

2.4 Equipment Modifications

No modifications were made to the EUT.

2.5 Local Support Equipment

Manufacturer	Description	Model	Serial Number
Dell	Laptop	PP18L	KX355 A01

2.6 External I/O Cabling List and Details

Cable Description	Length (m)	From	To
Trimble 82725-00 test cable	>2m	EUT	Power supply

2.7 Power Supply List and Details

Manufacturer	Description	Model	Serial Number
Delta Electronics, Inc.	AC/DC Adapter	ADP-65JH	B15W01900016

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 Requirements	Compliant
FCC §15.207 (a) IC RSS-Gen §7.2.4	AC Line Conducted Emissions	Compliant
FCC §15.205, §15.209, §15.247(d) IC RSS-210 §2.2, §A8.5	Restricted Bands, Spurious Radiated Emissions	Compliant
FCC §15.247 (a)(1) IC RSS-210 §A8.1	20 dB Channel Bandwidth	Compliant
FCC §15.247(a) IC RSS-210 §A8.4	Maximum Peak Output Power	Compliant
FCC §15.247(d) IC RSS-210 §A8.5	Band Edge	Compliant
FCC §15.247 (a)(1) IC RSS-210 §A8.1(b)	Hopping Channel Separation	Compliant
FCC §15.247 (a)(1) IC RSS-210 §A8.1(d)	Dwell Time	Compliant
FCC §15.247(b)(1) IC RSS-210 §A8.1	Number of Hopping Channels	Compliant

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

4.1 Applicable Standard

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

Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (minutes)
Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	* (100)	30
1.34-30	824/f	2.19/f	* ($180/f^2$)	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	f/1500	30
1500-100,000	/	/	1.0	30

f = frequency in MHz
* = Plane-wave equivalent power density

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 4 section 4.2, 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	$0.158\ f^{0.5}$	$4.21 \times 10\ -4\ f^{0.5}$	$6.67 \times 10^{-5}\ f$	$616000 / f^{1.2}$

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

Note: The EUT contains the following modules which can transmit simultaneously.

902-928 MHz:

Maximum peak output power at antenna input terminal (dBm):	29.96
Maximum peak output power at antenna input terminal (mW):	990.83
Prediction distance (cm):	50
Prediction frequency (MHz):	927.6
Maximum Antenna Gain, typical (dBi):	3
Maximum Antenna Gain (numeric):	1.99
Power density of prediction frequency at 50.0 cm (mW/cm^2):	0.0629
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.6184

MPE Percentage: 0.0629/0.6184*100% = 10.17%

2.4 GHz Wi-Fi:

Maximum peak output power at antenna input terminal (dBm):	14.85
Maximum peak output power at antenna input terminal (mW):	30.549
Prediction distance (cm):	50
Prediction frequency (MHz):	2412
Maximum Antenna Gain, typical (dBi):	4
Maximum Antenna Gain (numeric):	2.511
Power density of prediction frequency at 50.0 cm (mW/cm^2):	0.02443
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

MPE Percentage: 0.002443/1.0*100% = 0.24%

2.4 GHz BT:

Maximum peak output power at antenna input terminal (dBm):	2.16
Maximum peak output power at antenna input terminal (mW):	1.644
Prediction distance (cm):	50
Prediction frequency (MHz):	2402
Maximum Antenna Gain, typical (dBi):	4
Maximum Antenna Gain (numeric):	2.511
Power density of prediction frequency at 50.0 cm (mW/cm^2):	0.000131
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

MPE Percentage: 0.000131/1.0*100% = 0.01%

Cellular Band:

Maximum peak output power at antenna input terminal (dBm):	30.49
Maximum peak output power at antenna input terminal (mW):	1119.438
Prediction distance (cm):	50
Prediction frequency (MHz):	824.2
Maximum Antenna Gain, typical (dBi):	3.92
Maximum Antenna Gain (numeric):	2.466
Power density of prediction frequency at 50.0 cm (mW/cm^2):	0.0878
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.549

MPE Percentage: 0.0878/0.549*100% = 15.99%

Co-Location MPE: 10.17%+0.24%+0.013%+15.99%=26.413%.

The device meets FCC/IC MPE at 20 distance.

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 Antenna List

Manufacturers	Antenna Type/Pattern	Antenna Gain (dBi)
Trimble	Omni rubber duck	3

The antenna used an external antenna; therefore it complies with the antenna requirement.

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 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

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

**Decreases with the logarithm of the frequency.*

6.2 Test Setup

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

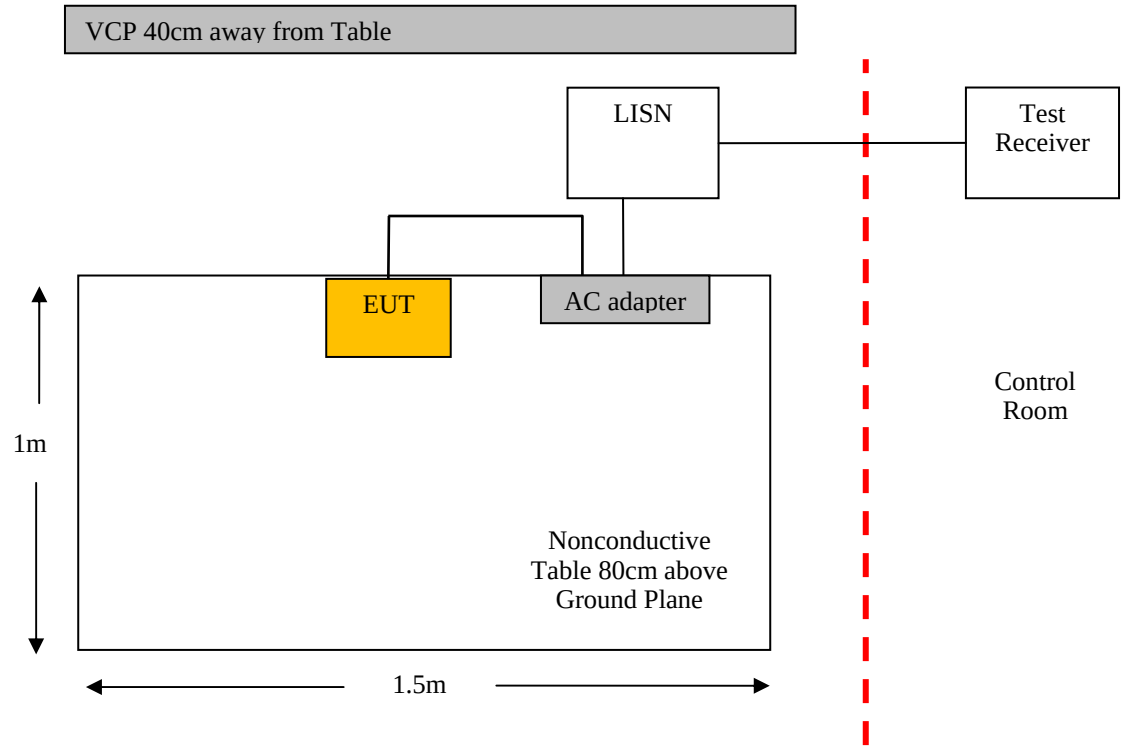
6.3 Test Procedure

During the conducted emissions test, the power adapter of the EUT was connected to a power strip on the table which is then connected to the LISN.

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

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

6.4 Test Setup Block Diagram



6.5 Corrected Amplitude & Margin Calculation

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

CA = Ai + CL + Atten

For example, a corrected amplitude of 46.2 dBuV = Indicated Reading (32.5 dBuV) + 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:

Margin = Corrected Amplitude - Limit

6.6 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100044	2013-10-29	1 year
Solar Electronics	LISN	9252-50-R-24-N	511205	2014-06-25	1 year
TTE	Filter, High Pass	H985-150k-50-720N	M1149	2014-05-30	1 year

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:	23 °C
Relative Humidity:	46 %
ATM Pressure:	101.58 kPa

The testing was performed by Chen Ge on 2014-10-23 at Chamber 3.

6.8 Summary of Test Results

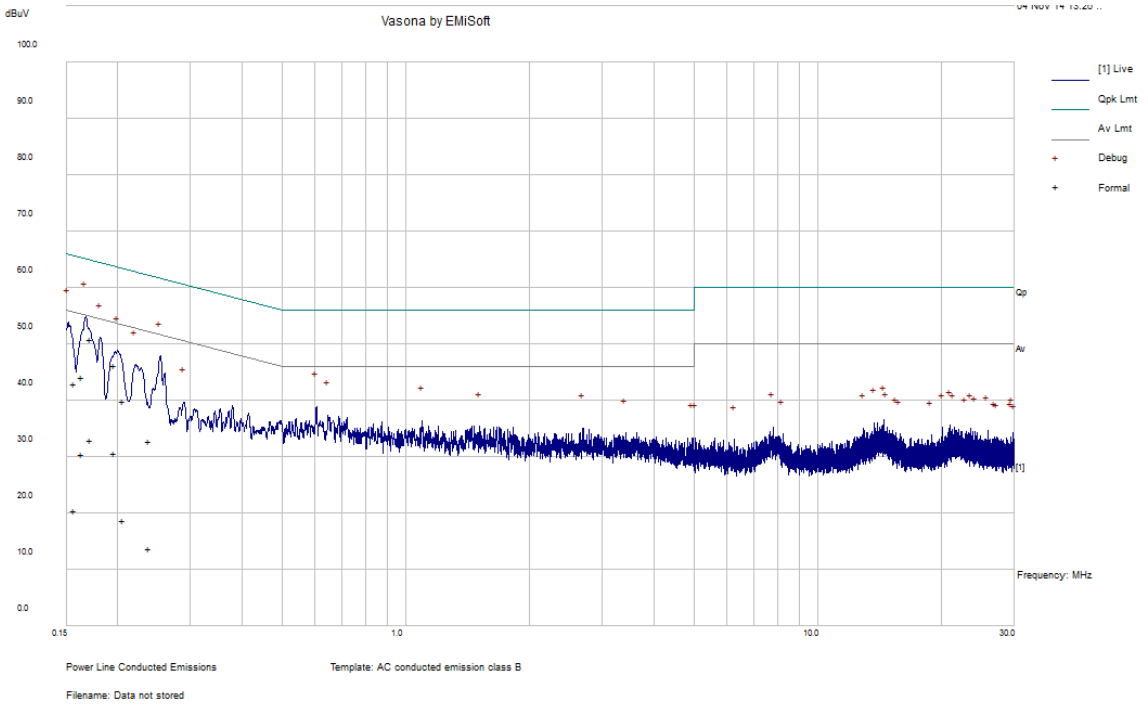
According to the recorded data in following table, the EUT complied with the FCC/IC standard's conducted emissions limits, with the margin reading of:

Connection: AC/DC Adapter connected to 120 V/60 Hz, AC			
Margin (dB)	**Frequency (MHz)**	**Conductor Mode (Line/Neutral)**	**Range (MHz)**
-14.06	0.17196	Line	0.15 to 30 MHz

6.9 Conducted Emissions Test Plots and Data

Worst case – Low channel

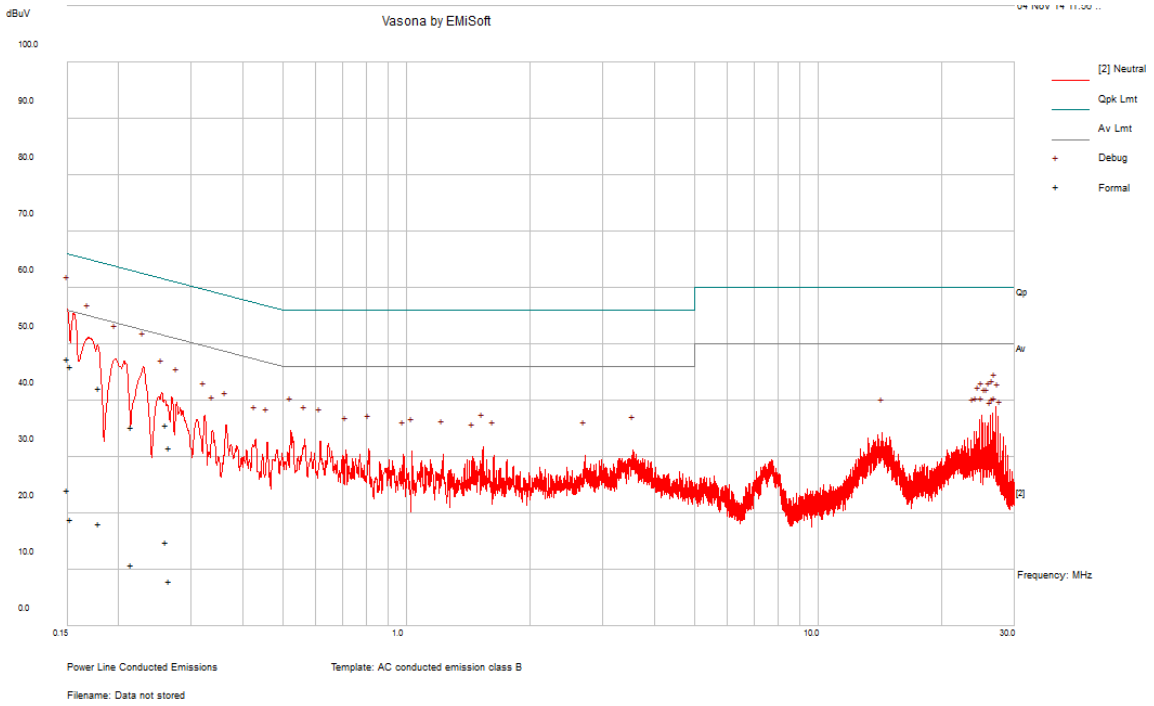
120 V, 60 Hz – Line



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.17196	50.81	Line	64.87	-14.06	QP
0.157304	43.02	Line	65.61	-22.58	QP
0.16367	44.22	Line	65.28	-21.05	QP
0.237579	32.85	Line	62.18	-29.33	QP
0.196082	46.36	Line	63.77	-17.41	QP
0.20561	39.98	Line	63.38	-23.4	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.17196	33.1	Line	54.87	-21.77	Ave.
0.157304	20.56	Line	55.61	-35.05	Ave.
0.16367	30.51	Line	55.28	-24.76	Ave.
0.237579	13.74	Line	52.18	-38.44	Ave.
0.196082	30.7	Line	53.77	-23.07	Ave.
0.20561	18.83	Line	53.38	-34.55	Ave.

120 V, 60 Hz – Neutral



Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.150214	47.34	Neutral	65.99	-18.65	QP
0.152729	46.16	Neutral	65.85	-19.69	QP
0.178776	42.19	Neutral	64.54	-22.36	QP
0.214904	35.35	Neutral	63.01	-27.66	QP
0.261048	35.68	Neutral	61.4	-25.72	QP
0.26555	31.67	Neutral	61.26	-29.59	QP

Frequency (MHz)	Corrected Amplitude (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)	Detector (QP/Ave.)
0.150214	24.11	Neutral	55.99	-31.88	Ave.
0.152729	19.07	Neutral	55.85	-36.78	Ave.
0.178776	18.13	Neutral	54.54	-36.41	Ave.
0.214904	10.96	Neutral	53.01	-42.05	Ave.
0.261048	15.03	Neutral	51.4	-36.37	Ave.
0.26555	7.98	Neutral	51.26	-43.28	Ave.

7 FCC §15.209, §15.247(d) & IC RSS-210 §A8.5 – Spurious Radiated Emissions

7.1 Applicable Standard

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

As per FCC §15.209(a) and RSS-210: Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

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

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

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

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

As per IC RSS-210 A8.5 Out-of-band Emissions, 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.

7.2 Test Setup

The radiated emissions tests were performed in the 5-meter Chamber, using the setup in accordance with ANSI C63.4-2009. The specification used was the FCC 15 Subpart C and IC RSS-210 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.

7.3 Test Procedure

The measurements are based on FCC KDB 558074 D01 DTS Measured Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 section 11: Emissions in non-restricted frequency bands and section 12: Emissions in restricted frequency bands. As well as ANSI C63.4: 2009 as described below:

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

7.4 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:

Margin = Corrected Amplitude - Limit

7.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2014-08-29	1 year
Sunol Sciences	Controller, System	SC104V	122303-1	Cal. Not required	N/A
Sunol Sciences	Antenna, Biconi-Log	JB3	A020106-2	2014-08-13	1 year
Hewlett Packard	Amplifier, Pre	8447D	2944A06639	2014-06-09	1 year
Hewlett Packard	Amplifier, Pre	8449B	3147A00400	2014-02-04	1 year
A.R.A.	Antenna, Horn	DRG-118/A	1132	2014-01-30	1 year
Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100338	2014-01-20	1 year

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

7.6 Test Environmental Conditions

Temperature:	21 °C
Relative Humidity:	42 %
ATM Pressure:	101.44 kPa

The testing was performed by Chen Ge on 2014-10-22 at the RF site.

7.7 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:

30-1000 MHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel**
-13.13	241.921	Horizontal	Low

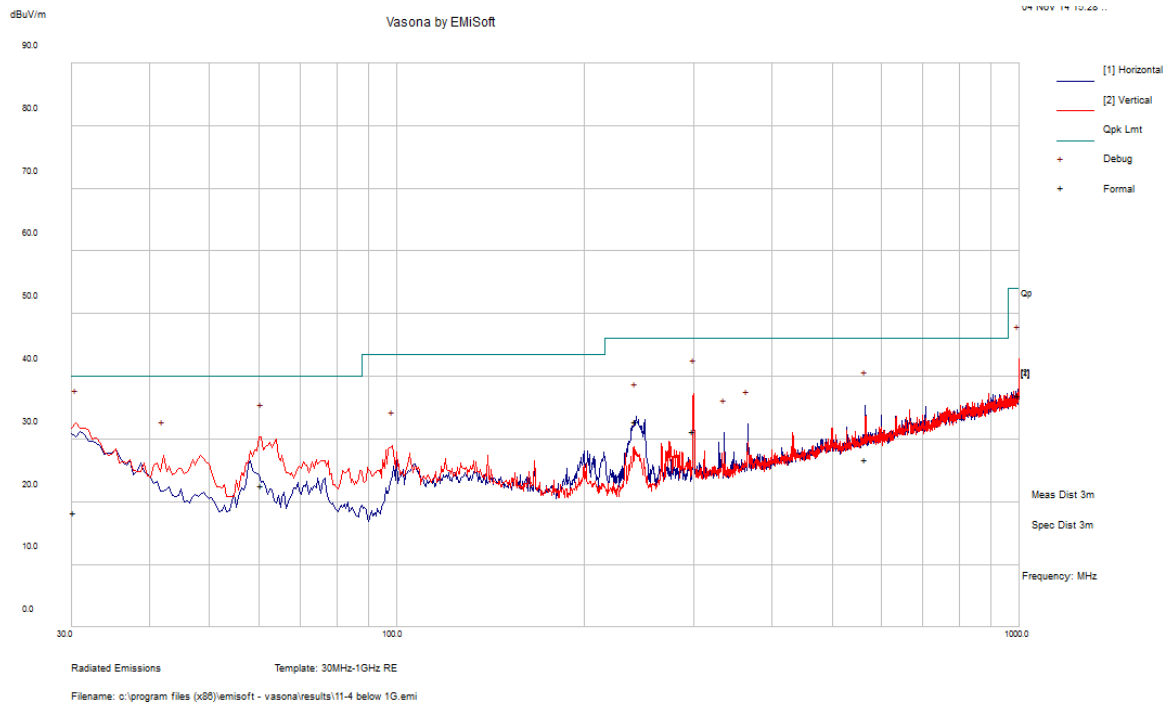
1-10 GHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel**
-18.638	3661.6	Horizontal	Middle

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

7.8 Radiated Emissions Test Data and Plots

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



Frequency (MHz)	Cord. Reading (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)	Comment (PK/QP/Ave)
30.27225	18.34	291	V	157	40	-21.66	QP
299.617	31.3	162	V	74	46	-14.7	QP
60.69425	22.54	100	V	66	40	-17.46	QP
566.1093	26.75	338	H	281	46	-19.25	QP
997.7058	36.97	186	V	63	54	-17.03	QP
241.921	32.87	109	H	177	46	-13.13	QP

2) 900 MHz–10 GHz, Measured at 3 meters

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments (PK/Ave)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 902.6 MHz, measured at 3 meters											
902.6	122.65	0	162	V	23.1	0.52	24.52	121.75	-	-	Peak
902.6	123.84	35	137	H	23.1	0.52	24.52	122.94	-	-	Peak
902.6	116.25	0	162	V	23.1	0.52	24.52	115.35	-	-	Ave
902.6	116.47	35	137	H	23.1	0.52	24.52	115.57	-	-	Ave
1805.2	68.33	71	140	V	26.065	3.35	34.29	63.455	101.75	-38.295	Peak
1805.2	55.62	121	133	H	26.065	3.35	34.29	50.745	102.94	-52.195	Peak
1805.2	60.15	71	140	V	26.065	3.35	34.29	55.275	95.35	-40.075	Ave
1805.2	42.25	121	133	H	26.065	3.35	34.29	37.375	95.57	-58.195	Ave
2707.8	49.3	0	100	V	29.717	3.78	34.39	48.407	74	-25.593	Peak
2707.8	49.41	0	120	H	29.717	3.78	34.39	48.517	74	-25.483	Peak
2707.8	35.25	0	100	V	29.717	3.78	34.39	34.357	54	-19.643	Ave
2707.8	35.21	0	120	H	29.717	3.78	34.39	34.317	54	-19.683	Ave
3610.4	48.48	0	100	V	31.132	4.4	34.9	49.112	74	-24.888	Peak
3610.4	48.39	0	100	H	31.132	4.4	34.9	49.022	74	-24.978	Peak
3610.4	34.22	0	100	V	31.132	4.4	34.9	34.852	54	-19.148	Ave
3610.4	34.68	0	100	H	31.132	4.4	34.9	35.312	54	-18.688	Ave
Middle Channel 915.4 MHz, measured at 3 meters											
915.4	123.14	28	165	V	23.1	0.52	24.52	122.24	-	-	Peak
915.4	123.74	0	129	H	23.1	0.52	24.52	122.84	-	-	Peak
915.4	117.96	28	165	V	23.1	0.52	24.52	117.06	-	-	Ave
915.4	118.64	0	129	H	23.1	0.52	24.52	117.74	-	-	Ave
1830.8	67.51	75	130	V	26.065	3.35	34.29	62.635	102.24	-39.605	Peak
1830.8	56.96	48	122	H	26.065	3.35	34.29	52.085	102.84	-50.755	Peak
1830.8	58.54	75	130	V	26.065	3.35	34.29	53.665	97.06	-43.395	Ave
1830.8	48.68	48	122	H	26.065	3.35	34.29	43.805	97.74	-53.935	Ave
2746.2	49.55	0	100	V	29.717	3.78	34.42	48.627	74	-25.373	Peak
2746.2	49.63	0	100	H	29.717	3.78	34.42	48.707	74	-25.293	Peak
2746.2	35.78	0	100	V	29.717	3.78	34.42	34.857	54	-19.143	Ave
2746.2	35.69	0	100	H	29.717	3.78	34.42	34.767	54	-19.233	Ave
3661.6	47.41	0	100	V	31.132	4.4	34.85	48.092	74	-25.908	Peak
3661.6	47.36	0	100	H	31.132	4.4	34.85	48.042	74	-25.958	Peak
3661.6	34.25	0	100	V	31.132	4.4	34.85	34.932	54	-19.068	Ave
3661.6	34.68	0	100	H	31.132	4.4	34.85	35.362	54	-18.638	Ave

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	FCC/IC		Comments (PK/Ave)
			Height (cm)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
High Channel 919.65 MHz, measured at 3 meters											
927.6	124.93	0	167	V	23.1	0.52	24.52	124.03	-	-	Peak
927.6	123.01	0	128	H	23.1	0.52	24.52	122.11	-	-	Peak
927.6	119.02	0	167	V	23.1	0.52	24.52	118.12	-	-	Ave
927.6	117.34	0	128	H	23.1	0.52	24.52	116.44	-	-	Ave
1855.2	63.46	327	141	V	26.065	3.35	34.42	58.455	104.03	-45.575	Peak
1855.2	62.15	125	141	H	26.065	3.35	34.42	57.145	102.11	-44.965	Peak
1855.2	55.82	327	141	V	26.065	3.35	34.42	50.815	98.12	-47.305	Ave
1855.2	55.68	125	141	H	26.065	3.35	34.42	50.675	96.44	-45.765	Ave
2782.8	51.25	0	100	V	29.717	3.78	34.44	50.307	74	-23.693	Peak
2782.8	51.39	0	100	H	29.717	3.78	34.44	50.447	74	-23.553	Peak
2782.8	35.61	0	100	V	29.717	3.78	34.44	34.667	54	-19.333	Ave
2782.8	35.78	0	100	H	29.717	3.78	34.44	34.837	54	-19.163	Ave
3710.4	46.25	0	100	V	31.074	4.4	34.84	46.884	74	-27.116	Peak
3710.4	46.38	0	100	H	31.074	4.4	34.84	47.014	74	-26.986	Peak
3710.4	32.18	0	100	V	31.074	4.4	34.84	32.814	54	-21.186	Ave
3710.4	32.69	0	100	H	31.074	4.4	34.84	33.324	54	-20.676	Ave

Note 1: *All other spurious emissions at noise floor level.*

8 FCC §15.247(a) & IC RSS-210 §A8.1 – Hopping Channel Bandwidth

8.1 Applicable Standard

According to FCC§15.247(a) (l) & RSS-210 §A8.1 (a), the maximum 20 dB bandwidth of the hopping channel shall be presented.

8.2 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 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.

8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2014-08-29	1 year

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

8.4 Test Environmental Conditions

Temperature:	23 °C
Relative Humidity:	46 %
ATM Pressure:	101.58 kPa

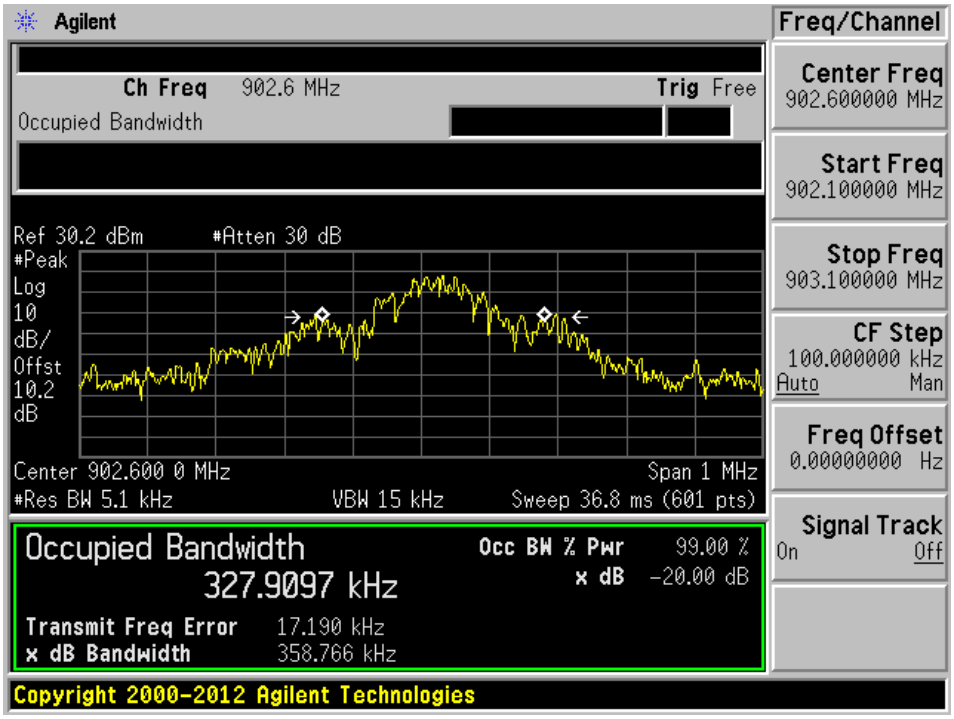
The testing was performed by Chen Ge on 2014-10-22 at the RF site.

8.5 Test Results

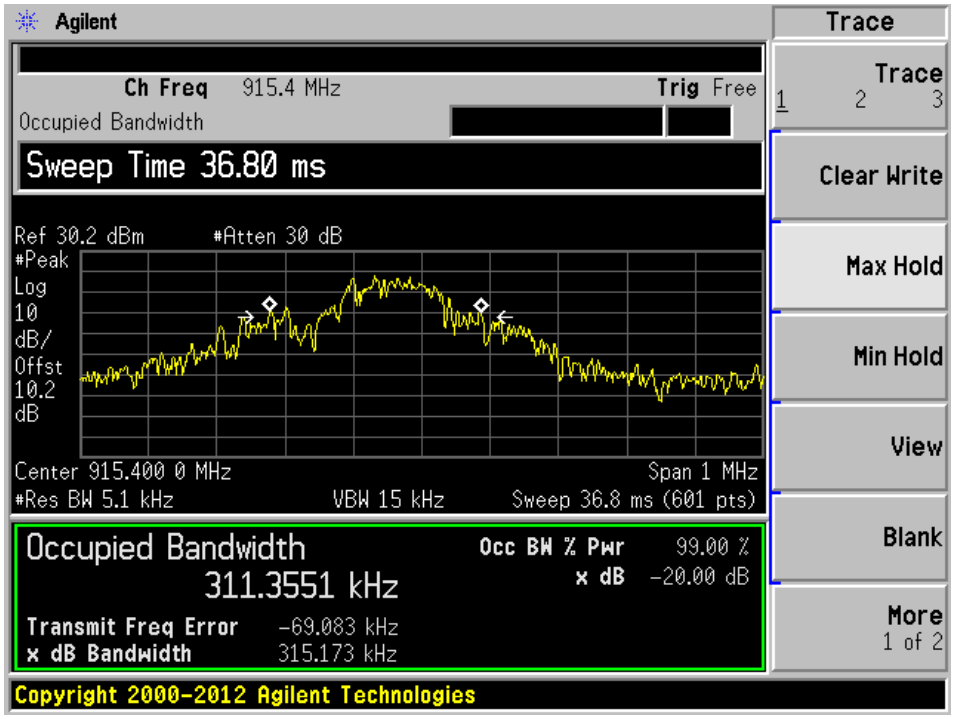
Channel	Frequency (MHz)	20 dB Emission Bandwidth (kHz)	99% Emission Bandwidth (kHz)
Low	902.6	358.766	327.9097
Middle 1	915.4	315.173	311.3551
Middle 2	922.0	375.610	346.3872
High	927.6	356.671	354.3078

Please refer to the following plots for detailed test results.

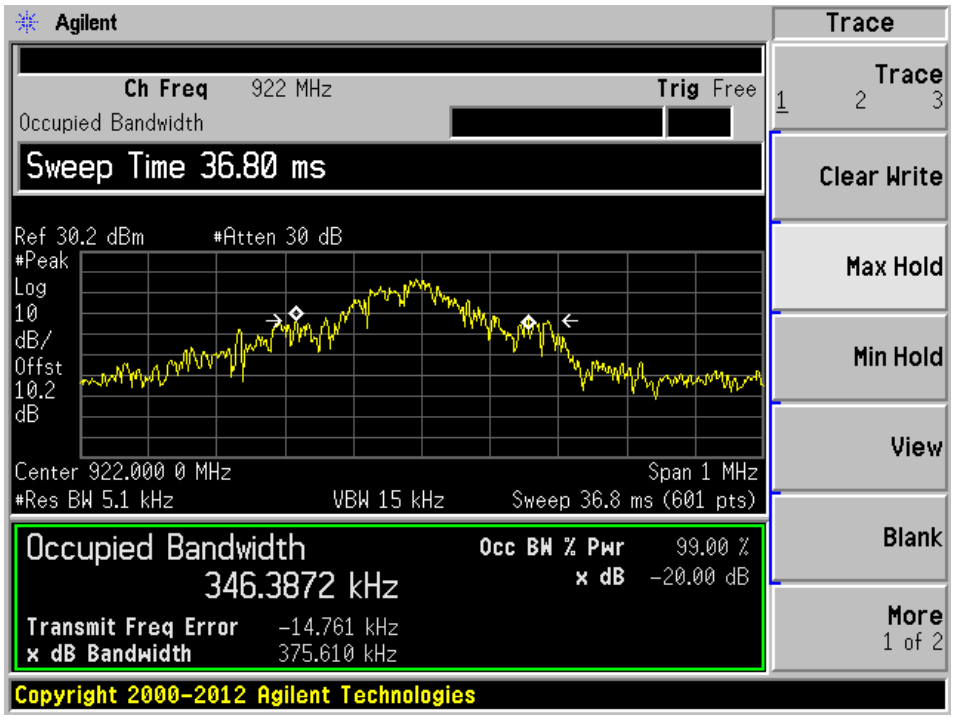
Low Channel



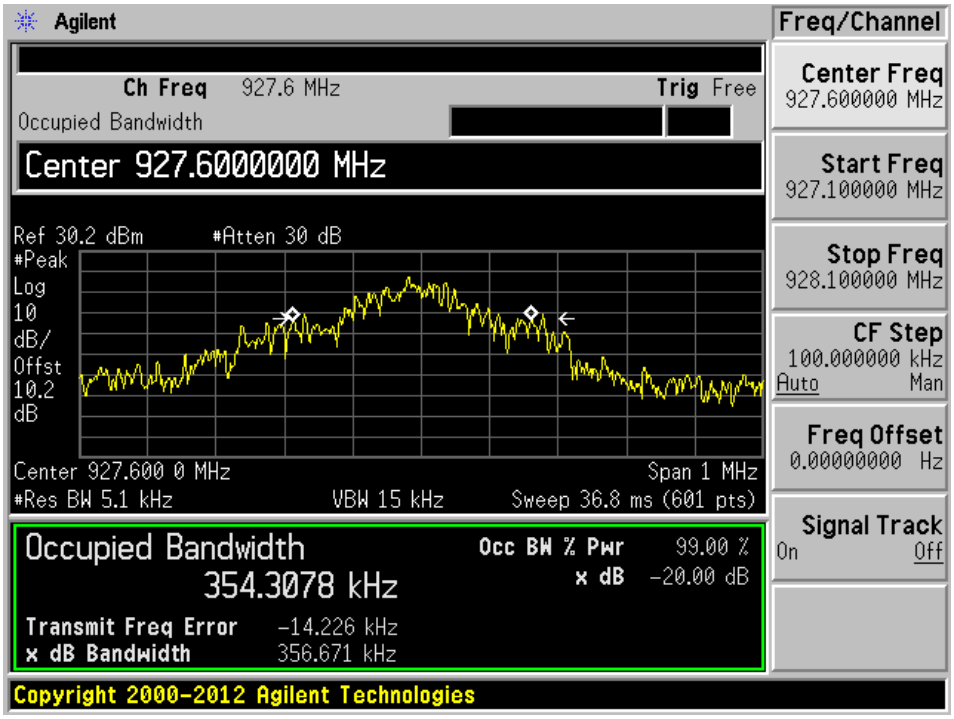
Middle Channel 1



Middle Channel 2



High Channel



9 FCC §15.247(a) & IC RSS-210 §A8.1 – Hopping Channel Separation

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.

9.2 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.

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2014-08-29	1 year

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° C
Relative Humidity:	46 %
ATM Pressure:	101.58 kPa

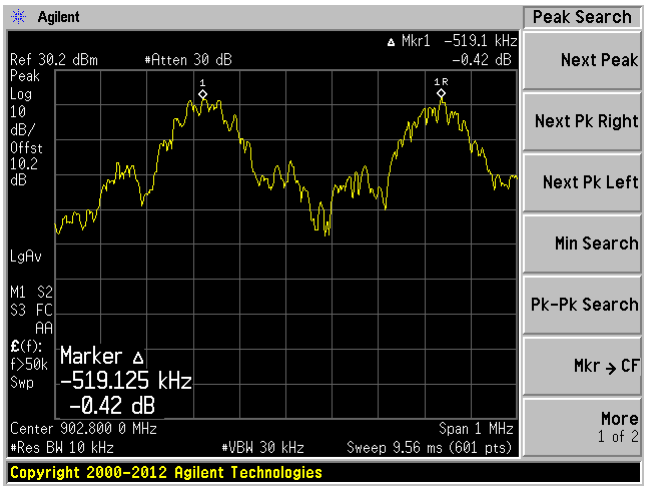
The testing was performed by Chen Ge on 2014-10-22 at the RF site.

9.5 Test Results

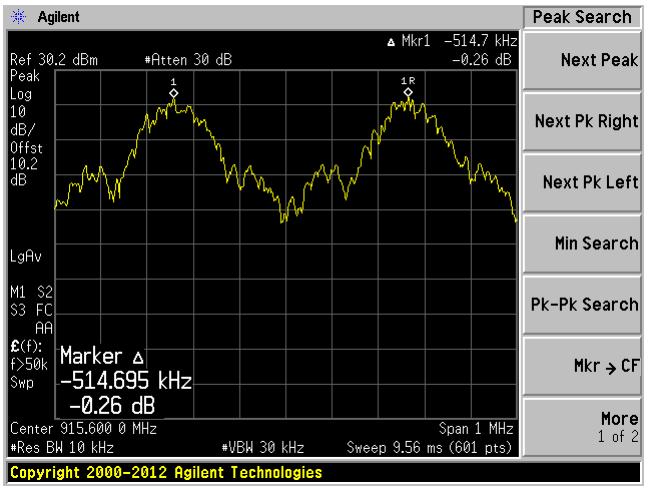
Channel	Frequency (MHz)	Channel Separation (kHz)	Limit > 20 dB OBW (kHz)
Low	902.6	519.125	358.766
Middle	915.4	514.695	315.173
-	922.0	515.172	375.610
High	927.6	542.692	356.671

Please refer to the following plots.

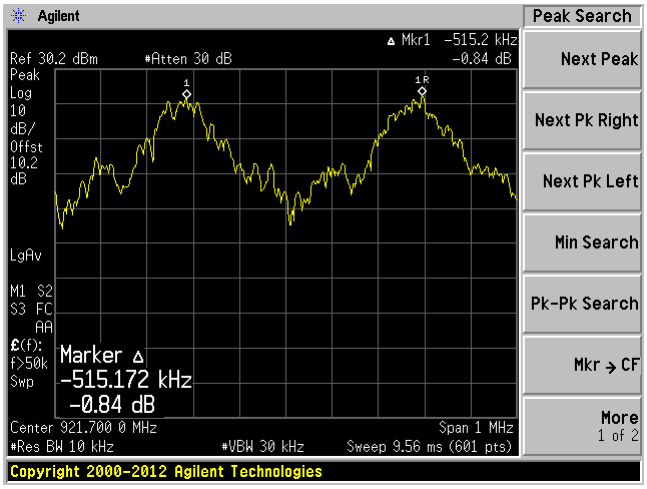
Low channel: 902.6 MHz



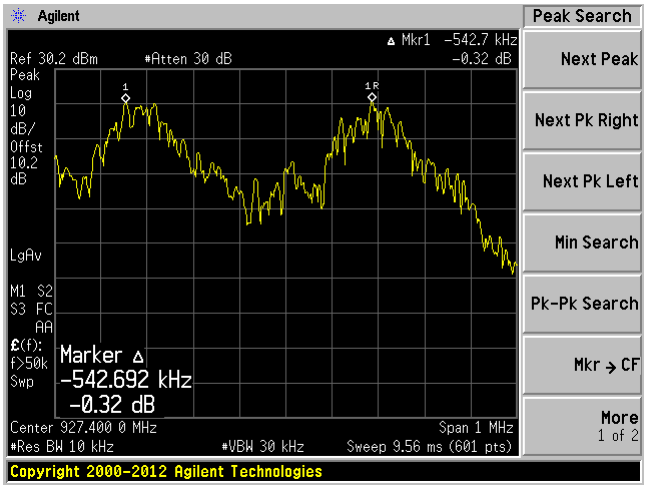
Middle Channel: 915.4 MHz



Channel: 922.0 MHz



High Channel: 927.6 MHz



10 FCC §15.247(a) & IC RSS-210 §A8.1 - Number of Hopping Channels

10.1 Applicable Standard

According to FCC §15.247(a)(1)(i), For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies

10.2 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.

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2014-08-29	1 year

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

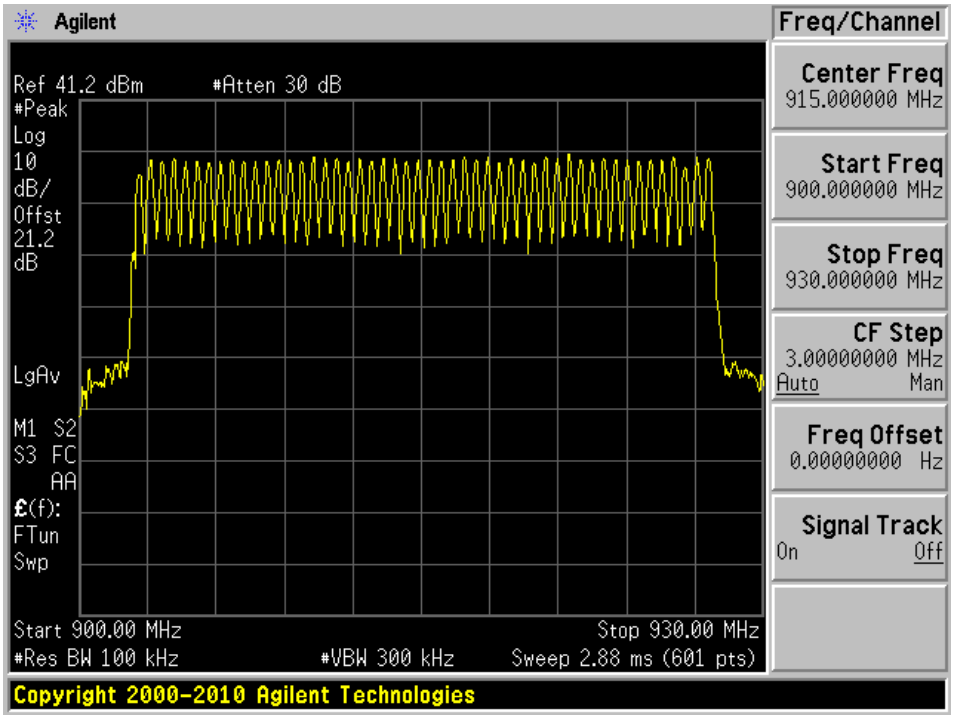
Temperature:	23° C
Relative Humidity:	46 %
ATM Pressure:	101.58 kPa

The testing was performed by Chen Ge on 2014-10-22 at the RF site.

10.5 Test Results

Total 50 channels; please refer to the plots hereinafter.

Hopping Channel Number: Total 50 Channels



11 FCC §15.247(a) & IC RSS-210 §A8.1 - Dwell Time

11.1 Applicable Standard

According to FCC §15.247 (a)(1)(i), For frequency hopping systems operating in the 902-928 MHz band: the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period

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 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.

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2014-08-29	1 year

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° C
Relative Humidity:	46 %
ATM Pressure:	101.58 kPa

The testing was performed by Chen Ge on 2014-10-22 at the RF site.

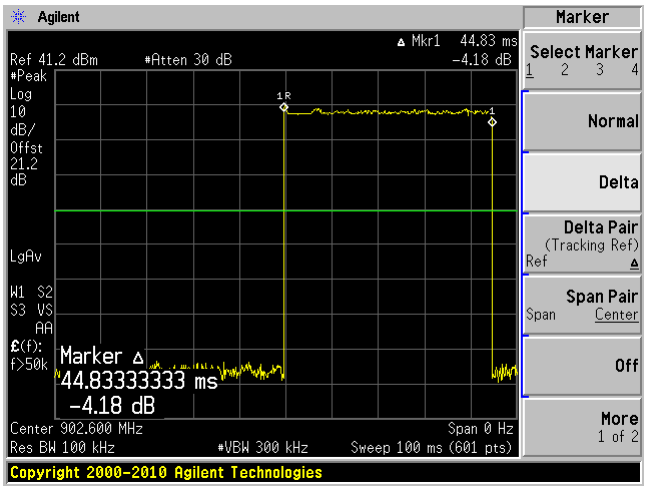
11.5 Test Results

Channel	Pulse Width (ms)	Dwell time (sec)	Limit (sec)	Results
Low	44.83	0.35	0.4	Pass
Mid 1	44.66	0.35	0.4	Pass
Mid 2	44.83	0.35	0.4	Pass
High	44.66	0.35	0.4	Pass

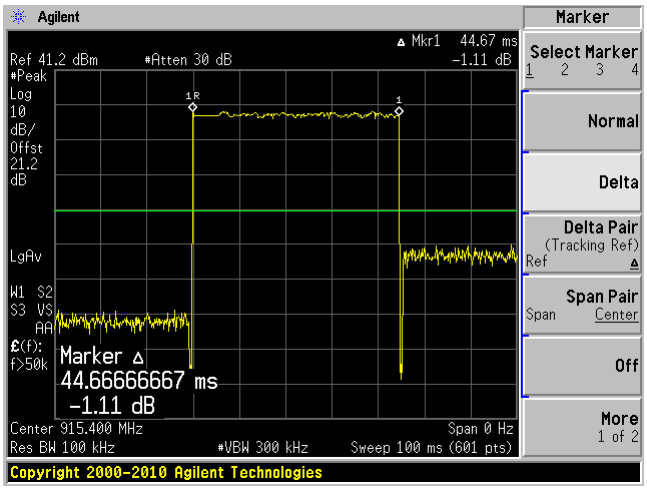
Note: There are 8 pulses during each 20 seconds.

Please refer to following plots:

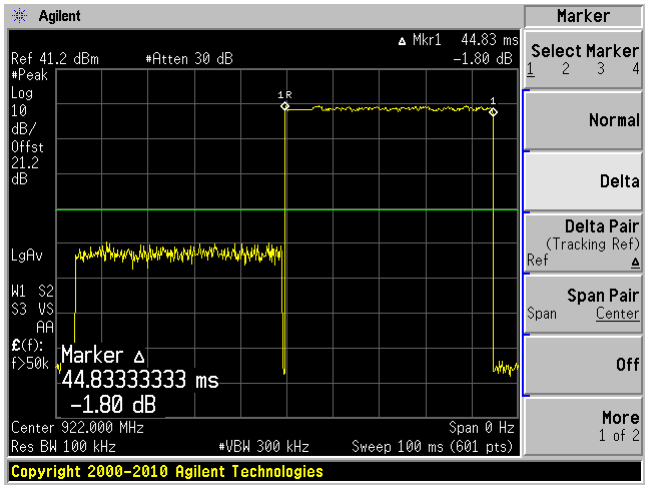
Low channel: 902.6 MHz



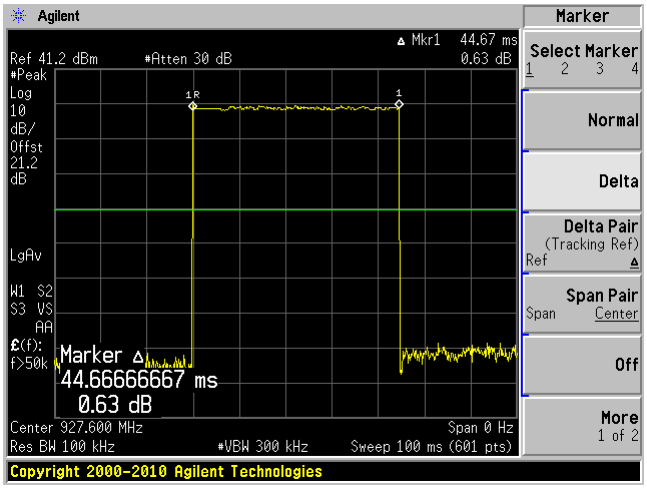
Middle channel: 915.4 MHz



Channel: 922.0 MHz



High channel: 927.6 MHz



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

12.1 Applicable Standard

According to FCC §15.247b (2): For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels

12.2 Measurement Procedure

DA 00-705: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
Section 15.247(b): Peak Output Power

12.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2014-08-29	1 year

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° C
Relative Humidity:	46 %
ATM Pressure:	101.58 kPa

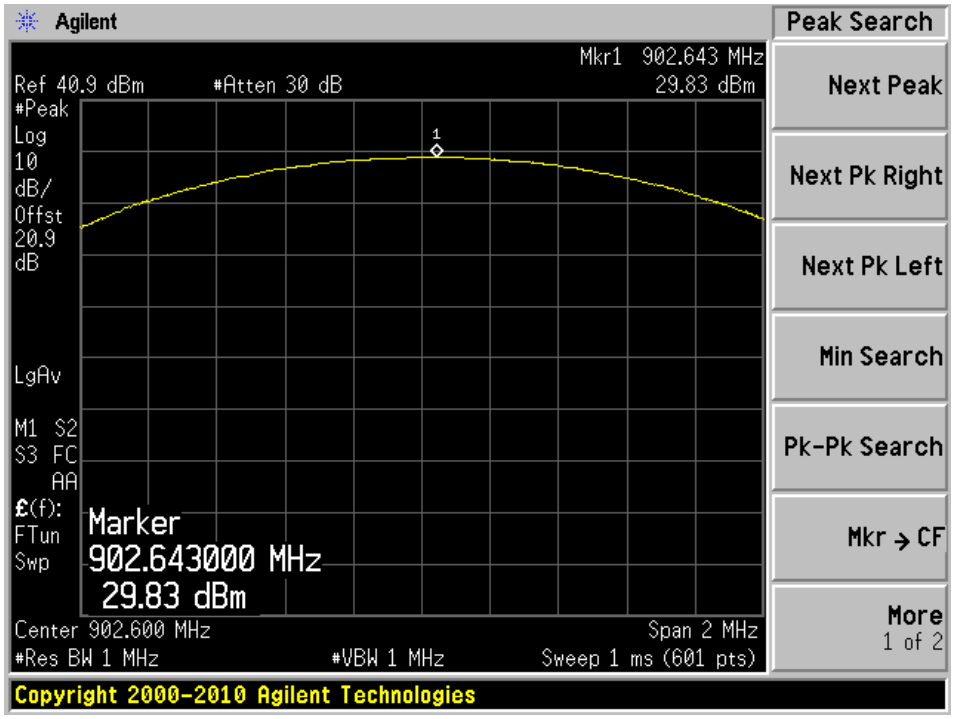
The testing was performed by Chen Ge on 2014-10-22 at the RF site.

12.5 Test Results

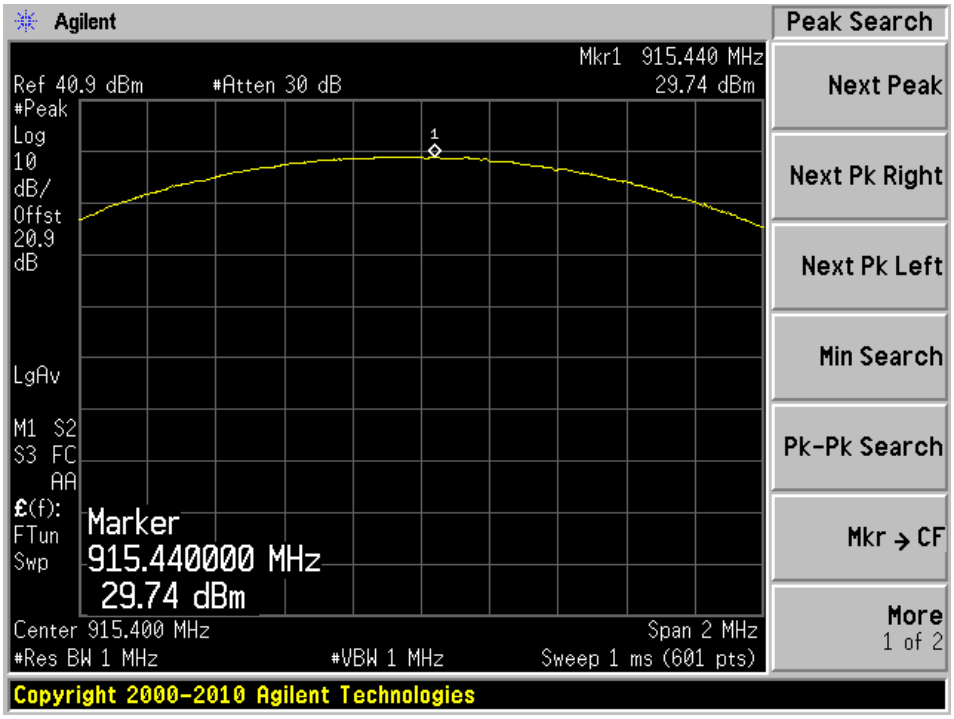
Channel	Frequency (MHz)	Conducted Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	902.6	29.83	30	-0.17
Middle 1	915.4	29.74	30	-0.26
Middle 2	922.0	29.74	30	-0.26
High	927.6	29.96	30	-0.04

Please refer to the following plots for detailed test results.

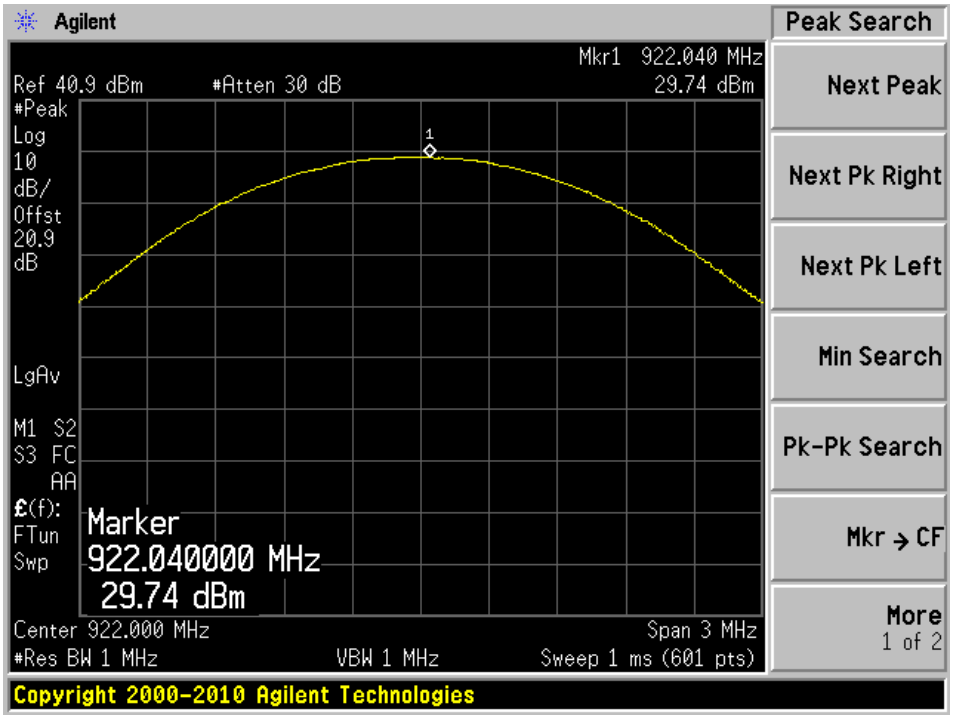
Low channel



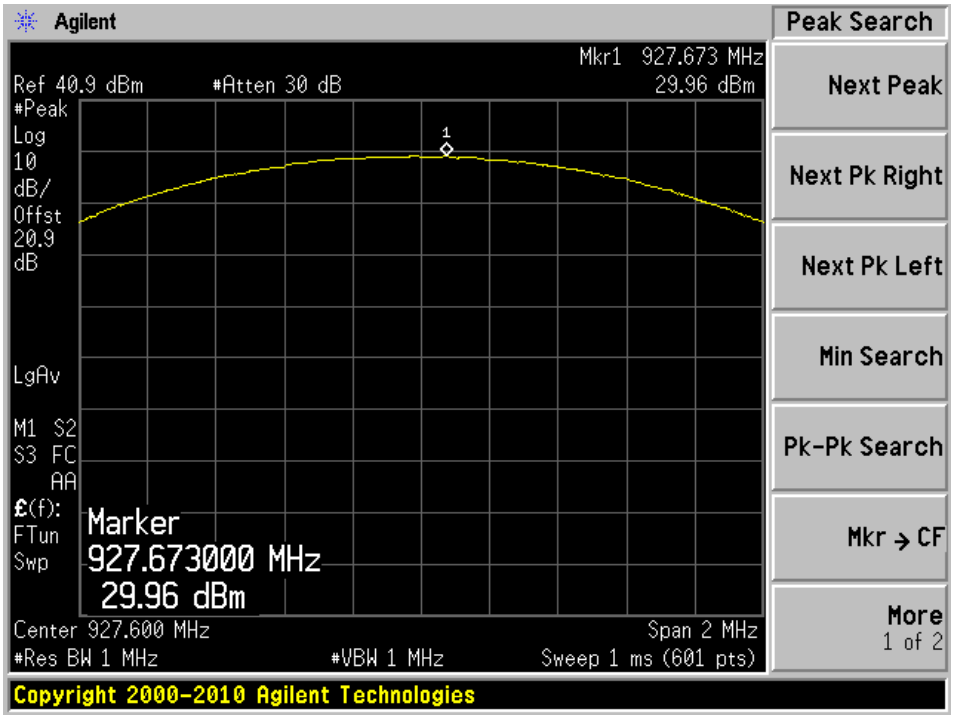
Middle channel 1



Middle channel 2



High channel



13 FCC §15.247(d) & IC RSS-210 §A8.5 – 100 kHz Bandwidth of Band Edges

13.1 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.

13.2 Measurement Procedure

DA 00-705: Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
Band-edge Compliance of RF Conducted Emissions

13.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2014-08-29	1 year

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

13.4 Test Environmental Conditions

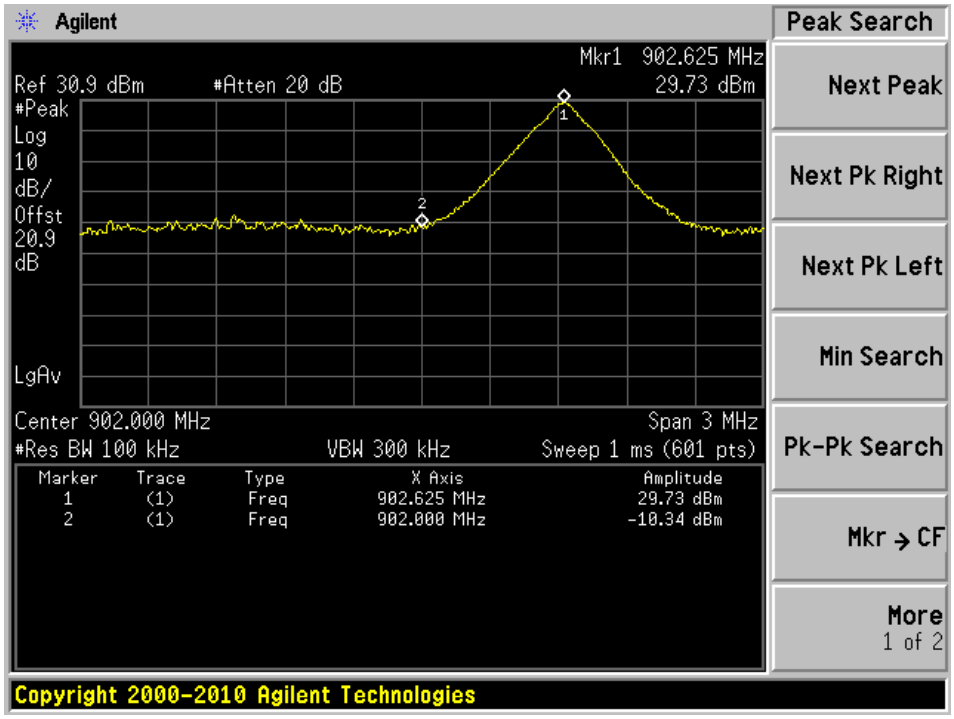
Temperature:	23° C
Relative Humidity:	46 %
ATM Pressure:	101.58 kPa

The testing was performed by Chen Ge on 2014-10-22 at the RF site.

13.5 Test Results

Please refer to following pages for plots of band edge.

Low Band Edge



High Band Edge