FCC PART 15 SUBPART C
TEST AND MEASUREMENT REPORT

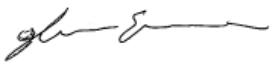
For

Silver Spring Networks

575 Broadway Street
Redwood City, California 94063

FCC ID: OWS-IMU521

Report Type:	**Product Type:**
Original Report	A Radio Module for Gas Meter

Prepared By	Glenn Escano Test Engineer	
Report Number	R1403142-247 Rev A	
Report Date	2014-04-30	
Reviewed By	Bo Li Test Engineer	
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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1403142-247	Original Report	2014-04-24
1	R1403142-247 Rev A	Updated plots	2014-04-30

1 General Description

1.1 Product Description for Equipment Under Test (EUT)

This test and measurement report was prepared on behalf of *Silver Spring Networks,* and their product FCC ID: OWS-IMU521, model: *IMU 300* or the "EUT" as referred on this report is "A Radio Module for Gas Meter".

1.2 Mechanical Description of EUT

The "EUT" measures approximately *"10.5"cm (L) x "7.7"cm (W) x "7"cm (H)*, and weighs approximately *"168"*g.

The data gathered are from a production sample provided by the Silver Spring Networks, serial number: 0013500400001165.

1.3 Objective

This report is prepared on behalf of *Silver Spring Networks* 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 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 and FCC KDB 558074 D01 DTS Meas Guidance v03r01: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

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 Luminares 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 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.

The EUT had been tested with the following settings (worst case):

Radio Mode	Bandwidth (kHz)	Frequency/Data Rate		
		Low CH (MHz)	Mid CH (MHz)	High CH (MHz)
FHSS	258	902.3	915.2	927.5

2.2 EUT Exercise Software

The test utility used was software version is 2.12.303B was provided by Silver Spring Networks and was verified by Chaoran Chu and Glenn Escano to comply with the standard requirements being tested against.

2.3 Special Equipment

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

2.4 Equipment Modifications

No modifications were made to the EUT.

2.5 Local Support Equipment

N/A

2.6 EUT Internal Configuration Details

Manufacturers	Descriptions	Models	Serial Numbers
Silver Spring Networks	PCB	170-0409-12 Rev.01	0013500400001165

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	RF Exposure	Compliant
FCC §15.203	Antenna Requirement	N/A
FCC §15.207(a)	AC Line Conducted Emissions	N/A
FCC §15.209	Spurious Emissions at Antenna Port	Compliant
FCC §15.205	Restricted Bands	N/A
FCC §15.209, §15.247(d)	Radiated Spurious Emissions	Compliant
FCC §15.247 (a)(2)	Hopping Channel Bandwidth	Compliant
FCC §15.247(b)(3)	Maximum Peak Output Power	Compliant
FCC §15.247(a) (1)	Hopping Channel Separation	Compliant
FCC §15.247(a)(1)(iii)	Number of Hopping Channels	Compliant
FCC §15.247(a)(1)(iii)	Dwell Time	Compliant
FCC §15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliant
FCC §15.247 (e)	Power Spectral Density	N/A
FCC §15.109	Receiver Spurious Emission	Compliant

4 FCC §15.247 (i), § 2.1091 RF Exposure

4.1 Applicable Standard

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

Limits for General Population/Uncontrolled Exposure

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

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

4.2 MPE Prediction

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

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

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

4.3 MPE Results

Maximum peak output power at antenna input terminal (dBm):	27.11
Maximum peak output power at antenna input terminal (mW):	514.0437
Prediction distance (cm):	20
Prediction frequency (MHz):	902.3
Maximum Antenna Gain, typical (dBi):	0
Maximum Antenna Gain (numeric):	1
Power density of prediction frequency at 20 cm (mW/cm^2):	0.102266
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	0.601533

The device is compliant with the requirement MPE limit for uncontrolled exposure. The maximum power density at the distance of 20 cm is 0.102266 mW/cm^2, limit is 0.601533 mW/cm^2.

5 FCC §2.1051, §15.247(d) – Spurious Emissions at Antenna Terminals

5.1 Applicable Standard

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

5.2 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.

5.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2013-08-29	1 year

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

5.4 Test Environmental Conditions

Temperature:	21°C
Relative Humidity:	41%
ATM Pressure:	101.89kPa

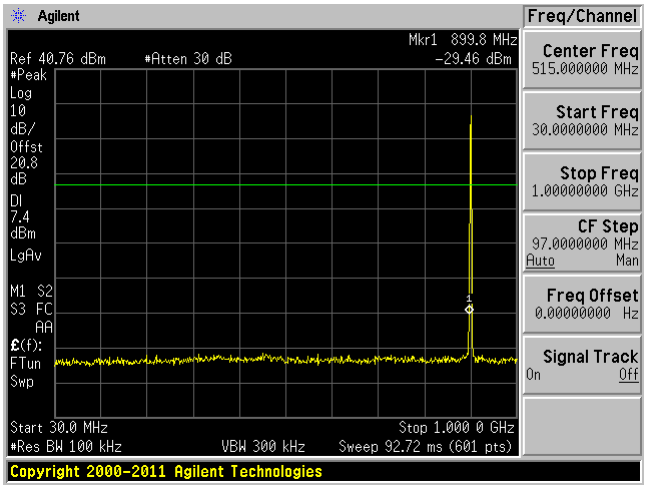
The testing was performed by Chaoran Chu on 2014-04-14 at RF Test Site.

5.5 Measurement Result

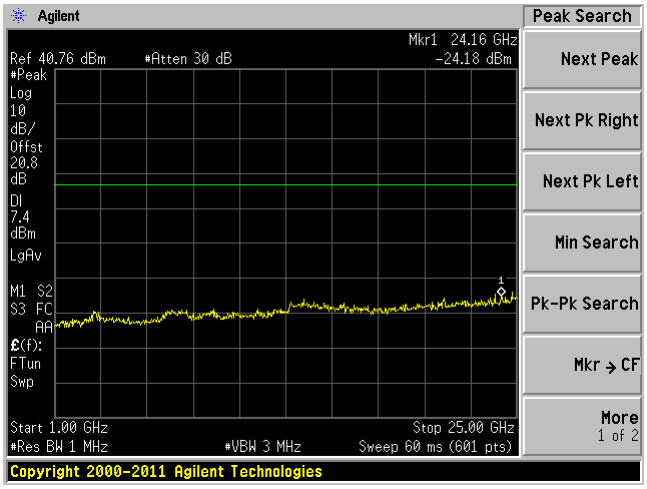
Please refer to following plots of spurious emissions.

Low Channel 902.3 MHz

30 MHz to 1 GHz

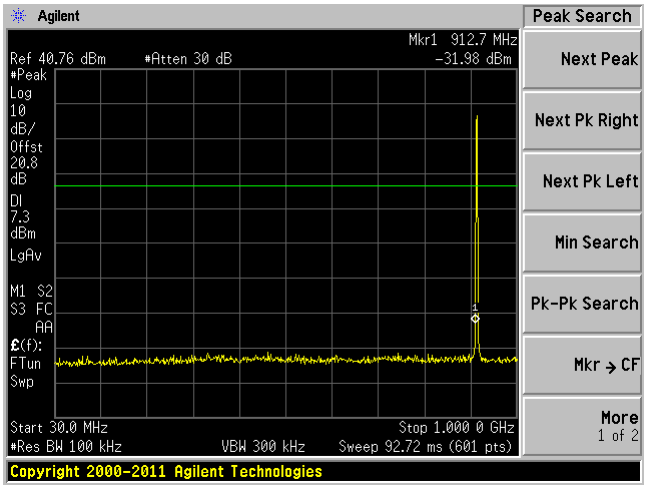


1 GHz to 25 GHz

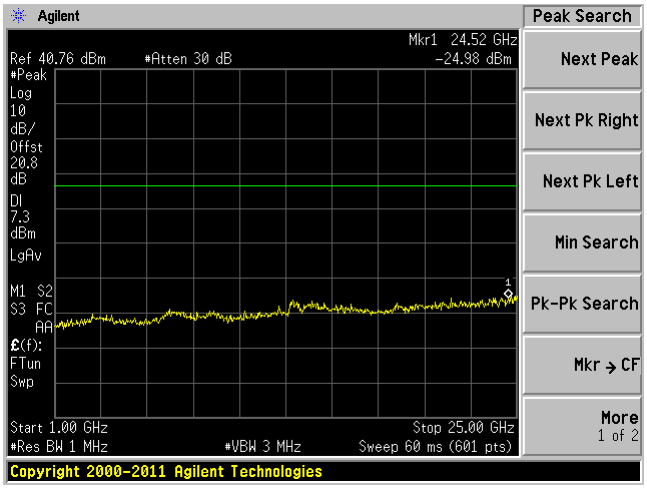


Middle Channel 915.2 MHz

30 MHz to 1 GHz

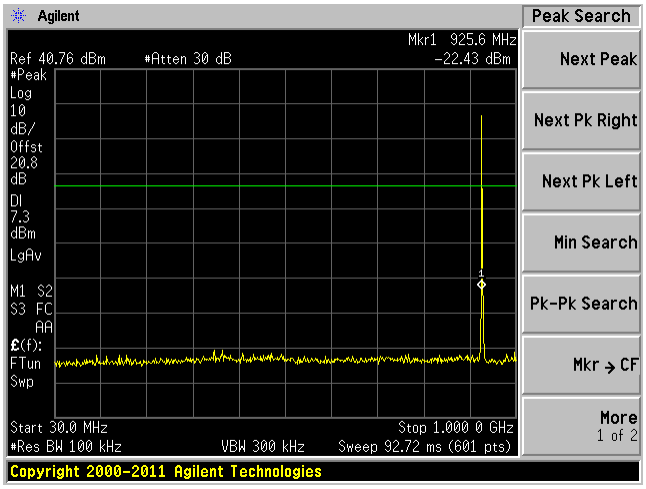


1 GHz to 25 GHz

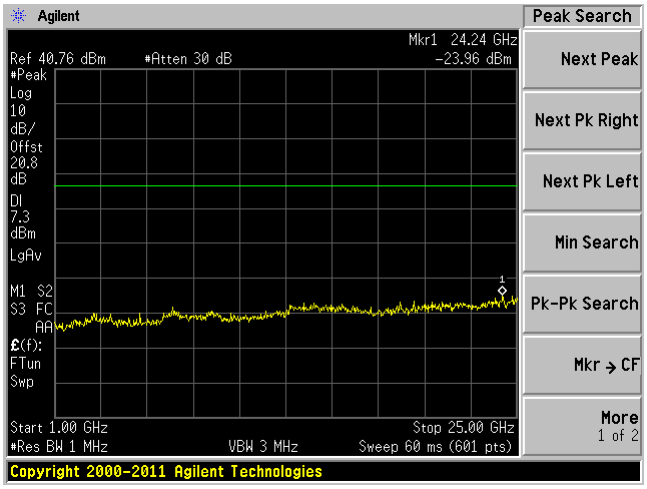


High Channel 927.5 MHz

30 MHz to 1 GHz



1 GHz to 25 GHz



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

6.1 Applicable Standard

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

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

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

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

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

MHz	MHz	MHz	GHz
0.090 – 0.110	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).

6.2 Test Setup

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

The spacing between the peripherals was 10 centimeters.

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

6.3 Test Procedure

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

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

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

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

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

Above 1000 MHz:

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

6.4 Corrected Amplitude & Margin Calculation

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

Corrected Amplitude = Indicated Reading + Cable Loss + Attenuator Factor

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

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

Margin = Corrected Amplitude - Limit

6.5 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Sunol Sciences	Antenna, Biconi-Log	JB3	A020106-3	2013-07-11	1 Year
HP	Pre Amplifier	8447D	2443A04374	2013-06-08	1 Year
Rohde & Schwarz	Receiver, EMI Test	ESCI 1166.5950K03	100338	2014-01-20	1 Year
Sunol Sciences	Controller, System	SC104V	113005-1	N/R	N/R
Sunol Sciences	Motor, Tower	TWR95-4	113005-3	N/R	N/R
Agilent	Spectrum Analyzer	E4446A	MY48250238	2013-08-29	1 Year
EMCO	Horn antenna	3115	9511-4627	2014-1-7	1 Year
Hewlett Packard	Amplifier, Pre	8449B OPT H02	3008A01103	2014-03-10	1 Year

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

6.6 Test Environmental Conditions

Temperature:	22º C
Relative Humidity:	41%
ATM Pressure:	101.69kPa

Testing was performed by Glenn Escano on 2014-04-14 in 5m chamber 2.

6.7 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC 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**
-10.61	176.3635	Horizontal	High Channel 927.5 MHz

Above 1GHz:

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel**
-1.429	2706.9	Horizontal	Low Channel 902.3 MHz

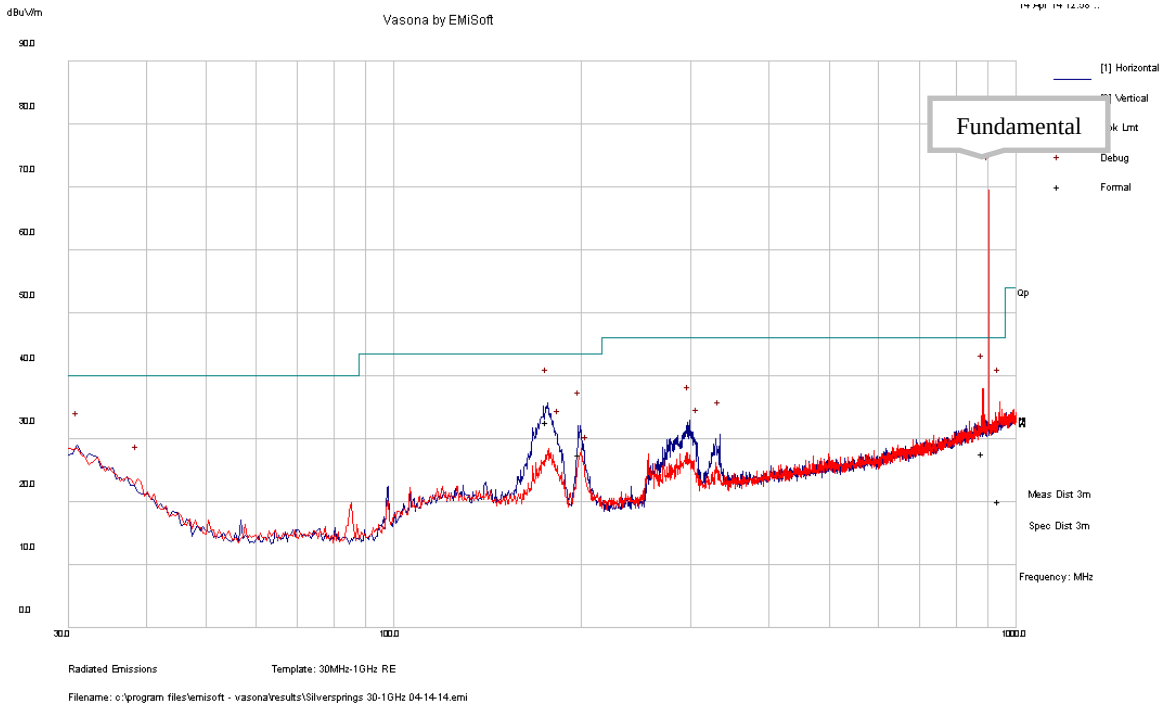
Please refer to the following table and plots for specific test result details

6.8 Radiated Emissions Test Result Data

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

Note: All 30MHz – 1GHz spurious are digital, other emissions are on the noise floor level. The worst case result was reported.

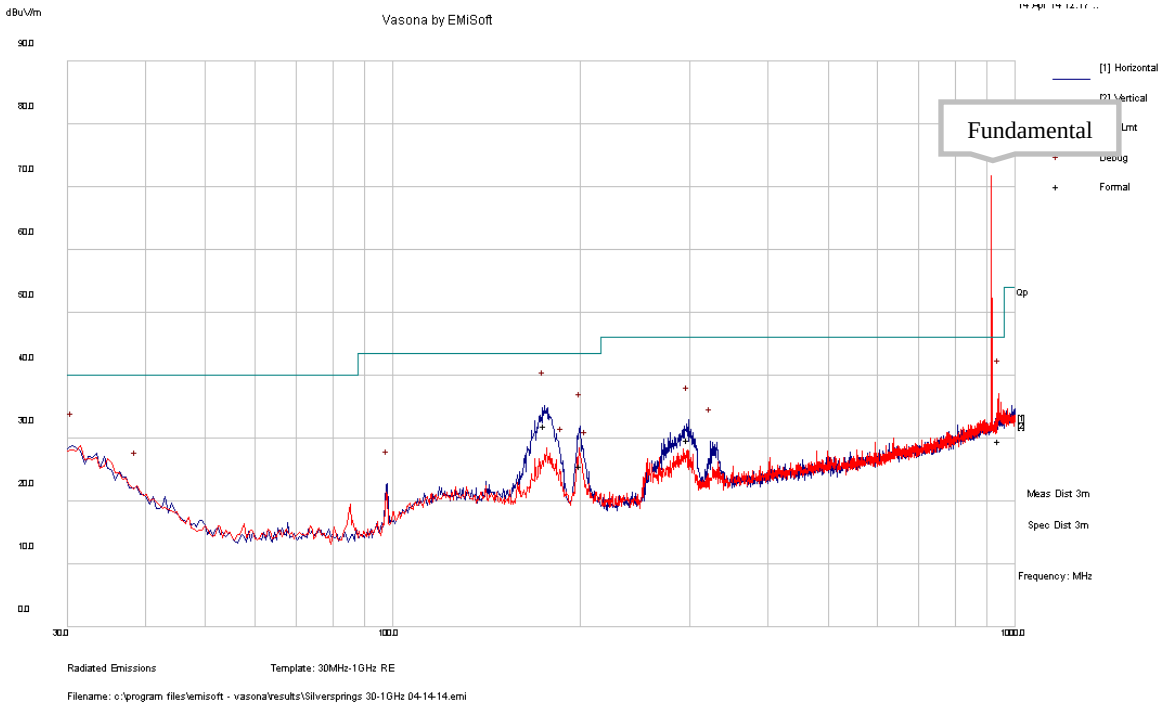
Low Channel 902.3 MHz



Quasi-peak Measurements

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Test Antenna		Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
		Height (cm)	Polarity (H/V)			
176.3873	32.60	180	H	239	43.5	-10.90
198.717	27.53	131	H	82	43.5	-15.97
883.382	27.75	99	V	236	46	-18.25
938.549	20.06	157	V	6	46	-25.94

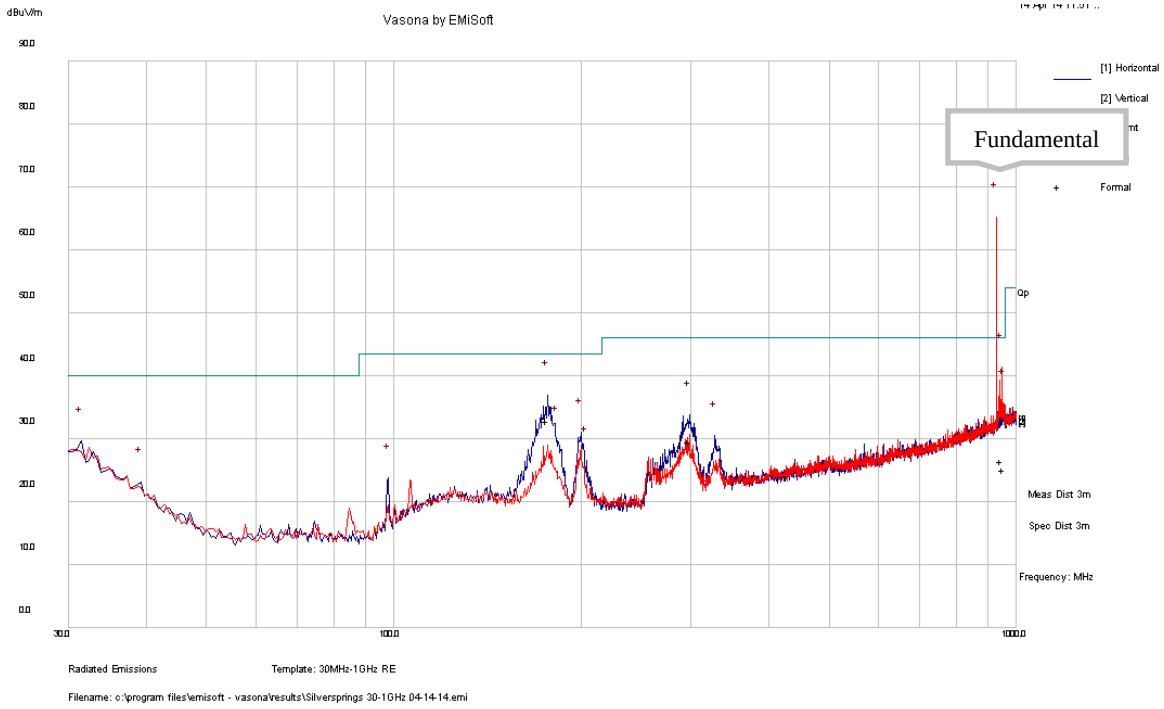
Middle Channel 915.2 MHz



Quasi-peak Measurements

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Test Antenna		Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
		Height (cm)	Polarity (H/V)			
175.1698	31.97	130	H	53	43.5	-11.53
298.2055	29.71	105	H	246	46	-16.29
940.8113	29.61	108	V	360	46	-16.39
200.2668	25.54	106	H	290	43.5	-17.96

High Channel 927.5 MHz



Quasi-peak Measurements

Frequency (MHz)	Corrected Amplitude (dBµV/m)	Test Antenna		Turntable Azimuth (degrees)	Limit (dBµV/m)	Margin (dB)
		Height (cm)	Polarity (H/V)			
176.3635	32.89	104	H	86	43.5	-10.61
298.11	29.50	112	H	97	46	-16.50
947.1538	26.55	105	V	281	46	-19.45
951.2518	25.16	104	V	277	46	-20.84

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

Low Channel 902.3 MHz

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	Part 15C		Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Low Channel 902.3 MHz, measured at 3 meters											
902.3	95.28	246	100	V	22.8	1.84	0	119.920	-	119.920	Peak/Fund
902.3	93.95	246	100	V	22.8	1.84	0	118.590	-	118.590	Ave/Fund
902.3	92.95	165	136	H	22.8	1.84	0	117.590	-	117.590	Peak/Fund
902.3	91.68	165	136	H	22.8	1.84	0	116.320	-	116.320	Ave/Fund
1804.6	54.6	259	100	V	26.1	3.35	36.5	47.550	99.920	-52.370	Peak
1804.6	47.78	259	100	V	26.1	3.35	36.5	40.730	98.590	-57.860	Ave
1804.6	52.24	166	100	H	26.1	3.35	36.5	45.190	97.590	-52.400	Peak
1804.6	42.69	166	100	H	26.1	3.35	36.5	35.640	96.320	-60.680	Ave
2706.9	57.59	74	137	V	29.7	3.75	36.42	54.641	74	-19.359	Peak
2706.9	53.86	74	137	V	29.7	3.75	36.42	50.911	54	-3.089	Ave
2706.9	58.63	298	100	H	29.7	3.75	36.42	55.681	74	-18.319	Peak
2706.9	55.52	298	100	H	29.7	3.75	36.42	52.571	54	-1.429	Ave
3609.2	51.56	157	126	V	31.1	4.40	36.04	51.053	74	-22.947	Peak
3609.2	45.29	157	126	V	31.1	4.40	36.04	44.783	54	-9.217	Ave
3609.2	53.14	1	100	H	31.1	4.40	36.04	52.633	74	-21.367	Peak
3609.2	47.64	1	100	H	31.1	4.40	36.04	47.133	54	-6.867	Ave

Middle Channel 915.2 MHz

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	Part 15C		Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
Middle Channel 915.2 MHz, measured at 3 meters											
915.2	97.2	319	103	V	22.9	1.86	0	121.960	-	121.960	Peak/Fund
915.2	96.12	319	103	V	22.9	1.86	0	120.880	-	120.880	Ave/Fund
915.2	93.88	156	146	H	22.9	1.86	0	118.640	-	118.640	Peak/Fund
915.2	92.81	156	146	H	22.9	1.86	0	117.570	-	117.570	Ave/Fund
1830.4	52.87	258	100	V	26.1	3.40	36.5	45.872	101.960	-56.088	Peak
1830.4	44.3	258	100	V	26.1	3.40	36.5	37.302	100.880	-63.578	Ave
1830.4	51.38	158	100	H	26.1	3.40	36.5	44.382	98.640	-54.258	Peak
1830.4	40.13	158	100	H	26.1	3.40	36.5	33.132	97.570	-64.438	Ave
2745.6	55.63	198	138	V	29.7	3.79	36.42	52.719	74	-21.281	Peak
2745.6	51.07	198	138	V	29.7	3.79	36.42	48.159	54	-5.841	Ave
2745.6	54.15	294	123	H	29.7	3.79	36.42	51.239	74	-22.761	Peak
2745.6	48.3	294	123	H	29.7	3.79	36.42	45.389	54	-8.611	Ave
3660.8	49.48	273	100	V	31.1	4.70	36.02	49.232	74	-24.768	Peak
3660.8	38.91	273	100	V	31.1	4.70	36.02	38.662	54	-15.338	Ave
3660.8	51.12	2	100	H	31.1	4.70	36.02	50.872	74	-23.128	Peak
3660.8	43.91	2	100	H	31.1	4.70	36.02	43.662	54	-10.338	Ave

High Channel 927.5 MHz

Frequency (MHz)	S.A. Reading (dBµV)	Turntable Azimuth (degrees)	Test Antenna			Cable Loss (dB)	Pre-Amp. (dB)	Cord. Reading (dBµV/m)	Part 15C		Comments
			Height (m)	Polarity (H/V)	Factor (dB/m)				Limit (dBµV/m)	Margin (dB)	
High Channel 927.5 MHz, measured at 3 meters											
927.5	98.46	244	105	V	23.1	1.89	0	123.450	-	123.450	Peak/Fund
927.5	97.45	244	105	V	23.1	1.89	0	122.440	-	122.440	Ave/Fund
927.5	95.77	156	141	H	23.1	1.89	0	120.760	-	120.760	Peak/Fund
927.5	94.82	156	141	H	23.1	1.89	0	119.810	-	119.810	Ave/Fund
1855	58.65	245	111	V	26.8	3.35	36.5	52.300	103.450	-51.150	Peak
1855	55.67	245	111	V	26.8	3.35	36.5	49.320	102.440	-53.120	Ave
1855	55.22	200	109	H	26.8	3.35	36.5	48.870	100.760	-51.890	Peak
1855	49.85	200	109	H	26.8	3.35	36.5	43.500	99.810	-56.310	Ave
2782.5	49.06	0	100	V	29.6	3.82	36.46	46.034	74	-27.966	Peak
2782.5	35.46	0	100	V	29.6	3.82	36.46	32.434	54	-21.566	Ave
2782.5	50.06	0	100	H	29.6	3.82	36.46	47.034	74	-26.966	Peak
2782.5	35.51	0	100	H	29.6	3.82	36.46	32.484	54	-21.516	Ave
3710	48.8	98	100	V	31.1	4.81	36.06	48.620	74	-25.380	Peak
3710	38.31	98	100	V	31.1	4.81	36.06	38.130	54	-15.870	Ave
3710	50.3	233	100	H	31.1	4.81	36.06	50.120	74	-23.880	Peak
3710	40.79	233	100	H	31.1	4.81	36.06	40.610	54	-13.390	Ave
4634.5	49.79	142	100	V	32.0	5.29	36.20	50.872	74	-23.128	Peak
4634.5	38.28	142	100	V	32.0	5.29	36.20	39.362	54	-14.638	Ave
4634.5	49.43	130	133	H	32.0	5.29	36.20	50.512	74	-23.488	Peak
4634.5	37.67	130	133	H	32.0	5.29	36.20	38.752	54	-15.248	Ave

*Note: * All other emissions are 20 dB below the limit and/or under the noise floor level.*

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

7.1 Applicable Standard

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

7.2 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.

7.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2013-08-29	1 year

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:	21°C
Relative Humidity:	41%
ATM Pressure:	101.89kPa

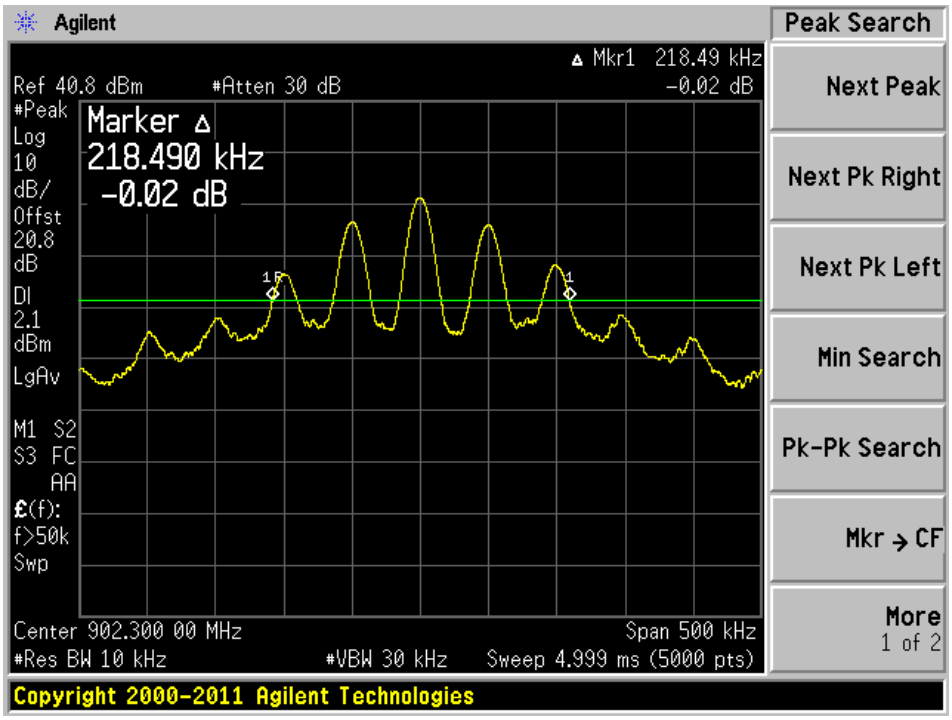
The testing was performed by Chaoran Chu on 2014-04-14 at RF Test Site.

7.5 Summary of Test Results

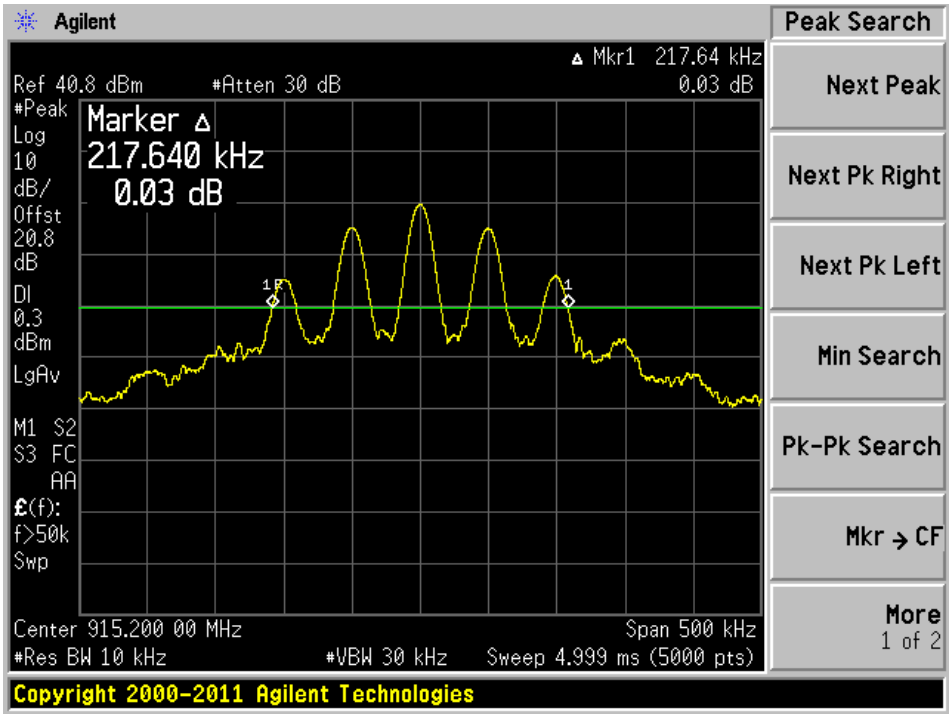
Channel	Frequency (MHz)	20 dB Channel Bandwidth (kHz)
Low	902.3	218.49
Mid	915.2	217.64
High	927.5	213.85

Please refer to the following plots for detailed test results:

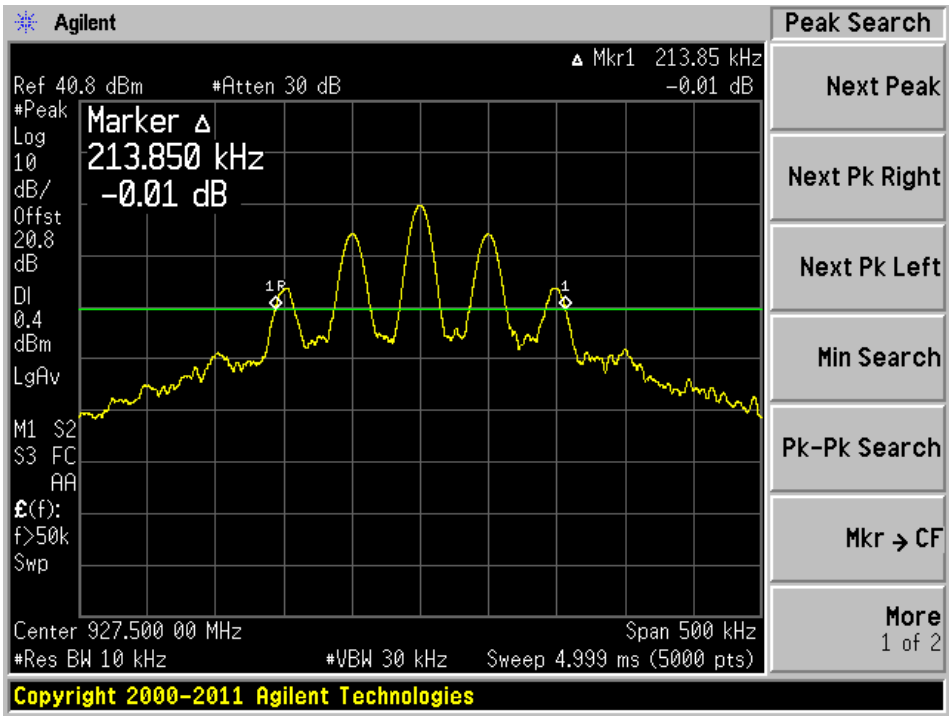
Low Channel 902.3 MHz



Middle Channel 915.2 MHz



High Channel 927.5 MHz



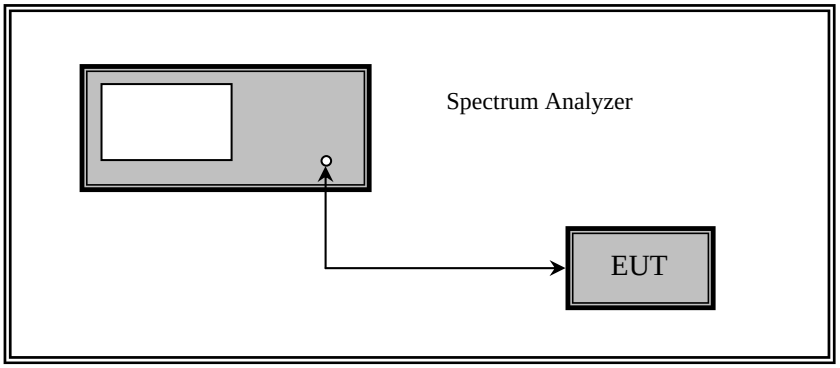
8 FCC §15.247(b) – Peak Output Power Measurement

8.1 Applicable Standard

According to FCC §15.247(b) (2), For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels.

8.2 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.



8.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2013-08-29	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:	21°C
Relative Humidity:	41%
ATM Pressure:	101.89kPa

The testing was performed by Chaoran Chu on 2014-04-14 at RF Test Site.

8.5 Summary of Test Results

Channel	Frequency (MHz)	Max Peak Output Power		Limit (W)	Result
		(dBm)	(mw)		
Low	902.3	27.11	514.044	1	Compliant
Mid	915.2	26.91	490.908	1	Compliant
High	927.5	26.93	493.174	1	Compliant

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

9.1 Applicable Standard

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

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 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.

9.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2013-08-29	1 year

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

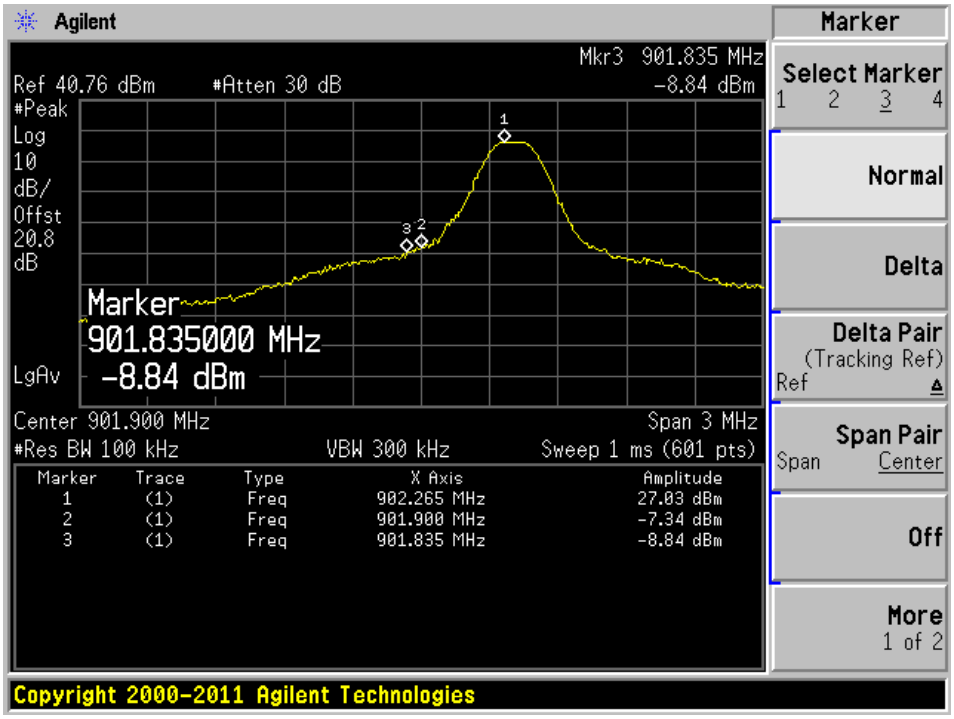
9.4 Test Environmental Conditions

Temperature:	21°C
Relative Humidity:	41%
ATM Pressure:	101.89kPa

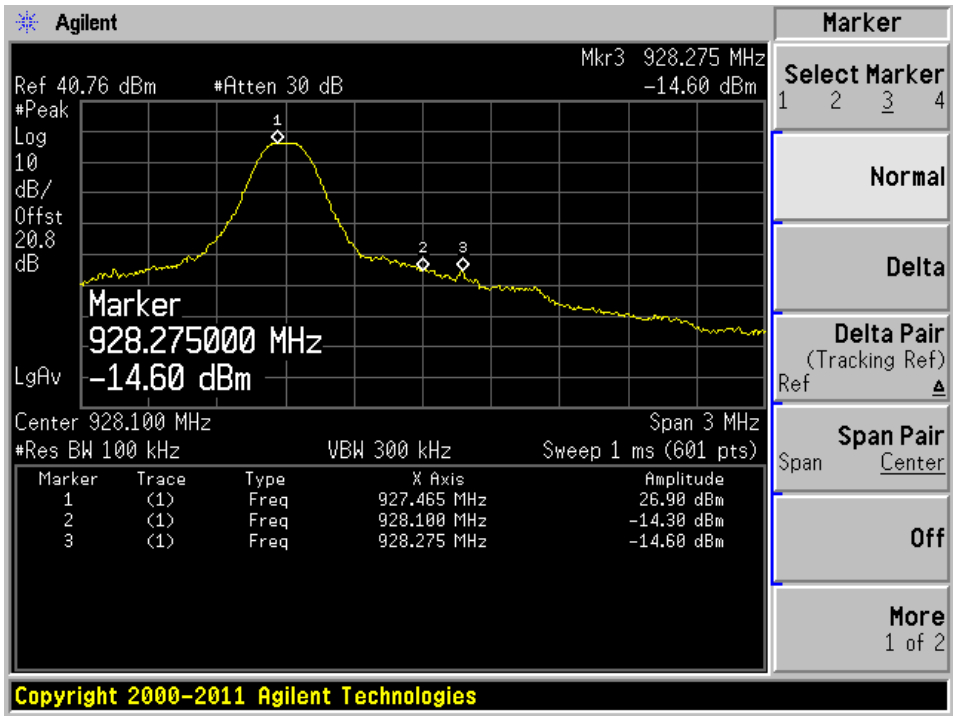
The testing was performed by Chaoran Chu on 2014-04-14 at RF Test Site.

9.5 Measurement Results

Low Channel 902.3 MHz



High Channel 927.5 MHz



10 FCC §15.247(a) (1) (i) – Hopping Channel Separation

10.1 Applicable Standard

According to FCC §15.247(a)(1): Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

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 less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

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 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.

10.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2013-08-29	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:	21°C
Relative Humidity:	41%
ATM Pressure:	101.89kPa

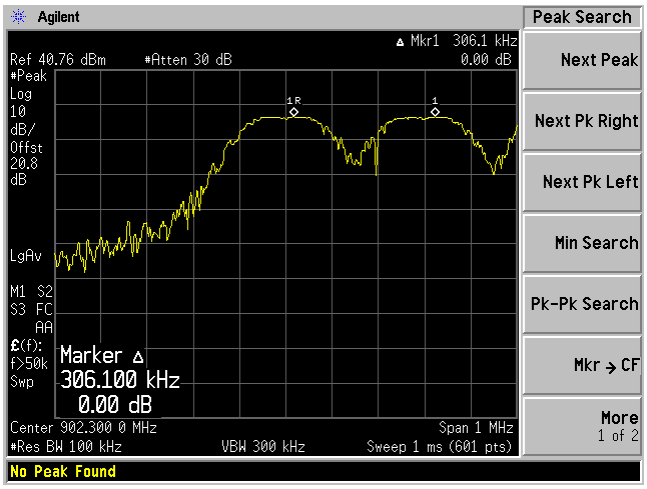
The testing was performed by Chaoran Chu on 2014-04-14 at RF Test Site.

10.5 Measurement Results

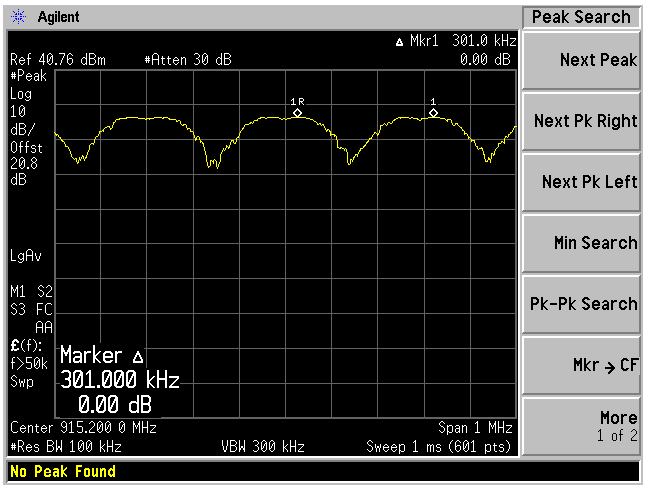
Channel	Frequency (MHz)	Channel Separation (kHz)	Limit > 2/3 20 dB BW (kHz)
Low	902.3	306.1	500
Mid	915.2	301	500
High	927.5	288.2	500

Please refer to the following plots.

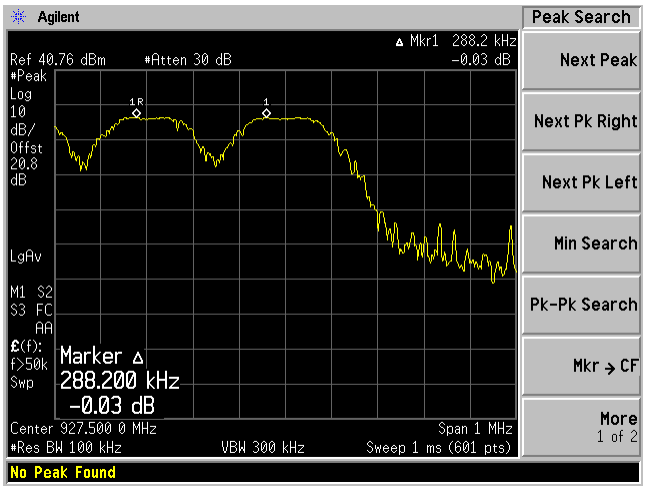
Low Channel



Middle Channel



High Channel



11 FCC §15.247(b) (2) (iii) – Number of Hopping Channels

11.1 Applicable Standard

According to FCC §15.247(b) (2), For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels.

11.2 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.

11.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2013-08-29	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

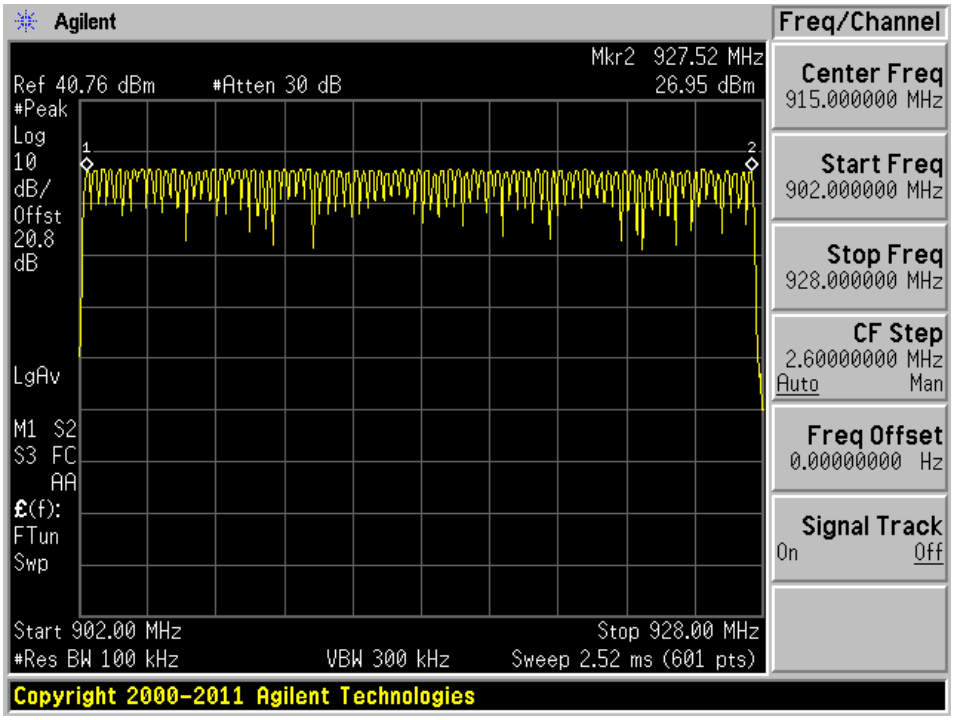
Temperature:	21°C
Relative Humidity:	41%
ATM Pressure:	101.89kPa

The testing was performed by Chaoran Chu on 2014-04-14 at RF Test Site.

11.5 Measurement Result

Please refer to the following plots.

Hopping Channel Number: Total 85Channels



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

12.1 Applicable Standard

According to FCC §15.247 (a)(1)(iii), the average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

12.2 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.

12.3 Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Interval
Agilent	Spectrum Analyzer	E4446A	MY48250238	2013-08-29	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:	21°C
Relative Humidity:	41%
ATM Pressure:	101.89kPa

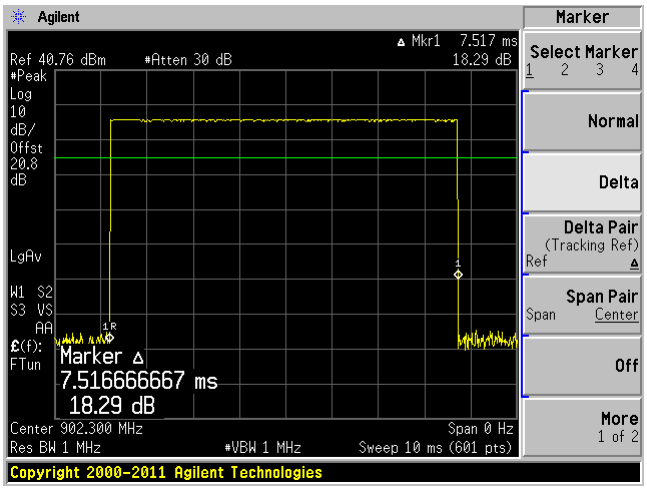
The testing was performed by Chaoran Chu on 2014-04-14 at RF Test Site.

12.5 Measurement Results

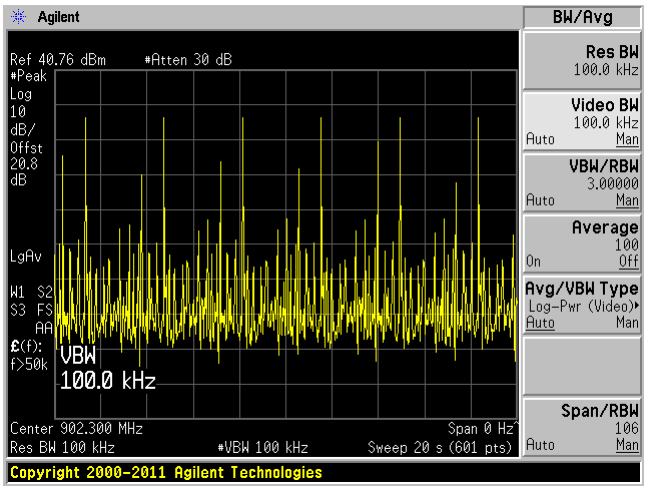
Channel	Frequency (MHz)	Pulse Width (ms)	Numbers in 20S	Dwell Time (Sec.)	Limit (Sec.)	Results
Low	902.3	7.516667	5	0.038	0.4	pass
Mid	915.2	7.533333	5	0.038	0.4	pass
High	927.5	7.516667	5	0.038	0.4	pass

Please refer the following plots.

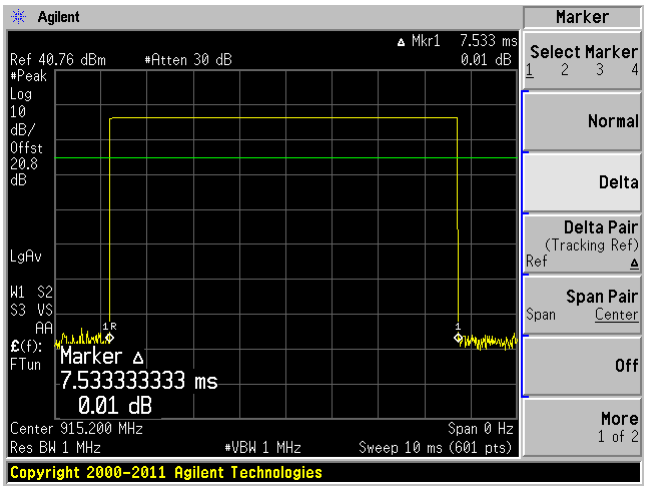
Low Channel



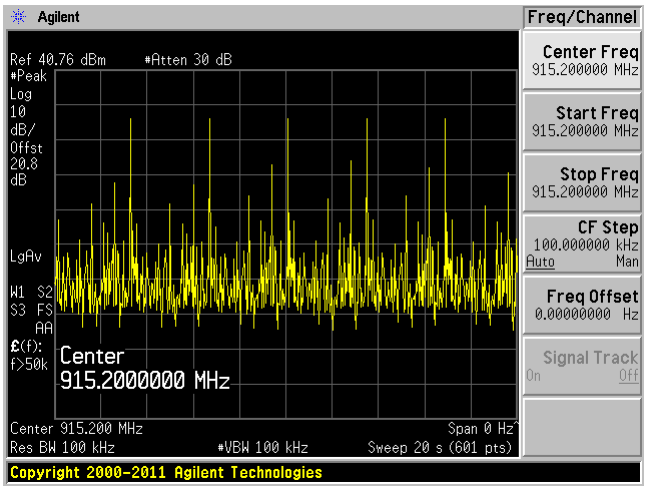
Low Channel 20 s



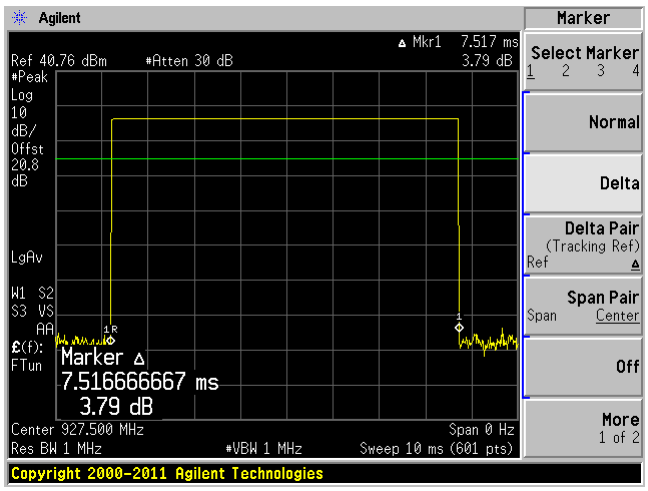
Middle Channel



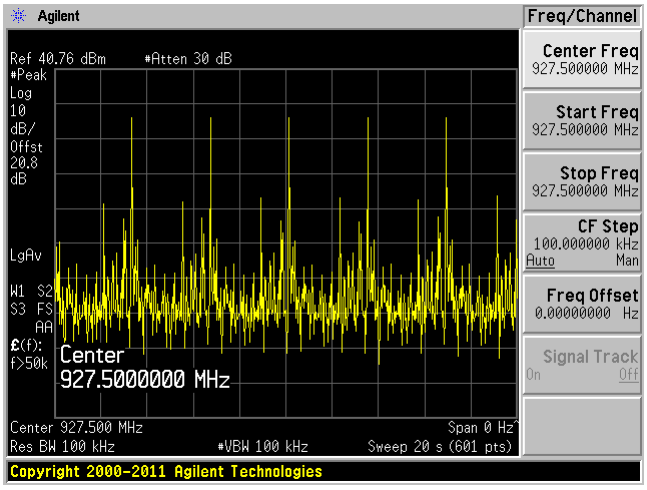
Middle Channel 20 s



High Channel



High Channel 20 s



13 Exhibit A – FCC Equipment Labeling Requirements

13.1 FCC ID Label Requirements

As per FCC §2.925,

(a) Each equipment covered in an application for equipment authorization shall bear a nameplate or label listing the following:

(1) FCC Identifier consisting of the two elements in the exact order specified in §2.926. The FCC Identifier shall be preceded by the term FCC ID in capital letters on a single line, and shall be of a type size large enough to be legible without the aid of magnification.

Example: FCC ID XXX123. XXX—Grantee Code 123—Equipment Product Code

13.2 As per FCC §15.19,

(3) All other devices shall bear the following statement in a conspicuous location on the device:

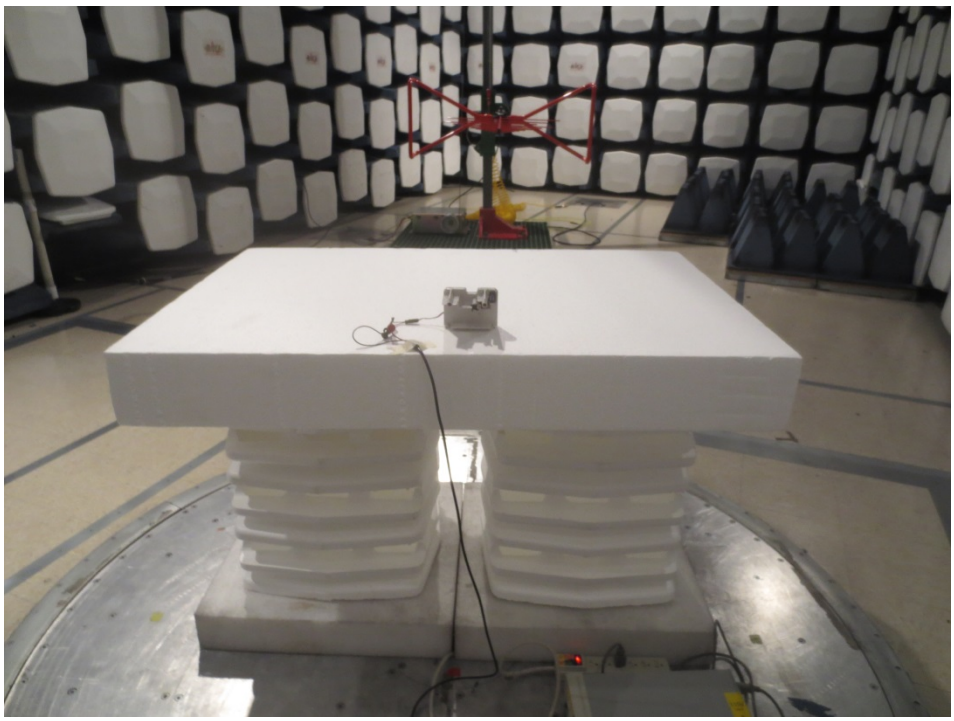
> This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
> (1) This device may not cause harmful interference, and
> (2) This device must accept any interference received, including interference that may cause undesired operation.

(4) The label shall not be a stick-on, paper label. The label on these products shall be permanently affixed to the product and shall be readily visible to the purchaser at the time of purchase, as described in §2.925(d) of this chapter. “Permanently affixed” means that the label is etched, engraved, stamped, silkscreened, indelibly printed, or otherwise permanently marked on a permanently attached part of the equipment or on a nameplate of metal, plastic, or other material fastened to the equipment by welding, riveting, or a permanent adhesive. The label must be designed to last the expected lifetime of the equipment in the environment in which the equipment may be operated and must not be readily detachable.

14 Exhibit B – Test Setup Photographs

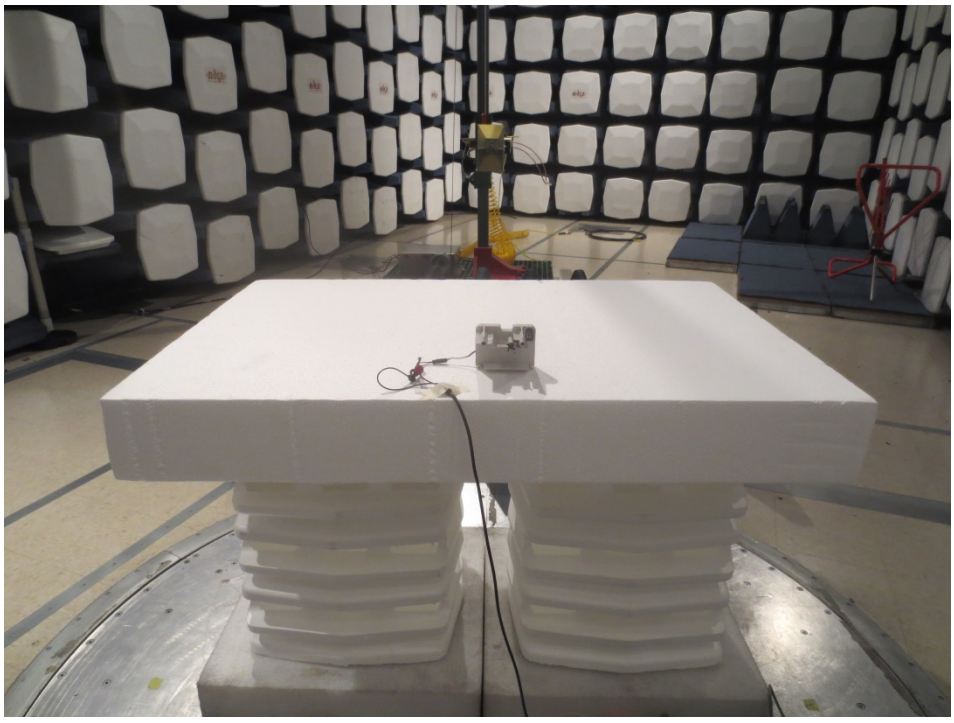
14.1 Radiated Spurious Emissions below 1GHz at 3 meter distance – Front View

14.2 Radiated Spurious Emissions below 1GHz at 3 meter distance – Rear View

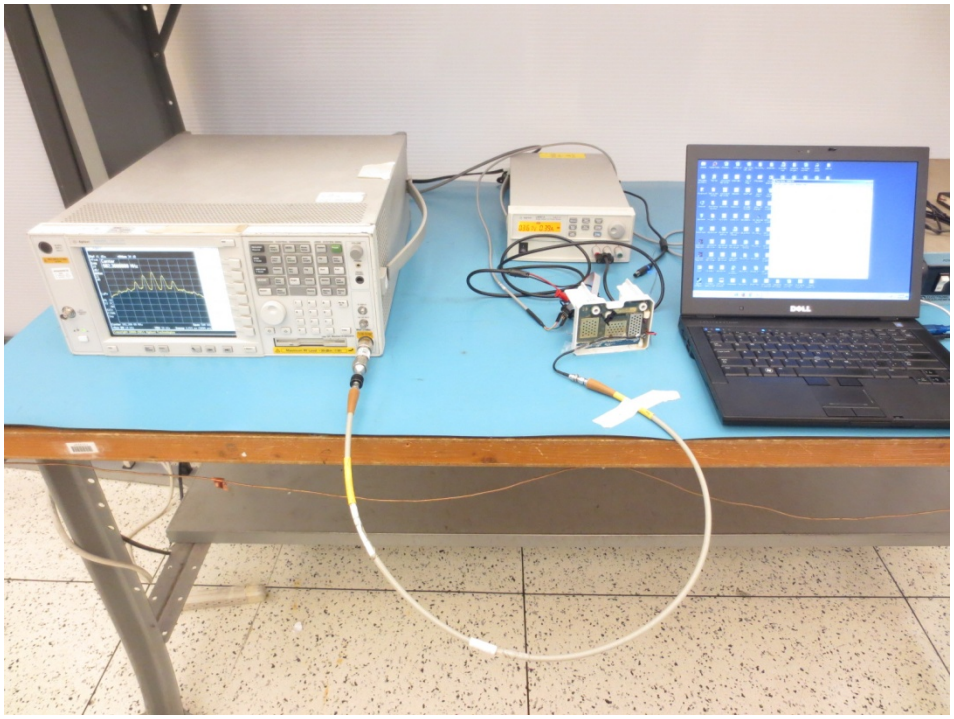


14.3 Radiated Spurious Emissions above 1GHz at 3 meter distance – Front View

14.4 Radiated Spurious Emissions above 1GHz at 3 meter distance – Rear View

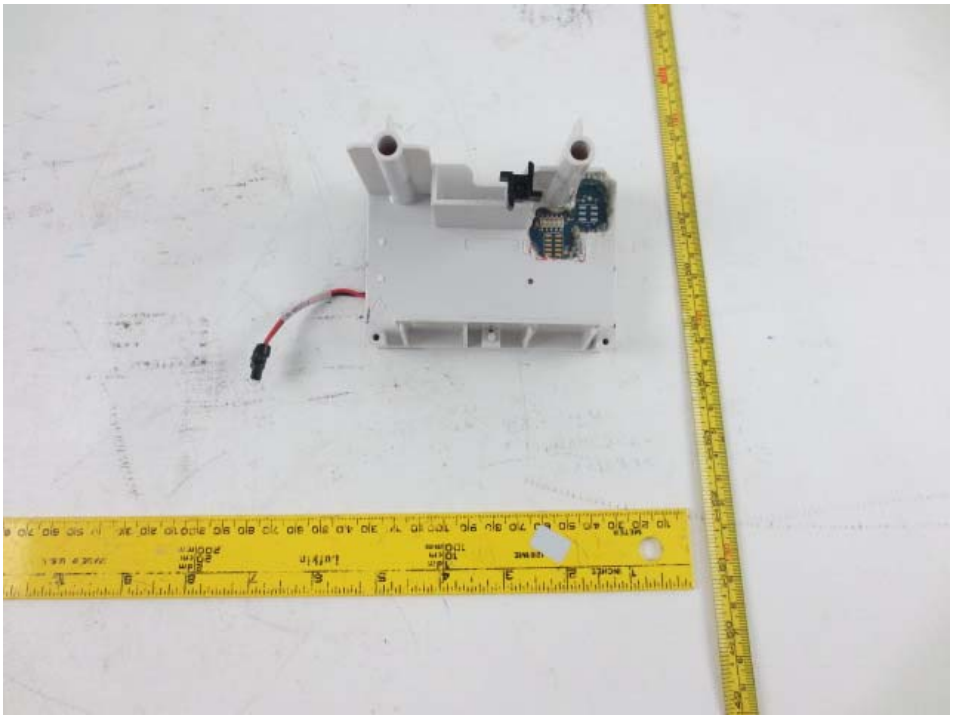


14.5 Conducted testing Setup

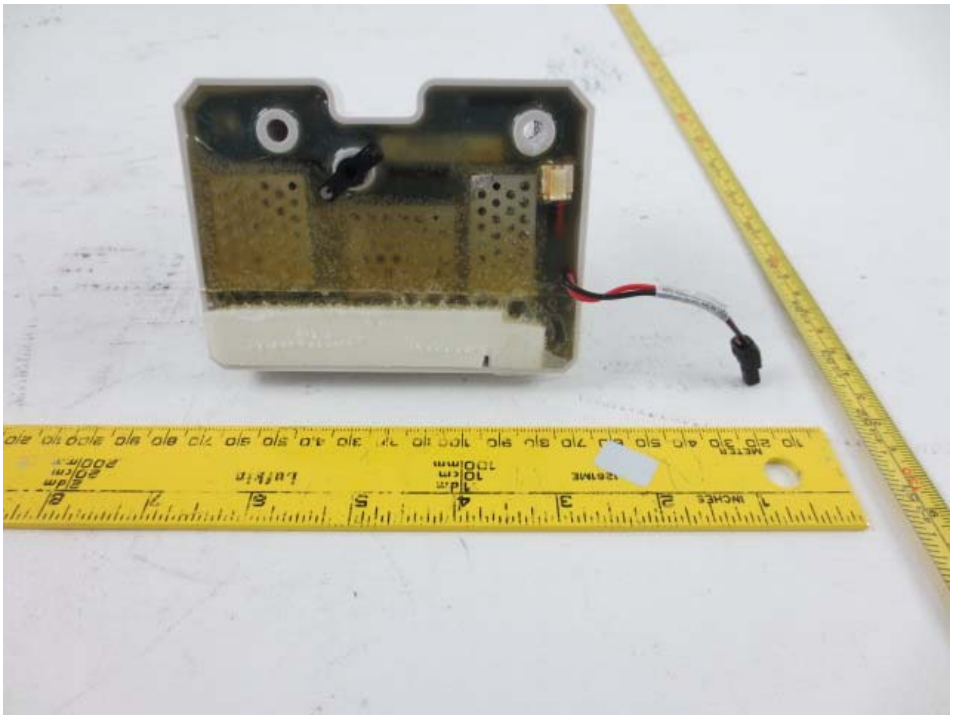


15 Exhibit C – EUT Photographs

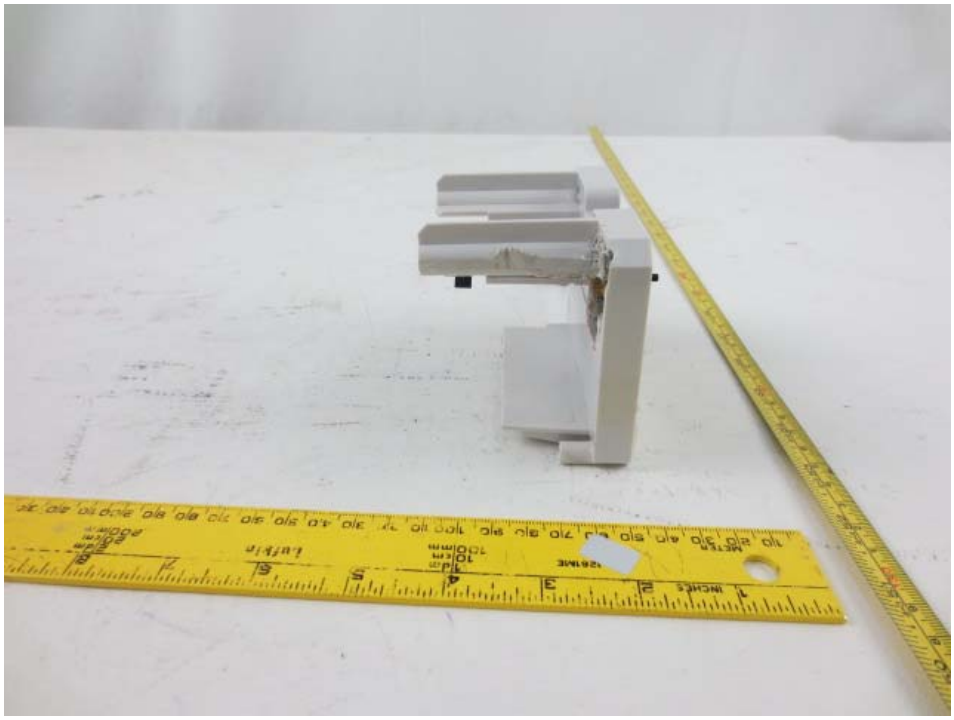
15.1 EUT – Front View



15.2 EUT – Rear View

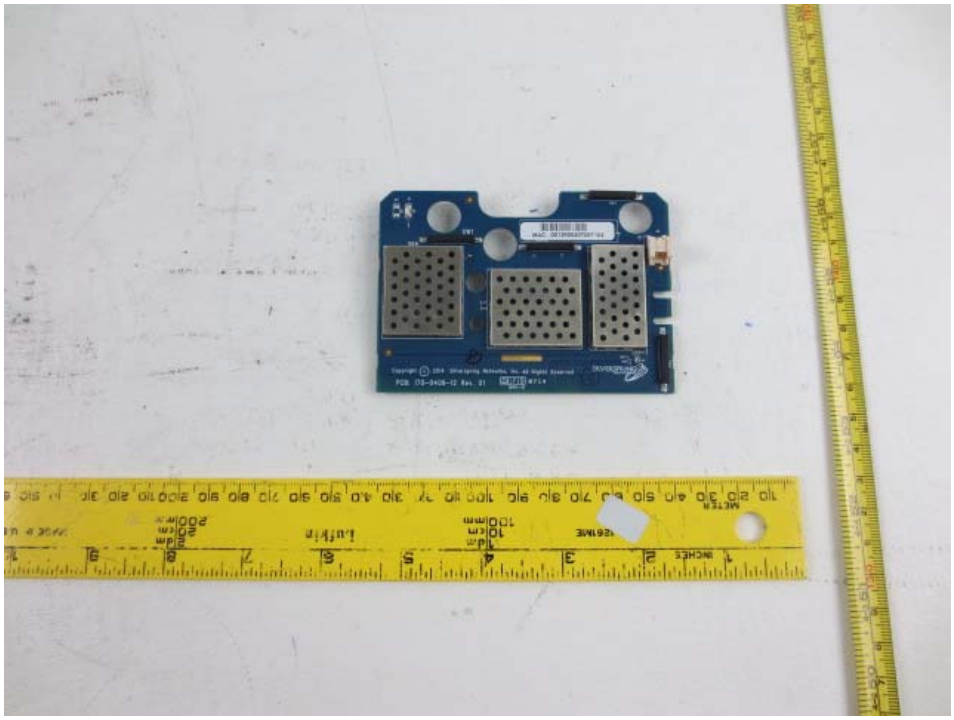


15.3 EUT – Side View

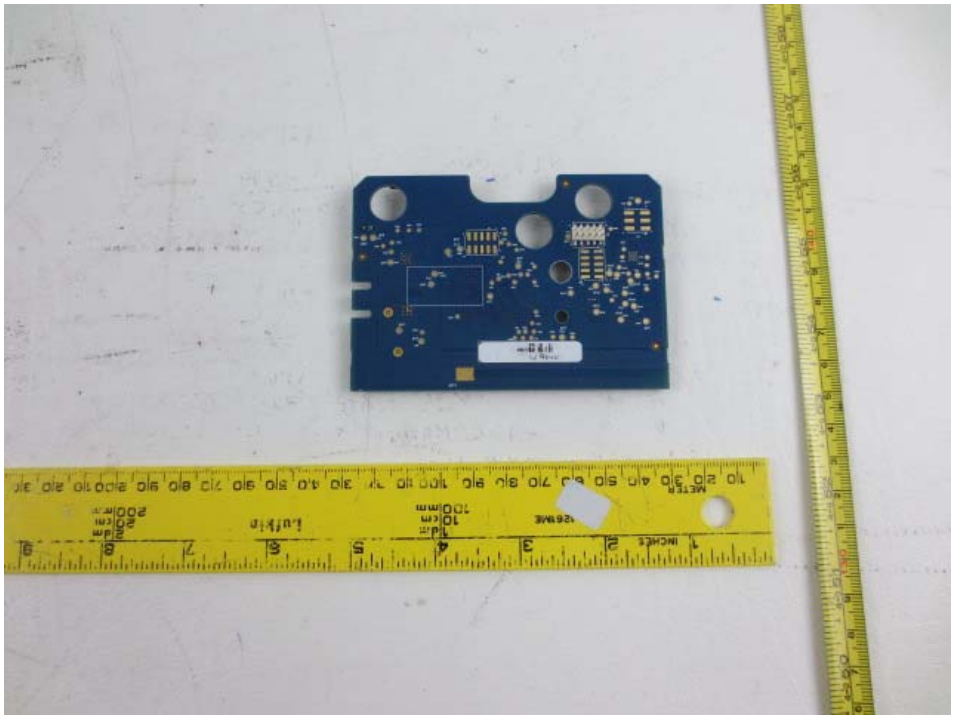


15.4 EUT – MAC Address View

15.5 EUT Main PCB – Front View



15.6 EUT Main PCB – Rear View



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