FCC PART 15.231
IC RSS-210, ISSUE 8
TEST AND MEASUREMENT REPORT

For

CentraLite Systems, Inc.

1000 Cody Road, Suite A, Mobile, Alabama 36695, USA

FCC ID: T3L-SS004
IC: 12192A-SS004

Report Type:	**Product Type:**
Original Report	Smart Sensor

Prepared By:	Jerry Tong Test Engineer
Report Number:	R1412025-231
Report Date:	2015-03-04
Reviewed By:	Bo Li RF Lead

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R1412025-231	Initial	2015-03-04

1 General Information

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report was prepared on behalf of *CentraLite Systems, Inc*., and their product FCC ID: T3L-SS004; IC: 12192A-SS004 model name: *3-Series Smart Garage Sensor, Model number: 3222* or the "EUT" as referred on this report. The EUT is a *Smart Sensor* operates in 433.92 MHz

1.2 Mechanical Description of EUT

The "EUT" measures approximately *6 cm (L) x 4 cm (W) x 1.4 cm (H)*, and weighs approximately *20* g.

The test data gathered are from typical production sample, serial number: R1412025-01 assigned by BACL.

1.3 Objective

This type approval report is prepared on behalf of *CentraLite Systems, Inc.*, in accordance with Part 2, Subpart J and Part 15, Subparts A, B and C of the Federal Communication Commission's rules.

The objective is to determine compliance with FCC rules for section 15.205, 15.209 and 15.231, RSS-Gen Issue 3 and RSS-210, Issue 8.

1.4 Related Submittal(s)/Grant(s)

Controller with FCC ID: T3L-SS003, IC: 12192A-SS003.

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.

All tests were performed at Bay Area Compliance Laboratories Corp.

1.6 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on CISPR16-4-2:2011, The Treatment of Uncertainty in EMC Measurements, the values ranging from $\pm$2.0 dB for Conducted Emissions tests and $\pm$4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

1.7 Test Facility

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 host system was configured for testing according to ANSI C63.4-2009.

EUT was connected and operational as in typical operating configuration, transmitting full power.

2.2 EUT Exercise Software

The EUT is in normal operation mode during the “Deactivation Time” testing. Except that, the EUT works in continuous transmit mode.

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Special Equipment

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

2.5 Local Support Equipment

N/A

2.6 EUT Internal Configuration Details

Manufacturer	Description	Model	Serial Number
Silicon Labs	FSK Transmitter/CPU	Si4010-C2-GR	-
ST	Micro Accelerometer	LIS3 DH	-

2.7 Power Supply List and Details

N/A

2.8 External I/O Cabling List and Details

There was no external I/O cabling used with the EUT.

3 Summary of Test Results

Results reported relate only to the product tested.

FCC & IC Rules	Description of Test	Result
FCC §15.203 IC RSS-Gen §8.3	Antenna Requirement	Compliant
FCC §15.231(a)(2) IC RSS-210 §A1.1.1(b)	Deactivation Time	Compliant
FCC §15.209, §15.231(b) IC RSS-210 §A1.1	Radiated Emissions	Compliant
FCC §15.207(a) IC RSS-Gen §8.8	AC Line Conducted Emission	N/A[1]
FCC §15.231(c) IC RSS-210 §A1.1.3	Emission Bandwidth	Compliant

[1] *EUT is battery powered.*

4 FCC §15.203 & IC RSS-Gen §8.3 – Antenna Requirements

4.1 Applicable Standards

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.

According to IC RSS-Gen §8.3: Transmitter Antenna for License-Exempt Radio Apparatus

The applicant for equipment certification, as per RSP-100, must provide a list of all antenna types that may be used with the license-exempt transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna.

License-exempt transmitters that have received equipment certification may operate with different types of antennas. However, it is not permissible to exceed the maximum equivalent isotopically radiated power (e.i.r.p.) limits specified in the applicable standard (RSS) for the license-exempt apparatus.

Testing shall be performed using the highest gain antenna of each combination of license-exempt transmitter and antenna type, with the transmitter output power set at the maximum level. 9 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 a measurement or on data from the antenna manufacturer.

User manuals for transmitters equipped with detachable antennas shall also contain the following notice in a conspicuous location:

This radio transmitter (identify the device by certification number) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi).

4.2 Antenna List

This antenna directly prints on the PCB board, it is non-replaceable, and it complies with the antenna requirement. The antenna gain is -20 dBi. Please refer to the internal photos.

5 FCC §15.231 (a) & IC RSS-210 §A1.1.1 (b) – Deactivation Time

5.1 Applicable Standards

According to FCC §15.231 (a) (2) and IC RSS-210 A1.1.1 (b), A transmitter activated automatically shall cease transmission within 5 seconds after activation.

5.2 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 via radiated Biconi-Log antenna. Then set it to any one convenient frequency within its operating range.
3. Set span to zero and record.
4. Repeat above procedures until all frequencies measured were complete.

5.3 Test Equipment List and Details

Manufacturers	Description	Model No.	Serial No.	Calibration Dates	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US 422221851	2014-08-26	1 Year
Sunol Sciences	Combination Antenna	JB3	A020106-3	2014-07-24	1 Year
Sunol Sciences	System Controller	SC99V	122303-1	N/R	N/R
Hewlett Packard	Pre-amplifier	8447D	2944A06639	2014-03-20	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:	59 %
ATM Pressure:	101.1 kPa

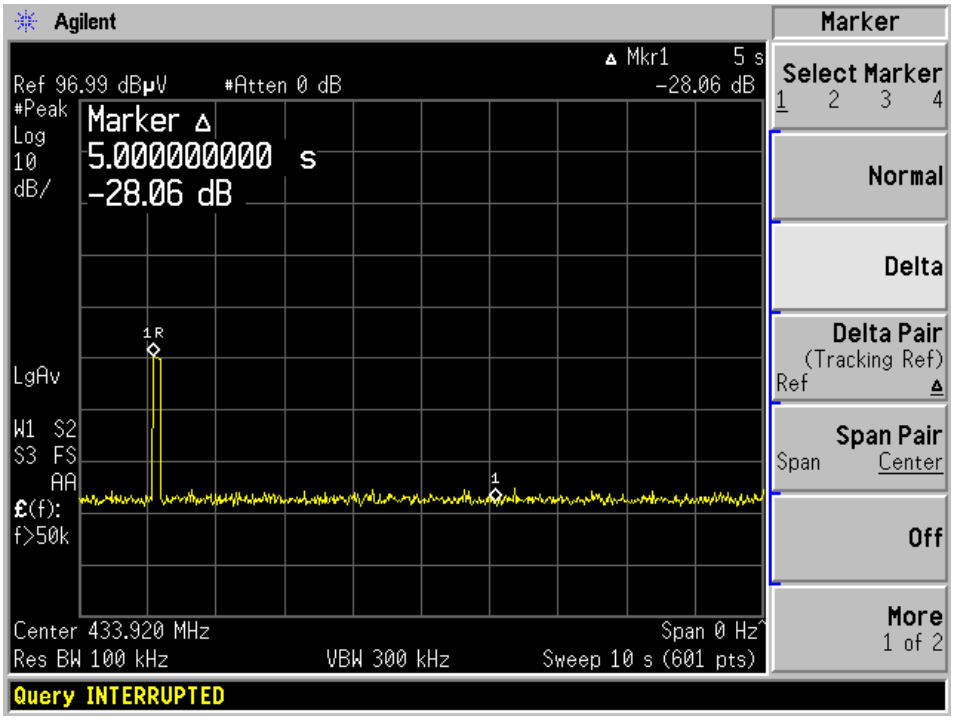
The testing was performed by Jerry Tong on 2015-03-02 at 5m chamber 2.

5.5 Test Results

Please refer to the following plots for detailed test results

Deactivation time (s)	Limit (s)	Result
0.1	< 5	Compliant

Deactivation Time



6 FCC §15.209, §15.231 (b) & IC RSS-210 §A1.1 – Radiated Emissions

6.1 Applicable Standards

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 §15.231(b): In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	11,250 to 3,750	1125 to 375
174-260	3,750	375
260-470	13,750 to 12,500	1375 to 1,250
Above 470	12,500	1,250

[1]Linear interpolations.

Pre IC RSS-210 §A1.1,

Fundamental Frequency (MHz), excluding restricted band frequencies of RSS-Gen	Field Strength of the Fundamental (Note 1) (microvolts/m at 3 metres)	Field Strength of Unwanted Emissions (Note 1) (microvolts/m at 3 metres)
40.66-40.70	See Section A2.7	
70-130	1,250	125
130-174	1,250 to 3,750*	125 to 375
174-260 (Note 2)	3,750	375
260-470 (Note 2)	3,750 to 12,500*	375 to 1,250
Above 470	12,500	1,250

Note 1: Limits on the field strength of emissions, as shown in this table, are based on the average value of the measured emissions. As an alternative, compliance with the limits in this table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector.

* Linear interpolation with frequency F in MHz:
For 130-174 MHz: FS (microvolts/m) = (56.82 x F)-6136
For 260-470 MHz: FS (microvolts/m) = (41.67 x F)-7083

6.2 Test Setup

The radiated emissions tests were performed using the setup accordance with the ANSI C63.4-2009. The specification used was the FCC Part 15.231 and IC RSS-210 §A1.1.

The spacing between the peripherals was 10 centimeters.

6.3 Test Procedure

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

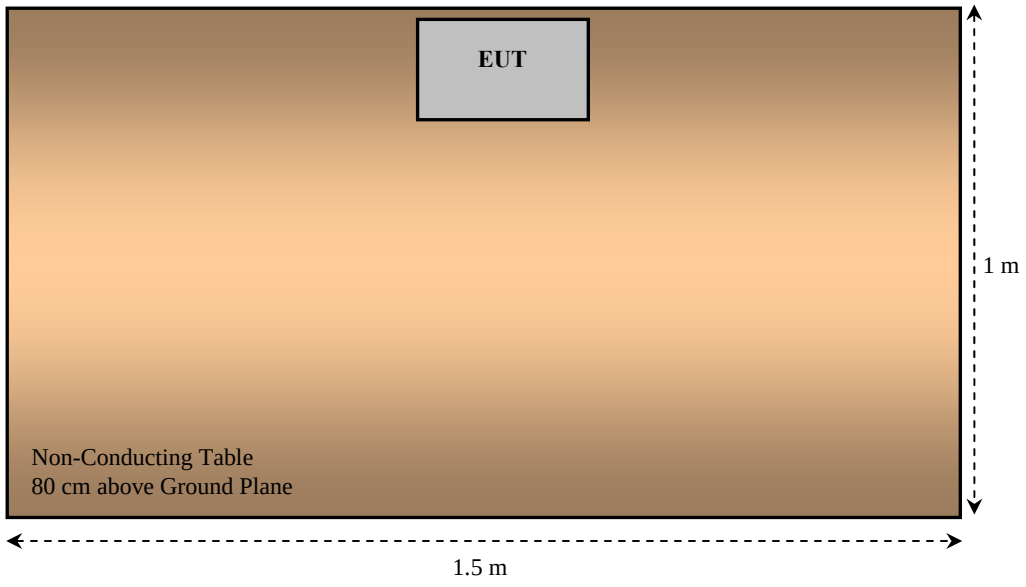
The EUT is set 3 meters away from the testing antenna, which is varied from 1-4 meters, and the EUT is placed on a turntable, which is 0.8 meter above ground plane, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both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

6.4 Test Setup Block Diagram



6.5 Corrected Amplitude & Margin Calculation

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

CA = Ai + AF + CL + Atten – Ga

For example, the Corrected Amplitude (CA) of 40.3 dBuV/m = indicated Amplitude reading (Ai) 32.5 dBuV + Antenna Factor (AF) 23.5dB + Cable Loss (CL) 3.7 dB + Attenuator (Atten) 10 dB - Amplifier Gain (Ga) 29.4 dB

Average Reading = Peak Reading (dBuV/m) + 20log (Duty Cycle), Where Duty Cycle is
(# of long pulses * long pulse width) + (# of short pulses * short pulse width) / 100 or T

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

Margin (dB) = Corrected Amplitude (dBuV/m) - Limit (dBuV/m)

6.6 Test Equipment List and Details

Manufacturers	Descriptions	Model No.	Serial No.	Calibration Dates	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US42221851	2014-08-26	1 Year
Eaton	Antenna, Horn	96001	2617	2014-11-18	1 Year
Hewlett Packard	Pre-amplifier	8447D	2944A06639	2014-03-20	1 Year
HP/ Agilant	Pre Amplifier	8449B	3008A0113	2014-03-10	1 Year
Sunol Sciences	Combination Antenna	JB3	A020106-2	2014-07-24	1 Year
Sunol Sciences	System Controller	SC99V	122303-1	N/R	N/R

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:	56 %
ATM Pressure:	101.3 kPa

The testing was performed by Jerry Tong on 2015-02-12 at 5m chamber 3.

6.8 Summary of Test Results

According to the data hereinafter, the EUT complied with the limits presented in FCC Title 47, Part 15.231 and IC RSS-210 §A1.1, and had the worst margin of:

Margin (dB)	Frequency (MHz)	Polarization (Horizontal/Vertical)	Comments
-14.816	1301.76	Horizontal	Average, Spurious

6.9 Radiated Emissions Results

Freq. (MHz)	S.A. Reading (dBuV)	Turntable Azimuth Degree	Test Antenna			Cable Loss (dB)	Pre-Amp. Gain (dB)	Cord. Amp. (dBµV/m)	FCC Part 15.231(b) IC RSS-210 §A1.1		
			Height (cm)	Polar. (H/V)	Factor (dB/m)				Limit (dBuV/m)	Margin (dB)	Comment
433.92	67.64	81	100	V	6	0.28	28.12	45.8	101	-55.20	Peak/Fund.
433.92	87.48	0	100	H	6	0.28	28.12	65.64	101	-35.36	Peak/Fund.
868.02	56.13	40	100	V	6.6	0.28	28.13	34.88	81	-46.12	Peak/Harm
868.02	69.87	113	100	H	6.6	0.28	28.13	48.62	81	-32.38	Peak/Harm
1301.76	68.97	80	100	V	6.087	2.26	32.77	44.547	74	-29.45	Peak/Spur
1301.76	80.31	90	100	H	6.194	2.26	32.77	55.994	74	**-18.01**	Peak/Spur
1735.68	74.95	241	100	V	9.086	2.59	33.08	53.546	81	-27.45	Peak/Harm
1735.68	82.43	323	100	H	8.924	2.59	33.08	60.864	81	-20.14	Peak/Harm
2169.6	64.29	82	100	V	9.691	2.8	33.16	43.621	81	-37.38	Peak/Harm
2169.6	73.61	0	100	H	9.577	2.8	33.16	52.827	81	-28.17	Peak/Harm
2603.52	67.68	80	100	V	9.448	3.02	33.21	46.938	81	-34.06	Peak/Harm
2603.52	72.88	162	100	H	9.471	3.02	33.21	52.161	81	-28.84	Peak/Harm
3037.44	68.05	81	100	V	9.721	3.3	33.81	47.261	81	-33.74	Peak/Harm
3037.44	73.73	40	100	H	9.695	3.3	33.81	52.915	81	-28.09	Peak/Harm
3471.36	60.62	0	100	V	9.73	3.48	35	38.83	81	-42.17	Peak/Harm
3471.36	63.4	69	100	H	9.664	3.48	35	41.544	81	-39.46	Peak/Harm
3905.28	56.71	121	100	V	9.298	3.83	35.04	34.798	74	-39.20	Peak/Spur
3905.28	54.8	80	100	H	9.257	3.83	35.04	32.847	74	-41.15	Peak/Spur
4339.2	55.95	84	100	V	10.768	4.11	34.84	35.988	74	-38.01	Peak/Spur
4339.2	52.53	0	100	H	10.85	4.11	34.84	32.65	74	-41.35	Peak/Spur

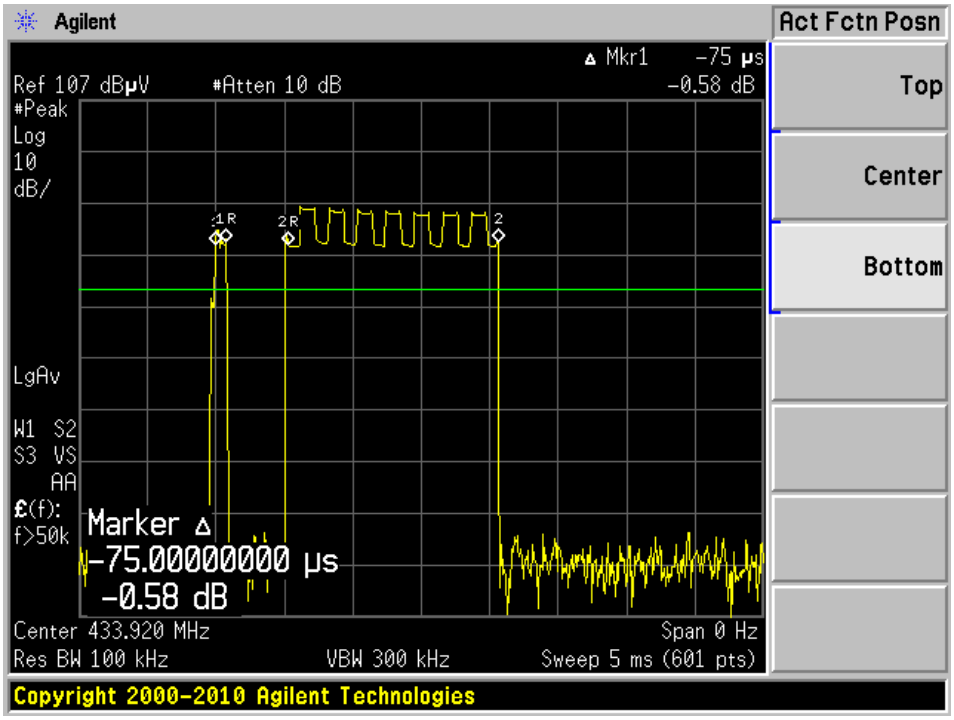
Field Strength of Average Emission							
Freq. (MHz)	Peak Measurement at 3m (dBuV/m)	Polar (H/V)	Duty Cycle Correlation Factor(dB)	Corrected Ampitude (dBµV/m)	FCC Part 15.231(b) IC RSS-210 §A1.1		
					Limit (dBuV/m)	Margin (dB)	Comment
433.92	45.8	V	-16.81	28.99	81	-52.01	Ave/Fund.
433.92	65.64	H	-16.81	48.83	81	-32.17	Ave/Fund.
868.02	34.88	V	-16.81	18.07	61	-42.93	Ave/Harm.
868.02	48.62	H	-16.81	31.81	61	-29.19	Ave/Harm.
1301.76	44.547	V	-16.81	27.737	54	-26.263	Ave/Spur.
1301.76	55.994	H	-16.81	39.184	54	**-14.816**	Ave/Spur.
1735.68	53.546	V	-16.81	36.736	61	-24.264	Ave/Harm.
1735.68	60.864	H	-16.81	44.054	61	-16.946	Ave/Harm.
2169.6	43.621	V	-16.81	26.811	61	-34.189	Ave/Harm.
2169.6	52.827	H	-16.81	36.017	61	-24.983	Ave/Harm.
2603.52	46.938	V	-16.81	30.128	61	-30.872	Ave/Harm.
2603.52	52.161	H	-16.81	35.351	61	-25.649	Ave/Harm.
3037.44	47.261	V	-16.81	30.451	61	-30.549	Ave/Harm.
3037.44	52.915	H	-16.81	36.105	61	-24.895	Ave/Harm.
3471.36	38.83	V	-16.81	22.02	61	-38.98	Ave/Harm.
3471.36	41.544	H	-16.81	24.734	61	-36.266	Ave/Harm.
3905.28	34.798	V	-16.81	17.988	54	-36.012	Ave/Spur.
3905.28	32.847	H	-16.81	16.037	54	-37.963	Ave/Spur.
4339.2	35.988	V	-16.81	19.178	54	-34.822	Ave/Spur.
4339.2	32.65	H	-16.81	15.84	54	-38.16	Ave/Spur.

Note: Fundamental = 433.92 MHz

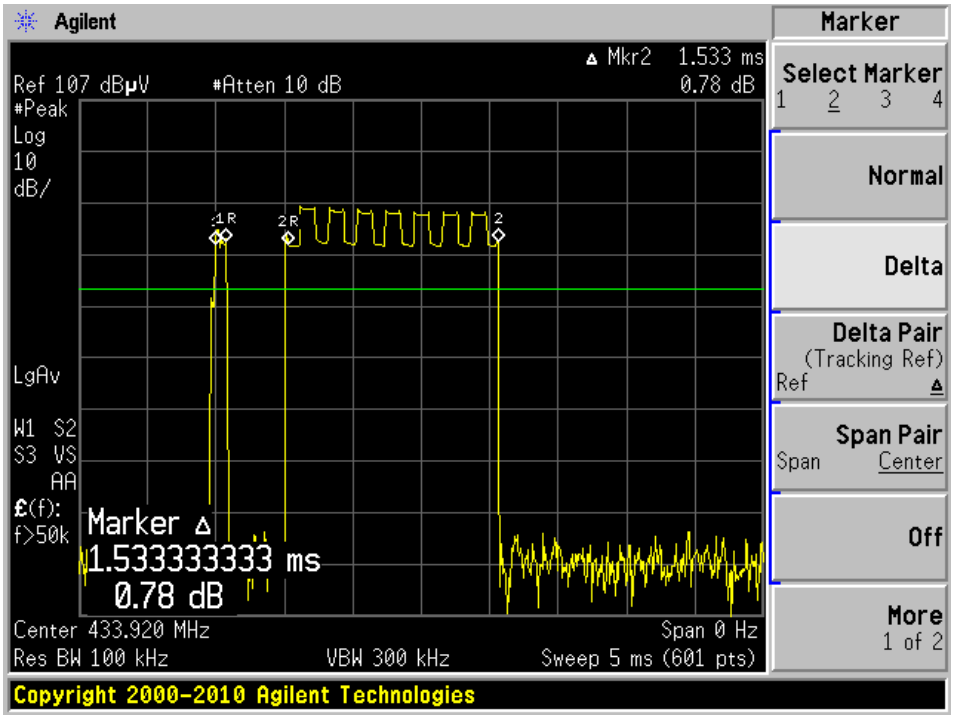
Duty Cycle Correction Factor Calculation:

One Period (ms)	Long Pulse Width (ms)	# of Long Pulse	Short Pulse Width (ms)	# of Short Pulse	Duty Cycle	20*Log Duty Cycle (dB)
100	1.53	9	0.075	9	0.144	-16.81

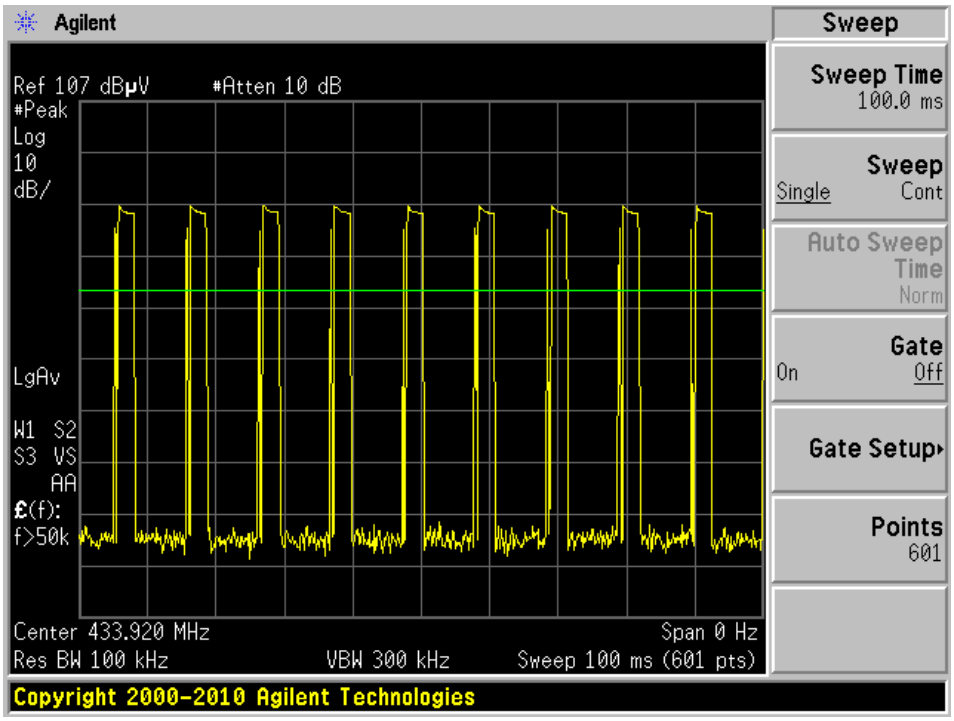
Short Pulse Width



Long Pulse Width



Number of Pulses



7 FCC §15.231 (c) & IC RSS-210 §A1.1.3 - Emission Bandwidth

7.1 Applicable Standards

FCC §15.231(c)

(c) The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

IC RSS-210 §A1.1.3

For the purpose of Section A1.1, the 99% Bandwidth shall be no wider than 0.25% of the center frequency for devices operating between 70-900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency.

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 via radiated horn antenna. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emissions bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

7.3 Test Equipment List and Details

Manufacturers	Description	Model No.	Serial No.	Calibration Dates	Calibration Interval
Agilent	Spectrum Analyzer	E4440A	US42221851	2014-08-26	1 year
Sunol Sciences	Combination Antenna	JB3	A020106-2	2014-07-24	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:	59 %
ATM Pressure:	101.1 kPa

The testing was performed by Jerry Tong on 2015-02-12 at 5 meter chamber 3.

7.5 Test Results

Please refer to the following plots for detailed test result.

Frequency	20 dB OBW (kHz)	99% OBW (kHz)	Limit (kHz)	Result
433.92	164.357	161.8332	1084.8	Compliant

Note: Limit = 433.92 MHz *0.25%= 1084.8 kHz

Emission Bandwidth