



## FCC PART 15.247

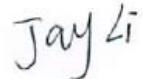
### TEST REPORT

For

**Sierra Lingo, LLC**

233 Route 17 Suite #8, Tuxedo Park, New York, United States, 10987

**FCC ID: 2AAOW0EOSTHERMOSTAT**

<b>Report Type:</b> Original Report	<b>Product Type:</b> wifi thermostat
<b>Test Engineer:</b> <u>Jay Li</u> 	
<b>Report Number:</b> <u>RSZ150427550-00</u>	
<b>Report Date:</b> <u>2015-06-25</u>	
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**Note:** This test report is prepared for the customer shown above and for the equipment described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp.

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## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

The *Sierra Lingo, LLC*'s product, model number: *SL-EOS-1100 (FCC ID: (2AAOW0EOSTHERMOSTAT)* or the "EUT" in this report was a *wifi thermostat*, which was measured approximately: 8.5cm (L) \* 8.5cm (W) \* 2.5 cm (H), rated with input voltage: AC 24V/60 Hz.

*\*All measurement and test data in this report was gathered from production sample serial number: 1504025 (Assigned by BACL, Shenzhen). The EUT supplied by the applicant was received on 2015-04-27.*

### Objective

This report is prepared on behalf of *Sierra Lingo, LLC* in accordance with Part 2-Subpart J, Part 15-Subparts A, B and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

### Related Submittal(s)/Grant(s)

No related submittal(s).

### Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement uncertainty with RF radiated emission is 5.91 dB for 30MHz-1GHz and 4.92 dB for above 1GHz, 1.95dB for conducted measurement.

### Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F, the 3<sup>rd</sup> Phase of WanLi Industrial Building, ShiHua Road, FuTian Free Trade Zone Shenzhen, Guangdong, China.

Test site at Bay Area Compliance Laboratories Corp. (Shenzhen) has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on December 06, 2010. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2009.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 382179. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

For 802.11b, 11 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437	/	/

EUT was tested with Channel 1, 6 and 11.

### Equipment Modifications

No modification was made to the EUT tested.

### EUT Exercise Software

Wifi test in the default power level.

### Support Equipment List and Details

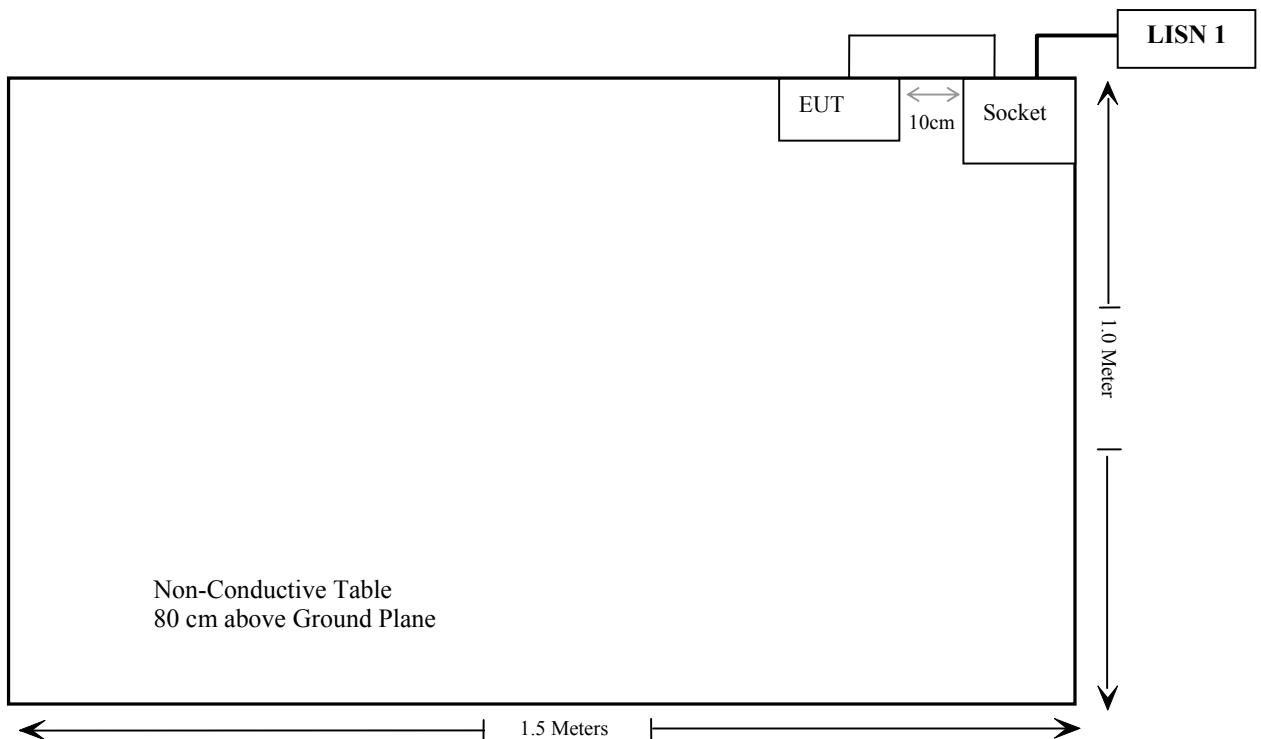
Manufacturer	Description	Model	Serial Number
N/A	variable-voltage transformer	TDGC2G-3	201102
N/A	Socket	N/A	DZ001

### External I/O Cable

Cable Description	Length (m)	From/Port	To
Un-shielding Un-detachable AC Cable	1.5	LISN	Socket
Un-shielding detachable AC Cable	1.0	EUT	Socket

### Block Diagram of Test Setup

For conducted emission



## SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §1.1307 (b)(1), §2.1091	Maximum Permissible Exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	Conducted Emissions	Compliance
§15.247(d)	Spurious Emissions at Antenna Port	Compliance*
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(2)	6 dB Bandwidth	Compliance*
§15.247(b)(3)	Maximum Peak Output Power	Compliance*
§15.247(d)	100kHz Bandwidth of Frequency Band Edge	Compliance*
§15.247(e)	Power Spectral Density	Compliance*

Note: Compliance\*: The device uses a module which was tested in Shenzhen Anbotek Commpliance Laboratory Limited with FCC ID: AZY-HF-LPB100 which Report NO.: 201311816F and it was granted on 2013-12-23. The data and photos refer to it.

## FCC §15.247 (i) & §1.1307 (b) (1) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

### Applicable Standard

According to subpart 15.247 (i) and subpart 1.1307 (b)(1), 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

#### Limits for General Population/Uncontrolled Exposure

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Averaging Time (Minutes)
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	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

### Result

#### Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm<sup>2</sup>)

P = power input to the antenna (in appropriate units, e.g., mW).

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

Frequency (MHz)	Antenna Gain		Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )
	(dBi)	(numeric)	(dBm)	(mW)			
2412	5	3.16	16.65	46.24	20	0.0291	1

Note: To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

#### Result: Compliance

## **FCC §15.203 - ANTENNA REQUIREMENT**

### **Applicable Standard**

According to § 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 user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
- b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### **Antenna Connector Construction**

The EUT has an internal monopole antenna arrangement for Wi-Fi which the gain was 5.0dBi; fulfill the requirement of this section. Please refer to the internal photos.

**Result:** Compliance.

## FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

### Applicable Standard

FCC§15.207

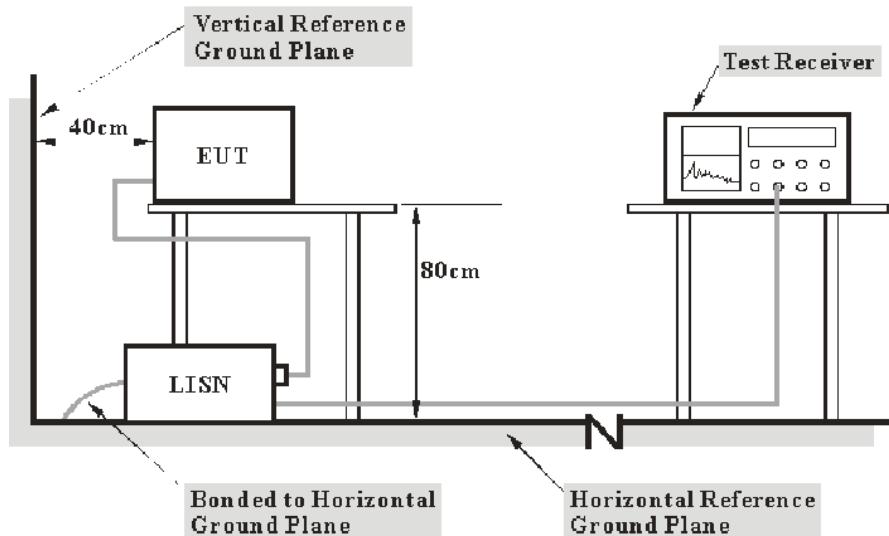
### Measurement Uncertainty

Input quantities to be considered for conducted disturbance measurements maybe receiver reading, attenuation of the connection between LISN and receiver, LISN voltage division factor, LISN VDF frequency interpolation and receiver related input quantities, etc.

Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of conducted disturbance test at Bay Area Compliance Laboratories Corp. (Shenzhen) is shown as below. And the uncertainty will not be taken into consideration for the test data recorded in the report.

Port	Expanded Measurement uncertainty
AC Mains	3.26 dB (k=2, 95% level of confidence)
CAT 3	3.70 dB (k=2, 95% level of confidence)
CAT 5	3.86 dB (k=2, 95% level of confidence)
CAT 6	4.64 dB (k=2, 95% level of confidence)

### EUT Setup



Note: 1. Support units were connected to second LISN.  
 2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The Socket was connected to a 24 VAC/60 Hz power source.

## EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

## Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the LISN.

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

All final data was recorded in the Quasi-peak and average detection mode.

## Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCS30	100176	2015-06-03	2016-06-03
Rohde & Schwarz	LISN	ENV216	3560.6650.12-101613-Yb	2014-12-01	2015-12-01
Rohde & Schwarz	Transient Limiter	ESH3Z2	DE25985	2014-10-15	2015-10-15
Rohde & Schwarz	CE Test software	EMC 32	V8.53	NCR	NCR

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

## Corrected Factor & Margin Calculation

The Corrected factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

$$\text{Correction Factor} = \text{LISN VDF} + \text{Cable Loss} + \text{Transient Limiter Attenuation}$$

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

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

## Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207, the worst margin reading as below:

**25.8 dB at 1.033270 MHz in the Line conducted mode**

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(Lm)} \leq L_{lim} + U_{cisp}$$

In BACL,  $U_{(Lm)}$  is less than  $U_{cisp}$ , if  $L_m$  is less than  $L_{lim}$ , it implies that the EUT complies with the limit.

## Test Data

### Environmental Conditions

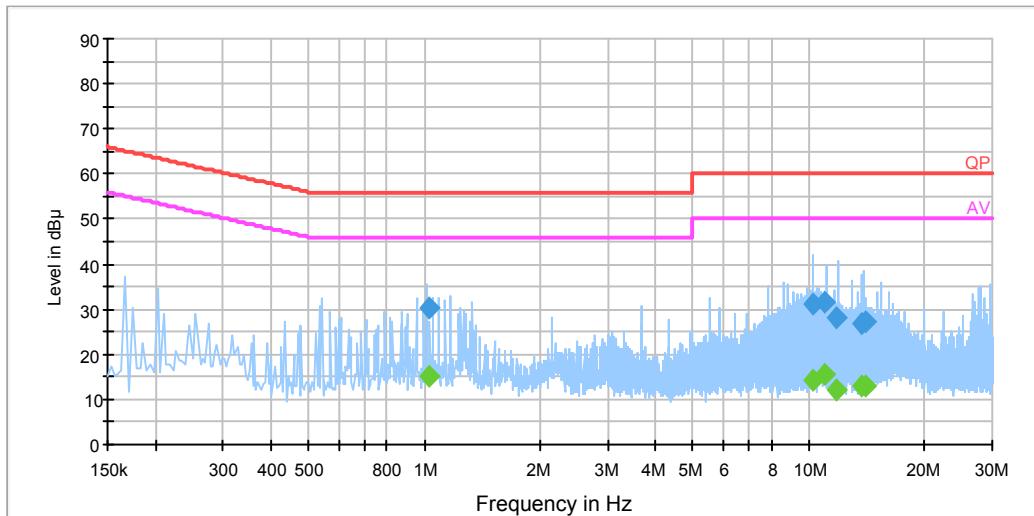
<b>Temperature:</b>	27°C
<b>Relative Humidity:</b>	50 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Jay Li on 2015-06-17.*

*EUT operation mode: Transmitting*

## AC 24V/60 Hz, Line

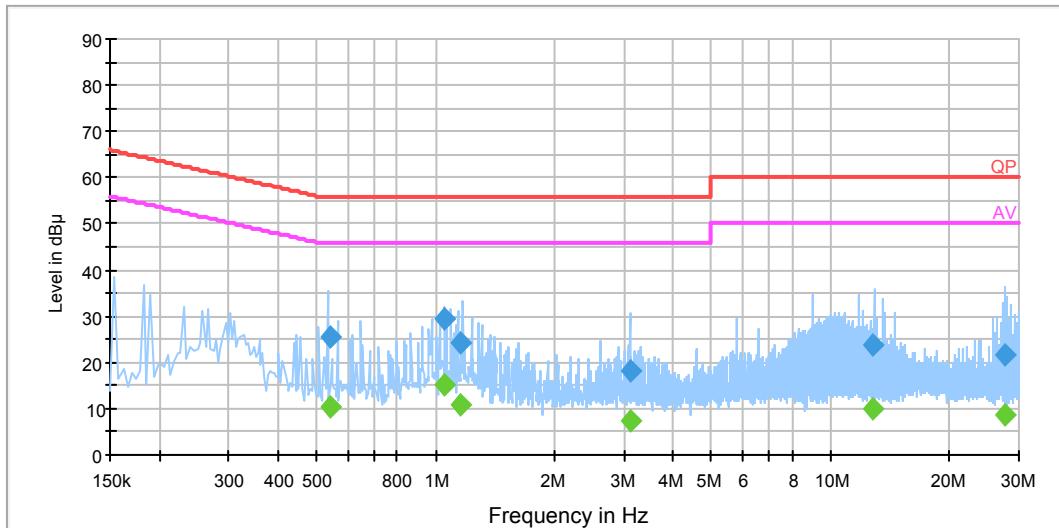
EMI Auto Test L



Frequency (MHz)	Corrected Amplitude (dB $\mu$ V)	Correction Factor (dB)	Limit (dB $\mu$ V)	Margin (dB)	Detector (PK/Ave./QP)
1.033270	30.2	20.0	56.0	25.8	QP
1.033270	15.0	20.0	46.0	31.0	Ave.
10.211950	31.0	20.1	60.0	29.0	QP
10.211950	14.3	20.1	50.0	35.7	Ave.
10.979110	31.5	20.1	60.0	28.5	QP
10.979110	15.7	20.1	50.0	34.3	Ave.
11.802450	28.2	20.1	60.0	31.8	QP
11.802450	12.0	20.1	50.0	38.0	Ave.
13.768770	27.0	20.1	60.0	33.0	QP
13.768770	13.1	20.1	50.0	36.9	Ave.
13.985050	27.5	20.1	60.0	32.5	QP
13.985050	13.0	20.1	50.0	37.0	Ave.

## AC 24V/60 Hz, Neutral

EMI Auto Test N



Frequency (MHz)	Corrected Amplitude (dB $\mu$ V)	Correction Factor (dB)	Limit (dB $\mu$ V)	Margin (dB)	Detector (PK/Ave./QP)
0.542010	25.5	19.9	56.0	30.5	QP
0.542010	10.3	19.9	46.0	35.7	Ave.
1.050130	29.5	20.0	56.0	26.5	QP
1.050130	15.1	20.0	46.0	30.9	Ave.
1.160390	24.3	20.0	56.0	31.7	QP
1.160390	10.9	20.0	46.0	35.1	Ave.
3.119470	18.0	20.0	56.0	38.0	QP
3.119470	7.2	20.0	46.0	38.8	Ave.
12.760890	23.7	20.1	60.0	36.3	QP
12.760890	10.1	20.1	50.0	39.9	Ave.
27.666590	21.7	20.2	60.0	38.3	QP
27.666590	8.7	20.2	50.0	41.3	Ave.

**Note:**

- 1) Correction Factor =LISN VDF (Voltage Division Factor) + Cable Loss + Transient Limiter Attenuation
- 2) Corrected Amplitude = Reading + Correction Factor
- 3) Margin = Limit – Corrected Amplitude

## **FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS**

### **Applicable Standard**

FCC §15.247 (d); §15.209; §15.205;

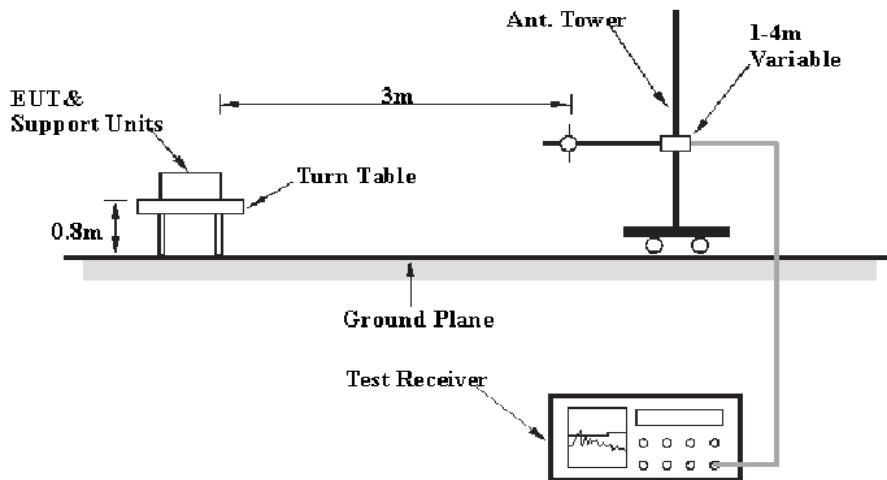
### **Measurement Uncertainty**

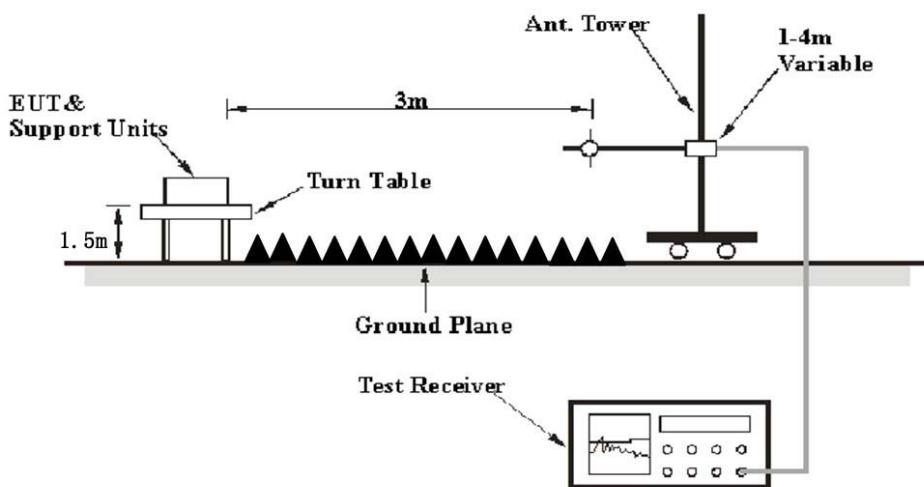
All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency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

Based on CISPR 16-4-2:2011, the expended combined standard uncertainty of radiation emissions at Bay Area Compliance Laboratories Corp. (Shenzhen) is 5.91 dB for 30MHz-1GHz and 4.92 dB for above 1GHz, 1.95dB for conducted measurement at antenna port. And the uncertainty will not be taken into consideration for the test data recorded in the report

### **EUT Setup**

**Below 1 GHz:**



**Above 1GHz:**

The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

The Socket was connected to a 24 VAC/60 Hz power source.

**EMI Test Receiver & Spectrum Analyzer Setup**

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Detector
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	Ave.

**Test Procedure**

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

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1 GHz, peak and Average detection modes for frequencies above 1 GHz.

## Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
HP	Amplifier	HP8447E	1937A01046	2015-05-06	2016-05-06
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2014-11-03	2015-11-03
Sunol Sciences	Broadband Antenna	JB3	A111513	2014-06-18	2017-06-17
Mini	Amplifier	ZVA-183-S+	5969001149	2015-04-23	2016-04-23
A.H. System	Horn Antenna	SAS-200/571	135	2013-02-11	2016-02-10
Rohde & Schwarz	Signal Analyzer	FSIQ26	837405/023	2014-08-22	2015-08-22
the electro-Mechanics Co.	Horn Antenna	3116	9510-2270	2013-10-14	2016-10-13
TDK	Chamber	Chamber A	2#	2012-10-15	2015-10-15
TDK	Chamber	Chamber B	1#	2014-07-22	2015-07-22
DUCOMMUN	Pre-amplifier	ALN-22093530-01	991373-01	2014-08-03	2015-08-03
R&S	Auto test Software	EMC32	V9.10	NCR	NCR

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

## Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

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

## Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247.

**8.46 dB at 9848.00 MHz in the Horizontal polarization for 802.11b mode High channel**

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(Lm)} \leq L_{\text{lim}} + U_{\text{cisp}}$$

In BACL,  $U_{(Lm)}$  is less than  $U_{\text{cisp}}$ , if  $L_m$  is less than  $L_{\text{lim}}$ , it implies that the EUT complies with the limit.

## Test Data

### Environmental Conditions

Temperature:	27 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Jay Li on 2015-06-17.

EUT operation mode: Transmitting

30 MHz-25 GHz:

802.11b Mode:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dB $\mu$ V/m)	FCC Part 15.247/205/209	
	Reading (dB $\mu$ V)	Detector (PK/QP/Ave.)		Height (m)	Polar (H/V)			Limit (dB $\mu$ V/m)	Margin (dB)
Low Channel (2412 MHz)									
262.11	47.41	QP	27	1.5	H	-14.8	32.61	46	13.39
2412.00	102.68	PK	186	1.5	H	4.27	106.95	/	/
2412.00	88.75	Ave.	186	1.5	H	4.27	93.02	/	/
2412.00	96.47	PK	112	1.6	V	4.17	100.64	/	/
2412.00	84.30	Ave.	112	1.6	V	4.17	88.47	/	/
2389.75	56.23	PK	180	1.2	H	4.27	60.50	74	13.50
2389.75	39.67	Ave.	180	1.2	H	4.27	43.94	54	10.06
2485.19	41.44	PK	282	2.5	H	7.99	49.43	74	24.57
2485.19	20.52	Ave.	282	2.5	H	7.99	28.51	54	25.49
2968.45	37.01	PK	130	1.1	V	11.08	48.09	74	25.91
2968.45	21.26	Ave.	130	1.1	V	11.08	32.34	54	21.66
4824.00	35.25	PK	273	2.2	H	18.31	53.56	74	20.44
4824.00	21.68	Ave.	273	2.2	H	18.31	39.99	54	14.01
7236.00	35.67	PK	45	2.0	H	22.28	57.95	74	16.05
7236.00	21.98	Ave.	45	2.0	H	22.28	44.26	54	9.74
9648.00	35.10	PK	99	2.0	V	25.22	60.32	74	13.68
9648.00	19.16	Ave.	99	2.0	V	25.22	44.38	54	9.62

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dB $\mu$ V/m)	FCC Part 15.247/205/209	
	Reading (dB $\mu$ V)	Detector (PK/QP/Ave.)		Height (m)	Polar (H/V)			Limit (dB $\mu$ V/m)	Margin (dB)
Middle Channel (2437 MHz)									
262.11	47.53	QP	27	1.5	H	-14.8	32.73	46	13.27
2437.00	101.58	PK	277	1.4	H	4.27	105.85	/	/
2437.00	86.67	Ave.	277	1.4	H	4.27	90.94	/	/
2437.00	94.32	PK	84	1.3	V	4.17	98.49	/	/
2437.00	80.46	Ave.	84	1.3	V	4.17	84.63	/	/
2354.88	38.66	PK	168	1.4	H	4.27	42.93	74	31.07
2354.88	23.52	Ave.	168	1.4	H	4.27	27.79	54	26.21
2484.38	42.22	PK	170	1.2	H	7.99	50.21	74	23.79
2484.38	20.52	Ave.	170	1.2	H	7.99	28.51	54	25.49
2815.69	37.13	PK	329	1.3	V	8.01	45.14	74	28.86
2815.69	22.91	Ave.	329	1.3	V	8.01	30.92	54	23.08
4874.00	36.32	PK	67	1.9	V	19.41	55.73	74	18.27
4874.00	22.22	Ave.	67	1.9	V	19.41	41.63	54	12.37
7311.00	35.88	PK	104	1.6	V	22.60	58.48	74	15.52
7311.00	21.64	Ave.	104	1.6	V	22.60	44.24	54	9.76
9748.00	35.21	PK	136	1.9	H	25.02	60.23	74	13.77
9748.00	19.18	Ave.	136	1.9	H	25.02	44.20	54	9.80
High Channel (2462 MHz)									
262.11	47.11	QP	27	1.5	H	-14.8	32.31	46	13.69
2462.00	98.02	PK	49	1.1	H	7.99	106.01	/	/
2462.00	91.79	Ave.	49	1.1	H	7.99	99.78	/	/
2462.00	97.21	PK	151	2.2	V	7.59	104.80	/	/
2462.00	89.52	Ave.	151	2.2	V	7.59	97.11	/	/
2380.77	37.42	PK	98	1.5	H	4.27	41.69	74	32.31
2380.77	24.66	Ave.	98	1.5	H	4.27	28.93	54	25.07
2489.79	41.87	PK	10	1.7	H	7.99	49.86	74	24.14
2489.79	20.52	Ave.	10	1.7	H	7.99	28.51	54	25.49
2492.56	37.83	PK	69	2.5	V	7.59	45.42	74	28.58
2492.56	21.73	Ave.	69	2.5	V	7.59	29.32	54	24.68
4924.00	36.24	PK	272	1.1	V	19.41	55.65	74	18.35
4924.00	21.40	Ave.	272	1.1	V	19.41	40.81	54	13.19
7386.00	35.87	PK	131	1.7	V	21.54	57.41	74	16.59
7386.00	20.77	Ave.	131	1.7	V	21.54	42.31	54	11.69
9848.00	35.24	PK	76	1.9	H	26.09	61.33	74	12.67
9848.00	19.45	Ave.	76	1.9	H	26.09	45.54	54	8.46

**Note:**

Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

Corrected Amplitude = Corrected Factor + Reading

Margin = Limit - Corrected. Amplitude

**\*\*\*\*\* END OF REPORT \*\*\*\*\***