

FCC PART 15.249

## TEST REPORT

For

### Light Engine Limited

6/F, Photonics Centre, 2 Science Park East Avenue,  
Hong Kong Science Park, Shatin, Hong Kong

**FCC ID: WNY6401404405**

<b>Report Type:</b> Original Report	<b>Product Type:</b> Inline ON/OFF Dimmer Switch
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<b>Report Number:</b> RSZ11031452-00	
<b>Report Date:</b> 2011-09-19	
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\* This report contains data that are not covered by the NVLAP accreditation and are marked with an asterisk "★" (Rev.2)

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## GENERAL INFORMATION

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

The *Light Engine Limited* 's product, model *P168 mother* (FCC ID: WNY6401404405), or the "EUT" as referred to in this report is a Inline ON/OFF Dimmer Switch, which measures approximately: 10.0 cm (L) x 5.1 cm (W) x 4.0 cm (H), rated input voltage: 24 V from power line.

*\* All measurement and test data in this report was gathered from production sample serial number: 1103011 (Assigned by BACL, Shenzhen). The EUT was received on 2011-03-14.*

### Objective

This Type approval report is prepared on behalf of *Light Engine Limited* in accordance with Part 2, Subpart J, and 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 15.249 rules.

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

N/A.

### Test Methodology

All measurements contained in this report were conducted 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 radiated and conducted 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.

### Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located in the 6/F, the 3rd 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.

Additionally, Bay Area Compliance Laboratories Corp. (Shenzhen) is an ISO/IEC 17025 accredited laboratory, and is accredited by National Voluntary Laboratory Accredited Program (Lab Code 200707-0).



The current scope of accreditations can be found at <http://ts.nist.gov/Standards/scopes/2007070.htm>

## SYSTEM TEST CONFIGURATION

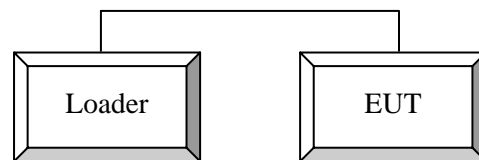
### Justification

The system was configured for testing in an engineering mode.

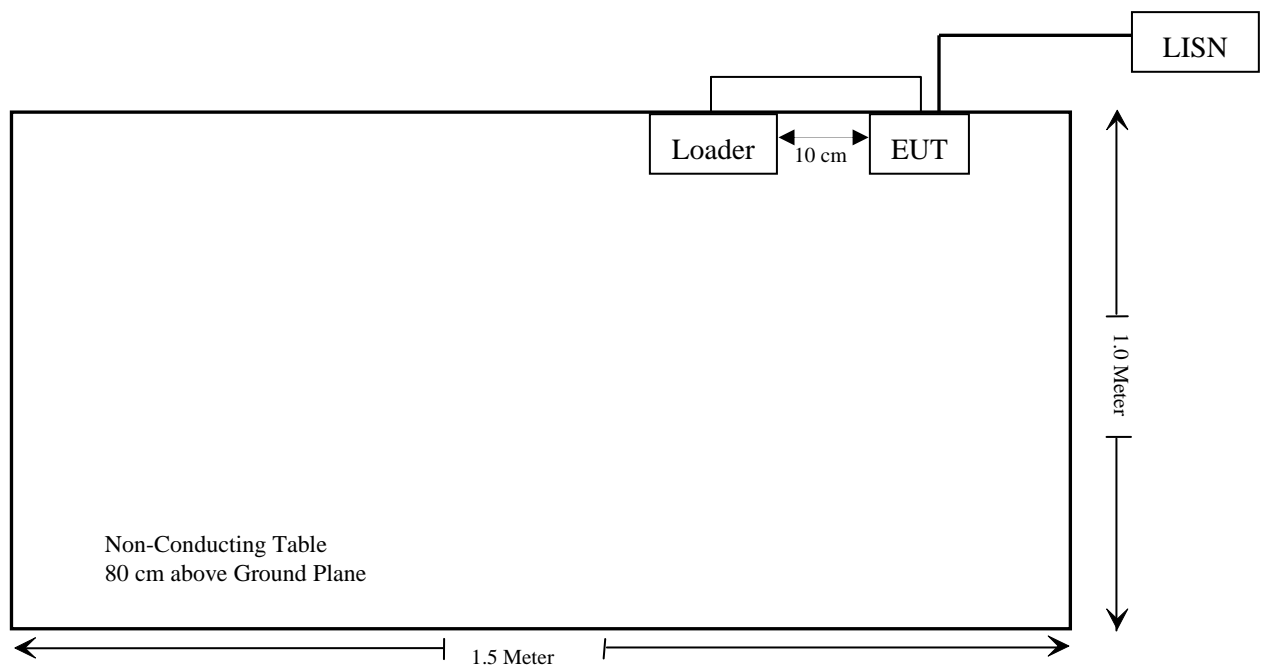
### Equipment Modifications

No modifications were made to the unit tested.

### Configuration of Test Setup



### Block Diagram of Test Setup



## SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207(a)	Conduction Emissions	Compliance
§15.209(a) §15.249(a) §15.249(c) §15.249(d)§15.35	Radiated Emissions	Compliance
§15.215(c)	20 dB Emission Bandwidth	Compliance

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

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### **Applicable Standard**

For intentional device, 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.

### **Antenna Connector Construction**

The EUT has a chip antenna on PCB, which in accordance to section 15.203, is considered sufficient to comply with the provisions of this section.

**Result:** Compliant.

Please refer to the EUT photos.

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

### Applicable Standard

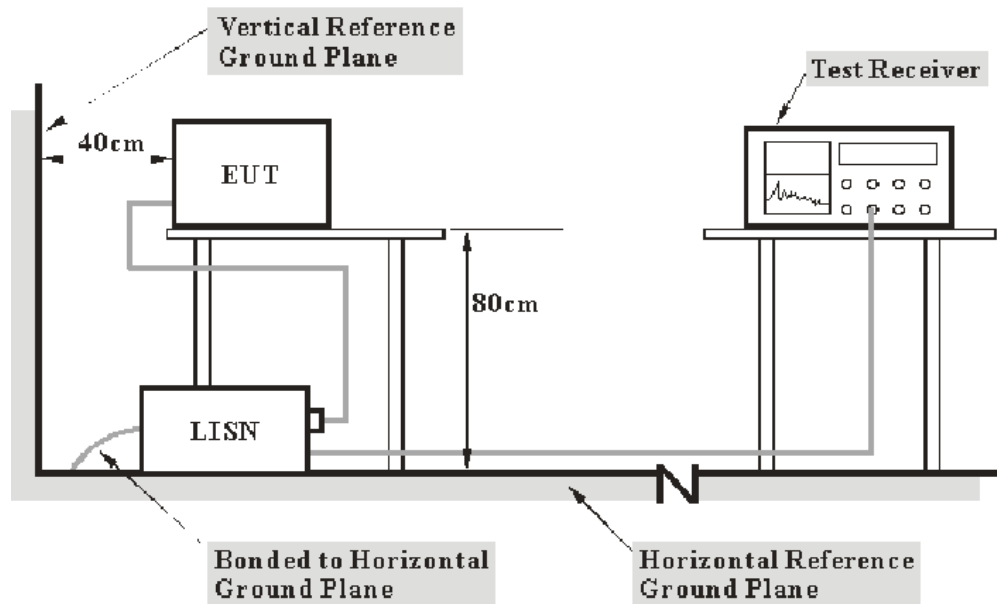
FCC §15.207

### Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, and LISN.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of any conducted emissions measurement at Bay Area Compliance Laboratory Corp. (Shenzhen) is  $\pm 2.4$  dB.

### 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 C63.4-2009 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.



## 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:

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

## Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	EMI Test Receiver	ESCS30	830245/006	2010-03-03	2011-03-02
Rohde & Schwarz	L.I.S.N.	ESH2-Z5	892107/021	2010-03-09	2011-03-08

\* **Statement of Traceability:** Bay Area Compliance Laboratory Corp. (Shenzhen) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

## Test Procedure

During the conducted emission test, maximizing procedure was performed on the six (6) highest emissions of the EUT.

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

## Test Results Summary

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

**20.14 dB at 0.200 MHz** in the **Line** conductor mode

## Test Data

### Environmental Conditions

Temperature:	25 °C
Relative Humidity:	48 %
ATM Pressure:	100.0 kPa

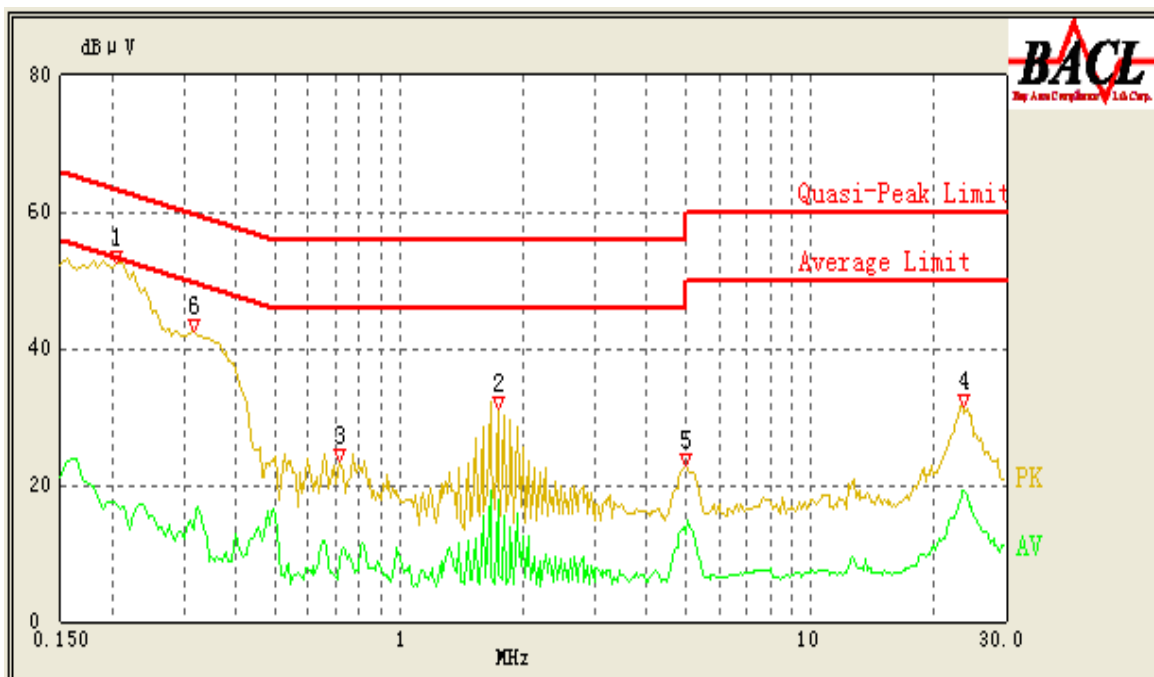
*The testing was performed by Leon Chen on 2011-07-07.*

Test Mode: Transmitting

120 V, 60 Hz, Line:



Conducted Emissions			FCC Part 15.207		
Frequency (MHz)	Cord. Result (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Remark (PK/QP/Ave.)
0.200	44.43	10.10	64.57	20.14	QP
1.665	30.15	10.13	56.00	25.85	QP
1.665	19.69	10.13	46.00	26.31	Ave
22.760	18.31	10.20	50.00	31.69	Ave
22.910	25.90	10.20	60.00	34.10	QP
4.995	10.58	10.20	46.00	35.42	Ave
0.200	19.03	10.10	54.57	35.54	Ave
4.995	18.13	10.20	56.00	37.87	QP
0.570	7.48	10.10	46.00	38.52	Ave
0.570	14.68	10.10	56.00	41.32	QP
9.945	7.67	10.20	50.00	42.33	Ave
9.925	11.19	10.20	60.00	48.81	QP

**120V, 60 Hz, Neutral:**

Conducted Emissions			FCC Part 15.207		
Frequency (MHz)	Cord. Result (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Remark (PK/QP/Ave.)
0.205	42.83	10.10	64.43	21.60	QP
1.735	29.07	10.13	56.00	26.93	QP
0.315	33.68	10.10	61.29	27.61	QP
1.735	17.99	10.13	46.00	28.01	Ave
23.500	19.20	10.20	50.00	30.80	Ave
4.995	13.00	10.20	46.00	33.00	Ave
23.565	24.11	10.20	60.00	35.89	QP
0.715	8.76	10.10	46.00	37.24	Ave
0.205	17.14	10.10	54.43	37.29	Ave
0.315	13.54	10.10	51.29	37.75	Ave
4.995	17.26	10.20	56.00	38.74	QP
0.715	14.01	10.10	56.00	41.99	QP

## FCC §15.205, §15.209 & §15.249 - RADIATED EMISSIONS

### Applicable Standard

As per FCC §15.249 (a), except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

As per FCC §15.249 (c), Field strength limits are specified at a distance of 3 meters.

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

### 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 NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement at Bay Area Compliance Laboratories Corp. (Shenzhen) is  $\pm 4.0$  dB.

### Test Equipment Setup

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

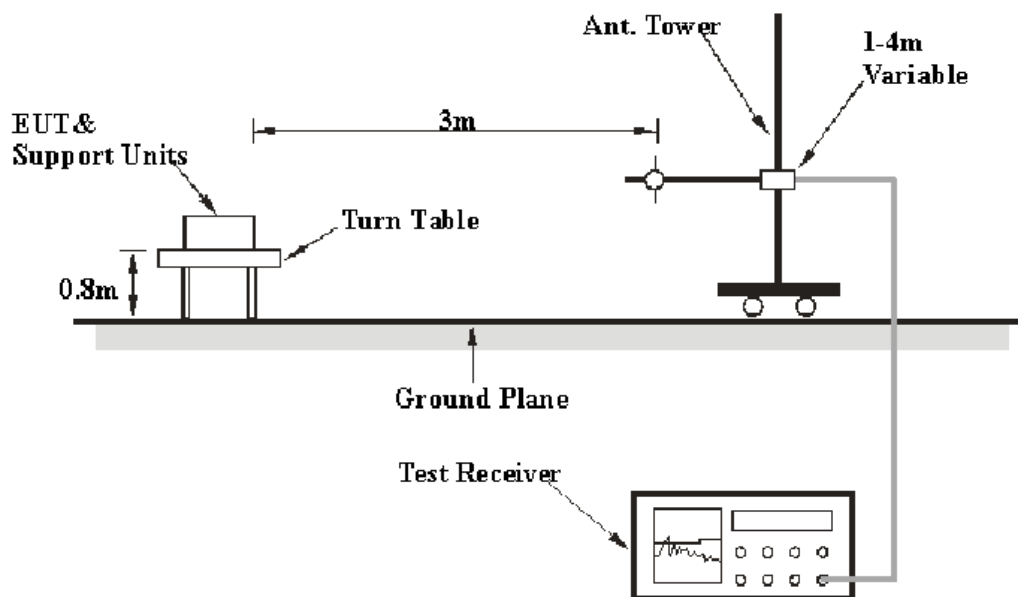
RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto

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

## EUT Setup



The radiated emission and out of band emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.4-2009. The specification used was the FCC 15.209 and FCC 15.249 limits.

## Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
HP	Amplifier	8447E	1937A01046	2010-08-02	2011-08-01
Rohde & Schwarz	EMI Test Receiver	ESCI	100224	2010-11-11	2011-11-10
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2010-07-05	2011-07-04
Mini-Circuits	Amplifier	ZVA-213+	T-E27H	2011-03-08	2012-03-07
Sunol Sciences	Horn Antenna	DRH-118	A052604	2011-05-05	2012-05-04
Rohde & Schwarz	Spectrum Analyzer	FSEM30	849720/019	2010-07-08	2011-07-07

**\* Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

## 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 meter away from the testing antenna, which is varied from 1-4 mete, 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.

## 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 data in the following table, the EUT complied with the FCC Part 15.209 & 15.249, with the worst margin reading of:

**1.44 dB at 4920 MHz in the Vertical polarization**

## Test Data

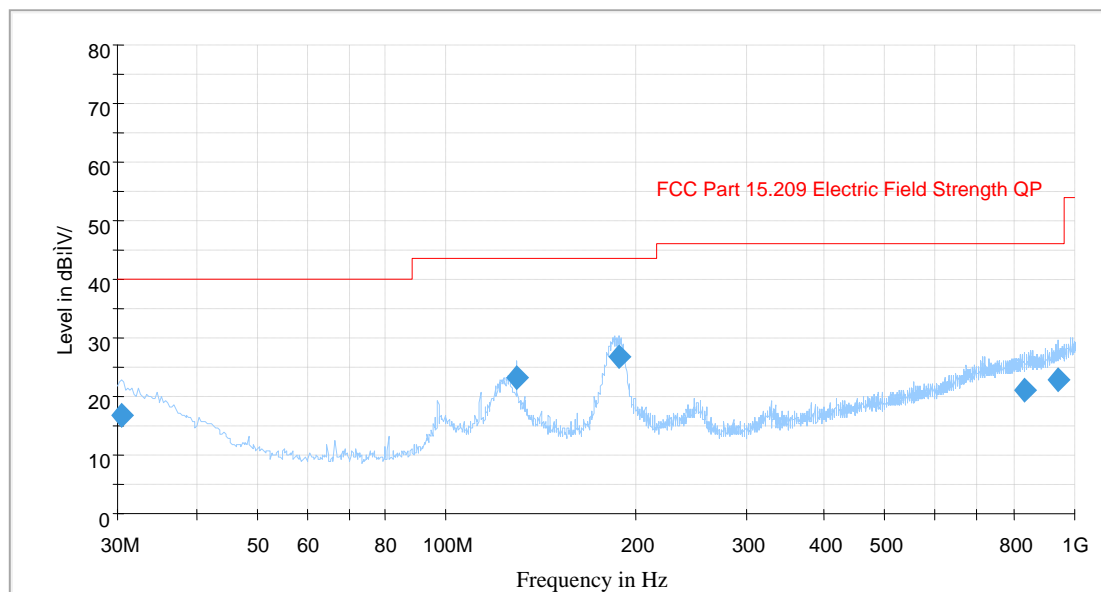
### Environmental Conditions

<b>Temperature:</b>	25 °C
<b>Relative Humidity:</b>	56 %
<b>ATM Pressure:</b>	100.2 kPa

*The testing was performed by Leon Chen on 2011-07-01.*

**1) 30-1000 MHz:***Test Mode: Transmitting**Auto test (FCC 15.209)*

Auto Test (FCC 15.209)



Frequency (MHz)	Corrected Amplitude (dBµV/m)	Test Antenna		Turntable Position (degree)	Correction Factor (dB)	Limit (dBµV/m)	Margin (dB)
		Height (cm)	Polarity (H/V)				
188.232750	26.7	193.0	H	159.0	-14.9	43.5	16.8
129.538750	23.3	305.0	H	77.0	-12.6	43.5	20.2
940.145250	22.9	329.0	H	90.0	0.4	46.0	23.1
30.392276	16.7	143.0	V	20.0	-5.7	40.0	23.3
834.378250	21.1	188.0	V	135.0	-1.3	46.0	24.9

**2) Above 1 GHz***Test Mode: Transmitting*

Freq. (MHz)	S.A. Reading (dBμV)	Detector QP/PK/Ave.	Turntable Direction Degree	Test Antenna			Cable Loss (dB)	Amp. Gain (dB)	Cord. Amp. (dBμV/m)	FCC 15.249/15.209		
				Height (m)	Polar (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	Comment
4920	40.25	Ave	173	1.5	V	34.8	4.30	26.79	52.56	54	1.44*	harmonic
4920	56.90	PK	173	1.5	V	34.8	4.30	26.79	69.21	74	4.79	harmonic
4920	30.28	Ave	252	2.0	H	35.9	4.30	26.79	43.69	54	10.31	harmonic
4920	47.94	PK	252	2.0	H	35.9	4.30	26.79	61.35	74	12.65	harmonic

\*Within measurement uncertainty.

**3) Field strength of fundamental**

Freq. (MHz)	S.A. Reading (dBμV)	Detector QP/PK/Ave	Turntable Direction Degree	Test Antenna			Cable Loss (dB)	Amp. Gain (dB)	Cord. Amp. (dBμV/m)	FCC 15.249		
				Height (m)	Polar (H/V)	Factor (dB/m)				Limit (dBμV/m)	Margin (dB)	Comment
2460	72.51	Ave	168	1.4	V	30.6	3.03	26.83	79.31	94	14.69	Fund.
2460	68.11	Ave	67	2.3	H	30.6	3.03	26.83	74.91	94	19.09	Fund.
2460	86.47	PK	169	1.6	V	30.6	3.03	26.83	93.27	114	20.73	Fund.
2460	80.86	PK	67	2.3	H	30.6	3.03	26.83	87.66	114	26.34	Fund.

**4) Out of band emissions**

Indicated		Detector (PK/Ave.)	Table Angle Degree	Test Antenna		Correction Factor			FCC 15.249/15.205/15.209			
Frequency (MHz)	S.A. Reading (dBμV)			Height (m)	Polar (H/V)	Ant. Factor (dB/m)	Cable Loss (dB)	Amp. Gain (dB)	Cord. Amp. (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Comment
2484.72	52.18	PK	33	1.9.	V	30.4	3.03	26.85	58.76	74	15.24	spurious
2484.72	29.47	Ave	33	1.9	V	30.4	3.03	26.85	36.05	54	17.95	spurious
2484.72	47.16	PK	247	2.2	H	30.4	3.03	26.85	53.74	74	20.26	spurious
2318.66	45.49	PK	64	2.3	H	30.3	3.03	26.85	51.97	74	22.03	spurious
2484.72	25.33	Ave	247	2.2	H	30.4	3.03	26.85	31.91	54	22.09	spurious
2318.66	22.32	Ave	64	2.3	H	30.3	3.03	26.85	28.80	54	25.20	spurious
2318.66	21.43	Ave	125	2.1	V	30.3	3.03	26.85	27.91	54	26.09	spurious
2318.66	35.62	PK	125	2.1	V	30.3	3.03	26.85	42.10	74	31.90	spurious



## FCC §15.215(c) – 20 dB EMISSION BANDWIDTH

### Applicable Standard

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Spectrum Analyzer	FSEM30	849720/019	2010-07-08	2011-07-07

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to NVLAP requirements, traceable to the NIST.

### Test 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 indicated 20dB bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

### Test Data

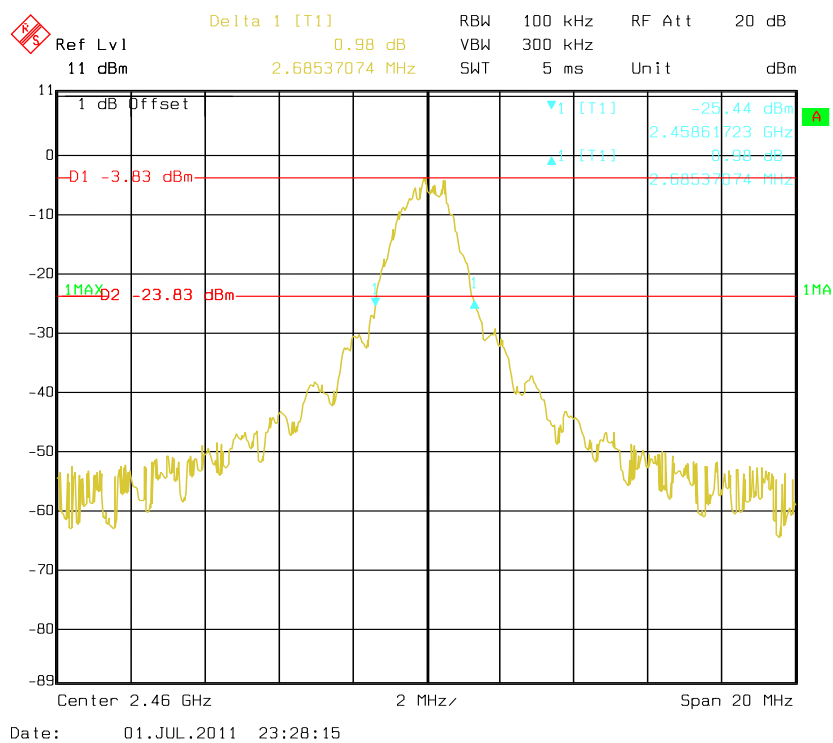
#### Environmental Conditions

Temperature:	25 °C
Relative Humidity:	56 %
ATM Pressure:	100.2 kPa

\*The testing was performed by Leon Chen on 2011-07-01.

Test Mode: Transmitting

Channel Frequency (MHz)	20 dB Bandwidth (MHz)
2460	2.69



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