

# FCC PART 18 TEST REPORT

For

## Whirlpool Microwave Products Development Limited

16/F, Paliburg Plaza 68 Yee Woo Street, Causeway Bay, Hong Kong

**FCC ID: PR4RED199X1**

<b>Report Type:</b> Original Report	<b>Product Type:</b> Microwave oven
<b>Test Engineer:</b> Webb Liu	<i>Webb Liu</i>
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<b>Reviewed By:</b> EMC Leader	<i>Dick Zhang</i>
<b>Prepared By:</b> Bay Area Compliance Laboratories Corp. (Shenzhen) 6/F, the 3rd Phase of WanLi Industrial Building, ShiHua Road, FuTian Free Trade Zone Shenzhen, Guangdong, China Tel: +86-755-33320018 Fax: +86-755-33320008 <a href="http://www.baclcorp.com.cn">www.baclcorp.com.cn</a>	

**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.

## **TABLE OF CONTENTS**

<b>GENERAL INFORMATION.....</b>	<b>3</b>
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT) .....	3
OBJECTIVE .....	3
RELATED SUBMITTAL(S)/GRANT(S).....	3
TEST METHODOLOGY .....	3
TEST FACILITY .....	4
<b>OPERATING CONDITION/TEST CONFIGURATION.....</b>	<b>5</b>
JUSTIFICATION .....	5
EQUIPMENT MODIFICATIONS .....	5
SUPPORT EQUIPMENT LIST AND DETAILS .....	5
EXTERNAL CABLE LIST AND DETAILS .....	5
CONFIGURATION OF TEST SETUP .....	5
BLOCK DIAGRAM OF TEST SETUP .....	6
<b>CONDUCTED EMISSIONS .....</b>	<b>7</b>
APPLICABLE STANDARD .....	7
MEASUREMENT UNCERTAINTY .....	7
EUT SETUP .....	7
EMI TEST RECEIVER SETUP.....	8
TEST PROCEDURE .....	8
TEST EQUIPMENT LIST AND DETAILS.....	8
TEST RESULTS SUMMARY .....	8
TEST DATA .....	9
<b>RADIATION HAZARD MEASUREMENT .....</b>	<b>11</b>
APPLICABLE STANDARD .....	11
ENVIRONMENTAL CONDITIONS.....	11
TEST EQUIPMENT LIST AND DETAILS.....	11
RADIATION HAZARD MEASUREMENT .....	11
INPUT POWER.....	12
LOAD FOR MICROWAVE OVENS.....	12
RF OUTPUT POWER MEASUREMENT .....	12
OPERATING FREQUENCY MEASUREMENT .....	14
<b>RADIATED EMISSIONS.....</b>	<b>16</b>
APPLICABLE STANDARD .....	16
MEASUREMENT UNCERTAINTY .....	16
EUT SETUP .....	16
EMI TEST RECEIVER SETUP AND SPECTRUM ANALYZER SETUP.....	17
TEST PROCEDURE .....	17
TEST EQUIPMENT LIST AND DETAILS.....	18
CORRECTED AMPLITUDE & MARGIN CALCULATION .....	18
TEST RESULTS SUMMARY .....	18
TEST DATA AND PLOTS.....	19

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## GENERAL INFORMATION

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

The *Whirlpool Microwave Products Development Limited*'s product, model number: *WMH31017 (FCC ID: PR4RED199X1)* or the "EUT" in this report is a *Microwave oven*, which was measured approximately: 75.5 cm (L) x 41.0 cm (W) x 44.0 cm (H), the rated with input voltage: AC 120V/60Hz. The operating frequency is 2450 MHz.

*\*All measurement and test data in this report was gathered from production sample serial number: 1410020 (Assigned by BACL, Shenzhen). The EUT supplied by the applicant was received on 2014-11-28.*

### Objective

This report is prepared on behalf of *Whirlpool Microwave Products Development Limited*. in accordance with Part 2-Subpart J, and Part 18-Subparts A, B and C of the Federal Communication Commissions rules and regulations.

The objective of the manufacturer is to determine compliance with FCC Part 18 limits.

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

No related submittal(s).

### Test Methodology

All measurements contained in this report were conducted with MP-5, FCC Methods of Measurements of Radio Noise Emissions from ISM Equipment, February 1986. All measurements were performed at Bay Area Compliance Laboratory Corporation. 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 on 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.

## OPERATING CONDITION/TEST CONFIGURATION

### Justification

The EUT was operated at maximum (continuous) RF output power. The loads consisted of water in a glass beaker in the amounts specified in the test procedure.

### Equipment Modifications

No modifications were made to the EUT tested.

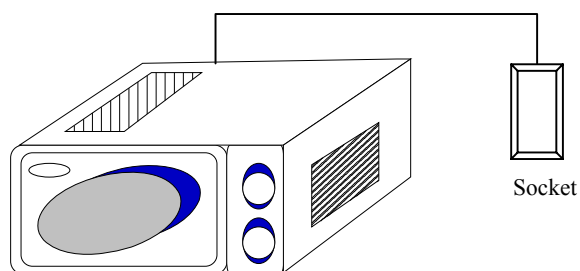
### Support Equipment List and Details

Manufacturer	Description	Model	Serial Number	Remark
N/A	Socket	N/A	140217	N/A

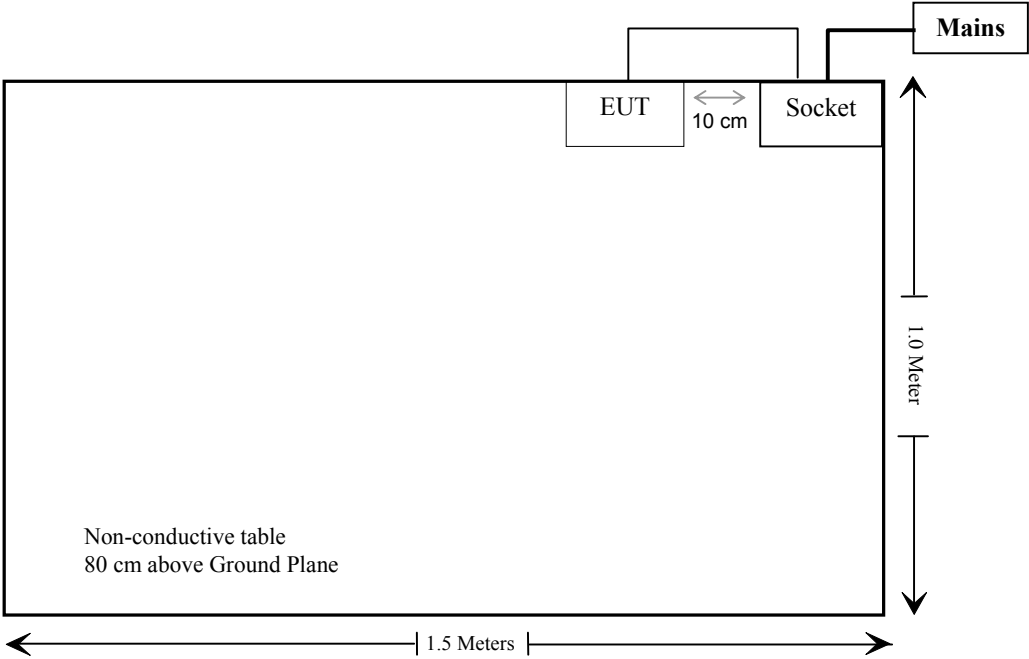
### External Cable List and Details

Cable Description	Length (m)	From/Port	To
Un-shielding Un-detachable AC Cable	0.9	EUT	Socket
Un-shielding Un-detachable AC Cable	1.0	Mains	Socket

### Configuration of Test Setup



Block Diagram of Test Setup



## CONDUCTED EMISSIONS

### Applicable Standard

FCC §18.307

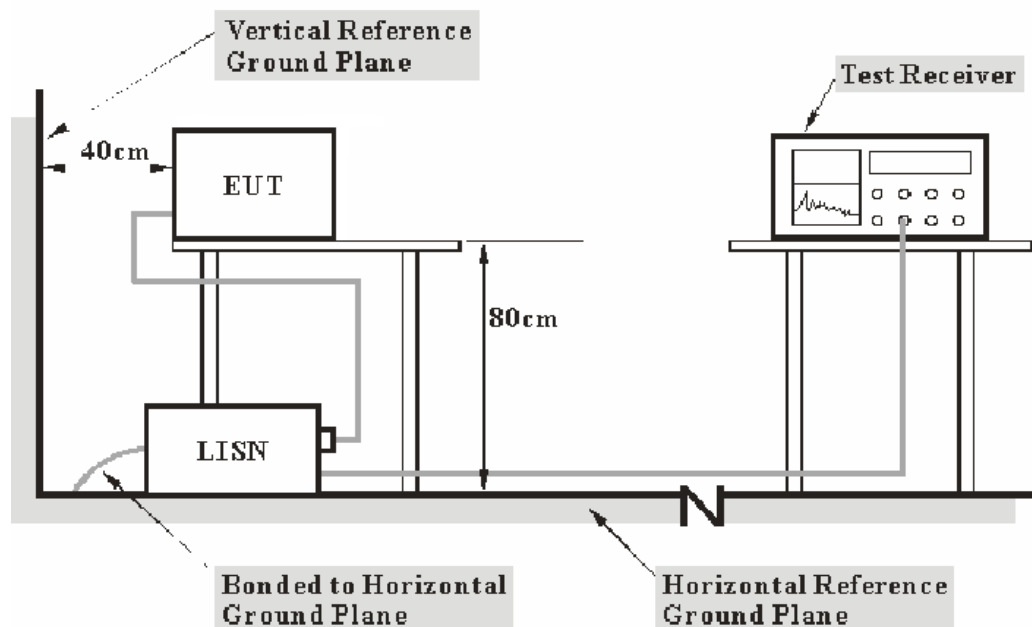
### Measurement Uncertainty

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 MP-5: 1986 measurement procedure. Specification used was with the FCC Part 18.

The spacing between the peripherals was 10 cm.

The socket was connected to a 120 VAC/ 60Hz 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

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	2014-06-03	2015-06-03
Rohde & Schwarz	LISN	ENV216	3560.6650.12-101613-Yb	2014-06-09	2015-06-09
Rohde & Schwarz	Transient Limiter	ESH3Z2	DE25985	2014-05-14	2015-05-14
Rohde & Schwarz	LISN	ESH3-Z5	100113	NCR	NCR
Rohde & Schwarz	CE Test software	EMC 32	V8.53.0	NCR	NCR

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

### Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC PART 18, the worst margin reading as below:

**6.2 dB at 16.227510 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

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

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



**Test Data****Environmental Conditions**

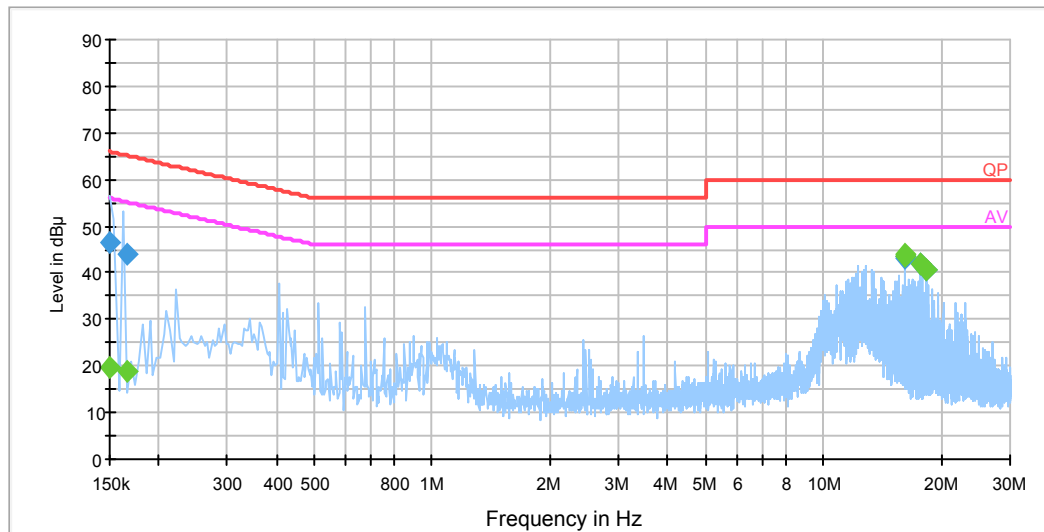
<b>Temperature:</b>	24
<b>Relative Humidity:</b>	48 %
<b>ATM Pressure:</b>	101.0 kPa

The testing was performed by Webb Liu on 2014-11-21.

Test Mode: The max fan speed, max brightness and max output power

**AC 120V/60Hz, Line:**

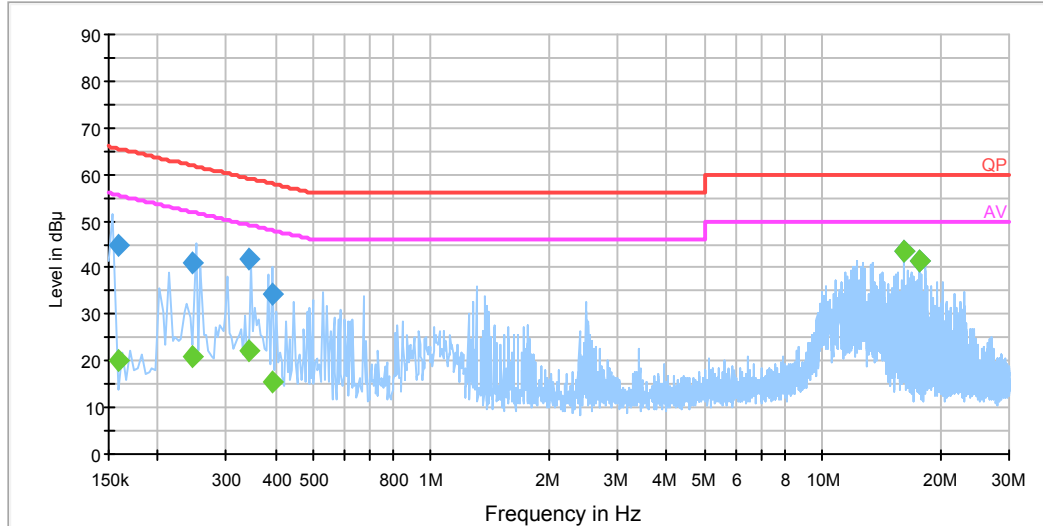
## EMI Auto Test L



Frequency (MHz)	Corrected Amplitude (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Detector (PK/Ave./QP)
0.150000	46.3	19.2	66.0	19.7	QP
0.150000	19.6	19.2	56.0	36.4	Ave.
0.165500	44.1	19.2	65.2	21.1	QP
0.165500	18.8	19.2	55.2	36.4	Ave.
16.226610	43.2	19.9	60.0	16.8	QP
16.226610	43.6	19.9	50.0	6.4	Ave.
16.227510	43.6	19.9	60.0	16.4	QP
16.227510	43.8	19.9	50.0	6.2	Ave.
17.692590	41.9	19.9	60.0	18.1	QP
17.692590	41.9	19.9	50.0	8.1	Ave.
18.244370	40.6	19.9	60.0	19.4	QP
18.244370	40.6	19.9	50.0	9.4	Ave.

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

## EMI Auto Test N



Frequency (MHz)	Corrected Amplitude (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Detector (PK/Ave./QP)
0.158500	44.6	19.2	65.5	20.9	QP
0.158500	19.9	19.2	55.5	35.6	Ave.
0.245500	40.9	19.2	61.9	21.0	QP
0.245500	20.9	19.2	51.9	31.0	Ave.
0.340810	42.0	19.2	59.2	17.2	QP
0.340810	22.2	19.2	49.2	27.0	Ave.
0.392090	34.4	19.2	58.0	23.6	QP
0.392090	15.4	19.2	48.0	32.6	Ave.
16.226610	43.5	19.6	60.0	16.5	QP
16.226610	43.7	19.6	50.0	6.3	Ave.
17.692590	41.5	19.6	60.0	18.5	QP
17.692590	41.4	19.6	50.0	8.6	Ave.

**Note:**

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

## RADIATION HAZARD MEASUREMENT

### Applicable Standard

FCC §18.301

### Environmental Conditions

Temperature:	24
Relative Humidity:	49 %
ATM Pressure:	101.0 kPa

*The testing was performed by Webb Liu on 2014-11-19.*

### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	8386001028	2014-11-12	2015-11-12
GW Instek	Power Meter	CL110034	1937A01046	2014-04-24	2015-04-24
A.H.System	Horn Antenna	SAS-200/571	135	2012-02-11	2015-02-10
MC	Thermometer	N/A	N/A	2014-11-01	2015-11-01
Holaday	Microwave Survey Meter	HI-1501	N/A	2014-11-01	2015-11-01

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

### Radiation Hazard Measurement

Radiation leakage was measured in the as-received condition with the oven door closed using a microwave leakage meter.

A 275 mL water load was placed in the center of the oven and the oven was operated at maximum output power.

☒ There was no microwave leakage exceeding a power level of 0.2mW/cm<sup>2</sup> observed at any point 5 cm or more from the external surface of the oven.

A maximum of 1.0 mW/cm<sup>2</sup> is allowed in accordance with the applicable Federal Standards. Hence, microwave leakage in the as-received condition with the oven door closed was below the maximum allowed.

## Input Power

Input power and current was measured using a power analyzer. A 1000 mL water load was placed in the center of the oven and the oven was operated at maximum output power. A 1000mL water load was chosen for its compatibility with the procedure commonly used by manufacturers to determine their input ratings.

Input Voltage (V <sub>AC</sub> /Hz)	Input Current (Amps)	Measured Input Power (Watts)	Rated Input Power (Watts)
120	14.18	1701.6	1800

☒ Based on the measured input power, the EUT was found to be operating within the intended specifications.

## Load for Microwave ovens

For all measurements, the energy developed by the oven was absorbed by a dummy load consisting of a quantity of tap water in a beaker. If the oven was provided with a shelf or other utensil support, this support was in its initial normal position. For ovens rated at 1000 watts or less power output, the beaker contained quantities of water as listed in the following subparagraphs. For ovens rated at more than 1000 watts output, each quantity was increased by 50% for each 500watts or fraction thereof in excess of 1000 watts. Additional beakers were used if necessary.

- Load for power output measurement: 1000 milliliters of water in the beaker located in the center of the oven.
- Load for frequency measurement: 1000 milliliters of water in the beaker located in the center of the oven.
- Load for measurement of radiation on second and third harmonic: Two loads, one of 700 and the other of 300 milliliters, of water are used. Each load is tested both with the beaker located in the center of the oven and with it in the right front corner.

## The RF output power is rated at 1000 watts

Load used for power output measurement = 1000 milliliters of water  
 Load used for frequency measurement = 1000 milliliters of water  
 Load used for harmonic measurement = 700 & 300 milliliters of water  
 Load used for other measurement = 700 milliliters of water

## RF Output Power Measurement

A cylindrical container of borosilicate glass is used for the test. It has a maximum thickness of 3 mm, an external diameter of approximately 190 mm and a height of approximately 90 mm. The mass of the container is determined.

At the start of the test, the oven and the empty container are at ambient temperature. Water having an initial temperature of  $10\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$  is used for the test. The water temperature is measured immediately before it is poured into the container.

A quantity of  $1\text{ }000\text{ g} \pm 5\text{ g}$  of water is added to the container and its actual mass obtained. The container is then immediately placed in the centre of the oven shelf, which is in its lowest normal position. The oven is operated and the time for the water temperature to attain  $20\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$  is measured. The oven is then switched off and the final water temperature is measured within 60 s.

$m_w$ (g)	$m_c$ (g)	$T_0$ (°C)	$T_1$ (°C)	$T_2$ (°C)	$t$ (s)
1000	377.0	25.0	10.0	20.0	45.0

RF Output Power =  $(4.187 \times 1000 \times (20.0 - 10) + 0.55 \times 377.0 \times (20.0 - 25)) / 45 = 907.41$  Watts

P is the microwave power output, in watts;

$m_w$  is the mass of the water, in grams;

$m_c$  is the mass of the container, in grams;

$T_0$  is the ambient temperature, in degrees Celsius;

$T_1$  is the initial temperature of the water, in degrees Celsius;

$T_2$  is the final temperature of the water, in degrees Celsius;

t is the heating time, in seconds, excluding the magnetron filament heating-up time.

☐ The measurement output power was found to be less than 500 watts. Therefore, in accordance with Section 18.305 of Subpart-C, the measured out-of-band emissions were compared to the limit of 25µV/meter at a 300-meter measurement distance.

☒ The measured output power was found to exceed 500 watts. Therefore, in accordance with Section 18.305 of Subpart-C, the measured out-of-band emissions were compared with the limit calculated as following:

$$LFS = 25 * \text{SQRT} (\text{Power Output} / 500)$$

$$LFS = 25 * \text{SQRT} (907.41 / 500)$$

$$LFS = 33.68$$

Where: LFS is the maximum allowable field strength for out-of-band emissions in µV/meter at a 300-meter measurement distance. Power Output is the measured output power in watts.

LFS µV/m@300m	dBµV/m@300m	dBµV/m@3m
33.68	30.55	70.55

## Operating Frequency Measurement

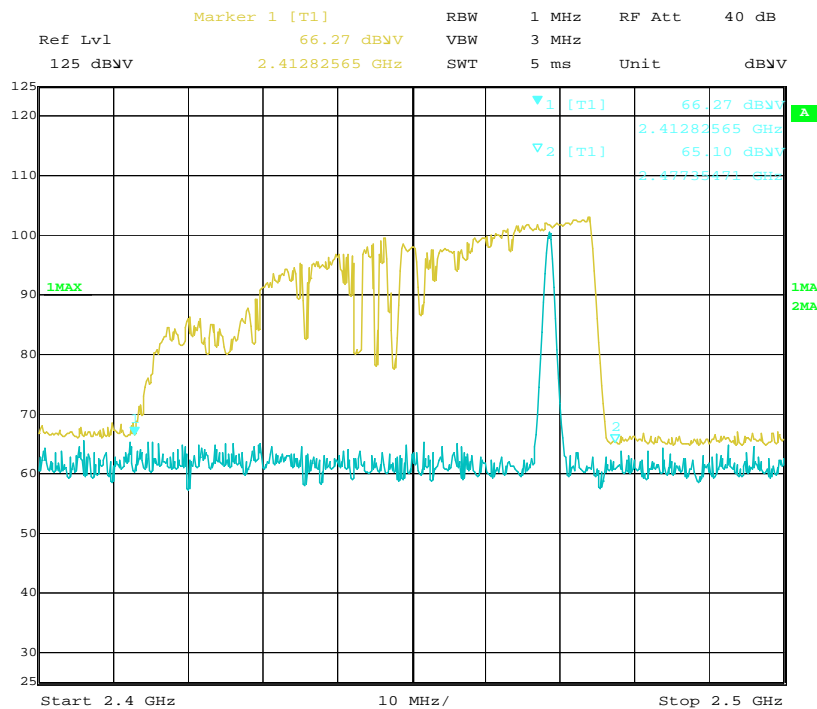
### Variation in Operating Frequency with Time

The operating frequency was measured using a spectrum analyzer. Starting with the EUT at room temperature, a 1000mL water load was placed in the center of the oven and the oven was operated at maximum output power. The fundamental operating frequency was monitored as the input voltage was varied between 80 and 125 percent of the original load.

The results of this test are as follows:

Low Frequency (MHz)	High Frequency (MHz)
2412.83	2477.35

Refer to data pages for details of the variation in operating frequency with time measurement.



### Variation in Operating Frequency with Line Voltage

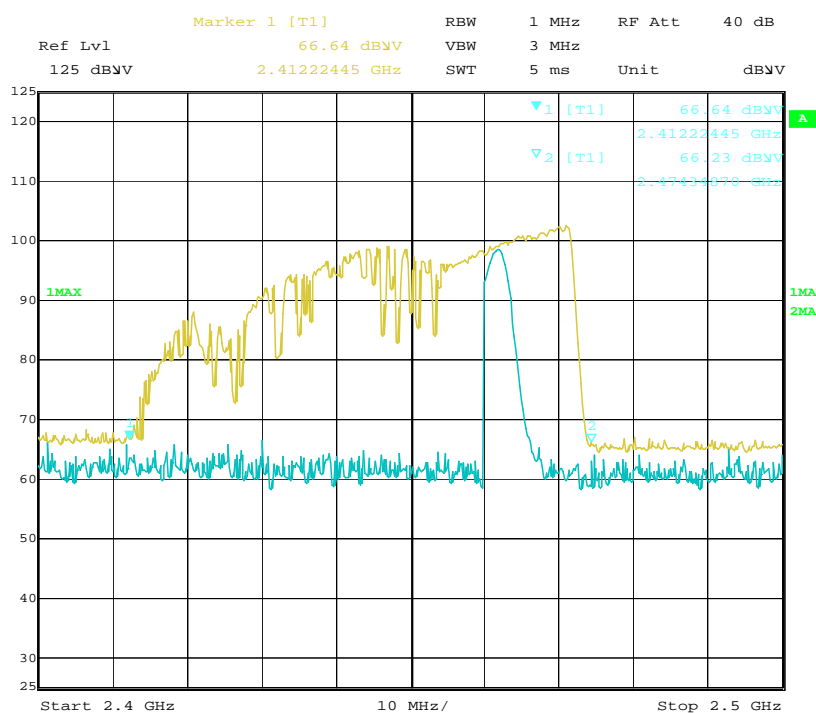
The EUT was operated / warmed by at least 10 minutes of use with a 1000 mL water load at room temperature at the beginning of the test. Then the operating frequency was monitored as the input voltage was varied between 80 and 125 percent of the nominal rating.

The results of this test are as follows:

Line voltage varied from 96 V<sub>AC</sub> to 150 V<sub>AC</sub>.

Low Frequency (MHz)	High Frequency (MHz)
2412.22	2474.35

Please refer to following pages for details of the variation in operating frequency with line voltage measurement.



## RADIATED EMISSIONS

### Applicable Standard

FCC §18.305 and FCC §18.309

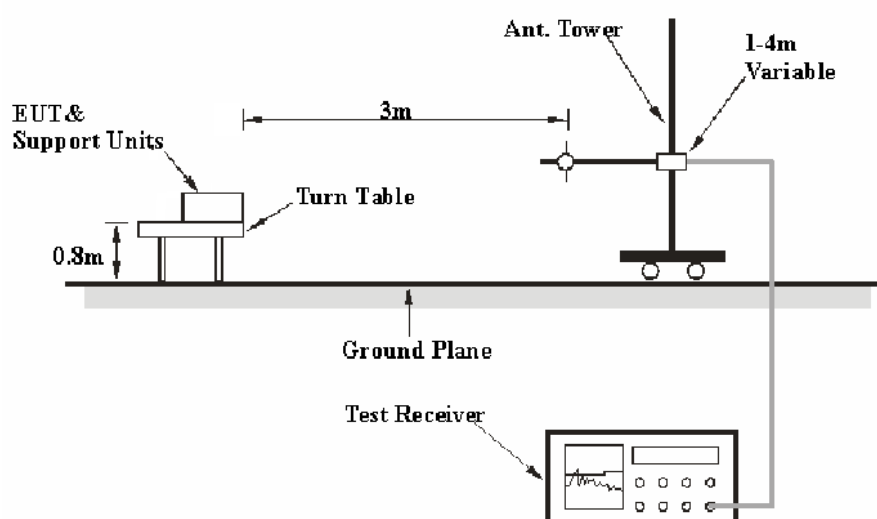
### Measurement Uncertainty

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 expanded combined standard uncertainty of radiation emissions at Bay Area Compliance Laboratories Corp. (Shenzhen) is shown in below table. And the uncertainty will not be taken into consideration for the test data recorded in the report

Frequency	Polarity	Measurement uncertainty
9 kHz~30MHz	/	4.11 dB (k=2, 95% level of confidence)
30MHz~200MHz	Horizontal	4.62 dB (k=2, 95% level of confidence)
	Vertical	4.54 dB (k=2, 95% level of confidence)
200MHz~1GHz	Horizontal	4.84 dB (k=2, 95% level of confidence)
	Vertical	5.91 dB (k=2, 95% level of confidence)
1 GHz~6 GHz	Horizontal / Vertical	4.68 dB (k=2, 95% level of confidence)
Above 6 GHz	Horizontal / Vertical	4.92 dB (k=2, 95% level of confidence)

### EUT Setup





The radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the FCC MP - 5. The specification used was the FCC part 18 limits.

The socket was connected to 120 VAC/60 Hz power source.

### EMI Test Receiver Setup and Spectrum Analyzer Setup

The system was investigated from 30 MHz to 24.5 GHz.

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

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

### Test Procedure

Maximizing procedure was performed on the six (6) highest emissions to ensure that the EUT complied with all installation combinations.

The EUT was in the normal (naïve) operating mode during the final qualification test to represent the worst results.

All final data was recorded in the Quasi-peak detection mode from 30 MHz to 1 GHz, the average detection mode for above 1 GHz.

### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
HP	Amplifier	8447E	1937A01046	2014-05-06	2015-05-06
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2014-11-03	2015-11-03
Sunol Sciences	Broadband Antenna	JB1	A040904-2	2011-11-28	2014-11-27
A.H. System	Horn Antenna	SAS-200/571	135	2012-02-11	2015-02-10
DUCOMMUN	Pre-amplifier	ALN-22093530-01	991373-01	2014-08-03	2015-08-03
DUCOMMUN	Horn Antenna	ARH-4223-02	1007726-03	2013-08-03	2016-08-03
Rohde & Schwarz	Signal Analyzer	FSIQ26	8386001028	2014-11-12	2015-11-12
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2014-04-03	2015-04-03
TDK	Chamber	Chamber A	2#	2012-10-15	2015-10-15
TDK	Chamber	Chamber B	1#	2014-07-23	2015-07-22
R&S	Auto test Software	EMC32	V9.10	-	-

\* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements, 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 data in the following table, the EUT complied with the FCC Part 18, the worst margin reading as below:

**23.24 dB at 4444.89MHz in the Vertical polarization**

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

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

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

**Test Data and Plots****Environmental Conditions**

<b>Temperature:</b>	24
<b>Relative Humidity:</b>	49 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Webb Liu on 2014-11-19.*

*Test Mode: The max fan speed, max brightness and max output power*

*30 MHz – 24.5 GHz*

Frequency (MHz)	Corrected Amplitude (dBμV/m)	Antenna height (cm)	Antenna Polarity	Turntable position (deg)	Correction Factor (dB/m)	Limit (dBμV/m)	Margin (dB)	Remark
54.77	18.02	138.00	V	292.0	-20.10	70.55	52.53	QP
56.43	19.79	223.00	V	208.0	-20.10	70.55	50.76	QP
57.38	23.40	124.00	V	293.0	-20.00	70.55	47.15	QP
58.16	19.01	113.00	V	141.0	-20.00	70.55	51.54	QP
59.09	23.47	136.00	V	345.0	-19.90	70.55	47.08	QP
892.12	18.85	113.00	V	181.0	-3.20	70.55	51.70	QP
2046.09	26.04	140.00	H	3.23	29.27	70.55	41.28	Ave.
3705.41	21.43	160.00	V	9.79	31.22	70.55	39.33	Ave.
4408.82	28.54	120.00	H	11.71	40.25	70.55	30.30	Ave.
4444.89	35.42	240.00	V	11.89	47.31	70.55	23.24	Ave.
8611.22	25.71	150.00	H	17.22	42.93	70.55	27.62	Ave.
8647.29	25.04	170.00	V	17.22	42.26	70.55	28.29	Ave.

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