

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: PR4REDACU2Y

Report Type: Original Report	Product Type: Microwave oven
Test Engineer: Jason Xiao	<i>Jason Xiao</i>
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Reviewed By: EMC Manager	<i>Suny Sun</i>
Prepared By: 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 www.baclcorp.com.cn	

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 *Whirlpool Microwave Products Development Limited.*'s product, model number: YMMV4205 (FCC ID: PR4REDACU2Y) or the "EUT" in this report is a *Microwave oven*, which was measured approximately: 76 cm (L) x 42 cm (W) x 42 cm (H), the input power is AC 120V/60Hz. The highest operating frequency is 2450 MHz.

**All measurement and test data in this report was gathered from production sample serial number: 1510005 (Assigned by BACL, Shenzhen). The EUT supplied by the applicant was received on 2015-10-10.*

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 October 31, 2013. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

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.

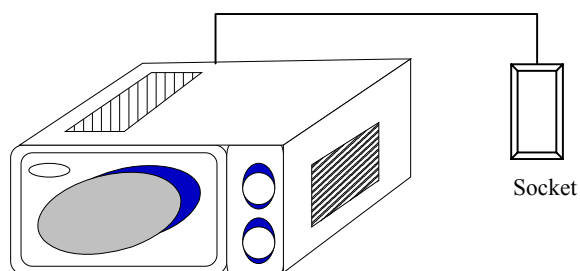
Support Equipment List and Details

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

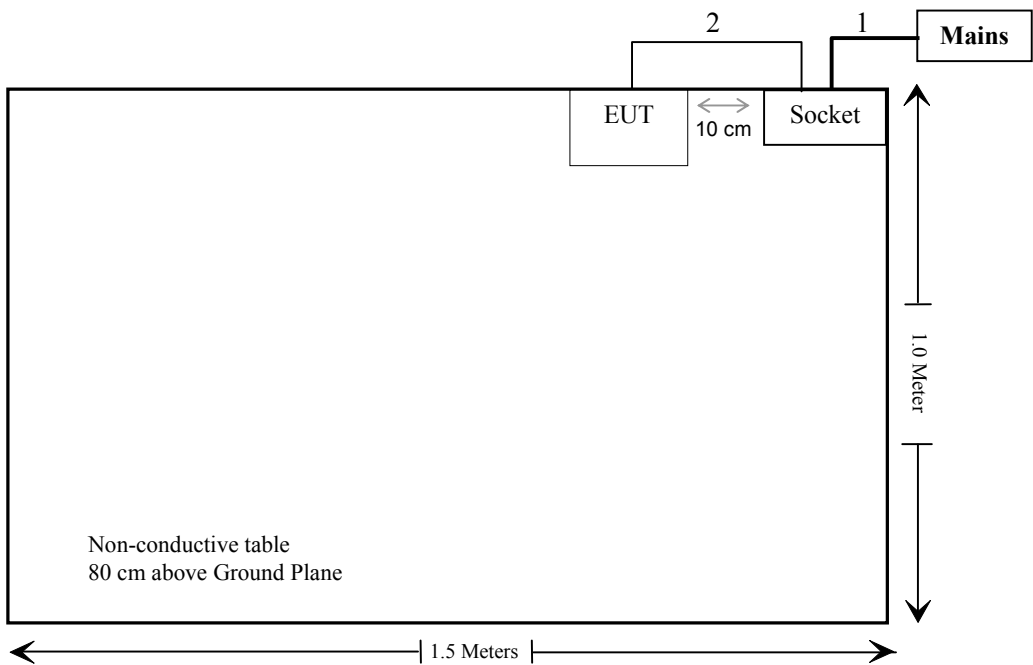
External Cable List and Details

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

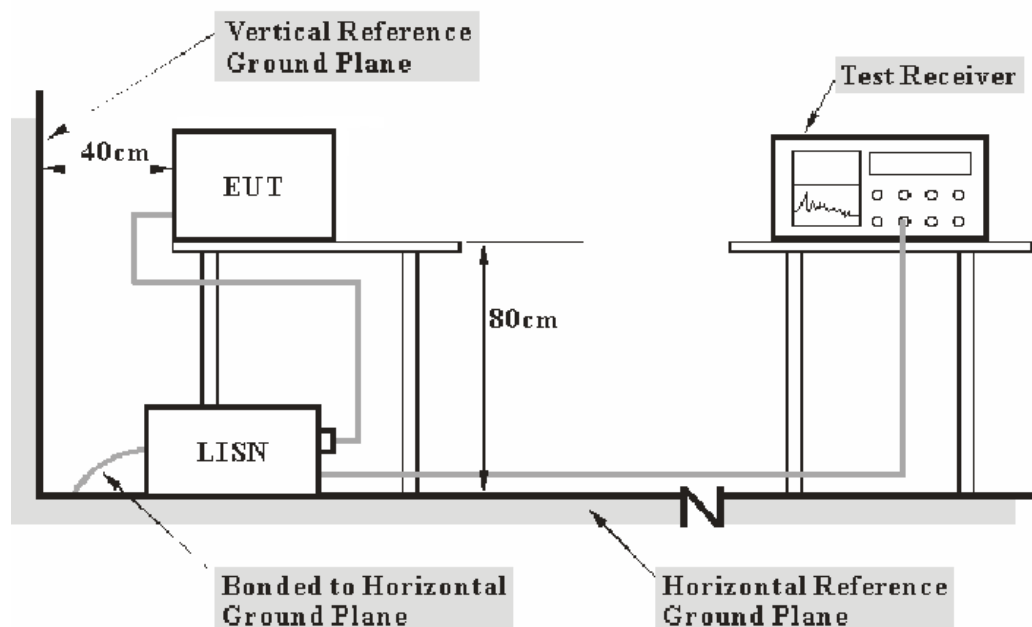
Measurement Uncertainty

Input quantities to be considered for conducted disturbance measurements maybe receiver reading, attenuation of the connection between AMN and receiver, AMN voltage division factor, AMN 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	Measurement uncertainty
AC Mains	3.26 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 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	2015-06-03	2016-06-03
Rohde & Schwarz	LISN	ENV216	3560.6650.12-101613-Yb	2015-06-09	2016-06-09
Rohde & Schwarz	Transient Limiter	ESH3Z2	DE25985	2015-05-14	2016-05-14
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:

8.1 dB at 0.165500 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

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

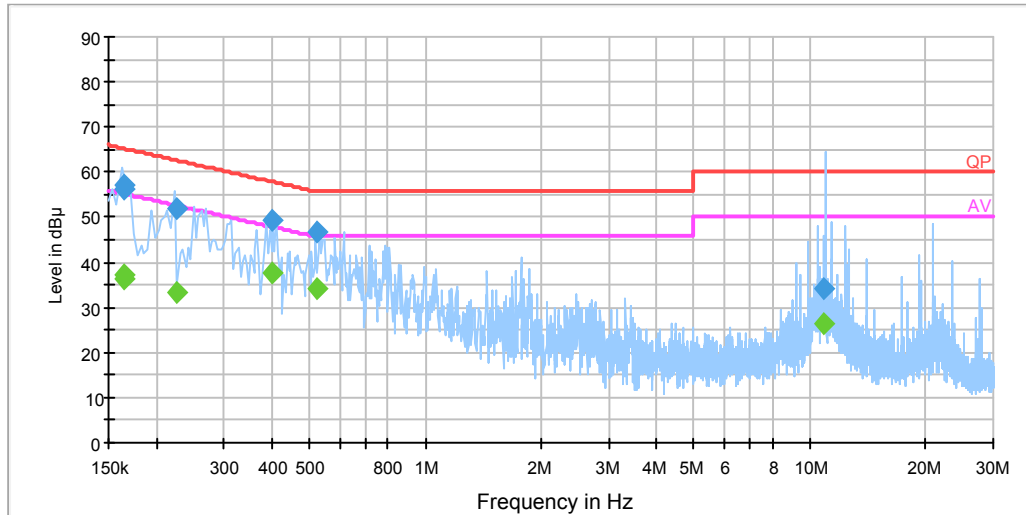
In BACL., $U_{(Lm)}$ is less than U_{cispr} , if L_m is less than L_{lim} , it implies that the EUT complies with the limit.

Test Data**Environmental Conditions**

Temperature:	25 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Jason Xiao on 2015-09-25.

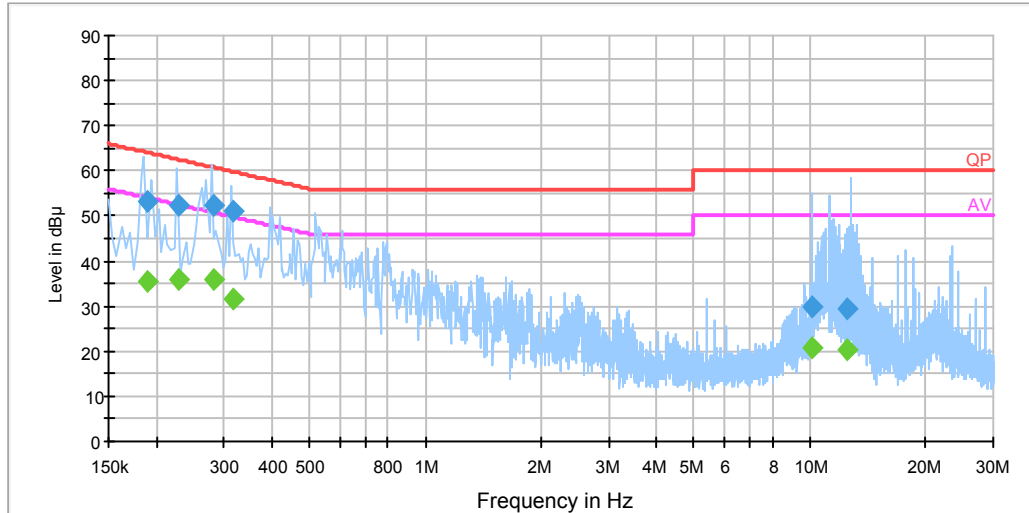
Test Mode:The Max Power

AC 120V/60 Hz, Line:**EMI Auto Test L**

Frequency (MHz)	Corrected Amplitude (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Detector (PK/Ave./QP)
0.165500	57.1	20.0	65.2	8.1	QP
0.165500	56.2	20.0	65.2	9.0	QP
0.165500	36.4	20.0	55.2	18.7	Ave.
0.165500	37.3	20.0	55.2	17.9	Ave.
0.226500	52.0	20.0	62.6	10.6	QP
0.226500	33.4	20.0	52.6	19.2	Ave.
0.399970	49.5	19.9	57.9	8.3	QP
0.399970	37.8	19.9	47.9	10.0	Ave.
0.522050	46.6	19.9	56.0	9.4	QP
0.522050	34.3	19.9	46.0	11.7	Ave.
10.920790	34.1	20.1	60.0	25.9	QP
10.920790	26.5	20.1	50.0	23.5	Ave.

AC 120V/ 60 Hz, Neutral:

EMI Auto Test N



Frequency (MHz)	Corrected Amplitude (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Detector (PK/Ave./QP)
0.190501	53.3	20.0	64.0	10.7	QP
0.190501	35.6	20.0	54.0	18.4	Ave.
0.229500	52.2	20.0	62.5	10.2	QP
0.229500	36.0	20.0	52.5	16.4	Ave.
0.281500	52.2	19.9	60.8	8.5	QP
0.281500	36.0	19.9	50.8	14.8	Ave.
0.317290	51.0	19.9	59.8	8.8	QP
0.317290	31.5	19.9	49.8	18.2	Ave.
10.085270	30.1	20.1	60.0	30.0	QP
10.085270	20.7	20.1	50.0	29.3	Ave.
12.562930	29.6	20.1	60.0	30.4	QP
12.562930	20.5	20.1	50.0	29.5	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:	28.9 °C
Relative Humidity:	59 %
ATM Pressure:	101.1 kPa

The testing was performed by Jason Xiao on 2015-09-25

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	2015-04-24	2016-04-24
A.H.System	Horn Antenna	SAS-200/571	135	2015-02-11	2016-02-10
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 0.1mW/cm² observed at any point 5 cm or more from the external surface of the oven.

A maximum of 1.0 mW/cm² 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 _{AC} /Hz)	Input Current (Amps)	Measured Input Power (Watts)	Rated Input Power (Watts)
120	12.47	1496	1500

☒ 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 900 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	24.0	10.0	20.0	46

RF Output Power = $(4.187 \times 1000 \times (20 - 10) + 0.55 \times 377.0 \times (20 - 24.0)) / 46 = 892.19$ 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:

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

$$LFS = 25 * \text{SQRT} (892.19 / 500)$$

$$LFS = 33.40$$

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
33.40	30.47	70.47

Note: Limit(dBµV/m@3m) = Limit(dBµV/m@300m) + 40(dB)

Operating Frequency Measurement

Variation in Operating Frequency with Time

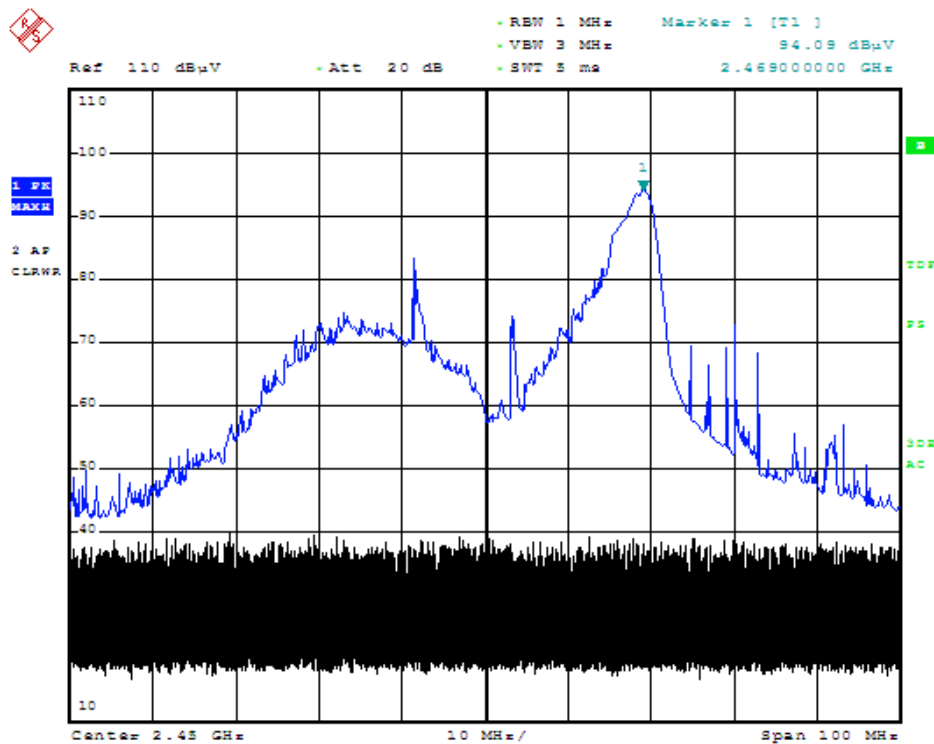
The operating frequency was measured using a spectrum analyzer. Starting with the EUT at room temperature, a 1000mL water load was placed in the center of the oven and the oven was operated at maximum output power. The fundamental operating frequency was monitored until the water load was reduced to 20 percent of the original load.

The results of this test are as follows:

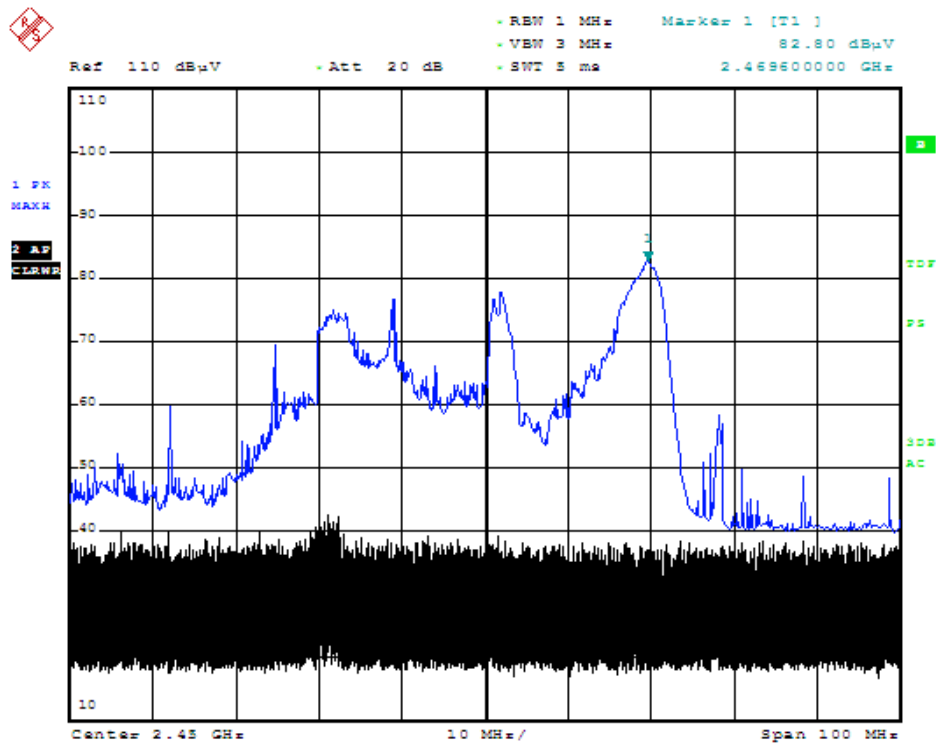
Low Frequency (MHz)	High Frequency (MHz)
2469.00	2469.60

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

Start time:



Final time:



Variation in Operating Frequency with Line Voltage

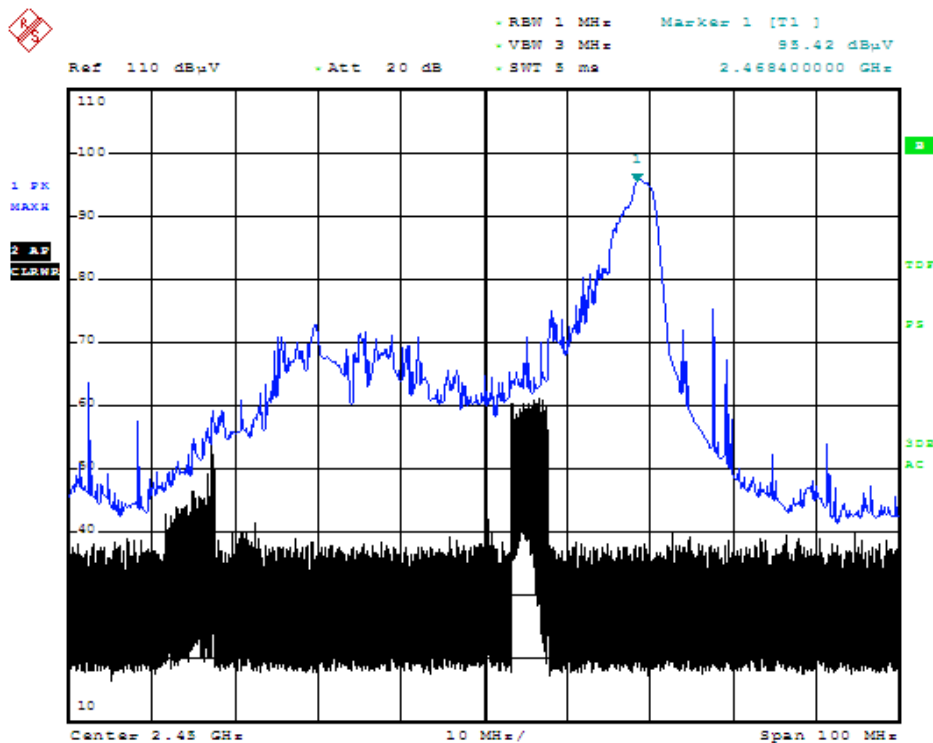
The EUT was operated / warmed by at least 10 minutes of use with a 1000 mL water load at room temperature at the beginning of the test. Then the operating frequency was monitored as the input voltage was varied between 80 and 125 percent of the nominal rating.

The results of this test are as follows:

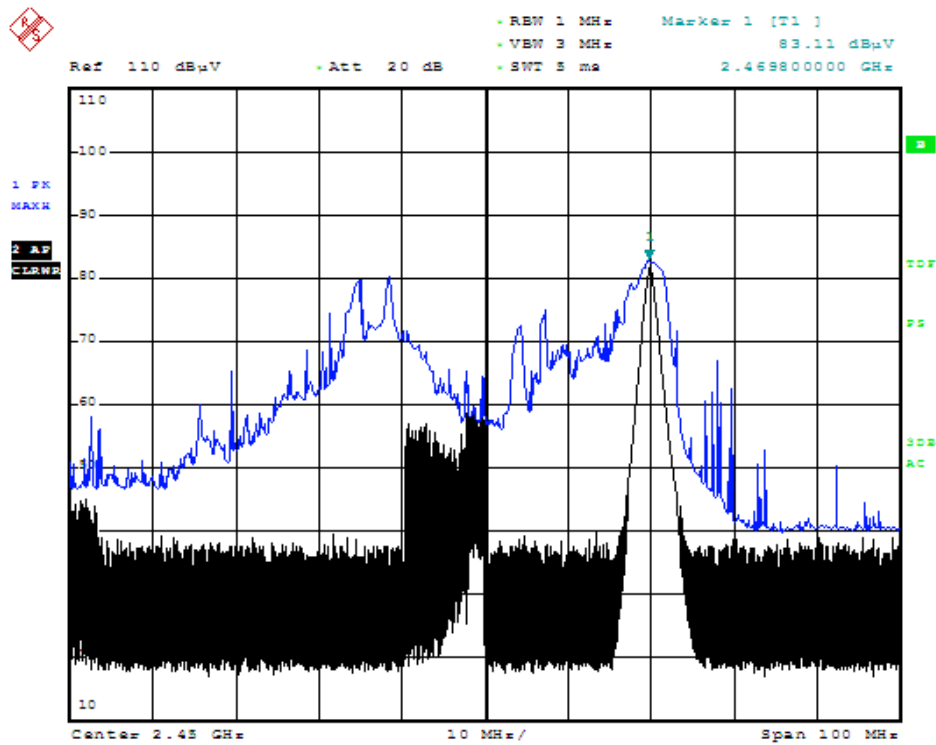
(Low voltage) Frequency (MHz)	(High voltage) Frequency (MHz)
2468.40	2469.80

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

Low voltage:



High voltage:



RADIATED EMISSIONS

Applicable Standard

FCC §18.305 and FCC §18.309

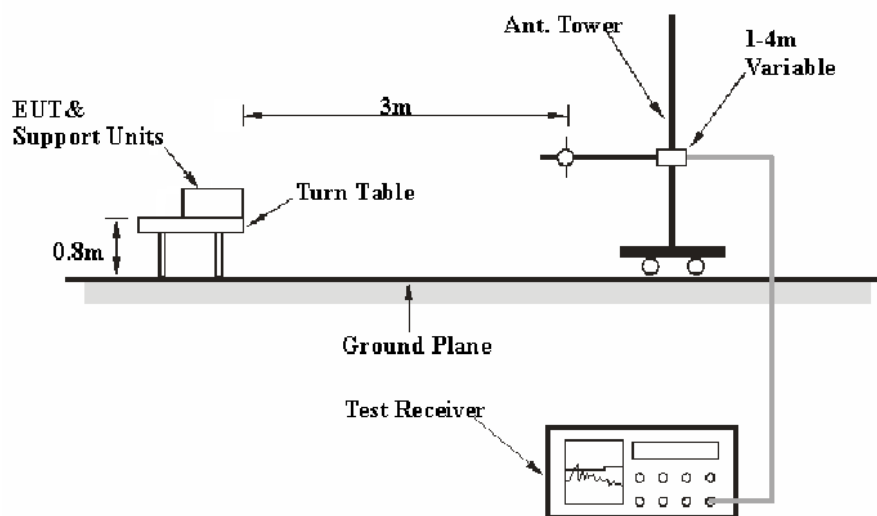
Measurement Uncertainty

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 expended 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 25 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.

The 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	HP8447E	1937A01046	2015-05-06	2016-05-06
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2014-11-03	2015-11-03
Sunol Sciences	Bi-log Antenna	JB1	A040904-2	2014-12-07	2017-12-06
A.H. System	Horn Antenna	SAS-200/571	135	2015-02-10	2018-02-09
Rohde & Schwarz	Signal Analyzer	FSIQ26	837405/023	2015-04-27	2016-04-26
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2015-04-03	2016-04-03
TDK	Chamber	Chamber A	2#	2013-10-15	2016-10-15
TDK	Chamber	Chamber B	1#	2015-07-23	2018-07-22
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, 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:

20.26 dB at 4447.04 MHz in the Horizontal polarization

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

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

In BACL., $U_{(L_m)}$ 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**

Temperature:	28.9 °C
Relative Humidity:	59%
ATM Pressure:	101.1 kPa

The testing was performed by Jason Xiao on 2015-09-25

Test Mode: Max 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
99.069875	24.43	239.0	H	141.0	-17.0	70.47	46.04	QP
704.044125	16.38	235.0	V	179.0	-5.4	70.47	54.09	QP
712.147250	27.41	199.0	V	188.0	-5.3	70.47	43.06	QP
746.417000	16.75	117.0	V	190.0	-5.3	70.47	53.72	QP
747.759500	16.32	199.0	V	0.0	-5.4	70.47	54.15	QP
749.868625	18.50	178.0	V	168.0	-5.4	70.47	51.97	QP
2746.05	27.46	1.5	H	317	6.61	70.47	36.4	Ave.
4447.04	37.96	1.0	H	204	12.25	70.47	20.26	Ave.
9862.63	24.39	1.3	H	121	23.60	70.47	22.48	Ave.
2345.15	24.36	1.4	V	346	4.63	70.47	41.48	Ave.
4404.70	20.82	1.2	V	106	12.25	70.47	37.4	Ave.
8653.06	24.37	1.9	V	196	20.78	70.47	25.32	Ave.
4900.00	24.96	1.2	H	305	16.91	70.47	28.6	Ave.
4900.00	23.71	1.7	V	240	16.91	70.47	29.85	Ave.

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