

FCC PART 18 TEST REPORT

For

Panasonic Appliances Microwave Oven (Shanghai) Co., Ltd.

888, 898 Long Dong Road, Pu Dong, Shanghai, China

FCC ID: ACLAPBT31

Report Type: Original Report	Product Type: Microwave oven
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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 Panasonic Appliances Microwave Oven (Shanghai) Co., Ltd.'s product, model number: NN-SN686S (FCC ID: ACLAPBT31) or the "EUT" in this report is a Microwave oven, which was measured approximately: 401 cm (L) * 525 cm (W) * 310 cm (H), the rated with input voltage: AC 120V/60Hz. The operating frequency is 2450 MHz.

EUT Model No. NN-SN661S, Output rating: 1200W (By IEC 705), and Magnetron: 2M261 —M39; Employed mode: Turntable; Door seal Type: Choke, This model already has an Issued FCC Grant with FCC ID ACLAP9Y21 that the Grant was issued on 06/09/2011. But maybe it used a Class 2 Low Voltage Transformer instead of the SMPS for the required 1 Watt Stand By Power for the DOE requirement.

**The product's series model number: NN-SD681S, NN-SN661S, NN-SN651B/W, NN-SA651S. They are different in model name. PCB, Components and Schematic are the same, except appearance color and control method in different model.*

**All measurement and test data in this report was gathered from production sample serial number: 15120501 (Assigned by BACL, Shenzhen). The EUT supplied by the applicant was received on 2015-12-05*

Objective

This report is prepared on behalf of Panasonic Appliances Microwave Oven (Shanghai) Co., Ltd. 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 and FCC MP-5.

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.

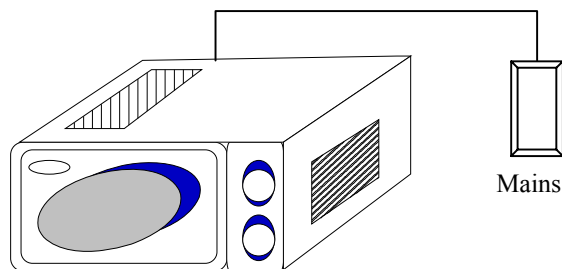
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number	Remark
/	/	/	/	/

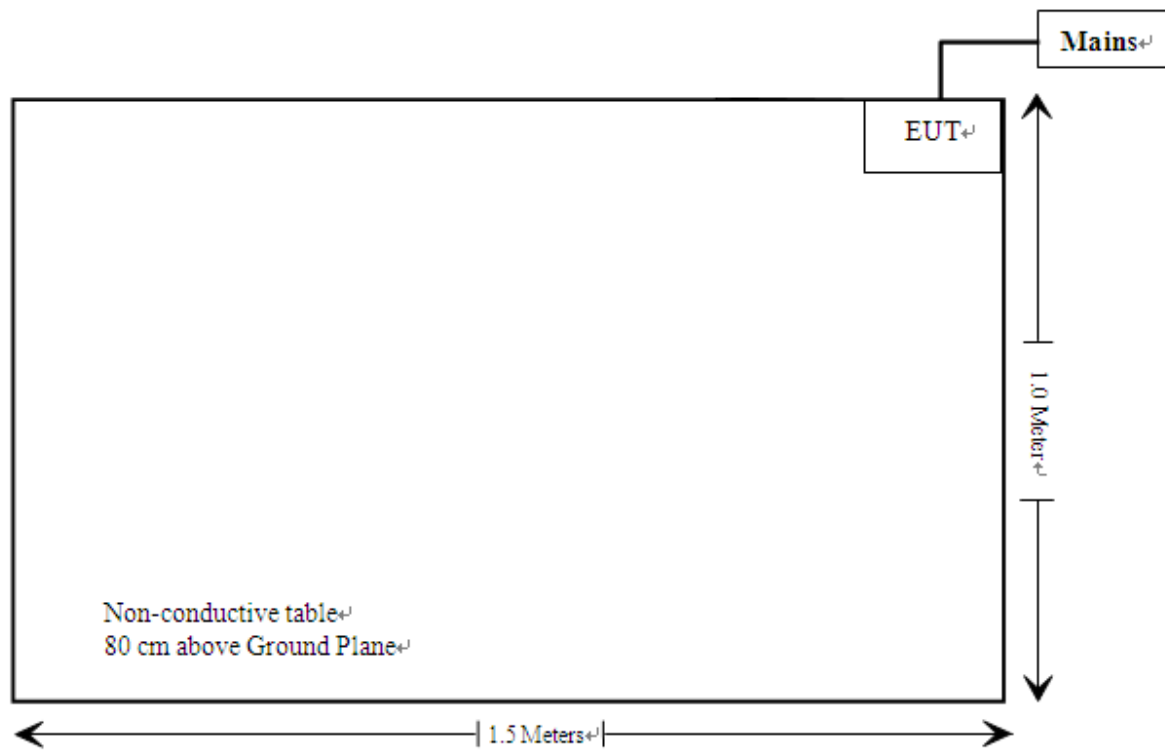
External Cable List and Details

Cable Description	Length (m)	From/Port	To
Un-shielding Un-detachable AC Cable	1.2	EUT	Mains

Configuration of Test Setup



Block Diagram of Test Setup



CONDUCTED EMISSIONS

Applicable Standard

FCC §18.307

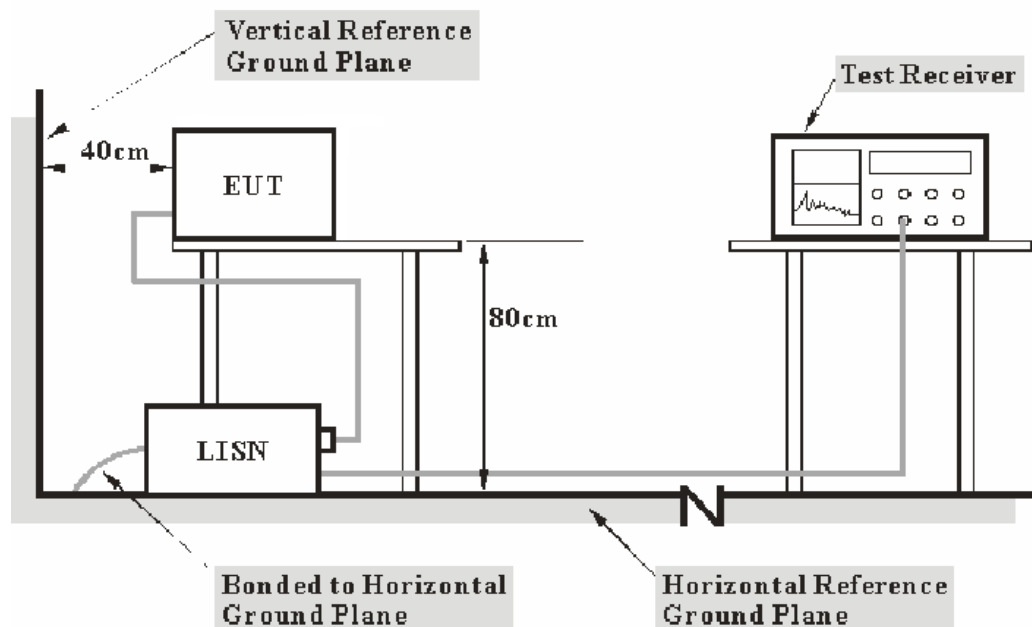
Measurement Uncertainty

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	831294/005	2015-09-16	2016-09-16
Rohde & Schwarz	LISN	ESH3-Z5	12005	2015-09-16	2016-09-16
Rohde & Schwarz	LISN	ESH3-Z5	12008	2015-09-16	2016-09-16
Rohde & Schwarz	CE Test software	EMC 32	V 09.10.0	--	--

* **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:

13.60 dB at 0.265000 MHz in the **Line** conducted mode
9.84 dB at 0.180000 MHz in the **Neutral** 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

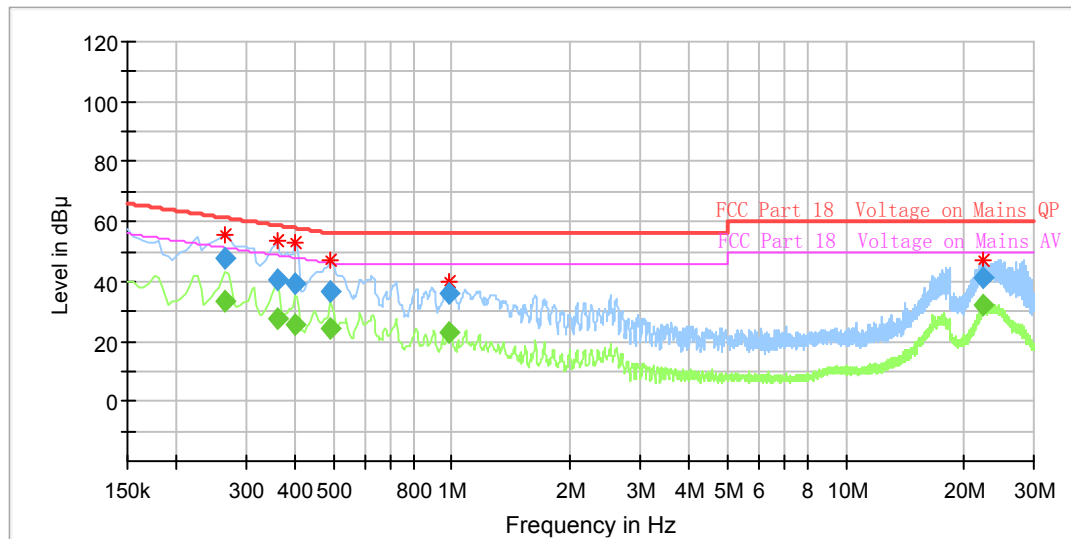
Environmental Conditions

Temperature:	24 °C
Relative Humidity:	48 %
ATM Pressure:	101.0 kPa

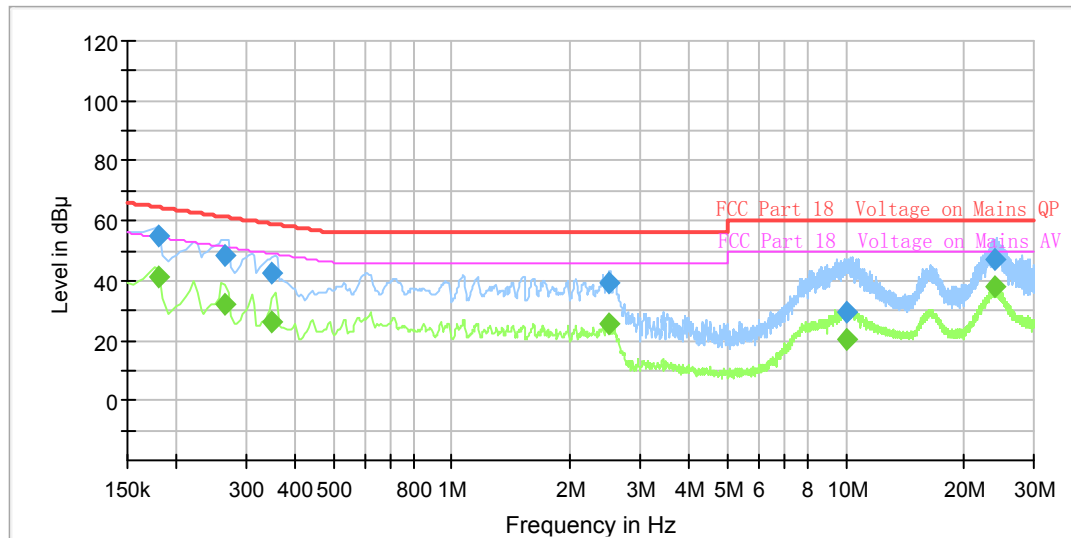
The testing was performed by test engineer on 2015-12-10

Test Mode: max output power

AC 120V/60Hz, Line:



Frequency (MHz)	QuasiPeak (dB μ V)	Average (dB μ V)	Limit (dB μ V)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.265000	---	33.28	51.27	17.99	9.000	L1	11.0
0.265000	47.67	---	61.27	13.60	9.000	L1	11.0
0.360000	---	27.28	48.73	21.45	9.000	L1	11.0
0.360000	40.60	---	58.73	18.13	9.000	L1	11.0
0.400000	---	25.41	47.85	22.44	9.000	L1	11.0
0.400000	39.41	---	57.85	18.44	9.000	L1	11.0
0.490000	---	24.01	46.17	22.16	9.000	L1	11.0
0.490000	36.43	---	56.17	19.74	9.000	L1	11.0
0.985000	---	22.86	46.00	23.14	9.000	L1	11.1
0.985000	35.84	---	56.00	20.16	9.000	L1	11.1
22.300000	---	32.22	50.00	17.78	9.000	L1	11.4
22.300000	41.08	---	60.00	18.92	9.000	L1	11.4

AC 120V/60Hz, Neutral:

Frequency (MHz)	QuasiPeak (dB μ V)	Average (dB μ V)	Limit (dB μ V)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.180000	---	41.21	54.49	13.28	9.000	N	11.0
0.180000	54.65	---	64.49	9.84	9.000	N	11.0
0.265000	---	32.11	51.27	19.16	9.000	N	11.0
0.265000	48.41	---	61.27	12.86	9.000	N	11.0
0.350000	---	26.15	48.96	22.81	9.000	N	11.0
0.350000	42.26	---	58.96	16.70	9.000	N	11.0
2.505000	---	25.73	46.00	20.27	9.000	N	11.3
2.505000	39.40	---	56.00	16.60	9.000	N	11.3
10.015000	---	20.24	50.00	29.76	9.000	N	11.4
10.015000	29.79	---	60.00	30.21	9.000	N	11.4
23.905000	---	37.84	50.00	12.16	9.000	N	11.4
23.905000	46.86	---	60.00	13.14	9.000	N	11.4

Note:

- 1) Correction Factor = LISN VDF (Voltage Division Factor) + Cable Loss
The corrected factor has been input into the transducer of the test software.
- 2) Margin = Limit – (QuasiPeak & Average)

RADIATION HAZARD MEASUREMENT

Applicable Standard

FCC §18.301

Environmental Conditions

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

The testing was performed by test engineer on 2015-12-10

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	8386001028	2015-11-12	2016-11-12
GW Instek	Power Meter	CL110034	1937A01046	2015-04-24	2016-04-24
A.H.System	Horn Antenna	SAS-200/571	135	2015-02-11	2018-02-10
MC	Thermometer	N/A	N/A	2015-11-01	2016-11-01
Holaday	Microwave Survey Meter	HI-1501	N/A	2015-11-01	2016-11-01

* **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 0.71mW/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)
120/60	12.00	1440	1480

* the measured values is After 30 minutes of steady state operation

☒ 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 1200 watts

Load used for power output measurement = 1200 milliliters of water
 Load used for frequency measurement = 1200 milliliters of water
 Load used for harmonic measurement = 840 & 360 milliliters of water
 Load used for other measurement = 840 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 $1200\text{ g} \pm 5\text{ g}$ 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)
1200	377.0	20.0	10	22	53

RF Output Power = $(4.187 \times 1200 \times (22.0 - 10) + 0.55 \times 377.0 \times (22.0 - 20)) / 53 = 1184.54 \text{ Watts}$

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 25 µV/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:

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

$$LFS = 25 * \text{SQRT} (1184.54 / 500)$$

$$LFS = 38.47$$

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
38.47	31.70	71.70

Operating Frequency Measurement

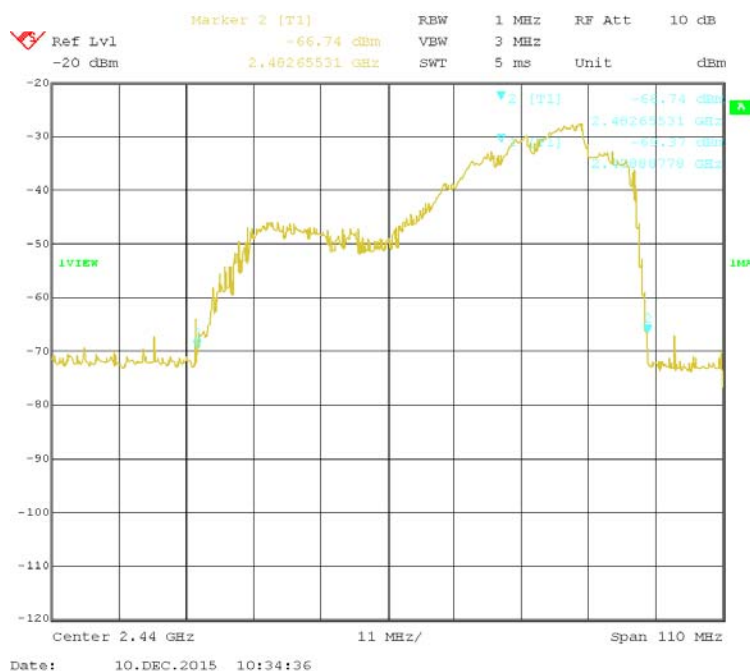
Variation in Operating Frequency with Time

The operating frequency was measured using a spectrum analyzer. Starting with the EUT at room temperature, a 1200mL 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)
2408.88	2482.65

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



Variation in Operating Frequency with Line Voltage

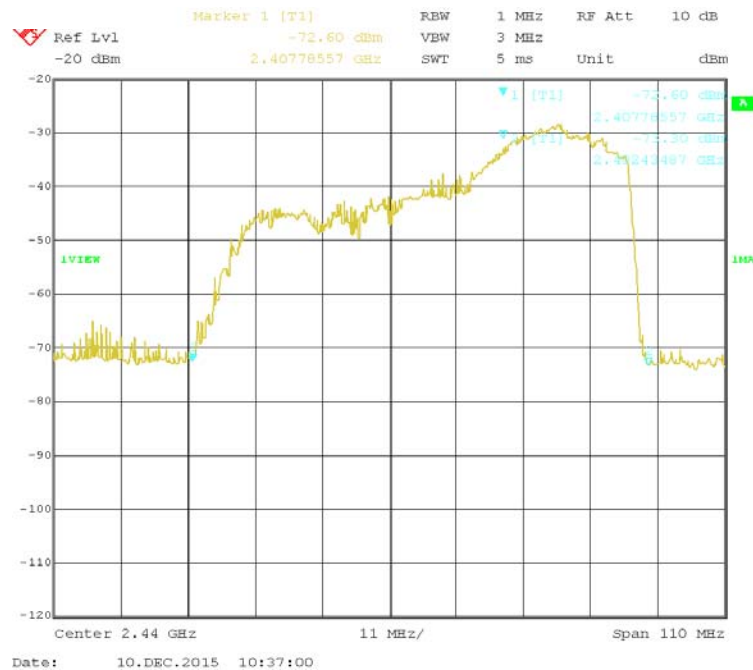
The EUT was operated / warmed by at least 10 minutes of use with a 1200 mL water load at room temperature at the beginning of the test. Then the operating frequency was monitored as the input voltage was varied between 80 and 125 percent of the nominal rating.

The results of this test are as follows:

Line voltage varied from 96 V_{AC} to 150 V_{AC}.

Low Frequency (MHz)	High Frequency (MHz)
2407.78	2482.43

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

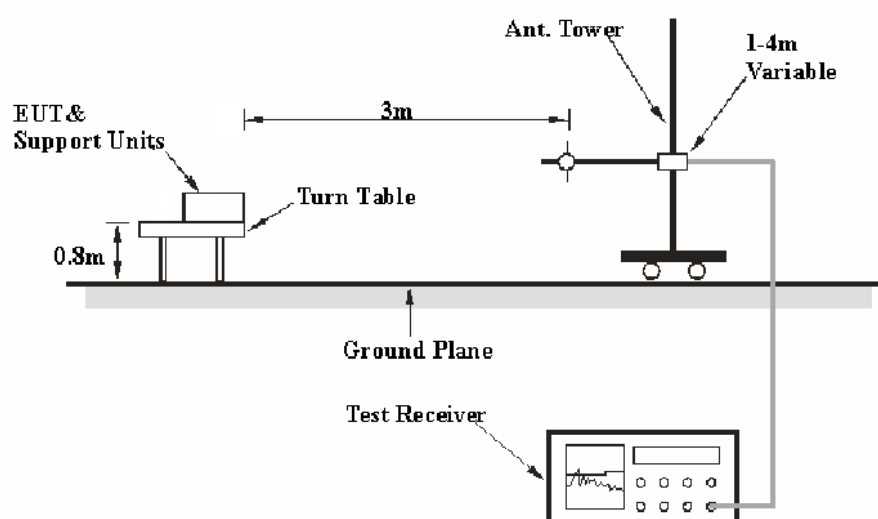
Measurement Uncertainty

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 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.

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
Sonoma Instrument	Amplifier	330	171377	2015-09-16	2016-09-16
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2015-09-16	2016-09-16
Sunol Sciences	Broadband Antenna	JB3	A090314-1	2015-09-12	2016-09-12
ETS	Horn Antenna	3115	6229	2015-09-12	2016-09-12
Rohde & Schwarz	Signal Analyzer	FSIQ26	100048	2015-09-16	2016-09-16
Mini	Pre-amplifier	ZVA-183-S+	857001418	2015-09-16	2016-09-16
champrotek	Chamber	Chamber A	1#	2015-09-17	2016-09-17
R&S	Auto test Software	EMC32	V 09.10.0	-	-

* **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:

32.50 dB at **261.325950 MHz** in the **Horizontal** polarization , 30 MHz – 1 GHz
19.77 dB at **17346.037845 MHz** in the **Horizontal** polarization , 1GHz – 25 GHz

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.

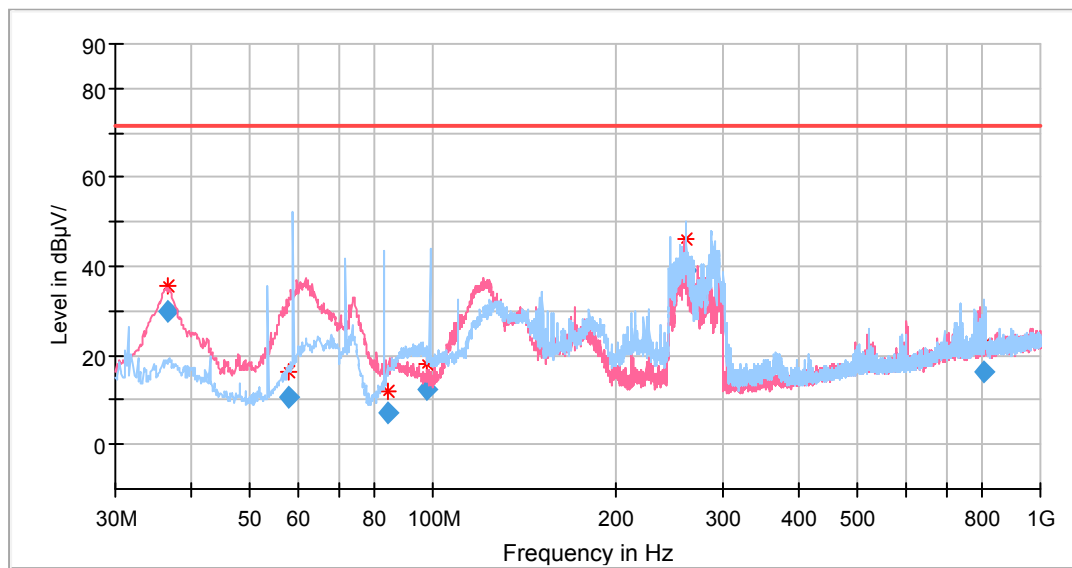
Test Data and Plots**Environmental Conditions**

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

The testing was performed by test engineer on 2015-12-10

Test Mode: max output power

30 MHz – 1 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
36.536650	29.71	100.0	V	74.0	-10.3	71.70	41.99	QP
57.912300	10.81	200.0	H	138.0	-16.6	71.70	60.89	QP
84.629050	6.98	200.0	H	62.0	-17.1	71.70	64.72	QP
97.736050	12.48	200.0	H	62.0	-16.9	71.70	59.22	QP
261.325950	39.20	100.0	H	338.0	-11.3	71.70	32.50	QP
806.383800	16.49	200.0	H	219.0	-1.4	71.70	55.21	QP

1GHz – 25 GHz

Frequency (MHz)	Corrected Amplitude (dB μ V/m)	Antenna height (cm)	Antenna Polarity	Turntable position (deg)	Correction Factor (dB/m)	Limit (dB μ V/m)	Margin (dB)	Remark
4964.233133	45.53	150.0	H	338.0	14.1	71.70	26.17	Ave.
7402.765531	36.23	150.0	V	255.0	21.6	71.70	35.47	Ave.
8162.849259	42.21	150.0	H	249.0	23.2	71.70	29.49	Ave.
10227.903551	43.53	150.0	H	324	26.8	71.70	28.17	Ave.
12321.565131	40.62	150.0	V	158.0	28.1	71.70	31.08	Ave.
14354.853706	46.58	250.0	V	307.0	29.2	71.70	25.12	Ave.
17346.037845	51.93	150.0	H	60.0	34.0	71.70	19.77	Ave.

Note: The emission level of 8th harmonic to 10th harmonic have not been detected, so there is no record about it.

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