FCC PART 18

MEASUREMENT AND TEST REPORT

For

Panasonic Corporation of North America

Two Riverfront Plaza, Newark New Jersey USA

FCC ID: ACLAPCD61

Report Type: Original Report	**Product Type:** Microwave Oven
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Report Number:	RSHD191029001-00A
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Applicant	Panasonic Corporation of North America
Manufacturer	Panasonic Appliances Microwave Oven (Shanghai) Co., Ltd.
Manufacturer Address	888, 898 Long Dong Road, Pu Dong, Shanghai, China
Test Model	NN-CD87KS
Product	Microwave Oven
Rate Voltage	AC 120V
Highest Operating Frequency	2450MHz

** All measurement and test data in this report was gathered from production sample serial number: 20191029001. (Assigned by BACL, Kunshan).The EUT supplied by the applicant was received on 2019-10-29.*

Objective

This report is prepared on behalf of *Panasonic Corporation of North America* in accordance with Part 2-Subpart J, and Part 18-Subparts A, B and C of the Federal Communication Commission rules and regulations.

The objective of the manufacturer is to determine the compliance of EUT 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. (Kunshan) to collect test data is located on the No.248 Chenghu Road, Kunshan, Jiangsu province, China.

Bay Area Compliance Laboratories Corp. (Kunshan) Lab is accredited to ISO/IEC 17025 by A2LA (Lab code: 4323.01) and the FCC designation No. CN1185 under the FCC KDB 974614 D01 and CAB identifier CN0004 under the ISED requirement. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

SYSTEM TEST CONFIGURATION

Justification

The system was configured for testing in a typical fashion (as normally used by a typical user).

Test Mode 1: Max output Power of Microwave
Test Mode 2: Max output Power of Grill

EUT Exercise Software

No software was used to test.

Special Accessories

No special accessory was used.

Equipment Modifications

No modification was made to the EUT tested.

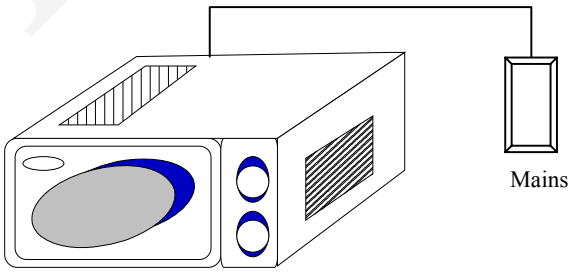
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
/	/	/	/

External I/O Cable

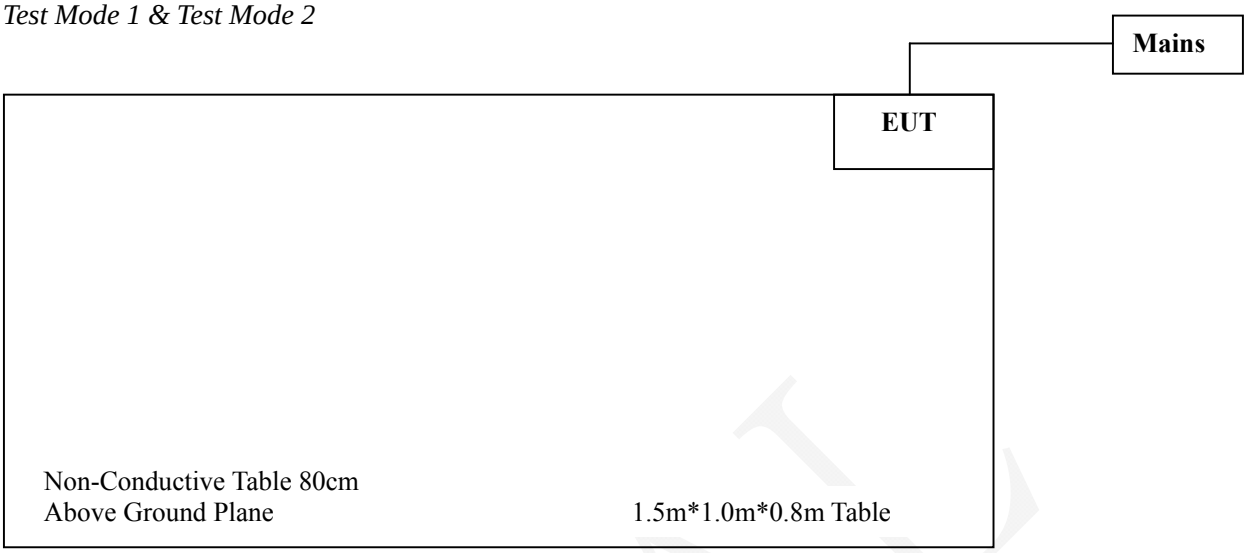
Cable Description	Length (m)	From/Port	To
Un-shielding Un-detachable AC Cable	1.2	EUT	Mains

Configuration of Test Setup



Block Diagram of Test Setup

Test Mode 1 & Test Mode 2



CONDUCTED EMISSIONS

Applicable Standard

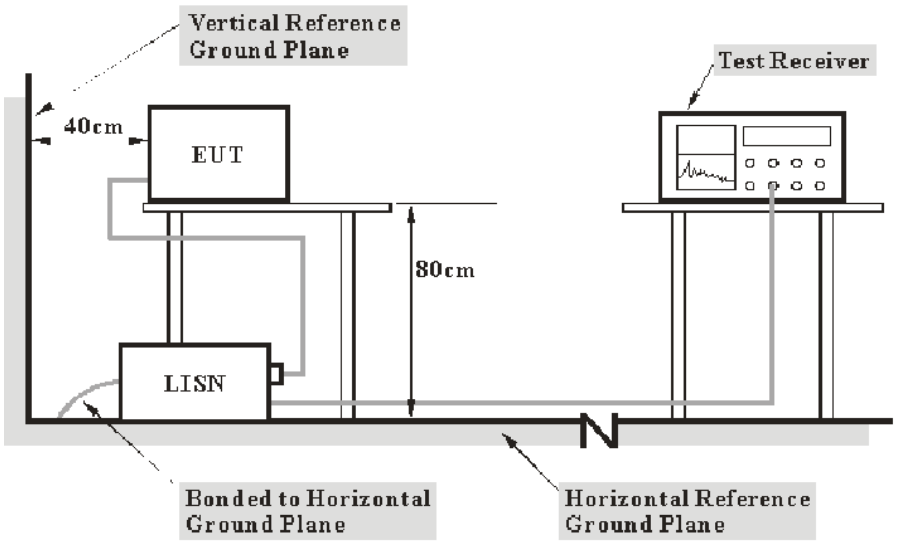
FCC §18.307

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.

Item		Measurement Uncertainty	U_{cispr}
AMN	150kHz~30MHz	3.19 dB	3.4 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 MP-5: 1986 measurement procedure. Specification used was with the FCC Part 18.

The EUT was connected to a AC 120 V/ 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

During the conducted emission test, the EUT 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	ESR	1316.3003K03-101746-zn	2019-07-11	2020-07-10
Rohde & Schwarz	LISN	ENV216	3560655016	2018-11-30	2019-11-29
Audix	Test Software	e3	V9	--	--
MICRO-COAX	Coaxial Cable	Cable-6	006	2019-09-08	2020-09-07

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

Factor & Over Limit Calculation

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

Factor (dB) = LISN VDF (dB) + Cable Loss (dB) + Transient Limiter Attenuation (dB)

The "**Over Limit**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over Limit of 7dB means the emission is 7 dB below the limit. The equation for Over Limit calculation is as follows:

Over Limit (dB) = Read level (dBµV) + Factor (dB) - Limit (dBµV)

Test Results Summary

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

-13.40 dB at **25.591 MHz** in the **Line** conducted mode
-12.25 dB at **19.845 MHz** in the **Neutral** conducted mode

Test Data

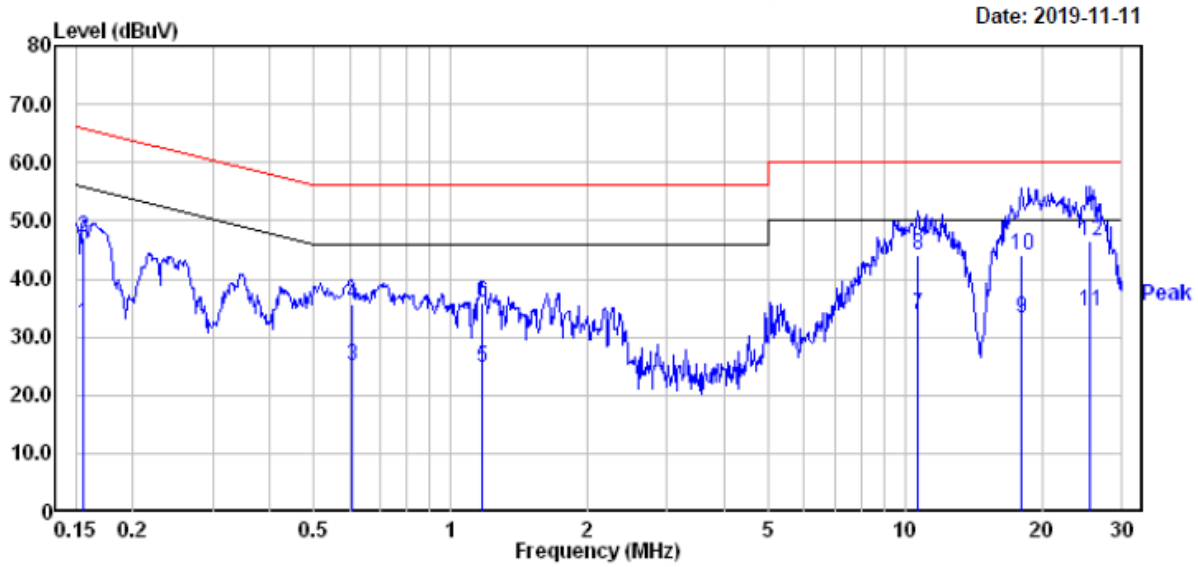
Environmental Conditions

Temperature:	24 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Dean Zhou on 2019-11-11.

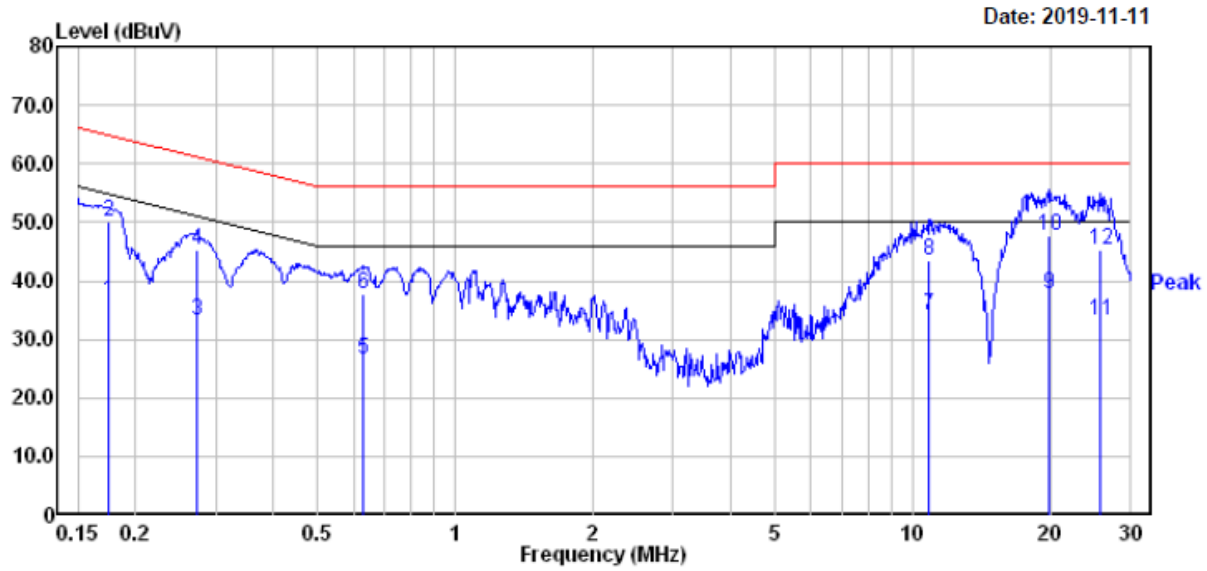
Test mode 1

Line:



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.156	12.60	19.82	32.42	55.69	-23.27	Average
2	0.156	27.30	19.82	47.12	65.69	-18.57	QP
3	0.608	5.40	19.75	25.15	46.00	-20.85	Average
4	0.608	16.00	19.75	35.75	56.00	-20.25	QP
5	1.172	4.80	19.81	24.61	46.00	-21.39	Average
6	1.172	16.10	19.81	35.91	56.00	-20.09	QP
7	10.676	14.11	19.56	33.67	50.00	-16.33	Average
8	10.676	24.41	19.56	43.97	60.00	-16.03	QP
9	18.039	13.30	19.84	33.14	50.00	-16.86	Average
10	18.039	24.10	19.84	43.94	60.00	-16.06	QP
11	25.591	14.59	19.71	34.30	50.00	-15.70	Average
12	25.591	26.89	19.71	46.60	60.00	-13.40	QP

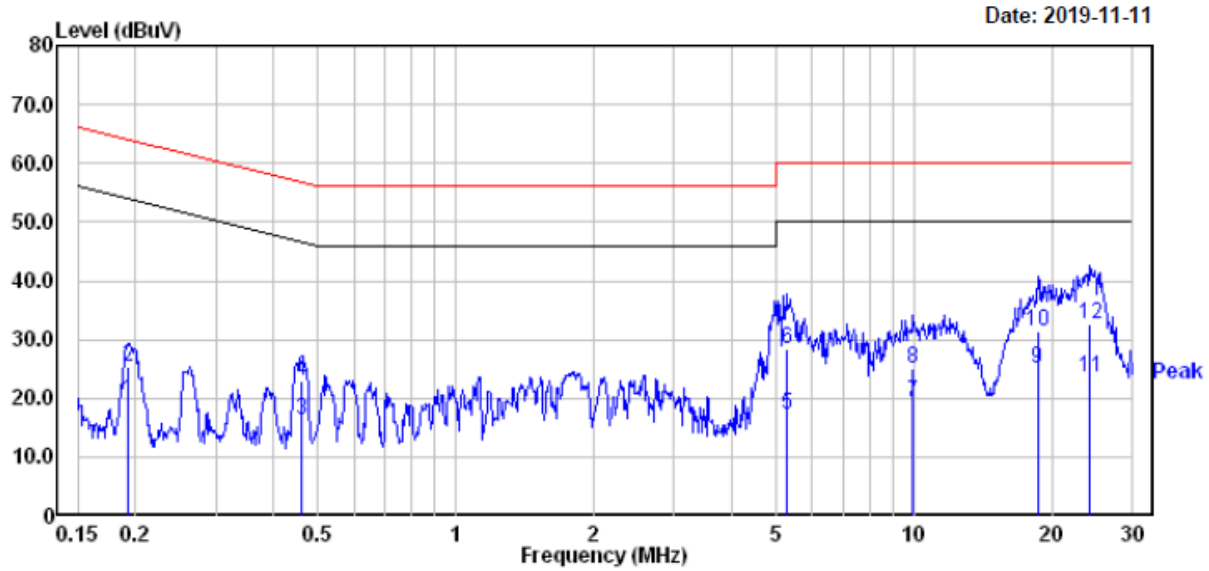
Neutral:



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.174	16.60	19.83	36.43	54.77	-18.34	Average
2	0.174	30.30	19.83	50.13	64.77	-14.64	QP
3	0.272	13.40	19.82	33.22	51.07	-17.85	Average
4	0.272	25.60	19.82	45.42	61.07	-15.65	QP
5	0.630	6.90	19.75	26.65	46.00	-19.35	Average
6	0.630	18.00	19.75	37.75	56.00	-18.25	QP
7	10.847	14.60	19.57	34.17	50.00	-15.83	Average
8	10.847	23.80	19.57	43.37	60.00	-16.63	QP
9	19.845	17.70	19.95	37.65	50.00	-12.35	Average
10	19.845	27.80	19.95	47.75	60.00	-12.25	QP
11	25.864	13.60	19.71	33.31	50.00	-16.69	Average
12	25.864	25.50	19.71	45.21	60.00	-14.79	QP

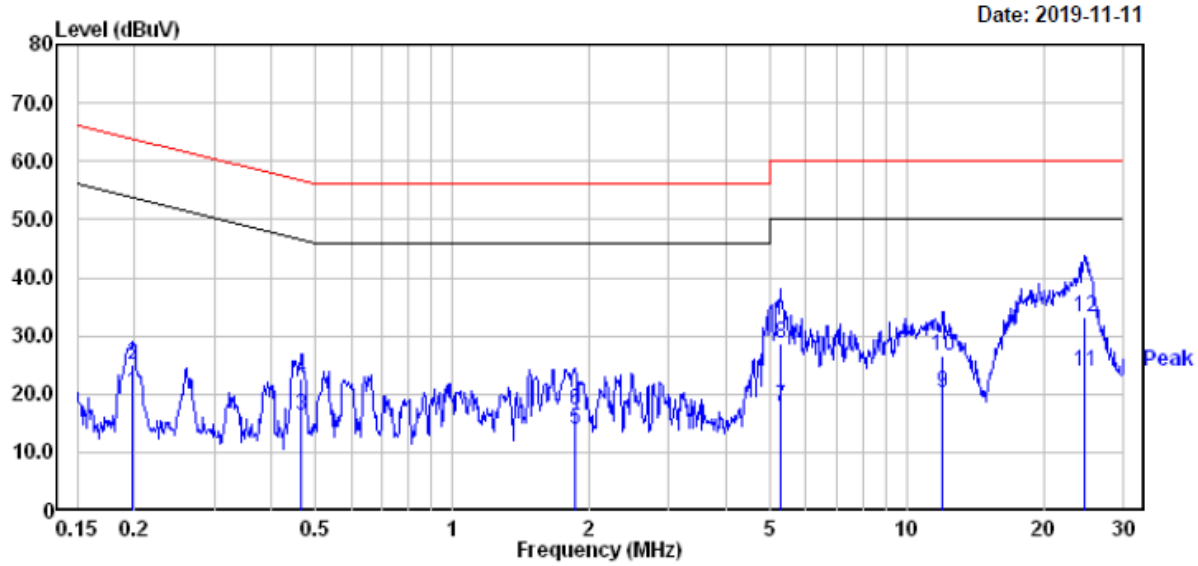
Test mode 2

Line:



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.193	-0.30	19.82	19.52	53.89	-34.37	Average
2	0.193	5.40	19.82	25.22	63.89	-38.67	QP
3	0.461	-3.30	19.75	16.45	46.67	-30.22	Average
4	0.461	3.20	19.75	22.95	56.67	-33.72	QP
5	5.277	-2.30	19.49	17.19	50.00	-32.81	Average
6	5.277	8.90	19.49	28.39	60.00	-31.61	QP
7	9.966	-0.10	19.55	19.45	50.00	-30.55	Average
8	9.966	5.60	19.55	25.15	60.00	-34.85	QP
9	18.622	5.10	19.87	24.97	50.00	-25.03	Average
10	18.622	11.40	19.87	31.27	60.00	-28.73	QP
11	24.271	3.70	19.73	23.43	50.00	-26.57	Average
12	24.271	13.00	19.73	32.73	60.00	-27.27	QP

Neutral:



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	
1	0.199	0.30	19.82	20.12	53.67	-33.55	Average
2	0.199	5.10	19.82	24.92	63.67	-38.75	QP
3	0.466	-3.40	19.75	16.35	46.58	-30.23	Average
4	0.466	3.00	19.75	22.75	56.58	-33.83	QP
5	1.868	-6.00	19.83	13.83	46.00	-32.17	Average
6	1.868	-2.50	19.83	17.33	56.00	-38.67	QP
7	5.277	-1.70	19.49	17.79	50.00	-32.21	Average
8	5.277	9.30	19.49	28.79	60.00	-31.21	QP
9	11.996	0.71	19.58	20.29	50.00	-29.71	Average
10	11.996	6.91	19.58	26.49	60.00	-33.51	QP
11	24.659	4.00	19.71	23.71	50.00	-26.29	Average
12	24.659	13.40	19.71	33.11	60.00	-26.89	QP

Note:

1) Factor (dB) = LISN VDF (dB) + Cable Loss (dB) + Transient Limiter Attenuation (dB)
2) Over Limit (dB) = Read level (dBµV) + Factor (dB) - Limit (dBµV)

RADIATION HAZARD MEASUREMENT

Applicable Standard

FCC §18.301 & FCC §18.305

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	100048	2018-11-30	2019-11-29
YUANFANG	dynamometer	PF9901	G135716CA8361400	2019-05-22	2020-05-21
ETS-LINDGREN	Horn Antenna	3115	9207-3900	2017-07-15	2020-07-14
MC	Thermometer	N/A	N/A	2019-11-01	2020-10-31
ETS-LINDGREN	Microwave Survey Meter	HI1801	00066890	2018-01-15	2020-01-14

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

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Dean Zhou on 2019-11-22.

Radiation Hazard Measurement for microwave

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/cm^2 observed at any point 5 cm or more from the external surface of the oven.

A maximum of 1.0 mW/cm^2 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 1000mL 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)	Mode
120/60	9.5	1104	1110	Microwave
120/60	11.4	1320	1350	Grill

☒ 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 ºC ± 1 ºC C is used for the test. The water temperature is measured immediately before it is poured into the container.

A quantity of 1000 g ± 5 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 ºC ± 2 ºC 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 (ºC)	T_1 (ºC)	T_2 (ºC)	t (s)
1000	377	21.9	19.3	32.9	60

RF Output Power = ((4.187x1000 x(32.9–19.3)+0.55x377.0x(32.9 – 21.9)) / 60= 987.0Watts

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_o 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-B, 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-B, the measured out-of-band emissions were compared with the limit calculated as following:

LFS = 25*SQRT (Power Output/500)

LFS = 25* SQRT (987.0 /500)

LFS = 35.12

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
35.12	30.90	70.90

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

Operating Frequency Measurement

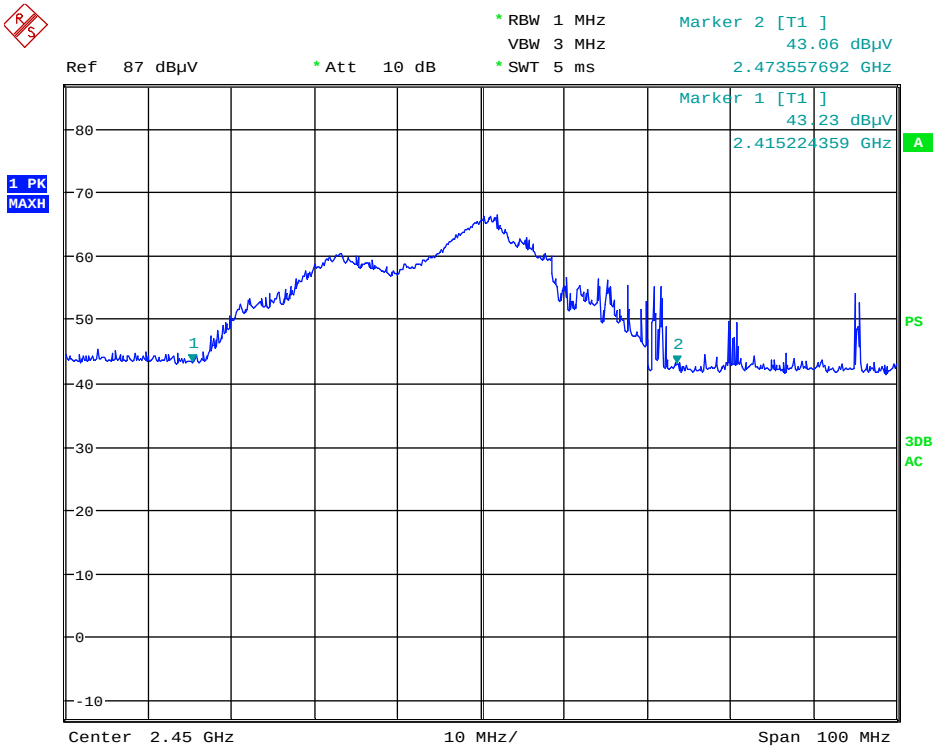
Variation in Operating Frequency with Time

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)
2415.22	2473.56

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



Variation in Operating Frequency with Line Voltage

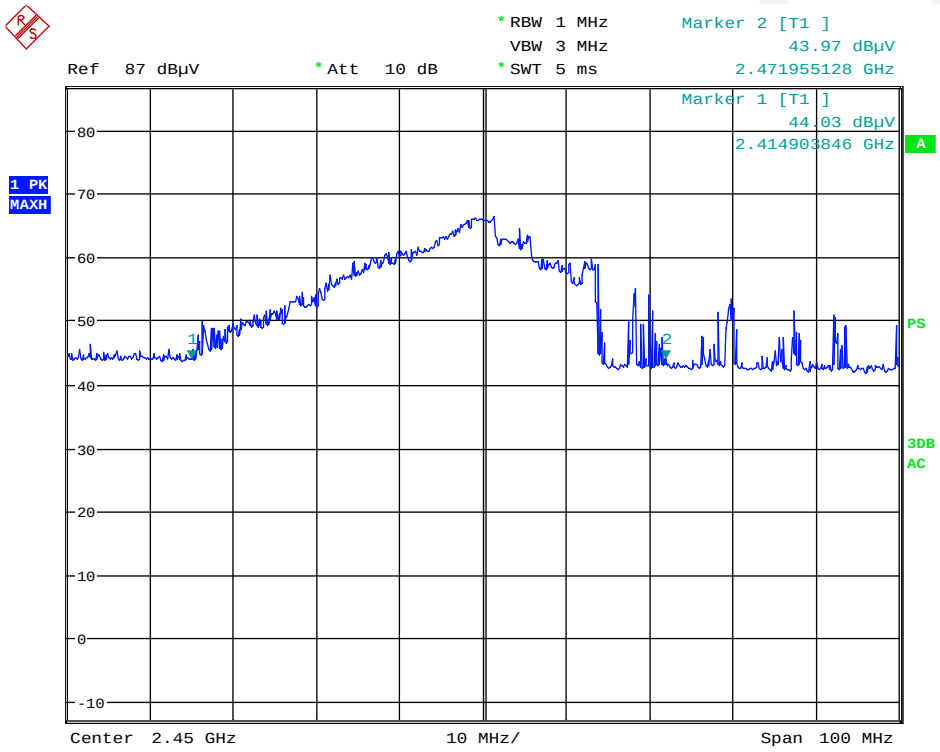
The EUT was operated / warmed by at least 10 minutes of use with a 1000 mL water load at room temperature at the beginning of the test. Then the operating frequency was monitored as the input voltage was varied between 80 and 125 percent of the nominal rating.

The results of this test are as follows:

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

Low Frequency (MHz)	High Frequency (MHz)
2414.90	2491.96

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



Radiation Hazard Measurement for Grill

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

LFS = 15*SQRT (Power Output/500)

LFS = 15*SQRT (1300/500)

LFS = 24.18

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
24.18	27.6	67.6

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

RADIATED EMISSIONS

Applicable Standard

FCC §18.305, §18.309

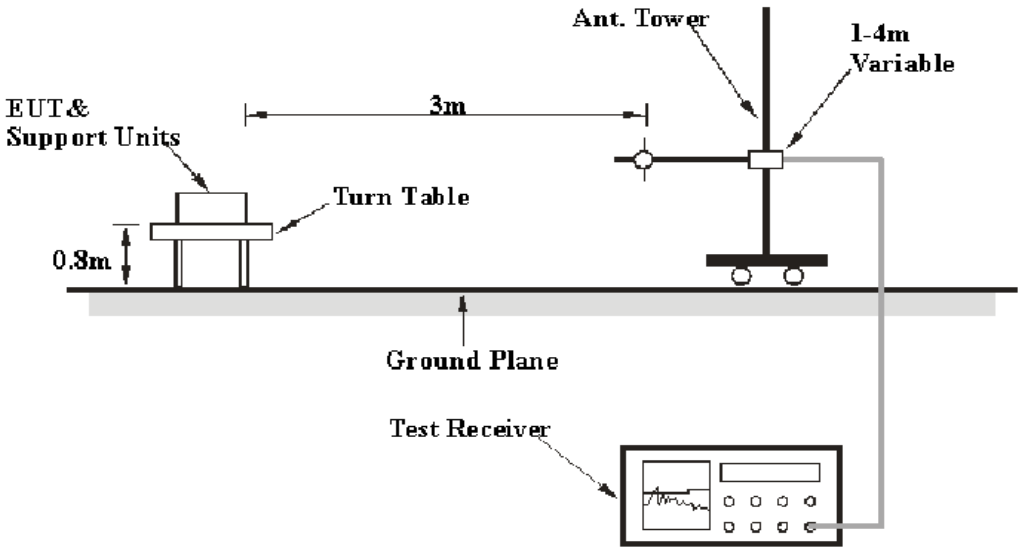
Measurement Uncertainty

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.

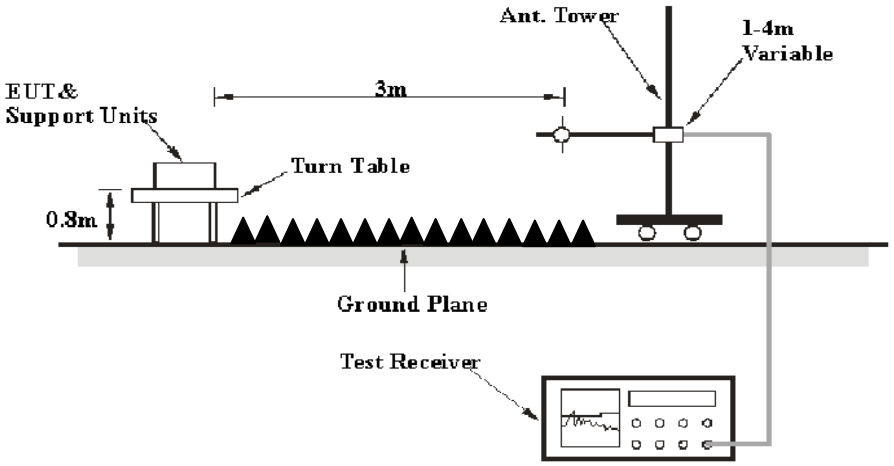
Item		Measurement Uncertainty	U_{cispr}
Radiated Emission	30MHz~1GHz	6.11dB	6.3 dB
	1GHz~6GHz	4.45dB	5.2 dB
	6 GHz ~18 GHz	5.23dB	5.5 dB

EUT Setup

Below 1GHz:



Above 1GHz:



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 EUT was connected to AC 120 V/60 Hz power source.

EMI Test Receiver Setup

The system was investigated from 30 MHz to 18 GHz.

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

Frequency Range	RBW	Video B/W	IF B/W	Detector Type
30MHz – 1000 MHz	120 kHz	300 kHz	120kHz	QP
Above 1 GHz	1MHz	3 MHz	/	Peak
	1MHz	3 MHz	1MHz	AVG

Test Procedure

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

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Sonoma Instrument	Amplifier	310N	185700	2019-08-14	2020-08-13
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2018-11-30	2019-11-29
Sunol Sciences	Broadband Antenna	JB3	A090413-1	2016-12-26	2019-12-25
Champrotek	Chamber	Chamber A	T-KSEMC049	-	-
Champrotek	Chamber	Chamber B	T-KSEMC080	-	-
R&S	Auto test Software	EMC32	100361	-	-
ETS-LINDGREN	Horn Antenna	3115	9207-3900	2017-07-15	2020-07-14
Rohde & Schwarz	EMI Receiver	ESU40	100207	2019-08-27	2020-08-26
A.H.Systems, inc	Amplifier	2641-1	491	2019-02-20	2020-02-19
MICRO-COAX	Coaxial Cable	Cable-8	008	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-9	009	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-10	010	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-4	004	2019-08-15	2020-08-14
MICRO-COAX	Coaxial Cable	Cable-5	005	2019-08-15	2020-08-14

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Kunshan) 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:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - Amplifier Gain

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:

Margin = Limit – 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:

28.74 dB at **230.062500 MHz** in the **Horizontal** polarization, 30 MHz – 1 GHz
18.90 dB at **17610.700000 MHz** in the **Vertical** polarization, 1GHz – 18 GHz

Test Data

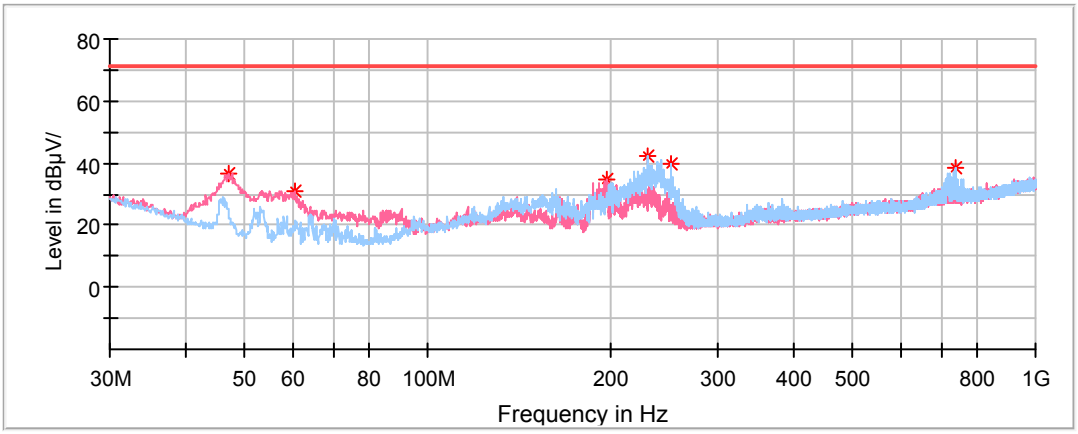
Environmental Conditions

Temperature:	20.2 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Dean Zhou on 2019-11-17.

Test Mode 1

1)30MHz ~ 1GHz:



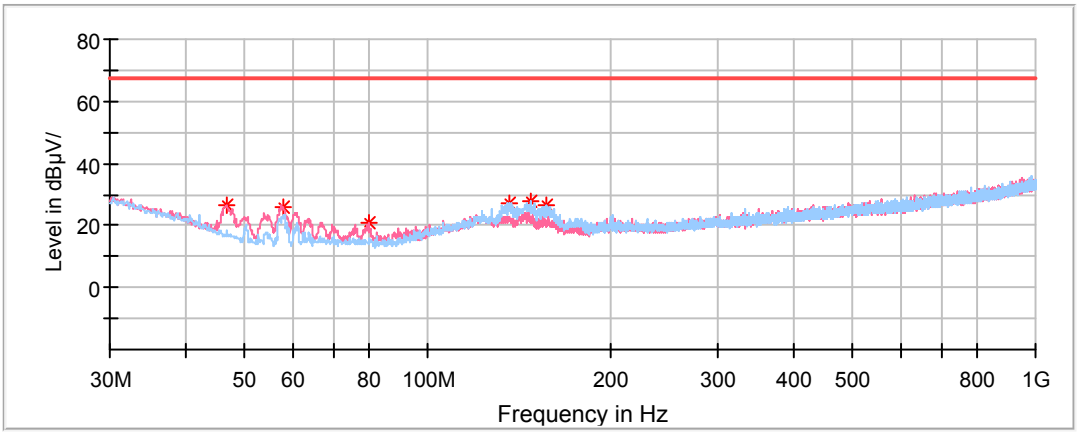
Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
46.975000	36.83	70.90	34.07	100.0	V	230.0	-15.5
60.312500	30.63	70.90	40.27	100.0	V	45.0	-17.9
197.567500	34.87	70.90	36.03	100.0	V	280.0	-12.5
230.062500	42.16	70.90	28.74	100.0	H	197.0	-12.2
252.251250	39.87	70.90	31.03	100.0	H	319.0	-12.0
739.676250	38.24	70.90	32.66	100.0	H	45.0	-2.6

Above 1 GHz:

Frequency (MHz)	Max Peak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1722.500000	---	32.40	71.90	39.50	100.0	V	0.0	-9.2
2246.100000	---	43.04	71.90	28.86	200.0	H	33.0	-7.6
4262.300000	---	49.48	71.90	22.42	100.0	H	203.0	-1.4
6450.200000	---	44.62	71.90	27.28	100.0	H	328.0	4.2
9170.200000	---	43.33	71.90	28.57	100.0	H	71.0	7.7
15274.900000	---	46.44	71.90	25.46	200.0	V	248.0	11.4

Test Mode 2

1)30MHz ~ 1GHz:



Frequency (MHz)	Peak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
46.732500	26.51	67.60	41.09	100.0	V	212.0	-15.3
57.766250	26.16	67.60	41.44	100.0	V	326.0	-17.8
79.833750	20.72	67.60	46.88	100.0	V	181.0	-17.8
136.093750	27.44	67.60	40.16	200.0	H	121.0	-11.8
147.370000	27.49	67.60	40.11	200.0	H	279.0	-12.2
157.312500	26.49	67.60	41.11	200.0	H	321.0	-12.6

Above 1 GHz:

Frequency (MHz)	Max Peak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1782.000000	---	27.23	67.60	40.37	100.0	V	201.0	-9.0
4267.400000	---	33.56	67.60	34.04	200.0	V	261.0	-1.4
6659.300000	---	40.31	67.60	27.29	200.0	V	12.0	4.7
9304.500000	---	42.21	67.60	25.39	200.0	V	82.0	7.7
13578.300000	---	46.10	67.60	21.50	200.0	H	38.0	12.0
17610.700000	---	48.70	67.60	18.90	200.0	V	0.0	14.1

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