Testing Tomorrow's Technology

October 12, 2017

Derek Shannon
Sharp Corporation
Compliance & Engineering Department Manager
4080 S. Mendenhall Rd
Memphis, TN 38193

Dear Mr. Shannon:

Enclosed please find the Sharp Corporation's file copy of the FCC Part 18 Subpart C Permissive Change Report for the FGMO206NTDA Countertop Microwave. This report has been generated to show that the product continues to meet the requirements with the modifications made to the product. The modification details as well as the test data are presented in the test report that follows.

If you have any questions, please don't hesitate to call. Thank you for your business.

Sincerely,

Alan Ghasiani
President – Consulting Engineer

3505 Francis Circle Alpharetta, GA 30004
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www.ustech-lab.com

Testing Tomorrow's Technology

CFR 47 Part 18 Industrial Scientific and Medical Equipment Subpart C Technical Standards, Part 18.305, Field Strength Limits and Part 18.307, Conducted limits Permissive Change Report

for the

Sharp Corporation

Countertop Microwave
Model: FGMO206NTDA

FCC ID: APYDMR0156

Test Date: September 20 & 28, 2017
Issue Date: October 12, 2017

UST Project No: 17-0391

Total Number of Pages Contained Within this report: 24

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I certify that I am authorized to sign for the manufacturer and that all of the statements in this report and in the exhibits attached hereto are true and correct to the best of my knowledge and belief:

US Tech (Agent responsible for test):

By: 
Name: Alan Ghasiani

Title: President – Consulting Engineer

Date: October 12, 2017

TESTING
NVLAP LAB CODE 200162-0

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1 General Information

1.1 Purpose of the Report

The purpose of the test report is to file a permissive change request for the Sharp Corporation Model: FGMO206NTDA microwave oven with FCC ID: APYDMR0156 for the following reason:

- An alternate magnetron is being certified for use with the product. The alternate magnetron is Sharp model: 2M303J(L).

1.2 Product Description

The Equipment Under Test (EUT) is the Sharp Corporation FGMO206NTDA Countertop Microwave Oven. The EUT is rated to be 1200 Watts. The input power is rated at 120 VAC, 60Hz.

The EUT was tested at 100% microwave power setting.

1.3 Related Submittal(s)/Grant(s)

The original Grant for this EUT was issued on February 24, 2005 and a subsequent Permissive Change Grant was issued on December 29, 2009.

1.4 Test Methodology

The EUT was configured as shown in the block diagram and photographs herein. The sample was tested per FCC measurement Procedure MP-5, “Methods of Measurement of Radio Noise Emissions from Industrial, Scientific and Medical Equipment” (1986) as well as per CFR 47 part 18. Conducted and radiated emissions data were taken with the Test Receiver or Spectrum Analyzer's resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. At frequencies above 1 GHz, the resolution bandwidth was increased to 1 MHz. The video bandwidth was three times more than resolution bandwidth on the spectrum analyzer. All measurements are peak unless stated otherwise. Interconnecting cables were manipulated as necessary to maximize emissions.

1.5 Test Facility

For equipment authorized under a Declaration of Conformity (DoC), the party performing the measurements shall be accredited for performing such measurements by an authorized accreditation body. US Tech currently is Accredited by the NIST NVLAP organization, Lab Code: 200162-0 and FCC Part 18 is in our Scope of Accreditation.

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. This site has been fully described and registered with the FCC under site designation number US5301. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under IC site number 9900A-1.

1.6 Test Equipment

The following table details the test equipment used in the evaluation of this product.

Table 1. Test Equipment

INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	CALIBRATION DUE DATE
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	06/22/2018
SPECTRUM ANALYZER	DSA815	RIGOL	DSA8A18030138	12/01/2017
PREAMPLIFIER	8449B	HEWLETT-PACKARD	3008A00480	12/01/2017
PREAMPLIFIER	8447D	HEWLETT-PACKARD	1937A02980	11/01/2017
BICONICAL ANTENNA	3110	EMCO	9307-1431	11/25/2017 2 yr extended
HORN ANTENNA	3115	EMCO	9107-3723	9/22/2018 2 yr
LOG PERIODIC ANTENNA	3146	EMCO	9305-3600	9/22/2018 2 yr
LISN (x2)	9028-50-TS24-BNC	SOLAR ELECTRONICS	910494 & 910495	06/22/2018
Fluke Data logger	Hydra Series II	FLUKE	8821014/ 8822004	02/28/2018
CALCULATION PROGRAM	N/A	N/A	N/A	N/A

Note: The calibration interval of the above test instruments is 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

2 System Test Configuration

2.1 Characterization of Sample Tested

The samples used for test were received on September 7, 2017 in good condition.

2.2 EUT Exercise Software

No software was exercised while the EUT was being tested. The EUT was programmed to perform at 100% power level. The test was performed using 1000 ml of tap water in a 150 mm diameter cylindrical glass vessel placed in the center of the oven.

2.3 Special Accessories

There were not special accessories required for this product testing.

2.4 Test Rationale

The EUT, cable and wiring arrangement, and mode of operation that produced the emissions with the highest levels relative to the applicable limits was selected for final measurements.

The interconnect cable(s) and/or power cord(s) were moved into various positions of the most likely configurations to maximize the emissions. In this case the placement of the cables had negligible effects. The test configuration photographs represent the final configuration used for testing.

2.5 Tested System Details

Table 2. EUT and Peripherals

PERIPHERAL/ MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID	CABLES P/D
Countertop Microwave (EUT)/ Sharp	FGMO206NTDA	9G71201898	APYDMR0156	N/A

U= unshielded S= shielded P= Power D= Data

Table 3. Detail of I/O Cables Attached to EUT

DESCRIPTION OF CABLE	DETAILS OF CABLE			CABLE LENGTH
Power Cable	Manufacturer and Part Number			1.5 m
	CND			
	Shield Type	Shield Termination	Type of Backshell	
	NA	NA	NA	

Shield Type
N/A = None
F = Foil
B = Braided
2B = Double Braided
CND = Could Not Determine
C = Conduit

Shield Termination
N/A = None
360 = 360°
P = Pigtail/Drain Wire
CND = Could Not Determine

Type of Backshell
N/A = Not Applicable
PS = Plastic Shielded
PU = Plastic Unshielded
MS = Metal Shielded
MU = Metal Unshielded

2.6 Configuration of Tested System

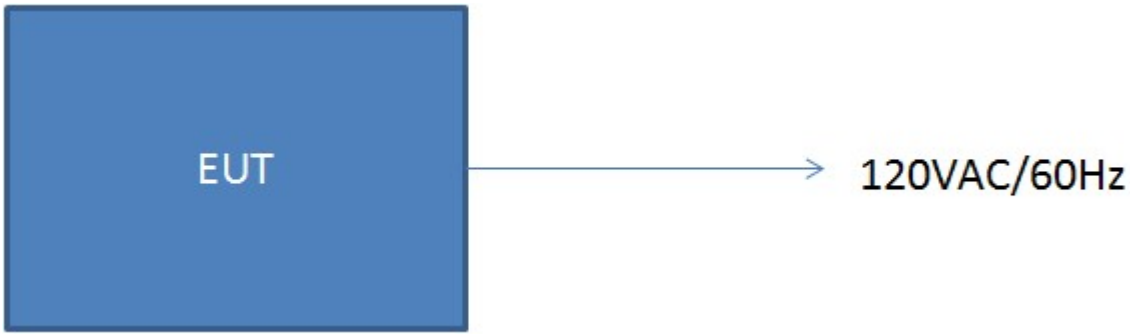

Figure 1. Block Diagram of Test Configuration

2.7 Equipment Modifications

No modifications were made to the EUT in order for it to meet the requirements.

2.8 Test Results

Line conducted emissions testing was conducted and compared to 18.307(b) limits. The worst case line conducted emission was 7.0 dB below the limit at 19.4670 MHz on the Phase line. All other conducted emissions were at least 10.8 dB below the limit.

Radiated emissions testing was conducted and compared to 18.305 (a) and (b) limits. The worst case radiated emission in the frequency range 30 MHz to 25 GHz was 6.5 dB below the limit at 4923 MHz All other radiated emissions were at least 7.0 dB below the limit in that range.

2.9 Measurement Uncertainty

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Conducted Emissions:

Measurement Uncertainty (within a 95% confidence level) for this test was ±2.8 dB.

☐ - The data listed in this test report may exceed the test limit because it does not have enough margin (more than 2.8 dB) to meet the measurement uncertainty interval. The EUT conditionally passes this test.

☒ - The data listed in this test report has enough margin, more than 2.8, dB to meet the measurement uncertainty interval. The EUT unconditionally passes this test.

Radiated Emissions:

Measurement Distance of 10 m:

The measurement uncertainty (with a 95% confidence level) for this test using a Biconnical Antenna is ±5.21 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna is ±4.99 dB.

Measurement Distance of 3 m:

The measurement uncertainty (with a 95% confidence level) for this test using a double ridge horn antenna is ±5.08 dB.

☐ - The data listed in this test report may exceed the test limit because it does not have enough margins to meet the measurement uncertainty interval. The EUT conditionally passes this test.

☒ - The data listed in this test report has enough margins to meet the measurement uncertainty interval. The EUT unconditionally passes this test.

3 Power Line Conducted Emissions Data (47 CFR 18.307)

3.1 Test Site Description

The mains terminal interference measurement facility is a shielded room (Lectro Magnetics, Inc., Type LDC6-0812-8-2793) 4.0 m deep x 2.5 m wide x 2.5 m high. Power for the shielded room is filtered (Lectroline, EMX-1020-2, rated 125/250 V, 20 A, 50/60 Hz).

The artificial mains networks are Solar Electronics models 8028. A nonconductive table 1.5 m deep x 1.0 m wide x 0.8 m high is used for tabletop equipment. All grounded conducting surfaces including the case or cases of one or more artificial mains networks is at least 0.8 m from any surface of the EUT. The EUT is a floor standing unit; therefore the unit was place on the floor 50cm away from all vertical coupling surfaces.

Table 4. Power Line Conducted Emissions

Conducted Emissions 120 VAC						
Tested By:	Test: Part 18.307 DoC		Client: Sharp Corporation			
JF	Project: 17-0391	Class: B	Model: FGMO206NTDA			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CA-AMP (dB)**	**Peak Results (dBuV)**	**Average Limits (dBuV)**	**Margin (dB)**	**Detector Used**
PHASE						
0.1535	36.37	0.40	36.77	55.8	19.0	**AVG**
0.7375	21.20	0.11	21.31	46.0	24.7	**AVG**
2.9800	18.97	0.16	19.13	46.0	26.9	**AVG**
9.3750	38.83	0.39	39.22	50.0	10.8	**PK**
19.4670	42.35	0.68	43.03	50.0	7.0	**PK**
23.330	15.09	0.81	15.90	50.0	34.1	**AVG**
NEUTRAL						
0.1768	31.18	0.43	31.61	54.6	23.0	**AVG**
0.6008	23.10	0.27	23.37	46.0	22.6	**AVG**
1.5133	24.74	0.31	25.05	46.0	21.0	**AVG**
9.7583	37.93	0.53	38.46	50.0	11.5	**PK**
10.5166	16.47	1.26	17.73	50.0	32.3	**AVG**
20.4330	33.02	0.82	33.84	50.0	16.2	**PK**

Sample Calculation at 0.1535 MHz:

Magnitude of Measured Frequency	36.37	dBuV
+Correction Factors	0.40	dB
Corrected Result	36.77	dBuV

Test Date: September 28, 2017

Tested by
Signature: _____ Name: John Freeman

4 Radiated Emissions Data (47 CFR 18.301, 18.303, 18.305)

4.1 Test Site Description

The radiated emissions disturbance measurement facility consists of a 8.5m meters long by 5.5 meter wide and 5.6 meter high shielded semi anechoic EMC Chamber. The chamber is lined with ferrite core and RF absorbers. The quiet zone is 2.0 meters.

The test facility layout is shown in the figure below. A remotely controlled 2.0 m diameter flush-mounted turntable is provided for rotating (through at least 360 degrees) the EUT. A nonconductive table, 1.5 m long by 1.0 m wide by 0.8 m high is used in conjunction with the turntable for tabletop equipment. Electrical service for the EUT is provided through openings at the center of the turntable.

Provision for receiving antenna power and data wires is provided by junction boxes place at the parameter of the chamber. The receive antenna mast is remotely controlled and can be varied in height from 1 m to 4 m.

Power and data cables for the radiated disturbance measurement facility are run through PVC tubing under the raised floor or are laid directly upon the ground plane.

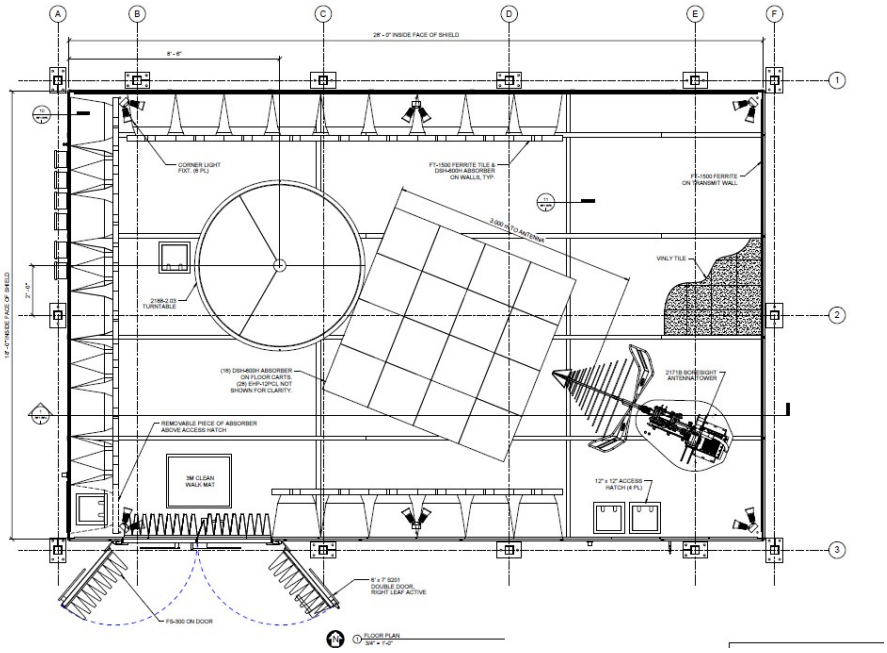


Figure 2. Radiated Emissions Disturbance Measurement Facility Diagram

4.2 Test Limits/Calculations

4.2.1 Part 18 ISM Test Limits

Per 47 CFR 18.301 the ISM equipment may be operated on any frequency above 9 kHz except as indicated in 47 CFR 18.303. The field strength limit per 47 CFR 18.305 for ISM equipment operating on a frequency specified in 47 CFR 18.301 is permitted unlimited radiated energy in the band specified for that frequency. The field strength levels of emissions which lie outside the bands specified in 47 CFR 18.301 must not exceed the limits detailed in CFR 18.305, unless otherwise indicated.

Per the table in 18.301, the frequency 2450 MHz ±50MHz is allowed unlimited radiated energy. The EUT fundamental frequency is stated to be 2450 MHz.

The field strength levels of emissions which lie outside the bands specified in 18.301, unless otherwise indicated, shall not exceed the following:

Any type of equipment unless otherwise specified that operate above 500 watts: 25 uV/m X SQRT (power/500) at the distance of 300m.

Therefore the limit converted to dBuV/m is: 20 log [(25) * √ (EUT power/500)]= dBuV/m + 20 log(300/test distance used) = XX.X dBuV/m

The measured EUT power P, is 1200 Watts as rated and tested by the manufacturer. This value was used in the calculation of the limit for this test.

Limit at 10 meters is 20 log [(25) * √ (1200/500)]= 31.76 + 20 log(300/10) =
61.3 dBuV/m.

Limit at 3 meters is 20 log [(25) * √ (1200/500)]= 31.76+ 20 log(300/3) =
71.76 dBuV/m.

Radiated emissions were evaluated based on 47 CFR 18.309.

4.2.2 General Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + CF – AG

where FS = Field Strength
RA = Receiver Amplitude (dBuV)
CF = Correction Factor (Antenna Factor & Cable Loss) (dB/m)
AG = Amplifier Gain

Assuming a receiver reading of 100 dBuV and a correction factor of 11.8 dB/m, the following calculation would apply:

FS (dBuV/m) = 100 dBuV + 11.8 dB/m = 111.8 dBuV/m

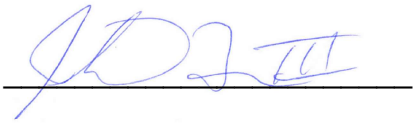
Table 5. Radiated Emissions Data 30 MHz to 1 GHz

Radiated Emissions							
Test By: JF	Test: Radiated	Client: Sharp Corporation					
	Project: 17-0391	Limits Based on: FCC 18.305	Model: FGMO206NTDA				
Frequency (MHz)	**Test Data (dBuV)**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**Average Limits (dBuV/m)**	**Application Test Distance/ Polarization**	**Margin (dB)**	**Detector Used**
67.39	42.27	-18.49	23.78	71.8	3m./VERT	48.0	**PK**
68.84	37.36	-17.39	19.97	71.8	3m./HORZ	51.8	**PK**
143.33	48.52	-13.70	34.62	71.8	3m./VERT	37.1	**PK**
174.64	37.12	-13.78	23.34	71.8	3m./HORZ	48.4	**PK**
215.52	38.81	-14.08	24.73	71.8	3m./HORZ	47.0	**PK**
215.52	36.92	-14.38	22.54	71.8	3m./VERT	49.2	**PK**
707.00	52.55	-2.93	49.62	71.8	3m./VERT	22.1	**PK**
873.32	57.24	-0.98	56.26	71.8	3m./HORZ	15.5	**PK**
973.38	40.14	-1.89	38.25	71.8	3m./VERT	33.5	**PK**
975.84	41.43	-1.29	40.14	71.8	3m./HORZ	31.6	**PK**
Measurements were made over the frequency range of 30 MHz – 1000 MHz All other emissions were more than 20 dB from the limit.							

Sample Calculation at 67.39 MHz:

Magnitude of Measured Frequency	42.27	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	-18.49	dB/m
Corrected Result	23.78	dBuV/m

Test Date: September 20, 2017

Tested by
Signature: 

Name: John Freeman

Table 6. Radiated Emissions Data 1 GHz to 25 GHz

Radiated Emissions								
Test By: JF	Test: Radiated		Client: Sharp Corporation					
	Project: 17-0391		Limits Based on: FCC18.305	Model: FGMO206NTDA				
Frequency (MHz)	**Test Data (dBuV)**	**Additional Factor**	**AF+CA-AMP (dB/m)**	**Results (dBuV/m)**	**Average Limits (dBuV/m)**	**Application Test Distance/ Polarization**	**Margin (dB)**	**Detector Used**
1737.00	40.60	0.00	-4.48	36.12	71.8	3.0m./VERT	37.2	**AVG**
1754.00	39.52	0.00	-4.41	35.11	71.8	3.0m./HORZ	38.2	**AVG**
4923.00	56.22	0.00	10.50	66.72	71.8	3.0m./VERT	6.5	**PK**
4931.00	39.18	0.00	10.56	49.74	71.8	3.0m./HORZ	23.5	**AVG**
6141.00	51.77	-9.50	14.98	57.25	71.8	1.0m./VERT	16.0	**PK**
6157.00	57.66	-9.50	14.98	63.14	71.8	1.0m./HORZ	10.1	**PK**
9827.00	51.82	-9.50	23.72	66.04	71.8	1.0m./VERT	7.2	**AVG**
9840.00	42.97	-9.50	23.69	57.16	71.8	1.0m./HORZ	16.1	**AVG**
12309.30	40.28	-9.50	31.28	62.06	71.8	1.0m./HORZ	11.2	**AVG**
12328.00	44.17	-9.50	31.44	66.11	71.8	1.0m./VERT	7.2	**AVG**
Measurements were made over the frequency range of 1 GHz to 25 GHz. All other emissions were more than 20 dB from the limit.								

Note: For measurements made at test distance of 1 meter an extrapolation factor of -9.5 dB was applied to correct the data for a 3 meter test distance.

Sample Calculation at 1737.00 MHz:

Magnitude of Measured Frequency	40.60	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	--4.48	dB/m
Corrected Result	36.12	dBuV/m

Test Date: September 20, 2017

Tested by
Signature: _____ Name: John Freeman

5 Variation in Operating Frequency

Frequency variation testing was performed per MP-5 section 4.5. The EUT was set up inside the EMC Chamber, and a double ridge horn antenna and spectrum analyzer were used to measure the fundamental frequency of the EUT. The test results are presented below.

5.1 Variation in Operating Frequency Over Time

The operating frequency was measured using a spectrum analyzer. Starting with the EUT at room temperature, a 1000 mL 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 over the length of time taken for the water level to reduce to 20 percent of the original level. In this case it took 24mins for the water level to reach 20% or 800 ml.

During the test the fundamental frequency of the EUT must remain within the ISM frequency band of 2450 MHz ±50 MHz, 2400 MHz to 2500 MHz. The results of this test are presented below.

Table 7. Measured Frequency Variation

Low Frequency (MHz)	High Frequency (MHz)
2400.00	2462.50

Test Date: September 20, 2017

Tested by
Signature: _____ Name: John Freeman

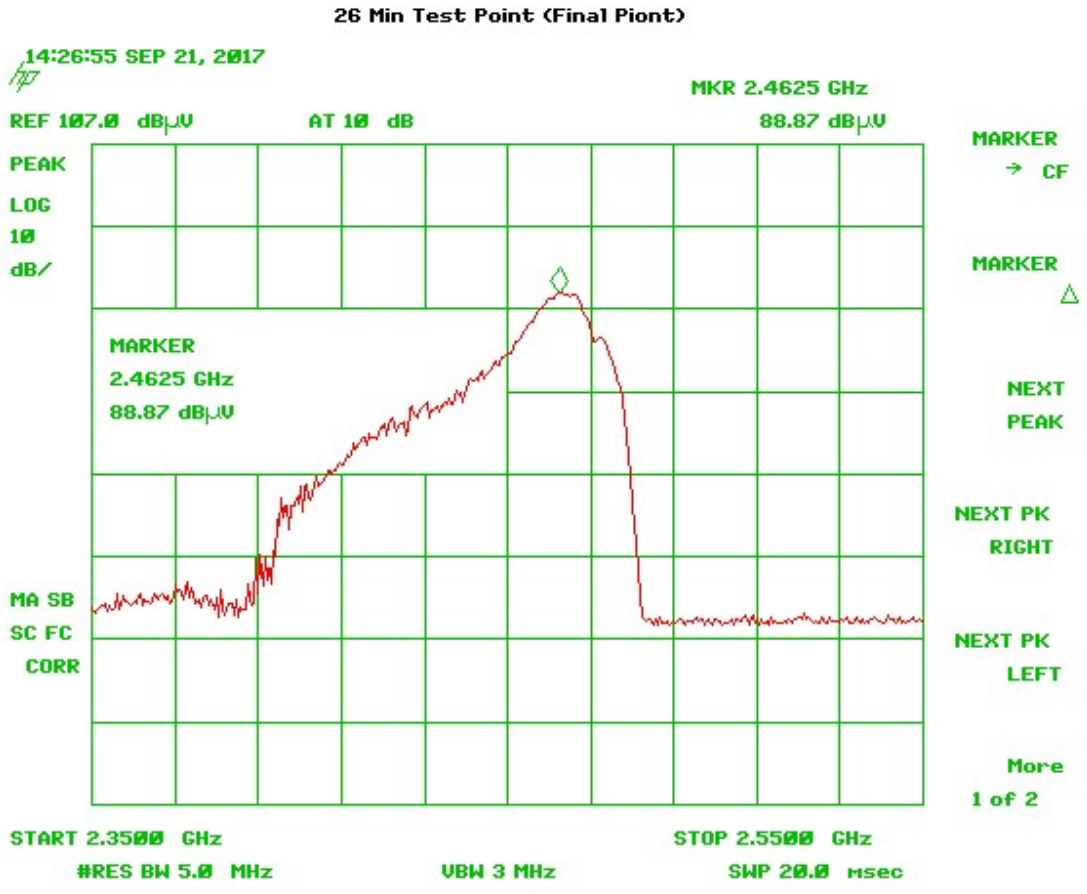


Figure 3. Frequency Variation at Nominal Voltage

5.2 Variation in Operating Frequency with Line Voltage

The EUT was operated/warmed up for at least 10 minutes of use with a 1700 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. At each varied voltage level, the EUT was allowed to operate for at least 5 minutes.

During the test, the fundamental frequency of the EUT must remain within the ISM frequency band of 2450 MHz ±50 MHz, or 2400 - 2500 MHz. The results of this test are presented below.

Line voltage varied from 96 VAC to 150 VAC.

Table 8. Measured Supply Voltage Variation

%	Supply Voltage (V) at 60 Hz	Measured Frequency (MHz)	
		Low Frequency	High Frequency
80%	96	2400.00	2466.5
125%	150	2400.00	2462.5

Test Date: September 20, 2017

Tested by
Signature: _____ Name: John Freeman

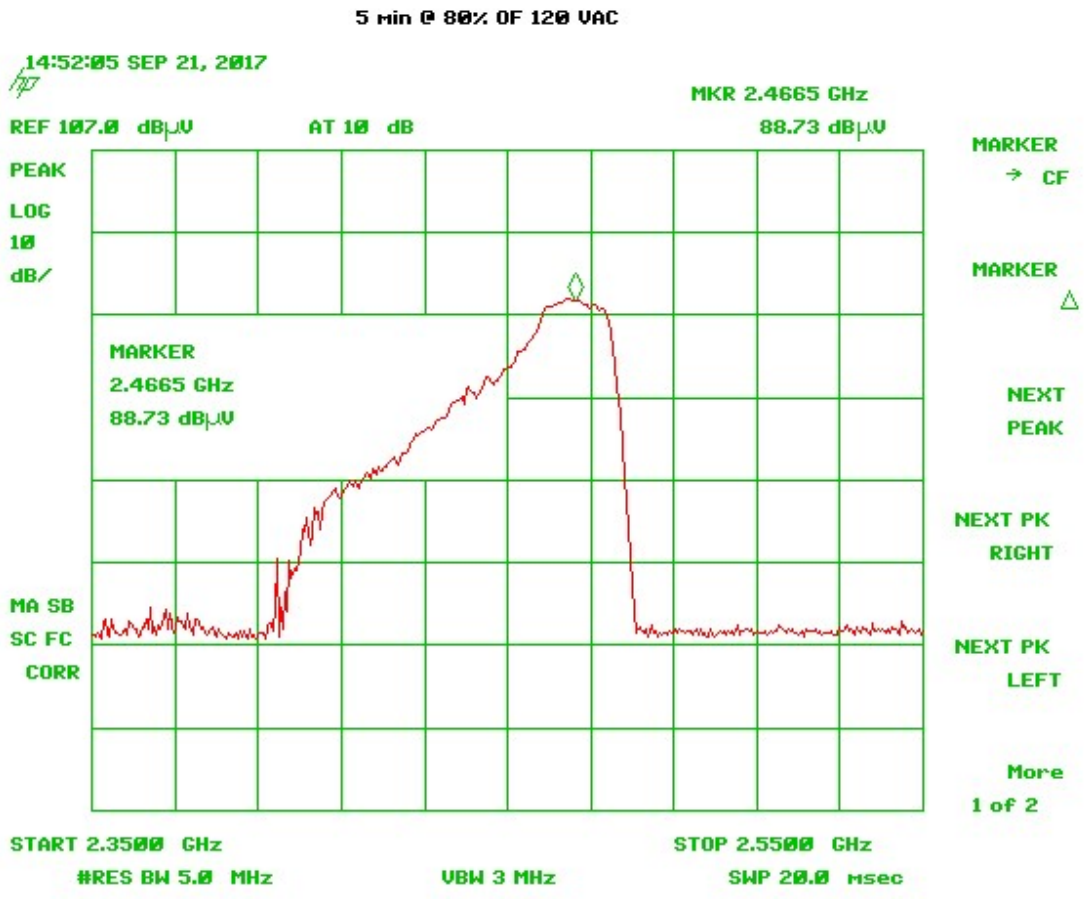


Figure 4. Frequency Variation at Low Voltage

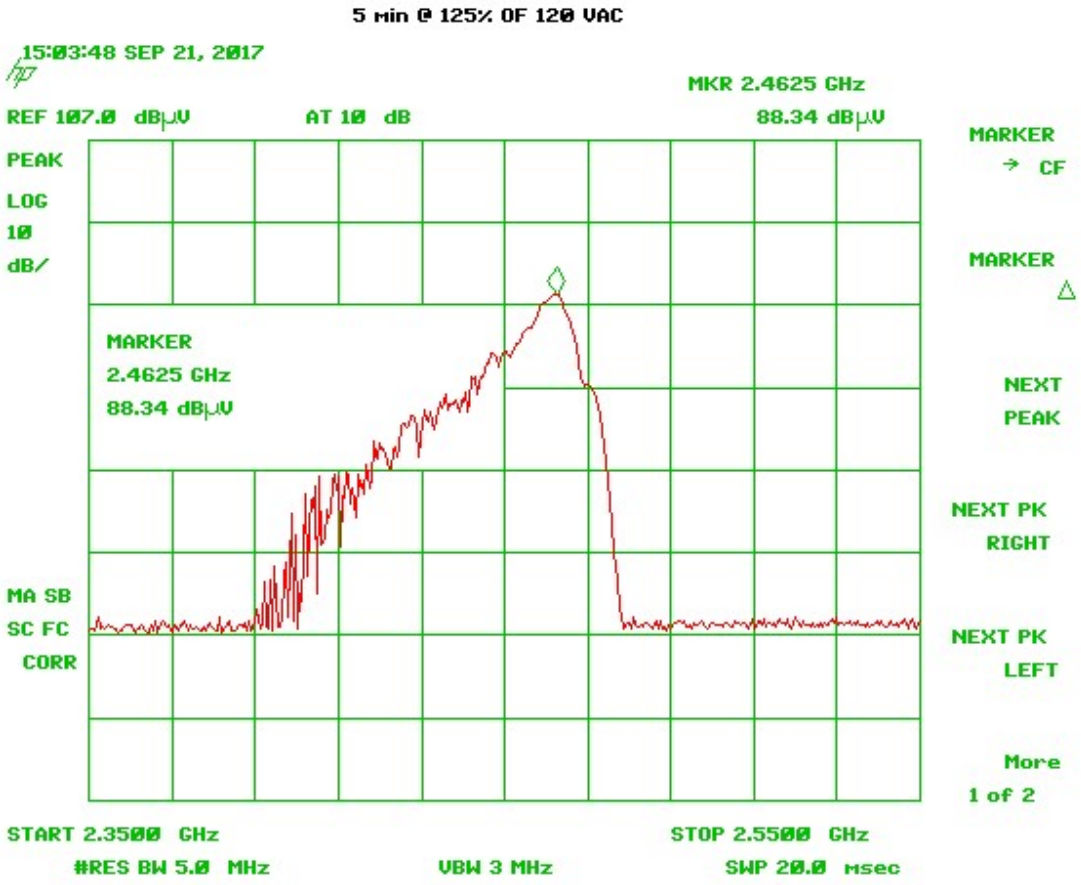


Figure 5. Frequency Variation at High Voltage

6 Output Power

The Caloric Method was used to determine maximum output power. The initial temperature of a 1000 ml water load was measured for ovens rated at 1000 watts or less power output. For ovens more than 1000 watts output rating, additional beakers by fraction thereof are used if necessary.

The water load was placed in the center of the oven. The oven was operated at maximum output power for 120 seconds, then the temperature of the water was re-measured.

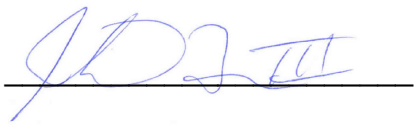
Three trials were performed and then the results calculated using the following formula: Output Power=((4.2 Joules/Cal)*(Volumn in ml)*(Temp Rise))/(Time in seconds)

Table 9. Output Power Results

Start Temperature (°C)	Final Temperature (°C)	Temperature Rise	Elapsed Time (seconds)	Water Volume (ml)	RF Power (Watts)
27.2	40.6	13.4	120	1700	797.30
26.4	40.0	13.6	120	1700	809.20
26.0	39.9	13.9	120	1700	827.05

Average from the three trials: 811.18 Watts

Test Date: September 20, 2017

Tested by
Signature: 

Name: John Freeman