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 Certification Report

for the

Sharp Corporation

Convection Microwave Oven Drawer
Model: SMD2499FSC

FCC ID: APYDMR0180

Test Dates: September 29- October 9, 2020
Issue Date: October 16, 2020

UST Project No: 20-0238

Total Number of Pages Contained Within this report: 43

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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 16, 2020

TESTING
NVLAP LAB CODE 200162-0

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1 General Information

1.1 Purpose of the Report

This report is prepared as a means of conveying test results and information concerning the suitability of this exact product for public distribution according to the FCC Rules and Regulations Part 18.305 and 18.307.

1.2 Product Description

The Equipment under Test (EUT) is the Sharp Corporation SMD2499FSC Convection Microwave Drawer. The EUT is rated at 900 Watts. The input power is rated at 120 VAC, 60Hz. The EUT is supplied with 1 of 2 optional Power Supplies: A Tamura Switching Power Supply or a Mitsuoka Switching Power Supply. Full Radiated Emissions and Conducted Emissions testing was completed with each power supply and results with each are reported herein.

The EUT incorporates a Wi-Fi radio module mearing FCC ID: RX3-B01 and IC: 2878F-B01

The EUT was tested at 100% microwave power setting.

1.3 Related Submittal(s)/Grant(s)

The EUT is subject to the following FCC authorizations:

a) Certification under FCC CFR 47:2007.
b) Verification under Part 18.305 and 18.307 Subpart C, Consumer.

The Verification requirement shares many common report elements with the Certification report. Therefore, though this report is mostly intended to provide data for the Certification process, the Verification authorization report (Part 18.305 and 18.307) for the EUT is included herein.

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

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.

US Tech currently is Accredited by the NIST NVLAP organization, Lab Code: 200162-0, and FCC Part 18 is in the Scope of Accreditation.

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	DSA815	RIGOL	DSA8A18030 0138	12/10/2021 2 yr.
SPECTRUM ANALYZER	E4407B	AGILENT	US41442935	9/22/2022 2 yr
BICONICAL ANTENNA	3110B	EMCO	9306-1708	6/27/2021 2 yr
LOG PERIODIC ANTENNA	3146	EMCO	9110-3236	8/22/2021 2 yr
LOG PERIODIC ANTENNA	3146	EMCO	9305-3600	2/01/2021 2 yr
HORN ANTENNA	3115	EMCO	9107-3723	11/28/2020 2 yr.
PRE-AMPLIFIER	8449B	HEWLETT-PACKARD	3008A00480	5/13/2021
PRE-AMPLIFIER	8447D	HEWLETT-PACKARD	1937A02980	5/13/2021
LISN x 2	9247-50-TS-50-N	SOLAR ELECTRONICS	955824 and 955826	5/11/2021
DATA LOGGER	2625A	FLUKE/HYDRA SERIES II	8821014	9/03/2022
POWER ANALYZER	2101	VALHALLA	3-6350	6/18/2021
RF ISOTROPIC FIELD PROBE	FP4036	AMPLIFIED RESEARCH	305667	3/07/2021

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 sample used for testing was received on September 25, 2020 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
Convection Microwave Drawer/ Sharp (EUT)	SMD2499FSC	Engineering Sample	APYDMR0180	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

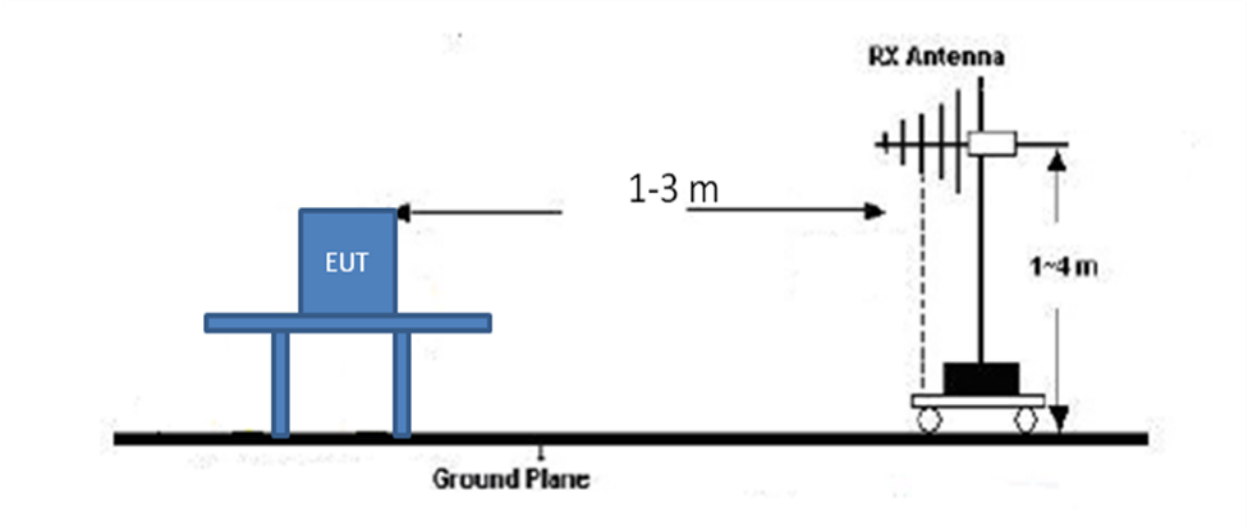


Figure 1. Block Diagram of Radiated Emissions Test Configuration

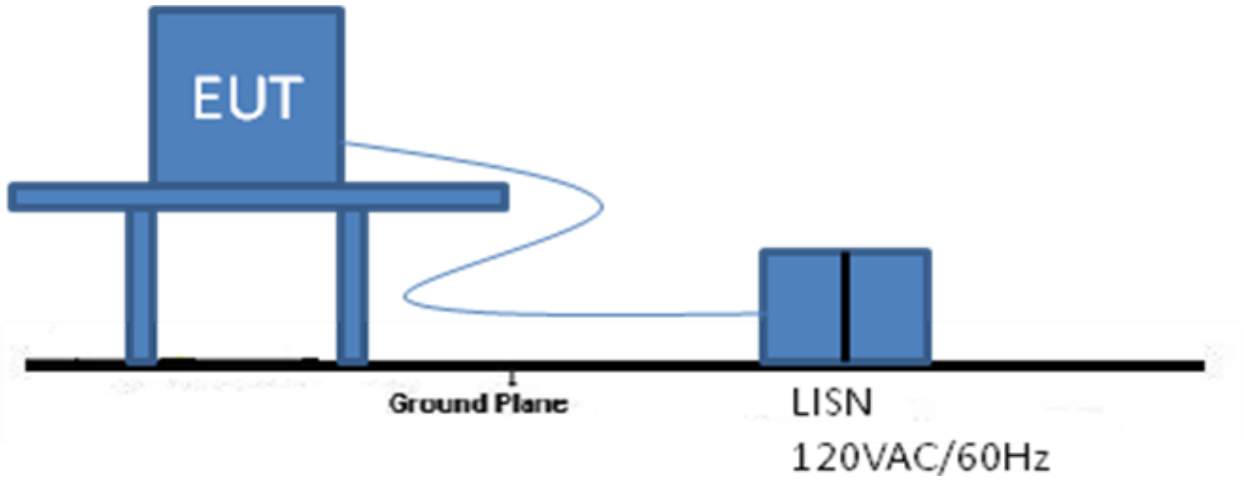


Figure 2. Block Diagram of AC Power Lines Conducted Emissions Test Configuration

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. For the Tamura switching power supply, the worst case line conducted emission was 5.6 dB Quasi Peak below the limit at 0.1582 MHz on the Phase line. All other conducted emissions were at least 8.3 dB below the limit. For the Mitsuoka switching power supply, the worst case line conducted emission was 8.1 dB below the limit at 2.7067 MHz on the Neutral line. All other conducted emissions were at least 8.9 dB below the limit.

Radiated emissions testing was conducted and compared to 18.305 (a) and (b) limits. For the Mitsuoka switching power supply, the worst case radiated emission in the frequency range 30 MHz to 25 GHz was 6.0 dB below the limit at 14793.06 MHz; all other radiated emissions were at least 11.0 dB below the limit. For the Tamura switching power supply, the worst case radiated emission in the frequency range 30 MHz to 25 GHz was 6.2 dB below the limit at 7444.51 MHz; all other radiated emissions were at least 7.5 dB below the limit.

2.9 Measurement Uncertainty

2.9.1 Conducted Emissions Measurement Uncertainty

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

2.9.2 Radiated Emissions Measurement Uncertainty

At a measurement Distance of 3 m, the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna is ±5.40 dB. The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna is ±5.19 dB. The measurement uncertainty (with a 95% confidence level) for this test using a double ridge horn antenna is ±5.08 dB.

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.

The load used for this measurement was with 700 to 1000 ml of water located in the center of the oven.

Table 4. Power Line Conducted Emissions (Mitsuoka Switching Power Supply)

Conducted Emissions 120 VAC/60 Hz						
Tested By:	Test: Part 18.307			Client: Sharp Corporation		
JF	Project: 20-0238		Class: B	Model: SMD2499FSC		
Frequency (MHz)	**Test Data (dBuV)**	**AF+CA-AMP (dB)**	**Peak Results (dBuV)**	**Average Limits (dBuV)**	**Margin (dB)**	**Detector Used**
PHASE						
0.1652	54.30	0.08	54.38	65.2*	10.8	**QP**
0.1652	39.86	0.08	39.94	55.2	15.3	**AVG**
0.6450	32.51	0.23	32.74	46.0	13.3	**PK**
2.5670	30.06	0.08	30.14	46.0	15.9	**PK**
5.4583	30.87	0.23	31.10	50.0	18.9	**PK**
10.8500	27.67	0.54	28.21	50.0	21.8	**PK**
29.2670	25.05	1.83	26.88	50.0	23.1	**PK**
NEUTRAL						
0.1605	55.26	0.13	55.39	65.4*	10.1	**QP**
0.1605	46.44	0.13	46.57	55.4	8.9	**AVG**
0.6883	31.79	0.51	32.30	46.0	13.7	**PK**
2.7067	37.48	0.44	37.92	46.0	8.1	**PK**
10.0000	28.11	0.69	28.80	50.0	21.2	**PK**
10.7500	30.73	0.72	31.45	50.0	18.6	**PK**
25.5500	25.84	1.81	27.65	50.0	22.4	**PK**

"*" denotes Quasi-peak limit used.

Sample Calculation at 0.1652 MHz:

Magnitude of Measured Frequency	54.30	dBuV
+Correction Factors	0.08	dB
Corrected Result	54.38	dBuV

Test Date: October 8, 2020

Tested by
Signature: 

Name: John Freeman

Table 5. Power Line Conducted Emissions (Tamura Switching Power Supply)

Conducted Emissions 120 VAC/60Hz						
Tested By:	Test: Part 18.307			Client: Sharp Corporation		
JF	Project: 20-0238		Class: B	Model: SMD2499FSC		
Frequency (MHz)	**Test Data (dBuV)**	**AF+CA-AMP (dB)**	**Peak Results (dBuV)**	**Average Limits (dBuV)**	**Margin (dB)**	**Detector Used**
PHASE						
0.1582	49.89	0.08	49.97	55.6	5.6	**QP**
0.6350	27.97	0.23	28.20	46.0	17.8	**PK**
1.6730	28.25	0.25	28.50	46.0	17.5	**PK**
8.3500	25.98	0.34	26.32	50.0	23.7	**PK**
10.6830	27.50	0.54	28.04	50.0	22.0	**PK**
22.0670	24.61	1.06	25.67	50.0	24.3	**PK**
NEUTRAL						
0.1535	47.40	0.13	47.53	55.8	8.3	**QP**
0.5375	25.27	0.51	25.78	46.0	20.2	**QP**
1.1530	33.87	0.51	34.38	46.0	11.6	**PK**
7.2830	27.20	0.51	27.71	50.0	22.3	**PK**
10.3500	28.73	0.69	29.42	50.0	20.6	**PK**
29.1000	24.35	2.36	26.71	50.0	23.3	**PK**

"*" denotes Quasi-peak limit used.

Sample Calculation at 0.1582 MHz:

Magnitude of Measured Frequency	49.89	dBuV
+Correction Factors	0.08	dB
Corrected Result	49.97	dBuV

Test Date: October 1, 2020

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 an 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.

Radiated emissions were evaluated based on 47 CFR 18.309 and MP-5 (1986). During testing the EUT was tested up to the 10^{th} harmonic or the highest detectable emission.

The load used for frequency measurement was 1000 ml of water in the beaker located in the center of the oven. For radiation on second and third harmonic two loads, one of 700 ml and one of 300 ml of water was used. Each load was tested both with the beaker located in the center of the oven and with it in the right front corner.

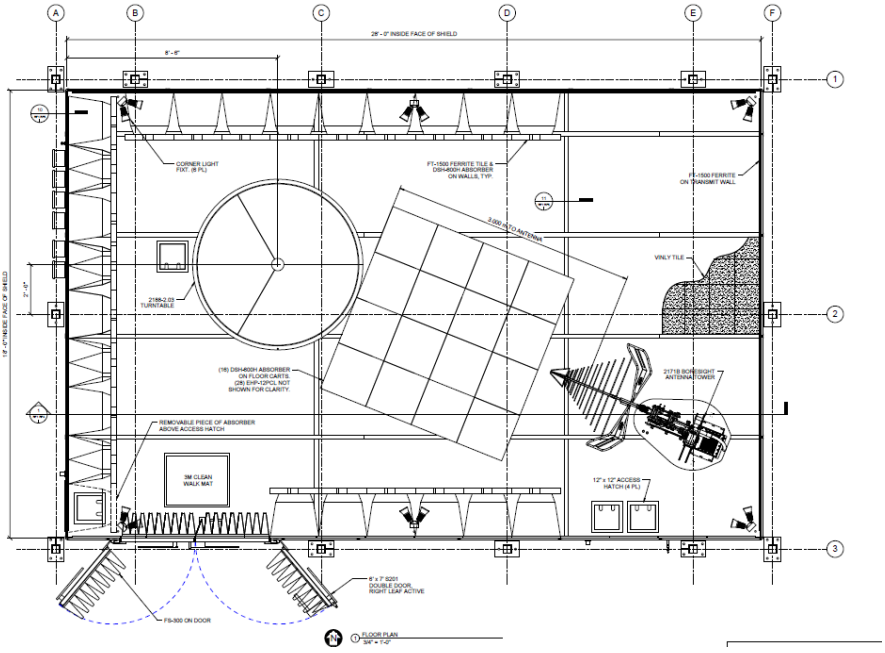


Figure 3. Radiated Emissions Disturbance Measurement Facility Diagram

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) * $\sqrt{}$ (EUT power/500)]= dBuV/m + 20 log(300/test distance used) = XX.X dBuV/m

The measured EUT power P is 900 Watts as rated and tested by the manufacturer. This value was used in the calculation of the limit for this test.

Limit at 3 meters is 20 log [(25) * $\sqrt{}$ (900/500)]= 30.51 + 20 log(300/3) =
70.51 dBuV/m.

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 6. Radiated Emissions Data 30 MHz to 1 GHz (Mitsuoka Switching Power Supply)

Radiated Emissions							
Test By: MA	Test: Radiated	Client: Sharp Corporation					
	Project: 20-0238	Limits Based on: FCC 18.305	Model: SMD2499FSC				
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**
Measurements were made over the frequency range of 30 MHz – 1000 MHz All emissions were more than 20 dB below the limit.							

Note: During spurious emissions testing both the microwave oven and WiFi radio were on and transmitting as normally intended. The results above show no increase in spurious emissions due to intermodulation effects or other effects as a result of having both radios operating simultaneously. The results do not warrant additional testing beyond the above test.

Test Date: October 9, 2020

Tested by
Signature: _____ Name: John Freeman

Table 7. Radiated Emissions Data 1 GHz to 25 GHz (Mitsuoka Switching Power Supply)

Radiated Emissions							
Test By: JF	Test: Radiated	Client: Sharp Corporation					
	Project: 20-0238	Limits Based on: FCC18.305	Model: SMD2499FSC				
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**
1817.16	66.83	-10.29	56.54	70.5	3.0m./HORZ	14.0	**PK**
4309.66	60.19	-0.69	59.50	70.5	3.0m./VERT	11.0	**PK**
14793.06	58.59	5.90	64.49	70.5	1.0m./VERT	6.0	**PK**
Measurements were made over the frequency range of 1 GHz to 25 GHz. All other emissions were more than 20 dB below the limit.							

Note 1: 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.
Note 2: During spurious emissions testing both the microwave oven and WiFi radios were on and transmitting as normally intended. The results above show no increase in spurious emissions due to intermodulation effects or other effects as a result of having both radios operating simultaneously. The results do not warrant additional testing beyond the above test.

Sample Calculation at 1817.16 MHz:

Magnitude of Measured Frequency	66.83	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	-10.29	dB/m
Corrected Result	56.54	dBuV/m

Test Date: October 9, 2020

Tested by
Signature: _____ Name: John Freeman

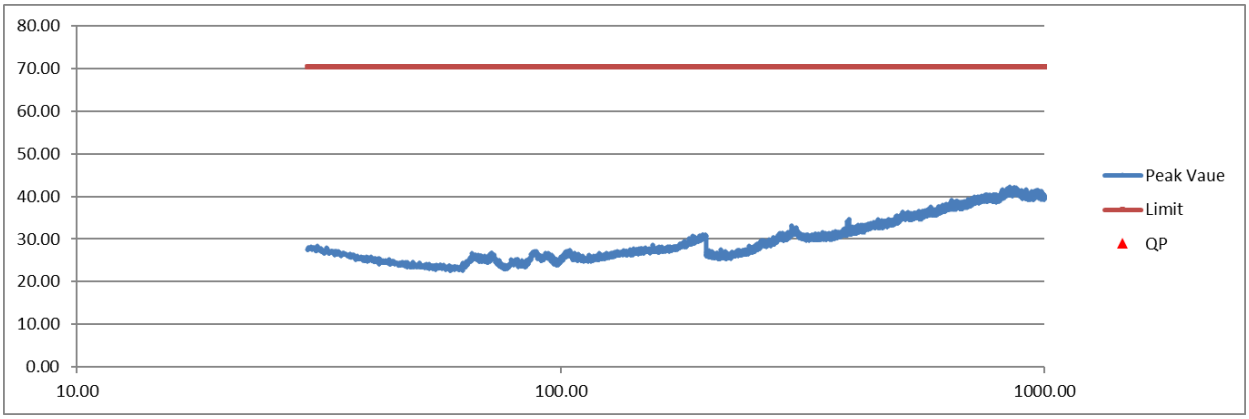


Figure 4. Horizontal Antenna Position, 30-1000 MHz - Mitsuoka Switching Power Supply

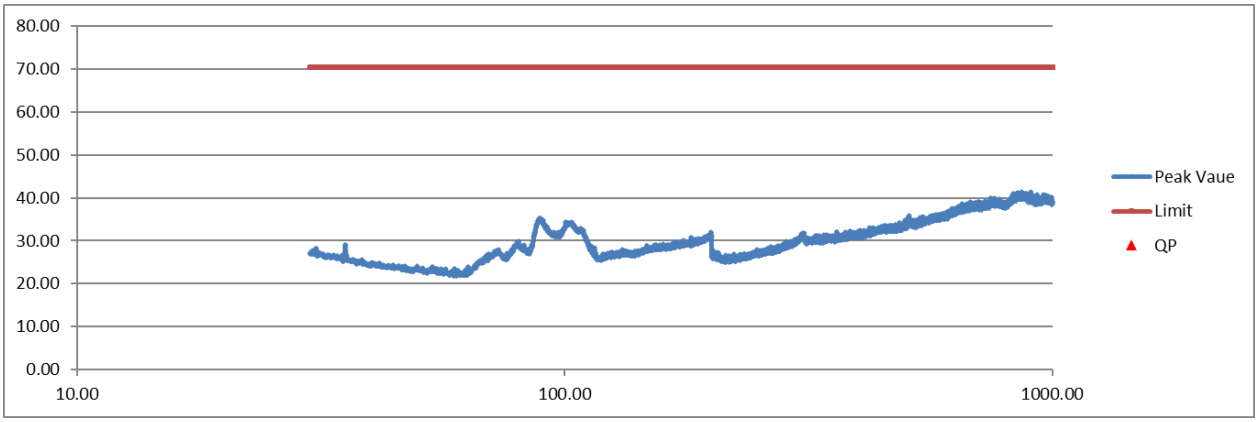
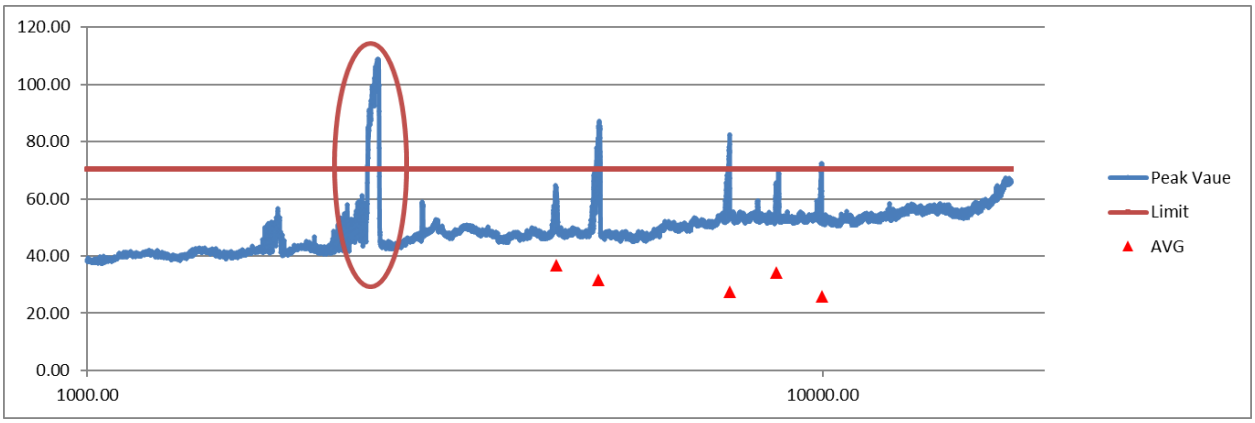
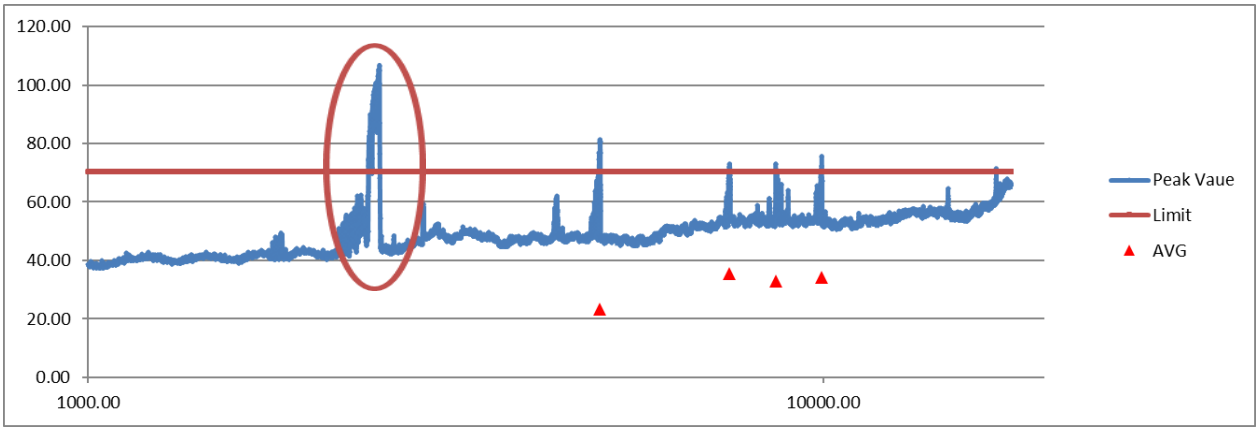


Figure 5. Vertical Antenna Position, 30-1000 MHz - Mitsuoka Switching Power Supply



*Red Circle- Microwave oven and WiFi radio

Figure 6. Horizontal Antenna Position, 1 – 18 GHz - Mitsuoka Switching Power Supply



*Red Circle- Microwave oven and WiFi radio

Figure 7. Vertical Antenna Position, 1 – 18 GHz - Mitsuoka Switching Power Supply

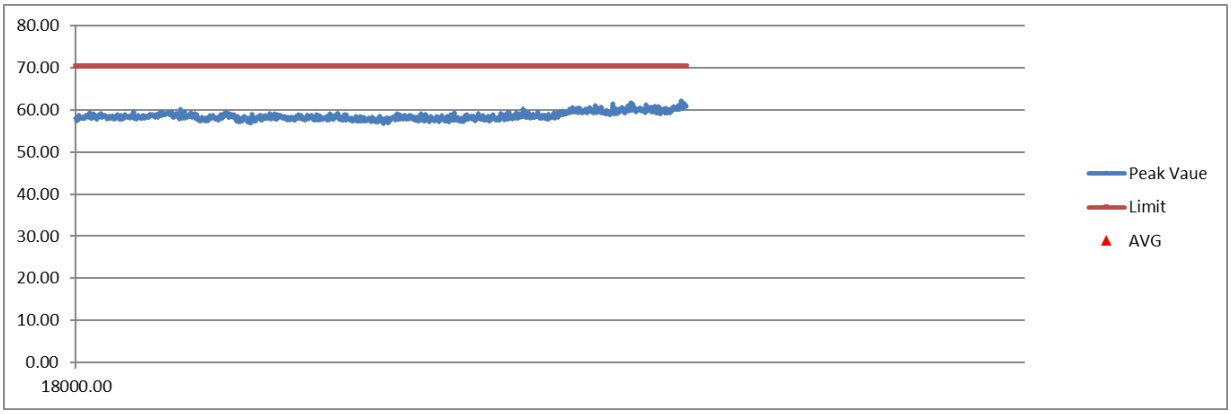


Figure 8. Horizontal Antenna Position, 18 – 25 GHz - Mitsuoka Switching Power Supply

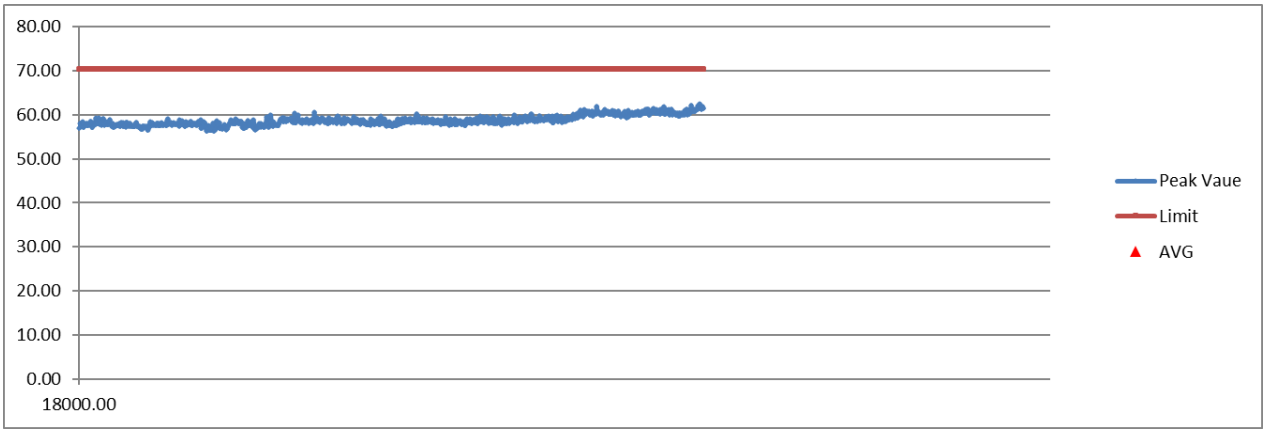


Figure 9. Vertical Antenna Position, 18 – 25 GHz - Mitsuoka Switching Power Supply

Table 8. Radiated Emissions Data 30 MHz to 1 GHz (Tamura switching power supply)

Radiated Emissions							
Test By: MA	Test: Radiated	Client: Sharp Corporation					
	Project: 20-0238	Limits Based on: FCC 18.305	Model: SMD2499FSC				
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**
Measurements were made over the frequency range of 30 MHz – 1000 MHz All emissions were more than 20 dB below the limit.							

Note: During spurious emissions testing both the microwave oven and WiFi radio were on and transmitting as normally intended. The results above show no increase in spurious emissions due to intermodulation effects or other effects as a result of having both radios operating simultaneously. The results do not warrant additional testing beyond the above test.

Test Date: September 30, 2020

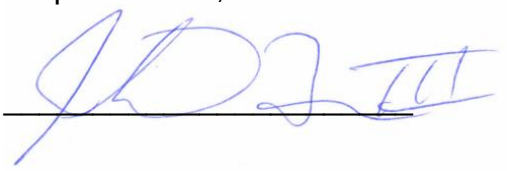
Tested by
Signature:  Name: John Freeman

Table 9. Radiated Emissions Data 1 GHz to 25 GHz (Tamura Switching Power Supply)

Radiated Emissions							
Test By: JF	Test: Radiated	Client: Sharp Corporation					
	Project: 20-0238	Limits Based on: FCC18.305	Model: SMD2499FSC				
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**
1765.15	64.28	-8.87	55.41	70.5	3.0m./HORZ	15.1	**PK**
4334.67	61.86	1.18	63.04	70.5	3.0m./HORZ	7.5	**PK**
7444.51	57.84	6.45	64.29	70.5	1.0m./VERT	6.2	**PK**
9914.54	59.32	3.24	62.56	70.5	1.0m./VERT	8.0	**PK**
Measurements were made over the frequency range of 1 GHz to 25 GHz. All other emissions were more than 20 dB below the limit.							

Note 1: 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.
Note 2: During spurious emissions testing both the microwave oven and WiFi radios were on and transmitting as normally intended. The results above show no increase in spurious emissions due to intermodulation effects or other effects as a result of having both radios operating simultaneously. The results do not warrant additional testing beyond the above test.

Sample Calculation at 1765.15 MHz:

Magnitude of Measured Frequency	64.28	dBuV
+Antenna Factor + Cable Loss+ Amplifier Gain	-8.87	dB/m
Corrected Result	55.41	dBuV/m

Test Date: October 2, 2020

Tested by
Signature: _____ Name: John Freeman

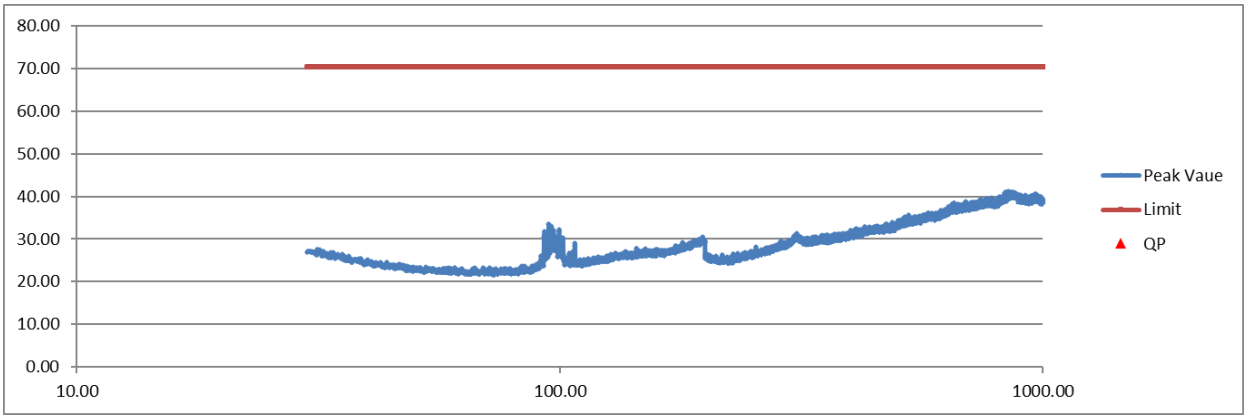


Figure 10. Horizontal Antenna Position, 30-1000 MHz -Tamura Switching Power Supply

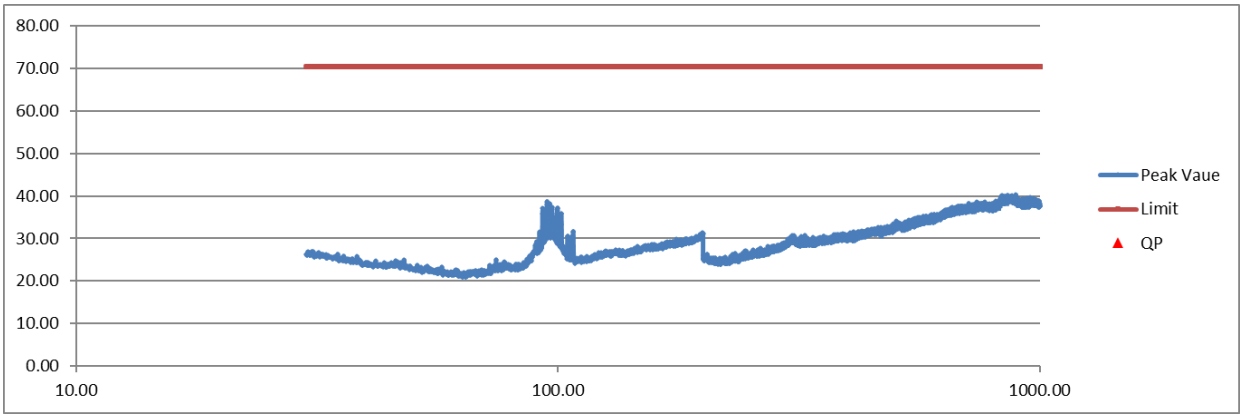
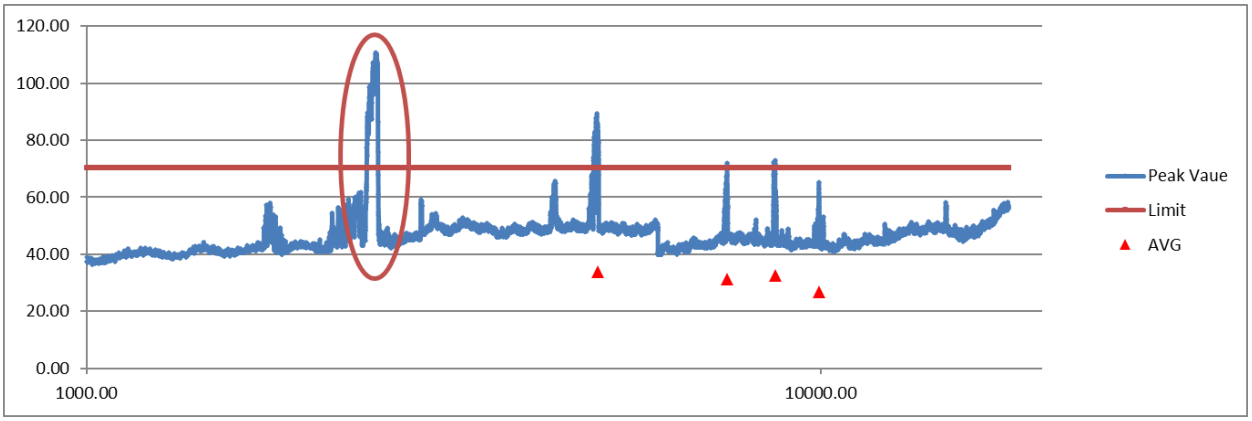
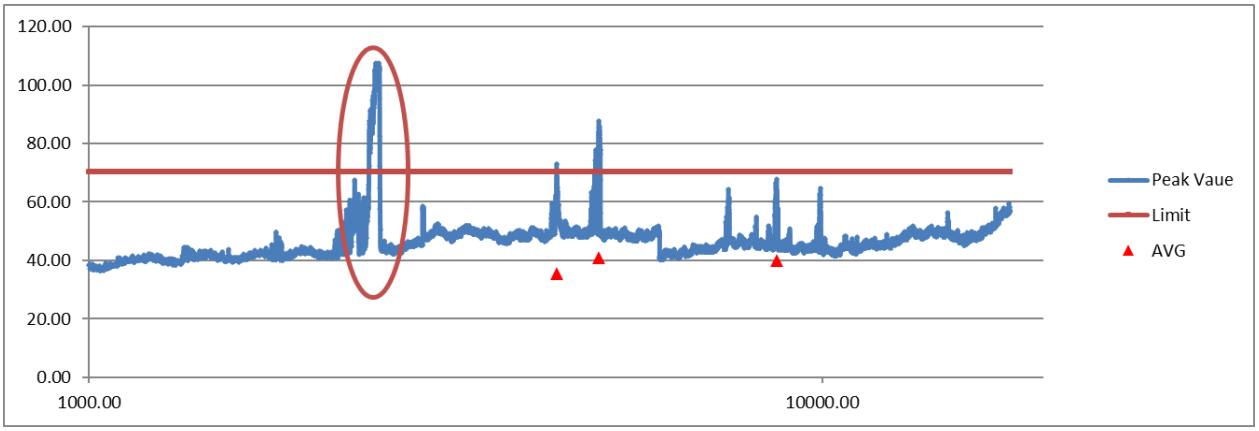


Figure 11. Vertical Antenna Position, 30-1000 Mhz - Tamura Switching Power Supply



*Red Circle- Microwave oven and WiFi radio

Figure 12. Horizontal Antenna Position, 1 – 18 Ghz - Tamura Switching Power Supply)



*Red Circle- Microwave oven and WiFi radio

Figure 13. Vertical Antenna Position, 1 – 18 Ghz -Tamura Switching Power Supply

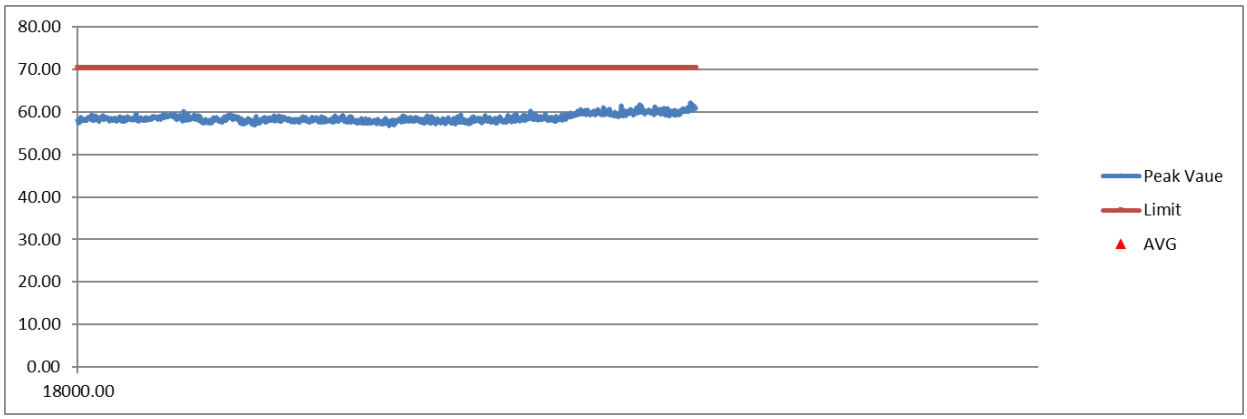


Figure 14. Horizontal Antenna Position, 18 – 25 Ghz - Tamura Switching Power Supply

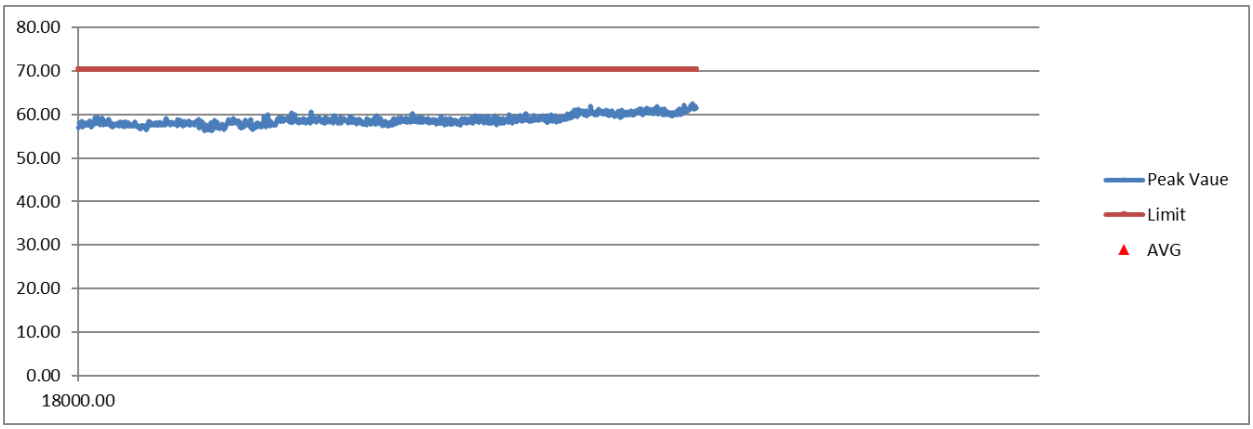


Figure 15. Vertical Antenna Position, 18 – 25 Ghz - Tamura Switching Power Supply

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 following.

5.1 Variation in Operating Frequency Over Time (Mitsuoka switching power supply)

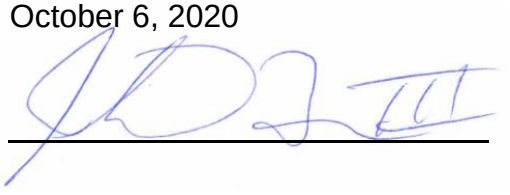
The operating frequency was measured using a spectrum analyzer. Starting with the EUT at room temperature, a 1000 mL water load was placed in the center of the oven and the oven was operated at maximum output power. The fundamental operating frequency was monitored over the length of time taken for the water level to reduce to 20 percent of the original level. In this case, it took 21 mins 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 10. Measured Frequency Variation (Mitsuoka Switching Power Supply)

Low Frequency (MHz)	High Frequency (MHz)
2404.50	2488.50

Test Date: October 6, 2020

Tested By
Signature: 

Name: John Freeman

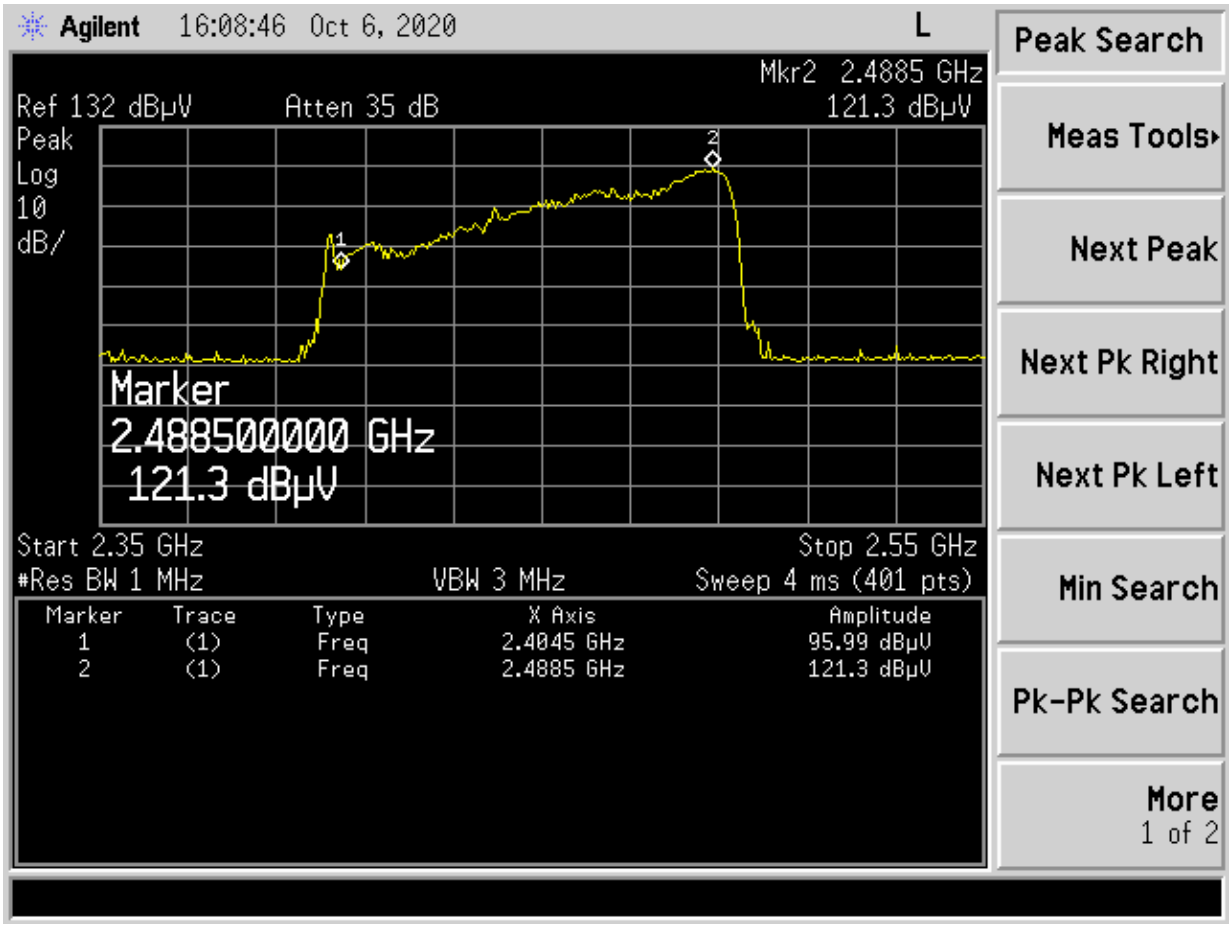


Figure 16. Frequency Variation at Nominal Voltage -Mitsuoka Switching Power Supply

5.2 Variation in Operating Frequency with Line Voltage

The EUT was operated/warmed up for 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. At each varied voltage level, the EUT was allowed to operate for at least 5 minutes.

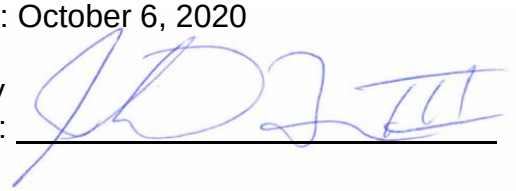
During the test, the fundamental frequency of the EUT must remain within the ISM frequency band of 2450 MHz ±50 MHz, or 2400 - 2500 MHz. The results of this test are presented following.

Line voltage varied from 96 VAC to 150 VAC.

Table 11. Measured Supply Voltage Variation (Mitsuoka Switching Power Supply)

%	Supply Voltage (V) at 60 Hz	Measured Frequency (MHz)	
		Low Frequency	High Frequency
80%	96	2402.00	2479.50
125%	150	2402.50	2489.50

Test Date: October 6, 2020

Tested By
Signature: 

Name: John Freeman

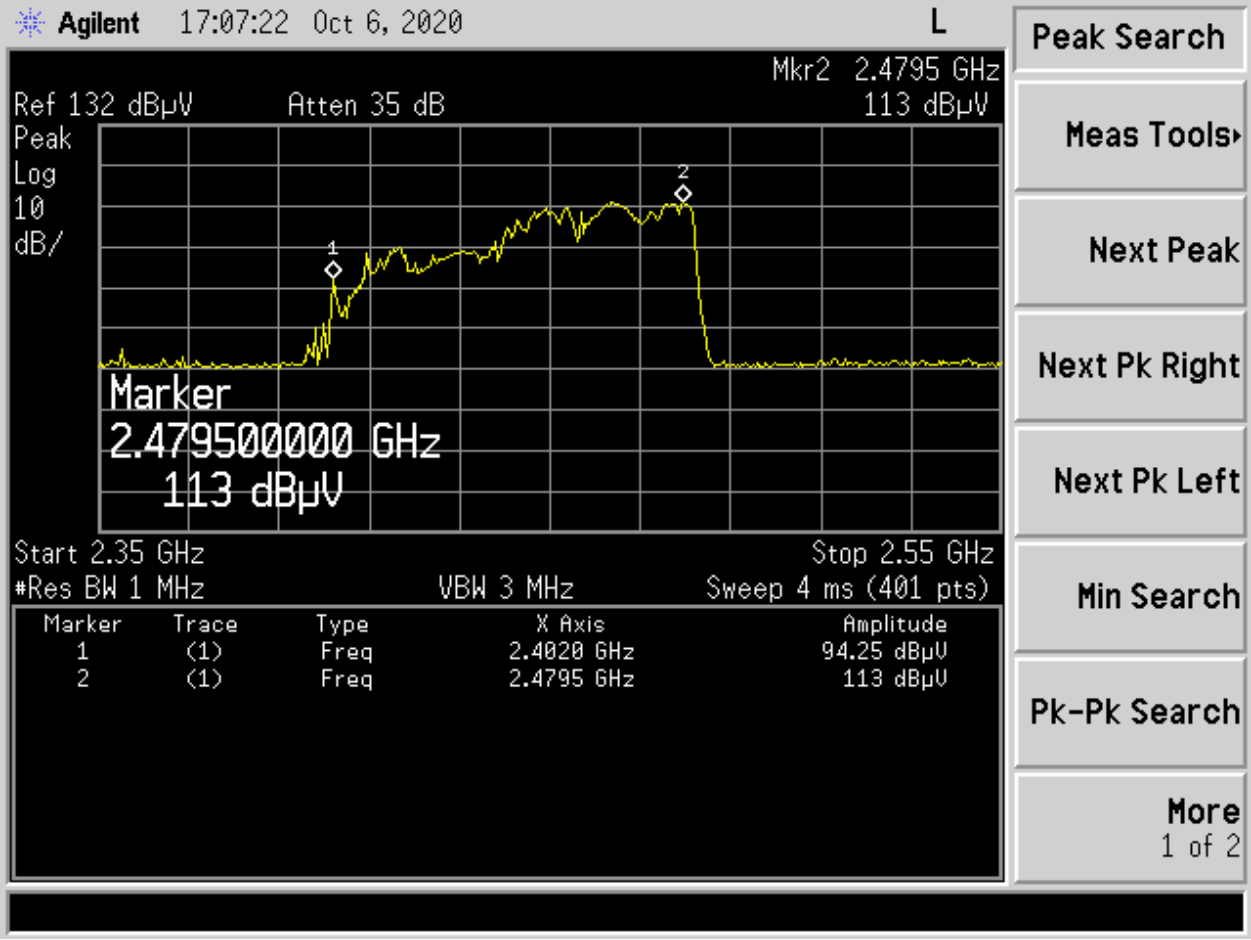


Figure 17. Frequency Variation at Low Voltage - Mitsuoka Switching Power Supply

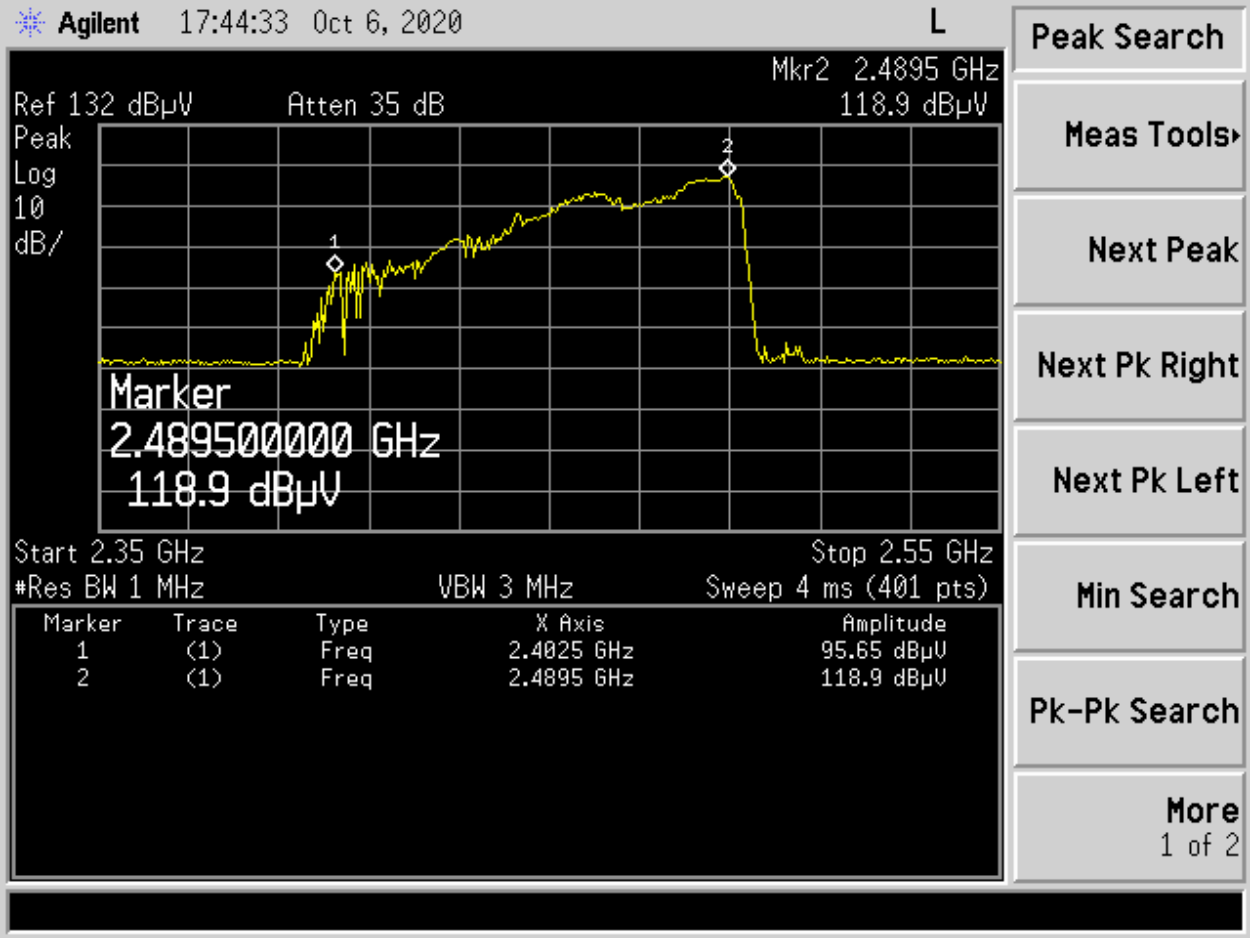


Figure 18. Frequency Variation at High Voltage - Mitsuoka Switching Power Supply

5.3 Variation in Operating Frequency Over Time (Tamura Switching Power Supply)

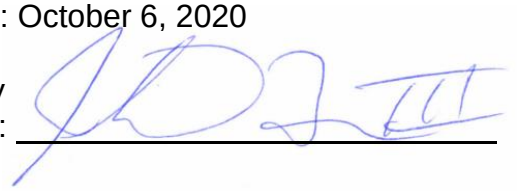
The operating frequency was measured using a spectrum analyzer. Starting with the EUT at room temperature, a 1000 mL water load was placed in the center of the oven and the oven was operated at maximum output power. The fundamental operating frequency was monitored over the length of time taken for the water level to reduce to 20 percent of the original level. In this case, it took 24 mins 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 12. Measured Frequency Variation (Tamura Switching Power Supply)

Low Frequency (MHz)	High Frequency (MHz)
2401.00	2487.00

Test Date: October 6, 2020

Tested By
Signature: 

Name: John Freeman

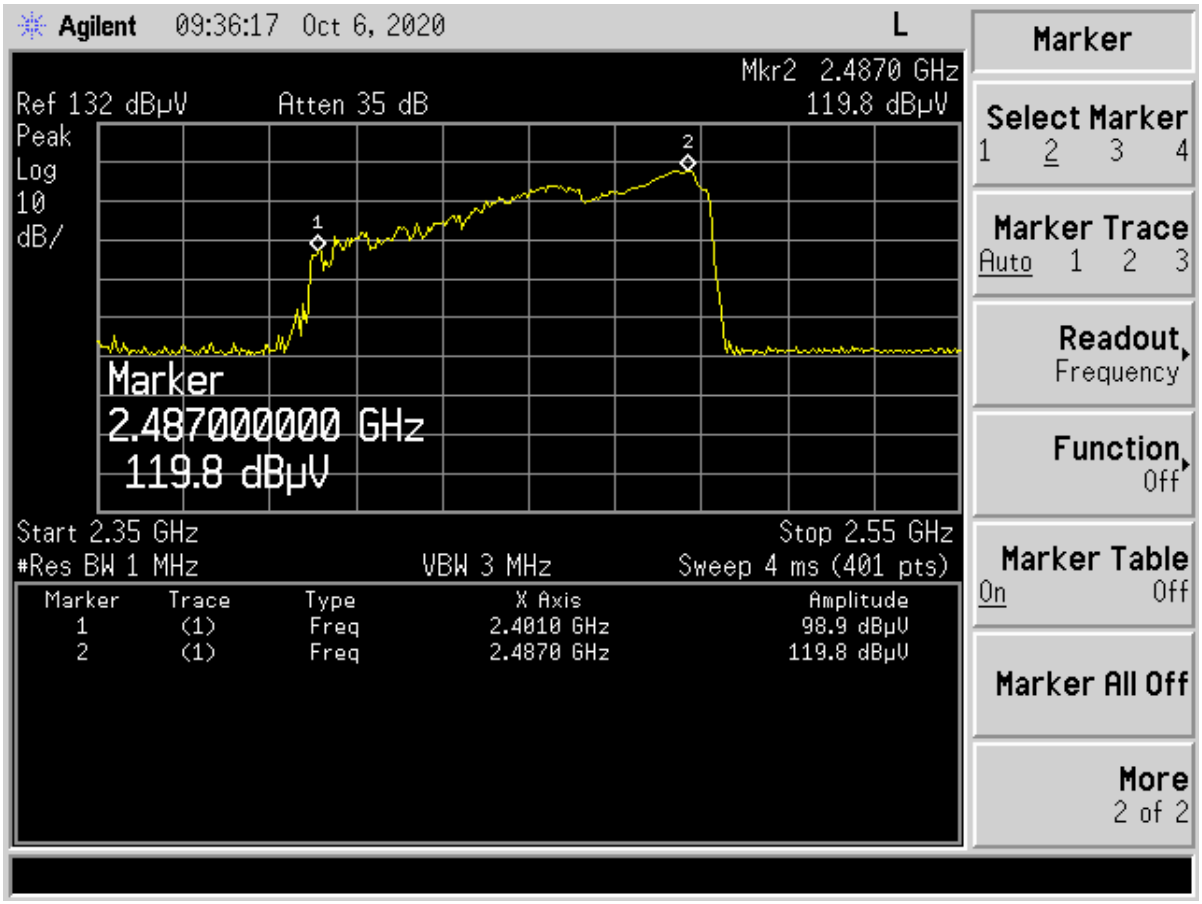


Figure 19. Frequency Variation at Nominal Voltage - Tamura Switching Power Supply

5.4 Variation in Operating Frequency with Line Voltage

The EUT was operated/warmed up for 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. At each varied voltage level, the EUT was allowed to operate for at least 5 minutes.

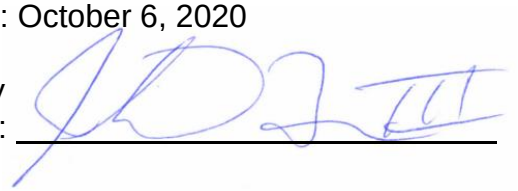
During the test, the fundamental frequency of the EUT must remain within the ISM frequency band of 2450 MHz ±50 MHz, or 2400 - 2500 MHz. The results of this test are presented below.

Line voltage varied from 96 VAC to 150 VAC.

Table 13. Measured Supply Voltage Variation (Tamura Switching Power Supply)

%	Supply Voltage (V) at 60 Hz	Measured Frequency (MHz)	
		Low Frequency	High Frequency
80%	96	2401.50	2484.00
125%	150	2401.50	2484.00

Test Date: October 6, 2020

Tested By
Signature: 

Name: John Freeman

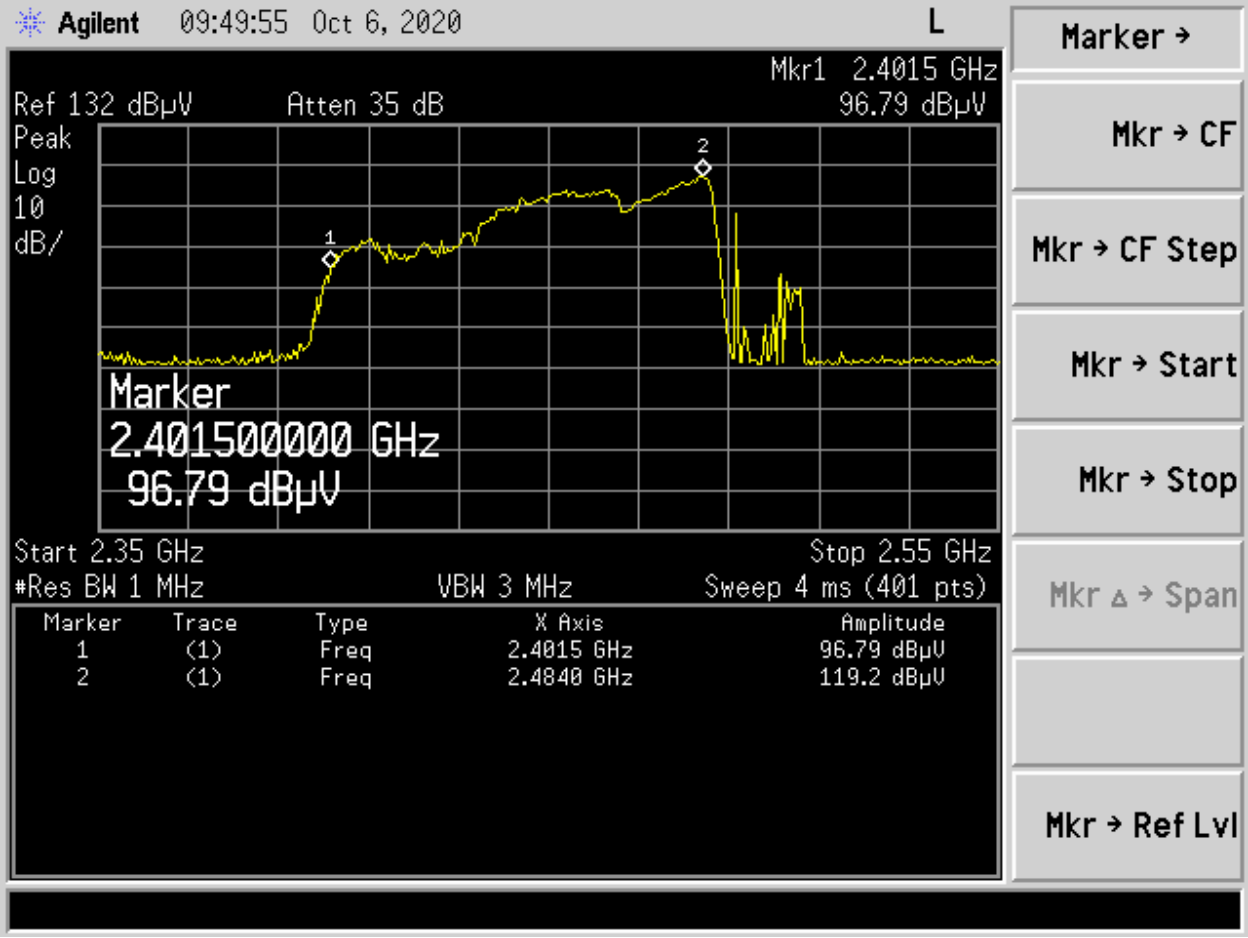


Figure 20. Frequency Variation at Low Voltage -Tamura Switching Power Supply

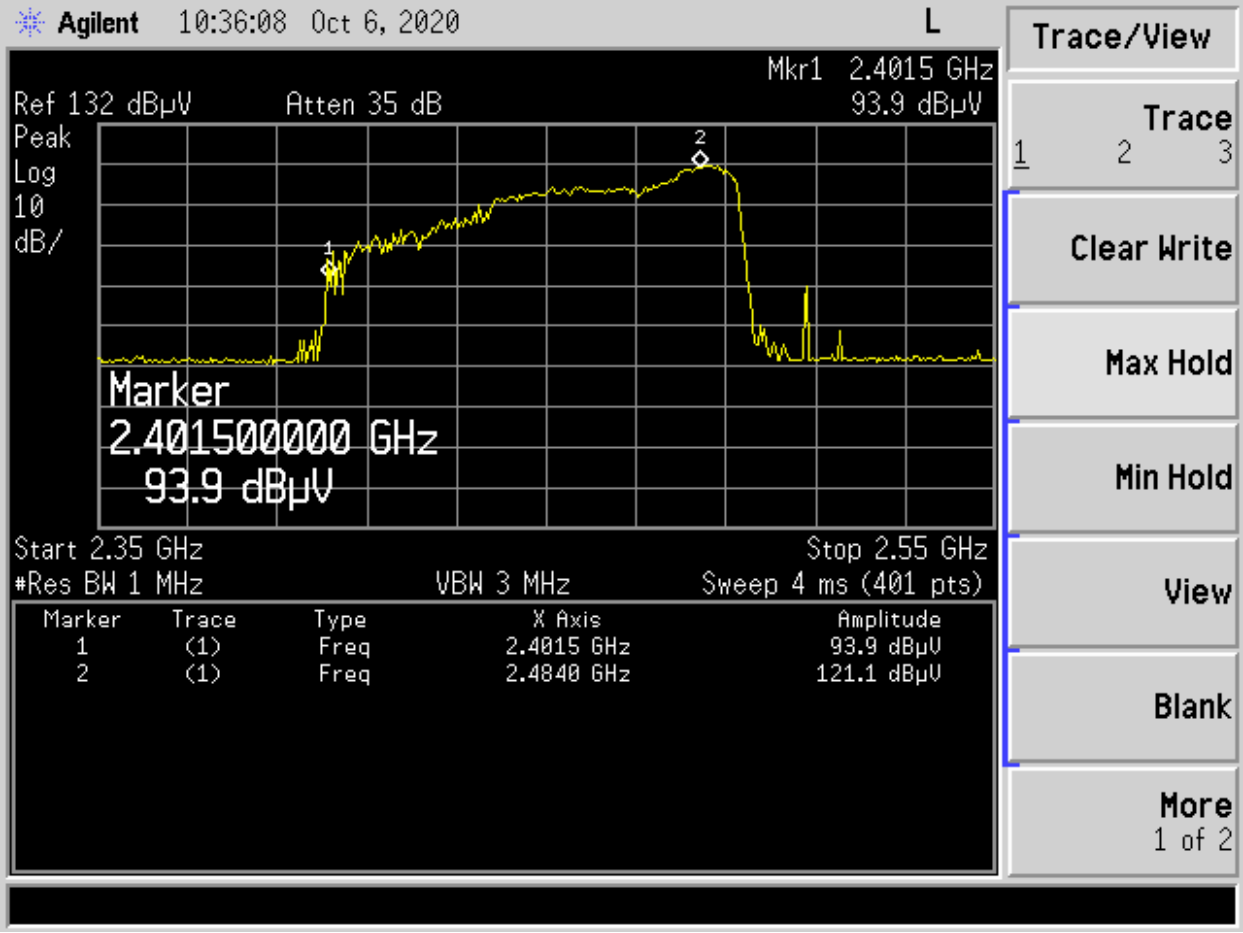


Figure 21. Frequency Variation at High Voltage -Tamura Switching Power Supply

6 EUT Power measurements

6.1 Output Power measurements

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 14. Output Power Results (Mitsuoka Switching Power Supply)

Start Temperature (°C)	Final Temperature (°C)	Temperature Rise	Elapsed Time (seconds)	Water Volume (ml)	RF Power (Watts)
22.1	45.3	23.2	120.0	1000.00	812.0
22.8	39.1	16.3	120.0	1000.00	570.5
23.0	39.8	16.8	120.0	1000.00	588.0

Average from the three trials: 656.83 Watts

Test Date: October 6, 2020

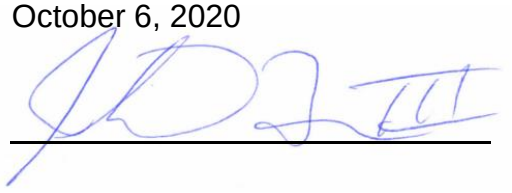
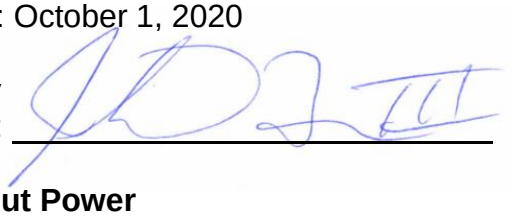
Tested By
Signature:  Name: John Freeman

Table 15. Output Power Results (Tamura Switching Power Supply)

Start Temperature (°C)	Final Temperature (°C)	Temperature Rise	Elapsed Time (seconds)	Water Volume (ml)	RF Power (Watts)
22.3	39.9	17.6	120.0	1000.00	616.0
22.9	41.5	18.6	120.0	1000.00	651.0
23.5	42.2	18.7	120.0	1000.00	654.5

Average from the three trials: 640.50 Watts

Test Date: October 1, 2020

Tested By
Signature:  Name: John Freeman

6.2 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.

Table 16. Input Power for Mitsuoka Switching Power Supply

Input Voltage (VAC/Hz)	Input Current (Amps)	Measured Input Power (Watts)	Rated Input Power (Watts)
109.4	14.22	1555.67	1700

Table 17. Input Power for Tamura Switching Power Supply

Input Voltage (VAC/Hz)	Input Current (Amps)	Measured Input Power (Watts)	Rated Input Power (Watts)
109.7	13.95	1530.31	1700

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

7 Radiation Hazard Measurement

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

A 1000 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.

Figure 22. Leakage from Mitsuoka Switching Power Supply

Limit: 1.0 mW/cm^2
Signal Strength (V/m) = 8.14 V/m

Power Flux Density (PFD) = $V/m^2/377 = W/m^2$
$= 8.14^2/377 = 0.176\ W/m^2$
$= (0.176\ W/m^2)\ (1m^2/W)\ (0.1\ mW/cm^2)$
$= 0.0176\ mW/cm^2$

which is << less than $S = 1.0\ mW/cm^2$

Figure 23. Leakage from Tamura Switching Power Supply

Limit: 1.0 mW/cm^2
Signal Strength (V/m) = 8.43 V/m

Power Flux Density (PFD) = V/m^2/377 = W/m^2
= 8.43^2/377 = 0.189 W/m^2
= (0.189 W/m^2) (1m^2/W) (0.1 mW/cm^2)
= 0.0189 mW/cm^2

which is << less than S = 1.0 mW/cm^2

8 Test Results

The EUT unconditionally passed the Technical Requirements of 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 and meets the criteria.