Excellence in Compliance Testing

Certification Test Report

FCC ID: ZC5022-GEN2-FP

FCC Rule Part: 15.231

ACS Report Number: 11-0009.W03.1A

Manufacturer: U.S. Jetting, Inc.
Model: 022-GEN2-FP

Test Begin Date: February 14, 2011
Test End Date: February 14, 2011

Report Issue Date: June 6, 2012

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Prepared by: _____

Kirby Munroe
Director, Wireless Certifications
ACS, Inc.

This report contains 17 pages

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1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations Title 47.

1.2 Product description

The 022-GEN2-FP foot pedal switch is part of the Gen II Wireless Remote Control System and works in conjunction with the main control board. The basic operation of the foot pedal switch is to turn water on/off and to shut down the system in case of emergency.

Frequency Range: 315.0 MHz
Operating channels: 1
Modulation: FM
Operating Voltage: 3VDC
Antenna Type/Gain: Antenna Factor #ANT-315-CW-HD reduced-height ¼-wave dipole; -5.25dBi
Antenna Coupling: RP-SMA

Manufacturer Information:
U.S. Jetting, Inc.
850 McFarland Pkwy
Alpharetta, GA 30004

Test Sample Serial Number(s): PD0711-FR08

Test Sample Condition: The test sample was provided in working order with no visible defects.

1.3 Test Methodology and Considerations

The EUT is a battery operated stand-alone device which was tested in an orientation that represents normal intended operation.

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program (NVLAP), Lab Code 200612-0. Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Registration Number: 511277
Industry Canada Lab Code: IC 4175A-1
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

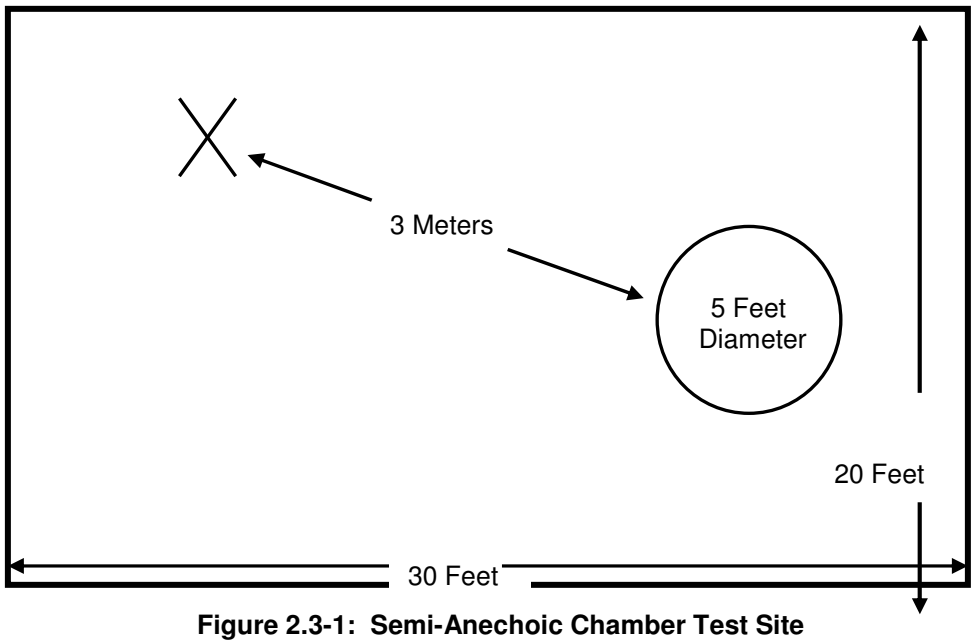

Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

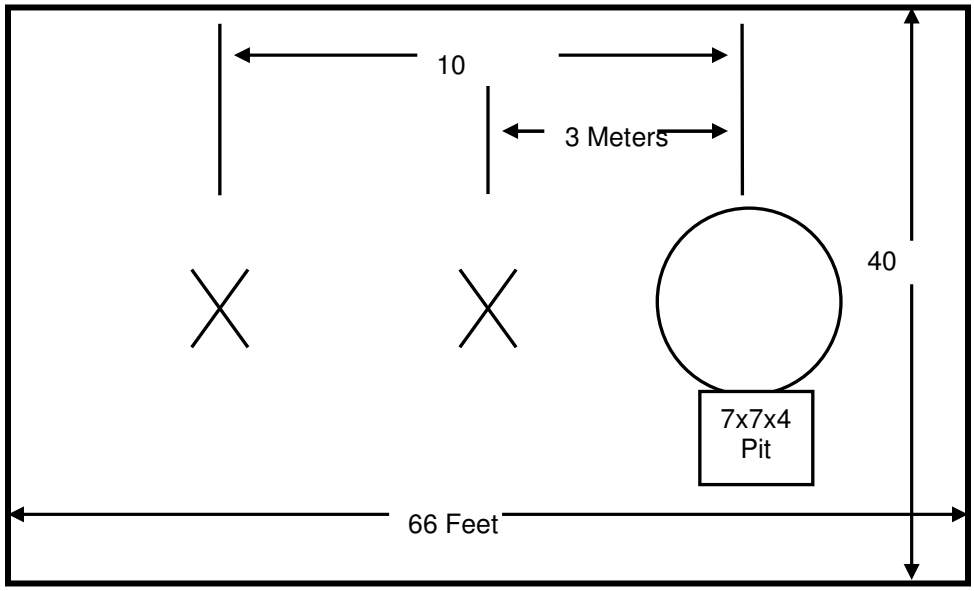

Figure 2.3-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 8' solid aluminum horizontal ground reference plane (GRP) bonded every 3" to an 8' X 8' vertical ground plane.

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 4.1.3-1:

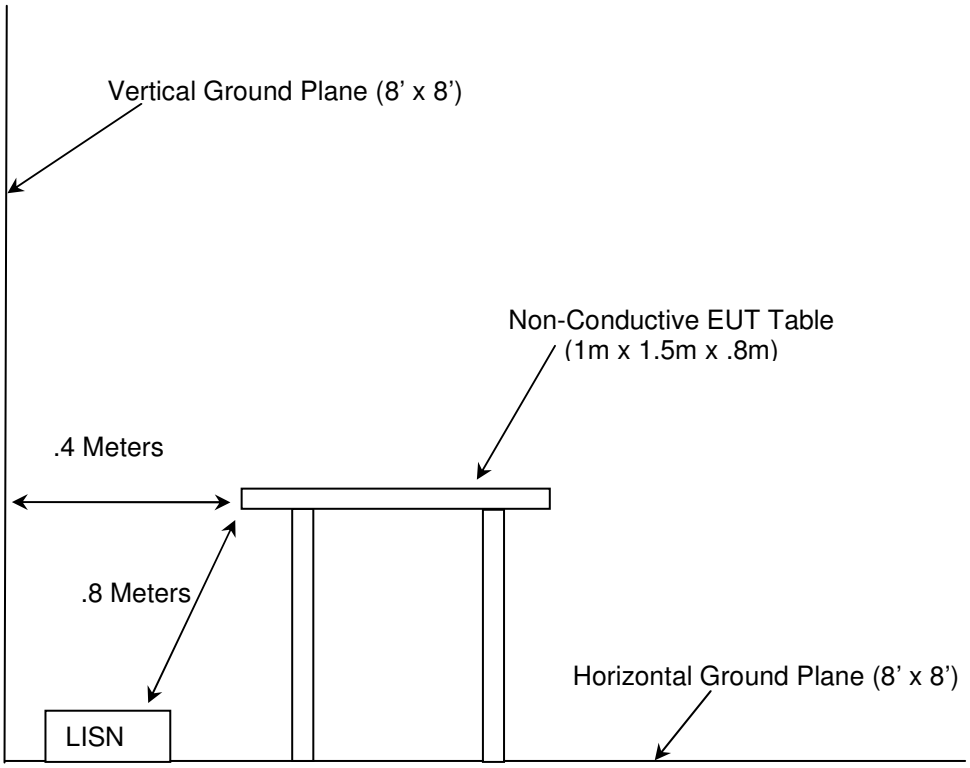

Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2012
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2012

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
1	Rohde & Schwarz	ESMI - Display	Spectrum Analyzers	833771/007	9/23/2010	9/23/2012
2	Rohde & Schwarz	ESMI-Receiver	Spectrum Analyzers	839587/003	9/23/2010	9/23/2012
40	EMCO	3104	Antennas	3211	2/11/2011	2/11/2013
167	ACS	Chamber EMI Cable Set	Cable Set	167	1/26/2011	1/26/2012
211	Eagle	C7RFM3NFNM	Filters	HLC-700	12/23/2010	12/23/2011
213	TEC	PA 102	Amplifiers	44927	12/23/2010	12/23/2011
277	Emco	93146	Antennas	9904-5199	8/25/2010	8/25/2012
291	Florida RF Cables	SMRE-200W-12.0-SMRE	Cables	None	12/7/2010	12/7/2011
292	Florida RF Cables	SMR-290AW-480.0-SMR	Cables	None	12/7/2010	12/7/2011
329	A.H.Systems	SAS-571	Antennas	721	8/4/2009	8/4/2011
338	Hewlett Packard	8449B	Amplifiers	3008A01111	10/29/2010	10/29/2011
422	Florida RF	SMS-200AW-72.0-SMR	Cables	805	12/29/2010	12/29/2011

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number	FCC ID
The EUT was tested stand-alone with no support equipment utilized.					

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

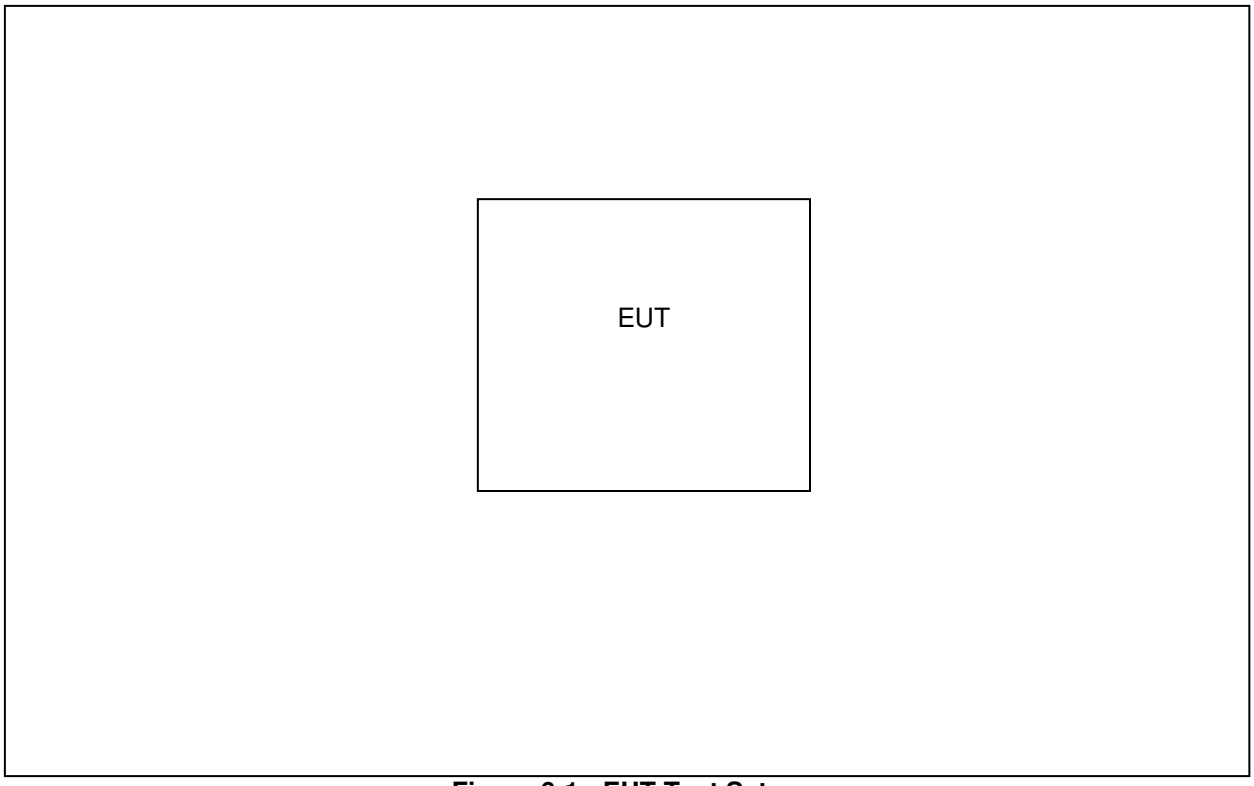

Figure 6-1: EUT Test Setup

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC: CFR 47 Part 15.203

The antenna used for the 022-GEN2-FP is an Antenna Factor #ANT-315-CW-HD reduced-height ¼-wave dipole with -5.25dBi of gain. The antenna coupling is RP-SMA.

7.2 Power Line Conducted Emissions – FCC: CFR 47 Part 15.207

The EUT is battery operated therefore the requirements for AC power line conducted emissions are not applicable.

7.3 Periodic Operation – FCC: CFR 47 15.231(a)

7.3.1 Test Methodology

A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

A transmitter activated automatically shall cease transmission within 5 seconds after activation.

The transmitter was activated manually and was evaluated using a spectrum analyzer at zero span with a ≥ 5 second sweep time.

7.3.2 Test Results

The transmitter ceased operation within 5s of the manual switch release. The results are shown in Figure 7.3.2-1.

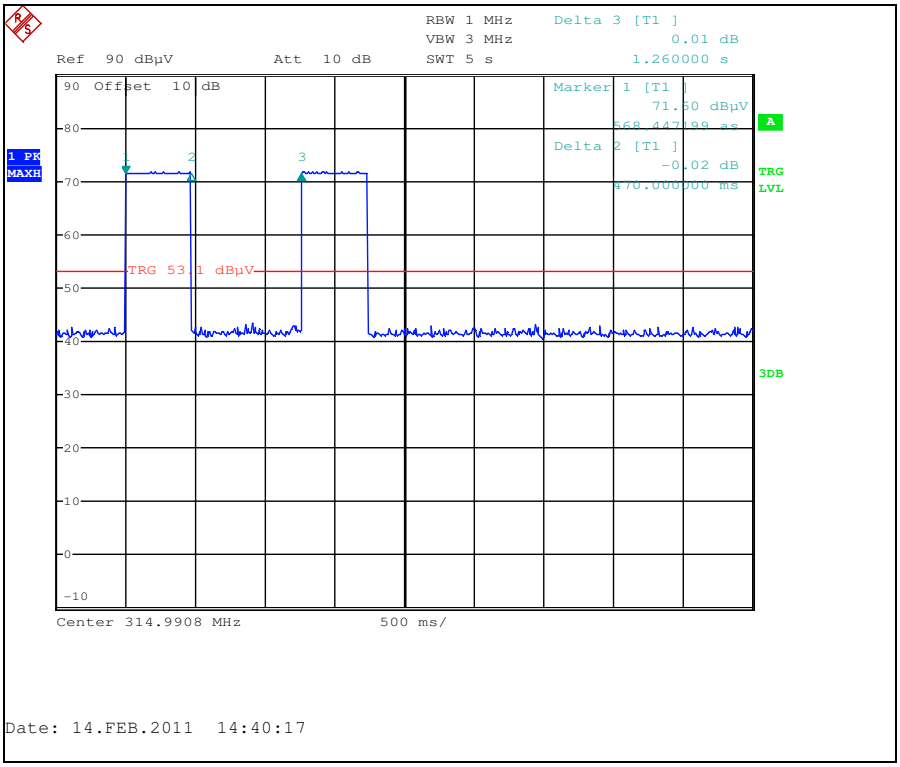

Figure 7.3.2-1: TX Hold Time

7.4 Occupied Bandwidth – FCC: CFR 47 15.231(c)(1)

7.4.1 Test Methodology

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer display was set ~ two times the occupied bandwidth (OBW) of the emission. The RBW of the spectrum analyzer was set to approximately 1 % to 5 % of the OBW. The trace was set to max hold with a peak detector active. The Delta function of the analyzer was utilized to determine the 20 dB bandwidth of the emission.

The occupied bandwidth measurement function of the analyzer was used for the 99% bandwidth. The span of the analyzer was set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth was set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth was set to 3 times the resolution bandwidth. A sampling detector was used.

7.4.2 Test Results

The 20dB and 99% bandwidths were measured as 51.0kHz and 50.64kHz respectively. 0.25% of the 315MHz center frequency is equivalent to 787.5kHz. Therefore the 20dB and 99% bandwidths of the emission is less than 0.25% of the center frequency. The results are shown in Figure 7.4.2-1 and 7.4.2-2.

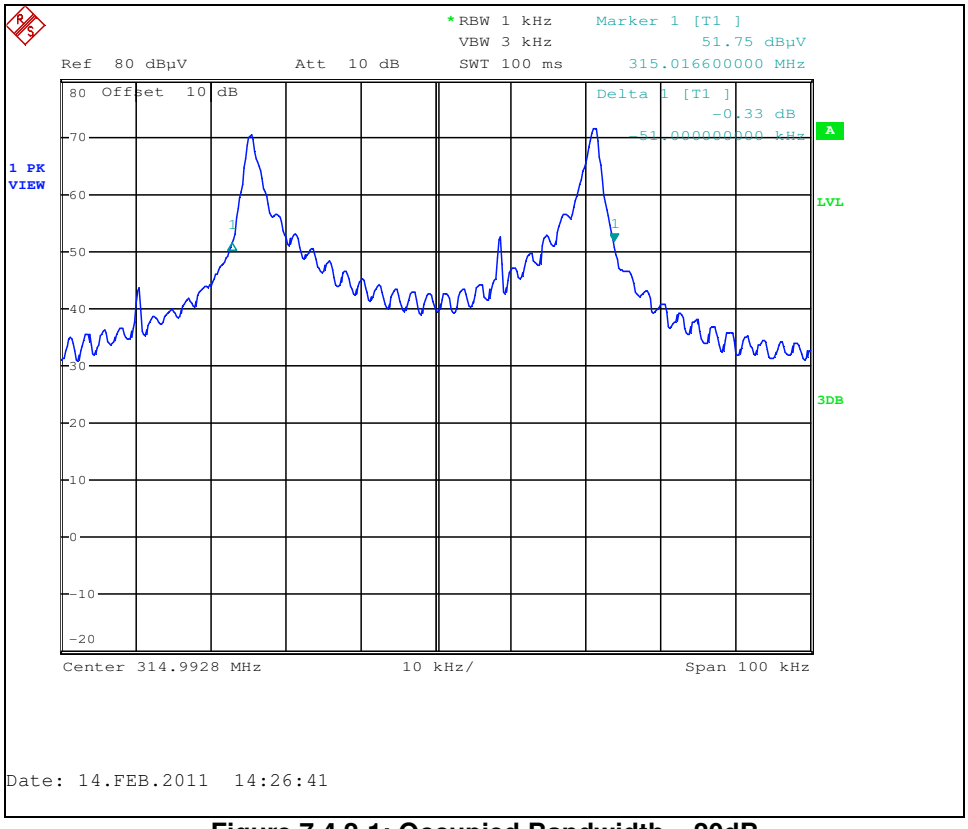

Figure 7.4.2-1: Occupied Bandwidth – 20dB

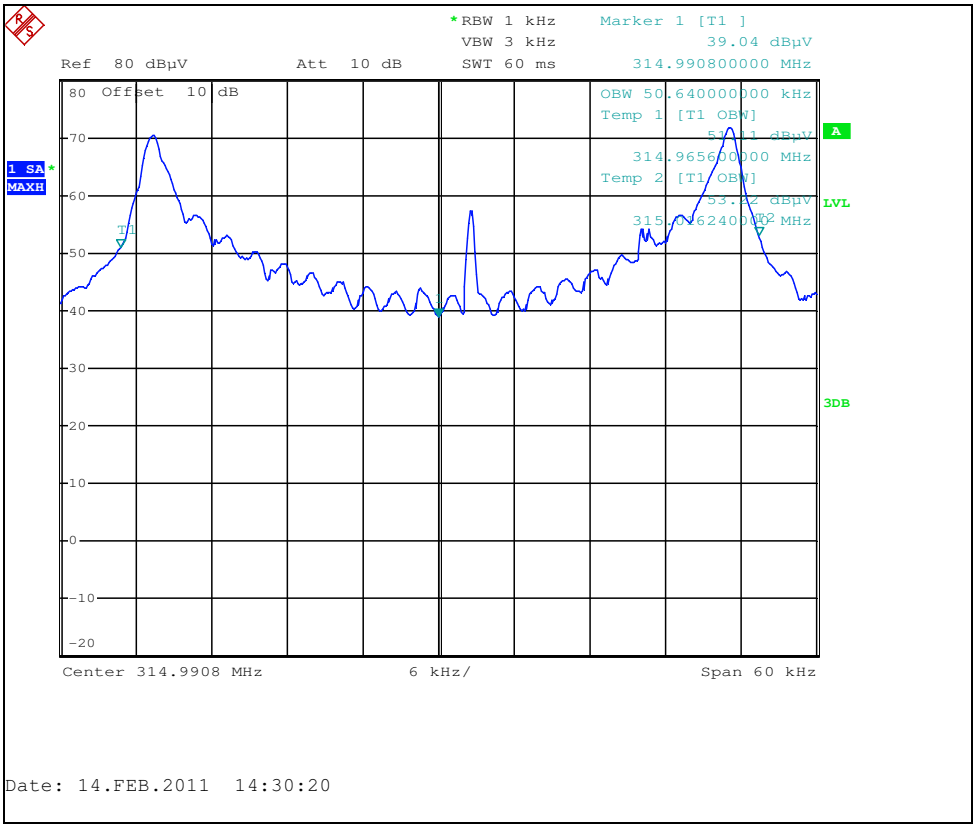

Figure 7.4.2-2: Occupied Bandwidth – 99%

7.5 Radiated Emissions – FCC: CFR 47 15.231(b)

7.5.1 Test Methodology

Radiated emissions tests were made over the frequency range of 30MHz to 3.15GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, average and peak measurements were made with a resolution bandwidth (RBW) of 120 kHz and a video bandwidth (VBW) of 300 kHz. For frequencies above 1000MHz, average and peak measurements were made with RBW of 1 MHz and a VBW of 3 MHz.

Further, compliance with the provisions of 15.205 was demonstrated using the measurement instrumentation specified in that section where applicable.

The EUT utilized pulsed modulation therefore peak measurements where corrected by the duty cycle for comparison to the average limits.

7.5.2 Duty Cycle Correction

For average radiated measurements, the measured level was reduced by a factor 3.62dB to account for the duty cycle of the EUT. The worst case duty cycle was determined to be 65.9%. The duty cycle correction factor is determined using the formula: 20log (0.659) = 3.62dB. Determination of the duty cycle correction is included in the plots and justification below.

Period (T) = 100ms
Number Pulses (N1) = 1
Pulse Width (T1) = 22ms
Number Pulse (N2) = 1
Pulse Width (T2) = 1.9ms
Number Pulse (N3) = 61
Pulse Width (T3) = 500us
Number Pulse (N4) = 11.5
Pulse Width (T4) = 1ms

(N1*T1 + N2*T2 + N3*T3 + N4*T4)/T = ((1*22) + (1*1.9) + (61*0.5) + (11.5*1))/100 = 0.659

Duty Cycle Correction Factor = 20*Log(0.659) = -3.62 dB

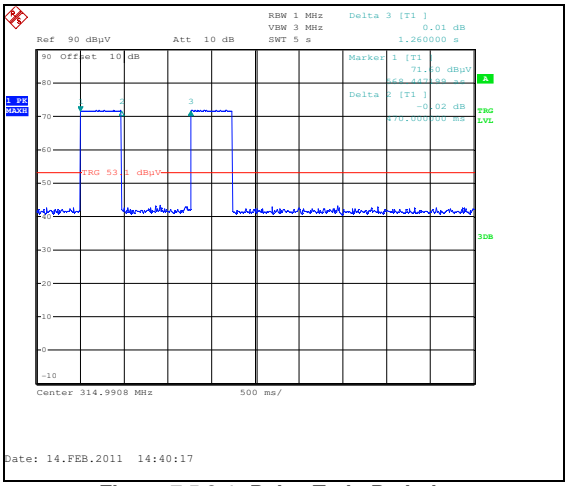

Figure 7.5.2-1: Pulse Train Period

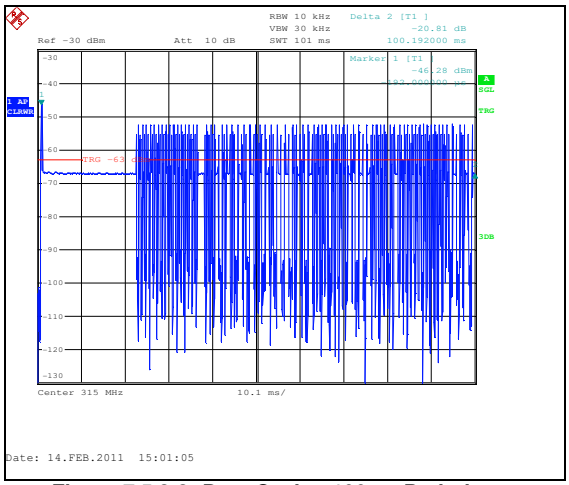

Figure 7.5.2-2: Duty Cycle - 100ms Period

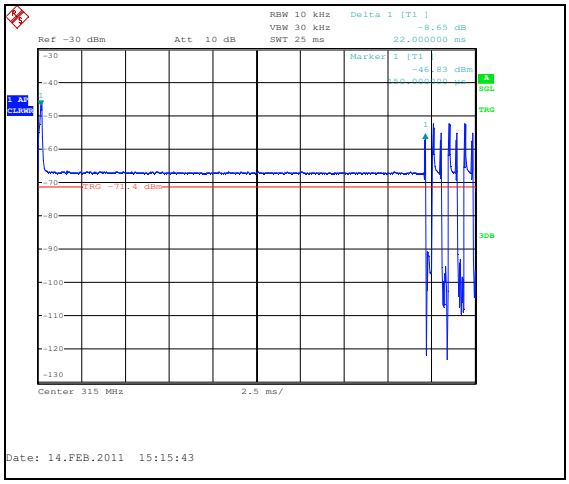

Figure 7.5.2-3: Duty Cycle – 0ms to 25ms

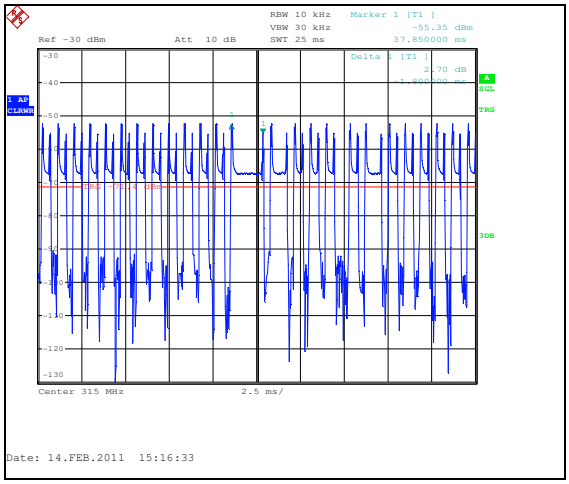

Figure 7.5.2-4: Duty Cycle – 25ms to 50ms

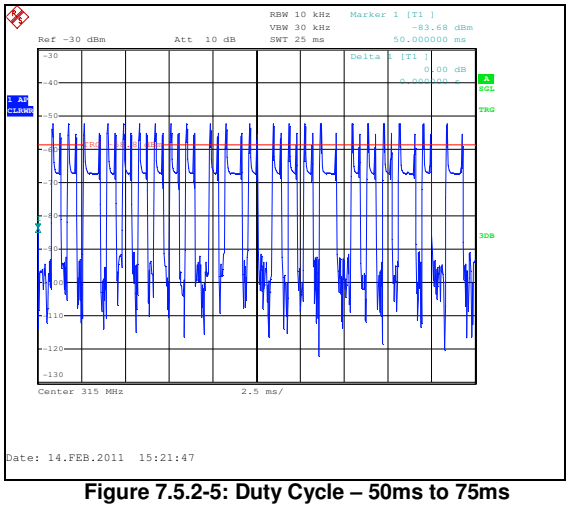

Figure 7.5.2-5: Duty Cycle – 50ms to 75ms

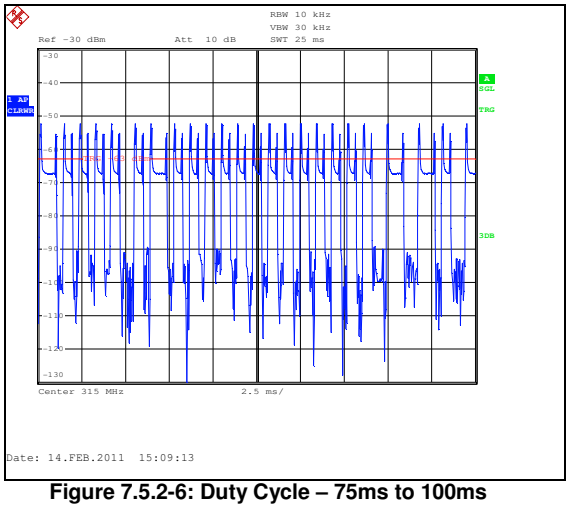

Figure 7.5.2-6: Duty Cycle – 75ms to 100ms

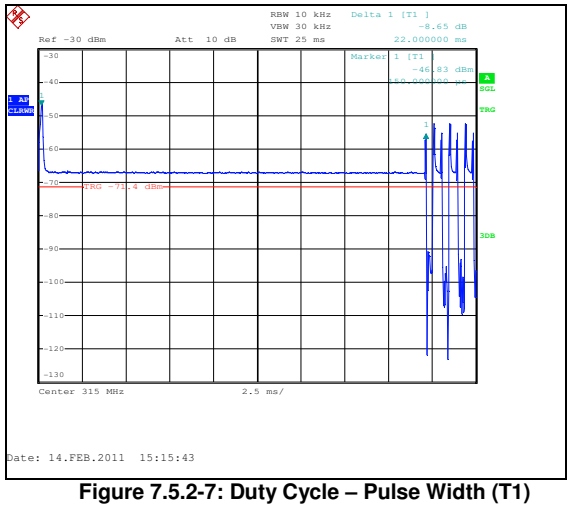

Figure 7.5.2-7: Duty Cycle – Pulse Width (T1)

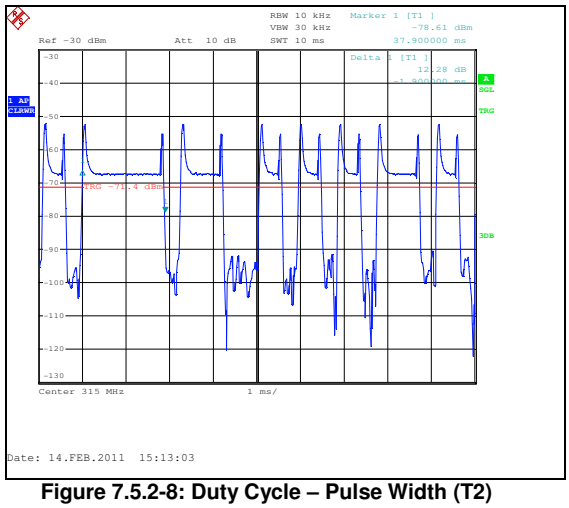

Figure 7.5.2-8: Duty Cycle – Pulse Width (T2)

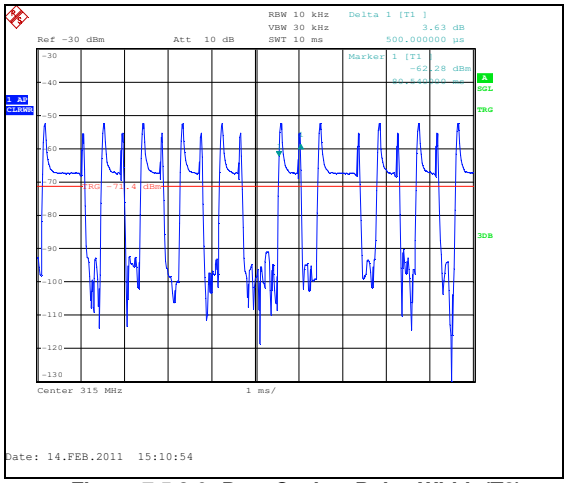

Figure 7.5.2-9: Duty Cycle – Pulse Width (T3)

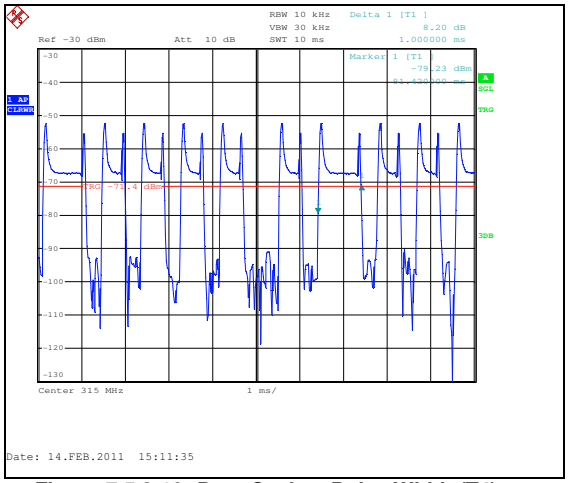

Figure 7.5.2-10: Duty Cycle – Pulse Width (T4)

7.5.3 Test Results

Radiated spurious emissions are reported in Table 7.5.3-1. Emissions not reported were below the noise floor of the measurement system.

Table 7.5.3-1: Radiated Emissions

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
Fundamental Emission										
315	64.89	64.89	V	-6.80	58.09	54.47	95.6	75.6	37.5	21.1
Spurious Emissions										
246	-----	44.95	H	-10.46	-----	30.87	-----	46.0	-----	15.1
383.2	57.07	57.07	H	-7.16	49.91	46.28	75.6	55.6	25.7	9.3
383.2	54.84	54.84	V	-7.16	47.68	44.05	75.6	55.6	27.9	11.6
698.2	44.33	44.33	H	0.24	44.57	40.94	75.6	55.6	31.0	14.7
698.2	48.58	48.58	V	0.24	48.82	45.19	75.6	55.6	26.8	10.4
740.8	43.48	43.48	H	-0.12	43.36	39.74	75.6	55.6	32.2	15.9
740.8	40.60	40.60	V	-0.12	40.48	36.86	75.6	55.6	35.1	18.8
766.3	42.82	42.82	H	0.74	43.57	39.94	75.6	55.6	32.0	15.7
766.3	39.77	39.77	V	0.74	40.52	36.89	75.6	55.6	35.1	18.7
808.6	38.95	38.95	H	-0.09	38.86	35.24	75.6	55.6	36.7	20.4
808.6	41.89	41.89	V	-0.09	41.80	38.18	75.6	55.6	33.8	17.4
945	35.76	35.76	H	2.60	38.36	34.74	75.6	55.6	37.2	20.9
945	40.44	40.44	V	2.60	43.04	39.42	75.6	55.6	32.6	16.2
1260	60.78	60.78	H	-11.84	48.94	45.32	75.6	55.6	26.7	10.3
1260	63.94	63.94	V	-11.84	52.10	48.48	75.6	55.6	23.5	7.1
1575	60.54	60.54	H	-9.77	50.77	47.15	74.0	54.0	23.2	6.8
1575	64.36	64.36	V	-9.77	54.59	50.97	74.0	54.0	19.4	3.0

7.5.4 Sample Calculation:

$R_C = R_U + CF_T$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Example Calculation: Fundamental Frequency

PEAK:
Corrected Level: 64.89 - 6.80 = 58.09dBuV
Margin: 95.6dBuV – 58.09dBuV = 37.5dB

AVERAGE:
Corrected Level: 64.89 - 6.80 - 3.62 = 54.47dBuV
Margin: 75.6dBuV – 54.47dBuV = 21.1dB

8 CONCLUSION

In the opinion of ACS, Inc. the 022-GEN2-FP manufactured by U.S. Jetting, Inc. met the requirements of FCC Part 15 subpart C.

END REPORT