Excellence in Compliance Testing

Certification Test Report

FCC ID: WYU-PROBE001

FCC Rule Part: 15.247

ACS Report Number: 08-0307-15C Probe DSS

Manufacturer: Orderite, Inc.
Model: PROBE001

Test Begin Date: August 12, 2008
Test End Date: August 22, 2008

Report Issue Date: February 2, 2009

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

This report is not be used to claim certification, approval, or endorsement by NVLAP, NIST or any government agency.

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This report contains 20 pages

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1.0 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.

1.2 Product Description

1.2.1 General

The PROBE001 is an RF sensor temperature probe used in a process management and food safety system which electronically monitors temperature of foods to maintain proper food safety. The PROBE001 utilizes frequency hopping in the 902-928 MHz frequency band under Part 15.247.

Manufacturer Information:
Orderite, Inc.
296 N. Jackson St.
Athens, GA 30604

Test Sample Serial Number(s):
ACS#5

Test Sample Condition:
The test sample and accessories were provided in good working order with no discernable defects.

Detailed photographs of the EUT are filed separately with this filing.

1.2.2 Intended Use

The PROBE001 is an RF sensor temperature probe used in a process management and food safety system which electronically monitors temperature of foods to maintain proper food safety.

1.3 Test Methodology and Considerations

The PROBE001 can operate in multiple orientations therefore the device was tested in multiple orientations and worst case data provided in this report.

The PROBE001 is a stand-alone battery operated device therefore no ac power line conducted emissions were performed.

2.0 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

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. In addition, ACS is compliant to ISO/IEC 17025 as certified by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program. The following certification numbers have been issued in recognition of these accreditations and certifications:

FCC Registration Number: 894540
Industry Canada Lab Code: IC 4175
VCCI Member Number: 1831

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

NVLAP Lab Code: 200612-0

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:

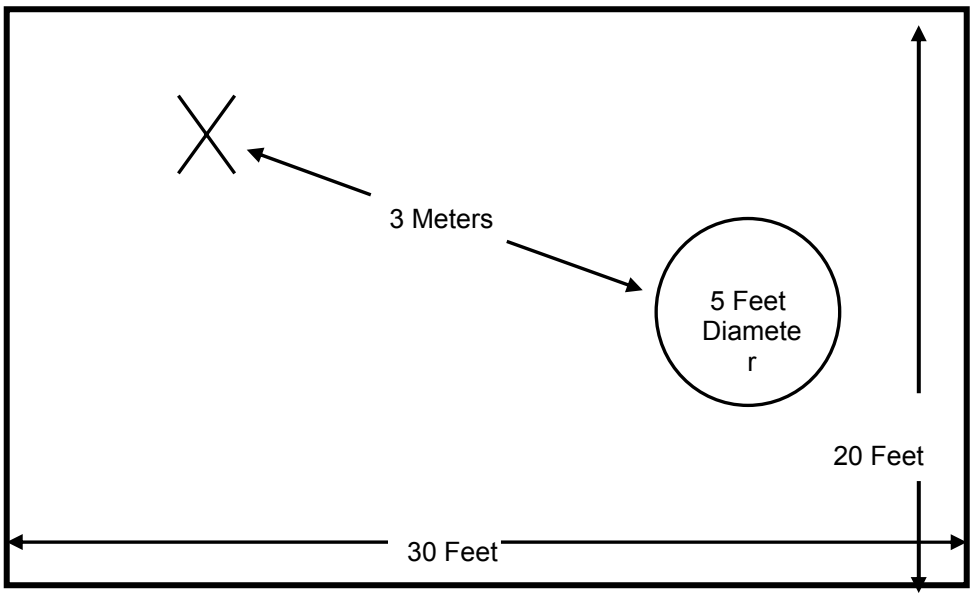

Figure 2.3-1: Semi-Anechoic Chamber Test Site

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:

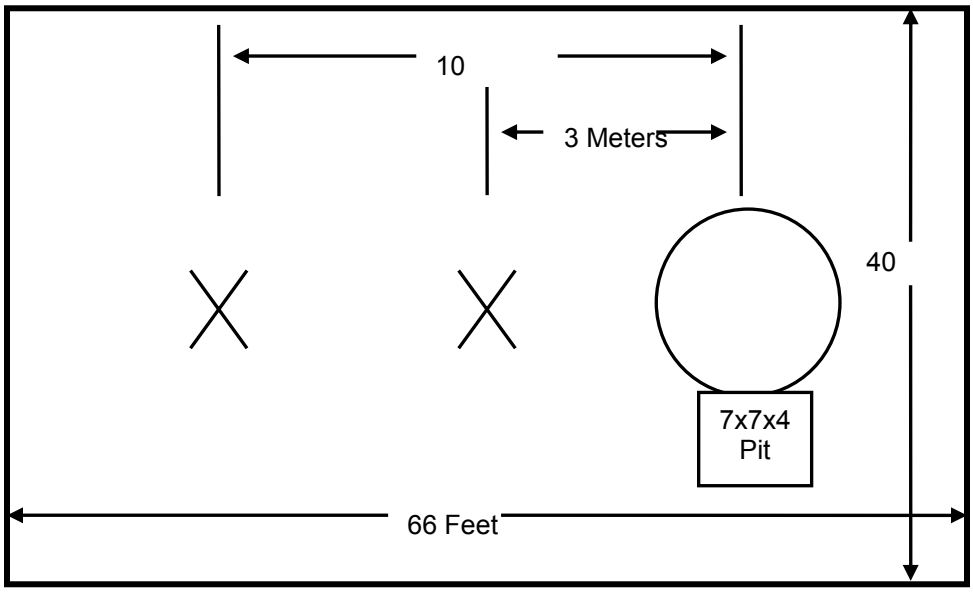

Figure 2.3-2: Open Area Test Site

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 group 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:

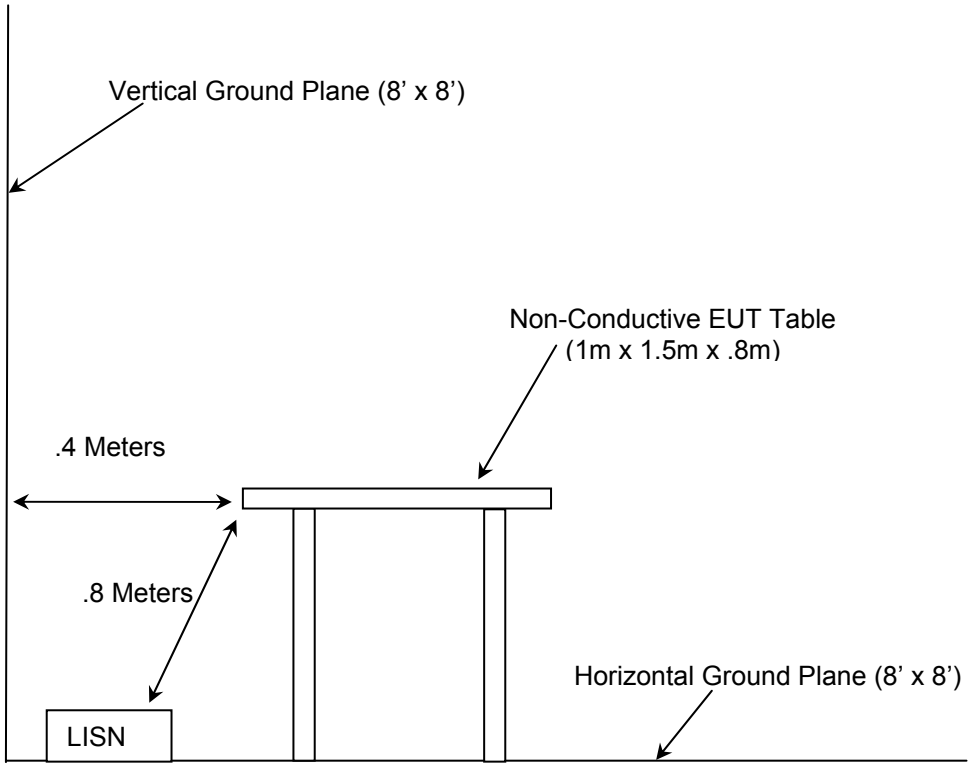

Figure 2.4-1: AC Mains Conducted EMI Site

3.0 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, 2008
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2008
- FCC OET Bulletin 65 Appendix C - Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, 2001
- FCC Public Notice DA 00-705 - Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems, March 30, 2000

4.0 LIST OF TEST EQUIPMENT

All test equipment used for regulatory testing is calibrated yearly or according to manufacturer's specifications.

Table 4-1: Test Equipment

Equipment Calibration Information					
ACS#	**Mfg.**	**Eq. type**	**Model**	**S/N**	**Cal. Due**
3	Rohde & Schwarz	ESMI-Display	839379/011	Spectrum Analyzer	10/26/08
4	Rohde & Schwarz	ESMI-Receiver	833827/003	Spectrum Analyzer	10/26/08
22	Agilent	8449B	3008A00526	Pre-Amplifier	10/25/08
30	Spectrum Technologies	DRH-0118	970102	Antenna	05/07/09
168	Hewlett Packard	Attenuators	11947A	44829	02/18/09
291	Florida RF Cables	SMRE-200W-12.0-SMRE	NA	Cables	11/21/08
283	Rohde & Schwarz	FSP40	1000033	Spectrum Analyzer	11/09/08
292	Florida RF Cables	SMR-290AW-480.0-SMR	NA	Cables	11/21/08
41	Electro Metrics	BIA-25	2925	Antenna	06/05/09
167	ACS	Chamber EMI Cable	167	Cables	01/04/09
412	Electro Metrics	LPA-25	1241	Antenna	07/08/09
331	Microwave Circuits	H1G513G1	31417	Filter	07/28/09
277	Emco	93146	9904-5199	Antenna	09/12/08
73	Agilent	8447D	2727A05624	Amplifier	12/19/08
422	Florida RF Cables	SMS-200AW-72.0-SMR	0805	Cables	02/25/09

5.0 SUPPORT EQUIPMENT

Table 5-3: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
The EUT is a stand-alone battery operated device therefore no support equipment was utilized.				

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM

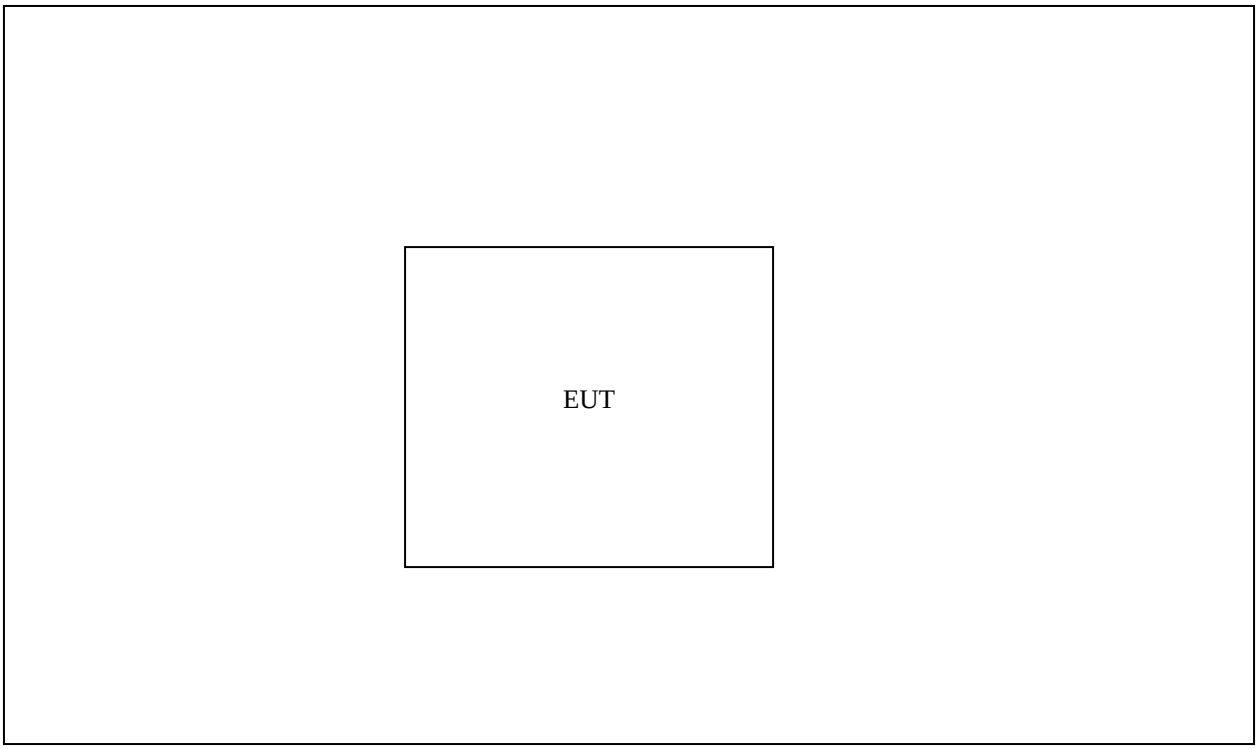

Figure 6-1: EUT Test Setup

*See Test Setup photographs for additional detail.

7.0 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: Section 15.203

The PROBE001 utilizes an integral wire antenna, AX100776-001 – Antenna Wire, 20AWG, 3.12" length, with gain of 0dBi.

7.2 Radiated Emissions – FCC: Section 15.109(Unintentional Radiation)

7.2.1 Test Methodology

Radiated emissions tests were performed over the frequency range of 30MHz to 10 GHz. Measurements of the radiated field strength were made at a distance of 3m from the boundary of the equipment under test (EUT) and the receiving antenna. The antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000 MHz a Quasi-peak detector was enabled and measurements were taken with the Spectrum Analyzer's resolution bandwidth set to 120 KHz. For frequencies above 1000MHz, measurements were made using an average detector and peak detector with RBW and VBW of 1 MHz and 3MHz respectively.

7.2.2 Test Results

Results of the test are given in Table 7.2.2-1 below:

Table 7.2.2-1: Radiated Emissions Tabulated Data

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
30		30.27	V	-14.10	---------	16.17	--------	40.0	---------	23.83
44.01		30.52	V	-15.84	---------	14.68	--------	40.0	---------	25.32
129.15		28.96	V	-14.17	---------	14.79	--------	43.5	---------	28.71
495.6		32.56	V	-5.52	---------	27.04	--------	46.0	---------	18.96
642.17		31.59	V	-3.31	---------	28.28	--------	46.0	---------	17.72
950.42		30.58	V	0.81	---------	31.39	--------	46.0	---------	14.61

* Note: All emissions above 950.42 MHz were attenuated below the permissible limit.

7.3 Peak Output Power - FCC Section 15.247(b)

7.3.1 Test Methodology

Antenna conducted measurements could not be performed on this device, therefore radiated tests were performed to show compliance with the peak output power limit according to the alternative test methods in the FCC publication DA 00-705.

The procedures set forth in ANSI C63.4 were followed with respect to maximizing the peak emission. The resolution bandwidth of the spectrum analyzer was set to 1 MHz which was greater the 20 dB bandwidth measured in section 7.5.4. The video bandwidth was set to 3 MHz and a peak detector using the Max Hold function was utilized.

The power was calculated using the following equation:

$$P = (E * d)^2 / 30 * G$$

Where: G = Numeric Gain of the transmitting antenna with reference to an isotropic radiator
d = The distance in meters from which the field strength was measured
E = The measured maximum fundamental field strength in V/m

7.3.2 Test Results

Results are shown below in tables 7.3.2-1 and 7.3.2-2 below:

Table 7.3.2-1: Fundamental Field Strength

Frequency (MHz)	Uncorrected Level (dBuV)	Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)
904.3968	70.68	V	27.19	97.87
915	70.91	V	27.30	98.21
924.4672	69.62	V	27.30	96.92

Table 7.3.2-2: Peak Output Power

Frequency (MHz)	Antenna Gain (dBi)	Field Strength (V/m)	Antenna Gain Num	Power (mW)	Power (dBm)
904.3968	0.0	0.08	1.00	1.84	2.64
915	0.0	0.08	1.00	1.99	2.98
924.4672	0.0	0.07	1.00	1.48	1.69

7.4 Channel Usage Requirements

7.4.1 Carrier Frequency Separation – FCC: Section 15.247(a)(1)

7.4.1.1 Test Methodology

The span of the spectrum analyzer was set wide enough to capture two adjacent peaks and the RBW and VBW were set to ≥ 1% of the span.

7.4.1.2 Test Results

The maximum 20dB bandwidth of the hopping channel was measured to be 321kHz (See figures 7.4.4.2-1 to 7.4.4.2-3 below). The adjacent channel separation was measured to be 404kHz. Results are shown in figure 7.4.1.2-1 below:

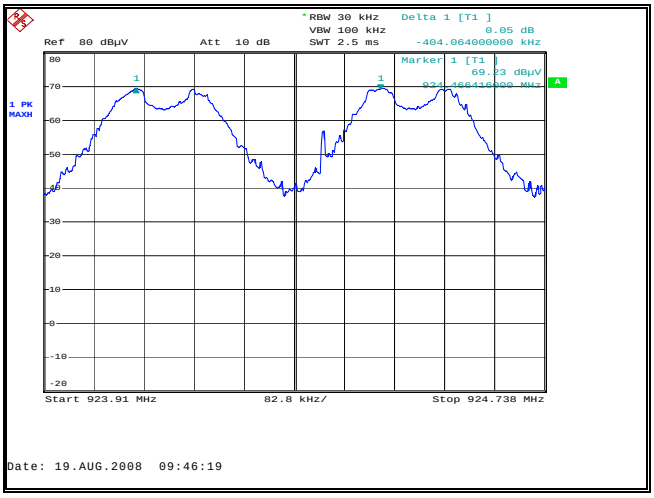

Figure 7.4.1.2-1: Carrier Frequency Separation

7.4.2 Number of Hopping Channels – FCC: Section 15.247(a)(1)(i)

The 20dB bandwidth of the device is greater than 250 kHz. The device employs 50 hopping channels which is greater than the 25 required. Results are shown in Figure 7.4.2-1 below:

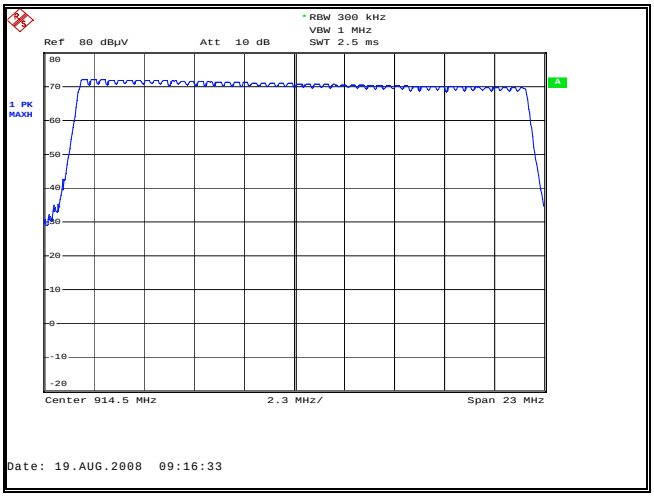

Figure 7.4.2-1: Number of Hopping Channels

7.4.3 Channel Dwell Time – FCC: Section 15.247(a)(1)(i)

7.4.3.1 Test Methodology

The emission measured centered on the analyzer and the span set to 0 Hz. The RBW was set to 1 MHz and the VBW to 3 MHz. Sweep time was set to 200 ms to capture the burst duration of the emission. The marker –delta function of the analyzer was employed to measure the burst duration.

7.4.3.2 Test Results

The duration of the RF transmission is 80 ms. A detailed description can be found in the Theory of Operations justifying the channel dwell time as >>20s.

A single transmission is shown in figure 7.4.3.2-1 below:

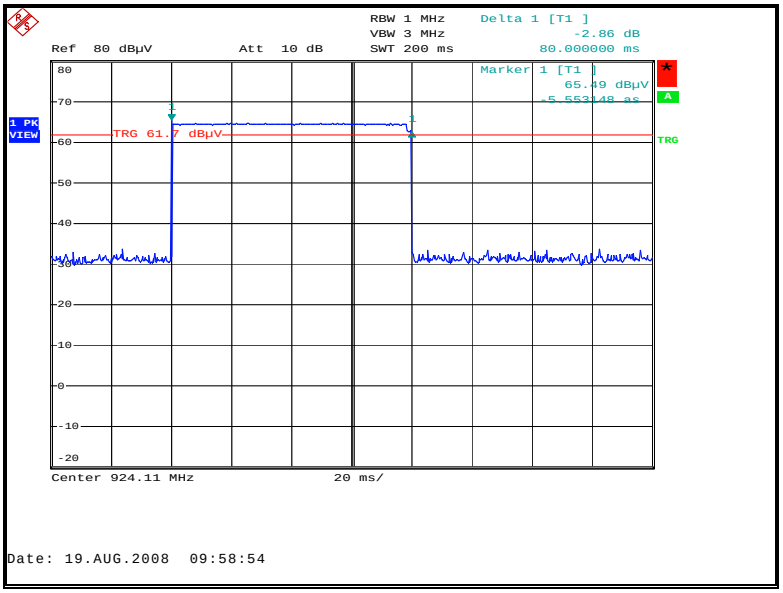

Figure 7.4.3.2-1: Channel Dwell Time

7.4.4 20dB Bandwidth -FCC: Section 15.247(a)(1)(i)

7.4.4.1 Test Methodology

The spectrum analyzer span was set to 2 to 3 times the estimated 20 dB bandwidth of the emission. The RBW was to ≥ 1% of the estimated 20 dB bandwidth. 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 span and RBW were examined and re-adjusted if necessary to meet the requirements of 2 to 3 times the 20 bandwidth for the span and ≥ 1% of the 20 dB bandwidth for the RBW.

7.4.4.2 Test Results

The maximum 20dB bandwidth was found to be approximately 321kHz. Results are shown below in Table 7.4.4.2-1 and Figures 7.4.4.2-1 through 7.4.4.2-3.

Table 7.4.4.2-1

Frequency [MHz]	Bandwidth [kHz]
904.3968	306
915	321
924.4672	308

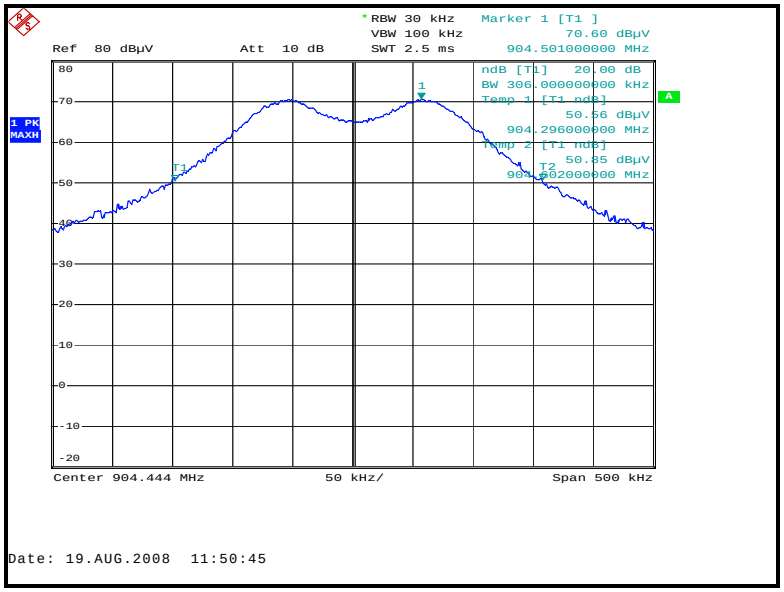

Figure 7.4.4.2-1: 20dB Bandwidth Low Channel

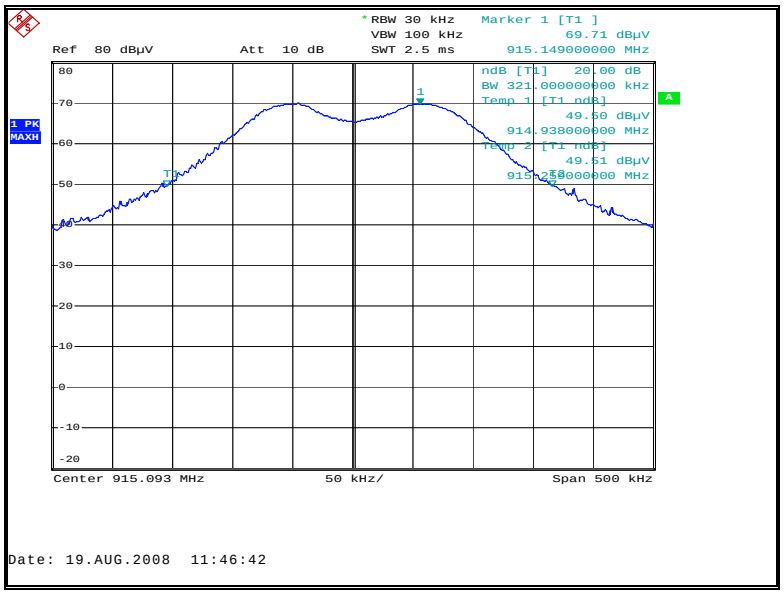

Figure 7.4.4.2-2: 20dB Bandwidth Mid Channel

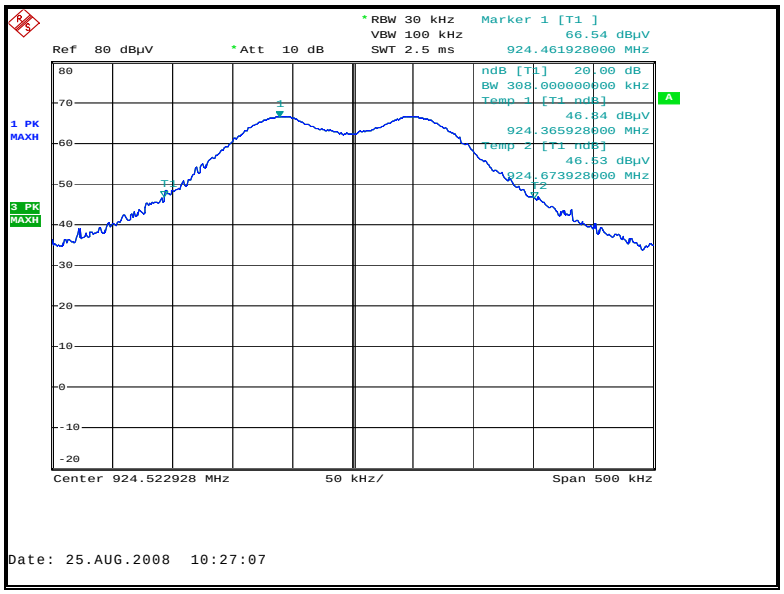

Figure 7.4.4.2-3: 20dB Bandwidth High Channel

7.5 Band-Edge Compliance and Spurious Emissions - FCC Section 15.247(d)

7.5.1 Band-Edge Compliance of RF Emissions

7.5.1.1 Test Methodology

The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement the spectrum analyzer's RBW was set to 100 kHz, which is ≥ 1% of the span, and the VBW was set to 300kHz.

Measurements were made with the EUT in continuous transmission mode and hopping mode.

7.5.1.2 Test Results

In a 100 kHz bandwidth at the lower and upper band-edge, the radio frequency power that was produced by the EUT is at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power. Band-edge compliance is displayed in Figures 7.5.1.2-1 - 7.5.1.2-4

Figure 7.5.1.2-1: Lower Band-edge

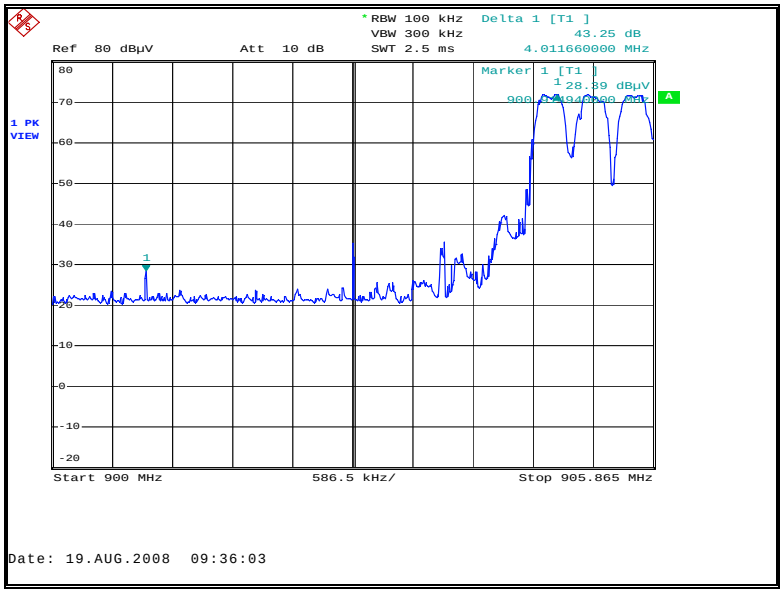

Figure 7.5.1.2-2: Lower Band-edge - Hopping Mode

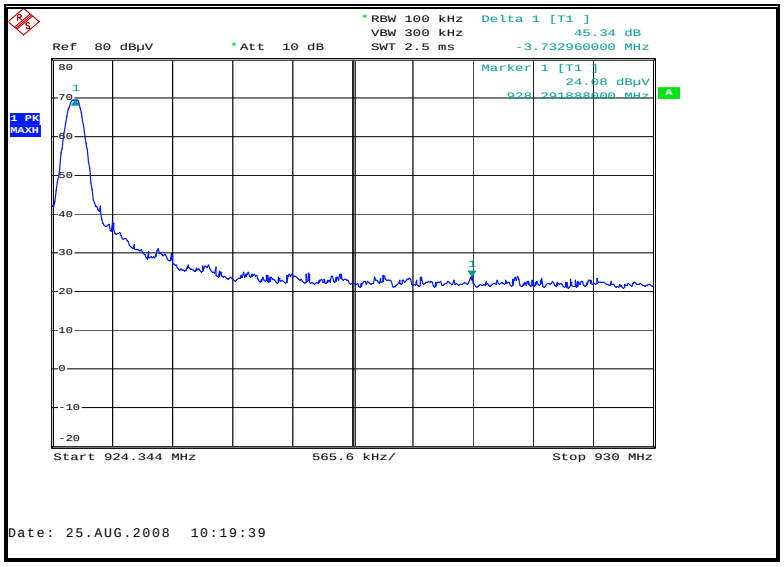

Figure 7.5.1.2-3: Upper Band-edge

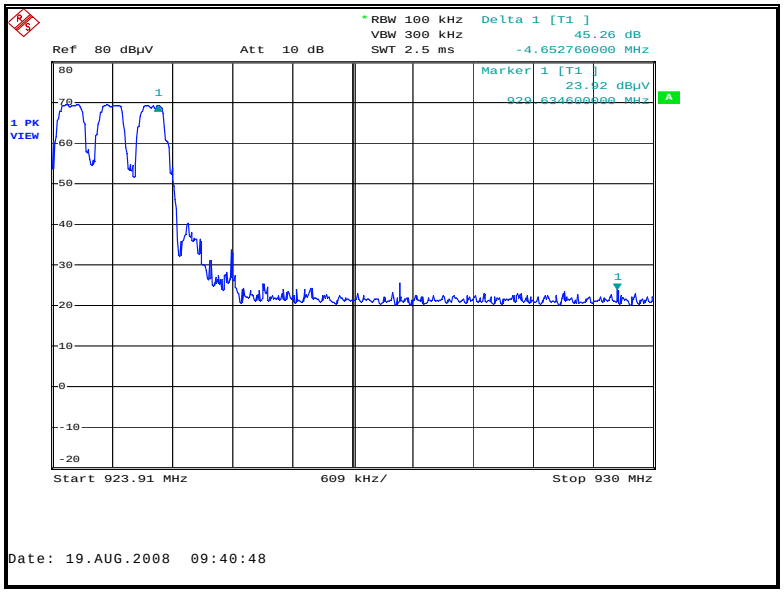

Figure 7.5.1.2-4: Upper Band-edge – Hopping Mode

7.5.2 RF Conducted Spurious Emissions

7.5.2.1 Test Methodology

Antenna conducted measurements could not be performed on this device, therefore radiated tests were performed to show compliance with the spurious RF conducted limit according to FCC publication DA 00-705.

For each measurement, the spectrum analyzer's RBW was set to 100 kHz and the VBW was set to 300 kHz. The peak detector and Max Hold function of the analyzer were utilized. The field strength of both the fundamental emission and all spurious emissions were measured with these settings. Procedures in ANSI C63.4 with respect to maximizing the emissions were followed. The measured field strength of all spurious emissions must be below the measured field strength of the fundamental emission by 20dB.

7.5.2.2 Test Results

The magnitude of all emissions are reported in section 7.5.3 with the appropriate limit as referenced to 20 dB below the fundamental frequency field strength. Emissions that fell within the restricted bands were referenced to the radiated emissions limit set forth in FCC Section 15.209 and IC RSS-210 Section 2.6.

7.5.3 Radiated Spurious Emissions – Intentional Radiation

7.5.3.1 Test Methodology

Radiated emissions tests were made over the frequency range of 30MHz to 10GHz, 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, quasi-peak measurements were made using a resolution bandwidth (RBW) of 120 kHz and a video bandwidth (VBW) of 300 kHz. For frequencies above 1000MHz, peak and average measurements were made using an RBW of 1 MHz and a VBW of 3 MHz respectively. For those frequencies that fell outside the restricted bands as defined in 15.205, the alternative test methods in the FCC publication DA 00-705 was followed using a RBW of 100kHz and VBW of 300kHz and peak detector.

The EUT was caused to generate a continuous carrier signal on the hopping channel.

7.5.3.2 Duty Cycle Correction

For average radiated measurements in restricted bands, the measured level was reduced by a factor 1.94dB to account for the duty cycle of the EUT. The EUT transmits on a single channel for 80ms within a 100ms period therefore the duty cycle is 80%. The duty cycle correction factor is determined using the formula: 20log (0.80) = -1.94dB. See section 7.4.3 for additional details.

7.5.3.3 Test Results

Radiated spurious emissions found in the band of 30MHz to 10GHz are reported in Tables 7.5.3.3-1 – 7.5.3.3-3.

Table 7.5.3.3-1: Radiated Spurious Emissions – Low Channel

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
904.3968	62.68	--------	H	27.79	90.47	--------	--------	--------	---------	---------
904.3968	70.68	--------	V	27.19	97.87	--------	--------	--------	---------	---------
1808.7936	54.07	--------	H	-3.19	50.88	---------	77.9	---------	26.99	---------
1808.7936	62.73	--------	V	-3.21	59.52	---------	77.9	---------	18.35	---------
2713.1904	50.39	46.48	H	0.58	50.97	45.12	74.0	54.0	23.03	8.88
2713.1904	56.31	54.48	V	0.38	56.69	52.92	74.0	54.0	17.31	1.08
3617.5872	45.92	37.60	H	3.69	49.61	39.36	74.0	54.0	24.39	14.64
3617.5872	46.48	38.51	V	3.72	50.20	40.29	74.0	54.0	23.80	13.71
4521.984	44.40	35.13	H	5.65	50.05	38.84	74.0	54.0	23.95	15.16

***** The magnitude of all emissions not reported were below the noise floor of the measurement system.

Table 7.5.3.3-2: Radiated Spurious Emissions – Mid Channel

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
915	62.77	--------	H	27.95	90.72	--------	--------	--------	---------	---------
915	70.84	--------	V	27.30	98.14	--------	--------	--------	---------	---------
1830	58.59	--------	H	-3.13	55.46	---------	78.1	---------	22.68	---------
1830	61.03	--------	V	-3.17	57.86	---------	78.1	---------	20.28	---------
2745	47.70	40.29	H	0.69	48.39	39.04	74.0	54.0	25.61	14.96
2745	50.82	45.72	V	0.49	51.31	44.27	74.0	54.0	22.69	9.73
3660	45.36	33.05	V	3.87	49.23	34.98	74.0	54.0	24.77	19.02

***** The magnitude of all emissions not reported were below the noise floor of the measurement system.

Table 7.5.3.3-3: Radiated Spurious Emissions – High Channel

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg			pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
924.4672	65.70	--------	H	28.04	93.74	--------	--------	--------	---------	---------
924.4672	69.59	--------	V	27.30	96.89	--------	--------	--------	---------	---------
Spurious Emissions										
1848.9344	54.32	--------	H	-3.09	51.23	---------	76.9	---------	25.66	---------
1848.9344	59.81	--------	V	-3.13	56.68	---------	76.9	---------	20.21	---------
2773.4016	48.58	41.97	H	0.79	49.37	40.83	74.0	54.0	24.63	13.17
2773.4016	54.06	50.43	V	0.59	54.65	49.09	74.0	54.0	19.35	4.91
3697.8688	50.32	41.02	V	4.01	54.33	43.10	74.0	54.0	19.67	10.90

***** The magnitude of all emissions not reported were below the noise floor of the measurement system.

7.5.3.4 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

PEAK:
Corrected Level: 50.39+ 0.58 = 50.97dBuV
Margin: 74dBuV – 50.97dBuV = 23.03dB

AVERAGE:
Corrected Level: 46.48+ 0.58 - 1.94= 45.12dBuV
Margin: 54dBuV – 45.12dBuV = 8.88dB

8.0 CONCLUSION
In the opinion of ACS, Inc. the PROBE001, manufactured by Orderite, Inc.meets the requirements of FCC Part 15 subpart C.

END REPORT