# Emissions Test Report

**EUT Name:** Energy Axis Gas Module

**EUT Model:** 5D25575

FCC Title 47, Part 15, SubpartC, RSS-210 Issue 7

*Prepared for:*

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*Report/Issue Date:* 02 January 2007
*Report Number:* 30762680.001

# Statement of Compliance

| | |
|---|---|
| *Manufacturer:* | Elster Electricity, LLC<br>208 South Rogers Lane<br>Raleigh, NC 27610<br>919 212-4700 |
| *Requester / Applicant:* | Steve Bragg |
| *Name of Equipment:* | Energy Axis Gas Module |
| *Operation Frequency Range* | 902.8 MHz to 927.6 |
| *Type of Equipment:* | Intentional Radiator |
| *Application of Regulations:* | FCC Title 47, Part 15, SubpartC, RSS-210 Issue 7 |
| *Test Dates:* | 26 November 2007 to 28 November 2007 |

*Guidance Documents:*

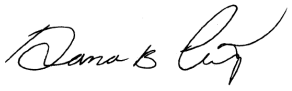
Emissions: FCC 47 CFR Part 15, RSS-210 Issue 7

*Test Methods:*

Emissions: ANSI C63.4:2003

The electromagnetic compatibility test and documented data described in this report has been performed and recorded by TUV Rheinland of North America, in accordance with the standards and procedures listed herein. As the responsible authorized agent of the EMC laboratory, I hereby declare that a sample of one, of the equipment described above, has been shown to be compliant with the EMC requirements of the stated regulations and standards based on these results. If any special accessories and/or modifications were required for compliance, they are listed in the Executive Summary of this report.

This report must not be used to claim product endorsement by NVLAP or any agency of the U.S. Government. This report contains data that are not covered by NVLAP accreditation. This report shall not be reproduced except in full, without the written authorization of the laboratory.



NVLAP Signatory

14 December 2007

Date

| NVLAP | FC | Industry Canada |
|---|---|---|
| 200094-0 | 90552 and 100881 | IC3755 |

# 1 Executive Summary

## *1.1 Scope*

This report is intended to document the status of conformance with the requirements of the FCC Title 47, Part 15, SubpartC, RSS-210 Issue 7 based on the results of testing performed on *26 November* 2007 through *28* November 2007 on the *Energy Axis Gas Module* Model No. *5D25575* manufactured by Elster Electricity, LLC. This report only applies to the specific samples tested under the stated test conditions. It is the responsibility of the manufacturer to assure that additional production units of this model are manufactured with identical or EMI equivalent electrical and mechanical components. This report is further intended to document changes and modifications to the EUT throughout its life cycle. All documentation will be included as a supplement.

## *1.2 Purpose*

Testing was performed to evaluate the EMC performance of the EUT in accordance with the applicable requirements, procedures, and criteria defined in the application of regulations and application of standards listed in this report.

## *1.3 Summary of Test Results*

Table 1 - Summary of Test Results

| Test | Test Method(s) | Test Parameters | Measurement | Result |
|---|---|---|---|---|
| Channel Separation | FCC Part 15.247(a)(1) RSS-210, Annex 8, Section A8.1 (2) | Greater of 25 kHz or 20 dB bandwidth | 400 kHz | **compliant** |
| Pseudorandom Hopping Algorithm | RSS-210, Annex 8, Section A8.1 | | | **compliant** |
| Time of Occupancy | FCC Part 15.247(a)(1)(i) RSS-210, Annex 8, Section A8.1 (3) | =<0.4 sec in 10 sec. | 0.304 sec. | **compliant** |
| Occupied Bandwidth | FCC Part 15.247(a)(1)(i) RSS-210, Annex 8, Section A8.1 (3) | =<400kHz | 335 kHz | **compliant** |
| Peak Output Power | FCC Part 15.247(b)(2) RSS-210, Annex 8, Section A8.4 (1) | 0.25 Watts | 0.19 Watts | **compliant** |
| Spurious Emissions | FCC Part 15.247(C) RSS-210, Annex 8, Section A8.5 | Table FCC Part 15.209 | 52.01 dBuV/m | **compliant** |
| Frequency Hopping Spread Spectrum Systems | FCC Part 15.247(g) RSS-210, Annex 8, Section A8.1 | | | **compliant** |
| Incorporation of Intelligence | FCC Part 15.247(h) RSS-210, Annex 8, Section A8.1 | | | **compliant** |
| Frequency Stability | FCC Part 15.215(c) | Containment of 20 dB bandwidth between 902 and 928 | | **compliant** |

### *1.4 Special Accessories*

No special accessories were necessary in order to achieve compliance.

### *1.5 Equipment Modifications*

No modifications were found to be necessary in order to achieve compliance.

# 2 Laboratory Information

### *2.1 Accreditations & Endorsements*

#### 2.1.1 US Federal Communications Commission

TUV Rheinland of North America at the 762 Park Ave. Youngsville, N.C 27596 address is accredited by the commission for performing testing services for the general public on a fee basis. This laboratory test facilities have been fully described in reports submitted to and accepted by the FCC (Registration No 90552 and 100881). The laboratory scope of accreditation includes: Title 47 CFR Part 15, 18, and 90. The accreditation is updated every 3 years.

#### 2.1.2 NIST / NVLAP

TUV Rheinland of North America is accredited by the National Voluntary Laboratory Accreditation Program, which is administered under the auspices of the National Institute of Standards and Technology. The laboratory has been assessed and accredited in accordance with ISO Guide 25 and ISO 9002 (Lab code 200094-0). The scope of laboratory accreditation includes emission and immunity testing. The accreditation is updated annually.

#### 2.1.3 Canada – Industry Canada

Registration No. IC3755

#### 2.1.4 Japan - VCCI

The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) is a group that consists of Information Technology Equipment (ITE) manufacturers and EMC test laboratories. The purpose of the Council is to take voluntary control measures against electromagnetic interference from Information Technology Equipment, and thereby contribute to the development of a socially beneficial and responsible state of affairs in the realm of Information Technology Equipment in Japan. TUV Rheinland of North America at the 762 Park Ave. Youngsville, N.C 27596 address has been assessed and approved in accordance with the Regulations for Voluntary Control Measures. (Registration No. R-1174 and C-1236).

### 2.1.5 Acceptance By Mutual Recognition Arrangement

The United States has an established agreement with specific countries under the Asia Pacific Laboratory Accreditation Corporation (APLAC) Mutual Recognition Arrangement. Under this agreement, all TUV Rheinland of North America at the 762 Park Ave. Youngsville, N.C 27596 address test results and test reports within the scope of the laboratory NIST / NVLAP accreditation will be accepted by each member country.

## *2.2 Test Facilities*

All of the test facilities are located at 762 Park Ave., Youngsville, North Carolina 27596, USA.

### 2.2.1 Emission Test Facility

The Open Area Test Site and AC Line Conducted measurement facility used to collect the radiated and conducted data has been constructed in accordance with ANSI C63.7:1992. The site has been measured in accordance with and verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4:2005, at a test distance of 3 and 10 meters. This site has been described in reports dated May 12, 1997, submitted to the FCC, and accepted by letter dated June 25, 1997 (31040/SIT 1300F2). The site is listed with the FCC and accredited by NVLAP (code 200094-0). The 5m semi-anechoic chamber used to collect the radiated data has been verified to comply with the theoretical normalized site attenuation requirements of ANSI C63.4:2005, at a test distance of 3 meters. A report detailing this site can be obtained from TUV Rheinland of North America.

### 2.2.2 Immunity Test Facility

ESD, EFT, Surge, PQF: These tests are performed in an environmentally controlled room with a 3.7m x 3.7m x 3.175mm thick aluminum floor connected to PE ground. For ESD testing, tabletop equipment is placed on an insulated mat with a surface resistivity of $10^9$ Ohms/square on a 1.6m x 0.8m x 0.8m high non-conductive table with a 3.175mm aluminum top (Horizontal Coupling Plane). The HCP is connected to the main ground plane via a low impedance ground strap through two 470 kΩ resistors. The Vertical Coupling Plane consists of an aluminum plate 50cm x 50cm x 3.175mm thick. The VCP is connected to the main ground plane via a low impedance ground strap through two 470 kΩ resistors. For each of the other tests, the HCP is removed.

RF Field Immunity testing is performed in a 7.3m x 3.7m x 3.2m anechoic chamber.

RF Conducted and Magnetic Field Immunity testing is performed on a 4.9m x 3.7m x 3.175mm thick aluminum ground plane which is connected to one end of the anechoic chamber.

All test areas allow a minimum distance of 1 meter from the EUT to walls or conducting objects.

### 2.3 Measurement Uncertainty

Two types of measurement uncertainty are expressed in this report, per *ISO Guide To The Expression Of Uncertainty In Measurement*, 1st addition, 1995.

*The Combined Standard Uncertainty* is the standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities, equal to the positive square root of a sum of terms, the terms being the variances or co-variances of these other quantities weighted according to how the measurement result varies with changes in these quantities. The term standard uncertainty is the result of a measurement expressed as a standard deviation.

*The Expanded Uncertainty* defines an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand. The fraction may be viewed as the coverage probability or level of confidence of the interval.

The test system for conducted emissions is defined as the LISN, spectrum analyzer, coaxial cables, and pads. The test system for radiated emissions is defined as the antenna, spectrum analyzer, pre-amplifier, coaxial cables, and pads. The conducted test system has a combined standard uncertainty of ± 1.2 dB. The radiated test system has a combined standard uncertainty of ± 1.6 dB. The expanded uncertainty at a level of 95% confidence is obtained by multiplying the combined standard uncertainty by a coverage factor of 2. Compliance criteria are not based on measurement uncertainty.

### 2.4 Calibration Traceability

All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Measurement method complies with ANSI/NCSL Z540-1-1994 and ISO Guide 25.

## 3 Product Information

### 3.1 Equipment Configuration

A description and justification of the equipment configuration is given in the EMC Test Plan. The EUT was tested as described in the EMC Test Plan and was configured and operated in a manner consistent with its intended use. The EUT was connected to rated power and allowed to warm up to normal operating conditions. The placement of the EUT system components was guided by the test standard and selected to represent typical installation conditions.

In the case of an EUT that can operate in more than one configuration, preliminary testing was performed to determine the configuration that produced maximum radiation.

The final configuration was selected to produce worse case radiation and place the EUT in the most susceptible state.

# 4 Emissions

Testing was performed in accordance with 47 CFR Part 15, ANSI C63.4:2003, RSS-210 Issue 7. These test methods are listed under the laboratory's NVLAP Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

## *4.1 Channel Separation Part 15.247(a)(1)*

Frequency hopping Systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

**Bandwidth**= 335 kHz

**Channel Separation**= 400 kHz

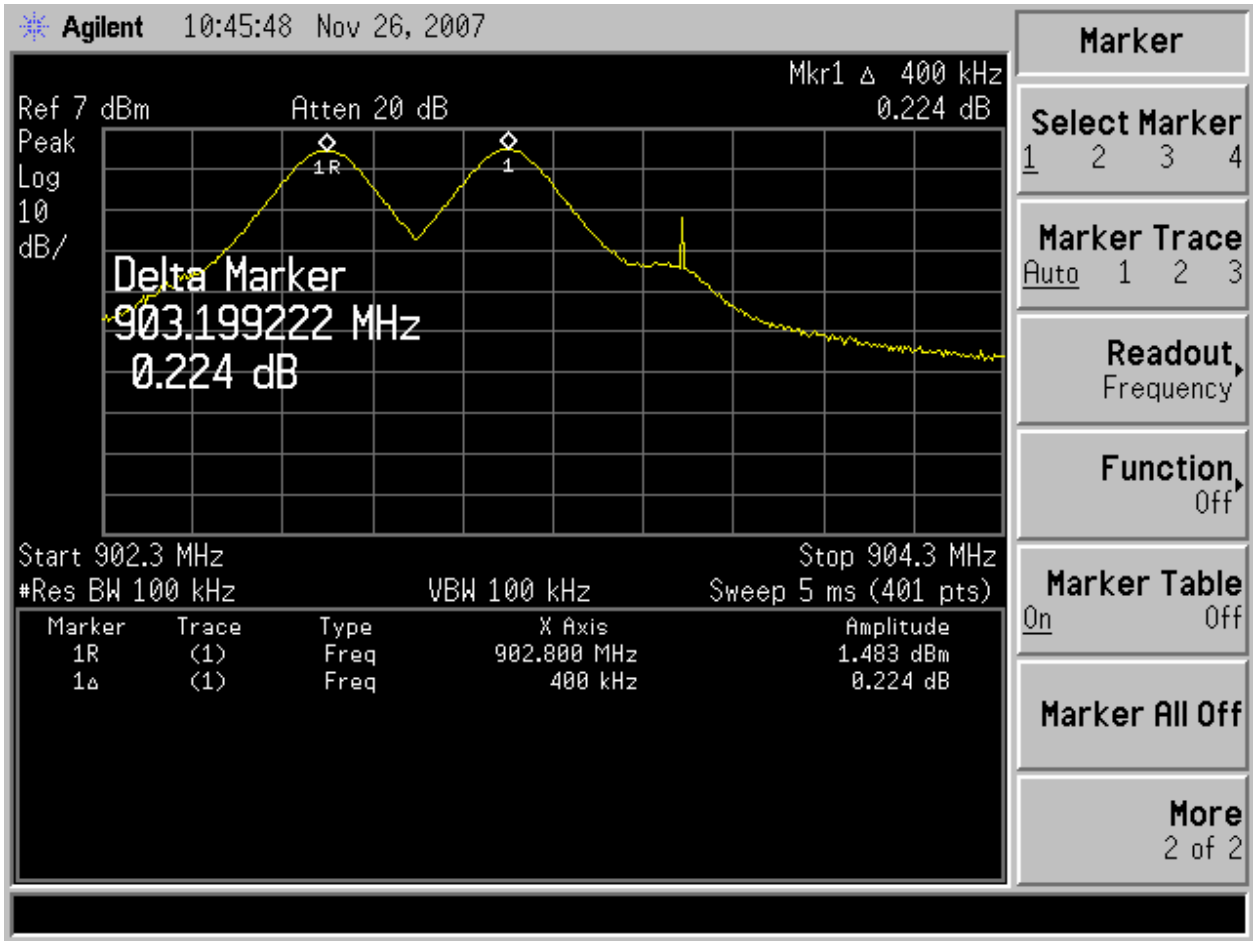



Figure 1 – Channel Separation

## *4.2 Pseudorandom Hopping Algorithm FCC Part 15.247(a)(1)*

The system shall hop to channel frequencies that are selected from a pseudorandomly ordered list of hopping frequencies. Each frequency must be used equally on average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their transmitters and shall shift frequencies in synchronization with the transmitted signals.

The pseudo-random hop table is used to determine the transmitter's frequency hop sequence. The transmitter is slow hopping frequency system where the entire data packet is sent on a single channel. After sending a data packet, the transmitter uses the next channel in the pseudo-random hop table. Each frequency in the hop table is used before the transmitter will hop to a frequency already used. The receiver is a single IF system whose bandwidth is 330 kHz. When not synchronized to a transmitting device, the receiver is constantly hopping across the 25 channels scanning for a valid preamble from a transmitter. Once a valid preamble is detected, the receiver is synchronized to the transmitter and receives the data packet. After the transmission, the receiver returns to the scanning mode where it can look for another packet from either the same device or a different device.

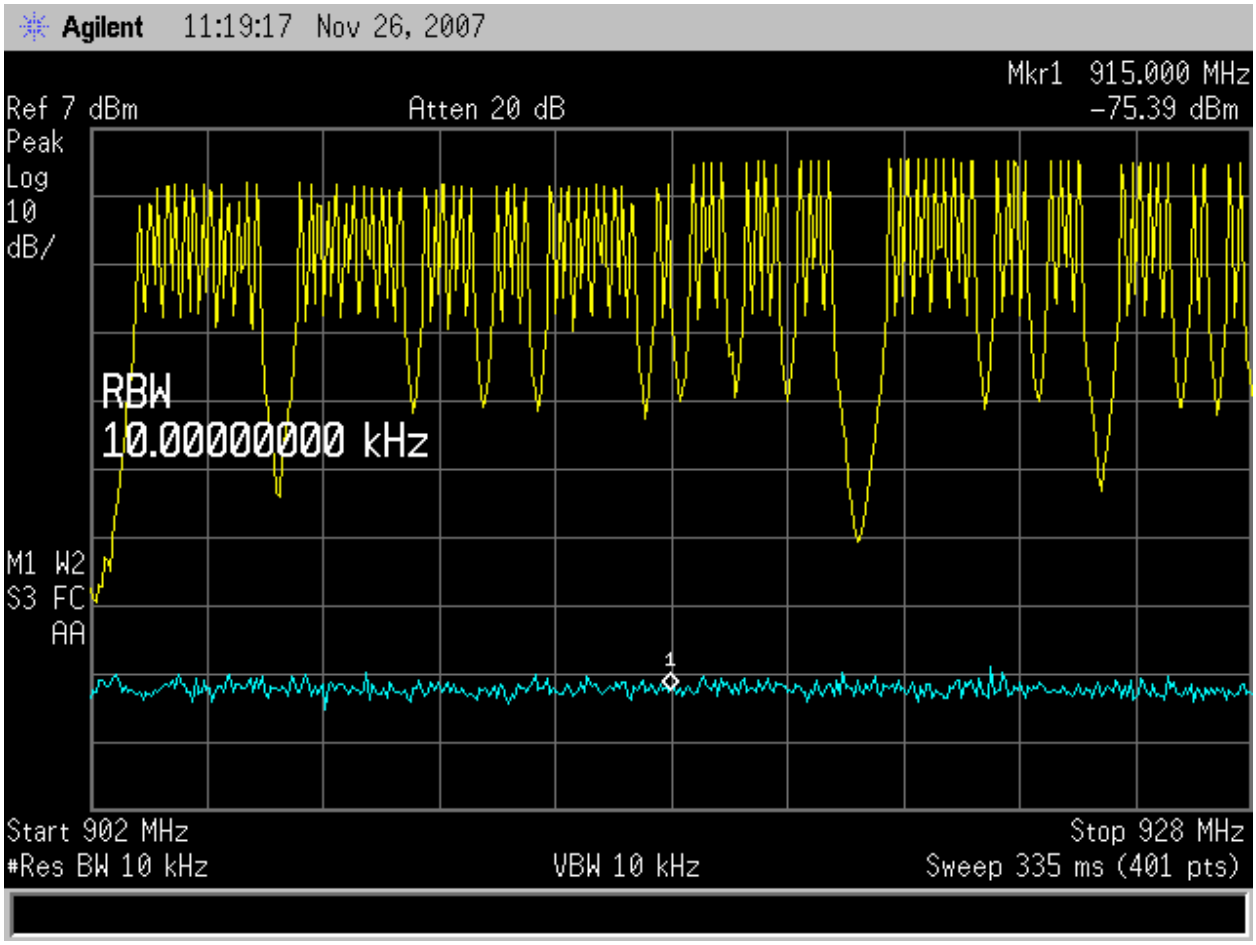



Figure 2 - Plot of available hopping Channels

Time of Occupancy FCC Part 15.247(a)(1)(i)

| Frequency Band (MHz) | 20 dB Bandwidth | Number of Hopping Channels | Average Time of Occupancy |
|---|---|---|---|
| 902.8-927.6 | =>250 kHz | 25 | =<0.4 sec. In 10 sec. |
| | | | |

The spectrum analyzer was set as follows:

RBW=1 MHz

VBW=RBW

Span=0Hz

LOG dB/div.= 10dB

Sweep = 10 Sec.

Trigger Video

The occupancy time was measured as above. There were 3 hops at .10125 seconds per hop for any 10 sec. Period. Time of occupancy equals number of hops multiplied by the duration of one hop.

**Time of Occupancy** = 0.304 seconds in any 10 second period.

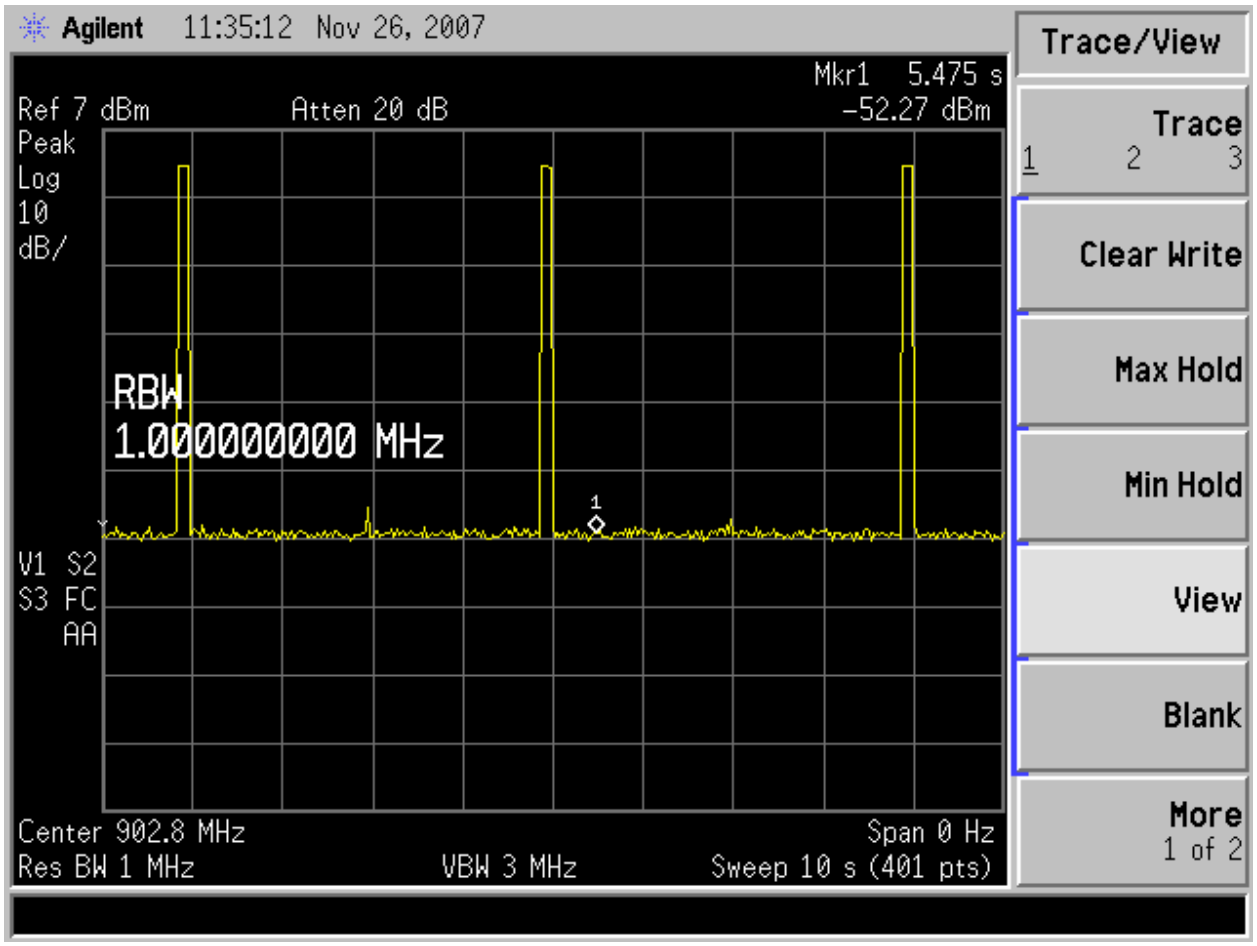



Figure 3 – 10 second sweep

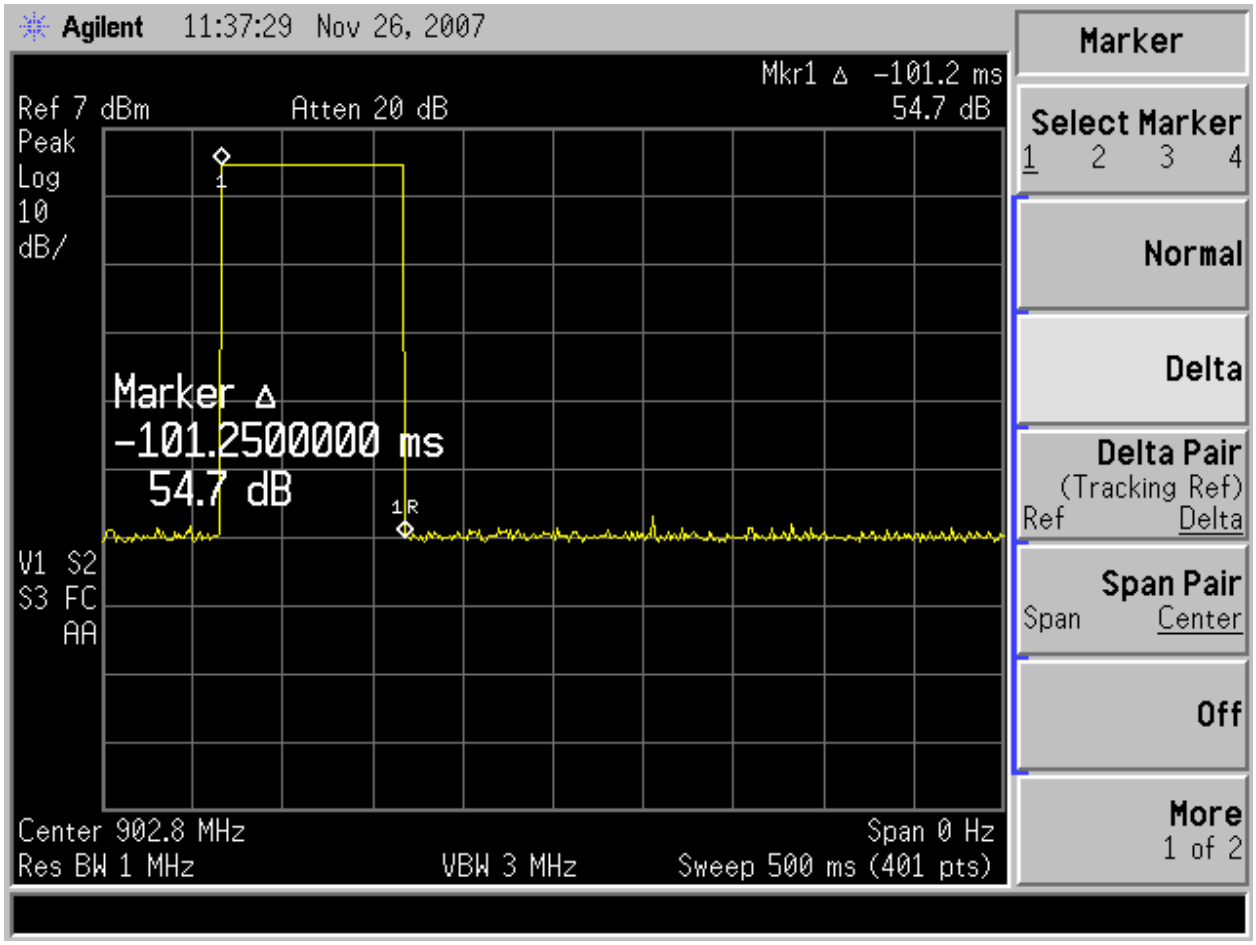



Figure 4 – Measurement of 1 hop

## *4.3 Occupied Bandwidth FCC Part 15.247(a)(1)(i)*

The maximum allowed 20 dB bandwidth of the hopping channel is 400 kHz.

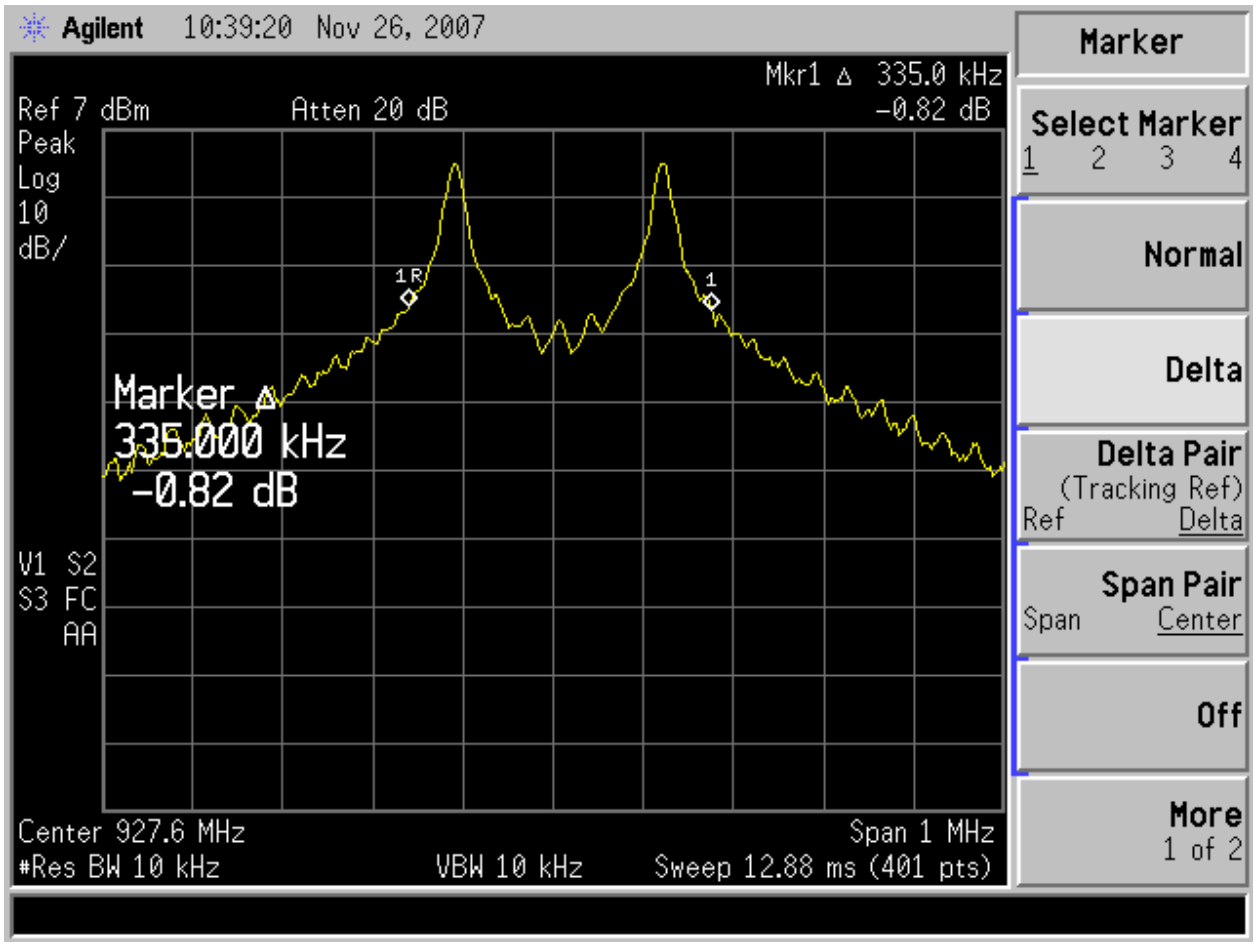



Figure 9 –927.6 MHz

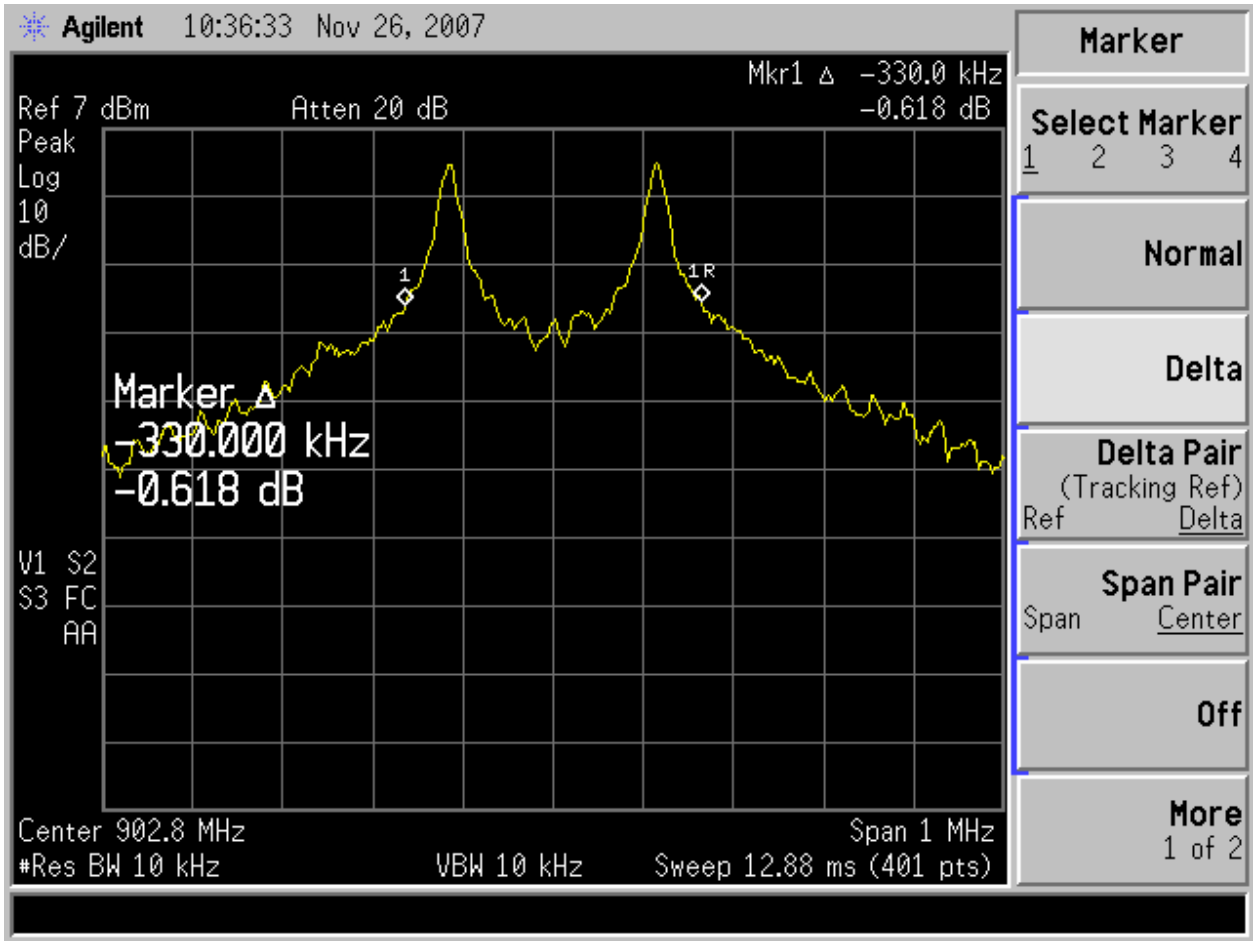



Figure 10 –902.8 MHz

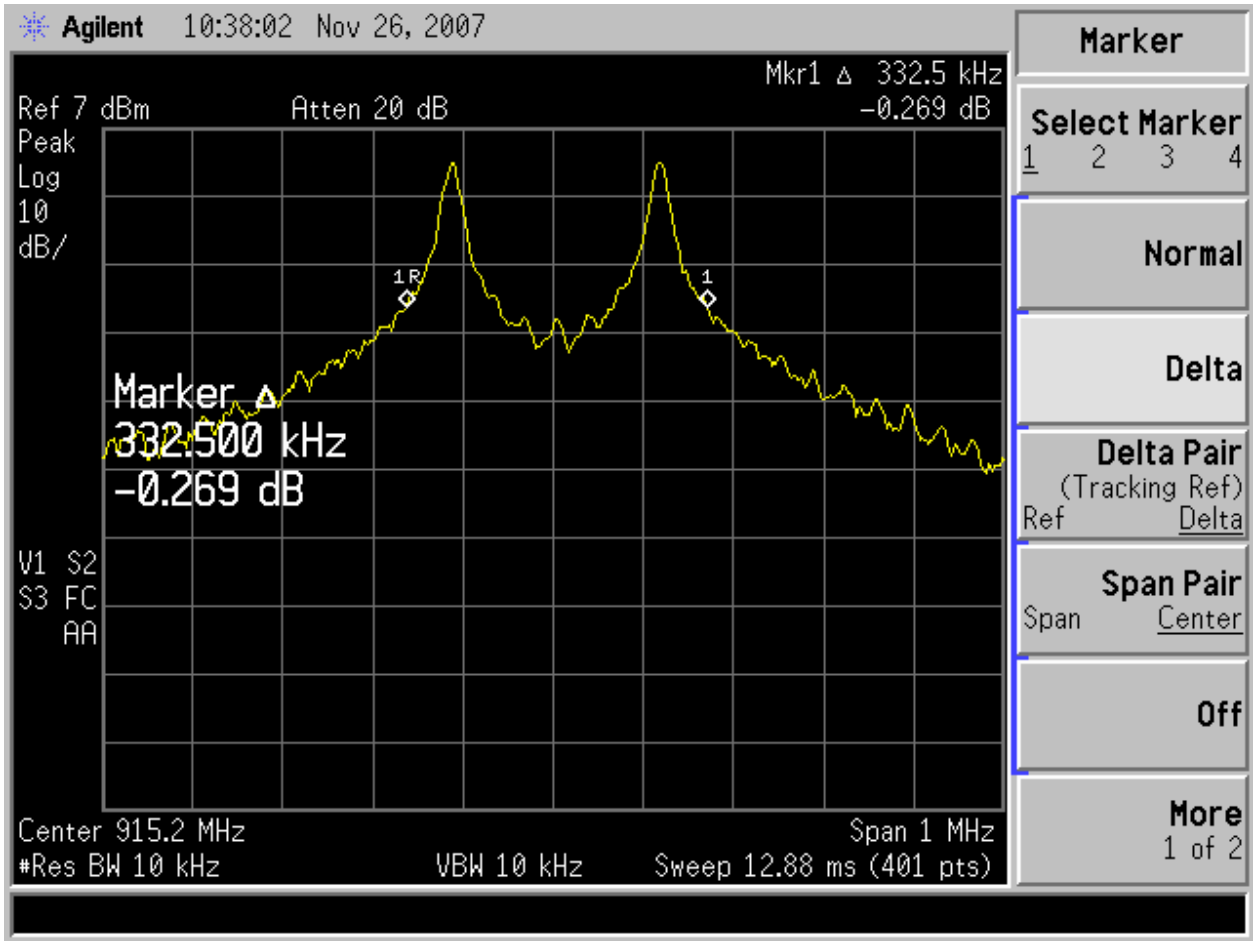



Figure 12 –915.2 MHz

## *4.4 Band Edge Compliance FCC Part 15.215(c)*

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

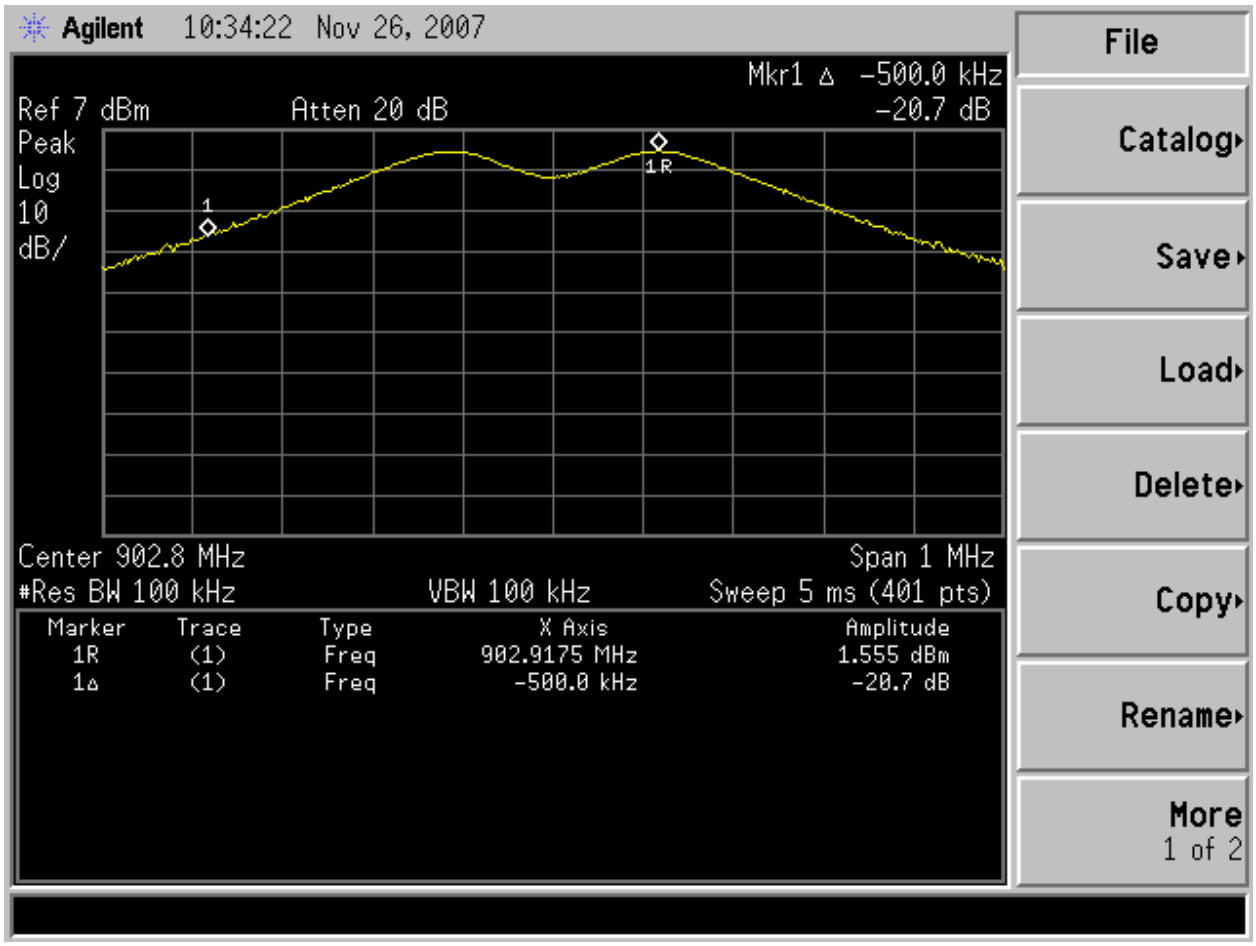



Figure 12 –902.8 MHz

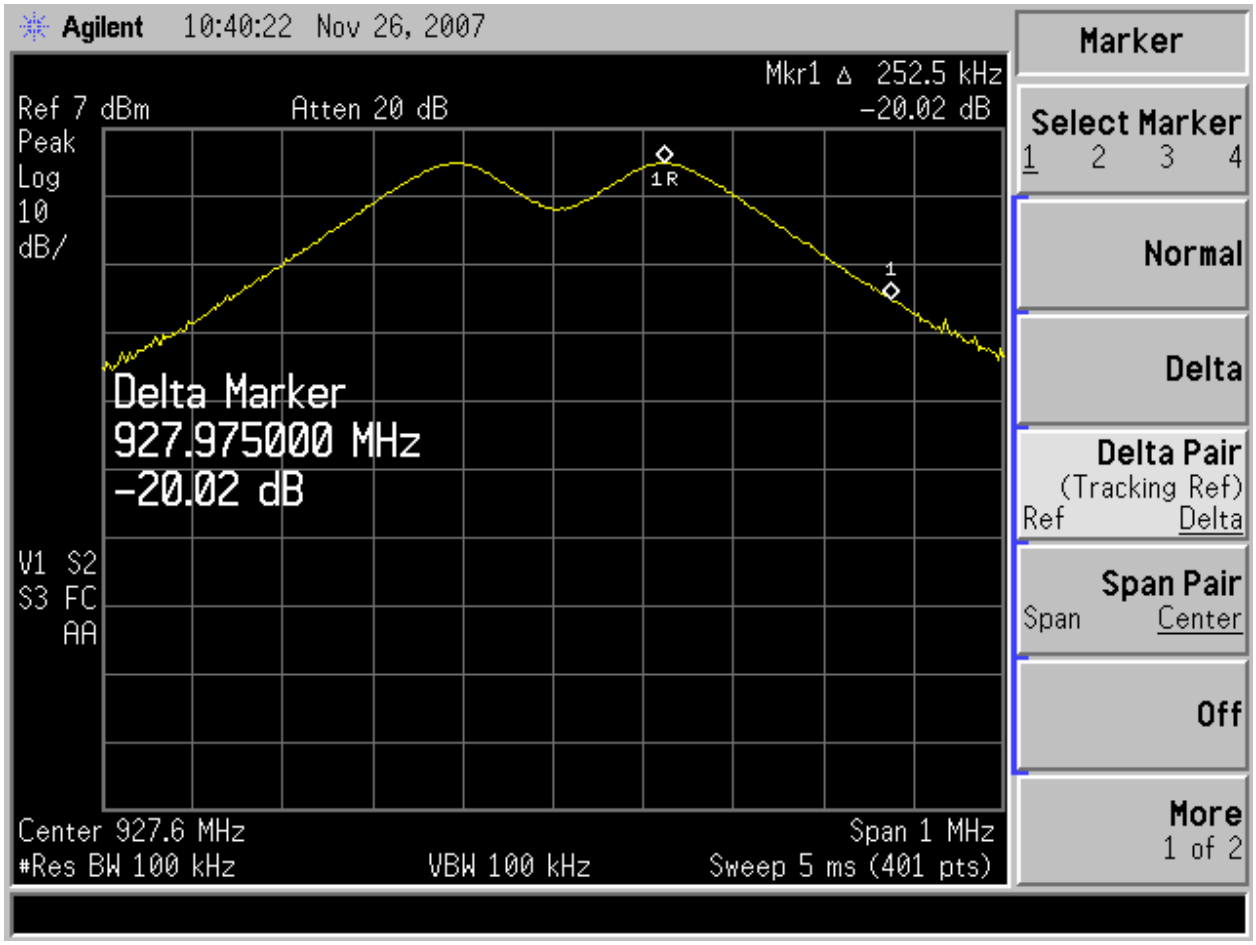



Figure 12 –927.6 MHz

## *4.5 Peak Output Power FCC Part 15.247(b)(2)*

The maximum peak output power of the intentional radiator shall not exceed 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels. (Conducted Measurement)

The measurement was made using a direct connection between the RF output of the EUT and the spectrum analyzer. After the measurement was made the cable loss and the attenuator was added to the measurement. The spectrum analyzer's resolution bandwidth was greater than the 20dB bandwidth of the modulated carrier and the video bandwidth was equal to the resolution bandwidth.

Test Setup


**Peak Power Output**

902.8 MHz = 0.18 Watts

915.2 MHz = 0.19 Watts

927.6 MHz = 0.18 Watts

### *4.6 Antenna*

The antenna is intergraded on the printed circuit board.

Antenna Gain is 2.53 dBi

# 5 Emissions

## *5.1 Radiated Emissions*

Testing was performed in accordance with 47 CFR 15, ANSI C63.4:2003, RSS-210 Issue 7. These test methods are listed under the laboratory's NVLAP Scope of Accreditation. This test measures the levels emanating from the EUT, thus evaluating the potential for the EUT to cause radio frequency interference to other electronic devices.

### 5.1.1 Test Methodology

#### *5.1.1.1 Preliminary Test*

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 300 kHz and provide a reading at each frequency for each 6° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

#### *5.1.1.2 Final Test*

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation. The six highest emissions relative to the limit were measured unless such emissions were more than 20 dB below the limit. If less than six emissions are within 20 dB of the limit, than the noise level of the receiver is measured at frequencies where emissions are expected. Multiples of all oscillator and microprocessor frequencies were also checked.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

#### *5.1.1.3 Deviations*

There were no deviations from this test methodology.

### 5.1.2 Test Results

Section 5.1.2.1 lists the final measurement data under the worst case operating modes, configurations, and/or cable positions. It also reflects the results including any modifications and/or special accessories listed in Sections 1.4 and 1.5.

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

#### *5.1.2.1 Final Data*

The data recorded in this section contains the final results under the worst-case conditions and with any modifications or special accessories implemented as the manufacturer intends.

## *5.2 Spurious Emissions FCC Part 15.247(c)*

### 5.2.1 Test Methodology

#### *5.2.1.1 Preliminary Test*

A test program that controls instrumentation and data logging was used to automate the preliminary RF emission test procedure. The frequency range of interest was divided into sub-ranges to yield a frequency resolution of approximately 300 kHz and provide a reading at each frequency for each 6° of turntable rotation. For each frequency sub-range the turntable was rotated 360° while peak emission data was recorded and plotted over the frequency range of interest in horizontal and vertical antenna polarization's.

Preliminary emission profile testing was performed inside the anechoic chamber. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the floor. The EUT was positioned as shown in the setup photographs. The receiving antenna was placed at a distance of 3m at a fixed height of 1m. Measurement equipment was located outside of the chamber. A video camera was placed inside the chamber to view the EUT.

#### *5.2.1.2 Final Test*

For each frequency measured, the peak emission was maximized by manipulating the receiving antenna from 1 to 4 meters above the ground plane and placing it at the position that produced the maximum signal strength reading. The turntable was then rotated through 360° while observing the peak signal and placing the EUT at the position that produced maximum radiation.

Final testing was performed on an NSA compliant test site. The EUT was placed on a 1.0m x 1.5m non-conductive table 80cm above the ground plane. The placement of EUT and cables were the same as for preliminary testing and is shown in the setup photographs.

#### *5.2.1.3 Deviations*

There were no deviations from this test methodology.

### 5.2.2 Test Results

As originally tested, the EUT was found to be compliant to the requirements of the test standard(s).

### *5.2.2.1 Radiated Emissions Outside the Frequency Band*

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of desired power, based on radiated measurements.

**SOP 1** Radiated Emissions

Tracking # 30762680.001 Page 1 of 5

| | | | |
|---|---|---|---|
| **EUT Name** | Energy Axis Gas Module | **Date** | 27 November 2007 |
| **EUT Model** | 5D25575 | **Temp / Hum in** | 72 deg. F / 44 %rh |
| **EUT Serial** | N/a | **Temp / Hum out** | N/A |
| **Standard** | FCC 47 CFR Part 15, RSS-210 Issue 7 | **Line DC** | 3.67 VDC |
| **Deg/sweep** | 12 deg. | **RBW / VBW** | 100KHz/100KHz |
| **Dist/Ant Used** | 3 meters 200MHz – 2GHz (CBL-6140A) | **Performed by** | Chris Eckert |
| **Configuration** | | | |

| Emission Freq (MHz) | ANT Polar (H/V) | ANT Pos (m) | Table Pos (deg) | FIM Value (dBuV) | Amp Gain (dB) | Cable Loss (dB) | ANT Factor (dB/m) | E-Field Value (dBuV/m) | 20dB Limit (dBuV/m) | Spec Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| 902.80 | H | 1.0 | 142 | 96.01 | 0.00 | 0.90 | 23.40 | 120.31 | | |
| 902.80 | V | 1.73 | 252 | 88.22 | 0.00 | 0.90 | 22.26 | 111.37 | | |
| 1806.00 | H | 2.13 | 85 | 43.44 | 35.87 | 5.82 | 26.81 | 40.19 | 100.31 | -60.12 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 915.20 | H | 1.0 | 149 | 95.19 | 0.00 | 0.92 | 23.51 | 119.62 | | |
| 915.20 | V | 1.82 | 70 | 91.05 | 0.00 | 0.92 | 22.60 | 114.57 | | |
| 1830.00 | H | 1.0 | 82 | 43.41 | 35.89 | 5.88 | 26.92 | 40.32 | 99.62 | -59.3 |
| 5491.00 | H | 1.7 | 167 | 41.27 | 35.17 | 9.33 | 34.29 | 49.72 | 99.62 | -49.9 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| 927.60 | H | 1.0 | 130 | 95.19 | 0.00 | 0.90 | 23.95 | 120.05 | | |
| 927.60 | V | 1.0 | 65 | 90.46 | 0.00 | 0.90 | 22.60 | 113.96 | | |
| 1855.00 | H | 1.0 | 111 | 44.15 | 35.98 | 5.94 | 27.03 | 41.14 | 100.05 | -58.91 |
| 9276.00 | H | 1.0 | 5 | 38.30 | 35.81 | 14.24 | 37.66 | 54.39 | 100.05 | -45.66 |
| | | | | | | | | | | |
| | | | | | | | | | | |

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor $\pm$ Uncertainty

Combined Standard Uncertainty $u_c(y) = \pm 1.6$dB Expanded Uncertainty $U = ku_c(y)$ $k = 2$ for 95% confidence

Notes:
RBW/VBW = 100KHz/100KHz

### *5.2.2.2 Restricted band measurements*

Radiated emissions which fall in the restricted bands, as defined in 15.205(a), must also comply with the radiated emission limits specified in 15.209(a) (see 15.205(c)).

**SOP 1** Radiated Emissions — Tracking # 30762680.001 Page 1 of 3

| | | | |
|---|---|---|---|
| **EUT Name** | Energy Axis Gas Module | **Date** | 27 November 2007 |
| **EUT Model** | 5D25575 | **Temp / Hum in** | 72 deg. F / 44 %rh |
| **EUT Serial** | N/a | **Temp / Hum out** | N/A |
| **Standard** | FCC 47 CFR Part 15, RSS-210 Issue 7 | **Line DC** | 3.67 VDC |
| **Deg/sweep** | 12 deg. | **RBW / VBW** | 1 MHz / 1 MHz |
| **Dist/Ant Used** | 3 meters 200MHz – 2GHz (CBL-6140A) | **Performed by** | Chris Eckert |
| **Configuration** | 902.8 MHz | | |

| Emission Freq (MHz) | ANT Polar (H/V) | ANT Pos (m) | Table Pos (deg) | FIM Value (dBuV) | Amp Gain (dB) | Cable Loss (dB) | ANT Factor (dB/m) | E-Field Value (dBuV/m) | Spec Limit (dBuV/m) | Spec Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Peak** | | | | | | | | | | |
| 2708.00 | V | 1.0 | 341 | 44.75 | 36.05 | 7.60 | 29.21 | 45.51 | 74.00 | -28.49 |
| 3611.00 | H | 1.97 | 356 | 52.23 | 35.39 | 8.49 | 31.82 | 57.15 | 74.00 | -16.85 |
| 4514.00 | V | 1.08 | 178 | 44.71 | 35.85 | 9.06 | 32.63 | 50.55 | 74.00 | -23.45 |
| 5417.00 | H | 1.42 | 29 | 44.26 | 35.22 | 9.58 | 34.17 | 52.79 | 74.00 | -21.21 |
| **Average** | | | | | | | | | | |
| 2708.00 | V | 1.0 | 341 | 36.34 | 36.05 | 7.60 | 29.21 | 37.10 | 54.00 | -16.90 |
| 3611.00 | H | 1.97 | 356 | 47.09 | 35.39 | 8.49 | 31.82 | 52.01 | 54.00 | -1.99 |
| 4514.00 | V | 1.08 | 178 | 36.78 | 35.85 | 9.06 | 32.63 | 42.62 | 54.00 | -11.38 |
| 5417.00 | H | 1.42 | 29 | 36.58 | 35.22 | 9.58 | 34.17 | 45.11 | 54.00 | -8.89 |

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ $k$ = 2 for 95% confidence

Notes: RBW/VBW = 1MHz/1MHz For frequencies between 1GHz and 10 GHz

**SOP 1** Radiated Emissions

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| | | | |
|---|---|---|---|
| **EUT Name** | Energy Axis Gas Module | **Date** | 27 November 2007 |
| **EUT Model** | 5D25575 | **Temp / Hum in** | 72 deg. F / 44 %rh |
| **EUT Serial** | N/a | **Temp / Hum out** | N/A |
| **Standard** | FCC 47 CFR Part 15, RSS-210 Issue 7 | **Line DC** | 3.67 VDC |
| **Deg/sweep** | 12 deg. | **RBW / VBW** | 1 MHz / 1 MHz |
| **Dist/Ant Used** | 3 meters 200MHz – 2GHz (CBL-6140A) | **Performed by** | Chris Eckert |
| **Configuration** | 915.2 MHz | | |

| Emission Freq (MHz) | ANT Polar (H/V) | ANT Pos (m) | Table Pos (deg) | FIM Value (dBuV) | Amp Gain (dB) | Cable Loss (dB) | ANT Factor (dB/m) | E-Field Value (dBuV/m) | Spec Limit (dBuV/m) | Spec Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Peak** | | | | | | | | | | |
| 2746.00 | H | 2.55 | 107 | 49.37 | 36.22 | 7.67 | 29.79 | 50.60 | 74.00 | -23.40 |
| 3661.00 | H | 2.29 | 200 | 46.00 | 35.59 | 8.52 | 31.92 | 50.85 | 74.00 | -23.15 |
| 4575.00 | V | 1.39 | 340 | 41.02 | 35.79 | 10.06 | 32.73 | 48.03 | 74.00 | -25.97 |
| 7322.00 | H | 1.56 | 116 | 43.44 | 35.32 | 12.11 | 36.41 | 56.64 | 74.00 | -17.36 |
| **Average** | | | | | | | | | | |
| 2746.00 | H | 2.55 | 107 | 43.84 | 36.22 | 7.67 | 29.79 | 45.07 | 54.00 | -8.93 |
| 3661.00 | H | 2.29 | 200 | 38.64 | 35.59 | 8.52 | 31.92 | 43.49 | 54.00 | -10.51 |
| 4575.00 | V | 1.39 | 340 | 30.88 | 35.79 | 10.06 | 32.73 | 37.89 | 54.00 | -16.11 |
| 7322.00 | H | 156 | 116 | 33.66 | 35.32 | 12.11 | 36.41 | 46.86 | 54.00 | -7.14 |

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ $k$ = 2 for 95% confidence

Notes: RBW/VBW = 1MHz/1MHz For frequencies between 1GHz and 10 GHz

**SOP 1** Radiated Emissions

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| | | | |
|---|---|---|---|
| **EUT Name** | Energy Axis Gas Module | **Date** | 27 November 2007 |
| **EUT Model** | 5D25575 | **Temp / Hum in** | 72 deg. F / 44 %rh |
| **EUT Serial** | N/a | **Temp / Hum out** | N/A |
| **Standard** | FCC 47 CFR Part 15, RSS-210 Issue 7 | **Line DC** | 3.67 VDC |
| **Deg/sweep** | 12 deg. | **RBW / VBW** | 1 MHz / 1 MHz |
| **Dist/Ant Used** | 3 meters 200MHz – 2GHz (CBL-6140A) | **Performed by** | Chris Eckert |
| **Configuration** | 927.6 MHz | | |

| Emission Freq (MHz) | ANT Polar (H/V) | ANT Pos (m) | Table Pos (deg) | FIM Value (dBuV) | Amp Gain (dB) | Cable Loss (dB) | ANT Factor (dB/m) | E-Field Value (dBuV/m) | Spec Limit (dBuV/m) | Spec Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Peak** | | | | | | | | | | |
| 2783.00 | V | 1.0 | 331 | 48.25 | 36.60 | 7.59 | 29.46 | 48.71 | 74.00 | -25.29 |
| 3710.00 | V | 1.59 | 173 | 45.58 | 35.46 | 8.59 | 31.89 | 50.59 | 74.00 | -23.41 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| **Average** | | | | | | | | | | |
| 2783.00 | V | 1.0 | 331 | 41.78 | 36.60 | 7.59 | 29.46 | 42.24 | 54.00 | -11.76 |
| 3710.00 | V | 1.59 | 173 | 37.45 | 35.46 | 8.59 | 31.89 | 42.46 | 54.00 | -11.54 |
| | | | | | | | | | | |
| | | | | | | | | | | |

Spec Margin = E-Field Value - Limit, E-Field Value = FIM Value - Amp Gain + Cable Loss + ANT Factor ± Uncertainty

Combined Standard Uncertainty $u_c(y)$ = ± 1.6dB Expanded Uncertainty $U = ku_c(y)$ $k$ = 2 for 95% confidence

Notes: RBW/VBW = 1MHz/1MHz For frequencies between 1GHz and 10 GHz

## *5.3 Frequency Stability FCC Part 15.215(c)*

The requirement to contain the 20 dB bandwidth of the emission within the specified frequency band includes effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage.

Spectrum Analyzer Parameters:

RBW=30KHz

VBW=RBW

Span=1MHz

LOG dB/div.= 10dB

Sweep = 9.167 mS

Trigger Video

### 5.3.1 Containment of the Emission during Variations in Temperature

The EUT was placed in an environmental temperature test chamber, supplied with the normal AC voltage, and with an antenna attached to the output port. If the antenna is an adjustable length antenna, it will be fully extended. The monitoring device (ie. Spectrum analyzer) was then attached to a receive antenna placed 15 cm away from the EUT via coaxial cable.

The temperature inside the chamber is then raised to the highest temperature specified and allowed sufficient time for the temperature of the chamber to stabilize. While maintaining a constant temperature inside the environmental chamber, the carrier signal was then measured 40 min after temperature stabilization. Then the above process is repeated for the lowest temperature specified and 10 degree Centigrade increments between the extremes thereafter.

**Results**

(Modulated) 902.8 MHz

| Temperature | Frequency in MHz measured 20dB below peak at the bandedges | | Permitted Band Edge in MHz | Results |
|---|---|---|---|---|
| -30˚ C | 902.425 | | 902 - 928 | Pass |
| -20˚ C | 902.415 | | 902 - 928 | Pass |
| -10˚ C | 902.44 | | 902 - 928 | Pass |
| 0˚ C | 902.4325 | | 902 - 928 | Pass |
| 10˚ C | 902.432 | | 902 - 928 | Pass |
| 20˚ C | 902.432 | | 902 - 928 | Pass |
| 30˚ C | 902.415 | | 902 - 928 | Pass |
| 40˚ C | 902.415 | | 902 - 928 | Pass |
| 50˚ C | 902.400 | | 902 - 928 | Pass |
| 60˚ C | 902.3975 | | 902 - 928 | Pass |
| 70˚ C | 902.400 | | 902 - 928 | Pass |

(Modulated) 927.6 MHz

| Temperature | Frequency in MHz measured 20dB below peak at the bandedges | | Permitted Band Edge in MHz | Results |
|---|---|---|---|---|
| -30˚ C | 927.985 | | 902 - 928 | Pass |
| -20˚ C | 927.9825 | | 902 - 928 | Pass |
| -10˚ C | 927.9875 | | 902 - 928 | Pass |
| 0˚ C | 927.9875 | | 902 - 928 | Pass |
| 10˚ C | 927.9875 | | 902 - 928 | Pass |
| 20˚ C | 927.9875 | | 902 - 928 | Pass |
| 30˚ C | 927.985 | | 902 - 928 | Pass |
| 40˚ C | 927.985 | | 902 - 928 | Pass |
| 50˚ C | 927.9775 | | 902 - 928 | Pass |
| 60˚ C | 927.98 | | 902 - 928 | Pass |
| 70˚ C | 927.98 | | 902 - 928 | Pass |

### 5.3.2 Containment of the Emission during Variations in Voltage

The setup was identical section 4.7.1 except the temperature inside of the chamber was set to 20 deg. C.

(Modulated)

| Voltage | Frequency in MHz measured 20dB below peak | | Permitted Band Edge in MHz | Results |
|---|---|---|---|---|
| New Battery | 902.432 | 902.762 | 902 - 928 | Pass |
| | | | | |

927.6 MHz (Modulated)

| Temperature | Frequency in MHz measured 20dB below peak | | Permitted Band Edge in MHz | Results |
|---|---|---|---|---|
| New Battery | 927.6525 | 927.9875 | 902 - 928 | Pass |
| | | | | |

Spectrum Analyzer Parameters:

RBW=100kHz

VBW=RBW

Span=100kHz

LOG dB/div.= 10dB

Sweep = 5 mS

Trigger Video

## *5.4 Conducted Emissions per FCC Part 15.207*

The device is powered with an internal battery, therefore this test is not applicable.

# 6 Test Equipment Use List

### *Test Equipment use list*

| Equipment | Manufacturer | Model # | Serial/Inst # | Last Cal dd/mm/yy | Next Cal dd/mm/yy |
|---|---|---|---|---|---|
| SOP 1 - Radiated Emissions (5 Meter Chamber) | | | | | |
| Amplifier, preamp | Agilent Technologies | 8449B | 3008A01480 | 10-Oct-2007 | 10-Oct-2008 |
| Amplifier, preamp | Hewlett Packard | 8447D | 2944A10139 | 08-Oct-2007 | 08-Oct-2008 |
| Ant. BiconiLog | EMCO | 3142 | 1006 | 2-May-2006 | 2-May2008 |
| Antenna Horn 1-18GHz | EMCO | 3115 | 2236 | 25-Jan-2007 | 25-Jan-2009 |
| Ant. BiconiLog | Chase | CBL6140A | 1108 | 16-May-2006 | 16-May-2008 |
| Receiver, EMI | Rohde & Schwarz | ESIB40 | 100043 | 12-Jul-2007 | 12-Jul-2008 |
| Spectrum Analyzer | Agilent Tec. | E7405A | US39440161 | 29-Jun-2007 | 29-Jun-2008 |
| Cable, Coax | Andrew | FSJ1-50A | 036 | 14-Mar-2007 | 14-Mar-2008 |
| Cable, Coax | Andrew | FSJ1-50A | 030 | 1-Nov-2007 | 1-Nov-2008 |
| Cable, Coax | Andrew | FSJ1-50A | 045 | 24-Jan-2007 | 24-Jan-2008 |
| | | | | | |
| | | | | | |
| SOP 2 - Conducted Emissions (AC/DC) | | | | | |
| LISN (6) 50mH/50Ω | Solar Electronics | 8028-50-TS-24 | 990442 | 08-Oct-2007 | 08-Oct-2008 |
| LISN (7) 50mH/50Ω | Solar Electronics | 8028-50-TS-24 | 990443 | 08-Oct-2007 | 08-Oct-2008 |
| Spectrum Analyzer[1] | Agilent Tec. | E7405A | US39440161 | 29-Jun-2007 | 29-Jun-2008 |
| Cable, Coax | Belden | RG-213 | 004 | 9-Oct-2007 | 9-Oct-2008 |
| | | | | | |
| | | | | | |
| | | | | | |

- Calibration of equipment past due for re-calibration will be performed expeditiously. If any equipment is found to be out of tolerance at that time, affected customers will be notified accordingly.