

# EMC Test Report

**Project Number:** 3101838

**Report Number:** 3101838EMC01

**Revision Level:** 1

**Client:** Radio Systems

**Equipment Under Test:** Invisible Fence pet containment unit

**Model Name:** Invisible Fence GPS Base

**Model Number:** RIG00-13727

**Applicable Standards:** FCC Part 95J

**Report issued on:** 12 June 2013

**Test Result:** Compliant

Tested by:



Brian Forster  
EMC Engineer

Reviewed by:



David Schramm  
EMC Manager

**Remarks:**

This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or Testing done by SGS International Electrical Approvals in connection with distribution or use of the product described in this report must be approved by SGS international Electrical Approvals in writing.

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## 1 Summary of Test Results

| Basic Standards  |                             | Test Result |
|--|-----------------------------|-------------|
| <b>Emissions Testing</b>                                   |                             |             |
| Radiated Spurious Emissions                                | Part 2.1053                 | Compliant   |
| Conducted Spurious Emissions                               | Part 2.1051 and 95.635      | Compliant   |
| Occupied Bandwidth   | Part 2.1049 and 95.633      | Compliant   |
| 95J Emissions Mask   | Part 2.1051                 | Compliant   |
| Output Power   | Part 2.1046 and 95.639(h)   | Compliant   |
| Radiated Power: ERP  |                             | Reported    |
| Frequency Stability over Temperature and Voltage Variation | Part 2.1055 and Part 95.632 | Compliant   |

### 1.1 Modifications Required to Compliance

None

## 2 General Information

### 2.1 Client Information

Name: Radio Systems  
 Address: 10427 Petsafe Way  
 City, State, Zip, Country: Knoxville TN 37932

### 2.2 Test Laboratory

Name: SGS North America, Inc.  
 Address: 620 Old Peachtree Road NW, Suite 100  
 City, State, Zip, Country: Suwanee, GA 30024, USA

### 2.3 General Information of EUT

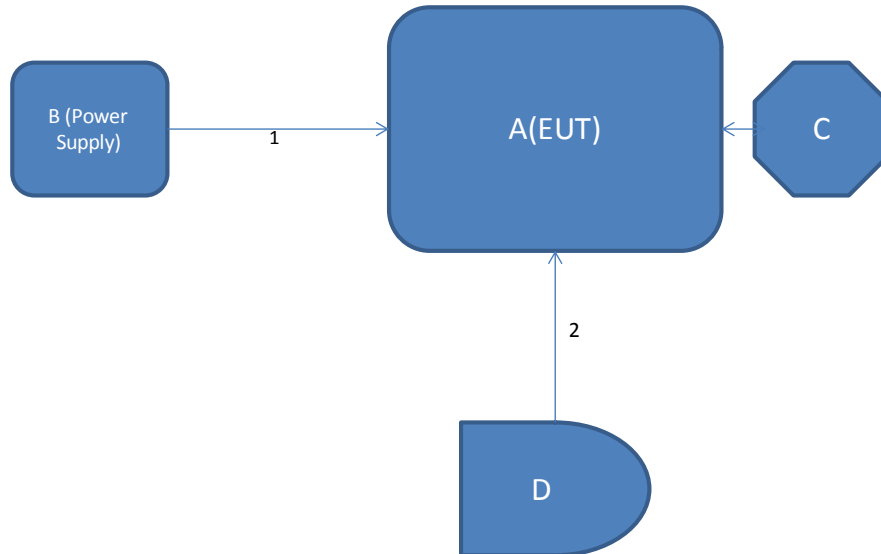
Model Name: GPSC Base Reference Unit  
 Model Number: RIG00-13727  
 Hardware Version: 00  
 Software Version: V0.406  
 Rated Voltage: 120VAC 60Hz  
 Test Voltage: 120VAC 60Hz

Sample Received Date: 20MAR2013  
 Dates of testing: 27MAR to 03APR2013

### 2.4 Operating Modes and Conditions

The EUT was programmed by the manufacturer to run continuously exercising all modes of operation.

## 2.5 EUT Connection Block Diagram



## 2.6 System Configurations

| Device reference | Manufacturer  | Description      | Model Number     | Serial Number |
|------------------|---------------|------------------|------------------|---------------|
| A                | Radio Systems | EUT              | RIG00-13727      | NA            |
| B                | Radio Systems | EUT Power supply | SPS-02C5-0.75-US | NA            |
| C                | Radio Systems | EUT MURS Antenna | 100-1130 Rev0    | NA            |
| D                | Radio Systems | GPS Antenna      | NA               | NA            |

## 2.7 Cable List

| Cable reference | Port Name   | Start       | End | Cable Length (m) | Ferrite installed? | Shielded? |
|-----------------|-------------|-------------|-----|------------------|--------------------|-----------|
| 1               | DC Power    | AC Mains    | EUT | 1.9              | N                  | N         |
| 2               | GPS Receive | GPS Antenna | EUT | 4.86             | N                  | Y         |

### 3 Field strength of spurious radiation

#### 3.1 Test Result

| Test Description                     | Basic Standards                                       | Test Result |
|--------------------------------------|---|-------------|
| Field strength of spurious radiation | FCC Part 2.1053<br>FCC Part 95, Subpart J<br>TIA-603C | Compliant   |

#### 3.2 Test Method

The EUT was set to operate at maximum power with the antenna port fitted with a 50 ohm non-radiating load. The initial preliminary exploratory scans were performed from 30 MHz to 2GHz using the max hold function and incorporating a Peak detector and using TILE! software. The final test data was measured using a Quasi-Peak detector below 1GHz and a Peak and Average detector above 1GHz. The receiver's resolution bandwidth was set to 120 kHz for measurements taken in the 30MHz to 1GHz frequency range and 1MHz for measurements for 1GHz and higher. Measurements were made with the antenna positioned in both the horizontal and vertical planes of polarization. The antenna height was varied from 1 m to 4 m and the EUT was rotated 360° to find the maximum emitting point for each frequency. The radiated measurements were recorded and compared to the limits indicated below.

Radiated emissions limit is defined outside the fundamental frequency by more than 12.5 kHz as being attenuated from the highest emission by  $50 + 10\log(P)$ ; which is -20 dBm, which was converted to a field strength measurement limit of 75.2 dBµV at 3m. Any emissions within 20 dB of the limit were measured using the substitution method.

#### 3.3 Test Site

3m Absorber Lined Shielded Enclosure (ALSE), Suwanee, GA

##### Environmental Conditions

Temperature: 22.7 °C  
Relative Humidity: 51.0 %  
Atmospheric Pressure: 101.5 kPa

#### 3.4 Test Equipment

Test Start Date: 3/28/2013

Tested By: BKF

Test End Date: 3/28/2013

| Equipment         | Model        | Manufacturer | Asset Number | Cal Due Date |
|-------------------|--------------|--------------|--------------|--------------|
| BiLog Antenna     | JB6          | Sunol        | B079690      | 12-Sep-13    |
| Spectrum Analyzer | ZVL          | R & S        | B09799       | 24-Sep-13    |
| Coaxial Cable     | Sucoflex 106 | Huber+Suhner | B079714      | 13-Aug-13    |
| Coaxial Cable     | Sucoflex 106 | Huber+Suhner | B079661      | 13-Aug-13    |

Note: The calibration period equipment is 1 year.

##### Software:

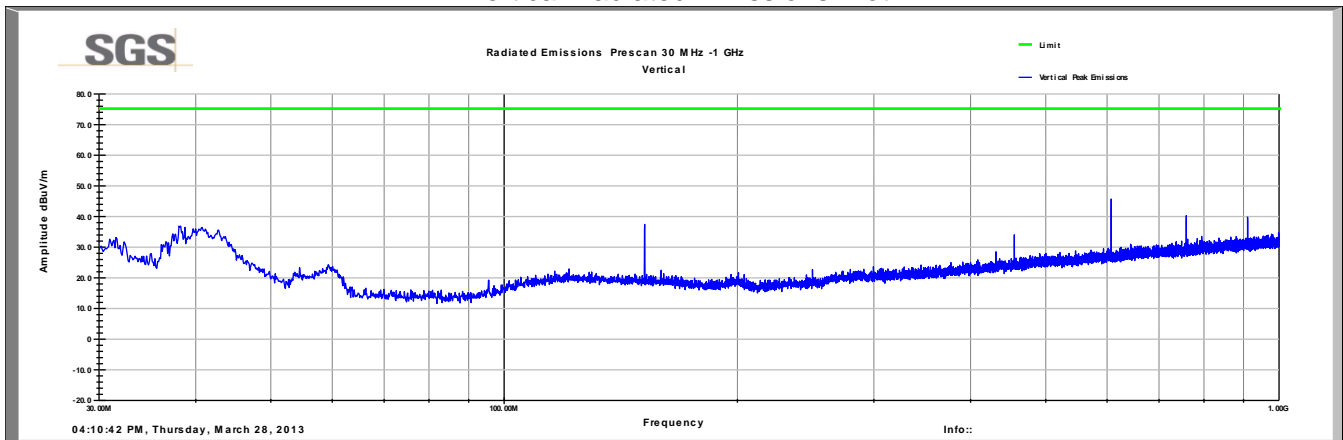
"Radiated Emissions" TILE! profile dated 28MAR2013

### 3.5 Test Setup Photographs

Photographs are contained in a separate exhibit

### 3.6 Test Data

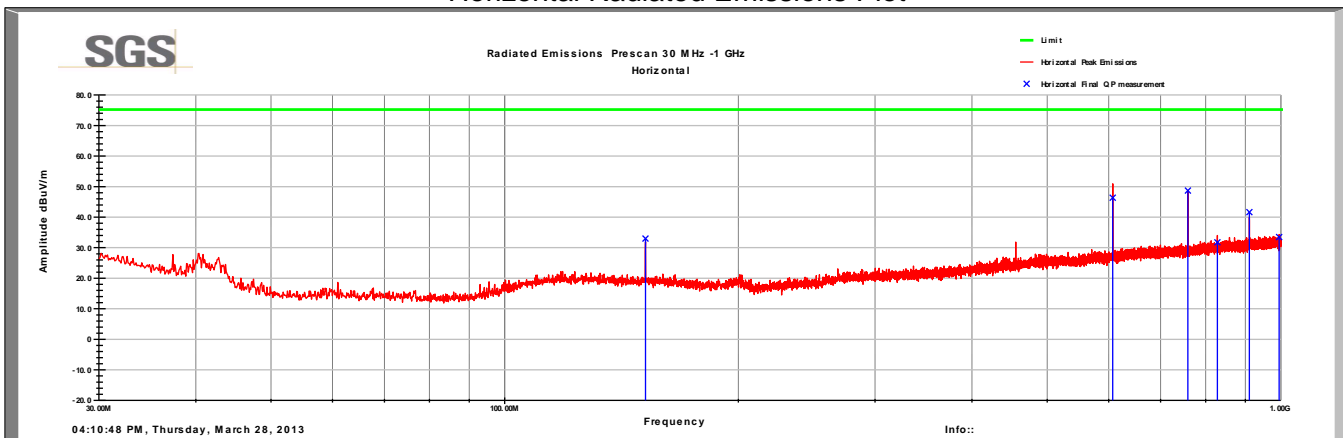
30 – 1000 MHz  
Vertical Radiated Emissions Plot



Vertical Radiated Emissions Data

| Frequency MHz | Raw QP dBuV | Polarity (V/H) | Azimuth (degrees) | Height (cm) | AF (dB/m) | CL (dB) | Amp (dB) | QP Value (dBuV/m) | Limit (dBuV/m) | Margin (dB) |
|---------------|-------------|----------------|-------------------|-------------|-----------|---------|----------|-------------------|----------------|-------------|
| 38.31         | 17.7        | V              | 163.0             | 100.0       | 14.8      | 0.5     | 0.0      | 33.0              | 75.2           | -42.2       |
| 40.68         | 21.1        | V              | 142.0             | 100.0       | 13.0      | 0.5     | 0.0      | 34.5              | 75.2           | -40.7       |
| 151.82        | 25.0        | V              | 125.0             | 100.0       | 12.7      | 0.9     | 0.0      | 38.7              | 75.2           | -36.5       |
| 607.27        | 24.3        | V              | 177.0             | 100.0       | 19.1      | 1.9     | 0.0      | 45.3              | 75.2           | -29.9       |
| 759.10        | 14.5        | V              | 192.0             | 100.0       | 21.0      | 2.1     | 0.0      | 37.7              | 75.2           | -37.5       |
| 910.91        | 12.7        | V              | 102.0             | 100.0       | 22.7      | 2.4     | 0.0      | 37.8              | 75.2           | -37.4       |

30 – 1000 MHz  
Horizontal Radiated Emissions Plot

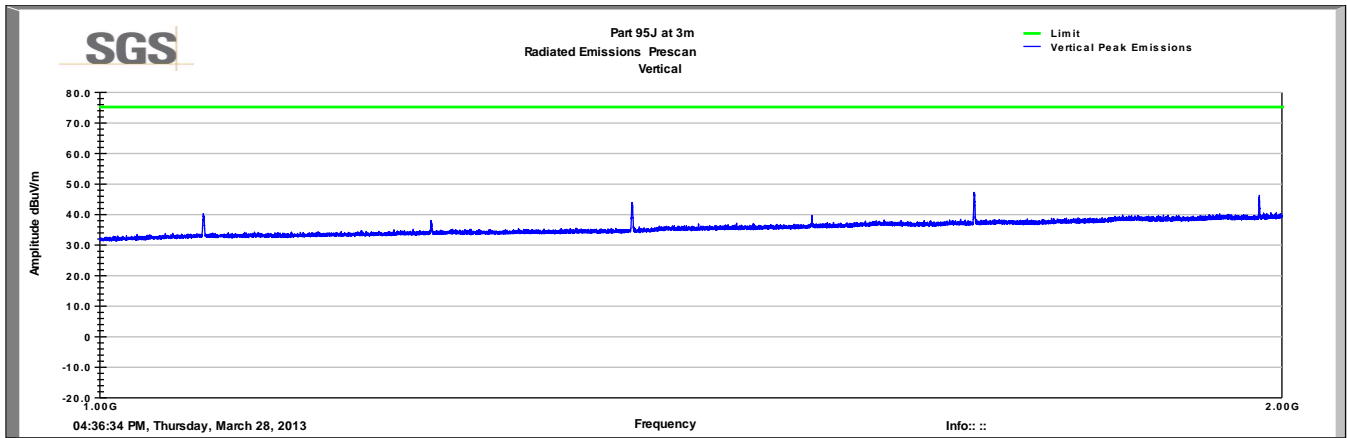


Horizontal Radiated Emissions Data

| Frequency<br>MHz | Raw QP<br>dBuV | Polarity<br>(V/H) | Azimuth<br>(degrees) | Height<br>(cm) | AF<br>(dB/m) | CL<br>(dB) | Amp<br>(dB) | QP Value<br>(dBuV/m) | Limit<br>(dBuV/m) | Margin<br>(dB) |
|------------------|----------------|-------------------|----------------------|----------------|--------------|------------|-------------|----------------------|-------------------|----------------|
| 151.82           | 19.3           | H                 | 198.0                | 100.0          | 12.7         | 0.9        | 0.0         | 33.0                 | 75.2              | -42.2          |
| 607.27           | 25.3           | H                 | 211.0                | 100.0          | 19.1         | 1.9        | 0.0         | 46.3                 | 75.2              | -28.9          |
| 759.10           | 25.5           | H                 | 115.0                | 100.0          | 21.0         | 2.1        | 0.0         | 48.7                 | 75.2              | -26.5          |
| 828.32           | 7.6            | H                 | 126.0                | 100.0          | 21.9         | 2.2        | 0.0         | 31.7                 | 75.2              | -43.5          |
| 910.91           | 16.5           | H                 | 141.0                | 100.0          | 22.7         | 2.4        | 0.0         | 41.6                 | 75.2              | -33.6          |
| 995.10           | 7.8            | H                 | 196.0                | 100.0          | 23.2         | 2.5        | 0.0         | 33.5                 | 75.2              | -41.7          |

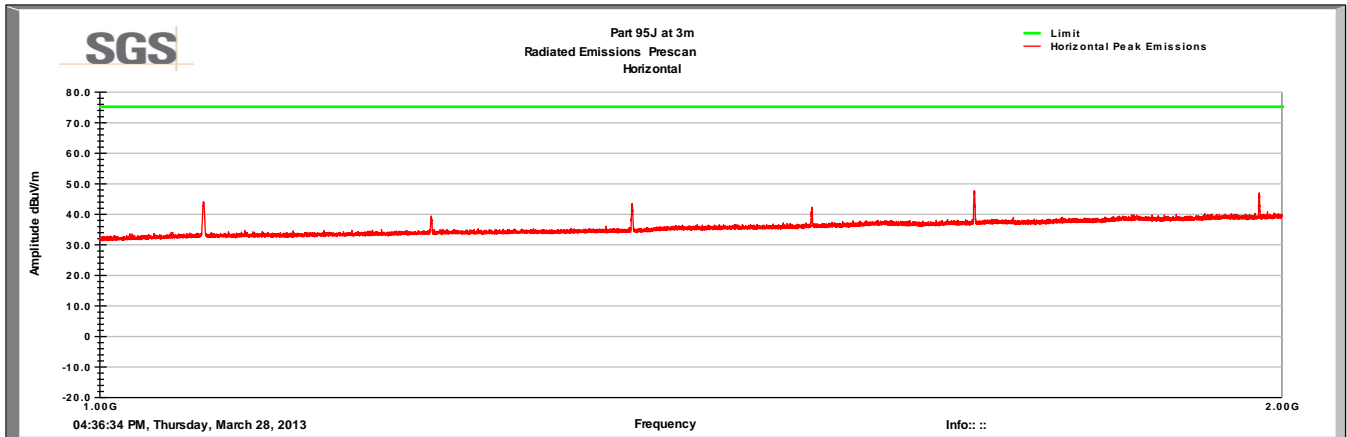
1 – 2 GHz

Vertical Radiated Emissions Plot



Note: No emissions detected within 20 dB of the Limit

Horizontal Radiated Emissions Plot



Note: No emissions detected within 20 dB of the Limit



## 4 Conducted Spurious Emissions

### 4.1 Test Result

| Test Description             | Basic Standards                                       | Test Result |
|------------------------------|---|-------------|
| Conducted Spurious Emissions | FCC Part 2.1051<br>FCC Part 95, Subpart J<br>TIA-603C | Compliant   |

### 4.2 Test Method

With the spectrum analyzer resolution bandwidth set to 100 kHz the initial preliminary exploratory scans were performed over the measuring frequency range using a max hold mode incorporating a Peak detector. The final test data was measured using a Peak detector and compared against the limit of  $50+10\log(P)$  relative to the highest emission detected, which was calculated to be -20dBm.

### 4.3 Test Site

SGS EMC Laboratory, Suwanee, GA

#### Environmental Conditions

Temperature: 22.4 °C  
Relative Humidity: 45.4 %  
Atmospheric Pressure: 100.7 kPa

### 4.4 Test Equipment

Note: The calibration period equipment is 1 year.

Test Start Date: 4/3/2013

Tested By: BKF

Test End Date: 4/3/2013

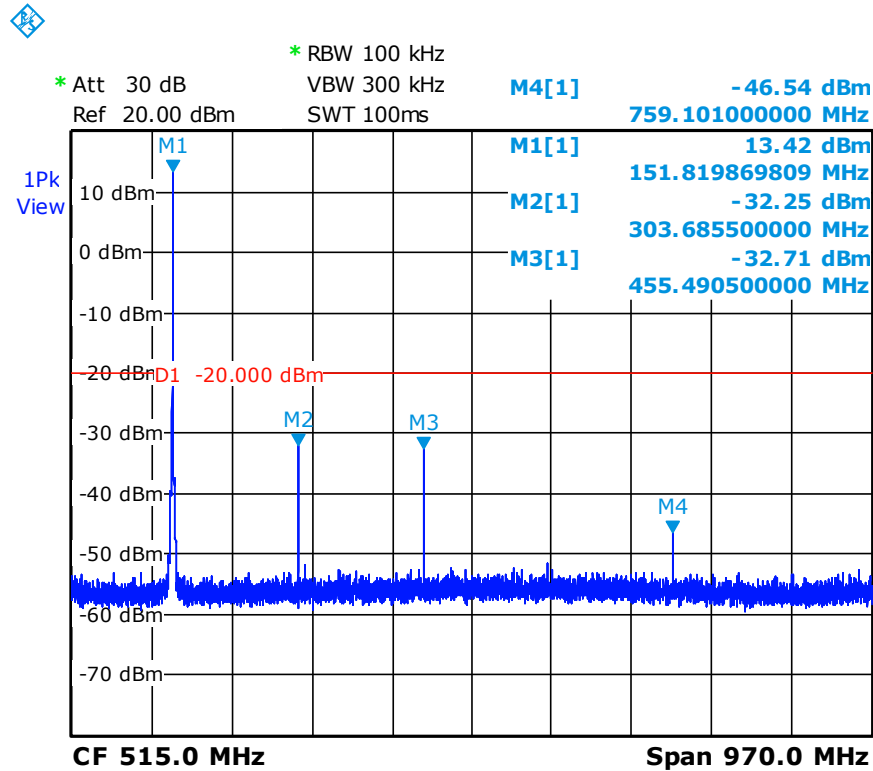
| Equipment         | Model        | Manufacturer | Asset Number | Cal Due Date |
|-------------------|--------------|--------------|--------------|--------------|
| Spectrum Analyzer | ZVL          | R & S        | B079799      | 24-Sep-13    |
| Coaxial Cable     | Sucoflex 102 | Huber+Suhner | B079822      | 2-Dec-13     |

### 4.5 Test Setup Photographs

Photographs are contained in a separate exhibit

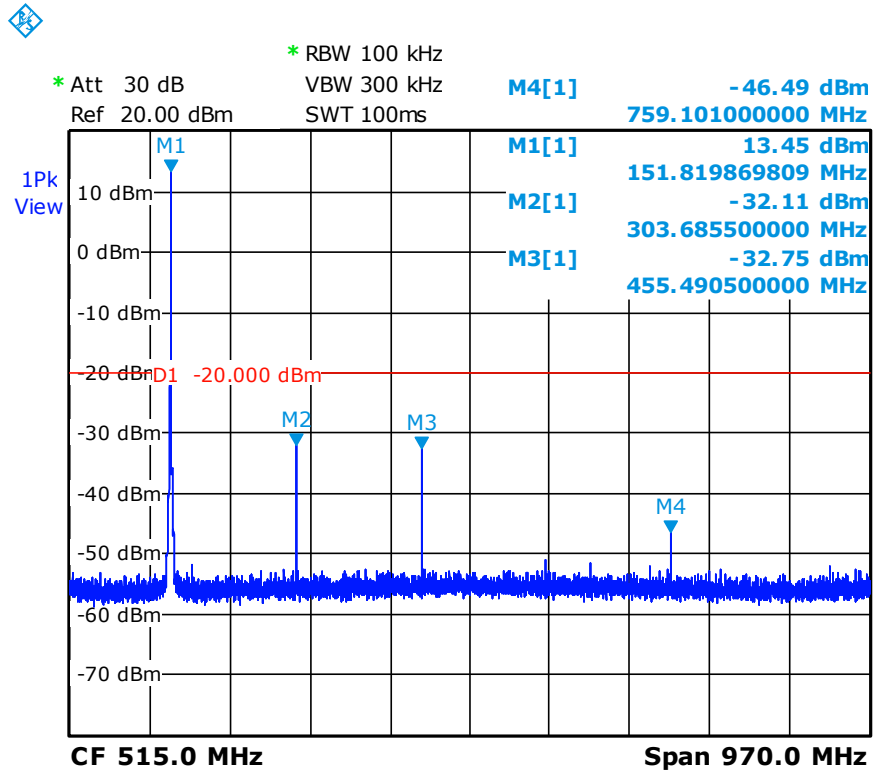
### 4.6 Test Data

Conducted Emissions Plot  
30MHz to 1GHz  
CW



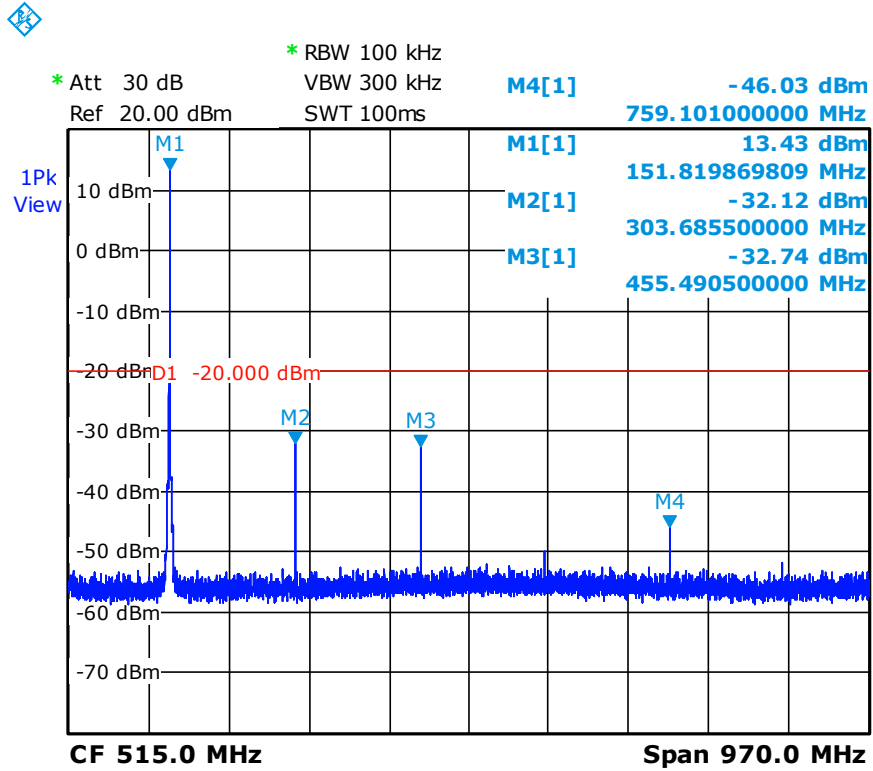
Date: 3.APR.2013 17:31:32

## 1010 Data



Date: 3.APR.2013 17:32:40

## PN9 Data



Date: 3.APR.2013 17:33:21

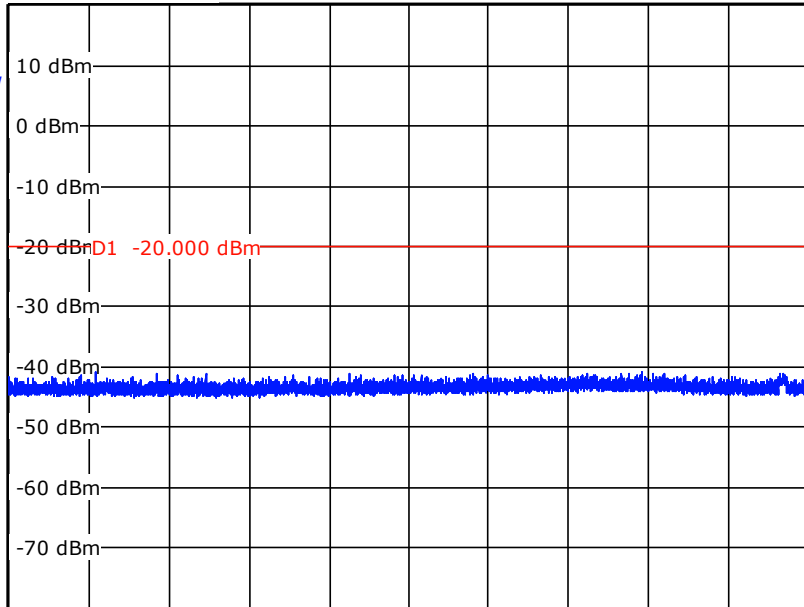
5

Conducted Emissions Data  
1 to 1.5 GHz



\* Att 30 dB                      \* RBW 1 MHz  
 Ref 20.00 dBm                  VBW 3 MHz  
     SWT 50ms

1Pk  
View



Start 1.0 GHz

Stop 1.5 GHz

Date: 3.APR.2013 17:38:39

Note: No signals above the equipment noise floor measured in any modulation.

## 5 Occupied Bandwidth

### 5.1 Test Result

| Test Description   | Basic Standards  | Test Result |
|--------------------|--|-------------|
| Occupied Bandwidth | FCC Part 2.1049<br>FCC Part 95 Subpart J<br>Part 95.633 f(1) | Compliant   |

### 5.2 Test Method

The maximum emission was determined via conducted measurement, the signal above and below the highest emission frequency at 26 dB down was measured and the difference in marker frequencies was reported as the occupied bandwidth. The authorized bandwidth for 151.82 MHz is 11.25 kHz.

### 5.3 Test Site

SGS EMC Laboratory, Suwanee, GA

#### Environmental Conditions

Temperature: 22.7 °C  
Relative Humidity: 51.0 %  
Atmospheric Pressure: 101.5 kPa

### 5.4 Test Equipment

Note: The calibration period equipment is 1 year.

Test Start Date: 3/29/2013

Tested By: BKF

Test End Date: 3/29/2013

| Equipment         | Model        | Manufacturer  | Asset Number | Cal Due Date |
|-------------------|--------------|---------------|--------------|--------------|
| Spectrum Analyzer | ZVL          | R & S         | B079799      | 1-Jul-13     |
| 30dB attenuator   | BW-S30W24    | Mini-Circuits | NA           | NA           |
| Coaxial Cable     | Sucoflex 102 | Huber+Suhner  | B079822      | 2-Dec-13     |

### 5.5 Test Results

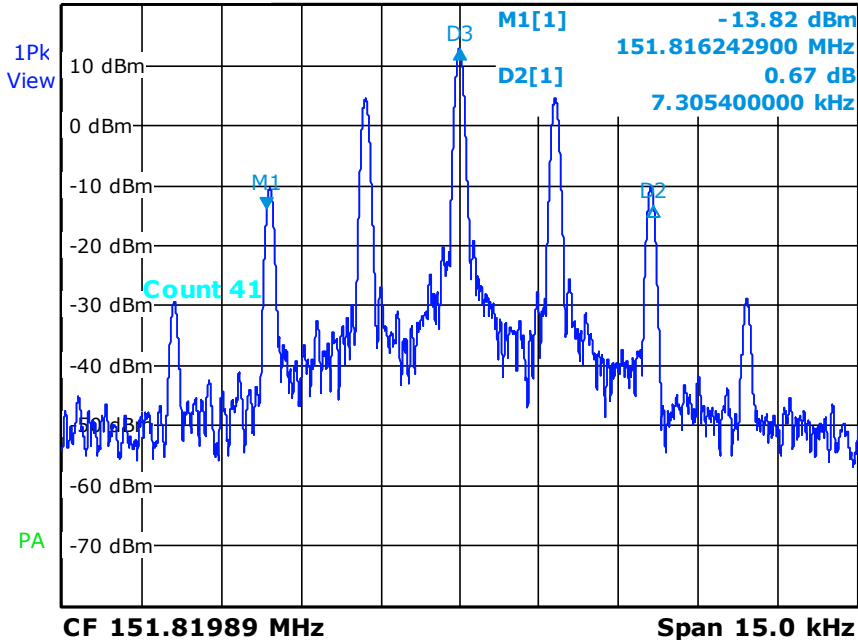
| Modulation | BW (kHz) |
|------------|----------|
| 1010 data  | 7.305    |
| PN9        | 6.899    |

## 5.6 Test Data

1010 Data

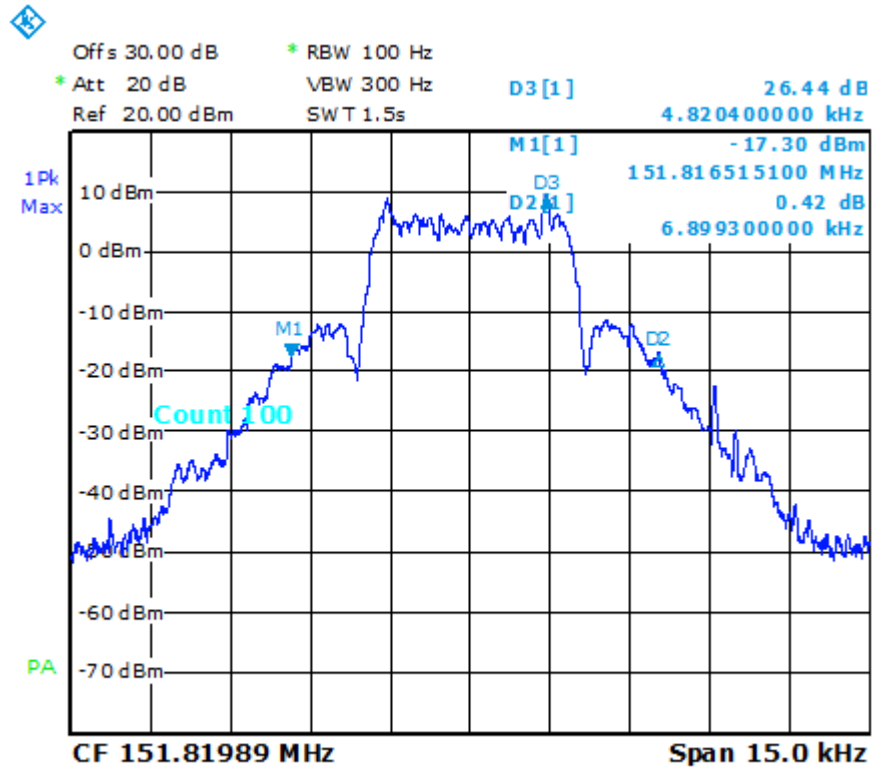


Offs 30.00 dB \* RBW 100 Hz  
 \* Att 20 dB VBW 300 Hz D3[1] 26.75 dB  
 Ref 20.00 dBm SWT 1.5s 3.652700000 kHz



Date: 29.MAR.2013 19:18:29

## PN9 Data



Date: 29.MAR.2013 19:30:55



## 6 Emissions Mask

### 6.1 Test Result

| Test Description | Basic Standards                            | Test Result |
|------------------|--|-------------|
| Emissions Mask   | FCC Part 2.1049<br>FCC Part 95, 635 e(1)ii | Compliant   |

### 6.2 Test Method

The EUT was connected to a spectrum analyzer and caused to transmit in both modulation modes available. The modulation envelope was compared to the Emissions Mask 1 limits.

### 6.3 Test Site

SGS EMC Laboratory, Suwanee, GA

Environmental Conditions

Temperature: 22.7 °C

Relative Humidity: 51.0 %

Atmospheric Pressure: 101.5 kPa

### 6.4 Test Equipment

Note: The calibration period equipment is 1 year.

Test Start Date: 3/27/2013

Tested By: BKF

Test End Date: 3/27/2013

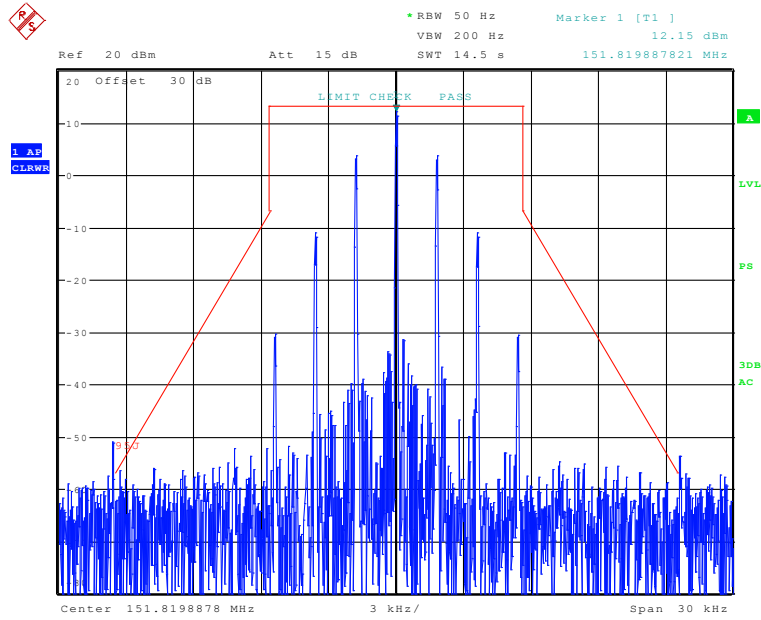
| Equipment         | Model        | Manufacturer  | Asset Number | Cal Due Date |
|-------------------|--------------|---------------|--------------|--------------|
| Spectrum Analyzer | ZVL          | R & S         | B079799      | 1-Jul-13     |
| 30dB attenuator   | BW-S30W24    | Mini-Circuits | NA           | NA           |
| Coaxial Cable     | Sucoflex 102 | Huber+Suhner  | B079822      | 2-Dec-13     |

### 6.5 Test Setup Photographs

Photographs are contained in a separate exhibit

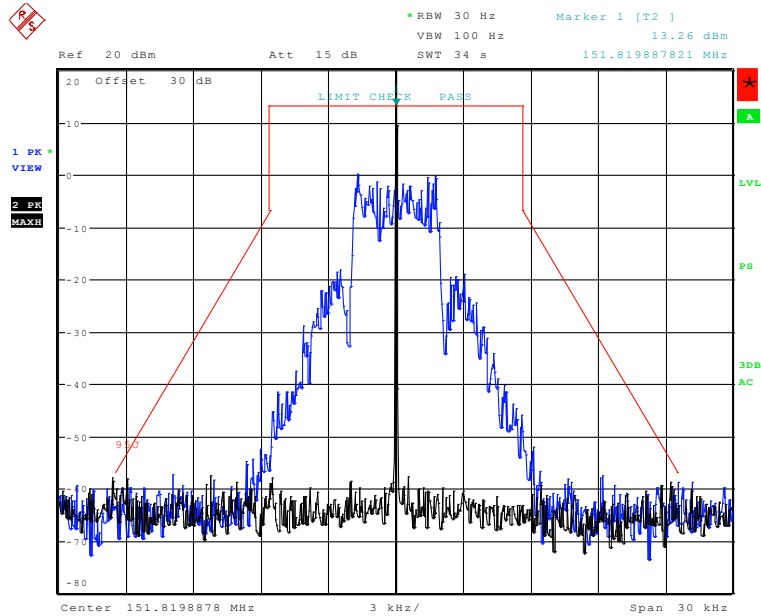
### 6.6 Test Data

#### 1010 Data



Date: 27.MAR.2013 22:30:31

#### PN9 Data



Date: 28.MAR.2013 16:14:35

## 7 Output Power

### 7.1 Test Result

| Test Description | Product Specific Standard           | Test Result |
|------------------|-------------------------------------|-------------|
| Output Power     | FCC Part 2.1049<br>FCC Part 95.639h | Compliant   |

### 7.2 Test Method

The EUT was connected to a spectrum analyzer with RBW greater than that of the occupied bandwidth, and tuned to the EUT fundamental frequency. The signal was measured and compared against the applicable limit of 2W(33dBm)

### 7.3 Test Site

SGS EMC Laboratory, Suwanee, GA

#### Environmental Conditions

Temperature: 24.0 °C  
 Relative Humidity: 23.4 %  
 Atmospheric Pressure: 98.7 kPa

### 7.4 Test Equipment

Note: The calibration period equipment is 1 year.

Test Start Date: 3/29/2013

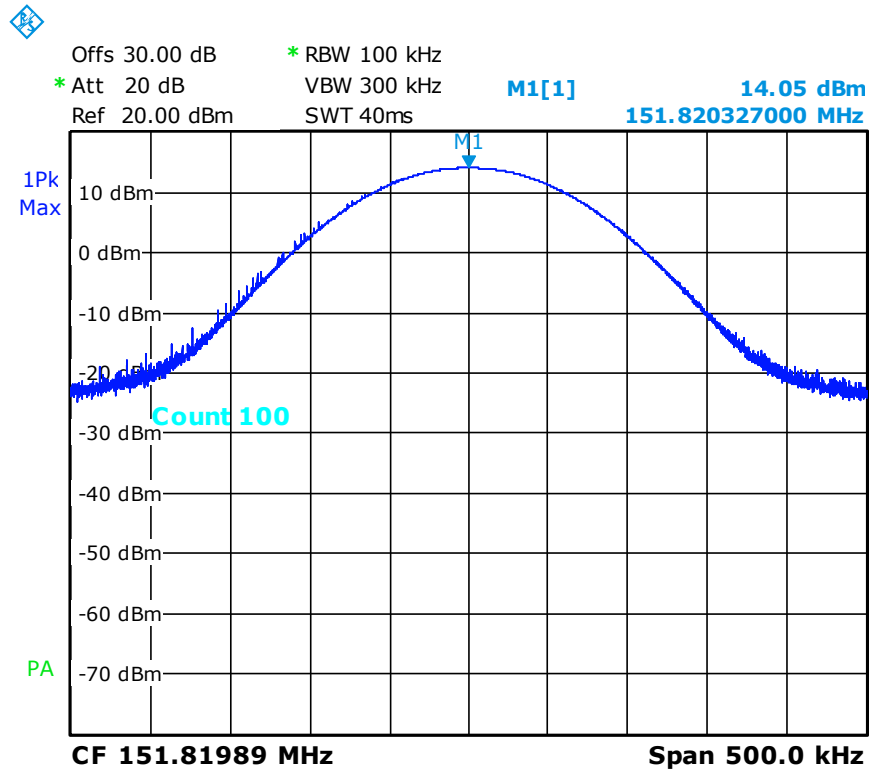
Test End Date: 3/29/2013

Tested By: BKF

| Equipment         | Model        | Manufacturer  | Asset Number | Cal Due Date |
|-------------------|--------------|---------------|--------------|--------------|
| Spectrum Analyzer | ZVL          | R & S         | B079799      | 1-Jul-13     |
| 30dB attenuator   | BW-S30W24    | Mini-Circuits | NA           | NA           |
| Coaxial Cable     | Sucoflex 102 | Huber+Suhner  | B079822      | 2-Dec-13     |

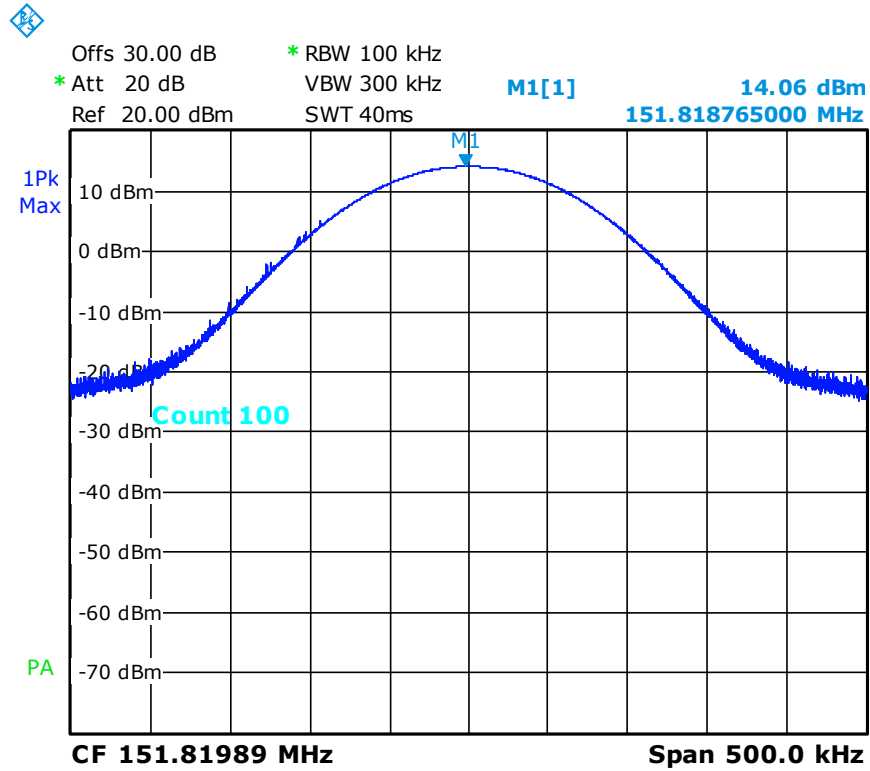
## 7.5 Test Data

### 1010 Data



Date: 29.MAR.2013 19:32:28

PN9 Data



Date: 29.MAR.2013 19:31:42

### 7.6 Measurement Results

| Modulation | Power(dBm) |
|------------|------------|
| 1010 data  | 14.050     |
| PN9        | 14.060     |

## 8 Frequency Stability

### 8.1 Test Result

| Test Description    | Product Specific Standard          | Test Result |
|---------------------|------------------------------------|-------------|
| Frequency Stability | FCC Part 2.1055<br>FCC Part 95.632 | Compliant   |

### 8.2 Test Method

The EUT was placed in a temperature controlled environment and connected to a spectrum analyzer. The temperature was varied from -30 to 50° C in 10° increments; allowing at least one half hour of temperature stabilization before a frequency measurement was taken. The PPM calculations were made as compared to a baseline frequency at 20°C. A RBW of 1Hz, VBW of 30Hz and a 1s sweep settings were utilized.

The EUT was also connected to a variable voltage source and varied from 85% to 115% of rated voltage. The fundamental frequency for each voltage setting was compared to the 100% voltage ambient temperature measurement and reported as compared to the limit, which is 5ppm.

### 8.3 Test Site

SGS EMC Laboratory, Suwanee, GA

### 8.4 Test Equipment

Test Start Date: 4/2/2013

Tested By: BKF

Test End Date: 4/2/2013

| Equipment         | Model        | Manufacturer | Asset Number | Cal Due Date |
|-------------------|--------------|--------------|--------------|--------------|
| Spectrum Analyzer | ZVL          | R & S        | B079629      | 1-Jul-13     |
| Coaxial Cable     | Sucoflex 102 | Huber+Suhner | B079822      | 2-Dec-13     |

Note: The calibration period equipment is 1 year.

### 8.5 Test Setup Photographs

Photographs are contained in a separate exhibit

## 8.6 Test Data

### Temperature Variation

| Voltage % | Power V <sub>AC</sub> | Temp °C   | Frequency Hz  | Freq Dev Hz | Freq Dev ppm |
|-----------|-----------------------|-----------|---------------|-------------|--------------|
| 100%      | 120                   | Reference | 151820000     |             |              |
| 100%      | 120.00                | 20.0      | 151819915.357 | +84.64      | +0.56        |
| 100%      | 120.00                | 30.0      | 151819923.893 | +76.11      | +0.50        |
| 100%      | 120.00                | 40.0      | 151819934.400 | +65.60      | +0.43        |
| 100%      | 120.00                | 50.0      | 151819933.800 | +66.20      | +0.44        |
| 100%      | 120.00                | 10.0      | 151819909.008 | +90.99      | +0.60        |
| 100%      | 120.00                | 0         | 151819904.121 | +95.88      | +0.63        |
| 100%      | 120.00                | -10       | 151819925.593 | +74.41      | +0.49        |
| 100%      | 120.00                | -20       | 151819902.658 | +97.34      | +0.64        |
| 100%      | 120.00                | -30       | 151819893.400 | +106.60     | +0.70        |

### Voltage Variation

| Voltage % | Power V <sub>AC</sub> | Temp °C   | Frequency Hz  | Freq Dev Hz | Freq Dev ppm |
|-----------|-----------------------|-----------|---------------|-------------|--------------|
| 100%      | 120.00                | Reference | 151820000.000 |             |              |
| 100%      | 120.00                | 24.0      | 151819929.410 | +70.59      | +0.46        |
| 85%       | 102.00                | 24.0      | 151819927.610 | +72.39      | +0.48        |
| 115%      | 138.00                | 24.0      | 151819927.010 | +72.99      | +0.48        |

## 9 Revision History

| Revision Level | Description of changes                           | Revision Date |
|----------------|--|---------------|
| 0              | Initial release                                  | 10APR2013     |
| 1              | Removed RF Exposure section to separate exhibit. | 12 June 2013  |
|                |  |               |
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