

## TEST REPORT

**Report Number: 3112806MPK-001**

**Project Number: 3112806**

**February 5, 2007**

**Testing performed on the**

**RFID Assembly**

**Part Number: J100051**

**FCCID: U2LJ100051**

**to**

**FCC Part 15.225**

**Class A**

**For**

**Juvent Inc.**



A2LA Certificate Number: 1755-01

Test Performed by:

Intertek

1365 Adams Court

Menlo Park, CA 94025

Test Authorized by:

Juvent Inc.

300 Atrium Drive

Somerset, NJ 08873

Prepared by:

A handwritten signature in blue ink, appearing to read 'Krishna K. Vemuri'.

Krishna K. Vemuri

**Date:** February 5, 2007

Reviewed by:

A handwritten signature in blue ink, appearing to read 'Ollie Moyrong'.

Ollie Moyrong

**Date:** February 5, 2007

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## 1.0 Summary of Tests

| TEST                                | REFERENCE            | RESULT   |
|-------------------------------------|----------------------|--|
| Field Strength of Fundamental       | 15.225(a)            | Complies   |
| Radiated Emissions outside the band | 15.225(b),<br>15.209 | Complies   |
| Frequency tolerance of the carrier  | 15.225(c)            | Complies   |
| Line Conducted Emissions            | 15.207               | Complies   |
| Antenna requirement                 | 15.203               | Complies. The antenna is permanently connected, internal to the PCB. |

## 2.0 General Description

### 2.1 Product Description

The EUT is a RFID assembly.

#### Overview of the EUT

|                                     |   |
|-------------------------------------|---|
| <b>Applicant name &amp; address</b> | Juvent Inc.<br>300 Atrium Drive<br>Somerset, NJ 08873 |
| <b>Contact info</b>                 | Benjamin S. Bertz,      BBertz@juvent.com             |
| <b>Part No.</b>                     | J100051   |
| <b>FCC Identifier</b>               | U2LJ100051  |
| <b>Operating Frequency</b>          | 13.56 MHz   |
| <b>Number of Channels</b>           | 1 channel   |
| <b>Type of Modulation</b>           | ASK   |
| <b>Modulation depth</b>             | 10%   |
| <b>Operating Temperature</b>        | -20 <sup>0</sup> C to +50 <sup>0</sup> C              |
| <b>Antenna</b>                      | Integral antenna, Loop Antenna                        |

A prototype version of the EUT was received on January 10, 2007 in good operating condition. As declared by the Applicant, it is identical to production units.

## 2.2 Related Submittal(s) Grants

This report is for use with an application for certification of a low power transmitter. One transmitter is included in the application.

## 2.3 Test Methodology

Both AC mains line-conducted and radiated emissions measurements were performed according to the procedures in ANSI C63.4 (1992). Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Data Sheet**" of this Application. All other measurements were made in accordance with the procedures in part 2 of CFR 47.

## 2.4 Test Facility

The 10m anechoic chamber and conducted measurement facility used to collect the radiated data is site #1. This test facility and site measurement data have been fully placed on file with the FCC and A2LA accredited.

### 3.0 System Test Configuration

#### 3.1 Support Equipment and description

##### System Support Equipment

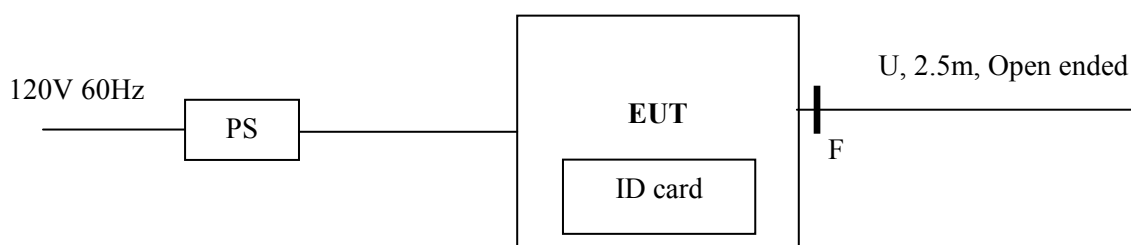
| Description        | Manufacturer | Model Number | Serial Number |
|--------------------|--------------|--------------|---------------|
| Power supply (PS)* | PHIHONG      | PSS-22U-150  | 01220         |

\* Used for radiated and conducted emission test

##### Cables Associated with EUT

| Description  | Length | Shielding | Ferrites | Connection |     |
|--------------|--------|-----------|----------|------------|-----|
|              |        |           |          | From       | To  |
| Serial cable | 2.5 m  | No        | Yes      | EUT        | --- |

#### 3.2 Block Diagram of Test Setup



|                       |                         |
|-----------------------|-------------------------|
| <b>S</b> = Shielded   | <b>F</b> = With Ferrite |
| <b>U</b> = Unshielded | <b>m</b> = Meter        |

### 3.3 Justification

For emission testing, the test procedures, as described in American National Standards Institute C63.4, were employed. The equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). During testing, all cables were manipulated to produce worst-case emissions.

### 3.4 Software Exercise Program

None.

### 3.5 Mode of operation during test

RFID Assembly was continuously transmitting during the tests. To make this operation the ID card was placed on top the RFID Assembly.

### 3.6 Modifications required for Compliance

To comply with radiated emissions test, one ferrite was installed on the serial cable. The details of the ferrite are:

Make: Würth Elektronik

Model: 742 711 12

No other modifications were installed by Intertek Testing Services during compliance testing in order to bring the product into compliance (Please note that this does not include changes made specifically by Juvent prior to compliance testing).

### 3.7 Additions, deviations and exclusions from standards

No additions, deviations or exclusion have been made from standard.

## 4.0 Measurement Results

### 4.1 Transmitter Radiated Emissions FCC Rules 15.225, 15.209

#### Requirements

The Field Strength of emissions at fundamental frequency shall not exceed 80 dB ( $\mu\text{V}/\text{m}$ ) at 30m, Emissions radiated outside of the specified frequency band shall not exceed the general radiated emission limits in 15.209.

#### Procedure

During the test the EUT is rotated and the measuring antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters.

Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. All readings are extrapolated back to the equivalent three-meter reading using inverse scaling with distance.

Radiated emission measurements were performed from 10 MHz to 1 GHz.  
Analyzer resolution is:

9 kHz or greater for frequencies 30 MHz and below  
100 kHz or greater for frequencies 1000 MHz and below,  
For those frequencies quasi-peak value was measured.

Data is included of the worst-case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included.

#### Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation is as follows:

$$FS = RA + AF + CF - AG$$

Where FS = Field Strength in dB ( $\mu\text{V}/\text{m}$ )

RA = Receiver Amplitude (including preamplifier) in dB ( $\mu\text{V}$ )

CF = Cable Attenuation Factor in dB

AF = Antenna Factor in dB (1/m)

AG = Amplifier Gain in dB



## Test Result

The data below shows the significant emission frequencies, the limit and the margin of compliance.

### Radiated emissions at fundamental frequency

| Frequency<br>MHz | Antenna<br>Polarization<br>H/V | SA<br>Reading<br>at 10m<br>dB(uV) | Antenna<br>Factor<br>dB(1/m) | Preamp<br>Gain<br>dB | Cable<br>Loss<br>dB | Distance<br>Correct.<br>Factor<br>dB | FS<br>at 30 m<br>dB(uV/m) | FS<br>Limit<br>at 30m<br>dB(uV/m) | Margin<br>dB |
|------------------|--------------------------------|-----------------------------------|------------------------------|----------------------|---------------------|--------------------------------------|---------------------------|-----------------------------------|--------------|
| 13.560           | -                              | 66.8                              | 17.5                         | 32.8                 | 0.5                 | -20.0                                | 32.0                      | 84.0                              | -52.0        |

FS – Field Strength

FS was measured with loop antenna

### Spurious Radiated emissions below 30 MHz

| Frequency<br>MHz | Antenna<br>Polarization<br>H/V | SA<br>Reading<br>at 10m<br>dB(uV) | Antenna<br>Factor<br>dB(1/m) | Preamp<br>Gain<br>dB | Cable<br>loss<br>dB | Distance<br>Correct.<br>Factor<br>dB | FS<br>at 30m<br>dB(uV/m) | FS<br>Limit<br>at 30m<br>dB(uV/m) | Margin<br>dB |
|------------------|--------------------------------|-----------------------------------|------------------------------|----------------------|---------------------|--------------------------------------|--------------------------|-----------------------------------|--------------|
| 13.553*          | -                              | 60.1                              | 17.5                         | 32.8                 | 0.5                 | -20                                  | 25.3                     | 50.5                              | -25.2        |
| 13.567*          | -                              | 62.4                              | 17.5                         | 32.8                 | 0.5                 | -20                                  | 27.6                     | 50.5                              | -22.9        |
| 13.590*          | -                              | 51.5                              | 17.5                         | 32.8                 | 0.5                 | -20                                  | 16.7                     | 50.5                              | -33.8        |
| 13.532*          | -                              | 49.4                              | 17.5                         | 32.8                 | 0.5                 | -20                                  | 14.6                     | 50.5                              | -35.9        |
| 13.709*          | -                              | 44.1                              | 17.5                         | 32.8                 | 0.5                 | -20                                  | 9.3                      | 40.5                              | -31.2        |
| 13.411*          | -                              | 44.5                              | 17.5                         | 32.8                 | 0.5                 | -20                                  | 9.7                      | 40.5                              | -30.8        |
| 27.121           | -                              | 47.8                              | 17.4                         | 32.8                 | 0.5                 | -20                                  | 12.9                     | 29.5                              | -16.6        |

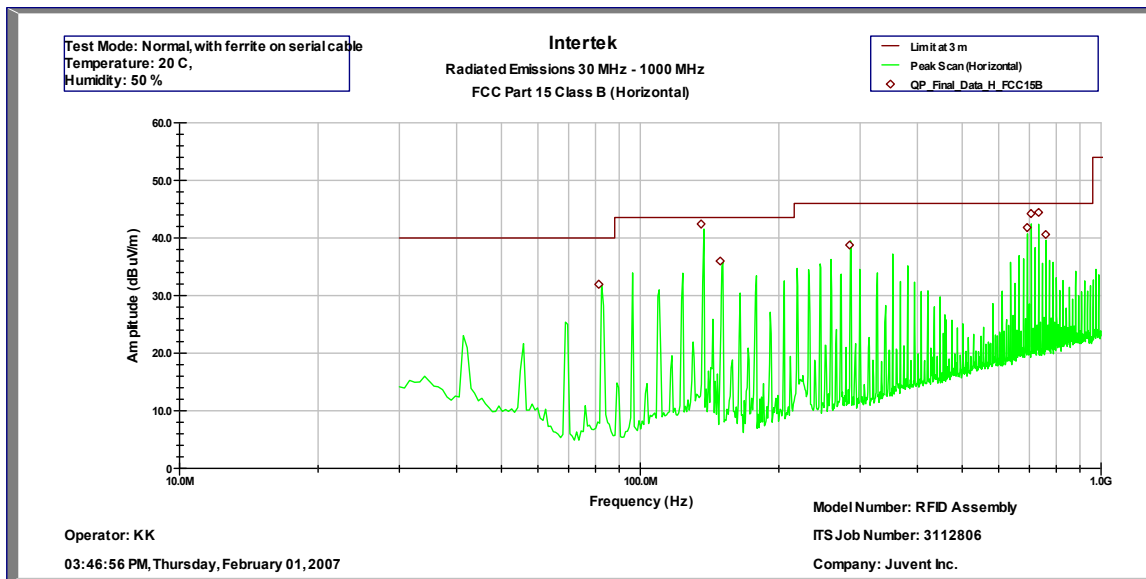
Note:

FS was measured with loop antenna

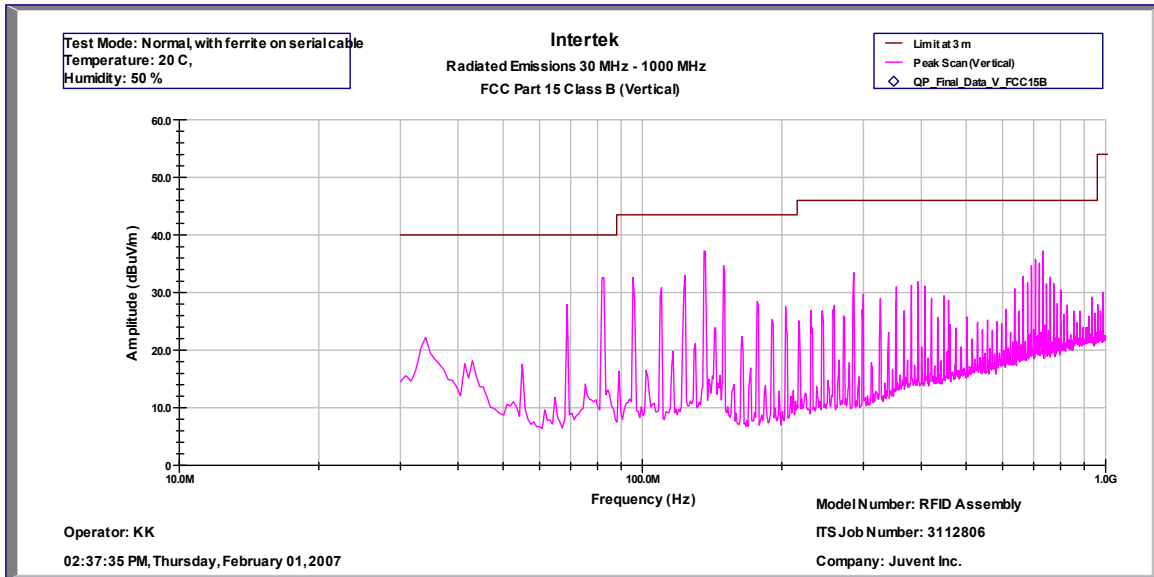
\*The FS on the band-edge frequencies was obtained from plots in sec. 4.3.

All other emissions not reported are noise floor, which is at least 20 dB below the limit.

## Spurious Radiated emissions above 30 MHz



| Intertek  |             |          |        |                             |      |     |         |       |
|---|-------------|----------|--------|-----------------------------|------|-----|---------|-------|
| Radiated Emissions 30 MHz - 1000 MHz            |             |          |        |                             |      |     |         |       |
| FCC Part 15 Class B (QP-Horizontal)             |             |          |        |                             |      |     |         |       |
| Operator: KK                                    |             |          |        | Model Number: RFID Assembly |      |     |         |       |
|   |             |          |        | ITS Job Number: 3112806     |      |     |         |       |
| 03:46:56 PM, Thursday, February 01, 2007        |             |          |        | Company: Juvent Inc.        |      |     |         |       |
| Frequency                                       | Quasi Pk FS | Limit@3m | Margin | RA @ 3m                     | AG   | CF  | AF      | Atten |
| MHz   | dB(uV/m)    | dB(uV/m) | dB     | dB(uV)                      | dB   | dB  | dB(1/m) | dB    |
| 81.38   | 31.9        | 40.0     | -8.1   | 51.6                        | 31.2 | 1.2 | 7.3     | 3.0   |
| 135.6   | 42.4        | 43.5     | -1.1   | 57.8                        | 31.2 | 1.6 | 11.2    | 3.0   |
| 149.164   | 36.0        | 43.5     | -7.5   | 53.7                        | 31.2 | 1.7 | 8.8     | 3.0   |
| 284.769   | 38.8        | 46.0     | -7.2   | 51.2                        | 31.2 | 2.5 | 13.3    | 3.0   |
| 691.6   | 41.8        | 46.0     | -4.2   | 45.4                        | 31.2 | 4.1 | 20.5    | 3.0   |
| 705.283   | 44.2        | 46.0     | -1.8   | 47.6                        | 31.2 | 4.1 | 20.7    | 3.0   |
| 732.283   | 44.4        | 46.0     | -1.6   | 47.7                        | 31.2 | 4.1 | 20.8    | 3.0   |
| 759.4   | 40.6        | 46.0     | -5.4   | 43.5                        | 31.2 | 4.3 | 21.0    | 3.0   |
| Test Mode: Normal, with ferrite on serial cable |             |          |        |                             |      |     |         |       |
| Temperature: 20 C,                              |             |          |        |                             |      |     |         |       |
| Humidity: 50 %                                  |             |          |        |                             |      |     |         |       |



|  |  |  |  |                             |  |  |  |
|--|--|--|--|-----------------------------|--|--|--|
| Intertek   |  |  |  |                             |  |  |  |
| Radiated Emissions 30 MHz - 1000 MHz   |  |  |  |                             |  |  |  |
| FCC Part 15 Class B (QP-Vertical)  |  |  |  |                             |  |  |  |
| Operator: KK   |  |  |  | Model Number: RFID Assembly |  |  |  |
|  |  |  |  | ITS Job Number: 3112806     |  |  |  |
| 02:37:35 PM, Thursday, February 01, 2007   |  |  |  | Company: Juvent Inc.        |  |  |  |
|  |  |  |  |                             |  |  |  |
| Horizontal polarization measurement is worst case measurement. Hence QP measurements were performed in horizontal polarization only. |  |  |  |                             |  |  |  |
|  |  |  |  |                             |  |  |  |
|  |  |  |  |                             |  |  |  |
| Test Mode: Normal, with ferrite on serial cable  |  |  |  |                             |  |  |  |
| Temperature: 20 C,   |  |  |  |                             |  |  |  |
| Humidity: 50 %   |  |  |  |                             |  |  |  |

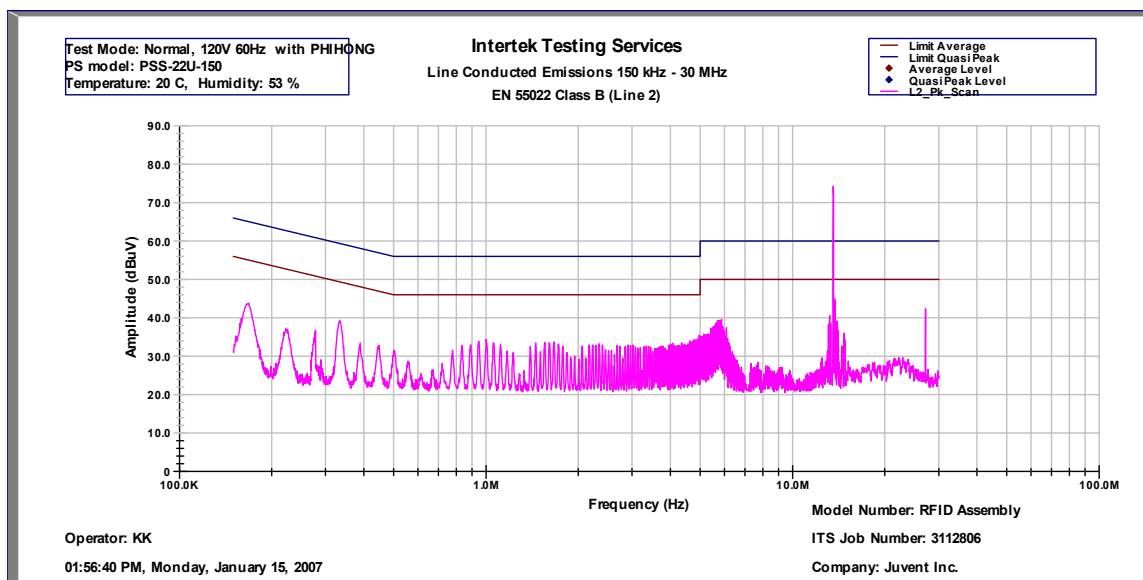
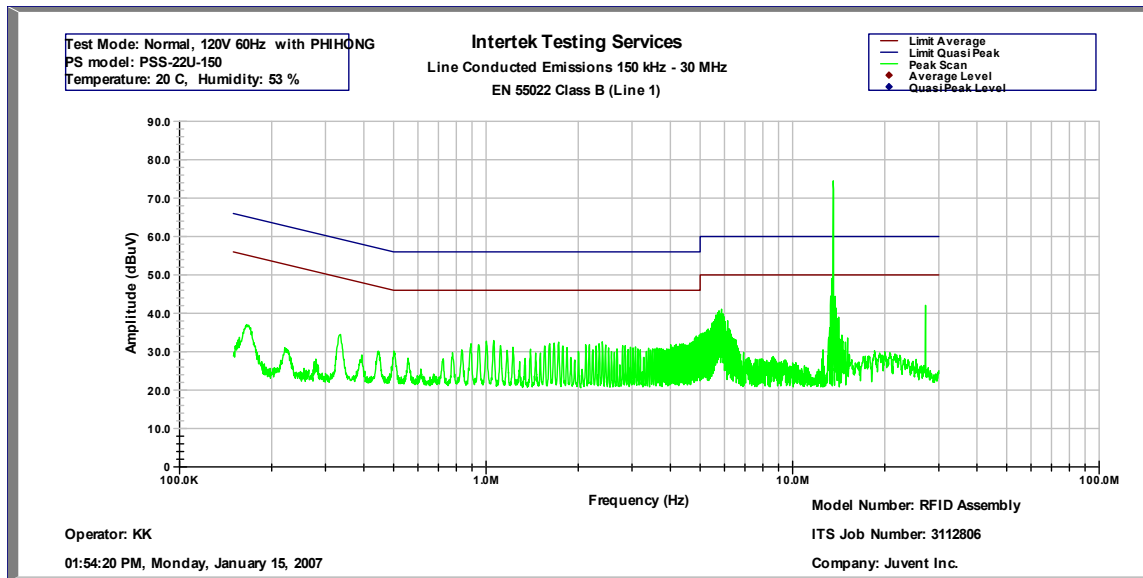
The EUT passed by 52.0 dB at fundamental frequency and by 1.1 dB at spurious emission frequencies.

4.2 AC Line Conducted Emission  
FCC Rule 15.207

AC line conducted emission test was performed according the ANSI C63.4 standard. The EUT was connected to its DC Power Supply, which was connected to the AC Line through the LISN.

For the test result, see the following pages.

The EUT passed the test by 7.7 dB.



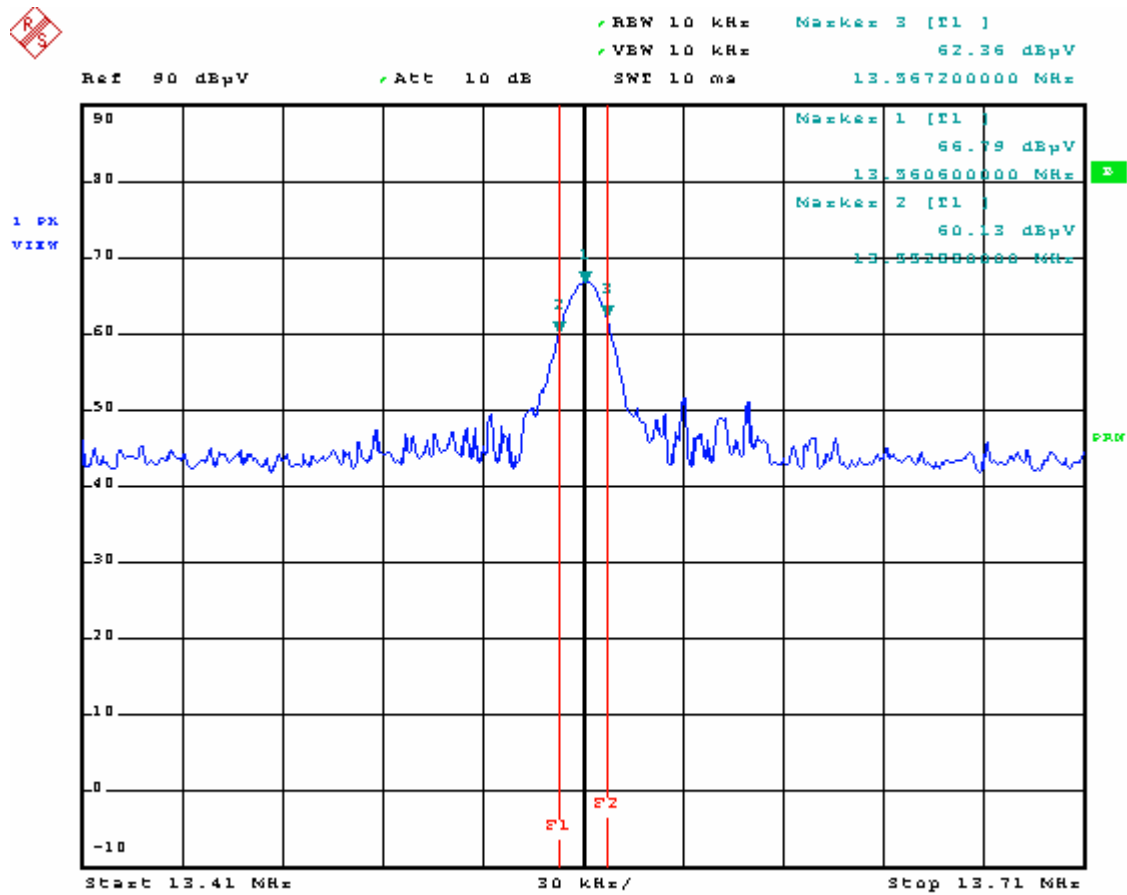
#### 4.3 Occupied Bandwidth and Out-of-band Emission Plots

The EUT was setup to transmit in normal operating condition.

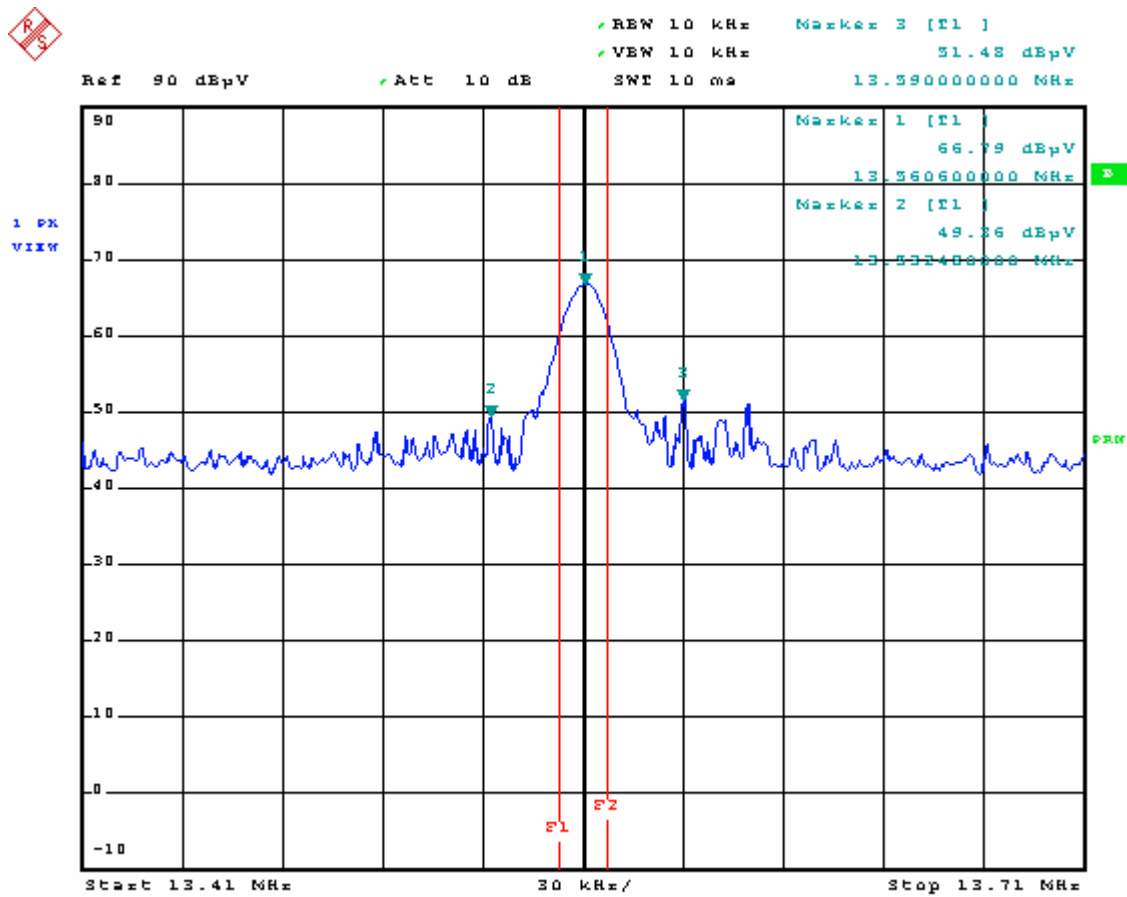
FS was measured with loop antenna at 10m distance using Spectrum Analyzer. The spectrum analyzer reading was plotted. The following plots show the in-band and out-of-band emissions.

| Plot # | Description   |
|--------|---|
| 1      | In-band emission, RBW=10 kHz                        |
| 2      | Out-of-band emission, scan 13.410 MHz to 13.710 MHz |
| 3      | Out-of-band emission, scan 13.110 MHz to 14.010 MHz |

Plot 1

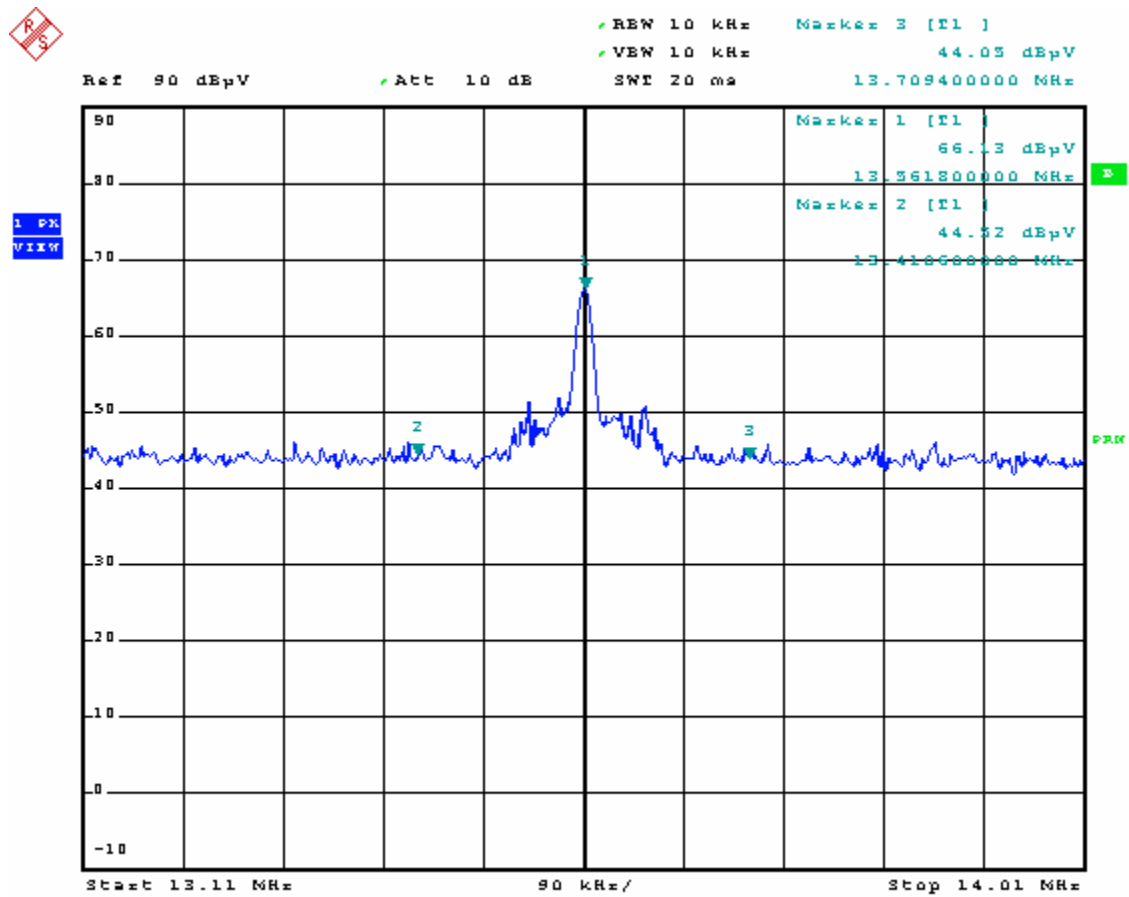


Plot 2





Plot 3



## 5.0 Frequency Tolerance

### Requirement

The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  of the operating frequency over a temperature variation of  $-20^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$  at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of  $+20^{\circ}\text{C}$ .

### Procedure

The EUT was placed in the temperature chamber and set to transmit unmodulated carrier. The transmitter was powered from a AC power supply 120V. The frequency counter was connected to the transmitter output. For each temperature, the carrier frequency was recorded. In addition, the carrier frequency was recorded when the power was set to 138 VDC (115% of 120VDC) and to 102 VDC (85% of 120V).

### Result

Nominal Frequency: 13560000 Hz

| Temperature, $^{\circ}\text{C}$ | Measured Frequency, Hz | Measured Frequency, Hz | Measured Frequency, Hz | Maximum difference, Hz |
|---------------------------------|------------------------|------------------------|------------------------|------------------------|
|                                 | 120V 60Hz              | 102V 60Hz              | 138V 60Hz              |                        |
| +50                             | 13560548               |                        |                        | 548                    |
| +40                             | 13560558               |                        |                        | 558                    |
| +30                             | 13560573               |                        |                        | 573                    |
| +20                             | 13560625               | 13.560625              | 13.560625              | 625                    |
| +10                             | 13560638               |                        |                        | 638                    |
| 0                               | 13560650               |                        |                        | 650                    |
| -10                             | 13560663               |                        |                        | 663                    |
| -20                             | 13560675               |                        |                        | 675                    |

The frequency tolerance is within  $-0.0040\%$  to  $0.0049\%$ .

**6.0 List of test equipment**

Measurement equipment used for emission compliance testing utilized the equipment on the following list:

| Equipment         | Manufacturer    | Model/Type         | Serial #   | Cal Int | Cal Due |
|-------------------|-----------------|--------------------|------------|---------|---------|
| RF Filter Section | Hewlett Packard | 85460A             | 3448A00267 | 12      | 9/11/07 |
| EMI Receiver      | Hewlett Packard | 8546A              | 3710A00373 | 12      | 9/11/07 |
| BI-Log Antenna    | ARA Inc.        | LPB-2513/A         | 1154       | 12      | 8/29/07 |
| Pre-Amplifier     | Sonoma Inst.    | 310                | 185634     | 12      | 2/20/07 |
| LISN              | FCC             | FCC-LISN-50-50-M-H | 2012       | 12      | 7/19/07 |
| Spectrum Analyzer | Hewlett Packard | 8591EM             | 3801A01250 | 12      | 9/13/07 |
| Loop Antenna      | EMCO            | 6507               | 9012-1259  | 12      | 8/15/07 |

## 7.0 Document History

| Revision/<br>Job Number | Writer<br>Initials | Date             | Change            |
|-------------------------|--------------------|------------------|-------------------|
| 1.0 / 3112806           | KK                 | February 5, 2007 | Original document |
|                         |                    |                  |                   |
|                         |                    |                  |                   |
|                         |                    |                  |                   |
|                         |                    |                  |                   |
|                         |                    |                  |                   |