

**IAL****INTERNATIONAL APPROVALS
LABORATORIES****EMC EMISSIONS - TEST REPORT (In-Part)**Test Report No. **BC300314-1** Issue Date: **Mon 18/Aug/2003**Model / Serial No. **FA5253XS / SN:EMC1**Product Type **Serial Data Transmitter**Client **Inovonics**Manufacturer **Inovonics**License holder **Inovonics**Address **315 CTC Boulevard****Louisville, CO 80027**Test Criteria Applied **FCC CFR47 Part 15 Class B**
Test Result **PASS**Test Project Number **BC300314-1** Title 47 CFR 15: RADIO FREQUENCY DEVICES
References
Total Pages **17**
Including
Appendices:*Todd Jackson*

Reviewed By :

Robert Crosswell

Approved By :

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Lab Code: 200624-0

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STATEMENT OF MEASUREMENT UNCERTAINTY

The data and results referenced in this document are true and accurate. The measurement uncertainty for Conducted Emissions in the frequency range of 150kHz – 30MHz is calculated to be $\pm 2.30\text{dB}$ and for Radiated Emissions is calculated to be $\pm 3.60\text{dB}$ in the frequency range of 30MHz – 200MHz and $\pm 3.38\text{dB}$ in the frequency range of 200MHz – 1000MHz.

EUT Received Date: 11-Aug-2003

Testing Start Date: 11-Aug-2003

Testing End Date: 11-Aug-2003

The tests were performed according to following regulations :

1. FCC CFR47 Part 15.247
2. FCC CFR47 Part 15. 209

Emission Test Results:

Conducted Emissions, Powerline - N/A

Test Result

Minimum limit margin _____ dB at _____ MHz

Maximum limit exceeding _____ dB at _____ MHz

Remarks: _____

Radiated Emissions (15.205) -

Test Result

Minimum limit margin 11.6 dB at 2731.18MHz

Maximum limit exceeding _____ dB at _____ MHz

Remarks: _____

Radiated Emissions (15.209) -

Test Result

Minimum limit margin 20.5 dB at 900.00 MHz

Maximum limit exceeding _____ dB at _____ MHz

Remarks: _____

Radiated Emissions (15.247) -

Test Result

Minimum limit margin 12.80 dB at 920.27 MHz

Maximum limit exceeding _____ dB at _____ MHz

Remarks: _____

GENERAL REMARKS:

Modifications required to pass:

Test Specification Deviations: Additions to or Exclusions from:

Limited testing to FCC CFR47 Part 15.247 was completed due to clients request. The client is testing the product covered herein to all other applicable parts.

Test-setup photo(s):
Radiated Emissions



Test-setup photo(s):
Radiated Emissions



Appendix A

Test Data Sheets
and
Test Equipment Used

Radiated Electromagnetic Emissions

Test Report #: BC300314 Run 01 Test Area: Pinewood Site 1 (3m)
 Test Method: FCC Part 15.209 Test Date: 05-Aug-2003
 EUT Model #: FA5253XS EUT Power: 3VDC
 EUT Serial #: EMC1
 Manufacturer: Inovonics
 EUT Description: Serial Data Transmitter
 Notes: _____

Temperature: 23.4 °C
 Relative Humidity: 36 %
 Air Pressure: 81 kPa
 Page: 1 of 2

| Level Key | |
|----------------|------------------|
| Pk – Peak | Nb – Narrow Band |
| Qp – QuasiPeak | Bb – Broad Band |
| Av - Average | |

| FREQ | LEVEL | CABLE / ANT / PREAMP | FINAL | POL / HGT / AZ | DELTA1 (dB) | DELTA2 (dB) |
|---|---------|----------------------|----------|-----------------|----------------|-------------|
| (MHz) | (dBuV) | (dB) (dB/m) (dB) | (dBuV/m) | (m) (DEG) | FCC B (< 1GHz) | N/A |
| No emissions found: 200 to 1000 MHz Vertical. | | | | | | |
| Noise floor. | | | | | | |
| 500.00 | 24.0 Qp | 2.4 / 18.2 / 22.3 | 22.2 | V / 1.0 / 270.0 | -23.8 | N/A |
| 1000.00 | 22.2 Qp | 3.2 / 24.4 / 21.5 | 28.4 | V / 1.0 / 270.0 | -25.6 | N/A |
| No emissions found: 200 to 1000 MHz Horizontal. | | | | | | |
| Noise floor. | | | | | | |
| 400.00 | 21.9 Qp | 2.1 / 15.1 / 21.8 | 17.4 | H / 1.0 / 270.0 | -28.6 | N/A |
| 900.00 | 21.7 Qp | 3.1 / 22.9 / 22.1 | 25.5 | H / 1.0 / 270.0 | -20.5 | N/A |
| No emissions found: 30 to 200 MHz. | | | | | | |
| Noise floor. | | | | | | |
| 30.00 | 28.1 Qp | 0.6 / 13.1 / 28.3 | 13.4 | V / 1.0 / 270.0 | -26.6 | N/A |
| No emissions found: 30 to 200 MHz Horizontal. | | | | | | |
| Noise floor. | | | | | | |
| 150.00 | 26.1 Qp | 1.2 / 12.4 / 27.8 | 11.8 | H / 1.0 / 270.0 | -31.7 | N/A |
| | | | | | | |

Radiated Electromagnetic Emissions

Test Report #: BC300314 Run 01 Test Area: Pinewood Site 1 (3m)
 Test Method: FCC Part 15.209 Test Date: 05-Aug-2003
 EUT Model #: FA5253XS EUT Power: 3VDC
 EUT Serial #: EMC1
 Manufacturer: Inovonics
 EUT Description: Serial Data Transmitter

Temperature: 23.4 °C
 Relative Humidity: 36 %
 Air Pressure: 81 kPa
 Page: 2 of 2

| Level Key | |
|----------------|------------------|
| Pk – Peak | Nb – Narrow Band |
| Qp – QuasiPeak | Bb – Broad Band |
| Av - Average | |

Notes: _____

| FREQ | LEVEL | CABLE / ANT / PREAMP | FINAL | POL / HGT / AZ | DELTA1 (dB) | DELTA2 (dB) |
|--|---------|----------------------|----------|-----------------|----------------|-------------|
| (MHz) | (dBuV) | (dB) (dB/m) (dB) | (dBuV/m) | (m) (DEG) | FCC B (< 1GHz) | N/A |
| ***** Measurement Summary ***** | | | | | | |
| 900.00 | 21.7 Qp | 3.1 / 22.9 / 22.1 | 25.5 | H / 1.0 / 270.0 | -20.5 | N/A |
| 500.00 | 24.0 Qp | 2.4 / 18.2 / 22.3 | 22.2 | V / 1.0 / 270.0 | -23.8 | N/A |
| 1000.00 | 22.2 Qp | 3.2 / 24.4 / 21.5 | 28.4 | V / 1.0 / 270.0 | -25.6 | N/A |
| 30.00 | 28.1 Qp | 0.6 / 13.1 / 28.3 | 13.4 | V / 1.0 / 270.0 | -26.6 | N/A |
| 400.00 | 21.9 Qp | 2.1 / 15.1 / 21.8 | 17.4 | H / 1.0 / 270.0 | -28.6 | N/A |
| 150.00 | 26.1 Qp | 1.2 / 12.4 / 27.8 | 11.8 | H / 1.0 / 270.0 | -31.7 | N/A |
| | | | | | | |

Radiated Electromagnetic Emissions

Test Report #: **BC300314 Run 02**
 Test Method: FCC CFR47 Part 15.247/205
 EUT Model #: FA5253XS
 EUT Serial #: EMC1
 Manufacturer: Inovonics
 EUT Description: Serial Data Transmitter

Test Area: Pinewood Site 1 (3m)
 Test Date: 05-Aug-2003
 EUT Power: 3VDC

Temperature: 23.4 °C
 Relative Humidity: 36 %
 Air Pressure: 81 kPa
 Page: 1 of 2

| Level Key | |
|----------------|------------------|
| Pk – Peak | Nb – Narrow Band |
| Qp – QuasiPeak | Bb – Broad Band |
| Av - Average | |

Notes: _____

| FREQ | LEVEL | CABLE / ANT / PREAMP | FINAL | POL / HGT / AZ | DELTA1 (dB) | DELTA2 (dB) |
|-------|--------|----------------------|--------|----------------|-------------|-------------|
| (MHz) | (dBuV) | (dB) (dB/m) (dB) | (dBuV) | (m) (DEG) | 15.247 | 15.205 |

Testing was completed utilizing maximum amplitude peaks for this device considering the device could not be taken into a CW Mode of operation. Care was taken through the maximization process to ensure that the maximum amplitude peaks were observed and recorded.

The testing performed in accordance to FCC CFR47 Part 15.205 (restricted bands of operation) emissions and delta limits were calculated as follows:

Final Corrected Peak Measurement – Duty Cycle Correction Factor* = Final Calculated Emission

The Final Calculated Emission was then compared to the Limits in CFR47 Part 15.209 and the emission/limit delta was calculated.

In this case, the maximum time that the carrier would dwell on any hopping channel is 5mS in a 100mS window. Therefore, the maximum Duty Cycle correction factor of 20dB was utilized in the calculation for the final measurement.

* the DTCF is calculated as follows $20 \cdot \log_{10}(\text{duty cycle in } 100\text{mS})$ "not to exceed 20dB"

High channel

| | | | | | | |
|--------|---------|------------------|-------|-----------------|-------|-----|
| 920.09 | 86.6 Pk | 3.1 / 23.1 / 0.0 | 112.8 | V / 1.5 / 132.0 | -18.2 | N/A |
| 920.27 | 92.0 Pk | 3.1 / 23.1 / 0.0 | 118.2 | H / 1.0 / 200.0 | -12.8 | N/A |

Low channel

| | | | | | | |
|--------|---------|------------------|-------|-----------------|-------|-----|
| 909.76 | 91.7 Pk | 3.1 / 22.8 / 0.0 | 117.5 | H / 1.0 / 200.0 | -13.5 | N/A |
| 909.89 | 87.2 Pk | 3.1 / 22.8 / 0.0 | 113.1 | V / 1.5 / 130.0 | -17.9 | N/A |

Mid channel

| | | | | | | |
|--------|---------|------------------|-------|-----------------|-------|-----|
| 913.94 | 86.8 Pk | 3.1 / 22.9 / 0.0 | 112.7 | V / 1.6 / 131.0 | -18.3 | N/A |
| 913.92 | 91.5 Pk | 3.1 / 22.9 / 0.0 | 117.5 | H / 1.6 / 202.0 | -13.5 | N/A |

| | | | | | | |
|---------|---------|------------------|------|-----------------|---------------------|-----|
| 1828.28 | 45.5 Pk | 3.4 / 27.9 / 0.0 | 76.8 | V / 1.3 / 245.0 | -15.9 (20dB Atten.) | N/A |
| 1828.42 | 50.1 Pk | 3.4 / 27.9 / 0.0 | 81.4 | H / 1.7 / 355.0 | -16.1 (20dB Atten.) | N/A |

| | | | | | | |
|---------|---------|-------------------|------|-----------------|-----|-------|
| 2742.62 | 64.2 Pk | 4.0 / 30.8 / 37.2 | 61.7 | H / 2.1 / 165.0 | N/A | -12.3 |
| 2742.56 | 63.1 Pk | 4.0 / 30.8 / 37.2 | 60.7 | V / 1.7 / 230.0 | N/A | -13.3 |

Removed filter.

| | | | | | | |
|---------|---------|-------------------|------|-----------------|-----|-------|
| 2742.54 | 65.0 Pk | 4.0 / 30.8 / 37.7 | 62.1 | V / 1.7 / 230.0 | N/A | -11.9 |
|---------|---------|-------------------|------|-----------------|-----|-------|

Replaced filter.

| | | | | | | |
|---------|---------|-------------------|------|-----------------|-----|-------|
| 3656.39 | 59.5 Pk | 4.5 / 33.1 / 37.2 | 59.9 | V / 1.2 / 272.0 | N/A | -13.1 |
| 3656.74 | 58.2 Pk | 4.5 / 33.1 / 37.1 | 58.8 | H / 1.8 / 113.0 | N/A | -15.2 |

Radiated Electromagnetic Emissions

Test Report #: **BC300314 Run 02**
 Test Method: **FCC CFR47 Part 15.247/205**
 EUT Model #: **FA5253XS**
 EUT Serial #: **EMC1**
 Manufacturer: **Inovonics**
 EUT Description: **Serial Data Transmitter**
 Notes: _____

Test Area: **Pinewood Site 1 (3m)**
 Test Date: **05-Aug-2003**
 EUT Power: **3VDC**

Temperature: **23.4** °C
 Relative Humidity: **36** %
 Air Pressure: **81** kPa
 Page: **2** of **2**

| Level Key | |
|----------------|------------------|
| Pk – Peak | Nb – Narrow Band |
| Qp – QuasiPeak | Bb – Broad Band |
| Av - Average | |

| FREQ (MHz) | LEVEL (dBuV) | CABLE / ANT / PREAMP (dB) (dB/m) (dB) | FINAL (dBuV) | POL / HGT / AZ (m) (DEG) | DELTA1 (dB) | DELTA2 (dB) |
|--------------|--------------|---------------------------------------|--------------|--------------------------|---------------------|-------------|
| | | | | | 15.247 | 15.205 |
| Low channel | | | | | | |
| 1820.00 | 48.6 Pk | 3.4 / 27.9 / 0.0 | 79.8 | H / 2.3 / 347.0 | -17.7 (20dB Atten.) | N/A |
| 1820.37 | 44.0 Pk | 3.4 / 27.9 / 0.0 | 75.2 | V / 1.4 / 25.0 | -17.9 (20dB Atten.) | N/A |
| 2731.18 | 64.3 Pk | 4.0 / 30.7 / 36.7 | 62.4 | V / 2.1 / 255.0 | N/A | -11.6 |
| 2731.14 | 62.8 Pk | 4.0 / 30.7 / 36.7 | 60.9 | H / 2.2 / 160.0 | N/A | -13.1 |
| 3640.75 | 58.5 Pk | 4.5 / 33.1 / 36.9 | 59.1 | H / 2.0 / 112.0 | N/A | -14.9 |
| 3641.24 | 55.0 Pk | 4.5 / 33.1 / 36.9 | 55.6 | V / 1.2 / 75.0 | N/A | -18.4 |
| High channel | | | | | | |
| 3681.81 | 58.1 Pk | 4.6 / 33.2 / 36.4 | 59.5 | V / 1.2 / 238.0 | N/A | -14.5 |
| 3681.59 | 55.8 Pk | 4.6 / 33.2 / 36.5 | 57.0 | H / 1.8 / 112.0 | N/A | -17 |
| 2760.73 | 62.1 Pk | 4.0 / 30.8 / 36.5 | 60.5 | H / 1.8 / 159.0 | N/A | -13.5 |
| 2761.28 | 60.9 Pk | 4.0 / 30.8 / 36.4 | 59.3 | V / 1.8 / 287.0 | N/A | -14.7 |
| 1840.87 | 44.1 Pk | 3.4 / 28.0 / 0.0 | 75.4 | V / 2.2 / 246.0 | -17.4 (20dB Atten.) | N/A |
| 1840.78 | 48.9 Pk | 3.4 / 28.0 / 0.0 | 80.2 | H / 2.2 / 348.0 | -18.0 (20dB Atten.) | N/A |

Project Report

Begin Date: 8/19/2003 **End Date:** 8/5/2003

Technician Michele Burns

Project: BC300314

| Capital Asset ID | Manufacturer | Model # | Serial # | Description | Test Performed | Cal Date | Cal Due |
|-------------------------|---------------------|----------------|-----------------|---|-----------------------|-----------------|----------------|
| 105 | EMCO | 3105 | 2076 | Doubled Ridged Guide Antenna (1-18 GHz) | R Radiated Emissions | 10/1/2002 | 10/1/2003 |
| 189 | EMCO | 3109 | 9801-3142 | Bicon Antenna 30 - 300 MHz | R Radiated Emissions | 9/30/2002 | 9/30/2003 |
| 209 | Hewlett-Packard | 85662A | 2403A08749 | Display Section | R Radiated Emissions | 10/21/2002 | 10/21/2003 |
| 210 | Hewlett-Packard | 8566B | 2410A00154 | Spectrum Analyzer (dc-22 GHz) | R Radiated Emissions | 10/21/2002 | 10/21/2003 |
| 211 | Hewlett-Packard | 85650A | 2043A00256 | Quasi Peak Adapter (set 1) | R Radiated Emissions | 9/17/2002 | 9/17/2003 |
| 213 | Mini-Circuits Lab | ZHL-42 | N052792-2 | Amplifier | R Radiated Emissions | 6/20/2003 | 6/20/2004 |
| 217 | EMCO | 3146 | 9203-3376 | Log Periodic Antenna | R Radiated Emissions | 9/11/2002 | 9/11/2003 |
| 248 | Hewlett-Packard | 8447F | 3113A05545 | 9 kHz- 1.3GHz Pre Amp | R Radiated Emissions | 6/5/2003 | 6/5/2004 |

Tuesday, August 19, 2003

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Appendix B

Test Plan
and
Constructional Data Form

To be supplied by Customer

Appendix C

Measurement Protocol

And

Test Procedures



MEASUREMENT PROTOCOL

GENERAL INFORMATION

Test Methodology

Conducted and radiated emission testing is performed according to the procedures in ANSI C63.4 & CNS13438.

Justification

The Equipment Under Test (EUT) is configured in a typical user arrangement in accordance with the manufacturer's instructions. A cable is connected to each available port and either terminated with a peripheral into its characteristic impedance or left unterminated. When appropriate, the cables are manually manipulated with respect to each other to obtain maximum emissions from the unit.

CONDUCTED EMISSIONS

The final level, expressed in dB μ V, is arrived at by taking the reading directly from the EMI receiver. This level is compared directly to the applicable limit.

To convert between dB μ V and μ V, the following conversions apply:

- $\text{dB}\mu\text{V} = 20(\log \mu\text{V})$
- $\mu\text{V} = \text{Inverse log}(\text{dB}\mu\text{V}/20)$

RADIATED EMISSIONS

The final level, expressed in dB μ V/m, is arrived at by taking the reading from the spectrum analyzer (Level dB μ V) and adding the antenna correction factor and cable loss factor (Factor dB) to it. This result then has the applicable limit subtracted from it to provide the Delta which gives the tabular data as shown in the data sheets in Attachment B. The amplifier gain is automatically accounted for by using an analyzer offset.

Example: At a Test Frequency of 30 MHz, with a peak reading on the spectrum analyzer or measuring receiver of 14 dB μ V:

| Measured Level | | Transducer & Cable Loss factor | | Corrected Reading | Specification Limit | | Corrected Reading | | Delta Specification |
|----------------|---|--------------------------------|---|-------------------|---------------------|---|-------------------|---|---------------------|
| (dB μ V) | + | (dB) | = | (dB μ V/m) | (dB μ V/m) | - | (dB μ V/m) | = | |
| 14.0 | | 14.9 | | 28.9 | 40.0 | | 28.9 | | -11.1 |

DETAILS OF TEST PROCEDURES

General Standard Information

The test methods used comply with ANSI C63.4-1992 - "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

Conducted Emissions

Conducted emissions on the 50 Hz and/or 60 Hz power interface of the EUT are measured in the frequency range of 150 kHz to 30 MHz. The measurements are performed using a receiver, which has CISPR characteristic bandwidth and quasi-peak detection, and a Line Impedance Stabilization Network (LISN), with 50 Ω /50 μ H (CISPR 16) characteristics. Table top equipment is placed on a non-conducting table 80 centimeters above the floor and is positioned 40 centimeters from the vertical ground plane (wall) of the screen room. In some cases, a pre-scan using a spectrum analyzer is initially performed on the units comprising the system under test to locate the highest emissions. If the minimum passing margin appears to be less than 20 dB with a peak mode measurement, the emissions are re-measured using a tuned receiver or spectrum analyzer with quasi-peak and average detection and recorded on the data sheets.

Radiated Emissions

Radiated emissions from the EUT are measured in the frequency range of 30 to 22GHz using a spectrum analyzer and appropriate broadband linearly polarized antennas. Measurements between 30 MHz and 1000 MHz are made with 120 kHz/6 dB bandwidth and quasi-peak detection and measurements above 1000 MHz are made with a 1 MHz/6 dB bandwidth and peak detection. Table top equipment is placed on a 1.0 X 1.5 meter non-conducting table 80 centimeters above the ground plane. Floor standing equipment is placed directly on the turntable/ground plane. Interface cables that are closer than 40 centimeters to the ground plane are bundled in the center in a serpentine fashion so they are at least 40 centimeters from the ground plane. Cables to simulators/testers (if used in this test) are routed through the center of the table and to a screen room located outside the test area. The antenna is positioned 3, 10 or 30 meters horizontally from the EUT. To locate maximum emissions from the test sample the antenna is varied in height from 1 to 4 meters, measurement scans are made with both horizontal and vertical antenna polarizations and the EUT are rotated 360 degrees.

Conducted Emissions Diagram:



