

## EMC EMISSIONS - TEST REPORT (In-Part)

|                            |                                                    |                                          |                            |
|----------------------------|----------------------------------------------------|------------------------------------------|----------------------------|
| Test Report No.            | <b>3090365-1</b>                                   | Issue Date:                              | <b>Tues. Jan. 31, 2006</b> |
| Model / Serial No.         | <b>ES1501, ES1501-XL/ 01564224, 01564072</b>       |                                          |                            |
| Product Type               | <b>Water Meter Transmitters.</b>                   |                                          |                            |
| Client                     | <b>Inovonics Wireless Corp.</b>                    |                                          |                            |
| Manufacturer               | <b>Inovonics Wireless Corp.</b>                    |                                          |                            |
| License holder             | <b>Inovonics Wireless Corp.</b>                    |                                          |                            |
| Address                    | <b>315 CTC Blvd</b><br><b>Louisville, CO 80027</b> |                                          |                            |
| Test Criteria Applied      | <b>FCC CFR47 Part 15.247</b>                       |                                          |                            |
| Test Result                | <b>PASS</b>                                        |                                          |                            |
| Test Project Number        | <b>3090365</b>                                     | Title 47 CFR 15: RADIO FREQUENCY DEVICES |                            |
| References                 |                                                    |                                          |                            |
| Total Pages                |                                                    |                                          |                            |
| Including                  | <b>45</b>                                          |                                          |                            |
| Appendices:                |                                                    |                                          |                            |
| <i>Michael Spataro</i>     | <i>Robert Creswell</i>                             |                                          |                            |
| Reviewed By : Mike Spataro | Approved By :                                      |                                          |                            |

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Lab Code:200264-0

The entity logos above are for reference only and may not apply to this test report.

## DIRECTORY

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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: 5-Jan-2006

Testing Start Date: 5-Jan-2006

Testing End Date: 7-Jan-2006

The tests were performed according to following regulations :

1. FCC CFR47 Part 15.205
2. FCC CFR47 Part 15.207
3. FCC CFR47 Part 15.209
4. FCC CFR47 Part 15.247
5. ICES-003

**Emission Test Results:**

**Conducted Emissions, Powerline (15.207) - Not Applicable**

**Test Result**

Minimum limit margin NA dB at NA MHz

Maximum limit exceeding        dB at        MHz

Remarks: \_\_\_\_\_

**Radiated Emissions (15.209) - PASS**

**Test Result**

Minimum limit margin -5.4 dB at 1159.61 MHz

Maximum limit exceeding        dB at        MHz

Remarks: \_\_\_\_\_

**Radiated Emissions (15.205)/(15.247) (c) - PASS**

**Test Result**

Minimum limit margin -3.92 dB at 2744.28 MHz

Maximum limit exceeding        dB at        MHz

Remarks: Emissions is from model: ES1501 on the mid channel

**Peak Output Power 15.247 (b)(2) - PASS**

**Test Result**

Minimum limit margin -1.7 dB at 902.37 MHz

Maximum limit exceeding        dB at        MHz

Remarks: Emissions is from model: ES1501-XL on the low channel

#### GENERAL REMARKS:

The following remarks are to be considered as “where applicable” and are taken into account while completing any FCC/IC/ETSI radio tests at Intertek, ETL Semko.

Testing was performed in 3 different orthogonal axis to determine the worst case emissions from the device. The worst case emissions measurements are shown in this report.

**FCC CFR47 Part 15.31: Measurement Standards:** In any case where the device is powered off a battery, a fresh battery was used during test. In cases where the device is powered off an AC supply, voltage was varied per Part 15.31 to find worst case emissions.

**FCC CFR47 Part 15.35: Measurement Detector Functions and Bandwidths:** FCC Part 15.35 was utilized when performing the measurements within this report.

This test report is in-part, Intertek, ETL Semko was asked to test only the field strength of the fundamental and harmonics as well as the unintentional radiated emissions and conducted emissions when applicable.

This report covers two models of the same family of products. Intentional emissions, fundamental and harmonics, was completed on each unit separately. Unintentional emissions were completed on the two units at the same time.

Modifications required to pass: None

Test Specification Deviations: Additions to or Exclusions from: None

### Required Information In Accordance to FCC CFR 47 Part 2.1033:

| Rule Part 11, 15 & 18 Devices | Other Rule Part Devices | Description                                                                   | Comments                                                                            |
|-------------------------------|-------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| 2.1033(b)(1)                  | 2.1033(c)(1)            | Manu. Contact                                                                 | See Page 1 of this report                                                           |
| 2.1033(b)(2)                  | 2.1033(c)(2)            | FCC Identifier                                                                |                                                                                     |
| 2.1033(b)(3)                  | 2.1033(c)(3)            | Users Manual to include Operating, installation                               | Attached as Exhibit                                                                 |
|                               | 2.1033(c)(4)            | Emissions Designator per 2.                                                   |                                                                                     |
|                               | 2.1033(c)(5)            | Frequency Range                                                               | Not Applicable to Part 15 Devcies                                                   |
|                               | 2.1033(c)(6)            | Power range and controls                                                      | Not Applicable to Part 15 Devcies                                                   |
|                               | 2.1033(c)(7)            | Maximum power ouput rating                                                    | Not Applicable to Part 15 Devcies                                                   |
|                               | 2.1033(c)(8)            | DC Voltage and Current suplying final RF stages                               | Not Applicable to Part 15 Devcies                                                   |
| 2.1033(b)(3)                  | 2.1033(c)(9)            | Tune –up procedure                                                            | Please refer to the users manual for applicability                                  |
| 2.1033(b)(4&5)                | 2.1033(c)(10)           | Complete Circuit Diagrams and circuit operation description                   | Attached as Exhibit                                                                 |
| 2.1033(b)(7)                  | 2.1033(c)(11)           | Photographs/drawings of the identification label & its location on the device | Attached as Exhibit                                                                 |
| 2.1033(b)(7)                  | 2.1033(c)(12)           | Photographs of the external and internal surfaces, and construction           | Attached as Exhibit                                                                 |
|                               | 2.1033(c)(13)           | Digital Modulation                                                            | Not Applicable                                                                      |
| 2.1033(b)(6)                  | 2.1033(c)(14)           | Report of Measurement Data Required by 2.1046 – 2.1057                        | See Data Below (This report consists of the testing required under Part 15.231)     |
| 2.1033(b)(8)                  |                         | Description of publicly available support equipment used during test          | Refer to Exhibit B of this report (Client Test Plan)                                |
| 2.1033(b)(9)                  |                         | Statement of Autorization to Part 15.37 of CFR47                              | The equipment herein is being authorized in accordance to 15.37 of the CFR47 Rules. |
| 2.1033(b)(10)                 |                         | Direct Sequence Spread Spectrum Devices (DSSS)                                | Exhibit of compliance to 15.247(e)                                                  |
| 2.1033(b)(10)                 |                         | Frequency Hopping Devices                                                     | Exhibit of compliance to 15.247(a)(1)                                               |
| 2.1033(b)(11)                 |                         | Scanning receiver construction                                                | Exhibit stating compliance to construction in accordance to 15.121.                 |
| 15.31                         | 15.31                   | Transmitter Supply Voltage                                                    | Testing herein was completed in accordance to FCC CFR47 Part 15.31                  |

### Exhibits Including (where applicable):

- |                                    |                                                         |
|------------------------------------|---------------------------------------------------------|
| 1. Users Manual                    | 7. Parts List                                           |
| 2. Operation Description           | 8. Tuning Procedure (if applicable)                     |
| 3. Block Diagram                   | 9. Test Setup Photograph                                |
| 4. Report of Measurement           | 10. Label Drawings and or Photograpghs                  |
| 5. External & Internal Photographs | 11. Description of Support Equipment (where Applicable) |
| 6. Schematic                       |                                                         |

### Required Information in Accordance to Industry Canada Regulations (In addition to the above):

| Information Required      | Description                            | Comments |
|---------------------------|----------------------------------------|----------|
| Modulation Type           | (i.e. ASK, NON, FSK, DSSS, FHSS, etc.) |          |
| Emissions Designator      | Per TRC-49                             |          |
| In Country Representative | Contact Information                    |          |
| 99% Bandwidth Measurement | Per RSS-210                            |          |

Test-setup photo(s):  
Conducted Emissions

**Not Applicable**



Test-setup photo(s):  
Radiated Intentional Emissions: ES1501



Test-setup photo(s):  
Radiated Intentional Emissions: ES1501



Test-setup photo(s):  
Radiated Intentional Emissions: ES1501-XL



Test-setup photo(s):  
Radiated Intentional Emissions: ES1501-XL



**Appendix A**

Test Data Sheets  
and  
Test Equipment Used



**15.209 Test Data**

# Radiated Electromagnetic Emissions

Test Report #: **3090365** Test Area: Pinewood Site 1 (3m)  
 Test Method: FCC Part 15.209 Test Date: 07-Jan-2006  
 EUT Model #: ES1501, ES1501-XL EUT Power: 3 VDC  
 EUT Serial #: 01564224, 01564072  
 Manufacturer: Inovonics  
 EUT Description: Water Meter Transmitter  
 Notes: Two units tested in field simultaneously.  
 Removable Battery(ES1501)  
 Fixed Battery(ES1501-XL)

Temperature: 18.0 °C  
 Relative Humidity: 26 %  
 Air Pressure: 81 kPa

Page:

| 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) (DEG)      | 15.209 <1GHz | 15.209 >1GHz |
| Loop antenna is perpendicular to EUT.                        |         |                      |        |                |              |              |
| No significant emissions detected between 10 kHz and 30 MHz. |         |                      |        |                |              |              |
| The following are noise floor points.                        |         |                      |        |                |              |              |
| 0.0100                                                       | 66.1 Qp | 0.0 / 18.5 / 0.0     | 84.6   | V / 1.0 / 0.0  | -43.0        | N/A          |
| 0.254                                                        | 43.1 Qp | 0.1 / 10.5 / 0.0     | 53.7   | V / 1.0 / 0.0  | -45.8        | N/A          |
| 0.446                                                        | 38.2 Qp | 0.1 / 10.4 / 0.0     | 48.7   | V / 1.0 / 0.0  | -45.9        | N/A          |
| 4.80                                                         | 28.9 Qp | 0.2 / 10.2 / 0.0     | 39.2   | V / 1.0 / 0.0  | -30.3        | N/A          |
| 19.45                                                        | 25.4 Qp | 0.4 / 10.3 / 0.0     | 36.2   | V / 1.0 / 0.0  | -33.3        | N/A          |
| 11.16                                                        | 23.7 Qp | 0.2 / 10.5 / 0.0     | 34.5   | V / 1.0 / 0.0  | -35.0        | N/A          |
| Loop is parallel to EUT.                                     |         |                      |        |                |              |              |
| 0.103                                                        | 60.6 Qp | 0.1 / 11.0 / 0.0     | 71.7   | H / 1.0 / 0.0  | -35.6        | N/A          |
| 0.184                                                        | 43.2 Qp | 0.1 / 10.7 / 0.0     | 54.0   | H / 1.0 / 0.0  | -48.3        | N/A          |
| 0.369                                                        | 40.8 Qp | 0.1 / 10.4 / 0.0     | 51.2   | H / 1.0 / 0.0  | -45.1        | N/A          |
| 2.26                                                         | 25.4 Qp | 0.1 / 10.2 / 0.0     | 35.7   | H / 1.0 / 0.0  | -33.8        | N/A          |
| 11.16                                                        | 30.6 Qp | 0.2 / 10.5 / 0.0     | 41.3   | H / 1.0 / 0.0  | -28.2        | N/A          |
| 29.75                                                        | 29.8 Qp | 0.5 / 8.5 / 0.0      | 38.9   | H / 1.0 / 0.0  | -30.6        | N/A          |
| Bicon Antenna                                                |         |                      |        |                |              |              |
| No significant emissions detected between 30 - 200 MHz.      |         |                      |        |                |              |              |
| The following are noise floor points.                        |         |                      |        |                |              |              |
| 30.00                                                        | 28.7 Qp | 0.5 / 13.1 / 28.2    | 14.1   | V / 1.0 / 0.0  | -25.9        | N/A          |
| 108.84                                                       | 36.4 Qp | 1.1 / 10.4 / 28.0    | 19.9   | V / 1.0 / 0.0  | -23.6        | N/A          |
| 173.49                                                       | 30.9 Qp | 1.4 / 12.5 / 27.6    | 17.3   | V / 1.0 / 0.0  | -26.2        | N/A          |
| Horizontal                                                   |         |                      |        |                |              |              |
| 50.12                                                        | 35.9 Qp | 0.7 / 10.3 / 28.2    | 18.6   | H / 2.0 / 0.0  | -21.4        | N/A          |
| 120.20                                                       | 26.9 Qp | 1.2 / 11.7 / 27.9    | 11.8   | H / 2.0 / 0.0  | -31.7        | N/A          |
| 190.20                                                       | 27.4 Qp | 1.4 / 13.5 / 27.5    | 14.8   | H / 2.0 / 0.0  | -28.7        | N/A          |
| Antenna: EMCO Log                                            |         |                      |        |                |              |              |
| No significant emissions detected between 200 - 1000 MHz.    |         |                      |        |                |              |              |

# Radiated Electromagnetic Emissions

Test Report #: **3090365** Test Area: Pinewood Site 1 (3m)  
 Test Method: FCC Part 15.209 Test Date: 07-Jan-2006  
 EUT Model #: ES1501, ES1501-XL EUT Power: 3 VDC  
 EUT Serial #: 01564224, 01564072  
 Manufacturer: Inovonics  
 EUT Description: Water Meter Transmitter  
 Notes: Two units tested in field simultaneously.  
 Removable Battery(ES1501)  
 Fixed Battery(ES1501-XL)

Temperature: 18.0 °C  
 Relative Humidity: 26 %  
 Air Pressure: 81 kPa

Page:

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

| FREQ<br>(MHz)                         | LEVEL<br>(dBuV) | CABLE / ANT / PREAMP<br>(dB) (dB\m) (dB) | FINAL<br>(dBuV) | POL / HGT / AZ<br>(m) (DEG) | DELTA1 (dB)<br>15.209 <1GHz | DELTA2 (dB)<br>15.209 >1GHz |
|---------------------------------------|-----------------|------------------------------------------|-----------------|-----------------------------|-----------------------------|-----------------------------|
| The following are noise floor points. |                 |                                          |                 |                             |                             |                             |
| 200.00                                | 21.9 Qp         | 1.5 / 11.5 / 27.4                        | 7.5             | V / 1.0 / 0.0               | -36.0                       | N/A                         |
| 275.00                                | 18.2 Qp         | 1.8 / 13.4 / 27.0                        | 6.4             | V / 1.0 / 0.0               | -39.6                       | N/A                         |
| 350.00                                | 17.8 Qp         | 2.1 / 15.2 / 27.3                        | 7.7             | V / 1.0 / 0.0               | -38.3                       | N/A                         |
| 425.00                                | 19.4 Qp         | 2.3 / 16.6 / 28.0                        | 10.3            | V / 1.0 / 0.0               | -35.7                       | N/A                         |
| 500.00                                | 20.1 Qp         | 2.6 / 18.8 / 28.4                        | 13.1            | V / 1.0 / 0.0               | -32.9                       | N/A                         |
| 575.00                                | 19.9 Qp         | 2.8 / 19.4 / 28.4                        | 13.7            | V / 1.0 / 0.0               | -32.3                       | N/A                         |
| 650.00                                | 19.4 Qp         | 3.0 / 20.2 / 28.4                        | 14.2            | V / 1.0 / 0.0               | -31.8                       | N/A                         |
| 725.00                                | 19.2 Qp         | 3.2 / 21.4 / 28.2                        | 15.6            | V / 1.0 / 0.0               | -30.4                       | N/A                         |
| 800.00                                | 18.3 Qp         | 3.3 / 21.7 / 28.0                        | 15.3            | V / 1.0 / 0.0               | -30.7                       | N/A                         |
| 875.00                                | 19.1 Qp         | 3.5 / 23.0 / 27.7                        | 17.8            | V / 1.0 / 0.0               | -28.2                       | N/A                         |
| 975.01                                | 18.6 Qp         | 3.7 / 23.8 / 27.4                        | 18.7            | V / 1.0 / 0.0               | -35.3                       | N/A                         |
| Horizontal                            |                 |                                          |                 |                             |                             |                             |
| 225.00                                | 25.1 Qp         | 1.6 / 11.1 / 27.2                        | 10.6            | H / 2.0 / 0.0               | -35.4                       | N/A                         |
| 300.00                                | 19.9 Qp         | 1.9 / 14.4 / 27.1                        | 9.1             | H / 2.0 / 0.0               | -36.9                       | N/A                         |
| 374.86                                | 19.8 Qp         | 2.1 / 15.7 / 27.5                        | 10.0            | H / 2.0 / 0.0               | -36.0                       | N/A                         |
| 450.00                                | 19.2 Qp         | 2.4 / 17.2 / 28.1                        | 10.7            | H / 2.0 / 0.0               | -35.3                       | N/A                         |
| 524.91                                | 19.2 Qp         | 2.6 / 19.0 / 28.4                        | 12.5            | H / 2.0 / 0.0               | -33.5                       | N/A                         |
| 600.01                                | 25.1 Qp         | 2.9 / 19.5 / 28.4                        | 19.1            | H / 2.0 / 0.0               | -26.9                       | N/A                         |
| 675.01                                | 19.9 Qp         | 3.1 / 21.2 / 28.3                        | 15.9            | H / 2.0 / 0.0               | -30.1                       | N/A                         |
| 750.01                                | 18.9 Qp         | 3.2 / 21.3 / 28.2                        | 15.2            | H / 2.0 / 0.0               | -30.8                       | N/A                         |
| 825.01                                | 18.4 Qp         | 3.3 / 22.0 / 28.0                        | 15.8            | H / 2.0 / 0.0               | -30.2                       | N/A                         |
| 900.01                                | 19.1 Qp         | 3.6 / 23.2 / 27.7                        | 18.2            | H / 2.0 / 0.0               | -27.8                       | N/A                         |
| 975.01                                | 18.6 Qp         | 3.7 / 23.8 / 27.4                        | 18.6            | H / 2.0 / 0.0               | -35.4                       | N/A                         |
| 602.65                                | 19.4 Qp         | 2.9 / 19.5 / 28.4                        | 13.4            | H / 2.0 / 0.0               | -32.6                       | N/A                         |
| 1 – 4 GHz                             |                 |                                          |                 |                             |                             |                             |
| 1159.61                               | 38.5 Av         | 2.4 / 22.5 / 16.7                        | 46.8            | V / 1.0 / 0.0               | N/A                         | -7.2                        |
| Maximizing emission                   |                 |                                          |                 |                             |                             |                             |
| 1159.61                               | 40.3 Av         | 2.4 / 22.5 / 16.7                        | 48.6            | V / 1.0 / 115.0             | N/A                         | -5.4                        |

# Radiated Electromagnetic Emissions

Test Report #: **3090365**  
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 EUT Serial #: 01564224, 01564072  
 Manufacturer: Inovonics  
 EUT Description: Water Meter Transmitter  
 Notes: Two units tested in field simultaneously.  
 Removable Battery(ES1501)  
 Fixed Battery(ES1501-XL)

Test Area: Pinewood Site 1 (3m)  
 Test Date: 07-Jan-2006  
 EUT Power: 3 VDC

Temperature: 18.0 °C  
 Relative Humidity: 26 %  
 Air Pressure: 81 kPa

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

| FREQ<br>(MHz)                                                                 | LEVEL<br>(dBuV) | CABLE / ANT / PREAMP<br>(dB) (dB/m) (dB) | FINAL<br>(dBuV) | POL / HGT / AZ<br>(m) (DEG) | DELTA1 (dB)<br>15.209 <1GHz | DELTA2 (dB)<br>15.209 >1GHz |
|-------------------------------------------------------------------------------|-----------------|------------------------------------------|-----------------|-----------------------------|-----------------------------|-----------------------------|
| Horizontal                                                                    |                 |                                          |                 |                             |                             |                             |
| the following emission was maximized                                          |                 |                                          |                 |                             |                             |                             |
| 1159.61                                                                       | 39.0 Av         | 2.4 / 22.5 / 16.7                        | 47.3            | H / 1.2 / 326.0             | N/A                         | -6.7                        |
| No other significant emissions detected the following are noise floor points. |                 |                                          |                 |                             |                             |                             |
| 1250.00                                                                       | 35.0 Av         | 2.5 / 22.8 / 19.2                        | 41.2            | H / 1.0 / 0.0               | N/A                         | -12.8                       |
| 2000.00                                                                       | 33.0 Av         | 3.2 / 25.9 / 36.4                        | 25.7            | H / 1.0 / 0.0               | N/A                         | -28.3                       |
| 2750.00                                                                       | 35.4 Av         | 4.3 / 27.0 / 37.7                        | 29.0            | H / 1.0 / 0.0               | N/A                         | -25.0                       |
| 3500.00                                                                       | 34.3 Av         | 4.8 / 28.6 / 36.7                        | 31.0            | H / 1.0 / 0.0               | N/A                         | -23.0                       |
| Vertical                                                                      |                 |                                          |                 |                             |                             |                             |
| 1000.00                                                                       | 33.2 Av         | 3.7 / 22.0 / 12.0                        | 46.9            | V / 1.0 / 0.0               | N/A                         | -7.1                        |
| 1750.00                                                                       | 35.2 Av         | 3.1 / 24.8 / 33.4                        | 29.6            | V / 1.0 / 0.0               | N/A                         | -24.4                       |
| 2500.00                                                                       | 33.7 Av         | 4.0 / 26.3 / 37.4                        | 26.5            | V / 1.0 / 0.0               | N/A                         | -27.5                       |
| 3250.00                                                                       | 34.2 Av         | 4.7 / 28.2 / 36.7                        | 30.4            | V / 1.0 / 0.0               | N/A                         | -23.6                       |
| 4000.00                                                                       | 35.2 Av         | 5.7 / 29.7 / 36.3                        | 34.3            | V / 1.0 / 0.0               | N/A                         | -19.7                       |
| No significant emissions detected between 4 - 8 GHz.                          |                 |                                          |                 |                             |                             |                             |
| The following are noise floor points.                                         |                 |                                          |                 |                             |                             |                             |
| 4500.00                                                                       | 24.1 Av         | 6.6 / 30.1 / 40.5                        | 20.3            | H / 1.0 / 0.0               | N/A                         | -33.7                       |
| 5500.00                                                                       | 33.0 Av         | 6.7 / 32.0 / 40.3                        | 31.4            | H / 1.0 / 0.0               | N/A                         | -22.6                       |
| 6500.00                                                                       | 32.6 Av         | 8.5 / 32.0 / 40.3                        | 32.8            | H / 1.0 / 0.0               | N/A                         | -21.2                       |
| 7500.00                                                                       | 32.2 Av         | 8.2 / 34.2 / 39.9                        | 34.7            | H / 1.0 / 0.0               | N/A                         | -19.3                       |
| Vertical                                                                      |                 |                                          |                 |                             |                             |                             |
| 5000.00                                                                       | 33.6 Av         | 7.6 / 31.4 / 40.4                        | 32.2            | V / 1.0 / 0.0               | N/A                         | -21.8                       |
| 6000.00                                                                       | 32.3 Av         | 7.7 / 32.2 / 39.6                        | 32.6            | V / 1.0 / 0.0               | N/A                         | -21.4                       |
| 7000.00                                                                       | 32.6 Av         | 8.1 / 33.1 / 40.5                        | 33.3            | V / 1.0 / 0.0               | N/A                         | -20.7                       |
| 8000.00                                                                       | 31.8 Av         | 8.3 / 34.3 / 40.6                        | 33.8            | V / 1.0 / 0.0               | N/A                         | -20.2                       |
| No significant emissions detected between 8 - 10 GHz.                         |                 |                                          |                 |                             |                             |                             |

# Radiated Electromagnetic Emissions

Test Report #: **3090365** Test Area: Pinewood Site 1 (3m)  
 Test Method: FCC Part 15.209 Test Date: 07-Jan-2006  
 EUT Model #: ES1501, ES1501-XL EUT Power: 3 VDC  
 EUT Serial #: 01564224, 01564072  
 Manufacturer: Inovonics  
 EUT Description: Water Meter Transmitter  
 Notes: Two units tested in field simultaneously.  
 Removable Battery(ES1501)  
 Fixed Battery(ES1501-XL)

Temperature: 18.0 °C  
 Relative Humidity: 26 %  
 Air Pressure: 81 kPa  
 Page:

| 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) (DEG)      | 15.209 <1GHz | 15.209 >1GHz |
| The following are noise floor points. |         |                      |        |                |              |              |
| 8500.00                               | 42.5 Av | 8.5 / 34.6 / 48.0    | 37.6   | V / 1.0 / 0.0  | N/A          | -16.4        |
| 9500.00                               | 40.1 Av | 9.4 / 35.6 / 48.9    | 36.3   | V / 1.0 / 0.0  | N/A          | -17.7        |
| Horizontal                            |         |                      |        |                |              |              |
| 10000.0                               | 43.2 Av | 9.5 / 35.4 / 48.6    | 39.6   | H / 1.0 / 0.0  | N/A          | -14.4        |
| 9000.00                               | 41.6 Av | 8.5 / 35.1 / 48.6    | 36.6   | H / 1.0 / 0.0  | N/A          | -17.4        |
| End of Run                            |         |                      |        |                |              |              |

# Radiated Electromagnetic Emissions

|                  |                                           |            |                      |
|------------------|-------------------------------------------|------------|----------------------|
| Test Report #:   | 3090365                                   | Test Area: | Pinewood Site 1 (3m) |
| Test Method:     | FCC Part 15.209                           | Test Date: | 07-Jan-2006          |
| EUT Model #:     | ES1501, ES1501-XL                         | EUT Power: | 3 VDC                |
| EUT Serial #:    | 01564224, 01564072                        |            |                      |
| Manufacturer:    | Inovonics                                 |            |                      |
| EUT Description: | Water Meter Transmitter                   |            |                      |
| Notes:           | Two units tested in field simultaneously. |            |                      |
|                  | Removable Battery(ES1501)                 |            |                      |
|                  | Fixed Battery(ES1501-XL)                  |            |                      |

|                    |      |     |
|--------------------|------|-----|
| Temperature:       | 18.0 | °C  |
| Relative Humidity: | 26   | %   |
| Air Pressure:      | 81   | kPa |

Page:

| 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) (DEG)       | 15.209 <1GHz | 15.209 >1GHz |
| ***** Measurement Summary ***** |         |                      |        |                 |              |              |
| 1159.61                         | 40.3 Av | 2.4 / 22.5 / 16.7    | 48.6   | V / 1.0 / 115.0 | N/A          | -5.4         |
| 1000.00                         | 33.2 Av | 3.7 / 22.0 / 12.0    | 46.9   | V / 1.0 / 0.0   | N/A          | -7.1         |
| 1250.00                         | 35.0 Av | 2.5 / 22.8 / 19.2    | 41.2   | H / 1.0 / 0.0   | N/A          | -12.8        |
| 10000.0                         | 43.2 Av | 9.5 / 35.4 / 48.6    | 39.6   | H / 1.0 / 0.0   | N/A          | -14.4        |
| 8500.00                         | 42.5 Av | 8.5 / 34.6 / 48.0    | 37.6   | V / 1.0 / 0.0   | N/A          | -16.4        |
| 9000.00                         | 41.6 Av | 8.5 / 35.1 / 48.6    | 36.6   | H / 1.0 / 0.0   | N/A          | -17.4        |
| 9500.00                         | 40.1 Av | 9.4 / 35.6 / 48.9    | 36.3   | V / 1.0 / 0.0   | N/A          | -17.7        |
| 7500.00                         | 32.2 Av | 8.2 / 34.2 / 39.9    | 34.7   | H / 1.0 / 0.0   | N/A          | -19.3        |
| 4000.00                         | 35.2 Av | 5.7 / 29.7 / 36.3    | 34.3   | V / 1.0 / 0.0   | N/A          | -19.7        |
| 8000.00                         | 31.8 Av | 8.3 / 34.3 / 40.6    | 33.8   | V / 1.0 / 0.0   | N/A          | -20.2        |
| 7000.00                         | 32.6 Av | 8.1 / 33.1 / 40.5    | 33.3   | V / 1.0 / 0.0   | N/A          | -20.7        |
| 6500.00                         | 32.6 Av | 8.5 / 32.0 / 40.3    | 32.8   | H / 1.0 / 0.0   | N/A          | -21.2        |
| 50.12                           | 35.9 Qp | 0.7 / 10.3 / 28.2    | 18.6   | H / 2.0 / 0.0   | -21.4        | N/A          |
| 6000.00                         | 32.3 Av | 7.7 / 32.2 / 39.6    | 32.6   | V / 1.0 / 0.0   | N/A          | -21.4        |
| 5000.00                         | 33.6 Av | 7.6 / 31.4 / 40.4    | 32.2   | V / 1.0 / 0.0   | N/A          | -21.8        |
| 5500.00                         | 33.0 Av | 6.7 / 32.0 / 40.3    | 31.4   | H / 1.0 / 0.0   | N/A          | -22.6        |
| 3500.00                         | 34.3 Av | 4.8 / 28.6 / 36.7    | 31.0   | H / 1.0 / 0.0   | N/A          | -23.0        |
| 108.84                          | 36.4 Qp | 1.1 / 10.4 / 28.0    | 19.9   | V / 1.0 / 0.0   | -23.6        | N/A          |
| 3250.00                         | 34.2 Av | 4.7 / 28.2 / 36.7    | 30.4   | V / 1.0 / 0.0   | N/A          | -23.6        |
| 1750.00                         | 35.2 Av | 3.1 / 24.8 / 33.4    | 29.6   | V / 1.0 / 0.0   | N/A          | -24.4        |
| 2750.00                         | 35.4 Av | 4.3 / 27.0 / 37.7    | 29.0   | H / 1.0 / 0.0   | N/A          | -25.0        |
| 30.00                           | 28.7 Qp | 0.5 / 13.1 / 28.2    | 14.1   | V / 1.0 / 0.0   | -25.9        | N/A          |
| 173.49                          | 30.9 Qp | 1.4 / 12.5 / 27.6    | 17.3   | V / 1.0 / 0.0   | -26.2        | N/A          |
| 2500.00                         | 33.7 Av | 4.0 / 26.3 / 37.4    | 26.5   | V / 1.0 / 0.0   | N/A          | -27.5        |
| 900.01                          | 19.1 Qp | 3.6 / 23.2 / 27.7    | 18.2   | H / 2.0 / 0.0   | -27.8        | N/A          |
| 11.16                           | 30.6 Qp | 0.2 / 10.5 / 0.0     | 41.3   | H / 1.0 / 0.0   | -28.2        | N/A          |
| 875.00                          | 19.1 Qp | 3.5 / 23.0 / 27.7    | 17.8   | V / 1.0 / 0.0   | -28.2        | N/A          |
| 2000.00                         | 33.0 Av | 3.2 / 25.9 / 36.4    | 25.7   | H / 1.0 / 0.0   | N/A          | -28.3        |
| 190.20                          | 27.4 Qp | 1.4 / 13.5 / 27.5    | 14.8   | H / 2.0 / 0.0   | -28.7        | N/A          |
| 675.01                          | 19.9 Qp | 3.1 / 21.2 / 28.3    | 15.9   | H / 2.0 / 0.0   | -30.1        | N/A          |

## Radiated Electromagnetic Emissions

|                  |                                           |            |                      |                    |      |     |
|------------------|-------------------------------------------|------------|----------------------|--------------------|------|-----|
| Test Report #:   | 3090365                                   | Test Area: | Pinewood Site 1 (3m) | Temperature:       | 18.0 | °C  |
| Test Method:     | FCC Part 15.209                           | Test Date: | 07-Jan-2006          | Relative Humidity: | 26   | %   |
| EUT Model #:     | ES1501, ES1501-XL                         | EUT Power: | 3 VDC                | Air Pressure:      | 81   | kPa |
| EUT Serial #:    | 01564224, 01564072                        |            |                      | Page:              |      |     |
| Manufacturer:    | Inovonics                                 |            |                      |                    |      |     |
| EUT Description: | Water Meter Transmitter                   |            |                      |                    |      |     |
| Notes:           | Two units tested in field simultaneously. |            |                      |                    |      |     |
|                  | Removable Battery(ES1501)                 |            |                      |                    |      |     |
|                  | Fixed Battery(ES1501-XL)                  |            |                      |                    |      |     |

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

| FREQ<br>(MHz) | LEVEL<br>(dBuV) | CABLE / ANT / PREAMP<br>(dB) (dB\m) (dB) | FINAL<br>(dBuV) | POL / HGT / AZ<br>(m) (DEG) | DELTA1 (dB)<br>15.209 <1GHz | DELTA2 (dB)<br>15.209 >1GHz |
|---------------|-----------------|------------------------------------------|-----------------|-----------------------------|-----------------------------|-----------------------------|
| 825.01        | 18.4 Qp         | 3.3 / 22.0 / 28.0                        | 15.8            | H / 2.0 / 0.0               | -30.2                       | N/A                         |
| 4.80          | 28.9 Qp         | 0.2 / 10.2 / 0.0                         | 39.2            | V / 1.0 / 0.0               | -30.3                       | N/A                         |
| 725.00        | 19.2 Qp         | 3.2 / 21.4 / 28.2                        | 15.6            | V / 1.0 / 0.0               | -30.4                       | N/A                         |
| 29.75         | 29.8 Qp         | 0.5 / 8.5 / 0.0                          | 38.9            | H / 1.0 / 0.0               | -30.6                       | N/A                         |
| 800.00        | 18.3 Qp         | 3.3 / 21.7 / 28.0                        | 15.3            | V / 1.0 / 0.0               | -30.7                       | N/A                         |
| 750.01        | 18.9 Qp         | 3.2 / 21.3 / 28.2                        | 15.2            | H / 2.0 / 0.0               | -30.8                       | N/A                         |
| 120.20        | 26.9 Qp         | 1.2 / 11.7 / 27.9                        | 11.8            | H / 2.0 / 0.0               | -31.7                       | N/A                         |
| 650.00        | 19.4 Qp         | 3.0 / 20.2 / 28.4                        | 14.2            | V / 1.0 / 0.0               | -31.8                       | N/A                         |
| 575.00        | 19.9 Qp         | 2.8 / 19.4 / 28.4                        | 13.7            | V / 1.0 / 0.0               | -32.3                       | N/A                         |
| 602.65        | 19.4 Qp         | 2.9 / 19.5 / 28.4                        | 13.4            | H / 2.0 / 0.0               | -32.6                       | N/A                         |
| 500.00        | 20.1 Qp         | 2.6 / 18.8 / 28.4                        | 13.1            | V / 1.0 / 0.0               | -32.9                       | N/A                         |
| 19.45         | 25.4 Qp         | 0.4 / 10.3 / 0.0                         | 36.2            | V / 1.0 / 0.0               | -33.3                       | N/A                         |
| 524.91        | 19.2 Qp         | 2.6 / 19.0 / 28.4                        | 12.5            | H / 2.0 / 0.0               | -33.5                       | N/A                         |
| 4500.00       | 24.1 Av         | 6.6 / 30.1 / 40.5                        | 20.3            | H / 1.0 / 0.0               | N/A                         | -33.7                       |
| 2.26          | 25.4 Qp         | 0.1 / 10.2 / 0.0                         | 35.7            | H / 1.0 / 0.0               | -33.8                       | N/A                         |
| 450.00        | 19.2 Qp         | 2.4 / 17.2 / 28.1                        | 10.7            | H / 2.0 / 0.0               | -35.3                       | N/A                         |
| 975.01        | 18.6 Qp         | 3.7 / 23.8 / 27.4                        | 18.7            | V / 1.0 / 0.0               | -35.3                       | N/A                         |
| 225.00        | 25.1 Qp         | 1.6 / 11.1 / 27.2                        | 10.6            | H / 2.0 / 0.0               | -35.4                       | N/A                         |
| 0.103         | 60.6 Qp         | 0.1 / 11.0 / 0.0                         | 71.7            | H / 1.0 / 0.0               | -35.6                       | N/A                         |
| 425.00        | 19.4 Qp         | 2.3 / 16.6 / 28.0                        | 10.3            | V / 1.0 / 0.0               | -35.7                       | N/A                         |
| 200.00        | 21.9 Qp         | 1.5 / 11.5 / 27.4                        | 7.5             | V / 1.0 / 0.0               | -36.0                       | N/A                         |
| 374.86        | 19.8 Qp         | 2.1 / 15.7 / 27.5                        | 10.0            | H / 2.0 / 0.0               | -36.0                       | N/A                         |
| 300.00        | 19.9 Qp         | 1.9 / 14.4 / 27.1                        | 9.1             | H / 2.0 / 0.0               | -36.9                       | N/A                         |
| 350.00        | 17.8 Qp         | 2.1 / 15.2 / 27.3                        | 7.7             | V / 1.0 / 0.0               | -38.3                       | N/A                         |
| 275.00        | 18.2 Qp         | 1.8 / 13.4 / 27.0                        | 6.4             | V / 1.0 / 0.0               | -39.6                       | N/A                         |
| 0.0100        | 66.1 Qp         | 0.0 / 18.5 / 0.0                         | 84.6            | V / 1.0 / 0.0               | -43.0                       | N/A                         |
| 0.369         | 40.8 Qp         | 0.1 / 10.4 / 0.0                         | 51.2            | H / 1.0 / 0.0               | -45.1                       | N/A                         |
| 0.254         | 43.1 Qp         | 0.1 / 10.5 / 0.0                         | 53.7            | V / 1.0 / 0.0               | -45.8                       | N/A                         |
| 0.446         | 38.2 Qp         | 0.1 / 10.4 / 0.0                         | 48.7            | V / 1.0 / 0.0               | -45.9                       | N/A                         |
| 0.184         | 43.2 Qp         | 0.1 / 10.7 / 0.0                         | 54.0            | H / 1.0 / 0.0               | -48.3                       | N/A                         |

**15.247 (b)(2), (c)/15.205 Test Data**

**ES1501**

# Field Strength Measurements

## Fundamental and Spurious of the Transmitter

| Test Report #:   | <b>3090365</b>            | Test Area:                                                                                                                                                                                                                                                             | Pinewood Site 1 (3m) | Temperature:       | 18.0 | °C  |           |  |           |                  |                |                 |              |  |
|------------------|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------------|------|-----|-----------|--|-----------|------------------|----------------|-----------------|--------------|--|
| Test Method:     | FCC Part 15.209           | Test Date:                                                                                                                                                                                                                                                             | 07-Jan-2006          | Relative Humidity: | 26   | %   |           |  |           |                  |                |                 |              |  |
| EUT Model #:     | ES1501                    | EUT Power:                                                                                                                                                                                                                                                             | 3 VDC                | Air Pressure:      | 81   | kPa |           |  |           |                  |                |                 |              |  |
| EUT Serial #:    | 01564224                  | Page:                                                                                                                                                                                                                                                                  |                      |                    |      |     |           |  |           |                  |                |                 |              |  |
| Manufacturer:    | Inovonics                 | <table border="1"> <thead> <tr> <th colspan="2">Level Key</th> </tr> </thead> <tbody> <tr> <td>Pk – Peak</td> <td>Nb – Narrow Band</td> </tr> <tr> <td>Qp – QuasiPeak</td> <td>Bb – Broad Band</td> </tr> <tr> <td>Av - Average</td> <td></td> </tr> </tbody> </table> |                      |                    |      |     | Level Key |  | Pk – Peak | Nb – Narrow Band | Qp – QuasiPeak | Bb – Broad Band | Av - Average |  |
| Level Key        |                           |                                                                                                                                                                                                                                                                        |                      |                    |      |     |           |  |           |                  |                |                 |              |  |
| Pk – Peak        | Nb – Narrow Band          |                                                                                                                                                                                                                                                                        |                      |                    |      |     |           |  |           |                  |                |                 |              |  |
| Qp – QuasiPeak   | Bb – Broad Band           |                                                                                                                                                                                                                                                                        |                      |                    |      |     |           |  |           |                  |                |                 |              |  |
| Av - Average     |                           |                                                                                                                                                                                                                                                                        |                      |                    |      |     |           |  |           |                  |                |                 |              |  |
| EUT Description: | Water Meter Transmitter   |                                                                                                                                                                                                                                                                        |                      |                    |      |     |           |  |           |                  |                |                 |              |  |
| Notes:           | Removable Battery(ES1501) |                                                                                                                                                                                                                                                                        |                      |                    |      |     |           |  |           |                  |                |                 |              |  |

| FREQ                                                                                                                                                                                                                                                                                                           | LEVEL   | CABLE / ANT /<br>PREAMP | FINAL  | POL / HGT / AZ  | Duty Cycle<br>Correction | Final Corrected | Limit    | DELTA |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-------------------------|--------|-----------------|--------------------------|-----------------|----------|-------|
| (MHz)                                                                                                                                                                                                                                                                                                          | (dBuV)  | (dB) (dBm) (dB)         | (dBuV) | (m) (DEG)       | (dB)                     | (dBuV/m)        | (dBuV/m) | (dB)  |
| The following duty cycle was declared by the manufacturer.<br>"In this case, the maximum time that the carrier would dwell on any hopping channel is 18.8 mS in a 100 mS window. Therefore, the maximum Duty Factor correction factor of 14.52 dB was utilized in the calculations for the final measurement." |         |                         |        |                 |                          |                 |          |       |
| <b>Averaging method for pulsed signals and calculation in accordance to FCC CFR47 Part 15.35 utilized to calculate field strength emissions.</b>                                                                                                                                                               |         |                         |        |                 |                          |                 |          |       |
| The testing performed in accordance to FCC CFR47 Part 15.205 (restricted bands of operation) and 15.247 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 15.247 and the emission/limit delta was calculated.                                                                                                                                                                     |         |                         |        |                 |                          |                 |          |       |
| the DTCF is calculated as follows $20 \cdot \log_{10}(\text{duty cycle in 100ms})$ "not to exceed 20dB"                                                                                                                                                                                                        |         |                         |        |                 |                          |                 |          |       |
| Part 15.247 and 15.205 Respectively                                                                                                                                                                                                                                                                            |         |                         |        |                 |                          |                 |          |       |
| Determining worst case axis for EUT.                                                                                                                                                                                                                                                                           |         |                         |        |                 |                          |                 |          |       |
| Axis 1, EUT Flat on table                                                                                                                                                                                                                                                                                      |         |                         |        |                 |                          |                 |          |       |
| Low Channel                                                                                                                                                                                                                                                                                                    |         |                         |        |                 |                          |                 |          |       |
| 902.41                                                                                                                                                                                                                                                                                                         | 85.0 Pk | 3.6 / 23.2 / 0.0        | 111.8  | V / 1.0 / 152.0 | 0                        | 111.8           | 119      | -7.2  |
| 902.41                                                                                                                                                                                                                                                                                                         | 88.0 Pk | 3.6 / 23.2 / 0.0        | 114.7  | H / 1.0 / 40.0  | 0                        | 114.7           | 119      | -4.3  |
| Mid Channel                                                                                                                                                                                                                                                                                                    |         |                         |        |                 |                          |                 |          |       |
| 914.83                                                                                                                                                                                                                                                                                                         | 88.4 Pk | 3.6 / 23.2 / 0.0        | 115.2  | H / 1.0 / 51.0  | 0                        | 115.2           | 119      | -3.8  |
| 914.83                                                                                                                                                                                                                                                                                                         | 83.6 Pk | 3.6 / 23.2 / 0.0        | 110.4  | V / 1.1 / 242.0 | 0                        | 110.4           | 119      | -8.6  |
| High Channel                                                                                                                                                                                                                                                                                                   |         |                         |        |                 |                          |                 |          |       |
| 927.62                                                                                                                                                                                                                                                                                                         | 79.7 Pk | 3.6 / 23.2 / 0.0        | 106.5  | V / 1.1 / 240.0 | 0                        | 106.5           | 119      | -12.5 |
| 927.62                                                                                                                                                                                                                                                                                                         | 82.8 Pk | 3.6 / 23.2 / 0.0        | 109.7  | H / 1.1 / 42.0  | 0                        | 109.7           | 119      | -9.3  |
| Axis 2, EUT on its side                                                                                                                                                                                                                                                                                        |         |                         |        |                 |                          |                 |          |       |
| High Channel                                                                                                                                                                                                                                                                                                   |         |                         |        |                 |                          |                 |          |       |
| 927.62                                                                                                                                                                                                                                                                                                         | 83.5 Pk | 3.6 / 23.2 / 0.0        | 110.3  | H / 1.5 / 210.0 | 0                        | 110.3           | 119      | -8.7  |
| 927.62                                                                                                                                                                                                                                                                                                         | 77.0 Pk | 3.6 / 23.2 / 0.0        | 103.8  | V / 1.0 / 22.0  | 0                        | 103.8           | 119      | -15.2 |
| Mid Channel                                                                                                                                                                                                                                                                                                    |         |                         |        |                 |                          |                 |          |       |
| 914.83                                                                                                                                                                                                                                                                                                         | 81.1 Pk | 3.6 / 23.2 / 0.0        | 107.9  | V / 1.0 / 46.0  | 0                        | 107.9           | 119      | -11.1 |
| 914.83                                                                                                                                                                                                                                                                                                         | 87.5 Pk | 3.6 / 23.2 / 0.0        | 114.3  | H / 1.0 / 337.0 | 0                        | 114.3           | 119      | -4.7  |
| Low Channel                                                                                                                                                                                                                                                                                                    |         |                         |        |                 |                          |                 |          |       |
| 902.41                                                                                                                                                                                                                                                                                                         | 90.0 Pk | 3.6 / 23.2 / 0.0        | 116.8  | H / 1.0 / 25.0  | 0                        | 116.8           | 119      | -2.2  |
| 902.41                                                                                                                                                                                                                                                                                                         | 83.2 Pk | 3.6 / 23.2 / 0.0        | 110    | V / 1.1 / 20.0  | 0                        | 110.0           | 119      | -9    |
| Axis 3, EUT standing up                                                                                                                                                                                                                                                                                        |         |                         |        |                 |                          |                 |          |       |
| Low Channel                                                                                                                                                                                                                                                                                                    |         |                         |        |                 |                          |                 |          |       |
| 902.41                                                                                                                                                                                                                                                                                                         | 87.5 Pk | 3.6 / 23.2 / 0.0        | 114.3  | V / 1.1 / 0.0   | 0                        | 114.3           | 119      | -4.7  |
| 902.41                                                                                                                                                                                                                                                                                                         | 88.1 Pk | 3.6 / 23.2 / 0.0        | 114.9  | H / 1.1 / 112.0 | 0                        | 114.9           | 119      | -4.1  |

# Field Strength Measurements

## Fundamental and Spurious of the Transmitter

| Test Report #:   | <b>3090365</b>            | Test Area:                                                                                                                                                                                                                                                             | Pinewood Site 1 (3m) | Temperature:       | 18.0 °C |           |  |           |                  |                |                 |              |  |
|------------------|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--------------------|---------|-----------|--|-----------|------------------|----------------|-----------------|--------------|--|
| Test Method:     | FCC Part 15.209           | Test Date:                                                                                                                                                                                                                                                             | 07-Jan-2006          | Relative Humidity: | 26 %    |           |  |           |                  |                |                 |              |  |
| EUT Model #:     | ES1501                    | EUT Power:                                                                                                                                                                                                                                                             | 3 VDC                | Air Pressure:      | 81 kPa  |           |  |           |                  |                |                 |              |  |
| EUT Serial #:    | 01564224                  | Page:                                                                                                                                                                                                                                                                  |                      |                    |         |           |  |           |                  |                |                 |              |  |
| Manufacturer:    | Inovonics                 | <table border="1"> <thead> <tr> <th colspan="2">Level Key</th> </tr> </thead> <tbody> <tr> <td>Pk – Peak</td> <td>Nb – Narrow Band</td> </tr> <tr> <td>Qp – QuasiPeak</td> <td>Bb – Broad Band</td> </tr> <tr> <td>Av - Average</td> <td></td> </tr> </tbody> </table> |                      |                    |         | Level Key |  | Pk – Peak | Nb – Narrow Band | Qp – QuasiPeak | Bb – Broad Band | Av - Average |  |
| Level Key        |                           |                                                                                                                                                                                                                                                                        |                      |                    |         |           |  |           |                  |                |                 |              |  |
| Pk – Peak        | Nb – Narrow Band          |                                                                                                                                                                                                                                                                        |                      |                    |         |           |  |           |                  |                |                 |              |  |
| Qp – QuasiPeak   | Bb – Broad Band           |                                                                                                                                                                                                                                                                        |                      |                    |         |           |  |           |                  |                |                 |              |  |
| Av - Average     |                           |                                                                                                                                                                                                                                                                        |                      |                    |         |           |  |           |                  |                |                 |              |  |
| EUT Description: | Water Meter Transmitter   |                                                                                                                                                                                                                                                                        |                      |                    |         |           |  |           |                  |                |                 |              |  |
| Notes:           | Removable Battery(ES1501) |                                                                                                                                                                                                                                                                        |                      |                    |         |           |  |           |                  |                |                 |              |  |

| FREQ                                                                                                                                                                                                                                                                                                           | LEVEL   | CABLE / ANT /<br>PREAMP | FINAL  | POL / HGT / AZ  | Duty Cycle<br>Correction | Final Corrected | Limit    | DELTA  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-------------------------|--------|-----------------|--------------------------|-----------------|----------|--------|
| (MHz)                                                                                                                                                                                                                                                                                                          | (dBuV)  | (dB) (dBm) (dB)         | (dBuV) | (m) (DEG)       | (dB)                     | (dBuV/m)        | (dBuV/m) | (dB)   |
| The following duty cycle was declared by the manufacturer.<br>"In this case, the maximum time that the carrier would dwell on any hopping channel is 18.8 mS in a 100 mS window. Therefore, the maximum Duty Factor correction factor of 14.52 dB was utilized in the calculations for the final measurement." |         |                         |        |                 |                          |                 |          |        |
| <b>Averaging method for pulsed signals and calculation in accordance to FCC CFR47 Part 15.35 utilized to calculate field strength emissions.</b>                                                                                                                                                               |         |                         |        |                 |                          |                 |          |        |
| The testing performed in accordance to FCC CFR47 Part 15.205 (restricted bands of operation) and 15.247 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 15.247 and the emission/limit delta was calculated.                                                                                                                                                                     |         |                         |        |                 |                          |                 |          |        |
| the DTCF is calculated as follows $20 \cdot \log_{10}(\text{duty cycle in 100ms})$ "not to exceed 20dB"                                                                                                                                                                                                        |         |                         |        |                 |                          |                 |          |        |
| Part 15.247 and 15.205 Respectively                                                                                                                                                                                                                                                                            |         |                         |        |                 |                          |                 |          |        |
| Mid Channel                                                                                                                                                                                                                                                                                                    |         |                         |        |                 |                          |                 |          |        |
| 914.83                                                                                                                                                                                                                                                                                                         | 87.2 Pk | 3.6 / 23.2 / 0.0        | 114    | H / 1.0 / 152.0 | 0                        | 114.0           | 119      | -5     |
| 914.83                                                                                                                                                                                                                                                                                                         | 86.0 Pk | 3.6 / 23.2 / 0.0        | 112.7  | V / 1.1 / 343.0 | 0                        | 112.7           | 119      | -6.3   |
| High Channel                                                                                                                                                                                                                                                                                                   |         |                         |        |                 |                          |                 |          |        |
| 927.62                                                                                                                                                                                                                                                                                                         | 82.8 Pk | 3.6 / 23.2 / 0.0        | 109.6  | V / 1.1 / 88.0  | 0                        | 109.6           | 119      | -9.4   |
| 927.62                                                                                                                                                                                                                                                                                                         | 82.7 Pk | 3.6 / 23.2 / 0.0        | 109.5  | H / 1.1 / 155.0 | 0                        | 109.5           | 119      | -9.5   |
| Axis 2 Determined to be worst case.                                                                                                                                                                                                                                                                            |         |                         |        |                 |                          |                 |          |        |
| EUT placed in worst case position for remaining testing.                                                                                                                                                                                                                                                       |         |                         |        |                 |                          |                 |          |        |
| Low channel                                                                                                                                                                                                                                                                                                    |         |                         |        |                 |                          |                 |          |        |
| 1804.74                                                                                                                                                                                                                                                                                                        | 69.9 Pk | 3.1 / 25.0 / 35.1       | 62.9   | V / 1.0 / 197.0 | -14.52                   | 48.38           | 99       | -50.62 |
| 1804.74                                                                                                                                                                                                                                                                                                        | 68.7 Pk | 3.1 / 25.0 / 35.1       | 61.7   | H / 1.0 / 189.0 | -14.52                   | 47.18           | 99       | -51.82 |
| 2707.1                                                                                                                                                                                                                                                                                                         | 64.4 Pk | 4.2 / 26.9 / 37.5       | 58     | V / 1.0 / 197.0 | -14.52                   | 43.48           | 54       | -10.52 |
| 2707.1                                                                                                                                                                                                                                                                                                         | 61.1 Pk | 4.2 / 26.9 / 37.5       | 54.7   | H / 1.1 / 191.0 | -14.52                   | 40.18           | 54       | -13.82 |
| 3609.43                                                                                                                                                                                                                                                                                                        | 61.0 Pk | 5.0 / 28.9 / 37.9       | 57     | V / 1.0 / 346.0 | -14.52                   | 42.48           | 54       | -11.52 |
| 3609.43                                                                                                                                                                                                                                                                                                        | 57.5 Pk | 5.0 / 28.9 / 37.9       | 53.5   | H / 1.9 / 146.0 | -14.52                   | 38.98           | 54       | -15.02 |
| 4511.79                                                                                                                                                                                                                                                                                                        | 61.0 Pk | 6.6 / 30.2 / 40.5       | 57.3   | V / 1.2 / 20.0  | -14.52                   | 42.78           | 54       | -11.22 |
| 4511.79                                                                                                                                                                                                                                                                                                        | 62.0 Pk | 6.6 / 30.2 / 40.5       | 58.2   | H / 1.6 / 75.0  | -14.52                   | 43.68           | 54       | -10.32 |
| 5414.12                                                                                                                                                                                                                                                                                                        | 58.4 Pk | 6.9 / 31.9 / 40.2       | 56.9   | V / 1.2 / 331.0 | -14.52                   | 42.38           | 54       | -11.62 |
| 5414.78                                                                                                                                                                                                                                                                                                        | 60.2 Pk | 6.9 / 31.9 / 40.2       | 58.7   | H / 1.5 / 128.0 | -14.52                   | 44.18           | 54       | -9.82  |
| 6316.37                                                                                                                                                                                                                                                                                                        | 62.9 Pk | 8.2 / 32.1 / 40.9       | 62.2   | V / 1.1 / 300.0 | -14.52                   | 47.68           | 99       | -51.32 |
| 6316.37                                                                                                                                                                                                                                                                                                        | 57.4 Pk | 8.2 / 32.1 / 40.9       | 56.8   | H / 1.4 / 210.0 | -14.52                   | 42.28           | 99       | -56.72 |
| 7218.73                                                                                                                                                                                                                                                                                                        | 53.8 Pk | 8.1 / 33.5 / 40.7       | 54.8   | V / 1.3 / 260.0 | -14.52                   | 40.28           | 99       | -58.72 |
| 7218.73                                                                                                                                                                                                                                                                                                        | 51.2 Pk | 8.1 / 33.5 / 40.7       | 52.3   | H / 1.7 / 97.0  | -14.52                   | 37.78           | 99       | -61.22 |
| 8121.07                                                                                                                                                                                                                                                                                                        | 66.7 Pk | 8.3 / 34.4 / 46.8       | 62.6   | V / 1.8 / 203.0 | -14.52                   | 48.08           | 54       | -5.92  |
| 8121.07                                                                                                                                                                                                                                                                                                        | 64.5 Pk | 8.3 / 34.4 / 46.8       | 60.5   | H / 1.6 / 332.0 | -14.52                   | 45.98           | 54       | -8.02  |
| 9023.4                                                                                                                                                                                                                                                                                                         | 61.7 Pk | 8.5 / 35.2 / 48.5       | 56.9   | V / 1.5 / 193.0 | -14.52                   | 42.38           | 54       | -11.62 |
| 9023.4                                                                                                                                                                                                                                                                                                         | 58.1 Pk | 8.5 / 35.2 / 48.5       | 53.3   | H / 1.5 / 70.0  | -14.52                   | 38.78           | 54       | -15.22 |

# Field Strength Measurements

## Fundamental and Spurious of the Transmitter

|                  |                           |            |                      |                    |      |     |
|------------------|---------------------------|------------|----------------------|--------------------|------|-----|
| Test Report #:   | 3090365                   | Test Area: | Pinewood Site 1 (3m) | Temperature:       | 18.0 | °C  |
| Test Method:     | FCC Part 15.209           | Test Date: | 07-Jan-2006          | Relative Humidity: | 26   | %   |
| EUT Model #:     | ES1501                    | EUT Power: | 3 VDC                | Air Pressure:      | 81   | kPa |
| EUT Serial #:    | 01564224                  |            |                      | Page:              |      |     |
| Manufacturer:    | Inovonics                 |            |                      |                    |      |     |
| EUT Description: | Water Meter Transmitter   |            |                      |                    |      |     |
| Notes:           | Removable Battery(ES1501) |            |                      |                    |      |     |

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

| FREQ                                                                                                                                                                                                                                                                                                           | LEVEL   | CABLE / ANT /<br>PREAMP | FINAL  | POL / HGT / AZ  | Duty Cycle<br>Correction | Final Corrected | Limit    | DELTA  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-------------------------|--------|-----------------|--------------------------|-----------------|----------|--------|
| (MHz)                                                                                                                                                                                                                                                                                                          | (dBuV)  | (dB) (dBm) (dB)         | (dBuV) | (m) (DEG)       | (dB)                     | (dBuV/m)        | (dBuV/m) | (dB)   |
| The following duty cycle was declared by the manufacturer.<br>"In this case, the maximum time that the carrier would dwell on any hopping channel is 18.8 mS in a 100 mS window. Therefore, the maximum Duty Factor correction factor of 14.52 dB was utilized in the calculations for the final measurement." |         |                         |        |                 |                          |                 |          |        |
| <b>Averaging method for pulsed signals and calculation in accordance to FCC CFR47 Part 15.35 utilized to calculate field strength emissions.</b>                                                                                                                                                               |         |                         |        |                 |                          |                 |          |        |
| The testing performed in accordance to FCC CFR47 Part 15.205 (restricted bands of operation) and 15.247 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 15.247 and the emission/limit delta was calculated.                                                                                                                                                                     |         |                         |        |                 |                          |                 |          |        |
| the DTCF is calculated as follows $20 \cdot \log_{10}(\text{duty cycle in 100ms})$ "not to exceed 20dB"                                                                                                                                                                                                        |         |                         |        |                 |                          |                 |          |        |
| Part 15.247 and 15.205 Respectively                                                                                                                                                                                                                                                                            |         |                         |        |                 |                          |                 |          |        |
| Mid Channel                                                                                                                                                                                                                                                                                                    |         |                         |        |                 |                          |                 |          |        |
| 1829.54                                                                                                                                                                                                                                                                                                        | 69.7 Pk | 3.1 / 25.1 / 35.8       | 62.1   | H / 1.2 / 331.0 | -14.52                   | 47.58           | 99       | -51.42 |
| 1829.54                                                                                                                                                                                                                                                                                                        | 70.3 Pk | 3.1 / 25.1 / 35.8       | 62.8   | V / 1.2 / 332.0 | -14.52                   | 48.28           | 99       | -50.72 |
| 2744.28                                                                                                                                                                                                                                                                                                        | 67.2 Pk | 4.3 / 27.0 / 37.7       | 60.8   | H / 1.9 / 342.0 | -14.52                   | 46.28           | 54       | -7.72  |
| 2744.28                                                                                                                                                                                                                                                                                                        | 71.0 Pk | 4.3 / 27.0 / 37.7       | 64.6   | V / 1.1 / 337.0 | -14.52                   | 50.08           | 54       | -3.92  |
| 3659.03                                                                                                                                                                                                                                                                                                        | 59.5 Pk | 5.1 / 29.0 / 37.7       | 55.8   | H / 1.9 / 142.0 | -14.52                   | 41.28           | 54       | -12.72 |
| 3659.47                                                                                                                                                                                                                                                                                                        | 64.8 Pk | 5.1 / 29.0 / 37.7       | 61.2   | V / 1.2 / 331.0 | -14.52                   | 46.68           | 54       | -7.32  |
| 4573.78                                                                                                                                                                                                                                                                                                        | 55.9 Pk | 6.7 / 30.3 / 40.5       | 52.5   | H / 1.9 / 110.0 | -14.52                   | 37.98           | 54       | -16.02 |
| 4574.32                                                                                                                                                                                                                                                                                                        | 65.7 Pk | 6.7 / 30.3 / 40.5       | 62.2   | V / 1.2 / 348.0 | -14.52                   | 47.68           | 54       | -6.32  |
| 5488.52                                                                                                                                                                                                                                                                                                        | 65.1 Pk | 6.7 / 32.0 / 40.3       | 63.5   | H / 1.7 / 215.0 | -14.52                   | 48.98           | 99       | -50.02 |
| 5489.18                                                                                                                                                                                                                                                                                                        | 62.7 Pk | 6.7 / 32.0 / 40.3       | 61.1   | V / 2.1 / 222.0 | -14.52                   | 46.58           | 99       | -52.42 |
| 6403.18                                                                                                                                                                                                                                                                                                        | 58.9 Pk | 8.3 / 32.0 / 40.8       | 58.4   | V / 1.4 / 293.0 | -14.52                   | 43.88           | 99       | -55.12 |
| 6403.96                                                                                                                                                                                                                                                                                                        | 52.4 Pk | 8.3 / 32.0 / 40.8       | 52     | H / 1.4 / 134.0 | -14.52                   | 37.48           | 99       | -61.52 |
| 7317.93                                                                                                                                                                                                                                                                                                        | 55.8 Pk | 8.2 / 33.8 / 40.4       | 57.3   | H / 1.5 / 160.0 | -14.52                   | 42.78           | 54       | -11.22 |
| 7317.93                                                                                                                                                                                                                                                                                                        | 59.5 Pk | 8.2 / 33.8 / 40.4       | 61     | V / 1.0 / 220.0 | -14.52                   | 46.48           | 54       | -7.52  |
| 8232.66                                                                                                                                                                                                                                                                                                        | 57.0 Pk | 8.4 / 34.5 / 47.1       | 52.8   | H / 1.7 / 320.0 | -14.52                   | 38.28           | 54       | -15.72 |
| 8233.66                                                                                                                                                                                                                                                                                                        | 59.5 Pk | 8.4 / 34.5 / 47.1       | 55.2   | V / 1.6 / 240.0 | -14.52                   | 40.68           | 54       | -13.32 |
| 9147.39                                                                                                                                                                                                                                                                                                        | 60.4 Pk | 8.8 / 35.3 / 48.1       | 56.4   | H / 1.6 / 176.0 | -14.52                   | 41.88           | 54       | -12.12 |
| 9147.39                                                                                                                                                                                                                                                                                                        | 61.8 Pk | 8.8 / 35.3 / 48.1       | 57.7   | V / 2.1 / 305.0 | -14.52                   | 43.18           | 54       | -10.82 |
| High Channel                                                                                                                                                                                                                                                                                                   |         |                         |        |                 |                          |                 |          |        |
| 1855.13                                                                                                                                                                                                                                                                                                        | 69.1 Pk | 3.1 / 25.3 / 35.8       | 61.7   | H / 1.1 / 135.0 | -14.52                   | 47.18           | 99       | -51.82 |
| 1855.15                                                                                                                                                                                                                                                                                                        | 71.8 Pk | 3.1 / 25.3 / 35.8       | 64.4   | V / 1.0 / 0.0   | -14.52                   | 49.88           | 99       | -49.12 |
| 2782.68                                                                                                                                                                                                                                                                                                        | 63.1 Pk | 4.3 / 27.1 / 37.7       | 56.8   | H / 1.1 / 187.0 | -14.52                   | 42.28           | 54       | -11.72 |
| 2782.69                                                                                                                                                                                                                                                                                                        | 68.3 Pk | 4.3 / 27.1 / 37.7       | 62     | V / 1.1 / 342.0 | -14.52                   | 47.48           | 54       | -6.52  |
| 3710.23                                                                                                                                                                                                                                                                                                        | 64.8 Pk | 5.2 / 29.1 / 37.5       | 61.7   | V / 1.0 / 335.0 | -14.52                   | 47.18           | 54       | -6.82  |
| 3710.23                                                                                                                                                                                                                                                                                                        | 56.6 Pk | 5.2 / 29.1 / 37.5       | 53.4   | H / 2.2 / 182.0 | -14.52                   | 38.88           | 54       | -15.12 |
| 4637.77                                                                                                                                                                                                                                                                                                        | 60.7 Pk | 6.9 / 30.5 / 40.4       | 57.6   | V / 1.2 / 11.0  | -14.52                   | 43.08           | 54       | -10.92 |
| 4637.77                                                                                                                                                                                                                                                                                                        | 56.5 Pk | 6.9 / 30.5 / 40.4       | 53.4   | H / 1.8 / 12.0  | -14.52                   | 38.88           | 54       | -15.12 |

# Field Strength Measurements

## Fundamental and Spurious of the Transmitter

|                  |                           |            |                      |                    |      |     |
|------------------|---------------------------|------------|----------------------|--------------------|------|-----|
| Test Report #:   | 3090365                   | Test Area: | Pinewood Site 1 (3m) | Temperature:       | 18.0 | °C  |
| Test Method:     | FCC Part 15.209           | Test Date: | 07-Jan-2006          | Relative Humidity: | 26   | %   |
| EUT Model #:     | ES1501                    | EUT Power: | 3 VDC                | Air Pressure:      | 81   | kPa |
| EUT Serial #:    | 01564224                  |            |                      | Page:              |      |     |
| Manufacturer:    | Inovonics                 |            |                      |                    |      |     |
| EUT Description: | Water Meter Transmitter   |            |                      |                    |      |     |
| Notes:           | Removable Battery(ES1501) |            |                      |                    |      |     |

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

| FREQ                                                                                                                                                                                                                                                                                                           | LEVEL   | CABLE / ANT /<br>PREAMP | FINAL  | POL / HGT / AZ  | Duty Cycle<br>Correction | Final Corrected | Limit    | DELTA  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-------------------------|--------|-----------------|--------------------------|-----------------|----------|--------|
| (MHz)                                                                                                                                                                                                                                                                                                          | (dBuV)  | (dB) (dBm) (dB)         | (dBuV) | (m) (DEG)       | (dB)                     | (dBuV/m)        | (dBuV/m) | (dB)   |
| The following duty cycle was declared by the manufacturer.<br>"In this case, the maximum time that the carrier would dwell on any hopping channel is 18.8 mS in a 100 mS window. Therefore, the maximum Duty Factor correction factor of 14.52 dB was utilized in the calculations for the final measurement." |         |                         |        |                 |                          |                 |          |        |
| <b>Averaging method for pulsed signals and calculation in accordance to FCC CFR47 Part 15.35 utilized to calculate field strength emissions.</b>                                                                                                                                                               |         |                         |        |                 |                          |                 |          |        |
| The testing performed in accordance to FCC CFR47 Part 15.205 (restricted bands of operation) and 15.247 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 15.247 and the emission/limit delta was calculated.                                                                                                                                                                     |         |                         |        |                 |                          |                 |          |        |
| the DTCF is calculated as follows $20 \cdot \log_{10}(\text{duty cycle in 100ms})$ "not to exceed 20dB"                                                                                                                                                                                                        |         |                         |        |                 |                          |                 |          |        |
| Part 15.247 and 15.205 Respectively                                                                                                                                                                                                                                                                            |         |                         |        |                 |                          |                 |          |        |
| 5565.31                                                                                                                                                                                                                                                                                                        | 69.5 Pk | 6.8 / 32.0 / 40.6       | 67.8   | V / 1.5 / 336.0 | -14.52                   | 53.28           | 99       | -45.72 |
| 5565.31                                                                                                                                                                                                                                                                                                        | 67.0 Pk | 6.8 / 32.0 / 40.6       | 65.3   | H / 1.5 / 130.0 | -14.52                   | 50.78           | 99       | -48.22 |
| 6492.77                                                                                                                                                                                                                                                                                                        | 54.0 Pk | 8.5 / 32.0 / 40.3       | 54.2   | V / 1.0 / 298.0 | -14.52                   | 39.68           | 99       | -59.32 |
| 6492.77                                                                                                                                                                                                                                                                                                        | 50.8 Pk | 8.5 / 32.0 / 40.3       | 50.9   | H / 1.4 / 293.0 | -14.52                   | 36.38           | 99       | -62.62 |
| 7420.31                                                                                                                                                                                                                                                                                                        | 56.2 Pk | 8.2 / 34.0 / 40.0       | 58.4   | V / 1.5 / 140.0 | -14.52                   | 43.88           | 54       | -10.12 |
| 7420.31                                                                                                                                                                                                                                                                                                        | 52.3 Pk | 8.2 / 34.0 / 40.0       | 54.5   | H / 1.7 / 156.0 | -14.52                   | 39.98           | 54       | -14.02 |
| 8347.86                                                                                                                                                                                                                                                                                                        | 62.8 Pk | 8.4 / 34.5 / 47.6       | 58.2   | V / 1.5 / 232.0 | -14.52                   | 43.68           | 54       | -10.32 |
| 8347.86                                                                                                                                                                                                                                                                                                        | 60.2 Pk | 8.4 / 34.5 / 47.6       | 55.6   | H / 1.7 / 161.0 | -14.52                   | 41.08           | 54       | -12.92 |
| 9275.4                                                                                                                                                                                                                                                                                                         | 52.9 Pk | 9.0 / 35.4 / 48.5       | 48.8   | V / 2.3 / 316.0 | -14.52                   | 34.28           | 99       | -64.72 |
| 9276.5                                                                                                                                                                                                                                                                                                         | 52.2 Pk | 9.0 / 35.4 / 48.5       | 48.2   | H / 1.6 / 176.0 | -14.52                   | 33.68           | 99       | -65.32 |

# ES1501-XL

# Field Strength Measurements Fundamental and Spurious of the Transmitter

|                  |                           |            |                      |                    |      |     |
|------------------|---------------------------|------------|----------------------|--------------------|------|-----|
| Test Report #:   | 3090365                   | Test Area: | Pinewood Site 1 (3m) | Temperature:       | 18.0 | °C  |
| Test Method:     | FCC Part 15.209           | Test Date: | 07-Jan-2006          | Relative Humidity: | 26   | %   |
| EUT Model #:     | ES1501-XL                 | EUT Power: | 3 VDC                | Air Pressure:      | 81   | kPa |
| EUT Serial #:    | 01564027                  |            |                      | Page:              |      |     |
| Manufacturer:    | Inovonics                 |            |                      |                    |      |     |
| EUT Description: | Water Meter Transmitter   |            |                      |                    |      |     |
| Notes:           | Removable Battery(ES1501) |            |                      |                    |      |     |

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

| FREQ                                                                                                                                                                                                                                                                                                           | LEVEL   | CABLE / ANT /<br>PREAMP | FINAL  | POL / HGT / AZ  | Duty Cycle<br>Correction | Final Corrected | Limit    | DELTA |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-------------------------|--------|-----------------|--------------------------|-----------------|----------|-------|
| (MHz)                                                                                                                                                                                                                                                                                                          | (dBuV)  | (dB) (dBm) (dB)         | (dBuV) | (m) (DEG)       | (dB)                     | (dBuV/m)        | (dBuV/m) | (dB)  |
| The following duty cycle was declared by the manufacturer.<br>"In this case, the maximum time that the carrier would dwell on any hopping channel is 18.8 mS in a 100 mS window. Therefore, the maximum Duty Factor correction factor of 14.52 dB was utilized in the calculations for the final measurement." |         |                         |        |                 |                          |                 |          |       |
| <b>Averaging method for pulsed signals and calculation in accordance to FCC CFR47 Part 15.35 utilized to calculate field strength emissions.</b>                                                                                                                                                               |         |                         |        |                 |                          |                 |          |       |
| The testing performed in accordance to FCC CFR47 Part 15.205 (restricted bands of operation) and 15.247 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 15.247 and the emission/limit delta was calculated.                                                                                                                                                                     |         |                         |        |                 |                          |                 |          |       |
| the DTCF is calculated as follows $20 \cdot \log_{10}(\text{duty cycle in 100ms})$ "not to exceed 20dB"                                                                                                                                                                                                        |         |                         |        |                 |                          |                 |          |       |
| Part 15.247 and 15.205 Respectively                                                                                                                                                                                                                                                                            |         |                         |        |                 |                          |                 |          |       |
| Determining worst case position                                                                                                                                                                                                                                                                                |         |                         |        |                 |                          |                 |          |       |
| Axis 1, EUT Flat on table                                                                                                                                                                                                                                                                                      |         |                         |        |                 |                          |                 |          |       |
| Low channel                                                                                                                                                                                                                                                                                                    |         |                         |        |                 |                          |                 |          |       |
| 902.37                                                                                                                                                                                                                                                                                                         | 85.8 Pk | 3.6 / 23.2 / 0.0        | 112.6  | V / 1.7 / 115.0 | 0                        | 112.6           | 119      | -6.4  |
| 902.37                                                                                                                                                                                                                                                                                                         | 90.5 Pk | 3.6 / 23.2 / 0.0        | 117.3  | H / 1.0 / 44.0  | 0                        | 117.3           | 119      | -1.7  |
| Mid Channel                                                                                                                                                                                                                                                                                                    |         |                         |        |                 |                          |                 |          |       |
| 914.78                                                                                                                                                                                                                                                                                                         | 89.5 Pk | 3.6 / 23.2 / 0.0        | 116.3  | H / 1.0 / 44.0  | 0                        | 116.3           | 119      | -2.7  |
| 914.78                                                                                                                                                                                                                                                                                                         | 84.1 Pk | 3.6 / 23.2 / 0.0        | 110.9  | V / 2.1 / 120.0 | 0                        | 110.9           | 119      | -8.1  |
| High Channel                                                                                                                                                                                                                                                                                                   |         |                         |        |                 |                          |                 |          |       |
| 927.58                                                                                                                                                                                                                                                                                                         | 84.5 Pk | 3.6 / 23.2 / 0.0        | 111.3  | V / 1.2 / 120.0 | 0                        | 111.3           | 119      | -7.7  |
| 927.58                                                                                                                                                                                                                                                                                                         | 87.0 Pk | 3.6 / 23.2 / 0.0        | 113.8  | H / 1.0 / 46.0  | 0                        | 113.8           | 119      | -5.2  |
| Axis 2, EUT on its side                                                                                                                                                                                                                                                                                        |         |                         |        |                 |                          |                 |          |       |
| High Channel                                                                                                                                                                                                                                                                                                   |         |                         |        |                 |                          |                 |          |       |
| 927.58                                                                                                                                                                                                                                                                                                         | 86.2 Pk | 3.6 / 23.2 / 0.0        | 113    | H / 1.0 / 39.0  | 0                        | 113             | 119      | -6    |
| 927.58                                                                                                                                                                                                                                                                                                         | 79.8 Pk | 3.6 / 23.2 / 0.0        | 106.6  | V / 1.3 / 123.0 | 0                        | 106.6           | 119      | -12.4 |
| Mid Channel                                                                                                                                                                                                                                                                                                    |         |                         |        |                 |                          |                 |          |       |
| 914.78                                                                                                                                                                                                                                                                                                         | 79.0 Pk | 3.6 / 23.2 / 0.0        | 105.8  | V / 1.3 / 25.0  | 0                        | 105.8           | 119      | -13.2 |
| 914.78                                                                                                                                                                                                                                                                                                         | 87.8 Pk | 3.6 / 23.2 / 0.0        | 114.5  | H / 1.0 / 46.0  | 0                        | 114.5           | 119      | -4.5  |
| Low Channel                                                                                                                                                                                                                                                                                                    |         |                         |        |                 |                          |                 |          |       |
| 902.37                                                                                                                                                                                                                                                                                                         | 89.5 Pk | 3.6 / 23.2 / 0.0        | 116.3  | H / 1.0 / 34.0  | 0                        | 116.3           | 119      | -2.7  |
| 902.37                                                                                                                                                                                                                                                                                                         | 82.8 Pk | 3.6 / 23.2 / 0.0        | 109.6  | V / 1.8 / 190.0 | 0                        | 109.6           | 119      | -9.4  |
| Axis 3, EUT standing up                                                                                                                                                                                                                                                                                        |         |                         |        |                 |                          |                 |          |       |
| Low Channel                                                                                                                                                                                                                                                                                                    |         |                         |        |                 |                          |                 |          |       |
| 902.37                                                                                                                                                                                                                                                                                                         | 89.0 Pk | 3.6 / 23.2 / 0.0        | 115.8  | V / 1.0 / 125.0 | 0                        | 115.8           | 119      | -3.2  |
| 902.37                                                                                                                                                                                                                                                                                                         | 87.7 Pk | 3.6 / 23.2 / 0.0        | 114.4  | H / 1.0 / 50.0  | 0                        | 114.4           | 119      | -4.6  |

# Field Strength Measurements

## Fundamental and Spurious of the Transmitter

|                  |                           |            |                      |                    |      |     |
|------------------|---------------------------|------------|----------------------|--------------------|------|-----|
| Test Report #:   | 3090365                   | Test Area: | Pinewood Site 1 (3m) | Temperature:       | 18.0 | °C  |
| Test Method:     | FCC Part 15.209           | Test Date: | 07-Jan-2006          | Relative Humidity: | 26   | %   |
| EUT Model #:     | ES1501-XL                 | EUT Power: | 3 VDC                | Air Pressure:      | 81   | kPa |
| EUT Serial #:    | 01564027                  |            |                      |                    |      |     |
| Manufacturer:    | Inovonics                 |            |                      |                    |      |     |
| EUT Description: | Water Meter Transmitter   |            |                      |                    |      |     |
| Notes:           | Removable Battery(ES1501) |            |                      |                    |      |     |

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

| FREQ  | LEVEL  | CABLE / ANT /<br>PREAMP | FINAL  | POL / HGT / AZ | Duty Cycle<br>Correction | Final Corrected | Limit    | DELTA |
|-------|--------|-------------------------|--------|----------------|--------------------------|-----------------|----------|-------|
| (MHz) | (dBuV) | (dB) (dBm) (dB)         | (dBuV) | (m) (DEG)      | (dB)                     | (dBuV/m)        | (dBuV/m) | (dB)  |

The following duty cycle was declared by the manufacturer.

"In this case, the maximum time that the carrier would dwell on any hopping channel is 18.8 mS in a 100 mS window. Therefore, the maximum Duty Factor correction factor of 14.52 dB was utilized in the calculations for the final measurement."

### Averaging method for pulsed signals and calculation in accordance to FCC CFR47 Part 15.35 utilized to calculate field strength emissions.

The testing performed in accordance to FCC CFR47 Part 15.205 (restricted bands of operation) and 15.247 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 15.247 and the emission/limit delta was calculated.

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

Part 15.247 and 15.205 Respectively

#### Mid Channel

|        |         |                  |       |                 |   |       |     |      |
|--------|---------|------------------|-------|-----------------|---|-------|-----|------|
| 914.78 | 88.4 Pk | 3.6 / 23.2 / 0.0 | 115.2 | H / 1.0 / 63.0  | 0 | 115.2 | 119 | -3.8 |
| 914.78 | 89.2 Pk | 3.6 / 23.2 / 0.0 | 116   | V / 1.0 / 128.0 | 0 | 116   | 119 | -3   |

#### High Channel

|        |         |                  |       |                 |   |       |     |      |
|--------|---------|------------------|-------|-----------------|---|-------|-----|------|
| 927.58 | 85.8 Pk | 3.6 / 23.2 / 0.0 | 112.7 | V / 1.0 / 128.0 | 0 | 112.7 | 119 | -6.3 |
| 927.58 | 85.0 Pk | 3.6 / 23.2 / 0.0 | 111.9 | H / 1.0 / 50.0  | 0 | 111.9 | 119 | -7.1 |

Axis 1 determined to be worst case. EUT now in Axis 1 for remaining testing.

#### Low Channel

|         |         |                   |      |                 |        |       |    |        |
|---------|---------|-------------------|------|-----------------|--------|-------|----|--------|
| 1804.72 | 62.2 Pk | 3.1 / 25.0 / 35.1 | 55.2 | V / 1.4 / 170.0 | -14.52 | 40.68 | 99 | -58.32 |
| 1804.72 | 64.5 Pk | 3.1 / 25.0 / 35.1 | 57.5 | H / 1.0 / 79.0  | -14.52 | 42.98 | 99 | -56.02 |
| 2707.07 | 63.5 Pk | 4.2 / 26.9 / 37.5 | 57.1 | V / 1.0 / 68.0  | -14.52 | 42.58 | 54 | -11.42 |
| 2707.07 | 58.6 Pk | 4.2 / 26.9 / 37.5 | 52.2 | H / 1.6 / 34.0  | -14.52 | 37.68 | 54 | -16.32 |
| 3609.41 | 50.5 Pk | 5.0 / 28.9 / 37.9 | 46.5 | V / 1.2 / 195.0 | -14.52 | 31.98 | 54 | -22.02 |
| 3609.41 | 49.5 Pk | 5.0 / 28.9 / 37.9 | 45.4 | H / 1.8 / 355.0 | -14.52 | 30.88 | 54 | -23.12 |
| 4511.76 | 55.0 Pk | 6.6 / 30.2 / 40.5 | 51.3 | H / 1.0 / 353.0 | -14.52 | 36.78 | 54 | -17.22 |
| 4511.76 | 54.7 Pk | 6.6 / 30.2 / 40.5 | 51   | V / 2.2 / 152.0 | -14.52 | 36.48 | 54 | -17.52 |
| 5414.1  | 45.0 Pk | 6.9 / 31.9 / 40.2 | 43.6 | H / 1.9 / 328.0 | -14.52 | 29.08 | 54 | -24.92 |
| 5414.1  | 50.4 Pk | 6.9 / 31.9 / 40.2 | 48.9 | V / 1.0 / 339.0 | -14.52 | 34.38 | 54 | -19.62 |
| 6316.37 | 57.3 Pk | 8.2 / 32.1 / 40.9 | 56.7 | H / 1.9 / 291.0 | -14.52 | 42.18 | 99 | -56.82 |
| 6316.37 | 63.7 Pk | 8.2 / 32.1 / 40.9 | 63.1 | V / 1.0 / 340.0 | -14.52 | 48.58 | 99 | -50.42 |
| 7218.72 | 46.9 Pk | 8.1 / 33.5 / 40.7 | 47.9 | H / 1.4 / 192.0 | -14.52 | 33.38 | 99 | -65.62 |
| 7218.72 | 53.0 Pk | 8.1 / 33.5 / 40.7 | 54   | V / 1.6 / 346.0 | -14.52 | 39.48 | 99 | -59.52 |
| 8121.07 | 66.6 Pk | 8.3 / 34.4 / 46.8 | 62.5 | V / 1.3 / 0.0   | -14.52 | 47.98 | 54 | -6.02  |
| 8121.07 | 59.4 Pk | 8.3 / 34.4 / 46.8 | 55.3 | H / 1.0 / 286.0 | -14.52 | 40.78 | 54 | -13.22 |
| 9023.4  | 56.9 Pk | 8.5 / 35.2 / 48.5 | 52   | V / 1.2 / 354.0 | -14.52 | 37.48 | 54 | -16.52 |
| 9023.4  | 51.5 Pk | 8.5 / 35.2 / 48.5 | 46.6 | H / 1.4 / 125.0 | -14.52 | 32.08 | 54 | -21.92 |

# Field Strength Measurements

## Fundamental and Spurious of the Transmitter

|                  |                           |            |                      |                    |      |     |
|------------------|---------------------------|------------|----------------------|--------------------|------|-----|
| Test Report #:   | 3090365                   | Test Area: | Pinewood Site 1 (3m) | Temperature:       | 18.0 | °C  |
| Test Method:     | FCC Part 15.209           | Test Date: | 07-Jan-2006          | Relative Humidity: | 26   | %   |
| EUT Model #:     | ES1501-XL                 | EUT Power: | 3 VDC                | Air Pressure:      | 81   | kPa |
| EUT Serial #:    | 01564027                  |            |                      |                    |      |     |
| Manufacturer:    | Inovonics                 |            |                      |                    |      |     |
| EUT Description: | Water Meter Transmitter   |            |                      |                    |      |     |
| Notes:           | Removable Battery(ES1501) |            |                      |                    |      |     |

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

| FREQ  | LEVEL  | CABLE / ANT /<br>PREAMP | FINAL  | POL / HGT / AZ | Duty Cycle<br>Correction | Final Corrected | Limit    | DELTA |
|-------|--------|-------------------------|--------|----------------|--------------------------|-----------------|----------|-------|
| (MHz) | (dBuV) | (dB) (dBm) (dB)         | (dBuV) | (m) (DEG)      | (dB)                     | (dBuV/m)        | (dBuV/m) | (dB)  |

The following duty cycle was declared by the manufacturer.

"In this case, the maximum time that the carrier would dwell on any hopping channel is 18.8 mS in a 100 mS window. Therefore, the maximum Duty Factor correction factor of 14.52 dB was utilized in the calculations for the final measurement."

### Averaging method for pulsed signals and calculation in accordance to FCC CFR47 Part 15.35 utilized to calculate field strength emissions.

The testing performed in accordance to FCC CFR47 Part 15.205 (restricted bands of operation) and 15.247 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 15.247 and the emission/limit delta was calculated.

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

Part 15.247 and 15.205 Respectively

#### Mid Channel

|         |         |                   |      |                 |        |       |    |        |
|---------|---------|-------------------|------|-----------------|--------|-------|----|--------|
| 1829.54 | 56.1 Pk | 3.1 / 25.1 / 35.8 | 48.6 | H / 1.3 / 21.0  | -14.52 | 34.08 | 99 | -64.92 |
| 1829.54 | 54.2 Pk | 3.1 / 25.1 / 35.8 | 46.7 | V / 1.0 / 115.0 | -14.52 | 32.18 | 99 | -66.82 |
| 2744.27 | 63.9 Pk | 4.3 / 27.0 / 37.7 | 57.5 | H / 1.1 / 235.0 | -14.52 | 42.98 | 54 | -11.02 |
| 2744.27 | 68.5 Pk | 4.3 / 27.0 / 37.7 | 62   | V / 1.0 / 108.0 | -14.52 | 47.48 | 54 | -6.52  |
| 3659.01 | 52.6 Pk | 5.1 / 29.0 / 37.7 | 48.9 | H / 1.8 / 357.0 | -14.52 | 34.38 | 54 | -19.62 |
| 3659.01 | 52.9 Pk | 5.1 / 29.0 / 37.7 | 49.2 | V / 2.3 / 13.0  | -14.52 | 34.68 | 54 | -19.32 |
| 4573.76 | 53.6 Pk | 6.7 / 30.3 / 40.5 | 50.2 | V / 1.0 / 343.0 | -14.52 | 35.68 | 54 | -18.32 |
| 4573.76 | 52.6 Pk | 6.7 / 30.3 / 40.5 | 49.2 | H / 1.0 / 238.0 | -14.52 | 34.68 | 54 | -19.32 |
| 5488.49 | 52.0 Pk | 6.7 / 32.0 / 40.3 | 50.5 | V / 1.7 / 359.0 | -14.52 | 35.98 | 99 | -63.02 |
| 5488.49 | 47.5 Pk | 6.7 / 32.0 / 40.3 | 45.9 | H / 1.0 / 354.0 | -14.52 | 31.38 | 99 | -67.62 |
| 6403.16 | 58.4 Pk | 8.3 / 32.0 / 40.8 | 57.9 | V / 1.1 / 346.0 | -14.52 | 43.38 | 99 | -55.62 |
| 6403.16 | 54.3 Pk | 8.3 / 32.0 / 40.8 | 53.9 | H / 1.0 / 112.0 | -14.52 | 39.38 | 99 | -59.62 |
| 7317.91 | 55.8 Pk | 8.2 / 33.8 / 40.4 | 57.3 | V / 1.8 / 323.0 | -14.52 | 42.78 | 54 | -11.22 |
| 7317.91 | 48.9 Pk | 8.2 / 33.8 / 40.4 | 50.4 | H / 1.5 / 119.0 | -14.52 | 35.88 | 54 | -18.12 |
| 8232.66 | 58.3 Pk | 8.4 / 34.5 / 47.1 | 54   | V / 1.5 / 0.0   | -14.52 | 39.48 | 54 | -14.52 |
| 8233.66 | 52.5 Pk | 8.4 / 34.5 / 47.1 | 48.3 | H / 1.1 / 271.0 | -14.52 | 33.78 | 54 | -20.22 |
| 9147.39 | 57.6 Pk | 8.8 / 35.3 / 48.1 | 53.6 | V / 2.2 / 45.0  | -14.52 | 39.08 | 54 | -14.92 |
| 9147.39 | 53.6 Pk | 8.8 / 35.3 / 48.1 | 49.6 | H / 1.6 / 148.0 | -14.52 | 35.08 | 54 | -18.92 |

#### High Channel

|         |         |                   |      |                 |        |       |    |        |
|---------|---------|-------------------|------|-----------------|--------|-------|----|--------|
| 1855.13 | 62.5 Pk | 3.1 / 25.3 / 35.8 | 55.1 | V / 1.0 / 30.0  | -14.52 | 40.58 | 99 | -58.42 |
| 1855.13 | 61.7 Pk | 3.1 / 25.3 / 35.8 | 54.3 | H / 1.2 / 268.0 | -14.52 | 39.78 | 99 | -59.22 |
| 2782.67 | 63.8 Pk | 4.3 / 27.1 / 37.7 | 57.4 | V / 1.8 / 10.0  | -14.52 | 42.88 | 54 | -11.12 |
| 2782.67 | 64.5 Pk | 4.3 / 27.1 / 37.7 | 58.1 | H / 1.1 / 33.0  | -14.52 | 43.58 | 54 | -10.42 |
| 3710.22 | 51.7 Pk | 5.2 / 29.1 / 37.5 | 48.5 | V / 1.4 / 67.0  | -14.52 | 33.98 | 54 | -20.02 |
| 3710.22 | 52.8 Pk | 5.2 / 29.1 / 37.5 | 49.6 | H / 2.2 / 343.0 | -14.52 | 35.08 | 54 | -18.92 |
| 4637.77 | 54.0 Pk | 6.9 / 30.5 / 40.4 | 50.9 | H / 1.6 / 95.0  | -14.52 | 36.38 | 54 | -17.62 |
| 4637.77 | 53.9 Pk | 6.9 / 30.5 / 40.4 | 50.8 | V / 1.1 / 15.0  | -14.52 | 36.28 | 54 | -17.72 |

# Field Strength Measurements

## Fundamental and Spurious of the Transmitter

|                  |                           |            |                      |                    |      |     |
|------------------|---------------------------|------------|----------------------|--------------------|------|-----|
| Test Report #:   | 3090365                   | Test Area: | Pinewood Site 1 (3m) | Temperature:       | 18.0 | °C  |
| Test Method:     | FCC Part 15.209           | Test Date: | 07-Jan-2006          | Relative Humidity: | 26   | %   |
| EUT Model #:     | ES1501-XL                 | EUT Power: | 3 VDC                | Air Pressure:      | 81   | kPa |
| EUT Serial #:    | 01564027                  |            |                      |                    |      |     |
| Manufacturer:    | Inovonics                 |            |                      |                    |      |     |
| EUT Description: | Water Meter Transmitter   |            |                      |                    |      |     |
| Notes:           | Removable Battery(ES1501) |            |                      |                    |      |     |

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

| FREQ  | LEVEL  | CABLE / ANT /<br>PREAMP | FINAL  | POL / HGT / AZ | Duty Cycle<br>Correction | Final Corrected | Limit    | DELTA |
|-------|--------|-------------------------|--------|----------------|--------------------------|-----------------|----------|-------|
| (MHz) | (dBuV) | (dB) (dBm) (dB)         | (dBuV) | (m) (DEG)      | (dB)                     | (dBuV/m)        | (dBuV/m) | (dB)  |

The following duty cycle was declared by the manufacturer.  
 "In this case, the maximum time that the carrier would dwell on any hopping channel is 18.8 mS in a 100 mS window. Therefore, the maximum Duty Factor correction factor of 14.52 dB was utilized in the calculations for the final measurement."

**Averaging method for pulsed signals and calculation in accordance to FCC CFR47 Part 15.35 utilized to calculate field strength emissions.**

The testing performed in accordance to FCC CFR47 Part 15.205 (restricted bands of operation) and 15.247 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 15.247 and the emission/limit delta was calculated. the DTCF is calculated as follows  $20 \cdot \log_{10}(\text{duty cycle in 100ms})$  "not to exceed 20dB"

**Part 15.247 and 15.205 Respectively**

|         |         |                   |      |                 |        |       |    |        |
|---------|---------|-------------------|------|-----------------|--------|-------|----|--------|
| 5565.28 | 54.4 Pk | 6.8 / 32.0 / 40.6 | 52.7 | V / 2.0 / 0.0   | -14.52 | 38.18 | 99 | -60.82 |
| 5565.31 | 52.5 Pk | 6.8 / 32.0 / 40.6 | 50.7 | H / 1.5 / 323.0 | -14.52 | 36.18 | 99 | -62.82 |
| 6492.77 | 50.9 Pk | 8.5 / 32.0 / 40.3 | 51   | H / 1.1 / 279.0 | -14.52 | 36.48 | 99 | -62.52 |
| 6493.52 | 53.0 Pk | 8.5 / 32.0 / 40.3 | 53.1 | V / 1.0 / 330.0 | -14.52 | 38.58 | 99 | -60.42 |
| 7420.31 | 46.6 Pk | 8.2 / 34.0 / 40.0 | 48.8 | H / 1.5 / 187.0 | -14.52 | 34.28 | 54 | -19.72 |
| 7420.31 | 55.3 Pk | 8.2 / 34.0 / 40.0 | 57.5 | V / 1.4 / 347.0 | -14.52 | 42.98 | 54 | -11.02 |
| 8347.86 | 59.6 Pk | 8.4 / 34.5 / 47.6 | 55   | H / 1.7 / 119.0 | -14.52 | 40.48 | 54 | -13.52 |
| 8347.86 | 63.8 Pk | 8.4 / 34.5 / 47.6 | 59.2 | V / 1.2 / 10.0  | -14.52 | 44.68 | 54 | -9.32  |
| 9275.41 | 48.0 Pk | 9.0 / 35.4 / 48.5 | 43.9 | H / 1.9 / 237.0 | -14.52 | 29.38 | 99 | -69.62 |
| 9275.41 | 52.3 Pk | 9.0 / 35.4 / 48.5 | 48.2 | V / 1.5 / 20.0  | -14.52 | 33.68 | 99 | -65.32 |

# Project Report

**Begin Date:** 1/5/2006    **End Date:** 1/7/2006

**Technician**    Mike Spataro

**Project** 3090365

| Capital Asset ID | Manufacturer      | Model #        | Serial #   | Description                        | Test Performed       | Service Type | Service Date | Service Due |
|------------------|-------------------|----------------|------------|------------------------------------|----------------------|--------------|--------------|-------------|
| 3                | Hewlett-Packard   | 85650A         | 2811A01300 | Q.P Adapter                        | R Radiated Emissions | For Cal      | 11/8/2005    | 11/8/2006   |
| 106              | TENSOR            | 4105           | 2020       | Ridged Guide Antenna 1-18GHz       | R Radiated Emissions | For Cal      | 5/9/2005     | 5/9/2006    |
| 135              | EMCO              | 3146           | 9402-3775  | Log Periodic Antenna (200-1000MHz) | R Radiated Emissions | For Cal      | 9/30/2005    | 9/30/2006   |
| 138              | EMC TEST SYSTEMS  | 3109           | 3142       | Biconical Antenna 30-300MHz        | R Radiated Emissions | For Cal      | 9/30/2005    | 9/30/2006   |
| 202              | Avantek           | AWT-18037      | 1002       | RF Pre-Amplifier (8-18 GHz)        | R Radiated Emissions | For Ver      | 4/4/2005     | 4/4/2006    |
| 203              | Avantek           | AFT97-8434-10F | 1007       | RF Pre-Amplifier (4-8 GHz)         | R Radiated Emissions | For Ver      | 4/4/2005     | 4/4/2006    |
| 209              | Hewlett-Packard   | 85662A         | 2403A08749 | Display Section                    | R Radiated Emissions | For Cal      | 8/8/2005     | 8/8/2006    |
| 210              | Hewlett-Packard   | 8566B          | 2410A00154 | Spectrum Analyzer (dc-22 GHz)      | R Radiated Emissions | For Cal      | 8/8/2005     | 8/8/2006    |
| 213              | Mini-Circuits Lab | ZHL-42         | N052792-2  | Amplifier                          | R Radiated Emissions | For Ver      | 5/6/2005     | 5/6/2006    |
| 248              | Hewlett-Packard   | 8447F          | 3113A05545 | 9 kHz- 1.3GHz Pre Amp              | R Radiated Emissions | For Ver      | 5/6/2005     | 5/6/2006    |
| 259              | Hewlett-Packard   | E7405A         | My44211889 | Spectrum Analyzer                  | R Radiated Emissions | For Cal      | 12/14/2005   | 12/14/2006  |

**Appendix B**

Test Plan  
and  
Constructional Data Form

**To be supplied by the customer**

July 13, 2004

Todd Seeley  
IA Labs  
5451 Central Ave.  
Boulder, CO 80301

Dear Todd,

Pursuant to section 15.247 of the FCC rules Inovonics transmitters are limited to 0.25 Watts maximum transmitted power. These devices contain integrated antennas and it is therefore impossible to measure the transmitted power in a conducted manner without significantly modifying the devices.

At the test lab the field strength is measured using an antenna located 3 meters from the device under test. The rules do not explicitly state the field strength at 3 meters corresponding to 0.25 Watts, so it must be calculated as follows:

The test facility measures the transmitted field strength, E, having units of Volts/meter, or the logarithmic equivalent. The transmitted power density as measured by the antenna is then  $\frac{E^2}{\eta}$ , where  $\eta$  is the intrinsic impedance of free space.

Assuming isotropic radiation from the product, the Effective Isotropic Radiated Power (EIRP) is found by multiplying the above power density by the area of a sphere having a radius of 3 meters,

$$P_{EIRP} = \frac{E^2}{\eta} 4\pi R^2 \quad (1)$$

Solving for E,

$$E = \frac{1}{2R} \left( \frac{\eta P_{EIRP}}{\pi} \right)^{1/2} \quad (2)$$

Given that  $P_{\text{EIRP}} = 0.25$  Watts (FCC limit),  $R = 3$  meters, and  $\eta = 377$  Ohms,  $E = 0.913$  V/m = 119.2 dB  $\mu$ V/m.

Remember the above assumption of isotropic radiation- all real antennas have non-isotropic radiation patterns. Using the 119.2 dB  $\mu$ V/m limit guarantees that the total RF power transmitted by the device is below the 0.25 Watt limit.

Also, according the part 15.35 we are allowed a relaxation of the general radiation limits found in 15.209 while using a peak detector, as applied to the harmonics of the fundamental. Inovonics EchoStream security transmitters have a transmission pulse duration of 20 ms, which corresponds to a duty cycle of 0.2 per 15.35(c). This duty cycle allows for a 14 dB relaxation of the general radiation limits from 54 dB  $\mu$ V/m (500  $\mu$ V/m, per 15.209(a) ) to 68 dB  $\mu$ V/m for peak measurements.

Sincerely,



Steven Dunbar  
RF Engineer

# Request for Estimate & Test Plan

## Laboratory/Agent Information:

|                 |                                                 |
|-----------------|-------------------------------------------------|
| Agent/Test Lab: | International Approvals Laboratories, LLC       |
| Contact:        | Todd Seeley                                     |
| Title:          | Principal Engineer (Services Development Focus) |
| Phone Number:   | (303) 402-5272                                  |
| Cell Number:    | (303) 503-2491                                  |
| Fax Number:     | (303) 449-6160                                  |
| Email Address:  | todd@ialabs.com                                 |

## Client Information:

|                 |                                         |
|-----------------|-----------------------------------------|
| License Holder: | Inovonics Wireless Corporation          |
| Address:        | 315 CTC Boulevard, Louisville, CO 80027 |
| Contact:        | David Henke                             |
| Title:          | Project Engineer                        |
| Phone Number:   | 303-209-7163                            |
| Fax Number:     | 303-939-8977                            |
| Email Address:  | dave@inovonics.com                      |

Please provide all pertinent information below and email this Form to Todd and Amy at [todd@ialabs.com](mailto:todd@ialabs.com) and [Amy@ialabs.com](mailto:Amy@ialabs.com) for a quotation:

## Estimates Requested:

| EMC Testing                                   |                                                          |
|-----------------------------------------------|----------------------------------------------------------|
| <input type="checkbox"/> Requesting Estimate  | <input checked="" type="checkbox"/> No Estimate Required |
| <input type="checkbox"/> Pre-Compliance Scans | <input type="checkbox"/> Engineering Test                |

| Radio Device Testing and Certification                         |                                                                             |
|----------------------------------------------------------------|-----------------------------------------------------------------------------|
| <input checked="" type="checkbox"/> Requesting Estimate        | <input type="checkbox"/> No Estimate Required                               |
| <input checked="" type="checkbox"/> FCC Certification          | <input type="checkbox"/> Industry Canada Certification (Receivers required) |
| <input type="checkbox"/> Class 2 Notification Under the R&TTED |                                                                             |

| Safety Testing and Certification                                                      |                                                                            |
|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------|
| <input type="checkbox"/> Requesting Estimate                                          | <input checked="" type="checkbox"/> No Estimate Required                   |
| <input type="checkbox"/> NRTL Listing                                                 | <input type="checkbox"/> 1 Day Pre-Assessment (conducted at your facility) |
| <input type="checkbox"/> Letter of Findings                                           | <input type="checkbox"/> CB Report Covering all country Deviations         |
| <input type="checkbox"/> CE Report to Cover the LVD                                   | <input type="checkbox"/> CB Report Covering - Specify Countries:           |
| Please list all applicable standards that you would like your device certified under: |                                                                            |

## General Product Information:

|                                                             |                                                                                                                                                                                                                                                                                                                                                                                 |                   |                 |                   |
|-------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------|-------------------|
| Product/Model Number(s):                                    | ES1501, ES1501-XL, ES1210                                                                                                                                                                                                                                                                                                                                                       |                   |                 |                   |
| Description of product(s):                                  | Frequency-hopping, spread-spectrum transmitters                                                                                                                                                                                                                                                                                                                                 |                   |                 |                   |
| Intended Use:                                               | <input type="checkbox"/> Household <input checked="" type="checkbox"/> Commercial <input type="checkbox"/> Industrial <input type="checkbox"/> Hospital <input type="checkbox"/> Life Supporting                                                                                                                                                                                |                   |                 |                   |
| Intended Location:                                          | <input checked="" type="checkbox"/> Dry <input checked="" type="checkbox"/> Damp <input type="checkbox"/> Wet <input type="checkbox"/> Hazardous Location                                                                                                                                                                                                                       |                   |                 |                   |
| Product Type:                                               | <input checked="" type="checkbox"/> Prototype <input checked="" type="checkbox"/> Production Sample<br><input type="checkbox"/> Manufacturing Design Change: Please Describe                                                                                                                                                                                                    |                   |                 |                   |
| If there is more than one product what are the differences? | ES1501 and ES1501-XL are used to monitor water meter usage and have inverted L antennas. ES1501-XL has a permanent battery; whereas, the ES1501 has a removable battery. ES1210 is used for security applications and has an inverted F antenna.                                                                                                                                |                   |                 |                   |
| Is the Product Enclosure:                                   | <input type="checkbox"/> Metal <input checked="" type="checkbox"/> Plastic <input type="checkbox"/> Both                                                                                                                                                                                                                                                                        |                   |                 |                   |
| Size:                                                       | Length:3.5 inches                                                                                                                                                                                                                                                                                                                                                               | Width:1.75 inches | Height:1 inches | Weight:2.0 ounces |
| What Voltages/Current does the EUT run at?                  | Rated Voltage:3VDC<br>Rated Current:25maDC (when transmitting)<br># of Phases/Conductors:none<br># of Power Cords:none                                                                                                                                                                                                                                                          |                   |                 |                   |
| Are their multiple suppliers of power supplies?             | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No<br>If Yes Please Describe:                                                                                                                                                                                                                                                                                  |                   |                 |                   |
| Are there Multiple Modes of Operation?                      | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No<br>If Yes Please Describe<br>ES1501, ES1501-XL<br>Normal Mode: Transmissions once per hour<br>Rapid TX Mode: Transmissions once per minute<br>Shipping Mode: No transmissions or microprocessor activity<br>ES1210<br>Normal Mode: Transmissions once per three minutes and whenever alarm condition occurs |                   |                 |                   |
| Can all modes of operation be operated simultaneously?      | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Explain:                                                                                                                                                                                                                                                                                                    |                   |                 |                   |
| In which countries will you be selling the product?         | US                                                                                                                                                                                                                                                                                                                                                                              |                   |                 |                   |

## EMC Information:

|                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| What EMC certifications are desired?                                                                                                                                  | <input type="checkbox"/> FCC/ICES (US & Canada)<br><input type="checkbox"/> CE / EMC / MMD<br><input type="checkbox"/> BSMI (Taiwan)<br><input type="checkbox"/> VCCI (Japan)<br><input type="checkbox"/> SII (Israel)<br><input type="checkbox"/> AS/NZS (Australia/New Zealand)<br><input type="checkbox"/> Other: Please Specify |
| Highest frequency utilized for device operation:                                                                                                                      |                                                                                                                                                                                                                                                                                                                                     |
| List of Clock Frequencies:                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                     |
| What is the time that it takes for the device to complete a full cycle of operation? (time required to identify any degradation in performance)                       |                                                                                                                                                                                                                                                                                                                                     |
| Total Number of I/O Cables:<br># Greater than 3m (9.75 feet) in Length<br># Greater than 30m (97.5 feet) in Length<br># of cables at a longer length (specify)        |                                                                                                                                                                                                                                                                                                                                     |
| Number of Dedicated Earth Equalization Ports                                                                                                                          |                                                                                                                                                                                                                                                                                                                                     |
| Number of Ethernet and/or Telecommunications Ports                                                                                                                    |                                                                                                                                                                                                                                                                                                                                     |
| When the device is a compilation of subsystems (in separate chassis) how many interconnecting I/O's are greater than 1 meter in length between the Subsystem chassis? |                                                                                                                                                                                                                                                                                                                                     |
| For medical devices:<br>Are there any coupled or direct patient contact points on the device?                                                                         | <input type="checkbox"/> Yes <input type="checkbox"/> No Describe:                                                                                                                                                                                                                                                                  |

## Radio Information:

|                                                                             |                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| What Radio certifications are desired?                                      | <input checked="" type="checkbox"/> FCC (USA) (FCC Part 15, 15.249)<br><input type="checkbox"/> Industry Canada<br><input type="checkbox"/> ETSI (R&TTE)<br><input type="checkbox"/> Other: Please Specify |
| Operating Frequency:                                                        | 902-928 MHZ (US ISM band)                                                                                                                                                                                  |
| RF Output Power:                                                            | 17 dBm                                                                                                                                                                                                     |
| Is there an RF Conducted Port?                                              | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Description:                                                                                                                           |
| Number of Antennas & Description:<br>(Internal, External, Known Gain, etc.) | ES1501, ES1501-XL: Inverted L<br>ES1210: Inverted F                                                                                                                                                        |
| Modulation Technique:                                                       | FSK                                                                                                                                                                                                        |
| Number of Channels/Number of Discrete frequencies per Channel:              | 1/25                                                                                                                                                                                                       |
| Can the device be operated in CW Mode?                                      | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No (But can put in CW mode for testing)                                                                                                   |
| What is the lowest utilized frequency within the device?                    | 902 MHz                                                                                                                                                                                                    |

**Notes: Please ensure to bring a notch filter covering your fundamental operating frequency.**

## Safety Information:

|                                                                                                                                                                                                         |                                                                                                                                                                                               |                                                                     |                        |             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|------------------------|-------------|
| Has the device been tested and certified for product safety before?<br><br>A. If it has been previously tested, to which standard and by which organization?<br><br>B. Can you provide the test report? | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No<br><br>Standard tested to:<br><br>Organization tested by:<br><br><input type="checkbox"/> Yes <input type="checkbox"/> No |                                                                     |                        |             |
| Is the power supply                                                                                                                                                                                     | <input type="checkbox"/> An approved off the shelf power supply<br><br>OR<br><br><input type="checkbox"/> A Custom Model that will need evaluation/ certification                             |                                                                     |                        |             |
| Does the device contain batteries?                                                                                                                                                                      | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No<br><br>What Type? Lithium<br><br>How Many? One per transmitter                                                            |                                                                     |                        |             |
| What technology is used? (i.e., lasers, X Ray, etc.)                                                                                                                                                    | 900 MHz RF                                                                                                                                                                                    |                                                                     |                        |             |
| If Laser:                                                                                                                                                                                               | Class:                                                                                                                                                                                        | Output Power:                                                       | Beam Divergence Angle: | Wavelength: |
| Is the product a Medical Device?                                                                                                                                                                        |                                                                                                                                                                                               | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |                        |             |
| Is it an In Vitro Diagnostic Device?                                                                                                                                                                    |                                                                                                                                                                                               | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |                        |             |
| Testing location: (to be filled in by IALabs)                                                                                                                                                           |                                                                                                                                                                                               |                                                                     |                        |             |

## Additional Information:

This information is required to be filled in to act as a test plan and constructional data form required to be supplied as part of the test report in accordance to the required standards. This information is not required to obtain a quote.

### Support Equipment:

IALabs requires our customers provide all support equipment necessary to fully operate the EUT. This includes any filters required for testing radio devices.

| Item | Description                                                 | Manufacturer | Model No. |
|------|-------------------------------------------------------------|--------------|-----------|
| 1    | (We will bring filter that you have already characterized.) |              |           |
| 2    |                                                             |              |           |
| 3    |                                                             |              |           |
| 4    |                                                             |              |           |

### Cabling Information:

| Cable | Function* | Type of Shield | Length | Connectors | Connection** |
|-------|-----------|----------------|--------|------------|--------------|
| 1     |           |                |        |            |              |
| 2     |           |                |        |            |              |
| 3     |           |                |        |            |              |
| 4     |           |                |        |            |              |
| 5     |           |                |        |            |              |
| 6     |           |                |        |            |              |

\* Function examples (Ethernet, RS232, USB, Analog, physiological parameter, etc.)

\*\* Connection examples (Outside Plant, Patient Coupled, Ring Voltage, etc.)

### Monitoring the EUT:

Please provide instructions below on how to observe the EUT to verify proper operation in all modes. (including software revision)

### Any other information required: (Notes, Photos, Block Diagrams, Drawings, etc.)

A minimum of a block diagram showing the equipment under test and its support equipment.

For International Approvals Laboratories, Use Only.  
Please do not fill in the following Information.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                        |                                                                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Quoting Engineer: todd</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                        |                                                                                                                                                                        |
| <b>Emissions Testing Required</b>                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                        |                                                                                                                                                                        |
| <input type="checkbox"/> Class A <input type="checkbox"/> Class B <input checked="" type="checkbox"/> Radio Device <input type="checkbox"/> Group 1 <input type="checkbox"/> Group 2                                                                                                                                                                                                                                                                                |                                                                                                                                                                        |                                                                                                                                                                        |
| <input checked="" type="checkbox"/> FCC Part 15                                                                                                                                                                                                                                                                                                                                                                                                                     | <input type="checkbox"/> ICES-003                                                                                                                                      | <input type="checkbox"/> VCCI                                                                                                                                          |
| <input type="checkbox"/> FCC Part 18                                                                                                                                                                                                                                                                                                                                                                                                                                | <input type="checkbox"/> BSMI                                                                                                                                          | <input type="checkbox"/> CISPR 22/EN 55022                                                                                                                             |
| <input type="checkbox"/> CISPR 11/EN 55011                                                                                                                                                                                                                                                                                                                                                                                                                          | <input type="checkbox"/> IEC/EN 61326                                                                                                                                  | <input type="checkbox"/> IEC/EN61000-6-3                                                                                                                               |
| <input type="checkbox"/> IEC/EN61000-6-4                                                                                                                                                                                                                                                                                                                                                                                                                            | <input type="checkbox"/> CNS13438                                                                                                                                      | <input type="checkbox"/> AS/NZS 3548                                                                                                                                   |
| <input type="checkbox"/> IEC/EN61000-3-2                                                                                                                                                                                                                                                                                                                                                                                                                            | <input type="checkbox"/> IEC/EN61000-3-3                                                                                                                               | <input type="checkbox"/> ETSI/EN 301 489                                                                                                                               |
| <input checked="" type="checkbox"/> Other: 15.247 only peak output power and Spurious emissions then 15.209 testing - pay attention to 15.205                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                        |                                                                                                                                                                        |
| <b>OATS Testing Voltages</b>                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                        |                                                                                                                                                                        |
| <input type="checkbox"/> 100VAC/50 Hz                                                                                                                                                                                                                                                                                                                                                                                                                               | <input type="checkbox"/> 120VAC/60Hz                                                                                                                                   | <input type="checkbox"/> 230VAC/50Hz                                                                                                                                   |
| <input type="checkbox"/> 110VAC/60Hz                                                                                                                                                                                                                                                                                                                                                                                                                                | <input type="checkbox"/> 220VAC/60Hz                                                                                                                                   | <input type="checkbox"/> 240VAC/50Hz                                                                                                                                   |
| <input type="checkbox"/> Other:                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                        |                                                                                                                                                                        |
| <b>Immunity Product Family Standard</b>                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                        |                                                                                                                                                                        |
| <input type="checkbox"/> CISPR24/EN 55024                                                                                                                                                                                                                                                                                                                                                                                                                           | <input type="checkbox"/> IEC/EN 61000-6-1                                                                                                                              | <input type="checkbox"/> IEC/EN 61000-6-2                                                                                                                              |
| <input type="checkbox"/> IEC/EN 60601-1-2 <input type="checkbox"/> Art. Hand.                                                                                                                                                                                                                                                                                                                                                                                       | <input type="checkbox"/> IEC/EN 61326                                                                                                                                  | <input type="checkbox"/> CISPR14/ EN 55014-2                                                                                                                           |
| <input type="checkbox"/> ETSI/EN 301 489                                                                                                                                                                                                                                                                                                                                                                                                                            | <input type="checkbox"/> Add Israel Frequencies                                                                                                                        |                                                                                                                                                                        |
| <input type="checkbox"/> Other:                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                        |                                                                                                                                                                        |
| <b>Immunity Methods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                        |                                                                                                                                                                        |
| <input type="checkbox"/> EN61000-4-2                                                                                                                                                                                                                                                                                                                                                                                                                                | <input type="checkbox"/> 4kV/8kV<br><input type="checkbox"/> 6kV/8kV                                                                                                   | <input type="checkbox"/> 8kV<br><input type="checkbox"/> 12kV<br><input type="checkbox"/> 15kV<br><input type="checkbox"/> Other:                                      |
| <input type="checkbox"/> EN61000-4-3                                                                                                                                                                                                                                                                                                                                                                                                                                | <input type="checkbox"/> 3V/m<br><input type="checkbox"/> 10V/m                                                                                                        | <input type="checkbox"/> 1 kHz Modulation<br><input type="checkbox"/> 400 Hz Modulation<br><input type="checkbox"/> 2 Hz Modulation<br><input type="checkbox"/> Other: |
| <input type="checkbox"/> EN61000-4-4                                                                                                                                                                                                                                                                                                                                                                                                                                | <input type="checkbox"/> 0.5 kV<br><input type="checkbox"/> 1.0 kV                                                                                                     | <input type="checkbox"/> 2.0 kV<br><input type="checkbox"/> Other:                                                                                                     |
| <input type="checkbox"/> EN61000-4-5                                                                                                                                                                                                                                                                                                                                                                                                                                | <input type="checkbox"/> 0.5 kV<br><input type="checkbox"/> 1.0 kV                                                                                                     | <input type="checkbox"/> 2.0 kV<br><input type="checkbox"/> 4.0 kV<br><input type="checkbox"/> Other:                                                                  |
| <input type="checkbox"/> EN61000-4-6                                                                                                                                                                                                                                                                                                                                                                                                                                | <input type="checkbox"/> 3Vrms<br><input type="checkbox"/> 10Vrms                                                                                                      | <input type="checkbox"/> 1 kHz Modulation<br><input type="checkbox"/> 400 Hz Modulation<br><input type="checkbox"/> 2 Hz Modulation<br><input type="checkbox"/> Other: |
| <input type="checkbox"/> EN61000-4-8                                                                                                                                                                                                                                                                                                                                                                                                                                | <input type="checkbox"/> 1A/m<br><input type="checkbox"/> 30A/m                                                                                                        | <input type="checkbox"/> 400A/m<br><input type="checkbox"/> Other:                                                                                                     |
| <input type="checkbox"/> EN61000-4-11                                                                                                                                                                                                                                                                                                                                                                                                                               | <input type="checkbox"/> >95% 0.5 Cycles<br><input type="checkbox"/> 30% 0.5 Cycles<br><input type="checkbox"/> 60% 5 Cycles<br><input type="checkbox"/> 60% 50 Cycles | <input type="checkbox"/> 30% 25 Cycles<br><input type="checkbox"/> >95% 250 Cycles<br><input type="checkbox"/> >95% 1 Cycle<br><input type="checkbox"/> Other:         |
| <b>Test Reports Requested</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                        |                                                                                                                                                                        |
| <input type="checkbox"/> Emissions                                                                                                                                                                                                                                                                                                                                                                                                                                  | <input type="checkbox"/> Engineering Data Only                                                                                                                         | <input type="checkbox"/> ETSI "Radio"                                                                                                                                  |
| <input type="checkbox"/> Immunity                                                                                                                                                                                                                                                                                                                                                                                                                                   | <input type="checkbox"/> FCC/Industry Canada "Radio"                                                                                                                   | <input type="checkbox"/> Other:                                                                                                                                        |
| <input checked="" type="checkbox"/> Other/special notes: no report requested.<br>start with intentional 3 orthogonal axis - follow setup in public release for peak output measurements<br>go to spurious output - follow public announcement for spurious<br><br>Set all transmitters on table and test for 15.209 - should be prescanned this afternoon for freq list - if no freq's - take 6 noise floor points per band<br>up to 30M - 30-1000M and 1000-10000M |                                                                                                                                                                        |                                                                                                                                                                        |

**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 $\mu$ 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 $\mu$ V and  $\mu$ 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 $\mu$ V/m, is arrived at by taking the reading from the spectrum analyzer (Level dB $\mu$ 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 $\mu$ V:*

| Measured Level | + | Transducer & Cable Loss factor | = | Corrected Reading | Specification Limit | - | Corrected Reading | = | Delta Specification |
|----------------|---|--------------------------------|---|-------------------|---------------------|---|-------------------|---|---------------------|
| (dB $\mu$ V)   |   | (dB)                           |   | (dB $\mu$ V/m)    | (dB $\mu$ V/m)      |   | (dB $\mu$ V/m)    |   |                     |
| <b>14.0</b>    |   | <b>14.9</b>                    |   | <b>28.9</b>       | <b>40.0</b>         |   | <b>28.9</b>       |   | <b>-11.1</b>        |

## 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  $\Omega$ /50  $\mu$ 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:



