

**DATE: 21 August 2003**

**I.T.L. (PRODUCT TESTING) LTD.**

**EMC Test**

**for**

**Nexus Data (1993) Ltd.**

**Equipment under test:**

**Water Meter Transmitter**

**WMIN01**

Approved by: \_\_\_\_\_

I. Raz, EMC Laboratory Manager

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This report relates only to items tested.

**Measurement/Technical Report for**  
**Nexus Data (1993) Ltd.**  
**Water Meter Transmitter**  
**(For Transmitter Section)**

**WMIN01**

**FCC ID:NL3WMIN01**

**21 August 2003**

This report concerns:                      Original Grant   x        Class II change

Class B verification             Class A verification             Class I change

Equipment type:                      Radio Telemetry Transmitter

Request Issue of Grant:

  x   Immediately upon completion of review

Limits used:

CISPR 22       

Part 15   x  

Measurement procedure used is ANSI C63.4-2001.

Application for Certification

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(different from "prepared by")

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# TABLE OF CONTENTS

|            |                                                              |           |
|------------|--------------------------------------------------------------|-----------|
| <b>1.</b>  | <b>GENERAL INFORMATION</b>                                   | <b>5</b>  |
| 1.1        | Administrative Information                                   | 5         |
| 1.2        | List of Accreditations                                       | 6         |
| 1.3        | Product Description                                          | 7         |
| 1.4        | Test Methodology                                             | 7         |
| 1.5        | Test Facility                                                | 7         |
| 1.6        | Measurement Uncertainty                                      | 7         |
| <b>2.</b>  | <b>PRODUCT LABELING</b>                                      | <b>8</b>  |
| <b>3.</b>  | <b>SYSTEM TEST CONFIGURATION</b>                             | <b>9</b>  |
| 3.1        | Justification                                                | 9         |
| 3.2        | EUT Exercise Software                                        | 9         |
| 3.3        | Special Accessories                                          | 9         |
| 3.4        | Equipment Modifications                                      | 9         |
| 3.5        | Configuration of Tested System                               | 10        |
| <b>4.</b>  | <b>BLOCK DIAGRAM</b>                                         | <b>11</b> |
| 4.1        | Schematic Block/Connection Diagram                           | 11        |
| 4.2        | Theory of Operation                                          | 12        |
| <b>5.</b>  | <b>SPURIOUS RADIATED MEASUREMENT PHOTOS</b>                  | <b>13</b> |
| <b>6.</b>  | <b>SPURIOUS RADIATED EMISSION, BELOW 1 GHZ</b>               | <b>14</b> |
| 6.1        | Test Specification                                           | 14        |
| 6.2        | Test Procedure                                               | 14        |
| 6.3        | Measured Data                                                | 15        |
| 6.4        | Test Instrumentation Used, Radiated Measurements             | 28        |
| 6.5        | Field Strength Calculation                                   | 29        |
| <b>7.</b>  | <b>SPURIOUS RADIATED EMISSION ABOVE 1 GHZ</b>                | <b>30</b> |
| 7.1        | Radiated Emission Above 1 GHz                                | 30        |
| 7.2        | Test Data                                                    | 30        |
| 7.3        | Test Instrumentation Used, Radiated Measurements Above 1 GHz | 55        |
| <b>8.</b>  | <b>MAXIMUM TRANSMITTED PEAK POWER OUTPUT</b>                 | <b>56</b> |
| 8.1        | Test procedure                                               | 56        |
| 8.2        | Results table                                                | 58        |
| 8.3        | Test Equipment Used                                          | 59        |
| <b>9.</b>  | <b>PEAK POWER OUTPUT OUT OF 902-928 MHZ BAND</b>             | <b>60</b> |
| 9.1        | Test procedure                                               | 60        |
| 9.2        | Results table                                                | 60        |
| 9.3        | Test Equipment Used                                          | 61        |
| <b>10.</b> | <b>6 DB MINIMUM BANDWIDTH</b>                                | <b>62</b> |
| 10.1       | Test procedure                                               | 62        |
| 10.2       | Results table                                                | 64        |
| 10.3       | Test Equipment Used                                          | 64        |
| <b>11.</b> | <b>BAND EDGE SPECTRUM</b>                                    | <b>65</b> |
| 11.1       | Test procedure                                               | 65        |
| 11.2       | Results table                                                | 67        |
| 11.3       | Test Equipment Used                                          | 67        |
| <b>12.</b> | <b>TRANSMITTED POWER DENSITY</b>                             | <b>68</b> |
| 12.1       | Test procedure                                               | 68        |
| 12.2       | Results table                                                | 70        |
| 12.3       | Test Equipment Used                                          | 70        |
| <b>13.</b> | <b>ANTENNA GAIN</b>                                          | <b>71</b> |



|     |                                    |    |
|-----|------------------------------------|----|
| 14. | R.F EXPOSURE/SAFETY -----          | 72 |
| 15. | PHOTOGRAPHS OF TESTED E.U.T. ----- | 73 |

# 1. General Information

## 1.1 Administrative Information

|                                |                                                                                               |
|--------------------------------|-----------------------------------------------------------------------------------------------|
| Manufacturer:                  | Nexus Data (1993) Ltd.                                                                        |
| Manufacturer's Address:        | 16 Hamelacha St.<br>Rosh Haayin 48091<br>Israel<br>Tel: +972-3-9032288<br>Fax: +972-3-9036105 |
| Manufacturer's Representative: | Shimon Zigdon                                                                                 |
| Equipment Under Test (E.U.T):  | Water Meter Transmitter                                                                       |
| Equipment Model No.:           | WMIN01                                                                                        |
| Equipment Serial No.:          | Not designated                                                                                |
| Date of Receipt of E.U.T:      | 07.08.03                                                                                      |
| Start of Test:                 | 07.08.03                                                                                      |
| End of Test:                   | 11.08.03                                                                                      |
| Test Laboratory Location:      | I.T.L (Product Testing) Ltd.<br>Kfar Bin Nun,<br>ISRAEL 99780                                 |
| Test Specifications:           | See Section 2                                                                                 |

## **1.2 List of Accreditations**

The EMC laboratory of I.T.L. is accredited by the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), Registration No. 90715.
3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
4. The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) (Japan), Registration Numbers: C-1350, R-1285.
5. Industry Canada (Canada), File No. IC 4025.
6. TUV Product Services, England, ASLLAS No. 97201.
7. Nemko (Norway), Authorization No. ELA 207.

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.

### **1.3 Product Description**

The device is a one-way messaging (burst) radio transmitter. It transmits 1 watt Direct Conversion, Direct sequence spread spectrum through a 0 dbi printed inverted-F antenna.

The transmitter frequency band is 904.6-925.4 MHz and channel spacing is 400 kHz; i.e. it has 53 channels. The transmitter local oscillator is synthesized using crystal oscillator reference of 15MHz. The modulation technique is SPSP Direct sequence BPSK with a chip rate of 1 Mchip/sec. The PN codes are 255 maximal length sequences.

### **1.4 Test Methodology**

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4: 2001. Radiated testing was performed at an antenna to EUT distance of 3 meters.

### **1.5 Test Facility**

The radiated emissions tests were performed at I.T.L.'s testing facility at Kfar Bin-Nun, Israel. This site is a FCC listed test laboratory (FCC Registration No. 90715, date of listing March 9, 2001).

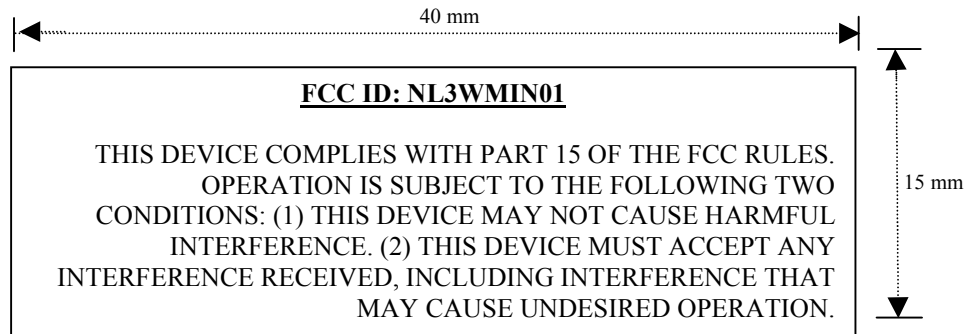
I.T.L.'s EMC Laboratory is also accredited by A2LA, certificate No. 1152.01. The other tests in this report were performed at the Nexus Data facility, Rosh Ha'ayin, Israel.

### **1.6 Measurement Uncertainty**

#### **Radiated Emission**

The Open Site complies with the  $\pm 4$  dB Normalized Site Attenuation requirements of ANSI C63.4-2001. In accordance with Paragraph 5.4.6.1 of this standard, this tolerance includes instrumentation calibration errors, measurement technique errors, and errors due to site anomalies.

## 2. Product Labeling



**Figure 1. FCC Label**



**Figure 2. Location of Label on EUT**

### **3. System Test Configuration**

#### **3.1 Justification**

The E.U.T (end-unit transmitter) was configured to a frequent periodic transmission mode.

In this mode, all the sources of emissions were active. The E.U.T. output power is not programmable, and therefore it was tested when transmitting full 1 watt peak output power. The E.U.T. configuration enabled investigation of emission power down, operating (housekeeping) and transmits modes.

#### **3.2 EUT Exercise Software**

The E.U.T. exercise program used in the testing procedures was the product's standard micro-controller operational firmware. The program was configured to operate the E.U.T. in 3 typical operational modes at the same time:

1. Only the I/O interface is under normal operating condition. The rest of the transmitter is in sleep mode.
2. House keeping mode in which the micro-controller wakes up in order to scan the external inputs.
3. Periodic transmission, in which the main micro-controller wakes up the transmitter section up periodically in order to transmit a typical status message.

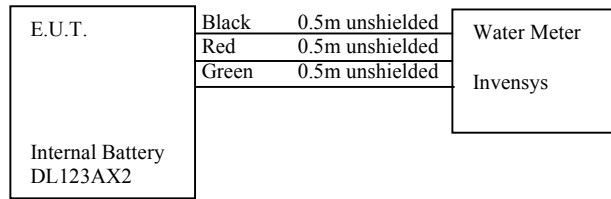
#### **3.3 Special Accessories**

No special accessories were needed to achieve compliance.

#### **3.4 Equipment Modifications**

No modifications were needed to achieve compliance.

### 3.5 Configuration of Tested System



**Figure 3. Configuration of Tested System**

## 4. Block Diagram

### 4.1 *Schematic Block/Connection Diagram*

Intentionally Blank for Reasons of Confidentiality

**Figure 4. E.U.T. Block Diagram**

## **4.2 Theory of Operation**

The E.U.T receiving outputs from the water meter and convert them into an Uplink messages. The E.U.T. transmits the Uplink messages to the base station by means of spread spectrum technology on ISM frequencies. The unit's operation is supervised and controlled by a micro-controller.

### Components

IO (input/output modules)

Transmitter module which includes the following components:

Micro-controller

ASIC (application Specific Integral Circuit)

Transmitter

External memory

## 5. Spurious Radiated Measurement Photos



Figure 5. Spurious Radiated Emission Test. Front



Figure 6. Spurious Radiated Emission Test. Side

## **6. Spurious Radiated Emission, Below 1 GHz**

### **6.1 Test Specification**

30-1000 MHz, F.C.C., Part 15, Subpart C

### **6.2 Test Procedure**

The E.U.T. operation mode and test set-up are as described in Section 3.

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The effect of varying the position of the cables was investigated to find the configuration that produces maximum emission. The configuration tested is shown in Figure 3.1.

The frequency range 30-1000 MHz was scanned, and the list of the highest emissions was verified and updated accordingly.

The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.

The emission levels for other frequencies were compared to the fundamental carrier level and the requirement of Section 15.249 (c).

The emissions were measured using a computerized EMI receiver complying to CISPR 16 requirements. The specification limits and applicable correction factors are loaded to the receiver via a 3.5" floppy disk.

The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

Verification of the E.U.T emissions was based on the following methods:

- Turning the E.U.T on and off.

- Using a frequency span less than 10 MHz.

- Observation of the signal level during turntable rotation. Background noise is not affected by the rotation of the E.U.T.

### 6.3 **Measured Data**

JUDGEMENT: Passed by 15.6 dB $\mu$ V/m

The EUT met the requirements of the F.C.C. Part 15, Subpart C, specification.  
The worst cases were:

for 904.6 MHz, 15.6 dB at 150.00 MHz frequency, vertical polarization.

for 915.0 MHz, 18.8 dB at 329.99 MHz frequency, horizontal polarization

for 925.4 MHz, 16.3 dB at 329.99 MHz frequency, horizontal polarization

The details of the highest emissions are given in Figure 7 to Figure 18.

TEST PERSONNEL:

Tester Signature: \_\_\_\_\_



Date: 26.08.03

Typed/Printed Name: Y. Mordukhovitch

## Radiated Emission

E.U.T Description Water Meter Transmitter  
 Type WMIN01  
 Serial Number: Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal Frequency range: 30 MHz to 300 MHz  
 Test Distance: 3 meters Detector: Quasi-peak  
 Operating Frequency: 904.6 MHz

| Frequency | Peak Amp | QP Amp   | Correction | Specification | Margin    |
|-----------|----------|----------|------------|---------------|-----------|
| (MHz)     | (dBμV/m) | (dBμV/m) | (dB)       | (dBμV/m)      | (dB μV/m) |
| 120.00    | 24.0     | 21.7     | 13.6       | 43.5          | -21.8     |
| 135.00    | 29.0     | 22.7     | 14.2       | 43.5          | -20.8     |
| 150.00    | 26.3     | 18.1     | 15.0       | 43.5          | -25.4     |
| 165.87    | 26.7     | 17.0     | 15.4       | 43.5          | -26.5     |
| 255.30    | 32.5     | 22.3     | 20.9       | 46.0          | -23.7     |

**Figure 7. Radiated Emission. Antenna Polarization: HORIZONTAL.  
 Detector: Quasi-peak**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal                    Frequency range: 300 MHz to 1 GHz  
 Test Distance: 3 meters                                Detector: Peak, Quasi-peak  
 Operating Frequency: 904.6 MHz

| Frequency<br>(MHz) | Peak Amp<br>(dB $\mu$ V/m) | QP Amp<br>(dB $\mu$ V/m) | Correction<br>(dB) | Specification<br>(dB $\mu$ V/m) | Margin<br>(dB $\mu$ V/m) |
|--------------------|----------------------------|--------------------------|--------------------|---------------------------------|--------------------------|
| 329.99             | 30.5                       | 57.6                     | 15.9               | 46.0                            | -18.4                    |
| 409.02             | 26.8                       | 19.6                     | 18.6               | 46.0                            | -28.4                    |
| 612.72             | 32.3                       | 24.2                     | 22.5               | 46.0                            | -21.8                    |
| 964.54             | 39.5                       | 32.0                     | 28.3               | 54.0                            | -22.0                    |

**Figure 8. Radiated Emission. Antenna Polarization: HORIZONTAL.  
 Detector: Peak, Quasi-peak**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission

E.U.T Description Water Meter Transmitter  
 Type WMIN01  
 Serial Number: Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical Frequency range: 30 MHz to 300 MHz  
 Test Distance: 3 meters Detector: Quasi-peak  
 Operating Frequency: 904.6 MHz

| Frequency<br>(MHz) | Peak Amp<br>(dBμV/m) | QP Amp<br>(dBμV/m) | Correction<br>(dB) | Specification<br>(dBμV/m) | Margin<br>(dB) |
|--------------------|----------------------|--------------------|--------------------|---------------------------|----------------|
| 111.97             | 24.6                 | 15.7               | 13.1               | 43.5                      | -27.8          |
| 135.00             | 23.6                 | 15.7               | 14.2               | 43.5                      | -27.8          |
| 150.00             | 27.9                 | 27.9               | 15.0               | 43.5                      | -15.6          |
| 170.00             | 37.5                 | 26.9               | 15.5               | 43.5                      | -16.6          |
| 270.00             | 33.1                 | 23.1               | 21.5               | 46.0                      | -22.9          |

**Figure 9. Radiated Emission. Antenna Polarization: VERTICAL.  
 Detector: Quasi-peak**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical  
 Test Distance: 3 meters  
 Operating Frequency: 904.6 MHz

Frequency range: 300 MHz to 1 GHz  
 Detector: Peak, Quasi-peak

| Frequency<br>(MHz) | Peak Amp<br>(dB $\mu$ V/m) | QP Amp<br>(dB $\mu$ V/m) | Correction<br>(dB) | Specification<br>(dB $\mu$ V/m) | Margin<br>(dB $\mu$ V/m) |
|--------------------|----------------------------|--------------------------|--------------------|---------------------------------|--------------------------|
| 329.990000         | 28.4                       | 25.3                     | 15.9               | 46.0                            | -20.7                    |
| 402.000000         | 28.4                       | 19.6                     | 18.5               | 46.0                            | -26.4                    |
| 612.000000         | 30.5                       | 23.9                     | 22.5               | 46.0                            | -22.1                    |
| 965.000000         | 37.6                       | 30.6                     | 28.3               | 54.0                            | -23.4                    |

**Figure 10. Radiated Emission. Antenna Polarization: VERTICAL.  
 Detector: Peak, Quasi-peak**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal                    Frequency range: 30 MHz to 300 MHz  
 Test Distance: 3 meters                                Detector: Quasi-peak  
 Operating Frequency: 915 MHz

| Frequency<br>(MHz) | Peak Amp<br>(dB $\mu$ V/m) | QP Amp<br>(dB $\mu$ V/m) | Correction<br>(dB) | Specification<br>(dB $\mu$ V/m) | Margin<br>(dB) |
|--------------------|----------------------------|--------------------------|--------------------|---------------------------------|----------------|
| 115.49             | 21.0                       | 14.3                     | 13.3               | 43.5                            | -29.2          |
| 125.19             | 21.1                       | 14.3                     | 13.8               | 43.5                            | -29.2          |
| 134.99             | 27.0                       | 21.3                     | 14.2               | 43.5                            | -22.2          |
| 165.09             | 22.4                       | 16.2                     | 15.4               | 43.5                            | -27.3          |
| 270.01             | 29.3                       | 22.3                     | 21.5               | 46.0                            | -23.7          |

**Figure 11. Radiated Emission. Antenna Polarization: HORIZONTAL.  
 Detector: Quasi-peak**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal                    Frequency range: 300 MHz to 1 GHz  
 Test Distance: 3 meters                                Detector: Peak, Quasi-peak  
 Operating Frequency: 915 MHz

| Frequency<br>(MHz) | Peak Amp<br>(dB $\mu$ V/m) | QP Amp<br>(dB $\mu$ V/m) | Correction<br>(dB) | Specification<br>(dB $\mu$ V/m) | Margin<br>(dB $\mu$ V/m) |
|--------------------|----------------------------|--------------------------|--------------------|---------------------------------|--------------------------|
| 329.99             | 30.4                       | 27.2                     | 15.9               | 46.0                            | -18.8                    |
| 408.30             | 26.5                       | 19.6                     | 18.6               | 46.0                            | -26.4                    |
| 610.00             | 31.5                       | 23.9                     | 22.4               | 46.0                            | -22.1                    |
| 965.00             | 36.9                       | 30.9                     | 28.3               | 54.0                            | -23.1                    |

**Figure 12. Radiated Emission. Antenna Polarization: HORIZONTAL.  
 Detector: Peak, Quasi-peak**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission

E.U.T Description Water Meter Transmitter  
 Type WMIN01  
 Serial Number: Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical Frequency range: 30 MHz to 300 MHz  
 Test Distance: 3 meters Detector: Quasi-peak  
 Operating Frequency: 915 MHz

| Frequency<br>(MHz) | Peak Amp<br>(dB $\mu$ V/m) | QP Amp<br>(dB $\mu$ V/m) | Correction<br>(dB) | Specification<br>(dB $\mu$ V/m) | Margin<br>(dB) |
|--------------------|----------------------------|--------------------------|--------------------|---------------------------------|----------------|
| 73.95              | 19.9                       | 13.8                     | 10.3               | 43.5                            | -26.2          |
| 115.94             | 24.8                       | 15.1                     | 13.4               | 43.5                            | -28.4          |
| 156.80             | 23.4                       | 15.9                     | 15.2               | 43.5                            | -27.6          |
| 162.29             | 23.8                       | 17.0                     | 15.3               | 43.5                            | -26.5          |
| 264.94             | 29.1                       | 22.0                     | 21.4               | 46.0                            | -24.0          |

**Figure 13. Radiated Emission. Antenna Polarization: VERTICAL.  
 Detector: Quasi-peak**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical  
 Test Distance: 3 meters  
 Operating Frequency: 915 MHz

Frequency range: 300 MHz to 1 GHz  
 Detector: Peak, Quasi-peak

| Frequency<br>(MHz) | Peak Amp<br>(dB $\mu$ V/m) | QP Amp<br>(dB $\mu$ V/m) | Correction<br>(dB) | Specification<br>(dB $\mu$ V/m) | Margin<br>(dB $\mu$ V/m) |
|--------------------|----------------------------|--------------------------|--------------------|---------------------------------|--------------------------|
| 329.99             | 28.0                       | 23.6                     | 15.9               | 46.0                            | -22.4                    |
| 400.91             | 26.4                       | 19.4                     | 18.5               | 46.0                            | -26.6                    |
| 611.07             | 31.1                       | 23.9                     | 22.4               | 46.0                            | -22.1                    |
| 975.00             | 37.1                       | 30.8                     | 28.4               | 46.0                            | -23.2                    |

**Figure 14. Radiated Emission. Antenna Polarization: VERTICAL.  
 Detector: Peak, Quasi-peak**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal                    Frequency range: 30 MHz to 300 MHz  
 Test Distance: 3 meters                                Detector: Quasi-peak  
 Operating Frequency: 925.4 MHz

| Frequency<br>(MHz) | Peak Amp<br>(dB $\mu$ V/m) | QP Amp<br>(dB $\mu$ V/m) | Correction<br>(dB) | Specification<br>(dB $\mu$ V/m) | Margin<br>(dB) |
|--------------------|----------------------------|--------------------------|--------------------|---------------------------------|----------------|
| 120.00             | 24.0                       | 22.1                     | 13.6               | 43.5                            | -21.4          |
| 135.00             | 37.1                       | 23.3                     | 14.2               | 43.5                            | -20.2          |
| 156.80             | 24.5                       | 17.3                     | 15.2               | 43.5                            | -26.2          |
| 170.00             | 25.9                       | 17.4                     | 15.5               | 43.5                            | -26.1          |
| 245.00             | 28.6                       | 21.0                     | 20.1               | 46.0                            | -25.0          |

**Figure 15. Radiated Emission. Antenna Polarization: HORIZONTAL.  
 Detector: Quasi-peak**

Note:    Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal                    Frequency range: 300 MHz to 1 GHz  
 Test Distance: 3 meters                                Detector: Peak, Quasi-peak  
 Operating Frequency: 925.4 MHz

| Frequency<br>(MHz) | Peak Amp<br>(dBμV/m) | QP Amp<br>(dBμV/m) | Correction<br>(dB) | Specification<br>(dBμV/m) | Margin<br>(dB μV/m) |
|--------------------|----------------------|--------------------|--------------------|---------------------------|---------------------|
| 329.99             | 31.1                 | 29.7               | 15.9               | 46.0                      | -16.3               |
| 408.00             | 25.1                 | 20.4               | 18.6               | 46.0                      | -25.6               |
| 611.32             | 29.3                 | 24.0               | 22.4               | 46.0                      | -22.0               |
| 972.59             | 36.1                 | 30.9               | 28.4               | 54.0                      | -23.1               |

**Figure 16. Radiated Emission. Antenna Polarization: HORIZONTAL.  
 Detector: Peak, Quasi-peak**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission

E.U.T Description Water Meter Transmitter  
 Type WMIN01  
 Serial Number: Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical Frequency range: 30 MHz to 300 MHz  
 Test Distance: 3 meters Detector: Quasi-peak  
 Operating Frequency: 925.4 MHz

| Frequency<br>(MHz) | Peak Amp<br>(dBμV/m) | QP Amp<br>(dBμV/m) | Correction<br>(dB) | Specification<br>(dBμV/m) | Margin<br>(dB) |
|--------------------|----------------------|--------------------|--------------------|---------------------------|----------------|
| 150.00             | 26.3                 | 22.6               | 15.0               | 43.5                      | -20.9          |
| 245.00             | 30.6                 | 20.9               | 20.1               | 46.0                      | -25.1          |
| 280.00             | 32.5                 | 23.3               | 21.9               | 46.0                      | -22.7          |

**Figure 17. Radiated Emission. Antenna Polarization: VERTICAL.  
 Detector: Quasi-peak**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical  
 Test Distance: 3 meters  
 Operating Frequency: 925.4 MHz

Frequency range: 300 MHz to 1 GHz  
 Detector: Peak, Quasi-peak

| Frequency<br>(MHz) | Peak Amp<br>(dB $\mu$ V/m) | QP Amp<br>(dB $\mu$ V/m) | Correction<br>(dB) | Specification<br>(dB $\mu$ V/m) | Margin<br>(dB $\mu$ V/m) |
|--------------------|----------------------------|--------------------------|--------------------|---------------------------------|--------------------------|
| 328.00             | 23.4                       | 16.8                     | 15.8               | 46.0                            | -29.2                    |
| 329.99             | 28.8                       | 25.5                     | 15.9               | 46.0                            | -20.5                    |
| 402.02             | 26.5                       | 19.7                     | 18.5               | 46.0                            | -26.3                    |
| 609.99             | 30.4                       | 24.1                     | 22.4               | 46.0                            | -21.9                    |
| 962.60             | 44.2                       | 35.3                     | 28.2               | 54.0                            | -18.7                    |

**Figure 18. Radiated Emission. Antenna Polarization: VERTICAL.  
 Detector: Peak, Quasi-peak**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

#### 6.4 Test Instrumentation Used, Radiated Measurements

| Instrument              | Manufacturer | Model         | Serial Number | Calibration      | Period |
|-------------------------|--------------|---------------|---------------|------------------|--------|
| EMI Receiver            | HP           | 85422E        | 3411A00102    | January 31, 2003 | 1 year |
| RF Section              | HP           | 85420E        | 3427A00103    | January 31, 2003 | 1 year |
| Antenna Bioconical      | ARA          | BCD 235/B     | 1041          | April 20, 2003   | 1 year |
| Antenna Mast            | ARA          | AAM-4A        | 1001          | N/A              | N/A    |
| Turntable               | ARA          | ART-1001/4    | 1001          | N/A              | N/A    |
| Mast & Table Controller | ARA          | ACU-2/5       | 1001          | N/A              | N/A    |
| Printer                 | HP           | ThinkJet 2225 | 2738508357.0  | N/A              | N/A    |

## 6.5 **Field Strength Calculation**

The field strength is calculated directly by the EMI Receiver software, and a "Correction Factors" data disk, using the following equation:

$$[\text{dB}\mu\text{V/m}] \text{ FS} = \text{RA} + \text{AF} + \text{CF}$$

FS: Field Strength [dB $\mu$ V/m]  
RA: Receiver Amplitude [dB $\mu$ V]  
AF: Receiving Antenna Correction Factor [dB/m]  
CF: Cable Attenuation Factor [dB]

No external pre-amplifiers are used.

## 7. Spurious Radiated Emission Above 1 GHz

### 7.1 Radiated Emission Above 1 GHz

The E.U.T operation mode and test set-up are as described in Section 3.

A preliminary measurement to characterize the E.U.T was performed inside the shielded room, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The effect of varying the position of the cables was investigated to find the configuration that produces maximum emission. The configuration tested is shown in Figure 3.1.

The levels of the emissions within the frequency ranges of the restricted bands (Section 15.205 of FCC Part 15) were compared to the limits of the table in Section 15.209 (a), General Requirements.

The emission levels for other frequencies were compared to the fundamental carrier level and the requirement of Section 15.249 (c).

In the frequency range 1-2.9 GHz, a computerized EMI receiver complying to CISPR 16 requirements and a High Pass Filter were used. The test distance was 3 meters.

In the frequency range 2.9-9.3 GHz, a spectrum analyzer including a low noise amplifier was used. The test distance was 3 meters. During peak measurements, the I.F. bandwidth was 1 MHz, and video bandwidth 3 MHz. During average measurements, the I.F. bandwidth was 1 MHz and video bandwidth was 100 Hz. The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

Verification of the E.U.T emissions was based on the following methods: turning the E.U.T on and off; using a frequency span less than 10 MHz; observation of the signal level during turntable rotation. (Background noise is not affected by the rotation of the E.U.T.)

### 7.2 Test Data

JUDGEMENT: Passed by 5.0 dB $\mu$ V/m

The EUT met the requirements of the F.C.C. Part 15, Subpart C, specification.  
The worst cases were:

for 904.6 MHz, 11.6 dB at 2713.80 MHz frequency, vertical polarization.  
for 915.0 MHz, 11.2 dB at 2745.00 MHz frequency, vertical polarization  
for 925.4 MHz, 5.0 dB at 2776.13 MHz frequency, horizontal and vertical polarizations

The details of the highest emissions are given in Figure 19 to Figure 42.

TEST PERSONNEL:

Tester Signature: 

Date: 26.08.03

Typed/Printed Name: Y. Mordukhovitch

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal                    Frequency range: 1 GHz to 2.9 GHz  
 Test Distance: 3 meters                                Detector: Average  
 Operating Frequency: 904.6 MHz

| <b>Freq.</b> | <b>Avg. Amp</b> | <b>Correction</b> | <b>Avg. Det. Spec.</b> | <b>Avg. Margin</b> |
|--------------|-----------------|-------------------|------------------------|--------------------|
| (MHz)        | (dB $\mu$ V/m)  | (dB)              | (dB $\mu$ V/m)         | (dB)               |
| 2713.80      | 42.3            | 44.1              | 54.0                   | -11.7              |

**Figure 19. Radiated Emission. Antenna Polarization: HORIZONTAL.  
 Detector: Average**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal                    Frequency range: 1 GHz to 2.9 GHz  
 Test Distance: 3 meters                                Detector: Peak  
 Operating Frequency: 904.6 MHz

| <b>Freq.</b><br>(MHz) | <b>Peak<br/>Amp</b><br>(dB $\mu$ V/m) | <b>Correction</b><br>(dB) | <b>Peak Det.<br/>Spec.</b><br>(dB $\mu$ V/m) | <b>Peak.<br/>Margin</b><br>(dB) |
|-----------------------|---------------------------------------|---------------------------|----------------------------------------------|---------------------------------|
| 2713.80               | 53.3                                  | 44.1                      | 74.0                                         | -20.7                           |

**Figure 20. Radiated Emission. Antenna Polarization: HORIZONTAL.  
 Detector: Peak**

Note:    Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal                    Frequency range: 2.9 GHz to 9.3 GHz  
 Test Distance: 3 meters                                Detector: Peak  
 Operating Frequency: 904.6 MHz

| Freq.   | Peak<br>Amp | Correction Factors |             |              | Peak.<br>Specification | Peak<br>Final<br>Result<br>FR (P)* | Peak.<br>Margin |
|---------|-------------|--------------------|-------------|--------------|------------------------|------------------------------------|-----------------|
| (MHz)   | (dBμV)      | Antenna<br>AF      | Cable<br>CF | Preamp<br>PF | (dB μV/m)              | (dB μV/m)<br>See Note *            | (dB)            |
| 3618.40 | 38.6        | 33.8               | 2.0         | 30.5         | 74.0                   | 43.9                               | -30.1           |
| 4523.0  | 37.0        | 35.2               | 2.6         | 30.5         | 74.0                   | 44.3                               | -29.7           |
| 5427.60 | 37.3        | 36.6               | 2.8         | 30.4         | 74.0                   | 46.3                               | -27.7           |
| 8141.40 | 40.3        | 40.0               | 3.7         | 29.9         | 74.0                   | 54.1                               | -19.9           |
| 9046.0  | 39.1        | 40.8               | 4.3         | 30.0         | 74.0                   | 54.2                               | -19.8           |

**Figure 21. Radiated Emission. Antenna Polarization: HORIZONTAL.  
 Detector: Peak**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Note \*: In the frequency range above 2.9 GHz, the field strength was manually calculated by using the following equation:

$$FR(P) = \text{Peak} + AF + CF - PF$$

Where: FR (P) is final peak detector result.

Peak is peak detector measurement.

AF is antenna factor.

CF is cable factor.

PF is preamplifier factor.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                      WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal                      Frequency range: 2.9 GHz to 9.3 GHz  
 Test Distance: 3 meters                                      Detector: Average  
 Operating Frequency: 904.6 MHz

| Freq.<br>(MHz) | Avg<br>Amp<br>(dBμV) | Correction<br>Factors |                     |                      | AVG<br>Specification<br>(dB μV/m) | AVG<br>Final<br>Result<br>FR (A)<br>(dB μV/m)<br>See Note * | AVG<br>Margin<br>(dB) |
|----------------|----------------------|-----------------------|---------------------|----------------------|-----------------------------------|-------------------------------------------------------------|-----------------------|
|                |                      | Antenna<br>AF<br>(dB) | Cable<br>CF<br>(dB) | Preamp<br>PF<br>(dB) |                                   |                                                             |                       |
| 3618.40        | 24.0                 | 33.8                  | 2.0                 | 30.5                 | 54.0                              | 29.3                                                        | -24.7                 |
| 4523.00        | 23.1                 | 35.2                  | 2.6                 | 30.5                 | 54.0                              | 30.4                                                        | -23.6                 |
| 5427.60        | 23.0                 | 36.6                  | 2.8                 | 30.4                 | 54.0                              | 32.0                                                        | -22.0                 |
| 8141.40        | 26.3                 | 40.0                  | 3.7                 | 29.9                 | 54.0                              | 40.1                                                        | -13.9                 |
| 9046.00        | 25.6                 | 40.8                  | 4.3                 | 30.0                 | 54.0                              | 40.7                                                        | -13.3                 |

**Figure 22. Radiated Emission. Antenna Polarization: HORIZONTAL.  
 Detector: Average**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Note\*: In the frequency range above 2.9 GHz, the field strength was manually calculated by using the following equation:

$$FR(A) = AVG + AF + CF - PF$$

Where: FR(A) is final average detector result.

AVG is average detector measurement.

AF is antenna factor.

CF is cable factor.

PF is preamplifier factor.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical                    Frequency range: 1 GHz to 2.9 GHz  
 Test Distance: 3 meters                            Detector: Average  
 Operating Frequency: 904.6 MHz

| <b>Freq.</b><br>(MHz) | <b>Avg. Amp</b><br>(dBμV/m) | <b>Correction</b><br>(dB) | <b>Avg. Det. Spec.</b><br>(dBμV/m) | <b>Avg. Margin</b><br>(dB) |
|-----------------------|-----------------------------|---------------------------|------------------------------------|----------------------------|
| 2713.80               | 42.4                        | 44.1                      | 54.0                               | -11.6                      |

**Figure 23. Radiated Emission. Antenna Polarization: VERTICAL.  
 Detector: Average**

Note:    Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical                    Frequency range: 1 GHz to 2.9 GHz  
 Test Distance: 3 meters                            Detector: Peak  
 Operating Frequency: 904.6 MHz

| <b>Freq.</b><br>(MHz) | <b>Peak<br/>Amp</b><br>(dB $\mu$ V/m) | <b>Correction</b><br>(dB) | <b>Peak. Det.<br/>Spec.</b><br>(dB $\mu$ V/m) | <b>Peak.<br/>Margin</b><br>(dB) |
|-----------------------|---------------------------------------|---------------------------|-----------------------------------------------|---------------------------------|
| 2713.80               | 56.7                                  | 44.1                      | 74.0                                          | -17.3                           |

**Figure 24. Radiated Emission. Antenna Polarization: VERTICAL.  
 Detector: Peak**

Note:    Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical                    Frequency range: 2.9 GHz to 9.3 GHz  
 Test Distance: 3 meters                            Detector: Peak  
 Operating Frequency: 904.6 MHz

| Freq.   | Peak<br>Amp | Correction Factors    |                     |                      | Peak.<br>Specification | Peak<br>Final<br>Result FR<br>(P)<br>(dB μV/m)<br>See Note * | Peak.<br>Margin |
|---------|-------------|-----------------------|---------------------|----------------------|------------------------|--------------------------------------------------------------|-----------------|
| (MHz)   | (dBμV/m)    | Antenna<br>AF<br>(dB) | Cable<br>CF<br>(dB) | Preamp<br>PF<br>(dB) | (dB μV/m)              |                                                              | (dB)            |
| 3618.40 | 38.6        | 33.8                  | 2.0                 | 30.5                 | 74.0                   | 43.9                                                         | -30.1           |
| 4523.00 | 37.0        | 35.2                  | 2.6                 | 30.5                 | 74.0                   | 44.3                                                         | -29.7           |
| 5427.60 | 37.3        | 36.6                  | 2.8                 | 30.4                 | 74.0                   | 46.3                                                         | -27.7           |
| 8141.40 | 40.3        | 40.0                  | 3.7                 | 29.9                 | 74.0                   | 54.1                                                         | -19.9           |
| 9046.00 | 39.1        | 40.8                  | 4.3                 | 30.0                 | 74.0                   | 54.2                                                         | -19.8           |

**Figure 25. Radiated Emission. Antenna Polarization: VERTICAL.  
 Detector: Peak**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Note\*: In the frequency range above 2.9 GHz, the field strength was manually calculated by using the following equation:

$$FR(P) = Peak + AF + CF - PF$$

Where: FR (P) is final peak detector result,

Peak is peak detector measurement,

AF is antenna factor,

CF is cable factor,

PF is preamplifier factor.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical                    Frequency range: 2.9 GHz to 9.3 GHz  
 Test Distance: 3 meters                            Detector: Average  
 Operating Frequency: 904.6 MHz

| Freq.<br>(MHz) | Avg<br>Amp<br>(dBμV) | Correction Factors |                  |                         | AVG<br>Specification<br>(dB μV/m) | AVG<br>Final<br>Result<br>FR (A)*<br>(dB μV/m)<br>See Note * | AVG<br>Margin<br>(dB) |
|----------------|----------------------|--------------------|------------------|-------------------------|-----------------------------------|--------------------------------------------------------------|-----------------------|
|                |                      | Antenna AF<br>(dB) | Cable CF<br>(dB) | Preamplifier PF<br>(dB) |                                   |                                                              |                       |
| 3618.40        | 24.0                 | 33.8               | 2.0              | 30.5                    | 54.0                              | 29.3                                                         | -24.7                 |
| 4523.00        | 23.1                 | 35.2               | 2.6              | 30.5                    | 54.0                              | 30.4                                                         | -23.6                 |
| 5427.60        | 23.0                 | 36.6               | 2.8              | 30.4                    | 54.0                              | 32.0                                                         | -22.0                 |
| 8141.40        | 26.3                 | 40.0               | 3.7              | 29.9                    | 54.0                              | 40.1                                                         | -13.9                 |
| 9046.00        | 25.6                 | 40.8               | 4.3              | 30.0                    | 54.0                              | 40.7                                                         | -13.3                 |

**Figure 26. Radiated Emission. Antenna Polarization: VERTICAL  
 Detector: Average**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Note\*: In the frequency range above 2.9 GHz, the field strength was manually calculated by using the following equation:

$$FR(A) = AVG + AF + CF - PF$$

Where: FR(A) is average detector result,

AVG is average detector measurement,

AF is antenna factor,

CF is cable factor,

PF is preamplifier factor.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal                    Frequency range: 1 GHz to 2.9 GHz  
 Test Distance: 3 meters                                Detector: Average  
 Operating Frequency: 915 MHz

| <b>Freq.</b><br>(MHz) | <b>Avg. Amp</b><br>(dBμV/m) | <b>Correction</b><br>(dB) | <b>Avg. Det. Spec.</b><br>(dBμV/m) | <b>Avg. Margin</b><br>(dB) |
|-----------------------|-----------------------------|---------------------------|------------------------------------|----------------------------|
| 2745.00               | 42.6                        | 44.3                      | 54.0                               | -11.4                      |

**Figure 27. Radiated Emission. Antenna Polarization: HORIZONTAL.  
 Detector: Average**

Note:    Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C:  
 Class B

Antenna Polarization: Horizontal                    Frequency range: 1 GHz to 2.9 GHz  
 Test Distance: 3 meters                                Detector: Peak  
 Operating Frequency: 915 MHz

| <b>Freq.</b> | <b>Peak<br/>Amp</b> | <b>Correction</b> | <b>Peak<br/>Det.<br/>Spec.</b> | <b>Peak.<br/>Margin</b> |
|--------------|---------------------|-------------------|--------------------------------|-------------------------|
| (MHz)        | (dBμV/m)            | (dB)              | (dBμV/m)                       | (dB)                    |
| 2745.00      | 56.3                | 44.3              | 74.0                           | -17.7                   |

**Figure 28. Radiated Emission. Antenna Polarization: HORIZONTAL.  
 Detector: Peak**

Note:    Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal  
 Test Distance: 3 meters  
 Operating Frequency: 915 MHz

Frequency range: 2.9 GHz to 9.3 GHz  
 Detector: Peak

| Freq.<br>(MHz) | Peak<br>Amp<br>(dBμV) | Correction Factor     |                     |                      | Peak.<br>Specification<br>(dB μV/m) | Peak<br>Final<br>Result<br>FR (P)<br>(dB μV/m)<br>See Note *. | Peak.<br>Margin<br>(dB) |
|----------------|-----------------------|-----------------------|---------------------|----------------------|-------------------------------------|---------------------------------------------------------------|-------------------------|
|                |                       | Antenna<br>AF<br>(dB) | Cable<br>CF<br>(dB) | Preamp<br>PF<br>(dB) |                                     |                                                               |                         |
| 3660.00        | 37.8                  | 33.8                  | 2.0                 | 30.5                 | 74.0                                | 43.1                                                          | -30.9                   |
| 4575.00        | 36.5                  | 35.4                  | 2.6                 | 30.5                 | 74.0                                | 44.0                                                          | -30.0                   |
| 7320.00        | 39.7                  | 39.0                  | 3.4                 | 29.8                 | 74.0                                | 52.3                                                          | -21.7                   |
| 8235.00        | 40.4                  | 40.1                  | 3.8                 | 29.9                 | 74.0                                | 54.4                                                          | -19.6                   |
| 9150.00        | 39.7                  | 41.0                  | 4.4                 | 30.0                 | 74.0                                | 55.1                                                          | -18.9                   |

**Figure 29. Radiated Emission. Antenna Polarization: HORIZONTAL.  
 Detector: Peak**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Note\*: In the frequency range above 2.9 GHz, the field strength was manually calculated by using the following equation:

$$FR(P) = \text{Peak} + AF + CF - PF$$

Where: FR (P) is final peak detector result,

Peak is peak detector measurement,

AF is antenna factor,

CF is cable factor,

PF is preamplifier factor.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal                    Frequency range: 2.9 GHz to 9.3 GHz  
 Test Distance: 3 meters                                Detector: Average  
 Operating Frequency: 915 MHz

| Freq.<br><br>(MHz) | Avg<br>Amp<br><br>(dBμV) | Correction Factors        |                         |                          | AVG<br>Specification<br><br>(dB μV/m) | AVG<br>Final<br>Result<br>FR (A)<br>(dB μV/m)<br>See Note *. | AVG<br>Margin<br><br>(dB) |
|--------------------|--------------------------|---------------------------|-------------------------|--------------------------|---------------------------------------|--------------------------------------------------------------|---------------------------|
|                    |                          | Antenna<br>AF<br><br>(dB) | Cable<br>CF<br><br>(dB) | Preamp<br>PF<br><br>(dB) |                                       |                                                              |                           |
| 3660.00            | 24.2                     | 33.8                      | 2.0                     | 30.5                     | 54.0                                  | 24.5                                                         | -24.5                     |
| 4575.00            | 23.0                     | 35.4                      | 2.6                     | 30.5                     | 54.0                                  | 30.5                                                         | -23.5                     |
| 7320.00            | 25.8                     | 39.0                      | 3.4                     | 29.8                     | 54.0                                  | 38.4                                                         | -15.6                     |
| 8235.00            | 26.6                     | 40.1                      | 3.8                     | 29.9                     | 54.0                                  | 40.6                                                         | -13.4                     |
| 9150.00            | 25.7                     | 41.0                      | 4.4                     | 30.0                     | 54.0                                  | 41.1                                                         | -12.9                     |

**Figure 30. Radiated Emission. Antenna Polarization: HORIZONTAL.  
 Detector: Average**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Note\*: In the frequency range above 2.9 GHz, the field strength was manually calculated by using the following equation:

$$FR(A) = AVG + AF + CF - PF$$

Where: FR(A) is final average detector result,  
 AVG is average detector measurement,  
 AF is antenna factor,  
 CF is cable factor,  
 PF is preamplifier factor.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical                    Frequency range: 1 GHz to 2.9 GHz  
 Test Distance: 3 meters                            Detector: Average  
 Operating Frequency: 915 MHz

| <b>Freq.</b><br>(MHz) | <b>Avg.<br/>Amp</b><br>(dB $\mu$ V/m) | <b>Correction</b><br>(dB) | <b>Avg. Det.<br/>Spec.</b><br>(dB $\mu$ V/m) | <b>Avg.<br/>Margin</b><br>(dB) |
|-----------------------|---------------------------------------|---------------------------|----------------------------------------------|--------------------------------|
| 2745.00               | 42.8                                  | 44.3                      | 54.0                                         | -11.2                          |

**Figure 31. Radiated Emission. Antenna Polarization: VERTICAL.  
 Detector: Average**

Note:    Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical                    Frequency range: 1 GHz to 2.9 GHz  
 Test Distance: 3 meters                            Detector: Peak  
 Operating Frequency: 915 MHz

| <b>Freq.</b> | <b>Peak<br/>Amp</b> | <b>Correction</b> | <b>Peak<br/>Det.<br/>Spec.</b> | <b>Peak.<br/>Margin</b> |
|--------------|---------------------|-------------------|--------------------------------|-------------------------|
| (MHz)        | (dBμV/m)            | (dB)              | (dBμV/m)                       | (dB)                    |
| 2745.00      | 57.2                | 44.3              | 74.0                           | -16.8                   |

**Figure 32. Radiated Emission. Antenna Polarization: VERTICAL.  
 Detector: Peak**

Note:    Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical                    Frequency range: 2.9 GHz to 9.3 GHz  
 Test Distance: 3 meters                            Detector: Peak  
 Operating Frequency: 915 MHz

| Freq.   | Peak<br>Amp | Correction Factor |             |              | Peak.<br>Specification | Peak<br>Final<br>Result<br>FR (P) | Peak.<br>Margin |
|---------|-------------|-------------------|-------------|--------------|------------------------|-----------------------------------|-----------------|
| (MHz)   | (dBμV)      | Antenna<br>AF     | Cable<br>CF | Preamp<br>PF | (dB μV/m)              | (dB μV/m)<br>See Note *.          | (dB)            |
| 3660.00 | 37.8        | 33.8              | 2.0         | 30.5         | 74.0                   | 43.1                              | -30.9           |
| 4575.00 | 36.5        | 35.4              | 2.6         | 30.5         | 74.0                   | 44.0                              | -30.0           |
| 7320.00 | 39.7        | 39.0              | 3.4         | 29.8         | 74.0                   | 52.3                              | -21.7           |
| 8235.00 | 40.4        | 40.1              | 3.8         | 29.9         | 74.0                   | 54.4                              | -19.6           |
| 9150.00 | 39.7        | 41.0              | 4.4         | 30.0         | 74.0                   | 55.1                              | -18.9           |

**Figure 33. Radiated Emission. Antenna Polarization: VERTICAL.  
 Detector: Peak**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Note\*: In the frequency range above 2.9 GHz, the field strength is manually calculated by using the following equation:

$$FR(P) = \text{Peak} + AF + CF - PF$$

Where: FR (P) is final peak detector result,  
 Peak is peak detector measurement,  
 AF is antenna factor,  
 CF is cable factor,  
 PF is preamplifier factor.

## Radiated Emission Above 1 GHz

E.U.T Description Water Meter Transmitter  
 Type WMIN01  
 Serial Number: Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical Frequency range: 2.9 GHz to 9.3 GHz  
 Test Distance: 3 meters Detector: Average  
 Operating Frequency: 915 MHz

| Freq.   | AVG<br>Amp | Correction Factors    |                     |                      | AVG<br>Specification | AVG<br>Final<br>Result<br>FR (A) | AVG<br>Margin |
|---------|------------|-----------------------|---------------------|----------------------|----------------------|----------------------------------|---------------|
| (MHz)   | (dBμV)     | Antenna<br>AF<br>(dB) | Cable<br>CF<br>(dB) | Preamp<br>PF<br>(dB) | (dB μV/m)            | (dB μV/m)<br>See Note*.          | (dB)          |
| 3660.00 | 24.2       | 33.8                  | 2.0                 | 30.5                 | 54.0                 | 29.5                             | -24.5         |
| 4575.00 | 23.0       | 35.4                  | 2.6                 | 30.5                 | 54.0                 | 30.5                             | -23.5         |
| 7320.00 | 25.8       | 39.0                  | 3.4                 | 29.8                 | 54.0                 | 38.4                             | -15.6         |
| 8235.00 | 26.6       | 40.1                  | 3.8                 | 29.9                 | 54.0                 | 40.6                             | -13.4         |
| 9150.00 | 25.7       | 41.0                  | 4.4                 | 30.0                 | 54.0                 | 41.1                             | -12.9         |

**Figure 34. Radiated Emission. Antenna Polarization: VERTICAL  
 Detector: Average**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Note\*: In the frequency range above 2.9 GHz, the field strength was manually calculated by using the following equation:

$$FR(A) = AVG + AF + CF - PF$$

Where: FR(A) is average detector result,

AVG is average detector measurement,

AF is antenna factor,

CF is cable factor,

PF is preamplifier factor.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal                    Frequency range: 1 GHz to 2.9 GHz  
 Test Distance: 3 meters                                Detector: Average  
 Operating Frequency: 925.4 MHz

| <b>Freq.</b> | <b>Avg. Amp</b> | <b>Correction</b> | <b>Avg. Det.</b> | <b>Avg.</b>   |
|--------------|-----------------|-------------------|------------------|---------------|
| (MHz)        | (dB $\mu$ V/m)  | (dB)              | <b>Spec.</b>     | <b>Margin</b> |
|              |                 |                   | (dB $\mu$ V/m)   | (dB)          |
| 2776.13      | 49.0            | 44.5              | 54.0             | -5.0          |

**Figure 35. Radiated Emission. Antenna Polarization: HORIZONTAL.  
 Detector: Average**

Note:    Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal                    Frequency range: 1 GHz to 2.9 GHz  
 Test Distance: 3 meters                                Detector: Peak  
 Operating Frequency: 925.4 MHz

| <b>Freq.</b> | <b>Peak<br/>Amp</b> | <b>Correction</b> | <b>Peak<br/>Det.<br/>Spec.</b> | <b>Peak.<br/>Margin</b> |
|--------------|---------------------|-------------------|--------------------------------|-------------------------|
| (MHz)        | (dBμV/m)            | (dB)              | (dBμV/m).                      | (dB)                    |
| 2776.13      | 63.0                | 44.5              | 74.0                           | -11.0                   |

**Figure 36. Radiated Emission. Antenna Polarization: HORIZONTAL.  
 Detector: Peak**

Note:    Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal                    Frequency range: 2.9 GHz to 9.3GHz  
 Test Distance: 3 meters                                Detector: Peak  
 Operating Frequency: 925.4 MHz

| Freq.   | Peak<br>Amp | Correction Factors |             |              | Peak.<br>Specification | Peak<br>Final<br>Result<br>FR (P)* | Peak.<br>Margin |
|---------|-------------|--------------------|-------------|--------------|------------------------|------------------------------------|-----------------|
| (MHz)   | (dBμV)      | Antenna<br>AF      | Cable<br>CF | Preamp<br>PF | (dB μV/m)              | (dB μV/m)<br>See Note *.           | (dB)            |
| 3701.60 | 37.2        | 33.9               | 2.0         | 30.5         | 74.0                   | 42.6                               | -31.4           |
| 4627.00 | 37.6        | 35.4               | 2.6         | 30.5         | 74.0                   | 45.1                               | -28.9           |
| 7403.20 | 40.0        | 39.1               | 3.4         | 29.8         | 74.0                   | 53.2                               | -19.8           |
| 8328.60 | 40.5        | 40.3               | 3.8         | 29.9         | 74.0                   | 54.7                               | -19.3           |

**Figure 37. Radiated Emission. Antenna Polarization: HORIZONTAL.  
 Detector: Peak**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Note\*: In the frequency range above 2.9 GHz, the field strength was manually calculated by using the following equation:

$$FR(P) = \text{Peak} + AF + CF - PF$$

Where: FR (P) is final peak detector result,  
 Peak is peak detector measurement,  
 AF is antenna factor,  
 CF is cable factor,  
 PF is preamplifier factor.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Horizontal                    Frequency range: 2.9 GHz to 9.3 GHz  
 Test Distance: 3 meters                                Detector: Average  
 Operating Frequency: 925.4 MHz

| Freq.<br>(MHz) | AVG<br>Amp<br>(dBμV) | Correction Factors    |                     |                      | AVG<br>Specification<br>(dB μV/m) | AVG<br>Final<br>Result<br>FR (A)<br>(dB μV/m)<br>See Note *. | AVG<br>Margin<br>(dB) |
|----------------|----------------------|-----------------------|---------------------|----------------------|-----------------------------------|--------------------------------------------------------------|-----------------------|
|                |                      | Antenna<br>AF<br>(dB) | Cable<br>CF<br>(dB) | Preamp<br>PF<br>(dB) |                                   |                                                              |                       |
| 3701.60        | 23.2                 | 33.9                  | 2.0                 | 30.5                 | 54.0                              | 28.6                                                         | -25.4                 |
| 4627.00        | 23.0                 | 35.4                  | 2.6                 | 30.5                 | 54.0                              | 30.5                                                         | -23.5                 |
| 7403.20        | 27.0                 | 39.1                  | 3.4                 | 29.3                 | 54.0                              | 40.2                                                         | -13.8                 |
| 8328.60        | 27.0                 | 40.3                  | 3.8                 | 29.9                 | 54.0                              | 41.2                                                         | -12.8                 |

**Figure 38. Radiated Emission. Antenna Polarization: AVERAGE.  
 Detector: Average**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Note\*: In the frequency range above 2.9 GHz, the field strength was manually calculated by using the following equation:

$$FR(A) = AVG + AF + CF - PF$$

Where: FR(A) is final average detector result,  
 AVG is average detector measurement,  
 AF is antenna factor,  
 CF is cable factor.  
 PF is preamplifier factor.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical                    Frequency range: 1 GHz to 2.9 GHz  
 Test Distance: 3 meters                            Detector: Average  
 Operating Frequency: 925.4 MHz

| <b>Freq.</b> | <b>Avg.<br/>Amp</b> | <b>Correction</b> | <b>Avg. Det.<br/>Spec.</b> | <b>Avg.<br/>Margin</b> |
|--------------|---------------------|-------------------|----------------------------|------------------------|
| (MHz)        | (dB $\mu$ V/m)      | (dB)              | (dB $\mu$ V/m)             | (dB)                   |
| 2776.13      | 49.0                | 44.5              | 54.0                       | -5.0                   |

**Figure 39. Radiated Emission. Antenna Polarization: VERTICAL.  
 Detector: Average**

Note:    Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical                    Frequency range: 1 GHz to 2.9 GHz  
 Test Distance: 3 meters                            Detector: Peak  
 Operating Frequency: 925.4 MHz

| <b>Freq.</b><br>(MHz) | <b>Peak<br/>Amp</b><br>(dB $\mu$ V/m) | <b>Correction</b><br>(dB) | <b>Peak<br/>Spec.</b><br>(dB $\mu$ V/m). | <b>Peak.<br/>Margin</b><br>(dB) |
|-----------------------|---------------------------------------|---------------------------|------------------------------------------|---------------------------------|
| 2776.13               | 62.6                                  | 44.4                      | 74.0                                     | -11.4                           |

**Figure 40. Radiated Emission. Antenna Polarization: VERTICAL.  
 Detector: Peak**

Note:    Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical                    Frequency range: 2.9 GHz to 9.3 GHz  
 Test Distance: 3 meters                            Detector: Peak  
 Operating Frequency: 925.4 MHz

| <b>Freq.</b> | <b>Peak<br/>Amp</b> | <b>Correction Factors</b> |                     |                      | <b>Peak.<br/>Specification</b> | <b>Peak<br/>Final<br/>Result<br/>FR (P)</b> | <b>Peak.<br/>Margin</b> |
|--------------|---------------------|---------------------------|---------------------|----------------------|--------------------------------|---------------------------------------------|-------------------------|
| (MHz)        | (dBμV)              | <b>Antenna<br/>AF</b>     | <b>Cable<br/>CF</b> | <b>Preamp<br/>PF</b> | (dB μV/m)                      | (dB μV/m)<br>See Note *.                    | (dB)                    |
| 3701.60      | 37.2                | 33.9                      | 2.0                 | 30.5                 | 74.0                           | 42.6                                        | -31.4                   |
| 4627.00      | 37.6                | 35.4                      | 2.6                 | 30.5                 | 74.0                           | 45.1                                        | -28.9                   |
| 7403.20      | 40.0                | 39.1                      | 3.4                 | 29.8                 | 74.0                           | 53.2                                        | -19.8                   |
| 8328.60      | 40.5                | 40.3                      | 3.8                 | 29.9                 | 74.0                           | 54.7                                        | -19.3                   |

**Figure 41. Radiated Emission. Antenna Polarization: VERTICAL.  
 Detector: Peak**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Note\*: In the frequency range above 2.9 GHz, the field strength was manually calculated by using the following equation:

$$FR(P) = Peak + AF + CF - PF$$

Where: FR (P) is final peak detector result,

Peak is peak detector measurement,

AF is antenna factor,

CF is cable factor,

PF is preamplifier factor.

## Radiated Emission Above 1 GHz

E.U.T Description    Water Meter Transmitter  
 Type                    WMIN01  
 Serial Number:        Not designated

Specification: F.C.C., Part 15, Subpart C

Antenna Polarization: Vertical                    Frequency range: 2.9 GHz to 9.3 GHz  
 Test Distance: 3 meters                            Detector: Average  
 Operating Frequency: 925.4 MHz

| Freq.   | AVG<br>Amp | Correction Factors |             |              | AVG<br>Specification | AVG<br>Final<br>Result<br>FR (A) | AVG<br>Margin |
|---------|------------|--------------------|-------------|--------------|----------------------|----------------------------------|---------------|
| (MHz)   | (dBμV)     | Antenna<br>AF      | Cable<br>CF | Preamp<br>PF | (dB μV/m)            | (dB μV/m)<br>See Note*.          | (dB)          |
| 3701.60 | 23.2       | 33.9               | 2.0         | 30.5         | 54.0                 | 28.6                             | -25.4         |
| 4627.00 | 23.0       | 35.4               | 2.6         | 30.5         | 54.0                 | 30.5                             | -23.5         |
| 7403.20 | 27.0       | 39.1               | 3.4         | 29.3         | 54.0                 | 40.2                             | -13.8         |
| 8328.60 | 27.0       | 40.3               | 3.8         | 29.9         | 54.0                 | 41.2                             | -12.8         |

**Figure 42. Radiated Emission. Antenna Polarization: VERTICAL  
 Detector: Average**

Note: Margin refers to the test results obtained minus specified requirement; thus a positive number indicates failure, and a negative result indicates that the product passes the test.

Note\*: In the frequency range above 2.9 GHz, the field strength was manually calculated by using the following equation:

$$FR(A) = AVG + AF + CF - PF$$

Where: FR(A) is average detector result,

AVG is average detector measurement,

AF is antenna factor,

CF is cable factor,

PF is preamplifier factor.

### 7.3 Test Instrumentation Used, Radiated Measurements Above 1 GHz

| Instrument              | Manufacturer  | Model            | Serial Number | Calibration      | Period |
|-------------------------|---------------|------------------|---------------|------------------|--------|
| Receiver                | HP            | 85422E           | 3411A00102    | January 31, 2003 | 1 year |
| RF Section              | HP            | 85420E           | 3427A00103    | January 31, 2003 | 1 year |
| Antenna Mast            | ARA           | AAM-4A           | 1001          | N/A              | N/A    |
| Turntable               | ARA           | ART-1001/4       | 1001.0        | N/A              | N/A    |
| Mast & Table Controller | ARA           | ACU-2/5          | 1001          | N/A              | N/A    |
| Printer                 | HP            | ThinkJet2225     | 2738508357.0  | N/A              | N/A    |
| Antenna-Log Periodic    | A.H.System    | SAS-200/511      | 253.0         | January 31,2003  | 2 year |
| Low Noise Amplifier     | DBS MICROWAVE | LNA-DBS-0411N313 | 013           | April 10, 2003   | 1 year |
| Spectrum Analyzer       | HP            | 8592L            | 3745A08184    | January 31,2003  | 1 year |

## 8. Maximum Transmitted Peak Power Output

### 8.1 Test procedure

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through appropriate coaxial cable. Special attention was taken to prevent Spectrum Analyzer RF input overload. The Spectrum Analyzer was set to 3 MHz resolution BW. Peak power level was measured at selected operation frequencies.

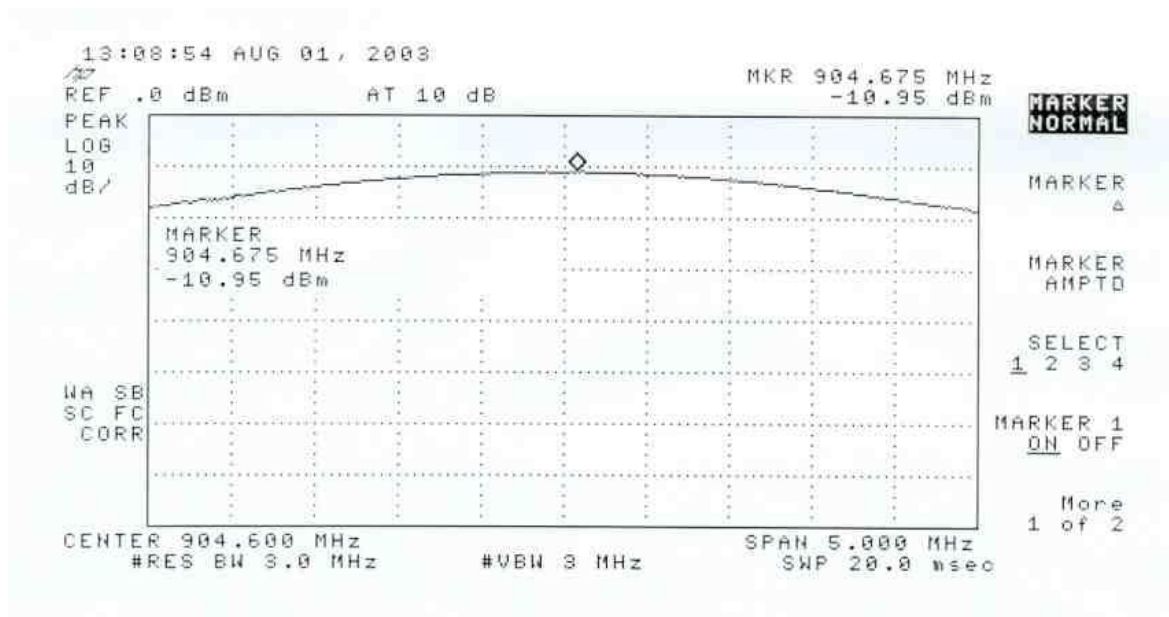


Figure 43.

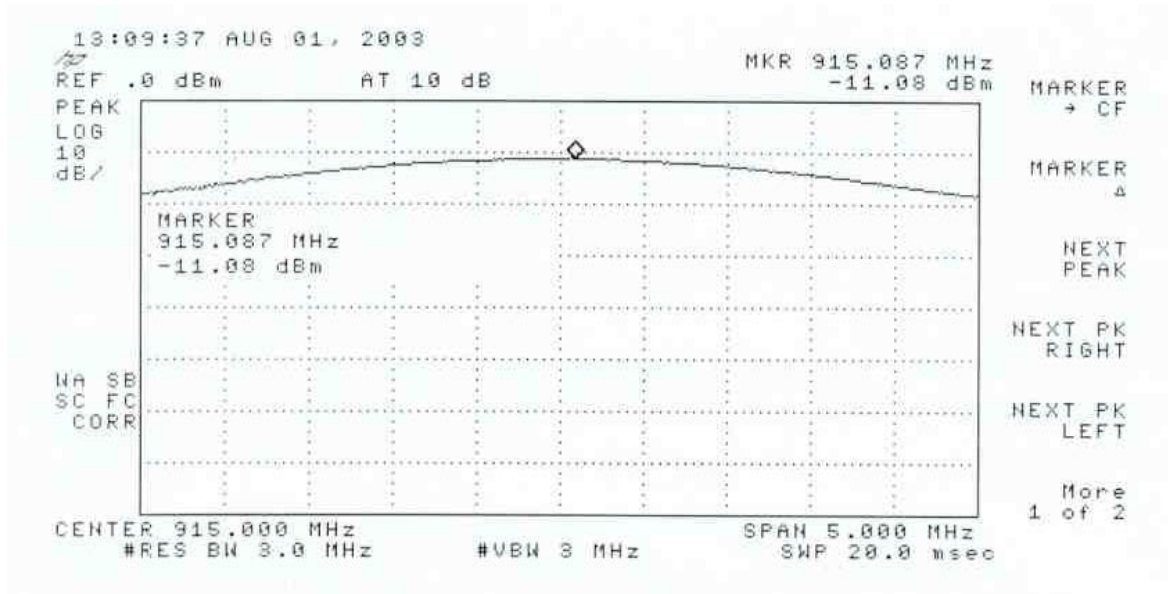


Figure 44.

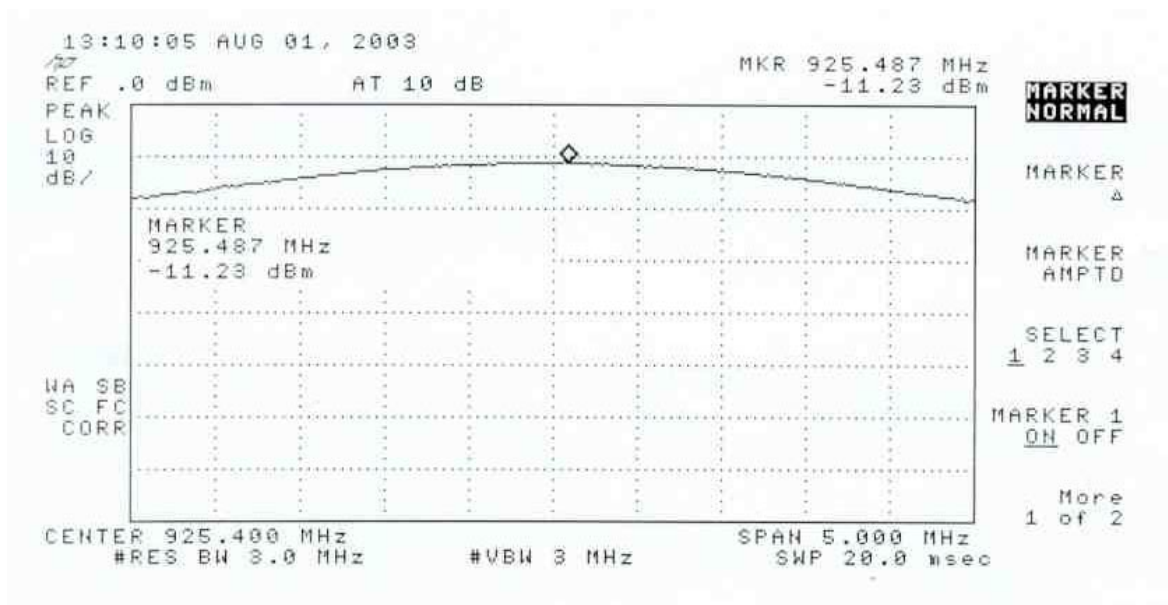


Figure 45.

## 8.2 Results table

E.U.T. Description: Water Meter Transmitter

Model No.: WMIN01

Serial Number: Not Designated

Specification: F.C.C. Part 15, Subpart C

| Operation Frequency (MHz) | Reading (dBm) | Final Result (dBm) | Specification (dBm) | Margin (dB) | Cable Attenuation (dB) |
|---------------------------|---------------|--------------------|---------------------|-------------|------------------------|
| 904.6                     | -10.95        | 29.55              | 30                  | 0.45        | 40.5                   |
| 915.0                     | -11.08        | 29.42              | 30                  | 0.58        | 40.5                   |
| 925.4                     | -11.23        | 29.27              | 30                  | 0.73        | 40.5                   |

**Figure 46 Maximum Power Output**

JUDGEMENT: Passed by 0.45 dB

TEST PERSONNEL:

Tester Signature: Shimon Zigdon

Date: 26.08.03

Typed/Printed Name: S. Zigdon

### 8.3 Test Equipment Used.

Peak Power Output

| Instrument        | Manufacture  | Model   | Serial Number | Calibration  |        |
|-------------------|--------------|---------|---------------|--------------|--------|
|                   |              |         |               | Last Calibr. | Period |
| Spectrum Analyzer | HP           | HP8594E | 3543A02712    | 29.5.03      | 1 year |
| Cable             | Huber Suhner | RG142   | None          | 31.7.03      | 1 year |
| Attenuator        | Mini Circuit | SAT-30  | None          | 31.7.03      | 1 year |
| Attenuator        | Mini Circuit | SAT-10  | None          | 31.7.03      | 1 year |

**Figure 47 Test Equipment Used**

## 9. Peak Power Output Out of 902-928 MHz Band

### 9.1 Test procedure

The E.U.T. antenna terminal was connected to the spectrum analyzer through appropriate coaxial cable. The spectrum analyzer was set to 100 kHz resolution BW. Frequency range from 10 kHz to 8.5 GHz was scanned. Level of spectrum components out of the 902-928 MHz was measured at the selected operation frequencies.

### 9.2 Results table

E.U.T Description: Water Meter Transmitter  
 Model No.: WMNI01  
 Serial Number: Not Designated  
 Specification: F.C.C. Part 15, Subpart C (15.247)

| Operation Frequency (MHz) | Reading (dBc) | Specification (dBc) | Margin (dB) |
|---------------------------|---------------|---------------------|-------------|
| 904.6                     | 64            | 20                  | 44          |
| 915.0                     | 65            | 20                  | 45          |
| 925.4                     | 65            | 20                  | 45          |

**Figure 48 Peak Power Output of 902-928 MHz Band**

JUDGEMENT: Passed by 44 dB

TEST PERSONNEL:

Tester Signature: Shimon Zigdon

Date: 26.08.03

Typed/Printed Name: S. Zigdon

### 9.3 Test Equipment Used.

Peak Power Output of 902-928 MHz Band

| Instrument        | Manufacture  | Model    | Serial Number | Calibration  |        |
|-------------------|--------------|----------|---------------|--------------|--------|
|                   |              |          |               | Last Calibr. | Period |
| Spectrum Analyzer | Anritzu      | MS 2602A | MT12370       | 29.5.03      | 1 year |
| Cable             | Huber Suhner | RG142    | None          | 31.7.03      | 1 year |

**Figure 49 Test Equipment Used**

## 10. 6 dB Minimum Bandwidth

### 10.1 Test procedure

The E.U.T. was set to the applicable test frequency. The E.U.T. antenna terminal was connected to the spectrum analyzer through an appropriate coaxial cable section. The spectrum analyzer was set to 100 kHz resolution BW. The spectrum bandwidth of the E.U.T. at the point of 6 dB below maximum peak power was measured and recorded.

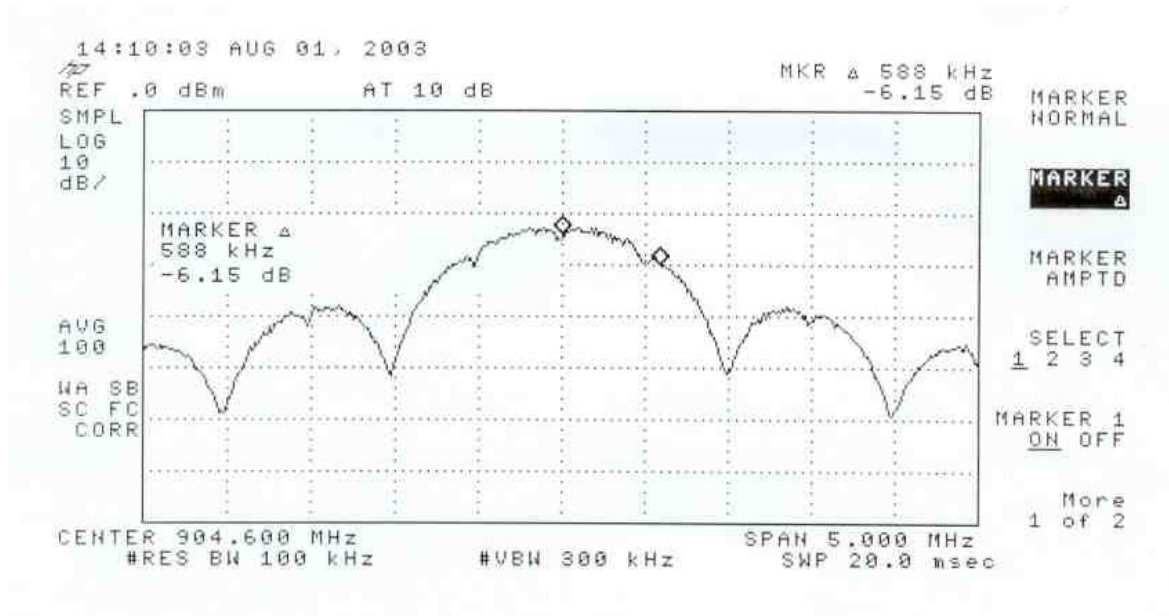


Figure 50



Figure 51



Figure 52

## 10.2 Results table

E.U.T Description: Water Meter Transmitter  
 Model No.: WMIN01  
 Serial Number: Not Designated  
 Specification: F.C.C. Part 15, Subpart C: (15.247-a2)

| Operation Frequency (MHz) | Reading (MHz) | Specification (MHz) | Margin (MHz) |
|---------------------------|---------------|---------------------|--------------|
| 904.6                     | 1.17          | 0.5                 | 0.67         |
| 915.0                     | 1.22          | 0.5                 | 0.72         |
| 925.4                     | 1.20          | 0.5                 | 0.70         |

**Figure 53 6 dB Minimum Bandwidth**

JUDGEMENT: Passed by 0.67 MHz

TEST PERSONNEL:

Tester Signature: Shimon Zigdon  
 Typed/Printed Name: S. Zigdon

Date: 26.08.03

## 10.3 Test Equipment Used.

6 dB Minimum Bandwidth

| Instrument        | Manufacture  | Model   | Serial Number | Calibration  |        |
|-------------------|--------------|---------|---------------|--------------|--------|
|                   |              |         |               | Last Calibr. | Period |
| Spectrum Analyzer | HP           | HP8594E | 3543A02712    | 29.5.03      | 1 year |
| Cable             | Huber Suhner | RG142   | None          | 31.7.03      | 1 year |
| Attenuator        | Mini Circuit | SAT-30  | None          | 31.7.03      | 1 year |
| Attenuator        | Mini Circuit | SAT-10  | None          | 31.7.03      | 1 year |

**Figure 54 Test Equipment Used**

## 11. Band Edge Spectrum

[In Accordance with section 15.247(c)]

### 11.1 Test procedure

Enclosed are spectrum analyzer plots for the lowest operation frequency (904.6 MHz) and the highest operation frequency (925.4 MHz) in which the E.U.T. is planned to be used.

The E.U.T. antenna terminal was connected to the spectrum analyzer through an appropriate coaxial cable. The spectrum analyzer was set to 100 kHz resolution BW. Maximum power level below 902 MHz and above 928 MHz was measured relative to power level at 904.6 MHz and 925.4 MHz correspondingly.

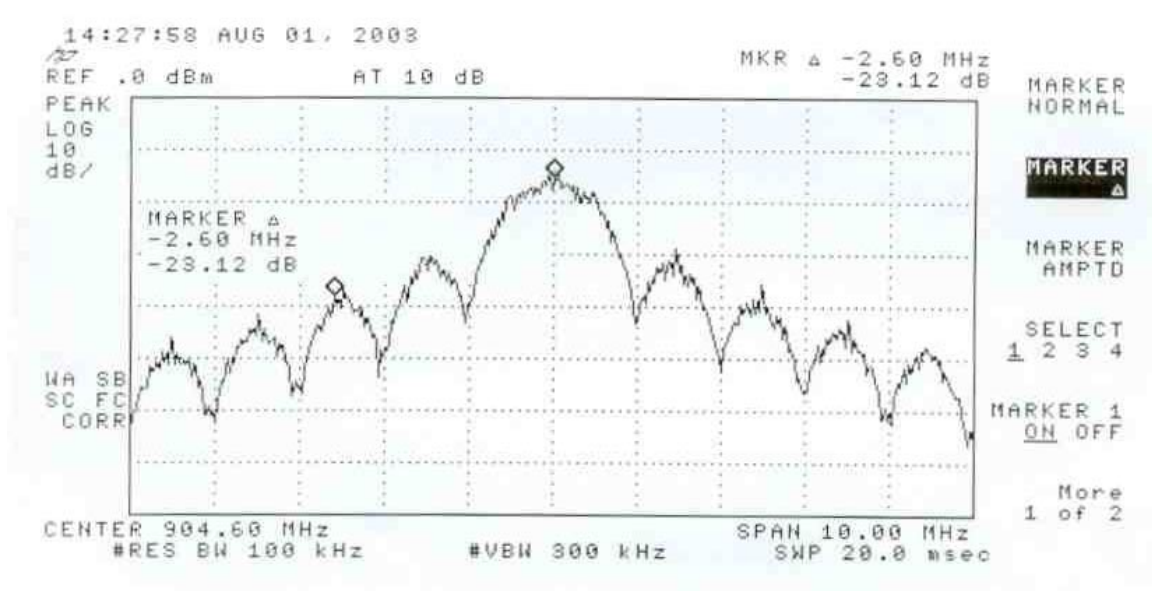


Figure 55

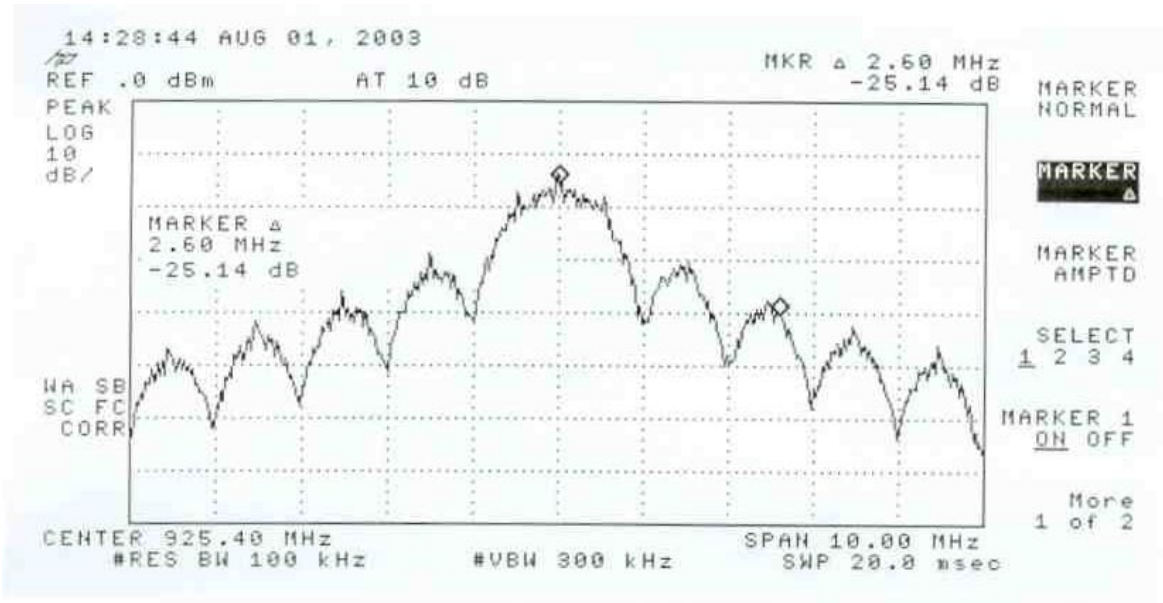


Figure 56

## 11.2 Results table

E.U.T. Description: Water Meter Transmitter  
 Model No.: WMIN01  
 Serial Number: Not Designated  
 Specification: F.C.C. Part 15, Subpart C (15.247)

| Operation Frequency (MHz) | Band Edge Frequency (MHz) | Spectrum Level (dBc) | Specification (dBc) | Margin (dB) |
|---------------------------|---------------------------|----------------------|---------------------|-------------|
| 904.6                     | 902                       | 23.12                | 20                  | 3.12        |
| 925.4                     | 928                       | 25.14                | 20                  | 5.14        |

**Figure 57 Band Edge Spectrum**

JUDGEMENT: Passed by 3.12 dB

TEST PERSONNEL:

Tester Signature: Shimon Zigdon  
 Typed/Printed Name: S. Zigdon

Date: 26.08.03

## 11.3 Test Equipment Used.

Band edge Spectrum

| Instrument        | Manufacture  | Model   | Serial Number | Calibration  |        |
|-------------------|--------------|---------|---------------|--------------|--------|
|                   |              |         |               | Last Calibr. | Period |
| Spectrum Analyzer | HP           | HP8594E | 3543A02712    | 29.5.03      | 1 year |
| Cable             | Huber Suhner | RG142   | None          | 31.7.03      | 1 year |
| Attenuator        | Mini Circuit | SAT-30  | None          | 31.7.03      | 1 year |
| Attenuator        | Mini Circuit | SAT-10  | None          | 31.7.03      | 1 year |

**Figure 58 Test Equipment Used**

## 12. Transmitted Power Density

[In accordance with section 15.247(d)]

### 12.1 Test procedure

The E.U.T. antenna terminal was connected to the spectrum analyzer through an appropriate coaxial cable. The spectrum analyzer was set to 3 kHz resolution BW, 10 kHz video BW and sweep time of 1 second for each 3 kHz “window”. The spectrum peaks were located at each of the 3 operating frequencies.

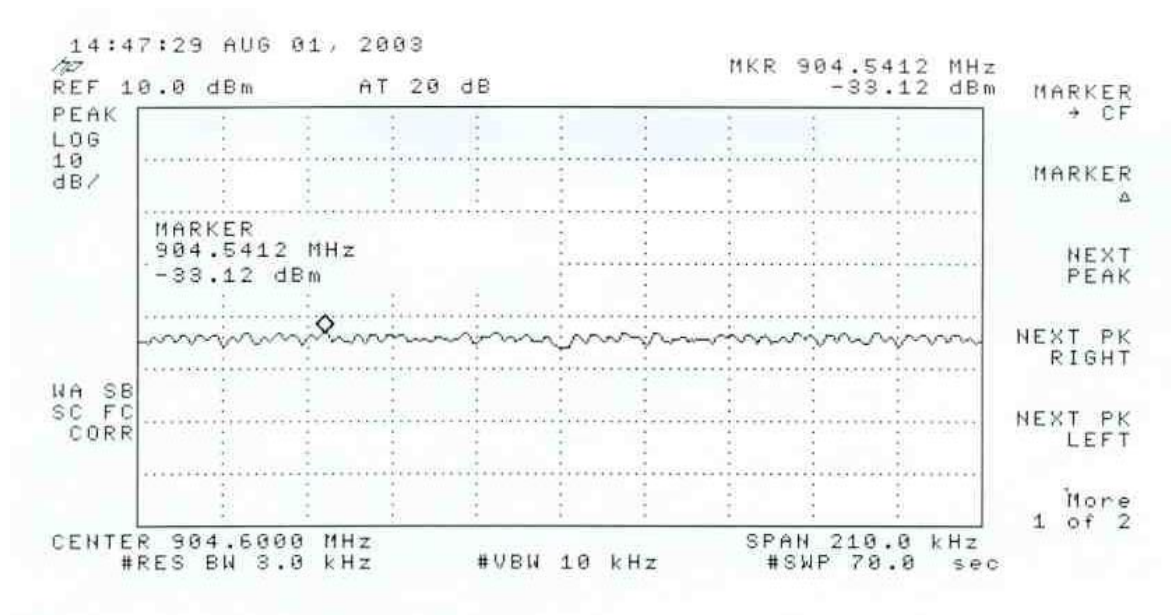


Figure 59

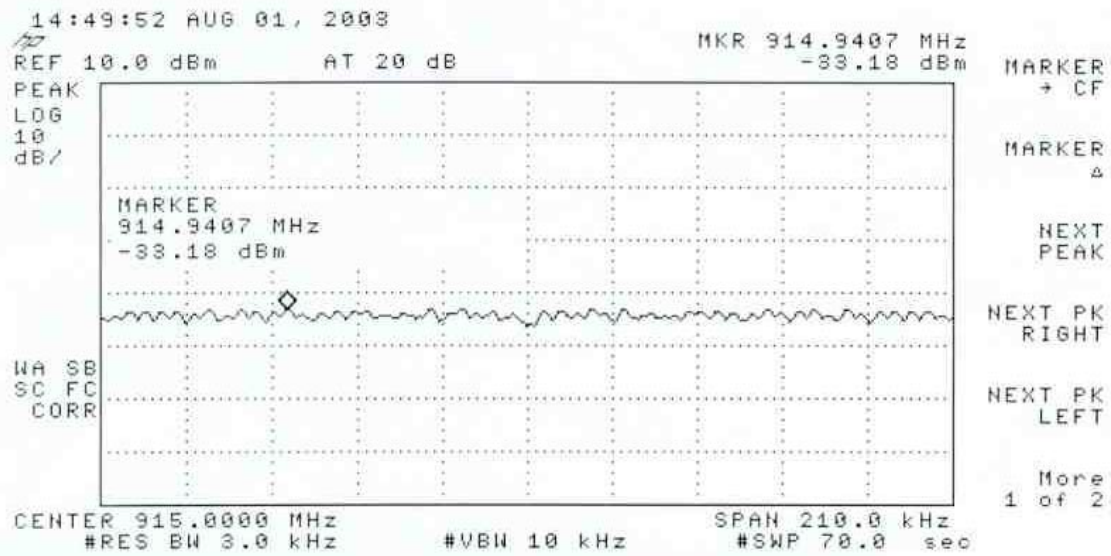


Figure 60

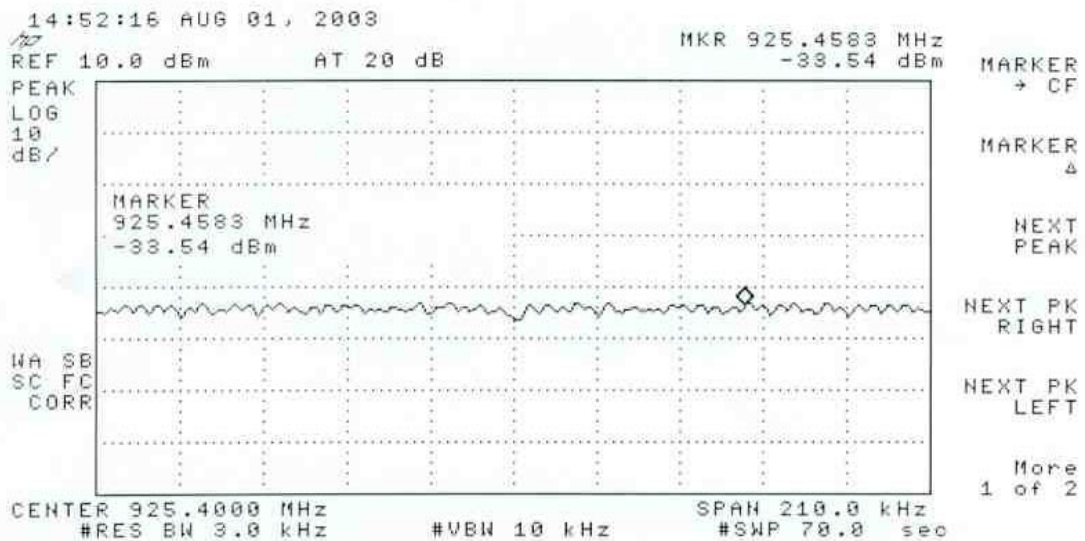


Figure 61

## 12.2 Results table

E.U.T. Description: Water Meter Transmitter  
 Model No.: WMIN01  
 Serial Number: Not Designated  
 Specification: F.C.C. Part 15, Subpart C (15.247)

| Operation Frequency (MHz) | Reading (dBm) | Final Result (dBm) | Specification (dBm) | Margin (dB) | Cable Attenuation (dB) |
|---------------------------|---------------|--------------------|---------------------|-------------|------------------------|
| 904.6                     | -33.12        | 7.38               | 8                   | 0.62        | 40.5                   |
| 915.0                     | -33.18        | 7.32               | 8                   | 0.68        | 40.5                   |
| 925.4                     | -33.54        | 6.96               | 8                   | 1.04        | 40.5                   |

**Figure 62 Test Equipment Used**

JUDGEMENT: Passed by 0.62 dB

TEST PERSONNEL:

Tester Signature: Shimon Zigdon  
 Typed/Printed Name: S. Zigdon

Date: 26.08.03

## 12.3 Test Equipment Used.

Transmitted Power Density

| Instrument        | Manufacture  | Model   | Serial Number | Calibration  |        |
|-------------------|--------------|---------|---------------|--------------|--------|
|                   |              |         |               | Last Calibr. | Period |
| Spectrum Analyzer | HP           | HP8594E | 3543A02712    | 29.5.03      | 1 year |
| Cable             | Huber Suhner | RG142   | None          | 31.7.03      | 1 year |
| Attenuator        | Mini Circuit | SAT-30  | None          | 31.7.03      | 1 year |
| Attenuator        | Mini Circuit | SAT-10  | None          | 31.7.03      | 1 year |

**Figure 63 Test Equipment Used**

## 13. Antenna Gain

The antenna implemented in the device is a small, wire antenna. The length of the antenna is less than a quarter wavelength. A theoretical upper limit of the gain of small wire antenna, is the gain of theoretical dipole antenna (2.5dBi). Then considering the inferiority of the implemented antenna vs. the theoretical dipole and the sub optimal efficiency of the antenna, the gain of the antenna is estimated to be 0dBi.

## 14. R.F Exposure/Safety

The E.U.T. is installed in fixed locations for application of transmitting data of water consumption to central data collection offices. The distance between the E.U.T. and the general population in normal use is at least several meters .

Calculation of Maximum Permissible Exposure (MPE)

Based on Section 1.1307(b)(1) Requirements

(a) FCC limits at 915 MHz

$$S = \frac{915}{1500} = 0.61 \frac{mW}{cm^2}$$

Using table 1 of Section 1.1310 limit for general population/uncontrolled exposures, the above level is an average over 30 minutes.

(b) The power density produced by the E.U.T. is

$$S = \frac{P_t G_t}{4\pi R^2}$$

$P_t$ - Transmitted Power 1000mw (Peak)

$G_t$ - Antenna Gain, 1.78(2.5dBi)

$R$ - Distance from Transmitter using 100cm worst case

(c) The peak power density is :

$$S_p = \frac{10^3 \times 1.78}{4\pi(100)^2} = 14.2 \times 10^{-3} \frac{mW}{cm^2}$$

(d) The duty cycle of transmission in actual worst case is 3 sec “on” and 6 hours “Off”.

The average power over 30 minutes is:

$$P_{AV} = \frac{1000 \times 3}{1800} = 1.6mW$$

(e) The averaged power density of the E.U.T. is:

$$S_{AV} = \frac{1.66 \times 1.78}{4\pi(100)^2} = 2.35 \times 10^{-5} \frac{mW}{cm^2}$$

(f) This is more than 4 orders of magnitude below the FCC limit.

## 15. Photographs of Tested E.U.T.



Figure 64 Top View External



Figure 65 Transmitter Connected to Water Meter



**Figure 66 Rear Side View**



**Figure 67 Rear View**



**Figure 68 Transmitter Unit Open**



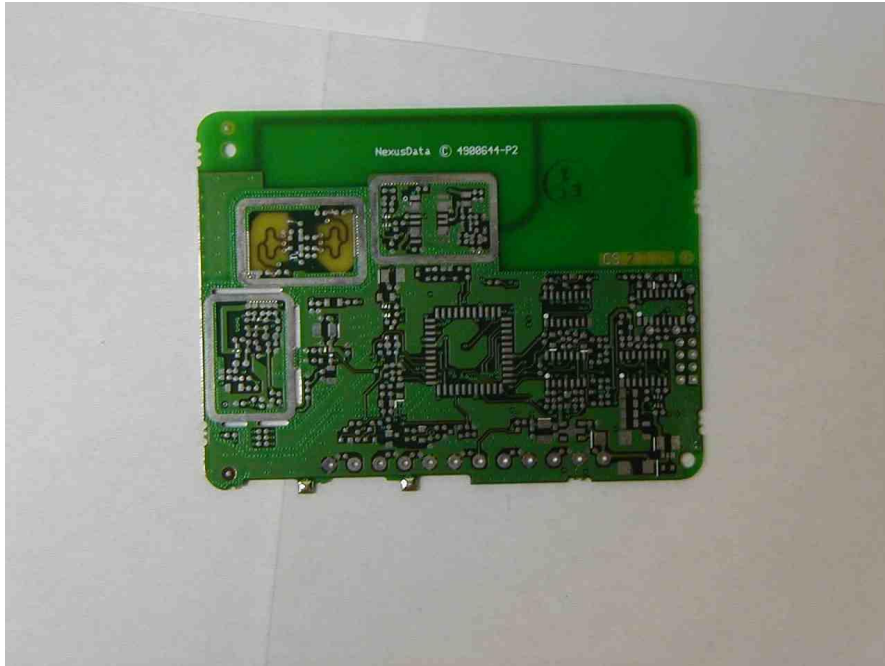
**Figure 69 PCB Side 1**



**Figure 70 PCB Side 2**



**Figure 71 PCB Shields Removed**



**Figure 72 PCB Side 2 Shields Removed**