



# Assessment of Compliance

for

Measurement of Maximum Permissible Exposure Evaluation  
with Respect to FCC Rule Part 47CFR §2.1091

**IX-250**  
**Laptop PC**

Intronix Corporation.



August 2000

ITRB-ITRONIX-IX-250-ARDIS-3524

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## **Engineering Report**

**Subject:** Maximum Permissible Exposure Evaluation with Respect to FCC Rule Part 47CFR §2.1091

**FCC ID:** KBCIX250RIM802

**Equipment:** Wireless laptop PC, containing built in RIM R802D-2-O radio-modem, equipped with a vehicle cradle and external vehicle-top mounting Unity Gain ARDIS/CDPD antenna

**Model:** Itronix IX-250

**Client:** **ITRONIX Corporation**  
801 South Stevens Street  
Spokane, WA 99204  
U.S.A.

**Project #:** ITRB IX-250 ARDIS-3524

**Prepared By:** APREL Laboratories,  
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Date: 30 Aug 2000

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**Dr. Jack J. Wojcik, P.Eng.**



**FCC ID:** KBCIX250RIM802  
**Client :** Itronix Corporation  
**Equipment :** Itronix IX-250 Wireless Laptop PC containing built in RIM R802D-2-O radio-modem, equipped with Vehicle Cradle and external vehicle-top mounting Unity Gain ARDIS/CDPD Antenna

## ENGINEERING SUMMARY

This report contains the results of the maximum permissible exposure (MPE) evaluation performed on the device under investigation (DUI) which was comprised of an Itronix IX-250 Wireless Laptop PC containing built in Research in Motion R802D-2-O radio-modem, equipped with Vehicle Cradle and external vehicle-top mounting Unity Gain ARDIS/CDPD Antenna. The tests were carried out in accordance with the applicable requirements of FCC rules found in 47CFR §2.1091 and the standards ANSI/IEEE C95.1-1992 and C95.3-1992.

The methodology and results for the test are described in the appropriate section of this report.

The DUI will not exceed the MPE requirements for the 806.00 – 821.00 MHz band. The maximum power exposure level measured at 20 cm was 0.51 mW/cm<sup>2</sup>. The DUI was tested on frequency 806.00 MHz, at the low channel, which was the channel with the highest ERP.

## FCC SUBMISSION INFORMATION

**FCC ID:** **KBCIX250RIM802**

**Equipment:** Wireless Laptop PC containing built in RIM R802D-2-O radio-modem, equipped with Vehicle Cradle and external vehicle-top mounting Unity Gain ARDIS/CDPD Antenna

**Model:** Itronix IX-250 with a Research in Motion R802D-2-O transceiver

**For:** Certification

**Applicant:** **ITRONIX Corporation**  
801 South Stevens Street  
Spokane, WA 99204  
U.S.A.

**Manufacturer:** **ITRONIX Corporation**  
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**Evaluated by:** **APREL Inc.**  
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## ACRONYMS

DUI	Device Under Investigation
ERP	Effective Radiated Power
FCC	Federal Communications Commission
MPE	Maximum Permissible Exposure
N/A	Not Applicable
NTS	Not To Scale
OATS	Open Area Test Site
OEM	Original Equipment Manufacturer
QA	Quality Assurance
RIM	Research in Motion

## **1.0 INTRODUCTION**

### **1.1 General**

This report describes the Maximum Permissible Exposure (MPE) tests on an Itronix IX-250 Wireless Laptop PC containing built in RIM R802D-2-O radio-modem, equipped with Vehicle Cradle and external vehicle-top mounting Unity Gain ARDIS/CDPD Antenna, the combination hereinafter called the DUI (Device Under Investigation).

### **1.2 Scope**

MPE evaluation was performed on the DUI in accordance with the requirements of the FCC rules for RF compliance found in 47CFR §2.1091 and the standard ANSI/IEEE C95.3-1992, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave. This Engineering Report contains the following:

- Methodology as to how the tests were performed.
- Test results and analysis.
- Identification of the test equipment used for the testing.
- Test set-up diagram.

### **1.3 Schedule**

The MPE tests were completed on August 9, 2000.

## **2.0 APPLICABLE DOCUMENTS**

FCC Rule Part 47CFR §2.1091

ANSI/IEEE C95.1-1992, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300GHz.

ANSI/IEEE C95.3-1992, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave.

OET Bulletin 65 (Edition 97-01), Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields.

### **3.0 TEST SAMPLE**

The MPE test described in this procedure was performed on:

- Itronix IX-250 wireless laptop PC with a RIM R802D-2-O radio-modem transceiver
- Itronix vehicle cradle
- vehicle-top mounting Unity Gain ARDIS/CDPD antenna.

### **4.0 GENERAL REQUIREMENTS**

#### **4.1 Location of Test Facilities**

The tests were performed by APREL Laboratories at APREL's test facility located in Nepean, Ontario, Canada. The laboratory operates a 3 and 10 meter Open Area Test Site (OATS) measurement facility. The test site is calibrated to ANSI C63.4-1992.

A description of the measurement facility in accordance with the radiated and AC line conducted test site criteria in ANSI C63.4-1992 is on file with the Federal Communications Commission and is in compliance with the requirements of Section 2.948 of the Commissions rules and regulations. APREL's registration number is 31070/SIT(1300F2).

APREL is accredited by Standard Council of Canada, under the PALCAN program (ISO Guide 25). All equipment used is calibrated or verified in accordance with the intent of AQAP-6/MIL-STD-45662. APREL is also accredited by Industry Canada (formerly DOC) and recognized by the Federal Communications Commission (FCC).

#### **4.2 Personnel**

EMC/EMI testing staff member, Roman Kuleba, carried out all MPE tests.

#### **4.3 Failure Criteria**

The device under investigation was considered to have failed if any of the following occurred:

When the MPE limits exceeded those permitted by appropriate limits defined by the



FCC.

#### **4.4 Power Source Required**

The following nominal DC Power was maintained during the test:

Voltage: 12 VDC.

#### **4.5 Tolerance**

The following tolerances on test conditions, exclusive of equipment accuracy, were maintained:

Voltage:  $\pm 10\%$ .

### **5.0 TEST INSTRUMENTATION & CALIBRATION**

#### **5.1 General**

APREL Laboratories, located in Nepean, Ontario is equipped with the necessary instrumentation to ensure accurate measurement of all data recorded during the tests outlined in this document. To ensure continued accuracy, each instrument is re-calibrated at intervals established by APREL and based on standards traceable to the National and International Standards. Accuracy surveillance is a function of APREL Quality Assurance.

#### **5.2 MPE Test Equipment Required**

The test equipment required to perform the MPE testing was selected from the equipment available at APREL as listed in APPENDIX C.

#### **5.3 Calibration Requirements**

All test equipment instrumentation required for MPE qualification testing was calibrated and controlled.

## 6.0 ELECTRICAL/MECHANICAL DESCRIPTION

The MPE Test Program was performed on an Itronix IX-250 Wireless Laptop PC containing built in RIM R802D-2-O radio-modem, equipped with Vehicle Cradle and external vehicle-top mounting Unity Gain ARDIS/CDPD Antenna, the combination hereinafter called the DUI. The test sample consisted of the components supplied by the customer and described below.

### 6.1 Test Unit Description

The Itronix Wireless Laptop PC containing built in RIM R802D-2-O radio-modem, equipped with Vehicle Cradle and external vehicle-top mounting Unity Gain ARDIS/CDPD Antenna, consisted of the following components:

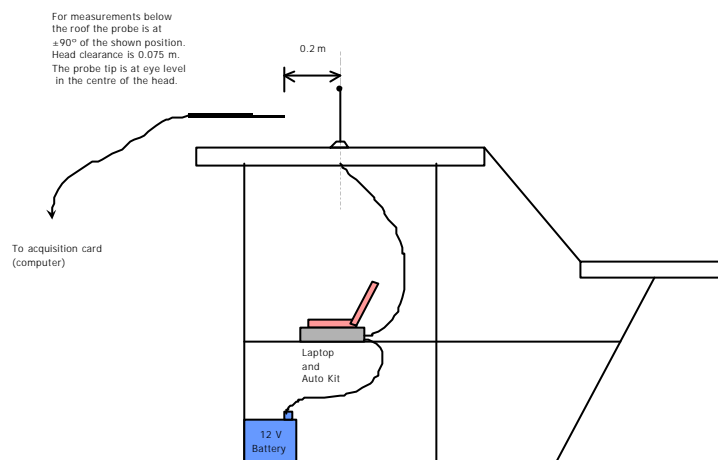
<u>Part Number</u>	<u>Description</u>
-	Itronix IX-250 wireless laptop PC
-	Itronix vehicle cradle
FCCTEST815	RIM Radio Type Tester 5.0 software
ID# 193	RIM execution lock device for radio tools
-	Vehicle-rooftop mounted unity-gain ARDIS/CDPD antenna
S/N: AME 0007027	2 Wolverine DC cells

### 6.2 MPE Test Setup

- The DUI antenna shall be installed in the centre of a ground plane simulating the rooftop of a vehicle. The other components shall be located underneath this ground plane to simulate operation from inside of the vehicle (see Figures 6.2.1 and 6.2.2).
- The vehicle simulator shall be positioned on the turntable in the OATS in such a way that the antenna will be located on the centre of rotation.
- The DUI shall be connected to the 12 VDC power supply.
- For the selection and placement of the measuring probe, the requirements of ANSI/IEEE C95.3-1992 shall be met.



**Figure 6.2.1. Photographs of the Setup.**



**Figure 6.2.2. Elevation View of the Setup.**

## 7.0 MAXIMUM PERMISSIBLE EXPOSURE (MPE) TEST

### 7.1 Purpose

This test method is used to verify that the DUI meets the MPE requirements as defined in the criteria for general population/uncontrolled exposure when operating at maximum ERP and in all operating modes.

### 7.2 Test Equipment

Description	Manufacturer	Model No.
E-Field Probe	APREL Inc.	APR Sensor

### 7.3 Criteria

Power Density Limits – The DUI shall not generate a power density beyond the limits in the frequency band listed in the left hand column of Table 7.3.1, and the power density given in the right hand column. The power density shall be measured 20 cm from the radiating antenna axis above the vehicle-top simulating ground plane, as well as in the approximate location of the head of possible vehicle drivers or passengers below the ground plane (see Figure 7.3.1). The measured values shall be recorded.

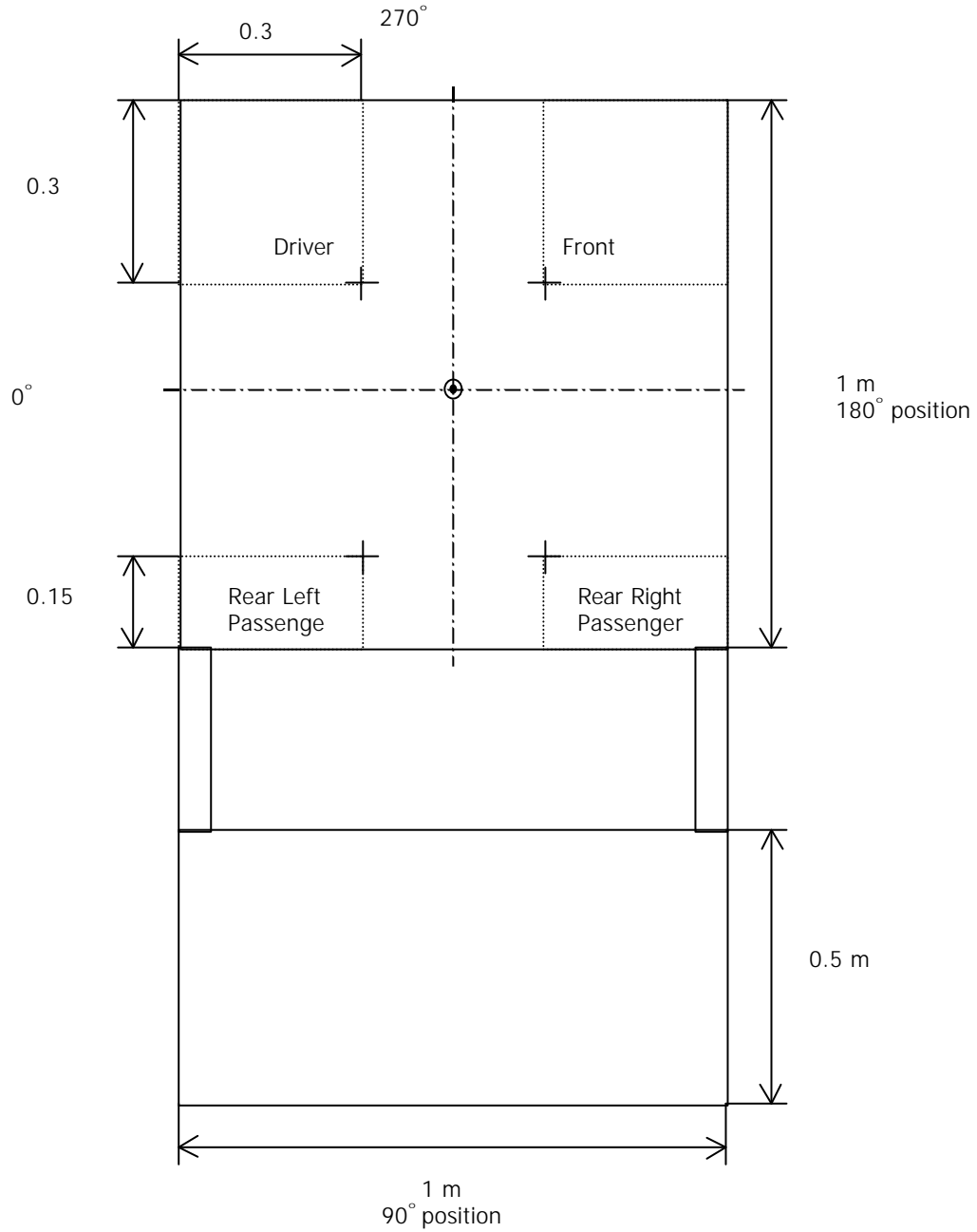
**Table 7.3.1**

Power Density Limits  
for General Population/Uncontrolled Exposure

Frequency Range	Power Density (mW/cm <sup>2</sup> )
300 - 1500 MHz	f/1500

Note: f = frequency in MHz

The measurements shall be performed at one transmitting frequency, the highest ERP of the high, middle or low channels.



**Figure 7.3.1. Plan View of Vehicle Simulator and Setup.**

## 7.4 Test Procedure

- a) The probe shall be positioned close to, and parallel to, the vehicle rooftop simulation with its tip 20 cm from the radiating antenna, and its axis normal to the antenna.
- b) Rotate the turntable so that the probe is at the 0° position (see Figure 7.3.1).
- c) Turn on the DUI and allow a sufficient time for stabilization. Turn on the transmitter and simulate normal operation conditions. Operate the transmitter at full rated output power.
- d) Determine the location of the maximum power density: locate the maximum emissions by scanning vertically along the DUI's antenna. Take and record measurements of the power density at a number of points along the length of the antenna as well as just past its tip.
- e) At every 45° of rotation take and record a measurement of the power density at the maximum power density height as for at least the following locations:
  - half the maximum power density height
  - height halfway between the maximum power density height and the tip of the radiating antenna
  - just above the tip of the antenna
- f) Turn off the DUI.
- g) Position the probe under the vehicle rooftop simulating ground plane in the approximate location of the centre of the head of a potential driver of the simulated vehicle (see Figure 7.3.1).
- h) Turn on the DUI and allow a sufficient time for stabilization. Turn on the transmitter and simulate normal operation conditions. Operate the transmitter at highest ERP.
- i) Take and record the measurement of the power density at this location.
- j) Turn off the DUI.
- k) Repeat steps g) through j) for the positions of the other potential occupants of the simulated vehicle as shown in Figure 7.3.1.

## 7.5 Results

Table 7.5.1 presents the results of the measurements made along the length of the antenna in order to find the location of the maximum power density (the antenna has a height of 9 cm). Column 1 shows the height at which the measurements were taken and column 2 shows the result. The cable loss associated with the supplied 11.5 ft *Belden RG-58/U* cable was adjusted to the nominal loss for a 6 foot length. Column 3 indicates the correction for the excess cable loss ( $5.5 \text{ ft} \times 0.138 \text{ dB/ft}$ ) that was applied to measured power density (column 2) to obtain the final adjusted power density (column 4).

**Table 7.5.1**  
Power Density Measured at  $0^\circ$  as a Function of Height

Height	Power Density	Excess cable loss	Adjusted Power Density	MPE Limit
[cm]	[mW/cm <sup>2</sup> ]	[dB]	[mW/cm <sup>2</sup> ]	[mW/cm <sup>2</sup> ]
4	0.42	0.8	0.50	0.54
6	0.36	0.8	0.43	0.54
8	0.27	0.8	0.33	0.54
10	0.21	0.8	0.25	0.54

The data in Table 7.5.1 is presented in Figure 7.5.1.

**Figure 7.5.1**

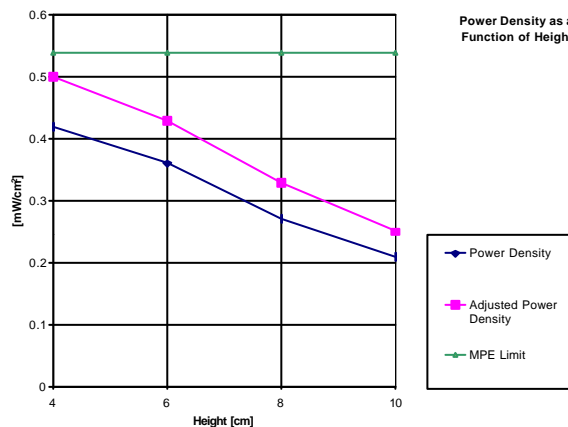




Table 7.5.2 presents the results of the measurements made around the antenna at every 45° of rotation. Column 1 shows the angle at which the measurements were taken and columns 2 through 5 show the final adjusted power density (see discussion surrounding Table 7.5.1) at the different measurement heights. The MPE value is determined by averaging the adjusted total power density along a vertical line up to the height of a tall typical individual, taken here as 6 ft or 180 cm. Since the height for the rooftop of the simulated vehicle is 143 cm, then the averaging has to be done over those measurements made between 0 and 37 cm above the simulated vehicle rooftop, which includes all scanned layers. Column 6 shows the results of this averaging.

**Table 7.5.2**

Power Density Measured  
at every 45° as a Function of Height

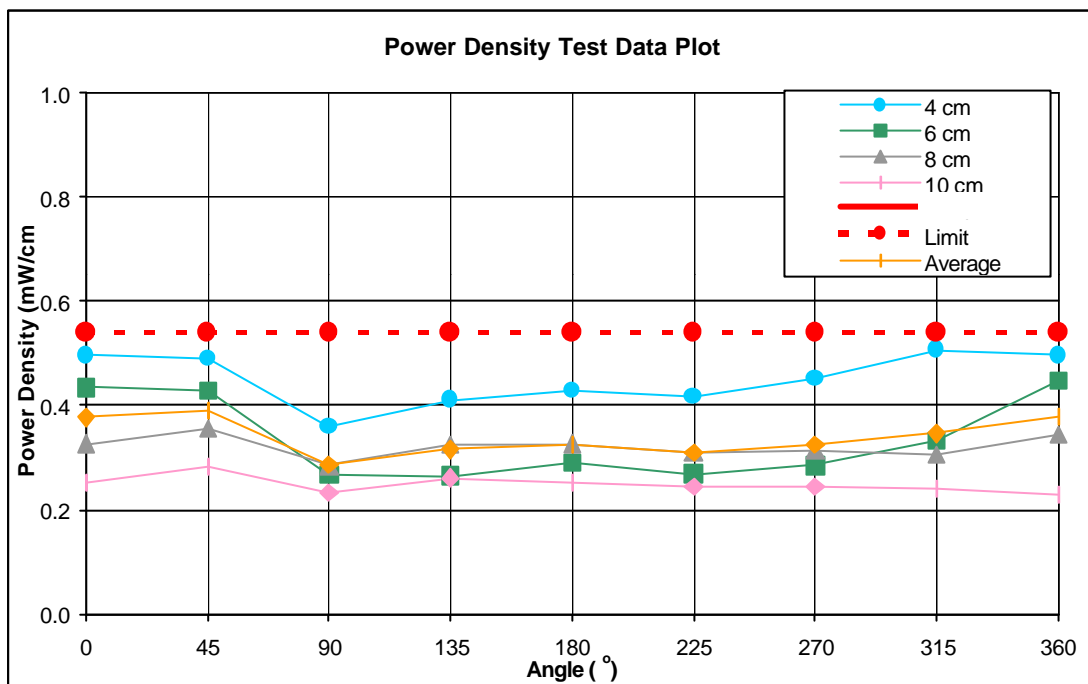
Angular Position  [ ° ]	Adjusted Total Power Density				Average of Values up to 10 cm [mW/cm <sup>2</sup> ]	MPE Limit [mW/cm <sup>2</sup> ]
	H1 [cm]	H2 [cm]	H3 [cm]	H4 [cm]		
	4 [mW/cm <sup>2</sup> ]	6 [mW/cm <sup>2</sup> ]	8 [mW/cm <sup>2</sup> ]	10 [mW/cm <sup>2</sup> ]		
0	0.50	0.43	0.33	0.25	0.38	0.54
45	0.49	0.43	0.35	0.28	0.39	0.54
90	0.36	0.27	0.28	0.23	0.29	0.54
135	0.41	0.27	0.33	0.26	0.32	0.54
180	0.43	0.29	0.33	0.25	0.32	0.54
225	0.42	0.27	0.31	0.24	0.31	0.54
270	0.45	0.28	0.31	0.24	0.32	0.54
315	0.51	0.33	0.31	0.24	0.35	0.54
360	0.50	0.45	0.34	0.23	0.38	0.54

Test performed by: Kulbeka Pomon

Date: Aug 30, 2000

The data in Table 7.5.2 is presented in Figure 7.5.2.

**Figure 7.5.2**





Measurements were made below the simulated vehicle rooftop, in the approximate location of the centre of the head of potential occupants. It was assumed that this typical position occurred 17.5 cm below the roof of the simulated vehicle (the clearance between the top of an occupant's head and a vehicle's roof is ~3" (7.5cm) and distance between the top of the head and the eyes is ~4" (10cm)). Figure 7.3.1 shows the location of measurements for the 4 potential occupants. Table 7.5.3 presents the results of the measurements. Column 1 shows the height at which the measurements were taken and column 2 shows the result ("total" indicates that this is the sum of the power density measured by each of the three orthogonal sensors in the probe). The cable loss associated with the supplied 11.5ft Belden RG-58/U cable was adjusted to the nominal loss for a 6 foot length. Column 3 indicates the correction for the excess cable loss ( $5.5 \text{ ft} \times 0.138 \text{ dB/ft}$ ) that was applied to measured power density (column 2) to obtain the final adjusted power density.

**Table 7.5.3**  
Power Density Measured  
at Position of Potential Vehicle Occupants

Position	Total [mW/cm <sup>2</sup> ]	Excess cable loss [dB]	Adjusted Total [mW/cm <sup>2</sup> ]	MPE Limit [mW/cm <sup>2</sup> ]
driver	0.00	0.8	0.00	0.54
front passenger	0.00	0.8	0.00	0.54
rear left	0.00	0.8	0.00	0.54
rear right	0.01	0.8	0.01	0.54

Test performed by: Kuldeep Poonen Date: Aug 30, 2000

## 8.0 CONCLUSION

The DUI consisting of an Itronix IX-250 Wireless Laptop PC containing built in RIM R802D-2-O radio-modem, equipped with Vehicle Cradle and external vehicle-top mounting Unity Gain ARDIS/CDPD Antenna will not exceed the MPE requirements for the 806-821 MHz band. The maximum power exposure level measured at 20 cm was  $0.51 \text{ mW/cm}^2$ .

ARDIS/CDPD Antenna will not exceed the MPE requirements for the 806-821 MHz band. The maximum power exposure level measured at 20 cm was 0.51 mW/cm<sup>2</sup>.

## APPENDIX

### List of Test Equipment

Description	Range	Manufacturer	Model #	APREL Asset #	Cal. Due Date
Field Sensor Probe	20 MHz – 3 GHz	APREL Inc	APR Sensor	301433	Aug 3, 2001
Digital Multimeter	–	Fluke	8505A	100665	July 17, 2001
RF-Signal Generator	10 kHz – 1.28 GHz	HP	8662A	100456	Nov 1, 2000
RF-Signal Generator	10 MHz – 26.5 GHz	HP	8340B	100955	Nov 1, 2000
RF Power Meter	–	Rhode & Schwarz	NRVS	100851	July 21, 2001
TEM Cell	–	Fisher Custom Comm., Inc.	FCC-TEM-JM1	301438	N/A
20 dB Attenuator	DC – 18 GHz	Narda	4779-20	301370	May 18, 2001
RF Amplifier	500 MHz – 1 GHz	–	–	100995	N/A
OATS	30 MHz – 1 GHz	APREL Inc.	3 m & 10 m	N/A	N/A
Mast with the Controller	1 m – 4 m	EMCO	1051 – 12	100507	N/A
Vehicle Simulator	–	APREL Inc.	–	301470	N/A
Turntable with the Controller	0° – 360°	EMCO	1060 – 1.241	100506	N/A