

---

Project Number: 00456-10

Prepared for:

**INVOCON, INC.**  
19221 IH45 South, Suite 530.  
Conroe, TX 77385

By

Professional Testing (EMI), Inc.  
1601 FM 1460, Suite B  
Round Rock, Texas 78664

June 2000

---

**CERTIFICATION**  
**Electromagnetic Interference**  
**Test Report**

**INVOCON, INC.**  
**MicroWIS PCIU**  
**(Intentional Radiator Portion)**

# Table of Contents

---

Title Page..... 1

Table of Contents..... 2

Certificate of Compliance ..... 3

1.0 EUT Description ..... 4

1.1 EUT Operation..... 4

2.0 Electromagnetic Emissions Testing..... 4

    2.2 Test Criteria ..... 5

    2.3 Test Results..... 5

3.0 Occupied Bandwidth Measurements ..... 5

    3.2 Test Criteria ..... 6

    3.3 Test Results..... 6

4.0 Antenna Requirement ..... 6

    4.1 Evaluation Procedure..... 6

    4.3 Evaluation Results ..... 7

5.0 Modifications to Equipment..... 7

6.0 List of Test Equipment ..... 7

    Radiated Emissions – Front View ..... 4

    Radiated Emissions – Back View..... 4

## Figures

Figure 1: Radiated Emissions Test Setup..... 9

## Appendices

Appendix A: Fundamental Emissions Test Data..... 11

Appendix B: Spurious Emissions Test Data..... 13

Appendix C: Occupied Bandwidth Test Data..... 16

*THIS REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE WRITTEN APPROVAL OF PROFESSIONAL TESTING (EMI), INC.*



# Certificate of Compliance

---

Applicant: INVOCON, Inc.  
Applicant's Address: 19221 IH45 South, Suite 530.  
Conroe, TX 77385

Model: MicroWIS PCIU  
Serial Number: N/A  
Project Number: 00456-10  
Test Dates: 08 March 2000, 09 March 2000, and 17 May 2000

I, Jeffrey A. Lenk, for Professional Testing (EMI), Inc., being familiar with the FCC rules and test procedures have reviewed the test setup, measured data and this report. I believe them to be true and accurate.

The **INVOCON, Inc. MicroWIS PCIU** was tested to and found to be in compliance with FCC Part 15 Subpart C for an Intentional Radiator.

The highest emissions generated by the above equipment are listed below:

	<u>Frequency (MHz)</u>	<u>Level (dB<math>\mu</math>V/m)</u>	<u>Limit (dB<math>\mu</math>V/m)</u>	<u>Margin (dB)</u>
Fundamental	916.5	80.7	93.9	13.2
Spurious	2749.56	41.5	49.5	8.0
<u>Occupied Bandwidth</u>	349kHz			

---

Jeffrey A. Lenk  
President

This report has been reviewed and accepted by INVOCON, Inc.. The undersigned is responsible for ensuring that the **MicroWIS PCIU** will continue to comply with the FCC rules.

---

## 1.0 EUT Description

The Equipment Under Test (EUT) is the **INVOCON, Inc. MicroWIS PCIU**. The **MicroWIS PCIU** is an RS-232 converter. The EUT functions as a transceiver between remote MicroWIS Transmitters. The EUT operates at 916.5 MHz and is designed for compliance with 47 CFR 15.249 of the FCC rules. Specific test requirements for this device include the following:

47 CFR 15.249	Fundamental Transmit Power
47 CFR 15.249(c)/15.209	Out of Band Emissions
47 CFR 15.203	Antenna Requirement

The system tested consisted of the following:

<u>Manufacturer &amp; Model</u>	<u>Serial #</u>	<u>FCC ID #</u>	<u>Description</u>
INVOCON, Inc. , MicroWIS PCIU	N/A	NJM0071-029	RS-232 converter (PC Interface Unit)

## 1.1 EUT Operation

The **MicroWIS PCIU** was connected to a Laptop PC and transmitted requests for data from a MicroWIS remote transmitter. Setup and operational modes cover worst case configuration and operational modes for the device. The frequency of the transmitting signal is 916.5 MHz.

## 2.0 Electromagnetic Emissions Testing

Professional Testing (EMI), Inc. (PTI), follows the guidelines of NIST for all uncertainty calculations, estimates and expressions thereof for EMC testing.

Radiated emission measurements were made of the Fundamental and Spurious Emission levels for the **MicroWIS PCIU**. Measurements of the occupied bandwidth were also made for the equipment.

Measurements of the maximum emission levels for the fundamental and the spurious/harmonic emissions of the **MicroWIS PCIU** were made at the Professional Testing "Open Field" Site 3, located in Round Rock, Texas to determine the radio noise radiated from the EUT. A "Description of Measurement Facilities" has been submitted to the FCC and approved pursuant to Section 2.948 of CFR 47 of the FCC rules.

Tests of the fundamental for the device were performed to determine the worst case polarization of the devices. The fundamental emissions of the device were measured with the antennas of the devices vertical and horizontal to the ground plane.

## 2.1 Test Procedure

The EUT was placed on a non-conductive table 0.8 meters above the ground plane. The table was centered on a motorized turntable which allows 360 degree rotation. For measurements of the fundamental signal, a measurement antenna was positioned at a distance of 3 meters as measured from the closest point of the EUT. For spurious/harmonic measurements above 1 GHz, the measurement antenna was placed 1 meter from the EUT. The radiated emissions were maximized by configuring the EUT, by rotating the EUT, and by raising and lowering the antenna from 1 to 4 meters.

A Spectrum Analyzer with peak detection was used to find the maximums of the radiated emissions during the variability testing. A drawing showing the test setup is given as Figure 1.

## 2.2 Test Criteria

The table below shows FCC Part 15.249 radiated limits for an intentional radiator operating at 902-928 MHz band. In addition to these requirements, the EUT must meet the restricted emission band requirements of §15.205. For this frequency range, the unintentional radiated emission limits of §15.249 for 902-928 MHz radiator is higher than the restricted band limits of §15.205. The limit of §15.205 was used for the spurious emission test. The spurious measurements of the harmonic were performed to the 10th harmonic of the fundamental. The reference distance for each limit is also shown in this table.

<u>Signal Type</u>	<u>Test Distance (Meters)</u>	<u>Field Strength</u>	
		<u>(<math>\mu</math>V/m)</u>	<u>(dB<math>\mu</math>V/m)</u>
Fundamental (902-928 MHz)	3	50,000	94
2nd Harmonics (1833.MHz)	3	500	54
Harmonics (3rd and above)	3	100	40

## 2.3 Test Results

The radiated test data for the fundamental is included in Appendix A. Quasi-Peak detector has been used during the test. The radiated emission test data for the harmonics is included in Appendix B. The emissions were maximized at each frequency and the highest emissions identified were measured using peak detection. The radiated emissions generated by the **MicroWIS PCIU** are below the FCC Part 15.249 and FCC Part 15.205 maximum emission criteria.

## 3.0 Occupied Bandwidth Measurements

Measurements of the occupied bandwidth for the fundamental signals of the of the FCC Part 15.249 were made at the Professional Testing's Round Rock, Texas laboratory. All measurements were made in a controlled indoor environment in a configuration which did not present measurement distortion or ambient interference.

### **3.1 Test Procedure**

The EUT was placed on a non-conductive table 0.8 meters above the floor. The table was rotated to an angle which presented the highest signal level. The occupied bandwidth was also measured on the device. Peak detection was used for all tests. The occupied bandwidth was based on a 26 dB criteria (26 dB down either side of the emission from the nominal center of the emission). A drawing showing the test setup is given as Figure 1.

### **3.2 Test Criteria**

Measurement of the occupied bandwidth was performed to verify that the emission bandwidth from the EUT did not exceed 1/2% of the carrier frequency.

### **3.3 Test Results**

The occupied bandwidth test data is included in Appendix C. The occupied bandwidth for a fundamental frequency of 916.5 MHz is 4.6 MHz which is well inside the 902 to 928 MHz band. The measured occupied bandwidth for the **MicroWIS PCIU** module is 349 kHz.

The center frequency for the EUT is at 916.5 MHz. The center frequency is within the allowed band. The fundamental signal generated by the **MicroWIS PCIU** is within the band allowed under FCC Part 15.249 emission band criteria.

### **4.0 Antenna Requirement**

An analysis of the **MicroWIS PCIU** was performed to determine compliance with Section 15.203 of the Rules. This section requires specific handling and control of antennas used for devices subject to regulations under the Intentional Radiator portions of Part 15.

### **4.1 Evaluation Procedure**

The structure and application of the **MicroWIS PCIU** were analyzed with respect to the rules. The antenna for this unit is an external antenna, which is soldered onto the main board and is not accessible by the user. An auxiliary antenna port is not present.

## 4.2 Evaluation Criteria

Section 15.203 of the rules states that the subject device must meet at least one of the following criteria:

- (a) Antenna be permanently attached to the unit.
- (b) Antenna must use a unique type of connector to attach to the EUT.
- (c) Unit must be professionally installed. Installer shall be responsible for verifying that the correct antenna is employed with the unit.

## 4.3 Evaluation Results

The **MicroWIS PCIU** meets the criteria of this rule by virtue of having an external antenna permanently attached to the unit. The EUT is therefore compliant with §15.203.

## 5.0 Modifications to Equipment

There were no modifications made on the **MicroWIS PCIU** during the performance of the test program in order to meet the FCC criteria.

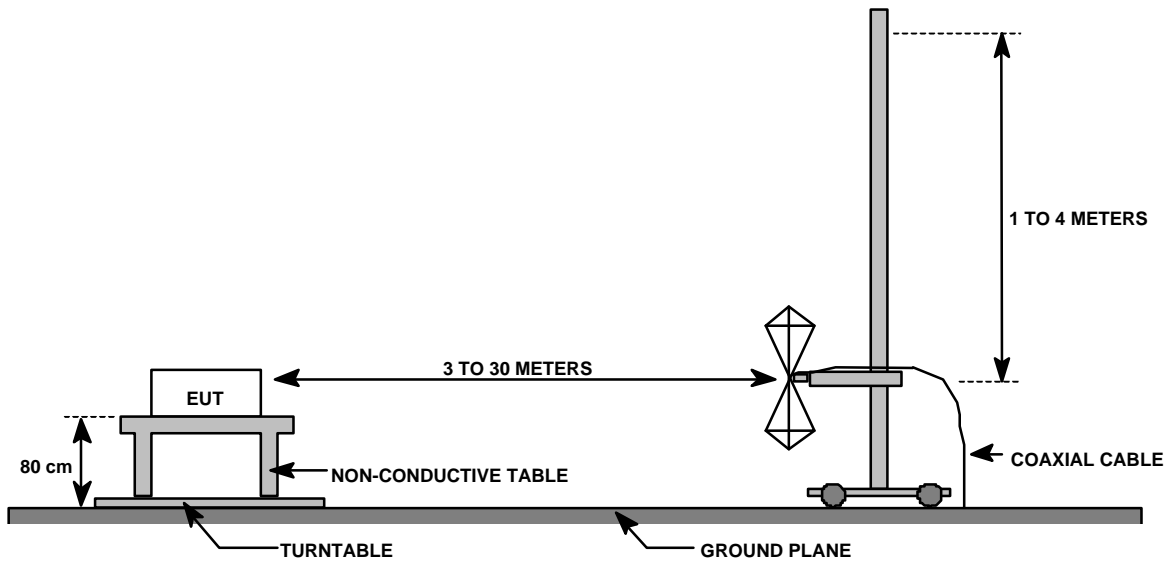
## 6.0 List of Test Equipment

A list of the test equipment utilized to perform the testing is given below. The date of calibration is given for each.

### Electromagnetic Emissions Test Equipment

<u>Device</u>	<u>Description</u>	<u>Date Last Calibrated</u>	<u>Calibration Due</u>
HP 8568B	Spectrum Analyzer	10/11/99	10/11/00
HP 85650A	Quasi Peak Adapter	10/08/99	10/08/00
HP 8566B	Spectrum Analyzer	07/22/99	07/22/00
HP 85650A	Quasi Peak Adapter	11/19/99	11/19/00
HP 8447F	Preamp	11/11/99	11/11/00
EMCO 3104C	Biconical Antenna	07/10/99	07/10/00
EMCO 3146	Log Antenna	07/10/99	07/10/00
EMCO 3115	Microwave Antenna	05/21/99	05/21/00
MITEQ	Preamp	05/15/00	05/15/01
AFS4-00101800-40-10P-N			

**FIGURE 1: Radiated Emissions Test Setup**





**Appendix A**

**Radiated  
Emissions Data Sheets**

---

**Fundamental Radiated Data Sheet**

**INVOCON, Inc.  
MicroWIS PCIU**

SERIAL #: N/A  
DATE: 08 Mar 2000  
PROJECT #: 00456-10

MEASUREMENT DISTANCE (m): 3  
DETECTOR FUNCTION: Quasi-Peak

*Antenna Horizontal*

Freq. (MHz)	EUT Dir. (Deg.)	Antenna Height (Meter)	Recorded Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
916.50	0.0	1.0	34.3	22.1	24.3	80.7	94.0	-13.3

*Antenna Vertical*

Freq. (MHz)	EUT Dir. (Deg.)	Antenna Height (Meter)	Recorded Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
916.50	0.0	1.0	26.0	22.1	24.3	72.4	94.0	-21.6

*Corrected Level = Recorded Level + Antenna Factor + Cable Loss*

**TEST ENGINEER:** John Baker **APPROVED BY:** Ben Bibb, NCE

**Appendix B**

**Spurious Radiated  
Emissions Data Sheets**

---

## Spurious Radiated Data Sheet

**INVOCON, Inc.  
MicroWIS PCIU**

SERIAL #: N/A  
DATE: 17May00  
PROJECT #: 00456-10

MEASUREMENT DISTANCE (m): 1  
ANTENNA POLARIZATION: Horizontal  
DETECTOR FUNCTION: Peak

Freq. (MHz)	EUT Dir. (Deg.)	Recorded Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1833.32	0	13.4	27.7	2.1	43.2	63.5	-20.3
2749.56	0	9.2	29.6	2.7	41.5	49.5	-8.0
3666.70	0	5.1	31.8	3.1	40.0	49.5	-9.5
4582.82	0	-4.3	33.2	3.4	32.3	49.5	-17.2
5499.38	0	-3.3	34.2	3.8	34.7	49.5	-14.8
6416.58	0	-1.8	34.8	4.2	37.2	63.5	-26.3
7332.60	0	-5.2	35.9	4.5	35.2	49.5	-14.3

*Corrected Level = Recorded Level + Antenna Factor + Cable Loss*

COMMENT #1: : Emissions measured at a distance of 3.0 M over the 30 MHz to 1,000 MHz band were found to be greater than 20 dB below the limits of 15.209.

COMMENT #2:

**TEST ENGINEER:** John Baker **APPROVED BY:** Ben Bibb, NCE

## Spurious Radiated Data Sheet

**INVOCON, Inc.  
MicroWIS PCIU**

SERIAL #: N/A  
DATE: 17May00  
PROJECT #: 00465-10

MEASUREMENT DISTANCE (m): 1  
ANTENNA POLARIZATION: Vertical  
DETECTOR FUNCTION: Peak

Freq. (MHz)	EUT Dir. (Deg.)	Recorded Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Corrected Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)
1833.34	0	20.7	27.7	2.1	50.5	63.5	-13.0
2750.00	0	5.4	29.6	2.7	37.7	49.5	-11.8
3666.73	0	4.4	31.8	3.1	39.3	49.5	-10.2
4582.42	0	-3.5	33.2	3.4	33.1	49.5	-16.4
5499.24	0	-5.7	34.2	3.8	32.3	49.5	-17.2
6415.69	0	-4.0	34.8	4.2	35.0	63.5	-28.5
7332.17	0	-2.7	35.9	4.5	37.7	49.5	-11.8

*Corrected Level = Recorded Level + Antenna Factor + Cable Loss*

COMMENT #1: Emissions measured at a distance of 3.0 M over the 30 MHz to 1,000 MHz band were found to be greater than 20 dB below the limits of 15.209.

COMMENT #2:

**TEST ENGINEER:** John Baker **APPROVED BY:** Ben Bibb, NCE

**Appendix C**

**Occupied  
Bandwidth Data Sheets**

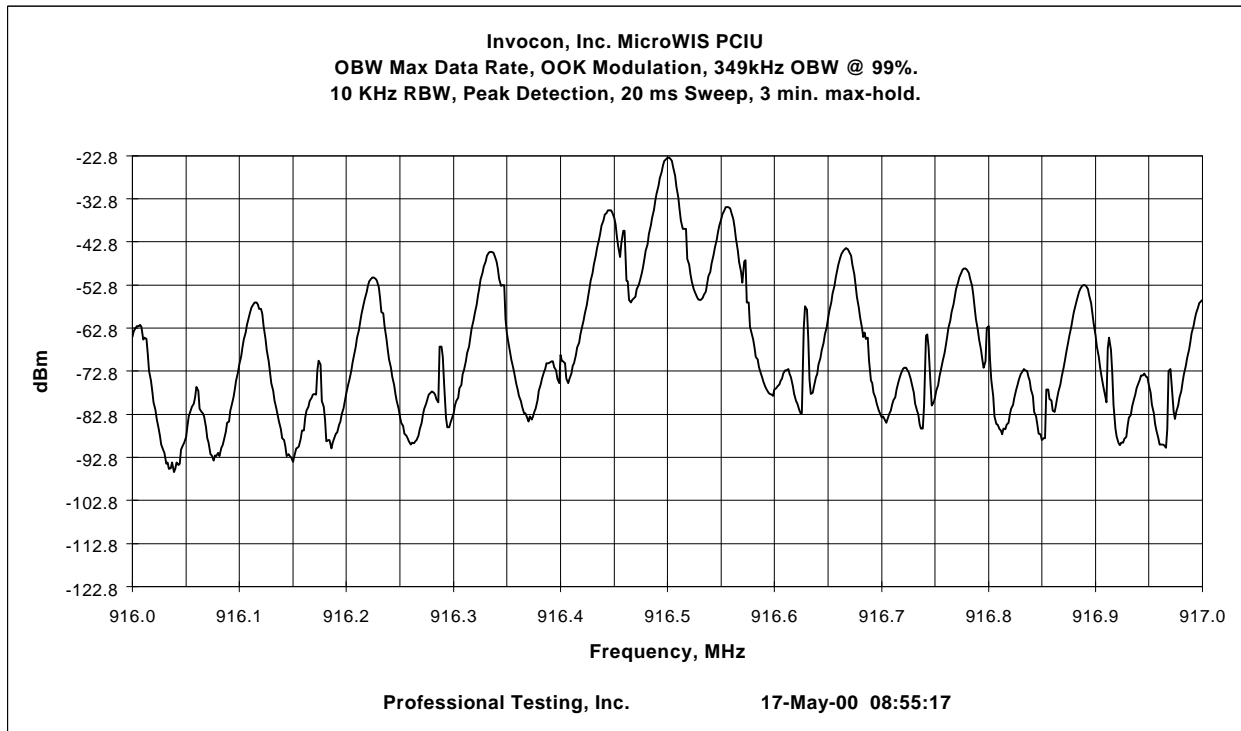
---

### Occupied Bandwidth Datasheet

#### INVOCON, Inc. MicroWIS PCIU

SERIAL #: N/A  
DATE: 17 May, 2000  
PROJECT #: 00456-10

MEASUREMENT DISTANCE (m): na  
ANTENNA POLARIZATION: na  
DETECTOR FUNCTION: Peak, Max Hold



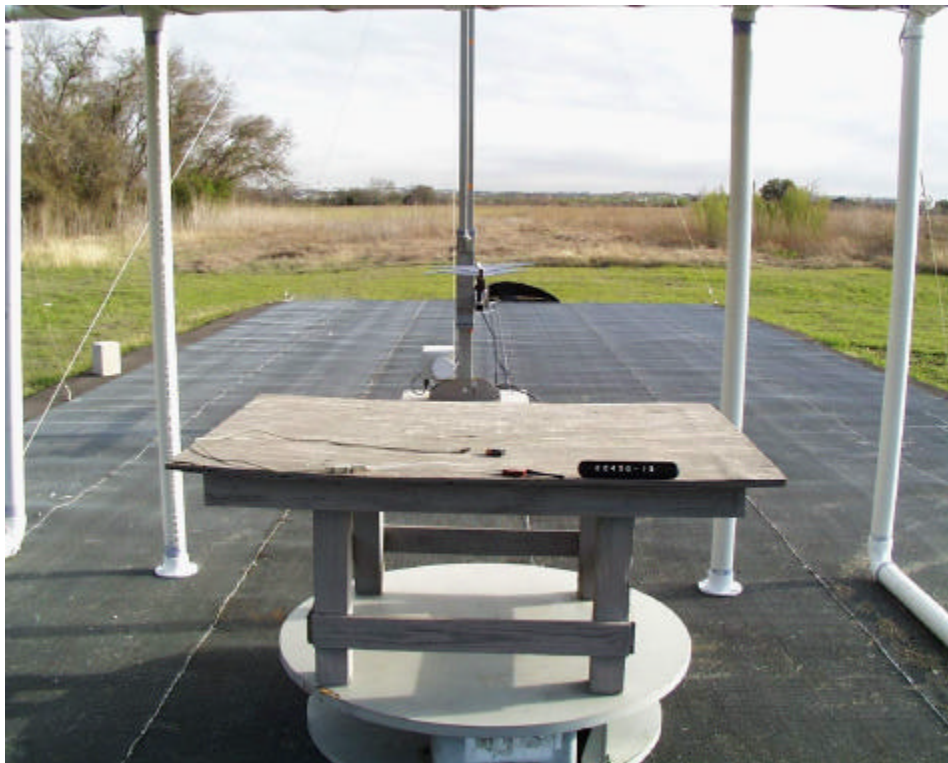
COMMENT #1:

COMMENT #2:

**TEST ENGINEER:** John Baker                      **APPROVED BY:** Ben Bibb



**Radiated Emissions – Front View**



**Radiated Emissions – Back View**