Project Number: 00457-10

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 Sensor Unit
(Intentional Radiator Portion)

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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 Sensor Unit
Serial Number:	N/A
Project Number:	00457-10
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 Sensor Unit** 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:

	Frequency (MHz)	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Fundamental	916.5	83.6	93.9, 3m	10.3
Spurious	2749.8	33.7	49.5, 1m	15.8
Occupied Bandwidth	395 kHz			

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Jeffrey A. Lenk
President

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

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1.0 EUT Description

The Equipment Under Test (EUT) is the **INVOCON, Inc. MicroWIS Sensor Unit**. The **MicroWIS Sensor Unit** is a transceiver used to send digital representations of analog sensor signals to a remote data acquisition computer. The EUT functions as a transceiver sending data to remote MicroWIS PC Interface Units (PCIU) . 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:

Manufacturer & Model	**Serial #**	**FCC ID #**	**Description**
INVOCON, Inc. , MicroWIS Sensor Unit	N/A	NJM0071-027-028	Data Acquisition Transceiver, 916.5 MHz

1.1 EUT Operation

The **MicroWIS SensorUnit** was made operational and placed on the test table. Normally it is interrogated by a host McroWIS PCIU usually installed in a Laptop PC which operated the remote transceiver. 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 SensorUnit**. 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 SensorUnit** 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 radiated harmonic measurements were performed to the 10th harmonic of the fundamental. The reference distance for each limit is also shown in this table below.

3m Limit translated to 1m as required by: 20 log (3m/1m)

Signal Type	Test Distance (Meters)	Field Strength (μV/m)	Field Strength (dBμV/m)
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 and average detection was used as required to demonstrate compliance. 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 Sensor Unit** 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 this test. 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 Sensor Unit** module is 395 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 Sensor Unit** is within the band allowed under FCC Part 15.249 emission band criteria.

4.0 Antenna Requirement

An analysis of the **MicroWIS Sensor Unit** 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 Sensor Unit** were analyzed with respect to the rules. The antenna for this unit is an external wire 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 Sensor Unit** 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 Sensor Unit** during the performance of the test program in order to meet the FCC criteria.

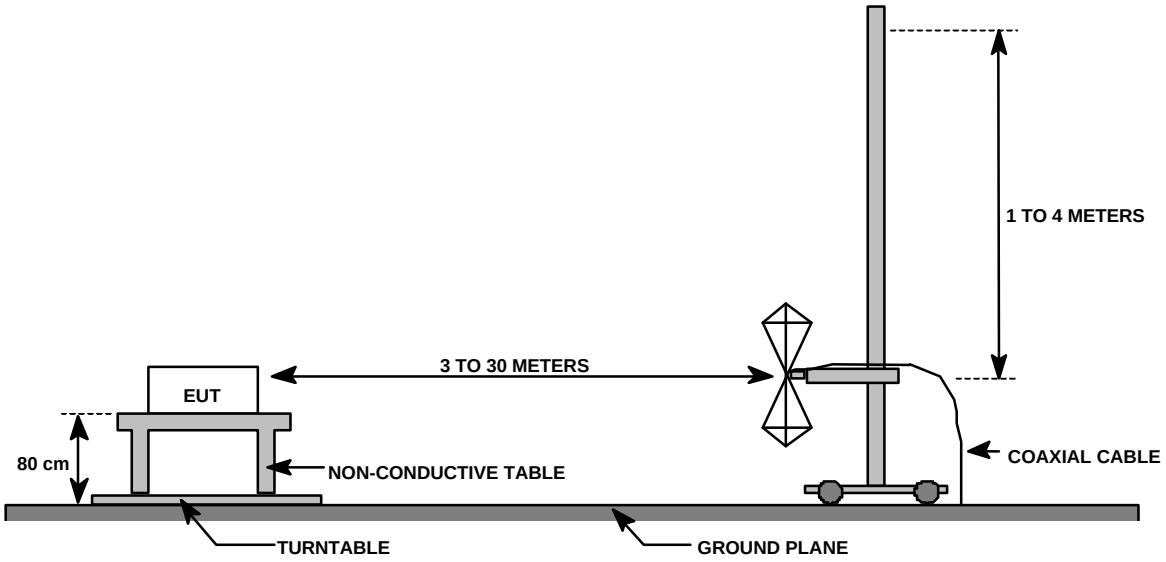
6.0 List of Test Equipment

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

Device	Description	Date Last Calibrated	Calibration Due
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	Pre-amp	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 AFS4-00101800-40-10P-N	Pre-amp	05/15/00	05/15/01

FIGURE 1: Radiated Emissions Test Setup



Appendix A Radiated Emissions Data Sheets

Fundamental Radiated Data Sheet

INVOCON, Inc.
MicroWIS Sensor Unit

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	37.2	22.1	24.3	83.6	94.0	-10.4

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	36.9	22.1	24.3	83.3	94.0	-10.7

Corrected Level = Recorded Level + Antenna Factor + Cable Loss

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

Appendix B Spurious Radiated Emissions Data Sheets

Spurious Radiated Data Sheet

INVOCON, Inc.
MicroWIS Sensor Unit

SERIAL #: N/A
DATE: 17May00
PROJECT #: 00457-10

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)
1833.20	270	6.8	27.7	2.1	36.6	63.5	-26.9
2749.80	270	1.4	29.6	2.7	33.7	49.5	-15.8
3666.41	270	-11.6	31.8	3.1	23.3	49.5	-26.2
4583.09	270	-10.4	33.2	3.4	26.2	49.5	-23.3
5499.59	270	-12.3	34.2	3.8	25.7	49.5	-23.8
6416.18	270	-14.5	34.8	4.2	24.5	63.5	-39.0
7332.70	270	-13.6	35.9	4.5	26.8	49.5	-22.7

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:

John Baker
TEST ENGINEER:_____

Ben Bibb, NCE
APPROVED BY:_____

Spurious Radiated Data Sheet

INVOCON, Inc.
MicroWIS Sensor Unit

SERIAL #: N/A
DATE: 17May00
PROJECT #: 00467-10

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)
1833.18	270	1.6	27.7	2.1	31.4	63.5	-32.1
2749.94	270	-6.22	29.6	2.7	26.1	49.5	-23.4
3666.60	270	-8.7	31.8	3.1	26.2	49.5	-23.3
4583.13	270	-10.3	33.2	3.4	26.3	49.5	-23.2
5499.43	270	-12.9	34.2	3.8	25.1	49.5	-24.4
6416.23	270	-12.4	34.8	4.2	26.6	63.5	-36.9
7332.73	270	-12.2	35.9	4.5	28.2	49.5	-21.3

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:

John Baker
TEST ENGINEER:_____

Ben Bibb, NCE
APPROVED BY:_____

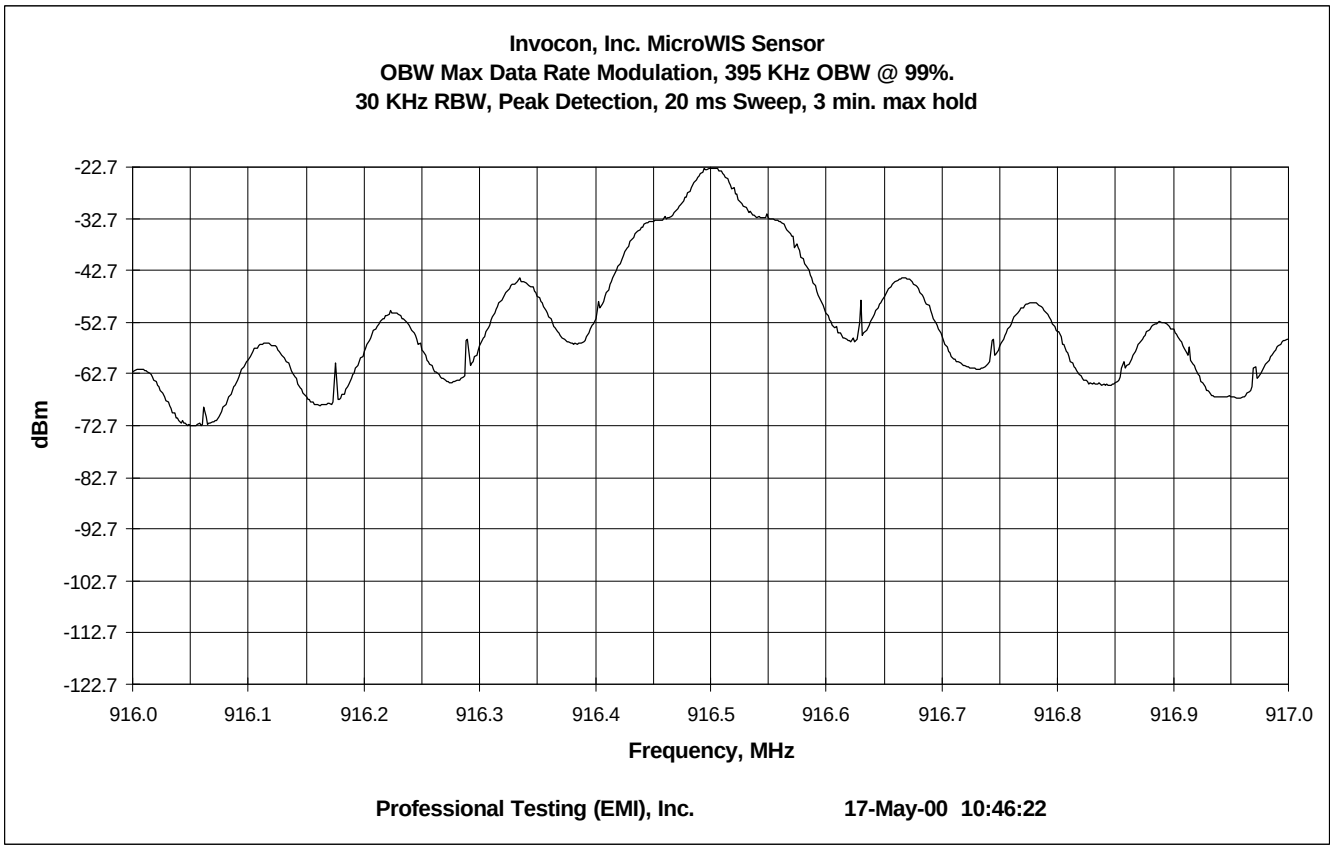
Appendix C Occupied Bandwidth Data Sheets

Occupied Bandwidth Datasheet

INVOCON, Inc.
MicroWIS Sensor Unit

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

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



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