

Certification Test Report

FCC Rule Part: 15.247

FCC ID: THO1017226

ACS Report Number: 05-0267-15C-B


Manufacturer: Respironics, Inc.
Model(s): Alice 5 System
Serial Number(s): A5B1017

Test Begin Date: July 15, 2005
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FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612


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This report contains 26 pages

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1.0 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations. The device covered under this test report contains an FCC modular approved Orinoco Gold 802.11b Wireless PC card with FCC ID IMRWLPCE2411R. Data required for certification under CFR 47 Part 15.247 not presented in this report should be referenced to the information on file for the modular approval under the above mentioned FCC ID.

The final configuration of the modular approved wireless PC card negates the modular approval under FCC ID IMRWLPCE2411R and therefore certification of the Alice 5 System is required. The wireless PC card is integrated internally to the Alice 5 System and the antenna is mounted externally to the Alice 5 System and utilizes a standard SMA RF connector.

1.2 Product Description

The Alice 5 System is a portable or lab-based computerized monitoring and data analysis system for polysomnographic and other sleep related studies. The system is able to record and simultaneously display multiple channels of waveform data. The system is adaptable to various patient age groups (infant to adult) for determining sleep and wakefulness and various disorders associated with sleep. The system includes a base station (Main Unit), Head-Box (Patient Interface Unit), and the Alice Host Software.

The Head-Box collects, amplifies, filters, and digitizes patient data and transmits it to the Base Station that consists of an off-the-shelf single board computer and hard drive. The Base station is capable of recording patient data and audio & visual images of patient activities through a video camera. Additionally the Base station is also configurable as a Web-base server that can transmit patient data through wired or wireless Ethernets to LAN connected host PCs for use by the Alice Host Software.

The Alice Host Software performs data analysis, archiving, and reporting. The software provides interactive sleep scoring with automatic detection of respiratory events and sleep staging. The user may modify the scoring by rejecting, adding, or modifying the scored events or changing the parameters used to automatically score the data and trigger reanalysis. Patient data can be archived on the host disk drive, permanent media, or a network. Multiple Customizable reports can be generated.

1.3 Intended Use

The Alice 5 System is a Polysomnography System that is intended to record, display, and print physiological information to clinicians/physicians. These parameters are presented graphically on a computer screen for diagnostic review, similar in application to the use of a traditional paper based polygraph recorder. The device will be used in hospitals, institutions, sleep centers or clinics, or other test environments where adults or infant patients require the documentation of various sleep or other physiological disorders.

1.4 Technical Specifications

Description	Model / Revision Number / Part Number / Identification
Alice 5 System Main Unit (Base Station) <ul style="list-style-type: none"> • Single Board Computer Module • Single Board Computer BIOS Software • Hard Disk • System Board • Daughter Board • Daughter Board Embedded Firmware • PC-104 Module • Wireless Ethernet Module • Auxiliary Channel Board • Control Panel Board • IrDA Board 	<ul style="list-style-type: none"> • AAEON Technology GENE 4312E • 1.03 • Fujitsu 60 GB HDD Model MHR2060AT • Rev. 9 • Rev. 5 • 4.03 • AAEON Technology PC 3115b • Orinoco Gold 802.11b Wireless PC Card, Part # 014916-D • Rev. 7 • Rev. 4 • Rev. 4
AC/DC Power Supply	Ault Medical Power Supply, Model MW116 Rev. D. Type KA0600F02
Patient Interface Device (Head-Box) <ul style="list-style-type: none"> • DSP Module • DSP Module Embedded Firmware • Masimo Module • Masimo Embedded Firmware • Analog Board • Patient Connector Board 	Respironics Alice 5 Headbox, REF: 1009901 <ul style="list-style-type: none"> • Rev. 11 • 1.8 • MS-7 • (DSP) 3.1.1.2 / (MCU) 1.0.2.9 • Rev. 11 • Rev. 8
Host Software	Respironics Alice Host v.2.0

1.5 Antenna Requirement - FCC Section 15.203

Professional installation is necessary for this device therefore the antenna and RF coupling method are not required to meet the regulations of Part 15.203.

2.0 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment. In addition, ACS is compliant to ISO 17025 as certified by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program. The following certification numbers have been issued in recognition of these accreditations and certifications:

FCC Registration Number: 89450

Industry Canada Lab Code: IC 4175

VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

NVLAP Lab Code: 200612

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

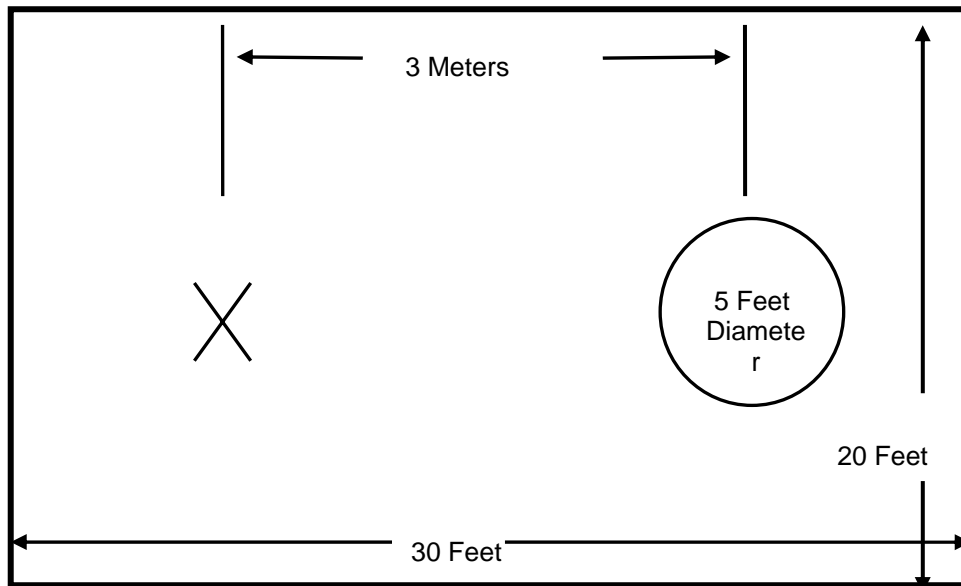


Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

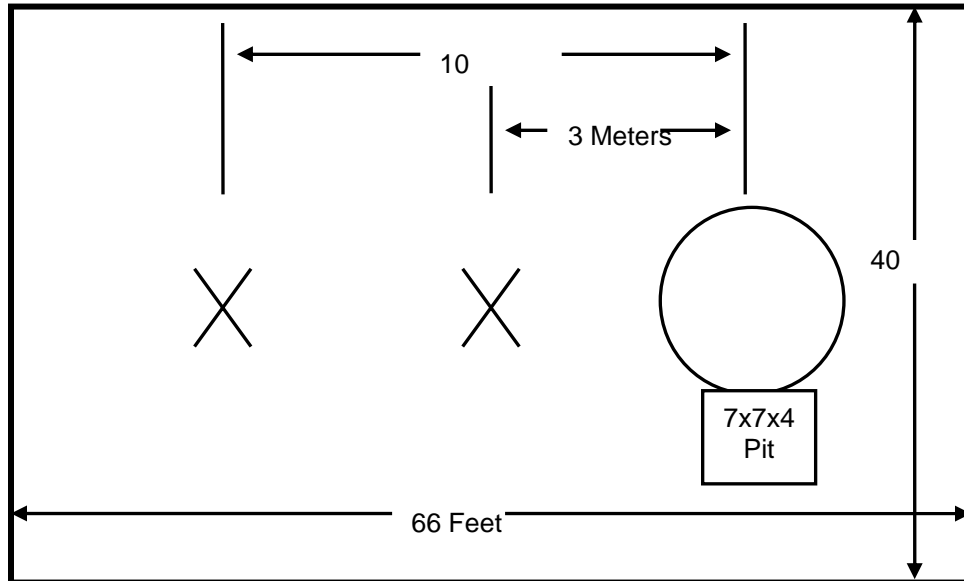


Figure 2.3-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is a shielded room with the following dimensions:

- Height: 3.0 Meters
- Width: 3.6 Meters
- Length: 4.9 Meters

The room is manufactured by Rayproof Corporation and installed by Panashield, Inc. Earth ground is provided to the room via an 8' copper ground rod. Each panel of the room is connected electrically at intervals of 4".

Power to the room is filtered to prevent ambient noise from coupling to the EUT and measurement equipment. Filters are models 1B42-60P manufactured by Rayproof Corporation.

The room is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 2.4-1:

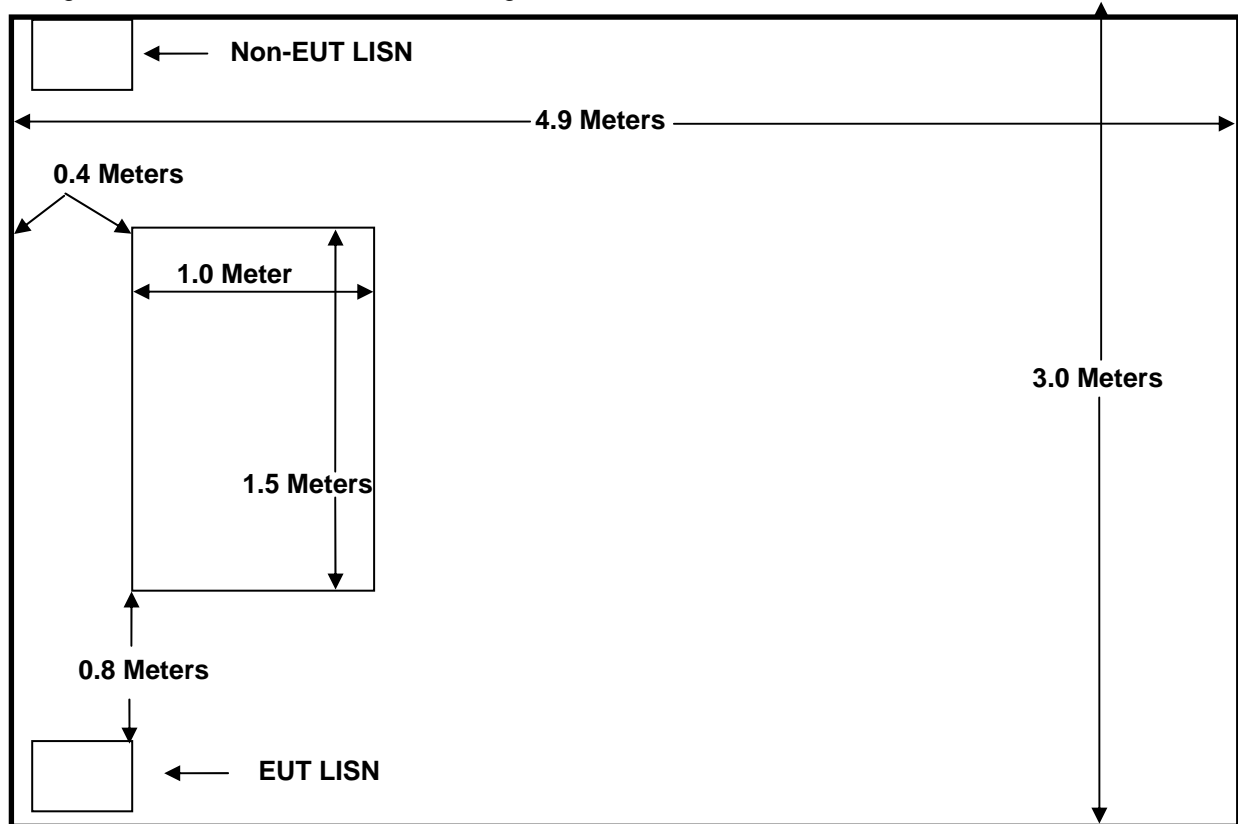


Figure 2.4-1: AC Mains Conducted EMI Site

3.0 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ❖ ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9 kHz to 40 GHz
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures (October 2004)
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart B & Subpart C: Radio Frequency Devices, (October 2004)

4.0 LIST OF TEST EQUIPMENT

All test equipment used for regulatory testing is calibrated yearly or according to manufacturer's specifications.

Table 4.0-1: Test Equipment

Equipment Calibration Information					
ACS#	Mfg.	Eq. type	Model	S/N	Cal. Due
<input checked="" type="checkbox"/> 26	Chase	Bi-Log Antenna	CBL6111	1044	10/15/05
<input checked="" type="checkbox"/> 153	EMCO	LISN	3825/2	9411-2268	12/20/05
<input checked="" type="checkbox"/> 193	ACS	OATS Cable Set	RG8	193	01/07/06
<input checked="" type="checkbox"/> 225	Andrew	OATS RF cable	Heliax	225	01/06/06
<input checked="" type="checkbox"/> 165	ACS	Conducted EMI Cable Set	RG8	165	01/06/06
<input checked="" type="checkbox"/> 22	Agilent	Pre-Amplifier	8449B	3008A00526	05/06/06
<input checked="" type="checkbox"/> 73	Agilent	Pre-Amplifier	8447D	272A05624	05/18/06
<input checked="" type="checkbox"/> 30	Spectrum Technologies	Horn Antenna	DRH-0118	970102	05/09/06
<input checked="" type="checkbox"/> 105	Microwave Circuits	High Pass Filter	H1G810G1	2123-01 DC0225	06/09/06
<input checked="" type="checkbox"/> 1	Rohde & Schwarz	Receiver Display	804.8932.52	833771/007	03/07/06
<input checked="" type="checkbox"/> 2	Rohde & Schwarz	ESMI Receiver	1032.5640.53	839587/003	03/07/06
<input checked="" type="checkbox"/> 3	Rohde & Schwarz	Receiver Display	804.8932.52	839379/011	12/15/05
<input checked="" type="checkbox"/> 4	Rohde & Schwarz	ESMI Receiver	1032.5640.53	833827/003	12/15/05
<input checked="" type="checkbox"/> ---	Agilent	Spectrum Analyzer	E7402A	US41110277	11/10/05
<input checked="" type="checkbox"/> 168	Hewlett Packard	Pulse Limiter	11947A	3107A02268	01/06/06
<input checked="" type="checkbox"/> 6	Harbour Industries	HF RF Cable	LL-335	00006	03/16/06
<input checked="" type="checkbox"/> 7	Harbour Industries	HF RF Cable	LL-335	00007	03/16/06
<input checked="" type="checkbox"/> 167	ACS	Chamber EMI Cable Set	RG6	167	12/29/05
<input checked="" type="checkbox"/> 204	ACS	Chamber EMI RF cable	RG8	204	01/07/06

5.0 INPUT/OUTPUT CABLE AND PORT CONFIGURATIONS

Table 5-1: Cable and Port Configurations

<i>Cable</i>	<i>Part Number</i>	<i>From</i>	<i>To</i>	<i>Number of Conductors</i>	<i>Shielded</i>	<i>Length</i>
AC Power Cord	NA	Mains	AC/DC Power Supply	3	No	10'
DC Output Cable	NA	AC/DC Power Supply	Base Station	4	No	5'
Headbox- Base Communication Cable	1009966	Base Station	Head-Box	8	No	10'
Serial/RS232 (Null Modem) Cable	NA	Base Station COMM Port 1	Base Station COMM Port 2	9	Yes	10'
USB Cable (2)	NA	Base Station	Resistive termination	4	Yes	80"
CAT-5 Ethernet Cable	NA	Base Station	LAN Connection	8	No	Vary
Audio/Line Output Cable	NA	Base Station	Resistive termination	2	Yes	6.5'
Microphone Cable	Model ECM-F01	Sony Flat Mic	Base Station	1	Yes	40"
Auxiliary Input Cable (4)	NA	Resistive termination	Base Station	2	Yes	6"
BNC Cable	NA	Resistive termination	Base Station	1	Yes	6"
Accessory Cable	NA	Base Station	Resistive termination	15	Yes	6"
EEG/EOG Lead (24)	NA	Head-box	Resistive termination	1	No	6"
EMG Lead (10)	NA	Head-box	Resistive termination	1	No	6"
ECG/EKG Lead (4)	NA	Head-box	Resistive termination	1	No	5"
Pressure-Based Air Flow Cable	Model P1304	Head-box	Canula Amplifier Module	2	No	8"
Thermister-Based Air Flow Cable	Model 1274	Head-box	Thermister-Based Air Flow Sensor	2	No	90"
Microphone Cable	Model P1696	Head-box	Patient Microphone	2	No	7.25'
Patient Effort Belt Cable (2)	Model P1586	Head-box	Patient Effort Belt Sensor	2	No	7.25'
Body Position Cable	Model P1694	Head-box	Patient Body Position Sensor	2	No	7.25'
Actimeter Cable (2)	NA	Head-box	Patient Actimeter Sensor	2	No	70"
Analog/Auxiliary Input Cable (2)	NA	Head-box	Resistive termination	5	No	6"
Oximeter Cable	REF1005	Head-box	Patient Oximeter Probe	6	Yes	90"

6.0 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM AND SUPPORT EQUIPMENT

6.1 Equipment Under Test Setup Block Diagram

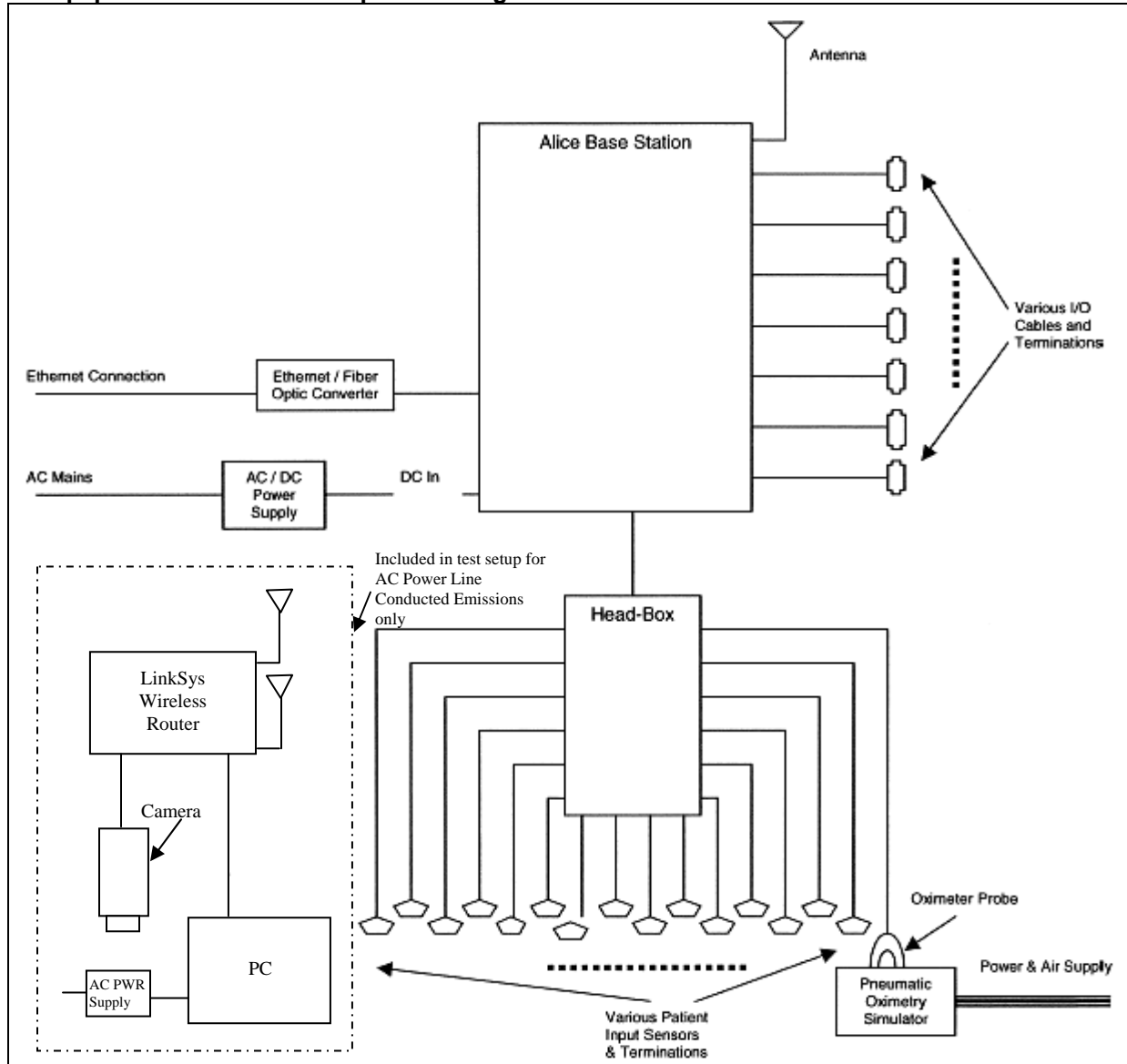


Figure 6.1-1: EUT Test Setup

6.2 Support Equipment

Table 6.2-1: Support Equipment

Equipment Type	Manufacturer	Model Number	Serial Number	FCC ID
Wireless 802.11b Router	LinkSys	BEFW1154	C27603407366	PKW-BEFW11S4V4
Laptop PC	Dell	PMP	0003018R-12800-052-3540	NA
PC Power Supply	Dell	AA20031	0004983D	NA
Network Camera	Axis Communications	2420	00408C5D4242	NA

The support equipment listed was utilized only in the AC Power Line Conducted Emissions test setup. These items were removed for radiated emissions tests and the EUT was manually configured for operation using the provided software.

7.0 SUMMARY OF TESTS

7.1 Power Line Conducted Emissions - FCC Section 15.207

7.1.1 Test Methodology

ANSI C63.4 sections 6 and 7 were the guiding documents for this evaluation. Conducted emissions were performed from 150 kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9 kHz and the video bandwidth set to 30 kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss

Margin = Corrected Reading – Applicable Limit

Testing was performed at one input level to the device, 120 VAC.

7.1.2 Test Results

Results of the test are shown below in and Tables 7.1.2-1 through 7.1.2-4 and Figure 7.1.2-1 through 7.1.2-2

Table 7.1.2-1: Line 1 Conducted EMI Results (Quasi-Peak)

Frequency MHz	Level dB μ V	Transducer dB	Limit dB μ V	Margin dB	Line	PE
0.996	29.2	9.9	56	26.7	L1	GND
1.110	32.8	10	56	23.1	L1	GND
1.440	27.8	10	56	28.2	L1	GND
1.776	31.4	10	56	24.5	L1	GND
1.884	23.0	10	56	32.9	L1	GND
2.220	28.2	10	56	27.8	L1	GND
2.664	24.0	10	56	31.9	L1	GND
3.000	27.7	10	56	28.2	L1	GND
3.108	18.8	10	56	37.1	L1	GND
3.888	20.7	10	56	35.2	L1	GND

Table 7.1.2-2: Line 1 Conducted EMI Results (Average)

Frequency MHz	Level dB μ V	Transducer dB	Limit dB μ V	Margin dB	Line	PE
1.002	39.1	9.9	46	6.8	L1	GND
1.110	33.8	10	46	12.1	L1	GND
1.446	39.3	10	46	6.6	L1	GND
1.776	31.3	10	46	14.6	L1	GND
1.890	35.8	10	46	10.1	L1	GND
2.226	38.3	10	46	7.6	L1	GND
2.670	35.5	10	46	10.4	L1	GND
3.000	26.5	10	46	19.4	L1	GND
3.114	30.6	10	46	15.3	L1	GND
3.894	29.4	10	46	16.5	L1	GND

Table 7.1.2-3: Line 2 Conducted EMI Results (Quasi-Peak)

Frequency MHz	Level dBµV	Transducer dB	Limit dBµV	Margin dB	Line	PE
0.192	40.7	9.9	63.9	23.2	L2	GND
1.008	33.9	9.9	56	22.0	L2	GND
1.116	26.7	10	56	29.2	L2	GND
1.452	28.1	10	56	27.9	L2	GND
1.788	26.6	10	56	29.3	L2	GND
1.902	30.4	10	56	25.5	L2	GND
2.238	30.4	10	56	25.5	L2	GND
2.574	28.3	10	56	27.7	L2	GND
2.688	31.9	10	56	24.0	L2	GND
3.024	31.4	10	56	24.5	L2	GND

Table 7.1.2-4: Line 2 Conducted EMI Results (Average)

Frequency MHz	Level dBµV	Transducer dB	Limit dBµV	Margin dB	Line	PE
0.222	37.3	9.9	52.7	15.4	L2	GND
1.008	33.7	9.9	46	12.2	L2	GND
1.122	33.0	10	46	12.9	L2	GND
1.458	35.2	10	46	10.7	L2	GND
1.794	34.3	10	46	11.6	L2	GND
1.902	29.2	10	46	16.7	L2	GND
2.238	29.0	10	46	16.9	L2	GND
2.574	26.2	10	46	19.7	L2	GND
2.688	30.5	10	46	15.4	L2	GND
3.024	29.4	10	46	16.5	L2	GND

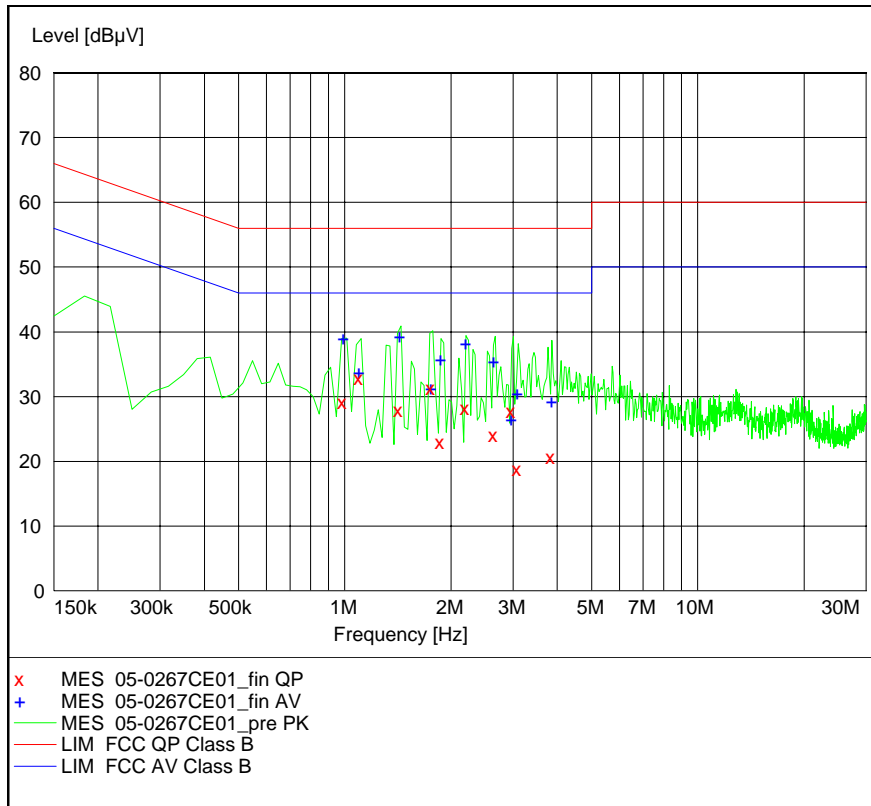


Figure 7.1.2-1: Conducted Emissions Graph – Line 1

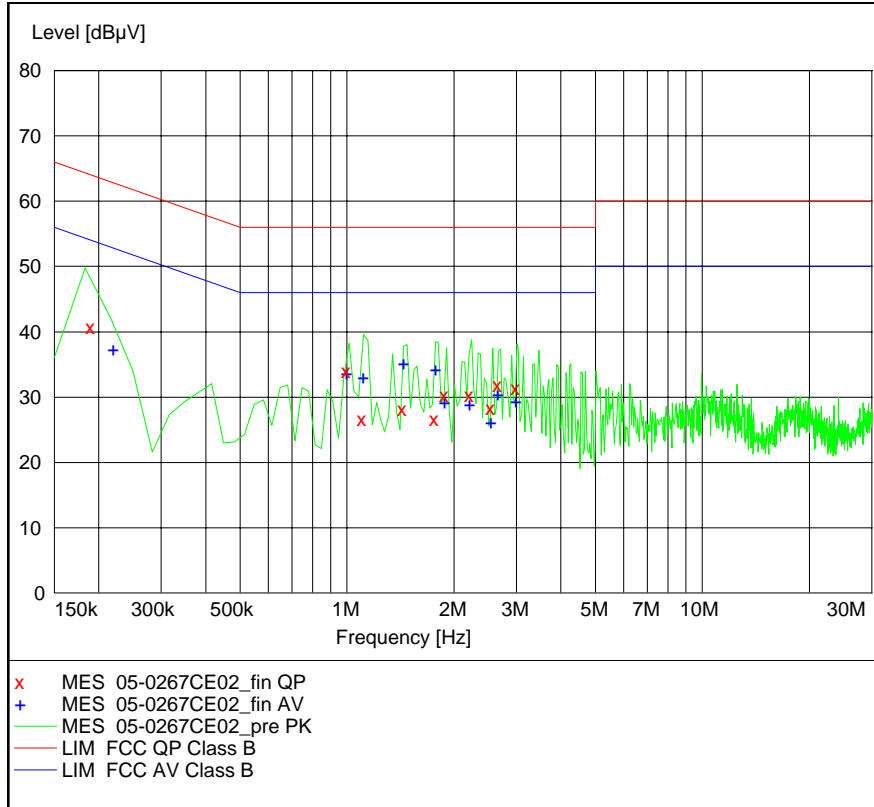


Figure 7.1.2-2: Conducted Emissions Graph – Line 2

7.2 Radiated Spurious Emissions - FCC Section 15.209 (Intentional Radiators)

7.2.1 Test Methodology

Radiated emissions tests were made over the frequency range of 30MHz to 10GHz, 10 times the highest fundamental frequency.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000MHz, quasi-peak measurements were made using a resolution bandwidth (RBW) of 120 kHz and a video bandwidth (VBW) of 300 kHz. For frequencies above 1000MHz, peak measurements were made using an RBW of 1 MHz and a VBW of 3 MHz. The average emissions were measured by using a VBW of 10 Hz and further corrected by the duty cycle of the EUT.

7.2.2 Duty Cycle Correction – Part 15.35

For radiated measurements compared to average limits, the measured average level can be reduced by a correction factor to account for the duty cycle of the EUT. It was not necessary to apply the duty cycle correction factor to the average measured emission levels to meet the required limits.

7.2.3 Test Results

No emissions could be detected above the noise floor of the measurement equipment and therefore the values shown represent the measured noise floor. Noise levels are displayed for the second harmonic only for the purpose of this report.

Table 7.2.3-1: Radiated Spurious Emissions

Frequency (MHz)	Level (dBuV)		Antenna Polarity (H/V)	Correction Factors (dB)	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	avg			pk	avg	pk	avg	pk	avg
Low Channel - 2412 MHz										
4824	40.54	27.28	H	8.97	49.51	36.25	74	54	24.49	17.75
4824	39.90	27.46	V	8.97	48.87	36.43	74	54	25.13	17.57
Middle Channel - 2437 MHz										
4874	40.39	26.78	H	9.20	49.59	35.98	74	54	24.41	18.02
4874	41.02	26.83	V	9.20	50.22	36.03	74	54	23.78	17.97
High Channel - 2462 MHz										
4924	39.06	26.85	H	9.42	48.48	36.27	74	54	25.52	17.73
4924	38.79	26.54	V	9.42	48.21	35.96	74	54	25.79	18.04

8.0 CONCLUSION

In the opinion of ACS, Inc. the Alice 5 System, manufactured by Resprionics, Inc. meets the requirements of FCC Part 15 Subpart C as applicable.

Appendix A

Test Setup Photographs



Figure A.1 – Conducted Emissions Test Setup

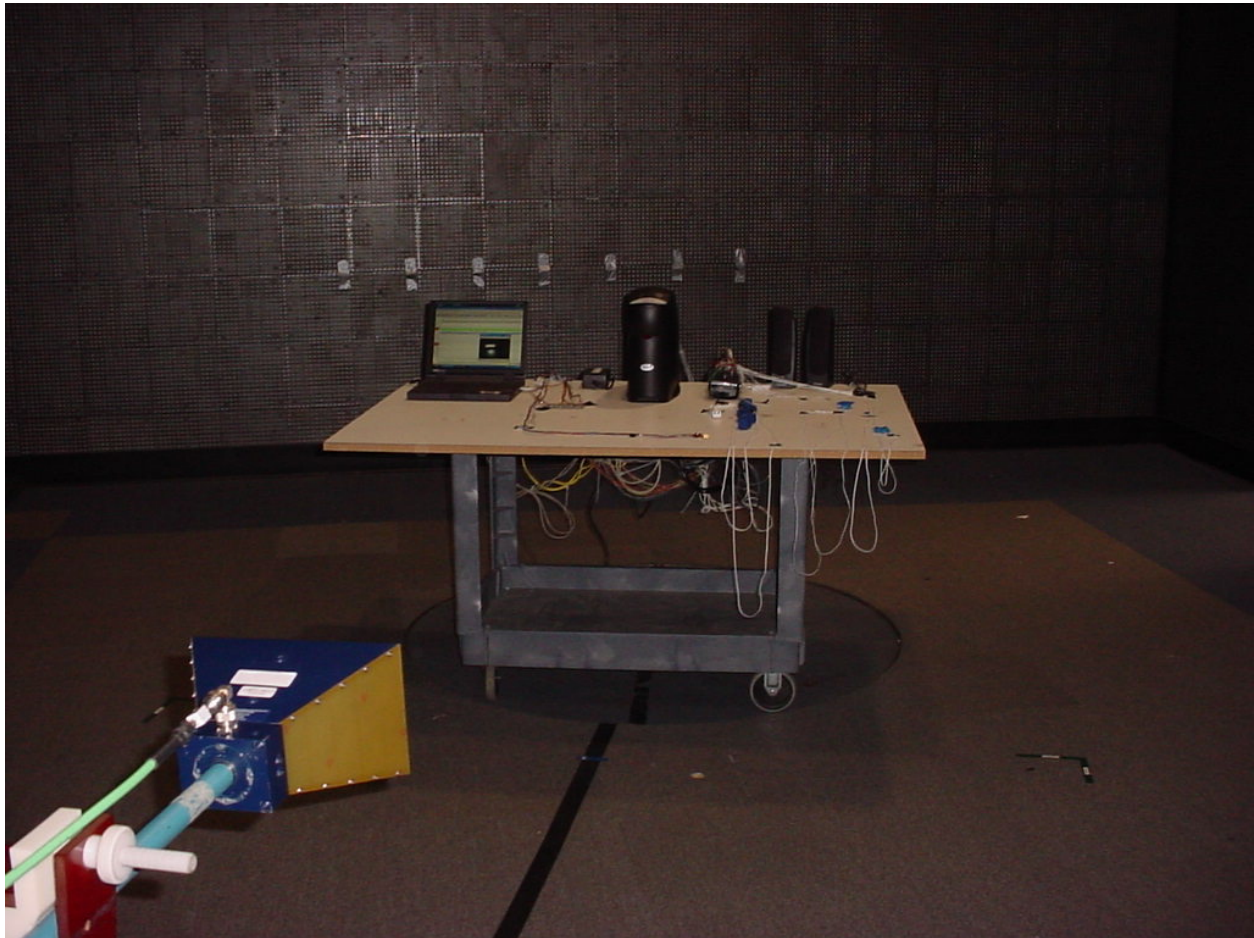


Figure A.2 – Final Emissions Test Setup

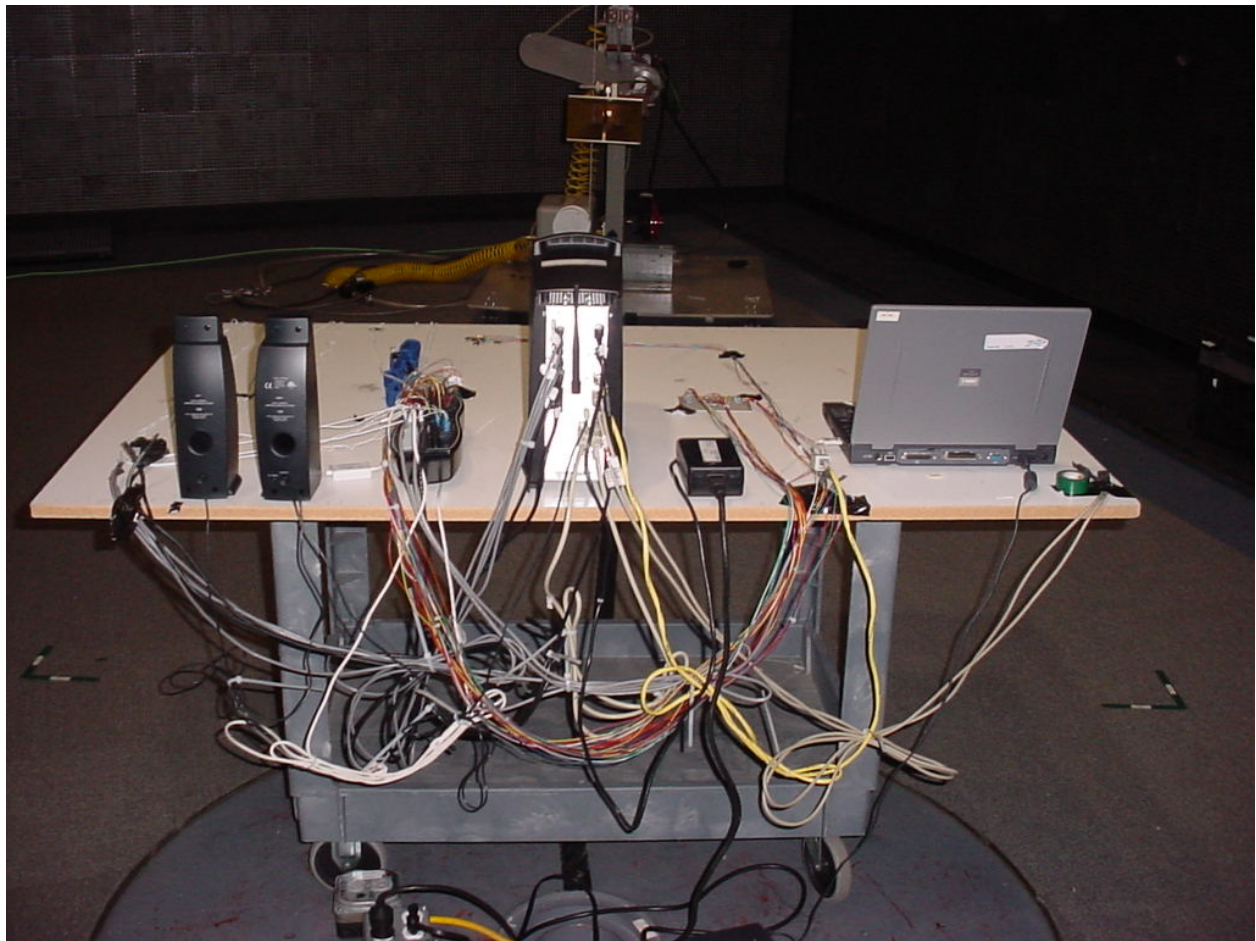


Figure A.3 – Final Emissions Test Setup

Appendix B

External Photographs



Figure B.1 – Front View



Figure B.3 – Side View



Figure B.4 – Top View

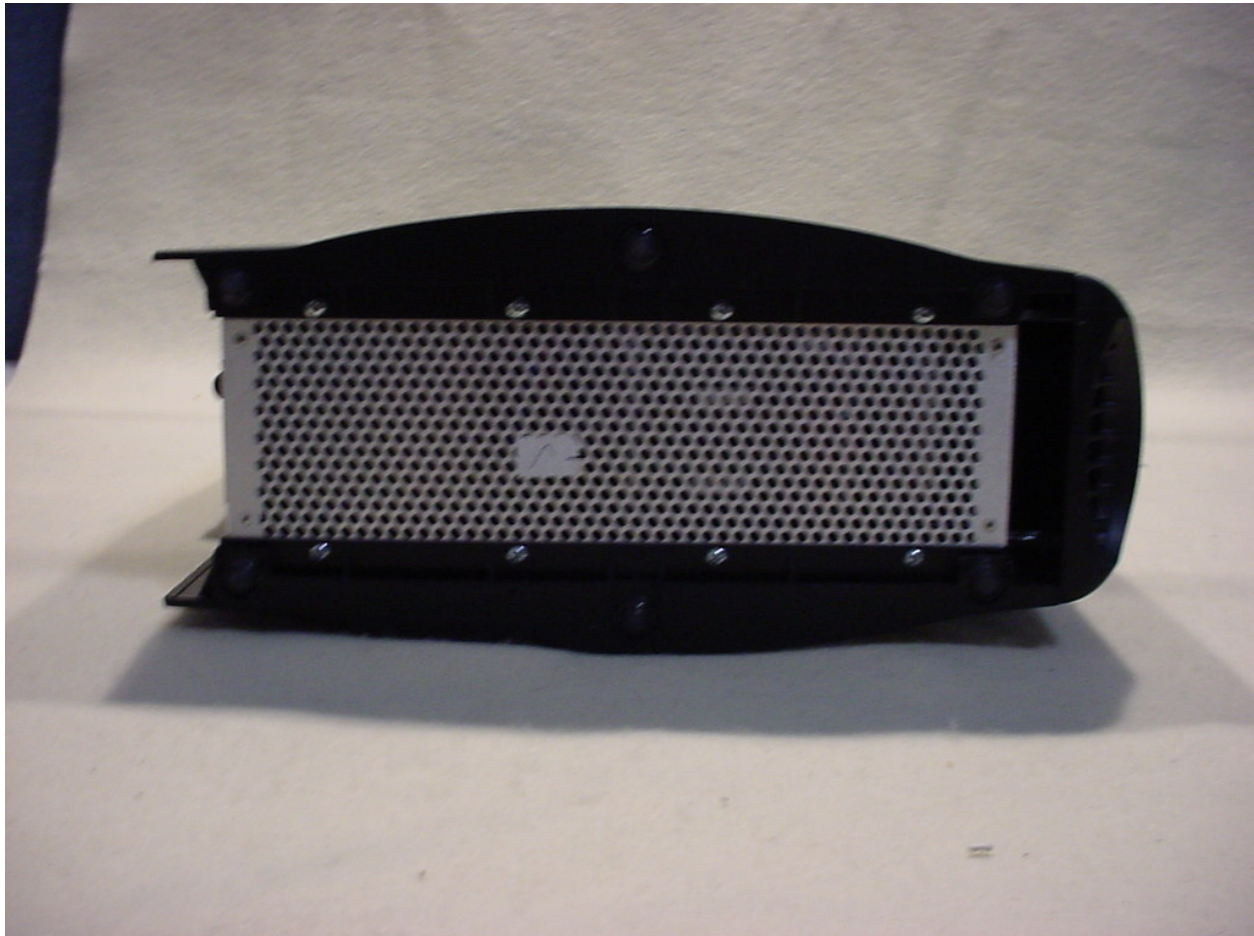


Figure B.5 – Bottom View

Appendix C

Internal Photographs

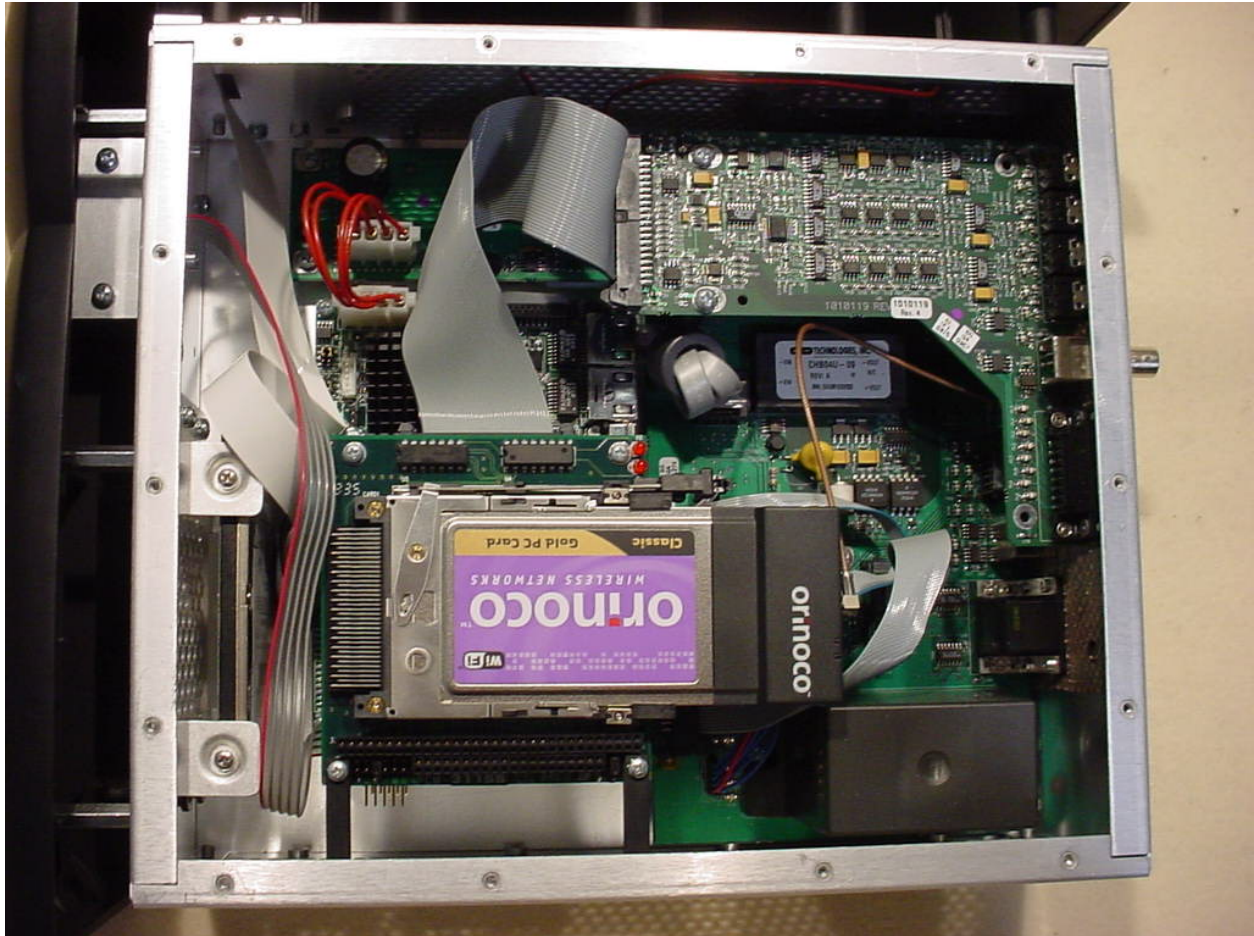


Figure C.1 – System View



Figure C.2 – Wireless PC Card Front View



Figure C.3 – Wireless PC Card Back View