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RD Systems Compliance

FCC Subpart C
FCC Class A
Test Report

For :
Isonas Incorporated
4810 Riverbend Road
Boulder, CO 80301

Equipment Tested :
Access Sensor

Model:
Clearnet Reader

Test Report Number:	Iso9851crFC
Date:	December 19, 1998

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GENERAL INFORMATION

Test Report Number:	Iso9851crFC
Date:	December 19, 1998
Applicant:	Isonas Incorporated 4810 Riverbend Road Boulder, CO 80301
Equipment Tested:	Access Sensor
Model:	Clearnet Reader
Purpose Of Test:	To demonstrate the **compliance** of the Access Sensor, Clearnet Reader with the requirements of FCC Part 15/ANSI C63.4-1992 Rules and Regulations **Subpart C** Limits and **FCC Class A** Limits.
Test Site Location: OATS	Atlas Compliance & Engineering, Inc. 726 Hidden Valley Road Watsonville, California 95076
Tested for Compliance With:	FCC Part 15 Rules and Regulations for **Subpart C** and **Subpart B Class A** to ANSI / C63.4-1992 procedures
Frequency Range Investigated:	10 kHz to 1000 MHz
Date Product Tested:	December 19, 1998
Test Personnel:	Mario Baraona EMC Engineer

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TEST EQUIPMENT

The following test equipment was utilized in making the measurements contained in this report.

1. EMI Test Receiver 9 kHz - 2500 MHz, Rohde & Schwarz, Model No. ESPC, S/N - 845296/024, Date Calibration due, July 6, 1999, Calibration Cycle 1 year.
2. Pre amp, Hewlett Packard, Model No. 8447D, S/N - 2944A08506, Date Calibration due, June 25, 1999, Calibration Cycle 1 year.
3. BiLog Antenna, Chase Electronics Limited, Model No. CBL6141, S/N - 4034, Date Calibration due, March 18,1999, Calibration Cycle 1 year.
4. Biconical Antenna, A.H. Systems, Model No. SAS 200/540, S/N - 272, Date Calibration due, September 3, 1999, Calibration Cycle 1 year.
5. Log Periodic Antenna, A.H. Systems, Model No. SAS 200/512, S/N - 061, Date Calibration due, September 3, 1999, Calibration Cycle 1 year.
6. Double Ridge Guide Horn Antenna, EMCO, Model No. 3115, S/N - 3340, Date Calibration due - August 28, 1999, Calibration Cycle 1 year.
7. LISN, Solar Electronic, Model No. 8012-50-R-24-BNC, Date Calibration due, August 29, 1999, Calibration Cycle 1 year.
8. LISN, EMCO, Model No. 3825/2, S/N - 9007-1683, Date Calibration due, August 29, 1999, Calibration Cycle 1 year.
9. Temperature and Humidity meter, OMEGA Engineering, Model No. RH-20-F, S/N - 200-97-082591, Date Calibration due - September 16, 1999, Calibration Cycle 1 year.
10. Active Loop Antenna, EMCO, Model No. 6502, S/N - 9307-2839, Date Calibration due, November 7, 1999

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EQUIPMENT UNDER TEST CONFIGURATION

Customer: Isonas Incorporated

Date: December 19, 1998

Specification: **FCC Part 15 Subpart C and FCC Class A/ANSI C63.4-1992**

EUT Description:

The Clearnet Reader is an access control panel. It was setup in a configuration to simulate a typical installation. The Clearnet Reader runs off a **12 VDC source** and was constantly reading an access card. EUT clocks at **32 kHz and 7.3728 MHz**.

EUT Support Devices:

Model:	Description:	S/N	FCC ID#
3003	Protek DC Power Supply	N/A	N/A

EUT Support Program:

The EUT and all support equipment were exercised in all operating modes for determination of worse case emission under typical operations. Data reported for conducted and radiated emissions reflects worse case conditions.

I/O Ports and Cables:

EUT:

I/O Port	Cable Type	Length	Connector	Termination
Power	Twisted Pair	10 feet	RCA – Solder	EUT

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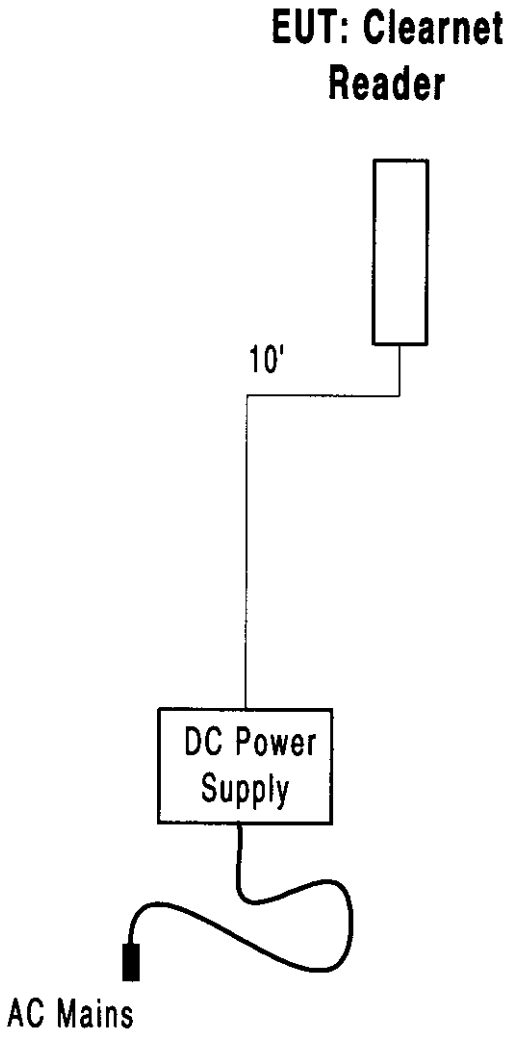
EQUIPMENT BLOCK DIAGRAM



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TEST SETUP (Conducted)

The Photographs below show worst case setup for Line Conducted.

Power is from a DC Source

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APPENDIX A: EUT Setup and Requirements

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Radiated Emissions

In general, the equipment under test (EUT) and the peripherals listed were setup in a manner that represented their normal use. Any special conditions required for the EUT to operate normally are identified in the comments that accompany Table 1 for radiated emission, and Table 2 for conducted emissions. Additionally a complete description of all ports and I/O cables is included in the configuration page.

During radiated emission testing, the EUT was placed on a nonconductive rotating table .8 meter above the conductive grid. The nonconductive table dimensions were 1 meter deep by 1.5 meters wide at .8 meter high. This configuration is typical for radiated emission testing of table top devices.

Conducted Emission

During conducted emission testing the EUT, was located on a wooden test bench measuring .8 meter high, 1 meter deep, and 1.5 meters in width. The EUT was placed on the wooden test bench surface. Alternatively, conducted emission testing is performed with the test bench on the top of the metal turntable and by placing the metal frame of the LISN on top of the conductive horizontal ground plane.

The metal plane used for conducted emission testing was grounded to the earth through the green wire safety ground. Power to the EUT was provided from a filter grounded to the metal plane to a LISN. The LISN was also grounded to the plane. All other objects were kept a minimum of 1 meter away from the EUT during the conducted test.

EUT Configuration

The AC power line and I/O cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available I/O ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produces maximum emission. This configuration was precisely noted in the test report. I/O cables were of the type and length specified in the individual requirements. If the length could be varied, the length which produced maximum emissions was selected.

Where there are multiple I/O ports all of the same type, connecting a cable to just one of the ports is sufficient if it can be shown that additional cables would not significantly affect the results.

If the length of cable between pieces of equipment, and the manufacturer did not provide specifications on their spacing, the interval between different pieces of equipment was about 10 centimeters.

If the length of cable between pieces of equipment was longer than necessary, all excessive cable was bundled with 30-40 cm lengths in a serpentine fashion. If the cable could be bundled in this fashion, it was arranged around the EUT. For more detail on the disposition of the

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cables during the test, refer to the information contained in the configuration page and on worst case photographs on the test setup page respectively.

Test Methods

The radiated and conducted emission data of the EUT was taken with the HP Spectrum Analyzer. Incorporating the application correction factors for distance, antenna, cable loss, and amplifier gain, the data was reduced as shown in the "Sample Calculations". The corrected data was then compared to **the FCC Part 15 Subpart C and to the Class A for the digital portion** emission limits to determine compliance.

Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

Measurement Uncertainty

Measurement uncertainty is caused by random effects and imperfect correction of systematic effects. The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 with a confidence level of 95%.

Total Uncertainty at 95% confidence probability = ±3.4dB

Sample Calculations

An example of how the spectrum analyzer reading is converted using correction factors is given for the six highest emissions recorded in Table 1 and 2. For radiated emissions in dBµV/m, the spectrum analyzer reading in dBµV is corrected by using the following formula:

Meter Reading (dBµV)
+ Antenna Factor (dB)
+ Cable Loss (dB)
- Pre-amplifier Gain (dB)
= Corrected Reading (dBµV/m)

This reading is then compared to the applicable specification limits and the difference will determine compliance. For conducted emissions, no correction factors are needed when a 50 µH LISN is used.

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Radiated Emission Testing (Electric Field)

During the primary radiated scan, the EUT was powered up and operating in its defined test mode. The frequency range of 30 MHz to 300 MHz was then scanned with the Biconical antenna located from 1 to 4 meters above the ground plane in the horizontal and vertical polarity. During these scans, the turntable was rotated and all peaks which were at or near the limits were recorded. Next the frequency range of 300 to 1000 MHz was scanned in the same manner, with a log periodic antenna, and the peaks recorded. Lastly, a scan of the FM band from 88 to 110 MHz was made, using a reduced resolution bandwidth and a reduced frequency span. Care was taken to ensure that no frequencies were missed within the FM and TV bands, an analysis was performed to determine if the signals that were at or near the limit were cause by an ambient transmission. If unable to determine by analysis, the equipment was powered down to make the final determination if the EUT was the source of the emission.

For the final radiated scan, the equipment was scanned using tuned Dipole antennas to any frequency within 6 dBμV of the limit, and a thorough scan of all frequency using a small frequency span was manually made. The turntable was rotated as needed. Comparison with the previously recorded measurements were then made. Using the peak readings from both scans as a guide, the test engineer then maximizes the readings with respect to the table rotation, antenna height and configuration of the peripherals and cables. The EUT components and cables were being moved and arranged on the EUT for maximum emissions. Figures and photographs showing the final worst case configuration of the EUT are contained in the Test Setup Page. The results of the Radiated Emissions Test are shown in Table 2.

Conducted Emission Testing

For conducted emissions testing a 30-50 second sweep time was used for automated measurements in the frequency bands of 450 kHz to 30 MHz. All readings within 20 dB of the limits were recorded, and those within 6 dB of the limit were examined with additional measurements using a slower sweep time. The results of the conducted emissions test are shown in Table 1.

For the conducted emissions, the LISN is manufactured by Solar Electronics, Model Type 8028-50-TS-24-BNC, 50 μH-/+5 ohms. The coupling capacitor in the Solar LISN is then changed to a value of 0.25 μf. Above 150 kHz, a 0.15 μf series capacitor is then added in-line prior to connecting the analyzer to restore the proper Impedance for the range.

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FCC PART 15 LIMITS

RADIATED LIMITS SECTION 15.209

Frequency MHz	Limit µV/m	Measurement Distance meters
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

10 Meter SECTION 15.109 CISPR Class A RADIATED LIMITS

Frequency MHz	Limit dBµV/m	Limit µV/m
30-230	40	100
230-1000	47	224

POWER LINE CONDUCTED LIMITS

Frequency MHz	CISPR 22 A Limit Quasi-Peak dBµV	CISPR 22 A Limit Average dBµV
.15-0.5	79	66
0.5-30	73	60

NOTE

1. The tighter limit shall apply at the edge between two frequency bands.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closest point of any part of the device or system.

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APPENDIX B: Measurement Data

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Report Of Measurements Radiated Data

The following table reports the results of the radiated measurements for the Access Sensor, Clearnet Reader.

Table 1 - Six Highest Radiated Emission Levels

Frequency MHz	QP Level dBµV	FCC Limit dBµV	Margin dBµV	Azimuth & Height	Polarization & Antenna
118.12	32.79	40.00	-7.21	0, 3.9M	Horizontal, BiLog
118.09	30.91	40.00	-9.09	340, 1.6M	Vertical, BiLog
119.59	30.52	40.00	-9.48	340, 1.6M	Vertical, BiLog
118.87	30.48	40.00	-9.52	340, 1.6M	Vertical, BiLog
179.08	30.08	40.00	-9.92	335, 3.7M	Horizontal, BiLog
180.07	30.05	40.00	-9.95	335, 3.7M	Horizontal, BiLog

Test Method: C63.4-1992
Spec Limit: FCC/EN 55022 Class A
Test Distance: 10 Meters
Azimuth in degrees, Height in meters

COMMENTS: System continuously running. Ambient temperature 65° F and relative humidity of 36%.

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REPORT OF MEASUREMENTS CONDUCTED DATA

The following table reports the results of the conducted measurements for Access Sensor, Clearnet Reader.

Table 2 - Six Highest Conducted Emission Levels

Frequency MHz	QP Level dBµV	CISPR Limit dBµV	Margin dB	Note	PE Termination

Test Method: CISPR 16-1
Spec Limit: EN 55022 Class A

NOTES: L1 = Neutral side
L2 = Hot side

COMMENTS: System derived power from a 12 VDC source.

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Radiated Data for EN-55022 Class A

Isonas Incorporated
Product Name - Access Sensor
Product Model - Clearnet Reader

Table 3 - Radiated Emission Data

Frequency MHz.	QP Level dBµV	FCC Limit dBµV	Margin dBµV	Azimuth, Ht.	Polarization & Antenna
118.12	32.79	40.00	-7.21	0, 3.9M	Horizontal, BiLog
120.1	28.46	40.00	-11.54	0, 3.9M	Horizontal, BiLog
120.34	28.52	40.00	-11.48	0, 3.9M	Horizontal, BiLog
120.82	28.50	40.00	-11.50	0, 3.9M	Horizontal, BiLog
179.08	30.08	40.00	-9.92	335, 3.7M	Horizontal, BiLog
180.07	30.05	40.00	-9.95	335, 3.7M	Horizontal, BiLog
182.26	28.67	40.00	-11.33	335, 3.7M	Horizontal, BiLog
182.77	29.09	40.00	-10.91	335, 3.7M	Horizontal, BiLog
53.21	27.93	40.00	-12.07	315, 2.2M	Vertical, BiLog
53.48	28.05	40.00	-11.95	315, 2.2M	Vertical, BiLog
97.46	26.39	40.00	-13.61	0, 1.5M	Vertical, BiLog
118.09	30.91	40.00	-9.09	340, 1.6M	Vertical, BiLog
118.87	30.48	40.00	-9.52	340, 1.6M	Vertical, BiLog
119.59	30.52	40.00	-9.48	340, 1.6M	Vertical, BiLog
120.58	29.99	40.00	-10.01	340, 1.6M	Vertical, BiLog
179.09	29.37	40.00	-10.63	80, 1.6M	Vertical, BiLog
179.57	29.54	40.00	-10.46	80, 1.6M	Vertical, BiLog

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Radiated Data for FCC Subpart C

The following table reports the results of the radiated measurements for the Access Sensor, Clearnet Reader per the requirements of Part 15 Subpart C 15.209. Measurements were taken using an EMCO Active Loop antenna, model 6502, calibration due November 1999. The test distance was 10 meters and the antenna height was 1 meter. The turntable was rotated to maximize the emissions.

Frequency MHz	EUT dBµV	Spec Limit	Margin dB	Azimuth
.1229	47.65	100.33	-52.68	0
.2461	68.31	91.49	-23.18	340
.3687	49.54	82.70	-33.16	25
.4916	46.25	53.99	-7.74	0
1.2291	34.23	47.31	-13.08	0

Test Method: C63.4-1992 Spec Limit: 15.209
Test Distance: **10 Meters**

Frequency MHz	EUT dBµV	Spec Limit	Margin dB	Azimuth
.1229	73.07	120.33	-47.26	335
.2458	72.10	111.52	-39.42	335
.3687	52.12	102.70	-50.58	0
.4900	51.18	74.00	-22.82	340
.6142	53.51	72.88	-19.37	335
1.1065	45.02	68.42	-23.40	0
1.229	46.19	67.31	-21.12	0
1.3519	45.40	66.20	-20.80	0
1.4744	42.06	65.09	-23.03	320
1.72	38.82	69.50	-30.68	335
1.8435	37.07	69.50	-32.43	0

Test Method: C63.4-1992 Spec Limit: 15.209
Test Distance: **3 Meters**

COMMENTS: System continuously running, power source 12 VDC. EUT dBµV is the emission measurement at a test distance of 10 meters. Spec limit is the specified limit from FCC

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Part 15 Subpart C section 15.209 as stated for the required measurement distance. A 40 dB/decade falloff extrapolation was calculated and algebraically added with the antenna factor and cable loss for the measured frequency to calculate the site CF. For frequencies from 9 kHz to 490 kHz the spec limit is stated at a test distance of 300 meters and the site CF is extrapolated to that distance. For frequencies from 490 kHz to 30 MHz the spec limit is stated at a test distance of 30 meters and the site CF is extrapolated to that distance.

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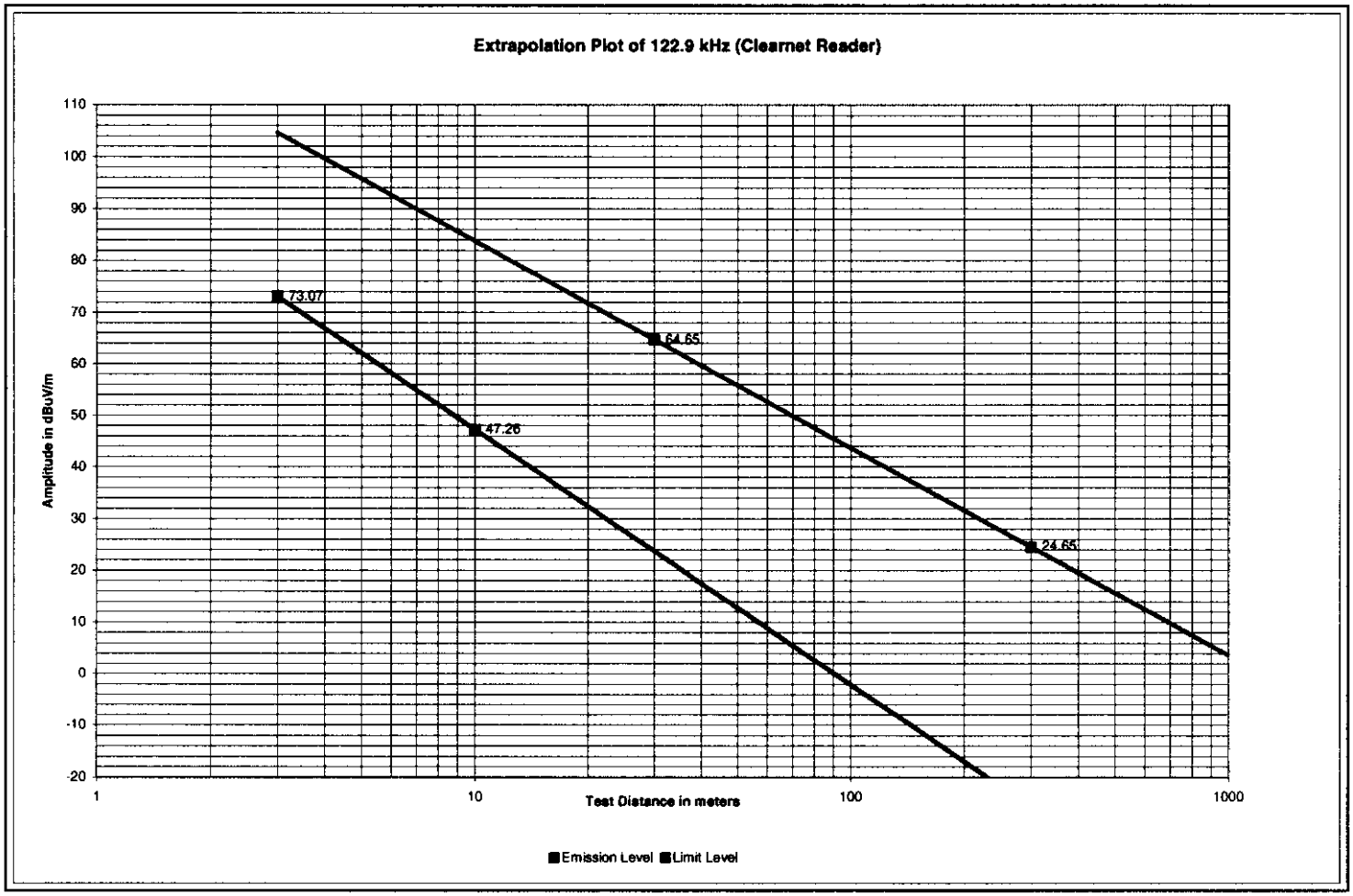
Extrapolation Plot for FCC Subpart C Data

Measurements were taken at the fundamental frequency of the intentional radiator with the EMCO 6502 loop antenna at test distances of 10 and 3 meters. The antenna was placed at a fixed height of 1 meter. Measurements were taken in **three orthogonal orientations to find the maximum emissions, vertical was observed to be worse case**. The turntable was rotated to maximize the emission. The first measurement was taken at 3 meters, then the antenna was moved to 10 meters and the emission was measured. These readings were then plotted to extrapolate the corrected reading at a test distance of 30 and 300 meters. The limit was then calculated using 40 dB/decade falloff rate to show the corrected limit at a test distance of 30 meters. These limits were then plotted on the graph to extrapolate the limit at 10 and 3 meters. Reference measurement standards Part 15 section 15.31(f)(2)



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COMPLIANCE VERIFICATION REPORT

Test Certificate

APPLICANT:	Isonas Incorporated 4810 Riverbend Road Boulder, CO 80301
Equipment Tested:	Access Sensor
Model:	Clearnet Reader

I HEREBY CERTIFY THAT:

The measurements shown in this report were made in accordance with the procedures indicated and that the energy emitted by this equipment was found to be within the **FCC Part 15 Subpart C and Class A limits.**

I FURTHER CERTIFY THAT:

On the basis of the measurements taken at the test site, that the equipment tested per the procedures of ANSI C63.4-1992 is capable of operation for **the compliance of the requirements set forth in FCC CFR 47 Part 15.207 and 15.209.**

On this Date: December 19, 1998

Mario E. Baraona Sr.
RD Systems Compliance

Printed Name

Signature
Isonas Incorporated Representative