L.S. Compliance, Inc.
W66 N220 Commerce Court
Cedarburg, WI 53012
262-375-4400

COMPLIANCE TESTING OF:

Contactless Guard Dog

PREPARED FOR:

Biocentric Solutions, Inc.
8417 Excelsior Drive
Madison, WI 53717

TEST REPORT NUMBER:

301378

DATES OF TESTING:

November 13th and 14th, 2001

Table of Contents

1. L. S. Compliance In Review

L. S. Compliance, Inc. is located in Cedarburg, Wisconsin – United States.

We may be contacted by:

Mail: L. S. Compliance, Inc.
W66 N220 Commerce Court
Cedarburg, Wisconsin 53012

Phone: 262-375-4400
Fax: 262-375-4248
E-mail: eng@lsr.com

As an EMC Testing Laboratory, our Accreditation and Assessments are recognized through the following:

A2LA – American Association for Laboratory Accreditation
Accreditation based on ISO/IEC 17025 : 1999
with Electrical (EMC) Scope of Accreditation
A2LA Certificate Number: **1255.01**

U. S. Conformity Assessment Body (CAB) Validation
Validated by the European Commission as a U. S. Conformity Assessment Body operating under the U. S. /EU, Mutual Recognition Agreement (MRA) operating under the European Union EMC Directive 89/336/EEC, Article 10.2.
Date of Validation: **January 16, 2001**

Federal Communications Commission (FCC) – USA
Listing of 3 Meter Semi-Anechoic Chamber based on 47CFR 2.948
FCC Registration Number: **90756**

Listing of 3 and 10 meter OATS based on 47CFR 2.948
FCC Registration Number: **90757**

Industry Canada
On-file, 3 Meter Semi-Anechoic Chamber based on 47CFR 2.948
File Number: **IC 3088**

On-file 3 and 10 Meter OATS based on RSS-210
File Number: **IC 3088-A**

2. A2LA Certificate of Accreditation

THE AMERICAN
ASSOCIATION
FOR LABORATORY
ACCREDITATION

ACCREDITED LABORATORY

A2LA has accredited

L.S. COMPLIANCE, INC.
Cedarburg, WI

for technical competence in the field of

Electrical (EMC) Testing

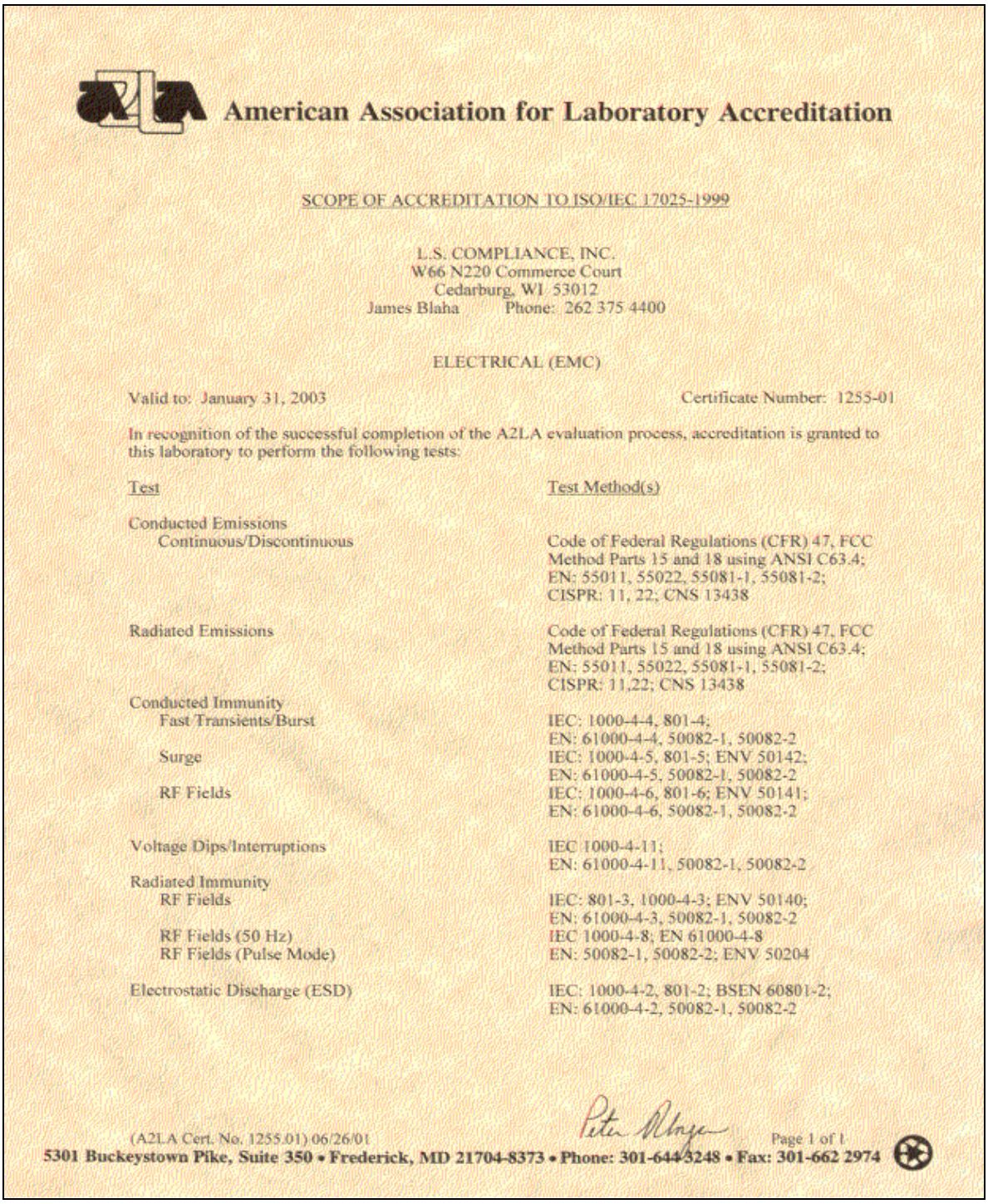
The accreditation covers the specific tests and types of tests listed on the agreed scope of accreditation. This laboratory meets the requirements of ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration Laboratories" and any additional program requirements in the identified field of testing. Testing and calibration laboratories that comply with this International Standard also operate in accordance with ISO 9001 or ISO 9002.

Presented this 26th day of June, 2001.

President
For the Accreditation Council
Certificate Number 1255.01
Valid to January 31, 2003

For tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical (EMC) Scope of Accreditation

3. A2LA Scope of Accreditation



American Association for Laboratory Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC 17025-1999

L.S. COMPLIANCE, INC.
W66 N220 Commerce Court
Cedarburg, WI 53012
James Blaha Phone: 262 375 4400

ELECTRICAL (EMC)

Valid to: January 31, 2003 Certificate Number: 1255-01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following tests:

Test	Test Method(s)
Conducted Emissions Continuous/Discontinuous	Code of Federal Regulations (CFR) 47, FCC Method Parts 15 and 18 using ANSI C63.4; EN: 55011, 55022, 55081-1, 55081-2; CISPR: 11, 22; CNS 13438
Radiated Emissions	Code of Federal Regulations (CFR) 47, FCC Method Parts 15 and 18 using ANSI C63.4; EN: 55011, 55022, 55081-1, 55081-2; CISPR: 11,22; CNS 13438
Conducted Immunity Fast Transients/Burst	IEC: 1000-4-4, 801-4; EN: 61000-4-4, 50082-1, 50082-2
Surge	IEC: 1000-4-5, 801-5; ENV 50142; EN: 61000-4-5, 50082-1, 50082-2
RF Fields	IEC: 1000-4-6, 801-6; ENV 50141; EN: 61000-4-6, 50082-1, 50082-2
Voltage Dips/Interruptions	IEC 1000-4-11; EN: 61000-4-11, 50082-1, 50082-2
Radiated Immunity RF Fields	IEC: 801-3, 1000-4-3; ENV 50140; EN: 61000-4-3, 50082-1, 50082-2
RF Fields (50 Hz)	IEC 1000-4-8; EN 61000-4-8
RF Fields (Pulse Mode)	EN: 50082-1, 50082-2; ENV 50204
Electrostatic Discharge (ESD)	IEC: 1000-4-2, 801-2; BSEN 60801-2; EN: 61000-4-2, 50082-1, 50082-2

(A2LA Cert. No. 1255.01) 06/26/01 Page 1 of 1

5301 Buckeystown Pike, Suite 350 • Frederick, MD 21704-8373 • Phone: 301-644-3248 • Fax: 301-662 2974

4. Validation Letter – U.S. Competent Body for EMC Directive 89/336/EEC

UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-

January 16, 2001

Mr. James J. Blaha
L.S. Compliance Inc.
W66 N220 Commerce Court
Cedarburg, WI 53012-2636

Dear Mr. Blaha:

I am pleased to inform you that the European Commission has validated your organization's nomination as a U.S. Conformity Assessment Body (CAB) for the following checked (✓) sectoral annex(es) of the U.S.-EU Mutual Recognition Agreement (MRA).

(✓) Electromagnetic Compatibility-Council Directive 89/336/EEC, Article 10(2)
( ) Telecommunication Equipment-Council Directive 98/13/EC, Annex III
( ) Telecommunication Equipment-Council Directive 98/13/EC, Annex III and IV
Identification Number:
( ) Telecommunication Equipment-Council Directive 98/13/EC, Annex V
Identification Number:

This validation is only for the location noted in the address block, unless otherwise indicated below.

(✓) Only the facility noted in the address block above has been approved.
( ) Additional EMC facilities:
( ) Additional R&TTE facilities:

Please note that an organization's validations for various sectors of the MRA are listed on our web site at http://ts.nist.gov/mra. You may now participate in the conformity assessment activities for the operational period of the MRA as described in the relevant sectoral annex or annexes of the U.S.-EU MRA document.

NIST will continue to work with you throughout the operational period. All CABs validated for the operational phase of the Agreement must sign and return the enclosed CAB declaration form, which states that each CAB is responsible for notifying NIST of any relevant changes such as accreditation status, liability insurance, and key staff involved with projects under the MRA. Please be sure that you fully understand the terms under which you are obligated to operate as a condition of designation as a CAB. As a designating authority, NIST is responsible for monitoring CAB performance to ensure continued competence under the terms of the MRA.

NIST

5. Signature Page

Prepared By:

Teresa A. White, Document Coordinator **Date**

Tested By:

Thomas T. Lee, EMC Engineer **Date**
NARTE Test Lab Engineer, ALT – 0064-E

Tested By and Approved By:

Kenneth L. Boston, EMC Lab Manager **Date**
PE#31926 Licensed Professional Engineer
Registered in the State of Wisconsin, United States

6. Product and General Information

Manufacturer:	Biocentric Solutions, Inc.
Model No.:	Contactless Guard Dog (CAG)
Serial No.:	Engineering Unit
Description:	Fingerprint Authentication
Frequency Range:	13.56 MHz
Environmental Conditions in the Test Lab:	Temperature: 20-25° Atmospheric Pressure: 30-60% Humidity: 86 kPa – 106 kPa

7. Introduction

On November 13th and 14th, 2001 a series of Radiated and Conducted Emission tests were performed on the EUT. These tests were performed using the procedures outlined in ANSI C63.4-2001 for intentional radiators, and in accordance with the limits set forth in FCC Part 15.225 (Industry Canada RSS-210) for a Low Power Transmitter. These tests were performed by Kenneth L. Boston, EMC Lab Manager and Thomas T. Lee, EMC Engineer/NARTE Test Lab Engineer of L.S. Compliance, Inc. and witnessed by Jim Baccus of Biocentric Solutions, Inc.

8. Purpose

All Radiated and Conducted Emission tests upon the EUT were performed to measure the emissions in the frequency bands described in title 47 CFR, FCC Part 15, including 15.35, 15.207, 15.209, 15.225 and Industry Canada RSS-210 to determine whether these emissions are below the limits expressed within the standards. These tests were performed in accordance with the procedure described in the American National Standard for methods of measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2001). Another document used as a reference for the EMI Receiver specification was the Comite International Special Des Perturbations Radioelelectriques (CISPR) Number 16-1, 1993.

9. Summary of Test Report

DECLARATION OF CONFORMITY

The Equipment Under Test (EUT) was found to **MEET** the requirements as described within the specification of Title 47 CFR, Part 15.225, and I.C. RSS-210, Section 6.2.2 (e) for a low power transmitter.

10. Product Description

The Guard Dog is a miniature, fingerprint authentication unit that compares stored fingerprint templates with fingerprint data acquired in real time. It is an intelligent device that can verify the identity of an individual by scanning his or her actual fingerprint and comparing the scanned print with fingerprint data stored on a personal I.D. Card. The I.D. Card is read by the 13.56 MHz link, and operates using the Phillips MIFARE Communication Standard (ISO 14443A).

11. Test Requirements

The transmitter in the Biocentric product is tested to the following requirements: 47 CFR, Part 15.225 for operation within the band 13.553 – 13.567 MHz.

12. Radiated Emissions Test

Test Setup

The test setup was assembled in accordance with Title 47, CFR Part 15 and ANSI C63.4-2001. The EUT was placed on an 80cm high non-conductive table centered on a flush mounted 2-meter diameter turntable inside the 3 Meter Semi-Anechoic, FCC listed Chamber located at L. S. Compliance, Inc., Cedarburg, Wisconsin. The EUT was operated in automatic mode, using an AC power wall transformer, as provided by the manufacturer. The applicable limits, as given, are meant to be measured at a 30-meter separation distance. The limits are extrapolated by a factor of 40 dB/decade for a pre-scan reading at 3m (of the low frequency emissions), taken in the Semi-Anechoic Chamber. The spurious radiation signals found above 30 MHz were scanned in the 3 Meter Chamber, and final readings were performed on the 10 meter OATS. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a list of the test equipment.

Test Procedure

Preliminary radiation measurements were performed on the EUT in the 3 Meter Semi-Anechoic, FCC listed Chamber, located at L. S. Compliance, Inc. in Cedarburg, Wisconsin. The frequency range from 2 MHz to 1000 MHz was pre-scanned, and levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on the non-conductive wooden table in the 3 Meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the test object. A Biconical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz. A Shielded Loop Antenna, at a fixed height of 1 meter, was used for the frequencies below 30 MHz. The maximum radiated emissions were found by raising and lowering the antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities.

The EUT was modified to operate in a continuous running mode during the test. For those frequencies that have significant emissions, measurements were repeated on an FCC listed, 10 meter Open Area Test Site (OATS). The signal level of the fundamental was also measured at 30 meters, while on the OATS. The EUT was scanned for emissions at those particular frequencies from 30 MHz to 1000 MHz to establish compliance in accordance with Part 15.35 and 15.109 (RSS-210). The Biconical, Log Periodic and Loop Antennas were used as the sensing antennas. The EUT was positioned on an 80 cm high wooden table in the center of a flush-mounted turntable. The EUT was rotated, and the antenna mast was scanned to obtain a maximum signal level. The main transmit carrier, as well as any spurious signals below 30 MHz, were measured with the Shielded Loop Antenna, at a fixed 1 meter height, and at a 30 meter separation distance.

Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. Included in this list is calibration information and equipment descriptions. All equipment is calibrated and used according to the operations manual supplied by the manufacturer. All calibrations of the antennas used were performed at an N.I.S.T. traceable site. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and a HP 8546A EMI Receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the HP 8546A EMI Receiver database. As a result, the data taken from the HP 8546A EMI Receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading. The HP 8546A EMI Receiver was operated with a bandwidth of 120 kHz for measurements from 30 MHz to 1 GHz, and 9 KHz bandwidth was used when measuring below 30 MHz. Both the Peak and Quasi-Peak Detector functions were utilized.

Test Results

The EUT was found to MEET the Radiated Emissions requirements of Title 47 CFR Part 15.225 and 15.209 for a low power radiator (Canada RSS-210). The frequencies with significant signals were recorded and plotted as shown in the Data Charts and Graphs.

Notes:

Calculation of Radiated Emissions Limits

The following table depicts the Spurious Emission limits for a low powered transmitter. These limits are obtained from Title 47 CFR, Part 15.209, for radiated emissions measurements.

Frequency (MHz)	3 m Limit µV/m	3 m Limit (dBµV/m)	10 m Limit (dBµV/m)
30-88	100	40.0	29.5
88-216	150	43.5	33.0
216-960	200	46.0	35.5
960-10,000	500	54.0	43.5

Sample conversion from field strength in µV/m to dBµV/m
$dB\mu V/m = 20 \log_{10} (100\mu V/m)$
= 40 dBµV/m (from 30-88 MHz)

For measurements made at 10 meters, a 10.5 dB correction has been invoked.

960 MHz to 10,000 MHz
500µV/m or 54.0 dB/µV/m at 3 meters
54.0 - 10.5 = 43.5 dB/µV/m at 10 meters

Also, under 47 CFR Part 15.209, for frequencies under 30 MHz, the following limit applies at 30 meters: [and corrected for 3 meters by 15.31 (f)(2)].

Frequency (MHz)	30 m Limit µV/m	30 m Limit (dBµV/m)	3 m Limit (dBµV/m)
1.705 – 30 MHz	30	29.5	69.5

Regarding the fundamental signal level, as per 15.225, the field strength shall not exceed 10,000 µV/m at 30 meters (80dBµV/m).

Summary of Results and Conclusions

Based on the procedures outlined in this report, and the test results included in Appendices A and B, it can be determined that the EUT does MEET the emission requirements of Title 47 CFR, FCC Part 15, Subpart C (Industry Canada RSS-210) for a low power transmitter.

The enclosed test results pertain to the samples of the test item listed, and only for the tests performed per the data sheets. Any subsequent modification or changes to the test items could invalidate the data contained herein, and could therefore invalidate the findings of this report.

Measurement of Electromagnetic Radiated Emissions
Upon a 3 Meter I. C. Listed Site

Frequency Range Inspected: 30 MHz - 10,000 MHz

Manufacturer: Biocentric Solutions, Inc.
Dates of Test: November 13th, and 14th, 2001
Model No.: Contactless Guard Dog (CAG)
Serial No.: Engineering Unit

Test Equipment Used: HP 8546A EMI Receiver; EMCO 6519 Shielded Loop Antenna; EMCO 3146A Log Periodic Antenna; EMCI 3110 Biconical Antenna
Specifications: 47 CFR Part 15.209; 15.225
Detector(s) Used: Quasi-Peak
Configuration: 0.8m height
Distance: 10 Meters, 30 meters

The following table depicts the level of significant emissions found:

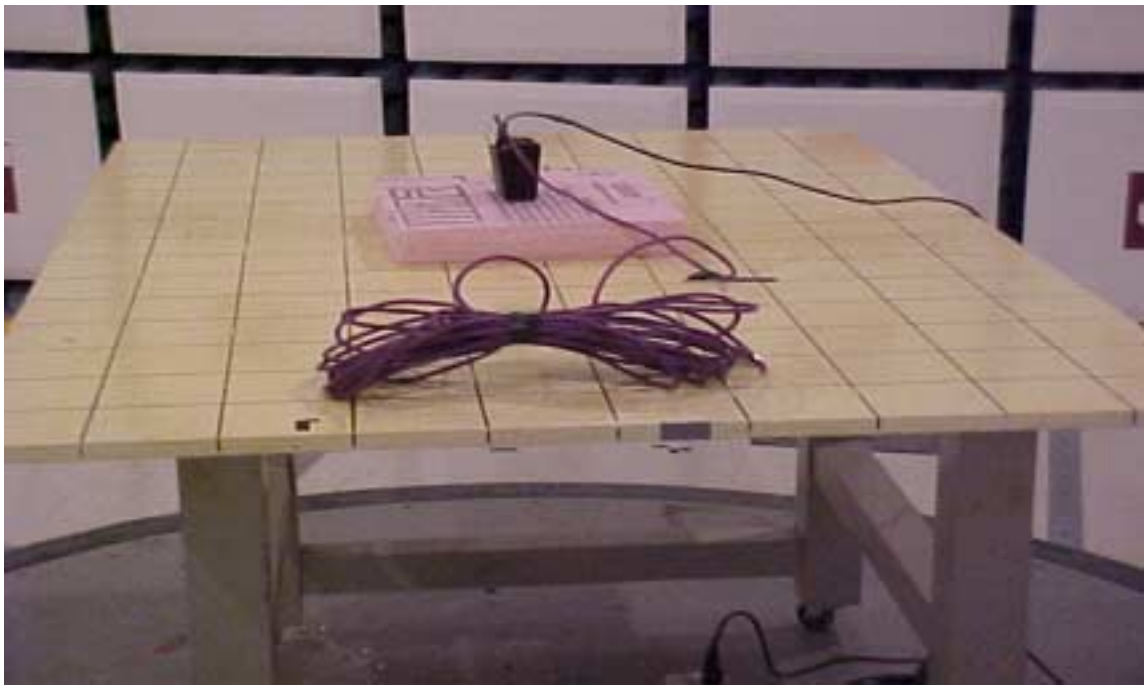
Frequency (MHz)	Antenna Polarity	Distance (Meters)	Height (Meters)	Azimuth (0° - 360°)	EMI Meter Reading (dBµV/m)	15.209 & 15.225 Limit (dBµV/m)	Margin
32.36	V	10	1.2	150	14.5	29.5	15.0
192.00	V	10	2.6	215	21.5	33.0	11.5
202.90	V	10	1.9	200	24.3	33.0	8.7
220.80	V	10	1.75	0	15.1	35.5	20.4
240.00	V	10	1.1	15	27.5	35.5	8.0
288.00	H	10	1.0	130	29.8	35.5	5.7
355.10	H	10	1.0	155	17.4	35.5	18.1
366.00	V	10	1.1	30	34.2	35.5	1.3
13.56	--	30	1.0	145	33.1 *	80.0	46.9

* Signal plus ambient, at 30 meters, maximum orientation.

Notes:
From the data taken at a 3 meter separation distance (see plot on Page 15), it can be seen that spurious signals below 30 MHz are greater than 20 dB below the fundamental signal level at 13.56 MHz. By correlation, these spurious signals are greater than 20 dB below the general 15.209 limit.

Photos Taken During Radiated Emission Testing

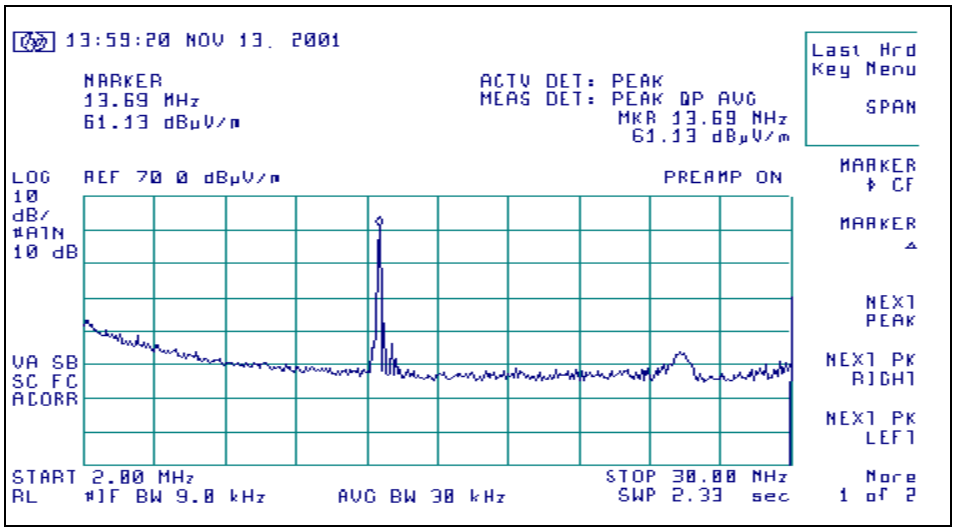
View of the Radiated Emission Testing in the 3 Meter Chamber



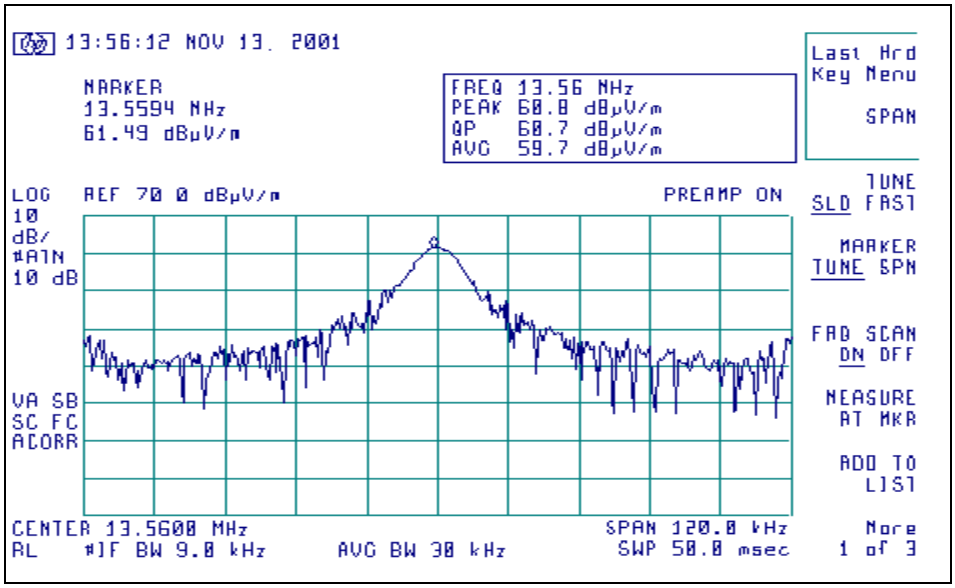
View of the EUT on the 10 Meter Site, during the Radiated Emission Testing.

Graphs made during Radiated Emission Testing

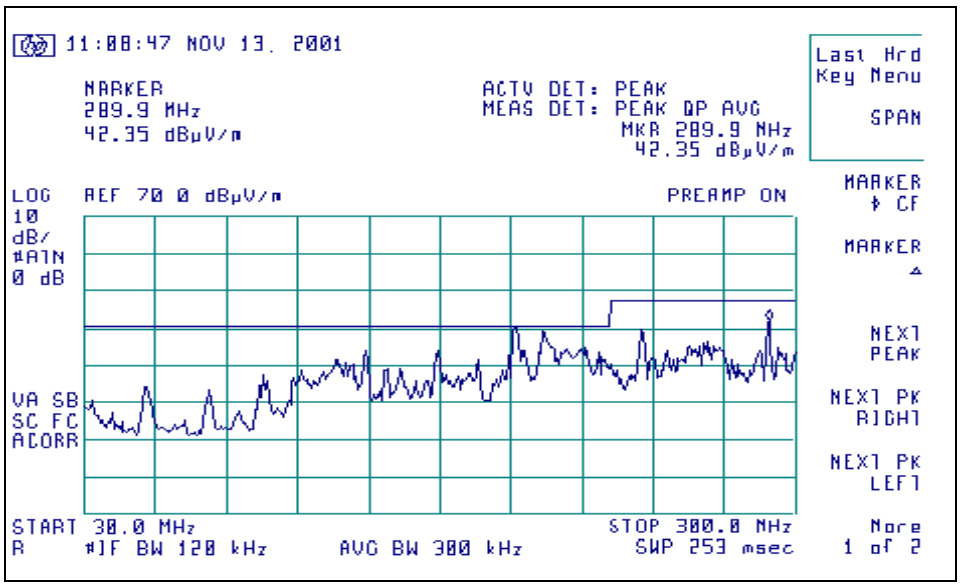
Signature Scan of Radiated Emissions
2 MHz – 30 MHz at 3 Meters



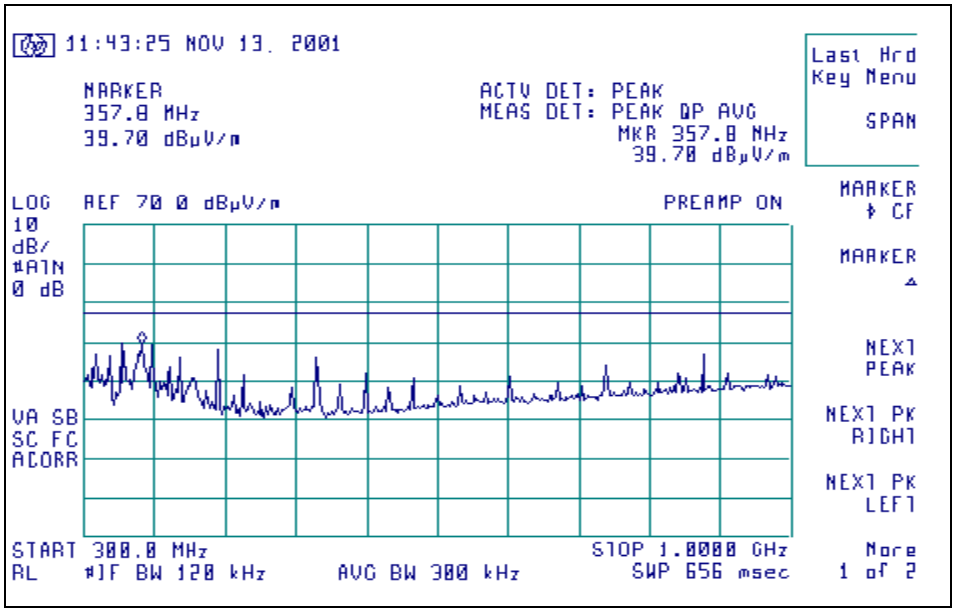
Signature Scan of Radiated Emissions
120 kHz (span closeup) at 3 Meters



Signature Scan of Radiated Emissions
Horizontal Polarity
30 MHz – 300 MHz at 3 Meters



Signature Scan of Radiated Emissions
Horizontal Polarity
300 MHz – 1000 MHz at 3 Meters



13. Conducted Emissions Test (AC Line)

Test Setup

The Conducted Emissions test was performed within the FCC listed Shielded Room, located at L.S. Compliance, Inc. in Cedarburg, Wisconsin. The test area and setup are in accordance with ANSI C63.4-2001 and with Title 47 CFR, FCC Part 15, Subpart B (Industry Canada RSS-210). The EUT was placed on a non-conductive wooden table, with a height of 80 cm above the reference ground plane. The EUT's power supply was plugged into a 50Ω (ohm), 50/250 µH Line Impedance Stabilization Network (LISN). The AC power supply of 120V was fed into the 3 Meter Semi-Anechoic Chamber via an appropriate broadband EMI Filter, and then to the LISN line input. Final readings were then taken and recorded. After the EUT was setup in the 3 Meter Semi-Anechoic Chamber and connected to the LISN, the RF Sampling Port of the LISN was cabled to a 10 dB Attenuator-Limiter, and then to the HP 8546A EMI Receiver. The EMCO LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral).

Test Procedure

The appropriate frequency range and bandwidths were entered into the EMI Receiver, and measurements were made. The bandwidth used for these measurements is 9 kHz, as specified in CISPR 16-1 (1993), Section 1, Table 1, for Quasi-Peak and Average detectors in the frequency range of 150 kHz to 30MHz. Final readings were then taken and recorded.

Test Equipment Utilized

A list of the test equipment and accessories utilized for the Conducted Emissions test is found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operations manual supplied by the manufacturer. Calibrations of the LISN and Limiter are traceable to N.I.S.T. All cables are calibrated and checked periodically for malfunction. The emissions are measured on the HP 8546A EMI Receiver, which has automatic correction for all factors stored in memory and allows direct readings to be taken.

Test Results

The EUT was found to MEET the Conducted Emission requirements of FCC Part 15.207, for an Intentional Radiator. See the Data Charts and Graphs for more details of the test results.

Notes:

Measurement of Electromagnetic Conducted Emission
In the Shielded Room

Frequency Range inspected: 450 KHz to 30 MHz

Manufacturer: Biocentric Solutions, Inc.
Dates of Test: November 13th and 14th, 2001
Model No.: Contactless Guard Dog
Serial No.: Engineering Unit

Test Equipment Used: HP 8546A EMI Receiver; EMCO 3816nm L.I.S.N.
Specifications: 47 CFR Part 15.207

Detector(s) Used: Quasi-Peak

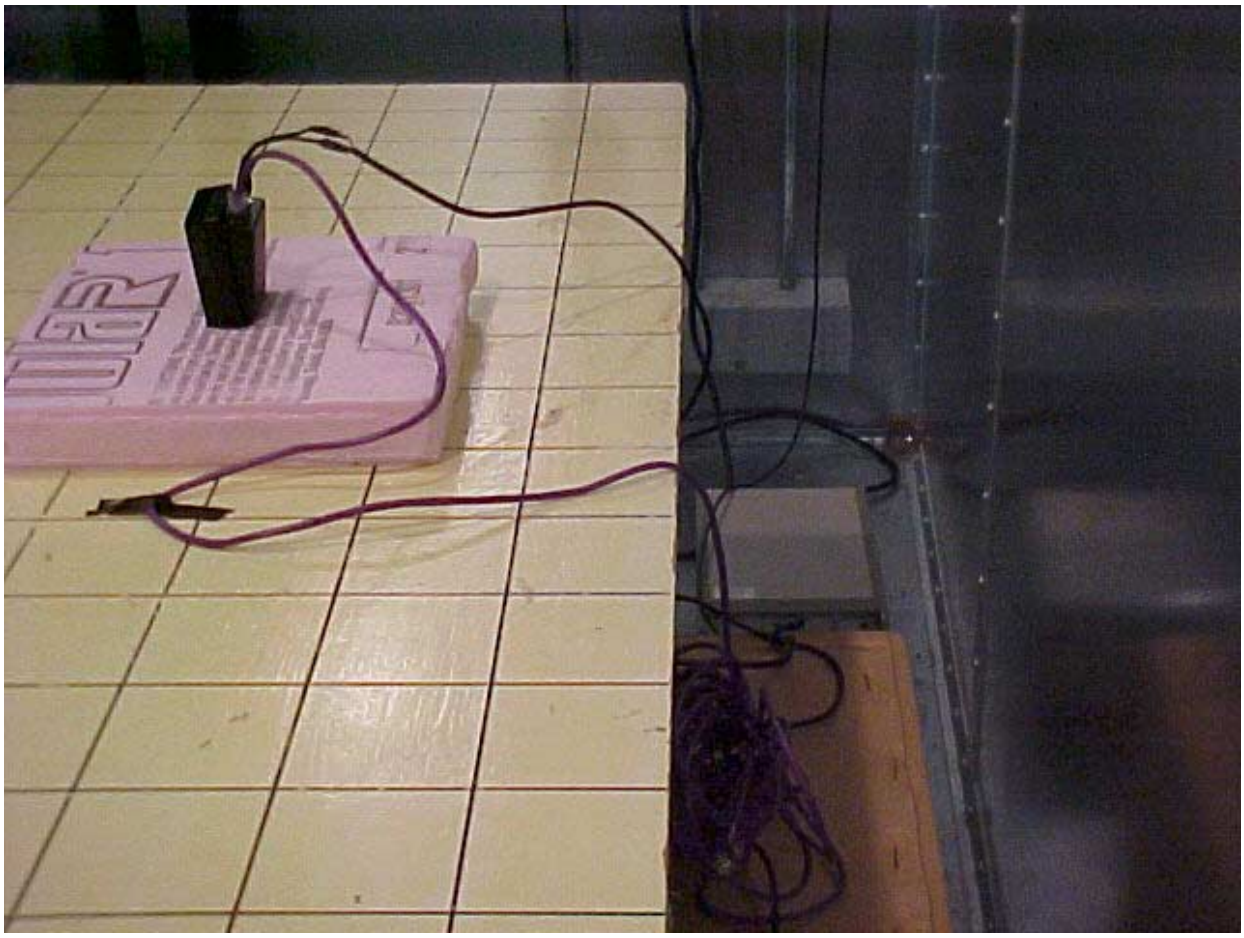
Configuration: 0.8m height above Ground Plane

Distance: N/A

Frequency (MHz)	Line	EMI Reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)
13.56	L1	43.7	48.0	4.3
13.56	L2	44.5	48.0	3.5

Photos Taken During Conducted Emission Testing

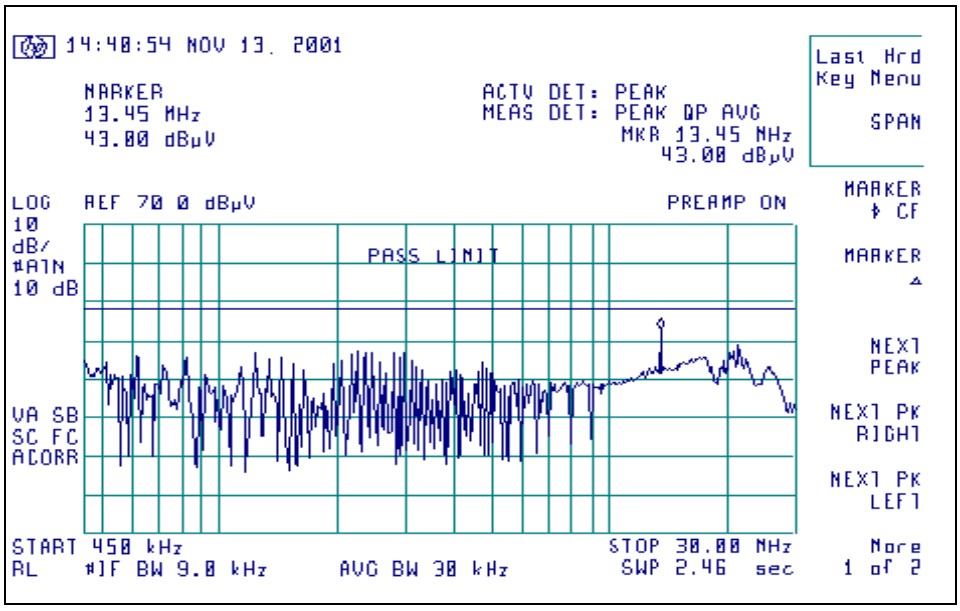
Test Setup for Conducted Emission Testing



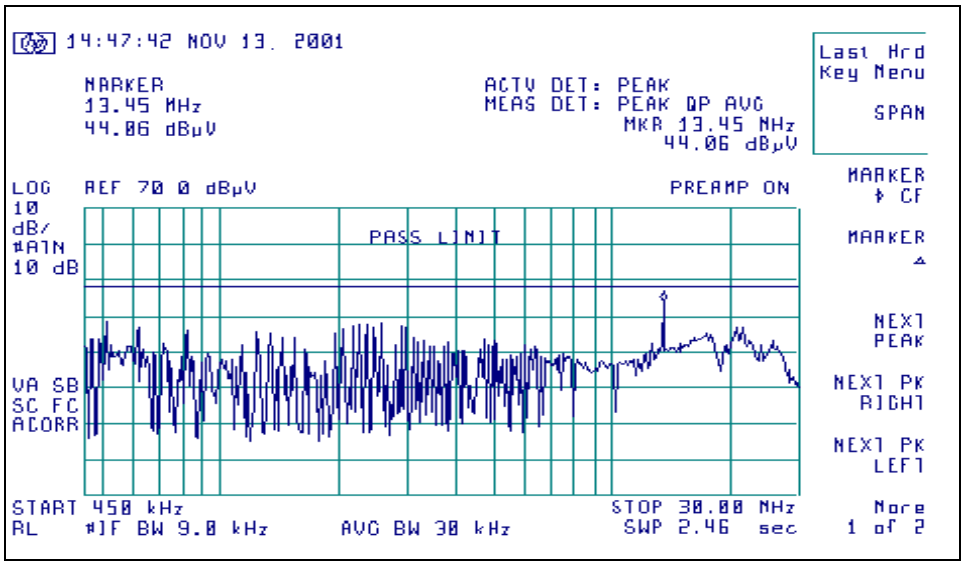
View of the EUT during the Conducted Emissions Test.

Graphs made during Conducted Emission Testing

Signature Scan of Conducted Emissions
Line 1



Signature Scan of Conducted Emissions
Line 2



14. Carrier Frequency Tolerance (15.225c)

During the tests of the Frequency error, the Guard Dog was tested at normal test conditions and also at extreme test conditions. To this purpose the Guard Dog was placed inside a Thermotron S-8C environmental chamber. AC power was fed in via a power cable, and the RF output was routed outside the chamber, and connected through a 10 dB pad to the HP E4407 Analyzer. The Guard Dog was powered on in continuous unmodulated transmit, and the signal was monitored during the test, whereby the temperature was varied from –20 degrees to 50 degrees Centigrade. At each 10 degree temperature plateau, the device was allowed to reach thermal equilibrium before the frequency was measured. The frequencies of the transmitter were also monitored while varying the AC line voltage to the Guard Dog AC wall transformer, over an 85% to 115% range. Results can be seen below. The test sample was found to meet the limits given in 47 CFR, Part 15.225, which is .01%, or 1356 Hz.

Temperature	Center Frequency	Design Frequency	Delta
-20° C	13.559970	13.560 MHz	-30Hz
-10° C	13.559980	13.560 MHz	-20 Hz
0° C	13.560000	13.560 MHz	0
10° C	13.55997	13.560 MHz	-30 Hz
20° C	13.55996	13.560 MHz	-40 Hz
30° C	13.55995	13.560 MHz	-50 Hz
40° C	13.55994	13.560 MHz	-60 Hz
50° C	13.55994	13.560 MHz	-60 Hz

AC	Center Frequency	Design Frequency	Delta
85 %	13.55997	13.560 MHz	-30 Hz
100 %	13.55996	13.560 MHz	-40 Hz
115 %	13.55996	13.560 MHz	-40 Hz

Note: Worst case variation seen is –60 Hz, which is less than the allowed frequency tolerance of ± 1356 Hz.

Appendix A

Test Equipment List

Asset #	Manufacturer	Model #	Serial #	Description	Calibration Information	
					Date	Due Date
AA960004	EMCO	93146	9512-4276	Log-Periodic Antenna	02-28-01	02-28-02
AA960005	EMCO	3110B	9601-2280	Biconical Antenna	09-24-01	09-24-02
AA960007	EMCO	3115	99111-4198	Double Ridge Horn Antenna	09-23-01	09-23-02
EE960004	EMCO	2090	9607-1164	Mast/Ttable Controller	N/A	N/A
EE960013	HP	8546A	3617A00320	Receiver RF Section	10-31-01	10-31-02
EE960014	HP	85460A	3448A00296	Receiver Pre-Selector	10-31-01	10-31-02
CC000221	HP	E4407b	Us39160256	26.5 GHz Spectrum Analyzer	11-08-00	11-08-01
N/A	LSC	Cable	0011	3 meter ½" Heliax Cable	12-07-00	12-07-01
N/A	LSC	Cable	0038	1 meter RG 214 Cable	12-07-00	12-07-01
N/A	LSC	Cable	0050	10 meter RG 214 Cable	12-07-00	12-07-01
N/A	LSC	Attenuator		10 db Attenuator		N/A

Note 1* - Equipment calibrated within a traceable system.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uc Value in Appropriate Units
Radiated Emissions	3 Meter Chamber, Biconical Antenna	4.24 dB
Radiated Emissions	3 Meter Chamber, Log Periodic Antenna	4.80 dB
Radiated Emissions	10 Meter OATS, Biconical Antenna	4.18 dB
Radiated Emissions	10 Meter OATS, Log Periodic Antenna	3.92 dB
Conducted Emissions	Shielded Room/EMCO LISN	1.60 dB
Radiated Immunity	3 Meter Chamber, 3 Volts/Meter	1.128 Volts/Meter
Conducted Immunity	3 Volt level	1.0 V