TEST REPORT FROM:

COMMUNICATION CERTIFICATION LABORATORY
1940 W. Alexander Street
Salt Lake City, Utah
84119-2039

Type of Report: Certification

TEST OF: 100392

FCC ID: QCL200226

To FCC PART 15, Subpart C
Section 15.209

Test Report Serial No: 73-7734

Applicant:

Donnelly Electronics
10410 North Holly Road
Holly, MI 48442

Date of Test: December 11, 2000

Issue Date: March 26, 2002

CERTIFICATION OF ENGINEERING REPORT

This report has been prepared by Communication Certification Laboratory to determine compliance of the device described below with the Certification requirements of FCC Part 15, Subpart C Section 15.209. This report may be reproduced in full, partial reproduction may only be made with the written consent of the laboratory. The results in this report apply only to the sample tested.

- Applicant: Donnelly Electronics
- Manufacturer: Donnelly Electronics
- Trade Name: Sentricon System
- Model Number: 100392
- FCC ID: QCL200226

On this 26th day of March 2002, I, individually, and for Communication Certification Laboratory, certify that the statements made in this engineering report are true, complete, and correct to the best of my knowledge, and are made in good faith.

Although NVLAP has recognized that the Communication Certification Laboratory EMC testing facilities are in good standing, NVLAP does not endorse the product described in this report.

COMMUNICATION CERTIFICATION LABORATORY

Roger J. Midgley
Tested by: Roger J. Midgley
EMC Engineering Manager

____
Report by: Kirk P. Thomas
Project Engineer

TABLE OF CONTENTS

SECTION 1.0 CLIENT INFORMATION

1.1 Client Information:

Company Name: Donnelly Electronics
10410 North Holly Road
Holly, MI 48442

Contact Name: Don Drost
Title: Product Engineer

SECTION 2.0 EQUIPMENT UNDER TEST (EUT)

2.1 Identification of EUT:

Trade Name:	Sentricon System
Model Name or Number:	100392
Serial Number:	None
Country of Manufacture:	U.S.A.

2.2 Description of EUT:

The Sentricon System consists of a transponder, sensor, interrogator, and a Hand Held Dolphin. The following sentences will give a brief description of each of these units. The system is used to detect termites.

The sensor is an electronic device that is sandwiched between the wooden monitoring devices of the Sentricon unit. The sensor is a passive device that can be consumed by termites. When this event occurs, the electronic state of the sensor is altered. This change of state of the sensor is the event that indicates the presence of termites within the Sentricon unit.

The Transponder is a device that contains all the electronics necessary to derive its power from the interrogator, detect the state of the sensor, and provide a unique identification code to allow PROLINX software to determine specific information about the Sentricon station.

The Interrogator housing contains visual displays and an audio alarm to give the user feedback regarding the status of the interrogator as well as the status of a Sentricon transponder. The 4 LED’s are as follows a green LED on the left of the display window indicates POWER; Sensor status displays are placed in the center of the display. The two LED's are labeled ACTIVE and INACTIVE. The ACTIVE LED is colored red when termites are present and the INACTIVE LED is colored green when no termites are present. On the right side of the display is the CHARGE LED, which is colored yellow when plugged into a wall outlet. The Dolphin cradle on top of the black box is for IR data communication between the Dolphin and the Interrogator.

The Dolphin 7200 receives data from the Interrogator stores the data and confirms the data is correct and sends an ok signal back to the interrogator, to notify the operator of the status of the transponder.

This report covers the 125 KHz transmitter used on the Transponder and on the Interrogator. The Dolphin Hand Held unit was previously certified under FCC ID HD5RFDOLPHIN-1, and the receiver and digital circuitry is covered under a separate Declaration of Conformity report.

SPECIFICATIONS

TRANSPONDER

POWER	PASSIVE
CARRIER FREQUENCY	125KHZ
MODULATION	BACKSCATTER FSK ENCODED
SENSOR INPUT	
'0'	0 – 35KOHM
'1'	450KOHM – 5 MEGOHM
DATA STREAM	10 ASCII CHARACTERS

INTERROGATOR

POWER	14.4VDC NiMH BATTERY
SENSOR CARRIER FREQUENCY	125KHZ
HARD WIRE LINK	RS-232 TO DOLPHIN CRADLE
RF Link Frequency	916.5 MHz

2.3 Modification Incorporated/Special Accessories on EUT:

There were no modifications or special accessories required to comply with the specification.

SECTION 3.0 TEST SPECIFICATION, METHODS & PROCEDURES

3.1 Test Specification:

Title: FCC PART 15, Subpart C (47 CFR 15).
Section 15.209

Radiation emissions limits, general requirements. Within the bands 9 kHz – above 960 MHz.

Purpose of Test: The tests were performed to demonstrate Initial compliance.

3.2 Methods & Procedures:

3.2.1 § 15.209

(a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F (kHz)	300
0.490 - 1.705	24000/F (kHz)	30
1.705 - 30	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** Except as provide in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54–72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of the Part, e.g., Sections 15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band edges.

(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other Sections within this Part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these bands are based on measurements employing an average detector.

(e) The provisions in Sections 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this Part.

(f) In accordance with Section 15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in Section 15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in Section 15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in Section 15.109 that are applicable to the incorporated digital device.

(g) Perimeter protection systems may operate in the 54-72 MHz and 76-88 MHz bands under the provisions of this section. The use of such perimeter protection systems is limited to industrial, business and commercial applications.

3.2.3 § 15.207 Conducted Limits

(a) For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 450 kHz to 30 MHz shall not exceed 250 microvolts. Compliance with the provision shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminals.

3.3 Test Procedure

The line conducted and radiated emissions testing was performed according to the procedures in ANSI C63.4 (2000). Line conducted and radiated emissions testing was performed at CCL's anechoic chamber located at 1940 W. Alexander Street in Salt Lake City, Utah. This site has been fully described in a report submitted to the FCC, and was accepted in a letter dated March 11, 2002 (90502).

CCL participates in the National Voluntary Laboratory Accreditation Program (NVLAP) and has been accepted under NVLAP Lab Code:100272-0, which is effective until September 30,2002.

For radiated emissions testing below 30 MHz that is performed at distances closer than the specified distance, an inverse proportionality factor of 40 dB per decade is used to normalize the measured data for determining compliance.

For radiated emissions testing above 30 MHz that is performed at distances closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance.

SECTION 4.0 OPERATION OF EUT DURING TESTING

4.1 Operating Environment:

Power Supply: 14.4 VDC
AC Mains Frequency: N/A
Current Rating: N/A

4.2 Operating Modes:

Each mode of operation was exercised to produce worst-case emissions. The worst-case emissions were with the 100392 powered up and transmitting at 125 kHz.

The 100392 operates on 14.4 VDC supplied via a NiMH battery that can be recharged via an AC battery charger; therefore, conducted emissions testing was performed on the AC battery charger while charging the battery.

4.3 EUT Exercise Software:

The 100392 used internal firmware to produce the worst-case emissions.

SECTION 5.0 SUMMARY OF TEST RESULTS

5.1 FCC PART 15, Subpart C Sections 15.209 and 15.249

5.1.1 Summary of Tests:

Section	Test Performed	Frequency Range (MHz)	Result
15.209 (a)	Radiated Emissions – Transmitting at 125 kHz	0.009 to 30	Complied
15.207	Line Conducted Emissions (Hot Lead to Ground)	0.45 to 30	Complied
15.207	Line Conducted Emissions (Neutral Lead to Ground)	0.45 to 30	Complied

5.2 Result

In the configuration tested, the EUT complied with the requirements of the specification.

SECTION 6.0 MEASUREMENTS, EXAMINATIONS AND DERIVED RESUTLS

6.1 General Comments:

This section contains the test results only. Details of the test methods used and a list of the test equipment used during the measurements can be found in Appendix 1 of this report.

Both the transponder and the interrogator were tested. The worst case emissions were recorded from the interrogator; therefore, this data is used below to show compliance.

6.2 Test Results (Sentircon System):

6.2.1 Radiated Interference Level Data 15.209 - (Transmitting at 125 kHz)

Frequency kHz	Detector	Receiver Reading dBμV	Correction Factor dB	Field Strength dBμV/m	Limit dBμV/m @3 Meters
125.0	Quasi-Peak	73.3	9.7	83.0	105.6
250.0	Peak	45.9	9.6	55.5	99.6
375.0	Peak	56.2	9.5	65.7	96.1
500.0 *	Peak	34.0	9.8	43.8	73.6
625.0	Peak	50.0	9.7	59.7	71.6
750.0	Peak	30.2	9.7	39.9	70.1
875.0	Peak	47.7	9.9	57.6	68.7
1000.0	Peak	33.6	10.2	43.8	67.6
1125.0	Peak	49.7	10.5	60.2	66.6
1250.0	Peak	26.6	10.5	37.1	65.6
2128.0	Peak	34.8	10.5	45.3	69.5
2384.0	Peak	34.9	10.5	45.4	69.5

Note 1: * Emissions within restricted bands of § 15.205

Note 2: ** No emission detected from 3 MHz to 30 MHz

Note 3: The measurements were performed at a distance of 3 meters, the limits were linearly extrapolated from the specified 300 meter or 30 meter distance to the measured distance of 3 meters using 40 dB/decade as per §15.31(f)(2)

6.2.4 Conducted Disturbance at Mains Ports Data (Hot Lead)

Frequency (MHz)	Detector	Measured Level (dBμV)	Limit (dBμV)	Margin (dB)
0.51	Peak (Note 1)	39.0	48.0	-9.0
0.70	Peak (Note 1)	34.0	48.0	-14.0
0.87	Peak (Note 1)	36.8	48.0	-11.2
1.06	Peak (Note 1)	37.3	48.0	-10.7
1.22	Peak (Note 1)	34.3	48.0	-13.7
1.76	Peak (Note 1)	35.2	48.0	-12.8
2.46	Peak (Note 1)	31.6	48.0	-16.4
2.63	Peak (Note 1)	29.9	48.0	-18.1
18.27	Peak (Note 1)	23.0	48.0	-25.0
25.47	Peak (Note 1)	24.3	48.0	-23.7

Note 1: The reference detector used for the measurements was peak and the data was compared to the quasi-peak limit.

Note 2: The reference detector used for the measurements ware quasi-peak and average. The level of the emission measured using the quasi-peak detector was 6 dB, or more, higher than the level of the same emission measured with average detection; therefore, the quasi-peak level was reduced by 13 dB for comparison to the limits, as per FCC § 15.107 (d).

Measurement Uncertainty

The measurement uncertainty (with a 95% confidence level) for this test was: ± 3.3 dB.

RESULT

The EUT complied with the specification limit by a margin of 9.0 dB.

6.2.5 Conducted Disturbance at Mains Ports Data (Neutral Lead)

Frequency (MHz)	Detector	Measured Level (dBμV)	Limit (dBμV)	Margin (dB)
0.54	Peak (Note 1)	40.2	48.0	-7.8
0.89	Peak (Note 1)	36.1	48.0	-11.9
1.06	Peak (Note 1)	38.2	48.0	-9.8
1.24	Peak (Note 1)	36.6	48.0	-11.4
1.76	Peak (Note 1)	36.3	48.0	-11.7
2.46	Peak (Note 1)	30.7	48.0	-17.3
2.63	Peak (Note 1)	30.6	48.0	-17.4
3.16	Peak (Note 1)	28.0	48.0	-20.0
22.71	Peak (Note 1)	24.6	48.0	-23.4
23.70	Peak (Note 1)	24.2	48.0	-23.8

Note 1: The reference detector used for the measurements was peak and the data was compared to the quasi-peak limit.

Note 2: The reference detector used for the measurements ware quasi-peak and average. The level of the emission measured using the quasi-peak detector was 6 dB, or more, higher than the level of the same emission measured with average detection; therefore, the quasi-peak level was reduced by 13 dB for comparison to the limits, as per FCC § 15.107 (d).

Measurement Uncertainty

The measurement uncertainty (with a 95% confidence level) for this test was: ± 3.3 dB.

RESULT

The EUT complied with the specification limit by a margin of 7.8 dB.

6.3 Sample Field Strength Calculation:

The field strength is calculated by adding the Correction Factor (Antenna Factor + Cable Factor), to the measured level from the receiver. The receiver amplitude reading is compensated for any amplifier gain. The basic equation with a sample calculation is shown below:

FS = RA + CF Where

FS = Field Strength
RA = Receiver Amplitude Reading (Receiver Reading - Amplifier Gain)
CF = Correction Factor (Antenna Factor + Cable Factor)

Assume a receiver reading of 42.5 dBμV is obtained from the receiver, an amplifier gain of 26.5 dB and a correction factor of 8.5 dB. The field strength is calculated by subtracting the amplifier gain and adding the correction factor, giving a field strength of 24.5 dBμV/m, FS = (42.5 - 26.5) + 8.5 = 24.5 dBμV/m

APPENDIX 1 TEST PROCEDURES AND TEST EQUIPMENT

Radiated Interference Emissions:

The radiated emission from the intentional radiator was measured using a spectrum analyzer with a quasi-peak adapter for peak and quasi-peak readings. A preamplifier with a fixed gain of 26 dB and a power amplifier with a fixed gain of 22 dB were used to increase the sensitivity of the measuring instrumentation. The quasi-peak adapter uses a bandwidth of 100 Hz, with the spectrum analyzer's resolution bandwidth set at 3 kHz, for readings in the 9 kHz to 30 MHz frequencies range. The quasi-peak adapter uses a bandwidth of 120 kHz; with the spectrum analyzer's resolution bandwidth set at 1 MHz, for readings in the 30 to 1000 MHz frequencies range. For peak emissions above 1000 MHz the spectrum analyzer’s resolution bandwidth was set to 1 MHz and the video bandwidth was set to 3 MHz. For average emissions 0above 1000 MHz the spectrum analyzer’s resolution bandwidth was set to 1 MHz and the video bandwidth was set to 1 Hz.

A Loop antenna was used to measure the frequency range of 9 kHz to 30 MHz; the loop antenna was moved about its vertical and horizontal axes in order to measure the highest emissions. A biconilog antenna was used to measure the frequency range of 30 to 1000 MHz and a Double Ridge Guide Horn antenna was used to measure the frequency range 1 GHz to 10 GHz, at a distance of 3 meters from the EUT. The readings obtained by these antennas are correlated to the levels obtained with a tuned dipole antenna by adding antenna factors.

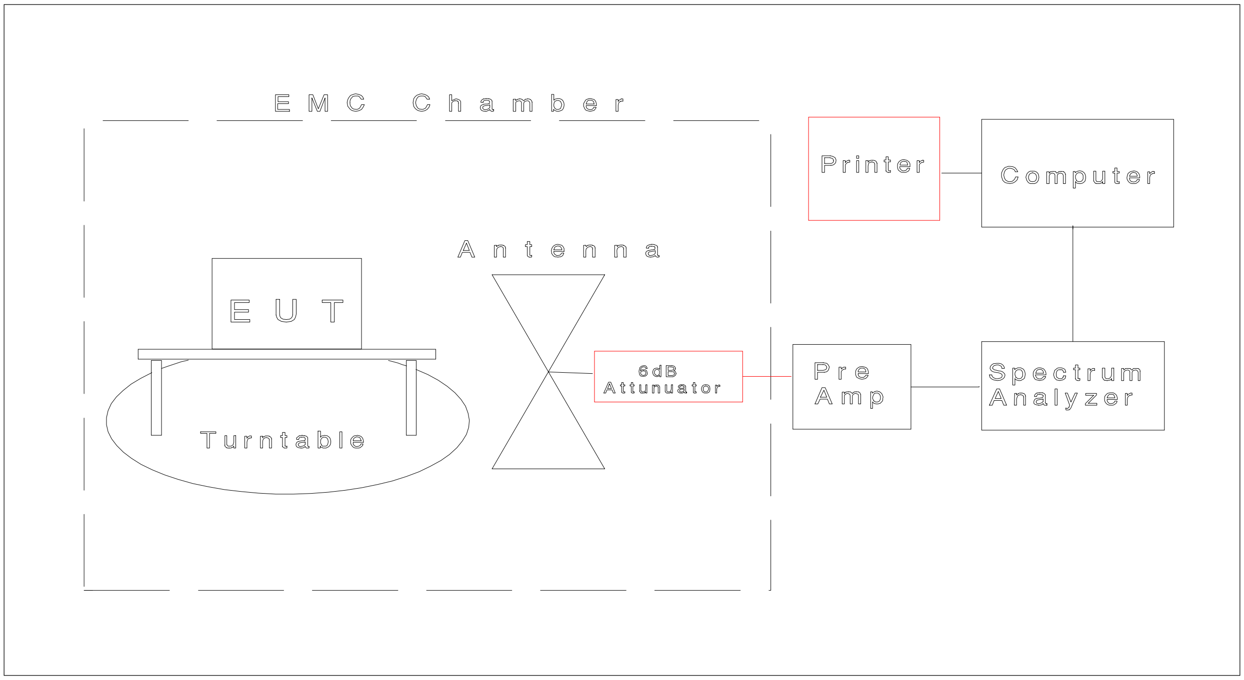
The configuration of the intentional radiator was varied to find the maximum radiated emission. The EUT was connected to the peripherals listed in Section 2.4 via the interconnecting cables listed in Section 2.5. A technician to obtain worst-case radiated emissions manipulated these interconnecting cables manually. The intentional radiator was rotated 360 degrees, and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission. Where there was multiple interface ports all of the same type, cables are either placed on all of the ports or cables added to these ports until the emissions do not increase by more than 2 dB.

Desktop intentional radiators are measured on a non-conducting table one meter above the ground plane. The table is placed on a turntable, which is level with the ground plane. The turntable has slip rings, which supply AC power to the intentional radiator. For equipment normally placed on floors, the equipment shall be placed directly on the turntable.

Type of Equipment	Manufacturer	Model Number	Serial Number
Anechoic Chamber Test Site #2	CCL	N/A	N/A
Test Software	CCL	Radiated Emissions	Revision 1.3
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711
Quasi-Peak Detector	Hewlett Packard	8565A	3107A01582
Loop Antenna	EMCO	6502	2011
Biconilog Antenna	EMCO	3141	1045
Double Ridged Guide Antenna	EMCO	3115	9409-4355
3 Meter Radiated Emissions Cable Anechoic Chamber	CCL	Cable B	N/A
Pre-Amplifier	Hewlett Packard	8447D	1937A03151
Power-Amplifier	Hewlett Packard	8447E	2434A01975
6 dB Attenuator	Hewlett Packard	8491A	32835

An independent calibration laboratory or CCL personal calibrates all the equipment listed above every 12 months following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

Radiated Emissions Test



Conducted Disturbance at Mains Ports:

The conducted disturbance at mains ports from the intentional radiator was measured using a spectrum analyzer with a quasi-peak adapter for peak, quasi-peak and average readings. The quasi-peak adapter uses a bandwidth of 9 kHz, with the spectrum analyzer's resolution bandwidth set at 100 kHz, for readings in the 450 kHz to 30 MHz frequency ranges.

The conducted disturbance at mains ports measurements are performed in a screen room using a (50 Ω/50 μH) Line Impedance Stabilization Network (LISN).

Where mains flexible power cords are longer than 1 m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4 m in length.

Where the EUT is a collection of intentional radiators with each intentional radiator having its own power cord, the point of connection for the LISN is determined from the following rules:

a) Each power cord, which is terminated in a mains supply plug, shall be tested separately.

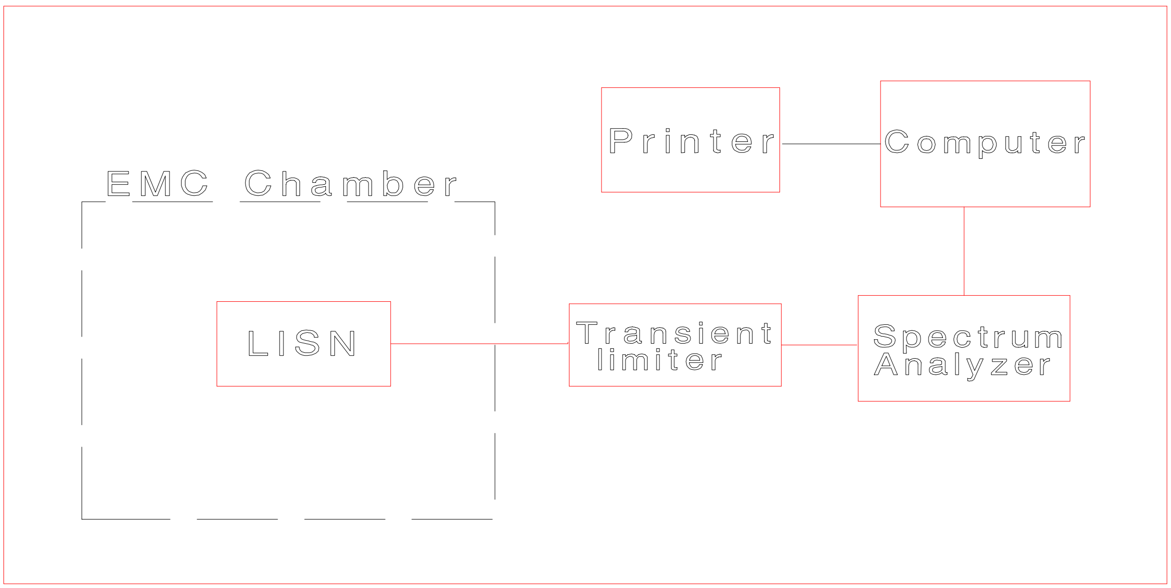
b) Power cords, which are not specified by the manufacturer to be connected via a host unit, shall be tested separately.
c) Power cords which are specified by the manufacturer to be connected via a host unit or other power supplying equipment shall be connected to that host unit and the power cords of that host unit connected to the LISN and tested.
d) Where a special connection is specified, the necessary hardware to effect the connection is supplied by the manufacturer for the testing purpose.
e) When testing equipment with multiple mains cords, those cords not under test are connected to an artificial mains network (AMN) different than the AMN used for the mains cord under test.

Desktop intentional radiators are placed on a non-conducting table at least 0.8 meters from the metallic floor. The equipment is placed a minimum of 40 cm from all walls. Floor standing equipment is placed directly on the earth grounded floor.

Type of Equipment	Manufacturer	Model Number	Serial Number
Anechoic Chamber Test Site #2	CCL	N/A	N/A
Test Software	CCL	Conducted Emissions	Revision 1.2
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711
Quasi-Peak Detector	Hewlett Packard	8565A	3107A01582
LISN	EMCO	3825/2	9307-1893
Conductance Cable Anechoic Chamber	CCL	Cable A	N/A
Transient Limiter	Hewlett Packard	11947A	3107A00895

An independent calibration laboratory or CCL personal calibrates all the equipment listed above every 12 months following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

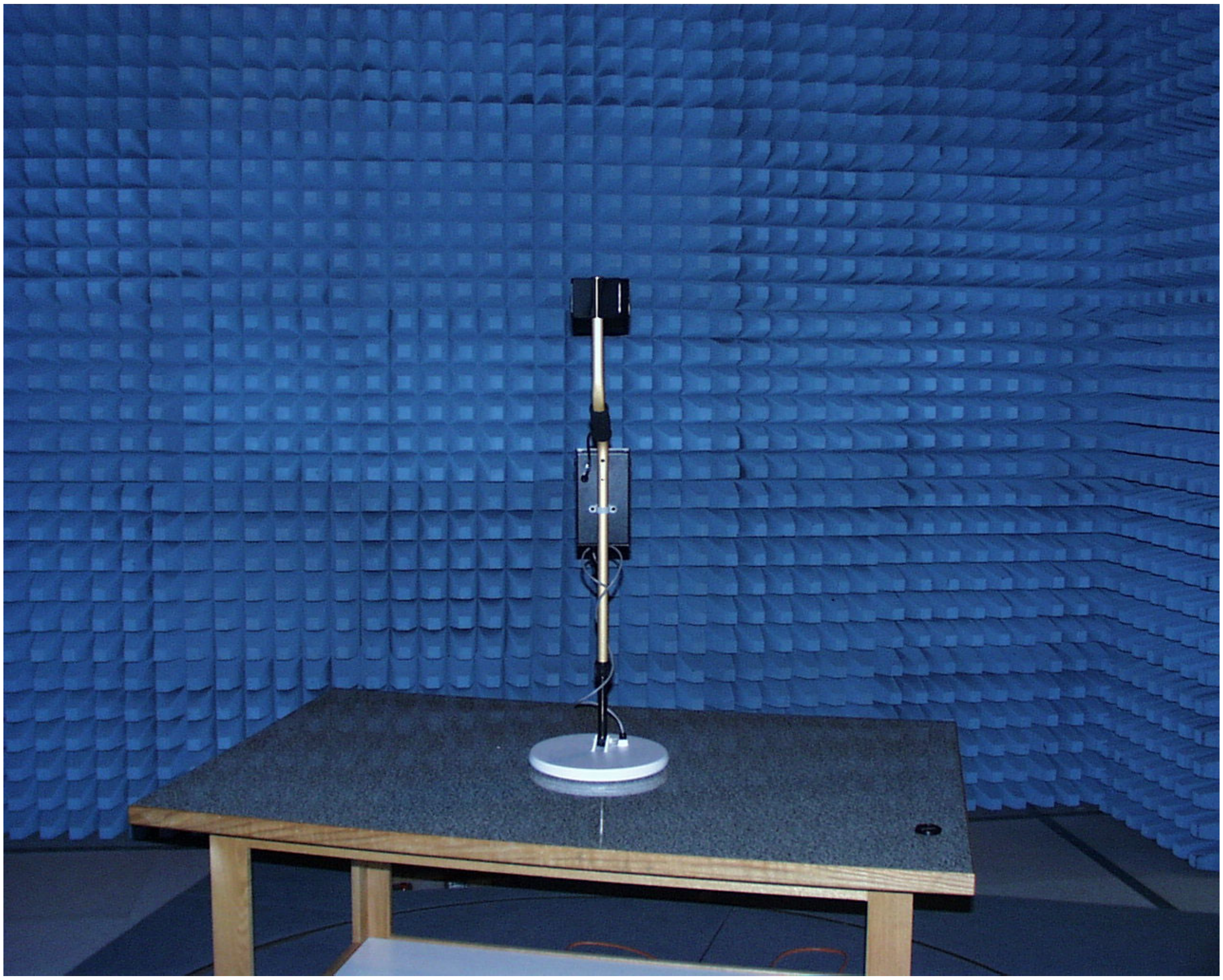
Line Conducted Emissions Test



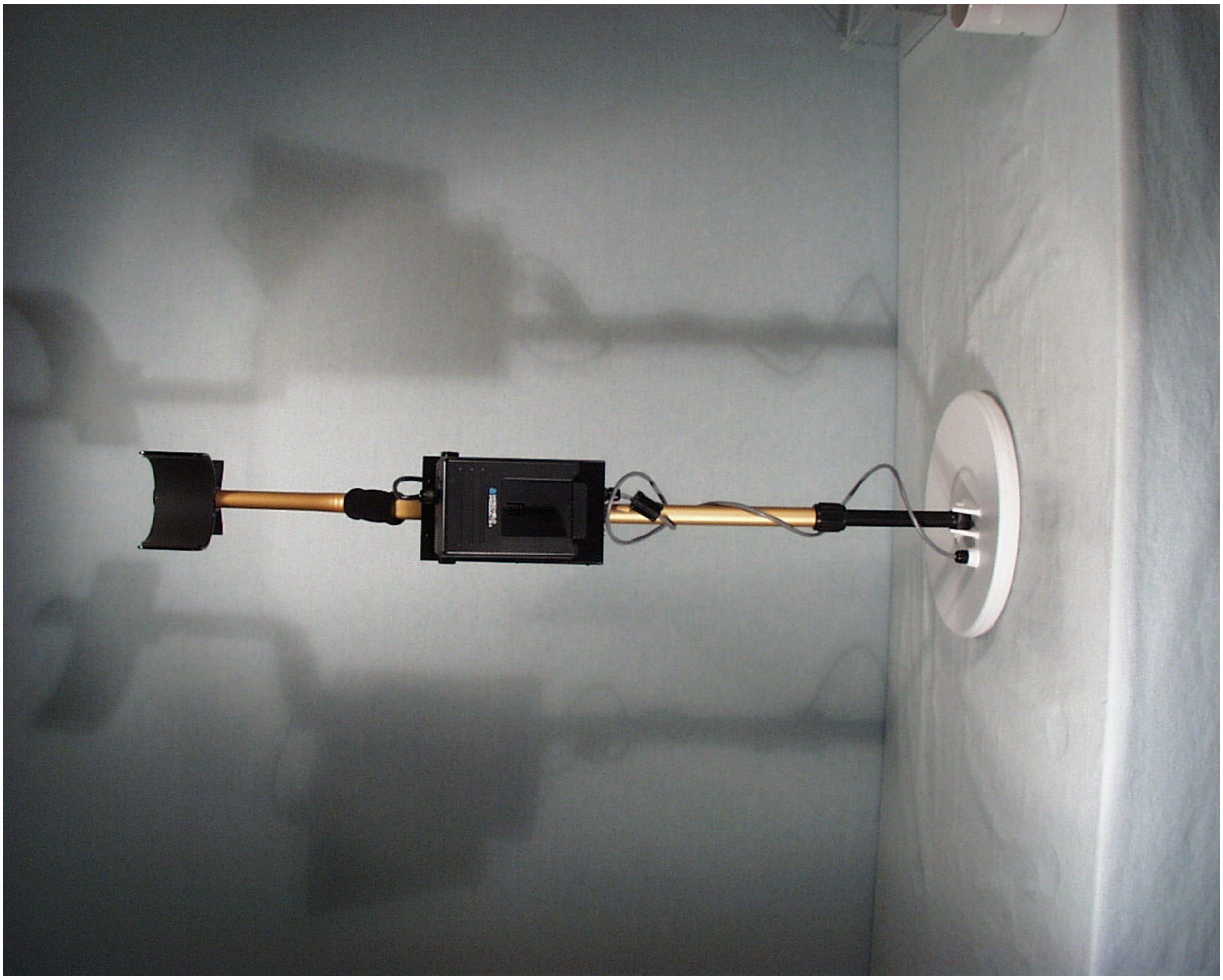
APPENDIX 2 Photographs

Front view of Test Setup

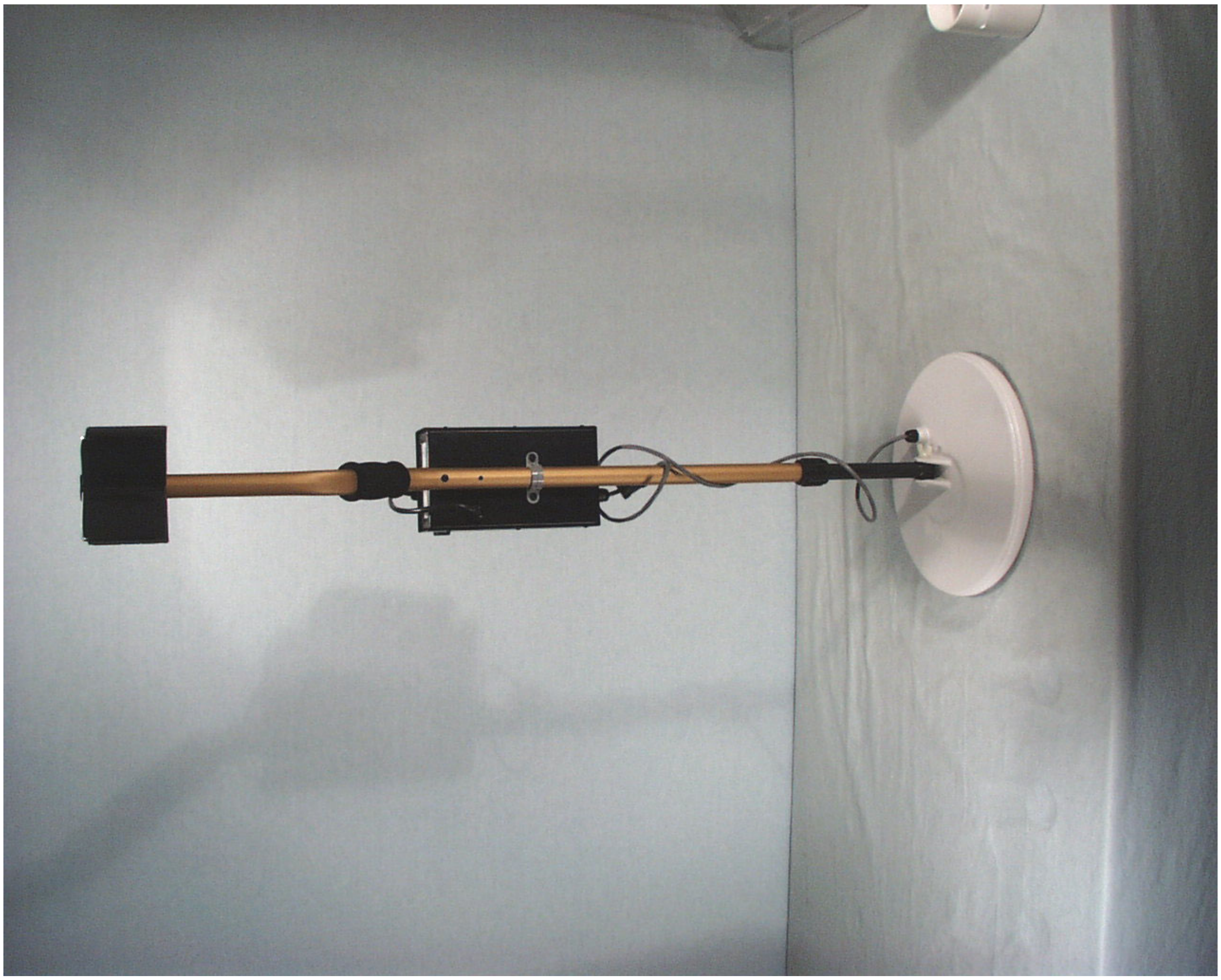
Back view of Test Setup



Front View of the Interrogator



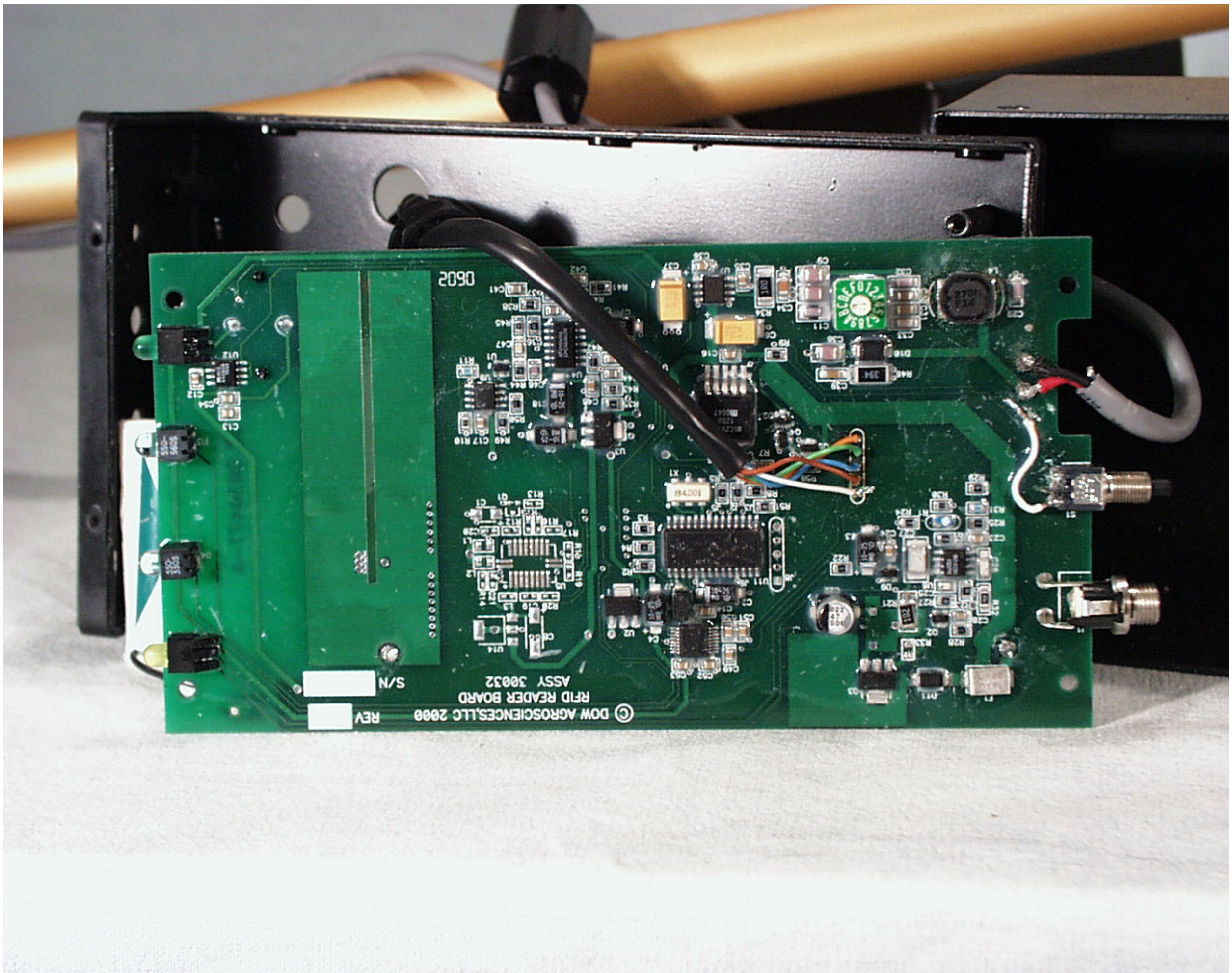
Back of the Interrogator



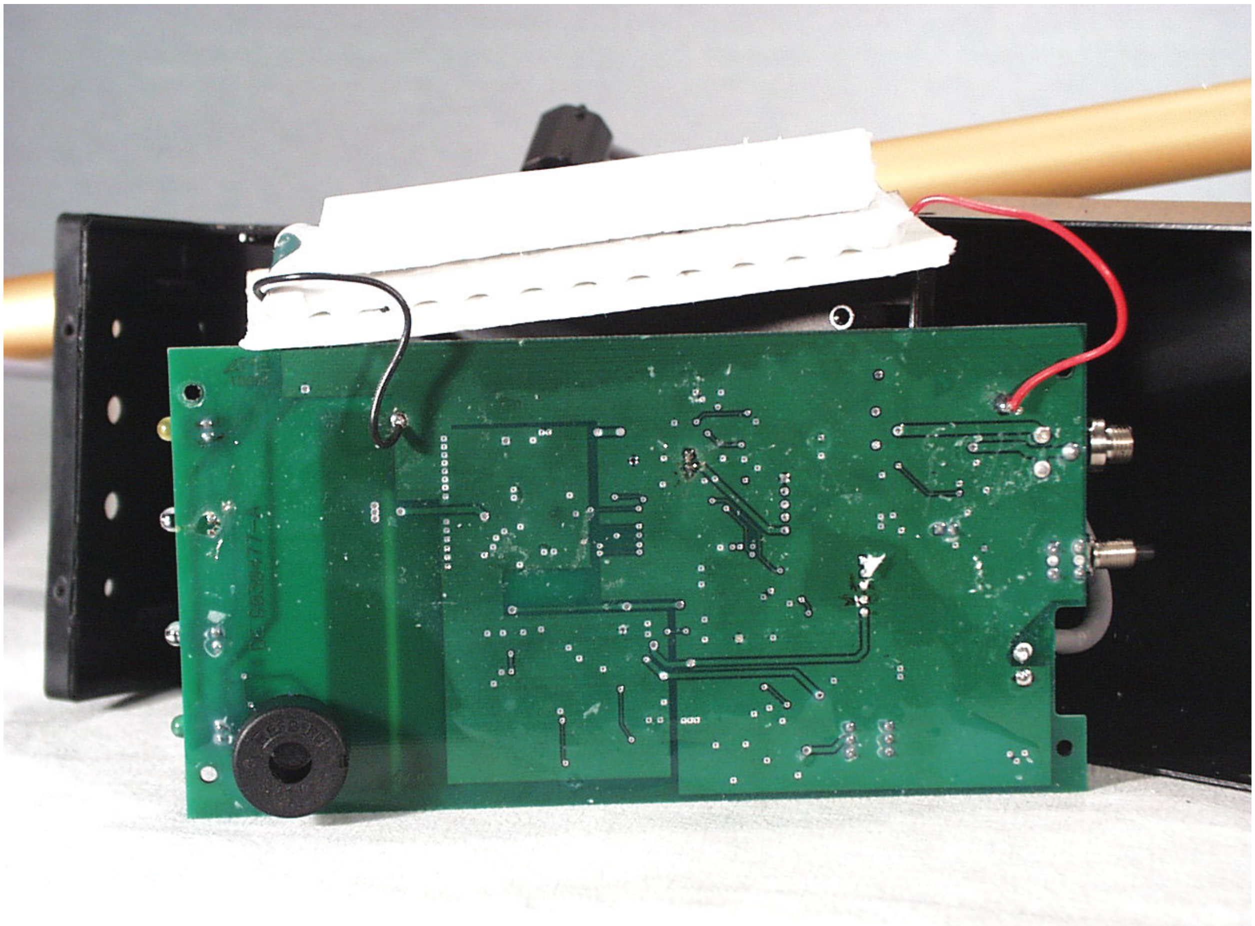
Front View of Interrogator box

Back View of the Interrogator Box

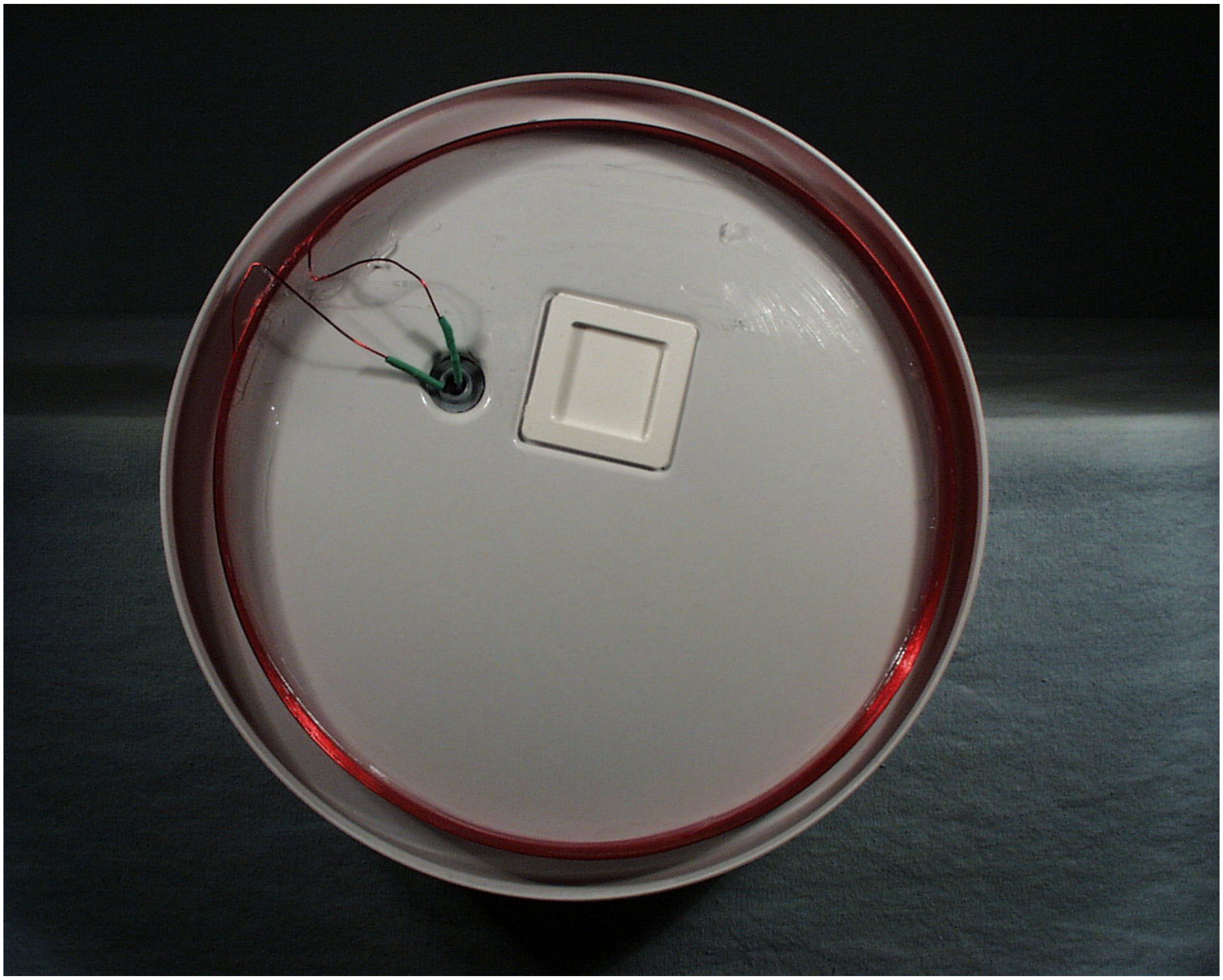
Front View of The Interrogator PCB



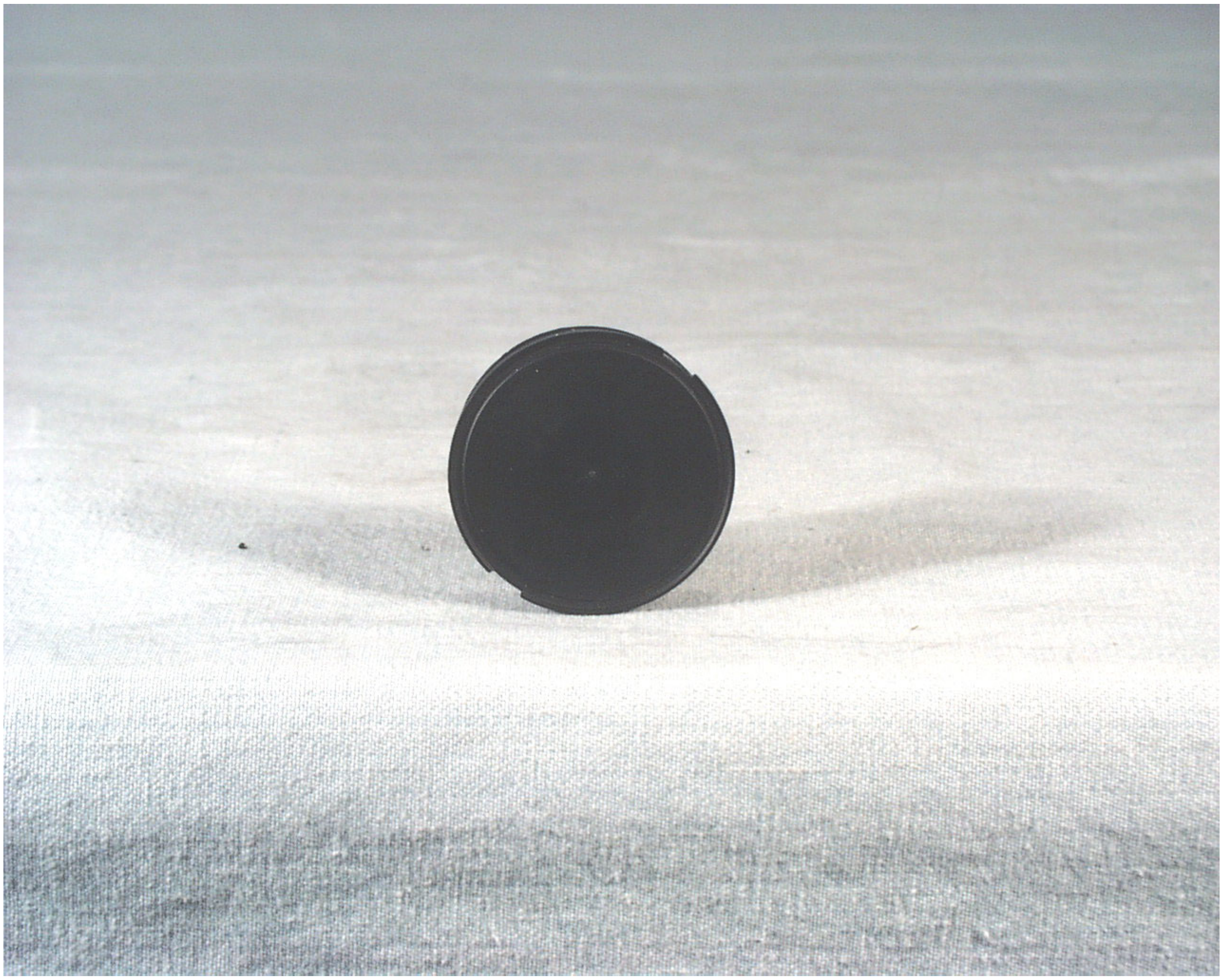
Back View of The Interrogator PCB



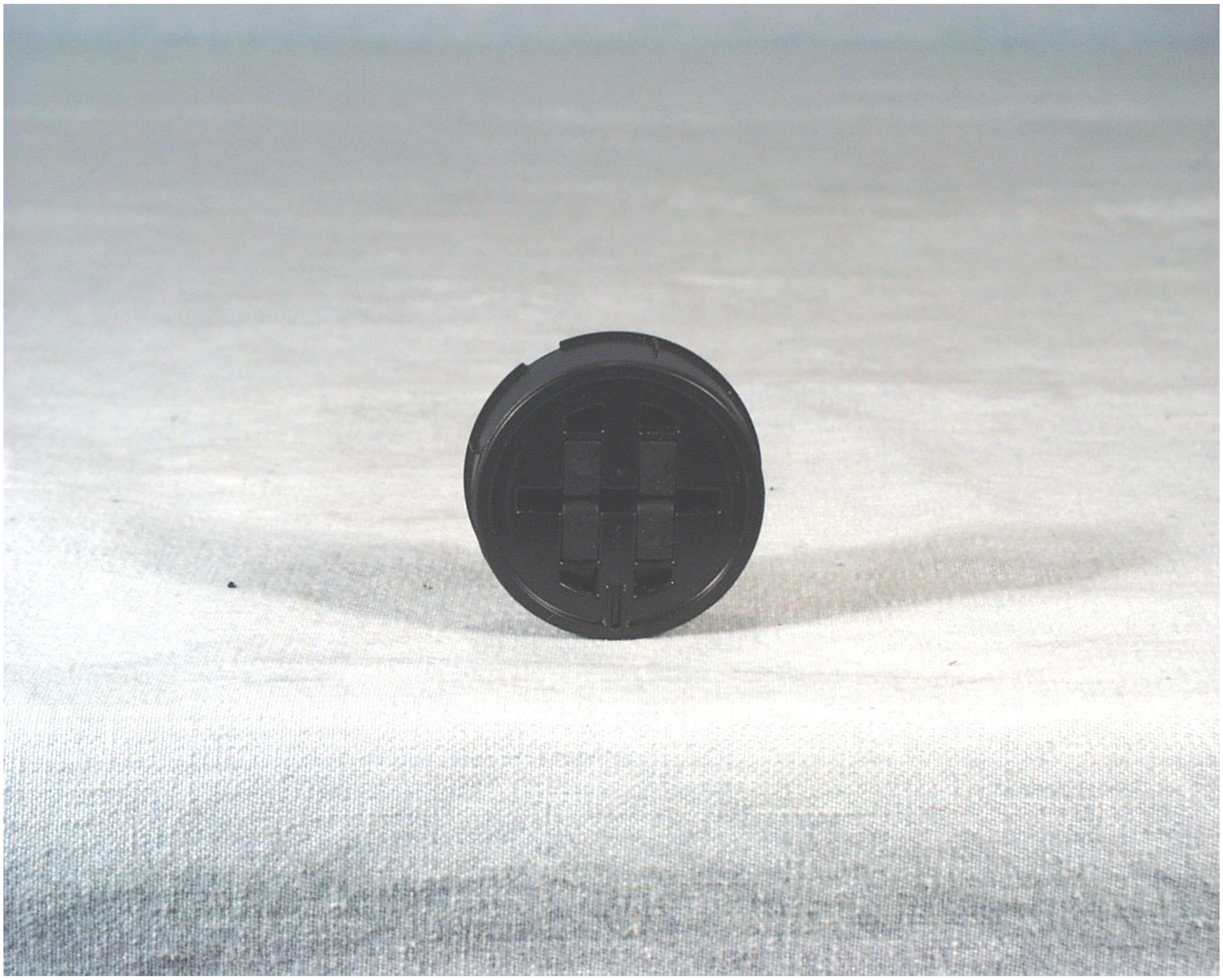
Inside view of the 125 kHz Antenna



Top view of the Transponder



Bottom view of the Transponder



Inside view of the Transponder