

Test Report Prepared By:

Electronics Test Centre
MPB Technologies Inc.
Unit 100
302 Legget Drive
Kanata Ontario K2K 1Y5

**FINAL REPORT
ON**

Sensor Tag A STA-434-01 and Tag Reader TR-434A

IN ACCORDANCE WITH

FCC part 15 Subpart C

MPBT Report No.: P37R2954

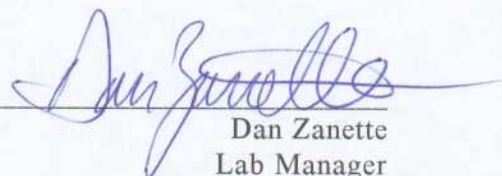
Customer P.O. No.: SCA-010-0104

Test Personnel: Janusz Lokaj

Prepared for:

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5375 rue Pare Suite #200
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Client Acceptance
Authorized Signatory



Dan Zanette
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Authorized Signatory

May 5, 2004
Report Composition Pages 1 to 28

Reviewed By



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1.0 INTRODUCTION

1.1 SCOPE

The purpose of this report is to present the findings and results of compliance testing performed, in accordance with FCC part 15 Subpart C.

1.2 APPLICANT

This test report has been prepared for Pultronics Inc.

1.3 APPLICABILITY

All test procedures, limits, and results defined in this document apply to the Pultronics Inc. Sensor Tag A STA-434-01 and Tag Reader TR-434A which shall be referred to herein as the Equipment Under Test (EUT).

The results contained in this report relate only to the item(s) tested.

This report does not imply product endorsement by NVLAP or the Canadian or US governments.

1.4 TEST SAMPLE DESCRIPTION

The test sample provided for testing were Sensor Tag A and Tag Reader TR-434A

Product Type:	Pre-production unit - Telecom
Serial Number:	N/A
Model Number:	STA-434-01 (Sensor Tag A) TR-434A-01 (Tag Reader)
Part Number:	N/A
Cables:	none (Sensor Tag A) Ethernet cable (Tag Reader)
Power Requirements:	Two Lithium coin cells (Sensor Tag A) 6-16Vdc (48Vdc optional) supplied as POE (Power Over Ethernet)
Peripheral Equipment:	None for Sensor Tag A PC, POE injector and AC/DC wall adapter for Tag Reader

1.5 GENERAL TEST CONDITIONS AND ASSUMPTIONS

The EUT was setup and exercised using the configurations, modes of operation and arrangements as defined in this report only. All inputs and outputs to and from other equipment associated with the EUT were adequately simulated.

Where relevant, the EUT was only tested using the monitoring methods and test criteria defined in this report.

All testing, unless otherwise noted, was performed under the following environmental conditions:

Temperature: 17 to 23 °C
Humidity: 45 to 75 %
Barometric Pressure: 68 to 106 kPa

1.6 SCOPE OF TESTING

Tests were performed in accordance with ANSI 63.4 1992 and CISPR 16

1.6.1 VARIATIONS IN TEST METHODS

There were no variations from the test procedures outlined above.

1.6.2 TEST SAMPLE MODIFICATIONS

There were no test sample modifications.

2.0 TEST CONCLUSION

The EUT was subjected to the following tests. Compliance is designated by a **PASS**; non-compliance by a **FAIL**.

The following table summarizes the test results and details the tests performed in terms of the specification and class or level applied, the unique test sample identification, and the EUT modification state, the mode of operation, configuration and cable arrangement (if applicable).

Test Case	Test Type	Specification	Class / Level	Mod State	ENG./ QUAL	Criteria	Result
2.1	Carrier level	FCC part 15.231(b), (e)	N/A	Typ.	QUAL	N/A	PASS
2.2	Unwanted Emissions - Transmitter	FCC part 15.231(b), (e)	N/A	Typ.	QUAL	N/A	PASS
2.3	Unwanted Emissions - Receiver	FCC part 15.205 & 15.209	N/A	TX off & standby	QUAL	N/A	PASS
2.4	Emission Bandwidth	FCC part 15.231(c)	N/A	Typ.	QUAL	N/A	PASS

STATEMENT OF COMPLIANCE

The client equipment referred to in this report was found to comply with the requirements as stated above.

ABBREVIATIONS

CE - Conducted Emissions
CS-Conducted Susceptibility(Immunity)
ESD - Electrostatic Discharge
EFT - Electrical Fast Transient Burst
E-Field - Electric Field

H-Field - Magnetic Field
N/T - Not Tested
N/A - Not Applicable
RE - Radiated Emissions
RS- Radiated Susceptibility(Immunity)

MEASUREMENT UNCERTAINTY

The following measurement uncertainty with 95% confidence level was calculated using the methods defined in NAMAS document NIS81: May 1994.

For Radiated E-Field Emissions

Frequency = $\pm 1 \times 10^{-3}$ MHz

Amplitude = ± 4.01 dB

For Conducted Emissions

Frequency = $\pm 1 \times 10^{-3}$ MHz

Amplitude = ± 3.25 dB

For Radiated Immunity E-Field

Frequency = $< 5 \times 10^{-12}$ at center frequency < 21.25 MHz
= < 0.8 MHz at center frequency ≥ 21.25 MHz

Amplitude = $< \pm 1.2$ dB at +13 dBm to -20 dBm (from 50 kHz to 680 MHz)
= $< \pm 1.7$ dB at +13 dBm to -20 dBm (from 680 kHz to 1360 MHz)
= $< \pm 1.7$ dB at -20 dBm to -143 dBm (from 50 kHz to 680 MHz)
= $< \pm 2.2$ dB at -20 dBm to -143 dBm (from 680 kHz to 1360 MHz)

Harmonics = < -65 dB below center frequency

For Electrostatic Discharge Tests

output voltage = $4 \text{ kV} \pm 5\%$ (measured at the tip)

For Electrical Fast Transient Tests

output voltage = $4 \text{ kV} - 0.0 + 0.4 \text{ kV}$

For Surge Immunity Tests

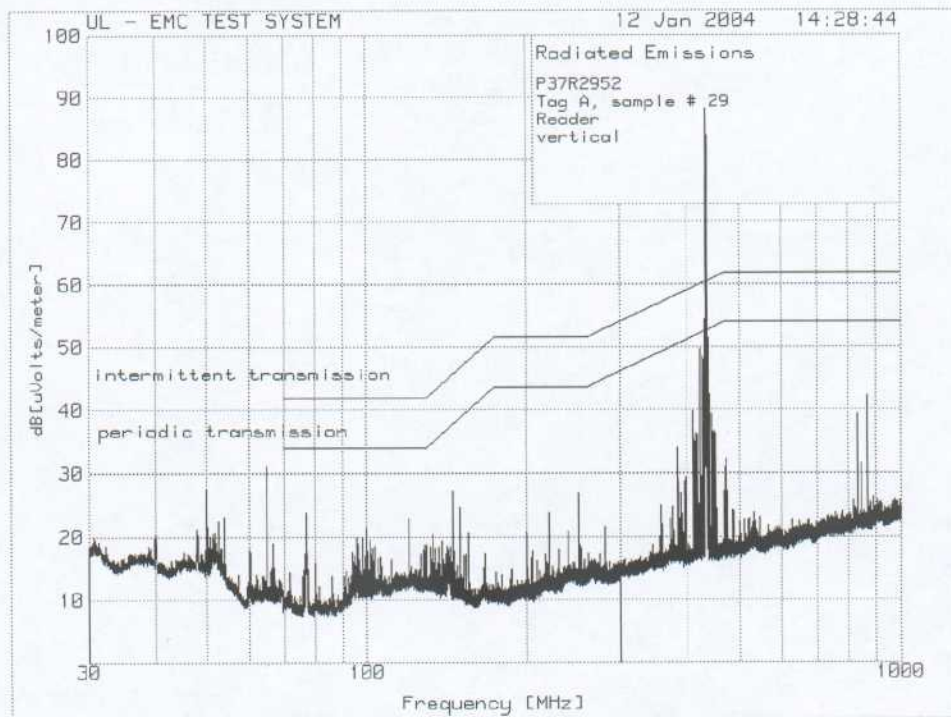
output voltage = $4 \text{ kV} - 0.0 + 0.4 \text{ kV}$

2.1 TRANSMIT CARRIER LEVEL

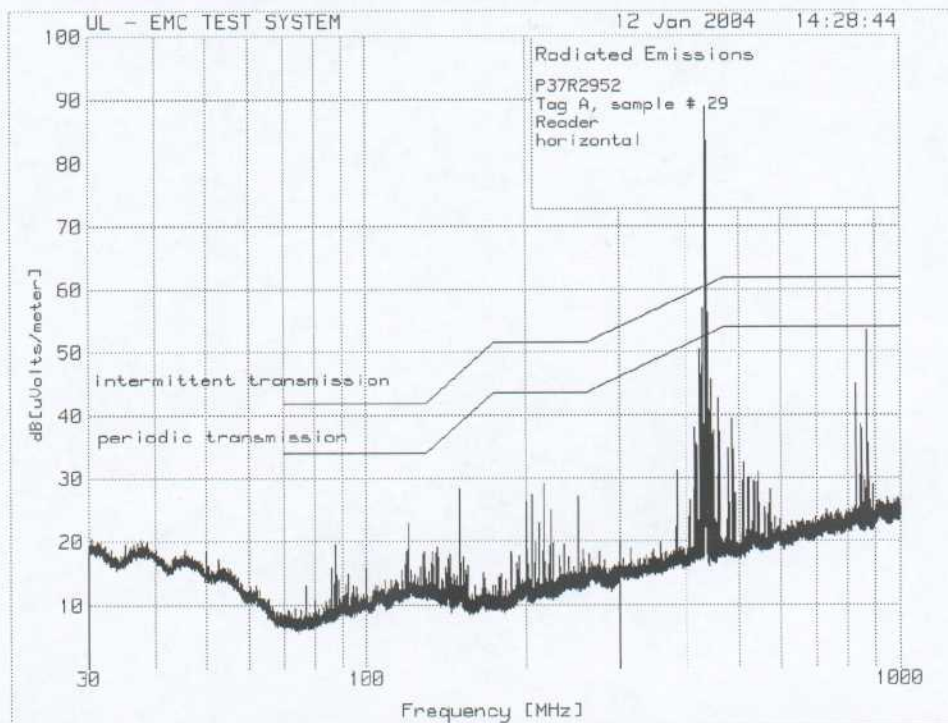
Test Summary	
Test Personnel: Janusz Lokaj	Test Date: January 12 and April 2, 2004

Test Description															
Objectives/Criteria	Specifications														
The electric fields radiated by a system or sub-system, shall not exceed the limits for the specifications as stated. It is recommended that a margin of 6dB be allowed for manufacturing tolerances. Worst case Emission was 56.3dBμV/m @ 434.014MHz. This is 24.9dB below the FCC Part 15.231(e) limit.	FCC Part 15.231(b) Subpart C (Intermittent Transmission) <table> <tr> <th>Frequency</th><th>Limits @3m</th></tr> <tr> <td>70 -130 MHz</td><td>61.9 dBμV</td></tr> <tr> <td>130-174 MHz</td><td>61.9 – 71.5 dBμV</td></tr> <tr> <td>174-260 MHz</td><td>71.5 dBμV</td></tr> <tr> <td>260-470 MHz</td><td>71.5 – 81.9 dBμV *</td></tr> <tr> <td>Above 470 MHz</td><td>81.9 dBμV</td></tr> <tr> <td>at 433.92MHz</td><td>81.2 dBμV</td></tr> </table>	Frequency	Limits @3m	70 -130 MHz	61.9 dB μ V	130-174 MHz	61.9 – 71.5 dB μ V	174-260 MHz	71.5 dB μ V	260-470 MHz	71.5 – 81.9 dB μ V *	Above 470 MHz	81.9 dB μ V	at 433.92MHz	81.2 dB μ V
Frequency	Limits @3m														
70 -130 MHz	61.9 dB μ V														
130-174 MHz	61.9 – 71.5 dB μ V														
174-260 MHz	71.5 dB μ V														
260-470 MHz	71.5 – 81.9 dB μ V *														
Above 470 MHz	81.9 dB μ V														
at 433.92MHz	81.2 dB μ V														
Test Result: PASS															

2.1.1 TRANSMIT CARRIER LEVEL - DATA



Radiated Emissions, 30 – 1000 MHz vertical peak prescan



Radiated Emissions, 30 – 1000 MHz horizontal peak prescan

Reader					
Polarization	Frequency	Peak Level	Pulse adjusted Level *	Limit	Margin
	[MHz]	[dB μ V/m]	[dB μ V/m]	[dB μ V/m]	[dB]
Vertical	434.014	87.8	56.3	81.2	-24.9
Horizontal	434.014	87.4	55.9	81.2	-25.3

Tag A					
Polarization	Frequency	Peak Level	Pulse adjusted Level *	Limit	Margin
	[MHz]	[dB μ V/m]	[dB μ V/m]	[dB μ V/m]	[dB]
Vertical	433.871	71.5	40.0	81.2	-41.2
Horizontal	433.871	81.6	50.1	81.2	-31.1

Note: Peak reading detector with resolution bandwidth 120kHz used below 1GHz. Readings adjusted for pulse desensitization as per FCC part 15.35 and CISPR16-1 table 3 – Isolated Pulses.

2.1.1 MEASUREMENT SETUP

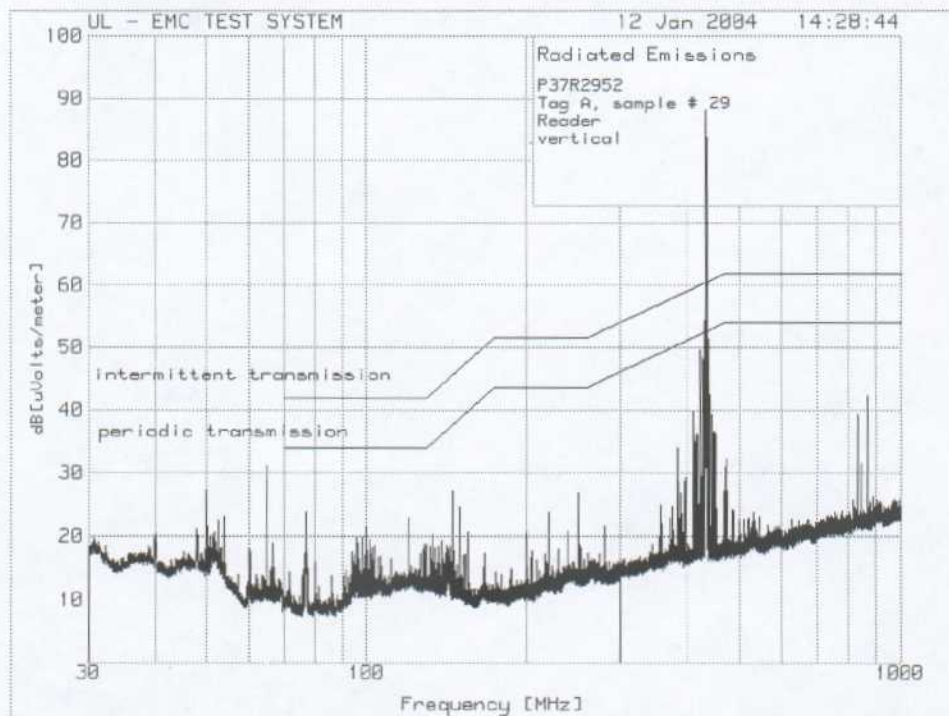


2.2 UNWANTED EMISSIONS - TRANSMIT

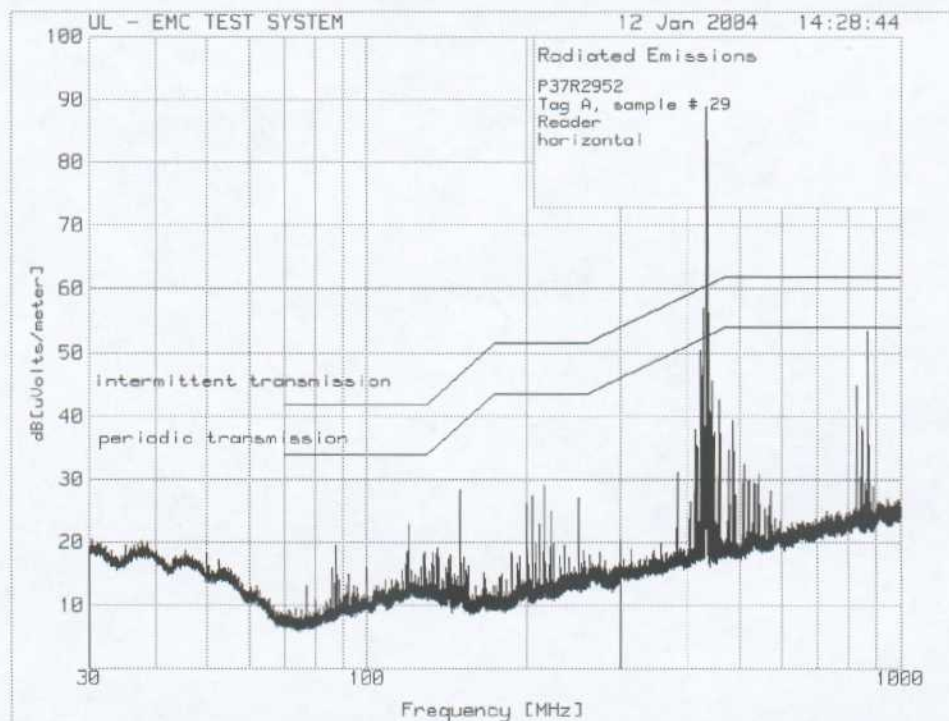
Test Summary	
Test Personnel: Janusz Lokaj	Test Date: January 12, 26-28, 2004

Test Description													
Objectives/Criteria	Specifications												
The electric fields radiated by a system or sub-system, shall not exceed the limits for the specifications as stated. It is recommended that a margin of 6dB be allowed for manufacturing tolerances. Worst case Emission was 50.4dBμV/m @ 1736.026MHz. This is 11.5dB below the FCC Part 15.231(b) limit.	FCC Part 15.231(b) Subpart C (Intermittent Transmission) <table> <tr> <th>Frequency</th><th>Limits @3m</th></tr> <tr> <td>70 -130 MHz</td><td>41.9 dBμV</td></tr> <tr> <td>130-174 MHz</td><td>41.9 – 51.5 dBμV</td></tr> <tr> <td>174-260 MHz</td><td>51.5 dBμV</td></tr> <tr> <td>260-470 MHz</td><td>51.5 – 61.9 dBμV *</td></tr> <tr> <td>Above 470 MHz</td><td>61.9 dBμV</td></tr> </table>	Frequency	Limits @3m	70 -130 MHz	41.9 dB μ V	130-174 MHz	41.9 – 51.5 dB μ V	174-260 MHz	51.5 dB μ V	260-470 MHz	51.5 – 61.9 dB μ V *	Above 470 MHz	61.9 dB μ V
Frequency	Limits @3m												
70 -130 MHz	41.9 dB μ V												
130-174 MHz	41.9 – 51.5 dB μ V												
174-260 MHz	51.5 dB μ V												
260-470 MHz	51.5 – 61.9 dB μ V *												
Above 470 MHz	61.9 dB μ V												
Test Result: PASS													

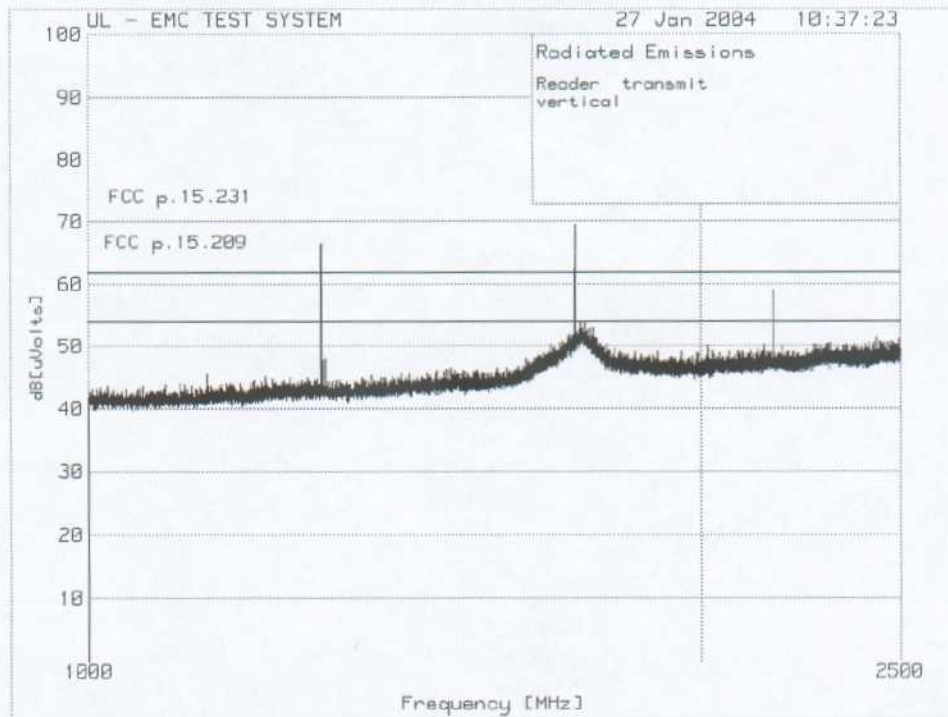
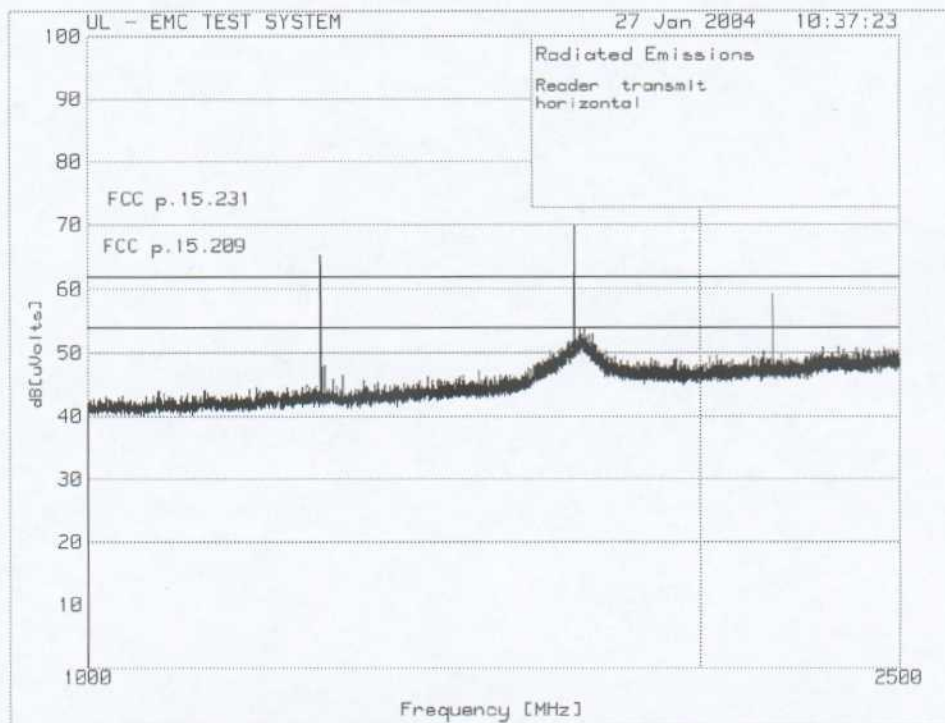
2.2.1 UNWANTED EMISSIONS DATA - TRANSMIT

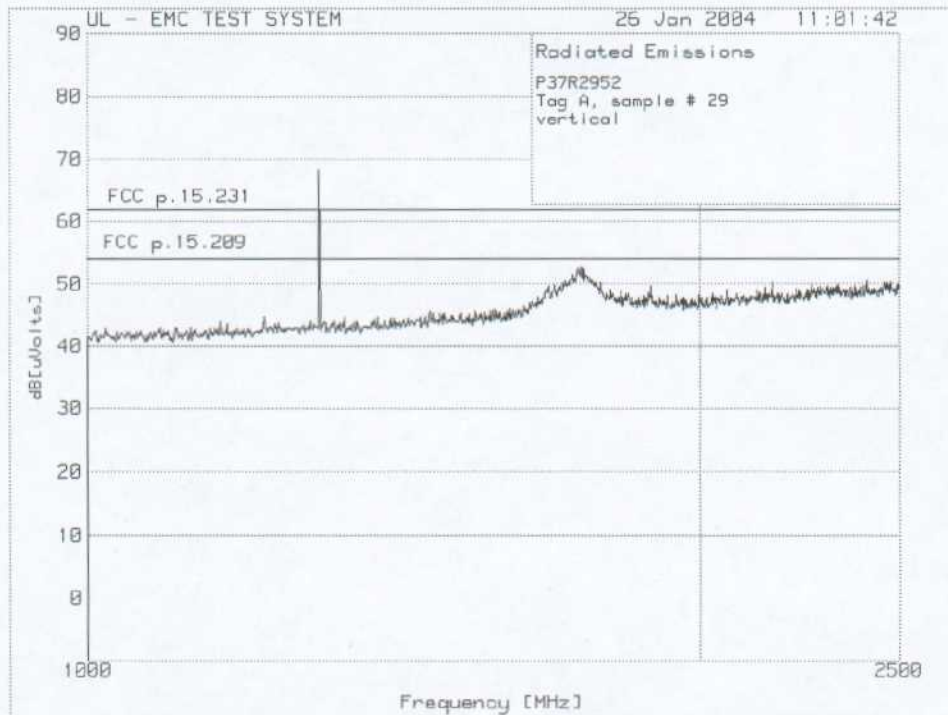
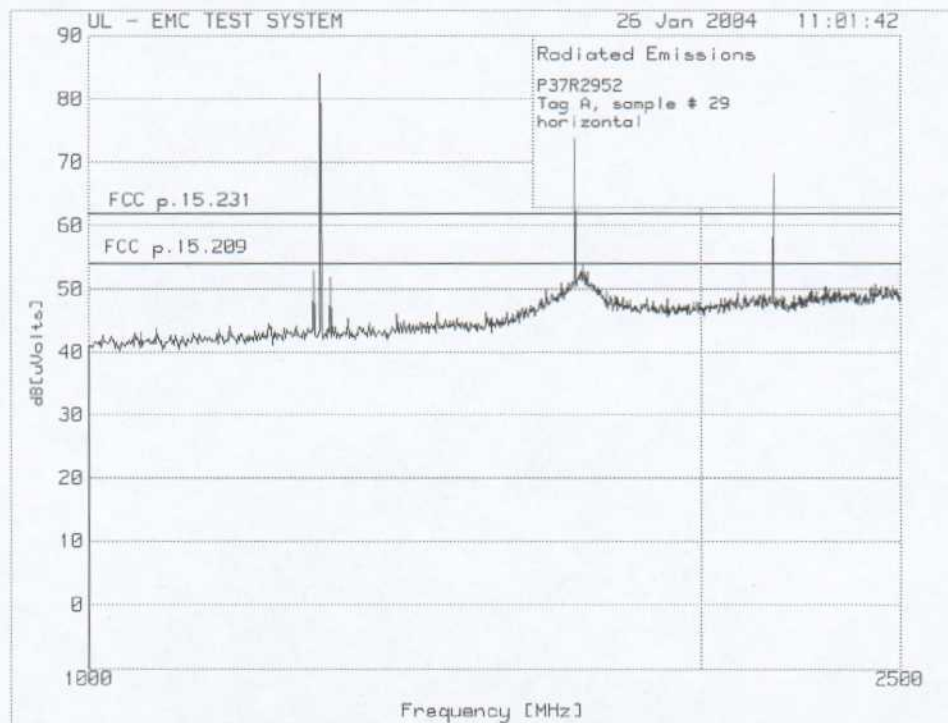


30 - 1000 MHz vertical peak prescan, Tag Reader & Sensor Tag A



30 - 1000 MHz horizontal peak prescan, Tag Reader & Sensor Tag A

**1 – 2.5 GHz vertical peak prescan. Tag Reader****1 – 2.5 GHz horizontal peak prescan. Tag Reader**

**1 – 2.5 GHz vertical peak prescan. Sensor Tag A****1 – 2.5 GHz horizontal peak prescan. Sensor Tag A**

Top Emissions – Tag Reader							
Vertical				Horizontal			
Freq. [MHz]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Freq. [MHz]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]
868.018	30.3	61.2	-30.9	868.018	34.7	61.2	-26.5
1302.024	42.4	61.9	-19.5	1302.024	42.4	61.9	-19.5
1736.026	50.2	61.9	-11.7	1736.026	50.4	61.9	-11.5
2170.031	47.5	61.9	-14.4	2170.031	47.3	61.9	-14.6

1. Peak reading detector with resolution bandwidth 120kHz used below 1GHz. Readings adjusted for pulse desensitization as per FCC part 15.35 and CISPR16-1 table 3 – Isolated pulses.
2. Average reading detector used above 1GHz.

Top Emissions – Sensor Tag A							
Vertical				Horizontal			
Freq. [MHz]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Freq. [MHz]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]
867.726	19.6	61.2	-41.6	867.726	27.8	61.2	-33.4
1301.591	35.8	61.9	-23.1	1301.591	35.5	61.9	-26.4
1735.455	40.9	61.9	-21.0	1735.455	39.7	61.9	-22.2
2169.317	38.6	61.9	-23.3	2169.317	36.9	61.9	-25.0

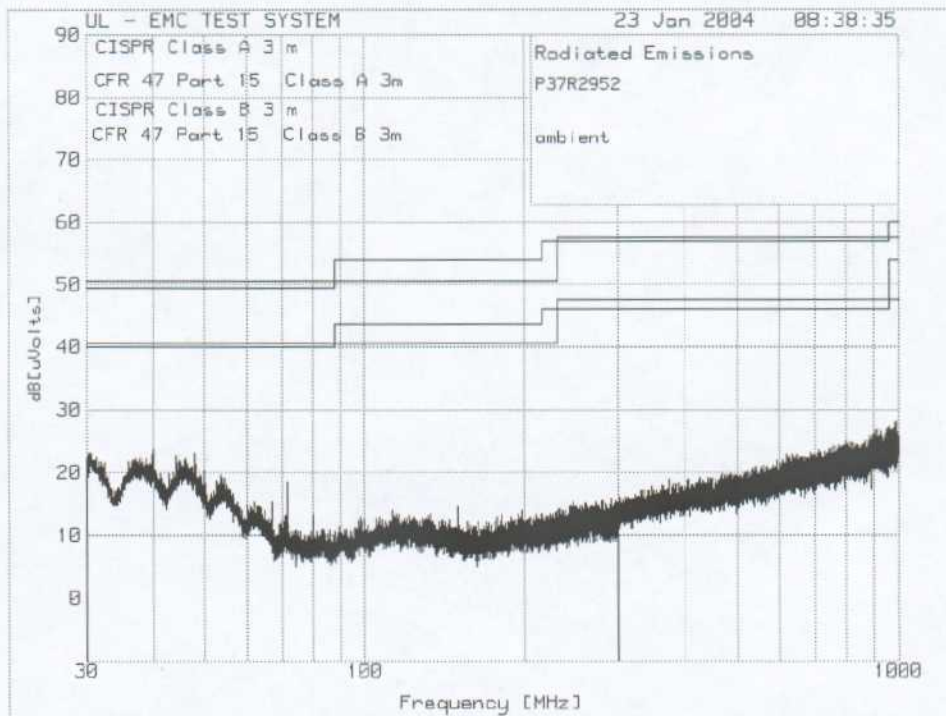
3. Peak reading detector with resolution bandwidth 120kHz used below 1GHz. Readings adjusted for pulse desensitization as per FCC part 15.35 and CISPR16-1 table 3 – Isolated pulses.
4. Average reading detector used above 1GHz.

2.3 UNWANTED EMISSIONS - RECEIVE

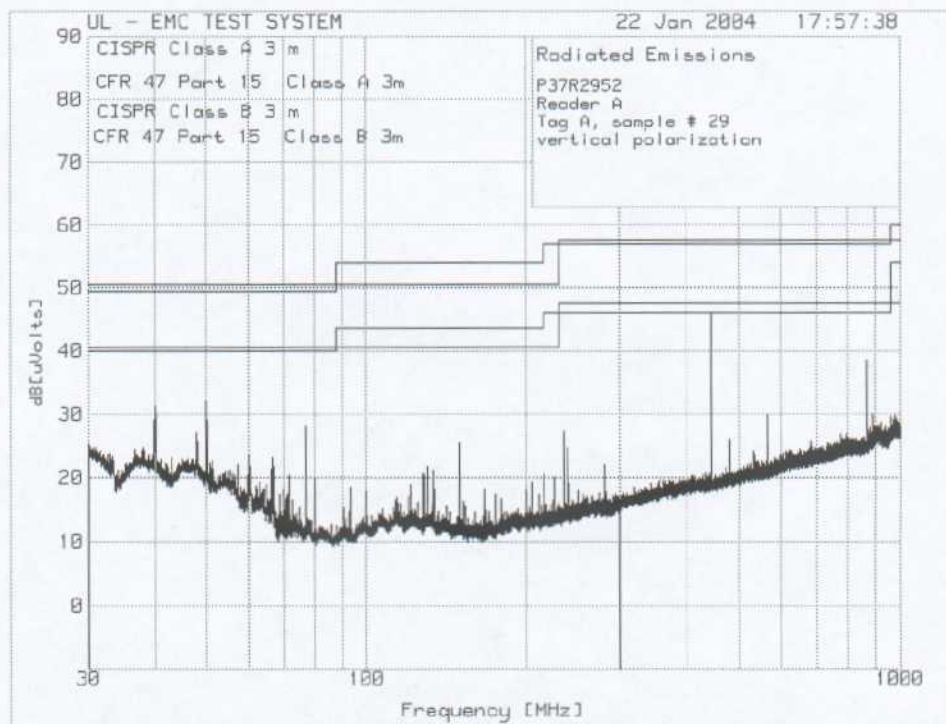
Test Summary	
Test Personnel: Janusz Lokaj	Test Date: January 22,23,27, 2004

Test Description											
Objectives/Criteria	Specifications										
The electric fields radiated by a system or sub-system, shall not exceed the limits for the specifications as stated. It is recommended that a margin of 6dB be allowed for manufacturing tolerances. Worst case Emission was 30.0dBμV/m @ 49.982MHz. This is 10.0dB below the FCC Part 15.209 limit. Worst case Emission was 20.0dBμV/m @ 49.982MHz. This is 10.0dB below the limit.	FCC Part 15.209 Subpart C <table> <tr> <td>Frequency</td><td>@3m</td></tr> <tr> <td>30-88 MHz</td><td>40.0 dBμV</td></tr> <tr> <td>88-216 MHz</td><td>43.5 dBμV</td></tr> <tr> <td>216-960 MHz</td><td>46.0 dBμV</td></tr> <tr> <td>> 960 MHz</td><td>54.0 dBμV</td></tr> </table>	Frequency	@3m	30-88 MHz	40.0 dB μ V	88-216 MHz	43.5 dB μ V	216-960 MHz	46.0 dB μ V	> 960 MHz	54.0 dB μ V
Frequency	@3m										
30-88 MHz	40.0 dB μ V										
88-216 MHz	43.5 dB μ V										
216-960 MHz	46.0 dB μ V										
> 960 MHz	54.0 dB μ V										
Test Result: PASS											

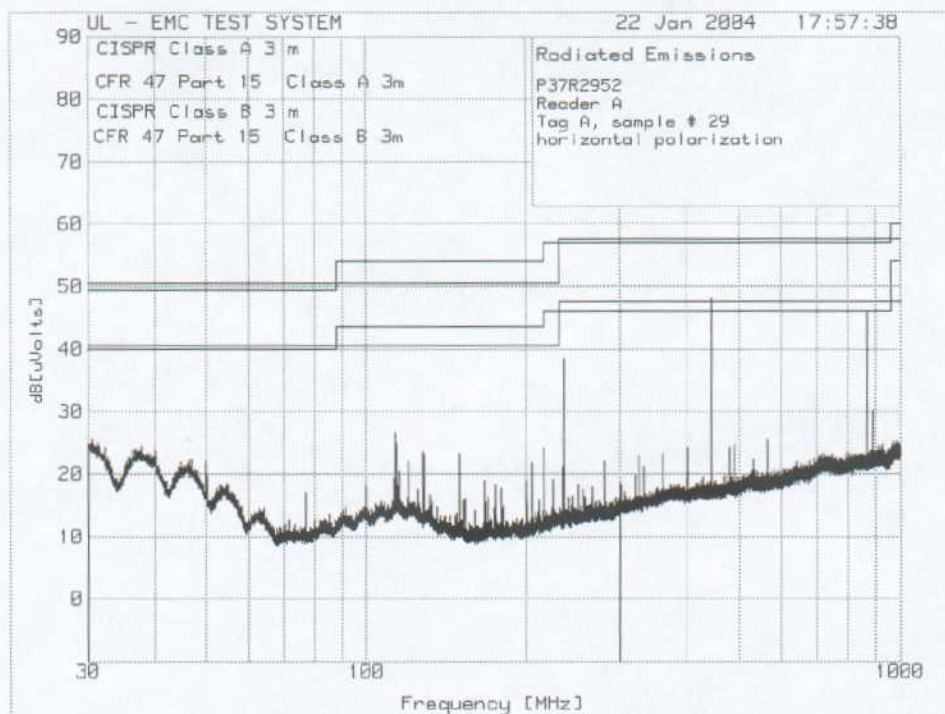
2.3.1 UNWANTED EMISSIONS DATA - RECEIVE



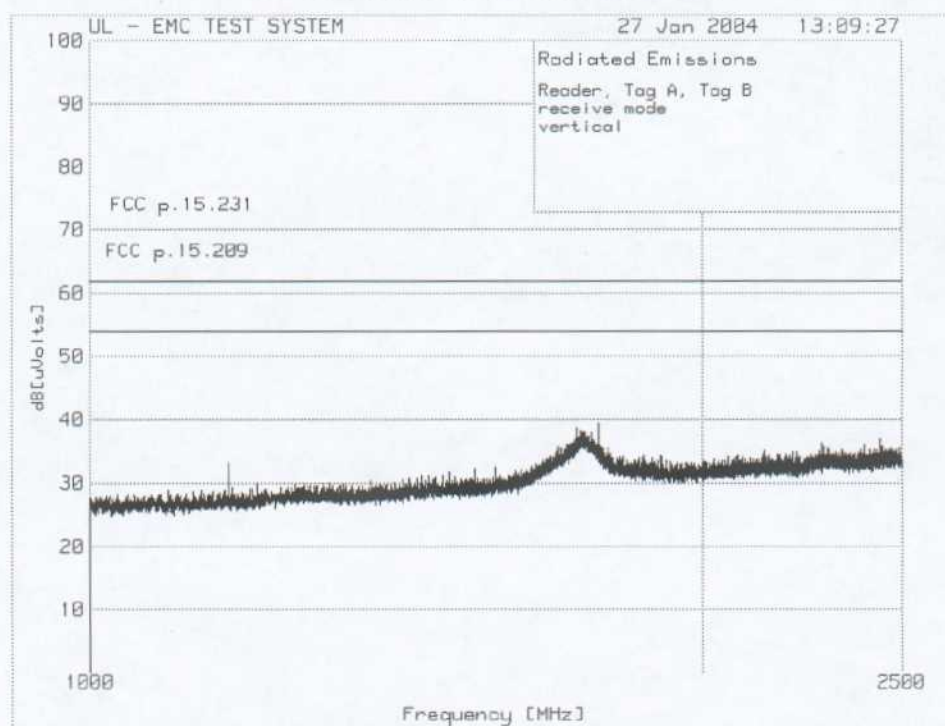
Ambient scan



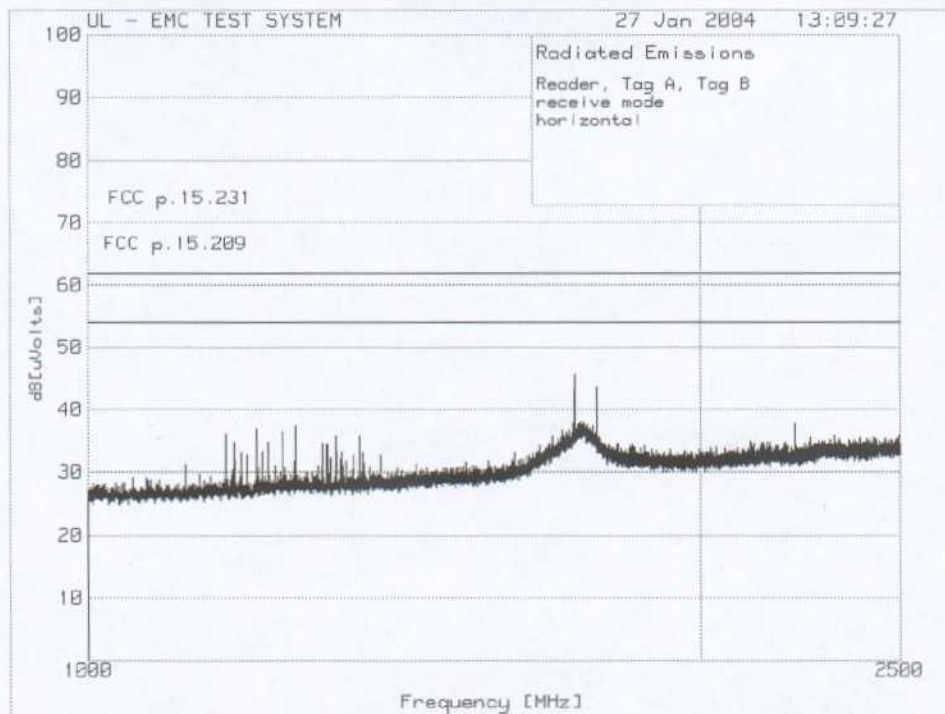
30-1000MHz, vertical prescan



30-1000MHz, horizontal prescan



1-2.5GHz, vertical prescan



Radiated Emissions 1-2.5GHz, horizontal prescan

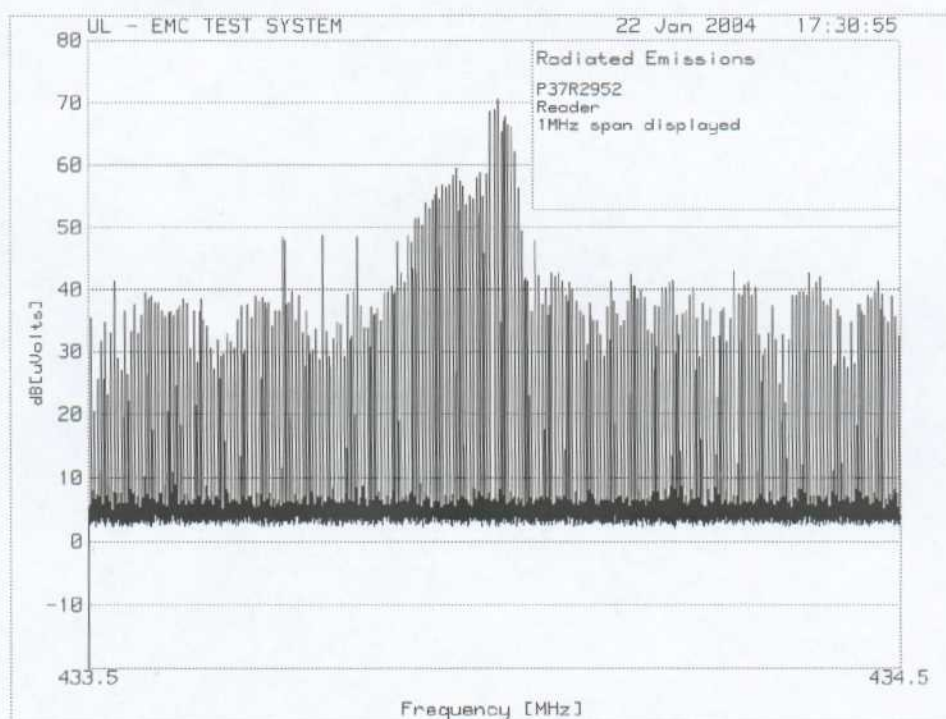
Top Six Emissions – FCC Part 15.209							
Vertical				Horizontal			
Freq. [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Freq. [MHz]	Level [dBμV/m]	Limit [dBμV/m]	Margin [dB]
49.982	30.0	40.0	-10.0	889.010	29.7	46.0	-16.3
40.070	28.3	40.0	-11.7	128.039	23.3	43.5	-20.2
76.814	27.6	40.0	-12.4	150.027	21.4	43.5	-22.1
567.239	28.7	46.0	-17.3	120.254	19.8	43.5	-23.7
149.516	8.4	43.5	-35.1	113.933	13.2	43.5	-30.3
234.965	9.3	46.0	-36.7	215.667	12.8	43.5	-30.8

2.4 EMISSION BANDWIDTH

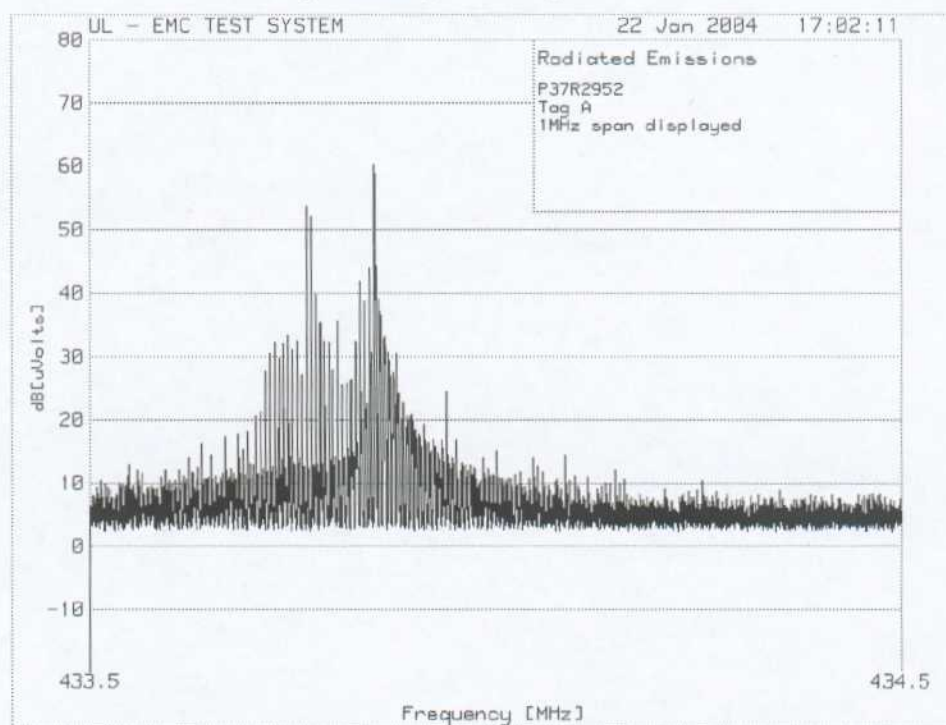
Test Summary	
Test Personnel: Janusz Lokaj	Test Date: January 22, 2004

Test Description	
Objectives/Criteria	Specifications
The emission bandwidth occupied by a system or sub-system, shall not exceed the limits for the specifications as stated.	FCC Part 15.231(c) 0.25% of the carrier: 1.08MHz at 433.92MHz
Test Result: PASS	

2.4.1 EMISSION BANDWIDTH DATA



Tag Reader, 1MHz span shown



Sensor Tag A, 1MHz span shown

3.0 TEST FACILITY

3.1 LOCATION

The EUT was tested for Electromagnetic Compatibility at the Electronics Test Centre, located in Kanata, Ontario, Canada.

3.2 GROUNDING PLAN

The EUT was located in a rack supplied by the client. No grounding was required according to the Clients specifications.

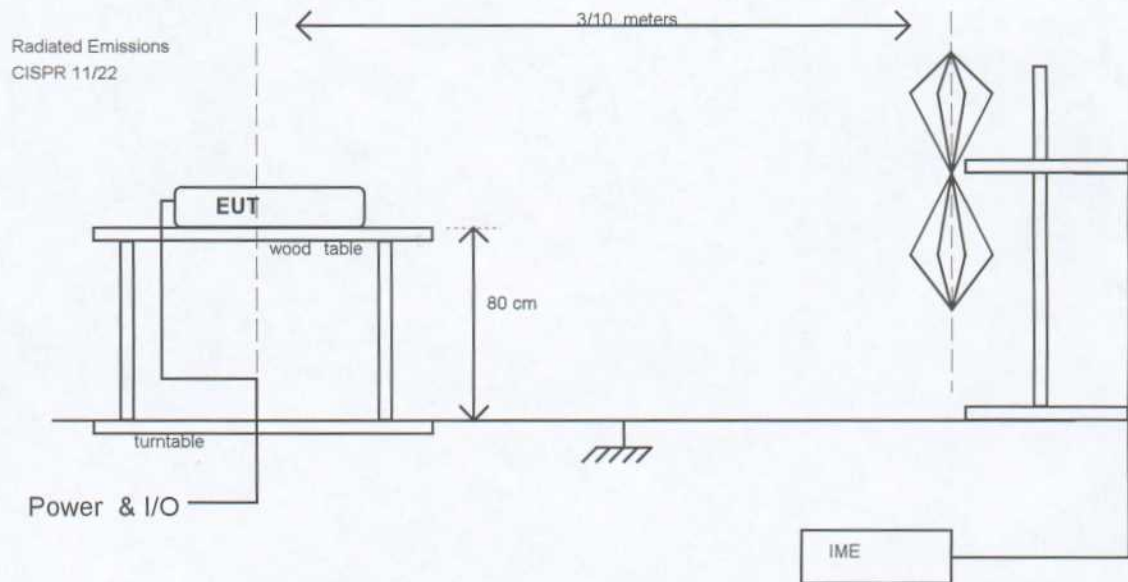
3.3 POWER

The EUT was self-powered.

3.4 TEST CONFIGURATION

3.4.1 TABLE TOP EQUIPMENT

The following diagrams illustrate the configuration of the EUT test and measurement equipment used for CISPR Radiated and Emissions Testing.



4.0 TEST EQUIPMENT

The following equipment was utilized for this procedure. All measurement devices are calibrated annually, traceable to NIST. Please refer to Appendix B for calibration data.

4.1 RADIATED EMISSIONS

- a) Spectrum Analyzer
- b) Receiver with CISPR Quasi-peak Adapter
- c) Power Isolation Transformers
- d) Biconilog antenna (25 MHz to 2 GHz)
- e) DRG Horn (1 GHz to 18 GHz)
- f) Antenna mast positioner, and controller
- f) Flush-mounted turntable, and controller
- e) Personal Computer and EMI/EMC Software

4.2 EMI SPECTRUM ANALYZER AND RECEIVER

4.2.1 SPECTRUM ANALYZER RANGE 1 of 2

Start Frequency	0.15 MHz
Stop Frequency	30 MHz
Transducer	LISN per CISPR 16
CISPR Bandwidths	200 Hz <i>Average</i> /9 kHz
Spectrum Analyzer BW	10 kHz
Video Bandwidth	100 kHz
Reference Level	100 dB μ V

4.2.2 SPECTRUM ANALYZER RANGE 2 of 2

Start Frequency	30 MHz
Stop Frequency	1000 MHz
Transducer	Biconilog Antenna
CISPR Bandwidth	120 kHz <i>Quasi-peak</i>
Spectrum Analyzer BW	120 kHz
Video Bandwidth	1 MHz
Reference Level	100 dB μ V

4.2.3 RECEIVER

Transducer	Biconilog Antenna
CISPR Bandwidth	120 kHz <i>Quasi-peak</i>
Measurement Window	20 dB μ V

APPENDIX A

Description provided by:

Pultronics Inc.

CLIENT SAMPLE DESCRIPTION

		New	Repeat
MPBT Personnel		Date	Project/Work Order
Janusz Lokaj			2952

Contact	Ewa Sokolowska	Address	
Company		5375 Pare str. #200	
	Pultronics Inc.	Montreal, QC, H4P 1P7	
		Canada	
Client Code			
		Phone: (514) 341-7001	Fax: (514) 341-7006

Product Application		Product Category		Product Type	
Military	☐	Telecom	☐ x	Avionics	☐
Commercial	☐ x	Info Tech.	☐	Other	☐
		Space	☐		
				Production Unit	☐
				Pre-production Unit	☐ x
				Prototype	☐

Product Name	Sensor TagA and Tag Reader TR-434A
Part Number	
Model Number	STA-434-01 (for Sensor TagA) and TR-434A-01 (for Tag Reader)
Serial Number	
Power Requirements: AC/DC, Current	Sensor TagA : Two Lithium coin cells (e.g. CR- 2032) Tag Reader: 6 to 16 V, optional to 48V DC supplied as POE (Power Over Ethernet)
Operational Frequency	Sensor TagA: transmit freq. 433.92 MHz, Tag Reader: transmit freq. 434.02 MHz, receive freq. 433.92 MHz
Typical Installation Instructions or Configuration	Sensor TagA is a self-contained equipment, no installation required. Tag Reader is connected with Ethernet cable to Power Over Ethernet injector, to the port carrying data and DC power. The DC power port of the injector is connected to a AC to DC wall adapter. The data port of the injector is connected with the Ethernet cable to LAN (PC, HUB, switch or router).
Ground EUT	No
# Interconnecting Leads	None for Sensor TagA Etherner cable for Tag Reader
Internal Clock Frequency	Sensor TagA : 32.768 kHz Tag Reader: 8 MHz and 20 MHz
Peripheral Equipment	None for Sensor TagA . PC, POE injector and AC to DC wall adapter for Tag Reader.
Cables	None for Sensor TagA . Ethernet cable for Tag Reader.
Functional or Self-Test Duration	
Brief Functional Description	
	Sensor TagA transmits in 433.92 MHz using FSK or ASK modulation. This tag has a motion, temperature sensors and brown out detection. Tag Reader, equipped with a built-in Ethernet controller, connects directly to a LAN (10Base-T) and communicates with the server using TCP/IP protocol. It is receiving RF data in 433.92 MHz band, recognizing data from the tags and transmitting collected data to the server. Tag Reader may be programmed to periodically send RF commands to the tags.

Other Remarks	
---------------	--

Prepared By:	Title:	Date:
Ewa Sokolowska		

APPENDIX B

TEST EQUIPMENT REPORT

Asset	Device	Characteristics	Manufacturer	Model	Serial	Cal. Date	Cal Due date
4297	Spectrum Analyzer	100Hz-22GHz	Hewlett Packard	HP8566B	2747A05484	4-Aug-03	4-Aug-04
2316	Preamplifier	10k-1000MHz	Electrometrics	BPA-1000	900710	Monitored	Monitored
5078	Biconilog Antenna	20MHz - 2GHz	Amplifier Research	LPB-2520/A	1173	5-Aug-03	5-Aug-04
2436	Quasi Peak Adapter		Hewlett Packard	85650A	2811A01123	4-Aug-03	4-Aug-04
	Anechoic Chamber					Monitored	Monitored