

TITLE: PLI Evaluation Report (RFI) **FCC ID: 0725346T (Pending)**
DRAWING: Q534615W.DWG
BY: Laura Bramschreiber and Phuong Nguyen

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Issued: 20 Feb 2005
Approved: Lee Pulver

This drawing consists of pages issued or re-issued on dates shown in the following list. *Italic underlined words* indicate content changes or additions on revised pages.

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1 - 41	20 Feb 2005

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Pulver Laboratories Inc. (PLI) File Number: 5346

Pulver Laboratories Inc. (PLI) Project Number: C2934

Product Names: (1) TouchChip ® Silicon Fingerprint and Smartcard Reader (EUT = Equipment Under Test)

Model Numbers: (1) TCRP

Serial Numbers: (1) 045000171

Pulver Laboratories Sample ID: (1) 5346C2934LG-02

Applicant: UPEK, Inc.
2001 Center Street, Suite 500
Berkeley, California 94704-1204
Telephone: 510.903.3226
Facsimile: 510.665.9730
www.upek.com

Location Certified: UPEK, Inc.
2001 Center Street, Suite 500
Berkeley, California 94704-1204
Telephone: 510.903.3226
Facsimile: 510.665.9730
www.upek.com

Manufacturing Location: Min Aik Technology Co, LTD
12F-1, #492-1, Sec 1
Wan Shou Rd.
Kuai Shan Shiang, Tao Yaun,
Hsian, Taiwan ROC
Telephone: 886-9-3381-0937
Contact: Johnson Lu

Pulver Laboratories Inc. (PLI) Control Number: 5346X

Equipment Category

Information Technology Equipment including Electrical Business Equipment

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Evaluated to the Following Standards

PLI Certification.

Certified by Pulver Laboratories Inc. to comply with the following standards.

FCC Certification.

Federal Communications Commission (FCC, USA)

Category Classification: Class B - Residential
FCC ID number - 0725346T (Pending)

- American National Standards Institute C63.4-2001 entitled Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
- Federal Communications Commission Rules and Regulations located in the Code of Federal Regulations, Title 47, Part 1.1307(b); Part 2.1091; Part 2 entitled Frequency Allocations and Radio Treaty Matters; General Rules and Regulations; Part 15 entitled Radio Frequency Devices, 26 January 2005 Edition.

ICAN Verification.

Industry Canada (ICAN)

Category Classification: Class B - Residential

- Canadian Standards Association (CSA) C108.8-M1983 (R2000) entitled Electromagnetic Emissions for Data Processing Equipment and Electronic Office Machines.
- Canadian Standards Association (CSA) CAN3-C108.3.1-M84 (R2000) entitled Limits and Measurement Methods of Electromagnetic Noise from AC Power Systems.
- Industry Canada. Interference-Causing Equipment Standard: ICES-003, Issue 3, 22 Nov 97, entitled "Interference-Causing Equipment Standard for Digital Apparatus".
- Industry Canada (ICAN) Radio Interference Regulation amendment dated 15 September 1988 (Radio Act Registration SOR/88-475); 3862 01 Data Processing Equipment.

CE Certification mark.

International Community

Category Classification: Class B - Residential

- EN55022 / CISPR 22 entitled Limits and methods of measurement of radio disturbance characteristics of information technology equipment, 1995 Edition.
- EN55022 / CISPR 22 entitled Limits and methods of measurement of radio disturbance characteristics of information technology equipment, 1998 Edition.

Referenced Test Standards

- EN55022 / CISPR 22 entitled Limits and methods of measurement of radio disturbance characteristics of information technology equipment, First Edition 1985.

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1.0 Engineering Considerations

1.1 General Engineering Considerations

1.1.1 This report deals with conformance to the:

- Code of Federal Regulations, 47 CFR, Part 2 and Part 15, issued 26 January 2005;
- American National Standards Institute standard number C63.4-2001 entitled Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz;
- EN55022 / CISPR 22 entitled Limits and methods of measurement of radio disturbance characteristics of information technology equipment, 1998 Edition.

1.1.2 To assist the Federal Communications Commission in the continuing education of applicants and grantees, Pulver Laboratories has advised UPEK, Inc. to review a copy of the Rules and Regulations located in the Code of Federal Regulations, Title 47, Part 2 entitled Frequency Allocations and Radio Treaty Matters; General Rules and Regulations; and Part 15 entitled Radio Frequency Devices, issued 26 January 2005.

1.1.3 The manufacturer has a contractual obligation to Pulver Laboratories to incorporate into production all modifications photographed and outlined in this report with associated documentation.

1.1.4 The Pulver Laboratories Certificate of Conformance issued with this report allows the manufacturer to ship and sell product using the Pulver Laboratories Product Certification Label. This label can only be used if the manufacturer allows Pulver Laboratories to conduct a Follow Up Service at the manufacturing facilities and conduct an Electromagnetic Interference test of the finished product every six months.

1.1.5 This report also deals with conformance to Radio Frequency Interference Suppression of High Frequency Equipment for Industrial, Scientific, and Medical (ISM) and similar purposes for Canada and the countries listed in the Pulver Laboratories Certificate of Conformance associated with this report.

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1.2 Specific Engineering Considerations

1.2.1 Climatic conditions:

Climatic Conditions	Limits	Readings
Ambient temperature	15°C to 35°C	13°C
Relative humidity	45% to 75%	93%
Atmospheric pressure	68 kPa (680 mbar) to 106 kPa (1060 mbar)	1011 mbar

1.2.2 Interconnecting low voltage cable lengths:

Cable Description	Length (feet)	Length (meters)	Shielded / Unshielded
EUT	5.64	1.72	Unshielded
Printer	5.51	1.68	Shielded
Keyboard	6.72	2.05	Unshielded
Monitor	5.84	1.78	Unshielded
Mouse	6.03	1.84	Unshielded
Modem	2.66	0.81	Shielded
Computer input power	5.84	1.78	Shielded
Media reader	3.28	1.0	Unshielded
Monitor power	5.7	1.74	Unshielded
Printer power	5.64	1.72	Unshielded
Modem power	6.23	1.9	Unshielded
CAT5 cable	6.56	2.0	Unshielded

1.2.3 Input / Output (I / O) Cables coiled and wrapped to maximum lengths of 30 to 40 cm, at least 40 cm from ground plane as recommended by ANSI 63.4-2001.

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- 1.2.4 Most severe cable orientation chosen when measuring unwanted radiated and conducted emissions.
- 1.2.5 To meet the agency criteria listed in this PLI Evaluation Report, the following modifications were made to the original design of the Equipment Under Test:
 - 1.2.5.1 No modifications were required.
- 1.2.6 There is one possible Equipment Under Test (TouchChip ® Silicon Fingerprint and Smartcard Reader, model TCRP) input power configuration:
 - 1.2.6.1 A USB port on the host computer supplies the EUT with voltage.
- 1.2.7 There is one possible EUT test configuration:
 - 1.2.7.1 **Test Configuration #1** consisted of the TouchChip ® Silicon Fingerprint and Smartcard Reader, TCRP connected to an IBM Compatible PC via the USB port.
- 1.2.8 This report does include measurement data to the 10th harmonic.

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1.3 **Product Description and Intended Use**

- 1.3.1 Built on the TouchChip Silicon Fingerprint Sensor, the TouchChip ® Silicon Fingerprint and Smartcard Reader is a fast, reliable and inexpensive fingerprint authentication peripheral. It is a revolutionary approach to personal authentication for computer and network security.
- 1.3.2 The TouchChip ® Silicon Fingerprint and Smartcard reader has been designed for demanding applications such Desktop Security, Network Security, Commercial Verification and Identification Systems.
- 1.3.3 The TouchChip ® Silicon Fingerprint and Smartcard reader is a fully integrated biometrics PC peripheral, which include all the typical biometric system: fingerprint sensing, image optimization and matching. The TouchChip silicon fingerprint sensor captures fingerprint images. PerfectPrint controls the TouchChip sensor to obtain the best possible fingerprint image in any environmental condition. PerfectMatch is a set of software algorithms performing two essential biometrics functions: extraction of fingerprint tem- Figure 1. TouchChip Biometric Subsystem Solution plates and matching of live fingerprints with previously stored fingerprint templates.
- 1.3.4 The TouchChip ® Silicon Fingerprint and Smartcard reader is delivered with Perfect-Match biometric service provider (BioAPI-compliant BSP) in order to integrate it in customer applications without in-depth knowledge of all the solution's components.

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1.4 **List of Photographs Contained in this Report**

FIGURE 1: PLI Photograph Number 5346C2934SJ-07 illustrates the front view of the Equipment Under Test with all peripherals attached in **Test Configuration #1**. The "open field" radiated and the "screen room" conducted Radio Frequency Interference / Electromagnetic Interference test programs utilized this equipment and cable configuration.

FIGURE 2: PLI Photograph Number 5346C2934SJ-06 illustrates the rear view of the Equipment Under Test with all peripherals attached in **Test Configuration #1**. The "open field" radiated and the "screen room" conducted Radio Frequency Interference / Electromagnetic Interference test programs utilized this equipment and cable configuration.

FIGURE 3: PLI Photograph Number 5346C2934SJ-08 illustrates the front view of the Equipment Under Test with all peripherals attached in conducted Electromagnetic Interference **Test Configuration #1**.

FIGURE 4: PLI Photograph Number 5346C2934SJ-09 illustrates the rear view of the Equipment Under Test with all peripherals attached in conducted Electromagnetic Interference **Test Configuration #1**.

FIGURE 5: PLI Photograph Number 5346C2934SJ-01 illustrates the top view of the EUT.

FIGURE 6: PLI Photograph Number 5346C2934SJ-02 illustrates the bottom view of the EUT.

FIGURE 7: PLI Photograph Number 5346C2934SJ-05 illustrates the bottom chassis removed showing cabling and internal components.

FIGURE 8: PLI Photograph Number 5346C2934SJ-03 illustrates the component side of the Sensor board, TCS1CD.

FIGURE 9: PLI Photograph Number 5346C2934SJ-04 illustrates the component side of the Input/Output board, TCRP v1.0.

1.5 Equipment used during measurements calibrated according to internationally acceptable laboratory procedures. Calibration data along with Certificates of conformance and traceability are on file at the testing facility. Each calibrated equipment item is individually labeled with date calibrated; due date for next calibration; initials of person who calibrated the equipment; and the name of the organization that performed the calibration service.

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Equipment Type	Manufacturer	Model Number	Serial Number	Calibration Date	Calibration Cycle
Spectrum Analyzer	Hewlett-Packard	8568A	2314A02738	11 May 2004	1 Year
Quasi-Peak Adapter	Hewlett-Packard	85650A	204300273	11 May 2004	1 Year
Amplifier	Hewlett-Packard	8447D Option 010	1937A03004	11 May 2004	1 Year
Spectrum Analyzer	Hewlett-Packard	8565A	PLI2200	11 May 2004	1 Year
Amplifier	Hewlett-Packard	8349A	PLI2201	11 May 2004	1 Year
Biconical Antenna	EMCO	3109	2089	22 Jun 2004	1 Year
Log Periodic Antenna	EMCO	3146	1118	22 Jun 2004	1 Year
Double Ridge Horn Antenna	EMCO	3115	4782	22 Jun 2004	1 Year
L.I.S.N	Solar Electronics	8012-50-R-24 BNC	PLI2202	14 Apr 2004	1 Year
L.I.S.N	Solar Electronics	8328-50-TS-50-N	PLI2203	14 Apr 2004	1 Year
High Pass Filter	Solar Electronics	7801-5.0	PLI2204	Not Applicable	
Tunable Band Pass Filter	K & L Microwave	5BT-48/95-5/B	NC583-1	Not Applicable	
Tunable Band Pass Filter	K & L Microwave	5BT-95/190-5/B	PLI2205	Not Applicable	
Magnetic Loop Antenna	Electro-Metrics	ALR-25M	M203680	Not Applicable	
Equipment Testing Turntable	EMCO	1061-06	PLI2206	Not Applicable	

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Laboratory Test Equipment					
Equipment Type	Manufacturer	Model Number	Serial Number	Calibration Date	Calibration Cycle
Antenna Positioning Tower	EMCO	1050	PLI2211	Not Applicable	
RF Attenuator	Narda	757C	35797	05 Jun 2004	1 Year
RF Attenuator	Narda	757C	36808	05 Jun 2004	1 Year
RF Attenuator	Narda	757C	40604	05 Jun 2004	1 Year
Close Field Antenna	Electro-Metrics	EFP-25	PLI2207	Not Applicable	
Oscilloscope	Tektronix	2445	PLI2208	Not Applicable	
Frequency Comb Generator	Hewlett-Packard	8406A	2246A02197	Not Applicable	
Absorbing Clamp	Schaffner EMC	MDS-21	831153	Not Applicable	
Line Probe	EMCO	3701	1007	Not Applicable	
Frequency Generator	Hewlett-Packard	TS-418B/U	PLI2209	Not Applicable	
Frequency Generator	Hewlett-Packard	TS-510A/U	PLI2210	Not Applicable	
Multimeter	Fluke	FLUKE 110 True RMS	78140239	12 Dec 2003	2 Years
Multimeter	Fluke	FLUKE 73 III	78850774	12 Dec 2003	2 Years
Digital Power Meter	Fluke	FLUKE 39	6836019	26 Feb 2004	2 Years
ELF Field Monitor	Walker Magnetic	ELF-50D	K71260-201	30 Dec 2003	2 Years

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- 1.6 List of Exhibits accompanying this report for FCC submission to help describe and clarify the Equipment Under Test.
 - 1.6.1 Schematics or detailed block diagrams.
 - 1.6.2 Equipment manual for operator or user showing enough detail to operate the equipment.
 - 1.6.3 Currently dated and originally signed FCC Application for Certification (Form 731) along with the FCC Certification fee (already submitted electronically).
 - 1.6.4 Current Agent Authorization letter.
 - 1.6.5 Proposed identification label representative of the production label to be placed on the equipment upon grant of the application. Positioned on equipment as shown in block rough in Section 2.1 of this report.

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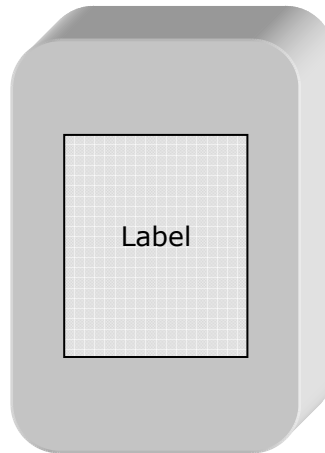
2.0 **Mandatory Labeling and Operators' Manual Information and Shipping Documents**

2.1 **Label**

The illustration on the next page shows the sample FCC label with the appropriate wording. Note the letters "EMI" on the label, which abbreviate "Electromagnetic Interference". Organizations like the Federal Communications Commission and their respective limits are listed on the label.

Also notice the letters "NRTL", which abbreviate "Nationally Recognized Testing Laboratory" as recommended by OSHA and the National Electrical Code for the United States. For Pulver Laboratories product Certification labels used for safety Certification, the phrase "SAFETY" appears on the label. Safety Certifying organizations like Pulver Laboratories are listed on the label adjacent to the testing standards used during equipment evaluation.

A rough sketch of the label location is shown below.

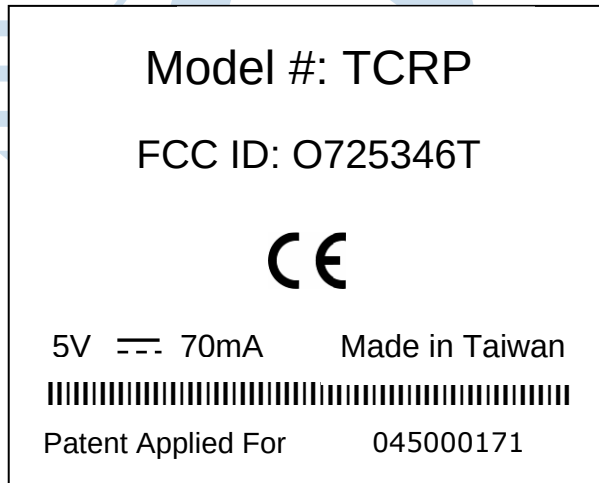


Base Plate of EUT

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**Label Illustration
Sample Label**



2.2 Operators' Manual Information

2.2.1 Insert the following information directly into the operators' manual to meet the requirements of product safety and Radio Frequency Interference (RFI) rules and regulations.

WARNING

Use a single shielded power cord to connect AC power to the host computer.

2.3 **FCC User Information** - Place the following statements in the front of the operators' manual so that the user of the EUT is aware of its interference potential. If available, provide additional information to the user about corrective measures.

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For a Class B Digital Device or Peripheral

**FCC NOTICE
INFORMATION FOR THE USER**

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- 1) Reorient or relocate the receiving antenna.
- 2) Increase the separation between the equipment and receiver.
- 3) Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- 4) Consult the dealer or an experienced radio/TV technician for help.

The user may find the following publication prepared by the Federal Communications Commission helpful:

"How to Identify and Resolve Radio-TV Interference Problems"
(Stock Number 004-000-00345-4).

Available exclusively from the Superintendent of Documents, Government Printing Office, Washington, DC 20402 (telephone 202-512-1800).

FCC WARNING

Changes or modifications not expressly approved by the party responsible for compliance to Part 15 of the FCC Rules could void the user's authority to operate the equipment.

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For a Class B or Class 2 Digital Device

**CE NOTICE
INFORMATION FOR THE USER**

This equipment has been tested and found to comply with the limits for a Class B or Class 2 digital device, pursuant to EN 55022 Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at the expense of the user.

The user may find the following publication prepared by the Federal Communications Commission helpful:

"How to Identify and Resolve Radio-TV Interference Problems" (Stock Number 004-000-00345-4).

Available exclusively from the Superintendent of Documents, Government Printing Office, Washington, DC 20402 (telephone 202-512-1800).

WARNING

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- 2.4 **Industry Canada** - Provide the ICAN statements that follow this paragraph along with the Pulver Laboratories Certificate of Conformance (in this report) in the first pages of the operators' manual and place with the shipping documents accompanying each product.

ICAN Class B Digital Equipment

This Class B digital apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

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FIGURE 1: PLI Photograph Number 5346C2934SJ-07 illustrates the front view of the Equipment Under Test with all peripherals attached in **Test Configuration #1**. The "open field" radiated and the "screen room" conducted Radio Frequency Interference / Electromagnetic Interference test programs utilized this equipment and cable configuration.



FIGURE 2: PLI Photograph Number 5346C2934SJ-06 illustrates the rear view of the Equipment Under Test with all peripherals attached in **Test Configuration #1**. The "open field" radiated and the "screen room" conducted Radio Frequency Interference / Electromagnetic Interference test programs utilized this equipment and cable configuration.



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FIGURE 3: PLI Photograph Number 5346C2934SJ-08 illustrates the front view of the Equipment Under Test with all peripherals attached in conducted Electromagnetic Interference **Test Configuration #1**.



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FIGURE 4: PLI Photograph Number 5346C2934SJ-09 illustrates the rear view of the Equipment Under Test with all peripherals attached in conducted Electromagnetic Interference **Test Configuration #1**.



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FIGURE 5: PLI Photograph Number 5346C2934SJ-01 illustrates the top view of the EUT.



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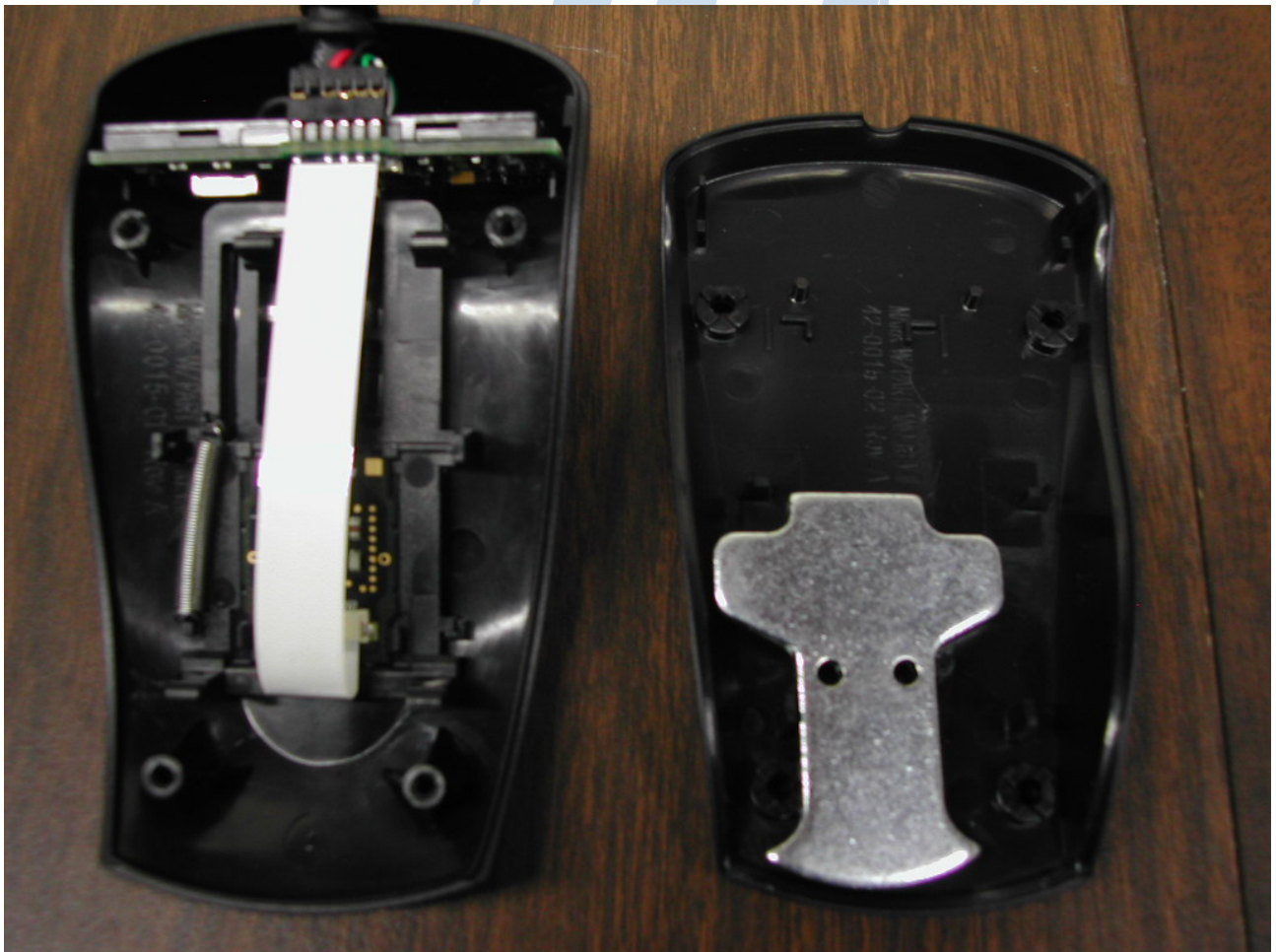
FIGURE 6: PLI Photograph Number 5346C2934SJ-02 illustrates the bottom view of the EUT.



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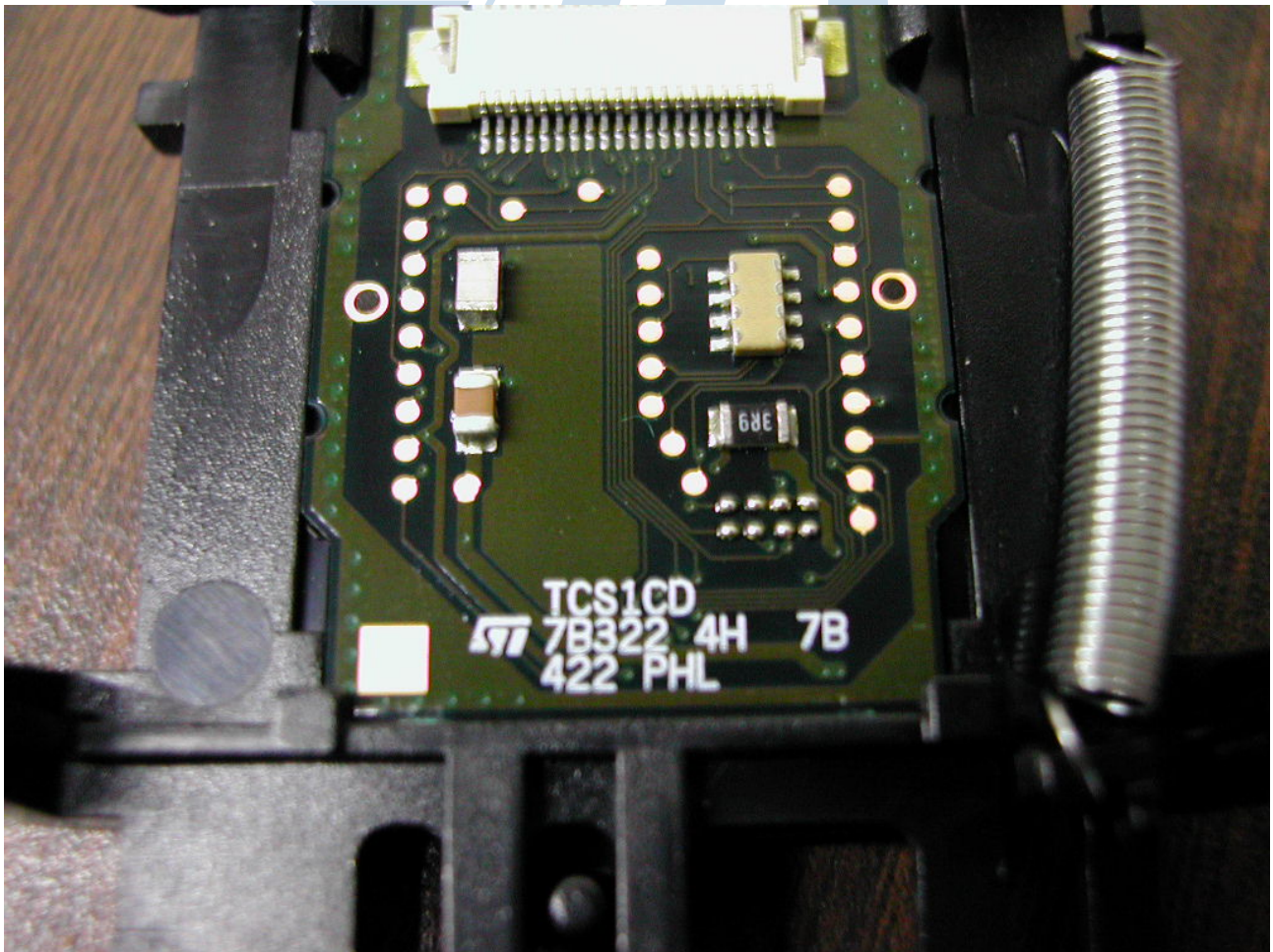
FIGURE 7: PLI Photograph Number 5346C2934SJ-05 illustrates the bottom chassis removed showing components inside and the cabling.



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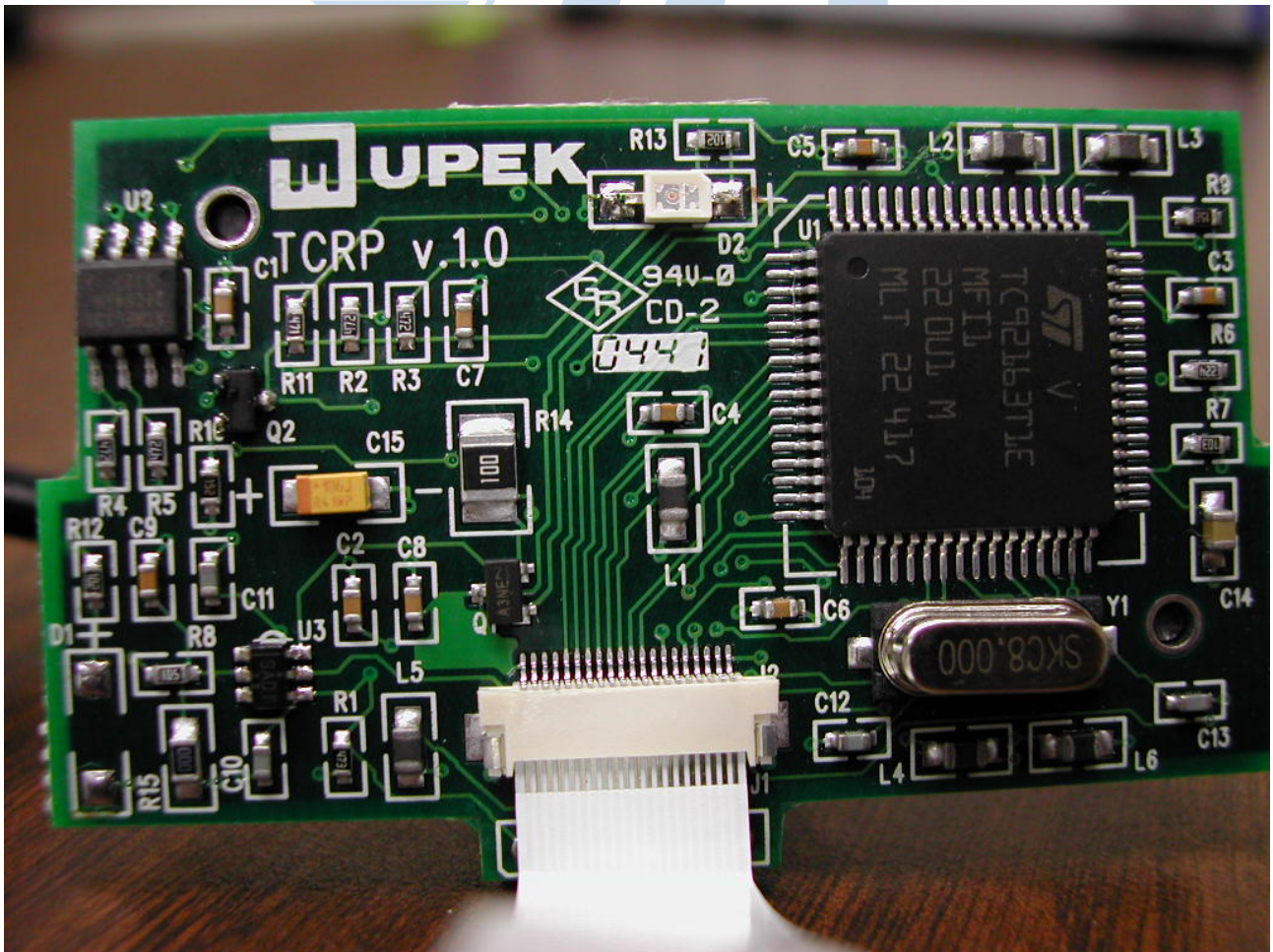
FIGURE 8: PLI Photograph Number 5346C2934SJ-03 illustrates the component side of the Sensor board, TCS1CD.



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FIGURE 9: PLI Photograph Number 5346C2934SJ-04 illustrates the component side of the Input/Output board, TCRP v1.0.



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Clock Oscillators and Frequencies of Operation		
Frequency	Component # / Location	Description of Use
8MHz	Y1	Input/output board
Use this table to simplify locating the oscillators in the accompanying schematics.		

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The diagram illustrates a typical PC system configuration. A central **Host PC** is connected to several peripherals:

- Monitor**: Connected to the Host PC via a vertical line.
- Keyboard**: Connected to the Host PC via a horizontal line.
- Mouse**: Connected to the Host PC via a horizontal line.
- Modem**: Connected to the Host PC via a vertical line and to a **PHONE LINE** via a dashed line.
- Media Reader**: Connected to the Host PC via a vertical line.
- EUT** (External Unit): Connected to the Host PC via a horizontal line.
- Printer**: Connected to the Host PC via a horizontal line.

Power connections are shown at the bottom:

- The **Keyboard** and **Mouse** are connected to a common line labeled **TO 120VAC MAINS POWER**.
- The **Host PC** is connected to a line labeled **TO 120VAC MAINS POWER**.
- The **Printer** is connected to a line labeled **TO 120VAC MAINS POWER**.

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www.PulverLabs.com
Los Gatos, California 95030-7243

Fax 408.399.7001
Voice 408.399.7000

3.0 Radiated Electromagnetic Interference (EMI) - Test Configuration

- 3.1 PLI placed the Equipment Under Test (EUT) on an 80-centimeter high table located on a 12.70 millimeter (0.5 inch) thick, 1.83-meter (6.00 foot) diameter, remote controlled steel turntable positioned 3.00 meters away from a receiving antenna assembly. This steel gear driven turntable has a 2400 pound capacity. The grounded turntable top surface is flush with a grounded screen consisting of 6.35 millimeter (0.25 inch) squares forming a wire mesh. The automated 4.00 meter mast and antenna assembly connects to an RF amplifier attached to a spectrum analyzer with quasi-peak adapter.
- 3.2 The Equipment Under Test (EUT) was operated at its specified load condition for which it was designed. After 30 minutes of continuous operation the EUT reached normal operating temperature. PLI recorded EMI data in this report during the normal load and operating temperature of the EUT.
- 3.3 The EUT and system configuration follows:

Test Configuration #1:

- a. The EUT was plugged into the USB port of the host computer.
 - b. The monitor, printer, modem, media reader, keyboard, and mouse were connected to the host computer.
 - c. The host computer was powered ON and the Windows XP operating system was allowed to initialize.
 - d. The software for TCRP was loaded, and the shortcut for "Test TCI" and "SCReader Test" were created on the desktop.
 - e. Clicked on "SCReaderTest" to test the security card.
 - f. Clicked on "TestTCI", and then clicked the "Start" button located in the "Continuous Image Grab" area.
 - g. The EUT "continuously grabbed" the fingerprint until the "Stop" button was clicked.
- 3.4 The following equipment list defines the system configuration:

EUT	:TouchChip ® Silicon Fingerprint and Smartcard Reader
Model Number	:TCRP
Serial Number	:045000171
FCC ID Number	:0725346T (Pending)
Manufacturer	:UPEK, Inc.
Product	:Computer
Model Number	:MCM
Serial Number	:566C711
FCC ID Number	:FCC DOC Authorized
Manufacturer	:Dell Corporation

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Product :Monitor
Model Number :E551C
Serial Number :CN-07G076-64180-IAK-00WX
FCC ID Number :ARSCM356N
Manufacturer :Dell Corp

Product Name :Keyboard
Model Number :SK-8100
Serial Number :CN-098C487-38840-ICR-5189 Rev A00
FCC ID Number :FCC DOC Authorized
Manufacturer :Dell Corporation

Product Name :Printer
Model Number :KX-P1091i
Serial Number :005
FCC ID Number :ACJ5Z6KX-P1091i
Manufacturer :Panasonic

Product Name :Mouse
Model Number :PS/2
Serial Number :X06-08477
FCC ID Number :FCC DOC Authorized
Manufacturer :Dell Corporation

Product Name :CompactFlash Media Reader
Model Number :F54140
Serial Number :31620141700739
FCC ID Number :FCC DOC Authorized
Manufacturer :Belkin

Product Name :Modem
Model Number :Accura 15328
Serial Number :1124-H08-15328-C1-0026
FCC ID Number :FCC DOC Authorized
Manufacturer :Hayes

Product Name :Power adapter for modem
Model Number :D7500
Serial Number :13136
FCC ID Number :none
Manufacturer :Hon-Kwang

Product Name :Ringdown
Model Number :DLE-200B
Serial Number :258193G
FCC ID Number :none
Manufacturer :Viking

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- 3.5 The Equipment Under Test was evaluated per the American National Standards Institute standard number C63.4-2001 entitled Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz. To maximize Electromagnetic Interference signal strength, PLI rotated the System Under Test 360 degrees and then adjusted the receiving antenna height until the maximum signal appeared on the spectrum analyzer. The input/output interface cables between units of the system were always positioned to yield maximum field strength.

4.0 Radiated EMI – Results

- 4.1 The investigated frequency spectrum revealed radiated EMI signals. The highest interference in the horizontal polarization occurred when the front of the unit was facing 180 degrees clockwise with respect to the antenna. The highest interference in the vertical polarization occurred when the front of the unit was facing 180 degrees clockwise with respect to the antenna.
- 4.2 The "ACF" (Antenna Correction Factor) shown in the test data in this report includes compensation for the antenna factor; cable attenuation; the series RF attenuator; the RF amplifier; and pre-selector system losses. PLI shows the spectrum analyzer data as quasi-peak amplitudes.
- 4.3 The test facility is FCC registered; the procedures are CISPR registered, ICAN registered, VCCI registered, VDE approved, and RegTP approved.

Type of Test	Radiated Electromagnetic Interference
Specification	FCC, ICAN, and EN55022 Class B
Date Data Collected	25 Jan 2005
Detection Technique	Spectrum Analyzer with Quasi-peak Adapter
Resolution Bandwidth (RB)	100 kHz 1 to 18 GHz: 1 MHz RB
Video Bandwidth (VB)	100 kHz 1 to 18 GHz: 10 MHz VB
Antennas	30 to 200 MHz High Field Biconical Antenna 200 to 1500 MHz Log-Periodic Antenna 1 to 18 GHz Double Ridge Guide Horn

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Test Configuration #1

Frequency MHz	EMI Data dBµV/M	ACF	Field Strength dBµV/M	FCC Limit dBµV/M	FCC Margin to Limit dBµV/M	EN Limit dBµV/M	EN Margin to Limit dBµV/M
30 - 1000 MHz							
Horizontal							
48.00	32.40	-9.88	22.52	40.00	-17.48	40.46	-17.94
80.83	38.80	-14.02	24.78	40.00	-15.22	40.46	-15.68
108.45	47.70	-11.22	36.48	43.50	-7.02	40.46	-3.98
109.33	46.80	-11.08	35.72	43.50	-7.78	40.46	-4.74
116.93	42.00	-9.82	32.18	43.50	-11.32	40.46	-8.28
147.53	42.10	-9.51	32.59	43.50	-10.91	40.46	-7.87
165.65	34.30	-8.84	25.46	43.50	-18.04	40.46	-15.00
173.30	33.80	-9.11	24.69	43.50	-18.81	40.46	-15.77
228.43	45.30	-9.48	35.82	46.00	-10.18	40.46	-4.64
232.95	43.20	-9.19	34.01	46.00	-11.99	47.46	-13.45
240.00	49.20	-8.73	40.47	46.00	-5.53	47.46	-6.99
282.25	36.50	-5.78	30.72	46.00	-15.28	47.46	-16.74
298.20	36.80	-5.61	31.19	46.00	-14.81	47.46	-16.27
299.88	36.80	-5.59	31.21	46.00	-14.79	47.46	-16.25
314.98	36.40	-5.80	30.60	46.00	-15.40	47.46	-16.86
366.58	32.30	-5.23	27.07	46.00	-18.93	47.46	-20.39
432.03	39.10	-2.27	36.83	46.00	-9.17	47.46	-10.63
537.28	31.10	-1.06	30.04	46.00	-15.96	47.46	-17.42
555.25	44.20	-0.96	43.24	46.00	-2.76	47.46	-4.22
641.60	34.70	-0.66	34.04	46.00	-11.96	47.46	-13.42
762.08	33.20	1.39	34.59	46.00	-11.41	47.46	-12.87

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Test Configuration #1

Frequency MHz	EMI Data dBµV/M	ACF	Field Strength dBµV/M	FCC Limit dBµV/M	FCC Margin to Limit dBµV/M	EN Limit dBµV/M	EN Margin to Limit dBµV/M
30 - 1000 MHz							
Vertical							
30.00	39.80	-8.39	31.41	40.00	-8.59	40.46	-9.05
32.03	45.00	-8.43	36.57	40.00	-3.43	40.46	-3.89
138.70	39.30	-7.05	32.25	43.50	-11.25	40.46	-8.21
165.68	36.10	-4.83	31.27	43.50	-12.23	40.46	-9.19
169.33	37.00	-4.60	32.40	43.50	-11.10	40.46	-8.06
177.83	37.80	-4.36	33.44	43.50	-10.06	47.46	-14.02
231.95	42.10	-3.51	38.59	46.00	-7.41	47.46	-8.87
233.20	42.30	-3.48	38.82	46.00	-7.18	47.46	-8.64
240.05	35.90	-3.36	32.54	46.00	-13.46	47.46	-14.92
288.03	34.20	-2.28	31.92	46.00	-14.08	47.46	-15.54
298.28	31.20	-1.99	29.21	46.00	-16.79	47.46	-18.25
319.28	31.70	-1.54	30.16	46.00	-15.84	47.46	-17.30
325.23	33.60	-1.42	32.18	46.00	-13.82	47.46	-15.28
343.25	34.90	-1.05	33.85	46.00	-12.15	47.46	-13.61
364.50	32.80	-0.61	32.19	46.00	-13.81	47.46	-15.27
366.58	32.50	-0.57	31.93	46.00	-14.07	47.46	-15.53
384.05	32.20	-0.20	32.00	46.00	-14.00	47.46	-15.46
432.05	38.00	0.79	38.79	46.00	-7.21	47.46	-8.67
439.25	33.60	0.94	34.54	46.00	-11.46	47.46	-12.92
528.08	31.10	2.71	33.81	46.00	-12.19	47.46	-13.65
720.10	30.60	6.38	36.98	46.00	-9.02	47.46	-10.48

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4.4 **Calculations and Notes Concerning Data Presentation**

4.4.1 "ACF" means the Antenna Correction Factor for either Horizontal or Vertical antenna orientation.

4.4.2 "H" designates the Horizontal antenna orientation.

4.4.3 "V" designates the Vertical antenna orientation.

4.4.4 "*" means the data shown in the "Margin to Limit" column exceeds the data in the "EN Limit" column, or exceeds the data in the "FCC Limit" column. "*" could also mean that the Margin to the Limit is greater than - 2.00 dB μ V per meter.

4.4.5 "A" designates an ambient signal.

4.4.6 "(-.-)" means the signal level is lower than the adjacent data or within the background ambients.

4.4.7 "EMI DATA" plus "ACF" equals "Field Strength".

4.4.8 "Field Strength" minus "EN Limit" and/or minus "FCC Limit" equals "Margin to Limit".

4.4.9 "Margin to Limit" negative numbers show Equipment Under Test "Field Strength" below the "EN Limit" and/or below the "FCC Limit". "Margin to Limit" positive numbers show Equipment Under Test "Field Strength" above the "EN Limit" and/or above the "FCC Limit".

4.5 The field strengths in this section were measured at 3.0 meters. None of the Electromagnetic Interference quasi-peaks are in excess of the ICAN (Industry Canada), FCC (Federal Communications Commission), and EC (European Community) Class B maximums, even when the field strength readings in the above table are reduced by 20 dB μ V (to represent 30 meter test site measurements, since an antenna positioned at 30.0 meters receives one tenth of the field strength recorded at 3.0 meters).

4.6 **Conclusion** - The radiated Electromagnetic Interference of the Equipment Under Test meets the requirements for Industry Canada (ICAN), Federal Communications Commission (FCC), and the European Community (EC) Class B devices.

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5.0 Conducted EMI - Test Configuration

- 5.1 Current input power leads of the Equipment Under Test were connected to a Line Impedance Stabilization Network (LISN), which isolate and couple the conducted interference from the power lines to a spectrum analyzer. The LISN and the Equipment Under Test were connected and positioned according to the Industry Canada and the Federal Communications Commission test recommendations. The Equipment Under Test was configured exactly as outlined in the Radiated Electromagnetic Interference Section of this report. The spectrum analyzer data is shown in the following table as quasi-peak amplitudes.
- 5.2 To increase data integrity and also meet the recommendations of the American National Standards Institute standard number C63.4-2001, all electrical devices comprising the system being tested with the Equipment Under Test were connected to the VAC mains using a second Line Impedance Stabilization Network.

6.0 Conducted EMI – Results

- 6.1 Investigation of the EUT revealed conducted interference levels as shown in the table below.

Type of Test	Conducted Electromagnetic Interference
Specification	FCC, ICAN, and EN55022 Class B
Date Data Collected	26 Jan 2005
Detection Technique	Spectrum Analyzer with Quasi-peak Adapter
Frequency Range	0.150 to 30.0 MHz
Resolution Bandwidth	10 kHz
Video Bandwidth	10 kHz
Line Impedance Stabilization Network	50 micro Henry; 50 ohm

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Test Configuration #1

Frequency MHz	Line Data dBμV	Neutral Data dBμV	FCC / EN Limit dBμV	FCC / EN Margin to To Limit (Line) dBμV	FCC / EN Margin to to Limit (Neutral) dBμV
0.17	40.40	-.-	65.53	-25.13	-.-
0.27	41.90	-.-	63.03	-21.13	-.-
0.34	47.70	-.-	61.11	-13.41	-.-
0.42	43.10	-.-	58.69	-15.59	-.-
0.80	40.60	-.-	56.00	-15.40	-.-
4.79	29.30	-.-	56.00	-26.70	-.-
6.29	28.30	-.-	60.00	-31.70	-.-
11.41	21.30	-.-	60.00	-38.70	-.-
15.14	24.90	-.-	60.00	-35.10	-.-
22.27	21.40	-.-	60.00	-38.60	-.-
25.12	21.10	-.-	60.00	-38.90	-.-
27.75	21.40	-.-	60.00	-38.60	-.-
0.17	-.-	41.00	65.53	-.-	-24.53
0.27	-.-	44.30	63.03	-.-	-18.73
0.34	-.-	51.60	61.11	-.-	- 9.51
0.42	-.-	44.20	58.69	-.-	-14.49
0.80	-.-	42.20	56.00	-.-	-13.80
2.44	-.-	27.00	56.00	-.-	-29.00
3.66	-.-	26.40	56.00	-.-	-29.60
4.48	-.-	26.20	56.00	-.-	-29.80
6.24	-.-	27.10	60.00	-.-	-32.90
12.09	-.-	24.70	60.00	-.-	-35.30
22.29	-.-	21.30	60.00	-.-	-38.70
27.45	-.-	21.20	60.00	-.-	-38.80

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6.2 Calculations and Notes Concerning Data Presentation

- 6.2.1 "*" means the "Margin to Limit" Exceeds the "FCC Limit" and/or Exceeds the "EN Limit" or is within a -2 dB μ V margin.
- 6.2.2 "(-.-)" means the signal level is lower than the adjacent data or within the background ambients.
- 6.2.3 "Line Data" minus "FCC Limit" and/or minus "EN Limit" equals "Margin to Limit" for the Line side of the input power cord.
- 6.2.4 "Neutral Data" minus "FCC Limit" and/or minus "EN Limit" equals "Margin to Limit" for the Neutral side of the input power cord.
- 6.2.5 "Margin to Limit" negative numbers show Equipment Under Test "Field Strength" **below** the "FCC Limit" and/or **below** the "EN Limit". "Margin to Limit" positive numbers show Equipment Under Test "Field Strength" **above** the "FCC Limit" and/or **above** the "EN Limit".
- 6.2.6 "A" means an Ambient signal.
- 6.2.7 The symbol " Σ " adjacent to a line of conducted Electromagnetic Interference data means that the "Field Strength" was recorded directly as a quasi-peak measurement, and then reduced by 13 dB μ V. The data obtained in quasi-peak mode was 6 dB μ V or higher than the level of the same emission measured with the spectrum analyzer detector function set to the average mode. The emission was considered broadband, since the quasi-peak mode bandwidth setting was identical to the average mode bandwidth setting. 100 samples were recorded represented by the following equation:

$$\left(\frac{1}{n}\right)\sum_{i=1}^n X_i$$

- 6.3 **Conclusion** - The conducted Electromagnetic Interference of the Equipment Under Test meets the requirements for Industry Canada (ICAN), Federal Communications Commission (FCC), and the European Community (EC) Class B devices.
- 6.4 Graphs of PEAK conducted Electromagnetic Interference for frequency ranges on Line and Neutral are shown on the following pages.
- 6.5 The recorded conducted data utilized a quasi-peak measurement procedure. Hence, any differences between the graphs and the data are merely the differences between peak and quasi-peak measurements.

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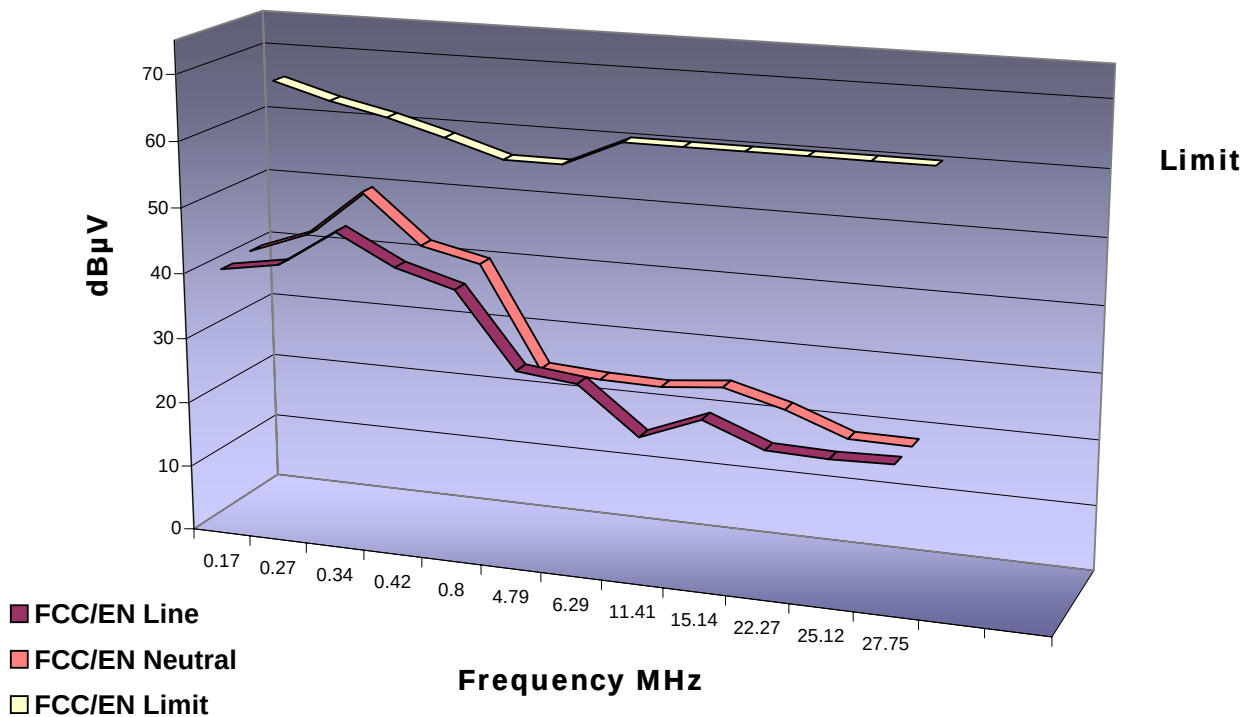
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- 6.6 There are 33 AM and 56 FM radio stations in the immediate San Jose, California, area which create large ambient signals. Typical radio stations are:
- 0.810 MHzKGO
 - 1.170 MHzKLOK
 - 1.370 MHzKEEN
 - 1.500 MHzKHTT
 - 1.590 MHzKLIV
- 6.7 The conducted Electromagnetic Interference graphs in this report show some of the large ambient signals for several of these radio stations.
- 6.8 The final Electromagnetic Interference conducted test and measurement equipment configuration was evaluated to assure that Data Compression or Intermodulation Distortion did not occur due to these large ambient signals.

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Conducted EMI Data Graphic Configuration #1 (EN/FCC)



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Signature Page - Last Page of Report

Project Coordinated by

Signed /Laura A. Bramschreiber/
Laura A. Bramschreiber

Data and Technical Details by

Signed / Phuong Nguyen/
Phuong Nguyen

Quality Assurance by

Signed / Phuong Nguyen/
Phuong Nguyen

Report Approved by

Signed /Lee J. Pulver/
Lee J. Pulver