

TITLE: PLI Evaluation Report (RFI)
DRAWING: 117852
BY: Zane Traub

FCC ID: 0725346X

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Issued: 17 Aug 2000
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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ISSUED

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17 Aug 2000

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Pulver Laboratories Inc. (PLI) File Number: 5346

Pulver Laboratories Inc. (PLI) Project Number: C2730

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

Model Numbers: TCRU1A

Serial Numbers: 0013-000030

Applicant: STMicroelectronics
2001 Center Street, Suite 500
Berkeley, California 94704-1204
Telephone: 510.647.1200
Facsimile: 510.665.9730

Location Certified: STMicroelectronics
2001 Center Street, Suite 500
Berkeley, California 94704-1204
Telephone: 510.647.1200
Facsimile: 510.665.9730

Manufacturing Location: STMicroelectronics
2001 Center Street, Suite 500
Berkeley, California 94704-1204
Telephone: 510.647.1200
Facsimile: 510.665.9730

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 - O725346X

- American National Standards Institute C63.4-1992 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 2 entitled Frequency Allocations and Radio Treaty Matters; General Rules and Regulations; and Part 15 entitled Radio Frequency Devices, October 1999 Edition.

ICAN Verification.

Industry Canada (ICAN)

Category Classification: Class B - Residential

- Canadian Standards Association (CSA) C108.8-M1983 entitled Electromagnetic Emissions for Data Processing Equipment and Electronic Office Machines.
- Canadian Standards Association (CSA) CAN3-C108.3.1-M84 entitled Limits and Measurement Methods of Electromagnetic Noise from AC Power Systems.
- Industry Canada (ICAN) Interference-Causing Equipment Standard ICES-003, Issue 1, June 1991, entitled "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

- EN 55011: 15 Sept 1998. Specification for Limits and methods of measurement of radio disturbance characteristics of industrial, scientific, and medical (ISM) radio-frequency equipment.
- EN55022 / CISPR 22 entitled Limits and methods of measurement of radio disturbance characteristics of information technology equipment, 1995 Edition.

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- 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, revised October 1999;
- American National Standards Institute standard number C63.4-1992 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, Second Edition 1993, with amendment A1, May 1995 Edition.

1.1.2 To assist the Federal Communications Commission in the continuing education of applicants and grantees, Pulver Laboratories has advised STMicroelectronics to purchase 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, 1 October 1998 Edition.

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.

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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.

1.2 Specific Engineering Considerations

1.2.1 Interconnecting low voltage computer cables lengths:

Cable Description	Length (feet)	Length (meters)
EUT: (USB Cable)	5.5	1.68
Monitor:	5.0	1.52
Keyboard:	5.0	1.52
Mouse:	6.6	2.01
Modem:	10.0	3.05
Printer:	8.7	2.65

1.2.2 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 63.4-1992.

1.2.3 Test Configuration with Monitor attached to input power mains radiated more electromagnetic interference than with the monitor connected to the CPU. Therefore, the data in this report reflects the monitor connected directly to the AC mains.

1.2.4 There is one possible Equipment Under Test (TouchChip ® Silicon Fingerprint Reader, Model TCRU1A) input power configuration:

1.2.4.1 A USB port on the host computer supplies the EUT with voltage.

1.2.5 There is one possible EUT test configuration:

1.2.5.1 **Test Configuration #1** consisted of the TCRU1A TouchChip ® Silicon Fingerprint Reader connected to an IBM Compatible PC via the USB port.

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1.3 Product Description and Intended Use

- 1.3.1 Built on the TouchChip Silicon Fingerprint Sensor, the TouchChip 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 reader has been designed for demanding applications such as Desktop Security, Network Security, Commercial Verification and Identification Systems.

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1.4 List of Photographs Contained in this Report

- FIGURE 1:** PLI Photograph Number 003553 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 2:** PLI Photograph Number 003557 illustrates the left rear oblique view of the Equipment Under Test with all peripherals attached in the "screen room" conducted Electromagnetic Interference **Test Configuration #1**.
- FIGURE 3:** PLI Photograph Number 003224 illustrates the top view of the EUT with the top cover removed showing the placement of the internal ribbon cable and associated internal system components.
- FIGURE 4:** PLI Photograph Number 003218 illustrates the component side of the (Mother Board) Controller Printed Circuit Assembly.
- FIGURE 5:** PLI Photograph Number 003220 illustrates the circuit side of the (Mother Board) Controller Printed Circuit Assembly.
- FIGURE 6:** PLI Photograph Number 003221 illustrates the component side of the Sensor Board Printed Circuit Assembly.
- FIGURE 7:** PLI Photograph Number 003222 illustrates the circuit side of the Sensor Board Printed Circuit Assembly.

- 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	Frequency Range
Spectrum Analyzer	Hewlett Packard	8568A	100 Hz - 1.5 GHz
Quasi-peak	Hewlett Packard	85650A	10 kHz - 1.00 GHz
Biconical Antenna	EMCO	3109	30 - 200 MHz
Log Periodic Antenna	EMCO	3146	200 - 1000 MHz
Magnetic Loop Antenna	Electro-Metrics	ALR-25M	10 kHz - 30 MHz
Oscilloscope Camera	Tektronix	C-5C	
Amplifier	Hewlett Packard	8447D Option 010	0.1 - 1300 MHz
Attenuator	Narda	757C (35797)	3 dB (DC - 12.4 GHz)
Attenuator	Narda	757C (36808)	6 dB (DC - 12.4 GHz)
Attenuator	Narda	757C (40604)	10 dB (DC - 12.4 GHz)
Attenuator	Narda	757C (40998)	20 dB (DC - 12.4 GHz)
Close Field Antenna	Electro-Metrics	EFP-25	
Oscilloscope	Tektronix	2445	up to 150 MHz

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Equipment Type	Manufacturer	Model Number	Frequency Range
Capacitor/ Inductor Z Meter	Sencore	1 picofarad to 200,000 microfarads 1 micro Henry to 10 Henries	
L.I.S.N	Solar Electronics Co.	8012-50-R-24 BNC	50 - 60 Hz
Equipment Testing Turn Table	EMCO	1061-06	
Antenna Positioning Tower	EMCO	1050	
Radio Interference Receiver	PRD Electronics Inc.	R-1040/URM-85	(two complete systems)
Antenna Coupler	PRD Electronics Inc.	Cu-893/URM-85	80 - 220 MHz
Antenna Tripod	PRD Electronics Inc.	MT-2459/URM-85	
Frequency Converter	Empire Devices Products Corp.	CV-1102/URM-85	20 - 220 MHz
Frequency Converter	PRD Electronics Inc.	CV-1104A/URM-85	400 - 1000 MHz
Frequency Converter	PRD Electronics Inc.	CV-1101A/URM-85	0.15 - 30 MHz
Frequency Converter	PRD Electronics Inc.	CV-1103/URM-85	200 - 400 MHz

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Equipment Type	Manufacturer	Model Number	Frequency Range
Frequency Converter	PRD Electronics Inc.	CV-1102A/URM-85	20 - 220 MHz
Antenna Coupler (two systems)	PRD Electronics Inc.	CU-890/URM-85	0.15 - 30 MHz
Loop Antenna (two systems)	PRD Electronics Inc.	AT-1026/URM-85	0.15 - 30 MHz
Frequency Comb Generator	Hewlett Packard	8406A	20 - 1200 MHz
Tunable Band Pass Filter	K & L Microwave Inc.	5BT-95/190-5/B	95 - 195 MHz
Tunable Band Pass Filter	K & L Microwave Inc.	5BT-48/95-5/B	50 - 95 MHz
High Pass Filter	Solar Electronics Co.	7801-5.0	5 kHz
Absorbing Clamp	Schaffner EMC Inc.	MDS-21	30 - 1000 MHz
Line Probe	EMCO	3701	
Antenna Set	EMCO	3121C	30 - 1000 MHz
L.I.S.N	Solar Electronics Co.	8328-50-TS-50-N	
Frequency Generator		TS-418B/U	400 - 1000 MHz
Frequency Generator		TS-510A/U	10 - 420 MHz

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Equipment Type	Manufacturer	Model Number	Frequency Range
Antenna Set	Electro-Metrics	TDA-25	30 - 200 MHz
Antenna Set	Electro-Metrics	TDS-25-1	200 - 500 MHz
Antenna Set	Electro-Metrics	TDS-25-2	500 - 1000 MHz
Antenna (two sets)	PRD Electronics Inc.	AT-1030/URM-85	400 - 1000 MHz
Coupler Antenna	PRD Electronics Inc.	CU-895/URM-85	20 - 1000 MHz
Electronic Field Probe	PRD Electronics Inc.	MX-3411/URM-85	0.15 - 1000 MHz
Fixed Attenuator	PRD Electronics Inc.	CN-721/URM-85	0.15 - 1000 MHz
Magnetic Field Probe	PRD Electronics Inc.	MX-3412/URM-85	20 - 1000 MHz
Coupler	PRD Electronics Inc.	CU-896/URM-85	20 - 1000 MHz
Coupler	PRD Electronics Inc.	CU-897/URM-85	20 - 1000 MHz
Ground Rod	PRD Electronics Inc.	GP-117/URM-85	
Coupler Antenna	PRD Electronics Inc.	CU-894/URM-85	200 - 400 MHz
Reflector Antenna	PRD Electronics Inc.	AT-1027/URM-85	0.15 - 30 MHz

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Equipment Type	Manufacturer	Model Number	Frequency Range
Cable Assembly Set	PRD Electronics Inc.	MX-3410/URM-85	
Cord Assembly	PRD Electronics Inc.	CX-4305/U	
Mega Cycle Tape	Disston Carlson	TM6625-351-12-8	17 - 1000 MHz
Antenna Discone	Empire Devices Products Corp.	AS-1158/URM-85	Broad Band
Headset	Empire Devices Products Corp.	H-113/U	
Mast Sections	Empire Devices Products Corp.	AB-21/GR	
Antenna Tripod			
EMI Line Filter	Stanford Applied Engineering	D30B	50 - 60 Hz 3 phase
Digital Power Meter	Fluke and Phillips	FLUKE 39	
Multimeter	Fluke and Phillips	FLUKE 87 True RMS	
Feed Through Caps	Solar Electronics Co.	6512-106 R 10 microfarad capacitors	275V RMS, 60 Hz
Multimeter	Beckman Industrial Corp.	Circuitmate DM15B	250V RMS, 400 Hz
RMS Multimeter	Beckman Industrial Corp.	Tech 310	

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Equipment Type	Manufacturer	Model Number
Multimeter	Fluke and Phillips	FLUKE 85
RMS Multimeter	Fluke and Phillips	FLUKE 87
ELF Field Monitor	Walker Magnetic Group	ELF 50D
RMS Multimeter	Fluke and Phillips	FLUKE 87

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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 Block diagram.
 - 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 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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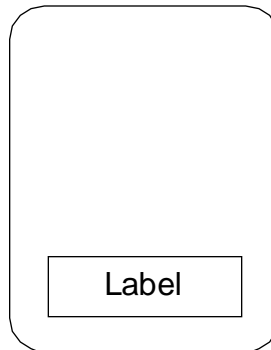
2.0 Mandatory Labeling and Operators' Manual Information and Shipping Documents

2.1 Label

Illustration 1.0 on the next page illustrates the actual label (three times the actual size) 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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Illustration 1.0
{three times the size of actual FCC Label}

Alternative Label

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2.2 Operators' Manual Information

2.2.1 The following information is inserted directly into the equipment user instruction manual to meet the requirements of product safety and Radio Frequency Interference (RFI) rules and regulations.

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

2.3 **User Information** - The following statements are placed in the front of the operators' manual so that the user of the EUT is aware of its interference potential. Additional information about corrective measures may also be provided to the user at the manufacturer's option.

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For a Class B Digital Device or Peripheral

FCC NOTICE INFORMATION FOR THE USER

FCC ID: 0725346X

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

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 of 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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- 2.4 **Industry Canada** - The ICAN statements that follow this paragraph (Illustration 2.0) shall be provided along with the Pulver Laboratories Certificate of Conformance (in this report) in the first pages of the operators' manual and be placed with the shipping documents accompanying each product.

Illustration 2.0

ICAN Class B Digital Equipment

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

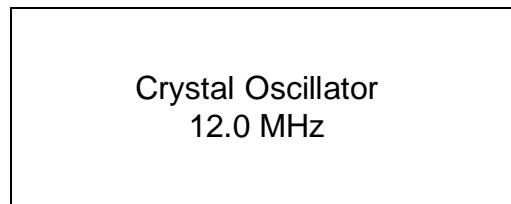
Cet appareil numérique de la classe B respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

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**Block Diagram of Equipment Under Test (EUT)
Showing Clock Oscillators and Frequencies of Operation**



**Use this diagram to simplify locating the oscillators
in the accompanying schematics.**

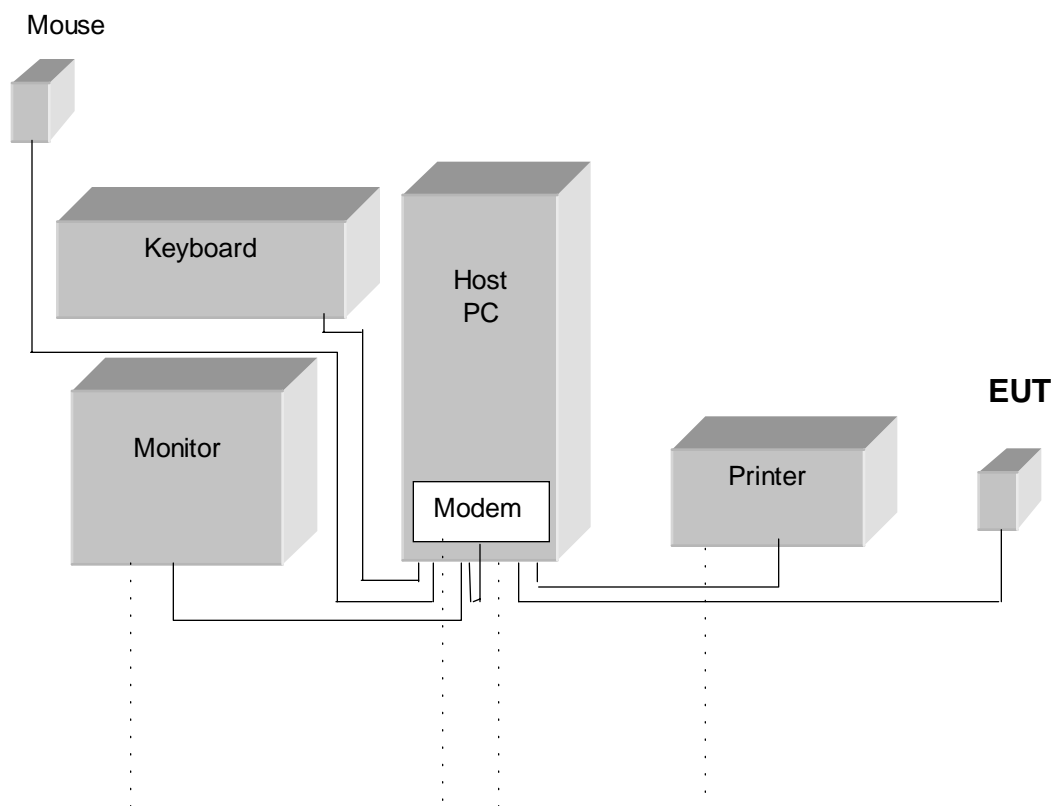
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Equipment Under Test Orientation and Configuration

180 Degrees



Zero Degrees

Cable Legend

—— Data Cables
..... Power Cables

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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. Recorded EMI data in this report was accumulated 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. A color monitor, keyboard, mouse, modem, and printer were connected to the host computer.
- c. The host computer was powered "ON" and the Windows 98 operating system loaded.
- d. Following initialization of the Windows 98 operating system, the software for capturing a fingerprint was loaded and directed to continuously send an input signal from the fingerprint sensor connected to the USB port to the digital video fingerprint display on the monitor using the following sequence:
 - Click on "TCTEST.EXE" Icon on the desktop
 - Select "STINITIALIZE" button, and wait for initialization
 - Select "STOPEN" button, and wait for initialization
 - Select "GRABCONTINUOUS" button
- e. This abnormal operation maintained a maximized, continuous data flow between the EUT and the host computer.

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The following equipment list defines the system configuration:

EUT :TouchChip ® Silicon Fingerprint Reader
Model Number :TCRU1A
Serial Number :0013-000030
FCC ID Number :O725346X (pending)
Manufacturer :STMicroelectronics

Product :E Tower 300MHZ PC
Model Number :E Tower 300
Serial Number :R300009405513
FCC ID Number :DOC Authorized
Manufacturer :E Machines Inc.

Product Name :Keyboard
Model Number :5900W
Serial Number :K890306016
FCC ID Number :DOC Authorized
Manufacturer :Brain Trust

Product Name :Trinitron Color Monitor Display
Model Number :CPD-100ES
Serial Number :4361844
FCC ID Number :GWGCPD100ES
Manufacturer :Sony Corporation

Product :Mouse
Model Number :T-CH11
Serial Number :LZB72905979
FCC ID Number :DZLT-CH11
Manufacturer :Logitech

Product Name :Smart Modem 2400
Model Number :231AA
Serial Number :AO3031003936
FCC ID Number :BFJ9D9-231AA
Manufacturer :Hayes MicroComputer Products Inc.

Product Name :Printer
Model Number :GE5251B
Serial Number :510A0112915
FCC ID Number :BDB9F2192
Manufacturer :Okidata

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- 3.4 The Equipment Under Test was evaluated per the American National Standards Institute standard number C63.4-1992 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. The spectrum analyzer data is shown as quasi-peak amplitudes.
- 4.3 The test facility is FCC registered; the procedures are CISPR registered, ICAN registered, VCCI registered, VDE approved, and BZT approved.

Type of Test	Radiated Electromagnetic Interference
Specification	FCC, ICAN, and EN55022 Class B
Date Data Collected	29 Aug 2000
Detection Technique	Spectrum Analyzer with Quasi-peak Adapter
Resolution Bandwidth	100 kHz
Video Bandwidth	100 kHz
Antennas	30 to 200 MHz High Field Biconical 200 to 1000 MHz Log-Periodic

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Test Configuration # 1

Frequency MHz	EMI Data dBµV/M	ACF	Field Strength dBµV/M	FCC Limit dBµV/M	Margin to Limit dBµV/M
Horizontal					
30.00	28.80	-8.24	20.56	40.00	-19.44
36.00	30.20	-8.66	21.54	40.00	-18.46
39.38	33.80	-8.90	24.90	40.00	-15.10
41.65	29.20	-9.13	20.07	40.00	-19.93
48.00	29.70	-9.88	19.82	40.00	-20.18
51.65	29.60	-10.23	19.37	40.00	-20.63
60.00	30.00	-10.78	19.22	40.00	-20.78
66.68	34.50	-11.73	22.77	40.00	-17.23
78.85	34.90	-13.78	21.12	40.00	-18.88
80.00	32.80	-13.98	18.82	40.00	-21.18
87.35	34.20	-14.34	19.86	40.00	-20.14
120.40	39.10	-9.34	29.76	43.50	-13.74
135.40	38.40	-9.88	28.52	43.50	-14.98
144.00	29.00	-9.74	19.26	43.50	-24.24
147.40	35.00	-9.52	25.48	43.50	-18.02
156.88	26.80	-7.82	18.98	43.50	-24.52
160.00	33.10	-7.12	25.98	43.50	-17.52
168.00	41.70	-9.56	32.14	43.50	-11.36
177.98	27.10	-7.61	19.49	43.50	-24.01
188.35	29.10	-8.77	20.33	43.50	-23.17
190.48	29.50	-9.23	20.27	43.50	-23.23
197.45	26.80	-10.75	16.05	43.50	-27.45
210.90	30.70	-10.61	20.09	43.50	-23.41
214.80	31.80	-10.36	21.44	43.50	-22.06
216.00	35.60	-10.28	25.32	43.50	-18.18
218.03	28.70	-10.15	18.55	46.00	-27.45
220.63	40.60	-9.99	30.61	46.00	-15.39
228.00	42.60	-9.51	33.09	46.00	-12.91
252.00	30.80	-7.93	22.87	46.00	-23.13
264.00	36.30	-7.02	29.28	46.00	-16.72

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Test Configuration # 1 - Continued

Frequency MHz	EMI Data dBμV/M	ACF	Field Strength dBμV/M	FCC Limit dBμV/M	Margin to Limit dBμV/M
Horizontal					
276.00	35.70	-6.11	29.59	46.00	-16.41
288.00	34.30	-5.72	28.58	46.00	-17.42
300.00	29.60	-5.59	24.01	46.00	-21.99
312.00	29.00	-5.76	23.24	46.00	-22.76
324.00	25.30	-5.93	19.37	46.00	-26.63
336.00	33.80	-6.10	27.70	46.00	-18.30
360.00	28.60	-5.65	22.95	46.00	-23.05
366.60	27.00	-5.23	21.77	46.00	-24.23
432.55	22.80	-2.25	20.55	46.00	-25.45
441.08	22.20	-2.03	20.17	46.00	-25.83
480.00	28.30	-1.45	26.85	46.00	-19.15
589.78	26.40	-0.67	25.73	46.00	-20.27
624.15	24.10	-0.63	23.47	46.00	-22.53
643.78	27.40	-0.67	26.73	46.00	-19.27
831.93	21.80	3.32	25.12	46.00	-20.88
850.65	21.90	3.90	25.80	46.00	-20.20
905.68	24.40	4.99	29.39	46.00	-16.61
999.90	21.60	7.74	29.34	54.00	-24.66

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Test Configuration #1

Frequency MHz	EMI Data dBµV/M	ACF	Field Strength dBµV/M	FCC Limit dBµV/M	Margin to Limit dBµV/M
Vertical					
36.00	30.00	-8.52	21.48	40.00	-18.52
48.00	41.40	-8.76	32.64	40.00	-7.36
50.00	30.20	-8.80	21.40	40.00	-18.60
59.88	28.70	-9.79	18.91	40.00	-21.09
71.90	31.80	0.00	21.63	40.00	-18.37
83.95	31.80	-9.44	22.36	40.00	-17.64
109.10	25.40	-8.34	17.06	43.50	-26.44
120.00	35.50	-7.90	27.60	43.50	-15.90
132.00	25.90	-7.31	18.59	43.50	-24.91
144.00	30.50	-6.72	23.78	43.50	-19.72
168.00	40.39	-4.68	35.71	43.50	-7.79
179.93	24.70	-4.30	20.40	43.50	-23.10
192.00	24.70	-4.30	20.40	43.50	-23.10
197.73	25.10	-4.30	20.80	43.50	-22.70
201.30	30.70	-11.22	19.48	43.50	-24.02
215.78	28.40	-10.29	18.11	43.50	-25.39
217.58	36.50	-10.18	26.32	46.00	-19.68
233.35	28.40	-9.16	19.24	46.00	-26.76
284.75	23.00	-5.76	17.24	46.00	-28.76
325.95	27.10	-5.96	21.14	46.00	-24.86
339.85	27.10	-6.15	20.95	46.00	-25.05
365.60	27.40	-5.29	22.11	46.00	-23.89
398.15	26.60	-3.21	23.39	46.00	-22.61
405.55	22.70	-2.95	19.75	46.00	-26.25
414.27	36.60	-2.72	33.88	46.00	-12.12
420.53	22.40	-2.56	19.84	46.00	-26.16
422.75	31.20	-2.50	28.70	46.00	-17.30
505.25	22.20	-1.20	21.00	46.00	-25.00
515.18	22.70	-1.16	21.54	46.00	-24.46
531.33	33.50	-1.09	32.41	46.00	-13.59

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Test Configuration #1 - Continued

Frequency MHz	EMI Data dBμV/M	ACF	Field Strength dBμV/M	FCC Limit dBμV/M	Margin to Limit dBμV/M
Vertical					
577.00	28.70	-0.78	27.92	46.00	-18.08
598.93	25.20	-0.59	24.61	46.00	-21.39
609.23	28.90	-0.60	28.30	46.00	-17.70
614.55	32.50	-0.61	31.89	46.00	-14.11
621.80	23.60	-0.62	22.98	46.00	-23.02
663.25	20.40	0.01	20.41	46.00	-25.59
687.25	27.40	1.27	28.67	46.00	-17.33
705.75	22.40	1.84	24.24	46.00	-21.76
725.30	22.30	1.51	23.81	46.00	-22.19
744.88	22.40	1.18	23.58	46.00	-22.42
773.83	25.90	1.68	27.58	46.00	-18.42
806.83	22.20	2.53	24.73	46.00	-21.27
843.15	22.50	3.67	26.17	46.00	-19.83
910.33	20.50	5.09	25.59	46.00	-20.41
991.00	20.60	7.40	28.00	54.00	-26.00

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Test Configuration #1

Frequency MHz	EMI Data dBµV/M	ACF	Field Strength dBµV/M	EN Limit dBµV/M	Margin to Limit dBµV/M
Horizontal					
30.00	28.80	-8.24	20.56	40.46	-19.90
36.00	30.20	-8.66	21.54	40.46	-18.92
39.38	33.80	-8.90	24.90	40.46	-15.56
41.65	29.20	-9.13	20.07	40.46	-20.39
48.00	29.70	-9.88	19.82	40.46	-20.64
51.65	29.60	-10.23	19.37	40.46	-21.09
60.00	30.00	-10.78	19.22	40.46	-21.24
66.68	34.50	-11.73	22.77	40.46	-17.69
78.85	34.90	-13.78	21.12	40.46	-19.34
80.00	32.80	-13.98	18.82	40.46	-21.64
87.35	34.20	-14.34	19.86	40.46	-20.60
120.40	39.10	-9.34	29.76	40.46	-10.70
135.40	38.40	-9.88	28.52	40.46	-11.94
144.00	29.00	-9.74	19.26	40.46	-21.20
147.40	35.00	-9.52	25.48	40.46	-14.98
156.88	26.80	-7.82	18.98	40.46	-21.48
160.00	33.10	-7.12	25.98	40.46	-14.48
168.00	41.70	-9.56	32.14	40.46	-8.32
177.98	27.10	-7.61	19.49	40.46	-20.97
188.35	29.10	-8.77	20.33	40.46	-20.13
190.48	29.50	-9.23	20.27	40.46	-20.19
197.45	26.80	-10.75	16.05	40.46	-24.41
210.90	30.70	-10.61	20.09	40.46	-20.37
214.80	31.80	-10.36	21.44	40.46	-19.02
216.00	35.60	-10.28	25.32	40.46	-15.14
218.03	28.70	-10.15	18.55	40.46	-21.91
220.63	40.60	-9.99	30.61	40.46	-9.85
228.00	42.60	-9.51	33.09	40.46	-7.37
252.00	30.80	-7.93	22.87	47.46	-24.59
264.00	36.30	-7.02	29.28	47.46	-18.18

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Test Configuration #1 - Continued

Frequency MHz	EMI Data dBµV/M	ACF	Field Strength dBµV/M	EN Limit dBµV/M	Margin to Limit dBµV/M
Horizontal					
276.00	35.70	-6.11	29.59	47.46	-17.87
288.00	34.30	-5.72	28.58	47.46	-18.88
300.00	29.60	-5.59	24.01	47.46	-23.45
312.00	29.00	-5.76	23.24	47.46	-24.22
324.00	25.30	-5.93	19.37	47.46	-28.09
336.00	33.80	-6.10	27.70	47.46	-19.76
360.00	28.60	-5.65	22.95	47.46	-24.51
366.60	27.00	-5.23	21.77	47.46	-25.69
432.55	22.80	-2.25	20.55	47.46	-26.91
441.08	22.20	-2.03	20.17	47.46	-27.29
480.00	28.30	-1.45	26.85	47.46	-20.61
589.78	26.40	-0.67	25.73	47.46	-21.73
624.15	24.10	-0.63	23.47	47.46	-23.99
643.78	27.40	-0.67	26.73	47.46	-20.73
831.93	21.80	3.32	25.12	47.46	-22.34
850.65	21.90	3.90	25.80	47.46	-21.66
905.68	24.40	4.99	29.39	47.46	-18.07
999.90	21.60	7.74	29.34	47.46	-18.12

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Test Configuration #1

Frequency MHz	EMI Data dBµV/M	ACF	Field Strength dBµV/M	EN Limit dBµV/M	Margin to Limit dBµV/M
Vertical					
36.00	30.00	-8.52	21.48	40.46	-18.98
48.00	41.40	-8.76	32.64	40.46	-7.82
50.00	30.20	-8.80	21.40	40.46	-19.06
59.88	28.70	-9.79	18.91	40.46	-21.55
71.90	31.80	-10.17	21.63	40.46	-18.83
83.95	31.80	-9.44	22.36	40.46	-18.10
109.10	25.40	-8.34	17.06	40.46	-23.40
120.00	35.50	-7.90	27.60	40.46	-12.86
132.00	25.90	-7.31	18.59	40.46	-21.87
144.00	30.50	-6.72	23.78	40.46	-16.68
168.00	40.39	-4.68	35.71	40.46	-4.75
179.93	24.70	-4.30	20.40	40.46	-20.06
192.00	24.70	-4.30	20.40	40.46	-20.06
197.73	25.10	-4.30	20.80	40.46	-19.66
201.30	30.70	-4.26	26.44	40.46	-14.02
215.78	28.40	-3.85	24.55	40.46	-15.91
217.58	36.50	-3.80	32.70	40.46	-7.76
233.35	28.40	-3.48	24.92	47.46	-22.54
284.75	23.00	-2.37	20.63	47.46	-26.83
325.95	27.10	-1.41	25.69	47.46	-21.77
339.85	27.10	-1.12	25.98	47.46	-21.48
365.60	27.40	-0.59	26.81	47.46	-20.65
398.15	26.60	0.09	26.69	47.46	-20.77
405.55	22.70	0.24	22.94	47.46	-24.52
414.27	36.60	0.42	37.02	47.46	-10.44
420.53	22.40	0.55	22.95	47.46	-24.51
422.75	31.20	0.60	31.80	47.46	-15.66
505.25	22.20	2.29	24.49	47.46	-22.97
515.18	22.70	2.47	25.17	47.46	-22.29
531.33	33.50	2.77	36.27	47.46	-11.19

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Test Configuration #1 - Continued

Frequency MHz	EMI Data dBμV/M	ACF	Field Strength dBμV/M	EN Limit dBμV/M	Margin to Limit dBμV/M
Vertical					
577.00	28.70	3.62	32.32	47.46	-15.14
598.93	25.20	4.03	29.23	47.46	-18.23
609.23	28.90	4.22	33.12	47.46	-14.34
614.55	32.50	4.32	36.82	47.46	-10.64
621.80	23.60	4.46	28.06	47.46	-19.40
663.25	20.40	5.25	25.65	47.46	-21.81
687.25	27.40	5.75	33.15	47.46	-14.31
705.75	22.40	6.12	28.52	47.46	-18.94
725.30	22.30	6.48	28.78	47.46	-18.68
744.88	22.40	6.84	29.24	47.46	-18.22
773.83	25.90	7.44	33.34	47.46	-14.12
806.83	22.20	8.11	30.31	47.46	-17.15
843.15	22.50	8.78	31.28	47.46	-16.18
910.33	20.50	10.15	30.65	47.46	-16.81
991.00	20.60	11.81	32.41	47.46	-15.05

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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" means Horizontal antenna orientation.

4.4.3 "V" means Vertical antenna orientation.

4.4.4 "*" means the "Margin to Limit" Exceeds the "EN Limit" and/or Exceeds the "FCC Limit" or is within a -2 dB μ V margin.

4.4.5 "A" designates an ambient signal.

4.4.6 "(-.-)" means the signal level as 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 C63.4-1992, 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	29 Aug 2000
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 Impedence Stabilization Network	50 micro Henry; 50 ohm

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Test Configuration #1

Frequency MHz	Line Data dBμV	Neutral Data dBμV	FCC Limit dBμV	Margin to Limit (Line) dBμV	Margin to Limit (Neutral) dBμV
0.45	35.40	33.30	48.00	-12.60	-14.70
1.05	32.00	-. -	48.00	-16.00	-. -
1.74	-. -	33.90	48.00	-. -	-14.10
2.10	30.00	-. -	48.00	-18.00	-. -
2.87	-. -	29.10	48.00	-. -	-18.90
3.15	24.90	-. -	48.00	-23.10	-. -
3.69	-. -	26.20	48.00	-. -	-21.80
4.05	27.60	-. -	48.00	-20.40	-. -
4.83	-. -	26.60	48.00	-. -	-21.40
5.18	23.80	-. -	48.00	-24.20	-. -
5.96	-. -	30.30	48.00	-. -	-17.70
6.07	21.10	-. -	48.00	-26.90	-. -
6.86	-. -	25.70	48.00	-. -	-22.30
7.13	25.30	-. -	48.00	-22.70	-. -
7.93	-. -	25.80	48.00	-. -	-22.20
8.07	26.00	-. -	48.00	-22.00	-. -
8.84	-. -	21.80	48.00	-. -	-26.20
9.09	26.90	-. -	48.00	-21.10	-. -
9.76	-. -	23.40	48.00	-. -	-24.60
10.14	22.60	-. -	48.00	-25.40	-. -
10.83	-. -	24.50	48.00	-. -	-23.50
11.35	21.10	-. -	48.00	-26.90	-. -
11.85	-. -	18.50	48.00	-. -	-29.50
12.19	22.20	-. -	48.00	-25.80	-. -
12.86	-. -	23.70	48.00	-. -	-24.30
13.18	18.50	-. -	48.00	-29.50	-. -
13.58	-. -	21.80	48.00	-. -	-26.20
14.25	18.00	-. -	48.00	-30.00	-. -
14.41	-. -	17.80	48.00	-. -	-30.20
15.21	-. -	17.80	48.00	-. -	-30.20
15.38	18.20	-. -	48.00	-29.80	-. -
16.36	-. -	17.80	48.00	-. -	-30.20

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16.47	20.50	-.-	48.00	-27.50	-.-
17.21	22.10	-.-	48.00	-25.90	-.-
17.69	-.-	22.30	48.00	-.-	-25.70
18.33	18.00	-.-	48.00	-30.00	-.-
18.71	-.-	21.70	48.00	-.-	-26.30
19.28	18.10	-.-	48.00	-29.90	-.-
19.67	-.-	18.10	48.00	-.-	-29.90
20.35	-.-	18.30	48.00	-.-	-29.70
20.46	17.90	-.-	48.00	-30.10	-.-
21.61	18.10	21.20	48.00	-29.90	-26.80
22.14	23.40	-.-	48.00	-24.60	-.-
22.77	-.-	18.70	48.00	-.-	-29.30
23.11	23.80	-.-	48.00	-24.20	-.-
23.54	-.-	21.70	48.00	-.-	-26.30
24.07	23.80	-.-	48.00	-24.20	-.-
24.80	-.-	22.00	48.00	-.-	-26.00
25.14	23.60	-.-	48.00	-24.40	-.-
25.86	-.-	22.20	48.00	-.-	-25.80
26.20	21.70	-.-	48.00	-26.30	-.-
26.78	-.-	18.00	48.00	-.-	-30.00
27.29	17.80	-.-	48.00	-30.20	-.-
27.79	-.-	22.50	48.00	-.-	-25.50
28.37	22.30	-.-	48.00	-25.70	-.-
28.57	-.-	20.10	48.00	-.-	-27.90
29.10	18.00	-.-	48.00	-30.00	-.-
29.93	18.10	18.10	48.00	-29.90	-29.90

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Test Configuration #1

Frequency MHz	Line Data dBμV	Neutral Data dBμV	EN Limit dBμV	Margin to Limit (Line) dBμV	Margin to Limit (Neutral) dBμV
0.15	47.10	-.-	56.00	-8.90	-.-
0.16	-.-	24.10	55.77	-.-	-31.67
0.45	35.40	33.30	48.00	-12.60	-14.70
1.05	32.00	-.-	48.00	-16.00	-.-
1.74	-.-	33.90	48.00	-.-	-14.10
2.10	30.00	-.-	48.00	-18.00	-.-
2.87	-.-	29.10	48.00	-.-	-18.90
3.15	24.90	-.-	48.00	-23.10	-.-
3.69	-.-	26.20	48.00	-.-	-21.80
4.05	27.60	-.-	48.00	-20.40	-.-
4.83	-.-	26.60	48.00	-.-	-21.40
5.18	23.80	-.-	48.00	-24.20	-.-
5.96	-.-	30.30	48.00	-.-	-17.70
6.07	21.10	-.-	48.00	-26.90	-.-
6.86	-.-	25.70	48.00	-.-	-22.30
7.13	25.30	-.-	48.00	-22.70	-.-
7.93	-.-	25.80	48.00	-.-	-22.20
8.07	26.00	-.-	48.00	-22.00	-.-
8.84	-.-	21.80	48.00	-.-	-26.20
9.09	26.90	-.-	48.00	-21.10	-.-
9.76	-.-	23.40	48.00	-.-	-24.60
10.14	22.60	-.-	48.00	-25.40	-.-
10.83	-.-	24.50	48.00	-.-	-23.50
11.35	21.10	-.-	48.00	-26.90	-.-
11.85	-.-	18.50	48.00	-.-	-29.50
12.19	22.20	-.-	48.00	-25.80	-.-
12.86	-.-	23.70	48.00	-.-	-24.30
13.18	18.50	-.-	48.00	-29.50	-.-
13.58	-.-	21.80	48.00	-.-	-26.20
14.25	18.00	-.-	48.00	-30.00	-.-
14.41	-.-	17.80	48.00	-.-	-30.20
15.21	-.-	17.80	48.00	-.-	-30.20

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Test Configuration #1 - Continued

15.38	18.20	-.-	48.00	-29.80	-.-
16.36	-.-	17.80	48.00	-.-	-30.20
16.47	20.50	-.-	48.00	-27.50	-.-
17.21	22.10	-.-	48.00	-25.90	-.-
17.69	-.-	22.30	48.00	-.-	-25.70
18.33	18.00	-.-	48.00	-30.00	-.-
18.71	-.-	21.70	48.00	-.-	-26.30
19.28	18.10	-.-	48.00	-29.90	-.-
19.67	-.-	18.10	48.00	-.-	-29.90
20.35	-.-	18.30	48.00	-.-	-29.70
20.46	17.90	-.-	48.00	-30.10	-.-
21.61	18.10	21.20	48.00	-29.90	-26.80
22.14	23.40	-.-	48.00	-24.60	-.-
22.77	-.-	18.70	48.00	-.-	-29.30
23.11	23.80	-.-	48.00	-24.20	-.-
23.54	-.-	21.70	48.00	-.-	-26.30
24.07	23.80	-.-	48.00	-24.20	-.-
24.80	-.-	22.00	48.00	-.-	-26.00
25.14	23.60	-.-	48.00	-24.40	-.-
25.86	-.-	22.20	48.00	-.-	-25.80
26.20	21.70	-.-	48.00	-26.30	-.-
26.78	-.-	18.00	48.00	-.-	-30.00
27.29	17.80	-.-	48.00	-30.20	-.-
27.79	-.-	22.50	48.00	-.-	-25.50
28.37	22.30	-.-	48.00	-25.70	-.-
28.57	-.-	20.10	48.00	-.-	-27.90
29.10	18.00	-.-	48.00	-30.00	-.-
29.93	18.10	18.10	48.00	-29.90	-29.90

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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 as 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 " " 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.

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- 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.
- 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 MHz KGO
 - 1.170 MHz KLOK
 - 1.370 MHz KEEN
 - 1.500 MHz KHTT
 - 1.590 MHz KLIV
- 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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Signature Page - Last Page of Report

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