

TITLE: PLI Evaluation Report (RFI) **FCC ID: Q3B5386X** Page 1 of 38
DRAWING: Q538601FCCW.DWG Issued: 28 Mar 2003
BY: Lee Pulver and Phuong Nguyen 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

28 Mar 2003

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Pulver Laboratories Inc. (PLI) File Number: 5386

Pulver Laboratories Inc. (PLI) Project Number: C0533

Product Name: (1) Fingerprint Detection Computer Peripheral (EUT)
(EUT = Equipment Under Test)

Trade Name: (1) Hamster

Model Number: (1) HFDU02A

Serial Number: (1) None

Pulver Laboratories Sample ID: (1) 5386C0533-02

Applicant: SecuGen Corporation
2356 Walsh Avenue
Santa Clara, California 95051
Telephone: 408.727.7787
Facsimile: 408.727-7105

Location Certified: SecuGen Corporation
2356 Walsh Avenue
Santa Clara, California 95051
Telephone: 408.727.7787
Facsimile: 408.727-7105

Manufacturing Location: SecuGen Corporation
2356 Walsh Avenue
Santa Clara, California 95051
Telephone: 408.727.7787
Facsimile: 408.727-7105

Pulver Laboratories Inc. (PLI) Control Number: 5386X

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 – Q3B5386X

- 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, 13 March 2003 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.
- Industry Canada. Interference-Causing Equipment Standard: ICES-001, Issue 3, 07 March 1998, entitled "Interference-Causing Equipment Standard for Industrial, Scientific, and Medical Radio Frequency Generators".
- 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.

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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 23 Aug 2002;
- 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 SecuGen Corporation 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 23 Aug 2002.

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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1.2 Specific Engineering Considerations

1.2.1 Interconnecting low voltage computer cables lengths:

Cable Description	Length (feet)	Length (meters)	Shielded / Unshielded
EUT:	4.75	1.45	Unshielded
Keyboard data:	6.8	2.07	Unshielded
Monitor data:	5.5	1.68	Unshielded
Mouse data:	6.1	1.86	Unshielded
Modem data:	6.0	1.83	Unshielded
Printer data:	5.0	1.52	Double Shielded
Printer power:	5.7	1.74	Unshielded
Modem power:	6.0	1.83	Unshielded
Monitor power:	5.6	1.71	Unshielded
Computer power:	5.6	1.71	Shielded

1.2.2 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 63.4-1992.

1.2.3 There is one possible Equipment Under Test (Fingerprint Detection Peripheral, HFDU02A) input power configuration:

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

1.2.4 There is one possible EUT test configuration:

1.2.4.1 **Test Configuration #1** consisted of the HFDU02A connected to an IBM Compatible PC via the USB port.

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1.2.5 This report includes measurement data to the 10th harmonic of the EUT.

1.3 Product Description and Intended Use

1.3.1 The HFDU02A is SecuGen's most versatile fingerprint recognition peripheral offering security, convenience, and ease of use all in one compact package. With no mechanical parts to maintain, the HFDU02A is rugged and lightweight which also makes it highly portable and convenient for laptop use. The ergonomic finger guide helps right-handed and left-handed users position their fingers more easily and consistently.

1.3.2 Accurate and durable, the HFDU02A is designed to let your fingerprints act like digital passwords, replacing regular passwords that can be forgotten, lost, or stolen.

1.4 List of Photographs (Electronically Appended)

FIGURE 1: PLI Photograph Number 5386C0533-24 illustrates the rear view of the Equipment Under Test with all peripherals attached in Test Configuration #1. The "open field" radiated and the conducted Radio Frequency Interference / Electromagnetic Interference test programs utilized this equipment and cable configuration.

FIGURE 2: PLI Photograph Number 5386C0533SJ-25 illustrates the rear view of the Equipment Under Test with all peripherals attached in conducted Electromagnetic Interference Test Configuration #1.

FIGURE 3: PLI Photograph Number 5386C0533SJ-22 illustrates the component side of the Input/Output Printed Circuit Assembly, board # EB1-0001A.

FIGURE 4: PLI Photograph Number 5386C0533SJ-21 illustrates the circuit side of the Input/Output Printed Circuit Assembly, board # EB1-0001A.

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FIGURE 5: PLI Photograph Number 5386C0533SJ-20 illustrates the circuit side of the Sensor Board Printed Circuit Assembly, board # EB3-0003A.

Not shown: component side of the Sensor Board Printed Circuit Assembly, board # EB3-0003A. The circuit side of the board is covered with a permanently installed protective plastic housing.

FIGURE 6: PLI Photograph Number 5386C0533SJ-18 illustrates the EUT with Sensor Board Printed Circuit Assembly and the Input/Output Printed Circuit Assembly partially removed to show board placement and cable routing with respect to the protective plastic housing. Also shown is the EUT base (right side).

- 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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Table of Laboratory Test Equipment Used

Equipment Type	Manufacturer	Model Number	Frequency Range
Spectrum Analyzer	Hewlett-Packard	8568A	100 Hz - 1.5 GHz
Quasi-peak Adapter	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)

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Equipment Type	Manufacturer	Model Number	Frequency Range
Close Field Antenna	Electro-Metrics	EFP-25	
Oscilloscope	Tektronix	2445	up to 150 MHz
Capacitor/ Inductor Z Meter	Sencore		1 pF to 200,000 μ F 1 μ H to 10 H
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 Coupler	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

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Equipment Type	Manufacturer	Model Number	Frequency Range
Frequency Converter	PRD Electronics Inc.	CV-1103/URM-85	200 - 400 MHz
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	

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Equipment Type	Manufacturer	Model Number	Frequency Range
Frequency Generator	Hewlett-Packard	TS-418B/U	400 - 1000 MHz
Frequency Generator	Hewlett-Packard	TS-510A/U	10 - 420 MHz
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

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Equipment Type	Manufacturer	Model Number	Frequency Range
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
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 Section	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	

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Equipment Type	Manufacturer	Model Number	Frequency Range
Multimeter	Fluke and Phillips	FLUKE 87 True RMS	
Feed Through Caps	Solar Electronics Co.	6512-106 R 10 μ F capacitors	275V RMS, 60 Hz
Multimeter	Beckman Industrial Corp.	Circuitmate DM15B	250V RMS, 400 Hz
RMS Multimeter	Beckman Industrial Corp.	Tech 310	
Multimeter	Fluke and Phillips	FLUKE 85	
ELF Field Monitor	Walker Magnetic Group	ELF-50D	

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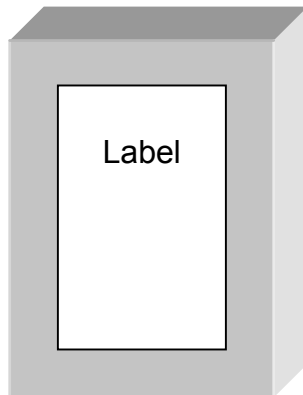
2.0 **Mandatory Labeling and Operators' Manual Information and Shipping Documents**

2.1 **Label**

The illustration on the next page shows the actual FCC 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.



Bottom Panel of EUT

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Label Illustration
{three times the size of actual FCC Label}

Actual Label



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2.2 Operators' Manual Information

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

CAUTION - Connections between peripherals of the computer equipment must be made with low voltage shielded computer data cables. Network connections may consist of non-shielded CAT 5 cable.

2.2.2 No information is required to be inserted 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 every component and peripheral of the system.

2.3 **FCC 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**

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

Changes or modifications not expressly approved by the party responsible for compliance to EN 55022 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 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.

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.

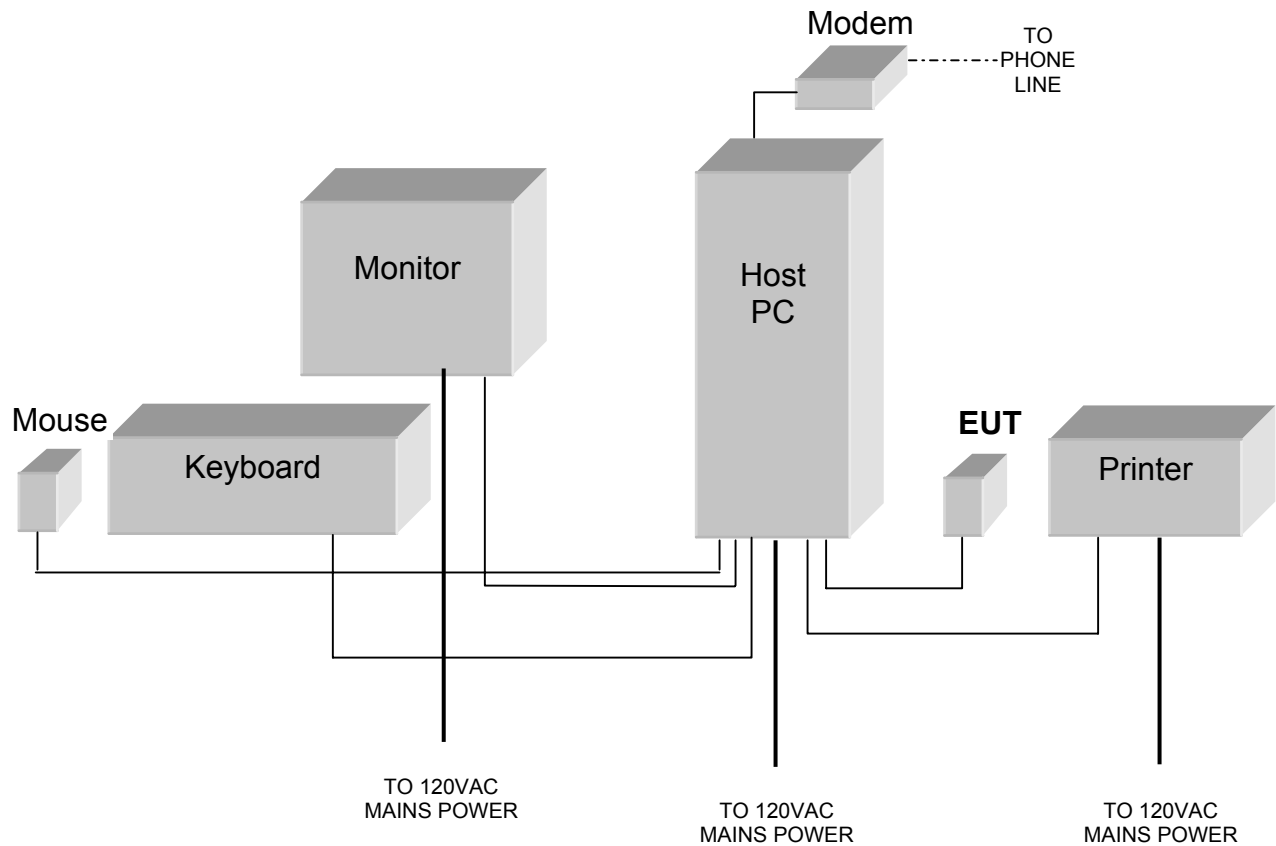
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Clock Oscillators and Frequencies of Operation		
Frequency	Component # / Location	Description of Use
12 MHz	Crystal / Controller Board	Synchronous operation
24 MHz	U1 / Controller Board	Synchronous operation
Use this table to simplify locating the oscillators in the accompanying schematics.		

Equipment Under Test Orientation and Configuration

**Zero Degrees
(front: no cables)**



**180 Degrees
(back: cables)**

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:
 - 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 operating system loaded.
 - d. Following initialization of the 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:
 - From the "Start" menu, select "Run" and press "ENTER" to run the "sqd" program.
 - The "SecuGen Fingerprint Device Diagnostic Utility" screen will appear.
 - Check the "Continuous Capture" box and click the "INT" button.
 - The bottom of the screen will display the message "Initialization Success..."
 - Click the "Start" button to activate the EUT.
 - The red light in the device will illuminate signifying the unit is active and ready for fingerprint capture. The red light will remain illuminated and the device active until the user clicks the "Stop" button.

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3.4 The following equipment list defines the system configuration:

EUT	: Fingerprint Detection Computer Peripheral
Model Number	: HFDU02A
Serial Number	: None
PLI Sample ID	: 5386C0533-02
FCC ID Number	: Q3B5386X
Manufacturer	: SecuGen Corporation
Product	: Monitor
Model Number	: E551C
Serial Number	: CN-07G076-64180-1AK-00WX
FCC ID Number	: FCC DOC Authorized
Manufacturer	: Dell Computer
Product	: Desktop Computer
Model Number	: Dimension 2100 MCM
Serial Number	: 560C711
FCC ID Number	: FCC DOC Authorized
Manufacturer	: Dell Computer
Product	: Keyboard
Model Number	: SK-8100
Serial Number	: CN-09C487-38840-1CR-5189
FCC ID Number	: FCC DOC Authorized
Manufacturer	: Dell Computer
Product	: Mouse
Model Number	: IntelliMouse 63618-OEM
Serial Number	: 0547345-6
FCC ID Number	: FCC DOC Authorized
Manufacturer	: Microsoft
Product	: Printer
Model Number	: KX-P1091i
Serial Number	: 7LKALJ12301
FCC ID Number	: ACJ5Z6KX-P1091i
Manufacturer	: Panasonic

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Product : Modem
Model Number : SupraExpress SUP2730
Serial Number : 0514400165456
FCC ID Number : FCC DOC Authorized
Manufacturer : Diamond

Product : Modem Power Adapter
Model Number : 41-6-500D
Serial Number : 41-6-500D-PLI1
FCC ID Number : None
Manufacturer : Diamond

- 3.5 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.

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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 RegTP approved.

Type of Test	Radiated Electromagnetic Interference
Specification	FCC, ICAN, and EN55022 Class B
Date Data Collected	19 Mar 2003
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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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
Horizontal							
125.18	34.50	-9.54	24.96	43.50	-18.54	40.46	-15.50
128.03	37.60	-9.67	27.93	43.50	-15.57	40.46	-12.53
130.00	42.00	-9.75	32.25	43.50	-11.25	40.46	-8.21
144.03	43.80	-9.74	34.06	43.50	-9.44	40.46	-6.40
150.10	35.50	-9.33	26.17	43.50	-17.33	40.46	-14.29
165.70	38.40	-8.86	29.54	43.50	-13.96	40.46	-10.92
168.00	40.60	-9.56	31.04	43.50	-12.46	40.46	-9.42
218.23	39.60	-10.14	29.46	46.00	-16.54	40.46	-11.00
231.95	40.40	-9.25	31.15	46.00	-14.85	47.46	-16.31
233.28	40.30	-9.16	31.14	46.00	-14.86	47.46	-16.32
240.03	45.70	-8.73	36.97	46.00	-9.03	47.46	-10.49
288.00	31.90	-5.72	26.18	46.00	-19.82	47.46	-21.28
332.35	29.60	-6.05	23.55	46.00	-22.45	47.46	-23.91
333.30	34.30	-6.06	28.24	46.00	-17.76	47.46	-19.22
336.00	41.80	-6.10	35.70	46.00	-10.30	47.46	-11.76
360.03	39.10	-5.65	33.45	46.00	-12.55	47.46	-14.01
364.48	35.50	-5.37	30.13	46.00	-15.87	47.46	-17.33
366.60	36.20	-5.23	30.97	46.00	-15.03	47.46	-16.49
384.03	35.60	-4.11	31.49	46.00	-14.51	47.46	-15.97
408.00	38.90	-2.88	36.02	46.00	-9.98	47.46	-11.44
432.03	40.20	-2.27	37.93	46.00	-8.07	47.46	-9.53
456.00	38.00	-1.73	36.27	46.00	-9.73	47.46	-11.19
468.00	32.90	-1.59	31.31	46.00	-14.69	47.46	-16.15
479.98	32.50	-1.45	31.05	46.00	-14.95	47.46	-16.41
496.98	31.30	-1.26	30.04	46.00	-15.96	47.46	-17.42
528.05	35.60	-1.10	34.50	46.00	-11.50	47.46	-12.96
636.00	33.10	-0.65	32.45	46.00	-13.55	47.46	-15.01
648.05	33.20	-0.68	32.52	46.00	-13.48	47.46	-14.94
669.25	37.00	0.33	37.33	46.00	-8.67	47.46	-10.13
720.08	35.10	1.60	36.70	46.00	-9.30	47.46	-10.76
743.98	37.60	1.19	38.79	46.00	-7.21	47.46	-8.67
768.08	34.00	1.54	35.54	46.00	-10.46	47.46	-11.92
792.05	33.60	2.13	35.73	46.00	-10.27	47.46	-11.73
800.00	37.00	2.32	39.32	46.00	-6.68	47.46	-8.14
840.03	35.30	3.57	38.87	46.00	-7.13	47.46	-8.59

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Vertical							
30.00	42.60	-8.39	34.21	40.00	-5.79	40.46	-6.25
35.00	43.80	-8.49	35.31	40.00	-4.69	40.46	-5.15
118.68	35.80	-7.95	27.85	43.50	-15.65	40.46	-12.61
128.03	36.70	-7.49	29.21	43.50	-14.29	40.46	-11.25
132.00	36.50	-7.31	29.19	43.50	-14.31	40.46	-11.27
136.60	33.90	-7.13	26.77	43.50	-16.73	40.46	-13.69
165.70	36.70	-4.83	31.87	43.50	-11.63	40.46	-8.59
166.60	36.10	-4.77	31.33	43.50	-12.17	40.46	-9.13
168.00	37.20	-4.68	32.52	43.50	-10.98	47.46	-14.94
231.95	38.00	-3.51	34.49	46.00	-11.51	47.46	-12.97
233.30	38.10	-3.48	34.62	46.00	-11.38	47.46	-12.84
240.05	37.00	-3.36	33.64	46.00	-12.36	47.46	-13.82
288.00	33.30	-2.28	31.02	46.00	-14.98	47.46	-16.44
336.03	34.90	-1.20	33.70	46.00	-12.30	47.46	-13.76
338.70	33.60	-1.14	32.46	46.00	-13.54	47.46	-15.00
364.53	35.60	-0.61	34.99	46.00	-11.01	47.46	-12.47
383.98	34.00	-0.20	33.80	46.00	-12.20	47.46	-13.66
395.13	33.10	0.03	33.13	46.00	-12.87	47.46	-14.33
408.00	31.70	0.29	31.99	46.00	-14.01	47.46	-15.47
409.75	28.20	0.33	28.53	46.00	-17.47	47.46	-18.93
432.03	38.70	0.79	39.49	46.00	-6.51	47.46	-7.97
450.53	28.90	1.17	30.07	46.00	-15.93	47.46	-17.39
456.03	36.30	1.28	37.58	46.00	-8.42	47.46	-9.88
458.70	35.70	1.34	37.04	46.00	-8.96	47.46	-10.42
479.83	39.70	1.77	41.47	46.00	-4.53	47.46	-5.99
497.00	30.90	2.13	33.03	46.00	-12.97	47.46	-14.43
528.03	36.40	2.71	39.11	46.00	-6.89	47.46	-8.35
540.00	33.50	2.93	36.43	46.00	-9.57	47.46	-11.03
552.00	38.40	3.16	41.56	46.00	-4.44	47.46	-5.90
588.03	32.80	3.83	36.63	46.00	-9.37	47.46	-10.83
636.03	31.40	4.72	36.12	46.00	-9.88	47.46	-11.34
648.03	34.80	4.94	39.74	46.00	-6.26	47.46	-7.72
744.00	35.70	6.83	42.53	46.00	-3.47	47.46	-4.93
758.83	32.80	7.12	39.92	46.00	-6.08	47.46	-7.54
762.10	29.80	7.19	36.99	46.00	-9.01	47.46	-10.47
766.55	30.10	7.28	37.38	46.00	-8.62	47.46	-10.08

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Frequency MHz	Data dBµV/M	ACF	Strength dBµV/M	Limit dBµV/M	to Limit dBµV/M	Limit dBµV/M	to Limit dBµV/M
Vertical							
768.05	33.80	7.32	41.12	46.00	-4.88	47.46	-6.34
792.00	36.20	7.81	44.01	46.00	-1.99 *	47.46	-3.45
803.98	32.30	8.05	40.35	46.00	-5.65	47.46	-7.11
816.03	31.80	8.28	40.08	46.00	-5.92	47.46	-7.38
840.00	34.10	8.72	42.82	46.00	-3.18	47.46	-4.64

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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.

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	19 Mar 2003
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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Frequency MHz	Line Data dBμV	Neutral Data dBμV	FCC Limit dBμV	FCC Margin to Limit (Line) dBμV	FCC Margin to Limit (Neutral) dBμV
0.81	26.10	-.-	48.00	-21.90	-.-
5.19	21.40	-.-	48.00	-26.60	-.-
7.24	21.50	-.-	48.00	-26.50	-.-
8.88	21.70	-.-	48.00	-26.30	-.-
10.49	21.70	-.-	48.00	-26.30	-.-
12.22	21.80	-.-	48.00	-26.20	-.-
14.22	21.30	-.-	48.00	-26.70	-.-
17.20	27.00	-.-	48.00	-21.00	-.-
18.90	21.70	-.-	48.00	-26.30	-.-
20.37	21.70	-.-	48.00	-26.30	-.-
22.55	21.60	-.-	48.00	-26.40	-.-
26.76	21.60	-.-	48.00	-26.40	-.-
0.81	-.-	26.00	48.00	-.-	-22.00
3.12	-.-	21.60	48.00	-.-	-26.40
5.29	-.-	21.60	48.00	-.-	-26.40
7.45	-.-	21.40	48.00	-.-	-26.60
9.77	-.-	21.80	48.00	-.-	-26.20
11.30	-.-	21.80	48.00	-.-	-26.20
12.54	-.-	21.60	48.00	-.-	-26.40
16.35	-.-	21.50	48.00	-.-	-26.50
17.20	-.-	27.40	48.00	-.-	-20.60
19.57	-.-	21.70	48.00	-.-	-26.30
22.24	-.-	21.70	48.00	-.-	-26.30
27.30	-.-	21.40	48.00	-.-	-26.60

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Test Configuration #1

Frequency MHz	Line Data dBµV	Neutral Data dBµV	EN Limit dBµV	EN Margin to Limit (Line) dBµV	EN Margin to Limit (Neutral) dBµV
0.15	27.00	-.-	66.01	-39.01	-.-
0.34	24.30	-.-	61.11	-36.81	-.-
0.81	26.10	-.-	56.00	-29.90	-.-
7.24	21.50	-.-	60.00	-38.50	-.-
8.88	21.70	-.-	60.00	-38.30	-.-
12.22	21.80	-.-	60.00	-38.20	-.-
14.22	21.30	-.-	60.00	-38.70	-.-
17.20	27.00	-.-	60.00	-33.00	-.-
18.90	21.70	-.-	60.00	-38.30	-.-
20.37	21.70	-.-	60.00	-38.30	-.-
22.55	21.60	-.-	60.00	-38.40	-.-
26.76	21.60	-.-	60.00	-38.40	-.-
0.15	-.-	27.10	66.04	-.-	-38.94
0.29	-.-	22.50	62.50	-.-	-40.00
0.81	-.-	26.00	56.00	-.-	-30.00
5.29	-.-	21.60	60.00	-.-	-38.40
9.77	-.-	21.80	60.00	-.-	-38.20
11.30	-.-	21.80	60.00	-.-	-38.20
12.54	-.-	21.60	60.00	-.-	-38.40
16.35	-.-	21.50	60.00	-.-	-38.50
17.20	-.-	27.40	60.00	-.-	-32.60
19.57	-.-	21.70	60.00	-.-	-38.30
22.24	-.-	21.70	60.00	-.-	-38.30
27.30	-.-	21.40	60.00	-.-	-38.60

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.

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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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Quality Assurance by

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