

TITLE: PLI Evaluation Report (RFI) **FCCID: RDL5392X**
DRAWING: Q539205FCCW.DWG
BY: Lee Pulver and Phuong Nguyen

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Issued: 11 Sep 2003
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

11 Sep 2003

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PLI223F11W.FRMx2
Q539205W.DWG

TITLE: PLI Evaluation Report (RFI) FCCID: RDL5392X
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Pulver Laboratories Inc. (PLI) File Number: 5392

Pulver Laboratories Inc. (PLI) Project Number: C2633 / C3333

Product Name: (1) Network Music Player (EUT)
(EUT = Equipment Under Test)

Model Name: (1) SqueezeBox

Serial Numbers: (1) None

Pulver Laboratories Sample ID: (1) 5392C2633-01

Applicant: Slim Devices, Inc.
958 San Leandro Avenue, Suite 900
Mountain View, California 94043
Telephone: (650) 210-9400
URL: www.SlimDevices.com

Location Certified: Slim Devices, Inc.
958 San Leandro Avenue, Suite 900
Mountain View, California 94043
Telephone: (650) 210-9400
URL: www.SlimDevices.com

Manufacturing Location: Slim Devices, Inc.
958 San Leandro Avenue, Suite 900
Mountain View, California 94043
Telephone: (650) 210-9400
URL: www.SlimDevices.com

Pulver Laboratories Inc. (PLI) Control Number: 5392X

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 - RDL5392X (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; and Part 15 entitled Radio Frequency Devices, 22 July 2003 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.

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Referenced Test Standards

- EN55011 entitled Specification for Limits and methods of measurement of radio disturbance characteristics of industrial, scientific, and medical (ISM) radio-frequency equipment. 15 Sept 1998.
- EN55014 entitled Limits and methods of measurement of radio disturbance characteristics of electrical motor-operated and thermal appliances for household and similar purposes, electric tools and similar electric apparatus, 1993 Edition.
- 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 1.1307(b); Part 2.1091; Part 2; and Part 15, issued 22 July 2003;
- 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;

1.1.2 To assist the Federal Communications Commission in the continuing education of applicants and grantees, Pulver Laboratories has advised Slim Devices, 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 22 July 2003.

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	17°C
Relative humidity	45% to 75%	52%
Atmospheric pressure	68 kPa (680 mbar) to 106 kPa (1060 mbar)	1017 mbar

1.2.2 Interconnecting low voltage cable lengths:

Cable Description	Length (feet)	Length (meters)	Shielded / Unshielded
EUT: Input Power	5.81	1.77	Unshielded
Headphones	4.56	1.39	Unshielded
CAT 5	5.15	1.57	Unshielded
Audio Cable	5.64	1.72	Unshielded
Fiber Optic Cable	5.64	1.72	Unshielded
Digital Cable	6.56	2.0	Unshielded
Fire wire cable	5.71	1.74	Unshielded
Hard Drive Power Cable	9.35	2.85	Unshielded
USB Data Cable	3.28	1.0	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 63.4-1992.

1.2.4 Most severe cable orientation chosen when measuring unwanted radiated and conducted emissions.

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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 Pulver Shield type 9000 material, part number 25425490, trade name "RF disc" applied to the Ubicom ip2022 main processor, as shown in PLI Photograph Number 5392C3233SJ-05. See Patent 6,455,770 entitled "Electromagnetic radiation shield for attenuating electromagnetic radiation from an active electronic device."

1.2.6 There is one possible Equipment Under Test input power configuration:

1.2.6.1 One external wall adapter plugged into 120VAC main power supplies the EUT with voltage.

1.2.7 There is one possible EUT test configuration:

1.2.7.1 **Test Configuration #1:** The Network Music Player, model *SqueezeBox* communicates directly with the laptop computer via a CAT5 cable.

1.2.8 This report includes measurement data to the 5th or to the 10th harmonic.

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1.3 Product Description and Intended Use

1.3.1 Marketing description: The Slim Devices, Inc. *SqueezeBox* Network Music Player is a digital music player that gives you fast access to your unlimited digital music collection: MP3, VBR, and MPEG2. The device frees your music from your computer, and is small enough so that you can put it anywhere in your house. It is easy to set up and use with remote control interface.

SLIMP3 Network MP3 Player

- Beautiful 40x2 vacuum fluorescent display—bright and easy to read.
- Gold-plated RCA outputs connect directly to your stereo.
- High quality 16 bit, 44.1KHz audio output.
- Supports easy flash firmware updating over the network.
- No moving parts (no fan, no hard disk or CD-ROM)—reliable and quiet: all you hear is your music!
- Supports all MP3 bit rates and VBR, plus MPEG2.
- Communicates using IP over ethernet, open streaming/control protocol.
- Custom infrared remote control.
- Small enough to place anywhere—on a shelf, bedside table, etc.
- Display brightness control.
- Low power - draws less than 4 watts during normal operation with the display turned on, and just a few milliwatts in standby mode.
- Large buffer—no clicks or skips because of network problems

SLIMP3 Server Software

- Easy to learn, easy to use remote control interface.
- Web interface—control the player and manage your playlists from your web browser!
- Shuffle and repeat modes.
- Alarm clock features.
- Browse and search for genres, artists, album and song titles.
- Supports .pls and .m3u playlist files.
- Unlimited capacity—your files are stored on your computer and streamed to the player.
- Internet radio—Shoutcast, Icecast, and Live365.
- Open-source server, written in Perl (GPL).

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1.3.2 Technical specifications:

- Dimensions: 8.5"W x 2.5"H x 2"D
- Display: Noritake 40x2 VFD
- CPU: Microchip PIC16F877 microcontroller
- Ethernet controller: Crystal CS8900A 10Mbps embedded Ethernet chip
- DMA controller: proprietary logic, Xilinx XC95144XL
- MP3 decoder: Micronas MAS3507D
- DAC: Crystal CS4334, 16-bit 44Khz
- Buffer RAM: 1Mb (8 seconds at 128Kbps)
- ROM: Rewritable flash program memory, EEPROM configuration memory
- IR: Standard 40Khz IR receiver
- Power supply 5V 1600mA, consumes 700mA maximum
- Protocols: DHCP, ARP, IP, ICMP, UDP
- Support for subnets/gateways
- Open UDP-based streaming and control protocols
- HTTP and command line control of the SLIMP3 server
- Open-source, high-speed, embedded firmware
- Written entirely in assembler for performance and compactness
- Integrated network firmware updater
- General-purpose architecture offloads most of the application to the server —new features can be added without firmware updates

1.4 List of Photographs Contained in this Report

FIGURE 1: PLI Photograph Number 5392C3333SJ-02 illustrates the rear view of the Equipment Under Test in Radiated Electromagnetic Interference Test Configuration #1.

FIGURE 2: PLI Photograph Number 5392C3333SJ-04 the rear view of the Equipment Under Test in Conducted Electromagnetic Interference Test Configuration #1.

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FIGURE 3: PLI Photograph Number 5392C3333SJ-07 illustrates the component side of the motherboard printed circuit assembly (assembly number Squeezebox 2.0 / 20030605). Note the Pulver Shield type 9000 material, trade name "RF disc", part number 25425490 applied to the Ubicom ip2022 main processor.

See Patent 6,455,770 entitled "Electromagnetic radiation shield for attenuating electromagnetic radiation from an active electronic device."

FIGURE 4: PLI Photograph Number 5392C2633SJ-11 illustrates the circuit side of the motherboard printed circuit assembly (assembly number Squeezebox 2.0 / 20030605).

FIGURE 5: PLI Photograph Number 5392C2633SJ-13 illustrates the circuit side of the LCD printed circuit assembly (assembly number CU40025SCP-B-U1A / PW-590-100).

FIGURE 6: PLI Photograph Number 5392C2633SJ-17 illustrates the Slim Devices Remote Control, model SC33 used to operate the Squeezebox.

FIGURE 7: PLI Photograph Number 5392C2633SJ-15 illustrates the disassembled remote control and the circuit side of the remote control printed circuit assembly (assembly number S-251G203).

FIGURE 8: PLI Photograph Number 5392C2633SJ-16 illustrates the component side of the remote control printed circuit assembly (assembly number S-251G203).

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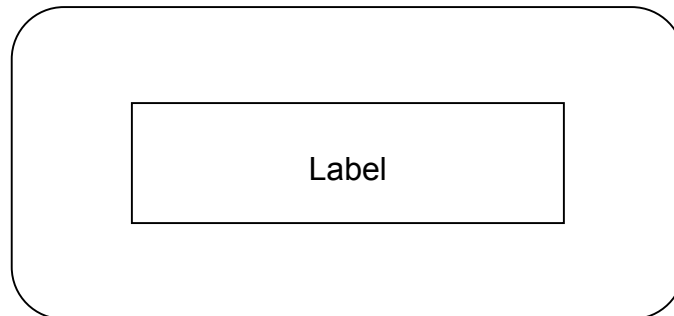
2.0 **Mandatory Labeling and Operators' Manual Information and Shipping Documents**

2.1 **Label**

The illustration on the next page shows the actual FCC label 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 - Alternative Label

{actual size of actual FCC 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 - Network connections may consist of non-shielded CAT 5 cable.

WARNING - Use only the Slim Devices specified wall adapter for this product. This Slim Devices wall adapter enhances the system performance and increases the product safety features.

Note to Slim Devices, Inc.:

The following warning can be placed in the operators' manual to show Slim Devices' concern for public safety. This warning is optional, not mandatory. This warning can be used in conjunction with the alternative label shown after the warning phrases.

WARNING - The phrase "contains PULVER[™] Shield" on the Product Certification Label means Slim Devices has elected to install this state-of-the-art technology dedicated to significantly reducing Electromagnetic Radiation and Interference. The PULVER[™] Shield protects operators of this equipment from Electromagnetic Radiation beyond requirements of presently recognized product standards.

For continued protection against Electromagnetic Radiation and to maintain FCC Certification, replace only with same model and version of PULVER[™] Shield: 12 dB μ V/m maximum attenuation from 30 to 1000 MHz. (RF disc, model 25425490, patent number 6,455,770).

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- 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.

For a Class B Digital Device

**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 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).

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 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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FIGURE 1: PLI Photograph Number 5392C3333SJ-02 illustrates the rear view of the Equipment Under Test in Radiated Electromagnetic Interference Test Configuration #1.



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FIGURE 2: PLI Photograph Number 5392C3333SJ-04 the rear view of the Equipment Under Test in Conducted Electromagnetic Interference Test Configuration #1.

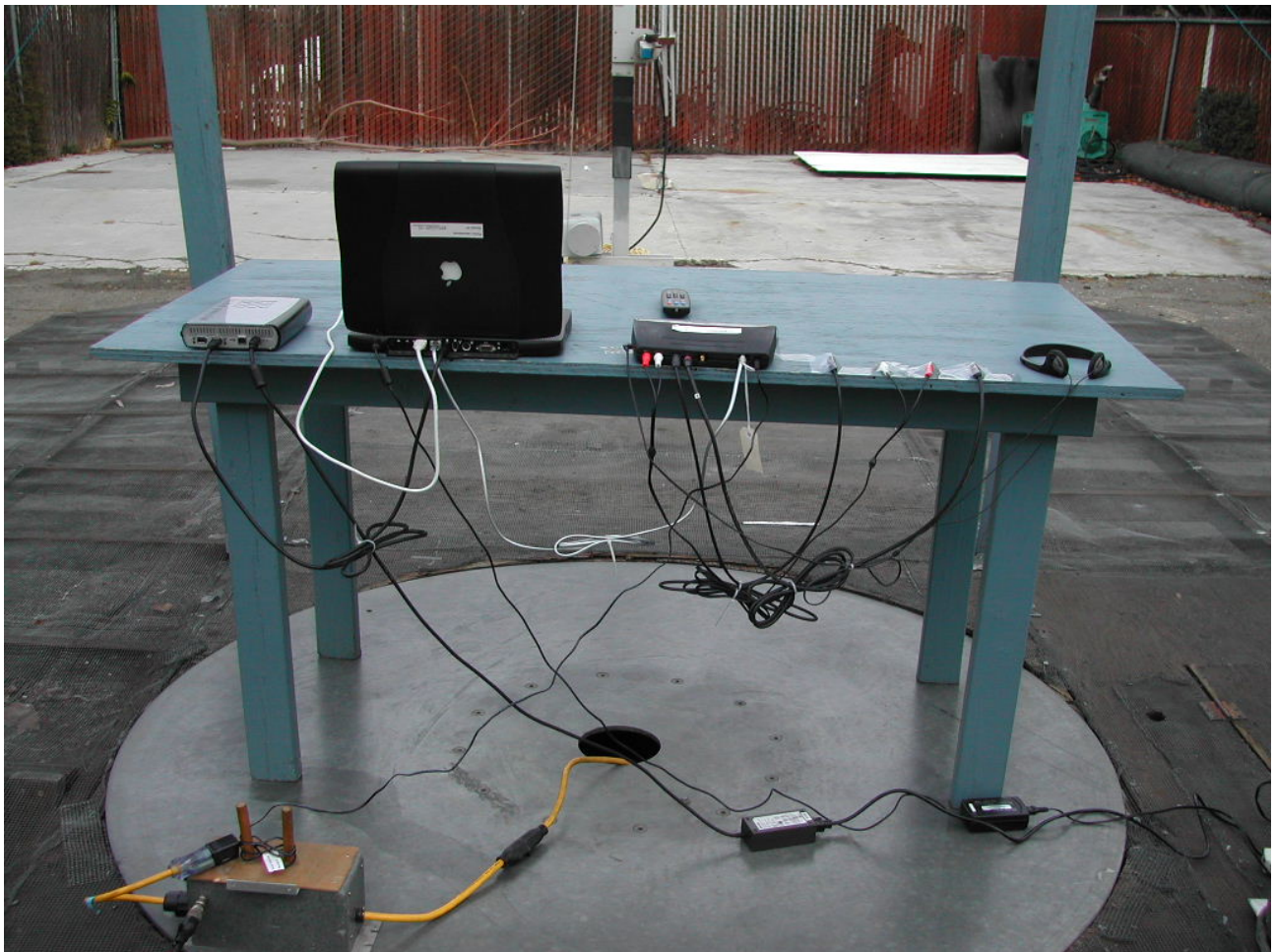
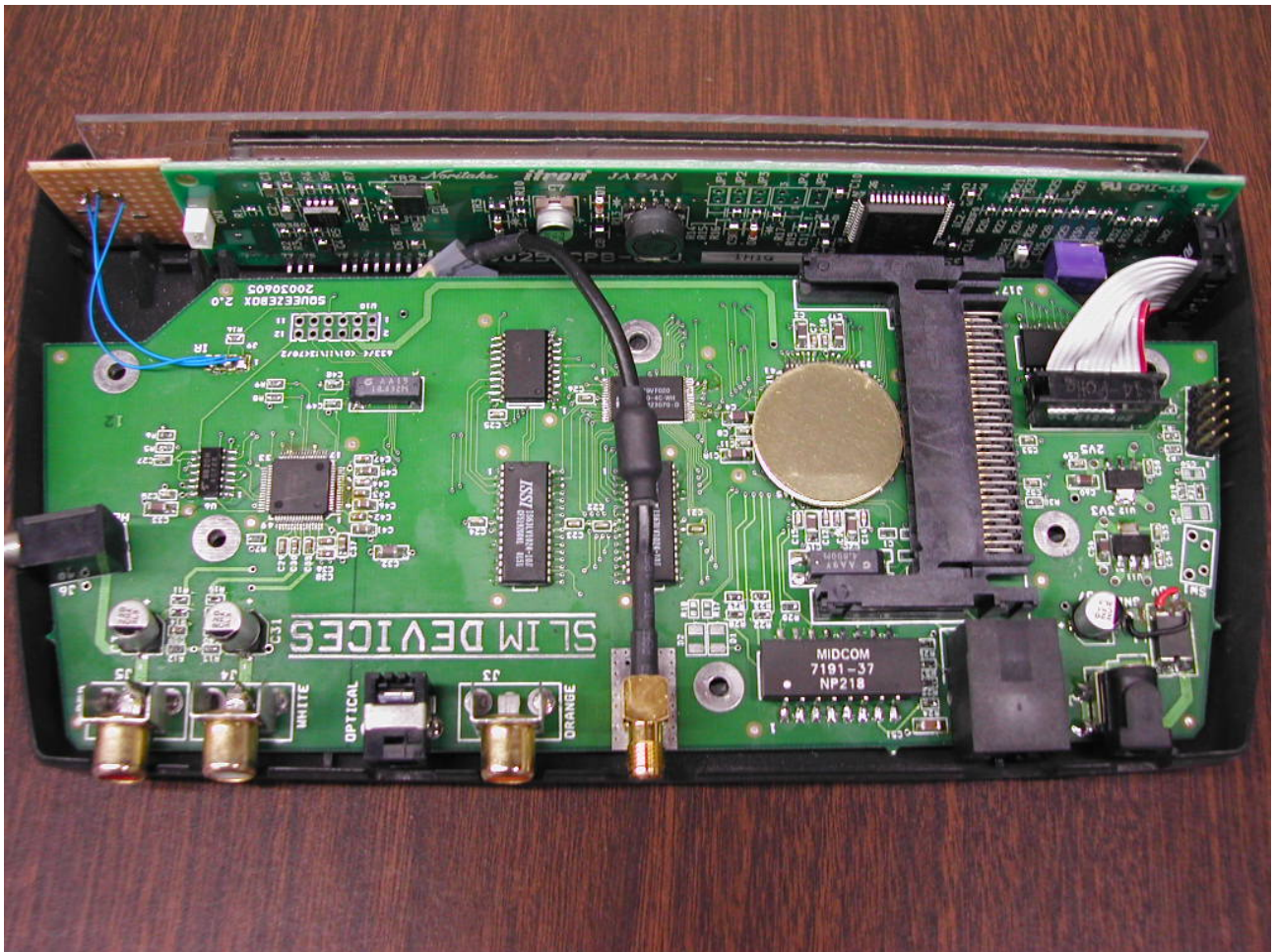


FIGURE 3: PLI Photograph Number 5392C3333SJ-07 illustrates the component side of the motherboard printed circuit assembly (assembly number Squeezebox 2.0 / 20030605). Note the Pulver Shield type 9000 material, trade name “RF disc”, part number 25425490 applied to the Ubicom ip2022 main processor.

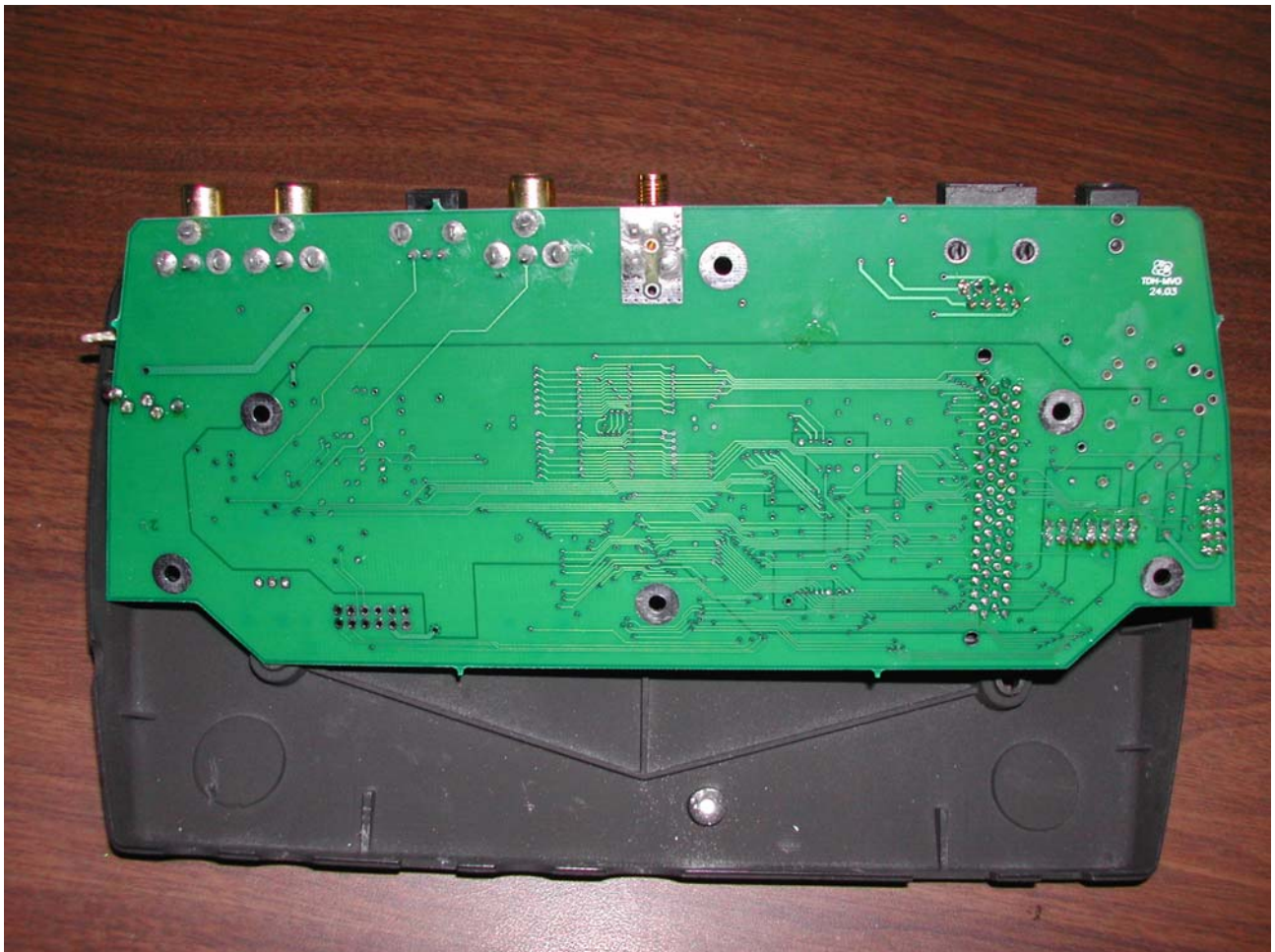
See Patent 6,455,770 entitled “Electromagnetic radiation shield for attenuating electromagnetic radiation from an active electronic device.”



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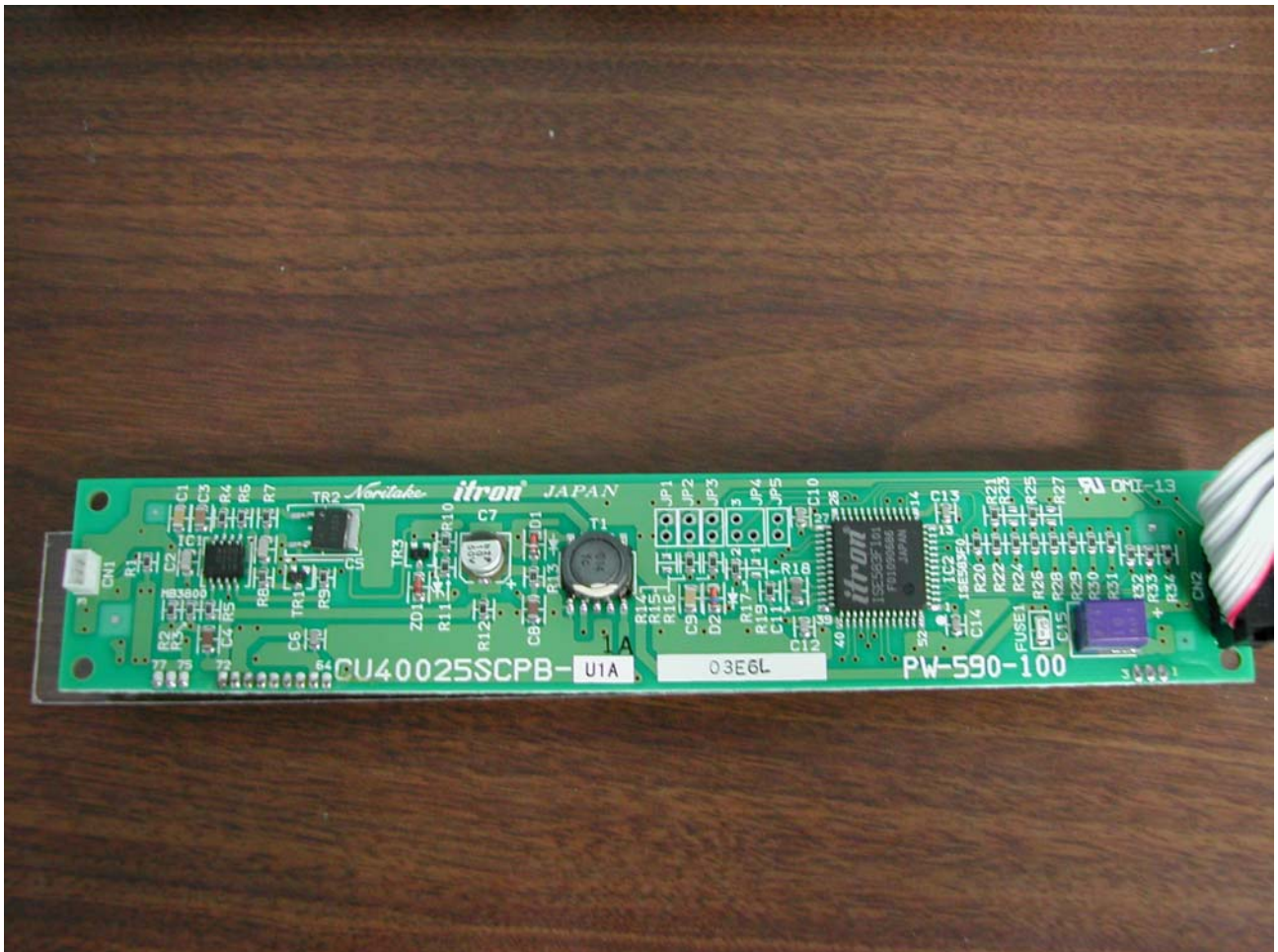
FIGURE 4: PLI Photograph Number 5392C2633SJ-11 illustrates the circuit side of the motherboard printed circuit assembly (assembly number Squeezebox 2.0 / 20030605).



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FIGURE 5: PLI Photograph Number 5392C2633SJ-13 illustrates the circuit side of the LCD printed circuit assembly (assembly number CU40025SCPBU1A / PW-590-100).



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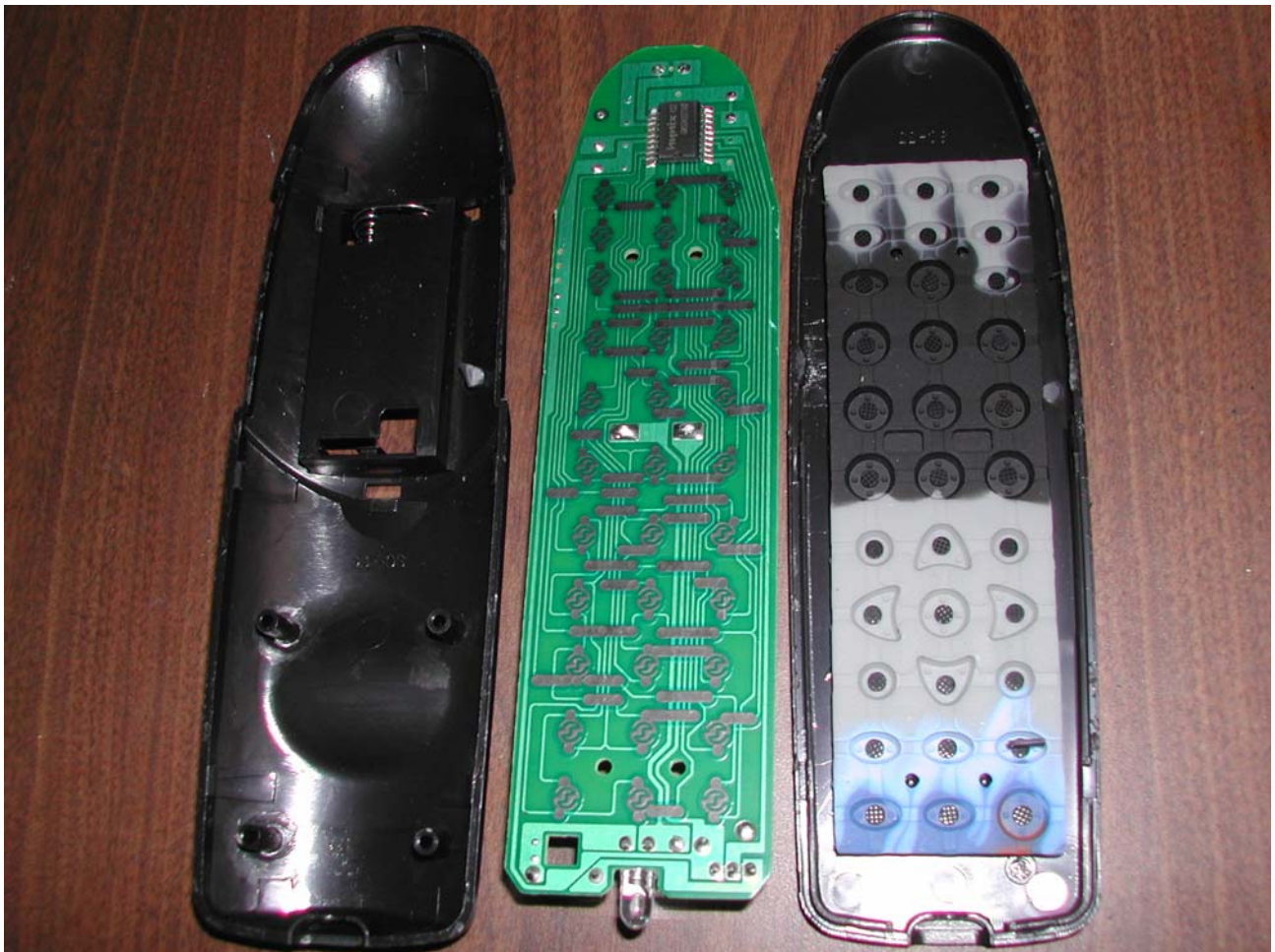
FIGURE 6: PLI Photograph Number 5392C2633SJ-17 illustrates the Slim Devices Remote Control, model SC33 used to operate the Squeezebox.



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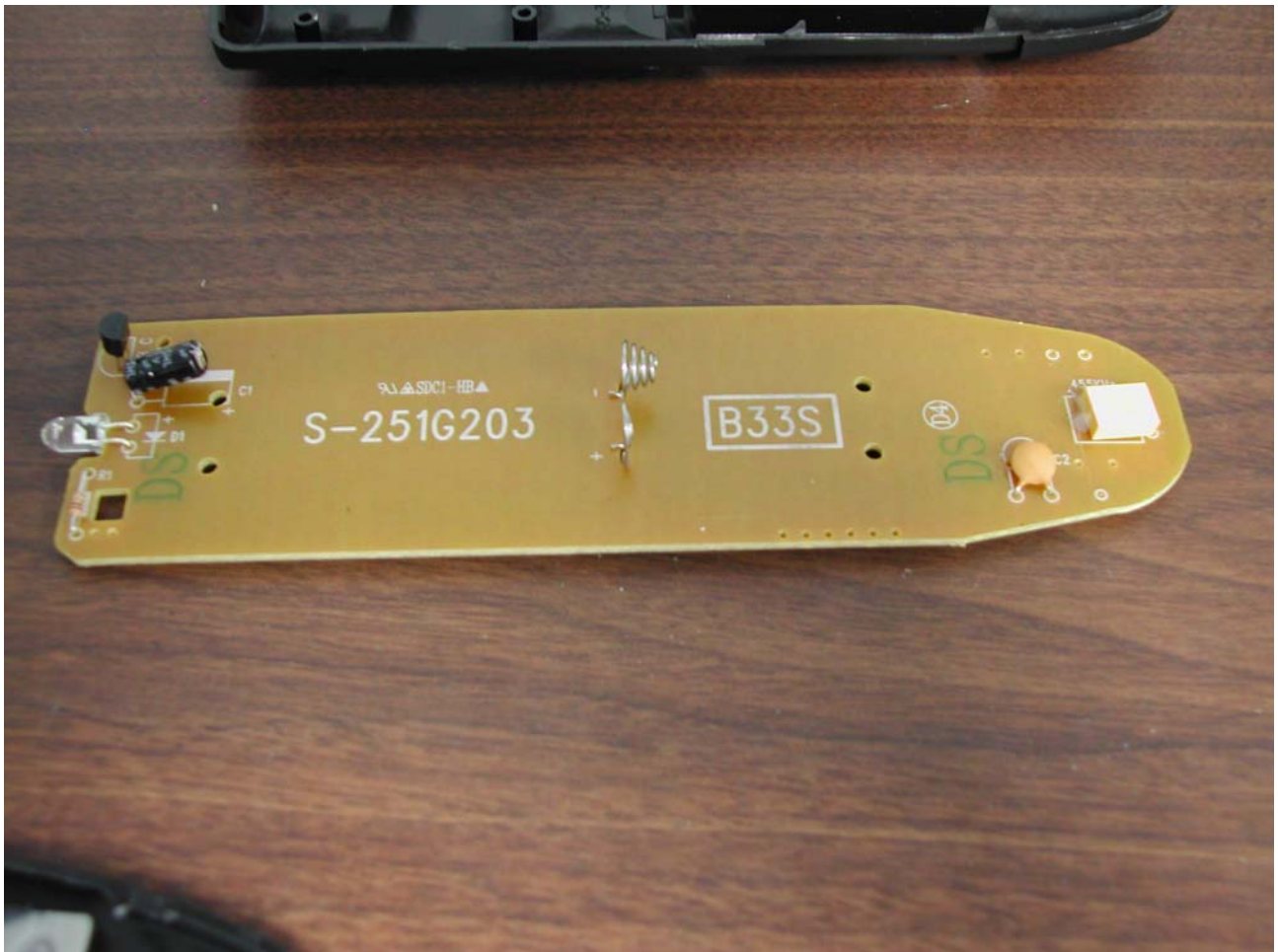
FIGURE 7: PLI Photograph Number 5392C2633SJ-15 illustrates the disassembled remote control and the circuit side of the remote control printed circuit assembly (assembly number S-251G203).



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FIGURE 8: PLI Photograph Number 5392C2633SJ-16 illustrates the component side of the remote control printed circuit assembly (assembly number S-251G203).



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Clock Oscillators and Frequencies of Operation		
Frequency	Component # / Location	Description of Use
4.8 MHz	Ubicom ip2022 main processor (crystal frequency)	Main board
120 MHz	Ubicom ip2022 main processor (internal frequency)	Main board
18.432MHz	Mas3509 decoder chip (crystal frequency)	Main board
Use this table to simplify locating the oscillators in the accompanying schematics.		

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Equipment Under Test Orientation and Configuration
Test Configuration #1

Refer to PLI Photograph Number 5392C3333SJ-02

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 Ultimate test configuration consists of headphones plugged into the headphone jack. Rationale: (1) other ports offer redundant functions; (2) most sever unwanted emissions with headphones connected; (3) optical port does not emit unwanted emissions.
 - 3.3.1 However, to assure conformance to the new ANSI C63.4-2001, note that a cable was connected to every EUT port for the test program.
 - 3.3.2 The most severe cable orientation was chosen for this test program.
- 3.4 The EUT did not function or operate with any peripherals attached to a laptop computer, so no peripherals were attached to the laptop computer for this test.

3.5 The EUT and system configuration follows:

Test Configuration #1

3.5.1 The EUT, remote control, laptop computer, headphones, an external hard drive, and a USB flash reader were placed on the test table.

3.5.2 All peripherals were connected and the headphone set was plugged into headphone jack of the EUT. All remaining cables were connected to the EUT with the opposite ends taped to the side of the test table.

3.5.2.1 During possible normal operation, any one of these cables connect to a device accommodating the output signal. This device could be located adjacent to the EUT.

3.5.2.2 For example, an amplifier accepting the analog signals would connect to the EUT with a two channel cable. This cable was plugged into the EUT, in the orientation of typical use. However, even though only one port is operational at any single time, cables were connected to all EUT ports, include the fiber optic output port of the EUT.

3.5.3 A 5VDC wall adapter was connected to the EUT and plugged into a 120VAC source.

3.5.4 The EUT communicates directly with the laptop computer via a CAT5 cable.

3.5.5 After the EUT is connected to power it initializes to the computer within a couple of seconds. Then,

3.5.5.1 Press "Play" on remote control.

3.5.5.2 The EUT plays the music in memory until the stop button is pressed on the remote control.

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3.6 The following equipment list defines the system configuration:

On-Site Equipment

EUT :Network Music Player
Model Number :SqueezeBox
Serial Number :none
PLI Sample ID :5392C2633-01
FCC ID Number :RDL5392X (Pending)
Manufacturer :Slim Devices, Inc.

Product Name :Wall Adapter for EUT
Model Number :UL110-0520
Serial Number :302-000219
PLI Sample ID :5392C2633-05
FCC ID Number :none
Manufacturer :Unifive

Product :Infrared Remote Control for EUT
Model Number :SC33
Serial Number :none
PLI Sample ID :5392C2633-02
FCC ID Number :Only sold with FCCID: RDL5392X (Pending)
Manufacturer :Slim Devices

Product :Headphones
Model Number :RP-HT20
Serial Number :none
FCC ID Number :none
Manufacturer :Panasonic

Product :Laptop Computer
Model Number :Power book 400MHz
Serial Number :QT0082JTHDP
PLI Sample ID :5392C2633-03
FCC ID Number :FCC DOC Authorized
Manufacturer :Apple Computer, Inc.

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Product Name :Power adapter for Laptop Computer
Model Number :MC-P5/G3
Serial Number :9348
PLI Sample ID :5392C2633-04
FCC ID Number :none
Manufacturer :Battery Technology

Product Name :External Hard Disk Drive
Model Number :WD1200B006-RNN
Serial Number :WMALD0000244
FCC ID Number :DOC Authorized
Manufacturer :Western Digital

Product Name :Power Supply for External Hard Disk Drive
Model Number :AC-005
Serial Number :AC005M0313LD6K13138
FCC ID Number :DOC Authorized
Manufacturer :Rexon Technology Corporation

Product Name :USB Flash Card Reader
Model Number :CF/CF2
Serial Number :31620209701395
FCC ID Number :DOC Authorized
Manufacturer :Belkin

- 3.7 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 and ICAN Class B
Date Data Collected	09-10 Sep 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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Test Configuration #1

Frequency MHz	EMI Data dBµV/M	ACF	Field Strength dBµV/M	FCC Limit dBµV/M	FCC Margin to Limit dBµV/M
Horizontal					
47.90	31.90	-9.87	22.03	40.00	-17.97
72.98	35.40	-12.74	22.66	40.00	-17.34
80.00	44.20	-13.98	30.22	40.00	-9.78
115.73	43.00	-10.02	32.98	43.50	-10.52
117.03	37.80	-9.81	27.99	43.50	-15.51
120.00	42.70	-9.32	33.38	43.50	-10.12
129.88	33.00	-9.75	23.25	43.50	-20.25
169.35	37.50	-9.97	27.53	43.50	-15.97
176.58	36.90	-8.06	28.84	43.50	-14.66
180.65	41.20	-7.10	34.10	43.50	-9.40
214.53	40.50	-10.37	30.13	43.50	-13.37
222.98	42.00	-9.83	32.17	46.00	-13.83
225.83	43.30	-9.65	33.65	46.00	-12.35
228.60	43.70	-9.47	34.23	46.00	-11.77
231.45	43.90	-9.28	34.62	46.00	-11.38
237.10	38.10	-8.92	29.18	46.00	-16.82
240.00	43.40	-8.73	34.67	46.00	-11.33
245.75	46.40	-8.36	38.04	46.00	-7.96
251.20	41.90	-7.99	33.91	46.00	-12.09
256.93	40.00	-7.56	32.44	46.00	-13.56
273.85	41.40	-6.27	35.13	46.00	-10.87
285.15	43.30	-5.75	37.55	46.00	-8.45
296.38	43.20	-5.63	37.57	46.00	-8.43
319.58	45.80	-5.86	39.94	46.00	-6.06
324.50	39.70	-5.93	33.77	46.00	-12.23
344.08	41.50	-6.21	35.29	46.00	-10.71
359.93	38.20	-5.66	32.54	46.00	-13.46
383.48	45.50	-4.15	41.35	46.00	-4.65
399.53	38.90	-3.12	35.78	46.00	-10.22
429.05	41.70	-2.34	39.36	46.00	-6.64
466.65	43.30	-1.61	41.69	46.00	-4.31
666.68	34.40	0.19	34.59	46.00	-11.41
840.05	36.10	3.57	39.67	46.00	-6.33

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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
Vertical					
40.08	41.20	-8.60	32.60	40.00	-7.40
80.00	47.10	-9.60	37.50	40.00	-2.50 A
115.70	45.20	-8.07	37.13	43.50	-6.37
117.08	40.00	-8.02	31.98	43.50	-11.52
120.00	51.40	-7.90	43.50	43.50	0.00 A
121.33	46.40	-7.83	38.57	43.50	-4.93
128.35	42.20	-7.47	34.73	43.50	-8.77
132.65	44.40	-7.28	37.12	43.50	-6.38
180.63	42.80	-4.30	38.50	43.50	-5.00
223.00	41.20	-3.67	37.53	46.00	-8.47
228.65	42.80	-3.57	39.23	46.00	-6.77
234.25	42.70	-3.46	39.24	46.00	-6.76
237.08	42.00	-3.41	38.59	46.00	-7.41
239.90	43.90	-3.36	40.54	46.00	-5.46
242.75	41.10	-3.31	37.79	46.00	-8.21
245.73	38.90	-3.25	35.65	46.00	-10.35
251.15	35.30	-3.14	32.16	46.00	-13.84
256.88	36.00	-3.02	32.98	46.00	-13.02
259.68	40.20	-2.95	37.25	46.00	-8.75
262.48	41.80	-2.89	38.91	46.00	-7.09
263.83	39.10	-2.86	36.24	46.00	-9.76
266.30	40.00	-2.81	37.19	46.00	-8.81
268.10	40.30	-2.77	37.53	46.00	-8.47
279.45	37.70	-2.51	35.19	46.00	-10.81
296.38	38.60	-2.04	36.56	46.00	-9.44
319.00	35.90	-1.55	34.35	46.00	-11.65
324.50	38.30	-1.44	36.86	46.00	-9.14
332.88	42.80	-1.26	41.54	46.00	-4.46
375.00	36.50	-0.39	36.11	46.00	-9.89
399.50	41.70	0.12	41.82	46.00	-4.18
440.25	38.60	0.96	39.56	46.00	-6.44
466.05	38.50	1.49	39.99	46.00	-6.01
499.35	38.40	2.18	40.58	46.00	-5.42
840.10	31.00	8.73	39.73	46.00	-6.27

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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 FCC (Federal Communications Commission) and ICAN (Industry Canada) 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 Federal Communications Commission (FCC) and Industry Canada (ICAN) 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 and ICAN Class B
Date Data Collected	10 Sep 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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Test Configuration #1

Frequency MHz	Line Data dBμV	Neutral Data dBμV	FCC Limit dBμV	FCC Margin to Limit (Line) dBμV	FCC Margin to Limit (Neutral) dBμV
0.68	25.00	-.-	48.00	-23.00	-.-
0.81	26.40	-.-	48.00	-21.60	-.-
8.02	21.50	-.-	48.00	-26.50	-.-
10.91	21.40	-.-	48.00	-26.60	-.-
11.80	21.40	-.-	48.00	-26.60	-.-
13.48	21.40	-.-	48.00	-26.60	-.-
15.89	21.30	-.-	48.00	-26.70	-.-
17.20	26.40	-.-	48.00	-21.60	-.-
19.54	21.40	-.-	48.00	-26.60	-.-
22.22	21.50	-.-	48.00	-26.50	-.-
25.48	21.50	-.-	48.00	-26.50	-.-
28.32	21.70	-.-	48.00	-26.30	-.-
0.68	-.-	22.30	48.00	-.-	-25.70
0.81	-.-	26.30	48.00	-.-	-21.70
5.65	-.-	21.20	48.00	-.-	-26.80
8.16	-.-	21.50	48.00	-.-	-26.50
10.15	-.-	21.50	48.00	-.-	-26.50
12.41	-.-	21.70	48.00	-.-	-26.30
15.25	-.-	21.50	48.00	-.-	-26.50
17.20	-.-	26.90	48.00	-.-	-21.10
20.10	-.-	21.30	48.00	-.-	-26.70
22.39	-.-	21.50	48.00	-.-	-26.50
25.66	-.-	21.10	48.00	-.-	-26.90
28.67	-.-	21.50	48.00	-.-	-26.50

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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 Federal Communications Commission (FCC) and Industry Canada (ICAN) 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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