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Electromagnetic Emissions Test Report and Application for Grant of Equipment Authorization pursuant to FCC Part 15, Subpart C (15.225) FCC Part 15, Subpart B (Class B Digital Device) Industry Canada RSS 210 Issue 5 for an Intentional Radiator on the LeapFrog Model: Cash Register

FCC ID:	QDX2025001
GRANTEE:	LeapFrog 130-D Knowles Drive Los Gatos, CA. 95032
TEST SITE:	Elliott Laboratories, Inc. 684 W. Maude Avenue Sunnyvale, CA 94086
REPORT DATE:	June 10, 2003
FINAL TEST DATE:	June 9, 2003
AUTHORIZED SIGNATORY:	Mark Briggs Director of Engineering

ACCREDITED

DECLARATIONS OF COMPLIANCE

Equipment Name and Model:
Cash Register

Manufacturer:
LeapFrog
130-D Knowles Drive
Los Gatos, CA. 95032

Tested to applicable standards:
RSS-210, Issue 5, November 2001 (Low Power License-Exempt Radiocommunication Devices)
FCC Part 15.225
FCC Part 15 Subpart B Class B Digital Device

Measurement Facility Description Filed With Department of Industry:

Departmental Acknowledgement Number: IC2845 **SV2** Dated August 12, 2001
Departmental Acknowledgement Number: IC2845 **SV3** Dated July 30, 2001

I declare that the testing was performed or supervised by me; that the test measurements were made in accordance with the above mentioned departmental standards (through the use of ANSI C63.4 as detailed in section 5.3 of RSS-210, Issue 5); and that the equipment performed in accordance with the data submitted in this report.

Signature	_____
Name	Mark Briggs
Title	Director of Engineering
Company	Elliott Laboratories Inc.
Address	684 W. Maude Ave Sunnyvale, CA 94086 USA
Date:	June 10, 2003

Maintenance of compliance with the above standards is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

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SCOPE

An electromagnetic emissions test has been performed on the LeapFrog model Cash Register pursuant to Subpart C of Part 15 of FCC Rules for intentional radiators, RSS-210 Issue 5 for licence-exempt low power devices and Subpart B of Part 15 of FCC Rules for digital devices. Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in ANSI C63.4-1992 as outlined in Elliott Laboratories test procedures.

The device under test has been tested in a simulated typical installation to demonstrate compliance with the relevant Industry Canada and FCC performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

The test results recorded herein are based on a single type test of the LeapFrog model Cash Register and therefore apply only to the tested sample. The sample was selected and prepared by Jim Cordova of LeapFrog

OBJECTIVE

The primary objective of the manufacturer is compliance with Subpart C of Part 15 of FCC Rules, Subpart B of Part 15 of FCC Rules and RSS-210 Issue 5 for license-exempt low power devices for the radiated and conducted emissions of digital devices and intentional radiators. Certification of these devices is required as a prerequisite to marketing as defined in Part 2 the FCC Rules.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to the FCC. The FCC issues a grant of equipment authorization upon successful completion of their review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units which are subsequently manufactured.

SUMMARY OF RESULTS

The results summary below contains the highest measurements with respect to the specified limits. The complete data is contained in an appendix of this report.

FCC Part 15 Section	RSS 210 Section	Description	Measured Value (Margin)	Limit	Result
15.225a		Output Field Strength	21.8dBuV/m @ 13.560 MHz	10,000 microvolts/m (80 dBuV/m) QP @ 30 metres	Complies (Note 1)
	6.2.2e	Output Field Strength	21.8dBuV/m @ 13.560 MHz	15.5 millivolts/m (84 dBuV/m) QP @ 30 metres	Complies (Note 1)
	6.2.2e	Field Strength Fc ±150 kHz,	N/A – fundamental signal below limit	334 microvolts/m (50.5 dBuV/m) @ 30 m	Complies
	6.2.2e	Field Strength - Fc ± 150 kHz to Fc ±450 kHz		106 microvolts/m (40.5 dBuV/m) @ 30 m	Complies
15.225b		Spurious emissions outside of the allocated band	37.5 dBuV/m @ 54.238 MHz (-2.5dB)	FCC 15.209 / RSS-210 Tables 3 and 7	Complies
15.255 c	6.2.2e	Frequency Stability	+0.03, -7.7 ppm	±0.01% (±100 ppm) Temperatures of -20°C, to +50°C 85% to 115% voltage variations.	Complies
15.107 / 15.207 c	6.2.2e	AC Conducted Emissions	-	Not applicable – device is battery powered	N/A
15.109 c	-	Radiated Emissions (Digital Device)	22.9dBuV/m@ 120.000MHz (-20.6dB)	15.109 Class B limits (Digital Device)	Complies

Note 1: Measurement made using a peak detector and 9kHz measurement bandwidth rather than a QP detector.

MEASUREMENT UNCERTAINTIES

ISO Guide 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with NAMAS document NIS 81.

Measurement Type	Frequency Range (MHz)	Calculated Uncertainty (dB)
Conducted Emissions	0.15 to 30	± 2.4
Radiated Emissions	0.15 to 30	± 1.9
Radiated Emissions	30 to 1000	± 3.6

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The LeapFrog model Cash Register is an educational toy that incorporates an RF ID reader to read passive tags at 13.56 MHz. Normally, the EUT would be placed on a tabletop during operation. The EUT was, therefore, treated as tabletop equipment during testing to simulate the end-user environment. The EUT operates from 4.5 VDC via internal batteries.

The sample was received on June 3, 2003 and tested on June 9, 2003.

The EUT consisted of the following component(s):

Manufacturer	Model	Description	Serial Number	FCC ID
Leapfrog	Cash Register	RF ID reader	N/A	QDX2025001

ENCLOSURE

The EUT enclosure is primarily constructed of plastic. It measures approximately 33 cm wide by 16.8 cm deep by 19.8 cm high.

MODIFICATIONS

The EUT did not require modifications during testing in order to comply with the emission specifications.

SUPPORT EQUIPMENT

No support equipment was used during emissions testing.

EUT INTERFACE PORTS

No interface ports were used during emissions testing.

EUT OPERATION DURING TESTING

Continuously transmitting at 13.56 MHz

ANTENNA REQUIREMENTS

The antenna is incorporated into the circuit board.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on June 9, 2003at the Elliott Laboratories Open Area Test Site #1 & 3 located at 684 West Maude Avenue, Sunnyvale, California. The test site contains separate areas for radiated and conducted emissions testing. Pursuant to section 2.948 of the Rules, construction, calibration, and equipment data has been filed with the Federal Communications Commission. In accordance with Industry Canada rules detailed in RSS 210 Issue 5 and RSS-212, construction, calibration, and equipment data for the test sites have been filed with the Federal Communications Commission.

The FCC recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement with the exception of predictable local TV, radio, and mobile communications traffic. The test site contains separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent FCC requirements.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.4-1992. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment. The test site is maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 guidelines.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde and Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

POWER METER

A power meter and peak power sensor are used for all direct output power measurements from transmitters as they provide a broadband indication of the power output.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A biconical antenna is used to cover the range from 30 MHz to 300 MHz and a log periodic antenna is utilized from 300 MHz to 1000 MHz. Narrowband tuned dipole antennas are used over the entire 30 to 1000 MHz range for precision measurements of field strength. Above 1000 MHz, a horn antenna is used. The antenna calibration factors are included in site factors programmed into the test receivers.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height.

ANSI C63.4 specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The FCC requires that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4, and the worst case orientation is used for final measurements.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.

RADIATED EMISSIONS

Radiated emissions measurements are performed in two phases as well. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed from 30 MHz up to the frequency required by the regulation specified on page 1. One or more of these is with the antenna polarized vertically while the one or more of these is with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360°, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit.

A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth which results in the highest emission is then maintained while varying the antenna height from one to four meters. The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain. Emissions which have values close to the specification limit may also be measured with a tuned dipole antenna to determine compliance.

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements are performed with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.

Measurement bandwidths (video and resolution) are set in accordance with FCC procedures for the type of radio being tested.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions from the AC power port are given in units of microvolts and the limits for radiated electric field emissions are given in units of microvolts per meter at a specified test. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m).

For reference, converting the voltage and electric field strength specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. Conversion of power specification limits from linear units (in milliwatts) to decibel form (in dBm) is accomplished by taking the base ten logarithm, then multiplying by 10.

FCC 15.255 and RSS 210 FUNDAMENTAL SIGNAL LIMITS

Operating Frequency (MHz)	RSS 210 6.2.2(e) Limit	FCC Part 15.255 Limit
13.553 – 13.567	84 dBuV/m @ 30m	80 dBuV/m @ 30m

RSS 210 AND FCC 15.247 SPURIOUS RADIATED EMISSIONS LIMITS

The limits for unwanted (spurious) emissions from the transmitter are:

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
0.009 to 0.490 2	400/F(kHz) @ 300m	52 - 20 Log[f(kHz)] @ 300m
0.490 to 1.705	24000/F(kHz) @ 30m	87.6 - 20 Log[f(kHz)] @ 30m
1.705 to 30.0	30 @ 30m	29.5 @ 30m
30 to 88	100 @ 3m	40 @ 3m
88 to 216	150 @ 3m	43.5 @ 3m
216 to 960	200 @ 3m	46.0 @ 3m
Above 960	500 @ 3m	54.0 @ 3m

FCC AC POWER PORT CONDUCTED EMISSIONS LIMITS

The table below shows the limits for emissions on the AC power line as detailed in FCC Part 15.207.

Frequency (MHz)	Average Limit (dBuV)	Quasi Peak Limit (dBuV)
0.150 to 0.500	Linear decrease on logarithmic frequency axis between 56.0 and 46.0	Linear decrease on logarithmic frequency axis between 66.0 and 56.0
0.500 to 5.000	46.0	56.0
5.000 to 30.000	50.0	60.0

RSS-210 SECTION 6.6 AC POWER PORT CONDUCTED EMISSIONS LIMITS

The table below shows the limits for emissions on the AC power line as detailed in Industry Canada RSS-210 section 6.6.

Frequency Range (MHz)	Limit (uV)	Limit (dBuV)
0.450 to 30.000	250	48

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - S = M$$

where:

R_r = Receiver Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements. A distance factor, when used for electric field measurements, is calculated by using the following formula:

$$F_d = 20\text{LOG}_{10} (D_m/D_s)$$

Note – for frequencies below 30MHz the correction factor is either calculated from measurements at two different distances or the factor is calculated using:

$$F_d = \mathbf{40}\text{LOG}_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_s = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

EXHIBIT 1: Test Equipment Calibration Data

1 Page

Radiated Emissions, 30 - 1000 MHz, 09-Jun-03
Engineer: jmartinez

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
Elliott Laboratories	Biconical Antenna, 30-300 MHz	EL30.300	773	12	3/18/2003	3/18/2004
EMCO	Log Periodic Antenna, 0.2-2 GHz	3148	1321	12	3/31/2003	3/31/2004
Rohde & Schwarz	Test Receiver, 20 -1300MHz	ESVP	273	12	2/13/2003	2/13/2004

Radiated Emissions, 30 - 1000 MHz, 09-Jun-03
Engineer: jmartinez

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
EMCO	Magnetic Loop Antenna, 10k-30MHz	6502	1299	12	12/16/2002	12/16/2003
Rohde & Schwarz	Test Receiver, 9kHz-2750MHz	ESCS 30	1337	12	12/27/2002	12/27/2003

Frequency Stability, 09-Jun-03
Engineer: jmartinez

Manufacturer	Description	Model #	Assett #	Cal interval	Last Calibrated	Cal Due
Thermotron	Environmental Chamber	SM-322	25-1031	12	4/4/2003	4/4/2004

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T51273 10 Pages

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EMC Test Data

Client:	Leapfrog	Job Number:	J51237
Model:	Cash Register	T-Log Number:	T51273
		Account Manager:	Rob Holt
Contact:	Jim Cordova		
Emissions Spec:	FCC 15.225	Class:	Radio
Immunity Spec:	-	Environment:	

EMC Test Data

For The

Leapfrog

Model

Cash Register

Date of Last Test: 6/3/2003

Client:	Leapfrog	Job Number:	J51237
Model:	Cash Register	T-Log Number:	T51273
		Account Manager:	Rob Holt
Contact:	Jim Cordova		
Emissions Spec:	FCC 15.225	Class:	Radio
Immunity Spec:	-	Environment:	

EUT INFORMATION

General Description

The EUT is a RF ID reader which is designed to be used in educational toy units. Normally, the EUT would be placed on a table top during operation. The EUT was, therefore, treated as table-top equipment during testing to simulate the end-user environment. The EUT operates on a 4.5 VDC.

Equipment Under Test

Manufacturer	Model	Description	Serial Number	FCC ID
Leapfrog	Cash Register	RF ID reader	N/A	QDX2025001

EUT Enclosure

The EUT enclosure is primarily constructed of plastic. It measures approximately 33 cm wide by 16.8 cm deep by 19.8 cm

Modification History

Mod. #	Test	Date	Modification
1			

Modifications applied are assumed to be used on subsequent tests unless otherwise stated as a further modification.

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EMC Test Data

Client:	Leapfrog	Job Number:	J51237
Model:	Cash Register	T-Log Number:	T51273
		Account Manager:	Rob Holt
Contact:	Jim Cordova		
Emissions Spec:	FCC 15.225	Class:	Radio
Immunity Spec:	-	Environment:	

Test Configuration #1

Local Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

Remote Support Equipment

Manufacturer	Model	Description	Serial Number	FCC ID
None				

Interface Cabling and Ports

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
None				

EUT Operation During Emissions

Continously transmitting at 13.56 MHz

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EMC Test Data

Client:	Leapfrog	Job Number:	J51237
Model:	Cash Register	T-Log Number:	T51273
		Account Manager:	Rob Holt
Contact:	Jim Cordova		
Spec:	FCC 15.225	Class:	Radio

Radiated Emissions

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 6/3/2003
Test Engineer: J Martinez
Test Location: SVOATS #1

Config. Used: 1
Config Change: None
EUT Voltage: Battery Operated

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated emissions testing.

For the fundamental emission below 30 MHz the measurement antenna was located 5 and 10 meters from the EUT as noted. Radiated magnetic field measurements were made with the loop antenna located one meter above the ground plane. The loop was rotated from 0 to 90 degrees to maximized pickup field strength. Harmonics below 30 MHz was performed at 3 meters, readings were extrapolated to the specified distance as stated in 15.209, and measured with a loop antenna. Harmonics above 30 MHz were performed at 3 meters per 15.209 and measured with a Biconical antenna.

Ambient Conditions:

Temperature: 27 °C
Rel. Humidity: 51 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	RE, Fundamental Measurement	15.225	Pass	-58.2dB @ 13.56 MHz
2	RE, 27 - 135.6 MHz, Harmonic Emissions	15.209	Pass	-2.5dB @ 54.23 MHz

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

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EMC Test Data

Client:	Leapfrog	Job Number:	J51237
Model:	Cash Register	T-Log Number:	T51273
		Account Manager:	Rob Holt
Contact:	Jim Cordova		
Spec:	FCC 15.225	Class:	Radio

Run #1: Fundamental Field Strength

EUT Loop antenna, Asset #1299, was elevated 1.00 meters from ground plane.

Frequency MHz	Reading dBµV	AF dB	Level dBuV/m	AF dB	Level dBuA/m	Detector	Distance (m)	Comments
13.560	30.9	10.5	**41.4**	-41.0	-10.1	Pk	5.0	Open Loop (device standing)
13.560	23.3	10.5	**33.8**	-41.0	-17.7	Pk	10.0	Open Loop (device standing)

AF: Antenna Factor

Data Summary - Extrapolation Factor (Device standing)

Freq (MHz)	Level At Test Distance @5m		@10m	
	dBuV/m	dBuA/m	dBuV/m	dBuA/m
13.56	**41.4**	-10.1	**33.8**	-17.7

Extrapolation Factors For Fundamental Signal

The following extrapolation factors are calculated by dividing the difference between the field strengths at the two distances by the log (base ten) of the ratio of the two distances.

5m to 10m -25.2

The equation used for extrapolation is:

Extrapolation =[(Fm - F) / Log (Dm/Ds)] dB

Where:

Fm = measured field strength in dBuV/m or dBuA/m

Ds is the specification test distance

Dm is the actual measurement distance used

The calculated extrapolation factor of -25.2 dB was used for extrapolating the fundamental signal level from the measurement taken at 10m to a 30m distance. Final measurements were performed with device standing up, since this will be the normal use of the product.

Fundamental Measurement

Freq (MHz)	Level (dBuV/m)	Limit dBuV/m	Margin dB	Comment
13.56	21.8	80.0	-58.2	Fundamental at 30m using extrapolation factor of -25.2 dB per decade of distance (Note 1)

Note 1 : Peak Measurement at 10m was used as the worst case.

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EMC Test Data

Client:	Leapfrog	Job Number:	J51237
Model:	Cash Register	T-Log Number:	T51273
		Account Manager:	Rob Holt
Contact:	Jim Cordova		
Spec:	FCC 15.225	Class:	Radio

Run #2 Radiated Harmonic Emissions, 27-135.6 MHz

FCC Part 15.209 Harmonics

Freq (MHz)	Level (dBuV/m)	Limit dBuV/m	Margin dB	Comment
27.125	15.3	29.5	-14.2	Field strength extrapolated to 30m (Note 1& 3)

Notes:

Note 1: Harmonics were measured at a distance of 10 meters from the EUT.

Note 2 : Peak Measurement at 10m was used as the worst case.

Note 3: Extrapolation factor of 20Log(Test Distance/Specification Distance) was used to correct to 30 Meters - more realistic than the 40dB/decade factor allowed in FCC Part 15.

Frequency	Level	Pol	15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
54.238	37.5	h	40.0	-2.5	QP	184	2.0	Note 1
122.040	39.5	h	43.5	-4.0	QP	210	2.7	Note 1
54.238	34.5	v	40.0	-5.5	QP	360	1.0	Note 1
67.800	32.5	v	40.0	-7.5	QP	360	1.0	Note 1
122.040	35.2	v	43.5	-8.3	QP	209	1.0	Note 1
67.800	30.7	h	40.0	-9.3	QP	34	2.2	Note 1
81.356	28.5	h	40.0	-11.5	QP	348	3.3	Note 1
108.478	30.4	h	43.5	-13.1	QP	204	1.8	Note 1
81.356	25.2	v	40.0	-14.8	QP	107	1.0	Note 1
40.675	24.5	h	40.0	-15.5	QP	12	3.5	Note 1
135.593	27.3	h	43.5	-16.2	QP	212	1.4	Note 1
135.593	23.4	v	43.5	-20.1	QP	109	1.0	Note 1
40.675	18.0	v	40.0	-22.0	QP	0	1.0	Note 1
108.478	18.0	v	43.5	-25.5	QP	125	1.0	Note 1

Note 1:	Measured at 3 meter distance per section 15.209

Elliott

EMC Test Data

Client:	Leapfrog	Job Number:	J51237
Model:	Cash Register	T-Log Number:	T51273
		Account Manager:	Rob Holt
Contact:	Jim Cordova		
Spec:	FCC 15.225	Class:	Radio

Radiated Emissions

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 5/22/2003
Test Engineer: J Martinez
Test Location: SVOATS #3

Config. Used: 1
Config Change: None
EUT Voltage: Battery Operated

General Test Configuration

The EUT was located on the turntable for radiated emissions testing.

On the OATS, the measurement antenna was located 3 meters from the EUT for the measurement range 30 - 1000 MHz.

Note, **preliminary** testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. **Maximized** testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Ambient Conditions:

Temperature: 16.7 °C
Rel. Humidity: 72 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
2	RE, 30 - 1000MHz, Maximized Emissions	FCC B	Pass	-20.6dB @ 120.000MHz

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

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EMC Test Data

Client:	Leapfrog	Job Number:	J51237
Model:	Cash Register	T-Log Number:	T51273
		Account Manager:	Rob Holt
Contact:	Jim Cordova		
Spec:	FCC 15.225	Class:	Radio

Run #1: Preliminary Radiated Emissions, 30-1000 MHz

Frequency	Level	Pol	FCC B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
120.000	22.9	v	43.5	-20.6	QP	20	1.0	
184.190	19.1	v	43.5	-24.4	QP	360	1.0	
217.182	18.7	v	46.0	-27.3	QP	0	1.0	
57.606	13.2	h	40.0	-26.8	QP	0	2.0	
62.993	10.2	h	40.0	-29.8	QP	0	2.0	
60.299	9.2	h	40.0	-30.8	QP	361	2.0	

Run #2: Maximized Readings From Run #1

Frequency	Level	Pol	FCC B		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
120.000	22.9	v	43.5	-20.6	QP	20	1.0	
184.190	19.1	v	43.5	-24.4	QP	360	1.0	
217.182	18.7	v	46.0	-27.3	QP	0	1.0	
57.606	13.2	h	40.0	-26.8	QP	0	2.0	
62.993	10.2	h	40.0	-29.8	QP	0	2.0	
60.299	9.2	h	40.0	-30.8	QP	361	2.0	

Elliott

EMC Test Data

Client:	Leapfrog	Job Number:	J51237
Model:	Cash Register	T-Log Number:	T51273
		Account Manager:	Rob Holt
Contact:	Jim Cordova		
Spec:	FCC 15.225	Class:	Radio

Frequency Stability-Section 15.225(c)

Test Specifics

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 6/9/2003
Test Engineer: jgonzales/jmartinez
Test Location: Environmental Chamber
Config. Used: 1
Config Change: None
EUT Voltage: Battery Operated

General Test Configuration

EUT was place inside the Temperature Chamber and all local support equipment were located outside on a table for testing. A field probe was used to capture the fundamental signal. The spectrum analyzer was used to monitor the drift.

Chamber was set to -20 to 50 degrees Celsius. Incremented 10 degrees per temperature and let unit stabilized for every temperature.

Voltage stability was done at 20 degrees Celsius. Varied the DC voltage to 85% and to 115% of the rated supply voltage.

Ambient Conditions:

Temperature: N/A
Rel. Humidity: N/A

Summary of Results

Run #	Test Performed	Limit	Result	Comment
1	Temperature Vs. Frequency	15.225(c)	Pass	.00047 %
2	Voltage Vs. Frequency	15.225(c)	Pass	.000003 %

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Leapfrog	Job Number:	J51237
Model:	Cash Register	T-Log Number:	T51273
		Account Manager:	Rob Holt
Contact:	Jim Cordova		
Spec:	FCC 15.225	Class:	Radio

Run# 1: Temperature Vs. Frequency

Drift	Frequency	Limit
(ppm)	(MHz)	(+/-Hz)
100	13.55994	1355.994

Temperature	Drift	Limit	Total Drift	Total Drift
(Celsius)	(Hz)	(+/-Hz)	(ppm)	(%)
-20	-764.0	1355.994	-7.640	-0.00076
-10	-77.0	1355.994	-0.770	-0.00008
0	-764.0	1355.994	-7.640	-0.00076
10	-737.0	1355.994	-7.370	-0.00074
20	-635.0	1355.994	-6.350	-0.00064
30	-696.0	1355.994	-6.960	-0.00070
40	-698.0	1355.994	-6.980	-0.00070
50	-642.0	1355.994	-6.420	-0.00064

Run# 2: Voltage Vs. Frequency

Nominal Voltage is 4.5Vdc.

Voltage	Drift	Limit	Total Drift	Total Drift
(Percentage)	(Hz)	(Hz)	ppm	percentage
85%	3.0	1355.994	0.030	0.0000030
115%	3.0	1355.994	0.030	0.0000030