COMMUNICATION CERTIFICATION LABORATORY

1940 West Alexander Street
Salt Lake City, UT 84119
801-972-6146

Test Report

Certification

TEST OF: L41XX

FCC ID: NVA00001

To FCC PART 15, Subpart C
Section 15.225 & 15.207

Test Report Serial No: 73-8228

Applicant:

Hypercom Corporation
2851 West Kathleen Road
Phoenix, AZ 85023

Date of Test: January 30, 2006 and
February 8 & 9, 2006

Issue Date: March 2, 2006

Accredited Testing Laboratory By:

NVLAP Lab Code 100272-0

CERTIFICATION OF ENGINEERING REPORT

This report has been prepared by Communication Certification Laboratory to determine compliance of the device described below with the certification requirements of FCC Part 15, Subpart C. This report may be reproduced in full, partial reproduction may only be made with the written consent of the laboratory. The results in this report apply only to the sample tested.

- Applicant: Hypercom Corporation
- Manufacturer: Hypercom Corporation
- Trade Name: Hypercom
- Model Number: L41XX
- FCC ID: NVA00001

On this 2nd day of March 2006, I, individually, and for Communication Certification Laboratory, certify that the statements made in this engineering report are true, complete, and correct to the best of my knowledge, and are made in good faith.

Although NVLAP has recognized that the Communication Certification Laboratory EMC testing facilities are in good standing, NVLAP does not endorse the product described in this report.

COMMUNICATION CERTIFICATION LABORATORY

Norman P Hansen

Tested by: Norman P. Hansen
EMC Technician

TABLE OF CONTENTS

SECTION 1.0 CLIENT INFORMATION.....4

SECTION 2.0 EQUIPMENT UNDER TEST (EUT).....5

SECTION 3.0 TEST SPECIFICATION, METHODS & PROCEDURES.....6

SECTION 4.0 OPERATION OF EUT DURING TESTING.....8

SECTION 5.0 SUMMARY OF TEST RESULTS.....9

SECTION 6.0 MEASUREMENTS, EXAMINATIONS AND DERIVED RESULTS.....10

APPENDIX 1 TEST PROCEDURES AND TEST EQUIPMENT.....16

APPENDIX 2 PHOTOGRAPHS.....20

SECTION 1.0 CLIENT INFORMATION

1.1 Client Information:

Company Name: Hypercom Corporation
2851 West Kathleen Road
Phoenix, AZ 85023

Contact Name: Ron Pickard
Title: Compliance Engineer

1.2 Manufacturer:

Company Name: Hypercom Corporation
2851 West Kathleen Road
Phoenix, AZ 85023

Contact Name: Ron Pickard
Title: Compliance Engineer

SECTION 2.0 EQUIPMENT UNDER TEST (EUT)

2.1 Identification of EUT:

Trade Name:	Hypercom
Model Number:	L41XX
Serial Number:	None
Options Fitted:	N/A
Country of Manufacture:	China

2.2 Description of EUT:

The L41XX is a series of Point of Sale terminals. The L41XX has a display, keypad, magnetic card reader, and RFID system. Serial and Ethernet communication protocols are supported. Power is typically supplied from the POS system over the serial cable; however, for this testing, a Hypercom UP03061120 power supply was used to power the L4100. The L4100 was tested as a representative sample of the series.

This report covers the RFID circuitry subject to the requirements of FCC Part 15.225. The circuitry of the L41XX subject to FCC Part 15 Subpart B is to be tested and covered in separate testing and reports.

SECTION 3.0 TEST SPECIFICATION, METHODS & PROCEDURES

3.1 Test Specification:

Title: FCC PART 15, Subpart C (47 CFR 15).
Section 15.225 and 15.207

Operation within the band 13.110 – 14.010 MHz
Conducted emission limits at the AC Mains

Purpose of Test: The tests were performed to demonstrate initial compliance.

3.2 Methods & Procedures:

3.2.1 §15.225

(a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

(b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

(c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

(e) The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of −20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

(f) In the case of radio frequency powered tags designed to operate with a device authorized under this section, the tag may be approved with the device or be considered as a separate device subject to its own authorization. Powered tags approved with a device under a single application shall be labeled with the same identification number as the device.

3.2.2 §15.207 Conducted Limits

(a) Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHZ to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15 – 0.5*	66 to 56*	56 to 46*
0.5 – 5	56	46
5 - 30	60	50

*Decreases with the logarithm of the frequency.

3.3 Test Procedure

The line conducted and radiated emissions testing was performed according to the procedures in ANSI C63.4 (2003). Testing was performed at CCL's Wanship open area test site #2, located at 550 West Wanship Road, Wanship, UT. This site has been fully described in a report submitted to the FCC, and was accepted in a letter dated August 11, 2003 (90504).

CCL participates in the National Voluntary Laboratory Accreditation Program (NVLAP) and has been accepted under NVLAP Lab Code:100272-0, which is effective until September 30, 2006.

For radiated emissions testing at 30 MHz or above that is performed at distances closer than the specified distance, an inverse proportionality factor of 20 dB per decade is used to normalize the measured data for determining compliance. At frequencies below 30 MHz, an inverse proportionality factor of 40 dB per decade is used to normalize the measured data.

SECTION 4.0 OPERATION OF EUT DURING TESTING

4.1 Operating Environment:

Power Supply: 120 VAC
60 Hz

4.2 Operating Modes:

The L4100 was tested when placed horizontally on the table top as if mounted on a counter and also placed vertically as if mounted on a wall. The transmitter was in a constant transmit state. An L4100 with a dummy load installed at the antenna was used for measuring conducted emissions at the AC mains port.

4.3 EUT Exercise Software:

Hypercom test software was used to exercise the EUT.

SECTION 5.0 SUMMARY OF TEST RESULTS

5.1 FCC PART 15, Subpart C Section 15.231

5.1.1 Summary of Tests:

Section	Test Performed	Frequency Range (MHz)	Result
15.225 (a)	Radiated Emissions	13.553 – 13.567	Complied
15.225 (b)	Radiated Emissions	13.410 – 13.553 and 13.567 – 13.710	Complied
15.225(c)	Radiated Emissions	13.110 – 13.410 and 13.710 – 14.010	Complied
15.225 (d)	Radiated Emissions	1.705 – 1000 excluding the frequency bands of paragraphs (a) through (c)	Complied
15.225 (e)	Frequency Stability	13.56	Complied
15.207	Line Conducted Emissions (Hot Lead to Ground)	0.15 to 30	Complied
15.207	Line Conducted Emissions (Neutral Lead to Ground)	0.15 to 30	Complied

5.2 Result

In the configuration tested, the EUT complied with the requirements of the specification.

SECTION 6.0 MEASUREMENTS, EXAMINATIONS AND DERIVED RESULTS

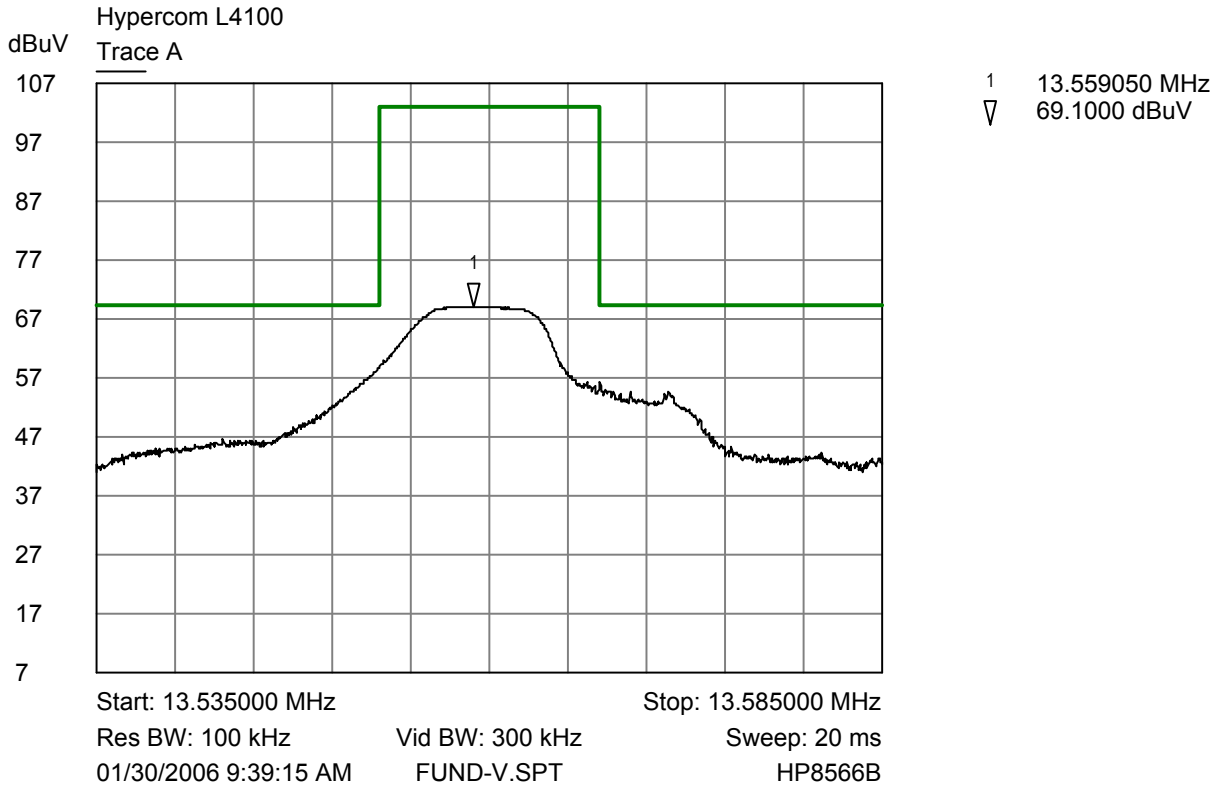
6.1 General Comments:

This section contains the test results only. Details of the test methods used and a list of the test equipment used during the measurements can be found in Appendix 1 of this report.

6.2 Test Results:

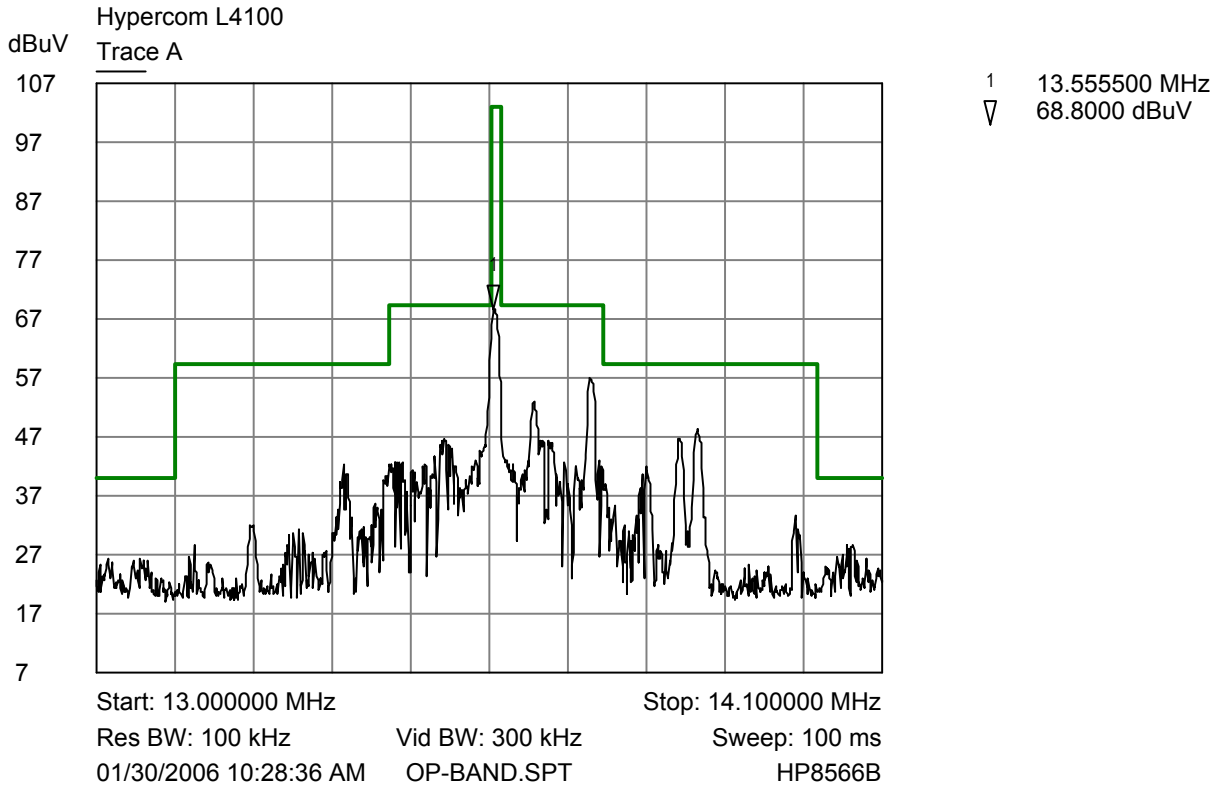
6.2.1 §15.225 (a) - (d)

The emissions from the L4100 must meet the emission mask specified in §15.225. The plots of the fundamental frequency and operating band of the transmitter are shown below. The data of spurious emissions seen is shown in a tabular format after the plots.



QP adapter in normal mode for 9 kHz RBW, 10 meter measurement distance

Trace A Peak Detection - Corrected Trace



QP adapter in normal mode for 9 kHz RBW, 10 meter measurement distance

Trace A Peak Detection - Corrected Trace

Radiated Interference Level Data

Frequency (MHz)	Detector (Note 1)	Antenna Polarity	Receiver Reading (dBμV)	Correction Factor (dB/m)	Field Strength (dBμV/m)	Limit (dBμV/m) (Note 3)	Margin (dB)
13.56	Peak	(Note 2)	58.3	10.8	69.1	103.1	-34.0
27.12	Peak	(Note 2)	6.9	9.4	16.3	48.6	-32.3
40.68	Peak	Vertical	10.8	14.2	25.0	40.0	-15.0
40.68	Peak	Horizontal	4.2	14.2	18.4	40.0	-21.6
54.24	Peak	Vertical	14.9	9.0	23.9	40.0	-16.1
54.24	Peak	Horizontal	7.4	9.0	16.4	40.0	-23.6
67.8	Peak	Vertical	14.4	8.0	22.4	40.0	-17.6
67.8	Peak	Horizontal	11.0	8.0	19.0	40.0	-21.0
81.36	Peak	Vertical	21.8	8.2	30.0	40.0	-10.0
81.36	Peak	Horizontal	6.5	8.2	14.7	40.0	-25.3
94.92	Peak	Vertical	15.6	9.3	24.9	43.5	-18.6
94.92	Peak	Horizontal	12.0	9.3	21.3	43.5	-22.2
108.48	Peak	Vertical	21.5	9.4	30.9	43.5	-12.6
108.48	Peak	Horizontal	8.6	9.4	18.0	43.5	-25.5
122.04	Peak	Vertical	11.2	8.7	19.9	43.5	-23.6
122.04	Peak	Horizontal	4.5	8.7	13.2	43.5	-30.3
135.60	Peak	Vertical	25.3	9.2	34.5	43.5	-9.0
135.60	Peak	Horizontal	13.5	9.2	22.7	43.5	-20.8

Note 1: The reference detector used for the measurements was peak and the data was compared to the quasi-peak limit.

Note 2: Active loop antenna was used for these measurements.

Note 3: At frequencies below 30 MHz, the measurement distance was 10 meters and the limit adjusted accordingly using an inverse proportionality factor of 40 dB per decade. At frequencies above 30 MHz, the measurement distance was 3 meters.

Sample Field Strength Calculation:

The field strength is calculated by adding the Correction Factor (Antenna Factor + Cable Factor) and the Average Factor to the measured level of the receiver. The receiver amplitude reading is compensated for any amplifier gain.

The basic equation with a sample calculation is shown below:

FS = RA + CF + AV Where

FS = Field Strength
RA = Receiver Amplitude Reading
CF = Correction Factor (Antenna Factor + Cable Factor)
AV = Averaging Factor

Assume a receiver reading of 44.2 dBμV is obtained from the receiver, with an average factor of −8.6 dB and a correction factor of 17.5 dB. The field strength is calculated by adding the correction factor and the average factor, giving a field strength of 53.1 dBμV/m, FS = 44.2 + 17.5 + (-8.6) = 53.1 dBμV/m

RESULT

In the configuration tested, the EUT complied with the requirements of §15.225 (a) – (d) with a nearest margin to the limit of 9 dB.

6.2.2 §15.225 (e) Frequency Stability Over Temperature and Voltage Fluctuations

The frequency tolerance of the carrier signal shall be maintained within +/-0.01% of the operating frequency over a temperature variation of -20° to +50°C at normal voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20°C.

The operating frequency of the L4100 is 13.56 MHz; therefore, the frequency must be maintained between 13.558644 MHz and 13.561,356 MHz.

13.56 MHz x 0.0001 = 1.356 kHz

Lower edge of range = 13.56 MHz - 1.356 kHz = 13.558644 MHz
Upper edge of range = 13.56 MHz + 1.356 kHz = 13.561356 MHz

Time of Measurement	120 VAC +20°C	120 VAC +50°C	120 VAC -20°C	102 VAC +20°C	138 VAC +20°C
Start up	13.55998	13.56003	13.55986	13.56001	13.55998
2 minutes	13.55995	13.56002	13.55983	13.55992	13.55993
5 minutes	13.55996	13.56002	13.55987	13.55992	13.55992
10 minutes	13.55993	13.56007	13.55992	13.55997	13.55994
Note: All measurements are shown in MHz.					

RESULT

The maximum deviation from the fundamental frequency of operation was 80 Hz or 0.0006%; therefore, the EUT meets the requirement of §15.225 (e).

6.2.3 §15.207 Conducted Emissions at the AC Mains Port

Frequency (MHz)	Mains Lead	Detector	Measured Level (dBμV)	Limit (dBμV)	Margin (dB)
0.17	Hot Lead	Quasi-Peak (Note 2)	53.4	64.8	-11.4
0.17	Hot Lead	Average (Note 2)	43.5	54.8	-11.3
0.21	Hot Lead	Peak (Note 1)	48.6	53.1	-4.5
0.26	Hot Lead	Peak (Note 1)	43.5	51.5	-8.0
0.30	Hot Lead	Peak (Note 1)	38.8	50.3	-11.5
0.34	Hot Lead	Peak (Note 1)	33.3	49.1	-15.8
13.60	Hot Lead	Peak (Note 1)	39.9	50.0	-10.1
0.17	Neutral Lead	Quasi-Peak (Note 2)	52.8	64.8	-12.0
0.17	Neutral Lead	Average (Note 2)	43.3	54.8	-11.5
0.21	Neutral Lead	Peak (Note 1)	48.5	53.1	-4.6
0.26	Neutral Lead	Peak (Note 1)	44.3	51.5	-7.2
0.30	Neutral Lead	Peak (Note 1)	38.8	50.3	-11.5
0.34	Neutral Lead	Peak (Note 1)	33.9	49.1	-15.2
13.60	Neutral Lead	Peak (Note 1)	39.3	50.0	-10.7

Note 1: The reference detector used for the measurements was Quasi-Peak or Peak and the data was compared to the average limit; therefore, the EUT was deemed to meet both the average and quasi-peak limits.

Note 2: The reference detector used for the measurements was quasi-peak and average and the data was compared to the respective limits.

Measurement Uncertainty

The measurement uncertainty (with a 95% confidence level) for this test was: ± 3.3 dB.

RESULT

The EUT complied with the specification limit by a margin of 4.5 dB.

APPENDIX 1 TEST PROCEDURES AND TEST EQUIPMENT

A.1.1 Radiated Interference Emissions

The radiated emission from the intentional radiator was measured using a spectrum analyzer. The resolution bandwidth was set to 100 kHz and using the Quasi-Peak Adapter, a resolution bandwidth of 9 kHz was used for measurements below 30 MHz. For frequencies above 30 MHz and below 1000 MHz, the resolution bandwidth was set at 100 kHz and the video bandwidth was set at 300 kHz, bypassing the Quasi-Peak Adapter.

An active loop antenna was used to measure frequencies below 30 MHz at a distance of 10 meters from the EUT. A biconilog antenna was used to measure the frequency range of 30 to 1000 MHz at a distance of 3 meters from the EUT. The readings obtained by the antenna are correlated to the levels obtained with a tuned dipole antenna by adding antenna factors.

The configuration of the intentional radiator was varied to find the maximum radiated emission. The intentional radiator was rotated 360 degrees, and the antenna height was varied from 1 to 4 meters to find the maximum radiated emission. Where there were multiple interface ports all of the same type, cables are either placed on all of the ports or cables added to these ports until the emissions do not increase by more than 2 dB.

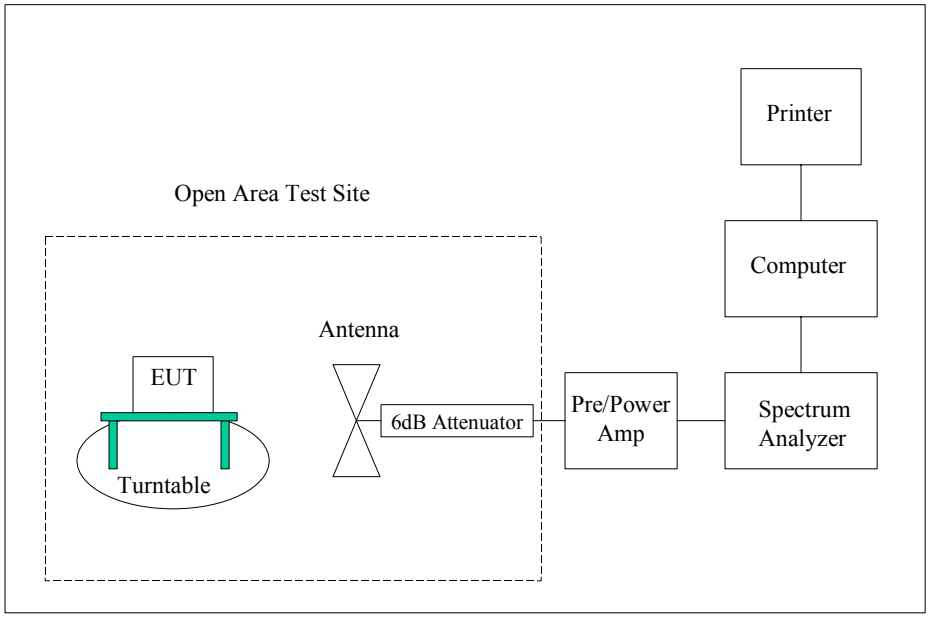
Desktop intentional radiators are measured on a non-conducting table 0.8 meter above the ground plane. The table is placed on a turntable which is level with the ground plane. For equipment normally placed on floors, the equipment shall be placed directly on the turntable.

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Wanship Open Area Test Site #2	CCL	N/A	N/A	10/28/2005
Test Software	CCL	Radiated Emissions	Revision 1.3	N/A
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711	10/10/2005
Biconilog Antenna	EMCO	3142	9601-1009	12/28/2005
Active Loop Antenna	EMCO	6502	2011	04/21/2005

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
3 Meter Radiated Emissions Cable Wanship Site #2	CCL	Cable K	N/A	12/12/2005
10 Meter Radiated Emissions Cable Wanship Site #2	CCL	Cable L	N/A	12/12/2005
Pre/Power-Amplifier	Hewlett Packard	8447F	3113A05161	09/19/2005
6 dB Attenuator	Hewlett Packard	8491A	32835	12/12/2005

An independent calibration laboratory or CCL personnel calibrates all the equipment listed above at intervals defined in ANSI C63.4:2003 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

Radiated Emissions Test Setup



A.1.2 Conducted Disturbance at Mains Ports

The conducted disturbance at mains ports from the ITE was measured using a spectrum analyzer with a quasi-peak adapter for peak, quasi-peak and average readings. The quasi-peak adapter uses a bandwidth of 9 kHz, with the spectrum analyzer's resolution bandwidth set at 100 kHz, for readings in the 150 kHz to 30 MHz frequency ranges.

The conducted disturbance at mains ports measurements are performed in a screen room using a (50 Ω/50 μH) Line Impedance Stabilization Network (LISN).

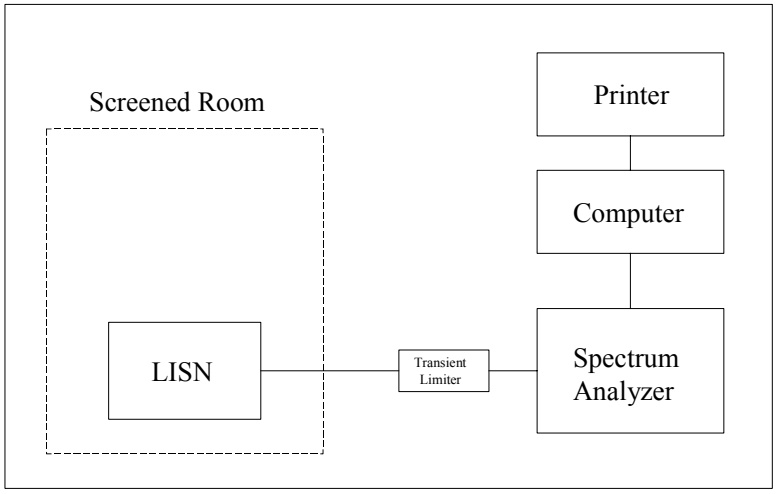
Where mains flexible power cords are longer than 1 m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4 m in length.

For AC mains port testing the desktop ITE are placed on a non-conducting table at least 0.8 meters from the metallic floor. The equipment is placed a minimum of 40 cm from all walls.

Type of Equipment	Manufacturer	Model Number	Serial Number	Date of Last Calibration
Wanship Open Area Test Site #2	CCL	N/A	N/A	10/28/2005
Test Software	CCL	Conducted Emissions	Revision 1.2	N/A
Spectrum Analyzer	Hewlett Packard	8566B	2230A01711	10/10/2005
Quasi-Peak Detector	Hewlett Packard	85650A	2332A02726	01/12/2005
LISN	EMCO	3825/2	9305-2099	03/18/2005
Conductance Cable Wanship Site #2	CCL	Cable J	N/A	12/12/2005
Transient Limiter	Hewlett Packard	11947A	3107A02266	12/12/2005

An independent calibration laboratory or CCL personnel calibrates all the equipment listed above at intervals defined in ANSI C63.4:2003 Section 4.4 following outlined calibration procedures. All measurement instrumentation is traceable to the National Institute of Standards and Technology (NIST). Supporting documentation relative to tractability is on file and is available for examination upon request.

Conducted Emissions Test Setup



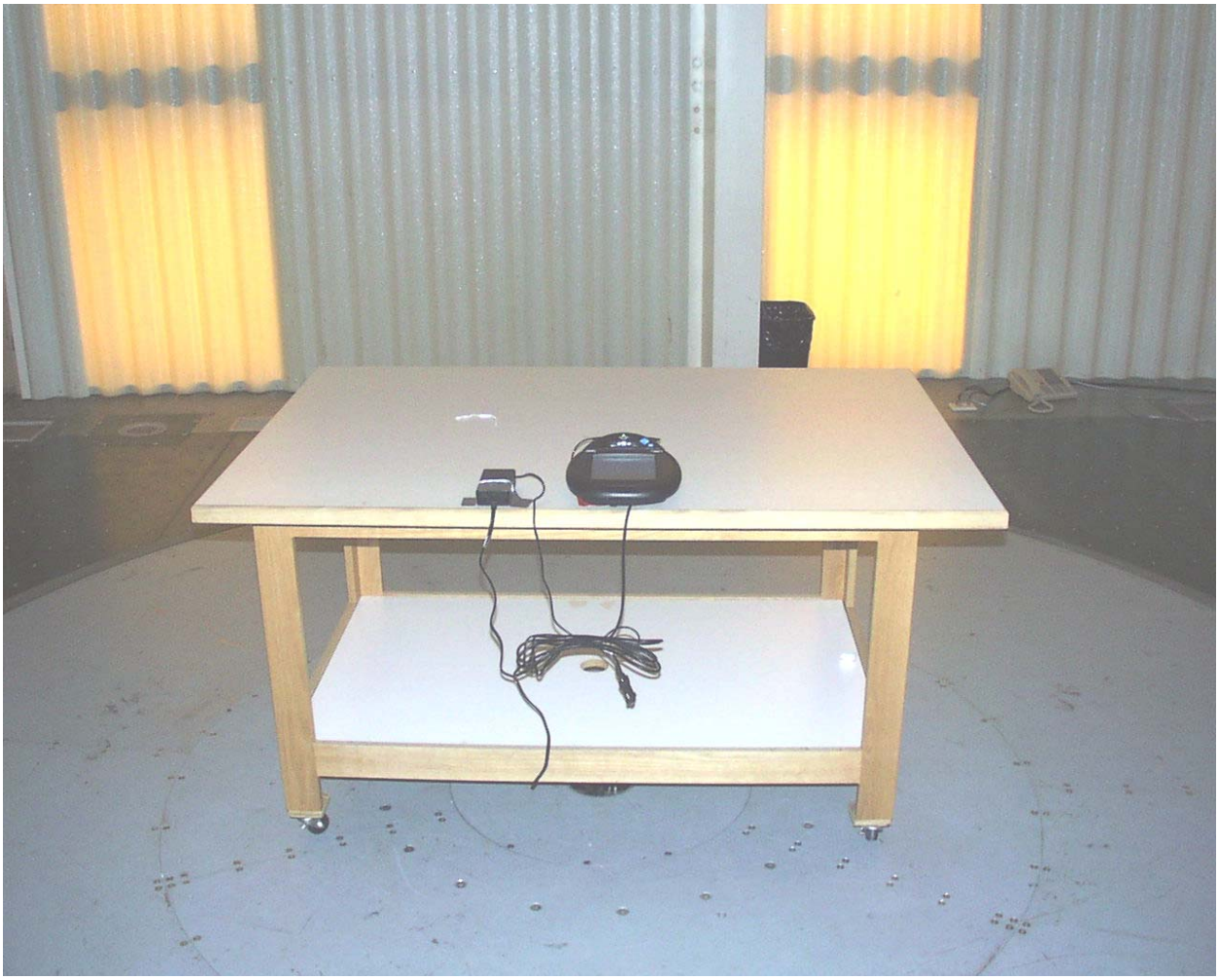
APPENDIX 2 PHOTOGRAPHS

Photograph 1 – Front View of the Radiated Test Setup
(Vertical Alignment)

Photograph 2 – Back View of the Radiated Test Setup
(Vertical Alignment)

Photograph 3 – View of the Radiated Test Setup
(Horizontal Alignment)

Photograph 4 – Back View of the Radiated Test Setup
(Horizontal Alignment)

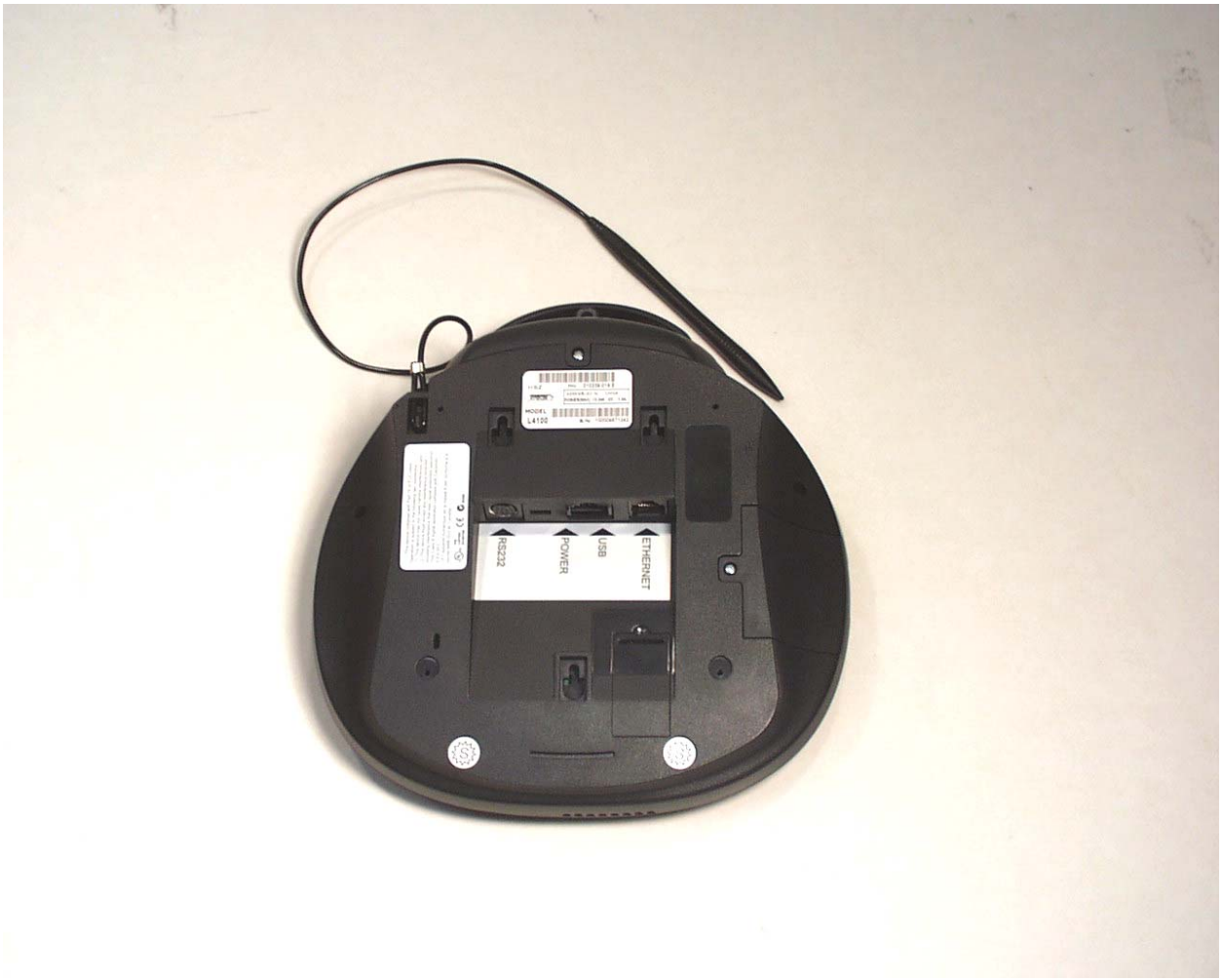


Photograph 5 – Front View of the Conducted Emission Setup

Photograph 6 – Back View of the Conducted Emission Setup

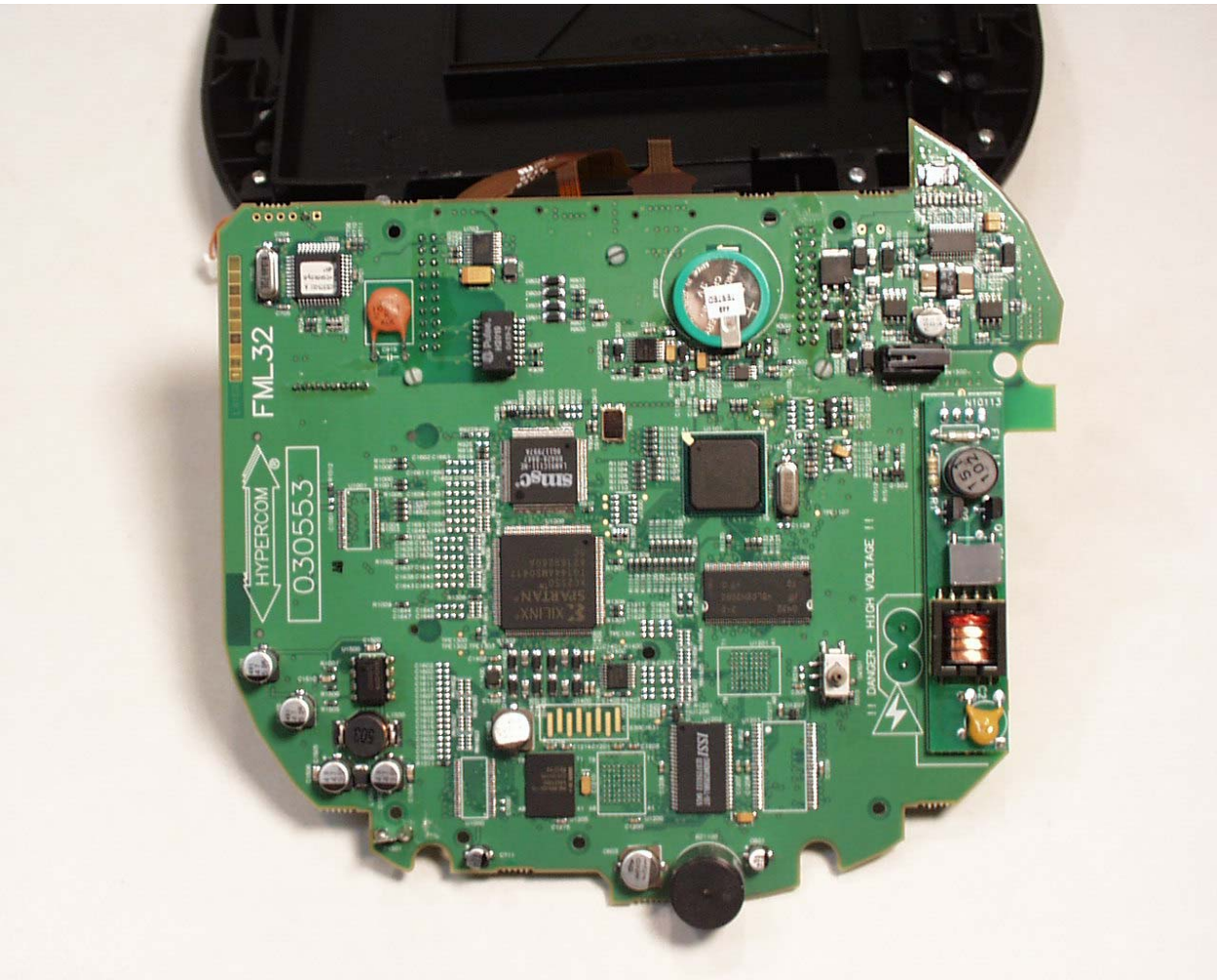
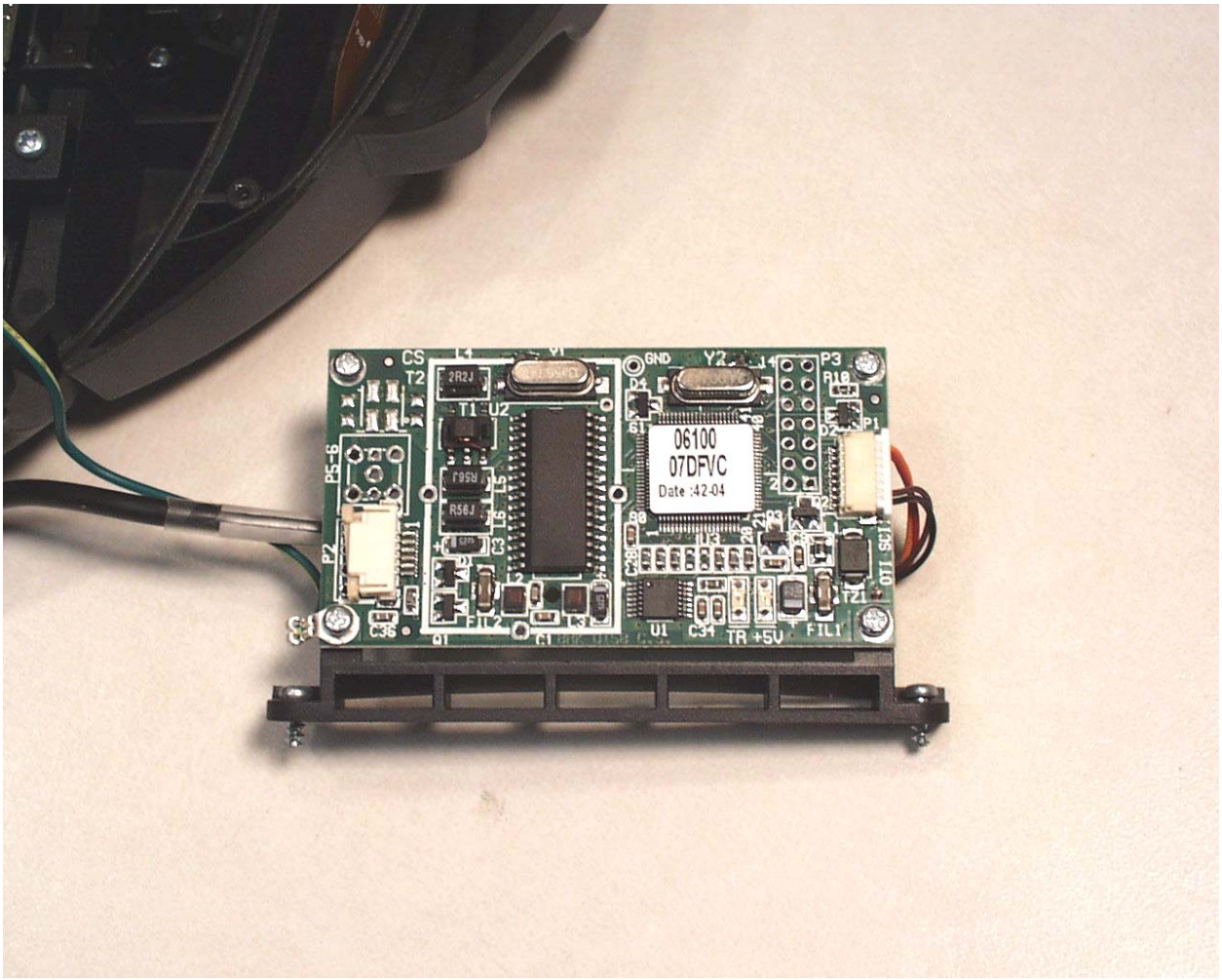
Photograph 7 - Front View of the EUT

Photograph 8 – Back View of the EUT



Photograph 9 – Internal View of the L4100

Photograph 10 – Bottom View of the Main PCB



Photograph 11 – View of the Magnetic Card Reader PCB