



UL International EMC Services  
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<http://www.ul.com/emc/>

August 2, 2002

Landauer Inc.  
Attn: Mr. Jukka Kahilainen  
2 Science Rd.  
Glenwood, IL 60425

UL Reference: File MC1476, Project 01NK42417

Subject: EMC Test and Measurement Report for  
Model 60204007 X-Ray Badge Reader

Dear Mr. Khadivar:

We have provided with this letter your EMC Test Report for the above referenced model. The product was determined to comply with the requirements noted in the report.

Please review the attached report and direct any questions or comments to me. Samples will be returned to your attention.

We appreciate your interest in UL's EMC Services, and encourage you to contact us in the future should you need EMC test services. This closes Project 01NK42417.

Best regards,

Reviewed by:

A handwritten signature in black ink, appearing to read 'Mike Ehas'.

Mike Ehas (Ext 42351)  
EMC Sr. Engineering Associate  
International EMC Services

A handwritten signature in black ink, appearing to read 'Jack Steiner'.

Jack Steiner  
Engineering Group Leader  
International EMC Services

# EMC – TEST REPORT

Issue Date: August 2, 2002

## Ö EMISSIONS IMMUNITY

Test Report File No. : MC1476  
Project No. : 01NK42417

Model / Type : 60204007  
Kind of Product : X-Ray Badge Reader

Applicant : Intermarketing Ltd.  
License Holder : Intermarketing Ltd.  
Address : Tietajantie 12  
: Espoo, Finland, FIN-02130

Manufacturer : Intermarketing Ltd.  
: Tietajantie 12  
: Espoo, Finland, FIN-02130

**Test Result : COMPLIANT**

**This report without appendices consists of 11 pages. Appendix A contains test photos, Appendix B contains original test data and Appendix C contains sample calculations.**

**The data contained in this report reflects only the items tested in the configurations and mode of operations described. An attempt has been made to arrange the EUT, with the equipment provided, into a test configuration which maximizes the observed emissions of the EUT while simulating, as close as practical, a typical end-use installation. The photos and data provided in this report document that configuration.**

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**Underwriters Laboratories Inc. 333 Pfingsten Rd. Northbrook, IL 60062  
Fax: (847) 272-8864**

# REPORT DIRECTORY

<u>SECTION</u>	<u>TITLE</u>
----------------	--------------

**GENERAL**

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| 1.3 | Calibration Details of Equipment Used for Measurement |
| 1.4 | EUT (Equipment Under Test) Configuration              |
| 1.5 | EUT Operating Mode                                    |
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| B | Test Data                                   |
| C | Sample Calculations                         |
| D | Block Diagram of the Measurement System     |

## 1.0 GENERAL PRODUCT DESCRIPTION

The Equipment Under Test (EUT) was an x-ray badge reader.

### 1.0.1 Equipment Mobility:

The base unit is either table-top or wall-mount therefore it was tested in two axis (X and Y). See Appendix A for configuration photos.

### 1.0.2 Test Voltage and Frequency:

<u>Voltage (V)</u>	<u>Frequency (Hz)</u>
120	60

## 1.1 MODEL DIFFERENCES

Any other model(s) represented by the models tested in this investigation will be documented by the manufacturer.

## 1.2 ENVIRONMENTAL CONDITIONS IN TEST LAB

Temperature:	20-25 °C
Relative Humidity:	30-60% RH
Atmospheric Pressure:	860-1060 mbar

## 1.3 CALIBRATION OF EQUIPMENT USED FOR MEASUREMENT

All test equipment and test accessories are calibrated on a regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less.

All test equipment calibrations are traceable to the National Institute of Standards and Technology (NIST), therefore, all test data recorded in this report is traceable to NIST.

#### 1.4 EUT CONFIGURATION(s)

See Appendix A for individual set-up configuration(s). In addition to the EUT, the following peripheral devices and/or cables were connected during the measurement:

Device	Manufacturer	Model	Serial #	FCC ID
EUT	Landauer	60204007	1615	QGL.60204007
Charger Base	Landuaer	60204205	-	-
Charger base	OY Intermarketing	60204203	-	-
Direct plug-in power supply	SPC Technology	SPC9706	-	-

Cable	Manufacturer	Length	Type	Shield Type	Shield Termination
Communication	Industry Standard	>3 M	Cat 5e FTP patch cable	None	None

#### 1.5 EUT OPERATING MODE(s)

The equipment under test was operated during the measurements under the following conditions:

Measurements were conducted on both charger bases in the normal operation mode. Normal operating mode is while the badge is polling the reader.

The reader operates under internal battery power even when the reader is plugged into the charger base. Therefore, mains supply voltage variation tests were not conducted.

#### 1.6 DEVICE MODIFICATIONS

The following modifications were necessary for compliance:

To comply with Conducted Emissions, a solid ferrite core was added to the output cable as close to the power supply as possible. The ferrite core was constructed of material number 114A-43. The core dimensions are 1.25 in. OD, 0.75 in. ID, 0.5 in. thick. 15 turns of the output cable were wound on the core.

To comply with Radiated Emissions, small charger base, a ferrite was added to the communication cable with one turn as close as possible to the cable exit point. To Comply with Radiated Emissions, large charger base, two ferrites were added, one on the communication cable and input power cable as close as possible to the cable exit point and one on the power cable with one additional turn as close as possible to the charger contact connector. Both ferrites were on the inside area of the enclosure. The ferrite is a clamp-on type, manufactured by WERTH, part number 742 7140.

## **2.0 EMISSIONS TEST REGULATIONS**

**The EUT was considered to be a Class B device.**

Emissions testing was performed according to the following regulations:

47 CFR Part 15 Subpart C: 2000 + ANSI C63.4 – 1992

47 CFR Part 15.205(a)

47 CFR Part 15.207(a)

47 CFR Part 15.209(a)(d)

47 CFR Part 15.225(a)(b)(c)

## **CONDUCTED VOLTAGE EMISSIONS**

### Test Location

Ground Plane (Test Station 3)

### UL Procedure

3014ANBK-LPG-001

### Test Instruments

#### Spectrum Analyzer / Quasi-peak Adapter

Advantest Model 3261A Spectrum Analyzer No. EMC4089

Last Cal. 10/11/01      Next Cal. 10/11/02

Model R3551 Preselector No. EMC4088

Last Cal. 09/07/01      Next Cal. 09/07/02

#### Line Impedance Stabilization Networks (LISNs)

SOLAR Model 8602-50-TS-50-N      S/N 963903      No. EMC4064

Last Cal. 06/13/01      Next Cal. 06/13/02

SOLAR Model 8602-50-TS-50-N      S/N 963904      No. EMC4065

Last Cal. 06/13/01      Next Cal. 06/13/02

#### Transient Limiter

Electro-Metrics Model: EM-7600-2

No. EMC4224

#### Frequency Range on each line

450kHz to 30 MHz

### Test Results

The requirements are:

MET

### Remarks

See App. B for complete test results.

## **RADIATED ELECTRIC FIELD EMISSIONS, 10kHz to 30MHz**

### Test Location

10 Meter Semi-Anechoic Chamber

### UL Procedure

3014ANBK-LPG-002

### Test Instruments

Spectrum Analyzer / Quasi-peak Adapter / Preamplifier / Preselector

Hewlett Packard Model 8566B Spectrum Analyzer

Last Cal. 04/19/01      Next Cal. 04/19/02

Last Cal. 05/08/02      Next Cal. 05/08/03

Model 85650A Quasi-peak Adapter

Last Cal. 04/16/01      Next Cal. 04/16/02

Last Cal. 05/08/02      Next Cal. 05/08/03

Model 85685A RF Preselector      No. EMC4015

Last Cal. 04/16/01      Next Cal. 04/16/02

Last Cal. 05/08/02      Next Cal. 05/08/03

### Antennas

Solar Electronics., Loop Sensor, Model 7334-1

Last Cal. 03/07/02      Next Cal. 03/07/03

### Frequency Range of Measurement

10kHz-30MHz

### Measurement Distance

10 meters

### Antenna Height

1.5 meters to the center of the loop

### Antenna Polarity

Peak scan was conducted with the antenna in the vertical polarity. Final emission (average) measurements were also checked in the horizontal polarity. The antenna polarity recording with the highest emission was documented.

### Test Results

The requirements are:

MET

### Remarks

See App. B for complete test results.



**RADIATED ELECTRIC FIELD EMISSIONS, 30MHz to 1000MHz**Test Location

10 Meter Semi-Anechoic Chamber

UL Procedure

3014ANBK-LPG-002

Test InstrumentsSpectrum Analyzer / Quasi-peak Adapter / Preamplifier / Preselector

Hewlett Packard Model 8566B Spectrum Analyzer

Last Cal. 04/19/01      Next Cal. 04/19/02

Last Cal. 05/08/02      Next Cal. 05/08/03

Model 85650A Quasi-peak Adapter

Last Cal. 04/16/01      Next Cal. 04/16/02

Last Cal. 05/08/02      Next Cal. 05/08/03

Miteq AM-3A-000110-N Preamp      No. FCA4003, EMC4016, EMC4151

Model 85685A RF Preselector      No. EMC4015

Last Cal. 04/16/01      Next Cal. 04/16/02

Last Cal. 05/08/02      Next Cal. 05/08/03

Antennas

Chase EMC Ltd., Biconical Antenna Model VBA6106A

S/N 1246

Last Cal. 05/25/01      Next Cal. 05/25/02

Chase EMC Ltd., Log Periodic Antenna Model UPA6108

S/N 1120

Last Cal. 05/25/01      Next Cal. 05/25/02

Frequency Range of Measurement

30MHz-1000MHz

Measurement Distance

3 meters

Test Results

The requirements are:

MET

Remarks

See App. B for complete test results.

Preliminary measurements (peak scans) were done by rotating the turntable 360° and at multiple antenna heights (1 meter and 3 meters).

If necessary, final measurements were conducted using a quasi-peak detector. These emissions were maximized by rotating the turntable 360° and positioning the receive antenna from 1 to 4 meters in height.

**FREQUENCY TOLERANCE / TEMPERATURE VARIATION**  
**-20 DEGREES C TO +50 DEGREES C**

Test Location

Open lab area

Test Instruments

Spectrum Analyzer

Advantest Model 3261A Spectrum Analyzer No. EMC4089

Last Cal. 10/11/01      Next Cal. 10/11/02

Environmental Chamber

Tenny Environmental, Model TNNY-VRSA-000, s/n 59316

Last Cal. 06/05/01      Next Cal. 06/05/02

Antenna

Near field probe

Frequency Range of Measurement

13.56 MHz plus/minus 0.01%

Temperature Range of Measurement

-20 degrees C to +50 degrees C

Test Results

The requirements are:

MET

Remarks

See App. B for complete test results.

## **RADIATED MISSIONS / BAND EDGE MEASUREMENT**

### Test Location

10 Meter Semi-Anechoic Chamber

### UL Procedure

3014ANBK-LPG-002

### Test Instruments

Spectrum Analyzer / Quasi-peak Adapter / Preamplifier / Preselector

Hewlett Packard Model 8566B Spectrum Analyzer

Last Cal. 04/19/01      Next Cal. 04/19/02

Last Cal. 05/08/02      Next Cal. 05/08/03

Model 85650A Quasi-peak Adapter

Last Cal. 04/16/01      Next Cal. 04/16/02

Last Cal. 05/08/02      Next Cal. 05/08/03

Model 85685A RF Preselector      No. EMC4015

Last Cal. 04/16/01      Next Cal. 04/16/02

Last Cal. 05/08/02      Next Cal. 05/08/03

### Antennas

Solar Electronics., Loop Sensor, Model 7334-1

Last Cal. 03/07/02      Next Cal. 03/07/03

### Frequency Range of Measurement

13.56 MHz

### Measurement Distance

10 meters

### Test Results

The requirements are:

MET

### Remarks

See App. B for complete test results.

### 3.0 IMMUNITY TEST REGULATIONS

**Immunity testing was not required nor performed.**

### 4.0 GENERAL REMARKS

Sample Receipt Date : October 2, 2001

Test Dates

Start : April 29, 2002  
End : June 03, 2002

### 4.1 SUMMARY

The requirements according to the technical regulations are:

MET

Underwriters Laboratories Inc.  
333 Pfingsten Road  
Northbrook, IL 60062 USA

**FCC Site Number: 31040/SIT 1300F2**

Best regards,



Mike Ehas (Ext 42351)  
EMC Sr. Engineering Associate  
International EMC Services

Reviewed by:



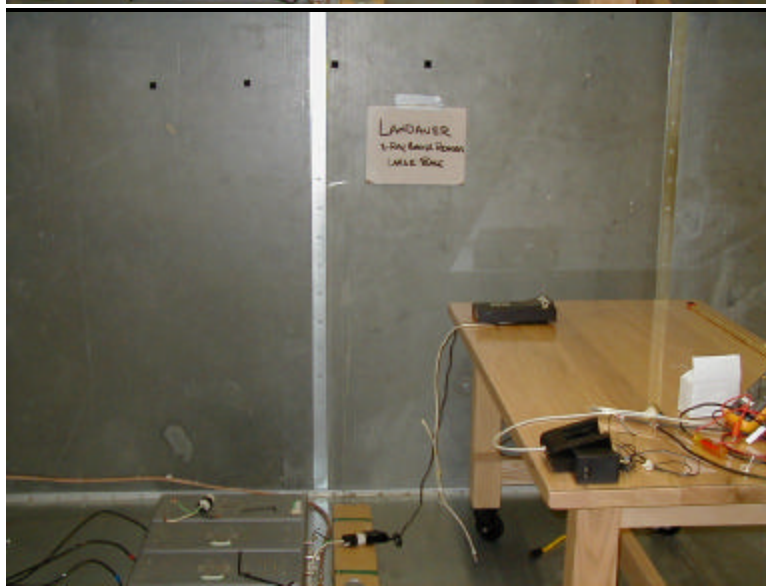
Jack Steiner  
Engineering Group Leader  
International EMC Services

**APPENDIX A**

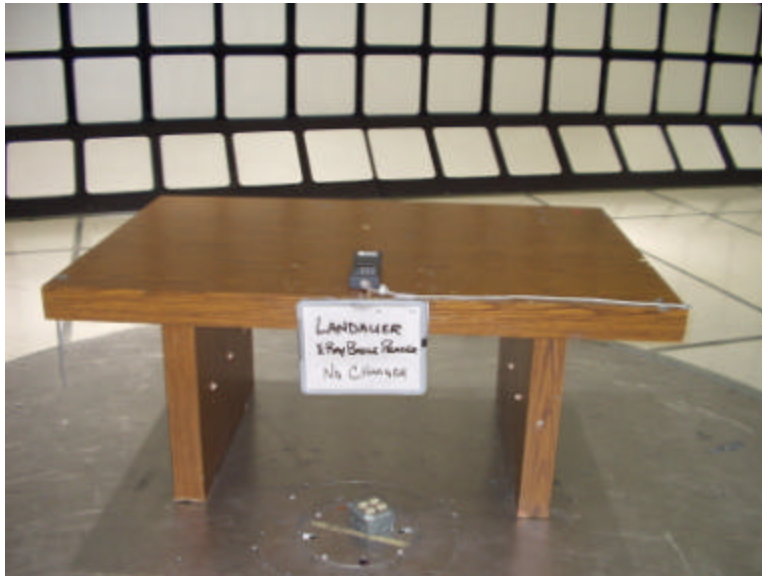
**PHOTOS**



**Conducted Emissions  
GP3 Small Charger Base**



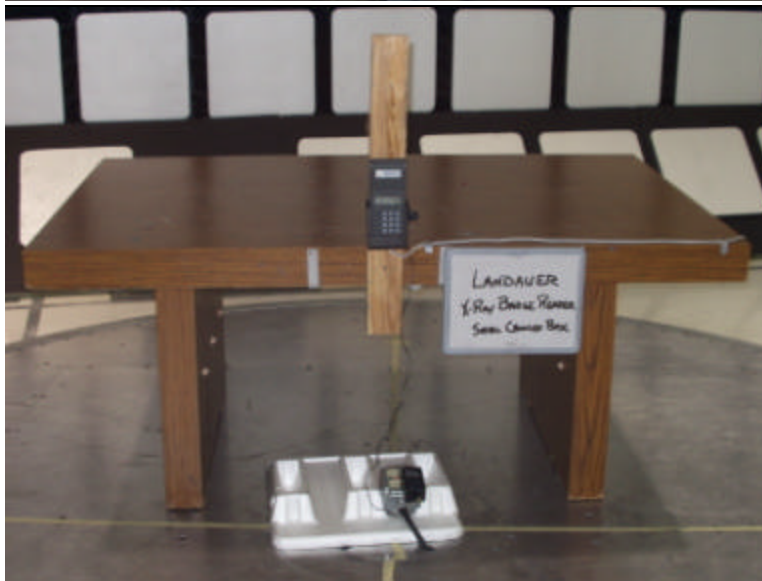
**Conducted Emissions  
GP3 Large Charger Base**



**Radiated Emissions  
10M Chamber  
X-Ray Badge Reader**



**Radiated Emissions  
10M Chamber  
Large Charger Base**



**Radiated Emissions  
10M Chamber  
Small Charger Base**





**APPENDIX B**

**TEST DATA**

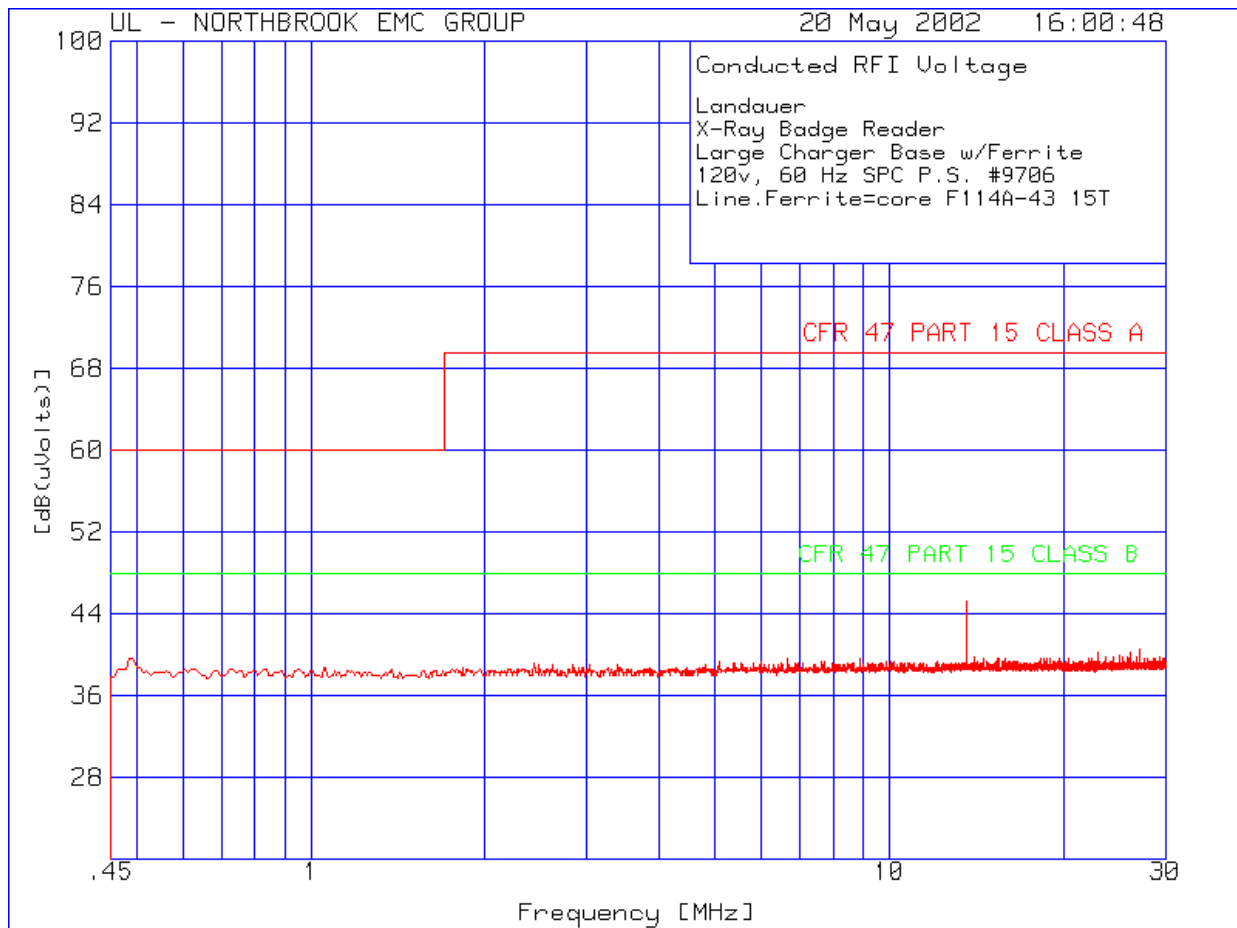
**EMISSIONS**

Conducted Voltage  
Radiated Electric Field Emissions  
Frequency Stability Measurement  
Band Edge Measurement

**UNDERWRITERS LABORATORIES INC.**  
**Conducted Emissions**

Date Tested: 20 May 2002

**Manufacturer** : Landauer Inc.  
**Equipment Under Test** : X-Ray Badge Reader (Large Charger Base)  
**Requirement** : CFR 47, Part 15, Class B  
**Detection Mode** : Quasi-peak (qp) or Peak (pk) or Average (ave)  
**Bandwidth** : 200 Hz for measurements 9 kHz to 150 kHz  
                   9 kHz for measurements 150 kHz to 30 MHz  
**Line** : L1



Landauer  
 X-Ray Badge Reader  
 Large Charger Base w/Ferrite  
 120v, 60 Hz SPC P.S. #9706  
 Line.Ferrite=core F114A-43 15T

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level [dB(uVolts)]	Limit:1	2
=====							
Range: 1 .45 - 30MHz							
1	13.58411	34.8 pk	10.4	0	45.2	69.5	48
				Margin [dB]		-24.3	-2.8

LIMIT 1: CFR 47 PART 15 CLASS A  
 LIMIT 2: CFR 47 PART 15 CLASS B

pk - Peak detector

Landauer  
 X-Ray Badge Reader  
 Large Charger Base w/Ferrite  
 120v, 60 Hz SPC P.S. #9706  
 Line.Ferrite=core F114A-43 15T

Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level [dB(uVolts)]	Limit:1	2
=====						
Range: 1 .45 - 30MHz						
13.559	33.3qp	10.4	0	43.7	69.5	48
			Margin [dB]:		-25.8	-4.3

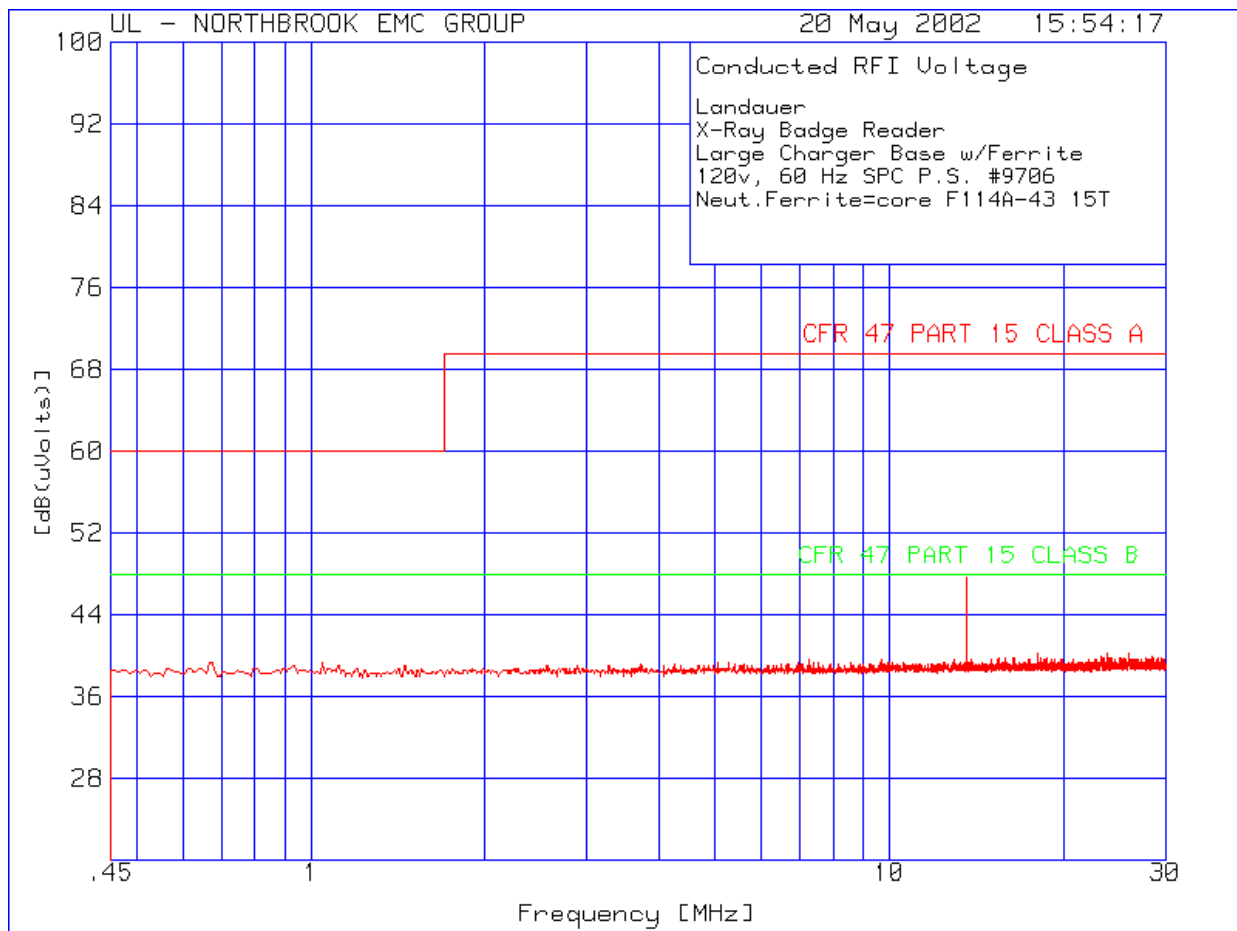
qp - Quasi-Peak detector

LIMIT 1: CFR 47 PART 15 CLASS A  
 LIMIT 2: CFR 47 PART 15 CLASS B

**UNDERWRITERS LABORATORIES INC.**  
**Conducted Emissions**

Date Tested: 20 May 2002

**Manufacturer** : Landauer Inc.  
**Equipment Under Test** : X-Ray Badge Reader (Large Charger Base)  
**Requirement** : CFR 47, Part 15, Class B  
**Detection Mode** : Quasi-peak (qp) or Peak (pk) or Average (ave)  
**Bandwidth** : 200 Hz for measurements 9 kHz to 150 kHz  
 9 kHz for measurements 150 kHz to 30 MHz  
**Line** : L2



Landauer  
 X-Ray Badge Reader  
 Large Charger Base w/Ferrite  
 120v, 60 Hz SPC P.S. #9706  
 Neut.Ferrite=core F114A-43 15T

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level [dB(uVolts)]	Limit:1	2
=====							
Range: 1 .45 - 30MHz							
1	13.58411	37.2 pk	10.4	0	47.6	69.5	48
				Margin [dB]		-21.9	-.4

LIMIT 1: CFR 47 PART 15 CLASS A  
 LIMIT 2: CFR 47 PART 15 CLASS B

pk - Peak detector

Landauer  
 X-Ray Badge Reader  
 Large Charger Base w/Ferrite  
 120v, 60 Hz SPC P.S. #9706  
 Neut.Ferrite=core F114A-43 15T

Frequency [MHz]	Test	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level [dB(uVolts)]	Limit:1	2
=====							
Range: 1 .45 - 30MHz							
13.5592		35.92qp	10.4	0	46.32	69.5	48
				Margin [dB]:		-23.18	-1.68

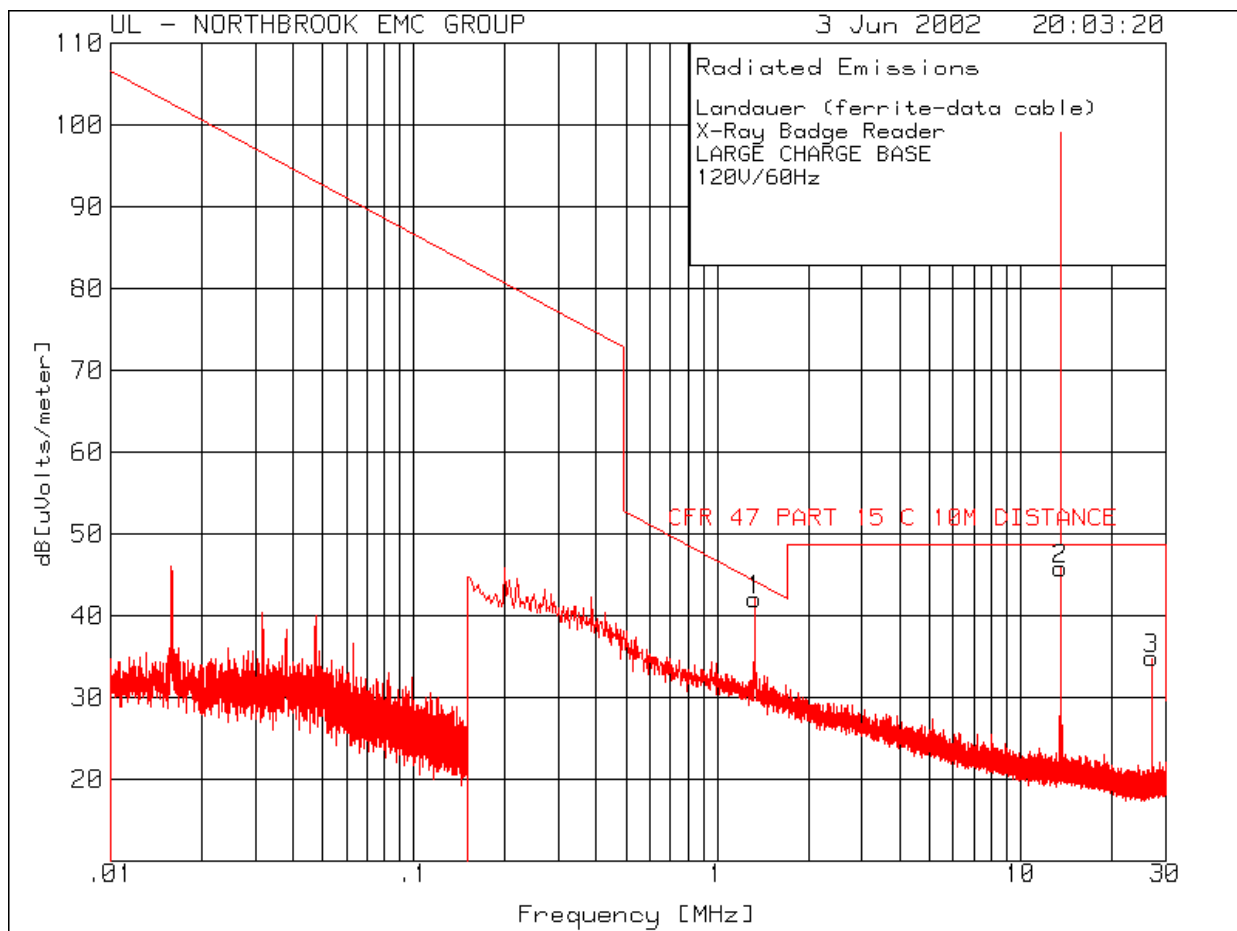
qp - Quasi-Peak detector

LIMIT 1: CFR 47 PART 15 CLASS A  
 LIMIT 2: CFR 47 PART 15 CLASS B

**UNDERWRITERS LABORATORIES INC.**  
**Radiated Emissions**

Date Tested: 03 June 2002

**Manufacturer** : Landauer Inc.  
**Equipment Under Test** : X-Ray Badge Reader (Large Charger Base)  
**Requirement** : CFR 47, Part 15, Class B  
**Detection Mode** : Quasi-peak (qp) and Average (Av)  
**Bandwidth** : 120 kHz  
**Measurement Distance** : 10 meter  
**Antenna Type** : 10 kHz – 30 MHz Loop Sensor



Landauer (ferrite-data cable)  
 X-Ray Badge Reader  
 LARGE CHARGE BASE  
 120V/60Hz

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1
1	1.33048	30.1 pk	0	11.9	42	44.2
	Azimuth:355	Height:100	Horz	Margin [dB]		-2.2
2	13.56026	34.4 pk	.5	10.9	45.8	99.1
	Azimuth:5	Height:100	Horz	Margin [dB]		-53.3
3	27.1246	24.5 pk	.9	9.4	34.8	39.4
	Azimuth:225	Height:100	Horz	Margin [dB]		-4.6

LIMIT 1: CFR 47 PART 15 C 10M DISTANCE

pk - Peak detector

Landauer (ferrite-data cable)  
 X-Ray Badge Reader  
 LARGE CHARGE BASE  
 120V/60Hz

Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1
13.5647	34.29 qp	.5	10.9	45.69	99.1
Azimuth: 0	Height:100	Horz	Margin [dB]:		-53.4
27.1255	25.07 qp	.9	9.4	35.37	48.6
Azimuth: 96	Height:100	Horz	Margin [dB]:		-13.2

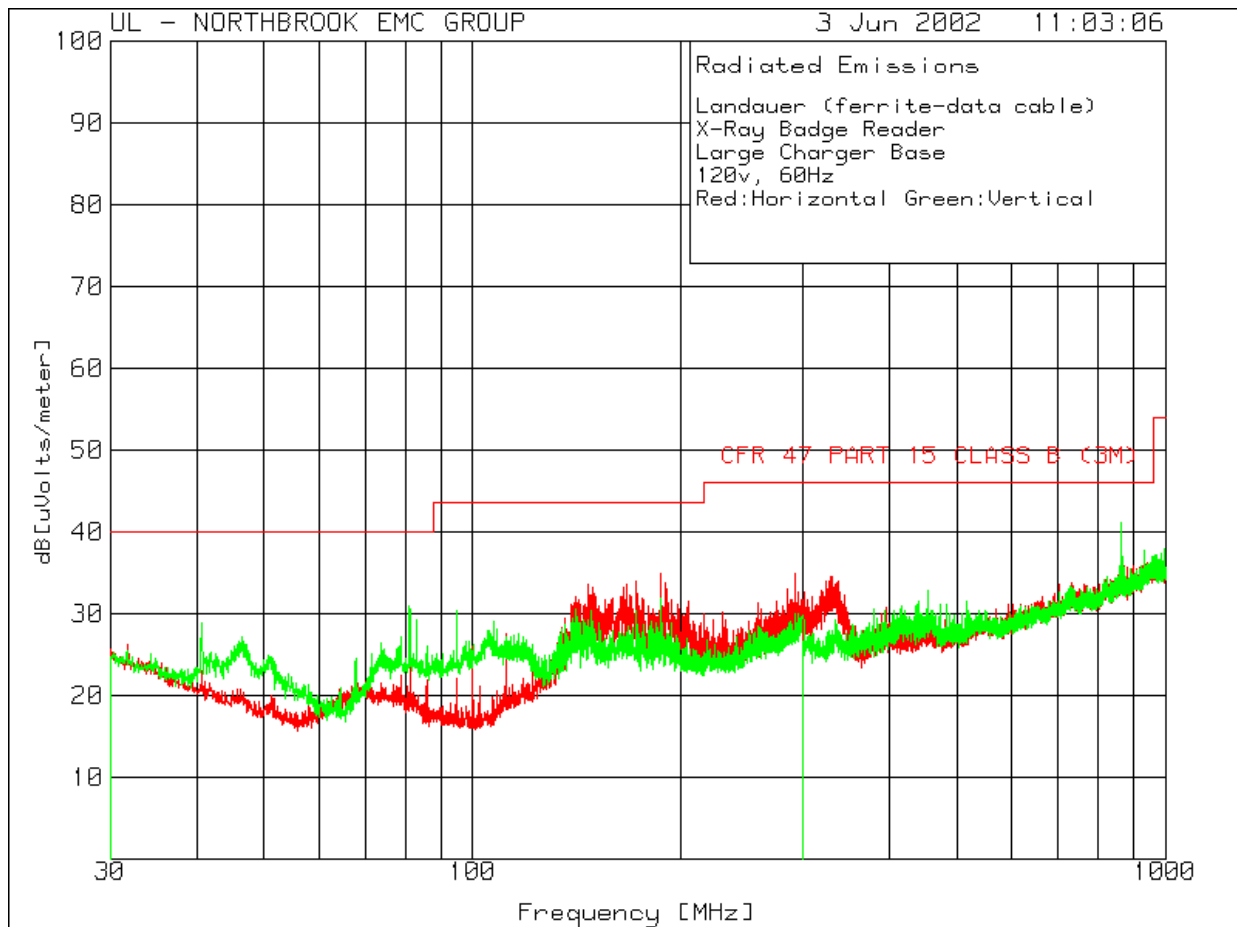
LIMIT 1: CFR 47 PART 15 C 10M DISTANCE

qp - Quasi-Peak detector

**UNDERWRITERS LABORATORIES INC.**  
**Radiated Emissions**

Date Tested: 03 June 2002

**Manufacturer** : Landauer Inc.  
**Equipment Under Test** : X-Ray Badge Reader (Large Charger Base)  
**Requirement** : CFR 47, Part 15, Class B  
**Detection Mode** : Quasi-peak (qp) and Average (Av)  
**Bandwidth** : 120 kHz  
**Measurement Distance** : 3 meters  
**Antenna Type** : 30 - 300 MHz, Biconical  
 300 - 1000 MHz, Log-Periodic





Landauer (ferrite-data cable)  
 X-Ray Badge Reader  
 Large Charger Base  
 120v, 60Hz  
 Red:Horizontal Green:Vertical

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1
4	146.9573	17.6 pk	1.2	14.7	33.5	43.5
	Azimuth:203	Height:200	Horz	Margin [dB]		-10
5	171.981	17.7 pk	1.1	15.1	33.9	43.5
	Azimuth:160	Height:100	Horz	Margin [dB]		-9.6
6	186.4152	17.9 pk	1.2	15.8	34.9	43.5
	Azimuth:353	Height:100	Horz	Margin [dB]		-8.6
7	291.5014	13.7 pk	1.7	19.6	35	46
	Azimuth:77	Height:100	Horz	Margin [dB]		-11
1	40.657	13.8 pk	.5	14.6	28.9	40
	Azimuth:356	Height:100	Vert	Margin [dB]		-11.1
2	81.0592	22.9 pk	.8	7.3	31	40
	Azimuth:110	Height:100	Vert	Margin [dB]		-9
3	94.8863	19.9 pk	.8	9.7	30.4	43.5
	Azimuth:358	Height:100	Vert	Margin [dB]		-13.1
8	330.7769	17.1 pk	1.8	15.6	34.5	46
	Azimuth:54	Height:99	Horz	Margin [dB]		-11.5

LIMIT 1: CFR 47 PART 15 CLASS B (3M)

pk - Peak detector

Landauer (ferrite-data cable)  
 X-Ray Badge Reader  
 Large Charger Base  
 120v, 60Hz  
 Red:Horizontal Green:Vertical

Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1
186.1074	16.61 qp	1.2	15.8	33.61	43.5
Azimuth: 20	Height:134	Horz	Margin [dB]:		-9.89

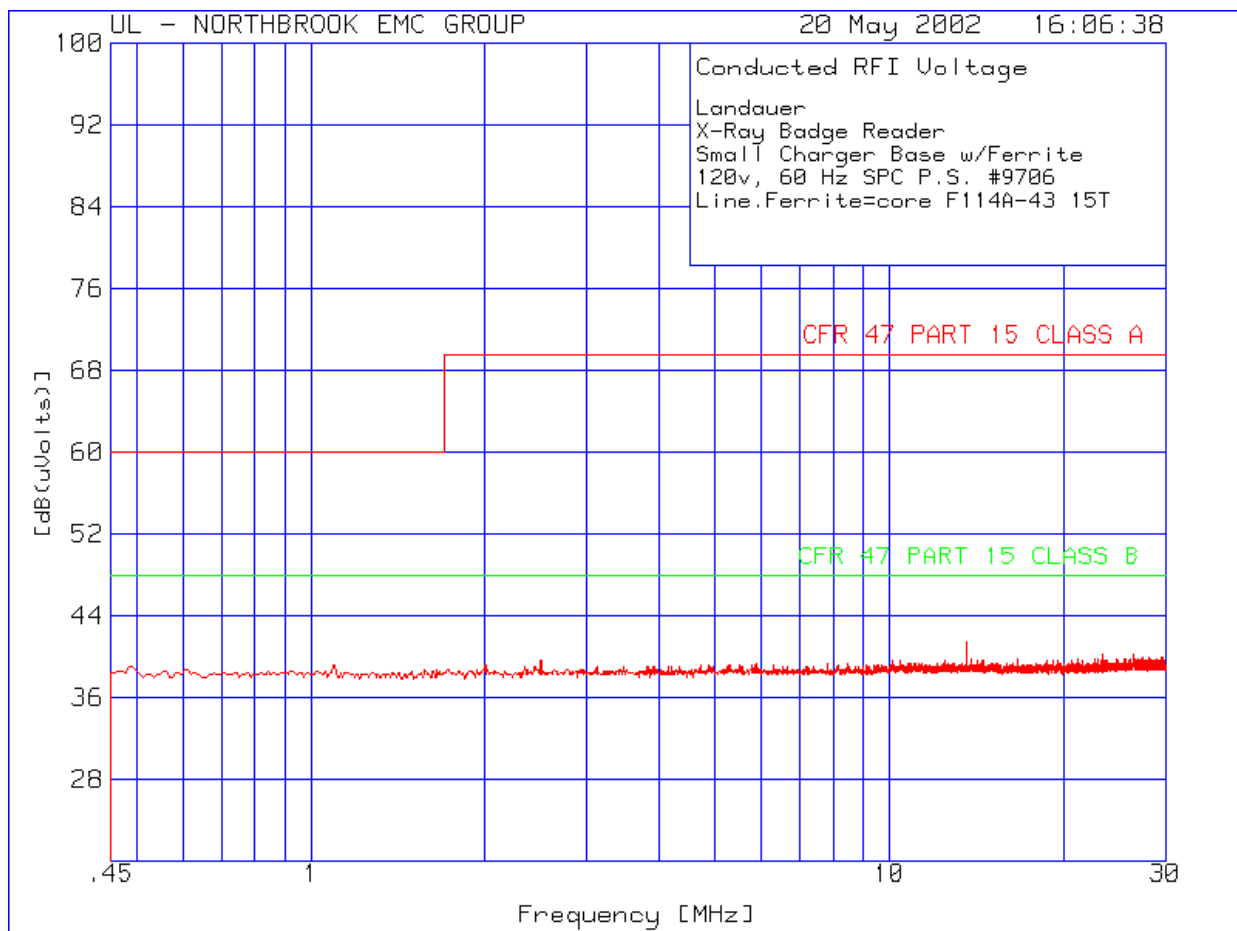
LIMIT 1: CFR 47 PART 15 CLASS B (3M)

qp - Quasi-Peak detector

**UNDERWRITERS LABORATORIES INC.**  
**Conducted Emissions**

Date Tested: 20 May 2002

**Manufacturer** : Landauer Inc.  
**Equipment Under Test** : X-Ray Badge Reader (Small Charger Base)  
**Requirement** : CFR 47, Part 15, Class B  
**Detection Mode** : Quasi-peak (qp) or Peak (pk) or Average (ave)  
**Bandwidth** : 200 Hz for measurements 9 kHz to 150 kHz  
                   9 kHz for measurements 150 kHz to 30 MHz  
**Line** : L1



Landauer  
 X-Ray Badge Reader  
 Small Charger Base w/Ferrite  
 120v, 60 Hz SPC P.S. #9706  
 Line.Ferrite=core F114A-43 15T

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level [dB(uVolts)]	Limit:1	2
=====							
Range: 1 .45 - 30MHz							
1	13.58411	31 pk	10.4	0	41.4	69.5	48
				Margin [dB]		-28.1	-6.6

LIMIT 1: CFR 47 PART 15 CLASS A  
 LIMIT 2: CFR 47 PART 15 CLASS B

pk - Peak detector

Landauer  
 X-Ray Badge Reader  
 Small Charger Base w/Ferrite  
 120v, 60 Hz SPC P.S. #9706  
 Line.Ferrite=core F114A-43 15T

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level [dB(uVolts)]	Limit:1	2
=====							
Range: 1 .45 - 30MHz							
	13.5577	24.97qp	10.4	0	35.37	69.5	48
				Margin [dB]:		-34.13	-12.63

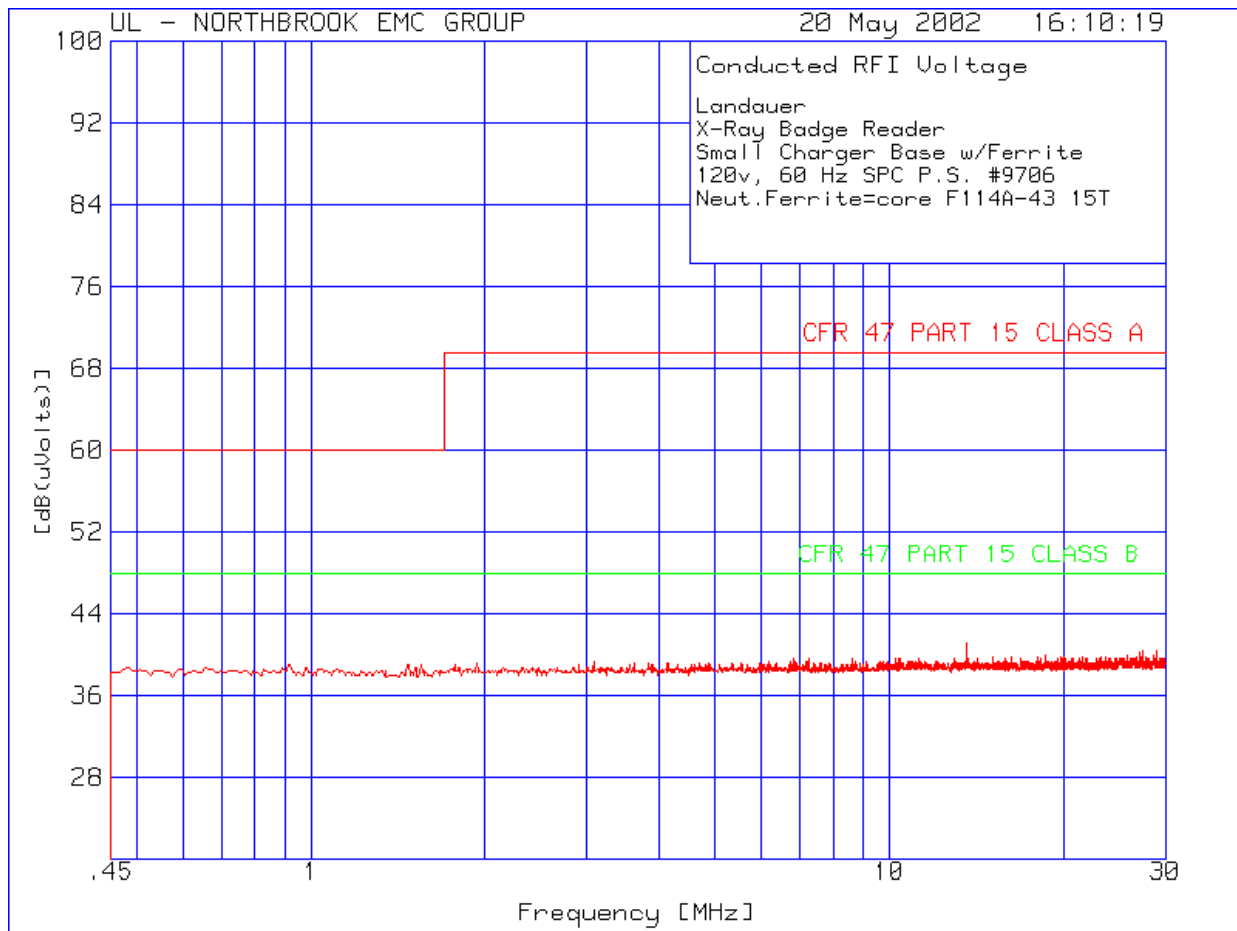
qp - Quasi-Peak detector

LIMIT 1: CFR 47 PART 15 CLASS A  
 LIMIT 2: CFR 47 PART 15 CLASS B

**UNDERWRITERS LABORATORIES INC.**  
**Conducted Emissions**

Date Tested: 20 May 2002

**Manufacturer** : Landauer Inc.  
**Equipment Under Test** : X-Ray Badge Reader (Small Charger Base)  
**Requirement** : CFR 47, Part 15, Class B  
**Detection Mode** : Quasi-peak (qp) or Peak (pk) or Average (ave)  
**Bandwidth** : 200 Hz for measurements 9 kHz to 150 kHz  
 9 kHz for measurements 150 kHz to 30 MHz  
**Line** : L2



Landauer  
 X-Ray Badge Reader  
 Small Charger Base w/Ferrite  
 120v, 60 Hz SPC P.S. #9706  
 Neut.Ferrite=core F114A-43 15T

Test No.	Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level [dB(uVolts)]	Limit:1	2
=====							
Range: 1 .45 - 30MHz							
1	13.58763	30.9 pk	10.3	0	41.2	69.5	48
				Margin [dB]		-28.3	-6.8

LIMIT 1: CFR 47 PART 15 CLASS A  
 LIMIT 2: CFR 47 PART 15 CLASS B

pk - Peak detector

Landauer  
 X-Ray Badge Reader  
 Small Charger Base w/Ferrite  
 120v, 60 Hz SPC P.S. #9706  
 Neut.Ferrite=core F114A-43 15T

Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level [dB(uVolts)]	Limit:1	2
=====						
Range: 1 .45 - 30MHz						
13.5585	25.7qp	10.4	0	36.1	69.5	48
			Margin [dB]:		-33.4	-11.9

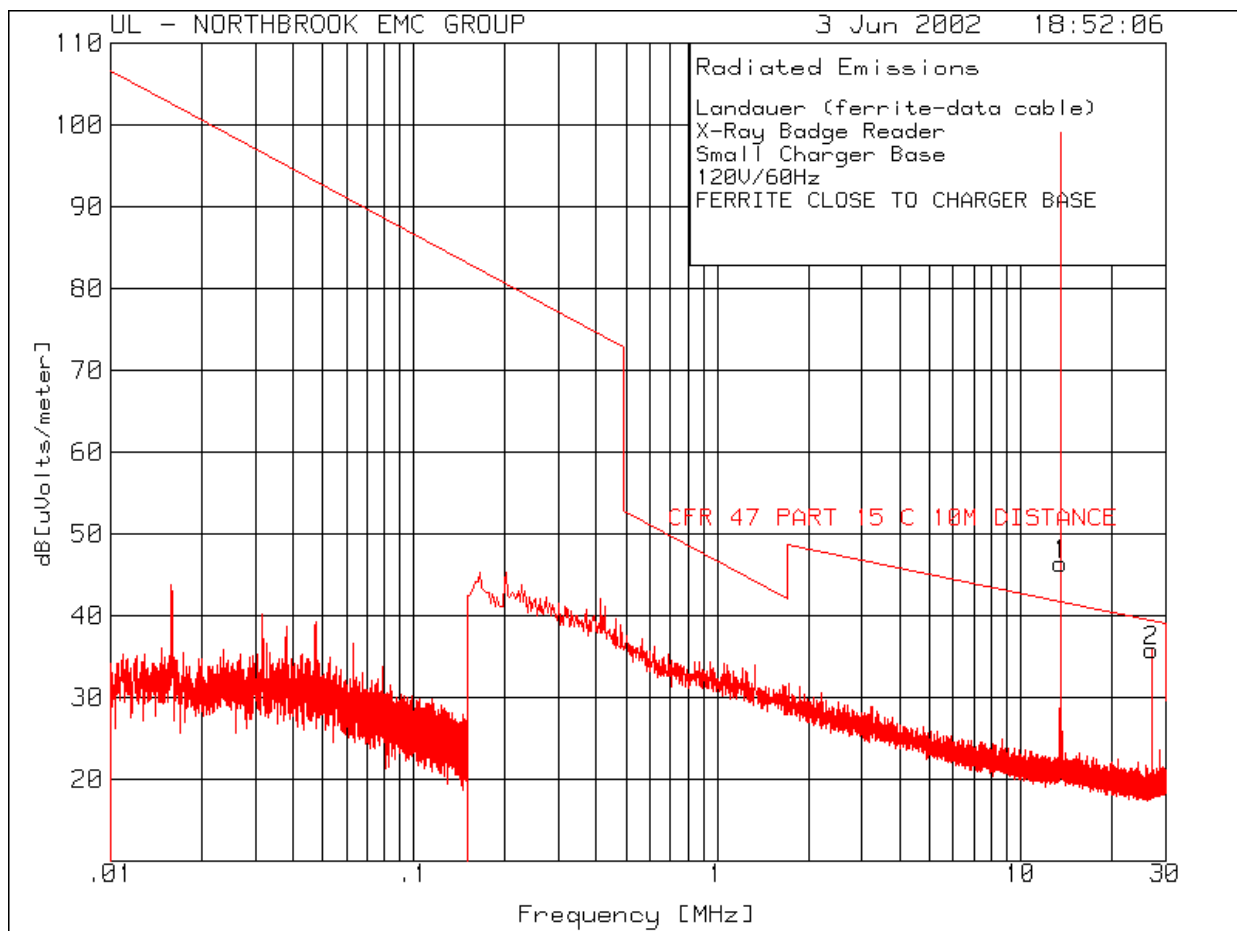
qp - Quasi-Peak detector

LIMIT 1: CFR 47 PART 15 CLASS A  
 LIMIT 2: CFR 47 PART 15 CLASS B

**UNDERWRITERS LABORATORIES INC.**  
**Radiated Emissions**

Date Tested: 03 June 2002

**Manufacturer** : Landauer Inc.  
**Equipment Under Test** : X-Ray Badge Reader (Small Charger Base)  
**Requirement** : CFR 47, Part 15, Class B  
**Detection Mode** : Quasi-peak (qp) and Average (Av)  
**Bandwidth** : 120 kHz  
**Measurement Distance** : 10 meter  
**Antenna Type** : 10 kHz – 30 MHz Loop Sensor



Landauer (ferrite-data cable)  
 X-Ray Badge Reader  
 Small Charger Base  
 120V/60Hz  
 FERRITE CLOSE TO CHARGER BASE

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1
=====						
Range: 2 .15 - 30MHz						
1	13.56026	34.9 pk	.5	10.9	46.3	99.1
	Azimuth:312	Height:100	Horz	Margin [dB]		-52.8
2	27.1246	25.5 pk	.9	9.4	35.8	48.6
	Azimuth:269	Height:100	Horz	Margin [dB]		-12.8

LIMIT 1: CFR 47 PART 15 C 10M DISTANCE

pk - Peak detector

Landauer (ferrite-data cable)  
 X-Ray Badge Reader  
 Small Charger Base  
 120V/60Hz  
 FERRITE CLOSE TO CHARGER BASE

4	Test Frequency [MHz]	5	Meter Reading [dB(uV)]	6	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1	2	3
=====										
	27.1261		26.4 qp		.9	9.4	36.7	48.6		
	Azimuth: 267		Height:100		Horz	Margin [dB]:		-11.9		
	13.5655		34.96 qp		.5	10.9	46.36	99.1		
	Azimuth: 340		Height:100		Horz	Margin [dB]:		-52.7		

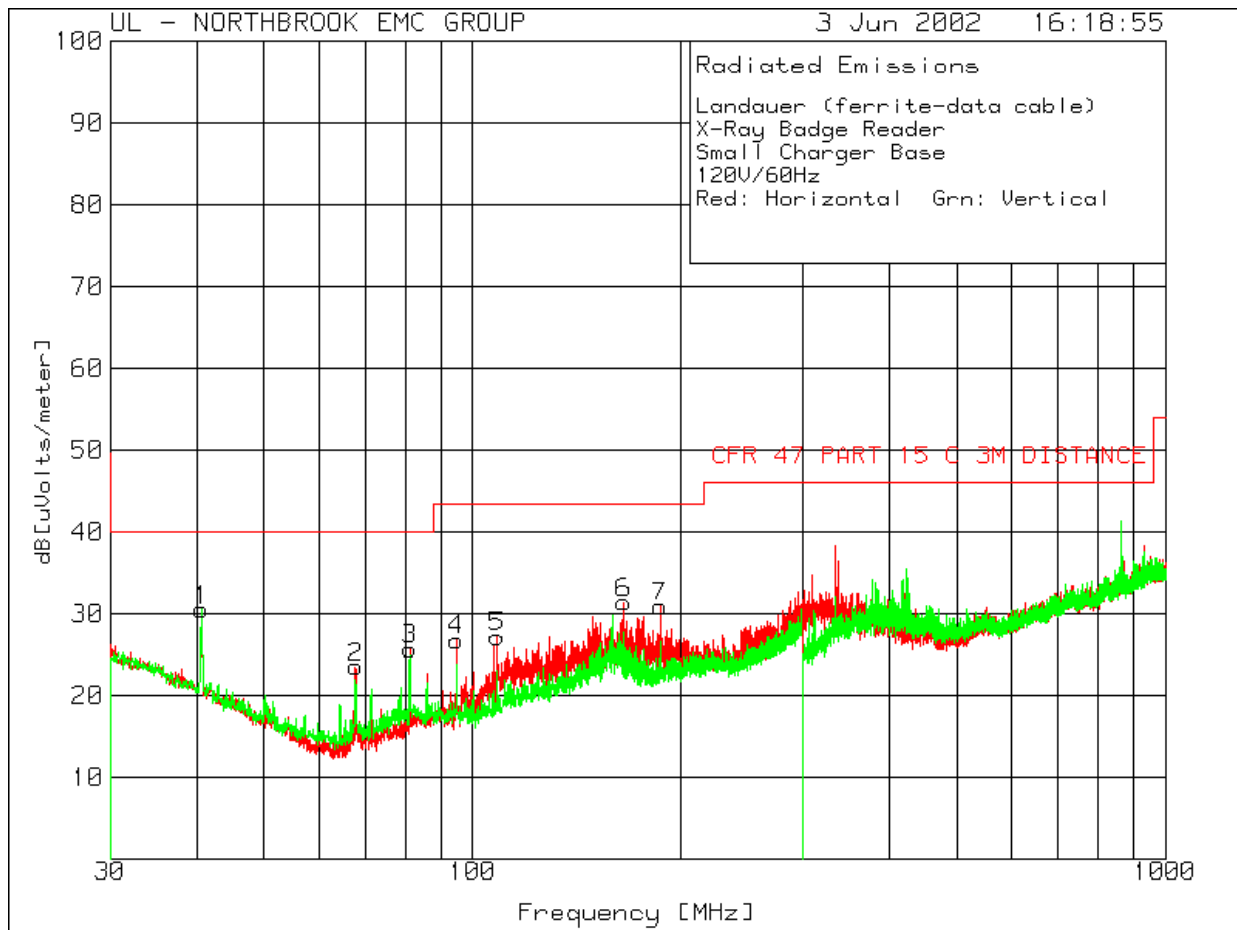
LIMIT 1: CFR 47 PART 15 C 10M DISTANCE

qp - Quasi-Peak detector

**UNDERWRITERS LABORATORIES INC.**  
**Radiated Emissions**

Date Tested: 03 June 2002

**Manufacturer** : Landauer Inc.  
**Equipment Under Test** : X-Ray Badge Reader (Small Charger Base)  
**Requirement** : CFR 47, Part 15, Class B  
**Detection Mode** : Quasi-peak (qp) and Average (Av)  
**Bandwidth** : 120 kHz  
**Measurement Distance** : 3 meters  
**Antenna Type** : 30 - 300 MHz, Biconical  
 300 - 1000 MHz, Log-Periodic





Landauer (ferrite-data cable)  
 X-Ray Badge Reader  
 Small Charger Base  
 120V/60Hz  
 Red: Horizontal Grn: Vertical

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1
=====						
Range: 3 300 - 1000MHz						
1	334.0994	21 pk	1.8	15.6	38.4	46
	Azimuth:292	Height:100	Horz	Margin [dB]		-7.6
Range: 4 300 - 1000MHz						
2	423.6323	16.3 pk	2.1	17.1	35.5	46
	Azimuth:341	Height:100	Vert	Margin [dB]		-10.5
3	865.0012	13.8 pk	3.5	24.1	41.4	46
	Azimuth:180	Height:100	Vert	Margin [dB]		-4.6
2	67.7042	17.1 pk	.7	5.7	23.5	40
	Azimuth:91	Height:300	Horz	Margin [dB]		-16.5
3	81.329	17.5 pk	.8	7.4	25.7	40
	Azimuth:340	Height:200	Horz	Margin [dB]		-14.3
4	94.8863	16.3 pk	.8	9.7	26.8	43.5
	Azimuth:340	Height:300	Horz	Margin [dB]		-16.7
5	108.4437	14.8 pk	.9	11.5	27.2	43.5
	Azimuth:201	Height:300	Horz	Margin [dB]		-16.3
6	165.2361	15.4 pk	1.1	14.9	31.4	43.5
	Azimuth:55	Height:100	Horz	Margin [dB]		-12.1
7	186.4152	13.9 pk	1.2	15.8	30.9	43.5
	Azimuth:2	Height:100	Horz	Margin [dB]		-12.6
Range: 2 30 - 300MHz						
1	40.657	15.4 pk	.5	14.6	30.5	40
	Azimuth:74	Height:100	Vert	Margin [dB]		-9.5

LIMIT 1: CFR 47 PART 15 C 3M DISTANCE

pk - Peak detector

Landauer (ferrite-data cable)  
 X-Ray Badge Reader  
 Small Charger Base  
 120V/60Hz  
 Red: Horizontal Grn: Vertical

Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1
=====					
Range: 1 30 - 300MHz					
67.8092	16.19 qp	.7	5.7	22.59	40
Azimuth: 23	Height:274	Horz	Margin [dB]:	-17.41	
81.3661	16.94 qp	.8	7.4	25.14	40
Azimuth: 189	Height:385	Horz	Margin [dB]:	-14.86	
94.9257	15.58 qp	.8	9.7	26.08	43.5
Azimuth: 183	Height:193	Horz	Margin [dB]:	-17.4	
108.5273	14.28 qp	1	11.5	26.78	43.5
Azimuth: 177	Height:304	Horz	Margin [dB]:	-16.7	
165.2235	11.89 qp	1.1	14.9	27.89	43.5
Azimuth: 170	Height:102	Horz	Margin [dB]:	-15.6	
186.1397	12.31 qp	1.2	15.8	29.31	43.5
Azimuth: 158	Height:107	Horz	Margin [dB]:	-14.1	
344.7412	15.1 qp	1.9	15.6	32.6	46
Azimuth: 77	Height:109	Horz	Margin [dB]:	-13.4	

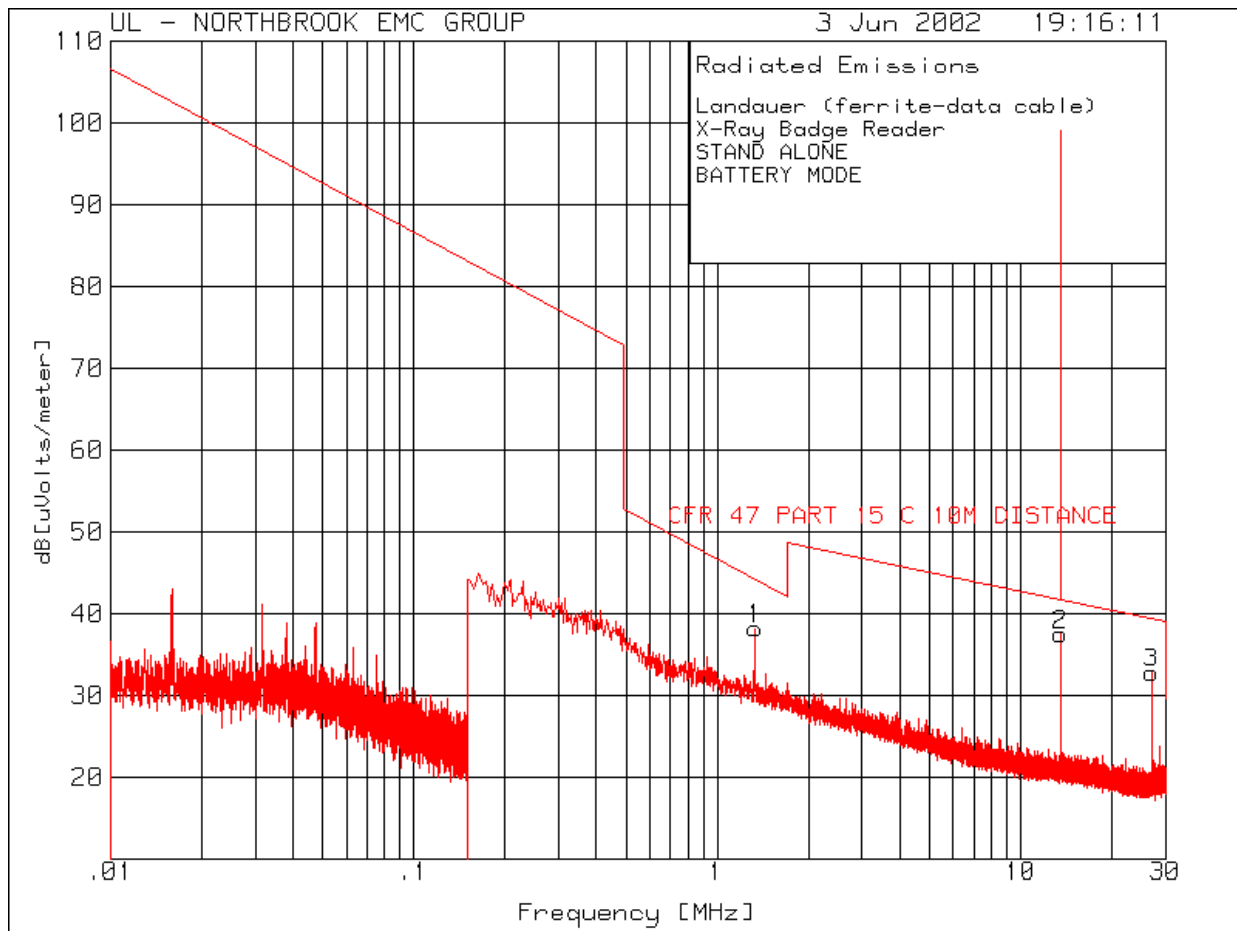
LIMIT 1: CFR 47 PART 15 C 3M DISTANCE

qp - Quasi-Peak detector  
 av - Average detector

**UNDERWRITERS LABORATORIES INC.**  
**Radiated Emissions**

Date Tested: 03 June 2002

**Manufacturer** : Landauer Inc.  
**Equipment Under Test** : X-Ray Badge Reader (Reader)  
**Requirement** : CFR 47, Part 15, Class B  
**Detection Mode** : Quasi-peak (qp) and Average (Av)  
**Bandwidth** : 120 kHz  
**Measurement Distance** : 10 meter  
**Antenna Type** : 10 kHz – 30 MHz Loop Sensor



Landauer (ferrite-data cable)  
 X-Ray Badge Reader  
 STAND ALONE  
 BATTERY MODE

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1
=====						
Range: 2 .15 - 30MHz						
AM STATION AMBIENT						
1	1.33297	26.3 pk	0	11.9	38.2	44.2
	Azimuth:2	Height:100	Horz	Margin [dB]		-6
2	13.5615	26.1 pk	.5	10.9	37.5	99.1
	Azimuth:225	Height:100	Horz	Margin [dB]		-61.6
3	27.12211	22.5 pk	.9	9.4	32.8	48.6
	Azimuth:314	Height:100	Horz	Margin [dB]		-15.8

LIMIT 1: CFR 47 PART 15 C 10M DISTANCE

pk - Peak detector

Landauer (ferrite-data cable)  
 X-Ray Badge Reader  
 STAND ALONE  
 BATTERY MODE

Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1
=====					
Range: 2 .15 - 30MHz					
13.5652	30.71 qp	.5	10.9	42.11	99.1
Azimuth: 155	Height:100	Horz	Margin [dB]:		-56.9
27.1254	21.75 qp	.9	9.4	32.05	48.6
Azimuth: 278	Height:100	Horz	Margin [dB]:		-16.55

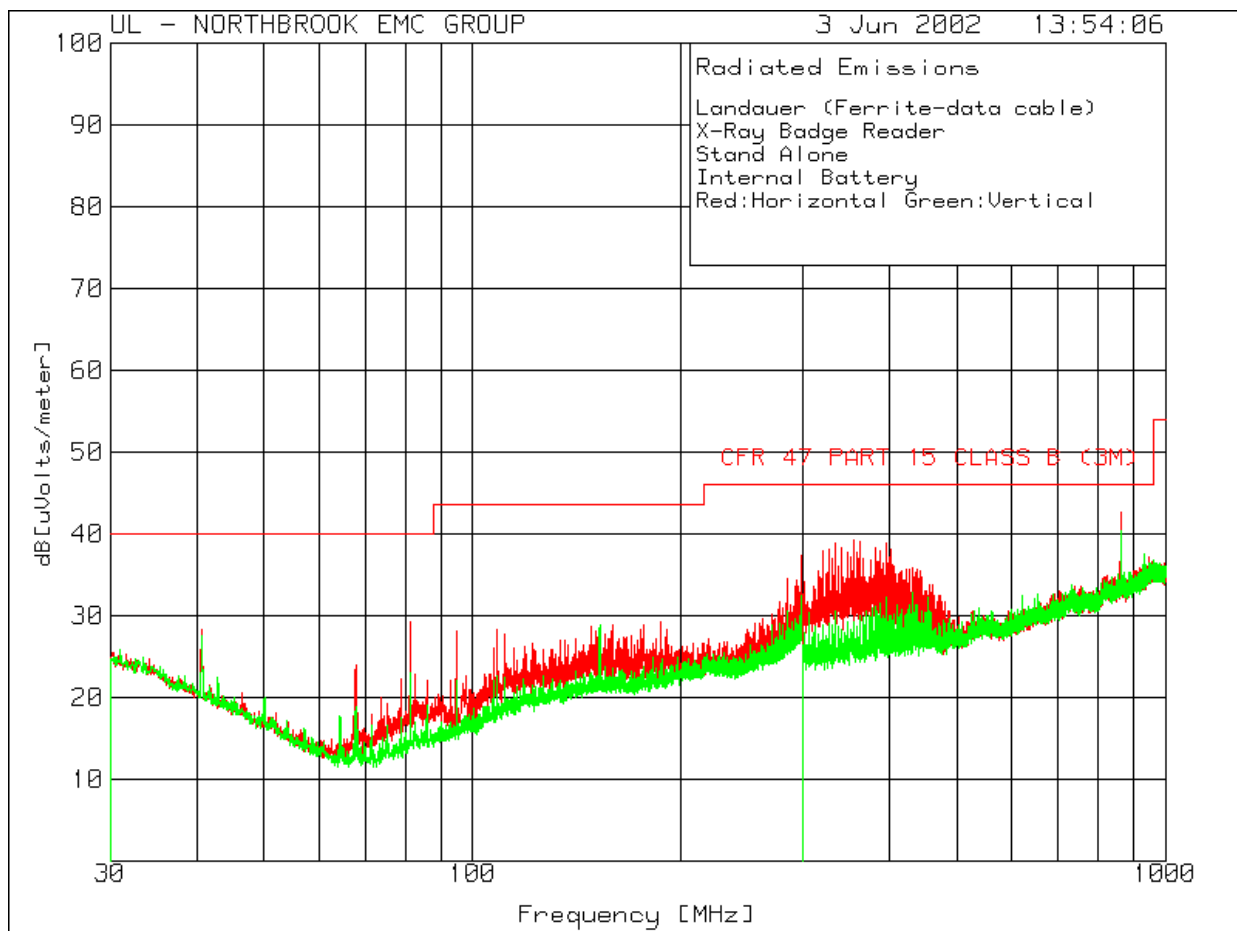
LIMIT 1: CFR 47 PART 15 C 10M DISTANCE

qp - Quasi-Peak detector

**UNDERWRITERS LABORATORIES INC.**  
**Radiated Emissions**

Date Tested: 03 June 2002

**Manufacturer** : Landauer Inc.  
**Equipment Under Test** : X-Ray Badge Reader (Reader)  
**Requirement** : CFR 47, Part 15, Class B  
**Detection Mode** : Quasi-peak (qp) and Average (Av)  
**Bandwidth** : 120 kHz  
**Measurement Distance** : 3 meters  
**Antenna Type** : 30 - 300 MHz, Biconical  
 300 - 1000 MHz, Log-Periodic



Landauer (Ferrite-data cable)  
 X-Ray Badge Reader  
 Stand Alone  
 Internal Battery  
 Red:Horizontal Green:Vertical

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1
=====						
Range: 1 30 - 300MHz						
1	67.7717	17.5 pk	.7	5.7	23.9	40
	Azimuth:110	Height:300	Horz	Margin [dB]		-16.1
2	81.329	21.1 pk	.8	7.4	29.3	40
	Azimuth:209	Height:199	Horz	Margin [dB]		-10.7
3	298.5836	15.2 pk	1.8	20.3	37.3	46
	Azimuth:258	Height:100	Horz	Margin [dB]		-8.7
Range: 3 300 - 1000MHz						
4	334.0994	21.4 pk	1.8	15.6	38.8	46
	Azimuth:351	Height:100	Horz	Margin [dB]		-7.2
5	355.7832	21.5 pk	2.1	15.6	39.2	46
	Azimuth:118	Height:100	Horz	Margin [dB]		-6.8
6	394.9538	20.2 pk	2	16.6	38.8	46
	Azimuth:341	Height:100	Horz	Margin [dB]		-7.2
7	865.0012	15.1 pk	3.5	24.1	42.7	46
	Azimuth:294	Height:100	Horz	Margin [dB]		-3.3

LIMIT 1: CFR 47 PART 15 CLASS B (3M)

pk - Peak detector

Landauer (Ferrite-data cable)  
 X-Ray Badge Reader  
 Stand Alone  
 Internal Battery  
 Red:Horizontal Green:Vertical

	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1
=====						
Range: 3 300 - 1000MHz						
	334.185	21.52 qp	1.8	15.7	39.02	46
	Azimuth: 266	Height:100	Horz	Margin [dB]:		-6.98
	354.163	17.7 qp	2.1	15.6	35.4	46
	Azimuth: 273	Height:100	Horz	Margin [dB]:		-10.6
	395.9764	14.62 qp	2	16.7	33.32	46
	Azimuth: 293	Height:102	Horz	Margin [dB]:		-12.68
	865.0362	10.33 qp	3.5	24.1	37.93	46
	Azimuth: 110	Height:382	Horz	Margin [dB]:		-8.07

LIMIT 1: CFR 47 PART 15 CLASS B (3M)

qp - Quasi-Peak detector

File MC1476 Project 01NK42417

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(800) USE UL EMC

**UNDERWRITERS LABORATORIES INC.**  
**Temperature/Frequency Stability**

Date Tested: 03 June 2002

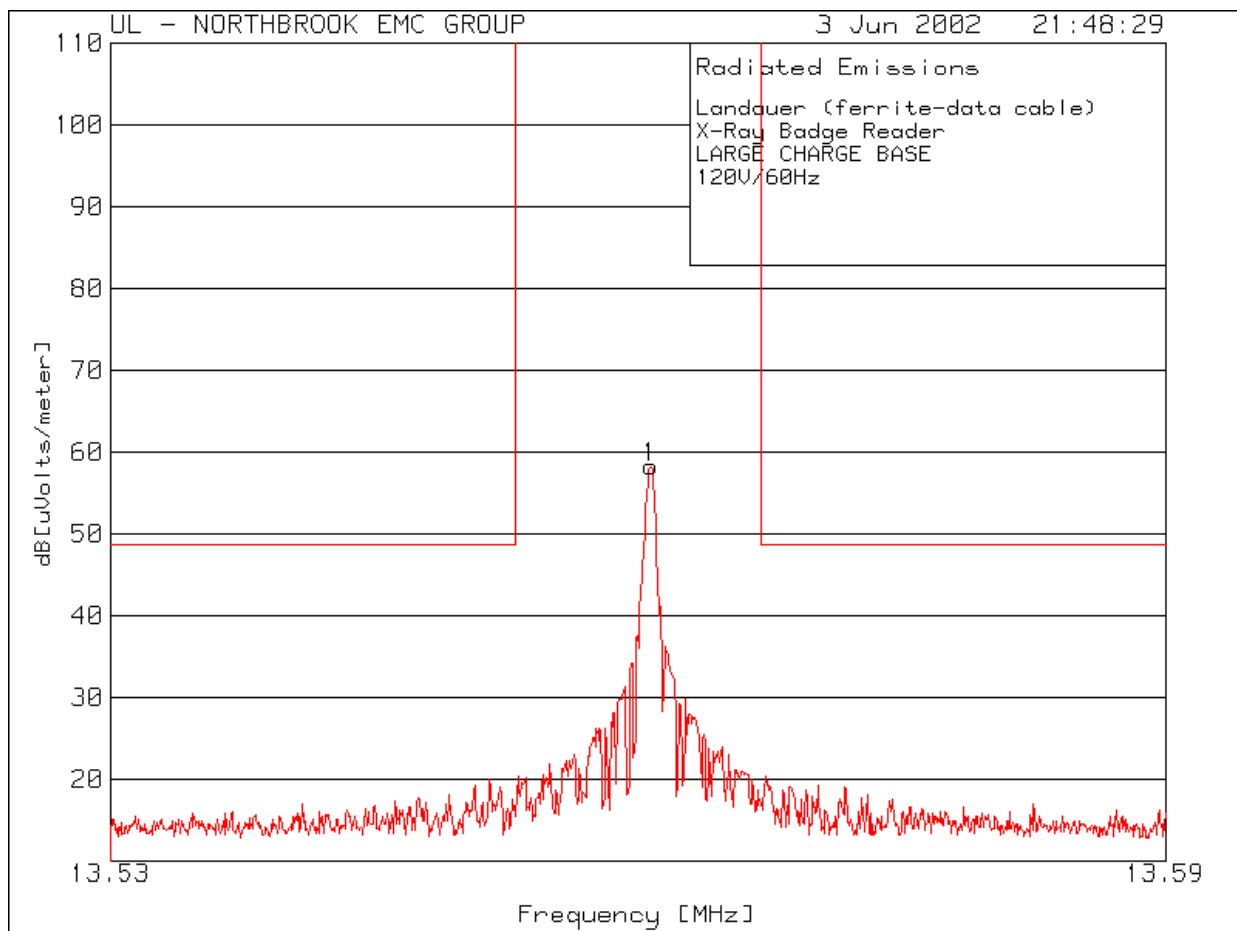
Fundamental Frequency = 13.56 MHz

Temperature °C	Frequency MHz	% Change	Requirement %	Limit MHz
-20	13.55972	-0.00206	0.01	Upper 13.561356 Lower 13.558644
-10	13.56022	+0.001622	0.01	Upper 13.561356 Lower 13.558644
0	13.56000	0	0.01	Upper 13.561356 Lower 13.558644
+10	13.55997	-0.00022	0.01	Upper 13.561356 Lower 13.558644
+20	13.55997	-.000022	0.01	Upper 13.561356 Lower 13.558644
+30	13.55982	-0.00133	0.01	Upper 13.561356 Lower 13.558644
+40	13.55975	-0.00184	0.01	Upper 13.561356 Lower 13.558644
+50	13.55965	-0.00258	0.01	Upper 13.561356 Lower 13.558644

**UNDERWRITERS LABORATORIES INC.**  
**Band Edge Measurement**

Date Tested: 03 June 2002

**Manufacturer** : Landauer Inc.  
**Equipment Under Test** : X-Ray Badge Reader  
**Requirement** : CFR 47, Part 15, Class B  
**Detection Mode** : Quasi-peak (qp) and Average (Av)  
**Bandwidth** : 120 kHz  
**Measurement Distance** : 10 meter  
**Antenna Type** : 10 kHz – 30 MHz Loop Sensor





Landauer (ferrite-data cable)  
 X-Ray Badge Reader  
 LARGE CHARGE BASE  
 120V/60Hz

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1
=====						
Range: 2 13.53 - 13.59MHz						
1	13.56069	46.8 pk	.5	10.9	58.2	99.08
		Height:100 Horz		Margin [dB]		-40.88

LIMIT 1:

pk - Peak detector

## **APPENDIX C**

### **Sample Calculations of Field Strengths**

#### **Basic Equation:**

The field strength is calculated by adding the Meter Reading, Cable Set Gain/Loss and Transducer (Antenna or LISN) Factor. The basic equation is as follows:

$$FS = MR + GL + TF$$

Where:

FS = Calculated Field Strength in dB(uV)/meter

MR = Meter Reading of receiver amplitude in dB(uV)

GL = Gain/Loss factor of cable set in dB

A negative Gain/Loss indicates signal amplification (gain)

A positive Gain/Loss indicates signal attenuation (loss)

TF = Transducer Factor of antenna or LISN in dB

#### **Sample Calculation:**

The measured receiver amplitude is 52.7 dB(uV).

The gain/loss factor is -30.2 dB (indicating a preamplifier is included in the cable set).

The transducer factor (antenna factor) is 6.6 dB.

These factors are added ( $52.7 + (-30.2) + 6.6$ ) resulting in a calculated field strength of 29.1 dB(uV)/meter.

## Sample Calculations of Limit

### Basic Equation:

The limit is calculated by using the information in table 15.209 for frequency (MHz), field strength (uV/m) and measurement distance (meters).

**The basic equation for converting uV/m to dBuV/m is as follows:**

$$20 \text{ Log (uV/m)} = \text{dBuV/m}$$

Where:

uV/m = micro volts per meter

dBuV/m = decibel micro volts per meter

### Sample Calculation:

The field strength per section 15.209 at 30 MHz (3 m measurement distance) is 30 uV/m.

$$20 \text{ Log (30 uV/m)} = 29.54 \text{ dBuV/m}$$