Washington Laboratories, Ltd.

FCC Certification Test Report
For the
InnerSpace Corporation
SYSTEM 100
FCC ID: VKC-SYSTEM100
IC ID: 7285A-SYS100

WLL REPORT# **9936-01 Rev 1**
November 21, 2007

Revised February 26, 2008

Prepared for:

InnerSpace Corporation
4 Reagan Drive
Jackson, NJ 08527

Prepared By:

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7560 Lindbergh Drive
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Prepared by:

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Compliance Engineer

Reviewed by:

Steven D. Koster
EMC Operations Manager

Abstract

This report has been prepared on behalf of InnerSpace Corporation to support the attached Application for Equipment Authorization. The test report and application are submitted for an Intentional Radiator under FCC Part 15.225 and Industry Canada RSS-210. This Certification Test Report documents the test configuration and test results for the InnerSpace Corporation RFID GBI-100 Module.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The InnerSpace Corporation SYSTEM 100 complies with the limits for an Intentional Radiator device under FCC Part 15.225 and Industry Canada RSS-210.

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1 Introduction

1.1 Compliance Statement

The InnerSpace Corporation RFID GBI 100 Module complies with the limits for an Intentional Radiator device under FCC Part 15.225 and Industry Canada RSS-210.

1.2 Test Scope Summary

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 2003 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	InnerSpace Corporation 4 Reagan Drive Jackson, NJ 08527
Quotation Number:	63396

1.4 Test Dates

Testing performed on the following date(s):	10/17/2007

1.5 Test and Support Personnel

Washington Laboratories, LTD	Steven Dovell, John Repella
Client Representative	Ron Marino

2 Equipment Under Test

2.1 EUT Identification & Description

The InnerSpace Corporation SYSTEM 100, Equipment Under Test (EUT), is a storage cabinet that provides automated management inventory using passive RFID tag technology (13.56 MHz). In addition the EUT will provide access control functionality (fingerprint scanner and/or key). EUT incorporates an embedded computer (WinSystems EPX-GX500 **)** to perform automated tasks and device control.

The GBI box also includes a certified (FCC ID PJMMR101-PR101) RFID reader (FEIG: ID ISC.MR101) that when connected to an antenna is considered an intentional radiator (1 watt @ 13.56 MHz). It is a multi-protocol reader in which the System 100 may program it to either the ISO 15693 or Philips UID protocol standard to read RFID tags.

Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	InnerSpace Corporation
FCC ID:	VKC-SYSTEM100
Industry Canada Number	7285A-SYS100
Model:	SYSTEM 100 RFID
FCC Rule Parts:	§15.225
Frequency Range:	13.56MHz
Maximum Output Power:	196.8 μV/m @ 10m
Modulation:	None
Occupied Bandwidth:	33.369kHz (20dB BW)
Type of Information:	Data
Number of Channels:	1
Power Output Level	Fixed
Antenna Type	External – Panel
Interface Cables:	LAN, Antenna
Power Source & Voltage:	120VAC

2.2 Test Configuration

The InnerSpace Corporation SYSTEM 100 , Equipment Under Test (EUT), was operated from a 120VAC power supply. The antenna panel contains 8 different antennas. Testing was accomplished using Antenna 2 as this produced the worst case emissions.

2.3 Support Equipment

The EUT was tested as a standalone device and did not require any external support equipment.

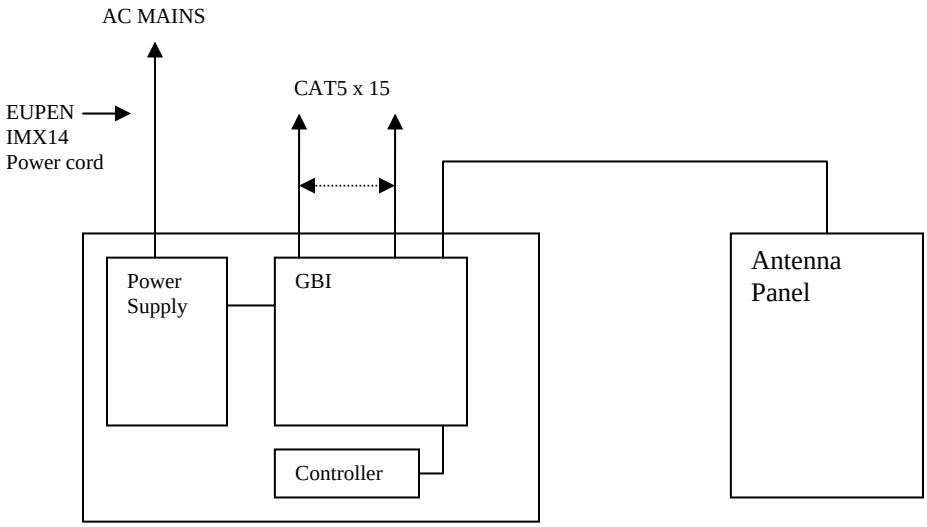

Figure 1: Test Configuration

2.4 Equipment Configuration

The EUT was set up as outlined in Figure 1. The EUT was comprised of the following equipment. (All Modules, PCBs, etc. listed were considered as part of the EUT, as tested.)

Table 2: Equipment Configuration

Name / Description	Model Number	Part Number	Serial Number
GBI		S00007	00001
Antenna Shelf Assembly		J00102	
ACM		P00011	N/A
Lock Module Assembly		P00010	N/A
Door Sensor Assembly		P00024	N/A
Key Switch Assembly		S00058	N/A
Power Supply		AL600ULXB	N/A
Battery		BP10-12	N/A
Full Cart	System 100	B00034	0001

2.5 Interface Cables

Table 3: Interface Cables

Port Identification	Connector Type	Cable Length	Shielded (Y/N)	Termination Point
Shelf/Bay (x16)	RJ45	1m	Y	Antennas
DC12	Barrel	<1m	N	Power Supply

2.6 EUT Modifications

The following modifications were performed in order to meet the test requirements:

The power cord was replaced with a Eupen IMX14 filtered power cord.

The power supply was replaced with a Lambda ZWS100AF-15

2.7 Testing Algorithm

Firmware used for regulatory testing is a modification of production firmware in that it is used to set system to dwell on specific conditions that are identical to the production version. This firmware also provides capability to set EUT to the maximum power draw condition (RF scanning with solenoid lock mechanism pulsing). This firmware used in regulatory testing will provide the functionalities below:

The **Inventory command provides for a modulated RF signal** and is not equivalent to just turning on the RF power. The same sequence of reader commands is used by the production firmware.

Worst case emission levels are provided in the test results data.

2.8 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The Industry Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

2.9 Measurements

2.9.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

2.10 Measurement Uncertainty

All results reported herein relate only to the equipment tested. For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ±2.3 dB. This has been

calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

Total Uncertainty = $(A^2 + B^2 + C^2)^{1/2}/(n-1)$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty = $0.5\ (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB.

3 Test Equipment

Table 4 shows a list of the test equipment used for measurements along with the calibration information.

Table 4: Test Equipment List

WLL Asset #	Manufacturer Model/Type	Function	Cal. Due
00117	RACAL DANA	COUNTER, FREQUENCY	5/8/2008
00473	FLUKE, 111	MULTIMETER	7/25/2008
00168	BIRD, 8401	LOAD, RF DUMMY	CNR
00125	SOLAR, 8028-50-TS-24-BNC	LISN	2/1/2008
00126	SOLAR, 8028-50-TS-24-BNC	LISN	2/1/2008
00068	HP, 85650A	ADAPTER, QP	7/6/2008
00072	HP, 8568B	ANALYZER, SPECTRUM	7/6/2008
00070	HP, 85685A	PRESELECTOR, RF W/OPT 8ZE	7/6/2008
00031	EMCO, 6502	ANTENNA, ACTIVE LOOP	2/12/2008
00382	SUNOL, JB1	ANTENNA, BICONLOG	2/2/2008

4 Test Results

4.1 Summary of Test Results for Industry Canada

Equipment Model:	Test Report Page or References
Transmitter tested to RSS-210 Section 6.2.2(e)	
Field Strength 196.8 µV/m at a distance of 10 meters	Table 7
RF Power N/A Watts	N/A
Peak-to-average ratio dB or □ CISPR	N/A
Test Conditions: **X** Radiated (sections 11 & 13)	
□ Terminated (section 10)	N/A
□ DC Input Power (section 12)	N/A
Transmitter Frequency: 13.56 MHz	
Bandwidth: 33.369kHz	Table 5
Frequency Tuning Range: N/A, Transmit is fixed frequency	N/A
Frequency Stability: ±0.01%	Section 4.5
Transmitter Spurious (worst case)	Section 4.3
Field Strength: 8.5 µV/m at a distance of 10.0 meters	Table 7
Frequency: 27.117 MHz	Table 7
Momentary Operation? □ Yes X No	
Holdover time after manual release: N/A seconds or Duration of transmission after automatic activation: N/A seconds	N/A
Transmitter/Receiver AC Wireline Conducted Emissions (worst case)	Section 4.4
Transmitter: RF level 221.3 microvolts Frequency 158 kHz	Table 9
Receiver : RF level N/A microvolts Frequency N/A	N/A
Receiver Spurious (worst case)	N/A
Field Strength N/A µV/m, at a distance of N/A meters or RF N/A nanowatts Frequency N/A	N/A
Attestation: The radio apparatus identified in this application has been subject to all the applicable test conditions specified in RSS-210 and all of the requirements of the Standard have been met.	
Title Steven Dovell, Compliance Engineer	
Name (print) Signature Date	

4.2 Occupied Bandwidth

Occupied bandwidth measurement was performed by coupling the output of the EUT to the input of a spectrum analyzer with a Near Field Probe.

The 20dB occupied bandwidth was measured as shown:

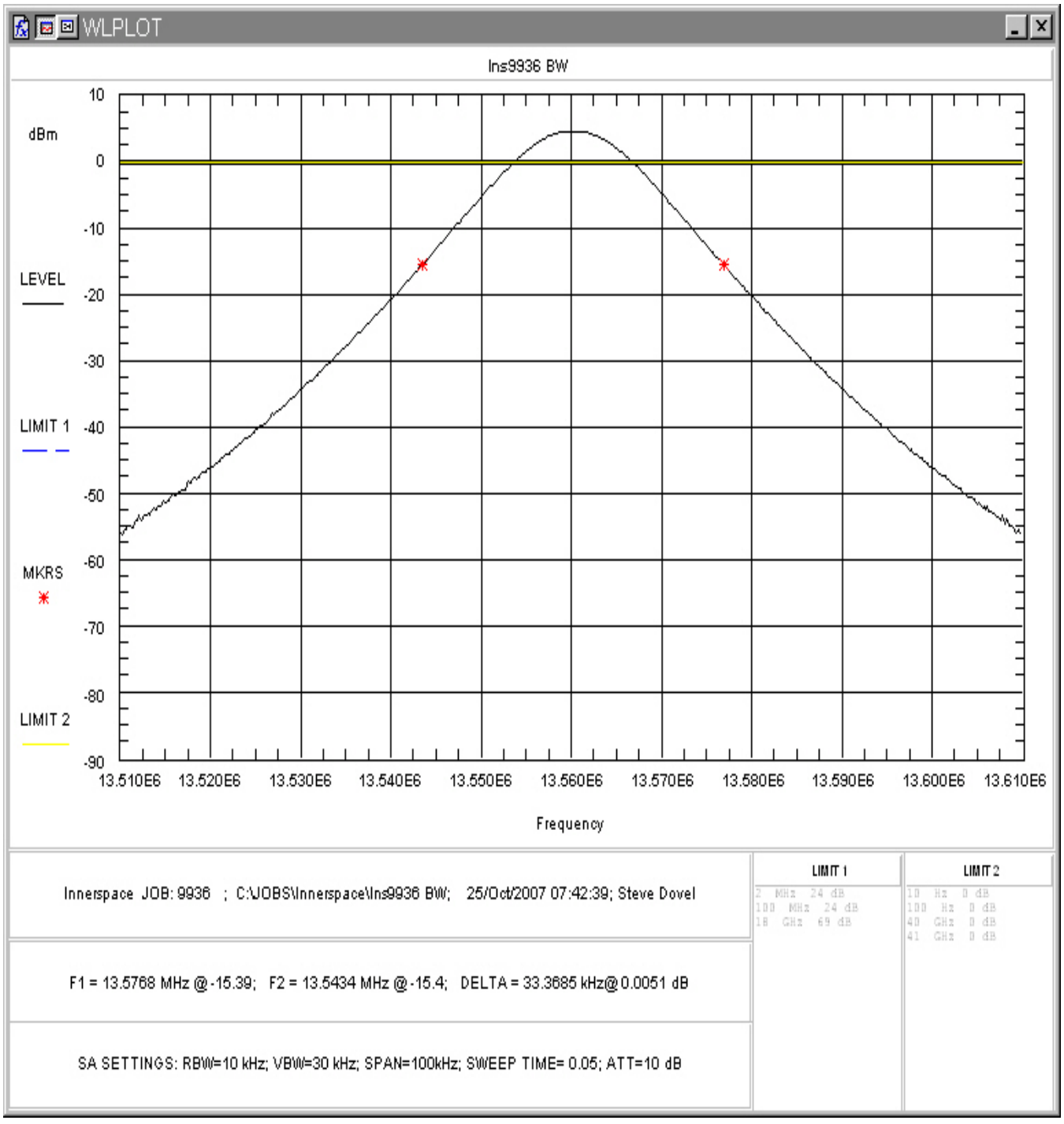

Figure 2. Occupied Bandwidth

Table 3 provides a summary of the Occupied Bandwidth Results.

Table 5. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
13.56MHz	33.369kHz	N/A	Pass

4.3 Radiated Spurious Emissions, §15.225, §15.209, and RSS-210

Radiated emissions from the EUT must comply with the field strength limits as specified in FCC Part 15.225 and 15.209 and Industry Canada RSS-210. The limits for the radiated emissions are as shown in the following table.

Table 6. Radiated Spurious Emissions Limits

Frequency (MHz)	Limit (μV/m)	Rule Part Reference
13.553 - 13.567	15,848 (@ 30m)	§15.225(a), RSS-210 6.2.2(e)
13.410 – 13.553	334 (@ 30m)	§15.225(b), RSS-210 6.2.2(e)
13.567 – 13.710	334 (@ 30m)	§15.225(b), RSS-210 6.2.2(e)
13.110 – 13.410	106 (@ 30m)	§15.225(c), RSS-210 6.2.2(e)
13.710 – 14.010	106 (@ 30m)	§15.225(c), RSS-210 6.2.2(e)
1.705 – 13.110 14.010 – 30.0	30 (@ 30m)	§15.225(d), §15.209, RSS-210 6.2.2(e)
30 - 88	100 (@ 3m)	§15.225(d), §15.209, RSS-210 6.2.2(e)
88 - 216	150 (@ 3m)	§15.225(d), §15.209, RSS-210 6.2.2(e)
216 - 960	200 (@ 3m)	§15.225(d), §15.209, RSS-210 6.2.2(e)
Above 960	500 (@ 3m)	§15.225(d), §15.209, RSS-210 6.2.2(e)

4.3.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on an Open Area Test Site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-2003. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured

Testing at frequencies below 30 MHz was performed at ten meters with a loop antenna. Limits were interpolated from the 30-meter limit to the equivalent at 10 meters. Three orientations of the loop antenna were tested. Resolution Bandwidth used was 9 kHz. VBW was 100 KHz.

Emissions were scanned up to 1 GHz. Only the 2nd harmonic of the fundamental frequency was detected. No other emissions were detected that were related to the RFID Transmitter. All other emissions detected were related to digital emissions of the GBI electronics. For emissions up to 30 MHz and above 1 GHz peak levels were recorded. Emissions from 30 MHz to 1000 MHz were measured using a Quasi-peak detector at a distance of 3m. Worst case emissions are reported in the data table.

The following is a sample calculation used in the data tables for calculating the final field strength of spurious emissions and comparing these levels to the specified limits.

Sample Calculation:

Spectrum Analyzer Voltage (SA Level): VdBµV
Antenna Factor (Ant Corr): AFdB/m
Cable Loss Correction (Cable Corr): CCdB
Amplifier Gain: GdB (if applicable)
Electric Field (Corr Level): EdBµV/m = VdBµV + AFdB/m + CCdB - GdB
To convert to linear units: EµV/m = antilog (EdBµV/m/20)

4.3.2 Test Results

The EUT complies with the radiated emission requirements of §15.225 and RSS-210 6.2.2(e). Test data is included in Table 7. Additionally, test data for the digital emissions are listed in Table 8.

Table 7: Radiated Spurious Emissions, §15.225, §15.209 and RSS-210

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Amplifier Gain (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
13.558	X	81.0	1.0	39.7	10.5	1.1	0.0	51.3	367.5	142632.0	-51.8
16.964	X	98.0	1.0	16.4	10.4	1.1	0.0	27.9	24.9	270.0	-20.7
27.117	X	40.0	1.0	10.8	8.8	1.2	0.0	20.8	10.9	270.0	-27.9
13.558	Y	337.0	1.0	40.2	10.5	1.1	0.0	51.8	389.3	142632.0	-51.3
27.117	Y	196.0	1.0	9.8	8.8	1.2	0.0	19.8	9.7	270.0	-28.9
13.558	Z	118.0	1.0	29.0	10.5	1.1	0.0	40.6	107.2	142632.0	-62.5
27.117	Z	225.0	1.0	5.2	8.8	1.2	0.0	15.2	5.7	270.0	-33.5

Table 8: Radiated Emissions Data, §15.109 and RSS-210

Digital Section Emissions

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin (dB)
40.680	V	349.0	1.8	14.3	13.2	1.4	28.9	27.8	100.0	-11.1
118.030	V	171.0	1.0	22.6	13.7	2.0	38.3	82.6	150.0	-5.2
134.200	V	143.0	1.0	15.3	13.4	2.1	30.8	34.7	150.0	-12.7
173.280	V	210.0	1.0	24.6	11.5	2.3	38.4	82.8	150.0	-5.2
257.420	V	9.0	1.0	13.3	12.1	2.5	27.9	24.7	200.0	-18.2
488.612	V	220.0	1.0	15.9	17.7	3.8	37.3	73.3	200.0	-8.7
566.490	V	0.0	1.0	17.7	18.5	4.1	40.3	103.9	200.0	-5.7
633.300	V	152.0	1.0	10.9	19.5	4.4	34.8	54.9	200.0	-11.2
966.390	V	224.0	1.0	5.5	22.8	5.8	34.1	50.7	500.0	-19.9
40.700	H	107.0	4.0	16.0	13.2	1.4	30.6	33.7	100.0	-9.4
114.500	H	0.0	4.0	19.6	13.4	2.0	35.0	56.1	150.0	-8.5
165.630	H	0.0	4.0	23.9	11.9	2.2	38.1	79.9	150.0	-5.5
142.800	H	346.0	3.0	18.7	12.8	2.1	33.6	48.0	150.0	-9.9
233.262	H	274.0	1.8	17.9	11.2	2.4	31.5	37.7	200.0	-14.5
260.000	H	350.0	1.6	20.7	12.2	2.5	35.5	59.2	200.0	-10.6
488.604	H	160.0	3.0	12.7	17.7	3.8	34.1	50.7	200.0	-11.9
566.520	H	146.0	1.7	14.6	18.5	4.1	37.2	72.7	200.0	-8.8

4.4 AC Power line Conducted Emissions: (FCC Part §15.207)

The EUT was placed on an 80 cm high 1 x 1.5 m non-conductive table above a ground plane. Power to the EUT was provided through a Solar Corporation 50 Ω/50 μH Line Impedance Stabilization Network bonded to a 3 x 2 meter ground plane. The LISN has its AC input supplied from a filtered AC power source. Power and data cables were moved about to obtain maximum emissions.

The 50 Ω output of the LISN was connected to the input of the spectrum analyzer and the emissions in the frequency range of 150 kHz to 30 MHz were measured. The detector function was set to quasi-peak or peak, as appropriate, and the resolution bandwidth during testing was at least 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth. Both Quasi-peak and Average measurements were made during the conducted emissions testing.

The test was performed with a filtered power cord (EUPEN type IMX14).

Data is recorded in Table 9.

Table 9. Conducted Emissions Test Data, Monitor Unit (with Eupen IMX-04 Power Cord)

LINE 1 - NEUTRAL

Frequency (MHz)	Level QP (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Limit QP (dBµV)	Level Corr (dBµV)	Margin QP (dB)	Level AVG (dBµV)	Cable Loss (dB)	Level Corr (dBµV)	Limit AVG (dBµV)	Margin AVG (dB)
0.152	33.8	10.0	0.8	65.9	44.6	-21.3	20.3	10.0	31.1	55.9	-24.8
0.185	36.2	10.1	0.6	64.3	46.9	-17.4	29.4	10.1	40.1	54.3	-14.2
0.280	24.7	10.3	0.4	60.8	35.3	-25.5	18.1	10.3	28.7	50.8	-22.1
12.990	11.6	11.7	1.9	60.0	25.2	-34.8	5.6	11.7	19.2	50.0	-30.8
13.100	11.2	11.7	1.9	60.0	24.8	-35.2	6.4	11.7	20.0	50.0	-30.0
13.557	30.7	11.8	2.0	60.0	44.5	-15.5	30.7	11.8	44.5	50.0	-5.5

LINE 2 - PHASE

Frequency (MHz)	Level QP (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Limit QP (dBµV)	Level Corr (dBµV)	Margin QP (dB)	Level AVG (dBµV)	Cable Loss (dB)	Level Corr (dBµV)	Limit AVG (dBµV)	Margin AVG (dB)
0.150	36.8	10.0	0.4	66.0	47.2	-18.8	20.7	10.0	31.1	56.0	-24.9
0.186	36.4	10.1	0.3	64.2	46.8	-17.4	29.6	10.1	40.0	54.2	-14.2
0.280	23.9	10.3	0.2	60.8	34.4	-26.4	18.1	10.3	28.6	50.8	-22.2
11.910	9.9	11.6	2.2	60.0	23.6	-36.4	-2.6	11.6	11.1	50.0	-38.9
13.220	10.9	11.8	2.6	60.0	25.2	-34.8	6.2	11.8	20.5	50.0	-29.5
13.557	32.2	11.8	2.7	60.0	46.7	-13.3	32.2	11.8	46.7	50.0	-3.3

4.5 Frequency Stability, §15.225(e) and RSS-210 6.2.2(e)

Frequency as a function of temperature and voltage variation shall be maintained within the FCC and Industry Canada prescribed tolerances.

The temperature stability was measured with the unit in an environmental chamber used to vary the temperature of the sample. The sample was held at each temperature step to allow the temperature of the sample to stabilize.

The EUT is powered by AC voltage supplied externally. The manufacturer's power requirements for the EUT are 110 VAC. Testing was performed at 85% (93.5 VAC) and 115% (126.5 VAC) of the rated voltage.

The frequency stability of the transmitter was examined at the voltage extremes and for the temperature range of -20°C to +50°C. The carrier frequency was measured while the EUT was in the temperature chamber. The reference frequency of the EUT was measured at the ambient room temperature with the frequency counter.

The following tables are the results of the frequency stability testing.

Table 10. Frequency Deviation as a Function of Temperature

Temperature (Centigrade)	Frequency (MHz)	Difference (Hz)	Deviation (%)
Ambient	13.559929	0.0	0
-30	13.559994	65.0	0.000479
-20	13.560040	111.0	0.000819
-10	13.560002	73.0	0.000538
0	13.559972	43.0	0.000317
10	13.559949	20.0	0.000147
20	13.559931	2.0	0.000015
30	13.559925	-4.0	0.000029
40	13.559928	-1.0	0.000007
50	13.559944	15.0	0.000111

Table 11. Frequency Deviation as a Function of Voltage

Voltage (Volts)	Frequency (MHz)	Difference (Hz)	Deviation (%)	Voltage (Volts) AC
At rated	13.559929	0	0.0	110.0
At 85%	13.559926	3	0.000022	93.5
At 115%	13.559927	2	0.000015	126.5

