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FCC/Industry Canada Certification Test Report
for the
CSA Medical
truFreeze Console RFID Reader

FCC ID: ZC3-TRUFREEZE
IC ID: 9573A-TRUFREEZE

WLL Report# **11885-01 Rev 1**
March 28, 2011

Re-issued May 5, 2011

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Prepared by:

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ACCLASS ACCREDITED TESTING

Testing Certificate AT-1448

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Prepared by:

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Reviewed by:

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Abstract

This report has been prepared on behalf of CSA MEDICAL to support the attached Application for Equipment Authorization. The test report and application are submitted for an Intentional Radiator under Part 15.225 of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy RSS-210 of Industry Canada. This Certification Test Report documents the test configuration and test results for a CSA MEDICAL TruFreeze Console RFID Reader

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. 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 ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

The CSA MEDICAL TruFreeze Console RFID Reader complies with the limits for an Intentional Radiator device under FCC Part 15.225 and Industry Canada RSS-210.

Revision History	Reason	Date
Rev 0	Initial Release	March 28, 2011
Rev 1	Corrected report format and model name	May 5, 2011

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1 Introduction

1.1 Compliance Statement

The CSA MEDICAL TruFreeze Console RFID Reader complies with the limits for an Intentional Radiator device under FCC Part 15.225 and Industry Canada RSS-210.

1.2 Test Scope

Tests for radiated and conducted emissions were performed. All measurements were performed in accordance with 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:	CSA Medical 1101 E 33rd Street E305 Baltimore, MD 21218
Purchase Order Number:	0275
Quotation Number:	65206B

1.4 Test and Support Personnel

Washington Laboratories, Ltd.	Steven Dovell
Client Representative	Suzanne O`Connor

1.5 Abbreviations

A	**A**mpere
ac	**a**lternating **c**urrent
AM	Amplitude Modulation
Amps	**Amp**eres
b/s	**b**its per **s**econd
BW	**B**and**w**idth
CE	**C**onducted **E**mission
cm	**c**enti**m**eter
CW	**C**ontinuous **W**ave
dB	**d**eci**b**el
dc	**d**irect **c**urrent
EMI	**E**lectro**m**agnetic **I**nterference
EUT	**E**quipment **U**nder **T**est
FM	**F**requency **M**odulation
G	**g**iga - prefix for 10^9 multiplier
Hz	**H**ertz
IF	**I**ntermediate **F**requency
k	**k**ilo - prefix for 10^3 multiplier
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
M	**M**ega - prefix for 10^6 multiplier
m	**m**eter
µ	**m**icro - prefix for 10^{-6} multiplier
NB	**N**arrow**b**and
QP	**Q**uasi-**P**eak
RE	**R**adiated **E**missions
RF	**R**adio **F**requency
rms	**r**oot-**m**ean-**s**quare
SN	**S**erial **N**umber
S/A	**S**pectrum **A**nalyzer
V	**V**olt

2 Equipment Under Test

2.1 EUT Identification & Description

The CSA Medical truFreeze is a cryogenic console used to deliver low pressure liquid nitrogen through a catheter to a patient. Remote control communications via Zigbee send signals to the Console access software to operate the machinery. The RFID radio is used to scan RFID tags of disposables.

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Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	CSA MEDICAL
FCC ID:	ZC3-TRUFREEZE
IC ID:	9573A-TRUFREEZE
Model:	TruFreeze Console RFID Reader
FCC Rule Parts:	§15.225
IC Rules	RSS210
Frequency Range:	13.56MHz
Maximum Output Power:	454.5 µV/m at 10 meters
Modulation:	None
Occupied Bandwidth:	1.7642 kHz @ -20dB 5.0294 KHz @ -26dB
Type of Information:	Data
Number of Channels:	1
Power Output Level	Fixed
Antenna Type	Internal PCB
Frequency Tolerance:	>±0.01% (±100 ppm)
Interface Cables:	Power
Power Source & Voltage:	5Vdc from 120Vac
Tx Spurious	46.8 µV/m at 10 meters
Rx Spurious	46.8 µV/m at 10 meters

2.2 Test Configuration

The TruFreeze Console RFID Reader was configured for testing as indicated in the figure below.

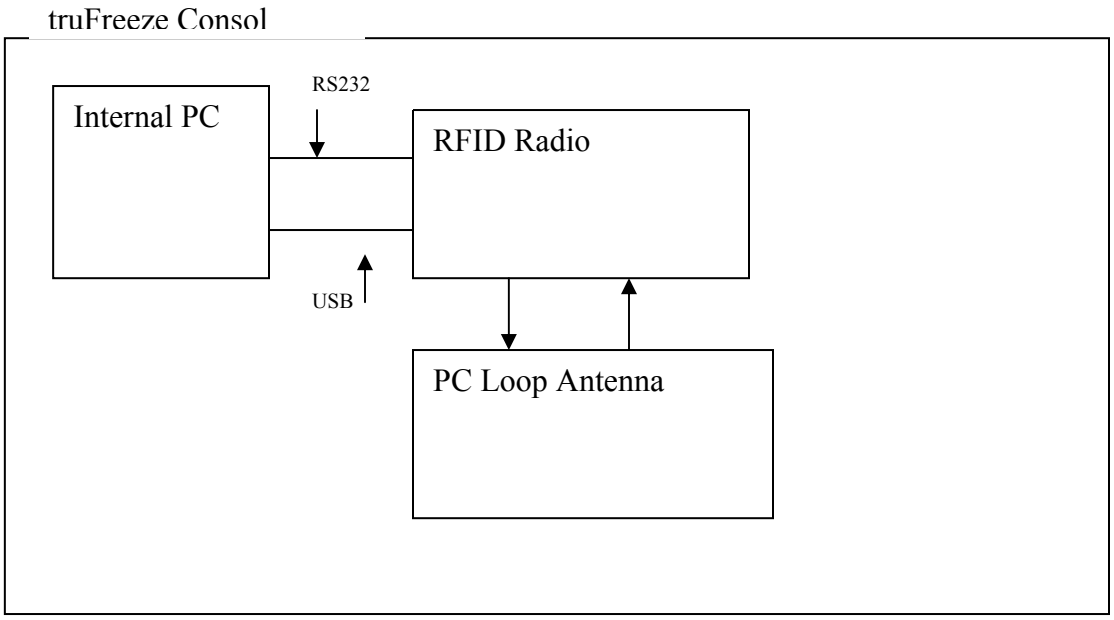

Figure 1: Test Configuration

2.3 Testing Algorithm

The truFreeze Console was operated continuously by using the built in service software routines to activate the RFID radio. For Spurious Radiated and Conducted Emissions, the warmer, suction pump and Build relay were activated.

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

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2.4 Test Location

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. 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 ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

2.5 Measurements

2.5.1 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

2.6 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:

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

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

Table 2: Test Equipment List

Test Name:	**Conducted Emissions Voltage**	Test Date:	**03/01/2011**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
125	SOLAR - 8028-50-TS-24-BNC	LISN	7/10/2011
126	SOLAR - 8028-50-TS-24-BNC	LISN	7/10/2011
68	HP - 85650A	ADAPTER QP	6/22/2011
72	HP - 8568B	ANALYZER SPECTRUM	6/22/2011
Test Name:	**Frequency Stability Test**	Test Date:	**03/01/2011**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
668	ENVIROTRONICS - 2-30 ROLLUP	WALK-IN CHAMBER SYSTEM - PT 1/2	12/7/2011
423	CHROMA - 6430	SUPPLY PROGRAMMABLE AC POWER SOURCE	7/15/2011
31	EMCO - 6502	ANTENNA ACTIVE LOOP	3/8/2012
Test Name:	**Radiated Emissions**	Test Date:	**03/02/2011**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
31	EMCO - 6502	ANTENNA ACTIVE LOOP	3/8/2012
644	SUNOL SCIENCES CORPORATION - JB1 925-833-9936	BICONALOG ANTENNA	12/20/2011
68	HP - 85650A	ADAPTER QP	6/22/2011
72	HP - 8568B	ANALYZER SPECTRUM	6/22/2011
70	HP - 85685A	PRESELECTOR RF W/OPT 8ZE	6/22/2011
522	HP - 8449B	PRE-AMPLIFIER 1-26.5GHZ	7/27/2011
626	ARA - DRG-118/A	ANTENNA HORN	6/3/2011
618	HP - 8563A	ANALYZER SPECTRUM	6/4/2011
7	ARA - LPB-2520	ANTENNA BICONILOG ANTENNA	10/11/2012
159	HP - 8648A	GENERATOR RF SIGNAL	12/18/2011

4 Test Results

4.1 Occupied Bandwidth §2.1049

4.1.1 Test Proceedure

Occupied bandwidth measurement was performed by measuring the output of the radio via a magnetic loop antenna and coupling the antenna to the input of a spectrum analyzer.

4.1.2 Test Results

The occupied bandwidth was measured as shown:

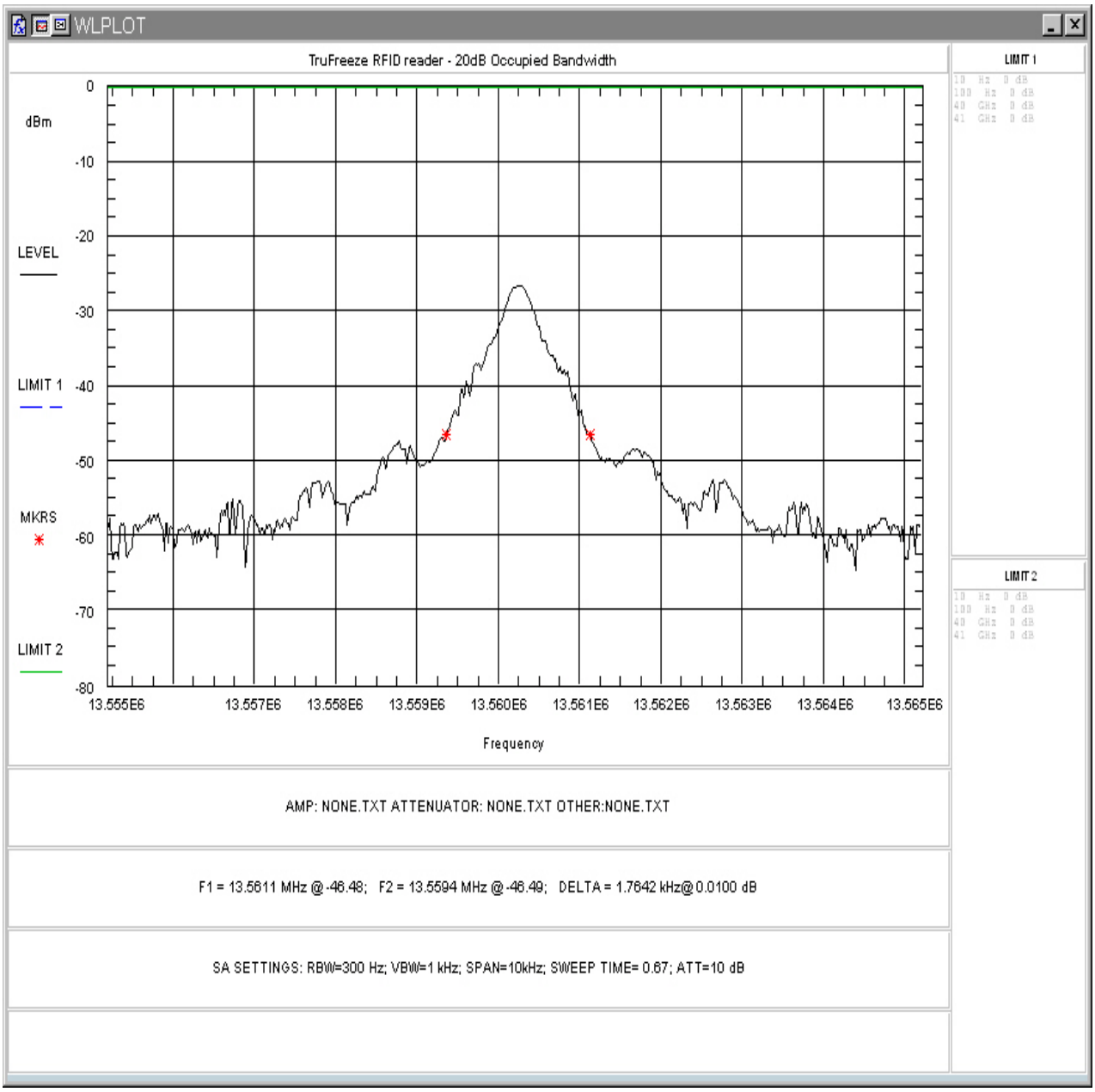

Figure 2. 20dB Occupied Bandwidth

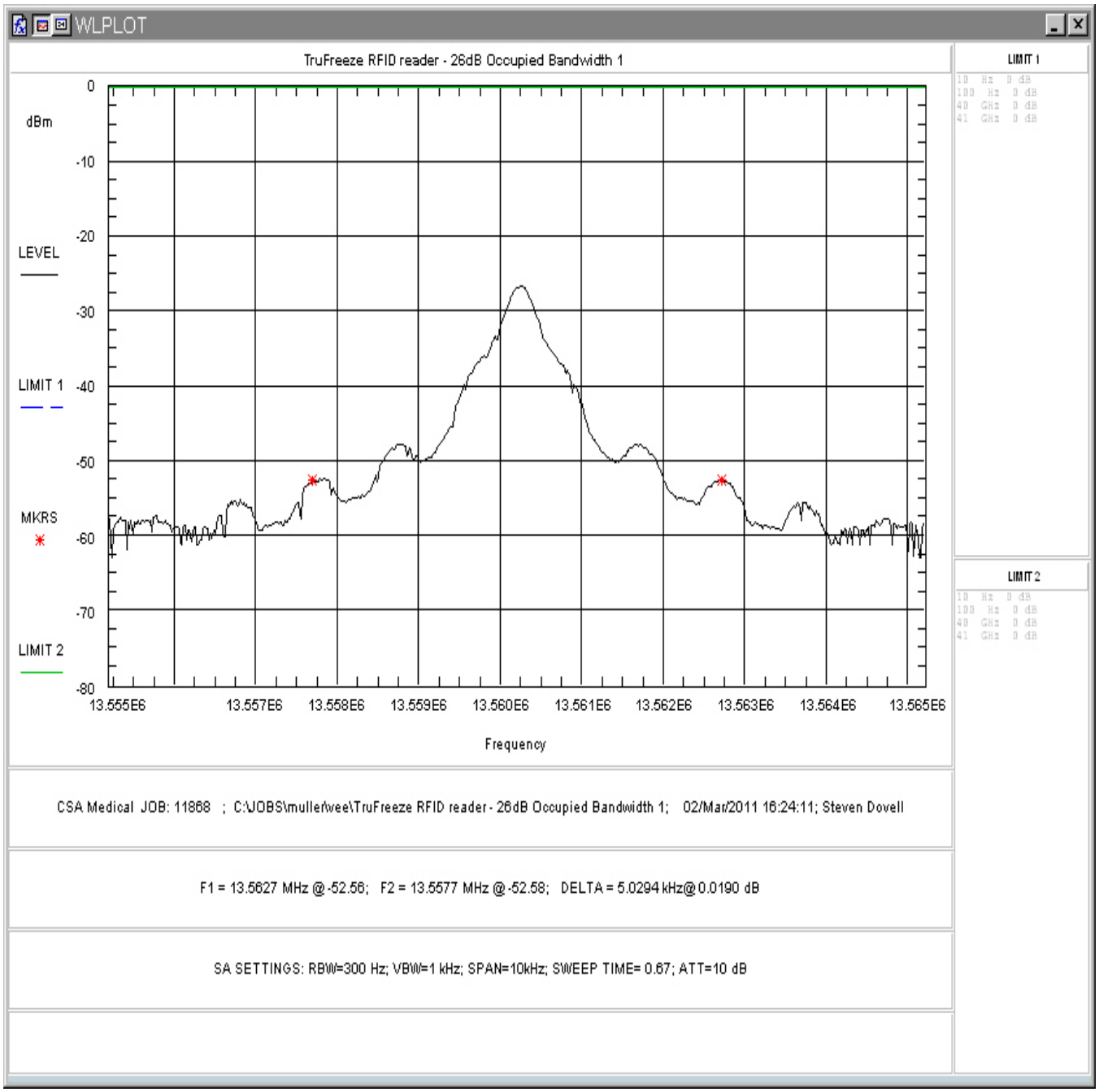

Figure 3. 26dB Occupied Bandwidth

Table 3 provides a summary of the Occupied Bandwidth Results.

Table 3: Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
13.560MHz	(20dB) 1.7642 kHz	N/A	Pass
13.560MHz	(26dB) 5.0294 kHz	N/A	Pass

4.2 Radiated Spurious Emissions: §15.225, §15.209

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

Table 4: Radiated Spurious Emissions Limits

Frequency (MHz)	Limit (μV/m)	Rule Part Reference
13.553 - 13.567	15,848 (@ 30m)	§15.225(a)
13.410 – 13.553	334 (@ 30m)	§15.225(b)
13.567 – 13.710	334 (@ 30m)	§15.225(b)
13.110 – 13.410	106 (@ 30m)	§15.225(c)
13.710 – 14.010	106 (@ 30m)	§15.225(c)
1.705 – 13.110 14.010 – 30.0	30 (@ 30m)	§15.225(d), §15.209
30.00 – 88.00	100 (@ 3m)	§15.225(d), §15.209
88.00 – 216.00	150 (@ 3m)	§15.225(d), §15.209
216.00 – 960.00	200 (@ 3m)	§15.225(d), §15.209
Above 960	500 (@ 3m)	§15.225(d), §15.209

4.2.1 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. The 30 meter limits were normalized to 10m. Three orientations of the loop antenna were tested.

Emissions were scanned up to 1 GHz. Only the fundamental frequency was detected. For emissions up to 30 MHz peak levels were recorded. Emissions from 30 MHz to 1000 MHz were measured using a Quasi-peak detector. 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)

4.2.2 Test Results

The EUT complies with the radiated emission requirements of §15.225.

Table 5: Radiated Emission Test Data, < 30MHz

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
13.56	X	90.00	1.00	39.60	11.9	373.7	142632.0	-51.6
13.94	X	90.00	1.00	13.30	11.8	18.1	954.0	-34.5
27.11	X	85.00	1.00	13.30	9.9	14.5	954.0	-36.4
13.56	Y	0.00	1.00	41.30	11.9	454.5	142632.0	-49.9
13.94	Y	335.00	1.00	13.50	11.8	18.5	954.0	-34.3
27.11	Y	70.00	1.00	12.10	9.9	12.6	954.0	-37.6
13.56	Z	346.00	1.00	36.50	11.9	261.5	142632.0	-54.7
13.94	Z	41.00	1.00	10.70	11.8	13.4	954.0	-37.1
27.11	Z	113.00	1.00	11.20	9.9	11.4	954.0	-38.5

Notes: 30m limit normalized to 10m

Table 6: Radiated Emission Test Data

Frequency (MHz)	Polarity (H/V)	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Corr. Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Peak or Average
36.54	V	0.0	1.0	10.2	16.0	26.2	30.0	-3.8	QP
73.35	V	0.0	1.0	11.7	9.3	21.0	30.0	-9.0	Peak
86.02	V	0.0	1.0	12.1	9.3	21.4	30.0	-8.6	QP
115.60	V	0.0	1.0	13.2	14.2	27.4	30.0	-2.6	QP
121.47	V	2.0	1.0	10.9	14.6	25.5	30.0	-4.5	QP
168.90	V	244.0	1.0	7.7	13.6	21.3	30.0	-8.7	Peak
194.39	V	26.0	1.0	8.4	13.8	22.2	30.0	-7.8	Peak
240.03	V	0.0	1.0	16.0	13.7	29.7	37.0	-7.3	Peak
320.00	V	10.0	3.3	14.7	16.5	31.2	37.0	-5.8	QP
336.00	V	0.0	3.2	8.1	16.7	24.8	37.0	-12.2	Peak
800.00	V	350.0	1.0	7.1	26.3	33.4	37.0	-3.6	QP
43.79	H	45.0	4.0	3.8	11.3	15.1	30.0	-14.9	Peak
55.85	H	40.0	4.0	7.5	8.6	16.1	30.0	-13.9	Peak
83.25	H	195.0	4.0	5.7	9.3	15.0	30.0	-15.0	Peak
109.76	H	108.0	4.0	8.0	13.5	21.5	30.0	-8.5	Peak
122.71	H	102.0	4.0	5.0	14.6	19.6	30.0	-10.4	Peak
171.00	H	292.0	4.0	3.5	13.3	16.8	30.0	-13.2	Peak
220.00	H	338.0	4.0	6.9	13.3	20.2	30.0	-9.8	Peak
233.49	H	331.0	3.2	11.3	13.6	24.9	37.0	-12.1	Peak
240.00	H	49.0	3.2	18.8	13.7	32.5	37.0	-4.5	QP
320.00	H	198.0	1.8	9.1	16.5	25.6	37.0	-11.4	Peak
330.00	H	324.0	2.0	5.1	16.5	21.6	37.0	-15.4	Peak

Notes:

Fundamental Frequency 13.56MHz

4.3 Frequency Stability: (FCC Part §2.1055)

Frequency as a function of temperature and voltage variation shall be maintained within the FCC-prescribed tolerances. Per §15.225(e) the frequency tolerance shall be maintained within ±0.01% of the reference frequency.

4.3.1 Test Procedure

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 frequency stability of the transmitter was examined at the voltage extremes and for the temperature range of -30°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 frequency stabilities can be maintained to a lesser temperature range provided that the transmitter is automatically inhibited from operating outside the lesser temperature range.

The RF carrier frequency shall not depart from the reference frequency (reference frequency is the frequency at 20ºC and rated supply voltage) in excess of +/-1356 Hz.

The EUT is powered by 5Vdc voltage supplied via an internal AC/DC power supply.

4.3.2 Test Results

The EUT complies with the temperature stability requirements of FCC §15.225(e). Test results are given in Table 7.

Table 7: Frequency Stability Test Data

Temperature (Centigrade)	Frequency (MHz)	Difference (Hz)	Deviation (%)
Ambient (20.3)	**13.5603**	**0**	**0**
-30	13.56043	0.00013	0.0010
-20	13.5605	0.0002	0.0015
-10	13.56047	0.00017	0.0013
0	13.56043	0.00013	0.0010
10	13.56037	7E-05	0.0005
20	13.5603	0	0.0000
30	13.5602	-1E-04	-0.0007
40	13.56013	-0.00017	-0.0013
50	13.5601	-0.0002	-0.0015

Voltage (Volts)	Frequency (MHz)	Difference (Hz)	Deviation (%)	Voltage (Volts)
At rated	13.5603	0	0	120VAC
At 85%	13.5603	0	0	102VAC
At 115%	13.5603	0	0	138VAC

4.4 Conducted Emissions (AC Power Line)

4.4.1 Test Procedure

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.

The unit was tested with the antenna terminated.

4.4.2 Test Results

The EUT complies with the conducted emissions requirements of FCC Part 15.207. AC Power Line conducted emissions test data are included in Table 8.

Table 8: AC Power Conducted Emissions Test Data

NEUTRAL

Frequency (MHz)	Level QP (dBµV)	Level AVG (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Level QP Corr (dBµV)	Level Corr Avg (dBµV)	Limit QP (dBµV)	Limit AVG (dBµV)	Margin QP (dB)	Margin AVG (dB)
0.150	50.8	35.4	10.3	0.5	61.6	46.2	66.0	56.0	-4.4	-9.8
0.363	41.2	24.6	10.2	0.4	51.8	35.2	58.7	48.7	-6.9	-13.5
0.170	47.9	42.2	10.3	0.6	58.8	53.1	65.0	55.0	-6.1	-1.8
0.494	22.1	20.2	10.2	0.4	32.7	30.8	56.1	46.1	-23.4	-15.3
3.140	16.1	4.6	10.7	0.4	27.1	15.6	56.0	46.0	-28.9	-30.4
13.580	30.5	5.6	11.2	1.1	42.8	17.9	60.0	50.0	-17.2	-32.1

PHASE

Frequency (MHz)	Level QP (dBµV)	Level AVG (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Level QP Corr (dBµV)	Level Corr Avg (dBµV)	Limit QP (dBµV)	Limit AVG (dBµV)	Margin QP (dB)	Margin AVG (dB)
0.150	50.8	35.6	10.3	0.7	61.8	46.6	66.0	56.0	-4.2	-9.4
0.170	47.5	42.2	10.3	0.7	58.5	53.2	65.0	55.0	-6.5	-1.7
0.346	28.2	23.6	10.2	0.6	39.0	34.4	59.0	49.0	-20.1	-14.7
0.493	22.7	17.3	10.2	0.4	33.3	27.9	56.1	46.1	-22.8	-18.2
11.940	17.4	8.4	11.1	1.4	29.9	20.9	60.0	50.0	-30.1	-29.1
13.580	32.4	6.1	11.2	1.6	45.3	19.0	60.0	50.0	-14.7	-31.0

