FCC PART 15.225
EMI MEASUREMENT AND TEST REPORT

For

VIVOtech, Inc.

451 El Camino Real, Santa Clara, CA 95050

FCC ID: Q55030XXVT

2004-10-09

This Report Concerns:	**Equipment Type:**
☒ Original Report	Wireless Payment Reader

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GENERAL INFORMATION

Product Description for Equipment Under Test (EUT)

The *VIVOtech, Inc.*'s product, FCC ID: Q55030XXVT or the "EUT" as referred to in this report is a Wireless Payment Reader. The EUT measures approximately 21cm (L) x 7cm (W) x 3cm (H).

** The test data gathered is from production samples, serial number: S0000019, provided by the manufacturer.*

Objective

This Type approval report is prepared on behalf of *VIVOtech, Inc.* in accordance with Part 2, Subpart J, and Part 15 Subpart C of the Federal Communication Commissions rules.

The objective of the manufacturer is to demonstrate compliance with FCC rules, Part 15, sec 15.35, sec 15.203, sec 15.205, sec 15.207, sec 15.209 and sec 15.225.

Related Submittal(s)/Grant(s)

No Related Submittals.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-2001, 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.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp.

Test Facility

The Open Area Test site used by Bay Area Compliance Laboratory Corporation to collect radiated and conducted emission measurement data is located in the back parking lot of the building at 230 Commercial Street, Sunnyvale, California, USA.

Test site at Bay Area Compliance Laboratory Corporation has been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the test methods and procedures set forth in ANSI C63.4-2001.

The Federal Communications Commission and Voluntary Control Council for Interference has the reports on file and is listed under FCC file 31040/SIT 1300F2 and VCCI Registration No.: C-1298 and R-1234. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, Bay Area Compliance Laboratory Corporation is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (NVLAP). The scope of the accreditation covers the FCC Method - 47 CFR Part 15 - Digital Devices, CISPR 22: 2002, and AS/NZS 3548: Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment test methods under NVLAP Lab Code 200167-0.

SYSTEM TEST CONFIGURATION

Justification

The EUT was configured for testing according to ANSI C63.4-2001.

EUT Exercise Software

The EUT exercising program used during radiated and conducted testing was designed to exercise the various system components.

Special Accessories

As shown in the following test setup block diagram, all interface cables used for compliance testing are shielded.

Schematics and Block Diagram

Please refer to Appendix D.

Equipment Modifications

No modifications were made to the EUT

Power Supply and Line Filters

Manufacturer	Description	Model	Serial Number	FCC ID
CUI Inc.	AC/DC Adapter	41-9-1000	EIA3630340S	None

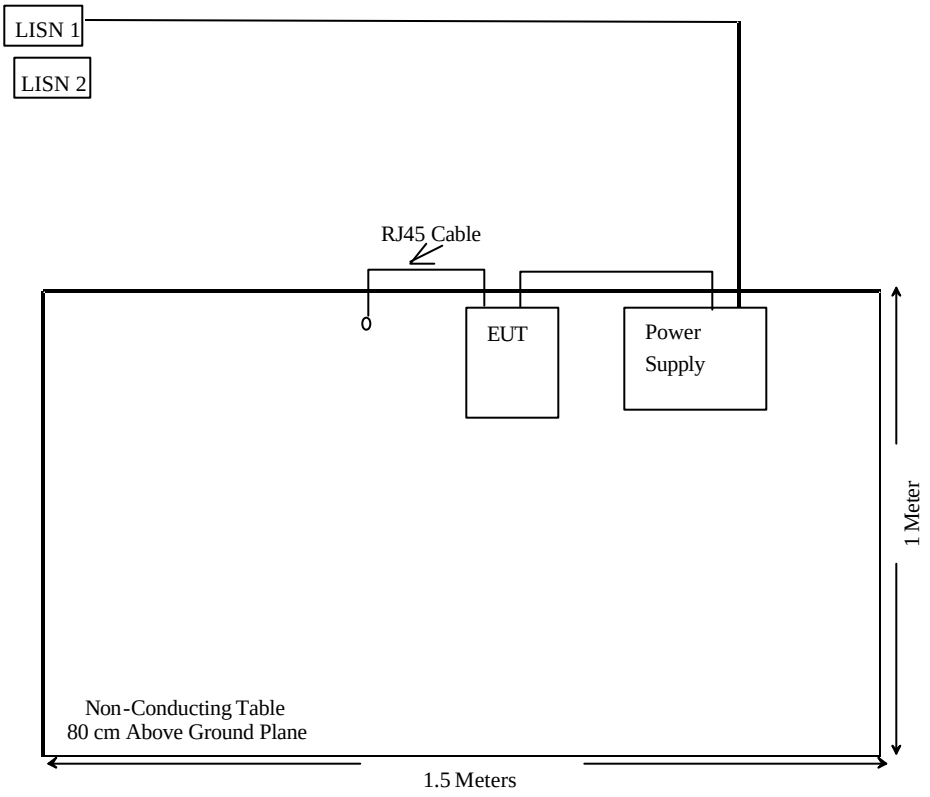
Interface Ports and Cabling

Manufacturer/Description	Length (M)	From	To
Ethernet Cable	1.5	RJ45 Port / EUT	Terminator

Test Setup Configuration

EUT

Test Setup Block Diagram



SUMMARY OF TEST RESULTS

FCC RULES	DESCRIPTION OF TEST	RESULT
§15.203	Antenna Requirement	Compliant
§ 15.35 § 15.205 § 15.209 § 15.225	Radiated Emission	Compliant
§ 15.207	Conducted Emission	Compliant
§15.225(e)	Frequency Stability	Compliant

§ 15.35, § 15.205, § 15.209, § 15.225 - RADIATED EMISSION TEST

Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement at BACL is ±4.0 dB.

EUT Setup

The radiated emission tests were performed in the open area 3-meter test site, using the setup accordance with the ANSI C63.4-2001. The specification used was the FCC Class C limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of test table and bundle when necessary.

The EUT was placed on the center of the back edge on the test table, connected to 120Vac/60Hz power source.

Spectrum Analyzer Setup

According to FCC Rules, 47 CFR 15.33, the EUT was tested to 1 GHz.

During the radiated emission test, the spectrum analyzer was set with the following configurations:

Frequency Range	***RBW***	***Video B/W***
Below 30MHz	10kHz	10kHz
30 – 1000MHz	100kHz	100kHz
Above 1000MHz	1MHz	1MHz

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date
Agilent	Amplifier, Pre	8447D	2944A10187	2003-10-24
EMCO	Antenna, Log-Periodic	3146	2101	2003-11-08
HP	Analyzer, Spectrum, RF	8566B	2332A02816	2004-08-13
HP	Analyzer, Spectrum, Display	85662A	2318A05603	2004-08-13
ETS	Antenna, Loop, H-Field, Passive	6512	34167	2004-03-26
HP	Adapter, Quasi-Peak	85650A	3107A01505	2004-09-30
EMCO	Antenna, Biconical	3110B	9309-1165	2004-10-01
HP	Plotter	7475A	2517A05739	N/R
Sunol Sciences	System Controller	SC99V	122303-1	N/R

* **Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

Test Procedure

Maximizing procedure was performed on the six (6) highest emissions to ensure EUT is compliant with all installation combination.

All data was recorded in the peak detection mode. Quasi-peak readings performed only when an emission was found to be marginal (within -4 dB of specification limitation), and are distinguished with a "**QP**" in the data table.

The EUT was operating at normal to represent worst case during final qualification test. Therefore, this configuration was used for final test data recorded in the following table of this report.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:

Margin = Corr. Ampl. - Limit

Summary of Test Results

According to the final data in the following table, the EUT complied with the FCC 15.225, FCC 15.209 and FCC 15.35 standards, and had the worst margin of:

-2.3 dB at **64 MHz** in the **Vertical** polarization

Environmental Conditions

Temperature:	22° C
Relative Humidity:	46%
ATM Pressure:	1018 mbar

Radiated Emissions Test Result Data

INDICATED		TABLE	ANTENNA		CORRECTION FACTOR				FCC 15 CLASS C	
Freq	Reading	Angle	Height	Polar	Antenna	Cable	Amp.	Correction Factor	Limit	Margin
MHz	dBµV	Degree	Meter	H/ V	dB	dB	dB	dBµV	dBµV	dB
64	54.9	200	1.2	V	9.7	1.7	28.6	37.7	40	-2.3
32	49.3	180	1.2	V	15.3	1.3	28.7	37.2	40	-2.8
160	49.6	300	1.5	H	13.2	2.5	28.1	37.2	43.5	-6.3
48	48.3	180	1.2	V	11.3	1.5	28.7	32.4	40	-7.6
128	49.4	330	2.0	H	12.3	2.3	28.3	35.7	43.5	-7.8
416	44.3	200	2.0	H	15.8	4.4	28.0	36.5	46	-9.5
112	48.3	200	1.2	V	11.7	2.2	28.5	33.7	43.5	-9.8
295.6	47.2	180	1.2	V	12.6	3.7	27.3	36.2	46	-9.8
144	46.3	200	1.0	V	13.2	2.4	28.2	33.7	43.5	-9.8
140	46.3	180	1.2	V	13.2	2.4	28.2	33.7	43.5	-9.8
64	47.3	270	1.5	H	9.7	1.7	28.6	30.1	40	-9.9
240	49.1	300	2.0	H	11.3	3.3	27.6	36.1	46	-9.9
128	47.3	180	1.2	V	12.3	2.3	28.3	33.6	43.5	-9.9
162.72	45.9	200	1.2	V	13.2	2.5	28.1	33.5	43.5	-10.0
160	45.8	220	1.1	V	13.2	2.5	28.1	33.4	43.5	-10.1
416	43.2	200	1.2	V	15.8	4.4	28.0	35.4	46	-10.6
149.16	45.3	200	1.2	V	13.4	2.5	28.3	32.9	43.5	-10.6
80	46.3	300	2.0	H	9.6	1.9	28.6	29.2	40	-10.8
192	43.2	200	1.0	V	14.4	2.9	27.9	32.6	43.5	-10.9
192	43.1	330	1.5	H	14.4	2.9	27.9	32.5	43.5	-11.0
288	45.3	200	1.5	H	12.6	3.6	27.4	34.1	46	-11.9
224	48.3	200	1.2	V	10.1	3.1	27.6	33.9	46	-12.1
224	48.2	270	2.0	H	10.1	3.1	27.6	33.8	46	-12.2

144	43.5	270	1.5	H	13.2	2.4	28.2	30.9	43.5	-12.6
240	46.3	180	1.2	V	11.3	3.3	27.6	33.3	46	-12.7
112	45.2	270	2.5	H	11.7	2.2	28.5	30.6	43.5	-12.9
272	45.2	180	1.2	V	11.7	3.4	27.5	32.8	46	-13.2
272	44.8	270	1.5	H	11.7	3.4	27.5	32.4	46	-13.6
80	43.2	180	1.2	V	9.6	1.9	28.6	26.1	40	-13.9
122	43.2	180	1.2	V	12.1	2.4	28.3	29.4	43.5	-14.1
32	37.2	200	1.5	H	15.3	1.3	28.7	25.1	40	-14.9
13.56	69.3	45	1.5	H	15.8	0.3	27.3	58.1	104	-45.9
13.56	68.9	0	1.2	V	15.8	0.3	27.3	57.7	104	-46.3
13.43	43.0	45	1.5	H	15.8	0.3	27.3	31.8	70.47	-38.67
13.46	44.0	0	1.2	V	15.8	0.3	27.3	32.8	70.47	-37.67

Note: F = Fundamental Frequency

§ 15.203 – ANTENNA REQUIEMENT

Standard Applicable

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Refer to statement below for compliance.

“The antenna for this device is an integral antenna that the end user cannot access. Furthermore the device is for indoor/outdoor use as detailed in the Users Manual and Operational Description”.

Antenna Connected Construction

This device has an integral antenna; it is a permanently attached antenna.

§ 15.207 – CONDUCTED EMISSIONS TEST

Measurement Uncertainty

All measurements involve certain levels of uncertainties. The factors contributing to uncertainties are spectrum analyzer, cable loss, and LISN.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of any conducted emissions measurement at BACL is ±2.4 dB.

EUT Setup

The measurement was performed in the shielded room, using the same setup per ANSI C63.4-2001 measurement procedure. The specification used was FCC 15 Class B limits.

The EUT was placed on the test table and connected to the power supply.

External I/O cables were draped along the edge of the test table and bundle when necessary.

Spectrum Analyzer Setup

The EMI test receiver was set to investigate the spectrum from 150 KHz to 30 MHz.

Test Equipment

Manufacturer	Description	Model	Serial Number	Cal. Date
Rohde & Schwarz	LISN	ESH2-Z5	871884/039	2004-03-28
Rohde & Schwarz	EMI Test Receiver	ESCS30	100176	2004-05-06
Fluke	Calibrated Voltmeter	189	18485-38	2004-07-18

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

Test Procedure

During the conducted emission test, the power cord of the host system was connected to the mains outlet of the LISN-1.

Maximizing procedure was performed on the six (6) highest emissions of each modes tested to ensure EUT is compliant with all installation combination.

All data was recorded in the peak detection mode. Quasi-peak readings were only performed when an emission was found to be marginal (within -4 dB of specification limits). Quasi-peak readings are distinguished with a "**Qp**".

Summary of Test Results

According to the data in the follwing table, the EUT complies with the FCC 15 Class B Conducted margin for a Class B device, and these test results is deemed as satisfactory evidence of compliance with ICES-003 of the Canadian Interference-Causing Equipment Regulations, with the worst margin reading of:

-19.5 dB at **0.15 MHz** in the **Neutral** mode

Environmental Conditions

Temperature:	25° C
Relative Humidity:	27%
ATM Pressure:	1020 mbar

Conducted Emissions Test Data

LINE CONDUCTED EMISSIONS				FCC 15 CLASS C	
Frequency MHz	Amplitude dBµV	Detector Qp/Ave/Peak	Phase Line/Neutral	Limit dBµV	Margin dB
0.150	46.5	QP	Neutral	66.0	-19.5
0.150	43.4	QP	Line	66.0	-22.6
1.170	28.7	QP	Neutral	56.0	-27.3
1.060	24.4	QP	Line	56.0	-31.6
1.110	23.1	QP	Line	56.0	-32.9
1.170	10.4	Ave	Neutral	46.0	-35.6
1.060	7.2	Ave	Line	46.0	-38.8
1.110	7.1	Ave	Line	46.0	-38.9
0.150	15.9	Ave	Neutral	56.0	-40.1
0.150	14.1	Ave	Line	56.0	-41.9
29.800	7.7	Ave	Neutral	50.0	-42.3
29.800	14.9	QP	Neutral	60.0	-45.1

Plot of Conducted Emissions Test Data

Plot(s) of Conducted Emissions Test Data is presented hereinafter as reference.

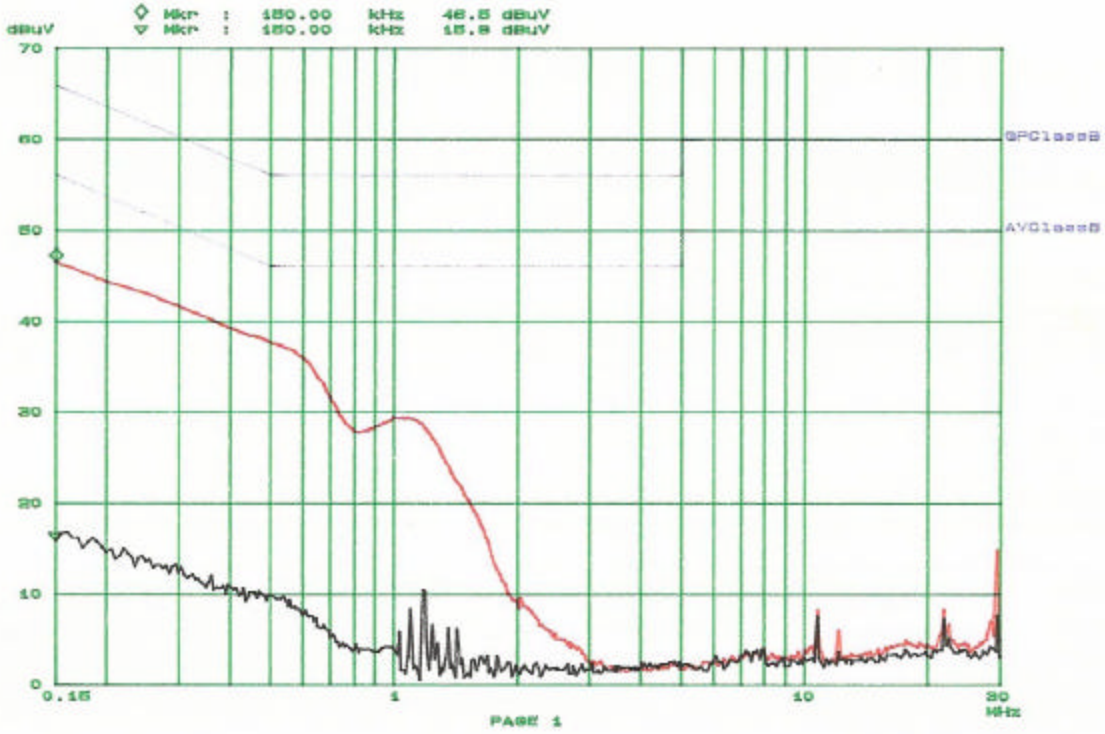
Bay Area Compliance Laboratory Corp 12. Oct 04 11:34

Class B

EUT: ViveTicket
Manuf: Vivetech
Op Cond: Normal
Operator: Hang
Comment: N

Scan Settings (3 Ranges)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp
150k	1M	8k	9k	QP+AV	20ms	15dBLN	OFF
1M	5M	10k	9k	QP+AV	1ms	15dBLN	OFF
5M	30M	100k	9k	QP+AV	1ms	15dBLN	OFF



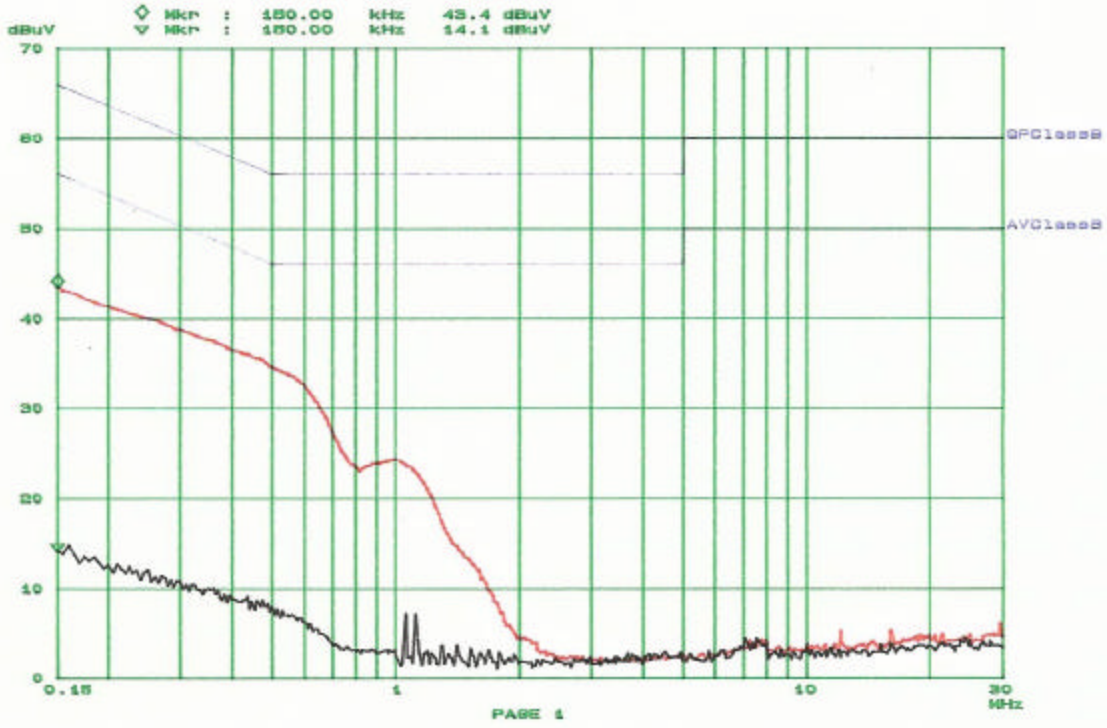
Bay Area Compliance Laboratory Corp 18. Oct 04 11:57

Class B

EUT: VivoTicket
Manuf: Vivotech
Op Cond: Normal
Operator: Hang
Comment: L

Scan Settings (3 Ranges)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp
150k	1M	5k	9k	QP+AV	20ms	15dBLN	OFF
1M	5M	10k	9k	QP+AV	1ms	15dBLN	OFF
5M	30M	100k	9k	QP+AV	1ms	15dBLN	OFF



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§ 15.225(e) - FREQUENCY STABILITY MEASUREMENT

Standard Applicable

According to FCC §15.225(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.

Test Procedure

Frequency stability versus environmental temperature

The equipment under test was connected to an external AC power supply and the RF output was connected to a frequency counter via feed through attenuators. The EUT was placed inside the temperature chamber.

After the temperature stabilized for approximately 20 minutes, the frequency of the output signal was recorded from the counter.

Frequency Stability versus Input Voltage

At room temperature (25±5°C), an external variable DC power supply was connected to the EUT. The frequency of the transmitter was measured for 115%, 100% and 85% of the nominal operating input voltage.

Test Equipment List and Details

Manufacturer	Description	Model	Serial No.	Calibration Date
HP	Spectrum Analyzer	8565EC	2517A0160	2004-01-22
Com-Power	Active Loop Antenna	AL-130	17043	2004-04-03
Tenny	Temperature Chamber	Versa Tenna	N/A	2004-04-23

*** Statement of Traceability: BACL Corp**. attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

Test Results

Reference Frequency: 13.5600 MHz, Limit = 0.01%			
Environment Temperature (°C)	Power Supplied (VAC)	Frequency Measure with Time Elapsed	
		MCF (MHz)	Error (%)
50	110V	13.5603	0.00221
40	110V	13.5606	0.00516
30	110V	13.5604	0.00294
20	110V	13.5605	0.00368
10	110V	13.5607	0.00516
0	110V	13.5604	0.00294
-10	110V	13.5608	0.00589
-20	110V	13.5606	0.00422

Frequency Stability Versus Battery Voltage

Reference Frequency: 13.5600 MHz, Limit = 0.01%						
Power Supplied (VAC)	Frequency Measure with Time Elapsed					
	2 Minutes		5 Minutes		10 Minutes	
	MHz	%	MHz	%	MHz	%
126.5V	13.5603	0.00221	13.5607	0.00516	13.5608	0.00589
110	13.5607	0.00516	13.5605	0.00368	13.5604	0.00292
93.5V	13.5606	0.00422	13.5604	0.00292	13.5605	0.00368

Conclusion: The EUT complied with the applicable Frequency Stability Limits.