

FCC PART 15.225

EMI MEASUREMENT AND TEST REPORT

For

VIVOtech, Inc.

451 El Camino Real, Santa Clara, CA 95050

FCC ID: Q55030XXDT

This Report Concerns: <input checked="" type="checkbox"/> Original Report	Equipment Type: Transmitter, Driver Through
Test Engineer: <u>Jerry Wang</u> 	
Report No.: <u>R0411031</u>	
Report Date: <u>2004-11-15</u>	
Reviewed By: <u>Daniel Deng</u> 	
Prepared By: Bay Area Compliance Laboratory Corporation (BACL) 230 Commercial Street Sunnyvale, CA 94085 Tel: (408) 732-9162 Fax: (408) 732 9164	

Note: This test report is specially limited to the above client company and product model only. It may not be duplicated without prior written consent of Bay Area Compliance Laboratory Corporation. This report **must not** be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the U.S. Government.

TABLE OF CONTENTS

GENERAL INFORMATION.....	3
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	3
OBJECTIVE	3
RELATED SUBMITTAL(S)/GRANT(S).....	3
TEST METHODOLOGY	3
TEST FACILITY	3
SYSTEM TEST CONFIGURATION.....	5
JUSTIFICATION	5
EUT EXERCISE SOFTWARE.....	5
SPECIAL ACCESSORIES.....	5
SCHEMATICS AND BLOCK DIAGRAM.....	5
EQUIPMENT MODIFICATIONS	5
POWER SUPPLY AND LINE FILTERS	5
INTERFACE PORTS AND CABLING.....	5
TEST SETUP CONFIGURATION	6
TEST SETUP BLOCK DIAGRAM.....	6
SUMMARY OF TEST RESULTS.....	7
§ 15.35, § 15.205, § 15.209, § 15.225 - RADIATED EMISSION TEST.....	8
MEASUREMENT UNCERTAINTY	8
EUT SETUP.....	8
SPECTRUM ANALYZER SETUP	8
TEST EQUIPMENT LIST AND DETAILS.....	9
TEST PROCEDURE	9
CORRECTED AMPLITUDE & MARGIN CALCULATION	9
SUMMARY OF TEST RESULTS	9
RADIATED EMISSIONS TEST RESULT DATA @ 3M	10
§ 15.203 – ANTENNA REQUIEIMENT.....	11
STANDARD APPLICABLE	11
ANTENNA CONNECTED CONSTRUCTION	11
§ 15.207 – CONDUCTED EMISSIONS TEST	12
MEASUREMENT UNCERTAINTY	12
EUT SETUP.....	12
SPECTRUM ANALYZER SETUP	12
TEST EQUIPMENT	12
TEST PROCEDURE	12
SUMMARY OF TEST RESULTS	13
CONDUCTED EMISSIONS TEST DATA	13
PLOT OF CONDUCTED EMISSIONS TEST DATA	13
§ 15.225(E) - FREQUENCY STABILITY MEASUREMENT.....	16
STANDARD APPLICABLE	16
TEST PROCEDURE	16
TEST EQUIPMENT LIST AND DETAILS.....	16
TEST RESULTS	17

GENERAL INFORMATION

Product Description for Equipment Under Test (EUT)

The VIVOtech, Inc.'s product, FCC ID: Q55030XXDT or the "EUT" as referred to in this report is a transmitter, driver through. The EUT measures approximately 14.0cm (L) x 12.5cm (W) x 3.5cm (H).

** The test data gathered is from production samples, serial number: MI4703, 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

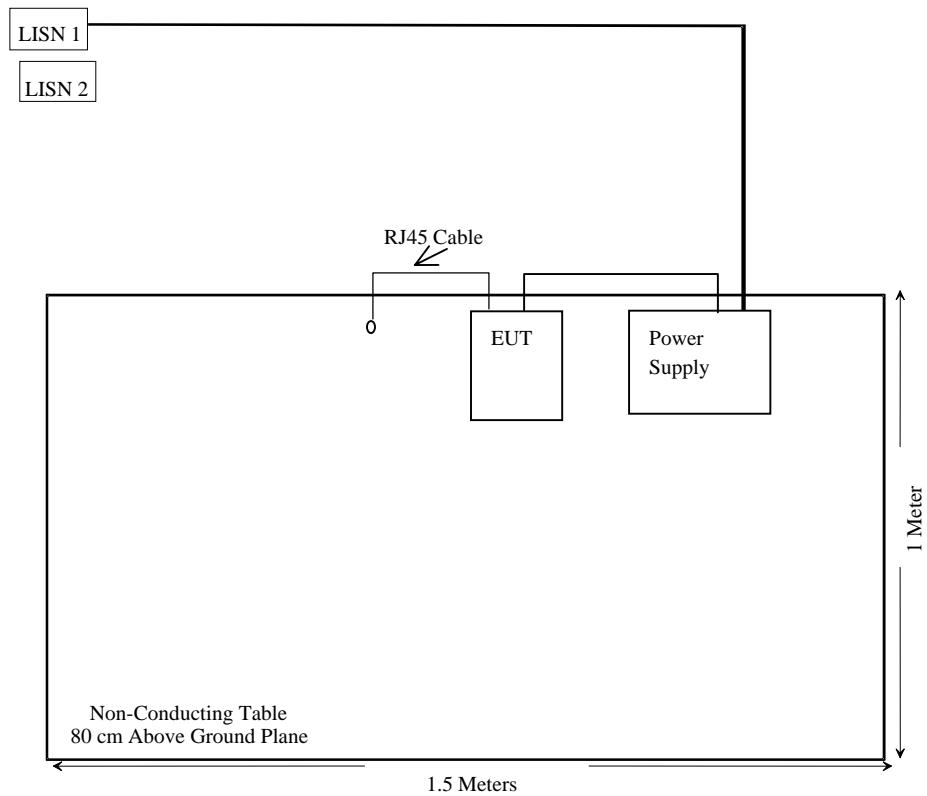
Manufacturer/Description	Length (M)	From	To
RJ45 Cable	0.25	RJ45 Port / EUT	Terminator

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 15 Subpart 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:

<u>Frequency Range</u>	<u>RBW</u>	<u>Video B/W</u>
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	2004-10-24
EMCO	Antenna, Log-Periodic	3146	2101	2004-11-08
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:

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Antenna Factor} + \text{Cable Factor} - \text{Amplifier Gain}$$

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:

$$\text{Margin} = \text{Corr. Ampl.} - \text{Limit}$$

Summary of Test Results

According to the final data in the following table, the EUT measures within the measurement uncertainty ± 4.0 dB, and had the worst margin of:

-3.9 dB at 610.23MHz in the Horizontal polarization

Environmental Conditions

Temperature:	19° C
Relative Humidity:	56%
ATM Pressure:	1020 mbar

Testing was performed by Jerry Wang on 2004-11-05.

Radiated Emissions Test Result Data @ 3M

INDICATED Freq MHz	TABLE Reading dB μ V	ANGLE Angle Degree	ANTENNA		CORRECTION FACTOR			FCC 15 SUBPART C		
			Height Meter	Polar H/V	Antenna dB	Cable dB	Amp. dB	Correction Factor dB μ V	Limit dB μ V	
610.23	46.4	200	1.5	H	19.5	5.4	29.2	42.1	46	-3.9
583.08	45.1	200	1.5	H	19.5	5.3	28.5	41.4	46	-4.6
610.48	45.1	200	1.2	V	19.5	5.4	29.2	40.8	46	-5.3
718.70	40.9	180	1.2	H	22.4	5.9	28.6	40.6	46	-5.4
67.80	50.9	180	1.2	V	9.7	1.7	28.6	33.7	40	-6.3
759.39	39.7	200	1.5	H	22.2	6.2	28.7	39.4	46	-6.6
759.39	39.2	180	1.2	V	22.2	6.2	28.7	38.9	46	-7.1
54.25	48.7	200	1.2	V	10.5	1.6	28.6	32.2	40	-7.8
718.70	37.8	200	1.2	V	22.4	5.9	28.6	37.5	46	-8.5
732.26	37.0	180	1.2	H	22.2	5.9	28.0	37.1	46	-8.9
583.12	40.7	180	1.2	V	19.5	5.3	28.5	37.0	46	-9.0
257.64	48.7	270	1.2	H	11.7	3.4	27.6	36.2	46	-9.8
40.68	45.3	180	1.2	V	12.1	1.4	28.7	30.1	40	-9.9
81.36	46.8	180	1.2	V	9.6	1.9	28.6	29.7	40	-10.3
284.76	46.7	270	1.2	H	12.6	3.5	27.5	35.3	46	-10.7
81.37	45.8	180	1.2	H	9.6	1.9	28.6	28.7	40	-11.3
311.88	43.9	180	1.2	V	13.9	3.8	27.6	34.0	46	-12.0
311.88	43.9	200	1.5	H	13.9	3.8	27.6	34.0	46	-12.0
298.34	43.5	270	1.5	H	12.6	3.7	27.3	32.5	46	-13.5
122.04	43.8	200	1.2	V	12.1	2.4	28.3	30.0	43.5	-13.5
298.33	43.4	200	1.2	V	12.6	3.7	27.3	32.4	46	-13.6
54.26	42.6	200	1.2	H	10.5	1.6	28.6	26.1	40	-13.9
230.52	42.8	330	1.3	H	11.3	3.3	27.5	29.9	46	-16.1
13.46	41.3	200	1.5	H	15.8	0.3	27.3	30.1	70.47	-40.4
13.45	40.2	180	1.2	V	15.8	0.3	27.3	29.0	70.47	-41.5
13.56	60.0	270	1.5	H	15.8	0.3	27.3	48.8	104	-55.2 *
13.56	58.9	180	1.2	V	15.8	0.3	27.3	47.7	104	-56.3 *

*: Fundamental Peak

§ 15.203 – ANTENNA REQUIREMENT

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 following 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 Line conductor

Environmental Conditions

Temperature:	18° C
Relative Humidity:	54%
ATM Pressure:	1019 mbar

Testing was performed by Jerry Wang on 2004-11-05.

Conducted Emissions Test Data

Frequency MHz	LINE CONDUCTED EMISSIONS			FCC 15 CLASS B	
	Amplitude dB μ V	Detector QP/Ave/Peak	Phase Line/Neutral	Limit dB μ V	Margin dB
0.15	46.5	QP	Line	66	-19.5
0.15	45.5	QP	Neutral	66	-20.5
0.90	33.6	QP	Neutral	56	-22.4
20.00	17.2	Ave	Line	50	-32.8
20.00	17.2	Ave	Neutral	50	-32.8
21.50	15.9	Ave	Line	50	-34.1
0.90	7.3	Ave	Neutral	46	-38.7
20.00	20.9	QP	Line	60	-39.1
0.15	16.9	Ave	Line	56	-39.1
0.15	15.9	Ave	Neutral	56	-40.1
20.00	17.8	QP	Neutral	60	-42.2
21.50	15.4	QP	Line	60	-44.6

Plot of Conducted Emissions Test Data

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

Bay Area Compliance Laboratory Corp
Class B

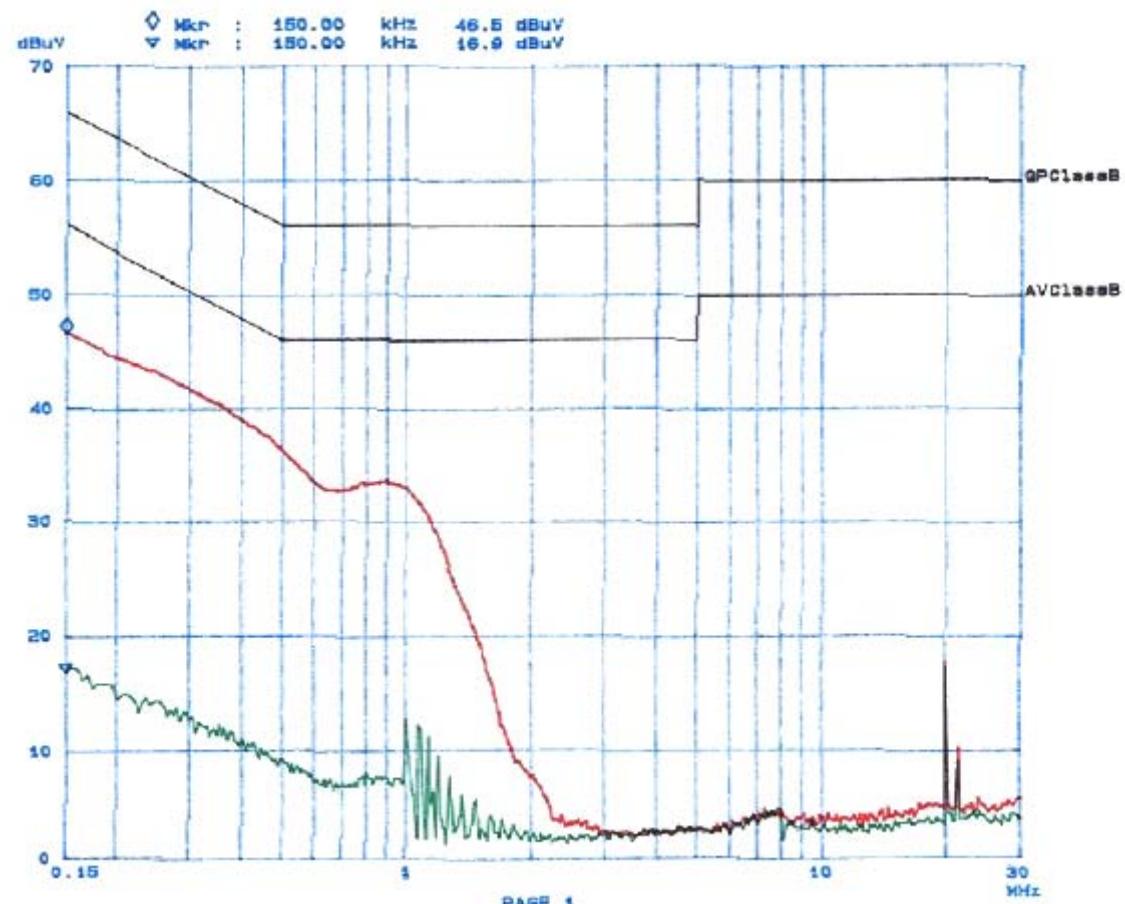
05. Nov 04 18:30

EUT: OT Driver Through
Manuf: Vivotech
Op Cond: Normal
Operator: Jerry
Comment: L

Jerry 11-05-2004

Scan Settings (3 Ranges)

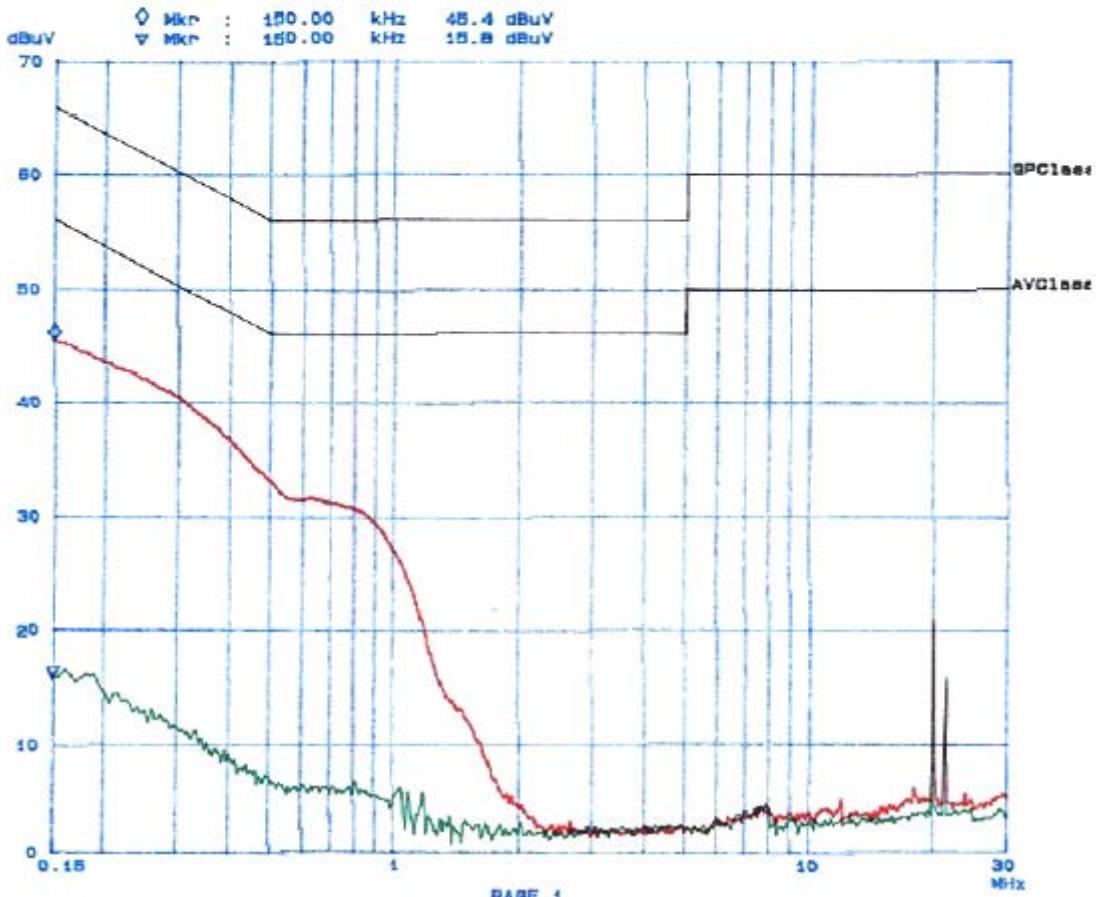
Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp
180k	1M	5k	9k	QP+AV	20ms	15dBULN	OFF
1M	5M	10k	9k	QP+AV	1ms	15dBULN	OFF
5M	30M	100k	9k	QP+AV	1ms	15dBULN	OFF



Bay Area Compliance Laboratory Corp
Class BJerry - 2004-11-05
05 Nov 04 18:08

EUT: BT Driver Through
Manuf: Vivotech
Op Cond: Normal
Operator: Jerry
Comment: N

Scan Settings (3 Ranges)
Frequencies | Receiver Settings
Start Stop Step IF BM Detector M-Time Atten Preamp
180k 1M 5k 9k QP+AV 20ms 15dBBLN OFF
1M 5M 10k 9k QP+AV 1ms 15dBBLN OFF
5M 30M 100k 9k QP+AV 1ms 15dBBLN OFF



§ 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 \pm 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 ($25\pm5^{\circ}\text{C}$), 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 = 100 PPM			
Environment Temperature (°C)	Power Supplied (VAC)	Frequency Measure with Time Elapsed	
		MCF (MHz)	PPM Error
50	110V	13.5603	22.12
40	110V	13.5603	22.12
30	110V	13.5604	29.40
20	110V	13.5602	14.70
10	110V	13.5602	14.70
0	110V	13.5604	29.40
-10	110V	13.5605	36.80
-20	110V	13.5603	22.12

Frequency Stability Versus Battery Voltage

Reference Frequency: 13.5600 MHz, Limit = 100 PPM						
Power Supplied (VAC)	Frequency Measure with Time Elapsed					
	2 Minutes		5 Minutes		10 Minutes	
	MHz	PPM	MHz	PPM	MHz	PPM
126.5V	13.5605	36.80	13.5606	44.2	13.5607	51.6
110V	13.5603	22.12	13.5605	36.8	13.5604	29.4
93.5V	13.5607	51.60	13.5607	51.6	13.5606	44.2

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