MEASUREMENT REPORT

Scope - Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission.

Applicant Name:	ZOLTRIX, INC.
Address:	41778 Christy Street Fremont, CA 94538
Attention:	Andrew Ma, General Manager

- **FCC ID:** **H4TFM-RIA3X**
- **Class:** **B Digital Device / Peripheral (JBP)**
- **EUT Type:** **16-Bit ISA Bus Data/Fax/Voice Modem Card**
- **Trade Name:** ***ZOLTRIX***
- **Model:** ***FM-VSP336I***
- Max. Baud Rate(s): 33,600 bps (Data Modem)
14,400 bps (Fax Send/Receive)
- Crystal/Oscillator(s): 52.416 MHz
- Ports/Connectors: (2) RJ-11C: Line & Phone
(3) Mini-Jacks: MIC IN, MIC OUT, Speaker
- FCC Rule Part(s): Part 15 Subpart B
- Test Procedure: ANSI C-63.4 (1992)
- Dates of Tests: December 12-13, 1996
- Place of Tests: PCTEST Lab, Columbia, MD U.S.A.
- Test Report S/N: B.980414277.H4T
- Job No.: CHANEY #8007E

Note: This report does not include FCC Part 68 testing and registration.

NVLAP
Lab Code 100431-0

Introduction

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40 GHz (ANSI C63.4-1992) was used in determining radiated and conducted emissions emanating from **ZOLTRIX, Inc. 16-Bit ISA Bus Data/Fax/Voice Modem Card FCC ID: H4TFM-RIA3X.**

These measurement tests were conducted at *PCTEST Engineering Laboratory* facility in New Concept Business Park, Guilford Industrial Park, Columbia, Maryland. The site address is 6660-B Dobbin Road, Columbia, MD 21045. The test site is one of the highest points in the Columbia area with an elevation of 390 feet above mean sea level. The site coordinates are 39°11'15" N latitude and 76°49'38" W longitude. The facility is 1.5 miles North of the FCC laboratory, and the ambient signal and ambient signal strength are approximately equal to those of the FCC laboratory. There are no FM or TV transmitters within 15 miles of the site. The detailed description of the PCTEST measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4 on October 19, 1992.

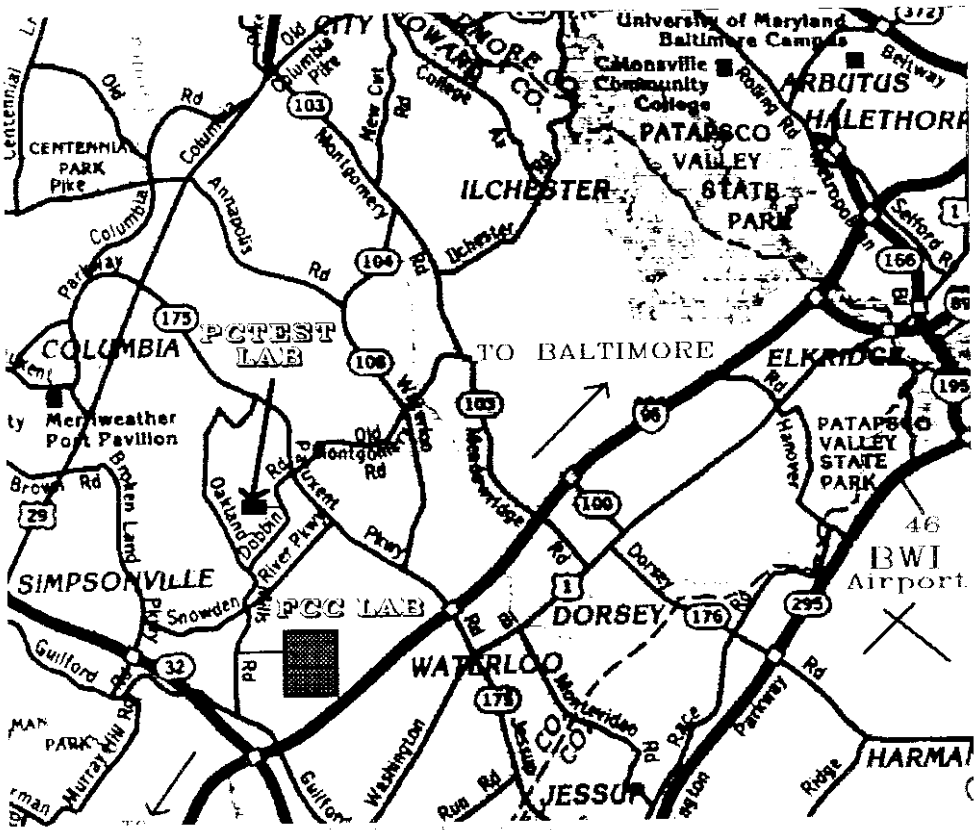

Fig. 1. The map above shows the Columbia vicinity area
The map also shows PCTest Lab, FCC Lab and BWI airport. (Scale 1"=2miles)

Product Information

Equipment Description:

The Equipment Under Test (EUT) is the **ZOLTRIX, Inc. (Model: *FM-VSP336I*) 16-Bit ISA Bus Data/Fax/Voice Modem Card FCC ID: H4TFM-VSPRIA3X**. The EUT features Speakerphone, and Personal Voice Messaging System.

Max. Baud Rate(s):	Data: 33,600 bps (Data) Fax: 14,400 bps (Send/Receive)
Crystal/Oscillator(s):	32.416MHz
Chipset(s):	ROCKWELL A95023-7
External Port(s):	RJ-11C : Telephone Line connector RJ-11C : Telephone Handset connector Mini-Jack: SPEAKER Mini-Jack: MIC IN Mini-Jack: MIC OUT
Cable(s):	*Unshielded* Telco wires *Shielded* Audio cables
Bus Compatibility:	16-Bit ISA Bus interface
Power Supply:	from host computer

EMI suppression device(s) installed in production:

- see schematics (Appendix B)

EMI suppression device(s) added and/or modified during testing:

- none

Description of Tests

Conducted Emissions

The line-conducted facility is located inside a 16'x20'x10' shielded enclosure. It is manufactured by Ray Proof Series 81 (Fig. 2). The shielding effectiveness of the shielded room is in accordance with Mil-Std-285 or NSA 65-6. A 1m.x1.5m. wooden table 80 cm. high is placed 40cm. away from the vertical wall and 1.5m away from the side wall of the shielded room (Fig. 3). Solar Electronics and EMCO Model 3725/2 (10kHz-30MHz) 50 Ω/50 uH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room (Fig. 4). The EUT is powered from the Solar LISN and the support equipment is powered from the EMCO LISN. Power to the LISNs are filtered by a high-current high-insertion loss Ray Proof power line filters (100dB 14kHz-10GHz). The purpose of the filter is to attenuate ambient signal interference and this filter is also bonded to the shielded enclosure. All electrical cables are shielded by braided tinned copper zipper tubing with inner diameter of 1/2". If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply lines will be connected to the Solar LISN. LISN schematic diagram is shown in Figure 5. All interconnecting cables more than 1 meter were shortened by non-inductive bundling (serpentine fashion) to a 1-meter length. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer to determine the frequency producing the maximum EMF from the EUT. The spectrum was scanned from 450 kHz to 30 MHz with 20 msec sweep time. The frequency producing the maximum level was reexamined using EMI/Field Intensity Meter and Quasi-Peak adapter. The detector function was set to CISPR quasi-peak mode. The bandwidth of the receiver was set to 10 kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each EME emission. Each emission was maximized by: switching power lines; varying the mode of operation or resolution, clock or data exchange speed; scrolling H pattern to the EUT and/or support equipment, and powering the monitor from the floor mounted outlet box and the computer aux AC outlet, if applicable; whichever determined the worst-case emission. Photographs of the worst-case emission can be seen in Appendix C. Each EME reported was calibrated using the HP8640B signal generator.

Fig. 2. Shielded Enclosure Line-Conducted Test Facility

Fig. 3. Line-Conducted Emission Test Set-Up

Fig. 4. Wooden Table & Bonded LISNs

Fig. 5. LISN Schematic Diagram

Radiated Emissions

Preliminary measurements were made indoors at 1 meter using broadband antennas, broadband amplifier, and spectrum analyzer to determine the frequency producing the maximum EME. Appropriate precaution was taken to ensure that all EME from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, turntable azimuth with respect to the antenna were noted for each frequency found. The spectrum was scanned from 30 to 200 MHz using biconical antenna and 200 to 1000 MHz using log-spiral antenna. Above 1 GHz, linearly polarized double ridge horn antennas are used.

Fig. 6. 3-Meter Test Site

Final measurements were made outdoors at 3-meter test range using Roberts™ Dipole antennas or horn antenna (see Figure 6). The test equipment was placed on a wooden and plastic bench situated on a 1.5 x 2 meter area adjacent to the measurement area (see Figure 7). Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. Each frequency found during pre-scan measurements was re-examined and investigated using EMI/Field Intensity Meter and Quasi-Peak Adapter. The detector function was set to CISPR quasi-peak mode and the bandwidth of the receiver was set to 100 kHz or 1 MHz depending on the frequency or type of signal.

Fig. 7. Dimensions of Outdoor Test Site

The half-wave dipole antenna was tuned to the frequency found during preliminary radiated measurements. The EUT, support equipment and interconnecting cables were re-configured to the set-up producing the maximum emission for the frequency and were placed on top of a 0.8-meter high non-metallic 1 x 1.5 meter table (see Figure 8). The EUT, support equipment, and interconnecting cables were re-arranged and manipulated to maximize each EME emission. The turntable containing the system was rotated; the antenna height was varied 1 to 4 meters and stopped at the azimuth or height producing the maximum emission. Each emission was maximized by: varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and/or support equipment, and powering the monitor from the floor mounted outlet box and the computer aux AC outlet if applicable; and changing the polarity of the antenna, whichever determined the worst-case emission. Photographs of the worst-case emission can be seen in Appendix C. Each EME reported was calibrated using the HP8640B signal generator. The Theoretical Normalized Site Attenuation Curves for both horizontal and vertical polarization are shown in Figure 9.

Fig. 8. Turntable and System Setup

Fig. 9. Normalized Site Attenuation Curves (H&V)

Support Equipment Used

1. All Phase Computer	FCC ID: MLFAPCS931014286 1.8 m. unshielded power cord	S/N: AP20522
ZOLTRIX Fax Modem	**FCC ID: H4TFM-RIA3X**	**(EUT)**
Everex PCI VGA Card	FCC ID: E3EEV-VGA-T64	
OPTi Inc. Sound Card	FCC ID: LCKOMSND931	
2. Panasonic Monitor	FCC ID: ACJ928KMX-F408 1.8 m. unshielded power cord 1.0 m. shielded cable	S/N: KB2440352
3. HP ThinkJet Printer	FCC ID: BS46XU2225C 1.8 m. unshielded AC power cord 1.0 m. shielded cable (bundled)	S/N: 2604S10169
4. Logitech Mouse	FCC ID: DZLMMD142 1.8 m. shielded cable	S/N: LC04410178896
5. EPSON Modem	FCC ID: BKM552C202A 1.8 m. unshielded DC power cord 1.2 m. shielded cable	S/N: 010289
6. Maxi-Switch Keyboard	FCC ID: D7J2192004-XX 1.6 m. shielded cable	S/N: M931105759
7. Duotone 406 Phone	Model: 43-453 1.8 m. unshielded power cord 1.8 m. unshielded Telco cable	S/N: 029789
8. Micro7 Line Simulator	Model: LS100 1.8 m. shielded power cord 1.8 m. unshielded Telco cable	S/N: 7601869
9. Sony Microphone	Model: F-V410 1.8 m. shielded cable	S/N: none
10. Sony Speaker	Model: SRS-58 1.0 m. shielded cable	S/N: none

(See Appendix C - "Test Photographs" for actual system set-up.)

Test Data

Conducted Emissions

FREQ (MHz)	LEVEL (dBm)	LINE	(μV)	MARGIN** (dB)
0.97	- 71.80	A	57.5	- 12.8
15.15	- 67.61	A	93.2	- 8.6
22.76	- 66.89	A	101.3	- 7.9
0.97	- 71.07	B	62.6	- 12.0
15.08	- 66.76	B	102.8	- 7.7
22.76	- 66.40	B	107.2	- 7.4

Table 1. Line Conducted Emissions Tabulated Data

NOTES:

1. ***All modes of operation were investigated and the worst-case emissions are reported.***
2. ***The limit for Class B device is 250 μV from 450kHz to 30MHz.***
3. ***Line A = Phase*** ***Line B = Neutral***
4. ***Deviations to the Specifications:*** ***None***

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* *All readings are calibrated by HP8640B signal generator with accuracy traceable to the National Institute of Standards and Technology (formerly NBS).*

** *Measurements using CISPR quasi-peak mode.*

Test Data

Radiated Emission

Freq. (MHz)	Level* (dBm)	AFCL** (dB)	POL (H/V)	Height (m)	Azimuth (° angle)	F/S (μV/m)	Margin*** (dB)
71.3	- 76.0	6.5	V	2.7	90	74.6	- 2.5
79.0	- 77.2	7.4	V	2.6	160	72.3	- 2.8
131.6	- 82.0	12.3	H	2.4	180	73.5	- 6.2
144.2	- 81.0	13.3	H	2.3	180	91.7	- 4.2
271.3	- 86.0	19.6	V	1.7	190	106.7	- 5.4
341.8	- 88.0	22.0	V	1.6	210	112.5	- 5.0

Table 2. Radiated Measurements at 3-meters.

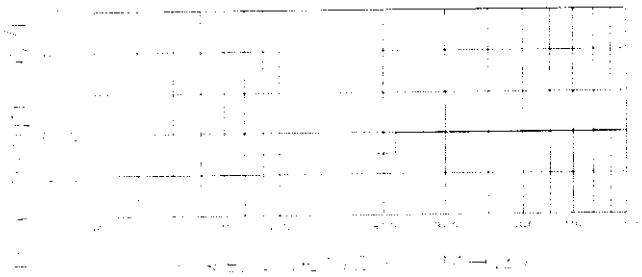


Fig. 10. Limits at 3 meters

NOTES:

1. All modes of operation were investigated and the worst-case emissions are reported.

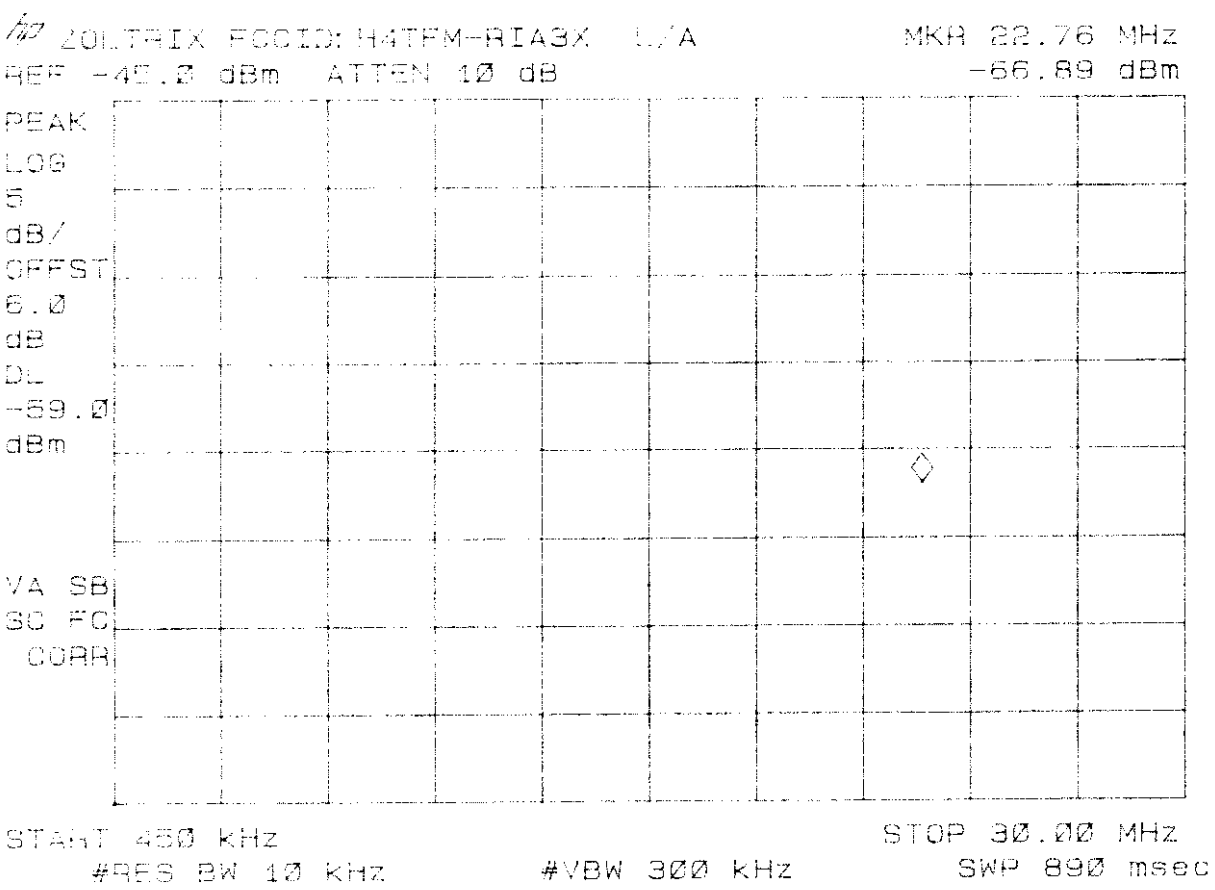
2. The radiated limits are shown on Figure 10. Above 1GHz the limit is 500μV/m.

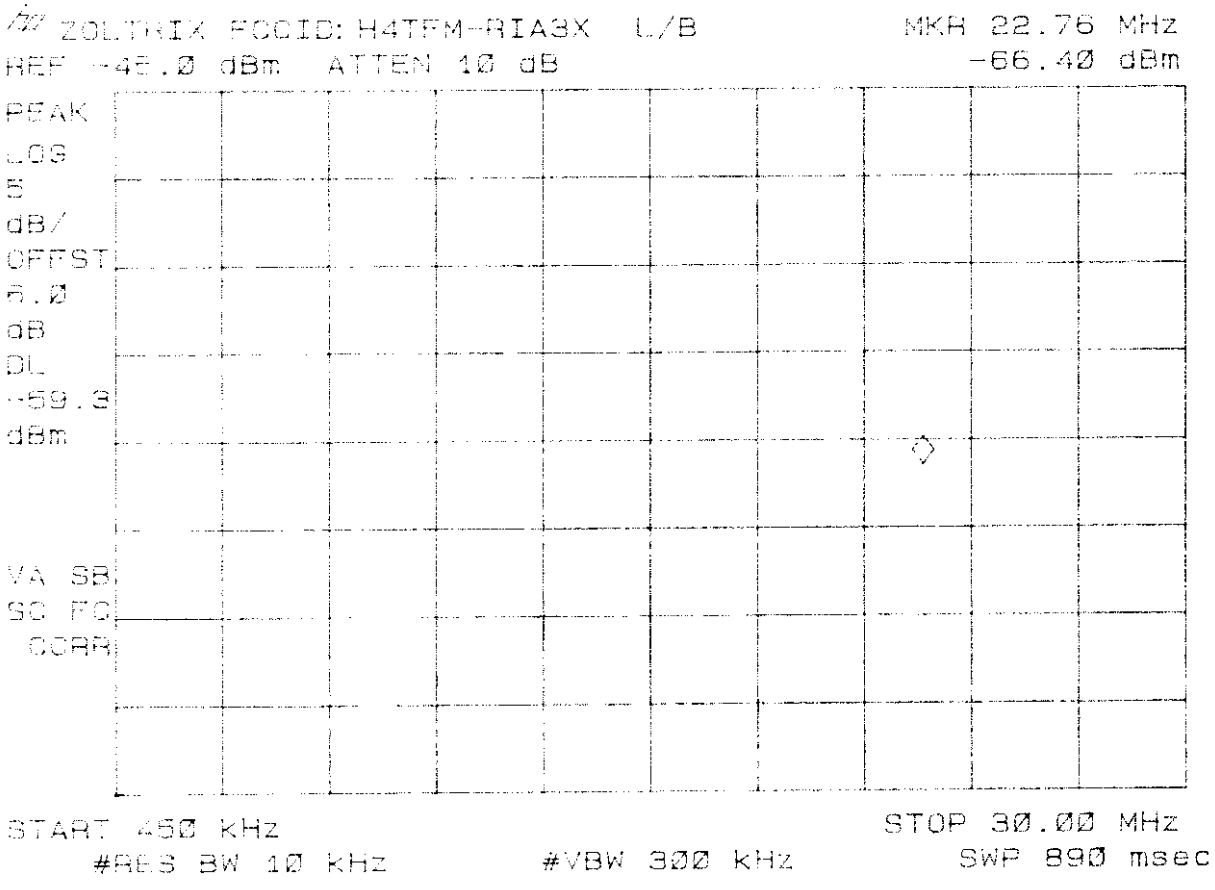
* All readings are calibrated by HP8640B signal generator with accuracy traceable to the National Institute of Standards and Technology (formerly NBS).

** AFCL = Antenna Factor + Reberts'94 dipole) and Cable Loss (30 ft. RG58C/U).

*** Measurements using CISPR quasi-peak mode. Above 1GHz, peak detector function mode is used using a resolution bandwidth of 1MHz and a video bandwidth of 1MHz. The peak level complies with the average limit. Peak mode is used with linearly polarized horn antenna and low-loss microwave cable.

Plot(s) of Conducted Emission


ZOLTRIX FCCID: H4TFM-RIA3X L/A
MKR 22.76 MHz
REF -45.0 dBm ATTEN 10 dB
-66.89 dBm
PEAK
LOG
5
dB/
OFFST
6.0
dB
DL
-59.0
dBm
VA SB
SC FC
CORR
START 450 kHz
STOP 30.00 MHz
#RES BW 10 kHz
#VBW 300 kHz
SWP 890 msec


ZOLTRIX FCCID: H4TFM-RIA3X L/B
MKR 22.76 MHz
REF -45.0 dBm ATTEN 10 dB
-66.40 dBm
PEAK
LOG
5
dB/
OFFST
6.0
dB
DL
-59.3
dBm
VA SB
SC FC
CORR
START 450 kHz
STOP 30.00 MHz
#RES BW 10 kHz
#VBW 300 kHz
SWP 890 msec

Sample Calculations

dB μV = 20 log 10 (μV/m)

dB μV = dBm + 107

EX. 1.

@ 20.3 MHz Class B limit = 250 μV = 47.96 dBμV

Reading = –67.8 dBm (calibrated level)
convert to dbμV = –67.8 + 107 = 39.2 dBμV

$10^{(39.2/20)}$ = 91.2 μV

Margin = 39.2 – 47.96 = –8.76
8.8 dB below limit

EX. 2.

@ 568.3 MHz Class B limit = 200 μV/m = 46 dBμV/m

Reading = –92.2 dBm (calibrated level)
convert to dBμV/m = –92.2 + 107 = 14.8 dBμV/m
Antenna factor + Cable Loss = 27.5 dB
Total = 42.3 dBμV/m

Margin = 42.3 – 46.0 = –3.7
3.7 dB below the limit

Accuracy of Measurement

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994).

Contribution (Line Conducted)	Probability Distribution	Uncertainty (+/- dB) 9kHz-150MHz	150-30 MHz
Receiver specification	Rectangular	1.5	1.5
LISN coupling specification	Rectangular	1.5	1.5
Cable and input attenuator calibration	Normal (k=2)	0.5	0.5
Mismatch: Receiver VRC Tr=0.03			
LISN VRC Ts=0.8 (9 kHz) 0.2 (30 MHz)	U-Shaped	0.2	0.35
Uncertainty limits 20Log(1 +/-(Tr Ts))			
System repeatability	Std. deviation	0.2	0.05
Repeatability of EUT			
Combined standard uncertainty	Normal	1.26	1.30
Expanded uncertainty	Normal (k=2)	2.5	2.6

Calculations for 150 kHz to 30 MHz:

$$u_c(y) = \sqrt{\sum_{i=1}^{m} u_i^2(y)} = \sqrt{\frac{1.5^2+1.5^2}{3}+(\frac{0.5}{2})^2+\frac{0.05^2}{2}+0.35^2} = +/- 1.298dB$$

$$U = 2U_c(y) = +/- 2.6dB$$

Contribution (Radiated Emissions)	Probability Distribution	Uncertainties (+/-dB) 3 m	10 m
Ambient signals			
Antenna factor Calibration	Normal (k=2)	+/- 1.0	+/- 1.0
Cable loss Calibration	Normal (k=2)	+/- 0.5	+/- 0.5
Receiver specification	Rectangular	+/- 1.5	+/- 1.5
Antenna directivity	Rectangular	+ 0.5/-0	+ 0.5
Antenna factor variation with height	Rectangular	+/- 2.0	+/- 0.5
Antenna phase centre variation	Rectangular	0.0	+/- 0.2
Antenna factor frequency interpolation	Rectangular	+/- 0.25	+/- 0.25
Measurement distance variation	Rectangular	+/- 0.6	+/- 0.4
Site imperfections	Rectangular	+/- 2.0	+/- 2.0
Mismatch: Receiver VRC Tr = 0.2		+ 1.3	
Antenna VRC Ta = 0.67 (Bil 0.3 dp)	U-Shaped		+/- 0.5
Uncertainty limits 20Log(1 +/- Tr Ta)		- 1.25	
System repeatability	Std. Deviation	+/- 0.5	+/- 0.5
Repeatability of EUT			
Combined Standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculations for 3m biconical antenna. Coverage factor of k=2 will ensure that the level of confidence will be approximately 95%, therefore:

$$U = 2u_c(y) = 2 \times +/- 2.19 = +/- 4.38\ dB$$

Test Equipment

Type	Model	Cal. Due Date	S/N
Microwave Spectrum Analyzer	HP8566B (100Hz-22GHz)	08/15/98	3638A08713
Microwave Spectrum Analyzer	HP8566B (100Hz-22GHz)	04/17/98	2542A11898
Spectrum Analyzer/Tracking Gen.	HP8591A (100Hz-1.8GHz)	08/10/98	3144A02458
Signal Generator	HP8640B (500Hz-1GHz)	04/07/98	2232A19558
Signal Generator	HP8640B (500Hz-1GHz)	08/09/98	1851A09816
Signal Generator	Rohde & Schwarz (0.1-1000MHz)	09/11/98	894215/012
Ailtech/Eaton Receiver	NM37/57A-SL (30-1000MHz)	04/12/98	0792-03271
Ailtech/Eaton Receiver	NM37/57A (30-1000MHz)	03/11/99	0805-03334
Ailtech/Eaton Receiver	NM17/27A (0.1-32MHz)	09/17/98	0608-03241
Quasi-Peak Adapter	HP85650A	08/15/98	2043A00301
Ailtech/Eaton Adapter	CCA-7 CISPR/ANSI QP Adapter	03/11/99	0194-04082
RG58 Coax Test Cable	No. 167		a/a
Harmonic/Flicker Test System	HP 6841A (IEC 555-2/3)		3531A00115
Broadband Amplifier (2)	HP8447D		1145A00470, 1937A03348
Broadband Amplifier	HP8447F		2443A03784
Transient Limiter	HP11947A (9kHz-200MHz)		2820A00300
Horn Antenna	EMCO Model 3115 (1-18GHz)		9704-5182
Horn Antenna	EMCO Model 3115 (1-18GHz)		9205-3874
Horn Antenna	EMCO Model 3116 (18-40GHz)		9203-2178
Biconical Antenna (4)	Eaton 94455/Eaton 94455-1/Singer 94455-1/Compliance Design		1295, 1332, 0355
Log-Spiral Antenna (3)	Ailtech/Eaton 93490-1		0608, 1103, 1104
Roberts Dipoles	Compliance Design (1 set)		
Ailtech Dipoles	DM-105A (1 set)		33448-111
EMCO LISN	3816/2		1079
EMCO LISN	3816/2		1077
EMCO LISN	3725/2		2009
Microwave Preamplifier 40dB Gain	HP83017A (0.5-26.5GHz)		3123A00181
Microwave Cables	MicroCoax (1.0-26.5GHz)		
Ailtech/Eaton Receiver	NM37/57A-SL		0792-03271
Spectrum Analyzer	HP8594A		3051A00187
Spectrum Analyzer (2)	HP8591A		3034A01395, 3108A02053
Modulation Analyzer	HP8901A		2432A03467
NTSC Pattern Generator Leader	408		0377433
Noise Figure Meter	HP 8970B		3106A02189
Noise Figure Meter	Ailtech 7510		TE31700
Noise Generator	Ailtech 7010		1473
Microwave Survey Meter	Holaday Model 1501 (2.450GHz)		80931
Digital Thermometer	Extech Instruments 421305		426966
Attenuator	HP 8495A (0-70dB) DC-4GHz		
Bi-Directional Coax Coupler	Narda 3020A (50-1000MHz)		
Shielded Screen Room	RF Lindgren Model 26-2/2-0		6710 (PCT270)
Shielded Semi-Anechoic Chamber	Ray Proof Model S81		R2437 (PCT278)
Enviromental Chamber	Associated Systems Model 1025 (Temperature/Humidity)		PCT285

Calibration traceable to the National Institute of Standards and Technology (NIST).

Test Software Used

```
10  CLS:COLOR 7,0
20  FOR I = 1 TO 80
30  PRINT "H";
40  NEXT I
50  FOR K= 1 TO 25
60  LPRINT "H";
70  NEXT K
80  OPEN "COM1:1200,N,8,1,CS0,DS0" FOR OUTPUT AS #1
90  PRINT#1,"ATDT,0123456789"
100 CLOSE:GOTO 20
```

NOTE:
This is a sample of the basic program used during the test. However, during testing a different software program may be used; whichever determines the worst-case condition. In addition, the program used also depends on the number and type of devices being tested.

Actual program used is the ZOLTRIX software driver/program using Windows environment and exercising all ports.

Recommendation/Conclusion

The data collected shows that the **ZOLTRIX, Inc. (Model: *FM-VSP336I*) 16-Bit ISA Bus Data/Fax/Voice Modem Card FCC ID: H4TFM-R1A3X** complies with §§ 15.107 and 15.109 of the FCC Rules. The highest emission observed with a minimum margin to the specifications was at 24.45 MHz for conducted emissions with a margin of 5.1 dB, and at 71.3 MHz for radiated emissions with a margin of 2.5 dB.