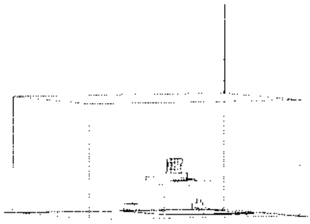
MEASUREMENT REPORT



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-PIB3X**
- **Class:** **B Digital Device / Peripheral (JBP)**
- **EUT Type:** **16-Bit ISA Bus Data/Fax/Voice Modem Card**
- **Trade Name:** ***ZOLTRIX***
- **Model:** ***FM-PIB3X***
- Max. Baud Rate(s): 56,000 (Flex) bps (Data Modem)
  14,400 bps (Fax Send/Receive)
- Crystal/Oscillator(s): 36.864 MHz
- Ports/Connectors: (2) RJ-11C: Line & Phone
- FCC Rule Part(s): Part 15 Subpart B
- Test Procedure: ANSI C-63.4 (1992)
- Dates of Tests: April 14-15, 1998
- Place of Tests: PCTEST Lab. Columbia, MD U.S.A.
- Test Report S/N: B.980414273.H4T
- Job No.: CHANEY #8007A

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-PIB3X.**

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.

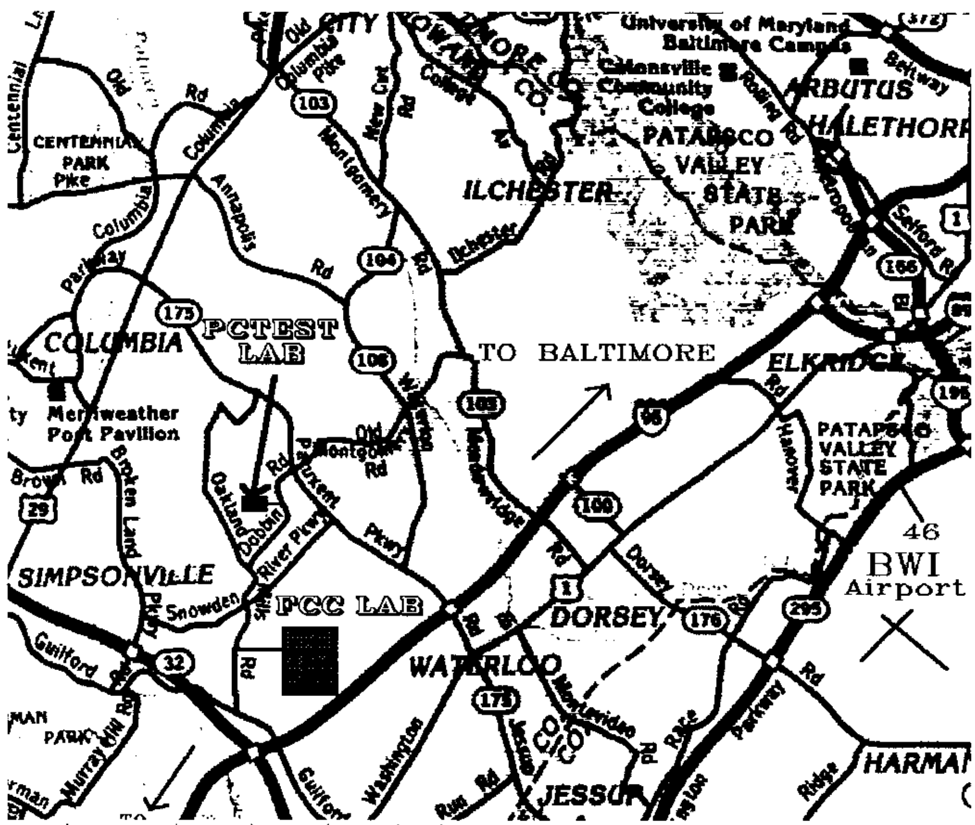


Fig. 1. The map above shows the Columbia vicinity area.
The map also shows PCTest Lab, FCC Lab and BWI airport. (Scale 1"=2miles)

Product Information

Equipment Description:

The Equipment Under Test (EUT) is the **ZOLTRIX, Inc. (Model: *FM-PIB3X*) 16-Bit ISA Bus Data/Fax/Voice Modem Card FCC ID: H4TFM-PIB3X**. The EUT features Speaker-phone, and Personal Voice Messaging System.

Max. Baud Rate(s):	Data: 56,000 (Flex) bps (Data) Fax: 14,400 bps (Send/Receive)
Crystal/Oscillator(s):	36.864MHz
Chipset(s):	PCTel PCT388P
External Port(s):	RJ-11C: Telephone Line connector RJ-11C: Telephone Handset connector
Cable(s):	*Unshielded* Telco wires
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

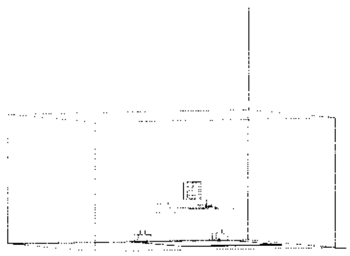


Fig. 2. Shielded Enclosure Line-Conducted Test Facility

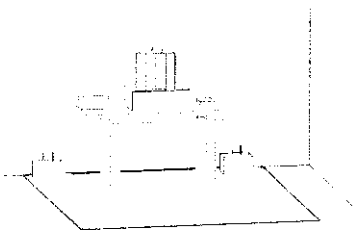


Fig. 3. Line-Conducted Emission Test Set-Up

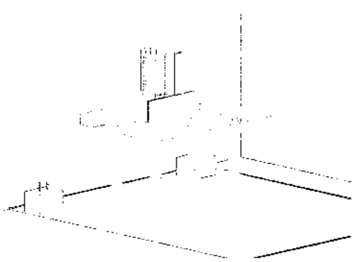


Fig. 4. Wooden Table & Bonded LISNs

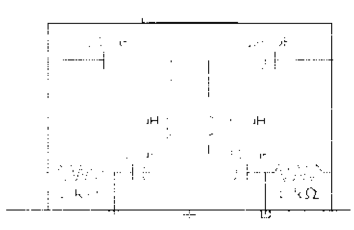


Fig. 5. LISN Schematic Diagram

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 EME 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.

Radiated Emissions

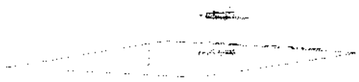


Fig. 6. 3-Meter Test Site

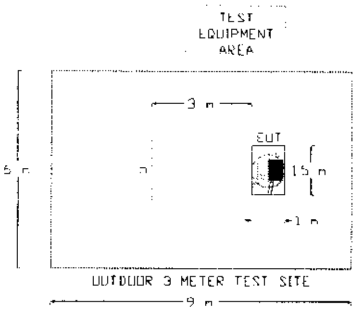


Fig. 7. Dimensions of Outdoor Test Site

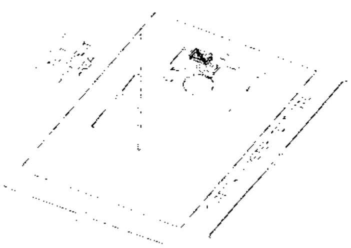


Fig. 8. Turntable and System Setup

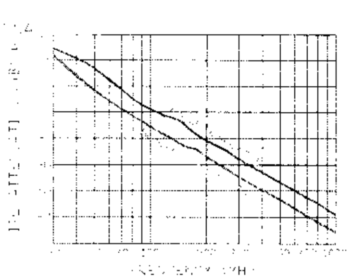


Fig. 9. Normalized Site Attenuation Curves (H&V)

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.

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.

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.

Support Equipment Used

1. GATEWAY Computer	FCC DoC Model: P55C-200	S/N: 0007078699
	1.8 m. unshielded power cord	
ZOLTRIX Fax Modem	**FCC ID: H4TFM-PIB3X**	**(EUT)**
STB PCI VGA Card	FCC DoC Model: Nitro 3D/GX EDO (Comes with PC)	
AZTECH Sound Card	FCC ID: I38-MMSN834	
2. DAEWOO Monitor	FCC ID: C5F7NFCMC1423B	S/N: 5102900037
	1.8 m. unshielded power cord	
	1.0 m. shielded D-sub cable	
3. HP ThinkJet Printer	FCC ID: BS46XU2225C	S/N: 2522S40719
	1.8 m. unshielded AC power cord	
	1.0 m. shielded cable (bundled)	
4. MICROSOFT Mouse	FCC ID: C3KKMP5	S/N: 00199713
	2.0 m. shielded cable	
5. EPSON Modem	FCC ID: BKM552C202A	S/N: 010289
	1.8 m. unshielded DC power cord	
	1.2 m. shielded cable	
6. MAXISWITCH Keyboard	FCC ID: D7J2196003-XX	S/N: 60310015
	2.0 m. shielded cable	
7. SOUTHWESTERN BELL Phone	REG. NO: EJN22G-60314-KH-E	S/N: 0146336
	1.8 m. unshielded power cord	
	2.0 m. unshielded Telco cable	
8. MICRO7 Line Simulator	Model: LS100-4	S/N: 7601869
	1.8 m. unshielded AC power cord	
	2.0 m. unshielded Telco cable	

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

Test Data

Conducted Emissions

FREQ (MHz)	LEVEL* (dBm)	LINE	(μV)	MARGIN** (dB)
12.64	- 68.62	A	83.0	- 9.6
15.23	- 66.54	A	105.4	- 7.5
18.99	- 69.07	A	78.8	- 10.2
1.04	- 70.37	B	67.8	- 11.3
15.15	- 65.25	B	122.3	- 6.2
18.92	- 69.19	B	77.7	- 10.2

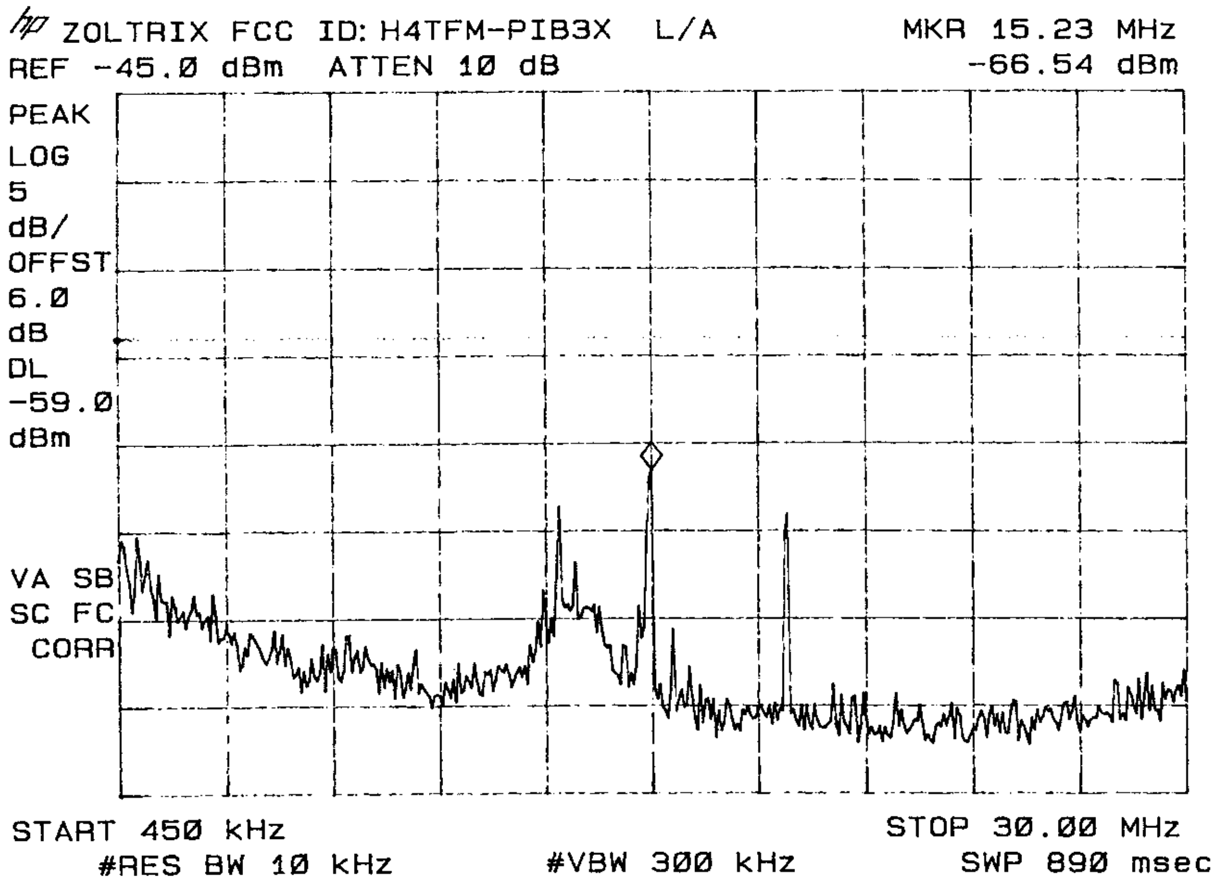
Table 1. Line Conducted Emissions Tabulated Data

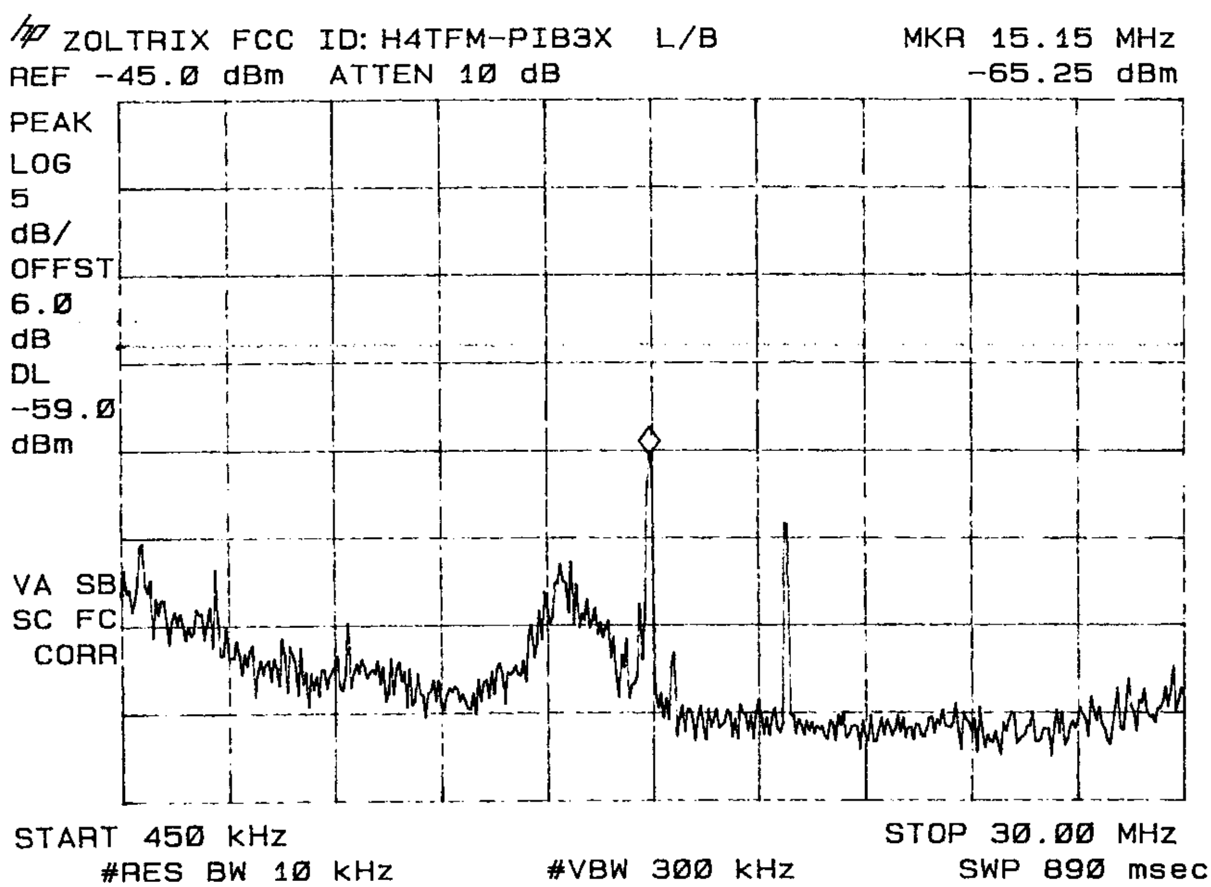
NOTES:

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. ***Devations to the Specifications:*** ***None***

* *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.*


ZOLTRIX FCC ID: H4TFM-PIB3X L/A
MKR 15.23 MHz
-66.54 dBm
REF -45.Ø dBm ATTEN 1Ø dB
PEAK
LOG
5
dB/
OFFST
6.Ø
dB
DL
-59.Ø
dBm
VA SB
SC FC
CORR
START 45Ø kHz
STOP 3Ø.ØØ MHz
#RES BW 1Ø kHz
#VBW 3ØØ kHz
SWP 89Ø msec


ZOLTRIX FCC ID: H4TFM-PIB3X L/B
MKR 15.15 MHz
-65.25 dBm
REF -45.Ø dBm ATTEN 1Ø dB
PEAK
LOG
5
dB/
OFFST
6.Ø
dB
DL
-59.Ø
dBm
VA SB
SC FC
CORR
START 45Ø kHz
STOP 3Ø.ØØ MHz
#RES BW 1Ø kHz
#VBW 3ØØ kHz
SWP 89Ø msec

Sample Calculations

$$dB\,\mu V = 20 \log_{10} (\mu V/m)$$

$$dB\,\mu V = dBm + 107$$

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

$10^{(39.2/20)} = 91.2\ \mu V$

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)	0.3	0.5
Mismatch: Receiver VRC Γ_1=0.03 LISN VRC Γ_R=0.8 (9 kHz) 0.2 (30 MHz) Uncertainty limits 20Log(1 +/-$\Gamma_1\Gamma_R$)	U-Shaped	0.2	0.35
System repeatability	Std. deviation	0.2	0.05
Repeatablility 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:

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

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

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 directivit	Rectangular	+ 0.5/-0	+ 0.5
Antenna factor variaton 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 Γ1= 0.2 Antenna VRC Γ_R = 0.67 (Bi) 0.3 (Lp) Uncertainty limits 20Log(1+/- $\Gamma_1\Gamma_R$)	U-Shaped	+ 1.1 - 1.25	+/- 0.5
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:

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

Appendix A - Sample Label

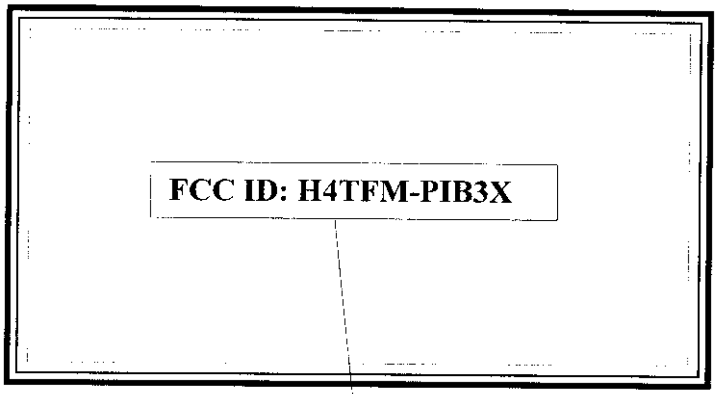


Fig. 11. Sample label

Labelling Requirements per §§ 2.925 & 15.19

The label shown shall be *permanently affixed* at a conspicuous location on the device and be *readily visible* to the user at the time of purchase. Required FCC statement will be placed in the users manual per § 15.19(c) of the FCC Rules.

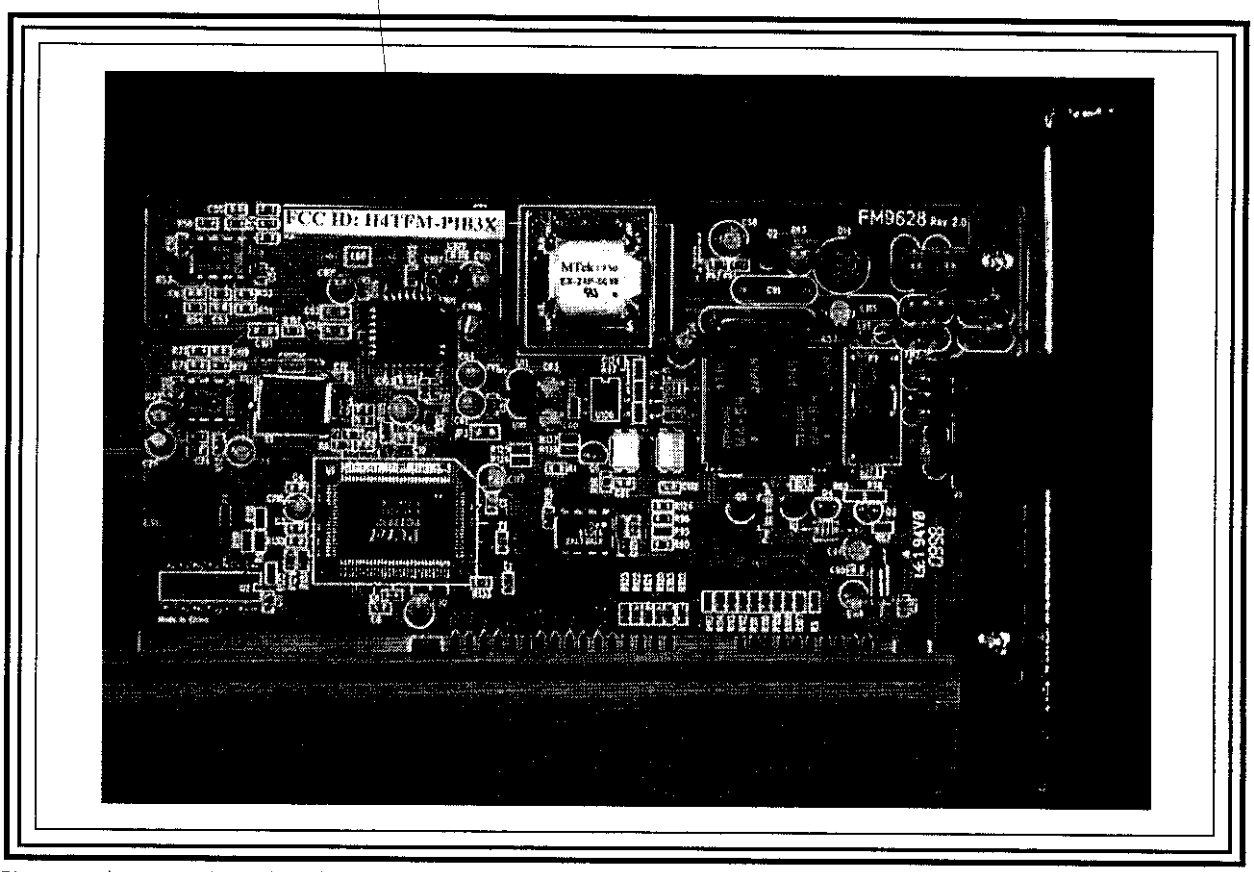


Fig. 12. Photograph of the physical location of the label.