

# **NanoFab**

[www.ualberta.ca/nanofab](http://www.ualberta.ca/nanofab)

W 1-60 ECERF Building

University of Alberta

Edmonton, AB T6G 2V4

## **Vibrations Analysis 1/3 Octave and Narrowband Plots**

Prepared by: Aruna Kroetch

Date: November 24, 2003

Version 1.0

# **Table of Contents**

Introduction

Instrumentation

Measurement Procedure

Data

Instructions for Vibration Analysis

# Introduction

Vibration analysis was performed to determine vibration levels in the NanoFab, specifically where the new Raith 150 machine will be located. Baseline measurements were taken so they can be compared to other vibration data gathered in the future. This will allow the NanoFab to compare and determine if vibration levels have altered and are affecting electron beam lithography.

## Instrumentation

- Stanford Research Network Analyser Model SR770
- PCB Piezotronics ICP Accelerometer Model 393B31
- Wilcoxon Research Seismic Accelerometer Model 731A
- PCB Piezotronics Battery Powered Signal Conditioner Model 480E09

The NanoFab has two accelerometers, the PCB Piezotronics ICP Accelerometer Model 393B31 and the Wilcoxon Research Seismic Accelerometer Model 731A. Both models have a sensitivity of  $10\text{V/g} \pm 10\%$ . \* Model 393B31 has a frequency range of 0.07 to 300 Hz and Model 731A has a range of 0.05Hz to 0.5kHz.

## Measurement Procedure

The baseline vibration measurements were measured in three directions and taken in the Leo 440 room on the cement floor. The accelerometer produced voltages that were converted into acceleration reading. Note, all readings were logarithmic and the Hanning window was used. Velocity was found by integrating the acceleration reading which corresponds to dividing the acceleration by the radial frequency,  $\omega = 2\pi f$ . The velocity measurements were used for the narrowband analysis. The 1/3 frequency bands were then found, and the square root of the sum of the power spectral densities (square of the magnitude) was determined for the 1/3 octave analysis.

## Data

Baseline readings were taken on November 19, 2003 with the PCB model and November 20, 2003 with the WR model. Measurements were performed during normal operations. Although these readings do not meet specification set out by Raith (denoted by the solid line in the following data), they are will be useful for

---

\* The PCB Piezotronics ICP Accelerometer Model 393B31 has a sensitivity of  $10\text{V/g} \pm 5\%$ , but the frequency range for  $\pm 10\%$  was used to gather data from a wider frequency range.

future vibrations analysis. Raith's specifications are that the floor velocity should not exceed 0.5  $\mu\text{m/s}$  rms below 16 Hz, or 1  $\mu\text{m/s}$  rms above 16 Hz.

Note: All of the data in the following graphs is easily accessible on the Vibrations CD. The PCB Piezotronics ICP Accelerometer Model 393B31 data has been saved as PCBTESTX, PCBTESTY, and PCBTESTZ and the Wilcoxon Research Seismic Accelerometer Model 731A has been saved as WRTESTX, WRTESTY, and WRTESTZ. In order to retrieve this data, the data for the three directions must be saved onto a floppy disk and renamed TESTX, TESTY, and TESTZ. Then Vibrations.xls should be opened and the macros enabled. This will give the same narrowband and 1/3 octave results as seen in the following graphs.