

**Report on  
Disturbance of SEM**

Prepared for

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## 1.0 Introduction

The purpose of this work was to identify the source(s) of disturbance on the image and to establish the baseline floor vibration, electromagnetic interference (EMI) and acoustic intensity levels at the location of the installed Scanning Electron Microscope.

## 2.0 Instrumentation

The instrumentation utilized to conduct the testing is itemized below:

Spectrum Analyzer:	Data Physics ACE DP-104
Accelerometer:	Wilcoxon 731 seismic accelerometer, Serial Number 791, 100 Volt per G.
EMI coil:	MSI Magcheck 95, 1.0 millivolt per milligauss
Microphone:	RS 33-2050

All instrumentation and the spectrum analyzer are currently calibrated with documentation in place traceable to the National Institute of Standards and Technology.

The analyzer has a low range sensitivity to -130 dB referenced to 1.

## 3.0 Test Procedures

Vibration measurements were made on the floor in three directions at the locations where the scanning electron microscope is proposed to be located. The EMI and sound pressure measurements were made approximately four feet above the floor.

The Peak-Peak acceleration measurements were first made at a bandwidth of 312 hertz. Power spectra functions of displacement are produced from the acceleration measurements by double integration. The displacement spectra with 312 hertz bandwidth, were taken and recorded on the disk of the analyzer.

The RMS EMI measurements were performed at a bandwidth of 625 hertz. Power spectra functions of EMI in three directions were recorded on disk for later processing and plotting.

The acoustic levels were measured with a calibrated microphone and the dBA and dBC levels were recorded and reported for each site.

All measurements were recorded on the internal disk of the analyzer for later processing. Measurements were taken under normal operating conditions.

The integrated displacement is calculated from the acceleration spectra by first dividing each amplitude value by the circular frequency ( $\omega = 2\pi \cdot \text{frequency}$ ) squared to obtain the displacement spectra from the acceleration spectra and then integrating by computing the area

under the curve. This method of calculation closely approximates the results obtained from an integrating analog displacement meter. It also accounts for both the broadband and narrow band displacement energy present in the floor spectra.

The test results are further summarized in the table(s) via peak to peak displacement, EMI ( rms ) values calculated from the power spectra functions and sound pressure level.

The measurement type, direction and measurement bandwidth are shown on each graph.

#### 4.0 System Specifications

<b>Vibration</b>	
<b>Frequency Hz</b>	<b>µm p-p</b>
1-5	2.0
5-6	1.8
7-10	2.0
10 - 100	3.0

**EMI:** AC < 1.8 mGauss RMS  
DC < 1.0 mGauss / 5 minutes

**Acoustic Noise:** < 75 dBC

#### 5.0 Conclusions

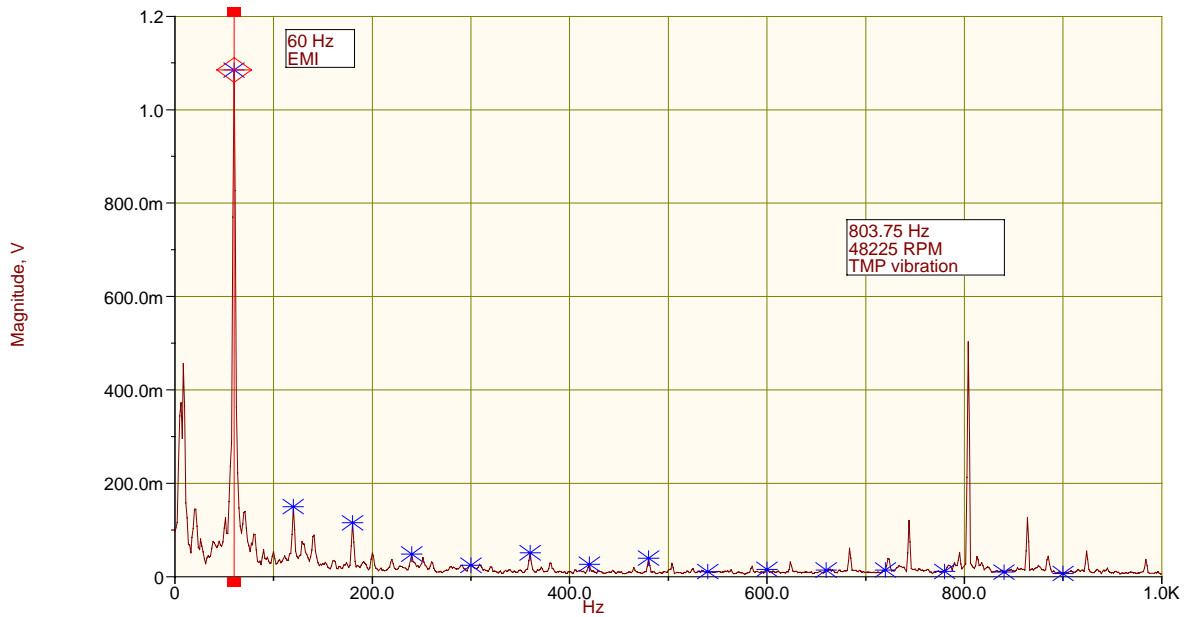
The shipping plate of the Turbo Molecular Pump had not been properly removed following the move, causing the a large source of disturbance. The plate had been raised so that the TMP was resting on it. This effectively shorted the pumps damping system. The plate was properly adjusted to eliminate the disturbance.

Excessive EMI is present in the room and is most easily seen at longer working distances and lower accelerating voltages. Rewiring the power panel to eliminate the ground to neutral short or installation of a field cancellation system will eliminate the problem.

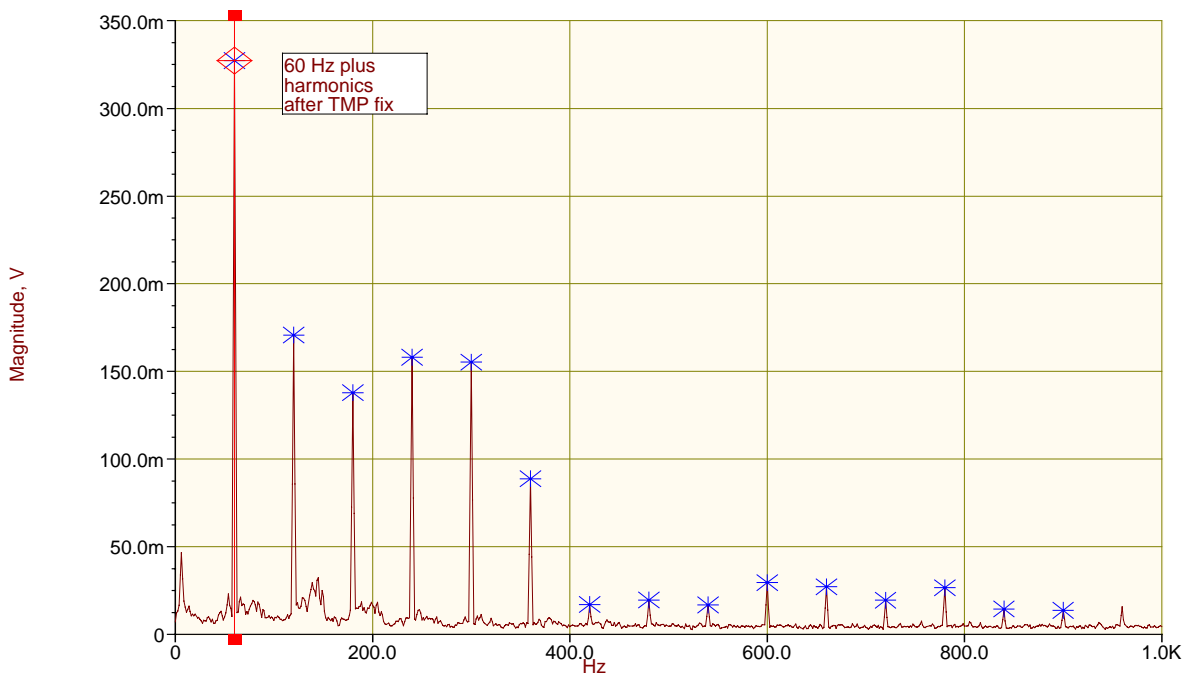
The result of these disturbances creates a substantial degradation of the image, however, after adjusting the TMP shipping assembly, the SEM is now useable for most application.

## 5.0 Disturbance data

Video spectra before TMP fix



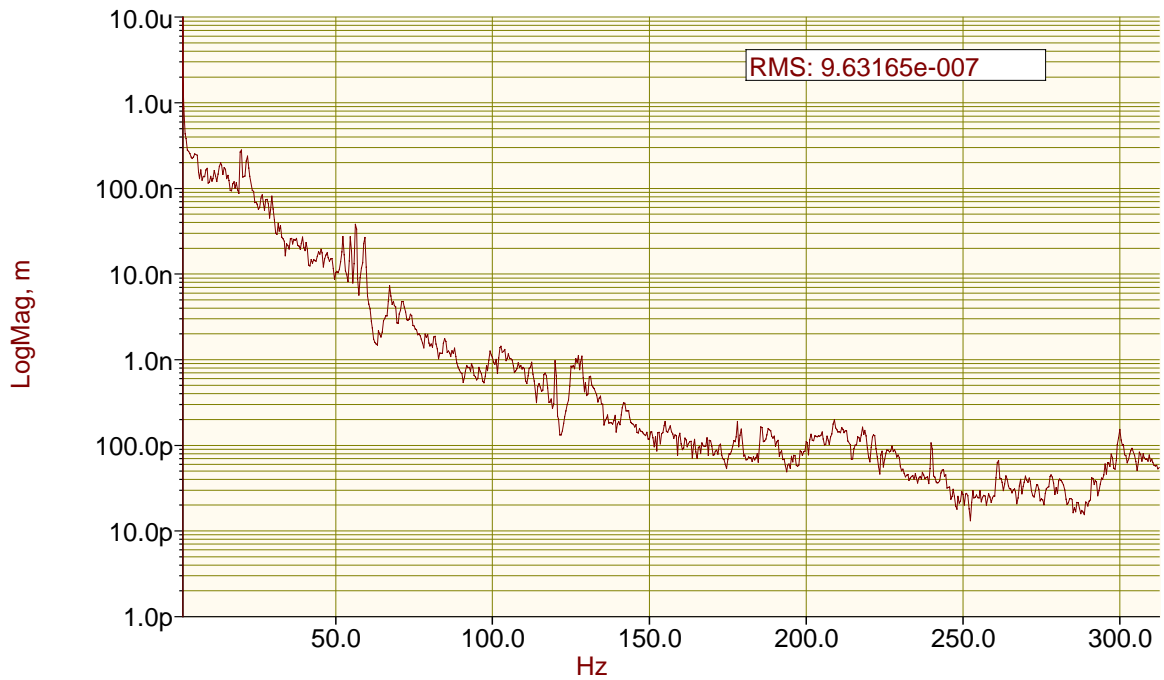
Video spectra after TMP fix



### X Displacement on air table



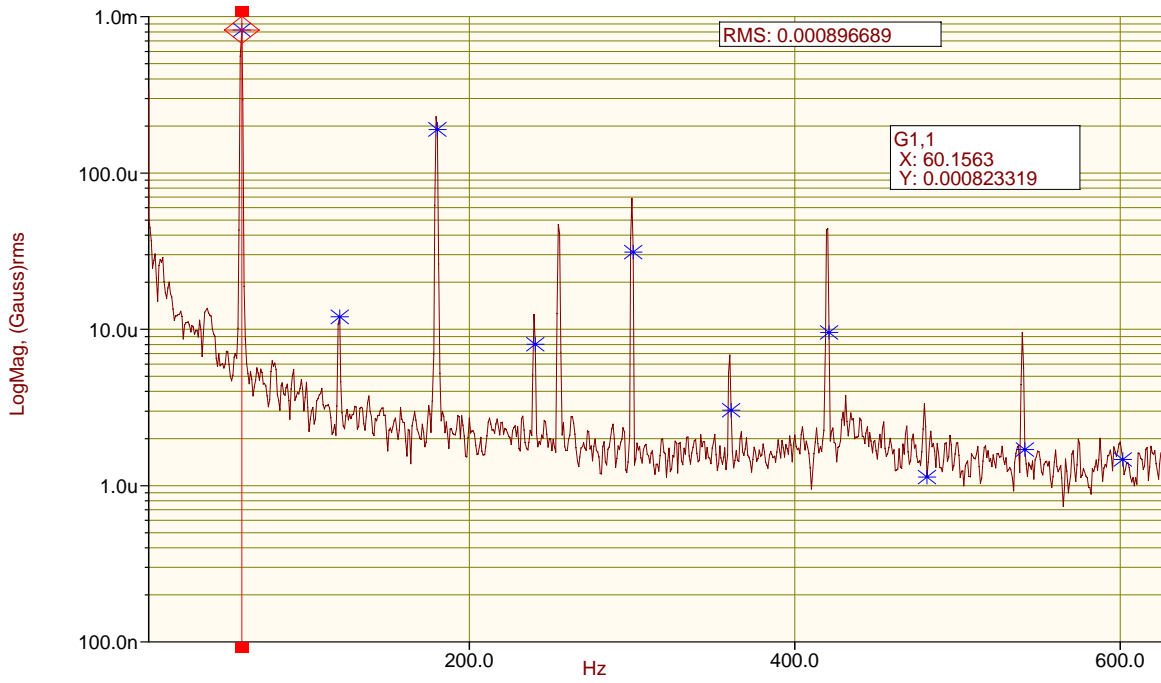
### Y Displacement on air table



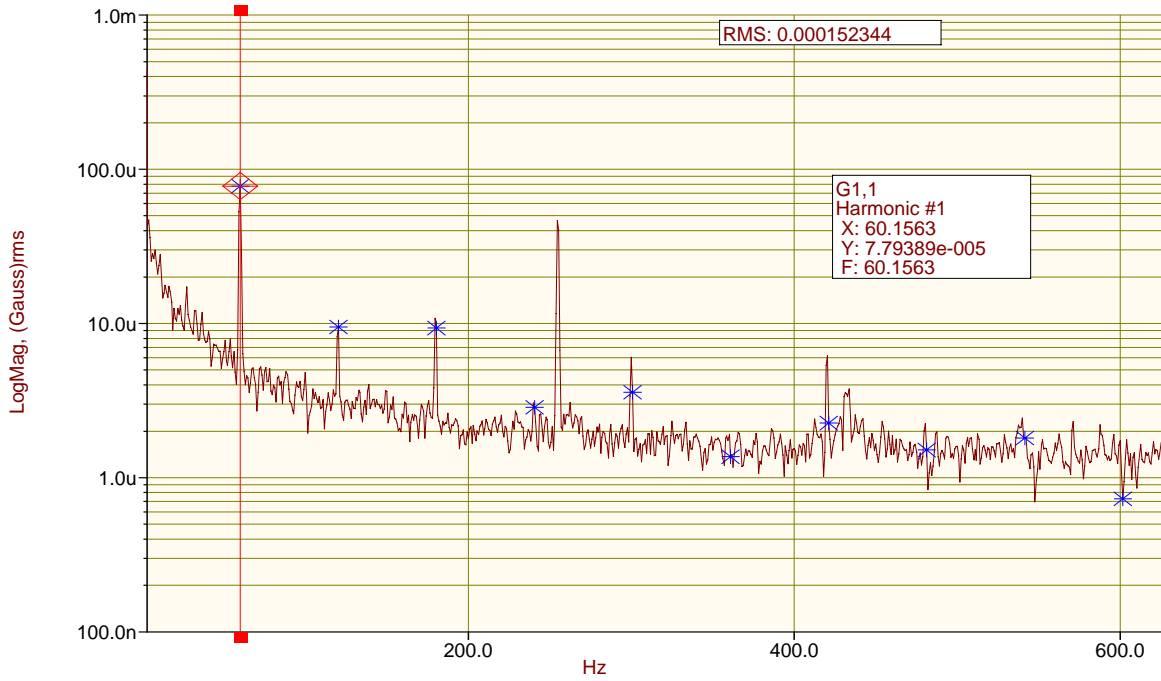
### Z Displacement on air table



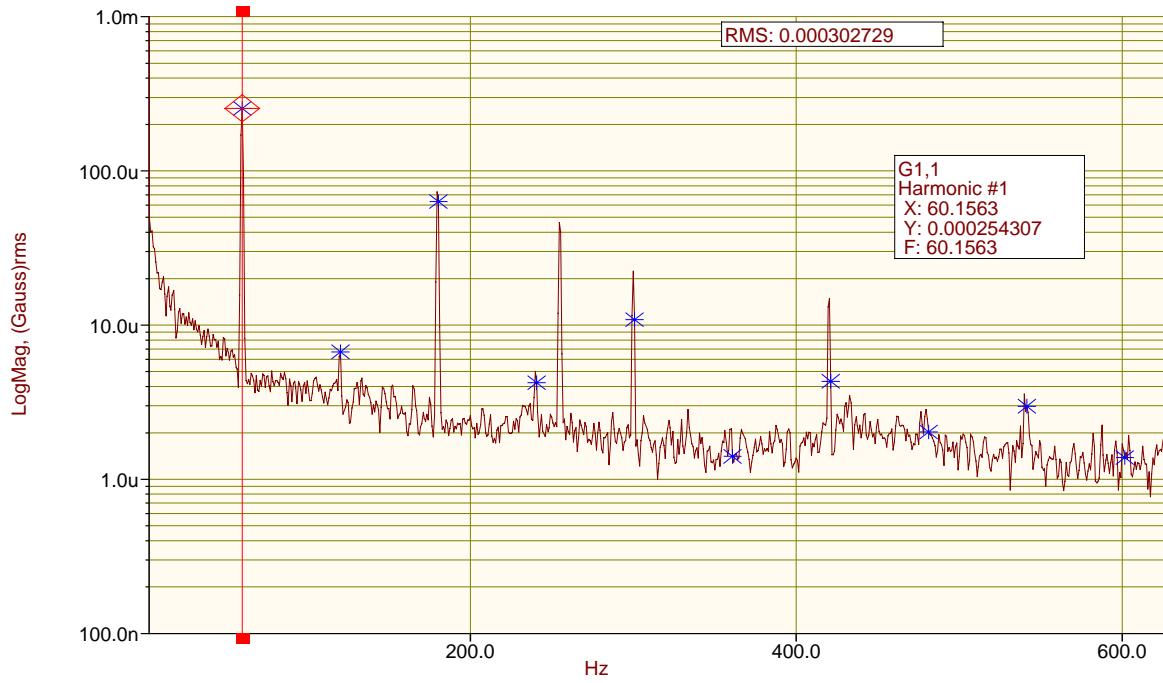
### X EMI



### Y EMI



### Z EMI



### Acoustics

