

Valid Data for Measuring Fundamental Frequency and Damping Ratio (Lab 3)

(1) Time response (Oscilloscope)

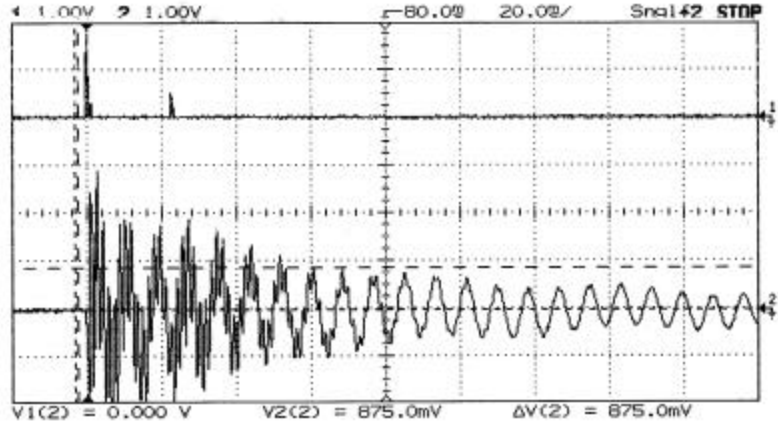
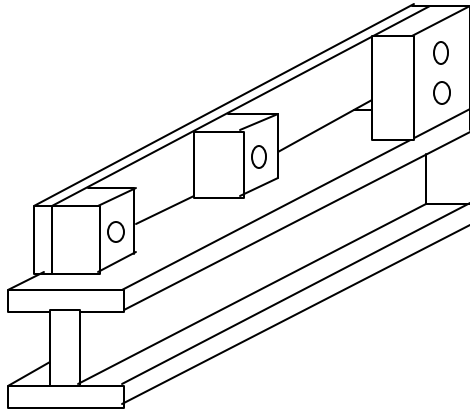


Fig. 1 Invalid Data

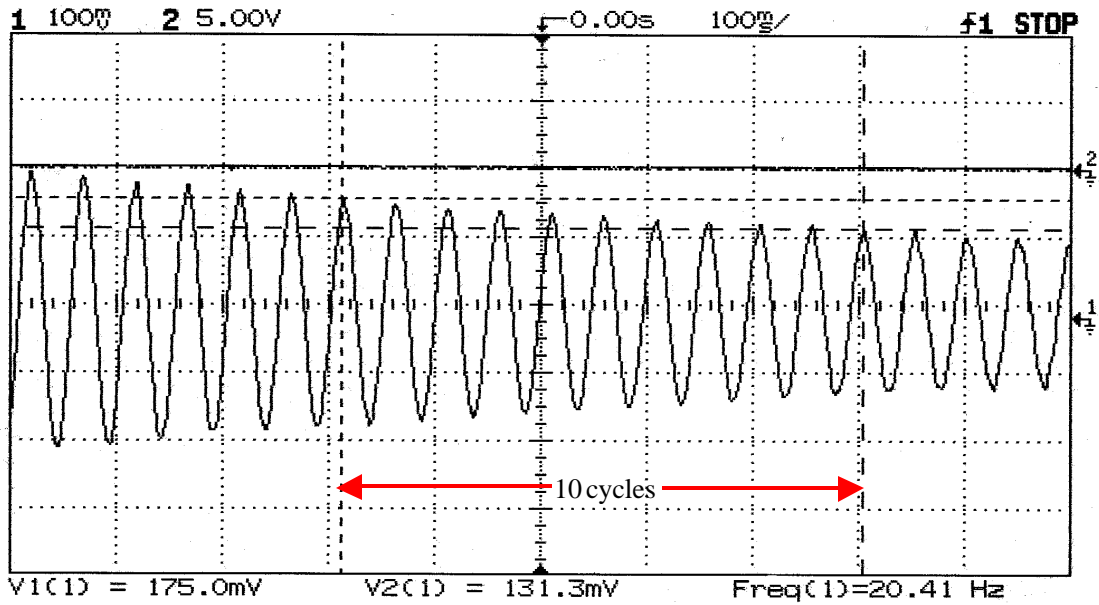


Fig. 2 A Free Response Time History of Acceleration

- Fundamental Frequency: 20.41 Hz
- Damping Ratio Calculation

$$\delta = \frac{1}{N} \ln \frac{X_1}{X_{N+1}} = \frac{1}{10} \ln \frac{175}{131.3} = 0.0287$$

$$\zeta = \frac{\delta}{\sqrt{4\pi^2 + \delta^2}} = \frac{0.0287}{\sqrt{4\pi^2 + 0.0287^2}} = 0.00457$$

(2) Frequency Response (Spectrum Analyzer)

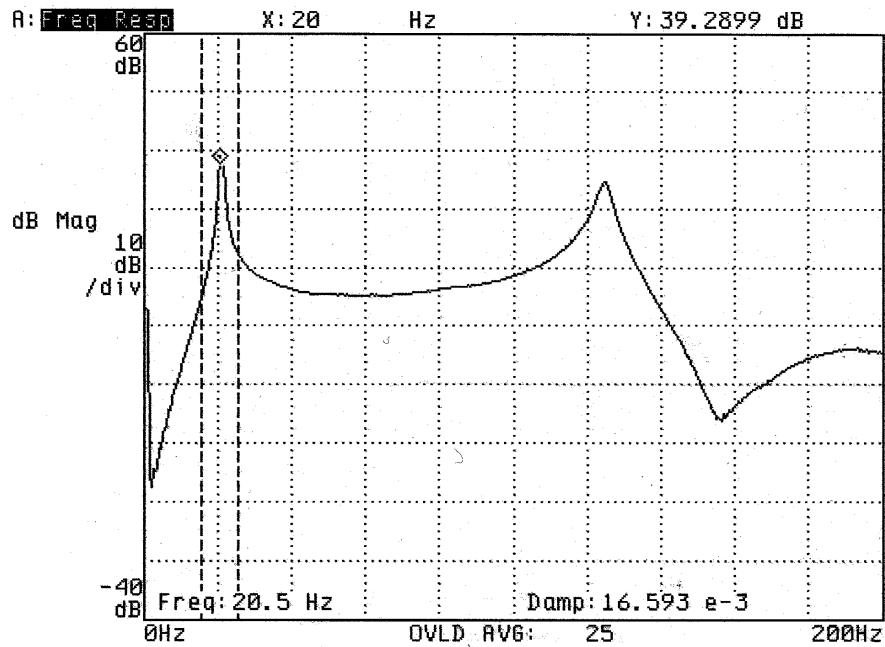


Fig. 3 FRF Amplitude Plot (in dB)

- Damping Ratio from Half Power Points

$$\zeta = \frac{\Delta f}{2f_0}$$

$$\Delta f = 2 \cdot \zeta \cdot f_0 = 2 \cdot (0.0046) \cdot (20.5) \cong 0.19 \text{ (Hz)}$$

- Minimum Resolution Needed  $\Rightarrow 0.19 \text{ (Hz/Line)}$
- Actual Resolution Used  $\Rightarrow 200 \text{ (Hz)} / 400 \text{ (Lines)} = 0.5 \text{ (Hz/Line)}$

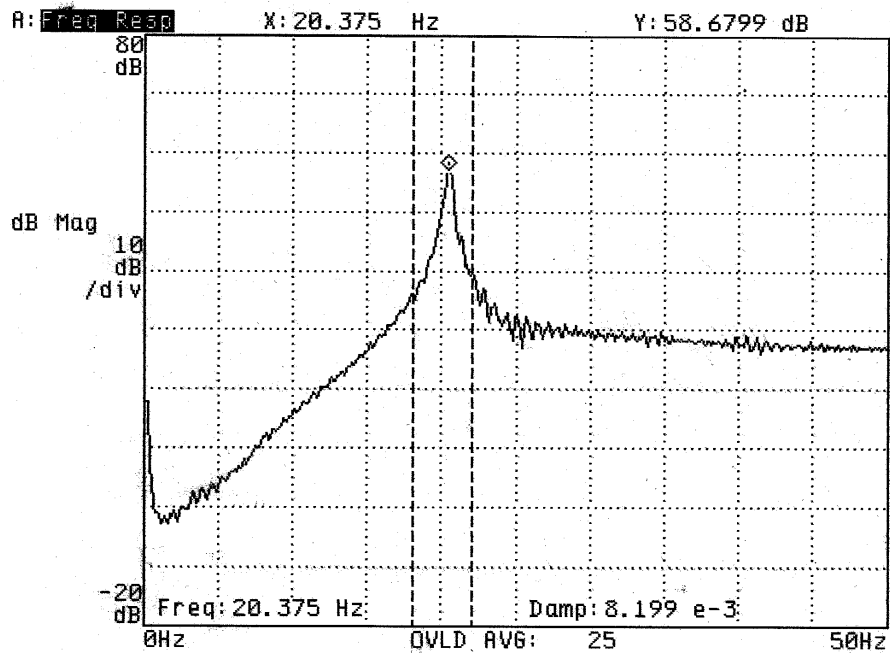


Fig. 4 Damping Ratio with Narrower Frequency Span (Resolution: 0.125Hz/Line)