

Detected Resonant Frequencies (0-200 Hz):

16
88
120
146

Estimated Damping Ratios:

Mode near 16.00 Hz → $\zeta = 0.1250$
Mode near 88.00 Hz → $\zeta = 0.0341$
Mode near 120.00 Hz → $\zeta = 0.0333$
Mode near 146.00 Hz → $\zeta = 0.0479$

Normalized Mode Shapes (0-200 Hz):

Mode at 16.00 Hz:

X: $0.048\angle 159.4^\circ$
Y: $0.106\angle 35.2^\circ$
Z: $1.000\angle 173.1^\circ$

Mode at 88.00 Hz:

X: $0.067\angle 71.5^\circ$
Y: $1.000\angle 140.7^\circ$
Z: $0.551\angle 4.8^\circ$

Mode at 120.00 Hz:

X: $0.126\angle 75.8^\circ$
Y: $0.166\angle 67.3^\circ$
Z: $1.000\angle 78.1^\circ$

Mode at 146.00 Hz:

X: $0.132\angle 15.0^\circ$
Y: $0.301\angle -14.1^\circ$
Z: $1.000\angle 23.8^\circ$

=== Modal Parameter Summary (0-200 Hz) ===

Freq_Hz	Damping	Phi_X	Phi_Y	Phi_Z
16	0.125	-0.044609+0.016774i	0.086681+0.061073i	-0.99276+0.12008i

88	0.034091	0.021341+0.063802i	-0.77407+0.6331i	0.54905+0.046559i
120	0.033333	0.03087+0.12209i	0.063896+0.15271i	0.20664+0.97842i
146	0.047945	0.12727+0.034122i	0.29216-0.073362i	0.91468+0.40418i

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Estimated Damping Ratios:

0.1250
0.0341
0.0333
0.0479

=== Modal Summary (0-200 Hz) ===

Mode 1: f=16.00 Hz, Damping=0.1250, k_dyn_X=4907994.45 N/m, k_dyn_Y=2205948.56 N/m, k_dyn_Z=233909.19 N/m

Mode Shape (X,Y,Z): 0.048∠159.4°, 0.106∠35.2°, 1.000∠173.1°

Mode 2: f=88.00 Hz, Damping=0.0341, k_dyn_X=581212219.87 N/m, k_dyn_Y=39101717.69 N/m, k_dyn_Z=70961723.10 N/m

Mode Shape (X,Y,Z): 0.067∠71.5°, 1.000∠140.7°, 0.551∠4.8°

Mode 3: f=120.00 Hz, Damping=0.0333, k_dyn_X=43820047.63 N/m, k_dyn_Y=33334848.89 N/m, k_dyn_Z=5518310.78 N/m

Mode Shape (X,Y,Z): 0.126∠75.8°, 0.166∠67.3°, 1.000∠78.1°

Mode 4: f=146.00 Hz, Damping=0.0479, k_dyn_X=314377523.16 N/m, k_dyn_Y=137516310.54 N/m, k_dyn_Z=41423394.95 N/m

Mode Shape (X,Y,Z): 0.132∠15.0°, 0.301∠-14.1°, 1.000∠23.8°