ANALOG DEVICES

AN-377
APPLICATION NOTE

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Increasing the Frequency Response of the ADXL Series Accelerometers

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The ADXL series of accelerometers are specified and tested for operation over the range from dc to 1 kHz typically. However, in many applications, such as vibration monitoring, a wider bandwidth is required. The bandwidth of these accelerometers can be increased by decreasing the demodulator capacitance.

The ADXL50 and ADXL05 are closed-loop forced feedback accelerometers (for theory of operation see their respective data sheets). The sensor acts as a well behaved single-pole system. The demodulator capacitor sets the dominant pole for the system and thus the –3 dB bandwidth of the control loop. The –3 dB bandwidth scales with the inverse of the capacitor value, i.e., halving the capacitor will double the –3 dB bandwidth. The ADXL50's sensor beam has a resonance at approximately 24 kHz. The ADXL05's beam resonance is 12 kHz. Thus at higher frequencies the single-pole response is affected by this resonance.

The frequency response of both accelerometers can be increased above 10 kHz as long as there is adequate phase margin to ensure stable operation. However, if an input pulse or shock signal has energy at the resonant frequency, this signal will be amplified and cause a damped ringing response. Figure 1 illustrates the effect of decreasing the demodulator capacitor for a typical ADXL50. Figure 2 is the same graph for the ADXL05.

Some temperature and part-to-part variations may occur. Temperature variation will change the –3 dB point by typically 4%; low temperature coefficient capacitors should be used to minimize this effect. Part-to-part variation can be as much as ±42%. Therefore, a demodulator capacitance value below 0.005 µF is not recommended (to ensure system stability).

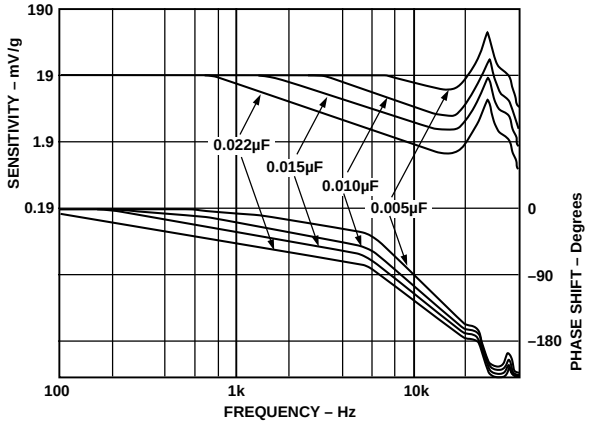

Figure 1. Frequency Response of the ADXL50 for Various Demodulator Capacitors

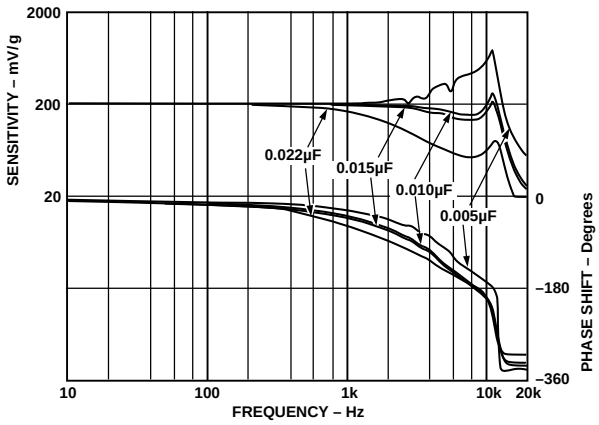

Figure 2. Frequency Response of the ADXL05 for Various Demodulator Capacitors