

# FBA-3

## Force Balance Accelerometer

The FBA-3 Force Balance Accelerometer is a high-sensitivity, low-frequency triaxial device suitable for a variety of seismic and structural applications. It is an economical instrument characterized by high reliability, ruggedness and low current drain.

Designed to meet the stringent requirements of USNRC Regulatory Guide 1.12 for nuclear power plants, the FBA-3 is deployed in over 100 nuclear power plants in the United States and abroad. Frequency response is flat from DC to 50 Hz. Nominal full-scale range is  $\pm 1$  g, but optional full-scale ranges are available.

The FBA-3 is packaged in a cast aluminum base and cover, sealed to prevent the entrance of moisture and dirt. The three accelerometers are orthogonally mounted on an internal deck plate.

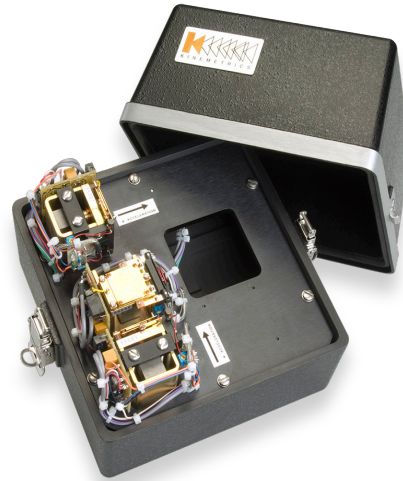
### SEISMIC QUALIFICATION

Kinematics/Systems has provided strong motion accelerograph systems to over 100 nuclear power plants throughout the world for over 30 years. Kinematics products have been carefully tested for generic qualification to meet most existing and future requirements.

### TECHNICAL DESCRIPTION

The FBA-3 is a spring-mass device which uses variable capacitance transduction, as shown in the schematic below. The output is fed back to the parallel combination of capacitor  $C_0$  and the torquer coil, which is an integral part of the mass. From the coil the feedback loop is completed through resistors  $R_0$  and  $R_n$ .

This has the effect of stiffening the system, thus increasing the natural frequency to 50 Hz. Resistor  $R_0$  (with  $C_0$ ) controls the damping, which normally is adjusted to 70% critical. The acceleration sensitivity is controlled by the gain  $K_p$  of the post-amplifier.



## FEATURES

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Kinematics seismic test characteristics for the FBA-3 accelerator have the following general characteristics:

- Biaxial: horizontal and vertical rotated, and repeated at 90 degrees.
- Five OBE's (Operating Base Earthquake) in each direction.
- Random excitation controlled at 1/3 octave intervals with incoherent phasing between axes, over the range 1 to 40 Hz.
- Test duration of thirty seconds minimum.
- Minimum SSE RRS ZPA (Required Response Spectrum Zero Period Acceleration) of 2g with 3% damped response accelerations exceeding 6g in the range 2 to 20Hz.
- Sensor SSE RRS ZPA of 6 g with 1% damped response accelerations exceeding 14 g in the range 2 to 30 Hz.
- Functional testing conducted on devices prior to, during and following seismic tests.

In addition, Kinematics has performed RIM (Required Input Motion) testing of pipe-mounted sensors. The FBA-3 accelerometer has been qualified as follows:

- Biaxial: horizontal and vertical rotated, and repeated at 50 degrees.
- Steady-state sinusoidal dwell tests at 1/2 octave intervals from 1 to 45 Hz.
- Dwell duration of 30 seconds at each frequency.
- 0-Peak input acceleration at each frequency of 4.5 g except limited by displacement (below 5 Hz)
- Functional tests conducted on devices prior to, during and following seismic tests.



**SPECIFICATIONS**

**TECHNICAL SPECIFICATIONS**

Full-scale range	±1.0g, (¼, ½ & 2 g optional)
Natural frequency	50 Hz*
Bandwidth	DC to 50 Hz (3 dB point)
Damping	70% critical*
Operating temperature	-20° to 70°C (0° to 160°F)
Range	
Output (full-scale)	±2.5V* into 50,000 Ω
Zero offset	Less than 25 mV*
Cross-axis sensitivity	Less than .03 g/g*
Linearity	Less than 1% of full-scale
Noise (0 to 50 Hz)	Less than ±25 μV*
Noise (0 to 10,000 Hz)	Less than ±2.5 mV*
Dynamic Range (0 to 50 Hz)	100dB
Temperature effects (zero drift and sensitivity)	Less than 2% of full-scale
Supply voltage	± 12 Vdc
Turn-on time	Operational within 0.1 second after power applied
Calibration	Electrical commands can be applied to produce damping and natural frequency outputs *Measured values furnished with each sensor.

**PHYSICAL CHARACTERISTICS**

Dimension	200mm × 200mm × 200mm water tight closure (8" cube)
Weight	7 kg (15 pounds)