

# Technology News

## MEMS-Accelerometers

### *MEMS – Break through innovation in Vibration Measurements brought to India by Structural Solutions*

#### Introduction

Accurate measurement of **Vibration & Seismic** data in today's emerging strenuous and demanding application areas is a major challenge only a few manufacturers in the world can rise to. Fewer would be those capable of offering modern and advanced solutions for such applications, utilizing innovative technologies to deliver enhanced performance.

**Silicon Designs Inc.**, has developed a miniature accelerometer design based on the innovative and emerging **MEMS** (Micro-Electro Mechanical Systems) technology. These new-age vibration sensors out-perform their conventional counterparts in critical application areas, virtue of their advanced features and superior design concept.

#### Conventional Vs MEMS Accelerometer Design

The traditional piezoelectric and peizoresisitive concepts of sensor design hinge on the measurement of the changes in the electric or resistive properties of elements to measure the vibrations that induce them.

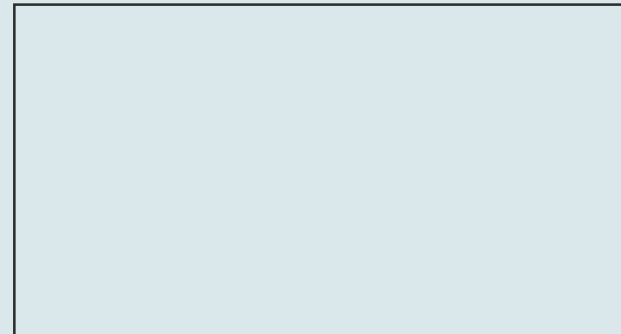
The innovative MEMS design adapted by SDI incorporates **measurement of changes in capacitance** to measure the acceleration that causes them, there by deviating from the traditional design concepts - to realize the following basic advantages.

- \* **Low temperature sensitivity** as compared to peizoresistive materials. Typically, the low thermal co-efficient of expansion of many materials can produce a thermal co-efficient of capacitance about two orders of magnitude **less** than the thermal co-efficient of resistivity of doped silicon.
- \* **Wide measurement range** from DC onwards, to levels as high as 10,000g
- \* **Built-in electronics** that can eliminate the need of further signal conditioning
- \* **Availability of Analog and Digital outputs** – enabling direct integration of the sensor output to digital processing systems or data loggers with out the need for separate A/D conversion.

#### MEMS Accelerometer design

**Silicon Design's** basic accelerometer unit is a 20 pin LCC package containing two parts – the **Sense element** (the sensor chip), and the **Application Specific Integrated Electronics** (ASIC) chip. These parts are integrated using standard die attach and gold wire bonding techniques, and the package is solder sealed to provide a rugged and fully hermetic device.

#### MEMS Accelerometer Packaging



The **Sense element** wing is a nickel plate supported above substrate surface by an arrangement of two torsion bars and pedestal. The wing is asymmetrically designed so that one side is heavier than the other. Between the sense element wing and the substrate surface, two conductive capacitor plates are symmetrically located on each side of the torsion bar axis. The upper wing and these two capacitor plates form two air-gap variable capacitors with a common connection. When an acceleration force produces a moment around the torsion bar axis, the upper wing is free to rotate, thereby causing the capacitance of these two capacitors to change (due to the changes in distance).

The **ASIC** accurately measures the miniscule acceleration caused capacitance changes of the sense element and converts them into a useful electric signal. SDI has designed two types of ASIC, one providing an **analog output**, and another providing a **digital output**.

The **analog output** enables the users to replace the existing conventional sensors with superior performance SDI MEMS sensors with out any major re-design in the existing set up. Further, the user can also reap the benefits of

- \* The **low output impedance** that can eliminate additional signal conditioning
- \* **Differential output** useful in rejecting common mode noise typically present in electrically noisy environments
- \* **Wide range of voltage output** (+4 to -4 V) linearly proportional to applied acceleration

The innovative **digital output** feature propels the sensor technology a leap ahead, by facilitating the users to

- \* **Directly couple** the sensor output to microprocessors/ data loggers with out the need for separate A/D converters
- \* Reap the advantages of the resultant **insensitivity to EMI interferences**.
- \* Design faster, efficient and more reliable vibration measurement and analysis systems for **seamless integration in digital domain**.

#### Applications

SDI sensors, virtue of the increased reliability, sensitivity and survivability, find a wide variety of **Vibration & Seismic Measurement** applications. Some of the major application areas include:

Commercial Accelerometers	Industrial Accelerometers	High Reliability Accelerometers
Automotive:	Crash Testing:	Military/Space/Aerospace:
Air Bags Active Suspension Adaptive Brakes Alarm Systems	Robotics	Telemetry Guidance Inertial Guidance Impact Detection
	Machine Control	
	Vibration Monitoring	Seismic Monitoring
	Modal Analysis	Tilt Measurement
Shipping Recorders	Vibration Analysis	High Shock Environments
Appliances	Instrumentation	High Temperature Operation

#### SDI Product Range

##### 1. Single Axis Accelerometer modules

Surface mount packages are available both in Hermetically sealed 20 pin LDC or sealed anodized aluminium case. Both analog and digital out put versions are available to suit any application.

##### 2. Tri-axial Accelerometer modules

Tri-axial accelerometer modules are available both in open frame or sealed anodised aluminium case. Both analog and digital out put versions are available to suit any application.

##### 3. Low Noise Seismic Accelerometer

Silicon Designs Inc specialises in low-cost, integrated accelerometer for use in zero to medium frequency instrumentation and seismic applications with extremely low noise. It is extremely insensitive to temperature changes and thermal gradients.

##### 4. G-Logger Data Acquisition Systems

For acquisition of acceleration and thermal data, this transportation data acquisition system provides upto 4,000 samples per second on each of its three axis. It is easily programmable by mission planning software and is battery powered for data acquisition upto 3 weeks.

#### Quality Assurance

SDIs standard quality assurance procedures include inspection and quality systems compliant with MIL-I-45208, equipment calibration to MIL-C-45662, clean room meeting FED-STD-209, ESD control to MIL-STD-1689, product screening to MIL-STD-883 and product qualification based on MIL-PRF-38534.

Additional special screening requirements can also be accommodated.

For further product, Price information or application support:



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