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High-Performance VC MEMS Accelerometers for Flight Testing

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Introduction

Flight testing is a fundamental aspect of aircraft validation, providing critical real-world data to support and validate computer-based simulations. Accelerometers play an essential role in these tests, measuring motion, vibration, and forces that affect key aircraft components. The data captured by these sensors enables engineers to verify performance, refine designs, and ensure the safety of flight systems under extreme conditions.

With the acquisition of Endevco, PCB Piezotronics now offers an expanded range of VC MEMS flight test accelerometers, including the PCB Series 3700 and Endevco 7290G, both designed to meet the rigorous demands of the aerospace industry. The variable capacitance (VC) MEMS accelerometers offer several advantages over piezoresistive models for flight testing applications, including greater thermal stability, ruggedness, and independence from excitation voltage, making them ideal for critical applications such as flutter testing, landing gear vibration analysis, and whole-body motion. This paper discusses the technology behind VC MEMS accelerometers and compares key models in both series.

The Role of VC MEMS Technology in Aircraft Testing

VC MEMS accelerometers are built with gas-damping mechanisms and internal over-range stops that protect them from high shock levels and vibration, making them ideal for environments where rapid changes in mechanical stress are common.

Unlike piezoresistive accelerometers, for which outputs vary depending on excitation voltage, VC MEMS accelerometers generate high-level, low-impedance outputs that remain consistent across varying power supplies. This voltage independence ensures stability during long-duration flight tests where power fluctuations might otherwise compromise data quality.

Additional key benefits of PCB and Endevco VC MEMS accelerometers include:

- Thermal Stability: Advanced temperature compensation circuits allow VC MEMS sensors to maintain accurate measurements across wide temperature ranges.
- Ruggedness: With shock tolerances up to 10,000 g, VC MEMS accelerometers are designed to survive high-shock events while delivering precise data at low amplitudes.
- Fast Recovery: After being subjected to severe shocks or vibrations, these accelerometers quickly recover from overload, ensuring that even brief disturbances are accurately captured.

These characteristics make VC MEMS accelerometers the preferred choice for critical flight test applications where durability, precision, and low-frequency accuracy are essential.

Overview of PCB Series 3700 Flight Test Accelerometers

PCB's Series 3700 offers a wide range of models, with full-scale measurement ranges from ±2g to ±200g, providing versatility across various test scenarios. Standard features include:

- Rugged Construction: Many of the Series 3700 accelerometers feature hermetic housings made from materials such as titanium, ensuring protection against environmental hazards like water, mud, and extreme temperatures.

- Gas-Damping Technology: This technology minimizes the impact of high-frequency transients, allowing the sensors to capture precise low-frequency data critical for applications such as flutter testing or landing gear vibration analysis.
- Single and Triaxial Options: The series offers both single-axis and triaxial accelerometers, providing flexibility based on the specific needs of each test.

The PCB 3711 and PCB 3713 models are engineered for applications that require rugged durability and low-profile designs. Packaged in hermetic titanium housing, PCB 3711 delivers precise single-axis measurements, while PCB 3713 extends this capability with a triaxial configuration. Each model offers a broad range of sensitivities, ensuring accuracy even under extreme environmental conditions.

For more sensitive applications, such as low-frequency vibration monitoring, the PCB 3741 provides higher sensitivity ranges and differential output for common mode noise rejection, making it ideal for capturing subtle vibration data. Its lightweight yet durable hard-anodized aluminum casing ensures that the sensor can withstand the mechanical stress of flight testing, while gas-damping technology filters out unwanted high-frequency transient inputs. When even greater durability is required, the PCB 3743 offers the same high-sensitivity performance in a triaxial accelerometer with a hermetically sealed titanium enclosure.

Endevco 7290G Series for Extreme Aerospace Applications

The Endevco 7290G accelerometers have become a key addition to PCB's aircraft testing portfolio. Designed specifically for low-level acceleration measurements, the Endevco 7290G series offers high shock survivability and precision digital temperature compensation, ensuring reliable performance in virtually any flight test environment.

The Endevco 7290GM5 model is particularly suited for outdoor flight tests, featuring a watertight IP-67 design and a reinforced PFA cable that provides additional protection against environmental stressors like moisture and dust. This model's shock resistance of up to 10,000 g ensures long-term survivability, making it a reliable option for applications where sensors are exposed to high mechanical stress and humidity.

One of the defining features of the Endevco accelerometers is their rapid recovery time after exposure to high-shock events and vibration. The ability to maintain precise measurements under these conditions makes the Endevco 7290G series ideal for applications such buffeting tests, carrier landing analysis, payload ejection, and simulated environmental testing using shakers and centrifuges.

Conclusion

PCB's Series 3700 and Endevco's 7290G accelerometers are among the most advanced VC MEMS solutions available today, offering the performance required to meet the rigorous standards of the aerospace industry.

Whether the application requires high sensitivity, ruggedness, or survivability in extreme environments, PCB and Endevco accelerometers deliver reliable data collection to ensure safety and optimize performance in flight test environments.

For more information on how these accelerometers can be tailored to your specific testing needs, please contact PCB today.

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