Polytec

Automotive Electronics

Non-Contact Measurement of Vibration-induced Movement

Field of Application

A Aerospace
B Audio & Acoustics
C Automotive
D Data Storage
G General Vibrometry
M Microstructures & -systems
P Production Testing
S Scientific & Medical
T Structural Testing
U Ultrasonics

Electronic devices are normally thought of as sitting on a table top or securely and safely mounted in a protective enclosure, but portable devices introduce totally different standard to which electronics must be built. Shock loads and vibrations that electronics must survive when mounted in a car or boat can be significant. The smooth roads are easy, but they need to also handle the worst dirt roads and roughest seas too, and these electronic devices must be built to handle these increased forces without failure.

Electronics in a vehicle are securely mounted to the chassis of the vehicle with varying types of isolation, yet these components can sustain more extreme vibration forces than the occupants. This makes the design of these devices challenging, especially for small, delicate automotive electronic structures. As electronics do more in our vehicles, their durability becomes even more critical. Tall or heavy items such as capacitors, relays, inductors and chokes must be mounted securely so they do not break their mountings, or flex so they break their electrical connections. Even when mounted sufficiently, they can flex an entire PC board resulting in failures in other locations when they encounter vehicle-induced vibration. Analyzing the motion in such modules is best done using a non contact method such as a laser vibrometer.

For studying the movements on automotive electronics, **Dr. Arvind Krishna at Delphi** discovered the advantages of the laser vibrometer. Doppler laser vibrometers require only a line of sight to the object being measured, do not require a location to bond the accelerometer, do not measure the shape or texture of the part, have a flat response curve, are highly accurate, and because they touch the part with only a beam of light – do not change the structure in any way.

Capacitors

Dr. Krishna measures tall components on PCBs which pose potential vibration durability problem for Delphi's applications. Capacitors are unique because they also can experience durability failures when exposed to vehicle induced vibrations.

Polytec GmbH
Optical Measurement Systems
Application Note
VIB-C-06
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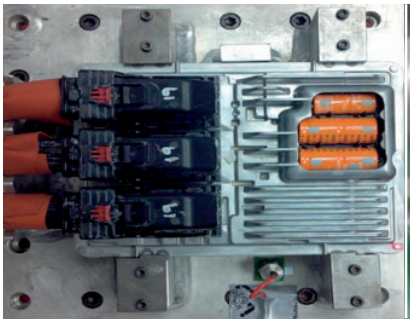
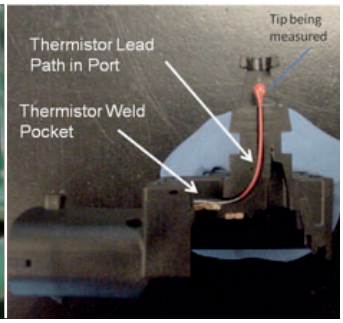


Measuring a capacitor's cradle while mounted in a product housing

Laser "Dot" indicating signal capture spot on the body of the Capacitor mounted on a PCB



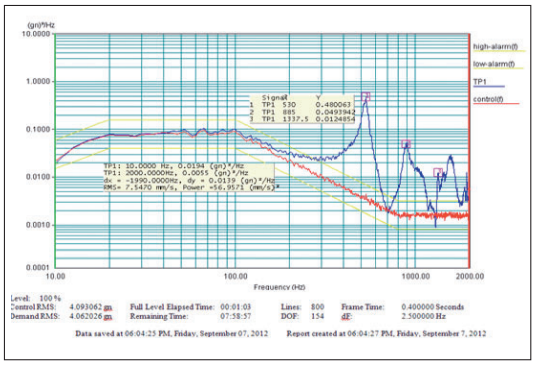
Pressure Sensor – Thermistor Lead Response

The housing must secure the capacitor, but the leads can't break, and the mounting can't flex the board so neighboring components fail either. Even when this is accomplished capacitors can fail internally. This makes capacitor selection and testing even more important.

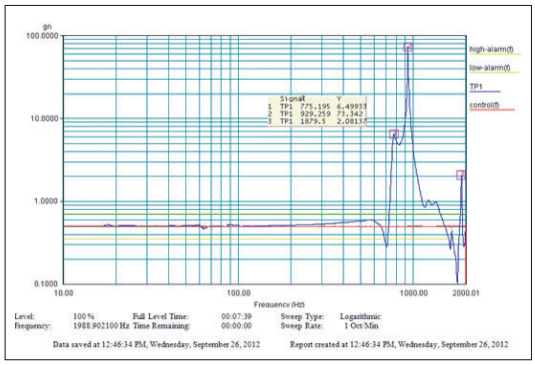
Pressure Sensors

Another particularly challenging device is a pressure sensor. Due to the small size of the thermistor (2 – 3 mm ball) and the slender lead wire, it required a laser to measure the motion without touching the device. The laser vibrometer's ability to measure both small and large amplitudes over a wide range of frequencies provided information about the tip's motion at 775, 9290, and 1879 Hz. This allows the researchers to explore new designs and new capabilities of the entire structure. Improvements Dr. Krishna was able to make to Delphi's devices were tied directly to information obtained from the laser vibrometer. Measuring on parts regardless of their material, construction, or size allows researchers to accurately identify the way a part is moving, and quantify the improvements from each modification.

Dr. Arvind Krishna about Laser Vibrometer: "Ease of use, transportability and accuracy have allowed the Polytec laser vibrometer to become a popular test alternative to traditional accelerometers in the lab. We look forward to finding novel applications for the laser equipment in the future!"



Acceleration response PSD captured using Polytec Vibrometer at capacitor body due to input random vibration



Excellent signal that provides tip motion information especially at frequency 930 Hz.

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