

Accelerometer design

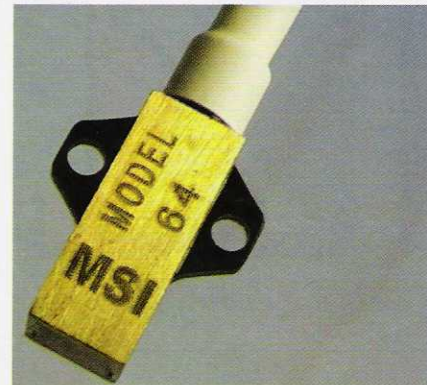
■ Transverse sensitivity or crosstalk (x-talk) refers to sensor output induced by motion acting on an accelerometer that is not in its principle axis. Any effect of such motion on signal output is interpreted as sensitivity error and is expressed as a percentage of designed sensitivity. Primary causes of transverse sensitivity are variations in the sensor itself and manufacturing tolerances.

Accelerometers used for general auto safety applications are typically specified at ≤ 3 per cent transverse sensitivity, with more critical applications requiring ≤ 1 per cent. An example of such a critical application is the mounting of three uniaxial accelerometers on a block inside the headform of a dummy. As motor vehicle accidents kill more people a year than most natural disasters combined, and more than 70 per cent of individuals in such accidents suffer head injuries, the essential collection of accurate information in the dummy headform becomes vital.

The high cost of accelerometers with ≤ 1 per cent transverse sensitivity is due

to a combination of three factors: keeping manufacturing tolerances among many parts tightly controlled; using highly skilled technicians to correctly position the sensing element without misalignment; and experiencing high yield losses from selection testing of units.

Measurement Specialties' Model 64 crash test accelerometer was specifically developed to minimize errors due to transverse sensitivity, and is the most cost-effective, high-accuracy accelerometer in the crash test market. The Model 64 accelerometer series is based on an advanced piezoresistive MEMS sensing element that offers intrinsically low misalignment in the MEMS sensing element. This unit features a full bridge configuration with onboard compensation resistors for span and zero correction from 0.0 to $+50^{\circ}\text{C}$. Internal gas damping provides outstanding shock survivability and flat frequency response. The footprint of this accelerometer also meets the SAE J211 specifications for anthropomorphic dummies.



The Model 64 accelerometer minimizes errors

The simple design of the Model 64 does not require tight tolerances or highly skilled technicians to keep die alignment within specification. (Note: 1° alignment error results in a 1.74 per cent transverse sensitivity error.) Furthermore, the company's cost-effective manufacturing processes with standard production testing procedures identify those units that will pass the rigorous transverse sensitivity testing for calibration certification.

X-talk Testers from Measurement Specialties were specifically designed and built for crash accelerometers. Their primary test method for quantifying transverse sensitivity is based on sound measurement principles that rely on a vibration exciter applying 7g sinusoidal motion at 13Hz to the unit under test (UUT). This is a relatively violent exposure with large physical displacement.

In setting up the test, the UUT is mounted so that the sensitive axis of the UUT is in-line with the 7g sinusoidal motion at 13Hz. This permits the UUT to be normalized for purposes of quantifying the transverse sensitivity as a percentage of full-scale output to the sensitive axis.

Next for the setup, the UUT is mounted perpendicular to the sensitive axis and the same 7g sinusoidal motion at 13Hz is applied to the UUT. The UUT is rotated during this exposure. As the UUT rotates in the plane perpendicular to the sensitive axis, the highest value of transverse sensitivity (as a percentage of full-scale output to the sensitive axis) is measured.

The benefits of this test method for quantifying transverse sensitivity are that the test is dynamic and accounts for all orientations in the plane perpendicular to the sensitive axis. ■

FURTHER INFORMATION

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