

Mechanical Drop Shock Testing

Accurate impact testing is a key component to establishing that a product is not only reliable, but durable in an end-use environment. ACI Technologies tested a high-g circuit board to demonstrate component durability and ruggedization for guided munitions. The Lansmont Model 23 Shock Test System customized with a Dual Mass Shock Amplifier was used for this testing (Figure 1).

Test fixtures were custom designed to mount a circular circuit board consisting of daisy chained electrical devices encapsulated within a 2" housing (Figure 2). Shock forces can be achieved up to 25,000 g with this equipment. Before and after testing, electrical and physical connectivity of the test vehicle was assessed using electrical resistance path measurements and x-ray imaging. A change in resistance within the electrical path indicates partial failure in at least one component in the chain, at which point individual segments of the board can be isolated to determine the source of the failure.

The amplitude and duration of the shock pulse waveform is optimized through adjustment of cushioning pads and the braking mechanism of the system. This calibration, along with data capture triggering, is critical for successful testing, particularly for the potentially destructive sample testing at high-g values. Cushioning pads of a variety of thickness and hardness values are used to effectively dampen the impact, with the goal of optimizing the time duration of peak impact as well as reduce additional oscillation intensity.

Captured event data is transmitted to the Test Partner 3 data acquisition system where a detailed shock response spectrum can be produced. A result from this testing for a sample at 15,000 g is shown in Figure 3.

A piezoelectric accelerometer is employed to accurately measure acceleration forces for events as short as 0.25 milliseconds in duration. As shown in Figure 4, the accelerometer consists of an embedded piezoelectric crystal fixed in position with a rigid base structure and a calibrated seismic load mass. During an acceleration event, the seismic mass imposes a force on the crystal following Newton's second law of motion ($\text{Force} = \text{mass} * \text{acceleration}$). Through the piezoelectric effect, the crystal responds to the increased

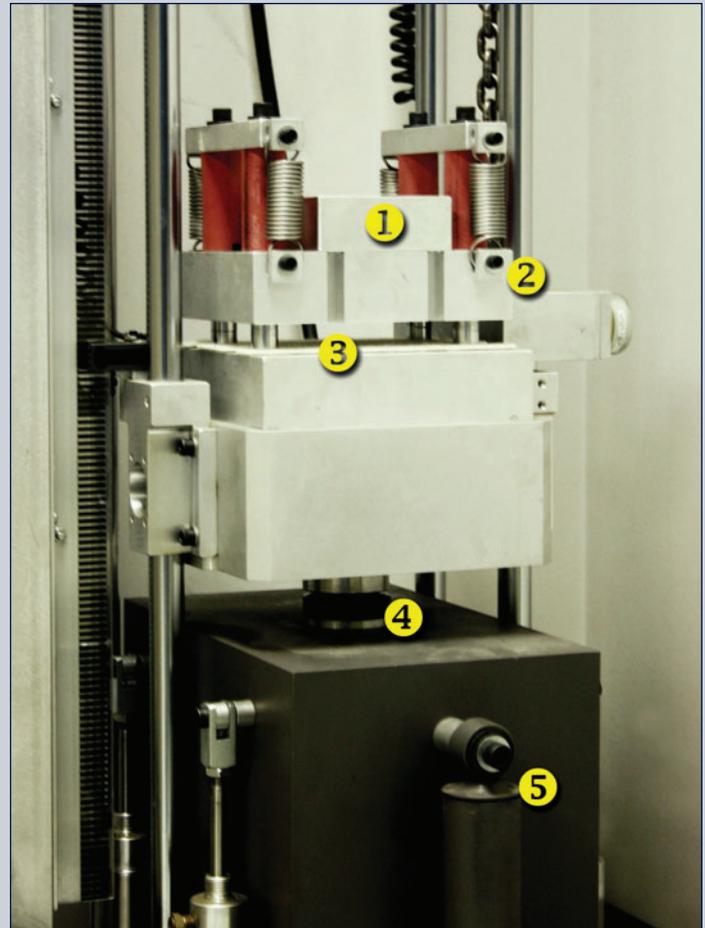


Figure 1: Lansmont Model 23 Drop Shock tester at ACI Technologies. Drop shock tester components: 1. sample mounting fixture, 2. dual mass shock amplifier, 3. cushion test surface, 4. shock pulse programmer, and 5. floating seismic reaction mass.

force with an increased voltage proportional to the acceleration experienced.

Custom fixturing can be designed to position test vehicles of a variety of sizes within a 9" x 9" footprint and along all three axes of orientation. In addition to performing a wide variety of programmable shock tests,



Figure 2: Fixture containing encapsulated test circuit board.

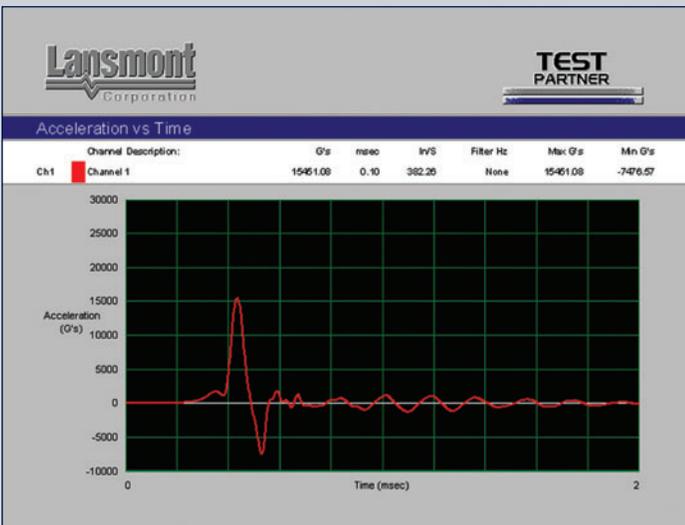


Figure 3: Data output for test sample experiencing 15,000 g.

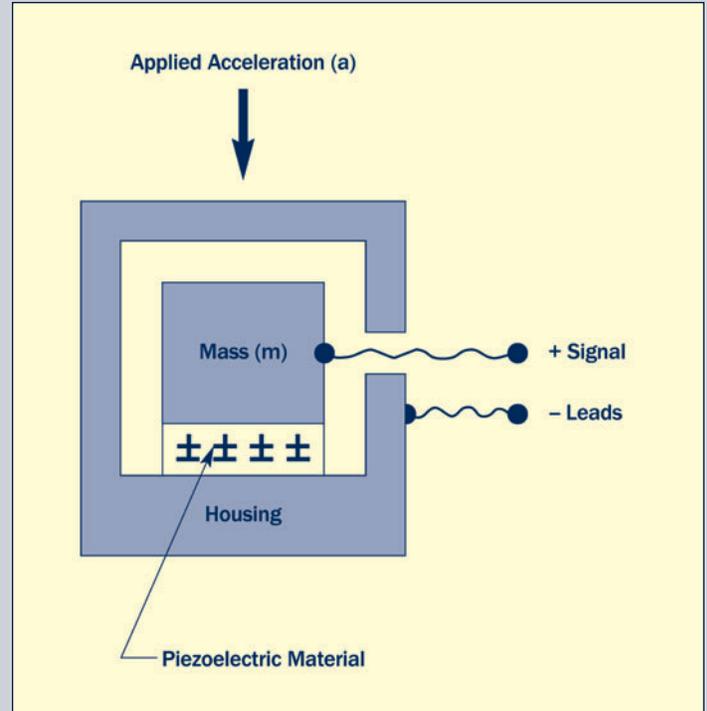


Figure 4: Theoretical schematic diagram of a piezoelectric accelerometer. Courtesy of PCB Piezotronics, Inc.

the system can also perform materials impact evaluation (cushion testing) by dropping a load mass onto a fixed stationary object.

To complement the mechanical drop shock testing, ACI Technologies also offers vibration testing using a Labworks vibration table. Shock and vibration testing can be combined with thermal cycling or thermal shock, Temperature Humidity Bias (THB) Testing, Highly Accelerated Stress Testing (HAST), salt fog, high temperature storage, or other environmental testing. For more information on shock or other reliability testing, please contact the Helpline at 610.362.1320 or via email to helpline@aciusa.org.

ACI Technologies, Inc.



ACI Technologies, Inc. 1 International Plaza, Suite 600 Philadelphia, PA 19113 phone: 610.362.1200 web: www.aciusa.org

Training Center phone: 610.362.1295 email: registrar@aciusa.org

Helpline phone: 610.362.1320 email: helpline@aciusa.org