*Can You Imagine . . .*

. . . a vibration isolator that can provide a stable environment for precision lithography equipment and can control vibrations in medical imaging devices.

# BMDO SPACE R&D RESULTS IN ULTRAQUIET EQUIPMENT

Advances in lithography have enabled the miniaturization of computer chips. Shrinking the circuit elements on these chips has resulted in tighter acceptable alignment tolerances for lithographic equipment, making the lithography process even more sensitive to vibration. Thus, chip makers are searching for new ways to keep their equipment isolated from excessive vibrations that can lead to flawed products. In a $151-billion industry that grew 37 percent in 1995,[1] throwing away even a small percentage of those chips is costly.

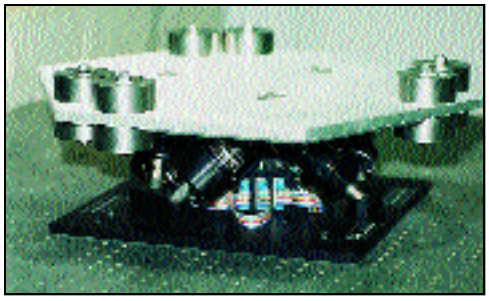
CSA Engineering, Inc. (Palo Alto, CA), developed an electromechanical control system that can control vibrations in precision lithography equipment. The system can also be used in other applications, such as cellular base station receivers and airborne sensors. It was derived from CSA's UltraQuiet Platform (UQP), a six-axis vibration isolation system for space-based sensors originally developed with BMDO SBIR funding.

The UQP system uses a novel combination of passive and active vibration suppression devices connected serially within each of six struts. This passive-active combination allows the use of high-force, short-stroke actuators, giving the UQP system superior performance over passive-only, active-only, or parallel passive-active systems. It also makes the control system less sensitive to vibrational modes of the isolated instrument or machine.

LEVERAGING ITS EXPERTISE IN ACTIVE AND PASSIVE VIBRATION SUPPRESSION, CSA FORMED A STRATEGIC ALLIANCE WITH NEWPORT CORPORATION.

Leveraging its expertise in vibration suppression, CSA formed a strategic alliance with Newport Corporation, which sells precision optical equipment. This alliance, which has already resulted in several small product-development projects, could grow significantly during the next few years. For example, the team may invest a large amount of time and capital in developing the next generation of active vibration-suppression equipment for the precision lithography machinery used in manufacturing semiconductors.

CSA has investigated excessive vibrations in the cooling system of a newly developed magnetic resonance imaging machine and created several technology fixes for it. The company is currently developing vibration isolation technology for the cryocoolers used to cool superconducting switches and junction boxes in base stations for cellular communications.



■ CSA Engineering's UQP system, pictured above, uses a novel combination of passive and active devices connected serially to suppress vibration.

## ABOUT THE TECHNOLOGY

The UQP system uses a novel combination of passive and active vibration-suppression devices connected serially. This six-legged, spider-shaped flexure provides the passive isolation to an intermediate stage. The system measures the damped motion of this stage and feeds it to the control circuitry for a base-mounted actuator that serves as an active isolator. The intermediate stage and the serial mounting reduce the amount of displacement the actuator must counter, making the system more efficient than either passive-only, active-only, or parallel passive-active systems. It also does a better job of canceling vibrational modes that arise in flexible payload structures.

The UQP system works optimally for stroke displacements of 25 to 50 microns (1 to 2 mils), frequencies greater than 5 Hz, and payloads of up to 100 pounds. It integrates all of the mechanical actuators, dampers, and electrical control components into a platform less than six inches high. A version of the UQP system designed for payloads up to 15,000 pounds would double the height.

[1]Singer, Peter H. 1996. Dataquest revises 1996 chip forecast sharply downward. *Semiconductor International*, June.