CSA Engineering, Inc. Vibration Journal

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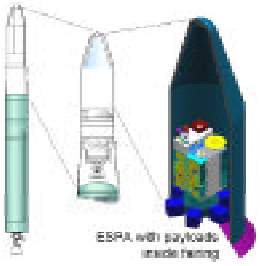
ESPA: EELV Secondary Payload Adapter

ESPA is a low-cost solution for launching multiple small satellites, a payload adapter conceived by the Air Force to take advantage of anticipated excess capacity on the new large expendable launch vehicles (EELVs) from Boeing (Delta 4) and Lockheed Martin (Atlas 5). ESPA's maiden voyage is scheduled for December 2005 on a Delta 4 mission.



CSA designed and built ESPA under contract to the Air Force Research Laboratory for the Air Force Space Test Program. ESPA is a 24-inch-tall, 62-inch-diameter cylinder machined as one piece from an aluminum forging. The standard primary-satellite interface for EELVs is replicated at the top and bottom of the cylinder, with 15-inch mounting rings for six 400-lb secondary payloads around the circumference. The first ESPA unit

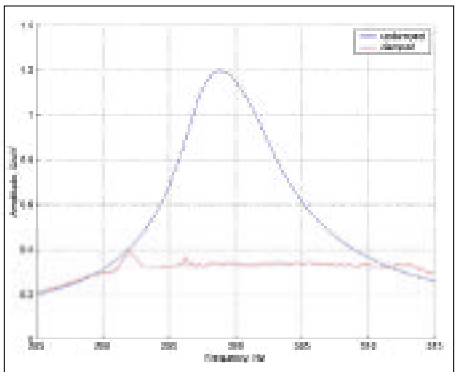
was manufactured in August, and qualification testing will begin in January 2002.

CSA has been a major contributor to the ESPA program since the conceptual design stage. Currently, preliminary coupled loads analysis is underway for the first mission, and shock isolation is being designed for candidate primary and secondary spacecraft. The structure and isolation system designs have used system coupled loads analyses with finite element models and load cases for both Atlas 5 and Delta 4.

CSA also designed and built the 15-ft-high qualification test structure for ESPA and, with support from the EELV manufacturers, is developing the flight qualification test program.

Particle Damping

In a series of recent efforts, CSA has added a new capability to our vibration control toolbox. *Particle damping* is a useful energy loss mechanism that arises from the interaction of particles with each other and with the walls of the cavity that contains them. Proper design and location of the particle container on a component subject to vibration enable significant peak reductions. In several tests, a dynamic amplification, Q, of 3 to 4 has been achieved with low added mass ratios. With particle damping, the frequency response near resonance is essentially 'sawn off'. Particle damping has other practical advantages as a damping mechanism: it is non-outgassing, uses no fluids, has no stray magnetic flux, and performance is essentially independent of temperature over a wide range. In a series of testbeds, CSA Engineering has demonstrated the effectiveness of particle damping based solutions on a broad range of structure types, damping modes from 10 to 1400 Hz over temperatures from -90 to +850 °F, and under significant centrifugal loads (up to 6000 G's).



Example data shown for 1000 rpm, ± 240 G's dynamic excitation

While particle damping is similar in general terms to single particle impact damping, it has operational advantages in reduced sensitivity to operating frequency and minimized out of band re-excitation effects.

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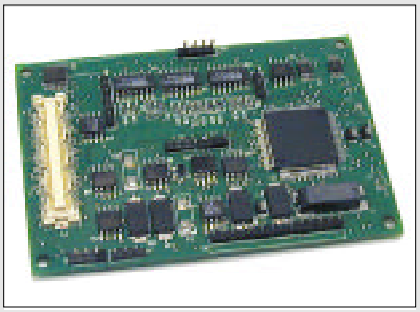
Featured Product:

HPC-2000

High Precision Embedded Controller

The HPC-2000 is the first product in CSA's high precision controller line. The compact low power modules were originally developed for use in custom CSA systems for active vibration cancellation and damping. Now the HPCs are available for other control tasks. The HPC-2000 is the core product in a family differentiated by speed, power and cost.

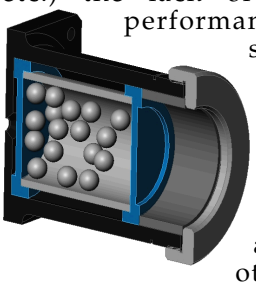
With the HPC, the user has freedom to employ separate subsystems for signal conditioning and power conversion/amplification. Or, with an application specific board that mates directly to the HPC, CSA provides a complete embedded control solution.



- 40 MIPS at 1 W
- 4 16-bit / 8 10-bit analog inputs
- 2 16-bit analog outputs
- 8 16-bit PWM channels
- Up to 16 digital I/O
- 50 x 75 x 8 mm
- Burnable code via Matlab

Continued "Particle Damping"

Although particle damping has long been used in consumer products (dead blow hammers, tennis rackets, etc.) the lack of demonstrated performance on relevant structures and the inability to predict behavior has limited the application of particle damping solutions to aerospace and other technology intensive applications. This has now changed with CSA's new design capabilities. For more information, contact particles@csaengineering.com.



Did You Know?

Over the next year, as we celebrate the 20th anniversary of CSA's founding, you'll read and hear more about the special events planned. The website (www.csaengineering.com) and this newsletter are two good sources of information. The upcoming events include an open house in Mountain View and an event celebrating our expanded facility in New Mexico.

Twenty years is a long time, especially for a company headquartered in Silicon Valley. Over the last few years we've watched some of our neighbors spring up and then fade away. Like many of the more recent startups, CSA's business has cutting edge technology at its core, but we deal with tangible physical systems, not speculative E-concepts.

Consistency and dependability have always counted and they do now. But CSA isn't standing still. The company today is much different from the one started by Warren Gibson, Conor Johnson, and Dave Kienholz in 1982. It's also changed quite a bit from the 20-person engineering house circa 1992. As we celebrate 20 years, we're proud to serve our customers through specialty products and an expanding standard product line, with diverse new engineering capabilities supporting our core competence in structural dynamics and vibration control.

Thank you to all our customers, and please let us know how we may serve you in the months and years to come.

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CSA Engineering provides products and services in the following areas:

- Structural dynamics and vibration control
- Electronic and software control of electromechanical systems
- Smart materials, devices and structures
- Mechanical design
- Dynamic testing
- DSP and embedded control
- Finite element modeling

We build components, devices and systems for use in space, aircraft, semiconductor equipment, precision manufacturing, and other industries.

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