Compact Low Power Avionics for the Europa Lander Concept and Other Missions to Ocean Worlds

IEEE ELECTRONICS PACKAGING SOCIETY

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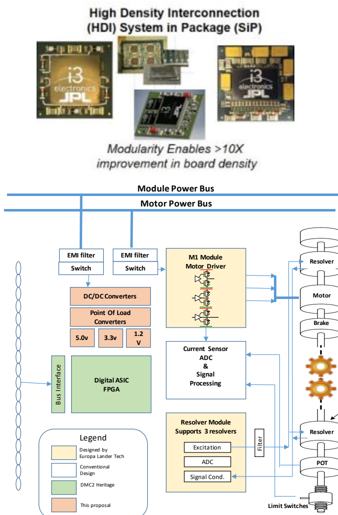
Introduction:

- Leverage advanced packaging, cold adaptable electronics and system-in-Package (SiP) technology to allow a Europa Lander to last longer on the surface and provide more room for additional science by reducing the volume, mass and power of its avionics and the amount of energy required to keep the avionics warm.
- New generation Motor Control provides: *10X SWaP over existing technologies / 300Krad tolerant / Controls 12X 3A Brushless DC Motors*



Approach:

- *Focus on cold survivability not cold operation.*
- *Advanced packaging decreases mass and volume which minimize the amount of energy to bring to operating temperature*

Advanced Electronic Packaging Technologies

Substrate technology

CoreEZ™ 3-4-3 Substrate

Advantages: reduction in thickness, tighter via pitch, finer line width and spaces, improved electrical performance

High Density Connectors

Up to 500 pins per connector 3x density of standard micro-D

Slice Based Design

Eliminates backplane and chassis mass

Radiation Shielding within System in Package (SiP) Module

Allows Distributed Architectures

Cold Capable Materials For future SiP Part Attach

Allows for 90 Kelvin survival temperatures

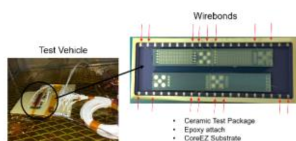
Optimizing Thin-film Technologies for use as Built-in Capacitors

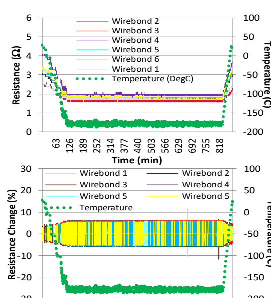
(allows for additional PWB density Improvement)

Interposer

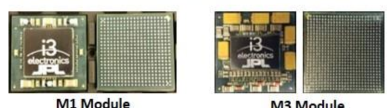
Results Summary:

Given the emphasis of custom SiP Module technologies needed for this effort, our first focus from a cryogenic reliability point of view was to determine performance of various Device Under Test (DUT) sizes and attach materials using a polyimide based test boards with ENEPIG finish.





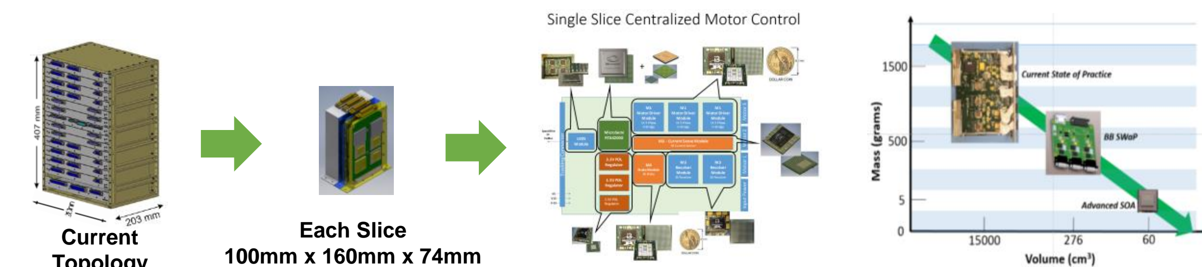
Production coupons or "Current Induced Thermal Cycle" (CITC's) coupons were used to characterize CoreEZ substrate technology for low temperature survivability



M1 and M3 Modules non-operational, passive low-temperature cycling, starting at +25°C to -184°C to +85°C and repeating for 100 cycles, with a ramp rate of 5°C/min

Summary

- Modularity Simplifies packaging topology. By creating a series of common custom SiP modules, allowed for a flexible approach to packaging topology and implementation. Modules can be used singly or combined as needed to create specific functionality throughout architected system. Module upgrades, replacements, or expansions are easily accomplished. Lower Costs through standardized modules, enhances the ability to either assemble a distributed or centralized system.
- Illustration of the relative size of a conventionally packaged board (10cm x 15cm) to the same electronics packaged using advanced packaging technology (2.5cm x 2.5cm).



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