X-LAT—E-Box—CAL Plate Mounting Trade Study

LAT-TD-01245-01, “X-LAT Plate and E-Box Mounting Trade Study”

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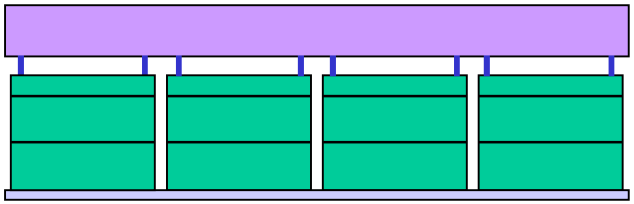
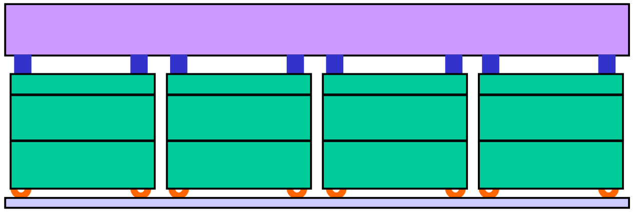
Trade Study Options

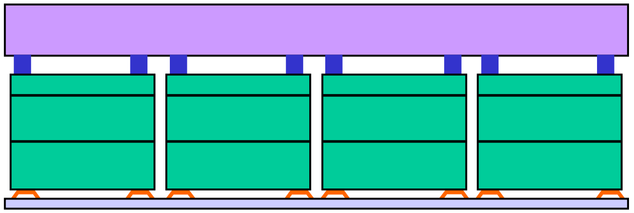
- dPDR Baseline
  - X-LAT to E-Box joint
    - Silicone wet joint
    - E-boxes leveled during integration
    - Bolted structural joint carries box shear
  - E-Box to CAL joint
    - Compliant posts
    - Push-me/pull-you allows adjustment



- Spring Finger design
  - X-LAT to E-Box joint
    - BeCu leaf springs conduct heat
    - Accommodates steps between boxes
    - Structural joint is laterally compliant
    - Bolts only provide leaf spring compression
  - E-Box to CAL joint
    - Boxes mounted on Ti stand-offs
    - CAL carries all E-box launch loads
    - No adjustment need or capability



- Thermal Strap design
  - X-LAT to E-Box joint
    - Cu straps bolt to X-LAT and E-boxes
    - Accommodate steps and motion
    - Bolts only needed to hold X-LAT Plate
  - E-Box to CAL joint
    - Boxes mounted on Ti stand-offs



Trade Study Drivers

- Thermal
  - All power dissipated in the E-boxes is conducted through the thermal joint to the X-LAT Plate, and into the X-LAT heat pipes, where it is transported out to the Radiator joint
  - This thermal joint is critical, in that over half of the LAT dissipated power is transmitted across the joint
  - Temperature rise across the joint impacts the peak temperatures in the E-Boxes
- Integration and Test
  - Since the X-LAT Plates cover up all E-boxes, access to the boxes is largely blocked after integration and during performance and environmental test
  - This means that a X-LAT Plate must be removed and re-integrated if there is any problem with a box which requires access to fix
  - Re-integration of a X-LAT Plate after environmental testing may require penalty testing. Increasing the joint reliability should reduce the needed complexity of the testing
- Structural
  - To avoid over-constraining the E-boxes, one of the joints (E-Box or X-LAT) must be compliant

Trade Study Summary

	dPDR Baseline	Spring Fingers	Thermal Strap
Total Score:	**58.25**	**40.5**	**27**
Thermal (wt = 1)	16 * 1 = 16	18 * 1 = 18	10 * 1 = 10
I, T (wt = 0.75)	45 * 0.75 = 33.75	20 * 0.75 = 15	16 * 0.75 = 12
Structural (wt = 0.5)	17 * 0.5 = 8.5	15 * 0.5 = 7.5	10 * .5 = 5
Thermal	**16**	**18**	**10**
	Superior thermal performance Poor repeatability Complex joint to make	Marginal thermal performance High development risk since design is unproven	Fair thermal performance, Deisgn has low development risk Joint is repeatable
Integration, Test, and Access	**45**	**20**	**16**
	Very difficult to integrate. Need to level all 16 E-box stacks Need to make a large-area wet joint during X-LAT integration. De-integrating X-LAT may damage it CAL vibe test STE is complex, since it must mimic load path of E-boxes	Structural and thermal integration is easy. Leaf springs engage automatically, so no adjustments are needed Reliability of finger engagement is questionable, so re-testing would be req'd	Integration is straightforward, but there are many bolts to torque Re-integration and re-test should be straightforward, but will take time.
Structural	**17**	**15**	**10**
	X-LAT must carry E-box lateral loads, driving honeycomb design CAL flex post bolted joint is difficult to verify	X-LAT mount only provides pre-load for spring, so loads are minimal E-box hard-mounts on stand-offs to CAL, a low risk design, easy to verify	No loads across X-LAT joint except to physically hold X-LAT plate E-box hard-mounts on stand-offs to CAL, a low risk design easy to verify

•Lower number = less risk and/or better performance

Conclusions and Recommendations

- Trade Study conclusions
  - The dPDR Baseline design involves the most development risk and integration complexity and risk
  - The preferred design is the Thermal Strap option
    - It balances all design drivers
    - Development risk is lowest, so pre-CDR work is minimized
    - Implementation risk is lowest, so risk of problems at integration is reduced
- Recommendations
  - Adopt Thermal Strap option as new LAT baseline
  - Incorporate design into interface design (System Engineering: Rich Bielawski)
    - Update CAL ICD to reflect design change
    - Incorporate change in thermal design into Electronics ICD currently being written
    - Update CAL and Electronics Interface Definition Drawings to reflect changes
  - Incorporate changes to structural and thermal design into LAT baseline analyses (Design Engineering: Youssef Ismail, Jeff Wang)
  - Direct Mechanical Systems to complete conceptual design of both joints (Mech Systems: Marc Campell, Giang Lam)
    - Prototype test thermal strap design to verify conductance
    - Finalize joint design