The Off-The-Shelf CubeSat Subsystem: Lessons Learned.

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Commercial CubeSat System Supplier Objectives

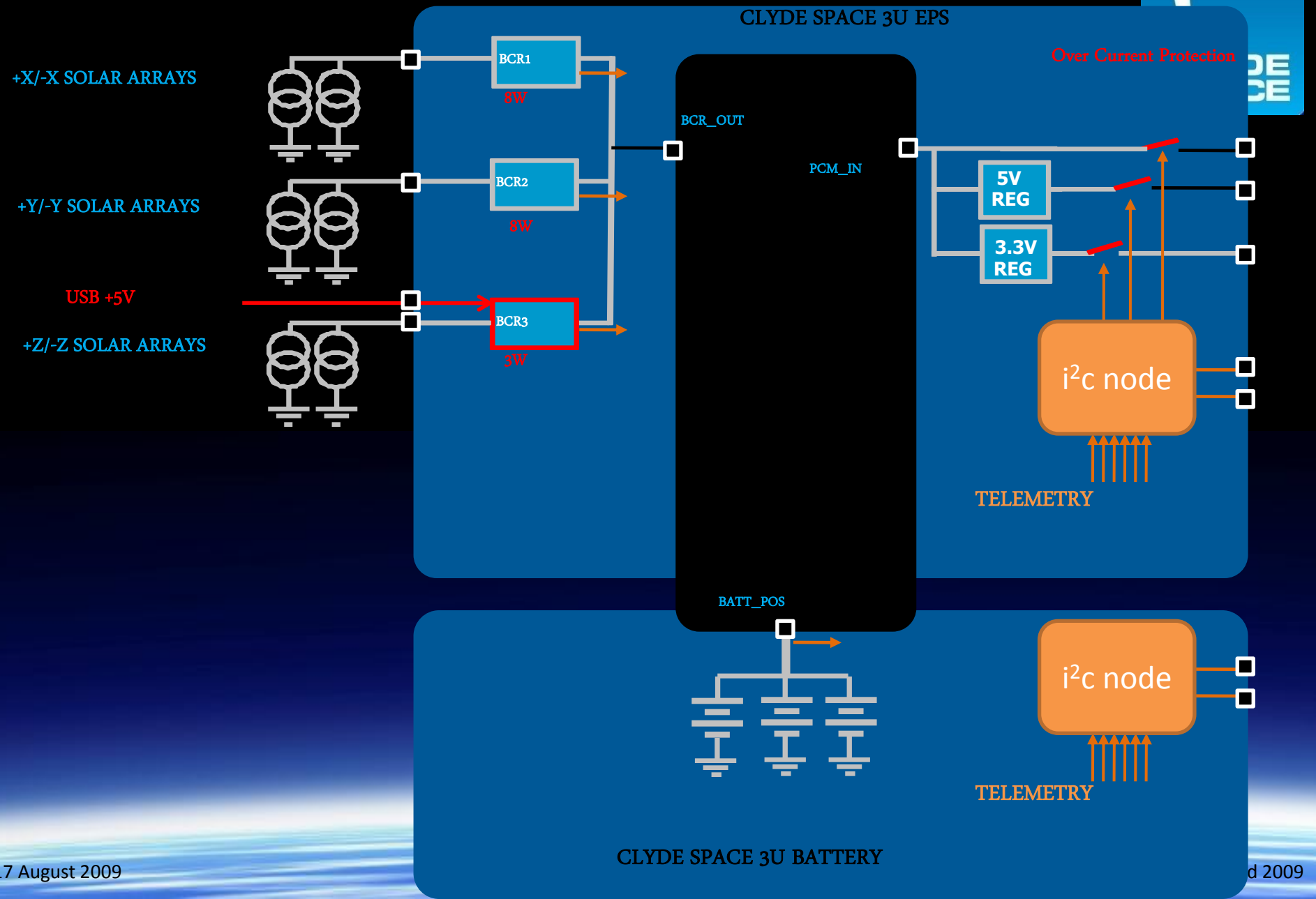
- Meets the budget of most CubeSat programmes.
- Meets the standard that is followed by most CubeSat missions.
- Is of a quality level to suit the application.
- Is high performance.
  - To attract customers
  - To enable more missions.

Specific to a CubeSat EPS

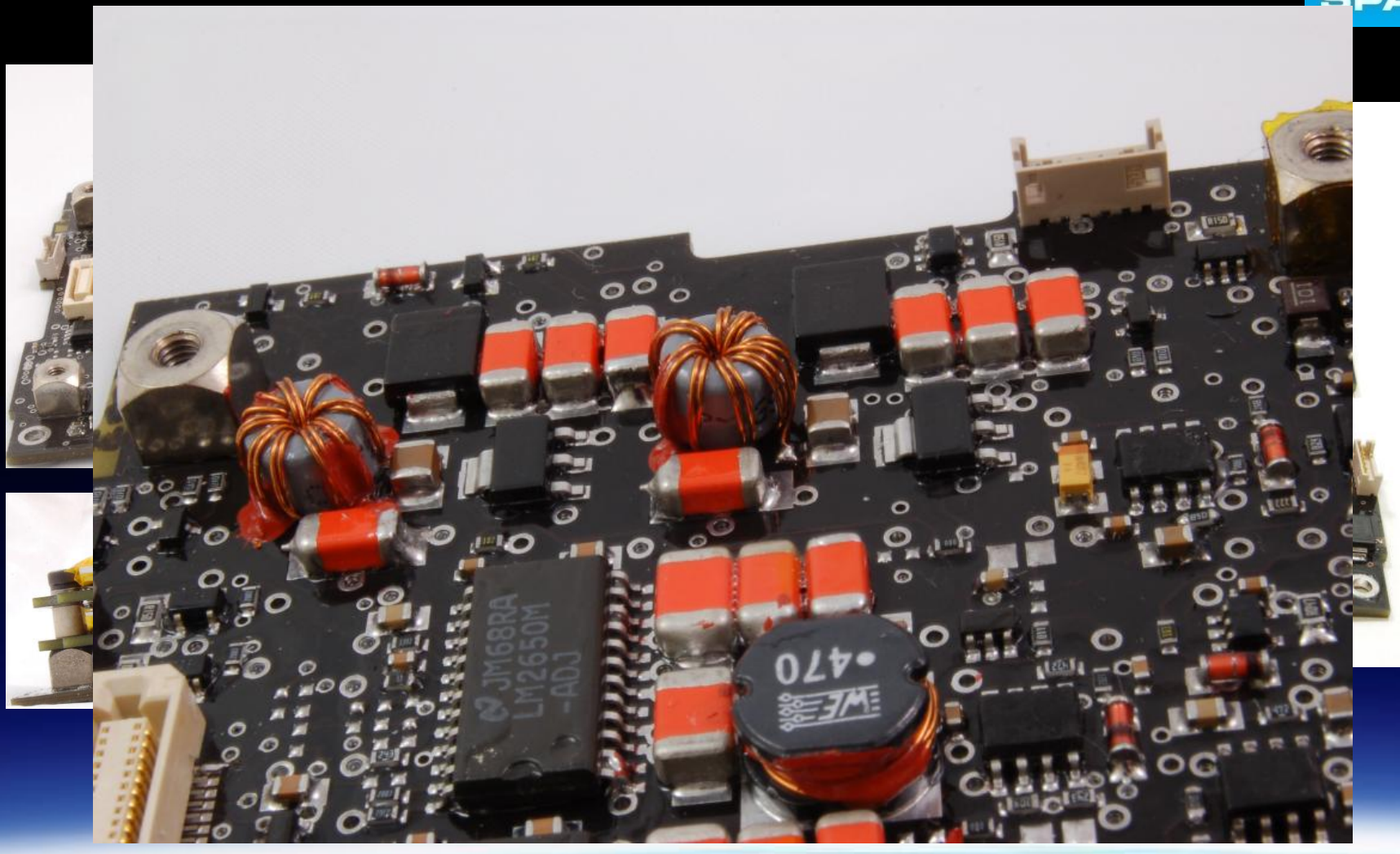
- EPS is additionally complex:
  - Interfaces to everything on the spacecraft.
  - Its performance is critical in all phases of the mission.
  - It must be compatible with customer ground test.
  - Be adaptable to various spacecraft configurations.
  - Be compatible with multiple interfacing configurations.
    - Digital comms.
    - Power/current ratings
    - Solar cell and solar panel types.
    - Launch switch configurations.

OVERVIEW OF CS EPS1

EPS1 Block Diagram



Clyde Space EPS1



Lessons Learned with EPS1

- Types of issues encountered.
  - ESD damage during customer handling.
  - Over-discharge of battery.
  - Battery protection circuitry incompatibility.
  - Accidental short-circuit of battery.
  - Vibration failure of magnetic component.
  - Test configuration issues resulting in component failure.
  - Launch switch configuration issues.
  - Conformal coating issues (header connector).
  - Build quality/gluing.
  - I2C comms interfacing difficulties.
  - General integration issues.
  - Current ratings of voltage lines.
  - Higher array power interface required

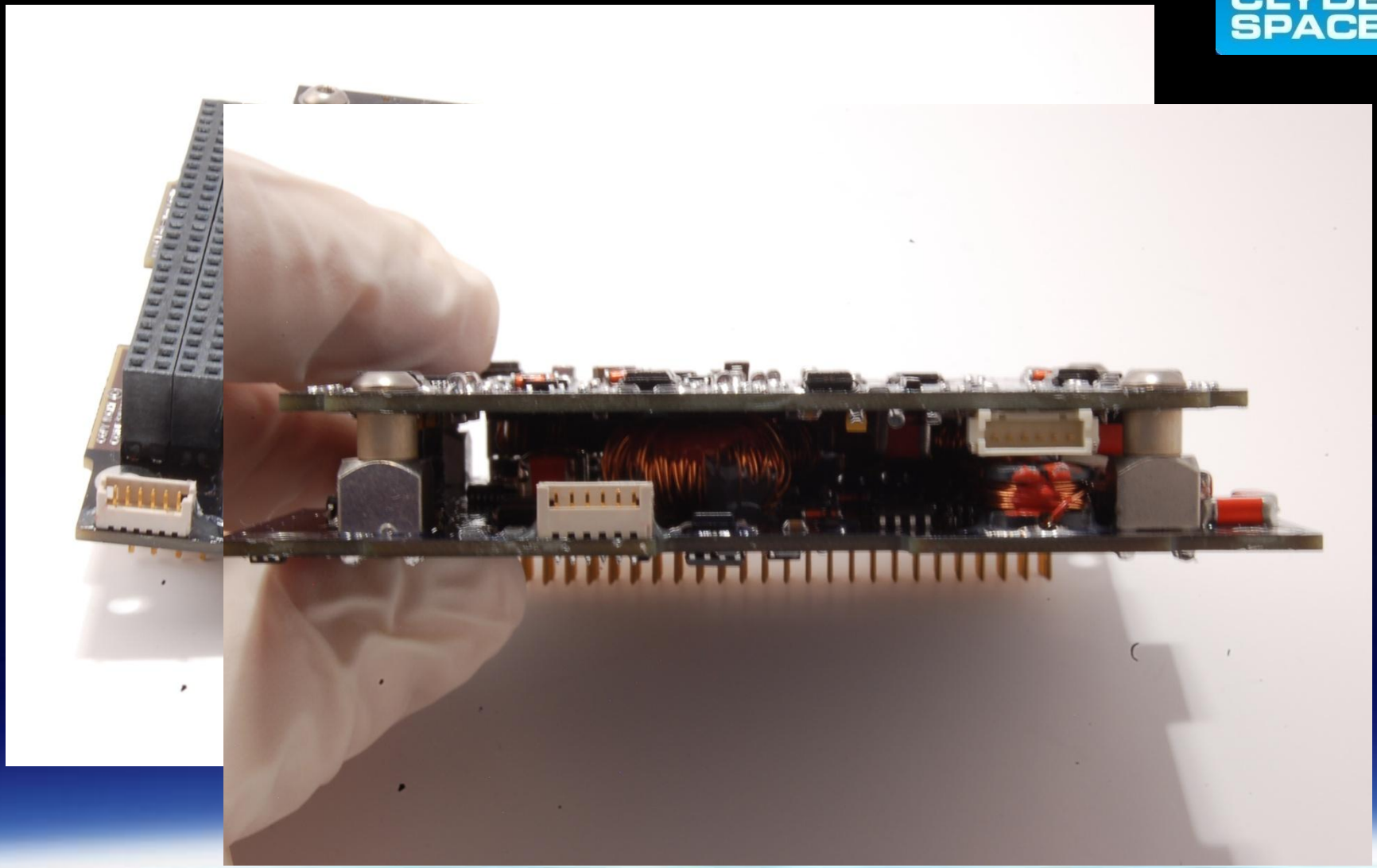
What we are doing about it

- We are listening.
- We are still clear on our objective.
  - To have available an affordable, off-the-shelf, high performance, high quality, play-n-play CubeSat power system.
- To achieve this, we have/are implementing the follow changes.

New User Manual

- Very comprehensive.
- Aimed at educating the user as much as possible as to the operation, usage and design of the EPS.
- Produced in conjunction with our key stakeholders within the CubeSat community.

Deployed EPS



EPS 2

- New EPS in design.
- Increased power on 5V and 3.3V lines
  - 95%-98% efficient and up to 4A per rail.
  - Zero power consumption on launch vehicle.
  - USB power and dummy load to enable alternative test configurations.
- Expected to be available in October2009.

Quality improvements

- We have performed gap analysis of our Quality Management System
- We have achieved ISO9001:2000 from BSI.
- Our assembly team is trained to assemble the boards to European Space Agency (ESA) standard.
- We have TWO ESA trained inspectors.
- We have recruited another senior designer to help speed our design improvements.

Summary

- We are working towards the ultimate CubeSat EPS.
- We are finding this is an evolution process that requires feedback from our customers.
- Small companies are thriving with innovation
  - CubeSats are more suited to SMEs.
  - The CubeSat SMEs will pull through to support the CubeSat community as it grows.
- Thank you for your support…

Thank you…