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 3U EPS

- Over Current Protection
- 5V REG
- 3.3V REG
- i²c node
- TELEMETRY
- BATT_POS
- PCM_IN

+X/-X SOLAR ARRAYS
+Y/-Y SOLAR ARRAYS
USB +5V
+Z/-Z SOLAR ARRAYS

BCR1 2W
BCR2 3W
BCR3 3W

USB +5V
CLYDE SPACE 3U BATTERY

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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 October 2009.
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...