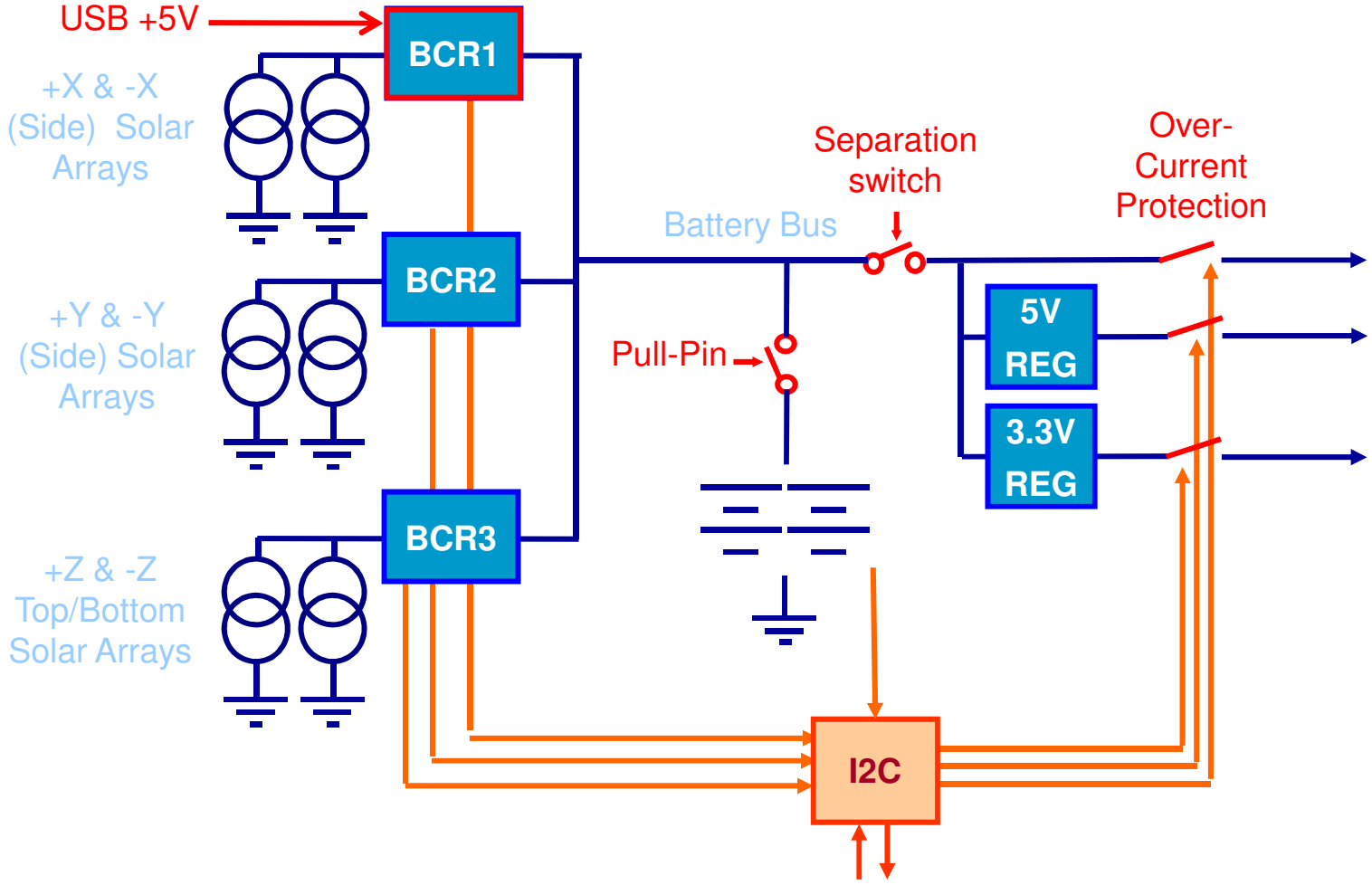
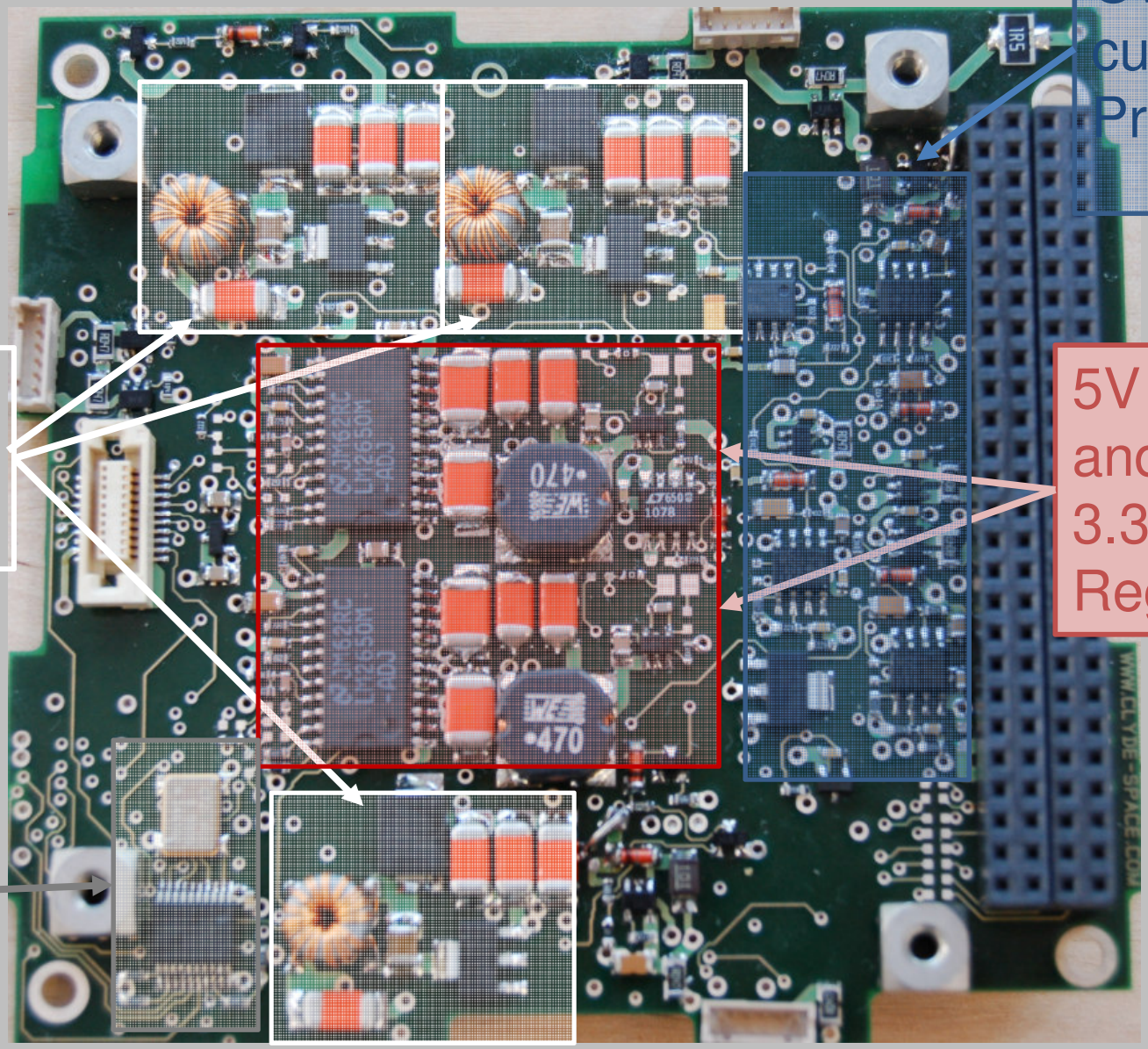
CubeSat EPS
12th August 2007

Introduction

- Clyde Space specialist Small Satellite subsystems company.
  - Our primary products are currently power management systems, batteries and solar panels.
  - We provide systems for spacecraft sizes from picosatellites to small GEO platforms.
- In May 2006 we started development of a CubeSat Power System.
  - Funded by Scottish Executive 'SMART Award'.
  - This was recently completed and we now have:
    - 1U Power System
    - 3U Power System
    - Integrated battery
    - Solar panels

Block Diagram



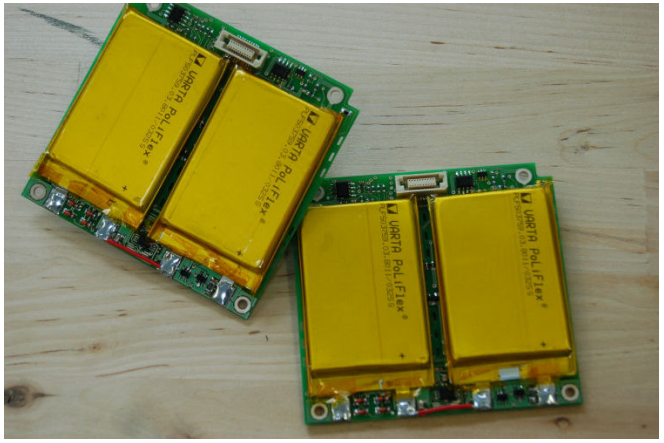


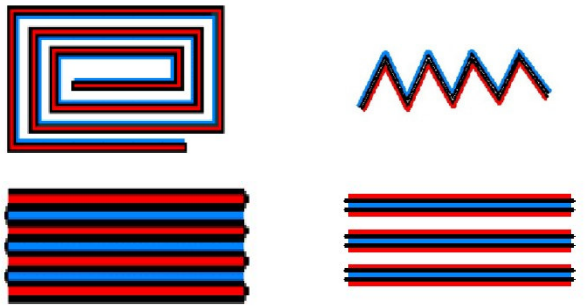
Specifications

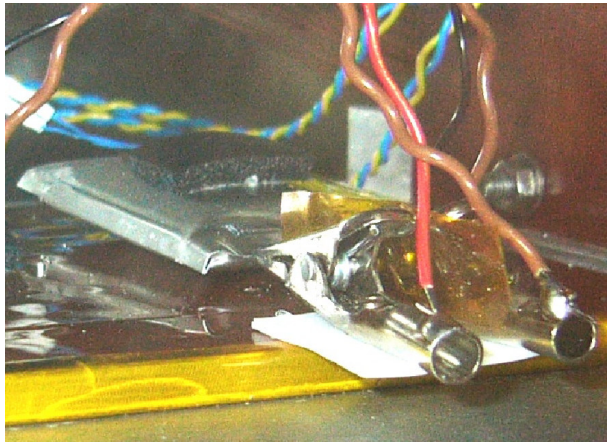
System Unit	Performances
3W [8W] BCR	Input voltage: 3.5V to 15V depending on mission configuration. Output voltage: 10V max. Output current: 0.5A [1.5A] max Efficiency: >90%
5V Regulator	Efficiency: >90% Output voltage: 5V +/- 1% over lifetime and temperature Output current: 20mA to 1A Light mode: zero to 20mA, 2.4% output voltage ripple
3.3V Regulator	Efficiency: >90% Output voltage: 5V +/- 1% over lifetime and temperature Output current: 20mA to 1A Light mode: zero to 20mA, 2.4% output voltage ripple
Over Current Protection	V_{BAT} BUS = 2A; 5V BUS = 1.2A; 3.3V BUS = 1.2A Over-current protection is 'timed' re-try (not permanent OFF)
Power System Mechanical Details	80g (including battery stand offs). Typical dimensions (with one 9.5Whr battery): 95mm (l) x 90mm (w) x 18.6mm [less than 15mm from top surface of PCB] (d).

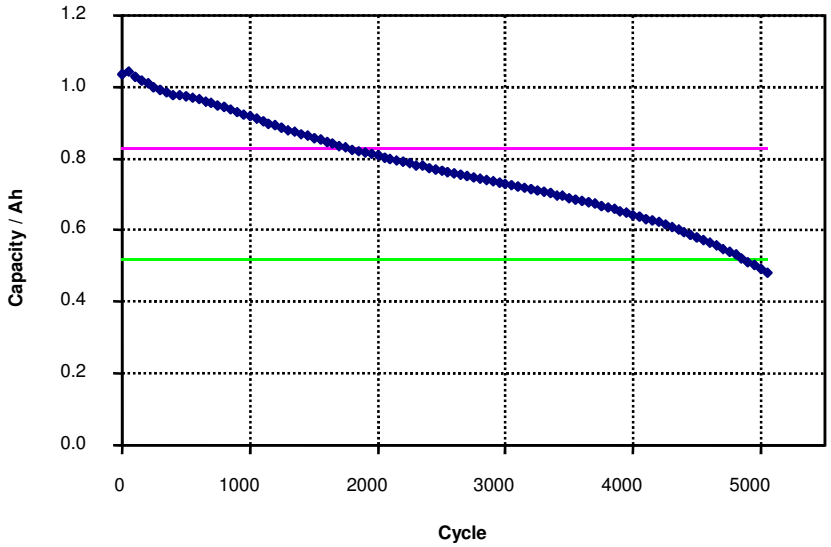
Lithium Polymer Battery

- High Energy Density, >150Wh/kg
- Suitable for hard vacuum conditions.
- 1 Year or more in LEO.
- Integrated battery heater with thermostat.
- Battery over-current protection (charge and discharge) using electronic fuse (no PTC).
- Cell under-voltage and over-voltage protection.
- Battery temperature, voltage, and current TLM.
- Low magnetic signature.
- 9.5Whr, 8.2V battery weighs 62g.

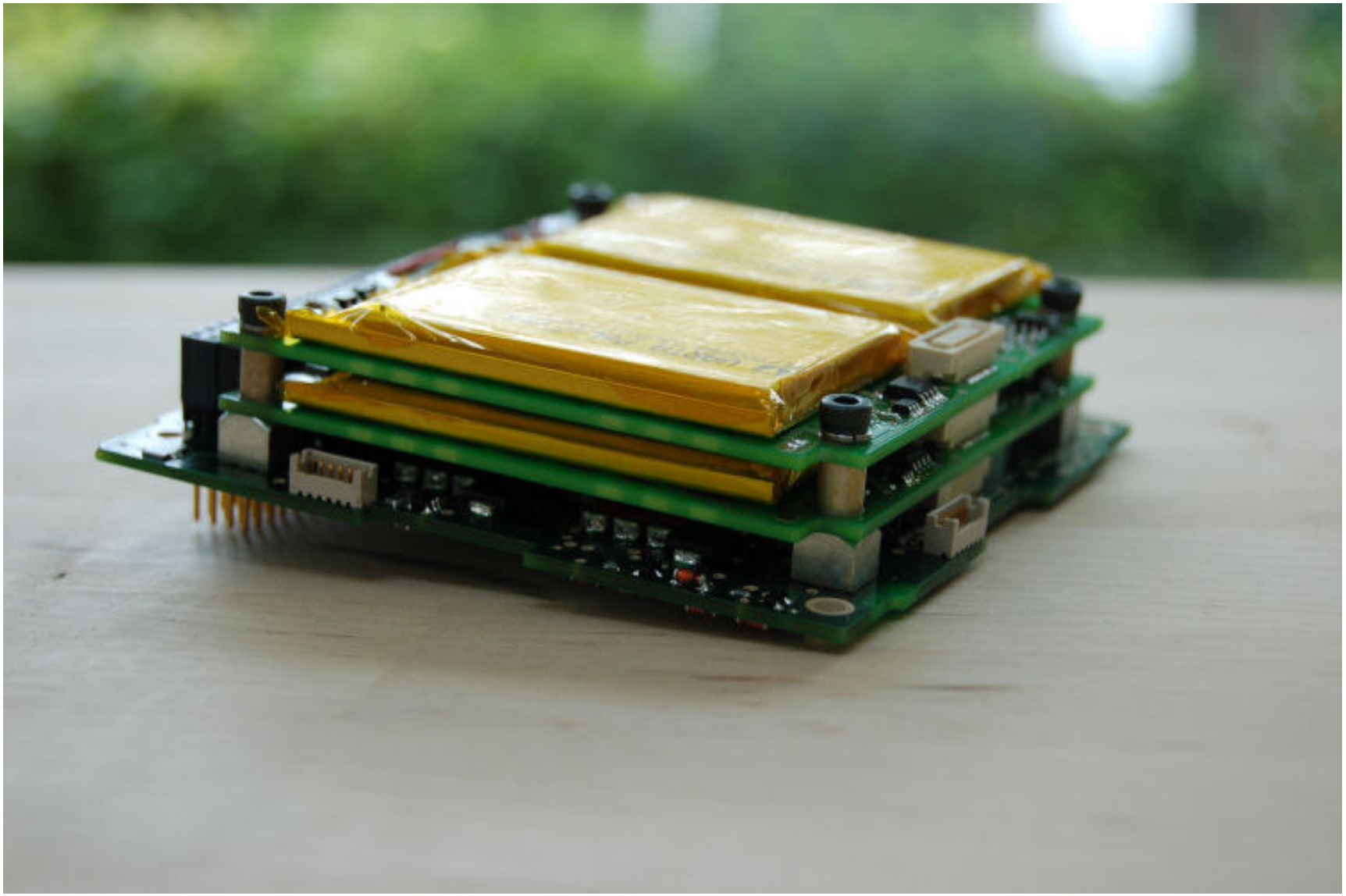




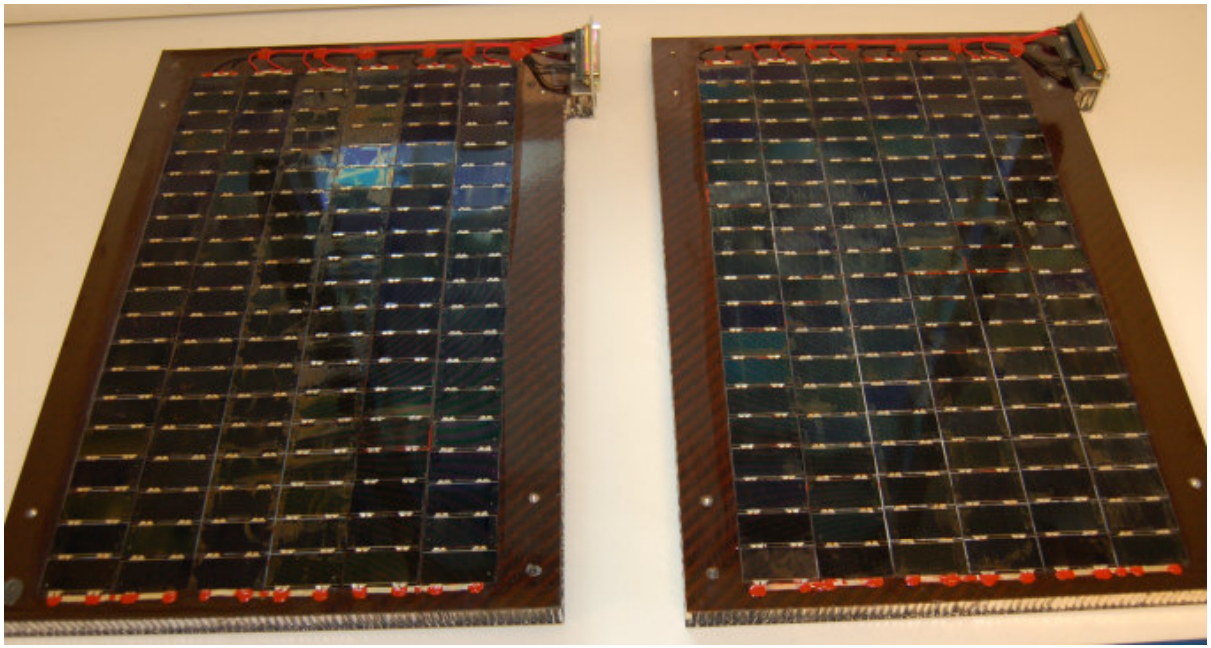


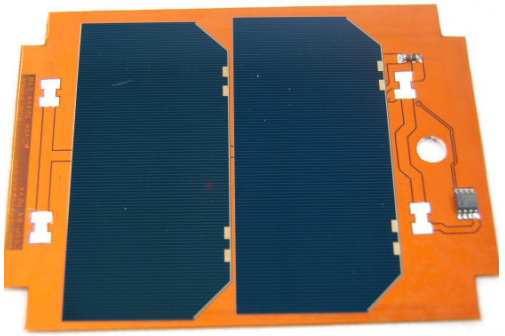


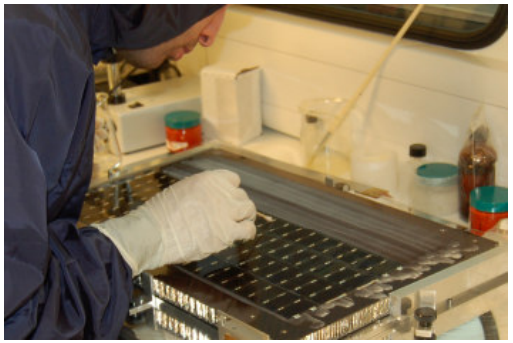
Integrated System



Solar Panels



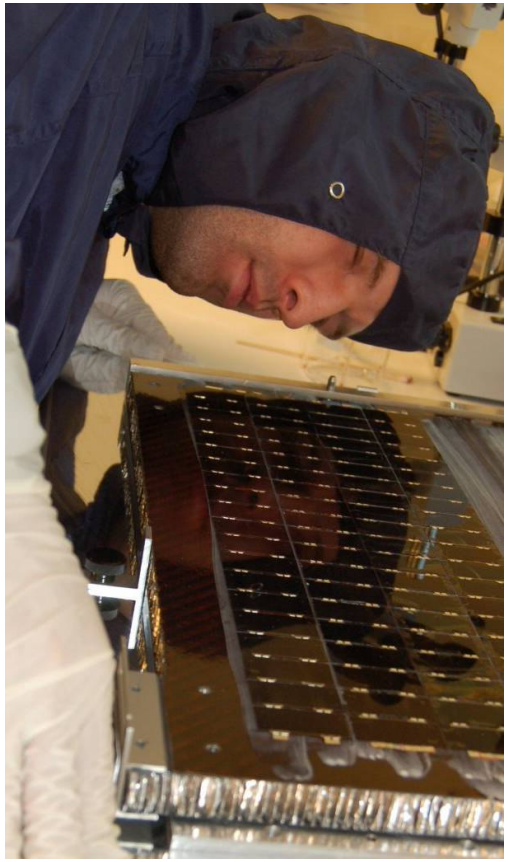




- Delivered: Two 24W SJ GaAs for SunSpace.
- Currently building:
  - CubeSat panels; 3U and 1U. (ATSB, ITU, INTA, IST)
  - High Efficiency and Silicon solar panels for SOHLA (Japan)

Future Developments

- Plug and play ADCS systems for picosatellites over the next 12 months.
  - The objective being to enable very low-cost formation flying of picosatellites.
- Solar Array Simulator for Small Satellites:
  - Multiple outputs.
  - Adjustable solar panel characteristics.
- Plug and Play Microsatellite Power System
  - Based on our CubeSat Power System; up-scaled for slightly higher power, multiple Serial interface protocols.



Concluding Remarks

- The Clyde Space EPS is planned for many CubeSat missions in the near future:
  - ATSB (Malaysia): TWO 3U missions called CubeSat and InnoSat
  - WIPSAT and PARADIGM at the University of Texas.
  - KYSAT
  - Many more…
- ITAR free.
- Feedback from CubeSat community very welcome.
- Please visit if you are in Scotland:
  - IAC2008 is in Glasgow!!