

Open Sourcing CubeSat Design



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on behalf of the
**LibreCube
Initiative**

at

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Outline of Presentation

- **Recap of CubeSat Success**
- **Definition of Open Design**
- **Why Open Source?**
- **The LibreCube Initiative**

Overall Objective

Open the **Access**
to **Space**

→ **Utilization**
→ **Contribution**

A Short Recap of the CubeSat Success

The Introduction of CubeSats

Education Tool

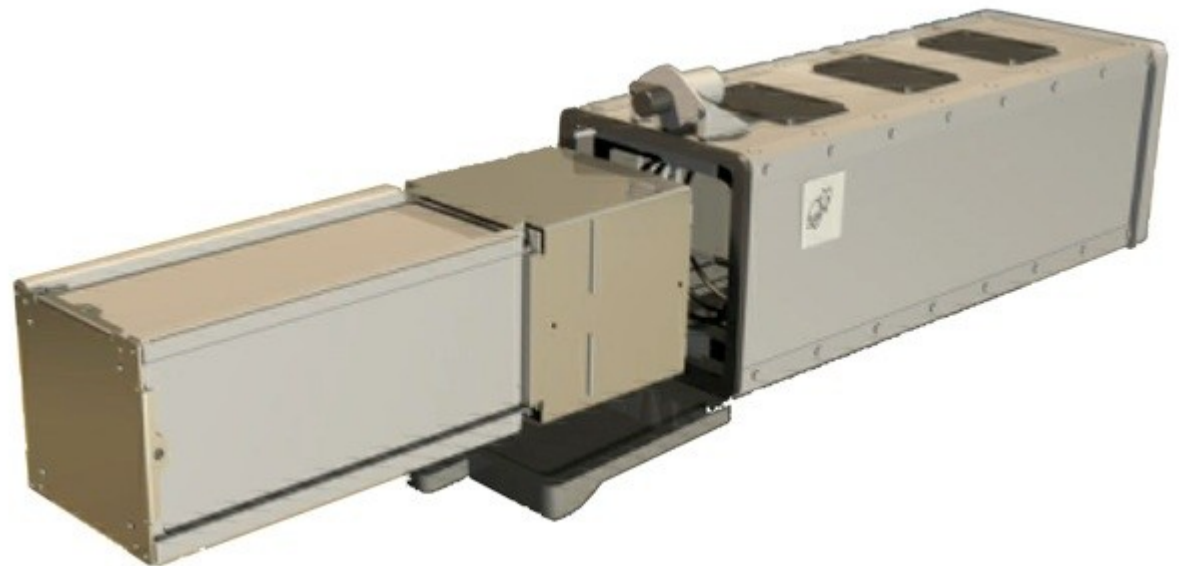
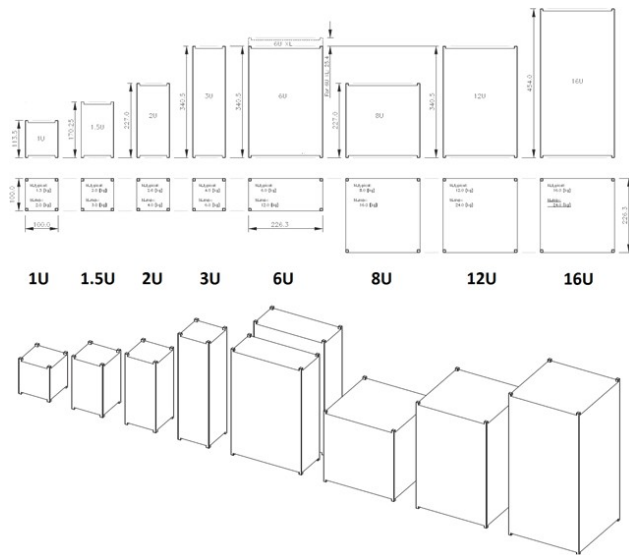
Science

Sharing



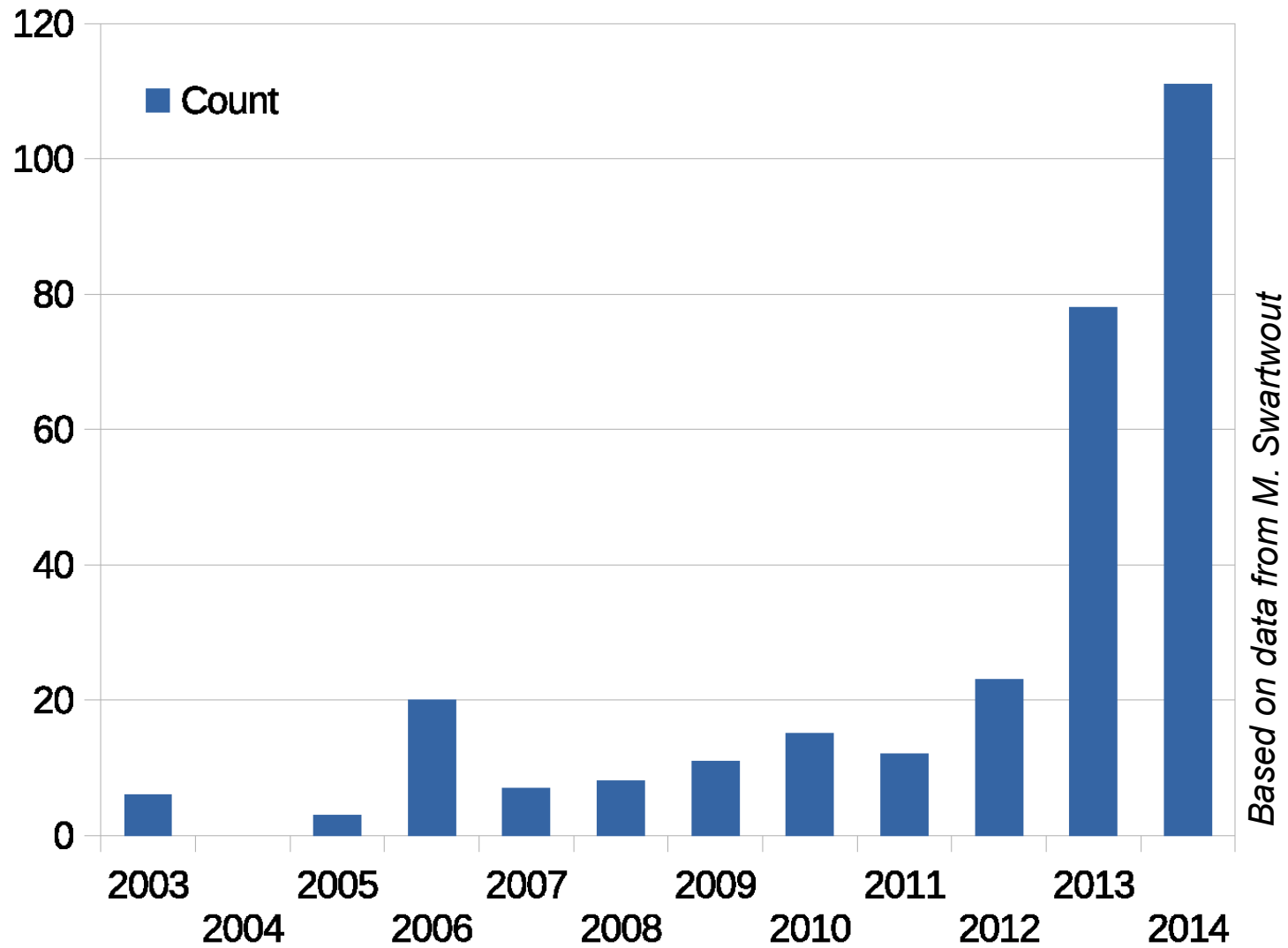
Standardization: Key to Success

Unified mechanical outline

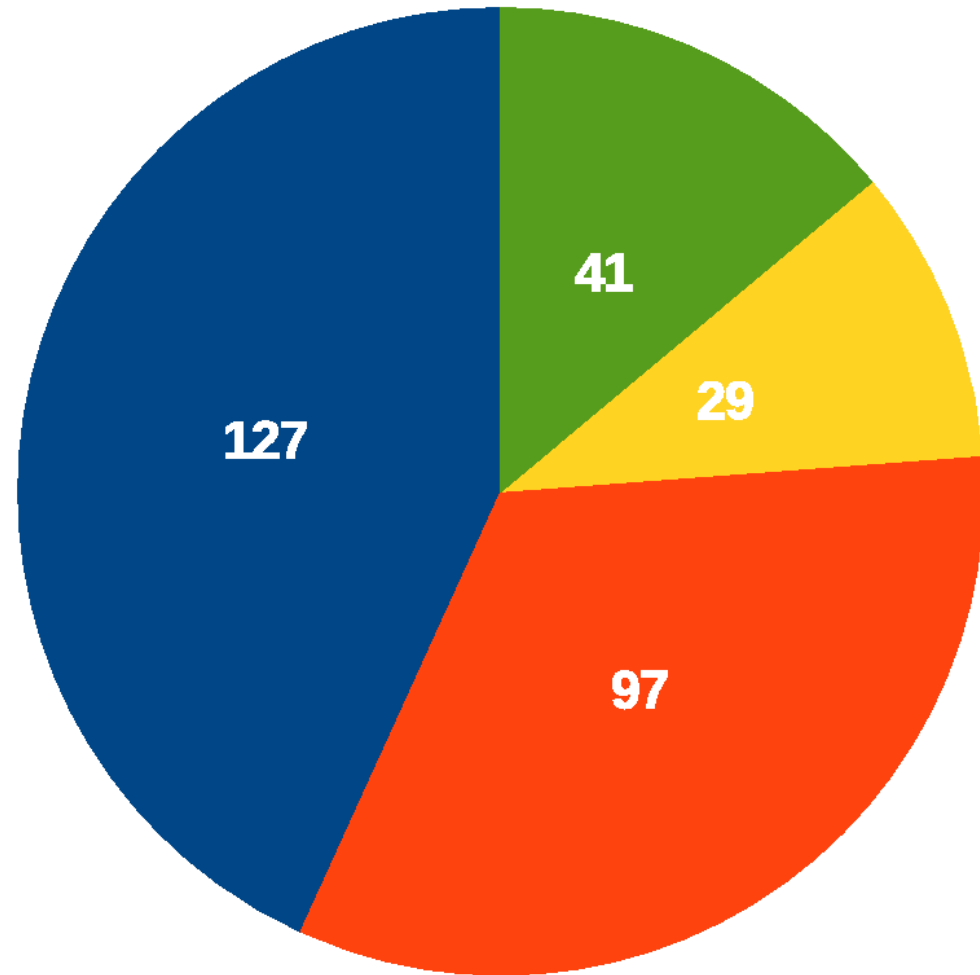


Decoupling from Launcher

From Education to Operation



CubeSat Operators



Based on data from M. Swartwout

■ University ■ Commercial ■ Agency ■ Military

Definition of Open Design

Intellectual Property Rights

Copyright

Protects how
information is presented

Patents

Protects the subject
matter of information

Trademarks

Protects “identifiers”

OPEN SOURCE

- Share the **Goal**
- Share the **Work**
- Share the **Result**

WHEN YOU PROGRAM OPEN SOURCE,
YOU'RE PROGRAMMING

COMMUNISM

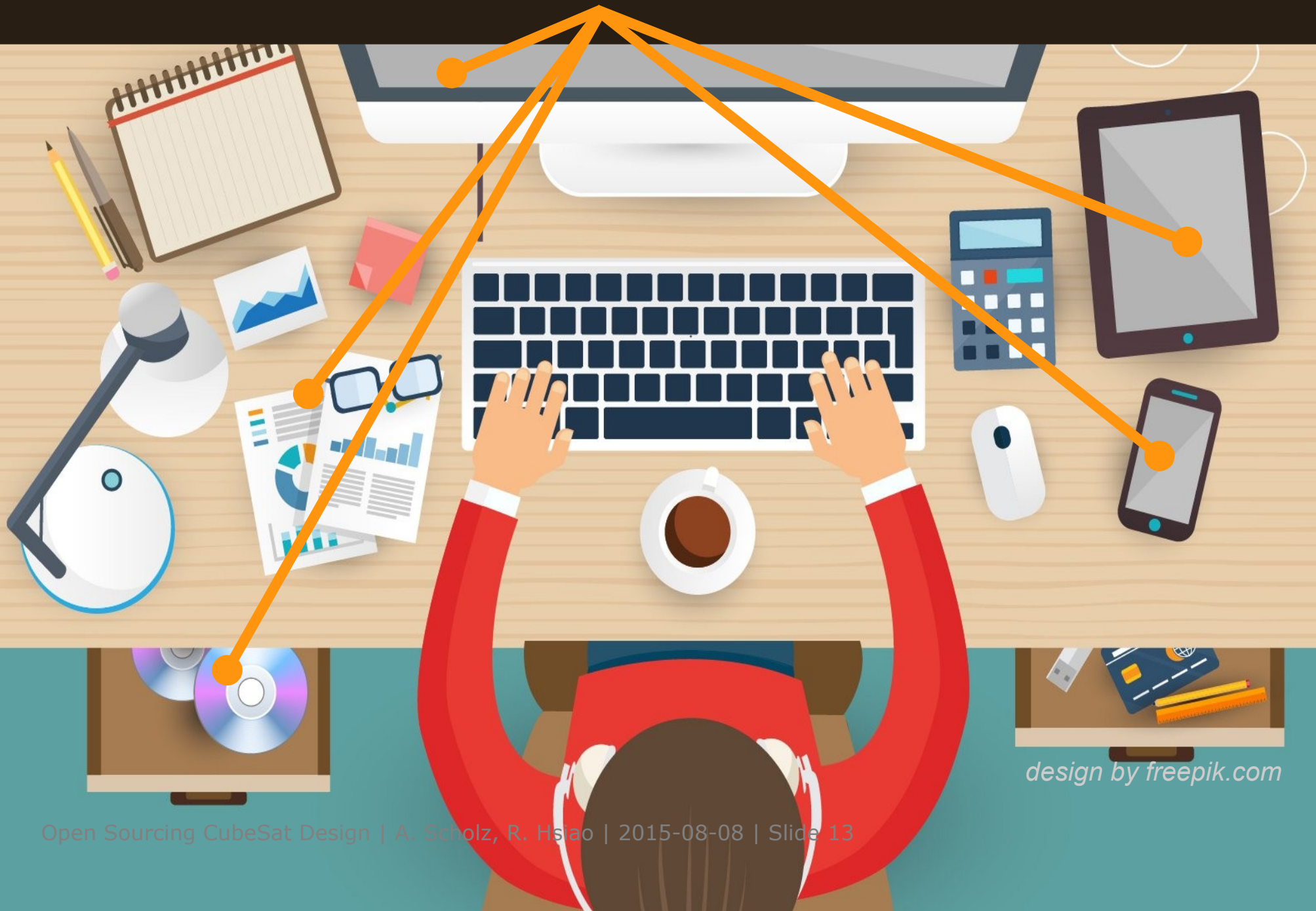


A REMINDER

from

YOUR FRIENDS AT MICROSOFT

Open Source is Everywhere



design by freepik.com

Why Open Source?

Open Sourcing YOUR CubeSat Project?

Why should I do this?

Who else is doing it?

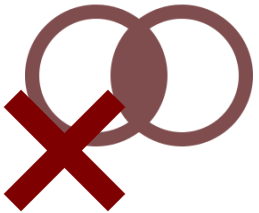
How can I do it?

How can this be profitable?

Downsides of Proprietary Solutions



Vendor Lock-In



Incompatibility



Restricted Insight

Benefits of Open Source Design



Reliability



Customization



Innovation



Collaboration



Cost

The LibreCube Initiative

The Pillars

Open Source

Modularity

Compatibility



Get Started: Browse Products

LibreCube Open source CubeSat projects

- Home
- About
- News
- Products
- Standards
- Resources
- Forums
- Contact


FOLLOW:

- Satellite Platform:
- Structure and Mechanisms
- Power
- Communication
- Processing
- Support Equipment:
- EGSE
- Ground Segment:
- Ground Station Systems
- Applications
- Tools:
- Firmware Development

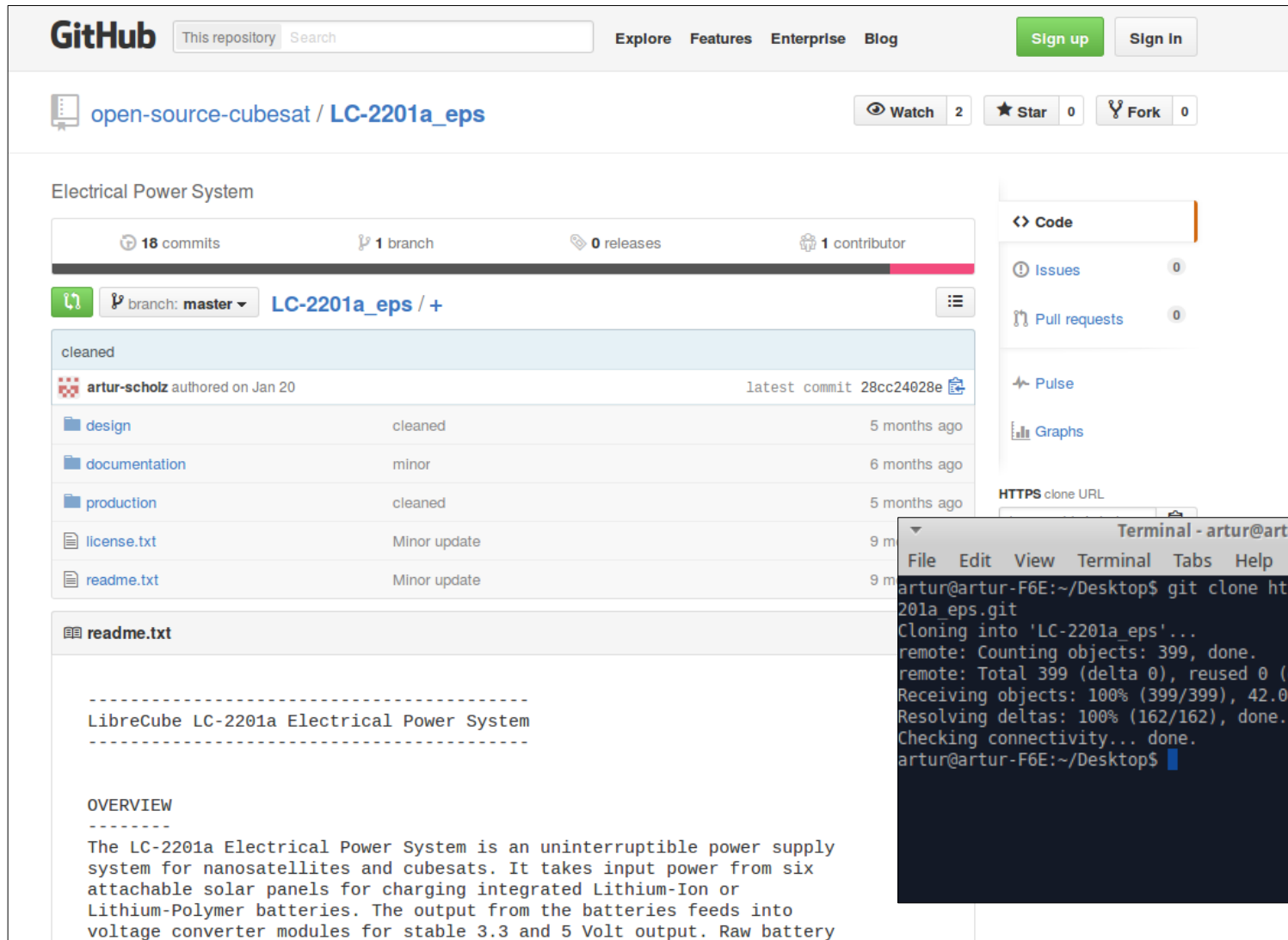
POWER

LC-2201a Electrical Power System [\[link\]](#)

Uninterruptible power supply system. Takes input power from six attachable solar panels for charging integrated Lithium-Ion or Lithium-Polymer batteries. The output from the batteries feeds into voltage converter modules for stable 3.3 and 5 Volt output. Raw battery voltage output is available as well. A system power switch controls the state of all power outputs. Measurements of currents, voltages, battery status and temperatures are automatically carried out by the device and are available via I2C interface.



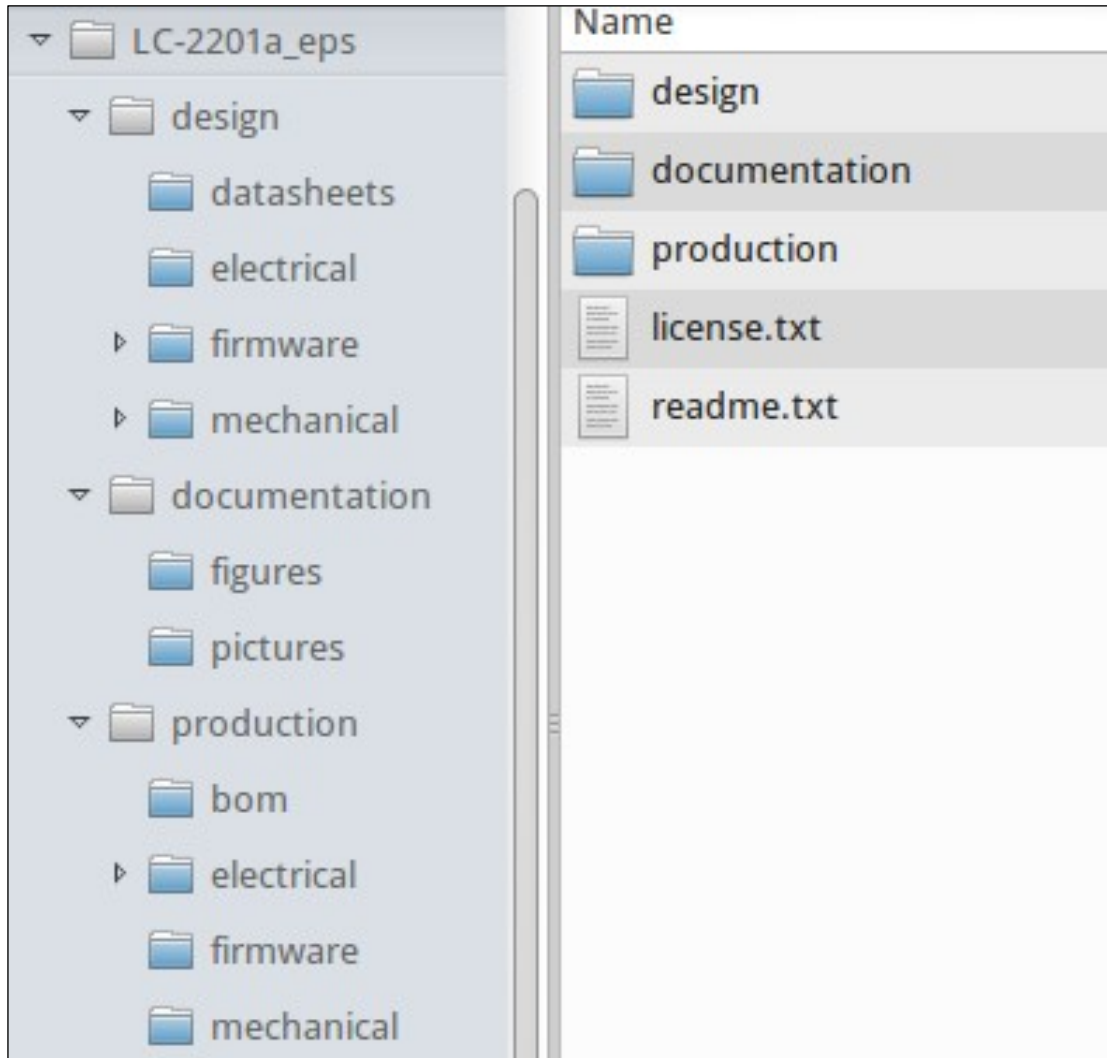
Download Repository



The image shows a GitHub repository page for 'open-source-cubesat / LC-2201a_eps'. The repository is titled 'Electrical Power System' and has 18 commits, 1 branch, 0 releases, and 1 contributor. The current branch is 'master'. The repository contains a directory 'cleaned' and files 'license.txt' and 'readme.txt'. The 'readme.txt' file is expanded, showing the title 'LibreCube LC-2201a Electrical Power System' and an overview section. The overview states: 'The LC-2201a Electrical Power System is an uninterruptible power supply system for nanosatellites and cubesats. It takes input power from six attachable solar panels for charging integrated Lithium-Ion or Lithium-Polymer batteries. The output from the batteries feeds into voltage converter modules for stable 3.3 and 5 Volt output. Raw battery'.

Overlaid on the bottom right is a terminal window titled 'Terminal - artur@artur-F6E: ~/Desktop'. The terminal shows the command 'git clone https://github.com/open-source-cubesat/LC-2201a_eps.git' being executed. The output is: 'Cloning into 'LC-2201a_eps'...' followed by progress information: 'remote: Counting objects: 399, done.', 'remote: Total 399 (delta 0), reused 0 (delta 0), pack-reused 399', 'Receiving objects: 100% (399/399), 42.08 MiB | 213.00 KiB/s, done.', 'Resolving deltas: 100% (162/162), done.', and 'Checking connectivity... done.'. The terminal prompt returns to 'artur@artur-F6E:~/Desktop\$'.

Then...



Study
Modify
Produce
Sell
Use

Give Feedback
Contribute

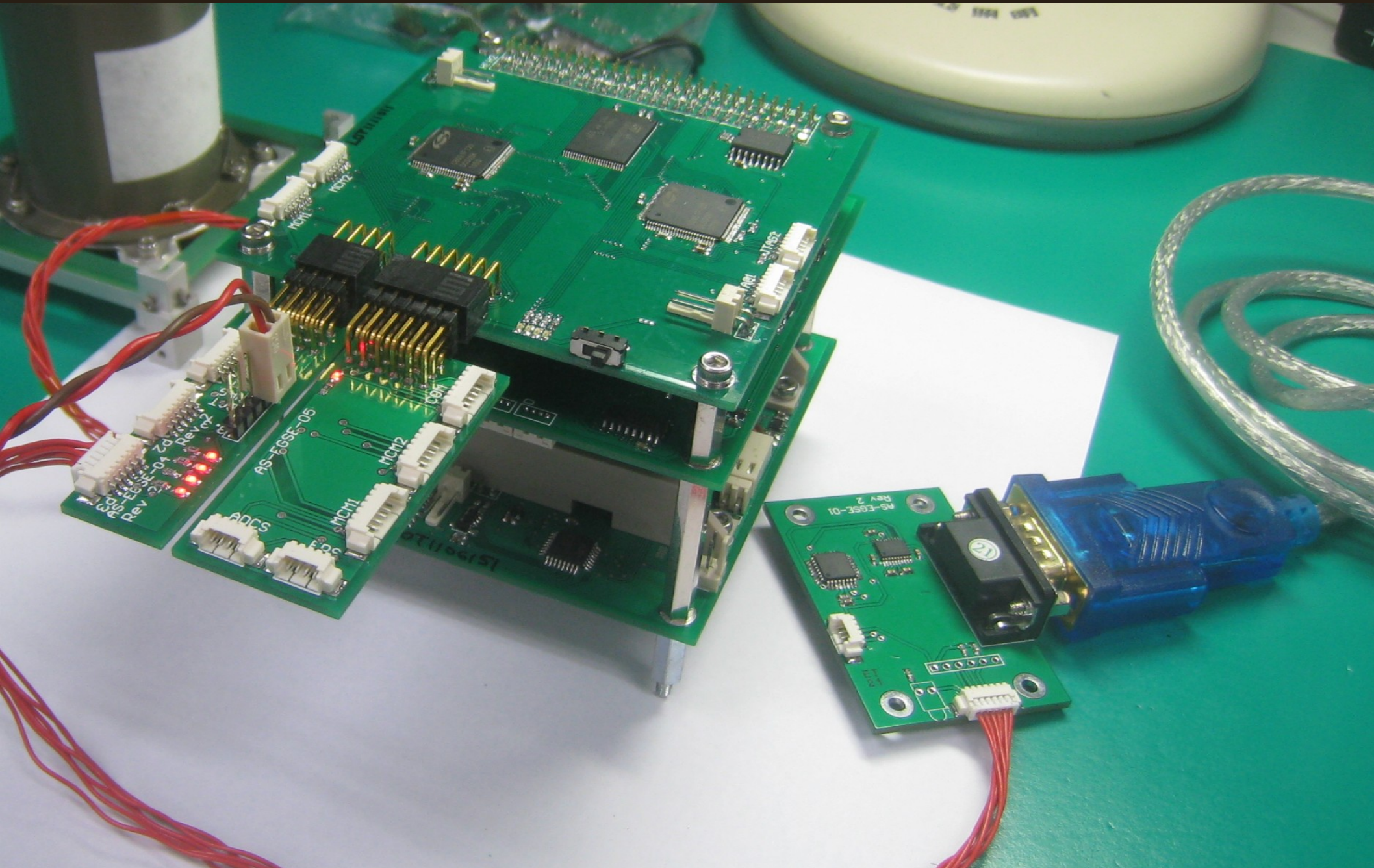
(some)

Examples

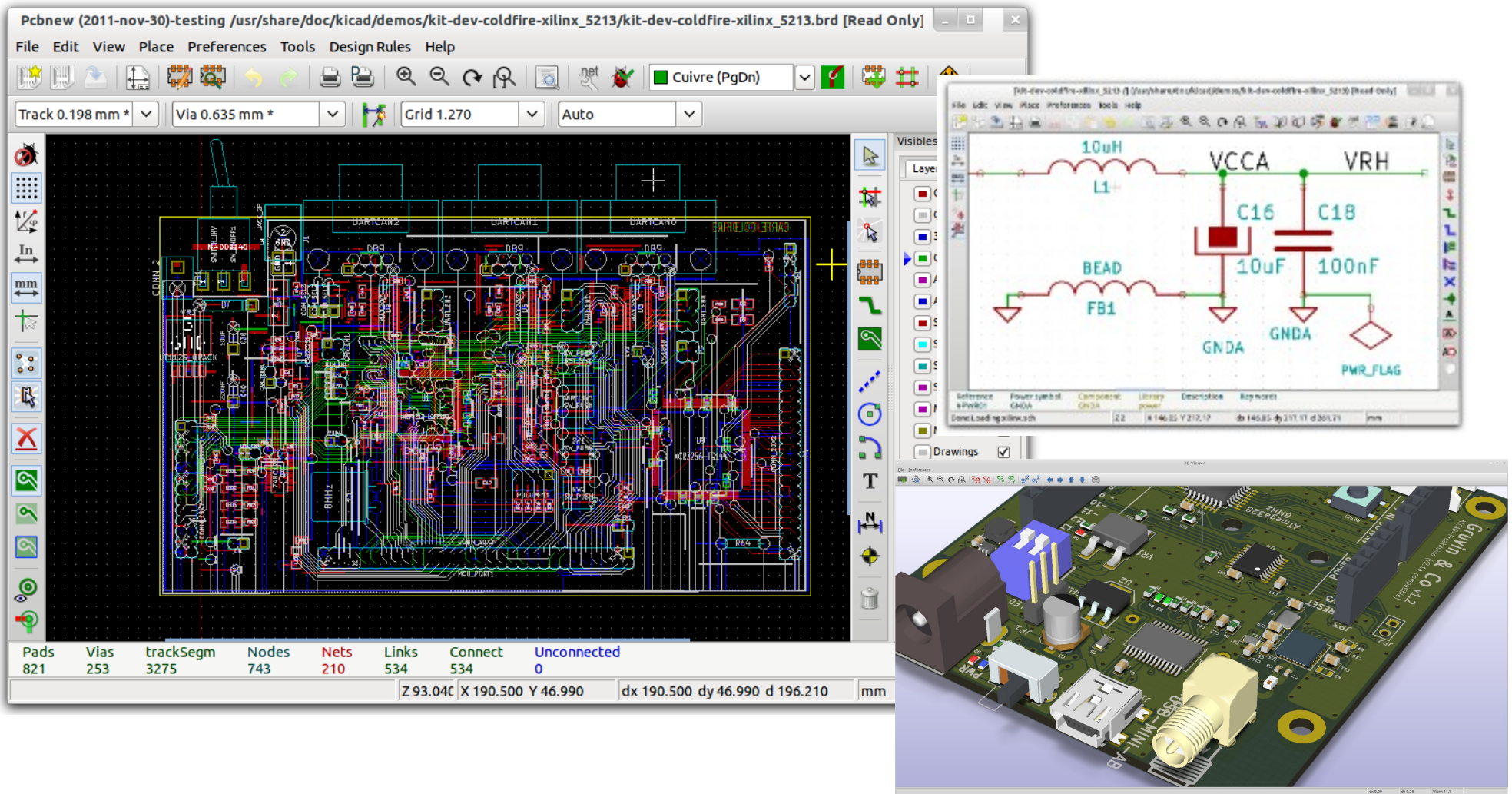
Example_1

FlatSat Board

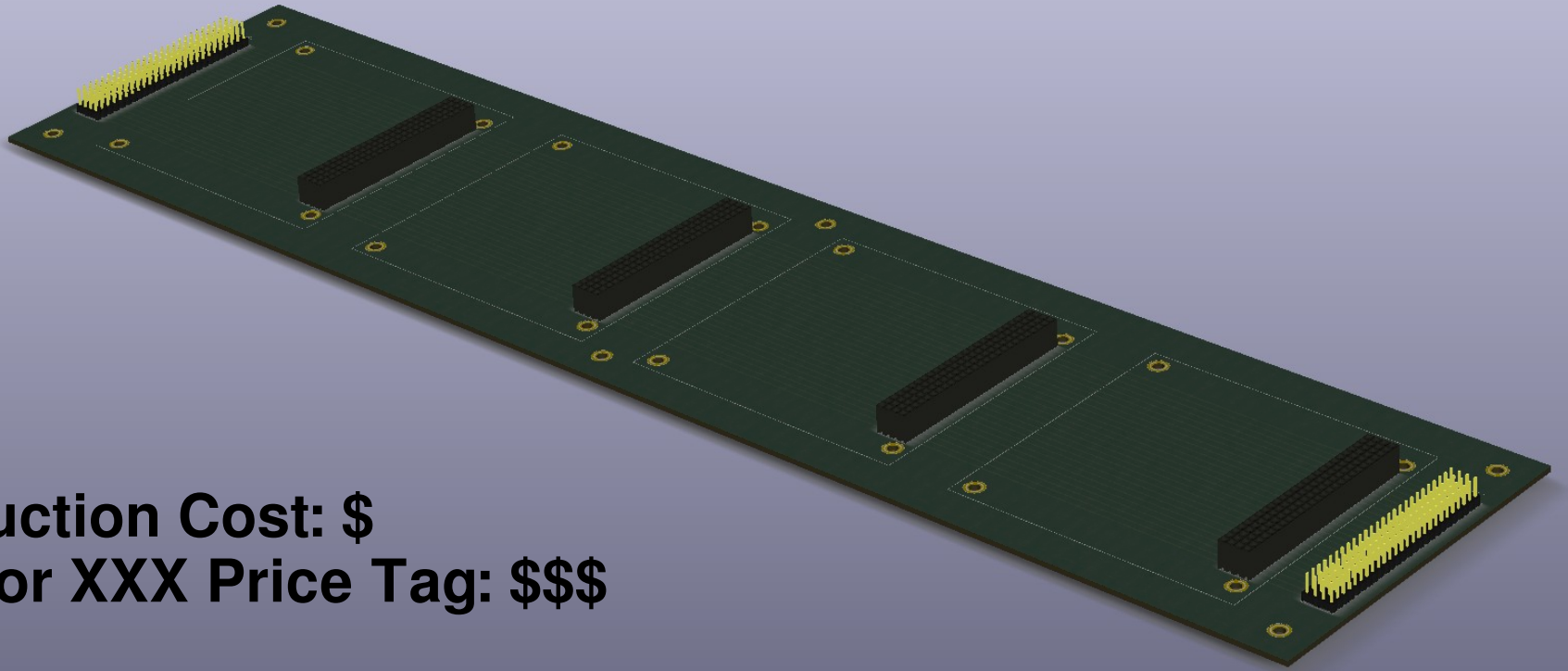
Objective: Easier Access to Pins



Challenge: Use KiCAD for the Task



Result: LC-3103a (Support Equipment / EGSE)



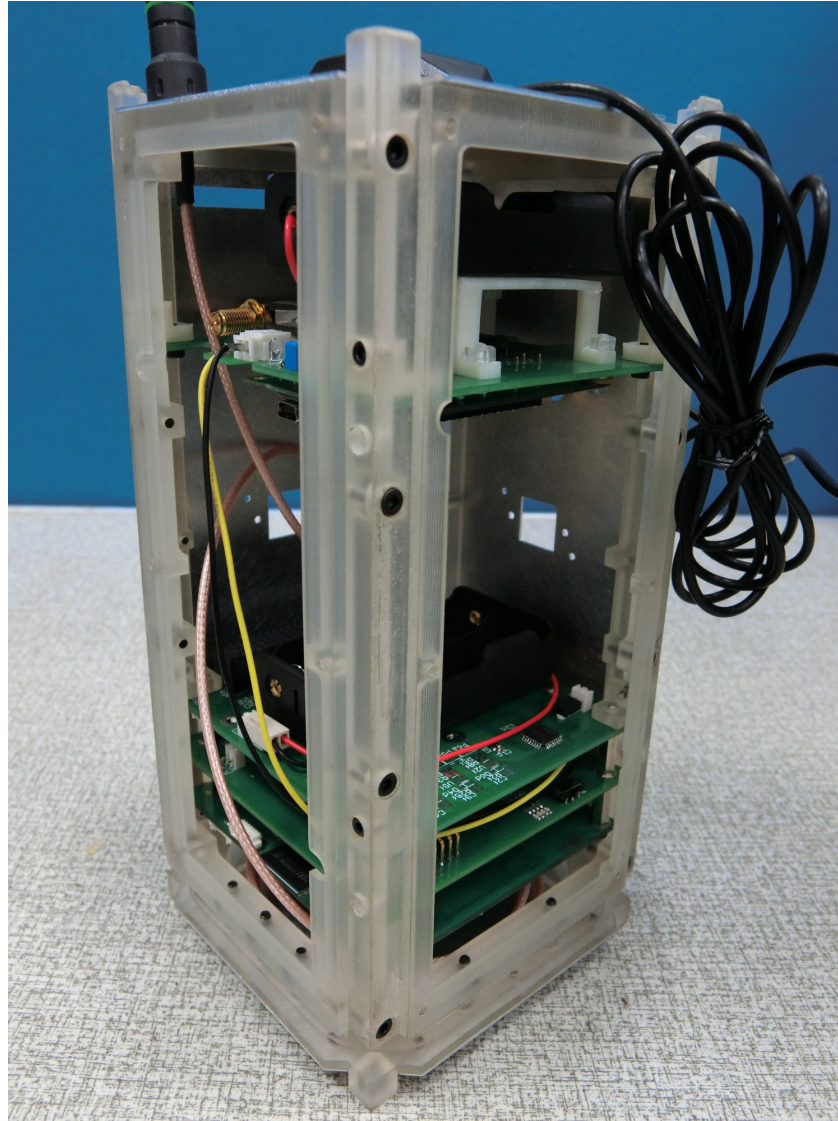
Production Cost: \$
Vendor XXX Price Tag: \$\$\$

Example_2

High Altitude Balloon Flight



The Platform



Flight Path



Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
Image © 2015 TerraMetrics
Data LDEO-Columbia, NSF, NOAA

Google™ earth

Conclusion

LibreCube is an exemplary open source initiative for CubeSats

An alternative to closed source business products
→ **focus is on collaboration and community**

Make CubeSats more accessible, more reliable, and foster standardization

Thanks for Your Attention !

