UNIVERSITY of HAWAI'I®
MĀNOA

Phys 475 - Design Review

Vihtori Virta
Khanh Le
James Ou

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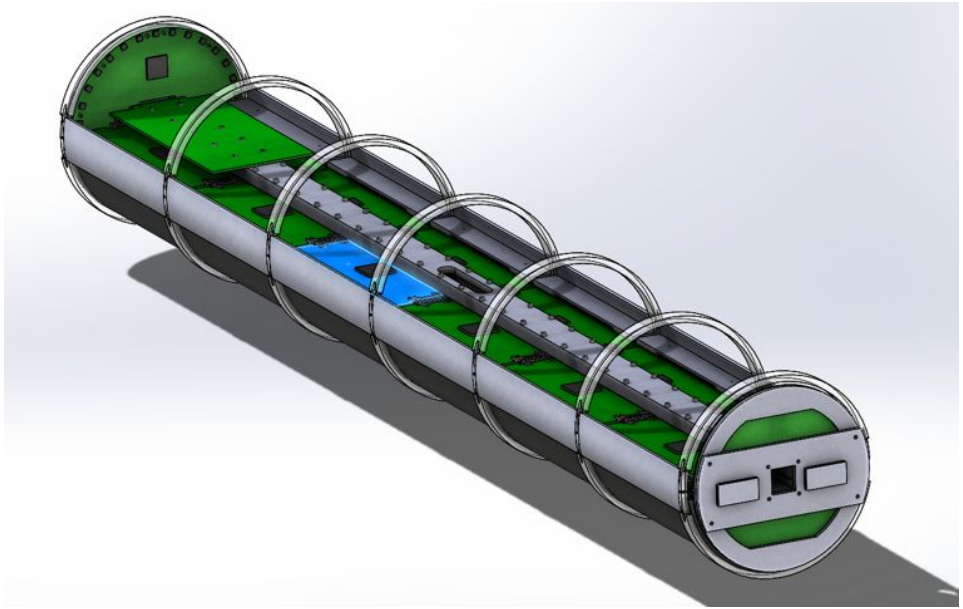


Figure 1. 3D model of Full BMD Detector

Overview / Background

- What
  - Design second version of muon detector using Multi-pixel Photon Counters (MPPC)
- Why
  - Tomographic reconstruction allows non invasive 3D imaging (e.g. CT scans, MRIs)
  - Muons have greater penetration, allowing deeper scanning than x-rays
  - 1st version was too large, thus there is a need to compress the system into 6” cylinder, approximately 1 meter long

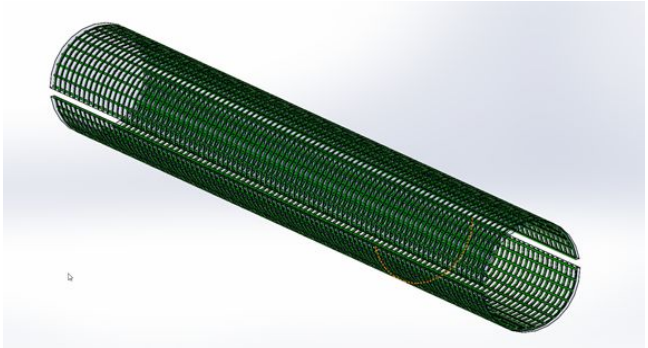


Figure 2. Cylindrical scintillator with light shifting fibers.

Overview / Background (continued)

- How
  - Remove long CAT 6 cables to reduce signal noise and congestion
  - Redesigning MPPC boards to include additional FPGA in order to have localized ASIC readout and initial data filtering
  - Changed shape of scintillator from square rods to round hollow cylinder with light shifting fibers epoxied around and along cylinder

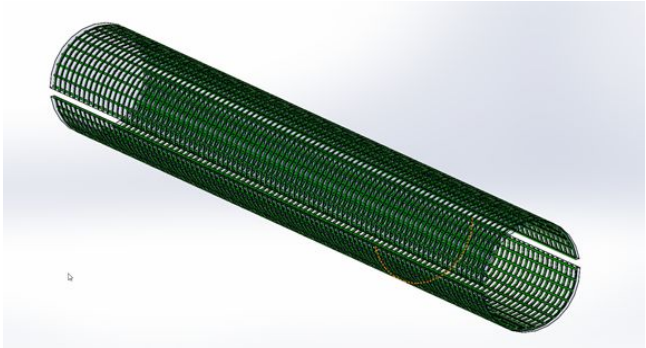


Figure 2. Cylindrical scintillator with light shifting fibers.

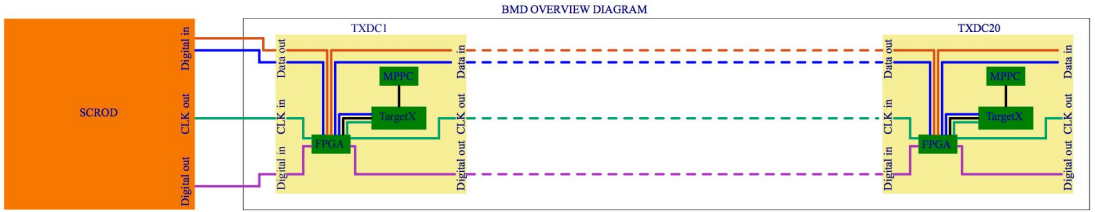
Project Objectives

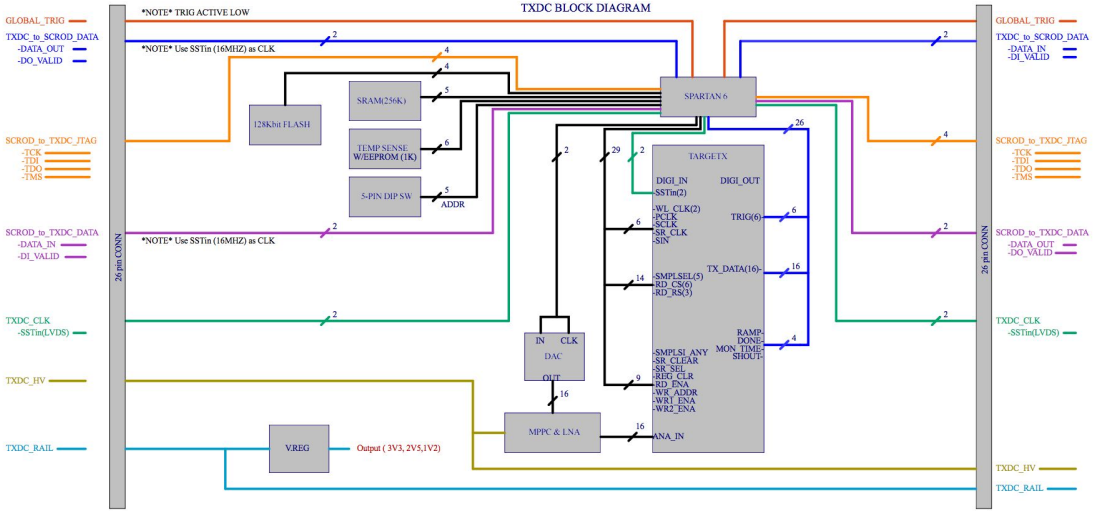
1. Design, fabricate, populate, and test the BMD daughter cards and interconnection board
2. Design, develop, integrate, and test firmware for subcomponents on daughter card
    a. DAC
    b. Temperature Sensor
    c. SRAM
3. BMD control/configuration firmware
4. Data readout

Specifications

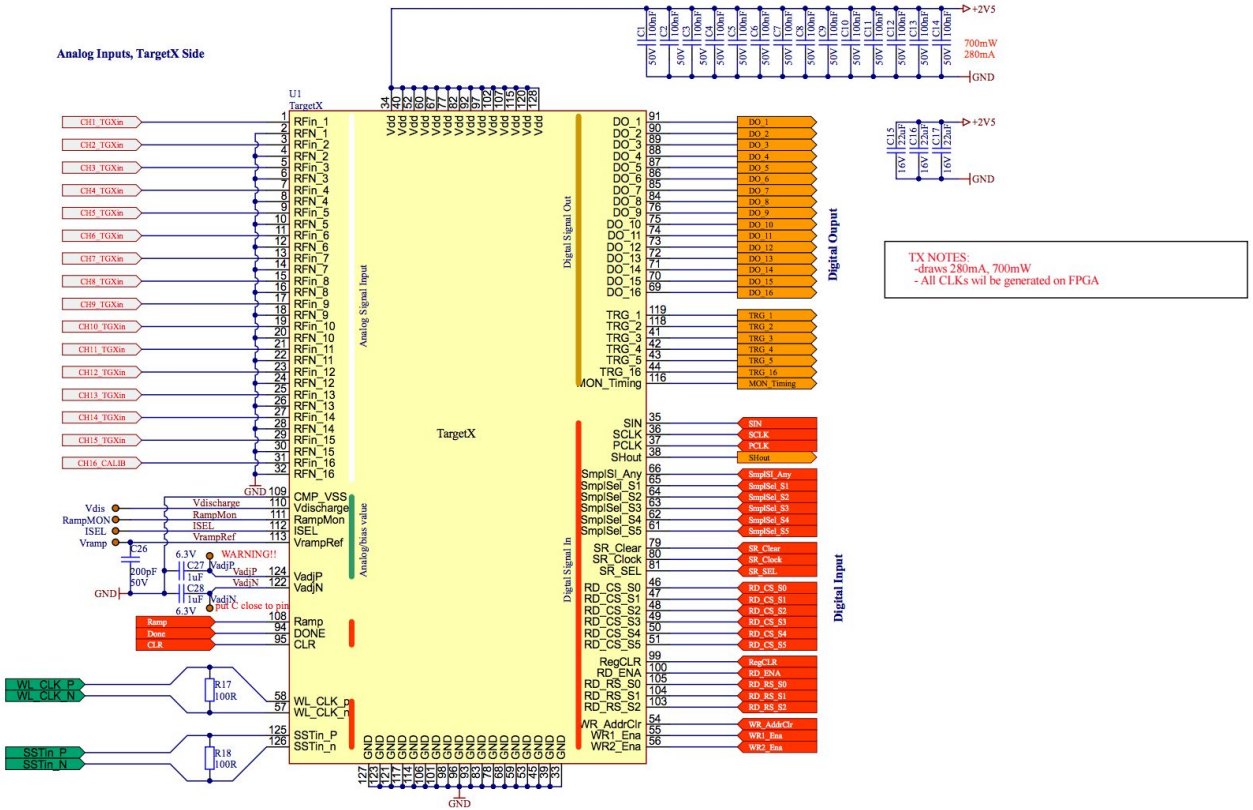
- Final BMD system will include
  - MPPC center daughter card
  - MPPC doughnut(end caps) daughter card
  - power board
  - SCROD
  - Cylindrical scintillator

Block Diagram

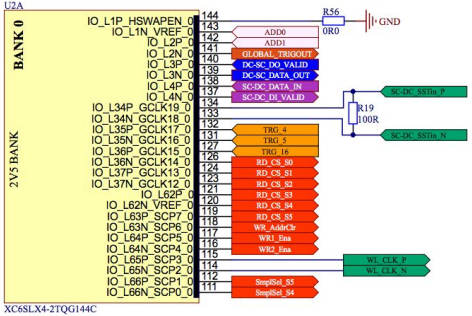


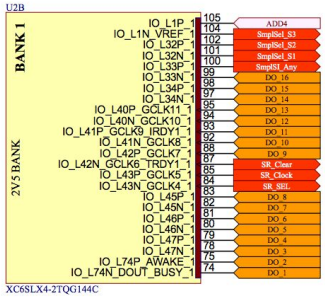


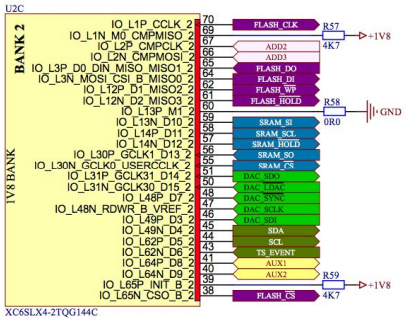
Detailed Schematics (TargetX)



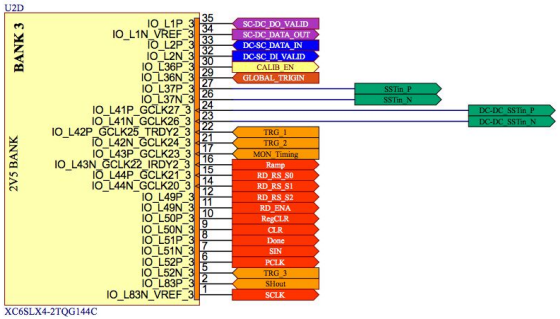
Detailed Schematics (FPGA)



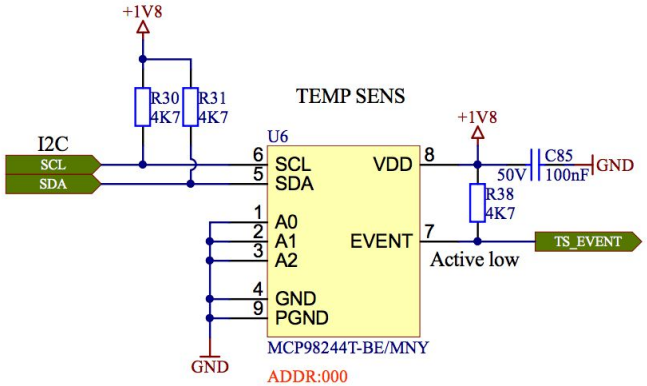


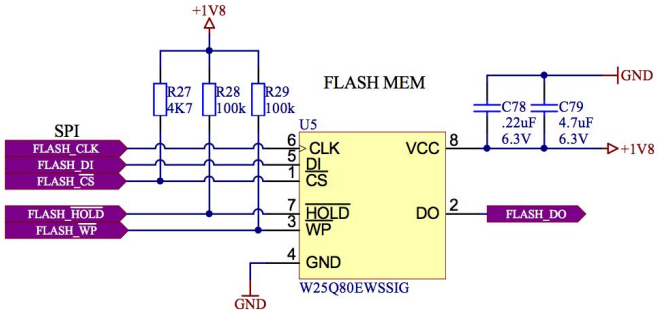


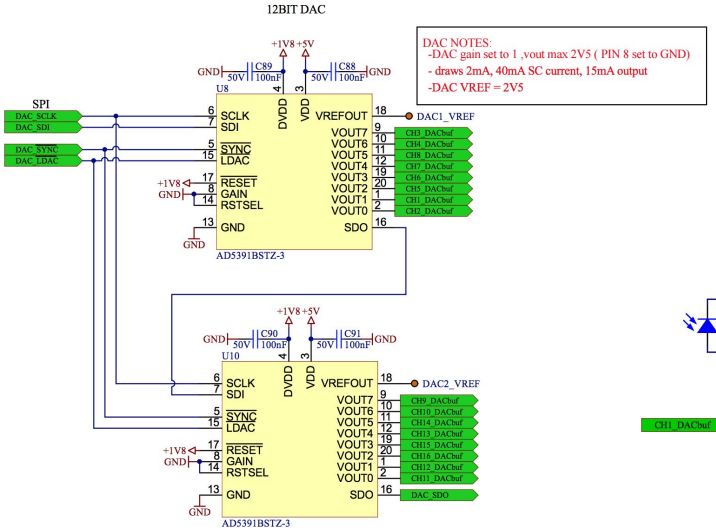
FPGA setup notes:
-FPGA set to master mode (pin 60 to GND 69 set to VCCO3)
-FPGA set serially for JTAG programing
-FPGA set to load image from flash memory

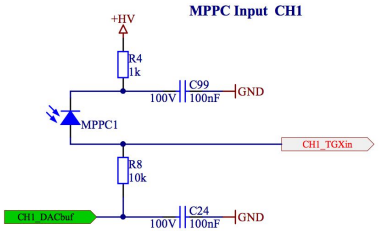


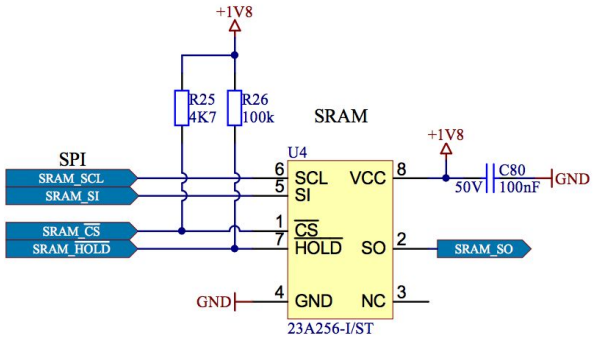
Detailed Schematics











Overview of Key Components

- Hamamatsu S12572-050/P MPPCs, along with the scintillators, are used for capturing and tracing the muons.
- TargetX waveform sampling/digitizing ASIC is used for capturing, saving, and digitizing the muon events.

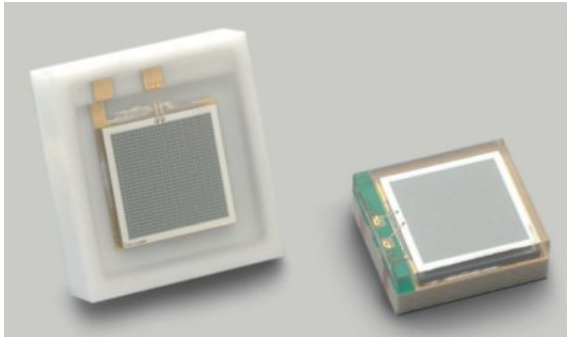


Figure 2. Hamamatsu S12572-050/PMPPC

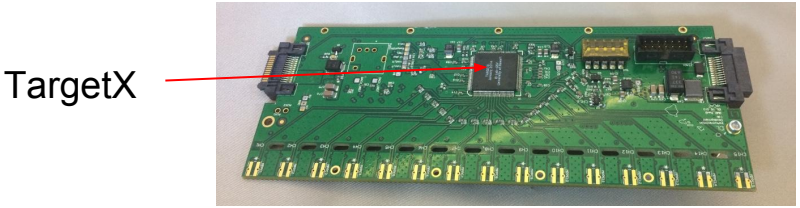


Figure 2. Daughter Card

Overview of Key Components (continued)

- Interface board
  - The purpose of the interface board is to connect SCROD with the daughter cards.
- SCROD
  - SCROD card acts as a mother board. The SPARTAN6 FPGA is used to control the daughter cards.

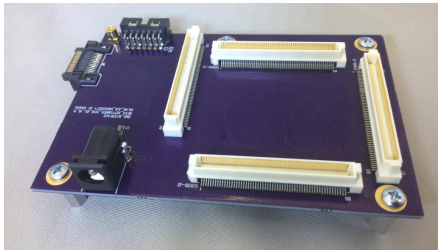


Figure 2. Interface Board

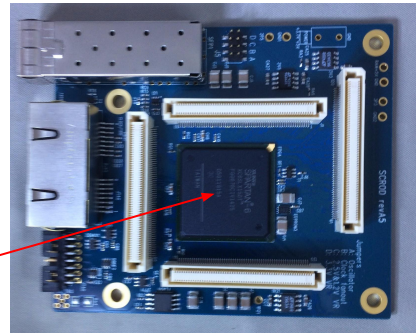
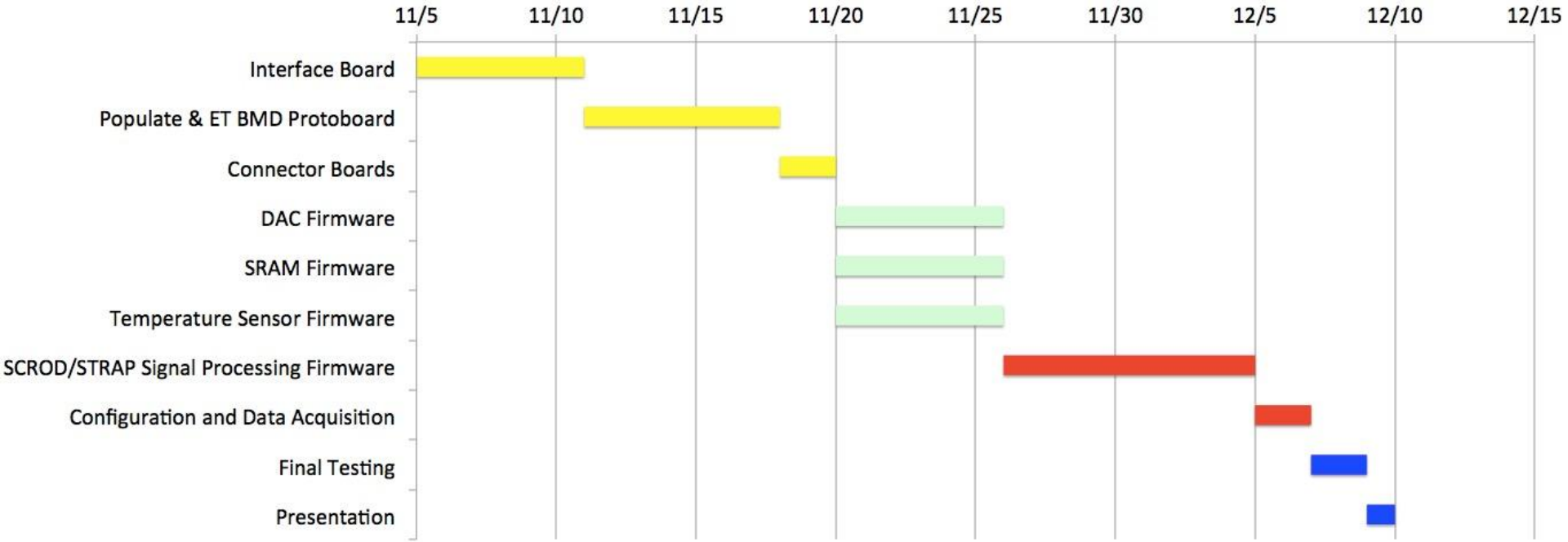


Figure 2. SCROD

Current Issues / Roadblocks

- Firmware for subcomponents cannot be tested until interconnection board and SCROD are integrated, allowing the clock to be fed from SCROD.
- Firmware and frontend for control, processing, and communications cannot be completed until existing SCROD/STRAP code is obtained for review.
- Full system cannot be tested until the mechanical components are complete.

GANTT chart


11/5
11/10
11/15
11/20
11/25
11/30
12/5
12/10
12/15
Interface Board
Populate & ET BMD Protoboard
Connector Boards
DAC Firmware
SRAM Firmware
Temperature Sensor Firmware
SCROD/STRAP Signal Processing Firmware
Configuration and Data Acquisition
Final Testing
Presentation

Conclusion

- The circuit boards are done
- Temperature sensor firmware is ready for integration
- DAC and SRAM firmwares are ongoing

Future Work

- SCROD/STRAP signal processing firmware
- Configuration and data taking software
- GUI display/running software
- Make a testing jig for the completed system

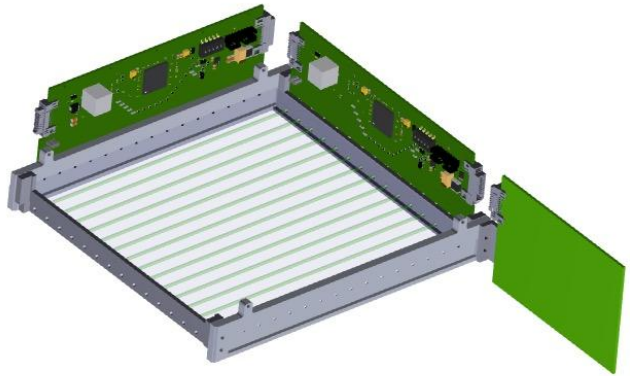


Figure 2. Testing Jig.

Questions?

(please say no)

(please clap)