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Implementation of Advanced Capabilities to the P-POD

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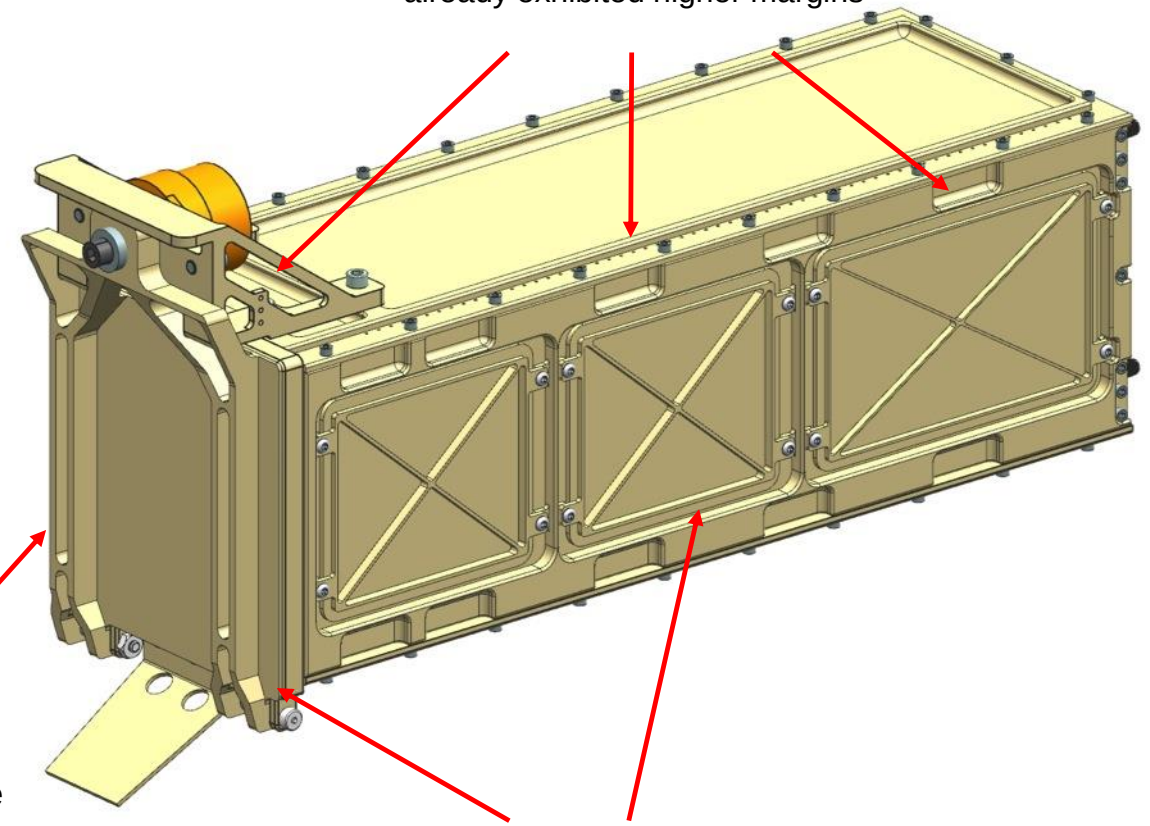
P-POD Mk. IV Design Motivation

- As CubeSat payloads become more sophisticated, basic dispenser function does not fully support some mission requirements
- High power transmitters or missions that require a power-on state during flight must be shielded to not disrupt any other LV functions
- Sensitive instruments require can require an inert gas purge (such as GN2) in order to survive the ground phase
- In some cases, the ability to receive power, telemetry, and command from the launch vehicle could make new missions possible
  - Referred to as “Power-On” system

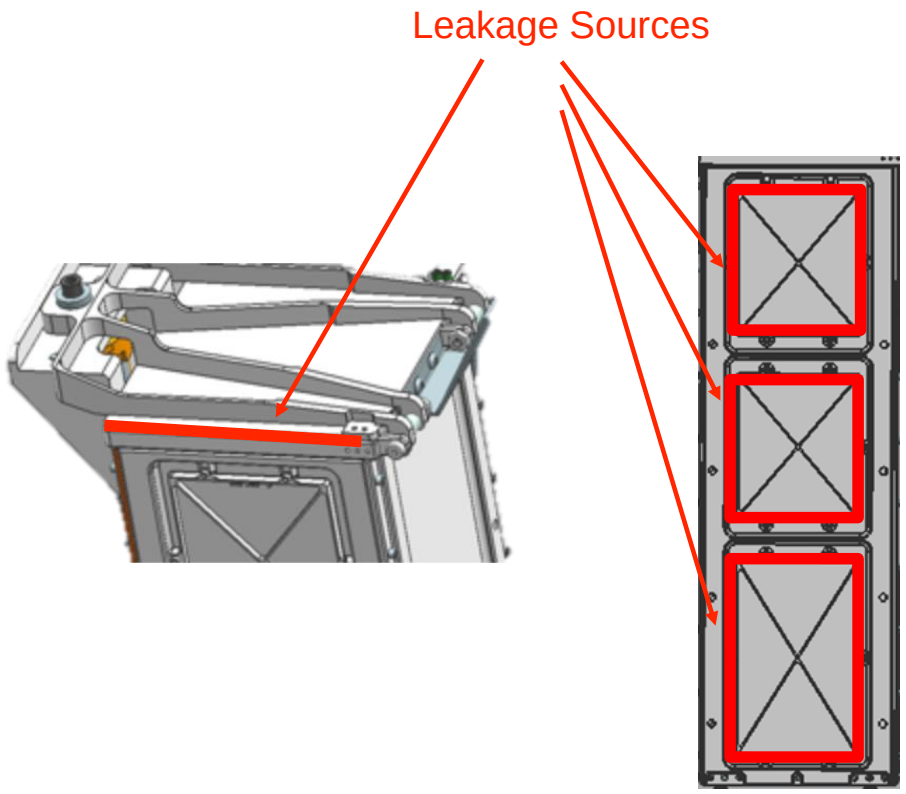
Overall P-POD Design Updates

- EMI Shielding Incorporation
  - Gasketed door-collar interface
  - Gasketed access ports
- Purge/Power-On accommodation incorporated to the back plate
- Door design modification to provide a stiffer load path and reduced stress concentration



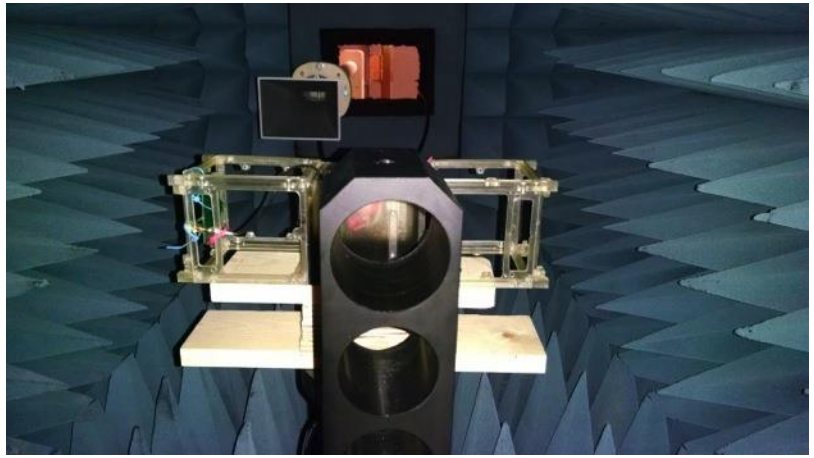
EMI Shielding Design

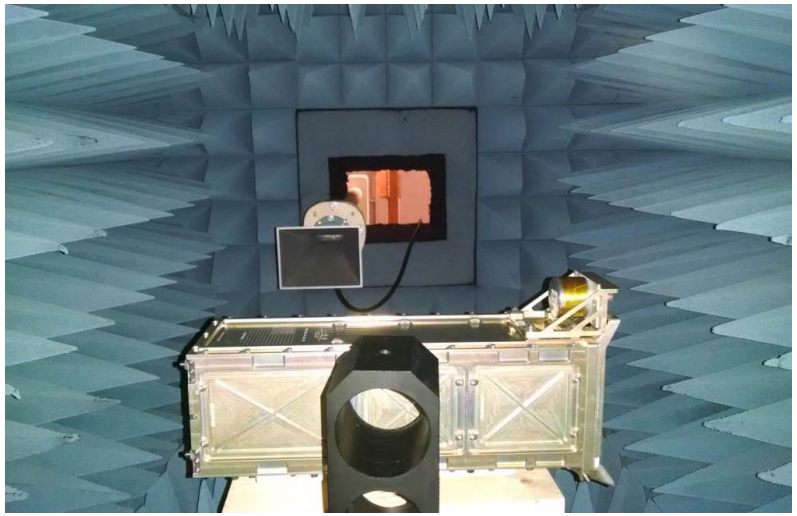
- Sources of RF leakage -> large fastener spacing
  - Access Port Gaps and Door interface
- Gaskets installed at appropriate interfaces
  - Collar/Door gasket held in place with conductive epoxy
- Sealing the gaps creates a need for ventable area
  - Vent hole array designed based on an analytical model and added to the +Y Top Panel
  - Meets launch vehicle ascent venting requirements



EMI Testing

- Initial testing utilized an antenna connected to a coaxial cable
  - Cable was not shielded enough to accurately measure shielding effectiveness
- Test setup changed to eliminate the coaxial cable to the inside of the P-POD
- Utilize a self-sustained transmitter inside of the P-POD and a receiving antenna 1-2 m away on the outside
  - Eliminates cable coupling concerns as there is no cabling on the receive end outside of the P-POD

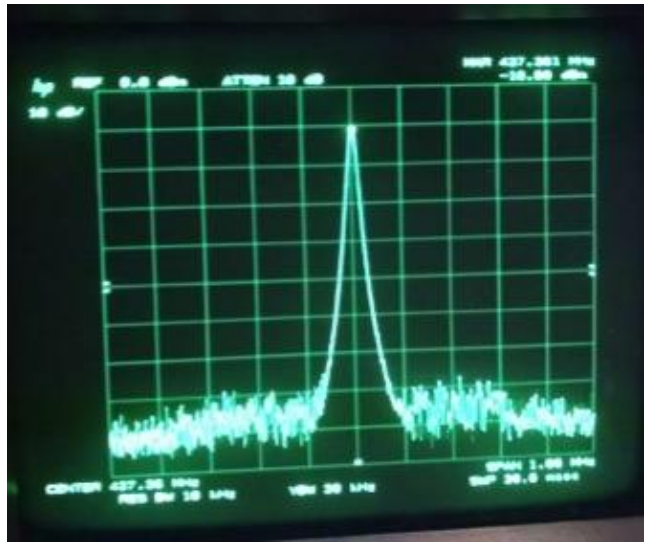




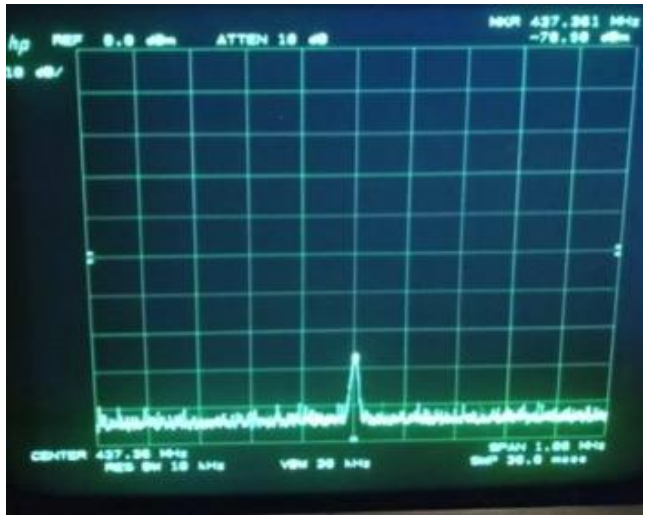
EMI Testing Results

- Shielding ranged from 30 to 74 dB from 437 MHz to 10 GHz

Frequency	P-POD +Y Attenuation (dB)	P-POD +X Attenuation (dB)	P-POD -Y Attenuation (dB)
437 MHz	64.6	73.8	66.1
4.3 GHz	40.5	36.3	43.3
5.2 GHz	39.9	36.9	42.9
8.6 GHz	40.8	35.7	35.1
10 GHz	30	38.6	31.8



437 MHz Baseline



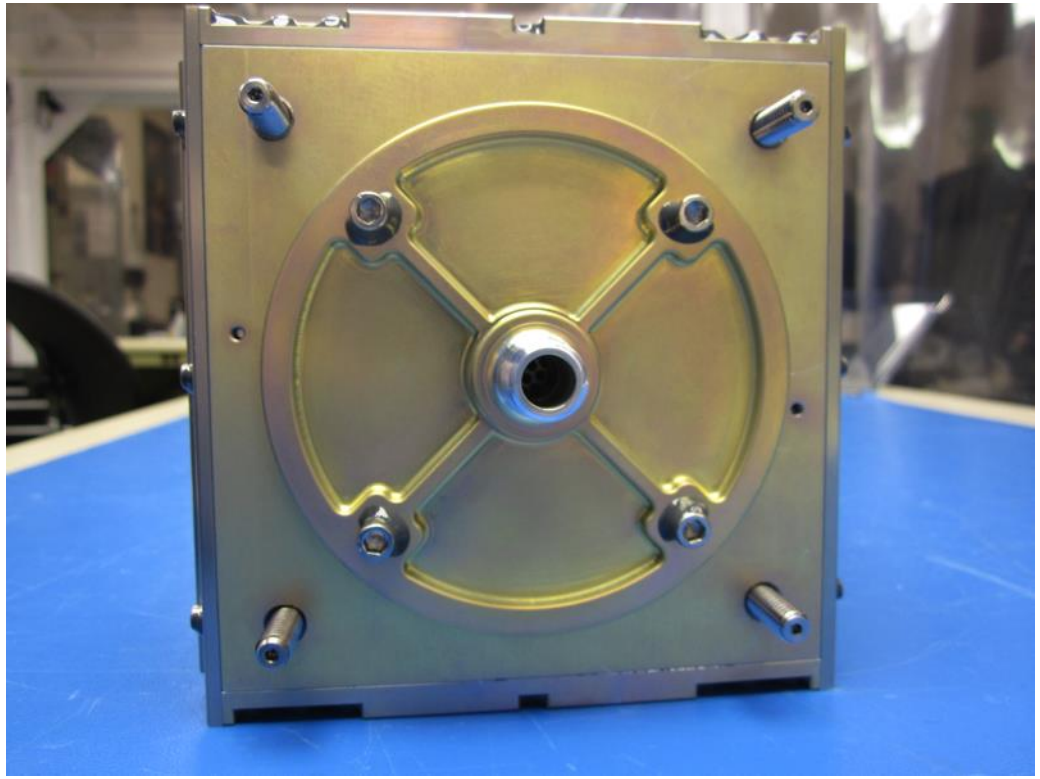
437 MHz +Y Measurement

CubeSat Mission Requiring EMI Shielding

- Cal Poly's "LEO" spacecraft is designed to measure the launch environment and transmit data to another CubeSat over Wi-Fi during launch
- The LV required that the CubeSat carrier be shielded in order for the mission to fly
  - Decision was to fly a P-POD Mk. IV to make the mission possible!
- P-POD Mk. IV first manifest

P-POD Mk. IV Back Plate Options

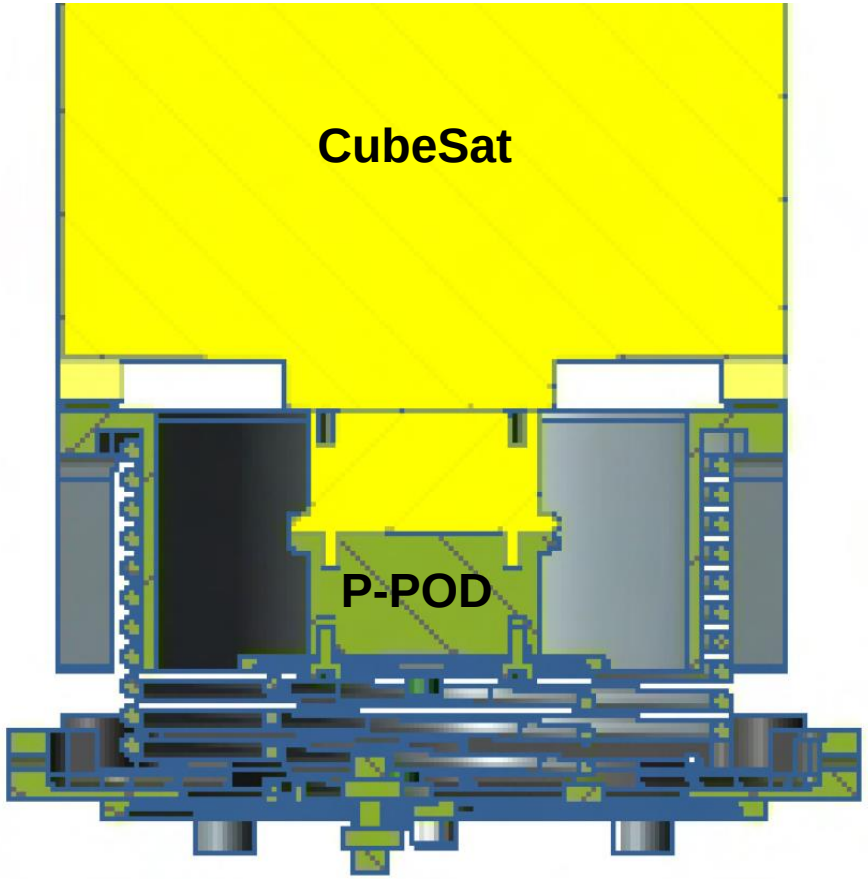
- Mk. IV back plate designed to easily add any optional capability on to the back plate of the P-POD
- Options include inert gas purge and “Power-On” Electrical Interface
- Nitrogen purge system flown successfully on ORS-3 on a Mk. III Rev. E P-POD
  - Design compatible with the P-POD Mk. IV



CubeSat Electrical Interface

- Electrical system to facilitate power-on signal, data, and battery charging
- Zero-force connector to facilitate a resistance-free disengagement
- Up to 15 pins or more

Photo credit: Glenair



Summary

- P-POD Mk. IV with EMI improvements successfully implemented, qualified for flight, and manifested
- EMI Shielding efforts successful
  - At least 30 dB attenuation across all frequencies (Over 60 dB at 437 MHz)
- Designed back plate to be adaptable to optional capabilities such as Nitrogen Purge and Power-On packages
- Increased door stiffness and minor reduction in overall P-POD mass