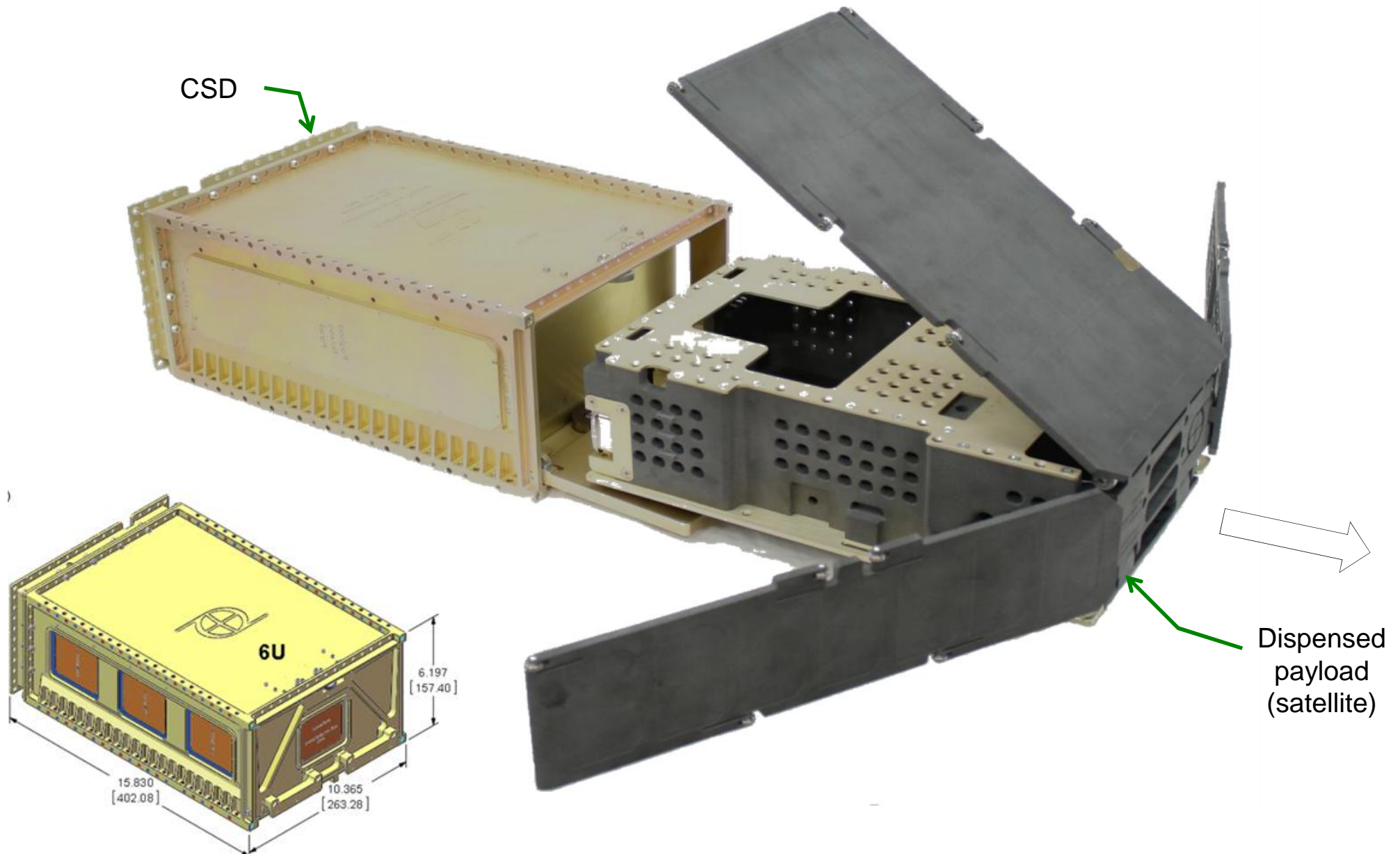


# Canisterized Satellite Dispenser (CSD) As A Standard For Integrating and Dispensing Hosted Payloads on Large Spacecraft and Launch Vehicles

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PSC

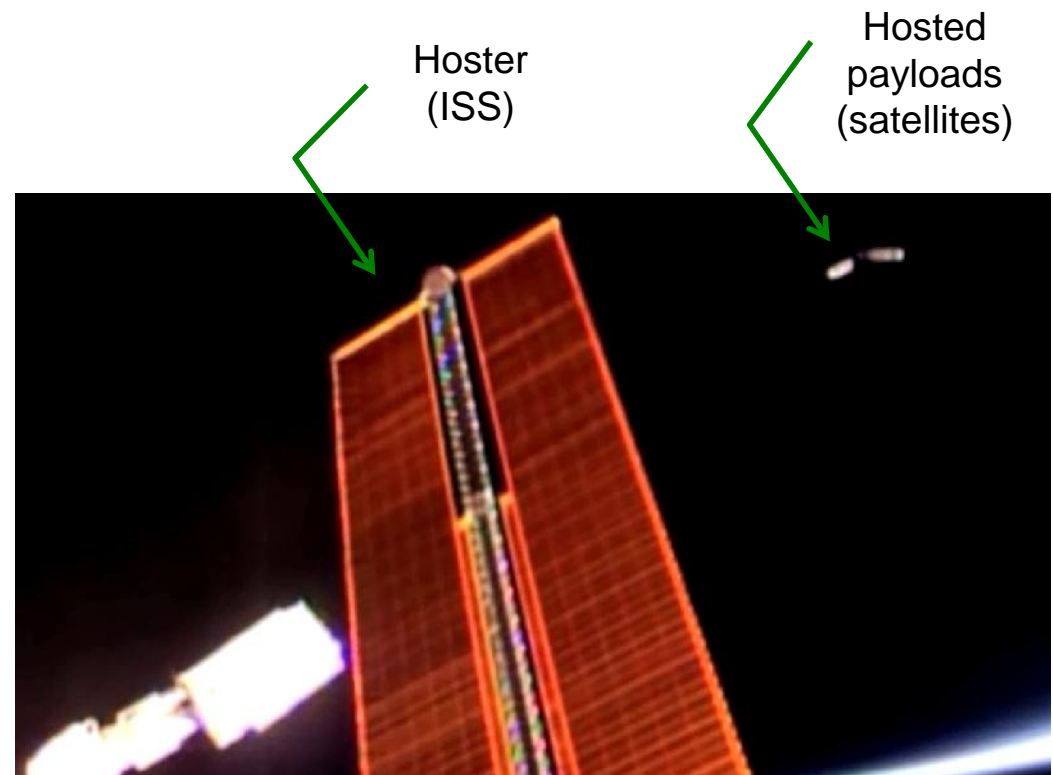
# What are Canisterized Satellite Dispensers (CSD)

- A rectangular box that dispenses a payload between 1 and 30 Kg spacecraft



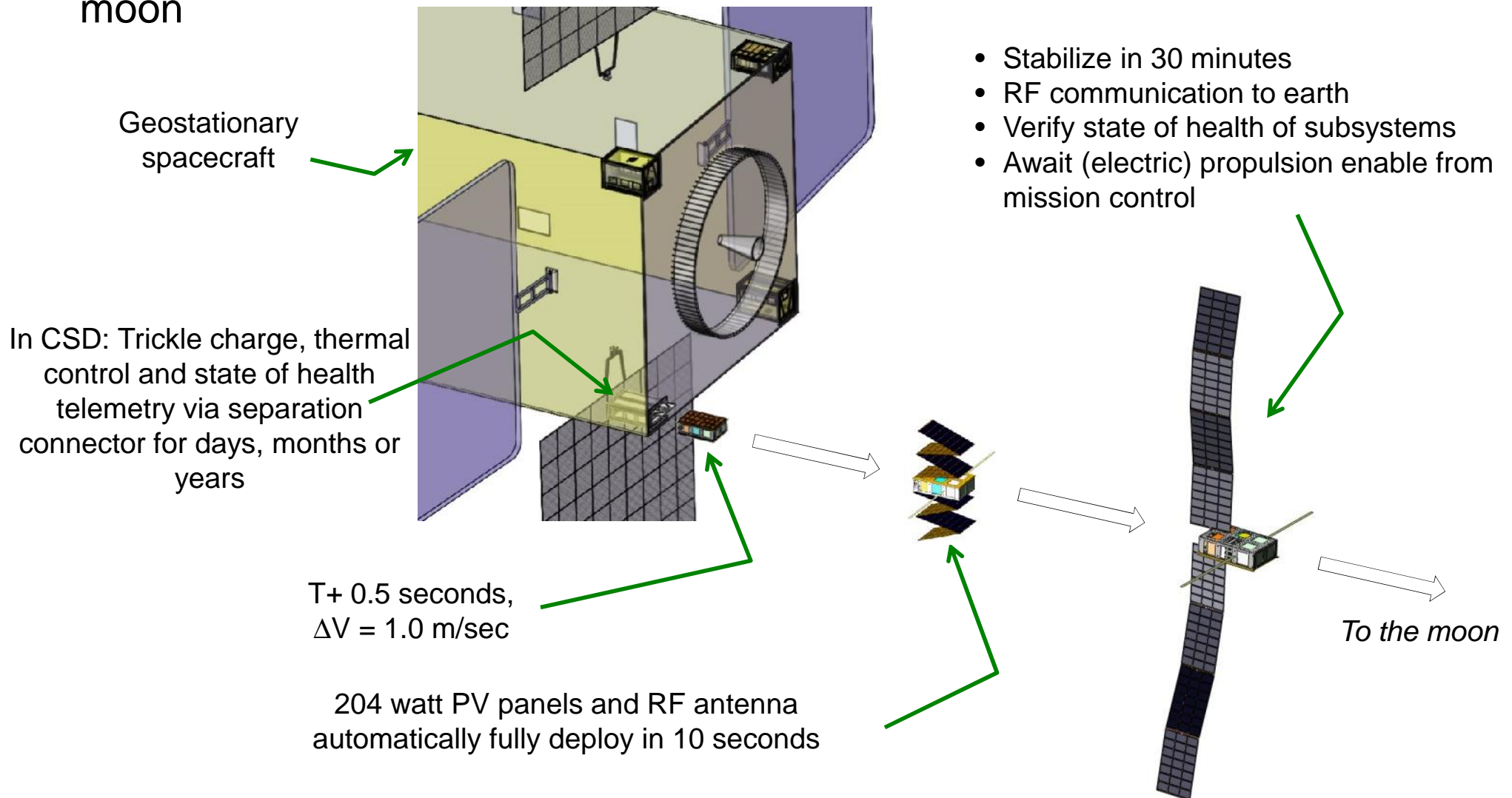
# Why is dispensing from a hosted payload valuable

- For the hosted payload it is an excellent launch service:
  - Reliable and frequent opportunities
  - Cost effective
  - Power and telemetry prior to dispensing
- For the hoster:
  - Added revenue for launch service
    - several \$M for 15 kg payload
  - As a co-orbiting spacecraft
    - Observing deployment
    - Increasing system aperture
    - Confusing adversaries



# An example mission: Lunar Water Distribution (LWaDi)

- A 10 kg, 200 watt NASA “CubeSat”
- Looks for water on the moon
- Uses electric propulsion to attain the needed 1.6 km/sec from Geostationary to moon



## What informs the standard

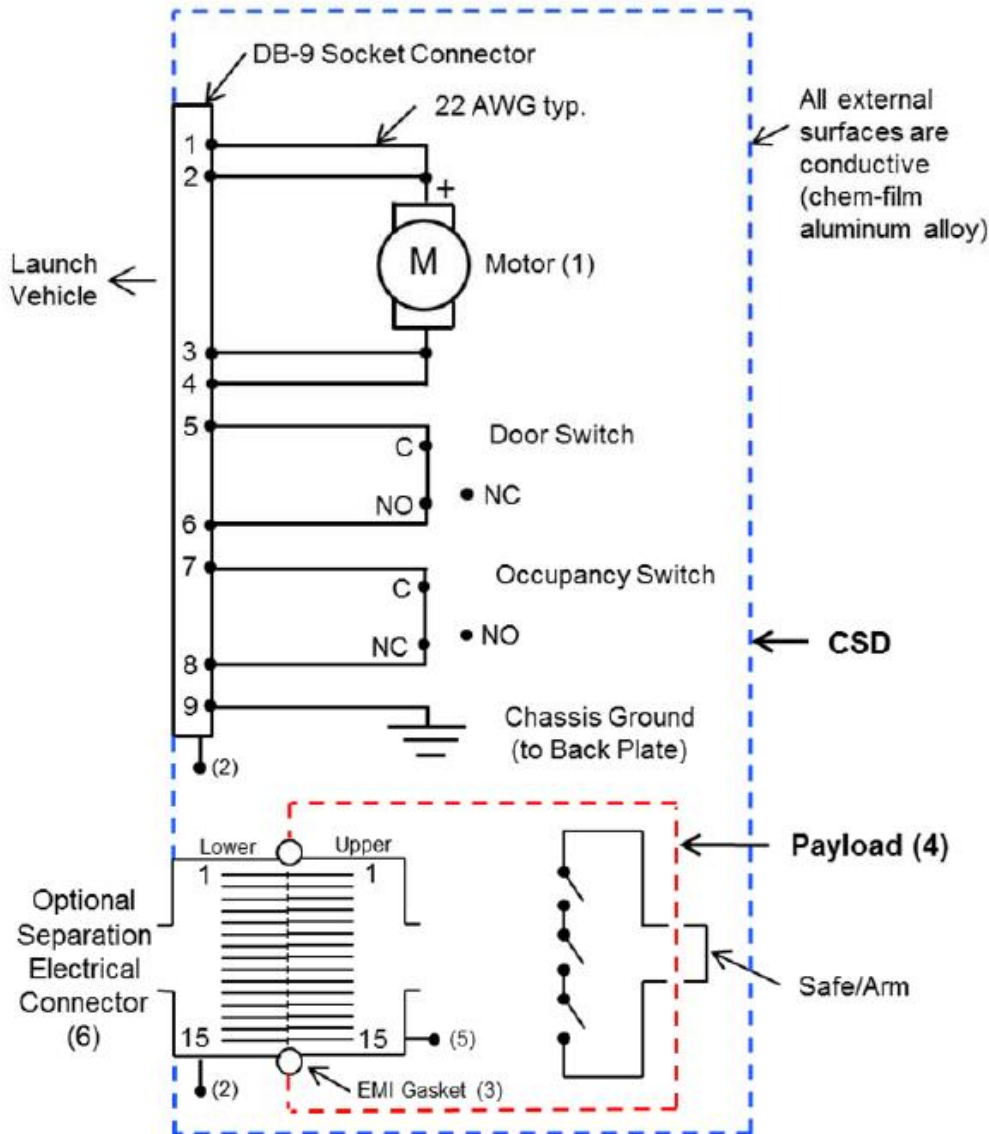
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- Hosted payload must
  - Not present a credible risk to the primary
    - Fail safe
  - Be very easily integrated to many launch streams
  - Need trivial power and telemetry
  - Have a mass well within margin of hoster

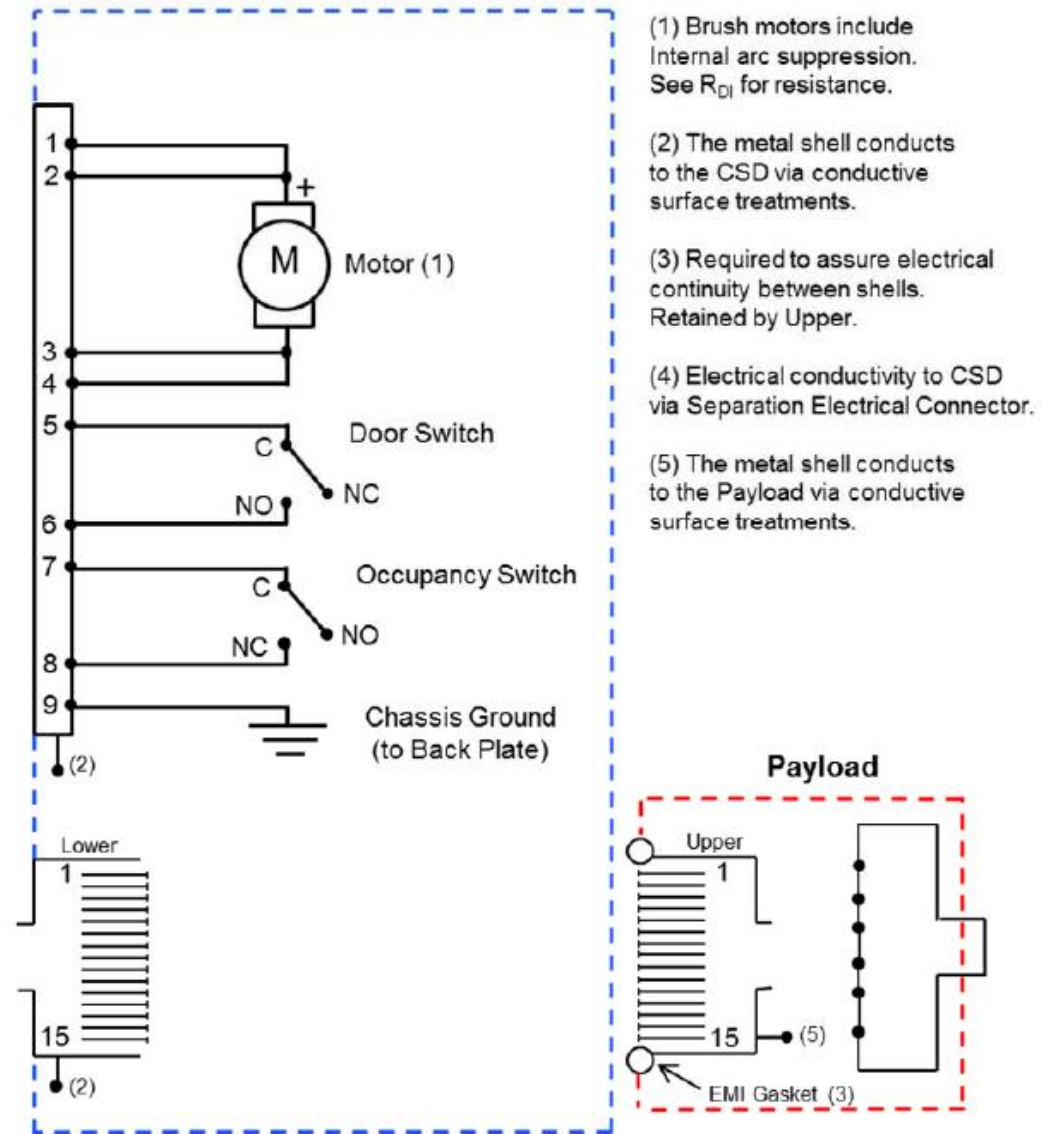


# Electrical Standard

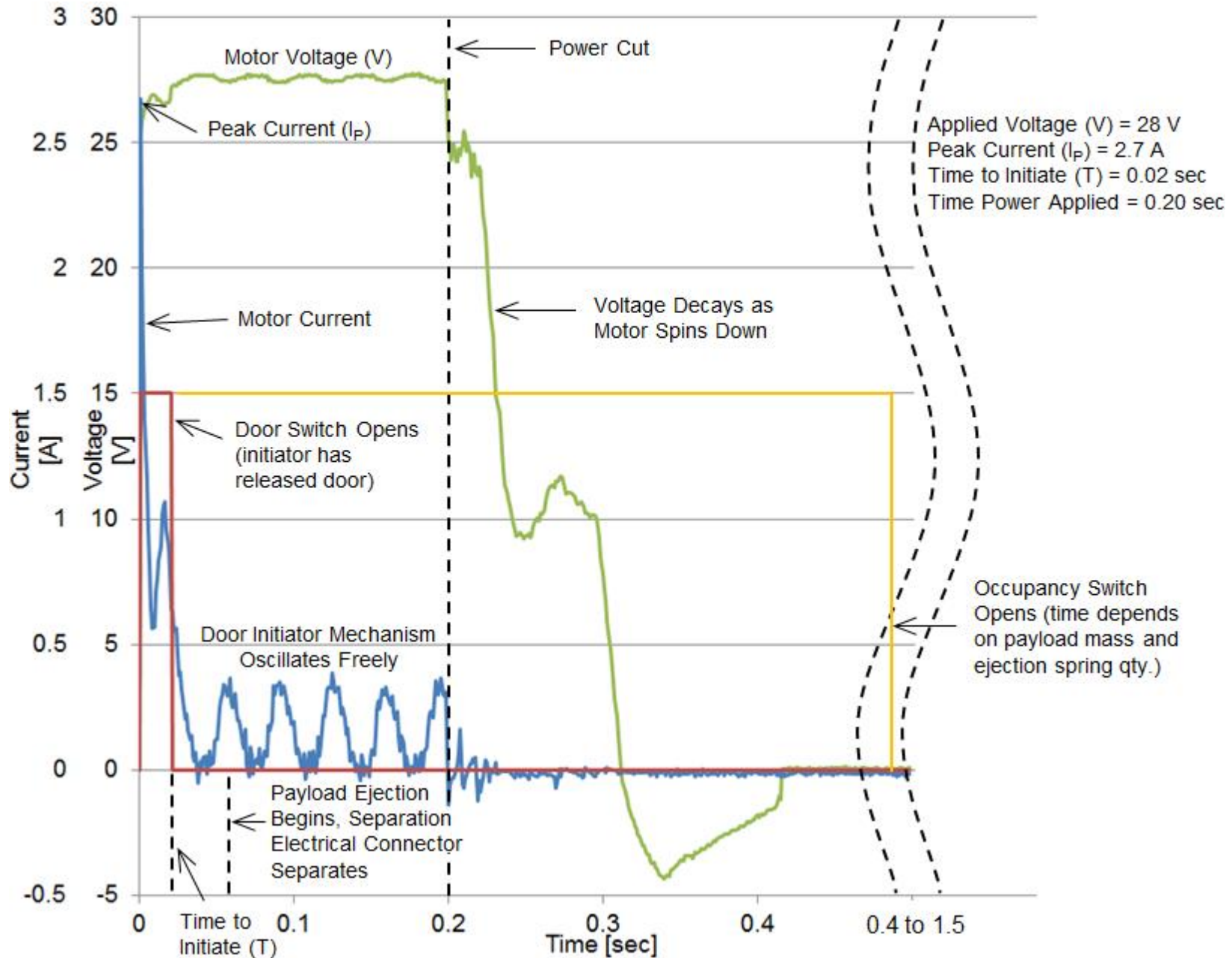
Payload: Installed  
CSD Door: Closed

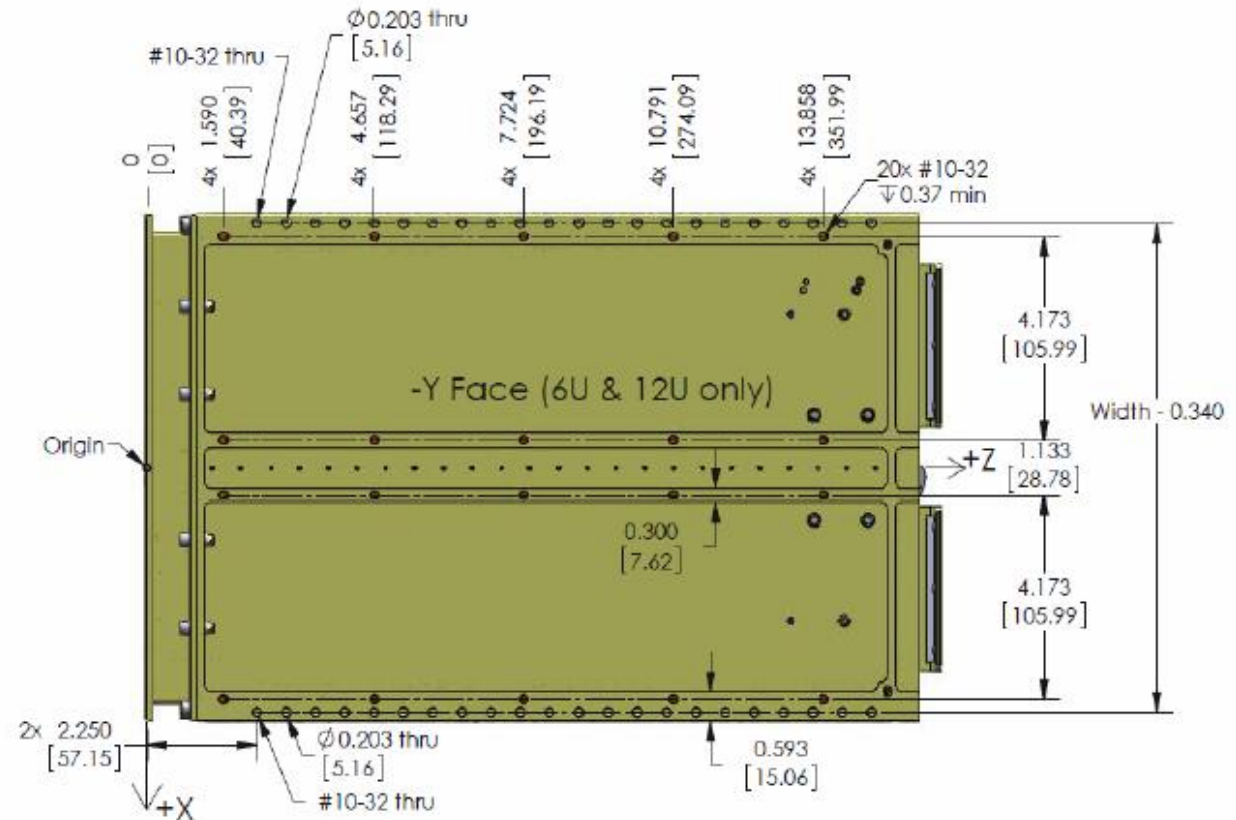
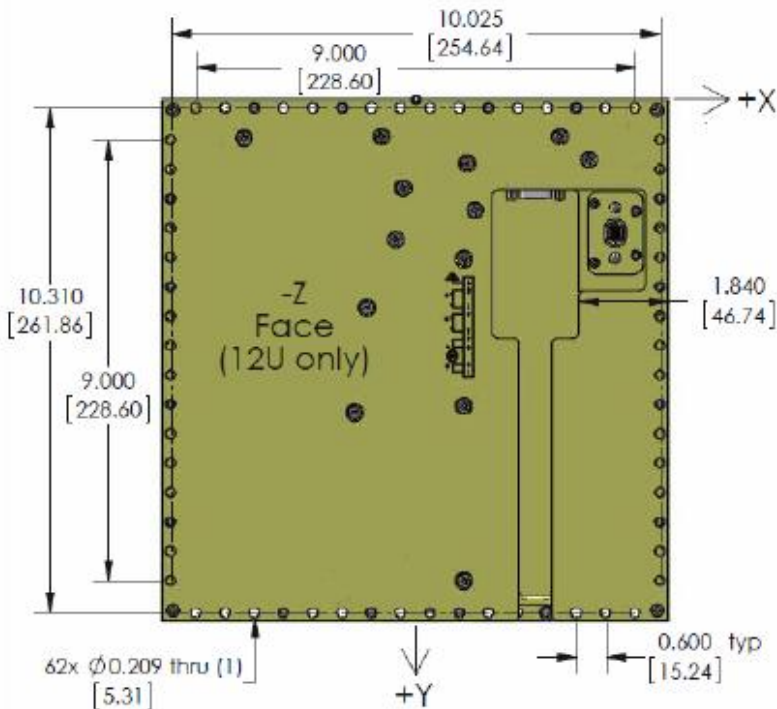
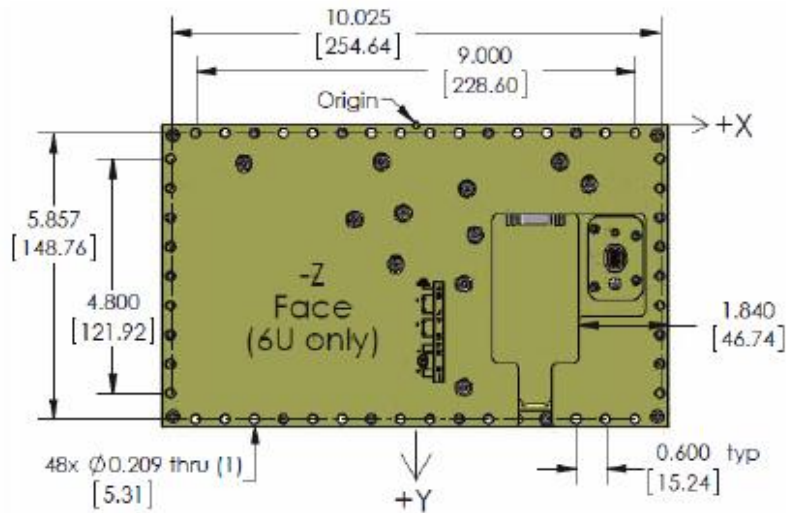


Payload: Dispensed  
CSD Door: Open



# Electrical Initiation of Dispensing





(1) Some holes will have limited usability due to nearby hardware. Contact PSC to obtain CAD model if mounting CSD from -Z face.



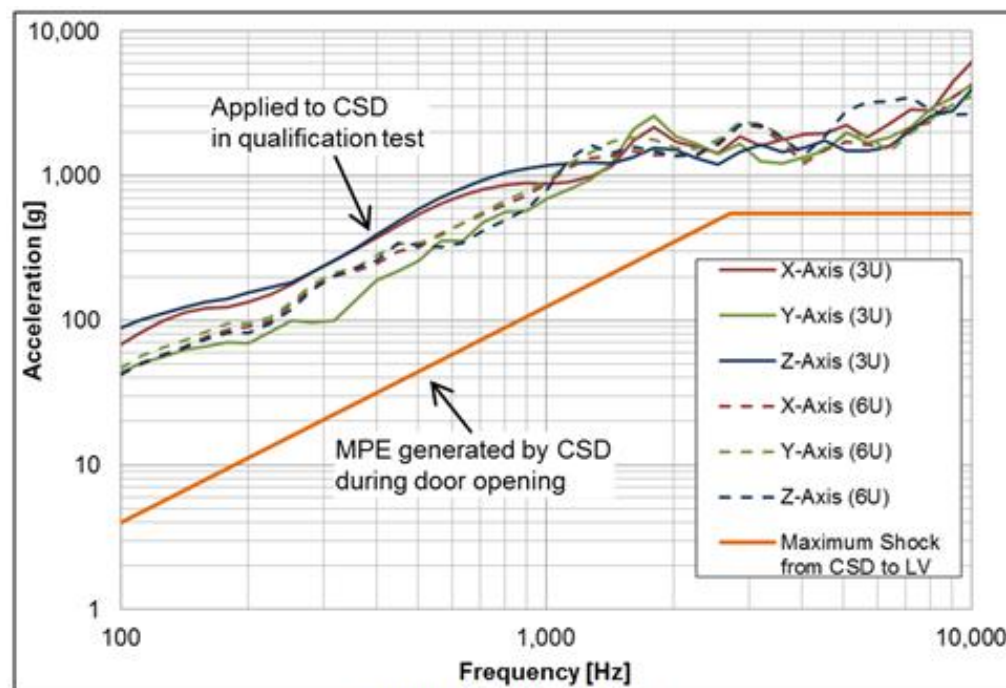
**Table 1: Test Levels**

Test	Qualification	Flight	EDU
Bench top Separations (1)	200 separations	10 separations	10 separations
Thermal Vacuum	Temperature: -45°C to +90°C	Temperature: -20°C to +70°C	Not Tested
	Pressure: <10E-5 torr	Pressure: <10E-5 torr	
	Cycles: 27	Cycles: 8	
	9 Separations +90°C: 22V, 28V, 36 V +23°C: 22V, 28V, 36 V -45°C: 22V, 28V, 36V	1 Separation (hot or cold, 22V)	
Strength as Sine Burst (3)	Level: 50g (3U), 40g (6U) Cycles: 5 per axis	Level: 20g Cycles: 5 per axis	Not Tested
Random Vibration (2,3)	Level: 14.1 Grms	Level: 10.0 Grms	Not Tested
	Duration: 3 min/axis	Duration: 1 min/axis	
	Payload Mass: Maximum	Payload Mass: Maximum	
Shock (2,3)	See Figure 15 3 impacts per axis	Not Tested	Not Tested

(1) 1atm, ~23°C.

(2) Full qualification was performed with CSD mounted via -Y face. Contact PSC if planning to mount CSD via any other face.

(3) 3U qualified with 6.1 kg payload. 6U qualified with 9.1 kg payload. Contact PSC if 6U payload is heavier than 9.1 kg.



**Figure 15: Shock Levels**

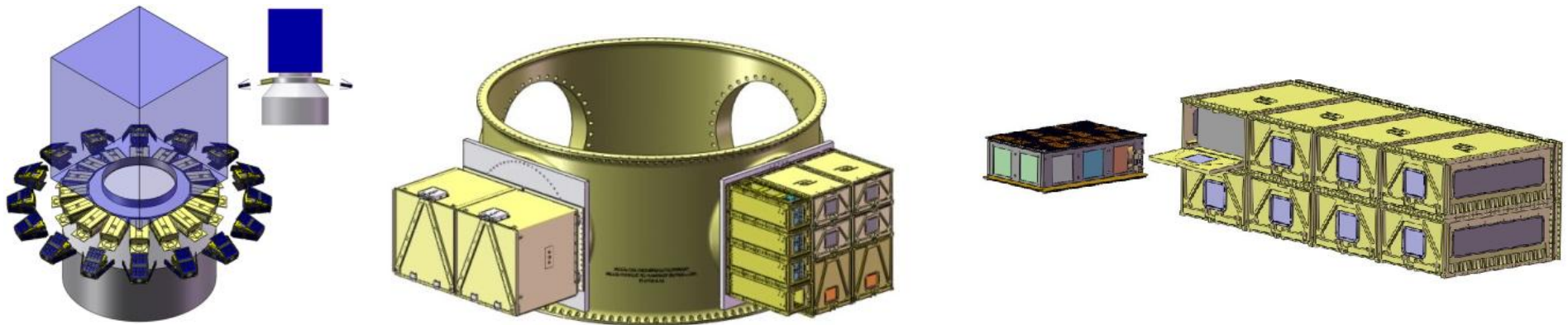
# Advantages of CSD Standard

## Accelerates Hoster's Business

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- 6U CSD has been adopted by four manifested DoD payloads; three NASA interplanetary and many university teams
- 6U CSD is available now
  - Revenue generating activity can begin now
  - Not a new development subject schedule slip, technical anomalies and extensive vetting
- CSD has zero refurbishment cost
- All procedures to integrate operate are ready and vetted by ORS, AFRL, NASA, SpaceX and the DoD

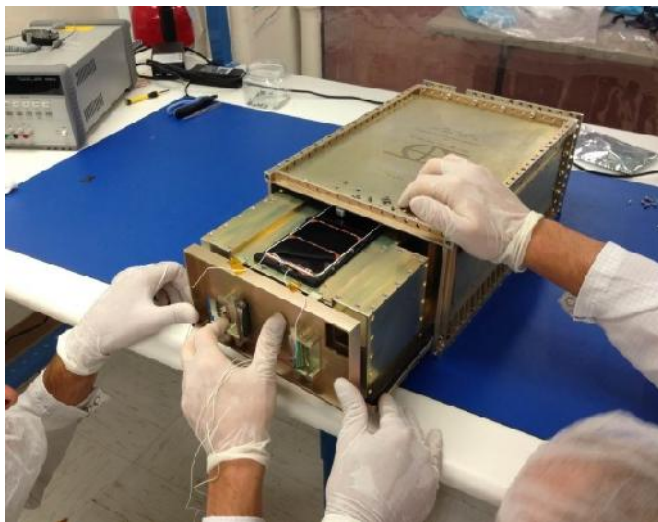
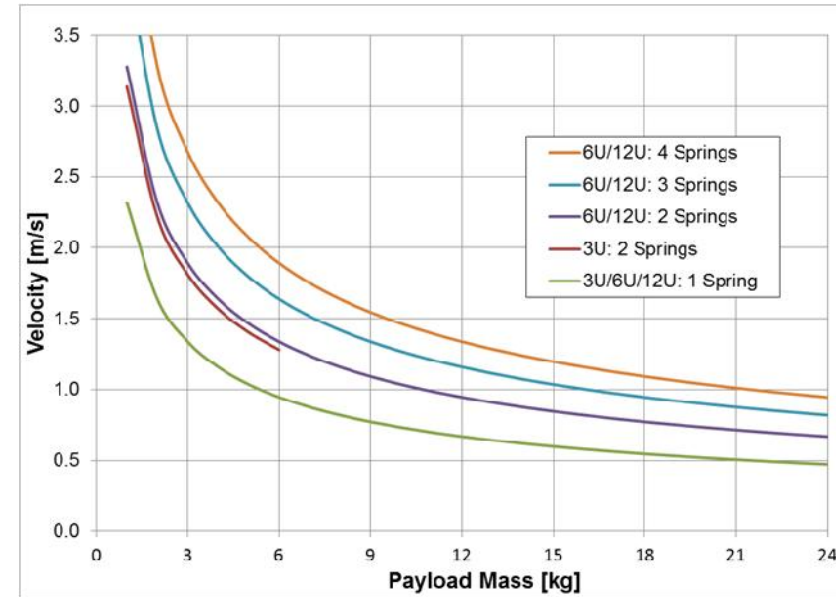
- **Qualified** for use on all US launch vehicles
  - Per Mil-STD-1540 and NASA GEVS
- **Preloaded Payload Tabs** create a predictable load path to and from the payload. In other words a \$30M payload won't jiggle creating a hang-fire risk.
- **Lower tipoff** Tabs, roller bearing and linear way minimize tipoff allowing payloads to detumble faster and avoid saturating ADACS
- **CSD Constrained Deployables** eliminate the payload's need for complex restraint mechanisms.
- **Six Mountable Sides** increase integration options. Hosters need to qualify less structure and can fly more revenue generating mass



- **Motor Driven Initiator** creates a reliable and testable deployment mechanism that automatically resets without consumables. NanoRacks lowers recurring cost.

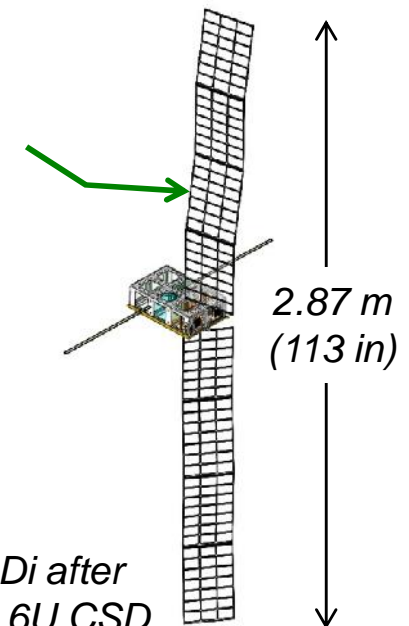
# Technical benefits

- **Constant force ejection spring** even at the end of stroke the ejector plate is pushing the payload out. Choosing one to four springs allows broad control over dispensing velocity
- **Manual override** allowing technicians to easily dispense payload
- **Smallest External Volume** versus existing designs increases packaging density on launch vehicle.
- **No tools required to stow or dispense**



**6U Payload integration**

204 Watt PV panel can drive electric propulsion to the moon and mars

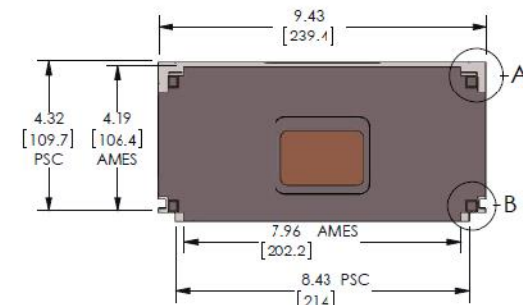
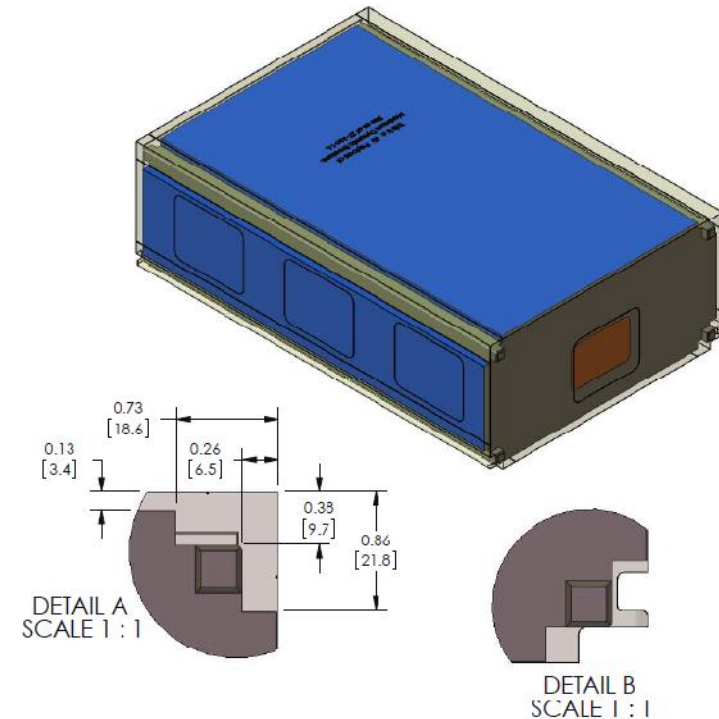
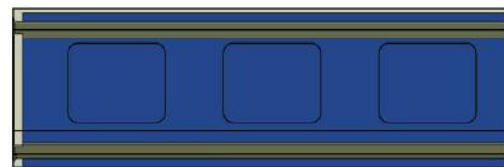
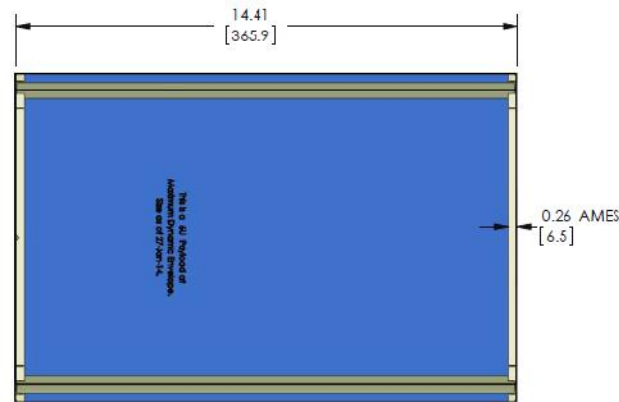


*NASA's 6U LWaDi after dispensing from a 6U CSD*

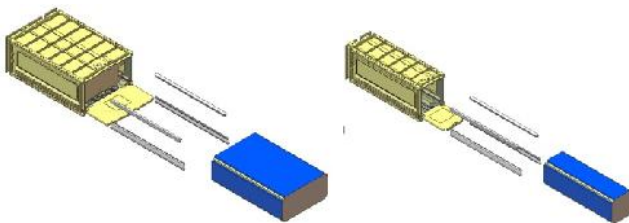


- **Largest Internal Volume** versus existing designs accommodates 11% larger payloads. Payloaders can easily add more deployable solar panels to make their mission better
- **Backwards Compatible Mechanical Interface** ensures compatibility with existing 1, 2, 3 and 6U Cubesats

Allowable Volume  
PSC: 615 in<sup>3</sup>  
AMES: 564 in<sup>3</sup>

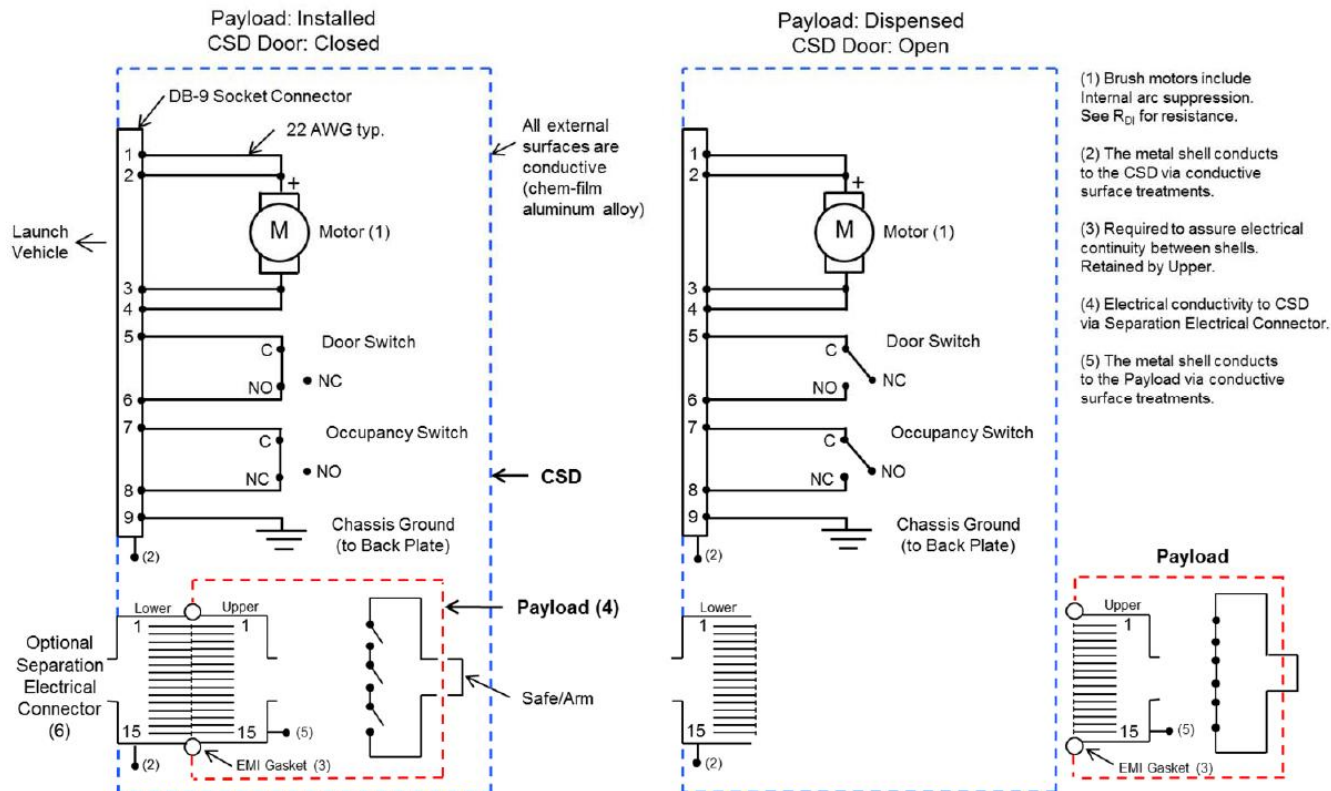


**The CDS standard has 11% more volume allowing end users more room for solar panels, antennas and thermal treatments**



**The rail kit allows the CSDs compatibility with other standards**

- **Reverse polarity protection** The CSD will properly initiate even if the wired backwards
- **Separation Electrical Connector** allows communication and charging between payload and launch vehicle. Can support high end / high revenue missions
- **State switches** Indicate door state; payload occupancy and dispensing velocity
- **Electrical redundancy** two independent circuits to the motor. Triple redundant commutator
- **Conductive outer surface** eliminates surface charging



- **Safe/Arm Access on Front Door** ensures payload access at all times.
- **Parametric design of CSDs** Commonality allows users easy understanding of electro-mechanical interface: 1/8U, 3U, 6U and 12U
- **Fully documented** Mechanical and electrical interfaces fully defined for CSD and Payload. See [http://www.planetarysystemscorp.com/#!\\_\\_downloads](http://www.planetarysystemscorp.com/#!__downloads)
- **CAD models** available on request

CANISTERIZED SATELLITE DISPENSER (CSD) DATA SHEET

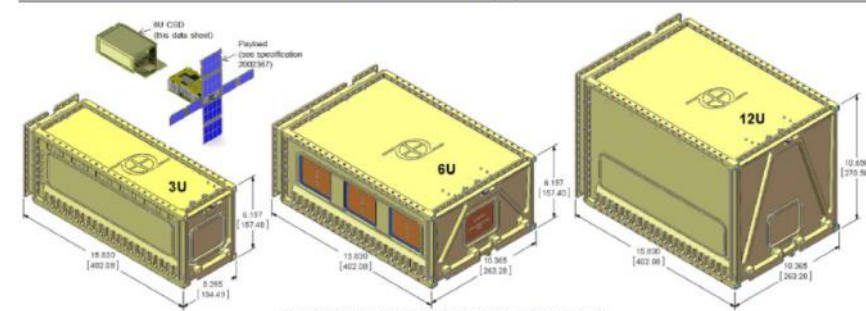


Figure 1: 3U, 6U and 12U CSDs. 9U Shown with Access Panels Removed.

**FEATURES AND BENEFITS**

- Preloaded Payload Tabs create a predictable load path to and from the payload.
- CSD Constrained Deployables eliminate the payload's need for complex restraint mechanisms.
- Six Mountable Sides increase integration options and greatly reduce the need for adjoining support structures.
- Motor Drive automatics.
- Robust Structure.
- Separation and launch.
- Conductive.
- Complete (or partial).
- Manual Do.
- P-Prof Com.
- Full Length.
- Lowest Ext.
- Largest Int.
- Safe/Arm Access.

The CSD is compatible with most payloads.  
The CSD is also compatible with most payloads.

2002337 Rev A

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PAYLOAD SPECIFICATION FOR 3U, 6U, 12U AND 27U

This is a standalone specification intended for payload designers. Planetary Systems Corporation does not design or manufacture payloads but can recommend vendors.

**DESCRIPTION**

These payloads are designed to be fully contained within a Canisterized Satellite Dispenser (CSD, canister or dispenser) during launch. A CSD encapsulates the payload during launch and dispenses it on orbit. CSDs reduce risk to the primary payload and therefore maximize potential launch opportunity. They also ease restrictions on payload materials and components. This specification currently encompasses four payload sizes, 3U, 6U, 12U and 27U.

The payloads incorporate two tabs running the length of the ejection axis. The CSD will grip these tabs, providing a secure, modifiable, preloaded junction.

The payload may use the CSD to restrain deployables. The allowable contact zones are defined.

A payload can be built to this specification without knowledge of the specific dispenser within it will fly. Similarly, dispenser manufacturers will be ensured of compatibility with payloads that conform to this specification.

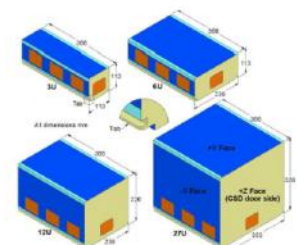


Figure 2: Payloads

CSD (see 2002337)      Payload (this specification)

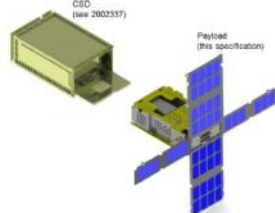



Figure 3: Payload Deploying from CSD

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# Thank You

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- Questions?