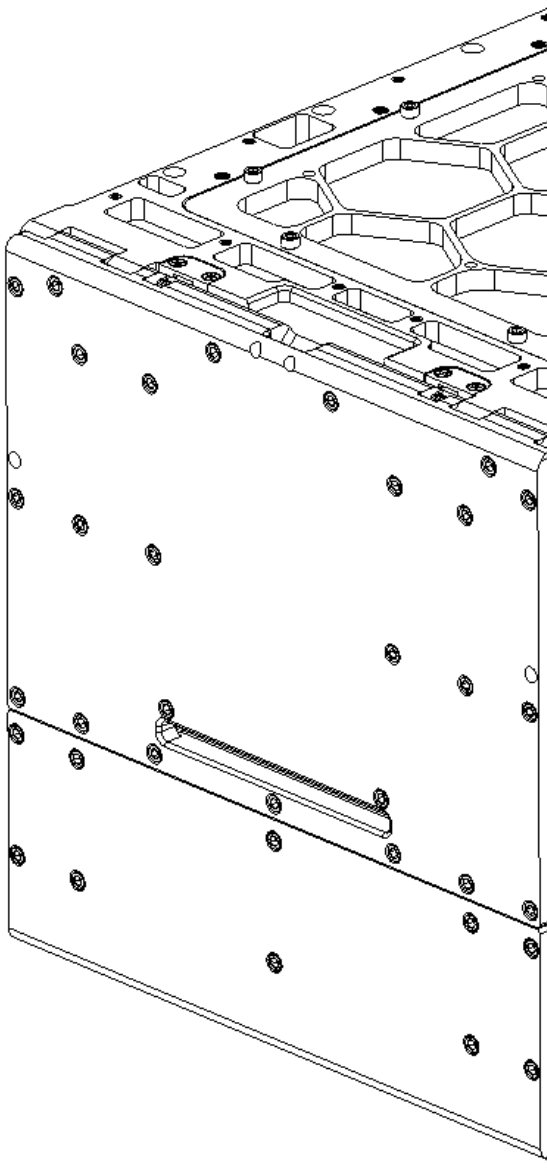
XTERRA

XCD-12U/16U USER'S GUIDE



XTD-100270
Revision 1.0
E250

REVISIONS

Rev	By	Date	Description
1.0	TH & AK	4-4-24	Initial Release

AUTHORS

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ADDITIONAL DOCUMENTATION

Document Number	Description
N/A	Launch Isolation Vibration for CubeSat Dispenser
E250 Information	https://www.ebad.com/tini-ejector-release-mechanism-erm/

ACRONYM DEFINITIONS

Acronym	Description
XCD	XTERRA CubeSat Dispenser
RBF	Remove Before Flight
TBD	To be determined / Work in progress

NOTE: This document is a work in progress and additional information will be added as it becomes available. Feedback sent to the authors is welcomed.

TABLE OF CONTENTS

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1. INTRODUCTION

Designed and built on over a decade of space systems deployment expertise with over 350 satellite deployments on legacy systems, the XTERRA CubeSat Dispenser (XCD), builds upon this experience to create a new generation of American made CubeSat dispensers. With our patent-pending modular approach to CubeSat dispenser design, the XCD is designed to reduce costs, cut lead times, and remove pain points from traditional CubeSat dispenser offerings.

Users of CubeSat dispensers, often find they need to access particular areas of a satellite once it's integrated. This is traditionally achieved using many small access panels, however, these access panels are often insufficient to provide access to the locations users need to access on the satellite, such as for RBF pins removal. Large access panels on the 12U/16U XCD are designed to maximize satellite access while integrated into the dispenser.

Additionally, users often need to purchase a 12U *or* a 16U form factor dispensers separately to cover potential dimensional or manifesting changes that can occur prior to flight. This problem is exacerbated by the often-tight schedules typical of launch date driven projects which may result in a change to the manifest last second. With the XCD, this is no longer a problem since the user can convert the dispenser between 12U and 16U satellites on their own in approximately an hour. No more waiting months for a vendor to get a legacy dispenser converted. Additionally, our novel spacer system allows us to rapidly produce spacers for custom length satellite you may want to fly, further decreasing operational complexity and lead time.

The XCD is rapidly resettable, offers exceptional access to the satellite, allows the users to convert between different form factors on their own, all at a lower cost and reduced lead times. No dispenser on the market rivals the flexibility or convenience of the XCD.

2. SYSTEM OVERVIEW

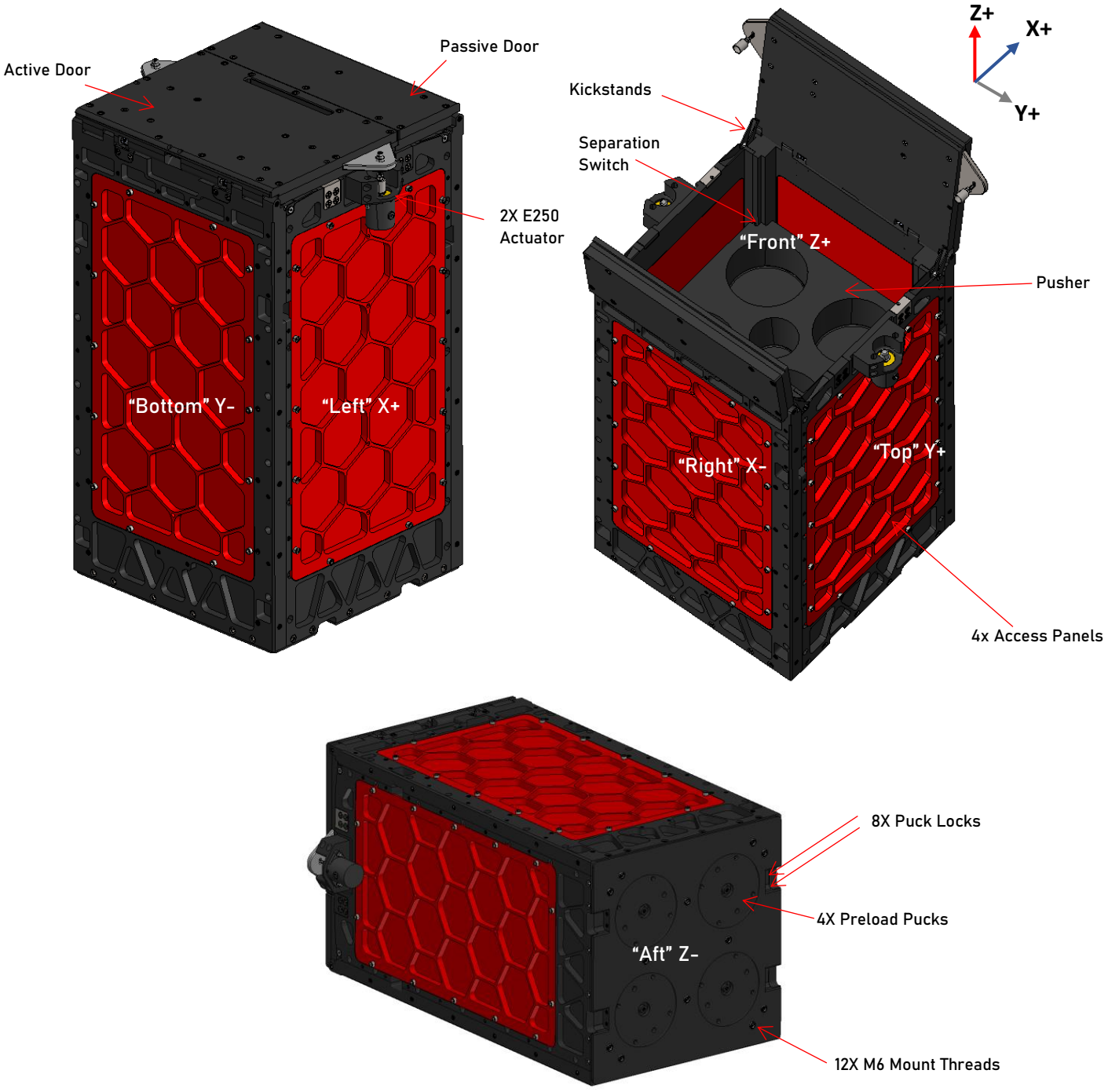

Figure 1: XCD-12U/16U Overview

3. UNIQUE DISPENSER FEATURES

3.1 PUCK PRELOAD & SPACERS

Custom satellite spacers to accommodate partially loaded dispensers or non-standard satellite have been radically simplified using the XCD puck design. This spacer design allows for a very short lead time spacer at a fraction of the cost of a traditional solution. Details in section 5.7. A result of this feature is this dispenser can be rapidly converted from a 16U compatible tube to a 12U compatible tube.

Preload Pucks

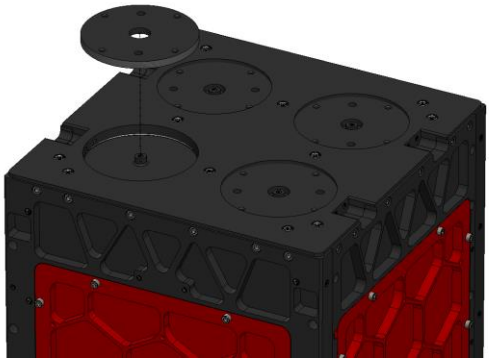

Figure 2: Puck and Spacer Details

3.2 RAPIDLY RESETTABLE

The ability to reset rapidly is key to many customer needs. Each actuator reset per Tini instructions, the dispenser is designed to rapidly reset these devices without removing them from the dispenser mounting positions.

Figure 3: Door Reset

3.3 LARGE ACCESS PANELS

Users have the most access of any 16U dispenser on the market to their satellite while integrated into the XCD. Panels on all four sides maximize flexibility and usability.

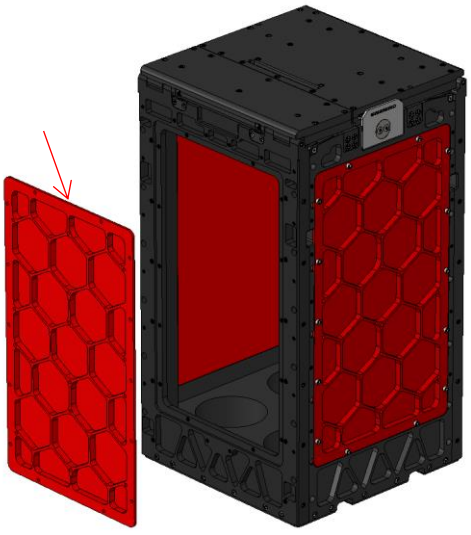

Figure 4: Large Access Panels

4. SATELLITE FUNDAMENTALS

4.1 FORMATS AND DIMENSIONS

12U and 16U satellites are compatible with this dispenser, details below. Dimensions are in [millimeters] and inches.

Satellite Format	12U	16U
Mass (kg)	*28 Max	*32 Max
Rail to Rail Length (mm)	340.5-366	454 Max

*Masses that exceed values shown can be considered, contact XTERRA for details

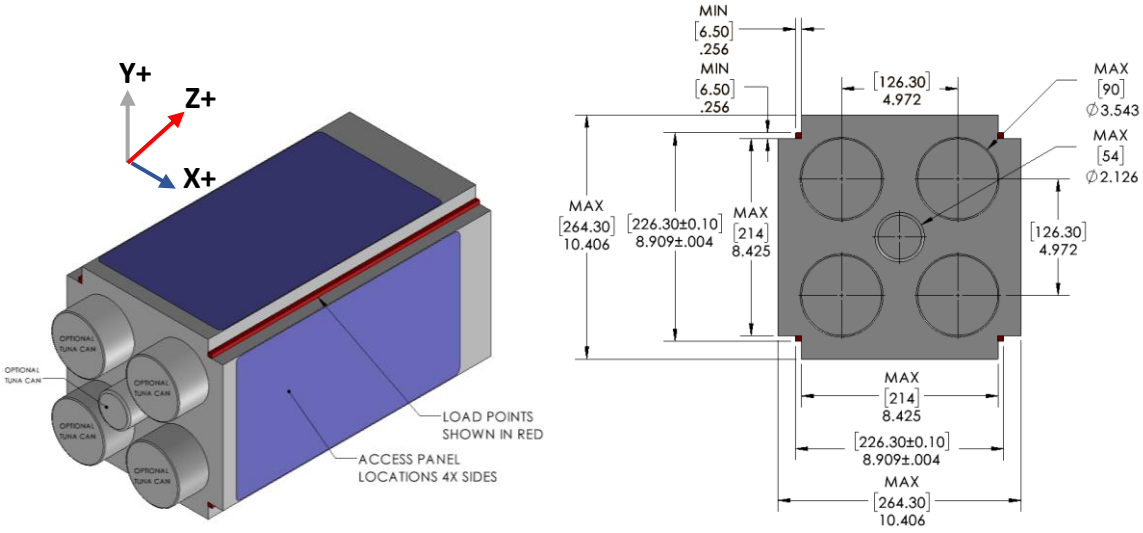

Figure 5: 12U/16U

4.2 RAILS

CubeSats must have 4X rails along the Z axis as shown in Figure 6 in red. These will directly interface with the dispenser rails during launch and will be the guiding surface during deployment. Each CubeSat rail shall have a minimum width in the X and Y axis of 6.5mm as shown in Figure 5. Noncontinuous rails may be acceptable but must be reviewed by XTERRA. Access panel locations are indicated in blue, note that the access panels are located the same on all 4 sides of the dispenser.

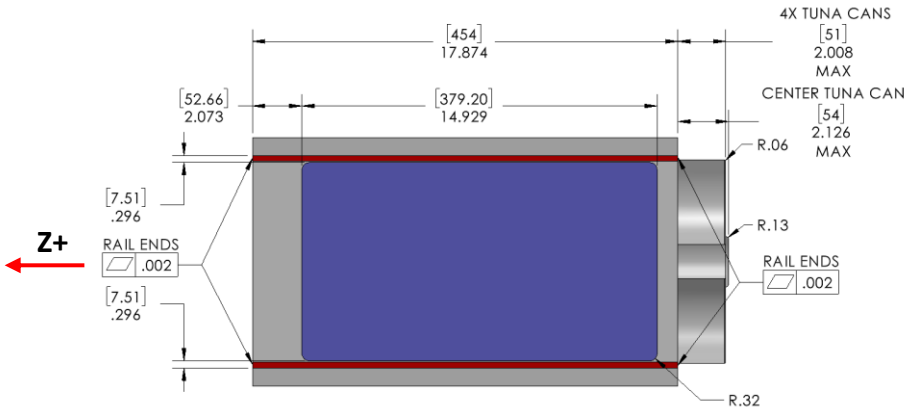

Figure 6: Rail profile/Access panel locations

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4.3 DEPLOYABLE APPENDAGES

It is recommended that any deployable satellite appendages are constrained through launch and at deployment. Appendages can be constrained by the dispenser during launch and deployment, but fit checks are highly recommended to ensure a reliable deployment using this method and an XTERRA review will be necessary.

4.4 INHIBIT/ACTIVATION SWITCHES

Switches that activate the satellite after deployment may be positioned anywhere compression is guaranteed between the satellite and the dispenser. Typically, these are switches on the ends of the rails in the Z axis or along sides of the rails in the X or Y axis. They can also be located at the front or rear face of the satellite if this face is colinear with the doors or pusher plate. A simplified dispenser CAD model can be provided for a digital fit check to ensure that switches will compress as desired.

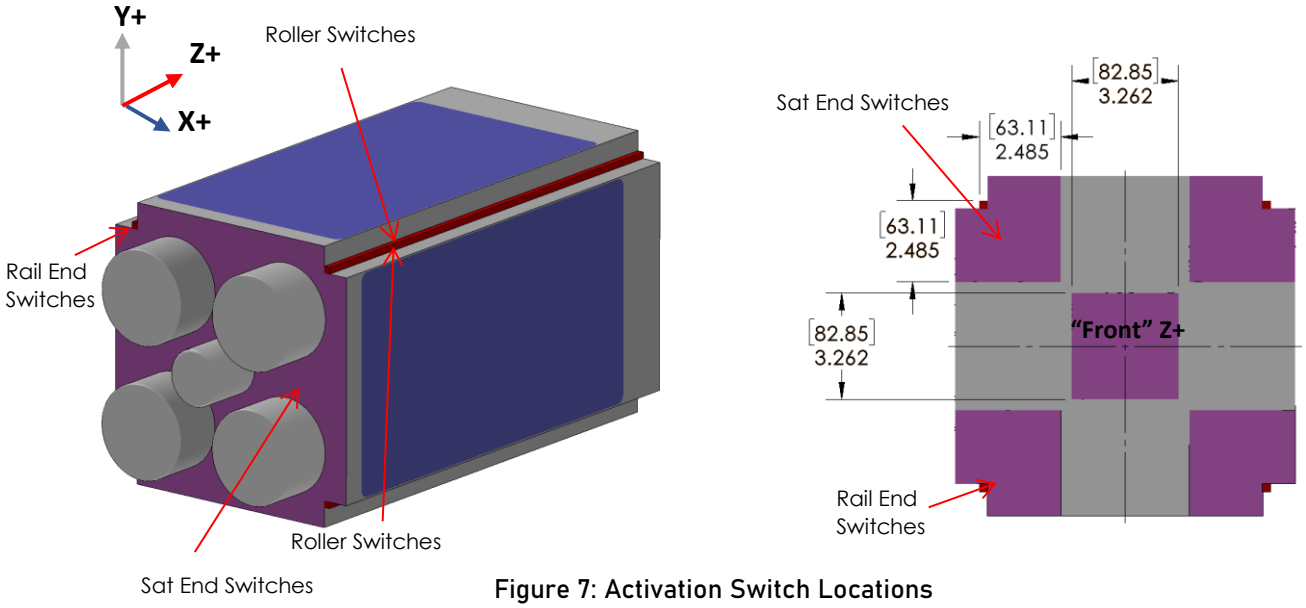


Figure 7: Activation Switch Locations

5. DISPENSER FUNDAMENTALS

5.1 MASS, DIMENSIONS, AND MOUNTING INTERFACES

Dimensions for the dispenser in 12U or 16U configuration are the same. Top Y+ face and bottom Y- face threaded features are mirrored on both sides. Right X- face and left X+ face threaded features are mirrored on both sides. Aft fasteners are located on the Z- face.

Configuration	12U	16U
Empty Dispenser Mass (kg)	17.74	17.29

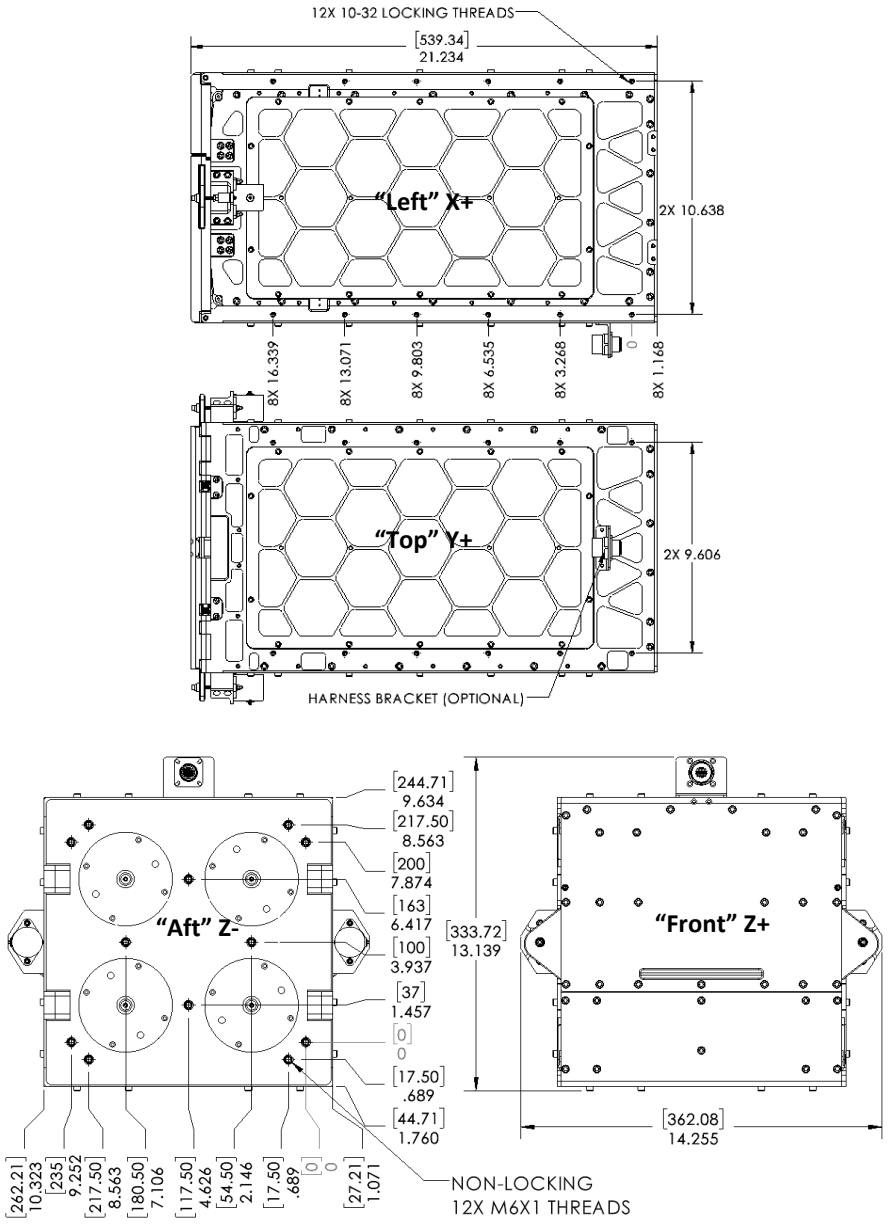


Figure 8: Dispenser profile and mass

5.2 LOADING BOLTS AND PUCK PRELOADING

Once the payload is installed, the threaded puck is the mechanism by which preload is applied along the deployment axis. By clamping the satellite on the Z- and Z+ face, rather than perpendicular to the deployment axis, the loads on the satellite are dampened at high frequencies during exposure to the flight environment and greatly improves the rail to satellite interface, decreasing the risk of hanging/catching on rails often associated with systems that use "dynamic rails". This CalPoly presentation explains why this is and illustrates evidence for less high frequency energy being transferred to the satellite with this approach.

Once the payload is inside the XCD, each puck is torqued to 100 in-lbs using a provided spanner tool along with the customer's torque wrench. Once the puck is torqued, it is locked with two set screws as shown in Figure 9 which are torqued to 5in-lb above running each. The puck should only be completely removed if the need arises to install a spacer (see section 5.6). Whenever a satellite is not in the tube, a loading bolt must be used to restrain the pusher plate against the puck as shown in Figure 10.

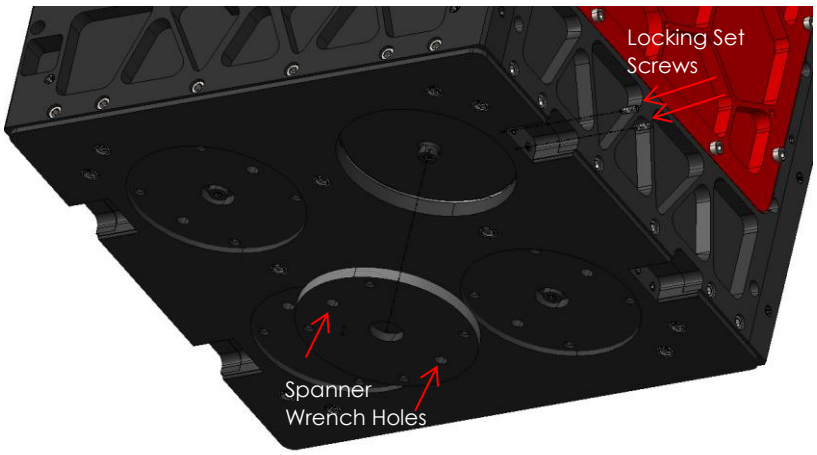


Figure 9: Puck Install

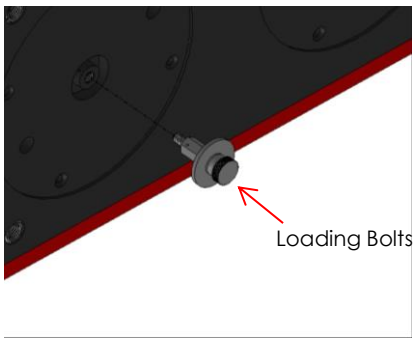


Figure 10: Loading Bolt Install

5.3 DOOR FEATURES

Doors on the XCD are held in place by lock plates which constrain the gate on the actuator. Once both actuators are fired, the doors open 95°-105° and are locked in place with an integrated spring-loaded kickstand to ensure that doors do not recontact the satellite while it is being deployed.

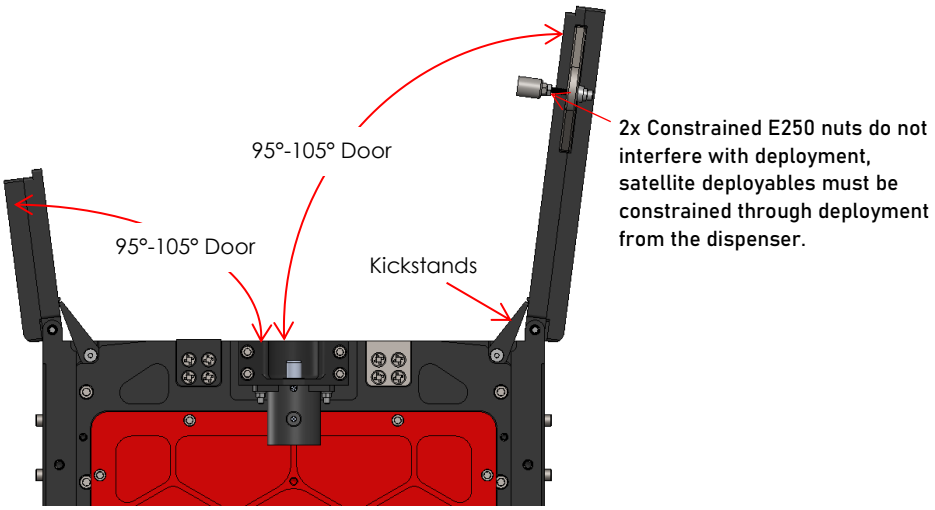


Figure 11: Independent Locking Doors

5.4 DEPLOYMENT CONFIRMATION

Confirming that the satellite has left the dispenser is a critical part of the mission. The XCD has switches embedded in the rails that send a signal once the pusher plate has reached the end of its stroke to confirm the satellite has been deployed. The switches are located in rail sections as shown in Figure 12.

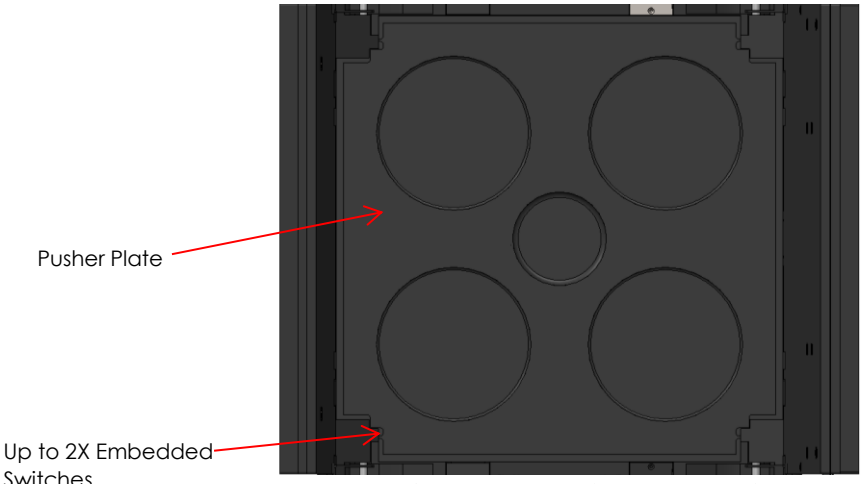


Figure 12: Deployment Confirmation Switch

5.5 DEPLOYMENT DYNAMICS

Deployment velocities shown in Figure 13 assume full pusher plate stroke in the tube with the mass specified (12U length 366mm and 16U length 454mm). If payloads mass is outside of the range shown and/or partial stroke deployments are to be considered, custom deployment velocity analysis can be done upon request. Tip-off is largely dependent on the CG of the satellite but typically tip-off will be less than 5 deg/s.

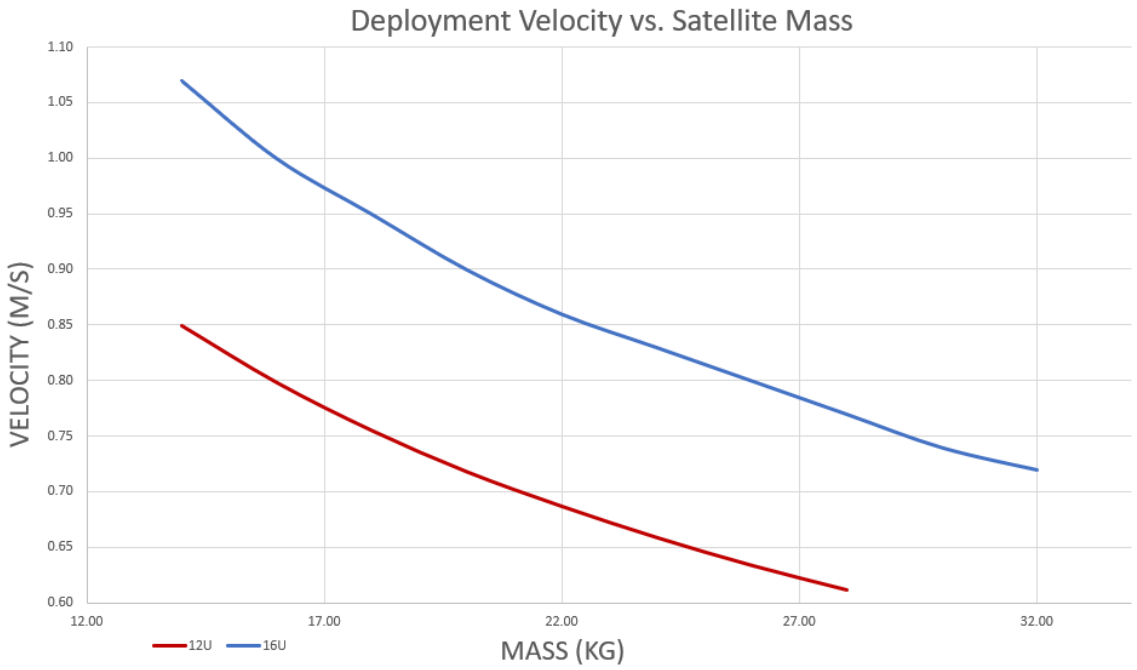


Figure 13: Deployment Velocity

5.6 SATELLITE SPACING

4x custom length spacers can be ordered to easily convert the XCD into a 12U dispenser. If satellite lengths are shorter than 340.5mm contact XTERRA. Fasteners come with the spacers and installation is as simple as removing the puck, fastening the spacer to the puck, and reinstalling the puck.

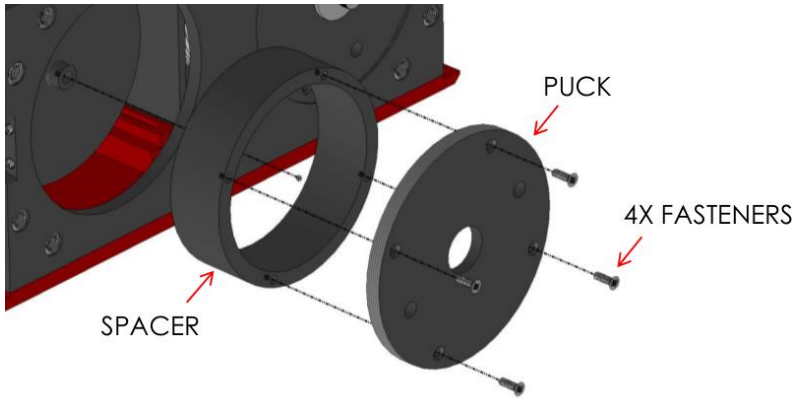


Figure 14: Spacers

6. ELECTRICAL CHARACTERISTICS

6.1 ELECTRICAL COMPONENTS

Three types of electrical components are used in the XCD-12U/16U. Up to two microswitches enable signal feedback to confirm deployment has been completed, two Tini E250 actuators side mounted to open the doors when commanded, and connectors which are connected to the microswitches and actuators. The E250 data sheet is available here https://www.ebad.com/tini-ejector-release-mechanism-erm/.

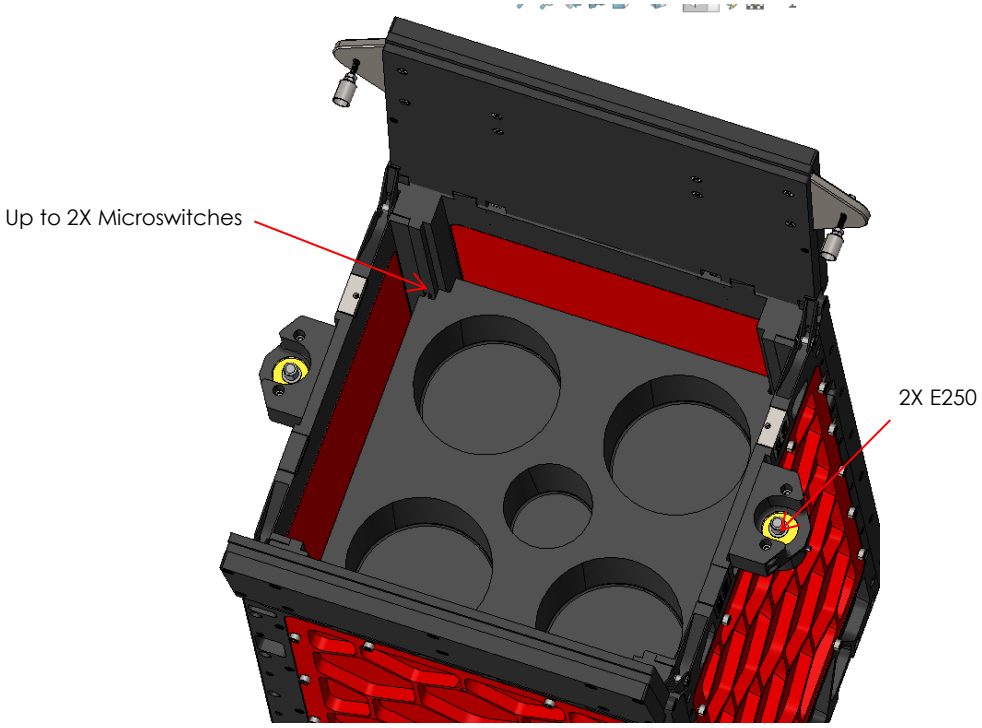
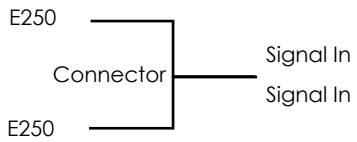


Figure 15: Electrical Components

6.2 HARNESS & INTERFACE OPTIONS

Customers may choose between flying leads or a specific connector to the actuators depending on the vehicles requirement. Two signals sent through a common connector for both actuators is required if power is limited. If adequate power is available, the two actuators may be able to run off of one signal. These actuators should be fired simultaneously. Contact XTERRA for details.



12U/16U