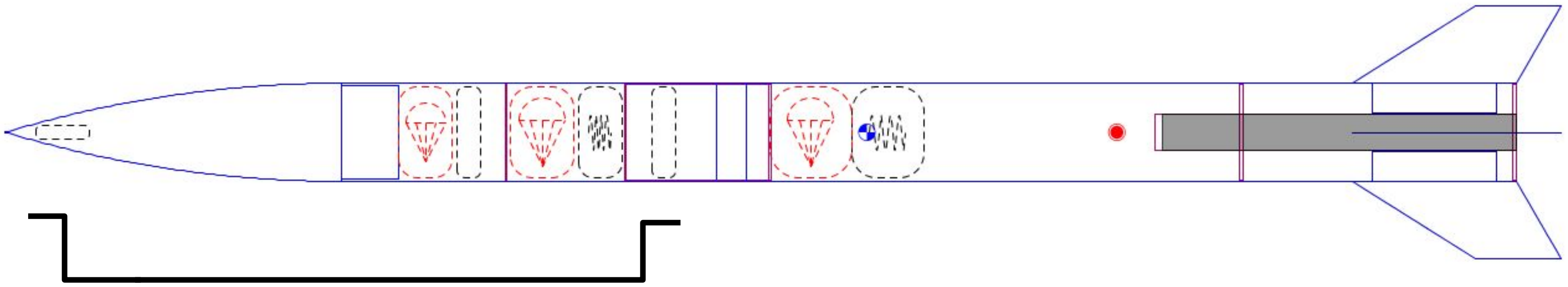
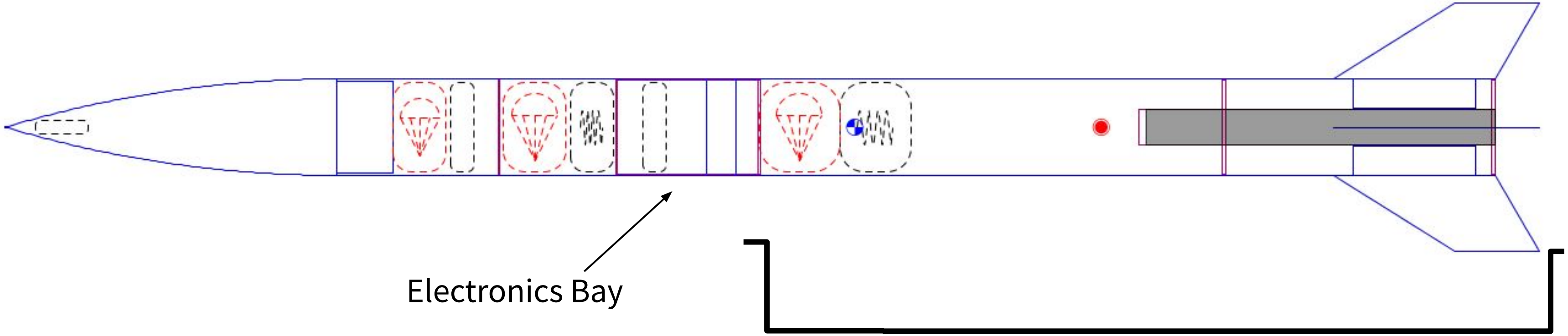
Explorer Post 1010
Student Launch Initiative 2021-2022
Preliminary Design Review

Vehicle Upper Section Design



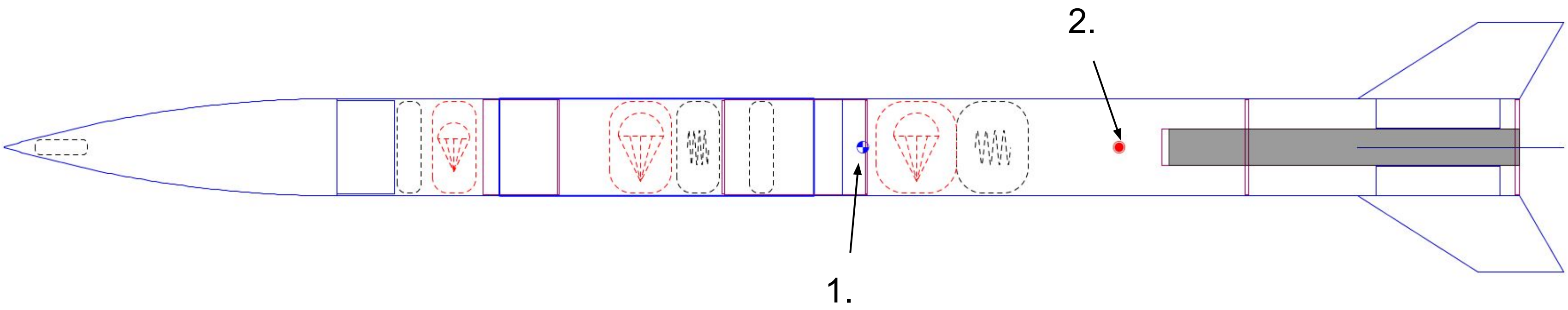
- Upper section recovered separately from rest of vehicle under parafoil
- 58.3 cm long, 713 grams

Vehicle Lower Section Design



- Recovered by drogue and main parachute
- 112 cm long including electronics bay
- 1704 grams including motor

Stability, Center of Mass, and Center of Pressure

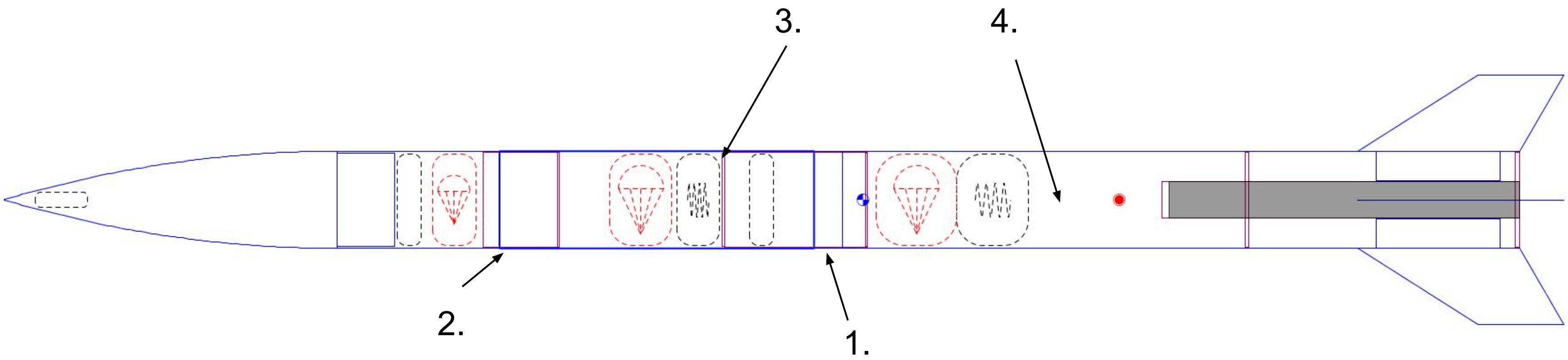


- Center of pressure located 117 cm from tip
- Center of mass located 90.1 cm from tip
- 2.65 Caliber of stability

Launch Vehicle Design

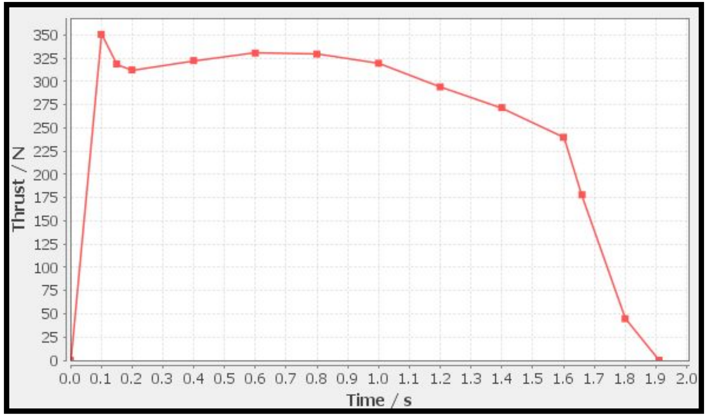
- Ultimately settled with thick walled paper due to lower mass, costs, and greater convenience to work with over fiberglass
- Decided to use polypropylene plastic nose cones
- Increased airframe diameter from 3” to 4” to allow necessary space for the payload
- Decided to use ogive nose cones due to higher aerodynamic performance over parabolic or elliptical
- Fin, centering rings material plywood

Energetics and Points of Separation

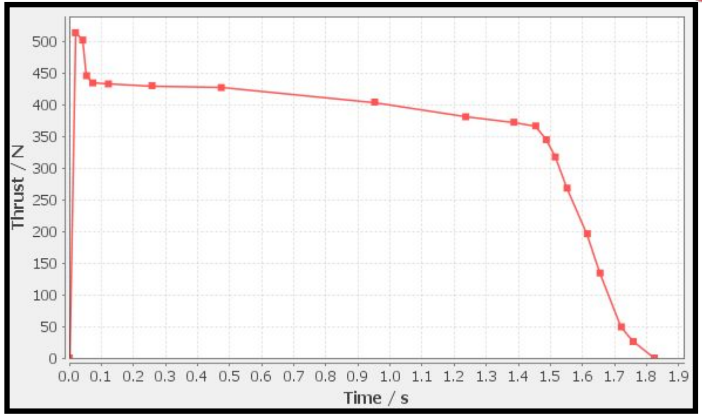


- Two separation points on either side of electronics bay (1, 2)
- Four total redundant ejection charges, two for main chute and two for drogue chute (3, 4)

Motor Selection



I285-14 Thrust Curve



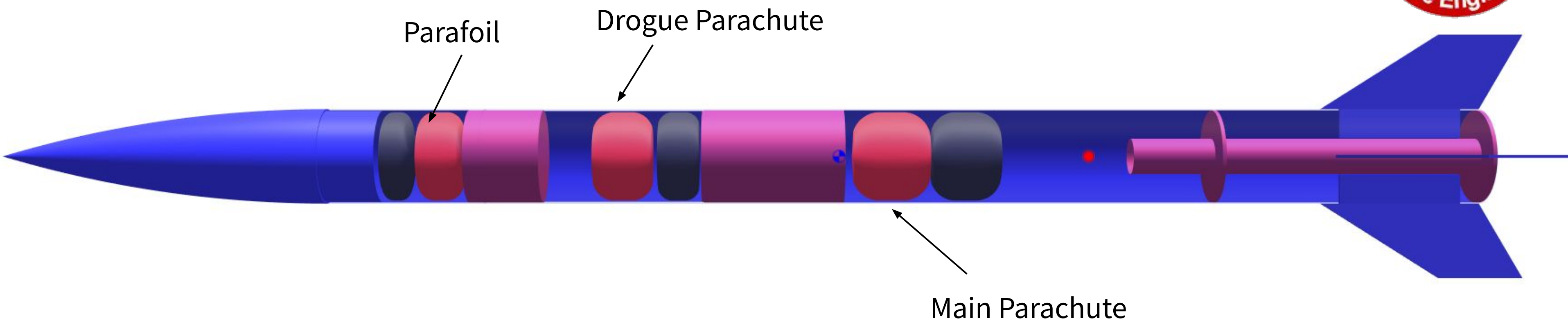
J357-14 Thrust Curve

- Top two choices were Cesaroni I285-14 and J357-14
- Switched to larger J motor when the diameter was increased from 3” to 4” because more impulse was needed

Thrust to Weight Ratio and Rail Exit Velocity

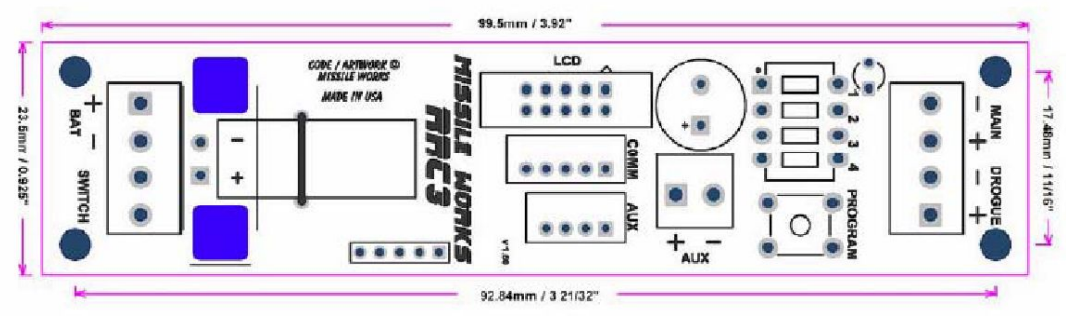
- 29.9 m/s velocity off rail
- 18.26:1 average thrust to weight
- Stability of 2.698 Calibers off the rail

Recovery System Overview



- Upper section of the rocket is recovered separate from the rest of the rocket
- 36” elliptical main parachute from Fruity chutes with 6.12 m/s predicted ground impact velocity
- 12” drogue parachute from Fruity chutes
- Shock cord for both the drogue chute and the main chute made of 1000 lb rated kevlar line, will be hooked on eye bolts on ebay

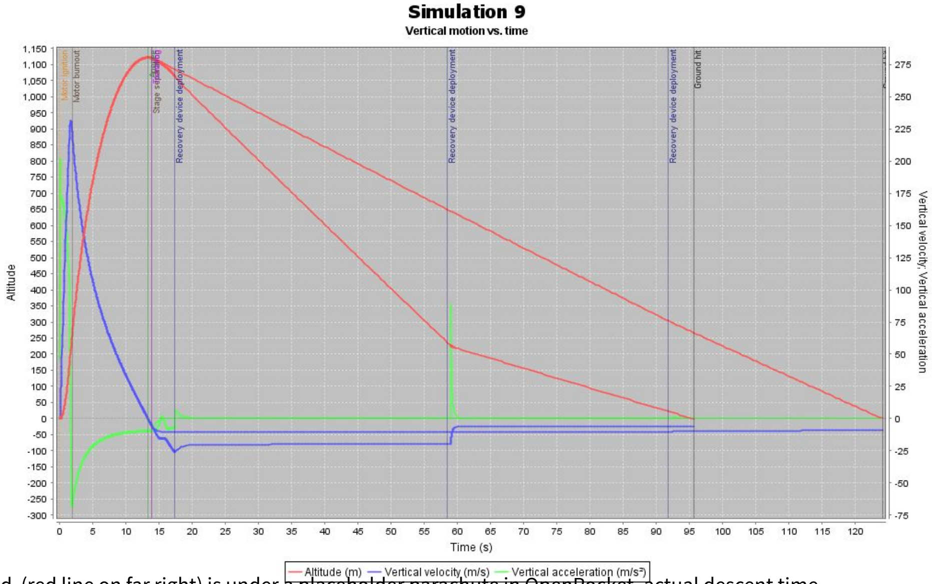
Recovery System Electronics



RRC3 Pinout Diagram

- Redundant RRC3 “Sport” Altimeter’s with completely separate systems and batteries
- Retained on avionics sled and bulkheads
- Dual redundant ejection charges for each section (upper and lower)

Mission Performance Predictions



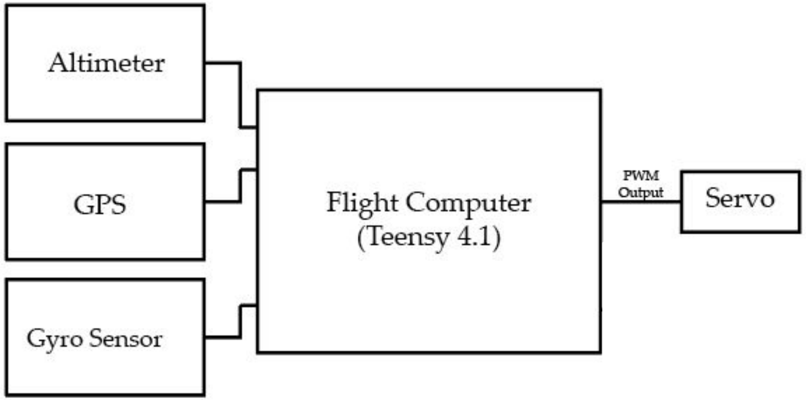
*Payload (red line on far right) is under a placeholder parachute in OpenRocket, actual descent time will be less than 90 seconds using a chute release system

Section	Upper Section	Total Lower Section
Kinetic Energy (Ft-lbs)	12.86	28.53

Kinetic Energy on Impact

Target Apogee Altitude: 3750 ft
Simulated Apogee Altitude: 3677.8 ft
Expected Flight Time: 100.655 seconds

Payload Design



- A brake line controls the parafoil. One line is longer than the other and attached to a servo.
- To turn one direction, we let the line out more so that drag affects that direction more. To turn the other direction, we pull the line in more so that the shorter line is relatively longer outside the rocket, making air resistance affect that direction more.

Compliance Plan

- Vehicle requirements
  - Deliver payload to an altitude of 3500 ft - 5500 ft, we are targeting 3750 ft.
  - Less than 4 separable sections
- Recovery requirements
  - Safely recover both payload and launch vehicle
  - Redundant ejection charges
- Payload requirements
  - Autonomously guide itself to designated location