# CRITICAL DESIGN REVIEW

## Windward Community College
## University of Hawaii
## 2009-2010

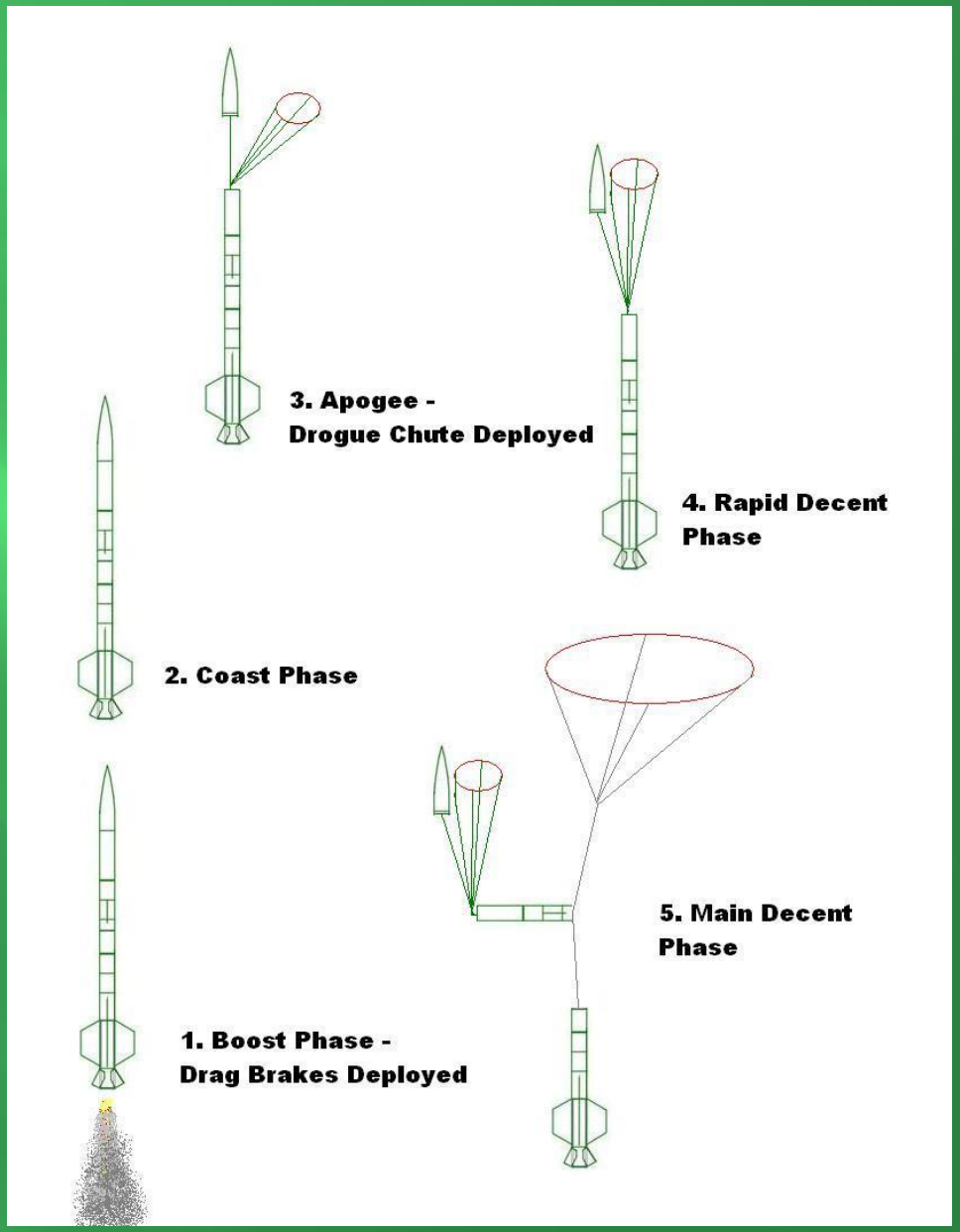
# PROJECT: LEO HANO

# Initial design criteria

- Build a Rocket to be launched to an altitude of 5280 ft. (1 mile)
- Rocket must carry a scientific payload
- Rocket must return safely

# Flight Profile

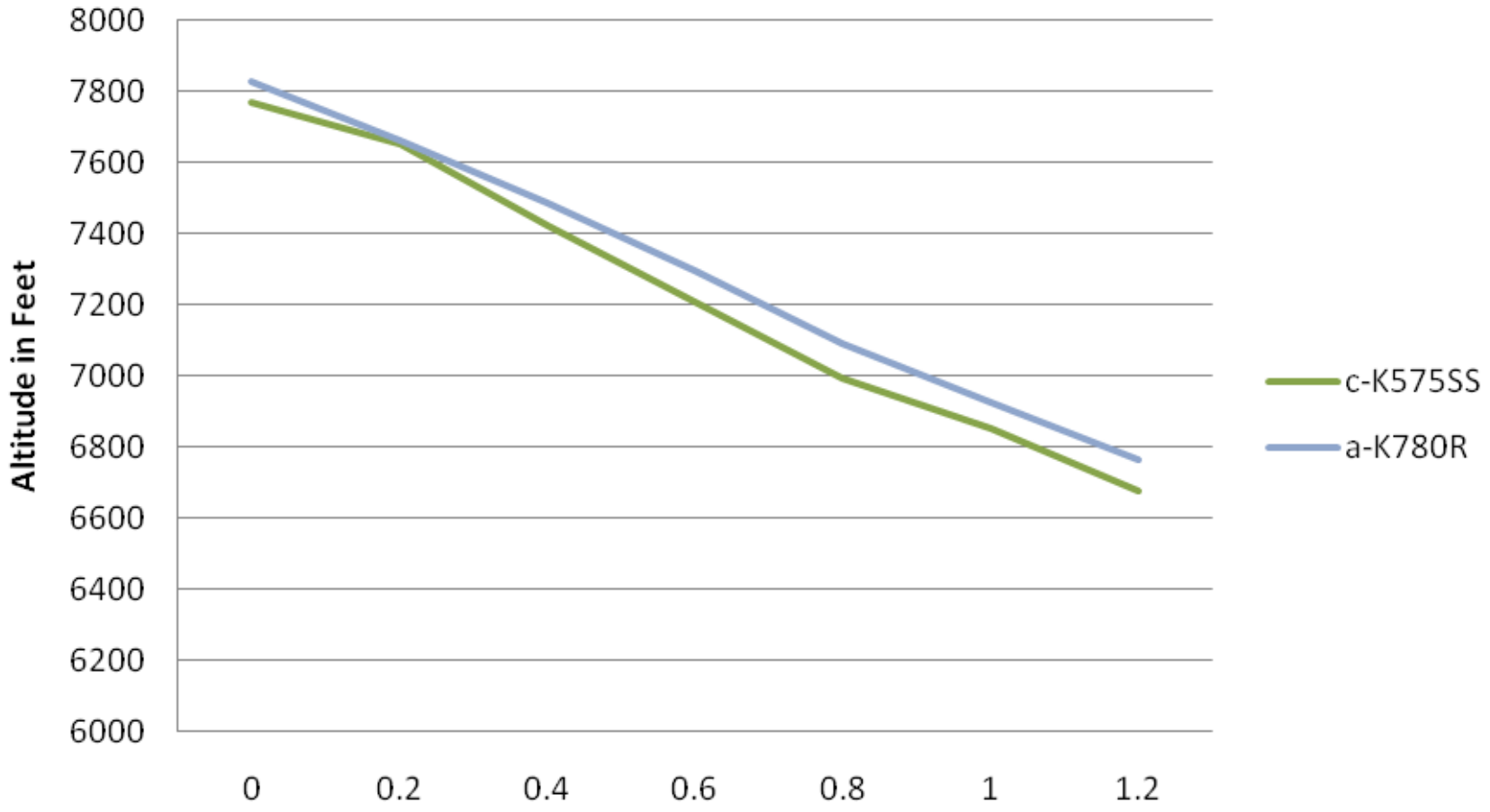
1. Boost Phase
2. Coast Phase
3. Apogee
   - Drogue Deployed
4. Rapid Decent Phase
   - 60 ft/sec
5. Main Decent Phase
   - ~20 ft/sec



# Rocket Design Details

- Length: 84”
- Diameter: 4”
- Weight: 13.9 lbs., unloaded
- Weight: ~20 lbs., on the pad
- Materials: G10 Fiberglass
- Recovery: Dual Deployment, electronic
- Propulsion: 75mm Aerotech K560W

# Altitude vs Payload Mass (in kilograms) - using K engines



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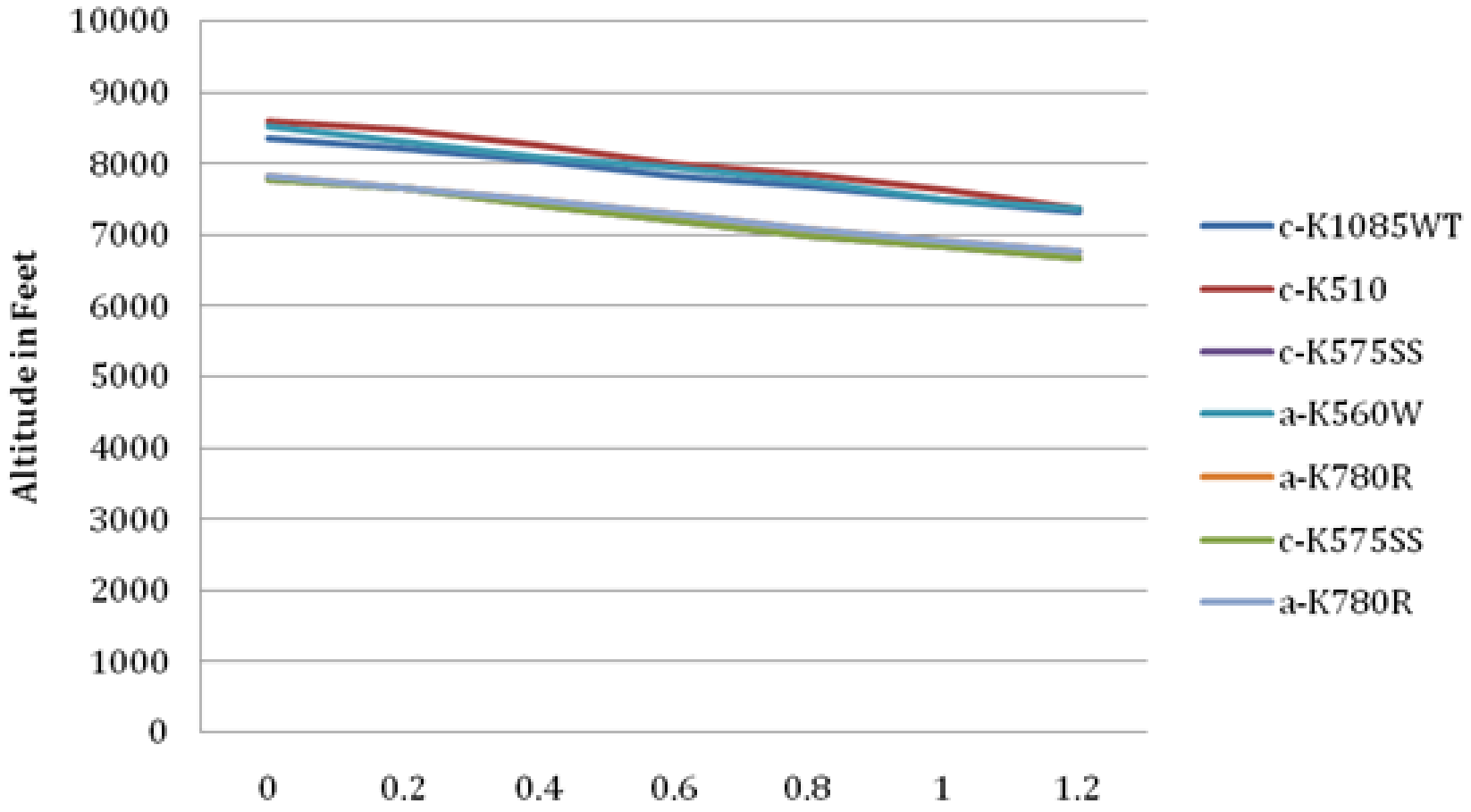

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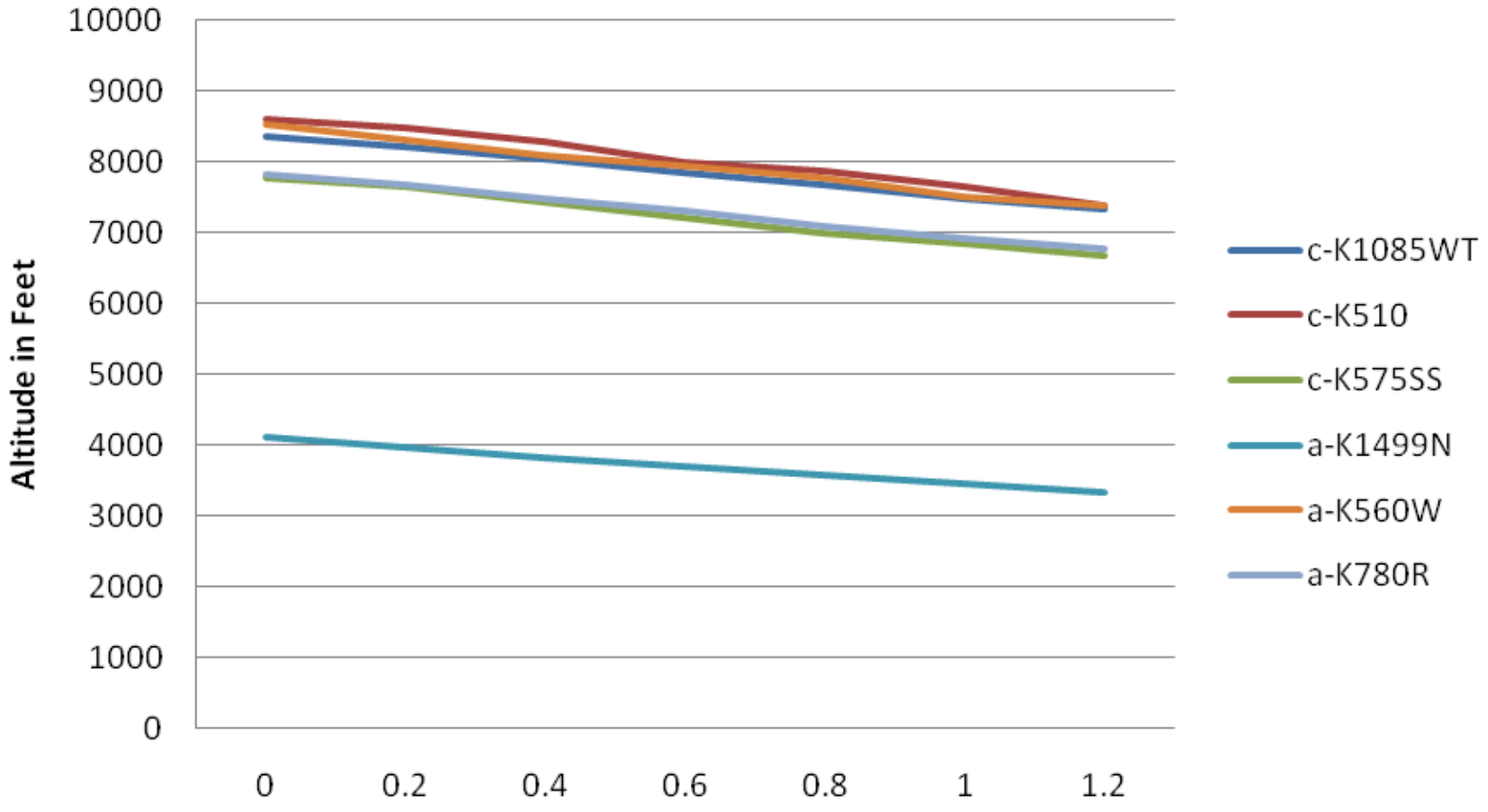
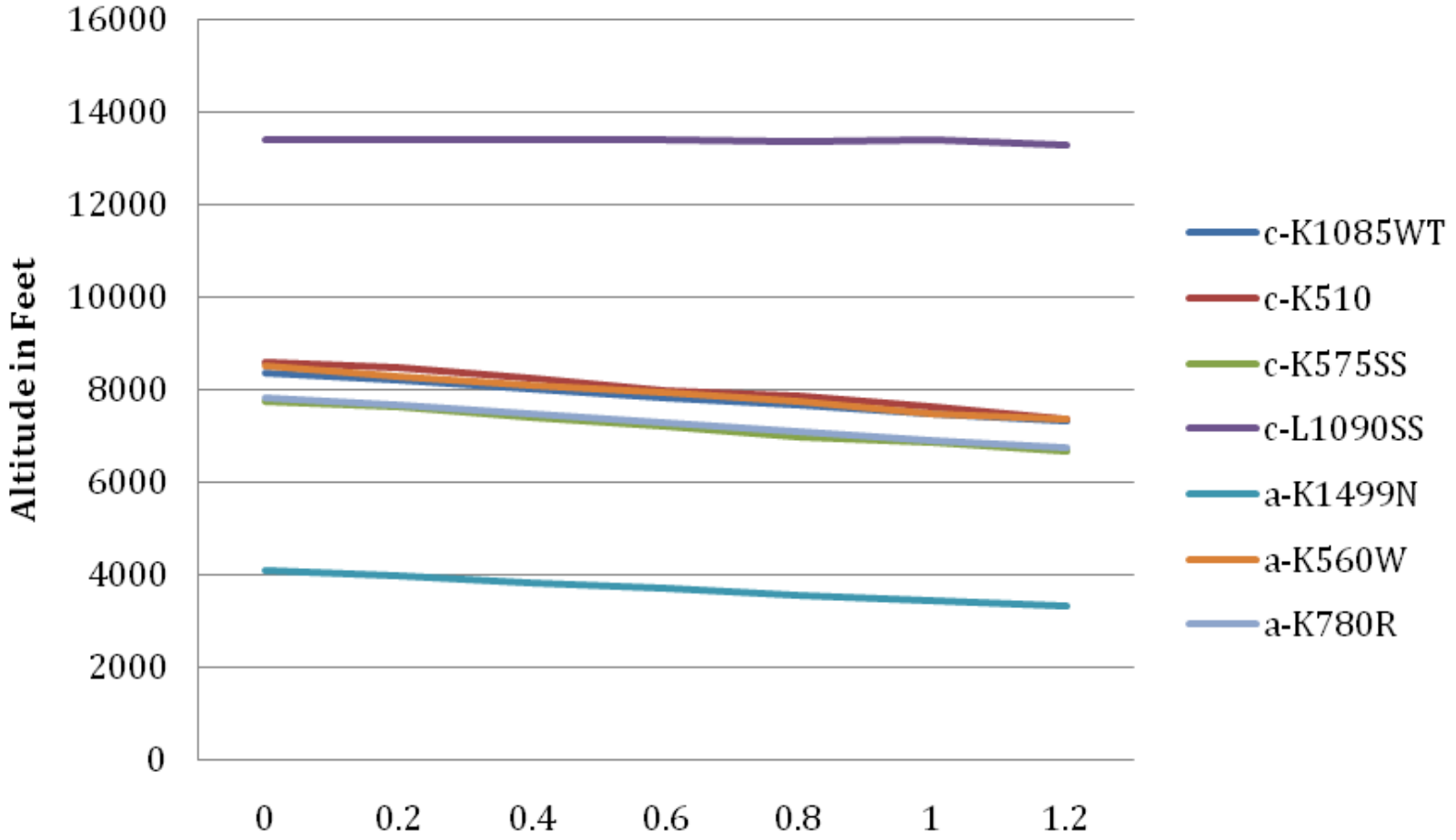
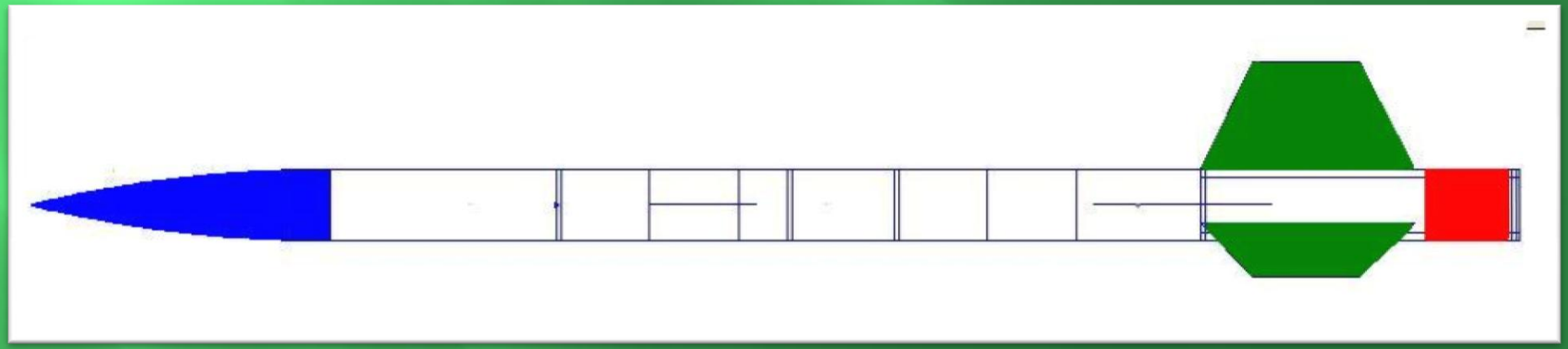


# Altitude vs Payload Mass (in kilograms) - using K & L engines

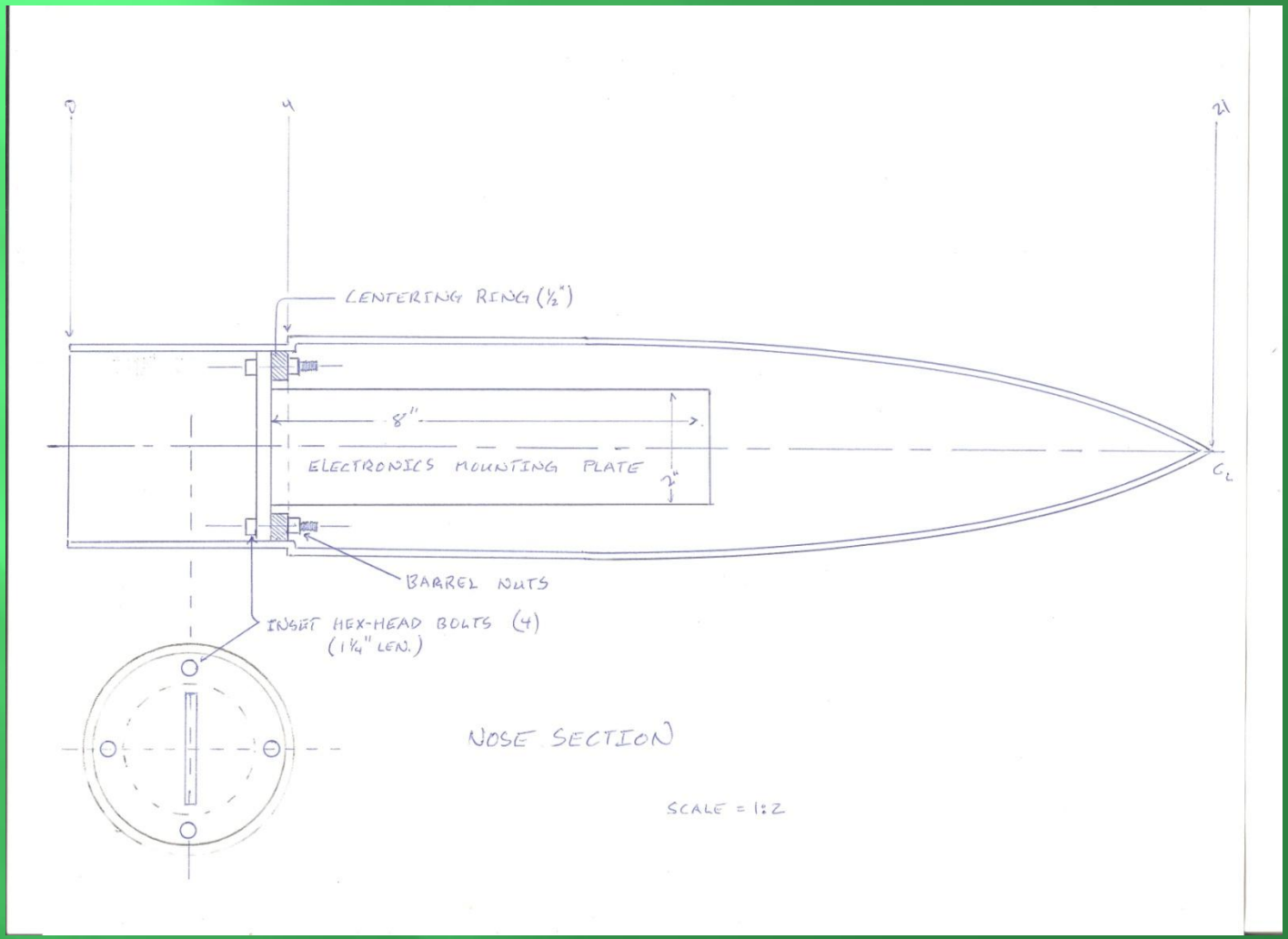


# Characteristics

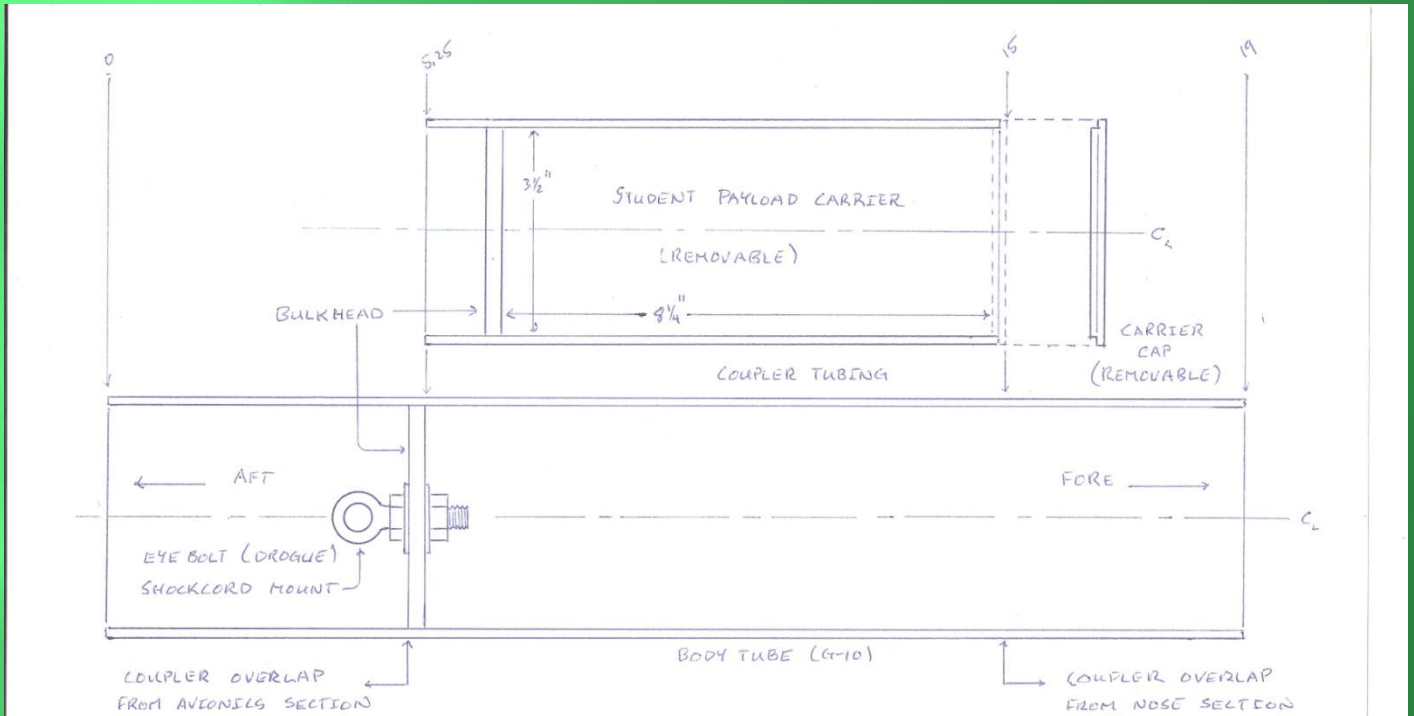
- Electronics in nose cone
- Air brake system
- Three fin design



# Nosecone Detail



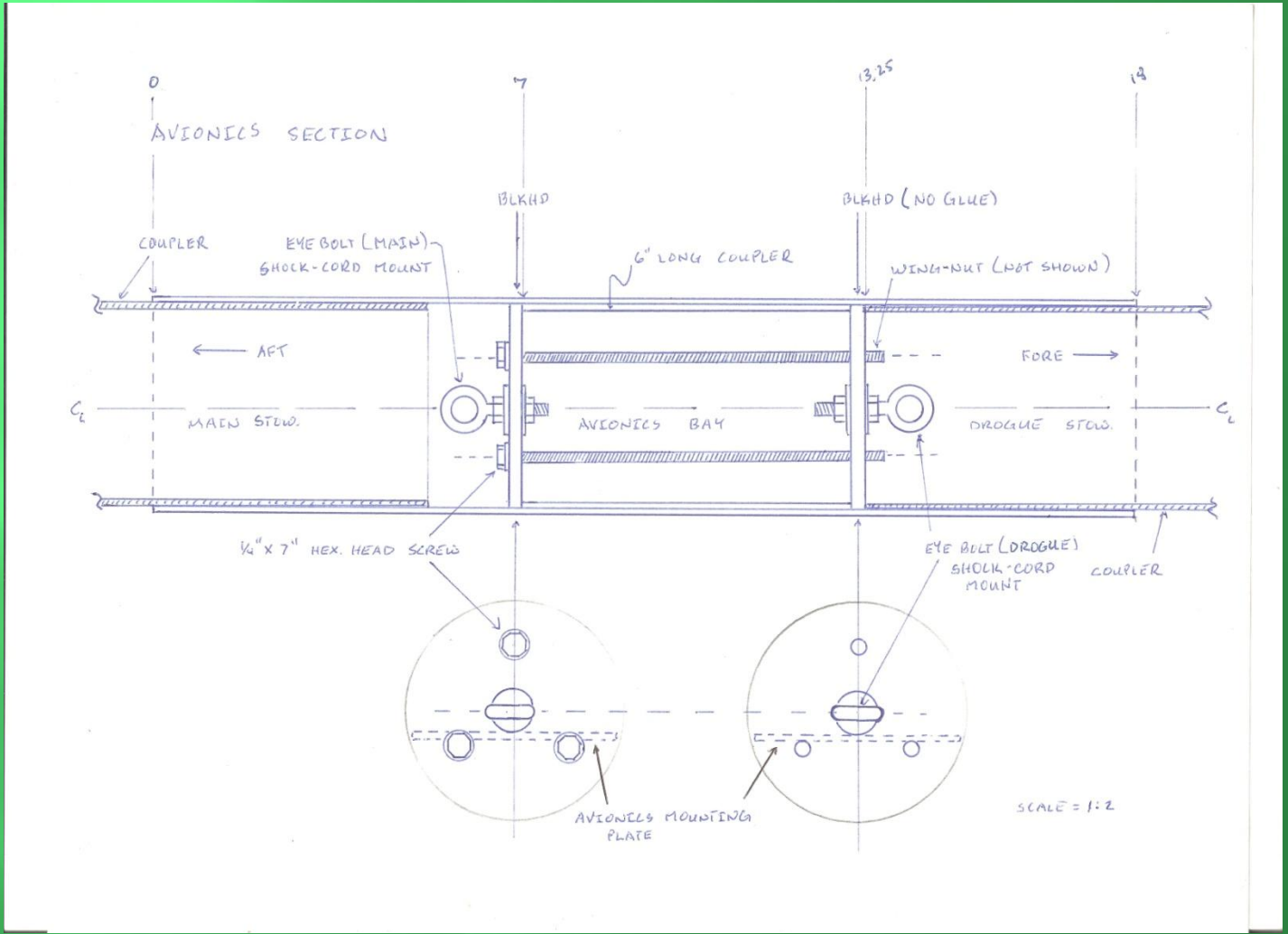
# Payload Detail



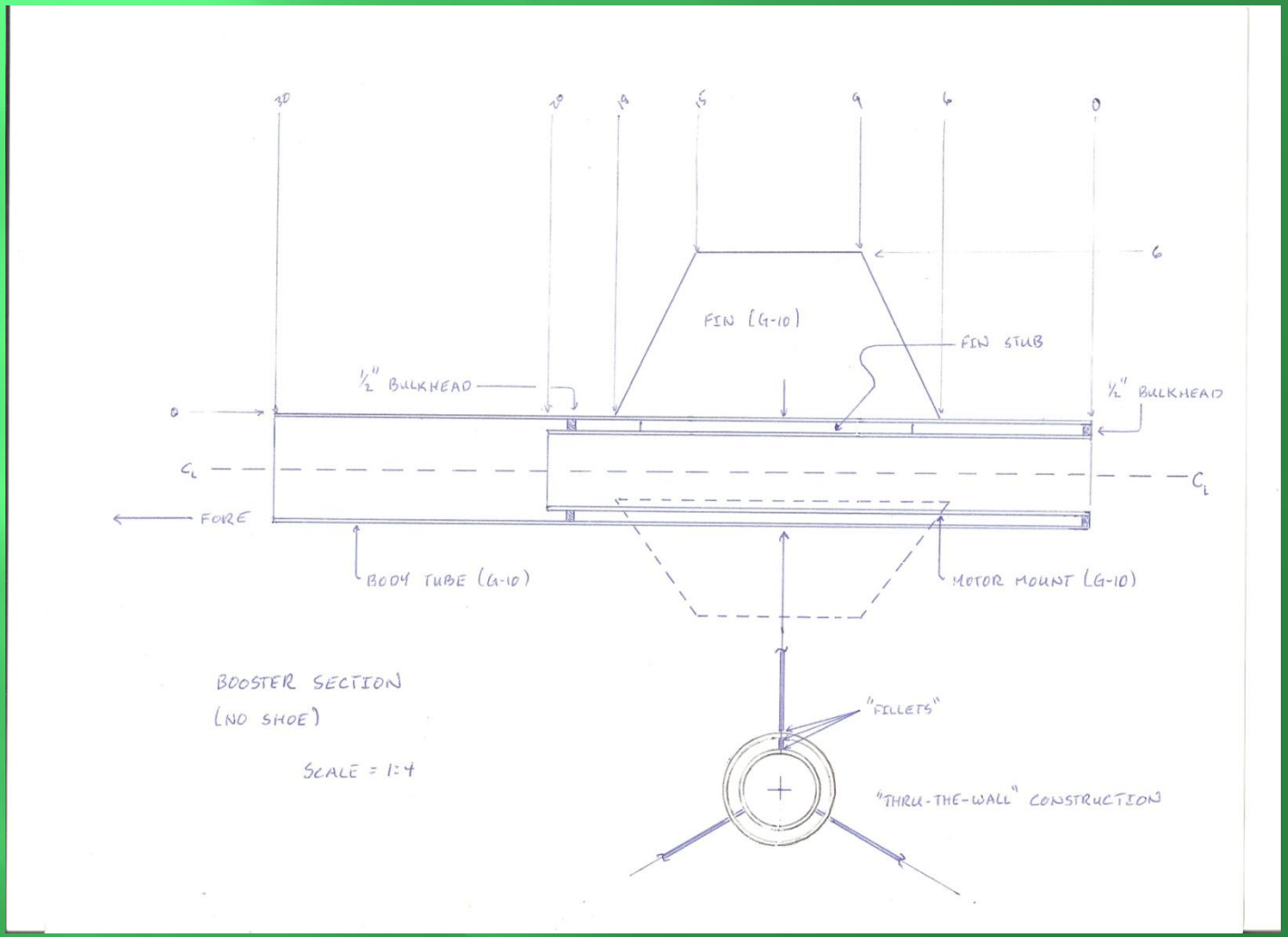

PAYLOAD SECTION & STUDENT PAYLOAD CARRIER

SCALE = 1:2

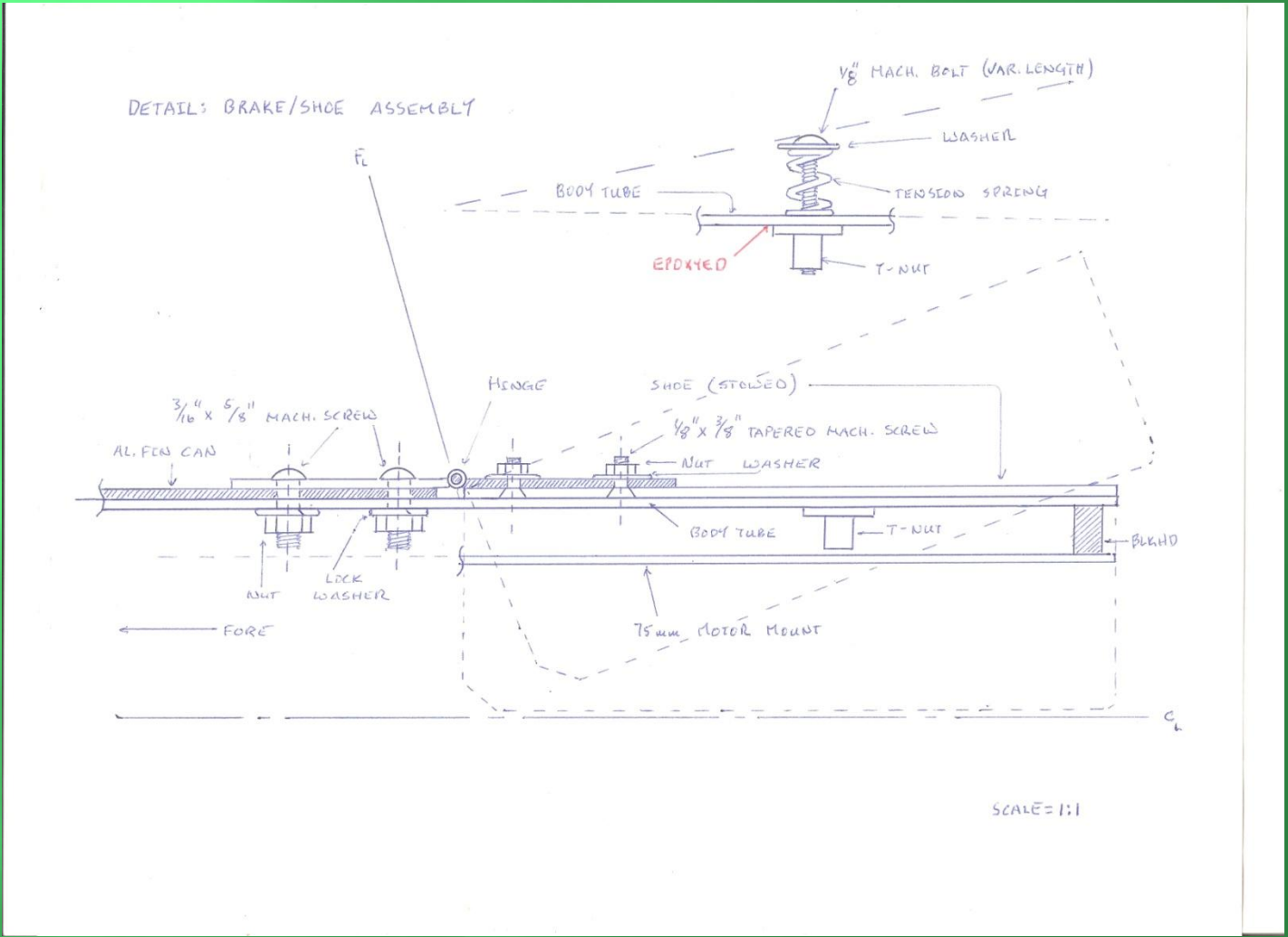
# Avionics Detail



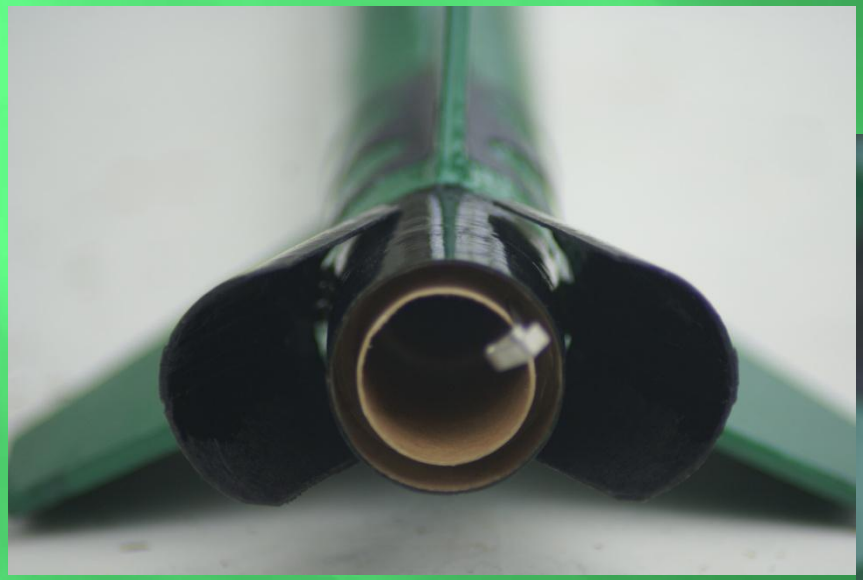
# Booster Detail



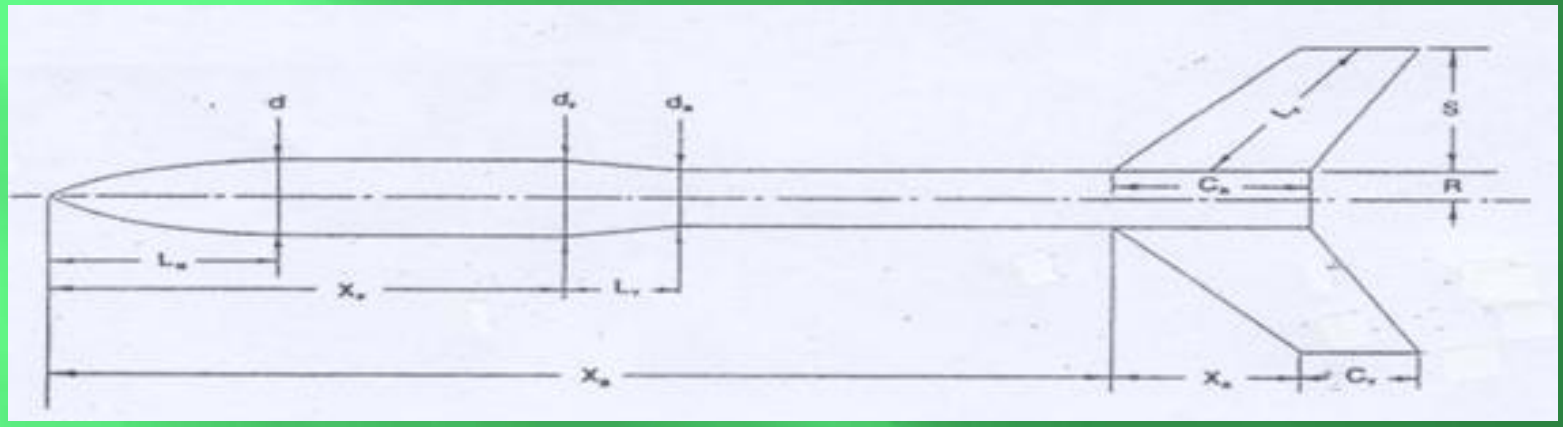
# Drag Shoe Detail



# 3/8 Scale Drag Shoe



# CP Calculation




*Nose:*

$L_N$ = length of nose

For Cone
$(C_N)_N = 2$
$X_N = 0.666 L_N$

For Ogive
$(C_N)_N = 2$
$X_N = 0.466 L_N$

$C_R$ = fin root chord
$C_T$ = fin tip chord
$S$ = fin semispan
$L_F$ = length of fin mid-chord line
$R$ = radius of body rear end
$X_R$ = distance between fin root leading edge and fin tip leading edge parallel to body
$X_B$ = distance from nose tip to fin root chord leading edge

For 3 fins:

$$(C_N)_F = \left[1 + \frac{R}{S + R}\right]\left[\frac{12\left(\frac{S}{d}\right)^2}{1 + \sqrt{1 + \left(\frac{2L_F}{C_R + C_T}\right)^2}}\right]$$

$$\bar{X}_F = X_B + \frac{X_R}{3}\frac{(C_R + 2C_T)}{(C_R + C_T)} + \frac{1}{6}\left[(C_R + C_T) - \frac{(C_R C_T)}{(C_R + C_T)}\right]$$

*Total Values:*

$$(C_N)_R = (C_N)_N + (C_N)_T + (C_N)_F + \ldots$$

(the sum of the force coefficient $C_N$ of each part calculated)

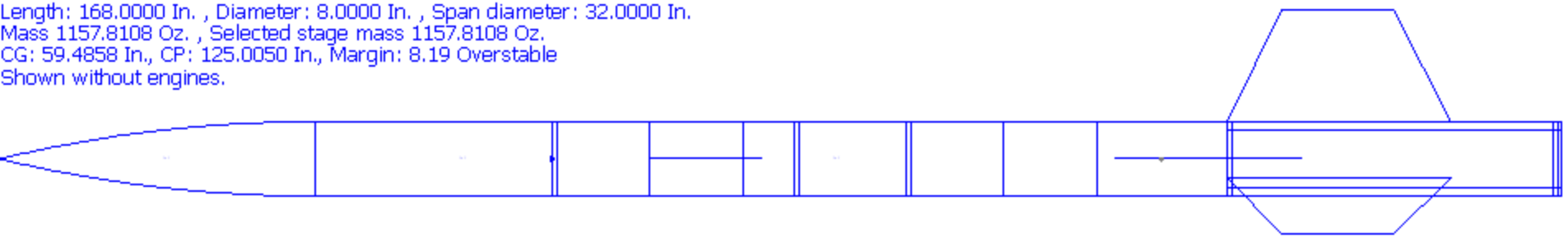
*CP Distance from Nose Tip* $= \bar{X}$

$$= \frac{(C_N)_N \bar{X}_N + (C_N)_T \bar{X}_T + (C_N)_F \bar{X}_F}{(C_N)_R}$$

(the sum of the products of the force coefficient $C_N$ and the part *CP* of each part divided by the total rocket $C_N$)

# RockSim Data

leo hana rocket
Length: 168.0000 In. , Diameter: 8.0000 In. , Span diameter: 32.0000 In.
Mass 1157.8108 Oz. , Selected stage mass 1157.8108 Oz.
CG: 59.4858 In., CP: 125.0050 In., Margin: 8.19 Overstable
Shown without engines.



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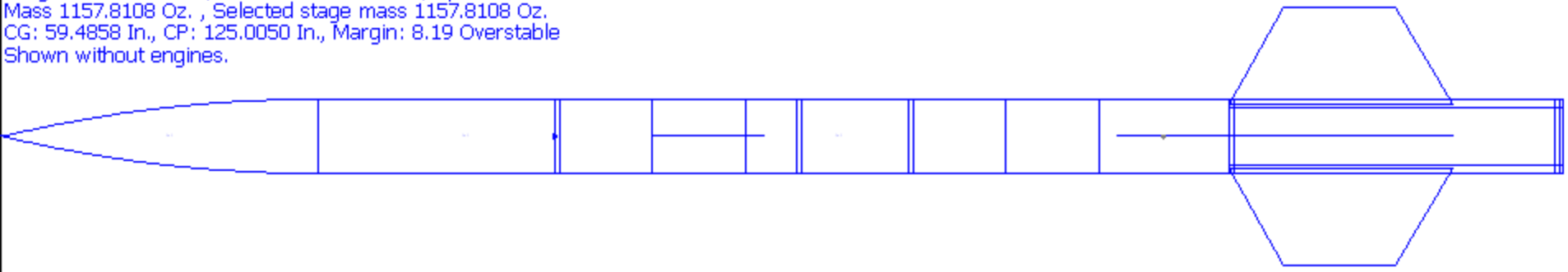

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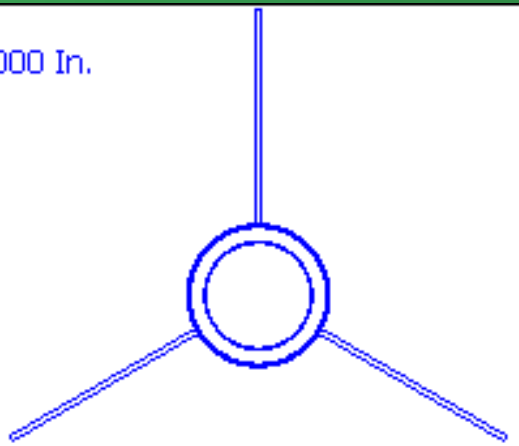
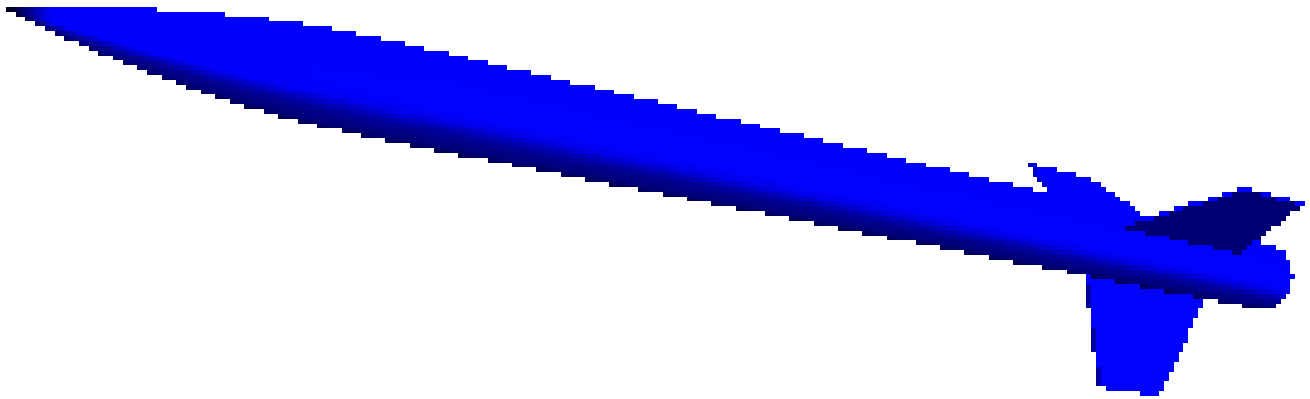




# RockSim Results

## Simulation control parameters

- Flight resolution: 800.000000 samples/second
- Descent resolution: 1.000000 samples/second
- Method: Explicit Euler
- End the simulation when the rocket reaches the ground.

## Launch conditions

- Altitude: 0.00000 Ft.
- Relative humidity: 50.000 %
- Temperature: 59.000 Deg. F
- Pressure: 29.9139 In.

**Wind speed model: Calm (0-2 MPH)**

- Low wind speed: 0.0000 MPH
- High wind speed: 2.0000 MPH

**Wind turbulence: Fairly constant speed (0.01)**

- Frequency: 0.010000 rad/second

- Wind starts at altitude: 0.00000 Ft.
- Launch guide angle: 0.000 Deg.
- Latitude: 0.000 Degrees

## Launch guide data:

- Launch guide length: 36.0000 In.
- Velocity at launch guide departure: 43.4297 ft/s
- The launch guide was cleared at : 0.178 Seconds
- User specified minimum velocity for stable flight: 43.9993 ft/s
- Minimum velocity for stable flight reached at: 37.9524 In.

# RockSim Results

## Max data values:

- Maximum acceleration:Vertical (y): 369.942 Ft./s/sHorizontal (x): 2.679 Ft./s/sMagnitude: 370.000 Ft./s/s
- Maximum velocity:Vertical (y): 1409.3348 ft/s, Horizontal (x): 2.9333 ft/s, Magnitude: 1409.4989 ft/s
- Maximum range from launch site: 427.87809 Ft.
- Maximum altitude: 18714.96241 Ft.

## Recovery system data

- P: Drogue Deployed at : 32.499 Seconds
- Velocity at deployment: 11.6554 ft/s
- Altitude at deployment: 18714.96240 Ft.
- Range at deployment: -427.87809 Ft.
- P: Main chute Deployed at : 267.926 Seconds
- Velocity at deployment: 68.1610 ft/s
- Altitude at deployment: 499.99519 Ft.
- Range at deployment: 110.94046 Ft.

## Time data

- Time to burnout: 5.861 Sec.
- Time to apogee: 32.499 Sec.
- Optimal ejection delay: 26.637 Sec.

## Landing data

- Successful landing
- Time to landing: 279.839 Sec.
- Range at landing: 120.95958
- Velocity at landing: Vertical: -40.6380 ft/s , Horizontal: 0.7629 ft/s , Magnitude: 40.6452 ft/s

# Recovery Details

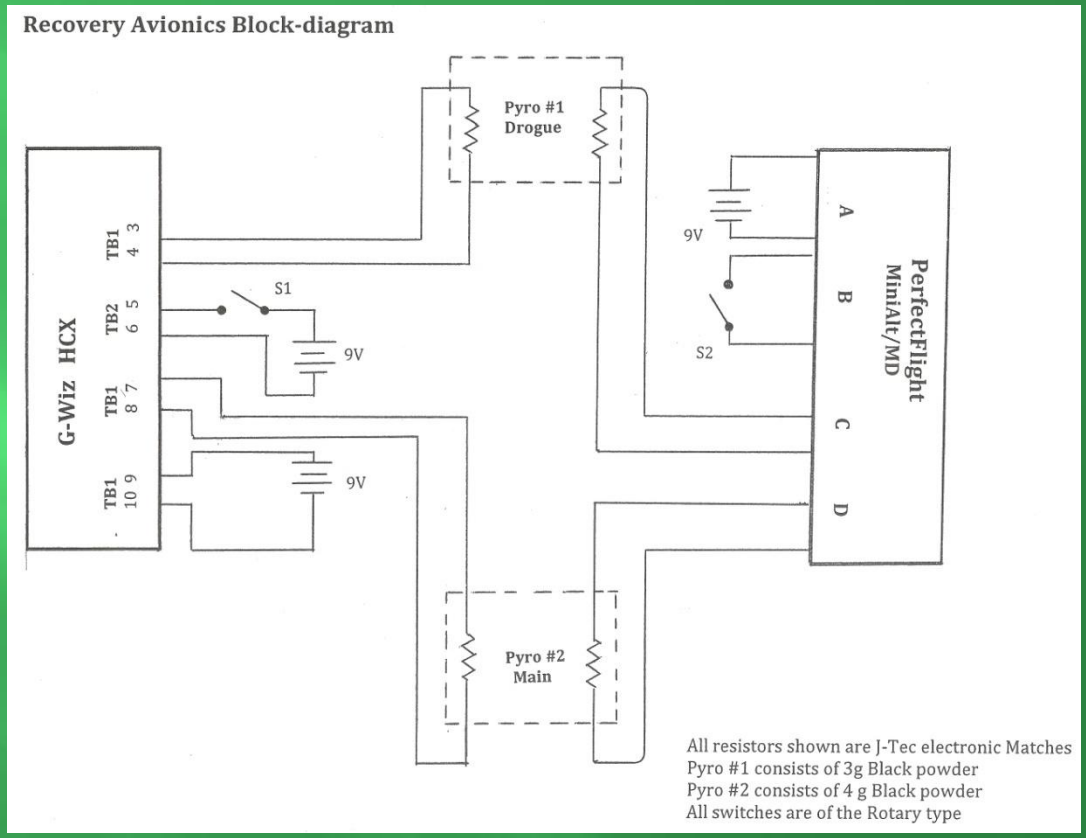
**Dual Deployment**

**Primary Controller:**
**G-Wiz HCX Flight Computer, Dual 9V Lithium batteries**

**Auxiliary Controller:**
**Perfect Flight MAWD, 9v Lithium**

**Drogue Chute: 36”**
**Deployed at Apogee**

**Main Chute: 96”**
**Deployed at 500’**




**Drogue Decent rate: 60ft/sec**
**Drogue Charge: 3g Black Powder**

**Main Decent rate: ~20ft/sec**
**Main Charge: 4g Black Powder**

# MYNAH BIRD 2 CANSAT

## Honolulu Community College CanSat Project

# Type of mission

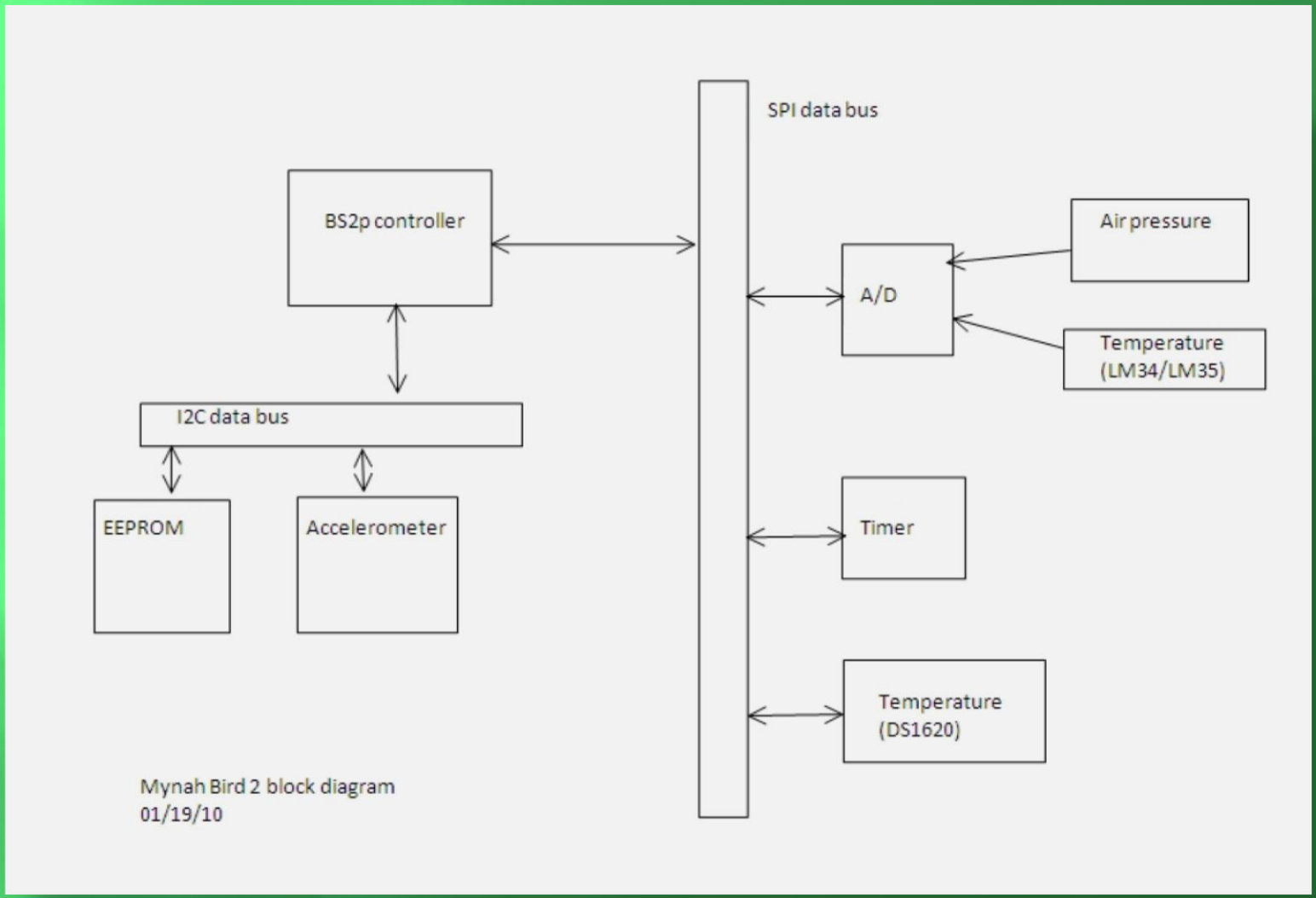
Measures and stores the following data in EEPROM

- Current time
- Acceleration
- Internal air temperature (using 2 sensors)
- External air temperature (using 2 sensors)
- Air pressure

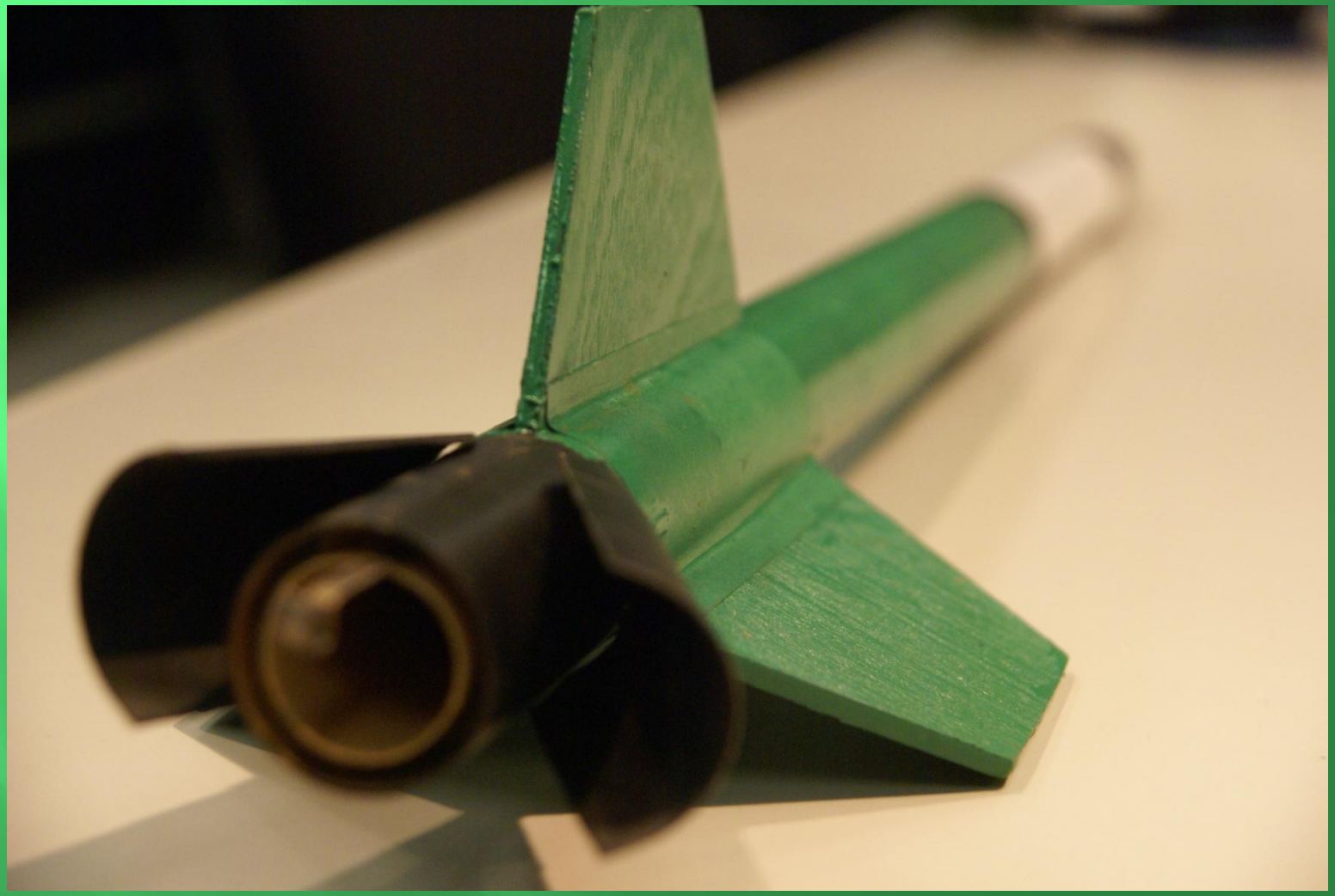
# Parts list and cost

| part | primary vendor | part id | unit cost | qty | price | | notes |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| Basic Stamp 2p | Parallax | BS2P24 | $79.00 | 1 | $79.00 | | controller |
| EEPROM | Digi-Key | 24LC256-I/P | $1.18 | 2 | $2.36 | | 32Kbyte EEPROM |
| MMA7455 | Parallax | 28526 | $34.99 | 1 | $34.99 | | 3 axis accelerometer |
| MCP3204 | Parallax | 604-00061 | $4.73 | 1 | $4.73 | | 4 channel A/D convertor |
| DS1620 | Parallax | 604-00002 | $6.99 | 1 | $6.99 | | Digital temperature sensor |
| LM34 | Parallax | 604-00011 | $3.99 | 3 | $11.97 | | Analog temperature sensor |
| DS1302 | Parallax | 604-00005 | $4.99 | 1 | $4.99 | | Time keeper |
| 32.768 kHz Crystal | Parallax | 251-03230 | $1.25 | 1 | $1.25 | | Needed by the DS1302 |
| MPX5100A | Digi-Key | MPX5100A-ND | $15.84 | 1 | $15.84 | | Air pressure sensor |
| | | | | | | | |
| subtotal | | | | | $162.12 | | |

Note: Not included in this list are the resistors, capacitors, LED, batteries, switches and wire


SPI data bus
BS2p controller
Air pressure
A/D
Temperature
(LM34/LM35)
I2C data bus
EEPROM
Accelerometer
Timer
Temperature
(DS1620)
Mynah Bird 2 block diagram
01/19/10

# 3/8 Scale Proof –of -Concept



# Flight Testing

# PAU