CanSat 2026
Preliminary Design Review (PDR)
Version 2.0

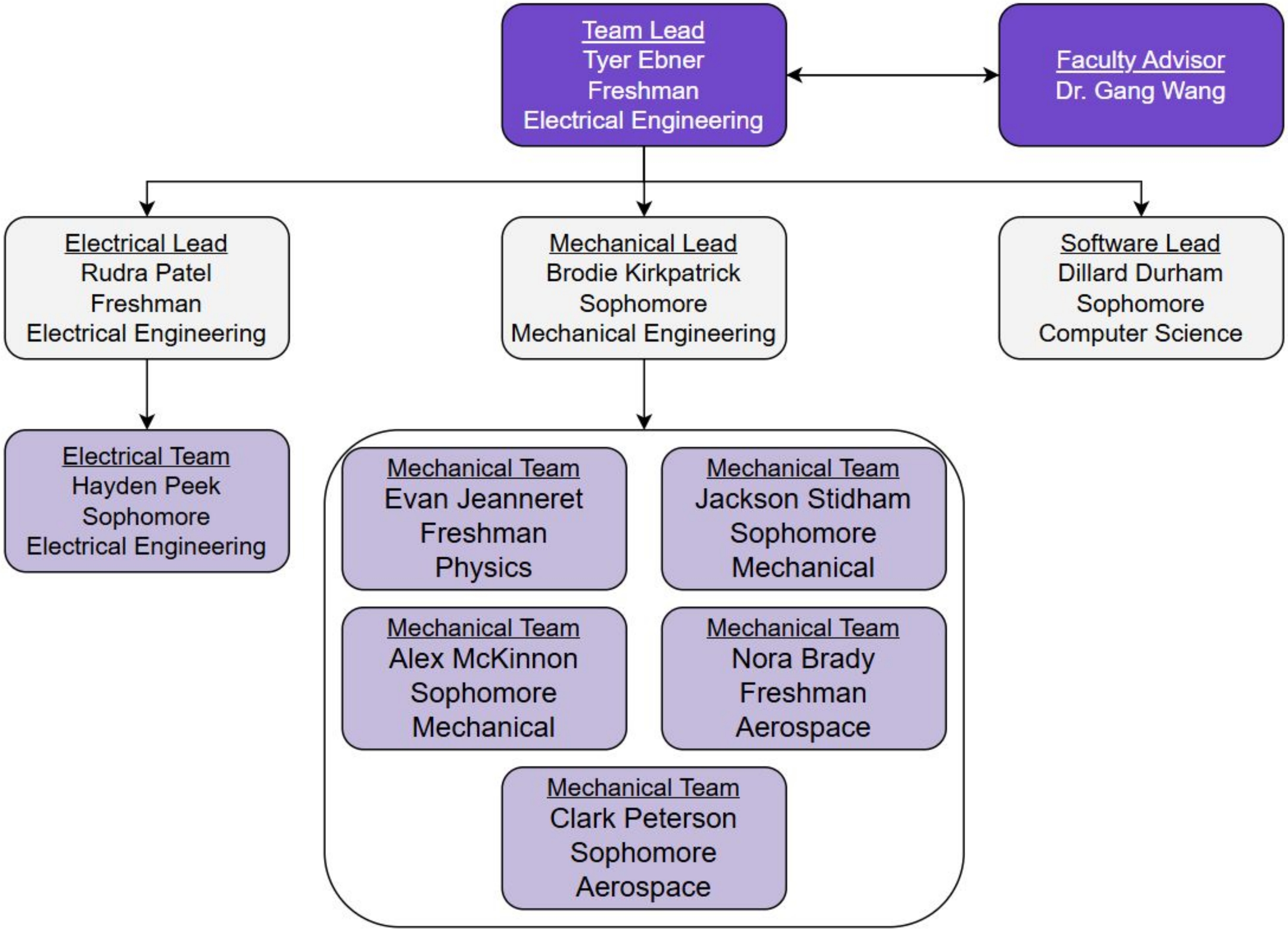
#1094

MetalHawk

Presentation Outline (1/2)

Presentation Outline (2/2)

Team Organization



Acronyms (1/5)

Acronym	Meaning	Acronym	Meaning
°	Degree	CAD	Computer Aided Design
°/min	Degrees per minute	Cd	Coefficient of drag
°/s	Degrees per second	CDH	Command Data Handling
$	Dollars (USD)	CDR	Critical Design Review
#	Number	cm	Centimeters
%	Percentage	Com.	Communication line
3D	Three Dimensional	combo	Combination
A	Amperes	Comm.	Communications
AC	Alternating current	COTS	Commercially Off The Shelf
bd	Baud	csv	Comma-Separated Values
C	Celsius	dB	Decibels

Acronyms (2/5)

Acronym	Meaning	Acronym	Meaning
dBi	Decibels relative to isotropic	g	Grams
DC	Direct current	G	G-force (accel. due to Earth’s gravity)
DCS	Decent control system	GB	Gigabytes
DOF	Degrees of freedom	GCS	Ground Control Software
EEPROM	Electrically Erasable Programmable Read-only Memory	GHz	Gigahertz
Elec	Electrical	GPS	Global Positioning System
EPS	Electrical Power System	GUI	Graphical User Interface
Etc.	Excetera	h	Hours
FSW	Flight Software	Hz	Hertz
ft	Feet	I2C	Inter-Integrated Circuit

Acronyms (3/5)

Acronym	Meaning	Acronym	Meaning
ID	Identification	LED	Light Emitting Diode
IDE	Integrated Development Environment	LLC	Limited Liability Corporation
in	Inch	m	Meters
JST	Japan Solderless Terminal	m/s	Meters per second
KB	Kilobyte	mA	MilliAmps
kg	Kilograms	Mag	Magnetometer
kg/cm	Kilogram per centimeter	mAh	MilliAmp hours
kJ/m	Kilojoules per meter	MB	MegaBytes
km	Kilometers	Mec.	Mechanism
kPA	Kilopascals	Mech.	Mechanical
lbs	Pounds	MHz	MegaHertz

Acronyms (4/5)

Acronym	Meaning	Acronym	Meaning
Min	Minimum	PA6-CF	PolyAmide 6 Carbon-Fiber Reinforced
mm	Millimeters	PCB	Printed Circuit Board
MOSFET	Metal Oxide Semiconductor Field Effect Transistor	PDR	Preliminary Design Review
MPa	Megapascals	PE foam	Polyethylene Foam
ms	Milliseconds	PETG	Polyethylene Terephthalate Glycol
NETID	Network Identification	PLA	Polylactic Acid
NMOS	N-Channel MOSFET	PMOS	P-Channel MOSFET
ns	Nanoseconds	PPM	Parts Per Million
Num	Number	RAM	Random Access Memory
Omni	Omnidirectional	Rel.	Relative
Pa	Pascals	Rqmt	Requirement

Acronyms (5/5)

Acronym	Meaning	Acronym	Meaning
s	Second	UART	Universal Asynchronous Receiver Transmitter
SD	Secure Digital	USB	Universal Serial Bus
sec	Second	USD	United States Dollar
SI	Système International	UTC	Coordinated Universal Time
SIM	Subscriber Identity Module	V	Voltage
SPI	Serial Peripheral Interface	VS	Virtual Studio
TPU	Thermoplastic Polyurethane	Wh	Watt Hours

Systems Overview

Brodie Kirkpatrick, Clark Peterson, and Alex McKinnon

Mission Summary

Mission Objectives	
1	Design a functioning CanSat containing a large hen's egg that releases at a designated elevation.
2	CanSat will operate as the nose cone of a rocket.
3	The CanSat will be launched to a maximum designated height and release from the rocket, deploying an autonomous chute to steer to a designated location.
4	At 2 meters the CanSat will release the egg which must remain intact.
5	CanSat will land in the required landing zone.
6	CanSat will deliver telemetry data to a ground station during flight and stop delivering data once landed.
7	CanSat will activate an audio beacon upon landing.

System Requirement Summary (1/3)

Requirement Number	Requirement
C1	The CanSat payload shall function as a nose cone during the rocket ascent portion of the flight.
C4	After deployment, the CanSat payload and container shall descend at 15 meters/second using a parachute that automatically deploys. Error is +/- 3 meters/sec.
C5	At 80% flight peak altitude, the payload shall be released from the container.
C6	At 80% peak altitude, the payload shall deploy a para-glider descent control system.
C7	The payload shall descend at 5 meters/sec averaged over the entire descent within +/- 3 meters/sec with the paraglider descent control system.
C8	The payload shall steer toward a target location.
C12	The payload shall release a protected hens egg when the payload is 2 meters +/- 0.5 m above the ground without breaking the egg.

System Requirement Summary (2/3)

Requirement Number	Requirement
C14	Cost of the CanSat shall be under $1000. Ground support and analysis tools are not included in the cost of the CanSat. Equipment from previous years shall be included in this cost, based on current market value.
S1	The CanSat and container mass shall be 1000 grams +/- 10 grams.
S2	The nose cone shall be symmetrical along the thrust axis.
S5	The nose cone shall be made as a single piece. Segments are not allowed.
S8	CanSat structure must survive 15 Gs vibration.
S9	CanSat shall survive 30 G shock.
S17	All electronics and mechanical components shall be hard mounted using proper mounts such as standoffs, screws, or high performance adhesives.

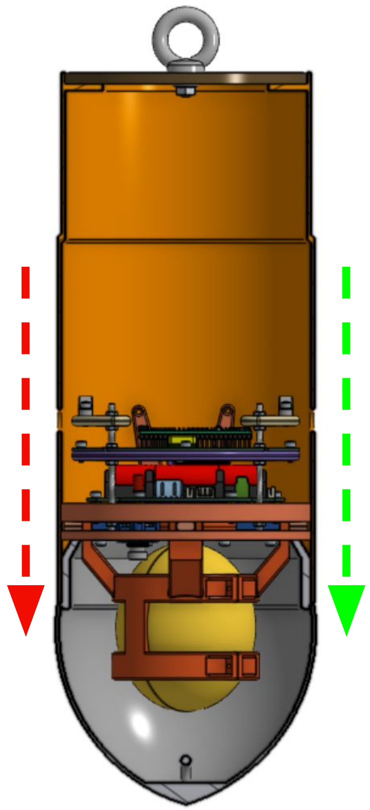
System Requirement Summary (3/3)

Requirement Number	Requirement
S20	If the nose cone is to separate from the payload after payload deployment, the nose cone shall descend at no more than 5 meters/sec.
E3	An easily accessible power switch through the container is required.
E4	The container shall have small access holes for power switches of no more than 10 mm.
E5	Power indicator is required.
E6	The CanSat shall operate for a minimum of two hours when integrated into the rocket.
G4	Each team shall develop their own ground station.
G17	The ground station shall be able to activate all mechanisms on command.

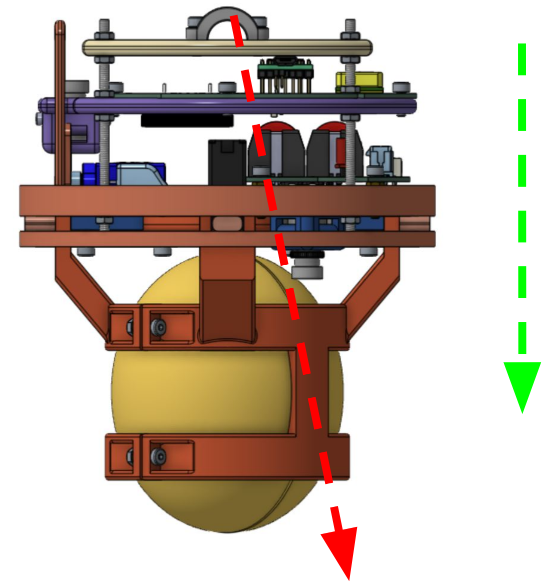
System Level CanSat Configuration Trade & Selection (1/6)

Design X

Direction of Travel: (red)
Nadir: (green)



Note: Nose cone will be dropped upon release, so it is hidden in the deployed configuration

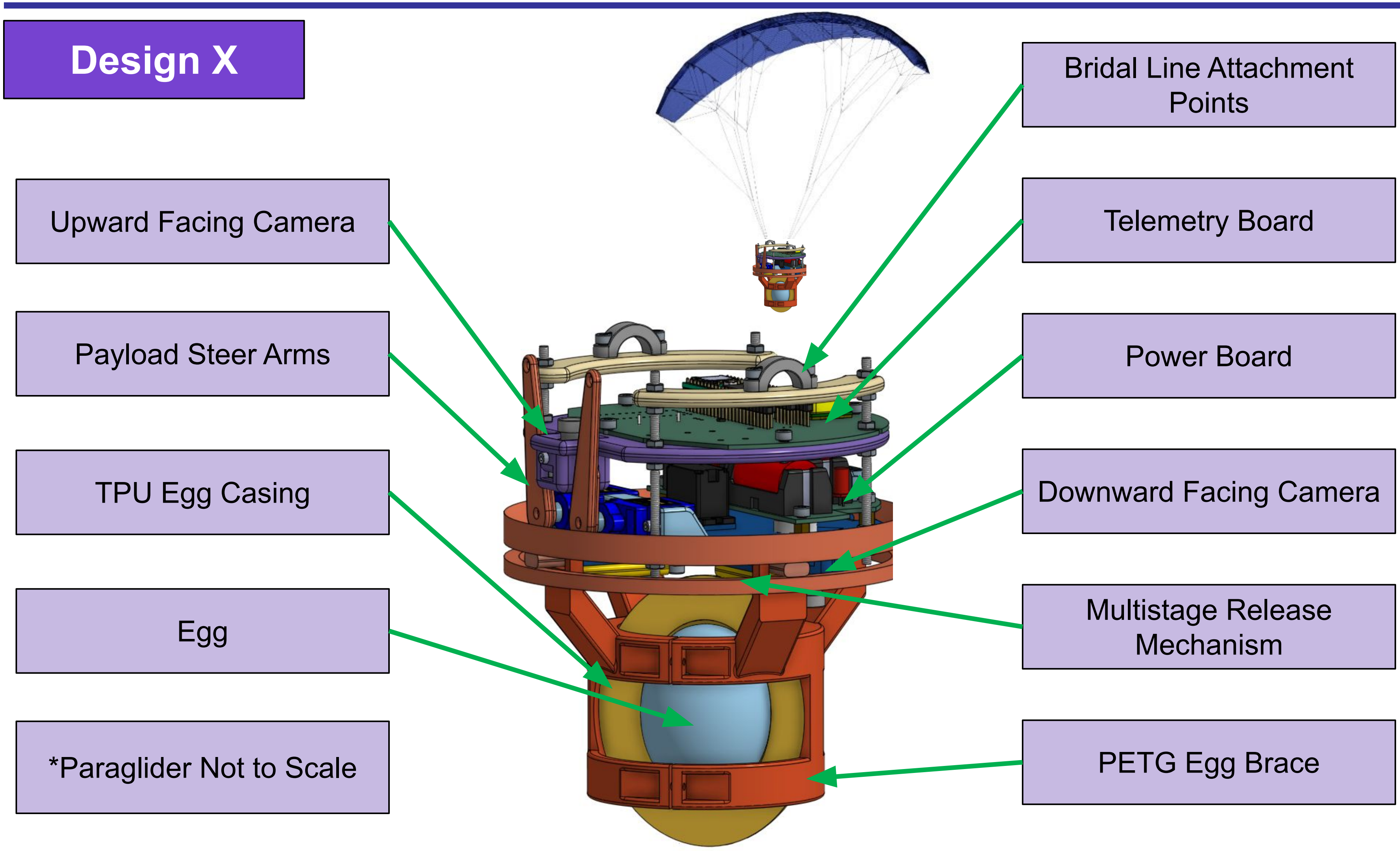


Stowed Configuration

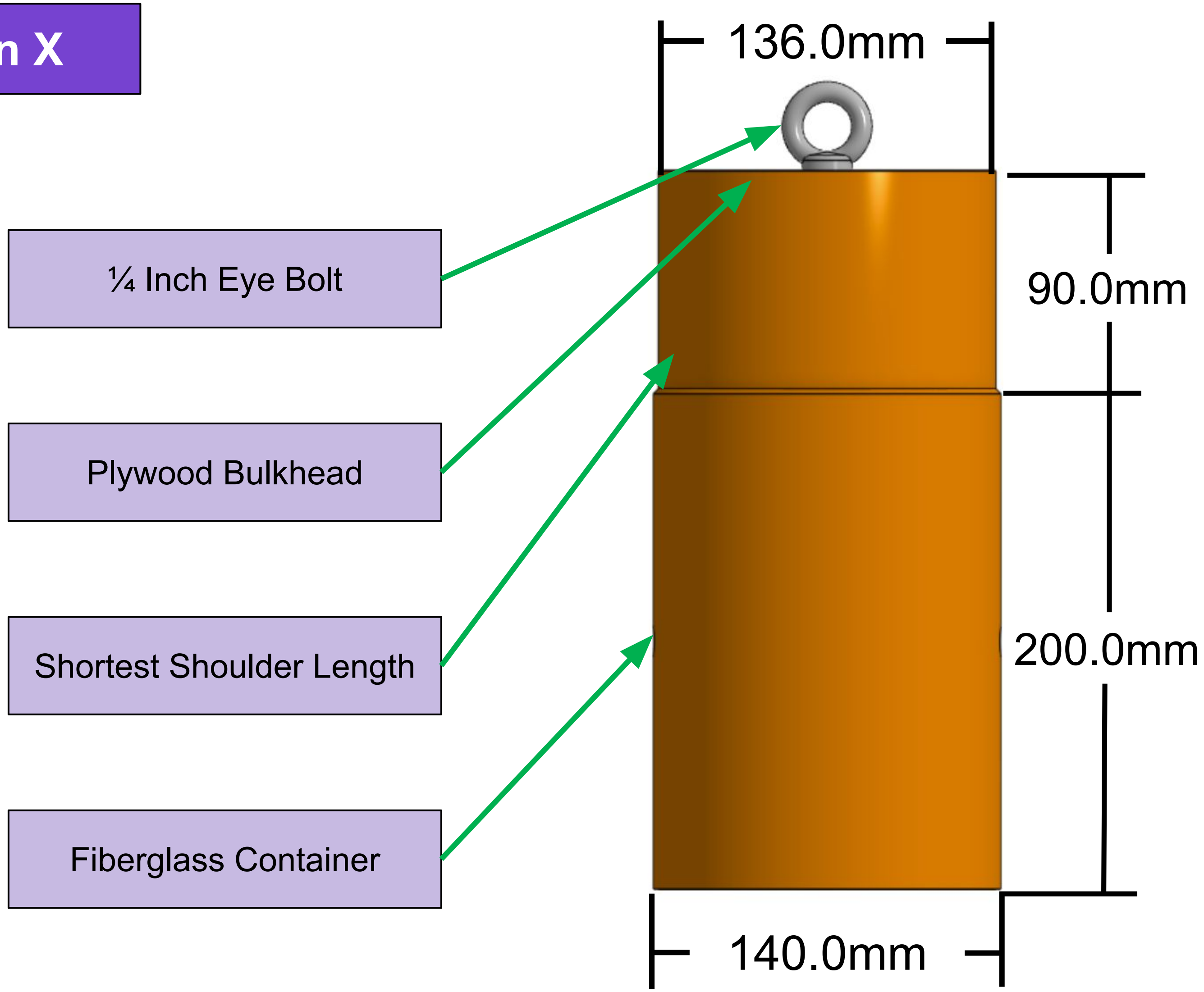
Deployed Configuration

System Level CanSat Configuration Trade & Selection (2/6)

Design X



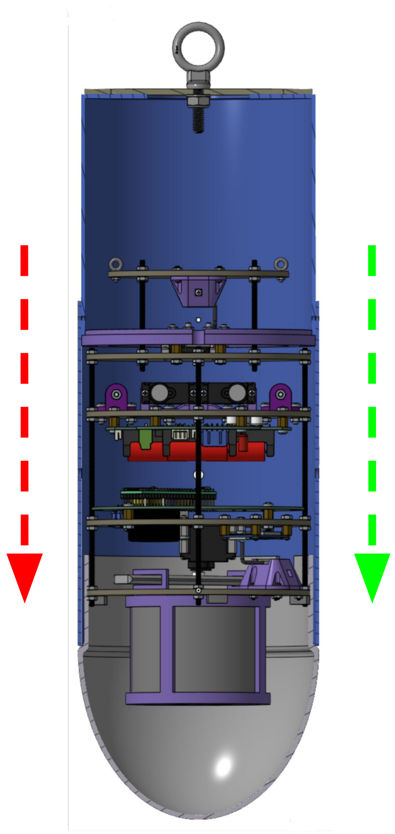
Design X



¼ Inch Eye Bolt
Plywood Bulkhead
Shortest Shoulder Length
Fiberglass Container
136.0mm
90.0mm
200.0mm
140.0mm

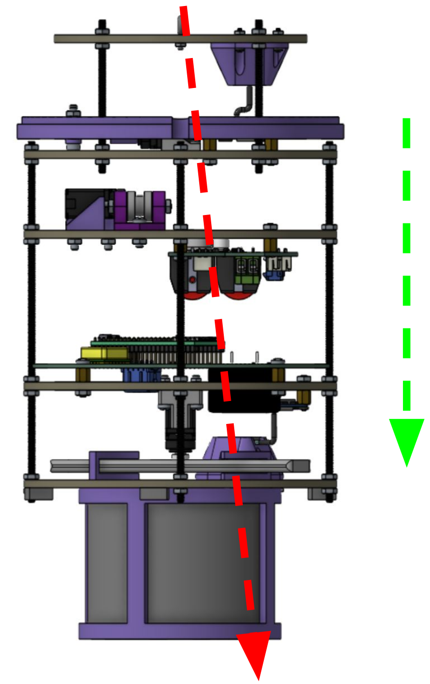
Design Y

Direction of Travel: (red)
Nadir: (green)



Stowed Configuration

Note: Nose cone will be dropped upon release, so it is hidden in the deployed configuration

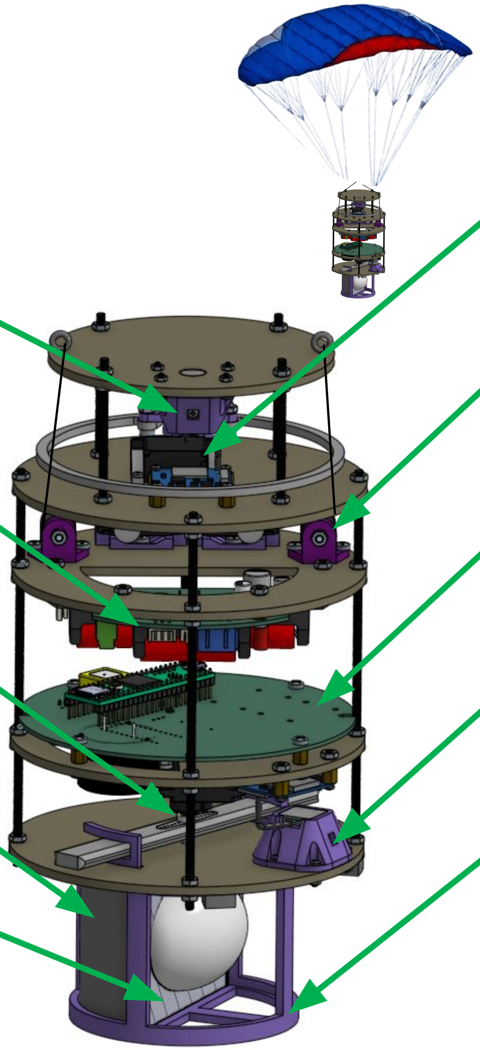


Deployed Configuration

System Level CanSat Configuration Trade & Selection (5/6)

Design Y

Paraglider
Image Credit: RCCastle



System Level CanSat Configuration Trade & Selection (6/6)

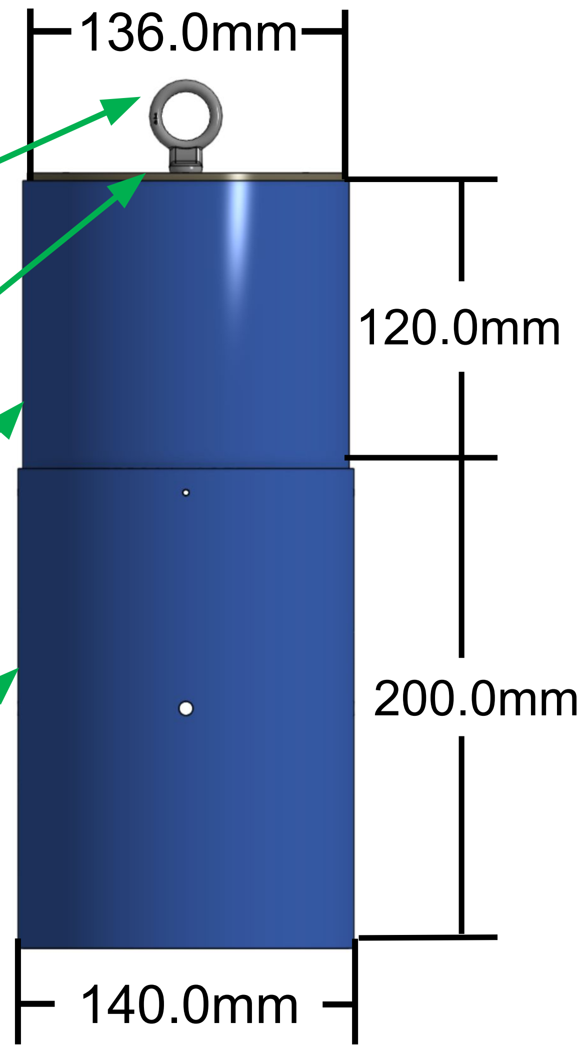
Design Y

¼ Inch Eye Bolt

Plywood Bulkhead

Longest Shoulder Length

PETG Container



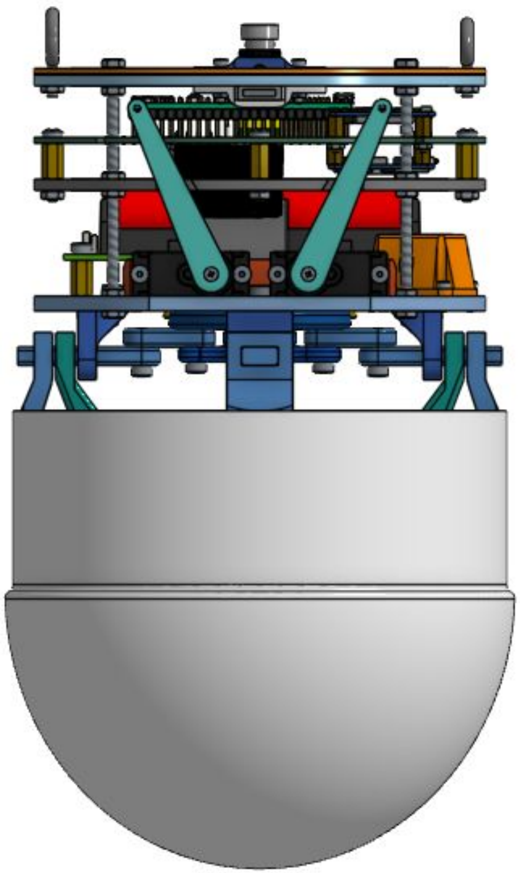
System Level Configuration Selection (1/2)

Subsystem	Design X	Design Y	Final Design
Parachute	Toroidal Parachute	Hemispherical Parachute	Design Y
Paraglider	Custom Sewed Ripstop Nylon Paraglider	Ordered Paraglider	Design X
Steering Mechanism	PA6-CF Lever Arms with 9g Servos	Pulley Systems with 14g Servos	Combination
Release Mechanism	Multistage Release Mechanism	Snap Ring Release	Design X
Camera Mount	Incorporated into Plate Print	3D Printed Mount that Screws Into Plate	Combination
Structure	PA6-CF Compact Plates Connected by M3 Threaded Rods	Circular Composite Plates with Various Cut-outs Connected by M3 Threaded Rods	Combination
Egg Mount	Sectional Mount that Screws Together with M3 Bolts and Nuts. Egg is Surrounded by TPU Air	Egg Surrounded by PE Foam, TPU Sleeve, and PETG Brace	Design X
Container	Fiberglass Container with 90mm Shoulder Length	PETG Container With 120mm Shoulder Length	Design X

System Level Configuration Selection (2/2)

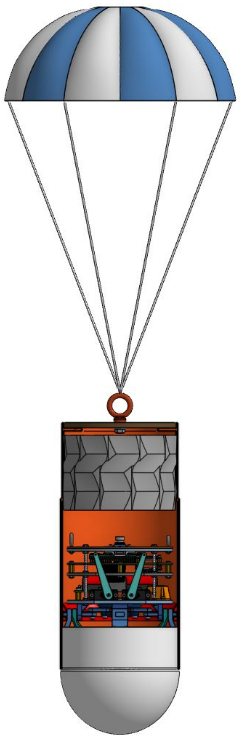
Final Part	Reasoning
Design Y Parachute	Smaller & Better Drag Coefficient
Design X Paraglider	Modularity & Cost
Combination Steering Mechanism	Servo Strength & Simplicity
Design X Release Mechanism	Integration with Other Systems
Combination Camera Mount	Ease of Access
Combination Structure	Compactness & Accessibility
Design X Egg Mount	Stability & Release Integration
Design X Container	Less Mass & Compatibility

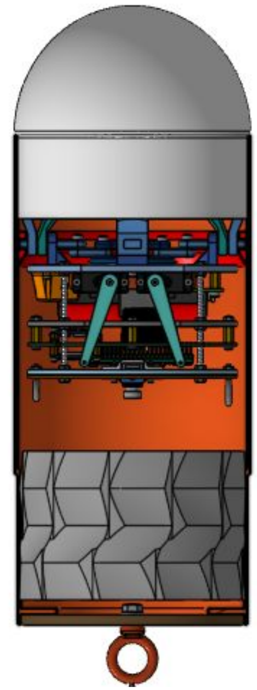
Final Design (Combination)



Physical Layout (1/7)

Final Design





Stowed Configuration

Launch Configuration

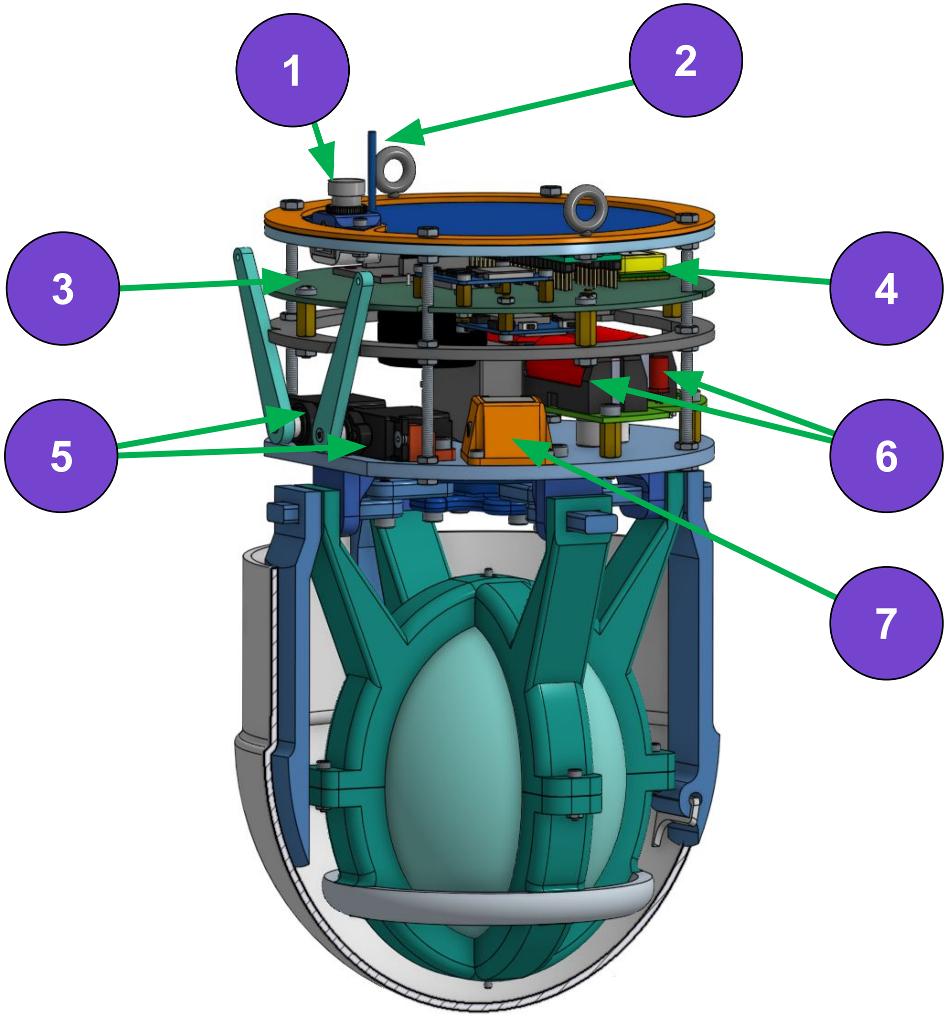
Deployed Configuration

Physical Layout (2/7)

Electronics

#	Component
1	Release Camera
2	Radio Antenna
3	Telemetry Board
4	GPS Antenna (Internal)
5	Servos
6	Power PCB & Batteries
7	Ground-Facing Camera

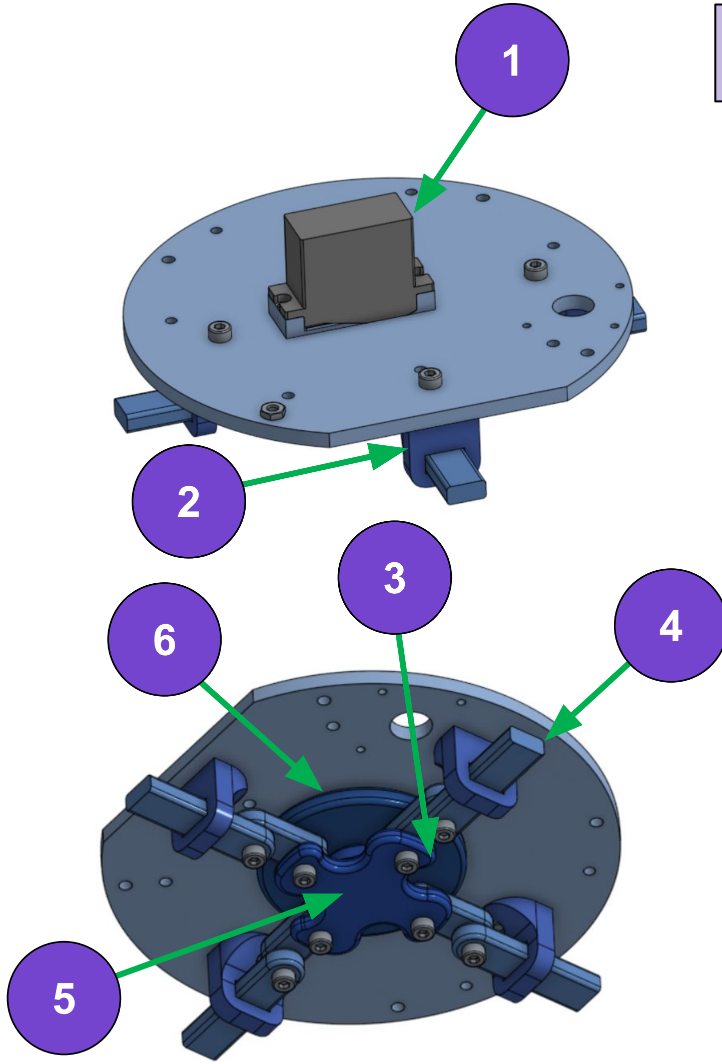
*Various Parts Sectioned for visibility



Physical Layout (3/7)

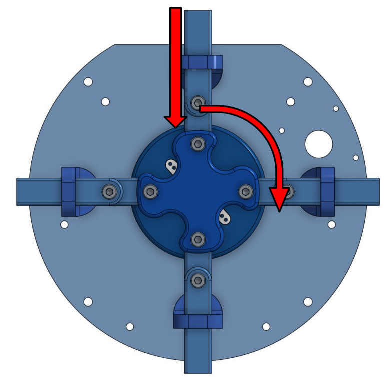
Release Mechanism

#	Component
1	Center Servo (17g)
2	Guide Slots
3	Center Arms
4	Outer Arms
5	Arm Spacer
6	Servo Mount Disk

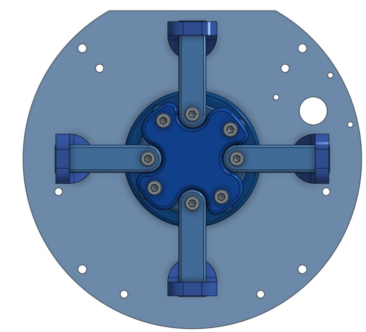


Direction of Travel:

Undeployed State



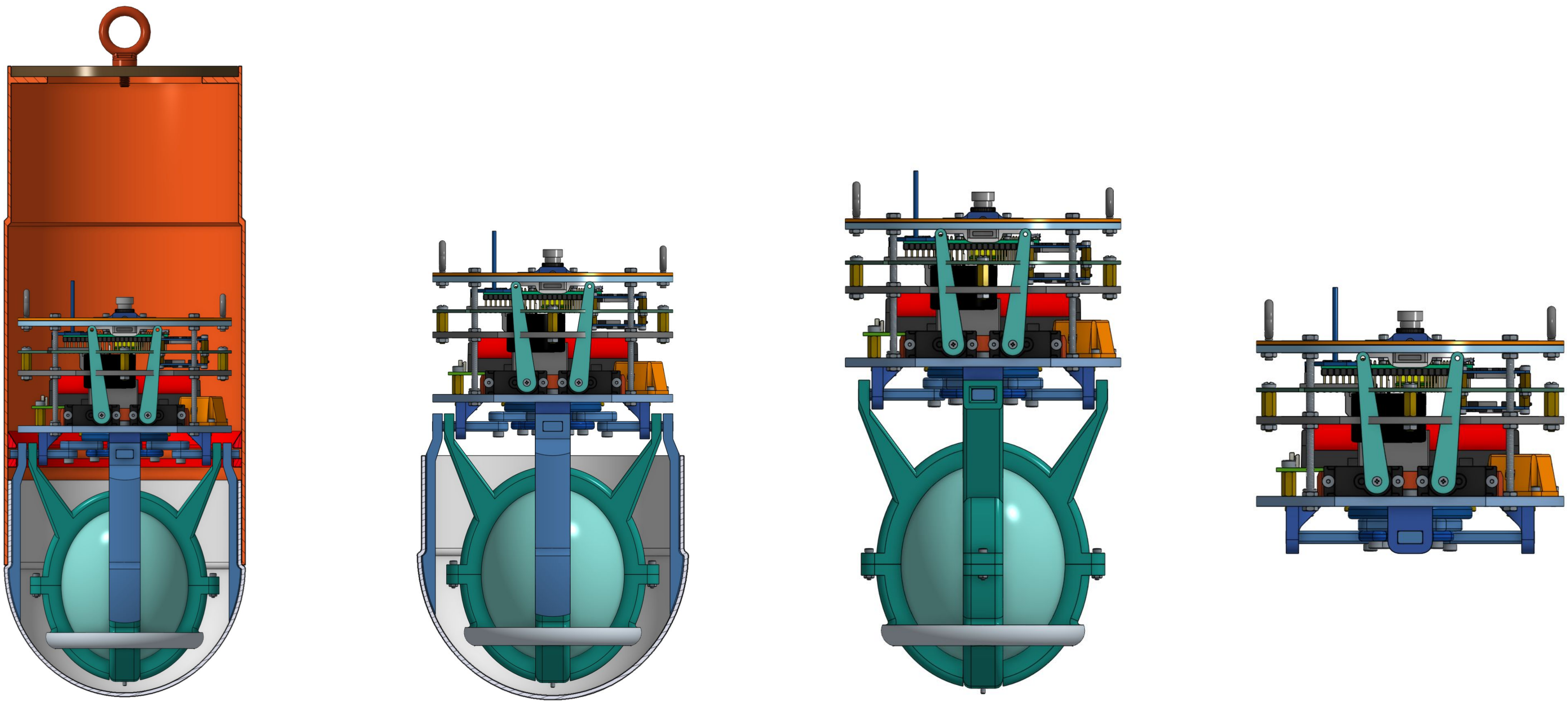
Fully Deployed



Release Mechanism

*Various Parts Sectioned & Paraglider/Parachutes Hidden for Visibility

State One	State Two	State Three	State Four

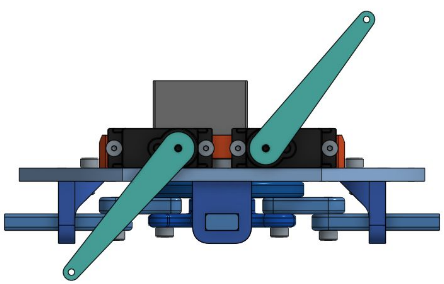


Physical Layout (5/7)

Control System

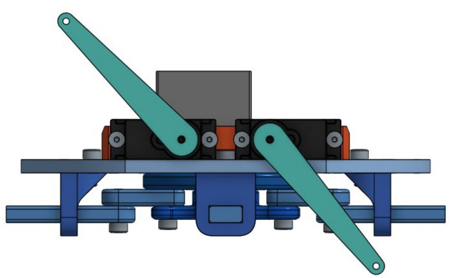
*Various Parts Hidden for Visibility

Turn Left



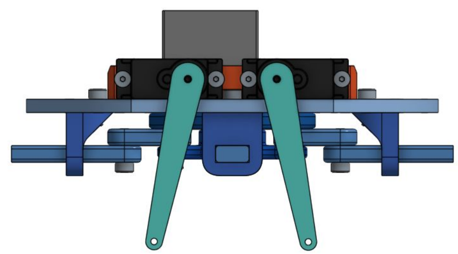
Servo Pulls Left Brake Line Down Increasing Camber of the Left Side Steering CanSat Left

Turn Right



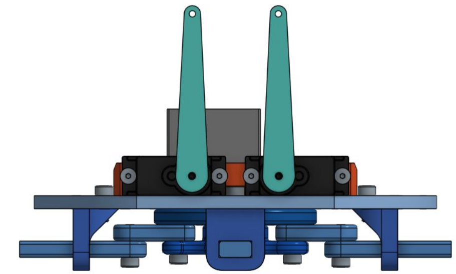
Servo Pulls Right Brake Line Down Increasing Camber of the Right Side Steering CanSat Right

Brake



Both Brake Lines are Pulled Increasing the Camber of the Airfoil Increasing Lift and Drag

Speed Up

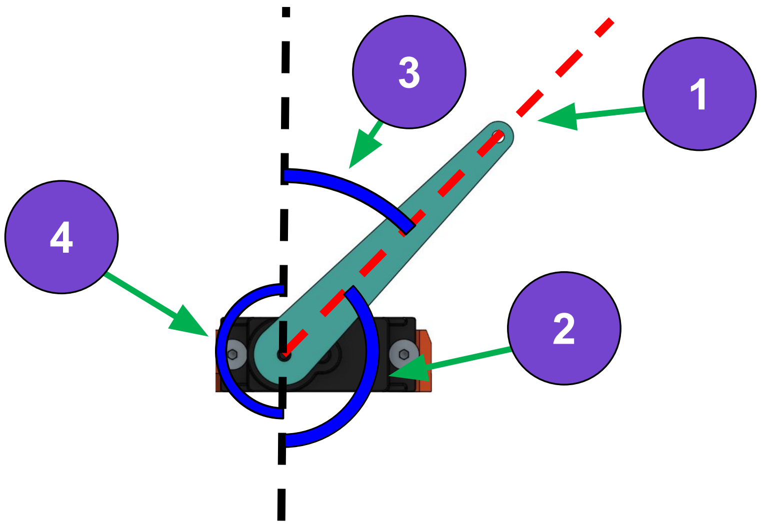


Servos Ease on the Brake Line Decreasing Camber of the Airfoil Decreasing Lift & Drag

Physical Layout (6/7)

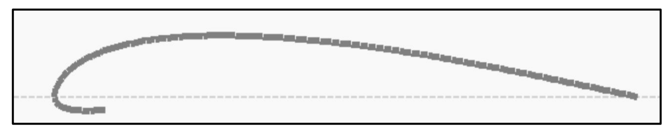
Control System

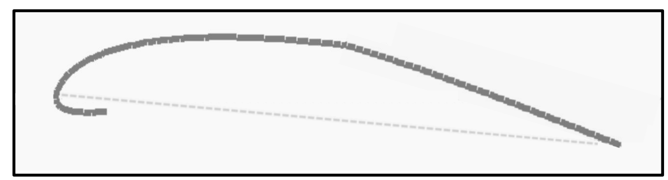
Available Steering Angle Vs Slack Angle



#	Section
1	Angle with No Slack or Tension in Brake Line
2	Allocated Available Angle for Braking/Turning(135°)
3	Allocated Available Angle for Slack (45°)
4	Total Available Range of Servo (180°)

Normal Vs Cambered Airfoil Profile

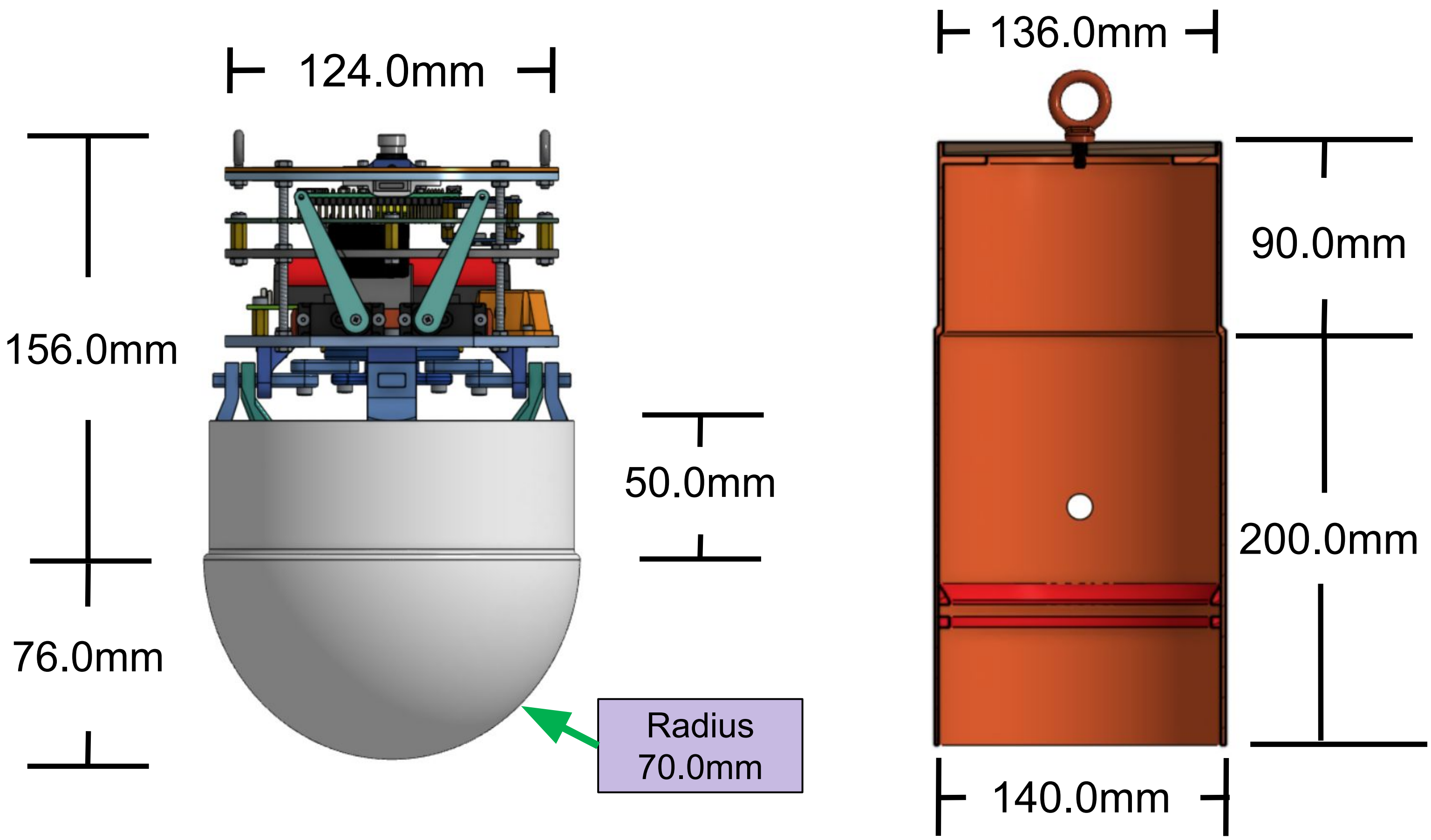




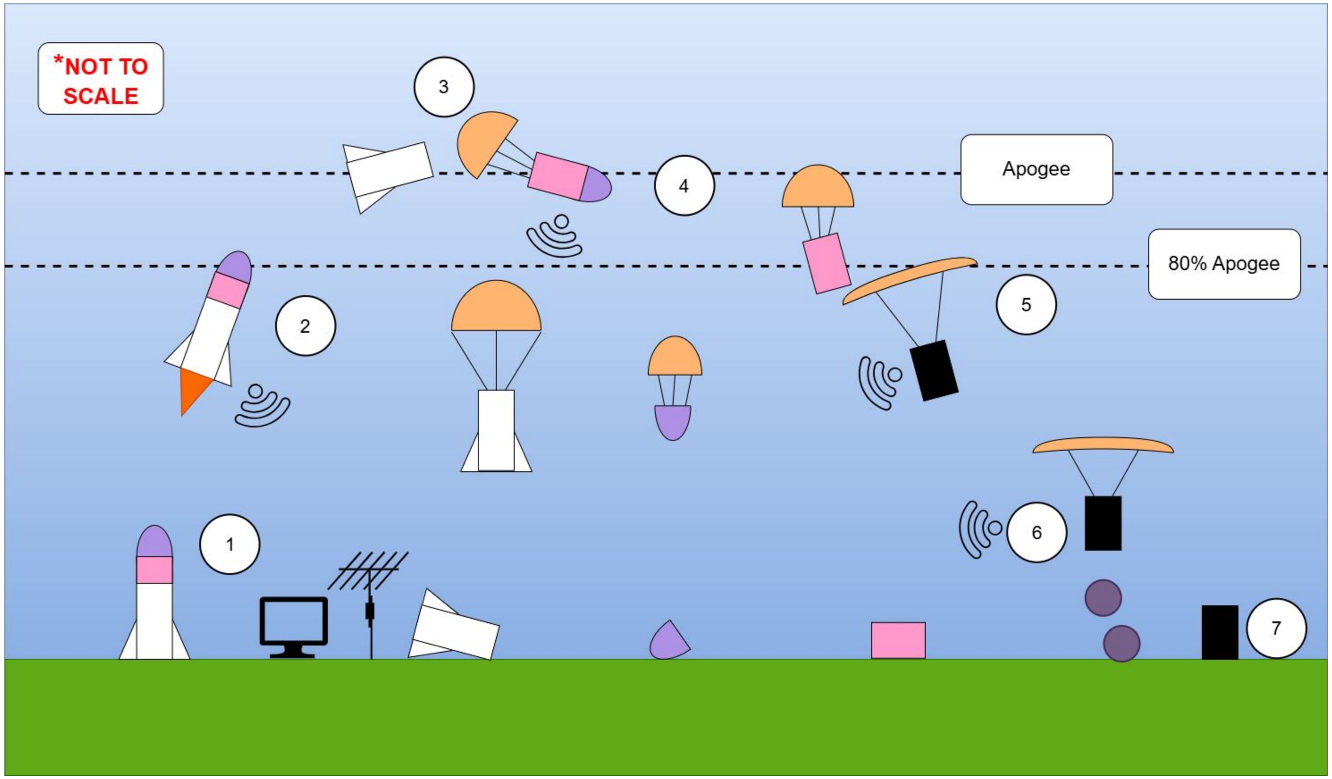
As the Servo Pulls on the Brake Lines, The Camber of the Airfoil Increases Also Increasing Lift and Drag

Physical Layout (7/7)

Dimensions



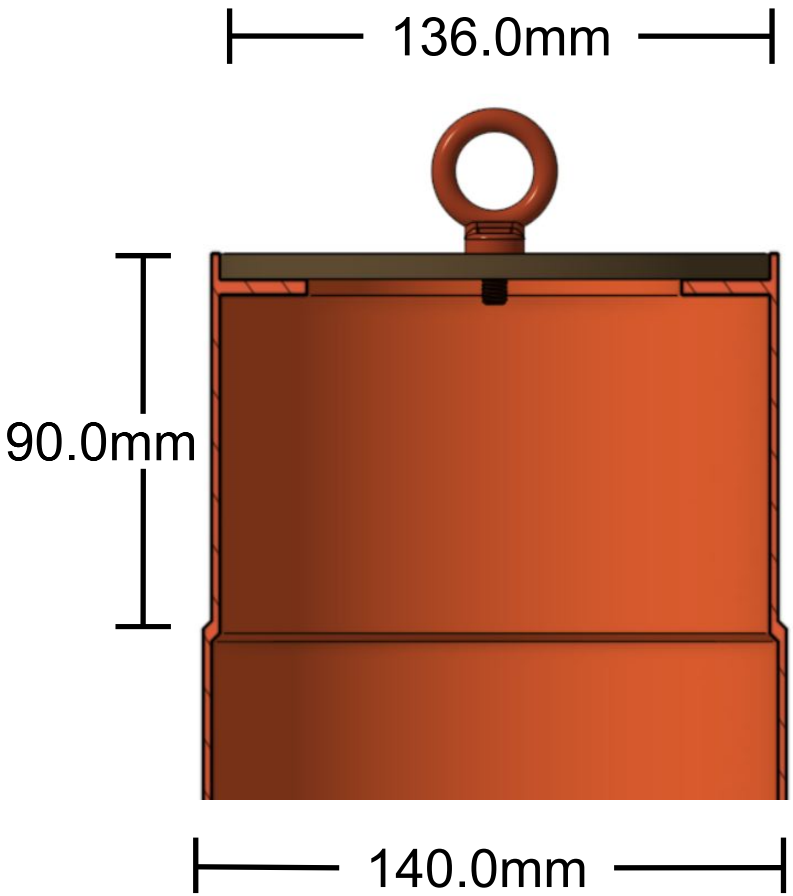
System Concept of Operations



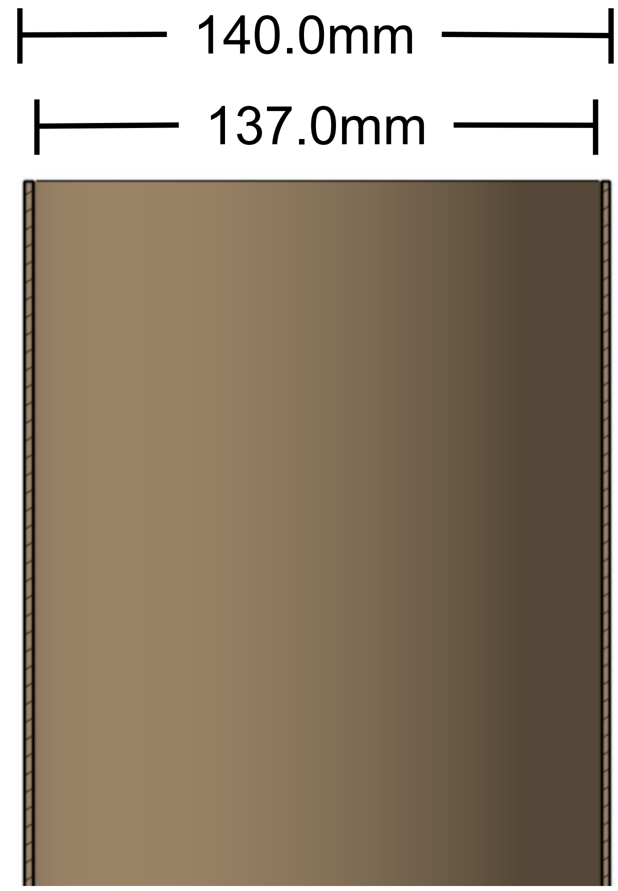
1) LAUNCH_PAD: CANSAT is on the launchpad and is ready for launch and begins transmitting telemetry data
2) ASCENT: CANSAT launches
3) APOGEE: CANSAT releases from the rocket and starts descending
4) DESCENT:Payload descends at 5 m/s and Nose cone is dropped
5) PROBE_RELEASE: Probe is released from the Can at 80% Apogee
6) PAYLOAD_REALEASE: Payload is released from the Probe at 2 meters
7) LANDED: CANSAT lands and stops transmitting telemetry data

Telemetry data is being transmitted for the extent of the mission

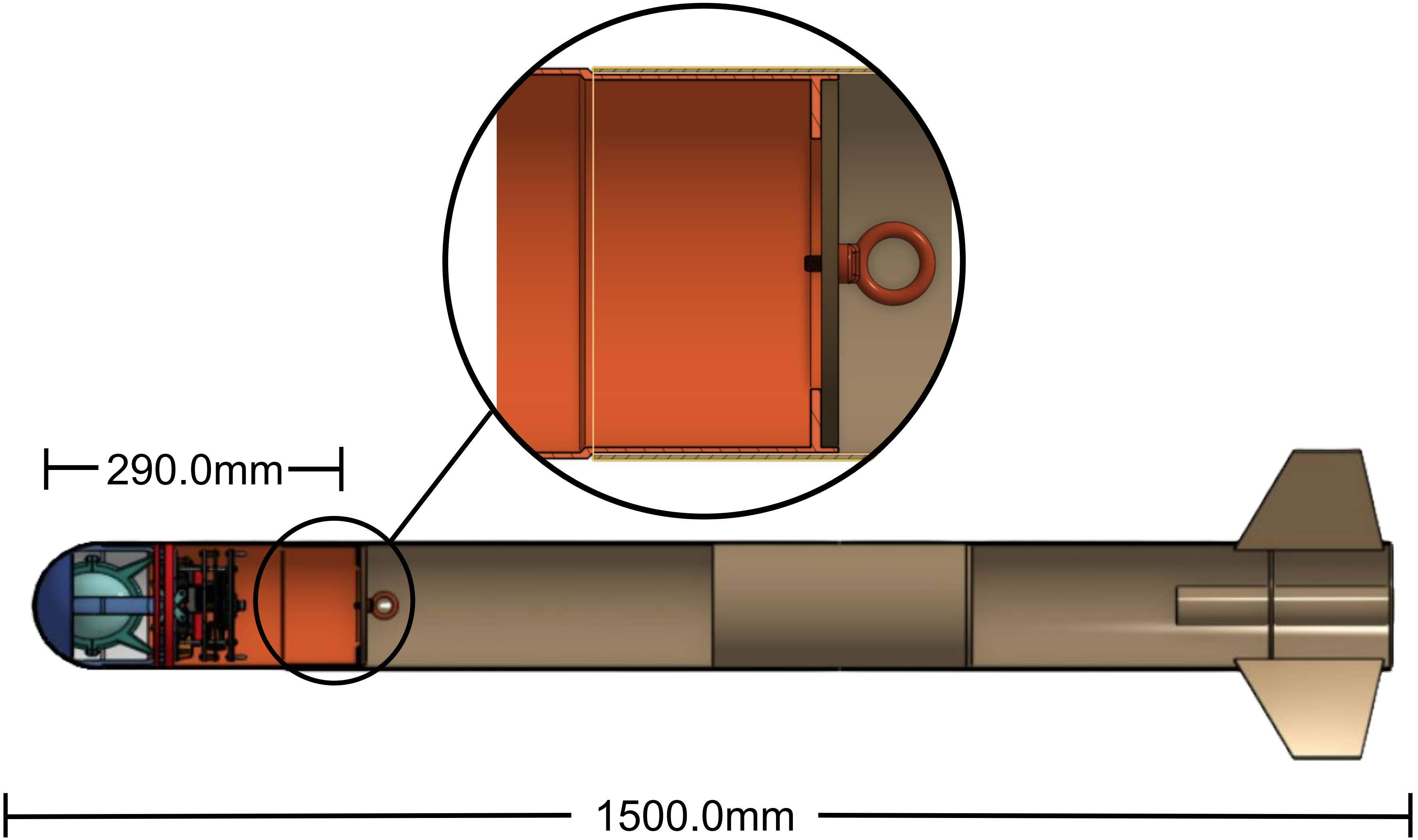
Launch Vehicle Compatibility (1/2)



The container shoulder diameter shall be 136 mm.
The container shoulder length shall be 90 to 120 mm.
Above the shoulder, the container diameter shall be 140 mm
0.5mm of clearance from each side of the container



Launch Vehicle Compatibility (2/2)



Sensor Subsystem Design

Hayden Peek

Sensor Subsystem Overview

System	Sensor	Description	Slide Number
Pressure	BMP581	Measures Pressure and Calculates Altitude	35-36
Temperature	BMP581	Monitors Air Temperature	37-38
Voltage & Current	INA260	Measures Battery Voltage and Current	39-40
GPS	SAM-M10Q	Tracks Longitude and Latitude of the CanSat	41-42
Orientation/ Acceleration	BNO085	Measures CanSat Orientation w/ 9 DOF	43-46
Descent Camera	Runcam Split v4	Records Parachute Release	47-48
Instrument Release	SAM-M10Q BMP581	Determines Time, Altitude, and Location for Instrument Release	49-52
Ground Camera	Runcam Split v4	Records Single View from the CanSat	53-54

Payload Air Pressure Sensor Trade & Selection (1/2)

Sensor	Rel. Barometer Accuracy (Pa)	Rel. Altitude Accuracy (m)	Current Draw (mA)	Cost (USD)
SparkFun MPL3115A2	±50	±0.3	0.040	$16.75
BMP581	±6	±0.5	0.013	$9.95
Grove DPS310	±6	±8	0.017	$7.50

AIr Pressure Will Be Used To Calculate Altitude

<u>Selection:</u> BMP581
- **Great Accuracy**
- **Low Current Draw**
- **Cost Effective**

Image Credit: DigiKey

Payload Air Pressure Sensor Trade & Selection (2/2)

Figures of Merit	Weight	Grove DPS310		BMP581		SparkFun BMP384	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Rel. Barometer Accuracy (Pa)	8	8	64	8	64	2	16
Rel. Altitude Accuracy (m)	8	2	16	8	64	8	64
Current Draw (mA)	4	4	16	2	8	1	4
Cost (USD)	2	8	16	4	8	2	4
Weighted Scores		112		144		88	

Payload Air Temperature Sensor Trade & Selection (1/2)

Sensor	Rel. Temp. Accuracy (°C)	Mass (g)	Current Draw (mA)	Cost (USD)
SparkFun MPL3115A2	±1	2	0.040	$16.75
BMP581	±0.5	2.4	0.013	$9.95
Grove DPS310	±0.5	9	0.017	$7.50

Selection: BMP581

- **Good Accuracy**
- **Best Current Draw**
- **Low Mass**

Image Credit: DigiKey

Payload Air Temperature Sensor Trade & Selection (2/2)

Figures of Merit	Weight	Sparkfun MPL3115A2		BMP581		Grove DPS310	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Rel. Temperature Accuracy (° C)	8	4	32	8	64	8	64
Current Draw (mA)	4	1	4	8	32	4	16
Mass (g)	2	4	8	8	16	2	4
Cost (USD)	1	1	1	4	4	4	4
Weighted Scores		45		109		88	

Payload Battery Voltage and Current Sensor Trade & Selection (1/2)

Sensor	Accuracy (V)	Measuring Range (V)	Current Draw (mA)	Cost (USD)
INA219	±0.130	0-26	0.7	$5.52
INA260	±0.054	0-36	0.31	$5.52
PAC1394	±0.320	0-32	0.41	$1.40

Selection: INA260
- **Great Accuracy**
- **Good Measuring Range**
- **Can Measure Current**
- **Low Current Draw**

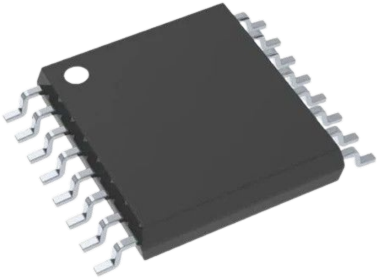


Image Credit: DigiKey

Current and Voltage Sensor

Payload Battery Voltage and Current Sensor Trade & Selection (2/2)

Figures of Merit	Weight	INA219		INA260		PAC1394	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Accuracy (V)	8	4	32	8	64	2	16
Measuring Range (V)	4	4	16	8	32	4	16
Current Draw (mA)	2	4	8	8	16	8	16
Cost (USD)	1	2	2	2	2	8	8
Weighted Scores		58		114		56	

Payload GNSS Sensor Trade & Selection (1/2)

Sensor	Position Accuracy (m)	Current Draw (mA)	Cold Start (s)	Hot Start (s)	Cost (USD)
ZOE-M8Q	±2.5	29	26	1	$27.00
SAM-M10Q	±1.5	13	26	1	$31.50
Adafruit Ultimate GPS Breakout	±3	30	34	34	$29.95

Selection: SAM-M10Q

- **Best Position Accuracy**
- **Good Current Draw**
- **Moderate Cold Start**
- **Excellent Hot Start**

Image Credit: DigiKey

Payload GNSS Sensor Trade & Selection (2/2)

Figures of Merit	Weight	ZOE-M8Q		SAM-M10Q		Adafruit Ultimate GPS Breakout	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Position Accuracy (m)	8	4	32	8	64	4	32
Current Draw (mA)	4	4	16	8	32	4	16
Cold Start (s)	2	4	8	4	8	2	4
Cost (USD)	1	4	4	2	2	4	4
Weighted Scores		60		106		56	

Payload Acceleration Sensor Trade & Selection (1/2)

Sensor	Full Scale Range (G)	Axis (DOF)	Current Draw (mA)	Cost (USD)
KX132	4	3	0.148	$15.50
BNO085	16	9	15	$24.95
BMA400	16	3	0.015	$10.50

Selection: BN0O85
- **Good Sensor Range**
- **9 Axis**
- **Includes Direction Vector**

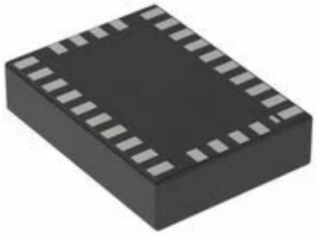


Image Credit: DigiKey

Payload Acceleration Sensor Trade & Selection (2/2)

Figures of Merit	Weight	KX132		BNO085		BMA400	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Full Scale Range (G)	8	2	16	8	64	8	64
Axis (DOF)	4	2	8	8	32	2	8
Current Draw (mA)	2	8	16	1	2	8	16
Cost (USD)	1	4	4	2	2	8	8
Weighted Scores		44		100		96	

Payload Rotation Rate Sensor Trade & Selection (1/2)

Sensor	Full Scale Range (°/s)	Drift (°/min)	Current Draw (mA)	Cost (USD)
MPU-6050	±2000	~1.0°/min	3.9	$3.00
BNO085	±2000	< 0.03°/min	15	$13.05
L3GD20H	±2000	~0.5°/min	6.1	$6.95

Selection: BNO085

- **Good Gyroscopic Range**
- **Moderate Current Draw**
- **Moderate Cost**
- **Best Drift**

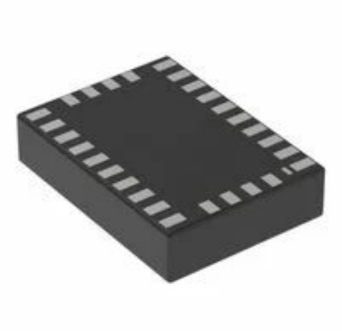


Image Credit: DigiKey

Payload Rotation Rate Sensor Trade & Selection (2/2)

Figures of Merit	Weight	MPU-6050		BNO085		L3GD20H	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Drift (°/min)	8	2	16	8	64	4	32
Current Draw (mA)	4	8	32	4	16	2	8
Full Scale Range (°/s)	2	8	16	8	16	8	16
Cost (USD)	1	8	8	1	1	4	4
Weighted Scores		72		97		60	

Payload Release Camera Trade & Selection (1/2)

Sensor	Mass (g)	Field of View (°)	Current Draw (mA)	Cost (USD)
OpenMV Cam RT1060	20	70.8	130	$120.00
RunCam Split 4 v2	10.2	140	450	$82.99
Hawkeye 4K Split V5	18.5	170	900	$85.99

<u>Selection:</u> RunCam Split 4 v2

- **Lowest Mass**
- **Good Field of View**
- **Relatively Low Cost**
- **Meets Required Resolution**

Image Credit: Adafruit.com

Payload Release Camera Trade & Selection (2/2)

Figures of Merit	Weight	OpenMV Cam RT1060		RunCam Split 4 v2		Hawkeye 4K Split V5	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Mass (g)	8	4	32	8	64	4	32
Field of View (°)	4	4	16	4	16	8	32
Current Draw (mA)	2	8	16	4	8	1	2
Cost (USD)	1	2	2	4	4	4	4
Weighted Scores		66		92		70	

Instrument Release Sensor Trade and Selection (1/4)

Sensor	Position Accuracy (m)	Current Draw (mA)	Time Pulse Accuracy (ns)	Cost (USD)
ZOE-M10Q	±2.5	29	30	$27.00
SAM-M10Q	±1.5	13	30	$31.50
Adafruit Ultimate GPS Breakout	±3	30	60	$29.95

GPS and Real Time Clock

Selection: SAM-M10Q
- **Great Time Pulse Accuracy**
- **Low Current Draw**
- **Great Position Accuracy**

Image Credit: DigiKey

Instrument Release Sensor Trade and Selection (2/4)

Figures of Merit	Weight	ZOE-M10Q		SAM-M10Q		Adafruit Ultimate GPS Breakout	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Position Accuracy (m)	8	4	32	8	64	4	32
Current Draw (mA)	4	4	16	8	32	4	16
Time Pulse Accuracy (ns)	2	4	8	4	8	2	4
Cost (USD)	1	8	8	4	4	8	8
Weighted Scores		64		108		60	

Instrument Release Sensor Trade and Selection (3/4)

Sensor	Rel. Barometer Accuracy (Pa)	Rel. Altitude Accuracy (m)	Current Draw (mA)	Cost (USD)
SparkFun MPL3115A2	±50	±0.3	0.040	$16.75
BMP581	±6	±0.5	0.013	$9.95
Grove DPS310	±6	±8	0.017	$7.50

Selection: **BMP581**
- **Great Barometer Accuracy**
- **Great Altitude Accuracy**
- **Best Current Draw**

Image Credit: DigiKey

Instrument Release Sensor Trade and Selection (4/4)

Figures of Merit	Weight	Sparkfun MPL3115A2		BMP581		Grove DPS310	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Rel. Altitude Accuracy (m)	8	8	64	8	64	2	16
Rel. Barometer Accuracy (Pa)	4	1	4	8	32	8	32
Current Draw (mA)	2	2	4	8	16	4	8
Cost (USD)	1	2	2	4	4	8	8
Weighted Scores		76		116		64	

Ground Camera Trade & Selection (1/2)

Sensor	Field of View (°)	Mass (g)	Current Draw (mA)	Cost (USD)
OpenMV Cam RT1060	70.8	20	130	$120.00
RunCam Split 4 v2	140	10.2	450	$82.99
Hawkeye 4K Split V5	170	18.5	900	$85.99

Selection: RunCam, Split 4 v2
- **Lowest Mass**
- **Good Field of View**
- **Relatively Low Cost**
- **Meets Required Resolution**

Image Credit: Adafruit.com

Ground Camera Trade & Selection (2/2)

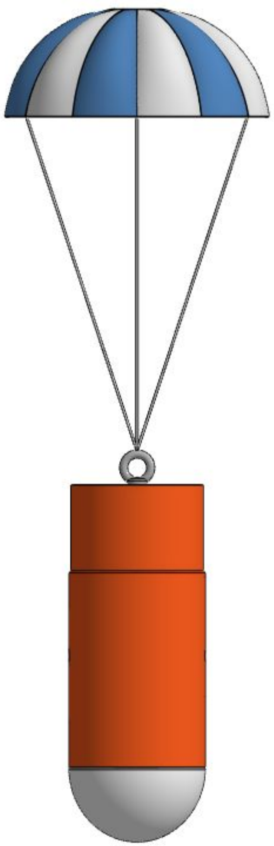
Figures of Merit	Weight	OpenMV Cam RT1060		RunCam Split 4 v2		Hawkeye 4K Split V5	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Field of View (°)	8	4	32	8	64	4	32
Mass (g)	4	4	16	4	16	8	32
Current Draw (mA)	2	8	16	4	8	1	2
Cost (USD)	1	2	2	4	4	4	4
Weighted Scores		66		92		70	

Descent Control Design

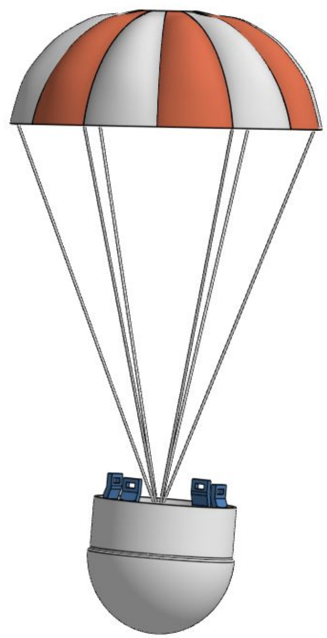
Nora Brady and Clark Peterson

Descent Control Overview (1/2)

Released from Rocket



Nose Cone Subsystem Released



Decent Mec.	Area	Decent Rate
Can	$0.055m^2$	14.05m/s
Paraglider	$1.000m^2$	2.02m/s
Nose	$0.063m^2$	5.00m/s

*Parachutes to scale

Descent Control Overview (2/2)

Released from Container

Decent Mec.	Area	Decent Rate
Can	$0.055m^2$	14.0m/s
Paraglider	$1.000m^2$	2.0m/s
Nose	$0.063m^2$	5.0m/s

*Paraglider not to scale

Container Parachute Descent Control Strategy Selection and Trade (1/4)

Design X

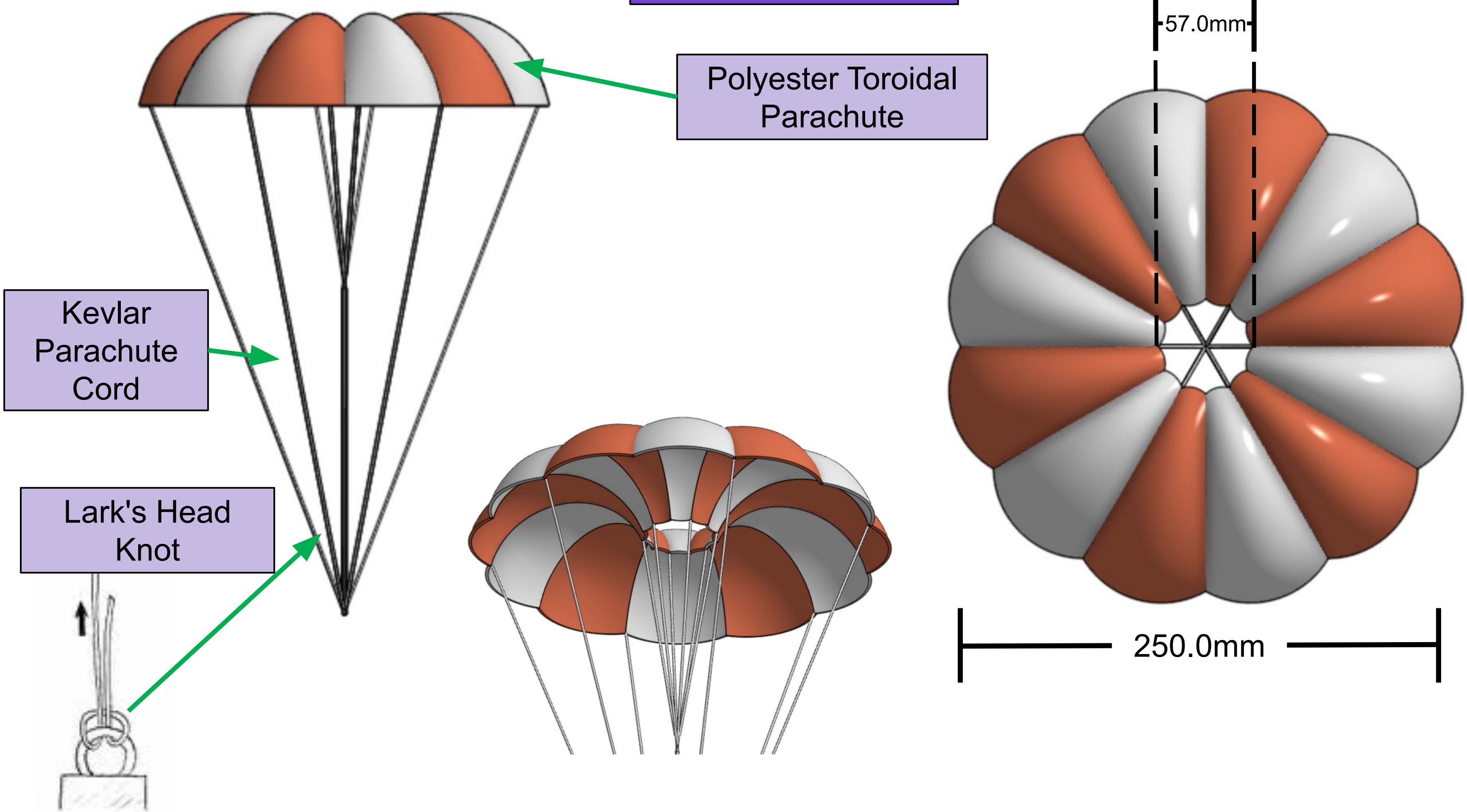


Image Credit: wikibooks.org

Container Parachute Descent Control Strategy Selection and Trade (2/4)

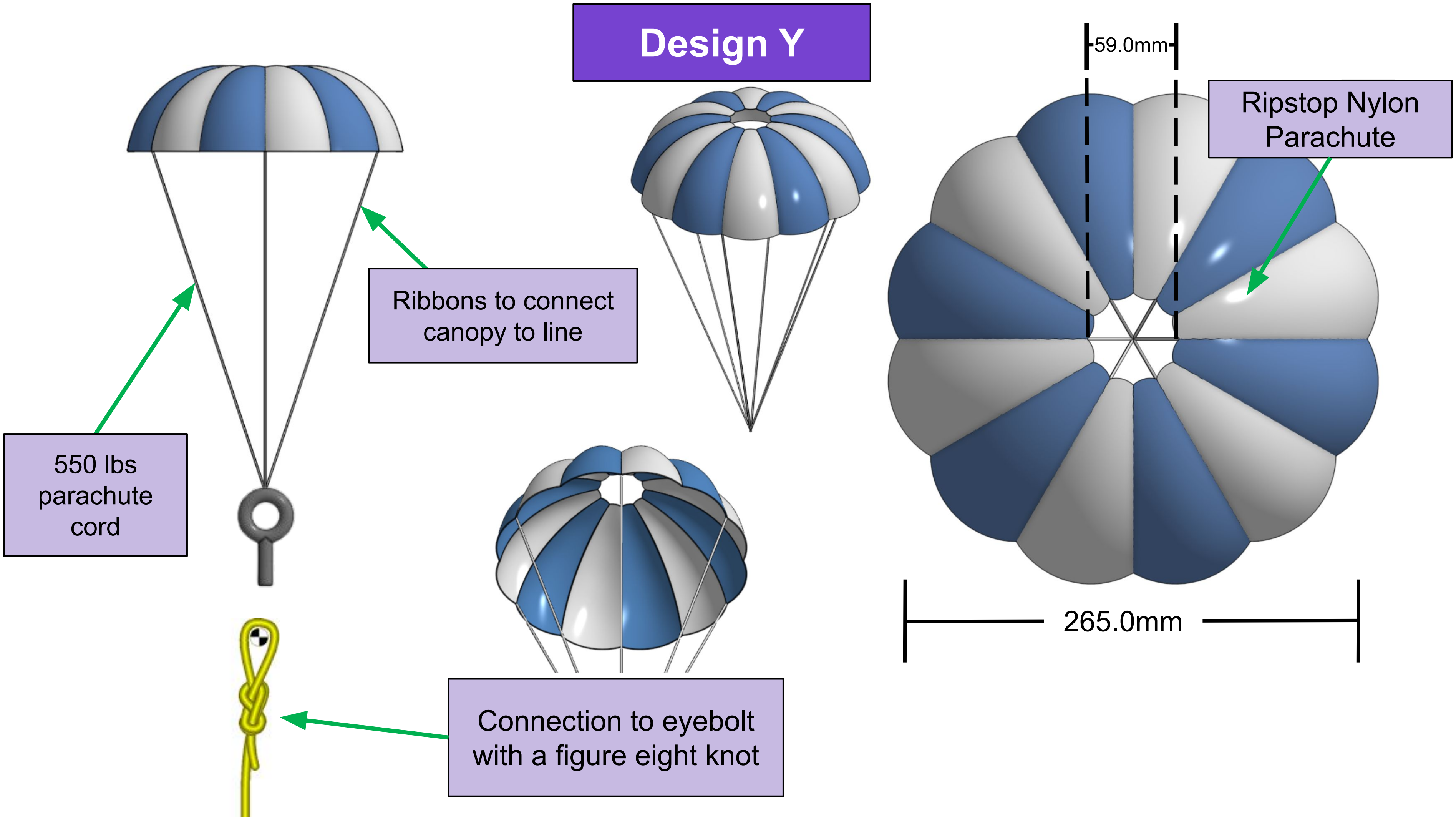


Image Credit: roperescuetraining.com

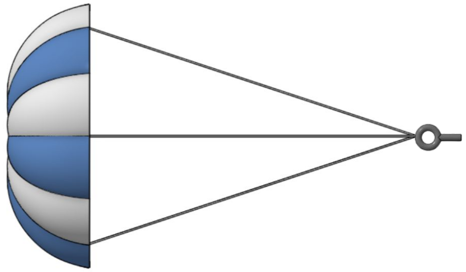
Container Parachute Descent Control Strategy Selection and Trade (3/4)

Category	2	4	8
Mass(g)	>25	20-25	<20
Strength of Cord (MPa)	<1000	1000-2000	>2000
Knot Type	Figure Eight Knot	-	Lark's Head Knot
Manufacturing Time (h)	>5	2-5	<2

Container Parachute Descent Control Strategy Selection and Trade (4/4)

Figures of Merit	Weight	Design X		Design Y	
		Unweighted	Weighted	Unweighted	Weighted
Mass(g)	8	2	16	8	64
Manufacturing Time (h)	4	2	8	4	8
Knot Type	2	8	16	2	4
Strength of Chord (MPa)	1	8	8	2	2
Weighted Scores		48		78	

Selection: Combination
- **Team Y for Lighter Mass and Faster Manufacturing**
- **Team X for a Stronger Knot and Better Chord Strength**



Payload Steering Control Strategy Selection and Trade (1/4)

Specifics
Wing Flat Wingspan: 1.95m
Wing Flat Area: 0.91m^2
Wing Cell Number: 11
Aspect Ratio: 4.2
Wing Weight: 100g
Material: 1 oz Ripstop Nylon
Cost: $60

Paraglider Built and Designed by the Team in Single Skin 3.0

Design X

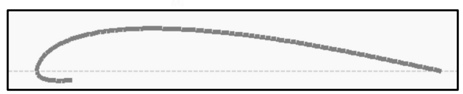
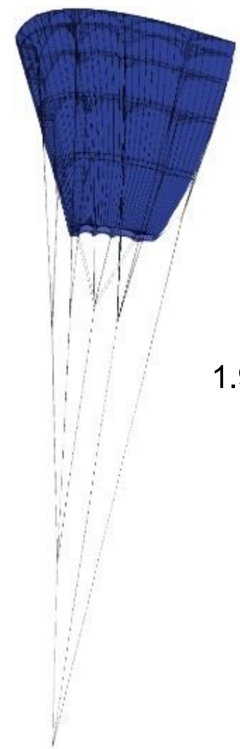
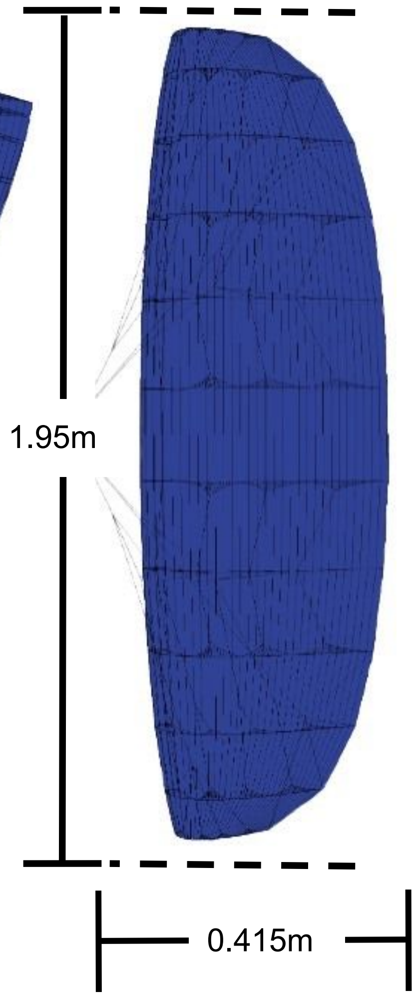


Image Credit: singleskin, Clark Peterson





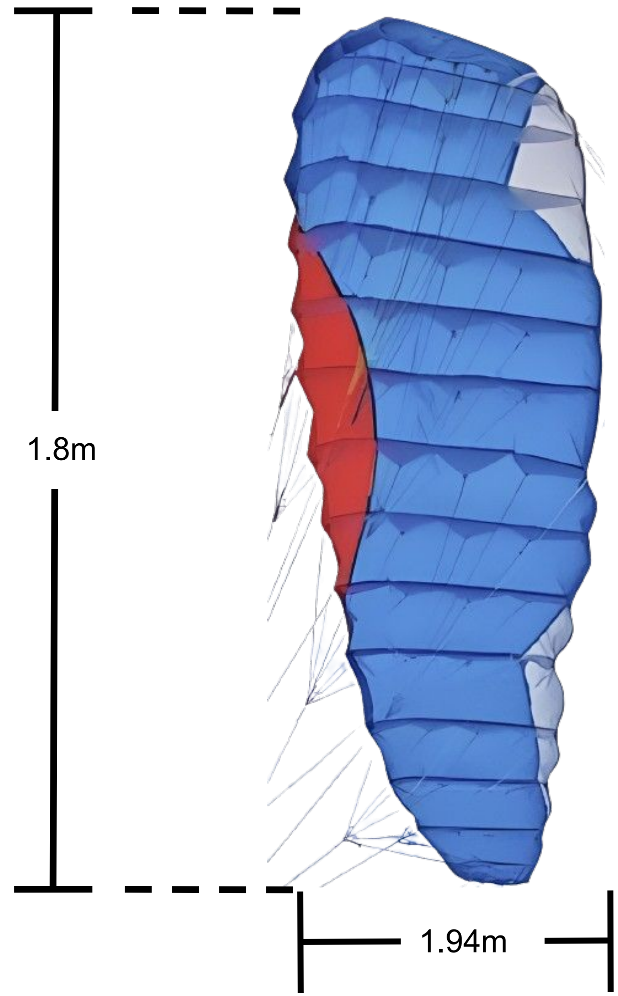
Payload Steering Control Strategy Selection and Trade (2/4)

Specifics
Wing Flat Wingspan: 1.80m
Wing Flat Area: 0.72m^2
Wing Cell Number: 17
Aspect Ratio: 4.5
Wing Weight: 88g
Material: Nylon 30D
Cost: $160

Parafun 1.8M Tech RC Paramotor Wing Part - Blue

Design Y

Image Credit: rc-castle.com



Payload Steering Control Strategy Selection and Trade (3/4)

Category	2	4	8
Cost ($)	>150	70-150	<70
Mass (g)	>90	80-90	<80
Adjustability	Not Modifiable	Minor Adjustments	Fully Customizable

Payload Steering Control Strategy Selection and Trade (4/4)

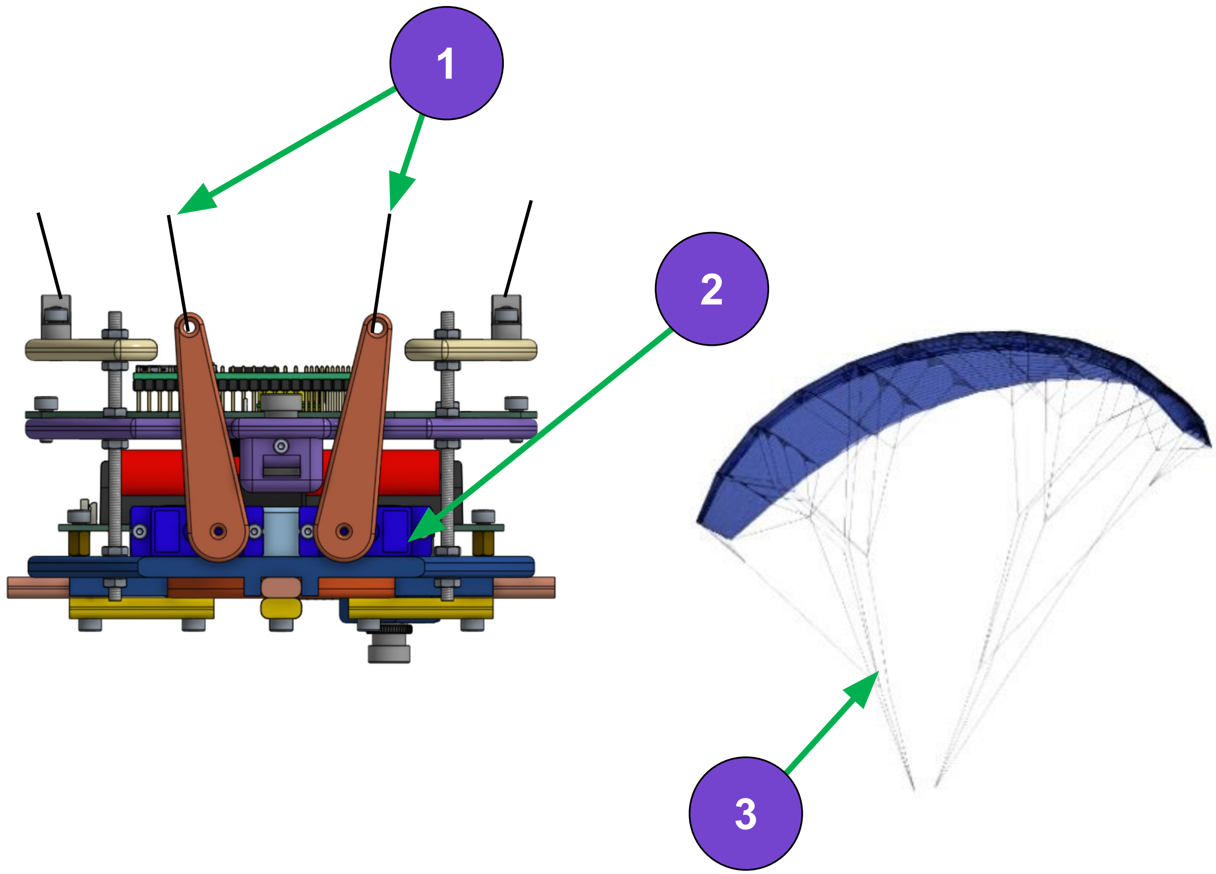
Figures of Merit	Weight	Design X		Design Y	
		Unweighted	Weighted	Unweighted	Weighted
Cost ($)	8	8	64	2	16
Mass (g)	4	2	8	8	24
Adjustability	2	8	16	4	8
Weighted Scores		88		48	

<u>Selection:</u> Design X
- **Design X for its Reduced Cost and Adjustability while Prototyping**

Para-Glider Descent Speed Control Strategy Selection and Trade (1/4)

Design X

#	Component
1	Active control system, paraglider lines are controlled by servos.
2	Solid control arms are rotated via servos.
3	Paraglider cords attach to the arms, rotations cause the paraglider to change shape. This can slow, speed up, or turn the CanSat.

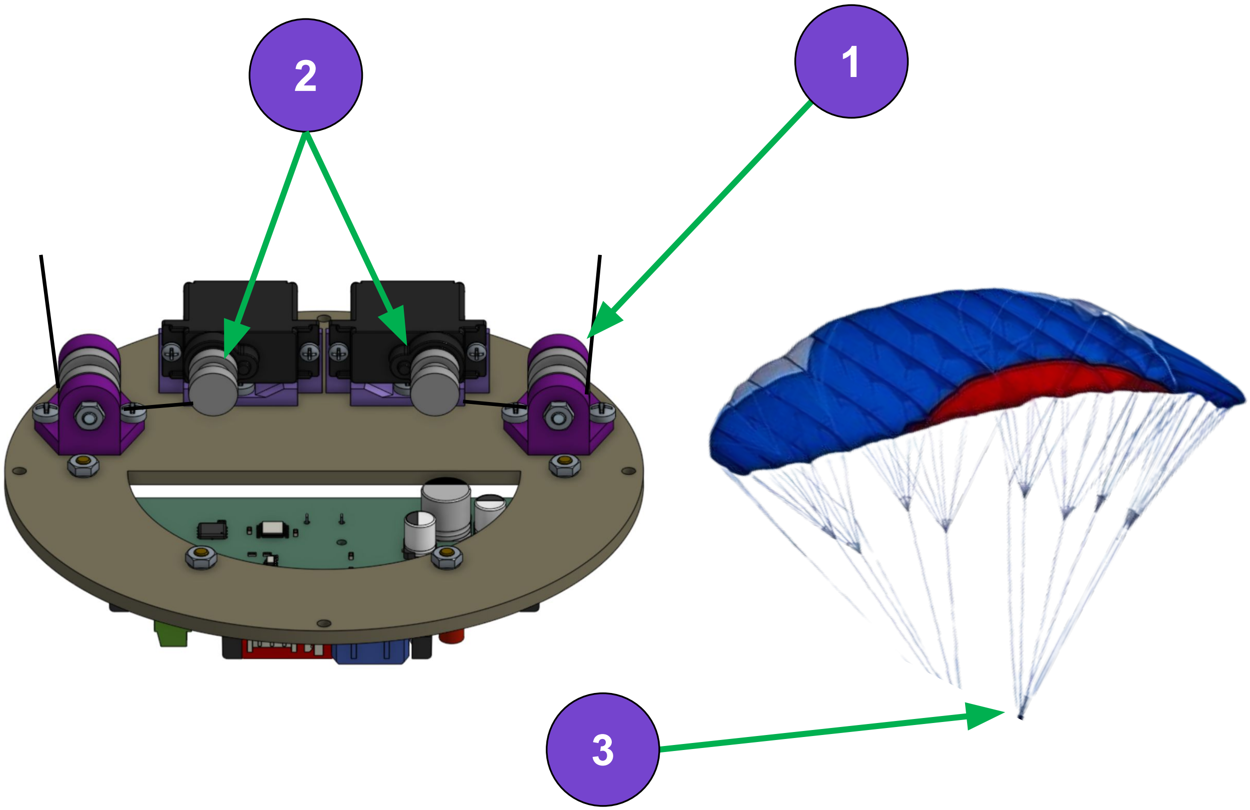


*Various Parts Hidden for Visibility

Para-Glider Descent Speed Control Strategy Selection and Trade (2/4)

Design Y

#	Component
1	Active control system, paraglider lines are controlled by servos.
2	Paraglider cords are controlled by a pulley system via servos.
3	Paraglider cords connected to the system control the shape of the paraglider.



*Various Parts Hidden for Visibility

Image Credit: rc-castle.com

Para-Glider Descent Speed Control Strategy Selection and Trade (3/4)

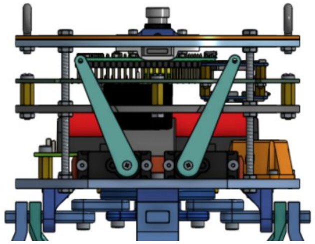
Category	2	4	8
Possibility of String Slippage (%)	>70	20-70	<20
Servo Strength (kg/cm)	2.2	2.5	3.4
Number of Parts	<10	5-10	>5

Para-Glider Descent Speed Control Strategy Selection and Trade (4/4)

Figures of Merit	Weight	Design X		Design Y	
		Unweighted	Weighted	Unweighted	Weighted
Possibility of String Slippage	8	8	64	2	16
Type of Servo	4	2	8	4	16
Number of Parts	2	8	16	2	4
Weighted Scores		84		36	

<u>Selection:</u> Combination

- **Control Arm Design From Team X for Less String Slippage**
- **Mg14 Servo from Team Y Design for Strength**



Parachute Descent Rates

Variables	Substituted Values
Mass – m	1 kg
Acceleration due to Gravity – g	9.81m/s^2
Area of Parachute – A	0.065 m^2
Coefficient of Drag – C_d	1.5
Air Density – ρ	1.02 kg/m^3

Equation	Substituted Values
$V_t = \sqrt{\frac{2mg}{\rho A C_d}}$	$V_t = \sqrt{\frac{2(1kg)(9.81\frac{m}{s^2})}{(1.02\frac{kg}{m^3})(0.055m^2)(1.5)}}$
Final Estimated Descent Rate = 14.05 m/s	

Estimates are based of the following assumptions

- Constant Density
- Steady Uniform Flow
- Coefficient of Drag of 1.5

Descent Rate Estimates (3/7)

Paraglider Descent Rates

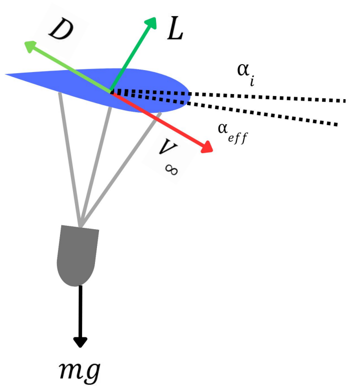
Variables	Substituted Values
Mass – m	0.7kg
Acceleration due to Gravity – g	$9.81m/s^2$
Area of Parachute – A	$0.80925\ m^2$
Coefficient of Drag – C_d	1.5
Coefficient of Lift – C_L	0.21
Air Density – ρ	$1.02\ kg/m^3$
Effective Angle	0.75°
Alpha Angle	3.2567°
Angle of Incidence	2.5067°

Descent Rate Estimates (4/7)

Equation	Substituted Values
$V = \sqrt{\frac{2mg}{(C_d sin(\alpha)+C_l cos(\alpha))(\rho S)}}$ $V_x = V cos(\alpha_{eff} + \alpha_i)$ $V_y = V sin(\alpha_{eff} + \alpha_i)$	$V = \sqrt{\frac{2(0.7kg)(9.81\frac{m}{s^2})}{(1.5sin(3.25°)+0.21cos(3.25°))(0.80925\ m^2 \cdot 1.02\frac{kg}{m^3})}}$ $V_x = 36\frac{m}{s}cos(0.75° + 2.5°)$ $V_y = 36\frac{m}{s}sin(0.75° + 2.5°)$
Final Estimated Descent Rate = 2.04 m/s	

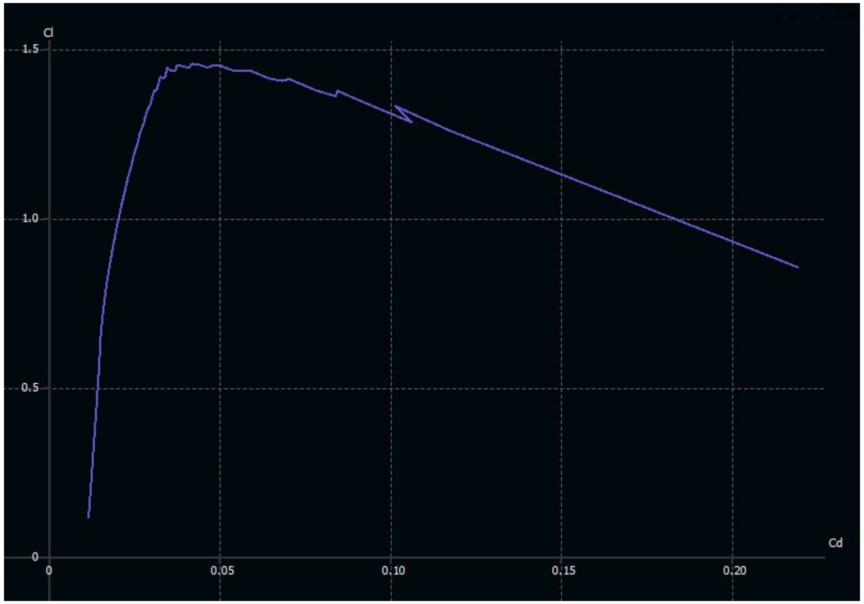
Estimates are based of the following assumptions

- Constant Density
- Steady Uniform Flow
- CanSat Drag is Equal to Airflow Drag
- Flies at Best Glide Ratio
- Lift is Greater than 0
- Angle of Incidence is Greater than 0
- Effective Angle is Greater than 0

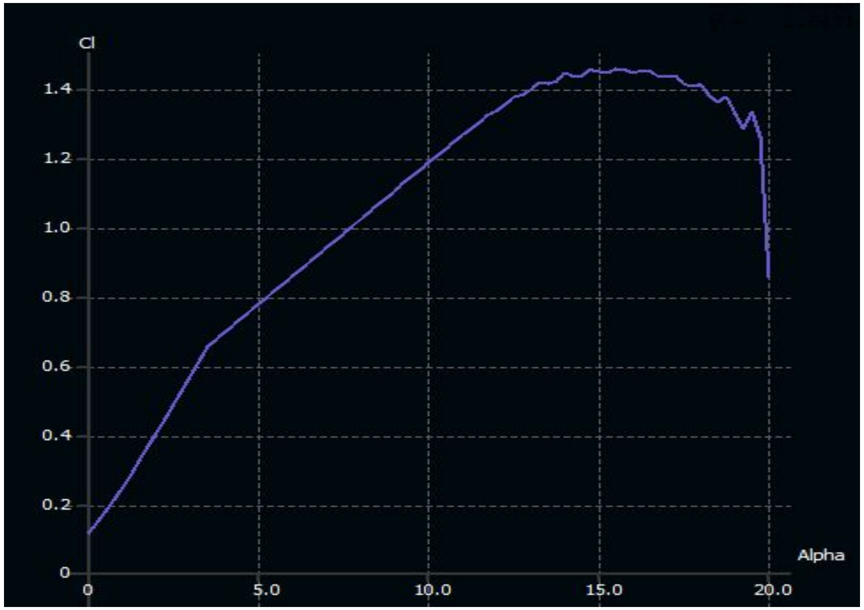


Descent Rate Estimates (5/7)

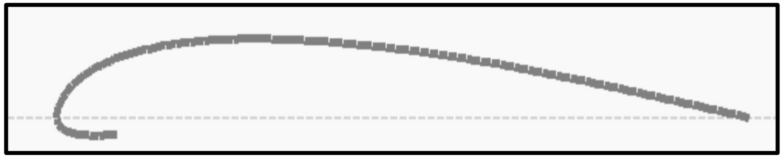
Cl Vs Cd

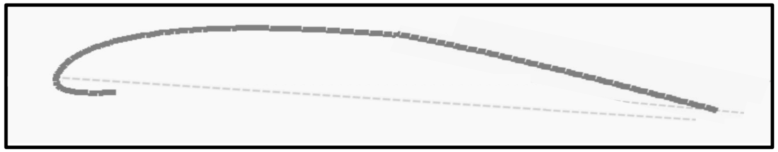


Cl Vs Effective Angle



Normal Vs Cambered Airfoil Profile





Descent Rate Estimates (6/7)

C_l Vs C_d

Effective Angle	Coefficient of Lift	Coefficient of Drag	Cl by Cd	Angle of Incidence	Alpha	Velocity (m/s)	Velocity X (m/s)	Velocity Y (m/s)
0	0.11	0.011	10.24	5.57	5.57	36.4	36.29	3.54
0.25	0.14	0.011	12.66	4.26	4.51	36.4	36.31	2.86
0.5	0.17	0.011	15.11	3.28	3.78	36.2	36.17	2.39
0.75	0.21	0.012	17.57	2.50	3.25	36.0	35.95	2.04
1	0.24	0.012	20.06	1.85	2.85	35.7	35.71	1.78
1.25	0.28	0.012	22.53	1.29	2.54	35.4	35.44	1.57
1.5	0.32	0.013	25.40	0.75	2.25	35.1	35.13	1.38
1.75	0.36	0.013	27.86	0.30	2.05	34.8	34.83	1.24

Descent Rate Estimates (7/7)

Decent Rate Summary

Descent Method	Estimated Vertical Descent Rate
Payload & Container – Parachute	14.05 m/s
Payload – Paraglider	2.04 m/s

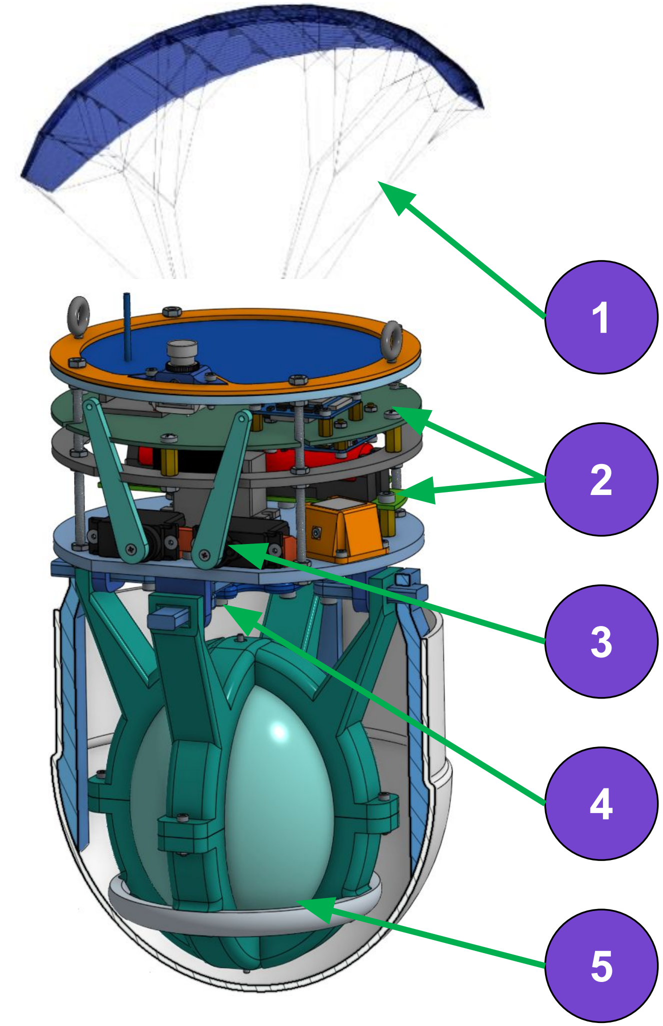
Mechanical Subsystem Design

Jackson Stidham, Alex McKinnon, and Evan Jeanneret

Payload Overview

*Paraglider not to scale

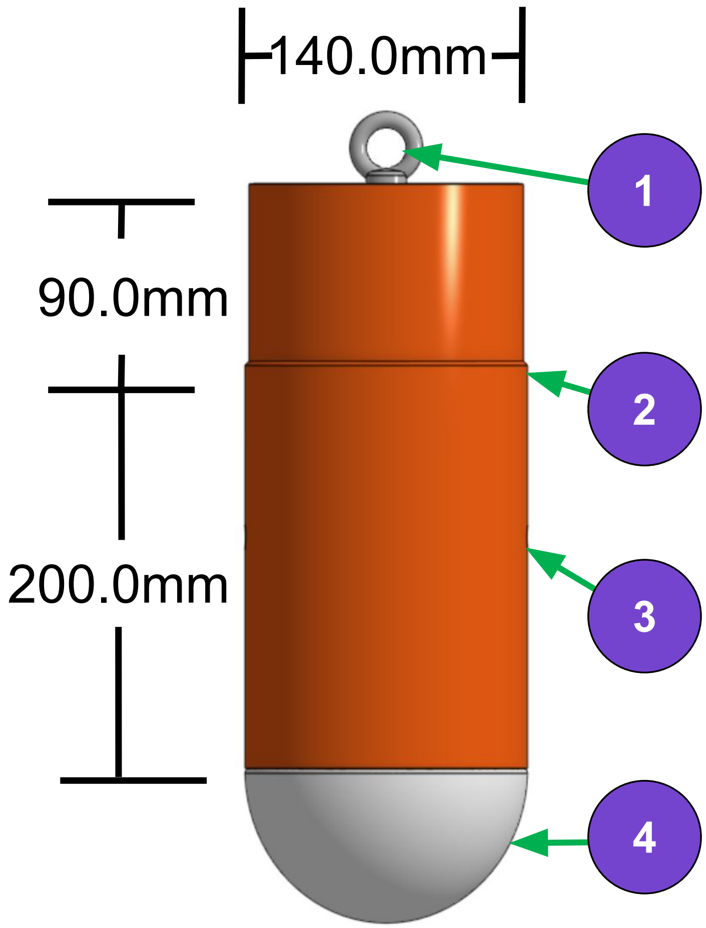
#	Subsystem	Description
1	Paraglider	Single Skin HyperD Ripstop Nylon
2	Electronics	PCBs, Batteries, and Sensors
3	Steering Mechanism	PA6-CF Lever Steer Arms
4	Release Mechanism	3 Stage Release for Payload, Nosecone, and Egg
5	Egg	TPU Shell with PA6-CF Outer Brace



Mechanical Subsystem Overview (2/2)

Container Overview

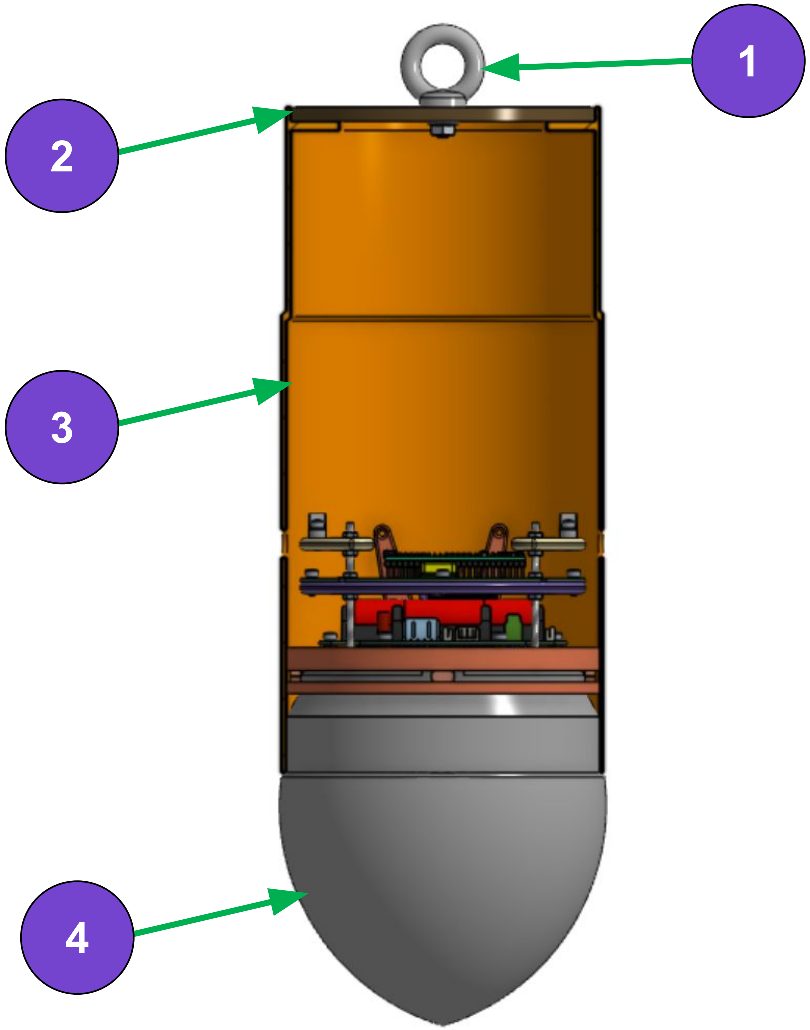
#	Subsystem	Description
1	¼ Inch Eye Bolt	Attachment for Parachute
2	Container	Woven Fiberglass/Epoxy Resin Composite Container
3	Breather Hole	Hole to Stabilize Pressure for Altimeter
4	Nose Cone	Woven Fiberglass/Epoxy Resin Composite Container



Cansat Mechanical Layout of Components Trade & Selection (1/17)

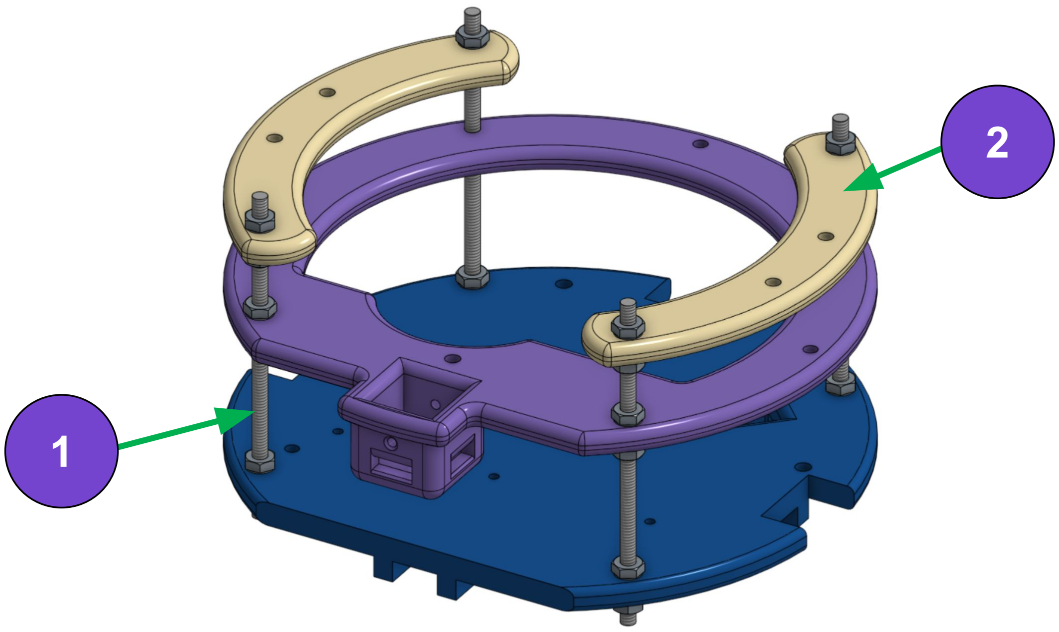
Design X Container

#	Component
1	¼ Inch Eye Bolt
2	Plywood Plate
3	Woven Fiberglass/Epoxy Resin Composite Container
4	Bambu Lab PA6-CF Nose Cone



Design X Structure

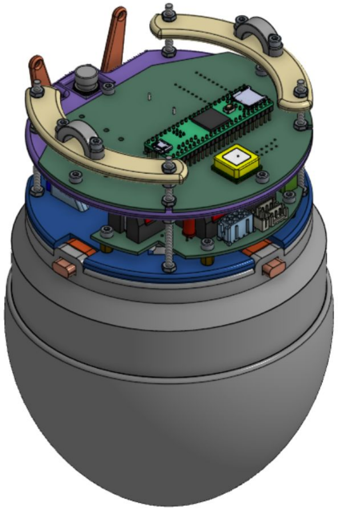
#	Component
1	M3 Threaded Structure Rods
2	PA6-CF Structure Plates

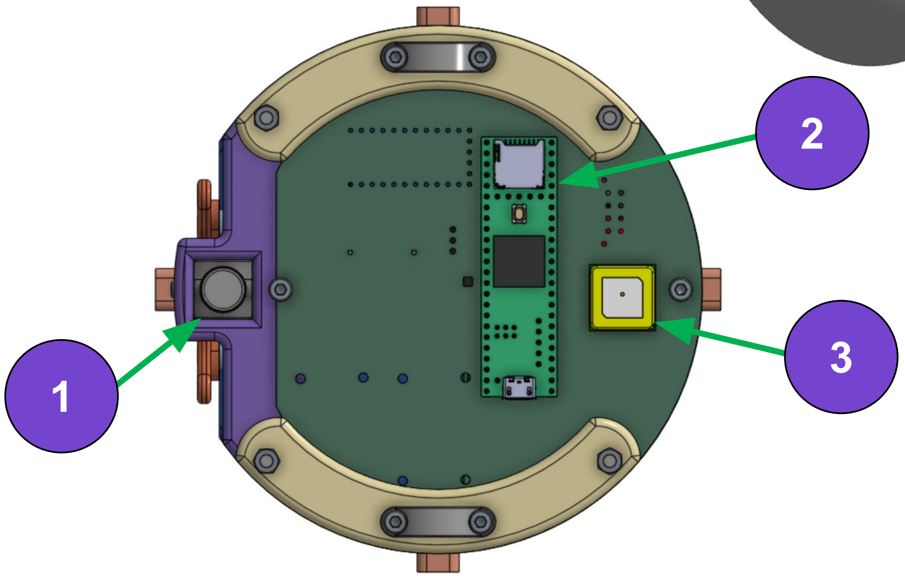


Cansat Mechanical Layout of Components Trade & Selection (3/17)

Design X Telemetry and Descent Camera

#	Component
1	Descent Control Pointing Camera
2	Teensy
3	SAM-M10Q

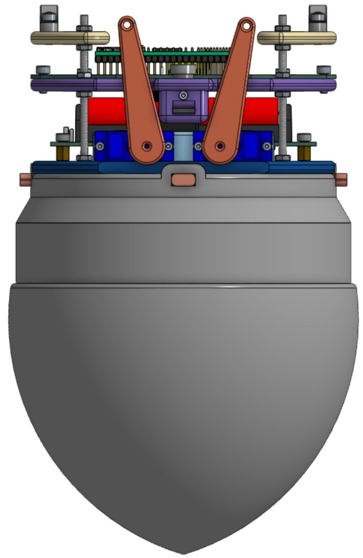


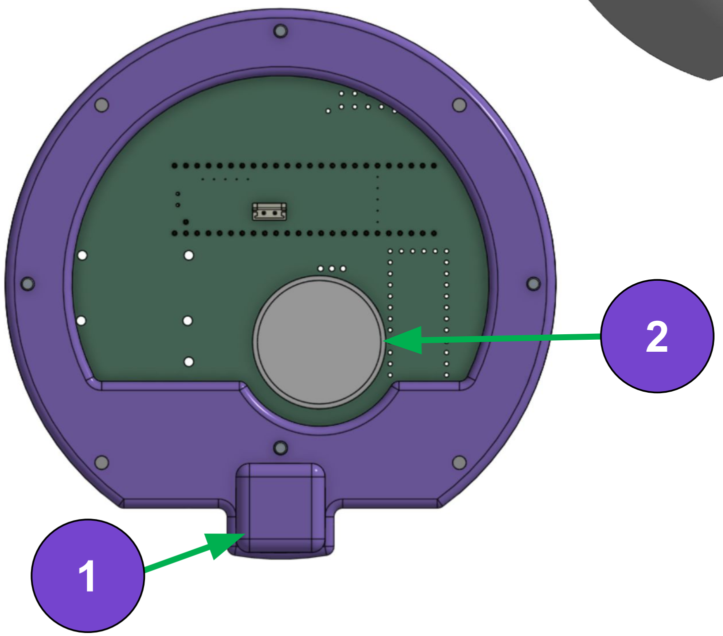


Cansat Mechanical Layout of Components Trade & Selection (4/17)

Design X Camera Mount and Buzzer

#	Component
1	Descent Control Pointing Camera Mount
2	Buzzer

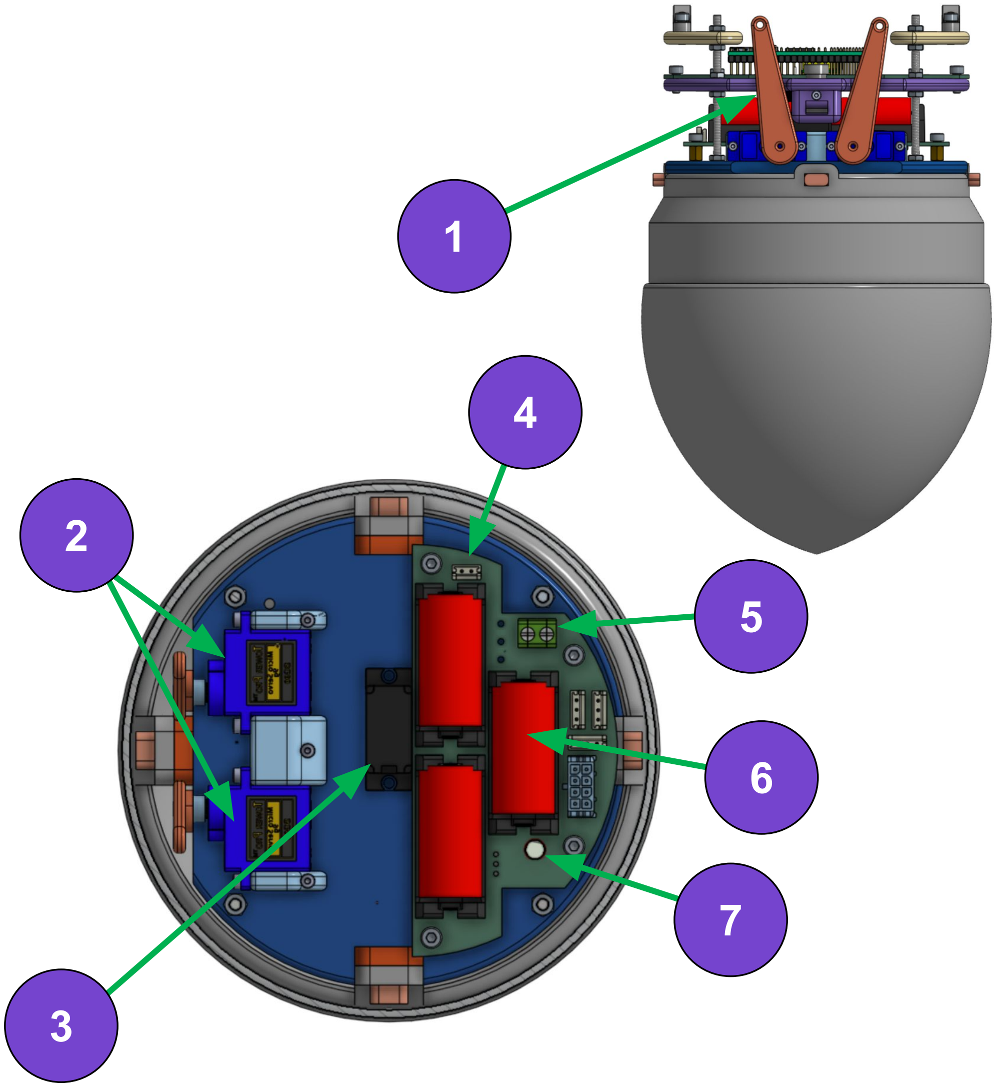




Cansat Mechanical Layout of Components Trade & Selection (5/17)

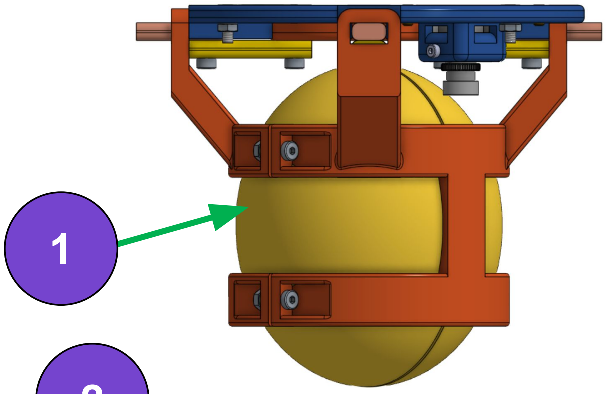
Design X Power and Steering

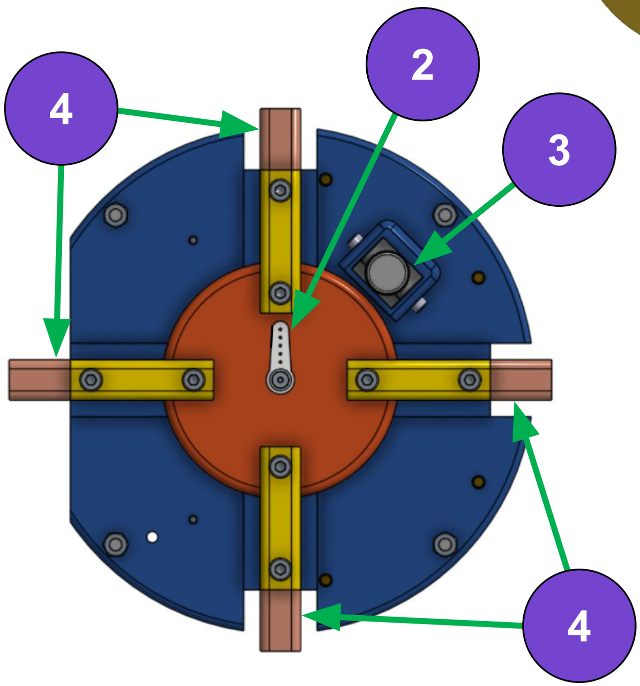
#	Component
1	Paraglider Control Arms
2	Mg90 Servos
3	Mg17 Servo
4	Switch
5	Servo JST
6	Batteries
7	LED



Design X Release and Ground Camera

#	Component
1	Egg Structure
2	Servo Horn
3	Ground Pointing Camera
4	Release Arms

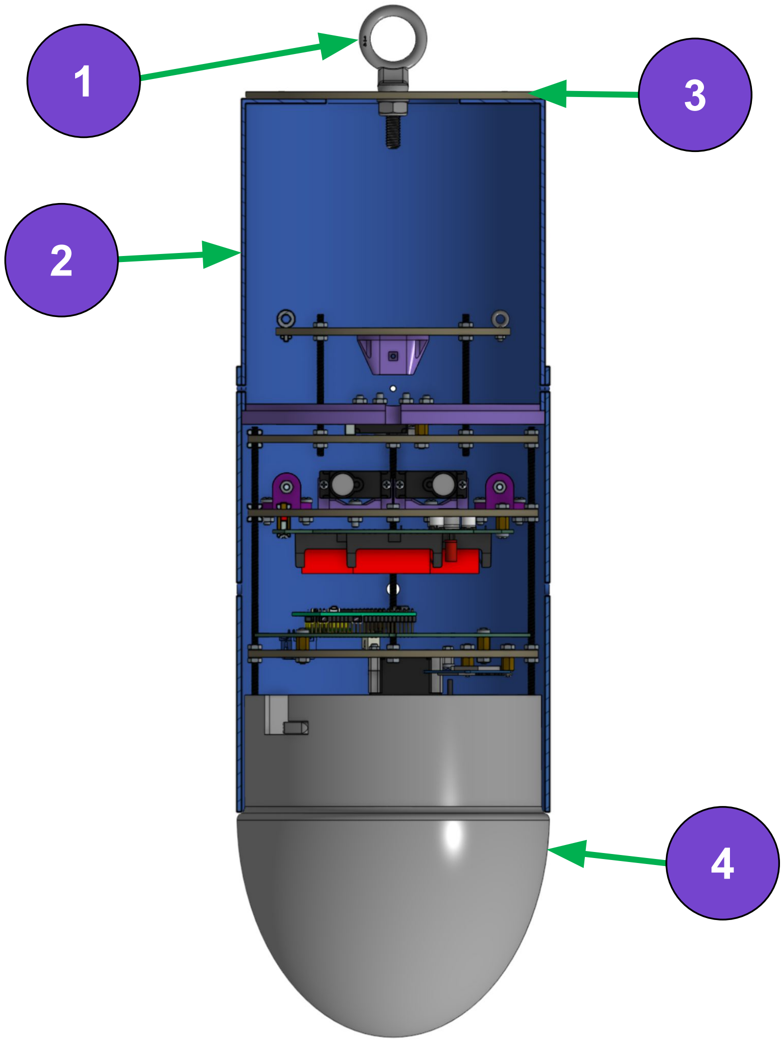




Cansat Mechanical Layout of Components Trade & Selection (7/17)

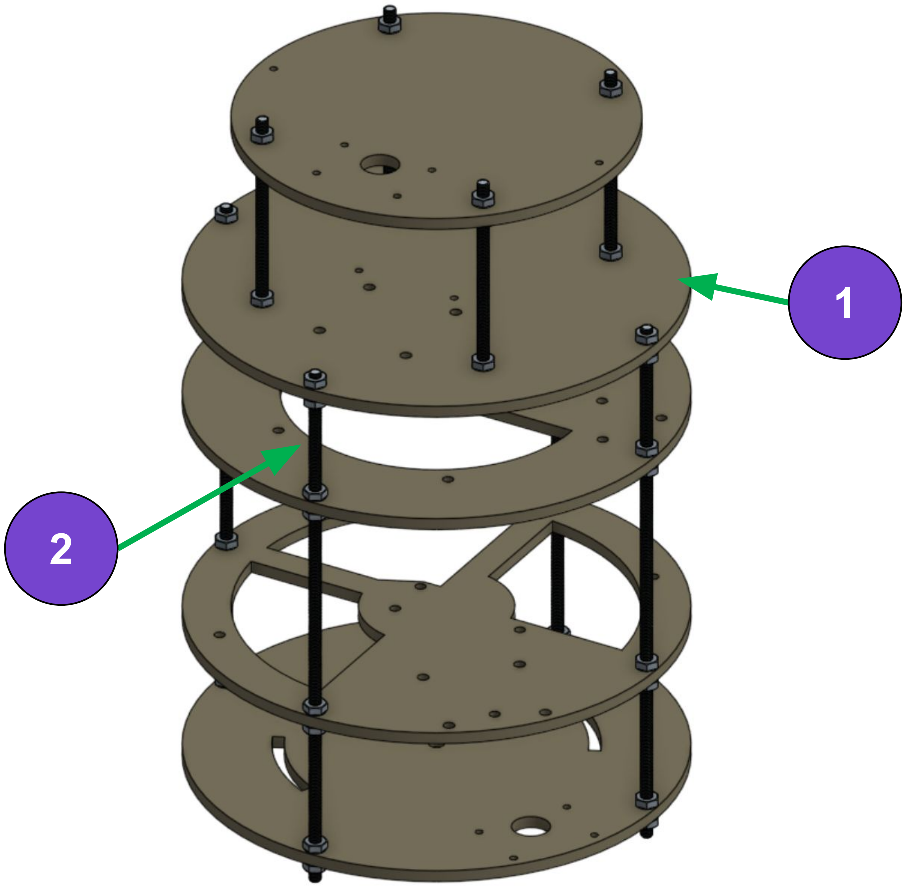
Design Y Container

#	Component
1	1/4in Eyebolt
2	Bambu Lab PA6-CF Container
3	Plywood Plate
4	Woven Fiberglass/Epoxy Resin Composite Nose Cone



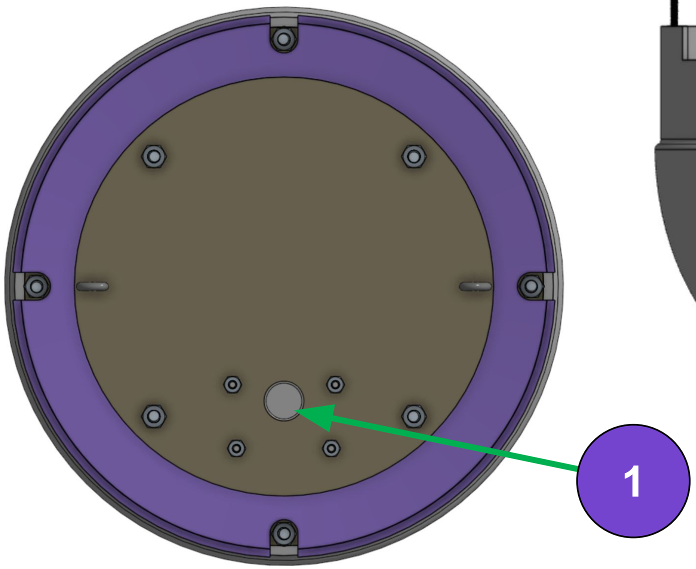
Design Y Structure

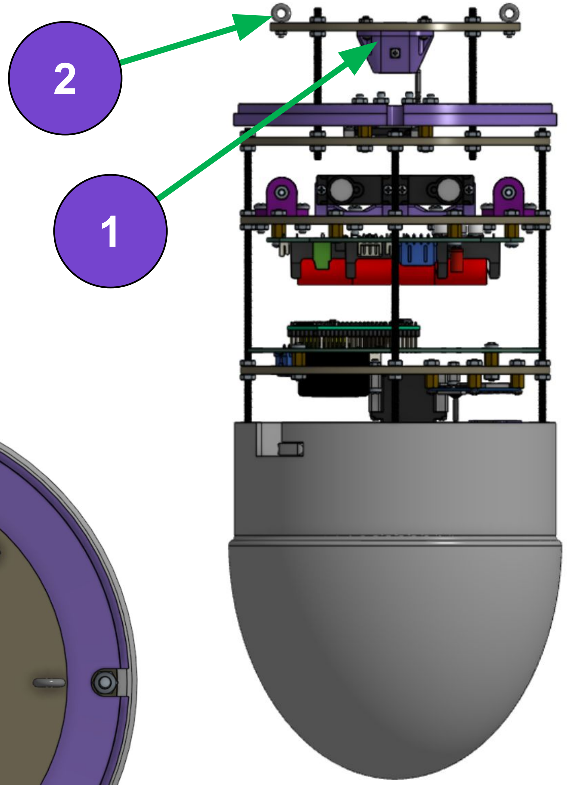
#	Component
1	Plywood Fiberglass Composite Sandwich Structure Plates
2	M3 Threaded Structure Rods



Design Y Camera

#	Component
1	Descent Control Pointing Camera
2	M2 Eyebolts

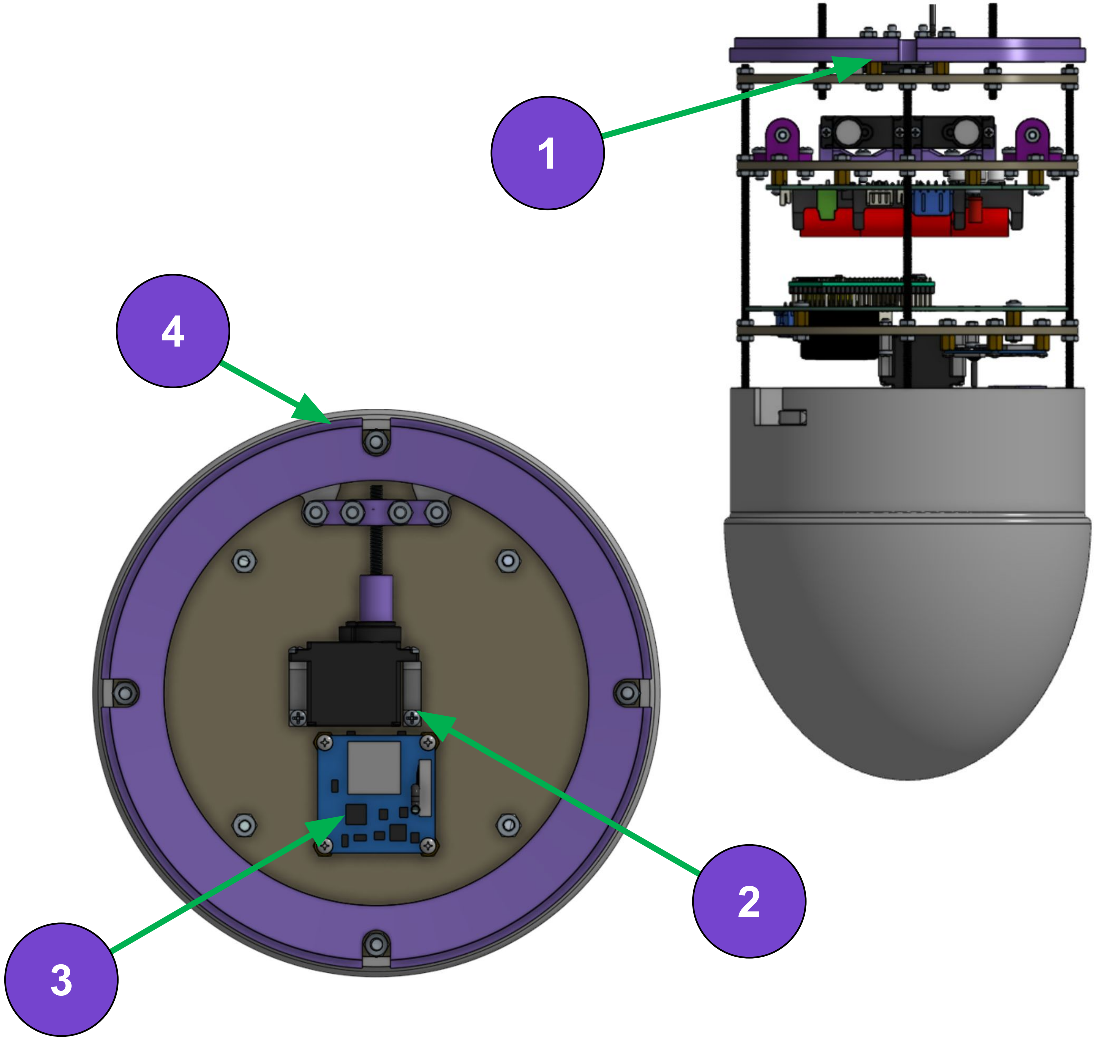




Cansat Mechanical Layout of Components Trade & Selection (10/17)

Design Y Release and Camera PCB

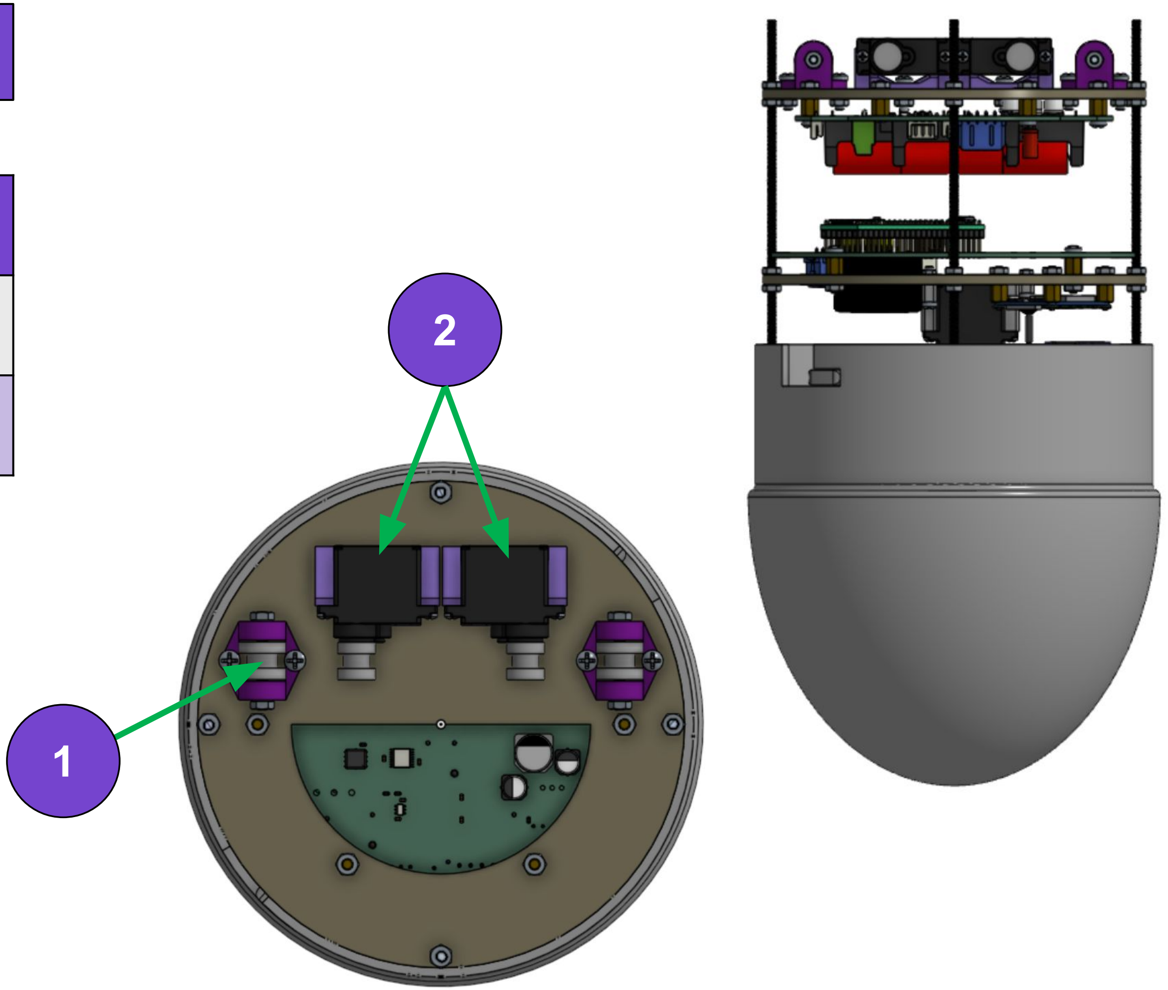
#	Component
1	Snap Ring Container Release System
2	Mg14 Servo
3	Camera PCB
4	Snap Ring Groove



Cansat Mechanical Layout of Components Trade & Selection (11/17)

Design Y Steering

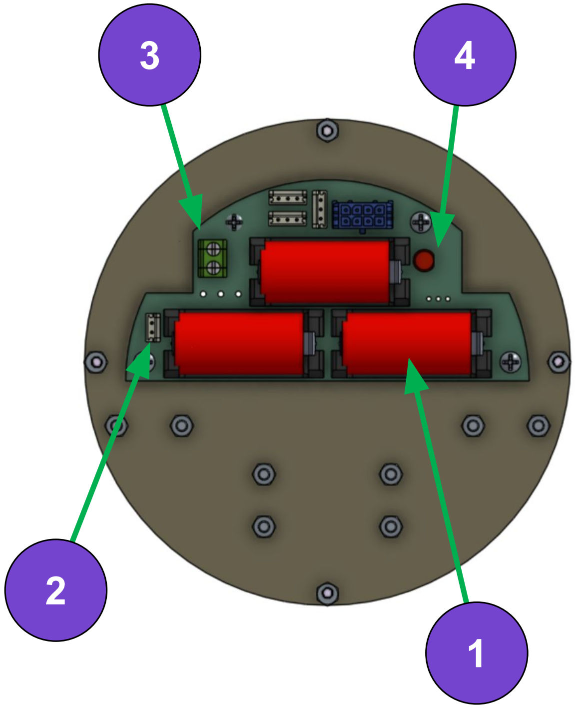
#	Component
1	Pulleys
2	Mg14 Servos

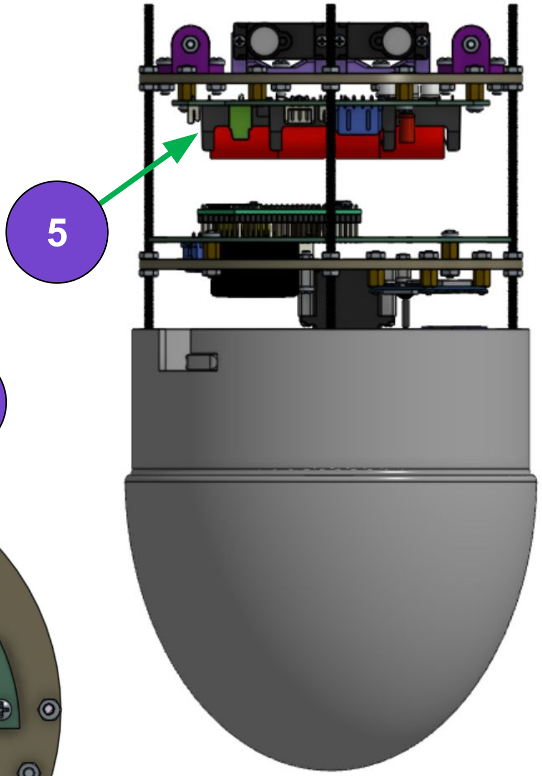


Cansat Mechanical Layout of Components Trade & Selection (12/17)

Design Y Power Board

#	Component
1	Batteries
2	Switch
3	Servo JST
4	LED
5	Power Board

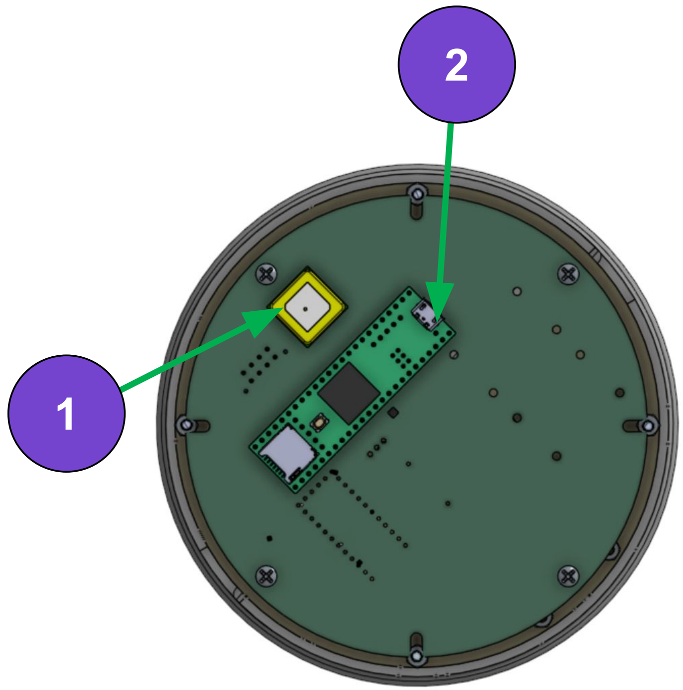


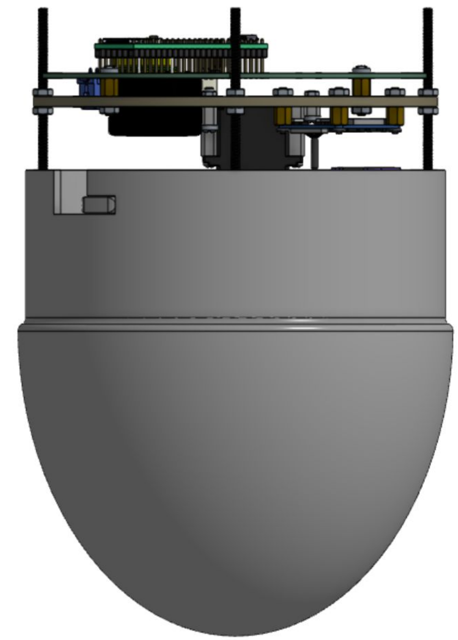


Cansat Mechanical Layout of Components Trade & Selection (13/17)

Design Y Telemetry

#	Component
1	SAM-M10Q
2	Teensy

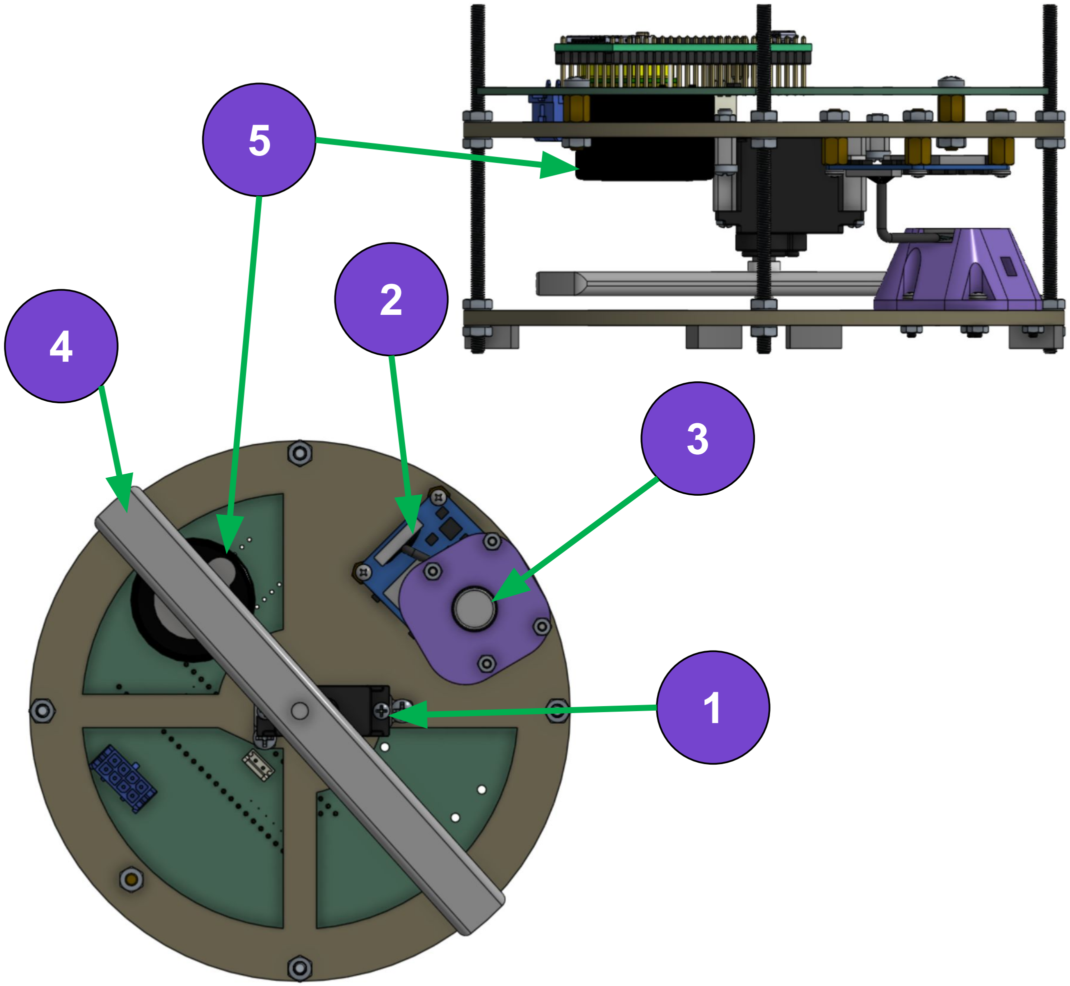




Cansat Mechanical Layout of Components Trade & Selection (14/17)

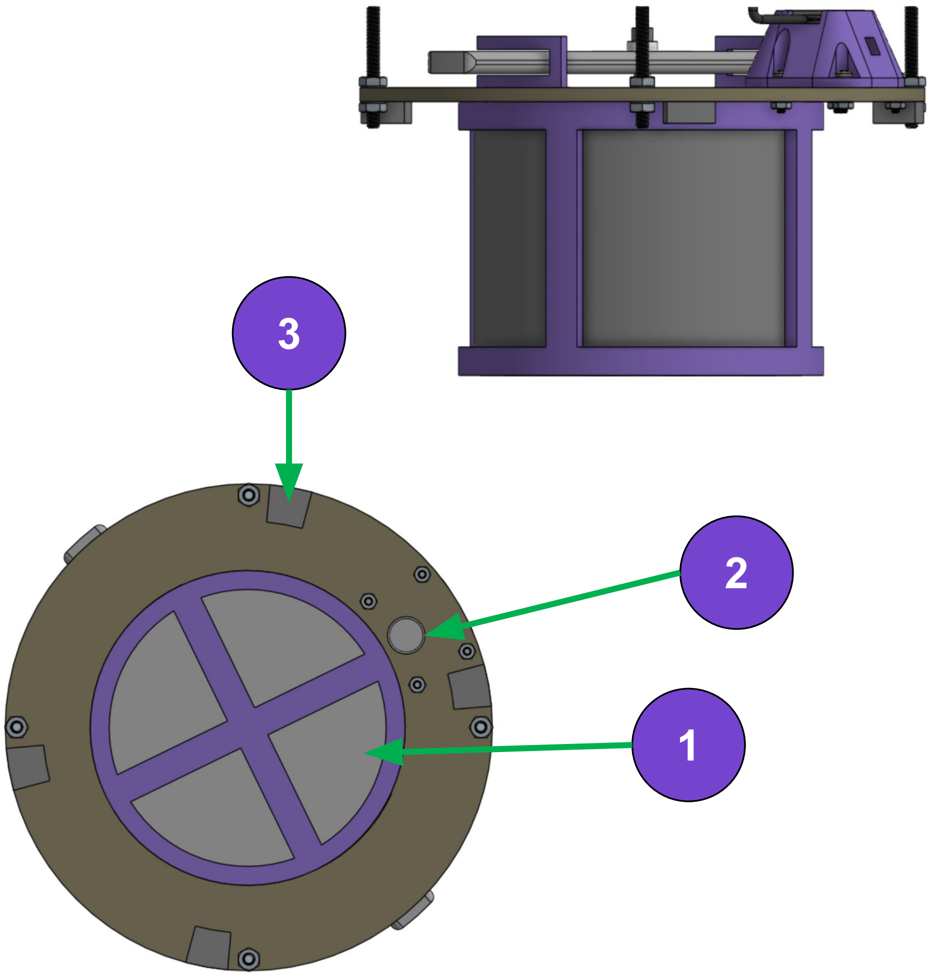
Design Y Nose Cone and Egg Release

#	Component
1	Mg14 Servo
2	Camera PCB
3	Ground Pointing Camera
4	Rotating Egg and Nose Release Arms
5	Buzzer



Design X Camera and Egg Structure

#	Component
1	Egg Structure
2	Camera
3	Nose Rotation Locks



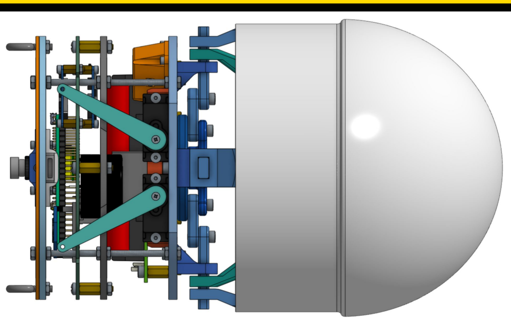
Cansat Mechanical Layout of Components Trade & Selection (16/17)

Category	2	4	8
Space Taken in Container	>200mm	150-200mm	<150mm
Plates Manufacturing Process	Plywood Plates	3D Printed Plates	Composite Plates
Plate Mounting Method	Integrated with 3D Plates	Integrated and Modular Parts	Modular (Screws)

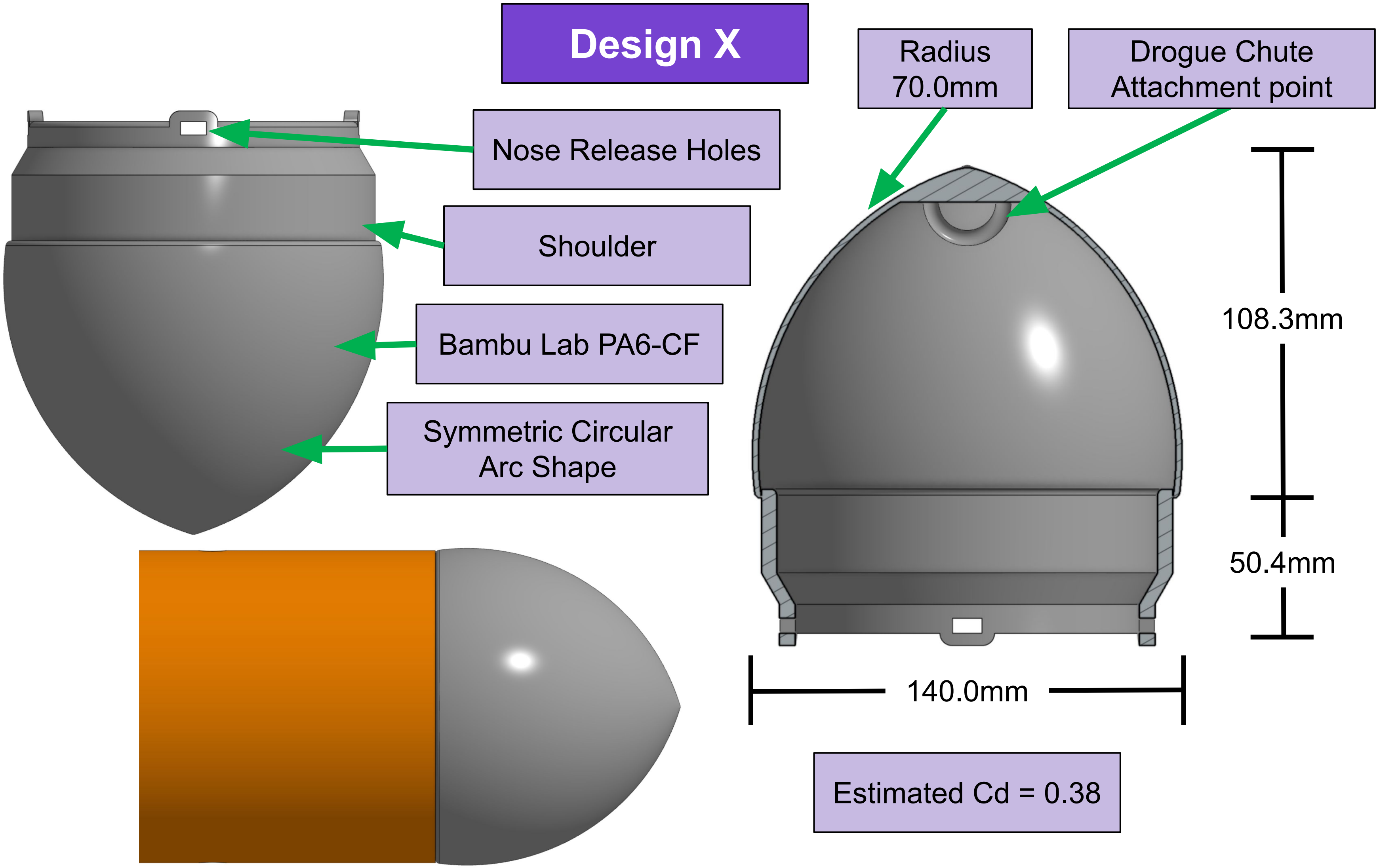
Cansat Mechanical Layout of Components Trade & Selection (17/17)

Figures of Merit	Weight	Design X		Design Y	
		Unweighted	Weighted	Unweighted	Weighted
Space Taken in Container	8	8	64	2	16
Plates Manufacturing Process	4	4	16	8	32
Plate Mounting Method	2	4	8	8	16
Weighted Scores		88		64	

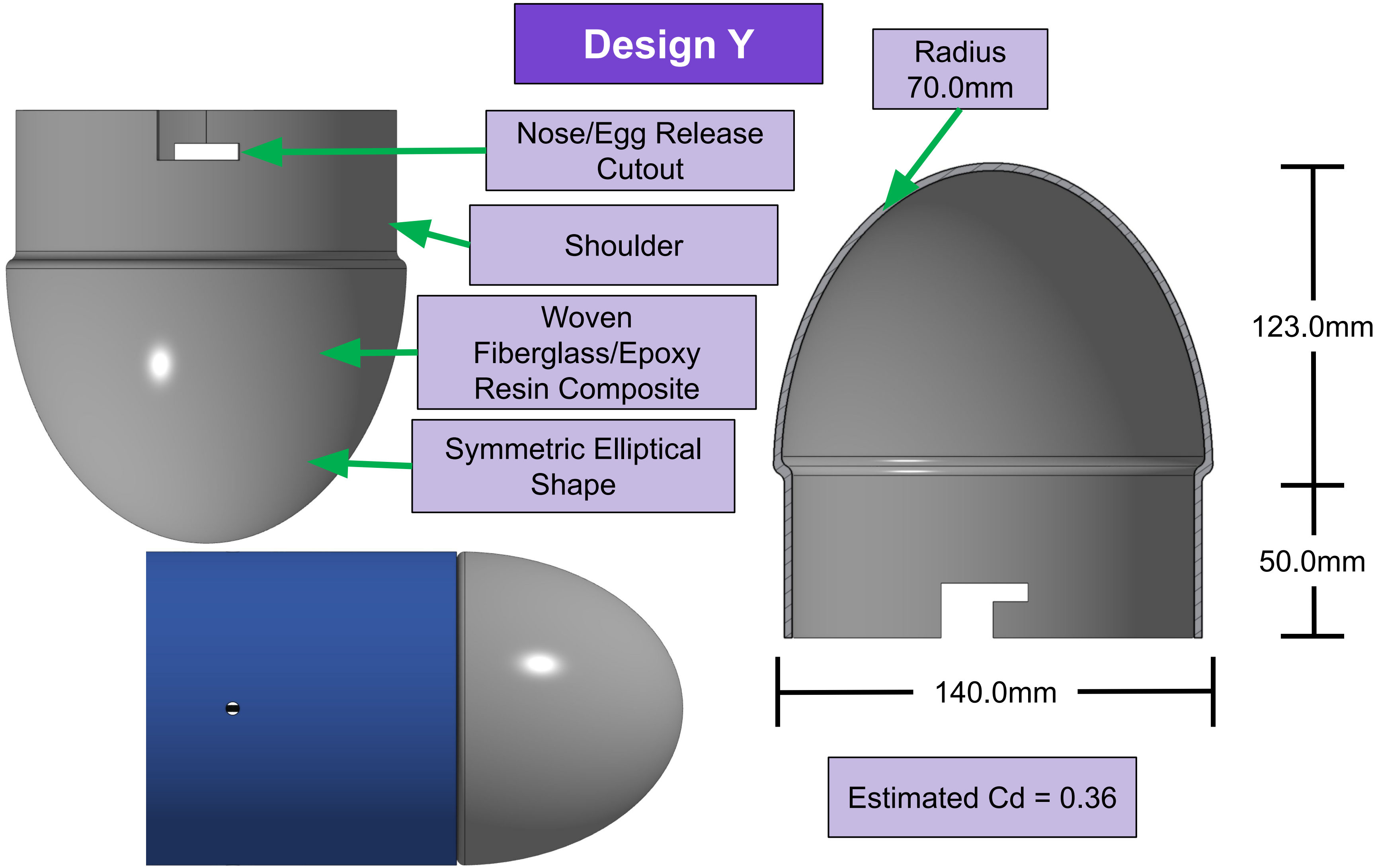
<u>Selection:</u> Combination
- **Y's Plate Mounting Method**
- **X's Compact Layout Style**



Nose Cone Design Trade & Selection (1/4)



Nose Cone Design Trade & Selection (2/4)



Nose Cone Design Trade & Selection (3/4)

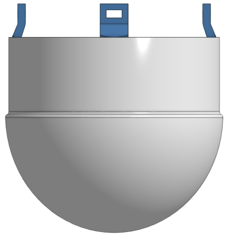
Category	2	4	8
Mass (g)	>100	50-100	<50
Cost of Materials Used (USD)	>10	10-5	<5
Impact Toughness (kJ/m^2)	<50	50-100	>100

Nose Cone Design Trade & Selection (4/4)

Figures of Merit	Weight	Design X		Design Y	
		Unweighted	Weighted	Unweighted	Weighted
Mass (g)	8	4	32	8	64
Cost of Materials Used (USD)	4	8	32	8	32
Impact Toughness (kJ/m^2)	2	4	8	4	8
Weighted Scores		72		104	

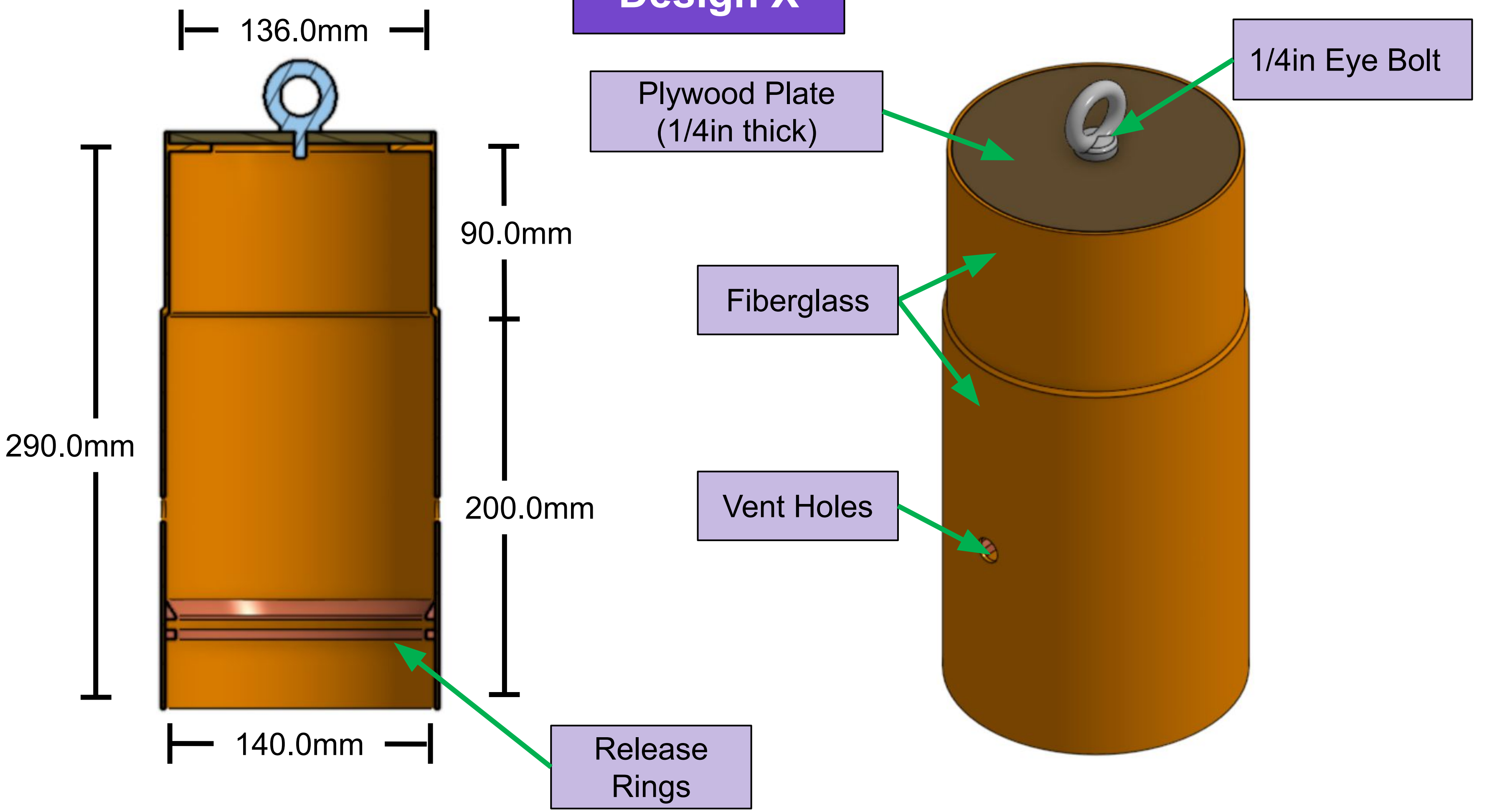
Selection: Combination

- **Composite Cone from Design Y**
- **3D Printed Release Attachment Points from Design X**



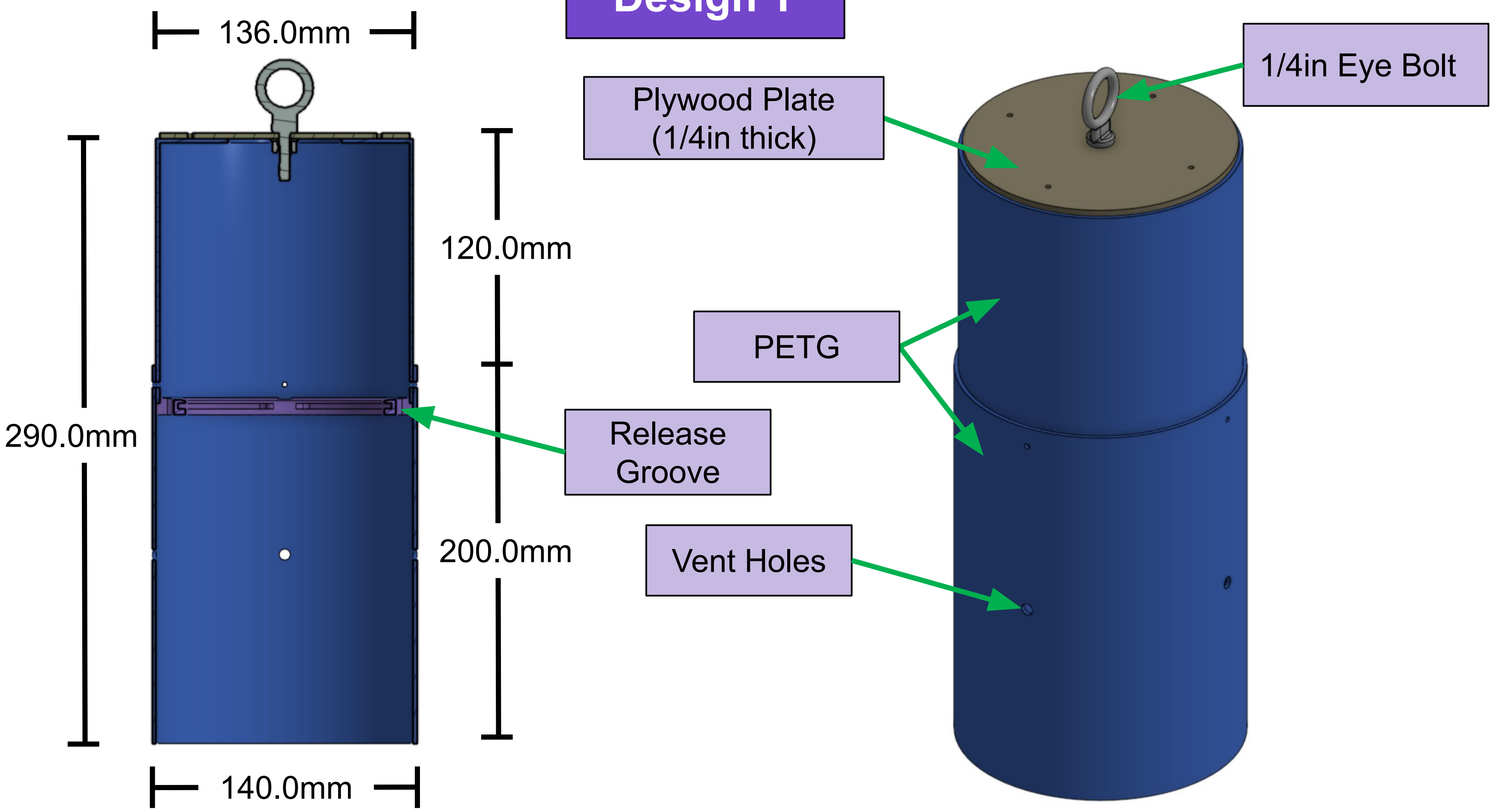
Container Design and Configuration Trade & Selection (1/4)

Design X



Container Design and Configuration Trade & Selection (2/4)

Design Y



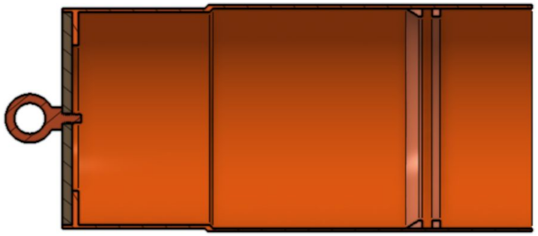
Container Design and Configuration Trade & Selection (3/4)

Category	2	4	8
Mass (g)	>160	120-160	<120
Material	PETG	PLA	Fiberglass
Surface area of attachment to container (mm^2)	1000>	1000-1300	>1300

Container Design and Configuration Trade & Selection (4/4)

Figures of Merit	Weight	Design X		Design Y	
		Unweighted	Weighted	Unweighted	Weighted
Mass	8	4	32	4	32
Material	4	8	32	2	8
Surface area	2	2	4	8	16
Weighted Scores		68		56	

<u>Selection:</u> Design X
- **Lighter**
- **Compatible with Selected Nose Cone and Release Mechanism**



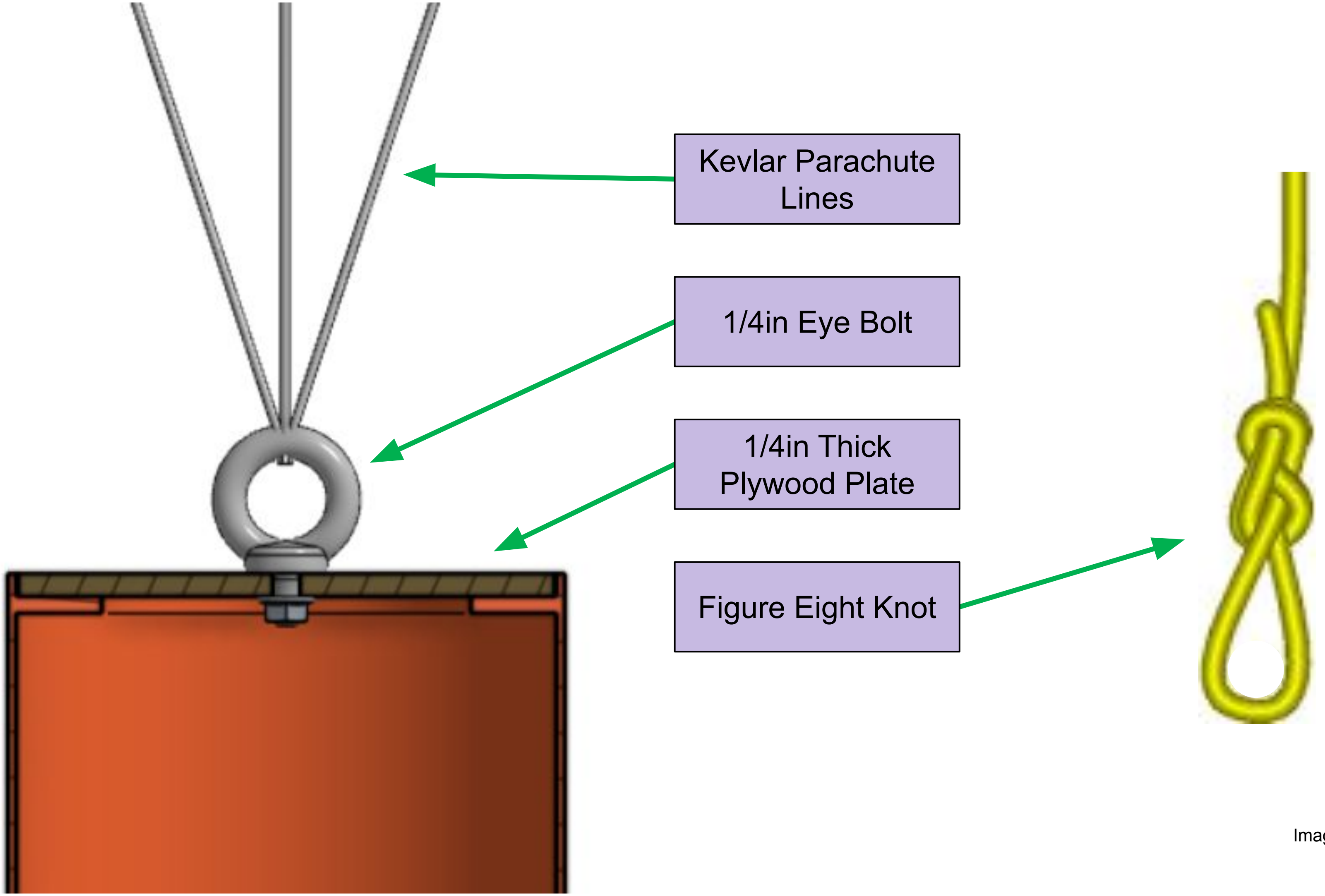
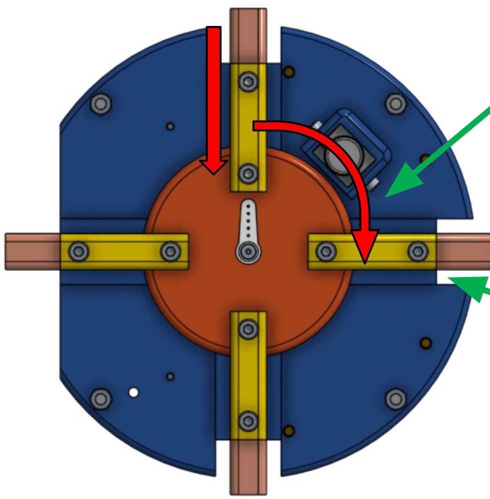


Image Credit: rrt.

Payload Release Trade & Selection (1/4)

Design X

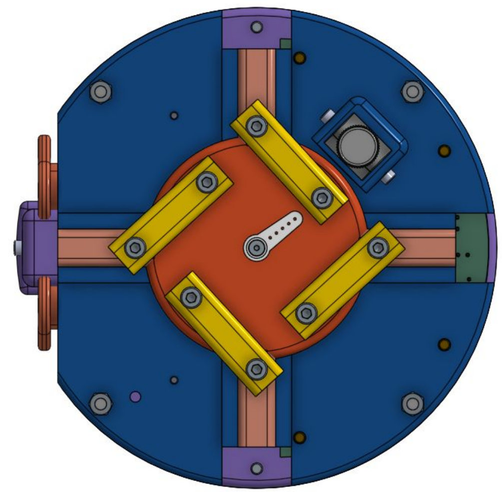
Undeployed State



Disc Rotates Pulling Rods in

Release Rods Slot into Payload Arms

Deployed State

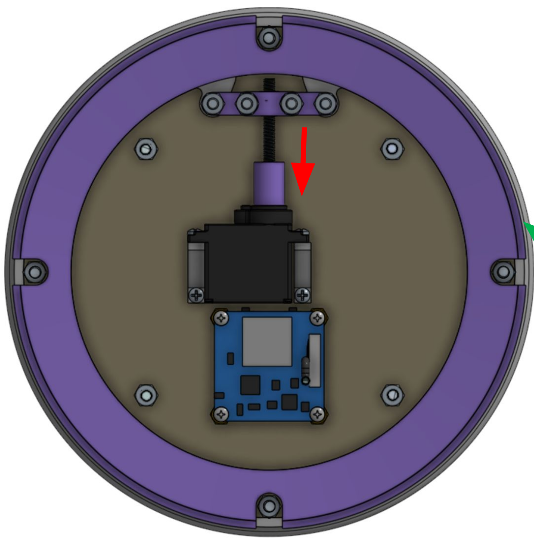


Direction of Travel:

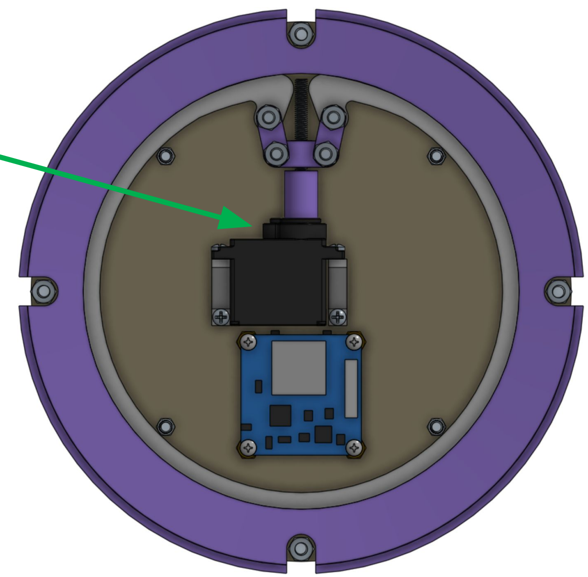
Payload Release Trade & Selection (2/4)

Design Y

Undeployed State



Deployed State



Snap Ring Retracts Via Mg14 Servo

Snap Ring Groove is Epoxied to the Inside of the Container

Direction of Travel:

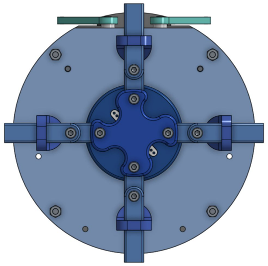
Payload Release Trade & Selection (3/4)

Category	2	4	8
Combined with Other Mechanisms	None	Nose Cone Release	Egg Release & Nose Cone Release
Surface Area of Attachment to Container (mm^2)	1000>	1000-1300	>1300
Servo Strength (kg/cm)	2.2	2.5	3.4

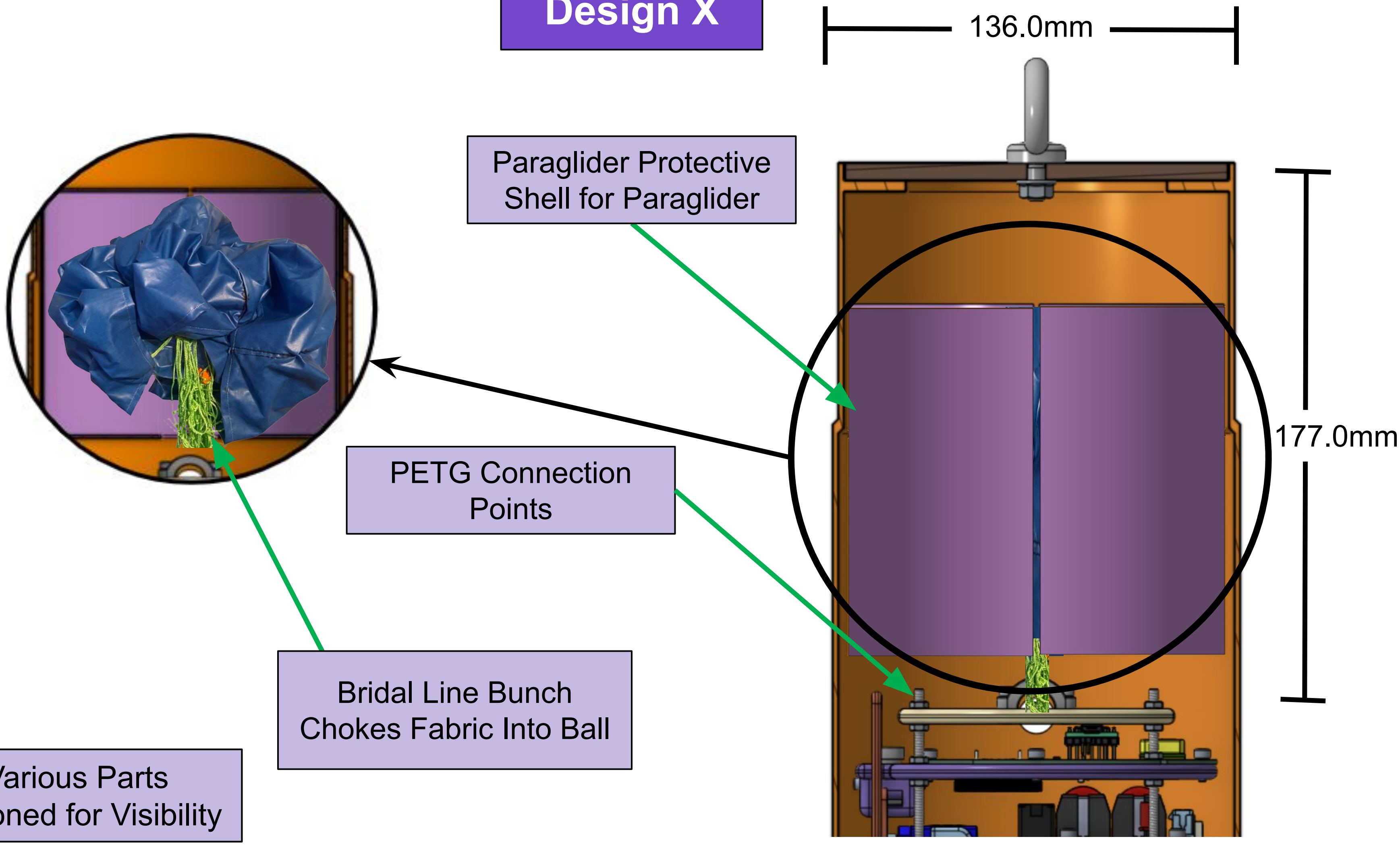
Payload Release Trade & Selection (4/4)

Figures of Merit	Weight	Design X		Design Y	
		Unweighted	Weighted	Unweighted	Weighted
Combined with Other Mechanisms	8	8	64	2	16
Surface Area	4	2	8	8	32
Servo Strength	2	4	8	4	8
Weighted Scores		80		56	

<u>Selection:</u> Design X (Modified)
- **Combines Multiple Mechanisms**



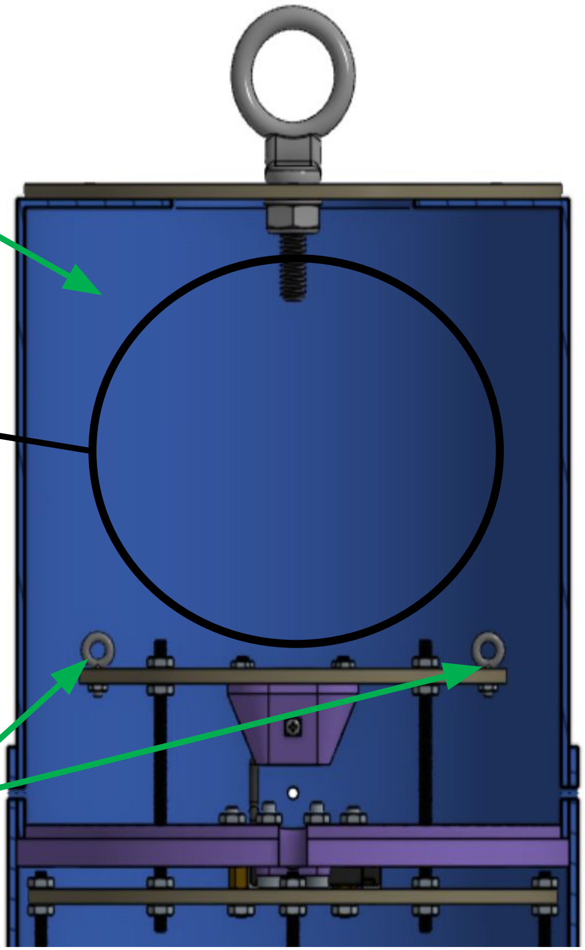
Design X



*Various Parts Sectioned for Visibility

Image Credit:
icaro-paragliders.com

Design Y



Z-Folded Paraglider is Stowed with no Protective Shell

Z-Folded Paraglider

Eye Bolts for Bridal Line Attachment

*Various Parts Sectioned for Visibility

Para-Glider Stow Configuration Trade & Selection (3/4)

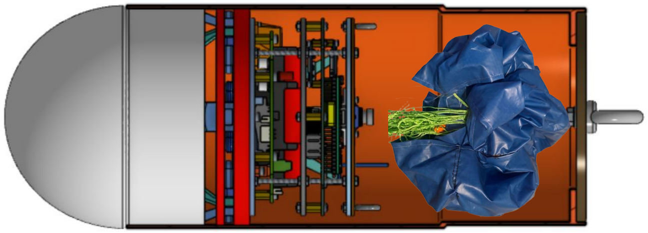
Category	2	4	8
Space for Folded Paraglider (m^3)	<0.001	0.001-0.002	>0.002
Likeliness to Get Caught on Other Components	High	-	Low
Time Taken to Stow (min)	<1	1-5	>5

Para-Glider Stow Configuration Trade & Selection (4/4)

Figures of Merit	Weight	Design X		Design Y	
		Unweighted	Weighted	Unweighted	Weighted
Space for Folded Paraglider (m^3)	8	8	64	4	32
Likeliness to Get Caught on Other Components	4	2	8	8	32
Time Taken to Stow (min)	2	8	16	2	4
Weighted Scores		88		68	

<u>Selection:</u> Combination

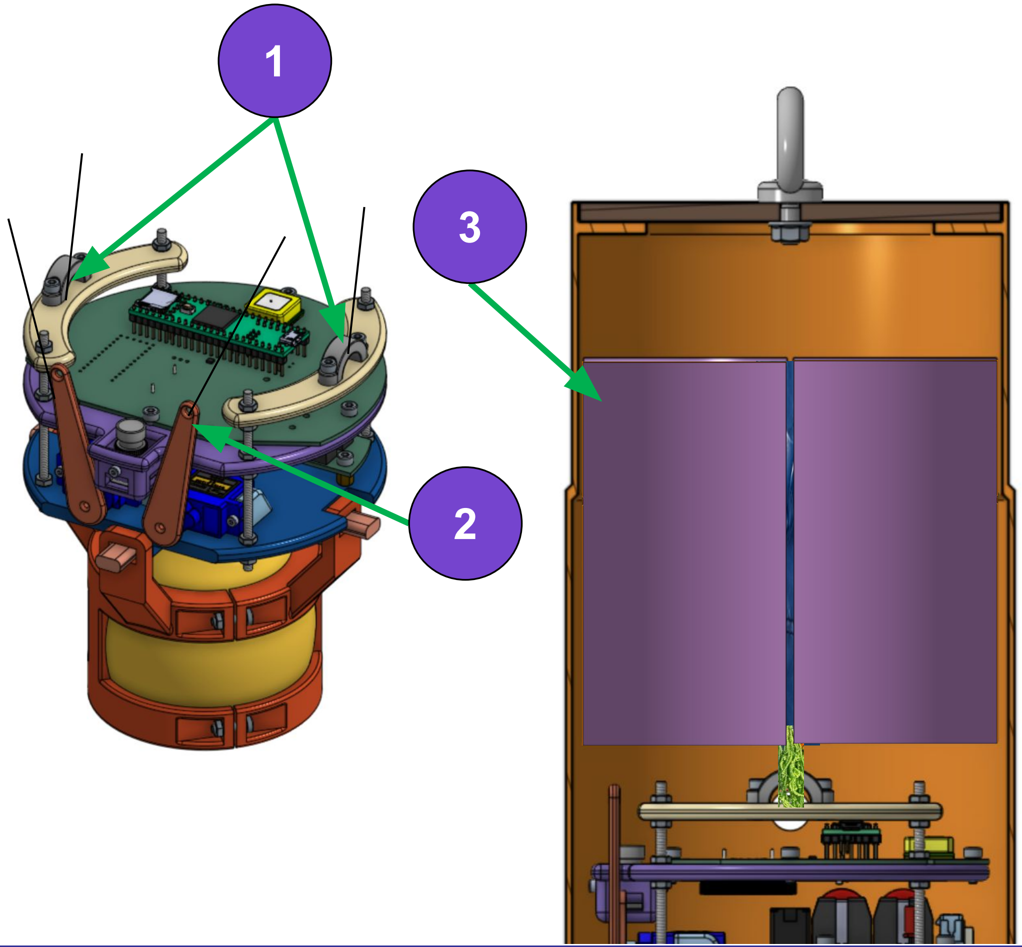
- **Roughly 0.002m^3 of Space for Paraglider**
- **Less Susceptible to Tangles**
- **Quicker to Stow**



Para-Glider Deployment Configuration Trade & Selection (1/4)

Design X

#	Component
1	Main Bridal Lines Connect to Loop and Can be Adjusted
2	Brake Line Connects for Control
3	Passive Deployment, Paraglider Protective Shell Covers the Bridal Line Bunch and Opens Once Released from the Container

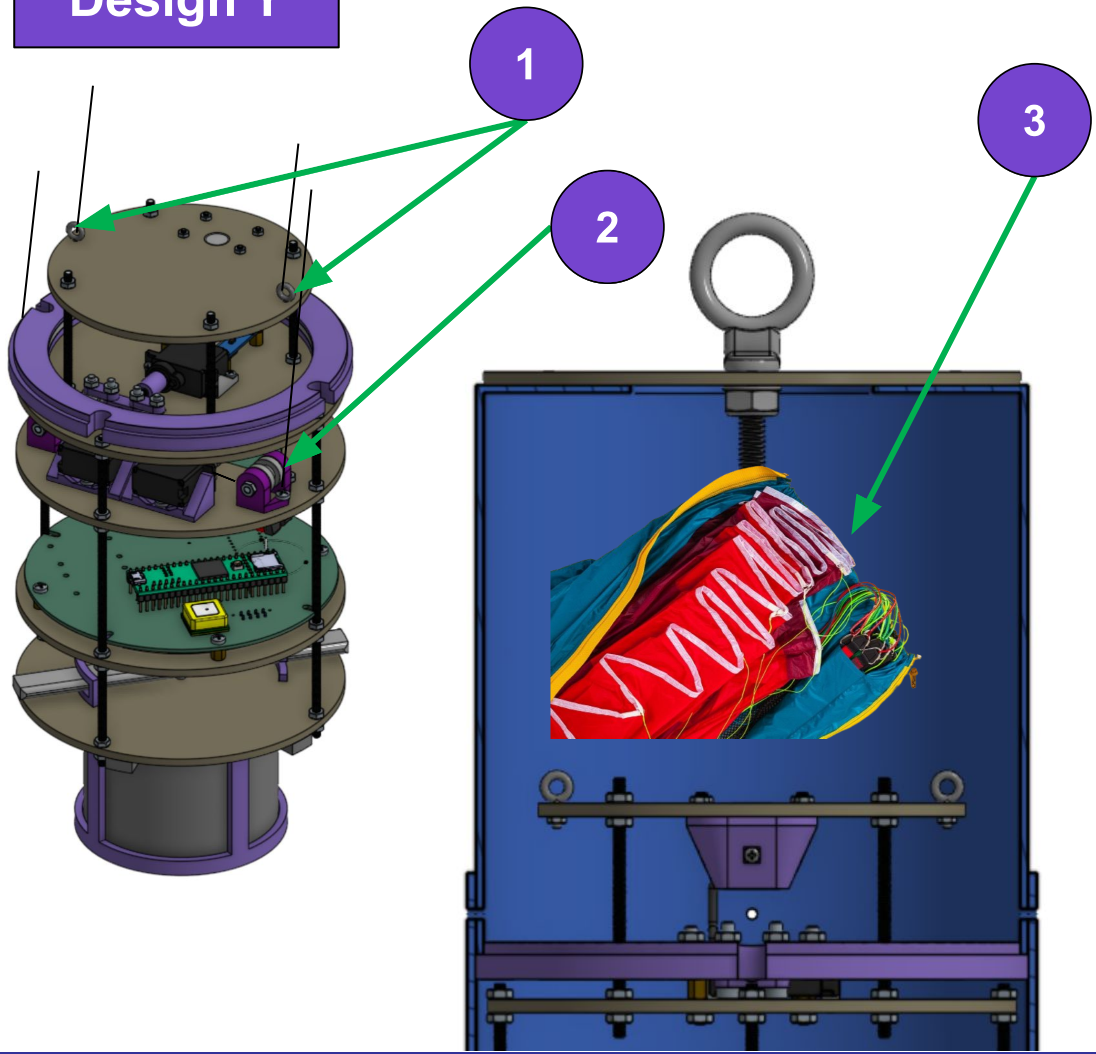


*Various Parts Hidden for Visibility

Para-Glider Deployment Configuration Trade & Selection (2/4)

Image Credit:
icaro-paragliders.com

Design Y



#	Component
1	Bridal Line Attachment Points
2	Brake Line Connects for Control
3	Passive Deployment, Z-Folded Parachute Becomes Undone Once Released

*Various Parts Hidden for Visibility

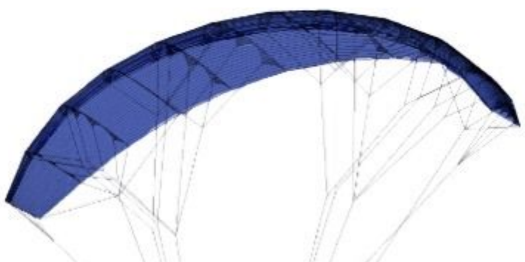
Para-Glider Deployment Configuration Trade & Selection (3/4)

Category	2	4	8
Mass (g)	>50	25-50	<25
Friction	High	-	Low
Complexity (Part #)	5+	1-4	0

Para-Glider Deployment Configuration Trade & Selection (4/4)

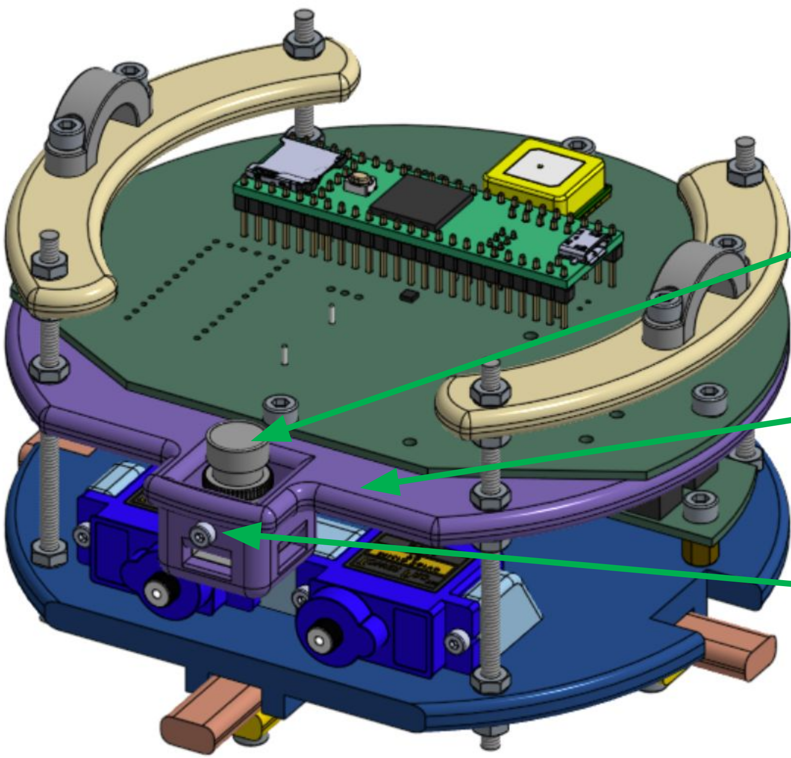
Figures of Merit	Weight	Design X		Design Y	
		Unweighted	Weighted	Unweighted	Weighted
Mass (g)	8	2	16	8	64
Friction	4	8	32	2	8
Complexity (Part #)	2	4	8	8	16
Weighted Scores		56		88	

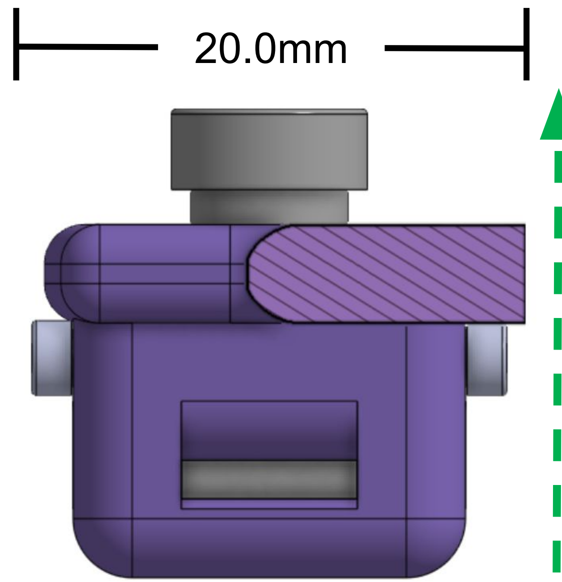
<u>Selection:</u> Design Y
- **Lower Mass**
- **Fewer Parts**



Descent Control Pointing Camera Mount Trade & Selection (1/4)

Design X



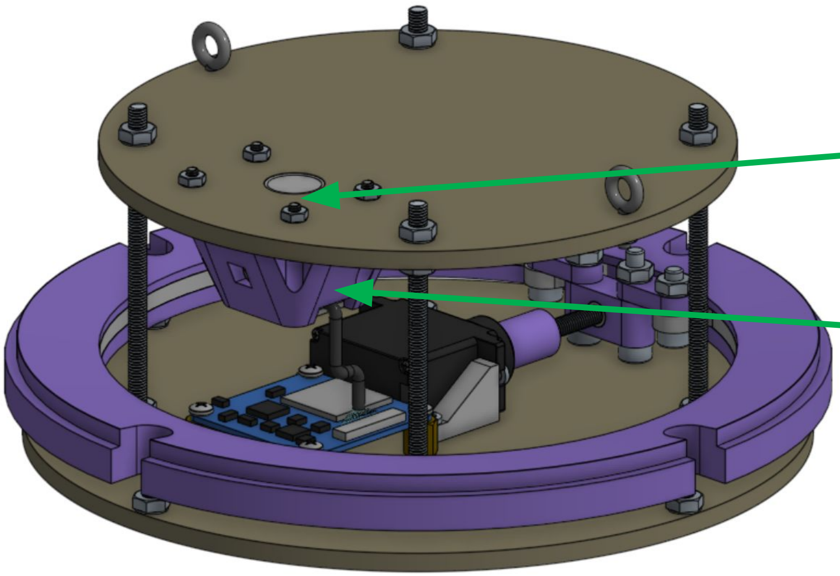


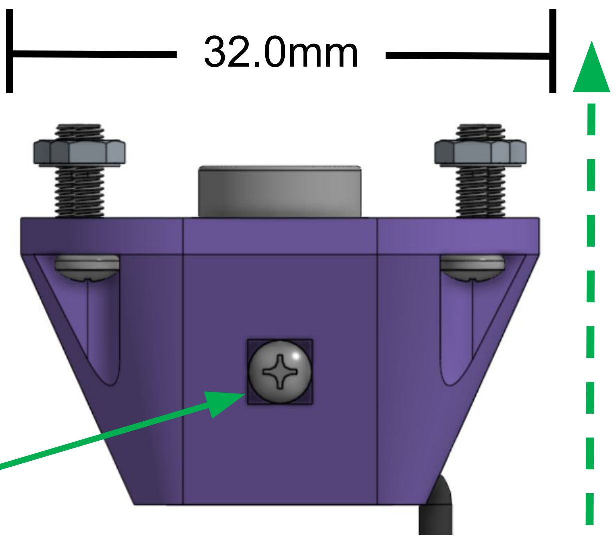
*Various Parts Sectioned for Visibility

Direction Towards Paraglider Position: ■

Descent Control Pointing Camera Mount Trade & Selection (2/4)

Design Y





*Various Parts Hidden for Visibility

Direction Towards Paraglider Position: ■

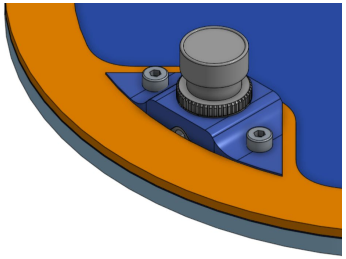
Descent Control Pointing Camera Mount Trade & Selection (3/4)

Category	2	6	8
Mass (g)	>15	10-15g	<10
Mounting Method	Integrated	Mixed	Modular
Compatible with Chosen Design	No	-	Yes

Descent Control Pointing Camera Mount Trade & Selection (4/4)

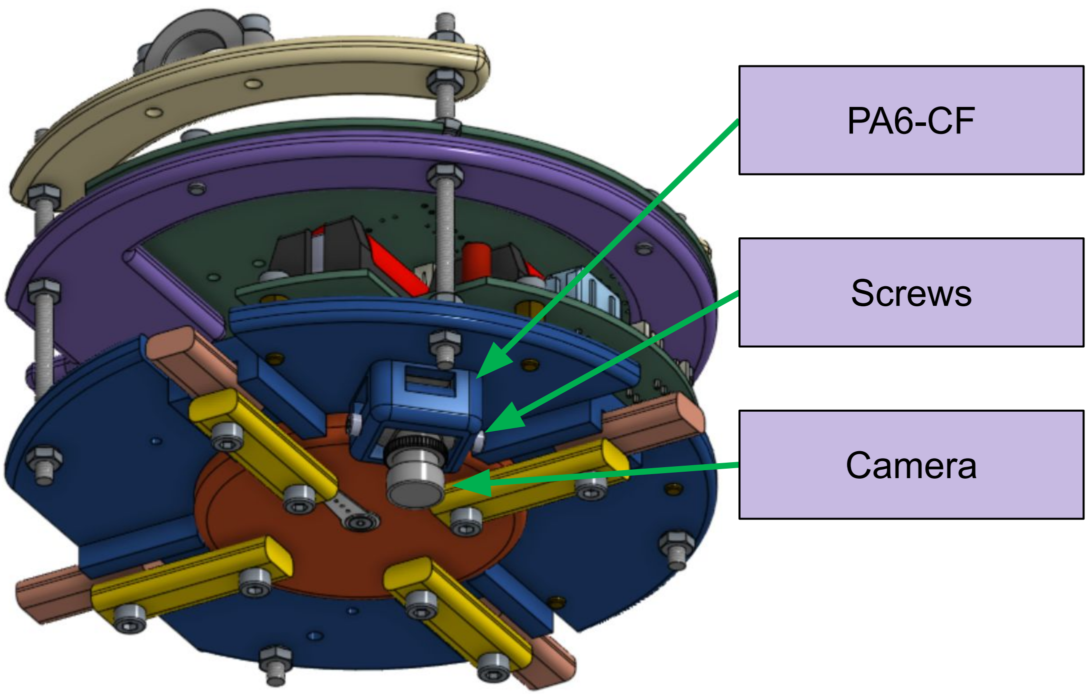
Figures of Merit	Weight	Design X		Design Y	
		Unweighted	Weighted	Unweighted	Weighted
Mounting Method	8	2	16	8	64
Mass	4	4	16	2	8
Compatible	2	8	16	8	16
Weighted Scores		48		88	

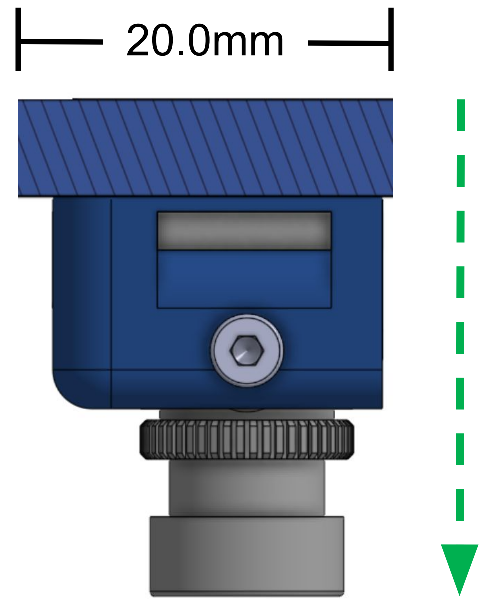
Selection: Combination
- **Easily Detachable**
- **Compatible with the Layered Nylon Plate Design**



Ground Pointing Camera Mount Trade & Selection (1/4)

Design X

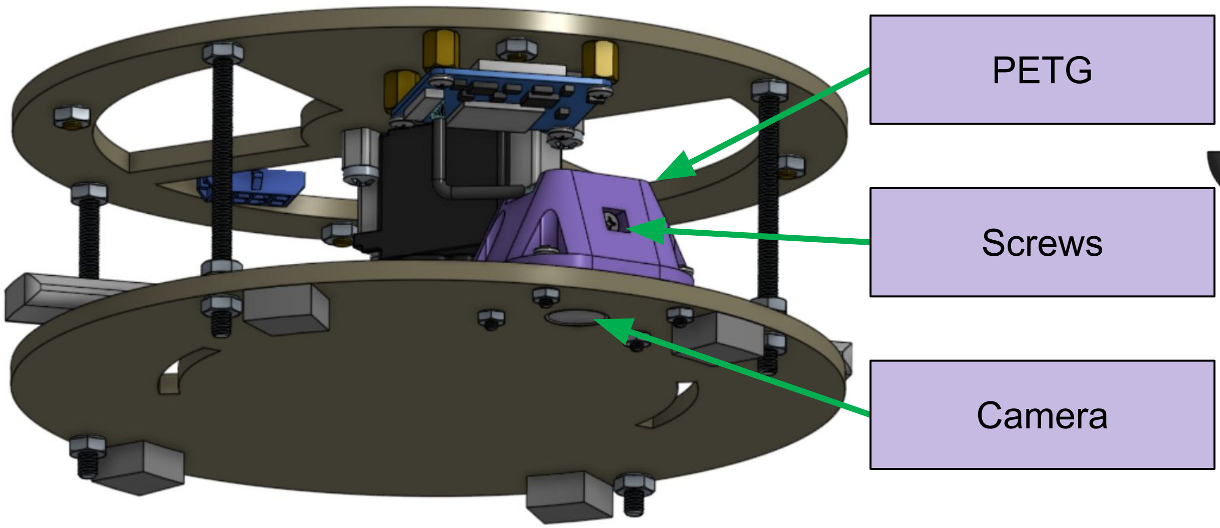


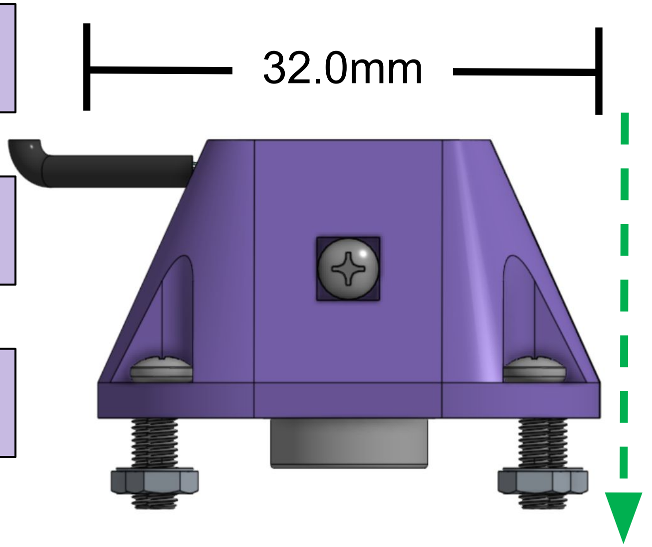


Direction Towards Ground Position:

Ground Pointing Camera Mount Trade & Selection (2/4)

Design Y





*Various Parts Hidden for Visibility

Direction Towards Ground Position: ■

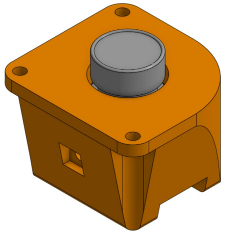
Ground Pointing Camera Mount Trade & Selection (3/4)

Category	2	6	8
Mass (g)	>15	10-15g	<10
Mounting Method	Integrated	Mixed	Modular
Camera Lens Position	Exposed	-	Flush

Ground Pointing Camera Mount Trade & Selection (4/4)

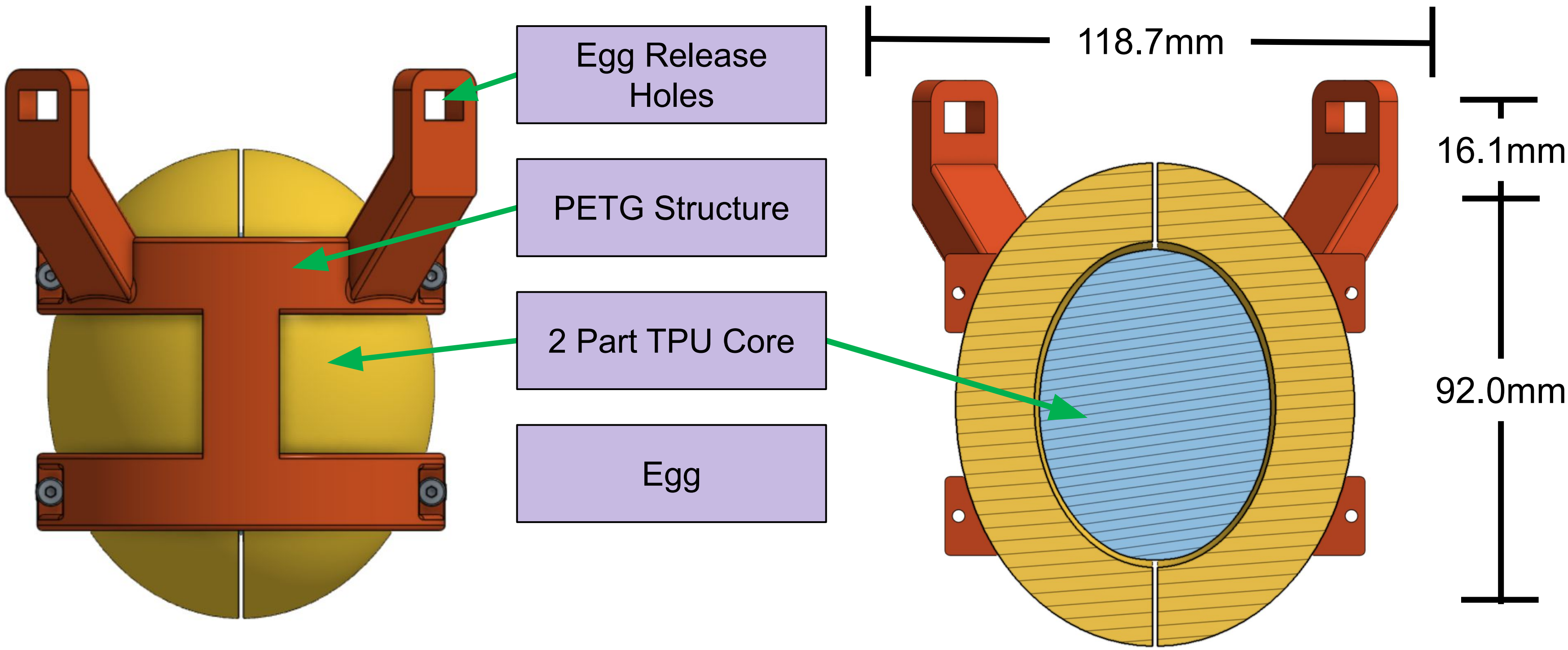
Figures of Merit	Weight	Design X		Design Y	
		Unweighted	Weighted	Unweighted	Weighted
Mounting Method	8	2	16	8	64
Mass	4	4	16	2	8
Lens Position	2	2	4	8	16
Weighted Scores		36		88	

<u>Selection:</u> Design Y (Modified)
- **Easily Detachable**
- **Protected Lens**



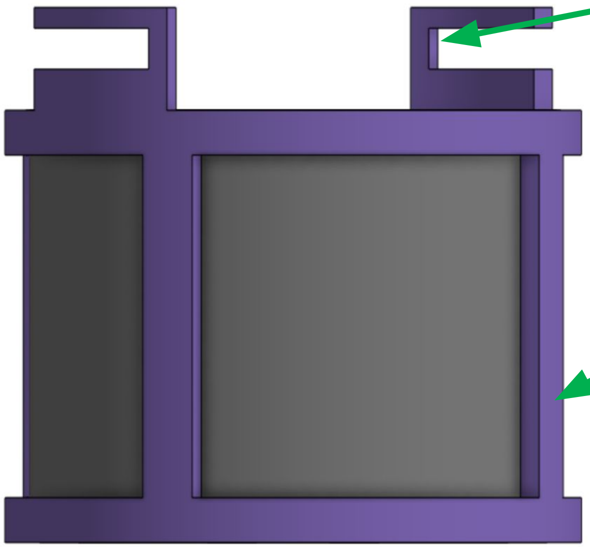
Egg Instrument Design Trade & Selection (1/4)

Design X



*Various Parts Sectioned for Visibility

Design Y



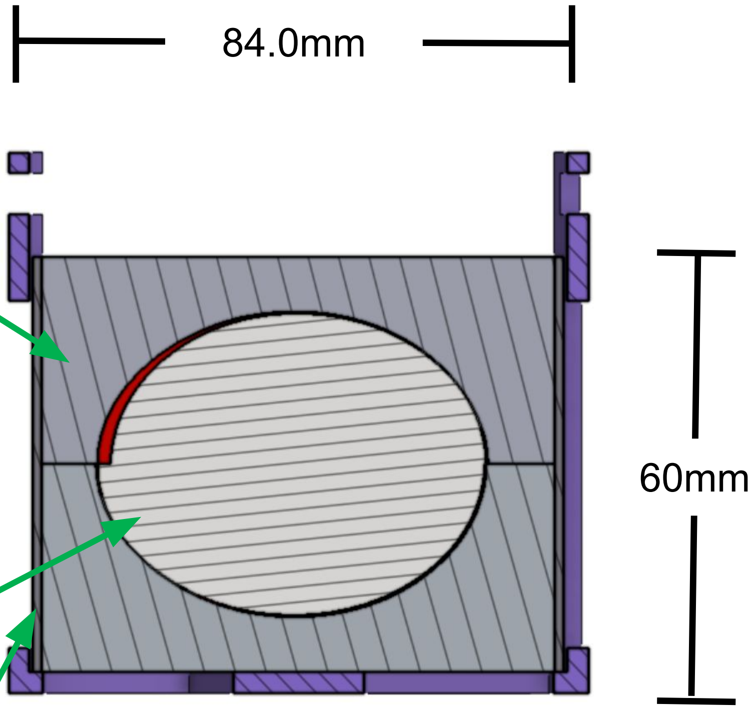
Egg Release Holes

PE Foam

PETG Structure

Egg

TPU Outer Casing



*Various Parts Sectioned for Visibility

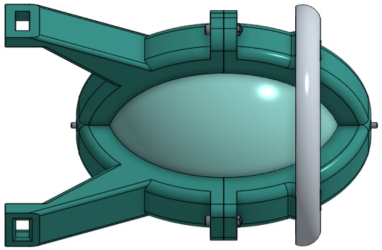
Egg Instrument Design Trade & Selection (3/4)

Category	2	4	8
Mass (g)	>150	100-125	<125
Shielding of Egg	PETG Core	TPU Core	PE Foam
Speed to Disassemble	>3 min	2-3 min	<2 min

Egg Instrument Design Trade & Selection (4/4)

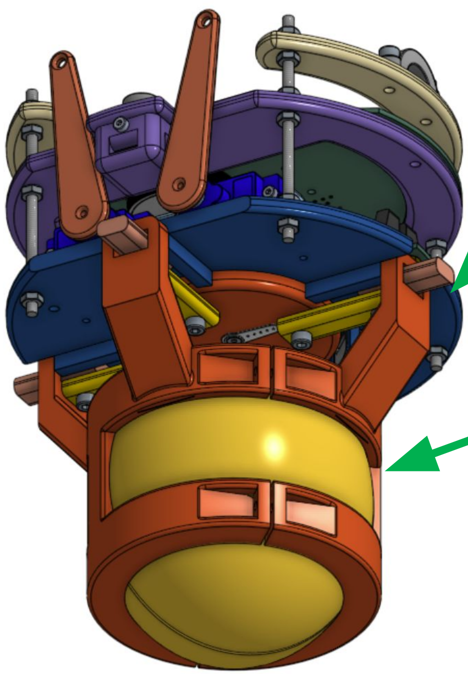
Figures of Merit	Weight	Design X		Design Y	
		Unweighted	Weighted	Unweighted	Weighted
Mass	8	8	64	2	16
Shielding of Egg	4	4	16	8	32
Speed to Disassemble	2	2	4	8	16
Weighted Scores		84		64	

Selection: Design X
- **Lower Mass**
- **More stability - More Condensed and has Additional Points of Attachment**



Egg Instrument Release Trade & Selection (1/4)

Design X



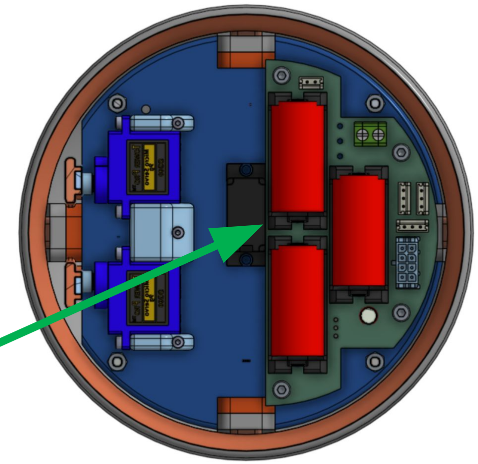
Egg Release Holes

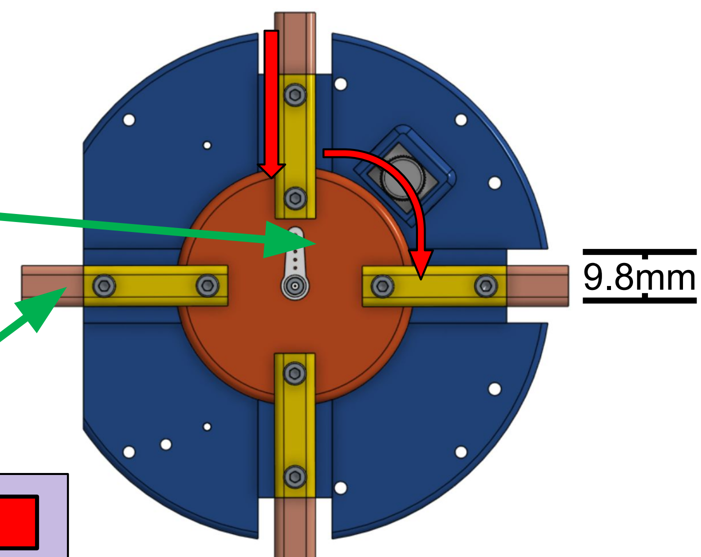
Mg17 Servo

Egg Structure

Servo Horn

Release Arms





*Various Parts Hidden for Visibility

Direction of Travel:

Egg Instrument Release Trade & Selection (2/4)

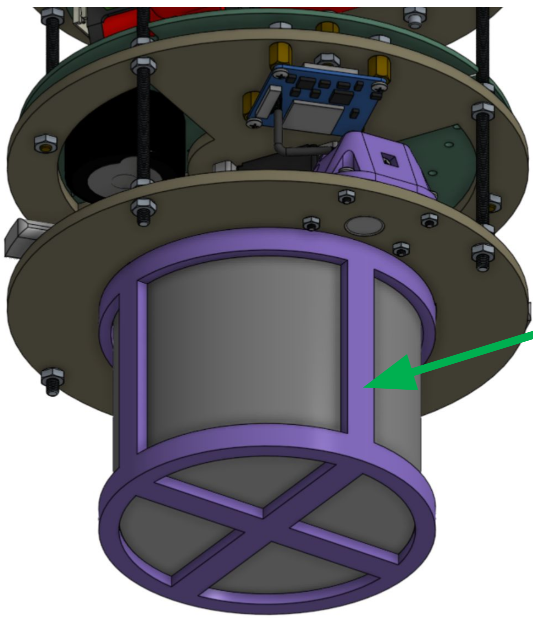
Design Y

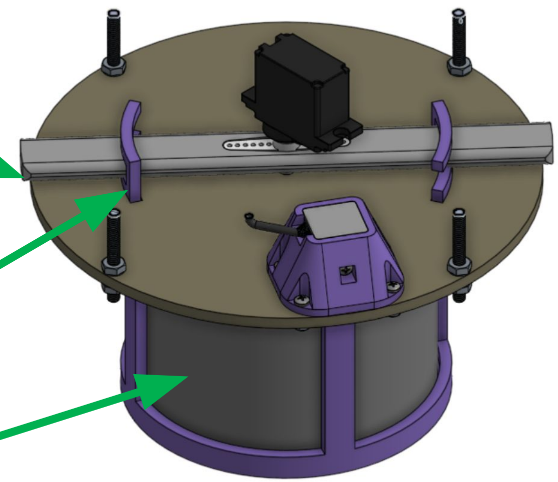
Rotating Release Arms

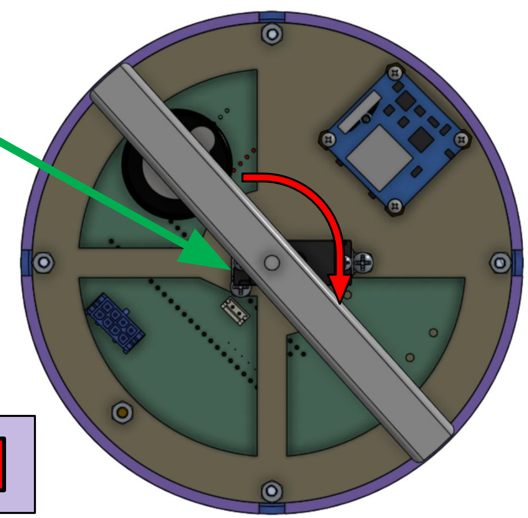
Egg Release Holes

Egg Structure

Mg14 Servo







*Various Parts Hidden for Visibility

Direction of Travel:

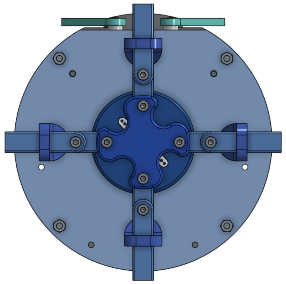
Egg Instrument Release Trade & Selection (3/4)

Category	2	4	8
Servo Strength (kg/cm)	2.2	2.5	3.4
Mass (g)	>20	15-20	<15
Complexity (Number of Parts)	>10	5-10	<5

Egg Instrument Release Trade & Selection (4/4)

Figures of Merit	Weight	Design X		Design Y	
		Unweighted	Weighted	Unweighted	Weighted
Servo Strength	8	8	64	4	32
Mass	4	2	8	8	16
Complexity	2	2	4	8	16
Weighted Scores		76		64	

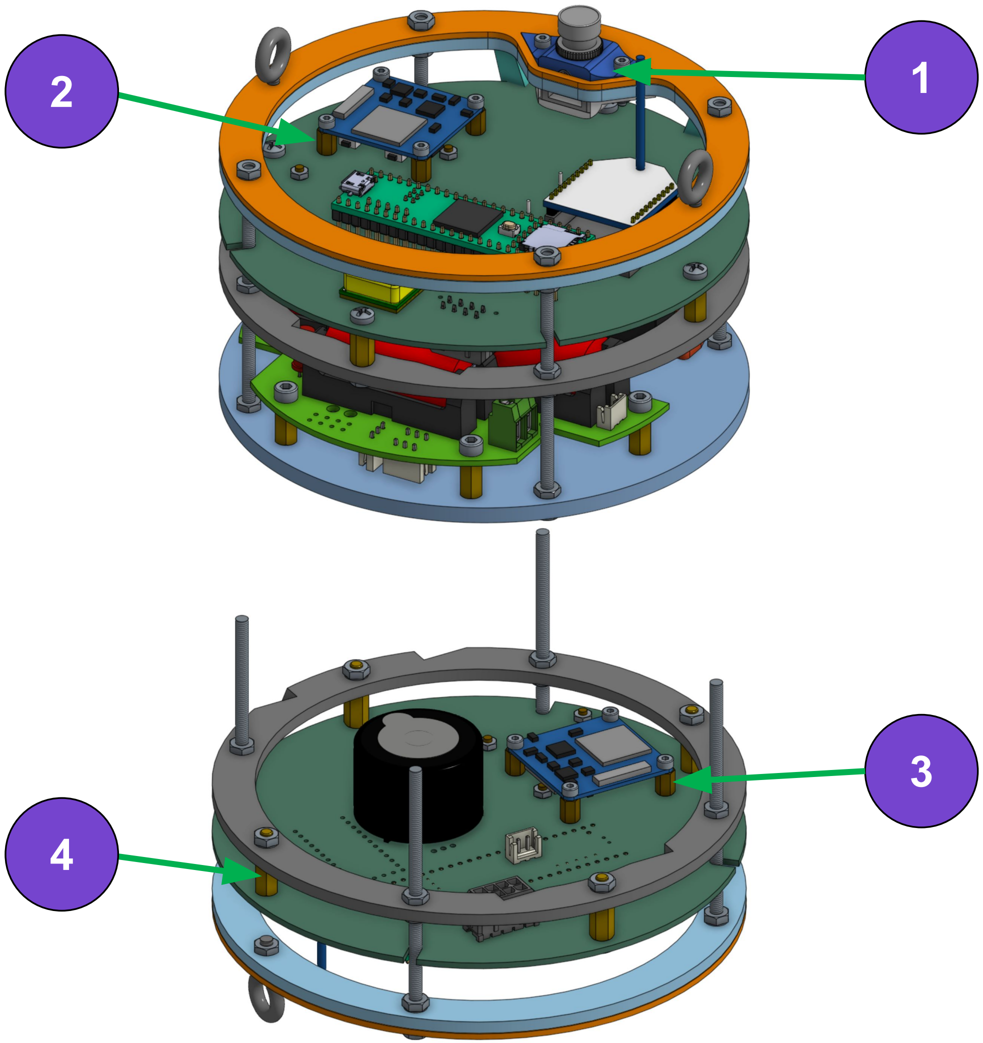
Selection: **X (Modified)**
- **Stability - More Arms**
- **Combined with Release Mechanism and Nose Release**



Electronics Structural Integrity (1/2)

#	Description
1	Top camera secured using integrated mount
2	Top camera board secured using standoffs
3	Bottom camera board secured using standoffs
4	Telemetry PCB attached to PA6-CF ring using standoffs

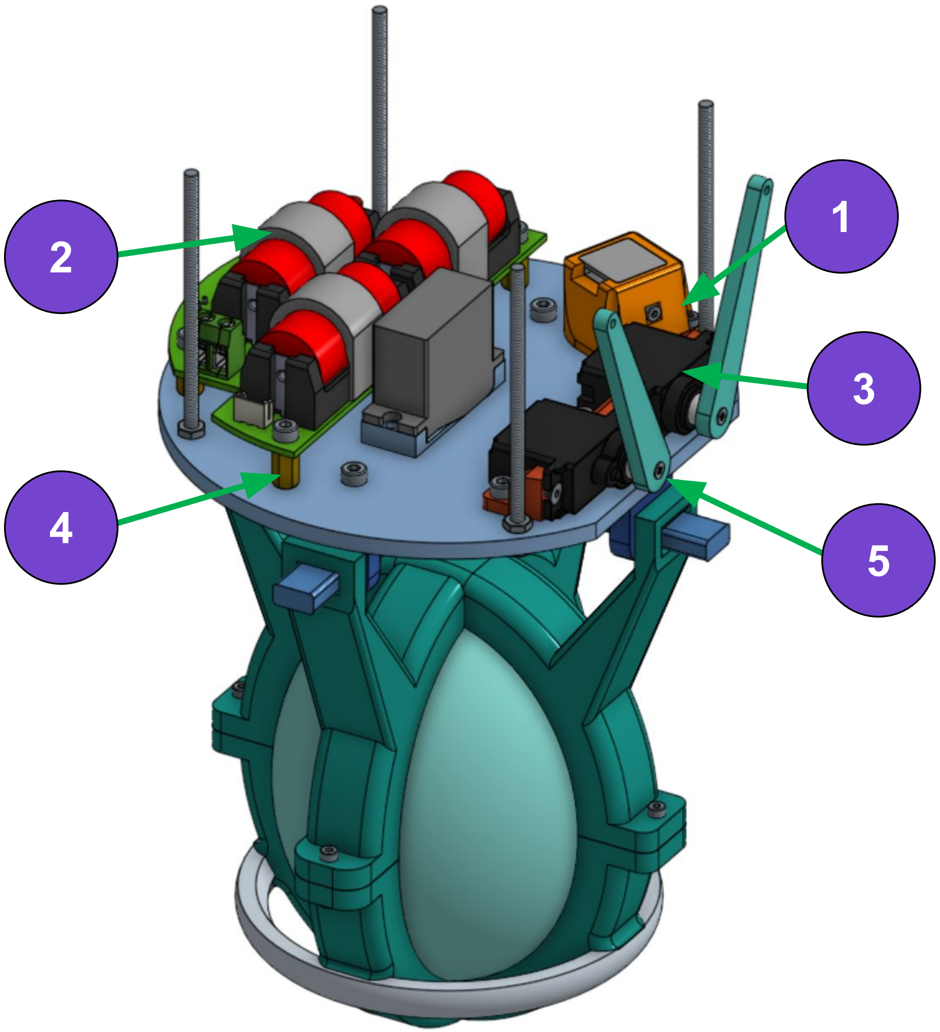
*Various Parts Hidden for Visibility



Electronics Structural Integrity (2/2)

#	Description
1	Bottom camera secured using PA6-CF mount
2	Batteries secured using clips
3	All servos mounted to PA6-CF mounts using M2-M3 screws
4	Power PCB attached to PA6-CF plate using standoffs
5	Descent control attachments screwed into servos

*Various Parts Hidden for Visibility



Mass Budget (1/7)

Component	SubTeam	Mass(g)	Amount	Total Mass(g)	Uncertainty (g)	Source
Power PCB	Electrical	15.0	1	15	±1	Measured
Telemetry PCB	Electrical	42.0	1	42	±1	Measured
Surefire CR123A	Electrical	17.0	3	51.0	±0.0	Datasheet
Teensy 4.1	Electrical	15.0	1	15.0	±0.0	Datasheet
XBEE 900HP PRO	Electrical	6.4	1	6.4	±0.0	Datasheet
RunCam Split 4 v2	Electrical	10.2	2	20.4	±0.0	Datasheet
XBEE BREAKOUT	Electrical	4.7	1	4.7	±0.0	Datasheet

Mass Budget (2/7)

Component	SubTeam	Mass(g)	Amount	Total Mass(g)	Uncertainty (g)	Source
CYS-S3019MG - Mg17 Servo	Electrical	23.0	1	23.0	±0	Datasheet
SER0011 - Mg14 Servo	Electrical	14.9	2	29.9	±0	Datasheet
Container	Structural	223.0	1	223.0	±22.3	Estimation
Nose Cone	Structural	71.7	1	71.7	±7.2	Estimation
Parachute	Structural	23.5	2	47.0	±2	Measured
Egg	Structural	60.0	1	60.0	±5.0	Estimation
Paraglider	Structural	100.0	1	100.0	±10	Estimation

Mass Budget (3/7)

Component	SubTeam	Mass(g)	Amount	Total Mass(g)	Uncertainty (g)	Source
Release Mec. Parts	Structural	22.1	1	22.1	±2.2	Estimation
Various Screws	Structural	26.8	1	26.8	±2.7	Estimation
Bottom Runcam Mount	Structural	3.2	1	3.2	±0.3	Estimation
Top Runcam Mount	Structural	1.5	1	1.5	±0.2	Estimation
Various Nuts	Structural	9.1	1	9.1	±0.9	Estimation
3mm Eyebolt	Structural	5.1	2	10.2	±1.0	Estimation
Paraglider Mount	Structural	14.5	1	14.5	±1.5	Estimation

Mass Budget (4/7)

Component	SubTeam	Mass(g)	Amount	Total Mass(g)	Uncertainty (g)	Source
¼ in Eyebolt	Structural	22.9	1	22.9	±2.3	Estimation
Release Plate	Structural	25	1	25	±2.5	Estimation
PCB Ring	Structural	8.2	1	8.2	±0.8	Estimation
M3 Steel Rods	Structural	3.8	4	15.5	±1.6	Estimation
Steer Arms	Structural	1.2	2	2.4	±0.2	Estimation
M3 Standoffs	Structural	1.7	8	13.5	±1.4	Estimation
Steer Servo Mounts	Structural	1.8	1	1.8	±0.2	Estimation

Mass Budget (5/7)

Component	SubTeam	Mass(g)	Amount	Total Mass(g)	Uncertainty (g)	Source
Release Ring	Structural	17.5	1	17.5	±1.8	Estimation
M2 Standoffs	Structural	0.7	8	5.4	±0.5	Estimation
Ripstop Nylon (Top Plate)	Structural	1.8	1	1.8	±0.2	Estimation
Egg Inner Ring	Structural	24.0	1	24.0	±2.4	Estimation
Egg Outer Ring	Structural	23.7	1	23.7	±2.4	Estimation
Egg Bottom Cap	Structural	4.9	1	4.9	±0.5	Estimation
Egg Core	Structural	23.1	1	23.1	±2.3	Estimation

Mass Budget (6/7)

Component	SubTeam	Mass(g)	Amount	Total Mass(g)	Uncertainty (g)	Source
Nose Connection Arms	Structural	21.3	1	21.3	±2.0	Estimation

Structural Components Mass
778.8g

Electrical Components Mass
207.4g

Total Components Mass
986.2g

Mass Budget Overview

Mass Overview	Plans to Correct Mass	Margin of Error
Our margin for the mass budget can be defined by the equation 1000g - 986.2g = 13.8g	To correct mass, we will increase the infill of a few parts to increase the strength of said parts.	Margin of error sourced from datasheets or slicing software, component's margins of error unable to be found used 10% of mass to calculate.

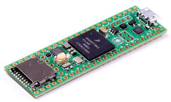
Communication and Data Handling (CDH) Subsystem Design

Tyler Ebner

Payload Command Data Handler (CDH) Overview

#	Component	Role	Com.
1	TEENSY 4.1	Microcontroller, holds and runs flight code	N/A
2	BMP581	Pressure, Altitude and Temperature Sensors	I2C
3	SAM-M8Q	GPS Sensors	I2C
4	BNO085	Measures orientation with 9 DOF	I2C
5	INA260AIPWR	Measures Battery Current and Voltage	I2C
6	XBEE 900HP Pro	Transmits Telemetry Data	UART
7	RunCam Split 4 v2	Records view of the payload and one records the parachute release	UART

1



Source:
ElectroMaker

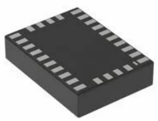
2

Source:
DigiKey

3

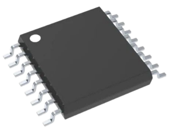
Source:
DigiKey

4



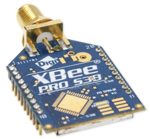
Source:
DigiKey

5



Source
DigiKey

6



Source
XBEE 900HP PRO

7

Source
RunCam

Payload Processor & Memory Trade & Selection (1/2)

Sensor	Boot Time (ms)	Processor Speed (MHz)	Data Interfaces and Amount	RAM (MB)	Flash Memory (MB)	Onboard SD Storage (GB)	Cost (USD)
Raspberry Pi Pico 2	16	133	2 x UART 2 x I2C 2 x SPI	0.52	2	N/A	$5.00
Teensy 4.1	300	600	8 x UART 3 x I2C 3 x SPI	1	8	32	$29.60
ESP32-DEVKITC-32UE	300	240	3 x UART 2 x I2C 3 x SPI	0.52	4	32	$10.00

Selection: Teensy 4.1
- **Fastest Speed**
- **Highest Ram**
- **Best Flash Memory**
- **Includes LED for Power Indication**

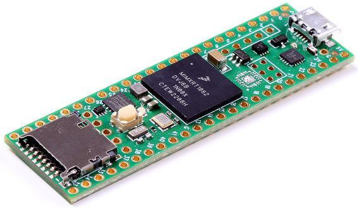


Image Credit: ElectroMaker

Payload Processor & Memory Trade & Selection (2/2)

Figures of Merit	Weight	Raspberry Pi Pico 2		Teensy 4.1		ESP32	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Processor Speed (mHz)	8	2	16	8	64	4	32
RAM (MB)	4	4	16	8	32	4	16
Flash Memory (MB)	2	2	4	8	16	4	8
Cost (USD)	1	8	8	1	1	4	4
Weighted Scores		44		113		60	

Payload Real-Time Clock (1/2)

Sensor	Accuracy (PPM)	Added Mass (g)	Current Draw (mA)	Added Cost (USD)
Onboard clock: Teensy 4.1	±30	+0	100	+0
SAM-M10Q	±0.01	+0	13	+0
Sparkfun DS1307	±75	+2.9	1.5	+8.50

Selection: SAM-M10Q
- **Extremely Accurate**
- **No Extra Mass Added**
- **Uses Satellite Signal for Higher Precision**

Image Credit: DigiKey

Payload Real-Time Clock (2/2)

Figures of Merit	Weight	Teensy 4.1		SAM-M10Q		Sparkfun RTC DS1307	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Accuracy (PPM)	8	2	16	8	64	2	16
Current Draw (mA)	4	2	8	4	16	8	32
Added Mass (g)	2	8	16	8	16	4	8
Added Cost (USD)	1	8	8	8	8	1	1
Weighted Scores		48		104		57	

Payload Antenna Trade & Selection (1/3)

Sensor	Range (km)	Radiation Pattern	Mass (g)	Cost (USD)
Integrated wire	1.6	Omnidirectional	<1	$0.00
Johanson 0915AT43A	0.5	Cardioid	<1	$1.85

Selection: Integrated Wire

- **Good Range**
- **Omnidirectional**
- **Low Mass**
- **No Additional Cost**

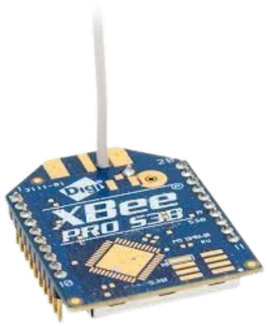


Image Credit: TrustClarity

Payload Antenna Trade & Selection (2/3)

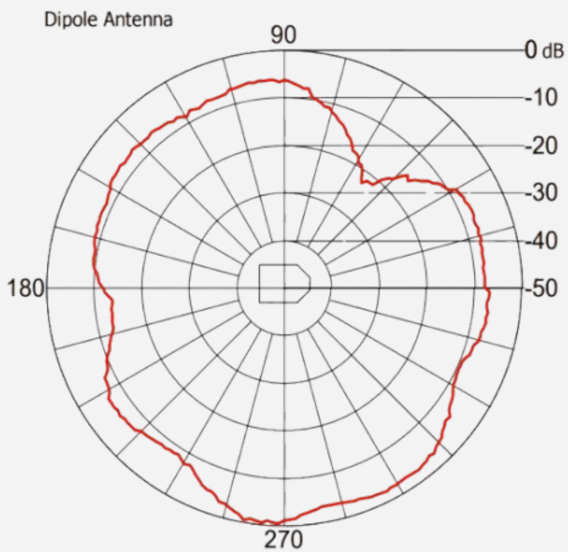
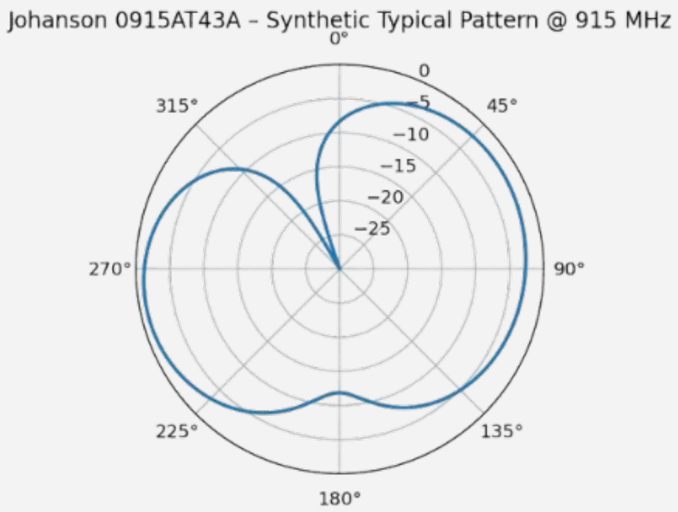
Integrated wire	Johanson 0915AT43A
	

Image Credit: Digi International

Selected Antenna (Integrated wire)

Payload Antenna Trade & Selection (3/3)

Figures of Merit	Weight	Linx ANT-916-CW-HWR		Integrated wire		Johanson 0915AT43A	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Range (km)	8	8	64	4	32	2	16
Radiation Pattern	4	4	16	4	16	1	4
Mass (g)	4	1	4	8	32	8	32
Cost (USD)	1	2	2	8	8	4	4
Weighted Scores		84		88		56	

Payload Radio Configuration

Radio	XBEE 900HP PRO
NETID	1094
Transmission Rate	1 Hz
Start Transmission	CanSat will only start transmission when given the CXON command
End Transmission	CanSat will end transmission either when given CXOFF command or when landing state is reached

XBEE will not be in Broadcast mode

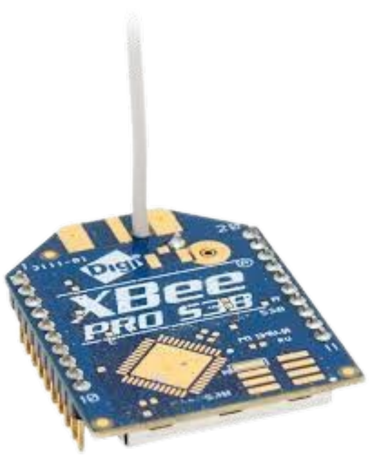


Image Credit: TrustClarity

Payload Telemetry Format (1/5)

Telemetry Format
TEAM_ID,MISSION_TIME,PACKET_COUNT,MODE,STATE,ALTITUDE,TEMPERATURE,PRESSURE,VOLTAGE,CURRENT,GYRO_R,GYRO_P,GYRO_Y,ACCEL_R,ACCEL_P,ACCEL_Y,GPS_TIME,GPS_ALLTITUDE,GPS_LATITUDE,GPS_LONGITUDE,GPS_SATS,CMD_ECHO,,STRB_ANGLE,PORT_ANGLE,VECTOR_PRODUCT

Example Packet (As string)
1094,10:46:07,576,F,ASCENT,68.0,34.3,96.4,5.7,11.87,-1,2,5,2,-1,0,10:46:07,67.4,36.3405,-82.3241,4,CXON,,70,145,1

Payload Telemetry Format (2/5)

Telemetry Requirement	Description	Units and Resolution
TEAM_ID	Four Digit Team Identification Number	1094
MISSION_TIME	Time Since Mission	hh:mm:ss 1 second resolution
PACKET_COUNT	Amount of packets sent by the probe since turned on (Resets by command when put on rocket)	Number of Packets
MODE	Flight Mode and Simulation Mode for Software	'F' or 'S'
STATE	Operating State of the Software	'LAUNCH_PAD', 'ASCENT', 'APOGEE', 'DESCENT', 'PROBE_RELEASE','PAYLOAD_RELEASE', 'LANDED'
ALTITUDE	Altitude Relative to the Ground Level of Launch Site (Determined by Pressure)	0.1 meters

Payload Telemetry Format (3/5)

Telemetry Requirement	Description	Units and Resolution
TEMPERATURE	Internal Temperature of the CanSat	0.1 degrees Celsius
PRESSURE	Air Pressure of the Sensor Used	0.1 kPa
VOLTAGE	Voltage of CanSat Power Bus	0.1 volts
CURRENT	Current from the battery	0.01 amperes
GYRO_R	Gyroscopic Reading of the CanSat from its original position in terms of roll	degrees/seconds
GYRO_P	Gyroscopic reading of the CanSat from its original position in terms of pitch	degrees/seconds

Payload Telemetry Format (4/5)

Telemetry Requirement	Description	Units and Resolution
GYRO_Y	Gyroscopic reading of the CanSat from its original position in terms of yaw	degrees/seconds
ACCEL_R	Accelerometer reading of CanSat in terms of roll	degrees/seconds^2
ACCEL_P	Accelerometer reading of CanSat in terms of pitch	degrees/seconds^2
ACCEL_Y	Accelerometer reading of CanSat in terms of yaw	degrees/seconds^2
GPS_TIME	Time from the GPS receiver	hh:mm:ss
GPS_ALLTITUDE	Altitude from the GPS receiver above average sea level	0.1 meters
GPS_LATITUDE	Latitude from GPS receiver	0.0001 degrees North

Payload Telemetry Format (5/5)

Telemetry Requirement	Description	Units and Resolution
GPS_LONGITUDE	Longitude from GPS receiver	0.0001 degrees West
GPS_SATS	Number of GPS satellites being tracked by GPS receiver	N/A
CMD_ECHO	Last Command received and Processed	N/A
STRB_ANGLE	Angle of the right servo	Degrees
PORT_ANGLE	Angle of the left servo	Degrees
VECTOR_PRODUCT	Vector product of heading and target vectors which is the sin of the error angle	N/A

All Telemetry is in International System of Units

Payload Command Formats (1/2)

Command	Description	Argument	Example
CX	Starts or ends Telemetry	ON OFF	CMD,1094,CX,ON CMD,1094,CX,OFF
ST	Sets Payload time to given time or GPS time in UTC within 1 second	<INPUT> GPS	CMD,1094,ST,##,##,## CMD,1094,ST,GPS
SIM	Starts Simulation mode with ENABLE and ACTIVATE, then ends it with DISABLE	ENABLE ACTIVATE DISABLE	CMD,1094,SIM,ENABLE CMD,1094,SIM,ACTIVATE CMD,1094,SIM,DISABLE
SIMP	Simulates the pressure with the given pressure in pascals (*Only used while in simulation mode*)	<PRESSURE>	CMD,1094,SIMP,######
CAL	Makes the flight software set the telemetered altitude to 0 meters	N/A	CMD,1094,CAL
MEC	Releases the probe from the CanSat or engages it	REL ENG	CMD,1094,MEC,REL CMD,1094,MEC,ENG

Payload Command Formats (2/2)

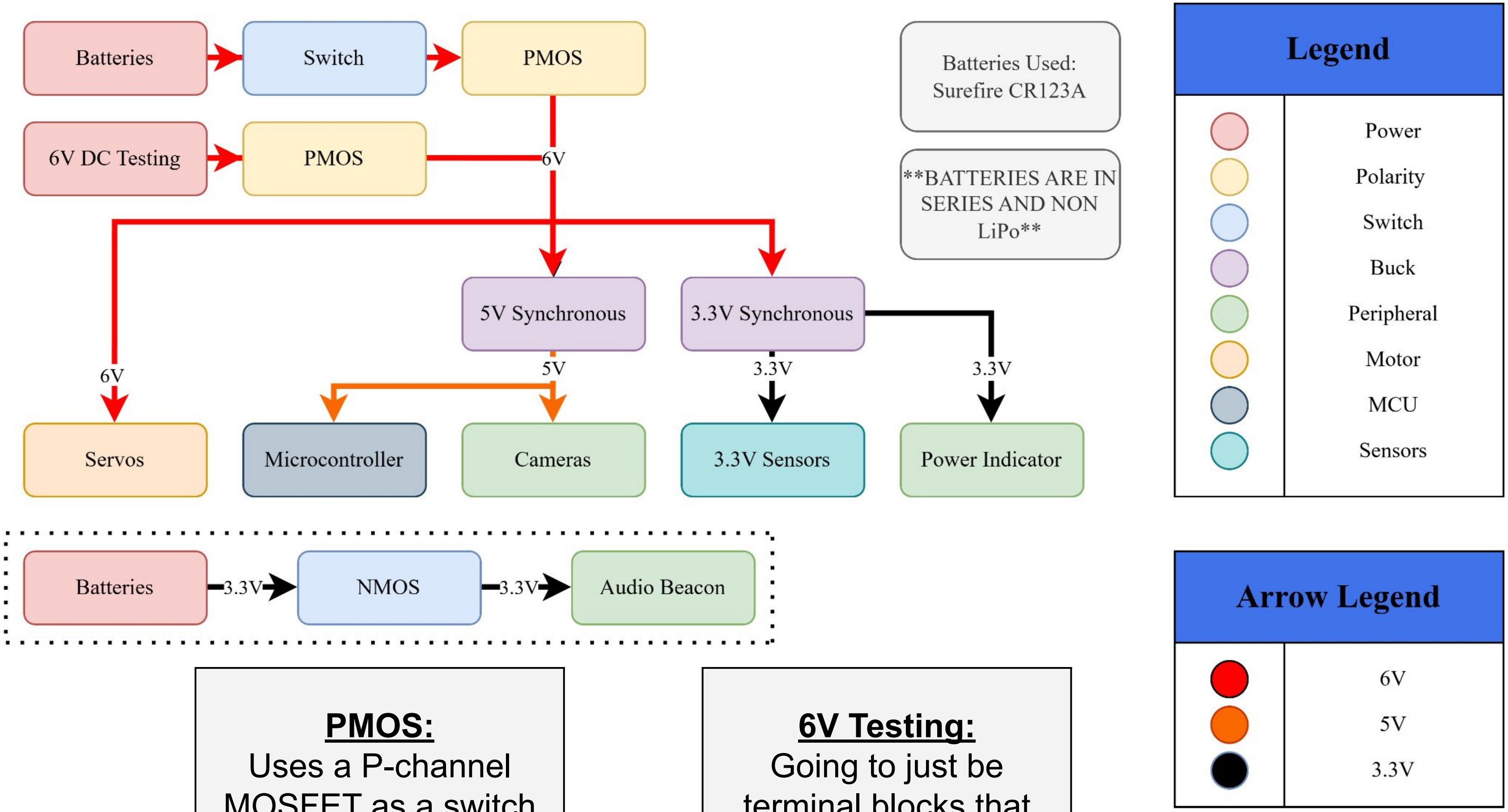
Command	Description	Argument	Example
NOSE	Releases the nose cone (*Only used after MEC command*)	REL ENG	CMD,1094,NOSE,REL CMD,1094,NOSE,ENG
EGG	Releases the payload (*Only used after NOSE command*)	REL ENG	CMD,1094,EGG,REL CMD,1094,EGGENG
LED	Blinks the LED	N/A	CMD,1094,LED
PORT	Turns the left servo by given amount	<DEGREES>	CMD,1094,PORT,##
STRB	Turns the right servo by given amount	<DEGREES>	CMD,1094,STRB,##
MMF	Manually sets the mid mission flag to True (In mission) or False (not in mission)	<TRUE> <FALSE>	CMD,1094,MMF,TRUE CMD1094,MMF,FALSE

All Commands on this slide are of our own design

Electrical Power Subsystem (EPS) Design

Rudra Patel

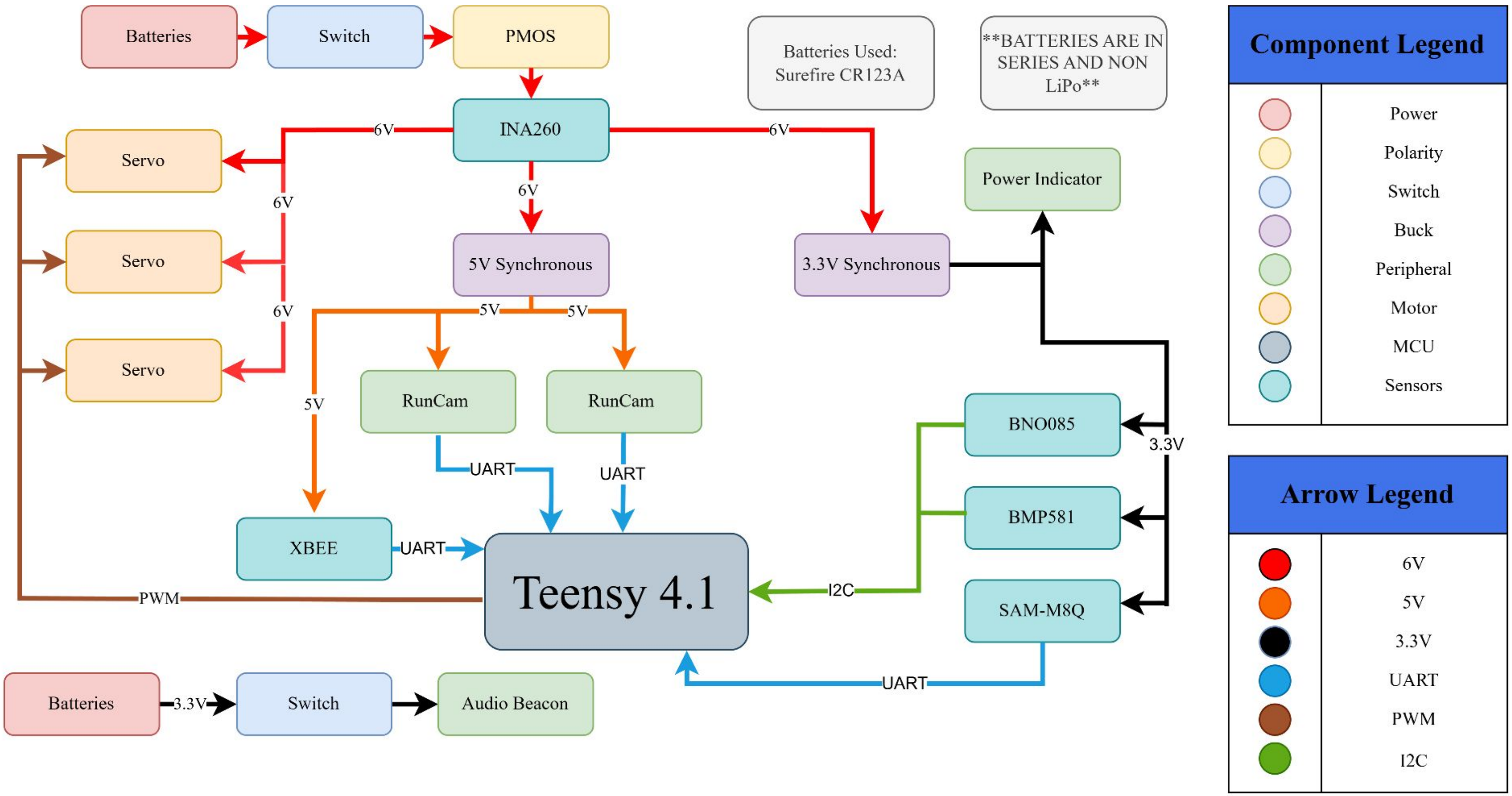
EPS Overview



PMOS:
Uses a P-channel MOSFET as a switch to block current when a power supply is connected backward

6V Testing:
Going to just be terminal blocks that allow us to connect a DC power supply to test our PCB's

Payload Electrical Block Diagram



Power Indicator displays ON/OFF and Switch is easily accessible on PCB

Payload Power Trade & Selection (1/2)

Sensor	Nominal Capacity (mAh)	Capacity (Wh)	Max Current	Quantity	Series or Parallel	Mass (g)	Cost (USD)
Procell PC1500	3125	4.68	~1.5	4	Series	24.7	$0.87
Surefire CR123A	1550	4.65	3	2	Series	17	$3.12
Procell 9V (PC1604)	673	6.057	~0.8	1	Series	48.7	$3.24

Selection: Surefire CR123A
- **Sufficient Capacity**
- **Minimal Quantity**
- **Low Mass**
- **High Current Dump**
- **Moderately Priced**

All Batteries shown are not lithium Polymer

Image Credit: Surefire CR123A

Payload Power Trade & Selection (2/2)

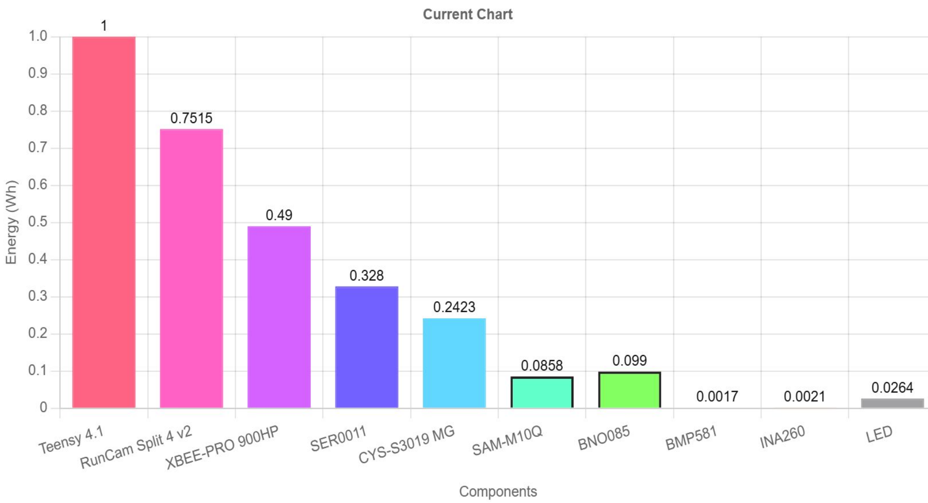
Figures of Merit	Weight	Procell PC1500		Surefire CR123A		Procell 9V (PC1604)	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Max Current (A)	8	1	8	4	32	2	16
Nominal Capacity (mAh)	4	8	32	4	16	2	8
Capacity (Wh)	4	2	8	2	8	4	16
Mass (g)	2	4	8	8	16	2	4
Cost (USD)	1	2	2	2	2	8	8
Weighted Scores		58		74		52	

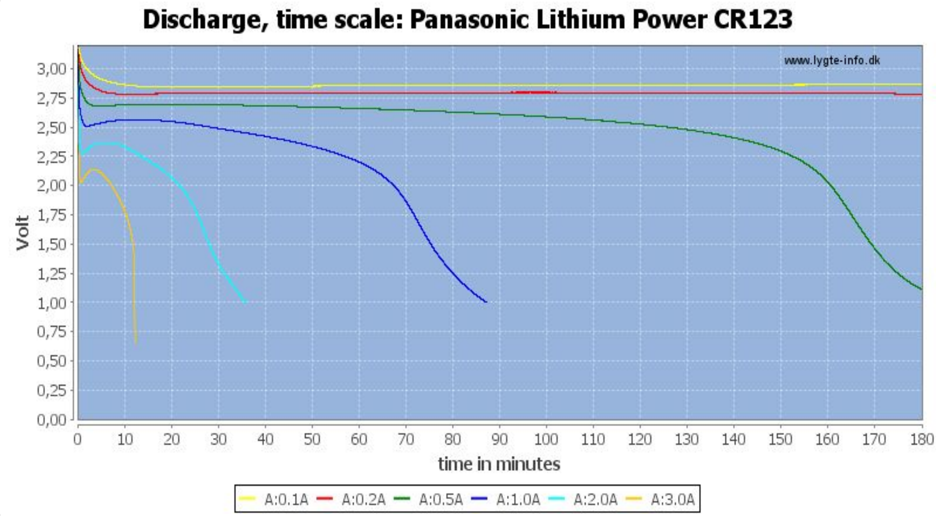
Payload Power Budget (1/3)

Components	Quantity	Voltage (V)	Active Current (mA)	Active Duration (h)	Idle Current (mA)	Idle Duration (h)	Energy (Wh)	Source
Teensy 4.1	1	5	100	2	0	0	1.0000	Datasheet
Runcam Split 4 v2	2	5	450	0.167	0	1.833	0.7515	Datasheet
XBee-PRO 900HP	1	5	215	0.4558	0	1.54	0.4900	Datasheet
SER0011	2	6	450	0.01667	10	1.9833	0.3280	Estimated
CYS-S3019 MG	1	6	700	0.00055	20	1.9994	0.2423	Estimated
SAM-M10Q	1	3.3	13	2	0	0	0.0858	Datasheet
BNO085	1	3.3	15	2	0	0	0.0990	Datasheet
BMP581	1	3.3	0.26	2	0	0	0.0017	Datasheet
INA260	1	3.3	0.31	2	0	0	0.0021	Datasheet
LED	1	3.3	4	2	0	0	0.0264	Calculated
***Assumed 2 Hour Flight Time and Maximum Current Draw XBEE calculation done with actual Duty Cycle using example packet**				Energy Subtotal (Wh)			3.0268	Calculated

Payload Power Budget (2/3)

Energy Consumption Subtotal:	3.0268 Wh
Power Supply Efficiency:	90%
Total Energy Consumption:	3.3631 Wh
Available Battery Energy:	9.3 Wh
Energy Margin:	5.9369 Wh
Remaining Battery Percentage:	63.8%





Buzzer Powered by Surefire CR123A

Components	Quantity	Voltage (V)	Active Current (mA)	Active Duration (h)	Idle Current (mA)	Idle Duration (h)	Energy (Wh)	Source
AI-3035-TWT-3V-R	1	3V	9	1	0	1	0.027	Datasheet
Energy Subtotal (Wh)							0.027	Calculated

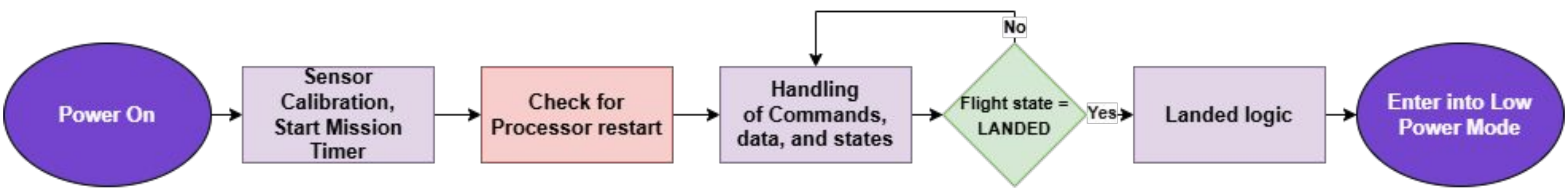
Energy Consumption	Available Battery Energy	Energy Margin	Remaining Battery Percentage
0.027 Wh	4.65 Wh	4.623	99.4%

Flight Software (FSW) Design

Dillard Durham

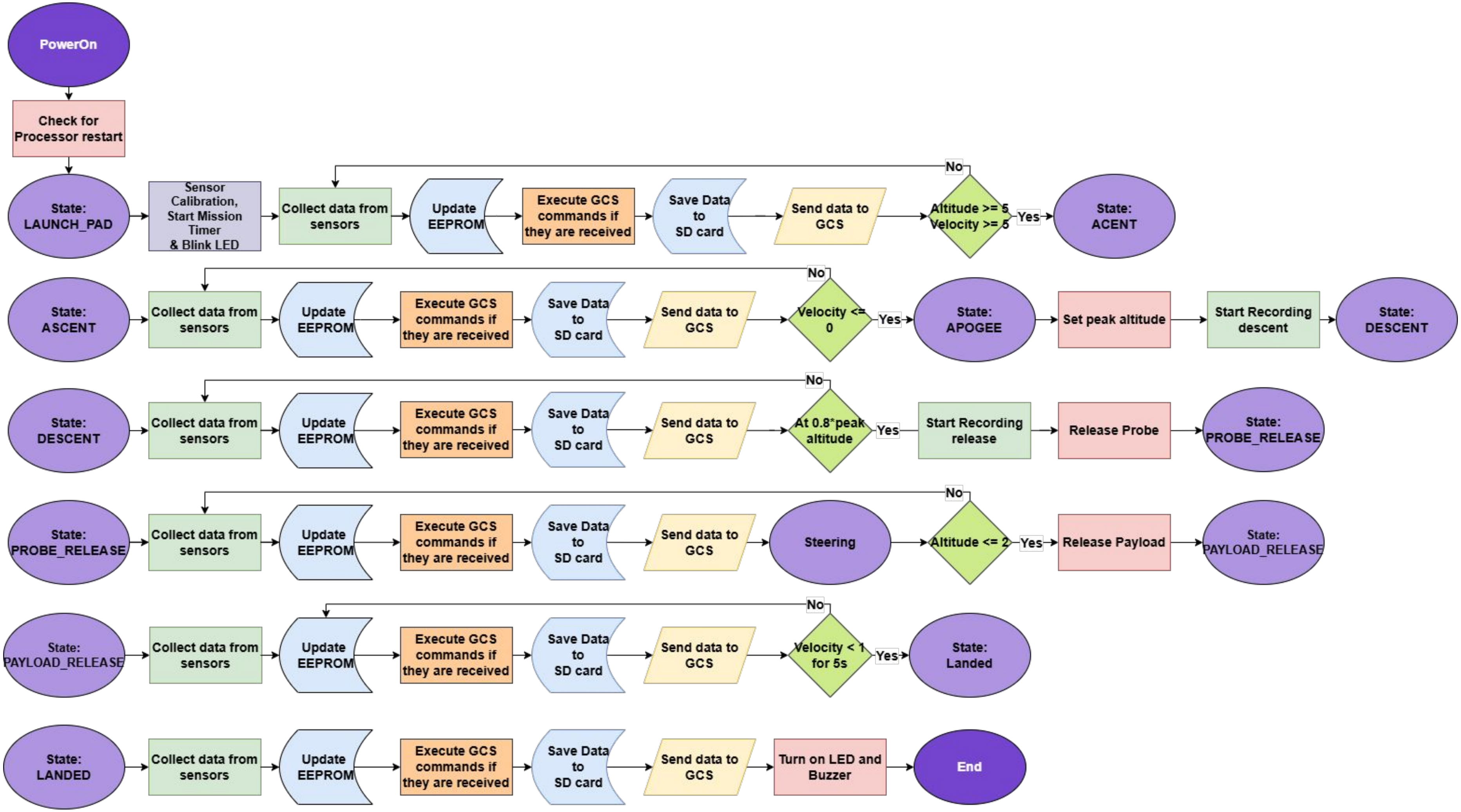
FSW Overview

Start Up	Flight Process	Landing
• Power on All Systems • Boot up Sensors • Check for Processor Restart • Zero Altitude • Await CXON to Begin Telemetry • Turn on LED	• Determine Flight State • Log and Transmit Telemetry Data • Update EEPROM • Release Probe at 80% Apogee	• Activate Recovery Beacon (LED/Buzzer) • Secure Camera Footage and Shutdown • Enter into Low Power Mode

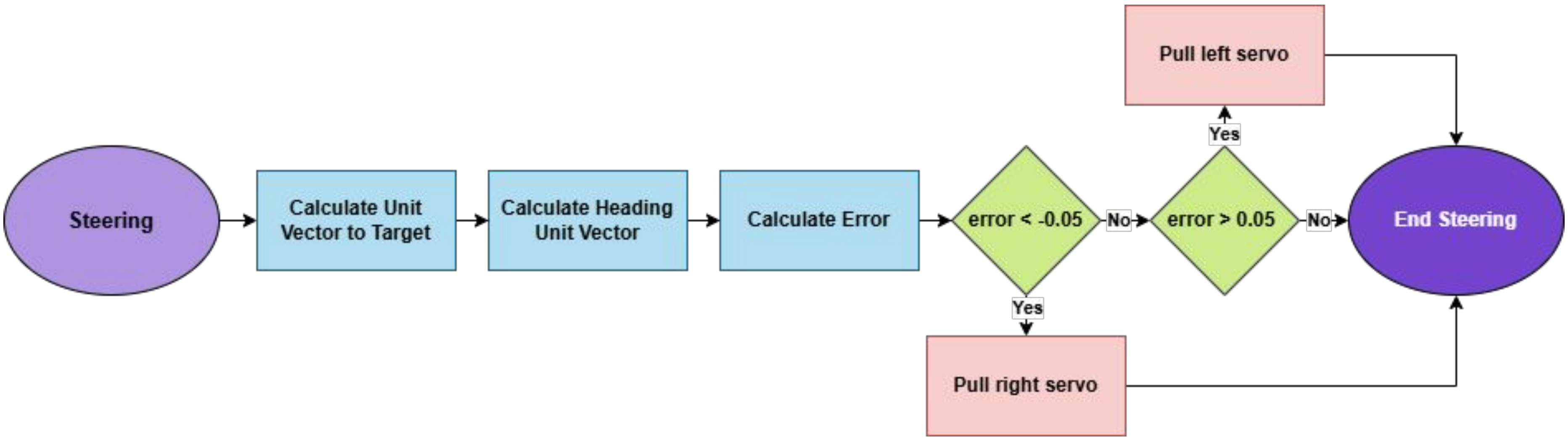


Flight Software is done in Arduino IDE using C++

Payload FSW State Diagram (1/3)



Payload FSW State Diagram (2/3)



If the Cross Product of these equations is negative the CanSat will turn right and if it is positive the CanSat will turn left

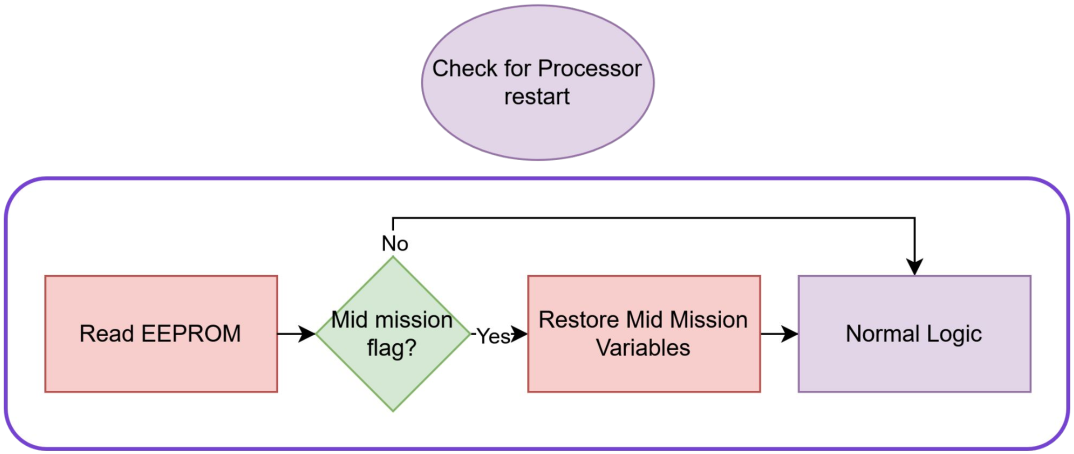
$$\hat{H} = sin(heading)\,\hat{i} + cos(heading)\,\hat{j} + 0\hat{k}$$

$$\hat{T} = T_x\hat{i} + T_y\hat{j} + T_z\hat{k}$$

$$\hat{H} \times \hat{T} = (H_xT_y - H_yT_x)$$

Payload FSW State Diagram (3/3)

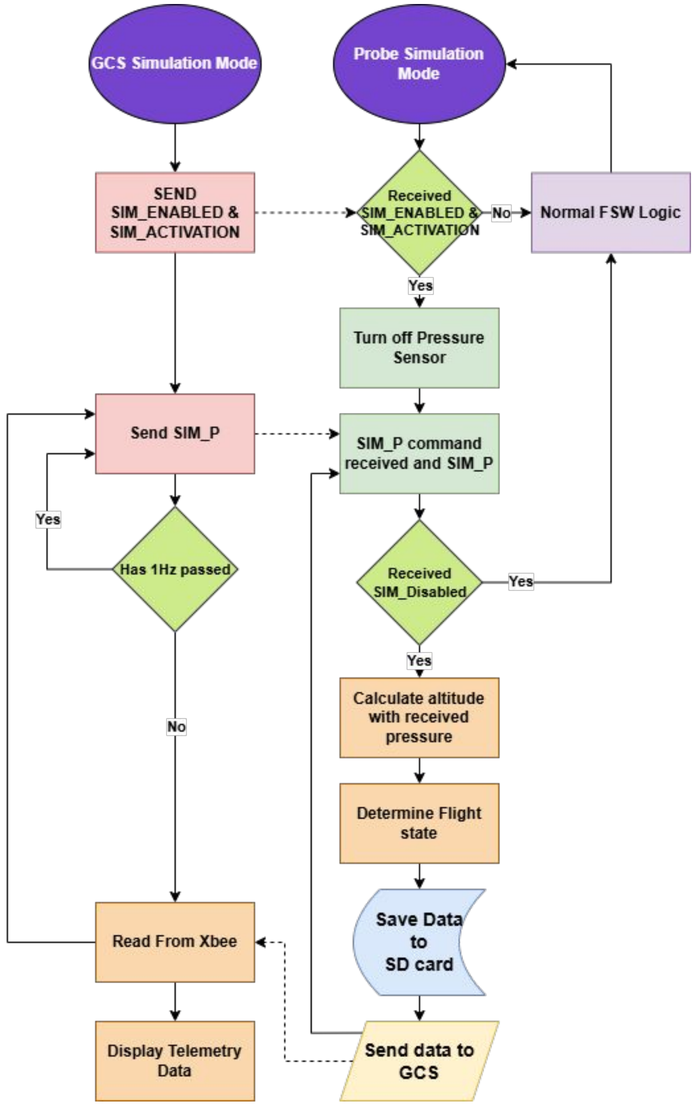
Processor restart	Mid Mission Variables	Data Transmission
• Send and save last 5 Mid Mission Variable packets to EEPROM • Check EEPROM for Mid Mission Flag (Set to true when STATE = ASCENT and false when STATE = LANDED)	• Flight State • Ground Level Pressure • Apogee • Packet Count • Mission Time • Mode • Heading Error	• Sensor data is pulled at 1 Hz • Telemetry data is transmitted every 1 Hz • Telemetry is saved at 1Hz to the onboard SD card • Mid Mission Variables are saved to EEPROM every 1Hz



Simulation Mode Software

Simulation Mode Commands
CMD,1094,SIM,DISABLE
CMD,1094,SIM,ACTIVATE
CMD,1094,SIM,ENABLE
CMD,1094,SIMP,######

SIMP commands will be sent at a rate of 1 Hz
To activate simulation mode, the SIM_ENABLE and SIM_ACTIVATE commands must both be sent and received
To disable simulation mode, the SIM_DISABLE command must be sent and received
The probe collects all other telemetry besides pressure which will be supplemented with SIMP commands from the ground station
Telemetry data will continue to transmit throughout the duration of simulation mode at 1Hz



Software Development Plan

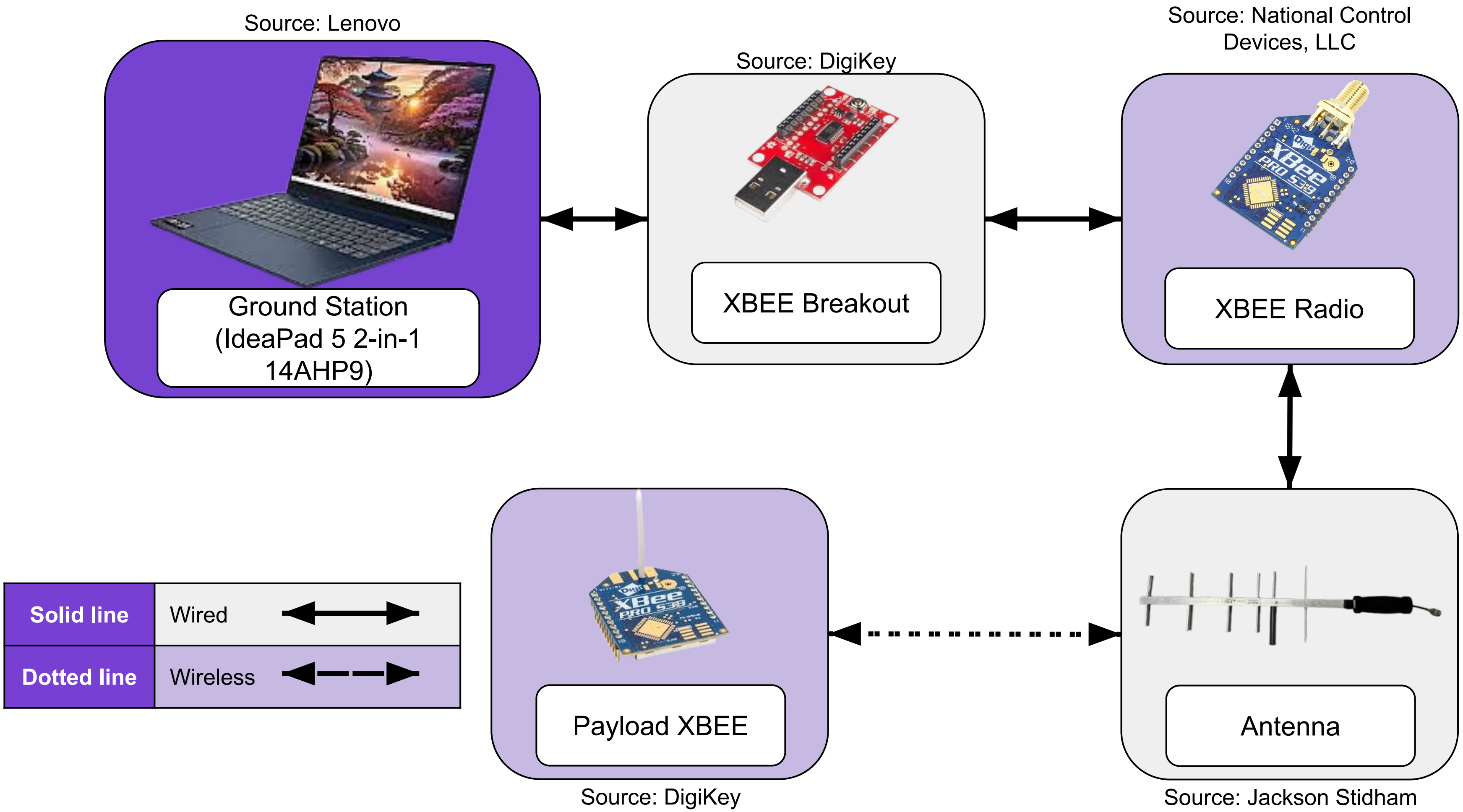
Team	Prototyping	Organization	Test Methodology
Dillard Durham	Arduino IDE (CanSat)	GitHub(Version control)	Focus on early development to maximize testing time
Tyler Ebner	VS code (Ground Station)	Google Drive and Taga (Project Management)	Ensure debugging is completed before scheduled launch

Software Schedule	Start	End	November				December					January			February			March					April				May					June	
			1	7	14	30	1	8	12	21	31	1	5	18	1	14	28	1	7	13	15	31	1	25	27	30	1	11	24	28	31	1	8
Software Flowchart	11/1/25	11/30/25	■	■	■	■																											
Ground Station Prototyping	11/30/25	1/25/26				■	■	■	■	■	■	■	■	■																			
Embedded draft (XBEE and sensors)	1/15/26	2/10/26										■	■	■	■	■																	
Embedded state machine test	2/5/26	2/11/26													■	■																	
Basic ground station test and development	2/11/26	3/15/26														■	■	■	■	■	■												
Ground Station Layout	1/1/26	3/14/26					■	■	■	■	■	■	■	■	■	■	■	■	■	■													
Finish Ground Station and embedded	3/15/26	4/14/26																■	■	■	■	■	■	■									
Testing of Simulation mode and Commands	3/31/26	5/28/26																				■	■	■	■	■	■	■	■	■	■	■	■

Ground Control System (GCS) Design

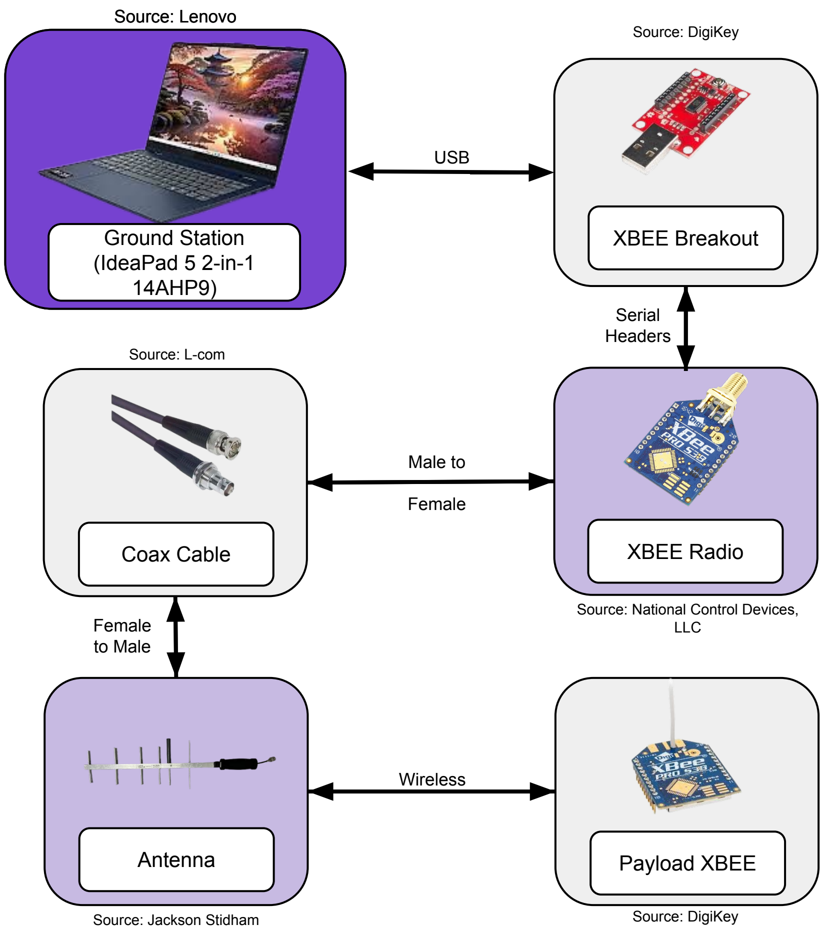
Tyler Ebner and Dillard Durham

GCS Overview



GCS Design

Possible Failure	Prevention Method
Battery Duration	Battery duration 6 Hours (Observed)
Overheating	An umbrella will be brought to keep the laptop out of direct sunlight
Auto Update	The laptop will be checked for updates the day before launch and auto updates will be turned off



GCS Antenna Trade & Selection (1/3)

Sensor	Front-to-Back Ratio (dB)	Radiation Pattern	Gain (dBi)	Frequency Range (MHz)	Horizontal Beamwidth (°)	Vertical Beamwidth (°)	Cost (USD)
Linx Dipole (Rubber Duck)	0	Omnidirectional	2.0	900-935	360	35	$13.75
PC906N	18	Unidirectional	8.5	896–940	65	55	$65.00
L-Com HG909P	15	Unidirectional	9.0	880-960	70	60	$45.00

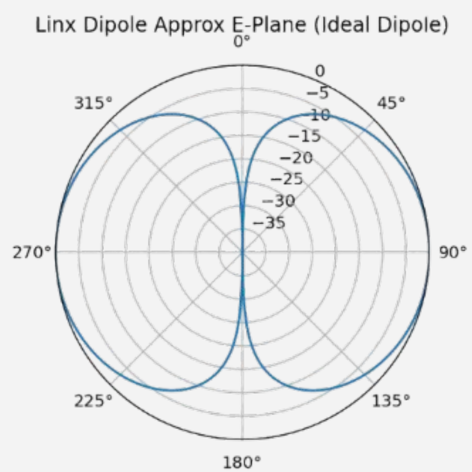
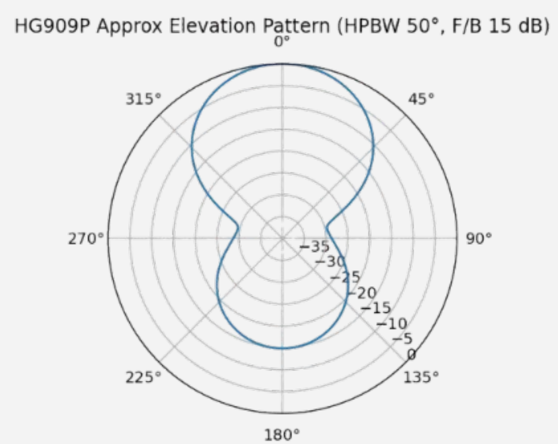
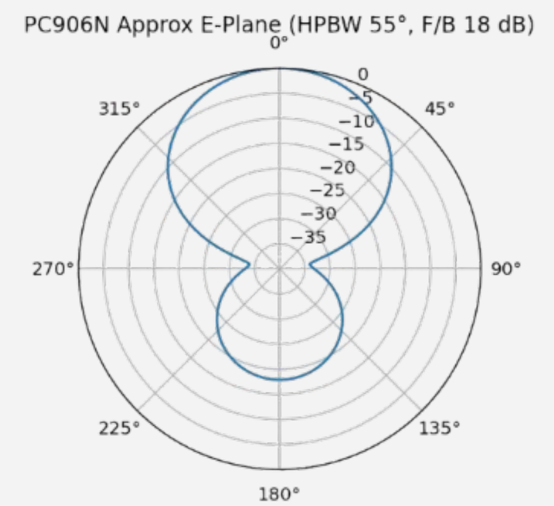
Selection: PC906N

- Good Front-to-Back ratio (directivity and ability to reduce interference)
- Omnidirectional
- Good Gain

All Antenna Shown are handheld

Image Credit: Jackson Stidham

GCS Antenna Trade & Selection (2/3)

Linx Dipole	PC906N	L-Com HG909P
		

Selected Antenna

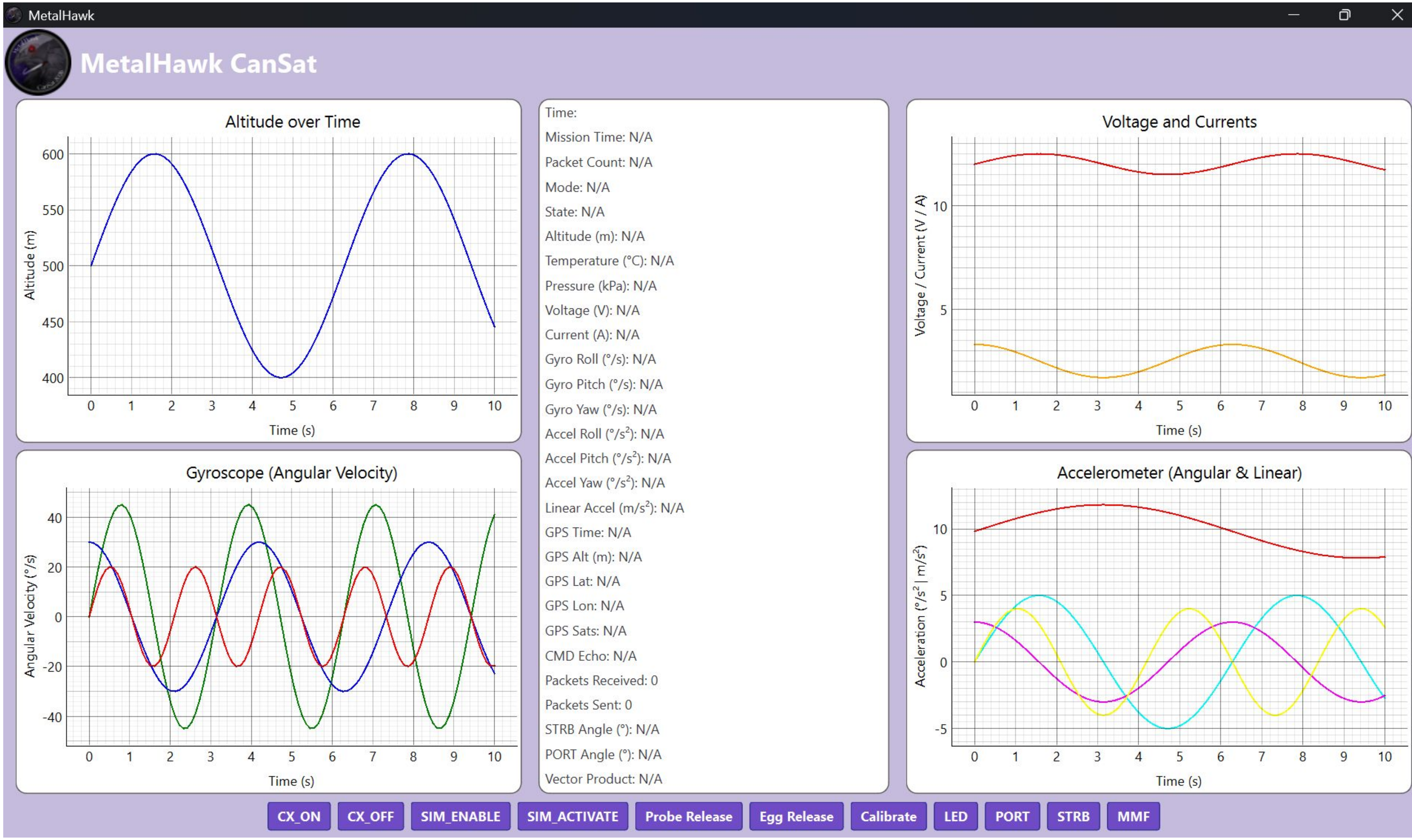
GCS Antenna Trade & Selection (3/3)

Figures of Merit	Weight	Linx Dipole (Rubber Duck)		PC906N		L-Com HG909P	
		Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Radiation Pattern	8	4	32	8	64	8	64
Front-To-Back Ratio	4	2	8	8	32	4	16
Horizontal Beamwidth	4	2	8	8	32	4	16
Vertical Beamwidth	4	2	8	4	16	4	16
Gain	4	2	16	4	4	4	16
Cost (USD)	1	8	8	2	2	4	4
Weighted Scores		80		150		132	

GCS Software (1/2)

Languages and Libraries	Software	Command Software and Interface
• Python 3.13.11 (programming Language) • pyside6 (library) • pyqtgraph (library) • numpy (library)	• Visual Studio Code • Windows • Qt Widgets Designer • pyside6 • Arduino IDE	• Interface will be made using pyside6 • Buttons built for easy use
Real-time Plotting Design	**Telemetry and Recordings**	**Simulation Mode**
• pyqtgraph library used to make plots • Plots with bold traces for easy visibility • Altitude, Battery Voltage, Battery Current, Acceleration and Rotation Rates will be plotted	• Telemetry will be sent at 1Hz and in SI units • Packet count and losses will be saved and displayed • Telemetry will be transferred over to a USB drive for the judges • Telemetry will be saved on onboard SD card in case of radio failure	• SIM mode is activated using the SIM_ENABLE and SIM_ACTIVATE commands • When entered into SIM mode the ground station will prompt for SIMP file • SIMP csv file data will be sent at 1Hz

GCS Software (2/2)



CanSat Integration and Test

Brodie Kirkpatrick

CanSat Integration and Test Overview

Test	Testing Plan	Pass Requirement
Subsystem Level Test	The individual subsystems within the CanSat will be tested to make sure that they can operate	Each subsystem works properly
Integrated level Functional Test	The CanSat will be fully assembled and each part will be tested to ensure that they fit within the the full CanSat	All parts properly fit within the CanSat and can serve their specific function
Environmental Test	CanSat will be put through various tests that simulate the environmental conditions that will be present on launch day	CanSat passes each individual test without major failure
Simulation Test	CanSat will have SIM ENABLE and SIM ACTIVATE commands sent and then a simulation packet will be uploaded	CanSat operates in simulation mode as if it where in normal flight

Subsystem Level Testing Plan (1/2)

Subsystem	Testing Plan	Pass Requirement
Sensors	Run the sensors with software to see if they measure and record data	Sensors measure and record data as expected
CDH	Send commands from the ground station to the CanSat to see if servos move	Command packets need to be sent successfully
EPS	Test power connections with batteries and DC Check specific sections using multimeters and oscilloscope	Batteries need to be able to power the entire CanSat including servos without brownouts, etc
Radio communications	Make sure XBEE's are able to communicate from distance from each other	Ground station and CanSat must communicate packets to each other flawlessly
FSW	Use simulation mode to test if data is being transmitted and collected on the SD card	Telemetry data is collected on the ground station and recorded on the SD card

Subsystem Level Testing Plan (2/2)

Subsystem	Testing Plan	Pass Requirement
Mechanical	All mechanical components will be tested by repeated usage	Components work without failing
Descent Control	The CanSat is tested to verify that it descends properly within the guidelines set out by the mission guide	The CanSat descends properly without failure and is stable

Integrated Level Functional Test Plan

Subsystem	Testing Plan	Pass Requirement
Descent	• Throwing CanSat off high place using simulated weights • Rocket tests 1 and 2	The CanSat shall fall at 5 ± 3m/s
Communication	• Long distance communication • Two-way communication • Optimal Antenna Position • All tested during test launches	Communication is stable at 1000m and still sends and receives packets throughout the flight and 2 hour battery test
Mechanism	• Simulated tests using ground station commands • Altitude tests with vacuum chamber	All release mechanisms work at the correct altitude
Deployment	• Ejection from the rocket • Test Flights 1 and 2	Clean ejection from the rocket without losing power, control, or mechanical function

Environmental Test Plan (1/2)

Test	Method	Description	Requirements
Drop Test	Attached Point Drop	Verifies structural integrity and function by securing the CanSat with a cord to a rigid structure. After powering on and confirming telemetry, the CanSat is raised to height and released	CanSat must not lose power, must continue delivering telemetry, and must not lose any parts/components
Thermal Test	Thermal Chamber	Verifies the CanSat's ability to operate in high-temperature environments. This test is specifically conducted at an elevated 60 degrees Celsius for two hours to ensure no materials warp, weaken, or fail to function	CanSat must stay operational, no materials may be warped or damaged by heat, structural integrity must stay secure
Vibration Test	Orbital Sander	Verifies the mounting integrity of all components, connections, and overall structural strength under significant mechanical stress, simulating launch vibrations	CanSat must not be damaged, all components and parts must remain structurally sound, CanSat data must continue to be transmitted

Environmental Test Plan (2/2)

Test	Method	Description	Requirements
Fit Check	Rocket Model	The CanSat is integrated with a model that has the same dimensions as the rocket used on flight day	The CanSat can fit inside the model and slide back out without difficulty
Vacuum Test	Vacuum Chamber	Verifies the deployment operation of the payload based on simulated altitude changes	All mechanisms must activate correctly, CanSat must deliver and save telemetry data, cameras must be operational

Simulation Test Plan

Test	Description	Requirements
CanSat Mechanism	While running through simulation mode check that all mechanisms release as expected at correct heights	All mechanisms release at the correct time and as expected
Ground Station Display	During simulation mode check if ground station receives and displays all graphs and telemetry data	All graphs display correctly and telemetry data with the CanSat's SD card
Ground Station Commands	Check if commands can be sent to activate simulation mode, run during simulation mode and end simulation mode	Commands send to the CanSat and are working as expected

Mission Operations & Analysis

Tyler Ebner

Overview of Mission Sequence of Events (1/2)

Chronological Order of Events in Descending Order

*Starting at launch day

Event	Team Member(s)
Arrival	Full Team
Check-in of CanSat	Full Team
Ground Station preparation	Ground Station Operators
Pre-Launch Checklist	Full Team
Launch Checklist	CanSat Crew, Ground Station Operators
Data Analysis	Ground Station Operators
Recovery, Return CanSat to Judges	Recovery Crew
Completion of PFR presentation	Full Team

Overview of Mission Sequence of Events (2/2)

Team Member(s)	Assigned Role	Description
Tyler Ebner	Mission Control Officer	Ensures the team follows the proper procedures outlined in the Missions Operations Manual
Brodie Kirkpatrick, Jackson Stidham, Evan Jeanneret, Alex McKinnon, Hayden Peek	CanSat Crew	Prepares the CanSat for launch and integrates it with the rocket
Nora Brady, Clark Peterson	Recovery Crew	Recovers the CanSat after launch and returns it for judging
Dillard Durham, Rudra Patel	Ground Station Operators	Checks the ground station, ensuring it runs properly, as well as handling the antenna connection

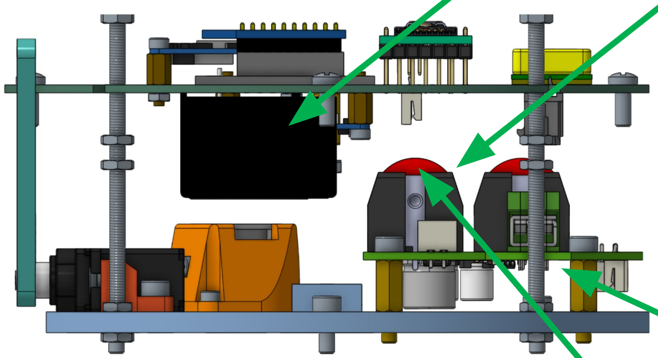
Mission Operations Manual Development Plan

Section	Explanation	Planned Due Date
Team Role Assignment	Assignment of team members to roles for launch day	1/11/26
Ground Station Preparation	Detailed notes on how to prepare the ground station and how to use all components	2/28/26
Pre-Launch Checklist	Checklist explaining the steps needed before launch and what each team member needs to do	2/28/26
Launch Checklist	Explanation of procedures required by team members to launch the CanSat	2/28/26
Recovery Checklist	Checklist detailing what to do once the CanSat has released and the steps to recover it	2/28/26

CanSat Location and Recovery

Component	Visibility
Container	Fluorescent Orange and MetalHawk logo
Visible Beacon	Bright Blue LED
Audio Beacon	100 dB Single Tone Audio
GPS	Real Time Position (Longitude & Latitude)
Team Contact	Phone Number of both team lead and recovery lead, return label address, and email address of team lead. Both on the CanSat and Nose Cone
Team Contact Info: **Tyler Ebner tde0010@uah.edu (678)-719-5875; Dillard Durham dtd0014@uah.edu (202)-770-5012;** **Dr. Gang Wang gang.wang@uah.edu (256)-824-6595** **601 John Wright Dr Huntsville AL 35805**	

CanSat Beacon Design



Audio Beacon

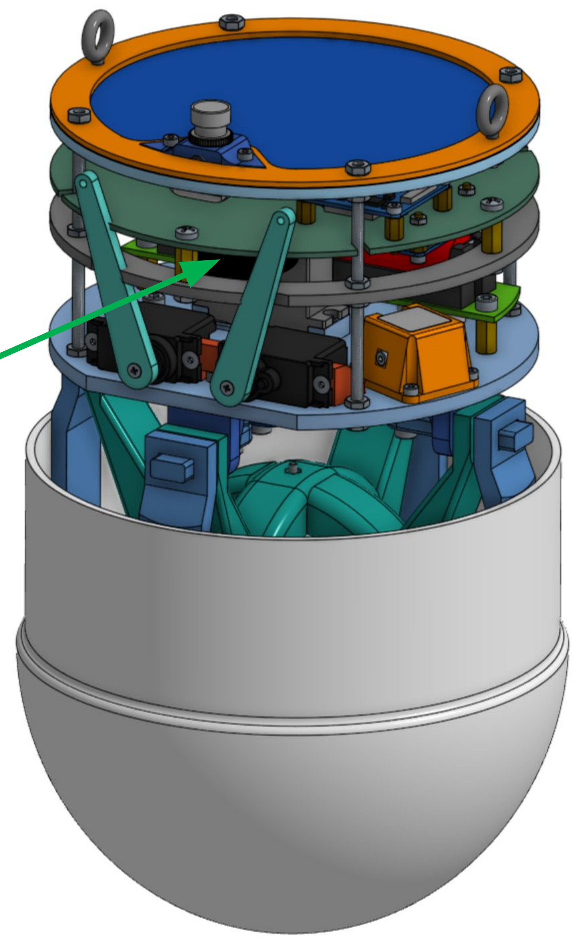
Separate Beacon Battery

Beacon in Full Assembly

Connected by Switch

Battery Retainer

Note: Some Parts are Hidden to Highlight Beacon Design



Requirements Compliance

Tyler Ebner

Requirements Compliance Overview

Compliance of mission guide requirements out of total

Compliance	Partial Compliance	No Compliance
83 out of 89	6 out of 89	0 out of 89

Partial compliance to the mission guide requirements is due to testing being required to acquire the data needed to prove compliance. The majority of mission guide requirements are fully compliant.

Requirements Compliance (1/12)

Rqmt Num	Requirement	Comply / No Comply / Partial	X-Ref Slide(s) Demonstrating Compliance	Team Comments or Notes
C1	The CanSat payload shall function as a nose cone during the rocket ascent portion of the flight.	Comply	32	
C2	The CanSat container shall be mounted on top of the rocket with the shoulder section inserted into the airframe.	Comply	32	
C3	The CanSat payload and container shall be deployed from the rocket when the rocket motor ejection charge fires.	Comply	56, 57	
C4	After deployment, the CanSat payload and container shall descend at 15 meters/second using a parachute that automatically deployed. Error is +/- 3m/s.	Comply	56	
C5	At 80% flight peak altitude, the payload shall be released from the container.	Comply	30	
C6	At 80% peak altitude, the payload shall deploy a para-glider descent control system.	Comply	30	
C7	The payload shall descend at 5 meters/second averaged over the entire descent within +/- 3 meters/sec with the para-glider descent control system.	Comply	56, 57	
C8	The payload shall steer toward a target location.	Comply	27	

Requirements Compliance (2/12)

Rqmt Num	Requirement	Comply / No Comply / Partial	X-Ref Slide(s) Demonstrating Compliance	Team Comments or Notes
C9	The sensor telemetry shall be transmitted at a 1 Hz rate.	Comply	152	
C10	The payload shall record video of the release of the payload from the container and the deployment of the para-glider descent control system.	Comply	24	
C11	A second video camera shall point at the ground.	Comply	24	
C12	The payload shall release a protected hens egg when the payload is 2 meters +/- 0.5 m above the ground without breaking the egg.	Comply	26	
C13	The CanSat payload shall include an audible beacon that is turned on separately and is independent of the CanSat battery and electronics.	Comply	196	
C14	Cost of the CanSat shall be under $1000. Ground support and analysis tools are not included in the cost of the CanSat. Equipment from previous years shall be included in the cost, based on current market value.	Comply	216	

Requirements Compliance (3/12)

Rqmt Num	Requirement	Comply / No Comply / Partial	X-Ref Slide(s) Demonstrating Compliance	Team Comments or Notes
S1	The CanSat and container mass shall be 1000 grams +/- 10 grams.	Partial	141	Measures Will be Taken to Increase
S2	The nose cone shall be symmetrical along the thrust axis.	Comply	15	
S3	Nose cone radius shall be exactly 70 mm.	Comply	29	
S4	Nose cone shoulder length shall be a minimum of 50 mm.	Comply	29	
S5	The nose cone shall be made as a single piece. Segments are not allowed.	Comply	29	
S6	The nose cone shall not have any openings allowing air flow to enter.	Comply	29	
S7	The nose cone height shall be a minimum of 76mm	Comply	29	
S8	CanSat structure must survive 15 Gs vibration.	Partial	N/A	Testing Required
S9	CanSat shall survive 30 G shock.	Partial	N/A	Testing Required
S10	The container shoulder length shall be 90 to 120 mm	Comply	29	
S11	The container shoulder diameter shall be 136mm	Comply	29	

Requirements Compliance (4/12)

Rqmt Num	Requirement	Comply / No Comply / Partial	X-Ref Slide(s) Demonstrating Compliance	Team Comments or Notes
S12	Above the shoulder, the container diameter shall be 140 mm.	Comply	29	
S13	The container wall thickness shall be at least 2 mm when 3D printed and must not flex or be deformed when under pressure.	Comply		Not Applicable
S14	The container length above the shoulder shall be 200mm +/-5%.	Comply	29	
S15	The CanSat shall perform the function of the nose cone during rocket ascent.	Comply	32	
S16	The CanSat container can be used to restrain any deployable part of the CanSat payload but shall allow the CanSat to slide out of the payload section freely.	Comply	31, 32	
S17	All electronics and mechanical components shall be hard mounted using proper mounts such as standoffs, screws, or high performance adhesives.	Comply	134, 135	
S18	The CanSat container shall meet all dimensions in section F.	Comply	29	
S19	The CanSat container materials shall meet all requirements in section F.	Comply	29	

Requirements Compliance (5/12)

Rqmt Num	Requirement	Comply / No Comply / Partial	X-Ref Slide(s) Demonstrating Compliance	Team Comments or Notes
S20	If the nose cone is to separate from the payload after payload deployment, the nose cone shall descent at no more than 5 meters/sec	Comply	56	
S21	If the nose cone is to separate from the payload after payload deployment, the nose cone shall be secured to the payload until payload deployment with a pull force to survive at least 15Gs acceleration.	Partial	N/A	Testing Required
M1	No pyrotechnical or chemical actuators are allowed.	Comply	24, 25	
M2	All mechanisms shall be capable of maintaining their configuration or states under all forces.	Partial	N/A	Testing Required
M3	All mechanisms shall be capable of maintaining their configuration or states under all forces	Partial	N/A	Testing Required
M4	Spring contacts shall not be used for making electrical connections to batteries. Shock forces can cause momentary disconnects.	Comply	24	
E1	Lithium polymer batteries are not allowed.	Comply	161-163	

Requirements Compliance (6/12)

Rqmt Num	Requirement	Comply / No Comply / Partial	X-Ref Slide(s) Demonstrating Compliance	Team Comments or Notes
E2	Battery source may be alkaline, Ni-Cad, Ni-MH or Lithium. Lithium polymer batteries are not allowed. Lithium cells must be manufactured with metal package similar to 18650 cells. Coin cells are allowed.	Comply	161-163	
E3	An easily accessible power switch through the container is required.	Comply	29	
E4	The container shall have small access holes for power switches of no more than 10mm.	Comply	29	
E5	Power indicator is required.	Comply	161-162	
E6	The CanSat shall operate for a minimum of two hours when integrated into the rocket.	Comply	165	
E7	The audio beacon shall operate on a separate battery.	Comply	196	
E8	The audio beacon shall have an easily accessible power switch through the container.	Comply	196	
X1	XBEE radios shall be used for telemetry. 2.4 GHz Series radios are allowed. 900 MHz XBEE radios are also allowed.	Comply	176-177	

Requirements Compliance (7/12)

Rqmt Num	Requirement	Comply / No Comply / Partial	X-Ref Slide(s) Demonstrating Compliance	Team Comments or Notes
X2	Xbee radios shall have their NETID/PANID set to their team number.	Comply	152	
X3	Xbee radios shall not use broadcast mode.	Comply	152	
X4	The CanSat shall transmit telemetry once per second.	Comply	152	
X5	The CanSat telemetry shall include altitude, air pressure, temperature, battery voltage, command echo, and GPS coordinates that include latitude, longitude, altitude and number of satellites tracked.	Comply	153-157, 182	
SN1	CanSat payload shall measure its altitude using air pressure.	Comply	35	
SN2	CanSat payload shall measure its internal temperature.	Comply	37	
SN3	CanSat payload shall measure its battery voltage.	Comply	39	
SN4	CanSat payload shall track its position using GPS.	Comply	41	
SN5	CanSat payload shall measure its acceleration and rotation rates.	Comply	43, 45	

Requirements Compliance (8/12)

Rqmt Num	Requirement	Comply / No Comply / Partial	X-Ref Slide(s) Demonstrating Compliance	Team Comments or Notes
SN6	CanSat payload shall video record the deployment of the para-glider at 80% peak altitude.	Comply	170	
SN7	CanSat payload shall video record the ground during descent.	Comply	170	
SN8	The ground pointing camera shall capture video of the instrument(egg) being released and reaching the ground.	Comply	170	
SN9	The video cameras shall record video in color and with a minimum resolution of 640x480.	Comply	47, 53	
SN10	CanSat payload shall measure its battery current.	Comply	39	
G1	The ground station shall command the CanSat to calibrate the altitude to zero when the CanSat is on the launch pad prior to launch.	Comply	182	
G2	The ground station shall generate csv files of all sensor data as specified in the Telemetry Requirements section.	Comply	181	
G3	Telemetry shall include mission time with 1 second resolution.	Comply	153	
G4	Each team shall develop their own ground station.	Comply	177, 182	

Requirements Compliance (9/12)

Rqmt Num	Requirement	Comply / No Comply / Partial	X-Ref Slide(s) Demonstrating Compliance	Team Comments or Notes
G5	All Telemetry shall be displayed in real time in text format during ascent and descent on the ground station.	Comply	182	
G6	All telemetry shall be displayed in International System of Units (SI) and the units shall be indicated on the displays.	Comply	157, 181	
G7	Teams shall plot altitude, battery voltage, battery current, accelerometer value and rotation rates in real time.	Comply	182	
G8	Teams shall display mission time, temperature, GPS position, received packer count, lost packet count, and flight software state in real time.	Comply	182	
G9	The ground station shall include one laptop computer with a minimum of two hours of battery operation, XBEE radio and an antenna.	Comply	176, 177	
G10	The ground station must be portable so the team can be positioned at the ground station operation site along the flight line. AC power will not be available at the ground station operation site.	Comply	176, 177	

Requirements Compliance (10/12)

Rqmt Num	Requirement	Comply / No Comply / Partial	X-Ref Slide(s) Demonstrating Compliance	Team Comments or Notes
G11	The ground station software shall be able to command the payload to operate in simulation mode by sending two commands, SIMULATION ENABLE and SIMULATION ACTIVE.	Comply	158, 173	
G12	When in simulation mode, the ground station shall transmit pressure data from a csv file provided by the competition at a 1 Hz interval to the CanSat.	Comply	173	
G13	The ground station shall use a table top or handheld antenna.	Comply	178	
G14	Because the ground station must be viewed in bright sunlight, the displays shall be designed with that in mind, including using larger fonts (14 point minimum), bold plot traces and axes, and a dark text on light background theme.	Comply	182	
G15	All data shall be shown simultaneously in the ground station GUI. Tabs are not allowed.	Comply	182	
G16	The ground system shall count the number of received packets. Note that this number is not equivalent to the transmitted packet counter, but it is the count of packets successfully received at the ground station for the duration of the flight.	Comply	182	
G17	The ground station shall be able to activate all mechanisms on command.	Comply	158, 159, 182	

Requirements Compliance (11/12)

Rqmt Num	Requirement	Comply / No Comply / Partial	X-Ref Slide(s) Demonstrating Compliance	Team Comments or Notes
F1	The flight software shall maintain a count of packets transmitted which shall increment with each packet transmission throughout the mission. The value shall be maintained through processor resets.	Comply	154, 172	
F2	The CanSat shall maintain mission time throughout the entire mission even in the event of a processor resets or momentary power loss.	Comply	172	
F3	The CanSat shall have its time set by ground command to within one second UTC time prior to launch.	Comply	158	
F4	The flight software shall support simulated flight mode where the ground station sends air pressure values at a one second interval using a provided flight profile file.	Comply	173, 181	
F5	In simulation mode, the flight software shall use the radio uplink pressure values in place of the pressure sensor for determining the payload altitude.	Comply	173, 181	
F6	The flight software shall only enter simulation mode after it receives the SIMULATION ENABLE and SIMULATION ACTIVATE commands.	Comply	158, 173, 181	

Requirements Compliance (12/12)

Rqmt Num	Requirement	Comply / No Comply / Partial	X-Ref Slide(s) Demonstrating Compliance	Team Comments or Notes
F7	The flight shall include commands to activate all mechanisms. These commands shall be documented in the mission manual.	Comply	158, 159	
F8	Configuration states such as zero altitude calibration software state shall be maintained in the event of a processor reset during launch and mission.	Comply	172	

Management

Tyler Ebner

CanSat Budget – Hardware (1/5)

Name	Team	Price ($)	Quantity	Total ($)	Source	Reuse
828-BMP581CT-ND - Pressure Sensor	Electrical	2.92	2	5.84	Digikey	
296-47777-1-ND - Current Monitor Regulator	Electrical	5.52	2	11.04	Digikey	
1888-1006-1-ND - IMU I2C 32BIT	Electrical	13.05	1	13.05	Digikey	
672-SAM-M10Q-00BCT-ND	Electrical	31.50	1	31.50	Digikey	
668-1204-ND - Buzzer	Electrical	3.38	1	3.38	Digikey	X
296-LMR51430XDDCRCT-ND - Switching Voltage Regulators	Electrical	1.58	2	3.16	Digikey	
WM1798-ND - CONN HEADER	Electrical	1.74	4	6.96	Digikey	
785-1421-1-ND - MOSFET P-30V	Electrical	1.50	2	3.00	Digikey	
MMSZ5242B-FDICT-ND - Diode	Electrical	0.12	5	0.60	Digikey	
36-1051-ND - Battery Holder	Electrical	2.14	3	6.42	Digikey	
36-1018C-ND - Battery Holder Retainer	Electrical	0.85	5	4.25	Digikey	
1738-1232-ND - Mg14 Servo	Electrical	8.62	2	17.24	Digikey	

CanSat Budget – Hardware (2/5)

Name	Team	Price ($)	Quantity	Total ($)	Source	Reuse
679-1877-ND - Switch Slide	Electrical	6.60	2	13.20	Digikey	
SRR1260A-5R6YCT-ND - IND	Electrical	1.23	3	3.69	Digikey	
490-18407-1-ND - Drum Core	Electrical	0.71	4	2.84	Digikey	
732-10955-ND - PCB	Electrical	0.36	2	0.72	Digikey	
728-1053-ND - Lithium Battery	Electrical	2.20	1	4.40	Digikey	
4878-BAT54CT-ND - Diode	Electrical	0.14	4	0.56	Digikey	
448-IRLB8748PBF-ND - MOSFET	Electrical	1.40	2	2.80	Digikey	
311-4.7KJRCT-ND - RES	Electrical	0.10	10	1.00	Digikey	
1276-1044-1-ND - CAP CER 4.7UF	Electrical	0.08	15	1.20	Digikey	
1276-1043-1-ND - CAP CER 0.1UF	Electrical	0.02	15	0.30	Digikey	
1276-1450-1-ND - CAP CER 10UF	Electrical	0.08	15	1.20	Digikey	
WM26387-ND - 8 Rectangular Connectors	Electrical	0.44	4	1.76	Digikey	
WM1837-ND - Socket Contact Tin	Electrical	0.18	50	9.00	Digikey	
AP63205WU-7DICT-ND - Regulator	Electrical	0.71	4	2.84	Digikey	

CanSat Budget – Hardware (3/5)

Name	Team	Price ($)	Quantity	Total ($)	Source	Reuse
4622 - Teensy 4.1	Electrical	31.50	1	31.50	Adafruit	
B08BWWXK49 - Runcam Split 4	Electrical	119.99	2	239.98	Amazon	
SF12-BB - 12 pack of 123A Batteries	Electrical	37.49	1	37.49	Surefire	
22UL1007KITS - Hook Up Wire, 22 AWG	Electrical	21.58	1	21.58	Remington Industries	
20UL1007KITS - Hook Up Wire, 20 AWG	Electrical	25.91	1	25.91	Remington Industries	
B0DZCD4Z9M - TPU	Mechanical	49.99	1	49.99	Amazon	
PA6-CF - Carbon Fiber Nylon Filament	Mechanical	34.39	1	34.39	Bambu Lab	
9396750002 - Mg17 Servo	Mechanical	14.39	1	14.39	Hobbyking	
90024A218 - Steel Threaded Rod	Mechanical	4.80	2	9.60	McMaster-Carr	
3014T45 - Steel Eyebolt 1/4in	Mechanical	3.82	1	3.82	McMaster-Carr	
3040T11- Steel Eyebolt	Mechanical	7.00	2	14.00	McMaster-Carr	
98952A108 - Aluminum Standoffs	Mechanical	0.81	8	6.48	McMaster-Carr	

CanSat Budget – Hardware (4/5)

Name	Team	Price ($)	Quantity	Total ($)	Source	Reuse
B0FGV5K8BT - M2 Hex Screw Set	Mechanical	9.99	1	9.99	Amazon	
B0FGV5FCBN - M3 Hex Screw Set	Mechanical	9.99	1	9.99	Amazon	
B07X7Q55MZ - Kevlar Cord	Mechanical	24.99	1	24.99	Amazon	
1.0 oz HyperD Ripstop Nylon	Mechanical	6.60	3	19.80	RipstopByThe Roll	

CanSat Budget – Hardware (5/5)

Cost Total	
Mechanical Parts Subtotal	$197.44
Electrical Parts Subtotal	$511.41
Total Hardware Cost	$708.85

CanSat Budget – Other Costs

Name	Team	Price ($)	Quantity	Total ($)	Source	Reuse
Ground Station Laptop	Software	869.00	1	869.00	Amazon	X
PC906N Antenna	Software	84.68	1	84.68	Digikey	X
Travel	All	100.00	10	1000.00	N/A	
Food	All	100.00	10	1000.00	N/A	
Housing	All	114.00	10	1140.00	N/A	
Prototyping Materials	All	150	1	150	N/A	

Cost Total	
Other Costs Subtotal	$4,243.68
Total Mission Cost	$4,952.53

Thank you to our Sponsors

Program Schedule Overview

General Schedule	Start	End	November				December					January			February			March					April				May					June	
			1	24	28	30	1	8	12	13	31	1	5	31	1	21	28	1	9	13	15	31	1	25	27	30	1	11	24	28	31	1	8
Team Formation	10/27/25	11/1/25																															
PDR Phase	11/1/25	2/21/26																															
Test Phase 1	2/21/26	3/15/26																															
Test Launch Phase 1	3/7/26	3/8/26																															
CDR Phase	3/16/26	4/25/26																															
Test Phase 2	4/25/26	5/11/26																															
Test Launch Phase 2	5/2/26	5/6/26																															
Enviromental Testing Phase	5/11/26	5/22/26																															
Competition Phase	5/11/26	6/8/26																															

42% Complete with All Task

Detailed Program Schedule (1/4)

General Schedule	Start	End	November				December					January			February			March					April				May					June	
			1	24	28	30	1	8	12	13	31	1	5	31	1	21	28	1	9	13	15	31	1	25	27	30	1	11	24	28	31	1	8
Team Formation	10/27/25	11/1/25																															
MCR Phase	11/1/25	12/1/25																															
Thanksgiving Holiday	11/24/25	11/28/25																															
Fall Finals	12/8/25	12/12/26																															
Christmas Holiday	12/13/25	1/5/26																															
PDR Phase	12/1/25	2/21/26																															
Test Phase 1	2/21/26	3/15/26																															
Test Launch Phase 1	3/7/26	3/8/26																															
Spring Holiday	3/9/26	3/13/26																															
CDR Phase	3/16/26	4/25/26																															
Test Phase 2	4/25/26	5/11/26																															
Spring Finals	4/27/26	5/1/26																															
Test Launch Phase 2	5/2/26	5/6/26																															
Enviromental Testing Phase	5/11/26	5/22/26																															
Competition Phase	5/11/26	6/8/26																															

Detailed Program Schedule (2/4)

Mechanical Gantt Chart

Mechanical Schedule	Start	End	November				December					January			February			March					April				May					June	
			1	24	28	30	1	8	12	13	31	1	5	31	1	21	28	1	9	13	15	31	1	25	27	30	1	11	24	28	31	1	8
Mechanical Design Development	11/1/25	11/20/25																															
Integrate Designs	11/20/25	11/25/25																															
Refine Final Design (PDR)	11/26/25	1/30/26																															
Prototype & Test (Release, Glider, Steering)	1/30/26	2/28/26																															
Complete Assembly for Test Launch 1	2/28/26	3/7/26																															
Refine Final Design (CDR Onward)	3/7/26	4/24/26																															
Updated Assembly for Test Launch 2	4/24/26	5/1/26																															
Fix Issues	5/2/26	5/26/26																															
Final Assembly for Competition	5/26/26	6/4/26																															

Team Members	Brodie Kirkpatrick	Evan Jeanneret	Alex McKinnon
	Clark Peterson	Jackson Stidham	Nora Brady

Electrical Gantt Chart

Electrical Schedule	Start	End	November				December					January			February			March					April				May					June	
			1	7	14	30	1	8	12	21	31	1	5	25	1	15	25	1	7	13	15	31	1	25	27	30	1	11	24	28	31	1	8
Trade Studies	11/1/25	11/30/25	■	■	■	■																											
Block Diagram	11/7/25	11/30/25		■	■	■																											
Power Subsystem	11/7/25	11/30/25		■	■	■																											
Power Budget	11/14/25	11/30/25			■	■																											
Schematic	11/30/25	12/21/25				■	■	■	■																								
PCB Creation/Ordering	12/12/25	1/1/26							■	■	■	■																					
PCB Assembly	1/1/26	1/25/26										■	■	■																			
PCB Reorder/Updates	1/25/26	2/15/26												■	■	■																	
PCB Assembly 2	2/15/26	2/25/26														■	■																
Troubleshooting/Debugging	2/25/26	5/28/25															■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		

Team Members	
	Rudra Patel
	Hayden Peek

Software Gantt Chart

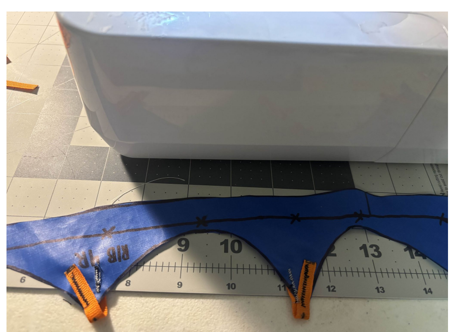
Software Schedule	Start	End	November				December					January			February			March					April				May					June	
			1	7	14	30	1	8	12	21	31	1	5	18	1	14	28	1	7	13	15	31	1	25	27	30	1	11	24	28	31	1	8
Software Flowchart	11/1/25	11/30/25	■	■	■	■																											
Ground Station Prototyping	11/30/25	1/25/26				■	■	■	■	■	■	■	■	■																			
Embedded draft (XBEE and sensors)	1/15/26	2/10/26										■	■	■	■	■																	
Embedded state machine test	2/5/26	2/11/26													■	■																	
Basic ground station test and development	2/11/26	3/15/26														■	■	■	■	■	■												
Ground Station Layout	1/1/26	3/14/26					■	■	■	■	■	■	■	■	■	■	■	■	■	■													
Finish Ground Station and embedded	3/15/26	4/14/26																■	■	■	■	■	■	■									
Testing of Simulation mode and Commands	3/31/26	5/28/26																				■	■	■	■	■	■	■	■	■	■	■	■

Team Members	
	Dillard Durham
	Tyler Ebner

Conclusions (1/4)

Mechanical Conclusions

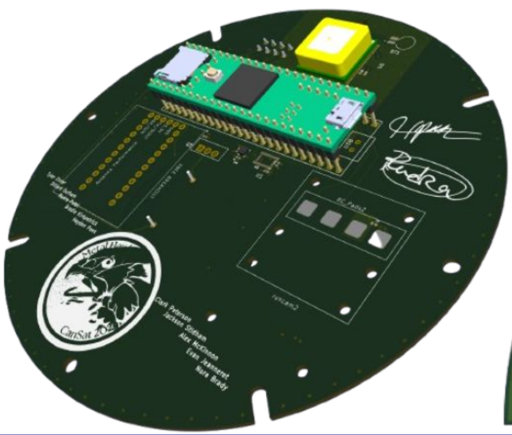
Accomplishments	Work to be Done	Why we are ready to move on to the next stage of development
• Successfully Designed a High Fidelity CAD Model • Created and Tested a Paraglider Prototype and Egg Protector	• Manufacture and Assemble Physical CanSat • Test Critical Parts (Release and Descent Control Mechanisms)	Mechanical has a Design that Meets all Requirements thus Far and is Ready to Manufacture a Prototype

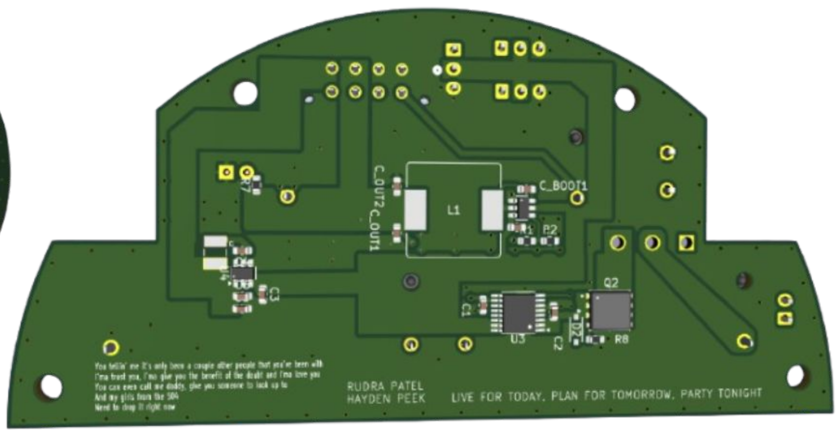


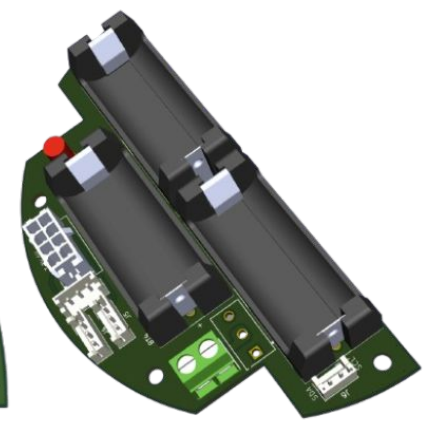
Conclusions (2/4)

Electrical Conclusions

Accomplishments	Work to be Done	Why we are ready to move on to the next stage of development
• Successfully Designed and Ordered Two Working Printed Circuit Boards • Created A Clear, Well-Organized Schematic	• Soldering components and Testing the PCB's • Work on Any Possible Improvements for the Boards	Electrical Has Completed All Requirements Thus Far and is Ready To Move Onto Soldering and Manufacturing

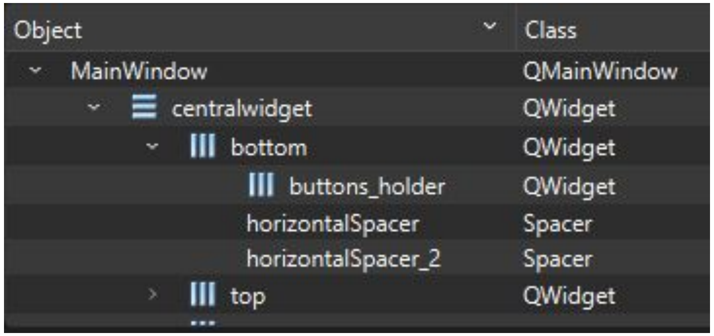


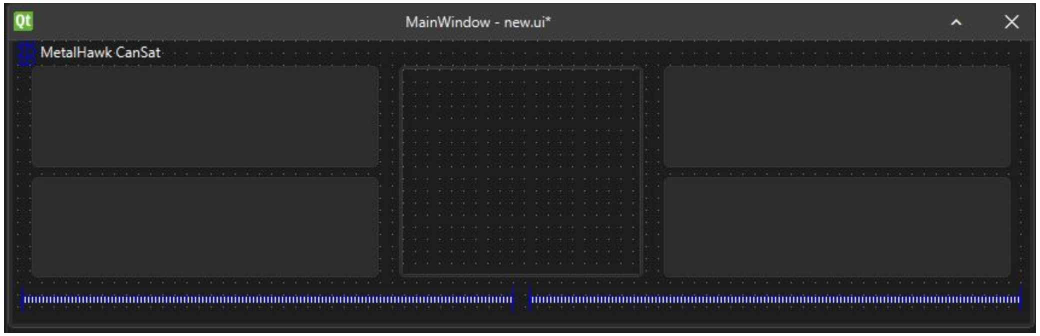




Software Conclusions

Accomplishments	Work to be Done	Why we are ready to move on to the next stage of development
• Ground station is Nearing Completion • Ground Station Styling is Approaching Visual Concept • Embedded Prototype and concept code is completed	• Finalize Ground Station Software • Implement Embedded • Test with Electrical Sensors and PCB • Test XBEE Communication	Software has Successfully Fulfilled all Mission Requirements and is on Track with the Competition





Conclusions (4/4)

General Conclusions

Accomplishments	Work to be Done	Why we are ready to move on to the next stage of development
Significant progress has been made on all three sub teams in accordance with the mission guide, test launches and practice flights have been scheduled	Testing is planned to be done, we will be preparing for own test launch to further test our hardware and software	The team is currently operating ahead of the projected timeline. With all subteam deliverables complete, we have already transitioned into the testing phase. This early validation provides the confidence needed to move into CDR with a head start