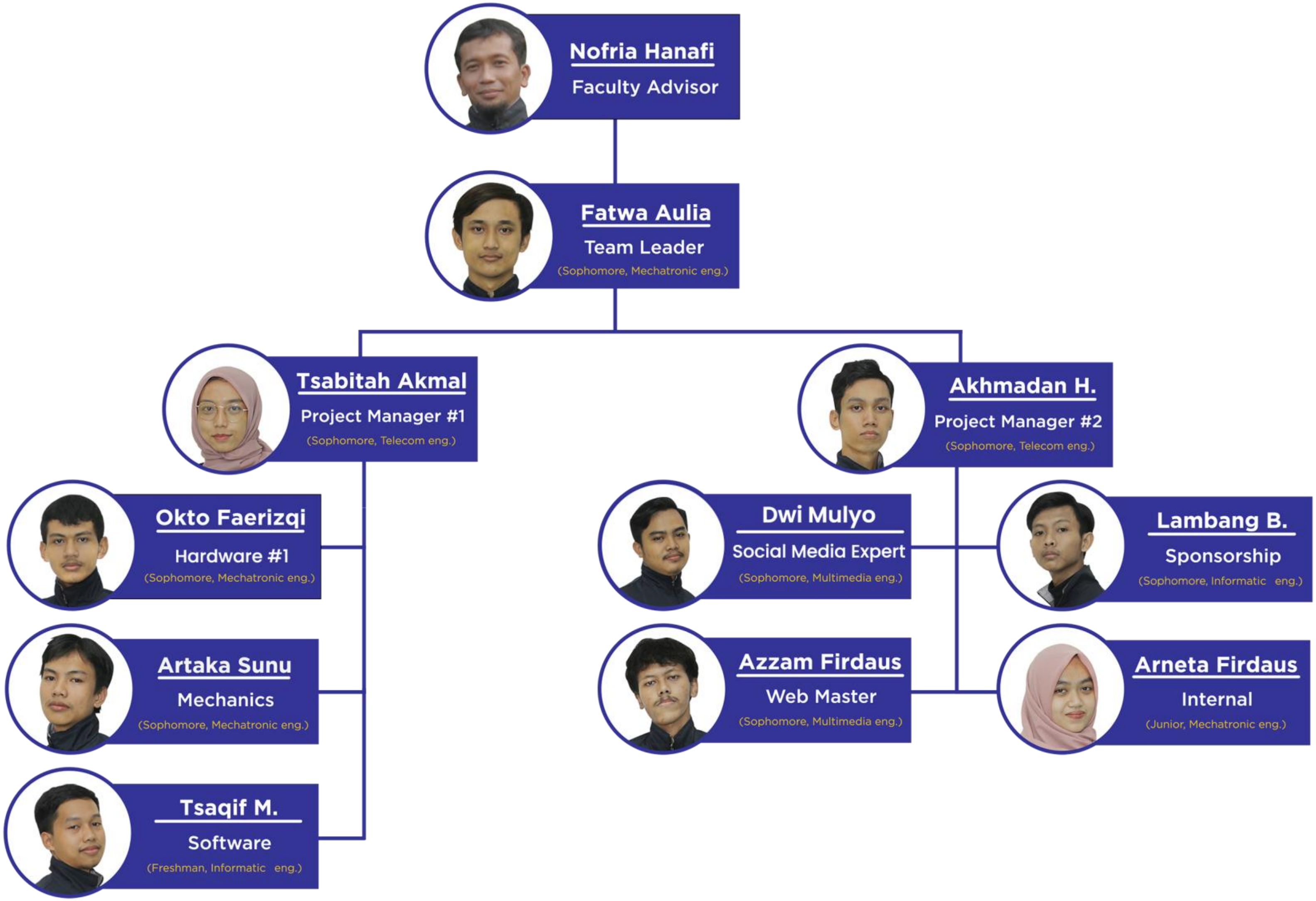
CanSat 2023
Critical Design Review (CDR)
Outline
Version 1.0

#1085

Bamantara EEPISAT

Presentation Outline

Team Organization



Acronyms

Acronyms	Definition
3D	Three Dimensional
ABS	Acrylonitrile Butadiene Styrene
AC	Alternating Current
ADC	Analog to Digital Converter
BM	Bonus Mission
CAD	Computer Aided Design
CDH	Communication Data Handling
CONOPS	Concept of Operation
CSV	Comma Separated Value
dB	Decibel
dBi	Decibel Isotropic
DC	Direct Current
DoF	Degree of Freedom
EPS	Electrical Power System
FSW	Flight Software
GCS	Ground Control Station
GND	Ground
GPIO	General Peripheral Input Output
GPS	Global Positioning System
Hz	Hertz
I/O	Input/Output
I2C	Inter-Integrated Circuit
IDE	Integrated Development Environment
MCU	Microcontroller Unit
PCB	Printed Circuit Board
PFR	Post Flight Review
PLA	Polylactic Acid
PWM	Pulse Width Modulation
RAM	Random Access Memory
RN	Requirement Number
RP-SMA	Reverse Polarity SMA
RTC	Real Time Clock
SD	Secure Digital
SPI	Serial Peripheral Interface
UART	Universal Asynchronous Receiver/Transmitter(Serial)
UTC	Universal Time Coordinated
XCTU	Next Generation Configuration Platform for XBEE/RF Solution

Acronyms	Verification Methods
A	Analysis
I	Inspection
T	Test
D	Demonstration

Systems Overview

Tsabitah Akmal Al Mumtazah

Mission Summary

Main Objectives

The mission is to simulate the landing sequence of a planetary probe

- Design a CanSat that shall consist of a container and a payload
- The CanSat shall be launched to an altitude ranging from 670 meters to 725 meters above the launch site and deployed near apogee
- After CanSat is deployed from the rocket, the CanSat shall descent using a parachute at a rate of 15 m/s
- At 500 meters, the CanSat shall release a payload that shall open a heat shield that will also be used as an aerobraking device with a descent rate of 20 m/s or less
- After the payload reaches 200 meters, the payload shall deploy a parachute and slow the descent rate to 5 m/s
- Once the payload has landed, it shall attempt to upright itself and raise a flag 500 mm above the base of the payload
- A video camera shall be included and point toward the ground during descent

Bonus Objectives

A video camera shall be integrated into the container and point toward the payload

- The camera shall record the event when the payload is released from the container
- Video shall be in color with a minimum resolution of 640x480 pixels and a minimum of 30 frames per second
- The video shall be recorded and retrieved when the container is retrieved

External Objectives

- We have the intention to acquire first place in CanSat Competition 2023
- To increase experience through any engineering project, adapt to the teamwork environment, and implement project and time management

Summary of Changes Since PDR (1/2)

Section	Part	PDR	CDR	Rationale
Electrical Power Subsystem	**Payload 5V Supply**	5V voltage regulator	Buck converter	Provide more efficiency of power
Mechanical Subsystem Design	**Bottom Lid Locking Mechanism**	Door with torsion spring	Velcro Locking door	Easy manufacturing process
	Bottom Holder	It doesn't exist	Bottom holder	To prevent the payload from getting stuck in the container when release
	DC Motor Bracket	Compatible with small motor and gearbox	Compatible with bigger motor and gearbox	The new version provides more torque to reduce the risk of stuck
	Flagpole Holder	Spring Without Holder	Spring With Holder	More sturdy and increase durability of Flagpole Holder
Descent Control Design	**There were no changes to the Sensor Subsystem Design**			

Summary of Changes Since PDR (2/2)

Section	Part	PDR	CDR	Rationale
Sensor Subsystem Design	**There were no changes to the Sensor Subsystem Design**			
Communication Data Handling	**There were no changes to the Communication and Data Handling Subsystem Design**			
Flight Software	**There were no changes to the Flight Software Design**			
Ground Control System	**GCS GUI**	Graph is using Livecharts2.Net Library	Graph is using ScottPlot library	A failure can occur when attempting to display real-time data that is delayed when being plotted
	Antenna	Antenna is using Moxon Antenna	Antenna is using Moxon-Yagi Antenna	Improve the design and quality of antenna to minimize data loss

System Requirement Summary (1/6)

RN	Requirement	Reasons	Priority	Verification			
				A	I	T	D
1	Total mass of the CanSat (science probe and container) shall be 700 grams +/- 10 grams.	Competition Requirement	High	✓	✓	✓	
2	CanSat shall fit in a cylindrical envelope of 125 mm diameter x 400 mm length. Tolerances are to be included to facilitate container deployment from the rocket fairing.	Competition Requirement	High		✓	✓	
3	The container shall not have any sharp edges to cause it to get stuck in the rocket payload section which is made of cardboard.	Competition Requirement	High		✓		
4	The container shall be solid and fully enclose the science probes. Small holes to allow access to turn on the science probes are allowed. The end of the container where the probe deploys may be open.	Competition Requirement	High		✓	✓	
5	The rocket airframe shall not be used to restrain any deployable parts of the CanSat.	Competition Requirement	High		✓		
6	The rocket airframe shall not be used as part of the CanSat operations.	Competition Requirement	High		✓		
7	The container's first parachute shall not be enclosed in the container structure. It shall be external and attached to the container so that it opens immediately when deployed from the rocket.	Competition Requirement	High		✓	✓	✓
8	The descent rate of the CanSat (container and science probe) shall be 15 meters/second +/- 5 m/s.	Competition Requirement	High	✓		✓	
9	0 altitude reference shall be at the launch pad.	Competition Requirement	High			✓	

System Requirement Summary (2/6)

RN	Requirement	Reasons	Priority	Verification			
				A	I	T	D
10	All structures shall be built to survive 15 Gs of launch acceleration.	Competition Requirement	High		✓	✓	✓
11	All structures shall be built to survive 30 Gs of shock.	Competition Requirement	High		✓	✓	✓
12	All electronics and mechanical components shall be hard mounted using proper mounts such as standoffs, screws, or high performance adhesives.	Competition Requirement	High		✓	✓	
13	All mechanisms shall be capable of maintaining their configuration or states under all forces.	Competition Requirement	High			✓	
14	Mechanisms that use heat (e.g., nichrome wire) shall not be exposed to the outside environment to reduce potential risk of setting vegetation on fire.	Competition Requirement	High		✓		
15	XBEE radios shall be used for telemetry. 2.4 GHz Series radios are allowed. 900 MHz XBEE radios are also allowed.	Competition Requirement	High	✓	✓	✓	
16	XBEE radios shall have their NETID/PANID set to their team number.	Competition Requirement	High		✓	✓	
17	XBEE radios shall not use broadcast mode.	Competition Requirement	High		✓	✓	
18	The container (if needed) and probe shall include an easily accessible power switch that can be accessed without disassembling the cansat and science probes and in the stowed configuration.	Competition Requirement	High		✓		✓

System Requirement Summary (3/6)

RN	Requirement	Reasons	Priority	Verification			
				A	I	T	D
19	The probe shall include a power indicator such as an LED or sound generating device that can be easily seen or heard without disassembling the cansat and in the stowed state.	Competition Requirement	High		✓		✓
20	An audio beacon is required for the probe. It shall be powered after landing.	Competition Requirement	High				✓
21	The audio beacon shall have a minimum sound pressure level of 92 dB, unobstructed.	Competition Requirement	High		✓	✓	
22	Battery source may be alkaline, Ni-Cad, Ni-MH or Lithium. Lithium polymer batteries are not allowed. Lithium cells must be manufactured with a metal package similar to 18650 cells. Coin cells are allowed.	Competition Requirement	High		✓		
23	An easily accessible battery compartment shall be included allowing batteries to be installed or removed in less than a minute and not require a total disassembly of the CanSat.	Competition Requirement	High		✓	✓	
24	Spring contacts shall not be used for making electrical connections to batteries. Shock forces can cause momentary disconnects.	Competition Requirement	High		✓	✓	
25	The CanSat shall operate during the environmental tests laid out in Section 3.5.	Competition Requirement	High	✓	✓	✓	✓
26	The CanSat shall operate for a minimum of two hours when integrated into the rocket.	Competition Requirement	High	✓	✓	✓	✓
27	The probe shall be released from the container when the CanSat reaches 500 meters.	Competition Requirement	High	✓		✓	

System Requirement Summary (4/6)

RN	Requirement	Reasons	Priority	Verification			
				A	I	T	D
28	The probe shall deploy a heat shield after leaving the container.	Competition Requirement	High	✓		✓	
29	The heat shield shall be used as an aerobrake and limit the descent rate to 20 m/s or less.	Competition Requirement	High	✓		✓	
30	At 200 meters, the probe shall release a parachute to reduce the descent rate to 5 m/s +/- 1m/sec.	Competition Requirement	High	✓		✓	
31	Once landed, the probe shall upright itself.	Competition Requirement	High	✓		✓	
32	After uprighting, the probe shall deploy a flag 500 mm above the base of the probe when the probe is in the upright position.	Competition Requirement	High	✓		✓	
33	The probe shall transmit telemetry once per second.	Competition Requirement	High		✓	✓	
34	The probe telemetry shall include altitude, air pressure, temperature, battery voltage, probe tilt angles, command echo, and GPS coordinates that include latitude, longitude, altitude and number of satellites tracked.	Competition Requirement	High	✓	✓	✓	✓
35	The probe shall include a video camera pointing down to the ground.	Competition Requirement	High	✓	✓	✓	
36	The video camera shall record the flight of the probe from release to landing.	Competition Requirement	High	✓	✓	✓	✓

System Requirement Summary (5/6)

RN	Requirement	Reasons	Priority	Verification			
				A	I	T	D
37	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.	Competition Requirement	High	✓		✓	✓
38	The probe shall maintain mission time throughout the whole mission even with processor resets or momentary power loss.	Competition Requirement	High	✓		✓	✓
39	The probe shall have its time set to within one second UTC time prior to launch.	Competition Requirement	High		✓	✓	
40	The probe 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 csv file.	Competition Requirement	High	✓	✓	✓	✓
41	In simulation mode, the flight software shall use the radio uplink pressure values in place of the pressure sensor for determining the payload altitude.	Competition Requirement	High			✓	✓
42	The payload flight software shall only enter simulation mode after it receives the SIMULATION ENABLE and SIMULATION ACTIVATE commands.	Competition Requirement	High		✓	✓	✓
43	The ground station shall command the CanSat to start calibrating the altitude to zero when the CanSat is on the launch pad prior to launch.	Competition Requirement	High			✓	
44	The ground station shall generate csv files of all sensor data as specified in the Telemetry Requirements section.	Competition Requirement	High		✓	✓	✓
45	Telemetry shall include mission time with 0.01 second or better resolution.	Competition Requirement	High			✓	

System Requirement Summary (6/6)

RN	Requirement	Reasons	Priority	Verification			
				A	I	T	D
46	Configuration states such as zero altitude calibration shall be maintained in the event of a processor reset during launch and mission.	Competition Requirement	High		✓	✓	
47	Each team shall develop their own ground station.	Competition Requirement	High	✓	✓	✓	
48	All telemetry shall be displayed in real time during descent on the ground station.	Competition Requirement	High	✓	✓	✓	✓
49	Teams shall plot each telemetry data field in real time during flight.	Competition Requirement	High		✓	✓	
50	The ground station shall include one laptop computer with a minimum of two hours of battery operation, XBEE radio and a hand-held antenna.	Competition Requirement	High		✓	✓	
51	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.	Competition Requirement	High		✓		
52	The ground station software shall be able to command the payload to operate in simulation mode by sending two commands, SIMULATION ENABLE and SIMULATION ACTIVATE.	Competition Requirement	High		✓	✓	
53	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.	Competition Requirement	High	✓	✓	✓	✓
BM	A video camera shall be integrated into the container and point toward the payload. The camera shall record the event when the payload is released from the container.	Mission Guide	High	✓	✓	✓	✓

System Concept of Operations (CONOPS) (1/3)

Pre-Launch

- Arrive at the launch site
- GCS and antenna setup
- Sensor system calibration and communication with the GCS command
- Final CanSat check completed
- Activate and load CanSat into a rocket

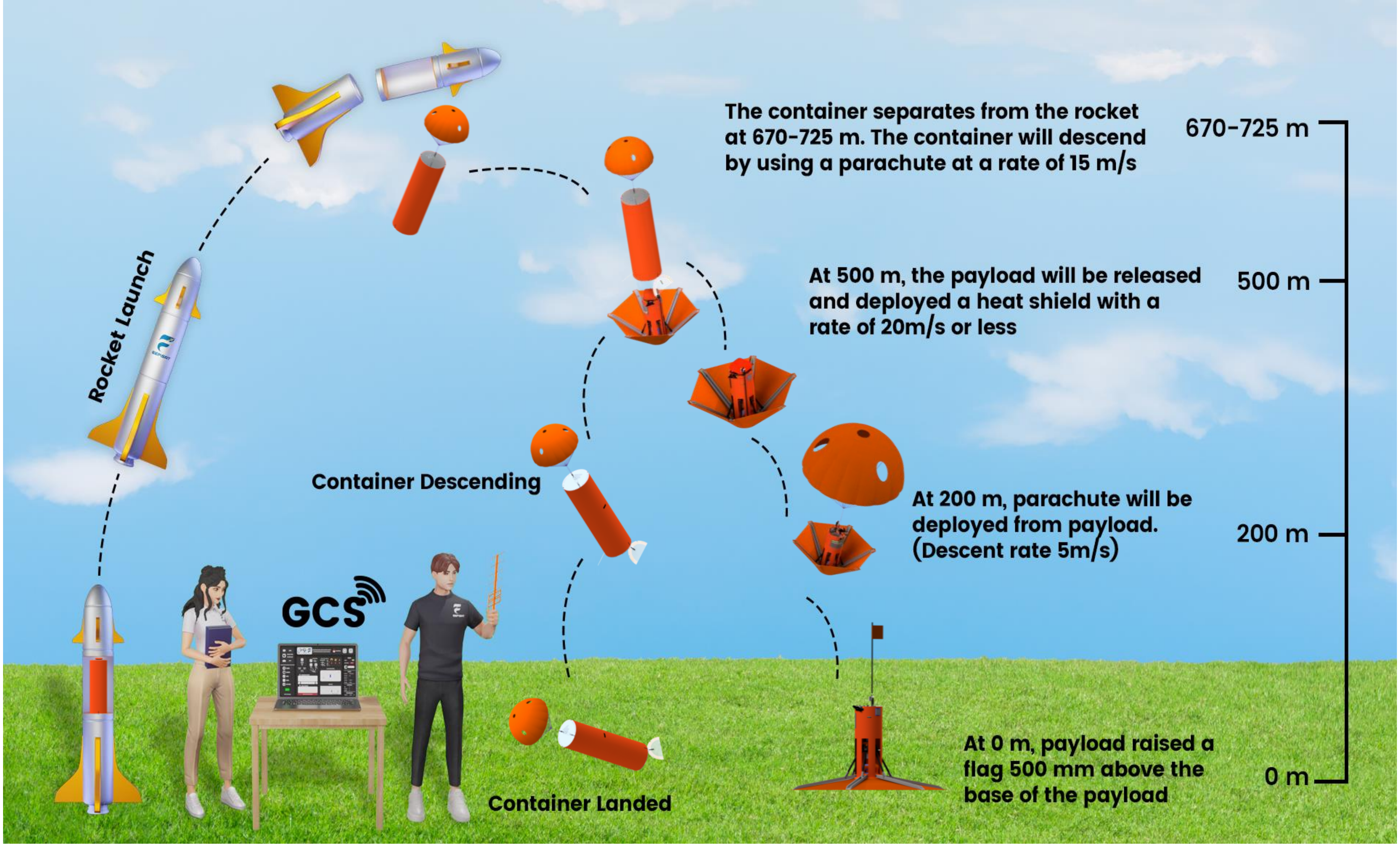
Launch

- CanSat in a rocket launch
- CanSat is released from the rocket (670–725 m)
- Container parachute deployment with a rate of 15 m/s
- The video camera started to record the separation of the payload then the payload open a heat shield at 500 m with a rate of 20 m/s or less
- Payload parachute deployment at 200 m with a rate of 5 m/s
- Payload landed in the upright position and raised a flag 500 mm above the base of the payload. Therefore video camera stopped recording
- Payload shall stop transmitting data to GCS

Post-Launch

- CanSat recovery by location from last telemetry and buzzer
- Inspection of CanSat damage
- Take the SD Card from the payload
- Analyze data received
- PFR preparation

System Concept of Operations (CONOPS) (2/3)



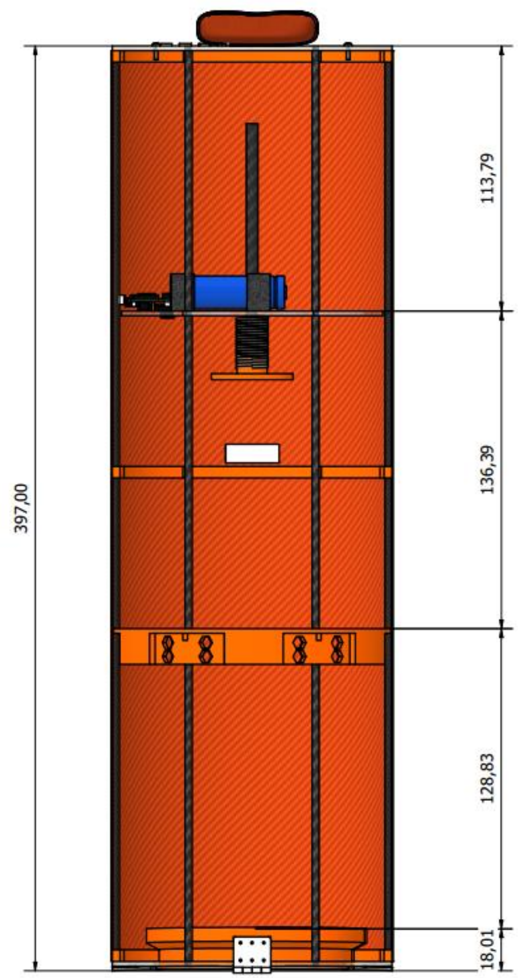
System Concept of Operations (CONOPS) (3/3)

Team Member Roles and Responsibilities

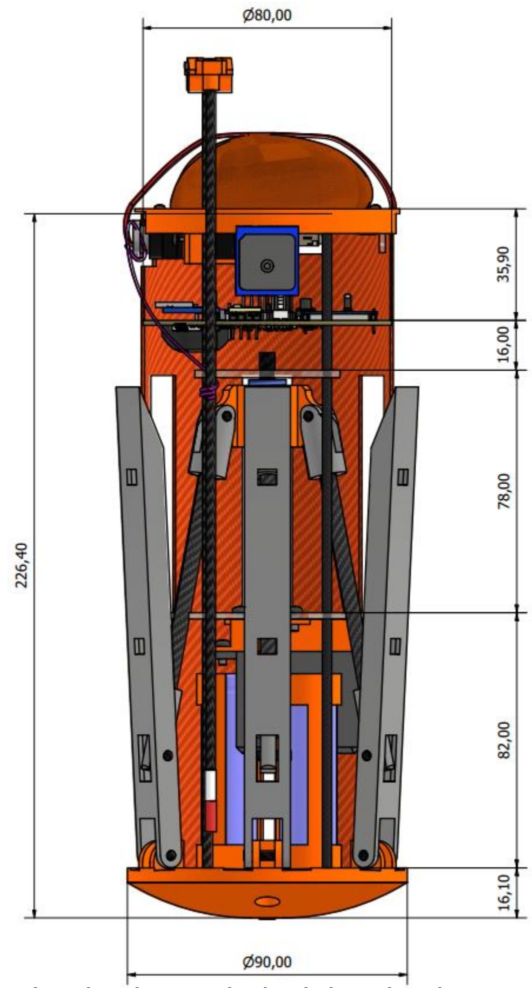
Roles	Member Name
Mission Control Officer *(Responsible for informing the Flight Coordinator when the team and their CanSat is ready to be launched)*	• Fatwa Aulia Al-Haq
Ground Station Crew *(Responsible for monitoring the ground station for telemetry reception and issuing commands to the CanSat)*	• Muhammad Tsaqif Mukhayyar
Recovery Crew *(Responsible for tracking the CanSat and going out into the field for recovery and interacting with the field judges)*	• Tsabitah Akmal Al Mumtazah • Akhmadan Habibullah
CanSat Crew *(Responsible for preparing the CanSat, integrating it into the rocket, and verifying its status)*	• Artaka Sunu Adhi Prasetya • Achmad Bagus Okto Faerizqi

CanSat Physical Layout (1/4)

Container Dimension



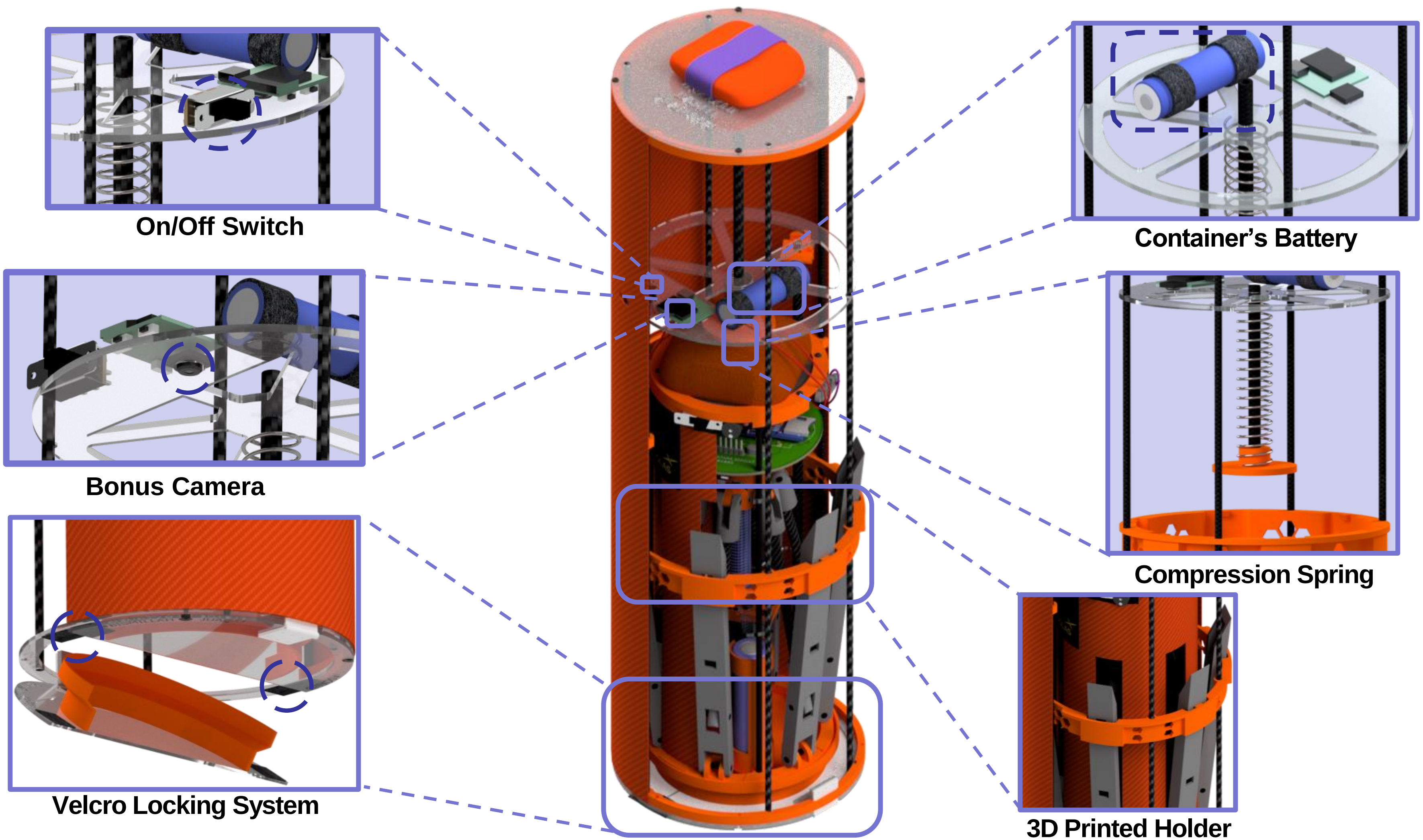
Payload Dimension



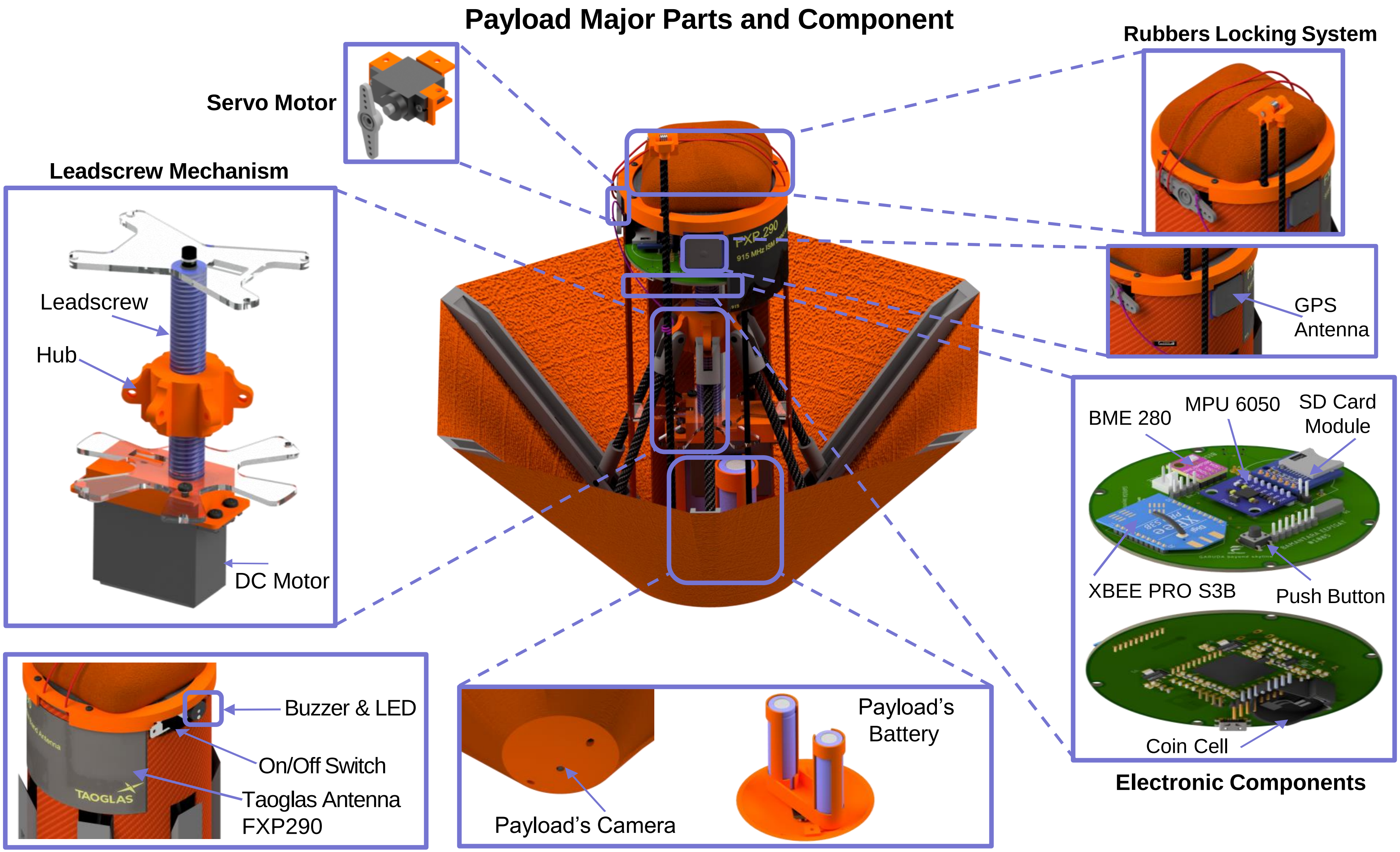
*The dimension of container and payload using technical drawing in CAD software

*All measurement units are in mm

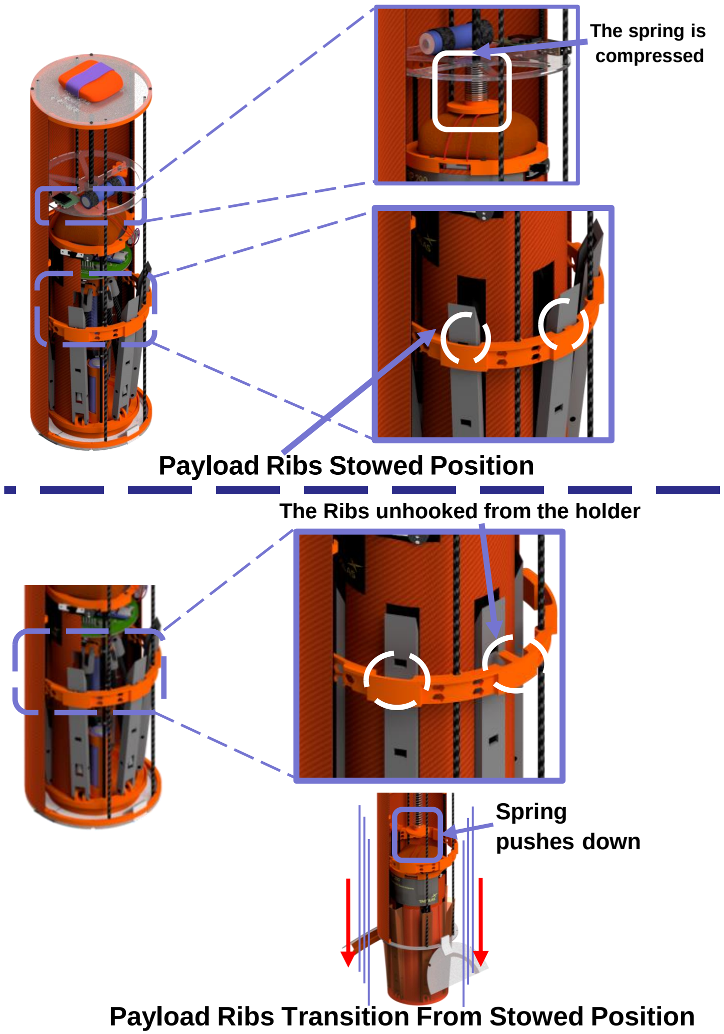
Container Placement of Major Component



CanSat Physical Layout (3/4)



Payload Launch and Deployed Configuration

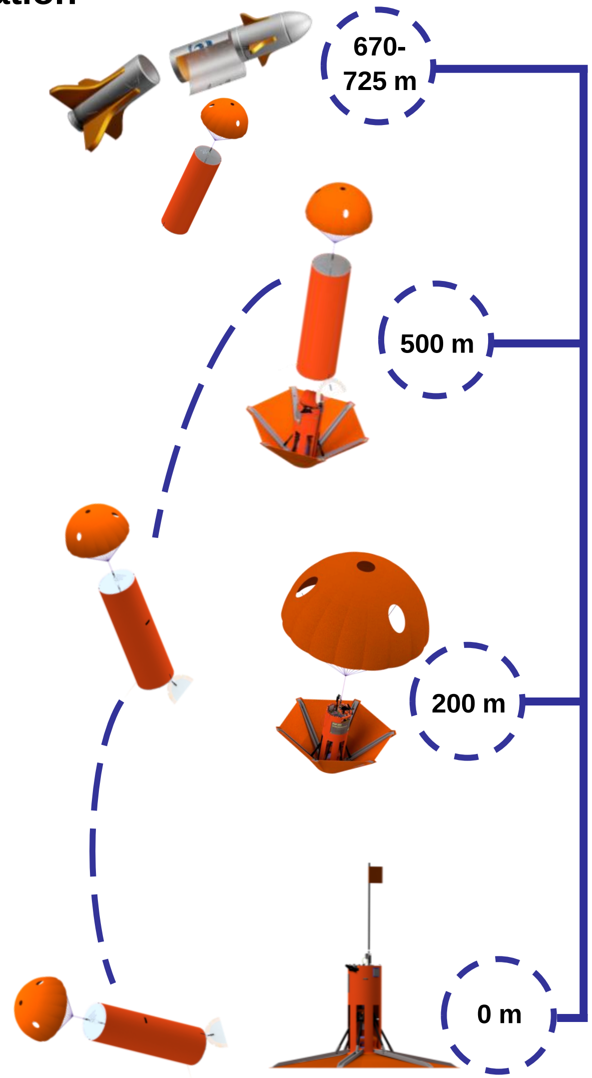


The container separates from the rocket at an altitude of 670-725 meters. The container will descend at a rate of 15 m/s using a parachute above the container.

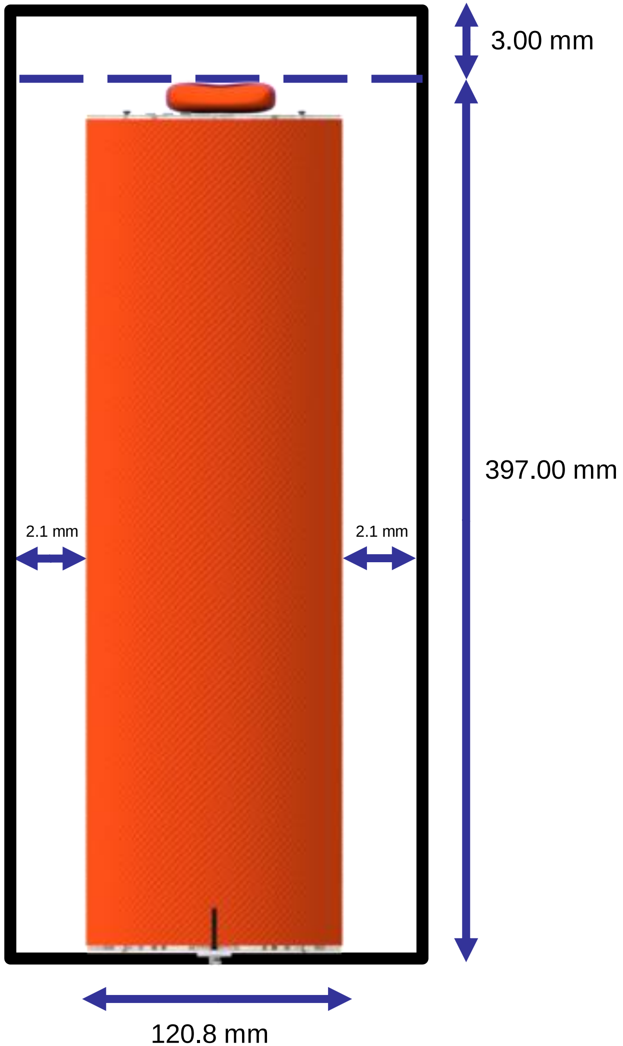
At an altitude of 500 meters, the payload will be released from the container and open a heat shield that will also be used as an aerobraking device, with a descent rate of 20 m/s or less.

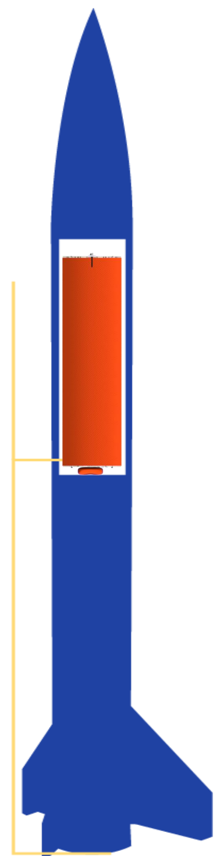
At an altitude of 200 meters, the parachute will be released from the payload. It will make the descent at a rate of 5 m/s.

The payload lands and after upright itself the payload raises a flag 500 mm above the base of the payload.



Launch Vehicle Compatibility





Dimension (Section)	Height (mm)	Diameter (mm)
Rocket (Requirement Dimensions)	400	125
Container	397.0	120.8
Payload	226.40	90

Information:

1. CanSat consists of two parts: container and payload
2. No sharp protrusions
3. The dimension of CanSat is designed to prevent shaking in the rocket and provide a gap to release
4. Rocket will not be used as part of CanSat operations

Sensor Subsystem Design

Achmad Bagus Okto Faerizqi

Sensor Subsystem Overview

Sensor Type	Selected Model	Function	Located In
Air Pressure	BME280	To measure air pressure in order to calculate altitude	Payload
Air Temperature	BME280	To measure air temperature inside of the payload	Payload
Battery Voltage	ADC Voltage Divider	To measure battery voltage of the payload	Payload
Tilt Sensor	MPU6050	To detect orientation or inclination	Payload
GPS	BN-220	To obtain position or location	Payload
Camera	Quelima SQ11	To record video during the mission process	Payload

Sensor Changes Since PDR

Part	PDR	CDR	Rationale
There were no changes to the Sensor Subsystem Design			

Payload Air Pressure Sensor Summary (1/2)

Model	Interface	Sensitivity (hPa)	Voltage (V)	Current (µA)	Range (hPa)	Accuracy (hPa)	Mass (g)	Size (mm)	Cost ($)
BME 280	I2C	0.0018	1.71 – 3.6	2.8	300 – 1100	± 1.0	1.0	13.5 x 10.5 x 2	9.05

BME280 ✓

BME280 will acquire pressure data based on the configured settings. Later, the pressure data will be transformed into altitude data.

Data Format	(Altitude, m)
Equation	$$Altitude = 44330 \times \left(1 - \left(\frac{P}{P_0}\right)^{\frac{1}{5.255}}\right)$$ P: Atmospheric pressure at current altitude (hPa) P_0: Atsmospheric pressure at sea level (hPa)
Sample Output	`Pressure : 1012.04 hPa` `Altitude : 10.0 m`

Sample output in packet data:

```
1085,15:00:10.01,100,F,LAUNCH_WAIT,100.1,P,C,M,30.0,100.1,3.1,00:09:02,100.2,17.0199,189.0077,7,1.12,2.12,CXON,,127
```

Payload Air Pressure Sensor Summary (2/2)

Sensor Settings

We are using a standard initiation of adafruit library BME280. The sensor settings are:

• Sensor Mode	: Normal Mode
• Pressure Sampling	: Oversampling 16x
• Temperature Sampling	: Oversampling 16x
• IIR Filter	: Off
• Stand by Time	: 0.5 ms

Pressure Sensor Acquisition Process

Kalman Filter

1. Obtain input (U), after that calculate $\widehat{U}_{k+1}$ using these equations:

$$k = \frac{P \cdot H}{H^2 \cdot P + R}$$

$$\widehat{U}_{k+1} = k \cdot \left(U - H \cdot \widehat{U}\right)$$

$$P = (1 - k \cdot H) \cdot P + Q$$

2. The $\widehat{U}_{k+1}$ is the output of Kalman Filter

Payload Air Temperature Sensor Summary (1/2)

Model	Interface	Sensitivity (°C)	Voltage (V)	Current (µA)	Range (°C)	Accuracy (°C)	Mass (g)	Size (mm)	Cost ($)
BME 280	I2C	0.01	1.71 – 3.6	2.8	-40 ~ 85	±1.0	1.0	13.5 x 10.5 x 2	9.05

BME280 ✓

BME280 will acquire temperature data based on the configured settings. After that, the temperature data will be processed using the moving average.

Data Format	(Temperature, °C)
Equation	*No equations for this measurement*
Sample Output	`Temperature : 30 C`

Sample output in packet data:

```
1085,15:00:10.01,100,F,LAUNCH_WAIT,100.1,P,C,M,30.0,100.1,3.1,00:09:02,100.2,17.0199,189.0077,7,1.12,2.12,CXON,,127
```

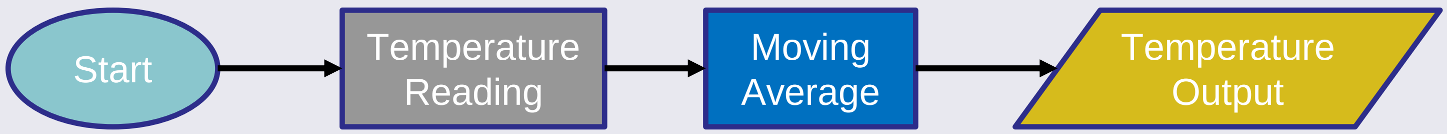
Payload Air Temperature Sensor Summary (2/2)

Sensor Settings

We are using a standard initiation of adafruit library BME280. The sensor settings are:

- Sensor Mode : Normal Mode
- Pressure Sampling : Oversampling 16x
- Temperature Sampling : Oversampling 16x
- IIR Filter : Off
- Stand by Time : 0.5 ms

Temperature Sensor Acquisition Process



Moving Average

1. Obtain first data of input (k=3), after that calculate the output using these equations:

$$MA_{k=3} = \frac{1}{k} \sum_{i=n-(k-1)}^{k} V_i$$

2. Following this step, it is necessary to eliminate the earliest data and substitute it with current data before continuing with the computations
3. Perform this process constantly

Payload GPS Sensor Summary (1/2)

Model	Interface	Range (m)	Sensitivity (dBm)	Voltage (V)	Resolution (m)	Supply Current (mA)	Mass (g)	Size (mm)	Cost ($)
BN-220	UART	As long can connect to satellites	-167	3 – 5.5	± 2.5	67	5.3	22 x 20 x 6	14

BN-220 ✓

BN-220 will connect to at least 3 satellites in the orbit and calculate the distance between them so it can make an output of GPS data.

Data Format	(Time, hh:mm:ss) (Latitude, °) (Longitude, °) (Altitude, m) (Satellites, integer value showing number of satellites that was connected)
Equation	It will automatically calculate the distance of this sensor with reference to satellite (at least 3)
Sample Output	GPS TIME:19:50:17 GPS LATITUDE :-7.2936 GPS LONGITUDE :112.8079 GPS ALTITUDE :19.9 GPS SATELITES :6

Sample output in packet data:

```
1085,15:00:10.01,100,F,LAUNCH_WAIT,100.1,P,C,M,30.0,100.1,3.1,00:09:02,100.2,17.0199,189.0077,7,1.12,2.12,CXON,,127
```

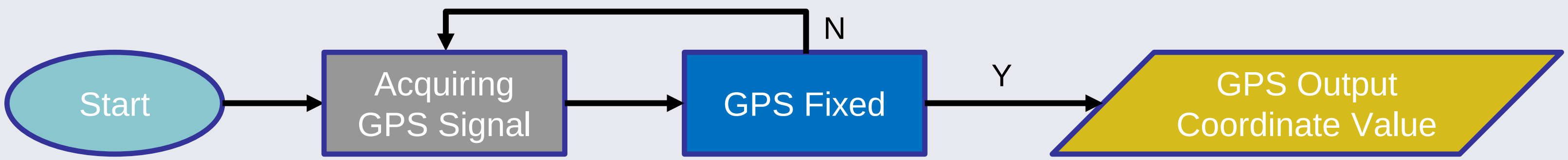
Payload GPS Sensor Summary (2/2)

Sensor Settings

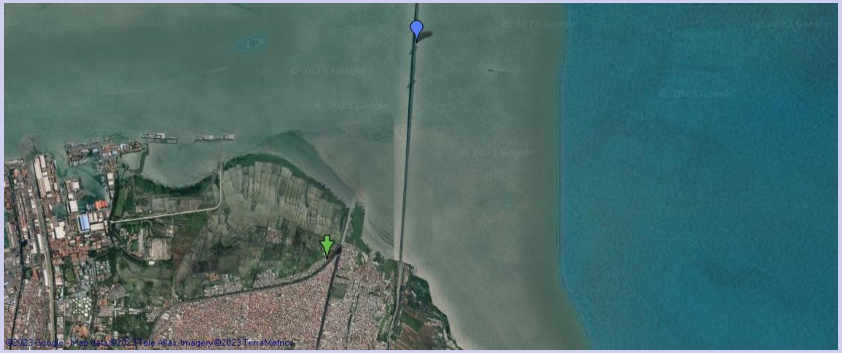
We are using a standard initiation of TinyGPS++ library. The sensor settings is already defined by manufacturer, the default mode are:

- Baud Rate : 9600 baud
- Data : 8 bits
- Stop : 1 stop bit
- Parity : None
- Output Protocol : NMEA

GPS Sensor Acquisition Process



GPS Test

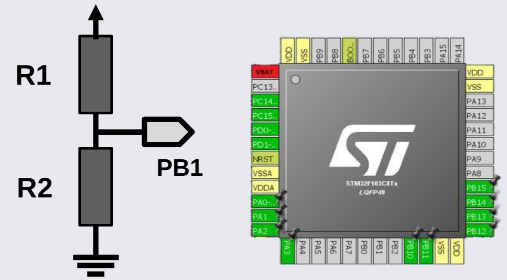


Latitude : -7.1827
Longitude : 112.7806

Payload Voltage Sensor Summary (1/2)

Model	Interface	Range (V)	Sensitivity (V)	Voltage (V)	Accuracy (%)	Mass (g)	Size (mm)	Cost ($)
ADC STM32F407VGT6	Analog	0 – 3.3	0.000805 (12 bit)	3.3	>90%	Embedded	Embedded	0

ADC STM32F407VGT6 ✓



Analog to Digital Converter will convert analog signal that represent battery voltage into binary numbers. After that, our program will convert this reading into battery voltage nominal and process it through moving average.

Data Format	(Battery Voltage, V)
Equation	$\boldsymbol{Battery\ Voltage = \frac{3.3}{4096} \times \frac{R_1 + R_2}{R_2} \times ADC\ Read}$ $R_1: First\ Resistor$ $R_2: Second\ Resistor$
Sample Output	Voltage : 8.2 V Voltage : 8.2 V

Sample output in packet data:

```
1085,15:00:10.01,100,F,LAUNCH_WAIT,100.1,P,C,M,30.0,100.1,3.1,00:09:02,100.2,17.0199,189.0077,7,1.12,2.12,CXON,,127
```

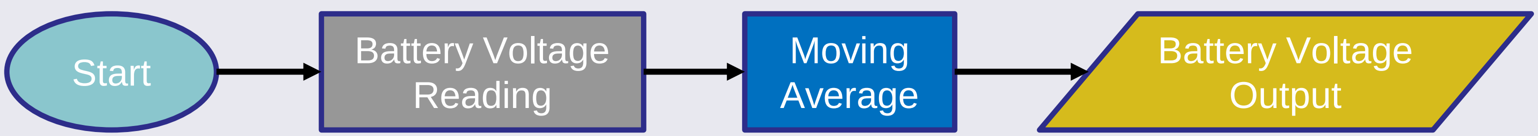
Payload Voltage Sensor Summary (2/2)

Sensor Settings

From our calculation, we choose 5100 Ω as our $\boldsymbol{R_1}$ and 3300 Ω as our $\boldsymbol{R_2}$. The following is the detail of our calculation:

$$Vbatt_{max} = 8.4\ V$$
$$V_{ADC} = 3.3\ V$$
$$R_1 = (8.4\ V - 3.3\ V) \times 1000 = 5.1 \times 1000 = 5100\ \Omega$$
$$R_2 = 3.3\ V \times 1000 = 3300\ \Omega$$

Voltage Sensor Acquisition Process



Moving Average

1. Obtain first data of input (k=3), after that calculate the output using these equations:

$$MA_{k=3} = \frac{1}{k} \sum_{i=n-(k-1)}^{k} V_i$$

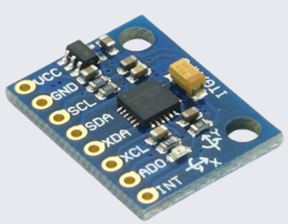
2. Following this step, it is necessary to eliminate the earliest data and substitute it with current data before continuing with the computations
3. Perform this process constantly

Payload Tilt Sensor Summary (1/2)

Model	Interface	Resolution (bits)	Voltage (V)	DoF	Mass (g)	Size (mm)	Cost ($)
MPU6050	I2C	12	3.3	6 (3 gyro, 3 accel)	2.1	14 x 12 x 2	1.5

Range	Sensitivity
Gyro (2000 dps) Accelerometer (16 G)	Gyro (14 bits) Accelerometer (14 bits)

MPU6050 ✓



IMU sensor sense Gyroscope and Accelerometer values.

Data Format

(Tilt X, °) (Tilt Y, °)

Equation

$$Tilt\ X = tan\left(\frac{A_y}{\sqrt{{A_x}^2 + {A_z}^2}}\right) \times \frac{180}{pi}$$

$$Tilt\ Y = atan2(A_x, A_z) \times \frac{180}{pi}$$

A_x = Raw data of X-axis accelerometer
A_y = Raw data of Y-axis accelerometer
A_z = Raw data of Z-axis accelerometer

Sample Output

```
Tilt Y :-3.54    Tilt X :2.65
Tilt Y :-3.45    Tilt X :2.57
Tilt Y :-3.39    Tilt X :2.52
```

Sample output in packet data:

```
1085,15:00:10.01,100,F,LAUNCH_WAIT,100.1,P,C,M,30.0,100.1,3.1,00:09:02,100.2,17.0199,189.0077,7,1.12,2.12,CXON,,127
```

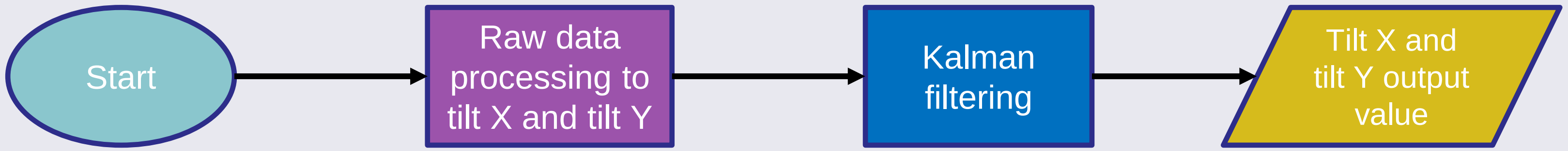
Payload Tilt Sensor Summary (2/2)

Sensor Settings

We are using our custom library to initialize and take sensor readings. The sensor settings are:

- Sensor Wake Up Register : 0x6B
- Data Rate : 25 Hz
- Accelerometer Config : +/- 2 G
- Gyroscope Config : +/- 250 degree/second

Tilt Sensor Acquisition Process



Kalman Filter

1. Obtain input (U), after that calculate $\widehat{U}_{k+1}$ using these equations:

$$k = \frac{P \cdot H}{H^2 \cdot P + R}$$

$$\widehat{U}_{k+1} = k \cdot \left(U - H \cdot \widehat{U}\right)$$

$$P = (1 - k \cdot H) \cdot P + Q$$

2. The $\widehat{U}_{k+1}$ is the output of Kalman Filter

Camera Summary

Model	Interface	Resolution (Pixels)	Voltage (V)	Frame Rate (fps)	View Angle (°)	Mass (g)	Size (mm)	Cost ($)
Quelima SQ11	Digital	1280 x 720	5	30	120	5.2	23 x 23 x 23	4.53

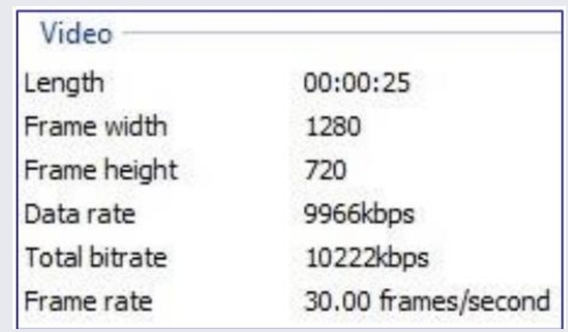
Quelima SQ11 ✓

Note:
We removed the camera from the case, because we designed our own camera case to minimize its size.

Reason

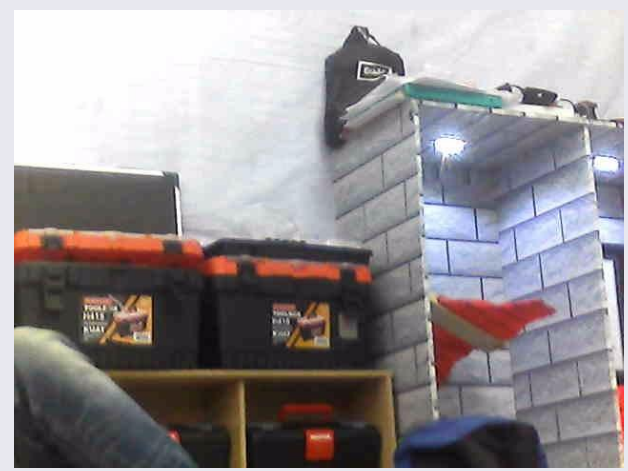
- Small size camera with high resolution
- Availability of SD card slot
- Wide angle lens

Quality



Video	
Length	00:00:25
Frame width	1280
Frame height	720
Data rate	9966kbps
Total bitrate	10222kbps
Frame rate	30.00 frames/second

Output Camera



Bonus Camera Summary

Model	Interface	Resolution (Pixels)	Voltage (V)	Frame Rate (fps)	View Angle (°)	Mass (g)	Size (mm)	Cost ($)
Quelima SQ11	Digital	1280 x 720	5	30	120	5.2	23 x 23 x 23	4.53

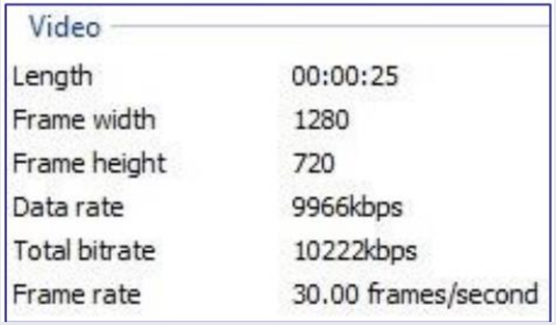
Quelima SQ11 ✓

Note:
We removed the camera from the case, because we designed our own camera case to minimize its size.

Reason

- Small size camera with high resolution
- Availability of SD card slot
- Wide angle lens

Quality



Output Camera

Descent Control Design

Artaka Sunu Adhi Prasetya

Descent Control Overview

Container

Material: Polycarbonate, Fiberglass Composite, ABS+.

Dimension: 397.00 mm in height and 120.8 mm in diameter.

Feature: Parachute attachment using Eye bolt, The 3D Printed holder can keep the payload at the stowed position.

Payload

Material: ABS+, Fiberglass Composite.

Dimension: 226.40 mm in height, 90 mm in diameter of the body, and 310 mm in diameter of the heatshield

Feature: DC motor and Leadscrew Mechanism

Parachute

Container Parachute

Material: Orange Ripstop Nylon

Dimension: 222 mm in diameter

Feature: Spill hole and side hole as stabilizer with 22.2 mm in diameter.

Payload Parachute

Material: Orange Ripstop Nylon

Dimension: 547 mm in diameter

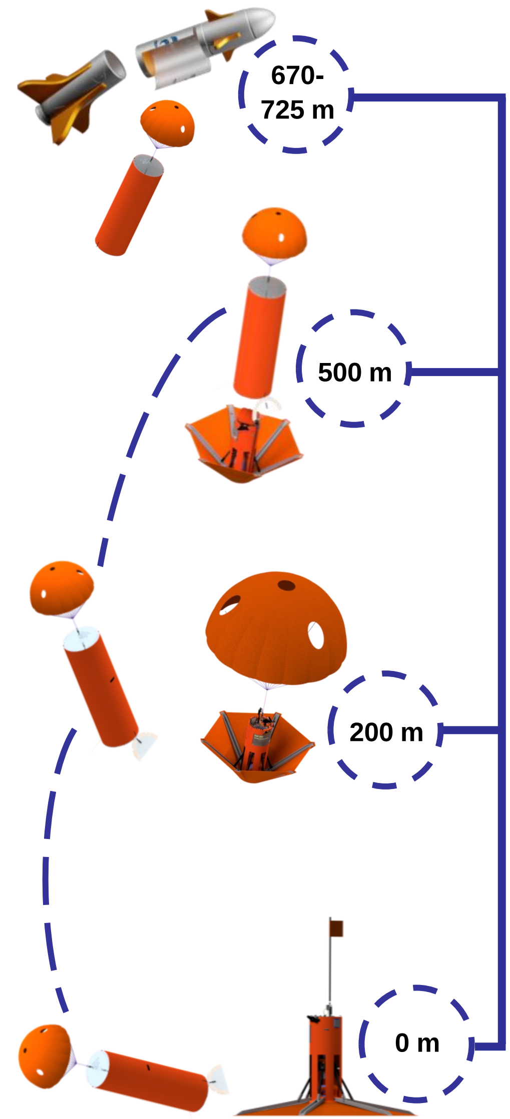
Feature: Spill hole and side hole as stabilizer with 54.7 mm in diameter.

The container separates from the rocket at an altitude of 670-725 meters. The container will descent at a rate of 15 m/s using a parachute above the container.

At an altitude of 500 meters, the payload will be released from the container and open a heat shield that will also be used as an aerobraking device, with a descent rate of 20 m/s or less.

At an altitude of 200 meters, the parachute will be released from the payload. It will make the descent at a rate of 5 m/s

The payload lands and after upright itself the payload raises a flag 500 mm above the base of the payload.



Descent Control Changes Since PDR (1/4)

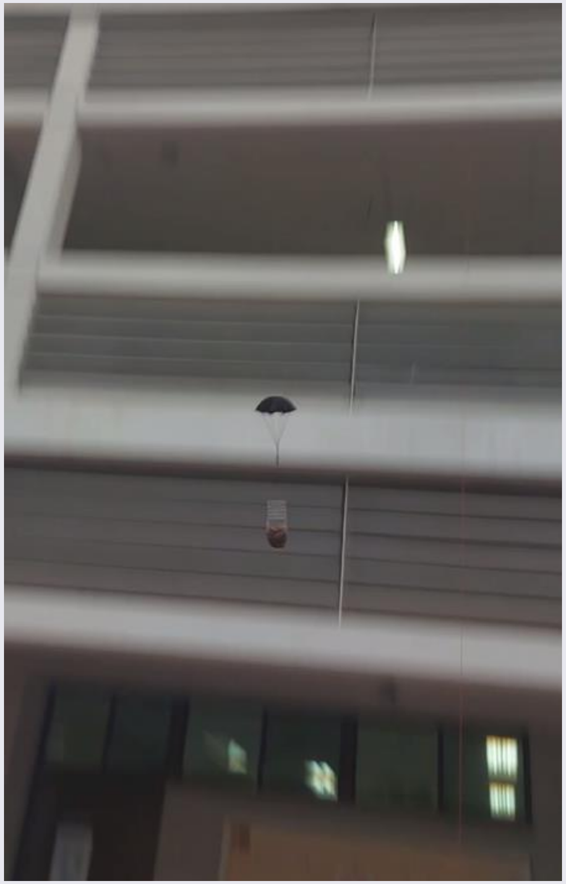
Part	PDR	CDR	Rationale

There were no changes to the Descent Control Design

Descent Control Changes Since PDR (2/4)

Descent Rate of Parachute Prototype Testing

Documentation



Container Parachute Descent	
Goal	The CanSat shall descend using container parachute. Container Parachute at a rate of 15 m/s.
Procedure	1. The parachute was tied to the dummy CanSat with a mass of 700 g. 2. The object was dropped 12.76 m from the building. 3. Observe and measure time elapsed for the object land.
Result	It takes time to be fully stable descend with a descent rate of ±15 m/s using the container parachute.

Descent Control Changes Since PDR (3/4)

Descent Rate of Parachute Prototype Testing

Documentation


Payload Parachute Descent	
Goal	The second parachute is able to release from payload after the rubber released and the descent rate is 5 m/s.
Procedure	1. Observe the payload parachute is able to release from the payload using rubber locking system. 2. Drop the payload prototype from top of building (21.5 m). 3. Observe and measure time elapsed for the object land.
Result	The payload parachute can release from the payload using rubber locking system. It takes time to be fully stable descend with a descent rate of 5 m/s using the payload parachute.

Descent Control Changes Since PDR (4/4)

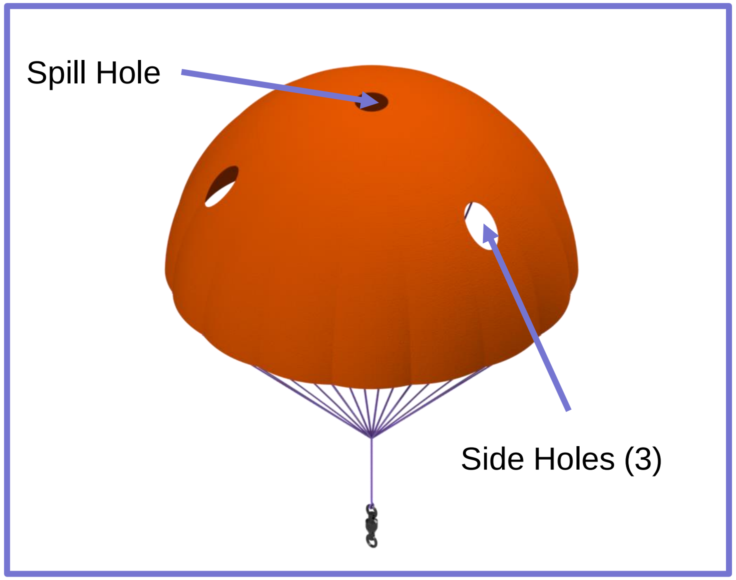
Payload Aerobraking Prototype Testing

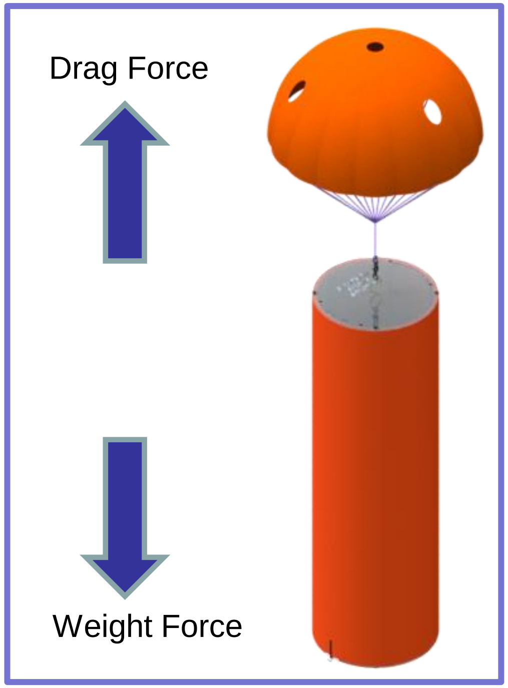
Documentation

Payload Aerobraking Descent	
Goal	The Payload shall open Heat shield that will be used aerobraking with descent rate is 20 m/s or less.
Procedure	1. The payload was dropped from the top of building (21.5 m) with an angle 45 degree. 2. Observe and measure the time elapsed for the object to land.
Result	The prototype was able to fully descend with a descent rate of ±14.56 m/s.

Container Descent Control Hardware Summary (1/4)

Container Descent Control Hardware





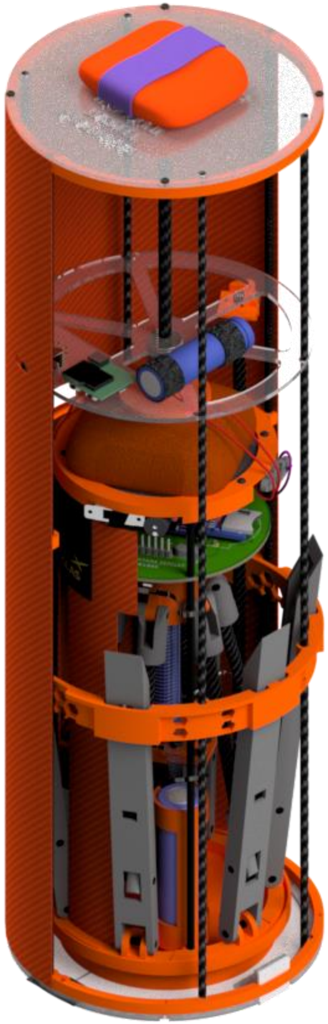
Size: Ø 222 mm
Key Design: Round Parachute
Color Selection: Orange
Spill Hole diameter: 22.2 mm
Side Holes diameter: 22.2 mm

How Container Descent Control Hardware Works

We use parachute to maintain the descent control of the container. The parachute is lifted by the drag force in order to achieve the desired rate of descent.

Container Descent Control Hardware Summary (2/4)

Passive Component of Container Descent Control Hardware



Key Design Considerations :

- The type of parachute are round parachute with spill hole and three side holes
- The container focuses mass at the bottom

Color Selection:

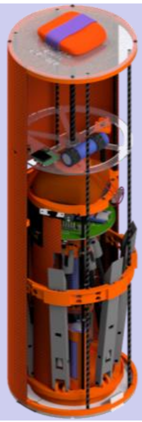
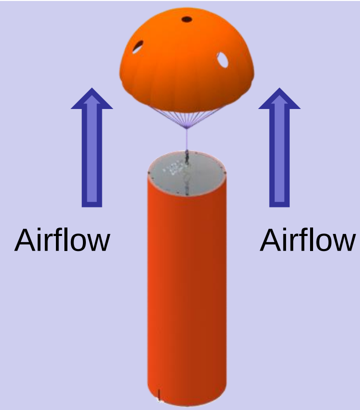
- Parachute is using orange ripstop nylon
- The cover of container's is orange fiberglass composite
- Lids are using transparent Polycarbonate

Passive Component:

- The container's parachute is attached to container by a swivel and an eyebolt

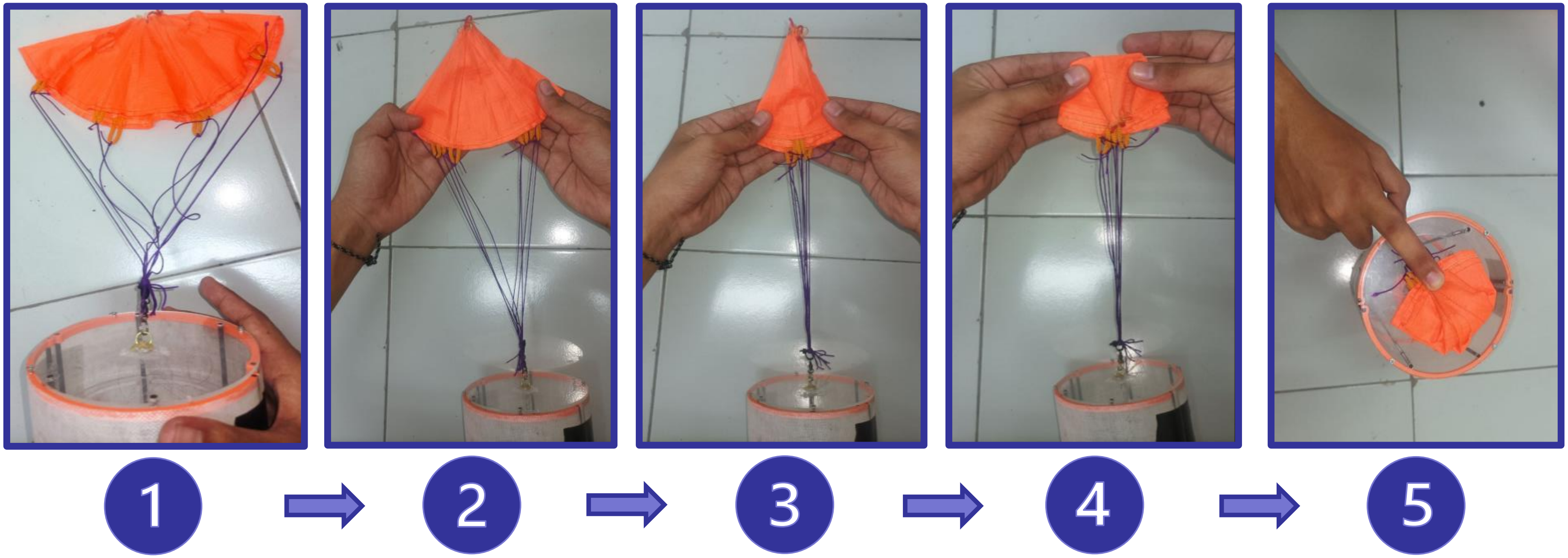
Container Descent Control Hardware Summary (3/4)

How Container Descent Control Hardware Stowed and Works

Pre-Deployment Configuration	Container Parachute Descent Control	Full Deploy Configuration
		
The Container parachute is placed on the top of container at folded position. The cord of parachute keeps release. The container parachute will be attached by a swivel and eye bolt.	The parachute will be opened by the air resistance assist.	The full deployed configuration has a descent rate of 15 m/s due to container parachute.

Container Descent Control Hardware Summary (4/4)

Container Parachute Stowed Representation

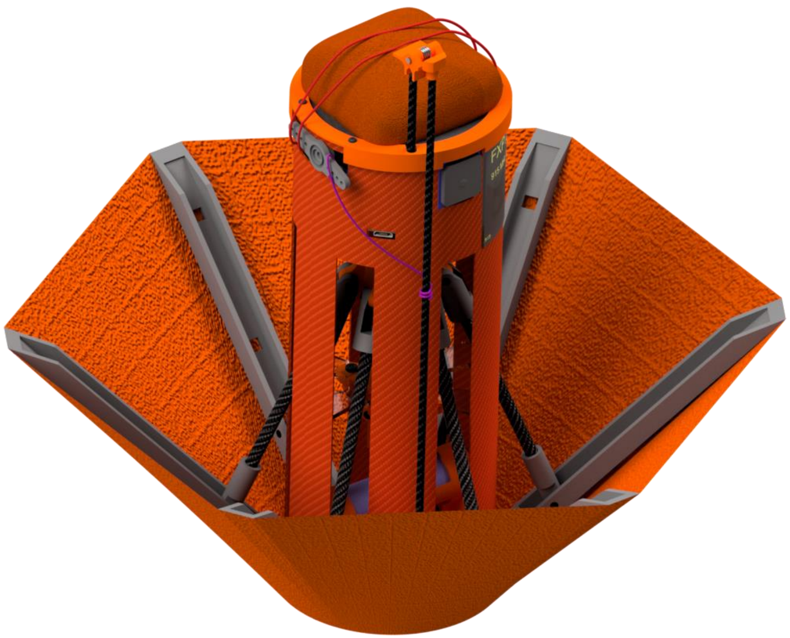


Information

The container parachute will be outside container and attached to the top frame of the container. It will open as soon as deployed from the rocket. In order to open easily and quickly when the parachute exposed to air, it will be fold as shown in picture.

Payload Aerobraking Descent Control Hardware Summary (1/3)

Active Component of Payload Descent Control Hardware



Key Design Considerations :
- The payload focuses mass at the bottom to maintain the nadir direction and prevent the payload from swaying
- A cone-shaped nose is often used in vehicle design to reduce the drag caused by air resistance and improve aerodynamic efficiency

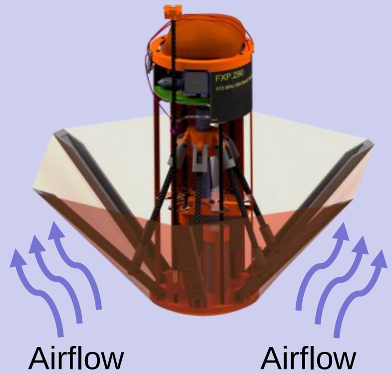
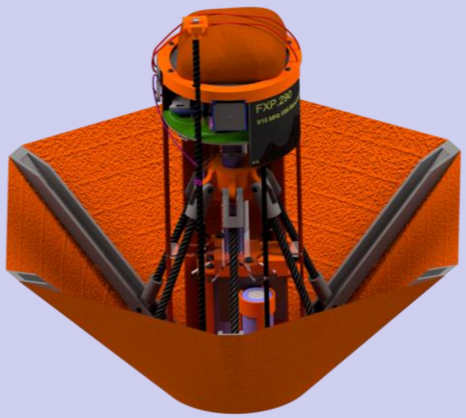
Color Selection:
- Heatshield material is using orange ripstop nylon
- The cover of payload is orange fiberglass composite

Active Component:
- DC motors and leadscrew mechanisms are used to adjust the angle of the heat shield to maintain the descent rate (typically 45 degree).

Component Sizing:
- Heat shield area : 840.78 cm^2
- Heat shield radius : 155 mm

Payload Aerobraking Descent Control Hardware Summary (2/3)

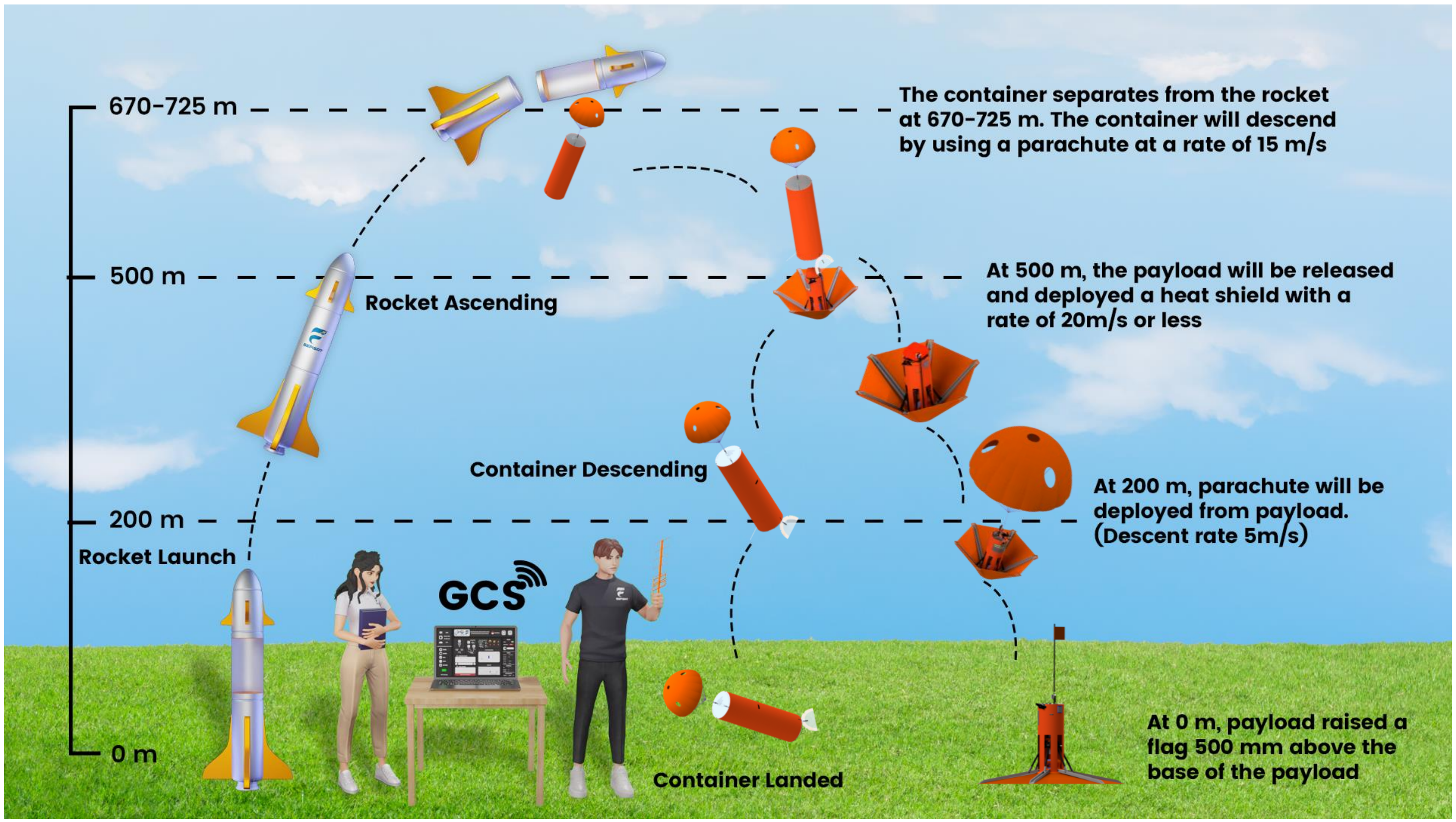
How Payload Aerobraking Descent Control Hardware Stowed and Works

Pre-Deployment Configuration	Payload Aerobraking Descent Control	Full Deploy Configuration
		
The payload is stowed in the container using 3D Printed Holder	The payload will release form the container when the heat shield ribs unhooks from the 3D printed holder with DC motor and leadscrew mechanism	The heatshield will be opened at 45 degree angle and start to aerobrake. The aerobraking payload is controlled actively and descent less than 20 m/s

Payload Aerobraking Descent Control Hardware Summary (3/3)

Payload Sensors Operation Sequence

Payload altitude sensor will be measured to aid the descent control process. Altitude data is obtained from BME 280. If the altitude data reaches at 500m it will command to activate the DC motor to release the payload from the container. Then, DC motor will actively control the angle of the heatshield to keep the descent rate less than 20 m/s.

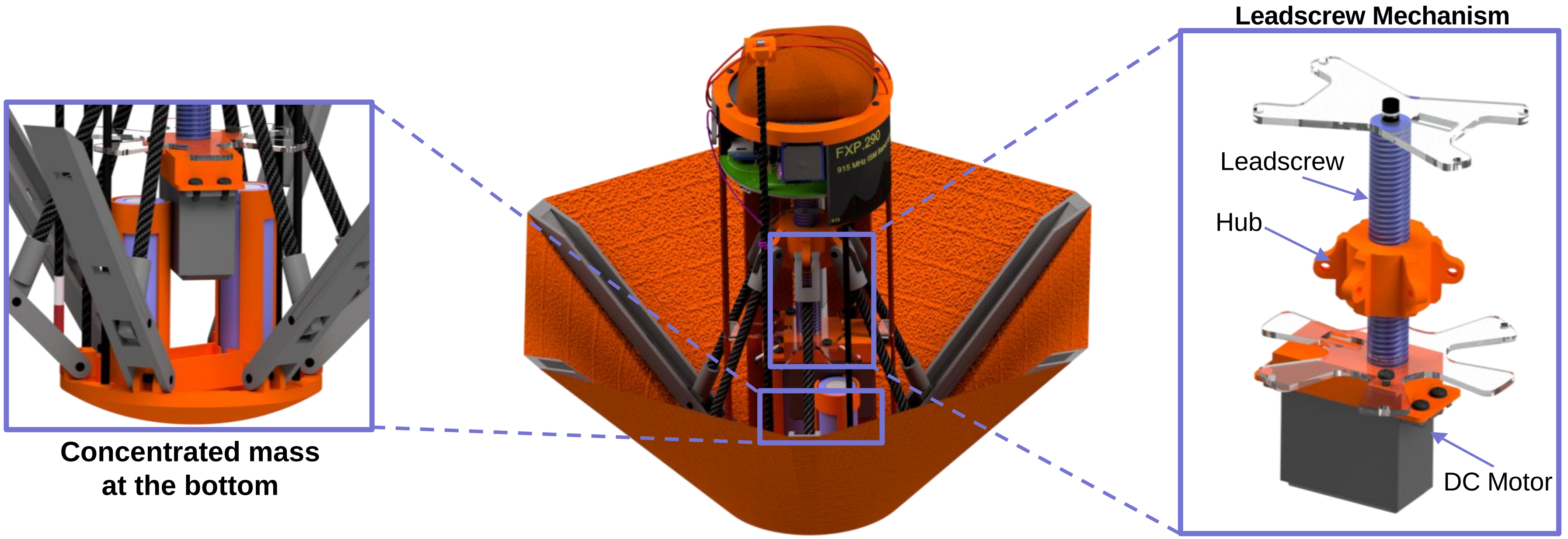


Sample Altitude

```
Altitude = 505.9m
Altitude = 503.2m
Altitude = 500.0m
Altitude = 408.1m
Altitude = 405.0m
```

Payload Descent Stability Control Design

Payload Descent Stability



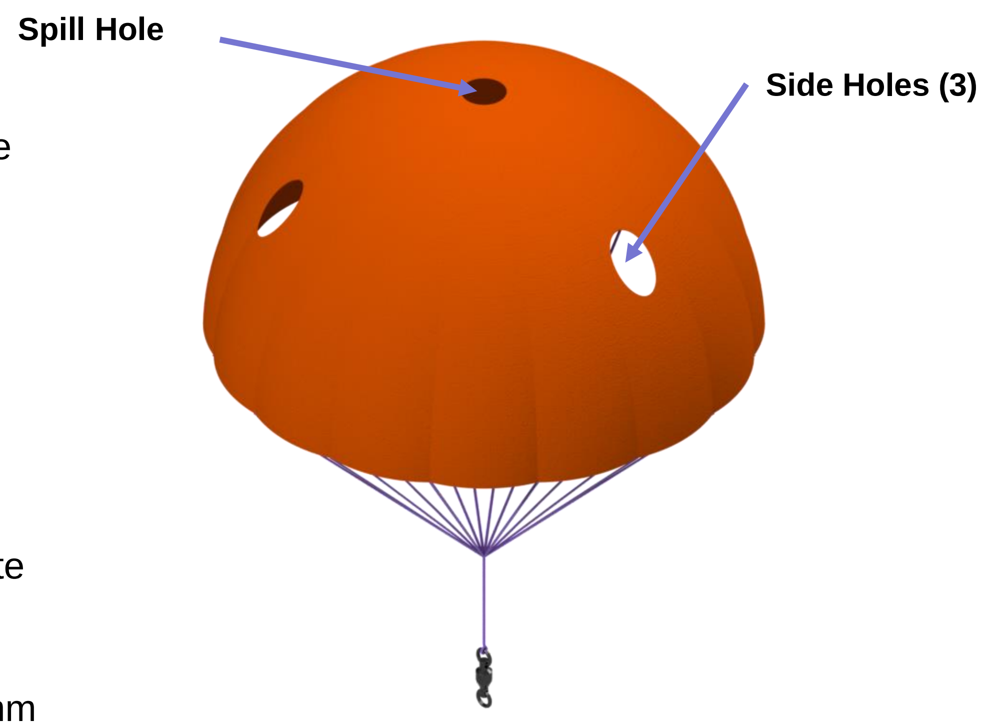
Concentrated mass at the bottom

Information

Type of Stability: Active Control
Description:
The payload is using leadscrew and DC motor to maintain descent stability. Other stability is maintained by placing major components at the bottom of the payload, so that the mass is focused at the bottom. This configuration helps to maintain the nadir direction and prevents the payload from swaying.

Active and Passive Component of

Payload Parachute Descent Control Hardware



Key Design Considerations :

- The type of parachute are round parachute with a spill hole and three side holes

Color Selection:

- Parachute is using orange ripstop nylon

Passive Component:

- The payload's parachute is attached to payload by a swivel and an eyebolt

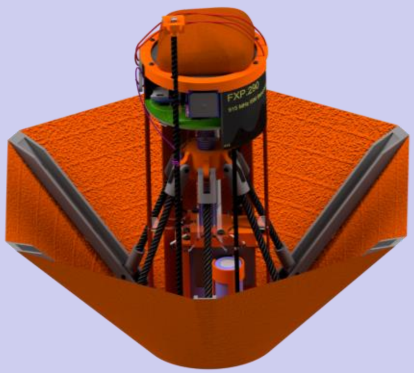
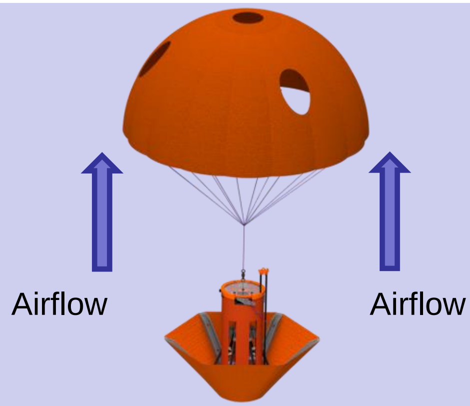
Active Component:

- Servo is used to release a rubber which causes the payload to deploy the parachute

Component Sizing:

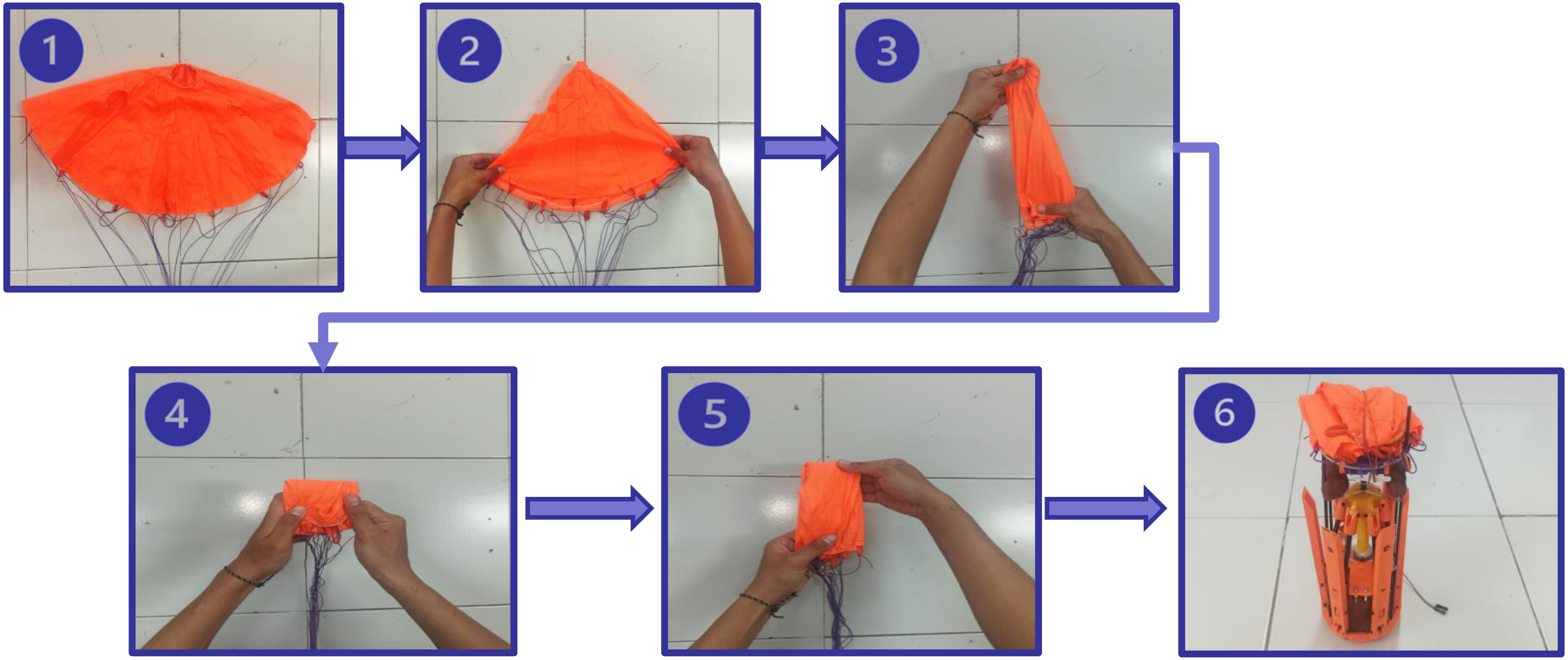
- Parachute diameter: 547 mm
- Spill hole and side holes diameter : 54.7 mm

How Payload Parachute Descent Control Hardware Stowed and Works

Pre-Deployment Configuration	Payload Parachute Descent Control	Full Deploy Configuration
		
The payload parachute is placed on the top frame of the payload in a folded position and is attached by an eye bolt to the payload. The eye bolt is attached to the parachute frame and hard-glued. The rubber keeps the payload parachute on the top frame before release. The payload parachute is connected to the eye bolt with a swivel as a connector	At 200 m, servo actives and the rubber will be released to deploy the payload's parachute from the top frame of the payload.	Fully deployed configuration has a descent rate of 5 m/s due to payload parachute.

Payload Parachute Descent Control Hardware Summary (3/3)

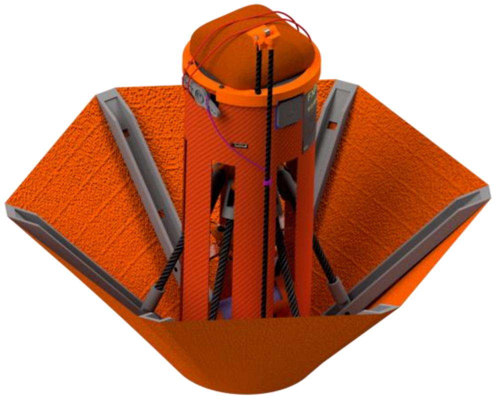
Payload Parachute Stowed Representation



Information

The payload parachute is placed on the top frame of the payload in a folded position and attached by an eye bolt to the payload. The eye bolt is attached to the parachute frame and hard-glued. Rubber keeps the payload's parachute on the top frame before release. In order to open easily and quickly when the parachute exposed to air, it will be fold as shown in pictures above.

Descent Rate Estimates (1/6)

The descent rate of each descent phase will be estimated using different parameters		
		
Container Parachute	**Payload Aerobraking**	**Payload Parachute**
Parameters: • Diameter of Parachute *(Dp)* • Diameter of spill hole and side holes *(Dsh)*	Parameters: • Radius of heat shield *(Rhs)*	Parameters: • Diameter of Parachute *(Dp)* • Diameter of spill hole and side holes *(Dsh)*
Requirement: Descent rate of 15 m/s ($\pm$ 5 m/s)	Requirement: Descent rate of 20 m/s or less	Requirement: Descent rate of 5 m/s ($\pm$ 1 m/s)

Container Parachute

We use the range of descent velocity between minimum [V min = 10 m/s] and maximum [Vmax = 20 m/s] to determine diameter of parachute

$$\sqrt{\frac{8\times m\times g}{\rho\times(v_{max})^2\times\pi\times Cd}} \leq Dp \leq \sqrt{\frac{8\times m\times g}{\rho\times(v_{max})^2\times\pi\times Cd}}$$

$$\sqrt{\frac{8\times0.7\times9.8}{1.225\times(20)^2\times3.14\times1.28}} \leq Dp \leq \sqrt{\frac{8\times0.7\times9.8}{1.225\times(10)^2\times3.14\times1.28}}$$

$$\mathbf{0.166 \leq Dp \leq 0.333}$$

Information:

$Dp =$ $The\ diameter\ of\ the\ parachute\ (m)$

$v =$ $Descent\ speed\ (m/s)$

$\pi = 3.14$

$g = gravitational\ acceleration\ (9.8\ m/s^2)$

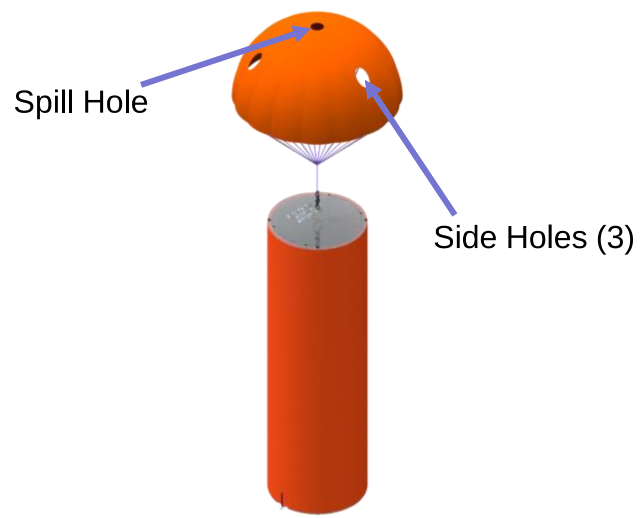
$Dsh = Spill\ hole\ and\ side\ holes\ diameter\ (m)$

***Assumption**

$* \ Cd = 1.28\ (Drag\ coefficient\ of\ parachute)$

$* \ m = 0.7\ kg\ (container + payload)$

$* \ \rho = air\ density\ (1.225\ kg/m^3)$



Chosen Diameter	Chosen Radius
0.222 m	**0.111 m**

Diameter of the spill hole and side holes is chosen to be 10% of the diameter of parachute

Diameter of spill hole and side holes = $Dsh = Dp \times 10\%$ = **0.0222 m**

Spill hole and side holes radius = $\frac{Dsh}{2}$ = **0.0111 m**

Descent Rate Estimates (3/6)

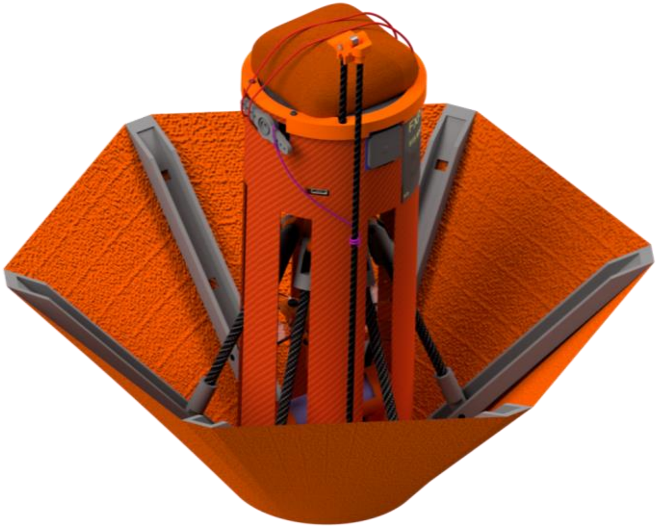
Payload Heat Shield

We use the range of descent velocity between minimum [V min = 10 m/s] and maximum [Vmax = 20 m/s] to determine the radius of heat shield

$$\sqrt{\frac{2\times m\times g}{\rho\times(v_{min})^2\times\pi\times Cd}} \leq Rhs \leq \sqrt{\frac{2\times m\times g}{\rho\times(v_{max})^2\times\pi\times Cd}}$$

$$\sqrt{\frac{2\times0.47\times9.8}{1.225\times(20)^2\times3.14\times0.47}} \leq Rhs \leq \sqrt{\frac{2\times0.47\times9.8}{1.225\times(10)^2\times3.14\times0.47}}$$

$$\mathbf{0.112 \leq Rhs \leq 0.225}$$



Chosen Radius	Chosen Diameter
0.155 m	**0.310 m**

Information:

$Rhs = The\ Radius\ of\ the\ heat\ shield\ (m)$

$v =\ Descent\ speed\ (m/s)$

$\pi = 3.14$

$g = gravitational\ acceleration\ (9.8\ m/s^2)$

***Assumption**

$*\ Cd\ =\ 0.47\ (when\ heat\ shield\ deploy\ 45^0)$

$(Drag\ coefficient\ of\ heat\ shield)$

$*\ m = 0.47\ kg\ (payload)$

$*\ \rho = air\ density\ (1.225\ kg/m^3)$

Descent Rate Estimates (4/6)

Payload Parachute

We use the range of descent velocity between minimum [V min = 4 m/s] and maximum [Vmax = 6 m/s] to determine diameter of parachute

$$\sqrt{\frac{8\times m\times g}{\rho\times(v_{max})^2\times\pi\times Cd}} \leq Dp \leq \sqrt{\frac{8\times m\times g}{\rho\times(v_{max})^2\times\pi\times Cd}}$$

$$\sqrt{\frac{8\times0.47\times9.8}{1.225\times(6)^2\times3.14\times1.28}} \leq Dp \leq \sqrt{\frac{8\times0.47\times9.8}{1.225\times(4)^2\times3.14\times1.28}}$$

$$\mathbf{0.45 \leq Dp \leq 0.68}$$

Information:

$Dp =$ *The diameter of the parachute* (m)

$v =$ *Descent speed* (m/s)

$\pi = 3.14$

$g =$ *gravitational acceleration* $(9.8\ m/s^2)$

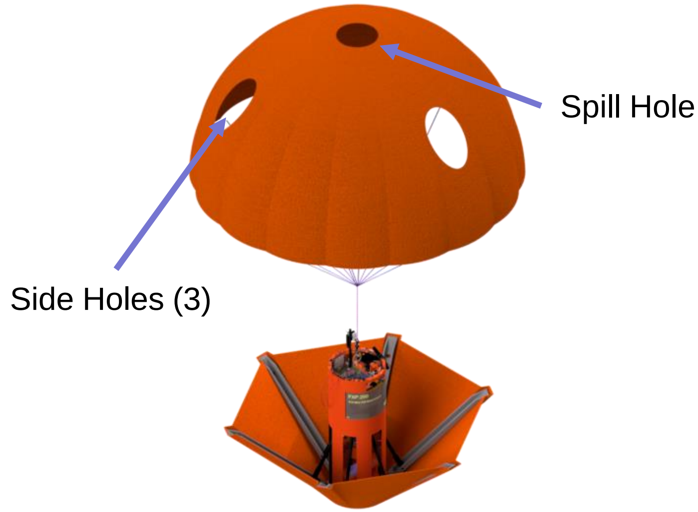
$Dsh =$ *Spill hole and side holes diameter* (m)

***Assumption**

$* \ Cd = 1.28$ (*Drag coefficient of parachute*)

$* \ m = 0.47\ kg$ (*payload*)

$* \ \rho =$ *air density* $(1.225\ kg/m^3)$



Chosen Diameter	Chosen Radius
0.547 m	**0.273 m**

Diameter of the spill hole and side holes is chosen to be 10% of the diameter of parachute

Diameter of spill hole and side holes = $Dsh = Dp \times 10\%$ = **0.0547 m**

Spill hole and side holes radius = $\frac{Dsh}{2}$ = **0.0273 m**

Descent Rate Estimates (5/6)

Information		
Container mass : 225.6 g Payload mass : 474.7 g **Total mass : 700.3 g**		
CanSat (Container + Payload) Descent Rate	**Payload Aerobraking Descent Rate**	**Payload Parachute Descent Rate**
$v = \sqrt{\frac{8 \times m \times g}{\rho \times (Dp)^2 \times \pi \times Cd}}$	$v = \sqrt{\frac{2 \times m \times g}{\rho \times (Rhs)^2 \times \pi \times Cd}}$	$v = \sqrt{\frac{8 \times m \times g}{\rho \times (Dp)^2 \times \pi \times Cd}}$
$v = \sqrt{\frac{8 \times (0.7) \times (9.8)}{1.225 \times (0.222)^2 \times (3.14) \times (1.28)}}$	$v = \sqrt{\frac{2 \times (0.47) \times (9.8)}{1.225 \times (0.155)^2 \times (3.14) \times (0.47)}}$	$v = \sqrt{\frac{8 \times (0.47) \times (9.8)}{1.225 \times (0.547)^2 \times (3.14) \times (1.28)}}$
$v = 15.03\ m/s$	$v = 14.56\ m/s$	$v = 5.00\ m/s$
		

Descent Rate Estimates (6/6)

Final Result

Parachute and Heat Shield Summary	
Altitude	**The descent rate each descent phase will be estimated using parameters**
725-500 m	Type parachute: Round parachute The diameter of container parachute: **0.222 m** Spill hole diameter: **0.0222 m** The descent speed: **15.03 m/s**
500-200 m	The radius of heat shield: **0.155 m** The descent speed: **14.56 m/s**
200-0 m	Type parachute: Round parachute The diameter of payload parachute: **0.547 m** Spill hole diameter: **0.0547 m** The descent speed: **5.00 m/s**

Container Summary

The container has a parachute to manage descent control. The parachute has a spill hole and three side holes to improve stability and maintain nadir direction.

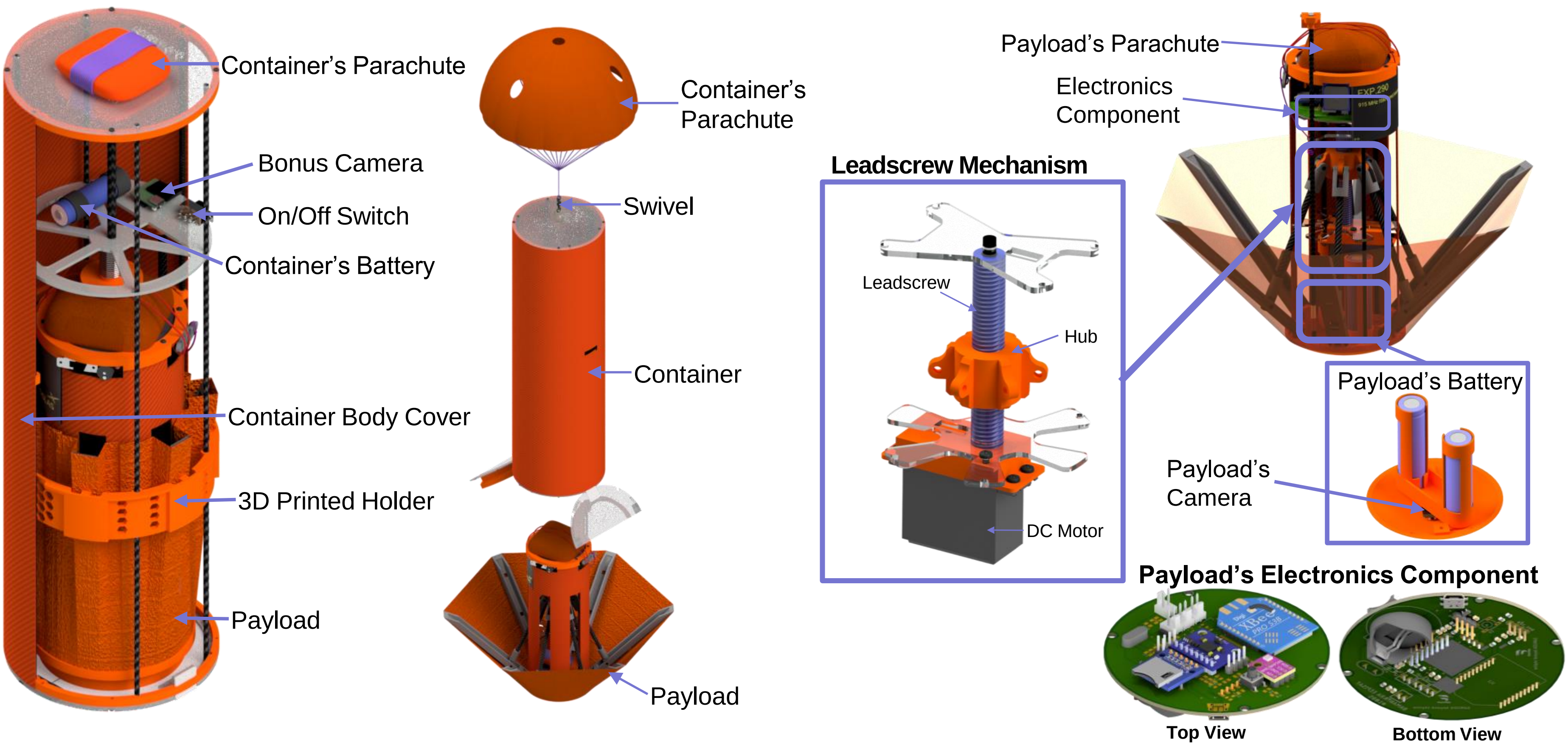
Payload Summary

The payload is using active control of aerobraking descent rate. DC motor and leadscrew mechanism are used to maintain the heat shield angle. The mass is focused at the bottom of the payload to keep stability and prevent from swaying.

Mechanical Subsystem Design

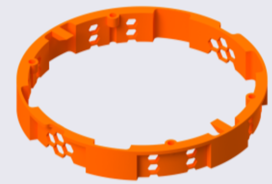
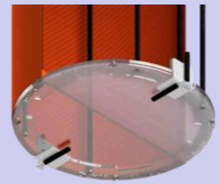
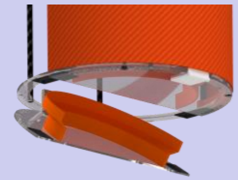
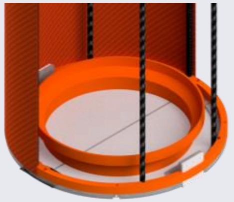
Artaka Sunu Adhi Prasetya

Mechanical Subsystem Overview

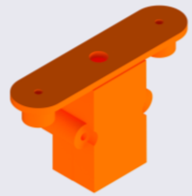
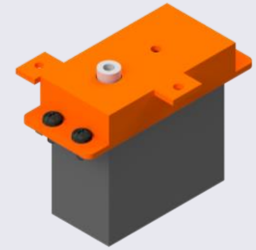
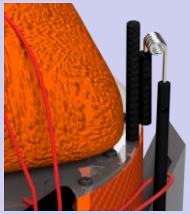
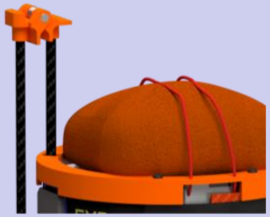


Container	Payload
Material: Polycarbonate, ABS+, Fiberglass **Parachute**: Ripstop Nylon **Note:** The container has a parachute	**Material**: ABS+, Polycarbonate, Fiberglass **Parachute**: Ripstop Nylon **Note:** The payload will be actively controlled by DC motor and leadscrew mechanism. The payload has a parachute

Mechanical Subsystem Changes Since PDR (1/3)

	Part	PDR	CDR	Rationale
Container	**3D Printed Holder**	 Long 3D Printed holder	 Shortened 3D Printed holder	Decrease mass
	Bottom Lid Locking Mechanism	 Door with torsion spring	 Velcro Locking door	Easy manufacturing process
	Bottom Holder	It doesn't exist	 Bottom holder	To prevent the payload from getting stuck in the container when release
	Material of Container	Frame : Acrylic	Frame : Polycarbonate	Greater strength, Lightweight

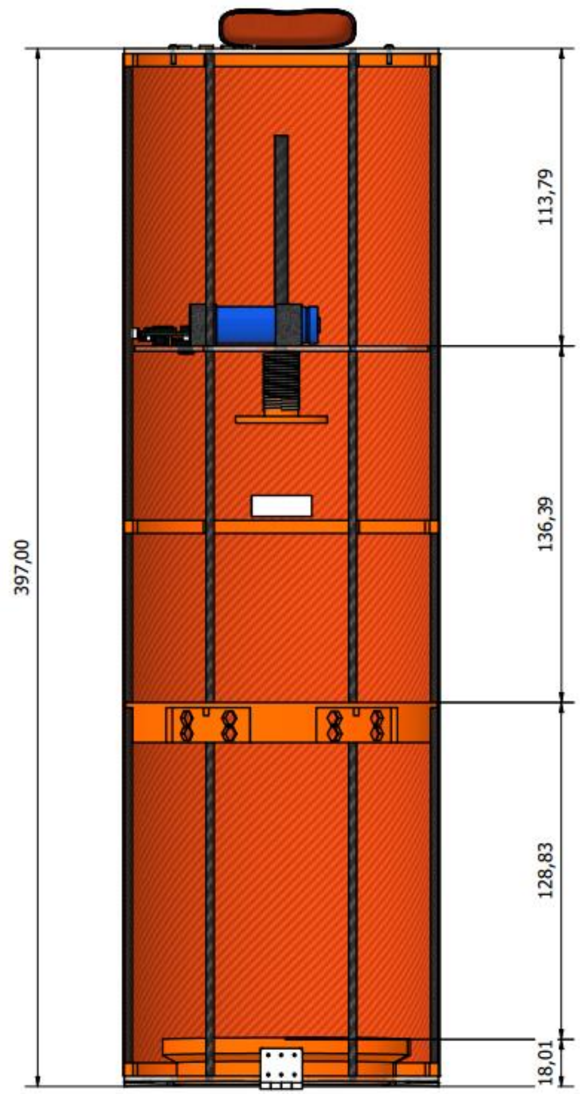
Mechanical Subsystem Changes Since PDR (2/3)

	Part	PDR	CDR	Rationale
Payload	**DC Motor Bracket**	 Compatible with small motor and gearbox	 Compatible with bigger motor and gearbox	The new version provides more torque to reduce the risk of stuck
	Flagpole Holder	 Spring Without Holder	 Spring With Holder	More sturdy and increase durability of Flagpole Holder
	Battery Holder	 Horizontal Position	 Vertical Position	Adapted to the new version of DC motor and gearbox

Mechanical Subsystem Changes Since PDR (3/3)

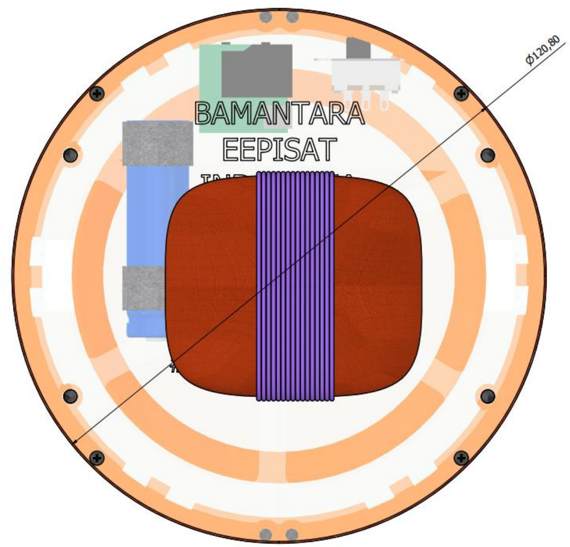
	Part	PDR	CDR	Rationale
Payload	**Material of Payload**	Leadscrew : Teflon	Leadscrew : eResin-PLA	Easy to shape and smoother surface
		Hub : ABS+	Hub : eResin-PLA	Easy to shape and smoother surface
		Frame : Acrylic	Frame : Polycarbonate	Greater strength, Lightweight

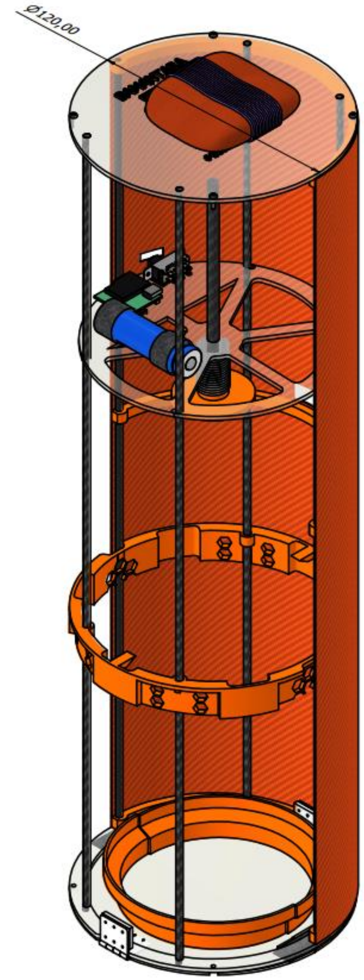
Container Mechanical Layout of Components (1/4)



CAD Model of Container Structure

Top View



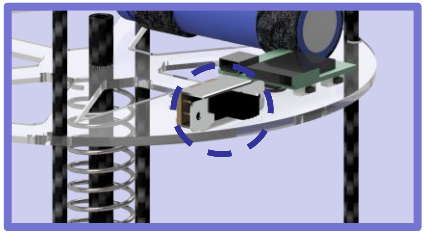


*The dimension of container and payload using technical drawing in CAD software

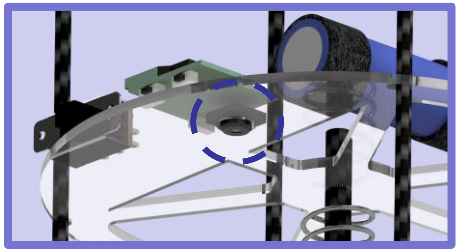
*All measurement units are in mm

Container Mechanical Layout of Components (2/4)

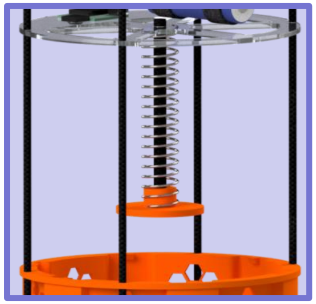
Container Major Parts and Components



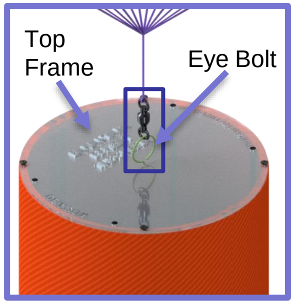
On/Off Switch



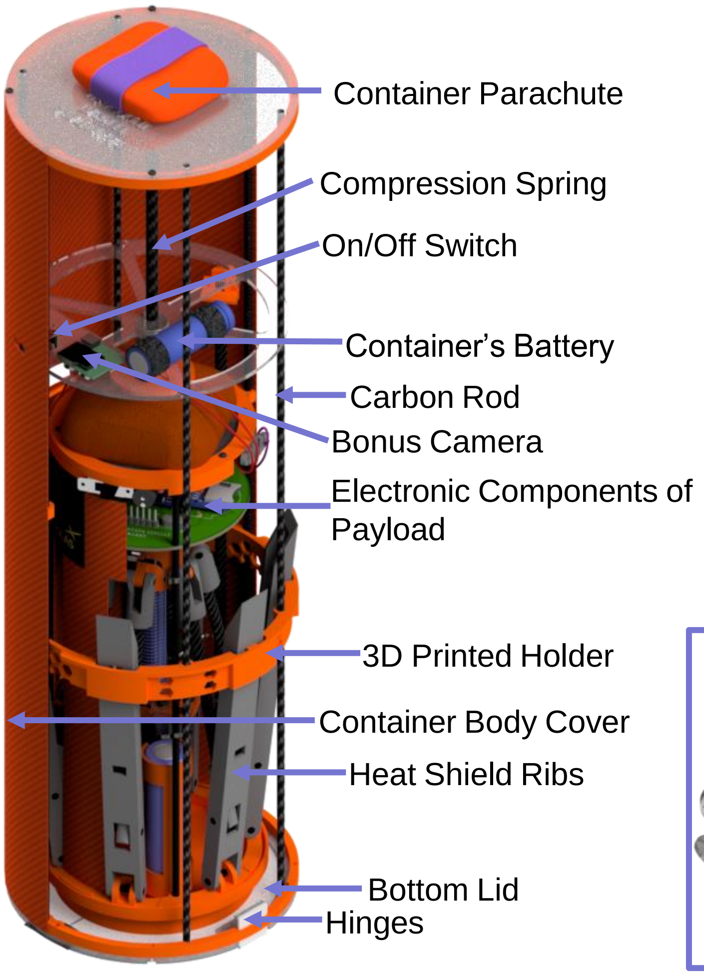
Bonus Camera

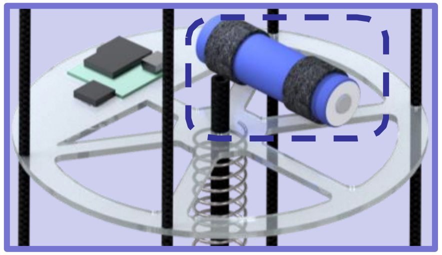


Compression Spring

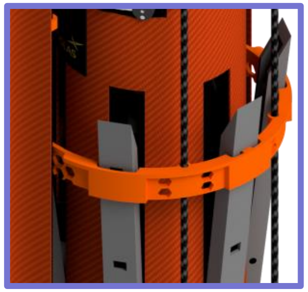


Attachment Point

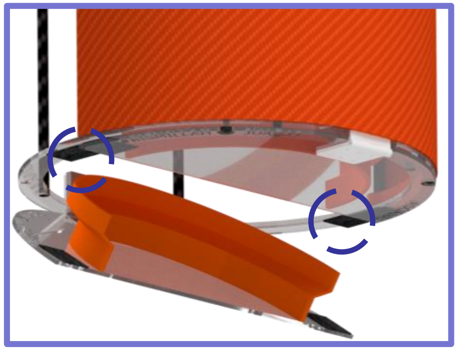




Container's Battery

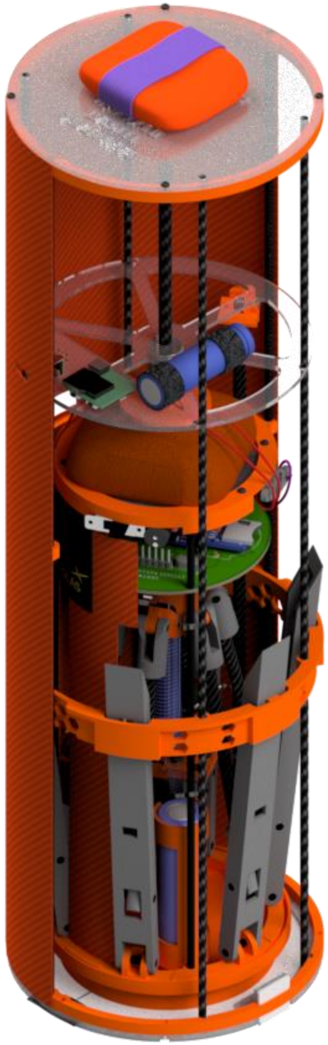


3D Printed Holder



Velcro Locking System

Container Design Key Features



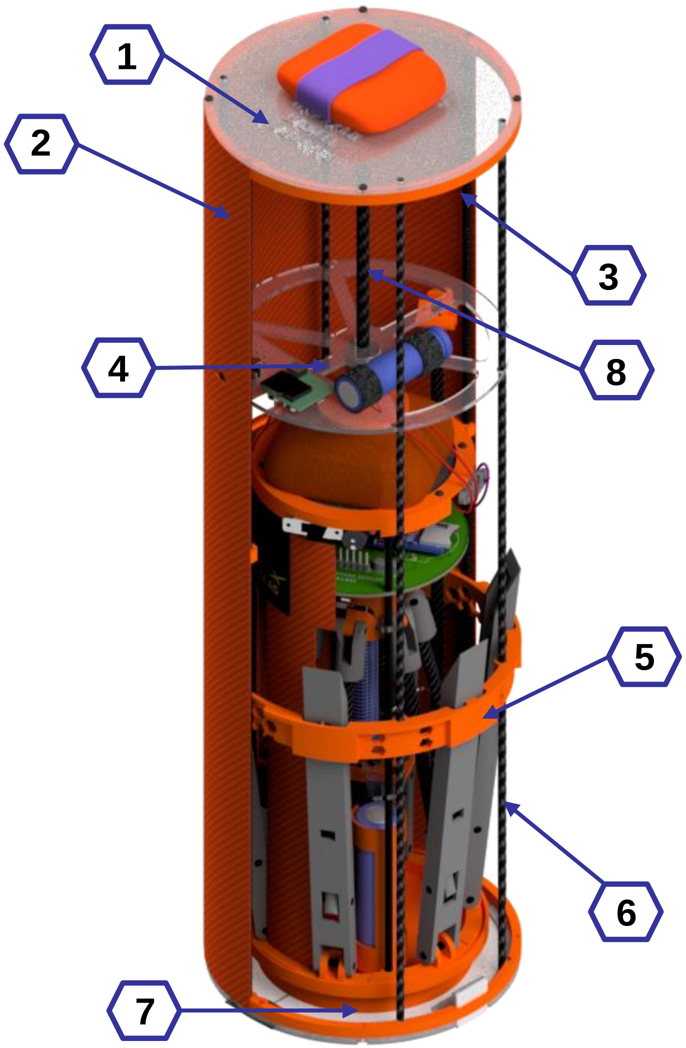
Structure and material

- Most of container material using fiberglass composite, Polycarbonate, ABS+, and carbon rod (Ø 3 mm)
- The body cover of container was assembled from the fiberglass composite, carbon rod (Ø 3 mm), and ABS+
- The carbon rod in the body cover acts as support to provides rigidity of the body cover
- Inside the container, the payload secured by 3D printed holder made of ABS+
- Container fully encloses the science payload
- Rounded edges (No sharp edges)

Functional part

- The 3D Printed holder will be used to prevent shock and vibration of the payload
- Compression Spring is used to pushes down the payload when released

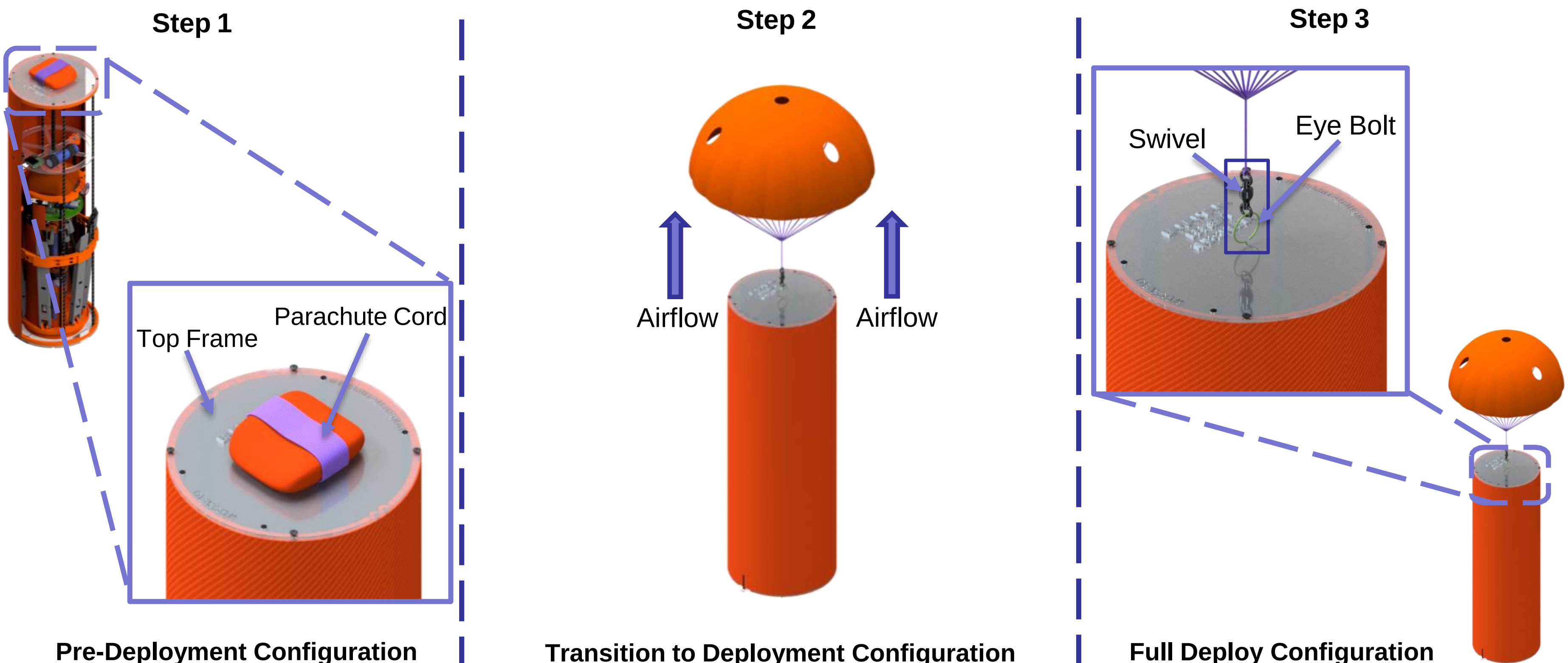
Container Mechanical Layout of Components (4/4)



Structural Material

Part	Material
[1] Top Frame [4] Spring Holder Frame [7] Bottom Lid Frame and Bottom Lid	Polycarbonate
[2] Container Body Covers	Fiberglass Composite
[3] Body Cover Frame [5] Payload Holder	ABS+ 3D Printing
[6] Longeron [8] Spring shoe	Carbon Rod

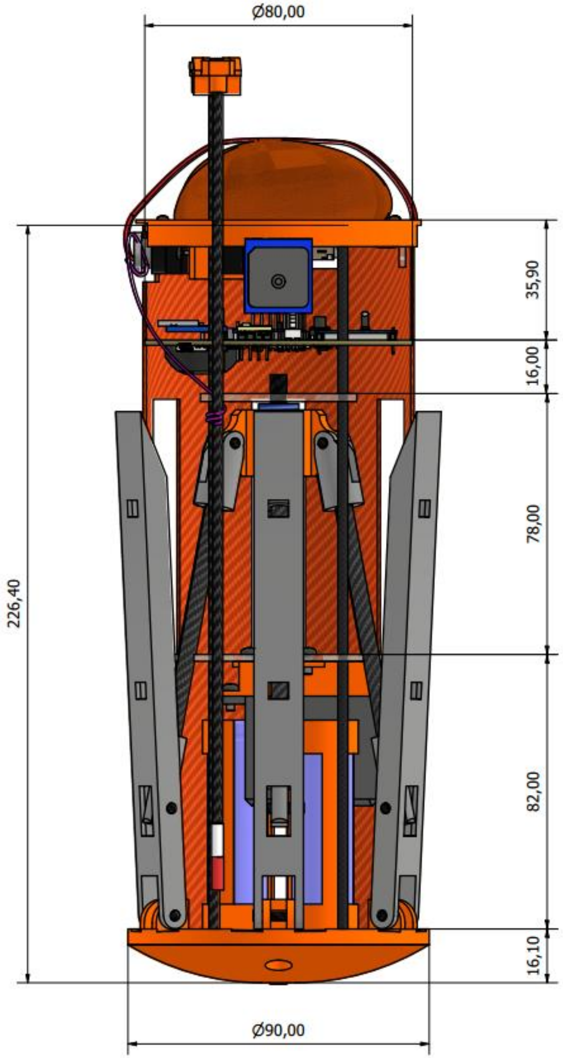
Container Parachute Attachment Mechanism

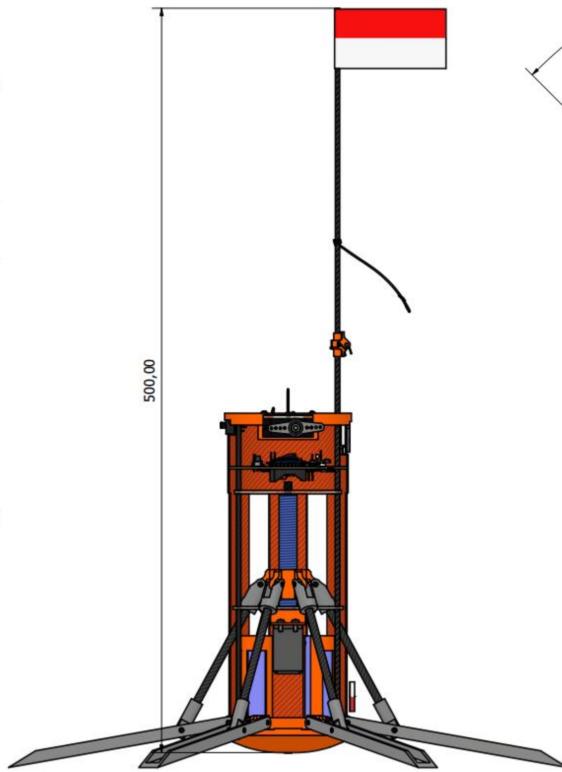


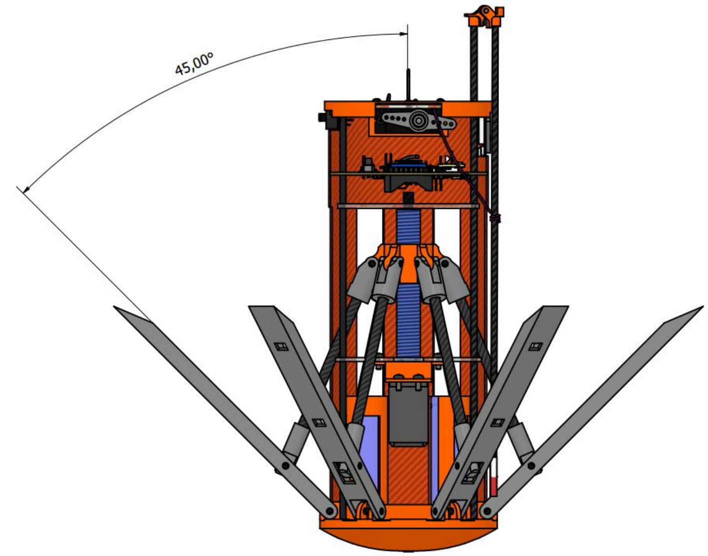
Information	
Step 1	The container's parachute is placed on the top of container at folded position
Step 2	The parachute will be opened by the air-resistance assist
Step 3	The container's parachute will be attached by a swivel and eye bolt to the top frame made of polycarbonate

Payload Mechanical Layout of Components (1/4)

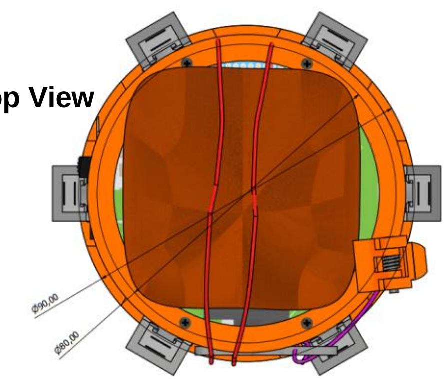
CAD Model of Payload Structure







Top View

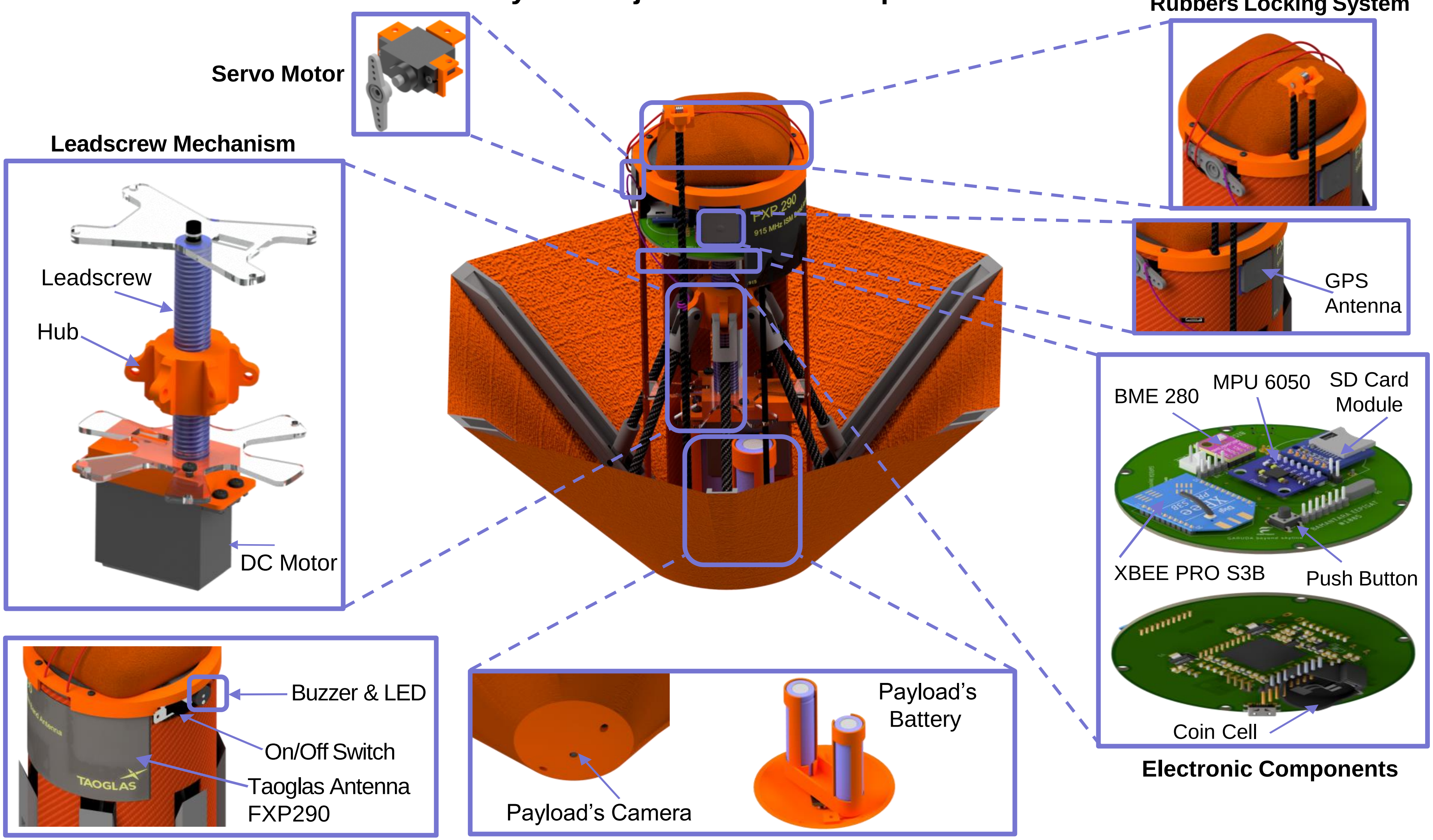


*The dimension of container and payload using technical drawing in CAD software

*All measurement units are in mm

Payload Mechanical Layout of Components (2/4)

Payload Major Parts and Component



Payload Mechanical Layout of Components (3/4)

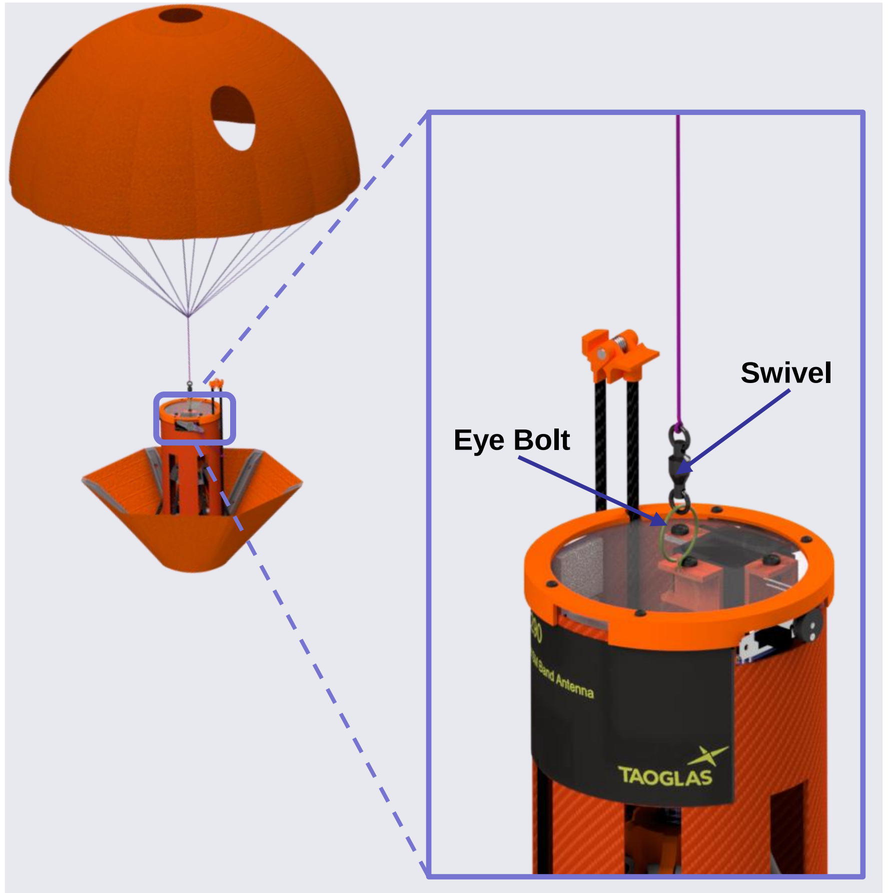
Payload Design Key Features

- Most of payload material will be made of ABS+, fiberglass composite, Polycarbonate and carbon rod (Ø 3 mm)
- The body cover of payload was assembled from the fiberglass composite
- The carbon rod in the body cover acts as support to provides the rigidity of body cover
- The payload shape like an upside down umbrella
- Payload's heatshield are made of Orange Ripstop Nylon
- Leadscrew and Hub are made of eResin-PLA

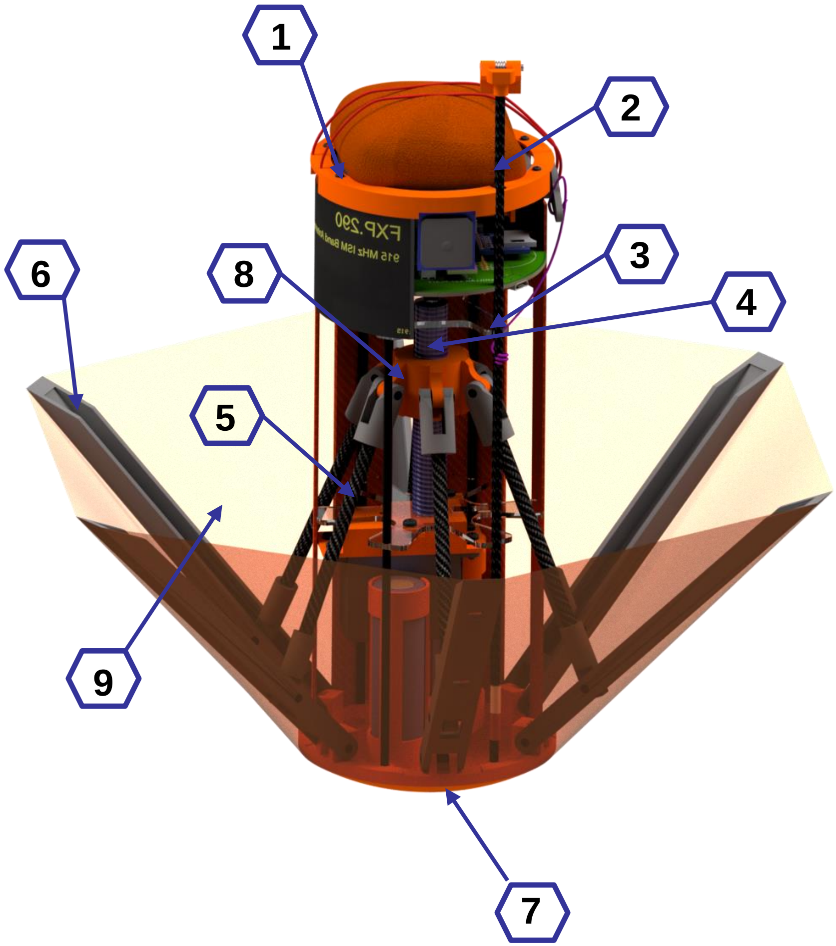
Functional part

- Electronic component such as servo are used to release parachute and flag
- DC Motor and leadscrew mechanism are used to adjust the heatshield angle

Attachment Point of Payload

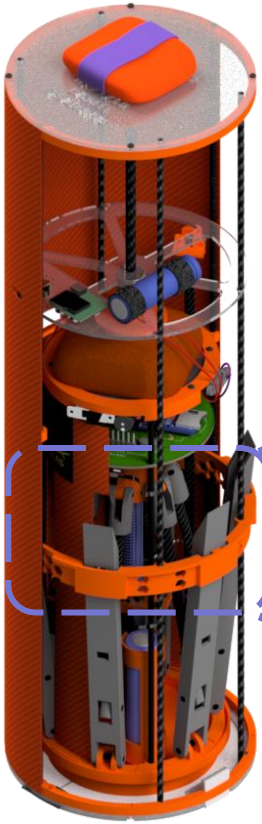


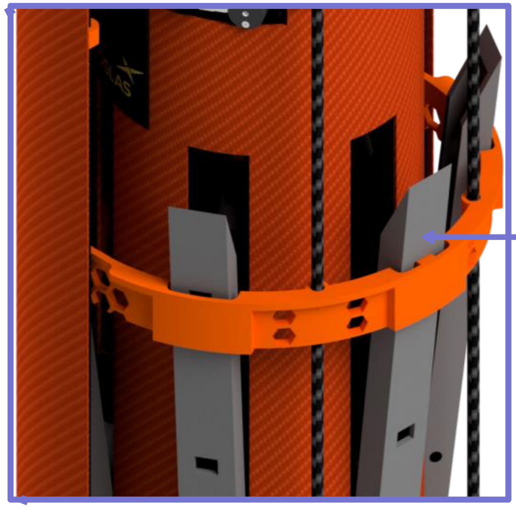
Structural Material



Part	Material
[1] Parachute Frame [3] Middle-top frame	Polycarbonate
[2] Longeron and Flagpole [5] Rib’s Connector	Carbon Rod
[4] Leadscrew [8] Hub	Resin 3D Printing
[6] Heatshield Ribs [7] Payload Nose	ABS+ 3D Printing
[9] Heat shield	Parachute Fabric (Ripstop Nylon)

Payload Pre Deployment Configuration



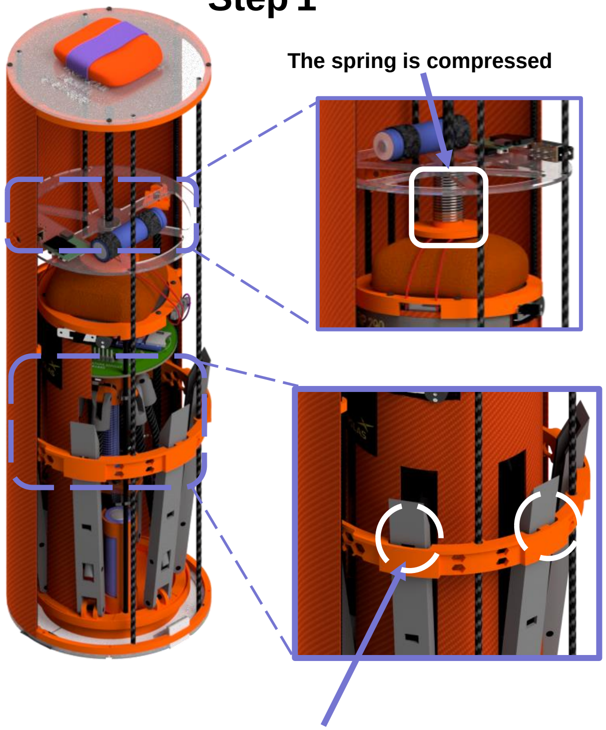


Information

1. The 3D printed holder will be made of ABS+
2. Holder is used to reduce the shock and prevent shifting while the payload is stowed
3. The holder has a shape that matches with the payload shape
4. In the pre-payload deployment condition, the ribs will hook onto the holder to lock the payload into position

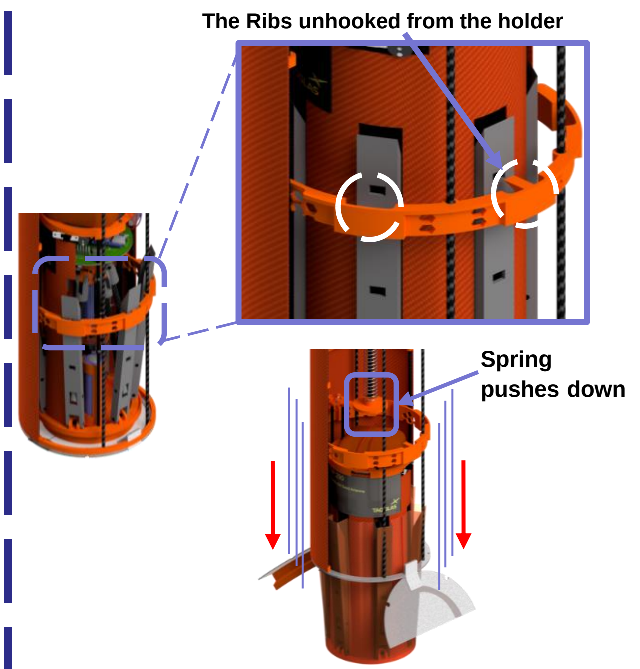
Payload Aerobraking Deployment Configuration

Step 1



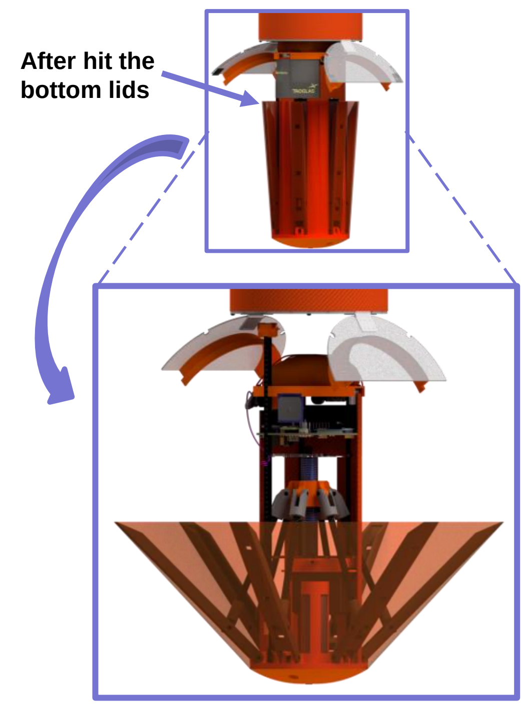
Payload Ribs Stowed Position

Step 2



Payload Ribs Transition From Stowed Position

Step 3



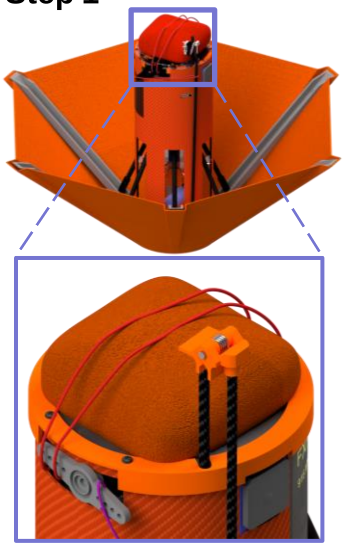
Payload Deployment Position

Information

The payload will be released when the heat shield ribs unhooks from the 3D printed holder with DC motor and leadscrew mechanism. After the ribs is unhooked from the holder, the spring in the container will push the payload out from the container. After that, DC motor will rotate to moves the hub downward to open up the heat shield.

Payload Parachute Deployment Configuration

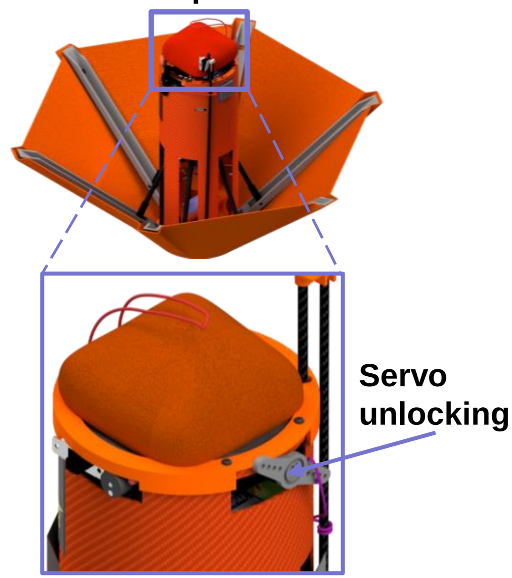
Step 1



Rubber locking system

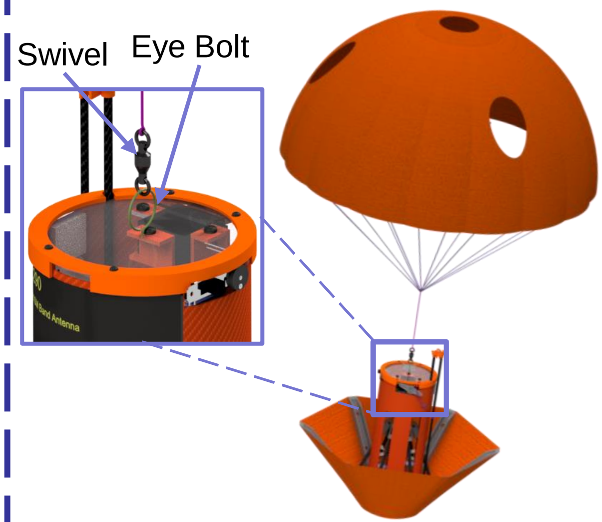
Stowed Position

Step 2



Transition to Release Position

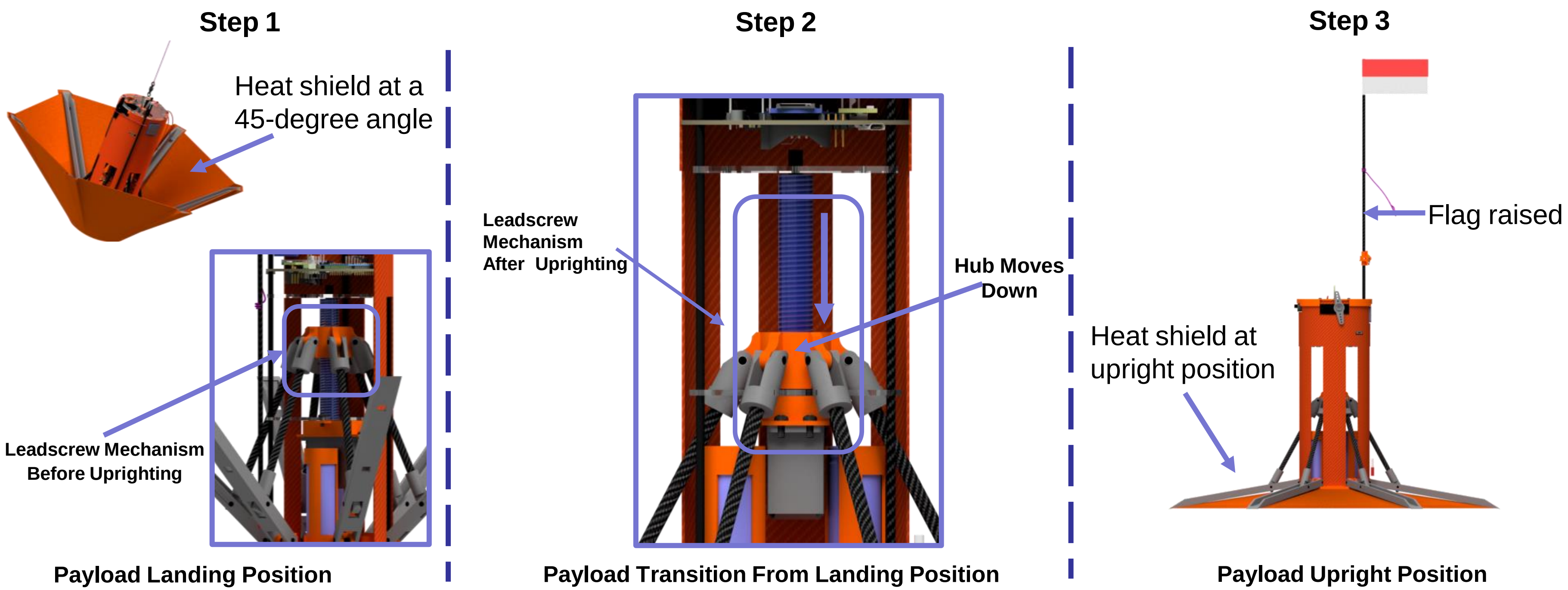
Step 3



Fully Deployed Position

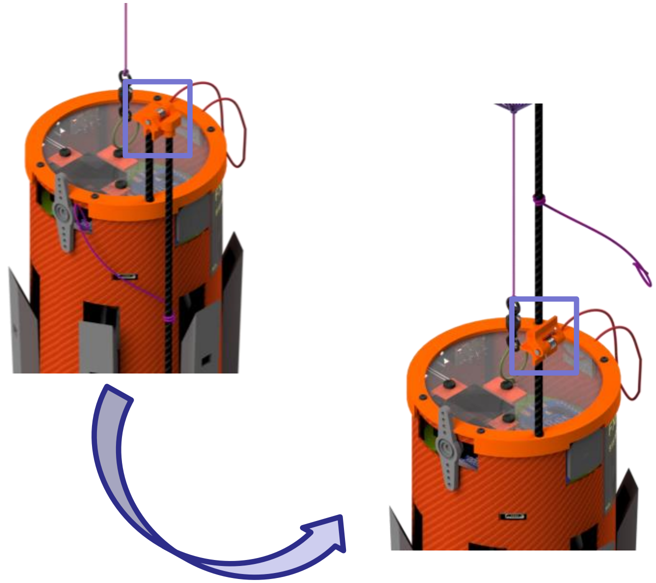
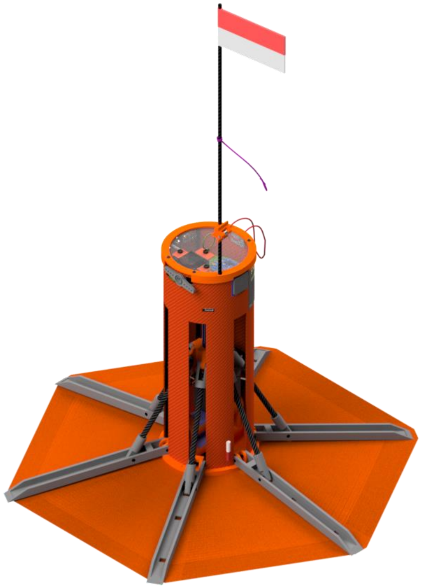
Information	
Step 1	The payload parachute is placed on the top frame of the payload in a folded position and is attached by an eye bolt to the payload. The eye bolt is attached to the parachute frame and hard-glued. The rubber keeps the payload parachute on the top frame before release. The payload parachute is connected to the eye bolt with a swivel as a connector
Step 2	At 200 m, servo actives and the rubber will be released
Step 3	After the rubber is released, the payload parachute deployed from the payload

Payload Uprighting Description



Information	
Step 1	The payload, which landed on the ground, uses a leadscrew mechanism to upright itself
Step 2	The leadscrew rotates to move the hub downward to adjust the heat shield ribs to upright position
Step 3	After the hub moved downward, the payload is in an upright position. Then, the servo is activated to release a cord that raises the flag

Payload Flag Deployment Configuration

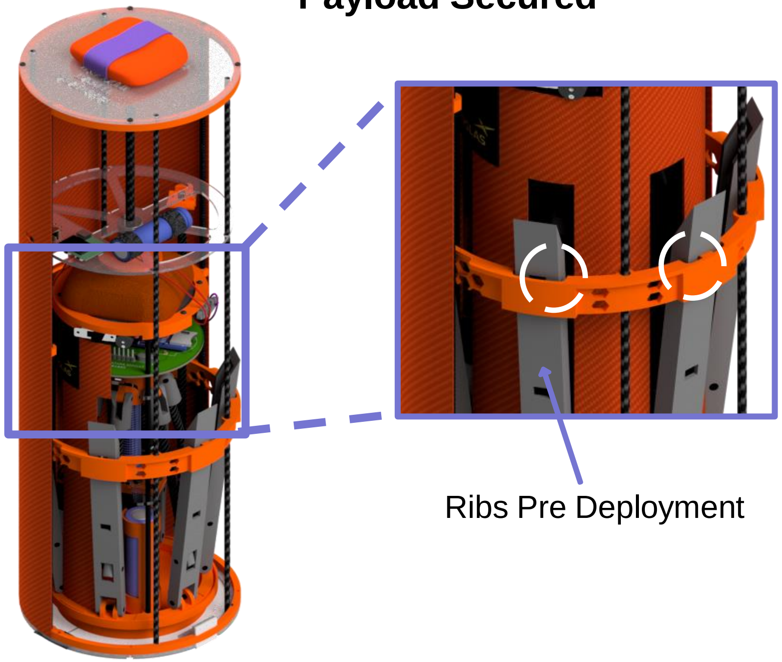
Step 1	Step 2	Step 3
		
Payload Flag Stowed Position	**Payload Transition From Flag Stowed Position**	**Payload Flag Deployed Position**

Information

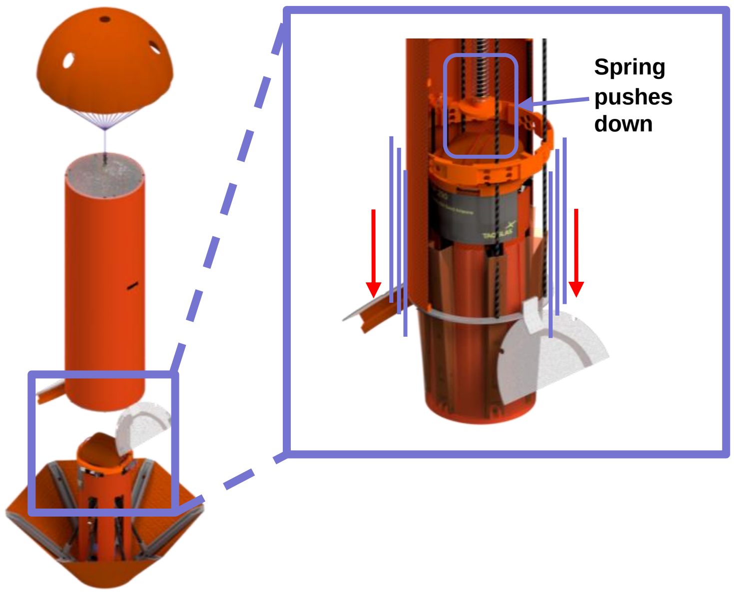
The flagpole will be attached by a 3D-printed holder to connect to the carbon rod. The flag (made from fabric) will be sewn and securely glued to the carbon rod. After the payload is in an upright position, the servo is activated to release a cord that raises the flag 500 mm above the base of the payload. The torsion spring causes a rotation of the flagpole from the stowed position to the deployed position.

Container Payload Mount

Payload Secured



Payload Mechanical Deployed Configuration



Information

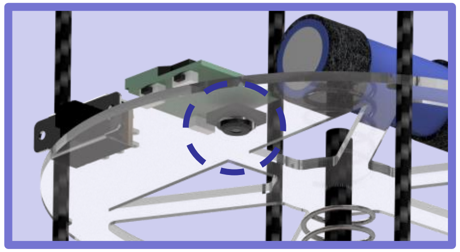
Payload is secured inside container using 3D printed holder. The holder is used to reduce the shock and prevent shifting while the payload is stowed.

Information

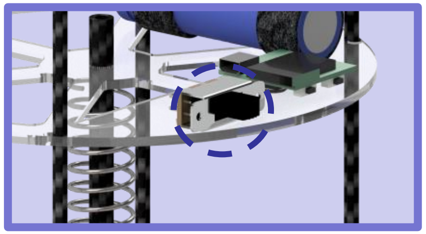
Payload can be deployed when the heat shield ribs unhooks from the 3D printed holder with DC motor and leadscrew mechanism. After the ribs is unhooked from the holder, the spring in the container will push the payload out from the container.

Structure Survivability (1/3)

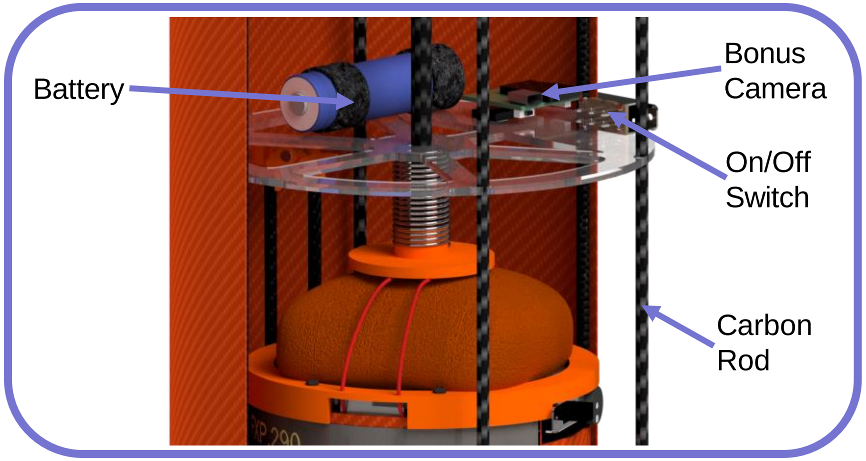
Container



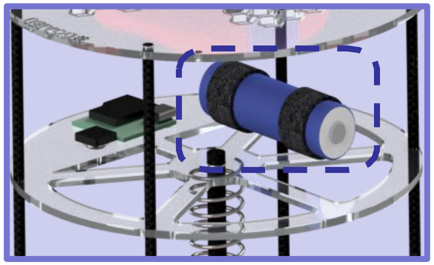
Bonus Camera



On/Off Switch



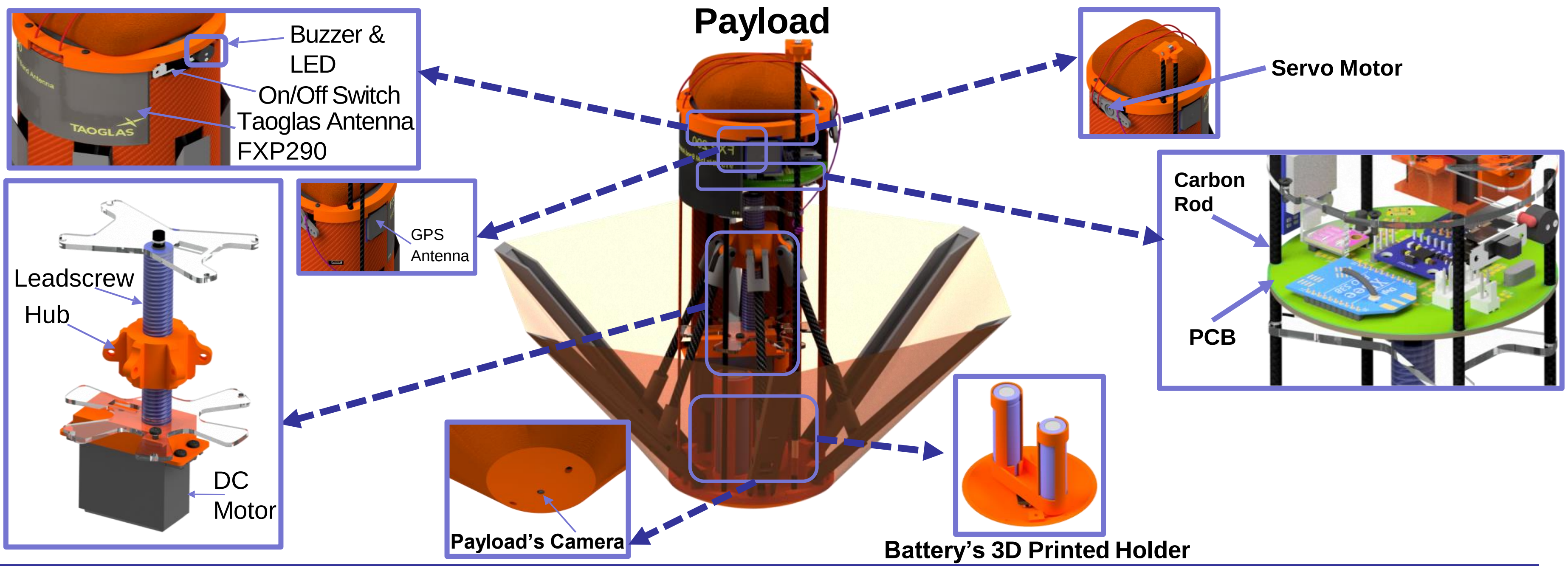
Electronics Component



Container's Battery

Mounting Method	Enclosures	Connection	Descent Control Attachment
1. Container's battery is mounted using battery strap	1. The battery of the container, bonus camera, On/Off Switch is fully enclosed inside its structural body	1. Bonus camera and On/Off Switch will be jumpered and secured to the battery	1. The descent rate of the container will be provided by the parachute connected to the swivel and eye bolt.

Structure Survivability (2/3)



Mounting Method	Enclosures	Connection	Descent Control Attachment
1. Payload's PCB is secured by carbon rod as standoffs.	1. Payload's PCB will be fully enclosed inside its structural body. 2. The battery of the payload will be kept by 3D printed holder to ease battery access.	1. Connectors of electronic components will be soldered and hot glued to the PCB. 2. Payload batteries, camera, On/Off Switch, Taoglas Antenna FXP290, DC Motor, and Servo Motor will be jumpered and secured to the electronic component.	1. The Payload's descent will be provided due to the payload mechanism using DC Motor and Leadscrew. 2. To open the rubber and flag mechanism, a servo will be used.

Structure Survivability (3/3)

Acceleration and Shock Forces Requirements Testing

Documentations

Requirement
CanSat survived given acceleration and shock force from 61cm feet attached to Cord. No electrical mounts disconnected, no parts falling off and no separation.

Testing
1. Attach 61cm cord to first parachute 2. Add a floor mat or pillow below the test fixture 3. Drop the CanSat 4. Observe if any parts of the CanSat fall apart

Results
The CanSat did not lose power. Inspect for any damage, or detached parts and verify telemetry is still being received.

Mass Budget (1/4)

Container-Electrical Component					
Component	**Quantity**	**Determination**	**Mass Unit (g)**	**Mass (g)**	**Margins (g)**
Soshine 14500 Battery	1	Measured	21	21	
Quelima SQ11	1	Measured	3.9	3.9	
Cable and Connector	2	Measured	2.3	4.6	
On/Off Switch	1	Measured	2	2	
Total Mass Electrical Component of Container				**31.5**	**0**

Container-Structural Component					
Component	**Quantity**	**Determination**	**Mass Unit (g)**	**Mass (g)**	**Margins (g)**
Top Frame	1	Measured	24.9	24.9	
Bottom Lid Frame	1	Measured	4.9	4.9	
Bottom Lid	2	Measured	15.6	31.2	
Spring Holder Frame	1	Measured	11.9	11.9	
Carbon Rod 397 mm	8	Measured	4.3	34.4	
Hinges	2	Measured	0.6	1.2	
Parachute	1	Measured	6.3	6.3	
Container's Body Cover	2	Estimated	28.5	57	11.4
3D Printed Holder	1	Measured	13.5	13.5	
Compression Spring	1	Measured	3.7	3.7	
Bolt	8	Estimated	0.1	0.8	0.16
Spring Shoe	1	Measured	4.3	4.3	
Total Mass Structural Component of Container				**194.1**	**11.56**

Note: Due to the complexity of overall system, mass estimation is derived from the 20% of its estimated value.

Mass Budget (2/4)

Payload-Electrical Component					
Component	**Quantity**	**Determination**	**Mass Unit (g)**	**Mass (g)**	**Margins (g)**
Olight 18650 Battery	2	Measured	49.5	99	
STM32F407VGT6	1	Estimated	2	2	0.4
MG90 Servo Motor	1	Measured	14.6	14.6	
MPU 6050	1	Measured	1.6	1.6	
XBEE Pro S3B	1	Measured	6.4	6.4	
BN-220	1	Measured	5.6	5.6	
BME280	1	Measured	1	1	
Taoglas Antenna FXP290	1	Measured	1.5	1.5	
Buzzer	1	Measured	5	5	
DC Motor	1	Measured	50	50	
On/Off Switch	1	Measured	2	2	
Limit Switch	2	Measured	0.5	1	
Quelima SQ11	1	Measured	3.9	3.9	
PCB	1	Measured	13.7	13.7	
SD Card Module	1	Measured	1.5	1.5	
3 mm LED	1	Measured	0.4	0.4	
Coin Cell Battery	1	Measured	4	4	
Cable and Connector	6	Measured	2.3	13.8	
Driver Motor MX	1	Measured	4	4	
Total Mass Structural Component of Payload				**230.4**	**0.4**

Note: Due to the complexity of overall system, mass estimation is derived from the 20% of its estimated value.

Mass Budget (3/4)

Payload-Structural Component					
Component	**Quantity**	**Determination**	**Mass Unit (g)**	**Mass (g)**	**Margins (g)**
Payload's Body Cover	1	Estimated	28.4	28.4	5.68
Carbon Rod 216 mm	4	Measured	2.3	9.2	
Parachute Frame	1	Measured	10.9	10.9	
Rubber	2	Measured	0.3	0.6	
Payload Middle-top frame	1	Measured	4	4	
Payload Middle-bottom frame	1	Measured	5.1	5.1	
Payload's Nose	1	Measured	27	27	
Leadscrew	1	Measured	5.8	5.8	
Hub	1	Measured	11.7	11.7	
Parachute	1	Measured	38.3	38.3	
Ribs Assembly	6	Measured	12.1	72.6	
Heat Shield	1	Measured	6.8	6.8	
DC Motor Bracket	1	Measured	4.5	4.5	
Torsion Spring	1	Measured	0.3	0.3	
Carbon Rod 250 mm (Flagpole)	1	Measured	3.8	3.8	
Battery Holder	1	Measured	9.2	9.2	1.84
Flag	1	Estimated	1	1	0.2
Bolt	15	Estimated	0.1	1.5	0.3
Servo Holder	1	Measured	3	3	
Total Mass Structural Component of Payload				**243.7**	**8.02**

Note: Due to the complexity of overall system, mass estimation is derived from the 20% of its estimated value.

Mass Budget (4/4)

RN 1: Total mass of the CanSat (science payload and container) shall be 700 grams ±10 grams

Total Mass	
Container	225.6 ± 11.56 g
Payload	474.7 ± 8.42 g
Total Mass of All System	**700.3 ± 19.98 g**

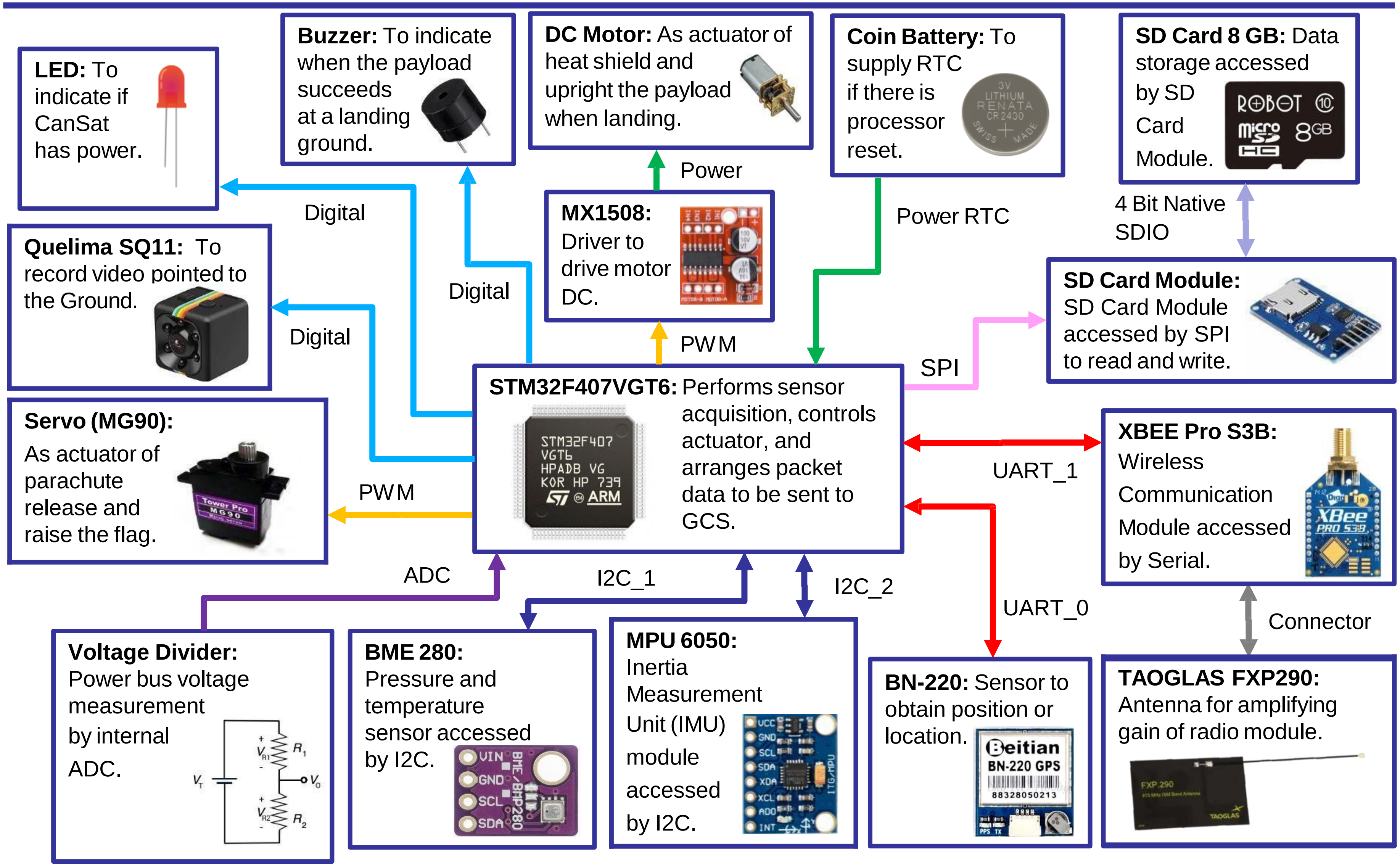
Margin
Mass Competition Requirement – Total Mass of All System = Margin **700 – 700.3 = -0.3 g (Fulfill Mass Tolerance)** Uncertainties = ± 19.98 g

Correction Method (Margin Competition ± 10 g)	
If total mass system < 690 grams	We will increase the mass of materials using higher infill density of 3D printed material for container or payload.
If total mass system > 710 grams	We will change the material with lighter material such as composite that has lower density for container and payload.

Communication and Data Handling (CDH) Subsystem Design

Achmad Bagus Okto Faerizqi

CDH Overview



CDH Changes Since PDR

Part	PDR	CDR	Rationale
There were no changes to the Communication and Data Handling Subsystem Design			

Payload Processor & Memory Selection (1/2)

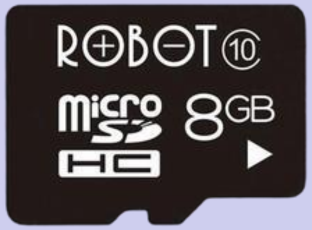
Model	Processor Speed (MHz)	Operating Voltage (V)	Data Interfaces (Types & Numbers)		Memory Storage
STM32F407VGT6 Minimum System	168	3.3	Digital Pin (82) PWM Pin (12)	Serial Pin (6) SPI Pin (3) I2C Pin (3)	EEPROM 4Kb Flash 1Mb RAM 192Kb

Data Bus Width (bit)	Power Consumption (mW)	Mass (g)	Size (mm)	Boot Time (s)	Cost ($)
32	127.512	1.4	14 x 14	0.001	15.00

Selected Processor	Reasons
 **STM32F407VGT6 Minimum System ✓**	• Fast boot time • It's a powerful microcontroller with many GPIOs • It's smaller and can be assembled to a customized minimum system

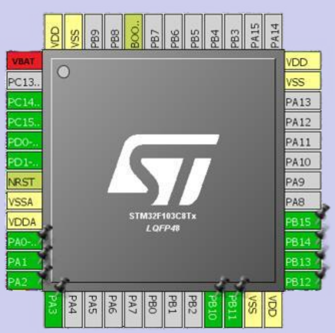
Payload Processor & Memory Selection (2/2)

Model	Memory (GB)	Interface	Data Transfer Rate		Cost ($)
			Write (MB/s)	Read (MB/s)	
ROBOT Micro SD	8	SD Card Interface	45	45	3.22

Selected Memory	Reasons
 **ROBOT Micro SD ✓**	• Stable data transfer rate • More reliable and easy to use • It has a great performance

Payload Real-Time Clock

Model	Operating Voltage (V)	Operating Current	Reset Tolerance	Accuracy (ppm)	Cost ($)
Built-in STM32F407VGT6	3.3	Built-in	In reset conditions, the software reads the last data from the RTC register value	± 20	0

Selected RTC		Reasons
 	**Built-in STM32F407VGT6 ✓**	• Minimize board size because it's included in STM32F407VGT6 • No cost (included in STM32F407VGT6) • Easy to use

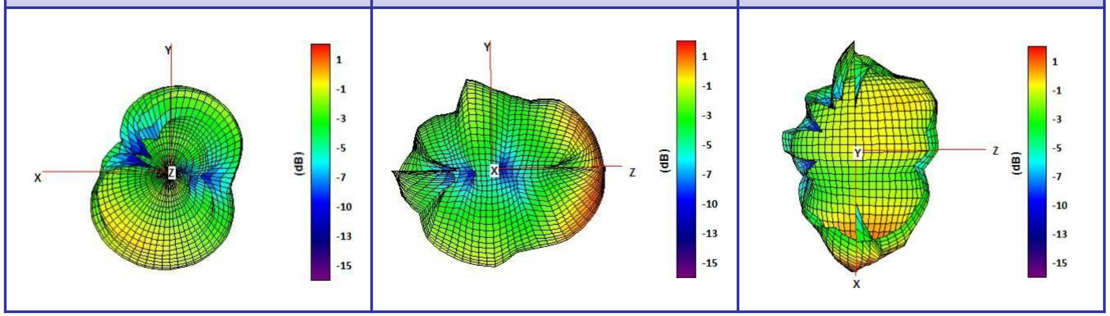
Payload Antenna Selection

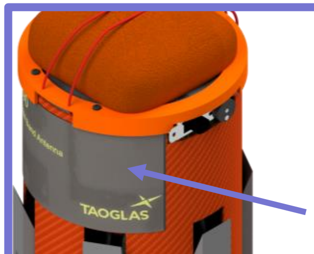
Payload-to-Ground link

Model	Range (km)	Frequency (MHz)	Gain (dBi)	Connector	Size (mm)	Mass (g)	Cost ($)
Taoglas FXP290	11.67	915	1.5	Micro FL	75.4 x 45.4	1.5	17.05

Radiation Patterns of Taoglas FXP290

XY	YZ	XZ



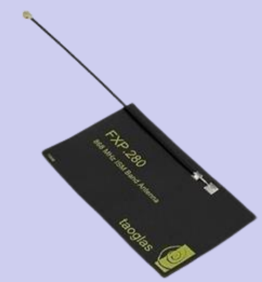


Taoglas Antenna FXP290

We have already test this antenna using several methods such as range test using vehicle. As the results are 2 km on average.

* The antenna is located at payload’s body

Selected Antenna



Taoglas FXP290 ✓

Reasons

- Can be placed to XBEE using a small micro FL
- Lightweight and small
- Affordable

Payload Radio Configuration (1/2)

Payload-to-Ground XBEE Radio Selection

Model	Supply Voltage (V)	Mass (g)	Frequency (MHz)	Cost ($)
XBEE Pro S3B	3.0 – 3.6	5.2	915	57.52

Range (km)	Sensitivity (dBm)	Receive Current (mA)	Transmit Current (mA)	Transmit Power (mW)
14	-107	26	215	250

Selected Radio	Reasons
 **XBEE Pro S3B ✓**	• Highest sensitivity • Better range than other XBEE • We have experience working with this radio module

Payload Radio Configuration (2/2)

Overview of Radio Configuration
• As presented in the slide above we are using one “XBEE Pro S3B” for radio communication device from payload to GCS • We are using NETID 1085 because our team ID is 1085

Transmission Control
1. The payload telemetry data will be transmitted to the GCS @1Hz 2. The payload will start sending data when commanded by GCS using command “CMD,1085,CX,ON” 3. The transmission of payload packet data will commence at the payload’s **LAUNCH_WAIT** state. Before **LAUNCH_WAIT** state, the payload remains idle 4. When the CanSat landed, the payload will stop sending data to the GCS 5. If somehow the STM32F407VGT6 runs into reset, it will recover the last packet count from SD Card, so the packet counting doesn’t reset

Payload Telemetry Format (1/2)

Payload Telemetry Data		
Data Format	**Sample Data**	**Description**
<TEAM_ID>	1085	The assigned team identification number. Our team ID is 1085
<MISSION_TIME>	00:09:02.22	UTC time in format hh:mm:ss.ss, where hh is hours, mm is minutes, and ss.ss is seconds (including hundredth of second)
<PACKET_COUNT>	12	The total count of transmitted packets since turn on, which is to be reset to zero by command when the CanSat is installed in the rocket on the launch pad at the beginning of the mission and maintained through processor reset
<MODE>	F	The ASCII character 'F' for flight (the default mode upon system start) and 'S' for simulation
<STATE>	LAUNCH_WAIT	The operating state of the payload
<ALTITUDE>	100.1	The payload altitude in units of meters and must be relative to ground level. The resolution must be 0.1 meters
<HS_DEPLOYED>	P	The ASCII character 'P' indicates the payload with heat shield deployed, 'N' otherwise
<PC_DELPLOYED>	C	The ASCII character 'C' indicates the payload parachute is deployed (at 200m), 'N' otherwise
<MAST_RAISED>	M	The ASCII character 'M' indicates the flag mast has been raised after landing, 'N' otherwise
<TEMPERATURE>	28.9	The payload temperature in units degrees Celsius. The resolution must be 0.1 degrees C
<VOLTAGE>	3.1	The payload power bus voltage in units volts. The resolution must be 0.1 V

Payload Telemetry Format (2/2)

Payload Telemetry Data		
Data Format	**Sample Data**	**Description**
<PRESSURE>	100.1	The payload air pressure of the sensor used in units kPa. The resolution must be 0.1 kPa
<GPS_TIME>	00:09:02	The time generated by the GPS receiver. The time must be reported in UTC and have a resolution of a second
<GPS_ALTITUDE>	100.2	The altitude generated by the GPS receiver in meters above mean sea level with a resolution of 0.1 meters
<GPS_LATITUDE>	17.0199	The latitude generated by the GPS receiver in decimal degrees with a resolution of 0.0001 degrees North
<GPS_LONGITUDE>	189.0077	The longitude generated by the GPS receiver in decimal degrees with a resolution of 0.0001 degrees West
<GPS_SATS>	5	The number of GPS satellites being tracked by the GPS receiver. This must be an integer number
<TILT_X, TILT_Y>	1.12, 2.12	The angle of the CanSat X and Y axes in degrees, with a resolution of 0.01 degrees, where zero degrees is defined as when the axes are perpendicular to the Z axis which is defined as towards the center of gravity of the Earth
<CMD_ECHO>	CXON	The fixed text command id and argument of the last received command with no commas
<CHECKSUM>	205	The checksum is total value each data packet is send to GCS at 1Hz, to correct the data receive

Payload Data Format will be transmitted @1 Hz to the GCS
1085,15:00:10.01,100,F,LAUNCH_WAIT,100.1,P,C,M,30.0,100.1,3.1,00:09:02,100.2,17.0199,189.0077,7,1.12,2.12,CXON,,205

Payload Command Formats (1/2)

Type of Command	Command Format	Description	Example Data
ST: Set Time	CMD, <TEAM_ID>, ST, <UTC_TIME>	• CMD and ST are static text • <TEAM ID> is the assigned team identification • <UTC_TIME> is UTC time in the format hh:mm:ss	The command CMD,1085, ST,13:50:02 sets the mission time to the value given
SIM: Simulation Mode Control Command	CMD, <TEAM_ID>, SIM, <MODE>	• CMD and SIM are static text • <TEAM_ID> is the assigned team identification • <MODE> is the string ‘ENABLE’ to enable the simulation mode, ‘ACTIVATE’ to activate the simulation mode, or ‘DISABLE’ which both disables and deactivates the simulation mode	Both the CMD,1085,SIM,ENABLE and CMD,1085,SIM,ACTIVATE commands are required to begin simulation mode
CX: Payload Transmission On/Off	CMD, <TEAM_ID>, CX, <ON_OFF>	• CMD is static text • CX are static text indicating to control telemetry for payload • <TEAM ID> is the assigned team identification • <ON_OFF> is the string ‘ON’ to activate the science payload transmissions and ‘OFF’ to turn off the transmissions	CMD,1085,CX,ON will trigger the payload to begin telemetry transmissions. CMD,1085,CX,OFF will trigger the payload to stop telemetry transmissions

Payload Command Formats (2/2)

Type of Command	Command Format	Description	Example Data
SIMP: Simulated Pressure Data (to be used in Simulation Mode only)	CMD, <TEAM_ID>, SIMP, <PRESSURE>	• For testing purpose only • CMD and SIMP are static text • <TEAM ID> is the assigned team identification • <PRESSURE> is the simulated atmospheric pressure data in units of pascals with a resolution of one pascal	CMD,1085,SIMP,101325 provides a simulated pressure reading to the payload (101325 Pascals = approximately sea level) **Note**: only in simulation mode
CAL: Payload reset and calibration	CMD, <TEAM_ID>, CAL	• CMD and CAL are static text • <TEAM ID> is the assigned team identification	CMD,1085,CAL will reset the microcontroller on payload to set new mission reference

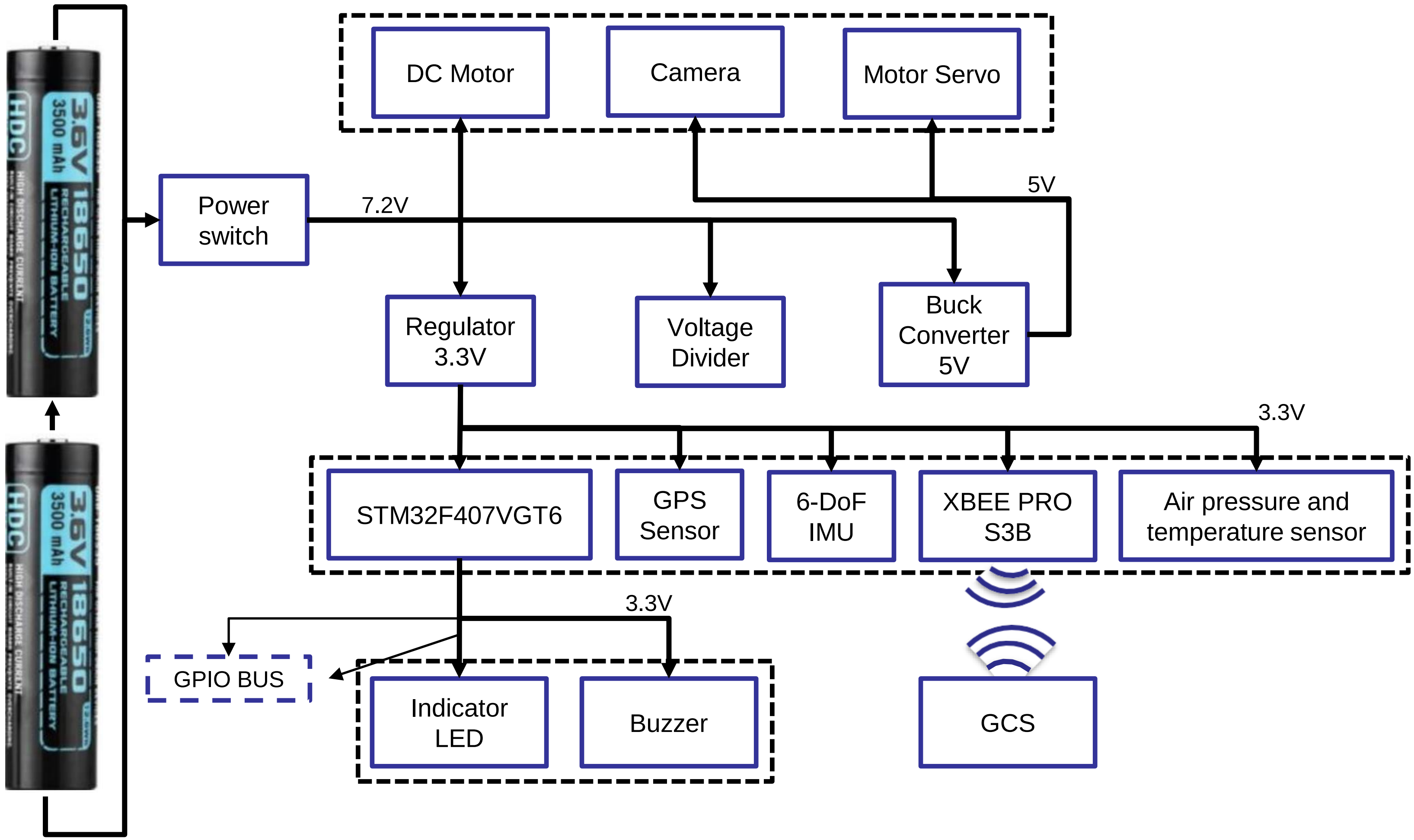
Electrical Power Subsystem Design

Achmad Bagus Okto Faerizqi

EPS Overview (1/2)

Component	Purpose
Power	• All components in the payload are powered by two Olight 18650 3.6V batteries connected series. The total voltage is 7.2V • Real-Time Clock (RTC) power is provided by a 3V coin battery • The payload will be reset and power connected and disconnected using an external on/off switch • All of the sensors and the XBEE in the payload are powered by the 3.3V regulator
MCU	• STM32F407VGT6 will operate all actuators and collect all sensor data. It will be supplied by 3.3V output from the regulator • SD Card will save all sensor data • RTC will keep mission time in case of a sudden reset
Sensors	• BME280 will collect temperature and pressure data. It will be supplied by 3.3V from the voltage regulator • The MPU6050 will collect orientation data. It will be supplied by 3.3V from the voltage regulator • The voltage divider will take battery voltage data. It will be connected to 7.2V from the batteries
Actuators	• The heat shield will be opened using a DC motor. It will receive 7.2V as power direct from the battery • The camera will be used to record terrain. It will be supplied by 5V from the buck converter • The LED indicator will turn on to show that the system is active. It will receive 3.3V from a GPIO pin as power • The servo will be used to deploy the parachute and the flag. It will be supplied by 5V from the buck converter
Communications	Data will be sent and received from the GCS by XBEE Pro S3B. The voltage regulator will provide 3.3V to power it

EPS Overview (2/2)

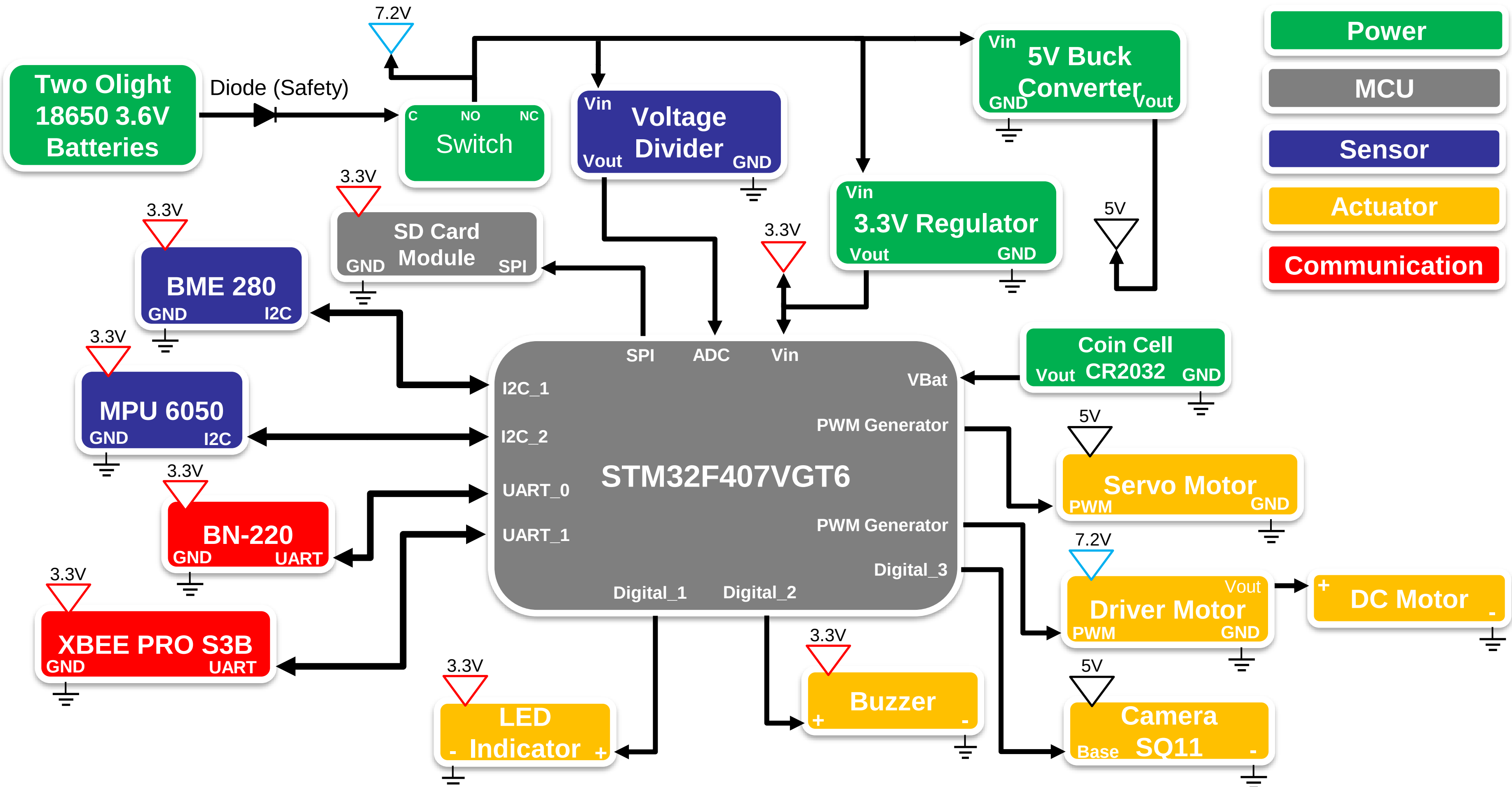


- Two Olight 18650 3.6V batteries connected series

EPS Changes Since PDR

Part	PDR	CDR	Rationale
Payload 5V Supply	5V voltage regulator	Buck converter	Provide more efficiency of power

Payload Electrical Block Diagram



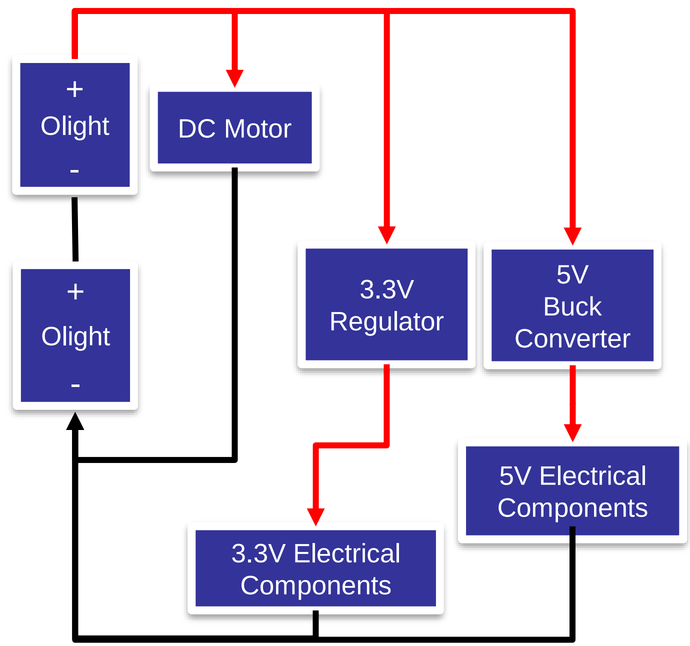
- The electronics system will be easily turned on/off by a switch
- The buzzer beeps and the LED blinks when the system is powered on
- A cell coin battery is used to supply the internal RTC in the MCU
- voltage divider is used as an intermediary before going to the ADC

Payload Power Source

Model	Battery Type	Voltage (V)	Weight (g)	Nominal Capacity (mAh)	Maximum Discharge Current	Dimension (mm)		Cost ($)
						Height	Diameter	
OLIGHT 18650	Lithium Ion	3.6	48.27	3500	10.000	69.8	18.5	25.13

Selected Battery	about
 **OLIGHT 18650 ✓**	• Two Olight 18650 battery supplies 7.2 volts. Single battery has an capacity of 3.6V and 3500mAh. The battery can discharge up to 10A instantly. • The battery supplies the system until more than 2 hours. • One battery can power all electronic components in the payload

Two battery will in series to all components



Payload Power Budget (1/2)

Component	Quantity	Source	Current (mA)	Voltage (V)	Duty Cycles in 1 Hour (%)	Power Consumption (Wh)
STM32F407VGT6 (include RTC)	1	Datasheet	50	3.3	100	0.165
XBEE Pro S3B	1	Datasheet	215	3.3	100	0.7095
BME280	1	Estimated	1.064	3.3	100	0.0035112
MPU6050	1	Datasheet	12.3	3.3	50	0.020295
Servo MG90	1	Measured	250	5	50	0.625
DC Motor	1	Measured	140	7.2	50	0.504
SD Card Module	1	Datasheet	20	3.3	50	0.033
SQ11 – Camera	1	Measured	80	5	50	0.2
LED	1	Estimated	30	3.3	100	0.099
Buzzer 95 dB	1	Datasheet	80	3.3	100	0.264
Voltage Divider	1	Estimated	0.878	7.2	100	0.0063216
BN-220	1	Measured	67	3.3	100	0.2211
Total						**2.8507278**
Consumption for 2 Hours						**5.7014556**

Payload Power Budget (2/2)

Selected Container Power: Olight 18650 ✓

Available power	= Voltage x Capacity
	= 7.2 V x 3.5 Ah
	= **25.2 Wh**
Power consumption (Wh)	= **5.7014556 Wh**
Margins	= Available power – Power consumption
	= 25.2 Wh – 5.593456 Wh
	= **19.4985444 Wh**

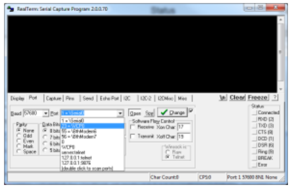
Flight Software (FSW) Design

Muhammad Tsaqif Mukhayyar

FSW Overview (1/4)

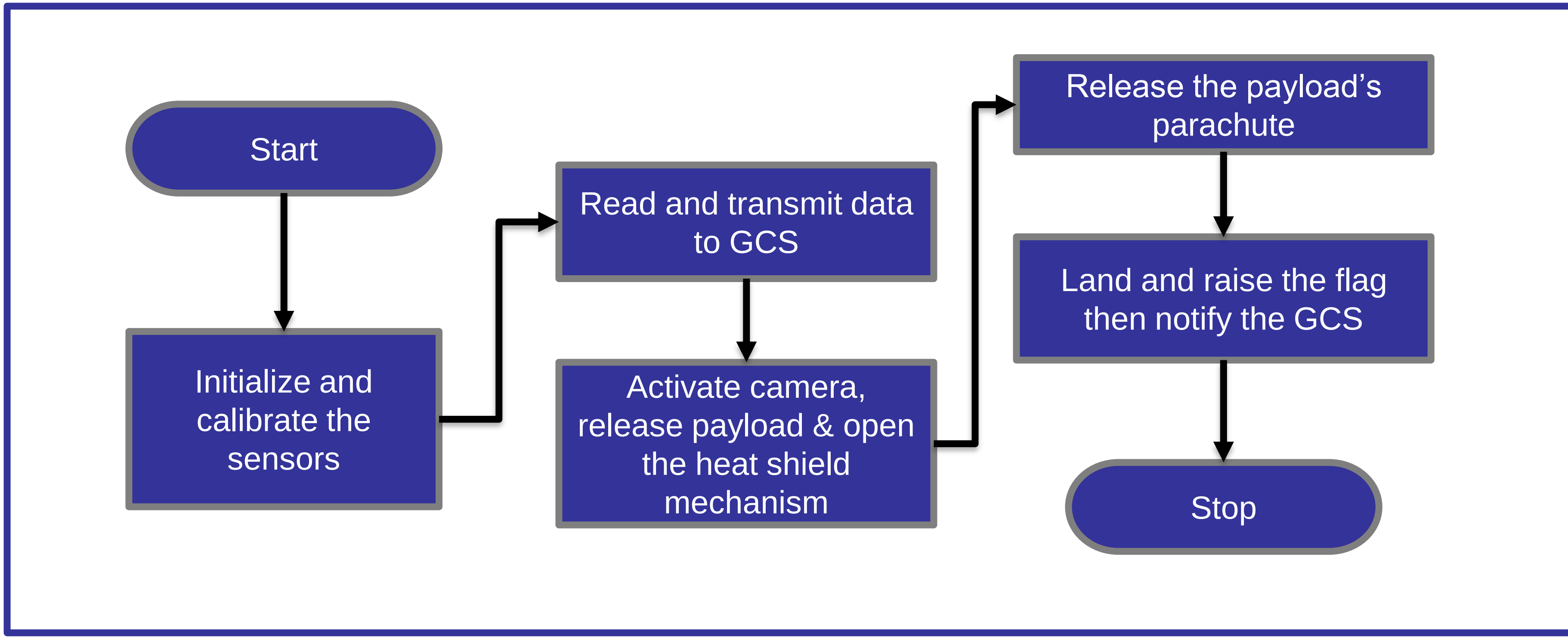
CanSat FSW Tasks
CanSat will collect data from sensors and transmit the data to GCS during ascent until it land. At 500 m, the CanSat will release a payload and then activate the heat shield mechanism in the payload. When the payload reaches 200 m, the payload will deploy a parachute. Once the payload has landed, it will raise a flag using the servo mechanism. The SD Card is used to back up the data and store the video on the container and payload. A video camera will be added to the payload and pointed toward the ground. The bonus video camera will be added to the container to record and show the separation of the payload.

Programming Languages	Development Environments
• C/C++	• Arduino IDE • STM32CubeIDE • XCTU • RealTerm



FSW Overview (2/4)

CanSat FSW Architecture



Payload **Next Flow**

FSW Overview (3/4)

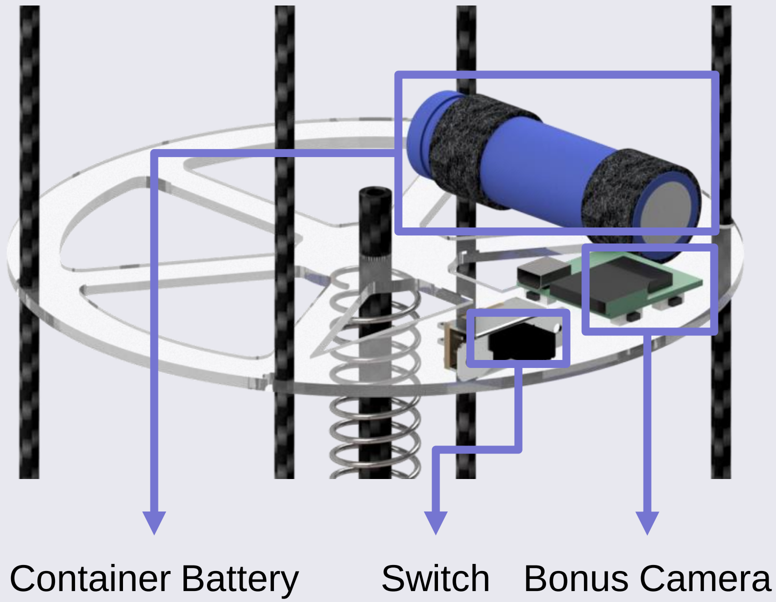
Payload FSW Tasks
1. The payload will set the new mission reference when receiving **CAL** from the GCS and save calibration data to the SD Card 2. The payload FSW mode will read from SD Card on the STM32F407VGT6, the default mode is Flight mode, and when the payload receives commands **SIM ENABLE** and **SIM ACTIVATE** from the GCS, the payload will enter the simulation mode 3. When the payload enters the **ASCENT** state, the payload will collect the packet data and then save it to the SD Card, the payload packet data will be transmitted @1Hz to the ground station via XBEE Pro S3B 4. In 500 m the payload will deploy the heat shield and the **HS_DEPLOYED** indicator change into **P** from **N** 5. In 200 m the payload will deploy its parachute and the **PC_DEPLOYED** indicator change into **C** from **N** 6. When the state is **LANDED** the payload will raise a flag and **MAST_RAISED** indicator changed to **M** from **N**, and all telemetry data transmission will be stopped 7. The mission will be completed

FSW Overview (4/4)

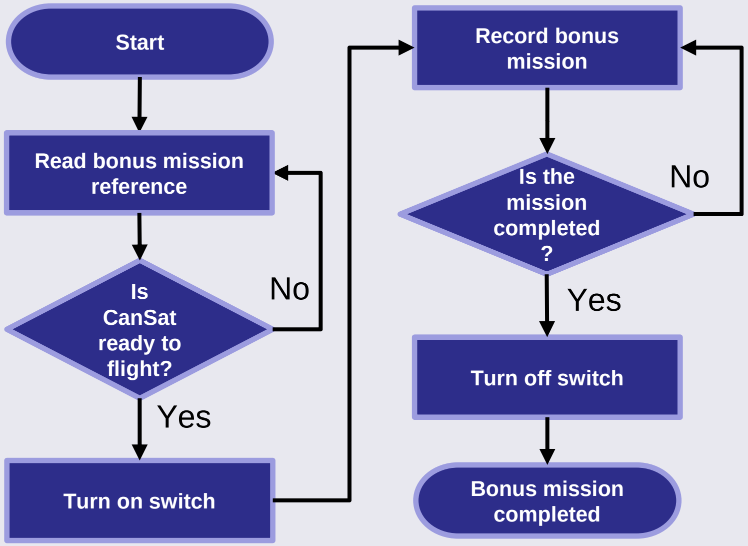
Bonus Mission Overview

1. The container will be installed with camera, battery and switch.
2. Before the launch camera switch will be turned on.
3. The camera will remain recording for 2 hours during pre-flight until the switch is turned off(post-flight).

Bonus Camera Container Placement



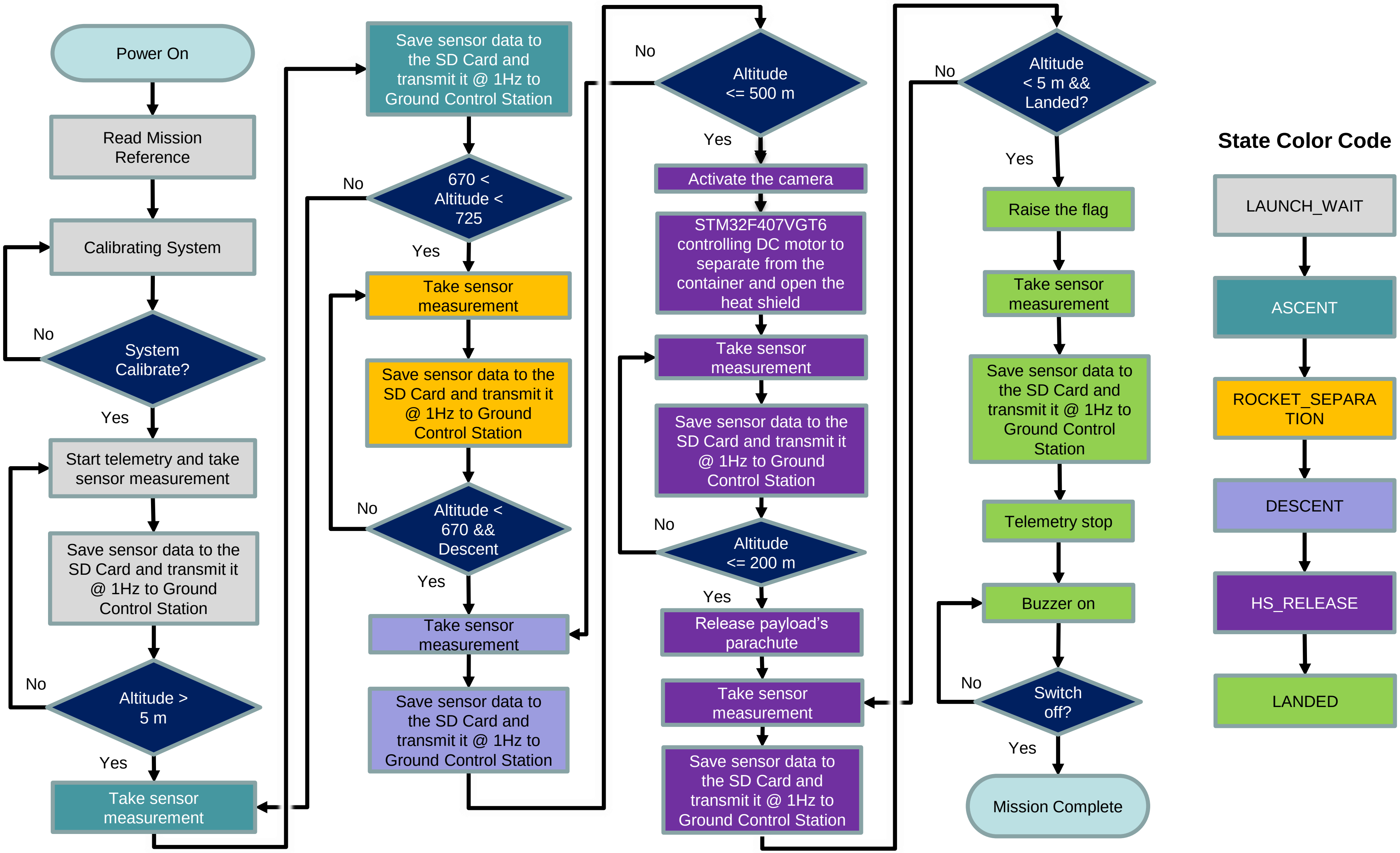
Flowchart



FSW Changes Since PDR

Part	PDR	CDR	Rationale
There were no changes to the Flight Software Design			

Payload CanSat FSW State Diagram (1/3)

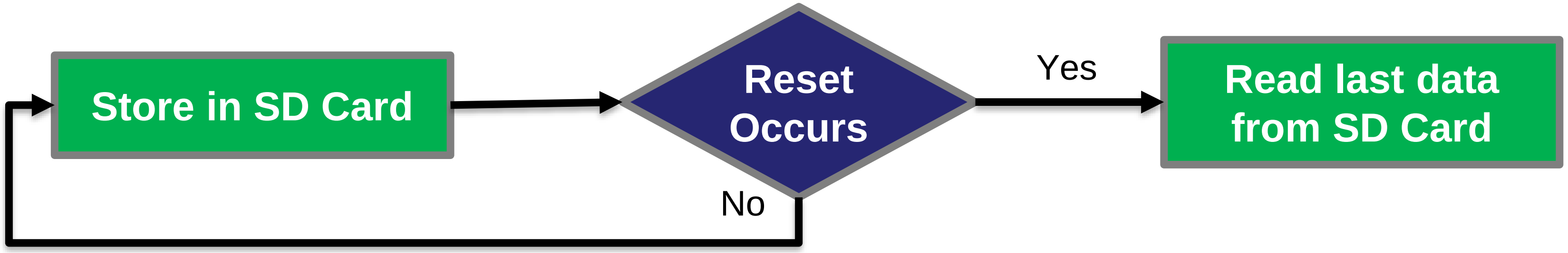


Payload CanSat FSW State Diagram (2/3)

Mechanism Activations
At 500 m, STM32F4 will activate : • The DC motor to control the payload to separate from container • The DC motor to control the payload ribs to open heat shield • The camera to record terrain At 200 m, STM32F4 will activate : • The servo to open rubber locking system to deploy payload's parachute. At Landed, STM32F4 will activate : • The servo to control the flag to raise • The DC motor to control the payload to upright position

Major Decision Points in The Logic
The altitude will be the major decision parameter among other parameters used as consideration.

Data Storage	Sampling of Sensors	Communications
• Video and backup telemetry data will be stored on the SD Card • SD Card is used for recovery after reset	The data sensor will be sampled at 1 Hz (1000ms).	Payload communicates using Taoglas FXP 290 and transmits data to the ground station. All commands will be included in CDH.



Payload Data Recovery

STM32F407VGT6 will recover (stored in SD Card):

- Packet Count
- Last State
- Command Echo
- Reference Altitude

Reason for Reset

Temporary power loss occurs

Power Management

For two hours flight is enough with (2x) 3.6V OLIGHT 18650 3500 mAh batteries

Simulation Mode Software (1/2)

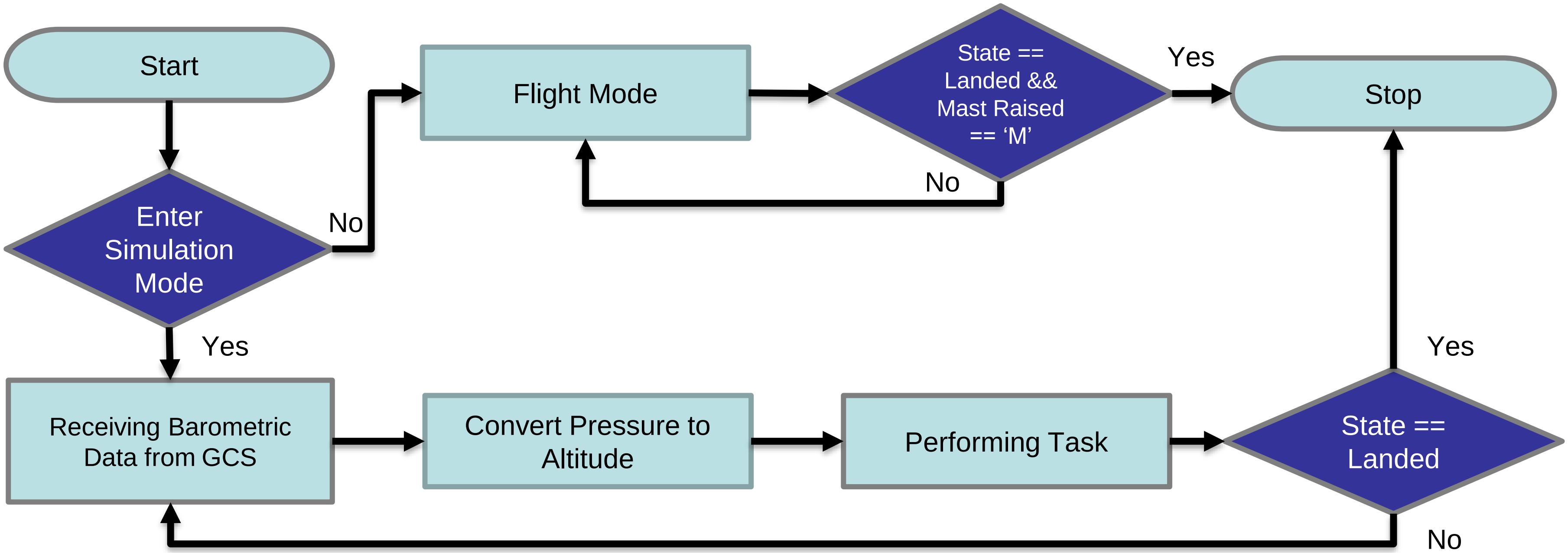
Simulation Mode
• Simulation mode is for testing, pre-flight demonstration, and contingency, where launch operations are not possible. The telemetered pressure sensor data should reflect the commanded simulation values, not the actual sensor readings • To activate the simulation mode, GCS must send **SIM ENABLE** followed by **SIM ACTIVATE** to the payload • The values other than the pressure and altitude (calculated from the pressure values) will be actual sensor readings. The relayed payload telemetry will contain actual sensor values • The barometric pressure data will be read by a .txt file in the GCS and transmitted value by the command to the payload at a rate of one data per second • After the simulation mode is active, flight software will receive barometric pressure sensor command (**SIMP**) from GCS and use the received values as if they were actual barometric pressure readings in the calculation of altitude, and determination software state • After GCS sends the **SIM DISABLE**, the flight software will switch to flight mode

Simulation Mode Software (2/2)

Simulation Mode Commands

CMD,<TEAM_ID>,SIM,<MODE>	CMD,<TEAM_ID>,SIMP,<PRESSURE>
<MODE> consists of : • **'ENABLE'** to enable simulation mode; • **'ACTIVATE'** to activate simulation mode; or • **'DISABLE'** to disable and deactivate simulation mode	This command provides a simulated pressure reading to the payload

Simulation Mode Flowchart



Software Development Plan (1/3)

Prototyping procedure and prototyping environment		
Subject	**Prototyping Environment**	**Prototyping Procedure**
STM32F4	STM32CubeIDE	Programming and debugging are done in STM32CubeIDE and the data will be monitored in **RealTerm**
Sensors	Breadboard and PCB	Each sensor is tested on the breadboard separately

Software Development Plan (2/3)

Software Subsystem Development Sequence	
Subsystem	**Development Sequence**
Sensors	• **Sensor trade and selection** - select the best sensors for our application • **Individual sensor programming** - program payload sensor with STM32CubeIDE
State Mechanism	Integrate all sensors and test it in state mechanism
XBee Telemetry	**Testing GCS and payload communication** – Configure and test all payload sensors data that will be transmitted to GCS
Heat Shield Mechanism	Program the payload mechanism with DC Motor to control the heat shield rib
Parachute Mechanism	Program the payload mechanism with servo to release the parachute
Flag Mechanism	Program the payload mechanism with servo to raise the flag
Integrate all	Integrate all software subsystem to ensure all system works well

Development Team

1. Achmad Bagus Okto Faerizqi
2. Muhammad Tsaqif Mukhayyar

Software Development Plan (3/3)

Test Methodology

- Necessary software is installed such as Arduino IDE and STM32Cube IDE to help the software development
- Telemetry software tests are simulated using XCTU
- Sensors and hardware were tested separately
- Test the state mechanism for the payload
- Test the system recovery for the payload
- Test the telemetry data and communication commands using hardware
- Test the flight mode software using GCS
- Test the simulation mode software using GCS
- Check whether the FSW meets the competition requirements
- Test integrated sensors and hardware according to the mission

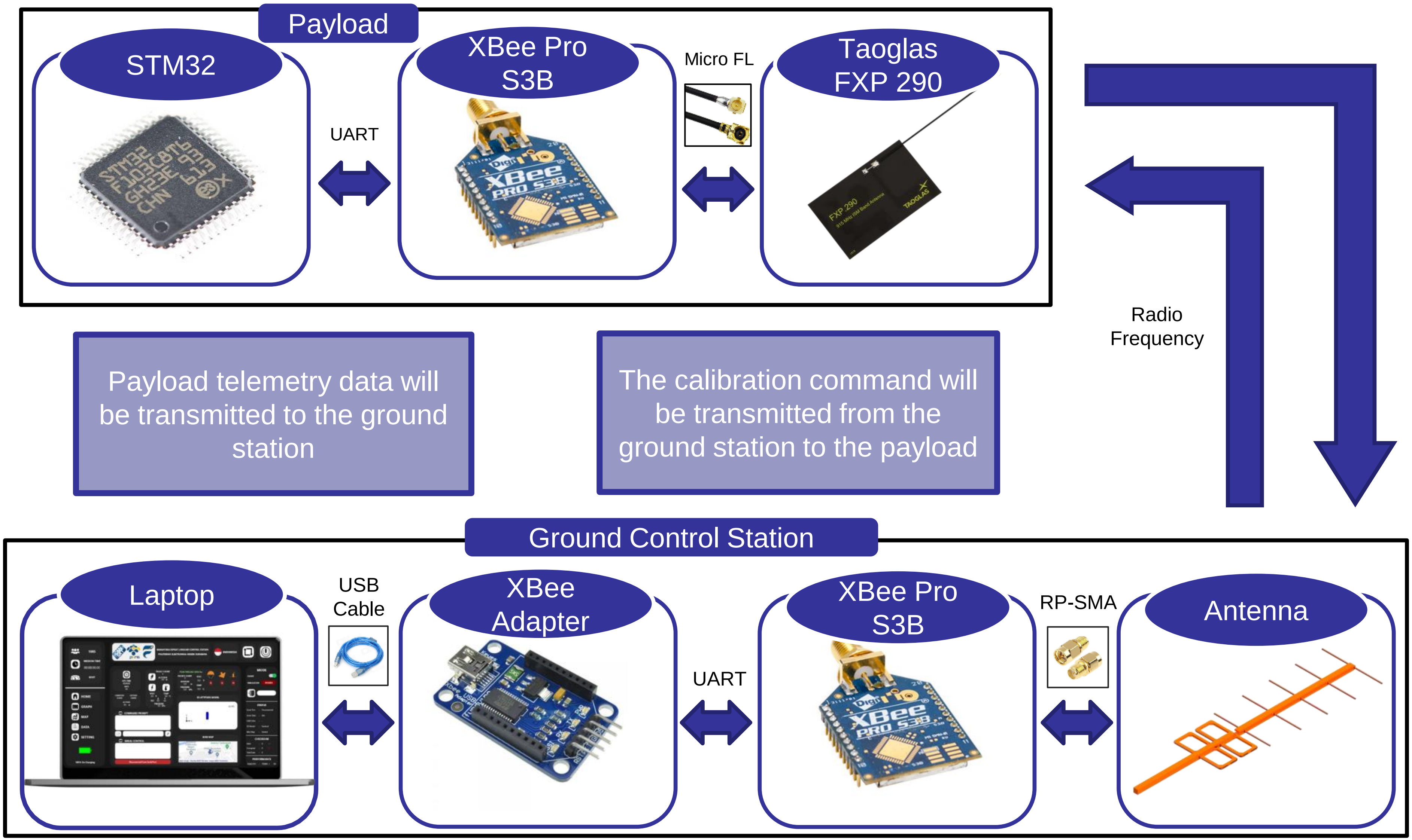
Progress Since PDR

1. Sensors were calibrated and tested.
2. Payload flight software states has been tested.
3. Payload is able to receive commands from GCS properly.
4. Payload is able to send data to the GCS properly.
5. Payload data recovery was tested.
6. Simulation mode has been tested with GCS.
7. Payload software development has been made based on mission guide.

Ground Control System (GCS) Design

Muhammad Tsaqif Mukhayyar

GCS Overview

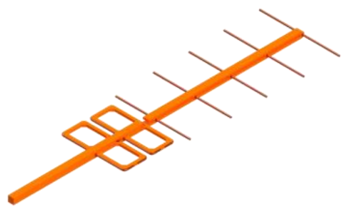


GCS Changes Since PDR

Part	PDR	CDR	Rationale
GCS GUI	Graph is using Livecharts2.Net Library	Graph is using ScottPlot library	A failure can occur when attempting to display real-time data that is delayed when being plotted
Antenna	Antenna is using Moxon Antenna	Antenna is using Moxon-Yagi Antenna	Improve the design and quality of antenna to minimize data loss

GCS Design

Antenna



RP-SMA

XBee Pro S3B

UART

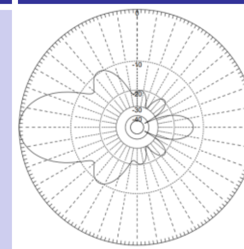
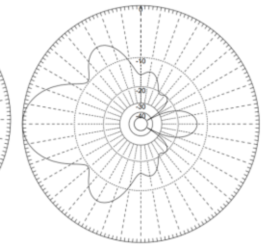
XBee Adapter

USB Cable

Laptop

Specifications	
Battery	GCS Laptop can operate 2.5 hours on battery from fully charged
Overheating Mitigation	There will be an external laptop cooling fan with power source from power bank and also an umbrella
Auto Update Mitigation	Auto update and internet connection will be disabled before the launch

GCS Antenna (1/2)

Model	Frequency Range (MHz)	Gain (dBi)	Beamwidth (Horizontal / Vertical)	Direction	Range (km)	Cost ($)	Antenna Pattern	
							Horizontal	Vertical
Moxon-Yagi Antenna	915 MHz	10.5	40 / 45	Directional	4	17		

Selected Mounting Antenna Design	Hand-Held Antenna
The antenna will be hand-held for easy targeting and minimize data loss since the payload altitude will change over time.	
Selected Anntena	**Moxon-Yagi Anntena**

Reasons:

- Higher gain than previous Moxon Antenna
- It can be brought easily
- Better range
- Cheap

GCS Antenna (2/2)

Link Budget Calculation

$$P_{RX} = P_{TX} + G_{TX} - L_{TX} - L_{FS} - L_M - G_{RX} - L_{RX}$$

$$= 24 + 10.5 - 0 - 101.2 - 5 + 1.5 - 0$$

$$= \mathbf{-68.2\ dBm}$$

All of losses are ignore, except L_{FS} and L_M

Misc Losses = 5 dBi (estimated)

Information :

P_{RX} = *Received Power (dBm)*
P_{TX} = *Transmitted Power Output (dBm)*
G_{TX} = *Transmitter Antenna Gain (dBi)*
L_{TX} = *Losses from Transmitter (dB)*
L_{FS} = *Free-Space Part Loss (dB)*
L_M = *Misc Losses (dB)*
G_{RX} = *Receiver Antenna Gain (dBm)*
L_{RX} = *Losses from Receiver (dB)*

Free-Space Part Loss Calculation

$$FSPL = 20\ log_{10}(d) + 20\ log_{10}(f) + 32.44$$

$$= 12.04 + 59.22 + 32.44$$

$$= \mathbf{103.7\ dB}$$

Distance = 4 km *(predicted)*

Information :

FSPL = Free-Space Path Loss (dB)
d = Distance between the antennas (km)
f = Frequency (MHz)

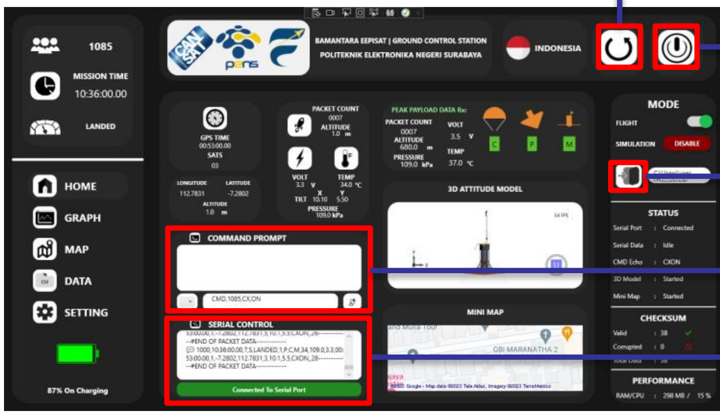
− 68.2 dBm > − 107 dBm

Xbee Receiver Sensitivity = -107 dBm

Our margin is **38.8 dBm** which can provides a reliable operation and it's sufficient for the requirement

GCS Software (1/5)

Commercial Off The Shelf (COTS) Software Packages Used	• Visual Studio 2022 Community Edition • XCTU (XBee Program Software)
Real-Time Plotting Software Design	The telemetry data that received from the serial port will be transferred to the PC by of USB connector, and processed with C# using ScottPlot and C# Windows Presentation Foundation (WPF) library to display in real time the telemetry and finally data will be saved in a .csv file
Command Software And Interface	There will be a command text box to calibrate all the telemetry data, and command the payload to start transmitting the telemetry data. To calibrate air pressure sensors and inertial measurement sensor, the calibration command will be sent to the payload. The air pressure sensor will acquire reference 0 meter pressure and save it. As for inertial measurement sensor will sent the stage of calibration to GCS until all component in the sensors are fully calibrated.
Telemetry Data Recording And Media Presentation To Judges For Inspection	Telemetry data in as a .csv file, the screenshot of the interface, and media data recorded from the container and payload using the camera will presented to the judges via USB memory storage device.
Description of .csv Telemetry File Creation For Judges	• All received telemetry data will be saved as .csv (Comma Separated Value) file. In CSV format, data is separated by comma. • CSV file name will be “Flight_<TEAM_ID>.csv
Simulation Mode Description	GCS will issue the payload the commands SIM ENABLE and SIM ACTIVATE. After that, GCS will read the lines of the.txt file containing the barometric pressure data and communicate it to the flight software at intervals of one second using the Simulated Pressure Data Command.
Commanding	GCS crew will send the command to the payload via a command text box. The command will be typed manually (described in Payload Command Format subsection), when the enter key is pressed the command will transmit to the payload.



GCS Restart Button

GCS Exit Button

Import .txt Button

Dashboard View

Command Text Box

Serial Monitor Box

Pressure Graph

Altitude Graph

Graph View

Voltage Graph

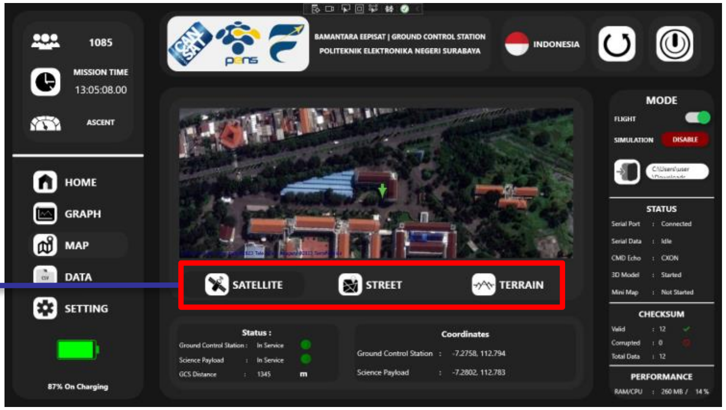
Temperature Graph

GPS Satellites Graph

Latitude & Longitude Graph

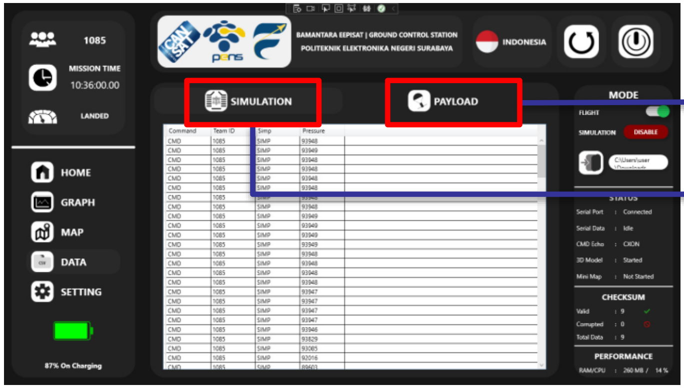
Tilt Graph

GCS Software(3/5)



Map type Button

Map View



Payload Data

Simulation Data

Data CSV View

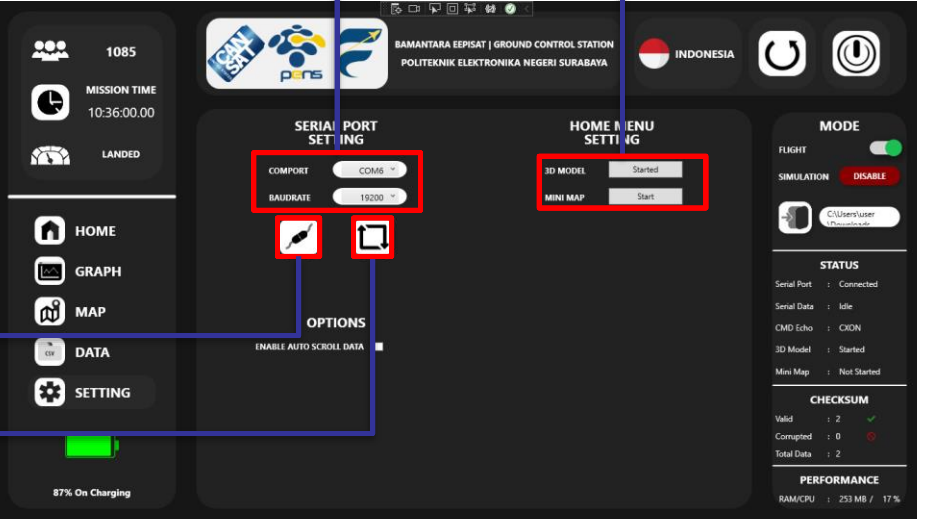
GCS Software(4/5)

3D and Mini Map Activation Button

Serial and Baudrate Combo Box

Connect or Disconnect Button

Refresh Button



Setting View

GCS Software (5/5)

Progress Since PDR

- GCS can transmit all the command to FSW.
- GCS can receive and visualize all the telemetry data in label, chart, 3D and map in real-time.
- GCS can save the payload telemetry data files in .csv format.
- GCS can read a .txt file that contains barometric pressure data and transmit it to payload in one second interval (1Hz) in simulation mode.
- The antenna has been made and tested, the results are appropriate.

CanSat Integration and Test

Tsabitah Akmal Al Mumtazah

CanSat Integration and Test Overview (1/3)

Subsystem Level	Integrated Level Functional	Environmental
• Sensors • CDH • EPS • Radio Communications • FSW • Mechanical • Descent Control	• Descent Testing • Communications • Mechanisms • Deployment • Simulation	• Drop Test • Thermal Test • Vibration Test • Fit Check • Vacuum Test

Preparing of Required Test Condition → Component Testing of Each Subsystem → Subsystem Level Testing → Integrated Level Functional Testing → Environmental Testing

CanSat Integration and Test Overview (2/3)

Subsystem Level Testing Details
Sensors: All sensors will be mounted on the PCB along with a microcontroller to begin processing data, and the resulting output will be shown on the serial monitor of the Arduino IDE.
CDH: The XBEE configuration will be tested on the PCB, and the XCTU software will be utilized to verify that no errors have occurred during data transmission.
EPS: To ensure a duration of 2 hours of operation, all electronic components will be linked to two batteries.
Radio Communications: Communication range testing with an XBEE and an antenna.
FSW: State and recovery tests were performed to confirm that the software worked properly.
Mechanical: Mechanisms such as hinges, servo, DC motor and leadscrew will be checked to ensure they fulfill competition requirements.
Descent Control: The rate of descent of the container and payload will be evaluated at specific altitudes.

Integrated Level Testing Details
Descent Testing: The CanSat's descent rate will be assessed in order to verify the accuracy of the calculations that have been performed.
Communications: Antenna tests will be performed on XBEE communication through GCS-Payload to ensure that telemetry data complies with competition requirements.
Mechanisms: All of the mechanisms will be repeatedly tested to ensure that the mechanical components can survive the required force limits.
Deployment: The DC motor and leadscrew will be tested to verify that the payload is released from the container and that the heat shield angle is maintained.
Simulation: Flight Software and GCS simulation mode testing.

CanSat Integration and Test Overview (3/3)

Environmental Testing Details
Drop Test: The CanSat will be attached to a fixed bar at a height of 2 meters using a 61 cm cord, and subsequently, a drop test will be performed to inspect the power, components, and mountings of the CanSat.
Thermal Test: The CanSat will be placed inside DIY insulated thermal chamber, and heat will be generated using a hot air gun to maintain a temperature range of 55-60°C for a period of 2 hours.
Vibration Test: A vibration test will be conducted using an orbital sander to ensure the mounting integrity of all components, mounting connections, structural integrity, and battery connections.
Fit Check: The dimensions of the CanSat will be measured using vernier calipers, a ruler, and tape.
Vacuum Test: The CanSat will be placed inside a vacuum chamber to start collecting data in telemetry format once it reaches its peak altitude.
Simulation Testing Details
GCS: The GCS simulation command will be tested to ensure it works properly and is able to read .txt files provided by the judges.
Flight Software: A simulation command can activate the microprocessor to process data received from the GCS.

Subsystem Level Testing Plan

Subsystem Level Testing Plan	
Sensors	• Functional tests of the sensors on the breadboard • High-accuracy sensor calibration
CDH	• XBEE data transfer range and configuration • Verify the data's accuracy and speed of transmission to the ground station • Ensure that the data format follows the mission guide
EPS	• Testing each component to ensure proper operation • Testing that power can fulfill the demand for electronic components • The watt-hour capacity of the battery will be measured to determine the margin
Radio Communications	• Antenna range test • Beam and stability of communication testing
FSW	• Accuracy of the data received from sensors and camera • Maintain recovery data in case of a microcontroller resets • Flight Algorithm test • State testing
Mechanical	• Payload release mechanism test • Ensure the component of CanSat can survive when it's launched • Ensure the payload is uprighted after landing • Servo and DC motor will be inspected carefully to ensure freedom of operation
Descent Control	• CanSat stability drop test • Parachute system test • Payload aerobraking test

Integrated Level Functional Test Plan (1/4)

Integrated Level Functional Test Plan	
Descent Testing	• The purpose of this test is to ensure that CanSat descends at the speed defined in the mission guide • We will drop a 700 g CanSat from the top of the buildings using a parachute to test its descent rate

Documentations

Integrated Level Functional Test Plan (2/4)

Integrated Level Functional Test Plan	
Communications	• The purpose of this test is to ensure that the communication system is functional • We will use flight software to communicate with the XBEE at 1Hz for the payload at various ranges. The data must be shown in the GCS monitor • This test will be performed in a crowded area to ensure that the signal is not interrupted

Documentations

Integrated Level Functional Test Plan (3/4)

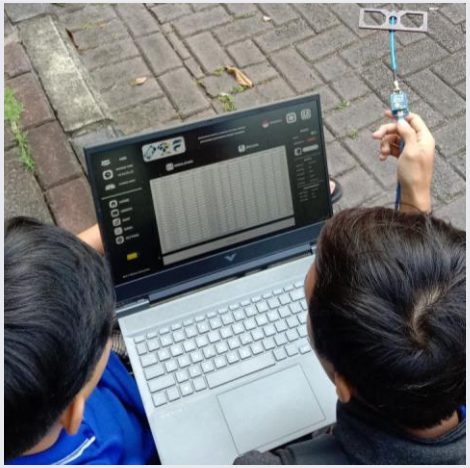
Integrated Level Functional Test Plan	
Mechanisms	• The purpose of this test is to ensure that the payload can be released from the container and the parachute mechanism operates correctly • Verify that the payload parachute mechanism is succeed • Ensure the payload deploys a heat shield after leaving the container • Verify all mechanisms doesn't breaks when tested under all forces
Deployment	• Parachute deployment will be tested at various altitude • CanSat deployment at various altitude • Check for any sharp edges and obstacles that could prohibit CanSat from being deployed • Test the payload release mechanism using simulated altitude triggering

Documentations

Integrated Level Functional Test Plan (4/4)

Integrated Level Functional Test Plan	
Simulation	• This test is designed to verify if the Ground Station is capable of reading a .txt file of barometric pressure data that simulates the mission profile and transmitting the values to the payload at a rate of one data per second (1 Hz) via commands • We will put it to the test by preparing barometric data in .txt file • Test if GCS is able to transmit the pressure value at one second interval (1Hz) to flight software

Documentations



Environmental Test Plan (1/5)

Drop Test

This test is designed to verify that the container parachute and attachment point will survive the deployment from the rocket payload section which can be very violent.

- Power on CanSat
- Verify telemetry is being received
- Raise CanSat by the a 61 cm non-stretching cord
- Release the CanSat
- Verify the CanSat did not lose power
- Inspect for any damage, or detached parts
- Verify telemetry is still being received

(CanSat mission guide)

Drop Test Frame

Environmental Test Plan (2/5)

Thermal Test

This test is to verify the CanSat and container can operate in a hot environment. The heat source will be provided by a thermal chamber and a hot air gun.

- Place CanSat into a thermal chamber, turn on the CanSat, close and seal the thermal chamber, turn on the heat source
- Monitor the temperature and turn off the heat source when the internal temperature reaches 60 °C and turn on the heat source when the temperature drops to 55 °C
- Maintain the test conditions for two hours
- Turn off the heat source and perform visual inspection and any functional tests to verify the CanSat survived the thermal exposure and can operate as expected
- With the CanSat still hot, test any mechanisms and structures to make sure the integrity has not been compromised. Take precautions to avoid injury
- Verify epoxy joints and composite materials still maintain their strengths

(CanSat mission guide)

EEPISAT's Thermal Chamber

Environmental Test Plan (3/5)

Vibration Test

This test is designed to verify the mounting integrity of all components, mounting connections, structural integrity, and battery connections. The vibration will be tested with an RK3000 Vertical Vibration Meter.

- Power on the CanSat
- Verify accelerometer data is being collected
- Power up the vibration machine. Once the vibration machine is up to full speed, wait 5 seconds
- Power down the vibration machine to a full stop. Repeat it four more times
- Inspect the CanSat for damage and functionality
- Verify accelerometer data is still being collected
- Power down CanSat

(CanSat mission guide)

RK3000 Vertical Vibration Meter

Fit Check
This test is designed to verify if the CanSat is able to fit in rocket. To ensure that CanSat fits in the rocket and reduces the possibility of deployment failure, we use vernier caliper to control the accuracy of CanSat's diameter with a margin of error. **(CanSat mission guide)**

Vernier Caliper
Source: https://www.aliexpress.us

Environmental Test Plan (5/5)

Vacuum Test

This test is designed to verify deployment operation of the payload.

- Suspend the fully configured and powered CanSat in the vacuum chamber
- Turn on the vacuum to start pulling a vacuum
- Monitor the telemetry and stop the vacuum when the peak altitude has been reached
- Let the air enter the vacuum chamber slowly and monitor the operation of the CanSat
- Collect and save telemetry
- Make the saved telemetry available for the judges to review

(CanSat mission guide)

Vacuum Chamber
Source: https://ubuy.co.id

Test Procedures Descriptions (1/3)

Test Proc	Test Description	RN	Pass/Fail Criteria	Status
1	Air Pressure Sensor Test	39	The data altitude refers to the actual altitude	Pass
2	Air Temperature Sensor Test	39	Temperature data and actual temperature are similar	Pass
3	GPS Sensor Test	39	Showing correct time and location	Pass
4	Voltage Sensor Test	39	Voltage data is similar to the Avometer calculation	Pass
5	Camera Test	40-42	Result of video capturing minimum resolution of 640x480 pixels and 30 frames per second	Pass
6	Tilt Sensor Test	39	RPM data is similar with tachometer	Pass
7	Power Consumption Test	31	Actual power consumption is similar with calculation result measured using Avometer	Pass
8	XBEE Communication Test and Antenna Range Test	20, 58	Communication data sent and received by GCS from 750m distance	Pass
9	Data Transmission at 1Hz Test	61	The data must be in correct order at 1 Hz rate	Pass
10	FSW State Test	53	State changes along as altitude increases and descends that calculated from pressure	Pass
11	Testing of Data Recovery Algorithm	44-45	The data (altitude reference, packet count, states, coordinate, etc) will be recovered to SD card and process will continue	Pass

Test Procedures Descriptions (2/3)

Test Proc	Test Description	RN	Pass/Fail Criteria	Status
12	GCS Interface Test	54-57	The GCS interface displays all telemetry data received (graph and labels)	Pass
13	GCS PC Battery Test	58	GCS PC is still operational after 2 hours of use	Pass
14	GCS Data Inspection and Data Format Save Test	47, 51, 61	The data is automatically presented in engineering units and saved into a .csv file	Pass
15	GCS Communication Test	50	GCS is able to send commands to payload to start send the telemetry data and calibrate the altitude	Pass
16	Container and Payload Descent Test	10, 11	Container descents at descent rate of 15m/s (±5m/s) for container parachute and 5m/s (±1m/s) for payload parachute	Pass
17	Payload Aerobraking Test	33, 34	The payload is able to open a heat shield and maintain a descent rate at 20m/s or less	Pass
18	CanSat Deployment Test	3, 6, 7	CanSat doesn’t have any sharp edges	Pass
19	Payload Parachute Deployment Test	35	Payload parachute able to deploy from the top frame of the payload	Pass
20	Payload Deployment Test	32	Payload able to deploy from container successfully	Pass
21	Payload Flag Deployment Test	37	Flag is deployed to 500 mm above the base of the payload	Pass

Test Procedures Descriptions (3/3)

Test Proc	Test Description	RN	Pass/Fail Criteria	Status
22	Drop Test	12, 30	CanSat survived a drop from 2 feet attached to cord. No parts falling off, no separation	**Upcoming**
23	Thermal Test	30	No CanSat materials warp, weaken, change characteristics, or fail to function	**Pass**
24	Vibration Test	13, 30	All mounting integrity of all components, mounting connections, structural integrity, and battery connections survived	**Upcoming**
25	Fit Check	1, 2, 3	Total Mass of CanSat 700 gr +/- 10 grams and dimension of CanSat under 125 x 400 mm	**Pass**
26	Vacuum Test	30	FSW is able to detect the altitude from pressure changes inside the vacuum chamber	**Upcoming**

Simulation Test Plan

GCS
This test is designed to verify if the Ground Station is capable of reading a .txt file of barometric pressure data that simulates the mission profile and transmitting the values to the payload at a rate of one data per second (1 Hz) via commands. We will put it to the test by preparing barometric data in .txt file. The **Simulated Pressure Data** command will read data containing a barometric pressure value and transmit it to the flight software at one second intervals (1 Hz) to start simulating altitude. GCS will receive the converted altitude value from the flight software.

Flight Software
This test is designed to verify that the GCS barometric pressure data was generated in altitude. We will enable simulation mode with **ENABLE** command from GCS. After that, we begin the simulation mode with **ACTIVATE** command to stop reading pressure from the sensor system. Substituted the data of the sensor with .txt file from the committee and make sure it transmitted to GCS in altitude data. At 101325 Pascals = approximately sea level barometric data will be saved to SD Card as an altitude ground level reference.

Mission Operations & Analysis

Tsabitah Akmal Al Mumtazah

Overview of Mission Sequence of Events (1/4)

1. Arrival

- Team arrival at the launch site
- GCS and antenna setup
- Check for any damages that may occur during travel

2. Pre-Launch

- Communication inspection
- Mechanism inspection
- Assembly of the container and payload
- Check the CanSat dimension and weight

3. Rocket Integration

- Final CanSat inspection completed before launch
- Turn on the CanSat, integrate it into the rocket, and ensure communication with GCS

Overview of Mission Sequence of Events (2/4)

4. Mission

- CanSat in a rocket launch
- Flight monitoring
- Display GCS to the judges and collect telemetry data during the mission
- Recovery crew preparation

5. Recovery

- CanSat recovery by location from last telemetry and buzzer
- Inspection of CanSat damage
- Retrieve data from SD Card in the payload

6. Data Analysis

- GCS data analysis and acquisition
- Deliver SD card and telemetry data to judges for scoring
- Evaluation team for launch day
- PFR preparation

Overview of Mission Sequence of Events (3/4)

Roles	Member Name
Mission Control Officer *(Responsible for informing the Flight Coordinator when the team and their CanSat is ready to be launched)*	• Fatwa Aulia Al-Haq
Ground Station Crew *(Responsible for monitoring the ground station for telemetry reception and issuing commands to the CanSat)*	• Muhammad Tsaqif Mukhayyar
Recovery Crew *(Responsible for tracking the CanSat and going out into the field for recovery and interacting with the field judges)*	• Tsabitah Akmal Al Mumtazah • Akhmadan Habibullah
CanSat Crew *(Responsible for preparing the CanSat, integrating it into the rocket, and verifying its status)*	• Artaka Sunu Adhi Prasetya • Achmad Bagus Okto Faerizqi

Overview of Mission Sequence of Events (4/4)

Antenna Construction and Ground System Setup	CanSat Assembly
• Set up the GCS equipment • Connect the XBEE to the laptop using the XBEE adapter, and attach the antenna to the XBEE using the RP-SMA Male connector • Power on the PC and disable the automatic Windows update feature • Conduct a communication test to confirm that all data is being successfully received • A team member will hold the antenna	• Assemble electrical component • Attach each component and store the payload inside the container • Prepare parachute for deployment • Power on the CanSat
CanSat Test	**Delivery of Telemetry Data File**
• CanSat fit and mass check • Drop test • Mechanism of separation test • Antenna and communication test • Sensor calibration and electronics component check • CanSat final check	• GCS receives telemetry data from XBEE • GCS save received telemetry data in .csv file format. • Retrieved .csv from the file manager into the PC and move it into a USB flash drive. • GCS Operator delivers .csv file using USB Drive

Field Safety Rules Compliance

Mission Operations Manual	Description
Ground Station Configuration	• Laptop and antenna preparation • Communication check and testing
CanSat Preparation	• CanSat assembly • Sensor calibration • Mass and size checking • Calibration system by command from GCS
CanSat Integration	• Fit check • Drop test • Battery verification
Launch Preparation	• Final communication check • Check CanSat stowed state inside the rocket
Launch Procedure	• Pre-launch checks • Verify with the ground station that the ground station is ready for launch

Development Status

- There will be two (2) Mission Operations Manual will be assembled into a three-ring binder. It consists of five sections and each section will start on its own page according to mission guide of CanSat
- Each member will familiarize themselves with the manual before launch day. The safety of each person on launch day is crucial
- Mission Operations Manual has been downloaded from the CanSat competition website. It will be updated as we encounter changes before the launch day

CanSat Location and Recovery

CanSat Recovery

- Recovery crew will maintain visual contact with the container and payload to aid recovery
- We will provide team details on CanSat's outside construction
- We also use GPS to track the payload
- The color of the container, payload, and parachute is orange
- Payload has a buzzer that will continuously buzz when it lands

CanSat COMPETITION 2023
Team #1085 BAMANTARA EEPISAT
eepisatindonesia@gmail.com
+62 896-6425-0927
PENS Campus, Surabaya,
East Java, Indonesia

This address labeling will be placed on our container and payload's body

Mission Rehearsal Activities

Ground System Radio Link Check *Rehearsed on March 26th 2023*	• Ensure that GCS receives data properly from XBEE • Command testing and calibration from GCS
Powering On/ Off CanSat *Rehearsed on April 14th 2023*	• Turn on CanSat with an external switch • Visual verification of loose electronic components before turning on • Ensure the serial sent to the ground station is correct
Launch Configuration Preparations *Rehearsed on April 21th 2023*	• Assembly CanSat into operating configuration • Fit Check • Main mechanisms check
Loading CanSat in the launch vehicle *Rehearsed on April 28th 2023*	• CanSat is placed inside a DIY rocket envelope with the dimensions as in the competition requirements • Visual verification for sharp edges before loading into the rocket
Telemetry processing, archiving and analysis *Rehearsed on April 30th 2023*	• Real-time graph check • Ensure the data processed is saved into .csv file • Analyze data displays on GCS GUI • Deliver telemetry data to judges via USB
Recovery *Rehearsed on April 28th 2023*	• Recovery will commence after telemetry is stopped • Last GPS location and fluorescent color will ease recovery

Requirements Compliance

Tsabitah Akmal Al Mumtazah

Requirements Compliance Overview

We designed and created CanSat by analyzing and identifying the CanSat Mission Guide 2023. The system will be tested in compliance with the CanSat Integration and Test section.

- We have complied with 58 requirements based on the CanSat Mission Guide 2023.
- There are 3 partial compliances that will require further testing. We need to build some prototypes in order to fully comply with these requirements that s were only partially met.
- There are not any requirements that don’t comply with our design.

(Comply)

(Partial)

(No Comply)

Requirements Compliance (1/7)

RN	Requirement	Compliance	Ref Slides	Notes
1	Total mass of the CanSat (science probe and container) shall be 700 grams +/- 10 grams.	**Comply**	84 – 87	
2	CanSat shall fit in a cylindrical envelope of 125 mm diameter x 400 mm length. Tolerances are to be included to facilitate container deployment from the rocket fairing.	**Comply**	22	
3	The container shall not have any sharp edges to cause it to get stuck in the rocket payload section which is made of cardboard.	**Comply**	22	
4	The container shall be a fluorescent color; pink, red or orange.	**Comply**	158	
5	The container shall be solid and fully enclose the science probes. Small holes to allow access to turn on the science probes are allowed. The end of the container where the probe deploys may be open.	**Comply**	68	
6	The rocket airframe shall not be used to restrain any deployable parts of the CanSat.	**Comply**	22	
7	The rocket airframe shall not be used as part of the CanSat operations.	**Comply**	22	
8	The container's parachute shall not be enclosed in the container structure. It shall be external and attached to the container so that it opens immediately when deployed from the rocket.	**Comply**	70	
9	The Parachute shall be fluorescent Pink or Orange.	**Comply**	39	
10	The descent rate of the CanSat (container and science probe) shall be 15 meters/second +/- 5 m/s.	**Comply**	59 – 60	
11	0 altitude reference shall be at the launch pad.	**Comply**	129	

Requirements Compliance (2/7)

RN	Requirement	Compliance	Ref Slides	Notes
12	All structures shall be built to survive 15 Gs of launch acceleration.	**Partial**	143	We have not integrated our CanSat yet
13	All structures shall be built to survive 30 Gs of shock.	**Partial**	145	We have not integrated our CanSat yet
14	All electronics and mechanical components shall be hard mounted using proper mounts such as standoffs, screws, or high performance adhesives.	**Comply**	81 – 83	
15	All mechanisms shall be capable of maintaining their configuration or states under all forces.	**Comply**	143 – 147	
16	Mechanisms shall not use pyrotechnics or chemicals.	**Comply**	62	
17	Mechanisms that use heat (e.g., nichrome wire) shall not be exposed to the outside environment to reduce potential risk of setting vegetation on fire.	**Comply**	62	
18	Both the container and probe shall be labeled with team contact information including email address.	**Comply**	158	
19	Cost of the CanSat shall be under $1000. Ground support and analysis tools are not included in the cost. Equipment from previous years shall be included in this cost, based on current market value.	**Comply**	173 – 176	
20	XBEE radios shall be used for telemetry. 2.4 GHz Series radios are allowed. 900 MHz XBEE radios are also allowed.	**Comply**	95	

Requirements Compliance (3/7)

RN	Requirement	Compliance	Ref Slides	Notes
21	XBEE radios shall have their NETID/PANID set to their team number.	**Comply**	96	
22	XBEE radios shall not use broadcast mode.	**Comply**	96	
23	The container (if needed) and probe shall include an easily accessible power switch that can be accessed without disassembling the cansat and science probes and in the stowed configuration.	**Comply**	20	
24	The probe shall include a power indicator such as an LED or sound generating device that can be easily seen or heard without disassembling the cansat and in the stowed state.	**Comply**	102 – 103	
25	An audio beacon is required for the probe. It shall be powered after landing.	**Comply**	102 – 103	
26	The audio beacon shall have a minimum sound pressure level of 92 dB, unobstructed.	**Comply**	102	
27	Battery source may be alkaline, Ni-Cad, Ni-MH or Lithium. Lithium polymer batteries are not allowed. Lithium cells must be manufactured with a metal package similar to 18650 cells. Coin cells are allowed.	**Comply**	106	
28	An easily accessible battery compartment shall be included allowing batteries to be installed or removed in less than a minute and not require a total disassembly of the CanSat.	**Comply**	18 – 21, 81 – 83	
29	Spring contacts shall not be used for making electrical connections to batteries. Shock forces can cause momentary disconnects.	**Comply**	81 – 83	

Requirements Compliance (4/7)

RN	Requirement	Compliance	Ref Slides	Notes
30	The CanSat shall operate during the environmental tests laid out in Section 3.5.	**Partial**	143 – 147	We have not integrated our CanSat yet
31	The CanSat shall operate for a minimum of two hours when integrated into the rocket.	**Comply**	106	
32	The probe shall be released from the container when the CanSat reaches 500 meters.	**Comply**	18 – 21	
33	The probe shall deploy a heat shield after leaving the container.	**Comply**	15 – 17	
34	The heat shield shall be used as an aerobrake and limit the descent rate to 20 m/s or less.	**Comply**	59 – 60	
35	At 200 meters, the probe shall release a parachute to reduce the descent rate to 5 m/s +/- 1m/sec.	**Comply**	57, 59 – 60	
36	Once landed, the probe shall upright itself.	**Comply**	78	
37	After uprighting, the probe shall deploy a flag 500 mm above the base of the probe when the probe is in the upright position.	**Comply**	79	
38	The probe shall transmit telemetry once per second.	**Comply**	96	
39	The probe telemetry shall include altitude, air pressure, temperature, battery voltage, probe tilt angles, command echo, and GPS coordinates that include latitude, longitude, altitude and number of satellites tracked.	**Comply**	97 – 98	
40	The probe shall include a video camera pointing down to the ground.	**Comply**	36	

Requirements Compliance (5/7)

RN	Requirement	Compliance	Ref Slides	Notes
41	The video camera shall record the flight of the probe from release to landing.	**Comply**	24	
42	The video camera shall record video in color and with a minimum resolution of 640x480.	**Comply**	36	
44	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**	117	
45	The probe shall maintain mission time throughout the whole mission even with processor resets or momentary power loss.	**Comply**	117	
46	The probe shall have its time set to within one second UTC time prior to launch.	**Comply**	96	
47	The probe 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 csv file.	**Comply**	118 – 119	
48	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**	118 – 119	
49	The payload flight software shall only enter simulation mode after it receives the SIMULATION ENABLE and SIMULATION ACTIVATE commands.	**Comply**	118 – 119	
50	The ground station shall command the CanSat to start calibrating the altitude to zero when the CanSat is on the launch pad prior to launch.	**Comply**	129	

Requirements Compliance (6/7)

RN	Requirement	Compliance	Ref Slides	Notes
51	The ground station shall generate csv files of all sensor data as specified in the Telemetry Requirements section.	**Comply**	129	
52	Telemetry shall include mission time with 0.01 second or better resolution.	**Comply**	117	
53	Configuration states such as zero altitude calibration shall be maintained in the event of a processor reset during launch and mission.	**Comply**	117	
54	Each team shall develop their own ground station.	**Comply**	124 – 133	
55	All telemetry shall be displayed in real time during descent on the ground station.	**Comply**	129	
56	All telemetry shall be displayed in engineering units (meters, meters/sec, Celsius, etc.)	**Comply**	129	
57	Teams shall plot each telemetry data field in real time during flight.	**Comply**	97 – 98	
58	The ground station shall include one laptop computer with a minimum of two hours of battery operation, XBEE radio and a hand-held antenna.	**Comply**	124 – 128	
59	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**	124 – 133	
60	The ground station software shall be able to command the container to operate in simulation mode by sending two commands, SIMULATION ENABLE and SIMULATION ACTIVATE.	**Comply**	129	

Requirements Compliance (7/7)

RN	Requirement	Compliance	Ref Slides	Notes
61	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**	118 – 119	
BM	A video camera shall be integrated into the container and point toward the payload. The camera shall record the event when the payload is released from the container. Video shall be in color with a minimum resolution of 640x480 pixels and a minimum of 30 frames per second. The video shall be recorded and retrieved when the container is retrieved.	**Comply**	37	

Management

Arneta Firdaus

Status of Procurements (1/3)

Mechanical Procurement

Component	Quantity	Order	Receive	Status
Carbon Rod 3mm	23	21/12/22	23/12/22	Received
Carbon Rod 5mm tube	3	21/12/22	23/12/22	Received
Carbon Rod 3mm tube	3	21/12/22	23/12/22	Received
Acrylic 2mm	2	14/11/22	16/11/22	Received
Filament ABS+	1	1/3/2022	1/3/2022	Received
Resin Epoxy & Katalis	1	29/11/22	29/11/22	Received
Fiberglass	1	n/a	n/a	In stock
Torsion Spring	6	-	-	Not Yet Ordered
Compression Spring	2	-	-	Not Yet Ordered
Chinese Knoting Cord	2	-	-	Not Yet Ordered
Polycarbonate	1	16/03/23	19/03/23	Received
Resin 3D Print	1	16/03/23	19/03/23	Received

Status of Procurements (2/3)

Electronics Procurement

Component	Quantity	Order	Receive	Status
STM32F407VGT6	1	1/3/2023	1/5/2023	Received
Camera SQ11	2	11/26/22	11/27/22	Received
AMS1117	2	n/a	n/a	In Stock
BN-220	1	12/11/22	15/11/22	Received
SD Card Module	1	12/9/22	12/11/22	Received
Limit Switch	4	n/a	n/a	In Stock
MPU6050	1	1/2/2023	3/4/2023	Received
MX1508	2	1/3/2023	3/5/2023	Received
Switch ON/OFF	1	n/a	n/a	In Stock
Servo SG90	2	2/7/2023	2/8/2023	Received
Coin Battery Holder	1	n/a	n/a	In Stock
Batttery CR2032	2	n/a	n/a	In Stock
PCB FR4	1	1/18/2023	1/25/2023	Received
Buzzer	1	n/a	n/a	In Stock
Buck Converter	1	2/23/2023	2/23/2023	Received
Push Button	1	n/a	n/a	In Stock
Battery Olight 18650	2	11/24/2022	2/27/2023	Received
Motor DC	1	1/3/2023	3/5/2023	Received
LED	1	n/a	n/a	In Stock
BME280	1	3/23/2023	3/23/2023	Received
Resistor 0805	10	n/a	n/a	In Stock
SD Card	1	2/13/2023	2/13/2023	Received

Status of Procurements (3/3)

Ground Station Procurement

Component	Quantity	Order	Receive	Status
RP SMA	2	2/28/2023	3/4/2023	Received
XBee S3B	1	n/a	n/a	In Stock
XBee Adapter	1	n/a	n/a	In Stock
USB Cable	1	n/a	n/a	In Stock
Moxon-Yagi Antenna	1	3/8/2023	3/8/2023	Received

Electronics Components

Component	Quantity	Considerations	Unit Cost ($)	Total Cost ($)
STM32F407VGT6	1	Actual	25	25
MPU6050	1	Actual	1.34	1.34
BME280	1	Actual	10.02	10.02
BN-220	1	Actual	13.35	13.35
Servo MG90	1	Actual	1.74	1.74
MX 1508 Driver Motor	1	Actual	0.47	0.47
DC Motor	1	Actual	3.34	3.34
SD Card Module	1	Actual	0.6	0.6
Xbee Pro S3B	1	Actual	57.52	57.52
Limit Switch	2	Actual	0.05	0.1
Taoglas Antenna FXP290	1	Actual	17.05	17.05
Camera SQ11	2	Actual	4.01	8.02
SD Card Robot 8GB	2	Actual	3.34	6.68
ON/OFF Switch	2	Actual	0.14	0.28
Micro USB Type B	1	Actual	0.05	0.05
Buzzer 5V	1	Actual	0.1	0.1
LED 3mm	2	Actual	0.03	0.06
Voltage Regulator	2	Actual	0.067	0.134
Olight 18650	2	Actual	25.13	50.26
Battery Charger 18650 (2 Slots)	1	Actual	2.81	2.81
CR2032 Coin Cell	1	Actual	0.17	0.17
PCB	2	Actual	1.05	2.1
Total Cost Electronics Components ($)				**201.194**

CanSat Budget – Hardware (2/4)

Mechanics Components

Component	Quantity	Considerations	Unit Cost ($)	Total Cost ($)
Carbon Fiber Rod Solid 3mm	10	Actual	0.83	8.3
Carbon Fiber Rod Tube 5mm	1	Actual	2.65	2.65
Bio PLA Resin	1	Actual	13.01	13.01
ABS+	1	Actual	12.09	12.09
Resin Epoxy	1	Actual	15.83	15.83
Ripstop Nylon	1	Actual	1.39	1.39
Chinese Knotting Cord	1	Actual	1.42	1.42
Polycarbonate 300 x 400 x 2 mm	2	Actual	3.88	7.76
Fiberglass Woven Cloth 0,17 x 1200 x 1000mm	1	Actual	1.42	1.42
Torsion Spring	1	Actual	0.32	0.32
Compression Spring	1	Actual	0.65	0.65
Hinges	5	Actual	0.17	0.85
Rubber	1	Actual	0.4	0.4
Flag	1	Actual	0.27	0.27
Bolt	30	Actual	0.03	0.9
Total Cost Mechanics Components ($)				**67.26**

CanSat Budget – Hardware (3/4)

Ground Station Components

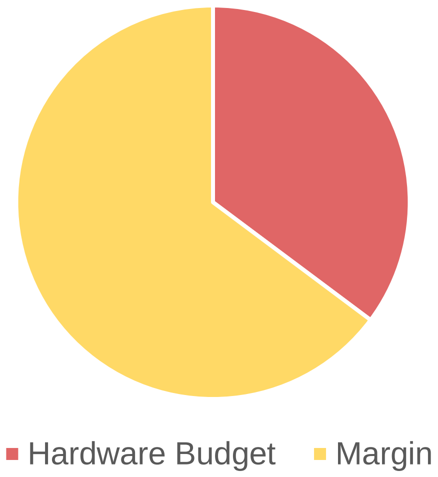
Component	Quantity	Considerations	Unit Cost ($)	Total Cost ($)
Moxon-Yagi Antenna	1	Actual	17	17
XBee Pro S3B	1	Actual	57.52	57.52
XBee Adapter	1	Actual	5.27	5.27
USB Cable	1	Actual	1.29	1.29
RP-SMA Cable	1	Actual	2.59	2.59
Total Cost Ground Station Components ($)				**83.67**

CanSat Budget – Hardware (4/4)

Component	Total Cost ($)
Total Cost Electronics Components	201.194
Total Cost Mechanics Components	67.26
Total Cost Ground Station Components	83.67
Total Hardware Budget ($)	**352.124**

CanSat Requirement Cost – Hardware Budget = **Margin**

$ 1000 - $ 352.124 = **$ 647.876**



CanSat Budget – Other Costs (1/2)

Others Cost

Component	Quantity	Considerations	Unit Cost ($)	Total Cost ($)
Registration	1	Actual	200	200
Prototyping	1	Estimated	100	100
Round Trip CGK-IAD Ticket	10 people	Estimated	1,745	17,450
Round Trip Train Ticket	10 people	Estimated	51.04	510.4
Visa	10 people	Estimated	160	1,600
Uniform	15 people	Actual	19.65	294.75
SIM Card	1 people	Actual	30	30
Guest House	7 nights	Estimated	100	700
Bus	10 people	Estimated	86	860
Total Other Costs ($)				**21,745.15**

Sources of Income

Sources of Income	Total Cost ($)
PENS Funding	3,272.36
Sponsorship	19,000
Total Income ($)	**22,272.36**

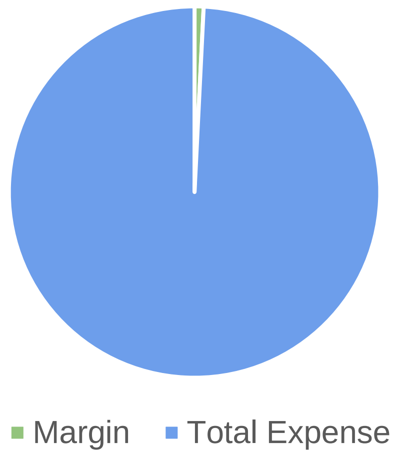
CanSat Budget – Other Costs (2/2)

Overall Cost

PDR Phase	
Categories	Cost ($)
Total Hardware	341.414
Total Other Cost	21,745.15
Total Expense ($)	**22,086.564**

CDR Phase	
Categories	Cost ($)
Total Hardware	352.124
Total Other Cost	21,745.15
Total Expense ($)	**22,097.27**

Overall Margin



Income – Total Expense = **Margin**
22,272.36 - 22,097.27 = **175.09**

Program Schedule Overview

CANSAT PROJECT SCHEDULE

Cansat 2023

Project Start Date: 01-Oct-22
Project Leader: Fatwa Aulia

PM=Project Manager **MC=Mechanical** **WM=Web Master**
AD=Administration **HW=Hardware** **BT=Brand**
SS=Sponsorship **SW=Software**

Task	Assign	Start	End	Days	Status	% Complete	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Summary																
Team Member Recruitment	ALL	1-Sep-22	27-Sep-22	26	Completed	100%										
Internal Funding	AD	27-Sep-22	27-Sep-22	1	Completed	100%										
Middle 1st Semester Exam	ALL	3-Oct-22	7-Oct-22	4	Exam	100%										
PDR Preparation	ALL	10-Oct-22	27-Jan-23	109	Completed	100%										
Procurement of Components & Materials	HW, MC,SW	10-Oct-22	30-Mar-23	171	Completed	100%										
Sponsorship	AD, SS, BT	14-Oct-22	25-May-23	223	On-going	75%										
EEPISAT's Website Developing	WM	14-Oct-22	18-Jun-23	247	On-going	68%										
Registration	PM	4-Nov-22	4-Nov-22	1	Completed	100%										
Final 1st Semester Exam	ALL	21-Nov-22	25-Nov-22	4	Exam	100%										
Team Member Vacation	ALL	25-Dec-22	19-Feb-23	56	Completed	100%										
PDR Submission	PM	1-Feb-23	1-Feb-23	1	Completed	100%										
CDR Preparation	ALL	1-Feb-23	1-Apr-23	59	Ongoing	98%										
System Integration	ALL	1-Mar-23	25-May-23	85	Ongoing	36%										
CDR Submission	PM	1-Apr-23	1-Apr-23	1	Upcoming	0%										
Mid 2nd Semester Exam	ALL	3-Apr-23	6-Apr-23	3	Exam	0%										
System Improvement	ALL	3-Apr-23	25-May-23	52	Upcoming	0%										
Final 2nd Semester Exam	ALL	22-May-23	26-May-23	4	Exam	0%										
Enviromental Test Submission	ALL	26-May-23	26-May-23	1	Upcoming	0%										
CanSat Shipping	ALL	29-May-23	29-May-23	1	Upcoming	0%										
FRR (Flight Readiness Review)	ALL	9-Jun-23	9-Jun-23	1	Upcoming	0%										
Competition	ALL	8-Jun-23	11-Jun-23	3	Upcoming	0%										
PFR	PM	11-Jun-23	11-Jun-23	1	Upcoming	0%										

(Completed) (On-going)

(Exam) (Upcoming)

Overall accomplishment: 54%

Detailed Program Schedule (1/3)

Task	Assign	Start	End	Days	Status	% Complete	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Mechanical															
Mission Guide Study	MC	1-Oct-22	8-Oct-22	7	Completed	100%									
Middle 1st Semester Exam	ALL	3-Oct-22	7-Oct-22	4	Exam	100%									
Prototype Manufacturing	MC	4-Oct-22	1-Nov-22	28	Completed	100%									
Material Trade	MC	9-Oct-22	31-Oct-22	22	Completed	100%									
Cansat 1st Design	MC	9-Oct-22	5-Dec-22	57	Completed	100%									
Procurement of Materials	MC	10-Oct-22	30-Mar-23	171	Completed	100%									
Prototype Testing	MC	29-Oct-22	2-Dec-22	34	Completed	100%									
Cansat 2nd Design	MC	10-Nov-22	27-Dec-22	47	Completed	100%									
Final 1st Semester Exam	ALL	21-Nov-22	25-Nov-22	4	Exam	100%									
Team Member Vacation	ALL	25-Dec-22	19-Feb-23	56	Completed	100%									
Mass Budget Calculate	MC	4-Jan-23	10-Jan-23	6	Completed	100%									
System Integrating	MC	1-Mar-23	25-May-23	85	Ongoing	36%									
Mid 2nd Semester Exam	ALL	03-Apr-23	6-Apr-23	3	Exam	0%									
System Improvement	MC	3-Apr-23	25-May-23	52	Upcoming	0%									
System Testing	MC	15-Apr-23	29-Apr-23	14	Upcoming	0%									
Final 2nd Semester Exam	ALL	22-May-23	26-May-23	4	Exam	0%									

Assign to: Artaka Sunu Adhi Prasetya (MC)

Overall accomplishment: 50%

(Completed) (On-going) (Mechanical)

(Exam) (Upcoming)

Detailed Program Schedule (2/3)

Task	Assign	Start	End	Days	Status	% Complete	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Hardware															
Mission Guide Study	HW	1-Oct-22	8-Oct-22	7	Completed	100%									
Middle 1st Semester Exam	ALL	3-Oct-22	7-Oct-22	4	Exam	100%									
Component Trade	HW	9-Oct-22	12-Nov-22	34	Completed	100%									
Procurement of Components	MC	10-Oct-22	30-Mar-23	171	Completed	100%									
Payload PCB Design	HW	20-Oct-22	30-Nov-22	41	Completed	100%									
XBEE Communication Test	HW	21-Oct-22	1-Nov-22	11	Completed	100%									
Electrical Prototype Test	HW	10-Nov-22	1-Dec-22	21	Completed	100%									
Component Testing	HW	12-Nov-22	1-Dec-22	19	Completed	100%									
Final 1st Semester Exam	ALL	21-Nov-22	25-Nov-22	4	Exam	100%									
Flight Algorithm	HW	1-Dec-22	4-Jan-23	34	Completed	100%									
Team Member Vacation	ALL	25-Dec-22	19-Feb-23	56	Completed	100%									
Camera Tracking Test	HW	15-Feb-23	16-Mar-23	29	Completed	100%									
System Integrating	HW	1-Mar-23	25-May-23	85	Ongoing	36%									
Mid 2nd Semester Exam	ALL	3-Apr-23	6-Apr-23	3	Exam	0%									
System Improvement	HW	3-Apr-23	25-May-23	52	Upcoming	0%									
System Testing	HW	15-Apr-23	29-Apr-23	14	Upcoming	0%									
Final 2nd Semester Exam	ALL	22-May-23	26-May-23	4	Exam	0%									

Assign to: Achmad Bagus Okto Faerizqi (HW)

Overall accomplishment: 50%

(Completed) (On-going) (Hardware)

(Exam) (Upcoming)

Detailed Program Schedule (3/3)

Task	Assign	Start	End	Days	Status	% Complete	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Software															
Mission Guide Study	SW	1-Oct-22	8-Oct-22	7	Completed	100%									
Middle 1st Semester Exam	ALL	3-Oct-22	7-Oct-22	4	Exam	100%									
GCS Design	SW	9-Oct-22	27-Dec-22	79	Completed	100%									
Antenna Trade	SW	17-Oct-22	28-Oct-22	11	Completed	100%									
Improve Antenna Design	SW	31-Oct-22	27-Dec-22	57	Completed	100%									
Final 1st Semester Exam	ALL	21-Nov-22	25-Nov-22	4	Exam	100%									
Team Member Vacation	ALL	25-Dec-22	19-Feb-23	56	Completed	100%									
Antenna Manufacturing	SW	26-Feb-23	20-Mar-23	22	Completed	100%									
System Integrating	SW	1-Mar-23	25-May-23	85	Ongoing	36%									
Antenna Range Test	SW	1-Apr-23	30-Apr-23	29	Upcoming	0%									
Mid 2nd Semester Exam	ALL	3-Apr-23	6-Apr-23	3	Exam	0%									
System Improvement	SW	3-Apr-23	25-May-23	52	Upcoming	0%									
System Testing	SW	15-Apr-23	29-Apr-23	14	Upcoming	0%									
Final 2nd Semester Exam	ALL	22-May-23	26-May-23	4	Exam	0%									

Assign to: Muhammad Tsaqif Mukhayyar (SW)

Overall accomplishment: 50%

(Completed) (On-going) (Software)

(Exam) (Upcoming)

Shipping and Transportation

Transportation	
Person	Surabaya – Jakarta: Indonesian Train Jakarta – Washington, D.C.: American Airlines Washington, D.C. – Blacksburg: Bus

Shipping	
Cansat and Tools	Surabaya – Charlotte: Cargo (FedEx) Shipping Address 1: Committee Office Shipping Address 2: Indonesian Embassy in Washington, D.C.

Notes:

- In order to minimize trouble for transporting the tools and CanSat, we will send one set of the CanSat and tools using cargo service and another set carried along with us aboard.

Conclusions (1/2)

Division	Major Accomplishments	Major Unfinished Work	Testing to Complete
Mechanical	• Major mechanism has been tested • Several environmental test has been completed	• Overall system integration • Design improvement based on testing results	• Environmental test
Hardware	• All sensors have been tested • XBEE Communication test completed	• Overall system integration	-
Software	• GUI Design Completed • Antenna has been built and tested • Flight software status has been developed and tested	• Overall system integration	-
Administration & Sponsorship	• Sponsorship and partnership contracted • Travel and shipment plans have been established	• Waiting for other sponsors	-
Brand Team & Web Master	• Official social media still active • New generation website development	• Developing the social media and website promotion	-

Conclusions (2/2)

Bamantara EEPISAT Are Ready to Proceed to The Next Stage of Development

- Critical Design Phase is completed for mechanical, software, and electronic systems.
- Major mechanisms has been tested and there will be further improvements to make sure all mechanisms works well.
- Travel and shipment plans have been established for competition day in Virginia Tech, Blacksburg, VA.