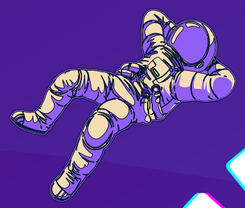
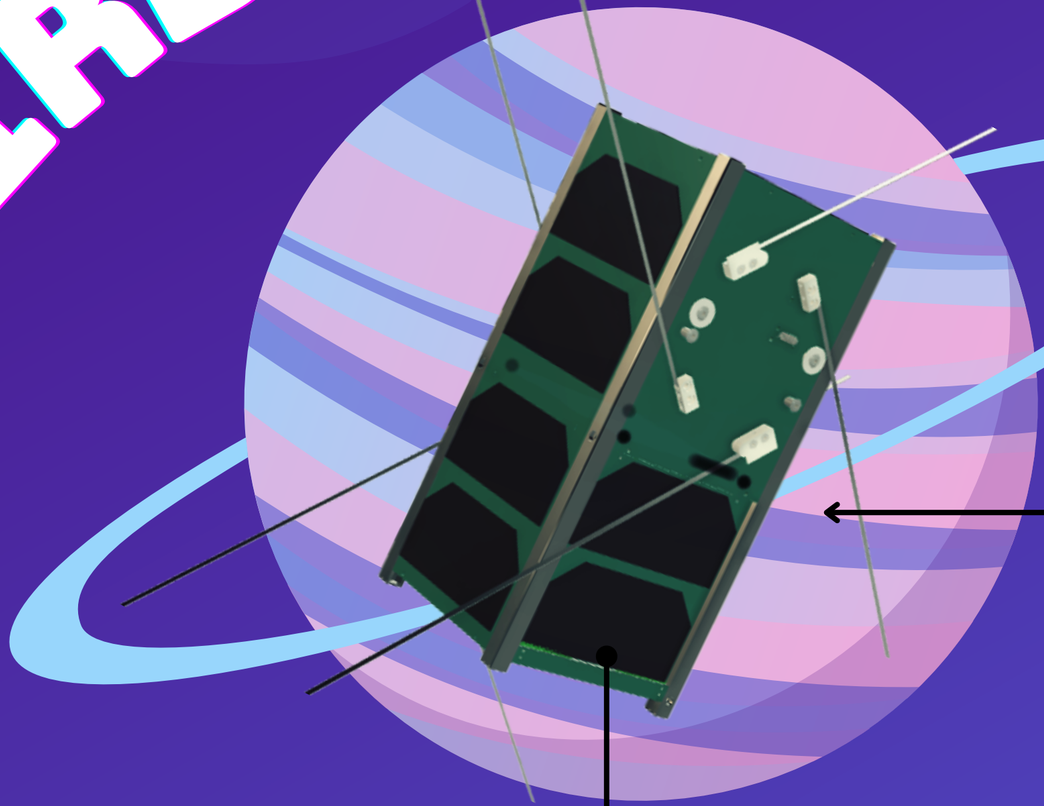
# BIRDS-X PROJECT





Dragonfly satellite

APRS Payload

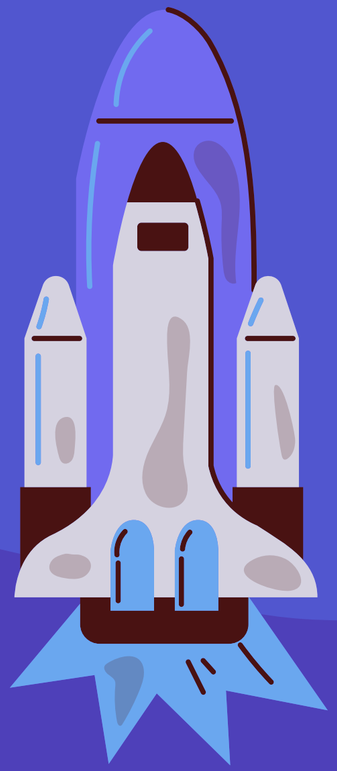
BIRDS-X
九州工業大学 APRS MISSION

La SEINE

# CONTENTS



# PHASE 2 TIMELINE



## PERIOD

15 March - 31 May

## SUBMISSION DEADLINE

5 May

## ANNOUNCEMENT OF 10 TEAMS

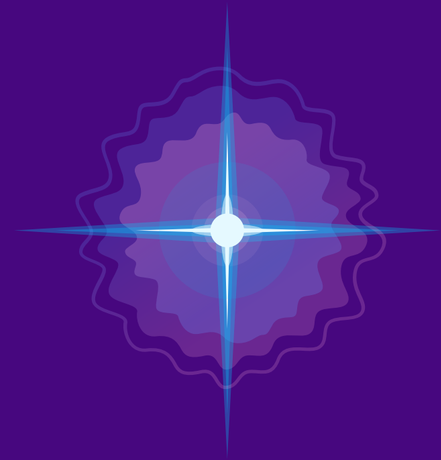
31 May

# PHASE 2 - POINT ALLOCATION

| | |
|---|---|
| System Block Diagram | **20 points** |
| Bill of material (BOM) | **5 points** |
| Feasibility study and functional test | **40 points** |
| Safety compliance | **10 points** |
| Quality of submission | **5 points** |
| Schedule | **10 points** |
| Outreach | **10 points** |

# PHASE 2 APPLICATION

- Deliverables
  - Detailed description of your payload
  - Developed Bread Board Model (BBM)
    Functional test results
  - Outreaching efforts
  - Video presentation



# PHASE 2 APPLICATION

## SUBMISSION

### APPLICATION FORM

### PRESENTATION VIDEO

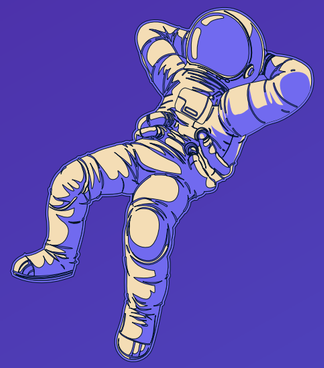
Within 15 slides

Within 10 minutes

Show your team members

NO BBM

# APPLICATION FORM



# SYSTEM BLOCK DIAGRAM

**SYSTEM BLOCK DIAGRAM**

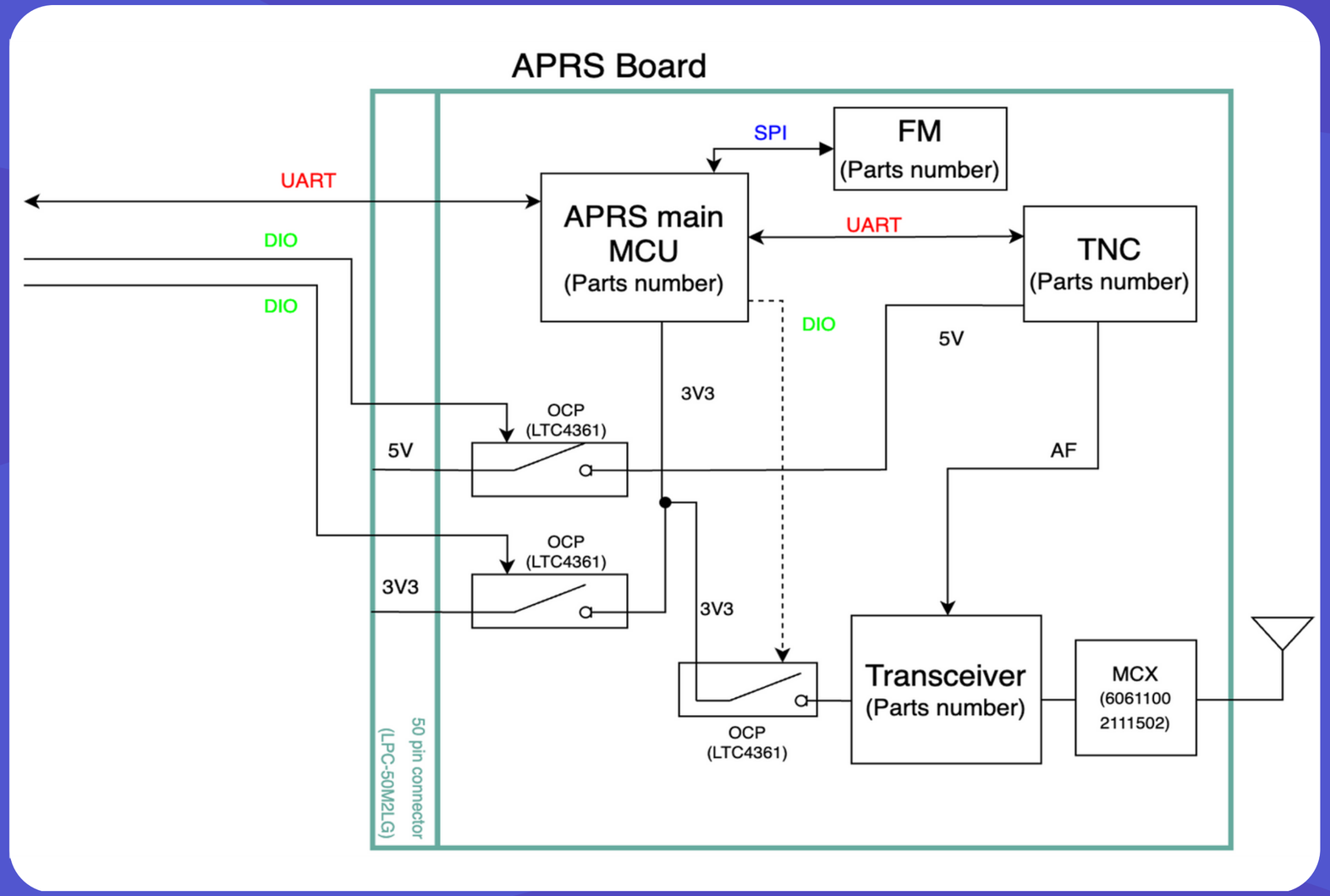
**SCHEMATIC**

**PARAMETERS**

Show the parts number, voltage, impedance, communication protocol, power consumption, etc.

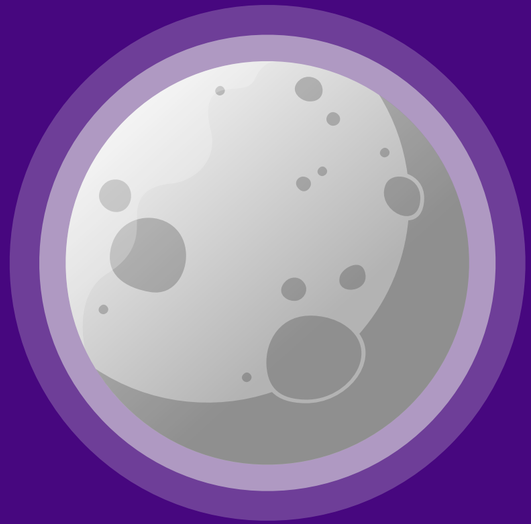
**WRITE A DETAILED EXPLANATION**

# SYSTEM BLOCK DIAGRAM



# PIN ASSIGNMENT

- 50 pin assignment table
- Detailed explanation for each pin
- Conciseness



# PIN ASSIGNMENT

| Signal name | Pin # | | Signal name |
|---|---|---|---|
| Programming/debug #2 | 2 | 1 | Programming/debug #1 |
| | 4 | 3 | Programming/debug #3 |
| GND_SYS | 14 | 13 | GND_SYS |
| SUP_5VO | 16 | 15 | SUP_5VO |
| UART (MCU Tx to Mission Boss) | 18 | 17 | UART (MCU Rx to Mission Boss) |
| DI/O_2 (5VO OCP control) | 20 | 19 | DI/O_2 (3V3 OCP control) |
| SUP_UNREG_1 | 24 | 23 | SUP_UNREG_1 |
| SUP_3V3_2 | 26 | 25 | SUP_3V3_2 |
| SUP_UNREG_2 | 36 | 35 | SUP_UNREG_2 |
| SUP_3V3_1 | 50 | 49 | SUP_3V3_1 |

**Pins No. 1 -3 are used for programming.**
Pin No.1 is for Master clear
Pin No.2 is for PGC
Pin No.3 is for PGD

**Pin No. 17-18 are used for UART communication between the payload mission control unit (MCU) and the Mission Boss PIC.**
Pin No.17 is for Rx
Pin No.18 is for Tx

**Pin No. 19-20 are used for DI/O line to control over current protection (OCP) from Mission Boss PIC.**
Pin No.19 is for controlling the 3.3V line
Pin No.20 is for controlling the  5V line

# BILL OF MATERIALS (BOM)

- Cost in USD (for each component)
- Operating temperature
- Mention inventory

| No. | Components | Manufacturer | Model number | Cost (USD) | Operating temperature |
|---|---|---|---|---|---|
| 1 | 0.1 uF capacitor | Kemet | C0603C104K3RAC7867 | 1.06 | -55 to 125C° |
| 2 | MCU | Microchip | PIC18F67J94-I PT | 62.93 | -40 to 85C° |
| 3 | Flash Memory | Micron | MT25QL01GBBB8ESF0SIT | 143.84 | -40 to 85C° |

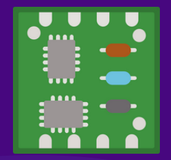
No.1 we can get this component on 20 May 2023

# FEASIBILITY STUDY

## Power budget

Power budget

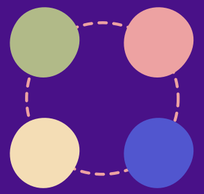
Time of operation



## Mass and volume

Mass & dimension

3D model



## Concept of operation

Flow process

Task definition

Sequence

## Preliminary link budget

Power output

Sensitivity

This part is the **most important** section of this phase

# POWER BUDGET

- The power budget requirements
  - Operating current
  - Operating voltage
  - Operating power
- Power consumption for each mode

# POWER BUDGET

Example

| Mode | Components | | Operating current (mA) | Operating Voltage (V) | Operating Power (mW) | Total power consumption of your board |
|---|---|---|---|---|---|---|
| Digipeating | Microcontroller | | 1.3 | 5 | 65 | Estimate here your total power consumption according to your design |
| | OCP | | 0.1 | 5 | 0.5 | |
| | OCP | | 0.1 | 5 | 0.5 | |
| | OCP | | 0.1 | 5 | 0.5 | |
| | Flash memory | | 16 | 3.3 | 52.8 | |
| | Transceiver | Rx | 32 | 5 | 160 | |
| | | Tx | 210 | 5 | 1050 | |
| | TNC | | 0.4 | 5 | 2 | |

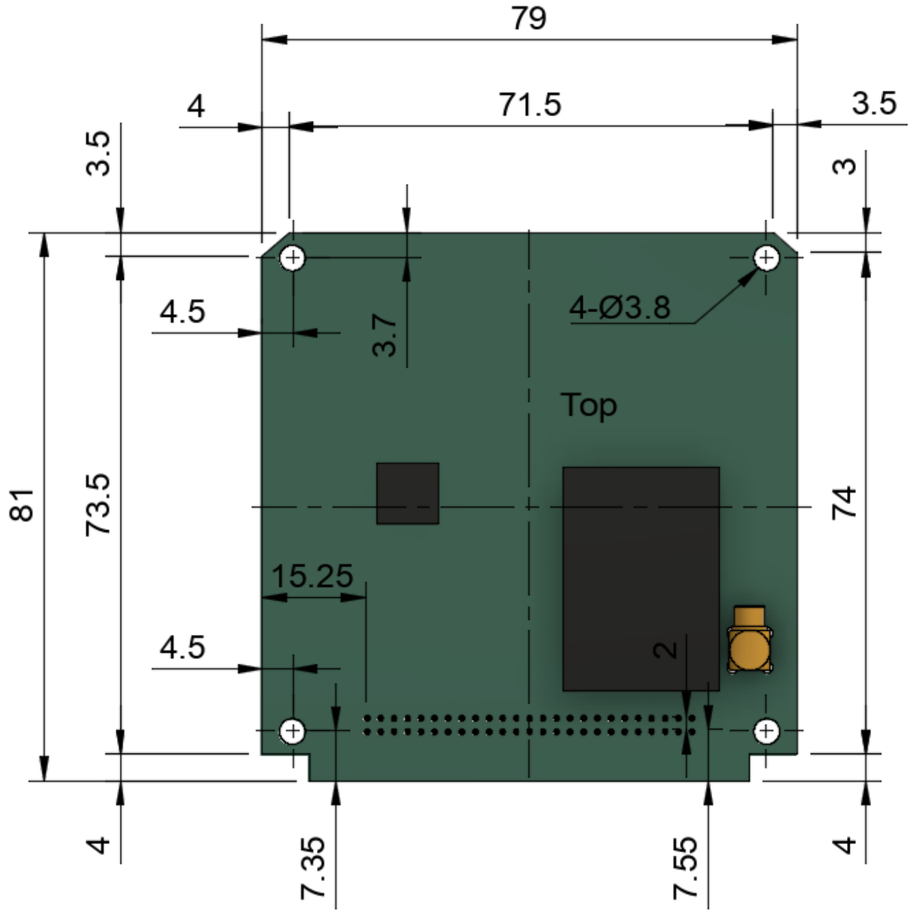
Don't forget to add Store and Forward mode

# POWER CONSUMPTION LIMITATION OF THE APRS BOARD

| APRS Power Consumption limitation | |
|---|---|
| **Mode** | **Max Power (mW)** |
| Rx | 300 |
| Tx | 1750 |

# MASS AND VOLUME

- Mass and dimension
- 3D model and/or picture
- Parts distribution
- Detailed explanation




Maximum thickness: 13.6 mm (including PCB)

Maximum mass: 90 g

# CONCEPT OF OPERATION

- Flow process of each working mode
- Task definition by component
- Sequence of the process

EXAMPLE

Digipeater mode

Note

The switch for the transceiver is usually turned on, and if the MCU receives a specific command from the Mission Boss, it will be turned off

Activation

- At first, the MCU of APRS and TNC will be turned on by Mission Boss.
- At the same time, the antenna will be connected to this board. (Mission Boss will switch the 6way RF switch)
- TNC will work for digipeating

Shut down

Mission Boss will turn off both OCP connected to power lines

# PRELIMINARY LINK BUDGET

Test

- Power output
- Sensitivity

# LINK BUDGET (UPLINK)

| PARAMETERS | | |
|---|---|---|
| Objective | | APRS-Digipeater and Store and Forward Mission |
| Frequency | [MHz] | 145.825 |
| Emission Type | | 15K0F2D |
| Modulation | | AFSK |
| Data Rate | [bps] | 1200 |
| Protocol | | AX.25 |
| **GROUND STATION** | | |
| Ground Station Transmitter Power Output | [W] | 50.0 |
| | [dBw] | 17.0 |
| Ground Station Total Transmission Line Losses | [dB] | 1.5 |
| Antenna Gain | [dBi] | 16.0 |
| Ground Station EIRP | [dBw] | 31.5 |

| UPLINK PATH | | |
|---|---|---|
| Orbit Altitude | [km] | 400 |
| Elevation Angle | [degree] | 10.0 |
| Slant Range | [km] | 1439.8 |
| Ground Station Antenna Pointing Loss | [dB] | 1.0 |
| Ground Station to Spacecraft Antenna Polarization Loss | [dB] | 3.0 |
| Path Loss | [dB] | 138.9 |
| Atmospheric Losses | [dB] | 1.1 |
| Ionospheric Losses | [dB] | 0.7 |
| Rain Losses | [dB] | 0.0 |
| Isotropic Signal Level at Spacecraft | [dBw] | -113.2 |
| **SPACECRAFT (RX Power Sensitivity Method)** | | |
| Spacecraft Antenna Pointing Loss | [dB] | 5.0 |
| Spacecraft Antenna Gain | [dBi] | 2.2 |
| Spacecraft Total Transmission Line Losses | [dB] | 2.3 |
| Signal Power at Spacecraft LNA Input | [dBw] | -118.4 |
| | [dBmW] | -88.4 |
| Required Signal Power at Spacecraft LNA Input | [dBmW] | -105.0 |
| System Link Margin | [dB] | 16.6 |

EXAMPLE

# LINK BUDGET (DOWNLINK)

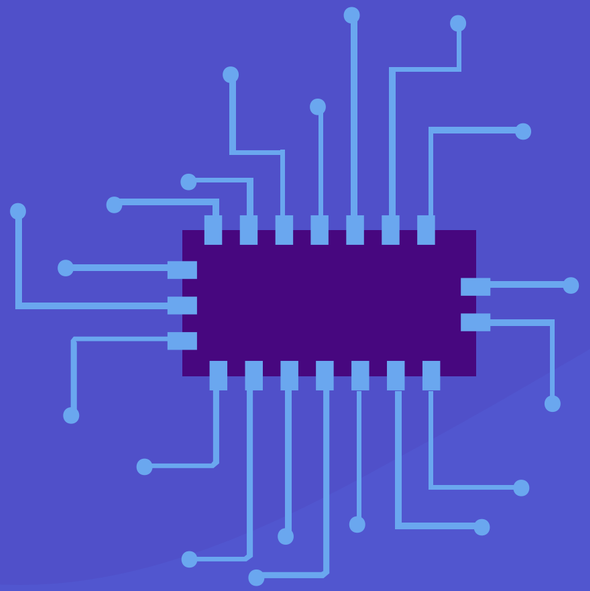
| PARAMETERS | | |
|---|---|---|
| Objective | | APRS-Digipeater and Store and Forward Mission |
| Frequency | [MHz} | 145.825 |
| Emission Type | | 15K0F2D |
| Modulation | | AFSK |
| Data Rate | [bps] | 1200 |
| Protocol | | AX.25 |
| SPACECRAFT | | |
| Spacecraft Transmitter Power Output | [W] | 2.0 |
| | [dBw] | 3.0 |
| Spacecraft Total Transmission Line Losses | [dB] | 2.3 |
| Spacecraft Antenna Gain | [dBi] | 2.2 |
| Spacecraft EIRP | [dBw] | 2.8 |

EXAMPLE

| DOWNLINK PATH | | |
|---|---|---|
| Orbit Altitude | [km] | 400 |
| Elevation Angle | [degree] | 10.0 |
| Slant Range | [km] | 1439.8 |
| Spacecraft Antenna Pointing Loss | [dB] | 5.0 |
| Spacecraft-to-Ground Antenna Polarization Loss | [dB] | 3.0 |
| Path Loss | [dB] | 138.9 |
| Atmospheric Losses | [dB] | 1.1 |
| Ionospheric Losses | [dB] | 0.7 |
| Rain Losses | [dB] | 0.0 |
| Isotropic Signal Level at Ground Station | [dBw] | -145.9 |
| GROUND STATION (SNR Method) | | |
| Ground Station Antenna Pointing Loss | [dB] | 1.0 |
| Ground Station Antenna Gain | [dBi] | 16.0 |
| Ground Station Total Transmission Line Losses | [dB] | 1.5 |
| Ground Station Effective Noise Temperature | [K] | 1000.0 |
| Signal Power at Ground Station LNA Input | [dBw] | -132.4 |
| Ground Station Receiver Bandwidth | [Hz] | 15000.0 |
| Ground Station Receiver Noise Power | [dBw] | -156.8 |
| Signal-to-Noise Power Ratio (SNR) at Ground Station Receiver | [dB] | 24.5 |
| Required SNR for Ground Station receiver | [dB] | 11.5 |
| System Link Margin | [dB] | 13.0 |

# SAFETY COMPLIANCE

- Avoid interference (mechanical and electrical)



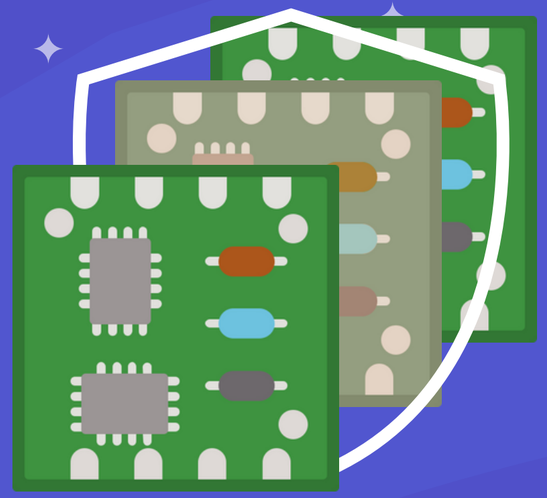
## ICD

Check the ICD

https://eprpartner.com/wp-content/uploads/2018/11/Blog-Marcel-S_example-of-RF-shielding-1.png

# ISOLATION SYSTEM

- Describe the way to isolate your payload
- Mention situations when the isolation system could work



# SCHEDULE

- Make schedule until the end of the competition
- Detailed schedule
- Mark finished, ongoing, and delayed tasks

# SCHEDULE

**TASKS**

Task1 : completed

Task2 : completed

Task3  : delayed

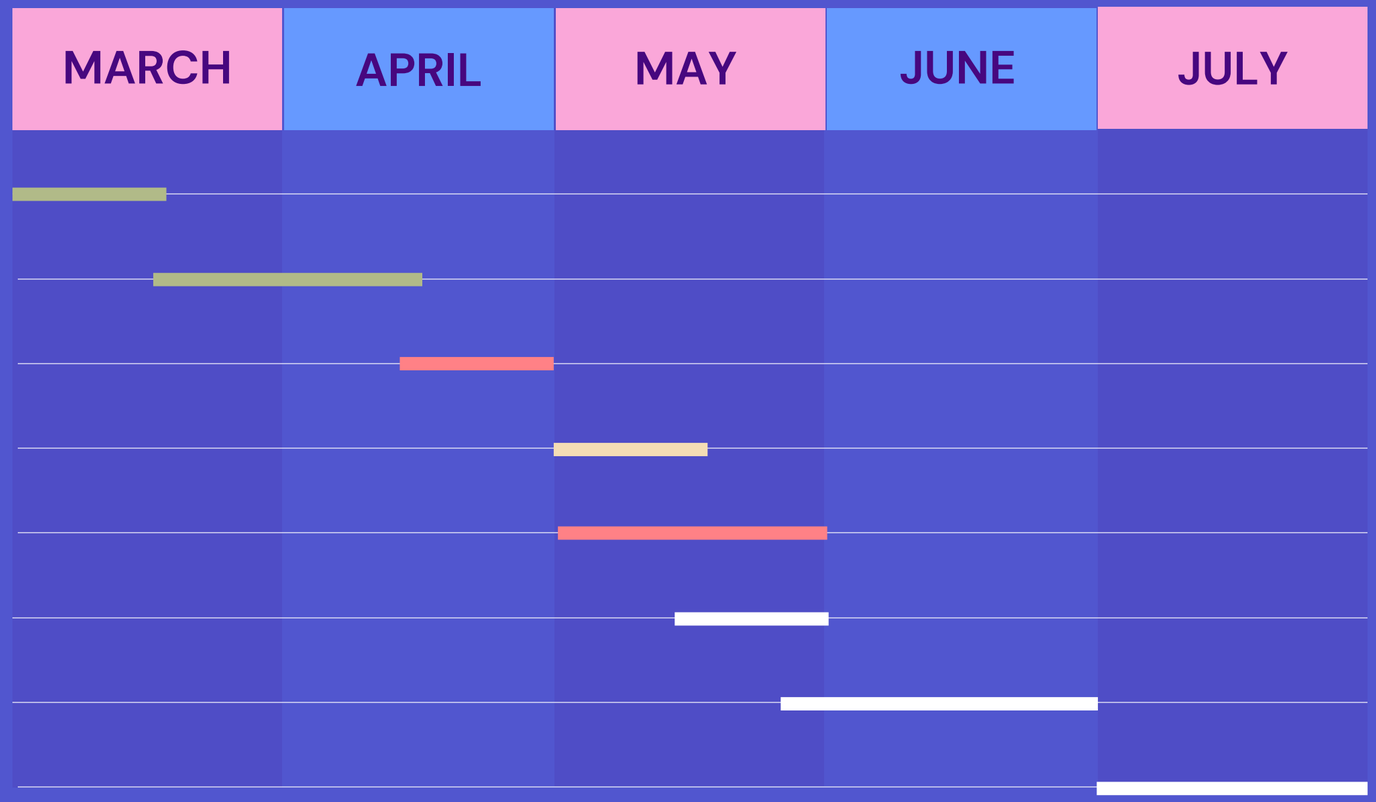
Task4 : on going

Task5 : delayed

Task6

Task7

Task8



# OUTREACH EFFORT

Show completed tasks and elaborate future plans

**SOCIAL MEDIA**

Instagram
LinkedIn
Facebook
YouTube
Twitter

**ATTEND CONFERENCES**

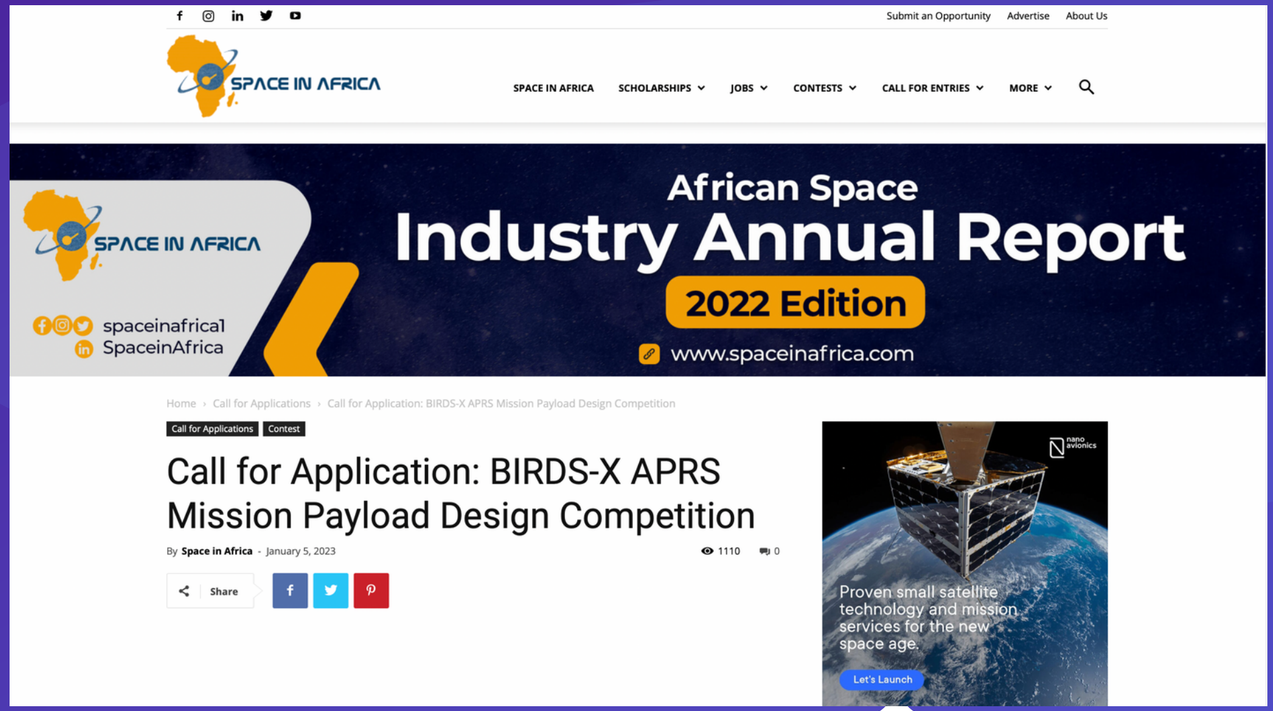
Amateur radio

**HOLD THE WORKSHOP**

Invite high school students

**FUTURE PLAN**

# OUTREACH EFFORT

# SOCIAL MEDIA

@BIRDSXKYUTECH

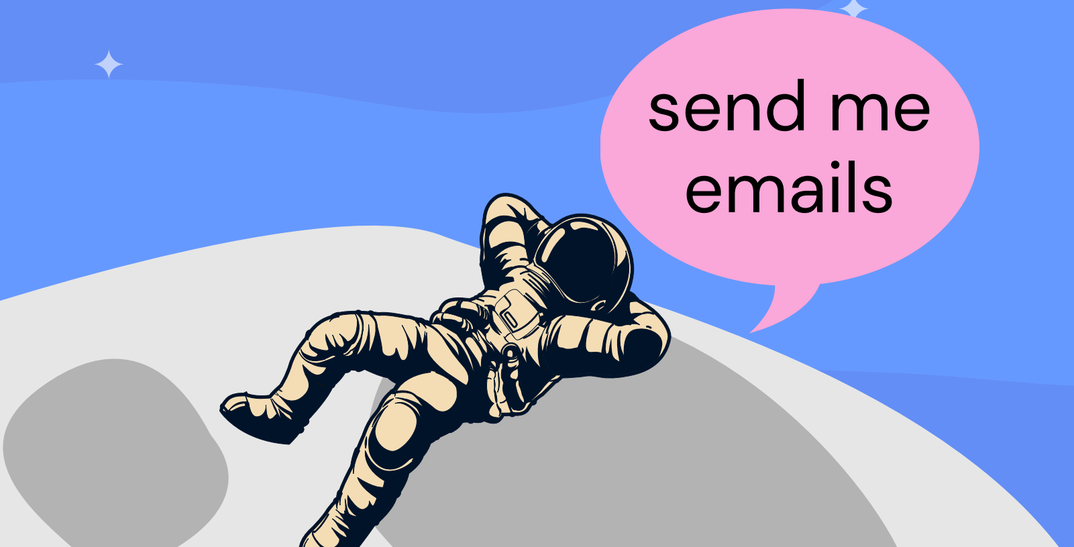
BIRDS-X SATELLITE PROJECT

BIRDSX_SATELLITE_PROJECT

# CONTACT US

BIRDS-X.BIRDS-PROJECT.COM

BIRDS-X-PROJECT@KYUTECH-LASEINE.NET



# QUESTION & ANSWER