



BIRDS-X Project





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BIRDS-X Team



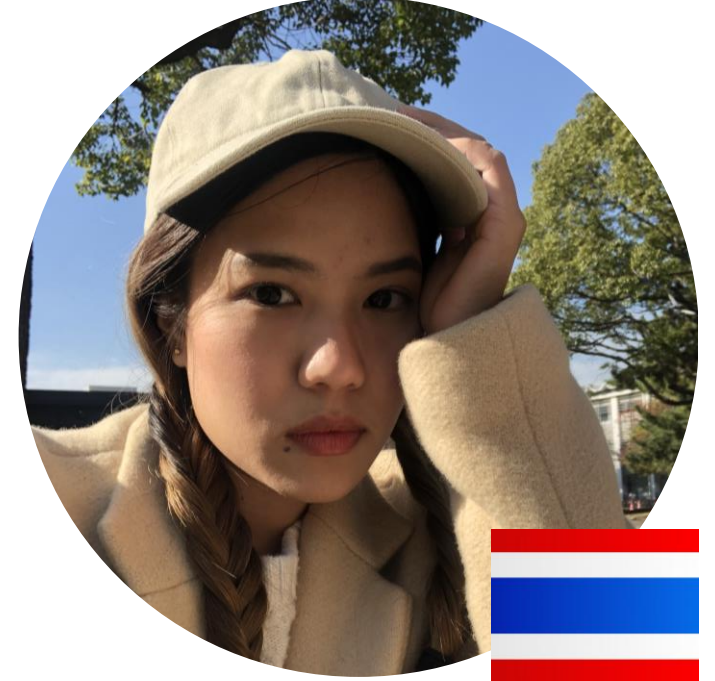
Project Members



Jorge Casir



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Ei Phyu Phyu



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Miyajima Souta



Project Members



Matsui Tasuku



Marco Panetti



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Project Members



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Etsunaga Yudai



Inoue Miyu



Overview



Goal	Bring diversity to the space sector and democratize the usage of space
Emphasis	Promotion of the satellite usage and Amateur Radio Community
Stakeholders	Kyutech with funding from ARDC
Missions	<ul style="list-style-type: none">▪ APRS Payload competition▪ APRS student mission▪ GT competition▪ UHF
Satellites	One 2U Satellite based on BIRDS bus
Approach	Lean Satellite
Team	Students
Operation	Use of BIRDS ground station network



Overview



Specification	Information
Mechanical Properties	
Dimension	100 x 100 x 227 mm \pm 0.1mm
Total Weight	~1.8 kg
Power Generation	
Cell Type	3G30 (AZURSPACE)
Cell Efficiency	Beginning of Life Efficiency 29.5%
Electrical Performance	Max V is 2.7 V, max I is 500mA, Power is 1.2 W
Cell Connectivity	2 Series, 8 Parallels
Power Storage	
Battery Type	Type AA, Nickel Metal Hydride Batteries
Battery Capacity / Nominal Voltage	2000 mAh type, 1900mAh min / 1.2 Volts



Overview



Specification	Information
Communication System	
Uplink Rate	4800 bps UHF
Downlink Rate	4800 bps UHF
Uplink Frequency	435 MHz
Downlink Frequency	437.375 MHz
Antenna System	
Antenna type	2 VHF Dipole Antennas
	2 UHF Dipole Antennas



AMATEUR RADIO DIGITAL COMMUNICATIONS

Amateur Radio Digital Communications (ARDC) is a private foundation that exists to support amateur radio and digital communication science and technology.

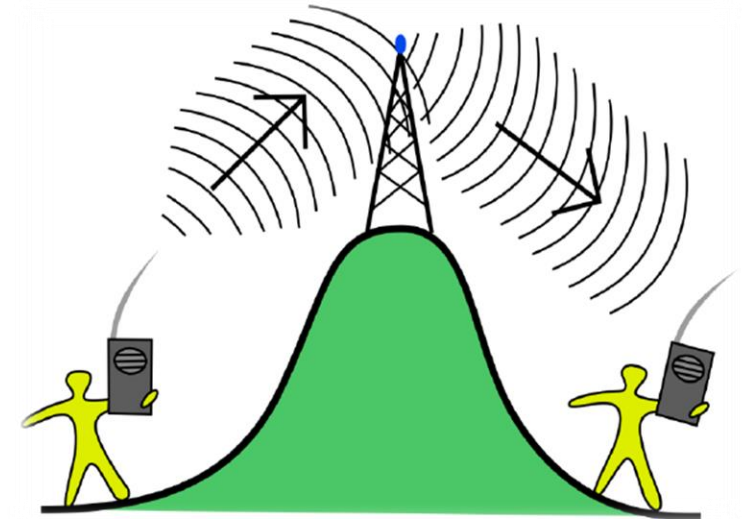


APRS



APRS – Automatic Packet Reporting System

- Position Information (Location, Speed, Altitude)
- Text messages
- E-Mails
- Weather information
- Bulletins
- Emergency Alerts
- Scientific Data



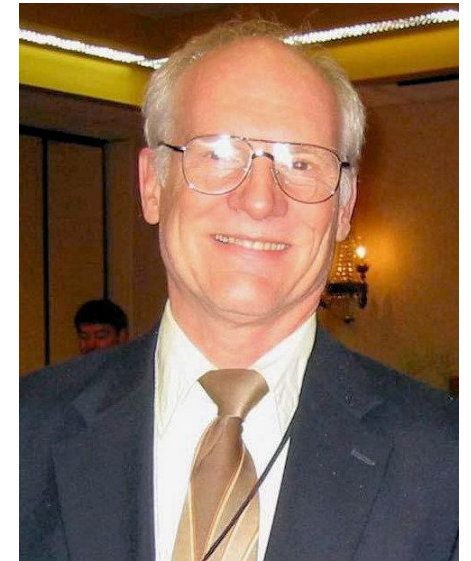
From BIRDS-4



Brief History



- Originating in the 80s as a program to plot the positions of the US Navy ships by **Bob Bruninga (WB4APR)**, it was initially called, Connectionless Emergency Traffic System (CETS)
- Later in 1992 was renamed Automatic Position Report System (APRS)
- Since APRS has more applications than being a position report system, today it is called **Automatic Packet Report System**



Bob Bruninga (WB4APR)
Silent key in Feb. 2022
Photo Source: ARRL

Silent key is a jargon when an amateur radio operator pass away

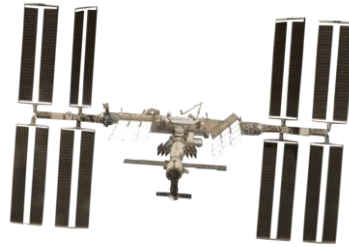


APRS Communication



Example of a packet received from ISS digipeater.

145.825 MHz (VHF)

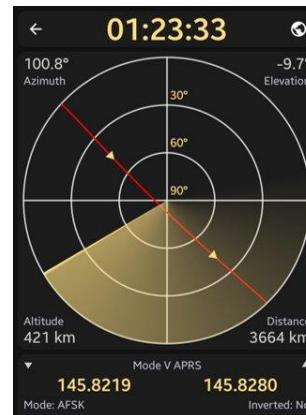


Source: <https://www.clipground.com/pics/get>



LW8EXS

Source: <https://amsat-uk.org/2013/07/22/ham-radio-satellite-operation-from-guernsey/>



LW4DMH

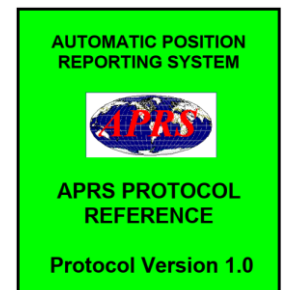
Source: <https://www.sparc-club.org/learn-about-ham-radio-satellite-communications-at-the-feb-1-sparc-meeting/>

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LW8EXS>CQ, NA1SS*, APRSAT, ARISS::LW4DMH :73s desde Mercedes (Bs.As.)
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LW8EXS > CQ, NA1SS*, APRSAT, ARISS :: LW4DMH : 73s desde Mercedes (Bs.As.)

LW8EXS CQ, NA1SS*, APRSAT, ARISS LW4DMH :73s desde Mercedes (Bs.As.)

Callsign (source) **Path** **Callsign (destination)** **Information**





BIRDS-X Satellite System Overview



- 2U CubeSat: 10 cm x 10 cm x 22.7 cm
- Adopt the design heritage of the BIRDS CubeSats
- ISS Orbit (400 km, roughly circular, 51.6° inclination)
 - Launch method: deployment from the ISS
 - Launch service provider: Kyutech/JAXA through the J-CUBE program
- Use Amateur radio frequencies



BIRDS-X Satellite System Overview

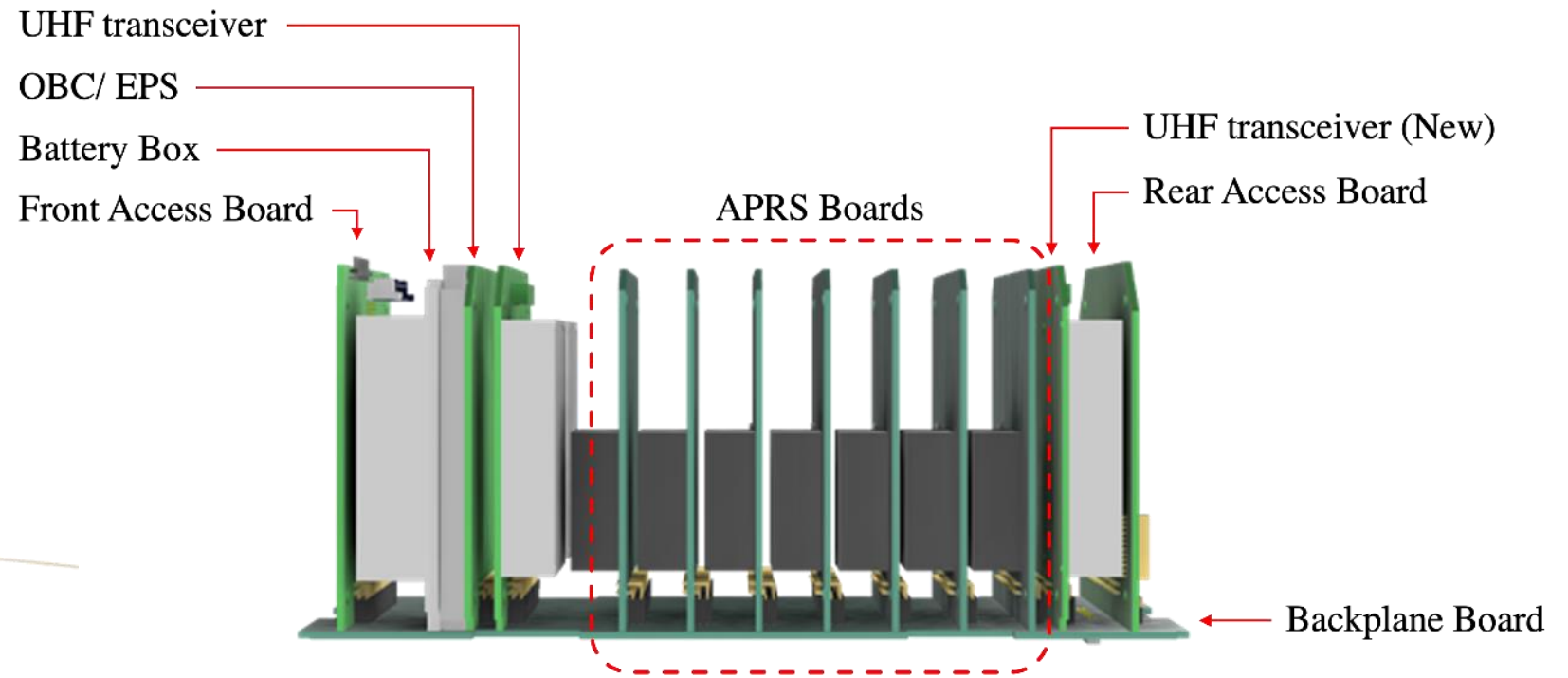


Overall view



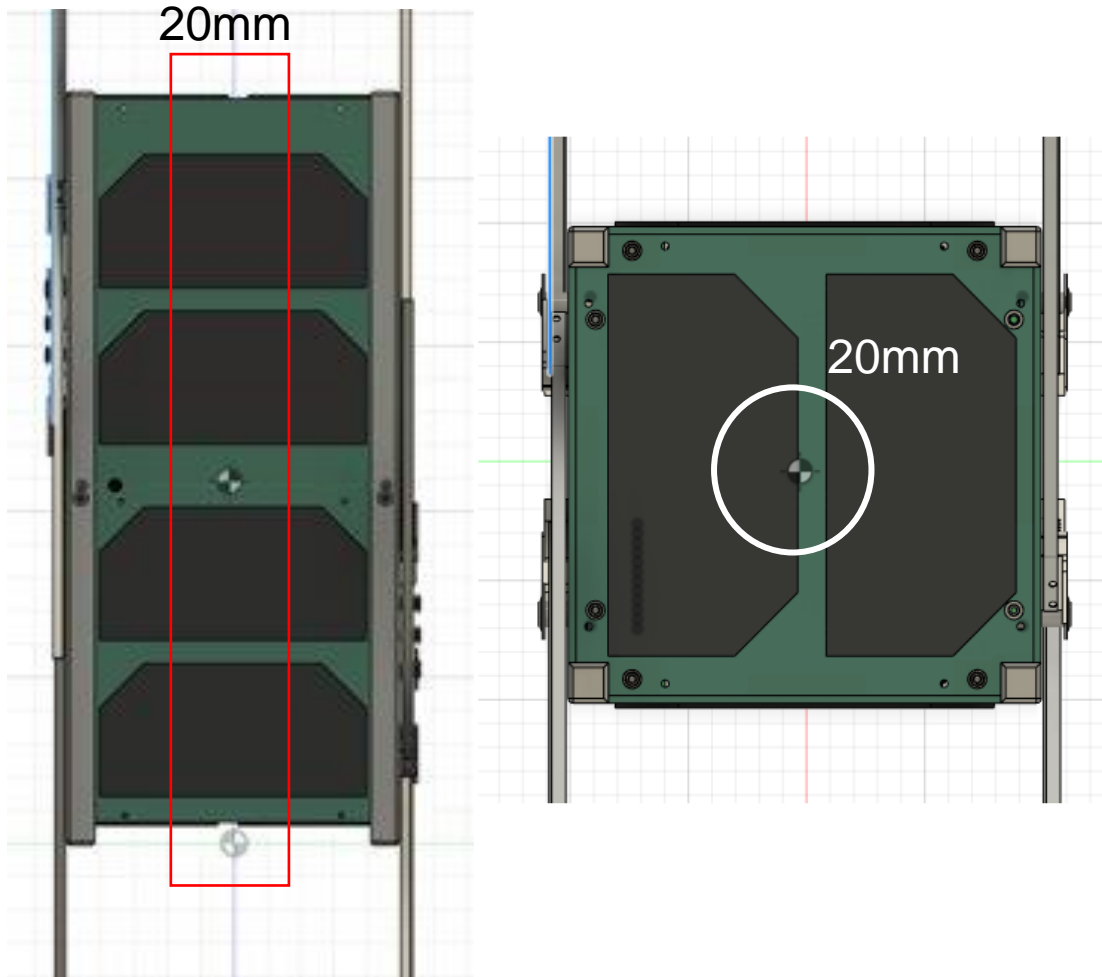


BIRDS-X Satellite System Overview





Properties



Specification	Information
Mechanical Properties	
Dimension	100 x 100 x 227 mm ± 0.1 mm
Total weight	~1.8 kg
Center of mass	Inside JAXA constrains
Materials:	
Rails	Aluminum 6061 T6
PCB	FR4



BIRDS-X Mission



- APRS Payload competition (APRS-P)
- APRS Ground Terminal competition (APRS-G)
- Demonstration of Low-cost UHF Transceiver
- APRS student mission (APRS-R)



01 | APRS Payload Competition



APRS Payload Competition

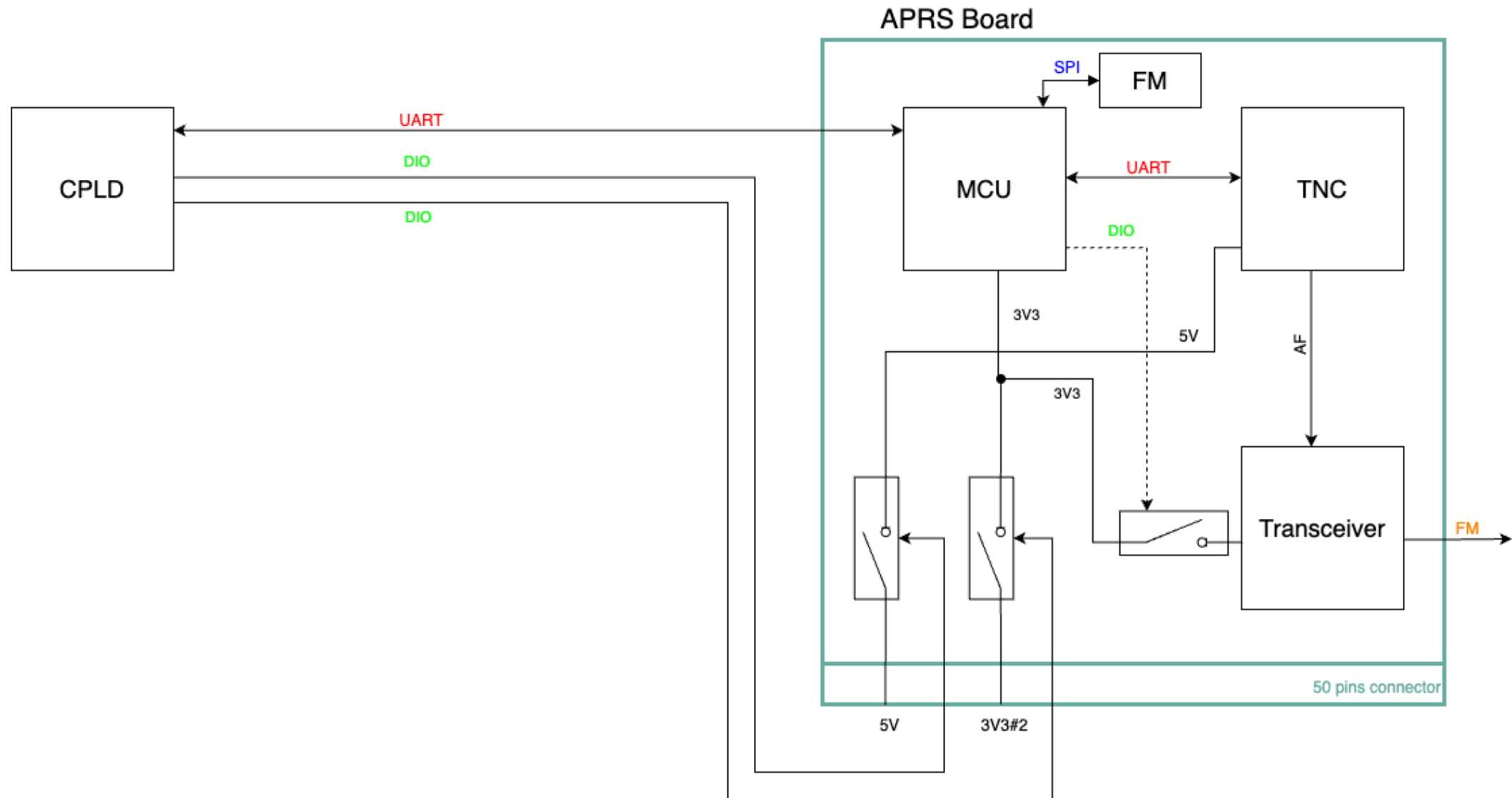


Objective:

Increase the users of amateur radio community by using one APRS payload space of a 2U CubeSat, as well as helping people to get involved in the creation, and operation of that payload, resulting in the improvement of technical skills and democratization of space.

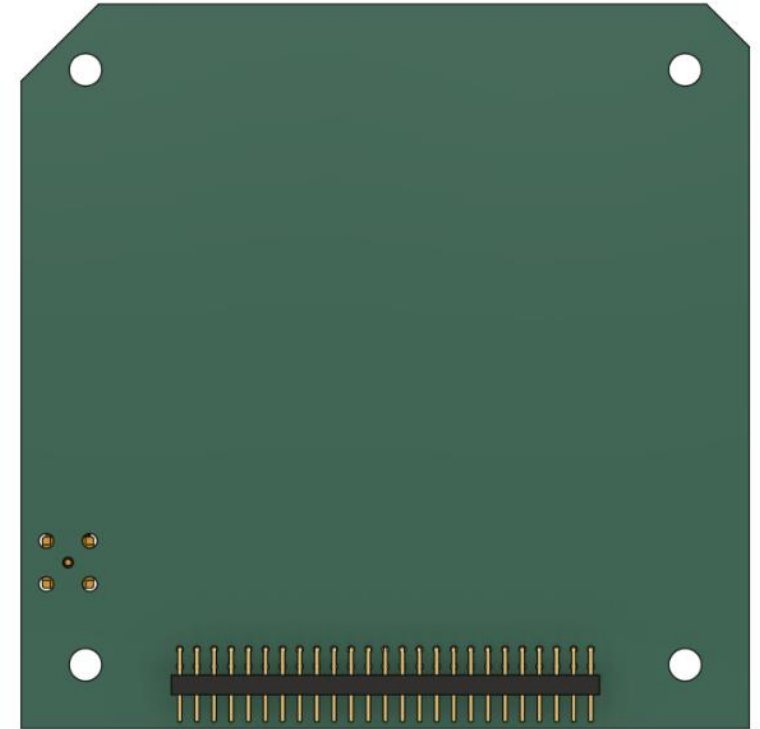
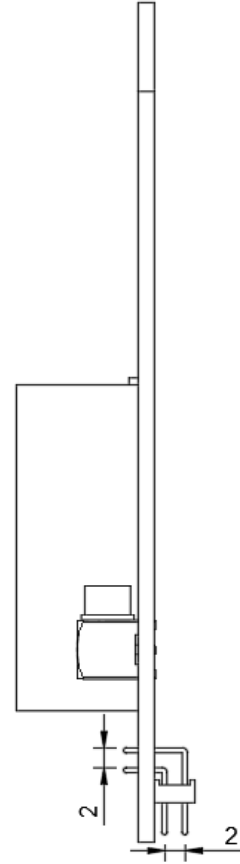
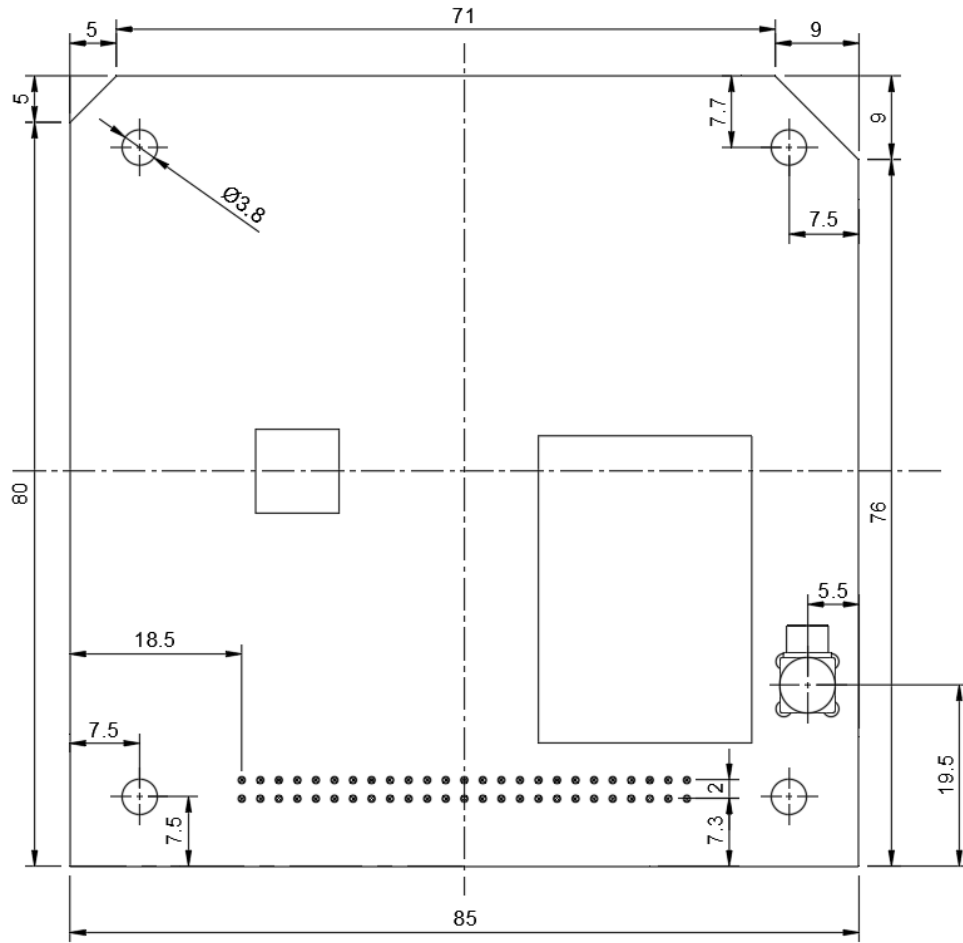


APRS Payload Block Diagram



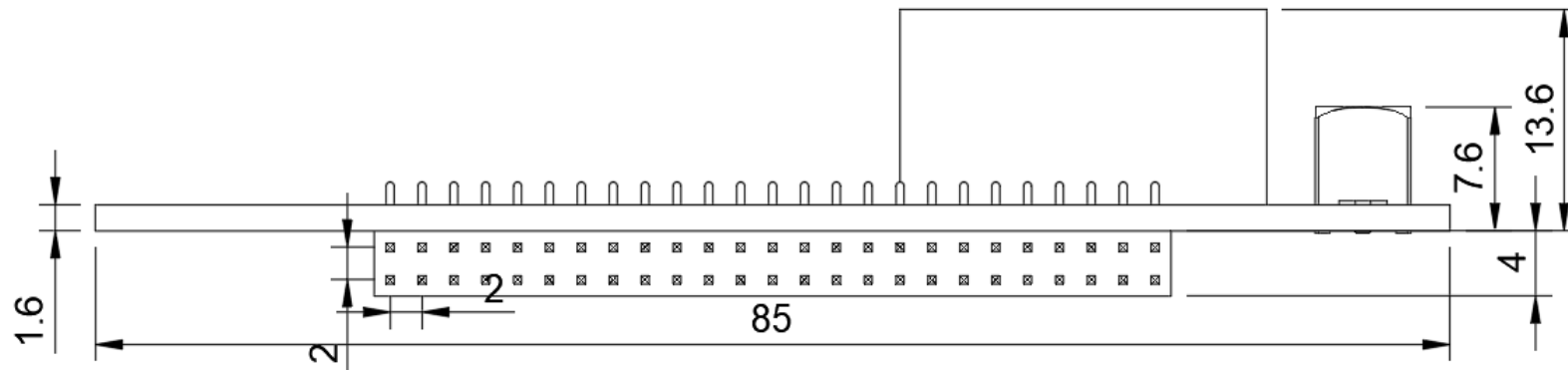
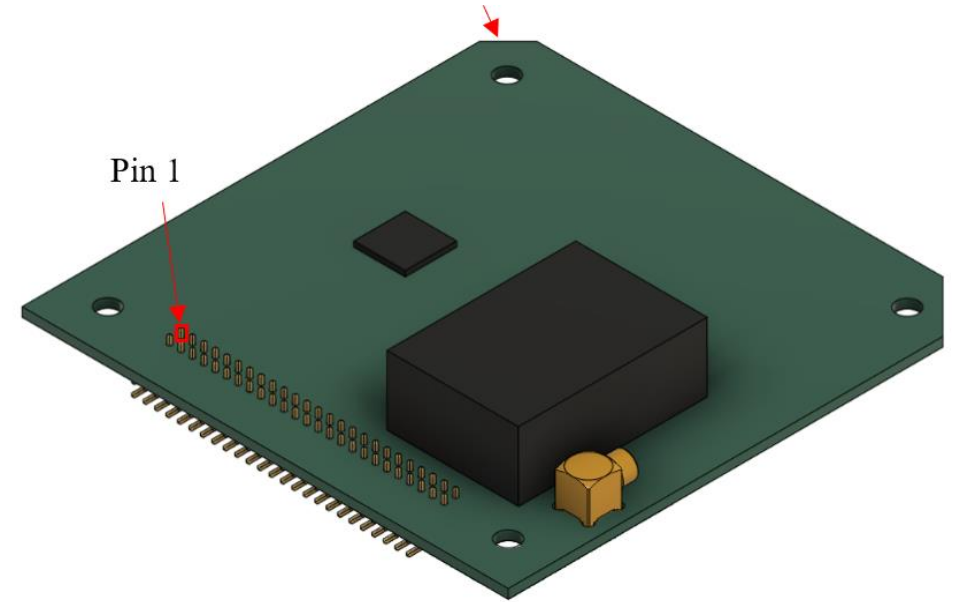
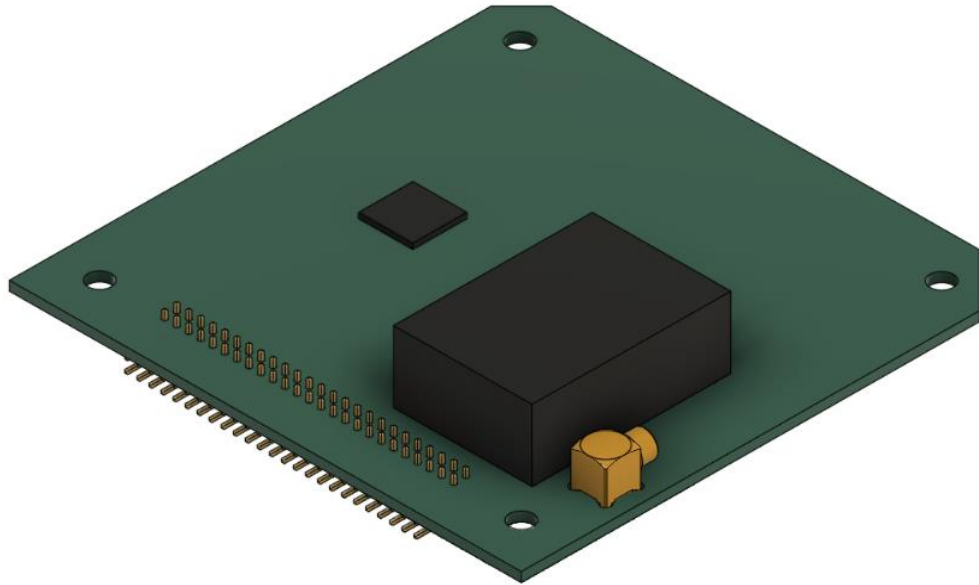


APRS Payload Measurements



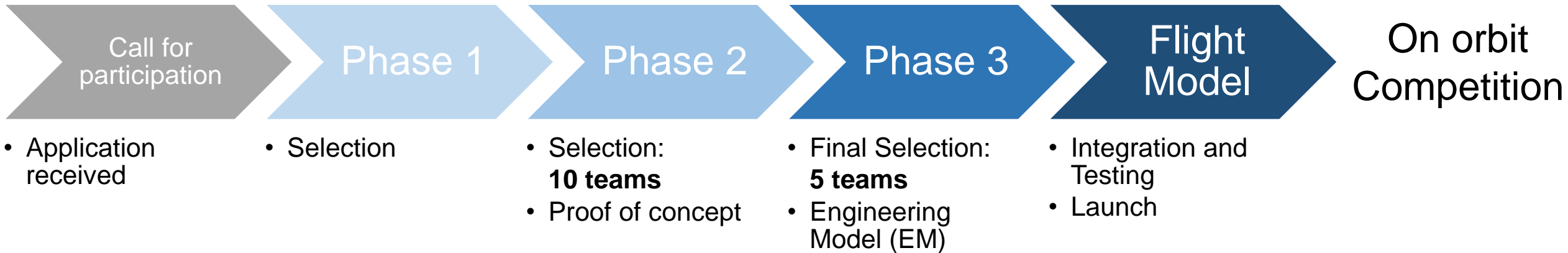


APRS Payload Measurements





APRS Payload Competition





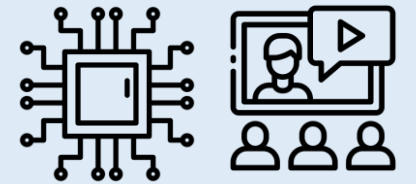
APRS Payload Competition



Phase 1

Application form:

- Team composition
- Affiliation for MOU
- Mission definition
- Payload's block diagram
- Preliminary budget plan
- Schedule
- Plan for outreach
- Quality of application
- Consent for open sourcing



ICD & Webinar

Preliminary selection process: From the end of December 2022 to mid-March 2023



APRS Payload Competition



Phase 1

TASK	Date	2023												
		JANUARY					FEBRUARY				MARCH			
		1	2	3	4	5	6	7	8	9	10	11	12	13
1st Phase		■	■	■	■	■	■	■	■	■	■	■		
Call for Participation		■	■	■	■	■	■	■	■					
Webinar 1	14-Jan-23		■											
Webinar 2	27-Jan-23			■										
Webinar 3	08-Feb-23						■							
Application Deadline										■				
Evaluation period											■	■		
Annoucement of selected teams												■		

Preliminary selection process: From the end of December 2022 to mid-March 2023



APRS Payload Competition



Phase1 Point allocation:

Extra points for developing country	5 points
Team composition	5 points (Max)
	All students up to MS 5 points
	Mix 3 points
	All professionals and PhD students 2 points
Motivation, objectives and expected outcome, Mission definition	30 points
Block diagram for the payload	10 points
Concept of operations	10 points
Preliminary budget plan	10 points
Schedule	10 points
Plan for outreach	10 points
Quality of application and Video Explanation	10 points



APRS Payload Competition

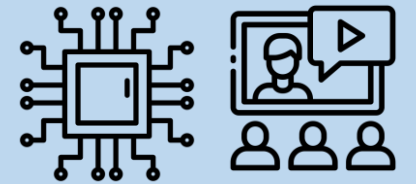


Phase 2

Required documents:

- System block diagram
- Bill of materials
- Feasibility study and functional test
- Safety compliance
- Schedule
- Outreach
- Budget

Presentation by each team



ICD & Webinar

Proof of concept: Selection of 10 teams From mid-March 2023 to the end of May 2023



APRS Payload Competition



Phase 2

TASK													
	MARCH				APRIL				MAY				
	10	11	12	13	14	15	16	17	18	19	20	21	22
2nd Phase													
Development period													
Submission deadline													
Evaluation period													
Annoucement of selected 10 (11) teams													

Proof of concept: Selection of 10 teams From mid-March 2023 to the end of May 2023



APRS Payload Competition



Phase 2 Point allocation:

System Block Diagram	20 points
Bill of material (BOM) (With components characteristics)	5 points
Feasibility study and functional test:	
• Power budget	10 points
• Mass & volume for each component and the total mass of the payload	10 points
• Concept of operation	10 points
• Preliminary link budget	10 points
Safety compliance	10 points
How to avoid interference to the other subsystems emergency plan	
How to isolate the payload from the satellite during emergency	
Quality of submission	5 points
Schedule	10 points
Outreach	10 points



APRS Payload Competition



Phase 3



Webinar

Requirements:

- Engineering model
- Functional test report
- Software operation manual (MCU)
- Link budget
- Schematics, PCB design
- 3D model
- Power budget
- Compliance to all requirements

EM and FM: Final selection of 5 teams From the end May 2023 to the end of December 2023



APRS Payload Competition



Phase 3

TASK	2023																																		
	MAY			JUNE				JULY				AUGUST					SEPTEMBER				OCTOBER				NOVEMBER				DECEMBER						
	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52		
3rd Phase																																			
Development period																																			
Submission of EM Board																																			
Evaluation period																																			
Announcement of selected 5 (6) teams																																			
Flight model development																																			
Flight model Arrival																																			

EM and FM: Final selection of 5 teams From the end May 2023 to the end of December 2023



APRS Payload Competition

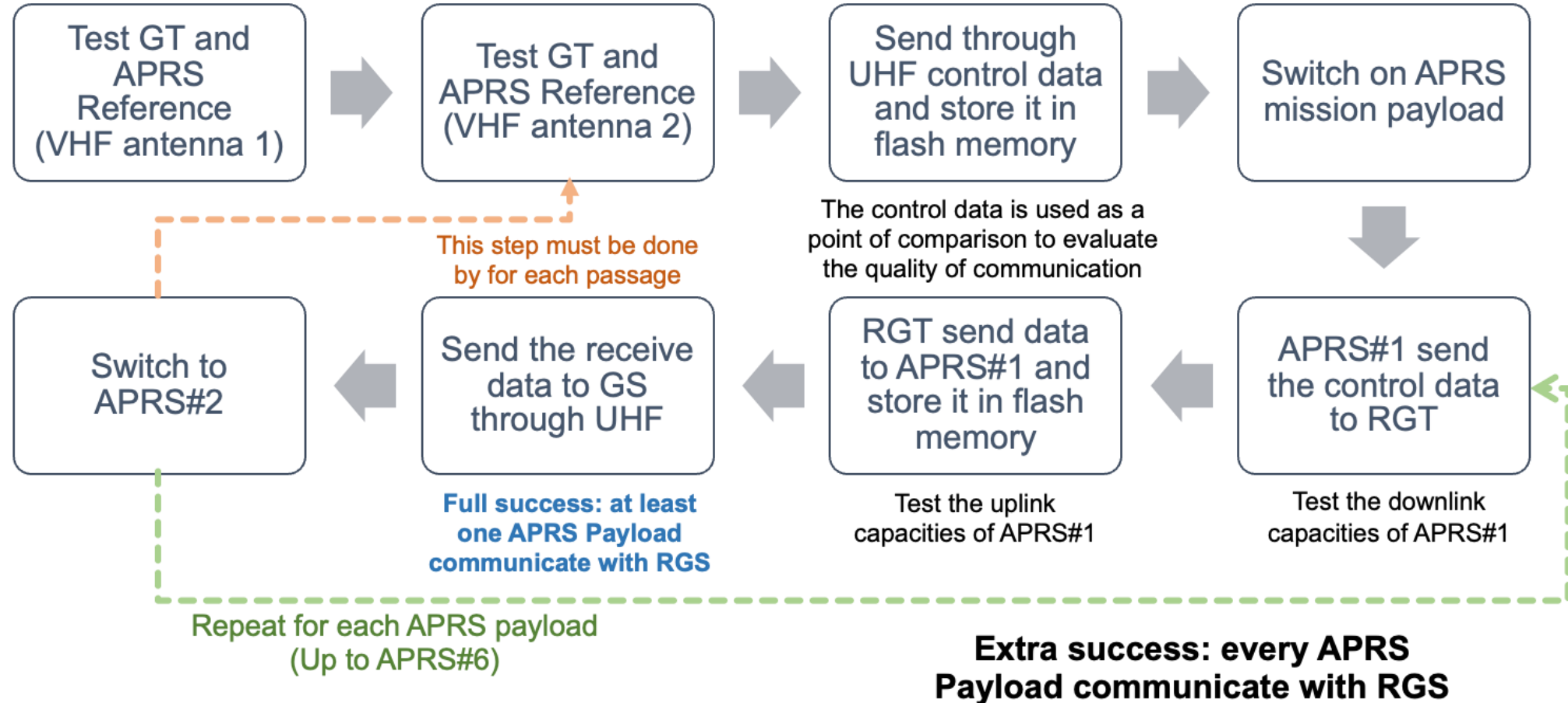


Schedule of Payload Selection

TASK	Date	2023																																																														
		JANUARY					FEBRUARY				MARCH				APRIL				MAY				JUNE				JULY				AUGUST				SEPTEMBER				OCTOBER				NOVEMBER				DECEMBER																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52											
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On Orbit Scenario





Success Criteria



Minimum	At least Four boards are selected as payload
Full	At least one APRS-P mission payload succeeds in communication (both transmitting and receiving) with the reference ground terminal
Extra	Four mission payloads succeed in communication with the reference ground terminal



02 | Ground Terminal Competition



GT Competition



Objective:

Increase the users of Amateur Radio Communication by communicating with our 2U CubeSat APRS payloads, as well as helping people to get involved in the creation, and operation of a Ground Terminal, resulting in the improvement of technical skills and democratization of space



GT Competition



Contest Details

Registration by Application Form (Google Form)

Operator Information: Call sign, Name, Address, Nationality, Contact information

Station Information

- Hardware reference
- Radio Information, Station Type (Fixed, Mobile, Handheld)
- TNC (Hardware, Software)
- Antenna Information
- Position
- Picture





GT Competition



Contest Details

Band

145.825 MHz

Entry Categories

Power output up to 100 watts

Power output up to 50 watts

Power output up to 25 watts



GT Competition



Terms of Participation

- Each participant will have 1 week to contact the satellite.
- Participants should provide proof of communication
(log file + elevation data + power output during transmission)
- All GS operator must have a valid license
- All comms should be performed following good radio amateur practices and competition rules
- Information provided by participants must be correct



GT Competition



Ranking

- The format for the message exchange with the BIRDS-X satellite is an APRS packet to other station
- The use of terrestrial gateway stations or internet gateways (i.e. EchoLink, IRLP, etc.) to uplink/downlink is not allowed
- Satellite APRS Digipeat and short-message contacts are worth **one point** each but must be complete verified two-way exchanges



GT Competition



Ranking

Every contact confirmed will be scored by 1 point		
Antenna Type	Omni	x2
	Directional (Tracking system)	x1
Station type	Fixed	x1
	Mobile	x2
	Handheld	x5
Elevation angle	Over 60°	x1
	Between 20° to 60°	x2
	Less than 20°	x3
Cost	Over than 1,000 USD	x1
	Less than 1,000 USD	x2
	Less than 500 USD	x3



Thank you for your attention!



<https://birds-x.birds-project.com>



birdsx_satellite_project



Birds-X Satellite Project - KyuTech



BIRDS-X Satellite Project