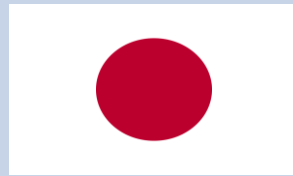


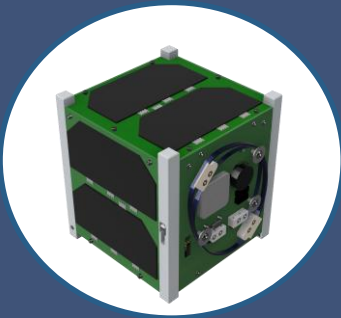


BIRDS-4

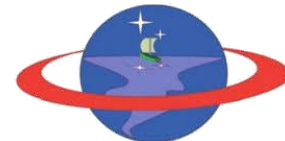
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SATELLITE PROJECT



An Overview of the BIRDS-4 Satellite Project and the First Satellite of Paraguay



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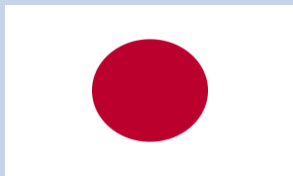
Adolfo JARA
javier.jara-cespedes758@mail.kyutech.jp



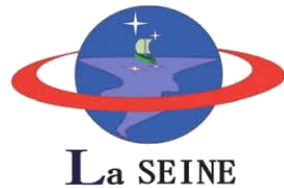


BIRDS-4

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Introduction

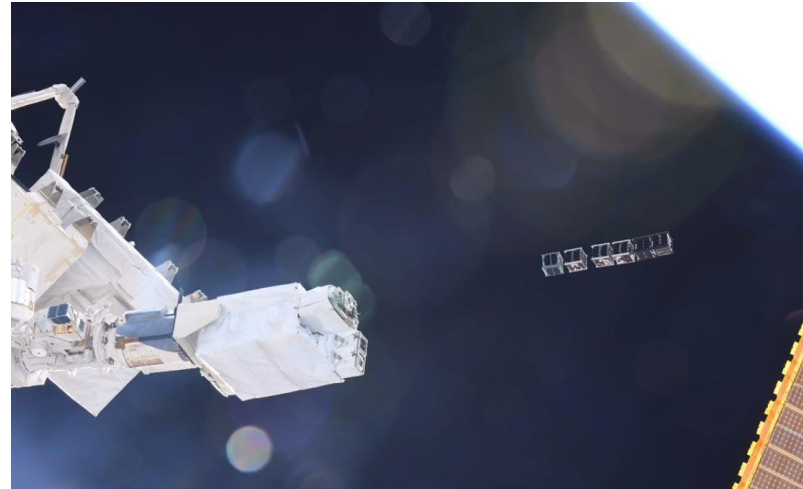


Introduction





The photo of flight models of BIRDS-4



Actual frames of satellite deployment from ISS released by JAXA

Project Team

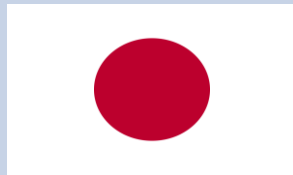


BIRDS-4 Team



BIRDS-4

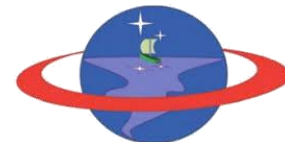
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System Overview

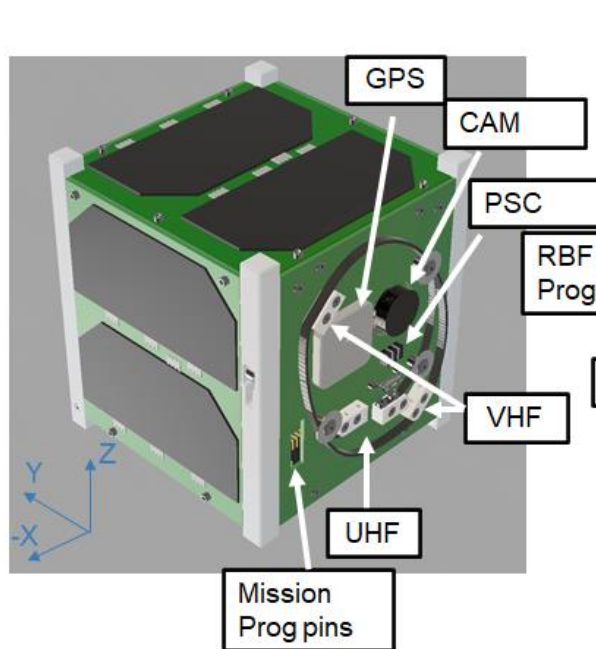


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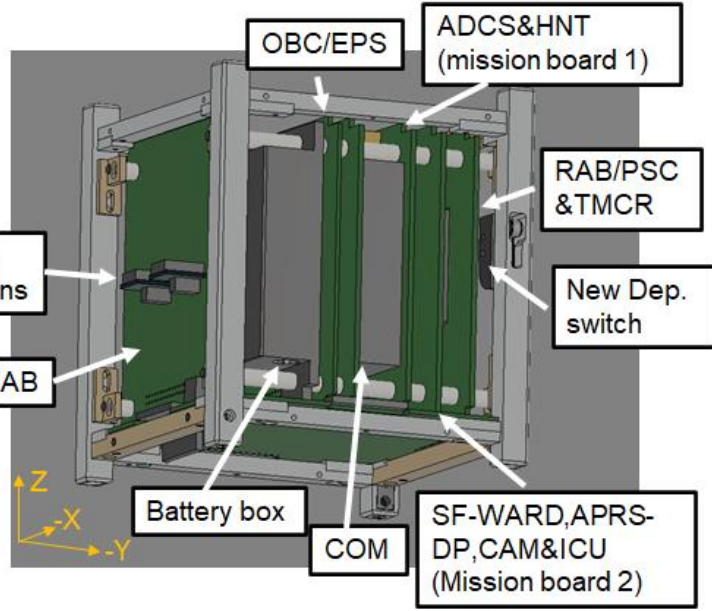


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CubeSat Description



External view of the BIRDS-4 CubeSat facing the -X axis

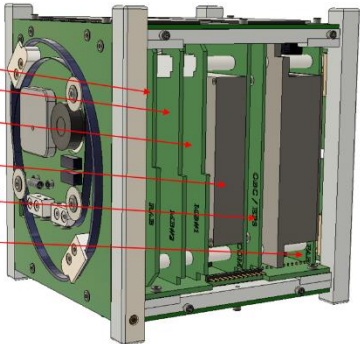


Internal view of the satellite without the external panels facing the +X axis

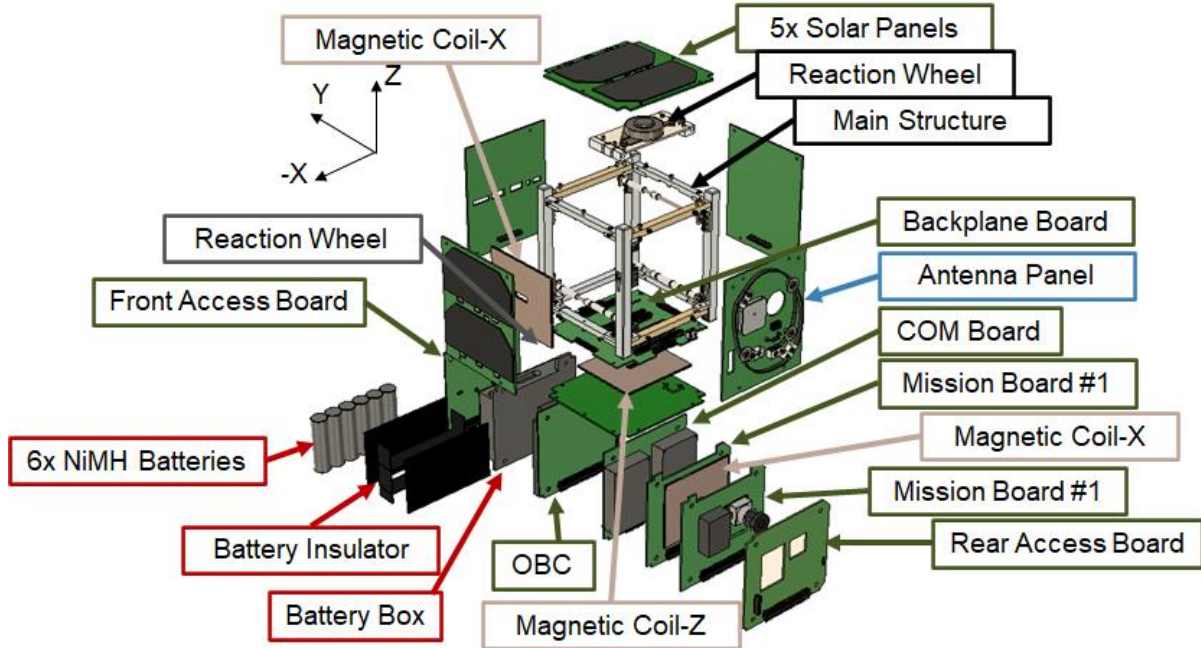


Bus System

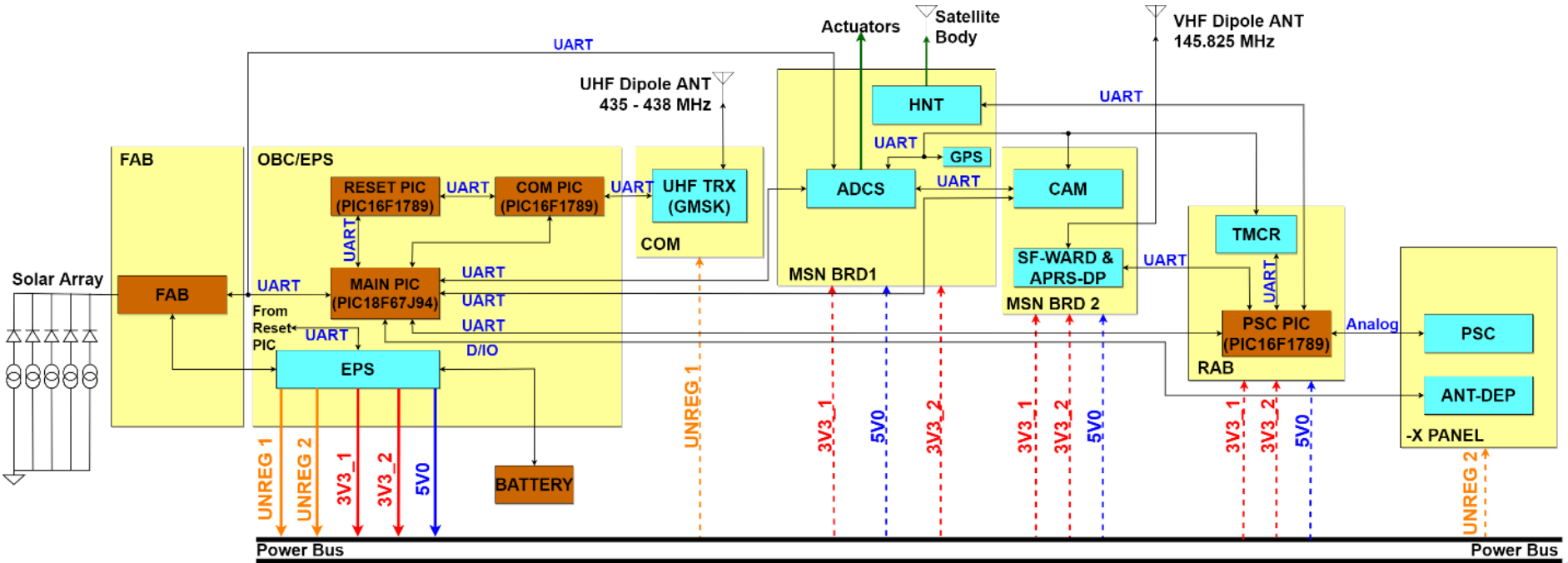
- RAB
- Mission Board 2
- Mission Board 1
- COM board
- OBC/EPS board
- FAB



Bus Configuration



Bus System

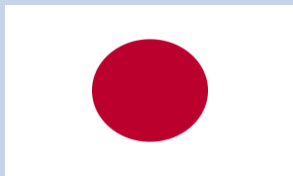


System block diagram

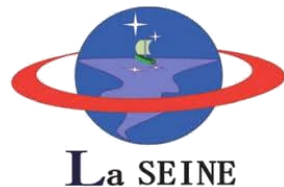


BIRDS-4

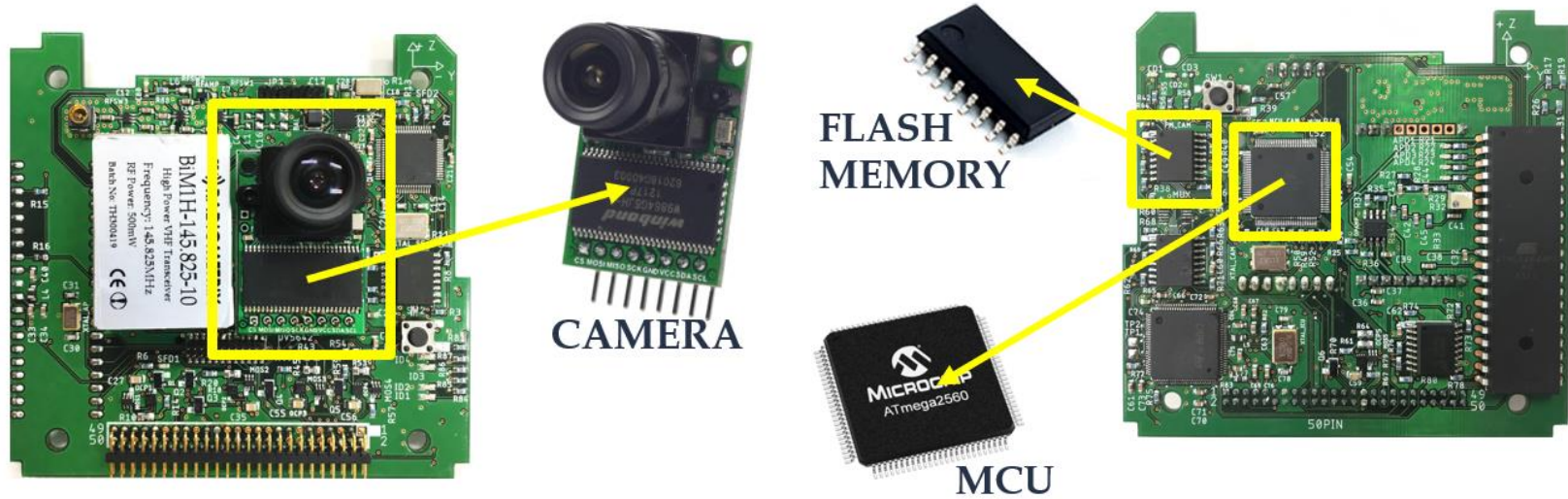
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Missions Overview

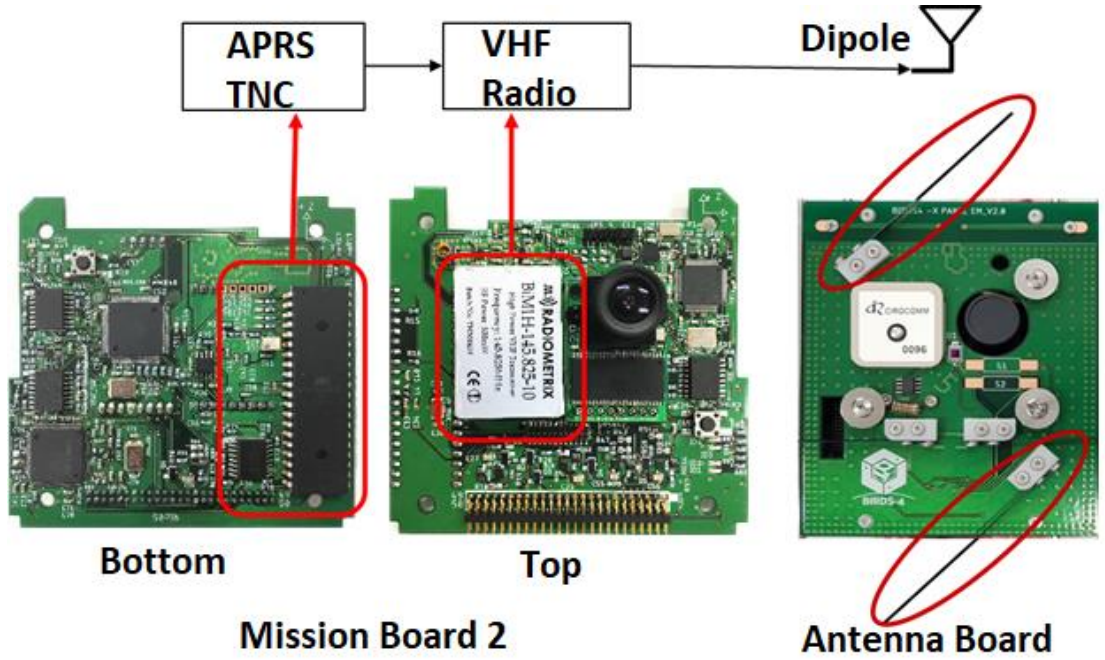


Imaging Mission (CAM)



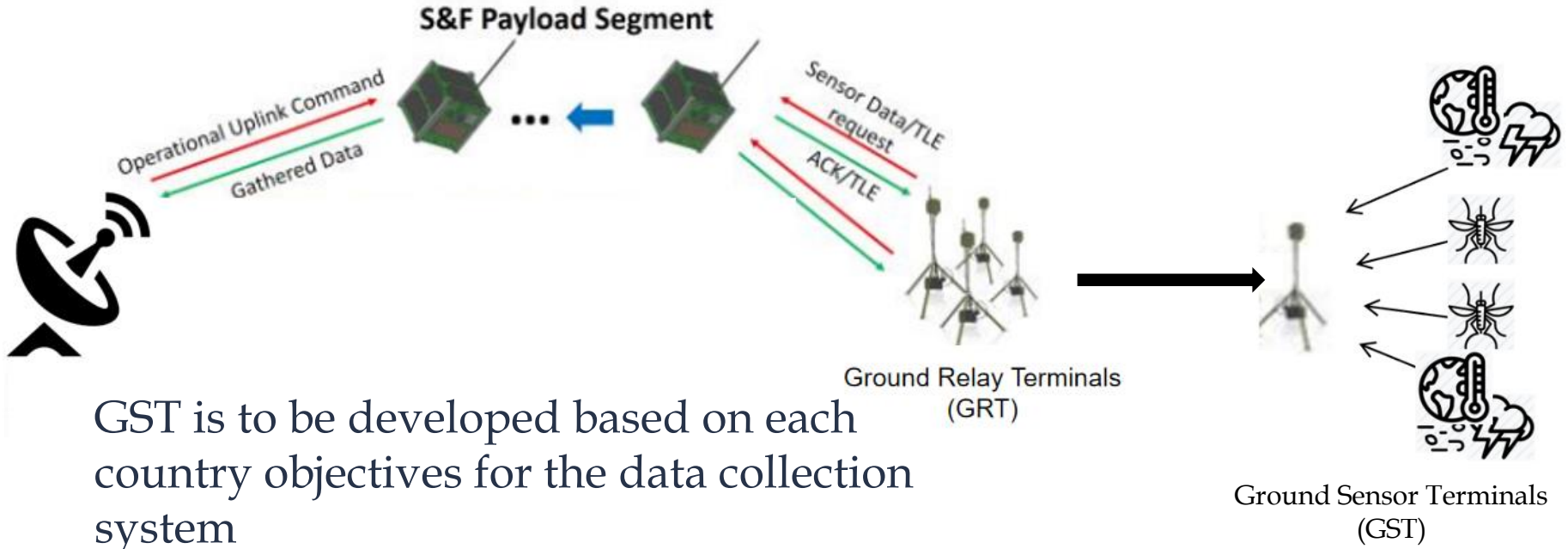
Imaging Mission Hardware.

Automatic Packet Reporting System (APRS)

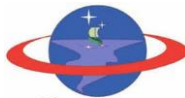


Mission Board 2 with APRS-Module, Transceiver, and the VHF dipole antenna.

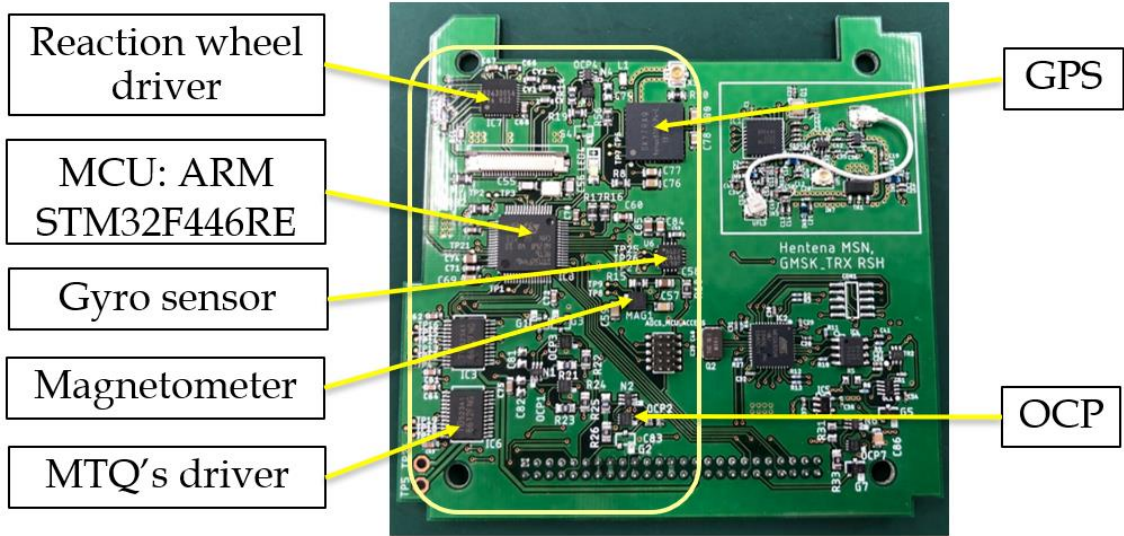
Store-and-Forward mission (SF)



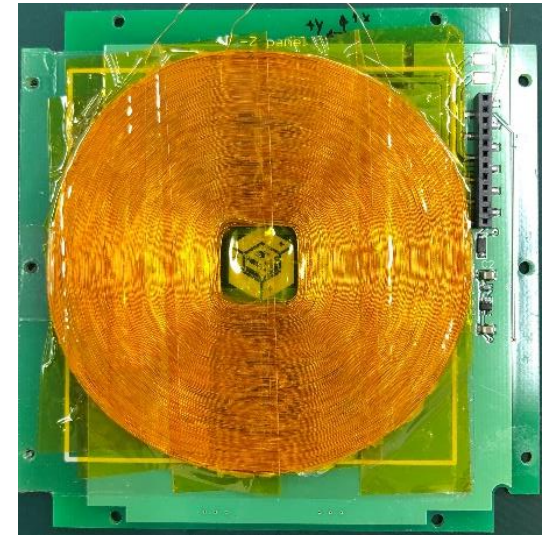
GST is to be developed based on each country objectives for the data collection system



Attitude Determination and Control Mission (ADCS)



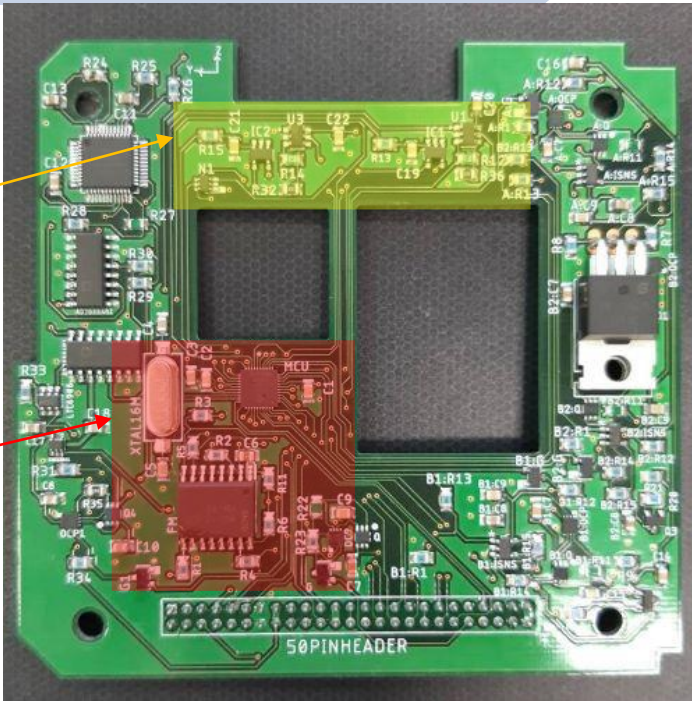
Mission Board 1 with ADCS components.



Magnetic torquer coil attached to -Z PCB.



Perovskite Solar cell mission (PSC)



PSC mission

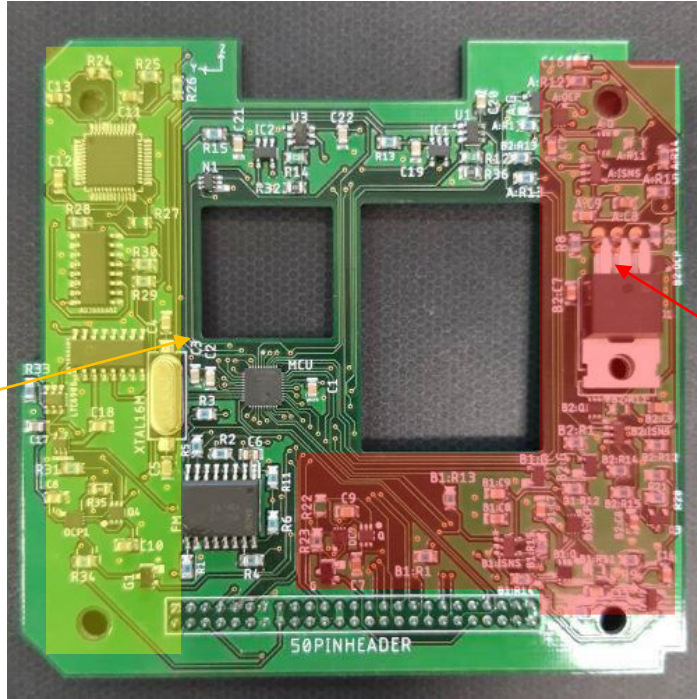
RAB PIC and FM

RAB board



Samples of perovskite solar cell attached to each satellite.

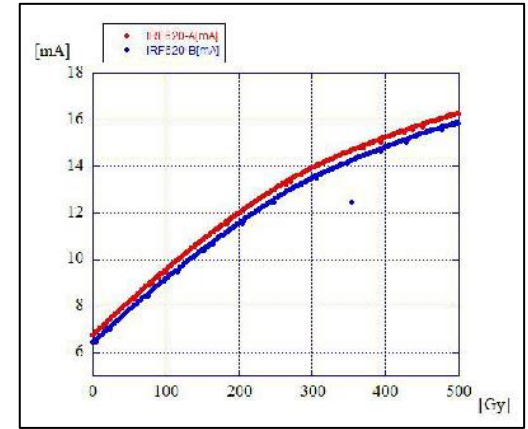
Total Ionizing Dose Measurement of COTS and Onboard Rad-Hard Components Mission (TMCR)



NTU mission

TMCR mission
 IRL620 × 1
 IRLML6402 × 2

RAB board



MOSFET(N ch) IRL620



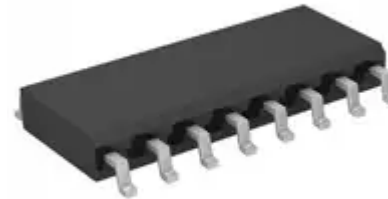
□ LDAP by NTU



□ Latch-up prone device

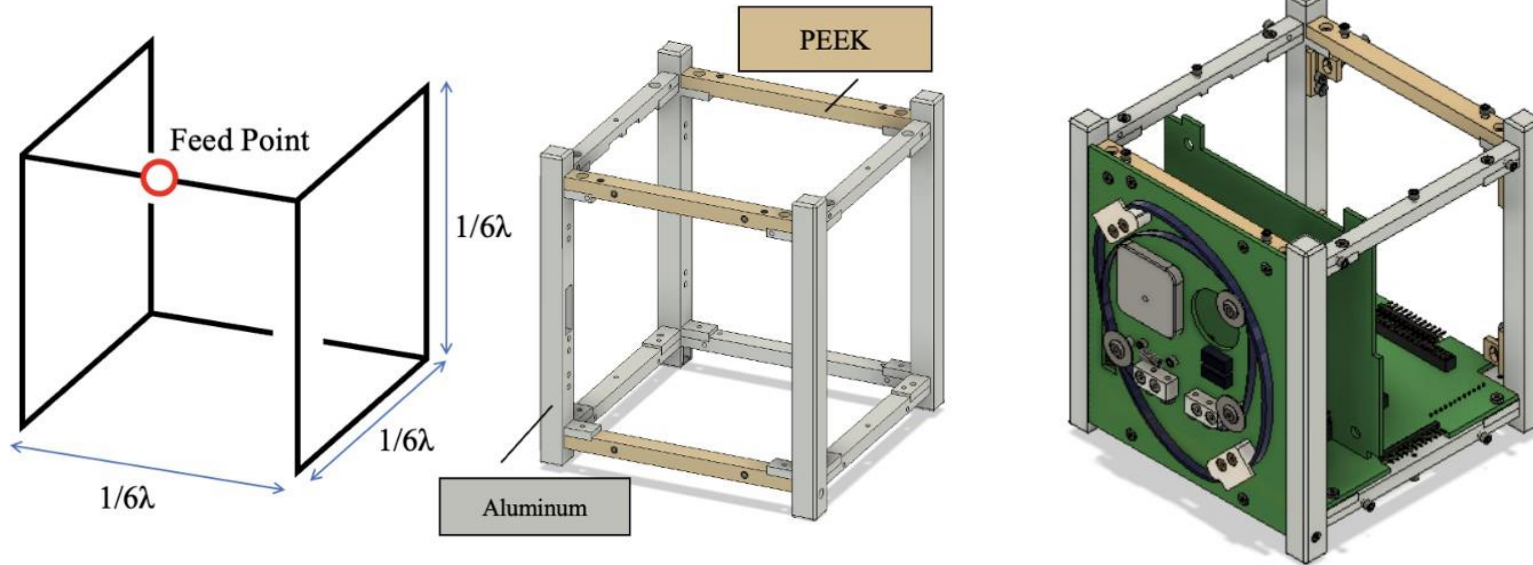
AD7888ARZ

AD converter





Satellite Structure as Antenna Mission (HNT)



Structure loop of hentenna and BIRDS-4 structure.



BIRDS-4

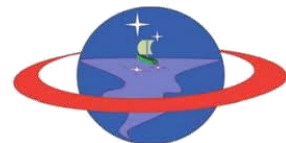
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Initial Operational Results



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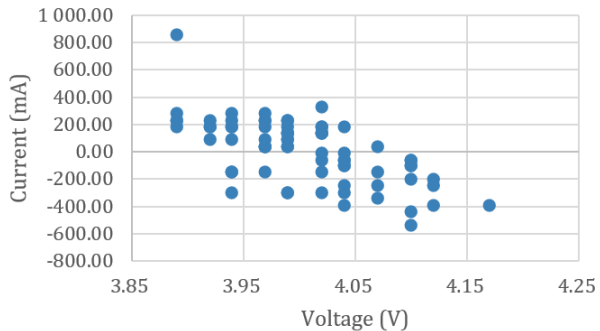
First 72 hours of operation



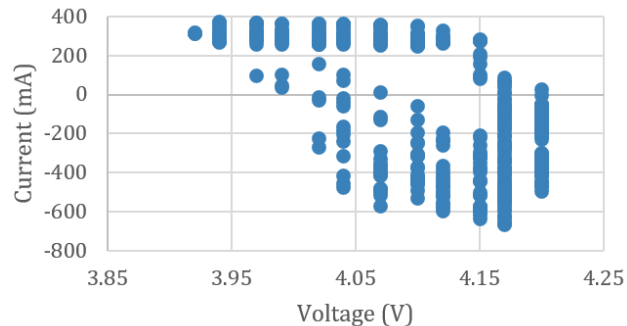
Tsuru 320x240 resolution image taken during deployment.



First 72 hours of operation



GuaraniSat-1 Battery voltage vs current.

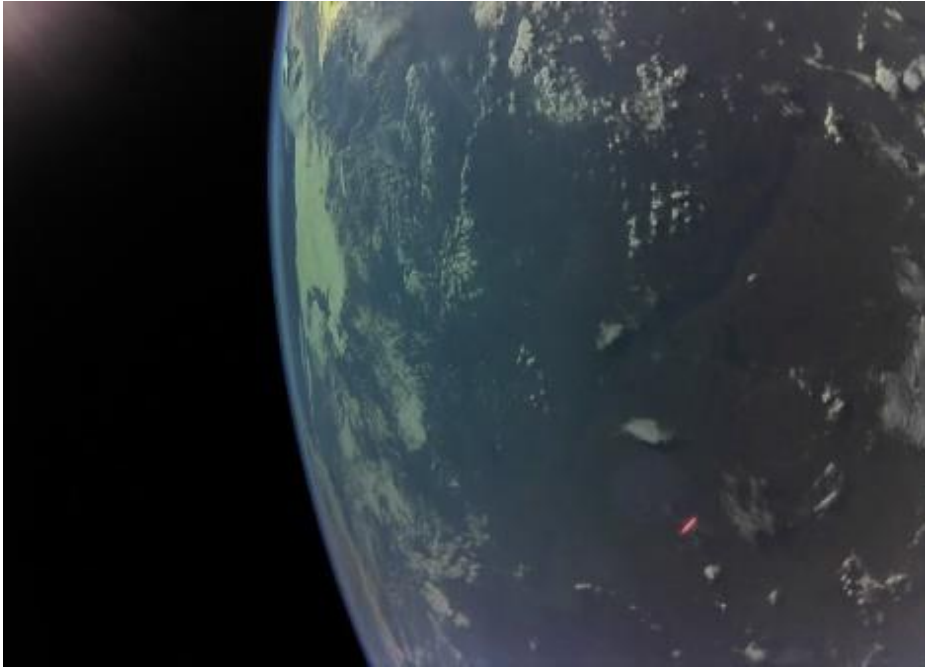


Tsuru Battery voltage vs current.

	Energy generation			Energy consumption per orbit
	5 panels	4 panels	3 panels	
MATLAB Calculation	1411	1178	821	1438 mWh
BIRDS-4 satellites	1513	1210	953	1483 mWh (w/ heater)

Energy generation/consumption summary

First 2 months of operation



Tsuru 1280x960 resolution image taken over South America.



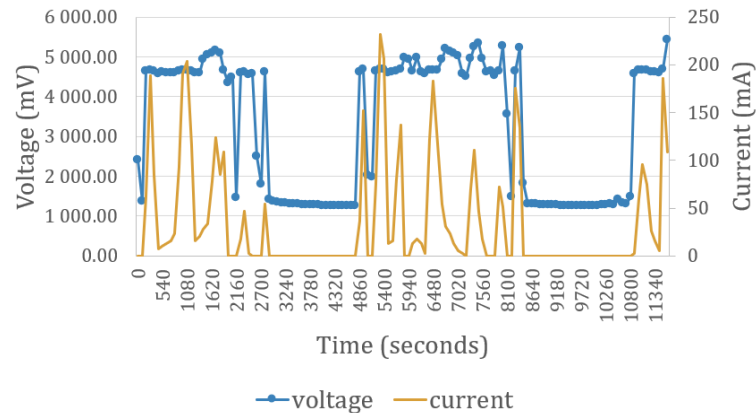
First 2 months of operation

```

Monitor
Scroll [bar] 0 Log ON No Filter Bea
Fm JG6YBA To APK003 Via WIDE-1-1 <UI pid=F0 Len=17 >[23:18:20]
:JG6YMX :jx{43
Fm JG6YBA To APK003 Via WIDE-1-1 <UI pid=F0 Len=17 >[23:18:21]
:JG6YMX :jn{44
Fm JG6YBA To APK003 Via WIDE-1-1 <UI pid=F0 Len=18 >[23:18:22]
:JG6YMX :j@m{45
Fm JG6YMX To APTT4 Via WIDE-1-1 <UI pid=F0 Len=16 >[23:18:24]
:JG6YBA :ack43
Fm JG6YMX To APTT4 Via WIDE-1-1 <UI pid=F0 Len=16 >[23:18:25]
:JG6YBA :ack45
Fm JG6YBA To APK003 Via WIDE-1-1 <UI pid=F0 Len=17 >[23:18:30]
:JG6YMX :jw{42
Fm JG6YMX To APTT4 Via WIDE-1-1 <UI pid=F0 Len=21 >[23:18:31]
hello! this is birdjp
Fm JG6YBA To APK003 Via WIDE-1-1 <UI pid=F0 Len=17 >[23:18:32]
:JG6YMX :jx{43

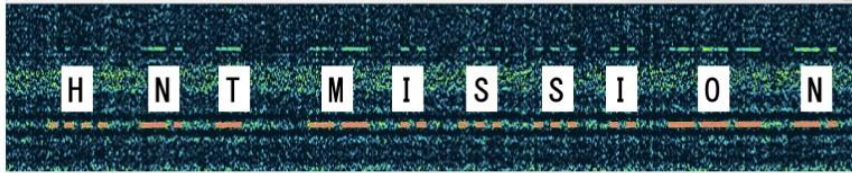
```

APRS mission acknowledge confirmation and beacon received by the Ground Station.

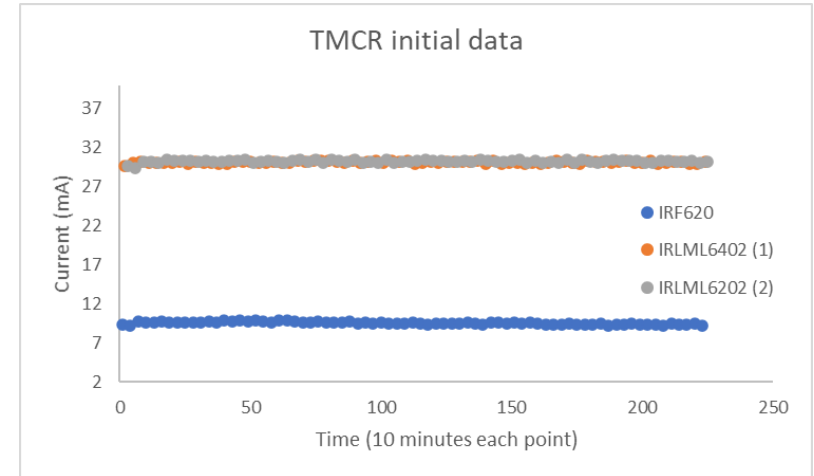


Glue mission voltages and currents values measured during two orbits.

First 2 months of operation

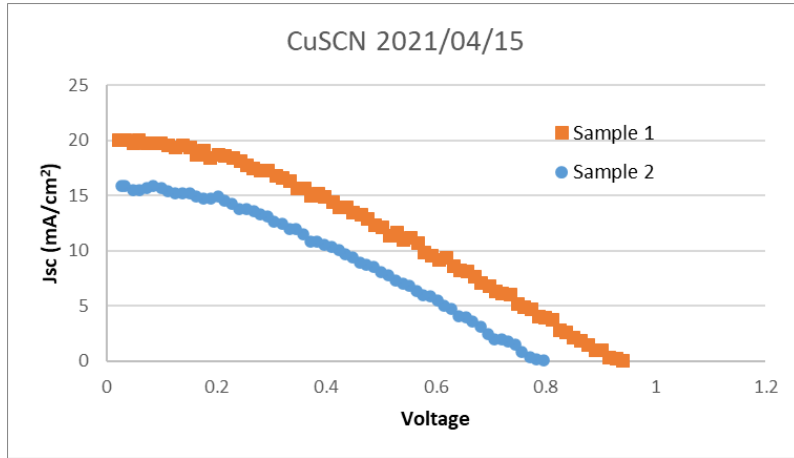


Morse code sent by HNT mission.

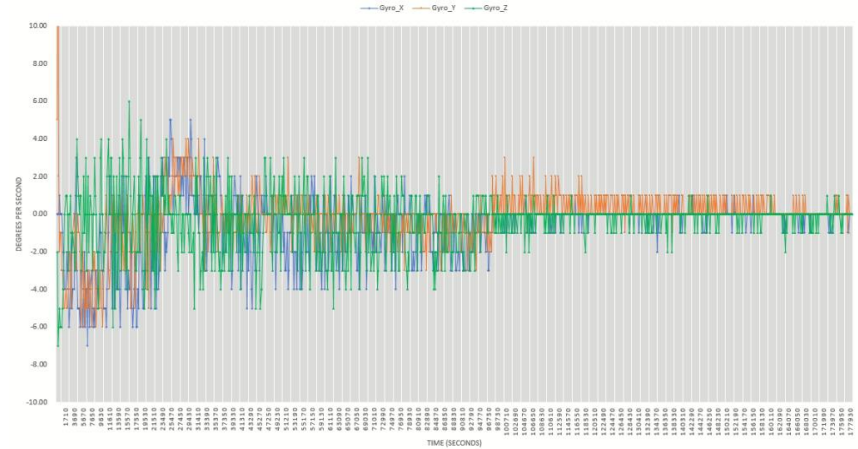


COTS components current consumption initial data

First 2 months of operation



Initial data of current-voltage (I-V) curve.

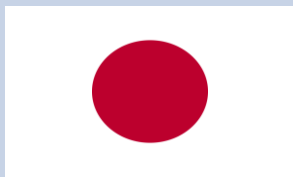


GuaraniSat-1 Gyro data.

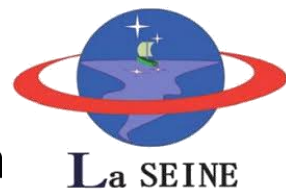


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Lessons Learned



Important lessons learned by the team before the satellite delivery and during operation should be accounted and passed down to the next satellite project. These include the following:

- **Frequency coordination.**
- **Power budget calculation.**
- **Flight software.**
- **Satellite operation.**

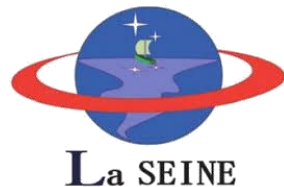


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Significance of this Satellite for Paraguay



Significance of this Satellite for Paraguay



Three-hour satellite launch tv program.



BIRDS-4

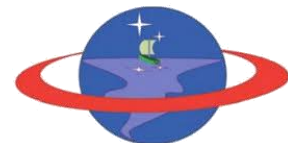
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Conclusions



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This paper presented the summary about each subsystem and mission design, as well as the preliminary on-orbit result of BIRDS-4 satellites.

- Maya-2 and GuaraniSat-1 are experiencing an imbalance between power generation and consumption.
- The satellites were able to take images of BIRDS member countries.
- Minimum success level was achieved for APRS, PSC, TMCR, HNT, and GLUE missions. SFWARD mission execution is on-going
- To improve the reliability of future projects, the lessons learned by the team were discussed.

Thank You!

