United Nations/Brazil Symposium on Basic Space Technology

“Creating Novel Opportunities with Small Satellite Space Missions”

Microsatellite μSat-3 Development
µSat-1

“Victor”
Nor-Oeste Argentino

"VICTOR"

Imagen Camara 1

22/7/98 8:46:28

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μSat-2
Inner and outer Structure
Paradigm Shift

Know How and Technology
Foreigners

Greater Total Cost

Minimum Human Resources Training

Local Technology and Know How

Lower Total Cost

Important Human Resources Training

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µSat-3
DEVELOPMENT

PHASE A: Concept Analysis  Feasibility of subsystems is assessed.

PHASE B: Concept Definition  System working at laboratory level.

PHASE C: Concept Development  System working at engineering model level.

PHASE D: Concept Qualification  System working at flight model level.
MAIN OBJECTIVES

To ‘take and send’ pictures of the Argentine mainland, both in Low Resolution Mode and in High Resolution mode, as requested by the Ground Station:

- High resolution 10 m/pixel
- Low resolution 100 m/pixel

Revisit Time < 4 days

Maintenance Maneuvers of orbit parameters

Orbital Position Maneuvers for flight in Constellation

Put out of Orbit
Development Philosophy

- Keeping paperwork at the minimum level.
- Producing real hardware and software as early as possible.
- Use of commercial/industrial hardware when possible.
- Qualification functional and environmental tests are performed at system level.
- Strong involvement of specialized task groups belonging to Government institutions, Universities and Industry.
- Very simple core group topology with a minimum of authority levels.
Dimensions: 340 x 340 x 430 mm.

Configuration: Three plates and four struts inner structure, outer lateral shroud.

Attach fitting: A single high reliability pyrobolt.

Mass: 33 Kg.
Vehicle General Layout – Inner and outer Structure

- Flux Gate Magnetometer
- Magneto Torquers
- High Accuracy Sun Sensor
- Reaction Wheels
- Pulsed Plasma Thrusters
Reaction Wheels

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Reaction Wheels

- Mass: 0.250 kg
- Dimensions: 75 mm diam. * 30 mm high
- Angular Moment: $4.45 \times 10^{-2}$ Nmseg
- Angular Speed: 6000 rpm
- Torque max.: $7 \times 10^{-3}$ Nm
- Power Supply: 12 V

- Error in Position: 60 deg (=> 0.005 deg)
- Error in Speed: 90 rpm (=> 0.044 deg/seg)

- $\Omega_{\text{sat}}$ max = 0.48 rpm (3 deg/seg)
- $\Omega_{\text{sat dot}}$ max = 9 mrad/seg$^2$ (0.5 deg(seg$^2$))
Magneto Torquers (Test)

- Based in µSat-2
- 3 Coils (Quadrature Axis), 0.5 A-vuelta-m²
- Independent Control

Raft Wood

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Camera 1 (wide angle):
Commercial/Industrial Cámara
Resolución 5 - 15 Megapíxeles
Focal Length 50 mm
Maximum Aperture 1:1.4.

Camera 2 (narrow angle):
Commercial/Industrial Camera
Resolución 5 - 15 Megapíxeles
Focal length 100 – 200 mm
Maximum Aperture 1:2.8
UHF link (Telemetry Data and Commands)
400MHz – FSK – Bit Rate 56Kbps – 5W

Band “S” link (Images)
2260Mhz – QPSK – Bit Rate 2Mbps – 5W

Ground Station (CIA)
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O.B.C.

Cortex-R4F@160Mhz RISC 32 Bits
- 1,66 DMIPS/MHz
- FPU double precision
- 3 MB Flash with ECC
- 256 KB RAM with ECC
- Power Consumption < 2 W
- Eurocard Form FaCTOR

• BIST integrated diagnostics, monitoring,
  - Voltage & Clock, redundant Watchdog
  - Automatic Switch to backup in case of failure
• Total or partial reconfiguration from ground
• Processor certified for Safety Critical Apps
  - Functional Safety. ISO26262
• SafeRTOS Certification Option
  - Aerospace DO178C DAL A

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Hardware in the Loop

- Gyrometer
- Magnetometer
- Motors
- OBC
- Batteries
- Solar Panel

Simulator Software

Real Time Results
3D Model

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Triaxial Magnetometer

Magnetic Field Simulation System

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3D Model

- Used OpenGL (Open Graphics Library) en C++

- Centrum of Coordinates Axis in the satellite.

- Sun Light incidence on the satellite.
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### BASIC CHARACTERISTICS

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status</td>
<td>Development Model</td>
</tr>
<tr>
<td>Power Required</td>
<td>25 Watts</td>
</tr>
<tr>
<td>Ejection Velocity</td>
<td>Between 10.000 m/s and 30.000 m/s</td>
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<tr>
<td>Total Impulse</td>
<td>1500 N·s</td>
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<tr>
<td>Total Thrust</td>
<td>0.28 mN</td>
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<tr>
<td>Specific Impulse</td>
<td>994 s</td>
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<tr>
<td>Total Mass</td>
<td>&lt; 5 kg</td>
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<tr>
<td>Propellant</td>
<td>PTFE (Teflón)</td>
</tr>
<tr>
<td>Applications</td>
<td>Attitude Control, orbit change and maintenance</td>
</tr>
</tbody>
</table>
Pulse Plasma Thruster
Solid Propellant

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Put Out of Orbit

- 30 days without propulsión
- 130 days with inverse propulsion
- Final Step 17/18 months (atmospheric braking)