Launch and Early orbit Phase (LEOP)

Leonardo Ghizoni, Victor Jungnell, Kevin Cuevas
GomSpace A/S

Munich, 28-30 November 2018

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 737183.

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GOMX-4B IOCR

ESTEC, 04.04.2018

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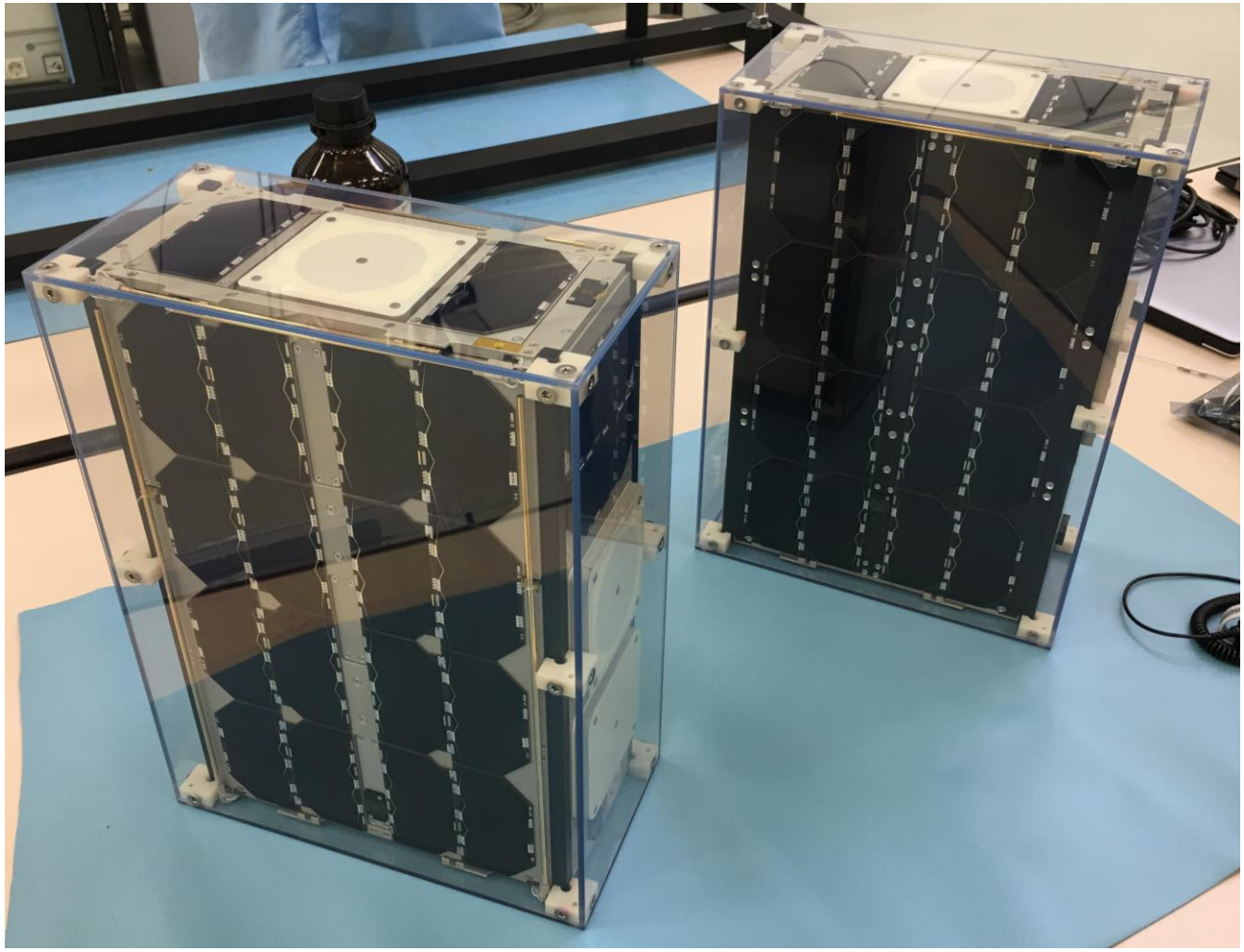

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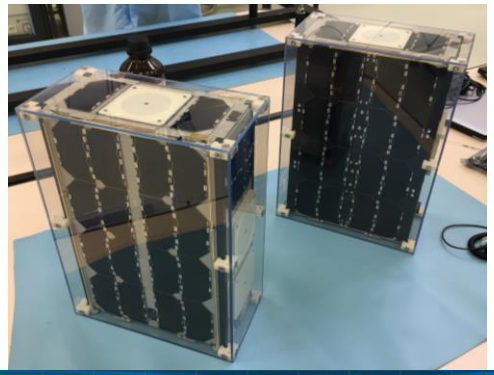
Mission Introduction

The GOMX-4 mission consists in **two 6U nanosatellites** with different payloads to demonstrate formation flying, Inter-Satellite Link and several advanced experiments.

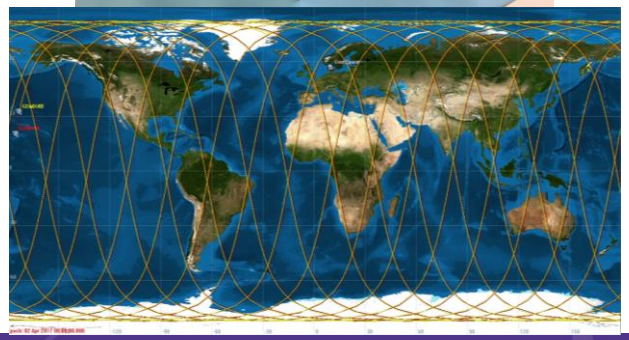
The satellites are called **GOMX-4A and GOMX-4B** and they both are based on Gomspace 6U platform components.

GOMX-4A is developed for the Danish Defence Adquisition and Logistics Organization (DALO) to monitor the artic region by using ADS-B and AIS data reception, Inter Satellite Communication and the GomSpace Nano- camera.



GOMX-4B is a payload demonstrator satellite founded by the European Space Agency (ESA). The demonstrations planned for GOMX-4B are:

- **Orbit control** capabilities using the NanoSpace 6U propulsion module
- **Inter Satellite Communication** using the Gomspace SDR platform and active S-band antenna
- Experiments with the miniaturized hyperspectral camera **HyperScou**t from Cosine
- Experiments with the **ISIS star-tracker** in relation to pointing accuracy
- With the **Chimera board** from ESA test of commercial computer memories in radiation environment of Space



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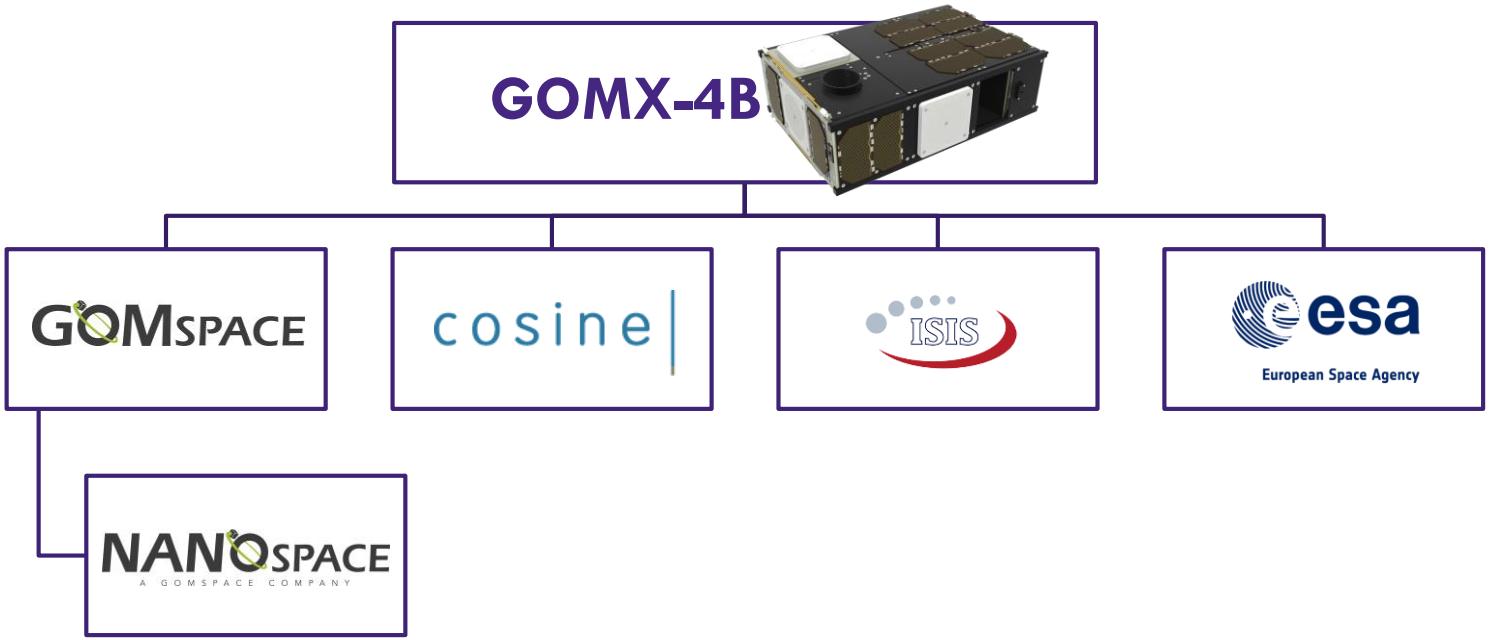
Program organization



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Project status and highlights

Activity overview:

- Kick off: 8th June 2015
- PDR: 21st of March 2016
- CDR: 12 of December 2016
- Integration completed: 18th May 2017
- Environmental tests: 19th May – 16th June 2017
- TRR: 11 of May 2017
- QAR close-out : 6th July 2017
- Launch delay from 15th August 2017 to Q1 2018
- Shipment from GS DK: 11th December 2017
- Launch site preparation: 18th – 23rd

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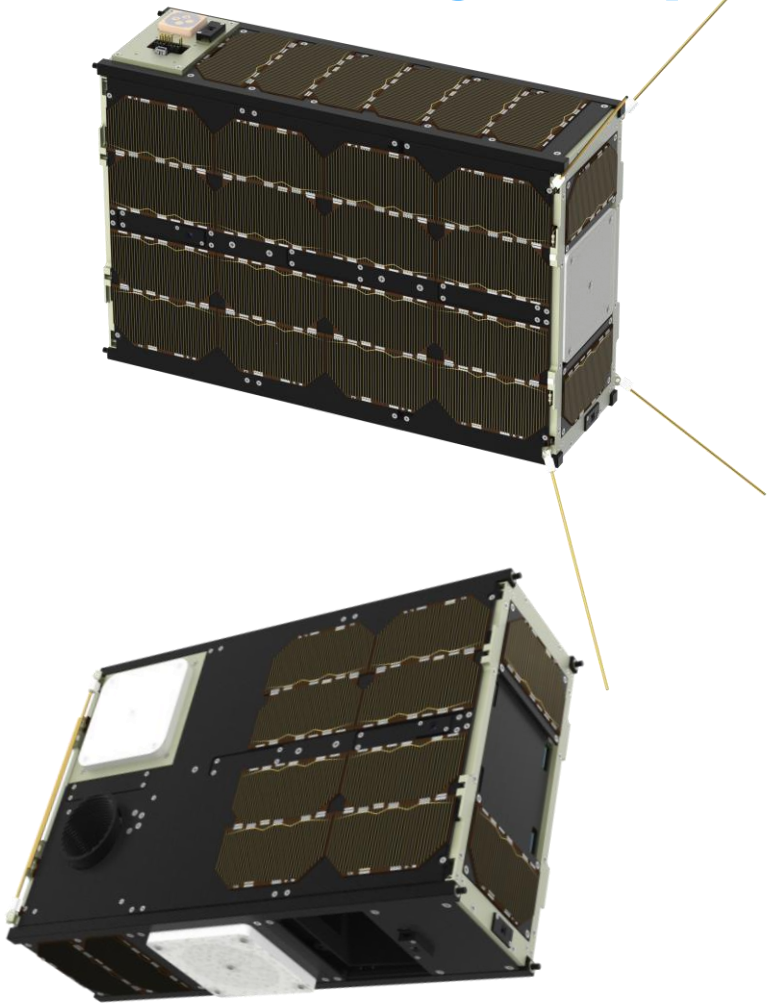
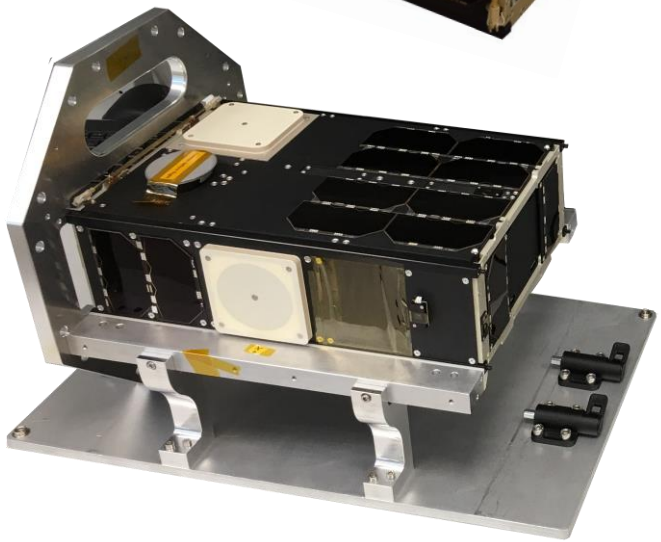
System Design implementation





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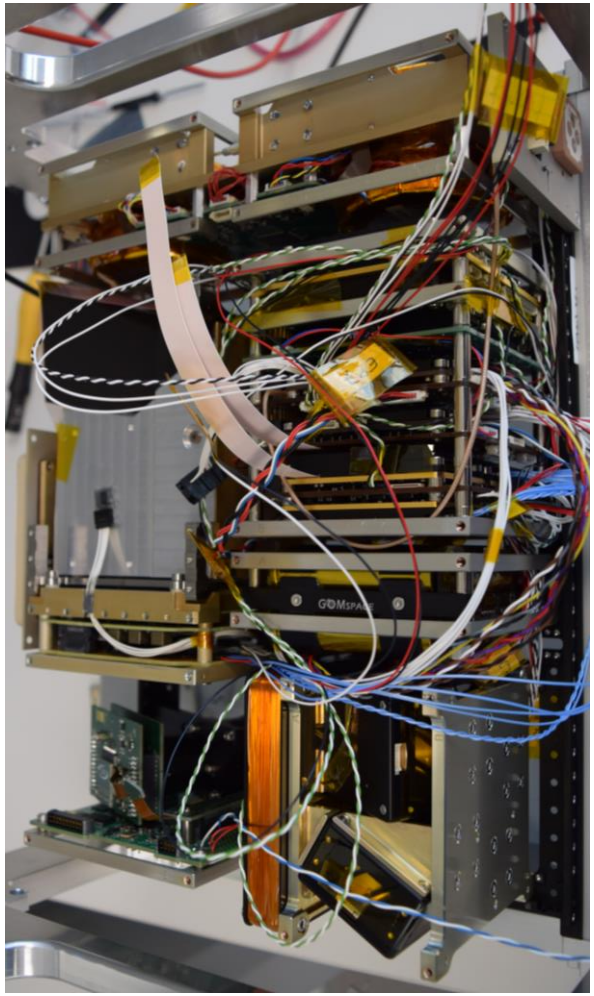
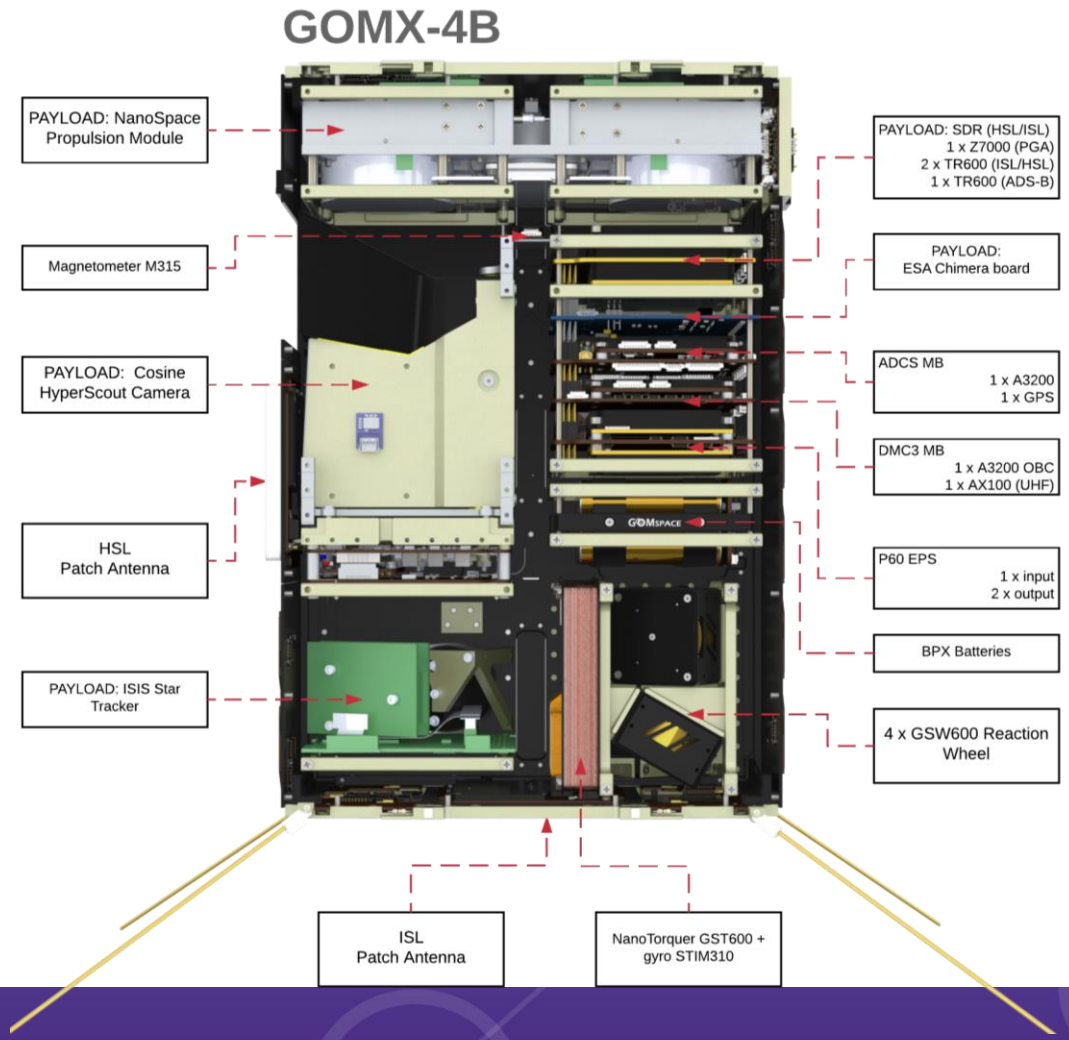
System Design implementation





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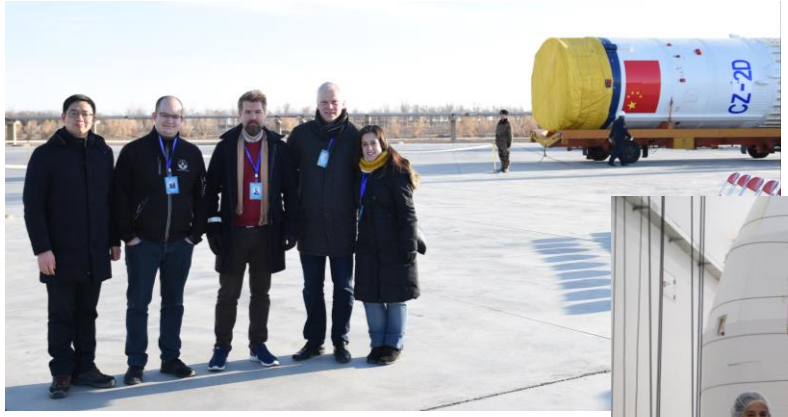
GOMX-4 Mission Launch



- Long March 2D-Y13
- 02nd February 2018 07:51 GMT
- Insertion parameters:
- Altitude 503 Km (GOMX-4B 320 m lower)
- LTAN 02:11 am, Inclination 97.35°
- Deployer: Astrofein PSL-P-HB06

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GOMX-4 Mission Launch

飞行时序图 Flight sequence

NO.	Events	事件	Theory time (s)
1	Lift–off	起飞	0.000
2	Pitch–over	程序转弯	17.000
3	1st stage ECO	一级发动机关机	155.293
4	1st/2nd stage separation	一、二级分离	156.493
5	PLF jettison	整流罩分离	186.493
6	2nd stage main engine ECO	二级主机关机	330.133
7	2nd stage vernier engine ECO	二级游机关机	651.423
8	TC–3/LV Separation	TC–3卫星星箭分离	683.423
9	The first group of Second payload separation	搭载星1组分离指令	713.423
10	The second group of Second payload separation	搭载星2组分离指令	741.423
11	The third group of Second payload separation	搭载星3组分离指令	786.423

注：t—以一级起飞为零点的总时间，搭载星1组指NewSat4、GOMX–4A；搭载星2组指NewSat5、GOMX–4B；搭载星3组指FMN–1星、少年星一号。

note：The first group of Second payload separation means NewSat4、GOMX-4A；The second group of Second payload separation means NewSat5、GOMX-4B；The third group of Second payload separation means FMN-1、Shaonian-1。

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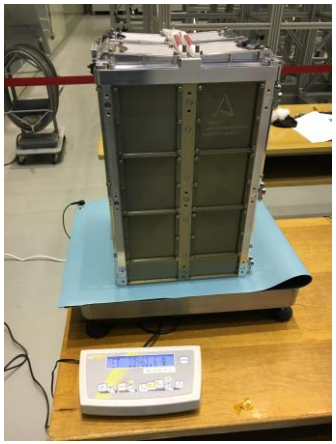
GOMX-4 Mission Launch



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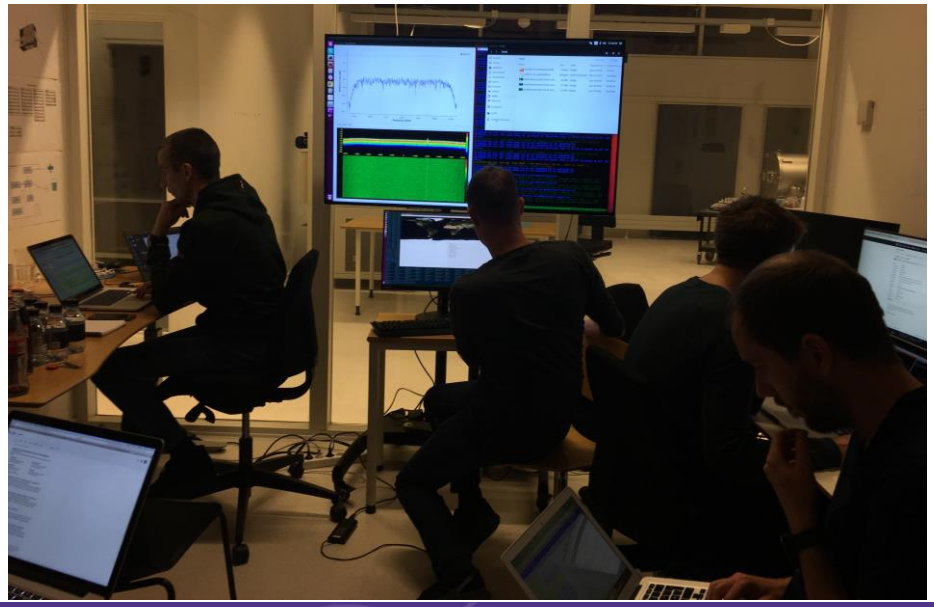
First day of contact

GOMX4 FIRST PASSES PLAN		
1	-	GROUND STATION PREPARATION
2	-	ANTENNA PARKING AT AOS AZIMUTH
3	-	DOWNLINK - BEACONS RECEIVED
4	-	BEGIN TRACKING OF SATELLITES
5	A	PING SUCCESSFUL
6	B	PING SUCCESSFUL
7	A	CHECK DETUMBLING STATUS
8	A	CHECK POWER STATUS
9	B	CHECK DETUMBLING STATUS
10	B	CHECK POWER STATUS
11	A	REQUEST HISTORICAL TELEMETRY
12	A	REQUEST STORING HISTORICAL TELEMETRY
13	A	RESET GND WATCHDOGS
14	A	TIMESYNC
15	B	REQUEST HISTORICAL TELEMETRY
16	B	REQUEST STORING HISTORICAL TELEMETRY
17	B	RESET GND WATCHDOGS
18	B	TIMESYNC
19	A	CHECK ANTENNA DEPLOYMENT
20	B	CHECK ANTENNA DEPLOYMENT
21	A	POWER ON GPS (OEM615)
22	B	POWER ON GPS (OEM615)

First contact: 02 Feb. 14:09 UTC (+6h 18min)

- Satellite responsive ✓
- Detumbling successfully active ✓
- UHF antenna deployed ✓
- GPS working ✓

Second pass: 02 Feb. 15:15 UTC



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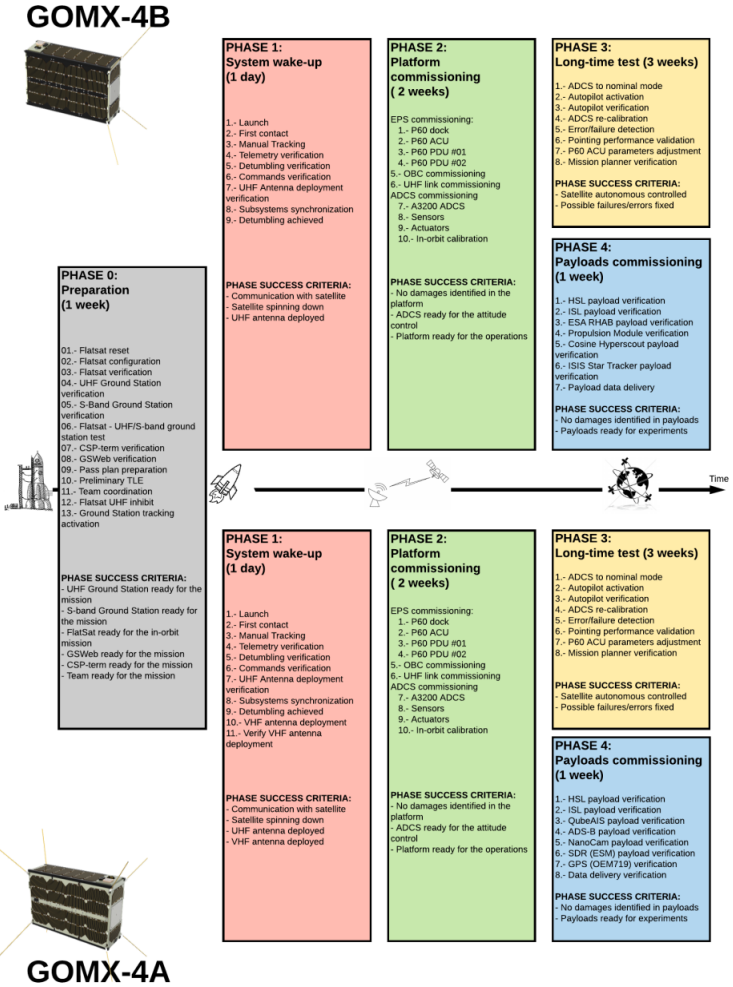
LEOP status overview



Phase	Description	Status
PHASE 0	Preparation	Done ✓
PHASE 1	System wake-up	Done ✓
PHASE 2	Platform commissioning	Done ✓
PHASE 3	Long-time test	Done ✓
PHASE 4	Payloads commissioning	Done ✓

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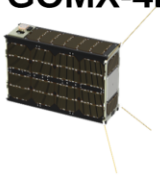
GOMX-4B



PHASE 0:
Preparation
(1 week)

01.- Flatsat reset
02.- Flatsat configuration
03.- Flatsat verification
04.- UHF Ground Station verification
05.- S-Band Ground Station verification
06.- Flatsat - UHF/S-band ground station test
07.- CSP-term verification
08.- GSWeb verification
09.- Pass plan preparation
10.- Preliminary TLE
11.- Team coordination
12.- Flatsat UHF inhibit
13.- Ground Station tracking activation

PHASE SUCCESS CRITERIA:
- UHF Ground Station ready for the mission
- S-band Ground Station ready for the mission
- FlatSat ready for the in-orbit mission
- GSWeb ready for the mission
- CSP-term ready for the mission
- Team ready for the mission

PHASE 1:
System wake-up
(1 day)

1.- Launch
2.- First contact
3.- Manual Tracking
4.- Telemetry verification
5.- Detumbling verification
6.- Commands verification
7.- UHF Antenna deployment verification
8.- Subsystems synchronization
9.- Detumbling achieved

PHASE SUCCESS CRITERIA:
- Communication with satellite
- Satellite spinning down
- UHF antenna deployed

PHASE 2:
Platform commissioning
(2 weeks)

EPS commissioning:
1.- P60 dock
2.- P60 ACU
3.- P60 PDU #01
4.- P60 PDU #02
5.- OBC commissioning
6.- UHF link commissioning
ADCS commissioning
7.- A3200 ADCS
8.- Sensors
9.- Actuators
10.- In-orbit calibration

PHASE SUCCESS CRITERIA:
- No damages identified in the platform
- ADCS ready for the attitude control
- Platform ready for the operations

PHASE 3:
Long-time test (3 weeks)

1.- ADCS to nominal mode
2.- Autopilot activation
3.- Autopilot verification
4.- ADCS re-calibration
5.- Error/failure detection
6.- Pointing performance validation
7.- P60 ACU parameters adjustment
8.- Mission planner verification

PHASE SUCCESS CRITERIA:
- Satellite autonomous controlled
- Possible failures/errors fixed

PHASE 4:
Payloads commissioning
(1 week)

1.- HSL payload verification
2.- ISL payload verification
3.- ESA RHAB payload verification
4.- Propulsion Module verification
5.- Cosine Hyperscout payload verification
6.- ISIS Star Tracker payload verification
7.- Payload data delivery

PHASE SUCCESS CRITERIA:
- No damages identified in payloads
- Payloads ready for experiments

PHASE 1:
System wake-up
(1 day)

1.- Launch
2.- First contact
3.- Manual Tracking
4.- Telemetry verification
5.- Detumbling verification
6.- Commands verification
7.- UHF Antenna deployment verification
8.- Subsystems synchronization
9.- Detumbling achieved
10.- VHF antenna deployment
11.- Verify VHF antenna deployment

PHASE SUCCESS CRITERIA:
- Communication with satellite
- Satellite spinning down
- UHF antenna deployed
- VHF antenna deployed

PHASE 2:
Platform commissioning
(2 weeks)

EPS commissioning:
1.- P60 dock
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4.- P60 PDU #02
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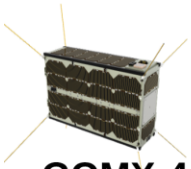
7.- P60 ACU parameters adjustment
8.- Mission planner verification

PHASE SUCCESS CRITERIA:
- Satellite autonomous controlled
- Possible failures/errors fixed

PHASE 4:
Payloads commissioning
(1 week)

1.- HSL payload verification
2.- ISL payload verification
3.- QubeAIS payload verification
4.- ADS-B payload verification
5.- NanoCam payload verification
6.- SDR (ESM) payload verification
7.- GPS (OEM719) verification
8.- Data delivery verification

PHASE SUCCESS CRITERIA:
- No damages identified in payloads
- Payloads ready for experiments



GOMX-4A

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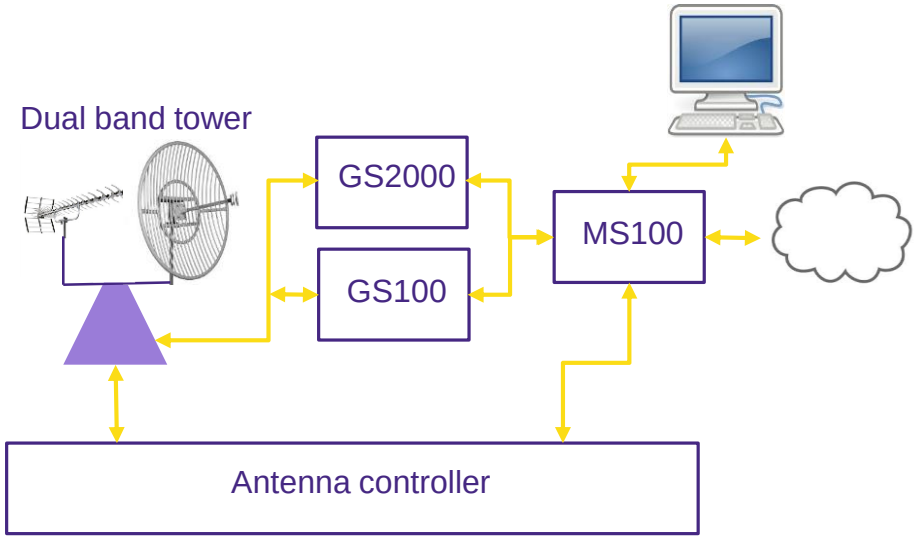
Ground Station Commissioning

Dual band ground segment covering the UHF and S-band on the same tower

- Test and calibration performed ✓



- S-band link performance are slightly better than anticipated – related to conservative estimates in the budget calculations ✓
- UHF is reuse from existing ground segment ✓

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Platform commissioning: UHF radio

UHF RADIO NOMINAL BEHAVIOUR AS EXPECTED ✓

NanoCom AX100 radio:

- Fluid transmission/reception ✓
- >19MB RX data (uplink) ✓
- >1GB TX data (downlink) ✓
- Temperatures between 7 deg. to 29 deg. (Average 19 deg.) ✓

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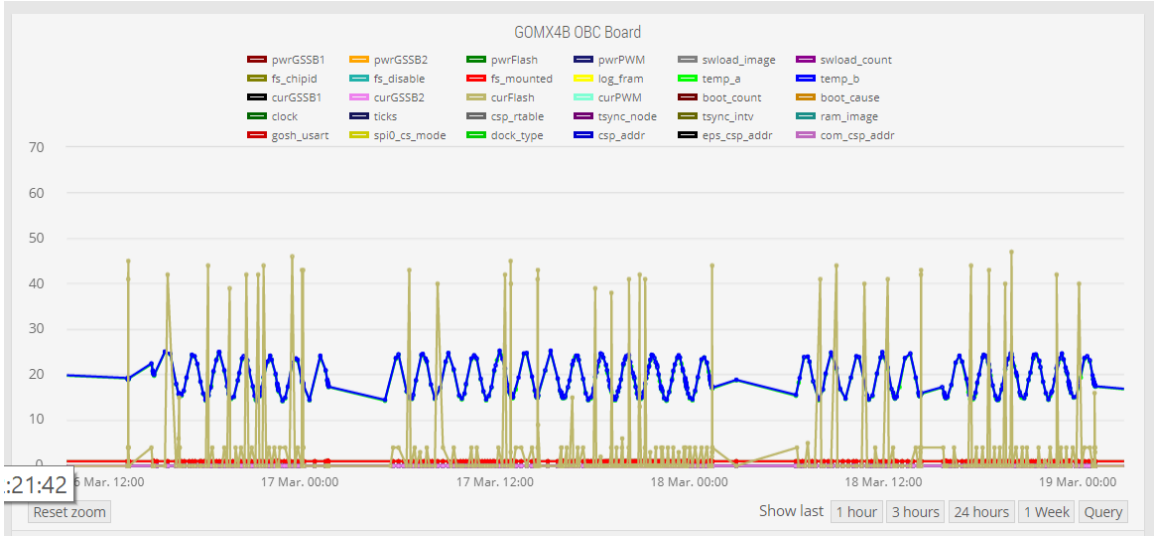
Platform commissioning: OBC

ON-BOARD COMPUTER NOMINAL BEHAVIOUR AS EXPECTED ✓

NanoMind A3200 OBC:

- Nominal on-board processing ✓
- Nominal flash memory activity ✓
- Functional payload features ✓
- Average temperature around 20 degC ✓



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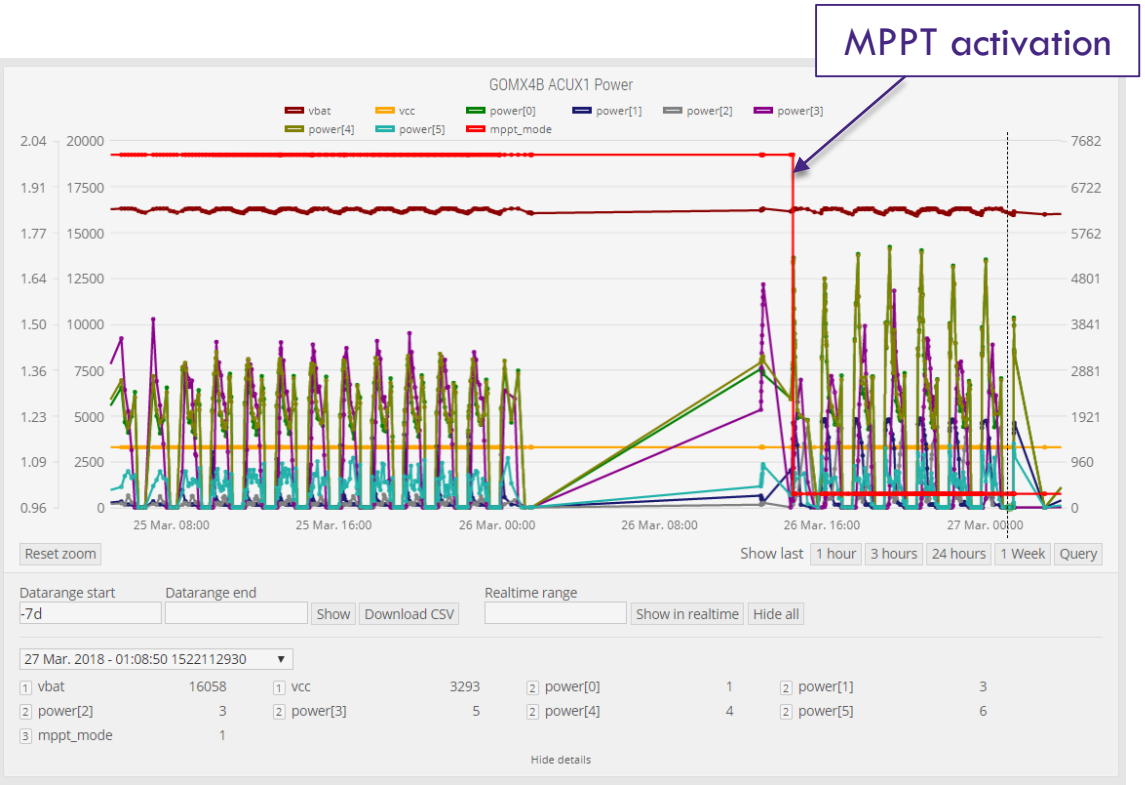
Platform commissioning: EPS

NANOPOWER P60 IS IN-ORBIT FOR FIRST TIME AND PERFORMING AS EXPECTED ✓



Battery pack:

- ➢ Battery Voltage stable ✓
- ➢ Battery charge/discharge responding properly ✓

Output modules:

- ➢ Latch Up protection and current limits verified ✓

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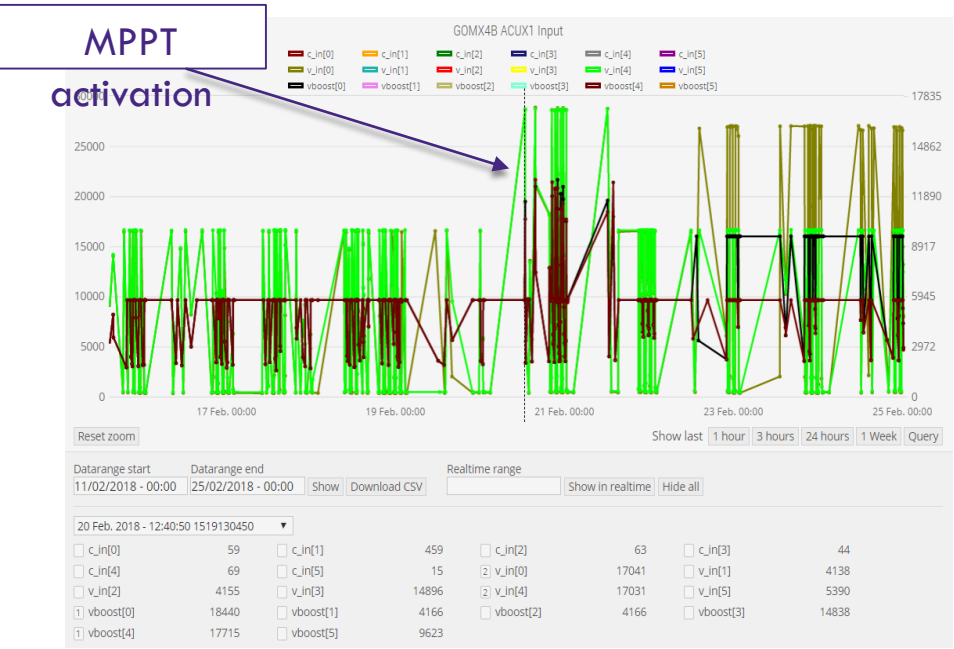
Platform commissioning: EPS

ANOMALY: DURING MPPT, UNEXPECTED THE INPUT VOLTAGES



- MPPT mode activate 20th February 12:27 UTC.
- Input voltage in channels 0 and 4 higher than expected.

GOMX-4B satellite			System design		Implemented in integration	
ACU(P60) Channel	Panel	Cells	Config.	Input Voltage (V)	Config.	Input Voltage (V)
0	+Y_1	8	4s2p	9.4	8s	18.8
4	+Y_2	8	4s2p	9.4	8s	18.8
3	+X	6	6s1p	14.1	6s1p	14.1
1	+Z	2	2s1p	4.7	2s1p	4.7
4	-Y_1	4	4s1p	9.4	4s1p	9.4
5	-Y_2	4	4s1p	9.4	4s1p	9.4
5	-X	2	2s1p	4.7	2s1p	4.7
2	-Z	2	2s1p	4.7	2s1p	4.7

NCR detected

Solar cells in +Y face wrongly connected all in series (8s) instead of 4s2p as the system design.

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Platform commissioning: EPS

IMPACT ANALYSIS AND MITIGATION PLAN FOR THE NCR

Impact:

- Input Power lost from 10 up to 20% (around 1 W less average).

Mitigation:

- Voltage charge limit reduced to keep the right safety margins.
- Power budget analysis and control during all mission operations period.

Conclusion:

✓ **There is no risk or modification in the mission plan and operations.**

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Platform commissioning: Temperatures

EXTERNAL TEMPERATURES:

- External temperatures between -30 deg. and +40 approximately (range -40 deg. to +85 deg.) ✓

Extreme temperatures in CSS in nadir pointing:

- +X from -27 deg. to +28 deg. ✓
- +Y from -26 deg. to 31 deg. ✓
- +Z from -23 deg. to 27 deg. ✓
- -X from -16 deg. to +9 deg. ✓
- -Y from -29 deg. to -14 deg. ✓
- -Z from -24 deg. to 37 deg. ✓

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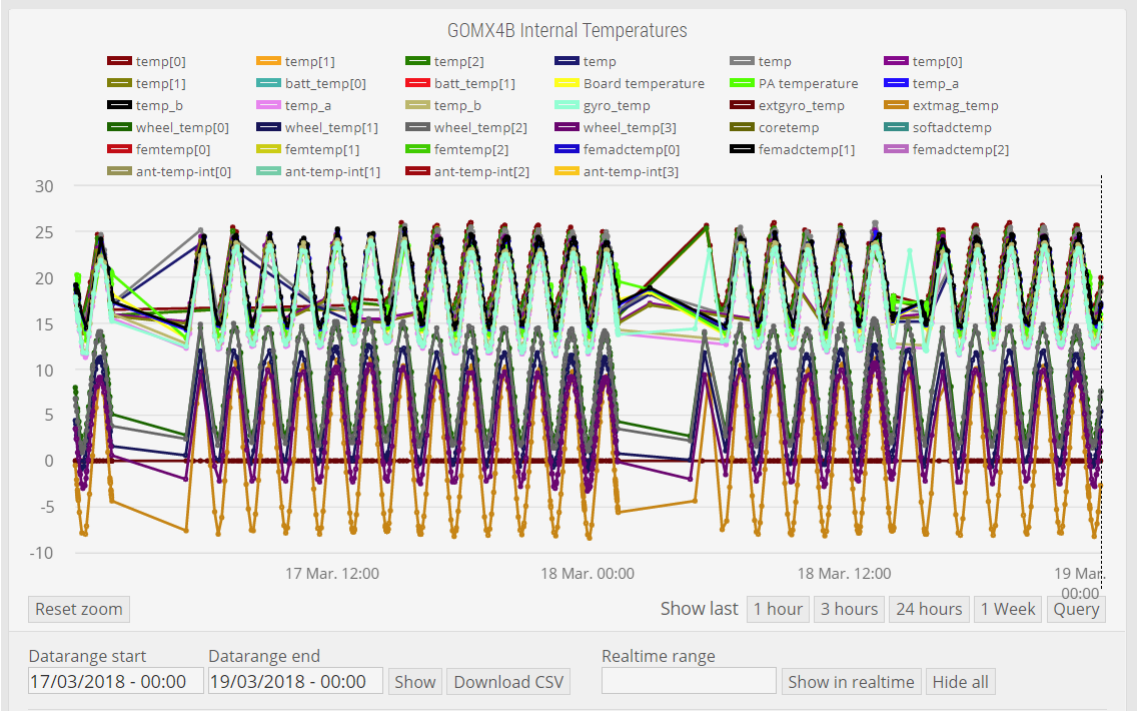
Platform commissioning: Temperatures

INTERNAL TEMPERATURES

- Internal temp. between -8 deg. and +26 deg. ✓
- All subsystems within their ranges ✓
- No historical data using payloads yet.



SUBSYSTEM	Limits (degC)	In-orbit temp. (degC)
UHF radio	-30 to +85	+13 to +24 ✓
OBC	-30 to +85	+14 to +25 ✓
Batteries	-5 to +60	+14 to +25 ✓
EPS - Dock	-40 to +85	+14 to +25 ✓
EPS – PDU#01	-40 to +85	+14 to +24 ✓
EPS – PDU#02	-40 to +85	+15 to +26 ✓
EPS – ACU	-40 to +85	+15 to +26 ✓
ADCS A3200	-30 to +85	+11 to +24 ✓
RW-600	-40 to +80	-3 to +15 ✓
Ext. gyro	-40 to +85	-2 to +18 ✓
Ext magn.	-40 to +85	-8 to +11 ✓

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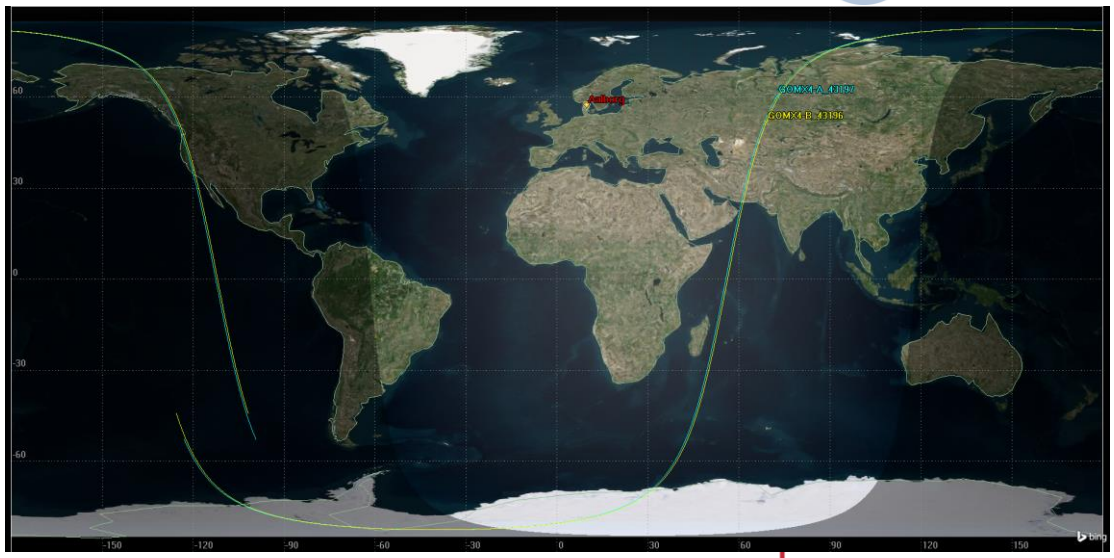
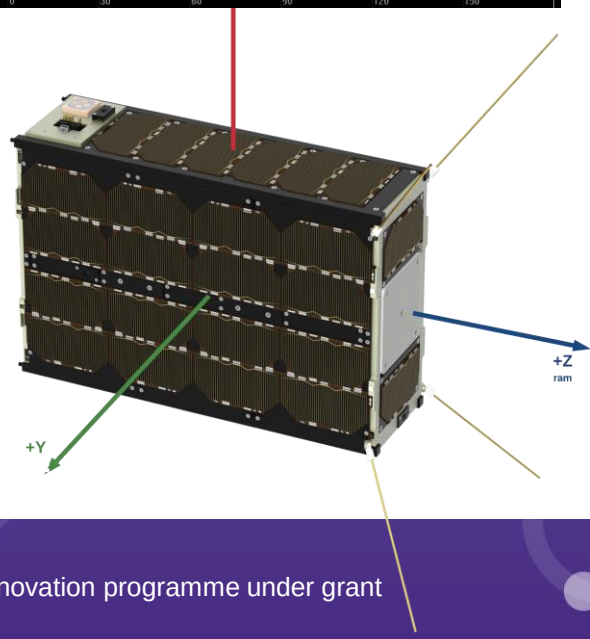
ADCS and orbit control

Attitude Control Modes used:

- Detumbling (B-dot controller)
  - Satellites were detumbled at first contact after launch



- 3-Axis pointing
  - Minimum Drag / RAM pointing (+Z ram)
    - Goal: nominal attitude and drag management to slow down the drift between both GOMX-4
  - Cosine pointing (+Y canted ram)
    - Goal: optimum attitude for HyperScout picture acquisition
  - Ground Station (Aalborg) tracking
    - Goal: perform HSL operations



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ADCS and orbit control

Main achievements:

- **Satellite detumbled** after the launch ✓
- Performance assessment with **On-Ground calibration** ✓
- **In-Orbit Calibration** of ADCS ✓
- Measure **pointing accuracy** analysis with in-orbit calibration ✓
- **ADCS mission modes** commissioned ✓
- **Drag management** between GOMX-4B and GOMX-4A ✓
- **Propulsion module commissioned** ✓
- **Propulsion maneuver** performed combined with drag management ✓

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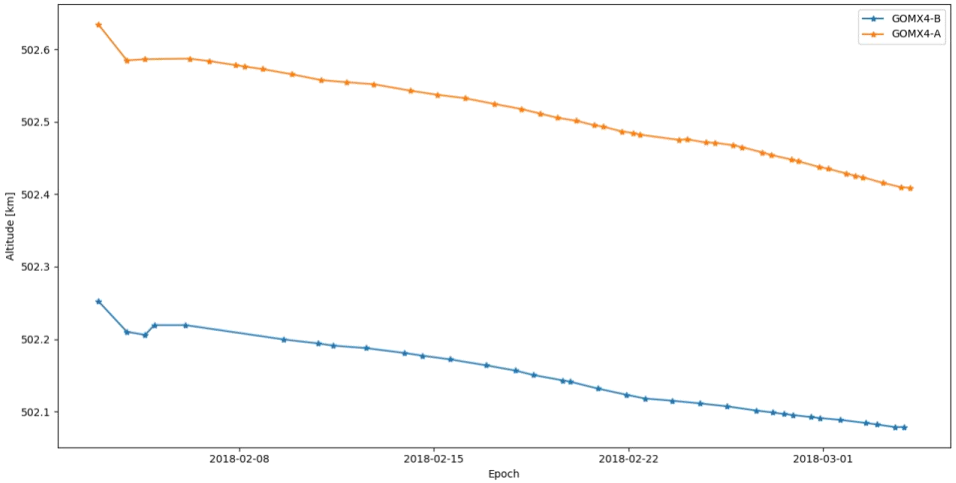
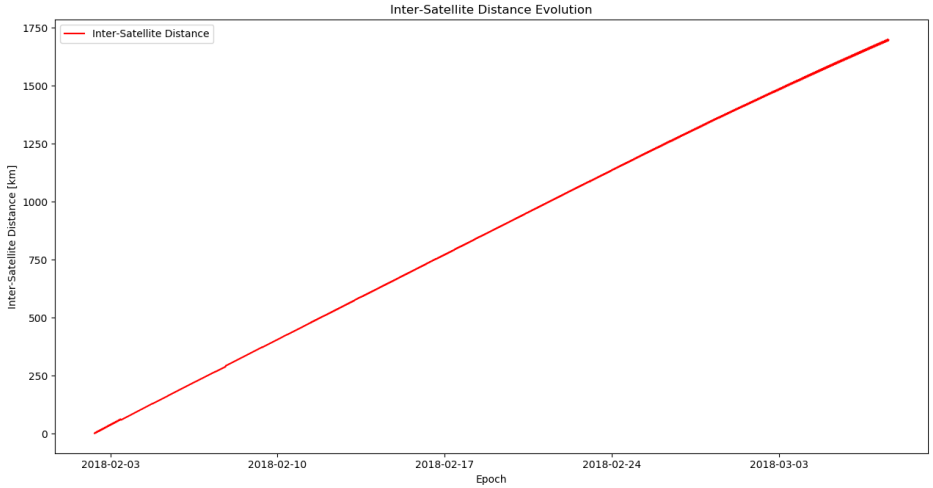
ADCS and orbit control

Altitude Evolution before maneuver:



- GOMX-4B was launched around 320 m below GOMX-4A.
- High drift between the satellites.

- Satellites separating with a ratio of 50 Km per day.
- Separation slowly decelerated by drag management but it would take 2-3 months to equal the altitude of satellites.
- Propulsion maneuver required.



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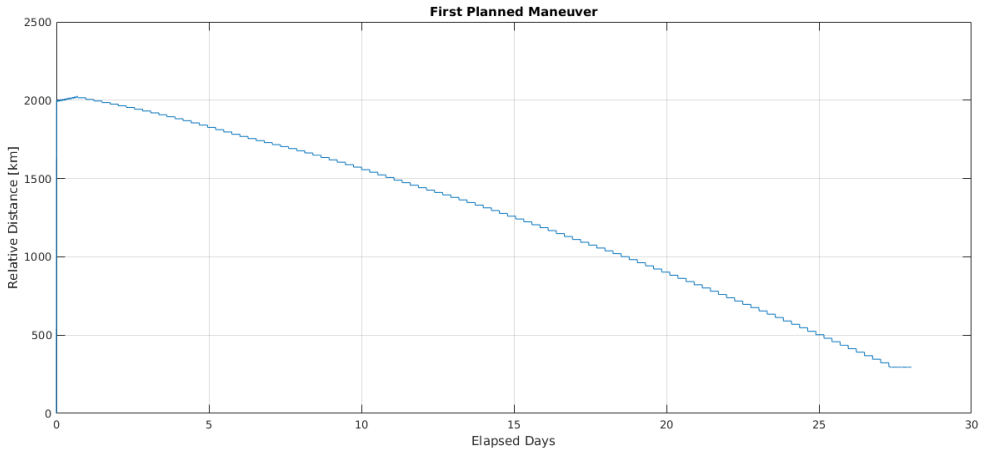
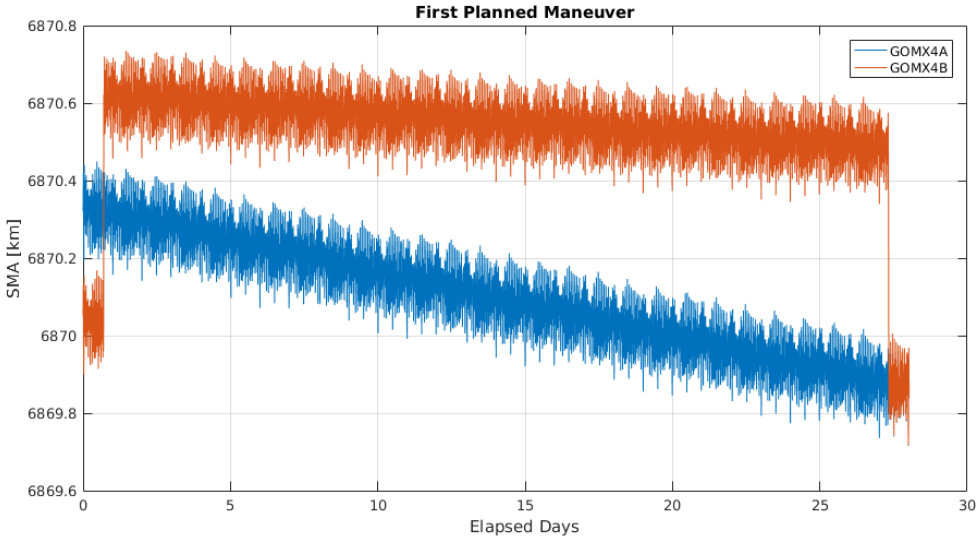
ADCS and orbit control

Propulsion maneuver plan:

Goal:

- Reduce the separation up to around 300 Km in less than 1 month.
- Equal the orbit altitude of both satellites.





Maneuver plan:

- Prograde burn for 640 s (10min 40 s).
- GOMX-4B reaches 350 m over GOMX-4A.
- Keep nominal ADCS for 26.1 days.
- Retrograde burn for 671 s (11min 11s).
- Total used propellant: 8.8 g.

Today

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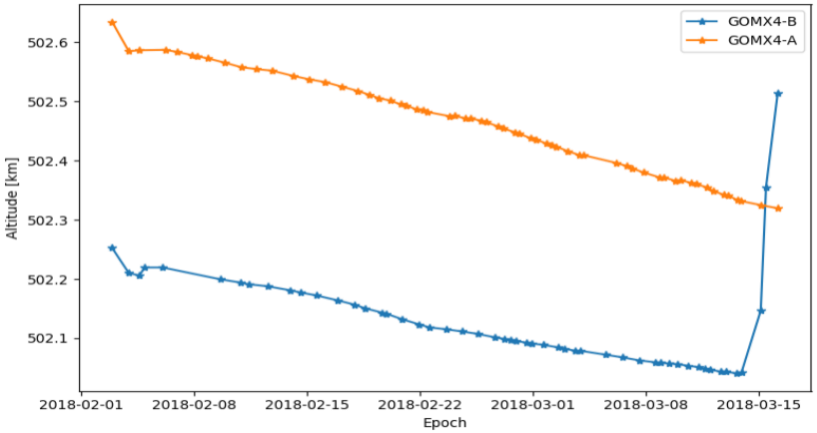
ADCS and orbit control

Propulsion maneuver:



Peak current consumption:

Current (mA)	5V0	12V
Burn 1	65 ✓	855 ✓
Burn 2	68 ✓	261 ✓
Burn 3	44 ✓	83 ✓
Burn 4	65 ✓	427 ✓
Limit	100	1000

		BURN 1	BURN 2	BURN 3	BURN 4
Epoch start burn UTC		13/mar 14:23	14/Mar 23:00	15/Mar 00:40	15/Mar 22:50
Burn duration		1 min	3 min	3 min	3 min 40 s
Propellant used [g]		0.392	1.235	1.235	1.509
Burn Time [s]	Thruster 1	85	270	285	371
	Thruster 2	85	210	195	280
	Thruster 3	85	210	220	280
	Thruster 4	90	215	225	240
Total Impulse [mNs]	Thruster 1	51.7	180	180	220
	Thruster 2	60	180	180	220
	Thruster 3	60	180	180	220
	Thruster 4	60	180	180	220
Thrust [µN]	Thruster 1	504-608	607-1078	595-935	563-904
	Thruster 2	681-790	768-1324	882-964	734-1066
	Thruster 3	673-779	771-1244	757-1094	730-1061
	Thruster 4	670-778	760-1208	743-1088	852-1159
Pressure [mbar]	Thruster 1	818-950	943-1519	931-1342	891-1303
	Thruster 2	883-1020	993-1665	1131-1234	949-1359
	Thruster 3	878-1017	1004-1601	991-1412	949-1368
	Thruster 4	834-968	953-1513	933-1362	1063-1456
	Tank Plenum	889-1079	1016-1754	1007-1510	963-1441
Temperature [degC]	Thruster 1	18-19	16-20	10-21	--
	Thruster 2	15-21	13-23	11-22	--
	Thruster 3	14-21	17-20	11-20	--
	Thruster 4	14-21	14-22	11-21	--
	Tank Plenum	9	14	13-14	--
	Tank 1	7-8	12-13	12-13	--
	Tank 2	1-4	3-15	3-16	--

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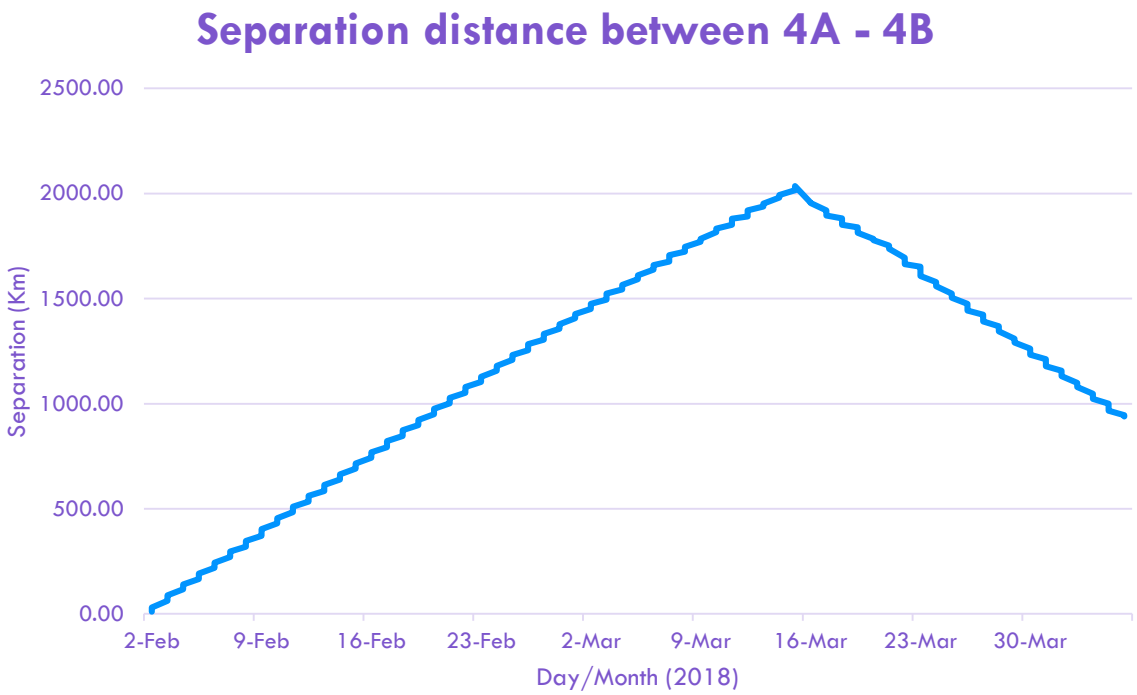
ADCS and orbit control

Altitude Evolution after maneuver:



- Simulation:
  - Around 1000 Km after 18 days
  - Propellant consumed 4.27 g
- In-orbit results:
  - Around 1000 Km after 18 days ✓
  - Propellant consumed: 4.371 g ✓

➢ Retrograde burn scheduled for 9th – 10th April 2018.

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Payloads commissioning: S-band radio

- S-band Radio based on GomSpace NanoCom SDR used for HSL and ISL.
- Radio consumption: peak 1215 mA, nominal 1070 mA ✓
- Expected behavior ✓

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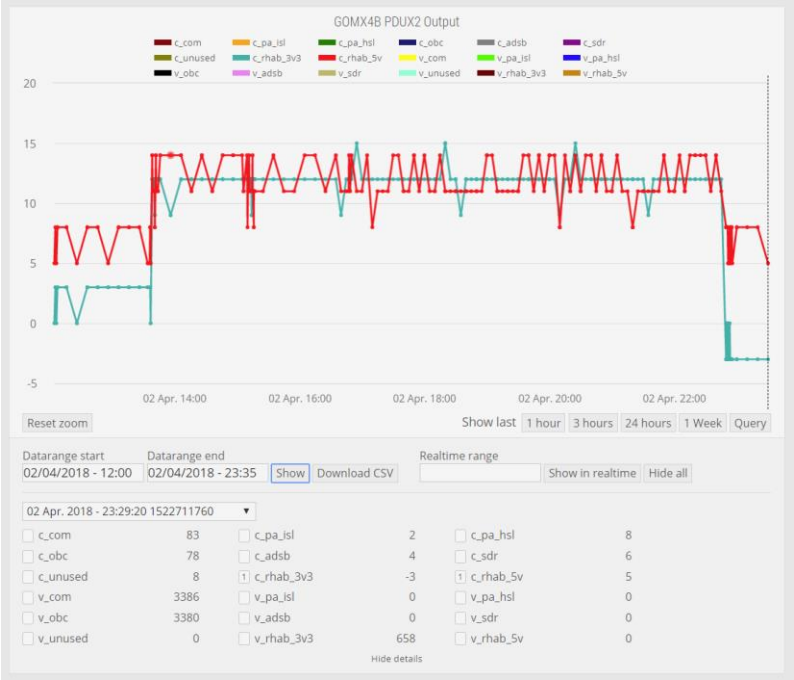
Payloads commissioning: Chimera board

- Commissioned on 10th February for 1 orbit and on 2nd April for 6 orbits.
- Average consumption:
  - ✓ 3v3 line: 12 mA (< 20 mA) ✓
  - ✓ 5v0 line: 14 mA (< 20 mA) ✓



- ✓ Status and data files properly transferred to the OBC ✓
- ✓ Latch-up events detected and limits under study.
  - ❑ 3v3: 25/30 → 30/40 (solved) ✓
  - ❑ 5v0: 25/30 → 70/80 (under investigation)

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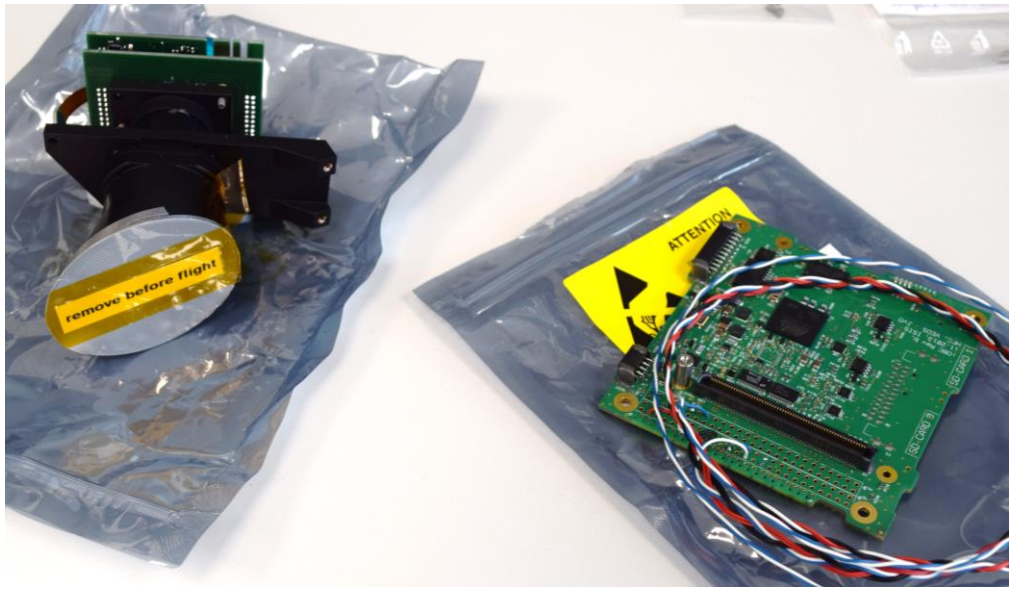
Payloads commissioning: Star Tracker



- Commissioning steps:
  1. Health check.
  2. Com2 to monitor telemetry during 1 orbit.
  3. Com3 to capture an image of stars.
- Current consumption:
  - Nominal 200 mA
  - Peak 300 mA

- ✓ Step 1 successfully performed on 14th March. Current consumption **177 mA** ✓
- ✓ Step 2 (Com2) failed on 19th and 20th March.
  - → SW bug fixed and test successfully repeated on 26th March. Current consumption: **177 mA** ✓
- ✓ Step 3 (Com3) successfully performed on 17th March generating the image imgb3.bin of 128.0 KB. Current consumption: **216 mA** ✓

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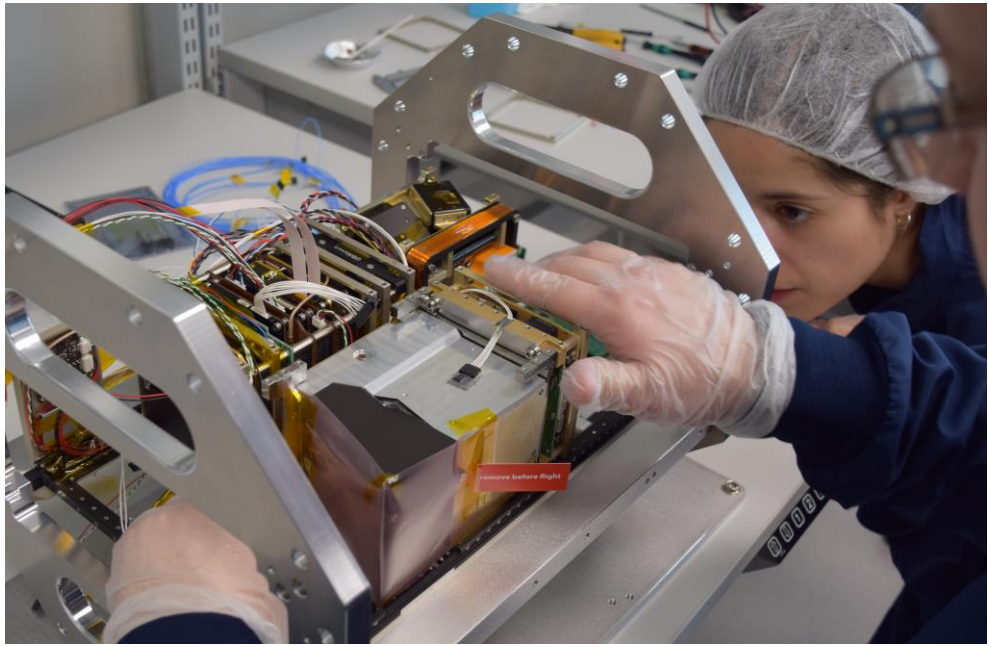
Payloads commissioning: HyperScout



- ✓ Health check and image capture above Netherlands performed on 20th March.
- ✓ Consumption:
  - 3V3 line: 90 mA (<120 mA) ✓
  - 12V line: 371 mA (<800 mA) ✓
- ✓ Telemetry good ✓
- ✗ Image part downloaded smaller than expected

- ✓ Second image capture above Cuba on 26th March ✓
- ✓ Consumption:
  - 3V3 line: 87 mA ✓
  - 12V0: 317 mA ✓
- ✓ Image pending of downloading and analysis.

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LEOP conclusions

Subsystem	Health	Functionality	Performance
EPS (P60)	✓	✓	✓
OBC	✓	✓	✓
UHF radio	✓	✓	✓
ADCS	✓	✓	✓
Propulsion payload	✓	✓	✓
S-band radio (HSL)	✓	✓	✓
ISL payload	✓	✓	(ops)
Chimera payload	✓	✓	(ops)
Star Tracker payload	✓	✓	(ops)
HyperScout payload	✓	✓	(ops)

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Requirements verification

Mission requirements:

Req. ID	Text	Class.	In-orbit results
M-10	The system shall have an expected lifetime of minimum 7 months.	MIS	→ To be verified at the end of the main operations phase.

UHF TMTC link requirements:

Req. ID	Text	Class.	In-orbit results
S-404	The UHF link shall be able to operate at 2k4, 4k8, 9k6 and 19k2 bps.	PER	✓ UHF link successfully stablished at 9k6 download and 4k8 uplink datarates, using all transmission power levels (0, 1 and 2) within this mission. → To be further verified at the end of the main operations phase.

High Speed Link (HSL) requirements:

Req. ID	Text	Class.	In-orbit results
S-800	If present, the HSL shall provide a data rate of at least 500 kBit/s when at an elevation angle of 40° or more with a minimum link margin of 3 dB.	FUN	✓ The HSL has been successfully stablished (margin larger than 3 dB) using a datarate of 1 Mbps up to an elevation lower than 20°.
S-801	If present, the space segment HSL shall use an RF power of no greater than 2W.	FUN	✓ The RX power used in the satellite until now it is 0.7 W.

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Requirements verification

ADCS requirements:

Req. ID	Text	Class.	In-orbit results
S-201	The ADCS shall be able to measure the satellites position to within 30 m (1 sigma).	PER	✓ On-board GPS (OEM615) must show an accuracy within 30 m and the new one on-board on GOMX-4A (OEM719) shows same performance. No absolute measurements available to determine exact accuracy.
S-202	The ADCS shall be able to determine its attitude with an AKE of less than 1 deg (1 sigma).	PER	✓ In Sun, AKE (1 sigma) is measured as between 0.2 to 1 deg. × Average in all orbit, AKE (1 sigma) is measured as between 1.4 to 3.0 deg.
S-203	The ADCS shall be able to track fixed orbit-frame vectors with an APE of less than 1 deg (1 sigma).	PER	✓ APE (1 sigma) is measured as between 0.2 to 0.4 deg.
S-204	The ADCS shall be able to provide pointing stability with an RPE of less than 1000 arc-second over a 30 sec window.	FUN	→ Pending to be analyzed.
S-205	The ADCS shall be able to detumble the satellite from 180 deg/s to less than 1 deg/s within 1 week.	PER	✓ Satellite spin lower than 1 deg/s after 2 days in-orbit.
S-206	The ADCS shall be able to automatically transition between detumbling and pointing modes.	FUN	✓ Automatic ADCS transition modes implemented and working in the flight satellite.

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Requirements verification

Propulsion module requirements:

Req. ID	Text	Class.	In-orbit results
S-024	The propulsion module shall generate a torque no greater than 0.2 mNm during maximum thrust firings.	PHY	✓ The propulsion system at 4 mN thrust generated 34 uNn torque in the satellite.
S-502	The propulsion system shall have a specific impulse of at least 57 seconds.	PER	✓ Specific impulse in the propulsion maneuver measured as 61 s.
S-505	The propulsion system shall provide at least 4 mN of total thrust.	PER	✓ The 3 burns executed for the maneuver provided a total thrust larger than 4 Nm.
S-507	Each thruster of the propulsion system shall be capable of throttling in the 0.5 mN - 1 mN range.	FUN	✓ All 4 thursters presented a thrust between 0.5 mN (thruster 1) and 1.2 mN (thruster 3).
S-512	The propulsion system shall be able to perform thruster firing for at least 300 seconds per burn event.	PER	✓ Currently, the maximum firing perform is 200 seconds in total where the thruster 1 took 371 s. → To be further verified at the end of the main operations phase.
S-515	The thrust vector shall maintain a mean error angle of 1 degree or less over a 300 second period.	FUN	→ Pending to be analyzed.

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Requirements verification

Inter-Satellite Link (ISL) requirements:

Req. ID	Text	Class.	In-orbit results
S-601	The ISL system shall be capable of a data rate of at least 9.6 kbit/s at 1500 km separation from the target with a link margin of at least 3 dB.	FUN	✓ Payload commissioning performed at 750 Km of separation distance stablishing successfully the link at 102 kbps using 0.7 W transmission power. → To be verified at the end of the main operations phase.
S-603	The ISL system shall retain a link margin of at least 3 dB given a separation distance of up to 4500 km with a minimum bitrate of 1.2 kbit/s.	FUN	→ To be verified at the end of the main operations phase.

Chimera payload requirements:

Req. ID	Text	Class.	In-orbit results
S-1000	The ESA Chimera RHAB payload shall have an average power consumption of 0.5 W or less.	FUN	✓ Chimera payload consumes 0.12 W in average during nominal operations. × Latch-up event detected in the 5V output line consuming higher than 0.5W of power peak during the power on.
S-1001	The ESA Chimera RHAB shall generate no more than 10 kB of data per day.	FUN	✓ Chimera payload transmits a data package of 91 bytes every 15 minutes as it was expected.

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Requirements verification

Star Tracker payload requirements:

Req. ID	Text	Class.	In-orbit results
S-1205	The ISIS Star Tracker shall use 3V3 with 0.3 A as peak current	FUN	✓ Maximum current consumption of the star tracker payload measured as 0.22 A.
S-1209	The ISIS Star Tracker shall consume 1 W or less.	FUN	✓ Maximum power consumption of the star tracker payload measured as 0.73 W.
S-1213	The ISIS Star Tracker shall limit the data to be transmitted to Ground at 800 KB or less	FUN	✓ During the early commissioning the test cases 1, 2 and 3 generated data results of 35 KB, 7 KB and 150 KB respectively. → To be further verified at the end of the main operations phase.
S-1214	The ISIS Star Tracker shall limit the data to be uplink at 100 KB or less	FUN	✓ During the early commissioning a total of 0.9 KB was uploaded: four scrips of 80 bytes, 623 bytes and 72 bytes to execute the test cases 1, 2 and 3 respectively plus a common gscript of 150 bytes. → To be further verified at the end of the main operations phase.

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Requirements verification

HyperScout payload requirements:

Req. ID	Text	Class.	In-orbit results
S-1107	The Cosine HyperScout shall be activated for commissioning purposes within the first 3 months of mission lifetime for a limited time of 5 orbits.	MIS	✓ The HyperScout payload performed its commissioning in around 4 orbits (6 hours). × The commissioning was performed twice to capture photo above Scotland and Cuba in two different slots of time.
S-1108	The Cosine HyperScout commissioning shall be constraint for a maximum generation data to transmit of 10 KB and a maximum energy consumption of 3000 J per orbit	FUN	× The data results to download was a total of 1.3 MB and 2 MB of data for the first and second commissioning operations respectively. ✓ The total energy consumption of the payload during the commissioning is 7610 J split in 3V3 87mA@3V3 during 6h and 326mA@12V during 6 minutes.
S-1110	The Cosine HyperScout shall use 3V3 and 12V0 of power lines with a maximum current limitation of 1 A and 2 A respectively.	FUN	✓ Maximum current consumption measured as 0.09 A and 0.37 A for the HyperScout payload in the 3V3 and 12V0 output lines respectively.
S-1113	The HyperScout data shall be split in packages of 10 KB as maximum in order to minimize the data losses for possible transmission interruptions.	FUN	× The packages for the image were split in files of around 270 KB. The transmission was successful and this deviation is acceptable.
S-1118	The Cosine HyperScout payload shall implement RS422 as the data interface to transmit the payload data to the NanoMind Z7000 with a maximum data rate up to 1 MB.	FUN	× The 2 MB data took around 5 minutes to be transferred from HyperScout ICU to the Z700 in the SDR. → To be further verified at the end of the main operations phase.

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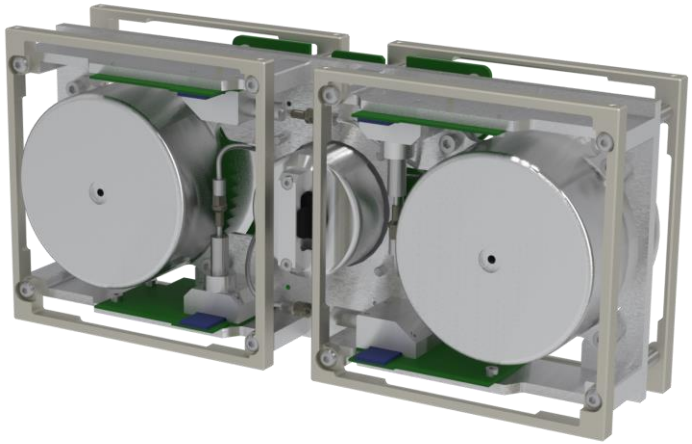
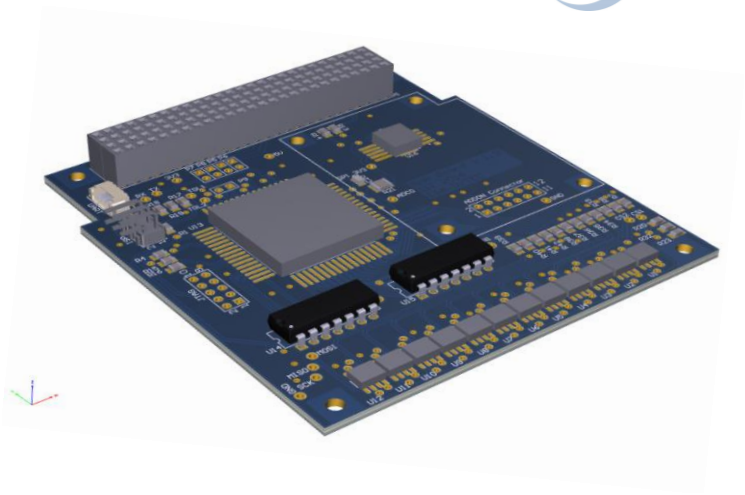
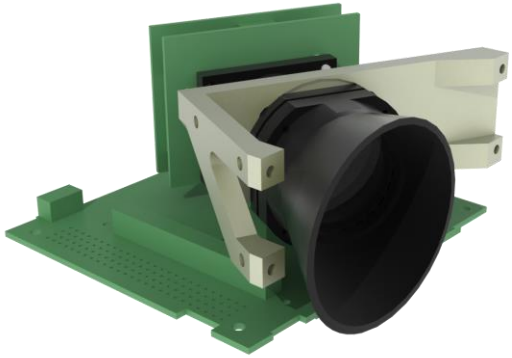
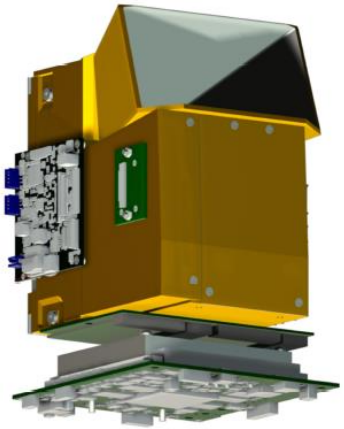
Individual AOCS/payloads presentations









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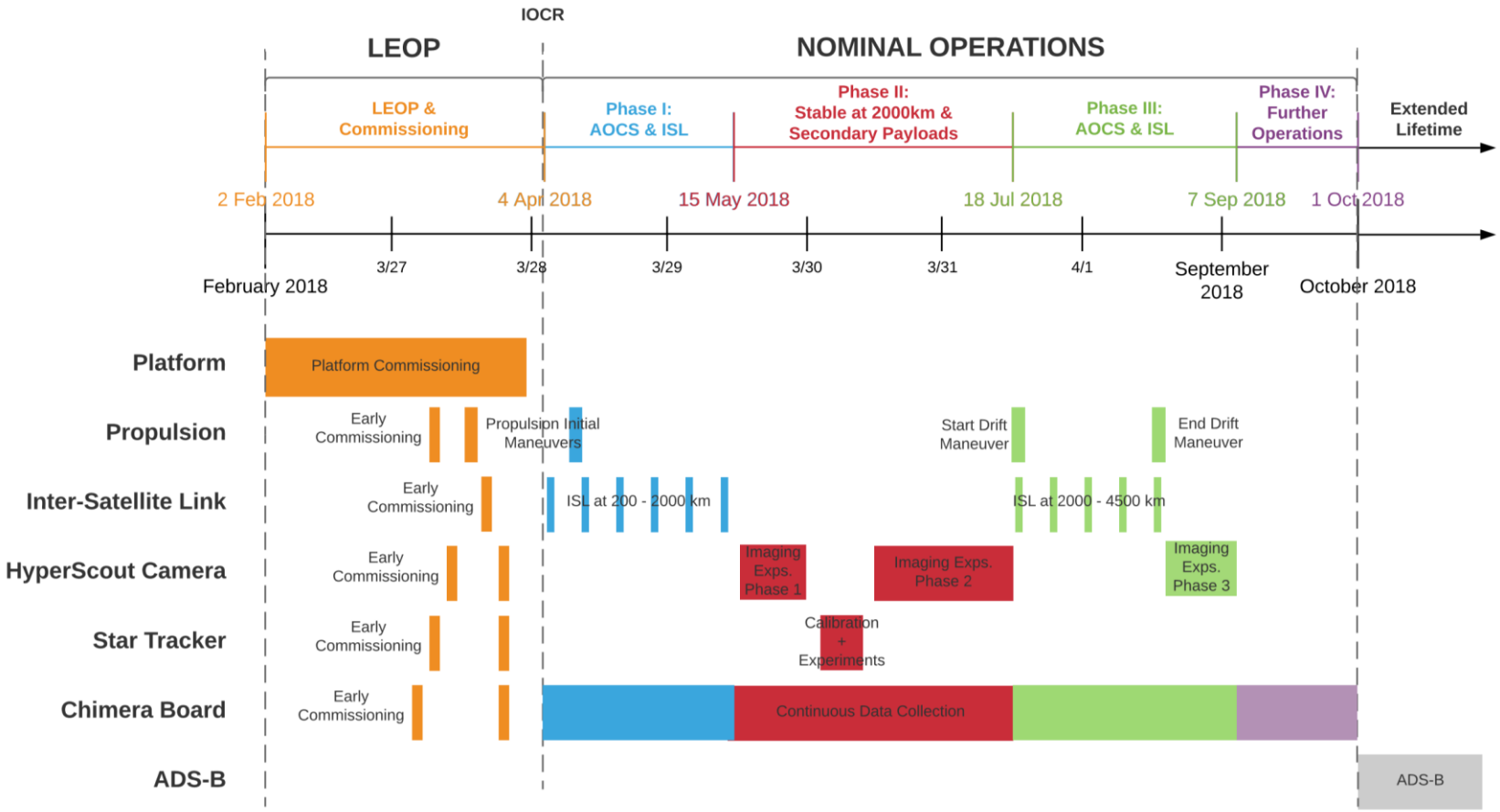
Mission Operations Plan

GOMX-4B OPERATIONS



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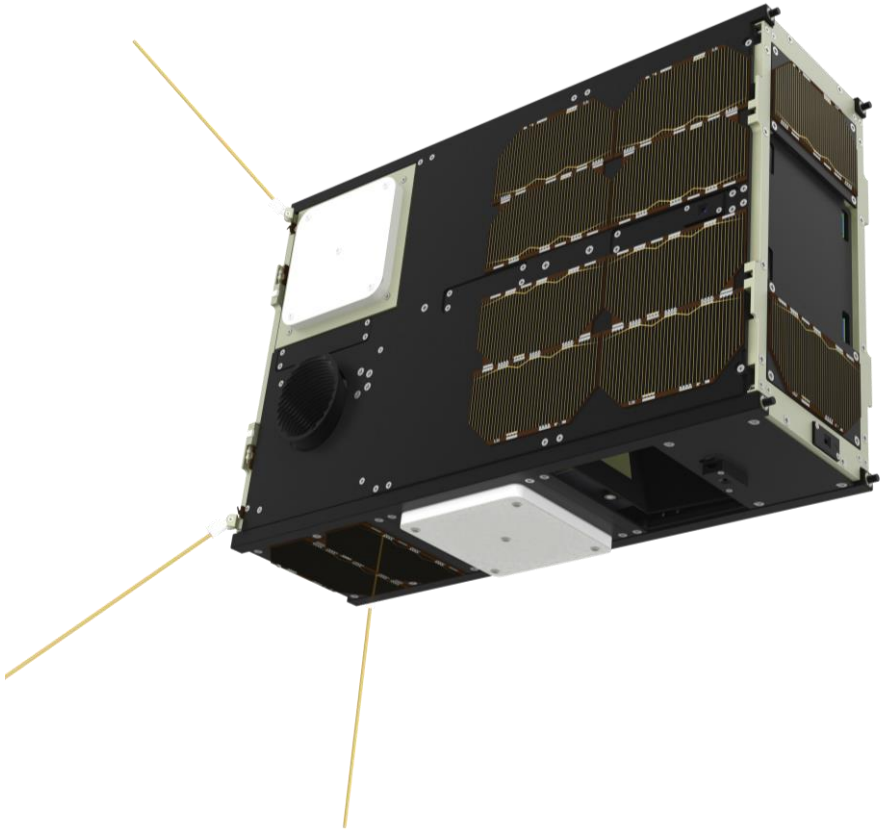
Thank You!



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