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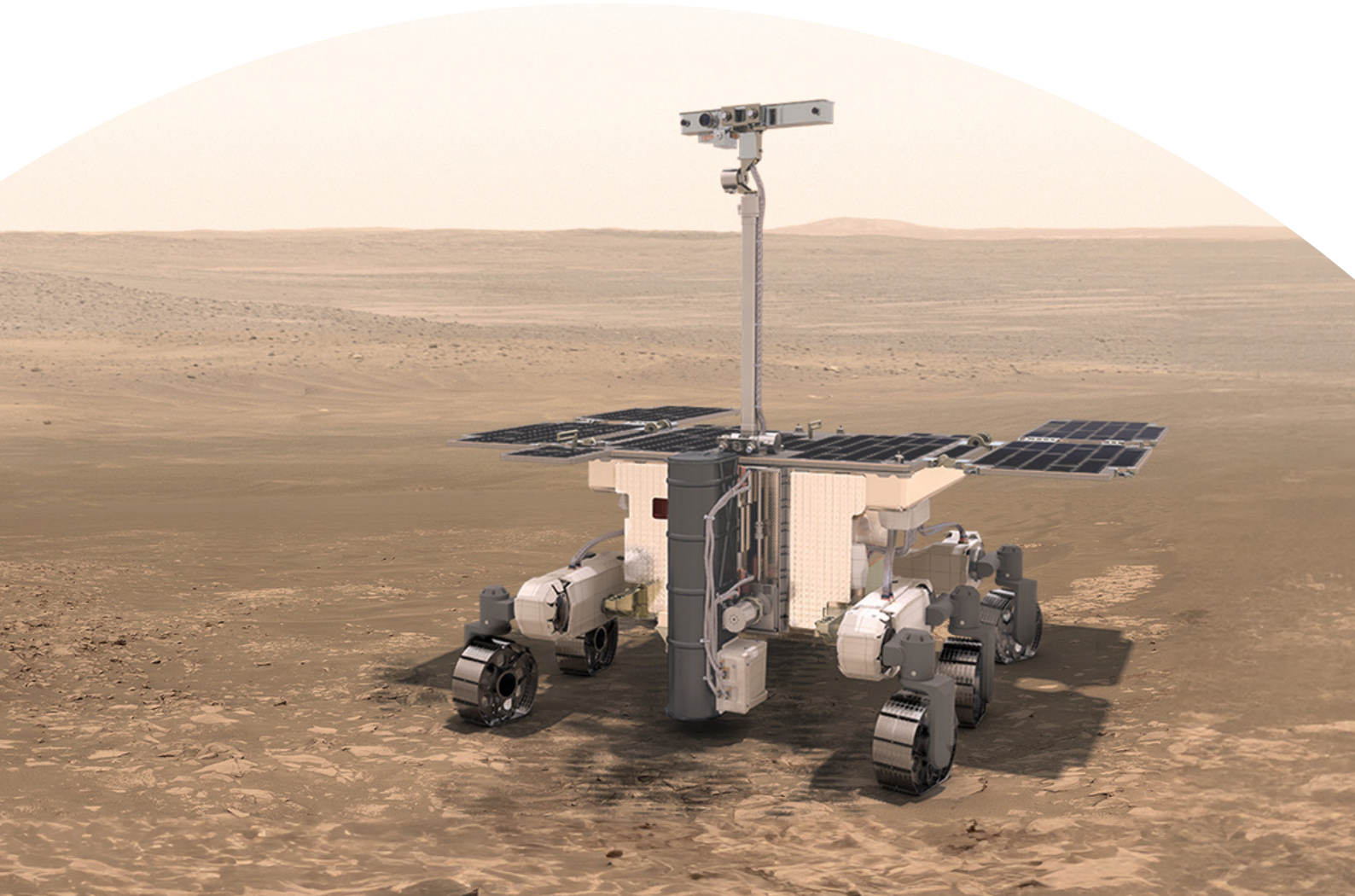
Mechanisms for space applications

Sener in Poland



About Sener in Poland

Sener in Poland has focused on developing innovative solutions in space engineering for the following institutions: European Space Agency (ESA), NASA and European Southern Observatory (ESO), as well as for commercial clients, among which, since 2012, are Airbus, Thales Alenia Space, OHB.

The company specializes in two fields of mechanical engineering: flight mechanisms and mechanical ground support equipment for satellite assembly. Sener in Poland is part of an international technology group with over **50 years** of experience in the space industry.

We cooperate with over **80 entities** from all over the country, acting as a link between them and the global space sector. Our Polish team of more than **40 people** carries out projects in the largest ESA missions, so that we contribute to building our country's recognition among the key actors of the European space market.

The company invests in research and development of its own products, such as containers for transporting and storage satellites. Satellite transport and storage containers are products that respond to a new trend in the space sector, which is to use a single solution for many different missions. The level of technological advancement of the containers is unique on a national scale, and after the completion of the project, Poland will join the elite group of manufacturers of this type of equipment in Europe. Due to the wide range of requirements, a whole group of products will be created – this customization of technology is particularly important for customers such as the European Space Agency or prime-contractors' companies.

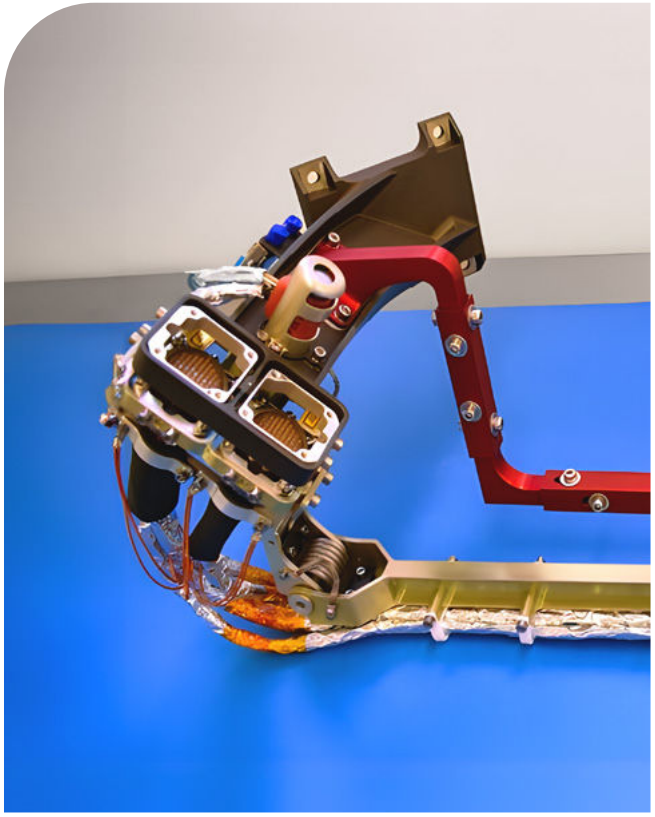
Products

MECHANISMS FOR:
HOLDING AND RELEASING
DEPLOYMENT
POSITIONING
TAILOR-MADE SPECIAL APPLICATIONS

MECHANICAL GROUND SUPPORT EQUIPMENT (MGSE) AS:
ADAPTERS
LIFTING DEVICES
MANIPULATORS
ROTATION DEVICES
SUPPORT DEVICES

Core Businesses

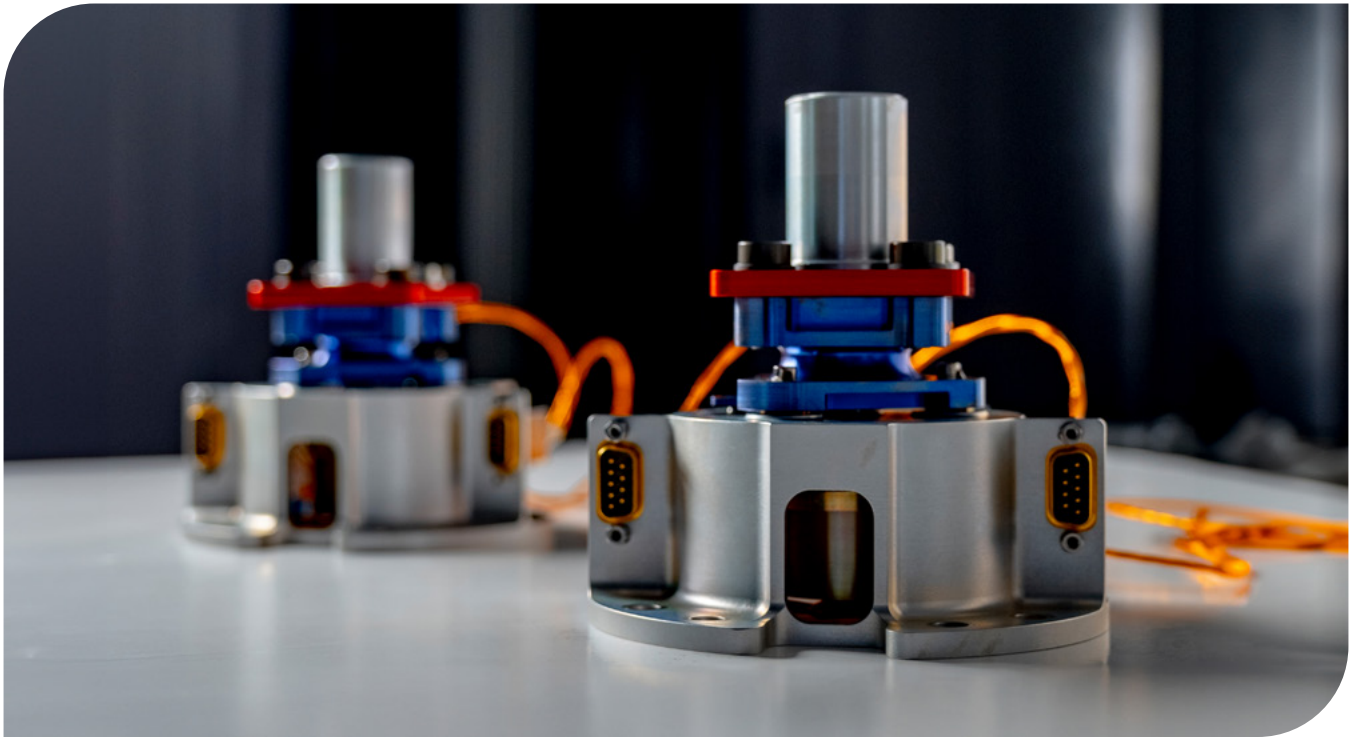
Mechanisms



Mechanical Ground Support Equipment

Excellence and reliability are trademarks of Sener in Poland's space mechanisms

Sener in Poland has been gaining experience and expertise in designing, constructing, testing, and assembling various kinds of space equipment, from hold down and release mechanisms through deployment, up to special applications mechanisms, since 2012. The company's engineering team strive for excellence and its out-of-the-box attitude has helped to mark the name of Sener in Poland as a trusted supplier for local and European companies. As a result, our mechanisms are now part of the most groundbreaking missions of ESA, such as ExoMars, Athena, or LISA, as well as commercial ventures, such as future use of our IBDM docking and berthing mechanism. We eagerly provide mechanisms from the field of our expertise as well as take up new challenges to turn our client's specific needs and agencies' requirements into reality for all kinds of satellites in Earth orbit and interplanetary exploration.



Heritage

MECHANISMS

HOLD DOWN DEVICES

DEPLOYMENT

- PANELS
- BOOMS
- STRUCTURES

- ANTENNAS
- SOLAR ARRAYS

SPECIAL APPLICATIONS

- POSITIONING AND POINTING
- CLAMPING
- SEPARATION MECHANISMS

MECHANICAL GROUND SUPPORT EQUIPMENT (MGSE)

ADAPTERS

- HANDLING & LIFTING ADAPTERS
- THERMAL ADAPTERS
- VIBRATION ADAPTERS
- PHYSICAL PROPERTIES MEASUREMENT ADAPTERS

LIFTING DEVICES

- VERTICAL LIFTING DEVICES
- HORIZONTAL LIFTING DEVICE
- PANEL/PAYLOAD LIFTING DEVICE

OTHERS

- MANIPULATION DEVICES
- STANDS / TROLLEYS
- SUPPORT FRAMES
- THERMAL / MASS DUMMIES

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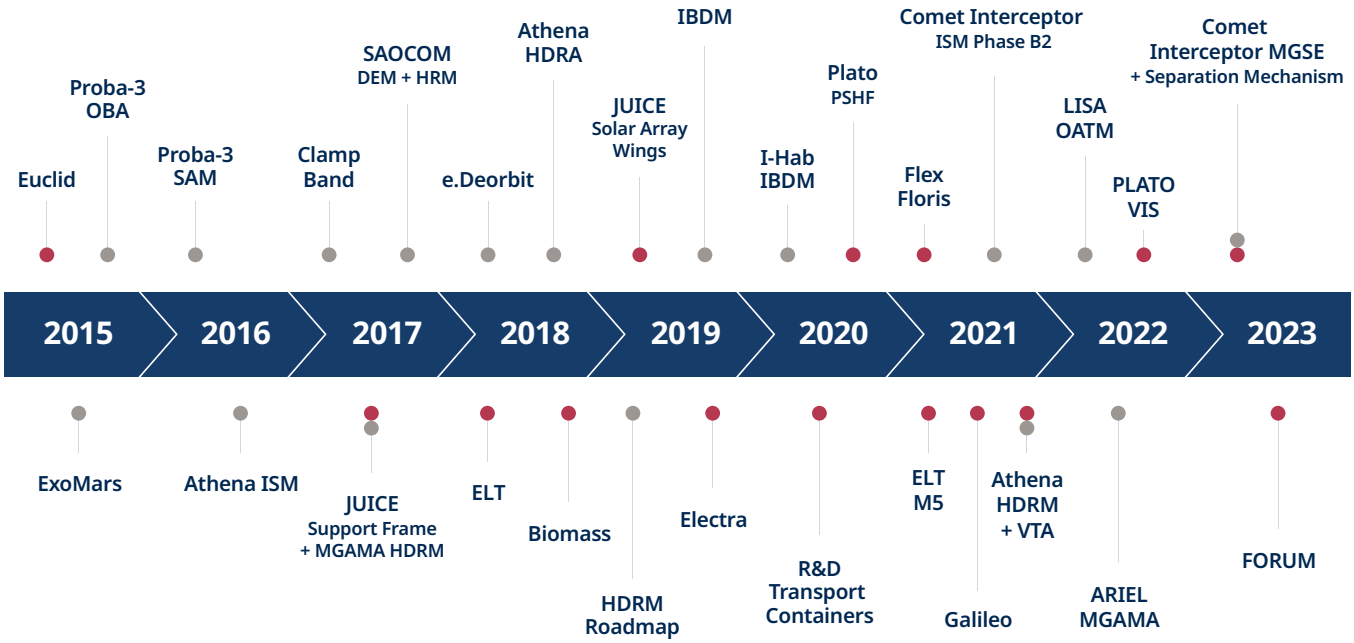
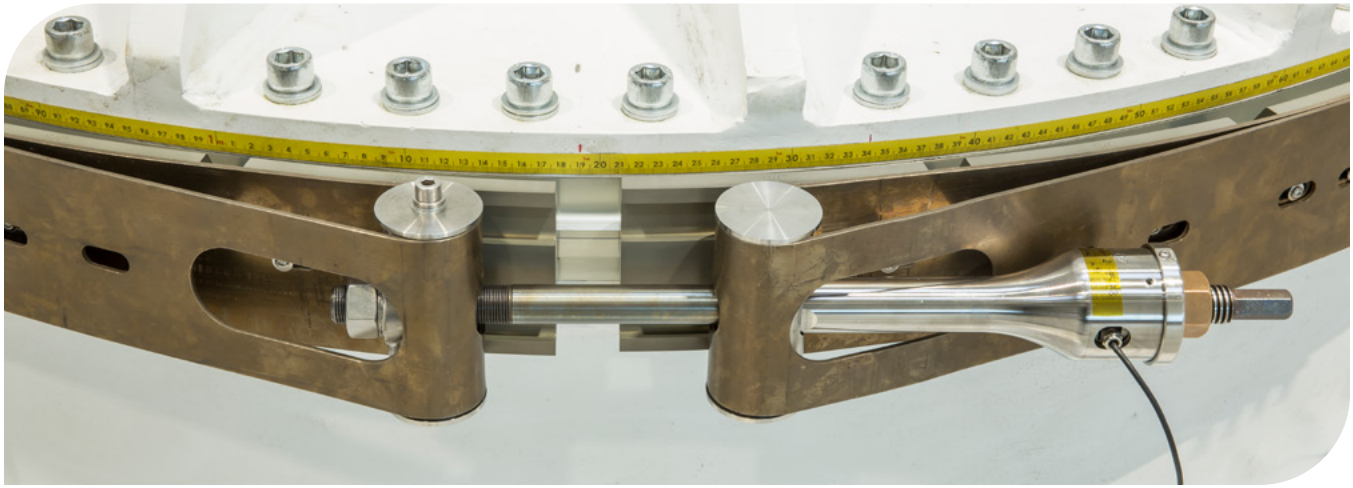
Project timeline



- Mechanical Ground Support Equipment (MGSE)
- Mechanisms

Product guide

Mechanisms



Along with the MGSE, mechanisms for space applications are a pillar of Sener in Poland's activity. The company's portfolio consists of hold-down and release mechanisms, deployment equipment: panels, booms and structures, and special applications, including mechanisms for positioning, clamping, and clamping and docking.

Each piece of equipment developed by Sener in Poland plays a vital role in the transportation of space vehicles into the launch vehicle loading spaces and in deploying space instruments such as antennas, solar panels and measuring instruments. First started in 2012, a path of development in space mechanisms has brought Sener in Poland to deliver for the most significant missions of ESA and NASA and commercial projects for leading world contractors. From the very first contracts, Sener in Poland worked on structures of high significance for the mission's success, such as a mechanism for unfolding the solar panel for PROBA-3 and an "umbilical" that will connect the Martian rover with the lander during transportation to Mars surface for ExoMars. Through the years of development, Sener in Poland has gained more and more trust as a developer and has undertaken more advanced projects. **In the latest, such as ARIEL acquired in 2022, Sener in Poland plays the role of a leader, developing not only a single mechanism but a whole system of ARIEL Medium Gain Anthena Assembly.**

Other missions, including Sener in Poland's projects, are ATHENA, SAOCOM, e.Deorbit, Comet Interceptor and LISA.

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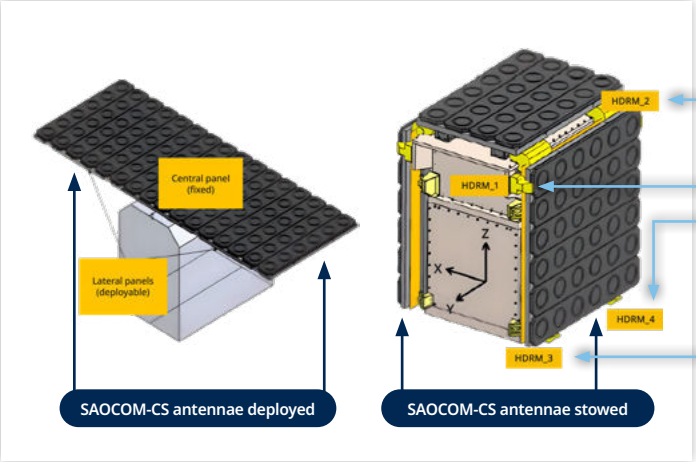
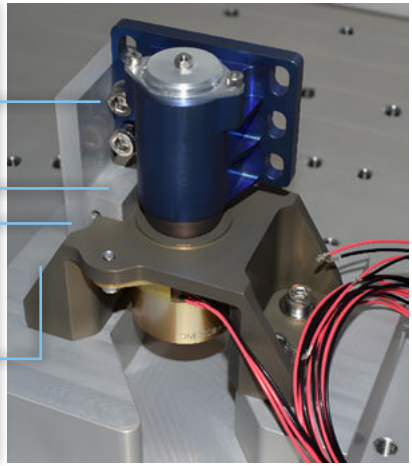
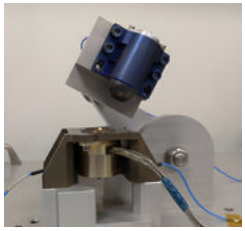
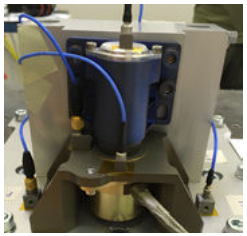
Mechanisms Portfolio

STATUS:
COMPLETED





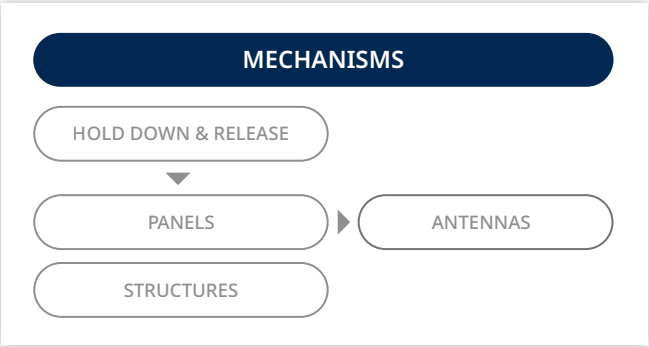




SAOCOM-CS L-band Antenna HDRM (QM)

8 HRMs (4 per each of two antenna panels) responsible for maintaining L-band antennae positions during launch and releasing it on orbit. Only 1x HRM was developed and subjected of the QM testing campaign.

- QM (delivered in 12/2019)



HRM Properties	
Hold-Down and Release Actuator (HDRA) used	NEA 9102G
Mass of the HRM	0.727 kg (single unit)
Nominal preload	10 kN
Actuation time	<50 ms (for 4 A actuation current)
Operational temperature	-40°C to +99°C
Non-operational temperature (before release)	-40°C to +99°C
Generated shock	<200 g below 1000 Hz, <700 g below 5500 Hz, <3000 g below 10000 Hz
Design loads (in the centre of spherical contact)	• 1300 N (axial, quasistatic), 3905 N (lateral, quasistatic) • 1100 N (lateral, thermoelastic), 18 Nm (bending, thermoelastic)
Eigen-frequency	>140 Hz
I/F	4x M6x20 (S/C) + 4x M6x20 (antenna)

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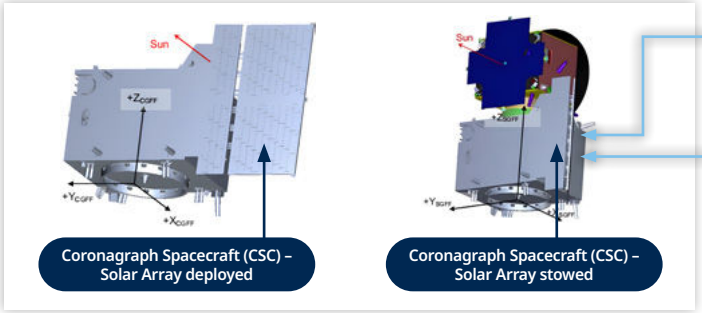
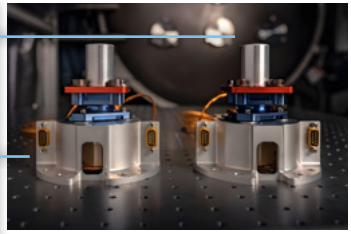
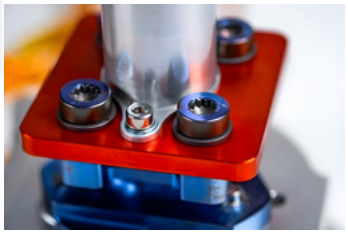
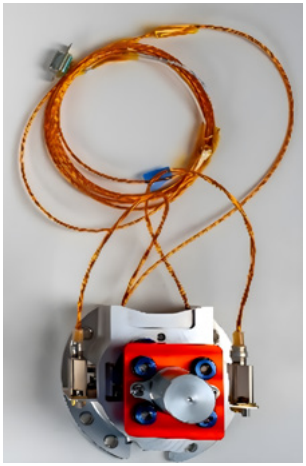
Mechanisms Portfolio

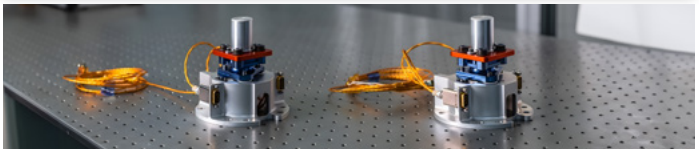
STATUS:
COMPLETED







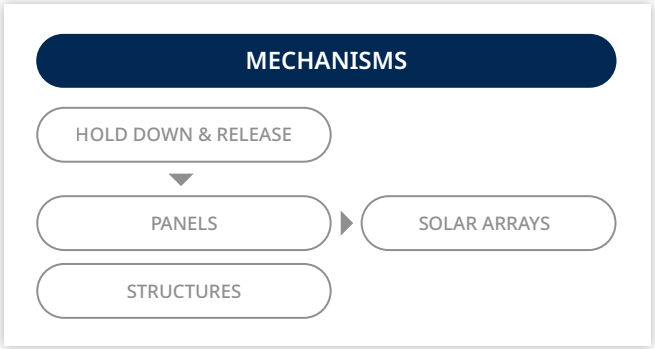




PROBA-3 SAHRMs (QM and FM)

2 SAHRMs are responsible for maintaining Solar Array's position during launch and releasing it on orbit. Properties of the panel: mass: 13 kg, inertia: 6 kg*m^2.

- QM (delivered in 03/2021)
- FM (delivered in 09/2022)



SAHRM Properties	
Hold-Down and Release Actuator (HDRA) used	NEA 9102G
Mass of the SAHRM	0.675 kg (single unit)
Nominal preload	12 kN
Actuation time	<50 ms (for 4 A actuation current)
Operational temperature	-75°C to +75°C
Non-operational temperature	-85°C to +85°C
Generated shock	<300 g below 1000 Hz
Design loads	• **Axial:** 1800 N / bending moment : 50 Nm • **Lateral:** 2800 N / bending moment: 100 Nm
Eigen-frequency	>140 Hz
I/F	6x M6 (S/C) + 4x M8 (SA)

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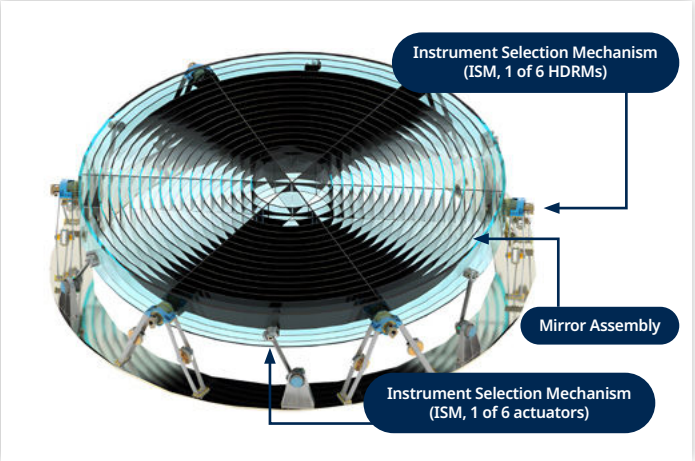
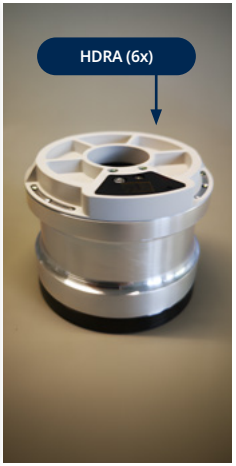
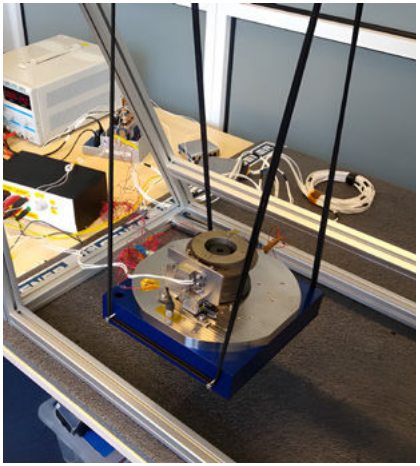
Mechanisms Portfolio

STATUS:

ONGOING (EM TRR)



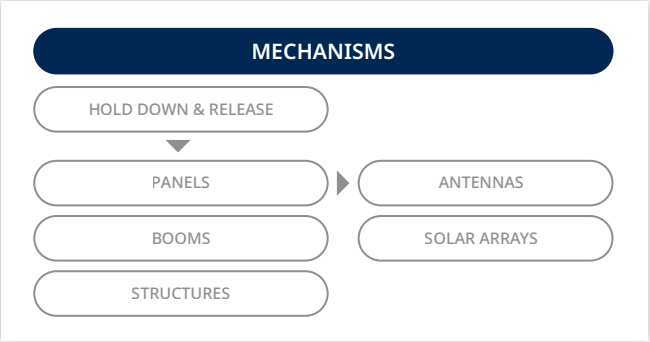




ATHENA HDRMA (EM)

6 Hold-Down and Release Mechanism Actuators (HDRMAs) mounted on a dedicated bipod structures with embedded visco-elastic dampers are used for keeping the ATHENA Mirror Assembly in the stowed position during launch. Project's scope is to develop a new release device able to provide 80kN of the nominal preload.

- EM (to be delivered in 09/2024)



HDRMA Properties	
Hold-Down and Release Actuator (HDRA) used	–
Mass of the HDRMA	<1.5 kg (single unit)
Nominal preload	80 kN
Actuation time	<5 s
Operational temperature	-80°C to +100°C
Non-operational temperature	-130°C to +130°C
Generated shock	<300 g below 1000 Hz
Design loads	187 kN
Eigen-frequency	>140 Hz
I/F	3x M4 on ø (S/C) + 1x M18x2.5 (preloaded structure)

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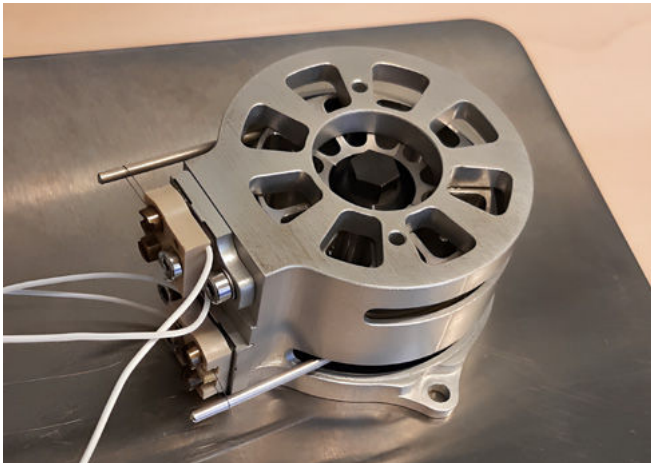
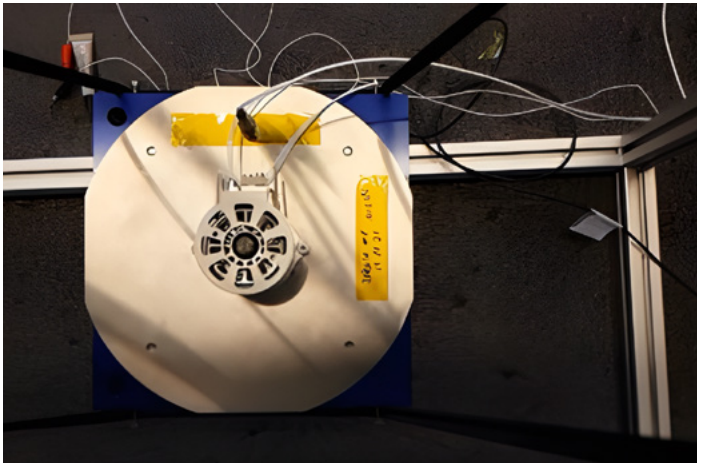
Mechanisms Portfolio

STATUS:
ONGOING (CDR)

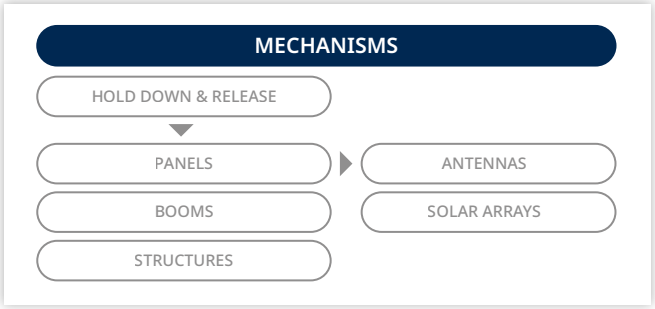




HDRM Roadmap (EM and QM)

In this application Hold-Down and Release Mechanism Actuator (HDRMA) is being developed. The application is not defined and the aim of the project is to introduce the qualified solution which can be used either in SENER's projects or offered on commercial basis to other companies. Project's scope is to develop a new release device able to provide 10kN of the nominal preload.

- EM (tested in 12/2021)
- QM (to be delivered in Q4/2024)



HDRM Properties	
Hold-Down and Release Actuator (HDRA) used	–
Mass of the HDRM	260 g (single unit)
Nominal preload	10 kN
Actuation time	<5 s
Actuation current	4 A
Operational temperature	-80°C to +100°C
Non-operational temperature	-135°C to +135°C
Generated shock	• <25 g below 1000 Hz, • <100 g below 10000 Hz
Design loads	15 kN
Eigen-frequency	>140 Hz
I/F	2x M4 (S/C) + 1x M6 (preloaded structure)

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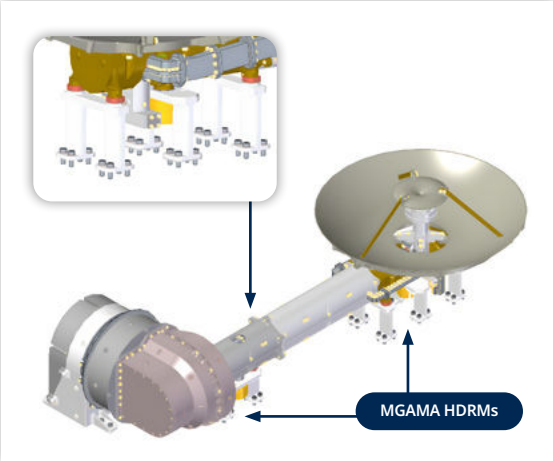
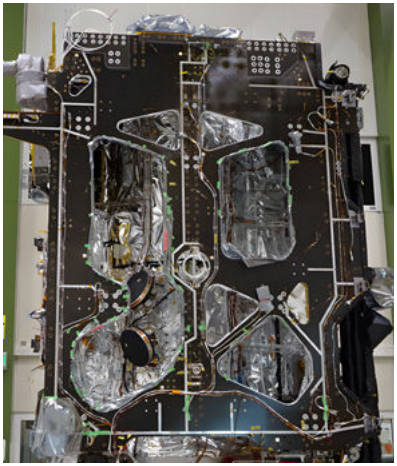
Mechanisms Portfolio

STATUS:
COMPLETED

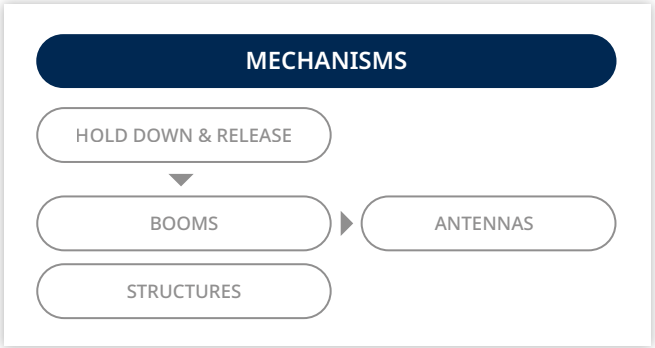




JUICE BOOM MGAMA HDRM

In this application two different HDRMs are used for keeping in stowed position and releasing the MGAMA (Medium Gain Antenna Main Assembly) on the orbit.

- PFM (delivered in 06/2022)



MGAMA HDRM Properties	
Hold-Down and Release Actuator (HDRA) used	NEA 9103
Mass of the HDRM	2.2 kg (all HDRMs)
Nominal preload	44 kN
Actuation time	<50 ms
Operational temperature	-80°C to +150°C
Non-operational temperature	-100°C to +150°C
Generated shock	<300 g SRS below 2000 Hz
Design loads	• **QS/Sine** 30 g 5-50 g 15 g 50-100 g • **Acoustic Pressure** 142.5 dB
Eigen-frequency	• **60 Hz** (stowed) • **5.57 Hz** (deployed)
I/F	M6 to the spacecraft panel

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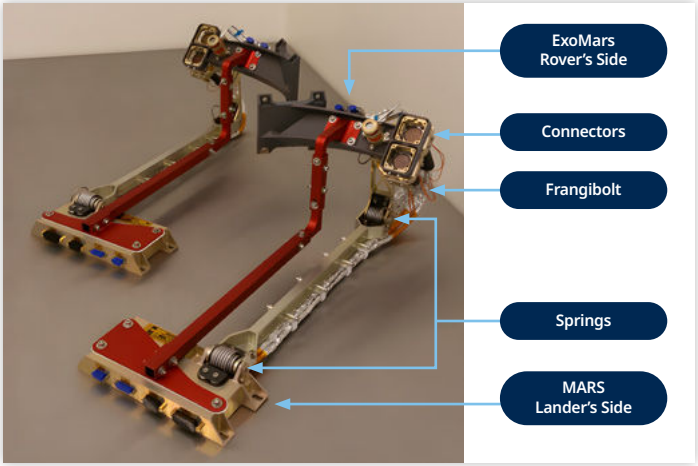
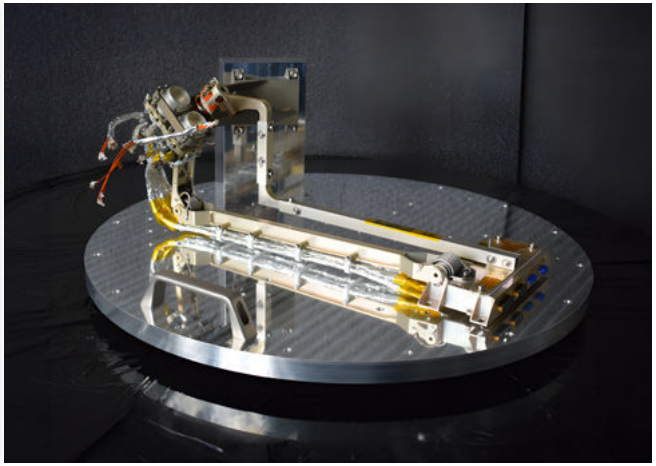
Mechanisms Portfolio

STATUS:
COMPLETED

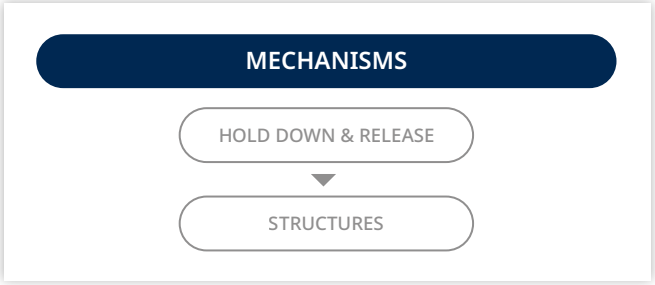




EXOMARS UMBILICAL RELEASE MECHANISM

2 URMs are responsible for providing electrical connection and data transfer to the Rover during the flight time as well as for releasing the Rover's connection from the egress platform after successful landing on the surface of Mars.

- EM (delivered in 05/2017)
- QM (delivered in 03/2019)
- FM (delivered in 05/2019)



SAHRM Properties	
Hold-Down and Release Actuator (HDRA) used	Frangibolt FC-3
Mass of the HDRM	1.2 kg (single URM device)
Nominal preload	3.5 kN
Actuation time	>150 sec (in -80°C)
Operational temperature	-80°C to +80°C
Non-operational temperature	-135°C to +80°C
Generated shock	~1000 g below 1000 Hz
Cleanliness level during delivery	Sterile
Eigen-frequency	~100 Hz
I/F	4x M6 (Rover) + 4x M5 (Lander)

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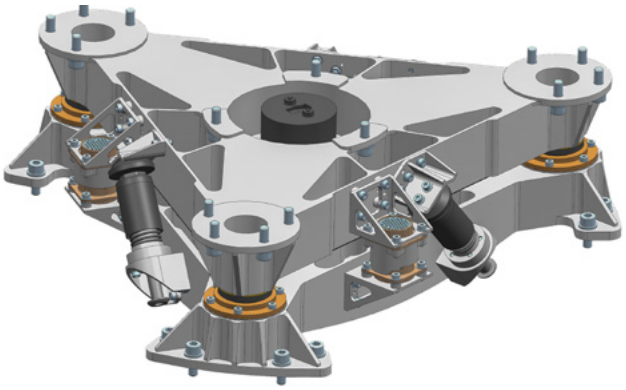
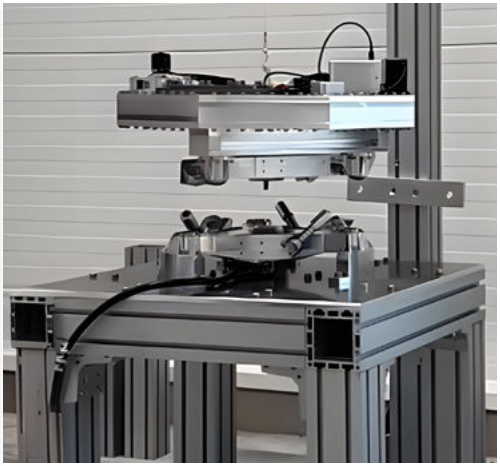
Mechanisms Portfolio

STATUS:

ONGOING (CDR)



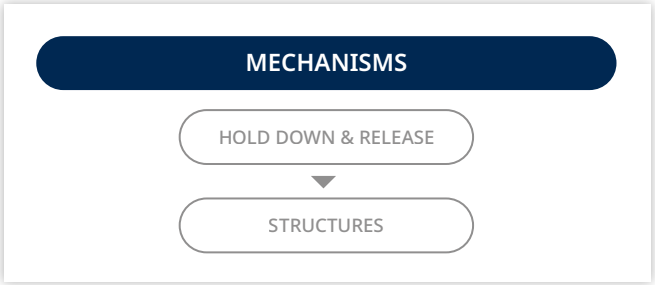


COMET INTERCEPTOR SEPARATION MECHANISM

COMET Interceptor Separation Mechanism will serve a combined function between the main Spacecraft and Probe B-2: on one hand it provides a rigid, separable structural connection for the Probe and on the other hand – it will provide initial linear and angular velocity to the Probe after separation.

- TRL 6 achieved 06/2023 (Phase B)
- QM (to be delivered 09/2024)
- FM (to be delivered 03/2025)

Separation Mechanism Properties	
Hold-Down and Release Actuator (HDRA) used	NEA 9103
Mass	4.5 kg
Nominal preload	25 kN
Operational temperature	-85°C / +95°C
Generated linear velocity	0.3 m/s
Generated angular velocity	14 RPM
Eigen-frequency	>125 Hz
I/F	12x M6 (S/C) + 15x M6 (Probe B-2)



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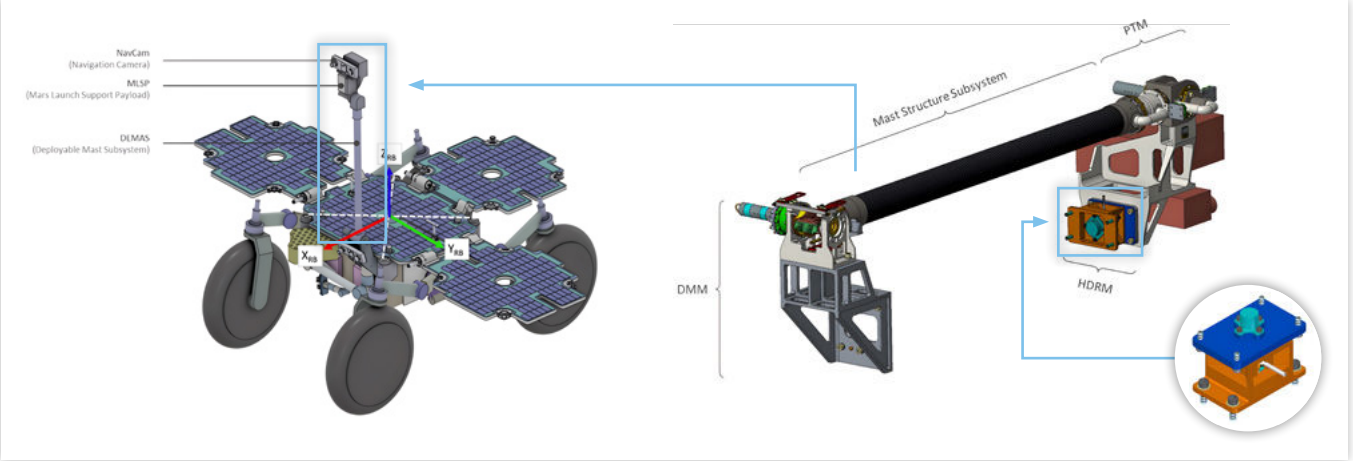
Mechanisms Portfolio

STATUS:

ON HOLD (PDR COMPLETED)



SFR DEMAS HDRM

HDRM is responsible for holding during flight time and releasing the DEMAS assembly (Deployment of camera MASt) when Sample Fetch Rover (SFR) lands on the surface of Mars.

MECHANISMS

HOLD DOWN & RELEASE

STRUCTURES

HDRM Properties	
Hold-Down and Release Actuator (HDRA) used	NEA 9103
Mass of the HDRM	<2 kg
Nominal preload	10-15 kN
Actuation time	<50 msec
Operational temperature	-80°C to +60°C
Non-operational temperature	-130°C to +60°C
Generated shock	• <20 g below 100 Hz • <1050 g below 10000 Hz
Design loads	• **Axial force:** 2.19 [kN] (TBC) • **Shear force:** 4.24 [kN] (TBC) • **Torsion Moment:** 45.21 [Nm] (TBC) • **Bending Moment:** 554.52 [Nm] (TBC)
Cleanliness level during delivery	Sterile
I/F	4x M6 (S/C) + 4x M6 (Camera Mast), TBC

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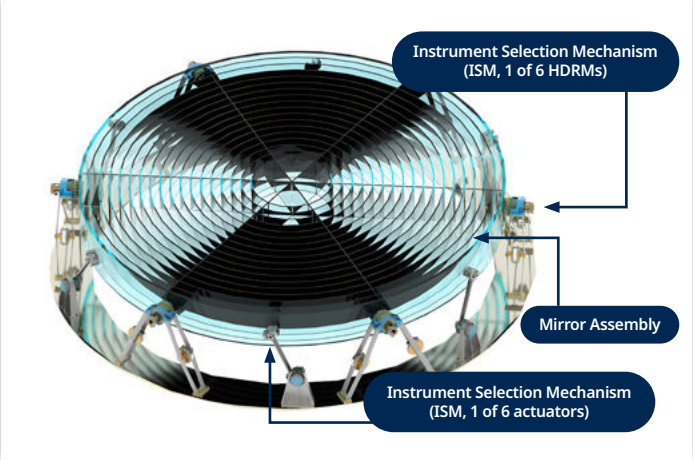
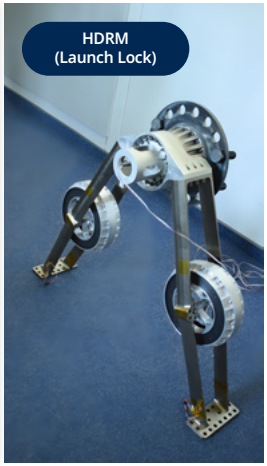
Mechanisms Portfolio

STATUS (ISM): COMPLETED

STATUS (HDRM): COMPLETED



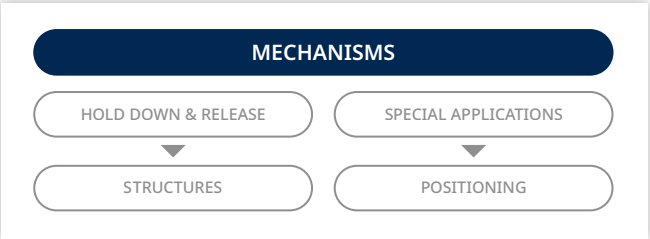


ATHENA INSTRUMENT SELECTION MECHANISM

In this application 6 rotary actuators that are used for pointing the ATHENA Mirror Assembly towards one of two instruments: spectrometer (X-IFU) and imager (WFI) which will share a single focal point provided by a single X-ray telescope. Pointing is realised by a system of linkages and universal joints (mainly flex pivots). In addition 6 launch locks (HDRMs) are used (based on visco-elastic dampers and NEA release devices).

- ISM EBM (delivered in 03/2021)
- HDRM (delivered in 03/2021, version with new dampers – finalised in 01/2023)

ISM Properties	
Mass of the ISM actuator	7.10 kg
Actuator used	DTA100
Input and peak power	26 V, ~6 W per actuator
Positioning accuracy (2sigma)	7.92 arc (rotations), 19µm (vertical translations)
Operational temperature	0°C to +40°C
Non-operational temperature	-15°C to 55°C
Design loads (ISM + HDRM)	• 10 g (lateral), • 15 g (axial, tension), • 10 g (axial, comp.)
Eigen-frequency	~125 Hz
I/F (ISM)	8 x M4 (mirror), 12 x M4 (S/C)
I/F (HDRM)	19 x M6 (mirror) 2x14 x M8 (S/C)



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Mechanisms Portfolio

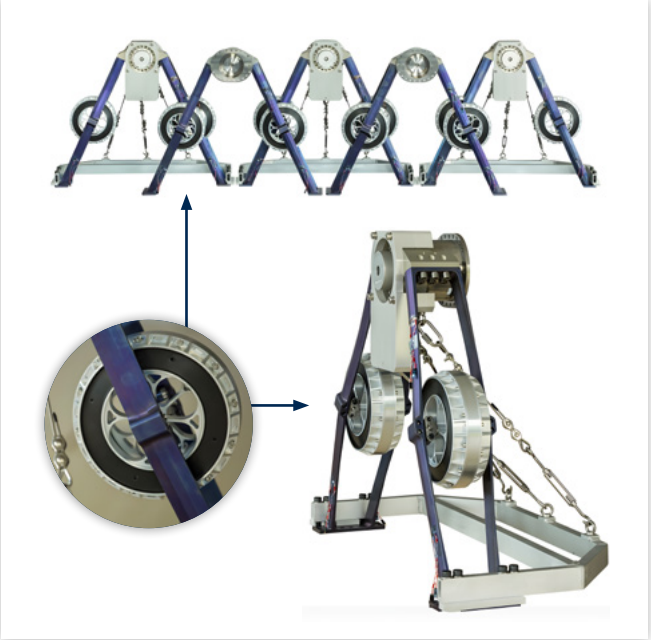
STATUS:

ONGOING (TRR)

ATHENA Mirror Assembly Module Demonstrator

For this application six Hold Down and Release Mechanisms (one with a release function and five dummies), previously developed in ATHENA ISM project, are manufactured and assembled for the usage in MAMD, which is a demonstrator of the ATHENA telescope's mirror. Each of them is equipped with two viscoelastic dampers which are protecting the mirrors from excessive loads. The HDRMs, as part of the MAMD, will be used to hold mirrors during environmental campaign (vibration tests). HDRMs were delivered in July and December 2023.

For this project, Sener is responsible also for a delivery of Vibration Test Adapter (VTA). This item was delivered in August 2023.



MECHANISMS

HOLD DOWN & RELEASE

STRUCTURES

HDRM Properties	
Mass of the HDRM	16 kg
Normal preload	70 kN
Actuactor used	NEA 9106
Operational temperature	0°C to +40°C
Non-operational temperature	-15°C to 55°C
Design loads (ISM + HDRM)	· **10 g** (lateral) · **15 g** (axial, tension) · **10 g** (axial, comp.)
Eigen-frequency	~125 Hz
I/F (HDRM)	19xM6 (Mirror) + 2x14xM8 (VTA)

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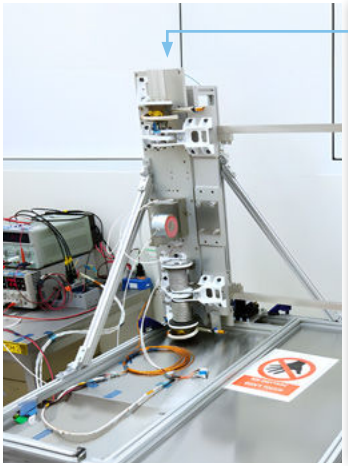
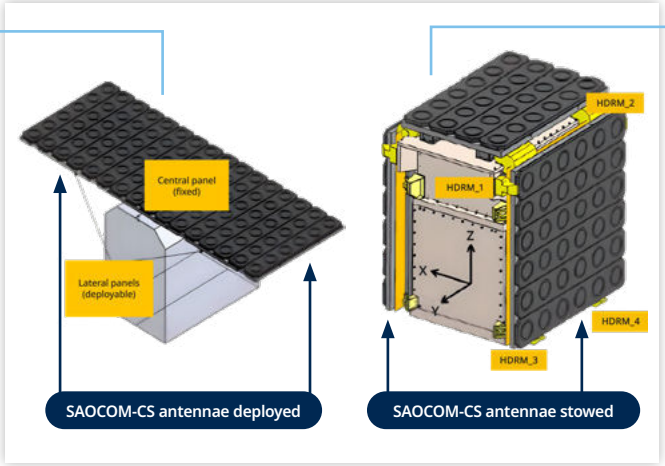
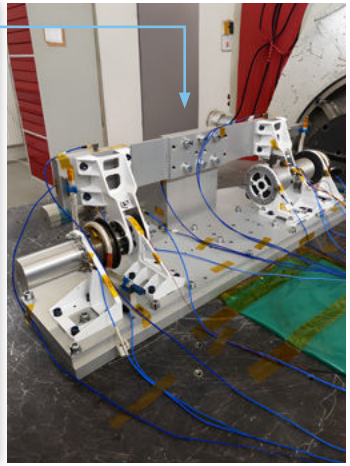
Mechanisms Portfolio

STATUS:
COMPLETED



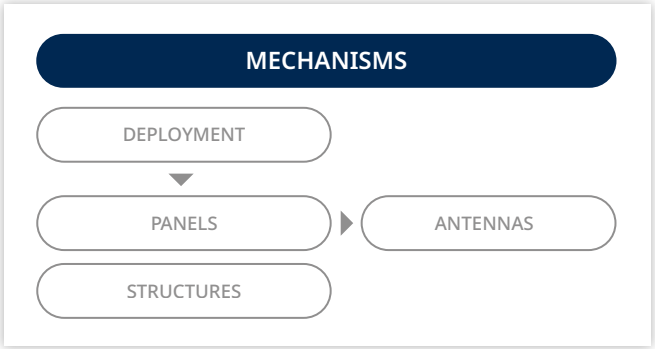




SAOCOM-CS L-band Antenna DEM (QM)

2 DEMs (1 per each antenna panels) are responsible for deploying L-band antenna and maintaining its position during the mission. Only 1x DEM was developed and subjected of the QM testing campaign.

- QM (delivered in 12/2019)



DEM Properties	
Mass of the antennae (qty=1)	28 kg
MoI of a single antenna (qty=1)	18 kgm^2
Mass of the mechanism (1x DEM)	3.825 kg
Deployment torque	• **17.8 Nm** (stowed) • **8.9 Nm** (deployed)
Deployment angle	90°
Deployment time	<60 s
Deployment accuracy	+/-0.1°
Damping	Viscous, piston type
Operational temperature	-28°C to +64°C
Non-operational temperature (before deployment)	-28°C to +64°C
Design loads	• 1450 N (axial – along deployment axis), • 1600 N-1950 N (lateral)
Eigen-frequency	>140 Hz
I/F (1x DEM)	18x M6x20 (S/C) + 8x M6x20 (antenna)

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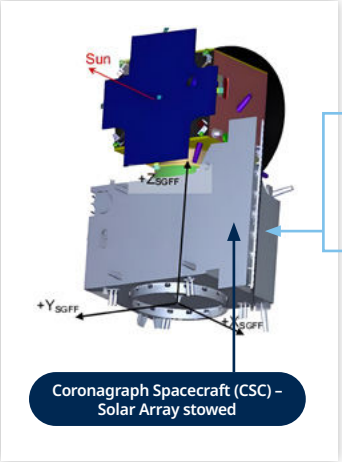
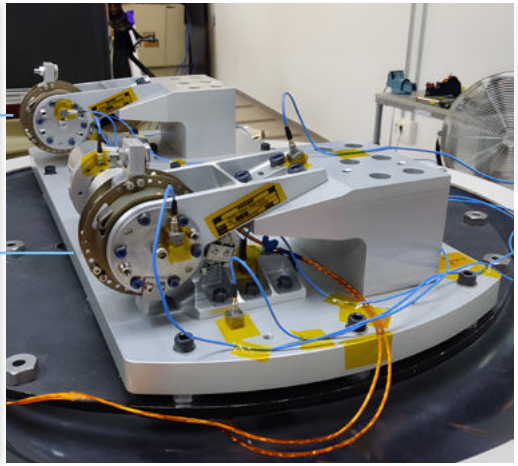
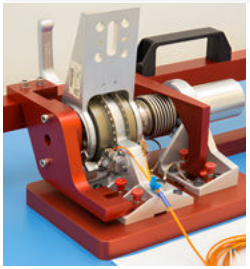
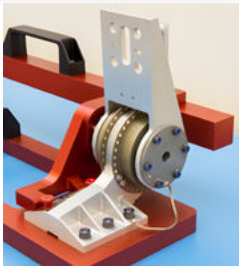
Mechanisms Portfolio

STATUS:
COMPLETED





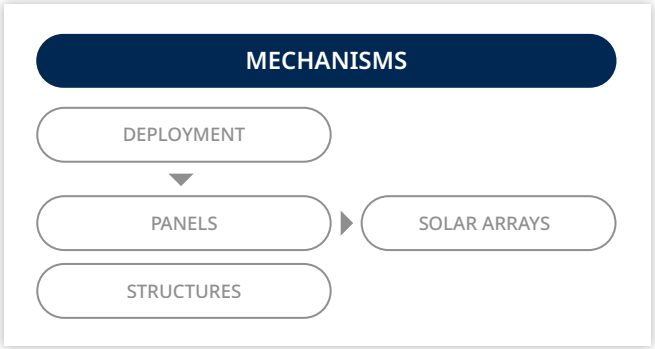




PROBA-3 Solar Array Deployment Mechanism (SADM)

One SADM (Solar Array Deployment Mechanism) is responsible for deploying solar array by 67°and maintaining this position for the rest of the mission.

- QM (delivered in 03/2021)
- FM (delivered in 05/2022)



SADM Properties	
Mass of the Solar Array (SA)	13 kg
MoI of the SA	5.8 kgm²
Mass of the mechanism	4.454 kg
Deployment torque	• **19.4 Nm** (stowed) • **8.7 Nm** (deployed)
Deployment angle	67°
Deployment time	<60 s
Deployment accuracy	+/-0.2°
Damping	Viscous, diaphragm type
Operational temperature	-25°C to +55°C
Non-operational temperature	-50°C to +85°C
Design loads	• **Out of plane:** 1500 N • **In plane:** 3200 N
Eigen-frequency	>140 Hz
I/F	16x M6 (S/C) + 8x M8 (SA)

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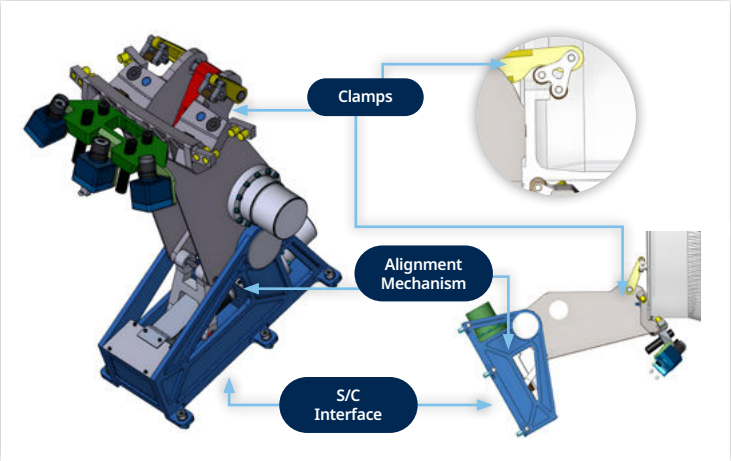
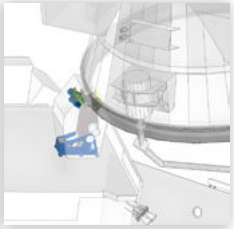
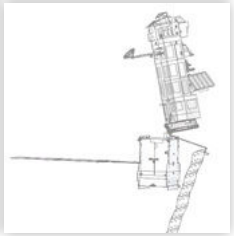
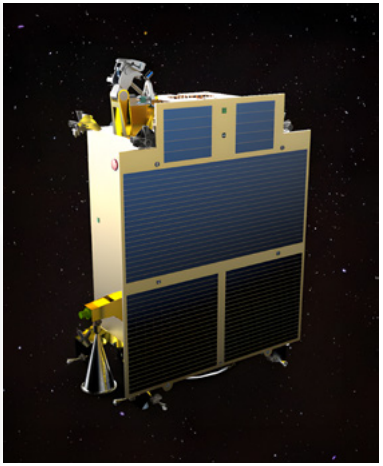
Mechanisms Portfolio

STATUS:
COMPLETED



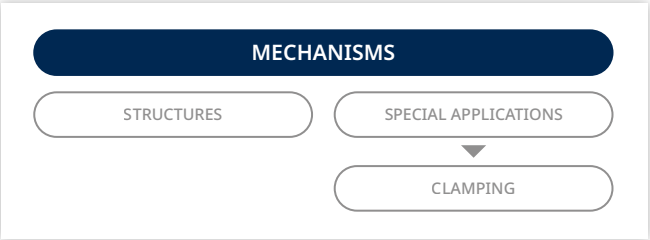






e.Deorbit CLAMPING MECHANISM (Phase B1/B2)

Clamping mechanism's role is to fix on the Envisat's Launch Adapter Ring (LAR, performed by the Fixing Mechanism) and to provide stiff structural connection between two satellites during de-orbit phase. Alignment mechanism is used to adjust thrust vector with target's CoG. Concept of the clamping mechanism was developed during Phase B1/B2 activities.



SADM Properties	
Mass of the mechanism	35 kg
Clamping torque	150 Nm
Clamping angle	90°
Clamping time	<25 s
Operational temperature	-90°C to +90°C
Non-operational temperature (before clamping)	-90°C to +90°C
Design loads	750 Nm, 1100 N
Stiffness	• **Lateral:** >1.3E+7, • **Rotary:** >1.6E+5
Eigen-frequency	66 Hz

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Mechanisms Portfolio

STATUS:
COMPLETED

Hard Capture System (HCS) for the IBDM (International Berthing and Docking Mechanism)

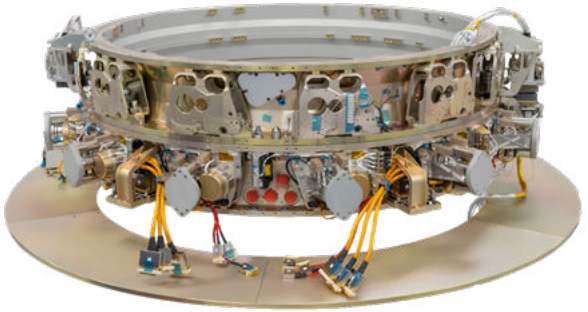
The purpose of the HCS, a system developed by Sener in Poland in collaboration with it's mother-company Sener Aeroespacial, is to provide a rigid connection between structures in order to create a sealed passage between two spacecraft. In addition, it can serve as a service connection and as a standard and emergency means of separating spacecraft. The main components of the Hard Capture System that were designed and manufactured in Poland are:

- Three Separators, which provide the energy needed to separate the vehicles during docking.
- Two Resource Transfer Umbilical devices to connect and disconnect electrical connections between the shuttle and the space station.
- A shield against micrometeoroids and space junk that could pose a threat to crew and mission safety.
- Two disconnection completion sensors to indicate that the spacecraft have been successfully separated.
- Three launch hook-up readiness sensors (RTH) to indicate that the two docking spacecraft are within hook-up range.

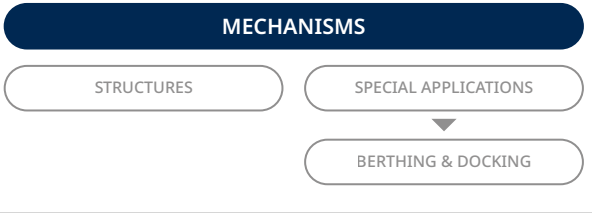
The IBDM mechanism was designed in accordance with the International Docking System Standard (IDSS) and is compatible with the docking adapter installed on the US portion of the International Space Station.

Polish mechanisms in the IBDM HCS system will be used in the docking systems of the I-HAB module of Gateway station.

- QM (delivered in 11/2021)



HCS Properties	
Mass	<200 kg
Diameter (passageway/outer)	800 mm / ~2000 mm
First natural frequency	~120 Hz
Operating temperatures	-40°C / +50°C



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Mechanisms Portfolio

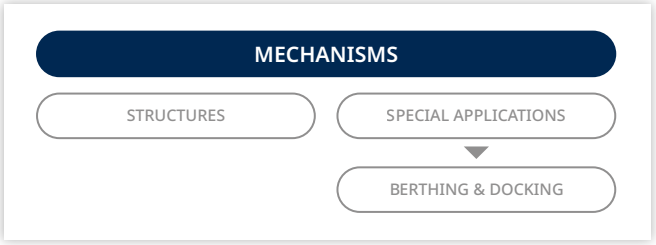
STATUS:
COMPLETED

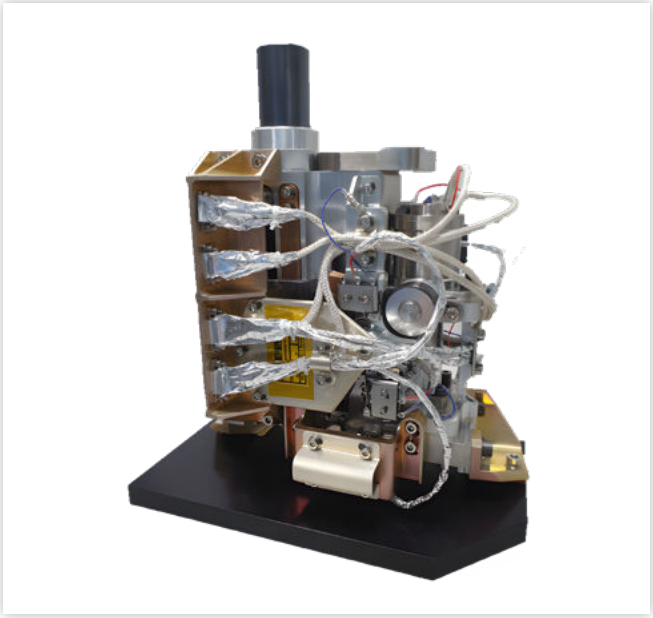
IBDM HCS – SEPARATION SYSTEM

The three separators generate axial thrust force to push off the hoisting vehicle from the ISS after the hooks opening maneuver. The torque is generated by a motorgear. The function of the separation system is double:

1. During undocking, they provide force required to break seal stiction and the energy needed to departure. In addition, separators provide back-up force to eventually demate umbilical connectors in case they failed to be demated by themselves.
2. During docking, if the mission operative need it for the soft docking phase, and with the vehicles unmated, the Separators will be extended unloaded before the SCS performs its soft capture function. The aim of extending the Separators at this phase is to provide a bumper feature which limits oscillations of IBDM.

- QM (delivered in 11/2021)





Separator Properties (per mechanism)	
Mass of the mechanism	3800 g
Max generated force	900 N
Charging time	180 sec
First natural frequency	>700 Hz
Energy delivered during undocking	~15 N*m
Current consumption at 28VDC	~110 mA
Operational temperature	-18°C to +68°C
Non-operational temperature	-26°C to +91°C

Mechanisms Portfolio

STATUS:
COMPLETED

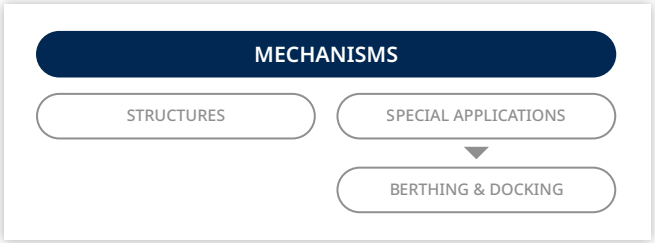
IBDM HCS – RTU (RESOURCE TRANSFER UMBILICAL)

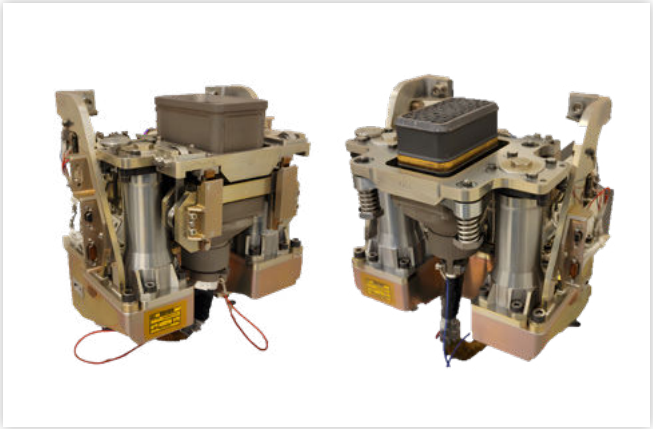
The umbilical connectors transfer power, data, and a ground safety wire between two docked vehicles. They are recessed below the docking mating plane during docking, and then are driven to mate after docking hard capture occurs by the Umbilical mechanisms. For undocking the connectors are driven to the unmated state prior to unlatching the hooks.

RTU mechanism can act as passive or active side of connection. In active side, connector is driven by mechanism driving unit between bottom (retracted) and upper (extended connection).

Each side of connector can accommodate misalignments in three of six possible DOF: Plug side accommodates planar translations and rotation around connector's vertical axis, Receptacle rotations in two other perpendicular axes and translation in vertical direction.

- QM (delivered in 11/2021)





RTU Properties	
Mass of the mechanism	~5.1 kg
Movement range for mating	~52 mm
Mating time	~160 sec
First natural frequency	>85 Hz
Current consumption at 28VDC	~120 mA
Operational temperature	-18°C to +74°C
Non-operational temperature	-26°C to +91°C
I/F	6x M6

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Mechanisms Portfolio

STATUS:
COMPLETED

IBDM HCS – Proximity Sensors

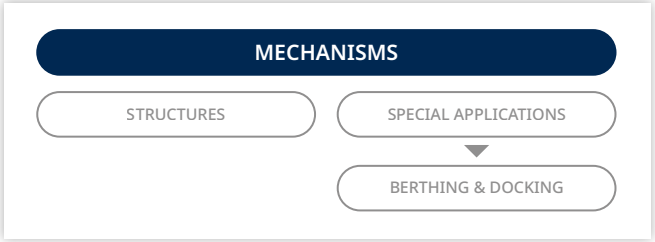
In IBDM HCS there are two types of proximity sensors – Ready To Hook (RTH) and Undocking Complete Sensor (UCS).

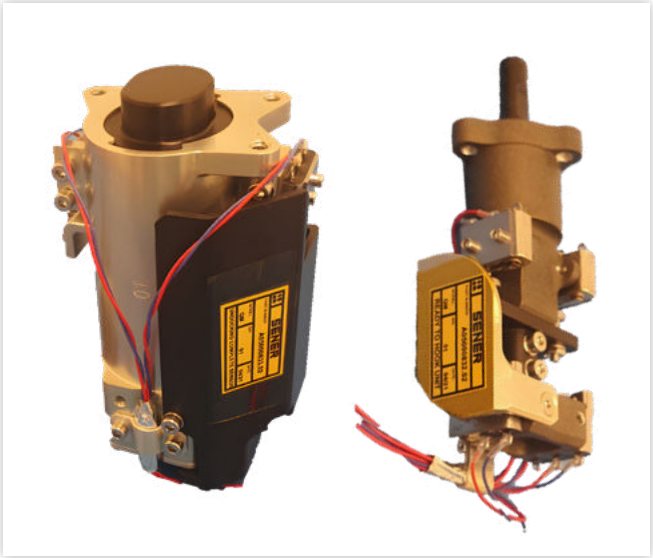
RTH provides an electric signal when the mating interfaces are in the range of active hooks engagement. After indicating proper distance, active hooks are commanded to engage with passive side. Moreover, it also provides an information when the interfaces are properly mated by hooks.

UCS confirms a proper undocking stage – more exactly the moment when guiding pins exit their female sockets.

HCS is equipped with three RTH sensors and two UCS sensors.

- QM (delivered in 11/2021)

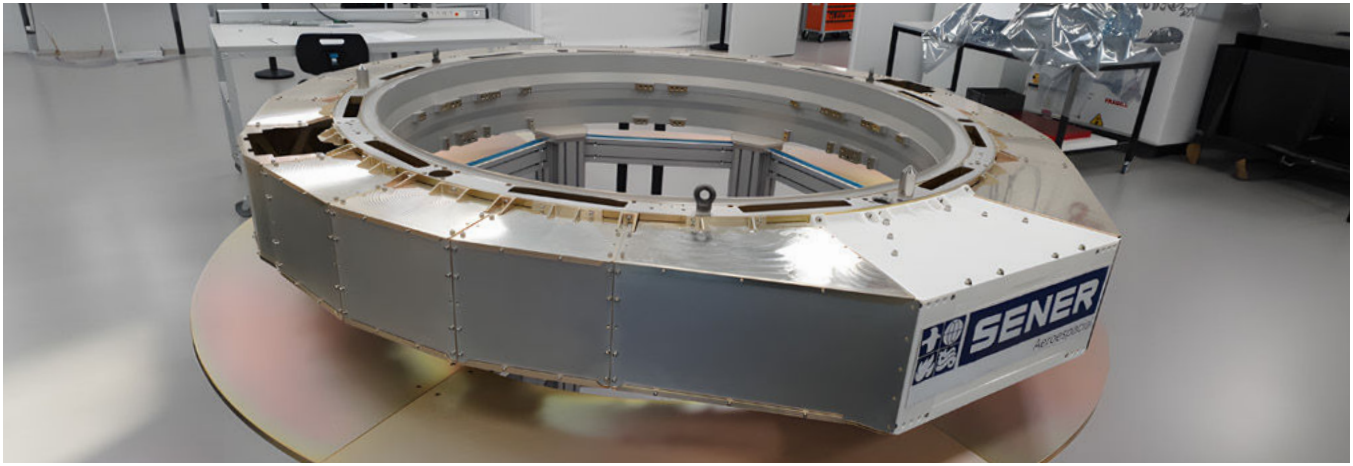




Sensors Properties	
RTH Mass	~140 grams
UCS Mass	~360 grams
Operational temperature	-18°C to +68°C
Non-operational temperature	-26°C to +91°C
I/F	3x M4

Mechanisms Portfolio

STATUS:
COMPLETED

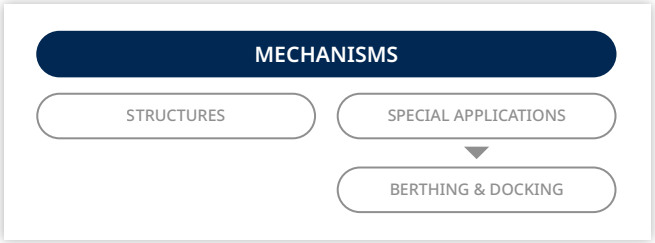


IBDM – MMOD (MICRO-METEOROIDS ORBITAL DEBRIS SHIELD)

The MMOD is designed to provide cover from the objects which may cause damage to the equipment or be hazardous to crew and mission safety during in-orbit operations. The shielding concept is based on a simple Whipple shield. Whipple shield for spacecraft consisting of a thin "sacrificial" bumper followed at a distance by a rear wall.

- QM (delivered in 11/2021)

MMOD Properties	
Mass	14.5 kg
Eigen-frequency	125 Hz
Probability of No Penetration (PNP)	≥ (0.99998) ^ (Area* Time)



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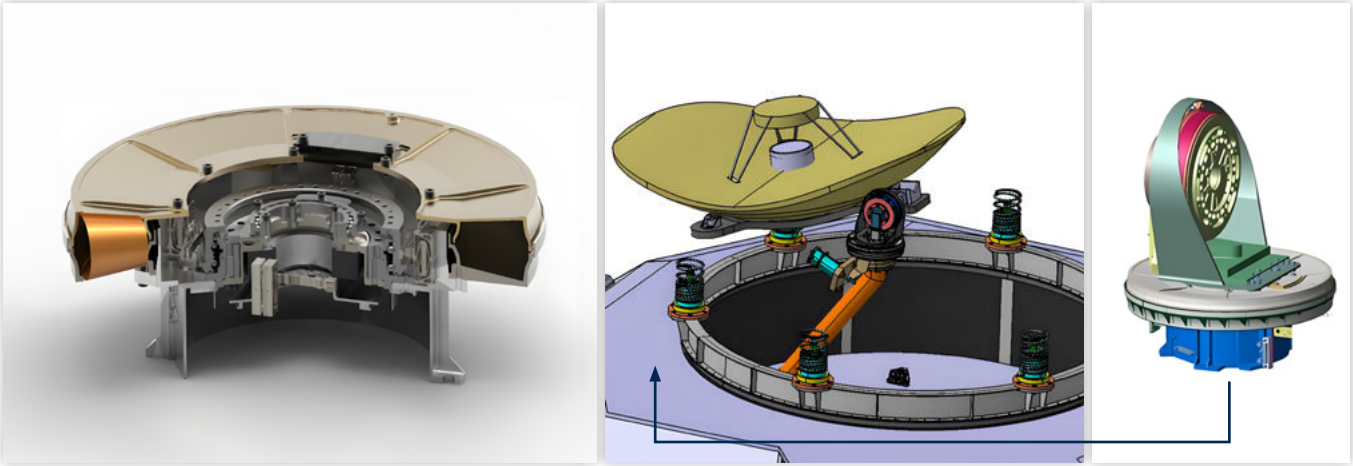
Mechanisms Portfolio

STATUS:

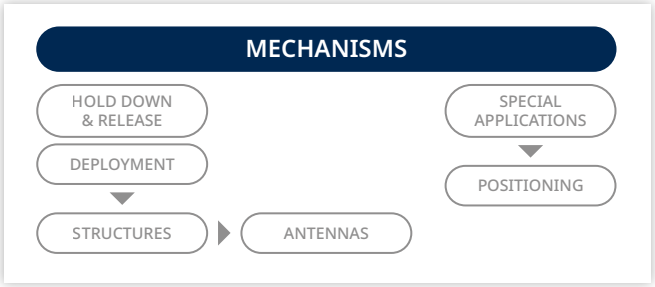
ONGOING (CR – CONCEPT REVIEW)



LISA Antenna Pointing Mechanism (Phase A)

The objective is to develop a low exported torque antenna pointing mechanism for LISA.

The mechanism's main components will be ball bearings, an inch-worm piezo electric actuator for antenna rotation and a feedback system that can be either a potentiometer or an electrical encoder. The current phase of the project focuses on development of Breadboard Model of single actuator.



LISA APM Properties	
Pointing Schemes	• Continuous pointing scheme • Intermittent repointing scheme
Movement range	• **Azimuth:** 0 to 360°, • **Elevation:** -30° to 90°
Pointing error	+/- 0.05°
Minimum steering velocity	• **Azimuth:** 1.1°/day, • **Elevation:** 0.1°/day
Maximal steering velocity	10°/min

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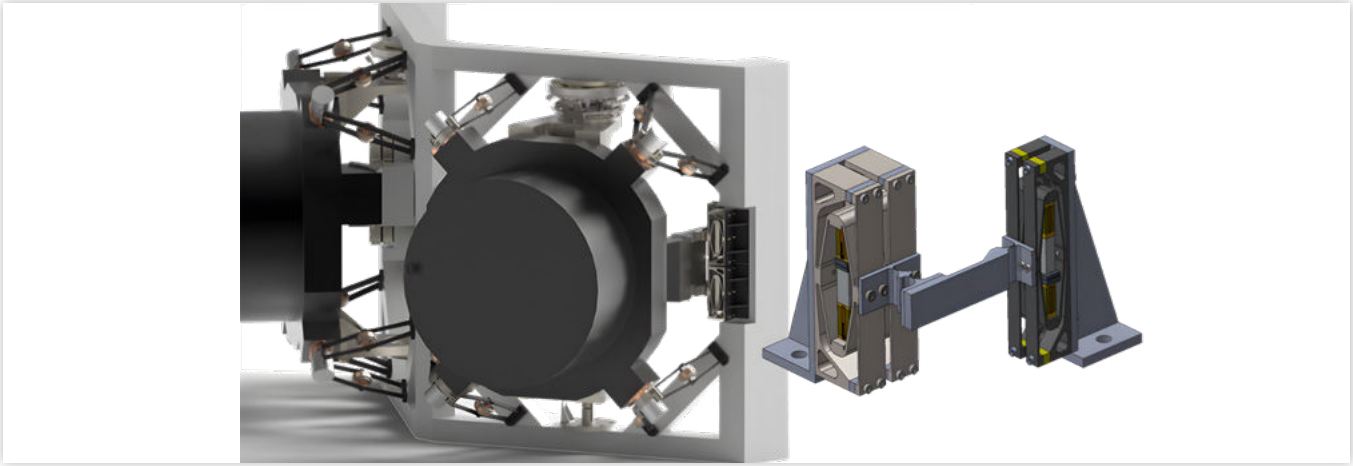
Mechanisms Portfolio

STATUS:

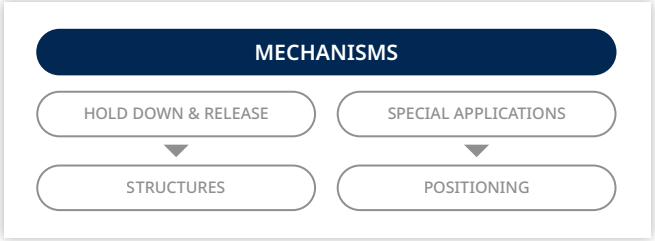
ONGOING (RR)



LISA Optical Assembly Tracking Mechanism (Phase A)

The objective is to develop a 1 DOF nrad resolution and stable mechanism for LISA observatory Optical Telescope, consisting of flexural hinges, piezoelectric actuation system, hold-down and release mechanisms, angular encoder, and flight electronics. The current phase of the project focuses on development of Breadboard Model of flexural hinges and piezoelectric actuation system.

LISA APM Properties	
Mechanism's mass	6 kg
Telescope Rotation range	58° and 62°
Motion resolution	1 nrad
Accuracy	0.5 µrad
Operational temperature	0°C to +30°C
Non-operational temperature	-80°C to +60°C



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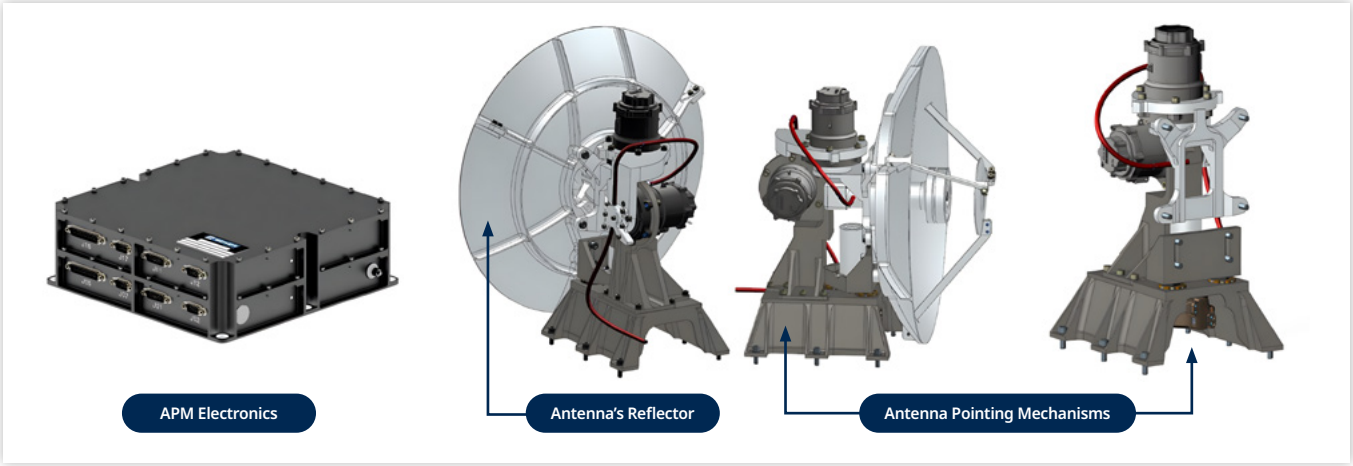
Mechanisms Portfolio

STATUS:
ONGOING (EQSR)

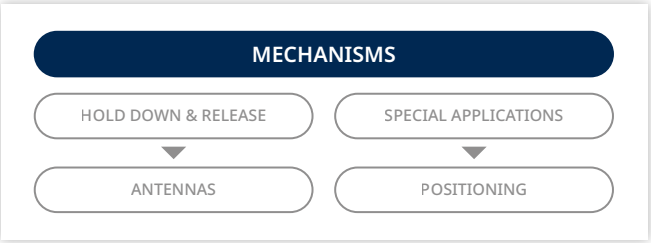


ARIEL Medium Gain Antenna

ARIEL MGAMA is the first project in which Sener in Poland acts as responsible for a delivery of flight model of complete antenna's system. MGAMA is a reflector's type antenna, working in X-band range. It is equipped with Antenna Pointing Mechanism, which allow to rotate a dish around two directions, Hold-Down and Release Mechanism to hold it during lunch and release it on orbit and APM Electronics, which provides control.

Sener in Poland team is responsible for management, system engineering, quality, mechanisms design and MGAMA assembly and test activities.

ARIEL MGAMA Properties	
Mass	13 kg including electronics
Rotation Range	Two axes +/- 68°
Motion Resolution	0.01°
Accuracy	0.05°
Operation Temp. Range	-40°C to 100°C
Non-operational Temp. Range	-70°C to 120°C



https://www.linkedin.com/company/sener-aerospace/

https://www.youtube.com/user/senerengineering

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