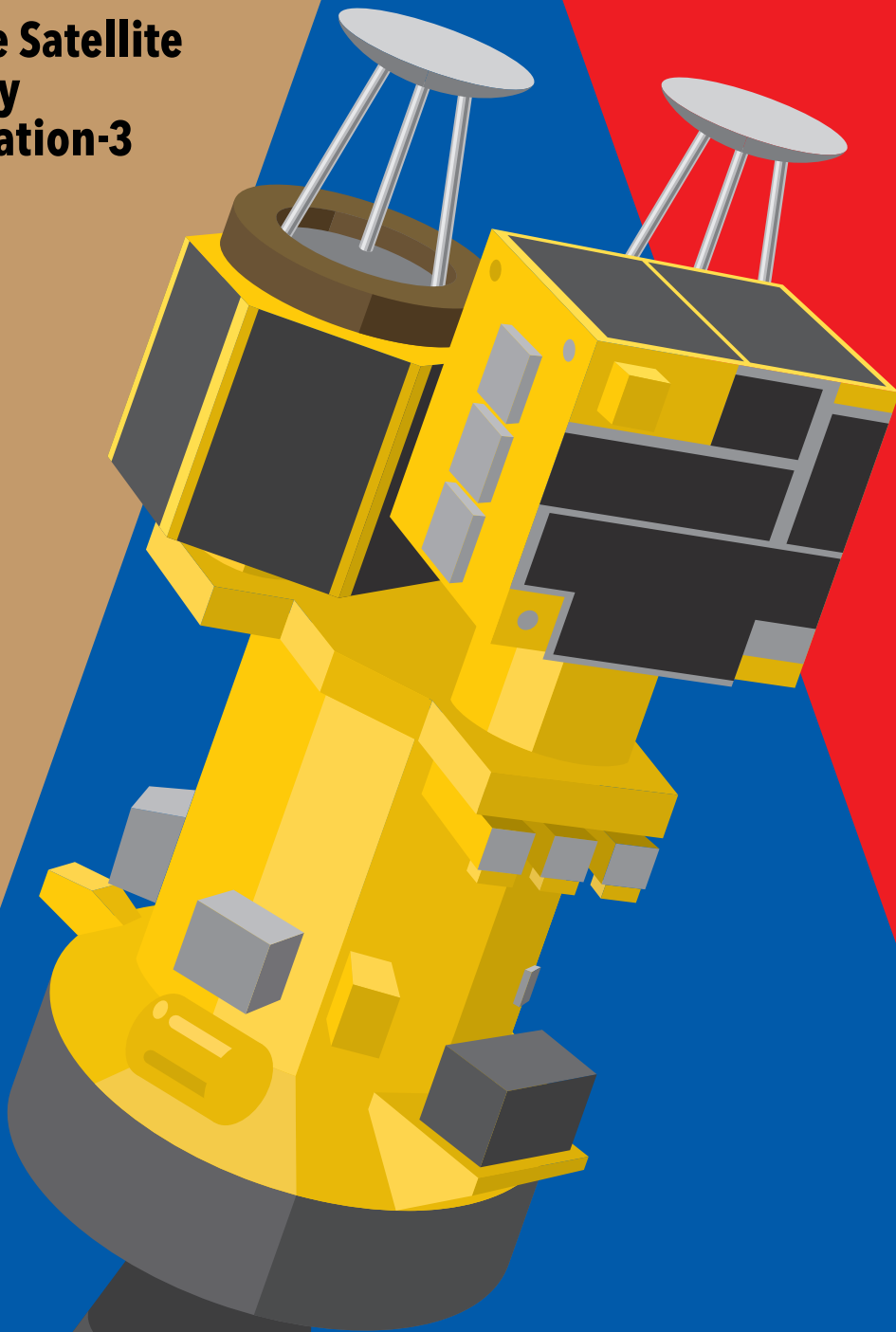




PRESS KIT

革新的衛星
技術実証3号機

Innovative Satellite
Technology
Demonstration-3



INNOVATIVE SATELLITES

RAISE-3 (LEOMI, SDRX, GEMINI, KIR, TMU-PPT, D-SAIL, HELIOS), KOYOH, PETREL, STARS-X,
MAGNARO, MITSUBA, KOSEN-2, WASEDA-SAT-ZERO, FSI-SAT

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Innovative Satellite Technology Demonstration Program



Purpose

This program is part of the basic plan for space policy to realize a comprehensive industrial base in outer space to provide opportunities to demonstrate equipment, parts, microsatellites and CubeSats developed by private companies, universities, research institutions, etc.

JAXA is aiming to realize the following through this program.

- [1] We will look forward to the future and demonstrate technologies and ideas that will lead to the creation of new uses and industrial competitive systems / subsystems while responding to the challenges of the country and industry.
- [2] Although the risk is high, we will preferentially take “innovative” technologies that are expected to achieve high results in the development of Japanese space technology and securing the international competitiveness of the space industry and demonstrate.



Outline of the Public Recruitment System

JAXA is offering proposals for “Innovative Satellite Technology Demonstration Program” throughout the year. For details of application conditions etc, please see the following website.



Innovative Satellite Technology Demonstration Program (Japanese only)
<https://www.kenkai.jaxa.jp/kakushin/index.html>

Previous Projects

Innovative Satellite Technology Demonstration-1



Innovative Satellite Technology Demonstration-1 (Japanese only)

Innovative Satellite Technology Demonstration-2

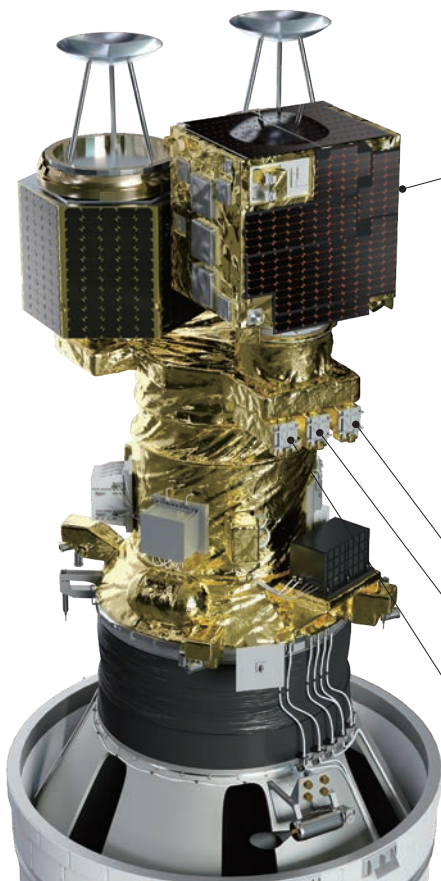


Innovative Satellite Technology Demonstration-2 (Japanese only)

Innovative Satellite Technology Demonstration-3

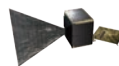
Outline

The "Innovative Satellite Technology Demonstration-3" is the third demonstration opportunity of the "Innovative Satellite Technology Demonstration Program" to publicly invite universities, research institutions, private companies, etc., equipped with 15 selected themes. It consists of 9 satellites, "RApid Innovative payload demonstration SatellitE-3" developed by JAXA entrusted to Mitsubishi Heavy Industries, Ltd. (with 7 demonstration themes) and 8 microsattelites / CubeSats.



RApid Innovative payload demonstration SatellitE-3

RAISE-3 To be launched by Epsilon Launch Vehicle No.6



- 01 Low Earth Orbit satellite MIMO for 920MHz band IoT platform "LEOMI"
- 02 Software Defined Receiver "SDRX"
- 03 cots GPU based Edge-computing for mission systems utilizing model based systems engineering "GEMINI"
- 04 Kakushin-3 water Ion-thruster and Resistojet-thruster "KIR"
- 05 Tokyo Metropolitan University Pulsed-Plasma Thruster "TMU-PPT"
- 06 Membrane deployment deorbit mechanism "D-SAIL"
- 07 Harvesting Energy with Lightweight Integrated Origami Structure "HELIOS"

CubeSat To be launched by Epsilon Launch Vehicle No.6

02 MITSUBA



04 WASEDA-SAT-ZERO



01 MAGnetically separating NAno-satellite with Rotation for Orbit control "MAGNARO"



03 KOSEN-2



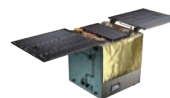
05 FSI-SAT



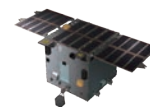
Multiple Satellite Mounting Structure

Microsatellite Launch vehicle is under adjusting

- 01 KOYOH
- 02 Platform for Extra and Terrestrial Remote Examination with LCTF "PETREL"
- 03 Space Tethered Autonomous Robotic Satellite "STARS-X"



KOYOH



PETREL



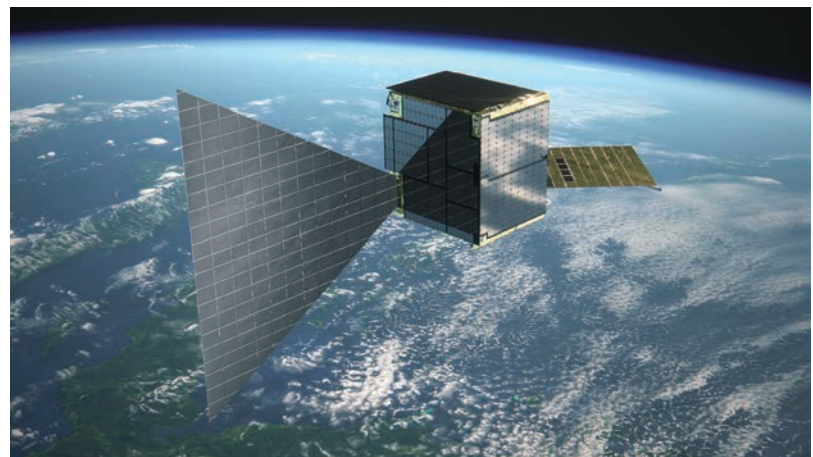
STARS-X

1

RApid Innovative payload demonstration Satellite-3 (RAISE-3)

Mission and Features of

“RApid Innovative payload demonstration Satellite-3 (RAISE-3)”



Mission

RAISE-3 (RApid Innovative payload demonstration Satellite-3) is a satellite for seven on-orbit demonstration themes selected in the "Innovative Satellite Technology Demonstration Program". RAISE-3 will be operated at the request of the proposers of each theme and provide them with opportunity to demonstrate their essential parts and new innovative technologies on orbit.

Features

1. Low-cost and Short-term development

“Innovative Satellite Technology Demonstration Program” provides demonstration opportunities about once every two years, and the RAISE satellite is required to be developed in less than two years and at a low cost. On the other hand, the RAISE satellite needs to be reliable enough to acquire demonstration data from each device. Achieving both short-term, low-cost development and ensuring reliability are important development issues for the RAISE satellite.

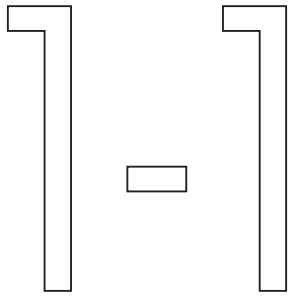
To challenge this development,

- RAISE-3 consists of almost flight-proven components and little modified components from flight-proven components to shorten the design and verification period, reduce development costs, and development risks.
- On-Board Computer (OBC) of RAISE-3, which is the key to satellite system control, has many small satellite heritages. This OBC is equipped with a highly radiation-resistant CPU, ensuring high reliability.

2. Development by MBSE

In the development of RAISE-3, MBSE (Model Based Systems Engineering) is attempted to improve the efficiency of satellite development through digital development.

MBSE is partially applied to environment construction, system modeling, design, traceability and review.



Satellite Systems

Integrated Satellite Control System

The Integrated Satellite Control (ICS) subsystem has the core functions of the satellite system such as data handling of telemetry commands, satellite management, and mission data processing. These ICS functions are provided by the On-Board Computer (OBC). RAISE-3 OBC is based on the flight-proven OBC and ensures reliability with main/slave-redundant configuration.

Communication System

The communication subsystem consists of S-band and X-band. S-band is telemetry command lines for satellite control, and X-band is a telemetry downlink line that transmits experiment data of each theme, etc. from the satellite to the ground system. The S-band communication components are flight-proven with a redundant configuration to improve reliability. The X-band has sufficient downlink data rate to transmit the experiment data of all themes stored in the satellite system to the ground system.

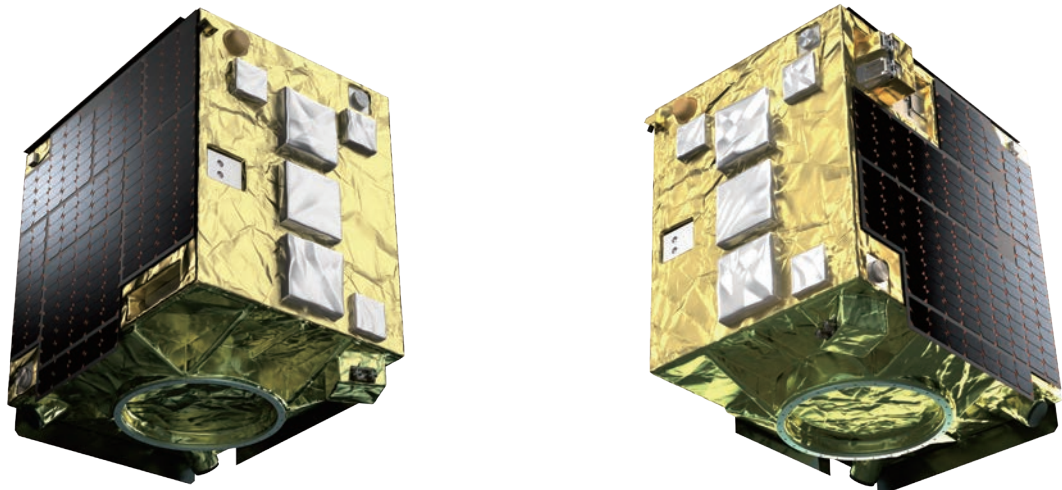
Electrical Power System

The Electrical Power Subsystem generates, stores, and supplies the power required for demonstration theme components, satellite bus system components, and heaters. On RAISE-3, solar panels are attached to the four sides of the satellite, and in the sunlight, one or more solar panels continues to generate power enough to each experiment. Li-ion battery with high volumetric and mass efficiency is used to store electric power.

Attitude Control System

The Attitude Control Subsystem (ACS) controls the satellite attitude with the three-axis attitude control. ACS has an attitude change maneuver function which enables attitude control necessary for satellite operation and experiments of each demonstration theme. If the ACS component fails partially, the remaining components enable to continue attitude control. That improves the robustness of the satellite system.

RAISE-3 Configuration

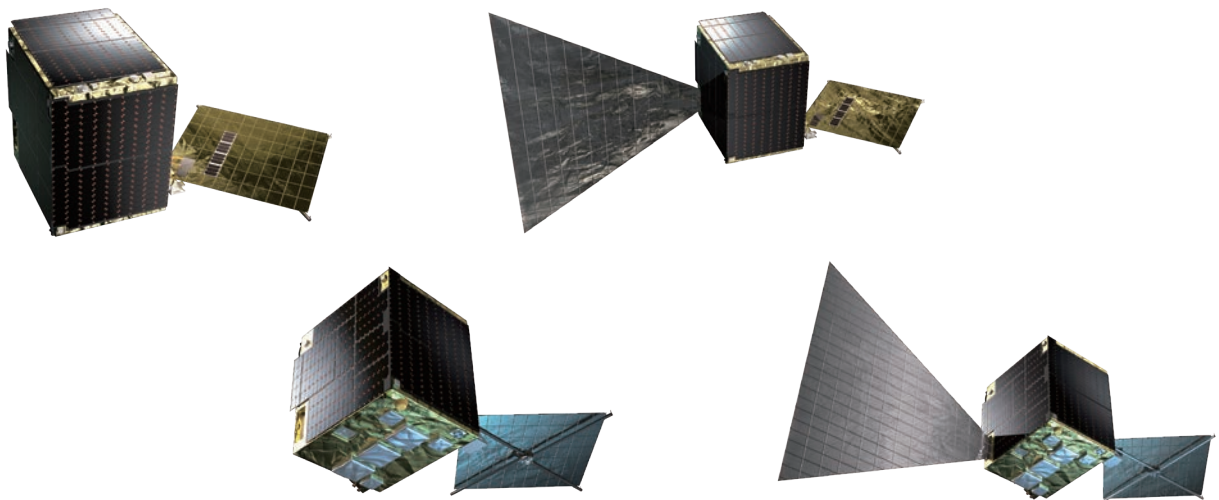


Innovative Satellite Technology Demonstration Program
Innovative Satellite Technology Demonstration-3
Rapid Innovative payload demonstration Satellite-3 (RAISE-3)
Microsatellite
CubeSat
Innovative Satellites

1-2

Main Characteristics

Launch	Launch Vehicle	Epsilon Launch Vehicle
	Launch Site	Uchinoura Space Center
	Launch Year	JFY 2022
Orbit	Sun-synchronous orbit	
	Altitude	560km
	Inclination	97.6 degree
	Local Sun Time at Descending Node	9:30
Shape	Box-shape with body mounted solar array panels	
	Dimensions	1m × 0.8m × 1m (Payload Adapter Fitting not included)
Weight	110 kg	
Attitude Control	Three-axis control (Earth-pointing, Sun-pointing, etc.)	
Power	Solar Array	Average during sunlight BOL : > 250W, EOL : > 230W
	Mission system	BOL : max105Wh, EOL : max62Wh
Mission Term	Initial Operation 1month and Nominal Operation 13 months	



1-3

Configuration

RAISE-3

Dimensions 1m × 0.8m × 1m (Payload Adapter Fitting not included)
Weight 110kg

01 LEOMI

Low Earth Orbit satellite MIMO for 920MHz band IoT platform

04 KIR

Kakushin-3 water Ion-thruster and Resistojet-thruster

05 TMU-PPT

Tokyo Metropolitan University Pulsed-Plasma Thruster

03 GEMINI

cots GPU based Edge-computing for mission systems utilizing model based systems engineering

06 D-SAIL

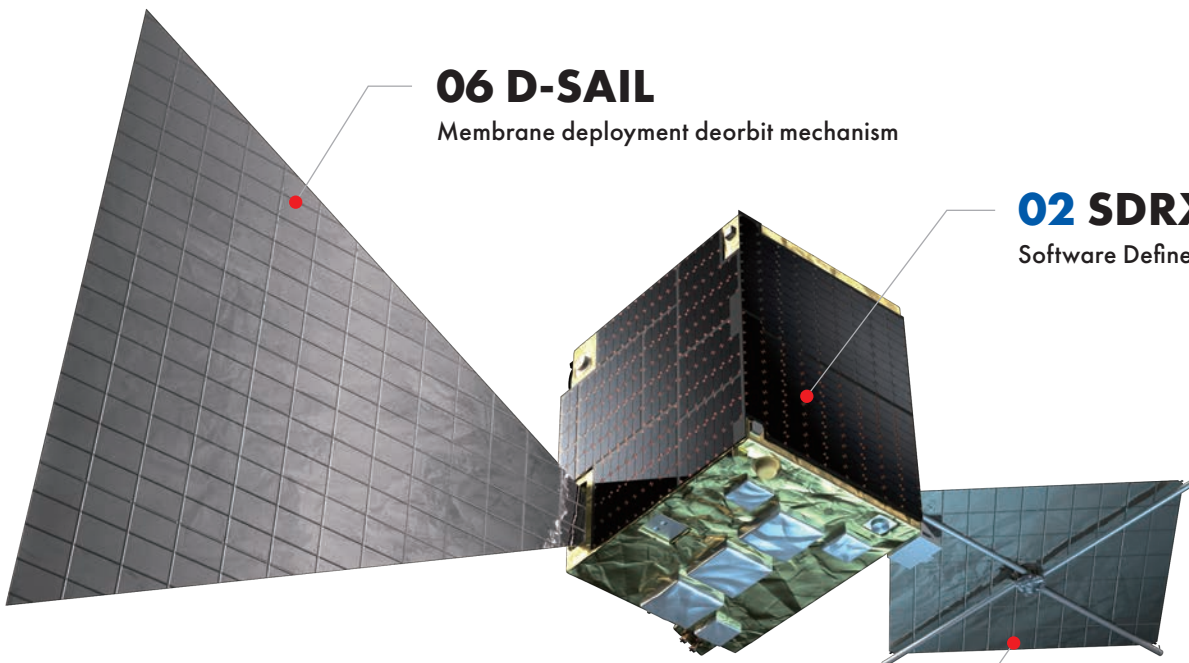
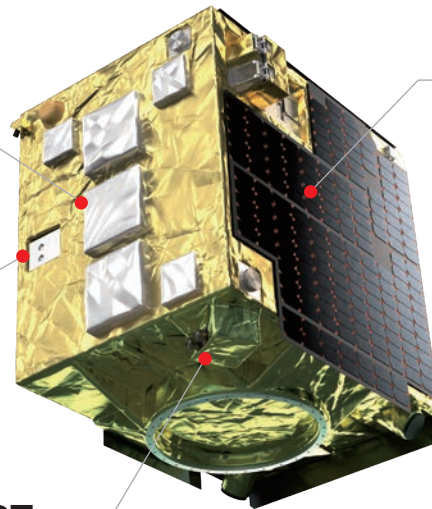
Membrane deployment deorbit mechanism

02 SDRX

Software Defined Receiver

07 HELIOS

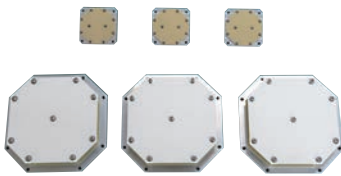
Harvesting Energy with Lightweight Integrated Origami Structure



Innovative Satellite Technology Demonstration Program
Innovative Satellite Technology Demonstration-3
Rapid Innovative payload demonstration Satellite-3 (RAISE-3)
Microsatellite
CubeSat
Innovative Satellites

1-4

Theme of on-orbit demonstration



©Nippon Telegraph and Telephone Corporation



01 Low Earth Orbit satellite MIMO for 920MHz band IoT platform "LEOMI"

Theme name On-orbit demonstration of 920 MHz band IoT platform that uses satellite MIMO technology

Proposing organization Nippon Telegraph and Telephone Corporation

Outline of mission To demonstrate a satellite MIMO technology to improve the spectral efficiency of satellite links. In addition, this project demonstrates a satellite IoT platform concept realizing ultra-wide area and protocol-free IoT services as a use case for expanding the high-capacity downlink channel by MIMO technology.

Dimensions LEOMI-TRX : 150mm×150mm×150mm
LEOMI-LANT : 172mm×172mm×42mm
LEOMI-XANT : 71mm×71mm×22mm

Weight Set : 4.0kg

Person responsible for implementation Fumihiro Yamashita
Nippon Telegraph and Telephone Corporation

Collaborators JAXA

02 Software Defined Receiver "SDRX"

Theme name Software-defined radio that enables flexible satellite development

Proposing organization NEC Space Technologies, Ltd.

Outline of mission Demonstrate a method for developing sophisticated and complex satellite systems in a short time and at low cost, as well as on-board rewrite/dynamic reconfiguration techniques in orbit, utilizing digital data related to the design and related processes.

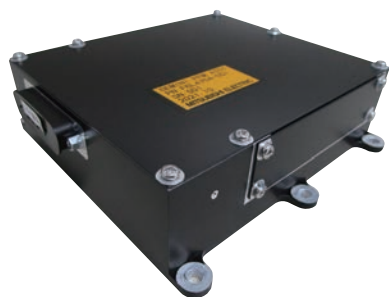
Dimensions 150mm×150mm×150mm **Weight** 1.4kg

Person responsible for implementation Masaharu Tsuchiya
NEC Space Technologies, Ltd.



©NEC Space Technologies, Ltd.





© Mitsubishi Electric Corporation



03 cots GPU based Edge-computing for mission systems utilizing model based systems engineering "GEMINI"

Theme name On-orbit evaluation and model-based development of a commercial GPU

Proposing organization Mitsubishi Electric Corporation

Outline of mission On-orbit demonstration of a consumer GPU capable of ultra-high-speed computation to enable high-speed signal processing such as AI processing and SAR regeneration processing. In addition, the software development for the GPU will be model-based, aiming to shorten the development period and improve quality.

Dimensions 143mm×143mm×45mm

Weight 0.7kg

Person responsible for implementation Shinya Hirakuri Mitsubishi Electric Corporation

04 Kakushin-3 water Ion-thruster and Resistojet-thruster "KIR"

Theme name On-orbit demonstration of an ultra-compact integrated propulsion system that uses water as a propellant

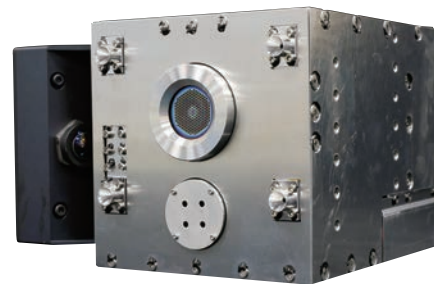
Proposing organization Pale Blue Inc.

Outline of mission Aim to enhance competitiveness through on-orbit demonstration of an ultra-compact integrated propulsion system that integrates two types of propulsion systems, resist jet thrusters and ion thrusters using water as the propellant, into a single component.

Dimensions 123mm×123mm×90mm

Weight 1.8kg

Person responsible for implementation Jun Asakawa Pale Blue Inc.



©Pale Blue Inc.



05 Tokyo Metropolitan University Pulsed-Plasma Thruster "TMU-PPT"

Theme name On-orbit demonstration and performance evaluation of a pulsed plasma thruster (PPT) for small satellites

Proposing organization Advanced Technology Institute, LLC

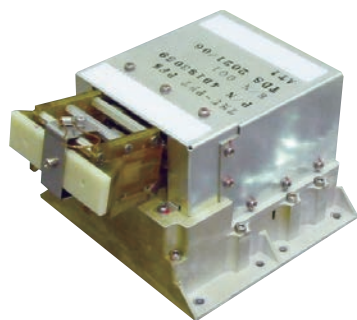
Outline of mission To conduct an on-orbit demonstration and performance evaluation of an electric propulsion system that is low-power, compact, and low-cost as a propulsion system for nano-satellites and small satellites.

Dimensions 160mm×130mm×100mm

Weight 1.4kg

Person responsible for implementation Mitsuteru Sugiki Advanced Technology Institute, LLC

Collaborators Tokyo Metropolitan University, University of Yamanashi, Takahashi Denki Seisakusho Corp



06 Membrane deployment deorbit mechanism "D-SAIL"

Theme name On-orbit demonstration of membrane deployment deorbit mechanism for microsattellites

Proposing organization Axelspace Corporation

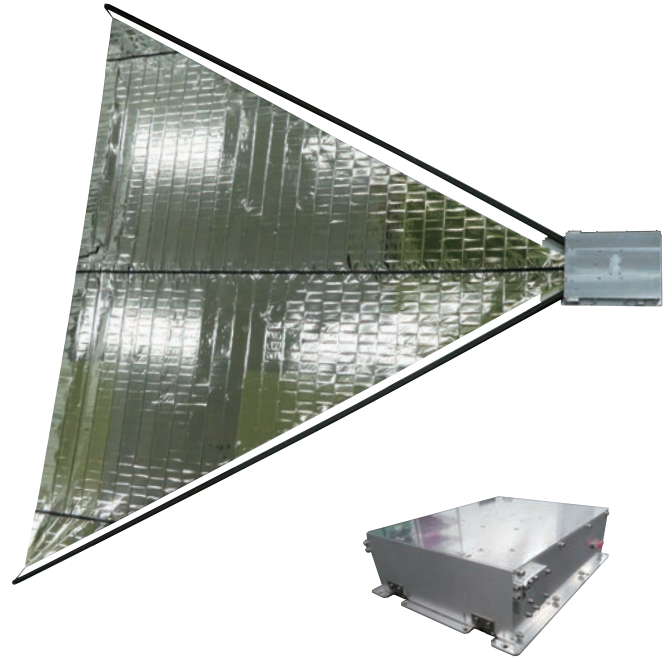
Outline of mission To further reduce the period of time that the satellite remains in orbit after the end of operations, the system of deorbit mechanisms will be validated.

Dimensions 2249mm×2080mm×73mm (when deployed)

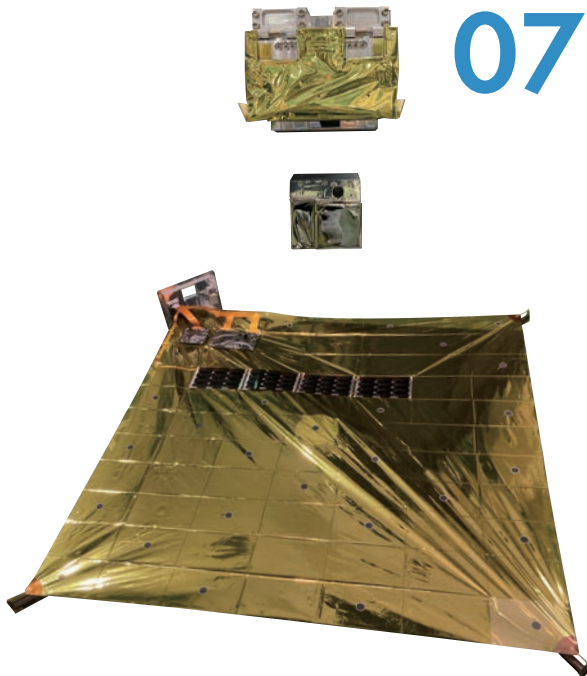
Weight 1.9kg

Person responsible for implementation Tomohiro Kawamura
Axelspace Corporation

Collaborators SAKASE ADTECH CO., LTD.



©Axelspace Corporation



©SAKASE ADTECH CO., LTD.



07 Harvesting Energy with Lightweight Integrated Origami Structure "HELIOS"

Theme name Demonstration of a lightweight, membrane deployment structure with power generation and antenna functions for Society 5.0

Proposing organization SAKASE ADTECH CO., LTD.

Outline of mission In order to achieve high performance (high power / high capacity 5G communication / high resolution observation by interferometry) of low-cost small satellites, on-orbit demonstration of a lightweight, high-delivery membrane structure with power generation and antenna functions will be performed.

Dimensions electric box : 130mm×110mm×110mm
membrane structure (when deployed) :
1000mm×1000mm×230mm

Weight Set : 2.3kg

Person responsible for implementation Yoshiharu Sakai
SAKASE ADTECH CO., LTD.

1-5

Equipment that increases added value of mission

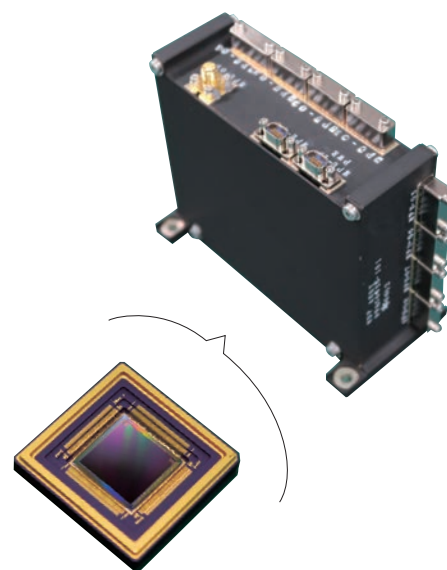
RAISE-3 is equipped with a component that increase added value of the mission.

01 On Board Computer slice

Outline The OBC slice is integrated into the SDRX to generate a pseudo-modulated signal for evaluation of the software receiving part (Rx part). A high-performance, small and low-power SOI-SOC MPU is used to generate the pseudo-modulated signal. The MPU is being developed for space applications and its radiation tolerance and operating system (OS) will be evaluated using OBC slice. As radiation tolerance evaluation of the MPU, on-orbit data acquisition of radiation tolerance of the MPU internal memory and on-orbit evaluation of various IO and serial interface of the MPU are performed.

Dimensions 60mm×133mm×107mm **Weight** 0.45kg
(connection cable not included)

Development organization JAXA, Mitsubishi Heavy Industries, Ltd.



SOI-SOC MPU

1-6

Operation

Each demonstration theme proposer makes an experiment request to the ground system via a web browser. In the ground system, based on the experiment request input and the experiment plan, satellite operation plan is created, and stored-command plan is generated.

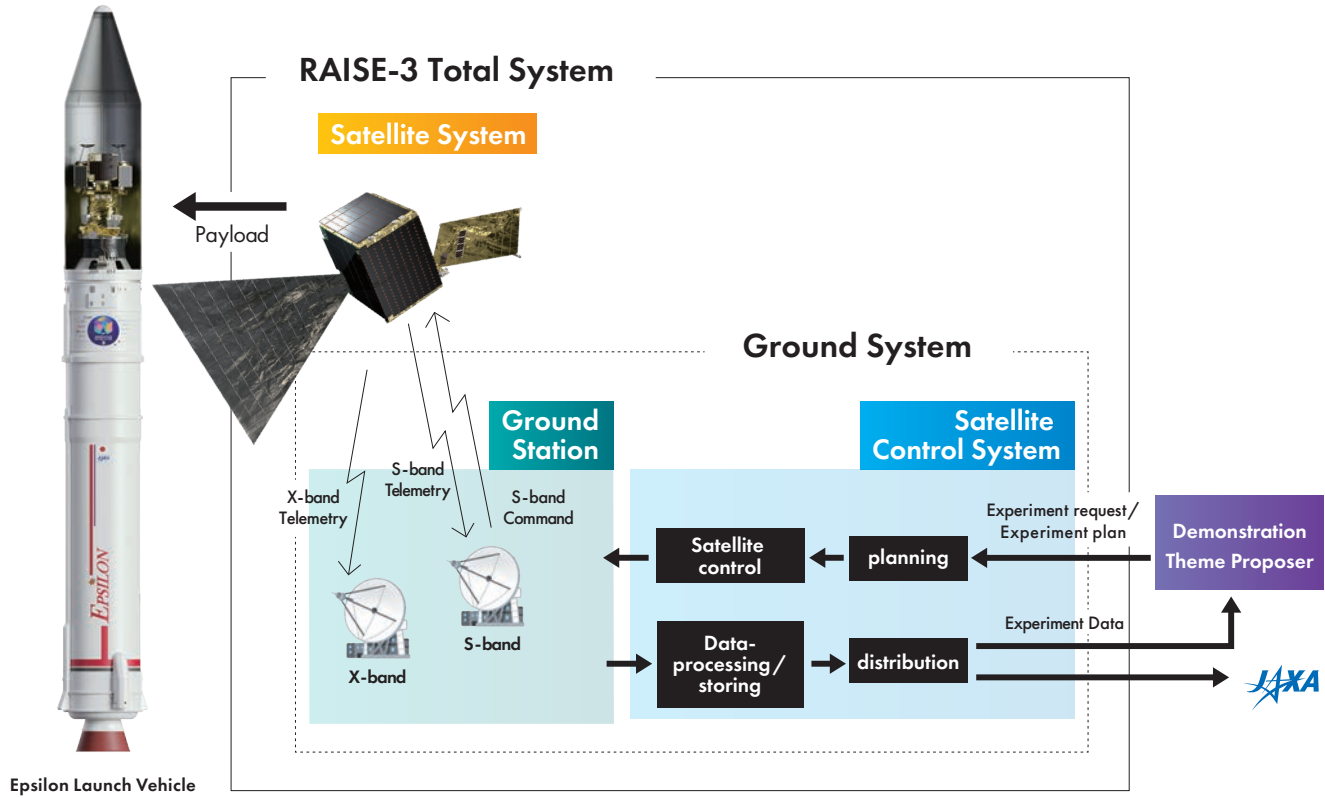
The generated stored commands are uploaded to the satellite from the ground station, and the satellite conducts experiments on each demonstration theme according to the stored commands and accumulates the experimental data in the onboard data recorder.

Accumulated experimental data is transmitted from the satellite to the ground system using the X-band telemetry downlink line. The ground system sorts the acquired telemetry data for each demonstration theme, and then generates and stores them as data that can be distributed together with the satellite House Keeping data required for experimental data evaluation. The demonstration theme proposer acquires experimental data via a web browser.

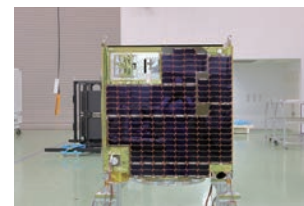
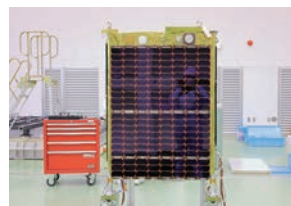
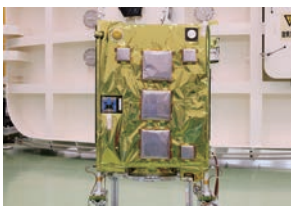
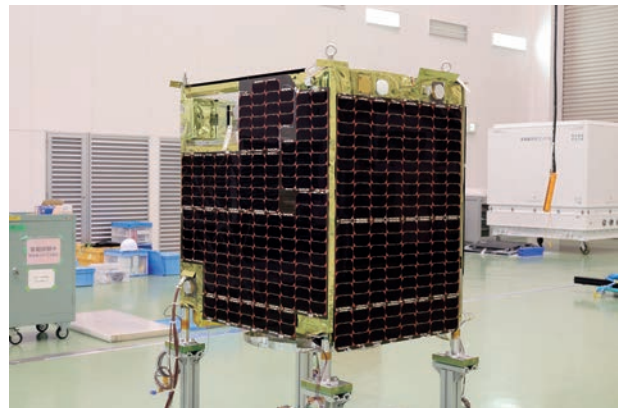
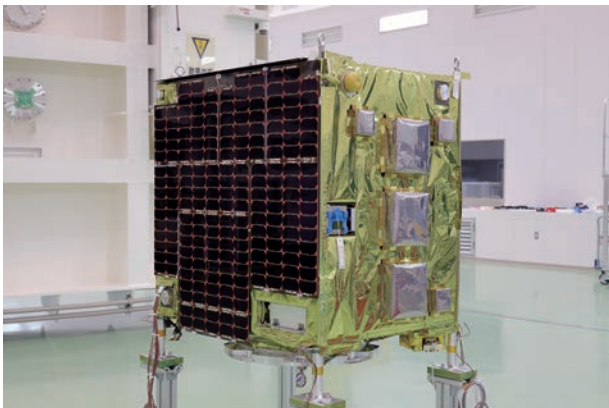
As described above, the demonstration theme proposer can obtain the convenience of being able to input the experiment request and acquire the experiment data all via the WEB browser.

1-7

RAISE-3 System Overview



RAISE-3 Flight Model



2

[Theme of on-orbit demonstration]

Microsatellite

Launch vehicle is under adjusting

01 KOYOH

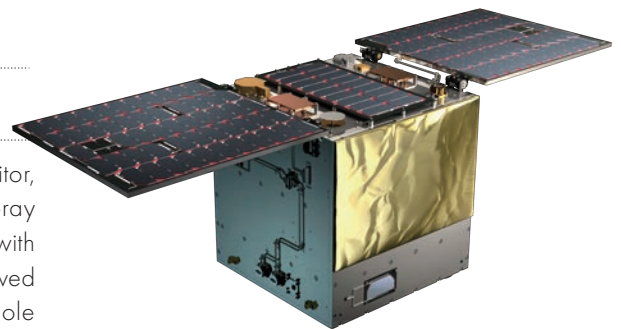
Theme name Development of a micro-satellite system for space science and engineering, and X-ray observation of gravitational wave sources

Proposing organization Kanazawa University

Outline of mission The satellite, KOYOH, has a wide field X-ray monitor, and will identify the time and direction of gamma-ray bursts and X-ray transient phenomena associated with gravitational wave radiation. It will share the observed information to ground/space observatories in whole over the world within quasi-real time.

Dimensions 493mm×450mm×488mm **Weight** 43kg

Person responsible for implementation Satoshi Yagitani
Kanazawa University



02 Platform for Extra and Terrestrial Remote Examination with LCTF "PETREL"

Theme name Demonstration of multi-spectral ocean observation technology that uses an ultra-low cost high-accuracy attitude control bus system

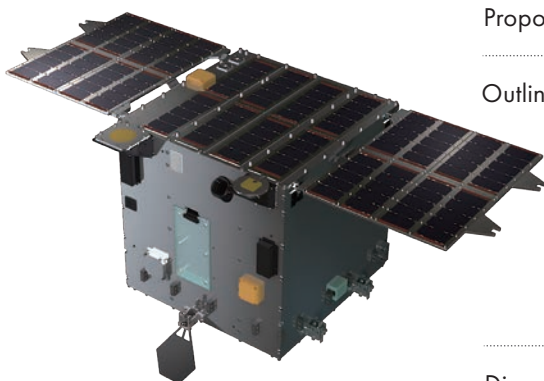
Proposing organization Tokyo Institute of Technology

Outline of mission An innovative multispectral camera will be mounted on a low-cost but high-performance microsatellite. This project including mission operation and providing data application services is conducted by a quite unique academic-industrial consortium in which members contribute via their own professionalities free of charge. This project will open up a new space business utilizing spectral data, and a new research style of space science.

Dimensions 467mm×530mm×512mm **Weight** 62kg

Person responsible for implementation Yoichi Yatsu Tokyo Institute of Technology

Collaborators Team Umitsubame



03 Space Tethered Autonomous Robotic Satellite "STARS-X"

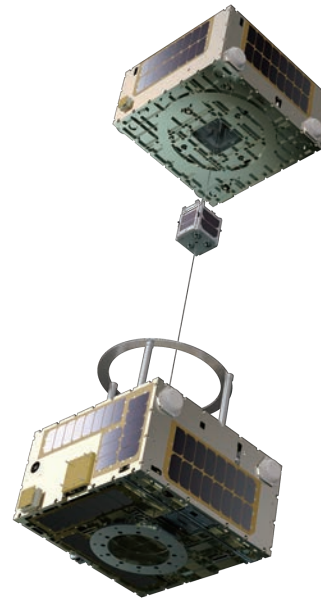
Theme name Demonstration of space tether technology for debris capture

Proposing organization Shizuoka University

Outline of mission A tether is extended 1km in space, and a robot (climber) moves on the tether to conduct a debris capture experiment with a net.

Dimensions 540mm×588mm×576mm **Weight** 60kg

Person responsible for implementation Masahiro Nohmi
Shizuoka University



Interview People involved in "Innovative Satellite Technology Demonstration-3"



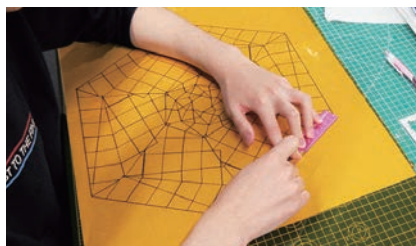
Interview articles with each organization are on the following website.



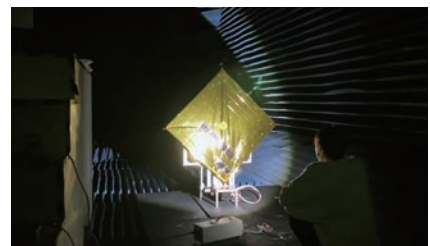
(Japanese only)



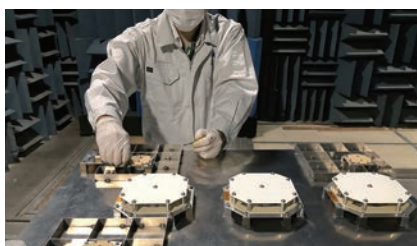
©Nagoya University



©Waseda University



©SAKASE ADTECH CO., LTD.



©Advanced Technology Institute, LLC



©Kanazawa University

3

[Theme of on-orbit demonstration]

CubeSat

To be launched by Epsilon Launch Vehicle No.6

01

MAGnetically separating NANO-satellite with Rotation for Orbit control "MAGNARO"

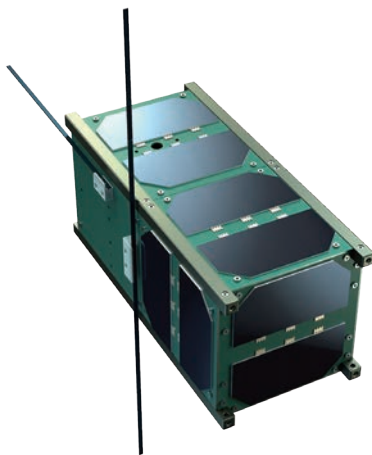
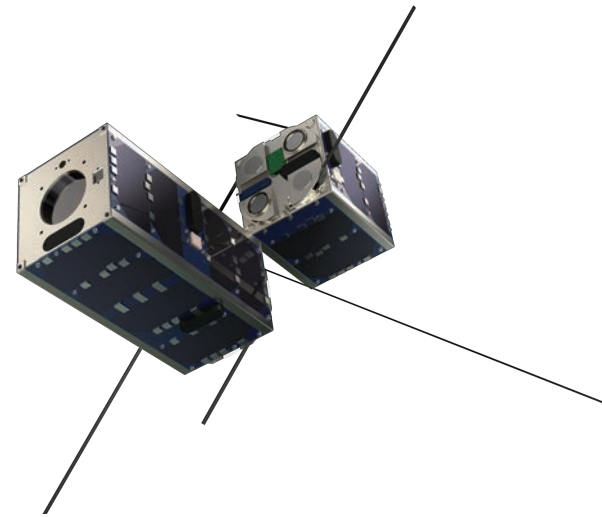
Theme name Rotation and separation of microsattellites to deploy their constellation

Proposing organization Nagoya University

Outline of mission We aim to establish a method to achieve resource saving, high accuracy, and formation by rotating and separating connected nano-satellites to form a formation, and to achieve multi-point simultaneous observation and continuous earth observation with nano-satellites.

Dimensions 111mm×111mm×340mm **Weight** 4.4kg

Person responsible for implementation Takaya Inamori
Nagoya University



02 MITSUBA

Theme name On-orbit demonstration aimed at expanding space application of commercial semiconductor devices and general-purpose equipment

Proposing organization Kyushu Institute of Technology

Outline of mission On-orbit degradation observation of COTS semi conductor for adding value to COTS data base and On orbit demonstration of general USB device.

Dimensions 105mm×100mm×227mm **Weight** 1.7kg

Person responsible for implementation Hirokazu Masui
Kyushu Institute of Technology



03 KOSEN-2

Theme name Demonstration of technology for a marine observation data collection satellite equipped with a directional antenna with ultra-high precision attitude control; Sustainable space engineer development; and Demonstration of a network-based satellite development scheme

Proposing organization National Institute of Technology (KOSEN), Yonago College

Outline of mission The project will collect observation data of seafloor crustal deformation by combining a LPWA (LoRa) receiver and a directional antenna, demonstrate the high-precision attitude control using a dual reaction wheel that integrates fish-eye cameras and magnetic sensors, and demonstrate satellite communications using a satellite data collection protocol specialized for multi-point reception.

Dimensions 111mm×111mm×227mm **Weight** 2.7kg

Person responsible for implementation Masahiro Tokumitsu
National Institute of Technology (KOSEN), Yonago College

Collaborators National Institute of Technology (KOSEN), Gunma College



04 WASEDA-SAT-ZERO

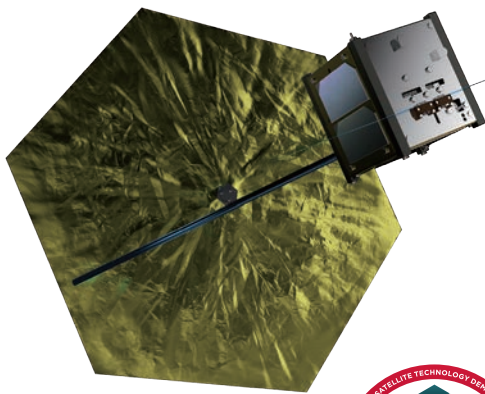
Theme name Demonstration of integral molding technology for satellite housing

Proposing organization Waseda University

Outline of mission Aiming for zero screws, zero mechanical parts, and zero debris by using 3D printer technology to mold the satellite chassis in one piece. Using this satellite chassis, we will conduct deployment experiments of a membrane surface composed of flat elements (like origami).

Dimensions 113mm×113mm×113mm **Weight** 1.2kg

Person responsible for implementation Tomoyuki Miyashita
Waseda University



05 FSI-SAT

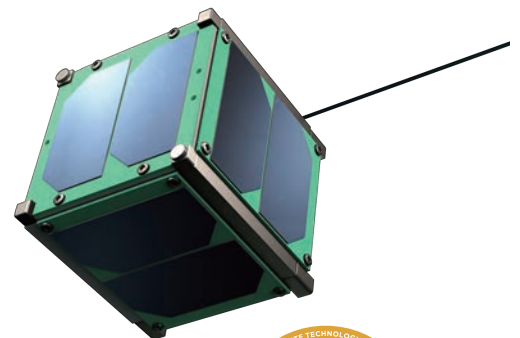
Theme name Demonstration of technology for a multi-spectral camera for CubeSat

Proposing organization Future Science Institute

Outline of mission A 1U size multispectral camera including data processing system will be developed at low cost to demonstrate basic operation in orbit.

Dimensions 110mm×110mm×113mm **Weight** 1.4kg

Person responsible for implementation Mitsuharu Shiwa Future Science Institute

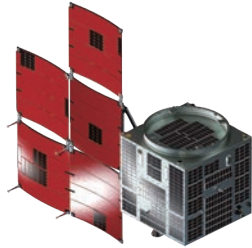




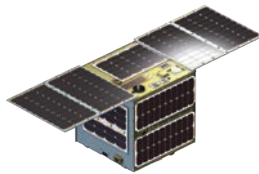
Innovative Satellites



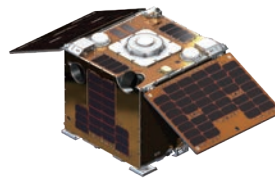
Innovative Satellite Technology Demonstration-1



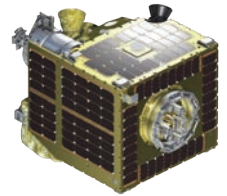
RAPid Innovative payload demonstration Satellite-1
RAPIS-1
JAXA



MicroDragon
Keio University

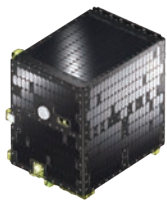


Rapid International Scientific Experiment Satellite
RISESAT
Tohoku University

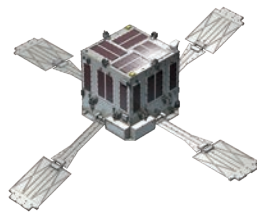


Man-made meteor shower Demonstration Satellite
ALE-1
ALE Co. Ltd.

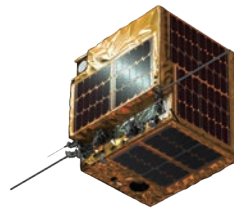
Innovative Satellite Technology Demonstration-2



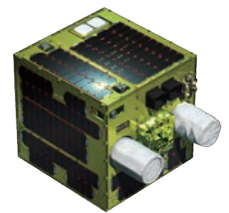
RAPid Innovative payload demonstration Satellite-2
RAISE-2
JAXA



Variable Shape Attitude Control Demonstration Microsatellite
HIBARI
Tokyo institute of Technology

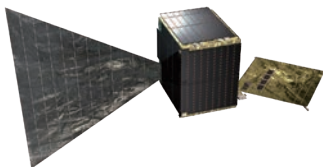


The multi wavelength infrared observation microsatellite
Z-Sat
Mitsubishi Heavy Industries, Ltd.

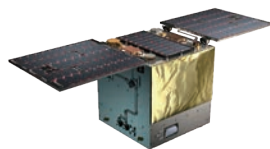


Debris Removal Unprecedented Micro-Satellite
DRUMS
Kawasaki Heavy Industries, Ltd.

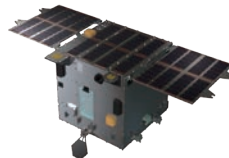
Innovative Satellite Technology Demonstration-3



RAPid Innovative payload demonstration Satellite-3
RAISE-3
JAXA



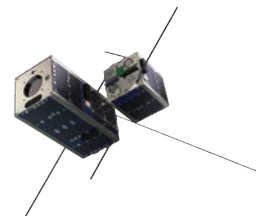
KOYOH
Kanazawa University



Platform for Extra and Terrestrial Remote Examination with LCTF
PETREL
Tokyo Institute of Technology

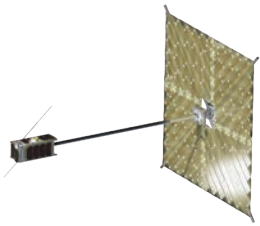


Space Tethered Autonomous Robotic Satellite
STARS-X
Shizuoka University

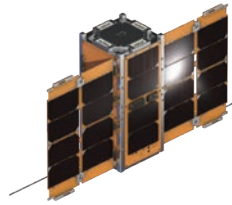


MAGnetically separating NANO-satellite with Rotation for Orbit control
MAGNARO
Nagoya University

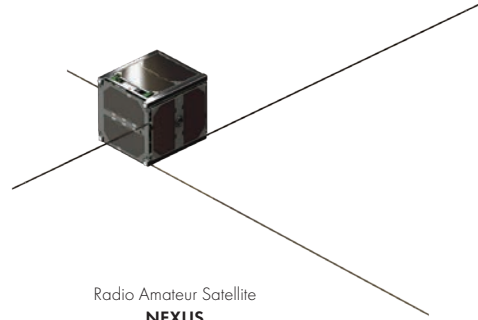
Innovative Satellite Technology Demonstration-4 — Coming soon!



Multi-Functional Deployable Membrane Structure Demonstrator
OrigamiSat-1
Tokyo Institute of Technology



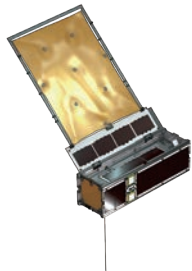
Lunar Exploration Technology Demonstration Satellite
Aoba VELOX-IV
Kyushu Institute of Technology



Radio Amateur Satellite
NEXUS
Nihon University



TeikyoSat-4
Teikyo University



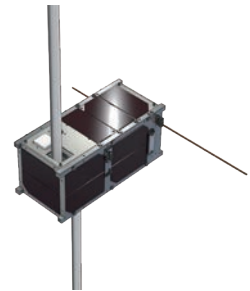
Advanced Satellite Toward Exploration of dust environment with In-Situ Cosmic dust sensor
ASTERISC
Chiba Institute of Technology



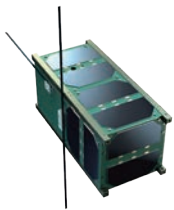
AGU Remote Innovative CubeSat Alert System
ARICA
Aoyama Gakuin University



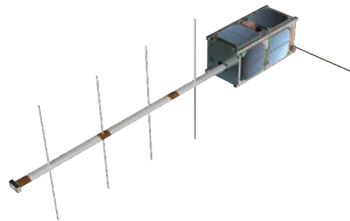
Advanced OBC of
NanoDragon
Meisei Electric Co. Ltd.



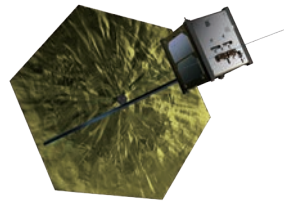
CubeSat for Technology Demonstration of Jupiter Radio Observation
KOSEN-1
National Institute of Technology, Kochi College



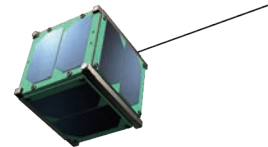
MITSUBA
Kyushu Institute of Technology



KOSEN-2
National Institute of Technology, Yonago College



WASEDA-SAT-ZERO
Waseda University



FSI-SAT
Future Science Institute

革新
INNOVATIVE
SATELLITE TECHNOLOGY
DEMONSTRATION PROGRAM



JAXA (日本語)



JAXA (English)



革新的衛星技術実証3号機
Innovative Satellite Technology Demonstration-3
(Japanese only)

国立研究開発法人宇宙航空研究開発機構
研究開発部門
〒305-8505 茨城県つくば市千現 2-1-1
Japan Aerospace Exploration Agency
Research and Development Directorate
2-1-1 Sengen, Tsukuba-shi, Ibaraki 305-8505 Japan



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