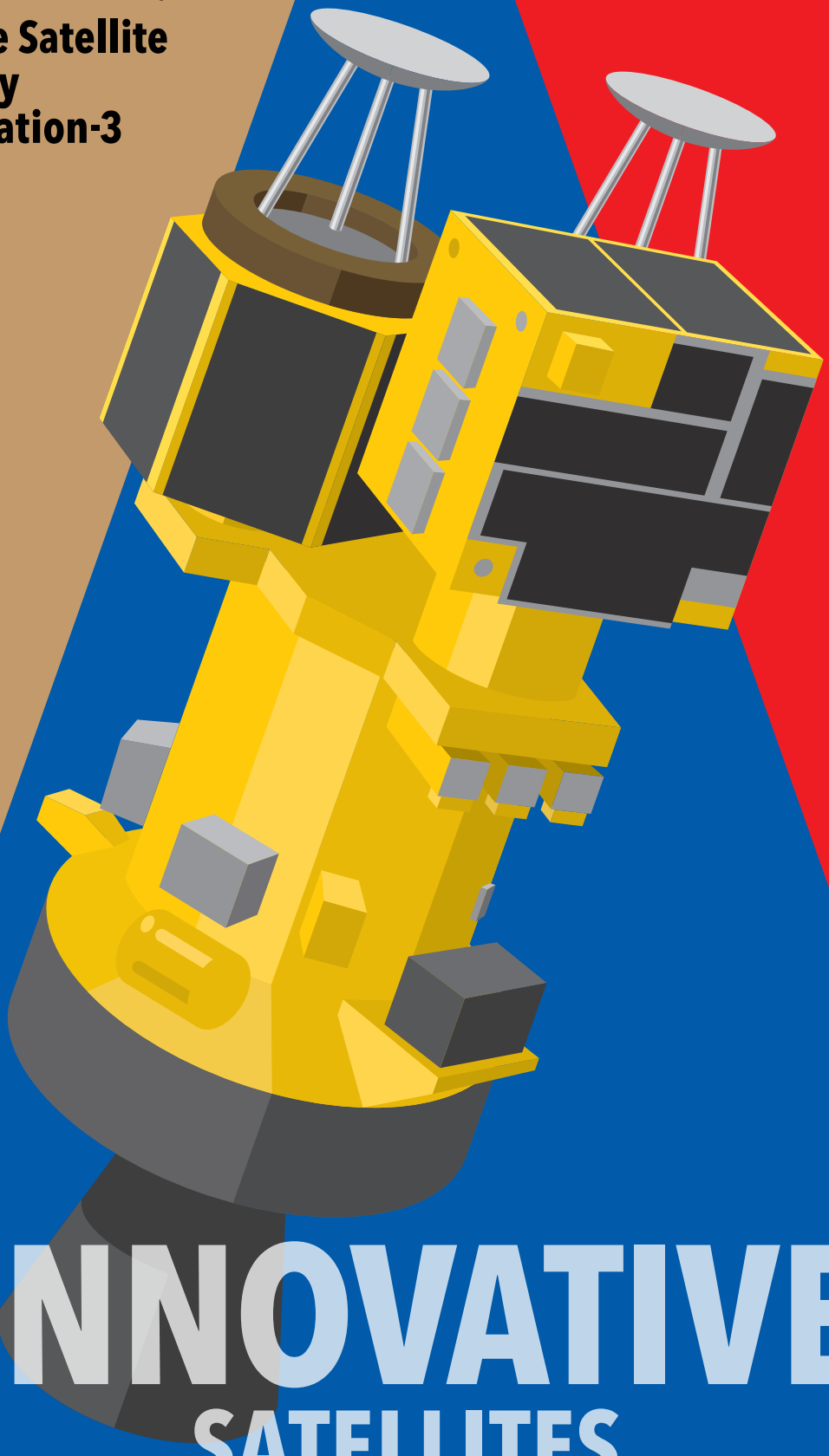
PRESS KIT

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

革新
INNOVATIVE
SATELLITE TECHNOLOGY
DEMONSTRATION PROGRAM

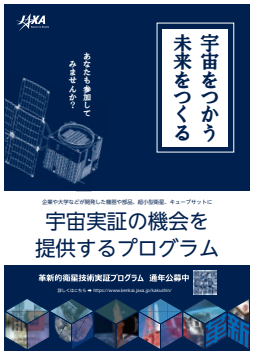
Purpose

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.



宇宙実証の機会を
提供するプログラム

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)

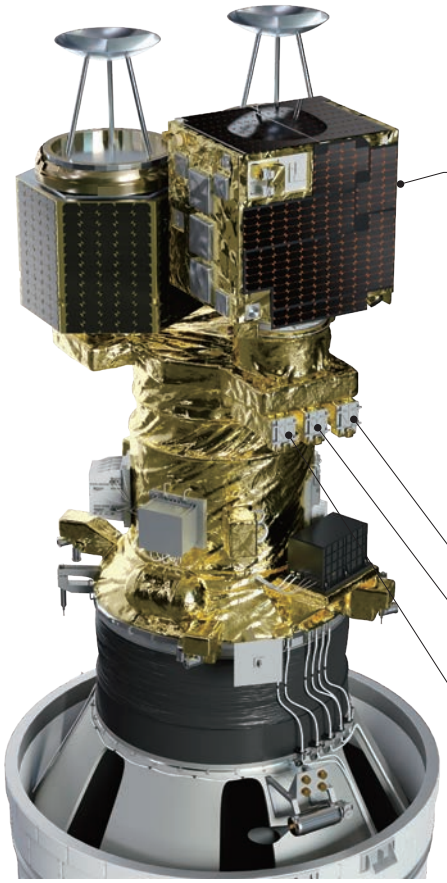
Innovative Satellite Technology Demonstration-2

Innovative Satellite Technology Demonstration-2 (Japanese only)

II Innovative Satellite Technology Demonstration-3

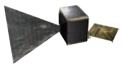
Outline

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 microsatellites / 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"

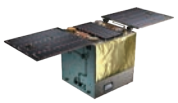
- 03 KOSEN-2

- 05 FSI-SAT

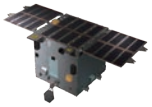
Multiple Satellite Mounting Structure

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



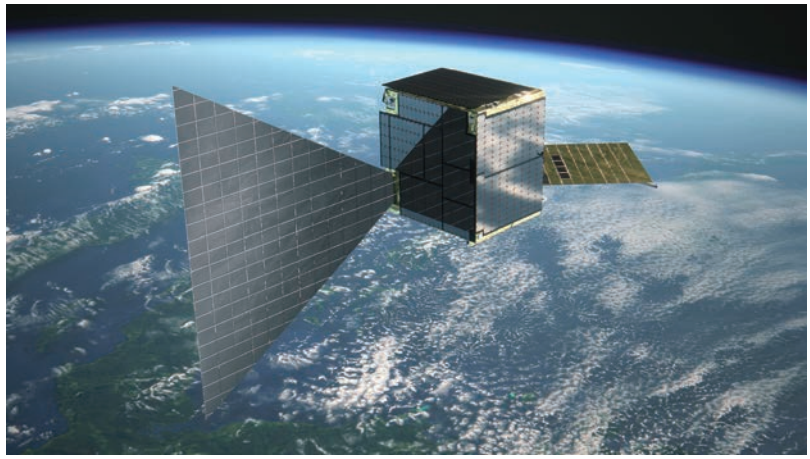
PETREL

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.

1-1 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.

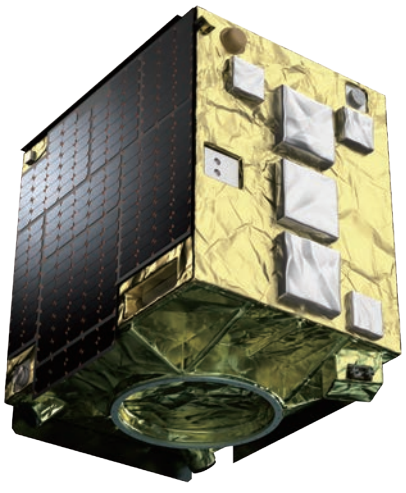
Electrical Power System

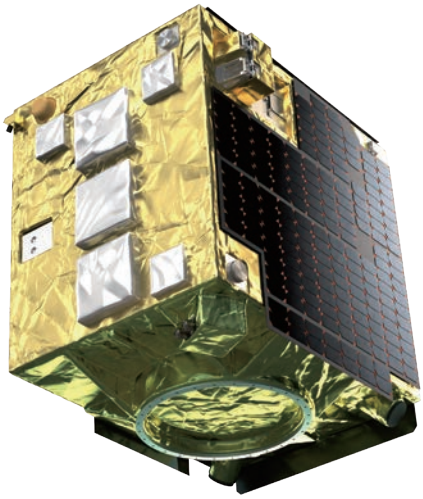
The Electrical Power Subsystem generates, stores, and supplies the power required for demonstration theme components, satellite bus system components, and heaters.
On RAISE-3, solar panels are attached to the four sides of the satellite, and in the sunlight, one or more solar panels continues to generate 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.

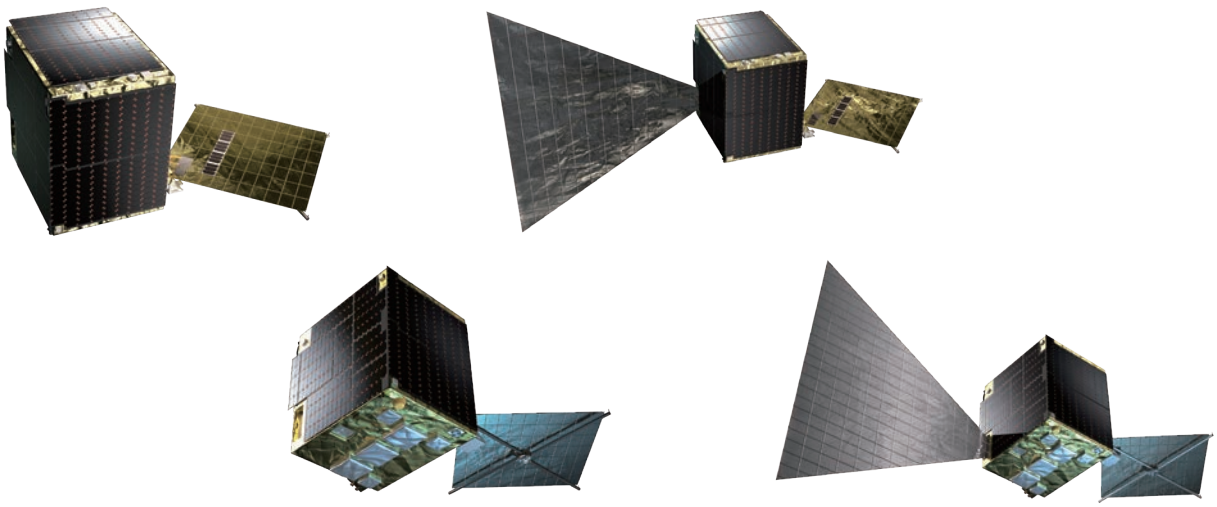
RAISE-3 Configuration





1-2 Main Characteristics

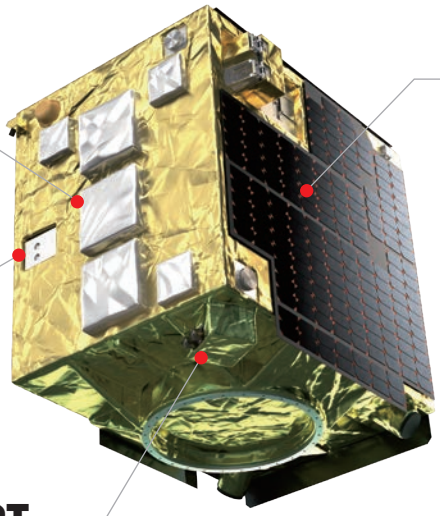
Launch	Launch Vehicle	Epsilon Launch Vehicle
	Launch Site	Uchinoura Space Center
	Launch Year	JFY 2022
Orbit	Sun-synchronous orbit	
	Altitude	560km
	Inclination	97.6 degree
	Local Sun Time at Descending Node	9:30
Shape	Box-shape with body mounted solar array panels	
	Dimensions	1m × 0.8m × 1m (Payload Adapter Fitting not included)
Mass	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)
Mass 110kg

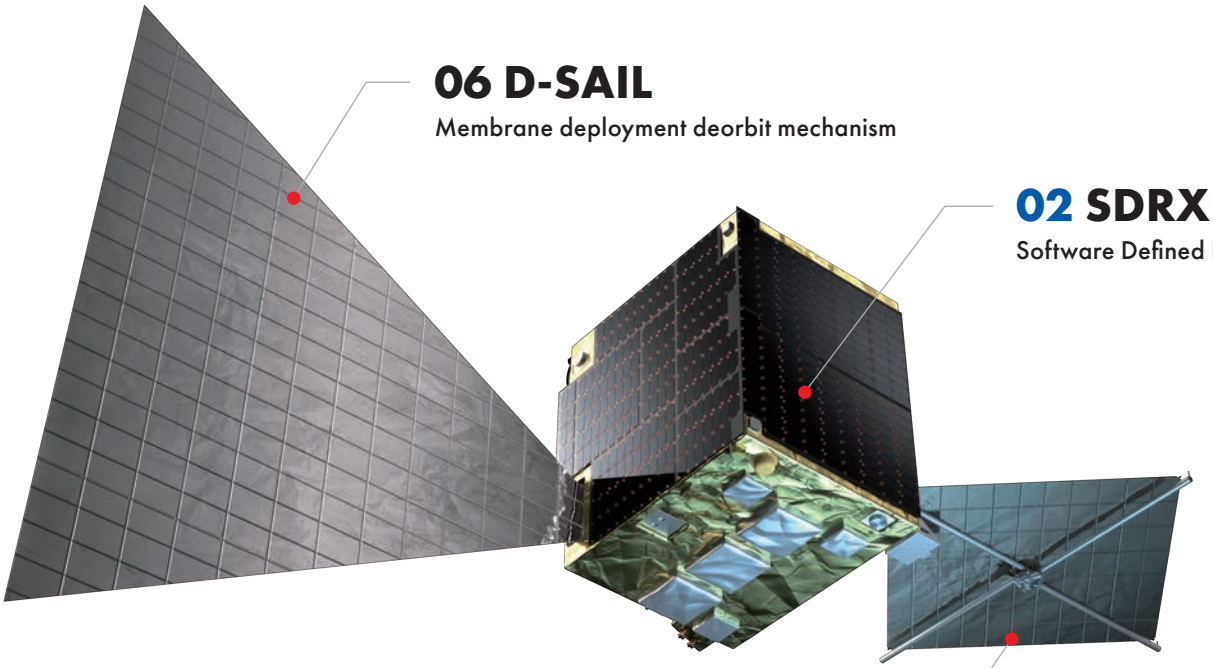


01 LEOMI
Low Earth Orbit satellite MIMO for 920MHz band IoT platform

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

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

05 TMU-PPT
Tokyo Metropolitan University Pulsed-Plasma Thruster

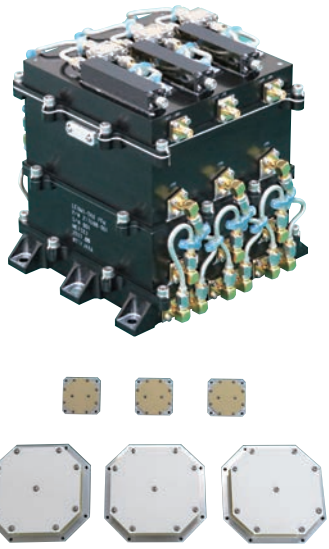


06 D-SAIL
Membrane deployment deorbit mechanism

02 SDRX
Software Defined Receiver

07 HELIOS
Harvesting Energy with Lightweight Integrated Origami Structure

1-4 Theme of on-orbit demonstration



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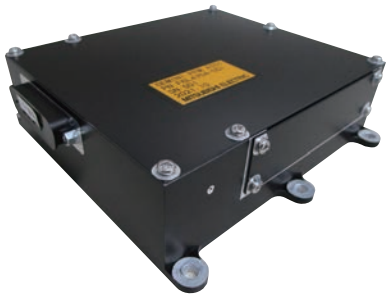
01 Low Earth Orbit satellite MIMO for 920MHz band IoT platform "LEOMI"

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
Mass	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
Mass	1.4kg
Person responsible for implementation	Masaharu Tsuchiya NEC Space Technologies, Ltd.

©NEC Space Technologies, Ltd.



©Mitsubishi Electric Corporation

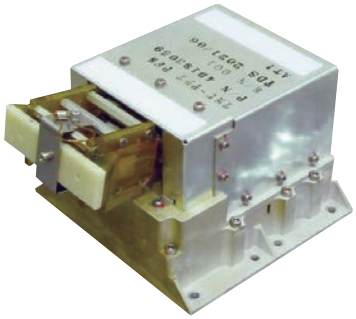
03 cots GPU based Edge-computing for mission systems utilizing model based systems engineering "GEMINI"

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
Mass	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
Mass	1.8kg
Person responsible for implementation	Jun Asakawa Pale Blue Inc.

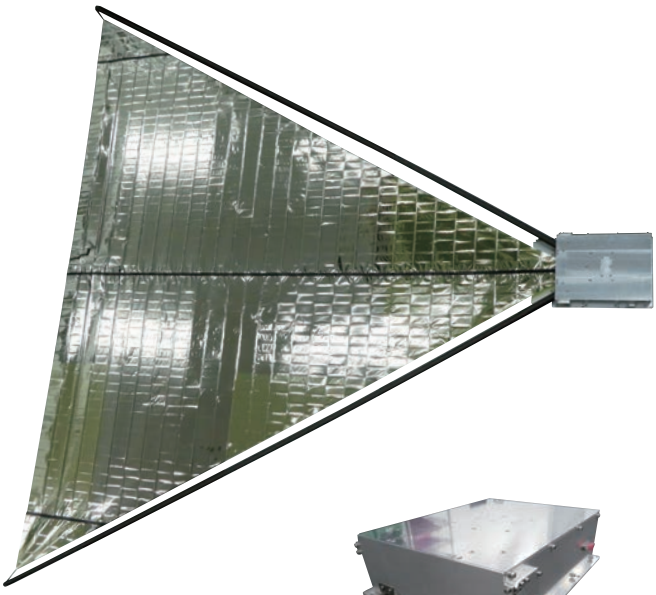
©Pale Blue Inc.

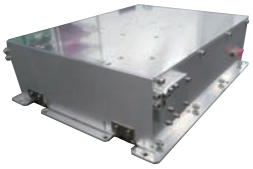


05 Tokyo Metropolitan University Pulsed-Plasma Thruster "TMU-PPT"

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
Mass	1.4kg
Person responsible for implementation	Mitsuteru Sugiki Advanced Technology Institute, LLC
Collaborators	Tokyo Metropolitan University, University of Yamanashi, Takahashi Denki Seisakusho Corp

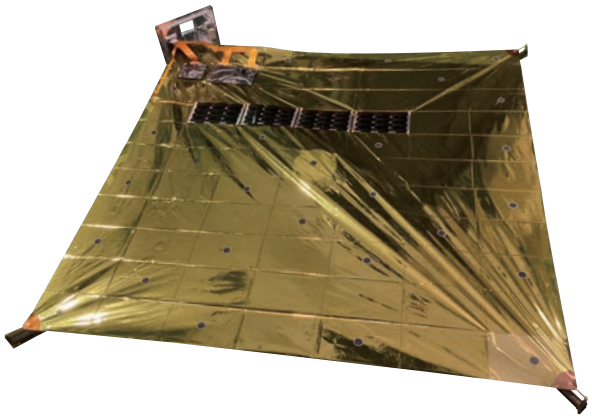
06 Membrane deployment deorbit mechanism "D-SAIL"





©Axelspace Corporation

Theme name	On-orbit demonstration of membrane deployment deorbit mechanism for microsatellites
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)
Mass	1.9kg
Person responsible for implementation	Tomohiro Kawamura Axelspace Corporation
Collaborators	SAKASE ADTECH CO., LTD.



©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
Mass	Set：2.3kg
Person responsible for implementation	Yoshiharu Sakai SAKASE ADTECH CO., LTD.

1-5 Equipment that increases added value of mission

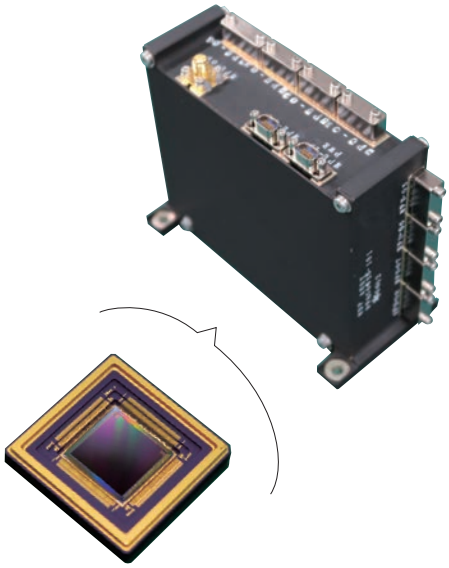
RAISE-3 is equipped with a component that increase added value of the mission.

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 **Mass** 0.45kg (connection cable not included)

Development oraganization JAXA, Mitsubishi Heavy Industries, Ltd.



SOI-SOC MPU

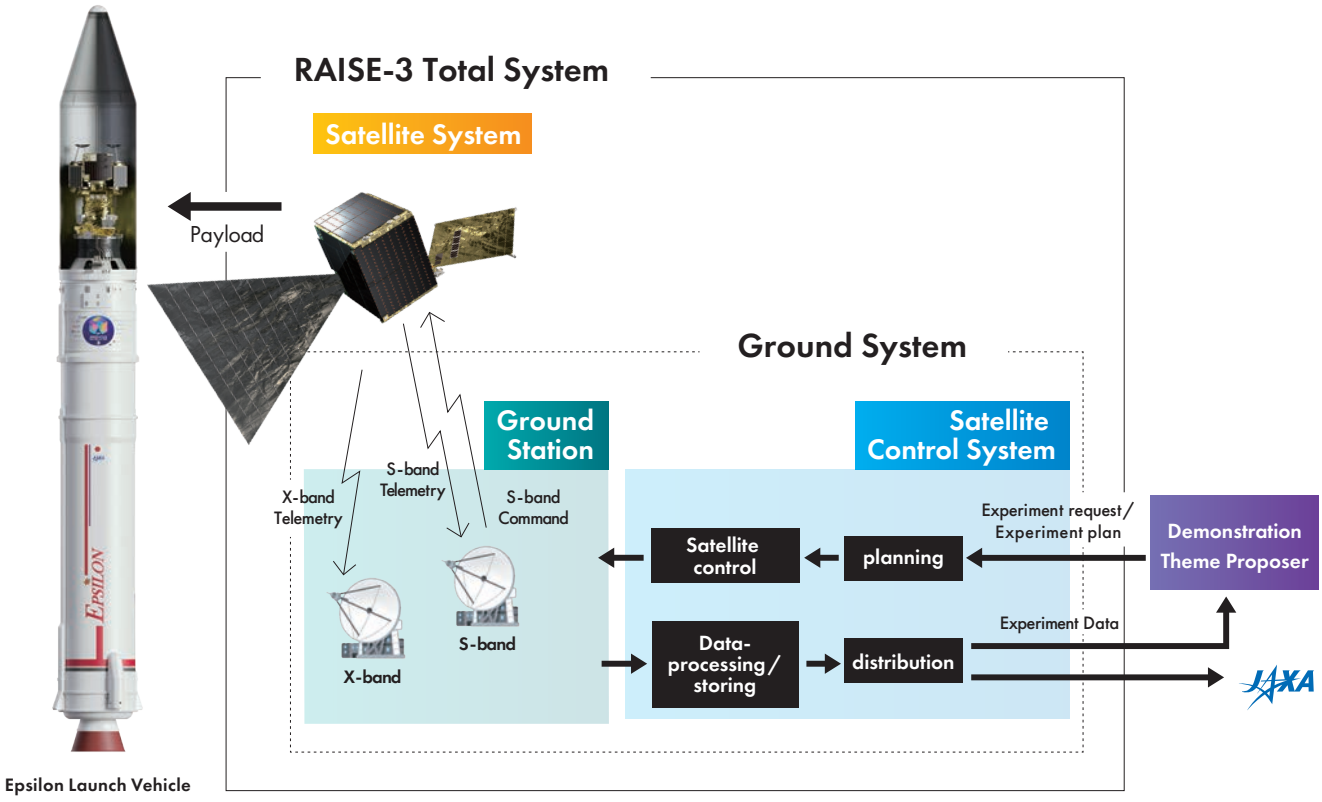
1-6 Operation

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.

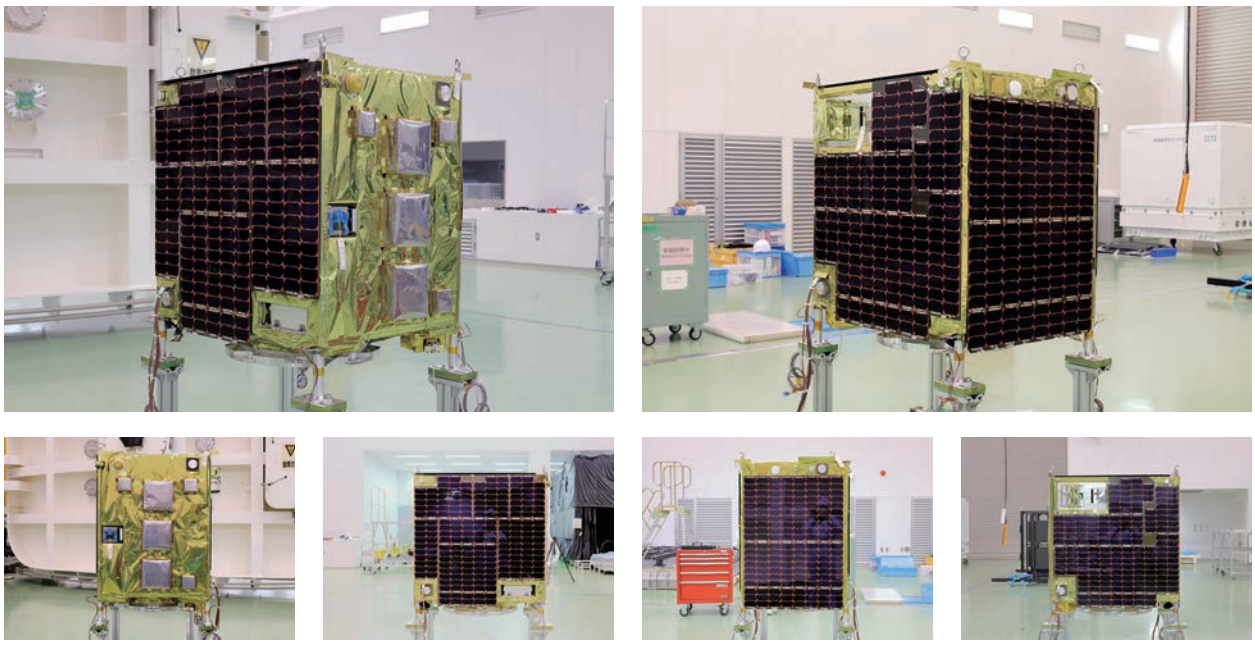
The generated stored commands are uploaded to the satellite from the ground station, and the satellite conducts experiments on each demonstration theme according to the stored commands and accumulates the experimental data in the onboard data recorder.

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

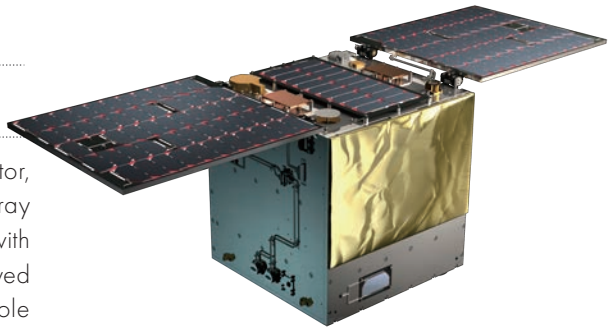
[Theme of on-orbit demonstration]

Microsatellite

Launch vehicle is under adjusting

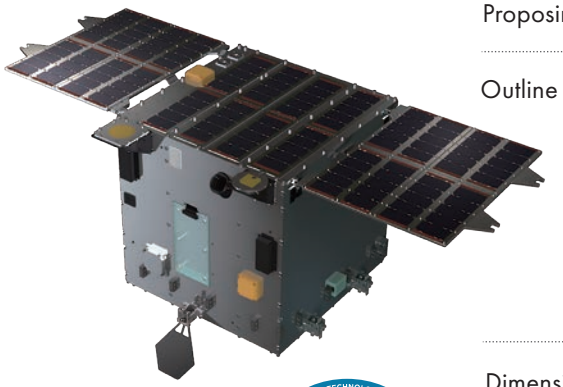
01 KOYOH

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
Mass	43kg
Person responsible for implementation	Satoshi Yagitani Kanazawa University



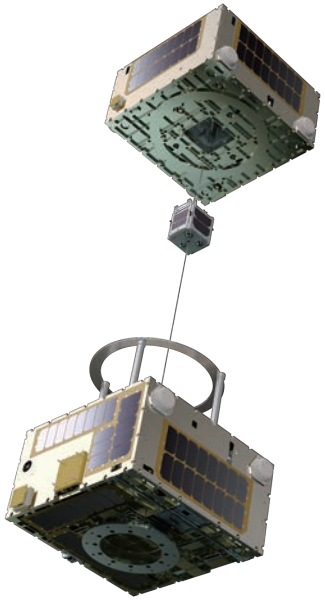
02 Platform for Extra and Terrestrial Remote Examination with LCTF "PETREL"

Theme name	Demonstration of multi-spectral ocean observation technology that uses an ultra-low cost high-accuracy attitude control bus system
Proposing organization	Institute of Science Tokyo
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 : approx. 600mm×600mm×650mm	Mass : approx. 65kg
Person responsible for implementation	Yoichi Yatsu Institute of Science Tokyo
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： approx. 560mm×580mm×600mm	Mass： approx. 65kg
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)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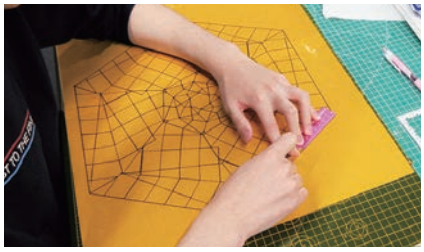
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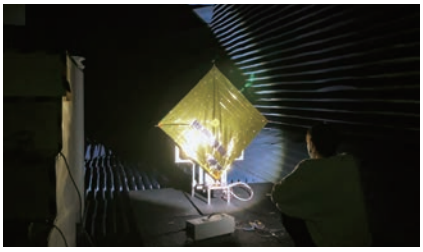
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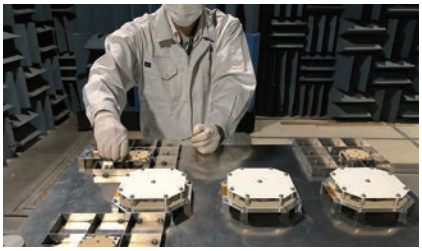

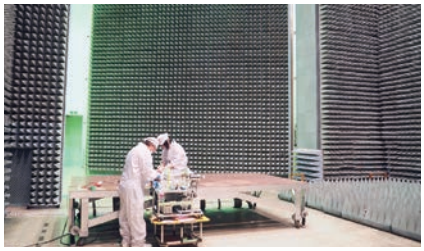
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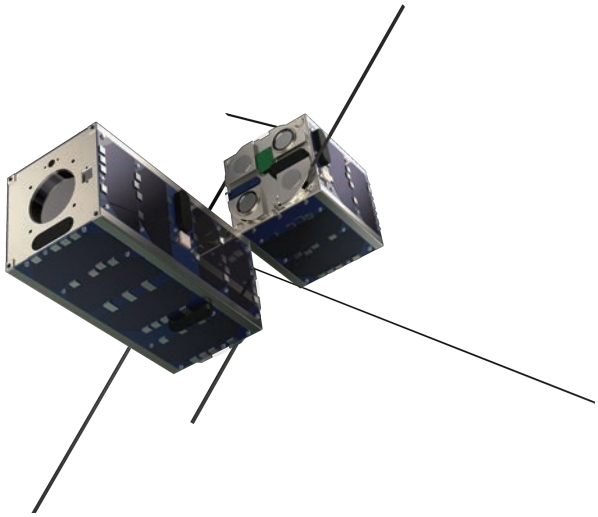
3

[Theme of on-orbit demonstration]

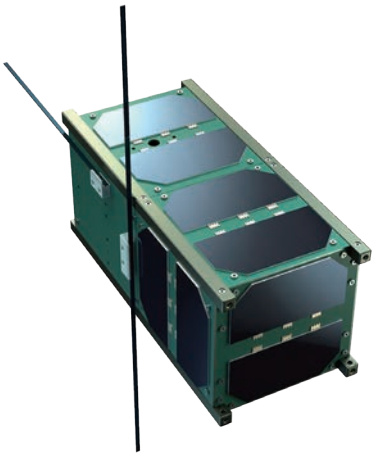
CubeSat

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 microsatellites 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
Mass	4.4kg
Person responsible for implementation	Takaya Inamori Nagoya University



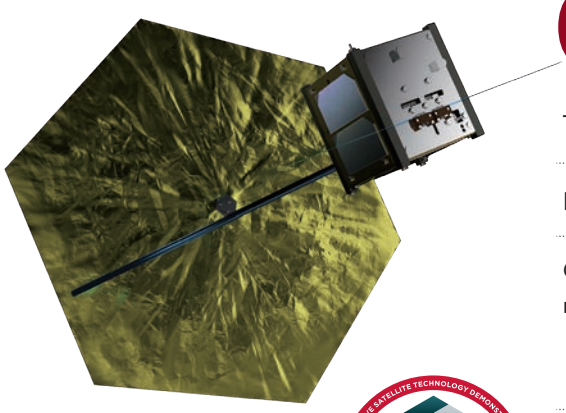
02 MITSUBA

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
Mass	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
Mass	2.7kg
Person responsible for implementation	Masahiro Tokumitsu National Institute of Technology (KOSEN), Yonago College
Collaborators	National Institute of Technology (KOSEN), Gunma College

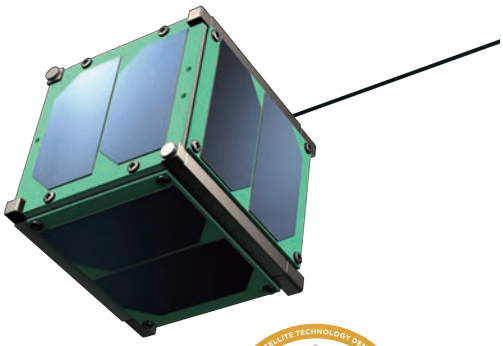
04 WASEDA-SAT-ZERO



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
Mass	1.2kg
Person responsible for implementation	Tomoyuki Miyashita Waseda University

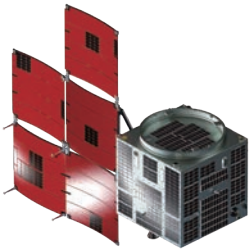
05 FSI-SAT

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
Mass	1.4kg
Person responsible for implementation	Mitsuharu Shiwa Future Science Institute

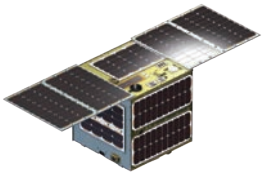


III Innovative Satellites

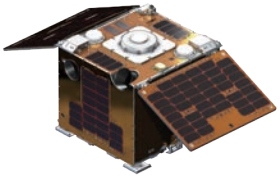
Innovative Satellite Technology Demonstration-1



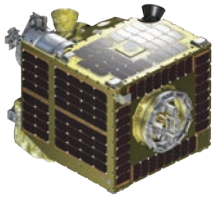
RApid Innovative payload demonstration Satellite-1
RAPIS-1
JAXA



MicroDragon
Keio University

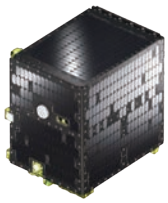


Rapid International Scientific Experiment Satellite
RISESAT
Tohoku University

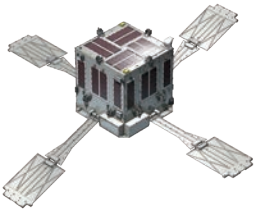


Man-made meteor shower Demonstration Satellite
ALE-1
ALE Co. Ltd.

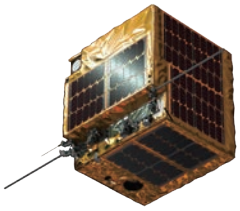
Innovative Satellite Technology Demonstration-2



RApid Innovative payload demonstration SatellitE-2
RAISE-2
JAXA



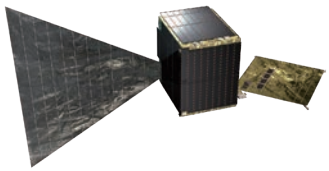
Variable Shape Attitude Control Demonstration Microsatellite
HIBARI
Institute of Science Tokyo



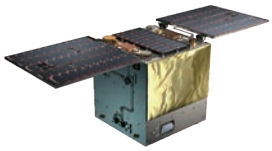
The multi wavelength infrared observation microsatellite
Z-Sat
Mitsubishi Heavy Industries, Ltd.

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

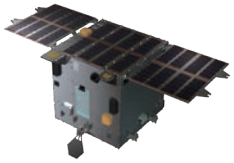
Innovative Satellite Technology Demonstration-3



RApid Innovative payload demonstration SatellitE-3
RAISE-3
JAXA

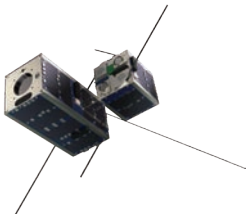


KOYOH
Kanazawa University



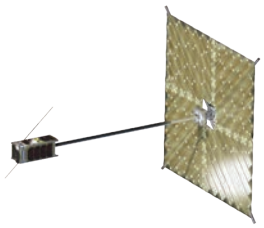
Platform for Extra and Terrestrial Remote Examination with LCTF
PETREL
Institute of Science Tokyo

Space Tethered Autonomous Robotic Satellite
STARS-X
Shizuoka University



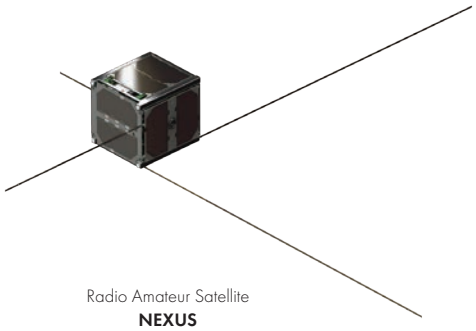
MAGnetically separating NAno-satellite with Rotation for Orbit control
MAGNARO
Nagoya University

Innovative Satellite Technology Demonstration-4 → Coming soon!

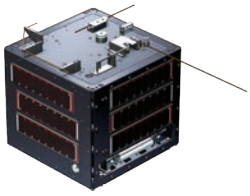


Multi-Functional Deployable
Membrane Structure Demonstrator
OrigamiSat-1
Institute of Science Tokyo

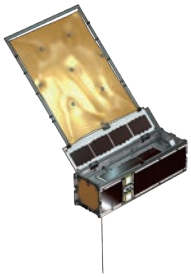
Lunar Exploration Technology
Demonstration Satellite
Aoba VELOX-IV
Kyushu Institute of Technology



Radio Amateur Satellite
NEXUS
Nihon University



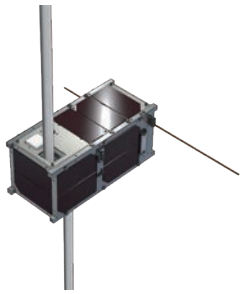
TeikyoSat-4
Teikyo University



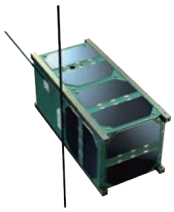
Advanced Satellite Toward
Exploration of dust enviRonment
with In-Situ Cosmic dust sensor
ASTERISC
Chiba Institute of Technology

AGU Remote Innovative
CubeSat Alert System
ARICA
Aoyama Gakuin University

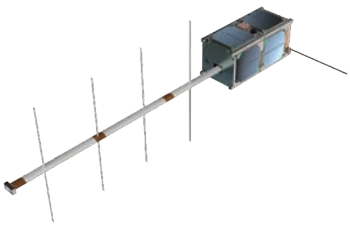
Advanced OBC of
NanoDragon
Meisei Electric Co. Ltd.



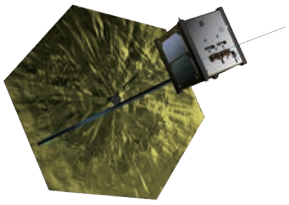
CubeSat for Technology Demonstration
of Jupiter Radio Observation
KOSEN-1
National Institute of Technology,
Kochi College



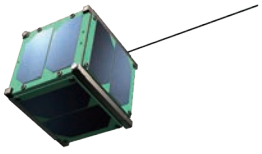
MITSUBA
Kyushu Institute of Technology



KOSEN-2
National Institute of Technology, Yonago College



WASEDA-SAT-ZERO
Waseda University



FSI-SAT
Future Science Institute

革新
INNOVATIVE
SATELLITE TECHNOLOGY
DEMONSTRATION PROGRAN

JAXA
INNOVATIVE
SATELLITES
3

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)

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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