



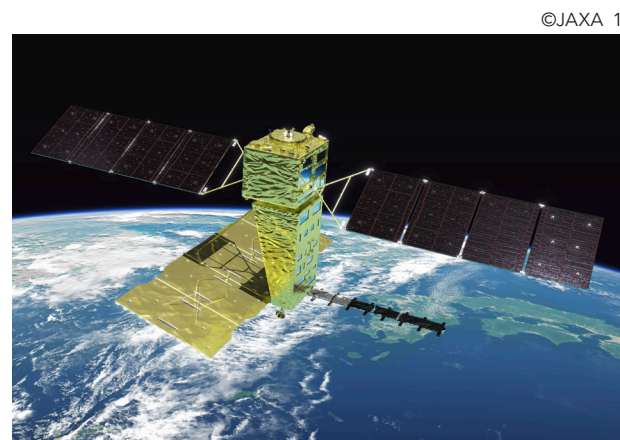
MITSUBISHI ELECTRIC SPACE SYSTEMS OVERVIEW





Since the 1960s, Mitsubishi Electric has been a pioneer of defense and space technology development, contributing significantly to Japan's national security and worldwide space development.

Utilizing our advanced technologies and production capacities, we develop and manufacture a diverse range of systems and solutions that help create a safe, secure, and sustainable society.



ALOS-4 (Advanced Land Observing Satellite-4)



GOSAT-GW (Global Observing SATellite for Greenhouse gases and Water cycle)

Earth Observation

Earth observation satellites monitor a wide range of phenomena across various fields, including maritime surveillance, disaster management, and environmental changes. By collecting data from space, these satellites generate valuable insights that assist resource management and help protect ecosystems.

Mitsubishi Electric is actively involved in developing observation satellites, including the ALOS series, which observe Earth day and night, and the GOSAT series, which monitors climate changes and greenhouse gases. We also develop data-processing equipment and advanced sensors that enhance these capabilities.

Communications and Broadcasting

Communications and broadcasting satellites provide high-capacity communication services to areas beyond the reach of terrestrial networks.

Mitsubishi Electric's communication and broadcasting satellites have been adopted in both domestic and international programs, providing reliable and stable communication services for the commercial and security sectors.

To meet global users' demands for cost-effectiveness and flexible communication methods, Mitsubishi Electric is developing the next generation of geostationary communication satellites, the Engineering Test Satellite-9.



ETS-9 (Engineering Test Satellite-9)



Es'Hail2

^{1,2} Provided by Japan Aerospace Exploration Agency.

Space Exploration

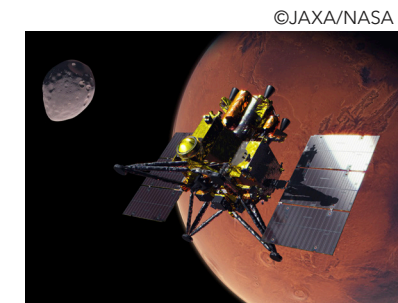
Scientific satellites and spacecraft are used for lunar, planetary, and astronomical observations as part of efforts to unravel the mysteries of the universe. These systems are equipped with a range of unique observation and data acquisition tools to identify new phenomena that drive scientific and human progress.

Mitsubishi Electric actively participates in this field including the Smart Lander for Investigating Moon (SLIM), which achieved the world's first high-precision landing on the lunar surface.

Furthermore, we also contributed to the Martian Moons eXploration (MMX) project, which aims to study the origin and evolutionary process of the satellites of Mars.



SLIM (Smart Lander for Investigating Moon)



MMX (Martian Moons eXploration)

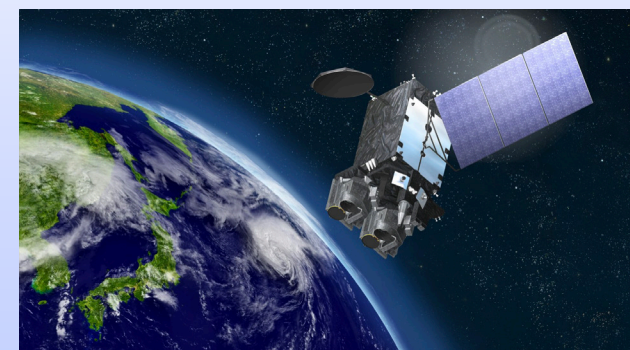
Meteorological Satellites

Meteorological satellites are an indispensable part of weather forecasting. They use meteorological imagers to collect and distribute weather data, leading to improvements in disaster prevention and more accurate weather information gathering.



Himawari-8, Himawari-9

Mitsubishi Electric is the main contractor for the development of Himawari-10, following MTSAT-2 (Himawari-7), Himawari-8 and Himawari-9, which have been responsible for Japan's meteorological observations for over the 20 years.



Himawari-10

Positioning

Satellite positioning technologies have become an everyday part of life as seen in the public's use of mobile phone map applications. To achieve more precise and continuous positioning information, Japan is constructing the seven-satellite Quasi-Zenith Satellite System (QZSS) constellation.

Mitsubishi Electric has developed the satellite bus and the Centimeter-Level Augmentation Service (CLAS). CLAS is a service limited to Japan. However, QZSS offers multiple services and provides positioning capabilities not only within Japan but also across the entire Asia-Oceania region, with expected applications in agriculture and marine industries.



QZSS (Quasi-Zenith Satellite System)



MICHIBIKI (Quasi-Zenith Satellite-1)

³ Provided by Japan Aerospace Exploration Agency.

International Space Station

Mitsubishi Electric participates in various projects for the sustainable activities of humankind in space, starting with "Kibo", the Japanese Experimental Module (JEM).

The H-II Transfer Vehicle (HTV) has been highly praised in Japan and internationally for its navigation guidance and control technology.

We also developed the HTV's successor, HTV-X. The HTV-X aims not only to deliver supplies to the ISS but also to serve as a platform for on-orbit technology demonstrations, experimental utilization, and future international space exploration initiatives.



HTV (H-II Transfer Vehicle)



HTV-X



Ground Control System for Himawari-8, 9



ALMA (Atacama Large Millimeter/submillimeter Array)

Ground System & Telescope

Ground systems are an indispensable component of satellite operation, including satellite tracking, control and data reception.

Our systems have been proven to perform efficiently in the full spectrum of antenna and satellite controls, providing a total solution from satellite to ground systems.

Mitsubishi Electric also contributes to the development of astronomy through radio and optical telescopes, such as the Subaru Telescope and the Atacama Large Millimeter/submillimeter Array (ALMA). Mitsubishi Electric is currently developing the Thirty Meter Telescope (TMT) and a solar telescope to be installed on SOLAR-C.



SSA Radar System



Optical telescope for SSA

SSA

Utilization of outer space is critical for collecting signals of natural disasters and securing surveillance capabilities over sea and airspace. Mitsubishi Electric contributes to building Space Situational Awareness (SSA) capabilities by maximizing our technologies for ISR capability and Deep Space radar (DSR) to track and monitor suspicious satellites and space debris that might pose a threat to Japan's satellites.

In addition, Mitsubishi Electric has applied optical telescope technology for astronomy to develop an optical telescope for SSA that enables high-precision observation of orbital objects. It operates as part of Japan's SSA system.

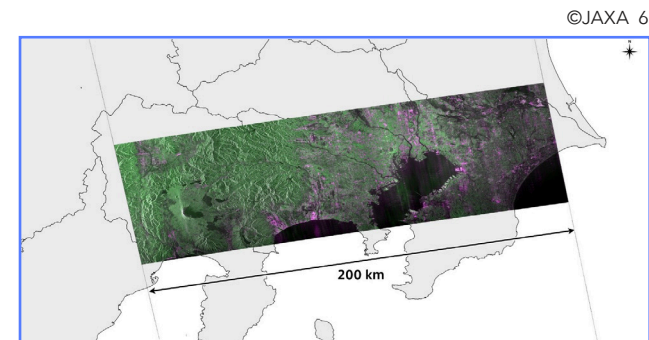
⁴ Provided by Japan Aerospace Exploration Agency. / National Aeronautics and Space Administration.

⁵ Provided by Japan Aerospace Exploration Agency.

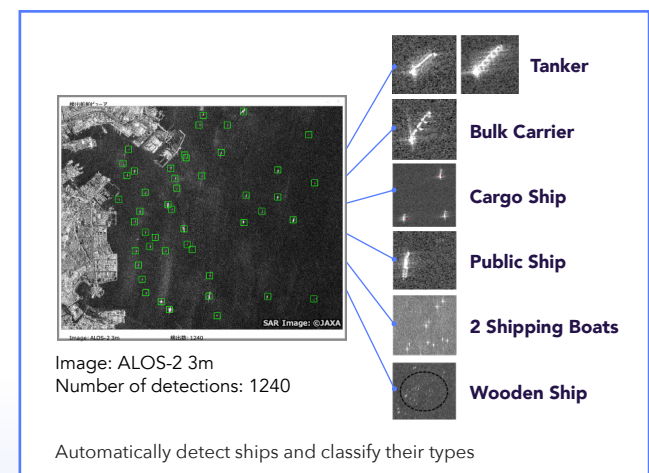


Space Capabilities for Defense Applications

To augment land, sea, and air defense, Mitsubishi Electric supplies a comprehensive range of space systems intended for defense applications. This includes Communications & Observation Satellites, Ground Infrastructure, Space Situational Awareness Systems, and Satellite Data Solutions.



First observation image from the ALOS-4



Automatically detect ships and classify their types

SAR Data Solution

SAR, or Synthetic-Aperture Radar, satellites enable continuous 24/7 observation, even in adverse weather conditions. The latest ALOS-4 satellite we manufactured can observe a 200 km-wide area at a 3m resolution.

By applying AI technology to such data, we provide satellite data services for security applications, including detecting and classifying vessels.

Additionally, we plan to develop, operate, and maintain systems for satellite constellations. Utilizing satellite constellation data to achieve faster, more advanced and near real time services.

We also provide optimal solutions through wide-area and near real-time observations.

Super-Resolution Technology for Optical Satellite Images

Our super-resolution technology can be applied to images from various optical satellites, boosting the resolution to twice its original level.

This capability is particularly valuable for the Navy in monitoring and identifying potential threats in vast maritime regions.



Original (Res. 60cm)

Processed using aerial photographs

Super-resolution processing (Res.30cm equivalent)

^{6,7} Provided by Japan Aerospace Exploration Agency. <https://www.satnavi.jaxa.jp/ja/news/2024/07/31/9609/index.html>

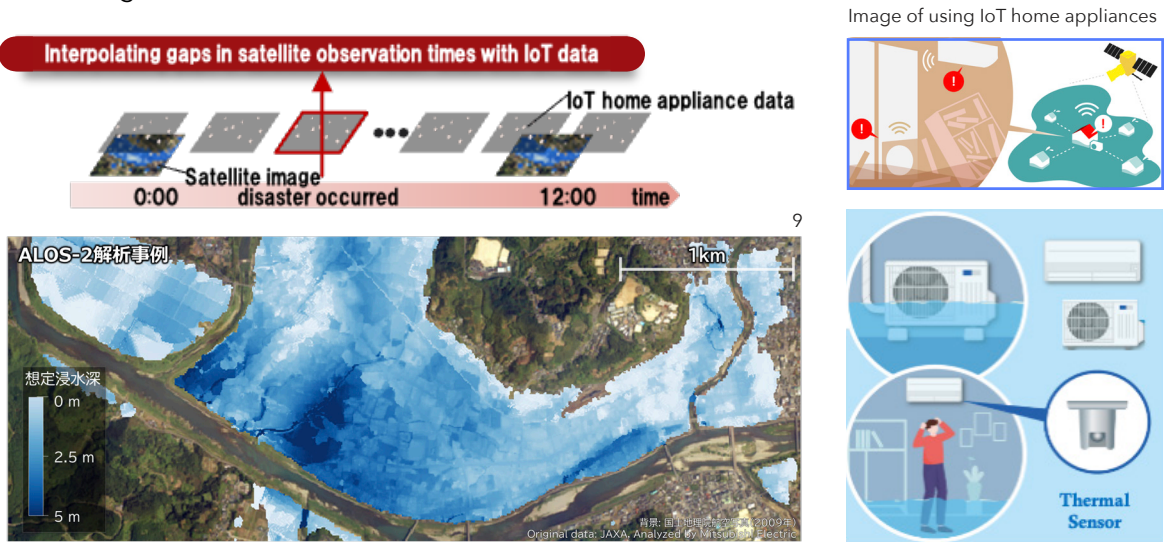
⁸ Geospatial Information Authority of Japan



Satellite Data Solution

Disaster Monitoring/Mitigation | SAR x IoT Solutions

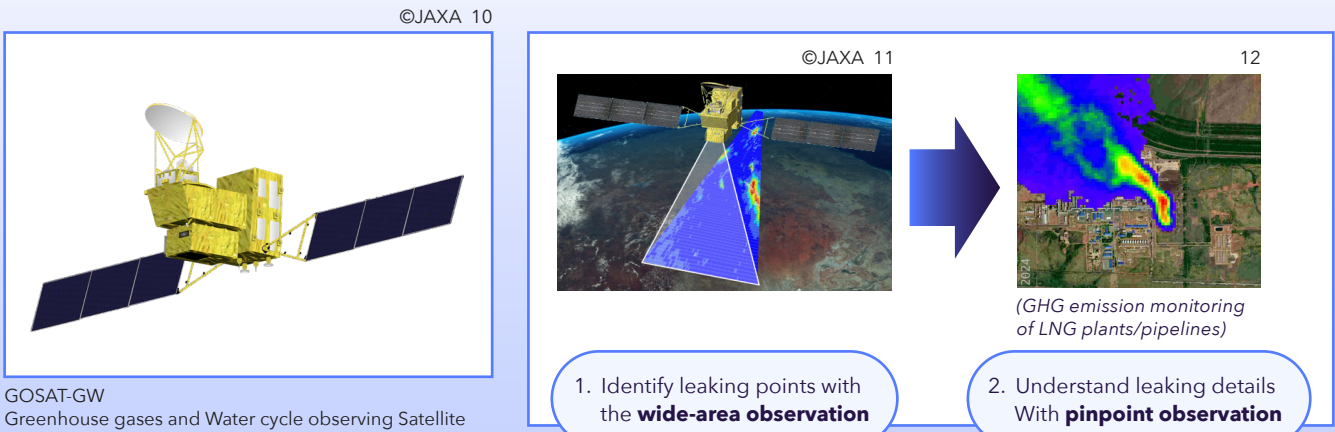
As one of the world's leading manufacturers of electrical and electronic products and systems, Mitsubishi Electric offers solutions that integrate wide-area satellite data with IoT point data. For disaster monitoring and mitigation, we combine satellite data with IoT appliance data, filling observational gaps between satellite passes and delivers highly accurate pinpoint information. Consequently, we achieve comprehensive, high-precision flood inundation monitoring on a wide scale.



GHG Emission Monitoring of LNG Plants/Pipelines

Creating New Value through Satellite-Based Visualization for a **Greener Earth**

Greenhouse gas emissions are a primary cause of global warming and a major factor in climate change, threatening the sustainability of our global environment. To monitor these emissions, objective, neutral, and traceable data are required. As an example of utilizing satellite data to measure greenhouse gas emissions, Satellite Data Service Corporation, Mitsubishi Electric, GHGSat, and MUFG Bank are conducting a project to monitor methane leakage from LNG plants and pipelines, potentially enabling early identification and repair of leaks. By combining the "Tip & Cue" approach—using wide-area satellite data to detect potential emission hotspots and then conducting pinpoint observations with GHGSat—this method aims to reduce greenhouse gas emissions more quickly and effectively.



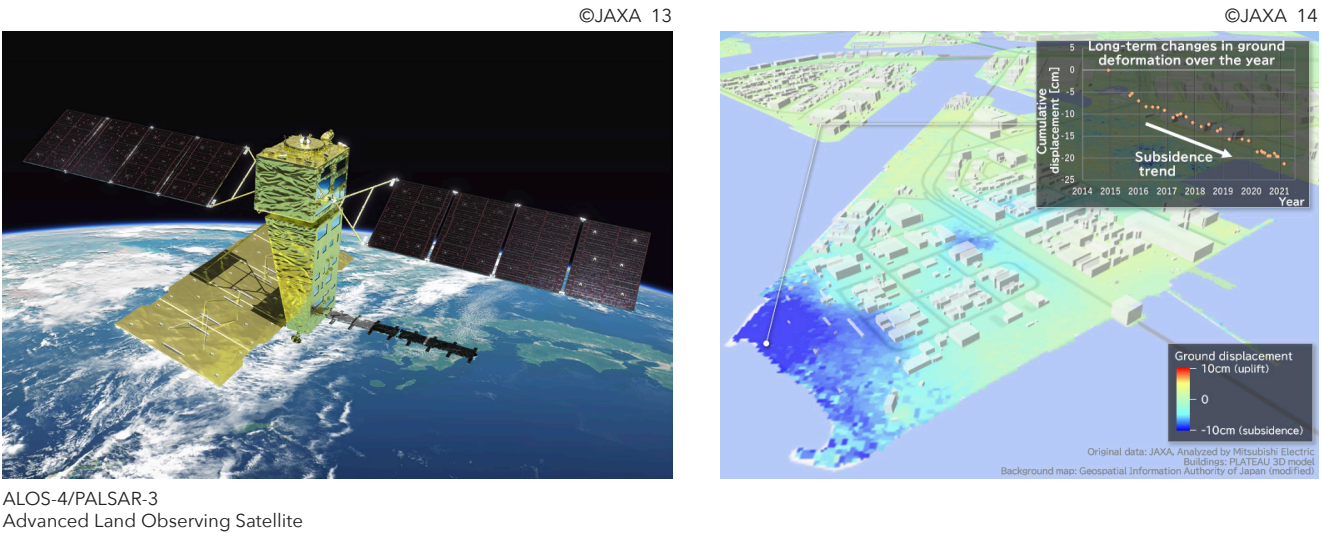
⁹ Background: Aerial photograph by Geospatial Information Authority of Japan (2009), Original data: JAXA, Analyzed by Mitsubishi Electric

^{10 11} Provided by Japan Aerospace Exploration Agency. <https://www.satnavi.jaxa.jp/ja/project/gosat-gw/index.html>

¹² Product: Column averaged CH₄ concentration in excess of local background by GHGSat
Background Image: ©Mapbox, ©OpenStreetMap and ©Maxar

Ground Deformation Monitoring via SAR Satellite Data

Satellite-Based Monitoring of Aging Infrastructure to Enable **Digital Transformation (DX)** and Enhance Efficiency



Time-series SAR analysis detects gradual ground deformations and infrastructure risks early, enabling experts to take preventive action before disasters occur. This technology leverages SAR satellite imagery to monitor surface changes over time and track the latest conditions. It applies not only to ground shifts but also to monitoring river embankments, bridges, buildings, and dams, and assessing the impact of construction and resource extraction projects.

Satellite-Driven City Innovation Project

Satellite and AI-Driven Insights to Enhance Well-Being in Mid-Sized Cities

Using our satellite data analysis technologies coupled with AI, we extract "city attributes" from satellite imagery of mid-sized cities. By integrating these insights with LWC (Liveable Well-Being City Index®) data, we evaluate the correlation between residents' well-being and regional characteristics or changes. These findings support the creation of urban environments that balance human well-being with the natural world.



¹³ Provided by Japan Aerospace Exploration Agency.

¹⁴ Original data: Provided by Japan Aerospace Exploration Agency.
Analyzed by Mitsubishi Electric

Buildings: PLATEAU 3Dmodel

Background: Geospatial Information Authority of Japan (modified)

¹⁵ Provided by Maxar Technology



Communication Systems



Source: Japan Ground Self Defense Force web site

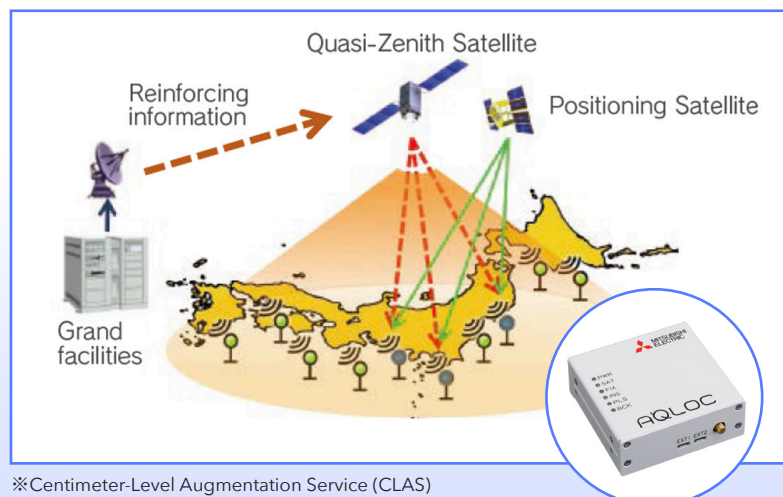


Source: Japan Maritime Self Defense Force web site

Mitsubishi Electric offers a lineup of various communications equipment for ground, shipborne, and satellite. These enable users' units to transmit from remote locations without existing infrastructure, such as in disaster response scenarios.



Positioning Systems



※Centimeter-Level Augmentation Service (CLAS)

This is the world's smallest positioning terminal. It receives CLAS signals from quasi-zenith satellites, and contributes to high-precision positioning of agricultural equipment, construction equipment, trains and drones etc.

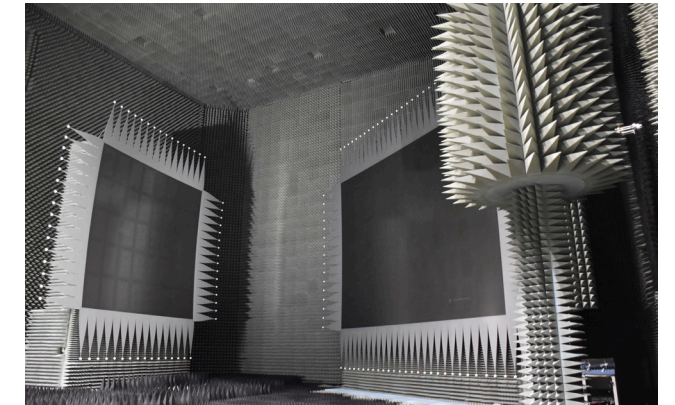


Production Capacity

Mitsubishi Electric is the sole Japanese manufacturer capable of consistently and comprehensively developing satellites, including everything from the design to manufacturing and testing to operation, with the capacity to produce multiple large satellites in parallel. In addition, we have the production facilities and technological expertise to meet the diverse needs of our customers and requirements for delivering a satellite into orbit.



Thermal vacuum chamber



Compact antenna test range



New facility at Kamakura Works

A planned expansion of our facility would increase production efficiency, shorten production time, reduce costs and elevate product quality for enhanced competitiveness.

It incorporates information technologies based on Mitsubishi Electric's e-F@ctory solutions, which extract hidden benefits from existing resources through integrated automation to realize improved efficiencies, reduced costs and increased productivity.

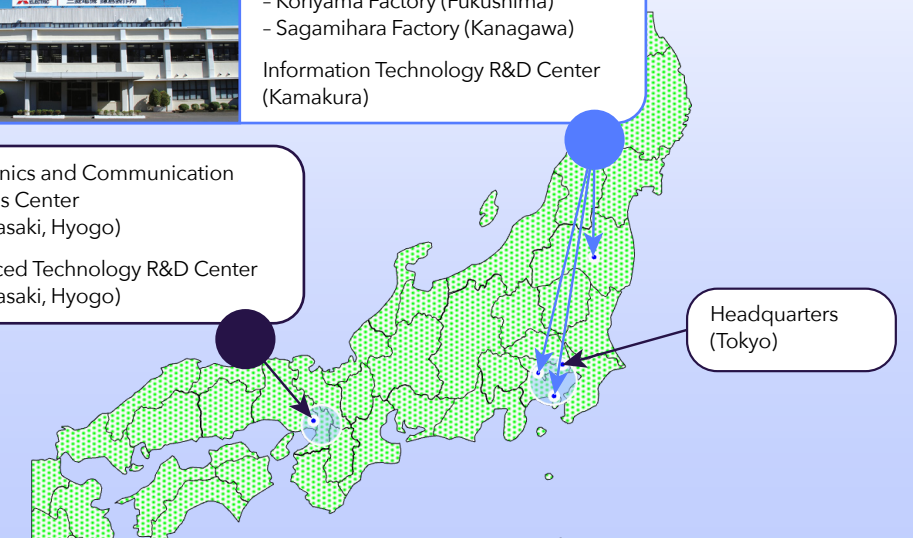
Together with existing facilities, Mitsubishi Electric's combined annual capacity will increase to 18 satellites.



Kamakura Works (Kamakura)
- Koriyama Factory (Fukushima)
- Sagami Factory (Kanagawa)
Information Technology R&D Center (Kamakura)



Electronics and Communication Systems Center (Amagasaki, Hyogo)
Advanced Technology R&D Center (Amagasaki, Hyogo)



¹⁶ Reference: Japan Ground Self Defense Force web site. <https://www.mod.go.jp/gsdff/equipment/ce/index.html>

¹⁷ Reference: Japan Maritime Self Defense Force web site. <https://www.mod.go.jp/msdf/equipment/aircraft/patrol/p-1/>

MITSUBISHI ELECTRIC CORPORATION

Please visit the following website for further details.

<https://www.mitsubishielectric.com/en/products-solutions/space/index.html>

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