JAXA updates and Current JAXA EEE program activities

Japan Aerospace Exploration Agency
Deputy Director for Safety and Mission Assurance department
Koichi Suzuki

JAXA Overview - Organization

As of April 1, 2024

General Auditor — **General Auditor Office**

YAMAKAWA Hiroshi
President

ISHII Yasuo
Senior Vice President

KOHATA Hiroki
Senior Chief Officer of Mission Assurance

- **Safety and Mission Assurance Department**

Senior Chief Engineer

- Chief Engineer Office

OKADA Masashi
Vice President
Director General

- Space Transportation Technology Directorate

TAKIGUCHI Futoshi
Vice President
Director General

- Space Technology Directorate I
- Space Technology Directorate II
- Spectrum Management Office
- Space Tracking and Communications Center
- Tsukuba Space Center Administration Department

MATSUURA Mayumi
Vice President
Director General

- Human Spaceflight Technology Directorate
- JAXA Space Exploration Center (JSEC) *Except Martian Moons Exploration Project Team
- Exploration Innovation Hub Center

KUNINAKA Hitoshi
Vice President
Director General

- Institute of Space and Astronautical Science (ISAS)
- JAXA Space Exploration Center (JSEC) *For Martian Moons Exploration Project Team

INABA Noriyasu
Vice President
Director General

- Aeronautical Technology Directorate
- Research and Development Directorate
- Environmental Test Technology Unit

SATOH Toshiaki
Vice President

- Strategic Planning and Management Department
- Public Affairs Department
- International Relations and Research Department
- Security and Information Systems Department
- Business Development and Industrial Relations Department
- Space Education Center

HARA Katsuhiko
Vice President

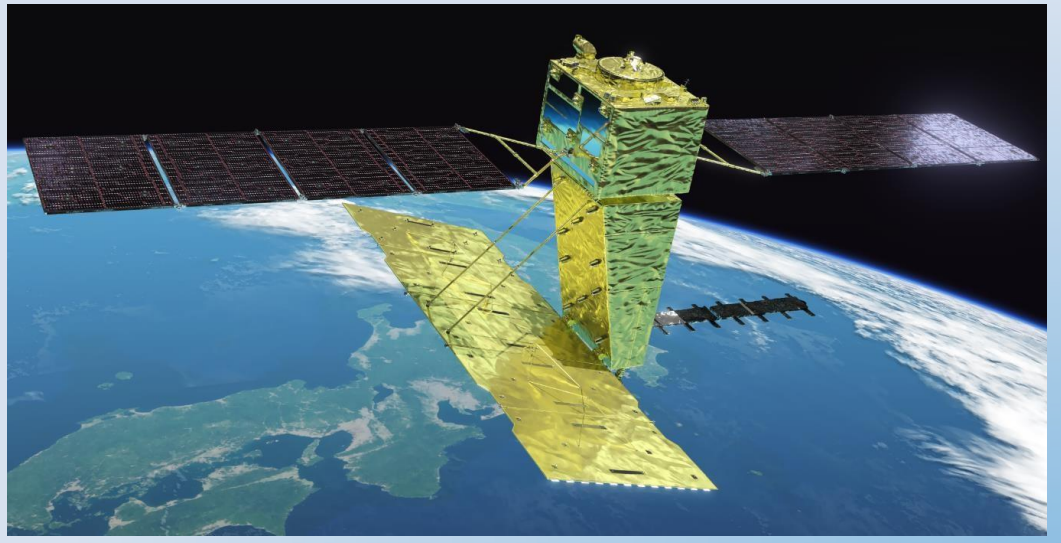
- Evaluation and Audit Department
- Work-Life Support and Diversity Office
- General Affairs Department
- Human Resources Department
- Finance Department
- Procurement Department
- Ground Facilities Department

H3 Rocket / ALOS-4

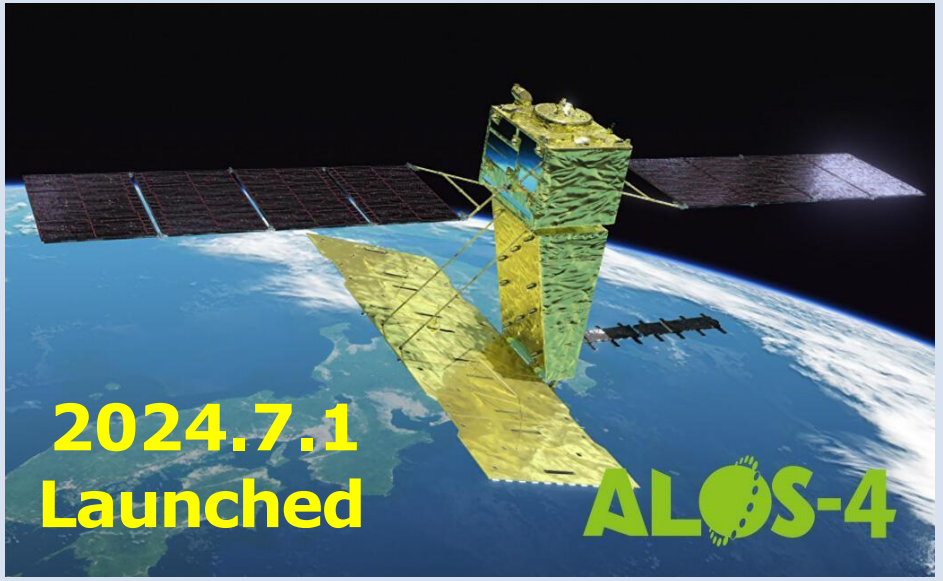
◆We launched the Advanced Land Observing Satellite-4 “DAICHI-4” (ALOS-4) aboard the third H3 Launch Vehicle at 12:06:42 (JST) on July 1, 2024 from the Tanegashima Space Center.

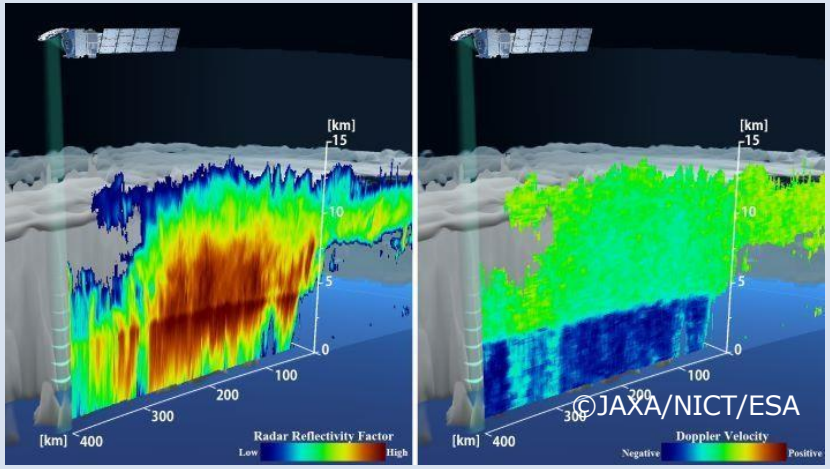
H3 Launch vehicle

➢Launch capability : more than 6.5t to GTO

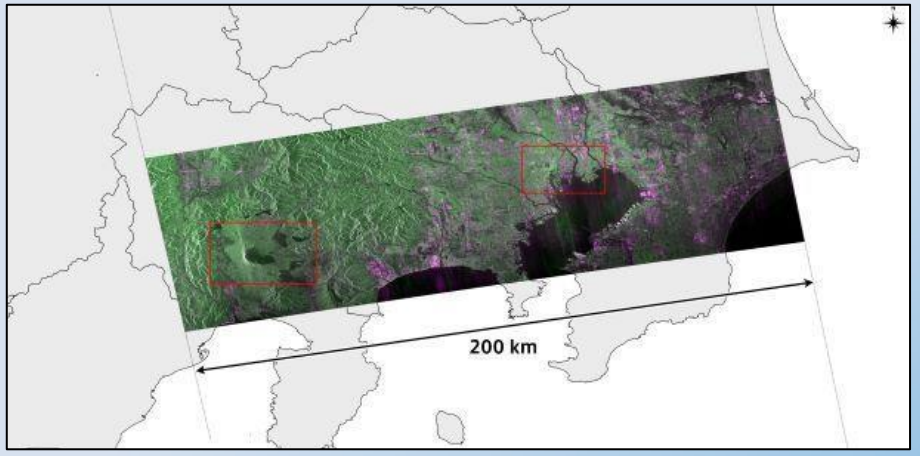


EarthCARE/CPR& ALOS-4 - Launch & Observation





Three-dimensional diagram showing the vertical distribution of the radar reflectivity factor (left) and Doppler velocity (right) by the CPR.



Observation including the Kanto region PALSAR-3 (Resolution 3 m, observation width 200 km)

Lunar Surface Landing

▲ Images of the Lunar surface taken by Transformable Lunar Robot “SORA-Q”

SLIM (Smart Lander for Investigating Moon) & Lunar Excursion Vehicles

- Launched by HIIA 47 on Sep. 7th, 2023
- Successfully landed on the lunar surface on January 20th JST, 2024, and achieved high-precision (“pinpoint”) landing technology

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Gateway & New JAXA Astronauts

Hello! EXPLORERS PROJECT

Gateway

SUWA Makoto

YONEDA Ayu

Source: https://www.nhk.or.jp/shutoken/newsup/20230301a.html

Crew Pressurized Rover

Expanding Human Sphere of Activities to the Moon...

Current JAXA EEE program activities

Object of JAXA EEE parts program

To ensure and keep risk free condition regarding parts for JAXA space system development.

Parts Risk:
Quality & Procurement

Basic Tactics of JAXA EEE parts program

(1) Management of strategy and initiatives

(2) Development of the strategic parts to upgrade JAXA space systems.

(3) Wider utilization of JAXA Qualified parts

(4) Improvement of imported parts acquisition (ensuring the quality of the imported parts)

(5) Cooperation with oversea partners

(6) Development of methods related terrestrial parts for space application

Current topics regarding
Tactics #1 Management of strategy and initiatives

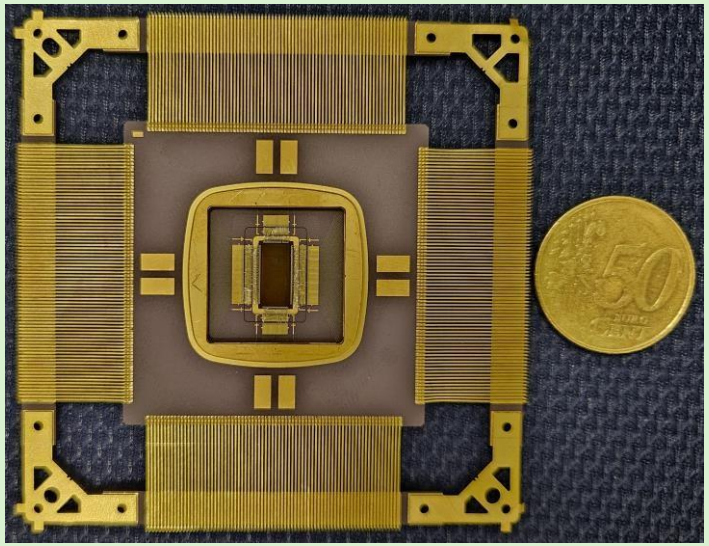
- Space parts technology consortium of Japan has established by space industries in 2023. As of July 2024, 14 companies are consisted consortium not only traditional space but also new space companies. JAXA is also member of consortium.
- Discussion in Space parts technology consortium of Japan is giving good understanding for current issue and future trend for space parts.
- Space parts technology consortium is summarizing comments and requests for JAXA's Space parts technology road map.
- JAXA's Space parts technology road map will updated referring comments and requests from Space parts consortium.

Current topics regarding
Tactics #2 Development of the strategic parts
to upgrade JAXA space systems

- JAXA R&D Directorate is developing strategic parts to support next decade high performance digital satellites.

- Development of new MPU named SOI-SOX4 completed February 2025. SOI-SOX4 will be aligned JAXA qualified parts in near future.
- Research of next generation FPGA using nano-bridge technology is proceeding now. Nano-bridge is non-volatile memory technology with good radiation tolerance.

HR5000S



・Performance
77CoreMark@50MHz
・Power Consumption
390mW
（Vdd=1.5V, 25℃,
Nominal condition）
・non-SoC

- ✓ 10 Times Higher Performance
- ✓ Low Power Consumption
- ✓ Variety Interface Protocols
- ✓ Reduce Parts Size(1/4)& Weight(1/4)

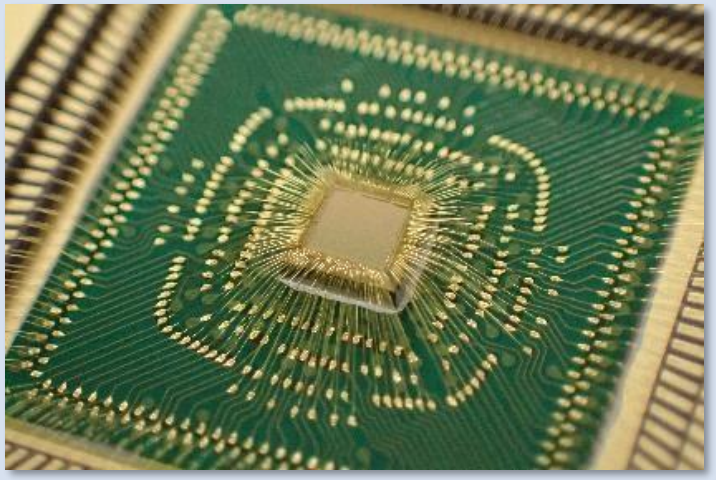
SOISOC4

・Performance
1041CoreMark@200MHz
(2.6coremark/MHz/core)
・Power Consumption
about 1W
（Vdd=1.2V, Vccq=3.3V, 25℃,
Nominal condition）
・System on Chip (SOC)
➢ On-chip Memory (code 4MB, share 2MB local 128kB)
➢ Variety I/O：
SpaceWire, 1553B, Ethernet, CAN, GPIO, etc.
➢ **Security (encryption)**
・Radiation Tolerant：
Local RAM：LETth≧40MeV/(mg/cm^2)、High Density
SRAM :LETth≧25MeV/(mg/cm^2) @LEO with a scrubbing

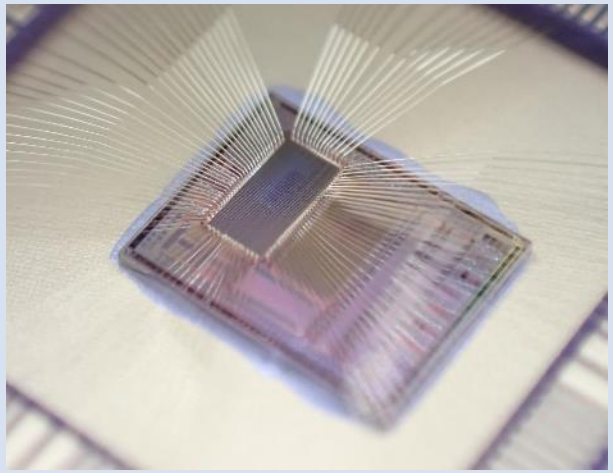
Atom switch based non-volatile FPGA “Nano-bridge FPGA”

In a two-year study starting in 2021, we have successfully completed the devising of RHBD circuits applicable to 16nm FinFET technology and the prototype evaluation of FPGA element circuits combined with nanobridge technology.

As a next step, a high-end SoC FPGA design based on these results is now underway, with the SoC design and prototyping scheduled for completion in 2025.



(a) 16nm Fin-FET RHBD



(b) Nano-Bridge FPGA element circuits

Next Step

Designing SoC(Completed)

Now Wafer fabrication and evaluation is in progress.

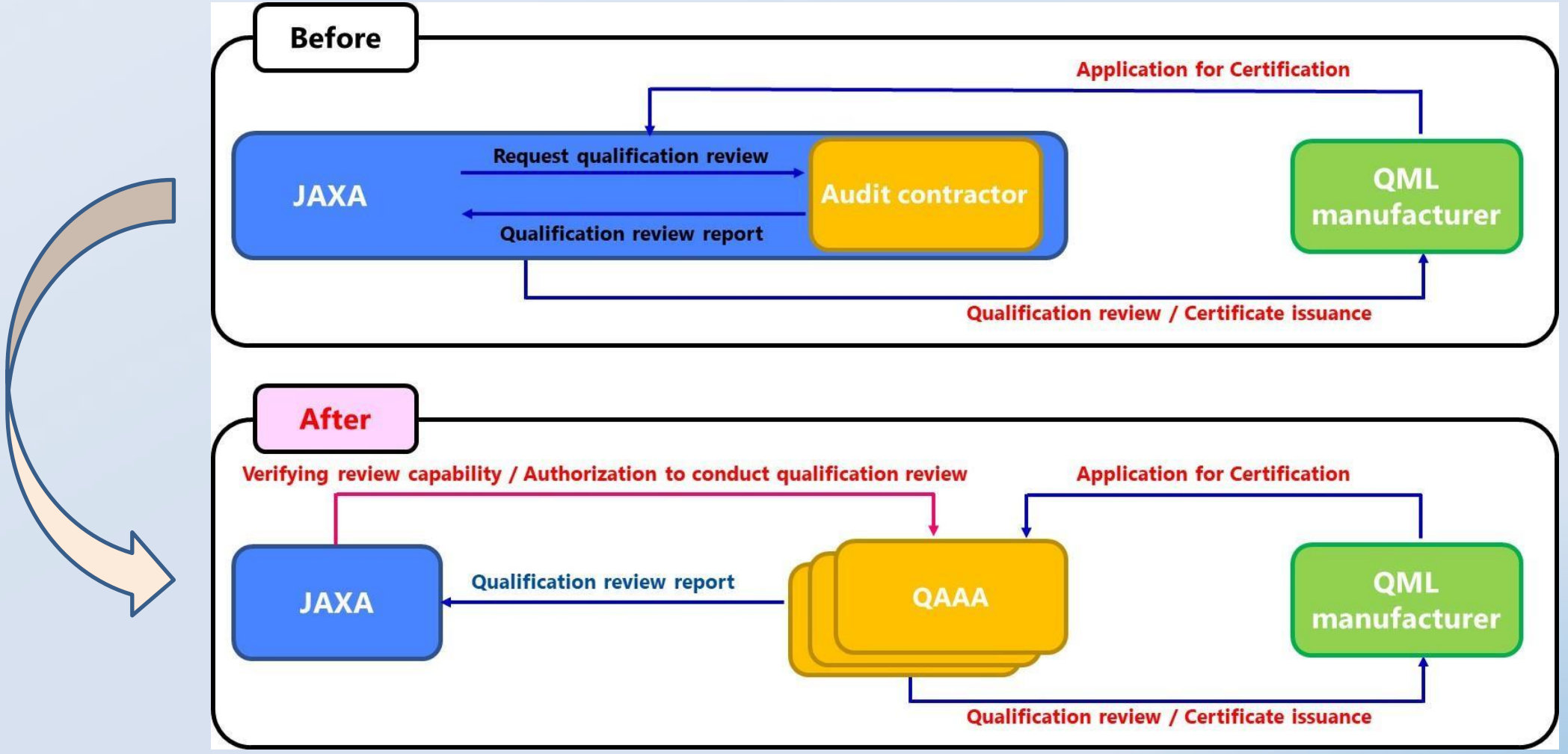
Current topics regarding
Tactics #3 Wider utilization of JAXA Qualified parts

(1) Transfer of qualification review to the private sector

- Qualification review has transferred to the private sector based on JAXA's business policy. Today, Qualification Audit Acting Agency (QAAA) is reviewing qualified manufacturers.
- HIREC and AES are certified as QAAA by JAXA.

- JAXA EEE parts engineers concentrate insertion next decade space parts technologies such as QTS updating, COTS evaluation methods.
- Communication with qualified manufacturer is useful activity to investigate technological generation change for EEE parts.

Transfer of qualification review to the private sector



Current topics regarding

Tactics #3 Wider utilization of JAXA Qualified parts

(2) JAXA QTS updating

- The efficiency of Screening and Quality Conformance Inspection (QCI) shall be improved to further reduce parts price.
- Upcoming major space crafts extend mission life up to 20 years. Reliability of EEE parts should be to meet space crafts mission life.
- Several working groups consisted by Space system manufacturers, qualified manufacturers and JAXA are evaluating JAXA QTS.
- Updated JAXA QTSs in FY 2024 are follows.

  JAXA-QTS-2180 : Platinum sensor

  JAXA-QTS-2220 : XO

  JAXA-QTS-2160 : Thermistor

✓製品名：耐放射線プローブシース形白金温度センサ
✓個別仕様書番号：JAXA-QTS-2180/103A

Current topics regarding
Tactics #3 Wider utilization of JAXA Qualified parts

(3) New entry manufacturers

- Non-space parts manufacturers have interest to get space qualification are requesting explanation of JAXA qualified parts system.
- CMK (PWB), Iriichi(Transformer) took JAXA qualification in 2023, 2024.
- Several manufacturers are considering to take JAXA qualification now.

(4) Impact surveillance of material regulations

- The impact surveillance of material regulations is continuing to cooperate with qualified manufacturers because of material regulations are giving impact for qualified manufacturer's business continuity.

➔ *PFAS issue will be presented by other presentation.*

Current topics regarding
Tactics #3 Wider utilization of JAXA Qualified parts

(5) 50 years anniversary for JAXA qualified parts supply

- JAXA qualified parts system has reached 50 years anniversary in 2023.
- JAXA sent letter of appreciation and memorial gift to the manufacturers of parts suppling 50 years.

November 2023 : Murata

December 2023 : Tamura, JAE, SHARP

November 2024 : Sanada KOWA

Current topics regarding
Tactics #5 Cooperation with oversea partners

(1)ESA-JAXA cooperation in the field of components and materials

- This cooperation gives important foundation of long term good relationship between JAXA and ESA in the filed of components and materials since 2007.
- Frequent working group meetings and Steering committees hold under this cooperation to exchange information, to set joint activities and so on.
- Current topics are development of space components, COTS usage, PFAS regulation, Lead free soldering and new technology insertion.

Current topics regarding
Tactics #5 Cooperation with oversea partners

(2)CNES-JAXA cooperation related to space environment and component

- Joint action group has acted under Interagency agreement to exchange Information concerning space environment and space components such as contamination, radiation assurance.

Current topics regarding
Tactics #5 Cooperation with oversea partners

(3)DLR-JAXA cooperation related to usage of automotive components in space applications.

- New cooperation started between DLR and JAXA in2023.
- This cooperation is focusing on usage of automotive components in space application. Also, DLR and JAXA encourage the cooperation between Japanese and German industries under this cooperation not only bilateral agency's cooperation.
- Semi-annual Workshop and bilateral working group hold under this cooperation.

Current topics regarding
Tactics #6 Development of methods related terrestrial parts for space application

(1) Radiation Tolerance Evaluation by Simulation

- Demand of COTS usage in Japanese space system is increasing not only new space but also traditional space. However radiation tolerances of COTS is unclear. Japanese space industry wants to confirm radiation tolerance for various type of COTS.
- Japanese irradiation test chance for space industry is decreasing because of aging of facility, increasing of non space area research.
- Radiation Tolerance Evaluation by Simulation is expecting as solution of confirmation of COTS radiation tolerance. This simulation Is developing under joint research with JAEA.

Radiation Tolerance Evaluation by Simulation

Background

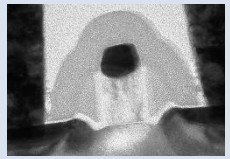
Increasing of COTS usage in space application

Decreasing of radiation facilities availability

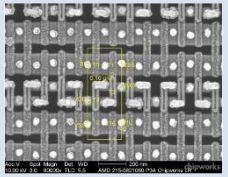
Shortage of radiation test chance !

Construction and characteristics of semiconductor

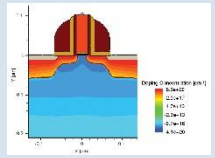
Tr. cross section /SRAM



https://www.tsmc.com/japanese/dedicatedFoundry/technology/logic/l_65nm

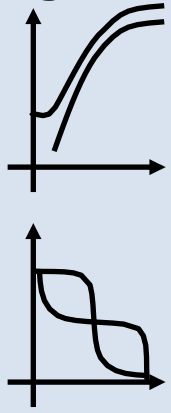


https://www.techinsights.com/ja/node/33404



Ma, T.. "Multilevel Modeling of Layout Impact on Mobility Enhancement with Dual Stress Liners 5 Simulation of a 45-nm CMOS Technology in TCAD Sentaurus." (2007).

DC IdVg, IdVd, SNM

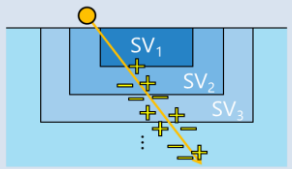


JAEA PHITS

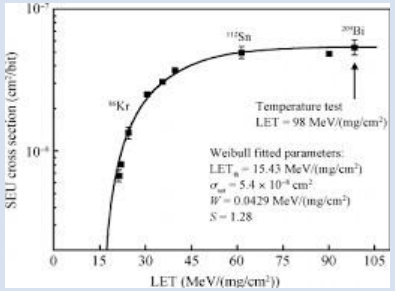
$$Q_{coll} = \sum_{i=1}^{n} \alpha_i \times Q_{dep,i}$$

Q_{coll} : 収集電荷量
$Q_{dep,\,i}$: i-th SV における付与電荷量
α_i : i-th SV における電荷収集効率

○ 多重SVモデル

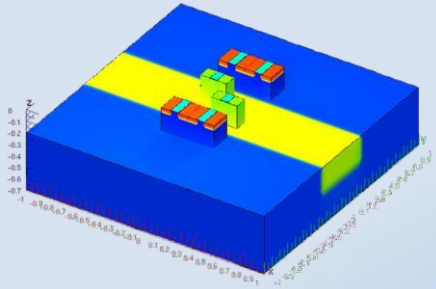


Real test data Cross-section, LETth



Compare and verify

JAXA TCAD



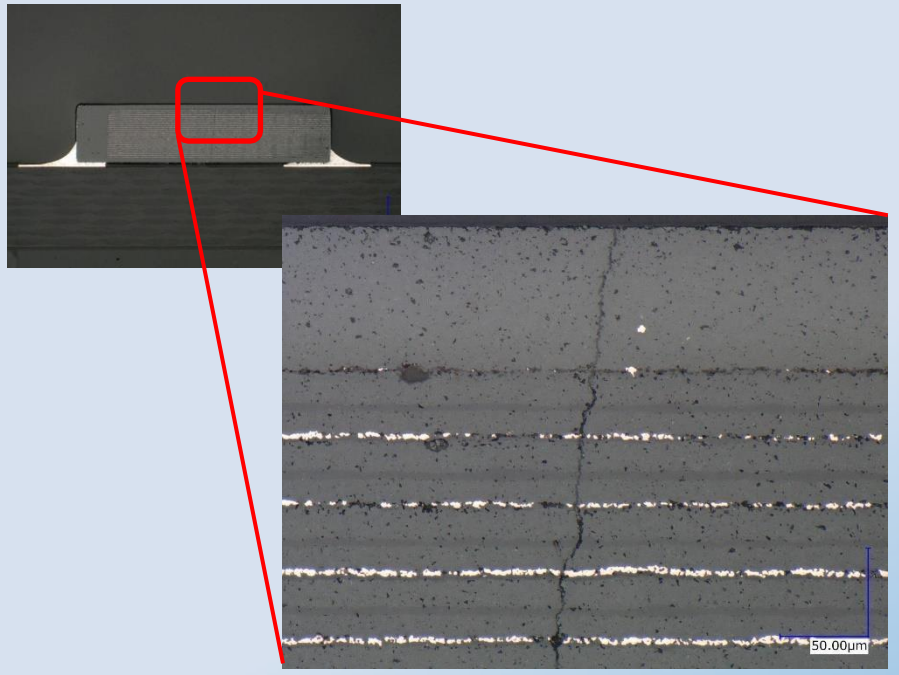
Simulated Cross-section, LETth

SEU rate on orbits

Current topics regarding
Tactics #6 Development of methods related terrestrial parts for space application

(2) COTS evaluation

➢Several automotive grade passive parts were evaluated referred JAXA-QTS or other standards to confirm capability of space use. Several problem are observed. (ex. Crack)



➢Radiation tolerance of COTS SSD was evaluated. Knowledge of this evaluation will be added JERG-2-143.

-> COTS SSD activity will be presented by other presentation.

Current topics regarding
Tactics #6 Development of methods related terrestrial parts for space application

(3) JERG related COTS usage

➢JERG-0-052B : “COTS parts for space usage Handbook (General) ” was updated major concept change.

COTS was a supplemental option of Space qualified parts in the previous version. COTS is an acceptable parts in the updated version.

➢NEW JERG : “COTS parts for space usage Handbook (for Small & CubeSat)” will be issued near future in 2025. This JERG explains knowledge, lessons learned and attention to use COTS for small sat & cube sat.

Current topics regarding
Tactics #6 Development of methods related terrestrial parts for space application

(3) JERG related COTS usage

➢JERG-0-064 : “Space application process standard for lead-free components” was issued in April 2024. This JERG explains over coating requirement to use lead free components in the short life and GEO sats.


Thank you for your attention