Electrical, Electronic, and Electromechanical (EEE) Parts Selection Idea For The Advanced Solid Rocket

April 14, 2008

○Kazuhiro Matsuzaki, Makoto Tamura, Koji Sunami, Tatsushi Izumi, Takayuki Imoto, Yasuhiro Morita

Space Transportation Mission Directorate
Japan Aerospace Exploration Agency
(JAXA)

Contents

1. Advanced Solid Rocket (ASR)

2. Rocket Avionics System

3. EEE Parts Activity

Advanced Solid Rocket (ASR)

- Purposes
  - To respond to the demands of small satellites flexibly and efficiently.
  - To evolve the solid rocket system technologies we had accumulated.

Advanced Solid Rocket (ASR)

◆ Aims (Quantitative Aims)

	ASR (Aims)	【References】 M-V rocket (Past results)
Payload ・LEO (250×500km) ・SSO transition (250×500km)	**1.2 tons** **0.6 tons**	1.8 tons 0.9 tons
Manufacturing lead time	**< 1 year**	3 years
Launch campaign period (From 1st stage VOS to one day after launch)	**7 days**	42 days

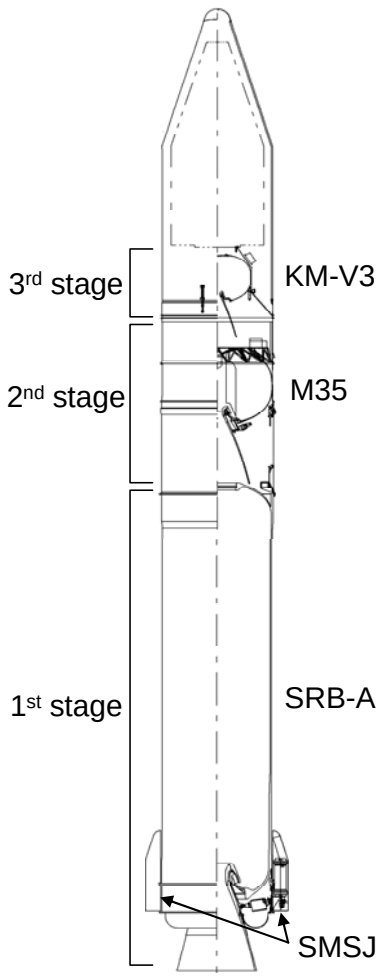
Advanced Solid Rocket (ASR)

- Development Policies

1. Flexible correspondence to small satellites
   - Corresponds to various orbits.
   - Mitigate the payload mechanical environment.
   - Corresponds to high frequency launching for a short term.
2. Reliability improvement
   - Share and strengthen the infrastructure with H-IIA rocket.
3. Cost reduction
   - Pursue the ground equipment simplification and the launch operation efficiency.
   - Balance with the advanced technologies.
4. Operability improvement
   - Adopt the next generation standard technologies.
   - Shortening of the period for the rocket assembly operations.
   - Utilize the advanced electronic intelligence networks.

Advanced Solid Rocket (ASR)

◆ Main Specification



Item		Specification
Length		23.7 m
Diameter		2.5 m
Total mass		90.2 tons
Stages		3 stages
Payload		・LEO(250× 500km) :1.2 tons ・SSO transition(250× 500km) :0.6 tons
1st stage	Motor	SRB-A
	Propellant	Poly-butadiene composite
	Attitude control	TVC + Solid Motor Side Jet (SMSJ)
	Total mass	74.5 tons
2nd stage	Motor	M-35
	Propellant	Poly-butadiene composite
	Attitude control	TVC + RCS
	Total mass	12.9 tons
3rd stage	Motor	KM-V3
	Propellant	Poly-butadiene composite
	Attitude control	Spin-stabilized (+G/J)
	Total mass	2.8 tons
Guidance system		Inertial guidance system

Rocket Avionics System

- What The Rocket Avionics System Should Be
  - Conditions
    1. Assume the future of the next around 10 years.
    2. Rocket avionics system should be as the key component to be able to give the rocket a competitive power.
  - Results
    1. Property
       - Maintainability & Expandability
       - Flexibility
    2. Innovation of system architecture
       - Modularization
       - Networking
    3. Innovation of implementation conformation
       - Digitization & Software of avionics element functions
       - Installation of automated onboard testing function and flight safety function
       - Advancement of the power supply system

Rocket Avionics System

- Direction Of The Research And Development

1. Modularization & Networking
   - Unification of interface for modules.
   - Modularization at each level.
   - Networking of the main onboard equipment.
   - Networking of the ground equipment.
2. Digitization & Software
   - Electrification of end-effectors and the digital interface of sensors.
   - RF, IF, and a base-band signal processing module.
   - Software-defined radio method.
3. Installation of automated onboard testing function and flight safety function
   - Automated onboard testing function
     - Development and performance proof about the fundamental module constitution of the interface devices.
     - Evaluate the technical maturity and introduce it into functions step-by-step .
   - Flight safety function
     - Perform a trade-off study of the judgment algorithm suitable for each flight phase.
     - Fundamental technology development and step-by-step proof.
4. Advancement of the power supply system
   - Substitution from the mechanical relay to the semiconductor relay.
   - Addition of the restraint function for the short circuit trouble propagation.
   - Uptake the control equipment to the network.

Rocket Avionics System

- ASR Avionics Development Plan
  1. High speed serial bus [Important item]
  2. Installation of automated onboard testing function [Important item]
  3. Improvement of built in test (BIT) coverage
  4. Installation of onboard equipment data acquisition function
  5. Innovate of the launching control system

EEE Parts Activity

- What The EEE Parts Should Be
  - Conditions
    1. Based on what the rocket avionics should be such as maintainability, expandability, flexibility, modularization, and networking.
  - Results
    1. Necessary condition
       - Plenty of quality and reliability as the rocket.
       - Low cost.
       - Procurement stability.
       - Radiation tolerance (Single event effect).
    2. Unit of modularization
       - Diversion and reuse of module are possible.
       - Module can be inspected.

         > MPU module, A/D&D/A converter module, Power supply module, Bus interface module.
    3. Necessary parts for modules
       - Special parts are not necessary.
       - We can choose the most suitable parts among the general-purpose parts of each field.

EEE Parts Activity

- Management Methods
  1. Standardization of rocket parts selection standard
     - Unify different parts selection and procurement requirements
  2. Standardization of rocket parts
     - Minimize the number of styles and generic types
  3. Package and joint procurement of rocket standard parts
     - Restrain parts cost
     - Ensure parts of short product life cycle

Conclusions

- Introduced
  - ASR
  - What The Rocket Avionics System Should Be
  - Rocket EEE Parts Activity
- ASR
  - Preliminary design study on-going
- Concrete plans
  - Push the study to make the concrete plans