JX-ESPC-101133-B

JEM Payload Accommodation Handbook
- Vol. 8 -
Small Satellite Deployment
Interface Control Document

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Japan Aerospace Exploration Agency (JAXA)

REVISION HISTORY

Rev.	Date	Description	Remarks
NC	2013/03	-	Initial Release
A	2013/05	Refer to JMX-2013116	
B	2015/01	Refer to JMX-2014444	
C			
D			

Contents

Appendices

1. Introduction

1.1. Overview

This document defines the technical interface requirements and safety requirements for a satellite to be released from the JEMRMS using the JEM Small Satellite Orbital Deployer (J-SSOD).

A satellite provider shall show the compliance that the satellite meets the requirements defined in this document.

The interface requirements between the J-SSOD and a satellite are developed based on the reference document (1) CubeSat Design Specification rev.12 published on August 1st, 2009 by the California Polytechnic State University with JEM unique requirements. (Refer to Appendix B "Correspondence to CubeSat Design Specification, Rev.12")

1.2. Scope

The interface requirements between the J-SSOD and a satellite in this document are applied to the satellite to be deployed from the JEMRMS.

The requirements defined in this document assume that the satellites will be un-powered from the launch to the deployment.

(So if a satellite requires the activation before the deployment in such case that a crew will access the satellite for the activation, the additional requirements such as the EMC will be addressed and the satellite shall meet these requirements.)

1.3. Documents

1.3.1. Applicable Documents

The latest versions of the following documents form a part of this document to the extent specified in this document. In the event of a conflict between the documents referenced herein and the contents of this specification, the contents of this specification shall be considered a superseding requirement.

(1) JSX-2010026	On-orbit Safety Requirements for a small satellite using J-SSSOD (Japanese Only)
(2) JMR-006	Configuration Control Standard (Japanese Only)
(3) CR-99117	JAXA Requiremetns for ISS Program Materials and Process Control (Japanese Only)
(4) CR-99218	JEM Materials Selection List (Japanese Only)
(5) MSFC-HDBK-527F (JSC-0904F)	MATERIALS SELECTION LIST FOR SPACE HARDWARE SYSTEMS
(6) JMR-003	Space Debris Mitigation Standard (Japanese Only)
(7) ASTM-E595-84	Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment
(8) MIL-A-8625	Anodic Coatings for Aluminum and Aluminum Alloys
(9) JMX-2012164 Appendix-2	JSC Frequency Authorization Input Form
(10) JSC Form 1230	Flight Payload Standardized Hazard Control Report
(11) ATV/HTV/KSC From 100	Integrated Safety Checklist for ISS Cargo At Launch or Processing Sites
(12) JMX-2012694	Structure Verification and Fracture Control Plan for JAXA Selected Small Satellite Released from J-SSOD
(13) SSP51700	Payloads Safety Policy and Requirements for the International Space Station
(14) SSP52005	Payload Flight Equipment Requirements and Guidelines for Safety-Critical Structures
(15) NASA-STD-5003	Fracture Control Requirements for Payloads using the Space Shuttle
(16) NSTS/ISS-13830C	Payload Safety Review and Data Submittal Requirements
(17) SSP50005	ISS Flight Crew Integration Standard
(18) SSP30233	Space Station Requirements for Materials and Process
(19) IADC-02-01	IADC Space Debris Mitigation Guidelines

1.3.2. Reference Documents

The following documents are referenced to develop this document.

(1)	NASDA-ESPC-1681A	JEM Payload Safety & Product Assurance Requirements (Japanese Only)
(2)	CubeSat Design Specification rev.12 (issued by California Polytechnic State University on 2009/08/01)	
(3)	SSP57003	Attached Payload Interface Requirements Document
	(57003-NA-0114	Correct Link for the JSC Frequency Management Homepage in 3.2.2.4.10, and Add New Radio Frequency Certification Requirement
	57003-NA-0115A	Add Deployable Payload Requirements to SSP 57003 and SSP 57004)
(4)	SSP50835	ISS Pressurized Volume Hardware Common Interface Requirements Document
(5)	NASDA-ESPC-2857	HTV Cargo Standard Interface Requirements Document
(6)	SSP57000	Pressurized Payload Interface Requirements Document
(7)	IEEE C95.1-2005	IEEE Standard for Safety Levels with Respect to Human Expose to Radio Frequency Electromagnetic Fields （sec 4.2.1, sec 4.2.3, sec 4.3）
(8)	SSP30243	Space Station Requirements for Electromagnetic Compatibility (sec 3.2.3)
(9)	SSP30237	Space Station Electromagnetic Emission and Susceptibility Requirements” (sec 3.2.4.2.2)

2. Interface Requirements for 10cm Class Satellite

2.1. Mechanical Interfaces

2.1.1. Coordinate System

The definitions of the coordinate systems are as follows.

- J-SSOD Coordinate System:(Xs、Ys、Zs)
- Satellite Body Coordinate System:(X、Y、Z)
- Zs and Z axes are located in the center of the Satellite Install Case and the Satellite, respectively.

(1) When a satellite is installed in the Satellite Install Case of the J-SSOD, all axes for both coordinate systems are aligned.

(2) +Z (+Zs) is towards the direction of the deployment. -Z (-Zs) towards the direction of the installation into the case. +Y (+Ys) towards the base-point of the case.

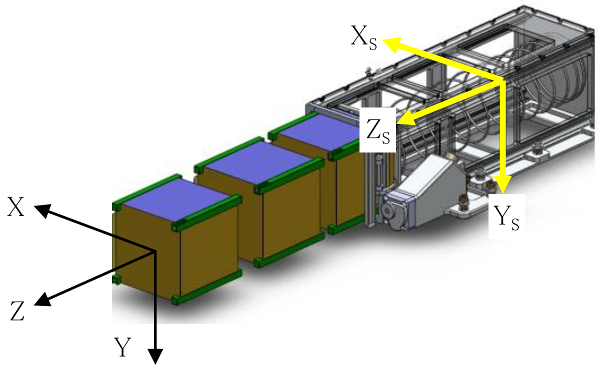


Figure 2.1.1-1 Coordinate System Definition

2.1.2. Dimensional Requirements

(1) The type of satellite which can be accommodated in the J-SSOD is defined in the Table 2.1.2-1 and the dimensional requirements are defined in the Figure 2.1.2-1.

(2) A satellite shall be 100+/-0.1 mm wide in X and Y per Figure 2.1.2-1.

(3) For 1U type satellite, a satellite shall be 113.5+/-0.1 mm tall in Z per Figure 2.1.2-1.

(4) For 2U type satellite, a satellite shall be 227.0+/-0.1 mm tall in Z per Figure 2.1.2-1.

(5) For 3U type satellite, a satellite shall be 340.5+/-0.3mm tall in Z per Figure 2.1.2-1.

Table 2.1.2-1 Satellite Type

		Exterior Dimensions (*1)	Rail Dimension	Reference Figure
10cm class satellite	1U	X:100×Y:100×Z:113.5mm	more than 8.5mm squres	Figure 2.1.2-1
	2U	X:100×Y:100×Z:227.0mm		
	3U	X:100×Y:100×Z:340.5mm		

(*1)Nominal dimension including rails

2.1.3. Rails

(1) A satellite shall have four rails on each corner along the Z axis to slide along the rail guides in the Satellite Install Case of the J-SSOD during ejection into orbit.

(2) The dimensional requirements are defined in the section 2.1.2 and the Figure 2.1.2-1.

(3) The rails shall have a minimum width of 8.5 mm.

(4) The rails shall not have a surface roughness greater than Ra1.6μm

(5) For 1U and 2U type satellite, the edges of the rails (+/-Z standoffs) shall be rounded to a radius of at least 1mm.
(As for sharp edges on surfaces of a satellite which crew may access, refer to section 4.2.2(1).)

(6) The edges of the rails on the +Z face shall have a minimum surface area of 6.5mm x 6.5mm for contacting with the adjacent satellite.

(7) At least 75% of the rail surfaces except for +/-Z surfaces shall be in contact with the rail guides of the Satellite Install Case of the J-SSOD. 25% of the rails can be recessed.

(For the 1U type, this means at least 85.1 mm of rail contacts with the rail guide.
For the 2U type, this means at least 170.3 mm of rail contacts with the rail guide.
For the 3U type, this means at least 255.4mm of rail contacts with the rail guide.)

(8) The rail surfaces which contact with the rail guides of the J-SSOD Satellite Install Case and the rail standoffs which contact with adjacent satellites shall be hard anodized aluminum after machining process. The thickness of the hard anodized coating shall be more than 10 μ m according to MIL-A-8625, Type3.

2.1.4. Envelope Requirements

(1) The dynamic envelope of a satellite shall meet the Figure 2.1.4-1.

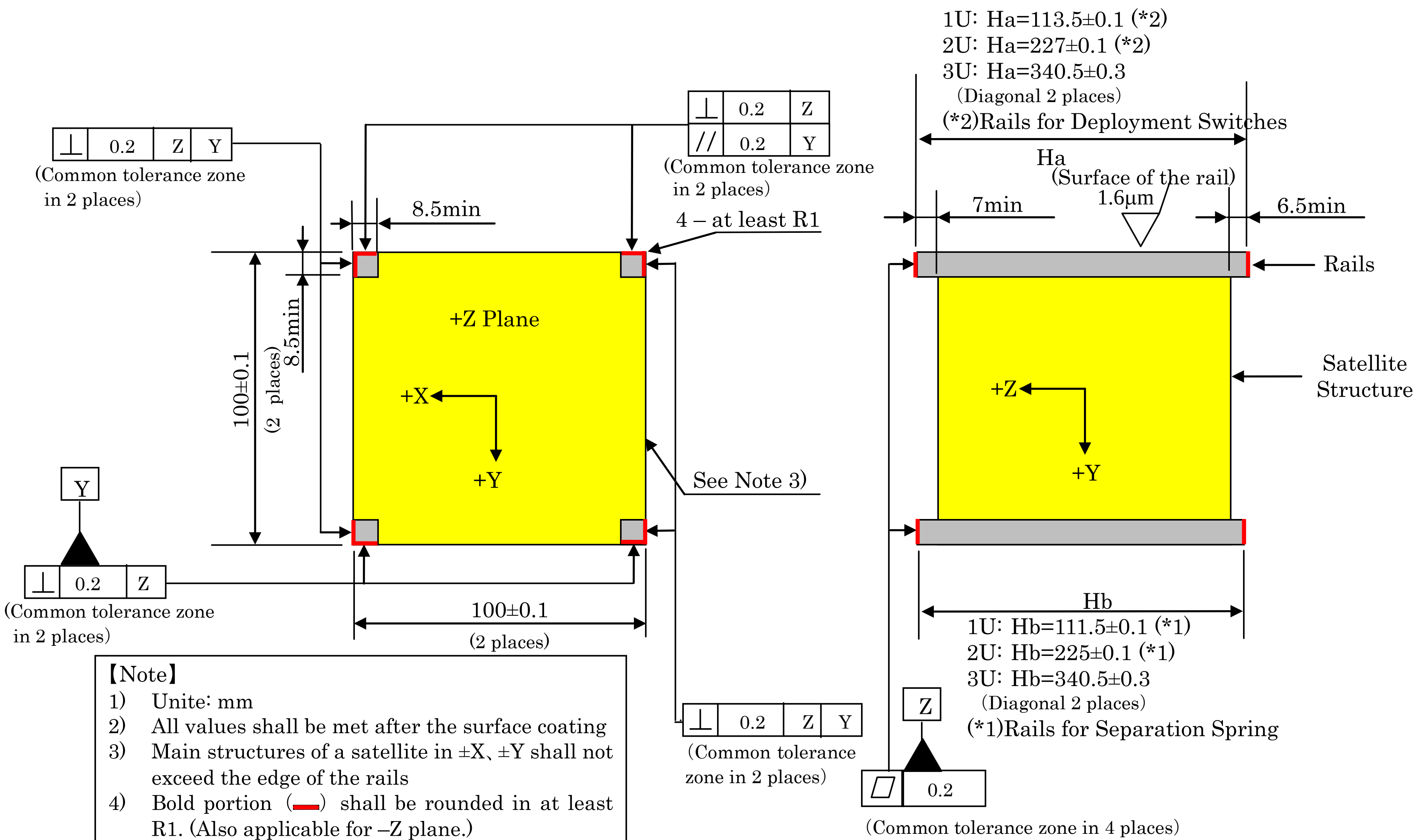
(2) The main structure of a satellite in +Z shall be recessed more than 7.0mm from the edge of the rails. All components in +Z shall be recessed more than 0.5mm from the edges of the rails.

(3) The main structure of a satellite in -Z shall be recessed more than 6.5mm from the edge of the rails. All components in -Z shall be recessed from the edges of the rails.

(4) The main structures of a satellite in +/-X and +/-Y shall not exceed the side surface of the rails. Any components in these surfaces shall not exceed 6.5mm normal to the side surface of the rails including the RBF pin discussed in the section 2.2.2.

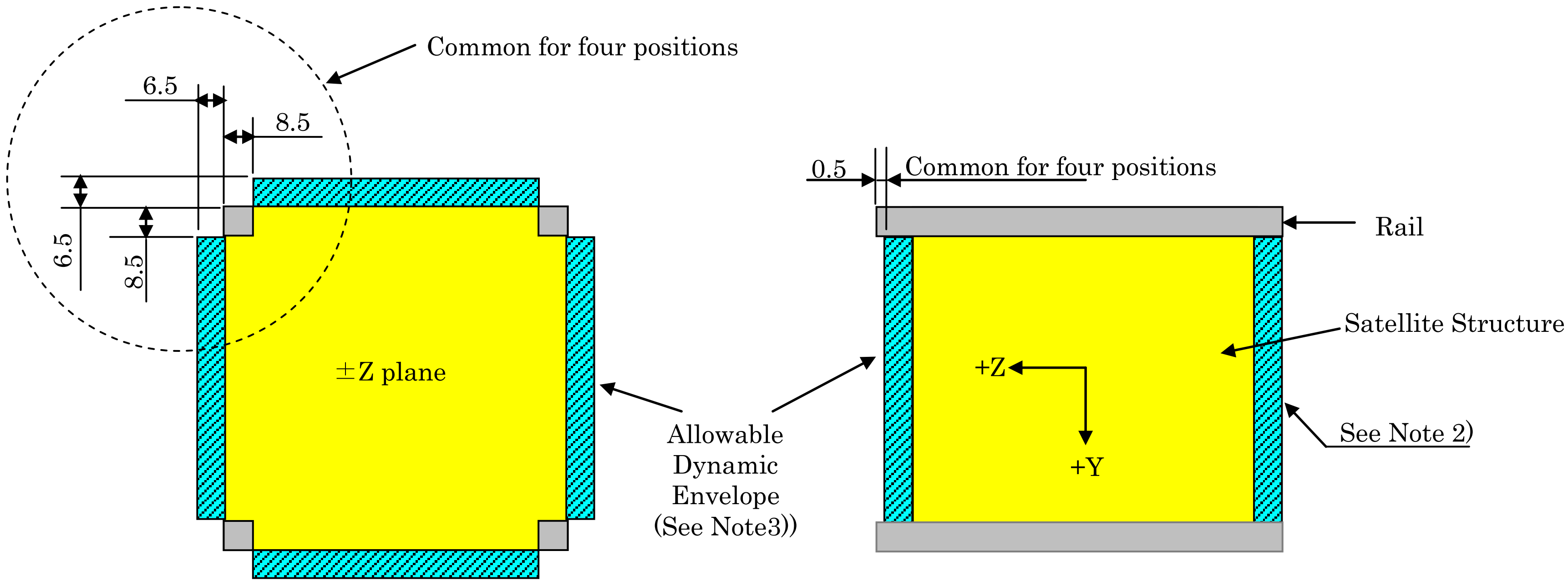
(5) Any deployable components shall be constrained by a satellite itself. The J-SSOD rail guides and walls shall not be used to constrain these deployable components.

(6) If any deployable components make contact with the inside wall of the J-SSOD Satellite Install Case in their unintentional deployment, the contact surface of the deployable components shall have more than 1mm thickness. (If deployable components have two failure tolerance against unintentional deployment based on the JSX-2010026 even after the RBF pin removal, this section in not applicable.)



【Note】
1) Unite: mm
2) All values shall be met after the surface coating
3) Main structures of a satellite in ±X、±Y shall not exceed the edge of the rails
4) Bold portion (▬) shall be rounded in at least R1. (Also applicable for –Z plane.)

Figure 2.1.2-1 Dimensional Requierments for Satellite



【Note】
1) Unit: mm
2) Any components shall be recessed from the edge of the -Z rail ends.
3) All external components shall be within the dynamic envelope.

Figure 2.1.4-1 Allowable Dynamic Envelope

2.1.5. Mass Properties

(1) The mass of a satellite shall be larger than 0.13kg and less than 1.33kg per 1U.

(2) The ballistic number (BN) of a satellite in the configuration that the satellite is installed in the J-SSOD Satellite Install Case, i.e. all deployables are stowed, shall be no greater than 100 kg/m^2. BN shall be calculated by the following formula.

BN = M/ (Cd・A) [kg/m^2]

M : The mass of a satellite [kg]

Cd : Coefficient of Drag (=2) [ND]

A : Average Frontal Area [m^2] (Average of projected area of a satellite XY, YZ, ZX plane)

(3) For 1U or 2U type satellite, the center of gravity for a satellite shall be located within a sphere of 20 mm from its geometric center. For 3U type satellite, the center of gravity for a satellite shall be located within 20mm radius from Zs axis.

2.1.6. Separation Spring

(1) As a separation spring, the 1U and 2U type satellite shall have two spring plungers which are provided by JAXA (P/N:251D939002-1) at the standoff of the diagonal pair of rails as shown in the Figure 2.1.6-2. The flange of the spring plungers shall be firmly contacted at the standoff of the rails as shown in the Figure 2.1.6-1.

(2) The separation springs are not required for the 3U type satellite.

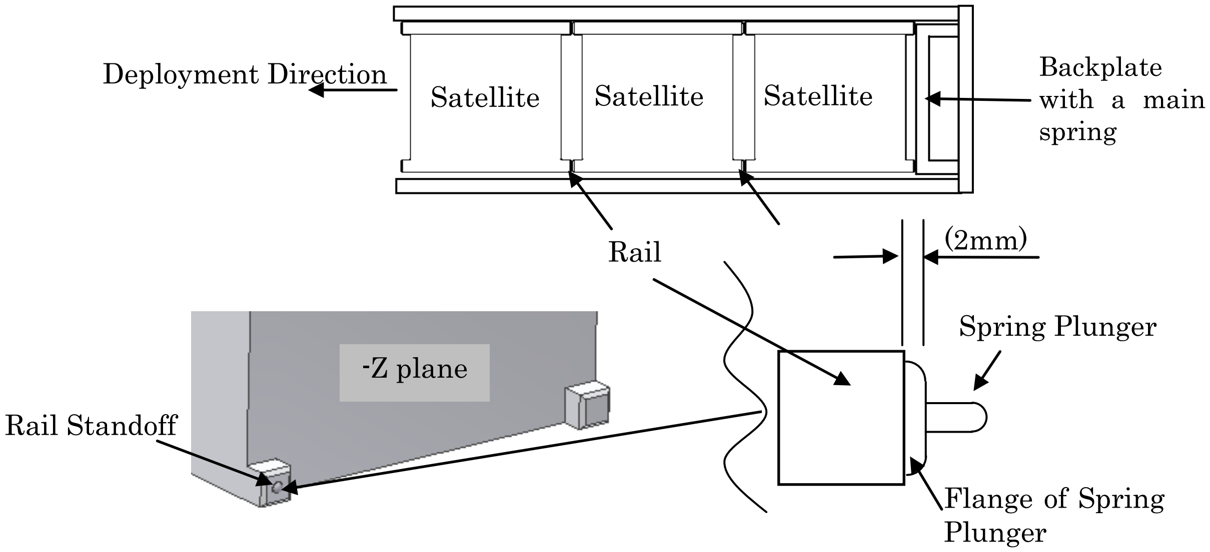
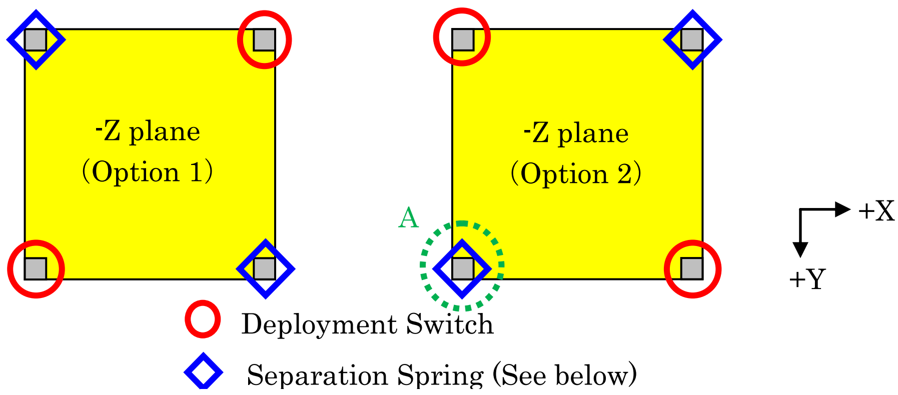
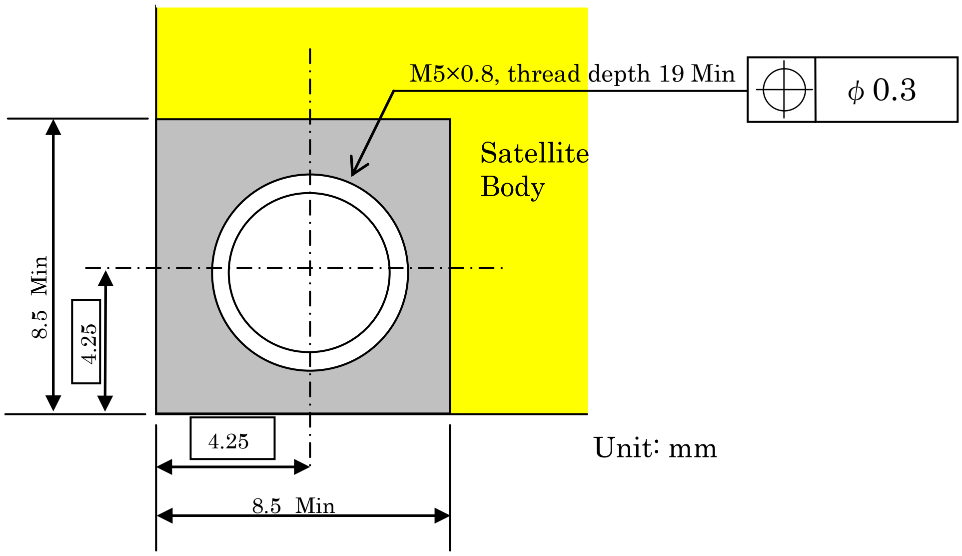


Figure 2.1.6-1 Overview of multiple satellites installation with spring plungers





Detail A (Detail Information for Separation Spring Interface)

Figure 2.1.6-2 Position of Separation Spring and Deployment Switch

2.1.7. Access Window

(1) Access to satellites after installation into the J-SSOD Satellite Install Case can be performed from the –Ys or +Xs as shown in the Figure 2.1.7-1.

(2) All equipments such as the RBF pin and connectors to be accessed after the installation into the J-SSOD Satellite Install Case shall be located in the area of the access windows.

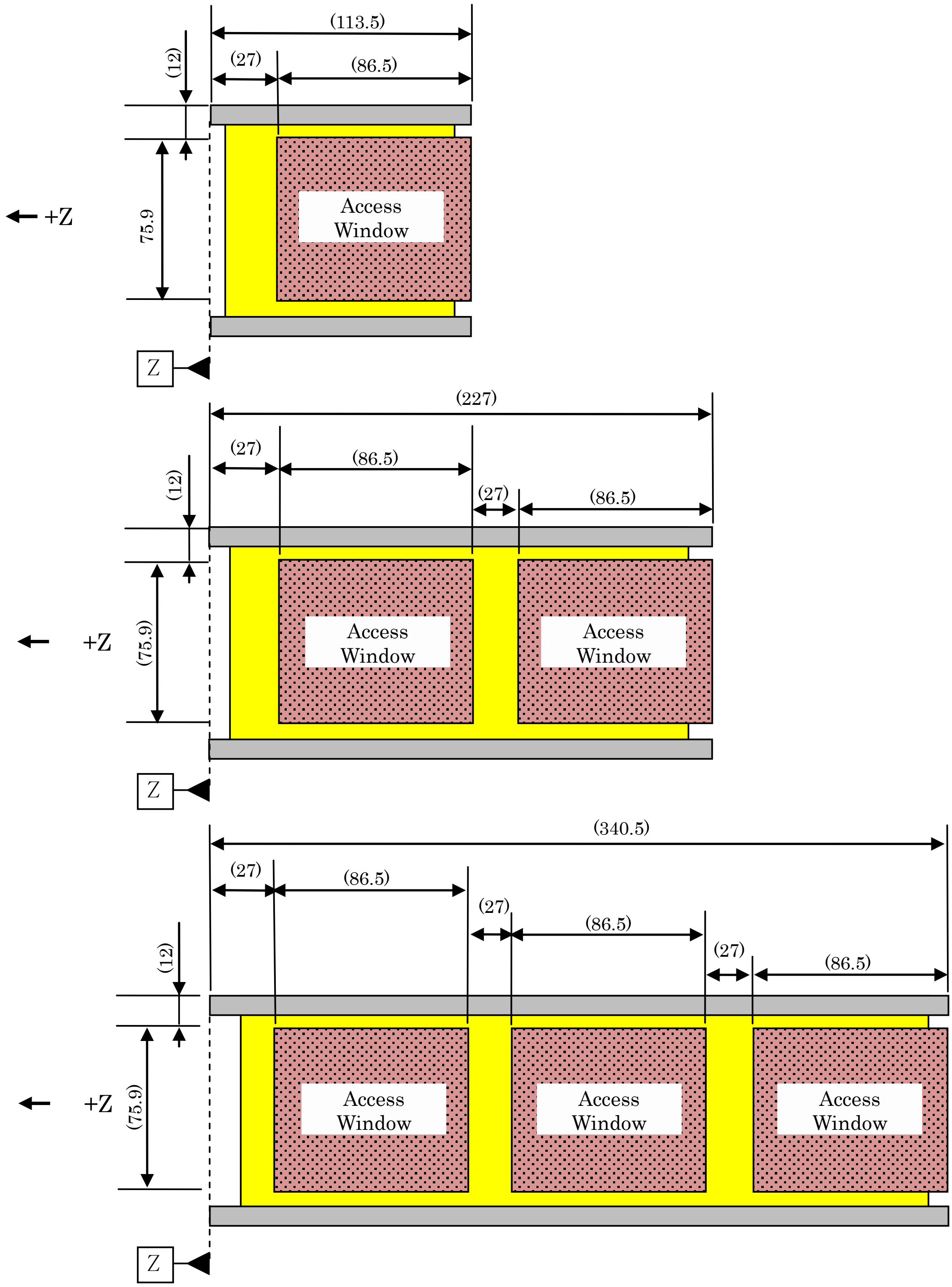
2.1.8. Structural Strength

(1) A satellite shall have a sufficient structural strength with a necessary margin of safety through the ground operation, testing, ground handling, launch and on-orbit operations. Launch environment is defined in the section 2.4.1.

(2) Each rail shall have a sufficient structural strength with considering that the rail is subject to compression force at 46.6 N due to a preload from the Backplate and main spring of J-SSOD.

2.1.9. Stiffness

The minimum fundamental frequency of a satellite shall be no less than 100 [Hz] on the condition that the four rails +/-Z standoffs are rigidly fixed. If the minimum fundamental frequency of the satellite is less than 100 [Hz], coordination with JAXA is needed since a random vibration environment subjected to the satellite may exceed the environment defined in the section 2.4.1(1) (b).



【Note】
1) Unit: mm
2) All dimensions are nominal values (without tolerance).
3) Refer to Figure 2.1.2-1 for the definition of surface Z.

Figure 2.1.7-1 Nominal Position of Access Window in -Ys(-Y)/+Xs(+X)

2.2. Electrical Interface

2.2.1. Deployment Switch

(1) A satellite shall have two or more deployment switches on the rail standoffs in -Z as shown in the Figure 2.1.6-2 in order to prevent the activation of the satellite in the J-SSOD Satellite Install Case. The deployment switches may be installed in the side of the rail (X or/and Y direction) if there is no impact on the deployment conditions such as reduction of the deployment speed.

(2) When one of the deployment switches remains depressed, a satellite shall not be activated. The definition of the depressed conditions is up to 0.75 mm maximum from the surface of the rail standoff as shown in the Figure 2.2.1-1. When the deployment switches are located in the side of the rail, those switches shall not be activated prior to the deployment considering the manufacturing and assembly tolerance of the satellite and the switches.

(3) If necessary, a battery charging needs to be enabled with the deployment switches depressed.

(4) The stroke of the deployment switch shall be less than 2.0 mm from the surface of the rail standoffs as shown in the Figure 2.2.1-1.

(5) The force generated by a deployment switch shall be no greater than 3N for each.

(6) A satellite shall have at least three inhibits for its activation by a solar cell or a battery as indicated in the section 4.2.2.2 (2), (3). An example of the implementation for this requirement is; a satellite shall have three deployment switches, or two deployment switches and one RBF pin. One of inhibits shall be placed on the ground return of the circuits. An example of two deployment switches arrangement on a circuit is shown in the Figure 2.2.1-2. If alternative implementation is selected, the proposed three inhibits shall be coordinated with JAXA.

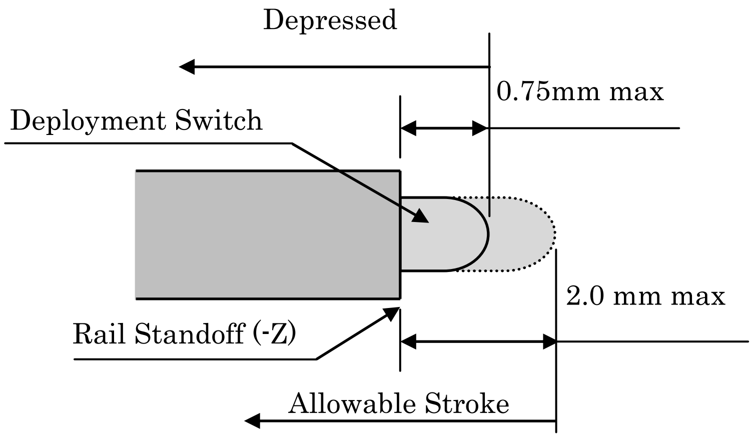


Figure 2.2.1-1 Depressed Condition and Allowable Stroke of Deployment Switches

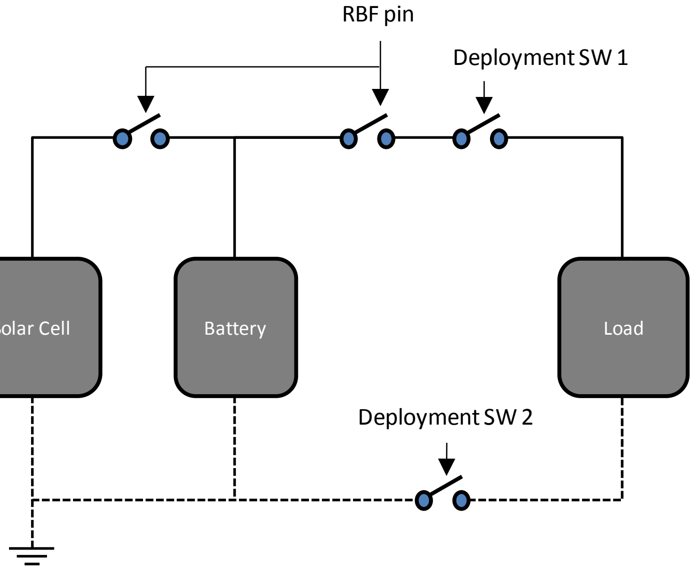


Figure 2.2.1-2 Example of two Deployment Switches and the RBF pin Arrangement

2.2.2. RBF(Remove Before Flight) Pin

(1) When it is impossible for three deployment switches to be installed in a satellite, RBF pin may be used for compliance with the requirement as indicated in the section 4.2.2.2 (2), (3).

(2) The RBF pin shall be accessible from the access window shown in the Figure 2.1.7-1.

(3) The RBF pin shall cut all power to a satellite once it is inserted into the satellite. An example of the RBF pin arrangement on a circuit is shown in the Figure 2.2.1-2.

(4) The RBF pin shall be within the envelope as shown in the Figure 2.1.4-1 when it is fully inserted to a satellite.

(5) A tether shall be attached to the RBF pin for crew to remove the RBF pin easily and prevent the RBF pin from losing. The tether is not subject to the Envelope Requirements defined in the section 2.4.1, but a satellite shall be able to be loaded into the J-SSOD Satellite Install Case with the tether attached.

2.2.3. Bonding

(1) A satellite shall have a bonding interface on the side of the access window in case that access is required when it is installed in the J-SSOD Satellite Install Case.

2.2.4. RF

(1) Frequency and Current Limit

If downlink frequency below 110 MHz is used, maximum current in the circuits shall not exceed 50 mA. (If RF transmitters have two failure tolerance based on the JSX-2010026 against their unintentional radiation in the J-SSOD Satellite Install Case even after the RBF pin removal, this section in not applicable.)

(2) Allowable RF Radiation Levels

RF radiation levels shall not exceed values of Table 2.2.4-1. (If RF transmitters have two failure tolerance based on the JSX-2010026 against their unintentional radiation in the J-SSOD Satellite Install Case even after the RBF pin removal, this section in not applicable.)

Table 2.2.4-1 Maximum allowable level for RF radiation*

Frequency range	Allowable Electric Field level	Allowable power density	Output power (only reference)
14 kHz to 200 MHz	1.58 V/m (124dBμV/m)	0.0066 (W/m^2)	0.075 (W)
200 MHz to 8 GHz	19 V/m (145.6dBμV/m)	0.955 (W/m^2)	11 (W)
8GHz to 10 GHz	6.3 V/m (136dBμV/m)	0.106 (W/m^2)	1.6 (W)
10 GHz to 13.3 GHz	(linear interpolation)	(linear interpolation)	(linear interpolation)
13.3 GHz to 15.2 GHz	58 V/m (155dBμV/m)	8.93 (W/m^2)	113 (W)

* Hazard severity should be determined by “Allowable Electric Field level” or “Allowable power density.” However, if output power does not exceed “Output power (only reference)” with antenna-gain included, hazard severity can be regarded as marginal.

2.3. Operational Requirements

(1) A satellite provider shall assume that the maximum stowage duration may be about 1 year until the deployment after installation in the J-SSOD Satellite Install Case on the ground.

(2) A satellite provider will not plan any activation, checkout or maintenance after installation in the J-SSOD Satellite Install Case on the ground.

(3) A satellite shall have a capability to survive in the cold launch environment. The satellite shall maintain deactivated from installation in the J-SSOD Satellite Install Case on the ground to the deployment.

(4) All deployables such as booms, antennas, and solar panels shall wait to deploy for 30 minutes at minimum after the deployment switches are activated at ejection of the satellite from the J-SSOD. Whenever either of two deployment switches is re-depressed, the timer shall be reset.

(5) RF transmissions shall wait to transmit for 30 minutes at minimum after the deployment switches are activated at ejection of the satellite from the J-SSOD. Whenever either of two deployment switches is re-depressed, the timer shall be reset.

(6) The order of satellite installation into the J-SSOD Satellite Install Case and a satellite deployment window will not be constrained by a satellite design. If such consideration is required for the mission success, an additional coordination is required with JAXA.

2.4. Environmental Requirements

A satellite shall be designed, analyzed and/or tested with the following environmental conditions based on the reference documents (4)~(6). As for a JAXA selected satellite, the launch vehicle will be determined by JAXA.

2.4.1. Random Vibration and Acceleration

(1) Launch

(a) Quasi-static Acceleration in any direction:

- HTV: 8.34 [g].
- ATV : 12.37 [g].
- SpX : 8.67 [g].
- Orbital Cygnus: 18.1 [g].

(b) Random Vibration: Refer to Table 2.4.1-1 and Figure 2.4.1-1.

Table 2.4.1-1 Random Vibration of each launch vehicle

HTV		ATV		SpX Dragon		Orbital Cygnus	
Freq. (Hz)	PSD (g^2/Hz)	Freq. (Hz)	PSD (g^2/Hz)	Freq. (Hz)	PSD (g^2/Hz)	Freq. (Hz)	PSD (g^2/Hz)
20	0.005	20	0.01	20	0.015	20	0.005
50	0.02	100	0.05	25.6	0.027	70	0.04
120	0.031	400	0.05	30	0.08	200	0.04
230	0.031	2000	0.001	80	0.08	2000	0.002
1000	0.0045			2000	0.001		
2000	0.0013						
Overall (grms)	4.0	Overall (grms)	5.48	Overall (grms)	4.06	Overall (grms)	4.4
Duration (sec)	60	Duration (sec)	60	Duration (sec)	7.2	Duration (sec)	60

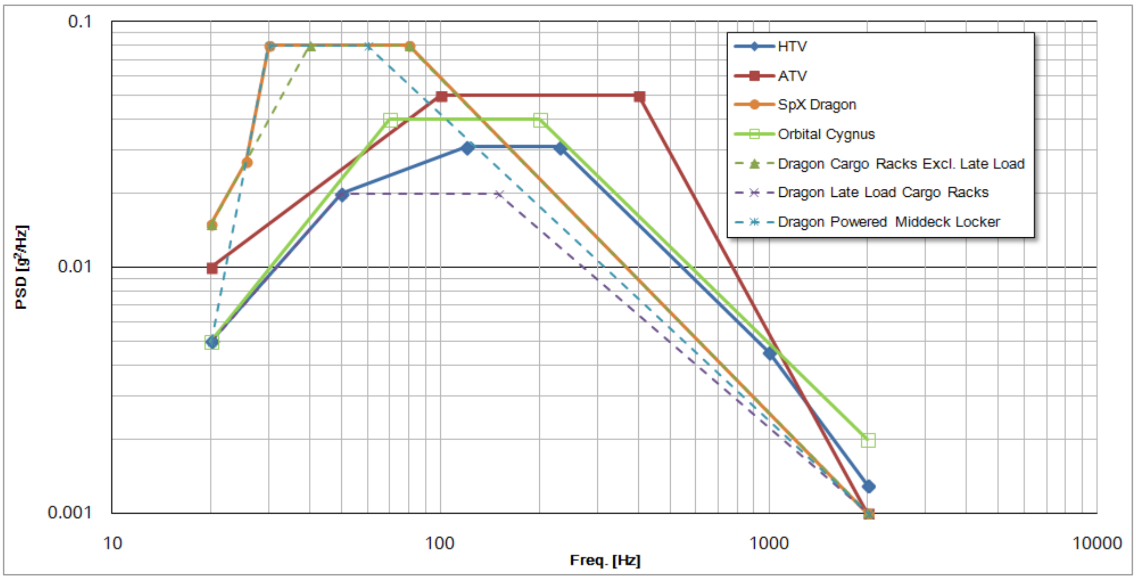


Figure 2.4.1-1 Random Vibration of each launch vehicle

2.4.2. On-orbit Acceleration

(a) On-orbit Acceleration: 2.0m/sec^2

(b) Acceleration induced by JEMRMS Emergency-Stop: 0.69m/sec^2

2.4.3. Pressure Environment

(a) Maximum pressure during launch and inside the ISS is as follows. A pressure inside JEM Airlock at depressurization and outboard is 0 [Pa].

- HTV, ATV, Cygnus : 104.8 [kPa]
- SpX : 102.7 [kPa]
- Inside the ISS : 104.8 [kPa]

(b) Depressurization Rates during launch, inside the ISS, and the JEM Airlock are as follows.

- HTV : 0.878 [kPa/sec] (7.64 [psi/min])
- ATV : 1.33 [kPa/sec] (11.6 [psi/min])
- SpX : 0.891 [kPa/sec] (7.75 [psi/min])
- Cygnus: TBD
- Inside the ISS : 0.878 [kPa/sec] (7.64 [psi/min])
- Inside the JEM Airlock: 1.0 [kPa/sec] (8.7 [psi/min])

The structural analysis are needed considering differential pressure occurred between inside and outside of a satellite by the depressurization during launch and inside the ISS and the JEM Airlock, only if the satellite internal volume (V [m^3]) and the area of exhaust ports (A [m^2]) do not meet the following condition. (Refer to JSC Form 1230, section 3 c).)

$V/A \leqq 50.8$ [m] (2000 [inch])

2.4.4. Thermal Environment

- HTV : +5 ~ +32 [deg C]
- ATV : +16 ~ +28 [deg C]
- SpX : +18.3 ~ +30 [deg C]
- Cygnus: +10 ~ +46 [deg C]
- Inside the ISS : +16.7 ~ +29.4 [deg C]
- Outside the ISS : -15 ~+60 [deg C] (When a satellite is inside J-SSOD)

2.4.5. Humidity Environment

- HTV : Dew point; -34 [deg C]   Relative Humidity; No Requirement
- ATV : Dew point; No Requirement   Relative Humidity; 30 ~ 70 [%]
- SpX : Dew point; No Requirement   Relative Humidity; 25 ~ 75 [%]
- Cygnus : Dew point; +4.4 ~ +15.6 [deg C]
  Relative Humidity; 25 ~ 75 [%]
- Inside the ISS : Dew point; +4.4 ~ +15.6 [deg C]
  Relative Humidity; 25 ~ 75 [%]

2.5. Out-gassing

Rating "A" materials which are identified in MSFC-HDBK-527F (JSC-0904F) or MAPTIS[1] shall be used for a satellite. When using materials other than Rating "A", an individual review and approval through MUA is needed.[2] (As for MUA, refer to the section 3.2.1 (3).)

[1] Materials and Processes Technical Information System
http://maptis.nasa.gov/home.aspx

[2] Satellite materials satisfy Rating "A", if they comply with the following low out-gassing criterion per ASTM-E595-84.
- TML (Total Mass Loss) ≦ 1.0%
- CVCM (Collected Volatile Condensable Material) ≦ 0.1%

3. Interface Requirements for 50cm Class Satellite

3.1. Mechanical Interfaces

3.1.1. Coordinate System

The definitions of the coordinate systems are as follows.

- J-SSOD Coordinate System:(Xs、Ys、Zs)
  The origin of the J-SSOD coordinate system is the same as the one of the Satellite Body Coordinate System when the satellite is installed in the J-SSOD.
- Satellite Body Coordinate System:(X、Y、Z)
  The origin of the Satellite Body coordinate system is shown in the Figure 3.1.5-1.

(1) When a satellite is installed in the Satellite Install Case of the J-SSOD, all axes for both coordinate systems are aligned.

(2) +Z (+Zs) is towards the direction of the deployment. -Z (-Zs) towards the direction of the installation into the case. +Y (+Ys) towards the base-point of the case.

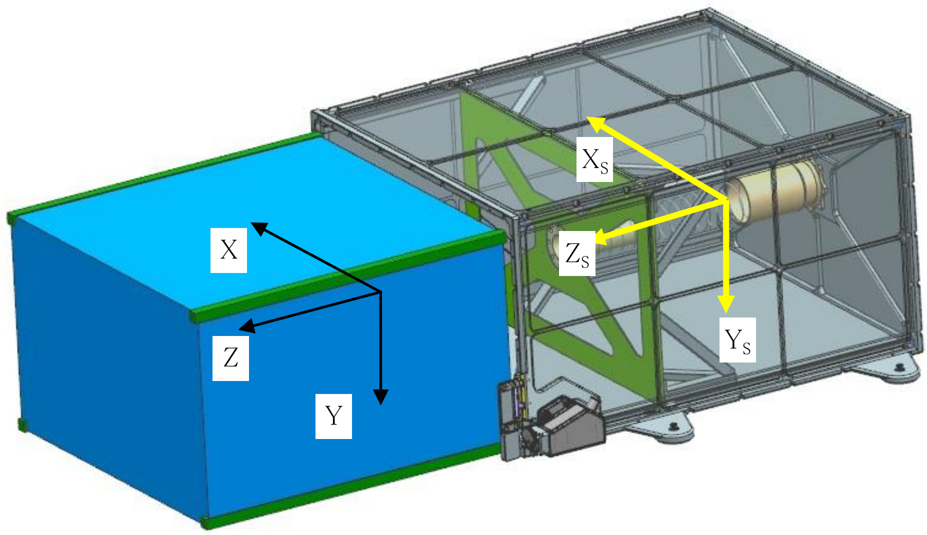


Figure 3.1.1-1 Coordinate System Definition

3.1.2. Dimensional Requirements

(1) The type of 50cm class satellite which can be accommodated in the J-SSOD is defined in the Table 3.1.2-1 and the dimensional requirements are defined in the Figure 3.1.2-1.
(2) A 50cm class satellite shall be 350+/-0.5 mm wide in Y per Figure 3.1.2-1.
(3) A 50cm class satellite shall be 550+/-0.5 mm wide in X per Figure 3.1.2-1.
(4) A 50cm class satellite shall be 550+/-0.25 mm tall in Z per Figure 3.1.2-1.

Table 3.1.2-1 Satellite dimensions

	Exterior Dimensions (*1)	Rail Dimension	Reference Figure
50cm class satellite	X:550×Y:350×Z:550mm	more than 17mm squres	Figure 3.1.2-1

(*1)Nominal dimension including rails

3.1.3. Rails

(1) A 50cm class satellite shall have four rails on each corner along the Z axis to slide along the rail guides in the Satellite Install Case of the J-SSOD during ejection into orbit.
(2) The dimensional requirements are defined in the section 3.1.2 and the Figure 3.1.2-1.
(3) The rails shall have a minimum width of 17 mm.
(4) The rails shall not have a surface roughness greater than Ra1.6 μ m
(5) The edges of the rails (+/-Z standoffs) shall be rounded to a radius of 1.5+/-0.5mm. (As for sharp edges on surfaces of a satellite which crew may access, refer to section 4.2.2(1).)
(6) (N/A)
(7) At least 75% of the rail surfaces except for +/-Z surfaces shall be in contact with the rail guides (rail length: 550mm) of the Satellite Install Case of the J-SSOD. 25% of the rails can be recessed. This means at least 412.5 mm of rail contacts with the rail guide.
(8) The rail surfaces which contact with the rail guides of the J-SSOD Satellite Install Case and the rail standoffs which contact with the J-SSOD Back Plate shall be hard anodized aluminum after machining process. The thickness of the hard anodized coating shall be more than 10µm according to MIL-A-8625, Type3.

3.1.4. Envelope Requirements

(1) The dynamic envelope of a satellite shall meet the Figure 3.1.4-1.

(2) All components in +/-Z shall be recessed more than 0.5mm from the edges of the rails.

(3) All components in +/-X and +/-Y shall not exceed 6.5mm normal to the side surface of the rails.

(4) A 50cm satellite shall not contact with the inside wall of the Satellite Install Case of the J-SSOD except the rail surface.

(5) Any deployable components shall be constrained by a satellite itself. The J-SSOD rail guides and walls shall not be used to constrain these deployable components.

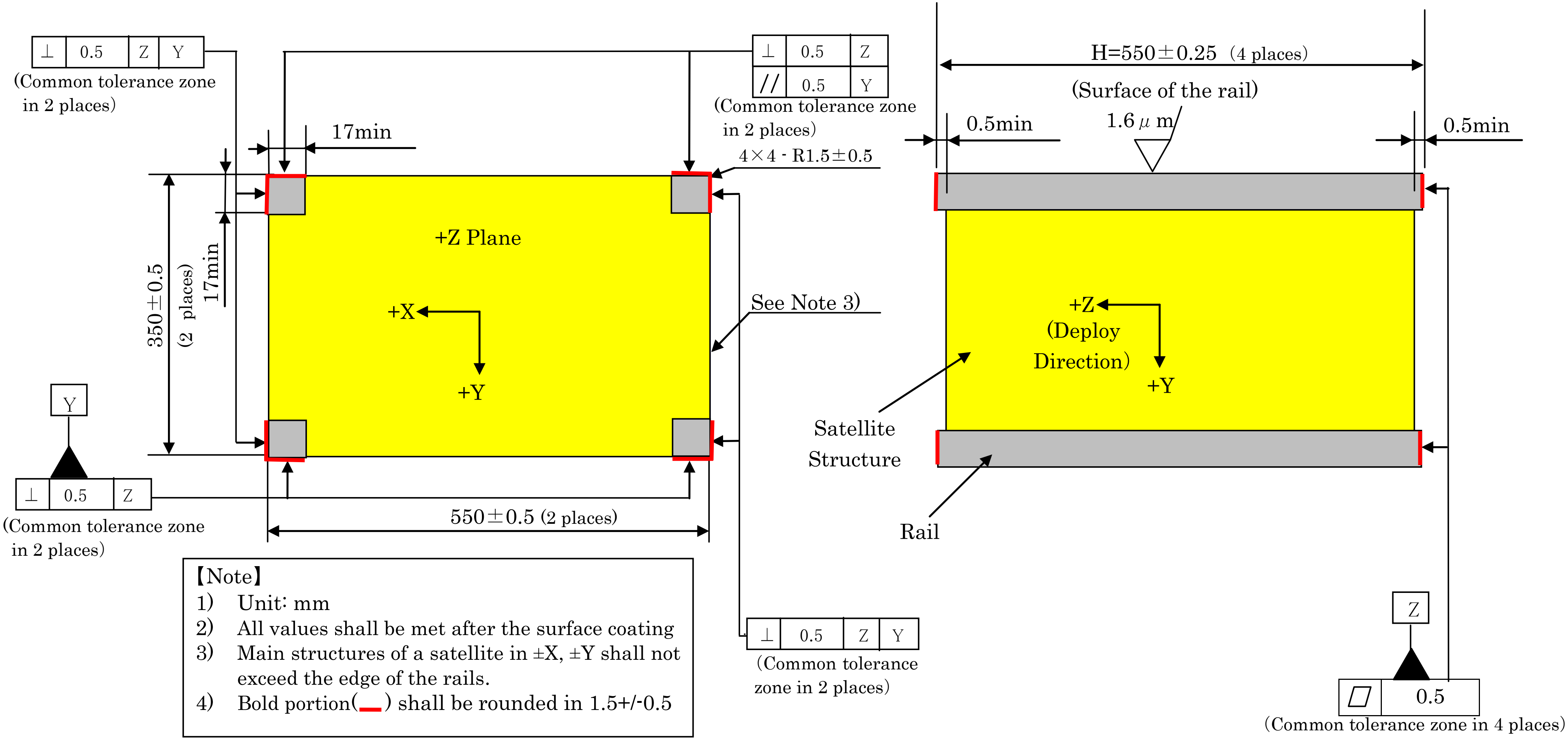
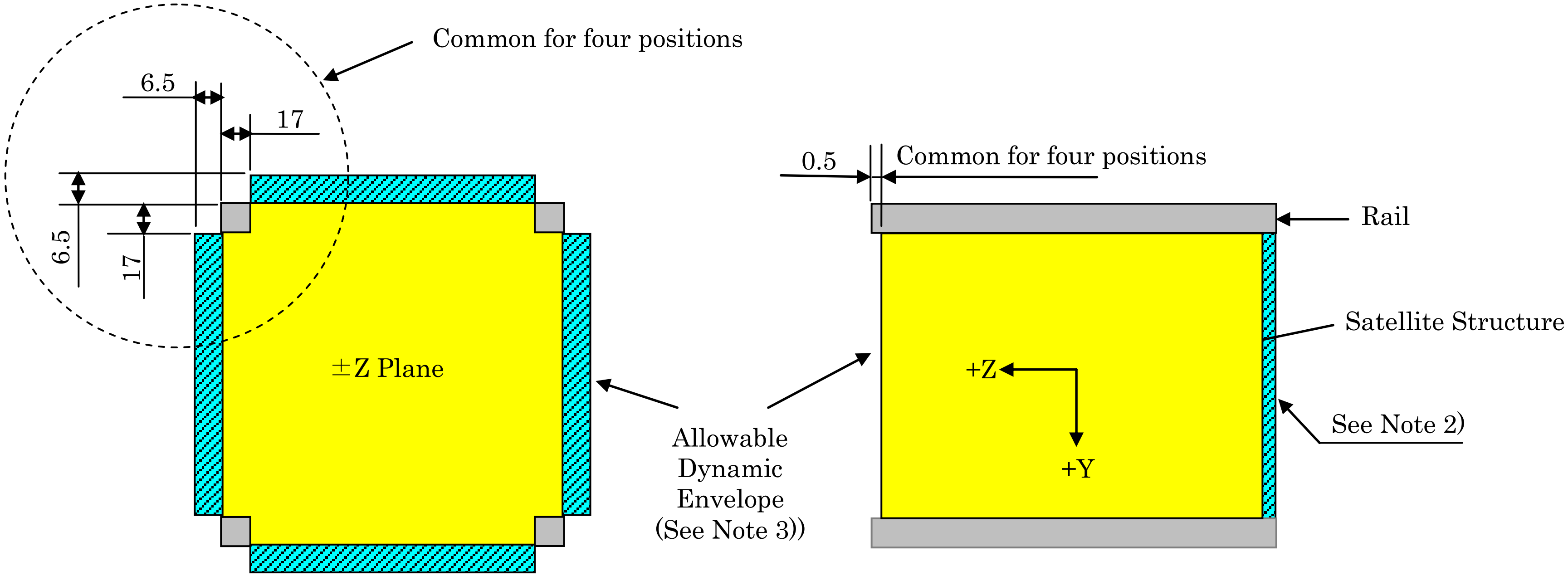


Figure 3.1.2-1 Dimensional Requirements for 50cm Class Satellite



【Note】
1) Unit: mm
2) Any components shall be recessed from the edge of the -Z rail ends.
3) All external components shall be within the dynamic envelope.

Figure 3.1.4-1 Dimensional Requirements for 50cm Class Satellite

3.1.5. Mass Properties

(1) The mass of 50 cm class satellite shall be 50 kg or less.

(2) The ballistic number (BN) of a satellite in the configuration the satellite is installed in the J-SSOD Satellite Install Case), i.e. all deployables are stowed, shall be no greater than 100 kg/m^2. BN shall be calculated by the following formula.

BN = M/ (Cd･A) [kg/m^2]

M : The mass of a satellite [kg]

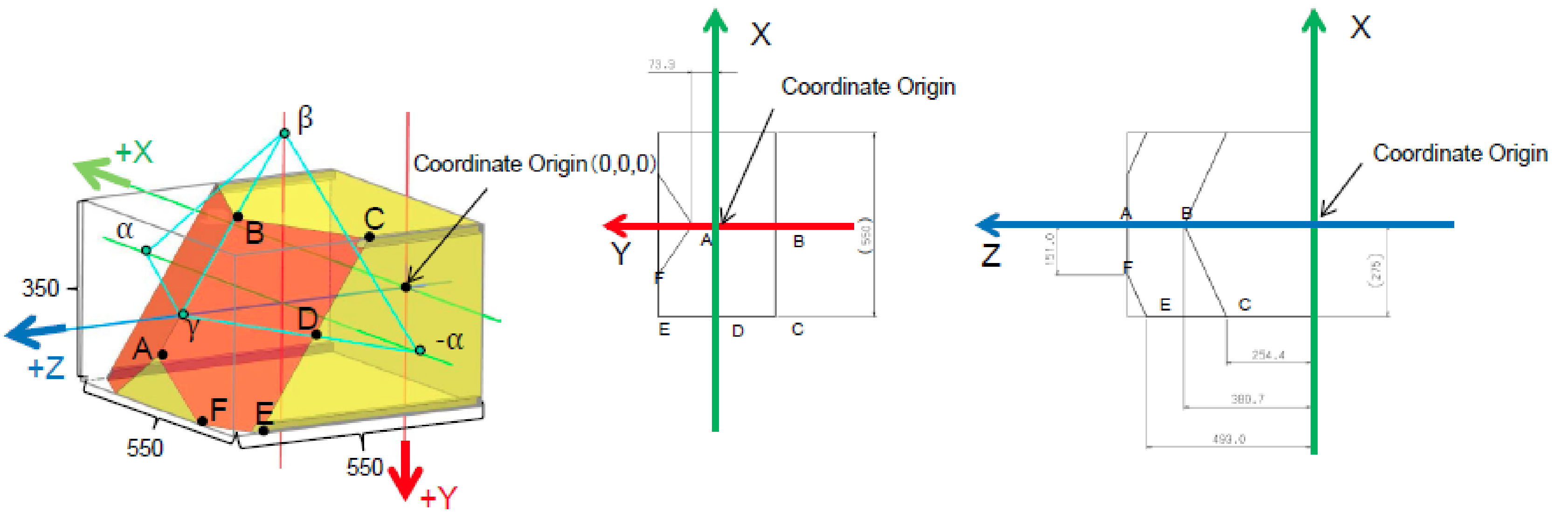
Cd : Coefficient of Drag (=2) [ND]

A : Average Frontal Area [m^2] (Average of projected area of a satellite XY, YZ, ZX plane)

(3) The center of gravity(CG) of a satellite shall be located as defined in Figure 3.1.5-1.

3.1.6. Separation Spring

The separation springs are not required for the 50 cm class satellite.



The Center of Gravity of the Satellite (XG,YG,ZG) shall meet the following inequality

$$\frac{|X_G|}{\alpha} - \frac{|Y_G|}{\beta} + \frac{|Z_G - 275|}{\gamma - 275} < 1 \quad (\alpha = 490,\ \beta = 330,\ \gamma = 500)$$

unit: mm

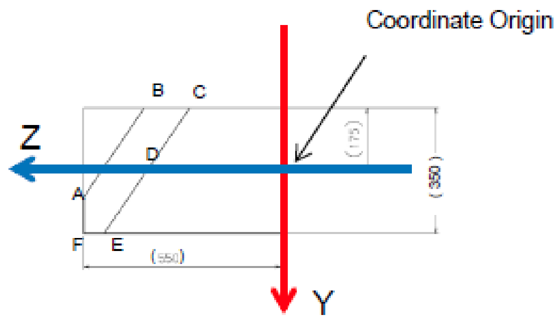


Figure 3.1.5-1 The Center of Gravity Requirements for 50cm Class Satellite

3.1.7. Access Window

Access to satellite after installation into the J-SSOD Satellite Install Case can be performed from only deployment direction surface (+Z end face) as shown in the Figure 3.1.7-1.

In addition, the deployment switch substituting for the RBF pin shall be installed to the end of the rail in the satellite release lock door side as shown in the Figure 3.1.7-1.

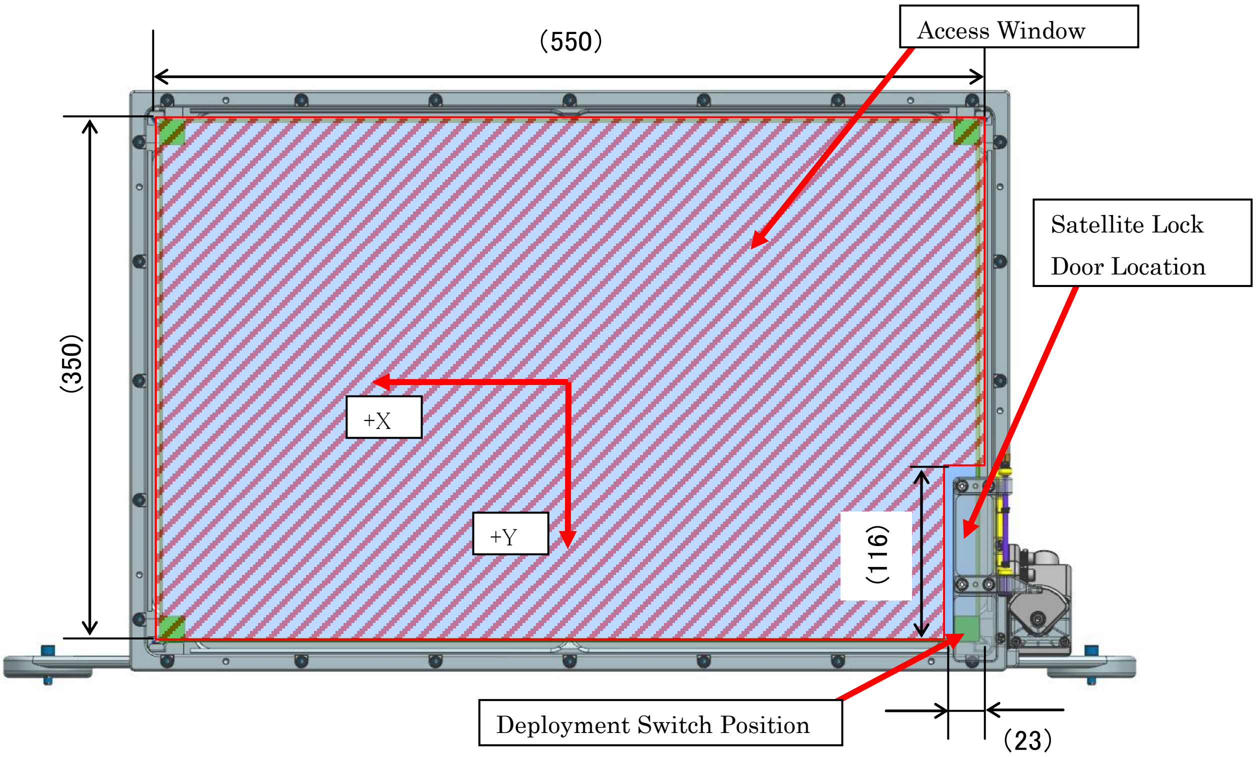


Figure 3.1.7-1 Satellite Access Window after removal of Launch Lock Cover

3.1.8. Structural Strength

Refer to 2.1.8.

3.1.9. Stiffness

Refer to 2.1.9.

3.1.10. Ground Handling

A satellite shall be equipped with the interfaces to attach four eyebolts in the opposite side of satellite deployment surface as shown in the Figure 3.1.10-1. The eyebolts shall be JIS standard. The factor of safety of 5.0 shall be applied for the ultimate strength against the hoisting loads.

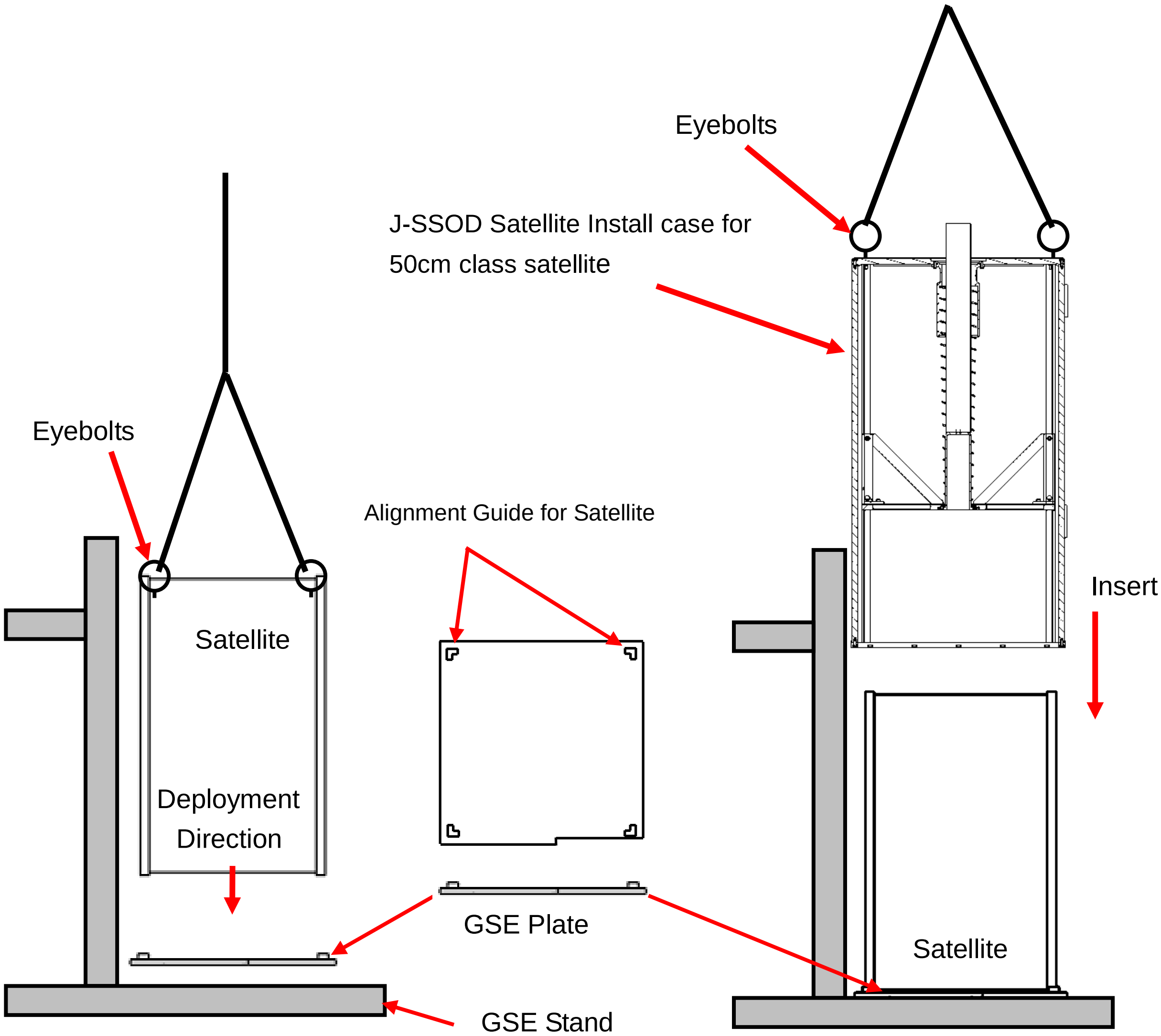


Figure 3.1.10-1 Satellite Installation into J-SSOD Satellite Install Case

3.2. Electrical Interfaces

3.2.1. Deployment Switch

(1) A satellite shall have two deployment switches on the rail standoffs in –Z and one deployment switch on the rail standoff in front of the lock door in order to prevent the activation of the satellite in the J-SSOD Satellite Install Case. Figure 3.2.1-1 and Figure 3.1.7-1 show the positions of the deployment switches.

(2) When one of the deployment switches remains depressed, a satellite shall not be activated. The definition of the depressed condition is up to 1.25mm maximum from the surface of the rail standoff as shown in the Figure 3.2.1-2.

(3) If necessary, a battery charging needs to be enabled with the deployment switches depressed.

(4) NA

(5) NA

(6) An example of three deployment switches arrangement on a circuit is shown in the Figure 3.2.1-3. A satellite shall have at least three inhibits for its activation by a solar cell or a battery, one of the inhibits shall be placed on the ground return of the circuit as indicated in the section 4.2.2.2 (2), (3).

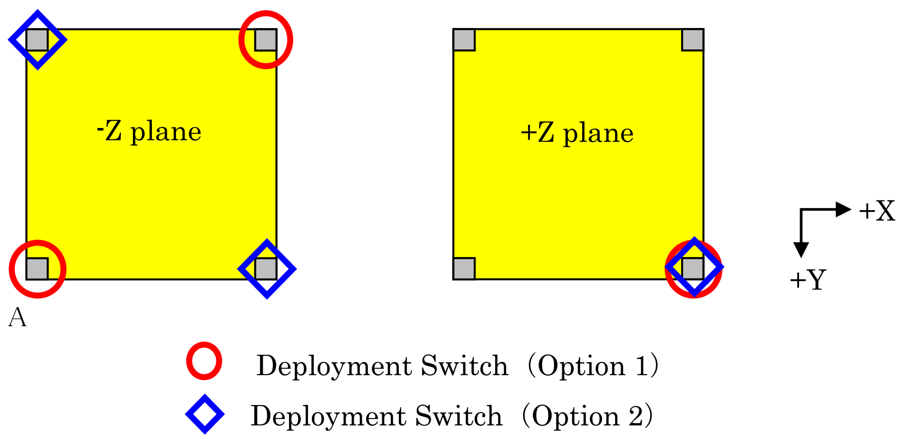


Figure 3.2.1-1 Position of Deployment Switches

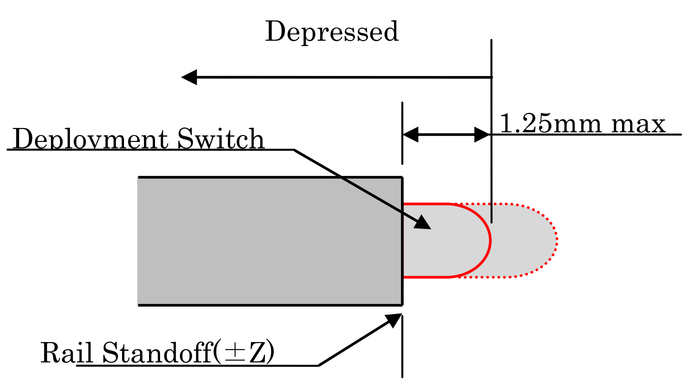


Figure 3.2.1-2 Depressed Condition of Deployment Switches

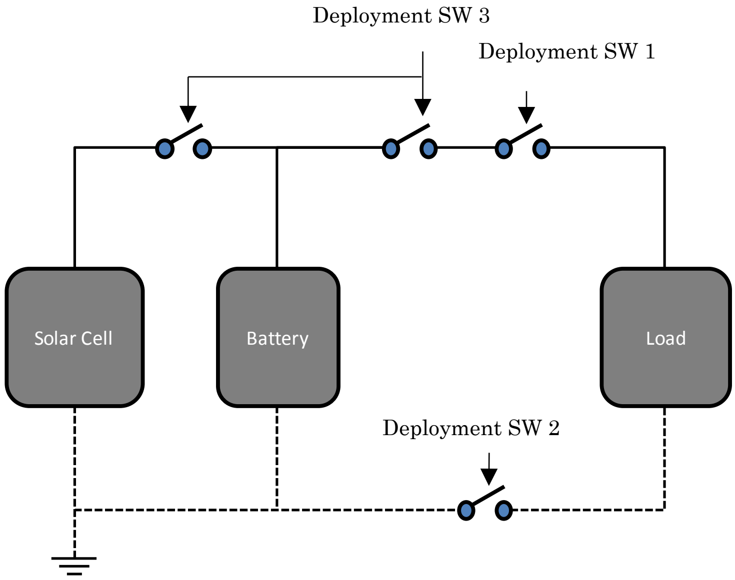


Figure 3.2.1-3 Example of three Deployment Switches

3.2.2. RBF(Remove Before Flight) Pin

N/A

3.2.3. Bonding

A satellite shall have a bonding interface on the side of the +Z plane so that the satellite can be accessed on ground after it is installed in the J-SSOD Satellite Install Case.

3.2.4. RF

Refer to 2.2.4.

3.3. Operational Requirements

Refer to 2.3.

3.4. Environmental Requirements

Refer to 2.4.

3.5. Out-gassing

Refer to 2.5.

4. Safety Assurance Requirements

This chapter shows the guideline of the minimum requirements for safety assurance applied to a JAXA selected satellite excerpted from NASDA-ESPC-1681A.

As for other satellites, they shall satisfy the following safety requirements.

General	SSP 51700
Structure	SSP 52005
Fracture Control	NASA-STD-5003
Safety Review Process	NSTS/ISS-13830C
Crew Safety	SSP 50005
Material & Process	SSP 30233
Launch Site & Vehicle Safety	ATV/HTV/KSC Form 100
Deployable Satellite from ISS	SSP 57003
Space Debris Mitigation Guidelines	IADC-02-01

4.1. Generic Requirements

(1) Significance of System Safety

The System Safety is to assure that appropriate measures to minimize risks are taken by clarifying and evaluating categories for safety assessment from a design to operation phases. Therefore, the following processes are mainly implemented for the System Safety.

a) To conduct safety analyses and identifying hazards related to hardware, software and their operations in all mission phase.

b) To eliminate or control identified hazards. To assure that the appropriate design is certainly progressed, documented, and implemented.

c) To conduct integrated safety risk assessments including identifying uneliminable hazards/risks. To inform the project manager and JAXA of residual hazards/risks attaching to corroborative evidences and rationales. To submit materials for JAXA deciding acceptance of the residual hazards/risk.

(2) Generic Requirements for Materials and Process

Used materials in JEM and the like shall be selected with due regard to the following operational requirements, technical properties of materials and MSDS (Material Safety Data Sheet) information. The conditions that have influences upon the deteriorating of the materials during hardware working shall be especially considered.

a) Operational Requirements

- Operational Temperature Limit
- Loads
- Contaminations
- Lifetime Limit
- Natural Environment
- Induced Environment
- Others

b) Technical Properties of Materials

- Mechanical Properties
- Fracture Toughness
- Flammable Properties
- Offgassing Properties
- Corrosion
- Electrolytic Corrosion
- Stress Corrosion
- Thermal Fatigue Properties
- Mechanical Fatigue Properties
- Vacuum Outgassing
- Fluid Compatibility
- Abrasion
- Seizing
- Others

(3) Proxy of JAXA

If JAXA employs a third party in order to implement Safety and Product Assurance sufficiently and effectively, a satellite developer shall accept this third party as the proxy of JAXA.

(4) Deviation and Waiver

A satellite provider shall submit Deviation or Waiver in accordance with JMR-006 to JAXA for approval, if a satellite cannot meet the requirements identified in this document.

4.2. Safety Assessment

4.2.1. Implementation of Safety Assessment

(1) Safety Assessment

A satellite provider shall make Safety Assessment Report (SAR) based on JSX-2010026 for on-orbit operations. It shall be reviewed and approved by JAXA.

A satellite provider shall fill in ATV/HTV/KSC Form 100 check list for launch site and vehicle safety assessment corresponding to the planned launch vehicle. If a satellite has pressure vessels (including the case that containers can be highly pressured under environment conditions from launch site to on-orbit), pyrotechnics or toxic materials, an additional coordination is required with JAXA.

(2) MIUL (Material Identification Usage List)

A satellite provider shall submit MIUL based on the section 3.1.4 of CR-99117 to JAXA for approval.

Commercial products and Electrical, Electronic, and Electromechanical (EEE) parts (an exposure surface of electric connector, an electric wire, a cable and a printed-circuit board) shall be contained in MIUL.

In order to get a Material Code and Rating, appropriate materials shall be selected and used among the CR-99218, MSFC-HDBK-527F (JSC-0904F) or MAPTIS. When using materials other than Rating “A”, an individual review by MUA is needed. (As for offgassing, Rating “H” and “K” are also acceptable. As for Stress Clacking Corrosion, Rating “N” is also acceptable.) However, if the safety of materials is confirmed as assembly level, MIUL can be described in this assembly level.

If a satellite uses a material whose Material Code and Rating are not identified in CR-99218, MSFC-HDBK-527F (JSC-0904F) or MAPTIS, JAXA can conduct flammability test and offgassing test, provided that a satellite provider submits a sample of the material and a JAXA-designated written request for the test to JAXA.

(3) MUA (Materials Usage Agreement)

If materials which do not meet the SSP30233 are used in a satellite, a satellite provider shall submit MUA based on the section 3.1.2 of CR-99117 to JAXA for approval.

(4)VUA (Volatile Organic Compound Usage Agreement)

If volatile organic compounds which do not meet the SSP30233 are used in a satellite, a satellite provider shall submit VUA based on the section 3.1.7 of CR-99117 to JAXA for approval.

4.2.2. Safety Design Guidelines

This section shows the safety design guidelines for major safety requirements about on-orbit operations imposed on general small satellite. Since all requirements are not mentioned in this section, JSX-2010026 are needed to be referred as for detailed requirements.

4.2.2.1. Standard_Hazards

Hazards which need to be considered for a satellite safety design regardless of a satellite design.

(1) Sharp Edges / Holes

In order to protect crewmembers from sharp edges and protrusions during all crew operations, they need to be rounded or planed greater than 0.7mm to the utmost. If a satellite has any potential sharp edges which cannot be rounded or planed (ex. An edge of a solar cell), a satellite provider shall identify the sharp edge positions with an acceptance rationale for JAXA approval.

Holes (round, slotted) without covers need to be 25 mm or longer, or be 10 mm or shorter in diameter.

(2) Shatterable Material Release

Shatterable materials such as glass need to be inspected their integrity after vibration test. If there is a potential of shattering due to an inadvertent contact with a crew, etc., the materials need to be contained or taken any other measures so as not to be shattered.

(3) Flammable Materials / Materials Offgassing

Refer to the section 4.2.1 (2)~(4).

(4) Battery Failure

As for a battery usage, it is necessary to comply with JSC Form 1230, 9. Battery Failure. Also, EP Form-03 needs to be submitted for review and approval of the validity of their design and verification plan.

(5) Rotating Equipment

Rotating equipment such as a motor needs to meet both of the following requirements:

- Enclosure has obvious containment capabilities.
- Rotating part does not exceed 200 mm in diameter and 8000 rpm speed in all conditions.

4.2.2.2. Unique Hazards

Hazards identified by depending on a satellite specific design. Examples are as follows.

(1) Structural Failure

If a satellite is deformed or broke up while a satellite is loaded inside the J-SSOD Satellite Install Case, there is a risk of collision to ISS after deployment because the deploy direction can be shifted by an inadvertent contact between a satellite and the J-SSOD Satellite Install Case. Therefore, structural design and fracture control need to be conducted in accordance with JMX-2012694.

(2) Radio Frequency (RF) Radiation

As long as the requirement of section 2.2.4 is satisfied, RF shock by inadvertent crew contact, and inadvertent RF radiation to crew and ISS system inside the J-SSOD Satellite Install Case are not regarded as hazard.

If RF transmitters have two failure tolerance based on the JSX-2010026 during the period from launch to deployment by the J-SSOD, section 2.2.4 is not applicable. In this case the existence of the two failure tolerance must be stated clearly in Safety Assessment Report (SAR).

(3) Deployable Structure

All deployables such as booms, antennas, etc., need to be designed considering a hazard caused by their inadvertent deployment. Especially, the inadvertent deployment inside the J-SSOD Satellite Install Case will cause injury of a crew or inadequate deployment of the satellite. However, as long as the requirement defined in section 2.1.4. (6) is satisfied, inadvertent deployment is not regarded as hazard.

If deployable components have two failure tolerance based on the JSX-2010026 against unintentional deployment during the period from launch to deployment by the J-SSOD, section 2.1.4. (6) is not applicable. In this case the existence of the two failure tolerance must be stated clearly in Safety Assessment Report (SAR).

4.3. Compatibility with Safety Requirements for Deployable Satellite from ISS and Space Debris Mitigation Guidelines

Section 3.3.1 and 3.3.2 show the safety requirements for a satellite based on SSP 57003, section 3.12 and JMR-003. The necessary verification categories of each requirement and data submittal are defined in Appendix-C "Verification Matrix".

4.3.1. Compatibility with Safety Requirements for Deployable Satellite from ISS

A satellite shall comply with the following requirements in order to be deployed safely from ISS.

4.3.1.1. Deployable Satellite Design Requirements

4.3.1.1.1. Ballistic Number

Refer to the section 2.1.5 (2).

4.3.1.1.2. Deployment Analysis

A satellite shall comply with the following requirements.

(1) A satellite minimum cross section (any cross section which can be physically or electromagnetically sighted) shall be no less than 100 cm^2 to be trackable by the Space Surveillance Network (SSN).[3]

(2) A satellite's Ballistic characteristics in combination with the method of deployment allow for a safe deployment (i.e. A satellite is moving safely away from ISS with a minimum risk of returning).

(3) There shall be no greater than 1/10,000 chance of human injury on the ground.

4.3.1.1.3. Propulsion Systems

If a satellite includes a propulsion system, that system shall remain inhibited until the satellite's orbit decays to an altitude such that the full delta-velocity (DV) capability of the satellite could not raise the satellite's apogee to less than 5 km delta-height (DH) relative to the ISS perigee.

If a satellite uses high pressure propellant (including the case that a propellant can be high pressure by environment conditions in each phase) or toxic propellant, an additional coordination is required with JAXA.

4.3.1.1.4. Deployable Subcomponents

If a satellite includes a deployable subcomponent, the subcomponent shall only be deployed once the following conditions are met:

[3] Since SSN can track objects bigger than 10cm and minimum requirements for a satellite size is 10cm, 100 cm^2 is set as minimum requirement..

(1) The satellite has achieved a downtrack range of ≥500 km.

(2) The primary satellite's and subcomponent's apogees are less than the ISS perigee.

4.3.1.2. Satellite Deployer Requirements

4.3.1.2.1. Generic Requirements

(1) A satellite will be deployed in a generally retrograde direction.

(2) A satellite should be deployed from a position that is below the ISS center of gravity in the Local Vertical - Local Horizontal (LVLH) reference frame.

(3) A satellite will exit the 200 m Keep-Out-Sphere (KOS) in one orbit or less.

(4) A satellite will maintain an opening rate relative to ISS while inside of the KOS. An exception to this is a closing rate due to the satellite release position relative to the ISS CG.

(5) While a satellite altitude remains less than 5 km below ISS, the satellite will not decrease its total range to less than half the maximum range achieved on the prior orbit.

4.3.1.2.2. J-SSOD Requirements

(1) Initial clearance of all ISS and visiting vehicle structures will be accomplished by ensuring that the planned deploy velocity vector of the deployed object is the axis of an unobstructed half-angle cone that is determined based on expected J-SSOD accuracy plus the pointing accuracy of the JEMRMS.

(2) The minimum deploy velocity will be greater than or equal to 0.05 m/s.

(3) J-SSOD maximum velocity capability will not exceed a velocity that will ensure maximum safe impact energy to any ISS structure.

4.3.2. Compatibility with Space Debris Mitigation Guidelines

A satellite shall comply with JMR-003. Major requirements are shown below.

<u>(1) Limit Debris Released during Normal Operations</u>

In all operational orbit regimes, a satellite shall be designed not to release debris during normal operations.

<u>(2) Minimize the Potential for On-Orbit Break-ups</u>

On-orbit break-ups caused by the following factors shall be prevented:

a) The potential for break-ups during mission should be minimized.

b) All space systems should be designed and operated so as to prevent accidental explosions and ruptures at end-of- mission.

c) Intentional destructions, which will generate long-lived orbital debris, should not be planned or conducted.

Especially, batteries should be adequately designed and manufactured, both structurally and electrically, to prevent break-ups. Pressure increase in battery cells and assemblies could be prevented by mechanical measures unless these measures cause an excessive reduction of mission assurance.

<u>(3)Post Mission Disposal</u>

There shall be no greater than 1/10,000 chance of human injury on the ground. In addition, a satellite will be judged to meet the requirement if a satellite does not load radioactive substances, toxic substances or any other environmental pollutants resulting from on-board articles in order to prevent ground environmental pollution.

<u>(4) Lifetime Limit</u>

A satellite's lifetime until the re-entry shall be equal to or under 25 years.

5. Requirements for Control

5.1. Quality and Reliability Control

A satellite provider needs to control satellite's quality and reliability (including any products prepared by the satellite provider).

5.2. Application for Approval and Authorization

A satellite provider shall go through the following procedures:

(1) Intentional Radiating and Receiving Authorization

A satellite that has intentional RF radiating and/or receiving devices shall be approved and certified by the NASA JSC Frequency Spectrum Manager for the use of a specified frequency band. Approval/Certification can be obtained via electronic submittal through the JSC Frequency Management Home Page.

As for a JAXA selected satellite, since JAXA will make an application to NASA JSC Frequency Spectrum Manager, a satellite provider shall fill in JSC Frequency Authorization Input Form identified in JMX-2012164 (Appendix-F) and submit it to JAXA.

(2) Radio Frequency Capability and Emission/Operation Authority

A satellite with radio frequency capability shall be certified for space operation in the desired/planned operating frequency bands prior to integration into launch vehicle. Certification is achieved by obtaining an equipment operating license from the National Regulatory Agency of the satellite. The license, along with the positions of any ground station asset that will be used to communicate with the satellite, shall be submitted to the NASA JSC Frequency Spectrum Manager for notification.

As for a JAXA selected satellite, a satellite provider shall submit a copy of the approved license to JAXA for submittal to NASA JSC Frequency Spectrum Manager.

(3) Registration of Objects Launched into Outer Space

(4) Other necessary legal procedures

5.3. Verification

A satellite provider is responsible for development and implementation of a satellite verification based on the verification matrix of this document Appendix-C "Verification Matrix".

Verification methods are classified into the following categories.

(1) Analysis

Method of validating and evaluating that design or a product satisfies its requirements by means of calculation using a mathematical model (including computer simulation) that has been guaranteed or whose reliability has been evaluated with techniques or tools such as academically widely recognized logical rules, etc.

This method is used when verification by inspection or testing is difficult and when satisfaction of requirements can be proved by analysis and calculation.

(2) Inspection

Method of verifying and evaluating that the physical properties of a product comply with the requirements without using special testing equipment, procedures, test tools or test support.

Ordinarily, the finish of a product is visually inspected or measured with examination equipment based on documents or drawings that specify physical conditions or standards.

(3) Test

Method of verifying compliance with functional and environmental durability requirements using hardware based on measurement data.

(4) Review of Design

Method of verifying compliance with the requirements based on confirming design documents or drawings.

5.4. Safety Review and Design Review

A satellite provider shall attend the following review panels and report on results of a satellite design, manufacture, test and so on.

(1) Safety Review

As for a JAXA selected satellite, JAXA is responsible for conducting safety reviews for the satellite in primary design phase (phase 0/I), in detailed design phase (phase II) and in acceptance test phase (phase III).

A satellite provider shall submit Safety Assessment Report (SAR) and necessary support documents for review by JAXA.

As for other satellites, they shall meet the safety review process defined in NSTS/ISS-13830C.

(2) Compatibility Verification Review

JAXA is responsible for conducting a review to confirm that the satellite verification results comply with the requirements defined in this document before the satellite delivery to JAXA.

A satellite provider shall conduct necessary verifications and submit necessary documents such as drawings, analysis reports and test reports for review by JAXA.

(3) Confirmation before a Satellite Installation

JAXA is responsible for confirming that all remaining action items which are identified in the Safety Reviews and Compatibility Verification Reviews have been closed before a satellite will be loaded into the J-SSOD Satellite Install Case.

A satellite provider shall close all the action items and show that the necessary documentation processes have been completed.

5.5. Process Control

A satellite developer shall submit a progress schedule promptly after a satellite is selected from the public appeal. Also, a satellite provider shall appropriately manage the progressing and report the latest situation to JAXA.

5.6. Preparation for Delivery to JAXA

(1)A satellite developer shall be fully aware of safety, the method of transport and the maintenance of a transport environment. Also, the easiness of work after the shipment shall be fully considered.

(2)Each packing shall be indicated at least the following information by labels or something. The information shall be easy to read, be durable and not be torn easily during unpacking or other work.

a) Satellite Name
b) Part Number
c) Serial Number
d) Satellite Developer Name

(3)Connectors shall be protected from a static electricity, if necessary. For example, an electrical conductive or an antistatic dust cap can be installed.

(4)A user's manual for work on the ground shall be submitted to JAXA when a satellite is delivered to JAXA.

Appendix A

System Description and Operational Overview

A1. System Description

A1.1 Overview

The J-SSOD is the launcher system to deploy small satellites from the JEMRMS as shown in the Figure A1.1-1.

The J-SSOD consists of mainly three components as shown in the Figure A1.1-2, the Satellite Install Case with the spring deployer mechanism, the Separation Mechanism to maintain satellites inside the case by holding the hinged door of the Satellite Install Case and the Electronics Box. The J-SSOD will be installed on the Multi-purpose Experiment Platforms for translation back and forth through the JEM AL and for the JEMRMS handling. The JEMRMS will position the platform with the J-SSOD towards the aft-nadir direction to assure retrograde deployment. The ballistic number of a satellite shall be less than $100kg/m^2$ for faster orbiting decay of the satellite than the ISS.

When the trigger commands are initiated, the separation mechanism rotates and opens the hinged door of the Satellite Install Case. The spring deployer mechanism in the case pushes out satellites with a spring force, and satellites are finally deployed. The Separation Mechanism and the Electronics Box are reusable on-orbit.

The Satellite Install Case has no heater but is covered by the Multi-Layer Insulation for the passive thermal control.

An empty Satellite Install Case can be also re-used. In this case, new satellite will be installed by crew onboard using the Satellite Handling Tool (OSE) into the Satellite Install Case.

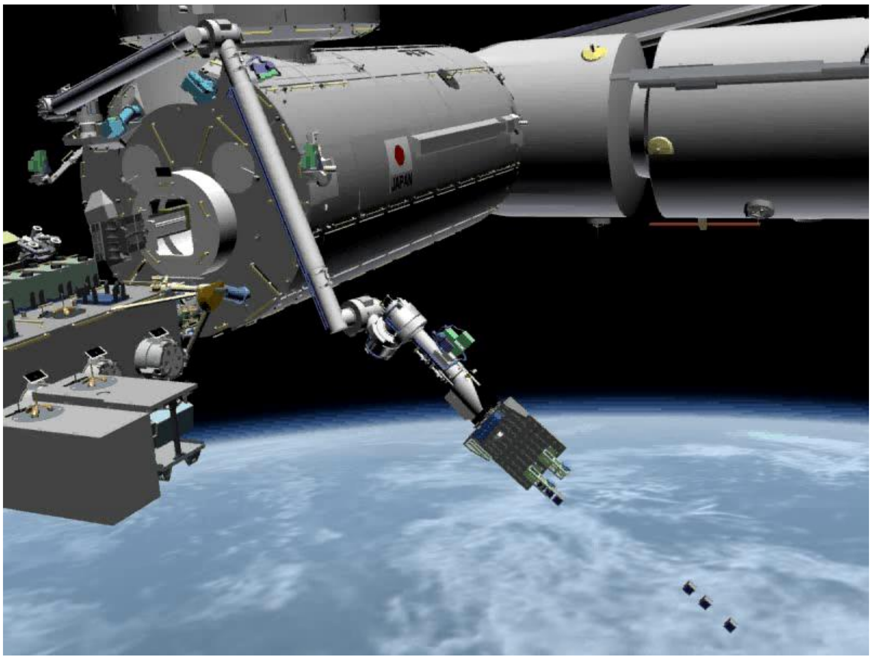


Figure A1.1-1 Satellite Deploy Operation

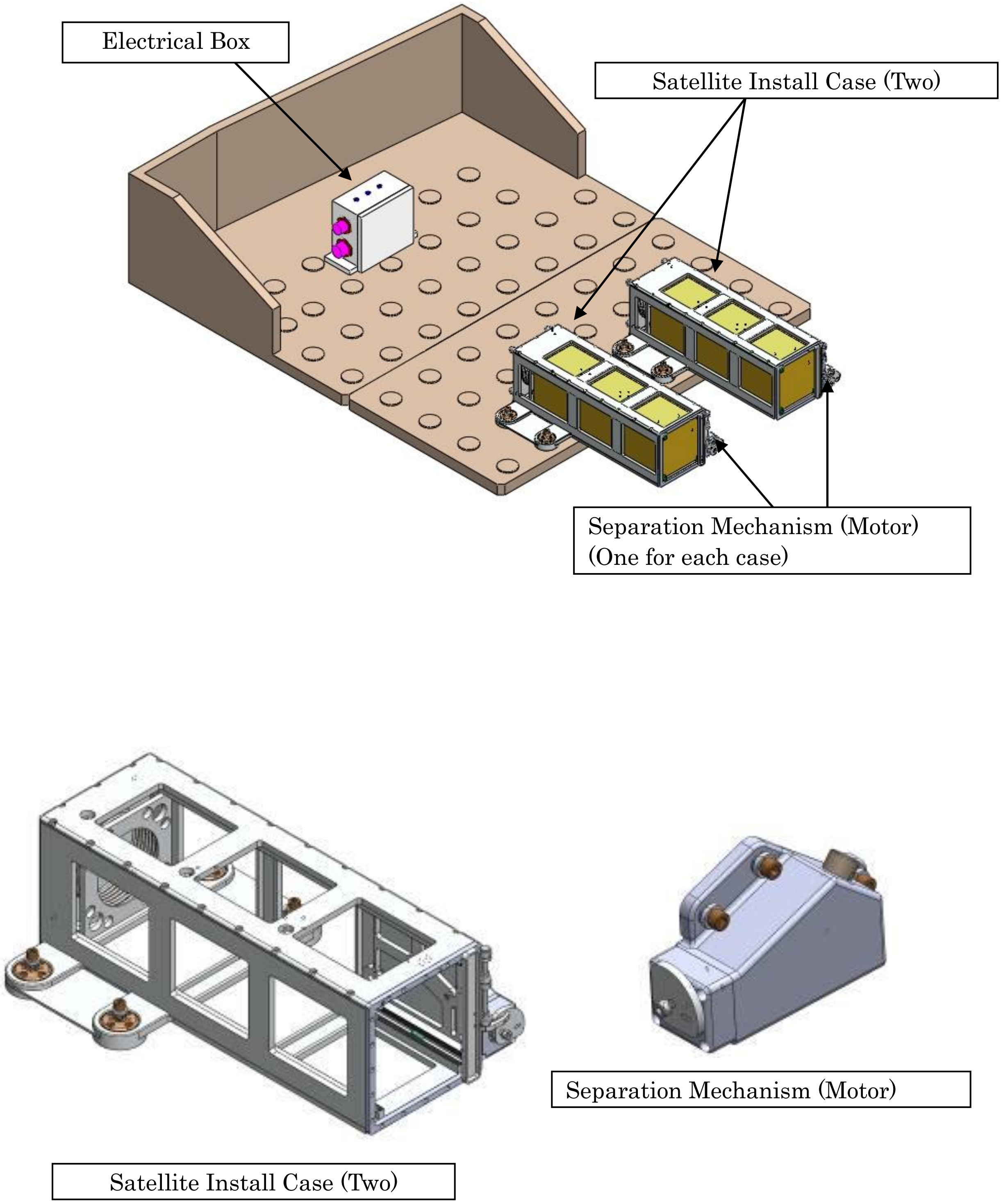


Figure A1.1-2　Major Components of Small Satellite Orbital Deployer

A1.2 Deployer Mechanism

The Separation Mechanism is installed in the Satellite Install Case. The Satellite Install Case consists of one compressed spring, the back plate and the hinged spring door. When satellites are installed, the spring is compressed but the satellites are kept in the case by the hinged spring door. Once the Separation Mechanism receives the command, the cam of the Separation rotates. The hook of the hinged spring door is out of the cam, and then the door is opened. Finally the satellites in the case are pushed out by the spring.

The accuracy of the deployment direction is appropriately controlled by guides in the Satellite Install Case and the rail equipments equipped on releasing satellites.

(Refer to Figure A1.2-1 and A1.2-2.)

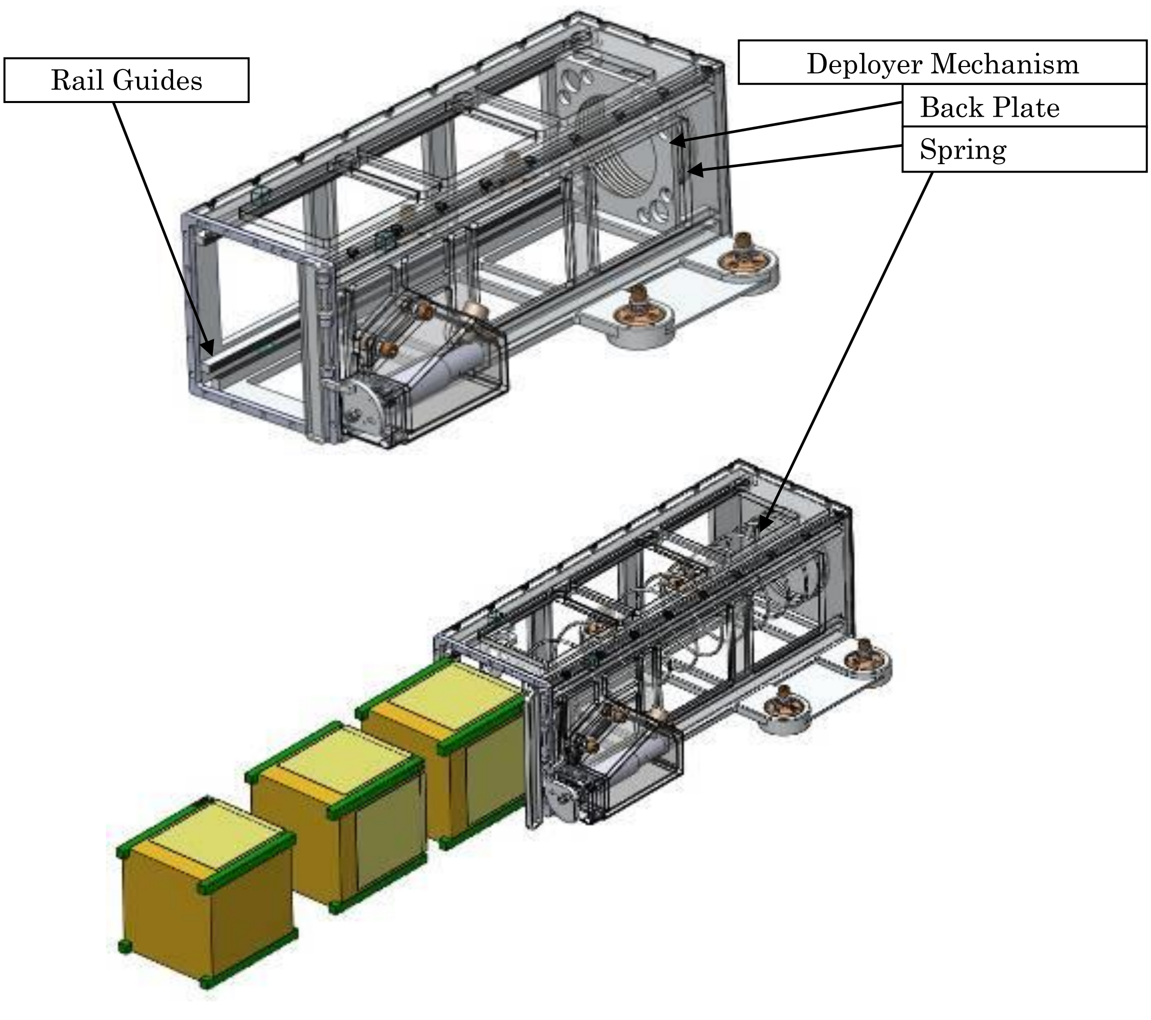
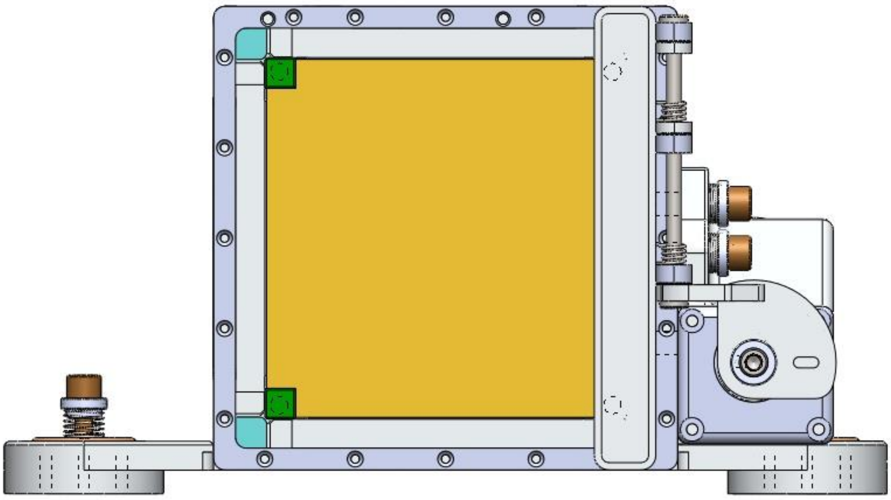
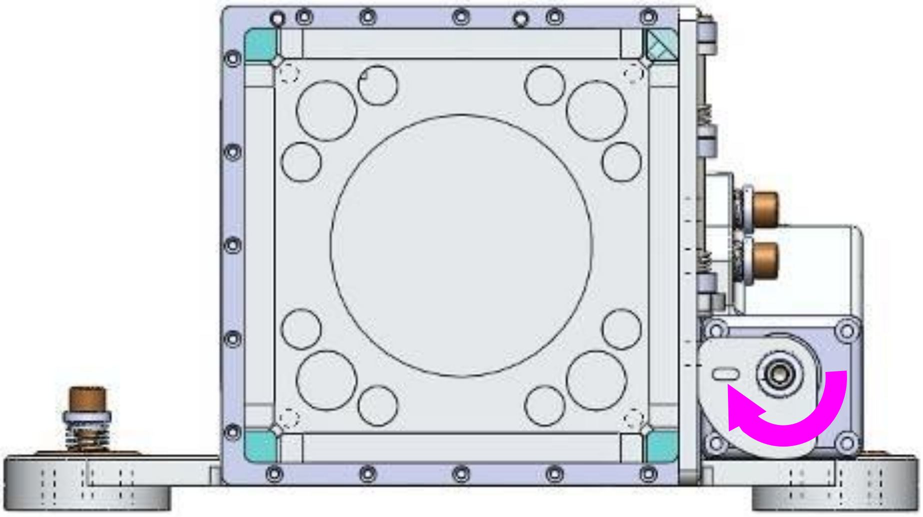


Figure A1.2-1 Satellite Install Case



<Initial Position>

Drive time	: 30 [sec] (Stop by the timer)
Turn Angle	: 180 [deg]



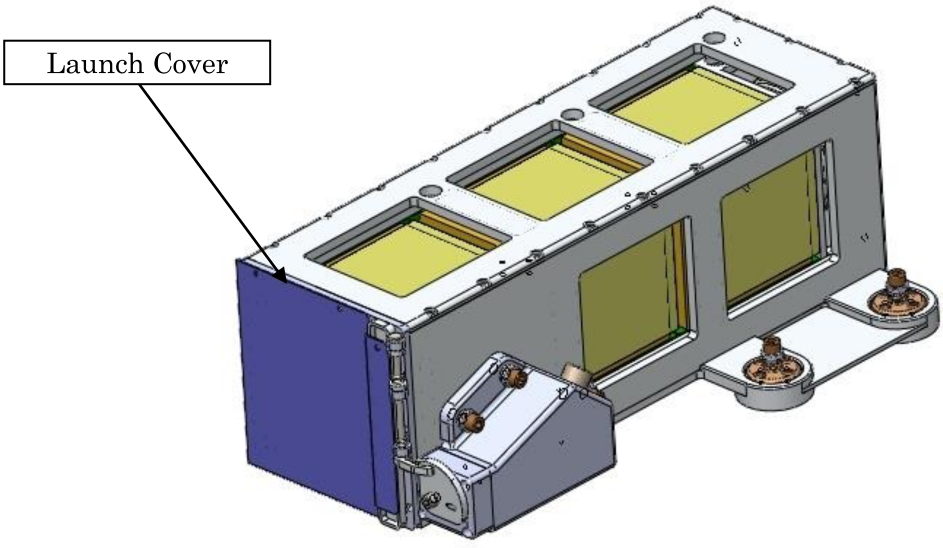
<Nominal Stop Position>

Figure A1.2-2 Separation Mechanism

A1.3. Launch Configuration

The satellites are installed in the Satellite Install Case and the case is packed in the Common Transfer Bag (CTB) for launch.

The Launch Cover is attached at the front and the two preload bolts are engaged to fix the back plate of the Satellite Install Case during the launch as shown in the Figure A1.3-1.



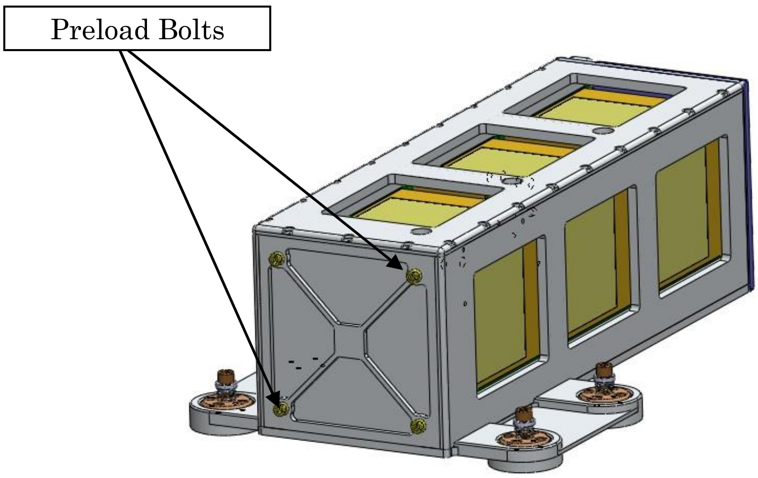
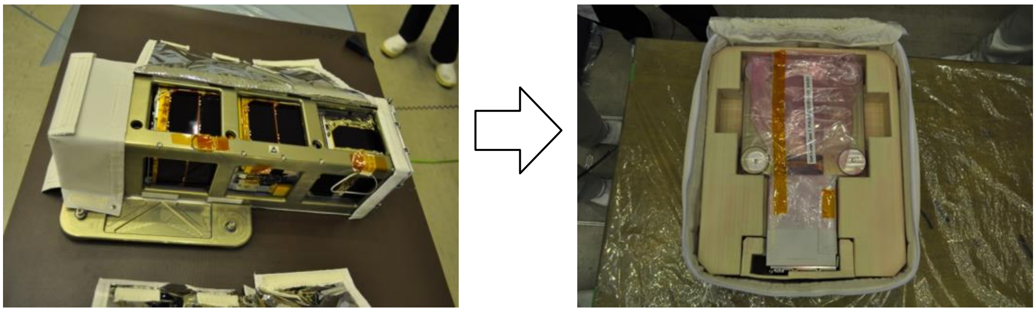


Figure A1.3-1 Launch Configuration

A1.4 Operation Scenario

Operation scenario after receiving satellite on ground is shown as below.

(1) Preparation for Launch
  (1-1) The satellite is installed in the Satellite Install Case and stowed inside Cargo Transfer Bag (CTB) with soft packing material.
  (1-2) The CTB is handed over to cargo integrator of Transfer Vehicle such as HTV.



(2) Launch

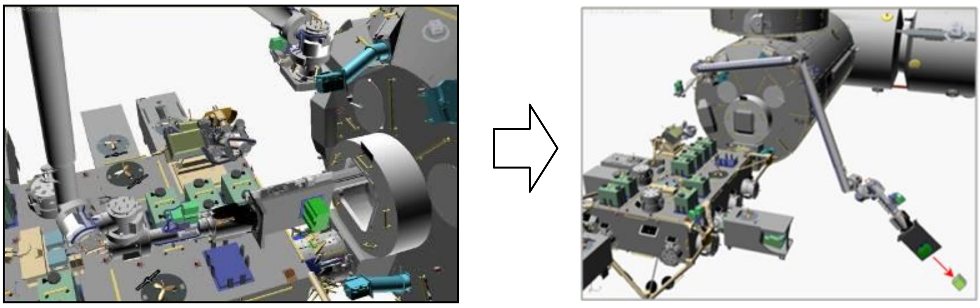
After launch CTB is moved into on-orbit JEM PM.

(3) Installation on the JEM Airlock table in JEM PM
  (3-1) Unpack the CTB.
  (3-2) Open the inner hatch of Airlock and extend the Airlock slide table into JEM PM
  (3-3) Install the all Satellite Cases with Electric Box and Separation Mechanisms on the Multi-Purpose Experiment Platform (MPEP) on the Airlock and then connect electric cables and signal cables.

(4) J-SSOD Checkout and Setup for Deployment
  (4-1) Connect the Checkout (C/O) cable to the MPEP.
  (4-2) Drive the separation mechanism by commands from the JEMRMS console (or the ground) and check out the Separation Mechanism.
  (4-3) Confirm the separation mechanism goes back to initial position. Disconnect the C/O cable.
  (4-4) Remove the launch cover from the Satellite Install Case.
  (4-5) Remove the RBF pin from each satellite.

(4-6) Put on the access-window cover to the Satellite Install Case for each satellite.
(4-7) Retrieve the JEM Airlock table into the JEM Airlock and close the inner hatch.

(5) Deployment
(5-1) Depressurize inside of Airlock.
(5-2) Open the outer hatch of Airlock and extend the slide table into outer space.
(5-3) Grapple the MPEP by the JEMRMS.
(5-4) Supply heater power to J-SSOD from the JEMRMS
(5-5) Maneuver the MPEP to appropriate deployment position.
(5-6) Deploy the first set of satellites by commands from the JEMRMS console (or the ground).
(5-7) Deploy the second set of satellites by commands from the JEMRMS console (or the ground).



(6) Stowage after deployment
(6-1) Install the MPEP onto the JEM Airlock slide table by the JEMRMS.
(6-2) Retrieve the JEM Airlock table into the JEM Airlock and close the outer hatch. Then repressurize inside of Airlock.

A1.5. Deployment Condition

The Table A1.5-1 shows the deployment condition. The deployment condition may vary depending on the actual ISS situation.

Table A1.5-1 Deployment Condition

Item	Specification
Deploy Orbit	(1) Approx. 380～420km (Nominal altitude of ISS) (2) Inclination : 51.6°
Deploy Direction	Nadir-Aft, 45[deg] from the nadir with respect to the ISS Body Coordinate System
Deploy Velocity	1.1 ~ 1.7 m/sec (depends on a satellite mass) * J-SSOD performance in 3U satellite deployment.
Deployment Accuracy	Less than ±5 degrees

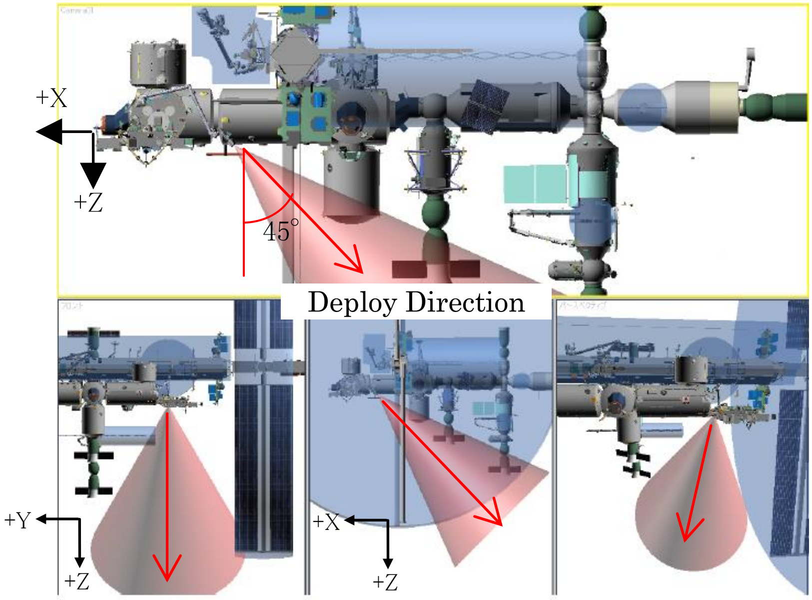


Figure A1.5-1 Deploy Direction

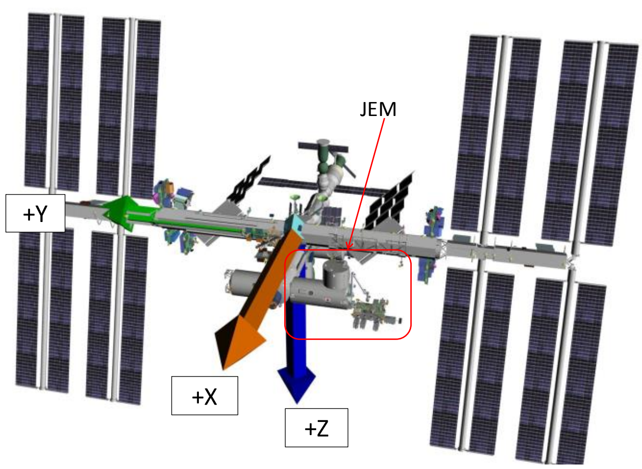


Figure A1.5-2 ISS Body Coordinate System

Appendix B

Correspondence to CubeSat Design Specification Rev.12

This document section 2.1 Mechanical Interfaces and 2.2 Electrical Interface reference CubeSat Design Specification Rev.12 issued by California Polytechnic State University on 2009/08/01. Correspondence to CubeSat Design Specification Rev.12 is shown in Table B-1. The following correspondences are specified in this Table.

A (Applicable) : CubeSat Design Specification is applied to this document without any modification.

A/M (Applicable with modification) : CubeSat Design Specification is applied to this document with partial modification due to J-SSOD design.

E (Equivalent) : ISS/JEM unique provision is applied to this document.

NA (Not Applicable) : CubeSat Design Specification is not applied to this document

Correspondent section numbers in this document are also shown in this Table.

Table B-1 Correspondence to CubeSat Design Specification Rev.12 (1/4)

No.	Requirement Description	Correspondence	Note (Correspondent section numbers etc.)
1.	Introduction	-	[Title]
1.1	Overview	NA	Explanation of P-POD
1.2	Purpose	NA	
1.3	Waiver Process	E	section 4.1 (4)
1.4	Interface	NA	Explanation of P-POD
2.	CubeSat Specification	-	[Title]
2.1	General Requirements	-	[Title]
2.1.1	CubeSats which incorporate any deviation from the CDS shall submit a DAR and adhere to the waiver process.	E	section 4.1 (4)
2.1.2	All parts shall remain attached to the CubeSats during launch, ejection and operation. No additional space debris shall be created.	A/M	section 4.3.2 (1)
2.1.3	Pyrotechnics shall not be permitted.	E	section 4.2.1 (1)
2.1.4	No pressure vessels over 1.2 standard atmosphere shall be permitted.	E	section 4.2.1 (1)
2.1.4.1	Pressure vessels shall have a factor of safety no less than 4.	NA	
2.1.5	Total stored chemical energy shall not exceed 100 Watt-Hours.	E	section 4.2.2 (4)
2.1.6	No hazardous materials shall be used on a CubeSat. Please contact us if you are unsure if a material is considered hazardous.	A/M	section 4.2.1 (2)~(4)
2.1.7	CubeSat materials shall satisfy the following low out-gassing criterion to prevent contamination of other spacecraft during integration, testing and launch.	A	section 2.5
2.1.7.1	Total Mass Loss (TML) shall be less than or equal 1.0%.		
2.1.7.2	Collected Volatile Condensable Material (CVCM) shall be less than or equal 0.1%.		
2.1.7.3	Note: A list of NASA approved low out-gassing materials can be found at: http://outgassing.nasa.gov.	NA	[Information Only]
2.1.8	The latest revision of the CubeSat Design Specification shall be the official version (http://cubesat.calpoly.edu/pages/documents/developers.php), which all CubeSat developers shall adhere to.	NA	[Information Only]
2.1.8.1	Cal Poly shall send updates to the CubeSat mailing list upon any changes to the specification. You can sign-up for the CubeSat mailing list here: http://ati.calpoly.edu/mailman/listinfo/cubesat	NA	[Information Only]
2.2	CubeSat Mechanical Requirements	-	[Title]

Table B-1 Correspondence to CubeSat Design Specification Rev.12 (2/4)

No.	Requirement Description	Correspondence	Note (Correspondent section numbers etc.)
2.2.1	Exterior Dimensions	-	[Title]
2.2.2	The CubeSat shall use the coordinate system as defined in Figure 5. The –Z face of the CubeSat will be inserted first into the P-POD.	A	section 2.1.1
2.2.3	The CubeSat configuration and physical dimensions shall be per Figure 5.	A/M	section 2.1.2 (1)
2.2.4	The CubeSat shall be 100.0+/-0.1mm wide (X and Y dimensions per Figure 5)	A	section 2.1.2 (2)
2.2.5	A single CubeSat shall be 113.5+/-0.1mm tall (Z dimension per Figure 5)	A	section 2.1.2 (3)
2.2.5.1	A Triple CubeSat shall be 340.5+/-0.3mm tall (Z dimension per Figure 5)	A	section 2.1.2 (3)
2.2.6	All components shall not exceed 6.5 mm normal to the surface of the 100.0 mm cube (the green and yellow shaded sides in Figure 5)	A	section 2.1.4 (1)
2.2.7	Exterior CubeSat components shall not contact the interior surface of the P-POD other than the designated CubeSat rails.	A	section 2.1.4 (2)~(4)
2.2.8	Deployables shall be constrained by the CubeSat. The P-POD rails and walls shall not to be used constrain CubeSat rails.	A	section 2.1.4 (5)
2.2.9	Rails shall have a minimum width of 8.5 mm.	A	section 2.1.3 (3)
2.2.10	The rails shall not have a surface roughness greater than 1.6 micro-m.	A	section 2.1.3 (4)
2.2.11	The edges of the rails shall be rounded to a radius of at least 1mm.	A	section 2.1.3 (5)
2.2.12	The ends of the rails on the +Z face shall have a minimum surface area of 6.5 mm x 6.5 mm contact area for neighboring CubeSat rails. (as per Figure 5)	A	section 2.1.3 (6)
2.2.13	At least 75% of the rails shall be in contact with the P-POD rails. 25% of the rails may be recessed and no part of the rails shall exceed the specification.	A	section 2.1.3 (7)
2.2.13.1	For single CubeSats this means at least 85.1 mm of rail contact.		
2.2.13.2	For triple CubeSats this means at least 255.4 mm of rail contact.		
2.2.14	Mass	-	[Title]
2.2.15	Each single CubeSat shall not exceed 1.33 kg mass.	A/M	section 2.1.5 (1)
2.2.16	Each triple CubeSat shall not exceed 4.0kg mass.		
2.2.17	The CubeSat center of gravity shall be located within a sphere of 2 cm from its geometric center.	A	section 2.1.5 (3)
2.2.18	Material	-	[Title]
2.2.19	Aluminum 7075 and 6061 shall be used for both the main Cube Sat structure and the rails.	A/M	section 4.2.1 (2)
2.2.19	If other materials are used the developer shall submit a DAR and adhere to the waiver process.	E	section 4.2.1 (2)~(4) MIUL/MUA/VUA

Table B-1 Correspondence to CubeSat Design Specification Rev.12 (3/4)

No.	Requirement Description	Correspondence	Note (Correspondent section numbers etc.)
2.2.20	The CubeSat rails and standoff, which contact the P-POD rails and adjacent CubeSat standoffs, shall to hard anodized aluminum to prevent any cold welding within the P-POD.	A	section 2.1.3 (8)
2.2.21	The CubeSat shall use separation spring (Figure 4) with characteristics defined in Table 1 on the designated rail standoff. Separation springs with characteristics can be found using McMaster Carr P/N 84985A76. The separation springs provide relative separation between CubeSats after deployment from the P-POD.	A/M	section 2.1.6 (1)
2.2.21.1	The compressed separation springs shall be at or below the level of the standoff.	A/M	section 2.1.6 (1)
2.2.21.2	The throw of the separation spring shall be a minimum of 0.05 inches above the standoff surface.	A/M	section 2.1.6 (1)
2.2.21.3	Separation springs are not required for 3U CubeSats.	A	section 2.1.6 (2)
2.3	Electrical Requirements	-	[Title]
2.3.1	No electronics shall be active during launch to prevent any electrical or RF interference with the launch vehicle and primary payloads. CubeSats with batteries shall be fully deactivated during launch or launch with discharged batteries.	A/M	section 2.3 (2)(3)(5) Activation, checkout or maintenance is not carried out inboard in principle.
2.3.2	The CubeSat shall include at least one deployment switch on the designated rail standoff (shown in Figure 5) to completely turn off satellite power once actuated. In the actuated state, the deployment switch shall be centered at or below the level of the standoff.	A/M	section 2.2.1 Two deployment switches shall be installed.
2.3.2.1	All systems shall be turned off, including real time clocks.	A	section 2.3 (3)
2.3.3	To allow for CubeSat diagnostics and battery charging after the CubeSats have been integrated into the P-POD all CubeSat umbilical connectors shall be within the designated Access Port positions, green shaded areas shown in Figure5.	A/M	section 2.2.1 (3)、2.3 (2) Activation, checkout or maintenance is not carried out inboard in principle.
2.3.3.1	Triple CubeSats shall use the designated Access Port positions (green shaded areas) show in Appendix C.	A	section 2.1.7
2.3.3.2	Note: CubeSat deployment switch shall be depressed while inside the P-POD. All diagnostics and battery charging shall be done while the deployment switch is depressed.	A/M	section 2.2.1 (1)(3)、2.3 (2)
2.3.4	The CubeSat shall include a Remove Before Flight (RBF) pin or launch with batteries fully discharged. The RBF pin shall be removed from the CubeSat after integration into the P-POD.	A/M	section 2.2.2 (1)
2.3.4.1	The RBF pin shall be accessible from the Access Port position, green shaded area in Figure 5.	A	section 2.2.2 (1)

Table B-1 Correspondence to CubeSat Design Specification Rev.12 (4/4)

No.	Requirement Description	Correspondence	Note (Correspondent section numbers etc.)
2.3.4.1.1	Triple CubeSats shall located their RBF pin in one of the 3 designated Access Port positions (green shaded areas) show in Appendix C.	A	section 2.1.7
2.3.4.2	The RBF pin shall cut all power to the satellite once it is inserted into the satellite.	A	section 2.2.2 (2)
2.3.4.3	The RBF in shall not protrude more than 6.5 mm from the rails when it is fully inserted in the satellite.	A	section 2.2.2 (3)
2.4	Operational Requirements	-	[Title]
2.4.1	CubeSats with batteries shall have the capability to receive a transmitter shutdown command, as per Federal Communications Commission (FCC) regulation.	NA	Refer to No.2.4.4.
2.4.2	All deployables such as booms, antennas and solar panels shall wait to deploy a minimum of 30 minutes after the CubeSat's deployment switch(es) are activated from P-POD ejection.	A	section 2.3 (4)
2.4.3	RF transmitters greater than 1mW shall wait to transmit a minimum of 30 minutes after the CubeSat's deployment switch(es) are activated from P-POD ejection.	A	section 2.3 (5)
2.4.4	Operators shall obtain and provide documentations of proper licenses for use of frequencies.	A/M	section 5.2 (1)(2) The intentional RF approval/certification process in ISS and the nation of a satellite developer is applied.
2.4.4.1	For amateur frequency use, this requires proof of frequency coordination by the International Amateur Radio Union (IARU). Applications can be found at www.iaru.org.	A	section 5.2 (1)(2)
2.4.5	The orbital decay lifetime of the CubeSats shall be less than 25 years after end of mission life.	A	section 4.3.1.1.2 (3), 4.3.2 (4)
2.4.6	Cal Poly shall conduct a minimum of one fit check in which developer hardware shall be inspected and integrated into the P-POD. A final fit check shall be conducted prior to launch. The CubeSat Acceptance Checklist (CAC) shall be used to verify compliance of the specification (Appendix B for single CubeSats and Appendix D for triple CubeSats.)	E	Appendix-C
3	Testing Requirements	E	Appendix-C
3.1	Random Vibration	E	Appendix-C
3.2	Thermal Vacuum Bake out	E	Appendix-C
3.3	Visual Inspection	E	Appendix-C
3.4	Qualification	E	Appendix-C
3.5	Protoflight	E	Appendix-C
3.6	Acceptance	E	Appendix-C

Appendix C

Verification Matrix

Table C-1 Verification Matrix for the interface requirements and safety requirements (1/12)

Section No.	Section	JAXA				Satellite Provider				Remarks
		Analysis	Inspection	Test	ROD	Analysis	Inspection	Test	ROD	
2	Interface Requirements for 10cm Class Satellite	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
2.1	Mechanical Interfaces	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
2.1.1	Coordinate System	NA	NA	NA	NA	NA	NA	NA	NA	[Definition]
2.1.2	Dimensional Requirements	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) The type of satellite	－	－	－	－	－	－	－	○	To clarify the type of satellite (1U, 2U, 3U)
	(2) Width (X, Y direction)	－	－	○	－	－	○	－	－	As for a JAXA selected satellite, JAXA will conduct Fit Check with J-SSOD.
	(3)～(5) Rail Length : Z direction	－	－	○	－	－	○	－	－	Same as the above.
2.1.3	Rails	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) The number and position of the rails	－	－	－	－	－	－	－	○	
	(2) Dimension	－	－	○	－	－	○	－	－	As for a JAXA selected satellite, JAXA will conduct Fit Check with J-SSOD.
	(3) Rails Width	－	－	－	－	－	○	－	－	
	(4) Rails Surface Roughness	－	－	－	－	－	○	－	－	
	(5) Rails Edges Rounding	－	－	○	－	－	○	－	－	JAXA will conduct Sharp Edge Touch Test as needed.
	(6) Rails Surface Area (+Z Plane)	－	－	－	－	－	○	－	－	
	(7) Rails Contact Length with J-SSOD Rail Guides	－	－	－	－	○	－	－	－	
	(8) Rails Finishing	－	－	－	－	－	○	－	－	

Table C-1 Verification Matrix for the interface requirements and safety requirements (2/12)

Section No.	Section	JAXA				Satellite Provider				Remarks
		Analysis	Inspection	Test	ROD	Analysis	Inspection	Test	ROD	
2.1.4	Envelope Requirements	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) Dynamic Envelope	—	—	○	—	—	○	—	—	Refer to the section 2.1.4(2)~(4)
	(2) Dynamic Envelope (+Z Plane)	—	—	○	—	—	○	—	—	As for a JAXA selected satellite, JAXA will conduct Fit Check with J-SSOD.
	(3) Dynamic Envelope (-Z Plane)	—	—	○	—	—	○	—	—	Same as the above.
	(4) Dynamic Envelope (±X and ±Y Plane)	—	—	○	—	—	○	—	—	Same as the above.
	(5) Constraints on deployable components	—	—	—	—	—	—	—	○	
	(6) Constraints on deployable components in inadvertent deployment	—	—	—	—	—	○	—	—	
2.1.5	Mass Properties	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) Mass	—	—	—	—	—	○	—	—	
	(2) Ballistic Number	—	—	—	—	○	—	—	—	
	(3) Center of Gravity	—	—	—	—	○	—	(○)	—	
2.1.6	Separation Spring	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) Requirement for 1U and 2U	—	—	—	—	—	○	—	—	
	(2) Requirement for 3U	NA	NA	NA	NA	NA	NA	NA	NA	Not applicable.

(○) : Conditions identified in concerned section are used in an analysis or a test.

Table C-1 Verification Matrix for the interface requirements and safety requirements (3/12)

Section No.	Section	JAXA				Satellite Provider				Remarks
		Analysis	Inspection	Test	ROD	Analysis	Inspection	Test	ROD	
2.1.7	Access Window	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) Position	NA	NA	NA	NA	NA	NA	NA	NA	[Design Information]
	(2) Accessibility	—	—	○	—	—	○	—	—	As for a JAXA selected satellite, JAXA will conduct Accessibility Check with J-SSOD.
2.1.8	Structural Strength	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) Main Structure Strength	—	—	—	—	○	—	—	—	
	(2) Rails Strength	—	—	—	—	○	—	—	—	
2.1.9	Stiffness	—	—	—	—	○	—	—	—	
2.2	Electrical Interface	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
2.2.1	Deployment Switch	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) Position	—	—	—	—	—	○	—	—	
	(2) Power Isolation	—	—	—	—	—	—	○	—	
	(3) Battery Charging	NA	NA	NA	NA	NA	NA	NA	NA	[Information Only]
	(4) Stroke	—	—	—	—	—	○	—	—	
	(5) Force	—	—	—	—	—	○	—	—	
	(6) Deployment Switch Arrangement	—	—	—	—	—	—	—	○	The position of one of the inhibits.

Table C-1 Verification Matrix for the interface requirements and safety requirements (4/12)

Section No.	Section	JAXA				Satellite Provider				Remarks
		Analysis	Inspection	Test	ROD	Analysis	Inspection	Test	ROD	
2.2.2	RBF(Remove Before Flight) Pin	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) Accessibility	—	—	○	—	—	○	—	—	As for a JAXA selected satellite, JAXA will conduct Accessibility Check with J-SSOD.
	(2) Power Isolation	—	—	—	—	—	—	○	—	
	(3) Envelope	—	—	—	—	—	○	—	—	
	(4) Tether	—	—	—	—	—	○	—	—	
2.2.3	Bonding	—	—	○	—	—	○	—	—	As for a JAXA selected satellite, JAXA will conduct Accessibility Check with J-SSOD.
2.2.4	RF	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) Current Limit for Downlink Frequency	—	—	—	—	○	—	—	—	
	(2) Allowable RF Radiation Levels	—	—	—	—	○	—	—	—	
2.3	Operational Requirements	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) Maximum Stowage Duration	—	—	—	—	—	—	—	○	
	(2) On-orbit Maintenance Limitation	—	—	—	—	—	—	—	○	
	(3) Cold Launch Requirements	—	—	—	—	—	—	—	○	
	(4) Minimum Time until Mechanism Deployment	—	—	—	—	—	—	○	—	
	(5) Minimum Time until RF Radiation	—	—	—	—	—	—	○	—	
	(6) Satellite Deployment Window	—	—	—	—	—	—	—	○	If limitation of the satellite deployment window exists, a satellite provider shall coordinate with JAXA

Table C-1 Verification Matrix for the interface requirements and safety requirements (5/12)

Section No.	Section	JAXA				Satellite Provider				Remarks
		Analysis	Inspection	Test	ROD	Analysis	Inspection	Test	ROD	
2.4	Environmental Requirements	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
2.4.1	Random Vibration and Acceleration	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(a) Quasi-static Acceleration	－	－	－	－	(○)	－	－	○	
	(b) Random Vibration	－	－	－	－	－	－	(○)	○	
2.4.2	On-orbit Acceleration	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(a) On-orbit Acceleration	－	－	－	－	(○)	－	－	○	
	(b) Acceleration induced by JEMRMS Emergency-Stop	－	－	－	－	(○)	－	－	○	
2.4.3	Pressure Environment	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(a) Pressure	－	－	－	－	－	－	－	○	
	(b) Depressurization Rate	－	－	－	－	(○)	－	－	○	Only if V/A > 50.8m (2000inch), Stress Analysis Report is needed.
2.4.4	Thermal Environment	－	－	－	－	－	－	(○)	○	
2.4.5	Humidity Environment	－	－	－	－	－	－	－	○	
2.5	Out-gassing	－	－	－	－	－	○	－	－	

(○) ：Conditions identified in concerned section are used in an analysis or a test.

Table C-1 Verification Matrix for the interface requirements and safety requirements (6/12)

Section No.	Section	JAXA				Satellite Provider				Remarks
		Analysis	Inspection	Test	ROD	Analysis	Inspection	Test	ROD	
3	Interface Requirements for 50cm Class Satellite	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
3.1	Mechanical Interfaces	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
3.1.1	Coordinate System	NA	NA	NA	NA	NA	NA	NA	NA	[Definition]
3.1.2	Dimensional Requirements	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) The type of satellite	—	—	—	—	—	—	—	○	To clarify the type of satellite (50cm Class Satellite)
	(2) (3)Width (X, Y direction)	—	—	○	—	—	○	—	—	As for a JAXA selected satellite, JAXA will conduct Fit Check with J-SSOD.
	(4)Rail Length : Z direction	—	—	○	—	—	○	—	—	Same as the above.
3.1.3	Rails	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) The number and position of the rails	—	—	—	—	—	—	—	○	
	(2) Dimension	—	—	○	—	—	○	—	—	As for a JAXA selected satellite, JAXA will conduct Fit Check with J-SSOD.
	(3) Rails Width	—	—	—	—	—	○	—	—	
	(4) Rails Surface Roughness	—	—	—	—	—	○	—	—	
	(5) Rails Edges Rounding	—	—	○	—	—	○	—	—	JAXA will conduct Sharp Edge Touch Test as needed.
	(6) Rails Surface Area (+Z Plane)	—	—	—	—	—	○	—	—	
	(7) Rails Contact Length with J-SSOD Rail Guides	—	—	—	—	○	—	—	—	
	(8) Rails Finishing	—	—	—	—	—	○	—	—	

(○) : Conditions identified in concerned section are used in an analysis or a test.

Table C-1 Verification Matrix for the interface requirements and safety requirements (7/12)

Section No.	Section	JAXA				Satellite Provider				Remarks
		Analysis	Inspection	Test	ROD	Analysis	Inspection	Test	ROD	
3.1.4	Envelope Requirements	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) Dynamic Envelope	—	—	○	—	—	○	—	—	Refer to the section 3.1.4(2)~(4)
	(2) Dynamic Envelope (+/-Z Plane)	—	—	○	—	—	○	—	—	As for a JAXA selected satellite, JAXA will conduct Fit Check with J-SSOD.
	(3) Dynamic Envelope (±X and ±Y Plane)	—	—	○	—	—	○	—	—	Same as the above.
	(4) No contact	—	—	○	—	—	○	—	—	Same as the above.
	(5) Constraints on deployable components	—	—	—	—	—	—	—	○	
3.1.5	Mass Properties	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) Mass	—	—	—	—	—	○	—	—	
	(2) Ballistic Number	—	—	—	—	○	—	—	—	
	(3) Center of Gravity	—	—	—	—	○	—	(○)	—	
3.1.6	Separation Spring	NA	NA	NA	NA	NA	NA	NA	NA	Not applicable.

(○) : Conditions identified in concerned section are used in an analysis or a test.

Table C-1 Verification Matrix for the interface requirements and safety requirements (8/12)

Section No.	Section	JAXA				Satellite Provider				Remarks
		Analysis	Inspection	Test	ROD	Analysis	Inspection	Test	ROD	
3.1.7	Access Window	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) Accessibility	—	—	○	—	—	○	—	—	As for a JAXA selected satellite, JAXA will conduct Accessibility Check with J-SSOD.
3.1.8	Structural Strength	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) Main Structure Strength	—	—	—	—	○	—	—	—	
	(2) Rails Strength	—	—	—	—	○	—	—	—	
3.1.9	Stiffness	—	—	—	—	○	—	—	—	
3.1.10	Ground Handling	—	—	—	—	○	—	—	—	
3.2	Electrical Interface	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
3.2.1	Deployment Switch	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) Position	—	—	—	—	—	○	—	—	
	(2) Power Isolation	—	—	—	—	—	—	○	—	
	(3) Battery Charging	NA	NA	NA	NA	NA	NA	NA	NA	[Information Only]
	(4) Reserved	NA	NA	NA	NA	NA	NA	NA	NA	
	(5) Reserved	NA	NA	NA	NA	NA	NA	NA	NA	
	(6) Deployment Switch Arrangement	—	—	—	—	—	—	—	○	The position of one of the inhibits.

Table C-1 Verification Matrix for the interface requirements and safety requirements (9/12)

Section No.	Section	JAXA				Satellite Provider				Remarks
		Analysis	Inspection	Test	ROD	Analysis	Inspection	Test	ROD	
3.2.2	RBF(Remove Before Flight) Pin	NA	NA	NA	NA	NA	NA	NA	NA	Not applicable
3.2.3	Bonding	—	—	○	—	—	○	—	—	As for a JAXA selected satellite, JAXA will conduct Accessibility Check with J-SSOD.
3.2.4	RF	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) Current Limit for Downlink Frequency	—	—	—	—	○	—	—	—	
	(2) Allowable RF Radiation Levels	—	—	—	—	○	—	—	—	
3.3	Operational Requirements	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) Maximum Stowage Duration	—	—	—	—	—	—	—	○	
	(2) On-orbit Maintenance Limitation	—	—	—	—	—	—	—	○	
	(3) Cold Launch Requirements	—	—	—	—	—	—	—	○	
	(4) Minimum Time until Mechanism Deployment	—	—	—	—	—	—	○	—	
	(5) Minimum Time until RF Radiation	—	—	—	—	—	—	○	—	
	(6) Satellite Deployment Window	—	—	—	—	—	—	—	○	If limitation of the satellite deployment window exists, a satellite provider shall coordinate with JAXA

Table C-1 Verification Matrix for the interface requirements and safety requirements (10/12)

Section No.	Section	JAXA				Satellite Provider				Remarks
		Analysis	Inspection	Test	ROD	Analysis	Inspection	Test	ROD	
3.4	Environmental Requirements	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
3.4.1	Random Vibration and Acceleration	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(a) Quasi-static Acceleration	—	—	—	—	(○)	—	—	○	
	(b) Random Vibration	—	—	—	—	—	—	(○)	○	
3.4.2	On-orbit Acceleration	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(a) On-orbit Acceleration	—	—	—	—	(○)	—	—	○	
	(b) Acceleration induced by JEMRMS Emergency-Stop	—	—	—	—	(○)	—	—	○	
3.4.3	Pressure Environment	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(a) Pressure	—	—	—	—	—	—	—	○	
	(b) Depressurization Rate	—	—	—	—	(○)	—	—	○	Only if V/A > 50.8m (2000inch), Stress Analysis Report is needed.
3.4.4	Thermal Environment	—	—	—	—	—	—	(○)	○	
3.4.5	Humidity Environment	—	—	—	—	—	—	—	○	
3.5	Out-gassing	—	—	—	—	—	○	—	—	

(○) ：Conditions identified in concerned section are used in an analysis or a test.

Table C-1 Verification Matrix for the interface requirements and safety requirements (11/12)

Section No.	Section	JAXA				Satellite Provider				Remarks
		Analysis	Inspection	Test	ROD	Analysis	Inspection	Test	ROD	
4	Safety and Product Assurance	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
4.1	Generic Requirements	NA	NA	NA	NA	NA	NA	NA	NA	Provision for policy and procedure for safety & product assurance.
4.2	Safety Assessment	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
4.2.1	Implementation of Safety Analysis and Safety Assessment	—	—	○	—	○	(○)*	(○)*	—	* A satellite provider shall conduct safety analysis and submit SAR. Necessary inspections and tests for safety assessment shall be also conducted. A satellite provider shall submit ATV/HTV/KSC Form 100 check list for launch site & vehicle safety assessment. Offgassing test will be conducted by JAXA.
4.2.2	Safety Design Guidelines	NA	NA	NA	NA	NA	NA	NA	NA	[Guidelines]
4.3	Compatibility with Safety Requirements for Deployable Satellite from ISS and Space Debris Mitigation Guidelines	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
4.3.1	Compatibility with Safety Requirements for Deployable Satellite from ISS	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
4.3.1.1	Deployable Satellite Design Requirements	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
4.3.1.1.1	Ballistic Number	NA	NA	NA	NA	NA	NA	NA	NA	Refer to the section 2.1.5 (2).
4.3.1.1.2	Deployment Analysis	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) Space Surveillance Network (SSN)	—	—	—	—	—	—	—	○	This requirement is satisfied under the section 2.1.2 Dimensional Requirements.
	(2) Analysis Methods	—	—	—	○	—	—	—	○	Ballistic Number shall be provided for JAXA to conduct analysis.
	(3) Chance of human injury on the ground	○	—	—	—	○	—	—	—	Dimensions of components, materials, mass, etc shall be provided for JAXA to conduct analysis.

Table C-1 Verification Matrix for the interface requirements and safety requirements (12/12)

Section No.	Section	JAXA				Satellite Provider				Remarks
		Analysis	Inspection	Test	ROD	Analysis	Inspection	Test	ROD	
4.3.1.1.3	Propulsion Systems	○	―	―	―	○	―	○	―	First, a satellite provider shall conduct analysis. After that, JAXA will conduct analysis based on requisite data provided by a satellite provider with the intention of double-check.
4.3.1.1.4	Deployable Subcomponents	○	―	―	―	○	―	―	―	Same as the above.
4.3.1.2	Satellite Deployer Requirements	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
4.3.1.2.1	Generic Requirements	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1)~(2) Deploy Position and Direction	○	―	―	―	NA	NA	NA	NA	Not Applicable, because this requirement is independent of a satellite design.
	(3)~(5) Orbit of a satellite	○	―	―	―	○	―	―	―	Ballistic Number shall be provided for JAXA to conduct analysis.
4.3.1.2.2	J-SSOD Requirements	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) Deploy Velocity Vector	―	―	―	―	―	○	―	―	This requirement is satisfied under the section 2.1.2 Dimensional Requirements.
	(2)~(3) Deploy Velocity	○	―	―	―	―	○	―	―	The mass of a satellite shall be provided for JAXA to conduct analysis.
4.3.2	Compatibility with Space Debris Mitigation Guidelines	○	―	―	―	○	―	―	―	JAXA will conduct re-entry analysis and a satellite orbital lifetime analysis.
5.2	Application for Approval and Authorization	NA	NA	NA	NA	NA	NA	NA	NA	[Title]
	(1) Intentional Radiating and Receiving Authorization	―	―	―	―	―	―	―	○	As for a JAXA selected satellite, JAXA will make an application for using intentional RF to JSC Frequency Manager based on JSC Frequency Authorization Input Form.
	(2) Radio Frequency Capability and Emission/Operation Authority	―	―	―	―	―	―	―	○	As for a JAXA selected satellite, JAXA will submit a copy of approved license to NASA.

Document No. [Defined by Satellite Developer]

J-SSOD & [Satellite Name] Interface Verification Record

(For 10cm-sized Small Satellite)

Satellite Developer Name ; [Defined by Satellite Developer]
Satellite Name ; [Defined by Satellite Developer]
P/N ; [Defined by Satellite Developer]
S/N ; [Defined by Satellite Developer]

SIGNATURES / Satellite Development, Sponsor agency

NAME DATE
Satellite Development Team (Initiate)

NAME DATE
Satellite Development Team (Reviewed)

NAME DATE
Satellite Development Team (Approved)

NAME DATE
Sponsor Agency (Approved)

J-SSOD / Satellite Interface Verification Record (1 /11)

Document No. [Defined by Satellite Developer]

No.	Item	Results	Requirement	Verification Method	Evidence document (Document No)	Reference
<< Mechanical Interface >>						
1.	Satellite Type	1U / 2U / 3U	1U, 2U, or 3U	N/A	N/A	Pare 2.1.2(1)
2.	Width in -Z Plane		100.0+/-0.1mm	Measurement		Para 2.1.2(2) Figure2.1.2-1, 2a~2d
	a. +X Plane	mm				
	b. +Y Plane	mm				
	c. -X Plane	mm				
	d. -Y Plane	mm				
3.	Width in +Z Plane		100.0+/-0.1mm	Measurement		Para 2.1.2(2) Figure2.1.2-1, 3a~3d
	a. +X Plane	mm				
	b. +Y Plane	mm				
	c. -X Plane	mm				
	d. -Y Plane	mm				
4.	Rails Length		[For Deployment S/W] 113.5+/-0.1mm (1U) 227.0+/-0.1mm (2U) 340.5+/-0.3mm (3U) [For Separation Spring] 111.5+/-0.1mm (1U) 225.0+/-0.1mm (2U) 340.5+/-0.3mm (3U)	Measurement		Para 2.1.2 (3)~(5) Para 2.1.3 (1) Figure2.1.2-1, 4a~4d
	a. Rail 1	mm (S/W or Spring)				
	b. Rail 2	mm (S/W or Spring)				
	c. Rail 3	mm (S/W or Spring)				
	d. Rail 4	mm (S/W or Spring)				
5.	Rails Width		Min 8.5 x 8.5 mm	Measurement		Para 2.1.3(3) Figure2.1.2-1, 5a~5d
	a. Rail 1	x mm				
	b. Rail 2	x mm				
	c. Rail 3	x mm				
	d. Rail 4	x mm				

J-SSOD / Satellite Interface Verification Record (2 /11)

Document No. [Defined by Satellite Developer]

No.	Item	Results	Requirement	Verification Method	Evidence document (Document No)	Reference
6.	**Rails Surface Roughness**		≦ 1.6μm (Ra) (*1)	Inspection (Machine work order, Inspection report, etc.)		Para 2.1.3(4) Figure2.1.2-1, 6a~6d
	a. Rail 1	OK / NG				
	b. Rail 2	OK / NG				
	c. Rail 3	OK / NG				
	d. Rail 4	OK / NG				
7.	**Rails Edges Rounding**		Min R1 mm	Inspection (Machine work order, Inspection report, etc.)		Para 2.1.3(5) Figure2.1.2-1, 7a~7d
	a. Rail 1	OK / NG				
	b. Rail 2	OK / NG				
	c. Rail 3	OK / NG				
	d. Rail 4	OK / NG				
8.	**Rails Surface Area (+Z Plane)**		Min 6.5 x 6.5 mm	Inspection (Manufacture drawing, etc.)		Para 2.1.3(6)
	a. Rail 1	OK / NG				
	b. Rail 2	OK / NG				
	c. Rail 3	OK / NG				
	d. Rail 4	OK / NG				
9.	**Rails Contact Length with J-SSOD Rail Guides**		≧ 85.1mm (1U) ≧ 170.3mm (2U) ≧ 255.4mm (3U)	Analysis (Assessment based on Manufacture drawing, etc. is allowed.)		Para 2.1.3(7)
	a. Rail 1, +X	mm				
	b. Rail 1, -Y	mm				
	c. Rail 2, -Y	mm				
	d. Rail 2, -X	mm				
	e. Rail 3, -X	mm				
	f. Rail 3, +Y	mm				
	g. Rail 4, +Y	mm				
	h. Rail 4, +X	mm				

*(*1) Arithmetic average of the roughness profile.*

J-SSOD / Satellite Interface Verification Record (3 /11)

Document No. [Defined by Satellite Developer]

No.	Item		Results	Requirement	Verification Method	Evidence document (Document No)	Reference
10.	Rail Surface Finish						
	a.	Rail 1	OK / NG	Anodized per MIL-A-8625 Type3	Inspection (Machine work order, Inspection report, etc.)		Para 2.1.3(8)
	b.	Rail 2	OK / NG				
	c.	Rail 3	OK / NG				
	d.	Rail 4	OK / NG				
11.	Clearance between Rail Edges & Main Structure (Z direction)						
	a.	Rail 1, +Z	mm	≧ 7mm	Inspection (Review of Manufacture drawing, etc.)		Para 2.1.3(2), 2.1.4(1)(2) Figure 2.1.2-1, 11a~11d
	b.	Rail 2, +Z	mm				
	c.	Rail 3, +Z	mm				
	d.	Rail 4, +Z	mm				
	e.	Rail 1, -Z	mm	≧ 6.5mm	Inspection (Review of Manufacture drawing, etc.)		Para 2.1.3(2), 2.1.4(1)(3) Figure 2.1.2-1, 11e~11h
	f.	Rail 2, -Z	mm				
	g.	Rail 3, -Z	mm				
	h.	Rail 4, -Z	mm				
12.	Rails Perpendicularity against +Z Plane						
	a.	Rail 1, +X	OK / NG	≦ 0.2mm	Inspection (Machine work order, Inspection report, etc.)		Para 2.1.3(2) Figure 2.1.2-1, 12a~12h
	b.	Rail 1, -Y	OK / NG				
	c.	Rail 2, -Y	OK / NG				
	d.	Rail 2, -X	OK / NG				
	e.	Rail 3, -X	OK / NG				
	f.	Rail 3, +Y	OK / NG				
	g.	Rail 4, +Y	OK / NG				
	h.	Rail 4, +X	OK / NG				

J-SSOD / Satellite Interface Verification Record (4 /11)

Document No. [Defined by Satellite Developer]

No.	Item		Results	Requirement	Verification Method	Evidence document (Document No)	Reference
13.	Rails Perpendicularity against +Y Plane						
	a.	Rail 1, +X	OK / NG	≦ 0.2mm	Inspection (Machine work order, Inspection report, etc.)		Para 2.1.3(2) Figure 2.1.2-1, 13a~13d
	b.	Rail 2, -X	OK / NG				
	c.	Rail 3, -X	OK / NG				
	d.	Rail 4, +X	OK / NG				
14.	Rails Parallelism to +Y Plane						
	a.	Rail 1, -Y	OK / NG	≦ 0.2mm	Inspection (Machine work order, Inspection report, etc.)		Para 2.1.3(2) Figure 2.1.2-1, 14a~14b
	b.	Rail 2, -Y	OK / NG				
15.	Rail Edges Flatness on +Z Plane						
	a.	Rail 1	OK / NG	≦ 0.2mm	Inspection (Machine work order, Inspection report, etc.)		Para 2.1.3(2) Figure 2.1.2-1, 15a~15d
	b.	Rail 2	OK / NG				
	c.	Rail 3	OK / NG				
	d.	Rail 4	OK / NG				
16.	Envelope (*2)		*(*2) Dynamic deformation shall be considered.*				
	a.	+X Plane	mm	≦ 6.5mm	Measurement (or Inspection)		Para 2.1.4 (1)&(4) Figure 2.1.4-1, 16a~16d
	b.	+Y Plane	mm				
	c.	-X Plane	mm				
	d.	-Y Plane	mm				
	e.	+Z Plane	mm	≧ 0.5mm from rail surfaces (+Z).	Measurement (or Inspection)		Para 2.1.4 (1)&(2) Figure 2.1.4-1, 16e
	f.	-Z Plane	OK / NG	No protrusion from rail surfaces (-Z).	Inspection		Para 2.1.4 (1)&(3) Figure 2.1.4-1, 16f
	g.	Constraints on deployable components	OK / NG	Any deployable components shall be constrained by the satellite itself. The J-SSOD rails and walls shall not be used to constrain these deployables.	Review of Design		Para 2.1.4 (5)

J-SSOD / Satellite Interface Verification Record (5 /11)

Document No. [Defined by Satellite Developer]

No.	Item	Results	Requirement	Verification Method	Evidence document (Document No)	Reference
17.	**Mass Properties**					
	a. Mass	Kg	0.13 ~ 1.33kg/1U	Measurement		Para 2.1.5(1)
	b. Ballistic Number	kg/m^2	≦ 100 kg/m^2	Analysis		Para 2.1.5(2)
	c. Center of Gravity	OK / NG	Within a sphere of 2 cm from the satellite geometric center.	Analysis (or Test)		Para 2.1.5(3)
18.	**Separation Spring (1U & 2U Only)**					
	a. Location	Option #	Option 1 or Option 2	Inspection (Manufacture drawing, etc.)		Para 2.1.6(1) Figure 2.1.6-2, 18a
	b. Parts Number	OK / NG	IA P/N: 251D939002-1	Inspection (Manufacture drawing, etc.)		Para 2.1.6(1)
	c. Positional Tolerance	mm	≦ 0.3mm (Basis: 4.25mm from rail surfaces)	Inspection (Manufacture drawing, etc.)		Para 2.1.6(1) Figure 2.1.6-2, 18c
19.	**Accessibility**	OK / NG	Accessible thru Access Window at either -Y or +X plane if required after the installation into the J-SSOD Satellite Install Case.	Inspection (Manufacture drawing, etc.), Fit Check with J-SSOD		Para 2.1.7(2)
20.	**Structural Strength**					
	a. Main Structure Strength	OK / NG	A satellite shall have a sufficient structural strength with a necessary safety margin through the ground operation, testing, ground handling, and on-orbit operations.	Analysis (Stress Analysis Report)		Para 2.1.8(1)
	b. Rails Strength	OK / NG	Each rail shall have a sufficient structural strength with 46.6 N of a combined load of the preload and the spring load by the main spring.	Analysis (Stress Analysis Report)		Para 2.1.8(2)
21.	**Stiffness**	Hz	Minimum fundamental frequency ≧ 100 [Hz]	Analysis (Stress Analysis Report)		Para 2.1.9

J-SSOD / Satellite Interface Verification Record (6 /11)

Document No. [Defined by Satellite Developer]

No.	Item	Results	Requirement	Verification Method	Evidence document (Document No)	Reference
<< Electrical Interface >>						
22.	Deployment Switches					
	a. Location	Option #	Option 1 or Option 2	Inspection (Drawing order, etc.)		Para 2.2.1(1) Figure 2.1.6-2, 22a
	b. Function Test	OK / NG	Satellite shall not be activated when either of two switches remains depressed, i.e. 0.75mm max. from the rail standoff surface.	Function Test		Para 2.2.1(2) Figure 2.2.1-1, 22b
	c. Stroke	mm	≦ 2.0mm	Function Test		Para 2.2.1(4) Figure 2.2.1-1, 22c
	d. Force	N	≦ 3N	Function Test		Para 2.2.1(5)
23.	RBF Pin					
	a. Accessibility	-Ys / +Xs	RBF pin shall be accessible thru Access Window at either -Ys or +Xs plane if required after the installation into the J-SSOD Satellite Install Case.	Inspection (Manufacture drawing, etc.), Fit Check with J-SSOD		Para 2.2.2(1)
	b. Function Test	OK / NG	RBF pin shall cut all power to the satellite once it is inserted into the satellite.	Function Test		Para 2.2.2(2)
	c. Envelope	mm	Protrudes ≦ 6.5mm	Inspection (Manufacture drawing, etc.), Fit Check		Para 2.2.2(3)
	d. Tether	OK / NG	- Tether shall be attached to the RBF pin. - A satellite shall be loaded into the J-SSOD Satellite Install Case with the tether attached.	Inspection (Manufacture drawing, etc.)		Para 2.2.2(4)
24.	Bonding	-Ys / +Xs	The bonding interface shall be accessible thru Access Window at either -Ys or +Xs plane.	Inspection (Drawing order, etc.)		Para 2.2.3(1)

J-SSOD / Satellite Interface Verification Record (7 /11)

Document No. [Defined by Satellite Developer]

No.	Item	Results	Requirement	Verification Method	Evidence document (Document No)	Reference
<< Operational Requirements >>						
25.	Maximum Stowage Duration	OK / NG	Maximum stowage duration shall assume the max stowage duration may be about 1 year.	Review of Design (*3)		Para 2.3(1)
26.	On-orbit Maintenance Limitation	OK / NG	On-orbit maintenance limitation will not plan any activation, checkout, or maintenance after the delivery.	Review of Design (*3)		Para 2.3(2)
27.	Cold Launch Requirements	OK / NG	A satellite shall have a capability to survive in the cold launch environment (i.e. w/o power).	Review of Design (*3)		Para 2.3(3)
			*(*3) It is allowed to describe a rationale in "Evidence document" instead of providing a document.*			
28.	Minimum Time until Appendage Deployment & RF Radiation					
	a. Timer Setting	OK / NG	≧ 30 minutes	Function Test		Para 2.3 (4)&(5)
	b. Function Test	OK / NG	Whenever either of two deployment switches is re-depressed, the timer shall be reset.	Function Test		Para 2.3 (4)&(5)
29.	Limitation of the satellite deployment window	OK / NG	A satellite deployment window shall not be restricted by a satellite design. If limitation of the satellite deployment window exists, a satellite developer shall coordinate with JAXA.	Review of Design		Para 2.3(6)
<< Environmental Requirements >>						
30.	Random Vibration and Acceleration					
	a. Quasi-static Acceleration	OK / NG	A satellite shall assume the condition defined in the section 2.4.1(a)	Analysis (Stress Analysis Report)		Para 2.4.1 (a)
	b. Random Vibration	OK / NG	A satellite shall assume the condition defined in the section 2.4.1(b)	Test (Vibration Test Report)		Para 2.4.1 (b)

J-SSOD / Satellite Interface Verification Record (8 /11)

Document No. [Defined by Satellite Developer]

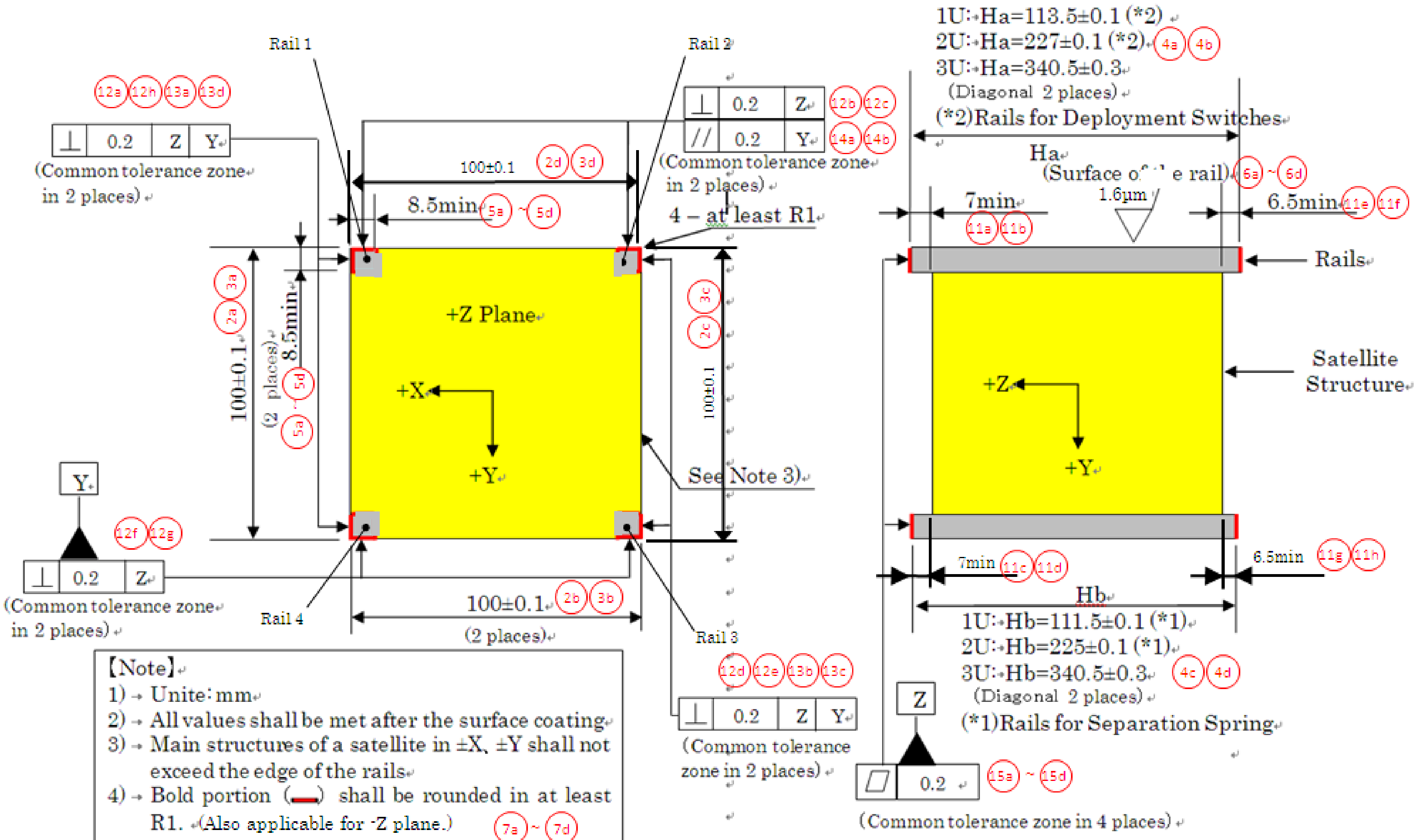
No.	Item	Results	Requirement	Verification Method	Evidence document (Document No)	Reference
31.	**On-orbit Acceleration**					
	a. On-orbit Acceleration	OK / NG	A satellite shall assume the condition defined in the section 2.4.2(a)	Analysis (Stress Analysis Report)		Para 2.4.2 (a)
	b. Acceleration induced by JEMRMS Emergency-Stop	OK / NG	A satellite shall assume the condition defined in the section 2.4.2(b)	Analysis (Stress Analysis Report)		Para 2.4.2 (b)
32.	**Pressure Environment**					
	a. Pressure	OK / NG	A satellite shall assume the condition defined in the section 2.4.3(a)	Review of Design (*5)		Para 2.4.3 (a)
	b. Depressurization Rate	m(*4)	If V/A ≦ 50.8m (2000inch), analysis is not needed. If V/A > 50.8m (2000inch), Stress Analysis Report is needed.	Analysis (Stress Analysis Report, if necessary)		Para 2.4.3 (b)
		(*4) Please fill in V/A.	(*5) It is allowed to write the purport of no problem in "Evidence document" instead of providing a document.			
33.	**Thermal Environment**	OK / NG	A satellite shall assume the condition defined in the section 2.4.4.	Test (Thermal Test Report)		Para 2.4.4
34.	**Humidity Environment**	OK / NG	A satellite shall assume the condition defined in the section 2.4.5.	Review of Design (*5)		Para 2.4.5
35.	**Out-gassing**	OK / NG	Rating "A" materials shall be used for a satellite.	Inspection (MIUL, MUA)		Para 2.5
	<< Safety Requirements >>					
36.	**Safety Assessment Analysis**					
	a. On-orbit Safety	OK / NG	A satellite provider shall conduct safety analysis and submit SAR. Necessary inspections and tests for safety assessment shall be also conducted.	Analysis, Test, Inspection (Phase III approved SAR)		para 3.2.1
	b. Launch Site & Vehicle Safety	OK / NG	A satellite provider shall submit ATV/HTV/KSC Form 100 check list for launch site & vehicle safety assessment.	Analysis, Test, Inspection (ATV/HTV/KSC Form 100 check list)		para 3.2.1

J-SSOD / Satellite Interface Verification Record (8 /11)

Document No. [Defined by Satellite Developer]

No.		Item	Results	Requirement	Verification Method	Evidence document (Document No)	Reference
37.	**Envelope**						
		Contact surface of the deployable components	mm	If any deployable components make contact with the inside wall of the J-SSOD Satellite Install Case in their unintentional deployment, the contact surface of the deployable components shall have more than 1mm thickness.	Inspection		Para 2.1.4 (6)
38.	**RF**						
	(1)	Frequency and Current Limit	mA	If downlink frequency below 110 MHz is used, maximum current in the circuits shall not exceed 50 mA.	Test		Para 2.2.4 (1)
	(2)	Allowable RF Radiation Levels	uV/m Hz	RF radiation levels shall not exceed values of Table 2.2.4-1.	Test		Para 2.2.4 (2)

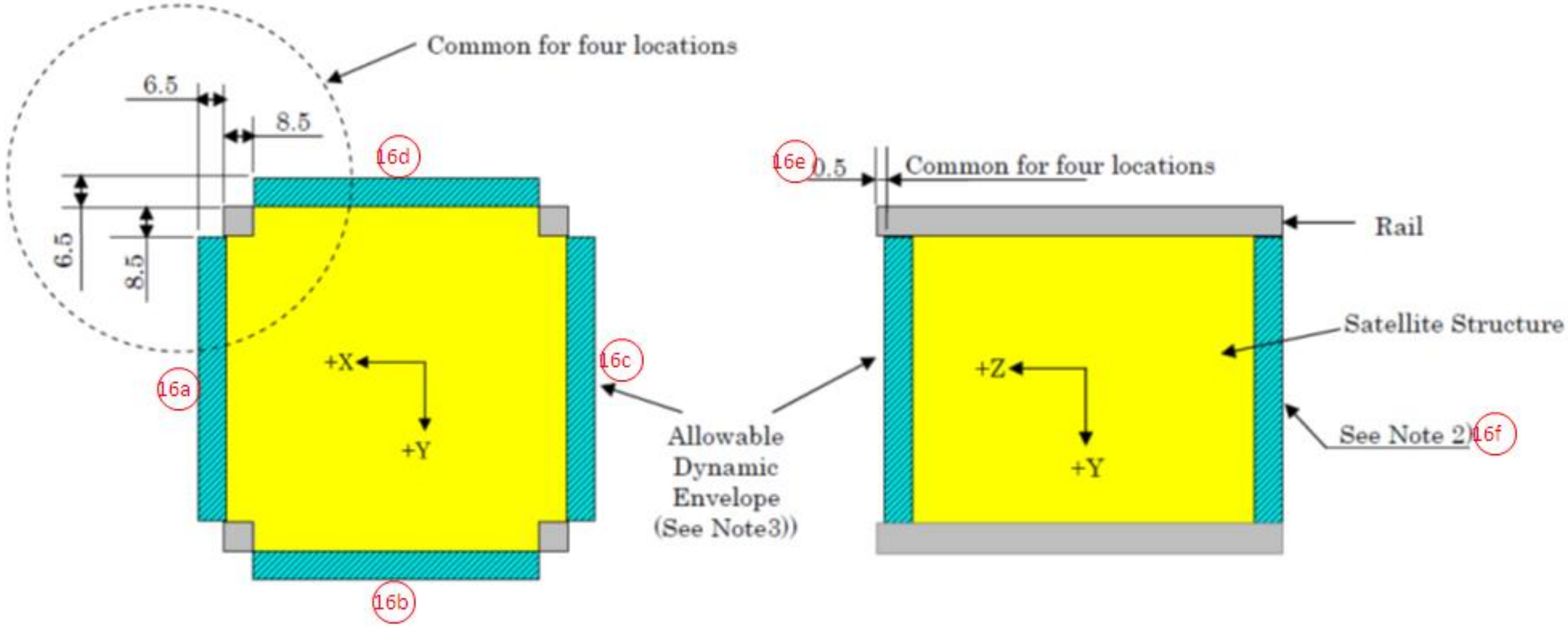
Document No. [Defined by Satellite Developer]



【Note】
1) Unite: mm
2) All values shall be met after the surface coating
3) Main structures of a satellite in ±X, ±Y shall not exceed the edge of the rails
4) Bold portion ( ) shall be rounded in at least R1. (Also applicable for -Z plane.)

Figure 2.1.2-1 Dimensional Requierments for Satellite

Document No. [Defined by Satellite Developer]



【Note】
1) Unit: mm
2) Any components shall be recessed from the edge of the -Z rail ends.
3) All external components shall be within the dynamic envelope.

Figure 2.1.4-1 Allowable Dynamic Envelope

Document No. [Defined by Satellite Developer]

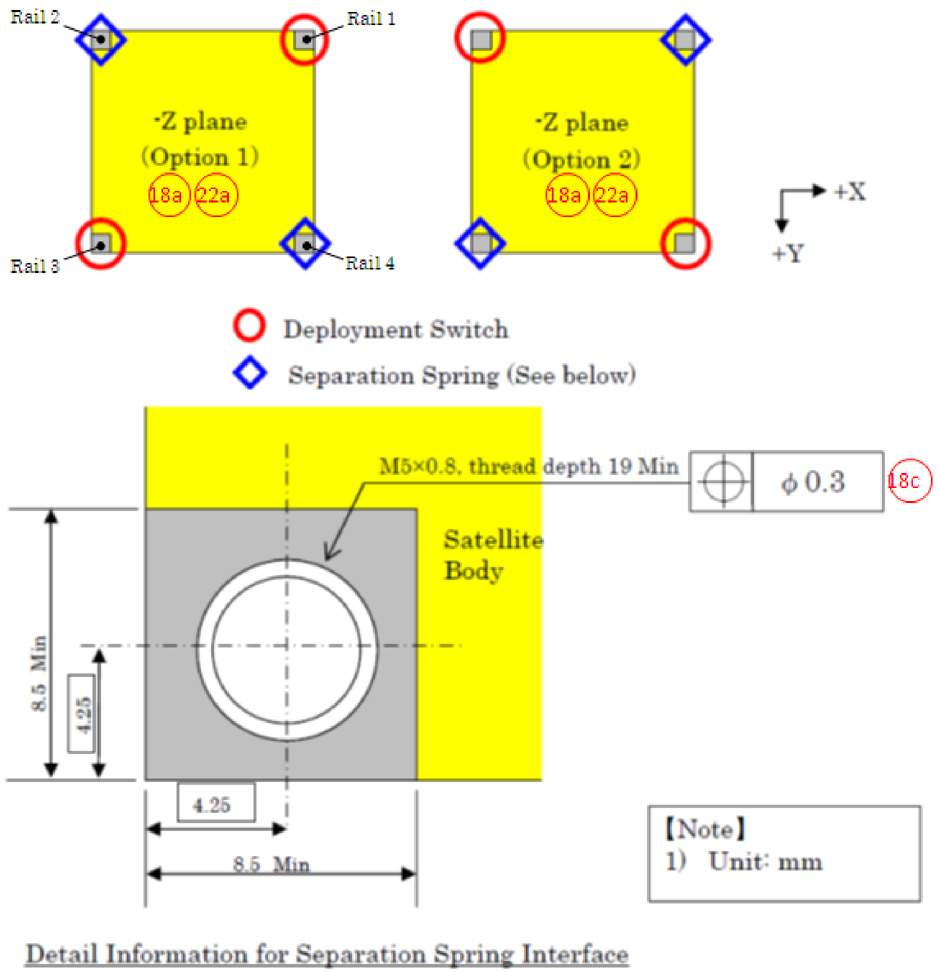


Figure 2.1.6-2 Location of Separation Spring and Deployment Switch

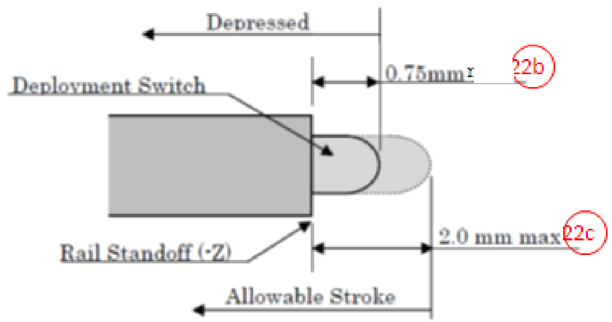


Figure 2.2.1-1 Depressed Condition and Allowable Stroke of Deployment Switches

Document No. [Defined by Satellite Developer]

J-SSOD & [Satellite Name] Interface Verification Record

(For 50cm-sized Small Satellite)

Satellite Developer Name	;	[Defined by Satellite Developer]
Satellite Name	;	[Defined by Satellite Developer]
P/N	;	[Defined by Satellite Developer]
S/N	;	[Defined by Satellite Developer]

SIGNATURES / Satellite Development, Sponsor agency

NAME DATE
Satellite Development Team (Initiate)

NAME DATE
Satellite Development Team (Reviewed)

NAME DATE
Satellite Development Team (Approved)

NAME DATE
Sponsor Agency (Approved)

J-SSOD / Satellite Interface Verification Record (1 /11)

Document No. [Defined by Satellite Developer]

No.	Item	Results	Requirement	Verification Method	Evidence document (Document No)	Reference
<< Mechanical Interface >>						
1.	Satellite Type	N/A	-	-	-	Pare 3.1.2(1)
2.	Width in -Z Plane			Measurement		Para 3.1.2(2) (3) Figure3.1.2-1, 2a~2d
a.	+X Plane	mm	350.0+/-0.5mm			
b.	-X Plane	mm				
c.	+Y Plane	mm	550.0+/-0.5mm			
d.	-Y Plane	mm				
3.	Width in +Z Plane			Measurement		Para 3.1.2(2) (3) Figure3.1.2-1, 3a~3d
a.	+X Plane	mm	350.0+/-0.5mm			
b.	-X Plane	mm				
c.	+Y Plane	mm	550.0+/-0.5mm			
d.	-Y Plane	mm				
4.	Rails Length		550.0+/-0.25mm	Measurement		Para 3.1.2 (1) Para 3.1.2 (4) Figure3.1.2-1, 4a~4d
a.	Rail 1	mm				
b.	Rail 2	mm				
c.	Rail 3	mm				
d.	Rail 4	mm				
5.	Rails Width		Min 17 x 17 mm	Measurement		Para 3.1.3(3) Figure3.1.2-1, 5a~5d
a.	Rail 1	x mm				
b.	Rail 2	x mm				
c.	Rail 3	x mm				
d.	Rail 4	x mm				

J-SSOD / Satellite Interface Verification Record (2 /11)

Document No. [Defined by Satellite Developer]

No.	Item	Results	Requirement	Verification Method	Evidence document (Document No)	Reference
6.	Rails Surface Roughness		≦ 1.6μm (Ra) (*1)	Inspection (Machine work order, Inspection report, etc.)		Para 3.1.3(4) Figure3.1.2-1, 6a~6d
	a. Rail 1	OK / NG				
	b. Rail 2	OK / NG				
	c. Rail 3	OK / NG				
	d. Rail 4	OK / NG				
			*(*1) Arithmetic average of the roughness profile.*			
7.	Rails Edges Rounding		R1.5 mm+/-0.5mm	Inspection (Machine work order, Inspection report, etc.)		Para 3.1.3(5) Figure3.1.2-1, 7a~7d
	a. Rail 1	OK / NG				
	b. Rail 2	OK / NG				
	c. Rail 3	OK / NG				
	d. Rail 4	OK / NG				
8.	Rails Surface Area (+Z Plane)		-	-	-	-
	a. Rail 1	N/A				
	b. Rail 2	N/A				
	c. Rail 3	N/A				
	d. Rail 4	N/A				
9.	Rails Contact Length with J-SSOD Rail Guides		≧ 412.5mm	Analysis (Assessment based on Manufacture drawing, etc. is allowed.)		Para 3.1.3(7)
	a. Rail 1, +X	mm				
	b. Rail 1, -Y	mm				
	c. Rail 2, -Y	mm				
	d. Rail 2, -X	mm				
	e. Rail 3, -X	mm				
	f. Rail 3, +Y	mm				
	g. Rail 4, +Y	mm				
	h. Rail 4, +X	mm				

J-SSOD / Satellite Interface Verification Record (3 /11)

Document No. [Defined by Satellite Developer]

No.	Item	Results	Requirement	Verification Method	Evidence document (Document No)	Reference
10.	Rail Surface Finish		Anodized per MIL-A-8625 Type3	Inspection (Machine work order, Inspection report, etc.)		Para 3.1.3(8)
	a. Rail 1	OK / NG				
	b. Rail 2	OK / NG				
	c. Rail 3	OK / NG				
	d. Rail 4	OK / NG				
11.	Clearance between Rail Edges & Main Structure (Z direction)					
	a. Rail 1, +Z	mm	≧ 0.5mm	Inspection (Review of Manufacture drawing, etc.)		Para 3.1.3(2), 3.1.4(1)(2) Figure 3.1.2-1,11a~11d
	b. Rail 2, +Z	mm				
	c. Rail 3, +Z	mm				
	d. Rail 4, +Z	mm				
	e. Rail 1, -Z	mm	≧ 0.5mm	Inspection (Review of Manufacture drawing, etc.)		Para 3.1.3(2), 3.1.4(1)(3) Figure 3.1.2-1,11e~11h
	f. Rail 2, -Z	mm				
	g. Rail 3, -Z	mm				
	h. Rail 4, -Z	mm				
12.	Rails Perpendicularity against +Z Plane		≦ 0.5mm	Inspection (Machine work order, Inspection report, etc.)		Para 3.1.3(2) Figure 3.1.2-1,12a~12h
	a. Rail 1, +X	OK / NG				
	b. Rail 1, -Y	OK / NG				
	c. Rail 2, -Y	OK / NG				
	d. Rail 2, -X	OK / NG				
	e. Rail 3, -X	OK / NG				
	f. Rail 3, +Y	OK / NG				
	g. Rail 4, +Y	OK / NG				
	h. Rail 4, +X	OK / NG				

J-SSOD / Satellite Interface Verification Record (4 /11)

Document No. [Defined by Satellite Developer]

No.	Item	Results	Requirement	Verification Method	Evidence document (Document No)	Reference
13.	**Rails Perpendicularity against +Y Plane**					
	a. Rail 1, +X	OK / NG	≦ 0.5mm	Inspection (Machine work order, Inspection report, etc.)		Para 3.1.3(2) Figure 3.1.2-1,13a~13d
	b. Rail 2, -X	OK / NG				
	c. Rail 3, -X	OK / NG				
	d. Rail 4, +X	OK / NG				
14.	**Rails Parallelism to +Y Plane**					
	a. Rail 1, -Y	OK / NG	≦ 0.5mm	Inspection (Machine work order, Inspection report, etc.)		Para 3.1.3(2) Figure 3.1.2-1,14a~14b
	b. Rail 2, -Y	OK / NG				
15.	**Rail Edges Flatness on -Z Plane**					
	a. Rail 1	OK / NG	≦ 0.5mm	Inspection (Machine work order, Inspection report, etc.)		Para 3.1.3(2) Figure 3.1.2-1,15a~15d
	b. Rail 2	OK / NG				
	c. Rail 3	OK / NG				
	d. Rail 4	OK / NG				
16.	**Envelope (*2)**	*(*2) Dynamic deformation shall be considered.*				
	a. +X Plane	mm	≦ 6.5mm	Measurement (or Inspection)		Para 3.1.4 (1)&(4) Figure 3.1.4-1,16a~16d
	b. +Y Plane	mm				
	c. -X Plane	mm				
	d. -Y Plane	mm				
	e. +Z Plane	mm	≧ 0.5mm from rail surfaces (+Z).	Measurement (or Inspection)		Para 3.1.4 (1) (2) Figure 3.1.4-1, 16e
	f. -Z Plane	OK / NG	No protrusion from rail surfaces (-Z).	Inspection		Para 3.1.4 (1) Figure 3.1.4-1, 16f
	g. Constraints on deployable components	OK / NG	Any deployable components shall be constrained by the satellite itself. The J-SSOD rails and walls shall not be used to constrain these deployables.	Review of Design		Para 3.1.4 (5)

J-SSOD / Satellite Interface Verification Record (5 /11)

Document No. [Defined by Satellite Developer]

No.	Item	Results	Requirement	Verification Method	Evidence document (Document No)	Reference
17.	**Mass Properties**					
	a. Mass	Kg	≦ 50kg	Measurement		Para 3.1.5(1)
	b. Ballistic Number	kg/m²	≦ 100 kg/m²	Analysis		Para 3.1.5(2)
	c. Center of Gravity	OK / NG	CG shall be located as defined in Figure 3.1.5-1.	Analysis (or Test)		Para 3.1.5(3)
18.	**Separation Spring (1U & 2U Only)**					
	a. Location	N/A	-	-	-	-
	b. Parts Number	N/A	-	-	-	-
	c. Positional Tolerance	N/A	-	-	-	-
19.	**Accessibility**	- - - -	-	-	-	-
20.	**Structural Strength**					
	a. Main Structure Strength	OK / NG	A satellite shall have a sufficient structural strength with a necessary safety margin through the ground operation, testing, ground handling, and on-orbit operations.	Analysis (Stress Analysis Report)		Para 3.1.8(1)
	b. Rails Strength	OK / NG	Each rail shall have a sufficient structural strength with 46.6 N of a combined load of the preload and the spring load by the main spring.	Analysis (Stress Analysis Report)		Para 3.1.8(2)
21.	**Stiffness**	Hz	Minimum fundamental frequency ≧ 100 [Hz]	Analysis (Stress Analysis Report)		Para 3.1.9

J-SSOD / Satellite Interface Verification Record (6 /11)

Document No. [Defined by Satellite Developer]

No.	Item	Results	Requirement	Verification Method	Evidence document (Document No)	Reference
<< Electrical Interface >>						
22.	Deployment Switches					
	a. Location	Option #	Option 1 or Option 2	Inspection (Drawing order, etc.)		Para 3.2.1(1) Figure 3.2.1-1, 22a
	b. Function Test	OK / NG	Satellite shall not be activated when either of two switches remains depressed, i.e. 1.25mm max. from the rail standoff surface.	Function Test		Para 3.2.1(2) Figure 3.2.1-2, 22b
	c. Stroke	N/A				
	d. Force	N/A				
23.	RBF Pin					
	a. Accessibility	N/A				
	b. Function Test	N/A				
	c. Envelope	N/A				
	d. Tether	N/A				
24.	Bonding	N/A				

J-SSOD / Satellite Interface Verification Record (7 /11)

Document No. [Defined by Satellite Developer]

No.	Item	Results	Requirement	Verification Method	Evidence document (Document No)	Reference
<< Operational Requirements >>						
25.	Maximum Stowage Duration	OK / NG	Maximum stowage duration shall assume the max stowage duration may be about 1 year.	Review of Design (*3)		Para 3.3(1)
26.	On-orbit Maintenance Limitation	OK / NG	On-orbit maintenance limitation will not plan any activation, checkout, or maintenance after the delivery.	Review of Design (*3)		Para 3.3(2)
27.	Cold Launch Requirements	OK / NG	A satellite shall have a capability to survive in the cold launch environment (i.e. w/o power).	Review of Design (*3)		Para 3.3(3)
			*(*3) It is allowed to describe a rationale in "Evidence document" instead of providing a document.*			
28.	Minimum Time until Appendage Deployment & RF Radiation					
	a. Timer Setting	OK / NG	≧ 30 minutes	Function Test		Para 3.3 (4)(5)
	b. Function Test	OK / NG	Whenever either of two deployment switches is re-depressed, the timer shall be reset.	Function Test		Para 3.3 (4)(5)
29.	Limitation of the satellite deployment window	OK / NG	A satellite deployment window shall not be restricted by a satellite design. If limitation of the satellite deployment window exists, a satellite developer shall coordinate with JAXA.	Review of Design		Para 3.3(6)
<< Environmental Requirements >>						
30.	Random Vibration and Acceleration					
	a. Quasi-static Acceleration	OK / NG	A satellite shall assume the condition defined in the section 2.4.1(a)	Analysis (Stress Analysis Report)		Para 3.4.1 (a)
	b. Random Vibration	OK / NG	A satellite shall assume the condition defined in the section 2.4.1(b)	Test (Vibration Test Report)		Para 3.4.1 (b)

J-SSOD / Satellite Interface Verification Record (8 /11)

Document No. [Defined by Satellite Developer]

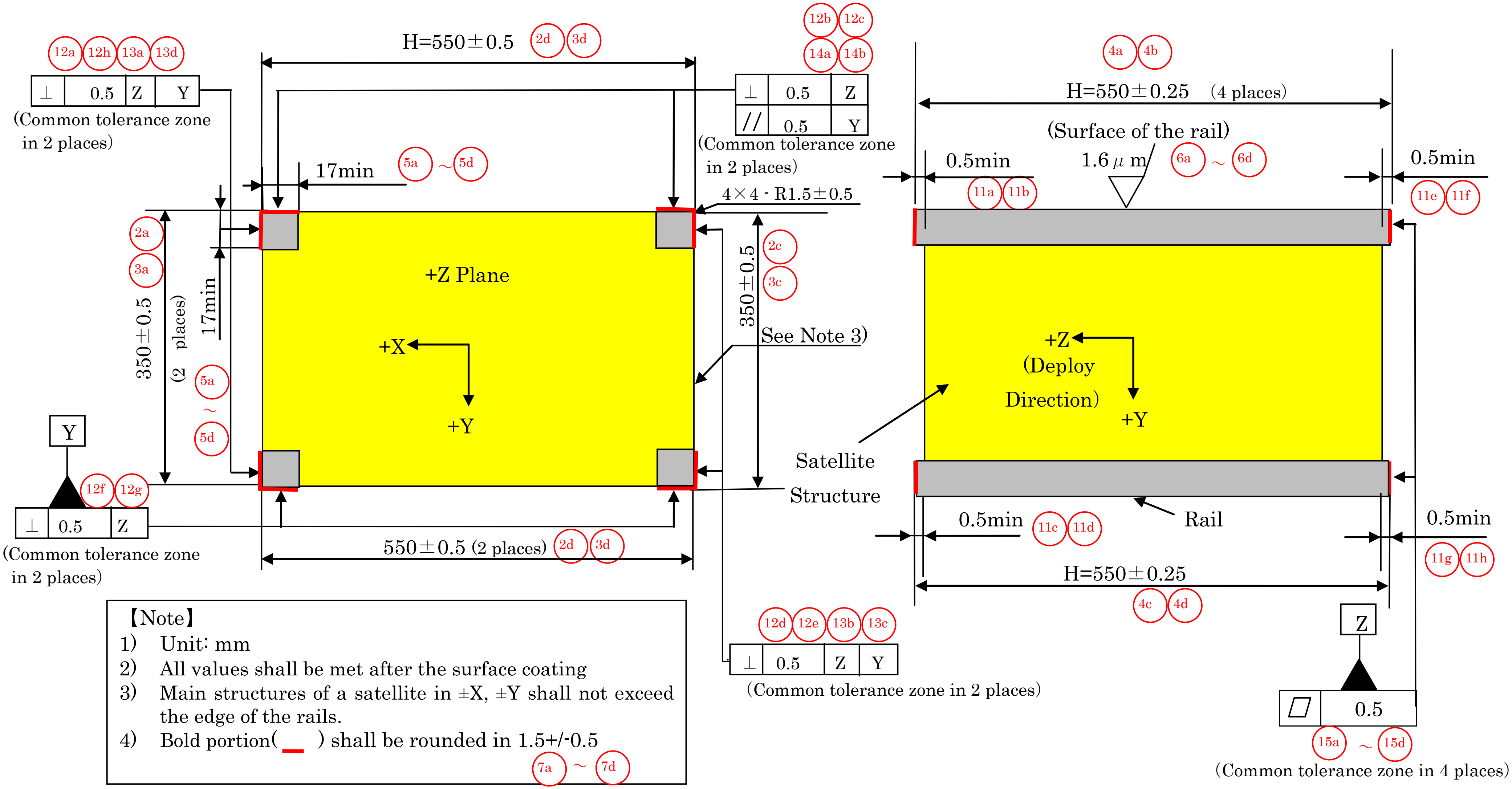
No.		Item	Results	Requirement	Verification Method	Evidence document (Document No)	Reference
31.		**On-orbit Acceleration**					
	a.	On-orbit Acceleration	OK / NG	A satellite shall assume the condition defined in the section 2.4.2(a)	Analysis (Stress Analysis Report)		Para 3.4.2 (a)
	b.	Acceleration induced by JEMRMS Emergency-Stop	OK / NG	A satellite shall assume the condition defined in the section 2.4.2(b)	Analysis (Stress Analysis Report)		Para 3.4.2 (b)
32.		**Pressure Environment**					
	a.	Pressure	OK / NG	A satellite shall assume the condition defined in the section 2.4.3(a)	Review of Design (*5)		Para 3.4.3 (a)
	b.	Depressurization Rate	m(*4)	If V/A ≦ 50.8m (2000inch), analysis is not needed. If V/A > 50.8m (2000inch), Stress Analysis Report is needed.	Analysis (Stress Analysis Report, if necessary)		Para 3.4.3 (b)
			*(*4) Please fill in V/A.*	*(*5) It is allowed to write the purport of no problem in "Evidence document" instead of providing a document.*			
33.		**Thermal Environment**	OK / NG	A satellite shall assume the condition defined in the section 2.4.4.	Test (Thermal Test Report)		Para 3.4.4
34.		**Humidity Environment**	OK / NG	A satellite shall assume the condition defined in the section 2.4.5.	Review of Design (*5)		Para 3.4.5
35.		**Out-gassing**	OK / NG	Rating "A" materials shall be used for a satellite.	Inspection (MIUL, MUA)		Para 3.5
		<< Safety Requirements >>					
36.		**Safety Assessment Analysis**					
	a.	On-orbit Safety	OK / NG	A satellite provider shall conduct safety analysis and submit SAR. Necessary inspections and tests for safety assessment shall be also conducted.	Analysis, Test, Inspection (Phase III approved SAR)		para 3.2.1
	b.	Launch Site & Vehicle Safety	OK / NG	A satellite provider shall submit ATV/HTV/KSC Form 100 check list for launch site & vehicle safety assessment.	Analysis, Test, Inspection (ATV/HTV/KSC Form 100 check list)		para 3.2.1

J-SSOD / Satellite Interface Verification Record (8 /11)

Document No. [Defined by Satellite Developer]

No.		Item	Results	Requirement	Verification Method	Evidence document (Document No)	Reference
37.	Envelope						
		Contact surface of the deployable components	N/A				
38.	RF						
	(1)	Frequency and Current Limit	mA	If downlink frequency below 110 MHz is used, maximum current in the circuits shall not exceed 50 mA.	Test		Para 3.2.4 (1)
	(2)	Allowable RF Radiation Levels	uV/m Hz	RF radiation levels shall not exceed values of Table 2.2.4-1.	Test		Para 3.2.4 (2)

Document No. [Defined by Satellite Developer]

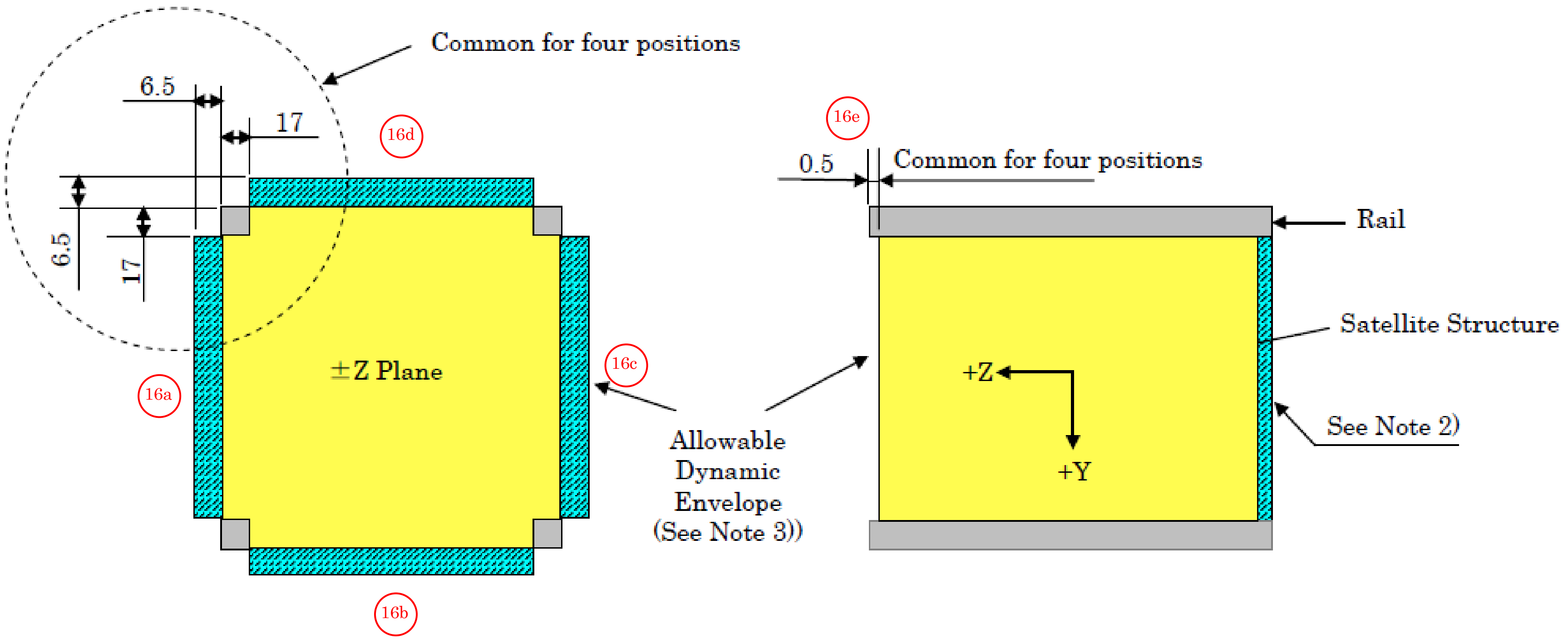


【Note】
1) Unit: mm
2) All values shall be met after the surface coating
3) Main structures of a satellite in ±X, ±Y shall not exceed the edge of the rails.
4) Bold portion(__) shall be rounded in 1.5+/-0.5

7a ～ 7d

Figure 3.1.2-1 Dimensional Requirements for 50cm Class Satellite

Document No. [Defined by Satellite Developer]



【Note】
1) Unit: mm
2) Any components shall be recessed from the edge of the -Z rail ends.
3) All external components shall be within the dynamic envelope.

Figure 3.1.4−1 Dimensional Requirements for 50 cm Class Satellite

Document No. [Defined by Satellite Developer]

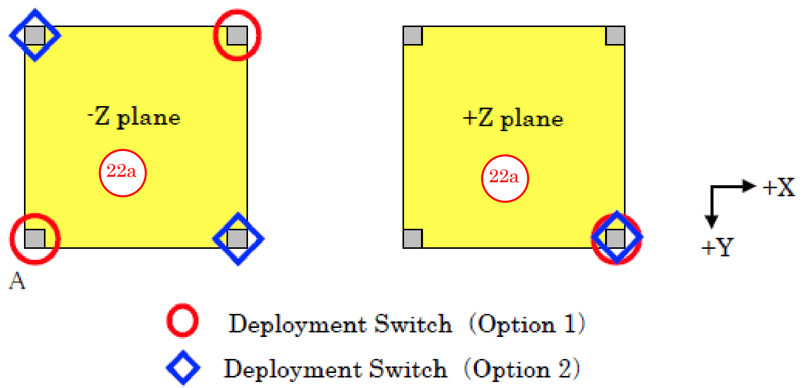


Figure 3.2.1-1 Position of Deployment Switches

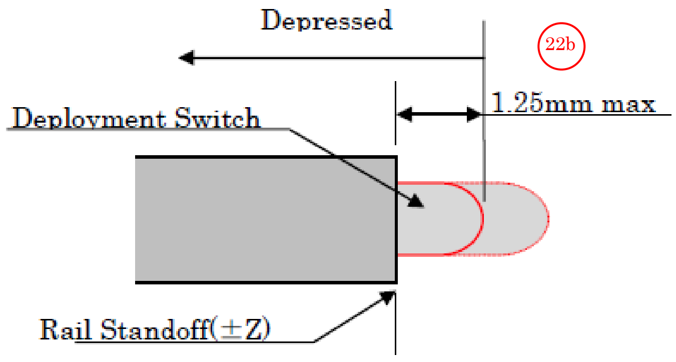


Figure 3.2.1-2 Depressed Condition of Deployment Switches

Appendix E

Abbreviation and Acronyms

AL	Airlock
ATV	Automated Transfer Vehicle
BN	Ballistic Number
Cd	Coefficient of Drag
CIL	Critical Item List
C/O	Check-Out
CTB	Common Transfer Bag
EMC	Electromagnetic Compatibility
EMGF	Electrical and Mechanical Grapple Fixture
HTV	H-II B Transfer Vehicle
IP	International Partner
ISS	Internatioanl Space Station
IVA	Intra-Vehicular Activity
JEM	Japanese Experiment Module
JEMRMS	JEM Remote Manipulator System
J-SSOD:	JEM Small Satellite Orbital Deployer
MS	Margin of Safety
MSDS	Material Safety Data Sheet
RBF	Remove Before Flight
RF	Radio Frequency
SAR	Safety Analysis Report
SSN	Space Surveillance Network
SpX:	Space-X Dragon
TBD	To Be Determined
TML	Total Mass Loss
VCM	Volatile Condensable Material
VV	Velocity Vector

1. Purpose of this Input sheet

Frequencies of Transmitters(Tx) and Receivers(Rx) used at ISS are controlled by NASA/JSC Frequency manager.
Therefore, small satellite developer is required to have an approval from JSC Frequency manager to use their Tx/Rx mounted in their satellite.

JAXA is responsible to submit the JSC frequency authorization input form to have an approval for small satellte deployed from J-SSOD.
And the information for the JSC frequency authorization input form is required to all small satellite developer.

2. Input Rules

JSC frequency authorization input form is consist of three sheets.
(1) GENERAL SYSTEM INFORMATION
(2) TRANSMITTER(TX)INFORMATION
(3) RECEIVER (RX) INFORMATION

When small satellite has more than one Tx/Rx,
payload developer need to copy (2)/(3) sheet for additional Tx/Rx in the same excel file.
(One sheet is required for one Tx/Rx as follows in the same excel file)

[Example]
Transmitter Info(1),Transmitter Info(2),...
Receiver Info(1), Receiver Info(2),...

JSC Frequency Authorization Input Form

GENERAL SYSTEM INFORMATION		
1	System Name:	
2	System Description:	
3	System Intended Use:	
4	Activation Date (mm/dd/yyyy):	

JSC Frequency Authorization Input Form

TRANSMITTER INFORMATION		
5	Frequency (Upper):	[MHz]
6	Frequency (Lower):	[MHz]
7	Transmit Power	[W]
8	TX Manufacturer/Model No	
9	TX Antenna Manufacturer	
10	Circuit Loss	[dB]
11	Antenna Type	<u>Select Antenna type from followings:</u> ・Dipole ・Helix ・Horn ・Loop ・Monopole ・Patch ・Phased_Array ・Reflector ・Slot ・Spiral ・Other
12	Antenna Gain	[dBi]
13	Antenna Polarization	<u>Select Polarization type from followings:</u> ・Horizontal ・Left_Handed_Elliptical ・Right_Handed_Elliptical ・Vertical ・Other
14	Antenna Axial Ratio:	[dB]
15	Antenna Location	[If antenna is attached to the satellite structure, please fill the satellite name]
16	Data Rate (Digital) or Bandwidth (Analog):	[Mbps for Digital] or [MHz for Analog] <u>For Spread Spectrum System, enter the data rate in Mcps:</u> [Mcps]
17	Modulation Scheme:	<u>Select Modulation Scheme from followings:</u> ・AM ・ASK ・BPSK ・FM ・FSK ・GMSK ・MSK ・QAM ・QPSK ・Other <u>For Analog FM</u> Modulation Index: Deviation: [MHz] Max.Mod.Freq [MHz]
18	Emission Bandwidth:	-3dB: [MHz] -20dB: [MHz] -40dB: [MHz] -60dB: [MHz]
19	Transmission Bandwidth:	-3dB: [MHz] -20dB: [MHz] -40dB: [MHz] -60dB: [MHz]

JSC Frequency Authorization Input Form

	RECEIVER (RX) INFORMATION		Remarks
20	**Frequency (Upper):**	[MHz]	Receiver frequency (upper limit)
21	**Frequency (Lower):**	[MHz]	Receiver frequency (lower limit)
22	**RX Manufacturer/Model No**		Product maker (model No)
23	**RX Antenna Manufacturer**		Product maker
24	**Circuit Loss:**	[dB]	[= Feedr Loss] Power loss due to the transmission line from output port of Tx to the feed point of the antenna.
25	**Antenna Type:**	<u>Select Antenna type from followings:</u> ・Dipole ・Helix ・Horn ・Loop ・Monopole ・Patch ・Phased_Array ・Reflector ・Slot ・Spiral ・Other	Select from options. If there is nothing to fit, please select "Other".
26	**Antenna Gain:**	[dBi]	[dBi] = (P $_{\text{isotolopic}}$ / P $_{\text{small satellite antenna}}$)
27	**Antenna Polarization:**	<u>Select Polarization type from followings:</u> ・Horizontal ・Left_Handed_Elliptical ・Right_Handed_Elliptical ・Vertical ・Other	Select from options. If there is nothing to fit, please select "Other".
28	**Antenna Axial Ratio:**	[dB]	<u>**Only apply to circularly polarized antenna.**</u> If small satellite does not have circularly polarized antenna, this item is N/A. AR = (|EL|+|ER|) / (|EL|−|ER|) --> $20\log_{10}\|AR\|$ (dB) Here, |EL| : Electrical field density of Left-handed circularly polarized wave |ER| : Electrical field density of Right-handed circularly polarized wave
29	**Receiver Noise Figure:**	[dB]	Please show the NF (Noise figure) of receiver itself. [Reference] Noise figure is defined as follow: the ratio of the signal-to-noise power ratio at the input to the signal-to-noise power ratio at the output. F = (Si/Ni)/(So/No) (1) NF= 10logF = 10log (Si/Ni) − 10log (So/No) (2)
30	**Receiver Noise Temperature**	[dBK]	Te (Noise Temperature) = To(F−1), where To is 290K (reference/room temperature)
31	**Antenna Location**	[If antenna is attached to the satellite structure, please fill the satellite name]	
32	**RF Selectivity:**	−3dB: [MHz] −20dB: [MHz] −40dB: [MHz] −60dB: [MHz]	RF selctivity is derived as frequency bandwidth according to the power degrdations (−3dB, −20dB, −40dB, −60dB) from the reference level (Average attenuated level of the received band