Appendix IV

Specification

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1 Introduction

1.1 Purpose

The purpose of this document is to define the requirements for developing the Antenna Panel Deployment Mechanism for FORMOSAT-9 (FS-9) Satellite.

1.2 Scope

The scope of this document is to provide the requirements and constraints for the Antenna Panel Deployment Mechanism hardware supplied in the context of the FS-9 Satellite development program. These requirements enclose:

1. The required performance, design and interfaces of the subject hardware
2. The deliverable hardware and documentation
3. The applicable verification and testing requirements

The FS-9 satellite is a 3-axis stabilized satellite to be located in a 550 - 750Km orbit. Possible launch vehicles: Falcon-9, Falcon Heavy, EELV-class launcher (e.g. Atlas 5, Delta IV) etc. The FS-9 satellite requires one Antenna Panel Deployment Mechanism.

The Antenna Panel Deployment Mechanism is required to provide the antenna panel at stowed configuration in the launcher and to deploy the antenna panel on the orbit. The system should consists of hinge mechanism, hold down and release mechanisms, latch mechanisms, speed regulator and structure frame of antenna unit. The deployment angle will be 90 degrees about the Antenna Panel Deployment Mechanism axis.

For the purpose of this RFP and your proposal, the term “[TBR]” means to be reviewed and determined by TASA upon receiving recommendations from the Bidder/Contractor.

2 Related Documents

2.1 Applicable Documents

ECSS-E-ST-33-01 Space Engineering Mechanisms

2.2 Referenced Documents

N/A

3 Definitions

3.1 Satellite Coordinate Systems

The definition of the satellite coordinate system is shown in Figure 3.1. It is a right-hand orthogonal, body fixed Cartesian coordinate system with,

- The origin in the geometric center of the separation ring bottom panel.
- +X points in the satellite's flight direction.
- +Z points in the satellite’s nominal nadir direction.
- +Y points in the pitch direction to the orbital plane, building a right-handed coordinate system. It is noted that Antenna Panel is on +Z side top panel.

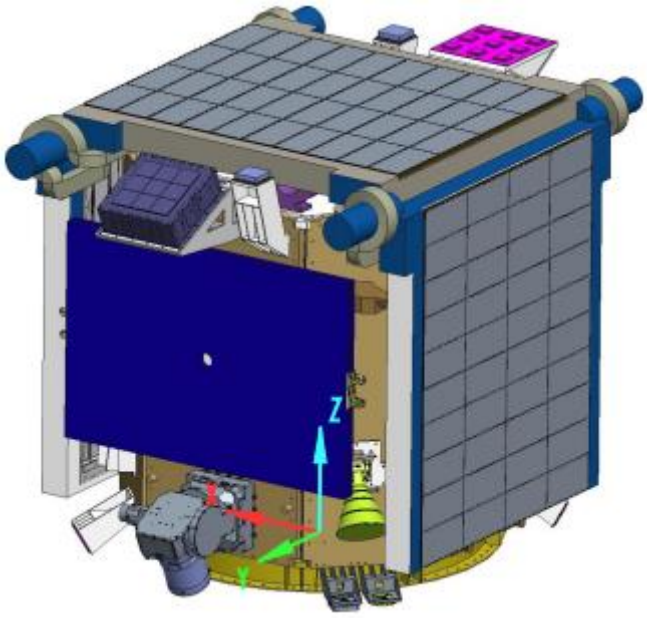

Figure 3.1. FS-9 Satellite Coordinate System Definition (ISO View)

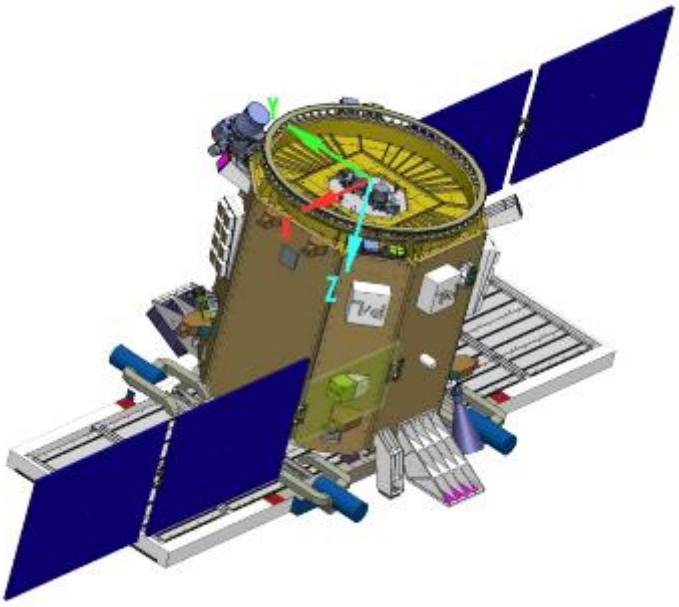

Figure 3.2. FS-9 Satellite Deployed Configuration

3.2 Acronyms and Abbreviations

CDR	Critical Design Review
CLIN	Contract Line Item Number
CSR	Consent to Ship Review
EIDP	End Item Data Package
EM	Engineering Model
ESD	Electrostatic Discharge
FMEA	Failure Mode and Effect Analysis
HDRM	Hold Down and Release Mechanism
ICD	Interface Control Document
MRR	Manufacturing Readiness Review
NEA	Non-Explosive Actuator
PA	Product Assurance
PDR	Preliminary Design Review
PFM	Proto Flight Model
QA	Quality Assurance
SOW	Statement of Work
TASA	Taiwan Space Agency
TBR	To Be Reviewed
TRR	Test Readiness Review

4 Requirements

FS-9-XPAA-SYS-0010	The mechanism design and sub-assemblies shall preferably be a fully qualified design with flight heritage or qualified by similarity with previous hardware. Any part of the design without 5+ years of flight heritage shall be identified and suitable justification / qualification proposed by the Contractor.

4.1 Antenna Panel Deployment Mechanism Configuration

FS-9-XPAA-SYS-0020	During the launch phase of the mission the antenna panel shall be stowed compactly against the ±X sidewalls of the satellite.
FS-9-XPAA-SYS-0030	The XPAA unit on the outward facing surface of the antenna panel when the wing is stowed shall be outward facing.
FS-9-XPAA-SYS-0040	Number of Deployed Wing per model: 1 panel per wing, 2 wings to be deployed for one satellite.

4.2 Ground Storage

FS-9-XPAA-STOR -0010	The Antenna Panel Deployment Mechanism shall provide the full requirement under the conditions defined in this specification after unpowered ground storage of up to 3 years.
FS-9-XPAA-STOR -0020	The design of the hinges shall be such as to allow off-loading operations of actuation devices if required during storage without any implication on the flight readiness of mechanism.
FS-9-XPAA-STOR -0030	The Antenna Panel Deployment Mechanism shall support one deployment test (partial or full) every year during storage if required.
FS-9-XPAA-STOR -0040	After being installed on the satellite and set for launch after 2 years the Antenna Panel Deployment Mechanism shall be still capable of meeting all mission requirements

4.3 Mechanical Requirement

FS-9-XPAA-MECH-0010	All Antenna Panel Deployment Mechanism hardware shall be designed to survive without degradation a maximum pressure decay rate of 70 mbar/s and a pressure decay of 0.8 bar in 27 sec.
FS-9-XPAA-MECH-0020	All materials and processes shall be demonstrated as suitable for use in a space application. The unit shall be designed to operate in space vacuum.
FS-9-XPAA-MECH-0030	Wherever possible, non-magnetic material shall be used and the utilization of permanent magnets avoided. If magnetic materials are proposed these should be identified in the proposal
FS-9-XPAA-MECH-0040	The loads induced by launch environmental back into the Antenna Panel Deployment Mechanism during vibration / acoustic / shock / QS / thermos-elastic loading shall not exceed the load capacity of the mechanism at interface defined in ANNEX IV including margins.
FS-9-XPAA-MECH-0050	Harness routing shall be defined in agreement with the Customer to minimize deployment resistance torque while maintaining the electrical and XPAA unit functionality
FS-9-XPAA-MECH-0060	Grounding Path Interface
FS-9-XPAA-MECH-0070	The unit shall be designed to withstand without damage or degradation in function a relative humidity of less than 60% during integration, test and transport phases.
FS-9-XPAA-MECH-0080	The out-gassing rate of any material used shall be less than 1% TML (Total Mass Loss) and 0.1% CVCM (Collected Volatile Condensable Material). The components shall have suitable venting provisions ($2mm^3$ venting hole area per liter volume). Outgassing vents shall be <5mm diameter.

4.3.1 Volume / Interfaces

The Antenna Panel Deployment Mechanism shall attach to the satellite ±X wall with Four (4) hold downs (per wing). The satellite bus structure are made with aluminum honeycomb core construction.

FS-9-XPAA-MECH-1010	The Antenna Panel Deployment Mechanism shall fit in the volume defined in ANNEX IV, The hold downs and release Mechanism (HDRM) interface shall be complied with the Mechanical Interface Requirement Drawing defined in ANNEX IV.
FS-9-XPAA-MECH-1020	The structure frame shall comply with the Antenna Panel Deployment Mechanism interface as defined in the Mechanical Interface Requirement Drawing in ANNEX IV.
FS-9-XPAA-MECH-1030	The Contractor shall define actual envelope and dimension in the Mechanical Interface Control Drawing (MICD).
FS-9-XPAA-MECH-1040	The fixing interface material on the satellite will be aluminum honeycomb panel. The Contractor is to confirm this is suitable and provide, minimum thread engagement, maximum thread engagement tightening torques / required preloads for their fixings to secure the array.
FS-9-XPAA-MECH-1050	The Contractor shall stipulate the required flatness across each hold down location and across hold down locations, between hold down and Antenna Panel Deployment Mechanism interfaces and hole positional tolerance as well as surface finish of any interfaces. If shimming is required this should be supplied by the Contractor.
FS-9-XPAA-MECH-1060	All mounting points and the contact area shall be in a common plane within 0.2 mm. Each contact area shall have a roughness of less than 3.2 microns.
FS-9-XPAA-MECH-1070	The mechanical property of antenna unit was defined in ANNEX VI.

4.3.2 Antenna Panel Stowage and Deployment

The deployment sequence is shown in Figure 4.1 depending on the proposed Antenna Panel Deployment Mechanism design, it is envisaged that the mechanism would have a separate single shot root hinge mechanism to deploy the array 90 degrees from the stowed axis, this would be done by the Antenna Panel Deployment Mechanism system, see Figure 4.1. The antenna panel would be fully deployed off the side of the spacecraft and then it will be 90 degrees from the stowed position.

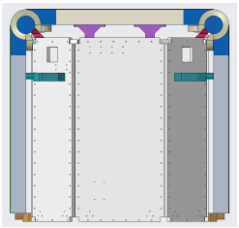	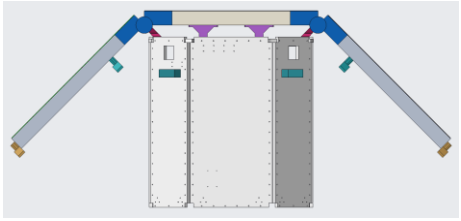	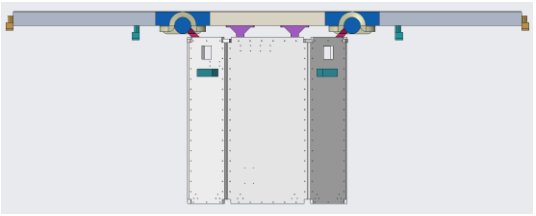
Stowed	during deployment	Fully deployment

Figure 4.1 Antenna Panel Deployment Mechanism in stowed and deployed position

FS-9-XPAA-MECH-2000	The antenna panel shall be stowed against the satellite ±X wall using Four (4) hold-downs per wing.
FS-9-XPAA-MECH-2010	The Contractor shall provide the mechanical and electrical interface / operational specification to the hold-down and release mechanisms.
FS-9-XPAA-MECH-2020	The deployment process shall not result in the generation of gaseous or particulate debris.
FS-9-XPAA-MECH-2030	The flight deployment shall be “single-shot” i.e. there is no requirement for re-stowage and re-deployment.
FS-9-XPAA-MECH-2040	All antenna panel panels shall be latched by latch device after deployment.
FS-9-XPAA-MECH-2050	The antenna panel shall be capable of at least 5 on ground deployments on top of any other storage requirements before setting for flight and operation in orbit without degradation. Limitations of on ground deployments be it partial or full including required equipment and consumables for re-set shall be defined in the proposal.
FS-9-XPAA-MECH-2060	Deployment hinges shall be passive. (There are no spare power channels available from the Antenna Panel Deployment

	Mechanism)
FS-9-XPAA-MECH-2070	The deployment sequence shall be controlled by damping or synchronization device to guarantee deployment without collision with the satellite and limit the end of deployment shock and over travel.
FS-9-XPAA-MECH-2080	Shock transmissibility back to the satellite via hold down release or latching of antenna panel / mechanisms shall be less than that defined in ANNEX II at the Antenna Panel Deployment Mechanism interface.
FS-9-XPAA-MECH-2090	The Contractor shall present a torque margin for deployment and latching budget and must show positive margin over the environmental conditions in this document including margins to be agreed with TASA.
FS-9-XPAA-MECH-2100	Deployment time: 10 – 12 mins
FS-9-XPAA-MECH-2110	Torque Margin: > 3x worst case friction torque
FS-9-XPAA-MECH-2120	Deployment Angle: 90 degrees from the stowed position
FS-9-XPAA-MECH-2130	Flatness (Deployment): ± 2mm
FS-9-XPAA-MECH-2140	Precision (deployment): ± 0.1°
FS-9-XPAA-MECH-2150	Repeatability (Deployment): ± 0.05°(maxmun result of 10 times deployment)
FS-9-XPAA-MECH-2160	Panel Angle Error (defined in ANNEX V)
FS-9-XPAA-MECH-2170	The Non-Explosive Actuator (NEA) shall retain the panel in the stow configuration and release the retention on a satellite issued command.
FS-9-XPAA-MECH-2180	The Non-Explosive Actuators (NEA) shall be able to be reset for flight after deployment test on the ground. (≥10 resets review number including deployments at Contractor side)
FS-9-XPAA-MECH-2190	Deployment Monitoring: Micro-switch device.
FS-9-XPAA-MECH-2200	No Loose Items: All items shall be captive or secured properly after deployment.
FS-9-XPAA-MECH-2210	S/C during deployment can experience a maximum rotation speed increased to 2.5 deg/s in all axis.

4.3.3 Structural characteristics

FS-9-XPAA-MECH-4000	The stowed fundamental frequency of a wing shall be greater than 70Hz, rigidly constrained at the mechanical interfaces.
FS-9-XPAA-MECH-4010	The deployed fundamental frequency of a wing shall be greater than 2.5Hz when assuming the structure frame bracket interface is rigid.
FS-9-XPAA-MECH-4020	The total weight of mechanism system (one satellite), including brackets shall be less than 40kg.
FS-9-XPAA-MECH-4030	The Contractor shall provide the total mass of the Antenna Panel Deployment Mechanism (including hold down devices, latch device, structure frame and all fixings, harness, thermal spacers, shims)
FS-9-XPAA-MECH-4040	The Contractor shall provide the moments of inertia (MOI) and center of gravity (CG) in the stowed and deployed configuration (including hold down devices and all fixings, harness, thermal spacers).

4.3.4 Mechanical Environment Loads

The satellite will be placed in LEO orbit. The possible launch vehicles: Falcon-9, Falcon Heavy, EELV-class launcher (e.g. Atlas 5, Delta IV).

FS-9-XPAA-MECH-5000	The design shall survive the launch environment and on station loads given in ANNEX I including design factors and margins.
FS-9-XPAA-MECH-5010	If the design / components are off-the-shelf, the Contractor shall provide the static, sine, random and acoustic environment in the stowed configuration the Antenna Panel Deployment Mechanism has been qualified to. If not qualified then the Contractor shall outline the test regime required to qualify the design.
FS-9-XPAA-MECH-5020	If the design / components are off-the-shelf, the Contractor shall provide the static environment in the deployed configuration the Antenna Panel Deployment Mechanism has been qualified to.
FS-9-XPAA-MECH-5030	The Contractor should conduct thermos-elastic analysis in the stowed and deployed configuration to prove the design is compatible with the resulting loading.
FS-9-XPAA-MECH-5040	The deployment mechanism shall be designed to withstand the deployment test on the ground without degradation for a minimum of ten (10) times at room temperature and ten (10) times at -55℃ and ten (10) times at +75℃.

4.3.5 Measurement accuracy

FS-9-XPAA-MECH-6000	All mass measurements (or analysis) shall be made to an accuracy of ± 10g.
FS-9-XPAA-MECH-6010	All moments of inertia (MOI) measurements (or analysis) shall be made to an accuracy of ± 10%.
FS-9-XPAA-MECH-6020	All center of gravity (CG) measurements (or analysis) in the stowed case shall be made to an accuracy of ± 10 mm in the X and Z directions of the satellite and ± 5 mm in the Y direction. All center of gravity (CG) measurements (or analysis) in the deployed case shall be made to an accuracy of ± 10 mm.

4.4 Electrical Requirements

4.4.1 Hold Down and Release

The Contractor shall stipulate if any other monitor such as temperature is required for typical / safe operation of the proposed hold downs or hinges.

FS-9-XPAA-ELEC-3010	Primary and Redundant actuation circuits are required per hold down actuator.
FS-9-XPAA-ELEC-3020	The release circuits shall be compatible with a unregulated 22V to 33V bus with a max current of 5A for 2 minutes per actuator. The primary and redundant circuits can be actuated singularly or together and the design shall be capable of releasing all hold downs together.
FS-9-XPAA-ELEC-3030	The Contractor shall propose the batch / lot acceptance for the hold down actuators.

4.5 Thermal requirements

The expected temperature range of the Antenna Panel Deployment Mechanism is -55 degree C to+75 degree C (TBR).

4.5.1 Thermal design

FS-9-XPAA-THERM-0010	The stowed wing temperature range shall be calculated by the Contractor. As a minimum, the temperature range shall cover -55 degree C to +75 degree C.
FS-9-XPAA-THERM-0020	The mechanism shall be designed to successfully deploy at temperatures 10°C below the lowest predicted stowed temperature and 10°C above the highest predicted stowed temperature .
FS-9-XPAA-THERM-0030	The mechanism on-station operational temperature range shall be calculated by the Contractor.
FS-9-XPAA-THERM-0040	The mechanism shall be designed to survive a temperature 10°C below the lowest operational temperature and 10°C above the highest operational temperature.

4.5.2 Thermal control

FS-9-XPAA-THERM-1000	Thermal control of the mechanism shall be achieved by passive means only, i.e. no heaters and no moving parts shall be used.
FS-9-XPAA-THERM-1010	The design also needs to limit heat flux into the satellite sidewall from the Antenna Panel hold downs when in the stowed configuration (thermal washers). A thermal brake may also need to be implemented at the hinge to antenna panel interface by mutual agreement.

4.5.3 Thermal fatigue

FS-9-XPAA-THERM-2000	The mechanism shall be capable of withstanding without performance degradation the thermal cycle profile, resulting from the temperature conditions, depending on the following factors: • 26,300 eclipses with a maximum duration of 35 minutes (100 minute total orbit duration). • Solar irradiation, Earth albedo and Earthshine

4.6 Maintainability

4.6.1 Accessibility

FS-9-XPAA-MAINT-1000	The following access shall be provided without removal of, or disturbance to, any other parts of the stowed antenna panel: • Pyrotechnics: the launch site requirements to electrically arm and disarm the pyros. • Adjustment points for positioning and pre-loading assemblies
FS-9-XPAA-MAINT-1010	The deployment mechanism shall be designed to meet all performance and functional requirements over specified lifetime without any need for maintenance.

4.7 Ground Support Equipment (GSE)

The Ground Support Equipment shall include the following functions and items, and meet the performance requirements as specified:

As a minimum, the Ground Support Equipment (GSE) for the Antenna Panel Deployment Mechanism shall include the following items:

- Installation device specific for the solar array wing and HDRM
- Handling and support Fixture for installation and deployment test at satellite level
- Panel Protectors

FS-9-XPAA-GSE-0010	The Ground Support Equipment shall be designed for a safety factor of 3.0 for yield and 5.0 for ultimate. The lifting device shall be proof load tested to 2.0 times.

4.8 Transportation, Handling and Storage

All equipment shall be properly packed according to the company standards and heritage to guarantee proper and safe transport (airfreight) to TASA. A written procedure shall be prepared and implemented by contractor for preservation, packaging, handling, transportation, and storage of flight equipment subject to damage or deterioration or requiring safety precautions throughout the entire handling, shipping, transportation, and storage activities. ESA PSS-01-202 or equivalent standard practices should be followed. The Contractor 's procedure shall be reviewed by TASA prior to shipment of equipment.

For transport, the following topics shall be considered:

- Equipment shall be double bagged with drying agent and humidity sensor to guarantee dry conditions below 70% humidity
- Shock sensors in three axis shall be mounted either directly to the equipment (preferred, e.g. on fixation plate) or at least mounted to each inner transport container to monitor shock levels during transport handling. The shock sensor sensitivity shall be selected in accordance to equipment sensitivity.
- The equipment shall be double packed using a inner container (suitable for cleanroom off-loading of the equipment) and an external transport package / protecting cover. Shock absorbing / damping materials shall be used for equipment packing in inner container and also for inner container packing in transport box (double packing / damping if possible).
- The inner container and external transport package shall be labeled with necessary handling and warning information / labels.
- The transport package itself shall be placed and fixed on a transport pallet. It shall be labeled with necessary handling / warning and transportation information / labels.

FS-9-XPAA-DELIV-0010	The Antenna Panel Deployment Mechanism shall be cleaned to the requirements of the solar array handling procedure (to be prepared by the Contractor). There shall be no evidence of contaminants.
FS-9-XPAA-DELIV-0020	Packaging shall be sufficient to protect deliverable hardware from the effects of shock, vibration, moisture and temperature. Suitable monitors shall be provided with the equipment to confirm the conditions are not exceeded, this should include TASA shipping the arrays around the world.

5 Requirements Verification

5.1 Test Requirements

The purpose of the tests is to demonstrate that the Antenna Panel Deployment Mechanism can meet the requirements of this specification after exposure to the predicted launch and orbital environments.

FS-9-XPAA-TEST-0010	The Contractor shall provide a test plan describing the proposed test activities.
FS-9-XPAA-TEST-0020	The Contractor shall provide a summary of test results to a depth that allows compliance to the performance requirements (where verified by test) to be fully reviewed by TASA.
FS-9-XPAA-TEST-0030	The tests listed in ANNEX III shall be performed on all flight components and assemblies before delivery to TASA as a minimum. The Contractor shall also list any other tests they will perform.
FS-9-XPAA-TEST-0040	The Antenna Panel Deployment Mechanism shall be tested for correct functionality of release and deployment before and after wing environmental tests.
FS-9-XPAA-TEST-0050	A detailed visual inspection of each Antenna Panel Deployment Mechanism shall be performed to establish the standards of workmanship, finish, integrity and conformance to general assembly drawings. Any defects (allowable and non-allowable) shall be recorded.
FS-9-XPAA-TEST-0060	The circuits of NEAs, harnesses, instrumentation, pyrotechnic and telemetry lines shall be checked to ensure electrical continuity.

ANNEX I. Mechanical Environment

1. Quasi Static levels (TBR)

- Component/System Level

The unit interface forces shall not exceed those induced by a static acceleration load factor times 9.81 m/s/s in any direction. The acceleration load factor is defined as a logarithmic scale linear interpolation of the values in the Table AI-1 Mass Acceleration Curve Table with an absolute limit of 55 g's.

Table AI-1 - Mass Acceleration Curve

Mass(kg)	Load (G)
Mass $\leqq$ 2	55
2 < Mass $\leqq$ 35	$70 / M^{0.35}$
Mass > 35	20

Qualification level= Load(G)*1.25

2. Sine Vibration Loading (TBR)

- Component Level

Table AI-2.1 - Sine Vibration Loading

Hz	Qualification (Design Level)
5-X	Max shaker capability
X-100	26.25g
Test Duration	1 sweep up with 2 oct/min

X $\leq$ 25

- System Level

Table AI-2.2 - Sine Vibration Loading

Hz	Qualification (Design Level)
5-X	Max shaker capability
X-100	26.25g
Test Duration	1 sweep up with 2 oct/min

X $\leq$ 25

3. Random Vibration Loading (TBR)

- **Component Level**

Table AI-3.1 Random Vibration Test Levels for Component Mass Over 2kg

Frequency Range (Hz)	Qualification level	
	Out-of-Plane	In-Plane
20-100	+3 dB/oct	+3 dB/oct
100-600	0.2 g^2/Hz	0.1 g^2/Hz
600-2000	-6 dB/oct	-6 dB/oct
Test Duration	2 min	
G_{rms}	13.92	9.84

Table AI-3.2 Random Vibration Test Levels for Component Mass Below 2kg

Frequency Range (Hz)	Qualification level	
	Out-of-Plane	In-Plane
20-100	+3 dB/oct	+3 dB/oct
100-400	0.4 g^2/Hz	0.2 g^2/Hz
400-2000	-5 dB/oct	-5 dB/oct
Test Duration	2 min	
G_{rms}	17.25	12.23

- **System Level**

Table AI-3.3 Random Vibration Loading

XPAA Interface – Random_X	
Freq. (Hz)	PSD (g^2/Hz)
20	0.005
200	0.1
300	0.1
310	0.2
400	0.2
500	0.04
600	0.04
680	0.2
950	0.2
1100	0.01
2000	0.005

XPAA Interface – Random_Y	
Freq. (Hz)	PSD (g^2/Hz)
20	0.01
60	0.03
140	0.03
160	0.2
200	0.2
220	0.06
750	0.06
800	0.3
910	0.3
1060	0.04
2000	0.01

XPAA Interface – Random_Z	
Freq. (Hz)	PSD (g^2/Hz)
20	0.01
60	0.03
75	0.15
200	0.15
230	0.9
240	0.9
320	0.1
400	0.1
600	0.03
2000	0.012

Qualification duration = 2 minutes per axis

4. Shock Loading (TBR)

Table AI-4 Shock loading at the Antenna Panel Deployment Mechanism interfaces

Qualification level	
Frequency [Hz]	SRS (Q=10) [g]
100	42
746	905
10000	905

5. Thermal Vacuum Tests (TBR)

Table AI-5 Test level summary of thermal vacuum test requirements.

Condition: **Thermal Vacuum**	Protoflight (PFM)
Temperature	Acceptance test range ± 5 ℃
Pressure, mbar	$\leqq 5\times10^{-5}$/ Ambient
Number of cycles	$\geqq$ 8
Dwell at high and low	$\geqq$ 2 hours

ANNEX II. Allowable induced shock Load

Table AII-1 Maximum allowable induced shock levels from HDRM

Frequency [Hz]	SRS (Q=10) [g]
100	10
1000	350
10000	350

ANNEX III. Verification Matrix (TBR)

The Contractor shall follow the PFM verification approach, and refer to the table as below for the Antenna Panel Deployment Mechanism. If the Antenna Panel Deployment Mechanism provided by the Contractor is a recurring design previously qualified from a heritage design, and the evidence provided is accepted by TASA, the qualification test shall be followed.

Test Items	I	A	T	Configuration
Functions of Mechanism	√	√	√	Component & System Level
Torque margin		√	√	Component & System Level
Alignment		√	√	System Level
Stowed Stiffness		√	√	System Level
Deployed Stiffness		√	√	System Level
Mass		√	√	Component & System Level
Envelope/Dimension			√	Component & System Level
Mounting Interface			√	Component & System Level
Lifetime Test			√	System Level
Quasi-Static Load		√	√	A: System Level T: Component Level
Sine Vibration		√	√	A: System Level T: Component Level
Random Vibration		√	√	A: System Level T: Component Level
Shock		√	√	A: System Level T: Component Level
Thermal		√	√	A: System Level T: Component Level

I: Inspection

A: Analysis

T: Test

ANNEX IV. Mechanical Interface Requirement Drawing

Note: dimension unit: mm

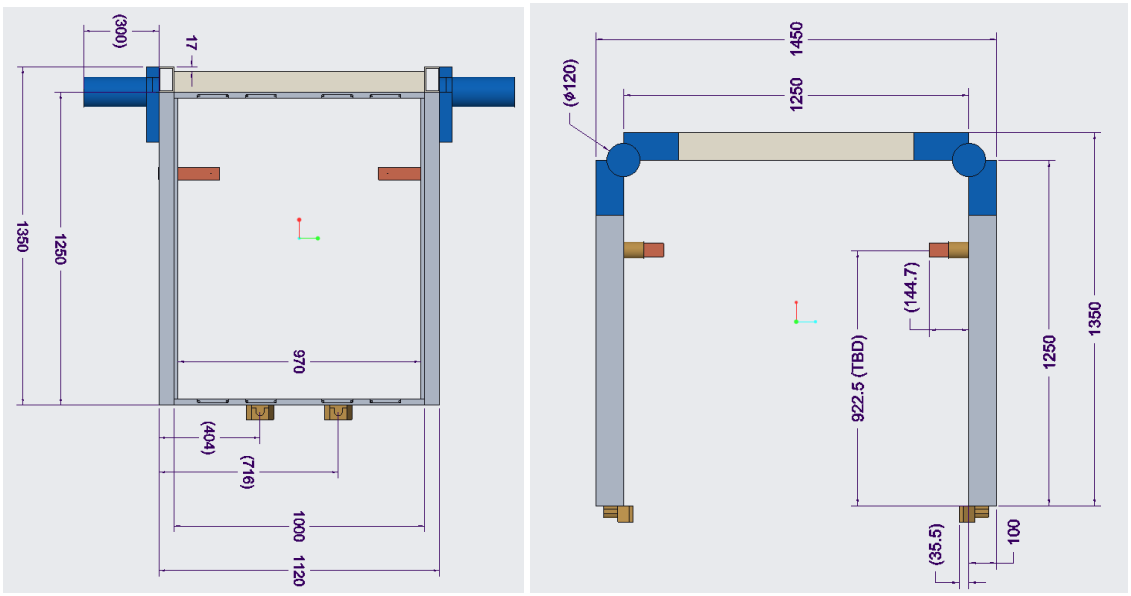

Figure AIV.1 Antenna Panel Deployment Mechanism Assembly

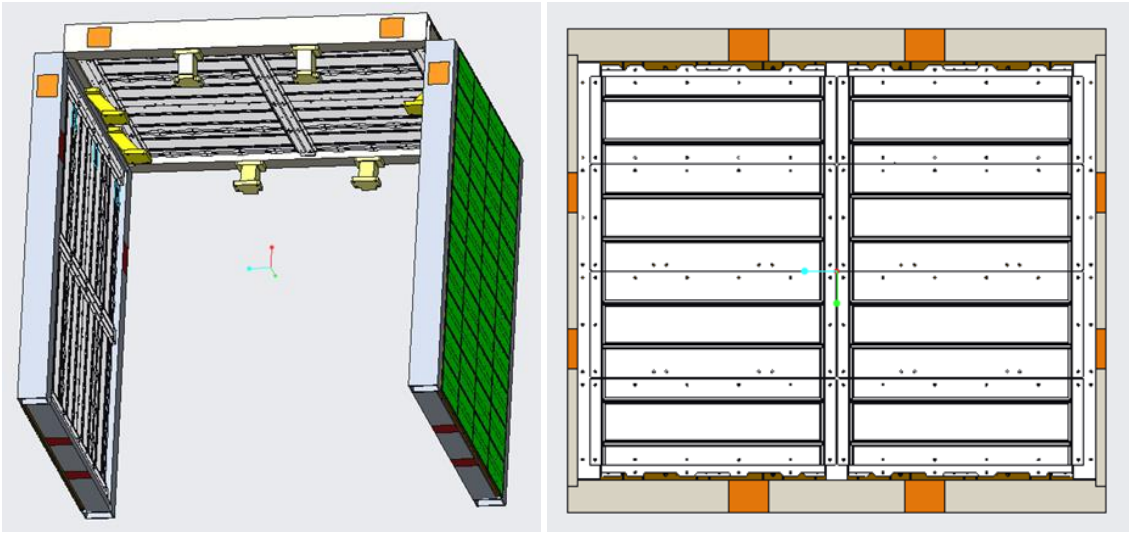

Figure AIV.2 Antenna Panel Deployment Mechanism Assembly include XPAA Unit

ANNEX V. Panel Angle Error Definition

The Panel Angle Error requirements for the Antenna Panel Deployment Mechanism.

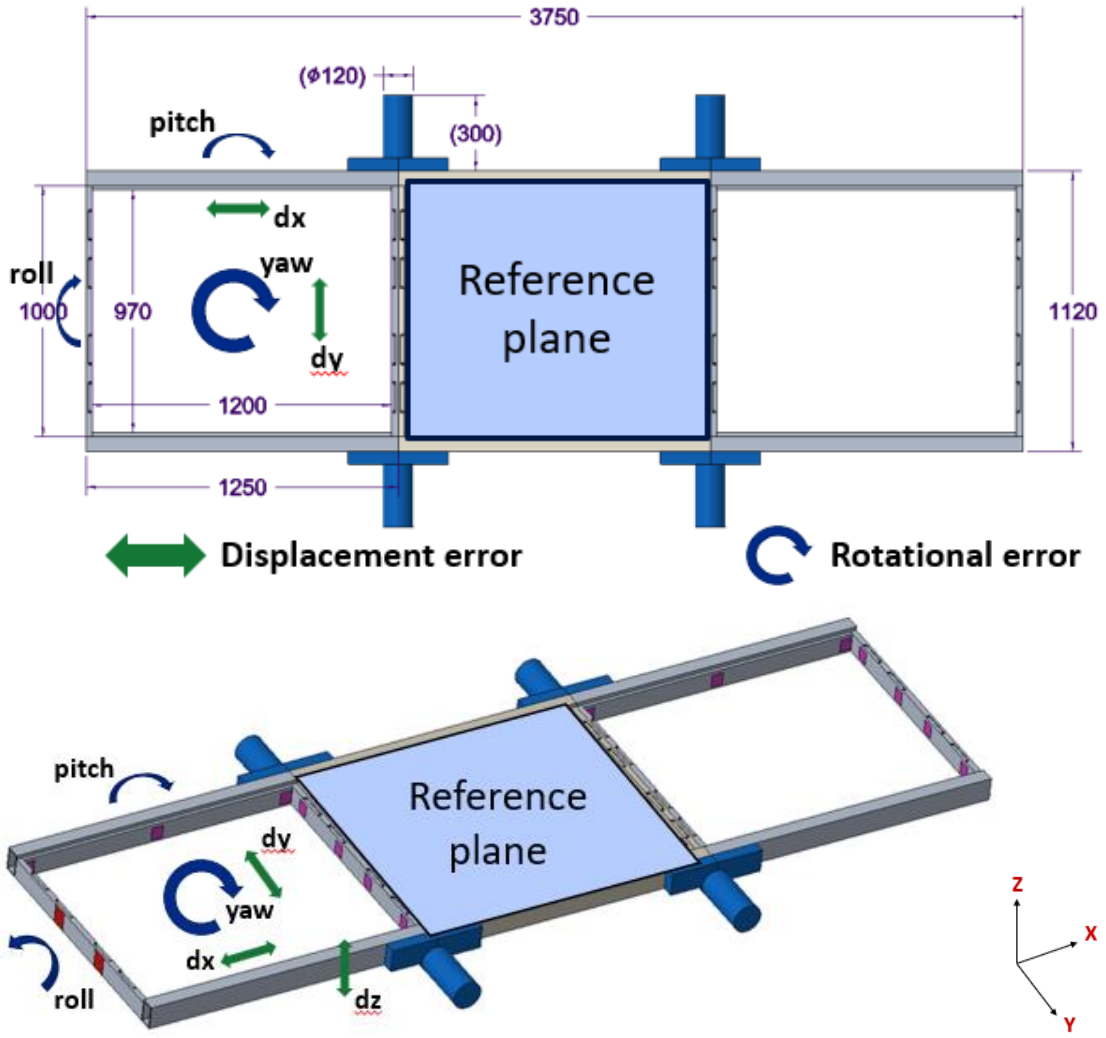

Figure AV.1 Panel Angle Error definition

Table AV-1 Panel Angle Error requirements

Error	Suggested Spec
Pitch	±0.1°
Yaw	±0.2°
Roll	±0.1°
dz	1mm
dx	1mm
dy	1mm

ANNEX VI. Antenna Unit Definition

- **Mass:** 80 kg/per panel

- **Dimensions:**