[BIRDS-5]

Flight Safety Assessment Report

for Phase III

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Kyushu Institute of Technology

REVISION HISTORY

REV.	DATE	Writer	DESCRIPTION
1	2023/10/6	Yamuchi	Initial Release

CONTENTS

1. Introduction

1.1 Purpose

The purpose of this document is to confirm compliance with International Space Station (ISS) safety requirements and verification results of the BIRDS-5 satellites, which will be deployed from Japanese Experiment Module (JEM) Small Satellite Deployer (hereafter called "J-SSOD"), at Phase III Payload Safety Review Panel (PSRP).

1.2 Scope

This document is prepared for the Phase III safety review by JAXA PSRP.

The scope of this document is to show safety design and verification results of CubeSat from its launch to deployment from ISS.

Satellite names are 001U(PearlAfricaSat-1), 001J(TAKA) and 001Z(ZIMSAT-1).

1.3 Applicable Documents

Current version of the following document is applicable as referred from this document.

(1) JX-ESPC-101132E JEM Payload Accommodation Handbook Vol.8 Small Satellite Deployment Interface Control Document

2. Safety Analysis Methodology

2.1 Methodology

Fault Tree Analysis (FTA) is performed to identify the possible hazard causes while reviewing detailed design of BIRDS-5 and its surrounding environment or conditions.

Hazard Report addresses all the hazards including hazard definition, hazard causes, hazard controls, verification method for the controls, and results of verification.

Compliance with ISS Jettison Policy are evaluated by J-SSOD system integrator in "Safety Assessment Report for series product."

2.2 Safety Requirements

Following safety requirements are applied.

(1) SSP51721 ISS Safety Requirement Documents

(2) PPD1101 ISS Jettison Policy

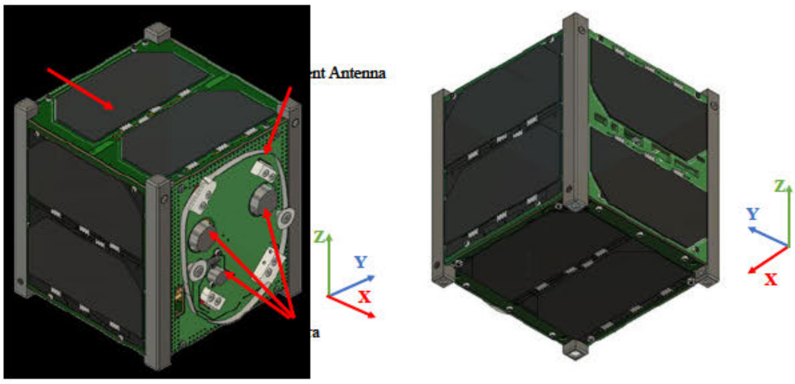
(3) SSP30599 Safety Review Process

3. System Description

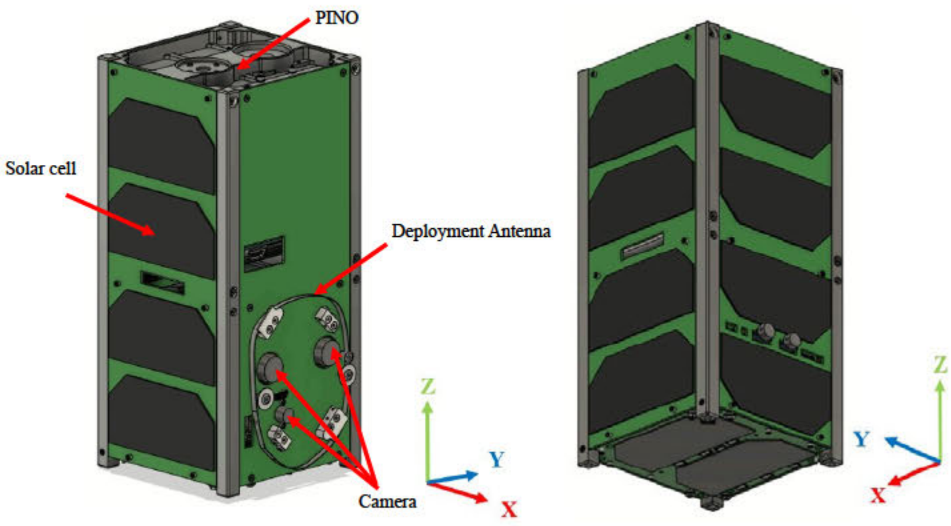
3.1 Overview

The BIRDS-5 project is a constellation of two 1U satellites (PearlAfricaSat-1 and ZIMSAT-1) and one 2U satellite (TAKA-1). 1U CubeSats whose dimension is 100 mm x 100 mm x 113.5 mm and weight are less than 1.33 kg, 2U CubeSat whose dimension is 100mm ×100mm × 227 mm and weight is less than 2.66 kg. External views of BIRDS-5 satellites in its stowed configuration and after deployment configuration are shown in Figure 3.1-1 and Figure 3.1-2, respectively.

[(PearlAfricaSat-1, TAKA-1, ZIMSAT-1)] shall perform several missions (Automatic Packet Reporting System (APRS) digipeater, Store-and-Forward (S&F), BIRDS-NEST, Particle Instrument for Nano-satellites (PINO), Attitude Visualization, On-board Image Classification, Land Use and Cover, Water Quality Assessment, Soil Fertility and shall be achieved with onboard mission payloads. PearlAfricaSat-1 and ZIMSAT-1 have different names, but the hardware is exactly the same.

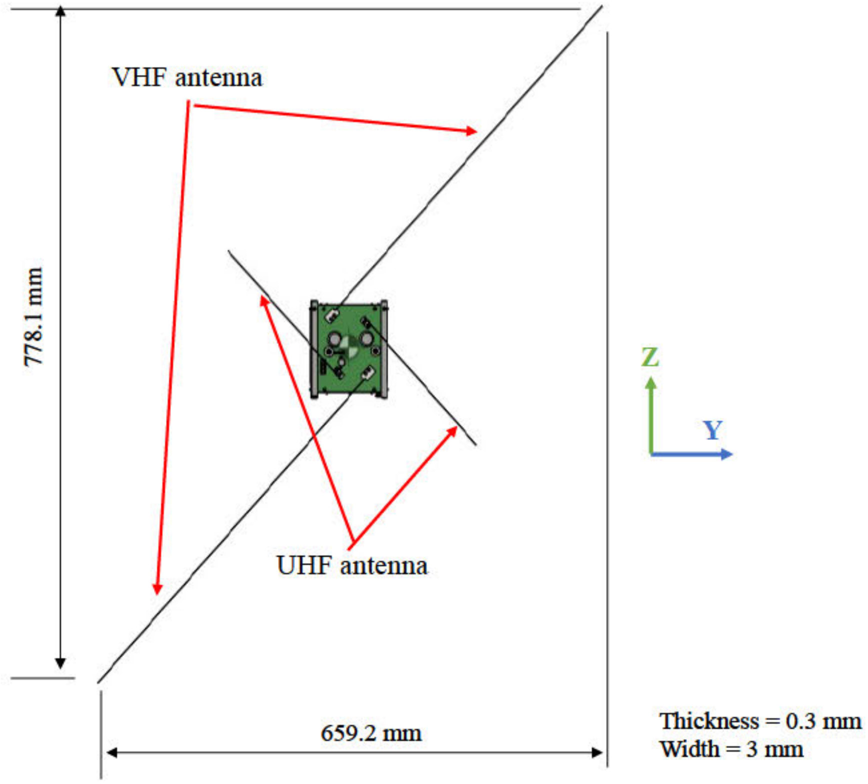


(a) 1U CubeSat

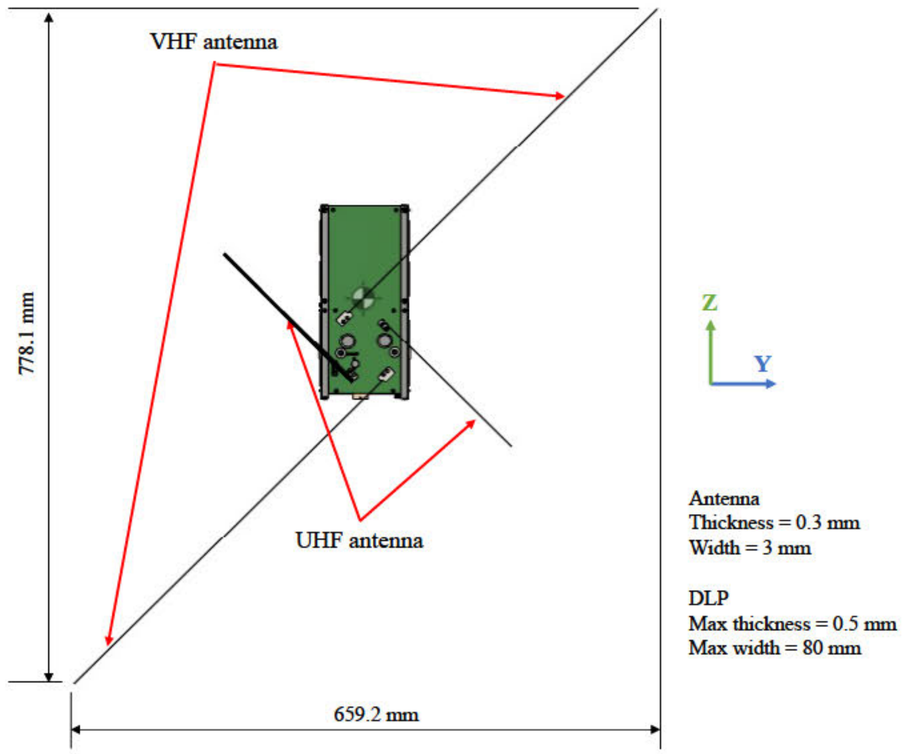


(b) 2U CubeSat

<u>Figure 3.1-1 External View of BIRDS-5 (Stowed configuration)</u>



(a) 1U CubeSat



(b) 2U CubeSat

Figure 3.1-2 External View of BIRDS-5 (After deployment configuration)

BIRDS5 Project:

BIRDS-5 mission objectives are as follows.

- COTS APRS-Digipeater demonstration on CubeSat (APRS-DP)
- Demonstration of ground data acquisition using Store and Forward (S&F)
- Demonstration of a mobile phone application displaying BIRDS satellite data (BIRDS-NEST)
- Measurement of precipitation of high-energy electrons in the radiation belt (PINO) (only TAKA-1)
- Demonstration of attitude visualization of the satellite
- Demonstration of image classification program by machine learning algorithms
- Demonstration of land use and cover by COTS multi-spectrum camera
- Demonstration of water quality evaluation of dams and lakes by COTS multi-spectrum camera
- Demonstration of analysis of soil nitrogen / fertility levels by COTS multi-spectrum camera

Figure 3.1-3 shows each satellite system. Three satellites are mostly identical with only one difference in missions, that is the PINO are mounted only on the "TAKA-1" satellite.

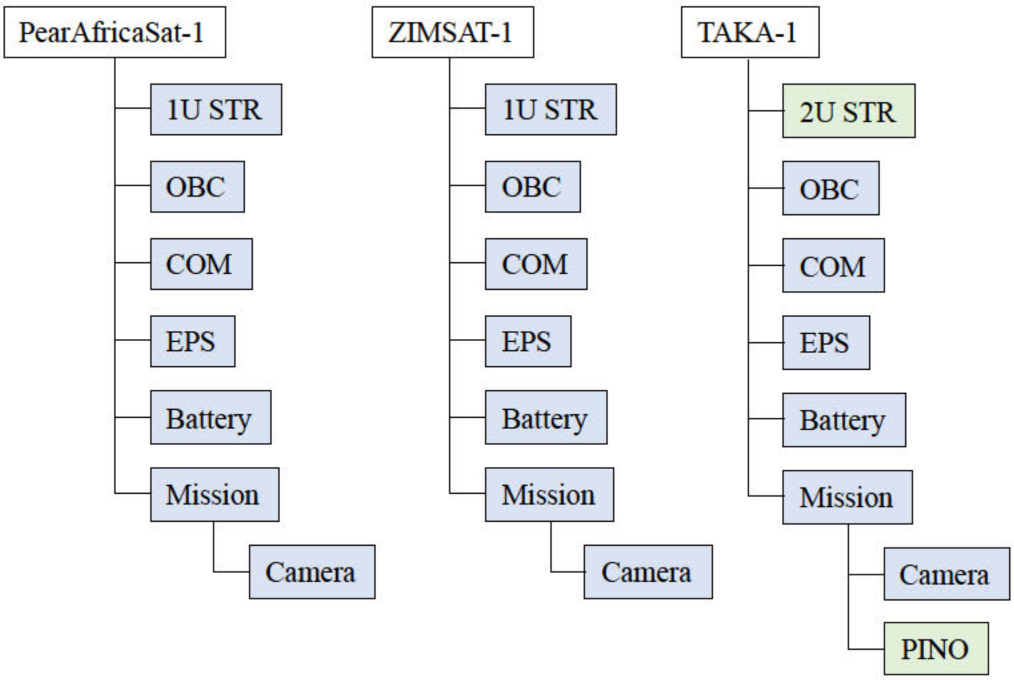


Figure 3.1-3 System for each satellite

3.2 Subsystems

3.2.1 Structure

Figure 3.2.1-1 and Figure 3.2.1-2 shows the primary structure and internal configuration. The primary structure is made of Aluminum alloy A6061-T6 and all four rails are hard anodized. These parts are not welded, forged, cast or quenched.

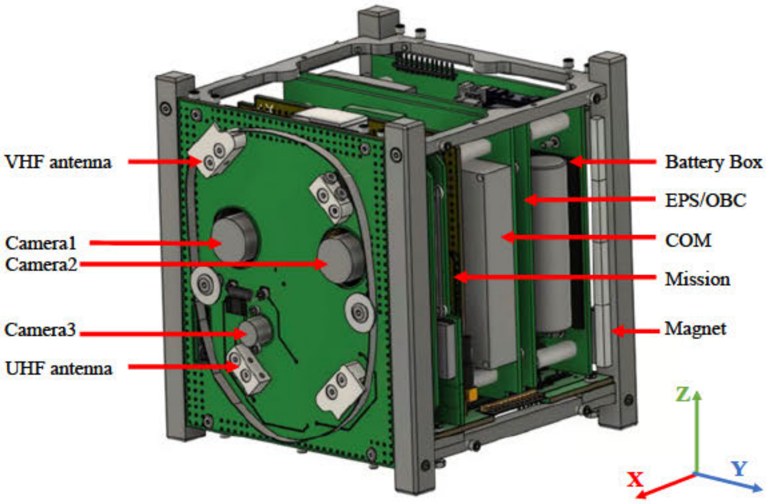


Figure 3.2.1-1 Primary Structure and internal Configuration of 1U CubeSat

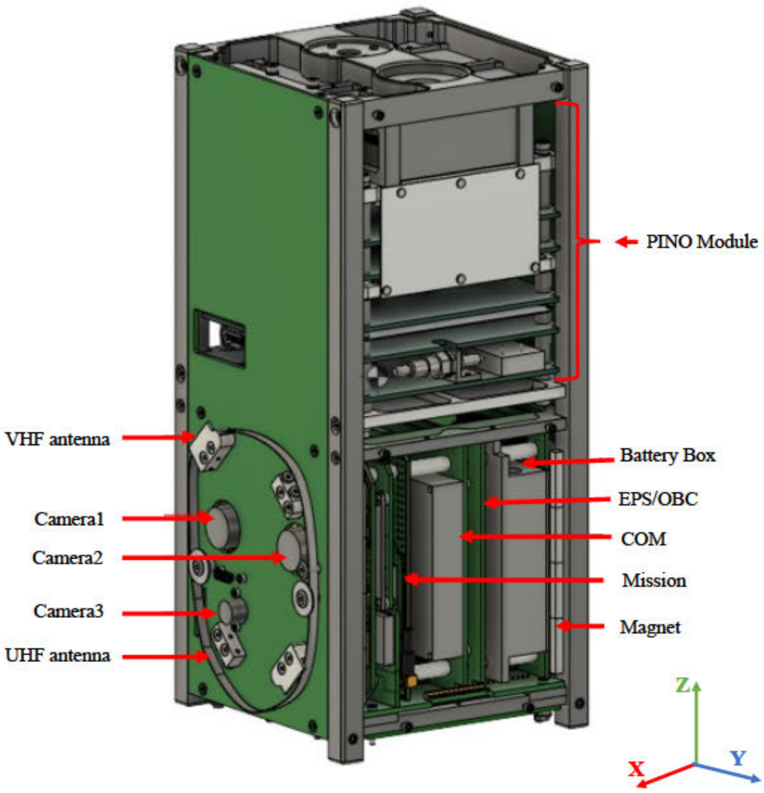
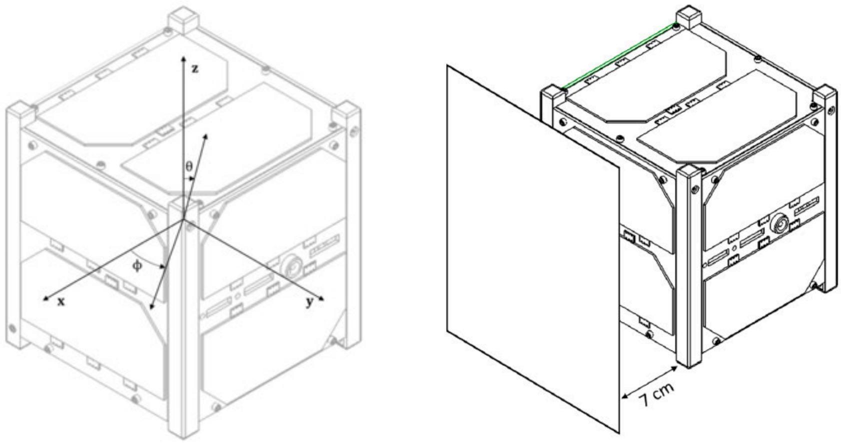


Figure 3.2.1-2 Primary Structure and internal Configuration of 2U CubeSat

3.2.2 Magnetic Field Analysis

Figure 3.2.1-1 shows the main structure of the BIRDS-5 satellite. Main structure consists of 4 rails, 4 ribs and 1 plate. Rails, ribs and the plate are composed of aluminum alloy (A6061-T6). All rails (4) are hard anodized (Anodized per MIL-A-8625 Type3). The magnet (four 3.2x3.2x19mm magnets are attached to each rail), made from an alloy of Aluminum, Nickel and Cobalt (AlNiCo) (Manufacture: MEDER electronic, Part No. 4003004018).



(a) (b)

Figure 3.2.2-1 (a)Coordinate system and (b)calculated plane

Each of the 4 rails will have 4 bar magnets (block), connected end to end, attached to their inner side. Thus, there will be a total of 16 bar magnets. (4 blocks). The resultant magnetic field is the superposition of the individual field of the magnetic blocks. Each block is modelled as a magnetic dipole. The magnetic moment is calculated on parallel planes at 7 cm from the satellite surface as shown in Figure 3.2.2-1.

Theoretical consideration for four bar magnets as a Single Dipole

Calculating the Volume of the Alnico 5 permanent magnets

Volume =Length*Breadth*Height

=1.90 cm * 0.32 cm * 0.32 cm

$$0.19\ cm^3\ each\ bar$$

For Four magnets

$$4 * 0.2 \quad 0.78\ cm^3$$

Calculating the Magnetic Moment

M: Magnetic moment [Am^2]

B: Remanence [T]

V: Volume [m^3]

μ: Permeability

$$\mu M = \mathrm{BV}$$

$$1.25 * 0.78 * 10 \;\; ^{6}$$

$$0.98 \times 10 \;\; ^{6} \; [Wb \cdot m$$

The magnetic flux density field of magnets oriented along the z axis is given by

$$B \quad \frac{|\mu M|}{4 * \pi * r^3}\left(2cos\theta\hat{r} + sin\theta\hat{\theta}\right)$$

Where

r: radial distance from the center of the magnetic moment

λ: Inclination angle (deg)

Since each rail is equipped with magnets, the total magnetic field is calculated as the sum of the magnetic fields from each magnet. The total magnetic field is calculated on the planes at 7 cm from the surface .at this distance, the maximum magnetic field is 2.27 Gauss. The analysis results of the magnetic field distribution are shown in Figure 3.2.2-2 and Figure 3.2.2-3. The maximum magnetic field is formed at a position close to the rail on a plane 7 cm from the satellite. The magnetic field is less than the required 3.16 Gauss so there is no hazard.

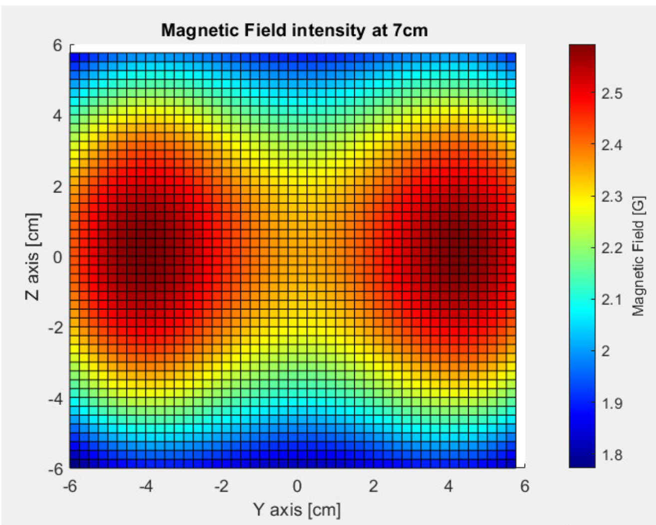


Figure 3.2.2-2 2D Map of magnetic field intensity of 16 bar magnets a parallel plane 7cm apart

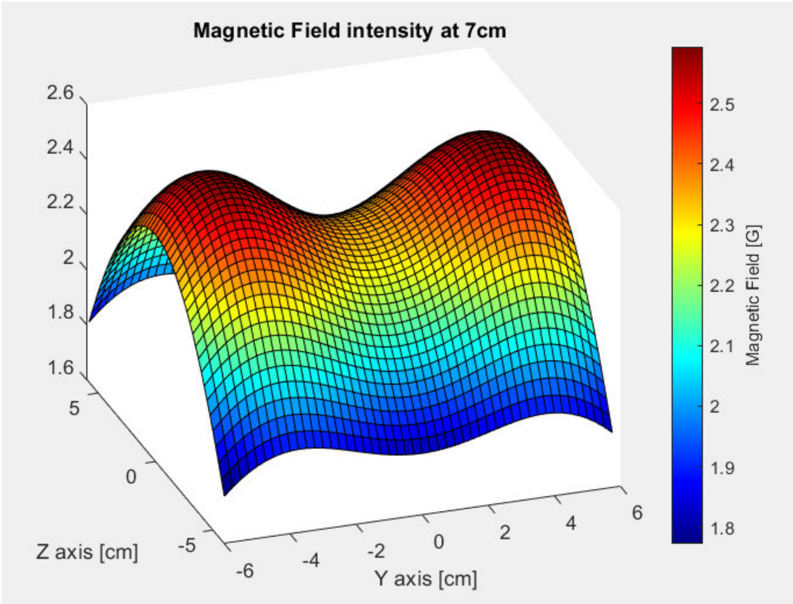


Figure 3.2.2-3 3D Map of magnetic field intensity of 16 bar magnets at a parallel plane 7cm apart

3.2.3 Mechanism

Antennae

BIRDS-5 has four deployable antennas. UHF and VHF antennas are dipole type and secured on the +X panel. Figure 3.2.3-1 shows the antenna deployment mechanism. UHF antennas (inside) are restrained by VHF antennas (outside). VHF antennas are restrained by double strings for redundancy. Each VHF antenna is 514 mm length, 4mm width and 0.3 mm thickness while each UHF antenna is 171 mm length, 4mm width and 0.3 mm thickness. The antenna folding is guided by guide rails with washers to prevent it from untangling.

Safety of the Antenna Deployment System

Antennae

The power supplied from the battery is required to activate the antenna deployment system. When the antennas are inadvertently deployed inside the J-SSOD, CubeSat may not be deployed from J-SSOD appropriately due to contact of the antenna with J-SSOD inner surface. To prevent this mis-operation, this CubeSat used two strings for VHF antennas (Figure 3.2.3-1). The UHF antenna is covered by a long outer VHF antenna, so the UHF antenna cannot be deployed unless the VHF antenna is deployed.

The heat cutter circuit is connected to the electrical power system. In order to release the satellite successfully the deployment switch (Dep-SW) has to be closed. Then, electric power is supplied to the burner circuit, the heat cutter is powered, and the wire is cut.

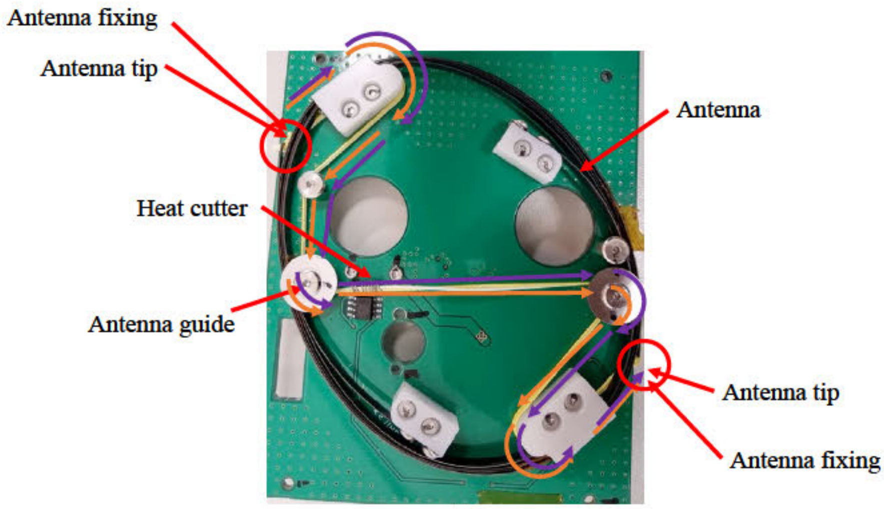


Figure 3.2.3-1 Stowed antenna configuration

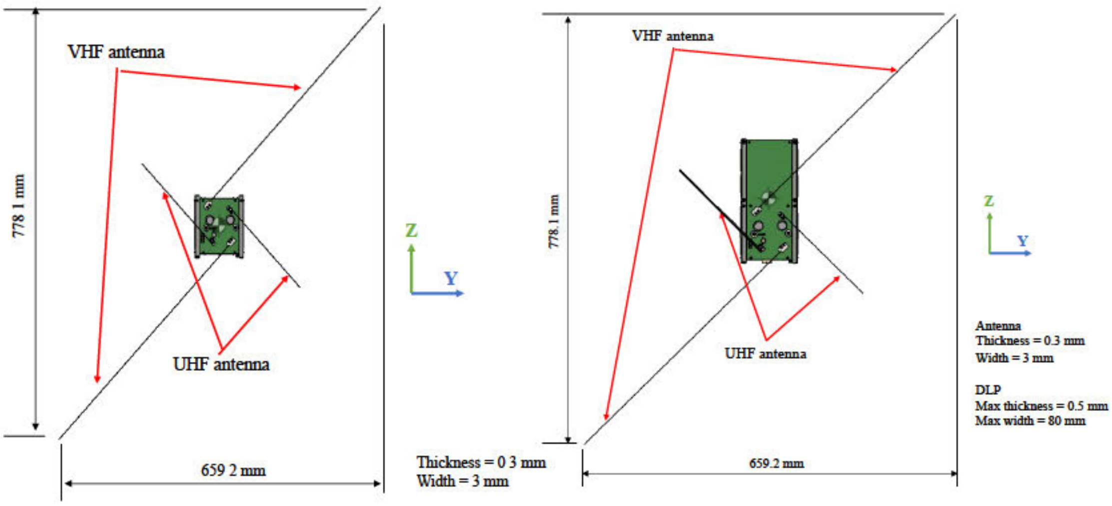
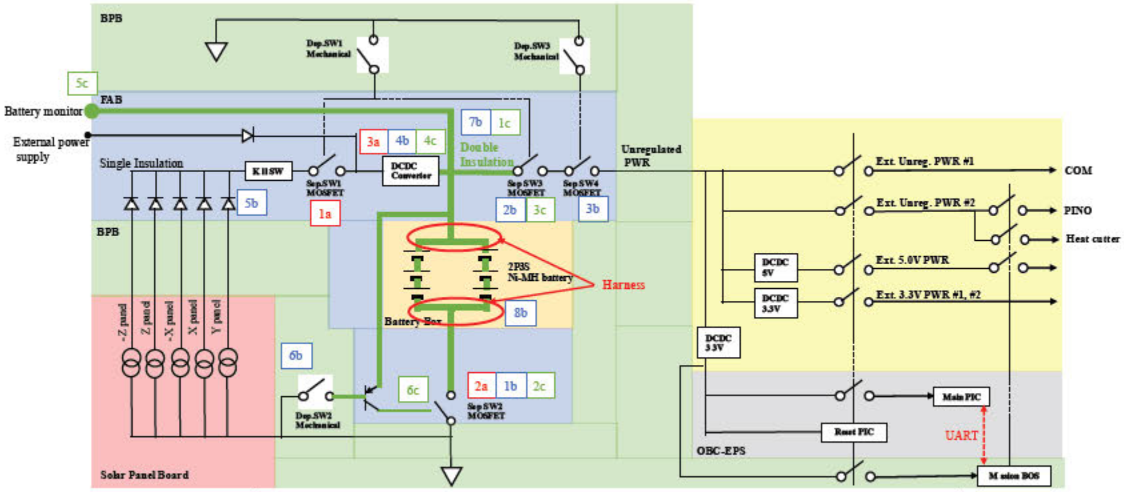


Figure 3.2.3-2 1U and 2U Deployed antenna configuration

3.2.4 Electrical Power System

Figure 3.2.4-1 shows inhibit schematic. There are three deployment switches to cut power for all loads before deployment, and these switches controls to prevent hazards.

Six Nickel Metal Hydride - NiOOH/metal alloy/KOH batteries are connected by three-series and two-parallel. The CubeSat does not use wet Electrolytic Capacitor in EPS.



Hazard		Hazard Control #1	Hazard Control #2	Hazard Control #3
Over-charge		SepSW1[1a]	SepSW2[2a]	DCDC converter[3a]
Over-discharge	Load side	SepSW2[1b]	SepSW3[2b]	SepSW4[3b]
	Solar cell side		DCDC converter[4b]	Diode[5b]
	DepSW2 side	DepSW2 [9b]	Proper Insulation[7b]	Proper charging [8b]
External short	Load side	Proper Insulation[1c]	SepSW2[2c]	SepSW3[3c]
	Solar cell side			DCDC converter[4c]
	External power supply side			DCDC converter[4c]
	Battery monitor side			Proper Insulation[5c]
	DepSW2 side			Proper Insulation[6c]

Note Proper insulation (double isolation is shown by green line in figure above, single isolation is black line)
All wires and components between the battery and the first power functions are assembled as double insulation. .
The DCDC converter (LTC3119) used for inhibit is a buck-boost converter and its internal FET configuration prevents reverse current.

Figure 3.2.4-1 Inhibit Schematic

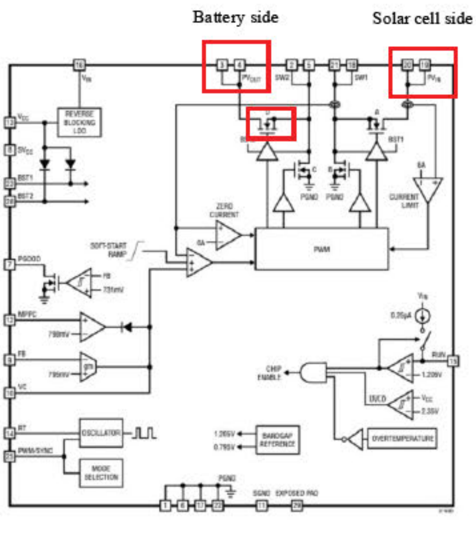


Figure 3.2.4-2 Inhibit Schematic of DCDC converter

3.2.4.1 Deployment Switch

Table 3.2.4.1-1 shows the design characteristics of the deployment switch. Figure 3.2.4.1-1 shows locations of the deployment switches.

Table 3.2.4.1-1 Deployment Switch Properties

Manufacture	C & K
Part Number	SDS002
Rated current (A)	100 mA (DC)
Rated voltage-DC	12 V
Actuator type	Overtravel plunger
Actuating Force	0.74 N
Releasing Force	0.25 N
Overtravel	2.15 mm
Operating temperature	-40 ° C to 85 ° C

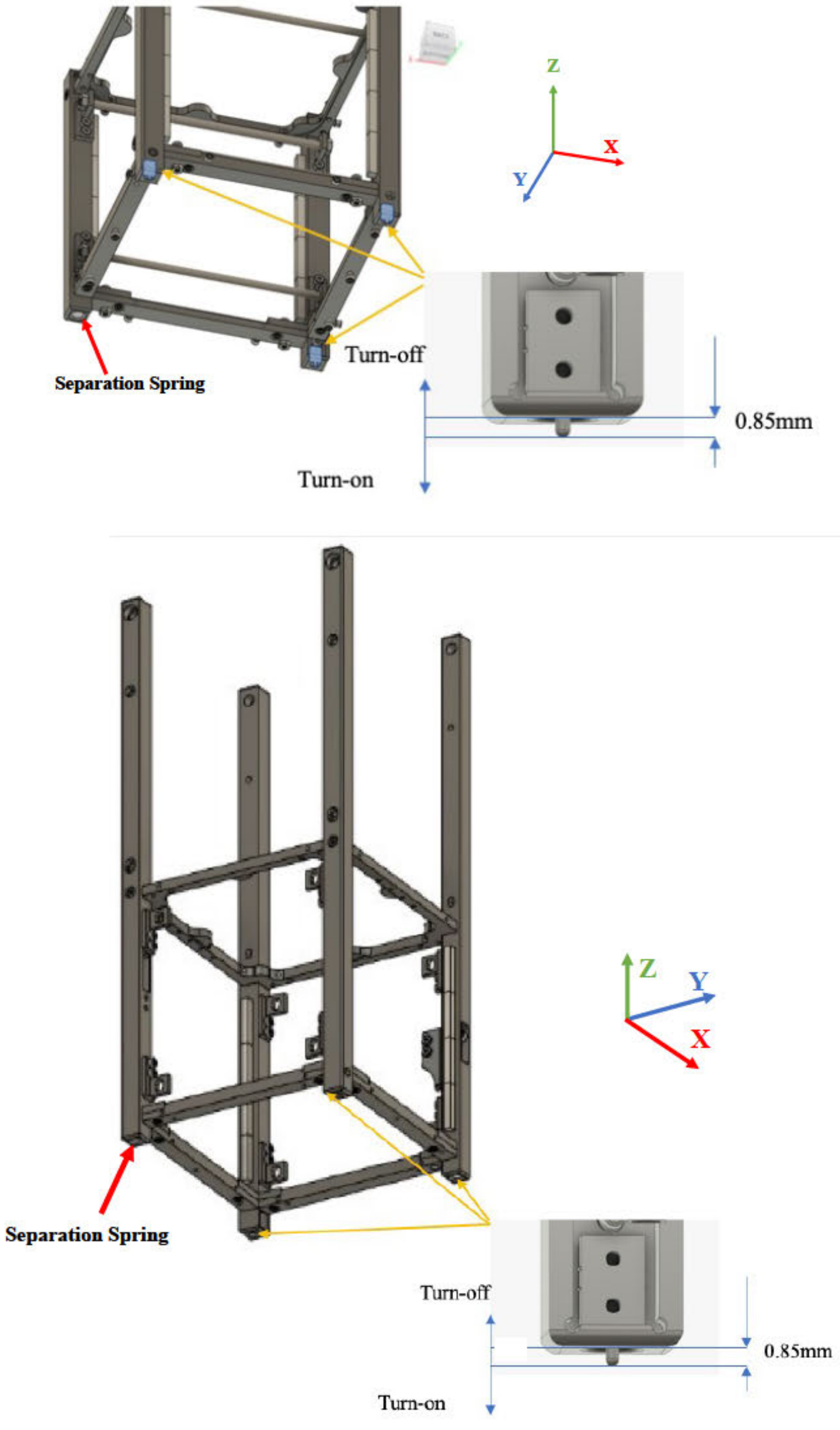


Figure 3.2.4.1-1 Deployment Switch

As separation springs, a spring plunger (P/N 251D939002-1) and deployment switches were used at the positions shown in Fig. 3.2.4.1-1. The spring force of the spring plunger is 0.6±0.06 [N]. The return force of the deployment switch is 0.25 [N]. The total spring force is 1.35 [N], which meets the requirements.

3.2.5 Communication

The Communication Subsystem as shown in Figure 3.2.5-1, receives command uplink from the ground station, sends telemetry/housekeeping/mission data to the ground station, and transmits Morse-coded CW beacon. Its command uplink receiver operates in the UHF amateur band (within 435-438MHz) and GMSK demodulation, 4,800 bps in AX.25 protocol. Similarly, the telemetry/housekeeping/mission data downlink transmitter operates in the UHF amateur band (437.375 MHz) and supports GMSK modulation, 9,600 bps in AX.25 protocol, with transmission power of 0.8W which conforms RF radiation criteria. The uplink command to the CubeSats is sent from the own ground station in Japan.

The APRS-DP/S&F Payload, which supports both the Automatic Packet Reporting System Digipeater Mission and Store-and-Forward Mission, operates in the VHF amateur band (145.825 MHz). The payload communicates with APRS-DP and S&F users at 145.825 MHz in both uplink and downlink. It supports AX.25 protocol, AFSK on FM demodulation/modulation, 1,200 bps data rate. The payload consists of a half-duplex VHF FM transceiver, an APRS-DP/AX.25 TNC with modem module, APSF MCU and flash memory for data storage. It utilizes the VHF antenna for operation. Activation and deactivation of the payload is controlled by the main OBC which also controls the power supply to the payload.

Below is the sequence of operation of the CubeSat after release from the ISS.

1) Deployment switches are closed.
2) OBC starts operation.
3) OBC waits for 2,000 seconds and confirms that batteries generate enough output voltage.
4) OBC activates the heater circuit connecting to nichrome wire for antenna deployment mechanism.
5) The heater circuit stops after antenna deployment.
6) The transceiver turns ON after antenna deployment and commands can be received. CW beacon is transmitted.

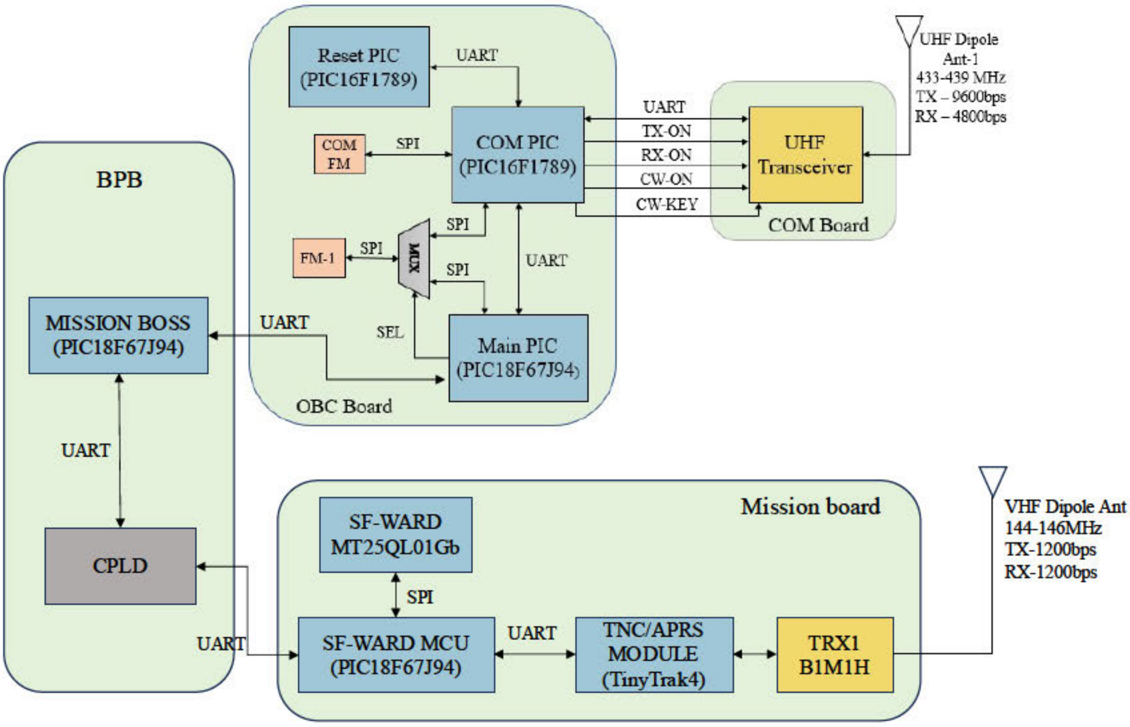


Figure 3.2.5-1 Communication Subsystem Block Diagram

3.2.6 Mission

3.2.6.1 PINO

PINO will observe high-energy electrons coming from the Van-Allen radiation belts. PINO carries solid-state detectors, which are designed to detect high-energy electrons in space. PINO can detect high-energy electrons precipitating into the Earth's upper atmosphere. PINO's field-of-view directs along the geomagnetic field since the high-energy electrons precipitate along the magnetic field lines. PINO will provide monitoring of the space environment at an altitude of approx. 400km, which could be useful for forecasting space weather.

PINO consists of stacked semiconductor detectors and five circuit boards. PINO is supplied with an unregulated voltage from the EPS subsystem. Figure 3.2.6.1-1 shows a high voltage part of the PINO module. From the unregulated voltage, PINO generates all the required regulated voltages including high voltage (max. 2kV) which is needed to bias the semiconductors. The PINO module is connected to the LOAD side of EPS system, and EPS system has 3 inhibit before the satellite deployment (Figure 3.2.4-1). Because the EPS system inhibits to supply the unregulated voltage before the satellite deployment, PINO is not turned on before the deployment.

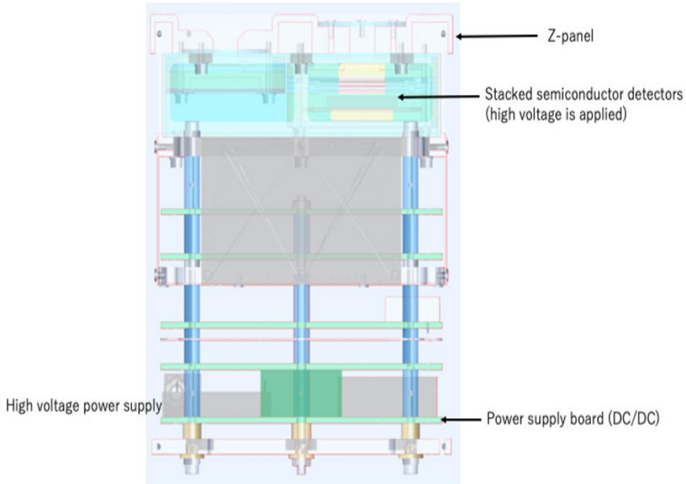


Figure 3.2.6.1-1 High voltage parts in the sectional view of PINO module

Figure 3.2.6.1-2 shows the +Z-plate. PINO has two holes, from which electrons come into the semiconductor detectors. The diameters of the holes are less than 10 mm, and the ISS crews cannot touch the inside of PINO.

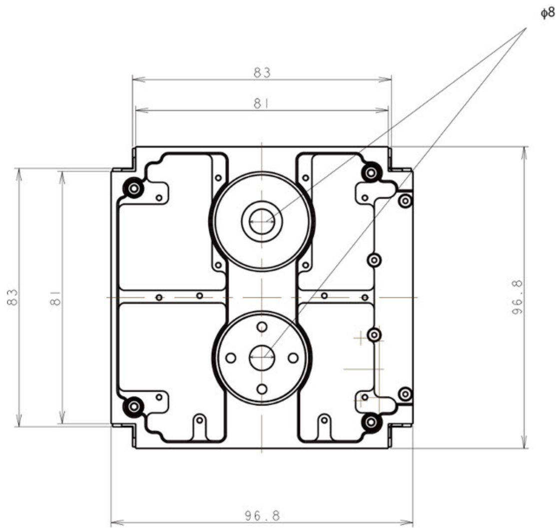


Figure 3.2.6.1-2 +Z plate of the 2U CubeSat

4. Launch Configuration

On ground, CubeSat is installed into Satellite Install Case of J-SSOD or J-SSOD-R Launch Case, and there is packed in a Cargo Transfer Bag (CTB) with cushion foam as shown in Figure 4-1.

The CTB is launched by HTV-X, NG Cygnus or Space-X Dragon and transferred to ISS as a pressurized cargo.

When CubeSat is inside J-SSOD or J-SSOD-R Launch Case, deployable antennas are restrained by wire so that the antenna is within the allowable satellite envelope defined in JX-ESPC-101132E “JEM Payload Accommodation Handbook Vol.8”.

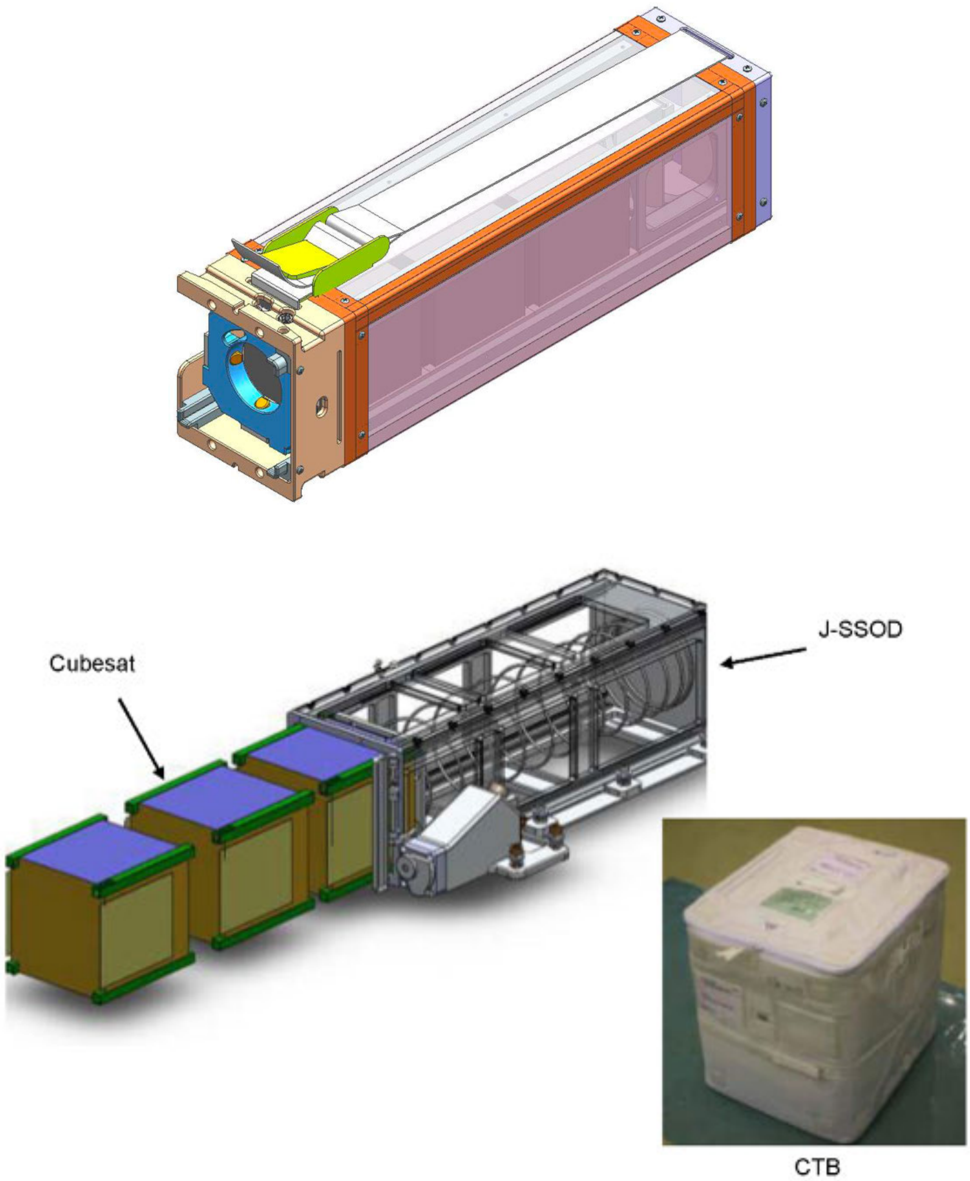


Figure 4-1 J-SSOD, J-SSOD-R Launch Case and CTB

5. Operation

[In case launched with J-SSOD]

CubeSat is cold-launched. After arrival of the CTB to ISS, the CTB is stowed inside ISS pressurized module. Before the CubeSat deployment mission, J-SSOD is picked up from the CTB and installed onto Japanese Experiment Module Remote Manipulator System (JEMRMS) Multi-Purpose Experiment Platform (MPEP), which is attached on JEM Airlock Slide Table. Then the J-SSOD with MPEP is transferred outside JEM Pressurized Module (PM) through JEM Airlock and manipulated by JEMRMS for the CubeSat deployment position and orientation. Finally, CubeSat is deployed from J-SSOD by command from IVA crew or ground operator to J-SSOD.

No on-orbit maintenance for CubeSat is planned.

[In case launched with J-SSOD-R]

CubeSat is cold-launched installed in Satellite Launch Case, and stowed in CTB. After arrival of the CTB to ISS, the CTB is stowed inside ISS pressurized module. Before the satellite deployment mission, Satellite Launch Case is picked up from the CTB and CubeSat is transferred from Satellite Launch Case to Satellite Deploy case. And Satellite Deploy case is installed onto JEMRMS Multi-purpose Experiment Platform (MPEP), which is attached on to the JEM Airlock Slide Table. Then the J-SSOD-R with MPEP is transferred outside JEM Pressurized Module (PM) through JEM Airlock and manipulated by JEMRMS for the CubeSat deployment position and orientation. Finally, CubeSat is deployed from J-SSOD by command from IVA crew or ground operator to J-SSOD.

No on-orbit maintenance for CubeSat is planned.

6. Hazard Analysis Results

6.1 Safety Feature

Fault Tree Analysis was performed for hazard identification as shown in Figure 6.2-1. Six kinds of standard hazard are identified for CubeSat as shown in Table 6.2-1 and summarized in Appendix B-1 with using JSC Form 1298. Also, five kinds of unique hazard are identified as shown in Table 6.1-2 and summarized in Appendix B-2 with using JSC Form 851.

[Standard Hazards]

(1) Flammable Material

There is no propagation path of fire since the CubeSat is kept inside the CTB within the Satellite Install Case of the J- SSOD during on-orbit stowage, this feature was reviewed through the standard MIUL and MUA process. (See Appendix B-1 JSC Form 1298, 1. Ignition of Flammable Material)

(2) Material Offgassing

There are many COTS parts and materials used for the CubeSat, however, the CubeSat design contains less than 20 pounds mass of polymeric material and does not contain any of the exclusions. (See Appendix B-1 JSC Form 1298, 2. Material Offgassing in Habitable Areas Exceed Allowable Concentrations)

(3) Inadvertent Release of Dust, Toxic, or Biological Hazardous Material into Habitable Volume

Battery has electrolyte that is identified toxic material. The material was reviewed through the standard HMST process.

(4) Inadvertent Release of Sharp Particles into Habitable Volumes

The CubeSat has camera lenses, filters, and cover glass for solar cells as shatterable materials.

<Camera lenses and filters>

Camera lenses are non-stressed (no delta pressure) and recessed, which reduce the risk of breakage on-orbit. (See Appendix B-1 of BIRDS5-UNQ-01) The filter is contained inside the camera barrel.

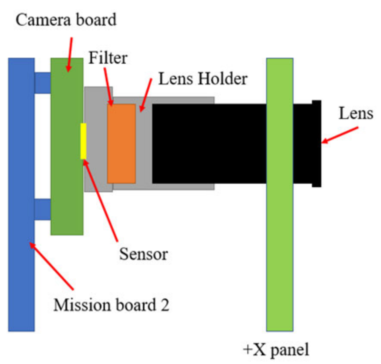


Figure 6.1-1 Configuration of Multi Spectral Camera

<Cover glass of solar cells>

The CubeSat is kept inside the Satellite Install Case of the J-SSOD. Cover glass of solar cells are non-stressed (no delta pressure), and not exposed IVA crew. J-SSOD HR (No. J-SSOD-03) and associated NCR-JAXA-JSSOD-03 are already approved with EVA No Touch Area (NTA) on the J-SSOD satellites.

In addition, the CubeSats were tested under the predicted launch vibration environment. (See Appendix B-2 BIRDS5-UNQ-01 Structural Failure)

(5) IVA Crew Exposure to Mechanical Hazards and Translation Path Obstructions

There are no potential sharp edges on the surfaces of the CubeSat. The CubeSat is kept inside the Satellite Install Case of the J-SSOD. The touch test was conducted to verify that there are no sharp edges on the surfaces of deploying direction.

In addition, there is no planned and contingency scenario for EVA crew to access the CubeSat. J-SSOD Hazard Report (No. J-SSOD-03) and associated NCR-JAXA-JSSOD-03 are already approved with no touch area on the J-SSOD satellites. (See Appendix B-1 JSC Form 1298, 5. IVA Crew Exposure to Mechanical Hazards and Translation Path Obstructions)

(6) IVA Crew Exposure to Touch Temperature Exceedances

N/A – There are no sources of heating and/or cooling in the CubeSat design. The CubeSat remains deactivated until the deployment from ISS by three deployment switches. It is not credible to exceed the temperature over 45degC at the outer panel with the maximum expected power consumption (4.8W).

[Note for EVA] J-SSOD Hazard Report (No. J-SSOD-03) and associated NCR-JAXA-JSSOD-03 are already approved with no touch area on the J-SSOD satellites.

(7) IVA Crew Exposure to Light Amplification by Stimulated Emission of Radiation (LASER) and/or Incoherent Electromagnetic Radiation Emissions.

N/A – The CubeSat has no LASERs and/or sources of incoherent electromagnetic radiation.

(8) IVA Crew Exposure to Noise Limit Exceedances

N/A – The CubeSat has no noise sources.

(9) Injury/Damage as a Result of Improperly Bonded and Grounded Equipment

N/A – No electrical power or data interface is provided to the CubeSat while on ISS and all electrical power is wholly contained within the CubeSat and J-SSOD.

(10) Injury/Damage as a Result of Improper Power Distribution Circuitry and Circuit Protection Devices

The CubeSat does not interface with ISS power and is unpowered until deployment. There are SepSW3, DCDC converters on the HOT side of the battery, and SepSW2 on the RTN side to serve as inhibits. Appropriate isolation was provided between the battery and the first inhibits. (See BIRDS5-STD-Attachment-02) The CubeSat provides safety inhibits to prevent inadvertent powering during IVA phases (including stowage and installation). (See Appendix B-1 JSC Form 1298, 10. Injury/Damage as a Result of Improper Power Distribution Circuitry and Circuit Protection Devices.) The mission payload contains a high voltage part of 32V or higher. (See Appendix B-2 BIRDS5-UNQ-05 Electric Shock)

(11) Mating and Demating of Energized Connector

N/A – No planned mating or demating of low powered CubeSat connectors.

(12) Non-Ionizing Radiation Interference

The EMI compatibility Test was not performed since the CubeSat is de-activated with three inhibits in place. This is approved by TIA process. (See Appendix B-1 JSC Form 1298, 12. Non-Ionizing Radiation Interference). Regarding the RF radiation hazard to both ISS hardware and ISS crew, the RF frequency, power level, and field strength for UHF (437.375 MHz) are OE-14-002 and SSP50005 (evaluated by SRAG sheet) compliant. VHF (145.825 MHz) is satisfied SSP50005 compliant but not satisfied OE-14-002, so BIRDS5-UNQ-03 is drafted.

<FET activation under radiated electric field>

On the other hand, there is likelihood to activate FET and transistor under radiated electric field in ISS. But, since all FETs and transistor involved in the inhibit activate at more than 0.1 Volts, they are acceptable. Refer to STD-12, BIRDS5-STD-Attachment-01 and JDX-2020277.

<Magnetic Field induced by magnet, magnetic torquers>

BIRDS-5 has 16 magnets, but the maximum magnitude of the magnetic field is 2.27 Gauss which meets the requirement (less than 3.16 gauss at 7 cm distance from the surface of equipment defined on SSP30237), so there is no hazard (See 3.2.2 Magnetic Field Analysis).

(13) Injury/Damage as a result of Rotating Equipment Failure

N/A – No rotating equipment is used in the CubeSat design.

(14) Injury/Damage as a result of Sealed Container Failure

N/A – No sealed containers (inherently pressurized) are used in the CubeSat design.

[Unique Hazards]

(1) Structural Failure

Since the CubeSat is launched in the CTB with cushion material, the launch environment is structurally moderate. However, based on the FTA, if a structural failure occurs in the Satellite Install Case of the J-SSOD, the direction of the deployment may be affected due to inadvertent contact between the CubeSat and the case, which may result in a collision of the deployed CubeSat against the ISS structure. Thus, the unique hazard is provided to control this potential hazard.

(2) Battery Leakage / Rupture

COTS rechargeable NiMH Batteries are used. The Battery Description Form is submitted and reviewed by JAXA battery expert.

(3) Exposure of the ISS to Excessive Levels of EMI radiation and RF radiation

Regarding the RF radiation hazard to both ISS hardware and ISS crew, the RF frequency, power level, and field strength for UHF (437.375 MHz) are OE-14-002 and SSP50005 (evaluated by SRAG sheet) compliant. VHF (145.825 MHz) is satisfied SSP50005 compliant but not satisfied OE-14-002, so UNQ-03 is drafted and controlled by 3 inhibits.

(4) Impact / Collision to ISS due to inappropriate CubeSat deployment from J-SSOD by inadvertently-deployment

If the antennas are inadvertently deployed inside Satellite Install Case, the 1U CubeSat antennas may invade the envelope of the ±Z side, 2U CubeSat antenna may invade the envelope of the -Z side. Therefore, we use two strings to fix the antenna, respectively. By controlling the inadvertent deployment, the antenna will not invade the envelope of the ±Z side. The deployment mechanism of the antenna is controlled according to UNQ-BIRDS5-04.

Even if the heat cutter is powered immediately after the release from J-SSOD (immediately after the inhibit is released) and the antennas are inadvertent deployed, the distance between the CubeSats and, between the CubeSat and J-SSOD will be sufficiently far apart in the time it takes for the wire to be cut.

Assuming CubeSat mass: 2.66 kg (2U size maximum) and total separation force: 1.08 N (the minimum value defined in JX-ESPC-101132E), and the time of force application is 0.2 s, the relative velocity v for adjacent CubeSat is

$v=F/m*t=1.08/2.66*0.2=0.08m/s$

This value is less than 0.77 m/s which is the lower limit of J-SSOD release speed (JX-ESPC-101132-D1 Table 4.3.1.2.2-1). The time until the CubeSat's heat cutter is turned on and the antenna is deployed is about 5 s.

Therefore, the relative distance x is

$x = 0.40$ m

Since the Z directional antenna length of the CubeSat is about 0.34 m, there will be no interference with the JSSOD or the adjacent CubeSat even if the antenna is mis-deployed immediately after ejection.

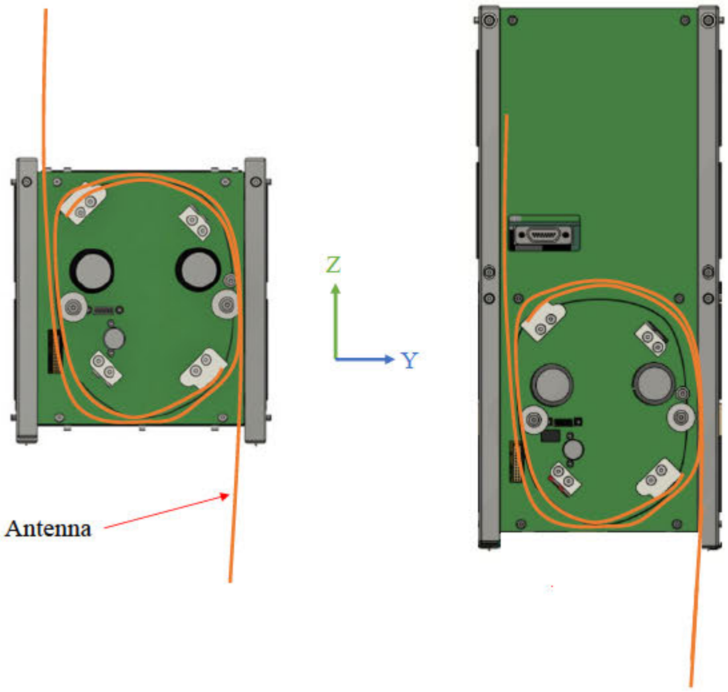


Figure 6.1-3 Location of inadvertent deployed antenna

(It shows the state when inadvertent deployment occurs)

(5) Electric Shock

If the ISS crew touches high-voltage parts caused by inadvertent power-on, there is a risk of electric shock or injury. UNQ-05 is drafted and controlled by 3 inhibits.

NOTE: The high voltages are NOT applied in the +Z panel of PINO module for the following two reasons.

-The high voltages component board is covered by a Kapton sheet. (Figure 6.1-4)

-There is enough space for insulation between the high voltages' component boards and +Z panel of PINO module. (Figure 6.1-5)

The high-voltage module is covered with Kapton tape and connected to the semiconductor by a coaxial high voltage cable (Max 18kV DC). The high voltage is applied to the lower part of the semiconductor. The distance between the semiconductor detector and the satellite +Z plate is 1 mm or more and is enough space for insulation.

+Z panel of PINO is connected to the ground. PINO monitors the high-voltage output as house-keeping data. If the high-voltage output is short-circuited to the +Z plane (GND), this high-voltage output monitor will drop. However, no such status was detected when 2kV was applied.

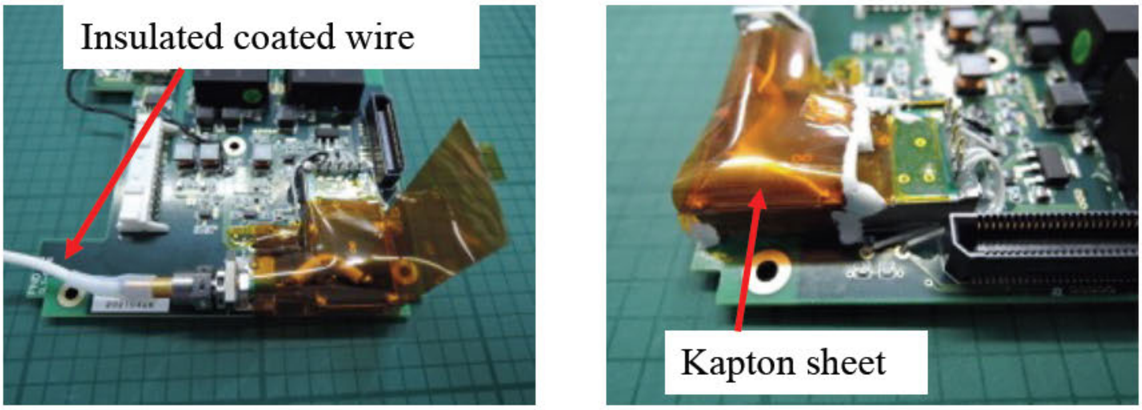


Figure 6.1-4 Insulation for High voltage generation parts

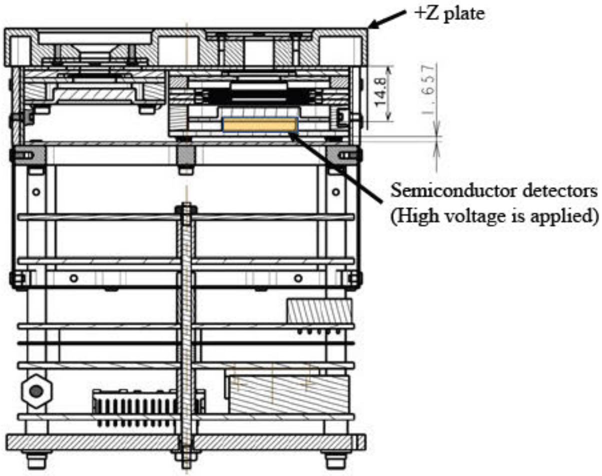


Figure 6.1-5 High voltage parts in the sectional view of PINO module

6.2 Safety Issue

All identified hazard causes are well controlled as shown in the standard hazard report and the unique hazard reports. There is no non-conformance identified.

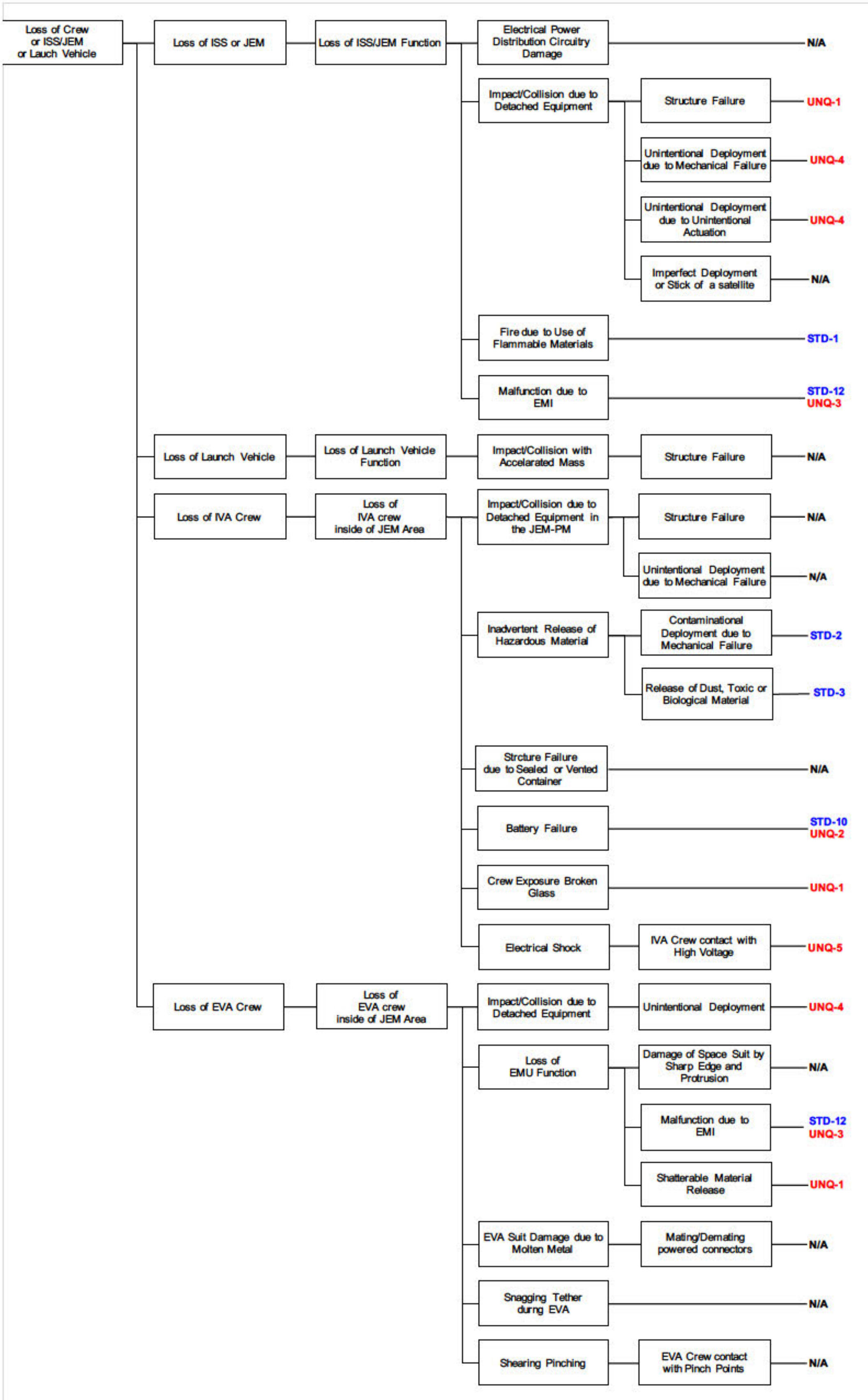


Figure 6.2-1 Result of FTA (1/2)

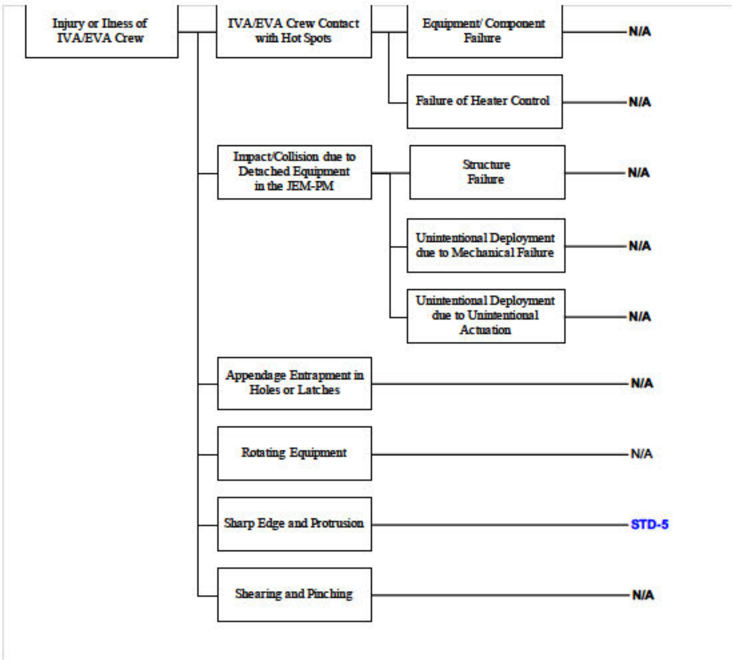


Figure 6.2-1 Result of FTA (2/2)

Table 6.2-1 Standard Hazard Report List

Hazard Number	Title		Identified Hazard (subsystem and phase)						Hazard Report Applicability		Safety Feature Description [N/A] Rationale for Not Aplicable or [UNQ HR] Reason for transferring to UNQ
			Identified subsystems (parts in the item list)	Launch	Stow	Operation	Return	Delposal	STD HR	UNQ HR	
1	Ignition of Flammable Material		all Items	√	√	√			App.	N/A	
2	Material Offgassing		all Items	√	√	√			App.	N/A	
3	Inadvertent Release of Dust, Toxic, or Biological Hazardous Material		Experiment regents	√	√	√			App.	N/A	
4	Inadvertent Release of Sharp Particles		Camera lens and Cover glasses	√	√	√			N/A	App.	The CubeSat has camera lenses, filters and cover glass for solar cells as shatterable materials. See UNQ-1
5	IVA Crew Exposure to Mechanical Hazards, etc	Sharp Edges, Corners, Holes, Etc	all Items			√			App.	N/A	
		Translation Path Loads							N/A	N/A	The CubeSat is not a device exposed inside the pressurization module. (This is evaluated on the J-SSOD side)
		Translation Path Protrusions and Entanglements							N/A	N/A	The CubeSat is not a device exposed inside the pressurization module. (This is evaluated on the J-SSOD side)
6	IVA Crew Exposure to Touch Temperature Exceedances								N/A	N/A	There are no sources of heating and/or cooling in the CubeSat design. The CubeSat remains deactivated until the deployment from ISS by three deployment switches.
7	IVA Crew Exposure to LASER / Incoherent Emissions	LASER Emissions							N/A	N/A	The CubeSat has no LASERs.
		Incoherent Emissions							N/A	N/A	The CubeSat has no sources of incoherent electromagnetic radiation.
8	IVA Crew Exposure to Noise Limit Exceedances								N/A	N/A	The CubeSat has no noise sources.
9	Improperly Bonded and Grounded Equipment								N/A	N/A	No electrical power or data interface is provided to the CubeSat while on ISS and all electrical power is wholly contained within the CubeSat and J-SSOD.
10	Improper Power Distribution Circuitry and Circuit Protection Devices		EPS	√	√	√			App.	App.	UNQ-05 is drafted and controlled by 3 inhibits. See UNQ-5
11	Mating and Demating of Energized Connectors								N/A	N/A	No planned mating or demating of low powered CubeSat connectors.
12	Non-Ionizing Radiation Interference	Electromagnetic Emissions	all powered Items	√	√	√			App.	N/A	
		Radio Frequency Transmitter	Communication system	√	√	√			App.	App.	VHF satisfies SSP50005 but not OE-14-002, so UNQ-03 is drafted and controlled by 3 inhibits. See UNQ-3
13	Injury/Damage as a Result of Rotating Equipment Failure								N/A	N/A	No rotating equipment is used in the CubeSat design.
14	Injury/Damage as a Result of Sealed Container Failure								N/A	N/A	No sealed containers (inherently pressurized) are used in the CubeSat design.

Table 6.2-2 Unique Hazard Report List

Hazard Report No.	Hazard Report Title
BIRDS5-UNQ-01	Structure Failure
BIRDS5-UNQ-02	Battery Leakage / Rupture
BIRDS5-UNQ-03	Exposure of the ISS to Excessive Levels of EMI radiation and RF radiation
BIRDS5-UNQ-04	Impact / Collision to ISS due to inappropriate CubeSat deployment from J-SSOD by inadvertently-deployment
BIRDS5-UNQ-05	Electric Shock

Table 6.2-3 RF radiation

Freq. [MHz]	Transmit Power [W] (*2)	Antenna Gain [dBi]	Max. Radiation Power [W]	Electrical Field Strength [V/m] (*1)	Criteria (*3)	
					Max. Output Power [W]	Electrical Field Strength [V/m] (*1)
145.825	0.5	2	0.79	4.88	0.075	1.55
437.375	0.8	0.5	0.90	5.19	7	19

(*1) at 1[m] away from the source.

(*2) The transmitter capable max output.

(*3) OE-14-002.

Note:

- **If Electrical Field Strength has to be calculated, the following equation can be used.**

  $$\text{Electrical Field Strength[V/m]} = \frac{\sqrt{30 \times 10^{(\text{Antenna Gain[dBi]}/10)} \times \text{Transmit Power[W]}}}{1[m]}$$

- **Max. Radiation Power is so called Effective Isotropic Radiated Power (EIRP). It can be calculated by the following equation.**

  $$\text{EIRP[W]} = 10^{[\{10\log(\text{Transmit Power[W]})+\text{Antenna Gain[dBi]}\}/10]}$$

Appendix A

Abbreviation and Acronyms

List of Abbreviations and Acronyms

COTS	Commercial Off-The-shelf
COM	Communication
CTB	Cargo Transfer Bag
DC/DC	Direct Current to Direct Current
EPS	Electrical Power System
EVA	Extra-Vehicular Activity
FAB	Front Access Board
ISS	International Space Station
IVA	Inter-Vehicular Activity
J-SSOD	JEM Small Satellite Orbital Deployer
JEM	Japanese Experiment Module
JSC	Johnson Space Center
MIUL	Materials Identification Usage List
MPEP	Multi-Purpose Experiment Platform
MUA	Material Usage Agreement
NASA	National Aeronautics and Space Administration
OBC	On-Board Computer
PINO	Particle Instrument for Nanosatellite
PSRP	Payload Safety Review Panel
RF	Radio Frequency
SAR	Safety Assessment Report

Appendix B-1

Standard Hazard Report

HR #: BIRDS5-STD-01	**System/Payload: Payload**
Item Name: BIRDS-5 FM	**Status: -**
Phase: Phase III	**Revision Date: October 6 2023**
Flight Applicability: HTV-X, Cygnus or Dragon	**Report POC: Yamauchi Takashi**
Interfaces:No direct interface with ISS, only with Deployer(J-SSOD) which interfaces with JEM Airlock and JEMRMS	

Hardware *Name (include part number(s))*

Satellite Name: BIRDS-5-FM-01
P/N: BIRDS-5-FM-01

APPROVAL	HARDWARE ORGANIZATION Printed Name, Signature, Date	ISS SAFETY REVIEW PANEL (ISRP) Printed Name, Signature, Date
Phase I	-	N/A
Phase II	-	-
Phase III	T.Yamauchi 2023.10.6	小林亮二 Oct. 27, 2023

Signatures about are effective for all the following pages

HR #: BIRDS5-STD-01			**System/Payload: Payload**		
Item Name: BIRDS-5 FM			**Status: -**		
Phase: Phase III			**Revision Date: October 6 2023**		
	CONTROL(S):	**√**	**VERIFICATION(S):**		

1. Ignition of Flammable Material

App. (STD only)

Hazard Description: Fire may occur due to improper material selection in the presence of an ignition source. Use of material that does not meet International Space Station (ISS)/Visiting Vehicle (VV) flammability requirements can lead to fatal injury to the crew and/or damage to the ISS/VV through fire, smoke, and heat.

[UNQ HRが必要な条件]Transfer to UNQ HR : In cases that require any additional unique Controls/Verifications for fire propagation.

Selection	Control	√	Verification		
[選択必須]	**Ctl-1.1**：**Materials Do Not Propagate Fire in Use Configuration** Materials are selected such that a fire propagation path is not created by their in use configuration. Select of Verifications: (In all cases) Flammability Assessment = (a) (Optional) Flammability Test = (b) If need, Ctl-1.2 or 1.3 be applied.	√	**V-1.1(a)** Analysis Verify Once	**Flammability Assessment** An assessment of the design has been performed to identify all non-metallic materials, their worst-case use conditions, and their flammability characteristics. The restriction of propagation paths by covering flammable material with a non-flammable material, or by separation of flammable material or other acceptable means (please describe other means) has been identified for all flammable material.	
			Status	**Completion Date**	**Closure Documentation**
			Closed	**August 3. 2021**	BIRDS5-MIUL-01
			and (in needed)		
			V-1.1(b) Test Verify Once	**Flammability Test** Flammability testing (worst-case exposure conditions and representative use thicknesses and product form) was performed on the non-metallic material.	
			Status	**Completion Date**	**Closure Documentation**
Option (Select with Ctl-1.1) [必要に応じて選択]	**Ctl-1.2**：**Ops Control (NASA OCAD) Stowage of Flammable Material** When not in use, flammable materials will be stowed in non-flammable containers or compartments. Non flammable stowage containers include CTBs, JSBs, other bags or containers made of non flammable materials, ZSR/RSR compartments, and designated stowage areas in payload or other racks/compartments without power connectors. When deployed in the open cabin for use, flammable items will be kept away from rack power outlets, UOPs/SUPs, and power strips (120V or 28V) regardless of configuration (capped, mated, open, powered, or unpowered). A guideline of 6 inches will be provided in crew training. Measurement in real-time is not required. This operational control applies to the list of items below. This list is not inclusive. 1) Plastic or Trash Bags (Ziplocs, waste bags, food packaging, etc) 2) Fabric and Foam (clothing, towels, Velcro, foam packaging material, etc) 3) Off-the-shelf plastics (camcorders, mp3 players, inflatable globe, etc) (not laptops) 4) Paper (procedure books, wipes, reading materials, pictures, post-its, etc) 5) Bungees		**V-1.2** NASA OCAD Verify Once	**[OPS CONTROL] Stowage of Flammable Material [Crew Preference Stowage Location, not Procedure Driven** Verification is completed once formal acceptance is provided by FOD through NASA OCAD #122607.	
Option (Select with Ctl-1.1) [必要に応じて選択]	**Ctl-1.3**：**Ops Control (JAXA OCAD) Stowage of Flammable Material** <Extract operational control from MIUL/MUA# and insert here.> [Note] the examples of operational control are as follows; - When in use, flammable material shall be kept away from ignition source. - When in use, flammable material shall be superviced by crew. - Usage time shall be limted less than 1 hour/day.		**V-1.3** JAXA OCAD Verify Once	**[OPS CONTROL] Stowage of Flammable Material** Verification is completed once formal acceptance is provided by JAXA Operation community through JAXA OCAD.	
	[Note]		**Status**	**Completion Date**	**Closure Documentation**
					Addendix-XX, OCM#

HR #: BIRDS5-STD-01		System/Payload: Payload		
Item Name: BIRDS-5 FM		Status: -		
Phase: Phase III		Revision Date: October 6 2023		

2. Material Offgassing in Habitable Areas Exceed Allowable Concentrations

App. (STD only)

Hazard Description: Use of offgassing products within the habitable areas may result in concentrations of gaseous contaminants reaching levels which may cause immediate illness or long term adverse effects on crew health.

[UNQ HRが必要な条件]Transfer to UNQ HR : N/A

[選択必須]	**Ctl-2：Polymeric Material Selection**	√	**V-2(a)**	**20-lb Offgassing Exemption Rule**	
	Polymeric materials have been selected to minimize the evolution of toxic gaseous products from the hardware. Select of verifications: (Optional) Apply 20-lb Offgassing Exemption Rule = (a) (Optional) Offgassing Assessment = (b) (Optional) Offgassing Test = (c) [Note] If apply some verifications in a control, refer to attachment for summary of applicated items to each verification.		Analysis Verify Once	The design contains less than 20 pounds mass of polymeric material and does not contain any of the exclusions.	
			Status	**Completion Date**	**Closure Documentation**
			Closed	**August 3. 2021**	BIRDS5-MIUL-01
			and/or		
			V-2(b)	**Offgassing Assessment**	
			Analysis Verify Once	An assessment of the design has been performed to identify all polymeric materials, their worst-case use conditions, and their offgassing characteristics by consulting the Materials and Process Technical Information System (MAPTIS) database, SSP 30233 or other applicable IP material process/segment specification.	
			Status	**Completion Date**	**Closure Documentation**
			and/or		
			V-2(c)	**Offgas Testing**	
			Test Verify Once	Offgas testing has been performed on hardware or on hardware materials lacking data in the MAPTIS database, SSP 30233 or other applicable IP material process/segment specification.	
			Status	**Completion Date**	**Closure Documentation**

HR #: BIRDS5-STD-01	System/Payload: Payload
Item Name: BIRDS-5 FM	**Status: -**
Phase: Phase III	**Revision Date: October 6 2023**

3. Inadvertent Release of Dust, Toxic, or Biological Hazardous Material into Habitable Volume

App. (STD only)

Hazard Description: Inadvertent release of chemicals, biological material and/or nuisance particles (dust) may result in a hazard to the crew, including irritation to the skin, eyes, and respiratory tract, and/or International Space Station (ISS) and or Visiting Vehicle (VV) hardware damage.

[UNQ HRが必要な条件]Transfer to UNQ HR : In case that exceedance of marginal level of V-3(a).

[選択必須]	**Ctl-3：Material Selection** Hazardous inert, insoluble nuisance particles, such as dust generated as a result of a failure, chemical and/or biological material are contained for the appropriate hazard level. Select of verifications: (Optional) Meet V-3(a) criteria= (a) (Optional for batteries) Meet Battery Common HMST = (b)		**V-3(a)** Analysis Verify Once	**HMST (preliminary, V-1)** The Hazardous Material Summary Table (HMST) confirms the hazardous material used in the design does not exceed any one of the applicable criteria outlined below: (criteria) (1) Toxicity Hazard Level (THL)=0; (2) Biological Safety Level (BSL)=1; (3) inert, insoluble particles > 10 μm with a concentration, C ≤ 10 mg/m3; (4) inert, insoluble particles ≤ 10 μm with a concentration, C ≤ 3 mg/m3. Note: This is a marginal hazard. Note(JAXA only)：For the final V2 HMST, instead of using a VTL, the JAXA ISS Safety Office tracks closure via the JAXA internal process document JSX-2012029. Refer to the flight-specific master HMSTs posted to IHS Record #44176	
			Status	**Completion Date**	**Closure Documentation**
					Addendix-XX, HMST#
					and/or
		√	**V-3(b) (JAXA only)** Analysis Verify Once	**HMST for Battery** Toxicity Hazard Level associated with electrolytes contained in batteries can be assessed to use Battery Common HMST.	
			Status	**Completion Date**	**Closure Documentation**
			Closed	**August 3. 2021**	Refer to [Appendix G-3] for the Common Batteries HMST Applicable Sheet. (Note) Leakage Hazard of Battery electrolytes is assessed in Battery Unique HR. HMST of battery electrolytes which cannot be included in Battery Common HMST will be attached to Battery Unique HR.

HR #: BIRDS5-STD-01	**System/Payload: Payload**
Item Name: BIRDS-5 FM	**Status: -**
Phase: Phase III	**Revision Date: October 6 2023**

4. Inadvertent Release of Sharp Particles into Habitable Volumes

Transfer to Unique Hazard Report

Hazard Description:
Sharp hazards, such as glass shards or other shatterable material, greater than 50 μm may imbed in or cut/damage the eye, resulting in a disabling injury, even for a short time.

[UNQ HRが必要な条件]Transfer to UNQ HR : In cases that require any additional unique Controls/Verifications to reduce the risk of release of sharp particles.
[NOTE] If require to withstand for a specificaliy load (e.g. mission load, crew load, pressure load) to the item throught all phase, the item should be assessed in UNQ HR to ensure it can withstand for a specificaliy load.

[制御の選択条件]Select of controls :
For Launch Phase, Ctl-4.1 shall be applicated.
For On-orbit Phase, Ctl-4.1 or 4.2 shall be applicated.
If need to contain when not in use, Ctl-4.3 should be applied.
If need to remove the containment(Ctl-4.1) during on mission, Ctl-4.4 should be applied.

Option	Control	Verification	Method / Status	Description
Option [必要に応じて選択]	**Ctl-4.1：Containment or Positive Protection** Glass or frangible components inside of the habitable volume are contained or have positive protection to prevent the inadvertent release of sharp particles > 50μm. Select of verifications: (In all cases) Review of Design and Inspection = (a) and (b) [Note] Refer to Attachment-XX for Control Methods Summary	**V-4.1(a)**	Analysis Verify Once	**Design of As-Built Hardware for Containment or Positive Protection** An assessment of the design has been performed to ensure the glass or frangible material is contained or has positive protection. The containment or positive protection preclude crew exposure to frangible material. **Status** / **Completion Date** / **Closure Documentation**
		and		
		V-4.1(b)	Inspection Verify Each Flight	**Inspection of As-Built Hardware for Containment or Positive Protection** An inspection of each flight unit has been performed to ensure the hardware is in accordance with approved engineering drawings, and containment or positive protection is present. **Status** / **Completion Date** / **Closure Documentation**
Option (For On-orbit only) [必要に応じて選択]	**Ctl-4.2：Non-Stressed Design for Optical Equipment** Camera lenses or similar pieces of optical equipment are non-stressed (no delta pressure) and have design features, such as recessed lenses or otherwise protected by design, which reduce the risk of breakage on-orbit. Select of verifications: (In all cases) Review of Design and Inspection = (a) and (b) [Note] Refer to Attachment-XX for Control Methods Summary	**V-4.2(a)**	Analysis Verify Once	**Design Features** An assessment of the design has been performed to determine that the camera lenses or similar pieces of optical equipment are non-stressed (no delta pressure) and have design features, such as recessed lenses or otherwise protected by design, which reduce the risk of breakage on-orbit. The design features are accomplished via the design features of the design camera lenses or similar pieces of optical equipment which reduce the risk of breakage on-orbit. **Status** / **Completion Date** / **Closure Documentation**
		and		
		V-4.2(b)	Inspection Verify Each Flight	**Inspection of As-Built Hardware for Design Features** An inspection of each flight unit has been performed to ensure the hardware is in accordance with the approved design, and design features has been verified. **Status** / **Completion Date** / **Closure Documentation**
Option (Select with Ctl-4.1 or 4.2) [必要に応じて選択]	**Ctl-4.3：Ops Control (JAXA OCAD) Stowage of Optical Equipment** Camera lenses and similar pieces of optical equipment are stowed or the glass elements contained/covered, when not in use. [Note] Refer to Attachment-XX for Control Methods Summary	**V-4.3**	JAXA OCAD Verify Once	**[OPS CONTROL] Stowage of Optical Equipment** Verification is completed once formal acceptance is provided by JAXA Operation community through JAXA OCAD. **Status** / **Completion Date** / **Closure Documentation**: Addendix-XX, OCM#
Option (Select with Ctl-4.1) [必要に応じて選択]	**Ctl-4.4：(JAXA only)** **Ops Control (JAXA OCAD) Check of Optical Equipment** Crew shall check no breakage for glass or frangible components before removal of containment or positive protection. [Note] Refer to Attachment-XX for Control Methods Summary	**V-4.4 (JAXA only)**	JAXA OCAD Verify Once	**[OPS CONTROL] Check of Optical Equipment** Verification is completed once formal acceptance is provided by JAXA Operation community through JAXA OCAD. **Status** / **Completion Date** / **Closure Documentation**: Addendix-XX, OCM#

HR #: BIRDS5-STD-01	**System/Payload: Payload**
Item Name: BIRDS-5 FM	**Status: -**
Phase: Phase III	**Revision Date: October 6 2023**

5. IVA Crew Exposure to Mechanical Hazards and Translation Path Obstructions

App.(STD only) : Sharp Edges, Corners, Holes, Etc
N/A(STD and UNQ) : Translation Path Loads
N/A(STD and UNQ) : Translation Path Protrusions and Entanglements

Hazard Description: Sharp edges, protusions, and translation path obstructions may result in crew injury or entanglement.

[UNQ HRが必要な条件]Transfer to UNQ HR : ･For EVA Crew Exposure to Mechanical Hazards and Translation Path Obstructions.
･In cases that require any additional unique Controls/Verifications to reduce the risk of release of Mechanical Hazards and Translation Path Obstructions.

	Control		Verification		
[選択必須]	**Ctl-5.1：Sharp Edges, Corners, Holes, Etc**	√	**V-5.1(a)**	**Drawing Analysis for Sharp Edges, Corner Protection, Holes, etc.**	
	All hardware within a pressurized module is designed to be free from sharp edges, corners, holes, etc., during all crew operations. Select of verifications: (In all cases (※)) Review of Drawing and Inspection = (a) and (b) (※) For COTS Hardware which has no Drawing, Inspection Only = (b)		Analysis Verify Once	An assessment of the design has been performed to comply the requirement to the intent of SSP51721, Secion 4.9.3, or IRD/ICD, the hardware is free from crew hazards created by sharp edges, corners, holes, etc.	
			Status	**Completion Date**	**Closure Documentation**
			Closed	**December 9,2021**	BIRDS5-AD-01 Note: Solar cell edges on the +Z plane are verified by touch testing.
				and	
		√	**V-5.1(b)**	**Inspection of As-Built for Sharp Edges, Corner Protection, Holes, etc**	
			Inspection Verify Each Flight	An inspection of each flight unit has been performed to ensure the hardware is in accordance with the approved design, and the manufacturing of the item has not created a hazard. Note(JAXA Only): COTS Hardware Inspection of As-Built shall be include touch test.	
			Status	**Completion Date**	**Closure Documentation**
			Closed	**February 15,2022**	BIRDS5-SEIR-01
[選択必須]	**Ctl-5.2：Translation Path Loads**		**V-5.2**	**IVA Crew Loads Assessment**	
	Hard mounted/rigidly attached hardware exposed in the translation path, which could result in a critical/catastrophic hazard upon failure, meet the crew-imposed minimum design and ultimate loads. [Note]This control apply for hardware which is exposed to cabin.		Analysis Verify Once	An assessment of the design has been performed to ensure the exposed to the translation path will withstand a design load of 556 N (125 lbf) and an ultimate load of 778 N (175 lbf) applied over a 10.16 cm X 10.16 cm (4 in. X 4 in.) area.	
			Status	**Completion Date**	**Closure Documentation**
[選択必須]	**Ctl-5.3：Translation Path Protrusions and Entanglements**		**V-5.3**	**Translation Path Protrusions and Entanglements**	
	Hardware exposed in the translation paths are designed to minimize the possibility of entanglement or injury to crewmembers and damage to adjacent equipment. [Note]This control apply for hardware which is exposed to cabin.		Analysis Verify Once	An assessment of the design has been performed to ensure all of the flex hoses, lines, and cables are tethered or otherwise restrained to prevent injury to crew and damage to adjacent hardware. A minimum emergency translation corridor of 32 X 45 inches (81 X 114 cm) is maintained within the USOS modules and 32 x 32 inches (81 x 81 cm) within the Russian Segment. A 32 X 45 in (81 X 114 cm) corridor allows for a crewmember to reverse direction at any point along the corridor during emergency situations.	
			Status	**Completion Date**	**Closure Documentation**

HR #: BIRDS5-STD-01	**System/Payload: Payload**
Item Name: BIRDS-5 FM	**Status: -**
Phase: Phase III	**Revision Date: October 6 2023**

6. IVA Crew Exposure to Touch Temperature Exceedances

N/A (STD and UNQ)

Hazard Description: Crew contact with surfaces of excessively high or low temperatures may result in skin damage.

[UNQ HRが必要な条件]Transfer to UNQ HR : ･For EVA Crew Exposure to Touch Temperature Exceedances
･In cases that require any additional unique Controls/Verifications to reduce the risk of IVA Touch Temperature Exceedances

Option [必要に応じて選択]

Ctl-6.1：IVA Touch Temperatures

Exposed surfaces in the crew IVA environment do not have surface temperatures greater than 45°C (113°F), less than 0°C (32°F), or are found to be acceptable by means of Permissible Material Temperature Calculation.

Note: If active thermal management (such as fans, heaters, etc.) is present in the design, the thermal analysis/test must address the worst-case failure scenario of the single fault tolerant design.

Select of Verifications:
(Optional) Thermal Analysis = (a)
(Optional) Thermal Testing = (b)

[Note] If apply some verifications, Refer to Attachment for Applicated items Summary, which identify for items.

V-6.1(a)	**Thermal Analysis**	
Analysis Verify Once	A thermal analysis of the design has been performed to ensure the exposed surface temperatures of the item do not exceed 45°C (113°F), are not less than 0°C (32°F) or are found to be acceptable by Permissible Materials Temperature Calculation.	
Status	**Completion Date**	**Closure Documentation**
		[Thermal analysis summary] Attachment-

and/or

V-6.1(b)	**Thermal Testing**	
Test Verify Once	A thermal test has been performed to ensure the exposed surface temperatures of the item do not exceed 45°C (113°F), are not less than 0°C (32°F) or are found to be acceptable by Permissible Materials Temperature Calculation.	
Status	**Completion Date**	**Closure Documentation**

Option [必要に応じて選択]

Ctl-6.2：IVA Touch Temperature Exceedances

Exposed surfaces in the crew IVA environment have surface temperatures greater than 45°C (113°F), less than 0°C (32°F), or are found to be acceptable by means of Permissible Material Temperature Calculation.

Note: If active thermal management (such as fans, heaters, etc.) is present in the design, the thermal analysis/test must address the worst-case failure scenario of the single fault tolerant design.

Select of Verifications:
(Optional) Thermal Analysis = (a) and (b)
(Optional) Thermal Testing = (c) and (d)

And, Ctl-6.3 and/or Ctl-6.4 should be applied.

V-6.2(a)	**Thermal Analysis**	
Analysis Verify Once	A thermal analysis of the design has been performed which identified the worst case thermal extremes present on accessible surfaces.	
Status	**Completion Date**	**Closure Documentation**
		[Thermal analysis summary] Attachment-

and

V-6.2(b)	**Thermal/Operational Analysis**	
Analysis Verify Once	The thermal analysis of the design has indicated that a minimum wait time.	
Status	**Completion Date**	**Closure Documentation**

or

V-6.2(c)	**Thermal Testing**	
Test Verify Once	A thermal test has been performed which identified the worst case thermal extremes present on accessible surfaces.	
Status	**Completion Date**	**Closure Documentation**

and

V-6.2(d)	**Thermal/Operational Testing**	
Test Verify Once	The thermal testing has indicated that a minimum wait time.	
Status	**Completion Date**	**Closure Documentation**

HR #: BIRDS5-STD-01			System/Payload: Payload		
Item Name: BIRDS-5 FM			Status: -		
Phase: Phase III			Revision Date: October 6 2023		
Option (Select with Ctl-6.2) [必要に応じて選択]	**Ctl-6.3：Ops Control (JAXA OCAD) Personal Protective Equipment**		**V-6.3**	**[OPS CONTROL] Personal Protective Equipment**	
	Crew shall wear [the PPE] during [operation] for [the item]. [Note] The PPE= operation= the item=		JAXA OCAD Verify Once	Verification is completed once formal acceptance is provided by JAXA Operation community through JASA OCAD.	
			Status	**Completion Date**	**Closure Documentation**
					Addendix-XX, OCM#
Option (Select with Ctl-6.2) [必要に応じて選択]	**Ctl-6.4：Ops Control (JAXA OCAD) Isolation**		**V-6.4**	**[OPS CONTROL] Isolation**	
	Crew must not touch the item until a period of the [indicated time] has passed to allow it to [recover] to the [acceptable temperature]. This period is measured from the time that [indicated time or operation task]. Or, Crew must not touch the item unless the observable temperature sensor at crew contact points shows 0 to 45 ° C. [Note] indicated time= recover=Warm up or Cool down acceptable temperature= indicated time or operation task=		JAXA OCAD Verify Once	Verification is completed once formal acceptance is provided by JAXA Operation community through JAXA OCAD.	
			Status	**Completion Date**	**Closure Documentation**
					Addendix-XX, OCM#

HR #: BIRDS5-STD-01				**System/Payload: Payload**		
Item Name: BIRDS-5 FM				**Status: -**		
Phase: Phase III				**Revision Date: October 6 2023**		
7. IVA Crew Exposure to Light Amplification by Stimulated Emission of Radiation (LASER) and/or Incoherent Electromagnetic Radiation Emissions						N/A(STD and UNQ) : LASER Emissions Exposure N/A(STD and UNQ) : Incoherent Light Emissions Exposure
Hazard Description: Crew exposure to high-intensity LASER and/or incoherent electromagnetic radiation emissions may result in biological damage to the eye or skin. Sustained damage to the eye is a common effect of exposure leading to crew incapacitation or blindness. Skin tissue destruction can also occur.						
[UNQ HRが必要な条件]Transfer to UNQ HR:Class 1M, 2M, 3R, 3B and 4 Laser or Incoherent Electromagnetic Radiation Emissions for over 10,000 nits						
[選択必須] **(For laser)**	**Ctl-7.1:LASER Emissions Exposure** The crew will not be exposed to high-intensity LASER emissions. Select of Verifications: (Optional) Use Class 1 Laser = (a) (Optional) Use Class 2 Laser = (b) [Note] If apply some verifications, Refer to Attachment for Applicated items Summary, which identify for items, each class, activation Phase(operation task)		**V-7.1(a)**	**Class 1 LASER**		
			Analysis Verify Once	An assessment has been performed to ensure the LASER design is not capable of emitting in excess of the Class 1 Accessible Emission Limit (AEL), which varies by wavelength and pulse duration, OR For COTS hardware only, the LASER (COTS hardware labeled as Class 1, but unable to confirm LASER strength) is enclosed via means of describe containment and features of the system to preclude crew exposure to the LASER emissions, which prohibits or limits access to the LASER radiation.		
			Status	**Completion Date**	**Closure Documentation**	
				and/or		
			V-7.1(b)	**Class 2 LASER**		
			Analysis Verify Once	An assessment has been performed to ensure that: (a) the LASER design Continuous Wave (CW) and repetitive-pulse LASERs emissions are in the visible region of the spectrum (0.4 to 0.7 μm), and (b) the LASERs can emit accessible radiant energy exceeding the Class 1 AEL for the maximum duration inherent in the LASER, but not exceeding the Class 1 AEL for any pulse duration < 0.25 s (the time estimated to blink or look away), and (c) not exceeding an average radiant power of 1 mW. OR For COTS hardware only, the LASER (COTS hardware labeled as Class 2, but unable to confirm LASER strength) is enclosed via means of describe containment and features of the system to preclude crew exposure to the LASER emissions, which prohibits or limits access to the LASER radiation.		
			Status	**Completion Date**	**Closure Documentation**	
[選択必須] **(For Incoherent Electromagnetic Radiation)**	**Ctl-7.2:Incoherent Electromagnetic Radiation Emissions Exposure** The crew will not be exposed to incoherent electromagnetic radiation emissions.		**V-7.2**	**Low Intensity Design**		
			Analysis Verify Once	An assessment has been performed to ensure the Incoherent Electromagnetic Radiation design is not capable of emitting in excess of 10,000 nits (nits=cd/m^2) to confirm the design is a marginal hazard.		
			Status	**Completion Date**	**Closure Documentation**	

HR #: BIRDS5-STD-01			**System/Payload: Payload**		
Item Name: BIRDS-5 FM			**Status: -**		
Phase: Phase III			**Revision Date: October 6 2023**		
8. IVA Crew Exposure to Noise Limit Exceedances					N/A (STD and UNQ)
Hazard Description: Crew exposure to noise in exceedance of acceptable sound pressure levels (SPL) may result in crewmember hearing damage or crew injury/death, as a result of communication interference or inability to detect caution and warning alarms.					
[UNQ HRが必要な条件]Transfer to UNQ HR : In cases that require any additional unique Controls/Verifications to Noise Limit Exceedances.					
[選択必須]	**Ctl-8：Noise Exposure**	**V-8(a)**	**Continuous Noise Limits**		
	Hardware within the habitable volume will not generate noise that may cause injury or hearing loss, interfere with voice communications, cause fatigue, or in any other way degrade overall human-machine system effectiveness. Select of Verifications: (Optional) Noise is continuous Only = (a) (Optional) Noise is intermittent Only = (b) (Optional) Noise is mixed continuous and intermittent = (c)	Test Verify Once	Continuous acoustics testing has been performed to ensure the design is compliant to SSP 51721, Section 4.9.1, or the IRD/ICD process.		
		Status	**Completion Date**	**Closure Documentation**	
			or		
		V-8(b)	**Intermittent Noise Limits**		
		Test Verify Once	Intermittent acoustics testing has been performed to ensure the design is compliant to SSP 51721, Section 4.9.1, or the IRD/ICD process. The noise duration is the total time that the non-integrated equipment item produces intermittent noise above the NC-40 limit during a 24-hour time period.		
		Status	**Completion Date**	**Closure Documentation**	
			or		
		V-8(c)	**Continuous and Intermittent Noise Limits**		
		Analysis Verify Once	An assessment of the design has been performed of all noise sources to ensure the is compliant to SSP 51721, Section 4.9.1, or the IRD/ICD process.		
		Status	**Completion Date**	**Closure Documentation**	

HR #: BIRDS5-STD-01	**System/Payload: Payload**
Item Name: BIRDS-5 FM	**Status: -**
Phase: Phase III	**Revision Date: October 6 2023**

9. Injury/Damage as a Result of Improperly Bonded and Grounded Equipment

N/A (STD and UNQ)

Hazard Description: In the event of failure of electrical insulation, an overcurrent event may lead to generation of hazardous products due to pyrolysis, ignition source, touch temperature, or propagation of hazard, which may result in critical/catastrophic injury to the crew and/or critical/catastrophic damage to the International Space Stations (ISS) or Visiting Vehicle (VV).

[UNQ HRが必要な条件]Transfer to UNQ HR：Input or internal power circuits is greater than 32V.

	Control		Verification	
[選択必須]	**Ctl-9.1：Bonding** All electrical equipment is properly bonded to comply with ISS Bonding requirement of SSR 30245. Select of verifications: (In all cases) Analysis and Inspection = (a) and (b)		**V-9.1(a)** Analysis Verify Once	**Bond Path Analysis** An assessment of the design has been performed to ensure: ・the item provides a fault current return path back to source (or electrical/mechanical interface) and each electrical bond within the return paths is a Class H bond ・the interface bonding methodology is compatible with the electrical/mechanical interface to ISS.

Status	Completion Date	Closure Documentation
		[Bond Path Analysis] Attachment/Figure-

and

Verification	
V-9.1(b) Inspection Verify Once	**Inspection of As-Built Hardware Bonding Surfaces/Paths** An inspection of each flight unit has been performed to ensure the bond paths are in accordance with the approved design. The inspection ensured: 1) The as-built provides a fault current return path back to the source (or electrical/mechanical interface); 2) Each as-built electrical bond within the return path is a class H bond.

Status	Completion Date	Closure Documentation

	Control		Verification	
[選択必須]	**Ctl-9.2：Grounding** All electrical equipment is properly grounded to comply with ISS Grounding requirement of SSP 30240. Select of verifications: (In all cases) Analysis and Inspection = (a) and (b)		**V-9.2(a)** Analysis Verify Once	**Grounding Analysis** An assessment of the design has been performed to ensure: 1) Electrical power consuming input power and data/signal isolation prevents inadvertent fault current return paths which may propagate a fault; 2) The item, which contain electrical power sources or electrical power converters that distribute power or signals external to the item, has outputs that are properly isolated from the electrical power inputs to prevent inadvertent fault current return paths which may propgate a fault; 3) The electrical power sources or converters, which route electrical power external to the item or provide electrical power to other external users, have electrical power outputs that are properly referenced to chassis/structure to facilitate a fault current return path back to the source to allow the proper operation of overcurrent protection devices. and, the interface grounding/isolation is compatible with the ISS electrical power and signal interface.

Status	Completion Date	Closure Documentation
		[Grounding Analysis] Attachment/Figure-

and

Verification	
V-9.2(b) Inspection Verify Once	**Inspection of As-Built Hardware Grounding Scheme** An inspection of each flight unit has been performed to ensure the grounding and isolation schemes are in accordance with the approved design. This inspection has ensured: 1) The as-built electrical power consuming input power and return is isolated and data/signal grounding/isolation scheme prevents ground loops and inadvertent fault current return paths; 2) The as-built hardware, which contain electrical power sources or electrical power converters that distribute power or signals external to the item, have outputs that are properly isolated from the electrical power inputs; 3) The as-built electrical power sources or converters, which route electrical power external to

HR #: BIRDS5-STD-01				System/Payload: Payload		
Item Name: BIRDS-5 FM				Status: -		
Phase: Phase III				Revision Date: October 6 2023		
				Status	Completion Date	Closure Documentation
10. Injury/Damage as a Result of Improper Power Distribution Circuitry and Circuit Protection Devices						App. (STD and UNQ)
Hazard Description: Improper fusing, circuit protection, current limits, wire sizing and derating may result in critical/catastrophic injury to the crew and/or critical/catastrophic damage to the International Space Stations (ISS) or Visiting Vehicle (VV).						
[UNQ HRが必要な条件]Transfer to UNQ HR：Input or internal power circuits is greater than 32V.						
Option [必要に応じて選択]	**Ctl-10.1：Proper Circuit Protective Devices and Wire/Cable Derating**	√	**V-10.1(a)**	**Wire Length less than Six Inches when Battery Powered**		
	All electrical equipment contain properly sized circuit protective devices, wire and cable to comply with SSP 51721 section4.3.1 or TM102179 . Select of verifications: (Optional) Wire Length less than Six Inches between the battery power source and first power function = (a) (Optional) Wire/Cable Derating Analysis =(b) and (c)		Analysis Verify Once	When the item only utilizes battery power for all any phases of launch, on-orbit operations, and landing, 18 AWG or smaller wire (non-silicone insulation) in length less than 6" between the battery power source and first power function, and the item does not contain safety critical function will not require additional verification provided to JAXA. Batteries will not cause damage to this wiring, or require additional circuit protection to prevent overheating/pyrolization of the wiring, and will not cause a touch temperature hazard.		
			Status	Completion Date	Closure Documentation	
			Closed	December 9. 2021	[Wire size and length analysis]BIRDS5-STD-Attachment-02	
		or				
		√	**V-10.1(b)**	**Protective Devices Sizing and Wire/Cable Derating Analysis**		
			Analysis Verify Once	Circuit protection and wire sizing analysis of the design has been performed to ensure that the maximum available upstream and/or worst-case current conditions are assessed and appropriately controlled. All analysis was based on IVA environmental conditions, in the specific flight system configuration (single or bundled wiring). See Protective Devices Sizing and Wire/Cable Derating Analysis <File Name.File Extension>		
			Status	Completion Date	Closure Documentation	
			Closed	September 15. 202	[Wires and Circuit Protection Devices analysis] BIRDS5-STD-Attachment-03	
		and				
		√	**V-10.1(c)**	**Inspection of As-Built Hardware Circuit Protective Devices and Wire/Cable**		
			Inspection Verify Once	An inspection of each flight unit has been performed to ensure the hardware is in accordance with the approved design and proper installation of fusing and protective devices are verified.		
			Status	Completion Date	Closure Documentation	
			Closed	September 15, 2023	BIRDS5-STD-Attachment-03	

HR #: BIRDS5-STD-01	**System/Payload: Payload**
Item Name: BIRDS-5 FM	**Status: -**
Phase: Phase III	**Revision Date: October 6 2023**

11. Mating and Demating of Energized Connectors

N/A (STD and UNQ)

Hazard Description: Mating and demating of energized connectors may result in critical/catastrophic injury to the crew. Molten metal may be generated by mating and demating of connectors under load and lead to crew eye or skin injury.

[UNQ HRが必要な条件]Transfer to UNQ HR：Input or internal power circuits is greater than 32V (for electrical shock) or 65A (for molten metal)

	Control	Verification			
Option [必要に応じて選択]	**Ctl-11.1：Low Power Design Features** Electrical equipment design protects the crew from exposure to a maximum continuous current to 3A and less with an open circuit voltage to no greater than 32V.	**V-11.1**	**Low Power Exception Analysis**		
		Analysis Verify Once	An assessment of the design has been performed to ensure the item has current limitation design features or upstream circuit protection that limits the maximum continuous current to 3A or less with an open circuit voltage no greater than 32V		
		Status	**Completion Date**	**Closure Documentation**	
				[Mating / Demating Power Connector analysis] Attachment-	
Option [必要に応じて選択]	**Ctl-11.2：Molten Metal Hazard** Electrical equipment design protects the crew from exposure to a maximum continuous current greater than 3A but less than 65A and an open circuit voltage no greater than 32V. For Molten Metal Hazard, Electrical equipment connectors employ the all following： [Connector Design Features] The design features that completely enclose or shroud the pins and sockets during mating/demating. [Protection from Powered Side] The design provides protection of the power side from debris/inadvertent shorting. [One Verifiable Upstream Inhibit] The design feature provides physical interruption of power to the connector. The physical interruption must be able to be checked or verified by the crew or ground personnel. Select of verifications: (In all cases) Select ALL : (a) ~ (d) And, Ctl-11.3 should be applied.	**V-11.2(a)**	**Molten Metal Hazard Analysis**		
		Analysis Verify Once	An assessment of the design has been performed to ensure the maximum continuous current is greater than 3A but less than 65A and an open circuit voltage no greater than 32V		
		Status	**Completion Date**	**Closure Documentation**	
				[Mating / Demating Power Connector analysis] Attachment-	
		and			
		V-11.2(b)	**Molten Metal Hazard Connector Design Features／Protection from Powered Side**		
		Analysis Verify Once	An assessment of the design has been performed to ensure connectors employ design features： ・The completely enclose or shroud the pins and sockets during mating/demating. A "scoop proof" like design is one where the power between the pins and the sockets is disconnected prior to the conductors being exposed to the outside environment. ・The power side of the connectors are terminated in sockets.		
		Status	**Completion Date**	**Closure Documentation**	
		and			
		V-11.2(c)	**Inspection of As-Built Hardware Connector Design Features／Powered Side of Connectors Terminated in Sockets**		
		Inspection Verify Once	An inspection of each flight unit has been performed to ensure the hardware is in accordance with the approved connector design features, the power side of the connectors are terminated in sockets.		
		Status	**Completion Date**	**Closure Documentation**	
				[Mating / Demating Power Connector analysis] Attachment-	
		and			
		V-11.2(d)	**Molten Metal Hazard One Verified Upstream Inhibit**		
		Analysis Verify Once	An assessment of the design has been performed to ensure the power circuit has at least one physical interruption (i.e. inhibit) which is capable of being verified at the time the interruption is applied.		
		Status	**Completion Date**	**Closure Documentation**	
Option (Select with Ctl-11.2) [必要に応じて選択]	**Ctl-11.3：Ops Control (JAXA OCAD) Molten Metal** Prior to mating/demating of the energized connector, the power shall be removed per attachment. [Note] Refer to attachment -XXXXX	**V-11.3**	**[OPS CONTROL] Molten Metal Hazard PS28**		
		JAXA OCAD Verify Once	Verification is completed once formal acceptance is provided by JAXA Operation community through JAXA OCAD		
		Status	**Completion Date**	**Closure Documentation**	
				Addendix-XX, OCM#	

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Item Name: BIRDS-5 FM	**Status: -**
Phase: Phase III	**Revision Date: October 6 2023**

12. Non-Ionizing Radiation Interference

App (STD only) : Electromagnetic Emissions

App.(STD and UNQ) : Radio Frequency Transmitter

Hazard Description: Non-ionizing radiation from electrical, electronic, or electromechanical devices can cause interference with International Space Station (ISS) or Visiting Vehicle (VV) critical systems necessary for daily ISS quiesent and VV proximity operations. Interference to critical systems could either be intermittent in nature or result in halting of system operations, which may resulting in a safety hazard for ISS or operational delays.

Transfer to UNQ HR: For Non-Ionizing Radiation Interference, in cases that require any additional unique Controls/Verifications.
For Radio Frequency Transmitter, in cases that not meet SSP51721 requirement.

Option	Control		Verification	
Option [必要に応じて選択]	**Ctl-12.1: Electromagnetic Emissions are Limited** Electronic, electrical, and electromagnetic equipment and subsystems are designed to meet emissions and susceptibilities.	√	**V-12.1** Analysis and/or Test Verify Once	**Compliance to the IRD/ICD or SSP30237/SSP30243** Compliance is documented in the IRD/ICD process or SSP30237/SSP30243. If susceptibility testing is not conducted, provide the rationale document or describe in attachment (failure of the item to function or erratic/unintended functioning of the item does not create a hazard, or The IRD/ICD process determines that susceptibility testing is not required, etc.).
Option [必要に応じて選択]	**Ctl-12.2: Electromagnetic Emissions are Limited (with TIA)** The designs (which not meet emissions and susceptibilities) for Electronic, electrical, and electromagnetic equipment and subsystems are acceptable by TIA assessment. If needed, Ctl-12.3 be applied.	√	**V-12.2** Analysis Verify Once	**Tailoring/Interpretation Agreement (TIA)** A violation was noted during the IRD/ICD process, a Tailoring/Interpretation Agreement (TIA) was required and an operational control was identified. If susceptibility testing is not conducted, provide the rationale document or describe in attachment (failure of the item to function or erratic/unintended functioning of the item does not create a hazard, or The IRD/ICD process determines that susceptibility testing is not required, etc.).
Option (Select with Ctl-12.2) [必要に応じて選択]	**Ctl-12.3: Ops Control (JAXA OCAD) Non-Ionizing Emission** <Extract operational control from TIA # and insert here.>		**V-12.3** JAXA OCAD Verify Once	**[OPS CONTROL] Non-Ionizing Emission** Verification is completed once formal acceptance is provided by JAXA Operation community through JAXA OCAD.
[選択必須] **(For Radio Frequency Transmitter)**	**Ctl-12.4: Radio Frequency Transmitter are Limited** Radio Frequency Transmitter are designed to meet emissions.	√	**V-12.4** Analysis and/or Test Verify Once	**Compliance to the IRD/ICD and SSP51721** Compliance is documented in the IRD/ICD process and SSP51721, Section 4.3.7, 4.3.8, to confirm the emission design is a marginal hazard.

V-12.1

Status	Completion Date	Closure Documentation
Closed	December 9,2021	[EMC assessment summary] BIRDS5-STD-Attachment-01
Closed	September 15. 202	BIRDS5-SAR-01 3.2.2

V-12.2

Status	Completion Date	Closure Documentation
Closed	May 30. 2014	[EMC assessment summary] Attachment-G-4

V-12.3

Status	Completion Date	Closure Documentation
		Addendix-XX, OCM#

V-12.4

Status	Completion Date	Closure Documentation
Closed	February 22,	BIRDS5-SAR-02, Table6.2-3 and Attachment-G-5

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Item Name: BIRDS-5 FM	**Status: -**
Phase: Phase III	**Revision Date: October 6 2023**

13. Injury/Damage as a Result of Rotating Equipment Failure

N/A (STD and UNQ)

Hazard Description:
Failure and liberation of rotating elements at a high velocity may result in critical/catastrophic injury to the crew and/or critical/catastrophic damage to the International Space Stations (ISS) or Visiting Vehicle (VV).

Transfer to UNQ HR：The rotating equipment has kinetic energy more than 14,240 ft-lbs (19,307 Joules) or not containmnet.

Option [必要に応じて選択]	**Ctl-13.1：Limiting the Potential Energy of Rotating Equipment**		**V-13.1(a)**	**Containment Capabilities Assessment**	
	Rotating equipment designs limit kinetic energy for mass release and/or have containment for liberated rotating elements. Select of verifications: (In all cases) Contaiment Design and Potential Energy Analysis= (a) and (b)		Analysis Verify Once	An assessment has been performed to ensure the design provides containment or has positive protection from all rotating equipment. The containment or positive protection is accomplished via containment/positive protection and the features of the system which preclude crew exposure to rotating equipment.	
			Status	**Completion Date**	**Closure Documentation**
					[Rotating Devices analysis summary] Attachment-
			and		
			V-13.1(b)	**Potential Energy (Non-Fracture Critical) Analysis**	
			Analysis Verify Once	An assessment has been performed to ensure the rotating equipment has kinetic energy less than 14,240 ft-lbs (19,307 Joules). Note: Rotating parts that do not exceed 200 mm in diameter and 8000 rpm in speed meet this requirement, therefore, no calculation is required.	
			Status	**Completion Date**	**Closure Documentation**
					[Rotating Devices analysis summary] Attachment-
Option (For HDD) [必要に応じて選択]	**Ctl-13.2：Limiting the Potential Energy of Rotating Equipment (HDD)**		**V-13.2**	**Unmodified Computer Disk Drive Assessment**	
	HDD have integrity containment for liberated rotating elements based on UL or IEC ratings.		Analysis Verify Once	An assessment has been performed to ensure that the contains a rotating hard drive within a computer chassis that meets UL or IEC ratings.	
			Status	**Completion Date**	**Closure Documentation**
					UL or IEC ratings：<Provide the actual rating.>

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Item Name: BIRDS-5 FM	**Status: -**
Phase: Phase III	**Revision Date: October 6 2023**

14. Injury/Damage as a Result of Sealed Container Failure

N/A (STD and UNQ)

Hazard Description: Structural failure of a sealed container and liberation of fragments at a high velocity may result in critical/catastrophic injury to the crew and/or critical/catastrophic damage to the International Space Stations (ISS) or Visiting Vehicle (VV). A sealed container is defined as any single, independent (not part of a pressurized system) container, component, or housing that is sealed to maintain an internal non-hazardous environment and that has a stored energy of less than 14,240 foot-pounds (19,310 Joules) and an internal pressure of less than 100 psia (689.5 kPa).

Transfer to UNQ HR： ：Internal pressure value is greater than 100 psia (689.5 kPa) or stored energy is exceedance of 14,240 ft-lbs (19,307 Joules).

Option [必要に応じて選択]	**Ctl-14.1：Kinetic Energy Limited (less than 1.5 atm)** Sealed container(s) design limit kinetic energy for mass release and pressure. Note: Sealed containers are inherently pressurized hardware (e.g., a sealed electronic box, cylinders) that are not a part of a pressure system and contain no hazardous materials (limited to THL=0, BSL=1). Select of verifications: (In all cases) Stored Energy/Pressure and maximum delta pressure Analysis= (a) and (b)		**V-14.1(a)**	**Stored Energy/Pressure Analysis of Sealed, Non-Fracture Critical Container**	
			Analysis Verify Once	For a sealed container containing non-hazardous material, an assessment has been performed to ensure the sealed container's expected internal pressure value is less than 100 psia (689.5 kPa) and contains less than 19 310 Joules (14 240 foot-pounds) of stored energy.	
			Status	**Completion Date**	**Closure Documentation**
				and	
			V-14.1(b)	**Pressure Analysis of Sealed Container**	
			Analysis Verify Once	An analysis of the design has been performed to ensure that the sealed container's maximum delta pressure less than 1.5 atm (22 psia, 1.5 bars).	
			Status	**Completion Date**	**Closure Documentation**
Option [必要に応じて選択]	**Ctl-14.2：Kinetic Energy Limited (over 1.5 atm)** Sealed container(s) design limit kinetic energy for mass release and pressure and design which MDP is over 1.5 atm provide appropriate strength. Select of verifications: (Optional) Pressure Analysis (2.5 x MDP) = (a) (Optional) Proof Test (1.5 x MDP) = (b)		**V-14.2(a)**	**Stored Energy/Pressure Analysis of Sealed, Non-Fracture Critical Container and Pressure Analysis of Sealed Containers (2 5 x MDP)**	
			Analysis Verify Once	An analysis of the design has been performed to ensure followings ・the sealed container's expected internal pressure value is less than 100 psia (689 5 kPa) and contains less than 19,310 Joules (14,240 foot-pounds) of stored energy. ・the sealed container's maximum delta pressure is over 1.5 atm (22 psia, 1.5 bars). ・the sealed container has an MDP greater than 1.5 atm (22 psia, 1.5 bars), but less than 6.81 atm (100 psia, 6.9 bars) and shows a minimum safety factor for the design is 2.5 X MDP.	
			Status	**Completion Date**	**Closure Documentation**
				or	
			V-14.2(b)	**Stored Energy/Pressure Analysis of Sealed, Non-Fracture Critical Container and Proof Test of Sealed Container (1.5 x MDP)**	
			Analysis and Test Verify Once	An analysis/test of the design has been performed to ensure followings ・the sealed container's expected internal pressure value is less than 100 psia (689 5 kPa) and contains less than 19,310 Joules (14,240 foot-pounds) of stored energy. ・the sealed container's maximum delta pressure is over 1.5 atm (22 psia, 1.5 bars). ・the sealed container has an MDP greater than 1.5 atm (22 psia, 1.5 bars), but less than 6.81 atm (100 psia, 6.9 bars) and each flight unit has passed a proof test to 1.5 X MDP.	
			Status	**Completion Date**	**Closure Documentation**

There is likelihood to activate FET and transistor under radiated electric field in ISS. But, since all FETs and transistor involved in the inhibit activate at more than 0.1 Volts, so there is no chance of malfunction.

Figure 1 shows the inhibit circuit diagram. The red boxes indicate the FETs and transistors involved in the inhibit.

The specifications for these are shown.

The DCDC converter used as an inhibit uses four FETs inside.

These FETs are controlled by a logic circuit inside the DCDC converter, and the lines connecting them to the gates are extremely short. Therefore, no evaluation is required.

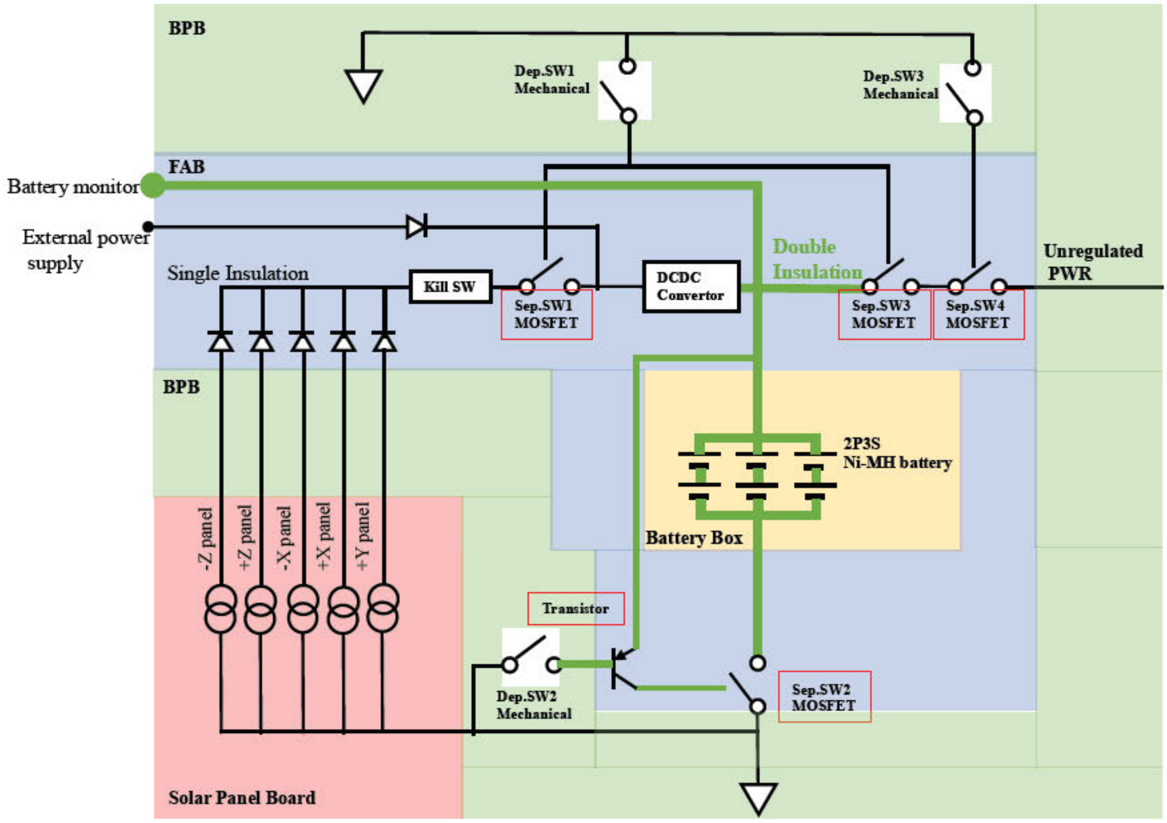


Figure 1 EPS diagram

Transistor: PDTA144E

SepSW1, 3, 4:SiA447DJ

SepSW2:Si7232DN

7. Characteristics

Table 8. Characteristics

T_{amb} = 25 °C unless otherwise specified.

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
I_{CBO}	collector-base cut-off current	V_{CB} = −50 V; I_E = 0 A		-	-	−100	nA
I_{CEO}	collector-emitter cut-off current	V_{CE} = −30 V; I_B = 0 A		-	-	−1	µA
		V_{CE} = −30 V; I_B = 0 A; T_j = 150 °C		-	-	−5	µA
I_{EBO}	emitter-base cut-off current	V_{EB} = −5 V; I_C = 0 A		-	-	−90	µA
h_{FE}	DC current gain	V_{CE} = −5 V; I_C = −5 mA		80	-	-	
V_{CEsat}	collector-emitter saturation voltage	I_C = −10 mA; I_B = −0.5 mA		-	-	−150	mV
$V_{I(off)}$	off-state input voltage	V_{CE} = −5 V; I_C = −100 µA		-	−1.2	−0.8	V
$V_{I(on)}$	on-state input voltage	V_{CE} = −0.3 V; I_C = −2 mA		−3	−1.6	-	V
R1	bias resistor 1 (input)			33	47	61	kΩ
R2/R1	bias resistor ratio			0.8	1	1.2	
C_c	collector capacitance	V_{CB} = −10 V; I_E = i_e = 0 A; f = 1 MHz		-	-	3	pF
f_T	transition frequency	V_{CE} = −5 V; I_C = −10 mA; f = 100 MHz	[1]	-	180	-	MHz

[1] Characteristics of built-in transistor

SPECIFICATIONS (T_J = 25 °C, unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Static						
Drain-source breakdown voltage	V_{DS}	V_{GS} = 0, I_D = -250 µA	-12	-	-	V
V_{DS} temperature coefficient	$\Delta V_{DS}/T_J$	I_D = -250 µA	-	-7	-	mV/°C
$V_{GS(th)}$ temperature coefficient	$\Delta V_{GS(th)}/T_J$		-	3	-	
Gate-source threshold voltage	$V_{GS(th)}$	$V_{DS} = V_{GS}$, I_D = -250 µA	-0.4	-	-0.85	V
Gate-source leakage	I_{GSS}	V_{DS} = 0 V, V_{GS} = ± 8 V	-	-	± 100	nA
Zero gate voltage drain current	I_{DSS}	V_{DS} = -12 V, V_{GS} = 0 V	-	-	-1	µA
		V_{DS} = -12 V, V_{GS} = 0 V, T_J = 55 °C	-	-	-10	
On-state drain current [a]	$I_{D(on)}$	$V_{DS} \leq$ -5 V, V_{GS} = -4.5 V	-10	-	-	A
Drain-source on-state resistance [a]	$R_{DS(on)}$	V_{GS} = -4.5 V, I_D = -7 A	-	0.0110	0.0135	Ω
		V_{GS} = -2.5 V, I_D = -5 A	-	0.0150	0.0194	
		V_{GS} = -1.8 V, I_D = -3 A	-	0.0230	0.0344	
		V_{GS} = -1.5 V, I_D = -1 A	-	0.0400	0.0710	
Forward transconductance [a]	g_{fs}	V_{DS} = -6 V, I_D = -7 A	-	35	-	S
Dynamic [b]						
Input capacitance	C_{iss}	V_{DS} = -6 V, V_{GS} = 0 V, f = 1 MHz	-	2880	-	pF
Output capacitance	C_{oss}		-	590	-	
Reverse transfer capacitance	C_{rss}		-	585	-	
Total gate charge	Q_g	V_{DS} = -6 V, V_{GS} = -8 V, I_D = -13 A	-	52	80	nC
		V_{DS} = -6 V, V_{GS} = -4.5 V, I_D = -13 A	-	31	47	
Gate-source charge	Q_{gs}		-	4.2	-	
Gate-drain charge	Q_{gd}		-	7.8	-	
Gate resistance	R_g	f = 1 MHz	0.8	4.3	8.6	Ω
Turn-on delay time	$t_{d(on)}$	V_{DD} = -6 V, R_L = 0.6 Ω $I_D \cong$ -10 A, V_{GEN} = -4.5 V, R_g = 1 Ω	-	30	60	ns
Rise time	t_r		-	30	60	
Turn-off delay time	$t_{d(off)}$		-	60	120	
Fall time	t_f		-	25	50	
Turn-on delay time	$t_{d(on)}$	V_{DD} = -6 V, R_L = 0.6 Ω $I_D \cong$ -10 A, V_{GEN} = -8 V, R_g = 1 Ω	-	12	25	
Rise time	t_r		-	10	20	
Turn-off delay time	$t_{d(off)}$		-	65	130	
Fall time	t_f		-	20	40	
Drain-Source Body Diode Characteristics						
Continuous source-drain diode current	I_S	T_C = 25 °C	-	-	-12	A
Pulse diode forward current	I_{SM}		-	-	-50	
Body diode voltage	V_{SD}	I_S = -10 A, V_{GS} = 0 V	-	-0.8	-1.2	V
Body diode reverse recovery time	t_{rr}	I_F = -10 A, di/dt = 100 A/µs, T_J = 25 °C	-	25	50	ns
Body diode reverse recovery charge	Q_{rr}		-	7.5	15	nC
Reverse recovery fall time	t_a		-	8	-	ns
Reverse recovery rise time	t_b		-	17	-	

Notes

a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2%

b. Guaranteed by design, not subject to production testing

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability

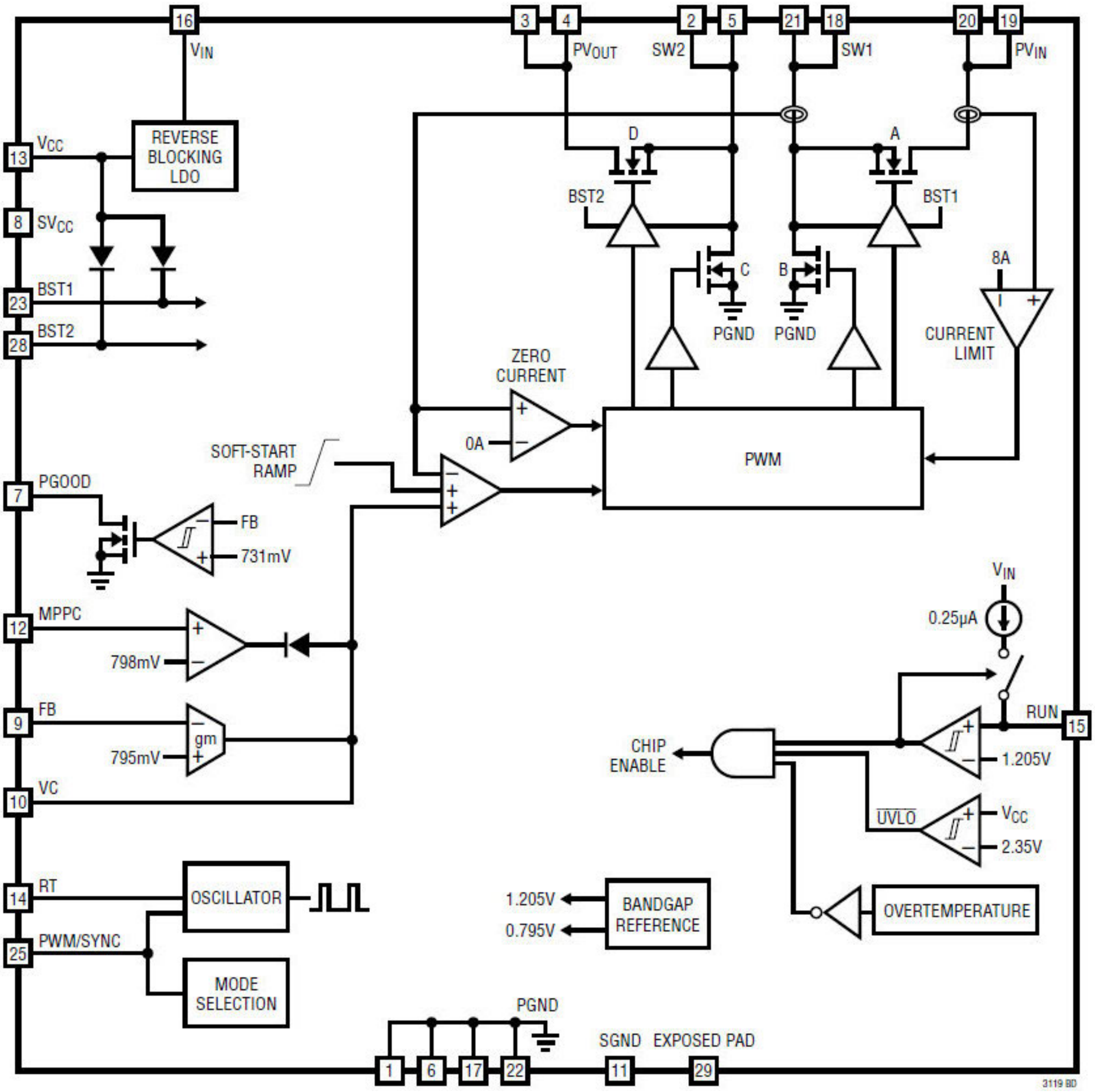
SPECIFICATIONS (T_J = 25 °C, unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Static						
Drain-Source Breakdown Voltage	V_{DS}	V_{GS} = 0 V, I_D = 250 µA	20	-	-	V
V_{DS} Temperature Coefficient	$\Delta V_{DS}/T_J$	I_D = 250 µA	-	22	-	mV/°C
$V_{GS(th)}$ Temperature Coefficient	$\Delta V_{GS(th)}/T_J$		-	-3	-	
Gate-Source Threshold Voltage	$V_{GS(th)}$	V_{DS} = V_{GS} , I_D = 250 µA	0.4	-	1	V
Gate-Source Leakage	I_{GSS}	V_{DS} = 0 V, V_{GS} = ± 8 V	-	-	± 100	nA
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 20 V, V_{GS} = 0 V	-	-	1	µA
		V_{DS} = 20 V, V_{GS} = 0 V, T_J = 55 °C	-	-	10	
On-State Drain Current [a]	$I_{D(on)}$	$V_{DS} \geq$ 5 V, V_{GS} = 10 V	20	-	-	A
Drain-Source On-State Resistance [a]	$R_{DS(on)}$	V_{GS} = 4.5 V, I_D = 10 A	-	0.0135	0.0164	Ω
		V_{GS} = 2.5 V, I_D = 9 A	-	0.0160	0.0200	
		V_{GS} = 1.8 V, I_D = 8.2 A	-	0.0190	0.0240	
Forward Transconductance [a]	g_{fs}	V_{DS} = 10 V, I_D = 10 A	-	47	-	S
Dynamic [b]						
Input Capacitance	C_{iss}	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	-	1220	-	pF
Output Capacitance	C_{oss}		-	180	-	
Reverse Transfer Capacitance	C_{rss}		-	80	-	
Total Gate Charge	Q_g	V_{DS} = 15 V, V_{GS} = 8 V, I_D = 10 A	-	21	32	nC
		V_{DS} = 15 V, V_{GS} = 4.5 V, I_D = 10 A	-	12	18	
Gate-Source Charge	Q_{gs}		-	2	-	
Gate-Drain Charge	Q_{gd}		-	1.3	-	
Gate Resistance	R_g	f = 1 MHz	-	1.8	3.6	Ω
Turn-On Delay Time	$t_{d(on)}$	V_{DD} = 10 V, R_L = 1.25 Ω $I_D \cong$ 8 A, V_{GEN} = 4.5 V, R_g = 1 Ω	-	10	15	ns
Rise Time	t_r		-	10	15	
Turn-Off Delay Time	$t_{d(off)}$		-	35	55	
Fall Time	t_f		-	10	15	
Turn-On Delay Time	$t_{d(on)}$	V_{DD} = 10 V, R_L = 1.25 Ω $I_D \cong$ 8 A, V_{GEN} = 8 V, R_g = 1 Ω	-	10	15	
Rise Time	t_r		-	10	15	
Turn-Off Delay Time	$t_{d(off)}$		-	25	40	
Fall Time	t_f		-	10	15	
Drain-Source Body Diode Characteristics						
Continuous Source-Drain Diode Current	I_S	T_C = 25 °C	-	-	19	A
Pulse Diode Forward Current	I_{SM}		-	-	40	
Body Diode Voltage	V_{SD}	I_S = 8 A, V_{GS} = 0 V	-	0.81	1.2	V
Body Diode Reverse Recovery Time	t_{rr}	I_F = 8 A, dI/dt = 100 A/µs, T_J = 25 °C	-	20	30	ns
Body Diode Reverse Recovery Charge	Q_{rr}		-	15	25	nC
Reverse Recovery Fall Time	t_a		-	12.5	-	ns
Reverse Recovery Rise Time	t_b		-	7.5	-	

Notes

a. Pulse test; pulse width ≤ 300 µs, duty cycle ≤ 2 %

b. Guaranteed by design, not subject to production testing.



Block Diagram of DCDC convertor

Implementation plan extracted from JAXA’s checklist for BIRDS-5

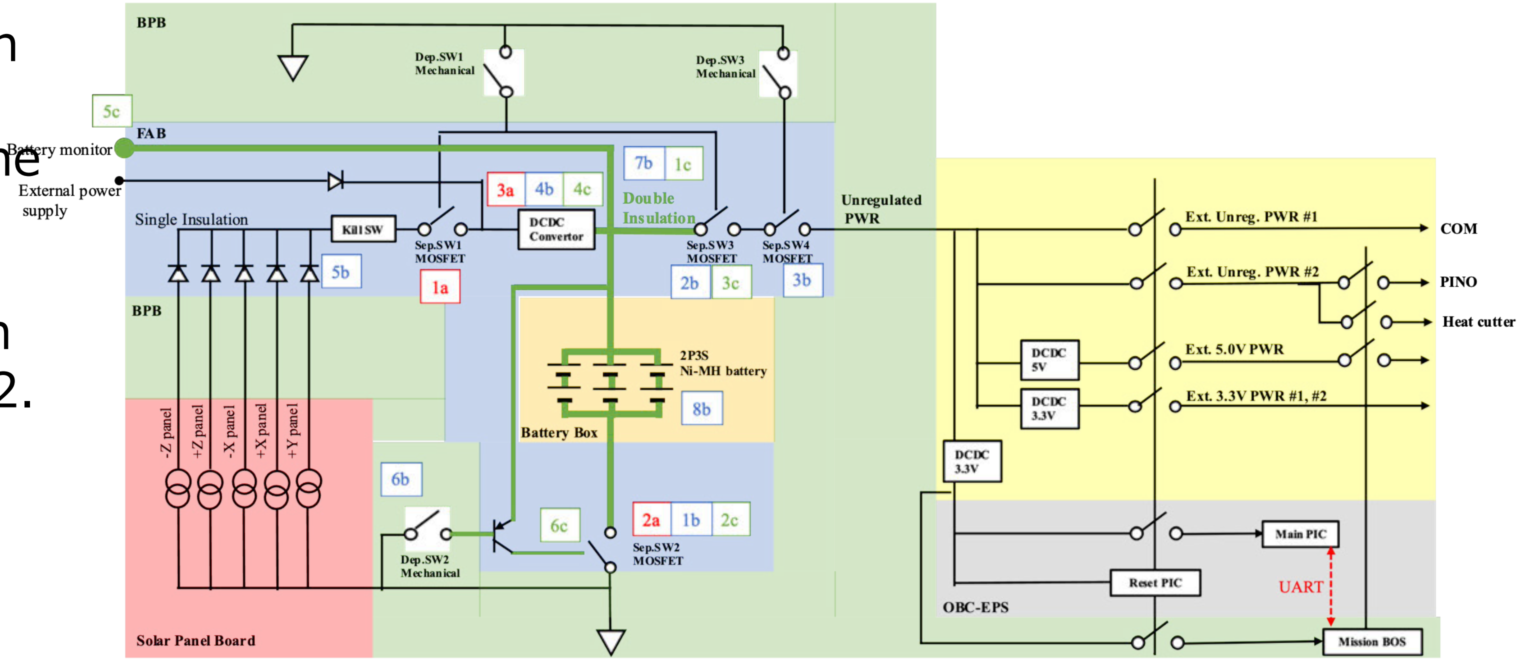
Items for DFMR	Implementation plan extracted from JAXA’s checklist	Implementation result for BIRDS-5
(1) Inhibits on the positive AND negative current paths. (supply and return). This allows failure of one inhibit and still safe operations.	No chassis connection on the supply or return path between the battery and the inhibits. Any chassis connection must have an inhibit between the chassis and the battery to mitigate the effects of battery short circuits to chassis.	• See page 2
, (2) Design to have no smart short between hot side and return side	Wiring: • Proper insulation (double insulation) • Wires connected to the battery positive and wires connected to the battery negative should not be in the same cable bundle. Or Additional insulation layers	• See *1 Wiring on page 3, 5, 7
	Battery: • Electrical connections to battery cells (tabs) should be insulated or covered with an insulating layer or cover. • Battery tabs and conductive surfaces covered with insulation to prevent shorting from conductive debris.	• See *2 Battery on page 3, 5, 7
	Circuit board: • RTV and Kapton tape to prevent shorting from FOD, etc.	• See *3 Board on page 4, 6, 8
	Connectors: • Either separate connectors for positive and negative conductors, or pin spacing on connectors between positive and negative sufficient to prevent shorting between positive and negative conductors if a connector pin is bent.	• See *4 Connector on page 4, 6, 8

Implementation plan extracted from JAXA's checklist for BIRDS-5

No chassis connection on the supply path between the battery, DCDC convertor, Deployment SW2 Separation SW3 and the battery monitor terminal.

No chassis connection on the return path between the battery and Separation SW2.

The Inhibit Schematic is shown on the right.



Hazard		Hazard Control #1	Hazard Control #2	Hazard Control #3
Over-charge		SepSW1[1a]	SepSW2[2a]	DCDC convertor[3a]
Over-discharge	Load side	SepSW2[1b]	SepSW3[2b]	SepSW4[3b]
	Solar cell side		DCDC convertor[4b]	Diode[5b]
	DepSW2 side	DepSW2 [9b]	Proper Insulation[7b]	Proper charging [8b]
External short	Load side	Proper Insulation[1c]	SepSW2[2c]	SepSW3[3c]
	Solar cell side			DCDC convertor[4c]
	External power supply side			DCDC convertor[4c]
	Battery monitor side			Proper Insulation[5c]
	DepSW2 side			Proper Insulation[6c]

Note: Proper insulation (double isolation is shown by green line in figure above, single isolation is black line)
All wires and components between the battery and the first power functions are assembled as double insulation. .

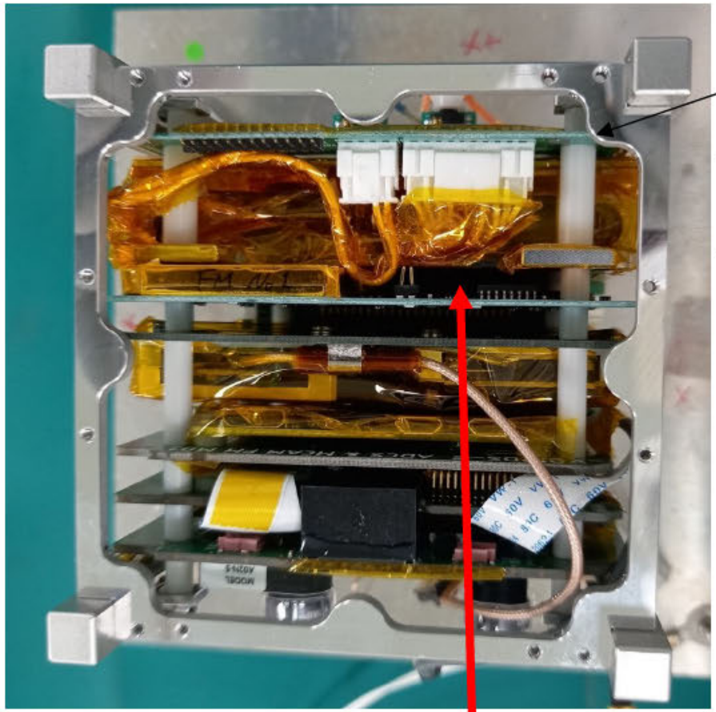
Inhibit Schematic

Implementation plan extracted from JAXA's checklist for BIRDS-5

PEARLAFRICASAT-1

*1 Wiring

The power wires connecting the battery to FAB are double insulated (wire insulation and covering by Kapton tape).



FAB
(Front Access Board)

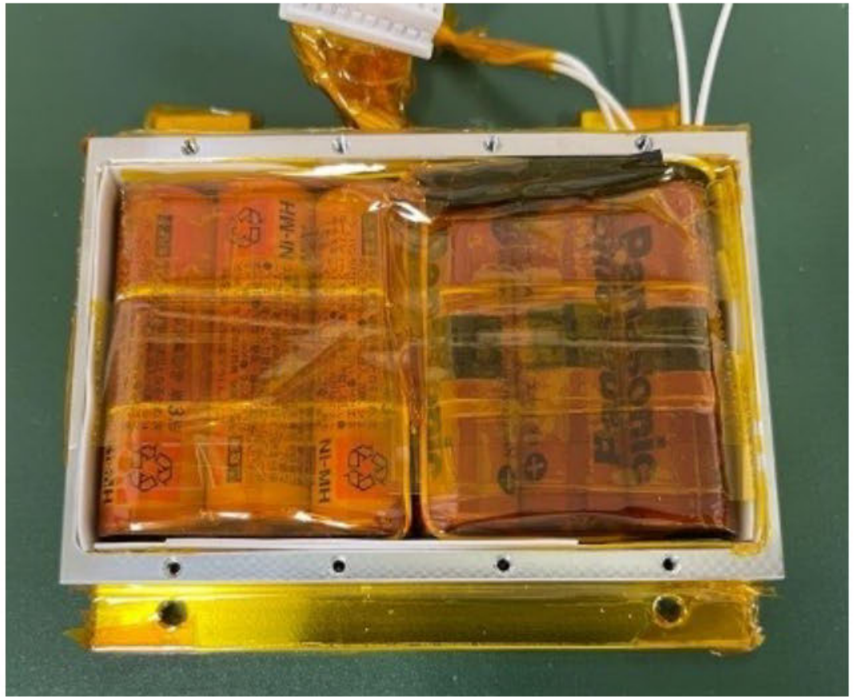
Battery box

Power wires

The HOT and GND cables separated and individually covered with Kapton tape and finally covered with Kapton tape.

*2 Battery

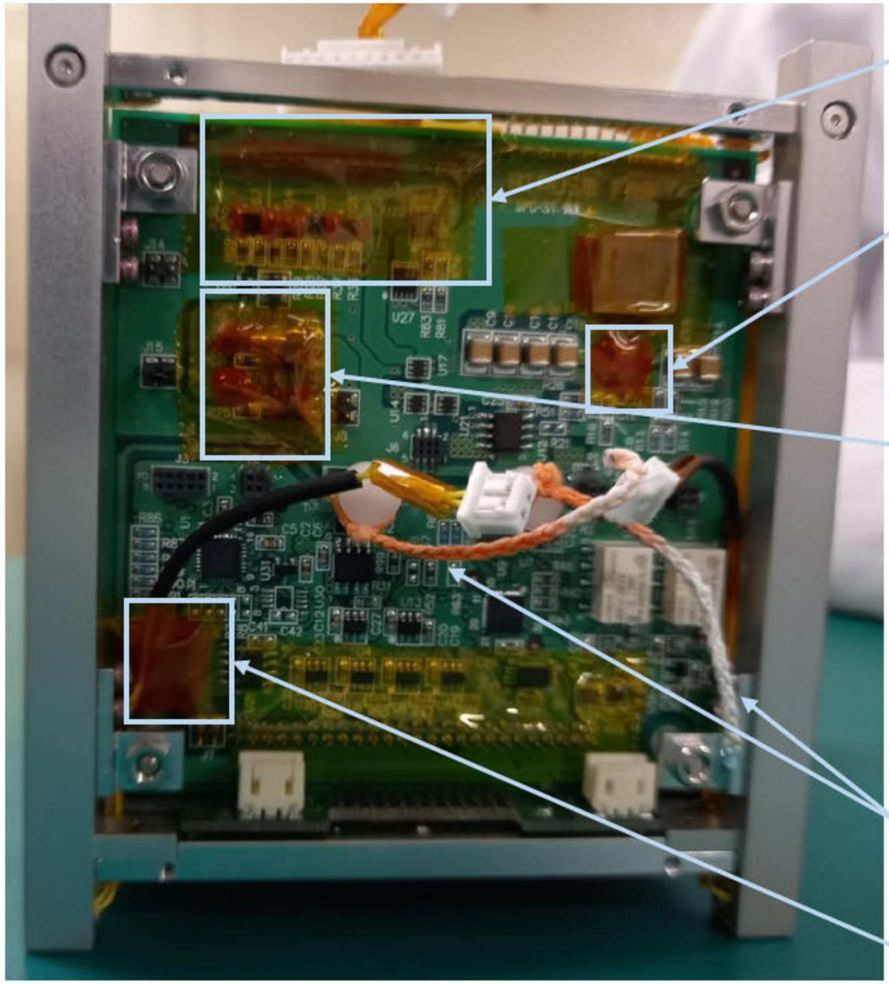
Electrical connections to battery cells (tabs) are covered with Kapton tape.
Battery tabs and conductive surfaces are covered with Kapton tape.



Implementation plan extracted from JAXA's checklist for BIRDS-5

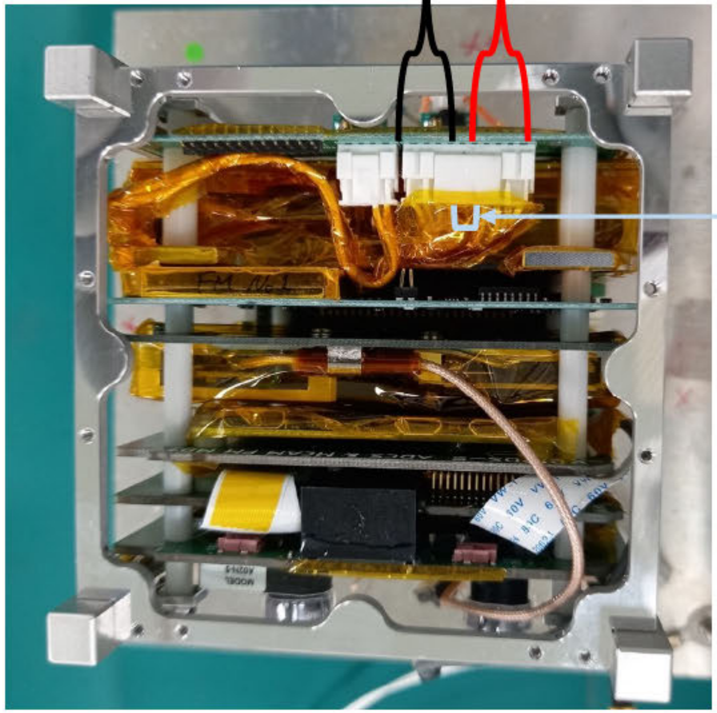
*3 Circuit board

The terminals of the electronic elements (DCDC convertor and Diode) from the battery to the first inhibit are covered with RTV. Moreover they were covered with Kapton tape.



*4 Connectors

The pins spacing on connectors between positive and negative sufficient.



Implementation plan extracted from JAXA's checklist for BIRDS-5

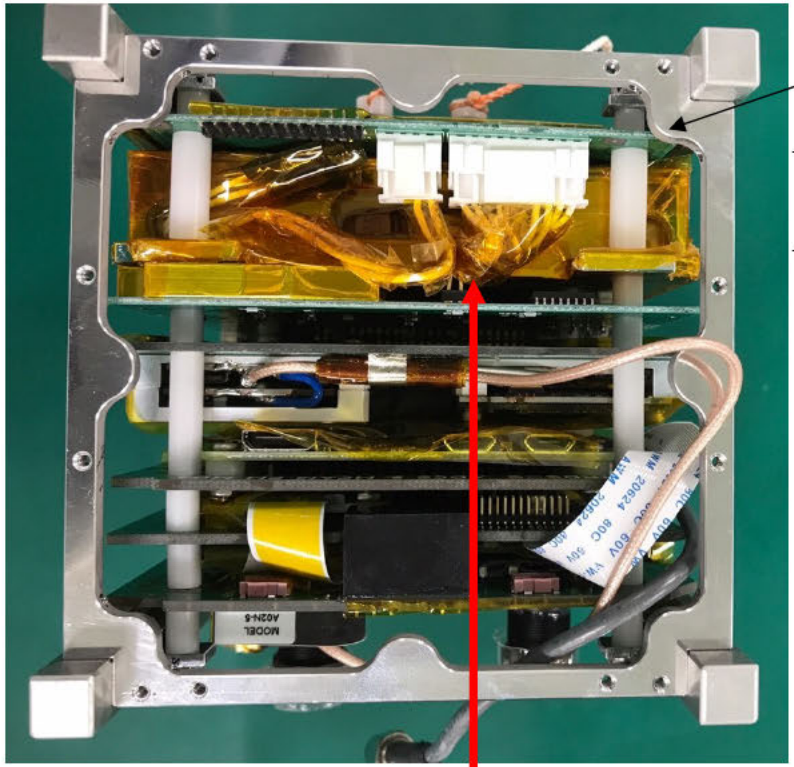
ZIMSAT-1

*1 Wiring

The power wires connecting the battery to FAB are double insulated (wire insulation and covering by Kapton tape).

*2 Battery

Electrical connections to battery cells (tabs) are covered with Kapton tape.
Battery tabs and conductive surfaces are covered with Kapton tape.

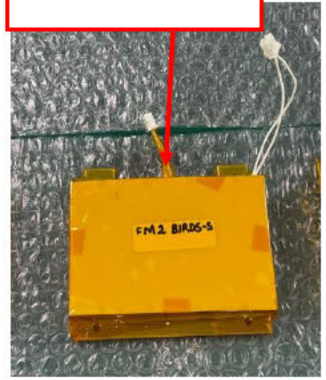


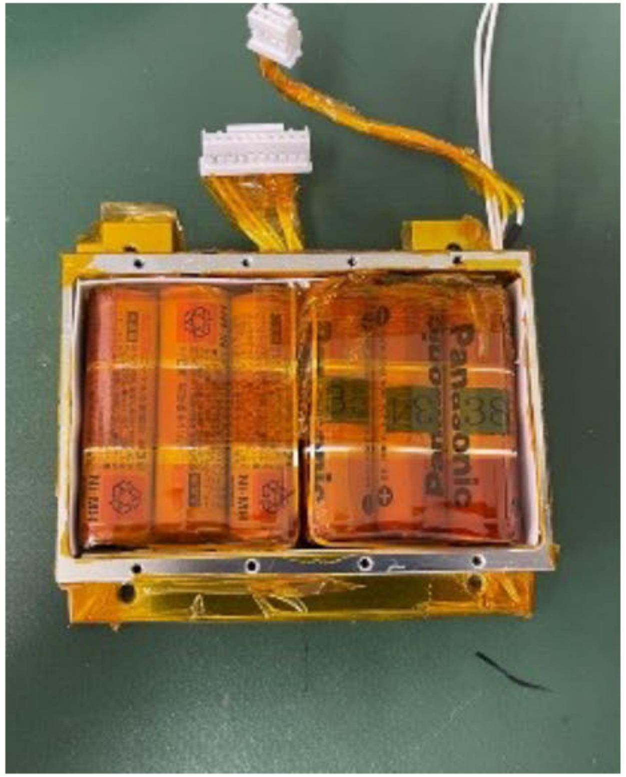
FAB
(Front Access Board)

Battery box

Power wires

The HOT and GND cables separated and individually covered with Kapton tape and finally covered with Kapton tape.

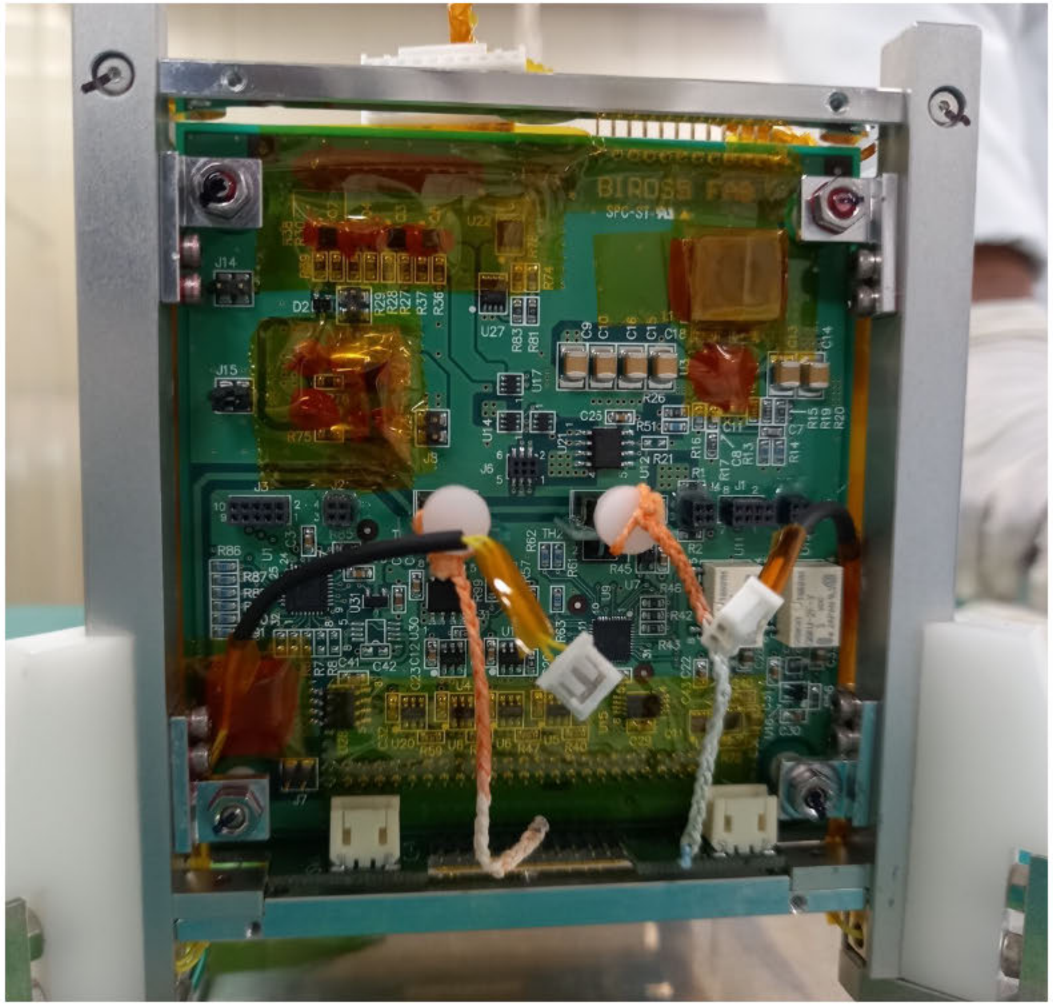




Implementation plan extracted from JAXA's checklist for BIRDS-5

*3 Circuit board

The terminals of the electronic elements (DCDC convertor and Diode) from the battery to the first inhibit are covered with RTV. Moreover they were covered with Kapton tape.

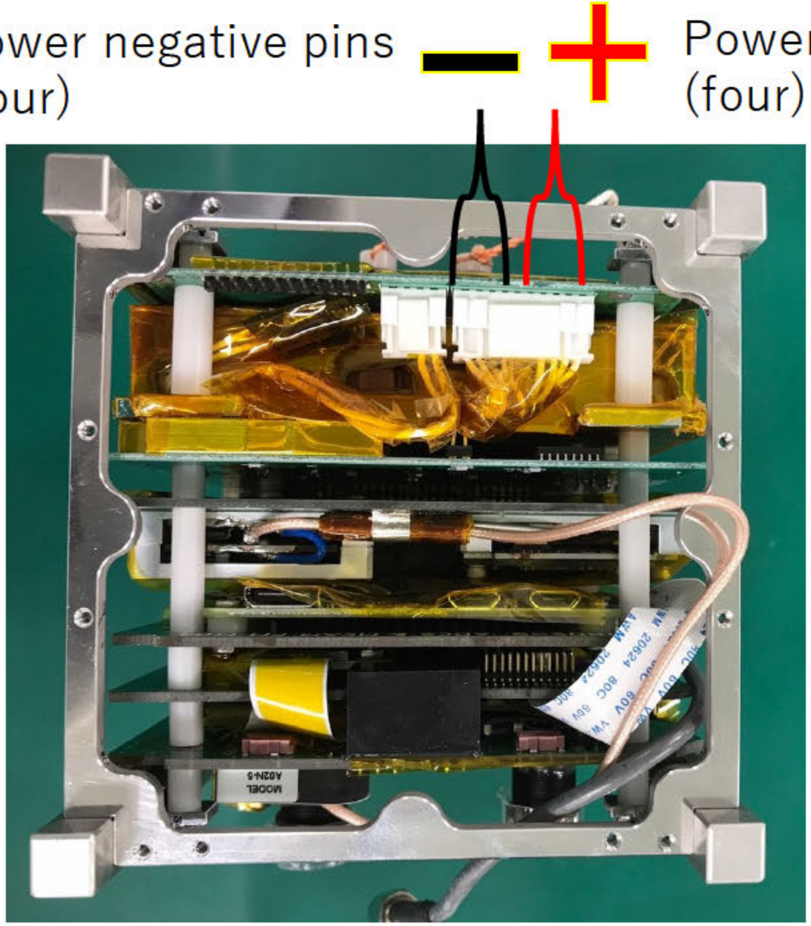


*4 Connectors

The pins spacing on connectors between positive and negative sufficient.

Power negative pins (four)

Power positive pins (four)

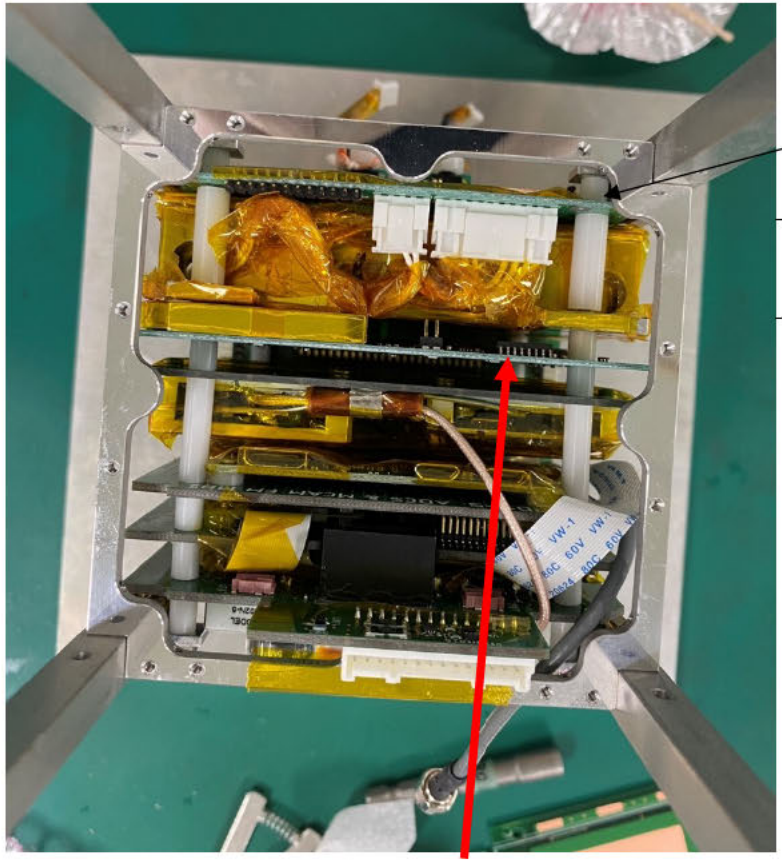


Implementation plan extracted from JAXA's checklist for BIRDS-5

TAKA

*1 Wiring

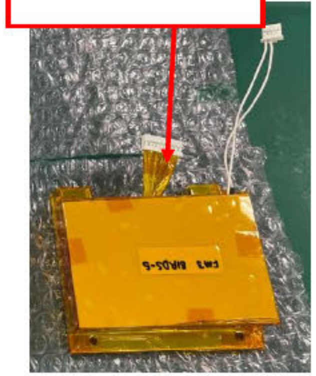
The power wires connecting the battery to FAB are double insulated (wire insulation and covering by Kapton tape).



FAB
(Front Access Board)

Battery box

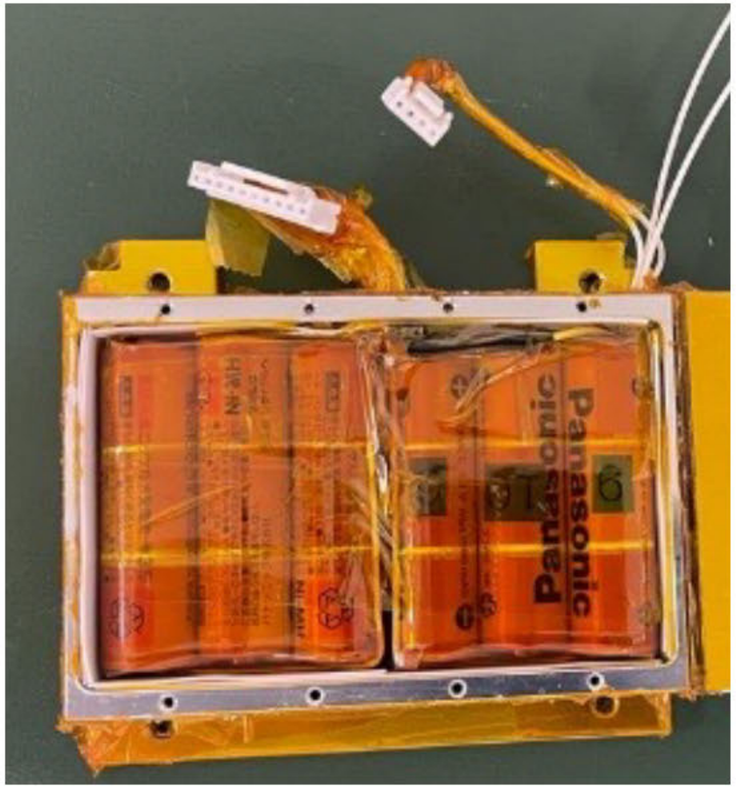
The HOT and GND cables separated and individually covered with Kapton tape and finally covered with Kapton tape.



Power wires

*2 Battery

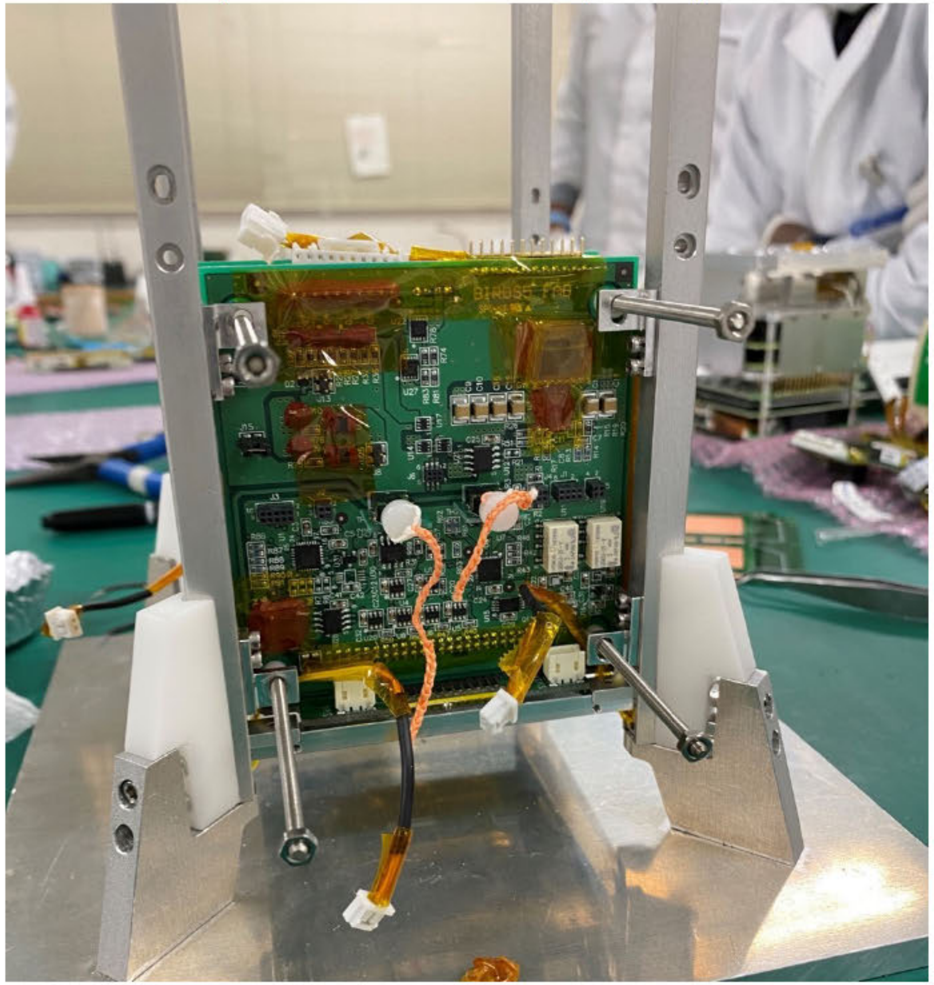
Electrical connections to battery cells (tabs) are covered with Kapton tape.
Battery tabs and conductive surfaces are covered with Kapton tape.



Implementation plan extracted from JAXA's checklist for BIRDS-5

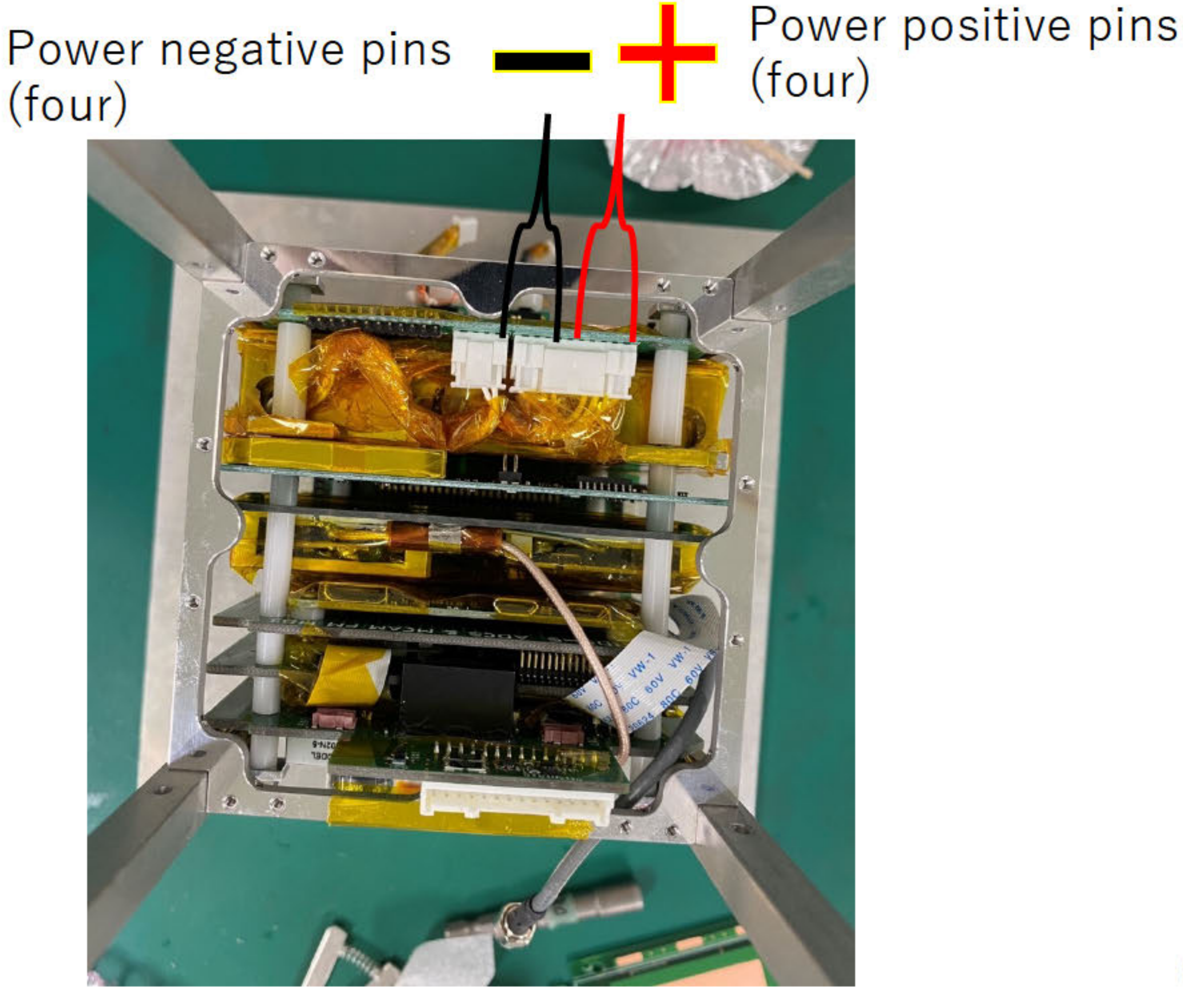
*3 Circuit board

The terminals of the electronic elements (DCDC convertor and Diode) from the battery to the first inhibit are covered with RTV. Moreover they were covered with Kapton tape.



*4 Connectors

The pins spacing on connectors between positive and negative sufficient.



Tabe STD-10 Seecton of Wres and Crcut Protecton Devces

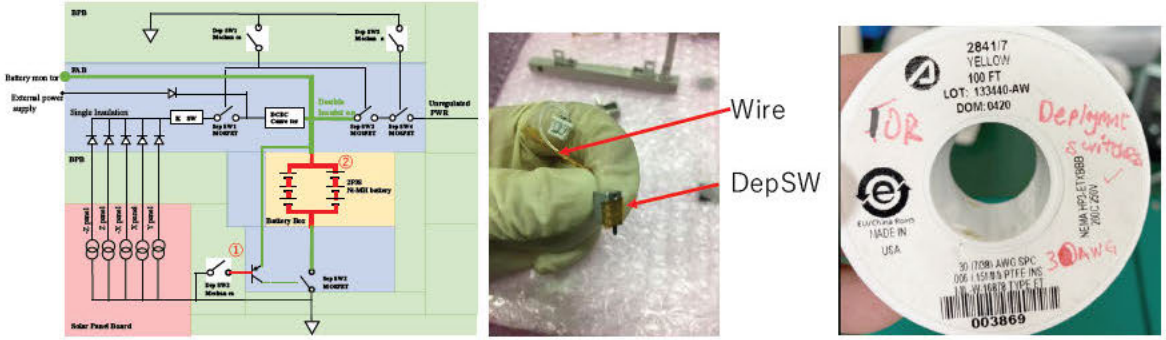
No.	Power Lne Wre	Max. App ed Load(A)	Max. Bow Current of Protecton Devce (A)	Crew accessbe Wre/Cabes (Yes/No)	Downstream Wre									Compatb ty for Wre Deratng (Yes/No)	Compatb ty for Touch Temperature (Yes/No)	Remarks
					Sze (AWG)	Rated. Temp (°C)	Current Carryng Capacty of a Snge Wre (A)	Current mt to meet touch temperature mted (A)※2	Quantty; Ho /Return	Bund ed (Yes/No)	Bunde Factor	Deratng Current (A)	Smart Short Current (A)			
1	DepSW2 sgna ne	267.4×10^{-6}	N/A	No	AWG30	200	1.3※1	-	1	No	N/A	1.3	N/A	Yes		
2	Battery cabe	379.9×10^{-6}	N/A	No	AWG22	200	6.5※3		6 / 6	No	N/A	6.5	N/A	Yes		

Note: Amb ent Temperature +22.2°C, Amb ent Pressure: 10^{-6} torr)

※1: Based on JAXA-JERG-2-212 5.2.1 Tabe 5.2-1 RECOMMENDED MAXIMUM CURRENT FOR SINGLE LINE as there was no ndcat on of wre sze to be used for SSP51721 4.3.1.2 Tabe 4.3.1 2-1.

※2: N/A because the target wre cannot be touched by the crew

※3: Based on SSP51721 4.3.1.2 Tabe 4.3.1.2-1 WIRE SIZE DERATING AND CIRCUIT PROTECTION CoumnA



① Wire

AlphaWire

Alpha Wire | 711 Lidgerwood Avenue, Elizabeth, NJ 07207
Tel: 1-800-52 ALPHA (25742), Web: www.alphawire.com

Customer Specification
PART NO. 2841/7

Construction

		Diameters (In)
1) Component 1	1 X 1 HOOKUP	
a) Conductor	30 (7/38) AWG SPC	0.012
b) Insulation	0.006" Wall, Nom. PTFE	0.024+/- 0.002
(1) Color(s)	WHITE, BLACK, RED, GREEN, YELLOW, BLUE, BROWN ORANGE, SLATE, VIOLET	

Applicable Specifications

1) Military	MIL-W-16878/6 (Type ET)	
2) Other	NEMA HP3-ETXBBB	

Environmental

1) EU Directive 2011/65/EU(RoHS2):	
	All materials used in the manufacture of this part are in compliance with European Directive 2011/65/EU regarding the restriction of use of certain hazardous substances in electrical and electronic equipment. Consult Alpha Wire's web site for RoHS C of C.
2) REACH Regulation (EC 1907/2006):	
	This product does not contain Substances of Very High Concern (SVHC) listed on the European Union's REACH candidate list in excess of 0.1% mass of the item. For up-to-date information, please see Alpha's REACH SVHC Declaration.
3) California Proposition 65:	The outer surface materials used in the manufacture of this part meet the requirements of California Proposition 65.

Properties

Physical & Mechanical Properties	
1) Temperature Range	-60 to 200°C
2) Bend Radius	10X Cable Diameter
3) Pull Tension	0.88 Lbs, Maximum
Electrical Properties	(For Engineering purposes only)
1) Voltage Rating	250 V_{RMS}
2) Inductance	0.06 µH/ft, Nominal
3) Conductor DCR	94 Ω/1000ft @20°C, Nominal

Other

Packaging	Flange x Traverse x Barrel (inches)
a) 1000 FT	3.5 x 3 x 1.125 Max. 3 separate pieces; Min length/piece 100 FT.
b) 100 FT	2.75 x 1 x 1.125 Continuous length
	[Spool dimensions may vary slightly]
Notes:	
a) Certain colors and put-up combinations may only be available by special order, minimums may apply.	

www.alphawire.com
Alpha Wire | 711 Lidgerwood Avenue, Elizabeth, NJ 07207

Tel: 1-800-52 ALPHA (25742)

AlphaWire

EU/China ROHS CERTIFICATE OF COMPLIANCE

To Whom It May Concern:

Alpha Wire Part Number: 2841/7

2841/7, RoHS-Compliant Commencing With 3/1/2005 Production

Note: all colors and put-ups

This document certifies that the Alpha part number cited above is manufactured in accordance with Directive 2011/65/EU of the European Parliament, better known as the RoHS Directive (commonly known as RoHS 2), with regards to restrictions of the use of certain hazardous substances used in the manufacture of electrical and electronic equipment. This certification extends to amending Directive 2015/863/EU which expanded the list of restricted substances to 10 items (commonly known as RoHS 3) The reader is referred to these Directives for the specific definitions and extents of the Directives. **No Exemptions are required for RoHS Compliance on this item**. Additionally, Alpha certifies that the listed part number is in compliance with China RoHS “Marking for Control of Pollution by Electronic Information Products” standard SJ/T 11364-2014.

Substance	Maximum Control Value
Lead	0.1% by weight (1000 ppm)
Mercury	0.1% by weight (1000 ppm)
Cadmium	0.01% by weight (100 ppm)
Hexavalent Chromium	0.1% by weight (1000 ppm)
Polybrominated Biphenyls (PBB)	0.1% by weight (1000 ppm)
Polybrominated Diphenyl Ethers (PBDE) ,	
Including Deca-BDE	0.1% by weight (1000 ppm)
Bis(2-ethylhexyl) phthalate (DEHP)	0.1% by weight (1000 ppm)
Butyl benzyl phthalate (BBP)	0.1% by weight (1000 ppm)
Dibutyl phthalate (DBP)	0.1% by weight (1000 ppm)
Diisobutyl phthalate (DIBP)	0.1% by weight (1000 ppm)

The information provided in this document and disclosure is correct to the best of Alpha Wire's knowledge, information and belief at the date of its release. The information provided is designed only as a general guide for the safe handling, storage, and any other operation of the product itself or the one that it will become part of. The intent of this document is not to be considered a warranty or quality specification. Regulatory information is for guidance purposes only. Product users are responsible for determining the applicability of legislation and regulations based on their individual usage of the product.

Authorized Signatory for the Alpha Wire:

Dave Watson, Director of Engineering & QA 9/29/2020

Alpha Wire

711 Lidgerwood Ave.

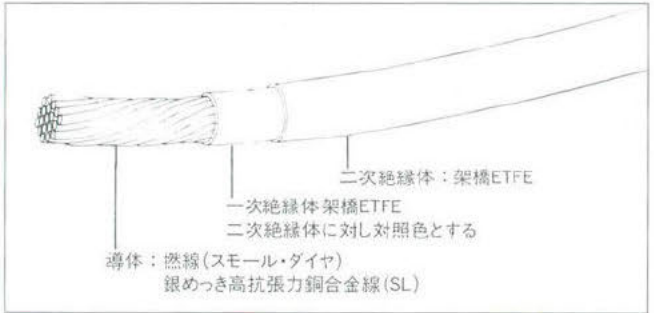
Elizabeth, NJ 07207

Tel: 1-908-925-8000

② Wire

航空宇宙機器用MIL規格ジュンフロン架橋ETFE(XL ETFE)電線

個別仕様書番号：MIL-W-22759／35C　定格：600V、200℃　認定番号：M-22759-82-0451B



導　体：MIL-W-22759に適合する銀めっき高抗張力銅合金撚線(SL)です。
絶縁体：架橋ETFEを導体上に均一の厚さに被覆し、絶縁体とします。
色　別：色別は、絶縁体によって行ないMIL-STD-104に適合する黒、茶、赤、橙、黄、緑、青、紫、灰、および白の10色です。

部品番号(注)	導体				絶縁体外径		導体抵抗	質量
	AWG	構成	外径				20℃、最大	最大
			最小	最大			Ω／km	kg／km
		No.×AWG(本／mm)	inch(mm)	inch(mm)	inch	mm	(Ω／1000ft)	(lbs／1000ft)
M22759/35-26-※	26	19×38(19/0.102)	.018(0.457)	.020(0.508)	.040±.002	1.016±0.051	147 (44.8)	2.58(1.7)
M22759/35-24-※	24	19×36(19/0.127)	.023(0.584)	.025(0.635)	.045±.002	1.143±0.051	93.2(28.4)	3.48(2.3)
M22759/35-22-※	22	19×34(19/0.160)	.029(0.737)	.032(0.813)	.050±.002	1.270±0.051	57.4(17.5)	4.97(3.3)
M22759/35-20-※	20	19×32(19/0.203)	.037(0.940)	.040(1.016)	.058±.002	1.473±0.051	35.1(10.7)	7.21(4.8)

注)部品番号の末尾の※は、二次絶縁体色記号に置き換えます。

インパルス耐電圧：8000V、絶縁抵抗(初期値)：1524MΩ・km(5000MΩ・1000ft)(最小)
高周波スパーク耐電圧：5700V

最低受注数量：100m(20m以上で3条長以内の組み合わせになる場合があります。)

Appendix B-2

Unique Hazard Report

Prov der Name:

Hazard Report #: BIRDS5-UNQ-01	Revision Date: 6 October, 2023	Review Level: Phase III
Title : Structural Failure		

System: BIRDS-5	**Sub-Subsystem:** Structure
Flight/Increment Applicability: HTV-X / Cygnus / Dragon Inc.(TBD) and subsequent stages.	**Mission Phases:** ☐Launch Processing: ☒Launch: ☐Rendezvous / Docking: ☒Deployment: ☐Orbital Assembly & Checkout: ☒On-orbit Operation: ☐On-orbit Maintenance: ☐Descent / Landing:
Scope: ☒Payload: ☐JEM - PM: ☐ JEM - EF: ☐ Other( ):	**Interfaces:** ☐JEM-PM ☐JEM-EF ☒JEM-AIRLOCK ☒JEMRMS ☐ Other( ):

Hazardous Condition Description:

If a structure failure of the CubeSat occurs in the Satellite Install Case of the J-SSOD, the CubeSat may not be appropriately released from the J-SSOD along with the expected contact to the Satellite Install Case. Consequently, the released satellite may collide against the ISS Structure. The release of shatterable material such as glass particles may cause injury to crew.

[Note] This UNQ HR addresses glass of solar cells, camera lens and filter.

- This UNQ HR addresses glass of solar cells, camera lens and filter.
- The IVA/EVA crew applied load is excluded because the aperture surface (+Z) of the J-SSOD or J-SSOD-R Launch Case is identified as NO Touch Area for the sharp edge hazard by J-SSOD Upgrade Unique Hazard Report (No. J-SSOD-UG-03) of JMX-2016127 and J-SSOD-R Unique Hazard Report (No. J-SSOD-R-03) of JMX-2017181. The other surfaces of the satellites are covered by the J-SSOD or J-SSOD-R Launch Case.

Cause Summary:

Cause 1. Structure failure of the CubeSat

Cause 2. Release of fragments from shatterable material. (Refer to Figure 1)

Remarks:

Submittal Concurrence:		Safety Review Panel Approval	
Signature	Date	Signature	Date
T.Yamauchi	2023.10.6	小林亮二	Oct. 27, 2023

ISS_OE_851
Export Contro C ass f cat on:
Propr etary Statement (f requ red):

Hazard Report #: BIRDS5-UNQ-01	Revision Date: 6 October, 2023	Review Level: Phase III
Title : Structural Failure		

Cause Number:	Cause Title:
1	Structure failure of the CubeSat

Hazard Cause Description:

1.1 Inadequate structural strength for launch, ascent, On-orbit load (excluding crew applied load) and depressurization.
1.2 Improper material selection and processing, including usage of stress corrosion sensitive materials.
1.3 Material fatigue or propagation of inherent cracks or internal flaws.
1.4 Use of counterfeit fasteners
1.5 Loosening of fasteners during launch and on-orbit
1.6 Improper manufacturing and/or assembly

Severity:	Likelihood:
☒I (Catastrophic) ☐II (Critical)	☐A (Probable) ☐B (Infrequent) ☒C (Remote) ☐D (Improbable)

Controls:	Verification Method and Status:
1.1-1. Design to meet the applicable requirements for soft-stowed items for launch	1.1-1(1). Inspection to verify that the CubeSat is installed per the approved packing requirement. [Status] Closed to VTL BIRDS5-VTL-01 1.1-1(2). Mass measurement to verify compatibility with JX-ESPC-101132E (Japanese) / 101133E (English). [Status] Closed: BIRDS5-IVR-01, BIRDS-5 Interface Verification Record (2022/02/21)
1.1-2. Safety critical structure shall be designed with positive margins of safety. For the launch environment, following factors of safety as defined in JMX-2011303E are used; For HTV launch, 1.5 for yield and 1.875 for ultimate For Dragon and Cygnus, 1.25 for yield and 2.0 for ultimate For the on-orbit loads, following factors of safety as defined in JMX-2011303E are used; 1.25 for yield and 2.0 for ultimate	1.1-2. Structural Analysis to verify structural integrity according to JMX-2011303E [Status] Closed: BIRDS5-SR-01, BIRDS-5 Structural Analysis Report (2021/12/09)

Hazard Report #: BIRDS5-UNQ-01	Revision Date: 6 October, 2023	Review Level: Phase III
Title : Structural Failure		

1.2. For safety critical structures, materials shall be selected according to CR-99117K, "JAXA Space Station Program Requirements for Materials and Processes".	1.2. Review of Materials used will be listed in Material Identification and Usage List (MIUL) by JAXA. [Status] Closed: BIRDS5 MIUL 01, BIRDS-5 MIUL (2022/03/11)
1.3 For safety critical structures, fracture control shall be implemented according to JAXA approved structure verification and fracture control plan (JMX-2011303E), of which scope covers JBX-97160B, JEM Payload Fracture Control Plan.	1.3 Fracture Control Evaluation Form is submitted to and approved by JAXA. [Status] Closed: BIRDS5-FCE-01, BIRDS-5 Fracture Control Evaluation Form for Phase 0/I/II (2022/03/14) [Status] Closed: BIRDS5-FCE-02, BIRDS-5 Fracture Control Evaluation Form for Phase III (2023/10/06)
1.4 For safety critical fasteners, fastener control shall be implemented according to JAXA approved structure verification and fracture control plan (JMX-2011303E), of which scope covers JBX-97159, JEM Payload Fastener Control Plan.	1.4(1). Fracture Control Evaluation Form is submitted to and approved by JAXA. [Status] Closed: BIRDS5-FCE-01, BIRDS-5 Fracture Control Evaluation Form for Phase 0/I/II (2022/03/14) [Status] Closed: BIRDS5-FCE-02, BIRDS-5 Fracture Control Evaluation Form for Phase III (2023/10/06) 1.4(2). The random vibration test at the flight level is performed and the inspection is also performed to verify if there are any damages after the test. [Status] Closed: BIRDS5-VT-01, BIRDS-5 Vibration Test Report (2022/02/18)
1.5 For safety critical fasteners, liquid locking compound shall be used to prevent back off.	1.5(1). Review of assembly procedures directing liquid locking compound. [Status] Closed: BIRDS5-AP-01, BIRDS-5 Assembly Procedure (2021/12/09)

Hazard Report #: BIRDS5-UNQ-01	**Revision Date:** 6 October, 2023	**Review Level:** Phase III
Title : Structural Failure		

	1.5(2). Inspection of as-built hardware per the assembly procedures which directs application of the liquid locking compound. [Status] Closed: BIRDS5-AR-01, BIRDS-5 Assembly Record (2022/02/18) 1.5(3). Inspection of no loosening of fasteners after vibration test. [Status] Closed: BIRDS5-VT-01, BIRDS-5 Vibration Test Report (2022/02/18)
1.6 Manufacture according to approved drawings	1.6(1). Review of design drawings complying with JX-ESPC-101132 E(Japanese) / 101133E (English). [Status] Closed: BIRDS5-AD-01, BIRDS-5 Assembly Drawing (2021/12/09) 1.6(2). Inspection of as-built hardware per the drawing. [Status] Closed: BIRDS5-AR-01, BIRDS-5 Assembly Record (2022/02/18)

Safety Requirements:

SSP51721
SSP52005F, Payload Flight Equipment Requirements and Guidelines for Safety-Critical Structures
SSP50835E, ISS Pressurized Volume Hardware Common Interface Requirements Document

Detection and Warning Methods:	**Additional Safety Features:**
-	-

Cause Remarks:

-

Mission Phases:	**Point of Contact**
☐**Launch Processing:** ☒**Launch:** ☐**Rendezvous / Docking:** ☒**Deployment:** ☒**Orbital Assembly & Checkout:** ☒**On-orbit Operation:** ☐**On-orbit Maintenance:** ☐**Descent / Landing:**	

Prov der Name:

Hazard Report #: BIRDS5-UNQ-01	Revision Date: 6 October, 2023	Review Level: Phase III
Title : Structural Failure		

Cause Number: 2	**Cause Title:** Release of fragments from shatterable material.
Hazard Cause Description: 2.1 Broken glass parts due to launch, ascent and on-orbit load (excluding crew applied load).	
Severity: ☒**I (Catastrophic)** ☐**II (Critical)**	**Likelihood:** ☐**A (Probable)** ☐**B (Infrequent)** ☒**C (Remote)** ☐**D (Improbable)**
Controls: 2.1.1. Shatterable materials are non-stressed (no delta pressure), recessed, and supervised by the crew when in exposed use.	**Verification Method and Status:** 2.1.1. Verification result for IVA and EVA are followings. <For IVA> The CubeSat is placed in protected storage (J-SSOD or J-SSOD-R Launch Case). Therefore, cover glass of solar cells is non-stressed, recessed and not exposed to IVA crew. <For EVA> J-SSOD Hazard Report (No. J-SSOD-03) and associated NCR-JAXA-JSSOD-03 are already approved with the aperture plane of the J-SSOD, the +Z plane of the satellite, as EVA No Touch Area (NTA). The other surfaces of the satellites are covered by the J-SSOD.
2.1.2. Shatterable materials have passed a vibration test at flight levels/post-test visual inspection.	2.1.2. The random vibration test at the flight level is performed and the inspection is also performed to verify if there are any damages after the test. [Status] Closed: BIRDS5-VT-01, BIRDS-5 Vibration Test Report (2022/02/18)
Safety Requirements: SSP51721 SSP52005F, Payload Flight Equipment Requirements and Guidelines for Safety-Critical Structures	
Detection and Warning Methods: -	**Additional Safety Features:** -
Cause Remarks: -	
Mission Phases:	**Point of Contact**

Prov der Name:

Hazard Report #: BIRDS5-UNQ-01	**Revision Date:** 6 October, 2023	**Review Level:** Phase III
Title : Structural Failure		

☐**Launch Processing:** ☒**Launch:** ☐**Rendezvous / Docking:** ☒**Deployment:** ☒**Orbital Assembly & Checkout:** ☒**On-orbit Operation:** ☐**On-orbit Maintenance:** ☐**Descent / Landing:**	

Attachment BIRDS5-UNQ-01, Summary of Structural Analysis Results for 1U

Table 1 Structural Analysis Results for 1U (Acceleration Load along X axis)

Part	Material	Max Stress (Smax) (MPa)	Yield strength (MPa)	Ultimate Strength, Ftu(MPa)	MS (Yield) FS=1.5	MS (Ultimate) FS=2	Smax/Ftu [%] <30
Structure-01	A6061-T6	37.9	276	310	3.9	3.1	12.2
Structure-02	A6061-T6	78.6	276	310	1.3	1.0	25.4
Structure-03	A6061-T6	40.4	276	310	3.6	2.8	13.0
Structure-04	A6061-T6	50.3	276	310	2.7	2.1	16.2
Structure-05	A6061-T6	38.7	276	310	3.7	3.0	12.5
Structure-06	A6061-T6	30.3	276	310	5.1	4.1	9.8
Structure-07	A6061-T6	25.3	276	310	6.3	5.1	8.2
Structure-08	A6061-T6	21.1	276	310	7.7	6.4	6.8
Structure-09	A6061-T6	26.5	276	310	5.9	4.8	8.6
Structure-10	A6061-T6	13.5	276	310	12.6	10.4	4.4
Plus Z panel	FR4	11.3	320	450	10.4	9.1	-
Minus Z panel	FR4	13.4	320	450	14.9	15.8	-
Plus X panel	FR4	23.0	320	450	8.3	8.8	-
Minus X panel	FR4	9.4	320	450	21.7	22.9	-
Plus Y panel	FR4	9.2	320	450	22.2	23.5	-
Minus Y panel	FR4	9.8	320	450	20.8	22.0	-

*1:Margin of Safety, *2:Factor of Safety

Table 2 Structural Analysis Results for 1U (Acceleration Load along Y axis)

Part	Material	Max Stress (Smax) (MPa)	Yield strength (MPa)	Ultimate Strength, Ftu(MPa)	MS (Yield) FS=1.5	MS (Ultimate) FS=2	Smax/Ftu [%] <30
Structure-01	A6061-T6	44.6	276	310	3.1	2.5	14.4
Structure-02	A6061-T6	79.6	276	310	1.3	0.9	25.7
Structure-03	A6061-T6	40.4	276	310	3.6	2.8	13.0
Structure-04	A6061-T6	50.4	276	310	2.7	2.1	16.3
Structure-05	A6061-T6	37.4	276	310	3.9	3.1	12.1
Structure-06	A6061-T6	30.4	276	310	5.1	4.1	9.8
Structure-07	A6061-T6	26.9	276	310	5.8	4.8	8.7
Structure-08	A6061-T6	20.9	276	310	7.8	6.4	6.7
Structure-09	A6061-T6	27.0	276	310	5.8	4.7	8.7
Structure-10	A6061-T6	14.0	276	310	12.1	10.0	4.5
Plus_Z panel	FR4	11.5	320	450	10.2	8.9	-
Minus_Z panel	FR4	13.4	320	450	15.0	15.9	-
Plus_X panel	FR4	23.2	320	450	8.2	8.7	-
Minus_X panel	FR4	9.5	320	450	21.5	22.7	-
Plus_Y panel	FR4	9.2	320	450	22.1	23.4	-
Minus_Y panel	FR4	10.3	320	450	19.7	20.8	-

*1:Margin of Safety, *2:Factor of Safety

Table 3 Structural Analysis Results for 1U (Acceleration Load along Z axis)

Part	Material	Max Stress (Smax) (MPa)	Yield strength (MPa)	Ultimate Strength, Ftu(MPa)	MS (Yield) FS=1.5	MS (Ultimate) FS=2	Smax/Ftu [%] <30
Structure-01	A6061-T6	53.6	276	310	2.4	1.9	17.3
Structure-02	A6061-T6	80.3	276	310	1.3	0.9	25.9
Structure-03	A6061-T6	39.8	276	310	3.6	2.9	12.8
Structure-04	A6061-T6	50.3	276	310	2.7	2.1	16.2
Structure-05	A6061-T6	50.9	276	310	2.6	2.0	16.4
Structure-06	A6061-T6	30.2	276	310	5.1	4.1	9.7
Structure-07	A6061-T6	29.9	276	310	5.1	4.2	9.7
Structure-08	A6061-T6	21.6	276	310	7.5	6.2	7.0
Structure-09	A6061-T6	27.3	276	310	5.7	4.7	8.8
Structure-10	A6061-T6	13.7	276	310	12.4	10.3	4.4
Plus_Z panel	FR4	11.7	320	450	10.0	8.7	-
Minus_Z panel	FR4	13.4	320	450	15.0	15.8	-
Plus_X panel	FR4	9.3	320	450	22.0	23.3	-
Minus_X panel	FR4	9.3	320	450	22.0	23.3	-
Plus_Y panel	FR4	9.4	320	450	21.8	23.1	-
Minus_Y panel	FR4	10.9	320	450	18.6	19.6	

*1:Margin of Safety, *2:Factor of Safety

Prov der Name:

Hazard Report #:	BIRDS5-UNQ-01	Revision Date:	6 October, 2023	Review Level:	Phase III
Title :	Structural Failure				

Attachment BIRDS5-UNQ-01, Shatterable materials used for 1U satellite

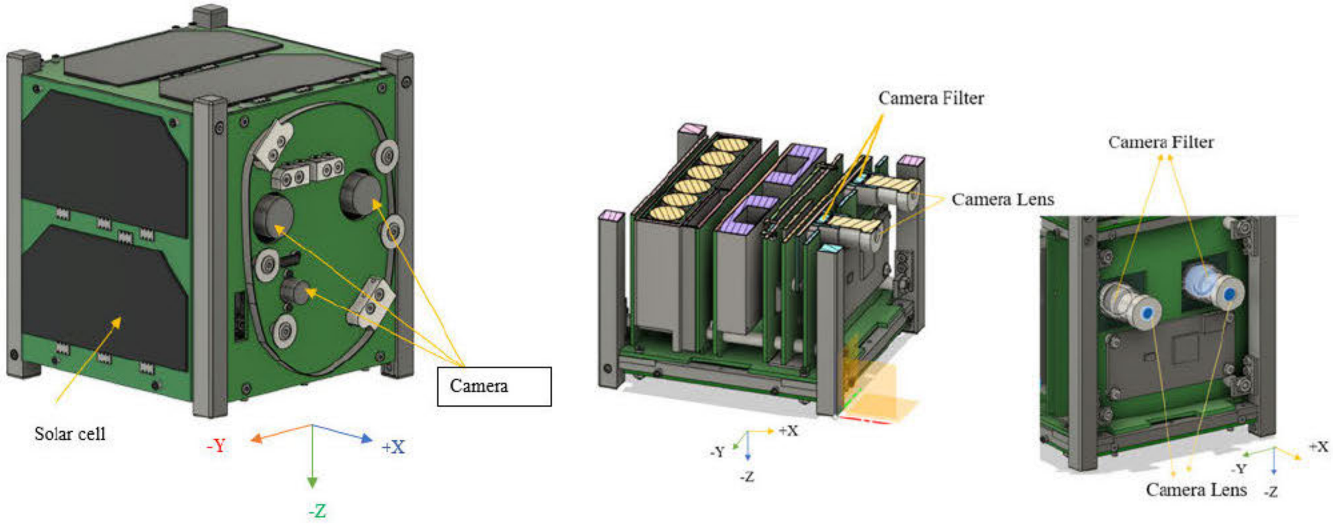


Figure1 1U Shatter able materials

Attachment BIRDS5-UNQ-01, Summary of Structural Analysis Results for 2U

Table 4 Structural Analysis Results for 2U (Acceleration Load along X axis)

Part	Material	Max Stress (Smax) (MPa)	Yield strength (MPa)	Ultimate Strength, Ftu(MPa)	MS (Yield) FS=1.5	MS (Ultimate) FS=2	Smax/Ftu [%] <30
Structure-01	A6061-T6	78.1	276	310	1.4	1.0	25.2
Structure-02	A6061-T6	42.0	276	310	3.4	2.7	13.5
Structure-03	A6061-T6	39.2	276	310	3.7	3.0	12.6
Structure-04	A6061-T6	64.2	276	310	1.9	1.4	20.7
Structure-05	A6061-T6	28.5	276	310	5.5	4.4	9.2
Structure-06	A6061-T6	53.9	276	310	2.4	1.9	17.4
Structure-07	A6061-T6	61.0	276	310	2.0	1.5	19.7
Structure-08	A6061-T6	37.7	276	310	3.9	3.1	12.2
Structure-09	A6061-T6	40.8	276	310	3.5	2.8	13.2
Structure-10	A6061-T6	11.8	276	310	14.6	12.1	3.8
Plus Z plate	A5052P	61.6	193	228	1.1	0.9	27.0
Minus Z panel	FR4	14.2	320	450	14.0	14.8	-
Plus X panel	FR4	18.6	320	450	10.5	11.1	-
Minus X panel	FR4	8.5	320	450	24.1	25.5	-
Plus Y panel	FR4	15.5	320	450	12.8	13.5	-
Minus Y panel	FR4	20.9	320	450	9.2	9.8	-

*1:Margin of Safety, *2:Factor of Safety

Table 5 Structural Analysis Results for 2U (Acceleration Load along Y axis)

Part	Material	Max Stress (Smax) (MPa)	Yield strength (MPa)	Ultimate Strength, Ftu(MPa)	MS (Yield) FS=1.5	MS (Ultimate) FS=2	Smax/Ftu [%] <30
Structure-01	A6061-T6	47.6	276	310	2.9	2.3	15.4
Structure-02	A6061-T6	38.6	276	310	3.8	3.0	12.5
Structure-03	A6061-T6	35.4	276	310	4.2	3.4	11.4
Structure-04	A6061-T6	64.4	276	310	1.9	1.4	20.8
Structure-05	A6061-T6	28.8	276	310	5.4	4.4	9.3
Structure-06	A6061-T6	53.3	276	310	2.5	1.9	17.2
Structure-07	A6061-T6	57.1	276	310	2.2	1.7	18.4
Structure-08	A6061-T6	36.0	276	310	4.1	3.3	11.6
Structure-09	A6061-T6	37.1	276	310	4.0	3.2	12.0
Structure-10	A6061-T6	9.9	276	310	17.6	14.7	3.2
Plus_Z plate	A5052P	57.1	193	228	1.3	1.0	25.0
Minus_Z panel	FR4	14.4	320	450	13.8	14.6	-
Plus_X panel	FR4	17.9	320	450	10.9	11.6	-
Minus_X panel	FR4	10.3	320	450	19.7	20.8	-
Plus_Y panel	FR4	14.0	320	450	14.2	15.1	-
Minus_Y panel	FR4	15.6	320	450	12.7	13.4	-

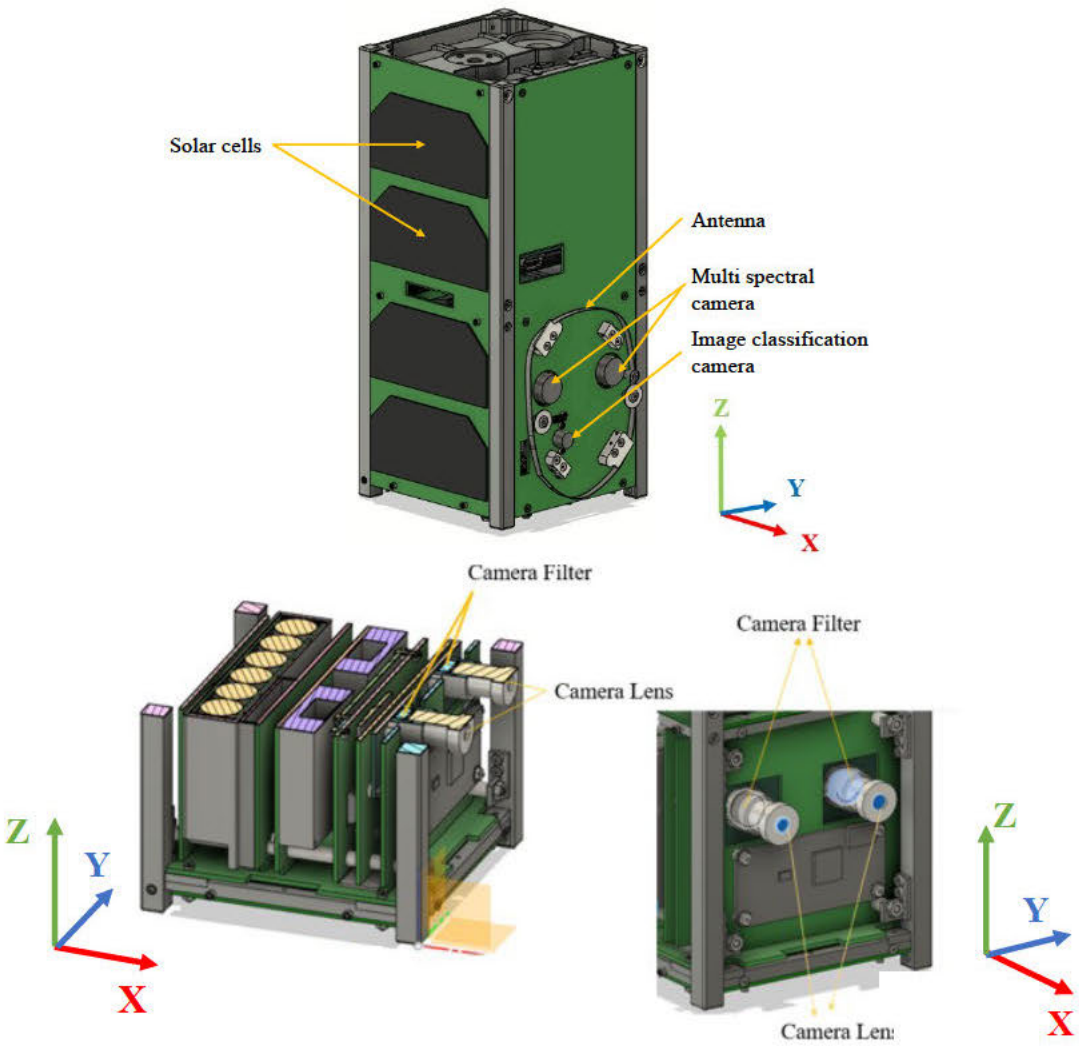
*1:Margin of Safety, *2:Factor of Safety

Table 6 Structural Analysis Results for 2U (Acceleration Load along Z axis)

Part	Material	Max Stress (Smax) (MPa)	Yield strength (MPa)	Ultimate Strength, Ftu(MPa)	MS (Yield) FS=1.5	MS (Ultimate) FS=2	Smax/Ftu [%] <30
Structure-01	A6061-T6	50.3	276	310	2.7	2.1	16.2
Structure-02	A6061-T6	38.7	276	310	3.8	3.0	12.5
Structure-03	A6061-T6	35.4	276	310	4.2	3.4	11.4
Structure-04	A6061-T6	64.4	276	310	1.9	1.4	20.8
Structure-05	A6061-T6	28.8	276	310	5.4	4.4	9.3
Structure-06	A6061-T6	54.3	276	310	2.4	1.9	17.5
Structure-07	A6061-T6	57.3	276	310	2.2	1.7	18.5
Structure-08	A6061-T6	31.8	276	310	4.8	3.9	10.3
Structure-09	A6061-T6	37.5	276	310	3.9	3.1	12.1
Structure-10	A6061-T6	10.6	276	310	16.4	13.6	3.4
Plus_Z plate	A5052P	52.2	193	228	1.5	1.2	22.9
Minus_Z panel	FR4	14.5	320	450	13.7	14.5	-
Plus_X panel	FR4	17.9	320	450	10.9	11.6	-
Minus_X panel	FR4	8.4	320	450	24.4	25.8	-
Plus_Y panel	FR4	14.0	320	450	14.2	15.1	-
Minus_Y panel	FR4	15.5	320	450	12.8	13.5	-

*1:Margin of Safety, *2:Factor of Safety

Attachment BIRDS5-UNQ-01, Shatterable materials used for 2U satellite



<u>Figure2 2U Shatter able materials</u>

Prov der Name:

Hazard Report #: BIRDS5-UNQ--02	**Revision Date:** 6 October, 2023	**Review Level:** Phase III
Title : Battery Leakage/Rapture		

System: BIRDS-5	**Sub-Subsystem:** Battery
Flight/Increment Applicability: HTV-X / Cygnus / Dragon Inc, (TBD) and subsequent stages.	**Mission Phases:** ☐ Launch Processing: ☒ Launch: ☐ Rendezvous / Docking: ☒ Deployment: ☒ Orbital Assembly & Checkout: ☒ On-orbit Operation: ☐ On-orbit Maintenance: ☐ Descent / Landing:
Scope: ☒ Payload: ☐ JEM - PM: ☐ JEM - EF: ☐ Other( ):	**Interfaces:** ☐ JEM-PM ☐ JEM-EF ☒ JEM-AIRLOCK ☒ JEMRMS ☐ Other( ):

Hazardous Condition Description:

Leakage of electrolyte or rupture of battery will potentially lead to contamination, corrosion, injury to ISS crew, or damage to other equipment on ISS.

Note. CubeSat uses Ni-MH battery cells.
Refer to Appendix G-2, BIRDS-5 Battery Description Form (Ni-MH, Panasonic, BK-3MCC, configuration 3S2P)

Cause Summary:

Cause 1. Battery Failure of the CubeSat

Remarks:

Submittal Concurrence:		**Safety Review Panel Approval**	
Signature T.Yamauchi	**Date** 2023.10.6	**Signature** 小林亮二	**Date** Oct. 27, 2023

ISS_OE_851
Export Contro C ass f cat on:
Propr etary Statement (f requ red):

Hazard Report #: BIRDS5-UNQ--02	Revision Date: 6 October, 2023	Review Level: Phase III
Title : Battery Leakage/Rapture		

Cause Number:	**Cause Title:**
1	Battery Failure of the CubeSat

Hazard Cause Description:
1.1 Battery cell internal short
1.2 Cell/battery external short
1.3 Overcharging of battery
1.4 Over-discharging of battery
1.5 Thermal Extremes

Severity:	**Likelihood:**
☒ I (Catastrophic) ☐ II (Critical)	☐ A (Probable) ☐ B (Infrequent) ☒ C (Remote) ☐ D (Improbable)

Controls:	**Verification Method and Status:**
1.1. Screening by environment test such as vibration and vacuum tests are performed to check that there is no defect in the battery cells (Refer to Figure 3).	1.1(1). Perform random vibration test at MSL (Minimum Screening Level) for each battery cells. [Status] Closed: BIRDS5-BVR-01, BIRDS-5 Battery verification report (2022/02/22) 1.1(2). Perform vacuum leak test (less than 0.1[psia] for longer than 6 hours) for each battery cells. [Status] Closed: BIRDS5-BVR-01, BIRDS-5 Battery verification report (2022/02/22) 1.1(3). Confirm there is no change in charge/discharge characteristics before and after the environmental tests. [Status] Closed: BIRDS5-BVR-01, BIRDS-5 Battery verification report (2022/02/22) 1.1(4). Perform the trend measurement of the open circuit voltage of the total battery, after the environment test of the satellite system. [Status] Closed: BIRDS5-BVR-01, BIRDS-5 Battery verification report (2022/02/22)

Hazard Report #: BIRDS5-UNQ--02	Revision Date: 6 October, 2023	Review Level: Phase III

Title : Battery Leakage/Rapture

1.2-1. Battery pack is designed / assembled with appropriate electrical isolation between each cell and wiring (Refer to Figure 2).	1.2-1. Inspection of flight hardware to ensure there is appropriate electrical isolation between each cell and wiring. [Status] Closed: BIRDS5-IFTR-01, BIRDS-5 Inhibit Function Test Report (2022/02/17)
1.2-2. Protection devices for short circuit are equipped to protect from external short. The protection devices are DCDC converter, SepSW2, SepSW3 and Isolation (Refer to Figure 1).	1.2-2(1). Confirm the protective design to prevent external short for the battery. [Status] Closed: BIRDS5-EP-01, BIRDS-5 Battery Description Form (2023/09/15) 1.2-2(2). Perform short circuit protection function test. [Status] Closed: BIRDS5-IFTR-01, BIRDS-5 Inhibit Function Test Report (2022/02/17)
1.3. Protection devices are equipped to protect from overcharging. The protection devices are SepSW1, SepSW2 and DCDC converter. (Refer to Figure 1). Note: The battery cells would not be charged even if a fluorescent light shines on the solar cells while on ISS.	1.3(1). Confirm the protective design to prevent overcharging for the battery. [Status] Closed: BIRDS5-EP-01, BIRDS-5 Battery Description Form (2023/09/15) 1.3(2). Perform overcharging protection function test. [Status] Closed: BIRDS5-IFTR-01, BIRDS-5 Inhibit Function Test Report (2022/02/17)
1.4-1. Protection device is equipped to protect from over-discharging. The protection devices are SepSW2, SepSW3, SepSW4, DCDC converter and Diode. (Refer to Figure 1).	1.4-1(1). Confirm the protective design to prevent over-discharging for the battery. [Status] Closed: BIRDS5-EP-01, BIRDS-5 Battery Description Form (2023/09/15) 1.4-1(2). Perform over-discharging protection function test. [Status] Closed: BIRDS5-IFTR-01, BIRDS-5 Inhibit Function Test Report (2022/02/17) 1.4-1(3). Confirm the battery monitor terminals are covered with Kapton tape [Status] Close to VTL: BIRDS5-VTL-01

Hazard Report #: BIRDS5-UNQ--02	Revision Date: 6 October, 2023	Review Level: Phase III

Title : Battery Leakage/Rapture

1.4-2. Proper charge the battery at the time of delivery as a measure against leakage current from signal lines.	1.4-2(1). Evaluate the leakage current of signal lines. [Status] Closed: BIRDS5-UNQ-02 Leak analysis (2023/09/15) 1.4-2(2). Confirm that the battery voltage is in a state of final charge (SOC > 80%) at the time of delivery. [Status] Close to VTL: BIRDS5-VTL-01
1.5. Battery cells which meet the thermal environment condition defined in JX-ESPC-101132E(Japanese)/101133E(English) JPAH Vol.8 Small Satellite Deployment ICD, are selected.	1.5. Perform thermal vacuum test covering the J-SSOD thermal environment condition for the battery cells from same lot with the flight cells. [Status] Closed: BIRDS5-BVR-01, BIRDS-5 Battery verification report (2022/02/22)

Safety Requirements:
SSP51721, ISS Safety Requirements Document

Detection and Warning Methods:	**Additional Safety Features:**
—	—

Cause Remarks:
—

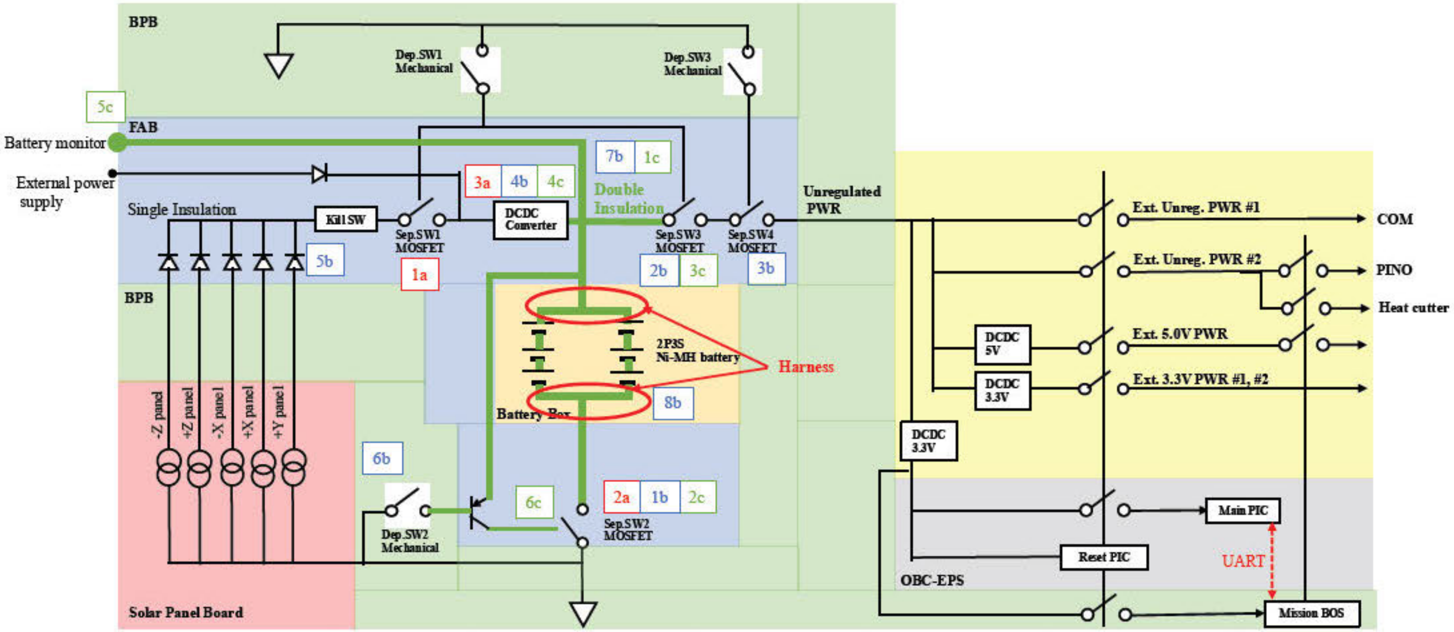
Mission Phases:	**Point of Contact**
☐ Launch Processing: ☒ Launch: ☐ Rendezvous / Docking: ☒ Deployment: ☒ Orbital Assembly & Checkout: ☒ On-orbit Operation: ☐ On-orbit Maintenance: ☐ Descent / Landing:	

Attachment BIRDS5-UNQ-02, Battery Description (1/3)

Figure 1 shows inhibit schematic. There are three deployment switches (SepSW1, SepSW2 and SepSW3)

Figure 2 shows battery connectivity.

Normal electricity consumption is ~1W on orbit. BIRDS-5 does not use the wet Electrolytic Capacitors in EPS.



Hazard		Hazard Control #1	Hazard Control #2	Hazard Control #3
Over-charge		SepSW1[1a]	SepSW2[2a]	DCDC converter[3a]
Over-discharge	Load side	SepSW2[1b]	SepSW3[2b]	SepSW4[3b]
	Solar cell side		DCDC converter[4b]	Diode[5b]
	DepSW2 side	DepSW2 [9b]	Proper Insulation[7b]	Proper charging [8b]
External short	Load side	Proper Insulation[1c]	SepSW2[2c]	SepSW3[3c]
	Solar cell side			DCDC converter[4c]
	External power supply side			DCDC converter[4c]
	Battery monitor side			Proper Insulation[5c]
	DepSW2 side			Proper Insulation[6c]

Note: Proper insulation (double isolation is shown by green line in figure above, single isolation is black line)
All wires and components between the battery and the first power functions are assembled as double insulation
The DCDC converter (LTC3119) used for inhibit is a buck-boost converter and its internal FET configuration prevents reverse current

Figure 1. Electrical Power Schematic

Attachment BIRDS5-UNQ-02, Battery Description (2/3)

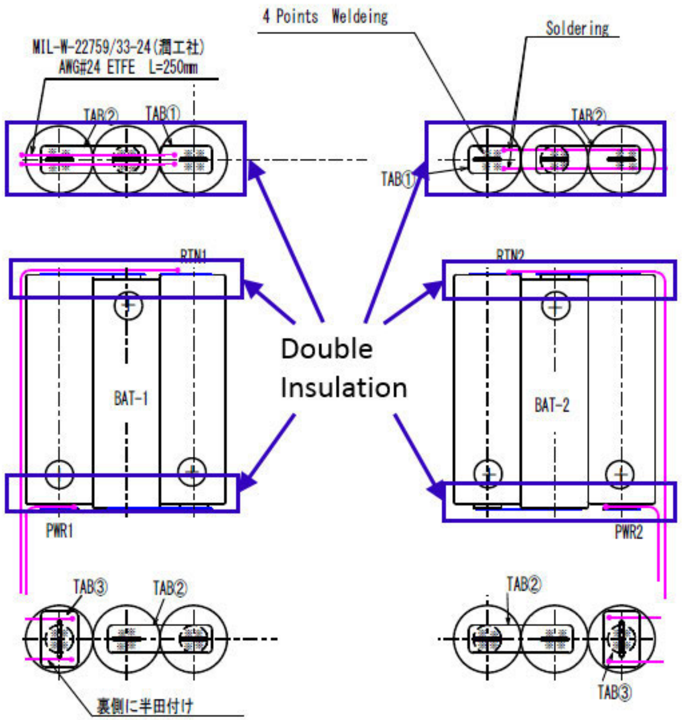
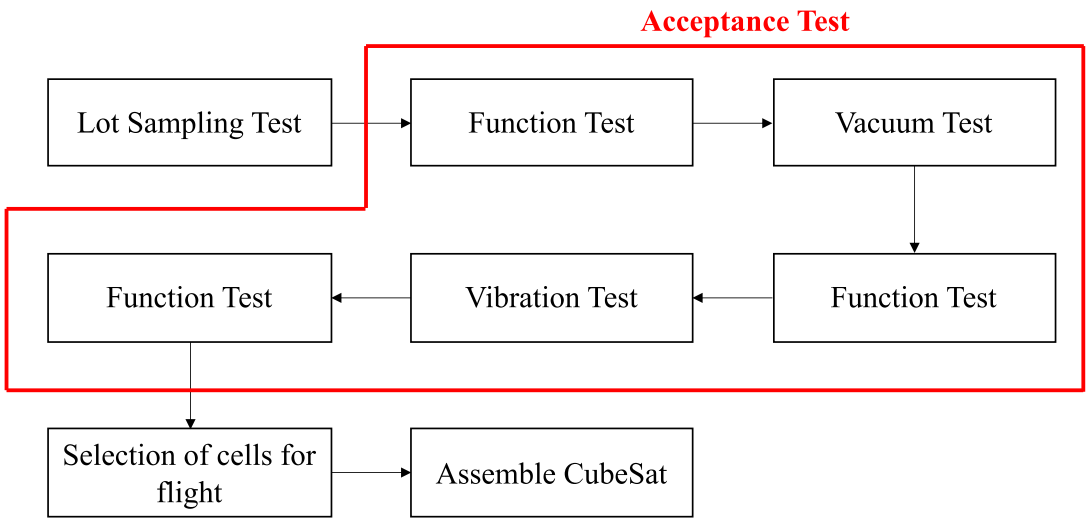


Figure 2. Battery Connectivity



Function Test

- Visual Inspection (scratches, misaligned seals, electrolyte leakage etc.)
- Measurement mass
- Measurement open circuit voltage
- Measurement charge and discharge characteristic / Temperature characteristic for discharge
- Measurement capacity

Figure 3. Flowchart for screening test

Leakage current evaluation of power supply circuits

The inhibit circuit of the BIRDS BUS has the circuit configuration shown in Figure 1. The MOSFET (SepSW2) on the battery GND side is operated by turning the transistor ON and OFF with DepSW2. Considering the bias resistance inside this transistor, etc., closing DepSW2 in Figure 2, causes current to flow through the bias resistance, etc. We analyzed the leakage current from the battery when two inhibit switches fail.

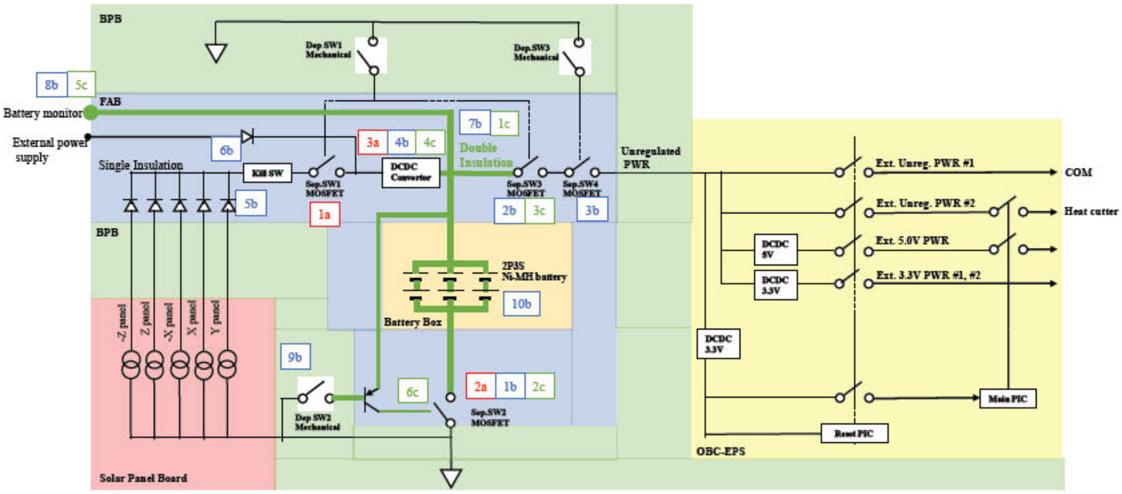


Figure1 Inhibit diagram

If DepSW1 and DepSW2 have an ON fault

Calculate the discharge current when DepSW1 and DepSW2 is turned on.

When DepSW1 is turned on and connected to GND, leakage current flows through the resistor placed in front of SepSW3 and FET in the DCDC convertor.

The following assumptions are made in the calculation.

・The main consumption currents are assumed to be I_1 to I_6.

・The bias resistance inside the transistor ranges from 33kΩ to 66kΩ, but as a worst-case scenario, R5, R6, R7, R8=33kΩ is assumed.

・R1, R2, R9, R10=1kΩ, R3, R4, R22, R32=100kΩ, R17=100kΩ, R21=430kΩ

・The battery voltage is assumed to be constant at 3.6V.

・Leakage current of the FET in the DCDC converter is 10 μA from the specification sheet (Table1)

Table1 Electrical characteristics of DCDC convertor

LTC3119

ELECTRICAL CHARACTERISTICS The ● denotes the specifications which apply over the specified operating junction temperature range, otherwise specifications are at $T_A = 25°C$. $V_{IN} = PV_{IN} = 12V$, $PV_{OUT} = 5V$, $R_T = 76.8k$ unless otherwise stated.

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
N-Channel Switch Resistance	Switch A (PV_{IN} to SW1) Switch B (SW1 to PGND) Switch C (SW2 to PGND) Switch D (SW2 to PV_{OUT})			30 30 30 30		mΩ mΩ mΩ mΩ
N-Channel Switch Leakage	$PV_{IN} = PV_{OUT} = 18V$, SW1 = SW2 = 0V, 18V			1	10	μA
V_{CC} Regulation Voltage		●	3.55	3.70	3.85	V
V_{CC} Dropout Voltage	V_{CC} Current = 50mA, V_{IN} = 3V			90		mV
V_{CC} Current Limit			180			mA
V_{CC} Reverse Current	V_{CC} = 5V, V_{IN} = 3V			5		μA

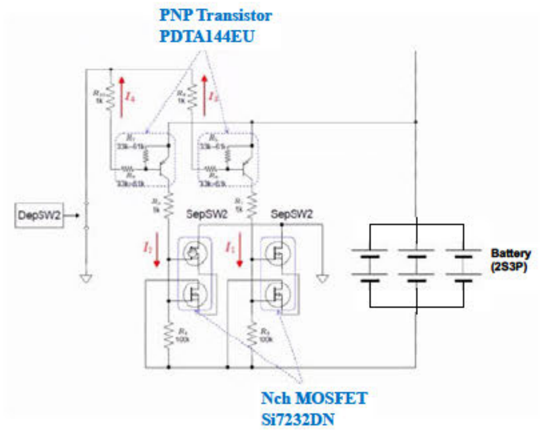


Figure2 Detail of the separation switch on GND side

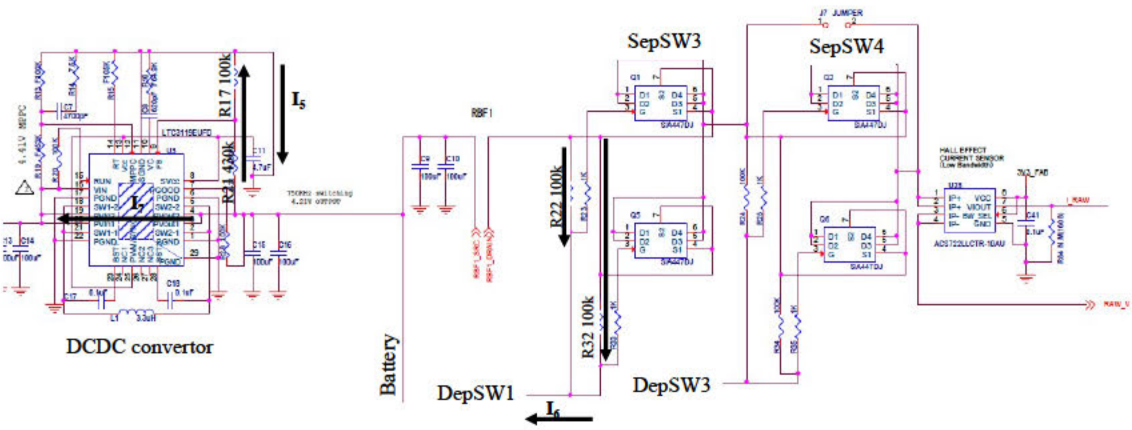


Figure3 Detail of the separation switch on HOT side

$$I_1 = \frac{V_{Bat}}{R_1 + R_3} = \frac{3.6}{10^3 + 10^5} = 35.6 \times 10^{-6}$$

$$I_2 = \frac{V_{Bat}}{R_2 + R_4} = \frac{3.6}{10^3 + 10^5} = 35.6 \times 10^{-6}$$

$$I_3 = \frac{V_{Bat}}{R_5 + R_6 + R_9} = \frac{3.6}{33 \times 10^3 + 33 \times 10^3 + 10^3} = 53.7 \times 10^{-6}$$

$$I_4 = \frac{V_{Bat}}{R_7 + R_8 + R_{10}} = \frac{3.6}{33 \times 10^3 + 33 \times 10^3 + 10^3} = 53.7 \times 10^{-6}$$

$$I_5 = \frac{V_{Bat}}{R_{17} + R_{21}} = \frac{3.6}{100 \times 10^3 + 430 \times 10^3} = 6.79 \times 10^{-6}$$

$$I_6 = \frac{V_{Bat}(R_{22} + R_{32})}{R_{22}R_{32}} = \frac{3.6(100 \times 10^3 + 100 \times 10^3)}{100 \times 10^3 \times 100 \times 10^3} = 72 \times 10^{-6}$$

$$I_7 = 10 \times 10^{-6}$$

$$I_{total} = I_1 + I_2 + I_3 + I_4 + I_5 + I_6 + I_7 = 267.39 \times 10^{-6}[A]$$

The total leakage current I_{total} is about 0.268 mA. The capacity at which the battery reaches over-discharge is 4,000 mAh, so if the battery is discharged from a full charge, it takes the following number of days for the battery to become over-discharged.

$$t = \frac{3800}{0.268} = 14.18 \times 10^3[h] \approx 590[day]$$

This number of days is well more than one year from satellite delivery to release. The calculations assume a fully charged battery at rated capacity. In an actual battery, the time until over-discharge is expected to be somewhat shorter than this calculation result, but it is still considered to be sufficient.

Prov der Name:

Hazard Report #: BIRDS5-UNQ-03	**Revision Date:** 6 October, 2023	**Review Level:** Phase III

Title : Exposure of the ISS to Excessive Levels of EMI radiation and RF radiation

System: BIRDS-5

Sub-Subsystem: Non-ionizing Radiation

Flight/Increment Applicability:
HTV / Cygnus / Dragon
Inc.(TBD) and subsequent stages.

Mission Phases:
☐ Launch Processing: ☒ Launch: ☐ Rendezvous / Docking:
☒ Deployment: ☒ Orbital Assembly & Checkout: ☒ On-orbit Operation:
☐ On-orbit Maintenance: ☐ Descent / Landing:

Scope:
☒ Payload: ☐ JEM - PM: ☐ JEM - EF:
☐ Other(　　　　):

Interfaces:
☐ JEM-PM ☐ JEM-EF ☒ JEM-AIRLOCK ☒ JEMRMS
☐ Other(　　　　):

Hazardous Condition Description:
Inadvertent RF radiation and/or EMI from VHF (145.825 MHz) in the habitable volume induce hazardous effects on ISS avionics/circuitry, other payloads, and/or visiting vehicles.

Freq. [MHz]	Transmit Power [W]	Antenna Gain [dBi]	Max. Radiation Power [W]	Electrical Field Strength [V/m] (*1)	Power Density $[W/m^2]$	Criteria(*2)	
						Max. Radiation Power [W]	Electrical Field Strength [V/m]
145.825	0.5	2	0.79	4.88	-39	0.075	1.58

(*1) at 1[m] away from the source. (*2) OE-14-002.

[Note1]: Regarding the power supply from the solar cell, the amount of light in the ISS is about 1,400Lm / m^2 (= 2.1W / m^2). The solar cells used on the outer surface of CubeSat are two in series on each side, and are attached to five sides for a total of ten solar cells for 1U CubeSat and a fourteen solar cells for 2U CubeSat. The area of each cell is 0.003mm2, and the total energy that can be generate is about 42.2mW for 1U CubeSat and 59.1mW for 2U CubeSat. The minimum power required to operate the Reset PIC, which controls the power supply to the OBC and COM, is 380 mW. Therefore, OBC and ResetPIC cannot be started with the power from the solar cell, and power cannot be supplied to the COM device.

Cause Summary:
Cause 1. Exposure of the ISS to Excessive Levels of EMI radiation and RF radiation

Remarks:

Submittal Concurrence:

Signature	Date
T.Yamauchi	2023.10.6

Safety Review Panel Approval

Signature	Date
小林亮二	Oct. 27, 2023

ISS_OE_851
Export Contro C ass f cat on:
Propr etary Statement (f requ red):

Prov der Name:

Hazard Report #: BIRDS5-UNQ-03	Revision Date: 6 October, 2023	Review Level: Phase III
Title : Exposure of the ISS to Excessive Levels of EMI radiation and RF radiation		

Cause Number:	**Cause Title:**
1	Exposure of the ISS to Excessive Levels of EMI radiation and RF radiation

Hazard Cause Description:
1.1 Electromagnetic Radiation (Non-ionizing) causing injury to crew or interference with ISS systems

Severity:	**Likelihood:**
☒ I (Catastrophic) ☐ II (Critical)	☐ A (Probable) ☐ B (Infrequent) ☒ C (Remote) ☐ D (Improbable)
Controls: 1.1. The transmitter is designed to provide adequate controls of the RF radiation hazard by using three separation switches. (Refer to Figure 1) [Inhibits for RF transmission] (1) Separation Switch #2 (2) Separation Switch #3 (3) Separation Switch #4	**Verification Method and Status:** 1.1. Perform function test of the protection devices. [Status] Closed: BIRDS5-IFTR-01, BIRDS-5 Inhibit Function Test Report (2022/02/17)

Safety Requirements:
SSP51721, ISS Safety Requirements Document

Detection and Warning Methods:	**Additional Safety Features:**
—	It does not emit RF with the electromotive force of Solar Array

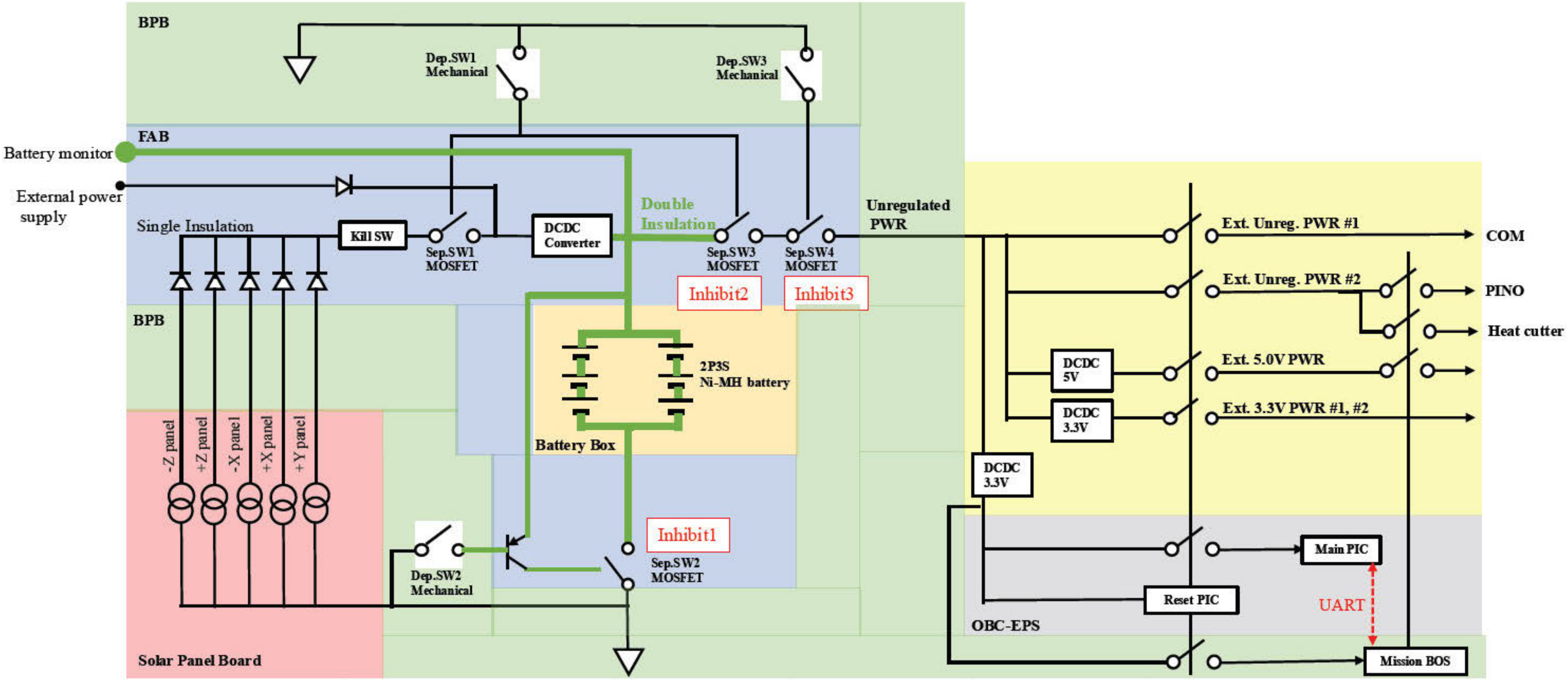
Cause Remarks:
—

Mission Phases:	**Point of Contact**
☐ Launch Processing: ☒ Launch: ☐ Rendezvous / Docking: ☒ Deployment: ☒ Orbital Assembly & Checkout: ☒ On-orbit Operation: ☐ On-orbit Maintenance: ☐ Descent / Landing:	

ISS_OE_851
Export Contro C ass f cat on:
Propr etary Statement (f requ red):

Attachment-1 of BIRDS5-UNQ-03, BIRDS-5 Inhibit Description (1/6)

When at least one of the three separation switches are turned off, current from battery to the communication system located at Load is cut by disconnecting circuit.



	Inhibit1	Inhibit2	Inibit3
Deactivate COM system	SepSW2	SepSW3	SepSW4

Figure 1. Inhibit Schematic

Attachment BIRDS5-UNQ-03, BIRDS-5 RF sequence Description (2/6)

The sequence of RF radiation is as follows.

1. DepSW1 keeps SepSW1 and SepSW3, DepSW2 keeps SepSW2 and DepSW3 keeps SepSW4 open until the satellite is released.
2. When the DepSW1, DepSW2, and DepSW3 are closed after the satellite is released from the ISS, the PIC microcomputer (Reset PIC) is worked.
3. After the Reset PIC counts for 2000 seconds, it starts energizing the Main PIC, COM.
4. The Main PIC gives instructions to the Mission BOS PIC.
5. The Mission BOS PIC receives the instruction and turns on the power of the heat cutter.
6. Antennas are deployed, and communication begins.

Attachment BIRDS5-UNQ-03, BIRDS-5 Verification of solar cell power (3/6)

Since walls of J-SSOD-R launch case are transparent, if there are not enough inhibits and all inhibits located on the closed circuit from solar cell to load are accidentally closed, there is possibility to generate power with solar cells and activate some function of satellite which may cause hazard. To prove this function are not activated with the power generated by light inside JEM, it is required to show the power for activating the function is larger than the generated power with solar cells.

[Presupposition]

All we got from JAXA are shown below.

1. Graph of Relative Intensity of 3 mode of GLA (General Luminaire Assembly) (Figure 5)
2. Value of Max Illuminance at 1m from deck*: 1400[lx]

*There are 8 GLA in every 1m on each standoff of AFT/OVHD and FWD/OVHD inside JEM PM as shown in Figure 6. It is little difficult to calculate the distance from all GLA to work space, so this value was calculated by considering the work space surrounded by 2 GLA which has 8 times power of real GLA for each are located on AFT/OVHD and FWD/OVHD. Thus, it is very conservative value.

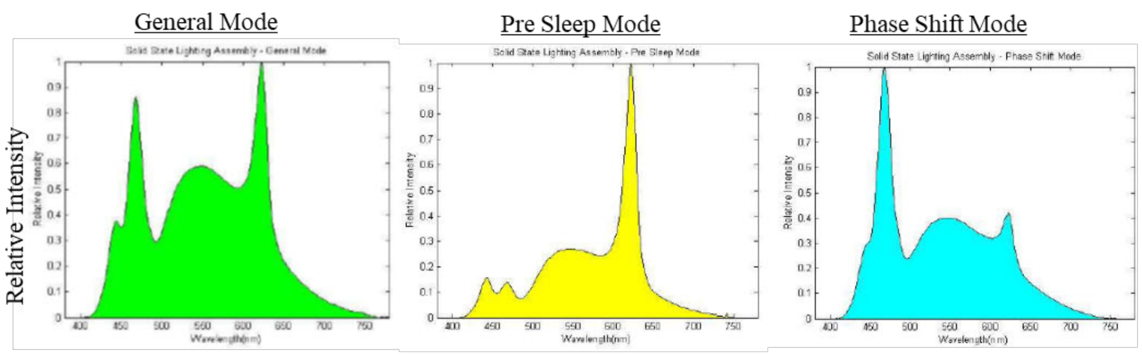


Figure 5: Relative Intensity

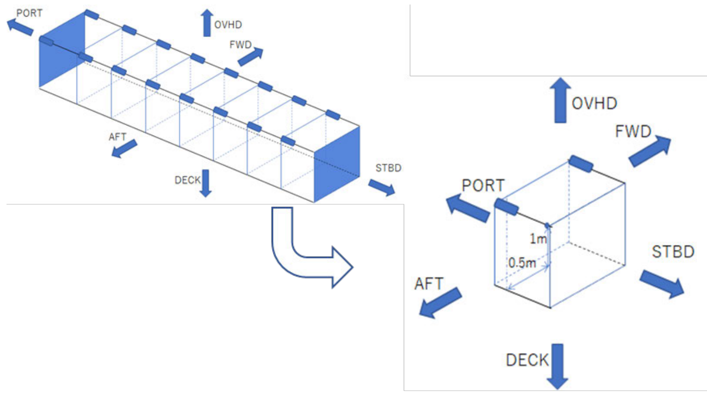


Figure 6: Illuminance inside JEM

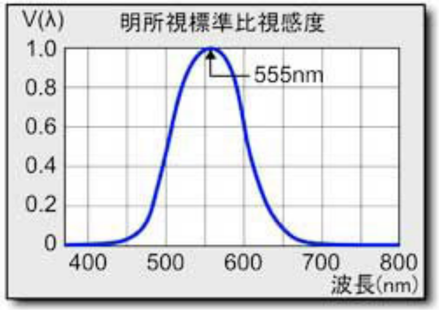
Attachment BIRDS5-UNQ-03, BIRDS-5 Verification of solar cell power (4/6)

Illuminance is calculated by the following formula.

Illuminance[lx] = Σ (683[lm/W] x Luminosity Function @each wave length x Irradiance [W/m2)@each wave length)

= Σ (683 x A x Relative Intensity @each wave length x Irradiance [W/m2)@each wave length)

683: Max Luminous Sensitivity. , Luminosity Function: shown right. It is defined as CIE1924., A: Absolute Irradiance/Relative Intensity



To get total irradiance [W/m2] of all wavelengths of the GLA, we have to integrate Irradiance @each wavelength. And, to get absolute Irradiance@ each wavelength, factor A (Absolute Irradiance/Relative Intensity) is needed. With the value read from each relative intensity graph, luminosity function and Max Illuminance 1400[lx], the whole irradiance was calculated, and the result are shown below.

<u>General Mode</u>

A: 3.32 x 10^-2

Irradiance: 4.47 [W/m2]

<u>Pre-Sleep Mode</u>

A: 7.26 x 10^-2

Irradiance: 4.19 [W/m2]

<u>Phase Shift Mode</u>

A: 5.32 x 10^-2

Irradiance: 4.69 [W/m2]

・1U CubeSat case

[Generated Power]

Spec, number of solar cells of BIRDS-5 is shown below.

Area of each solar cell: 0.003 [m2]

Number of solar cells: 10

Conversion Efficiency: 30 [%] * *Exact value of this solar cells is unknown. So, theoretical max value is used.

The generated power on each mode is calculated as shown below.

General Mode

Generated Power : 4.47 x 0.003 x 10 x 0.3 = 0.0402[W]

Pre-Sleep Mode

Generated Power : 4.19 x 0.003 x 10 x 0.3 = 0.0377[W]

Phase Shift Mode

Generated Power : 4.69 x 0.003 x 10 x 0.3 = 0.0422[W]

・2U CubeSat case

[Generated Power]

Spec, number of solar cells of BIRDS-5 is shown below.

Area of each solar cell: 0.003[m2]

Number of solar cell: 14

Conversion Efficiency: 30[%]* *Exact value of this solar cells are unknown. So, theoretical max value is used.

The generated power on each mode is calculated as shown below.

General Mode

Generated Power : 4.47 x 0.003 x 14 x 0.3 = 0.0563[W]

Pre-Sleep Mode

Generated Power : 4.19 x 0.003 x 14 x 0.3 = 0.0528 [W]

Phase Shift Mode

Generated Power : 4.69 x 0.003 x 14 x 0.3 = 0.0591[W]

[Required Power for Activate Function]

The function of the BRIDS-5 whose accidental activation may cause hazard are a battery heater and a RF radiation.

The battery heater is activated by the OBC.

The minimum power required to operate the Reset PIC, which controls the power supply to the OBC and COM is shown below.

Activation of Reset PIC: 0.380 [W]

Conclusion

The required power for activating the battery heater and the COM is very larger than power generated with solar cells with light inside ISS, even Reset PIC cannot be activated with power generated with solar cells. Thus, there is no possibility to cause hazard by this function activation.

Prov der Name:

Hazard Report #: BIRDS5-UNQ-04	Revision Date: 6 October, 2023	Review Level: Phase III

Title : Impact / Collision to ISS due to inappropriate CubeSat deployment from J-SSOD by inadvertently-deployment

System: BIRDS-5	**Sub-Subsystem:** Mechanical
Flight/Increment Applicability: HTV / Cygnus / Dragon Inc.(TBD) and subsequent stages.	**Mission Phases:** ☐ Launch Processing: ☒ Launch: ☐ Rendezvous / Docking: ☒ Deployment: ☒ Orbital Assembly & Checkout: ☒ On-orbit Operation: ☐ On-orbit Maintenance: ☐ Descent / Landing:
Scope: ☒ Payload: ☐ JEM - PM: ☐ JEM - EF: ☐ Other( ):	**Interfaces:** ☐ JEM-PM ☐ JEM-EF ☒ JEM-AIRLOCK ☒ JEMRMS ☐ Other( ):

Hazardous Condition Description:

Inadvertent deployment of antenna inside J-SSOD will potentially cause collision with ISS structure due to sticking of the CubeSat antenna into any gap of the J-SSOD inner surface or adjacent satellites. Also, inappropriate design and/or manufacturing of the satellite may lead to inappropriate satellite deployment from J-SSOD.

Cause Summary:

Cause 1. Inadvertently Deployed of the CubeSat deployment

Remarks:

Submittal Concurrence:		**Safety Review Panel Approval**	
Signature T.Yamauchi	**Date** 2023.10.6	**Signature** 小林亮二	**Date** Oct. 27, 2023

ISS_OE_851
Export Contro C ass f cat on:
Propr etary Statement (f requ red):

Hazard Report #: BIRDS5-UNQ-04	Revision Date: 6 October, 2023	Review Level: Phase III
Title : Impact / Collision to ISS due to inappropriate CubeSat deployment from J-SSOD by inadvertently-deployment		

Cause Number:	Cause Title:
1	Inadvertently Deployed of the CubeSat deployment

Hazard Cause Description:

1.1 Sticking due to inadvertent deployment inside J-SSOD.
1.2 Inappropriate design or manufacturing of the satellite.

[Note 1]. Unintentional deployment of the antennas is controlled by three deployment switches. These three deployment switches are released after deploying the CubeSat from the Satellite Install Case, then the CubeSat activates, and the deployment items are deployed after 30 minutes.

[Note 2]: Regarding the power supply from the solar cell, the amount of light in the ISS is about 1,400Lm / m^2 (= 2.1W / m^2). The solar cells used on the outer surface of CubeSat are two in series on each side, and are attached to five sides for a total of ten solar cells for 1U CubeSat and a fourteen solar cells for 2U CubeSat. The area of each cell is 0.003mm2, and the total energy that can be generate is about 42.2mW for 1U CubeSat and 59.1mW for 2U CubeSat. The minimum power required to operate the Reset PIC, which controls the power supply to the OBC and COM, is 380 mW. Therefore, OBC and Reset PIC cannot be started with the power from the solar cell, and power cannot be supplied to the COM device.

Severity:	Likelihood:
☒ I (Catastrophic) ☐ II (Critical)	☐ A (Probable) ☐ B (Infrequent) ☒ C (Remote) ☐ D (Improbable)

Controls:	Verification Method and Status:
1.1-1 Protection devices are equipped to deactivate deployment mechanism before deployment. The protection devices are three deployment switches.	1.1-1(1) Perform function test of the protection devices. [Status] Closed: BIRDS5-IFTR-01, BIRDS5 Inhibit Function Test report (2022/02/17) 1.1-1(2) Inspection of the proper insulation. [Status] Closed: BIRDS5-IFTR-01, BIRDS5 Inhibit Function Test report (2022/02/17)
1.1-2 The CubeSat shall be implemented according to JAXA approved structure verification and control plan (JMX-2011303E), of which scope covers JBX-97160C, JEM Payload Fracture Control Plan.	1.1-2 Fracture Control Evaluation Form is submitted to and approved by JAXA. [Status] Closed: BIRDS5-FCE-01, BIRDS-5 Fracture Control Evaluation Form for Phase 0/I/II (2023/09/15)

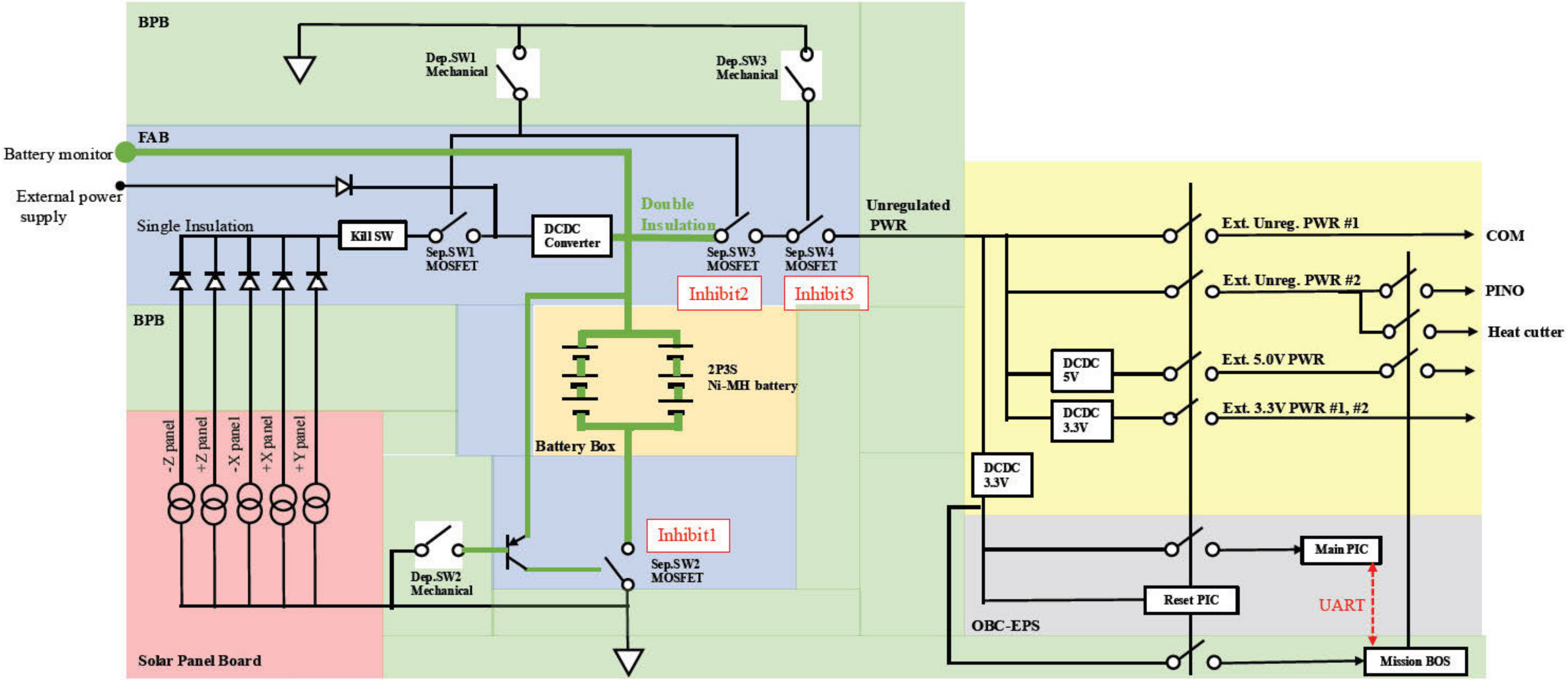
Hazard Report #: BIRDS5-UNQ-04	Revision Date: 6 October, 2023	Review Level: Phase III
Title : Impact / Collision to ISS due to inappropriate CubeSat deployment from J-SSOD by inadvertently-deployment		

	[Status] Closed: BIRDS5-FCE-02, BIRDS-5 Fracture Control Evaluation Form for Phase III (2023/10/06)
1.2 Design and Manufacture the satellite in accordance with the JX-ESPC-101132E(Japanese) / 101133E(English) dimension and mass requirements.	1.2 Inspection of as-built hardware. [Status] Closed: BIRDS5-AD-01, BIRDS-5 FM Assembly Drawing (2021/12/09) [Status] Closed: BIRDS5-AP-01, BIRDS-5 Assembly Procedure (2021/12/09) [Status] Closed: BIRDS5-AR-01, BIRDS-5 Assembly Record (2022/02/18)
Safety Requirements: SSP51721, ISS Safety Requirements Document JX-ESPC-101132 E (Japanese) / 101133E (English), JEM Payload Accommodation Handbook Vol.8	
Detection and Warning Methods: —	**Additional Safety Features:** —
Cause Remarks: —	
Mission Phases: ☐ Launch Processing: ☒ Launch: ☐ Rendezvous / Docking: ☒ Deployment: ☒ Orbital Assembly & Checkout: ☒ On-orbit Operation: ☐ On-orbit Maintenance: ☐ Descent / Landing:	**Point of Contact**

Attachment-1 of BIRDS5-UNQ-04 (1/7)

When at least one of the three deployment switches are pushed in, current from battery to the heat cutter is cut by disconnecting circuit.

Furthermore, a sufficient power is not expected to be generated by solar panels to deploy the antenna since they are covered by J-SSOD's outer structure.



	Inhibit1	Inhibit2	Inibit3
Deactivate the heat cutter circuit	SepSW2	SepSW3	SepSW4

Figure 1. Inhibit Schematic with Deployment System

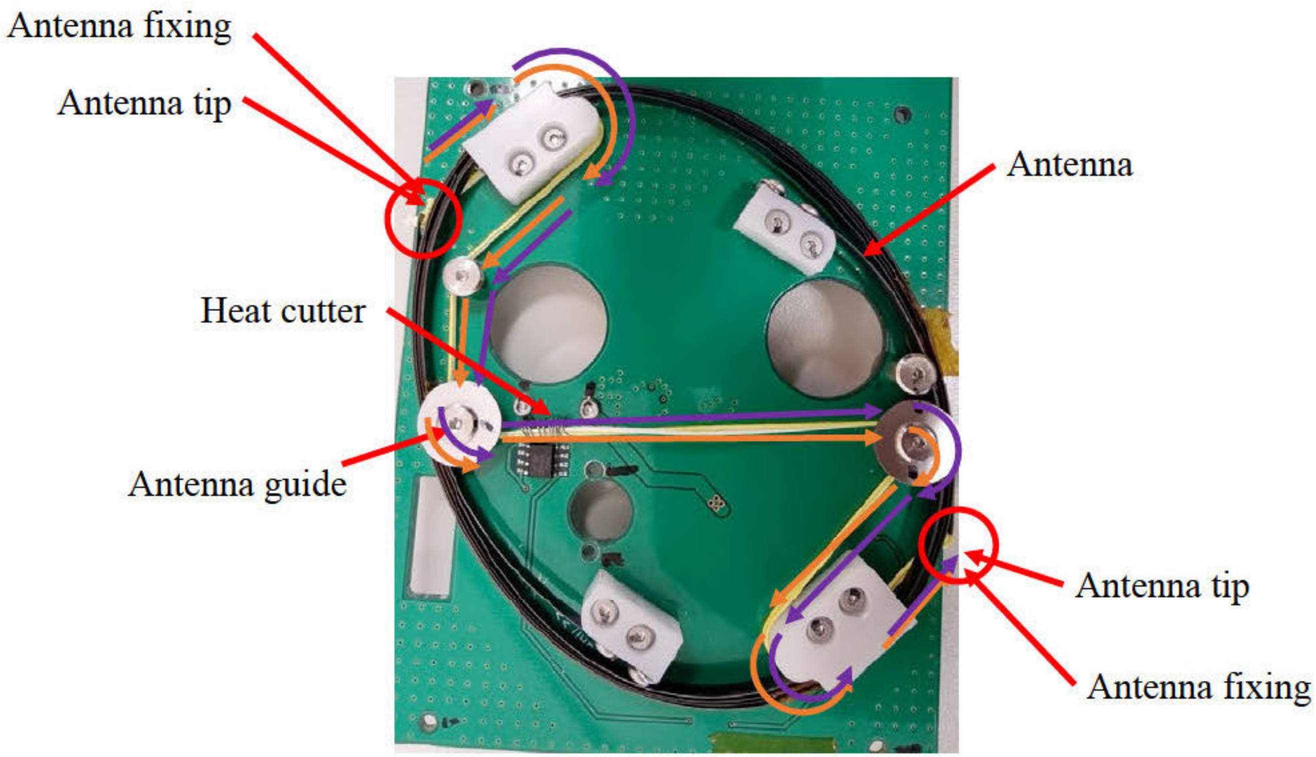


Figure 2 Stowed Antenna Configuration

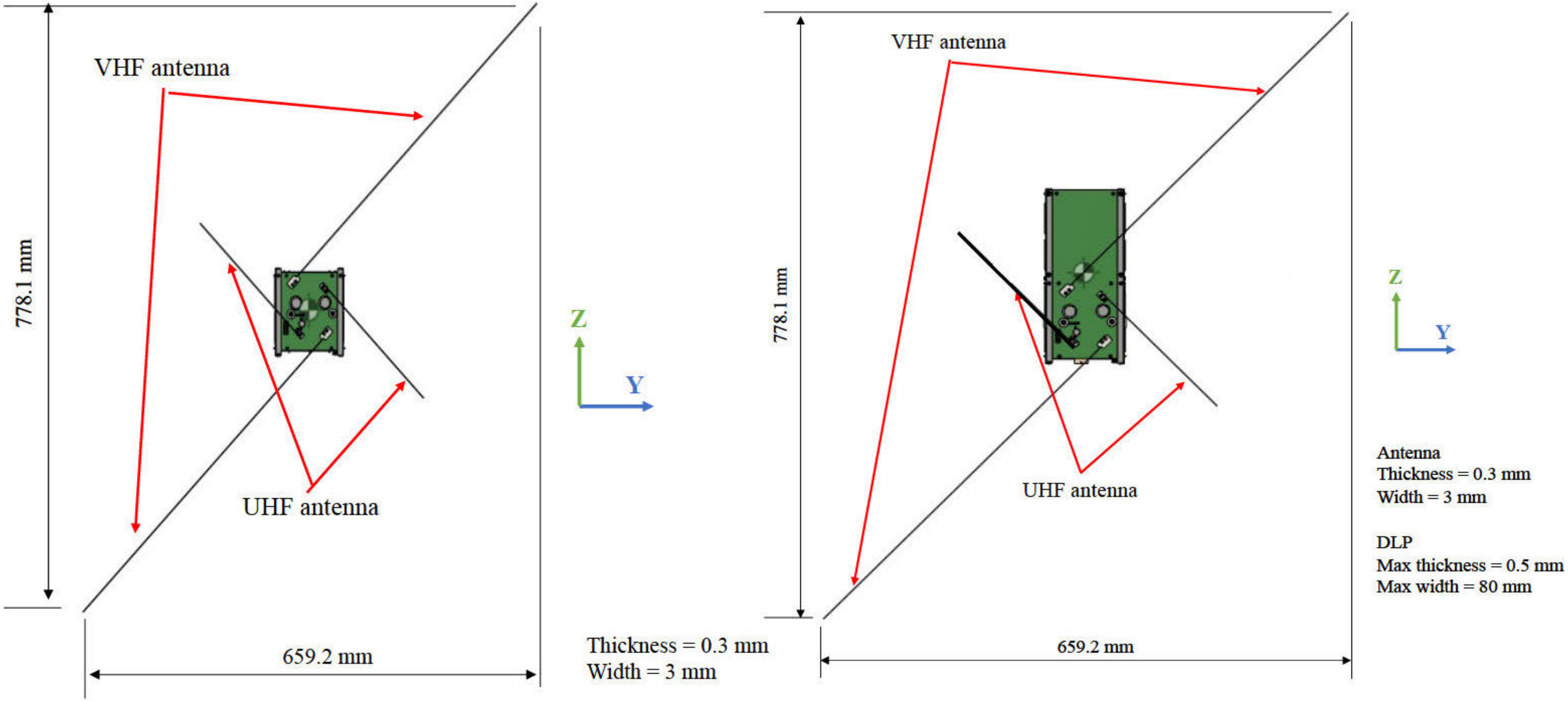


Figure 3 Deployed Antenna Configuration

Attachment BIRDS5-UNQ-04, BIRDS-5 Verification of solar cell power (4/7)

Since walls of J-SSOD-R launch case are transparent, if there are not enough inhibits and all inhibits located on the closed circuit from solar cell to load are accidentally closed, there is possibility to generate power with solar cells and activate some function of satellite which may cause hazard. To prove this function are not activated with the power generated by light inside JEM, it is required to show the power for activating the function is larger than the generated power with solar cells.

[Presupposition]

All we got from JAXA are shown below.

1. Graph of Relative Intensity of 3 mode of GLA (General Luminaire Assembly) (Figure 5)
2. Value of Max Illuminance at 1m from deck*: 1400[lx]

*There are 8 GLA in every 1m on each standoff of AFT/OVHD and FWD/OVHD inside JEM PM as shown in Figure 6. It is little difficult to calculate the distance from all GLA to work space, so this value was calculated by considering the work space surrounded by 2 GLA which has 8 times power of real GLA for each are located on AFT/OVHD and FWD/OVHD. Thus, it is very conservative value.

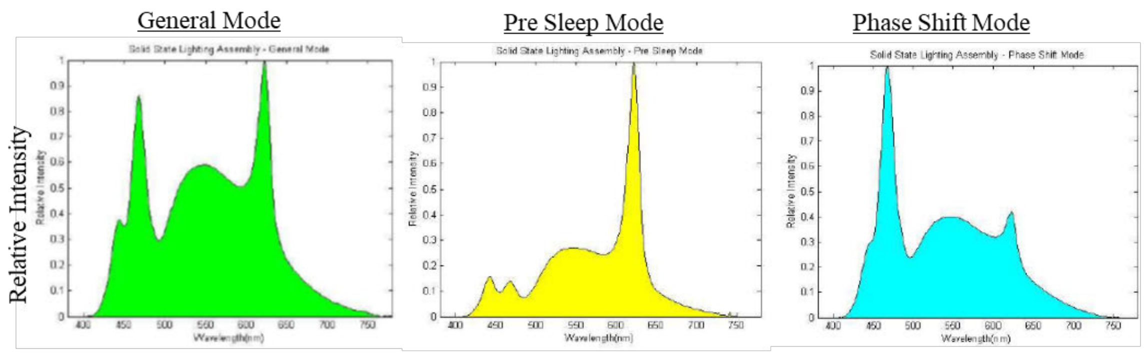


Figure 5: Relative Intensity

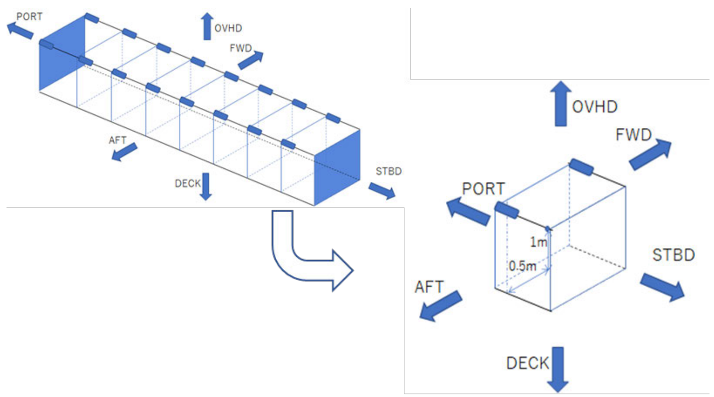


Figure 6: Illuminance inside JEM

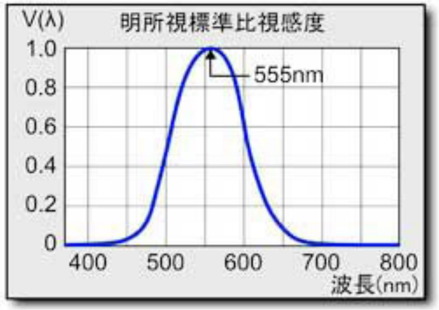
Attachment BIRDS5-UNQ-04, BIRDS-5 Verification of solar cell power (5/7)

Illuminance is calculated by the following formula.

Illuminance[lx] = Σ (683[lm/W] x Luminosity Function @each wave length x Irradiance [W/m2)@each wave length)

= Σ (683 x A x Relative Intensity @each wave length x Irradiance [W/m2)@each wave length)

683: Max Luminous Sensitivity. , Luminosity Function: shown right. It is defined as CIE1924., A: Absolute Irradiance/Relative Intensity



To get total irradiance [W/m2] of all wavelengths of the GLA, we have to integrate Irradiance @each wavelength. And, to get absolute Irradiance@ each wavelength, factor A (Absolute Irradiance/Relative Intensity) is needed. With the value read from each relative intensity graph, luminosity function and Max Illuminance 1400[lx], the whole irradiance was calculated, and the result are shown below.

<u>General Mode</u>

A: 3.32 x 10^-2

Irradiance: 4.47 [W/m2]

<u>Pre-Sleep Mode</u>

A: 7.26 x 10^-2

Irradiance: 4.19 [W/m2]

<u>Phase Shift Mode</u>

A: 5.32 x 10^-2

Irradiance: 4.69 [W/m2]

Attachment BIRDS5-UNQ-04, BIRDS-5 Verification of solar cell power (6/7)

・1U CubeSat case

[Generated Power]

Spec, number of solar cells of BIRDS-5 is shown below.

Area of each solar cell: 0.003 [m2]

Number of solar cells: 10

Conversion Efficiency: 30 [%] * *Exact value of this solar cells is unknown. So, theoretical max value is used.

The generated power on each mode is calculated as shown below.

General Mode

Generated Power : 4.47 x 0.003 x 10 x 0.3 = 0.0402[W]

Pre-Sleep Mode

Generated Power : 4.19 x 0.003 x 10 x 0.3 = 0.0377[W]

Phase Shift Mode

Generated Power : 4.69 x 0.003 x 10 x 0.3 = 0.0422[W]

・2U CubeSat case

[Generated Power]

Spec, number of solar cells of BIRDS-5 is shown below.

Area of each solar cell: 0.003[m2]

Number of solar cell: 14

Conversion Efficiency: 30[%]* *Exact value of this solar cells are unknown. So, theoretical max value is used.

Attachment BIRDS5-UNQ-04, BIRDS-5 Verification of solar cell power (7/7)

The generated power on each mode is calculated as shown below.

General Mode

Generated Power : 4.47 x 0.003 x 14 x 0.3 = 0.0563[W]

Pre-Sleep Mode

Generated Power : 4.19 x 0.003 x 14 x 0.3 = 0.0528 [W]

Phase Shift Mode

Generated Power : 4.69 x 0.003 x 14 x 0.3 = 0.0591[W]

[Required Power for Activate Function]

The function of the BRIDS-5 whose accidental activation may cause hazard are a Heat cutter, a RF radiation and PINO.

The heat cutter is activated by the OBC.

The minimum power required to operate the Reset PIC, which controls the power supply to the OBC and COM is shown below.

Activation of Reset PIC: 0.380 [W]

Conclusion

The required power for activating the heat cutter, the COM and the PINO is very larger than power generated with solar cells with light inside ISS, even Reset PIC cannot be activated with power generated with solar cells. Thus, there is no possibility to cause hazard by this function activation.

Provider Name:

Hazard Report #: BIRDS5-UNQ-05	Revision Date: 6 October, 2023	Review Level: Phase III
Title : Electric Shock		

System : BIRDS-5	Sub-Subsystem: Power Line
Flight/Increment Applicability: HTV / Cygnus / Dragon Inc.(TBD) and subsequent stages.	**Mission Phases:** ☐Launch Processing: ☒Launch: ☐Rendezvous / Docking: ☒Deployment: ☒Orbital Assembly & Checkout: ☒On-orbit Operation: ☐On-orbit Maintenance: ☐Descent / Landing:
Scope: ☒Payload: ☐JEM - PM: ☐ JEM - EF: ☐ Other( ):	**Interfaces:** ☐JEM-PM ☐JEM-EF ☒JEM-AIRLOCK ☒JEMRMS ☐ Other( ):

Hazardous Condition Description:

BIRDS-5 2U "TAKA" has the electrical board generating High voltage* for the radiation measurement of precipitation of high-energy electrons in the Van-Allen radiation belt inside PINO module, which may cause electrical shock of ISS crew. To prevent electrical shock of crew, three deployment switches are equipped independently to cut the power.

*2kV maximum for PINO (Particle Instrument for Nano-satellites) module.

[Note1]: Regarding the power supply from the solar cell, the amount of light in the ISS is about 1400Lm / m^2 (= 2.1W / m^2). The solar cells used on the outer surface of CubeSat are two in series on each side, and are attached to five sides for a total of ten solar cells for 1U CubeSat and a fourteen solar cells for 2U CubeSat. The area of each cell is 0.003mm2, and the total energy that can be generate is about 42.2mW for 1U CubeSat and 59.1mW for 2U CubeSat. The minimum power required to operate the Reset PIC, which controls the power supply to the OBC and COM, is 380 mW. Therefore, OBC and ResetPIC cannot be started with the power from the solar cell, and power cannot be supplied to the COM device.

Cause Summary:

Cause 1. Contact to activating high voltage circuit

Remarks:

Submittal Concurrence: Signature	Date	Safety Review Panel Approval Signature	Date
T.Yamauchi	2023.10.6	小林亮二	Oct. 27, 2023

ISS OE 851
Export Control Classification:
Proprietary Statement (if required):

Provider Name:

Hazard Report #: BIRDS5-UNQ-05	Revision Date: 6 October, 2023	Review Level: Phase III
Title : Electric Shock		

Cause Number: 1	**Cause Title:** Contact to activating high voltage circuit
Hazard Cause Description: 1.1 Contact to activating high voltage circuit	
Severity: ☒**I (Catastrophic)** ☐**II (Critical)**	**Likelihood:** ☐**A (Probable)** ☐**B (Infrequent)** ☒**C (Remote)** ☐**D (Improbable)**
Controls:	**Verification Method and Status:**
1.1-1 Protection device for activating high voltage circuit is equipped. The protection device is Separation Switch 4 by deployment Switch 3 shown in Figure 1.	1.1-1. Perform protection function test to check satellite is deactivated by pushing the Deployment Switch 3 after FM vibration test. [Status] Closed: BIRDS5-IFTR-01, Inhibit Function Test report (2022/02/17)
1.1-2 Protection device for activating high voltage circuit is equipped. The protection device is Separation Switch 2 by deployment Switch 2 shown in Figure 1.	1.1-2. Perform protection function test to check satellite is deactivated by pushing Deployment Switch 2 after FM vibration test. [Status] Closed: BIRDS5-IFTR-01, Inhibit Function Test report (2022/02/17)
1.1-3 Protection device for activating high voltage circuit is equipped. The protection device is Separation Switch 3 by deployment Switch 1 shown in Figure 1. [NOTE] The circuit that goes the line of the Solar cells and Load (not through the battery line) in Figure 1 has two independent inhibits of three separation switches (Sep SW 1, 3 and 4). Even if these three separation switches are closed, the satellite sustains the condition of deactivation.	1.1-3. Perform protection function test to check satellite is deactivated by pushing Deployment Switch 1 after FM vibration test. [Status] Closed: BIRDS5-IFTR-01, Inhibit Function Test report (2022/02/17)
Safety Requirements:	

ISS OE 851
Export Control Classification:
Proprietary Statement (if required):

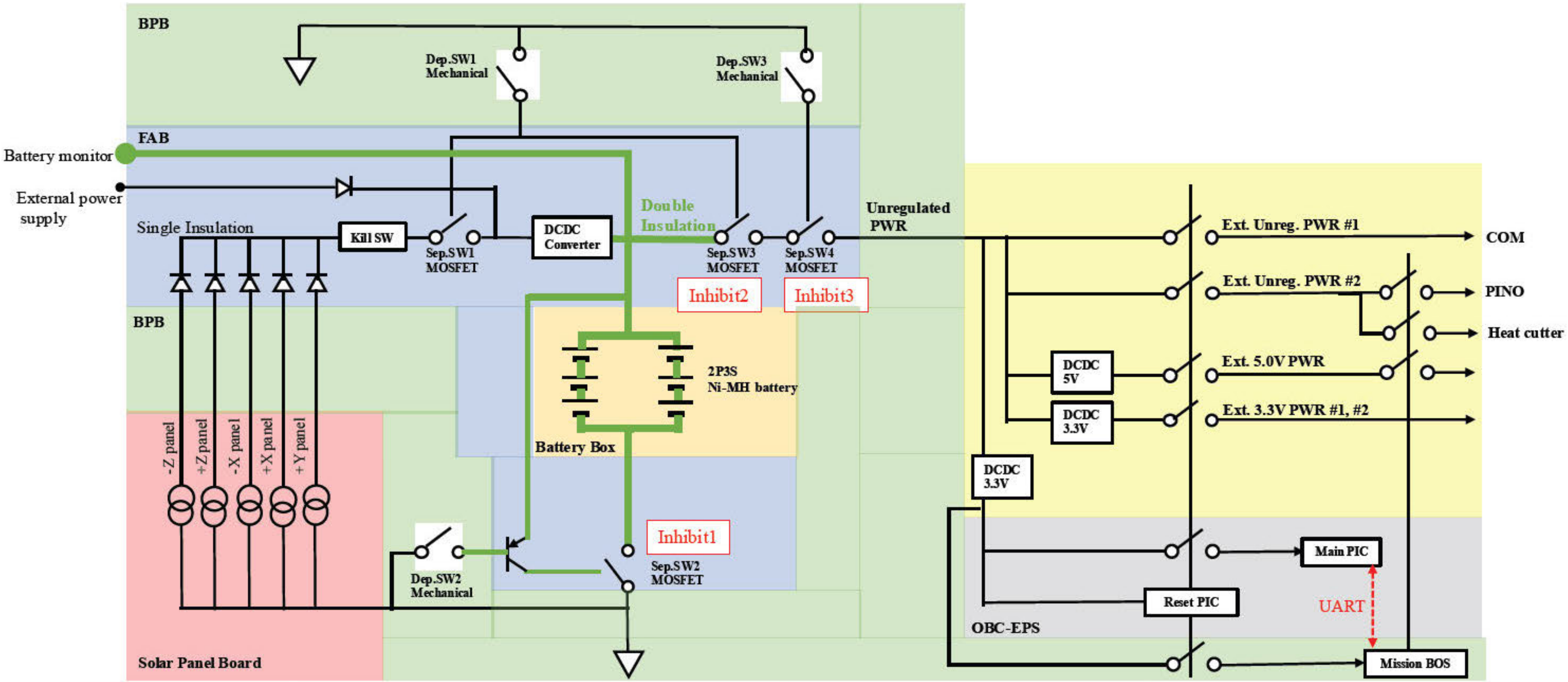
Provider Name:

Hazard Report #: BIRDS5-UNQ-05	Revision Date: 6 October, 2023	Review Level: Phase III
Title : Electric Shock		

JSC Form 1298, 10. SSP51721, ISS Safety Requirements Document	
Detection and Warning Methods: -	**Additional Safety Features:** -
Cause Remarks: -	
Mission Phases: ☐**Launch Processing:** ☒**Launch:** ☐**Rendezvous / Docking:** ☒**Deployment:** ☒**Orbital Assembly & Checkout:** ☒**On-orbit Operation:** ☐**On-orbit Maintenance:** ☐**Descent / Landing:**	**Point of Contact**

Attachment of BIRDS5-UNQ-05 (1/7)

When at least one of the three separation switches are turned off, current from battery to the PINO system located at Load is cut by disconnecting circuit.



	Inhibit1	Inhibit2	Inibit3
Deactivate PINO system	SepSW2	SepSW3	SepSW4

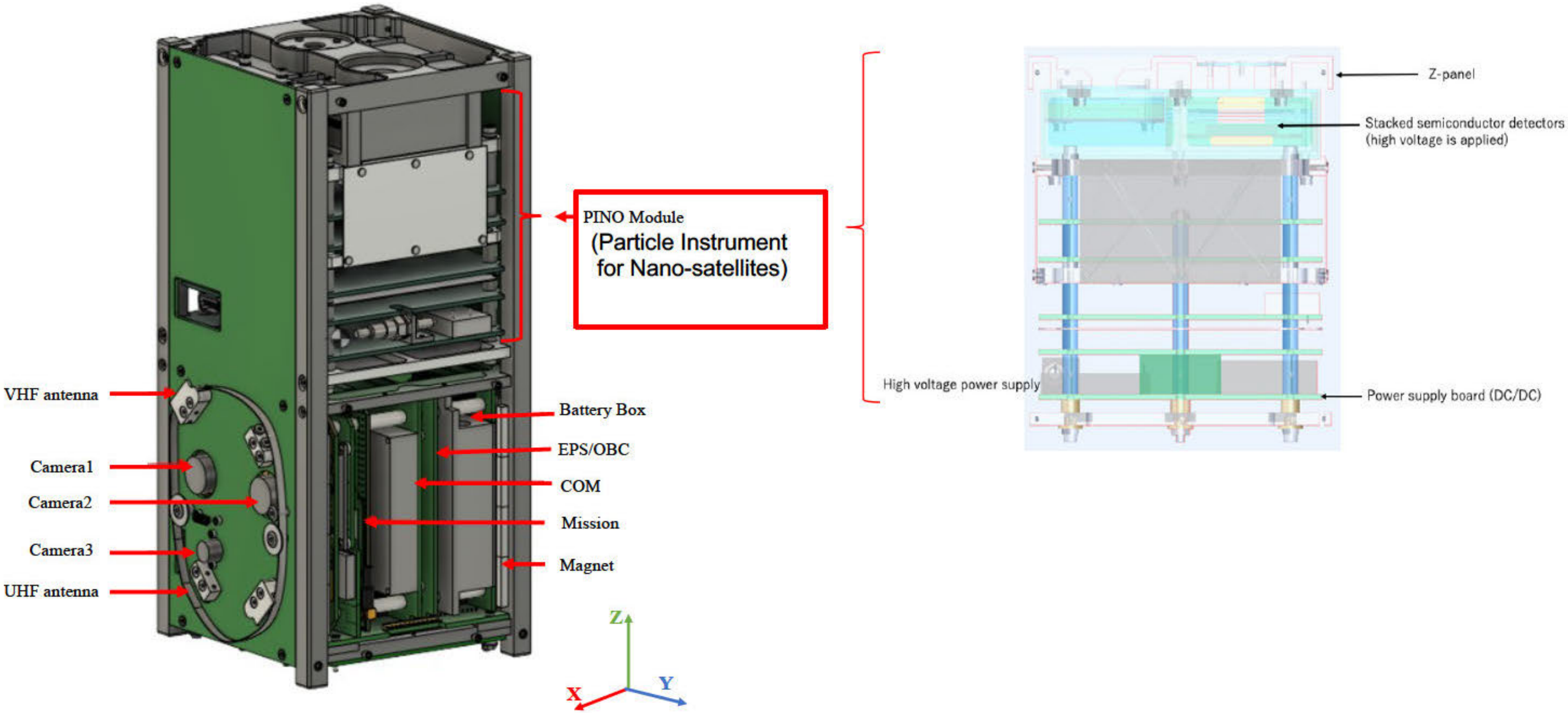
Figure 1. Inhibit Schematic with Deployment System

Attachment BIRDS5-UNQ-05 PINO sequence Description (2/7)

The sequence of PINO system is as follows.

1. DepSW1 keeps SepSW1 and SepSW3, DepSW2 keeps SepSW2 and DepSW3 keeps SepSW4 open until the satellite is released.
2. When the DepSW1, DepSW2, and DepSW3 are closed after the satellite is released from the ISS, the PIC microcomputer (Reset PIC) is worked.
3. After the Reset PIC counts for 2000 seconds, it starts energizing the Main PIC, COM.
4. The Main PIC gives instructions to the Mission BOS PIC.
5. The Mission BOS PIC receives the instruction and turns on the power of the heat cutter.
6. Antennas are deployed, and communication begins.
7. Received PINO system start command from GS.
8. Main PIC gives an instruction to start PINO system to Mission BOS PIC.
9. Mission BOS PIC receives instructions and starts supplying power to PINO system.

Attachment of BIRDS5-UNQ-05 (3/7)



<u>Figure 2 PINO module and High voltage parts in the sectional view</u>

Since walls of J-SSOD-R launch case are transparent, if there are not enough inhibits and all inhibits located on the closed circuit from solar cell to load are accidentally closed, there is possibility to generate power with solar cells and activate some function of satellite which may cause hazard. To prove this function are not activated with the power generated by light inside JEM, it is required to show the power for activating the function is larger than the generated power with solar cells.

[Presupposition]
All we got from JAXA are shown below.

1. Graph of Relative Intensity of 3 mode of GLA (General Luminaire Assembly) (Figure 5)
2. Value of Max Illuminance at 1m from deck*: 1400[lx]

*There are 8 GLA in every 1m on each standoff of AFT/OVHD and FWD/OVHD inside JEM PM as shown in Figure 6. It is little difficult to calculate the distance from all GLA to work space, so this value was calculated by considering the work space surrounded by 2 GLA which has 8 times power of real GLA for each are located on AFT/OVHD and FWD/OVHD. Thus, it is very conservative value.

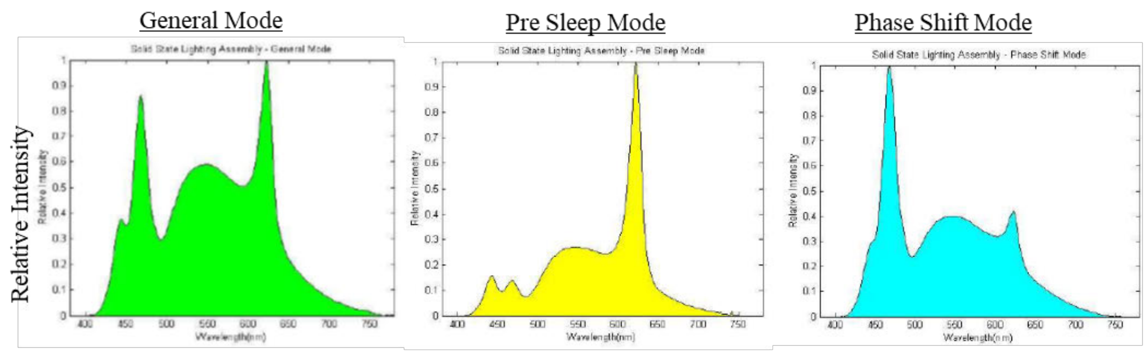


Figure 5: Relative Intensity

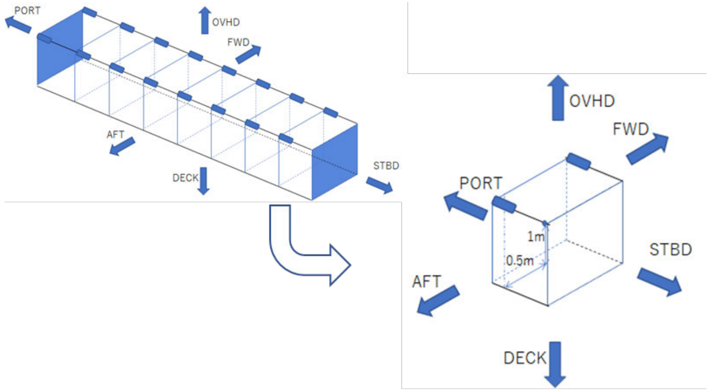
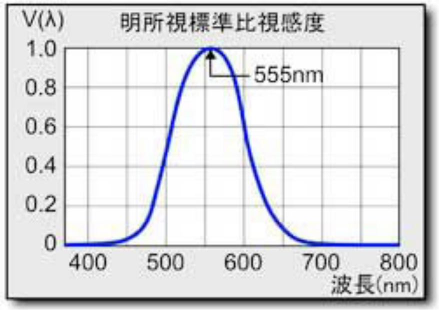


Figure 6: Illuminance inside JEM

Attachment BIRDS5-UNQ-05, BIRDS-5 Verification of solar cell power (5/7)

Illuminance is calculated by the following formula.
Illuminance[lx] = Σ (683[lm/W] x Luminosity Function @each wave length x Irradiance [W/m2)@each wave length)
= Σ (683 x A x Relative Intensity @each wave length x Irradiance [W/m2)@each wave length)
683: Max Luminous Sensitivity. , Luminosity Function: shown right. It is defined as CIE1924., A: Absolute Irradiance/Relative Intensity

To get total irradiance [W/m2] of all wavelengths of the GLA, we have to integrate Irradiance @each wavelength. And, to get absolute Irradiance@ each wavelength, factor A (Absolute Irradiance/Relative Intensity) is needed. With the value read from each relative intensity graph, luminosity function and Max Illuminance 1400[lx], the whole irradiance was calculated, and the result are shown below.



<u>General Mode</u>

A: 3.32 x 10^-2

Irradiance: 4.47 [W/m2]

<u>Pre-Sleep Mode</u>

A: 7.26 x 10^-2

Irradiance: 4.19 [W/m2]

<u>Phase Shift Mode</u>

A: 5.32 x 10^-2

Irradiance: 4.69 [W/m2]

・1U CubeSat case

[Generated Power]

Spec, number of solar cells of BIRDS-5 is shown below.

Area of each solar cell: 0.003 [m2]
Number of solar cells: 10
Conversion Efficiency: 30 [%] * *Exact value of this solar cells is unknown. So, theoretical max value is used.

The generated power on each mode is calculated as shown below.

General Mode

Generated Power : 4.47 x 0.003 x 10 x 0.3 = 0.0402[W]

Pre-Sleep Mode

Generated Power : 4.19 x 0.003 x 10 x 0.3 = 0.0377[W]

Phase Shift Mode

Generated Power : 4.69 x 0.003 x 10 x 0.3 = 0.0422[W]

・2U CubeSat case

[Generated Power]

Spec, number of solar cells of BIRDS-5 is shown below.

Area of each solar cell: 0.003[m2]
Number of solar cell: 14
Conversion Efficiency: 30[%]* *Exact value of this solar cells are unknown. So, theoretical max value is used.

The generated power on each mode is calculated as shown below.

General Mode

Generated Power : 4.47 x 0.003 x 14 x 0.3 = 0.0563[W]

Pre-Sleep Mode

Generated Power : 4.19 x 0.003 x 14 x 0.3 = 0.0528 [W]

Phase Shift Mode

Generated Power : 4.69 x 0.003 x 14 x 0.3 = 0.0591[W]

[Required Power for Activate Function]

The function of the BRIDS-5 whose accidental activation may cause hazard are a battery heater, a RF radiation and a PINO system.

The battery heater is activated by the OBC.

The minimum power required to operate the Reset PIC, which controls the power supply to the OBC and COM is shown below.

Activation of Reset PIC: 0.380 [W]

Conclusion

The required power for activating the battery heater and the COM is very larger than power generated with solar cells with light inside ISS, even Reset PIC cannot be activated with power generated with solar cells. Thus, there is no possibility to cause hazard by this function activation.

Appendix C

Fire Detection and Suppression (FDS)

Implementation Approach

Appendix D

Critical Services

Not Applicable

Appendix E

JAXA SR A/I Status

Not Applicable

Appendix F

Waiver and Deviation

Not Applicable

Appendix G

Support Documents

G-1 Fracture Control Evaluation Form

Structure Fracture Control Evaluation Form for Small Satellite deployed from J-SSOD

Satellite Name : BIRDS-5 【Phase 3】

JAXA Structure and Fracture Control Board (JAXA SFCB)

Form Ver. March 23, 2018

	Signature	DATE
JAXA SFCB Chair		2022/04/11
Satellite Project Manager		2022.4.4

If all of condition A) to G) are fulfilled or approved waiver, this form can be applicable instead of Fracture Control Summary Report.
If any of condition H) to M) are applicable, correspondent verifications must be implemented.

Check	Title	Condition	Verification Document
✓	A) Soft Stowed Launch	Launched with stowed in softbag.	[Phase 012] Closed, Document No. :09_BIRDS5-SAR-01 Safety Assessment Report for Phase012 (2021/12/09) [Phase 3] Closed, Document No. :16_BIRDS5-SAR-02 Safety Assessment Report for Phase3 (2022/02/22)
✓	B) Mass	Less than 1.33kg per 1U.	[Phase 012] Closed, Document No. :09_BIRDS5-SAR-01 Safety Assessment Report for Phase012 (2021/12/09) [Phase 3] Closed, Document No. :16_BIRDS5-SAR-02 Safety Assessment Report for Phase3 (2022/02/22)
✓	C) Neither Pressure System nor Pressure Vessel	With neither Pressure System nor Pressure Vessel	[Phase 012] Closed, Document No. :09_BIRDS5-SAR-01 Safety Assessment Report for Phase012 (2021/12/09) [Phase 3] Closed, Document No. :16_BIRDS5-SAR-02 Safety Assessment Report for Phase3 (2022/02/22)
✓	D) No Hazardous Materials	No toxic or biological material except for electrolyte of battery.	[Phase 012] Closed, Document No. :09_BIRDS5-SAR-01 Safety Assessment Report for Phase012 (2021/12/09) [Phase 3] Closed, Document No. :16_BIRDS5-SAR-02 Safety Assessment Report for Phase3 (2022/02/22)
☑	E) Minimum Stress History	H/W is not exposed to the stress environment other than the followings: 1) Random vibration test 2) Ground Transportation 3) Launch(1 time)	[Phase 012] Closed, Document No. :09_BIRDS5-SAR-01 Safety Assessment Report for Phase012 (2021/12/09) [Phase 3] Closed, Document No. :16_BIRDS5-SAR-02 Safety Assessment Report for Phase3 (2022/02/22)
-	F) Low Risk Fracture Part	Outer structure meets the following criteria (as Low Risk Fracture Part)	—
✓	F-1) Maximum Stress	Total tensile stresses are no greater than 30% of ultimate tensile strength	[Phase012] Closed, Document No. :02_BIRDS5-SR-01 Structural Analysis Report (2022/03/15)
✓	F-2) Material	Aluminum alloy and A-rated in MSFC-HDBK-527/JSC09604/CR-99117 or Table-I in MSFC-STD-3029	[Phase012] Closed, Document No. :03_BIRDS5-MIUL-01 MIUL (2021/08/03)
✓	F-3) Material Processing	Not using a process such as welding, forging, casting, or quenching heat treatment	[Phase012] Closed, Document No. :02_BIRDS5-SR-01 Structural Analysis Report (2022/03/15)
☑	F-4) Visual Inspection	No defects or surface damage is detected by visual inspection	[Phase3] Closed, Document No. :25_BIRDS5-VT-01 Vibration Test Report (2022/02/18)
☑	G) No Delta Pressure Hazard	No hazard is identified regarding the delta-pressure during launch, pressurization/ depressurization in airlock.	[Phase 012] Closed, Document No. :09_BIRDS5-SAR-01 Safety Assessment Report for Phase012 (2021/12/09) [Phase 3] Closed, Document No. :16_BIRDS5-SAR-02 Safety Assessment Report for Phase3 (2022/02/22)

If the satellite consists of the following items, applicable section (H) to N)) should be fulfilled.

✓ applicable	H) Shatterable Structure	Shatterable Structure (Camera Lens, Solar Cell Cover etc.)	—
☑	H-1) Vibration Test	1. Verified by visual inspection after vibration test under the condition specified in JX-ESPC-101132/101133	[Phase3] Closed, Document No. :25_BIRDS5-VT-01 Vibration Test Report (2022/02/18)
✓ applicable	J) Deployment Structure	Deployment restraint wire whose fracture could cause hazard.	
✓	J-1) Fail Safe Approach	Redundant wire	[Phase 012] Closed, Document No. :06_BIRDS5-AP-01 Assembly Procedure(2021/12/09) [Phase 3] Closed, Document No. :18_BIRDS5-AR-01 Assembly Record (2022/02/18)
✓	J-2) Proof Test	Each wire is proof-tested and visual-inspected	[Phase 3] Closed, Document No. :27_BIRDS5-WTR-01 Wire Strength Test Report (2022/03/09)
✓	J-3) Assembly Procedure	Wire handling process is defined in assembly procedure.	[Phase 012] Closed, Document No. :06_BIRDS5-AP-01 Assembly Procedure(2021/12/09) [Phase 3] Closed, Document No. :18_BIRDS5-AR-01 Assembly Record (2022/02/18)
✓	J-4) Round	(If any) The part touching the wire is rounded appropriately.	[Phase 012] Closed, Document No. :06_BIRDS5-AP-01 Assembly Procedure(2021/12/09) [Phase 3] Closed, Document No. :18_BIRDS5-AR-01 Assembly Record (2022/02/18)
☑	J-5) Loosening Prevention	(If any) Loose prevention is provided on the tied portion.	[Phase 012] Closed, Document No. :06_BIRDS5-AP-01 Assembly Procedure(2021/12/09) [Phase 3] Closed, Document No. :18_BIRDS5-AR-01 Assembly Record (2022/02/18)
✓ applicable	K) Fail Safe Fastener	Fail Safe Fastener	—
✓	K-1) Fail Safe Analysis	K-1) Fail safety analysis shows MS >0. (F.S = 1.0)	[Phase012] Closed, Document No. :02_BIRDS5-SR-01 Structural Analysis Report (2022/03/15)
✓	K-2) Quality Control	Quality Control meets the condition L-2) to L-5)	Please refer from L-2) to L-5).
✓ applicable	L) Safety Critical Fastener	Safety Critical Fastener	—
✓	L-1-1) Secondary Locking Feature	L-1-1b) Locking compound of which the application process MUA is approved.	[Phase 012] Closed, Document No. :06_BIRDS5-AP-01 Assembly Procedure(2021/12/09) [Phase 3] Closed, Document No. :18_BIRDS5-AR-01 Assembly Record (2022/02/18)
✓	L-2-1) Certificates for fastener materials	L-2-1) Certificates for fastener materials	[Phase 012] Closed, Document No. :05_BIRDS5-AD-01 Assembly Drawing (2021/12/09)
✓	L-3) Torque mark inspection	L-3) Torque mark inspection	[Phase 012] Closed, Document No. :06_BIRDS5-AP-01 Assembly Procedure(2021/12/09) [Phase 3] Closed, Document No. :18_BIRDS5-AR-01 Assembly Record (2022/02/18) [Phase3] Closed, Document No. :25_BIRDS5-VT-01 Vibration Test Report (2022/02/18)
✓	L-4) Fastening torque control	L-4) Fastening torque control	[Phase 012] Closed, Document No. :06_BIRDS5-AP-01 Assembly Procedure(2021/12/09) [Phase 3] Closed, Document No. :18_BIRDS5-AR-01 Assembly Record (2022/02/18)
✓	L-5) Fastener traceability	L-5) Fastener traceability	[Phase 012] Closed, Document No. :06_BIRDS5-AP-01 Assembly Procedure(2021/12/09) [Phase 3] Closed, Document No. :18_BIRDS5-AR-01 Assembly Record (2022/02/18)
applicable	M) Sealed Container	Sealed Container	—
	M-1) Container characteristic	Single, independent Container containing a non-hazardous substance.	
	M-2) Stored Energy	Contain less than 19,310 Joules(14,240 foot-pounds) of stored energy	
	M-3) Maximum delta pressure	Maximum delta pressure is less than 1.5atm(22psia, 1.5bars)	
✓ applicable	N) Fracture Critical Part	Fracture Critical Part	—
✓	N-1) Design Verification	Verified by Structural Analysis with appropriate mechanical properties	[Phase012] Closed, Document No. :02_BIRDS5-SR-01 Structural Analysis Report (2022/03/15)
	N-2) Production Verification	Verified by appropriate material selection and production process	[Phase 3] Closed, Document No. :18_BIRDS5-AR-01 Assembly Record (2022/02/18)
☑	N-3) Product Verification	Verified by visual inspection after vibration test under the condition specified in JX-ESPC-101132/101133 Visual Inspection and NDE(Tapping test acceptable) before and after Tests	[Phase3] Closed, Document No. :25_BIRDS5-VT-01 Vibration Test Report (2022/02/18)

G-2 Battery Description Form

Battery Description HR Attachment

For the Phase 0/I Safety Data Package, provide the following information:

1a. Hardware Point-of-Contact:
(Name/Company/Phone/Fax/email)

Yamauch Takash

Kyushu Inst tute of Techno ogy

+81-93-884-3295

yamauch .takash 098@ma .kyutech.jp

1b.

Hardware Name:	BIRDS5
Hardware Part Number:	BIRDS5-FM-01
Hardware Acronym:	BIRDS5
Battery Name:	Ni-MH Battery

2a. Hardware / Battery Managing Group, Company, or Agency:

Kyushu Inst tute of Techno ogy

2b. Hardware and Battery Environmental Requirements:

Thermal Environment (max, min, operational and non-operational ranges):

-15 to +60 degC outs de ISS

+16.7 to +29.4 degC ns de ISS

[Note]: Battery specification: Storage: -20 to +50 degC

Since battery thermal specification does not cover the thermal environment, we will confirm by thermal test.

Pressure Environment (EVA, IVA):

Both EVA and IVA env ronments. Max mum pressure dur ng aunch and ns de the ISS s as fo ows. A pressure ns de JEM A r ock at depressur zat on and outboard s 0 Pa.

HTV, Cygnus: 104.8 kPa, Dragon: 102.7 kPa, Ins de the ISS: 104.8 kPa

Life (calendar/shelf, cycle/service):

Duration 3 years / Product warranty of stowage is 5 years to keep more than 90% capacity from fully charged

3a. Battery and Hardware Description:

Is the battery pack (including all components) Commercial-off-the-shelf (COTS)? ☒Yes ☐ No

Function/Operating modes (continuous, pulse, intermittent, clock backup, memory, etc.):

No operat on ns de J-SSOD. Cont nuous operat on after dep oyment.

Battery/Cell crew access on-orbit? ☐Yes ☒ No

<u>Short Description of Battery System</u>: (Number of batteries to be flown; details if multiple batteries are required to power Application, unique design information, etc.)

Battery cells, FAB and EPS are COTS.

[Battery pack]

Part Name: BIRDS5-Battery

Type: N -MH Battery

Part Number: BIRDS5-Battery-01

Spec f cat on: 14.4 Wh

Manufacturer: Kyushu Inst tute of Techno ogy

[FAB]

Part Name: BIRDS5-FAB

Part Number: BIRDS5-FAB-01

Manufacturer: Sagam Tsush n

[EPS]

Part Name: BIRDS5-EPS

Part Number: BIRDS5-EPS-01

Manufacturer: Sagam Tsush n

3b. Cell Description:

Chemistry (If li-ion, what type: NMC, NCA, FePO4, etc.): N -MH

Cell size: 14.35 mm d a. x 50.4 mm

Manufacture and Model: Panason c / BK-3MCC

Nominal OCV: 1.2 V **Maximum Voltage:** 1.6 V **Minimum Voltage:** 1.0 V

Rated Capacity: 2,000 mAh

Maximum Rated OEM Discharge Current: Nonpub c nformat on

Maximum Recommended OEM Charge Current: 2,000 mA

Minimum and Maximum OEM Discharge Temperatures: 0 to +50 degC

Minimum and Maximum OEM Charge Temperatures: 0 to +40 degC

Minimum and Maximum Storage Temperatures: -20 to +40 degC

Date of Manufacture (Mo/Yr): 05/2020

3c. Battery Information: (9 V COTS batteries shall be considered as single units)

Quantity of total cells: 6 per sate te

Cell connectivity (#P#S, #S#P): 3S2P

Operational Battery Environment Temperatures Range (Min/Max): 0 to +40 degC

Nominal OCV: 3.6 V **Maximum Voltage:** 4.8 V **Minimum Voltage:** 3.0 V

For the Phase II/III Safety Data Package, provide the following information:

Stowage location (launch and on-orbit use locations):
Insta ed ns de CubeSat. BIRDS-5 (1U and 2U CubeSat) w be aunched to ISS by HTV-X, NG Cygnus or Space-X Dragon w th be ng nsta ed ns de J-SSOD (JEM Sma Sate te Orb ta Dep oyer) sate te nsta case or a ded cated aunch case, wh ch s soft stowed ns de a bag.

Packaging and hardware approved by flammability group (reference requirement):
08/03/2021

Is the battery charged on orbit?, Yes: ☐ **No:** ☒
If yes, describe charge rate, charger hardware, and protections to prevent overcharge

Is the battery being discharged on-orbit? Yes: ☐ **No:** ☒ **If yes what is the discharge rate(s):**

Circuit Description and Electrical Schematic (attach electronically or reference location in HR):

All of the cells are covered by TEFLON panels and metal box same as BIRDS-1: EP-J-17-001 (Figure 1).

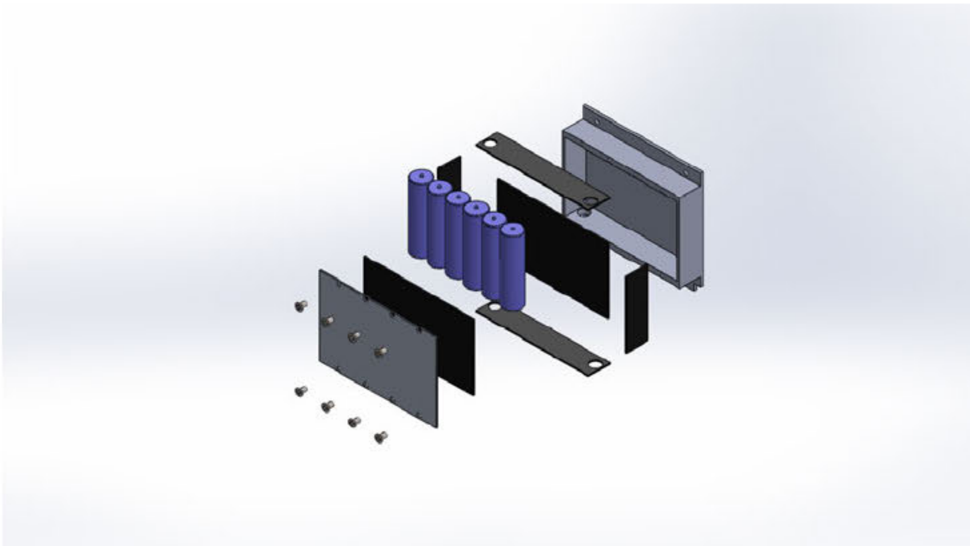


Figure 1 Battery Box

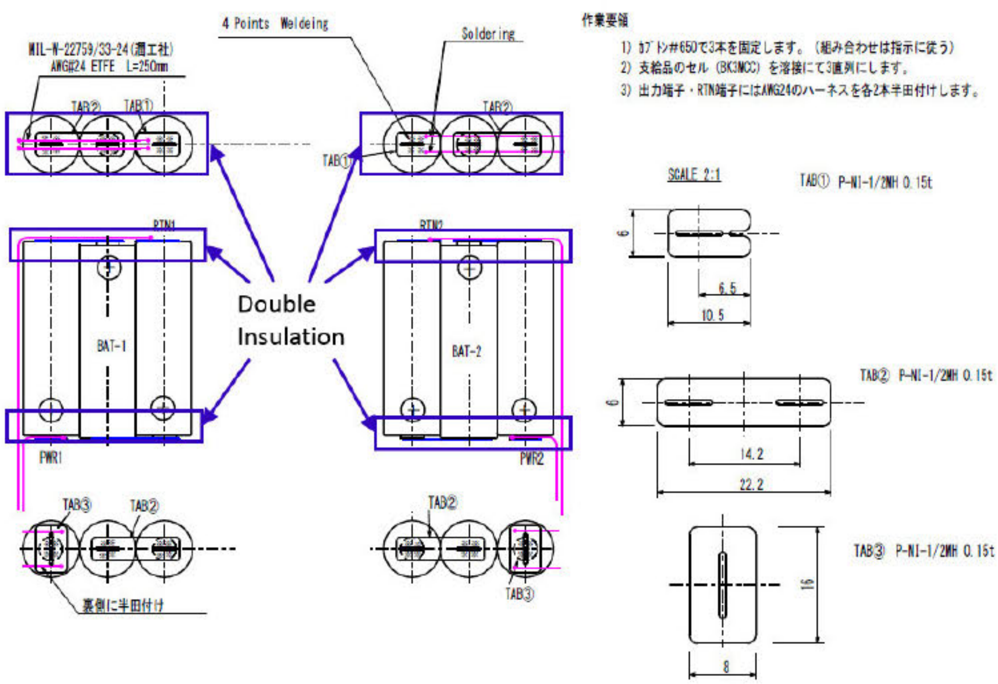
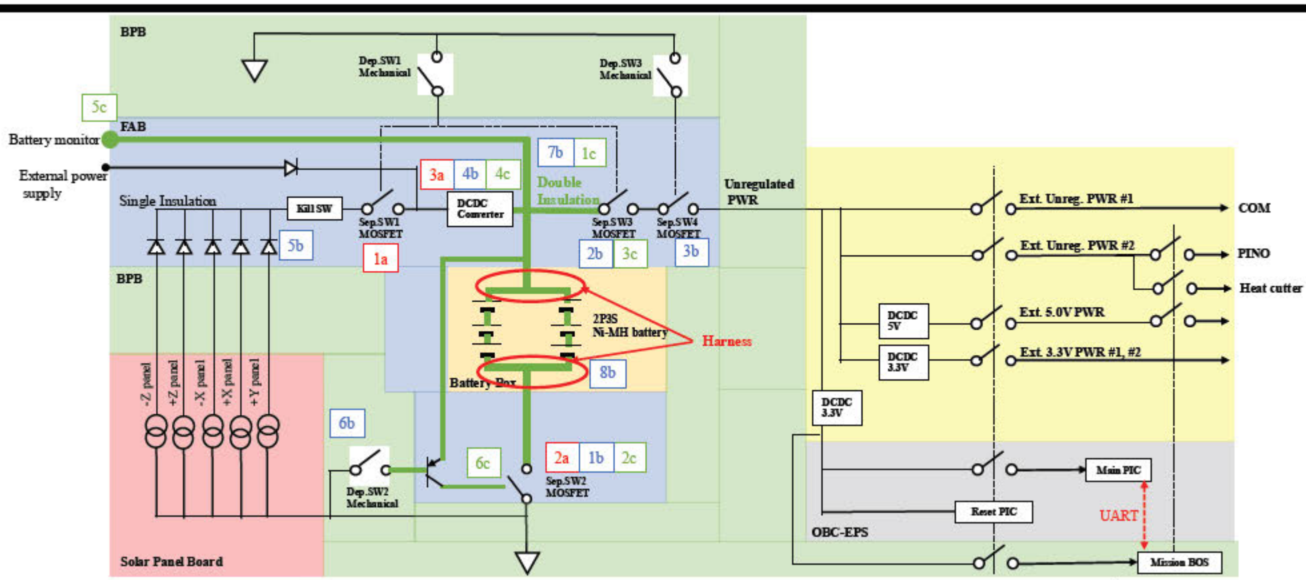


Figure 2 Battery Connectivity



Hazard		Hazard Control #1	Hazard Control #2	Hazard Control #3
Over-charge		SepSW1[1a]	SepSW2[2a]	DCDC converter[3a]
Over-discharge	Load side	SepSW2[1b]	SepSW3[2b]	SepSW4[3b]
	Solar cell side		DCDC converter[4b]	Diode[5b]
	DepSW2 side	DepSW2 [9b]	Proper Insulation[7b]	Proper charging [8b]
External short	Load side	Proper Insulation[1c]	SepSW2[2c]	SepSW3[3c]
	Solar cell side			DCDC converter[4c]
	External power supply side			DCDC converter[4c]
	Battery monitor side			Proper Insulation[5c]
	DepSW2 side			Proper Insulation[6c]

Note: Proper insulation (double isolation is shown by green line in figure above, single isolation is black line)
All wires and components between the battery and the first power functions are assembled as double insulation
The DCDC converter (LTC3119) used for inhibit is a buck-boost converter and its internal FET configuration prevents reverse current

Figure 3 Inhibit schematics.

Overcharge protection

Sep SW1, Sep SW2 and DCDC converter are equipped in the solar cell side or the GND side of the battery as shown in Figure above. DCDC converter controls the input voltage from the solar cells to the battery pack to 4.2V.

Over dis-charge protection

(Load Side)

Sep SW2, Sep SW3 and SepSW4 are equipped in the Load side of the battery as shown in Figure 3.

(Solar cell Side)

Sep SW2, DCDC converter and Diodes are equipped in the Solar cell side of the battery as shown in Figure 3.

(DepSW2 Side)

Dep SW2 is equipped in the HOT side of the battery as shown in Figure 3. Double Insulation is set between the battery and the DepSW2. Proper charging before satellite delivery.

External short protection

(Load Side)
Sep SW2 and Sep SW3 are equipped as shown in Figure 3. And double insulation is set between battery and Separation Switches.

(Solar cell Side)
Sep SW2 and DCDC converter are equipped as shown in Figure 3. And double insulation is set between battery and Separation Switch and DCDC converter.

(External power supply Side)
Sep SW2 and DCDC converter are equipped as shown in Figure 3. And double insulation is set between battery and Separation Switch and DCDC converter.

(Battery monitor Side)
Sep SW2 is equipped in the GND side of the battery as shown in Figure 3. Double insulation is set between battery and Battery monitor connector.

(DepSW2 Side)
Sep SW2 is equipped as shown in Figure 3. Double insulation is set between the Drain of SepSW2 and the battery and the Gate of Sep SW2.

Summary of circuit protections and include trip/reset points (i.e. fuses, diodes, MOSFETs, resistors, source isolation, etc.):
Covered cables are used from the battery to GND or the first inhibit. The covered cables are further covered with Kapton tape to provide double insulation. In addition, GND and HOT lines on a surface of a circuit board are separated by 1mm or more, and the surface is covered with Kapton tape for double insulation.

Battery testing complete and report uploaded to this HR? Yes: ☐ **No:** ☒
If yes, provide a short summary test results including anomalies or failures.

Summary of safety testing performed or planned :

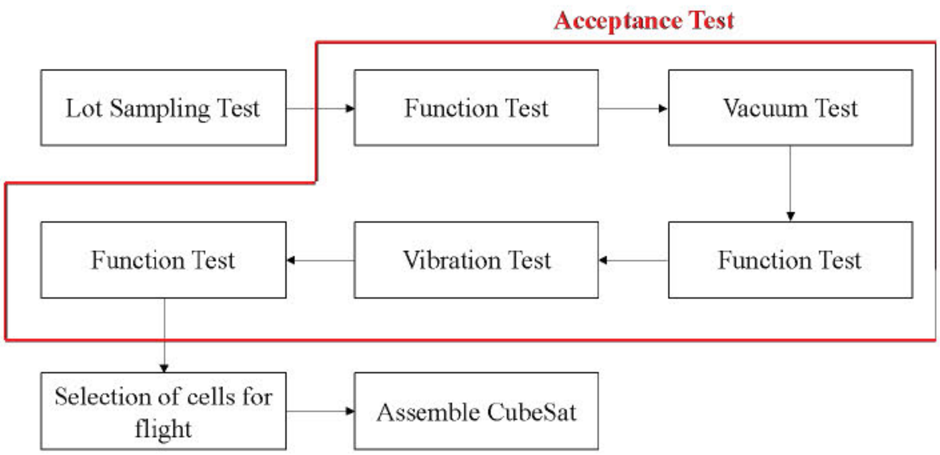


Figure 4 Flowchart for Screening Test

1. **Lot sampling Test**

(1) Therma Test

Therma test of battery ce s performed for conf rmat on of temperature to erance. Test cond t on s summar zed as be ow.

- Temperature: more than +60 degreeC
- Test Durat on: Over 2 hours

Before and after the therma test, severa funct on tests be ow are performed to see that there s no change n character st cs.

- V sua nspect on (scratches, m sa gned sea s, e ectro yte eakage, etc.)
- Open C rcu t Vo tage (the change s ess than 0.1%)
- Mass (the change s ess than 0.1%)
- Capac ty (the change s ess than 5%)
- Charge/D scharge Character st c

- D scharge Temperature

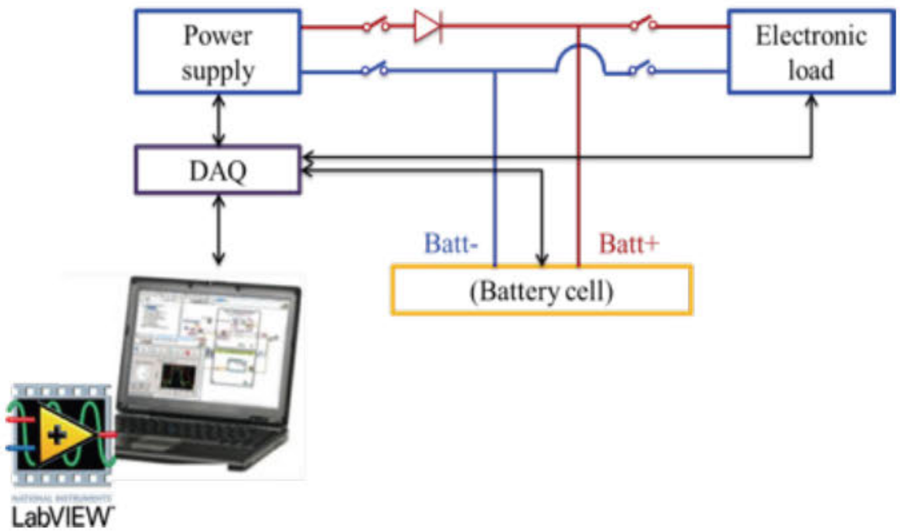


Figure 5 Charge/Discharge Characteristics Test Configuration

2. Acceptance Test

(1) Vacuum Test

Vacuum test of battery ce eve s performed for screen ng. Test cond t on s summar zed as be ow:

- Vacuum Leve : ess than 0.1 ps a
- Test Durat on: Over 6 hours

(2) Random V brat on Test

Random v brat on test for f ght ce s s performed for screen ng purposes.

Test cond t on s summar zed as be ow.

- V brat on Leve : M n mum Screen ng Leve (MSL)
- To erance: +/- 1.5dB for PSD
- D rect on: 2 axes (Rad a d rect on and Ax a d rect on)
- Test Durat on: Over 60 sec

Random V brat on Leve for ce s

Freq. [Hz]	PSD [G^2/Hz] (MSL)
20	0.01
80	0.04
350	0.04
2000	0.007
Overa	6.06 Grms
Durat on	1m n/ax s

(3) Funct on Test

Before and after the env ronment tests (v brat on test and vacuum test), severa funct on tests be ow w be performed to see that there s no change n character st cs.

Note that the Charge/D scharge Character st cs test measures the range between max mum vo tage and m n mum vo tage.

Test Load: 1.9 [A]

Test Contents;

- V sua nspect on (scratches, m sa gned sea s, e ectro yte eakage, etc.)
- Open C rcu t Vo tage (the change s ess than 0.1%)
- Mass (the change s ess than 0.1%)
- Capac ty (the change s ess than 5%)
- Charge/D scharge Character st c
- D scharge Temperature

3. Safety Function Test for system

(1) Function Test for system

After assemb ng the sate te, before and after the env ronmenta test, the fo ow ng funct ona tests are performed to conf rm that there are no prob ems w th the assemb ed battery.

Test content

- Open C rcu t Vo tage (Everyday for a 5 days)

(2) Function Test for safety function

Protect ve dev ces (DC/DC converter, D ode) are funct ona y tested for f ght products before FM v brat on test. Funct on of separat on sw tches (Sep SW) w be conf rmed after the FM v brat on test. Funct ona tests are performed w th the board assemb ed, but the so ar pane s not assemb ed because the test s performed us ng the nput ne from the so ar pane . To eva uate the e ectron c e ements after the env ronmenta test, the sate te must be d sassemb ed, wh ch s r sky, so the eva uat on s performed before the env ronmenta test. The funct ona ty of surface-mounted e ectron c e ements s a ready ver f ed n the QT eve test for EM. Therefore, there are no prob ems w th the e ectron c e ements n the v brat on test for FM. On the other hand, mechan ca sw tches are nspected after the env ronmenta test because they may be broken n the env ronmenta test.

・SepSW1 test

SepSW1 s on the battery charg ng ne from so ar pane s. P ace the sate te n front of a so ar s mu ator w th a Dep SW pressed.

When the sate te s exposed to the ght of the so ar s mu ator, the Inh b t (SepSW1) prevents the battery from charg ng when DepSW1 s pressed. On the other hand, after DepSW1 s re eased, the vo tage w be app ed to the battery ne. Therefore, the soundness of SepSW1 can be conf rmed by check ng the source vo tage to the battery from the so ar pane s.

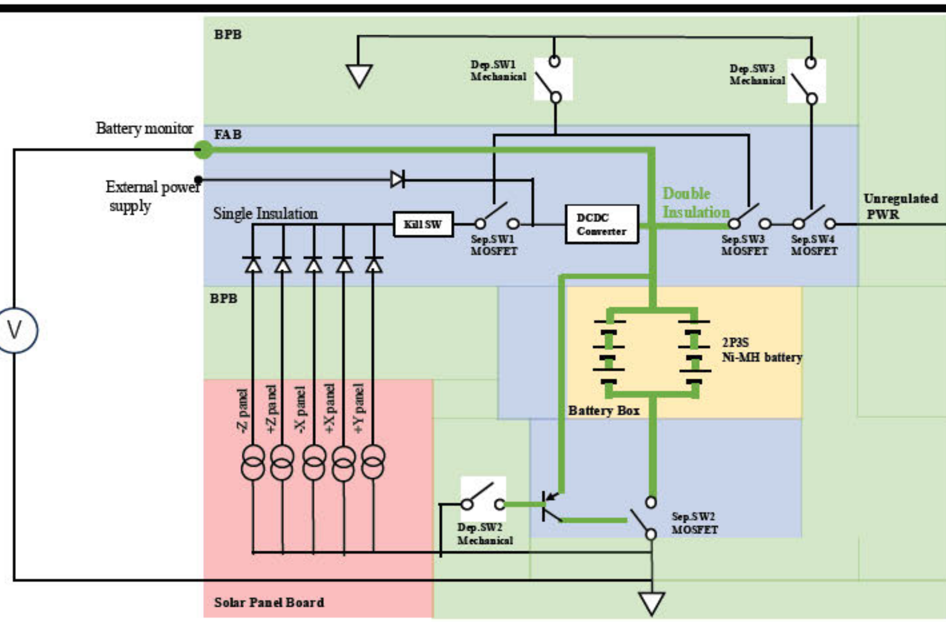


Figure5 SepSW1 test configuration

・**SepSW2,3,4 test**

Connect the debugger to the access port of the sate te so that ser a data from the sate te can be output to an externa PC.

When the sate te s n OFF-state and the debugger s connected between the sate te and the PC, there shou d be no output the ser a data n the PC d sp ay. OFF-state of the sate te s when one of the Inh b ts are pressed. On the other hand, the sate te s n ON-state when a   nh b ts are re eased, as such, the sate te shou d d sp ay nformat on on the PC.

SepSW1 and SepSW3 can be operated by DepSW1, SepSW2 can be operated by DepSW2, and SepSW4 can be operated by DepSW3.

Check the ser a data output when DepSW1, 2, and 3 are turned on respect ve y, and check the funct on of SepSW2, 3, and 4.

・**DCDC converter test (for overcharge)**

The output of the so ar ce   s regu ated by one DCDC converter to charge the battery. Connect an externa power supp y to the FAB board and s mu ate the nput vo tage from the so ar ce . Then, measure the DCDC output vo tage from the connector that connects to the battery. The battery overcharge vo tage s 8.5 V or h gher. When the DC/DC nput vo tage s supp ed by 4.2 V, we nspect the DC/DC output vo tage shou d be be ow 8.4V by measur ng the vo tage at the battery s ot.

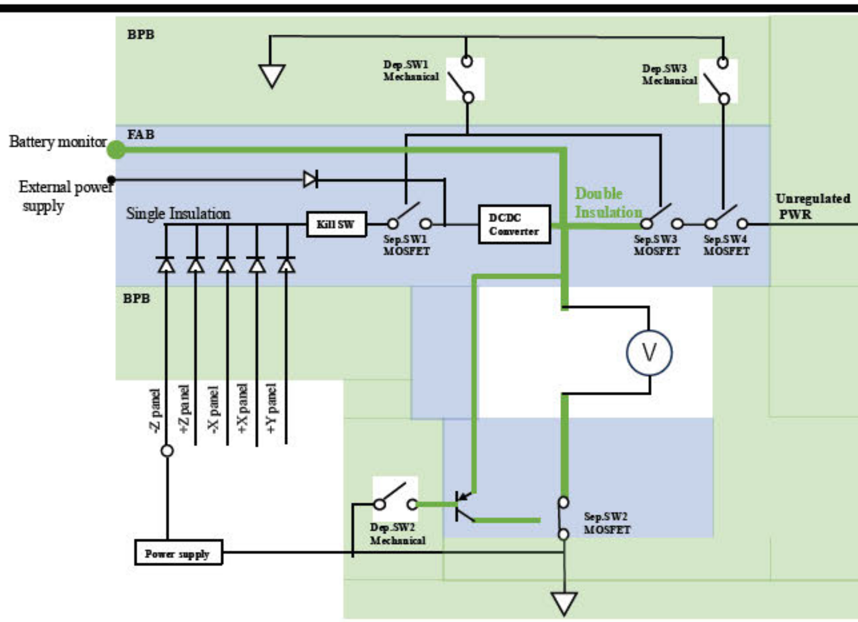


Figure6 DCDC converter test configuration

・DCDC converter test (for over-discharge and external short)

Ensure that the DCDC converter prevents reverse current f ow. Connect an externa power supp y to the EPS1 board nstead of the battery. W th DepSW2 turned on, check the vo tage on the nput and output s des of the DCDC converter. Ver fy that the vo tage from the externa power supp y s app ed to the output s de and that the vo tage s not app ed to the nput s de.

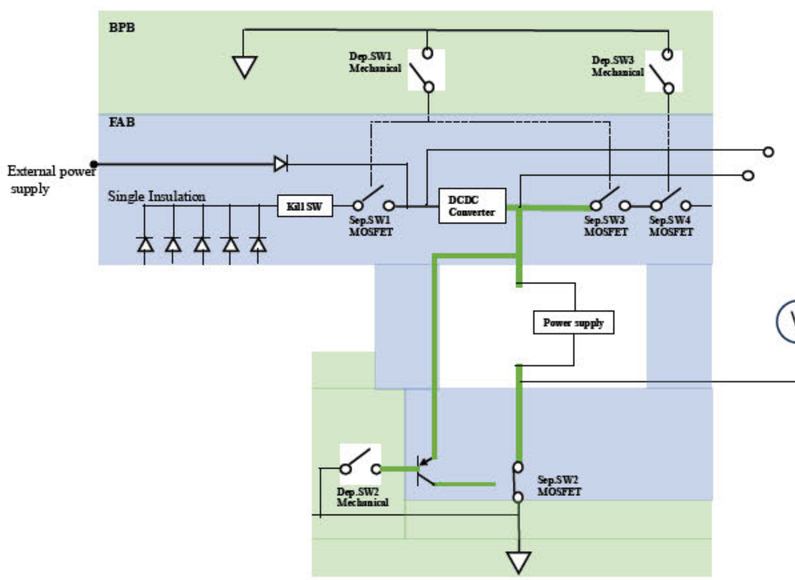


Figure7 DCDC converter test configuration

・**Diode test** (So ar ce s de)

In order to check f current f ows n the reverse d rect on of the d ode, an e ectron c oad s connected n p ace of the so ar pane s. The anode s de of the d ode under test s connected to the e ectron c oad and a power supp y s connected to the cathode s de of the d ode under test. When the e ectron c oad s act vated to draw current, the d ode shou d prevent t from do ng so.

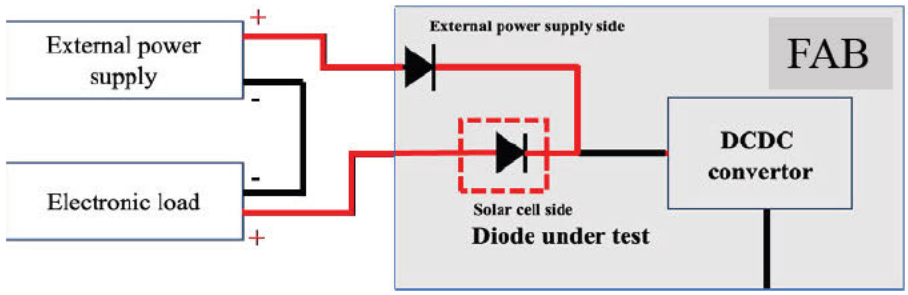


Figure 8 Diode test configuration

Has the pre-flight processing, flight acceptance plan, on-orbit processes, operational constraints, and the on-orbit and post-flight battery disposal plan for the hardware been conducted in accordance with JWI 8705.3?

Yes: ☐ No: ☒ If yes, prov de accompany ng documentat on.

No on-orb t process ng of the battery s p anned before CubeSat dep oyment from ISS.

CubeSat nc ud ng the battery w not return to the ground but w be burned up at atmospher c reentry.

(Document No.#21-011, Date of review: Sep.22.2023)

G-3. Toxicity Analysis (HMST)

Common Batteries HAZARDOUS MATERIALS SUMMARY TABLE Applicable sheet

[BIRDS-5] ASCENT to ISS Increment ALL

Batteries Name	Chemicals or BiologicalMaterials Commonly Flown Battery Chemistries	QTY	Applicable Parts Batteris Including Parts Name (P/N,S/N)	QTY
BK-3MCC	Nickel Metal Hydride - NiOOH/metal alloy/KOH	6	PearlAfricaSat-1	1
BK-3MCC	Nickel Metal Hydride - NiOOH/metal alloy/KOH	6	TAKA	1
BK-3MCC	Nickel Metal Hydride - NiOOH/metal alloy/KOH	6	ZIMSAT-1	1

FINAL HAZARDOUS MATERIALS SUMMARY TABLE

ASCENT to ISS Increment ALL

Verification Status
V-1: *Previously Flown*
V-2: *N/A*

Expt /Hdwr/Item: **Common Batteries**

Expt/HW Acronym: **NA**

OpNom:

Record # Common.Bat — PAYLOAD CHEMICAL or BIOLOGICAL INFORMATION

Last Modified 8/22/19 Part #	Sub System	Label	Chemicals or Biological Materials	Maximum Concentration	Maximum Volume or Amount	Tox Lvl	BioSafety Lvl	Flammability HazLvl
	Batteries	Batteries	Commonly Flown Battery Chemistries **Alkaline** Zn/MnO2/KOH **Zinc Carbon** Zn/carbon rod/NH4Cl (ZnCl2) **Lead Acid** Metallic Pb/PbO2/H2SO4 **Lithium Ion** LiCoO2, LiNMC, LiNCA LiMO2, LiFePO4, or other LiTi4O5 or lithium alloys of Si or Sn LiPF6, LiBOB, LiBF4 or other **Lithium Primary** Li-MnO2; LiFeS2; LiCFx **EXCLUDING:** Li-SOCl2, Li-SO2 Li-SO2Cl2, and Li-BCX **Nickel-Cadmium** NiOOH/Cd(OH)2/KOH **Nickel-Hydrogen** H2/Ni(OH)2/KOH **Nickel Metal Hydride** NiOOH/metal alloy/KOH **Silver-Zinc** ZnO/Ag/KOH **Silver Oxide** Ag2O/Zn/KOH or NaOH **Zinc Air** Zn/Air/KOH	NA	NA	2	NA	0

HAZARD RESPONSE LEVEL (HRL) = 2

SPECIFIC HAZARD LEVELS

Toxicity (THL) **2** BioSafety (BSL) **NA** Flammability **0**

Target Organ(s): Eye, Skin

Principal Adverse Effects:

Electrolytes contained in batteries may cause severe eye irritation and possible permanent eye damage when they come into contact with the eyes.

SPECIAL NOTE THIS RECORD DOES **NOT** COVER BATTERIES WITH THL > 2, WHICH ARE GENERALLY NOT ALLOWED IN THE HABITABLE VOLUME OF SPACECRAFT. Batteries containing sulfur dioxide and/or thionyl chloride may be THL 4 and **MUST** be assessed separately. Toxic vapors from batteries with THL 4 chemistry can be life threatening to crew (reference memo SF23-07-073).

Contact: [redacted]

Comments: Most batteries contain electrolytes that are rated THL 2. It is therefore prudent to assume that all batteries contain irritating or corrosive electrolytes. **NOTE:** As of May 21, 2019, specific battery information will now be contained within the battery/capacitor spreadsheet located in IHS record #48243.

ECLS Environmental Rating = **NA** ECLS Hardware Rating = **NA**

As of August 22, 2019 10:46:59 AM Page 1 **Record # Common.Bat**

Currently assessed by:
Mission Toxicologist: JSC Toxicology

G-4. ISS EME Tailoring/Interpretation Agreement

ISS Electromagnetic Effects Panel
Tailoring/Interpretation Agreement

SUBMITTAL DATE	AGREEMENT NO.	REV.	FLIGHT #(s)	1 of 2
2014/05/30	TIA # 1416	a.	NFS	

SYSTEM	ORIGINATOR and PHONE NO.	ORGANIZATION / CONTRACTOR
Flight Hardware	Masaru Wada/+81-50-3362-2377	JAXA, JEM

END ITEM/CONFIG. ID NO.	PART NUMBER(s)	DESCRIPTION	ASSEMBLY(s)	GFE	Payload
N/A	N/A	Cube Satellites EMI Testing	All elements excepts Russian element	No	Yes

SPECIFICATION NUMBER	SPEC. PARAGRAPH NO.	MANUFACTURER	CRITICALITY	SEVERITY
SSP 30237	3.1	N/A	3	3

ISSUE DESCRIPTION (use continuation pages if required)

No EMI testing will be performed on the small satellites (CubeSats) to be deployed from JEM using NanoRacks CubeSat Deployer (NRCSD) or JEM-Small Satellite Orbital Deployer (J-SSOD).

TAILORING /INTERPRETATION AGREEMENT (use continuation pages if required)

EMI testing required by SSP30237 is not mandatory for the cube satellites to be deployed from JEM using NRCSD or JEM-Small Satellite Orbital Deployer (J-SSOD).(See TIA 1268)

RATIONALE (use continuation pages if required)

1) Satellites will not be activated during the launch and deployment phases from JEM. There are inhibits to prevent activation and the satellites are not activated until more than 1 mile away from the ISS.

2) Satellites comply with the criteria of Letter OE-14-002 "Intentional Radio Frequency Transmitter Hazards" as defined in the following table. .

Table TIA 1416-1 Electrical Field and Radiation Power Density by RF radiation

Frequency	RS03-10dB	Power density@RS03-10dB
14 kHz to 200 MHz	1 58 V/m (124dBuV/m)	0 0066 (W/m^2)
200 MHz to 8 GHz	19 V/m (145 6dB uV/m)	0 955 (W/m^2)
8 GHz to 10 GHz	6 3 V/m (136dB uV/m)	0 106 (W/m^2)
10 GHz to 13 7 GHz	(Linear)	(Linear)
13 7 GHz to 15 2 GHz	79 V/m (158dB uV/m)	16 58 (W/m^2)

Note: The frequency interference will be reviewed by the JSC Frequency manager through the dedicated process.

This is criticality 3 and severity 3 hardware. This TIA does not impose any operational constraints. This TIA is for all the ISS except the Russian Segment. **This is an interpretation.**

AGREEMENT DISPOSITION

PRIME EME	NASA EME	DATE	APPROVE	WITHDRAW	REJECT
[redacted]	[redacted]	06/24/14	X		

COMMENTS

06/24/14 TIA approved out of board.

Rev 02 October 2008

ISS Electromagnetic Effects Panel
Tailoring/Interpretation Agreement
Technical Concurrence

SUBMITTAL DATE	AGREEMENT NO.	REV.	FLIGHT #(s)	2 of 2
2014/05/30	TIA # 1416	a	NFS	

SYSTEM	ORIGINATOR and PHONE NO.	ORGANIZATION / CONTRACTOR
Flight Hardware	Masaru Wada/+81-50-3362-2377	JAXA, JEM

[redacted]

NAME	DATE	
		[redacted]
		[redacted]
		[redacted]
		[redacted]
		[redacted]
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Rev 02 October 2008

G-5. Hazard Analysis Verification

for Space Radiation Analysis Group (SRAG)

ISS System/Payload:		Hazard Analysis Verification Space Radiation Analysis Group (SRAG)
Safety Review Panel POC:		Date: 09/19/2023 [redacted]
System/Payload POC:	Takashi Yamauchi	MM/DD/Y

RF Emitter Name	Frequency [MHz]	Max Power [W]	Attenuator (Gain loss) [dB]	Max Gain [dBi]	Emitter Power Density [W/m²]	Power Density Requrement [W/m²]	Minimum Safe Distance [m]	Hazard Severity	Payload Actions
BIRDS5 UHF COM	437 38	0 9	0	0 5	0 89	2 92	No Hazard	No Hazard	There is no Crew Hazard, Please submit this form to NIR SME and document on the THINCC form.
BIRDS5 VHF COM	145 83	0 79	0	2	1 11	2 00	No Hazard	No Hazard	There is no Crew Hazard, Please submit this form to NIR SME and document on the THINCC form.

General Notes (for System/Payload input as applicable :

Appendix H

List of Safety-related failures and accidents

Not Applicable

Appendix I

Operational Control Matrix (OCM)

Not Applicable

Appendix J

Safety Verification Tracking Log (SVTL)

International Space Station
Safety Verification Tracking Log

Mission/Element			J-SSOD		Date:			2021/10/28		
							Completed by Project		Confirmation by JAXA S&PA	
Log Number	Hazard Report Number	Safety Verification Number	Description (Identify Procedures by Number and Title)	Operation(s) Constrained	Independent Verification Required (Yes/No)	Scheduled Date	Completion Date	Method of Closure Comments/Verification Completion Notice (VCN)	Completion Date	Remarks As a Result of Independent Validation and Verification
1	BIRDS5-UNQ-01	1.1-1(1)	Inspection to verify that the satellites are installed per the approved packing requirement.	No	No	31-5-22				
2	BIRDS5-UNQ-02	1.4-1(3)	Confirm the battery monitor terminals are covered with Kapton tape	No	No	31-5-22				
3	BIRDS5-UNQ-02	1.4-2(2)	Confirm that the battery voltage is in a state of final charge (SOC > 80%) at the time of delivery.	No	No	31-5-22				