# BIRDS-3 Project
# EM Thermal Vacuum Test Procedure

Kyushu Institute of Technology
Laboratory of Spacecraft Environment Interaction Engineering

| Date | Version Number | Writer | Annotations |
|---|---|---|---|
| 2018/07/20 | v1.0 | Sasaki Yuji | First Draft |
| 2018/07/25 | v1.1 | Sasaki Yuji | Corrections |
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| 2018/08/23 | v1.9 | Abhas, Makiko | Edit all |
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**Contents**

# 1. Introduction

## 1.1. General

The Thermal Vacuum Test (TVT) of the Engineering Model (EM) of BIRDS-3 satellite shall pass qualification requirements under vacuum conditions and temperature extremes which simulate predicted space environment.

## 1.2. Objectives

The following are the test objectives:

- Check and analyze various satellite point temperatures under extreme hot and cold conditions.
- Check and analyze functionality and operation of the satellite under the defined temperature range (extreme hot, extreme cold and middle temperature conditions).
- Check and analyze antenna deployment mechanism under worst cold temperature.
- Check and analyze operation of battery heater and thermal monitors under the defined temperature range.

## 1.3. Scope

This document is applied to thermal vacuum test for BIRDS-3 EM using the small vacuum chamber at the Center for Nanosatellite Testing (CENT) at Kyutech.

# 2. Reference

| Document number | Document description | Revision level or Release date |
|---|---|---|
| ISBN 1-884989-11-X | Spacecraft Thermal Control Handbook | Second Edition, 2002 |
| BIRDS-3 RAS | BIRDS-3 Project Requirement Allocation Sheet | Version 1 (2018/4/24) |

# 3. Nomenclature

## 3.1. Acronyms

| | |
|---|---|
| ADCS | Attitude Determination and Control System |
| COM-UHF TRX | UHF transceiver board |
| EM | Engineering Model |
| EPS | Electric Power Subsystem |
| FAB | Front Access Board |
| GPS | Global Positioning System |
| GS | Ground Station |
| LN2 | Liquid Nitrogen |
| OBC | Onboard Computer |
| PCB | Printed Circuit Board |
| RAB | Rear Access Board |
| RBF | Remove-Before-Flight |
| SP | Solar Panel |
| TC | Thermocouple |
| TVT | Thermal Vacuum Test |

**3.2 Symbols**

| | |
|---|---|
| ℃ | Degree Celsius |
| Ω | Ohm (resistance value) |
| W | Watt |
| Pa | Pascal |

## 4. Test Purpose

### 4.1. Overall test purpose

1. Measure temperatures at different satellite points under extreme hot and cold conditions.
2. Check functionality and operation of the satellite under defined temperature range (extreme hot, extreme cold and middle temperature conditions).
3. Check antenna deployment mechanism under worst cold temperature.
4. Check operation of battery heater and thermal monitors under defined temperature range.

### 4.2. Corresponding Requirements from RAS

Table 1. Requirements from RAS to be satisfied by the test

| Requirement Number (from RAS) | Requirement Description |
|---|---|
| **N/A** | All of BIRDS-3's components/parts temperature range shall be within the operating temperature ranges. |
| **DR1.9.1** | BIRDS-3 shall be equipped with a heater circuit to increase internal temperature when necessary. |
| **DR1.10.1** | The heaters shall maintain the battery packs temperature in allowable temperature. |
| **DR1.10.2** | The heaters shall not be damaged during the operation. |
| **DR1.10.3** | Heater power consumption shall be less than 1W. |
| **DR4.1.1** | Allowable internal temperature range shall be from -10ºC to 45ºC. |
| **DR4.1.2** | Allowable external temperature range shall be from -40ºC to +80ºC. |
| **DR4.1.3** | Appropriate surface material shall be selected. |
| **DR4.2.1** | Suitable sensors shall be selected for the satellite temperature range. |
| **DR4.2.3** | Temperature measurement shall be correct within ±0.5 ºC. |
| **No assigned ID** | The battery shall be kept within temperature range (+5ºC to 35ºC). |

## 5. Test Description

### 5.1. Test Place and Time

#### 5.1.1. Test Date

The thermal vacuum test will be conducted from **July 30 to August 3, 2018** (5 days) which includes setup preparation, the actual test cycles (with satellite functional test) and setup recovery.

#### 5.1.2. Test Place

Center for Nanosatellite Testing
Laboratory of Spacecraft Environment Interaction Engineering
Kyushu Institute of technology
1-1 Sensui, Tobata, Kitakyushu, 804-8550 Fukuoka, Japan

### 5.2. Test Contents

The test shall consist of:

1. Preparation of the satellite, thermocouples (TCs), sheet heaters, connectors, GS setup and other materials to be used for the test
2. Attachment of TCs and heaters to the satellite and checking the response/resistance
3. Satellite assembly and checking of satellite functionality in normal laboratory setup (in BIRDS Room condition)
4. Installation of the satellite, TCs, heaters, and connectors inside the vacuum chamber and checking connectivity and responses.
5. Checking the satellite functionality inside the vacuum chamber before closing (atmospheric condition)
6. Vacuuming
7. Measurement of temperature of various satellite points in vacuum condition during the thermal vacuum test (especially at extreme cold condition, extreme hot condition and during the temperature transition)
8. Checking the satellite functionality during the thermal vacuum test (especially at extreme cold condition, extreme hot condition and during the temperature transition)
9. Antenna deployment test at extreme cold temperature of the Cycle 4
10. Checking battery heater operation during the thermal vacuum test
11. Setup recovery and removing the satellite from the vacuum chamber

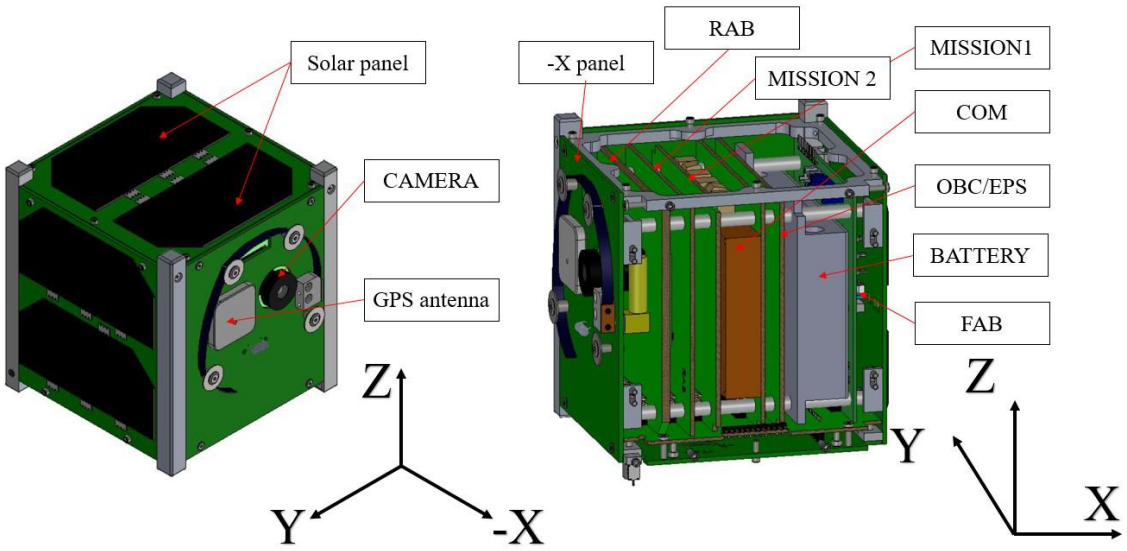
### 5.3. Test Article

The test article description is shown in Table 2.

Table 2. Test article description

| No. | Article name | Quantity | Manufacturer |
|---|---|---|---|
| **1** | BIRDS-3 EM | 1 | - |

The EM 3D model is shown in Figure 1.



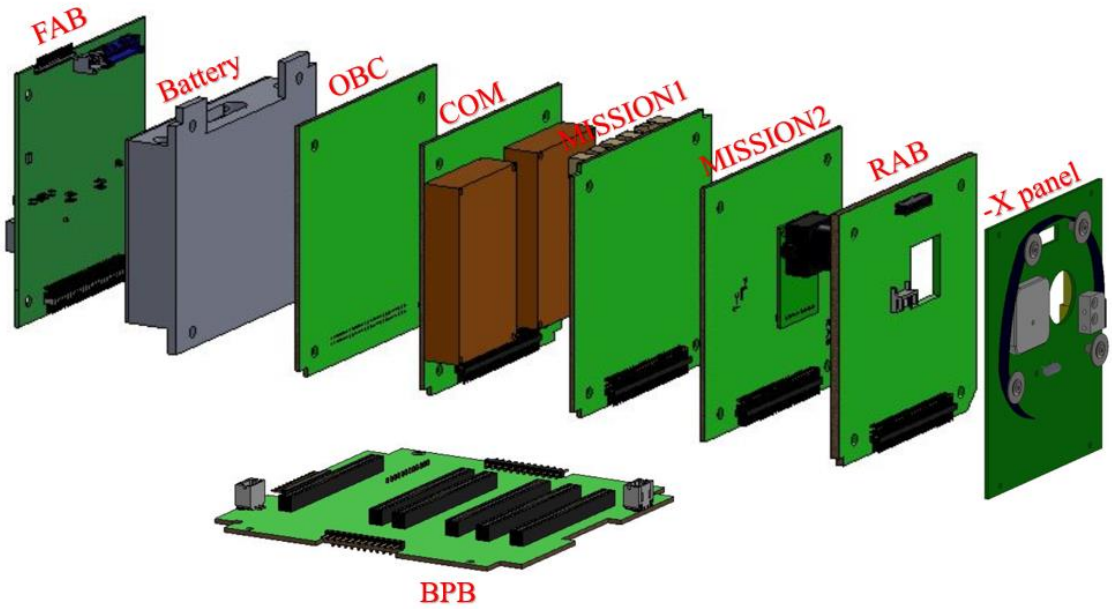



**Figure 1. BIRDS-3 EM 3D model**

### 5.4. Test Flow, Level and Conditions

Pressure, temperature and testing duration are described below

- Pressure: the chamber pressure shall be kept below 1 x 10-3 Pa during all conditions of the thermal vacuum test. In this pressure range, heat exchange by molecular flow is negligible.
- Test flow:

Table 3 shows the condition of heater power for thermal vacuum test. The power conditions shall be based on the calculation from orbit analysis for worst cases.

**Table 3. Heater power in thermal vacuum test**

| Phase | Duration (Hours) | Time (HH:MM) | +X, +Z Sheet Heater Power (W) | -X, -Z Sheet Heater Power (W) | +Y, -Y Sheet Heater Power (W) | Battery Sheet Heater Power (W) |
|---|---|---|---|---|---|---|
| Vacuuming | | | 0 | 0 | 0 | 0 |
| Vacuum reached, room temperature | | | 0 | 0 | 0 | 0 |
| Cold Ramp 1 Start | | | | | | |
| Cold Ramp 1 Stop | | | | | | |
| Cold Soak 1 Start | | | | | | |
| Cold Soak 1 Stop | | | | | | |
| Cold Start | | | | | | |
| FT | | | | | | |
| Hot Ramp 1 Start | | | | | | |
| Hot Ramp 1 Stop | | | | | | |
| Hot Soak 1 Start | | | | | | |
| Hot Soak 1 Stop | | | | | | |
| FT | | | | | | |
| Cold Ramp 2 Start | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Cold Ramp 2 | Stop | | | | | | |
| Cold Soak 2 | Start | | | | | | |
| Cold Soak 2 | Stop | | | | | | |
| FT | | | | | | | |
| Hot Ramp 2 | Start | | | | | | |
| Hot Ramp 2 | Stop | | | | | | |
| Hot Soak 2 | Start | | | | | | |
| Hot Soak 2 | Stop | | | | | | |
| FT | | | | | | | |
| Cold Ramp 3 | Start | | | | | | |
| Cold Ramp 3 | Stop | | | | | | |
| Cold Soak 3 | Start | | | | | | |
| Cold Soak 3 | Stop | | | | | | |
| FT | | | | | | | |
| Hot Ramp 3 | Start | | | | | | |
| Hot Ramp 3 | Stop | | | | | | |
| Hot Soak 3 | Start | | | | | | |
| Hot Soak 3 | Stop | | | | | | |
| FT | | | | | | | |
| Cold Ramp 4 | Start | | | | | | |
| Cold Ramp 4 | Stop | | | | | | |
| Cold Soak 4 | Start | | | | | | |
| Cold Soak 4 | Stop | | | | | | |
| FT | | | | | | | |
| Antenna Deployment | | | | | | | |
| Hot Ramp 4 | Start | | | | | | |
| Hot Ramp 4 | Stop | | | | | | |
| Hot Soak 4 | Start | | | | | | |
| Hot Soak 4 | Stop | | | | | | |
| FT | | | | | | | |
| Ramp down to room temperature | | | | | | | |
| FT | | | | | | | |
| De-vacuuming and recovery | | | | | | | |

## 6. Test Facility, Setup and Equipment

### 6.1 Test Facility

Specifications of the thermal vacuum chamber are shown in Table 4.

**Table 4. Small thermal vacuum chamber specification**

| No. | Items | Specification |
|---|---|---|
| 1 | Size [mm] | |
| 2 | Ultimate Vacuum [Pa] | |
| 3 | Pump | Rotary pump (____/s)<br>Turbo-molecular pump (____/s) |
| 4 | Shroud temperature [°C] | |
| 5 | Size of testable [mm] | |
| 6 | Mass [kg] | |
| 6 | Characteristics | |

Figure 2 is an illustration of CeNT's small thermal vacuum chamber.

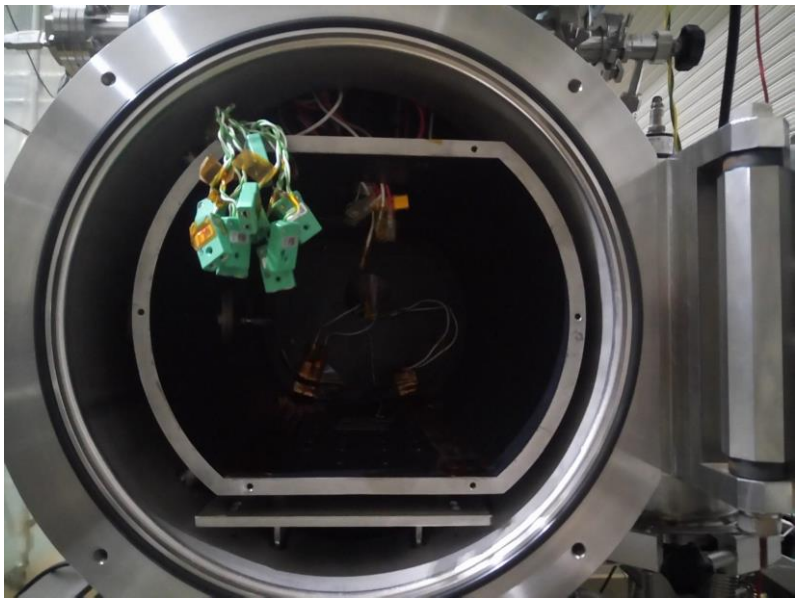


**Figure 2. Small Thermal Vacuum Chamber at CeNT**

### 6.2 Test Setup

The setup diagrams are shown below.

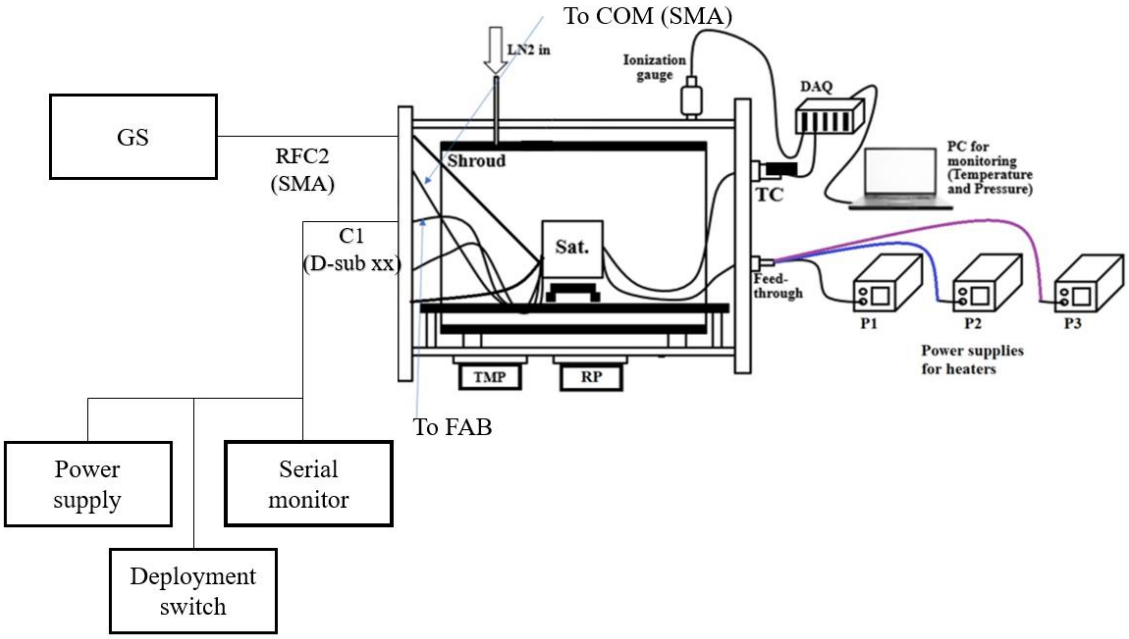



**Figure 3. Overall test setup**

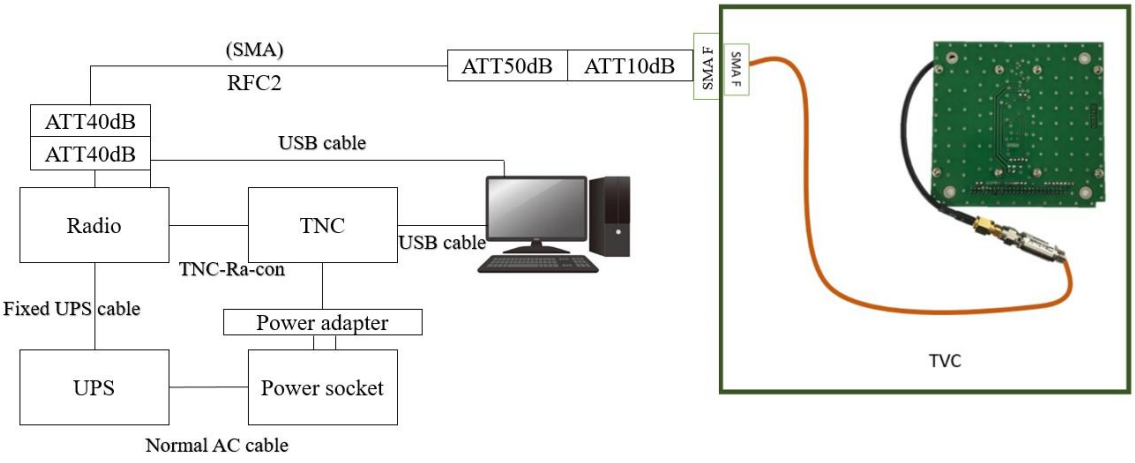



**Figure 4. Connection from COM-UHF transceiver boards to GS equipment**

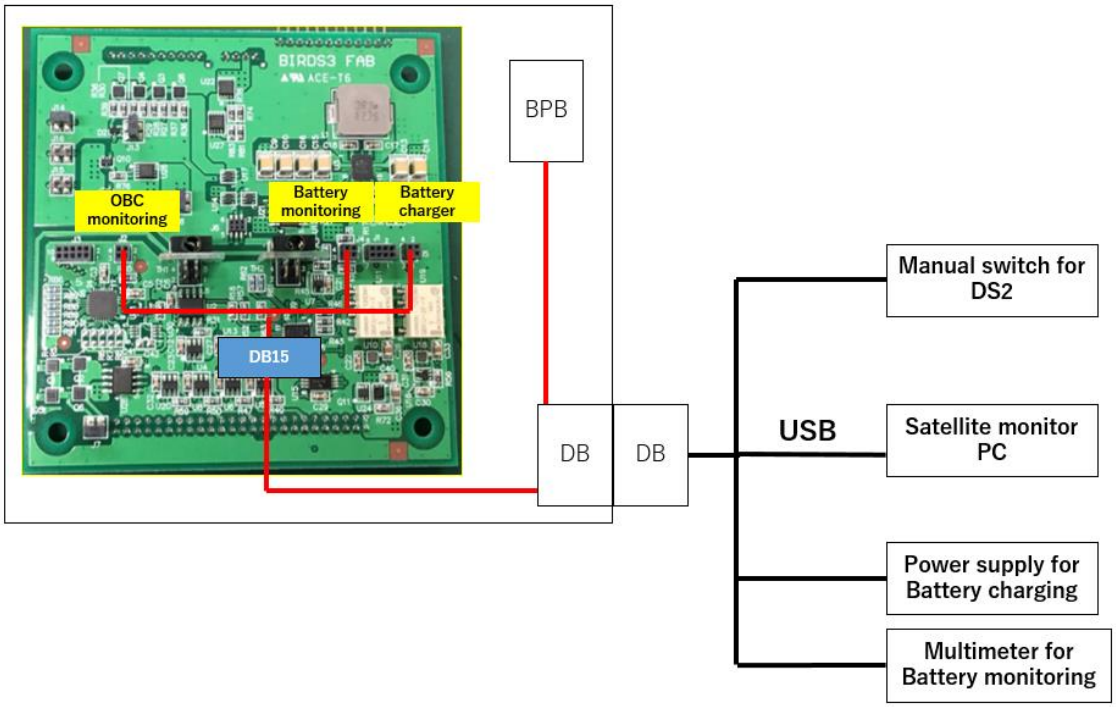



**Figure 5. Connection from FAB to programming board, satellite monitoring PC, manual switch for RBF and power supply for battery charging**

### 6.3 Thermal Cycle Profile

- The test will be conducted with 4 cycles (4 cold and 4 hot) as shown in Figure 6. At the extreme cold temperature and at the extreme hot temperature of each cycle, soaking time is 2 hours then followed by functionality tests of subsystems and missions within the next 1 hour.
- There are a total 16 temperature measurement points for the satellite, including the six on the external panels points.
- The monitoring/control temperature is battery for cold case and battery and COM for hot.
- The temperature ramp-up (worst cold to worst hot) rate is 45°C/hour and the temperature ramp-down (worst hot to worst cold) is 30°C/hour.
- The worst cold condition for battery is 0°C and will be used as controls.
- The worst hot condition which is control is the battery at +40°C or +50°C of COM, which ever arrives first.
- The battery heater of the satellite thermal subsystem will be activated. Its operation will be verified – whether it is able to maintain battery temperature above +5°C.
- The battery temperature will be controlled to get lowest 0°C in a short time during the last cold soak phase to verify the battery operation in worst cold case.

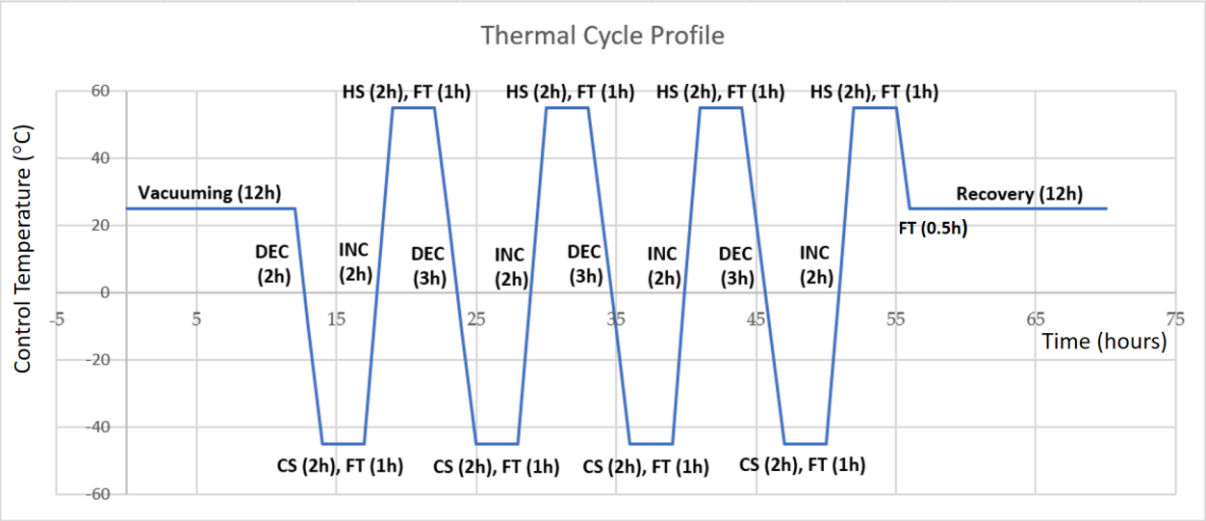



**Figure 6. Test Cycle Profile**

### 6.4 Heater Positions

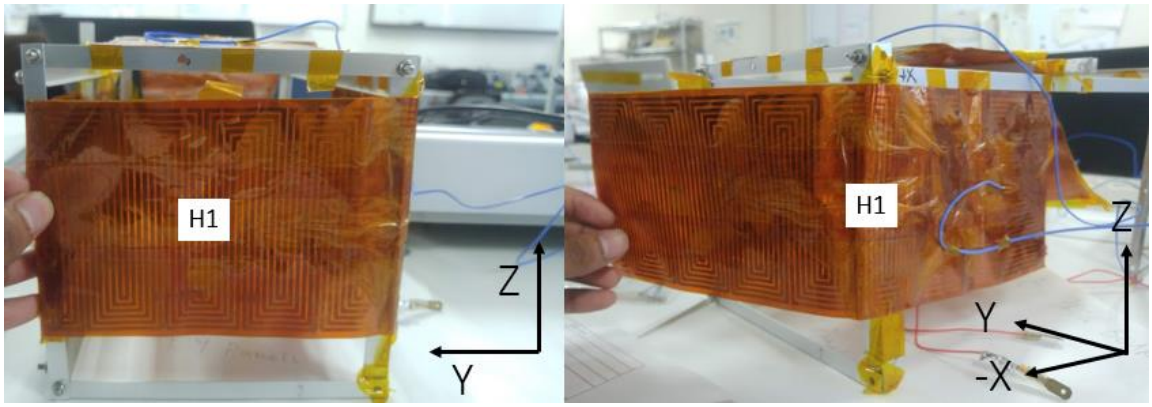
Table 5 provides the sheet heater parameters such as position, size, resistance and maximum power that can be used for the test.

**Table 5. Heater Parameters**

Parallel Connection

| Heater Number | Position | Size [mm] | Resistance (Ω) | Total Resistance (Ω) | Maximum Power (W) | Power Supply Number |
|---|---|---|---|---|---|---|
| H1 | -Y, -X | 300 mm x 100 mm | 28.5 | ~14.5 | | P1 |
| H2 | +Y | 300 mm x 100 mm | 29 | | | P1 |
| H3 | +X, Z | 300 mm x 100 mm | 28.5 | 28.5 | | P2 |
| H4 | -Z | 165 mm x 105 mm | 12.5 | 12.5 | | P3 |

The placement of the sheet heaters is shown in Figure 7 below. In the final setup, the heaters will be attached to their respective positions by first fixing using aluminum tape and then covering with Kapton tape, as shown in Figure 8. The Kapton tape is intended to improve the overall emissivity of the test article so that the temperature will decrease faster than that of the configuration with Aluminum tape alone.



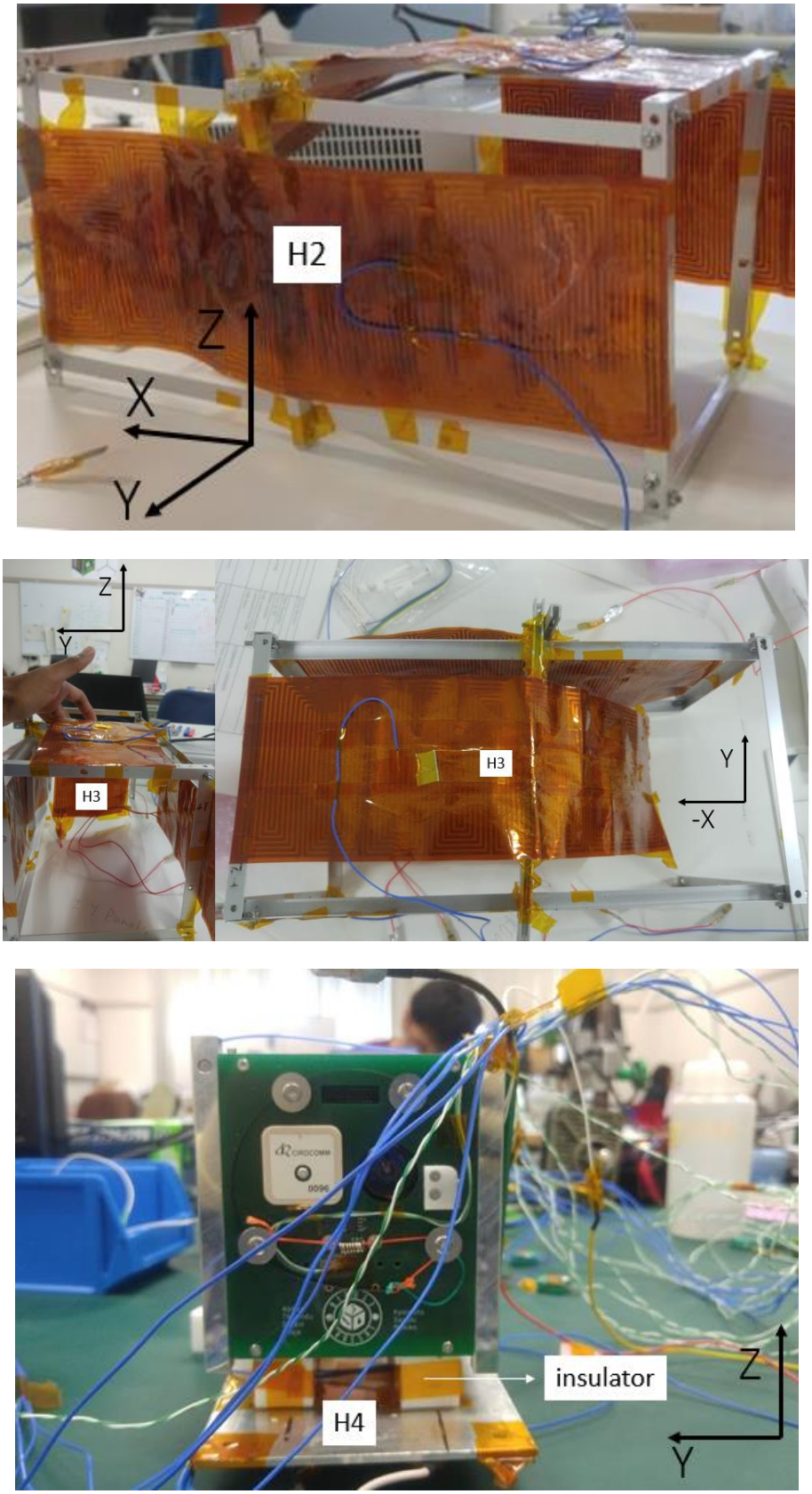



**Figure 7. Heater Positions**

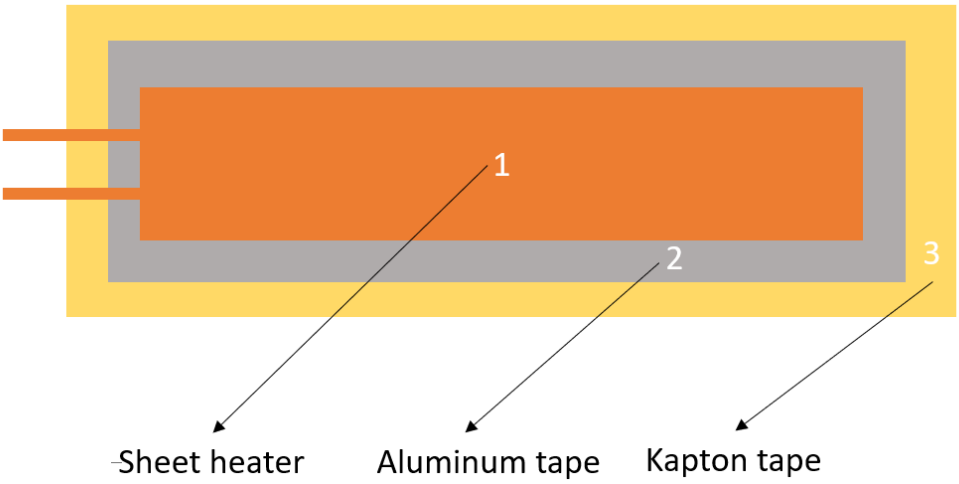



**Figure 8. Attachment of sheet heater**

### 6.5 Thermocouple Positions

The positions of thermocouples are summarized in Table 6.

**Table 6. Positions of Thermocouples**

| | Position | TC Number | Connector Number Inside of Chamber | TC Number in PC | Measurement Point |
|---|---|---|---|---|---|
| **1** | Shroud Top | | | 9 | |
| **2** | Shroud Bottom | | | 10 | |
| **3** | LN2 Control | | | 11 | |
| **4** | Battery Box – Front | K01 | | 0 | Figure 9 |
| **5** | Battery Box – Back | K02 | | 1 | Figure 10 |
| **6** | Battery – Inside Battery Box | K03 | | 2 | Figure 11 |
| **7** | Front Access Board | K04 | | 3 | Processor, Figure 12 |
| **8** | OBC Board | Kxx | | 4 | Processor, Figure 13 |
| **9** | COM-UHF TRX Board | K06 | | 5 | Processor, Figure 14 |
| **10** | LDM Board | K07 | | 6 | Processor, Figure 15 |
| **11** | Mission Board II | K08 | | 7 | Processor, Figure 16 |
| **12** | Rear Access Board | K09 | | 8 | Figure 17 |
| **13** | -X | K10 | | 12 | Near Nichrome Wire Figure 18 |
| **14** | +X | K11 | | 13 | Figure 19 |
| **15** | +Y | K12 | | 14 | Figure 20 |
| **16** | -Y | K13 | | 15 | Figure 21 |
| **17** | +Z | K14 | | 16 | Figure 22 |
| **18** | -Z | K15 | | 17 | Figure 23 |
| **19** | CPLD Backplane Board | K16 | | 18 | CPLD, Figure 24 |
| **20** | H1 | K20 | | 19 | Figure 7 |
| **21** | H2 | K17 | | 20 | Figure 7 |
| **22** | H3 | K18 | | 21 | Figure 7 |
| **23** | H4 | K19 | | 22 | Figure 7 |

Figure 9 to Figure 24 show the position of thermocouples will be attached to the satellite:

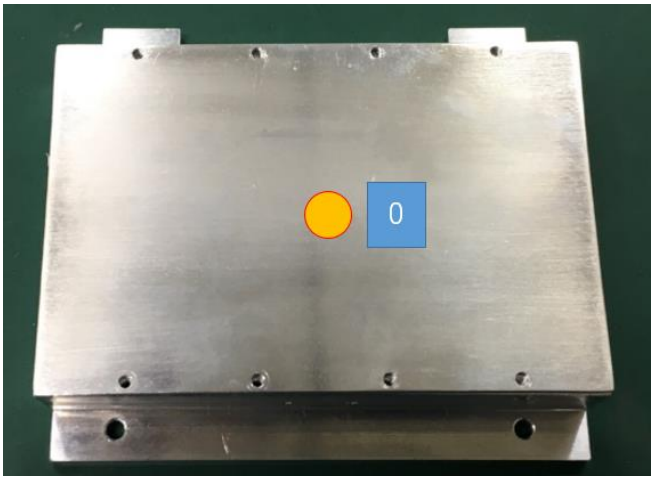



**Figure 9.** Battery Box – Front Side

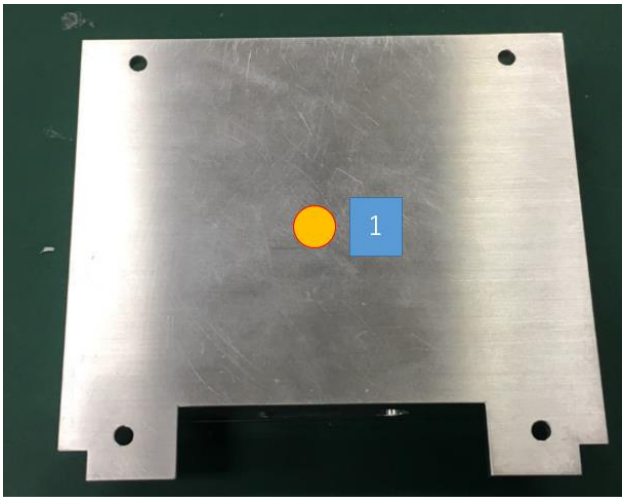



**Figure 10.** Battery Box – Back Side


**Figure 11.** Battery – Inside Battery Box


**Figure 12**. Front Access Board

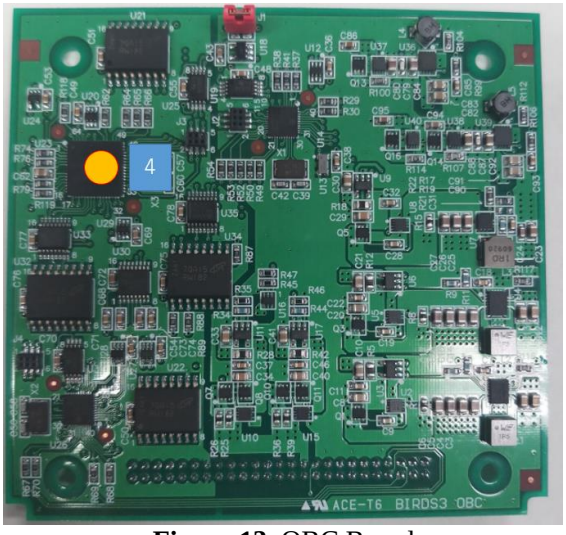



**Figure 13.** OBC Board

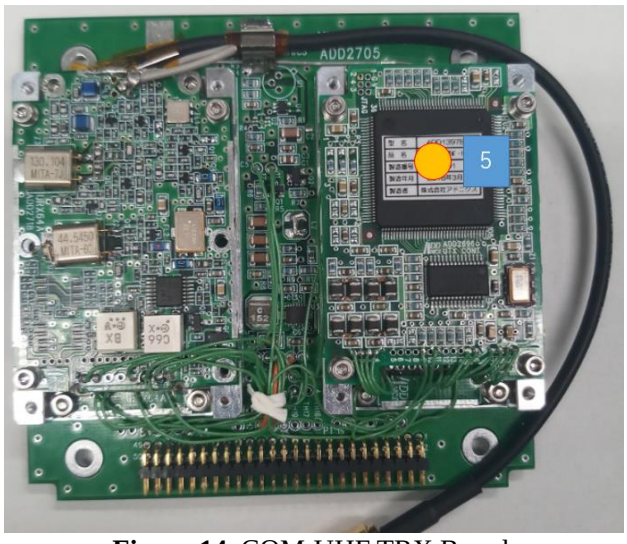



**Figure 14.** COM-UHF TRX Board


**Figure 15.** LDM Board

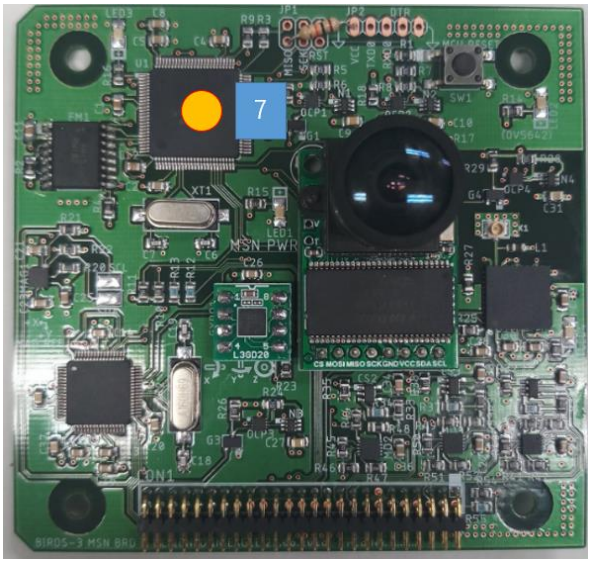



**Figure 16.** Mission Board Ⅱ

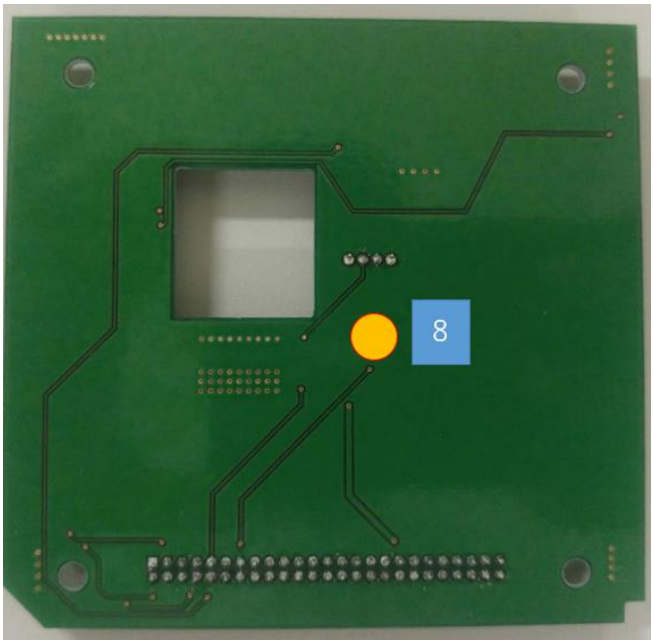



**Figure 17.** Rear Access Board


**Figure 18.** –X external panel

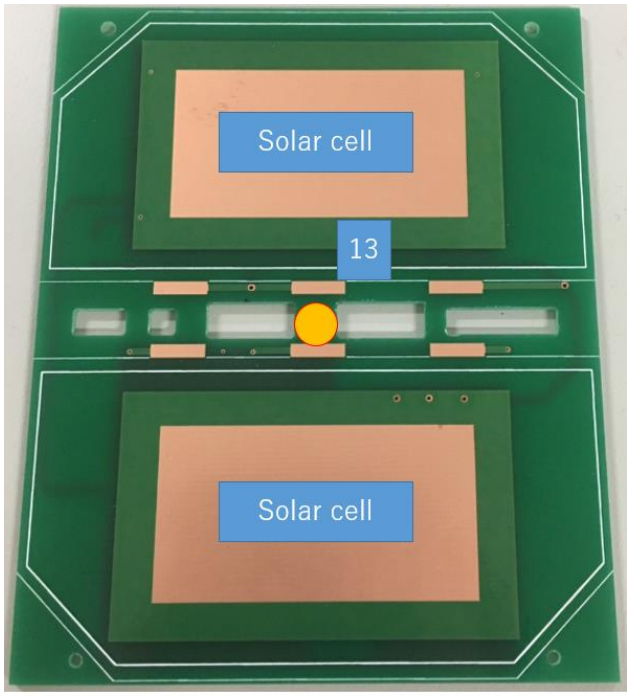



**Figure 19.** +X External Panel

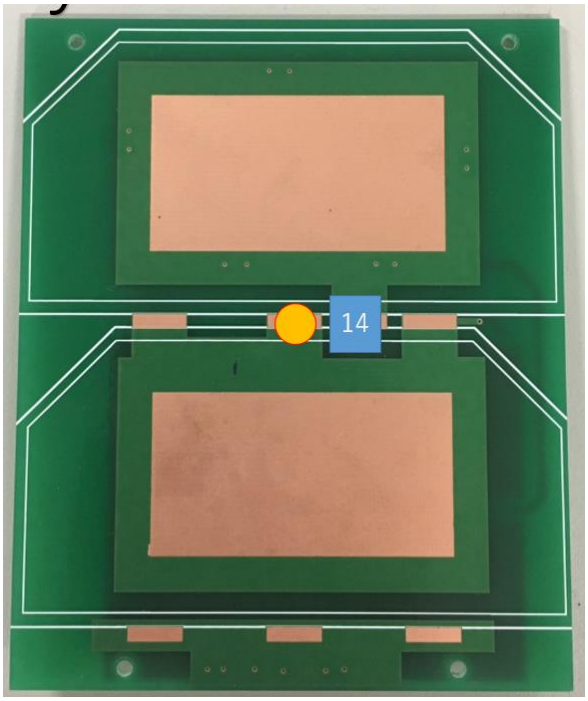



**Figure 20.** +Y External Panel

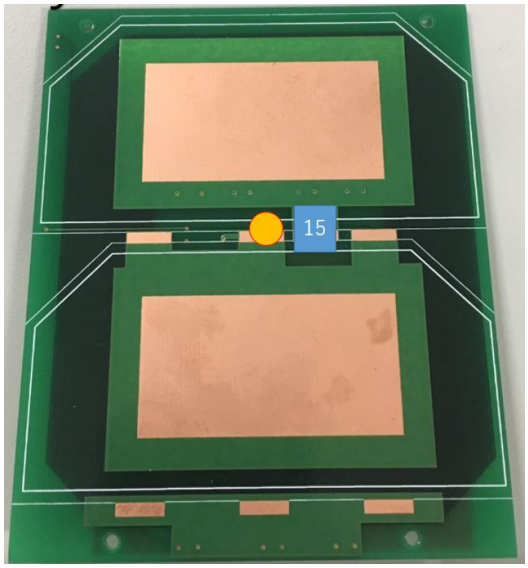



**Figure 21.** -Y Internal Panel

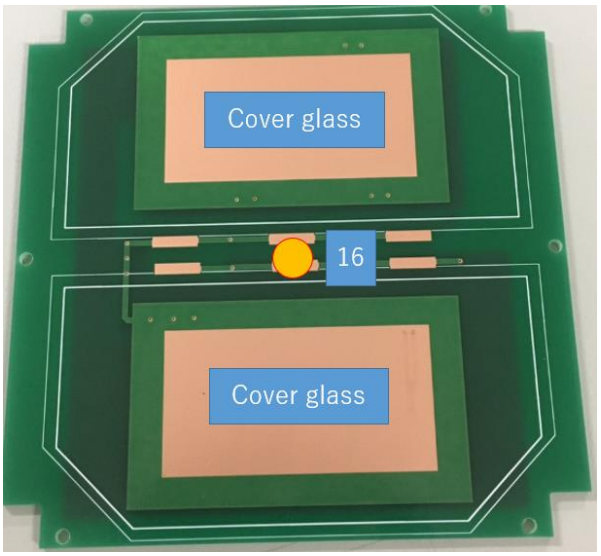



**Figure 22.** +Z External Panel

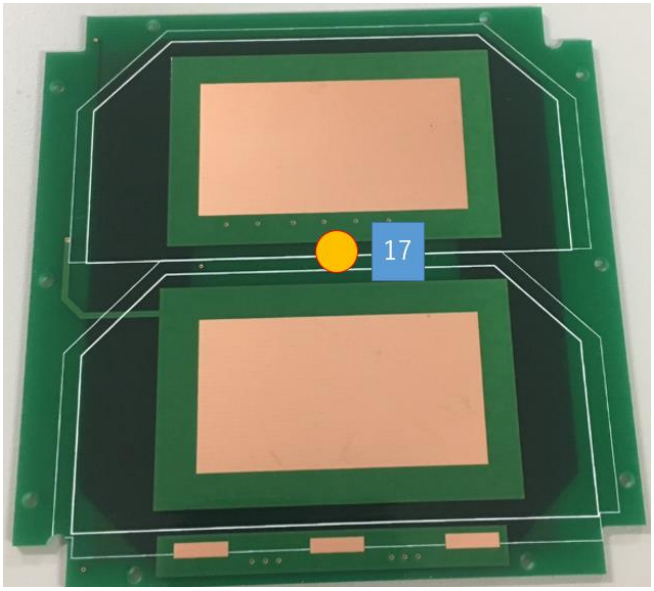



**Figure 23.** -Z External Panel

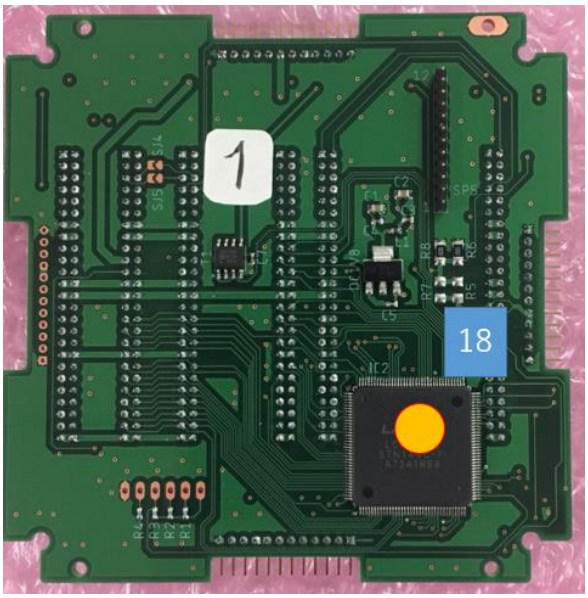



**Figure 24.** CPLD Backplane Board

### 6.6 Attachment of Thermocouples

Figure 25 shows the steps of attaching the thermocouples to satellite surfaces and components.

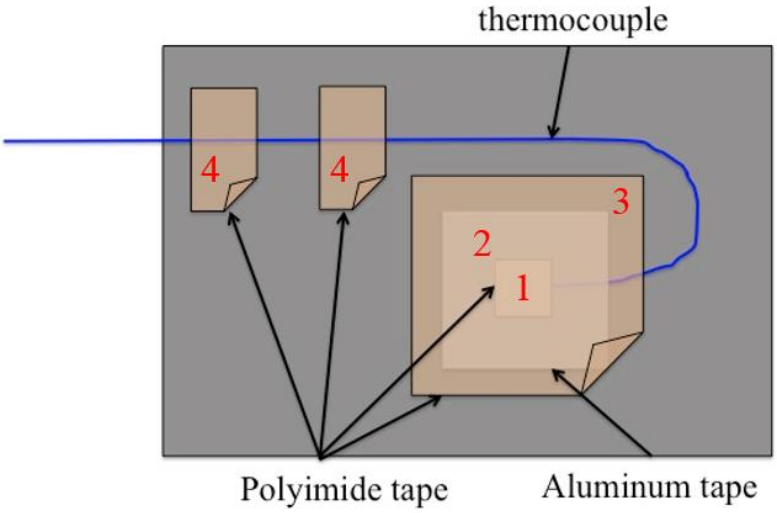



**Figure 25. Attach Thermocouple**

- Step 1: Cover thermocouple tips by a small piece of polyimide tape
- Step 2: Fix the thermocouple terminal using aluminum tape
- Step 3: Cover the aluminum tape by polyimide tape
- Step 4: Fix the thermocouple wire by polyimide tapes

### 6.7 Placement of satellite inside the small vacuum chamber

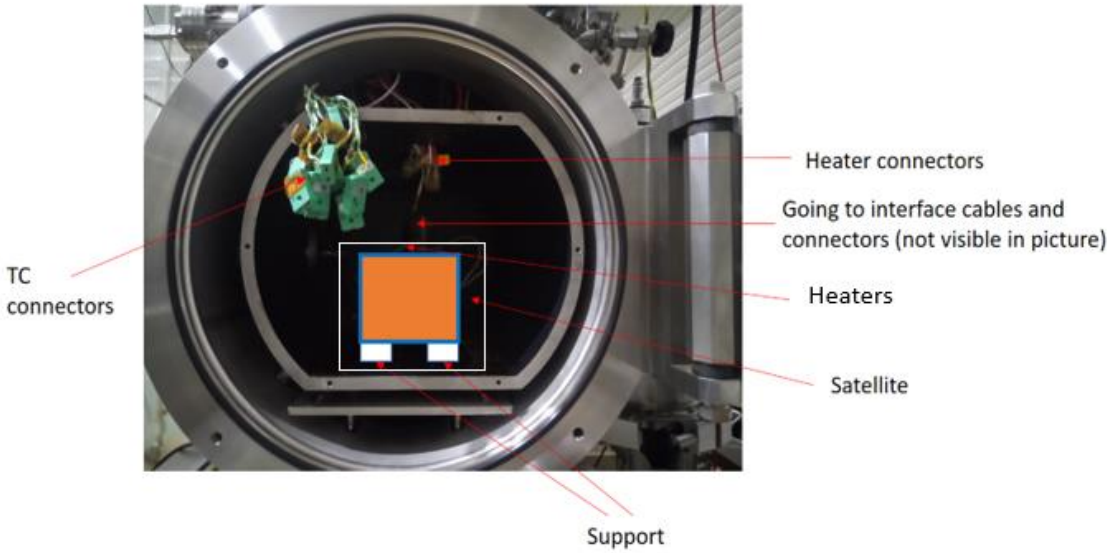



**Figure 26. Placement of the satellite inside the small vacuum chamber**

### 6.8 Equipment and Measuring Instruments

**Table 7** shows a list of equipment needed during the thermal vacuum test.

**Table 7.** Equipment and measuring instruments details

| No | Equipment | Quantity | Model | Comments |
|---|---|---|---|---|
| 1 | Thermocouple | 20 | Type-K | -180 to +1300 °C |
| 2 | Sheet Heater | 3 | | 89Ω |
| 3 | Sheet Heater | 2 | | 97Ω |
| 4 | Data acquisition PC | 1 | Desktop PC | For chamber control |
| 5 | DAQ-mx | 4 | NI 9213 | 24 bit ADC |
| 6 | Power Supply | 4 | | 0-320V |
| 7 | Camera | 1 | D3200 | 24 Mpx |
| 8 | Transceiver | 1 | IC-9100 | For functional test |
| 9 | Attenuator | 3 | | For functional test |
| 11 | Functional Test PC | 2 | N/A | For functional test |
| 12 | Terminal Node Controller | 1 | KPC-9612+ | For functional test |

## 7. Test Schedule

The test schedule is shown in Table 8 below, the schedule is tentative and can be changed base on the actual test conditions.

**Table 8.** Test schedule

| | 7/30 AM | 7/30 PM | 7/31 AM | 7/31 PM | 8/1 AM | 8/1 PM | 8/2 AM | 8/2 PM | 8/3 AM |
|---|---|---|---|---|---|---|---|---|---|
| Preparation of the satellite, thermocouples (TCs), sheet heaters, connectors, GS setup and other materials to be used for the test | | | | | | | | | |
| Attachment of TCs and heaters to the satellite and checking the response/resistance | | | | | | | | | |
| Satellite assembly and checking of satellite functionality in normal laboratory setup (in BIRDS-3 Room condition)<br>Installation of the satellite, TCs, heaters, and connectors inside the vacuum chamber and checking connectivity and responses. | | | | | | | | | |
| Checking the satellite functionality inside the vacuum chamber before closing (atmospheric condition) | | | | | | | | | |
| Vacuuming | | | | | | | | | |
| Inject LN2 | | | | | | | | | |
| Thermal Cycle | | | | | | | | | |
| De-vacuuming, setup recovery and removing the satellite from the vacuum chamber | | | | | | | | | |

## 8. Detailed Test Procedure

The detail test procedures shown in Table 9 with tasks need to be done before, during and after the test, the person in charge of each task should check the task once it finished.

| |
|---|
| Verification |
| Preparation and checking the satellite and chamber |
| Make vacuum and conduct the thermal test and functional test |
| Stop the test, clean up and check the satellite |

**Table 9.** Detailed test procedure

| No. | Procedure | Check |
|---|---|---|
| 0 | Verify all satellite functionalities and operation (preliminary, in BIRDS-3 Room) | |
| 1 | Prepare and check thermocouples | |
| 2 | Prepare and check heaters | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3 | Check chamber's heater connections | | | | | | |
| 4 | Check chamber's thermocouple connections | | | | | | |
| 5 | Check chamber's D-Sub and RF port connections | | | | | | |
| 6 | Disassemble structure and center box | | | | | | |
| 7 | Attach thermocouples and heaters to BIRDS-3 CubeSat (see Figures 8-26) | | | | | | |
| 8 | Take photos and note the heaters' and TCs' positions | | | | | | |
| 9 | Reassemble satellite and check thermocouples and heaters connection | | | | | | |
| 10 | Check satellite functionalities | | | | | | |
| 11 | Move satellite to the chamber | | | | | | |
| 12 | Install the satellite in the chamber (see Fig. 27) | | | | | | |
| 13 | Check again all heaters' and TCs' response on the PC | | | | | | |
| 14 | Check satellite functionalities | | | | | | |
| 15 | Close the chamber | | | | | | |
| 16 | Make vacuum | | Duration | Time | -Y, -X, +Y Sheet Heater (H1,H2) Power (W) | +X, Z Sheet Heater (H3) Power (W) | -Z Heater (H4) Power(W) |
| | | | (Hours) | (HH:MM) | | | |
| 17 | Inject LN2 | | | | 0 | 0 | 0 |
| 18 | Start cold ramp 1 | | | | 0 | 0 | 0 |
| 19 | Start cold soak 1 | | | | | | |
| 20 | Satellite functional test 1-C | | | | | | |
| 21 | Start hot ramp 1 | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 22 | Start hot soak 1 | | | | | | |
| 23 | Satellite functional test 1-H, battery charging | | | | | | |
| 24 | Start cold ramp 2 | | | | | | |
| 25 | Start cold soak 2 | | | | | | |
| 26 | Satellite functional test 2-C | | | | | | |
| 27 | Start hot ramp 2 | | | | | | |
| 28 | Start hot soak 2 | | | | | | |
| 29 | Satellite functional test 2-H, battery charging | | | | | | |
| 30 | Start cold ramp 3 | | | | | | |
| 31 | Start cold soak 3 | | | | | | |
| 32 | Satellite functional test 3-C | | | | | | |
| 33 | Start hot ramp 3 | | | | | | |
| 34 | Start hot soak 3 | | | | | | |
| 35 | Satellite functional test 3-H, battery charging | | | | | | |
| 36 | Start cold ramp 4 | | | | | | |
| 37 | Start cold soak 4 | | | | | | |
| 35 | Satellite functional test 4-C | | | | | | |
| 36 | Start hot ramp 4 | | | | | | |
| 37 | Start hot soak 4 | | | | | | |
| 38 | Satellite functional test 4-H, battery charging | | | | | | |
| 39 | Start ramp down to room temperature | | | | | | |
| 40 | Satellite functional test at room temperature | | | | | | |
| 41 | Stop LN2 injection | | | | | | |
| 42 | Turn on chamber heater to increase chamber temperature | | | | | | |
| 43 | Open chamber, move satellite to clean room | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 44 | Satellite functional testing | | | | | | |
| 45 | Disassemble satellite | | | | | | |
| 46 | Remove TCs and heaters | | | | | | |

## 9. Test Output

### 9.1. Data analysis strategy

Table 10 below show the operating temperature range of BIRDS-3 satellite. The temperature of each subsystem during the test should be inside of operating temperature range.

**Table 10. Subsystem operating temperature range**

| Subsystem | Lowest (°C) | Highest (°C) | |
|---|---|---|---|
| Front Access Board | -20°C | +85°C | |
| OBC/EPS Board | -40°C | +85°C | |
| Battery | +0°C | +40°C | Hot + Cold Control Case |
| COM-UHF TRX Board | -20°C | +60°C | |
| LDM Board | -40°C | +60°C | |
| Mission Board II | -40°C | +85°C | |
| Rear Access Board | -40°C | +140°C | |
| -X Panel | -40°C | +85°C | |
| CPLD Backplane | -40°C | +105°C | |

### 9.2. Test report

- The thermal analysis for BIRDS-3 EM model with includes the configuration of the model and temperature profiles.
- Temperature profile of all measurement points during the test.
- Results on functionality tests, battery heater operation and antenna deployment test
- Evaluation of the test results.

## 10. Quality Insurance

Temperature [°C] : 20 ± 5
Humidity [%] : 70 ± 10
Atmosphere : 10^-5 Pa

## 11. Personnel Assignment

Tables 11 show the personnel assignment for the thermal vacuum test.

**Table 11. Personnel Assignment During Setup Preparation**

| Task | Responsible Person |
|---|---|
| Ground Station Equipment | |
| Preparation and installation of heaters and thermocouples | |
| D-sub Connector Preparation | |
| Battery Charging Setup | |
| Antenna preparation and deployment test trial | |
| Documentation | |
| Support | |
| TVT Lead | |
| Team Management | |

## 12. Safety Requirement

During the test period, in consideration of the safety of work, strictly observe the following matters:

1. During testing, the field officer shall supervise all work and instruct properly to assure the safety of work.
2. Use a crane or a handcart to move any heavy item with anticipated risk.
3. The ceiling crane shall be operated only by licensed personnel. I-bolt / lifting equipment should be inspected each time before operating the crane. No entry to the area under the suspended material is permitted.
4. During testing, keep unnecessary items away from the testing machine.
5. Gloves shall be worn when handling a satellite or sensors.
6. Do not place any item on safety-related motion lines, such as the emergency exit, corridor, fire extinguishers, etc.
7. When a high voltage apparatus is used, turn off the power before inspecting, touching, or modifying, etc.
8. In the case of a natural disaster or a serious accident, take emergency measures and prevent secondary accidents immediately. Then communicate via the following emergency communication links shown below in Figure 27.

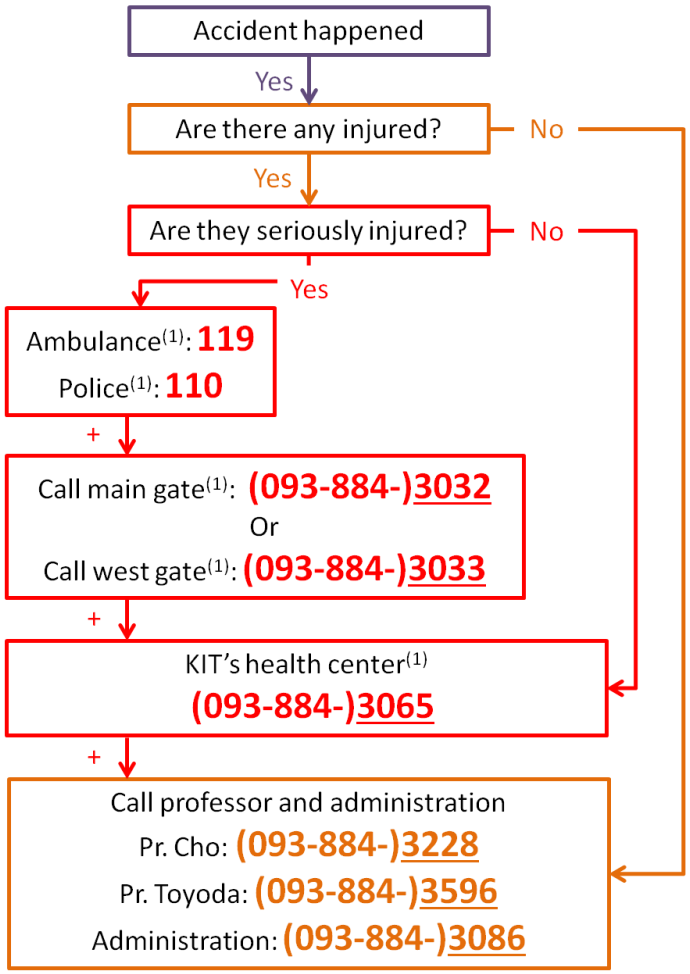



**Figure 27.** Emergency procedure flow chart

(1) What to say in Japanese

(a) You are the **center, 4th floor**

Kyushu kogyo daigaku, **kogakubu no sogo kenkyu ichi-goto, yonkai de _____nin fushosha (= injured)/kasai (= fire)** ga hassei shimasita. Watashi ha _____ (your name) desu.

Kyushu Institute of Technology, General Research Building No. 1, 4th floor. There are _____ people **injured**/There is a **fire**. I am _____ (your name).

(b) You are at **SVBL, 1st floor**

Kyushu kogyo daigaku, **kogakubu no sogo kenkyu ni-goto, ichikai de _____nin fushosha (= injured)/kasai (= fire)** ga hassei shimasita. Watashi ha _____ (your name) desu.

Kyushu Institute of Technology, General Research Building No. 2, 1st floor. There are _____ people **injured**/There is a **fire**. I am _____ (your name).

(c) You are at **SVBL, 2nd floor**

Kyushu kogyo daigaku, **kogakubu no sogo kenkyu ni-goto, nikai de _____nin fushosha (= injured)/kasai (= fire)** ga hassei shimasita. Watashi ha _____ (your name) desu.

Kyushu Institute of Technology, General Research Building No. 2, 2nd floor. There are _____ people **injured**/There is a **fire**. I am _____ (your name).

(d) You are at **SVBL, 3rd floor**

Kyushu kogyo daigaku, **kogakubu no sogo kenkyu ni-goto, sankai de _____nin fushosha (= injured)/kasai (= fire)** ga hassei shimasita. Watashi ha _____ (your name) desu.

Kyushu Institute of Technology, General Research Building No. 2, 3rd floor. There are _____ people **injured**/There is a **fire**. I am _____ (your name).