BIRDS-5 Project

Antenna Deployment and RF Transmission Test Report

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| --- | --- | --- | --- |
| **Date** | **Version Number** | **Writer** | **Annotation** |
| XXXX/XX/XX | NC | Edgar MUJUNI | Initial Release |

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# **Purpose**

This document summarizes the results of antenna deployment and RF transmissions test for BIRDS-5 satellites which will be deployed from JEM Small Satellites Orbital Deployer (J-SSOD). The antennae of the BIRDS-5 satellites will be deployed 30 minutes after being released from the J-SSOD. BIRDS-5 will transmit its CW beacon (437.375 MHz) after the antennae are deployed

# **Applicable Document and Requirements**

1. JX-ESPC-101132-D JEM Payload Accommodation Handbook-Vol.8-

Small Satellite Deployment Interface Control Document

**Section 2.3. Operational Requirements**

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

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

1. 16\_BIRDS5-SAR-02(Φ3) Flight Safety Assessment Report for phase III

# **Design for the Circuit of Antenna Deployment and RF transmissions**

All deployable antenna shall wait to deploy, and RF transmissions shall wait to transmit for 30 minutes at minimum after the deployment switches are activated at deployment of the satellite from the J-SSOD. Two signals are necessary to activate the burner circuit of BIRDS-5. The 3V3 signal from the ADCS and the unregulated lines from the EPS. Upon release to space, only the 3V3 signal turns ON. After 30 minutes, the whole electrical system of the satellite turns ON therefore, activating the unregulated lines. This causes the heat cutter circuit to activate hence cutting the wires stowing the antennae. the unregulated line turns OFF after 1 minute. the transmission of the CW beacon of BIRDS-5 starts 1 minute and 2 minutes respectively, after the antennae are deployed.

ダイアグラム が含まれている画像

自動的に生成された説明

**Figure 3-1 Antenna Deployment Mechanism (Nichrome wire as the heat cutter)**

# **Test Method**

## 4.1 30 minutes timer test

1. Figure 4-1 shows a test flow of the Antenna Deployment and RF transmissions test.
2. The battery is charged until the planned voltage at launch.
3. Press one deployment switch to reset the satellite.
4. Release the deployment switch of the pressed satellite and start the stopwatch.
5. All deployment switches are released, then the satellite is activated.
6. 30 minutes after releasing the last deployment switch, confirm that the four arms of the antenna are deployed, and an RF signal is transmitted. A picture of configuration after deployment is taken, and record time of deployment and starting RF transmission.

Diagram

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**Figure 4-1 Test sequence**

## 4.2 Reset function test

After the 30 minutes timer test, the satellite reset function is inspected.

1. Press one deployment switch to reset the satellite.
2. Release the deployment switch of the pressed satellite and start the stopwatch.
3. All deployment switches are released, then the satellite is activated.
4. 30 minutes after releasing the last deployment switch, confirm that the RF signal is transmitted. Record time of starting RF transmission. Compare the RF emission start times before and after the reset and verify that the 30 timer has been reset.

**Table 4-1 Test objectives**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Objectives | Quantity | Remarks |
| 1 | PearlAfricaSat-1 | 1 |  |
| 2 | Taka | 1 |  |
| 3 | ZimSat-1 | 1 |  |
| 4 | Stopwatch | 1 | - |
| 5 | Video Camera | 1 | - |
| 6 | Ground Station PC | 1 | - |
| 7 | Ground Station Transceiver | 1 | RTL SDR |
| 8 | Ground Station Antenna | 1 | Monopole antenna |

# **Test Results**

Date of test: 2022/02/11

Place of test: Center for Nanosatellite Testing (CeNT)

Laboratory of Lean Satellite Enterprises and In-Orbit Experiments

Kyushu Institute of Technology

1-1, Sensui, Tobata, Kitakyushu, 804-8550 Fukuoka, Japan

## 5.1 30 minutes timer test

Figures 5-1 to 5-8 and Table 5-1 show the result of the Antenna Deployment and RF transmissions test. Deployment of antennas and transmission of CW beacon were conducted over 30 minutes after releasing the deployment switches.

A picture containing text, table, room, worktable

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ZIMSAT-1

TAKA

PEARLAFRICASAT-1

**Figure 5-1 Start of the test**

A picture containing text, indoor, green, table

Description automatically generated

ZIMSAT-1

TAKA

PEARLAFRICASAT-1

**Figure 5-2 Past 30 minutes before antenna deployment**

A picture containing text, indoor, table, floor

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TAKA

ZIMSAT-1

PEARLAFRICASAT-1

**Figure 5-3 ZIMSAT-1 and TAKA antennas deployed (after 31 min 07 sec))**

**A picture containing text, floor, indoor, table

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PEARLAFRICASAT-1

ZIMSAT-1

TAKA

**Figure 5-4 PearlAfricaSat-1 antenna deployed (after 31 min 09 sec)**

**Graphical user interface

Description automatically generated**

**Jg6yoc**

**Figure 5-5 Received CW Beacon from ZIMSAT-1 (Jg6yoc) (after 32 min 14 sec)**

Chart

Description automatically generated with medium confidence

**Jg6yod**

**Figure 5-6 Received CW Beacon from PEARLAFRICASAT-1 (Jg6yod) (after 33 min 12 sec)**

Chart

Description automatically generated

**Jg6yoe**

**Figure 5-7 Received CW Beacon from TAKA (Jg6yoe) (after 34 min 13 sec)**

**Table 5-1 Result of activation sequence**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Action | Requirement | Recorded time |
| 1 | Release all deployment switches | - | 00:00:00 |
| 2 | Antennas of ZIMSAT-1 are deployed | Over 30 min from releasing all switches | 00:31:07 |
| 3 | Antennas of TAKA are deployed | Over 30 min from releasing all switches | 00:31:07 |
| 4 | Antennas of PEARLAFRICASAT-1 are deployed | Over 30 min from releasing all switches | 00:31:09 |
| 5 | ZIMSAT-1 starts transmitting its CW beacon | Over 30 min from releasing all switches | 00:32:14 |
| 6 | PEARLAFRICASAT-1 starts transmitting its CW beacon | Over 30 min from releasing all switches | 00:33:12 |
| 7 | TAKA starts transmitting its CW beacon | Over 30 min from releasing all switches | 00:34:13 |

## (b). Reset function test

Figures 5-9 to 5-18 and Table 5-2 show the result of the reset function test. Pressing any of the three deployment switches resets the timer.

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TAKA

ZIMSAT-1

PEARLAFRICASAT-1

**Figure 5-9 Start of the test**

Graphical user interface

Description automatically generated

**Jg6yoc**

**Figure 5-9 Received CW Beacon from ZIMSAT-1 after resetting by DepSW1**

**(after 32 min 14 sec)**

Graphical user interface, application

Description automatically generated

**Jg6yoc**

**Figure 5-10 Received CW Beacon from ZIMSAT-1 after resetting by DepSW2**

**(after 32min 12 sec)**

Graphical user interface

Description automatically generated

**Jg6yoc**

**Figure 5-11 Received CW Beacon from ZIMSAT-1 after resetting by DepSW3**

**(after 32 min 13sec)**

Chart

Description automatically generated

**Jg6yod**

**Figure 5-12 Received CW Beacon from PEARLAFRICASAT-1 after resetting by DepSW1**

**(after 33 min 13 sec)**

Chart

Description automatically generated with low confidence

**Jg6yod**

**Figure 5-13 Received CW Beacon from PEARLAFRICASAT-1 after resetting by DepSW2**

**(after 33 min 14 sec)**

Chart

Description automatically generated

**Jg6yod**

**Figure 5-14 Received CW Beacon from PEARLAFRICASAT-1 after resetting by DepSW3**

**(after 33 min 13 sec)**

Chart

Description automatically generated

**Jg6yoe**

**Figure 5-15 Received CW Beacon from TAKA after resetting by DepSW1**

**(after 34 min 13 sec)**

Graphical user interface

Description automatically generated with low confidence

**Jg6yoe**

**Figure 5-16 Received CW Beacon from TAKA after resetting by DepSW2**

**(after 34 min 13 sec)**

Graphical user interface

Description automatically generated with medium confidence

**Jg6yoe**

**Figure 5-17 Received CW Beacon from TAKA after resetting by DepSW3**

**(after 34 min 13 sec)**

**Table 5-2 Result of reset function test**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Satellite | Action | Recorded time |
| 1 | ZIMSAT-1 | CubeSat starts transmitting its CW beacon after resetting by DepSW1 | 00:32:14 |
| 2 | CubeSat starts transmitting its CW beacon after resetting by DepSW2 | 00:32:13 |
| 3 | CubeSat starts transmitting its CW beacon after resetting by DepSW3 | 00:32:13 |
| 4 | PEARLAFRICASAT-1 | CubeSat starts transmitting its CW beacon after resetting by DepSW1 | 00:33:13 |
| 5 | CubeSat starts transmitting its CW beacon after resetting by DepSW2 | 00:33:14 |
| 6 | CubeSat starts transmitting its CW beacon after resetting by DepSW3 | 00:33:13 |
| 7 | TAKA | CubeSat starts transmitting its CW beacon after resetting by DepSW1 | 00:34:13 |
| 8 | CubeSat starts transmitting its CW beacon after resetting by DepSW2 | 00:34:13 |
| 9 | CubeSat starts transmitting its CW beacon after resetting by DepSW3 | 00:34:13 |

# **Conclusion**

The results of the Antenna deployment and RF transmission test shows that BIRDS-5 satellites conform with the requirements set by JAXA. After 30 minutes releasing all deployment switch, the antennas were deployed, and RF transmission was transmitted. Pressing any deployment switches reset the satellite timer.