

OrigamiSat-1  
5.84GHz Downlink Data Format  
(English version)

Document#	OP-S1-0117	Revision	Ver. 1.1
Date	2019/01/11		
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Revision history

Date	Version	Content
2019/01/11	1.0, 1.1	Translated from Japanese document OP-S1-0111, ver. 1.1. (Sakamoto, Ide)

**Contents**

- Contents..... 3
- 1 Overview..... 4
- 2 Data format..... 4
  - 2.1 Mission data format ..... 4
  - 2.2 JPEG data..... 4
  - 2.3 H264 data..... 5
- 3 Preamble format ..... 5
  - 3.1 End-of-data detection preamble ..... 5
  - 3.2 Downlink rest preamble..... 6
- 4 Image restoration method..... 6

## 1 Overview

This document specifies the downlink data format for 5.84GHz communication (which is called “5.8G” hereafter) by 3U Cubesat, OrigamiSat-1 (JS1YAX).

## 2 Data format

The 5.8G data consists of (i) **binary picture data (mission data)**, (ii) **preambles** attached in the beginning as well as the end of transmission data to reduce packet losses.

- ✓ The baud rate is 115200 bps in default setting. The rate can be changed between 14400 bps and 57600 bps by an uplink command from Tokyo Tech ground station.
- ✓ Transmission from the satellite lasts for 10 seconds, and **rests** for 5 seconds. Then, this set repeats. The rests avoid overheating the transmitter. This transmission timing can be also changed by an uplink command from Tokyo Tech ground station.
- ✓ We currently plan to execute the transmission only when the satellite is visible from Japan, to avoid overheating and save the battery.
- ✓ The downlink data repeats “mission data” and “preamble” alternately.

### 2.1 Mission data format

Picture data on the satellite has markers. These markers in the data facilitate the restoration of the image from the received binary data with several kB.

There are two kinds of mission data: (a) photo data with “JPEG” extension, and (b) movie data with “H264” extension. The following section 2.2 and 2.3 explain (a) and (b) respectively.

### 2.2 JPEG data

The satellite takes the photos of the extensible mast and the deployable membrane in space. The photo data is stored as JPEG. There are two kinds of transmission methods: (1) Non-segmented, and (2) Segmented. During the actual mission, we first down link the compressed Non-segmented photos with very small size around 20kB (thumbnails). Then, after choosing some good photos at the ground station, we try to downlink Segmented photos with high resolution.

The details of the two formats are shown as follows.

(1) Non-segmented photo	
FF 20	SOI 0
FF D8	SOI
...	JPEG photo data
FF D9	EOI
...	Time stamp
FF 1E	EOF

(2) Segmented photo						
FF 20	SOI0	FF 21	SOI1		FF 27	SOI7
FF D8	SOI				...	JPEG photo data
...	JPEG photo data	...	JPEG photo data	...	FF D9	EOI
					...	Time stamp
FF 1E	EOF	FF 1E	EOF		FF 1E	EOF

FF 20, 21, ... , 27 : The number marker to recognize which of the 8 segments

FF D8 : The binary number which is common in JPEG extension file. This is called SOI (Start Of Image).

FF 1E : The marker that shows the end of each segment. This is called EOF (End Of File).

FF D9 : The binary number which is common in JPEG extension file. This is called EOI (End Of Image).

Time stamp : The time when the photo was taken.

### 2.3 H264 data

The membrane deployment is taken by movie, and the movie data is stored in H264. Since the size of movie data is relatively large, the data is segmented and downloaded. The table below shows the format.

Segmented movie						
00 00 01 A0	SOF0	00 00 01 A1	SOF1		00 00 01 A7	SOF7
...	H264 data	...	H264 data	...	...	H264 data
00 00 01 1E	EOF	00 00 01 1E	EOF		00 00 01 1E	EOF

00 00 01 A0, A1, ..., A7 : The number marker to recognize which segment

00 00 01 1E : The marker that shows the end of each segment

## 3 Preamble format

5.8G transmitter's amplifier overheats easily during downlink. Therefore, in the default setting, the transmitter repeats 10-second transmission and 5-seconds rest alternately. Since this intermittent transmission may cause packet loss, preambles are added in the downlink data as follows.

### 3.1 End-of-data detection preamble

The data is first stored in FROM (Flash Memory) on the satellite's 5.8G transmitter module. The end-of-data is continuously detected by 0xFF, which is the default number of FROM.

0D	0A	30	31	...	00	0D	0A	30	31	...	0D	0A
----	----	----	----	-----	----	----	----	----	----	-----	----	----

0D 0A : Linefeed code

30 31 30 31 ... : Preamble for end-of-data

### 3.2 Downlink rest preamble

There is a preamble added every after 10-second transmission.

0D	0A	41	42	...	00	0D	0A	41	42	...	0D	0A
----	----	----	----	-----	----	----	----	----	----	-----	----	----

41 42 41 42... : Preamble when the transmission rests

## 4 Image restoration method

Received binary data is restored to pictures as follows. By using binary processing software, like "FavBinEdit," we erase these preambles. In general, JPEG extension data starts with FFD8 and ends with FFD9. Therefore, other data should be preambles to be erased. However, downlink data usually has data loss. Thus, we will downlink the same data several times, and we collect data by majority rule.

(End of document)

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