UHF FM Downlink Data Format

HORYU-IV Project

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1. Communication Protocol

HORYU-IV satellite uses UHF band and S-band to send data to the ground. This document is an explanation for FM UHF downlink data format. HORYU-IV uses a frequency of 437.375 MHz with baud rate of 1200bps for FM data transmission.

2. UHF FM Downlink Data Format

In FM downlink, there are 86 bytes data sent to the ground with following structure in Table 1.

Table 1 Downlink data structure

HORYU-IV Downlink Formation		
0~7 byte	**8~81 byte**	**82~85 byte**
Header Information Identification signal + address information of data	Mission Data Information + Hamming Code	Footer Information Identification Signal + Check byte

The header is composed of 8 bytes and the format is described in Table 2.

Table 2 Header format

Header Information (byte)							
byte 0	**byte 1**	**byte 2**	**byte 3**	**byte 4**	**byte 5**	**byte 6**	**byte 7**
0xdd	0xdd	Address page 1	Address page 2	Hamming code	Mode (command [1])	CRC	Hamming code

The footer is composed of 4 bytes and the format is described in Table 3.

Table 3 Footer format

Footer Information (byte)			
byte 82	**byte 83**	**byte 84**	**byte 85**
Hamming code	Check byte 0xaa	Check byte 0xaa	Check byte 0xaa

Mission data information that contains mission log information (Past Mission) and Hamming Cod are described in section 3.

3. Mission Data Information

Mission log information is composed of a total of 5 arrays (from 0 to 4), which results in a total of 50 log Past Mission (from 0 to 49). Format array for log information is:

PAST_MISSION [i][0] → total.day [dd]
PAST_MISSION [i][1] → total.day [dd]
PAST_MISSION [i][2] → total.hour[hh]
PAST_MISSION [i][3] → total.minute[mm]
PAST_MISSION [i][4] → Mode

List of mission modes are explained in Table 4.

Table 4 List of mission modes

0x10	HVSA "Discharge Count or I-V Measurement"
0x11	HVSA + OBO "Simple Waveform Capture + Counter"
0x12	HVSA + OBO "Full Waveform Capture + Counter"
0x13	HVSA + OBO + AVC "Simple Waveform Capture + AVC + Counter"
0x14	HVSA + OBO + AVC "Full Waveform Capture + AVC + Counter"
0x15	HVSA + VAT + OBO "Waveform Capture + Counter"
0x16	HVSA + VAT + OBO + AVC "Waveform Capture + AVC + Counter"
0x17	AVC "AVC Reference Picture Mode"
0x18	DLP, PEC "Normal Measurement"
0x19	DLP + HVSA, ELF + HVSA, VAT + HVSA "Measurement with High Voltage Source"
0x1A	CAM "Timer, Target, Nomal Mode"
0x1B	SNG
0x20	Share (HK data)
0x21	Bigapple1 (DLP, ELF, VAT, PEC)
0x22	CAM
0x23	AODS
0x24	HVSA
0x25	OBO1
0x26	OBO2
0x27	OBO3
0x28	OBO4

0x29	AVC1
0x2A	AVC2
0x2B	AVC3
0x2C	AVC4
0x01	OBO (OBC mode)
0x02	AVC (OBC mode)
0x03	HVSA (OBC mode)
0x04	CAM (OBC mode)
0x05	AODS (OBC mode)
0x06	Big Apple (OBC mode)
0x07	Share (OBC mode)
0x81	OBO (S-band mode)
0x82	AVC (S-band mode)
0x83	HVSA (S-band mode)
0x84	CAM (S-band mode)
0x85	AODS (S-band mode)
0x86	Big Apple (S-band mode)
0x87	Share (S-band mode)
0xA0	Downlink
0xA8	Transponder
0x50	System downlink
0x51	Reset
0x52	Kill switch
0x53	Date
0x54	Reset of reserved command
0x55	Heater
0x56	Transmit
0x57	SW, MUX on/off
0x60	Uplink data CAM (Latitude, Longitude)
0x61	Uplink data AODS (GPS on/off, CAM on/off, Period, Gyro type)

4. FM Log Example

An example of HORYU-IV mission log data is presented in Table 5.

Table 5 Mission log example

Data Number	Downlink Data	
0	0xdd	Header information
1	0xdd	
2	0x00 Page number1	
3	0x00 Page number2	
4	Hamming code ([2], [3])	
5	0x51 Mode (Command [1])	
6	CRC (50 bytes)	
7	Hamming code ([5], [6])	
8	PAST_MISSION [0][0]	5 array mission log information. Total of all log: 50 log (PAST_MISSION [0][0] – PAST_MISSION [49][4])
9	PAST_MISSION [0][1]	
10	Hamming code	
11	PAST_MISSION [0][2]	
12	PAST_MISSION [0][3]	
13	Hamming code	
14	PAST_MISSION [0][4]	
…	…	
85	0xaa	Footer

5. Additional Information