PRISM Uplink Command & Downlink Data Format

Intelligent Space Systems Laboratory
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1. Introduction

Super small satellite "PRISM" is developed by Intelligent Space Systems Laboratory (ISSL), University of Tokyo. In this document, CW downlink data formats of PRISM, and specifications of communication system of the satellite are described so that people all around the world can communicate with it.

Enjoy your HAM life with our satellite!

2. Uplink Lines

PRISM has 2 uplink lines. One of them is used only for control, and the other is for amateur radio users. HAM service will be open to everyone in FY2009.

Table 1 Uplink Communication Lines of PRISM

Frequency [MHz]	Protocol	Modulation	Way of Use
Not published	Not published	Not published	Control Use Only
Published in FY2009	Published in FY2009	Published in FY2009	HAM Service

3. Downlink Lines

Following table shows all of downlink lines of PRISM.

Table 2 Downlink Communication Lines of PRISM

Frequency [MHz]	Protocol	Modulation	When it is transmitted
437.250	Morse Coding	CW	Transmitted all the time, everywhere.
437.425	Ax.25	FM AFSK1200bps	As a reply to uplink commands from GS
437.425	Ax.25	FM GMSK9600bps	As a reply to uplink commands from GS

The satellite always transmits CW signals, excepting during the FM operation by ISSL. The transmission frequency (without Doppler shift) may slightly have offset, and the offset value will be published in our web site as soon as possible after launch.

4. Uplink Command Format

Commands for HAM services will be published in FY2009.

5. Downlink Data Format

5.1. CW Data Format

CW telemetry data of PRISM consists of 14 frames (sentences), which are described in the following tables. Each sentence starts with 3-byte header "PR*" which is followed by some telemetry data of power subsystem. All of numerical data are expressed in hexadecimal format.

Table 3 CW Data Format

header	length	Contained data	1 (9)	2 (10)	3 (11)	4 (12)	5 (13)	6 (14)	7 (15)	8 (16)
PR0	19	Sensor data	00	VP-E3.3	V-05	V-P	V-E5	V-TX	V-RXM	V-RXS
PR1	19	Sensor data	00	V-MTQ	V-XL	V-XH	V-SA	V-BATP	I-BATC	I-BATD
PR2	19	Sensor data	00	I-SAP+X	I-SAP-X	I-SAP+Y	I-SAP-Y	I-SAN+X	I-SAN-X	I-SAN+Y
PR2	19	Sensor data	00	I-SAN-Y	I-SAB+X	I-SAB-X	I-SAB+Y	I-SAB-Y	I-E3.3	I-05
PR4	19	Sensor data	00	I-P	I-E5	I-TX	I-RXM	I-RXS	I-XL	I-XH
PR5	19	Sensor data	00	I-SNS	I-HTR	I-DPL	GY-X	GY-Y	GY-Z	RSSI-M
PR6	19	Sensor data	00	TMP+X	TMP-X	TMP+Y	TMP-Y	TMP+Z	TMP-Z	00
PR7	19	Sensor data	00	TMPPN+X	TMPPN-X	TMPPN+Y	TMPPN-Y	TMPBAT1	TMPBAT2	00
PR8	27	Power mode history	E3.3	05	E5	TX	RXM	RXS	XL	MTQ
			XH	SNS	HTR	DPL				
PR9	35	Power mode status	E3.3	05	E5	TX	RXM	RXS	XL	MTQ
			XH	SNS	HTR	DPL	OCX	OC3	CHG2	EMG
PRA	13	Time and mode	Time ticks of OBC				Mode			
PRB	21	Error log	Pointer	Error 1	Error 2	Error 3	Error 4	Error 5	Error 6	Error 7
			Error 8							
PRC	30	URL	//WWW.SPACE.T.U-TOKYO.AC.JP							
PRD	variable	Message								

6. Data Conversion to Physical Value

This Section describes all of CW data frame and the way how to convert the contained data to physical values.

6.1. Frame 0

Data length 8byte (= 16 characters in morse code)

(CW) [PR0]AABBCCDDEEFFGGHH

Data	Contents	Abbreviation	Conversion formula	Example
AA(a)	(fixed value)	-	-	(00)
BB(b)	C&DH subsystem voltage (A)	VP-E3.3	(4.69×b/255) [V]	B2 -> 3.27[V]
CC(c)	Mission subsystem voltage	V-O5	(4.69×c/255) ×1.667 [V]	23 -> 1.07[V]
DD(d)	Power subsystem voltage	V-P	(4.69×d/255) ×1.667 [V]	A4 -> 5.03[V]
EE(e)	C&DH subsystem voltage (B)	V-E5	(4.69×e/255) ×1.667 [V]	A3 -> 5.00[V]
FF(f)	Tx subsystem voltage	V-TX	(4.69×f/255) ×1.667 [V]	1f -> 0.95[V]
GG(g)	Main Rx subsystem voltage	V-RXM	(4.69×g/255) ×1.667 [V]	A4 -> 5.03[V]
HH(h)	Sub Rx subsystem voltage	V-RXS	(4.69×h/255) ×1.667 [V]	A3 -> 4.99[V]

6.2. Frame 1

Data length 8byte

(CW) [PR1]AABBCCDDEEFFGGHH

Data	Contents	Abbreviation	Conversion formula	Example
AA(a)	(fixed value)	-	-	(00)
BB(b)	Magnetic torquer supply voltage	V-MTQ	(4.69×b/255) ×1.667 [V]	A3 -> 4.99[V]
CC(c)	AFSK radio supply voltage	V-XL	(4.69×c/255) ×1.667 [V]	A4 -> 5.03[V]
DD(d)	GMSK radio supply voltage	V-XH	(4.69×d/255) ×2.5 [V]	D4 -> 9.75[V]
EE(e)	Solar cells output voltage	V-SA	(4.69×e/255) ×2.5 [V]	DD -> 10.2[V]
FF(f)	Battery voltage	V-BATP	(4.69×f/255) ×2.5 [V]	D4 -> 9.75[V]
GG(g)	Charging current	I-BATC	(4.69×g/255) ×666.67 [mA]	11 -> 208[mA]
HH(h)	Discharging current	I-BATD	(4.69×h/255) ×666.67 [mA]	00 -> 0[mA]

6.3. Frame 2

Data length 8byte

(CW) [PR2]AABBCCDDEEFFGGHH

Data	Contents	Abbreviation	Conversion formula	Example
AA(a)	(fixed value)	-	-	(00)
BB(b)	Solar cell output current (+X panel)	I-SAP+X	(4.69×b/255) ×227.27 [mA]	21 -> 137.9[mA]
CC(c)	Solar cell output current (-X panel)	I-SAP-X	(4.69×c/255) ×227.27 [mA]	20 -> 133.8[mA]
DD(d)	Solar cell output current (+Y panel)	I-SAP+Y	(4.69×d/255) ×227.27 [mA]	21 -> 137.9[mA]
EE(e)	Solar cell output current (-Y panel)	I-SAP-Y	(4.69×e/255) ×227.27 [mA]	20 -> 133.8[mA]
FF(f)	Solar cell output current (+X panel, reverse side)	I-SAN+X	(4.69×f/255) ×106.38 [mA]	00 -> 0.0[mA]
GG(g)	Solar cell output current (-X panel, reverse side)	I-SAN-X	(4.69×g/255) ×106.38 [mA]	00 -> 0.0[mA]
HH(h)	Solar cell output current (+Y panel, reverse side)	I-SAN+Y	(4.69×h/255) ×106.38 [mA]	00 -> 0.0[mA]

6.4. Frame 3

Data length 8byte

(CW) [PR3]AABBCCDDEEFFGGHH

Data	Contents	Abbreviation	Conversion formula	Example
AA(a)	(fixed value)	-	-	(00)
BB(b)	Solar cell output current (−Y panel, reverse side)	I-SAN-Y	(4.69×b/255) ×106.38 [mA]	00 -> 0.0[mA]
CC(c)	Solar cell output current (body +X side)	I-SAB+X	(4.69×c/255) ×106.38 [mA]	1D -> 56.7[mA]
DD(d)	Solar cell output current (body -X side)	I-SAB-X	(4.69×d/255) ×106.38 [mA]	0B -> 21.5[mA]
EE(e)	Solar cell output current (body +Y side)	I-SAB+Y	(4.69×e/255) ×106.38 [mA]	00 -> 0.0[mA]
FF(f)	Solar cell output current (body -Y side)	I-SAB-Y	(4.69×f/255) ×106.38 [mA]	00 -> 0.0[mA]
GG(g)	C&DH subsystem supply current (A)	I-E3.3	(4.69×g/255) ×333.33 [mA]	2A -> 257[mA]
HH(h)	Mission subsystem supply current	I-05	(4.69×h/255) ×227.27 [mA]	02 -> 8.3[mA]

6.5. Frame 4

Data length　8byte

（CW） [PR4]AABBCCDDEEFFGGHH

Data	Contents	Abbreviation	Conversion formula	Example
AA(a)	(fixed value)	-	-	(00)
BB(b)	Power subsystem supply current	I-P	(4.69×b/255) ×33.33 [mA]	31 -> 30.0[mA]
CC(c)	C&DH subsystem supply current (B)	I-E5	(4.69×c/255) ×22.73 [mA]	26 -> 15.9[mA]
DD(d)	Tx subsystem supply current	I-TX	(4.69×d/255) ×33.33 [mA]	00 -> 0.0[mA]
EE(e)	Main Rx subsystem supply current	I-RXM	(4.69×e/255) ×22.73 [mA]	2E -> 19.2[mA]
FF(f)	Sub Rx subsystem supply current	I-RXS	(4.69×f/255) ×22.73 [mA]	2A -> 17.6[mA]
GG(g)	AFSK radio supply current	I-XL	(4.69×g/255) ×333.33 [mA]	07 -> 42.9[mA]
HH(h)	GMSK radio supply current	I-XH	(4.69×h/255) ×666.67 [mA]	00 -> 0.0[mA]

6.6. Frame 5

Data length　8byte

（CW） [PR5]AABBCCDDEEFFGGHH

Data	Contents	Abbreviation	Conversion formula	Example
AA(a)	(fixed value)	-	-	(00)
BB(b)	Sensor system supply current	I-SNS	(4.69×b/255) ×50.0 [mA]	5B -> 83.7[mA]
CC(c)	Heater supply current	I-HTR	(4.69×c/255) ×227.27 [mA]	00 -> 0.0[mA]
DD(d)	Deployment system supply current	I-DPL	(4.69×d/255) ×666.67 [mA]	00 -> 0.0[mA]
EE(e)	Gyroscope (X)	GY-X	[(4.69×e/255)-2.50] /(-0.025) [deg/s]	88 -> 0.053[deg/s]
FF(f)	Gyroscope (Y)	GY-Y	[(4.69×f/255) -2.50] /0.025 [deg/s]	87 -> 0.682[deg/s]
GG(g)	Gyroscope (Z)	GY-Z	[(4.69×g/255) -2.50] /(-0.025) [deg/s]	77 -> 12.4[deg/s]
HH(h)	(Not used)	-	(4.69×h/255)	(77)

6.7. Frame 6

Data length　8byte

（ＣＷ）　[PR6]AABBCCDDEEFFGGHH

Data	Contents	Abbreviation	Conversion formula	Example
AA(a)	(fixed value)	-	-	(00)
BB(b)	Temperature (body ＋X side)	TMP+X	(4.69×b/255) ×(-87.5) +162.5 [℃]	54 -> 27.3[℃]
CC(c)	Temperature (body -X side)	TMP-X	(4.69×c/255) ×(-87.5) +162.5 [℃]	56 -> 24.1[℃]
DD(d)	Temperature (body ＋Y side)	TMP+Y	(4.69×d/255) ×(-87.5) +162.5 [℃]	68 -> -4.9[℃]
EE(e)	Temperature (body -Y side)	TMP-Y	(4.69×e/255) ×(-87.5) +162.5 [℃]	6B -> -9.7[℃]
FF(f)	Temperature (body ＋Z side)	TMP+Z	(4.69×f/255) ×(-87.5) +162.5 [℃]	5F -> 9.6[℃]
GG(g)	Temperature (body -Z side)	TMP-Z	(4.69×g/255) ×(-87.5) +162.5 [℃]	50 -> 33.8[℃]
HH(h)	(fixed value)	-	-	(00)

6.8. Frame 7

Data length　8byte

（ＣＷ）　[PR7]AABBCCDDEEFFGGHH

Data	Contents	Abbreviation	Conversion formula	Example
AA(a)	(fixed value)	-	-	(00)
BB(b)	Temperature (panel ＋X side)	TMPPN+X	(4.69×b/255) ×(-87.5) +162.5 [℃]	42 -> 56.3[℃]
CC(c)	Temperature (panel -X side)	TMPPN-X	(4.69×c/255) ×(-87.5) +162.5 [℃]	44 -> 53.1[℃]
DD(d)	Temperature (panel ＋Y side)	TMPPN+Y	(4.69×d/255) ×(-87.5) +162.5 [℃]	4D -> 41.8[℃]
EE(e)	Temperature (panel-Y side)	TMPPN-Y	(4.69×e/255) ×(-87.5) +162.5 [℃]	4B -> 38.6[℃]
FF(f)	Temperature (Battery, A)	TMPBAT1	(4.69×f/255) ×(-87.5) +162.5 [℃]	61 -> 6.4[℃]
GG(g)	Temperature (Battery, B)	TMPBAT2	(4.69×g/255) ×(-87.5) +162.5 [℃]	60 -> 8.0[℃]
HH(h)	(fixed value)	-	-	(00)

6.9. Frame 8

Data length　12byte

（ＣＷ）　[PR8]$A^1A^2B^{21}BC^1C^2D^1D^2E^1E^2F^1F^2G^1G^2H^1H^2I^1I^2J^1J^2K^1K^2L^1L^2$

Data	Contents	Abbreviation	Conversion formula	Example
A^1A^2 (a)	Power switching history of C&DH subsystem (A)	SWL-E3.3	A^1:Origin of reset A^2:number of times	23 -> over current, 3 times
B^1B^2 (b)	Power switching history of Mission subsystem	SWL-O5	B^1:Origin of reset B^2:number of times	10 -> Uplink command
C^1C^2 (c)	Power switching history of C&DH subsystem (B)	SWL-E5	C^1:Origin of reset C^2:number of times	00 -> None
D^1D^2 (d)	Power switching history of Tx subsystem	SWL-TX	D^1:Origin of reset D^2:number of times	00 -> None
E^1E^2 (e)	Power switching history of Main Rx subsystem	SWL-RXM	E^1:Origin of reset E^2:number of times	00 -> None
F^1F^2 (f)	Power switching history of Sub Rx subsystem	SWL-RXS	F^1:Origin of reset F^2:number of times	00 -> None
G^1G^2 (g)	Power switching history of AFSK radio	SWL-XL	G^1:Origin of reset G^2:number of times	00 -> None
H^1H^2 (h)	Power switching history of Magnetic Torquer	SWL-MTQ	H^1:Origin of reset H^2:number of times	00 -> None
I^1I^2 (i)	Power switching history of GMSK radio	SWL-XH	I^1:Origin of reset I^2:number of times	00 -> None
J^1J^2 (j)	Power switching history of Sensor system	SWL-SNS	J^1:Origin of reset J^2:number of times	00 -> None
K^1K^2 (k)	Power switching history of heater system	SWL-HTR	K^1:Origin of reset K^2:number of times	00 -> None
L^1L^2 (l)	Power switching history of deployment system	SWL-DPL	L^1:Origin of reset L^2:number of times	00 -> None

Origin of Reset

Indicator	Origin of Reset	Note
0	None	
1	Uplink command	Number of times is set to 0
2	Over current	Judge from AD conversion data
3	Over voltage	Judge from AD conversion data
4	Over current	By over current protection circuit

5	Mutual monitoring	
6	Regulation	
7	Switching times exceeded a certain limit	

6.10. Frame 9

Data length　16byte

(CW)　[PR9] AABBCCDDEEFFGGHHIIJJKKLLMMNNOOPP

Data	Contents	Abbreviation	Conversion formula	Example
AA(a)	Switching status of C&DH subsystem (A)	SWS-E3.3	3f:OFF　40:ON	40 -> ON
BB(b)	Switching status of Mission subsystem	SWS-O5	3f:OFF　40:ON	40 -> ON
CC(c)	Switching status of C&DH subsystem (B)	SWS-E5	3f:OFF　40:ON	40 -> ON
DD(d)	Switching status of Tx subsystem	SWS-TX	3f:OFF　40:ON	3F -> OFF
EE(e)	Switching status of Main Rx subsystem	SWS-RXM	3f:OFF　40:ON	40 -> ON
FF(f)	Switching status of Sub Rx subsystem	SWS-RXS	3f:OFF　40:ON	40 -> ON
GG(g)	Switching status of AFSK radio	SWS-XL	3f:OFF　40:ON	40 -> ON
HH(h)	Switching status of Magnetic Torquer	SWS-MTQ	3f:OFF　40:ON	40 -> ON
II(i)	Switching status of Tx GMSK radio	SWS-XH	3f:OFF　40:ON	40 -> ON
JJ(j)	Switching status of Tx Sensor system	SWS-SNS	3f:OFF　40:ON	40 -> ON
KK(k)	Switching status of Tx Heater system	SWS-HTR	3f:OFF　40:ON	40 -> ON
LL(l)	Switching status of Tx Deployment system	SWS-DPL	3f:OFF　40:ON	3F -> OFF
MM(m)	Switching status of over current protection circuit of GMSK	SWS-OCX	3f:OFF　40:ON	40 -> ON
NN(n)	Switching status of over current protection circuit of C&DH	SWS-OC3	3f:OFF　40:ON	40 -> ON
OO(o)	Switching status of battery charge	SWS-CHG2	3f:OFF　40:ON	3F -> OFF
PP(p)	Switching status of emergency battery	SWS-EMG	3f:OFF　40:ON	3F -> OFF

6.11. Frame a

Data length　5byte

(CW)　[PRA] AABBCCDDEE

Data	Contents	Abbreviation	Conversion formula	Example
AA(a)	Time ticks From power subsystem rebooting	—	0xAABBCCDD or $a \times 256^3 + b \times 256^2 + c \times 256^1 + d$ [count] (1 count ≒ 1 second)	0000103f -> 4159[count]
BB(b)				
CC(c)				
DD(d)				
EE(e)	Operation mode	—	53:Safe　4e:Normal　52:Reset	53 -> Safe

6.12. Frame b

Data length 9byte

(CW) [PRB] AABBCCDDEEFFGGHHII

Data	Contents	Note
AA(a)	Latest error pointer	1. This pointer indicates which error log is the latest. 2. Value "0" is set if there is no error. 3. For example, if this field contains a value "4", then the field "Error log 4" contains the latest error, and "error log 3" the second latest.
BB(b)	Error log 1	Ref.) Error table
CC(c)	Error log 2	Ref.) Error table
DD(d)	Error log 3	Ref.) Error table
EE(e)	Error log 4	Ref.) Error table
FF(f)	Error log 5	Ref.) Error table
GG(g)	Error log 6	Ref.) Error table
HH(h)	Error log 7	Ref.) Error table
II(i)	Error log 8	Ref.) Error table

Error Table

Data	Error reason		Data	Error reason
01	Timeout of AD conversion		1f	Battery voltage error
02	AD conversion did not finish		20	CAN Error : DATA OVERRUN ERROR
10	Switching times of E3.3 exceeded the limit		21	CAN Error : ERROR COUNTER OVER or BUS STATUS CHANGE
12	Switching times of E5 exceeded the limit		30	CAN Error : received invalid message
13	Switching times of Tx exceeded the limit		31	received invalid command(returned N/A)
14	Switching times of Main Rx exceeded the limit		40	no reply
15	Switching times of Sub Rx exceeded the limit		41	reply invalid
16	Switching times of AFSK radio exceeded the limit		42	Operation competing of some commands
19	Switching times of Sensor system exceeded the limit		50	Serial communication error (Main Rx)
1e	Charging current (or voltage) error		51	Serial communication error (Debug)

6.13. Frame c

Data length　27byte

（CW）　[PRC] //WWW.SPACE.T.U-TOKYO.AC.JP

6.14. Frame d

Data length　(variable)

（CW）　[PRD]－(Message from ISSL members and some collaborators)

7. Web Site

Information about operation: http://www.space.t.u-tokyo.ac.jp/gs/en/index.aspx

Information about PRISM project: http://www.space.t.u-tokyo.ac.jp/prism/

8. Contact to us

If you have questions, feel free to contact us with following e-mail address:

prism_info@space.t.u-tokyo.ac.jp