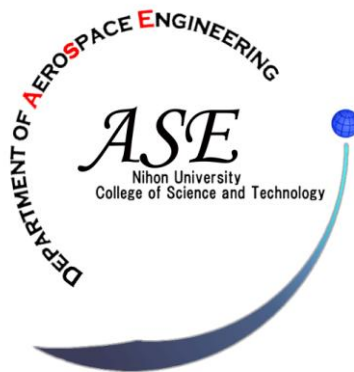


CW Telemetry Data Format

For CubeSat “SEEDS”

English Version



Nihon University CubeSat Project

Revision	Date	Authored by	Notes
1	06/22/2006	Nobuaki Kinoshita	CW telemetry Format
2	01/09/2008	Kosuke Arita	Revised for 2 nd SEEDS
3	21/04/2008	Kosuke Arita	Considered calibration result of sensors Revised some mistakes
4	28/04/2008	Kosuke Arita	Revised telemetry format
5	01/05/2008	Kosuke Arita	Described Uplink Reply
6	14/05/2008	Kosuke Arita	Revised telemetry format

CW Telemetry Data Format for SEEDS

SEEDS CW telemetry data comes in 5 types as shown below.

1. HK (House Keeping) data long mode

JQ1YGU SEEDS G4 00000000 111 222 333 444 555 666 777 888 999 AAA BBB CCC DE FFFF GGGG HHHH IIII JJJJ KK MM NO

HK data long mode				
Data	Digits number	Notation	Designation	Conversion equation
JQ1YGU	6	Alphabet	Call sign	—
SEEDS	5	Alphabet	Satellite name	—
G4	2	Alphabet	Mode	—
0 ₇ 0 ₆ 0 ₅ 0 ₄ 0 ₃ 0 ₂ 0 ₁ 0 ₀	8	HEX	Satellite time	$(0_7 \times 16^7 + 0_6 \times 16^6 + 0_5 \times 16^5 + 0_4 \times 16^4 + 0_3 \times 16^3 + 0_2 \times 16^2 + 0_1 \times 16^1 + 0_0 \times 16^0) / 2$ [s]
1 ₂ 1 ₁ 1 ₀	3	HEX	Li-ion batteries voltage	$5 \times (1_2 \times 16^2 + 1_1 \times 16^1 + 1_0 \times 16^0) / 4096$ [V]
2 ₂ 2 ₁ 2 ₀	3	HEX	Bus voltage	$5 \times (2_2 \times 16^2 + 2_1 \times 16^1 + 2_0 \times 16^0) / 4096$ [V]
3 ₂ 3 ₁ 3 ₀	3	HEX	Solar cell 1 current	$5 \times (3_2 \times 16^2 + 3_1 \times 16^1 + 3_0 \times 16^0) / 4096 \times 90.90909$ [mA]
4 ₂ 4 ₁ 4 ₀	3	HEX	Solar cell 2 current	$5 \times (4_2 \times 16^2 + 4_1 \times 16^1 + 4_0 \times 16^0) / 4096 \times 90.90909$ [mA]
5 ₂ 5 ₁ 5 ₀	3	HEX	Solar cell 3 current	$5 \times (5_2 \times 16^2 + 5_1 \times 16^1 + 5_0 \times 16^0) / 4096 \times 90.90909$ [mA]
6 ₂ 6 ₁ 6 ₀	3	HEX	Solar cell 4 current	$5 \times (6_2 \times 16^2 + 6_1 \times 16^1 + 6_0 \times 16^0) / 4096 \times 90.90909$ [mA]
7 ₂ 7 ₁ 7 ₀	3	HEX	Solar cell 5 current	$5 \times (7_2 \times 16^2 + 7_1 \times 16^1 + 7_0 \times 16^0) / 4096 \times 90.90909$ [mA]
8 ₂ 8 ₁ 8 ₀	3	HEX	Solar cell 6 current	$5 \times (8_2 \times 16^2 + 8_1 \times 16^1 + 8_0 \times 16^0) / 4096 \times 90.90909$ [mA]
9 ₂ 9 ₁ 9 ₀	3	HEX	Temperature (Li-ion battery 1)	$0.15797 \times (5 \times (9_2 \times 16^2 + 9_1 \times 16^1 + 9_0 \times 16^0) / 4096) - 39.553 \times (5 \times (9_2 \times 16^2 + 9_1 \times 16^1 + 9_0 \times 16^0) / 4096) + 129.59$ [deg. C]
A ₂ A ₁ A ₀	3	HEX	Temperature (Li-ion battery 2)	$0.18923 \times (5 \times (A_2 \times 16^2 + A_1 \times 16^1 + A_0 \times 16^0) / 4096) - 39.27 \times (5 \times (A_2 \times 16^2 + A_1 \times 16^1 + A_0 \times 16^0) / 4096) + 128.33$ [deg. C]
B ₂ B ₁ B ₀	3	HEX	Temperature (Transmitter)	$-0.38082 \times (5 \times (B_2 \times 16^2 + B_1 \times 16^1 + B_0 \times 16^0) / 4096) - 36.125 \times (5 \times (B_2 \times 16^2 + B_1 \times 16^1 + B_0 \times 16^0) / 4096) + 121.31$ [deg. C]
C ₂ C ₁ C ₀	3	HEX	Temperature (Receiver)	$-0.062626 \times (5 \times (C_2 \times 16^2 + C_1 \times 16^1 + C_0 \times 16^0) / 4096) - 38.305 \times (5 \times (C_2 \times 16^2 + C_1 \times 16^1 + C_0 \times 16^0) / 4096) + 126.89$ [deg. C]
D ₀	1	HEX	CW transmission interval	$D_0 \times 3$ [s]
E ₀	1	HEX	Switch status	Convert to binary. Its least 3 digits from LSB to 3 rd bit represent the status of Switch1, Switch2 and Switch3 respectively. MSB should be ignored. [EXAMPLE] When E ₀ =1(HEX)=0001(BIN). S1(ON), S2(OFF), S3(OFF).
F ₃ F ₂ F ₁ F ₀	4	HEX	MPU reset times (EPS)	$F_3 \times 16^3 + F_2 \times 16^2 + F_1 \times 16^1 + F_0 \times 16^0$ [times]
G ₃ G ₂ G ₁ G ₀	4	HEX	MPU reset times (FMR)	$G_3 \times 16^3 + G_2 \times 16^2 + G_1 \times 16^1 + G_0 \times 16^0$ [times]
H ₃ H ₂ H ₁ H ₀	4	HEX	MPU reset times (C&DH)	$H_3 \times 16^3 + H_2 \times 16^2 + H_1 \times 16^1 + H_0 \times 16^0$ [times]

Data	Digits number	Notation	Designation	Conversion equation
$I_3I_2I_1I_0$	4	HEX	MPU reset times (CW)	$I_3 \times 16^3 + I_2 \times 16^2 + I_1 \times 16^1 + I_0 \times 16^0$ [times]
$J_3J_2J_1J_0$	4	HEX	CW transmission count	$J_3 \times 16^3 + J_2 \times 16^2 + J_1 \times 16^1 + J_0 \times 16^0$ [times]
K_1K_0	2	HEX	Uplink count	$K_1 \times 16^1 + K_0 \times 16^0$ [times]
M_1M_0	2	HEX	Command status	$M_1 \times 16^1 + M_0 \times 16^0$ [-]
N_0	1	HEX	Battery status	<p>Convert to binary. Its 4 digits from LSB represent the status of "larger than 3.0V", "larger than 4.0V", "larger than 4.2V", and "forced no-charge mode" respectively.</p> <p>[EXAMPLE] When $N_0=3$(HEX)=0011(BIN). Battery voltage is larger than 4.0V and smaller than 4.2V, and forced no-charge mode is OFF.</p>
O_0	1	HEX	Shunt circuit status	<p>Convert to binary. Its 2 digits from LSB represent the mode of shunt circuit, and next 1 digit represents the status of shunt circuit. 4th digit should be ignored.</p> <p>The mode of shunt circuit is classified as follows.</p> <p>00 : Auto shunt mode 01 : Forced shunt mode 10 : Forced no-shunt mode</p> <p>[EXAMPLE] When $O_0=5$(HEX)=0101(BIN). The mode of shunt circuit is forced shunt mode, and shunt circuit is performing now.</p>

2. HK data short mode

JQ1YGU SEEDS G1 00000000 111 222 333 444 555 666 777 888 999 AAA BBB CCC D

HK data short mode				
Data	Digits number	Notation	Designation	Conversion equation
JQ1YGU	6	Alphabet	Call sign	—
SEEDS	5	Alphabet	Satellite name	—
G1	2	Alphabet	Mode	—
0 ₇ 0 ₆ 0 ₅ 0 ₄ 0 ₃ 0 ₂ 0 ₁ 0 ₀	8	HEX	Satellite time	$(0_7 \times 16^7 + 0_6 \times 16^6 + 0_5 \times 16^5 + 0_4 \times 16^4 + 0_3 \times 16^3 + 0_2 \times 16^2 + 0_1 \times 16^1 + 0_0 \times 16^0) / 2[s]$
1 ₂ 1 ₁ 1 ₀	3	HEX	Li-ion batteries voltage	$5 \times (1_2 \times 16^2 + 1_1 \times 16^1 + 1_0 \times 16^0) / 4096 [V]$
2 ₂ 2 ₁ 2 ₀	3	HEX	Bus voltage	$5 \times (2_2 \times 16^2 + 2_1 \times 16^1 + 2_0 \times 16^0) / 4096 [V]$
3 ₂ 3 ₁ 3 ₀	3	HEX	Solar cell 1 current	$5 \times (3_2 \times 16^2 + 3_1 \times 16^1 + 3_0 \times 16^0) / 4096 \times 90.90909 [mA]$
4 ₂ 4 ₁ 4 ₀	3	HEX	Solar cell 2 current	$5 \times (4_2 \times 16^2 + 4_1 \times 16^1 + 4_0 \times 16^0) / 4096 \times 90.90909 [mA]$
5 ₂ 5 ₁ 5 ₀	3	HEX	Solar cell 3 current	$5 \times (5_2 \times 16^2 + 5_1 \times 16^1 + 5_0 \times 16^0) / 4096 \times 90.90909 [mA]$
6 ₂ 6 ₁ 6 ₀	3	HEX	Solar cell 4 current	$5 \times (6_2 \times 16^2 + 6_1 \times 16^1 + 6_0 \times 16^0) / 4096 \times 90.90909 [mA]$
7 ₂ 7 ₁ 7 ₀	3	HEX	Solar cell 5 current	$5 \times (7_2 \times 16^2 + 7_1 \times 16^1 + 7_0 \times 16^0) / 4096 \times 90.90909 [mA]$
8 ₂ 8 ₁ 8 ₀	3	HEX	Solar cell 6 current	$5 \times (8_2 \times 16^2 + 8_1 \times 16^1 + 8_0 \times 16^0) / 4096 \times 90.90909 [mA]$
9 ₂ 9 ₁ 9 ₀	3	HEX	Temperature (Li-ion battery 1)	$0.15797 \times (5 \times (9_2 \times 16^2 + 9_1 \times 16^1 + 9_0 \times 16^0) / 4096) - 39.553 \times (5 \times (9_2 \times 16^2 + 9_1 \times 16^1 + 9_0 \times 16^0) / 4096) + 129.59 [deg. C]$
A ₂ A ₁ A ₀	3	HEX	Temperature (Li-ion battery 2)	$0.18923 \times (5 \times (A_2 \times 16^2 + A_1 \times 16^1 + A_0 \times 16^0) / 4096) - 39.27 \times (5 \times (A_2 \times 16^2 + A_1 \times 16^1 + A_0 \times 16^0) / 4096) + 128.33 [deg. C]$
B ₂ B ₁ B ₀	3	HEX	Temperature (Transmitter)	$-0.38082 \times (5 \times (B_2 \times 16^2 + B_1 \times 16^1 + B_0 \times 16^0) / 4096) - 36.125 \times (5 \times (B_2 \times 16^2 + B_1 \times 16^1 + B_0 \times 16^0) / 4096) + 121.31 [deg. C]$
C ₂ C ₁ C ₀	3	HEX	Temperature (Receiver)	$-0.062626 \times (5 \times (C_2 \times 16^2 + C_1 \times 16^1 + C_0 \times 16^0) / 4096) - 38.305 \times (5 \times (C_2 \times 16^2 + C_1 \times 16^1 + C_0 \times 16^0) / 4096) + 126.89 [deg. C]$
D ₀	1	HEX	CW transmission interval	$D_0 \times 3[s]$

3. ROM data downlink mode

SEEDS G3 00000000 1111 222 333 444 555 666 777 888 999 AAA BBB CCC DDD

ROM data downlink mode				
Data	Digits number	Notation	Designation	Conversion equation
SEEDS	5	Alphabet	Satellite name	—
G3	2	Alphabet	Mode	—
0 ₇ 0 ₆ 0 ₅ 0 ₄ 0 ₃ 0 ₂ 0 ₁ 0 ₀	8	HEX	Satellite time	$(0_7 \times 16^7 + 0_6 \times 16^6 + 0_5 \times 16^5 + 0_4 \times 16^4 + 0_3 \times 16^3 + 0_2 \times 16^2 + 0_1 \times 16^1 + 0_0 \times 16^0) / 2 [s]$
1 ₃ 1 ₂ 1 ₁ 1 ₀	4	HEX	Address block	$1_3 \times 16^3 + 1_2 \times 16^2 + 1_1 \times 16^1 + 1_0 \times 16^0 [-]$
2 ₂ 2 ₁ 2 ₀	3	HEX	Solar cell 1 current	$5 \times (3_2 \times 16^2 + 3_1 \times 16^1 + 3_0 \times 16^0) / 4096 \times 90.90909 [mA]$
3 ₂ 3 ₁ 3 ₀	3	HEX	Solar cell 2 current	$5 \times (4_2 \times 16^2 + 4_1 \times 16^1 + 4_0 \times 16^0) / 4096 \times 90.90909 [mA]$
4 ₂ 4 ₁ 4 ₀	3	HEX	Solar cell 3 current	$5 \times (5_2 \times 16^2 + 5_1 \times 16^1 + 5_0 \times 16^0) / 4096 \times 90.90909 [mA]$
5 ₂ 5 ₁ 5 ₀	3	HEX	Solar cell 4 current	$5 \times (6_2 \times 16^2 + 6_1 \times 16^1 + 6_0 \times 16^0) / 4096 \times 90.90909 [mA]$
6 ₂ 6 ₁ 6 ₀	3	HEX	Solar cell 5 current	$5 \times (7_2 \times 16^2 + 7_1 \times 16^1 + 7_0 \times 16^0) / 4096 \times 90.90909 [mA]$
7 ₂ 7 ₁ 7 ₀	3	HEX	Solar cell 6 current	$5 \times (8_2 \times 16^2 + 8_1 \times 16^1 + 8_0 \times 16^0) / 4096 \times 90.90909 [mA]$
8 ₂ 8 ₁ 8 ₀	3	HEX	Temperature (Li-ion battery 1)	$0.15797 \times (5 \times (9_2 \times 16^2 + 9_1 \times 16^1 + 9_0 \times 16^0) / 4096)^2 - 39.553 \times (5 \times (9_2 \times 16^2 + 9_1 \times 16^1 + 9_0 \times 16^0) / 4096) + 129.59 [deg. C]$
9 ₂ 9 ₁ 9 ₀	3	HEX	Temperature (Li-ion battery 2)	$0.18923 \times (5 \times (A_2 \times 16^2 + A_1 \times 16^1 + A_0 \times 16^0) / 4096)^2 - 39.27 \times (5 \times (A_2 \times 16^2 + A_1 \times 16^1 + A_0 \times 16^0) / 4096) + 128.33 [deg. C]$
A ₂ A ₁ A ₀	3	HEX	Temperature (Transmitter)	$-0.38082 \times (5 \times (B_2 \times 16^2 + B_1 \times 16^1 + B_0 \times 16^0) / 4096)^2 - 36.125 \times (5 \times (B_2 \times 16^2 + B_1 \times 16^1 + B_0 \times 16^0) / 4096) + 121.31 [deg. C]$
B ₂ B ₁ B ₀	3	HEX	Temperature (Receiver)	$-0.062626 \times (5 \times (C_2 \times 16^2 + C_1 \times 16^1 + C_0 \times 16^0) / 4096)^2 - 38.305 \times (5 \times (C_2 \times 16^2 + C_1 \times 16^1 + C_0 \times 16^0) / 4096) + 126.89 [deg. C]$
C ₂ C ₁ C ₀	3	HEX	Li-ion batteries voltage	$5 \times (C_2 \times 16^2 + C_1 \times 16^1 + C_0 \times 16^0) / 4096 [V]$
D ₂ D ₁ D ₀	3	HEX	Bus voltage	$5 \times (D_2 \times 16^2 + D_1 \times 16^1 + D_0 \times 16^0) / 4096 [V]$

4. Test mode

JQ1YGU SEEDS G0 000 111

Test mode				
Data	Digits number	Notation	Designation	Conversion equation
JQ1YGU	6	Alphabet	Call sign	—
SEEDS	5	Alphabet	Satellite name	—
G0	2	Alphabet	Mode	—
0 ₂ 0 ₁ 0 ₀	3	HEX	Li-ion batteries voltage	$5 \times (0_2 \times 16^2 + 0_1 \times 16^1 + 0_0 \times 16^0) / 4096$ [V]
1 ₂ 1 ₁ 1 ₀	3	HEX	Bus voltage	$5 \times (1_2 \times 16^2 + 1_1 \times 16^1 + 1_0 \times 16^0) / 4096$ [V]

5. Charge mode

JQ1YGU SEEDS G6 000

Charge mode				
Data	Digits number	Notation	Designation	Conversion equation
JQ1YGU	6	Alphabet	Call sign	—
SEEDS	5	Alphabet	Satellite name	—
G6	2	Alphabet	Mode	—
0 ₂ 0 ₁ 0 ₀	3	HEX	Li-ion batteries voltage	$5 \times (0_2 \times 16^2 + 0_1 \times 16^1 + 0_0 \times 16^0) / 4096$ [V]

6. Uplink Reply

SEEDS EPS CDHR

If SEEDS accept uplink command from ground station, SEEDS send “SEEDS EPS CDHR”.

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