XW-2 Satellites CW Telemetry Beacon Encoding Format

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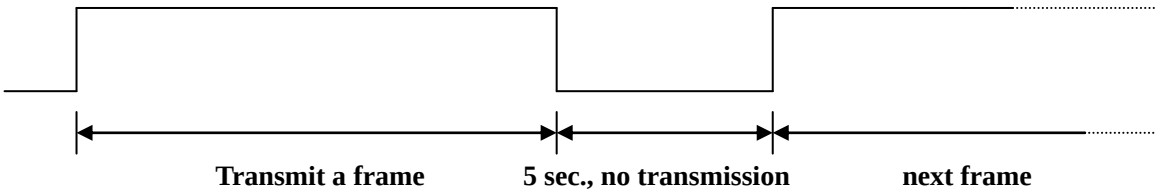
1、 Telemetry beacon transmission timing：



2、Satellites callsign list：

Satellite Name	Callsign
XW-2A	BJ1SB
XW-2B	BJ1SC
XW-2C	BJ1SD
XW-2D	BJ1SE
XW-2E	BJ1SF
XW-2F	BJ1SG

3、Telemetry modulation and encoding：

（1）Modulation:　CW；
（2）Encoding:　Morse Code；
（3）Transmitting speed:　22wps；
（4）Numeric telemetry data encoding：

Numeral	Encoding
0	**T**
1	**R**
2	**U**
3	**V**
4	**4**
5	**I**
6	**6**
7	**K**
8	**M**
9	**N**

4、XW-2A、2B、2C and 2D

(1) Content of a telemetry fame

Transmission Sequence	Content of Transmission	Note	Encoding
1	**BJ1Sx** (x=B - E)	Satellite Callsign	Standard Morse Code
2	**DFH**	Start Identifier	Standard Morse Code
3	**XW2**	Start Identifier	Standard Morse Code
4	**XW2**	Start Identifier	Standard Morse Code
5	**CH1**	Telemetry Data Channel 1	Encoded Morse Code
6	**CH2**	Telemetry Data Channel 2	Encoded Morse Code
7	**CH3**	Telemetry Data Channel 3	Encoded Morse Code
8	**CH4**	Telemetry Data Channel 4	Encoded Morse Code
9	**CH5**	Telemetry Data Channel 5	Encoded Morse Code
10	**CH6**	Telemetry Data Channel 6	Encoded Morse Code
11	**CH7**	Telemetry Data Channel 7	Encoded Morse Code
12	**CH8**	Telemetry Data Channel 8	Encoded Morse Code
13	**CH9**	Telemetry Data Channel 9	Encoded Morse Code
14	**CH10**	Telemetry Data Channel 10	Encoded Morse Code
15	**CH11**	Telemetry Data Channel 11	Encoded Morse Code
16	**CH12**	Telemetry Data Channel 12	Encoded Morse Code
17	**CH13**	Telemetry Data Channel 13	Encoded Morse Code
18	**CH14**	Telemetry Data Channel 14	Encoded Morse Code
19	**CH15**	Telemetry Data Channel 15	Encoded Morse Code
20	**CH16**	Telemetry Data Channel 16	Encoded Morse Code
21	**CH17**	Telemetry Data Channel 17	Encoded Morse Code
22	**CH18**	Telemetry Data Channel 18	Encoded Morse Code
23	**CH19**	Telemetry Data Channel 19	Encoded Morse Code
24	**CH20**	Telemetry Data Channel 20	Encoded Morse Code
25	**CH21**	Telemetry Data Channel 21	Encoded Morse Code
26	**CH22**	Telemetry Data Channel 22	Encoded Morse Code
27	**CAMSAT**	Stop Identifier	Standard Morse Code
28	**CAMSAT**	Stop Identifier	Standard Morse Code

(2) Content of telemetry data channel

Channel	Name of Parameter	Type	Data Range		Description and Equation
			N(min)	N(max)	
CH1	Data frame mark	Status	—	—	①
CH2	Current operating mode	Status	000	111	②
CH3	Primary power supply voltage	Data	000	200	/10（V）
CH4	Primary power supply current	Data	000	500	（mA）
CH5	DC / DC converter output voltage	Data	000	255	（N+256）/100（V）
CH6	DC / DC converter output current	Data	000	255	N+256（mA）
CH7	OBC power voltage	Data	000	255	Nx2/100（V）
CH8	OBC temperature	Data	064	199	N-64 (The last two number)（℃） ⑤
CH9	RF power amplifier temperature	Data	064	199	（℃） ⑤
CH10	Receiver AGC voltage	Data	000	255	Nx1.3/100（V）
CH11	RF forward power	Data	000	500	（mW）
CH12	RF reflected power	Data	000	500	/10（mW）
CH13	CPU Reset Counter	Data	00H	FFH	W0 Display in decimal
	Command transmission counter	Data	0H	7H	W1B7～B5 Display in decimal
	CRC check result	Status	0B	1B	W1B4 1：Correct，0：Error
CH14	Instruction counter 1	Data	000H	FFFH	W1B3～B0W2 Display in decimal
CH15	Instruction counter 2	Data	000H	FFFH	W3W4B7～B4 Display in decimal
CH16	Telemetry frames received counter	Data	0H	FH	W4B3～B0 Display in decimal
	Telemetry frames transmitted counter	Data	00H	FFH	W5 Display in decimal
CH17	Instruction counter 3	Data	000H	FFFH	W6，W7 B7～B4 Display in decimal
CH18	Instruction counter 4	Data	00H	FFH	W7B3~B0W8B7~B4 Display in decimal
	Power on operating mode	Status	0H	7H	W8B3~B1 ③
	Write FLASH success flag	Status	0B	1B	W8B0 0: Succeed，1: Failure
CH19	I2C software watchdog switch flag	Status	0B	1B	W9B7 0: On, 1: Off
	I2C reconnecting initialized counter	Data	0H	7H	W9B6~B4 Display in decimal
	TC software watchdog switch flag	Status	0B	1B	W9B3 0: On, 1: Off
	TC software watchdog reset times counter	Data	0H	7H	W9B2~B0 Display in decimal
	ADC software watchdog switch flag	Status	0B	1B	W10B7 0: On, 1: Off
	ADC software watchdog reset times counter	Data	0H	7H	W10B6~B4 Display in decimal
CH20	Temperature measurement software watchdog switch flag	Status	0B	1B	W10B3 0: On, 1: Off
	Temperature software watchdog reset times counter	Data	0H	7H	W10B2~B0 Display in decimal
	CPU ADC watchdog switch flag	Status	0B	1B	W11B7 0: On, 1: Off
	CPU ADC watchdog reset times counter	Data	0H	7H	W11B6~B4 Display in decimal
	SPI software watchdog switch flag	Status	0B	1B	W11B3 0: On, 1: Off
	SPI reconnecting initialized counter	Data	0H	7H	W11B2~B0 Display in decimal

CH21	FLASH successfully configured flag	Status	0B	1B	W12B7	0: Succeed，1: Failure
	Telemetry data packet counter	Data	0H	7H	W12B6~B4	Display in decimal
	Satellite Number	Status	1	6	W12B3~B0	④
	Software version number	Status	0	15	W13B7~B4	Display in decimal
CH22	Telemetry transmission rate flag	Status	0B	1B	W13B3	0: 19.2kbps, 1: 9.6kbps
	Check flag	Status	000H	EFFH	W13B2～B0W14	

Note：

（1）CH1 Data frame mark：

AAA：Telemetry
BBB：FLASH Download Succeed
CCC：FLASH Download Failure

（2）CH2 Current operating mode：

001:Mode 1（CW Beacon，Transmit Per 6 minutes）
010:Mode 2（CW Beacon， Continuously）
011:Mode 3（CW Beacon + Linear Transponder）
100:Mode 4（CW Beacon + Telemetry）
101:Mode 5（CW Beacon + Telemetry + Linear Transponder）
110:Mode 6（Inter-satellite Link）
111:Mode 7（Test Mode）

（3）CH18 Power on operating mode：

001:Mode 1（CW Beacon，Transmit Per 6 minutes）
010:Mode 2（CW Beacon， Continuously）
011:Mode 3（CW Beacon + Linear Transponder）
100:Mode 4（CW Beacon + Telemetry）
101:Mode 5（CW Beacon + Telemetry + Linear Transponder）
110:Mode 6（Inter-satellite Link）
111:Mode 7（Test Mode）

（4）CH21 Satellite Number：

001: XW-2A
010: XW-2B
011: XW-2C
100: XW-2D
101: XW-2E
110: XW-2F

（5）Temperature：

First character =0, T= -N(Last Two characters)
First character=1, T= +N(Last Two characters)

（6）Example: W3W4B7～B4 =

bit7(Word3) bit6(Word3) bit5(Word3) bit4(Word3) bit3(Word3) bit2(Word3) bit1(Word3) bit0(Word3) bit7(Word4) bit6(Word4) bit5(Word4) bit4(Word4)

5、XW-2E and 2F

(1) Content of a telemetry fame

Transmission Sequence	Content of Transmission	Note	Encoding
1	**BJ1Sx** (x=F、G)	Satellite Callsign	Standard Morse Code
2	**DFH**	Start Identifier	Standard Morse Code
3	**XW2**	Start Identifier	Standard Morse Code
4	**XW2**	Start Identifier	Standard Morse Code
5	**CH1**	Telemetry Data Channel 1	Encoded Morse Code
6	**CH2**	Telemetry Data Channel 2	Encoded Morse Code
7	**CH3**	Telemetry Data Channel 3	Encoded Morse Code
8	**CH4**	Telemetry Data Channel 4	Encoded Morse Code
9	**CH5**	Telemetry Data Channel 5	Encoded Morse Code
10	**CH6**	Telemetry Data Channel 6	Encoded Morse Code
11	**CH7**	Telemetry Data Channel 7	Encoded Morse Code
12	**CH8**	Telemetry Data Channel 8	Encoded Morse Code
13	**CH9**	Telemetry Data Channel 9	Encoded Morse Code
14	**CH10**	Telemetry Data Channel 10	Encoded Morse Code
15	**CH11**	Telemetry Data Channel 11	Encoded Morse Code
16	**CH12**	Telemetry Data Channel 12	Encoded Morse Code
17	**CH13**	Telemetry Data Channel 13	Encoded Morse Code
18	**CH14**	Telemetry Data Channel 14	Encoded Morse Code
19	**CH15**	Telemetry Data Channel 15	Encoded Morse Code
20	**CH16**	Telemetry Data Channel 16	Encoded Morse Code
21	**CH17**	Telemetry Data Channel 17	Encoded Morse Code
22	**CH18**	Telemetry Data Channel 18	Encoded Morse Code
23	**CH19**	Telemetry Data Channel 19	Encoded Morse Code
24	**CH20**	Telemetry Data Channel 20	Encoded Morse Code
25	**CH21**	Telemetry Data Channel 21	Encoded Morse Code
26	**CH22**	Telemetry Data Channel 22	Encoded Morse Code
27	**CH23**	Telemetry Data Channel 23	Encoded Morse Code
28	**CH24**	Telemetry Data Channel 24	Encoded Morse Code
29	**CAMSAT**	Stop Identifier	Standard Morse Code
30	**CAMSAT**	Stop Identifier	Standard Morse Code

(2) Content of telemetry data channel

Channel	Name of Parameter	Type	Data Range		Description and Equation
			N(min)	N(min)	
CH1	Data frame mark	Status	—	—	W0W1 ①
CH2	Primary power supply voltage	Data	00H	FFH	W2 8bits, Unsigned binary integers N(Measured value) /10（V）
	Primary power supply current	Data	00H	FFH	W3 8bits, Unsigned binary integers N(Measured value)（mA）
CH3	DC / DC converter output voltage	Data	00H	FFH	W4 8bits, Unsigned binary integers (N(Measured value) + 256) /100（V）
	DC / DC converter output current	Data	00H	FFH	W5 8bits, Unsigned binary integers (N(Measured value) + 256)（mA）
CH4	OBC power voltage	Data	00H	FFH	W6 8bits, Unsigned binary integers 2×N(Measured value)/100（V）
	OBC temperature	Data	00H	FFH	W7 8bits, Unsigned binary integers N(Measured value) - 128（℃）
CH5	RF power amplifier temperature	Data	00H	FFH	W8 8bits, Unsigned binary integers N(Measured value) - 59（℃）
	Receiver AGC voltage	Data	00H	FFH	W9 8bits, Unsigned binary integers N(Measured value) x1.3/100（V）
CH6	Battery discharge switch status	Status	0B	1B	W10B7 0: On, 1: Off
	Battery charge switch status	Status	0B	1B	W10B6 0: On, 1: Off
	Current operating mode	Status	0H	FH	W10B5~B2 ②
	Battery charge and discharge current	Data	000H	3FFH	W10B1~W11B0 10bits, Lower 9 bits unsigned binary integers ((2.4/512)×N(Measured value) - 1.5)/(0.0025) (mA) Positive = discharge, negative = charge Absolute value is the current value
CH7	Battery output voltage	Data	000H	3FFH	W12B7~W13B6 10bits, Unsigned binary integers 4.3×2.4/512×N(Measured value) (V)
	CRC check result	Status	0B	1B	W13B5 0：Correct，1：Error
	Instruction identifies	Status	0B	1B	W13B4 0：Correct，1：Error
	Autonomous operation switch	Status	0B	1B	W13B3 0: On, 1: Off
	Antenna deployment master switch status	Status	0B	1B	W13B2 0: On, 1: Off
	UHF antenna deployment switch status	Status	0B	1B	W13B1 0: On, 1: Off
	VHF antenna deployment switch status	Status	0B	1B	W13B0 0: On, 1: Off
CH8	RF forward power	Data	00H	FFH	W14 （mW） Display in decimal
	RF reflected power	Data	00H	FFH	W15 /10（mW） Display in decimal
CH9	Solar array output current	Data	00H	FFH	W16 8bits, Unsigned binary integers 2.4/256×N(Measured value)/0.0033 (mA)
	Battery pack temperature (Central)	Data	00H	FFH	W17 8bits, Unsigned binary integers N(Higher 8 bits) - 64（℃）
CH10	Battery pack temperature (edges)	Data	00H	FFH	W18 8bits, Unsigned binary integers N(Higher 8 bits) - 64（℃）
	+X panel temperature	Data	00H	FFH	W19 8bits, Unsigned binary integers N(Higher 8 bits) - 64（℃）
CH11	+Y panel temperature	Data	00H	FFH	W20 8bits, Unsigned binary integers N(Higher 8 bits) - 64（℃）
	-Y panel temperature	Data	00H	FFH	W21 8bits, Unsigned binary integers N(Higher 8 bits) - 64（℃）

CH12	-Z panel temperature	Data	00H	FFH	W22 8bits, Unsigned binary integers N(Higher 8 bits) - 64（℃）
	Inter-satellite link command transmission counter	Data	00H	FFH	W23 Display in hexadecimal
CH13	Instruction counter 1	Data	0000H	FFFFH	W24W25 Display in hexadecimal
CH14	Instruction counter 2	Data	0000H	FFFFH	W26W27 Display in hexadecimal
CH15	Instruction status word	Status	0000H	FFFFH	W28W29 Display in hexadecimal
CH16	TC software watchdog switch flag	Status	0B	1B	W30B7 0: On, 1: Off
	TC software watchdog reset times counter	Data	0H	7H	W30B6~B4 Display in hexadecimal
	ADC software watchdog switch flag	Status	0B	1B	W30B3 0: On, 1: Off
	ADC software watchdog reset times counter	Data	0H	7H	W30B2~B0 Display in hexadecimal
	CPU watchdog switch flag	Status	0B	1B	W31B7 0: On, 1: Off
	CPU watchdog reset times counter	Data	0H	7H	W31B6~B4 Display in hexadecimal
	CPU ADC watchdog switch flag	Status	0B	1B	W31B3 0: On, 1: Off
	CPU ADC watchdog reset times counter	Data	0H	7H	W31B2~B0 Display in hexadecimal
CH17	CPU Reset Counter	Data	00H	FFH	W32 Display in hexadecimal
	Battery reconnected counter	Data	0H	FH	W33B7~B4
	Power on operating mode	Status	0H	FH	W33B3~B0 ③
CH18	Satellite Number	Status	0H	FH	W34B7~B4 ④
	Software version number	Status	0H	FH	W34B3~B0
	Battery reconnected enable state	Status	0B	1B	W35B7 0: Off, 1: On
	Telemetry data packet counter	Data	00H	1FH	W35B6~B2
CH19	Software upload status 1	Status	0000H	FFFFH	Transmit letter DDDD for normal operation
CH20	Software upload status 2	Status	0000H	FFFFH	Transmit letter DDDD for normal operation
CH21	Software upload status 3	Status	0000H	FFFFH	Transmit letter DDDD for normal operation
CH22	Software upload status 4	Status	0000H	FFFFH	Transmit letter DDDD for normal operation
CH23	Software upload status 5	Status	0000H	FFFFH	Transmit letter DDDD for normal operation
CH24	Software upload status 6	Status	0000H	FFFFH	Transmit letter DDDD for normal operation

Note：

（1）CH1 Data frame mark：

AAAA：Telemetry

BBBB：FLASH Download Succeed

CCCC：FLASH Download Failure

（2）CH6 Current operating mode：

0001:Mode 1（CW Beacon，Transmit Per 6 minutes）

0010:Mode 2（CW Beacon， Continuously）

0011:Mode 3（CW Beacon + Linear Transponder）

0100:Mode 4（CW Beacon + Telemetry）

0101:Mode 5（CW Beacon + Telemetry + Linear Transponder）

0110:Mode 6（Inter-satellite Link）

0111:Mode 7（Test Mode）

1000: Mode 8（Mode 5+2 Channels Heater）

1001: Mode 9（Mode 5+4 Channels Heater）

（3）CH17 Power on operating mode：

0001:Mode 1（CW Beacon，Transmit Per 6 minutes）
0010:Mode 2（CW Beacon， Continuously）
0011:Mode 3（CW Beacon + Linear Transponder）
0100:Mode 4（CW Beacon + Telemetry）
0101:Mode 5（CW Beacon + Telemetry + Linear Transponder）
0110:Mode 6（Inter-satellite Link）
0111:Mode 7（Test Mode）
1000: Mode 8（Mode 5+2 Channels Heater）
1001: Mode 9（Mode 5+4 Channels Heater）

（4）CH18 Satellite Number：

0001: XW-2A
0010: XW-2B
0011: XW-2C
0100: XW-2D
0101: XW-2E
0110: XW-2F