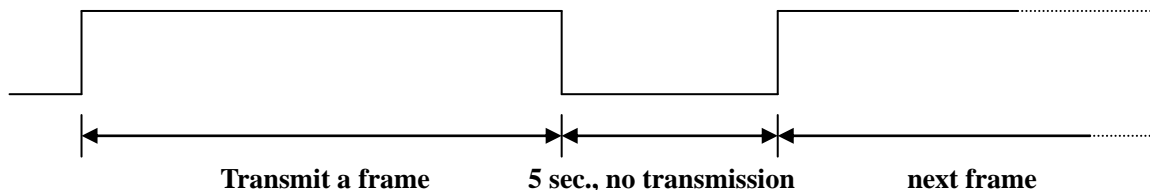




XW-2 Satellites CW Telemetry Beacon Encoding Format

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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 frame

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) (°C) ⑤
CH9	RF power amplifier temperature	Data	064	199	(°C) 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~W8B4 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
CH20	ADC software watchdog reset times counter	Data	0H	7H	W10B6~B4 Display in decimal
	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
CH20	SPI reconnecting initialized counter	Data	0H	7H	W11B2~B0 Display in decimal



XW-2 Satellites CW Telemetry Beacon Encoding Format

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	W12B7~B4	Display in decimal
CH22	Telemetry transmission rate flag	Status	0B	1B	W12B3	0: 19.2kbps, 1: 9.6kbps
	Check flag	Status	000H	EFFH	W12B2~B0W13	

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 frame

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(max)	
CH1	Data frame mark	Status	—	—	W0W1 ①
CH2	Primary power supply voltage	Data	00H	FFH	W2 8bits, Unsigned binary integers $N(\text{Measured value}) / 10 \text{ (V)}$
	Primary power supply current	Data	00H	FFH	W3 8bits, Unsigned binary integers $N(\text{Measured value}) \text{ (mA)}$
CH3	DC / DC converter output voltage	Data	00H	FFH	W4 8bits, Unsigned binary integers $(N(\text{Measured value}) + 256) / 100 \text{ (V)}$
	DC / DC converter output current	Data	00H	FFH	W5 8bits, Unsigned binary integers $(N(\text{Measured value}) + 256) \text{ (mA)}$
CH4	OBC power voltage	Data	00H	FFH	W6 8bits, Unsigned binary integers $2 \times N(\text{Measured value}) \text{ (V)}$
	OBC temperature	Data	00H	FFH	W7 8bits, Unsigned binary integers $N(\text{Measured value}) - 64 \text{ (}^\circ\text{C)}$
CH5	RF power amplifier temperature	Data	00H	FFH	W8 8bits, Unsigned binary integers $N(\text{Measured value}) - 59 \text{ (}^\circ\text{C)}$
	Receiver AGC voltage	Data	00H	FFH	W9 8bits, Unsigned binary integers $N(\text{Measured value}) \times 1.3 / 100 \text{ (V)}$
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 $(2.4/512 \times N(\text{Measured value}) - 1.5) / (0.0025) \text{ (mA)}$ Positive = discharge, negative = charge Absolute value is the current value
CH7	Battery output voltage	Data	000H	3FFH	W12B7~W13B6 10bits, Unsigned binary integers $4.3 \times 2.4 / 512 \times N(\text{Measured value}) \text{ (V)}$
	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
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 $2.4/256 \times N(\text{Measured value}) / 0.0033 \text{ (mA)}$
	Battery pack temperature (Central)	Data	00H	FFH	W17 8bits, Unsigned binary integers $N(\text{Higher 8 bits}) - 64 \text{ (}^\circ\text{C)}$
CH10	Battery pack temperature (edges)	Data	00H	FFH	W18 8bits, Unsigned binary integers $N(\text{Higher 8 bits}) - 64 \text{ (}^\circ\text{C)}$
	+X panel temperature	Data	00H	FFH	W19 8bits, Unsigned binary integers $N(\text{Higher 8 bits}) - 64 \text{ (}^\circ\text{C)}$
CH11	+Y panel temperature	Data	00H	FFH	W20 8bits, Unsigned binary integers $N(\text{Higher 8 bits}) - 64 \text{ (}^\circ\text{C)}$
	-Y panel temperature	Data	00H	FFH	W21 8bits, Unsigned binary integers $N(\text{Higher 8 bits}) - 64 \text{ (}^\circ\text{C)}$



XW-2 Satellites CW Telemetry Beacon Encoding Format

CH12	-Z panel temperature	Data	00H	FFH	W22	8bits, Unsigned binary integers N(Higher 8 bits) - 64 (°C)
	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)

(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)

(4) CH18 Satellite Number:

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