Control Protocol

2022.

Document Modification Record

Version number	Modify content description	Date
1.0	Create	2019.9
1.2	The return status adds the laser ranging return value in bytes 26 and 27.	2020.9.16
1.3	Return speed ratio changed to 0.01	2021.3.4
1.4	Add electric lock mode	2021.3.12
1.5	Add target position solution	2021.10.12
1.6	Modify video switching and add time	2021.12.17
1.7	Single return of command status	2022.1.24
1.8	Add laser switch status and zoom ratio by 1 bit	2022.2.10
1.9	Add SEI information	2022.5.17
2.0	Add relative height	2022.5.20
2.1	Modify height resolution and SEI information	2022.5.27
2.2	Added low-light mode and digital zoom	2022.8.6
2.3	Add network control	2022.8.18
2.4	Add photo taking and modify the returned zoom ratio bit length	2022.9.1
2.5	Add digital index and specify attitude angles	2022.11.14
2.6	Add target calibration	2022.12.02
2.7	Add lifting mechanism control and calibrate gyroscope instructions	2022.12.09
2.8	Add image board switch	2022.12.22
2.9	Add self-test status	2023.4.13

1.Range

This agreement specifies the data communication process and control protocol between DYT and controllers (flight control, pod controller, etc.)。

2.Communication Between DYT and Controller

2.1 Data Communication Process

a) The controller sends instructions to DYT. The contents of the instructions are shown in Table 1. The instructions are triggered and can be sent once;

b) After the DYT power-on self-inspection, it sends the information to the controller in a period of 16.7ms, and the information content is shown in Table 2；

c) For multi-byte variables, the low byte comes first and the high byte comes last;

d) The default baud rate of the serial port is 115200, and theverification method is no verification;

e) When the target position calculation and data indexing functions are required, the attitude angle and longitude and latitude information of the carrier aircraft shall be sent to DYT at a frequency of 1~60Hz;

f) SEI information is data superimposed in H.264 video stream, whichis not available by default

2.2 Communication Protocol

Table 1 .Control Command Data

Source		Controller		
Target		DYT		
Send Frequency		Trigger Sending		
Byte Sequence Number	Parameter Name	Data Type	Description	Occupied Bytes
0	Sync code 1	U8	0xEB	1
1	Sync code 1	U8	0x90	1
2	Control	U8	0x00: null instruction 0x01: visible light 1	1

	Information		0x02: visible light 2 0x03: Infrared 1 0x04: Infrared 2 0x05: Image enhancement on 0x06: Image enhancement off (default) 0x07: Target identification on 0x08: Target recognition off (default) 0x09: Storage on 0x0A: Storage off (default) 0x0D: Pointing and tracking (X, Y coordinates) 0x0E: Stop tracing 0x0F: The target is found to be locked automatically 0x10: The target is found to be semi-automatically locked 0x11: Infrared white heat 0x12: Infrared black heat 0x13: Tracking algorithm - adaptive 0x14: Tracking algorithm - personnel 0x15: Tracking algorithm - vehicle 0x16: Tracking algorithm - architecture 0x24: PTZ search 0x25: zoom command 0x26: Specify frame angle 0x27: Turn on the motor 0x28: Turn off the motor 0x29: Close follow 0x2a: azimuth follow 0x2b: centering 0x2c: Suppress gyro drift 0x2d: laser ranging on 0x2e: laser ranging off 0x30: Electric lock mode 0x31: Unlock 0x39: Calibrate the gyroscope (parameter 3 is zero, it is necessary to close the motor in advance, keep it stationary for 10s after sending the command, and then open the motor) 0x3a: data citation 0x3b: Specify attitude angle 0x3c: Calibrate the zero position of flight control and pod attitude angle 0x4a: Image board power control	

			0x50: false color 0x51: osd display on 0x52: osd display off 0x55: Low illumination mode off 0x56: Low illumination mode on 0x58: digital zoom on 0x59: Digital zoom off 0x5a: Specify zoom factor 0x5b: Take photos 0x5c: Focus mode 0x5d: focusing position 0xa0: Save FLASH parameters 0xb0: lifting mechanism control 0xb1: Set the current angle to zero	
3、4	Parameter X	S16	The default is 0; When the control information is 0x0D "pointing tracking", it means the horizontal pixel coordinate value of the locking point, and the image center point is 0 When the control information is 0x24 "PTZ search", it indicates the azimuth speed, with the unit of 0.1 °/s; When the control information is 0x26 "specified frame angle" and 0x3b "specified space angle", it indicates the azimuth, in 0.01 degree; When the control information is 0x2c "Suppress gyro drift", it is int16, ranging from - 2000 to 2000; When the control information is 0x5a "Specified zoom factor", it means the zoom factor, in 0.1 times; When the control message is 0xb0 "lift control", 0 means stop, 1 means rise, 2 means fall; When the control information is 0x4a "Image board power control", 0 means restart, 1 means power on, 2 means power off	2
5、6	Parameter Y	S16	The default is 0; When the control information is 0x0D "pointing tracking", it means the vertical pixel coordinate value of the locking point, and the image center point is 0 When the control information is 0x24 "PTZ	2

			search", it means pitch speed, unit: 0.1 °/s When the control information is 0x26 "specified frame angle" and 0x3b "specified space angle", it indicates the pitch angle, in 0.01 degrees	
7	Parameter 3	U8	0x01~0x04: small picture in picture 0=cancel multiple pictures; 1=visible 1; 2=visible 2; 3=infrared 1; 4=infrared 2; When small picture==large picture, cancel multiple pictures.	1
8	Zoom rate	S8	When the control information is "zoom command", 0~+100 indicates the amplification rate; 0~- 100 indicates the reduction rate	1
9~14	Reserve			6
15	Checksum	U8	Add from byte 0, take the lower 8 bits	1
	Total			16

When the control information is 0x3a "data index", the 3-14 bytes are shown in the following table.

Byte Sequence Number	Parameter Name	Data Type	Unit	Description	Occupied Bytes
3	Data indexing status	U8		0x00: Exit geographic tracking 0x01: Geographic tracking of the current center of view 0x02: Geographic tracking specified location 0x0a: Calibrate according to known target	1
4~7	Target Latitude	Int32	10^-7°		4
8~11	Target longitude	Int32	10^-7°		4
12、13	Target altitude	S16	0.2m		2

14	reserve	U8			1

Instruction Example:

Rotate to the right at a speed of 10 °/s: EB 90 24 64 00 00 00 00 00 00 00 00 00 00 03
Rotate downwards at a speed of 10 °/s: EB 90 24 00 00 9C FF 00 00 00 00 00 00 00 3A
Stop rotation: EB 90 24 00 00 00 00 00 00 00 00 00 00 00 9F
Turn to azimuth angle 10, pitch angle -10: EB 90 26 E8 03 18 FC 00 00 00 00 00 00 00 A0
Zoom+: EB 90 25 00 00 00 00 00 32 00 00 00 00 00 00 D2
Zoom-: EB 90 25 00 00 00 00 00 CE 00 00 00 00 00 00 6E
Stop zoom: EB 90 25 00 00 00 00 00 00 00 00 00 00 00 A0
Zoom to 5x: EB 90 5A 32 00 00 00 00 32 00 00 00 00 00 00 39
Point out tracking coordinates (100, -200) : EB 90 0D 64 00 37 FF 01 32 00 00 00 00 00 00 55
Stop tracking: EB 90 0E 00 00 00 00 00 00 00 00 00 00 00 00 89

Table 2. Periodic Telemetry Information

Source		DYT			
Target		Controller			
Send Frequency		60Hz			
Byte Sequence Number	Parameter Name	Data Type	Unit	Description	Occupied Bytes
0	Sync Word 1	U8		0xEE	
1	Sync Word 2	U8		0x16	
2	Status information feedback 1	U8		Bit7-6: Tracked video source 00: visible light 1 01: Visible light 2 10: Infrared 1 11: Infrared 2 Bit5-4: Tracking algorithm type 00: Adaptive 01: Personnel 10: Vehicle 11: Architecture Bit3: target automatic prompt 1: On 0: Off Bit2: target tracking status 1: Lock 0: Search Bit1~Bit0: standby	1

3	Status information feedback 2	U8		Bit7: image enhancement 1: On 0: Off Bit6: Reserved Bit5: storage 1: On 0: Off Bit4: Reserved Bit3: motor status 1: On 0: Off Bit2: follow mode 1: On 0: Off Bit1: electric lock mode 1: On 0: Off Bit0: laser status 1: On 0: Off	1

4	Zoom ratio low 8 bits	U8	0.1X	U16 with bit0-3 of byte 5	1
5	Status feedback information 3	U8		Bit7-6: Large screen displayed Bit5-4: small screen displayed 00: Visible 1 (zoom/front view) 01: Visible 2 (wide angle/side view) 10: Infrared 1 11: Infrared 2	1
				Bit0-3：Zoom ratio high 4 bits	
6、7	Target miss X-axis offset angle	S16	0.05°	Indicates the horizontal and vertical deviation of the locking point, and the image center point is 0. The numerical value corresponds to the direct physical quantity. The different field angles of the visible light and the infrared lens are uniformly calculated by the DYT.	2
8、9	Target miss Y axis offset angle	S16	0.05°		2
10、11	Roll frame angle	S16	0.01°	Left negative right positive Upper positive and lower negative	
12、13	Pitch frame angle	S16	0.01°		2
14、15	Azimuth frame angle	S16	0.01°		2
16、17	reserve				2
18、19	reserve				2
20、21	Roll angular velocity	S16	0.01° /s	Left negative right positive Upper positive and lower negative	2
22、23	Pitch angular velocity	S16	0.01° /s		2
24、25	Azimuth velocity	S16	0.01° /s		2
26、27	laser ranging	U16	0.1m	0 means invalid	2

28	Self-inspection results	U8		Bit7： Self inspection completed 1: Self inspection completed 0: Self checking in progress Bit3~Bit6:reserve Bit2：Gyroscope calibration 1： Calibrations failed 0： Calibration Successful Bit1： Encoder and servo drive 1：Error 0：Normal Bit0： Imaging plate 1：Error 0：Normal	1
29、30	reserve				2
31	Checksum	U8		Add from byte 0, take the lower 8 bits	1

Table 3 .Aircraft Attitude and Latitude and Longitude Information

Source		Controller			
Target		DYT			
Send Frequency		Periodic transmission with a frequency of 1 ~ 60Hz			
Byte Number	Parameter Name	Data Type	Unit	Description	Occupied Bytes
0	Sync word 1	U8		0xEB	1
1	Sync word 2	U8		0x91	1
2、3	Carrier aircraft roll angle	S16	0.01°	From the tail to the head; Azimuth angle: nose pointing to due north is zero, nose pointing to northeast is positive, and northwest is negative; Pitch Angle: the Angle between the nose and the horizontal, the horizontal is zero,The nose is positive up and negative down;Roll Angle: body level is zero, right tilt is positive, left tilt is negative (send 0 if not)	2
4、5	Carrier aircraft pitch angle	S16	0.01°		2
6、7	Carrier aircraft yaw angle	S16	0.01°		2

8~11	Latitude	Int32	10^-7°		4
12~15	Longitude	Int32	10^-7°		4
16、17	Altitude	S16	0.2m		2
18、19	Relative Altitude	S16	0.2m		2
20	Year	U8		+2000	1
21	Month	U8			1
22	Day	U8			1
23	Hour	U8			1
24	Minute	U8			1
25	Second	U8			1
26	Centisecond	U8	10ms		1
27、28	Airspeed	U16	0.5m/s		2
29、30	Satellite earth velocity	U16	0.5m/s		2
31	Checksum	U8		Add from the 0 byte and take the lower 8 bits	1
	Total				32

Table 4 .Target Latitude and Longitude Information

Source		DYT			
Target		Controller			
Send Frequency		Periodic transmission, frequency 1~60Hz, determined by the longitude and latitude of the carrier and laser ranging frequency			
Byte Number	Parameter Name	Data Type	Unit	Description	Occupied Bytes
0	Sync word 1	U8		0xEE	1
1	Sync word 2	U8		0x18	1
2~5	latitude	Int32	10^-7°		4
6~9	longitude	Int32	10^-7°		4
10、11	Altitude	S16	0.2m		2
12、13	Relative Altitude	S16	0.2m		2
14	Year	U8		+2000	1
15	Month	U8			1
16	Day	U8			1
17	Hour	U8			1
18	Minute	U8			1
19	Second	U8			1
20	Centisecond	U8	10ms		1
21~30	Reserved				10
31	Checksum	U8		Add from the 0 byte and take the lower 8 bits	1
	Total				32

Table 5. Single Status Return

Source		DYT			
Target		Controller			
Send Frequency		Trigger			
Byte Number	Parameter Name	Data Type	Unit	Description	Occupied Bytes
0	Sync word 1	U8		0xEE	1
1	Sync word 2	U8		0x19	1
2	Corresponding control code	U8		Control code corresponding to this status	1
3	parameter length	U8		N	1
4~N+3	parameter			When N is 0, there is no parameter	N
N+4	Checksum	U8		Add from the 0 byte and take the lower 8 bits	1

If the control code is 0x3a " digital indexing ", the parameter length is 2

Byte Number	Parameter Name	Data Type	Unit	Description	Occupied Bytes
4	Digital indexing command	U8		0x00：Exit geo-tracking 0x01： Geo-tracking the current center of the field of view 0x02： Geographic tracking of a specified location 0x0a： Calibrate against known targets	1
5	Status	U8		0 is success, 1 is failure	1

When the control code is 0xb0 "Lift Control", the parameter length is 1

Byte Number	Parameter Name	Data Type	Unit	Description	Occupied Bytes
4	Jacking Condition	U8		0 means stop, 1 means rise, 2 means fall, 3 means rise in place, 4 means fall in place, and 0xff means error	1

Table 6. SEI Information

Source		Pod Video			
Target		Image Transmission			
Send Frequency		30Hz			
Byte Number	Parameter Name	Data Type	Unit	Description	Occupied Bytes
0	synchronization word 1	U8		0xEE	1
1	synchronization word 2	U8		0x16	1
2	Status information feedback 1	U8		Bit7-6：Tracked video source 00: visible light 1 01: visible light 2 10: infrared 1 11： infrared 2 Bit5-4：Type of tracking algorithm 00： self-adaption 01： peoples 10： vehicle 11：building Bit3：Target autosuggest 1: turn on	1

				0: turn off Bit2：Target tracking state 1:lock 0:search Bit1~Bit0： Reserve	
3	Status information feedback 2	U8		Bit7：image enhancement 1:turn on 0:turn off Bit6：Reserve Bit5：storage 1: turn off 0: turn on Bit4： Reserve Bit3：Motor situation 1：turn on 0：turn off Bit2：follow-up mode 1：turn on 0：turn off Bit1： Reserve Bit0： Reserve	1
4	Zoom is 8 bits lower	U8	0.1 times	Form u16 with bit0-3 of byte 5	1
5	abnormal information	U8		Bit7-6：The big screen displayed Bit5-4：The small screen displayed 00: Visible 1 (Zoom/forward view) 01: Visible 2 (wide angle/side view) 10:Infrared 1 11: Infrared 2	1
				Bit0-3：Zoom 4 digits higher	
6、7	Target miss distance X axis offset angle	S16	0.05°	Represents the transverse and longitudinal deviation of the locking point, and the center point of the image is 0. Numerical and physical quantities correspond directly, visible light and infrared lens of different viewing angle by calculating pod internal unity.	2
8、9	Target miss distance Y axis offset angle	S16	0.05°		2

10、11	Roll frame angle	S16	0.01°	Negative left and positive right Up is positive and down is negative	2
12、13	Pitch frame angle	S16	0.01°		2
14、15	Azimuth frame angle	S16	0.01°		2
16、17	Reserve				2
18、19	Reserve				2
20、21	Angular roll velocity	S16	0.01° /s		2
22、23	Pitch velocity	S16	0.01° /s		2
24、25	Azimuth velocity	S16	0.01° /s		2
26、27	Laser ranging	U16	0.1m	0 means invalid	2
28	Result of self-check	U8			1
29、30	Reserve				2
31、32	Carrier aircraft roll angle	S16	0.01°	From the tail to the head; Azimuth angle: nose pointing to due north is zero, nose pointing to northeast is positive, and northwest is negative; Pitch Angle: the Angle between the nose and the horizontal, the horizontal is zero,The nose is positive up and negative down;Roll Angle: body level is zero, right tilt is positive, left tilt is negative (send 0 if not)	2
33、34	Carrier aircraft pitch angle	S16	0.01°		2
35、36	Carrier aircraft yaw angle	S16	0.01°		2
37~40	Latitude	Int32	10^-7°		4
41~44	Longitude	Int32	10^-7°		4
45、46	Altitude	S16	0.2m		2
47、48	Relative altitude	S16	0.2m		2
49	Year	U8		+2000	1
50	Month	U8			1

51	Day	U8			1
52	Hour	U8			1
53	Minute	U8			1
54	Sencond	U8			1
55	Centisecond	U8	10ms		1
56、57	Airspeed	U16	0.5m/s		2
58、59	Satellite earth velocity	U16	0.5m/s		2
60	Frame Counter	U8	0-255 circulation		1
61、62	Reserve				2
63	Checksum	U8		Add from the 0 th byte and take the lower 8 bits	1
	Total				64

2.3 Network Control

When network control is required, tcp connects to port 2000 of the pod. The tcp protocol is encapsulated on the basis of the preceding protocols. The protocol for pod return remains the same as above.

Byte No.	Name	Content	Description
0	FH(frame header)	0xeb	
1	FH(frame header)	0x90	
2	Data Length	N	U8 type， N is the data length
3~2+N	Data	EB 90……	
3+n	Checksum		Add up from the third byte, taking the lower eight bits

For example： eb 90 10 eb 90 2b 00 00 00 00 00 00 00 00 00 00 00 00 a6 4c
（4c is the checksum, adding up from the second eb）
Where: eb 90 2b 00 00 00 00 00 00 00 00 a6 is valid data (a6 is checksum, starting from eb)