Udp&uart-Protocol

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Revision record

Date	Revised version	Description	Author
2019/08/31	B1	Original version	
2019/09/28	V1.0.1	Added PTZ control commands	
2019/10/22	V1.0.2	Modify the speed mode protocol	
2019/10/25	V1.0.3	Improve zoom and focus control commands	
2020/06/06	V1.0.4	Fixed some commands	
2022/01/07	V1.1.0	Added extension commands	
2022/10/10	V1.1.1	Added digital zoom commands	
2025/12/29	V1.1.2	Modify the command to set the digital zoom magnification	Shen Canquan

Table of contents

1. Overview

This communication protocol document is applicable to the SIP series products of Topo Lianchuang, including single optical and dual optical products

2. Command format

1: Frame structure

Frame Header (3char)	Address bit (2char)	Data length (1char)	Control bit (1char)	Identifica tion bit (3char)	Data1 (char)	◦ ◦ ◦ ◦ (char)	Data L (char)	Check position (2char)
#tp	U/M/D/E/P/G	Len	w/r	X1X2X3	D1	◦ ◦ ◦ ◦	DL	CR

Frame header:

#TP: Fixed length command, data length is 2;

#tp: Variable length command, the data length is determined according to the length bit, the maximum length: 0x0F;

#tP: Extend command, the data length bit is in hex form instead of ASCII form, and the maximum data bit length is determined by   0x0F expanded to 0xFF;

#Tp: Extend commands, control bits as data length bits, and take hex form instead of ASCII form, number   The maximum length of the position is expanded from 0x0F to 0xFFFF;

Address bit: (2 bytes, source address first, destination address last)

U	M	D	E	P	G
Uart	Lens	System and graphics	Secondary equipment	Network side	Gimbal

U: The address of the serial port device, that is, the external control module is controlled by the external port, then the address of the external control module is U;

M: Lens address, i.e., commands related to lens functions, such as zoom, focus;

D: System and image address, such as photo, video, memory card status, etc.;

E: Address of secondary equipment, such as laser fill-in-light, laser ranging module, etc.;

G: Gimbal address, such as gimbal pitch control, gimbal attitude acquisition;

P: The address of the network end, for example, if the PC controls the device through the network, the address of the PC is P;

Data length: The longest number of characters in data 0x0F bits (the longest 0xFF of the extension command).

Control: r —> query w —> setting   , control

Identification bit: Identification function (see Appendix 1 for details)

Data: data bits, according to the length of the data;

CRC: Convert the frame header to HEX before the check bit, do the sum of the sum, and then convert the result to ASC-II. Two bytes,High position in front, (see Appendix 2)

Serial port configuration:

Baud rate: 115200, data bit: 8, stop bit: 1, check bit: none

Network Settings:

Bitstream (RTSP)

Master stream URL: rtsp://192.168.31.66:554/stream=0

Substream URL: rtsp://192.168.31.66:554/stream=1

Note: IP is based on device settings

Control (UDP)

Pod IP: Equipment IP;
Pod Port: 9003;
Customer side port: 9004;

3. Detailed explanation of M-class commands

1：ZOOM

1.1 Control

Control Position: W

Logo bit: ZMC

Data bits:

00	stop
01	zoom out
02	zoom in

Note: Zoom in and out should be used in conjunction with the stop command

Example of the uart command:

    #tpUM2wZMC009C   stop

    #tpUM2wZMC019D   zoom out

    #tpUM2wZMC029E   zoom in

udp command example:

    #tpPM2wZMC0097   stop

    #tpPM2wZMC0198   zoom out

    #tpPM2wZMC0299   zoom in

1.2 Read

Control Position: R

Logo bit: ZOM

Data bits: 00

Example of the uart command:

    send：#tpUM2rZOM00A3

    receive：#tpMU4rZOM $Z_0Z_1Z_2Z_3$ RR

udp command example:

    #tpPM2rZOM009E

    receive：#tpMP4rZOM $Z_0Z_1Z_2Z_3$ RR

Z0Z1Z2Z3: A symbolic zoom position value in the form of a four-character complement, with the high bit first

    eg：#tpMU4rZOMFFB447

    Z0Z1Z2Z3 = FFB4(char) -> FFB4(Hex) ->-76

    That is, the current position of zoom is -76

2：FOCUS

2.1 Control

Control Position: W

Flag bit: FCC

Data bits:

00	stop
01	focus +
02	focus -
10	Auto focus
11	Manual focus
12	Manual focus(save)
13	Auto focus(save)

Note: + —To be used with the stop command

Example of the uart command:

    #tpUM2wFCC007E   stop

    #tpUM2wFCC017F   focus+

    #tpUM2wFCC0280   focus-

Example of the uart command:

    #tpPM2wFCC0079   stop

    #tpPM2wFCC017A   focus+

    #tpPM2wFCC027B   focus-

2.2 Read

Control Position: R

Flag bit: FOC

Data bits: 00

Example of the uart command:

    send：#tpUM2rFOC0085

    receive：#tpMU4rFOC $F_{0F1F2F3}$ RR

udp command example:

    send：#tpPM2rFOC0080

    receive：#tpMP4rFOC $F_{0F1F2F3}$ RR

    F0F1F2F3: A symbolic focus position value in the form of a four-character

complement, with the high position first

    eg：#tpMU4rFOCFFB429

    F0F1F2F3 = FFB4(char) -> FFB4(Hex) ->-76

    That is, the current position of focus is -76

3: Set the zoom and focus locations

Control Position: W

Flag bit: ZFP

Data bits: Z0Z1Z2Z3 F0F1F2F3

Z0Z1Z2Z3: A symbolic zoom position value in the form of a four-character complement,

with the high bit first

F0F1F2F3: A symbolic focus position value in the form of a four-character complement,

with the high position first

eg: If the zoom position is set to -76 and the focus position is 50, then -76 and 50 will be converted into complement forms FFB4 and 0032, and then converted to the characters 'F'"F"B'"4'and '0"0'3'"2', and then add the frame header, address, frame length, command and check bit, and the final command is #tpUM8wZFPFFB400320F

Note: If only the zoom position is set, the focus value will be filled in 'N"N"N"N', and the camera will autofocus after setting;

4: Automatic transmission of magnification and ZOOM position

Control Position: R
Logo bit: ZMP
Data bits: M0M1M2Z0Z1Z2Z3

$M_0M_1M_2$: Magnification (0.1x)

$Z_0Z_1Z_2Z_3$: A symbolic zoom position value in the form of a four-character complement, with the high bit first

Description: After the zoom change, it will be automatically sent out;

eg:M_{0M1M2}:"123", indicating that the current multiplier is 12.3x

$Z_0Z_1Z_2Z_3$: A symbolic zoom position value in the form of a four-character complement, with the high bit first

eg：#tpMU4rZOMFFB447 ； $Z_{0Z1Z2Z3}$ = FFB4(char) -> FFB4(Hex) ->-76

That is, the current position of zoom is -76

5: Remotely turn on the slave device (not yet supported).

Set		
Cmd	#TPUM2wSWH X0X1 RR	
X0	5（5v）	C（12v）
	Laser ranging, fine dust detection	Fill in the light
X1	0	1
	Shut down	On
Get		
Send	#TPUM2rSWH005F	
X0	5	C
	Laser ranging, fine dust detection	Fill in the light
X1	0	1
	Shut down	On

6: Switch between day and night

Control Position: W
Flag bit: IRC
Data bits: x1x2

00	Daytime
01	night
0A	State flip

Example of a uart command: #tpUM2wIRC0090
udp command example: #tpPM2wIRC008B

7: ATE mode

Control Position: W

Logo bit: ATE

Data bits: x1x2

00	Shut down
01	Enable

Example of the uart command: #tpUM2wATE008C

udp command example: #tpPM2wATE0087

8: Version acquisition

Control Position: R

Flag bit: VSN

Data bits: x1x2

Example of a uart command: #tpUM2rVSN00A4

udp command example: #tpPM2rVSN009F

receive：#tpPM5rVSNM33265D

9: Optical magnification control (supported by some models)

9.1 Setup

Control Position: W

Logo bit: MUL

Data bits: x1x2x3x4

x1x2x3x4: The number in decimal represented by four characters, in 0.1 times

For example, 0123 means 12.3 times

Example of a uart command: #tpUM4wMUL012308

Example of a udp command: #tpPM4wMUL012303

9.2 Reading

Control Position: R

Logo bit: MUL

Received command data bit: x1x2x3x4

x1x2x3x4: The number in decimal represented by four characters, in 0.1 times

For example, 0123 means 12.3 times

Example of sending commands:

Example of a uart command: #tpUM2rMUL009B

udp command example: #tpPM2rMUL0096

10: Aperture Control (supported on some models)

Control Position: W

Flag bit: APC

Data bits: x1x2

Example of the uart command:

#tpUM2wAPC0086   stop

#tpUM2wAPC0187   aperture -

#tpUM2wAPC0288   aperture +

udp command example:

#tpPM2wAPC0081   stop

#tpPM2wAPC0182   aperture -

#tpPM2wAPC0283   aperture +

Fourth: Detailed explanation of Class G commands

1: PTZ control

Control Position: W

Flag bit: PTZ

Data bits: x1x2

x1x2	00	01	02	03	04	05
Description	stop	up	down	left	right	Back to the middle
x1x2	06	07	08	09	0A	
Description	Lock head	Follow	Follow the lock switch	Gimbal calibration	One click down	

Example of a uart command: #TPUG2wPTZ006A

2: Gimbal speed mode control

Control Position: W

Flag bits: GSY, GSP, GSR, GSM

Data bits: x1x2

Gimbal speed Control	
Heading Cmd	#TPUG 2 w GSY X_{0X1} RR
	X0X1
	Rotational speed (-99,99) (deg/s)
Pitch Cmd	#TPUG 2 w GSP X_{0X1} RR
	X0X1
	Rotational speed (-99, +99) (deg/s)
Roll Cmd	#TPUG 2 w GSR X_{0X1} RR
	X0X1
	Rotational speed (-99, +99) (deg/s)
Yaw&Pitch	#tpUG 4 w GSM Y_{0Y1} $P0P_1$ RR
	Y0Y1 P0P1
	Rotational speed (-99,99) (deg/s)
Roll&Pitch	#tpUG 4 w RPS R_{0R1} $P0P_1$ RR
	R0R1 P0P1
	Rotational speed (-99,99) (deg/s)
Yaw&Pitch&Roll	#tpUG 6 w YPR Y_{0Y1} $P0P1R0R_1$ RR
	Y0Y1 P0P1R0R1
	Rotational speed (-99,99) (deg/s)

Eg:#TPUG2wGSYE276

Data bit analysis: The control gimbal rotates at speed X0X, **X0X1 is the number of 8 bits with symbols (unit 0.1degree/s) represented by characters**, heading right is positive, pitch down is positive (eg: rotate to the left at a speed of 3.0, then the hexadecimal representation of -30 is converted 0xE2 'E','2'）； RR check bit;

3: Gimbal angle mode control

3.1 Magnetically encoded angle control

For example, if the pitch is set to 90 degrees, it is at a 90-degree angle with the aircraft, if the aircraft is horizontal, the camera is vertically downward, and if the aircraft is tilted up, the camera is no longer vertically down;

Control Position: W
Logo bits: GAY, GAP, GAR, GAM
Data bits: See table below

Gimbal_Angle_Control		
Yaw	#tpUG 6 w GAY $X_{0}X_{1}X_{2}X_{3}$ $X_{4}X_{5}$ RR	
	X0X1X2X3	X4X5
	Angle (-150.00, 150.00)	Rotational speed (0,99) (0.1deg/s)
Pitch	#tpUG 6 w GAP $X_{0}X_{1}X_{2}X_{3}$ $X_{4}X_{5}$ RR	
	X0X1X2X3	X4X5
	Angle (-90.00, +90.00)	Rotational speed (0,99) (0.1deg/s)
Roll	#tpUG 6 w GAR $X_{0}X_{1}X_{2}X_{3}$ $X_{4}X_{5}$ RR	
	X0X1X2X3	X4X5
	Angle (-90.00, +90.00)	Rotational speed (0,99) (0.1deg/s)
Yaw&Pitch	#tpUG C w GAM $Y_{0}Y_{1}Y_{2}Y_{3}$ $Y_{4}Y_{5}$ $P_{0}P_{1}P_{2}P_{3}$ $P_{4}P_{5}$ RR	
	Y0Y1Y2Y3 / P0P1P2P3	Y4Y5 / P4P5
	Angle (-150.00, 150.00) / (-90.00, +90.00)	Rotational speed (0,99) (0.1deg/s)

Eg:#tpUG6wGAYEF073288

control gimbal rotate at speed X4X5 to point to the angle **X0X1X2X3; X0X1X2X3 represents the angle, and the 16 bits represented by the character are signed (unit 0.01 degree**), the heading is positive to the right, and the pitch is positive (eg: go to -50 degrees, that is, the hexadecimal representation of -5000 0xEC78 convert it to 'E', 'C' , '7', '8'), **X4X5** represents the rotation speed, and the hexadecimal number represented by the characters; RR check bit;

3.2 Gyroscope angle control

Relative to the spatial coordinate system, for example, if the pitch is set to 90 degrees, the camera will be vertically downwards no matter what attitude the aircraft is in;

Control Position: W
Logo bits: GIY, GIP, GIR, GIM
Data bits: See table below

Gimbal_Angle_Control		
Yaw	#tpUG 6 w GIY $X_{0}X_{1}X_{2}X_{3}$ $X_{4}X_{5}$ RR	
	X0X1X2X3	X4X5
	Angle (-150.00, 150.00)	Rotational speed (0,99) (0.1deg/s)
Pitch	#tpUG 6 w GIP $X_{0}X_{1}X_{2}X_{3}$ $X_{4}X_{5}$ RR	
	X0X1X2X3	X4X5
	Angle (-90.00, +90.00)	Rotational speed (0,99) (0.1deg/s)
Roll	#tpUG 6 w GIR $X_{0}X_{1}X_{2}X_{3}$ $X_{4}X_{5}$ RR	
	X0X1X2X3	X4X5
	Angle (-90.00, +90.00)	Rotational speed (0,99) (0.1deg/s)
Yaw&Pitch	#tpUG C w GIM $Y_{0}Y_{1}Y_{2}Y_{3}$ $Y_{4}Y_{5}$ $P_{0}P_{1}P_{2}P_{3}$ $P_{4}P_{5}$ RR	
	Y0Y1Y2Y3 / P0P1P2P3	Y4Y5 / P4P5
	Angle (-150.00, 150.00) / (-90.00, +90.00)	Rotational speed (0,99) (0.1deg/s)

Eg:#tpUG6wGIYEF073290

control gimbal rotate at speed X4X5 to point to the angle **X0X1X2X3; X0X1X2X3 represents the angle, and the 16 bits represented by the character are signed (unit 0.01 degree**), the heading is positive to the right, and the pitch is positive (eg: go to -50 degrees, that is, the hexadecimal representation of -5000 0xEC78 convert it to 'E', 'C' , '7', '8'), **X4X5** represents the rotation speed, and the hexadecimal number represented by the characters; RR check bit;

3.3 Pose acquisition

Read the magnetic encoded angle;
Control Position: R
Logo bit: GAC
Data bits: 00
Example of the uart command:
send：#TPUG2rGAC0032
receive：#tpGU C r GAC Y0Y1Y2Y3P0P1P2P3R0R1R2R3   CC

Y0Y1Y2Y3	P0P$_{1P2}$P3	R0R1R$_2$R3
Heading angle	Pitch angle	Roll angle

The angle is a hexadecimal number represented by the character type, with the high position first

Eg：Y0Y1Y2Y3 = 'E' 'C' '7' '8' = 0xEC78 = -5000（0.01degree）

3.4 The gimbal posture is actively sent

Set up:

Control Position: W

Logo bit: GAA

Data bits: x1x2

01	Enable
00	Shut down

Example of a uart command: #TPUG2wGAA0136

Inquire:

Control Position: R

Logo bit: GAA

Data bits: 00

receive:	#TPGU2rGAA x1x2 RR
00	Shut down
01	Enable

Example of a uart command: #TPUG2rGAA0030

3.5 Gyroscope Attitude Acquisition

Read gyroscope angles;
Control Position: R
Logo bit: GIC
Data bits: 00
Example of the uart command:
send：#TPUG2rGIC003A
receive：#tpGU C r GIC Y0Y1Y2Y3P0P1P2P3R0R1R2R3   CC

Y0Y1Y2Y3	P0P1P2P3	R0R1R2R3
Heading angle	Pitch angle	Roll angle

The angle is a hexadecimal number represented by the character type, with the high position first

Eg：Y0Y1Y2Y3 = 'E' 'C' '7' '8' = 0xEC78 = -5000（0.01degree）

3.6 The gyroscope attitude is actively sent

Set up:
    Control Position: W
    Logo bit: GIA
    Data bits: x1x2

01	Enable
00	Shut down

Example uart command: #TPUG2wGIA013E

Inquire:
    Control Position: R
    Logo bit: GIA
    Data bits: 00

receive:	#TPGU2rGIA x1x2 RR
00	Shut down
01	Enable

Example of a uart command: #TPUG2rGIA0038

4: Gimbal motor switch

Set up:
Control Position: W
Flag bit: GMS
Data bits: x1x2

01	Open it
00	Shut down

    Example of the uart command:

        #tpUG2wGMS0194

    udp command example:

        #tpPG2wGMS018F

Inquire:
Control Position: R
Flag bit: GMS
Data bits: See Settings

5: Serial number reading (supported by some models)

5.1 Read

Control Position: R
Identification bit: VER
Data bits: 00
Read data: X0-X13 (14-bit characters)
Example of a uart command: #TPUG2rVER0054

5. Detailed explanation of Class D commands

1: Video recording

1.1 Control

Control Position: W
Identification bit: REC
Data bits: x1x2

x2	Function description
0	Stop it
1	Begin
A	State flip

Example of a uart command: #TPUD2wREC0A54
Feedback Commands:
    #tpDUAwREC11xxxxxxxxRR Start recording
    #tpDUAwREC00xxxxxxxxRR Stop recording
xxxxxxxx: Represents the index idx of the file, the character type hexadecimal number
Visible video naming convention: stream_0_idx.h264
Thermal imaging video naming convention: stream_1_idx.h264

1.2 Inquiry

Control Position: R
Identification bit: REC
Data bits: x1x2

x2	Description
0	Stop it
1	Begin

Example of a uart command: #TPUD2rREC003E

2: Take a photo

Control Position: W
Identification bit: CAP
Data bit: X1X2

x2	Description
1	Visible light + thermal imaging
2	Only visible light to take pictures
3	Single thermal imaging to take pictures
5	Visible light, thermal imaging, temperature measurement files

Example of the uart command: #TPUD2wCAP013E
Feedback command: #tpDUAwCAP11xxxxxxxxRR
xxxxxxxx: Represents the index idx of the file, the character type hexadecimal number
Visible photo naming rules :snap_0_idx.jpeg
Thermal imaging photo naming rules :snap_1_idx.jpeg
The naming rules for thermal imaging temperature measurement data :raw_idx.raw

3: Resolution

3.1 Settings

Control Position: W
Identification bit: VID
Data bits: x1x2

x1	Description	x2	Description
0	Video resolution	0	3840*2160
1	Photo resolution	1	1920*1080
2	RTSP resolution	2	1280*720
		3	640*480

Example of a uart command: #TPUD2wVID214F   Set the RTSP stream resolution to 1920*1080

3.2 Reading

Control Position: R
Identification bit: VID
Data bits: 00
Meaning of the data read:

x1	Description	x2	Description
0	Video resolution	0	3840*2160
1	Photo resolution	1	1920*1080
2	RTSP resolution	2	1280*720
		3	640*480

Example of a uart command: #TPUD2rVID0047

4: Bit rate

4.1 Setup

Control Position: W
Identification bit: BIT
Data bits: x1x2x3x4x5x6

x2	Description	x2	Description
1	1Mbps	5	5Mbps
2	2Mbps	6	6Mbps
3	3Mbps	7	7Mbps
4	4Mbps	8	8Mbps

Note: If the bitrate of stream=0 is set separately, x1 will fill in 0, and only X2 will be valid, which means the table as shown in the table

When x1='K', set the bit rate of stream=0 in kbps, and the value of x2x3x4x5x6 decimal is the bit rate to be set, and the unit is kb/s; The minimum value of 50kb/s is K00050

For example, K01234, which means that the set bit rate is 1234kb/s; #tpPD6wBITK012346C

4.2 Reading

Control Position: R
Identification bit: BIT
Data bits: 00
Meaning of the data read:

x1x2	Description	x1x2	Description
1	1Mbps	5	5Mbps
2	2Mbps	6	6Mbps
3	3Mbps	7	7Mbps
4	4Mbps	8	8Mbps

Example of a uart command: #TPUD2rBIT0043

5: Memory card capacity

Control Position: R
Identification bit: SDC
Data bits: x1x2

x1x2	Description	x1x2	Description
00	Get the remaining capacity	01	Get the total capacity

Example of a uart command: #TPUD2rSDC003E

Meaning of the read data: **x0x1x2x3x4**

Memory card remaining capacity (hex, bit first, unit MB)
NNNNN: Indicates that the memory card is not inserted

6: Flip the mirror

3.1 Settings

Control Position: W
Identification bit: ROT
Data bits: x1x2

x1x2	Description	x1x2	Description
00	0 degrees	02	180 degrees

Example of a uart command: #TPUD2wROT005E   Set the screen not to be flipped or mirrored

3.2 Reading

Control Position: R
Identification bit: ROT
Data bits: x1x2
Meaning of the data read:

x1x2	Description	x1x2	Description
00	0 degrees	02	180 degrees

Example of a uart command: #TPUD2rROT0059

7: Network Settings

IP	
cmd	**#tpUDDwIPV192.168.31.22D7**
Gateway	
cmd	**#tpUDCwGTW192.168.31.1A6**
Reset	
cmd	**#TPUD2wRST0163** **ip：192.168.144.108** **gateway:192.168.144.10**

8：GPS

8.1: Longitude

Control Position: W
Identification bit: LON
Meaning of data bits: The first bit of the data bit is E or W, followed by the GPS coordinates in degree format, the format is dddmm.mmmm (the first bit is zero will also be transmitted) (the same data format as $GPGGA);

8.2: Dimensions

Control Position: W
Identification bit: LAT
Meaning of data bit: The first bit of the data bit is N or S, followed by the GPS coordinates in degree format, and the format is ddmm.mmmm (the first bit is zero and will also be transmitted) (the same data format as $GPGGA);

8.3: Height

Control Position: W
Identification bit: ALT
Data bit meaning: -9999.9 to 9999.9 meters (same data format as $GPGGA).

8.4: Heading

Control Position: W
Identification bit: AZI
Data bit meaning: ground heading (000.0~359.9 degrees, using true north as the reference reference, the previous 0 will also be transmitted) (the same data format as $GPRMC).

8.5：GPS

Control Position: W
Identification bit: GPS
The command structure is as follows:
```
#pragma pack(1)
typedef struct
{
    char frameHead[3];        // '#tp'
    char srcAdd;                   // 'U'    // depends on the sending address
    char dstAdd;                 // 'D'
    char msgLen;                   // 'E'
    char controlFlag;        // 'w'
    char cmdKey[3];              // 'GPS'
    int16_t uavHeading;     Aircraft nose orientation (when the pod is installed, it
needs to be centered and the nose direction is heavier.)                          stacked,
if it does not overlap, the deviation value needs to be added, the deviation value is negative
on the left and positive on the right)
    int32_t gpsLongitude;           // GPSlongitude 10^-7° ; Range[-180, 180]
    int32_t gpsLatitude;            // GPSDimension 10^-7° ; Range[-90, 90]
    int32_t gpsAltitude;            // GPSheight 10^-3m ; Range[-500, 10000]
    char crc[2];
}sTPGpsInfo;
#pragma pack()
```

8.6: UAV attitude

Control Position: W
Identification bit: UAV
The command structure is as follows:

```
#pragma pack(1)
typedef struct
{
    char frameHead[3];           // '#tp'
    char srcAdd;                      // 'U'         //source address
    char dstAdd;                    // 'D'
    char msgLen;                      // 'A'
    char controlFlag;          // 'w'
    char cmdKey[3];                // 'UAV'
    int16_t uavYawAngle;    // UAV Yaw Angle 0.01degree   [0,36000]
    int16_t uavPitchAngle;  // UAV Pitch Angle 0.01degree [-9000, 9000], down >0
    int16_t uavRollAngle;   // UAV Roll Angle 0.01degree [-9000, 9000], right >0
    uint16_t uavSpeed;       // flight speed 0.01m/s [0, 20000]
    uint16_t uavFlightPathAngle; //UAV flight path Angle 0.01degree   [0,36000]
    char crc[2];
}sTPUavInfo;
#pragma pack()
```

8.7: Target Solution

Description: After receiving the longitude, latitude, altitude and heading data, the ranging version of the model can calculate the GPS coordinates of the target according to the attitude and ranging results of the pod, and output the longitude and latitude of the target, the output format is as follows:

Longitude: Control bit: w, Identification bit: LON, Data bit: 11 bytes of fixed-length data, Byte[0]: 'E' or 'W'

Byte[1]-byte[10]:d dd.dddddd (unit: degrees)

Latitude: Control bit: w, Identification bit: LAT, Data bit: 10 bytes fixed-length data, Byte[0]: 'N' or 'S'

Byte[1]-byte[9]:d d.dddddd (in degrees)

9: Ranging

Description: The ranging version of the model will automatically send out the measurement result after the measurement is successful;

Control Position: W

Identification bit: LRF

Data bits: $X_1X_2X_3X_4X_5$ X_6

$X_1X_2X_3X_4X_5$ Integer bits

X_6 decimal places

Accurate to 0.1m

Note 1: $X_1X_2X_3$ == ERR indicates measurement failure (usually too close or too far)

Note 2: The long-distance ranging version is a protection ranging module, and the following commands need to be sent to control the ranging function:

Control bit: w Destination address: M Identification bit: LRF

Data bits: 2 bits; 00 Distance Measurement Stop, 01 Distance Measurement Open, 02 Single Measurement, 03 Continuous Measurement (Transmit 00 Stop)

Example of a uart command: #TPUM2wLRF0258

10: Time

Beijing time:

Control Position: W

Identification bit: TIM

Data bit: YYYYMMDDHHMMSS

Note: The time command is 14 bits long, and the insufficient data bit is preceded by 0, and the decimal method is adopted

eg：char cmd[30] = "#tpPDEwTIM0000000000000000";
sprintf(cmd+10, "%04d", time.wYear);
sprintf(cmd+14, "%02d", time.wMonth);
sprintf(cmd+16, "%02d", time.wDay);
sprintf(cmd+18, "%02d", time.wHour);
sprintf(cmd+20, "%02d", time.wMinute);
sprintf(cmd+22, "%02d", time.wSecond);

UTC time:

Control Position: W

Identification bit: UTC

Data bit: HHMMSSDDMMYY (hours, minutes, seconds, days, months, years)

Note: The time command is 12 bits long, and the insufficient data bit is preceded by 0, and the decimal method is adopted

eg：char cmd[30] = "#tpPDCwUTC00000000000000";

11: Picture within a picture

11.1 Setup

Control Position: W
Identification bit: PIP
Data bit: X0X1

x	0	1	2	3	A	B
	m only	m+s	s+m	s only	Next	-

Note: When it is a dual visible light lens, x0/**x1 is effective,** M main camera, S secondary camera;

Example of a uart command: #TPUD2wPIP0A63

11.2 Reading

Control Position: R
Identification bit: PIP
Data bits: 00
Read data: X0X1 (see settings table for data meaning)
Example of the uart command: #TPUD2rPIP004D

12: Temperature measurement

12.1 Maximum temperature and center point temperature

#tpDPDwTMP XHXHXHYHYH THTHTHTH $T_{CTCTCTC}$ RR
XHXHXH High temperature point X coordinates[0,320]
YHYH High Temperature Point Y Coordinate[0,256]
THTHTHTH high temperature point temperature value, 0.01° C
TCTCTC center point temperature value, 0.01° C

12.2 Maximum temperature, minimum temperature, center point temperature

#tPDP16TMP XHXHXHYHYH THTHTHTH XLXLXLYLYL TLTLTLTL $T_{ATATATA}$ RR
XHXHXH High temperature point X coordinates[0.320]
YHYH High Temperature Point Y Coordinate[0,256]
THTHTHTH high temperature point temperature value, 0.1° C
XLXLXL Cryogenic Point X Coordinates[0.320]
YLYL Low Temperature Point Y Coordinate[0.256]
TLTLTLTL cryogenic point temperature value, 0.1° C
TATATATA Screen center point temperature, 0.1° C
Note: The frame length of this command does not match the frame format description and has not been modified yet

12.3 Point Temperature Measurement and Zone Temperature Measurement (supported by some models)

Send command format:
#tpPDArTMP XXX YYY WW HH RR
XXX: Upper left vertex X coordinate of the rectangular area [0,640]
YYY: Y coordinate of the upper left vertex of the rectangular area[0,512]
WW: Rectangular Area Width [0, 64]
HH: Rectangular area height [0,64]
Receive Command Format:
  #tpDPErTMP XXX YYY WW HH TTTT   RR

XXX: Upper left vertex X coordinate of the rectangular area [0,640]

YYY: Y coordinate of the upper left vertex of the rectangular area[0,512]

WW: Rectangular Area Width [0, 64]

HH: Rectangular area height [0,64]

TTTT: Average temperature value (0.01°C)

Note 1: When the width and height are 0, the point temperature is measured

Note 2: Only some models support point temperature measurement and area temperature measurement

12.4 Two-speed temperature measurement (supported by some models)

Control Position: W

Identification bit: TMR

Data bit: X0X1

X0X1:00 The first level temperature measurement is -20°C~150°C

X0X1:01 The second gear temperature measurement is -20°C~550°C

Example of the uart command: #tpUD2wTMR009C

udp command example: #tpPD2wTMR0097

Note 1: The first gear is the default temperature measurement when the power is turned on

13: False color

13.1 Setup

Control Position: W

Identification bit: IMG

Data bit: X0X1

X1X2	00	01	02	03	04	05	06	07	08	09	0A	0B
Description	White-hot	Lava	Iron red	Hot iron	Medical	Arctic	Rainbow 1	Rainbow 2	Paint red	Black fever	Next	Pre

Example of a uart command: #TPUD2wIMG0A57

13.2 Reading

Control Position: R

Identification bit: IMG

Data bits: 00

Read data: X0X1 (see settings table for data meaning)

Example of a uart command: #TPUD2rIMG0041

Note: Different models have different pseudo-colors due to different thermal imaging, and this pseudo-color list is for reference only

14: Digital zoom (supported on some models)

14.1 Setup

Control Position: W

Identification bit: DZM

Data bit: X0X1X2

X0	X1X2	X1X2	X1X2	X1X2	X1X2	X1X2	X1X2
0: Lord visible light, 1: Thermal imaging 2: If there is more than one visible light, it means a sub-visible	00-80 Directly change to a specified multiple (0.1)	0A Zoom In (0.5 per session)	0B Zoom Out (0.5 times)	0C Zoom In (Works with Stop 0E)	0D Zoom Out (Works with Stop 0E)	0E Zoom Stop	OF You can set a digital zoom magnification greater than 8.0x, and the last 3 bytes express the specific

light camera							multiplier.

Example of a uart command: #tpUD3wDZM00AD6 #tpUD3wDZM10AD7

(1) X0 Description

0: Represents the main visible light camera, when there is multiple visible light in the pod, if there is a zoom camera, the zoom camera   The image head is the main camera, and if the zoom camera is not present, the first prime camera is the main camera.

2: Indicates a secondary visible light camera.

(2) X1X2 is the description of 0F

The last 3 bytes are the specific digital zoom multiplier, because the minimum unit of the digital zoom multiple is 0.1 times.   So the digital zoom multiplier multiplied by 10 is the final multiple,

For example, the digital zoom you want to set is 6.1x, and the multiplier sent to the pod is 6.1 * 10 = 61. Put 61   Converted to a hexadecimal 0x3D, because 3 bytes represent the multiple of the digital zoom, which is not enough to make up for 0, so it finally becomes 0x03D

For example, for example, a user wants to set the digital zoom to 14x. Multiply by 10 to become 140, 140 converts to hexadecimal 0x8C, because 3 bytes represent the multiple of digital zoom, which is not enough to make up for 0, so it finally becomes 0x08C, and the final command sequence #tpPD6wDZM00F08C84

14.2 Read

Control Position: R
Identification bit: DZM
Data bits: 00
Read data: X0X1X2X3
X0X1 : Thermal Digital Zoom Increase (0.1)
X2X3 : Visible Digital Zoom Increase (0.1)
Example of a uart command: #TPUD2rDZM004F

15: Electronic transfog (supported by some models)

15.1 Setup

Control Position: W
Identification bit: DFG
Data bit: X0X1X2

X0	0	1	2
Control bit		Automatic	Manually
X1X2	Fog Penetration[0,255]		

Example command: #tpPD3wDFG232AD
Electronic mist manual mode with 0x32 intensity

15.2 Read

Control Position: R
Identification bit: DFG
Data bits: 00
Read data: X0X1X2 (see settings table for data meaning)
Example of a uart command: #TPPD2rDFG0030

16: Version number read

Table of contents

Wrong! No catalog item found.

Control Position: R
Identification bit: VSN
Data bits: 00
Read data: X0-X1 (2 digits)
UDP command example: #TPPD2rVSN0056

17: Coding method

17.1 Setup

Control Position: W
Identification bit: ENT
Data bits: x1x2

x1	Description	x2	Description
0	Stream=0	0	H264
1	Stream=1	1	H265
2	Main camera record		
3	Second camera record		

Example of a uart command: #TPUD2wENT0050   Set   the   stream=0   encoding
method to H264

Appendix 1: Identification bits

Identification bit	Description		Identification bit	Description
ZMC	ZOOM control		FCC	focus control
ZOM	Read the ZOOM location		FOC	Read the focus position
REC	Video		CAP	Take photos
ZFP	Set the zoom & focus position		ZMP	Magnification and zoom position
ROT	Flip the mirror		VID	resolution
SDC	Memory card capacity		BIT	Rtsp stream=0 stream bitrate
PTZ	Gimbal control		IRC	Switch between day and night
GAC	Gimbal posture		GAA	The gimbal posture actively transmits control
GSY	Gimbal heading axis speed control		GAY	Gimbal heading axis angular control
GSP	Gimbal pitch axis speed control		GAP	Gimbal pitch axis angle control
GSR	Gimbal roller axis speed control		GAR	Gimbal roller axis angle control
GSM	Gimbal heading & pitch axis joint speed control		GAM	Gimbal heading & pitch axis joint speed control
LON	Longitude		LAT	Dimensions
ALT	height		AZI	Heading
TMP	Temperature measurement		LRF	Ranging results
DZM	Thermal digital zoom		IMG	Thermal imaging pseudo-color
DFG	Electronic misting			

Appendix II:crc verification

```
/*-----------------------------------------
 * Add check to command
 * sizeof(cmd) >= len+2;
*/
unsigned char Add_TPCmd_Crc(unsigned char* cmd, unsigned char len){
    unsigned char i;
    unsigned char crc = 0;

    for(i=0; i<len; i++){
        crc += cmd[i];
    }
    sprintf(cmd+len, "%02X", crc);

    return crc;
}
```
eg：cmd[14] = {"#TPUD2wAWB01"};
The value of the generated CRC is 0x44

then the final command is a string: cmd[14] = {"#TPUD2wAWB0144"};