Topotek-HI-series-Protocol

（Version：V1.03）

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Revision

Data	Version	Descript	Writer
2019/08/31	B1	Initial version	Liang
2019/09/28	V1.0.1	Add gimbal control command	Liang
2019/10/22	V1.0.2	Modify speed mode protocol	Liang
2019/10/25	V1.0.3	Modify zoom、focus command	Liang
2020.04.22		English version	Cai

Catalog

1. Introduction

This tele-com protocols is based on HI series optical zoom gimbal system，include HI20S90, HI20S77,HI20S85,SIIP30SQ6, WPD30Q6.

2. Command Format

1：Frame Structure

12 to 27 char

Frame Head (3char)	Target Bit (2char)	Data Length (1char)	Control Bit (1char)	Identify Bit (3char)	Data1 (char)	。。。。 (char)	Data L (char)	Correlation Bit (2char)
#TP	U/M/D/E/P/G	L	w/r	X1X2X3	D1	。。。。	DL	CRC

Frame Head:

#TP - data length is 2 byte, fixed length command;

#tp - various length command, data length depends on length bit, the maximum length is 0x0F;

Target Bit：（source address, target address）

U	M	D	E	G
Uart	lens	ISP image	Auxiliary equipment	Gimbal

U：UART device address bit, that is, the external control module address is u when the external control module is controlled through the serial port；

M: Zoom lens address bit, the command to lens, such as : zoom， focus;

D：ISP processor address, such as record, photo, TF status ,and so on ;

E：Auxiliary equipment address, such as thermal camera, laser measure(LRF);

G：Gimbal address, such as pitch, yaw control, angle reading；

P：Network terminal address, for example, if the PC passes through the network control equipment, the address of the PC is P；

[Target] same as above;

[Data Length] depends on how many data we have, the maximum length is F;

[Control bit] r->query; w->setup; c->callback

[Data1] data;

[Identifier] to be used for identifying; (see about Appendix I）

[CRC] all converted to HEX except the head. Use accumulation to add up, then convert result to ASC-II, 2 chars, high bit is in front; see attachment in the last page. （see about Appendix II）

Serial Port setting:

Baud Rate :115200， data length is 8, stop bit is 1, CRC is none.

Network settings:

Video stream (RTSP by TCP)
Main stream URL: RTSP: / / 192.168.31.20:554 / stream = 0
Sub stream URL: RTSP: / / 192.168.31.20:554 / stream = 1
Note: IP is based on device settings
Control (UDP)
IP: device IP;
Port：9003；

2：Response

(1) correct command:
Control command: echo the same as before, exchange source address and destination;
Query command: put query content in frame Data Bit to echo, exchange source address and destination;
(2) wrong command：
Command failed：#TP dd 2wERE!! RR
Example: #TPMU2wERE!!30
Exchange source address and destination

3. M command

1：ZOOM

1.1 Control

Control bit：w

Identify Bit：ZMC

Data bit：

00	stop
01	zoom in
02	zoom out

Note: zoom in/out shall be used together with stop commands

Uart command example：

#TPUM2wZMC005C stop
#TPUM2wZMC015D zoom in
#TPUM2wZMC025E zoom out

1.2 Reading

Control bit：w

Identify Bit：ZMC

Data bit：00

Uart command example：

send：#TPUM2rZOM0063

receive：#tpMU4rZOM Z0Z1Z2Z3 RR

Z0Z1Z2Z3：use four chars to represent signed char zoom location, high bit is in front;

eg：#tpMU4rZOMFFB447

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

Note that zoom location is -76

2：FOCUS

2.1 Control

Control bit：w

Identify Bit：FCC

Data bit：X_0X_1

X_0X_1	
00	stop
01	focus +
02	focus -
10	Auto mode（To be added）
11	Manual mode（To be added）
12	Keying mode（To be added）
20	Trigger one focus（To be added）

Note: focus in/out shall be used together with stop commands

Uart command example：

#TPUM2wFCC003E stop
#TPUM2wFCC013F focus+
#TPUM2wFCC0240 focus-

2.2 Reading

Control bit：w
Identify Bit：FCC
Data bit：00
Uart command example：
send：#TPUM2rFOC0045
receive：#tpMU2rFOC　F0F1F2F3 RR

F0F1F2F3：use four chars to represent signed char zoom location, high bit is in front;
eg：#tpMU4rFOCFFB429
F0F1F2F3 = FFB4(char) -> FFB4(Hex) ->-76
Note that zoom location is -76

3：configure zoom and focus position

Control bit：w
Identify Bit：ZFP
Data bit：Z0Z1Z2Z3 F0F1F2F3

Z0Z1Z2Z3：use four chars to represent signed char zoom location, high bit is in front;
Z0Z1Z2Z3：use four chars to represent signed char focus location, high bit is in front;

Example：set zoom position as -76，focus position as 50，convert -76 and 50 to complement form FFB4 and 0032. Then convert them to be 'F''F''B''4' and '0''0''3''2'; Add frame head、address、frame length、commands and CRC. Finally name it as #tpUM8wZFPFFB400320F.

Note: If only set zoom position, focus value should be filled with 'N''N''N''N'；and the camera will autofocus after setting.

4：IRCUT switch(day/night switch)

Control bit：w
Identify Bit：IRC
Data bit：x_1x_2

00	Day mode
01	Night mode
0A	Reverse status

Uart command example：#TPUM2wIRC0A61

5：Remote device turn on（need customized）

Control bit：w
Identify Bit：SWH
Data bit：X_0X_1

X_0	5	C
	Laser measure, PM2.5 detector	Thermal camera, laser zoom light
X_1	0	1
	Close	Open

Uart command send example：#TPUM2wSWHC178
Control bit：r
Identify Bit：SWH
Data bit：X_0X_1

Send	#TPUM2rSWH005F	
Receive	#TPUM2rSWH X0X1 RR	
X_0	5	C
	Laser measure, PM2.5 detector	Thermal camera, laser zoom light
X_1	0	1
	Close	Open

6：Camera preset（need customized）

Camera_Zoom_Reserved	
Cmd	#tpUM 4 w CZR $X_0X_1X_2X_3$ RR

Eg:#tpUM4wCZR000A14

X0 refers to the preset bit, x1x2x3 refers to the zoom value, the data bit is 10 times of the camera zoom, the camera magnification range is 0 ~ 36.0, the maximum of all data bits is 0 ~ 360, and the corresponding Hex is 0x0000 ~ 0x0168

Camera preset reading **#tpUM4rCZR$X_0$000FE**

X0 is the preset bit (starting from 1)

4. G command

1： Gimbal /PTZ control

Control bit：w
Identify Bit：PTZ
Data bit：x1x2

x1x2	00	01	02	03	04	05
Func	stop	up	down	left	right	Goto Center position
x1x2	06	07	08	09		
Func	Follow	Lock	Lock/follow switch	Gimbal calibration		

Uart command example：#TPUG2wPTZ006A

2：Gimbal speed mode control

Control bit：w
Identify Bit：GSY、GSP、GSR、GSM
Data bit：x1x2

Gimbal_speed_Control	
YAW Cmd	#TPUG 2 w GSY X0X1 RR
	X0X1
	Rotation Speed（-99,99）(0.1deg/s)
PITCH Cmd	#TPUG 2 w GSP X0X1 RR
	X0X1
	Rotation Speed（-99,+99）(0.1deg/s)
ROLL Cmd	#TPUG 2 w GSR X0X1 RR
	X0X1
	Rotation Speed（-99,+99）(0.1deg/s)
Yaw&Pitch	#tpUG 4 w GSM Y0Y1 P0P1 RR
	Y0Y1 P0P1
	Rotation Speed（-99,99）(0.1deg/s)

#TPUG2wGSYE276

Gimbal rotation speed is X0X where X0X1 is 8 signed char（unit is 0.1degree/s），The right direction of Yaw is positive. The up of Pitch is positive. E.g. gimbal rotates at speed 3 degree/sec to left, we have to convert -30 to 0xE2, then further converted to ’E’、’2’. Noe that RR is calibration.

3：Gimbal Angle Control Mode

3.1 Gimbal_Angle_Control

Control bit：w
Identify Bit：GAY、GAP、GAR、GAM
Data bit：see below

Gimbal_Angle_Control		
Yaw	#tpUG 6 w GAY X0X1X2X3 X4X5 RR	
	X0X1X2X3	X4X5
	Angle （-150.00,150.00）	Rotation Speed is (0,99) with precision (0.1deg/s)
Pitch	#tpUG 6 w GAP X0X1X2X3 X4X5 RR	

	X0X1X2X3	X4X5
	Angle （-90.00,+90.00）	Rotation Speed is (0,99) with precision (0.1deg/s)
Roll	#tpUG 6 w GAR X0X1X2X3 X4X5 RR	
	X0X1X2X3	X4X5
	Angle （-90.00,+90.00）	Rotation Speed is (0,99) with precision (0.1deg/s)
Yaw&Pitch	#tpUG C w GAM Y0Y1Y2Y3 Y4Y5 P0P1P2P3 P4P5 RR	
	Y0Y1Y2Y3 / P0P1P2P3	Y4Y5 / P4P5
	Angle（-150.00,150.00）/（-90.00,+90.00）	Rotation Speed is (0,99) with precision (0.1deg/s)

Example:#tpUG6wGAYEF073288

Gimbal rotates at speed of X4X5. X0X1X2X3 indicates angle. They are using 16 bits data to represent string. The right-side of Yaw is positive, the up-side of Pitch is positive. E.g. Angle is -50 degree. We have to use -5000, then convert it to be 16 bit binary number 0xEC78, then further convert it to be 'E'、'C'、'7'、'8'. X4X5 ； Note that RR is calibration.

3.2 Get Gimbal Current Angle

Control bit：r

Identify Bit：GAC

Data bit：00

Uart command example：

send：#TPUG2rGAC0032

receive：#tpUG C r GAC Y0Y1Y2Y3P0P1P2P3R0R1R2R3 CC

Y0Y1Y2Y3	P0P1P2P3	R0R1R2R3
Yaw Angle	Pitch Angle	Roll Angle

Angle is 16 bit binary data. High bit is in front.

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

3.3 Gimbal angle info send out regularly

Gimbal angle info send out regularly Setting ：

Control bit：w

Identify Bit：GAA

Data bit：X0X1

X0X1	
01	Enable sending
00	Close sending

Uart command example：#TPUG2wGAA0136

Inquiry the regularly sending status：

Control bit：r

Identify Bit：GAA

Data bit：00

receive:	#TPGU2rGAA x1x2 RR
00	Close
01	enable

Uart command example：#TPUG2rGAA0030

4：Tracking Cursor movement（Not support）

4.1 x axis moving

Control bit：w
Identify Bit：SYC
Data bit：$X_0X_1X_2X_3$

4.1 Y axis moving

Control bit：w
Identify Bit：SPC
Data bit：X0X1X2X3

Control the crosshairs to move to x0x1x2x3; x0x1x2x3 indicates the number of pixels deviating from the center point, the 16 bit signed number represented by the character (unit: pixel), the right of X axis is positive, and the lower of Y axis is positive (eg: move to the position of 50 pixels on the left, i.e., convert - 50 hex representation 0xffce to 'f', 'f', 'C', 'e'); RR check bit

Note：Initially, any movement of the transmit cursor will result in a Crosshairs；

5：Tracking control（Not support）

Control bit：w
Identify Bit：SUM
Data bit：X_0X_1

X_0X_1	
00	Tracking stop
01	Tracking confirm
02	Secondary tracking (reselect target during existing tracking)

#TPUG2wSUM0061 Tracking stop
#TPUG2wSUM0162 Tracking confirm
#TPUG2wSUM0263 Secondary tracking

Note: if the crosshairs do not appear, the tracking confirmation will be sent directly, and the center point will be the target;

6: Gimbal preset mode contro（Not support）

Gimbal_Angle_Reserved_Set	
Cmd	#tpUG A w GAR X0X1 X2X3X4X5X6X7X8X9 RR

Eg:#tpUG5wGPE1B4B448

X0x1 is identified as the preset bit. X2x3x4x5 is the YAW angle (- 150, + 150), x6x7x8x9 is the Pitch angle (- 110, + 110).

Gimbal_Angle_Reserved_Read			
Send	#TPUG 2 r GAR X_0X_1 RR		
	X_0X_1	00	其他
	Description	Get all preset value	Return the preset value
Receive	#tpGU A GAR X_0X_1 $X_2X_3X_4X_5X_6X_7X_8X_9$ RR		
	X_0X_1	Preset No	
	$X_2X_3X_4X_5$	Angle of YAW	
	$X_6X_7X_8X_9$	Angle of Pitch	

Gimbal_Angle_Reserved_Call		
Send	#TPUG 2 c GAR X_0X_1 RR	
	X_0X_1	Preset No

5. D command

1：Record

1.1 control

Control bit：w
Identify Bit：REC
Data bit：x_1x_2

x_1x_2	Function description
00	Stop record
01	Start record
0A	Overturn status

Uart command example：#TPUD2wREC0A54

1.2 inquiry status

Control bit：r
Identify Bit：REC
Data bit：x_1x_2

X_2	0	1
description	No record	Being record

Uart command example：#TPUD2rREC003E

2：Photograph

Control bit：w
Identify Bit：CAP
Data bit：0 1
Uart command example：#TPUD2wCAP013E

3： Resolution of video and photo

Setting
Control bit：w
Identify Bit：VID
Data bit：X_0X_1

x_1	Description	x_2	Description
0	Video resolution	0	3840*2160
1	Photo resolution	1	1920*1080
2	RTSP resolution	2	1280*720
		3	640*480

Uart command example：#TPUD2wVID214F Set the RTSP stream resolution to 1920*1080

Reading
Control bit：r
Identify Bit：VID
Data bit：00
Data return: X_0X_1
Return data meaning：

x_1	Description	x_2	Description
0	Video resolution	0	3840*2160
1	Photo resolution	1	1920*1080
2	RTSP resolution	2	1280*720
		3	640*480

Uart command example：#TPUD2rVID0047

4：Stream rate

Setting:

Control bit：w
Identify Bit：BIT
Data bit：x_1x_2

x_1x_2	Description	x_1x_2	Description
00	1024	04	5120
01	2048	05	6144
02	3072	06	7168
03	4096	07	8192

Uart command example：#TPUD2wBIT034B setting RTSP stream rate to 4096kbps

Reading:

Control bit：r
Identify Bit：BIT
Data bit：00
Return data meaning：

x_1x_2	Description	x_1x_2	Description
00	1024	04	5120
01	2048	05	6144
02	3072	06	7168
03	4096	07	8192

Uart command example：#TPUD2rBIT0043

5：TF card capacity

Control bit：r
Identify Bit：SDC
Data bit：x_1x_2

x_1x_2	Description	x_1x_2	Description
00	Get remaining capacity	01	Get total capacity

Uart command example：#TPUD2rSDC003E

Data meaning read：**$X_0X_1X_2X_3X_4$**
Remaining capacity of TF card（Hexadecimal, big Endian, in MB）
NNNNN：Indicates that the TF card is not inserted

6：Flip mirror

Setting:

Control bit：w
Identify Bit：ROT
Data bit：x_1x_2

x_1x_2	Description	x_1x_2	Description

00	Normal	02	Mirror
01	Flip	03	Flip and mirror

Uart command example：#TPUD2wROT005E setting the screen normal, no flip, no mirror

Reading:

Control bit：r
Identify Bit：ROT
Data bit：x_1x_2
Return data meaning：

x_1x_2	Description	x_1x_2	Description
00	Normal	02	Mirror
01	Flip	03	Flip and mirror

Uart command example：#TPUD2rROT0059

6: Tracking control（Not support）

Control bit：w
Identify Bit：TRC
Data bit：x_0x_1

x_0x_1	**00**	**0A**
	Stop	Adaptive to state

Uart command example：#TPUD2wTRC0153

6. E command

1：Thermal camera

1.1 Pseudo color

Setting

Control bit：w

Identify Bit：IMG

Data bit：X_0X_1

X_1X_2	00	01	02	03	04	05	06	07	08	09	0A	0B
descript	White/black	White/black/high tmp red	Red hot	Yellow hot outline	Yellow hot	color 4	color5	color6	color7	color8	Next	Pre

Uart command example：#TPUE2wIMG0A58

Reading

Control bit：r

Identify Bit：IMG

Data bit：00

Data return: X_0X_1（See setting table for data meaning）

Uart command example：#TPUE2rIMG0042

1.2 Digital zoom

Setting

Control bit：w

Identify Bit：DZM

Data bit：X_0X_1

X_0X_1	01	02	03	04	0A	0B
	1x	2x	3x	4x	Zoom+	Zoom-

Uart command example：#TPUE2wDZM0AF5

Reading

Control bit：r

Identify Bit：DZM

Data bit：00

Data return: X_0X_1（See setting table for data meaning）

Uart command example：#TPUE2rDZMF0

1.3 Record

Control bit：w

Identify Bit：REC

Data bit：X_0X_1

X_0X_1	00	01	0A
Record status	Stop	Start	Overturn

1.4 Photograph

Control bit：w

Identify Bit：CAP

Data bit：X_0X_1

X_0X_1	01	02	03
Photo type	raw	HVT	jpeg

2：Laser range finder

Appendix I：Identify Bit

Identify Bit	Description		Identify Bit	Description
ZMC	ZOOM control		REC	Record
FCC	Focus control		CAP	Photograph
ZFP	Setting zoom& focus position		IRC	IR cut switch
PTZ	Gimbal control (PTZ)		MNU	Menu
GAC	Gimbal angle status		GAA	Gimbal angle send out regularly
GSY	Speed control of YAW axis of PTZ		GAY	Angle control of YAW axis of PTZ
GSP	Speed control of Pitch axis of PTZ		GAP	Angle control of Pitch axis of PTZ
GSR	Speed control of Roll axis of PTZ		GAR	Angle control of Roll axis of PTZ
GSM	Speed control of YAW& Pitch axis of PTZ		GAM	Angle control of YAW& Pitch axis of PTZ
SDC	TF card capacity		AWB	Auto white balance
ISO	Photo sensibility		EVS	Exposure compensation
LAT	latitude		ALT	height
LON	longitude		TIM	Time

Appendix II：CRC calculation

```
char CalculateCrc(volatile char *cmd, char len){
    char crc;
    int i;

    crc=0;
    for(i=0; i<len; i++){
        crc += cmd[i];
    }
    return(crc);
}
```

To convert the generated hex to two characters:
eg：#TPUD2wAWB01
The value of the generated CRC is 0x44
Then the final command is a string：#TPUD2wAWB0144

If the product version needs to be upgraded or the functions are required to be changed, please feel free to contact us for further technical support.

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