V-1.1-2019.09.18

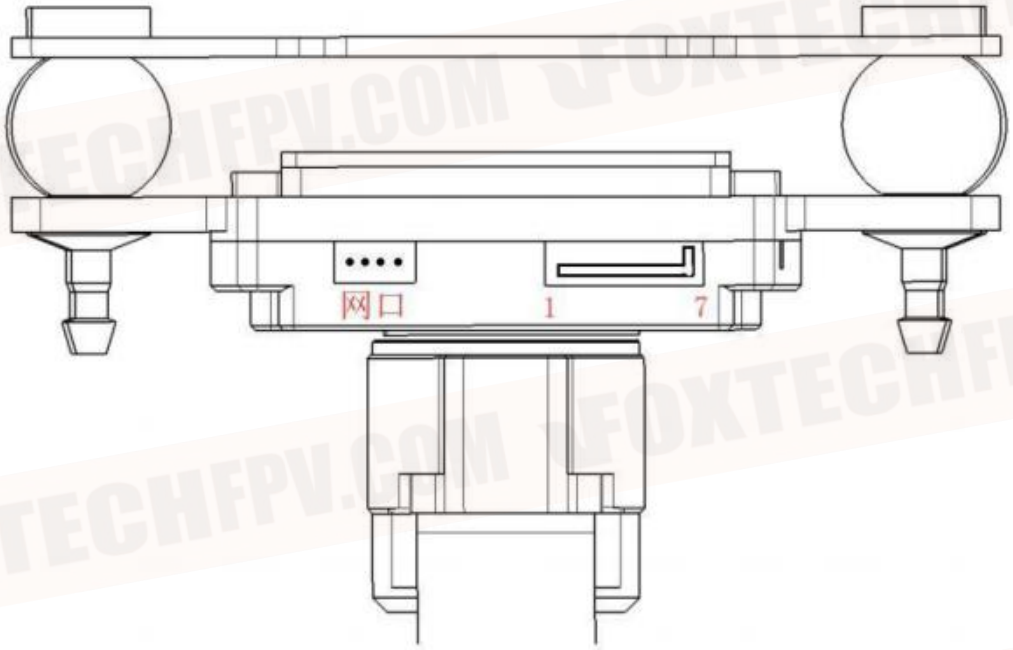
Chapter I Hardware Interface and Function Description

1.1 IDU Hardware Interface Diagram

CAN connector type SATA 7P

CAN、serial port sequence

Number	1	2	3	4	5	6	7
Name	CAN L-	CAN H+	/	/	USART RX	USART TX	DRND



1.2 Function Description

Hardware Interface	Function	Remarks
RJ45	1.access to camera, get video streaming	Camera IP: 192.168.42.108
	2.access to serial server, control gimbal	Serial Server IP: 192.168.42.200

	3.access to other serial devices (connecting to serial ports)	Port Number: 2000	
USART	Serial port of serial server can be accessed via TCP	Baud rate: 115200	
CAN (1M/S)	1.Control gimbal	CAN ID: 0x00000F01	
	2.Information postback	CAN ID: 0x030F0001	
	3.Receive drone information	GPS	CAN ID: 0x0000FF15
		H	CAN ID: 0x0000FF16
		θ	CAN ID: 0x0000FF13
	4. Other information written (ASCII code)	Start	CAN ID: 0x02008201
		End	CAN ID: 0x02008202
USB	Firmware upgrade, gimbal calibration		

1.3 Video Streaming Address

Gimbal Type	Code Stream	Address
A2000		rtsp：//<IP>: live 554/ Example: rtsp：//192.168.42.108：554/live
X3、argus Series	Maincode stream	rtsp://admin:admin@<IP>:554/cam/realmonitor?channel=1&subtype=0
	Auxiliary code stream 1	rtsp://admin:admin@<IP>:554/cam/realmonitor?channel=1&subtype=1
	Auxiliary code stream 2	rtsp://admin:admin@<IP>:554/cam/realmonitor?channel=1&subtype=2
Dual Light Series	Main code stream	rtsp://admin:admin@<IP>:554/cam/realmonitor?channel=1&subtype=0
	Auxiliary code stream 1	rtsp://admin:admin@<IP>:554/cam/realmonitor?channel=1&subtype=1
	Infrared code stream	rtsp://admin:admin@<IP>:554/cam/realmonitor?channel=1&subtype=2
F10		rtsp：//<IP>: 554/ch1/sub/av_stream

Chapter II CAN Protocol

CAN baud rate: 1 M/S; Use extended frame ID; Message length =8

2.1 Gimbal Control

CAN ID: 0x00000F01

S_ID	CMD	DATA1	DATA2	DATA3	DATA4	DATA5	DATA6

Periphera Name	CMD(1 bytes)	DATA(6 bytes)
Gimbal 0x0F	0x01: Pointing zoom	Byte1-2: Lateral distance off image center,[- 10000, 10000] Byte3-4: Vertical distance off image center,[-10000, 10000]
	0x02: Nose-following	
	0x03: One-click back to center	
	0x04: Gimbal operation	Byte1-2: Heading Speed (deg/s)*100, [-10000, 10000] Byte3-4: Pitch Speed (deg/s)*100, [-10000, 10000]
	0x05: Start tracking	Byte1-2: Horizontal axis of the box center point [0, 8191] 1 Low 2 High Byte3-4: Longitudinal axis of the box center point [0, 8191] 3 Low 4 High Byte5: length(X)/16 Byte6: Width (Y)/16 Note: Coordinate of the upper left corner of the screen (0, 0) bottom right corner (8191, 8191)
	0x06: Stop tracking	
	0x07: One-click down 90 degrees	
	0x08: Specify angle	Byte1: control type 1, 2, 3 Byte1=1: Byte2-3: Gimbal heading angle*10 [0, 3600] 2 Low 3High; Byte1=2: Byte2-3: Gimbal pitch angle*10[-1000, 600] 2 Low 3 High; Byte1=3： Byte2-3: Camera multiple*100[100, 3000(3500)] 2 Low 3 High
	0x10: Core photograph	Byte1: 0x01: Take a picture 0x02: continuous shooting 0x03: Time-lapse photograph 0x04: Timing photograph 0x05: Stop photographing Byte2： If Byte1= 0x02, Byte2= number of continuous shooting

		If Byte1= 0x03, Byte2= Delay time (s) If Byte1= 0x04, Byte2= Timing time (s)
	0x11: Core video	Byte1=1: Start recording Byte1=2: Stop recording
	0x12: Core zoom	Byte1=1: Zoom in continuously Byte1=2: Zoom out continuously Byte1=3: Stop zoom Byte1=4: ZOOM=1 Byte1=5: Zoom in 2 times Byte1=6: Zoom out 2 times
	0x13: Core focus	Byte1=1: Focus + Byte1=2: Focus - Byte1=3: Stop focus Byte1=4: Auto-focus
	0x14: Pointing focus	Byte1-2: Horizontal axis of the box center point [0, 8191] 1 Low 2 High Byte3-4: Longitudinal axis of the box center point [0, 8191] 3 Low 4 High Byte5: 25 Byte6: 25 Note: Coordinate of the upper left corner of the screen (0,0) bottom right corner (8191,8191)
0x0F	0xF0: Fast calibration	
0x1F	0x12: Dual light electronic zooming	Byte1=1: Zoom in continuously Byte1=2: Zoom out continuously Byte1=3: Stop zoom
0x1F	0x04: Gimbal operation (dual light)	Byte1-2: Heading Speed (deg/s)*100, [-10000, 10000] Byte3-4: Pitch Speed (deg/s)*100, [-10000, 10000]
0x1F	0x05: Start tracking (dual light)	Byte1-2: Horizontal axis of the box center point [0, 8191] 1 Low 2 High Byte3-4: Longitudinal axis of the box center point [0, 8191] 3 Low 4 High Byte5: length(X)/16 Byte6: Width (Y)/16 Note: Coordinate of the upper left corner of the screen (0, 0) bottom right corner (8191, 8191)
0x1F	0x07: Stop tracking (dual light)	
0x1F	0x01: Pointing zoom (dual light)	Byte1-2：Lateral distance off image center(%), [-10000, 10000]

		Byte3-4：Vertical distance off image center(%), [-10000, 10000]
0x1F	0x02：Image effect selection (dual light)	Byte1: pp Thermal image: pp=0 black hot pp=1 white hot pp=2 iron red pp=3 rainbow pp=4 lava pp=5 rainbow enhancement pp=6 molten metal pp=7 bluish red pp=8 amber pp=9 amber inversion pp=a ice blue pp=b high contrast pp=c grayscale inversion pp=d high-temperature red pp=e low-temperature blue

2.2.1 Examples

0x01: Pointing zoom

The ground station sends the position of the "target" to gimbal, and the gimbal transfers the "target" to the center of the screen and amplifies it twice. The position of the "target" shall be converted to the coordinates of horizontal and longitudinal axis [-1000010000] .

Coordinate axis: upper left (-10000, -10000); bottom right (100000, 10000)

0x04: Gimbal Operation

Send the command continuously, and the gimbal can rotate continuously. It is recommended to 50ms once. Stop sending the command, and the gimbal can stop the rotation.

0x05: Start tracking

The ground station sends the center point position, length and width of the target box to the gimbal, that is to turn on the target tracking.

Coordinate axis: upper left (0, 0); bottom right (8191, 8191)

0x08: Specify angle

Heading angle instruction,

when the flight control attitude is connected, it is the angle relative to the north direction.

when the flight control attitude is not connected, it is the angle relative to the nose direction.

Several common frame format are given as follows:

Function	Details	CANDATA (HEX)							
0x02 Nose-following		*0F*	*02*	*00*	*00*	*00*	*00*	*00*	*00*
0x04 Gimbal operation	Left 5°/ S	*0F*	*04*	*0C*	*FE*	*00*	*00*	*00*	*00*
	Up 5°/ S	*0F*	*04*	*00*	*00*	*F4*	*01*	*00*	*00*
0x08 Specify angle	Heading angle: 45	*0F*	*08*	*01*	*C2*	*01*	*00*	*00*	*00*
	Pitch angle: -45	*0F*	*08*	*02*	*3E*	*FE*	*00*	*00*	*00*
	Multiple: 10	*0F*	*08*	*03*	*E8*	*03*	*00*	*00*	*00*
0x10: Core photograph	Single shot	*0F*	*10*	*01*	*00*	*00*	*00*	*00*	*00*
0x11: Video	Start recording	*0F*	*11*	*01*	*00*	*00*	*00*	*00*	*00*

2.2 Information Postback

The information is sent back by CAN in four frames. Send one full frame per 500 ms. The full frame protocol is as follows:

Data	Content	Length (bytes)	Remarks
0	Head	2	0xEB 0x90
2	length	1	0x0C
3	....	9	0x00
12	CMD+DID	2	0x210xFE
14	C_ID	1	Equipment ID 0x0F
15	Data_id	1	0x01
16	g_type	1	Gimbal Type (see Note 1 for details)
17	trace_flag	1	Whether it is tracking
18	control_mode	1	Control mode (see Note 2 for details)
19	theta	2	Pitch angle *100 Scope :[-11000, 6000] Lower position first (the same below)
21	psi	2	Heading angle*100 (geomagnetism) Scope: [0,36000]
23	Motor_psi	2	Heading motor*100 Scope :[-17000,17000] /(3.5 times) [-32500, 32500]

25	Crc	2	Check code, Note 3
27---31	0x00	5	Note 4

Note 1:

Gimbal Type:

01: X30/X30GT

02: X30T

03: 3.5 times

04: 3.5x dual light

05: Laser ranging

06: A2000

07:30x dual light

Note 2:

1: Full Lock (controllable speed) 2: Heading Follow 3: Lock (controllable angle)

Note 3:

```
        uint16_t wCRC_Table[] =
{
    0x0000, 0xCC01, 0xD801, 0x1400, 0xF001, 0x3C00, 0x2800, 0xE401,
    0xA001, 0x6C00, 0x7800, 0xB401, 0x5000, 0x9C01, 0x8801, 0x4400
};

        uint16_t crc_fly16(u8 *pBuffer, uint16_t length) {
    uint16_t len = length;
    uint16_t tmp;
    uint16_t crcTmp;
    crcTmp = 0xFFFF;
    while (length-- > 0) {
        //crc_accumulate(*pBuffer++, &crcTmp);
        tmp = wCRC_Table[(pBuffer[len-length-1] ^ crcTmp) & 15] ^ (crcTmp >> 4);
        crcTmp = wCRC_Table[((pBuffer[len-length-1] >> 4) ^ tmp) & 15] ^ (tmp >> 4);
}
  return (crcTmp);
}
```

Note 4:

Gimbal uses CAN to send the protocol data. CAN sends 8 valid bytes each time. So message length less than multiple of 8 will be padded with 0.

2.3 Access to Flight Control Information

2.3.1 GPS

Category		Content	Remarks
ID		0x0000FF15	sender 0x00, receiver 0xFF, frame number 0x15
Length		0x08	Longitude and latitude
Data	Data[0]	pos_lat	Latitude ,*1e7deg, s32
	Data[1]	pos_lat>>8	
	Data[2]	pos_lat>>16	
	Data[3]	pos_lat>>24	
	Data[4]	pos_lng	Fusion longitude ,*1e7deg, s32
	Data[5]	pos_lng>>8	
	Data[6]	pos_lng>>16	
	Data[7]	pos_lng>>24	

2.3.2 Flight Altitude

Category		Content	Remarks
ID		0x0000FF16	sender 0x00, receiver 0xFF, frame number 0x16
Length		0x08	Altitude
Data	Data[0]	H	Altitude *100, s32
	Data[1]	H>>8	
	Data[2]	H>>16	
	Data[3]	H>>24	

2.3.3 Drone Attitude Angle

Category		Content	Remarks
ID		0x0000FF13	sender 0x00, receiver 0xFF, frame number 0x13
Length		0x08	drone attitude angle
Data	Data[0]	Pitch angle	*100，s16
	Data[1]		
	Data[2]	Roll angle	*100，s16
	Data[3]		
	Data[4]	Heading angle	*100，s16

	Data[5]		
	Data[6]		
	Data[7]		

2.4 Other Information Written

Category		Content	Remarks
ID		0x02008201	0x02008202
Length		0x08	Information send frame
Data	Data[0]	ASCII code	Information written ID starts with 0x02008201, 8 bytes per frame, Inbetween ID also is 0x02008201, and end frame ID is 0x02008202.
	Data[1]		
	Data[2]		
	Data[3]		
	Data[4]		
	Data[5]		
	Data[6]		
	Data[7]		

Chapter III TCP Protocol

This protocol is used by TCP, accessing to the serial server to control gimbal.

HEAD+CANDATA+CRC

0xEB	0x90	0x0A	0x00	0x00	0x00	0x00	0x00	0x00	0x00
0x00	0x00	0x40	0x88	Can0	Can1	Can2	Can3	Can4	Can5
Can6	Can7	CRC							

CANDATA 14-21：See CAN protocol —2.1 Gimbal control for details

CRC 22-23: From EB90 to CAN7, See CAN protocol —2.2 Information postback for details

The "one-click down 90 degrees" TCP protocol frame format:

EB 90 0A 00 00 00 00 00 00 00 00 00 40 88 0F 07 00 00 00 00 00 00 68 5e