# Gimbal Interface Definition and Protocols
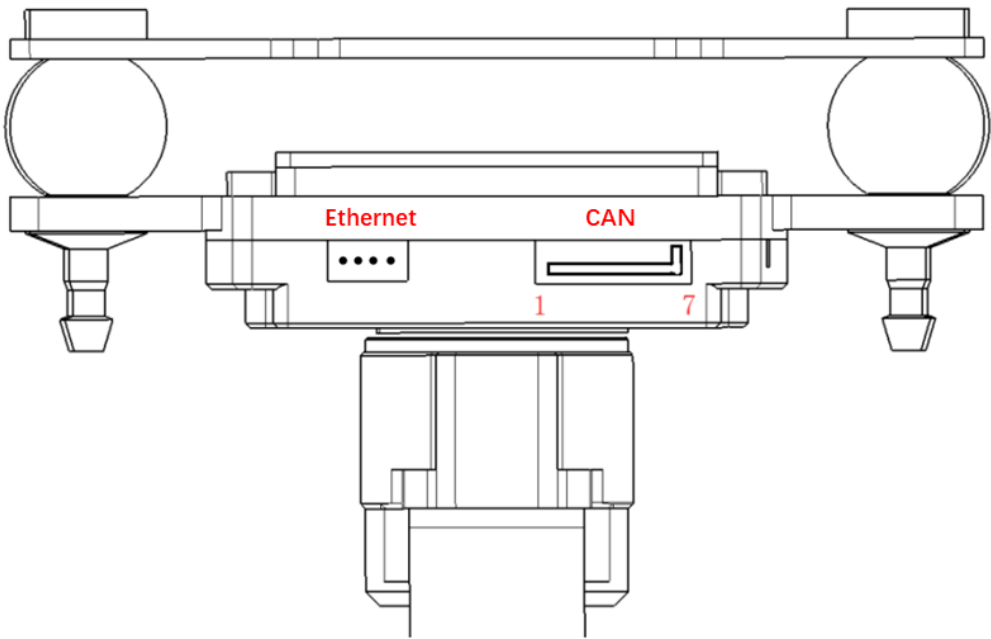
## Chapter 1 Physical Interface and Functional Description

### 1.1 IDU Physical Interface Diagram

CAN interface standard: SATA 7Pin

CAN Functional definition

| No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|------|--------|--------|------|------|----------|----------|-----|
| Name | CAN L- | CAN H+ | null | null | USART RX | USART TX | GND |



### 1.2 Description

| Physical Interface | Description | Remark | |
|---|---|---|---|
| Ethernet | 1.Login camera web GUI, Get video streaming | Camera IP: 192.168.42.108 | |
| | 2.Control gimbal | IDU Board IP:192.168.42.200    Port：2000 | |
| CAN | 1.Control gimbal | CAN ID:    0x00000F01 | |
| | 2.Gimbal feedback | CAN ID:    0x030F0001 | |
| (1M/S) | 3.Receive UAV/Drone status information | GPS | CAN ID:    0x0000FF15 |

| | | H | CAN ID: 0x0000FF16 |
| | | θ | CAN ID: 0x0000FF13 |

## 1.3 Video Streaming Address

| Type | Stream | Address |
|---|---|---|
| Optical Series | Main | rtsp://admin:admin@<IP>:554/cam/realmonitor?channel=1&subtype=0 |
| | Sub 1 | rtsp://admin:admin@<IP>:554/cam/realmonitor?channel=1&subtype=1 |
| | Sub 2 | rtsp://admin:admin@<IP>:554/cam/realmonitor?channel=1&subtype=2 |
| Dual-Sensor Series | Main | rtsp://admin:admin@<IP>:554/cam/realmonitor?channel=1&subtype=0 |
| | Sub 1 | rtsp://admin:admin@<IP>:554/cam/realmonitor?channel=1&subtype=1 |
| | Thermal | rtsp://admin:admin@<IP>:554/cam/realmonitor?channel=1&subtype=2 |

# Chapter 2 The CAN Protocols

CAN baud rate：1M/S, Using extended frames ID, Message Length =8

## 2.1 Gimbal Control

CAN ID: 0x00000F01

| S_ID | CMD | DATA1 | DATA2 | DATA3 | DATA4 | DATA5 | DATA6 |
|---|---|---|---|---|---|---|---|

| Components | CMD(1 bytes) | DATA(6 bytes) |
|---|---|---|
| Gimbal 0x0F | 0x01: TapZoom | Byte1-2: Horizontal distance from the center of the image(%), [-10000,10000]<br>Byte3-4: Longitudinal distance from the center of the image(%), [-10000,10000] |
| | 0x02: Forward | |
| | 0x03: One Key to 1× Image | |
| | 0x04: Gimbal Control | Byte1-2: Pan Speed(°/Sec)*100，[-10000, 10000]<br>Byte3-4: Tilt Speed(°/Sec)*100，[-10000, 10000] |
| | 0x05: Tracking | Byte1-2: Horizontal coordinates of the center point of the rectangular box [0, 8191] 1Low 2High<br>Byte3-4: Vertical coordinates of the center point of the rectangular box [0, 8191] 3Low 4High<br>Byte5: lengths (X)/16<br>Byte6: width(Y)/16 |

| | | |
|---|---|---|
| | | Note: Top left corner of the screen (0, 0) Bottom right. (8191, 8191) |
| | 0x06:Tracking stop | |
| | 0x07: One key to down | |
| | 0x08: Specified Angle | Byte1: Control type    1，2，3<br>Byte1=1：<br>Byte2-3: Angle of Yaw*10[0,3600]    2 Low 3 High；<br>Byte1=2：<br>Byte2-3: Angle of Pitch *10[-1000,600]    2 Low 3 High；<br>Byte1=3：<br>Byte2-3: Zoom*100[100,3000(3500)]    2Low 3 High<br>Byte4: Airframe coordinate system<br>else: Geodetic coordinate system |
| | 0x10: Snapshot | Byte1：<br>　　0x01: single shot<br>　　0x02: continuous shooting<br>　　0x03: time-lapse shooting<br>　　0x04: timed shot<br>　　0x05: Stop shooting.<br>Byte2：<br>　　If Byte1= 0x02, Byte2= Number of continuous shots<br>　　If Byte1= 0x03, Byte2= Delayed time (Sec)<br>　　If Byte1= 0x04, Byte2= Timed time (Sec) |
| | 0x11: Recoding | Byte1=1: Start recording.<br>Byte1=2: Stop the video. |
| | 0x12: Zoom | Byte1=1：Zoom in<br>Byte1=2：Zoom out<br>Byte1=3：Stop<br>Byte1=4：ZOOM=1<br>Byte1=5：2× Zoom in<br>Byte1=6：2× Zoom out |
| | 0x13: Focus | Byte1=1：Focus +<br>Byte1=2：Focus -<br>Byte1=3：Stop<br>Byte1=4：auto Focus |
| | 0x14: TapFocus | Byte1-2: Horizontal coordinates of the center point of the rectangular box   [0,8191]    1 Low 2 High<br>Byte3-4: Vertical coordinates of the center point of the rectangular box   [0,8191]    3 low 4 High<br>Byte5: 25<br>Byte6: 25<br>Note: Top left corner of the screen (0,0) Bottom right. (8191,8191) |
| 0x0F | 0xF0: Quick Calibration | |

| 0x1F | 0x12: Digital Zoom (Dual-Sensor) | Byte1=1: Zoom in<br>Byte1=2: Zoom out<br>Byte1=3: Stop |
|---|---|---|
| 0x1F | 0x04:Gimbal Control (Dual-Sensor) | Byte1-2: Yaw Speed(°/Sec)*100，[-10000,10000]<br>Byte3-4: Pitch Speed(°/Sec)*100，[-10000,10000] |
| 0x1F | 0x05: Tracking (Dual-Sensor) | Byte1-2: Horizontal coordinates of the center point of the rectangular box [0,8191] 1 Low 2 High<br>Byte3-4: Vertical coordinates of the center point of the rectangular box [0,8191] 3 Low 4 High<br>Byte5: lengths (X)/16<br>Byte6: width(Y)/16<br>Note: Top left corner of the screen (0,0) Bottom right. (8191,8191) |
| 0x1F | 0x07: Stop Tracking (Dual-Sensor) | |
| 0x1F | 0x01: TapZoom (Dual-Sensor) | Byte1-2: Horizontal distance from the center of the image (%), [-10000,10000]<br>Byte3-4: Longitudinal distance from the center of the image (%) , [-10000,10000] |
| 0x1F | 0x02: Color Palettes (Dual-Sensor) | Byte1：pp<br>Thermal：<br>pp=0 Blackhot<br>pp=1 Whitehot<br>pp=2 Iron-red<br>pp=3 Rainbows<br>pp=4 Lava<br>pp=5 Rainbow enhancement<br>pp=6 molten metal<br>pp=7 Blue-red<br>pp=8 Amber<br>pp=9 Amber Reversal.<br>pp=a Ice blue<br>pp=b High contrast<br>pp=c Grayscale reversal<br>pp=d High temperature red<br>pp=e Cryogenic blue |
| 0x1F | 0x03: Picture-in-picture mode cycle switching | |

## 2.1.1 Example

**0x01：TapZoom**

The ground station sends the position of the "target point" to the gimbal, which turns the

"target point" to the center of the screen, and Zoom in twice. With regard to the position of the "target point", it shall be converted to the horizontal and vertical axis [-10000,10000] coordinate system.

Coordinate axis: top left (-10000，-10000), bottom right (10000，10000)

**0x04：Gimbal Control**

If you keep sending this command, the gimbal will keep rotating, 50ms at a time is recommended; if you stop sending it, it will stop rotating.

**0x05：Tracking**

The ground station sends the center point position of the target box to the gimbal with the length and width, i.e. turning on target tracking.

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

**0x08：Specified Angle**

Directional angle commands, where the angle is a relative north-side angle when the flight control attitude is accessed.

When not in the flight control attitude, the angle is the angle of clamping relative to the head direction of the UAV/Drone.

**Examples of common functions:**

| Function | Describe | CANDATA（HEX） | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0x02 Forward | | 0F | 02 | 00 | 00 | 00 | 00 | 00 | 00 |
| 0x04 Gimbal Control | Turn left 5°/Sec | 0F | 04 | 0C | FE | 00 | 00 | 00 | 00 |
| | Pull up 5°/Sec | 0F | 04 | 00 | 00 | F4 | 01 | 00 | 00 |
| 0x08 Specified Angle | Yaw: 45 | 0F | 08 | 01 | C2 | 01 | 00 | 00 | 00 |
| | Pitch: -45 | 0F | 08 | 02 | 3E | FE | 00 | 00 | 00 |
| | Zoom：10 | 0F | 08 | 03 | E8 | 03 | 00 | 00 | 00 |
| 0x10：Snapshot | Single shot | 0F | 10 | 01 | 00 | 00 | 00 | 00 | 00 |
| 0x11：Recording | Recording | 0F | 11 | 01 | 00 | 00 | 00 | 00 | 00 |

## 2.2 Gimbal Feedback

Gimbal feedback sent by CAN in four frames, sending one full frame every 500ms. The protocol for the complete frame is as follows.

| Data | Function | Lengths (bytes) | Remark |
|---|---|---|---|
| 0 | Head | 2 | 0xEB 0x90 |
| 2 | length | 1 | 0x0C |
| 3 | …. | 9 | 0x00 |
| 12 | CMD+DID | 2 | 0x210xFE |
| 14 | C_ID | 1 | Device ID　0x0F |
| 15 | Data_id | 1 | 0x01 |
| 16 | g_type | 1 | Gimbal Type (Note 1) |

| 17 | trace_flag | 1 | Determining whether or not it's tracking |
|---|---|---|---|
| 18 | Control_mode | 1 | (Note 2) |
| 19 | theta | 2 | Pitch angel *100<br>Range: [-11000, 6000 ], low and ahead |
| 21 | psi | 2 | Yaw angle*100<br>(Geomagnetic)<br>Range：[0, 36000 ], low and ahead |
| 23 | Motor_psi | 2 | Yaw motor*100<br>Range: [-17000, 17000]<br>/ (3.5× Zoom)<br>[-32500, 32500] |
| 25 | Crc | 2 | Checkpoint code, Note3 |
| 27---31 | 0x00 | 5 | Note 4 |

| Data | Function | Lengths (bytes) | Remark |
|---|---|---|---|
| 0 | Head | 2 | 0xEB 0x90 |
| 2 | length | 1 | 0x10 |
| 3 | …. | 9 | 0x00 |
| 12 | CMD+DID | 2 | 0x210xFE |
| 14 | C_ID | 1 | Device ID    0x0F |
| 15 | Data_id | 1 | 0x01 |
| 16 | Distance measuring success markers | 1 | Gimbal Type (Note 1) |
| 17 | Target distance | 2 | 0.1m |
| 19 | Target height | 2 | 0.1m |
| 21 | Target longitude | 4 | *1e7deg, s32 |
| 25 | Target latitude | 4 | *1e7deg, s32 |
| 29 | Crc | 2 | Checkpoint code, Note3 |
| 31 | 0x00 | 5 | Note 4 |

**Note 1：**

Gimbal Type：

01: 35× Zoom 2Mp/30X Zoom 4K Resolution

02: 30× Zoom, 5MP Resolution

03: 3.5× Zoom

04: 3.5× Zoom Dual-Sensor

05: Laser distance measurement

07: 30× Zoom Dual-Sensor

**Note 2：**

1: Full lock. (speed controlled)      2: course-following        3: Locking (angle controlled)

**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：**

The gimbal sends this protocols data via CAN, which sends 8 valid bytes at a time, so that the entire message length is less than a multiple of 8.

## 2.3 Receive UAV/Drone status information

### 2.3.1 GPS

| Type | | Content. | Remark |
|---|---|---|---|
| ID | | 0x0000FF15 | Transmitter: 0x00, Recipient: 0xFF, Frame Number: 0x15 |
| Lengths | | 0x08 | Latitude and Longitude |
| 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

| Type | | Content. | Remark |
|---|---|---|---|
| ID | | 0x0000FF16 | Transmitter: 0x00，Recipient: 0xFF，Frame Number: 0x16 |
| Lengths | | 0x08 | Altitude |
| Data | Data[0] | H | Altitude*100，s32 |
| | Data[1] | H>>8 | |
| | Data[2] | H>>16 | |
| | Data[3] | H>>24 | |

### 2.3.3 UAV/Drone Attitude Angle

| Type | | Content. | Remark |
|---|---|---|---|
| ID | | 0x0000FF13 | Transmitter: 0x00, Recipient: 0xFF, Frame Number: 0x13 |
| Lengths | | 0x08 | UAV/Drone Attitude Angle |
| Data | Data[0] | Pitch angle | *100，s16 |
| | Data[1] | | |
| | Data[2] | Roll angle | *100，s16 |
| | Data[3] | | |
| | Data[4] | Yaw angle | *100，s16 |
| | Data[5] | | |
| | Data[6] | | |
| | Data[7] | | |

### 2.3.4  Other Info

| Type | | Content. | Remark |
|---|---|---|---|
| ID | | 0x02008201 | 0x02008202 |
| Lengths | | 0x08 | Message sending frame |
| Data | Data[0] | ASCII | Message ID for message writing starting with 0x02008201, 8 bytes per frame.<br>Intermediate frame ID: 0x02008201.<br>End frame ID: 0x02008202. |
| | Data[1] | | |
| | Data[2] | | |
| | Data[3] | | |
| | Data[4] | | |
| | Data[5] | | |
| | Data[6] | | |
| | Data[7] | | |

# Chapter 3 The TCP Protocols

This protocol is used for TCP access IDU control of the 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: please check Chapter 2 CAN Protocols ——2.1 Gimbal Control

CRC 22-23：from EB90 to CAN7，please check Chapter 2 CAN Protocols—2.2 Gimbal feedback

**For example, ” One key to down”：**

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

TTL sends GPS info protocols：

| 0xEB | 0x90 | 0x0B | CAN_ID |  |  |  | 0x00 | 0x00 | 0x00 |
|------|------|------|--------|------|------|------|------|------|------|
| 0x00 | 0x00 | 0x40 | 0x88 | Can0 | Can1 | Can2 | Can3 | Can4 | Can5 |
| Can6 | Can7 | CRC (not calibrated) |  |  |  |  |  |  |  |

**For example ：**
Longitude 118.1234567（0x46683587）
Latitude: 31.1234567（0x128D1007）
Altitude :506.78（0xC5F6）

EB 90 0B 00 00 FF 15 00 00 00 00 00 40 88 07 10 8D 12 87 35 68 46 00 00

EB 90 0B 00 00 FF 16 00 00 00 00 00 40 88 f6 c5 00 00 00 00 00 00 00 00