**Frame**: 2 byte header + 1 byte DestID + 1 byte SrcID + 1 byte Seq + 1 byte len + 1 byte MsgID + payload + 2 CRC byte.

- **Header**: “GB” (0x47 0x42).

- **DestID và SrcID**: image processing software 0x01, broadcast 0xff, gimbal controller 0x02.

- **Seq**: bắt đầu từ 0x00, tăng lên 1 với msg mới, khi tới 0xff thì trở về 0.

- **Len**: gồm 1 byte msgID VÀ payload VÀ 2 byte CRC.

- **MsgID**: xem bảng bên dưới.

- **Payload**: 1 byte AxisID (1: trục azimuth, 2: trục elevator, 3: cả 2 trục) + n bytes data (xem bảng bên dưới).

- **CRC**: lấy tổng các byte từ header tới payload rồi lấy bù 1.

|  |  |  |
| --- | --- | --- |
| **Msg** | **MsgID** | **Data** |
| Home | 0x01 | Send: None  Response: (sau khi đã về home) 0: OK, 1: Error |
| Stop | 0x02 | Send: None  Response: (ngay lập tức) 0: OK, 1: Error |
| Emergency stop | 0x03 | Send: None  Response: (ngay lập tức) 0: OK, 1: Error |
| Turn on/off stabilizing mode | 0x04 | Send: 1 byte mode  0: none  1: velocity  2: velocity with outer loop  Response: (ngay lập tức) 0: OK, 1: Error |
| Get Mode | 0x05 | Send: None  Response: (ngay lập tức) 2 byte (1 byte mode + 1 byte submode) |
| Set pos | 0x06 | Send: 4 byte position đơn vị 0.01 độ (position x 100), 4 byte velocity đơn vị 0.01 deg/s (velocity x 100).  Response: (ngay lập tức) 0: OK, 1: Error |
| Set vel | 0x07 | Send 1 axis: 4 byte velocity x 100.  Send 2 axes: 4 byte velocity az x 100 + 4 byte velocity el x 100.  Response: (ngay lập tức) 0: OK, 1: Error |
| Set pos vel | 0x08 | Send: 4 byte velocity x 100 + 4 byte position x 100  Response: (ngay lập tức) 0: OK, 1: Error |
| Get pos | 0x09 | Send: none  Response: (ngay lập tức) 4 byte position x 100 |
| Set Kp | 0x0A | Send: 1 byte PIDController\_ID +4 byte Kp x 106  Response: (ngay lập tức) 0: OK, 1: Error |
| Set Ki | 0x0B | Send: 1 byte PIDController\_ID +4 byte Ki x 106  Response: (ngay lập tức) 0: OK, 1: Error |
| Set Kd | 0x0C | Send: 1 byte PIDController\_ID +4 byte Kd x 106  Response: (ngay lập tức) 0: OK, 1: Error |
| Set Kff1 | 0x0D | Send: 1 byte PIDController\_ID +4 byte Kff1 x 106  Response: (ngay lập tức) 0: OK, 1: Error |
| Set Kff2 | 0x0E | Send: 1 byte PIDController\_ID +4 byte Kff2 x 106  Response: (ngay lập tức) 0: OK, 1: Error |
| Get params | 0x0F | Send: 1 byte PIDController\_ID  Response: (ngay lập tức) 0: 4 byte Kp x 106 + 4 byte Ki x 106 + 4 byte Kd x 106 + 4 byte Kff1 x 106 + 4 byte Kff2 x 106. |
| Set Active Axis | 0x10 | Send: 1 byte status  0: disable  1: enable  Response: (ngay lập tức) 0: OK, 1: Error |
| Get Active Axis | 0x11 | Send: None  Response: (ngay lập tức) 1 byte status  0: disable  1: enable |

Trong 4 byte data, byte MSB được truyền đầu tiên, byte LSB được truyền cuối cùng

**Ví dụ:**

Ý nghĩa: Frame pos-vel truyền từ software xuống controller, điều khiển trục azimuth, vận tốc đặt 90 độ/s, góc đặt 60 độ.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Header | DestID | SrcID | Seq | Len | MsgID | AxisID | Data | CRC |
| 0x47 0x42 | 0x02 | 0x01 | 0x00 | 0x0C | 0x07 | 0x01 | 0x00 0x00 0x23 0x28 0x00 0x00 0x17 0x70 | 0xFE 0x8D |

Ý nghĩa: Frame response cmd pos-vel truyền từ controller về software, xác nhận lệnh OK và thực thi.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Header | DestID | SrcID | Seq | Len | MsgID | AxisID | Data | CRC |
| 0x47 0x42 | 0x01 | 0x02 | 0x00 | 0x05 | 0x07 | 0x01 | 0x00 | 0xFF 0x66 |

Ý nghĩa: Frame set Kp truyền từ software xuống controller, trục elevator, Kp=0.5.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Header | DestID | SrcID | Seq | Len | MsgID | AxisID | Data | CRC |
| 0x47 0x42 | 0x02 | 0x01 | 0x01 | 0x08 | 0x09 | 0x02 | 0x00 0x07 0xA1 0x20 | 0xFE 0x97 |

Ý nghĩa: Frame set Kp truyền từ controller lên software, trục elevator, Kp=0.5.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Header | DestID | SrcID | Seq | Len | MsgID | AxisID | Data | CRC |
| 0x47 0x42 | 0x01 | 0x02 | 0x01 | 0x05 | 0x09 | 0x02 | 0x00 | 0xFF 0x62 |

Ý nghĩa: Frame response cmd set Kp truyền từ controller về software, xác nhận lệnh OK và thực thi.