

K40T-MINI Quad-Sensor User Control Protocol

K40T-MINI Quad-Sensor User Control Protocol - 1.4.18

Modify records

modification time	Modify content	Version
20231012	initial version	V1.0.0
20231020	Added camera IP address acquisition command	V1.1.0
20231112	Added camera precise reshooting instructions	V1.2.0
20231212	Added specified mixed zoom command	V1.3.0
20240125	Added restore factory settings command	V1.4.0
20240410	Added camera osd watermark custom copywriting command	V1.4.1
20240429	Added gimbal impeller speed setting command	V1.4.2
20240430	Add network port description	V1.4.3
20240510	Modify the instructions for reporting gimbal attitude information, reporting gimbal status, etc.	V1.4.4
20240708	Improve the protocol, visible light single-channel setting	V1.4.5

20240802	Delete visible light photo and video resolution setting instructions (0x000201, 0x000202, 0x00020C)	V1.4.6
20240809	Added flight control request target GPS information command (0x000320)	V1.4.7
20241115	Added gimbal debugging function (0x000013, 0x00002D, 0x00002E, 0x00002F, 0x000030, 0x000031)	V1.4.8
20241210	Corrected infrared area temperature measurement instructions and infrared point temperature measurement instructions	V1.4.9
20241214	Restore visible light photo and video resolution setting command (0x000201, 0x000202)	V1.4.10
20250117	Added gimbal stabilization command (0x000033) and modified gimbal status message (0x000001)	V1.4.11
20250324	Added AI recognition/tracking instructions (0x000319, 0x000324)	V1.4.12
20251024	Added infrared super-resolution command	V1.4.13
20251128	Increase infrared brightness/contrast/denoising/image enhancement instructions Remove temperature measurement command	V1.4.14
20251128	Modify camera and video parameter switching instructions	V1.4.15
20251201	Remove precise retake command	V1.4.16
20260106	Added SBUS configuration reading protocol	V1.4.17
20260208	Restore temperature measurement instructions/merge multiple series	V1.4.18

2. Protocol Definition

2.1 Protocol frame format

BLST V1 Frame 12-255bytes									
STX	LEN	DT SYS ID	DA COMP ID	SEQ	SA SYS ID	SA COMP ID	MESSAGE ID	PAYLOAD DATA	CHECKSUM
1 bytes	1 bytes	1 bytes	1 bytes	1 bytes	1 bytes	1 bytes	3 bytes	0-243 bytes	2 bytes

Byte number	Type	Content	Value	Explanation
0	UInt8_t	packet start flag	0xFD	Protocol-specific text start (stx) marker used to indicate the start of a new packet. Any system that does not recognize the protocol version will skip the packet.
1	UInt8_t	load length	0-255	Displays the length of the payload section. This may be affected by message data.
2	UInt8_t	System ID (recipient)	0-255	Refers to the recipient system ID, which is used to distinguish the systems of different products.
3	UInt8_t	Component ID (receiver)	0-255	Refers to the recipient system ID, used to distinguish components of different products.
4	UInt8_t	Packet sequence number	0-255	Used to detect packet loss, the component increments the value for each message sent.
5	UInt8_t	System ID (sender)	1-255	Refers to the sender system ID, used to distinguish systems on the network.
6	UInt8_t	Component ID (sender)	1-255	Refers to the sender component ID, used to distinguish components in the

				system.
7-9	UInt32_t	Message ID (low, medium, high byte)	0-16777215	The id of the message type in the payload, used to decode the data back into the message object.
10-n+10	UInt8_t[243]	payload		message data. Depends on message type (i.e. message ID) and content.
N+11 - N+12	UInt16_t	Checksum		X.16 CRC (check data starting from 0XFD and all data)

App address: System ID: 0x01; Component ID: 0x01

Flight control address: System ID: 0x02; Component ID: 0x01

Quad-Sensor Gimbal Camera address: System ID: 0x04; Component ID: 0x01

Set the high byte of the message ID to 0x00

Set the high byte of the message ID of the ACK of the message reply to 0x01

Set the high byte of the message ID of the status frame message of the message reply to 0x02

For example: after specifying the hybrid zoom (0x000304) setting, the message ID of the ACK is 0x010304 and the message ID of the status frame is 0x020304.

The multi-byte parameters of the message payload (except ACK) are all low byte first, high byte last.

Note:

Setting message: message sent by App or host computer to gimbal

ACK: Feedback of whether the gimbal receives and executes the setting information normally

Status frame: status feedback during gimbal execution

crc code:

```
C
static void crc_accumulate(uint8_t data, uint16_t *crcAccum)
{
    uint8_t tmp;
    tmp = data ^ (uint8_t)(*crcAccum &0xff);
    tmp ^= (tmp<<4);
    *crcAccum = (*crcAccum>>8)^(tmp<<8)^(tmp<<3)^(tmp>>4);
}
```

```

#define X25_INIT_CRC 0xffff
static void crc_init(uint16_t* crcAccum)
{
    *crcAccum = X25_INIT_CRC;
}

uint16_t crc_calculate(const uint8_t* pBuffer, uint16_t length)
{
    uint16_t crcTmp;
    crc_init(&crcTmp);
    while (length--)
    {
        crc_accumulate(*pBuffer++, &crcTmp);
    }
    return (crcTmp);
}

```

2.2 Serial port description

2.2.1 Serial port interface definition

The serial port is a 3.3V TTL serial port.

2.2.2 Serial port description and configuration

The basic configuration of the serial port is:

Serial port baud rate	115200
Serial port level standard	TTL3.3V level
Serial data bits	8Bit
Serial port stop bit	1Bit
parity bit	None
Serial port flow control	None

2.3 Network port description

2.3.1 Default IP address of camera network port

K40T-MINI-A/K8T/K8: 192.168.144.119

K40T-MINI-B: 192.168.144.64

2.3.2 RTSP streaming address

K40T-MINI-A/K8T/K8 default push address: rtsp://IP:8600/live0

For example: rtsp://192.168.144.119:8600/live0

K40T-MINI-B default push address: rtsp://IP:558/live/single

For example: rtsp://192.168.144.64:558/live/single

2.3.3.udp network port control

Gimbal pod server port: 1030;

1. Electrical interface

1. Quad-Sensor Gimbal external electrical interface protocol

pin	Function	Name	Notes
To be determined	Power interface	To be determined	
To be determined	network interface	LAN_TX_P	
		LAN_TX_N	
		LAN_RX_N	
		LAN_RX_P	
To be determined	Communication interface	USART_RX	
		USART_TX	
To be determined	clock sync pin	RTC_IO	

3. Gimbal System

3.1 gimbal payload protocol (Sysid: 0x03)

3.1.1 Periodic reporting of messages (0x000001-0x00000F)

3.1.1.1 gimbal status message (500ms) (msgid: 0x000001)

Note: This message is for uploading status information of the gimbal. Reporting cycle: 2HZ

payload:

Byte1	Byte2	Byte3	Byte4	Byte5	Byte6-7
gimbal status	Upgrade status	Self-test results	Steady image state	reserved	reserved

The specific instructions are as follows:

Gimbal Status Notification	Byte1	gimbal status, uint8_t type data Low 4 bits: 0: gimbal connection is normal; 1: gimbal connection is abnormal High 4 bits: 0: The camera connection is normal; 1: The camera connection is abnormal
	Byte2	Upgrade status: uint8_t type data 0x00: Upgrade is normal 0x01: Kernel upgrade not completed 0x02: Firmware upgrade not completed
	Byte3	Self-test results Bit0: Infrared movement: 1-normal; 0-abnormal Bit1: telephoto visible light movement: 1-normal; 0-abnormal Bit2: Wide-angle visible light movement: 1-normal; 0-abnormal Bit3: Laser: 1-normal; 0-abnormal Bit5-7: reserved
	Byte4	Stabilization status: 0: Stabilization not turned on, 1: Stabilization in progress, 2: Stabilization failed, 3: Stabilization features lost

	Byte5	reserved
	Byte6-7	reserved

3.1.1.2 gimbal attitude information (100ms) (msgid: 0x000002)

This message is the upload of gimbal attitude angle information. Reporting cycle: 10HZ

payload:

Byte1-2	Byte3-4	Byte5-6	Byte7-8	Byte9-10	Byte11-12
Yaw angle of gimbal (joint angle)	Gimbal roll angle (joint angle)	Gimbal pitch angle (joint angle)	Gimbal yaw angle (attitude angle)	Gimbal roll angle (attitude angle)	Gimbal pitch angle (attitude angle)
Byte13-14	Byte15-16	Byte17-18	Byte19-20		
Gimbal yaw angular velocity	Gimbal pitch angle speed	Gimbal roll angular velocity	reserved		

The specific instructions are as follows:

gimbal information	Byte1-2	Yaw angle of gimbal (joint angle), unsigned integer; unit: degree*100
	Byte3-4	Gimbal roll angle (joint angle), unsigned integer; unit: degree*100
	Byte5-6	Pan/tilt pitch angle (joint angle), unsigned integer; unit: degree*100
	Byte7-8	Yaw angle of gimbal (attitude angle), unsigned integer; unit: degree*100
	Byte9-10	Gimbal roll angle (attitude angle), unsigned integer;

		unit: degree*100
	Byte11-12	Gimbal pitch angle (attitude angle), low byte first; unit: degree*100
	Byte13-14	Pan/tilt azimuth velocity int16, x100 times, accuracy 0.01°/s
	Byte15-16	Gimbal pitch angle speed int16, x100 times, accuracy 0.01°/s
	Byte17-18	Gimbal roll angular speed int16, x100 times, accuracy 0.01°/s
	Byte19-20	reserved

3.1.2 Request messages (0x000010-0x0000FF)

3.1.2.1 gimbal control command (msgid: 0x000010)

Explanation: This message is to control the action of the gimbal
payload:

Byte1	Byte2	Byte3	Byte4
Working modes and quick functions	Orientation control	pitch control	reserved

The specific instructions are as follows:

Remote control pan/tilt information	Byte1	High 4 digits: gimbal working mode 00(0000): No operation, default 01(0001): Indicates that the gimbal returns to center 02(0010): Indicates that the gimbal is looking down at 90° Lower 4 bits: reserved
	Byte2	Set the direction of azimuth movement (0: move to the left, 1: move to the right, 2: stop moving)
	Byte3	Set the direction of pitch movement (0: upward

		movement, 1: downward movement, 2: stop movement)
	Byte4	reserved

Ack

Byte1-2
response code

3.1.2.2 Specify the gimbal angle control command (msgid: 0x000012)

Description: This message specifies that the gimbal moves to the corresponding angular position.

payload:

Byte1-3	Byte4-6	Byte7
Specify gimbal pitch angle	Specify the azimuth angle of the gimbal	reserved

The specific instructions are as follows:

Specify gimbal angle command	Byte1-3	Byte1 specifies the tilt movement direction of the gimbal. 0: Specify the angle upwards 1: Specify the angle downwards 2: No movement Byte2-3 specifies the pitch movement angle of the gimbal (30 degrees up, 90 degrees down)
	Byte4-6	Byte4 specifies the yaw movement direction of the gimbal. 0: Specify the angle to the left 1: Specify the angle to the right 2: No movement Byte5-6 specifies the yaw movement angle of the gimbal (left 180 degrees, right 180 degrees)
	Byte7	reserved

Ack

Byte1-2

response code

3.1.2.3 One-click gimbal calibration command (0x000013)

Description: The App sends a one-click gyro calibration command to control the gimbal to perform gyro calibration.

Request frame: payload:

Byte 1	Byte 2
Calibration status	reserved

The specific instructions are as follows:

One-click calibration of the gimbal	Byte1	0x01: Start calibration
	Byte2	reserved

Ack

Byte1-2
response code

3.1.2.4 gimbal pulsator speed setting command (msgid: 0x000017)

Description: App sets the maximum dial speed command of the gimbal.

Request frame: payload:

Byte 1	Byte 2	Byte 3
Gimbal pitch wheel speed	Gimbal azimuth dial speed	reserved

The specific instructions are as follows:

gimbal maximum impeller speed	Byte1	Gimbal pitching wheel speed: Byte1 gimbal pitching wave wheel speed, uint8_t type, range 5-150, Corresponds to movement speed of 1-30
-------------------------------	-------	---

setting command		degrees/second
	Byte2	gimbal azimuth wave wheel speed: Byte1 gimbal azimuth wave wheel speed, uint8_t type, range 5-150, corresponding to the movement speed of 1-30 degrees/second
	Byte 3	reserved

Ack

Byte1-2
response code

3.1.2.5 Get the gimbal version number (msgid: 0x000018)

Description: Get the gimbal version number

payload:

Byte 1	Byte 2
Get the gimbal version number	reserved

The specific instructions are as follows:

Get the gimbal version number	Byte1	Byte1 0x01: Get the gimbal version number
	Byte2	reserved

Ack:

Byte1-2	Byte3-5	Byte6-8	Byte9
response code	gimbal hardware version number	gimbal software version number	reserved

The specific instructions are as follows:

Get the gimbal version number	Byte1-2	response code
	Byte3	gimbal hardware version number (major version number)
	Byte4	gimbal hardware version number (minor version number)
	Byte5	gimbal hardware version number (minor version number)
	Byte6	gimbal software version (major version number)
	Byte7	gimbal software version (minor version number)
	Byte8	gimbal software version (minor version number)
	Byte9	reserved

3.1.2.6 gimbal pointing and alignment command (0x00002C)

Description: gimbal pointing and alignment control command

payload:

Byte1	Byte 2-3	Byte4-5	Byte6-7
Zoom lens selection	Mixed zoom ratio	Point to align the X coordinate point	Point to align the Y coordinate point

The specific instructions are as follows:

gimbal pointing and alignment instructions	Byte1	Zoom lens selection 0x00: Telephoto lens 0x01: Wide angle lens 0x02: Infrared lens
	Byte2-3	Mixed variable magnification, Uint16_t Telephoto lens unit 0.1x range (3.5-11.0 is optical zoom, 11.0-160 is electronic magnification) Wide-angle lens unit 0.1x (supports integer

		electronic magnification of 1-8) Infrared lens unit 0.1 times (supports integer electronic magnification of 1-8)
	Byte4-5	Point to align the X coordinate point, uint16 type, range 1-1920, middle value 960
	Byte6-7	Point to align the Y coordinate point, uint16 type, range 1-1080, middle value 540

Ack:

Byte1-2
response code

3.1.2.7 Turn off gimbal servo command (0x00002D)

Description: App requests the gimbal to turn off the servo.

Request frame: payload:

Byte 1	Byte 2
Turn off servo (0x00)	reserved

Ack:

Byte1-2
response code

3.1.2.8 gimbal linear calibration command (0x00002E)

Description: App requests gimbal linear calibration.

Request frame: payload:

Byte 1	Byte 2
Linear calibration (0x01)	reserved

Ack:

Byte1-2
response code

3.1.2.9 gimbal soft restart command (0x00002F)

Description: The App requests a soft restart of the gimbal.

Request frame: payload:

Byte 1	Byte 2
Soft restart (0x01)	reserved

Ack:

Byte1-2
response code

3.1.2.10 The gimbal uses the flight control fake attitude command (0x000030)

Description: The App requests the gimbal to use the flight control fake attitude.

Request frame: payload:

Byte 1	Byte 2
Use flight control fake attitude (0x01)	reserved

Ack:

Byte1-2
response code

3.1.2.11 gimbal calibration movement acceleration offset command (0x000031)

Description: The App requests the gimbal to calibrate the motion acceleration offset.

Request frame: payload:

Byte 1	Byte 2
Calibrate motion acceleration (0x01)	reserved

Ack:

Byte1-2
response code

3.1.2.12 The flight controller sends flight control information to the gimbal command (0x000032)

Message ID: 0x0032

Frequency: 10HZ

Description: The flight controller sends the drone's desired heading angle, pitch angle, roll angle, heading angle, acceleration information, and takeoff flag to the gimbal.

Request frame: payload:

Byte 1-2	Byte3-4	Byte5-6	Byte7-8	Byte9-10	Byte11-12	Byte13-14	Byte15
UAV desired heading angle	UAV pitch angle	UAV roll angle	UAV heading angle	Drone acceleration (x-axis acceleration)	Drone acceleration (y-axis acceleration)	Drone acceleration (z-axis acceleration)	Takeoff sign

The specific instructions are as follows:

Flight controller sends information	Byte 1-2	UAV desired heading angle, current flight angle; unit: degree*100 Type: int16_t
	Byte3-4	UAV pitch angle, unit: degree*100 Type: int16_t
	Byte5-6	UAV roll angle, unit: degree*100

		Type: int16_t
	Byte7-8	UAV heading angle, real-time angle; unit: degree*100 Type: int16_t
	Byte9-10	Drone acceleration (x-axis acceleration), unit: speed * 1000 Type: uint16_t
	Byte11-12	Drone acceleration (y-axis acceleration), unit: speed * 1000 Type: uint16_t
	Byte13-14	UAV acceleration (z-axis acceleration), unit: speed*1000 Type: uint16_t
	Byte15	Takeoff sign Bit0: 0: means the plane has not taken off, 1: means the plane has taken off Bit1-Bit6: reserved Bit7: 0: indicates that the flight control data is invalid, 1: indicates that the flight control data is valid

Ack:

Byte1-2
response code

3.1.2.13 gimbal image stabilization command (0x000033)

Description: App requests gimbal image stabilization settings.

Request frame: payload:

Byte 1	Byte 2
Image stabilization (0x01: turn on image stabilization; 0x00: turn off image stabilization)	reserved

Ack:

Byte1-2
response code

3.2 Camera payload protocol (Sysid: 0x04)

3.2.1 Periodic reporting messages (status reporting) (0x000001-0x00000F)

3.2.1.1 Camera system status feedback (1s) (msgid: 0x000003)

This message is the upload of camera system status information. Reporting cycle:
1HZ

payload:

Byte 1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
Photo/video mode	Network rendering resolution	Video encoding format	Push mode	Video output bit rate	Set photo mode	Delayed photo time
Byte8	Byte9	Byte10-11	Byte12-13	Byte14-15	Byte16	
Number of continuous shots	sd status	sd card total capacity	sd card remaining capacity	sd card used capacity	reserved	

The specific instructions are as follows:

Camera status feedback	Byte 1	Photo and video mode 0: Photo mode 1: Video mode
	Byte 2	Network output resolution 0: 1080P30fps 1: 720P30fps
	Byte3	Video encoding format 0: H264 1: H265

	Byte4	Push mode: 00: Infrared push 0x05/0x06: Visible light push 0x07: Split-screen push
	Byte5	Video output bit rate 1:1M 2:1.5M 3:2M 4: 4M 5: 8M 6: 12M
	Byte6	Photo mode 0: Single shot 1: Continuous shot of 3/5 shots 2: Time-lapse shot
	Byte7	Time-lapse photography time 5/7/30/60
	Byte8	Continuous shooting number setting 3/5
	Byte9	SD card status 0: Normal card 1: Abnormal card 2: Current card reading and writing speed is slow 3: SD card not inserted 4: SD card is full 5: SD card format error
	Byte10-11	Total capacity of SD card Unit: MB*10
	Byte12-13	SD card remaining capacity Unit: MB*10
	Byte14-15	SD card used capacity Unit: MB*10
	Byte16	reserved

3.2.1.2 Infrared camera status feedback (200ms) (msgid: 0x000004)

Note: This message is the infrared status information uploaded to the flight controller and App;

Reporting cycle: 5HZ

payload:

Byte 1-2	Byte3-4	Byte5-6	Byte7-8	Byte9-10	Byte11-14	Byte15-18	Byte19-22
Regional maximum	Regional minimum	Regional center temperature	Point temperature measure	Regional average	Regional maximum	Regional minimum	Regional central temperature

temperature value	temperature value	value	ment temperature value	temperature value	temperature coordinates	temperature coordinates	ature coordinates
Byte23-26	Byte27	Byte28	Byte29	Byte30	Byte31-34		
Point temperature measurement coordinates	High temperature warning sign	Low temperature warning sign	Temperature difference warning sign	Threshold temperature warning flag	reserved		

The specific instructions are as follows:

Infrared camera status feedback	Byte1-2	Regional maximum temperature value, int16_t type, unit 0.1°C
	Byte3-4	Regional minimum temperature value, int16_t type, unit 0.1°C
	Byte5-6	Regional center temperature value, int16_t type, unit 0.1°C
	Byte7-8	Point temperature measurement temperature value, int16_t type, unit 0.1°C
	Byte9-10	Regional average temperature value, int16_t type, unit 0.1°C
	Byte11-14	Regional maximum temperature coordinates Byte11-12: Regional maximum temperature coordinate X, uint16_t type Byte13-14: Regional maximum temperature coordinate Y, uint16_t type
	Byte15-18	Regional minimum temperature coordinates Byte15-16: Regional minimum temperature coordinate X, uint16_t type

		Byte17-18: Regional minimum temperature coordinate Y, uint16_t type
	Byte19-22	Regional central temperature coordinates Byte19-20: Regional central temperature coordinate X, uint16_t type Byte21-22: Regional central temperature coordinate Y, uint16_t type
	Byte23-26	Point temperature measurement coordinates Byte23-24: Point temperature measurement coordinate X, uint16_t type Byte25-26: Point temperature measurement coordinate Y, uint16_t type
	Byte27	High temperature warning sign: 0: No warning 1: Start warning
	Byte28	Low temperature warning flag: 0: No warning 1: Start warning
	Byte29	Temperature difference warning flag: 0: No warning 1: Start warning
	Byte30	Threshold temperature warning flag: 0: No warning 1: Start warning
	Byte31-34	reserved

Note: The regional temperature measurement reports the highest temperature, lowest temperature, average temperature, central temperature, and the coordinates of the highest temperature, lowest temperature, and central temperature in the region; the point temperature measurement reports the point temperature value and its coordinates of the point temperature measurement.

3.2.1.3 Visible light camera status feedback (200ms) (msgid: 0x000005)

Description: This message is the upload of visible light camera parameter status information.

Reporting cycle: 5HZ

payload:

Byte1	Byte 2-3	Byte4-5	Byte6	Byte 7-8	Byte 9-10	Byte 11	Byte 12	Byte13-14	Byte15
Zoom state	focal length	Mixed zoom magnification	EV value reporting	ISO value reporting	Electronic shutter reporting	AE_LOCK status	focus status	Accurate repeat shooting focus	reserved

The specific instructions are as follows:

Visible light camera parameter status information	Byte1	Zoom status 0x00: Zoom completed 0x01: Zoom in progress
	Byte2-3	Focal length, unit: 0.01mm
	Byte4-5	Hybrid zoom ratio: The telephoto hybrid ratio includes optical zoom and electronic zoom. Above 11 times, it is electronic magnification, and the unit is 0.1 times.
	Byte6	EV value reporting 0x00:Auto 0x0A:+2 0x10:+1 0x16:0 0x1C:-1 0x23:-2
	Byte 7-8	ISO value reporting unit 0.1db
	Byte9-10	Electronic shutter value reporting unit: microsecond
	Byte11	AE_LOCK status 0x01 on, 0x02 off
	Byte12	Focus status 0x00: Focusing completed 0x01: Focusing in progress
	Byte13-14	Accurate repeat shooting focus

	Byte15	reserved
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3.2.2 Infrared camera setting message (0x000100-0x0001FF)

3.2.2.1 Infrared camera all setting parameter reading command (0x000100)

Description: Read all parameters of infrared camera.

payload:

Byte1	Byte2
Read all camera settings instructions	reserved

The specific instructions are as follows:

App reads all camera parameter instructions	Byte1	0x01: Read all setting instructions of the infrared camera
	Byte2	reserved

Ack

Byte1-2	Byte3-23
response code	Feedback on all camera settings parameters

The specific instructions are as follows:

ACK	Byte1-2	Feedback, ACK: 0 indicates successful feedback
All parameters of infrared camera	Byte3	Infrared camera image settings Pseudo color settings: 1-20
	Byte4	Temperature measurement and electronic amplification configuration Byte4 (bit7-bit0) : bit0 temperature measurement switch (0 is on, 1 is off) Bit1 temperature measurement type (0 point

		temperature measurement, 1 area temperature measurement) Bit2 infrared movement type (0 viewing version, 1 temperature measurement version) Bit3-7 electronic amplification
	Byte5	Infrared sharpening parameter range, see support instructions
	Byte6	Infrared gain mode (0: high gain mode 1: low gain mode 2: automatic)
	Byte7	Infrared brightness setting range, see support instructions
	Byte8	Infrared contrast setting range, see support instructions
	Byte9	Denoising settings Byte3 (bit7) denoising switch 0: off; 1: on Byte3 (bit6-bit0) denoising level
	Byte10	Enhance settings Byte10 (bit0) enhancement switch: 0: off; 1: on Byte10 (bit6-0) enhanced parameters
	Byte11-12	High temperature warning temperature setting: Open and set the temperature range: -1000-5000 Turn off high temperature warning: -2732 Unit: 0.1°C Data type: int
	Byte13-14	Low temperature warning temperature setting: Open and set the temperature range: -1000-5000 Turn off low temperature warning: -2732 Unit: 0.1°C Data type: int

	Byte15-16	Temperature difference warning setting: Open and set the temperature difference range: 1-6000 Turn off temperature difference warning: -2732 Unit: 0.1°C Data type: int
	Byte17	Threshold temperature warning switch: Set the threshold temperature difference alarm function switch: 0: off; 1: on
	Byte18-19	Temperature difference reference value setting (-30°C to 50°C): Set the temperature difference reference value: -300-500 Unit: 0.1°C Data type: int
	Byte20-21	Temperature floating value setting: Set temperature floating value: 0-800 Unit: 0.1°C Data type: int
	Byte22	Over-resolution switch status 1 open 0 off
	Byte23	reserved

3.2.2.2 Infrared electronic amplification setting command (0x000105)

Description: Set the infrared electronic amplification command

Request frame: payload:

Byte 1	Byte 2
Infrared electronic amplification	reserved

settings	
----------	--

The specific instructions are as follows:

Infrared electronic amplification settings	Byte1	Byte1: 0x01: No amplification 0x02-0x08: 2-8 times electronic amplification
	Byte2	reserved

Ack:

Byte1-2
response code

3.2.2.3 Infrared pseudo color setting command (0x000106)

Description: Set the infrared pseudo color setting request command.

Request frame: payload:

Byte 1	Byte 2
Infrared pseudo color settings	reserved

The specific instructions are as follows:

Infrared pseudo color settings	Byte1	1-20 respectively represent white hot , black body , rainbow , high contrast color red , iron red , magma, sky, medium gray, gray red , purple orange, special 1 , warning red, ice fire, cyan red , special 2, gradient red, gradient green , gradient yellow, warning green, warning blue (K40T-MINI-A only has blue part of the pseudo color)
	Byte2	reserved

Ack:

Byte1-2

response code

3.2.2.4 Infrared brightness setting command (0x00010B)

Description: Set the infrared brightness request command

Request frame: payload:

Byte 1	Byte 2
IR brightness setting	reserved

The specific instructions are as follows:

IR brightness setting	Byte1	Byte1 brightness parameter 0-100
	Byte2	reserved

Ack:

Byte1-2
response code

3.2.2.5 Infrared contrast setting command (0x00010C)

Description: Set infrared contrast request command

Request frame: payload:

Byte 1	Byte 2
IR contrast setting	reserved

The specific instructions are as follows:

IR contrast setting	Byte1	Byte1 contrast parameter 0-100
	Byte2	reserved

Ack:

Byte1-2
response code

3.2.2.6 Infrared denoising setting command (0x00010D)

Description: Set the infrared denoising request command

Request frame: payload:

Byte 1-2	Byte 3
IR denoising settings	reserved

The specific instructions are as follows:

IR denoising settings	Byte1-2	Byte1: Denoising switch 0: Off 1: On Byte2: Denoising level: 0-100
	Byte3	reserved

Ack:

Byte1-2
response code

3.2.2.7 Infrared image enhancement setting command (0x00010E)

Description: Infrared enhancement setting instructions

Request frame: payload:

Byte1	Byte2
IR enhancement settings	reserved

The specific instructions are as follows:

IR enhancement settings	Byte1	Infrared image enhancement setting: 0, off; 1-10: set level.
-------------------------	-------	--

	Byte2	reserved
--	-------	----------

Ack:

Byte1-2
response code

3.2.2.8 Infrared point temperature measurement setting command (0x00010F)

Description: Set the infrared point temperature measurement command

Request frame: payload:

Byte1-2	Byte3-4	Byte5
X-axis cursor point	Y axis cursor point	reserved

The specific instructions are as follows:

	Byte1-2	Byte1-Byte2 X-axis cursor point
	Byte3-4	Byte3-Byte4 Y-axis cursor point
	Byte5	reserved

Ack:

Byte1-2
response code

Note: The x coordinate range is between 320-1599; the y coordinate range is between 28-1051.

3.2.2.9 Infrared area temperature measurement setting command (0x000110)

Description: App sets the infrared rectangular frame temperature measurement command

Request frame: payload:

Byte 1-2	Byte 3-4	Byte 5-6	Byte 7-8	Byte 9
Infrared rectangular frame width	Infrared rectangular frame height	Infrared rectangular frame center coordinate X	Infrared rectangular frame center coordinate Y	reserved

The specific instructions are as follows:

Infrared rectangular frame settings	Byte1-2	Byte1-Byte2 area box width
	Byte3-4	Byte3-Byte4 area box height
	Byte5-6	Byte5-Byte6 X coordinate of area box center
	Byte7-8	Byte7-Byte8 Y coordinate of area box center
	Byte9	reserved

Ack:

Byte1-2
response code

Note: Half the width of the rectangular box plus the x-coordinate range is between 320-1599; half the height of the rectangular box plus the y-coordinate range is between 28-1051.

3.2.2.10 Infrared camera gain mode setting command (0x000123)

Description: App sets infrared camera gain mode instructions

Request frame: payload:

Byte1	Byte2
Infrared camera gain mode setting	reserved

The specific instructions are as follows:

Infrared camera gain mode setting	Byte1	0x00: high gain mode 0x01: low gain mode
-----------------------------------	-------	---

		0x02: Automatic mode
	Byte2	reserved

Ack:

Byte1-2
response code

3.2.2.11 Infrared over-resolution switch command (0x000180)

Description: Set the infrared ultra-resolution switch request command

Request frame: payload:

Byte 1	Byte 2
Infrared over-resolution switch	reserved

The specific instructions are as follows:

Infrared over-resolution switch	Byte1	Byte1 0x00: The ultra-resolution switch is turned off 0x01: The over-resolution switch is on;
	Byte2	reserved

Ack:

Byte1-2
response code

3.2.3 Visible light camera (0x000200-0x0002FF)

3.2.3.1 Read command for all setting parameters of visible light camera (0x000200)

Description: Instructions to read all parameters of visible light camera

Request frame: payload:

Byte1	Byte2
Read all setting instructions of visible light camera	reserved

The specific instructions are as follows:

App reads all camera parameter instructions	Byte1	0x01: Read all setting instructions of visible light camera
	Byte2	reserved

Ack

Byte1-2	Byte3-19
response code	Feedback on all camera settings parameters

ACK	Byte1-2	Feedback, ACK: 0 indicates successful feedback
Feedback on all camera settings parameters	Byte3	Visible light photography resolution 0x14: 8000*6000 (K40T-MINI-B) 0x15: 4000*3000 (K40T-MINI-B) 0x16: 3840*2160 (K40T-MINI-B) 0x80: 3840*2160 (K40T-MINI-A) 0x86: 1920*1080 (K40T-MINI-A)
	Byte4	Visible light video resolution Telephoto 0x08: 1080p:1920*1080 (K40T-MINI-A) 0x26: 4K:3840*2160 (K40T-MINI-A) 0x36: 1200W:4000*3000 (K40T-MINI-B)
	Byte5	Visible light video bit rate (K40T-MINI-B) In H264 encoding format 0x00:6M; 0x01:8M; 0x02:10M; 0x03:12M (1080P)

		video resolution) 0x00:30M; 0x01:40M; 0x02:50M; 0x03:60M (4K video resolution) 0x00:40M; 0x01:55M; 0x02:70M; In H265 encoding format (default H265) 0x00:3M; 0x01:4M; 0x02:5M; 0x03:6M (1080P video resolution) 0x00:15M; 0x01:20M; 0x02:25M; 0x03:30M (4K video resolution)
	Byte6	bit3-0 white balance setting: 0001: Auto 0010: Incandescent lamp 0011: Fluorescent lamp 0100: Warm fluorescent lamp 0101: Daytime 0110: Cloudy day 0111: Dusk 1000: Dark bit7-4: reserved
	Byte7-8	reserved
	Byte9	EV value 0x00:Auto 0x0A:+2 0x10:+1 0x16:0 0x1C:-1 0x23:-2
	Byte10	ISO settings 0x00: AUTO 0x01: ISO100 0x02: ISO200 0x03: ISO400 0x04: ISO800 0x05: ISO1600 0x06: ISO3200 0x07: ISO6400
	Byte11	electronic shutter Photo mode: Auto: 0x00: Auto Manual: 0x01: 1/4 0x02: 1/8 0x03: 1/15 0x04: 1/30 0x05: 1/60 0x06: 1/125 0x07: 1/250 0x08: 1/500 0x09: 1/1000 0x0A: 1/2000 0x0B: 1/4000 0x0C: 1/5000

	0x0C: 1/6000 0x0E: 1/8000 Recording mode: Auto: 0x00: Auto Manual: 0x01: 1/4 0x02: 1/8 0x03: 1/15 0x04: 1/30 0x05: 1/60 0x06: 1/125 0x07: 1/250 0x08: 1/500 0x09: 1/1000 0x0A: 1/2000 0x0B: 1/4000 0x0C: 1/5000 0x0C: 1/6000 0x0E: 1/8000
Byte12	Zoom fine adjustment value 0-100
Byte13	Backlight compensation Bit7: Backlight compensation switch 0x01: On 0x02: Off Bit6-Bit0: Backlight compensation value: 0-100
Byte14	Strong light suppression Bit7: Strong light suppression switch 0x01: On 0x02: Off Bit6-Bit0: Strong light suppression value: 0-100
Byte15	AE LOCK Feedback: 0x1: on 0x2: off
Byte16-17	Visible OSD watermark switch (low byte first, high byte last) bit0 custom string 1 1: on 0: off bit1 custom string 2 1: on 0: off bit2 custom string 3 1: on 0: off bit3 timestamp 1: on 0: off bit4 field of view and multiple 1: on 0: off bit5 ranging distance 1: on 0: off bit6 photo and video prompts 1: On 0: Off bit7 aircraft heading angle 1: on 0: off bit8 gimbal yaw angle, elevation angle 1: On 0: Off

		bit9 TF card remaining capacity 1: On 0: Off bit10 maximum temperature 1: on 0: off bit11 minimum temperature 1: on 0: off bit12 average temperature 1: on 0: off bit13 aircraft longitude and latitude 1: on 0: off bit14 target longitude and latitude 1: on 0: off bit15 reserved
	Byte18	Anti-flicker status 0x01: Turn off anti-flicker 0x02: 50HZ anti-flicker 0x03: 60HZ anti-flicker 0x04: Automatic
	Byte19	Visible light metering mode setting feedback 0x01: Center-weighted metering 0x02: Area metering 0x03: Average metering

3.2.3.2 Visible light video resolution setting command (0x000201)

Description: Set the visible light video resolution request command.

Request frame: payload:

Byte 1	Byte 2
Start setting up	Visible light video resolution setting

The specific instructions are as follows:

Visible light video resolution setting	Byte1	0x00: Start setting
	Byte2	0x08:1920*1080 0x26:3840*2160 0x36:4000*3000

Ack:

Byte1-2
response code

3.2.3.3 Visible light photography resolution setting command (0x000202)

Description: Set visible light photography resolution request command.

Request frame: payload:

Byte 1	Byte 2
Start setting up	Visible light photography resolution settings

The specific instructions are as follows:

Photo resolution setting in the light	Byte1	0x00: Start setting
	Byte2	0x14: 8000*6000 (K40T-MINIB) 0x15: 4000*3000 (K40T-MINIB) 0x16: 3840*2160 (K40T-MINIB) 0x80: 3840*2160(K40T-MINIA) 0x86: 1920*1080 (K40T-MINIA)

Ack:

Byte1-2
response code

3.2.4 Common part (0x000300-0x0003FF)

3.2.4.1 Photo and video mode setting instructions (0x000300)

Description: Request command to set visible light photo and video mode

Request frame: payload:

Byte 1	Byte 2
--------	--------

Photo/video mode settings	reserved
---------------------------	----------

The specific instructions are as follows:

Visible light photo and video mode settings	Byte1	Byte1 mode switching: 0: photo mode; 1: video mode
	Byte2	reserved

Note: It does not respond to video recording commands in photo taking mode; it does not respond to photo taking commands in video recording mode.

3.2.4.2 Photo Parameter Setting Command (0x000301)

Description: Set the photo parameter setting request command

Request frame: payload:

Byte 1	Byte2	Byte3	Byte 4
Photo function settings	Time-lapse interval	Number of continuous shots	reserved

The specific instructions are as follows:

Visible light photography parameter settings	Byte1	0x00: Normal single shot 0x01: Continuous shooting: 3/5 pictures 0x02: Time-lapse photography
	Byte2	Byte2 delay interval: 5/7/30/60
	Byte3	Byte3 Number of continuous shots: 3/5
	Byte4	reserved

Ack:

Byte1-2
response code

3.2.4.3 Photography command (0x000302)

Description: Camera photography instructions

Request frame: payload:

Byte 1	Byte 2	Byte3-22	Byte23-54
Photo mode	Camera photo instructions	folder name	Picture name

The specific instructions are as follows:

Camera photo instructions	Byte1	Photo mode 0x00: Default photo taking (infrared + visible light taken together) 0x01: Infrared photo (resolution: 640*512) 0x02: Visible light photography (Resolution: (K40T-MINI-A: 3840*2160), K40T-MINI-B: 4000*3000)) 0x03: Infrared + visible light photography
	Byte2	Camera photo instructions 0x00: Single shot/start taking pictures 0x01: Stop taking pictures (only valid in continuous shooting mode)
	Byte3-22	Folder name, does not contain '\0', total 20 bytes, This byte array forms a string (string A). When the string is NULL or "", this field is not used and is placed in the root directory of the image file. If the string is not empty, this field is used. If the root directory of the image has the folder, there is no need to create it. If there is no such folder, the folder needs to be created.
	Byte23-byte54	Image name, excluding '\0', 32 bytes in total, This byte array forms a string. When the string is NULL or "", the default name rule is used. If the string is not empty, the string is used as the image name.

Ack

Byte1-2
response code

status frame

Byte 1	Byte2	Byte3-4	Byte5-7
Photo mode status	Current photo feedback	Number of continuous shots	reserved

Photo status feedback	Byte1	0-default photo 1-Infrared photography 2-Visible light photography 3-Infrared + visible light photography
	Byte2	Current photo feedback 0-Photography completed 1-Single shooting 2-Continuous shooting 3- Taking time-lapse shooting 4-Stop taking photos 6-Failed to take pictures 7-SD card not inserted 8-SD card is full 9-Exception card 10-Low speed card 11-SD card format error
	Byte3-4	Number of continuous shots
	Byte5-7	reserved

Note: Before taking pictures, a GPS request command will be sent to the flight controller to obtain GPS information.

3.2.4.4 Recording command (0x000303)

Description: Camera recording command

Request frame: payload:

Byte 1	Byte 2	Byte3-22	Byte23-54
Recording mode	Camera recording command	folder name	Picture name

The specific instructions are as follows:

Camera recording command	Byte1	Recording mode 0x00: Default recording (infrared + visible light recording together) 0x01: Infrared video (resolution: 640*512) 0x02: Visible light video (resolution: K40T-MINI-A 3840*2160/K40T-MINI-B4000*3000) 0x03: Infrared + visible light video 0x04: Video streaming screen recording (resolution: 1920*1080)
	Byte2	0x01: Start recording (sending again will not stop recording. To stop, you need to send a stop recording command) 0x02: Stop recording
	Byte3-22	Folder name, does not contain '\0', total 20 bytes, This byte array forms a string (string A). When the string is NULL or "", this field is not used and is placed in the root directory of the image file. If the string is not empty, this field is used. If the root directory of the image has the folder, there is no need to create it. If there is no such folder, the folder needs to be created.
	Byte23-byte54	Video name, excluding '\0', total 32 bytes, This byte array forms a string. When the string is NULL or "", the default name rule is used. If the string is not empty, the string is used as the video name.

Ack

Byte1-2
response code

Status frame (1HZ)

Byte 1	Byte 2	Byte3-4	Byte5-7
Current recording mode feedback	Current video feedback	Recording time	reserved

Recording status feedback	Byte1	Current recording mode feedback 0-Default recording 1-Infrared video 2-Visible light video 3 - Infrared + Visible Light Recording 4-Video streaming screen recording
	Byte2	Current video feedback 0-stop recording; 1-Recording; 2-Waiting for time-lapse recording; 3-Time-lapse video recording 4-SD card not inserted 5-SD card is full 6-Exception card 7-Low speed card 8-SD card format error
	Byte3-4	Recording time
	Byte5-7	reserved

3.2.4.5 Specify mixed zoom instruction (0x000304)

Description: Specify the hybrid variable magnification command

Request frame: payload:

Byte 1	Byte2-3
Start setting up	Mixed zoom ratio

The specific instructions are as follows:

Visible light specifies precise zoom ratio	Byte1	0: Start setting
	Byte2-3	Specify the hybrid zoom magnification*10 (the magnification is the actual supported magnification of the camera, accurate to one decimal place) (K40T-MINIA 1-80x hybrid zoom, K40T-MINIB 1-100x hybrid zoom)

Ack:

Byte1-2
response code

status frame

Byte 1	Byte 2
Zoom state	reserved

Visible light specified variable magnification status frame	Byte1	Byte1 zoom status 0x01: Zooming in 0x00: Zoom completed
	Byte2	reserved

3.2.4.6 Continuous mixed zoom instruction (0x000306)

Description: Perform continuous zoom command

Request frame: payload:

Byte1	Byte2
-------	-------

Camera zoom control	reserved
---------------------	----------

The specific instructions are as follows:

Camera zoom control	Byte1	0x00: Continuous amplification 0x01: Continuous reduction 0x02: Stop zooming 0x03: Zoom in 0x04: Zoom out
	Byte2	reserved

Ack:

Byte1-2
response code

3.2.4.7 Video output stream setting command (0x000308)

Description: Set the camera video output stream command.

Request frame: payload:

Byte1	Byte2
Camera output stream settings	reserved

The specific instructions are as follows:

Camera output stream settings	Byte1	1:1M 2:1.5M 3:2M 4: 4M 5: 8M 6: 12M
	Byte2	reserved

Ack:

Byte1-2

response code

3.2.4.8 Video output resolution setting command (0x00030A)

Description: Set camera video output format instructions.

Request frame: payload:

Byte1	Byte2
Video output resolution	reserved

The specific instructions are as follows:

Camera output stream settings	Byte1	1: 1080P30fps 2: 720P30fps
	Byte2	reserved

Ack:

Byte1-2

response code

3.2.4.9 Video encoding format setting command (0x00030B)

Description: Set the video output encoding format setting instructions.

Request frame: payload:

Byte1	Byte2
Video output encoding format	reserved

The specific instructions are as follows:

	Byte1	0: H264 1: H265
--	-------	--------------------

	Byte2	Byte2: reserved
--	-------	--------------------

Ack:

Byte1-2
response code

3.2.4.10 gimbal camera timing command (0x00030E)

Description: gimbal camera timing command.

Request frame: payload:

Byte 1-8	Byte9-12	Byte13-16
Timestamp (number of milliseconds since 1970-01- 0100:00:00	Time zone tz_minuteswest /* minutes west of Greenwich */	Time zone tz_dsttime /* type of dst correction */

1. System Connection Diagram

Main Platform <---- Serial Port ----> Camera
Main Platform <----- GPIO Port -----> Camera

2. Time Synchronization Method

The main platform first outputs a high-level signal through the GPIO port, and then sends a capture command through the serial port.

After receiving the GPIO high-level signal, the camera records the current system time. After receiving the capture command, the camera records the capture time and calculates the delay between the GPIO trigger and the capture command.

Capture Time = Main Platform Time + Delay Time

Delay Time = Time when capture command is received -
Time when GPIO high-level signal is received

Following this method, time synchronization is performed every 10 seconds.

Ack

Byte1-2
response code

3.2.4.11 The camera requests GPS information command from the flight controller (0x000310)

Description: The camera sends a command to the flight controller to request GPS information at a specified time.

Request frame: payload:

Byte 1-6
GPS time information

The specific instructions are as follows:

time information	Byte1	Lens enable, 0: Disabled 1: Enabled
	Byte2	Hours: 0-23
	Byte3	Points: 0-59
	Byte4	Seconds: 0-59
	Byte5-6	Milliseconds: 0-999

Ack: (sent from flight control to gimbal)

Byte1-2	Byte3-19	Byte20-25
response code	GPS information	Aircraft attitude information

The specific instructions are as follows:

GPS information	Byte1-2	response code
	Byte3	Hours: 0-23 (consistent with the request content)
	Byte4	Points: 0-59 (consistent with the request content)
	Byte5	Seconds: 0-59 (consistent with the request)

		content)
	Byte6-7	Milliseconds: 0-999 (consistent with the request content)
	Byte8-11	Longitude angle (unit °)*10 ⁷ , signed integer
	Byte12-15	Latitude angle (unit °)*10 ⁷ , signed integer
	Byte16-17	Relative height (unit m)*10, signed integer
	Byte18-19	Altitude (unit m)*10, signed integer
	Byte20-21	2-byte signed integer, aircraft azimuth angle*100
	Byte22-23	2-byte signed integer, aircraft roll angle*100
	Byte24-25	2-byte signed integer, aircraft pitch angle*100
	Byte26-27	2-byte signed integer, pan/tilt azimuth angle*100
	Byte28-29	2-byte signed integer, gimbal roll angle*100
	Byte30-31	2-byte signed integer, gimbal pitch angle*100

Note: The gps information in the photo attributes needs this command to obtain

3.2.4.12 Camera IP address setting command (0x000311)

Description: Set camera IP address command

Request frame: payload:

Byte1	Byte2-5	Byte6-9	Byte10-13
IP type	IP address	subnet mask	Default gateway

The specific instructions are as follows:

Example	Byte1	0: Static setting 1: Dynamic acquisition
	Byte2	145 (example)
	Byte3	192

	Byte4	1	0x00: NULL
	Byte5	20	
	Byte6	255	
	Byte7	255	
	Byte8	255	
	Byte9	0	0x00: NULL
	Byte10	145	
	Byte11	192	
	Byte12	1	
	Byte13	1	

Ack:

Byte1-2
response code

3.2.4.13 Camera IP address acquisition command (0x000312)

Description: Query camera IP address command.

Request frame: payload:

Byte1	Byte2
Query IP address	reserved

The specific instructions are as follows:

Example	Byte1	1: Query IP address
	Byte2	reserved

Ack:

Byte1-2	Byte3-6	Byte7-10	Byte11-14
response code	IP address	subnet mask	Default gateway

The specific instructions are as follows:

Byte1-2	response code
Byte3	145 (example)
Byte4	192
Byte5	1
Byte6	20
Byte7	255
Byte8	255
Byte9	255
Byte10	0
Byte11	145
Byte12	192
Byte13	1
Byte14	1

3.2.4.14 Camera OSD watermark switch (0x000314)

Description: Set the camera OSD watermark switch.

Request frame: payload:

Byte1	Byte2	Byte3
Watermark switch	reserved	reserved

The specific instructions are as follows:

	Byte1	Watermark switch: 0: off 1: open Master switch for configured watermarks
	Byte2	reserved
	Byte3	reserved

Ack:

Byte1-2
response code

3.2.4.15 Camera shutdown command (0x000316)

Description: Camera shutdown command

Request frame: payload:

Byte1	Byte2
Camera shutdown command	reserved

The specific instructions are as follows:

Camera shutdown command	Byte1	Byte1 0x01: About to shut down
	Byte2	reserved

Ack:

Byte1-2
response code

3.2.4.16 Get camera version number (0x000317)

Description: Get the camera version number

Request frame: payload:

Byte 1	Byte 2
Get camera version number	reserved

The specific instructions are as follows:

Get camera version number	Byte1	0x01: Get camera version number
	Byte2	reserved

Ack:

Byte1-2	Byte3	Byte4	Byte5
response code	Major version number	minor version number	minor version number

3.2.4.17 Image mode setting command (0x000318)

Description: Set camera image mode command

Request frame: payload:

Byte 1	Byte 2
Image mode	reserved

The specific instructions are as follows:

Image mode settings	Byte1	0x00: Infrared image 0x05/0x06: visible light 0x07: Split screen
	Byte2	reserved

Ack:

Byte1-2
response

code

3.2.4.18 Intelligent identification command (0x000319)

Description: AI intelligent recognition instructions

Request frame: payload:

Byte 1	Byte 2	Byte 3-12
Identification switch	Specify the model type to load	Identify target categories

The specific instructions are as follows:

AI smart switch settings	Byte1	Identification switch 0x01: on 0x02: off
	Byte2	Specify the type of model to be loaded. The currently supported model is the yolov series model. By default this byte is 0x00
	Byte 3-12	Target categories identified simultaneously. Recognize up to 10 categories at the same time

Ack:

Byte1-2
response code

Status frame (reported every 40 milliseconds):

Byte1-Byte(10*N) (used if there is target recognition, not used if there is no target)	Byte(10*N+1)	Byte(10*N+2)
Multiple/single target data: Struct single target occupies 10 bytes { Byte1-2:X in the upper left	1 byte High 4 bits: total number of packets sent Low 4 bits: current package ID	Detection status (1 byte): 0x00 Detection successful 0x02 No target detected;

corner Byte3-4:Y in the upper left corner Byte5-6: width Byte7-8: high Byte9 target confidence (conf*100) Byte10 category id } N targets occupy 10*N bytes. Note: 0 targets occupy 0 words.		
--	--	--

Note:

1. The coordinates are reported at a resolution of 1920*1088. The upper left point of the screen is (0, 0) and the lower right point is (1920, 1088). A single package can transmit multiple target detection frames, and supports up to 24 targets in the screen.
2. When the frame-selected target tracking command is enabled, the coordinate information of a single tracking target is reported.
3. The target category ID range is determined based on the label file recognized by the model. After AI intelligent recognition is turned on, the camera will automatically select and identify objects. The recognition category IDs are as follows: 1: Pedestrian 2: Crowd 3: Bicycle 4: Car 5: Truck 6: Truck 7: Tricycle 8: Sunshade-Tricycle 9: Bus 10: Motorcycle

3.2.4.19 Flight control request target GPS information command (0x000320)

Description: The flight controller requests the GPS information of the current laser alignment target from the camera.

Request frame: payload:

Byte1-42
request information

The specific instructions are as follows:

Camera	Byte1	Request to mount
--------	-------	------------------

shutdown command		Bit0: 1: Mount 1 requested, 0: Mount 1 not requested Bit1: 1: Mount 2 requested, 0: Mount 2 not requested Bit2: 1: Mount 3 requested, 0: Mount 3 not requested Bit3: 1: Mount 4 requested, 0: Mount 4 not requested Bit4: 1: Mount 5 requested, 0: Mount 5 not requested Bit5: 1: Mount 6 requested, 0: Mount 6 not requested Bit6: 1: Mount 7 requested, 0: Mount 7 not requested Bit7: 1: Mount 8 requested, 0: Mount 8 not requested Default request mount 1
	Byte2	GPS status 0: GPS is not connected 1: GPS is connected, no positioning information 2: 2D positioning 3: 3D positioning 4: 3D positioning supported by DGPS/SBAS 5: Floating RTK, 3D positioning 6: Fixed RTK, 3D positioning 7: Static fixed state, used for base station 8: PPP, 3D positioning Note: 3 and above are considered positioning accuracy available.
	Byte3-10	UTC timestamp in milliseconds, low byte first
	Byte11-14	Longitude angle (unit °)*10 ⁷ , signed integer, low byte first
	Byte15-18	Latitude angle (unit °)*10 ⁷ , signed integer, low byte first
	Byte19-22	Relative height (unit m) * 1000, signed integer, low byte first
	Byte23-26	Altitude (unit m) * 1000, signed integer, low byte first
	Byte27-28	Aircraft azimuth angle*100 signed integer, low byte

		first
	Byte29-30	Aircraft roll angle*100 signed integer, low byte first
	Byte31-32	Aircraft pitch angle*100 signed integer, low byte first
	Byte33-34	Airspeed*100 (current airspeed) unit: m/s low byte first
	Byte35-36	Ground speed*100 (current airspeed) unit: m/s low byte first
	Byte37-38	Heading*100 (current heading expressed in compass units (0-360, 0: north)) Unit: deg low byte first
	Byte39-40	Throttle*100 (current throttle setting: 0-100) Unit: % low byte first
	Byte41-42	Climb rate*100 (current climb rate) unit: m/s low byte first

Ack:

Byte1-2	Byte3	Byte4-11	Byte12-27
response code	Mount enable	time information	GPS information

response code	Byte1-2	ACK response code
Mount enable	Byte3	The mount required to obtain the target GPS is fixed to: 0x1f
time information	Byte4-11	UTC timestamp, unit: millisecond, low byte first
GPS information	Byte12-15	Longitude angle (unit °)*10 ⁷ , signed integer, low byte first
	Byte16-19	Latitude angle (unit °)*10 ⁷ , signed integer, low byte first

	Byte20-23	Relative height (unit m) * 1000, signed integer, low byte first
	Byte24-27	Altitude (unit m) * 1000, signed integer, low byte first

3.2.4.20 Frame selection target tracking command (0x000324)

Description: Set camera frame selection target tracking instructions

Request frame: payload:

Byte1	Byte2-3	Byte4-5	Byte6-7	Byte8-9	Byte10
Frame selection settings	The x coordinate of the upper left point of the target box	The y coordinate of the upper left point of the target box	Target box width	Target box height	reserved

The specific instructions are as follows:

Frame selection target tracking settings	Byte1	0x01: Enable frame selection 0x02: Close frame selection
	Byte2-3	The x coordinate of the upper left point of the target box ranges from 0-1920
	Byte4-5	The y coordinate of the upper left point of the target box ranges from 0-1088
	Byte6-7	Target box width: The x coordinate value of the tracking box plus the width does not exceed 1920
	Byte8-9	The height of the target frame. The y coordinate value of the tracking frame plus the height does not exceed 1088.
	Byte10	reserved

Ack:

Byte1-2

response
code

Status frame (reported every 40 milliseconds):

Byte1-Byte10	Byte11	Byte12
Single target data: Struct single target occupies 10 bytes { Byte1-2:X in the upper left corner Byte3-4:Y in the upper left corner Byte5-6: width Byte7-8: high Byte9 target confidence (conf*100) Byte10 category id }	High 4 bits: total number of packets sent Low 4 bits: current package ID	detection status 0x00 detection successful; 0x02 No target detected;

Note: It is necessary to perform frame-selected target tracking when AI detection is turned on. There are two types of tracking:

1. If the area selected by the frame overlaps the area recognized, use the recognition frame to track it.
2. The frame-selected area does not overlap with the identified area, and the frame-selected area is used for tracking.
3. When tracking is enabled, the reporting of recognition status frames will be stopped and the reporting of tracking status frames will be enabled; if tracking is lost or tracking is turned off, the reporting of status frames will be stopped and the reporting of recognition status frames will be enabled.

3.2.5 Laser payload protocol

3.2.5.1 Laser ranging setting command (0x000400)

Description: Request laser ranging setting instructions

Request frame: payload:

Byte 1	Byte2
Laser ranging settings	reserved

The specific instructions are as follows:

Laser ranging settings	Byte1	Byte1 0: Disable; 1: Enable single ranging
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Ack:

Byte1-2	Byte3-4
response code	Laser ranging feedback uint16_t type, unit 0.1 meter (no value feedback 0)

3.2.5.2 Laser periodic ranging setting command (0x000406)

Description: Request laser periodic ranging setting instructions

Request frame: payload:

Byte 1	Byte2
Periodic ranging settings	reserved

The specific instructions are as follows:

Periodic ranging settings	Byte1	Byte1 0: Disable; 1: Enable 1s period ranging
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Ack:

Byte1-2
response code

Status frame:

Byte1-2	0x00 response code
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Byte3-4	Laser ranging distance, uint16_t type, unit 0.1 meter (no value feedback 0)
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3.2.6 SBUS channel protocol

3.2.6.1 SBUS channel configuration command (0x000501)

Description: Configure the SBUS channel corresponding to the function

Request frame: payload:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Push settings	Zoom setting	Photo settings	Recording settings	Pan/Tilt Pitch	gimbal heading	gimbal back to center	Infrared pseudo color

The specific instructions are as follows:

Configure the SBUS channel corresponding to the function	Byte1	Configure the channel for push streaming settings. The setting range is: 0-16. 0-15 corresponds to channels 1-16. 16 means not occupying any channel.
	Byte2	Configure the channel for zoom setting, setting range: 0-16, 0-15 corresponds to channels 1-16, 16 means not occupying any channel
	Byte3	Configure the channel for taking pictures. The setting range is: 0-16. 0-15 corresponds to channels 1-16. 16 means not occupying any channel.
	Byte4	Configure the channel for recording settings. Setting range: 0-16. 0-15 corresponds to channels 1-16. 16 means not occupying any channel.
	Byte5	Configure the gimbal pitch channel, setting range: 0-16, 0-15 corresponds to channels 1-16, 16 means not occupying any channel
	Byte6	Configure the channel for gimbal heading. Setting range: 0-16. 0-15 corresponds to channels 1-16. 16 means not occupying any channel.

	Byte7	Configure the channel for gimbal centering. The setting range is: 0-16. 0-15 corresponds to channels 1-16. 16 means not occupying any channel.
	Byte8	Configure the channel for infrared pseudo-color, setting range: 0-16, 0-15 corresponds to channels 1-16, 16 means not occupying any channel

Ack:

Byte1-2
response code

Note:

1. Streaming settings, photo settings, video settings, pan/tilt centering, and infrared pseudo-color functions are fixed-point switches from maximum to minimum, and each switch requires one operation.
 - a. The push flow is infrared, visible light, and split-screen rotation;
 - b. Photo switching takes one photo at a time;
 - c. Video recording is switched on once and off once;
 - d. The gimbal back-to-center switch sends a gimbal back-to-center command once.
 - e. Infrared pseudo-color switching in turns
2. The middle value of the zoom setting is stop, the maximum value is zoom out, and the minimum value is zoom in.
3. The center value of gimbal heading and pitch is stop. The greater the difference between the gimbal and the center value, the faster the movement.
4. After the configuration is modified, it needs to be powered off and restarted before it can take effect.

3.2.6.2 SBUS configuration acquisition command (0x000502)

Description: Get the current configuration of SBUS, including the range of setting values and the channels corresponding to the functions.

Request frame: payload:

Byte 1	Byte2
Get sbus	reserved

configuration	
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The specific instructions are as follows:

Get the current configuration of SBUS	Byte 1	0x01: Request to obtain sbus configuration instructions
	Byte 2	reserved

Return value:

Byte1-2	Byte3-4	Byte5-6	Byte7	Byte8	Byte9
response code	sbus set maximum value	sbus sets minimum value	Push streaming settings channel settings	Zoom setting channel setting	Photo settings channel settings
Byte10	Byte11	Byte12	Byte13	Byte14	
Recording settings channel settings	Gimbal pitch channel settings	gimbal heading channel settings	gimbal back-to-center channel settings	bit0: sbus switch (0x01: on; 0x00: off) bit1-5: Infrared pseudo color channel setting bit6-bit7: reserved	

,3.3 ACK feedback form

	ACK value	Description
0x0001-0x01ff Generic error response code	0x0000	OK, successful
	0x0001	failed
	0x0002	unknown error
	0x0003	Verification failed
	0x0004	timeout
	0x0005	MD5 check failed

	0x0006	Not enough system space
	0x0007	The data length does not match the actual
	0x0008	In progress, repeat request
	0x0009	File does not exist
	0x000A	File merge error
0x0201 - 0x02ff Gimbal pod system error response code	0x0201	Recording
	0x0202	Camera failed to open
	0x0203	Photos are being taken
	0x0204	SD card not inserted