

Viewlink Serial

Command Communication Protocol

V3.4.4

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Update Records:

2022.05.07	V 3.4.4	Add some message into protocol.
2022.04.21	V 3.4.3	Change in D1 packet. Chang unit of range finder feedback data to 0.1m.
2022.02.09	V3.4.3	Update U, V packet.
2021.10.05	V3.3.3	Add manual correct and auto correct functions of calculating yaw and pitch angle in S2 packet.
2021.09.28	V3.3.3	Add manually adjust error amount of calculating pitch angle and yaw angle in A2 packet.
2021.09.13	V3.3.3	Add A, C, K packet protocol.
2021.06.07	V3.3.3	Add U, V packet protocol, add A1 packet manual relative angle control mode and manual RC control mode.
2021.05.06	V3.3.3	Add example commands.

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1. Physical Layer

Baudrate range for console: 9600 bps, 19200 bps, 38400 bps, 57600 bps, 115200bps, 230400bps, 921600bps etc, default: 115200,

Re. 3. 1 U Communication Configuration Control,

3. 2 V Communication Configuration Status.

Standard: TTL, Full duplex

Data bit: 8

Stop bit: 1

Parity bit: None

Flow control: None

2. Link Layer

2.1 Frame Structure (Big-Endian)

Byte	Name	Value	Note
0	Header	0x55	
1		0xaa	
2		0xdc	
3	body length	bit 0~5: Body length: n = all bytes from byte3 to checksum. Min=4, max=63. bit 6~7: Frame counter	The length counters from this byte to the checksum byte.
4	CMD_ID_SET		
5~n+1	DATA N bytes data		Big-endian
n+2	CHECKSUM	CS =byte3 ~byte(1+n) XOR	

2.2 Data Flow for Entire System

Single frame application layer composition: The application layer of each frame may be composed of more than one data packet, and the combination relationship is as follows:

Direction	Data Packet Composition	Frame ID	Remark
Console to Payload	A1+C1+E1	0x30	14(9+2+3)
	A1+C1+E1+S1	0x32	28(9+2+3+14)
	A1	0x1A	9
	C1	0x1C	2
	E1	0x1E	3
	S1	0x16	14
	A2+C2+E2	0x31	10(2+3+5)
	A2+C2+E2+S2	0x33	15(2+3+5+5)
	A2	0x2A	2
	C2	0x2C	3
	E2	0x2E	5
	S2	0x26	5
	U	0x01	10
	Payload to Console	T1+F1+B1+D1	0x40
T1+F1+B1+D1		0x42	41 (Refresh OSD)
T2+F2+B2+D2		0x41	49(18+15+11+5)
V		0x02	23
AHRS(FC) to Payload	M	0xB1	42
Identify information output	F3	0xF3	Undefined length
Payload to Console Handshake	SH	0x00	1
Payload to Console Heartbeat	HB	0x10	1
Payload to Console Confirm	ACK	0xAC	1
Payload to Console	D1	0x1D	
Payload to Console	B1	0x1B	
Payload to Console	F1	0x1F	
Payload to Console	T1	0x17	
Payload to Console	T2	0x27	
Payload to Console	F2	0x2F	
Payload to Console	B2	0x2B	
Payload to Console	D2	0x2D	
Payload to Console Data transparent transmission	FW	0xFF	
Console to Payload	CMD_SD	0x5D	2

Payload to Console	ACK_SD	0xD5	5
Console to Payload	IP_INQ	0X19	
Console to Payload	IP_SET	0X29	
Payload to Console	ACK_IP	0X92	

2.3 Notes

- a) Infrequently used frame request from the console: the payload normally responds to the T1+F1+B1+D1 frame. Only when a frame A2+C2+E2+S2 (and "infrequently used status feedback control bit" of A2 is set to 1) sent by the console is received, a frame of T2+F2+B2+D2 will be returned, and the infrequent frame request is valid only once, see byte1, bit5 of A2 packet for details.
- b) For the control enumeration used in the internal communication of the system, if there is no special instructions, it should be used in accordance with the logic of "edge trigger", that is, it will be executed corresponding operation only when the received control enumeration **has change**. Correspondingly, for the received control parameter quantity, the most recent one shall prevail. For example, for the variable field of view operation of a continuous zoom lens, after receiving the first variable field of view instruction, the lens will continue to change the field of view until it receives the "no action" or "stop" command.
- c) When sending a heartbeat packet or A1+C1+E1+(S1) packet, reply T1+F1+B1+D1. When sending A2+C2+E2+S2 and the "unusual state return control bit" in A2 is set to 1, it will reply one frame T2+F2+B2+D2.

3. Application Layer

3.1 U Communication Configuration Control 10 Bytes----Frame ID: 0x01

This packet is used to set configurations of payload.

Byte No.	Name	Range	Note
1	Control Commands	0x00: Meaningless 0x02: Protocol control 0x04: Set time zone 0x05: Set OSD_1 0x07: Set OSD_2 0x08: Set baud rate of serial port 0x0A: Set alarm temperature of thermal camera 0x10: Set RC channel mapping 0x82: Query protocol control setting 0x84: Query time zone setting 0x85: Query OSD setting 0x88: Query baud rate setting of serial port 0x8A: Query alarm temperature setting of thermal camera 0x90: Query RC channel mapping setting 0xD0: Query gimbal firmware version 0xE4: Query gimbal model 0xEE: Query gimbal S/N code	
2~10	Parameters		

3.1.1.1 For control command: protocol control 0x02

2	Parameter 1 Byte	0x10 Enable 1800 m LRF (laser range finder) protocol 0x3F Enable 3000 m LRF protocol 0x00 Disable LRF protocol
3	Parameter 1 Byte	0x24 Enable GPS protocol NEMA-0183 0x00 Disable GPS protocol NEMA-0183
4	Parameter 1 Byte	0x3E Enable 3E gimbal control protocol 0x00 Disable 3E gimbal control protocol
5	Parameter 1 Byte	0X7E Enable 7E target tracking protocol 0X00 Disable 7E target tracking protocol
6	Parameter 1 Byte	0x81 Enable Sony VISCA protocol 0x00 Disable Sony VISCA protocol

7	Parameter 1 Byte	0xF9 Enable target position calculate protocol 0x00 Disable target position calculate protocol (You can ask us for this protocol)
8	Parameter 1 Byte	0xED Enable MAVLINK V1 and V2 0x00 Disable MAVLINK
9	Parameter 1 Byte	0xFF Enable PELCO-D protocol 0x00 Enable PELCO-D protocol
10	Parameter 1 Byte	0x01 Use Viewlink protocol to package feedback protocol before output 0x00 Feedback protocol output directly

3.1.1.2 For control command: set time zone 0x04

2	Parameter 1 1 Byte	Int 8 signed int, time zone hour setting
3	Parameter 2 1 Byte	Int 8 signed int, time zone minute setting
4~10	7 Byte	No meaning

3.1.1.3 For control command: set OSD_1 0x05

2	Parameter 1 1 Byte	Uint8 Unsigned int BIT0 0: OSD visible 1: OSD hide all BIT1 0: Cross visible 1: Cross hide BIT2 0: Angle display 1: Angle hide BIT3 0: Offset display(T) 1: Offset hide(T) BIT4 0: GPS_1 display 1: GPS_1 hide BIT5 0: Time display 1: Time hide BIT6 0: EO FOV/ zoom level display 1: EO FOV/ zoom level hide BIT7 0: Small font(T) 1: Big font(T) 0: Identification boundary display(A) 1: Identification boundary hide(A) TIP: T means for T-series products, A means for A-series.
3~10		Reserved

3.1.1.4 For control command: set OSD_2 0x07

2	Parameter 1 1 Byte	Uint8 Unsigned int BIT0 0: Not save settings 1: Save settings BIT1 0: IR hide 1: IR display BIT2 0: LRF hide 1: LRF display BIT3 0: GPS use Geographical coordinates 1: GPS use MGRS coordinates BIT4 0: TF hide 1: TF display BIT5 0: Target GPS hide 1: Target GPS display BIT6 0: Zoom level(T)/ Green font(R) 1: FOV(T)/ White font(R) BIT7 0: GPS data display in degrees, minutes, seconds 1: GPS data display in decimal
3~10		Reserved

3.1.1.5 For control command: set baud rate 0x08

2	Parameter 1 Byte	Unsigned int 0x01 4800 bps 0x02 9600 bps 0x03 19200 bps 0x04 38400 bps 0x05 57600 bps 0x06 115200 bps 0x07 S.BUS
3~10		Reserved

3.1.1.6 For control command: set alarm temperature of thermal camera 0x0A

2~3	Parameter 2 Bytes	Int16, set alarm temperature value
4~10		No meaning

3.1.1.7 For control command: set RC control channels 0x10

2	Parameter 1 1 byte	Yaw, 0xYW, unsigned int, Yaw control channel setting chan# = 0xY yaw right (1900), chan# = 0xW yaw left (1100)
3	Parameter 2 1 byte	Pitch, 0xPT, unsigned int, Pitch control channel setting chan# = 0xP pitch down (1900), chan# = 0xT pitch up (1100)
4	Parameter 3 1 byte	Mode:0xMD, unsigned int, Mode control channel setting chan# = 0xM recenter (1900), chan# = 0xD slow speed (1100)
5	Parameter 4 1 byte	Zoom: 0xZM, unsigned int, Zoom control channel setting chan# = 0x0Z zoom in (1900), chan# = 0x0M zoom out (1100)
6	Parameter 5 1 byte	Focus:0xFC, unsigned int, Focus/ Picture in Picture control channel setting chan# = 0x0F focus in (1900), chan# = 0x0C focus out (1100)
7	Parameter 6 1 byte	PIC/REC: 0xRP, unsigned int, Picture/ Record control channel setting chan# = 0x0R record (1900), chan# = 0x0P shoot (1100)
8	Parameter 7 1 byte	Multi :0xMU, unsigned int, Multi control channel setting chan# = 0x0M track (1900), chan# = 0x0U stop track (1100)
9	Parameter 8 1 byte	YPRZ channels reverse control (default is 0xff) Bit0: Zoom out 1: 1100us 0: 1900us Bit1: Zoom in 1:1900us 0: 1100us Bit2: Speed adjust 1:1100us 0: 1900us Bit3: Recenter 1:1900us 0: 1100us Bit4: Pitch Up 1: 1100us 0: 1900us Bit5: pitch down 1:1900us 0: 1100us Bit6: YAW Left 1:1100us 0: 1900us Bit7: YAW right 1:1900us 0: 1100us
10	Parameter 9 1 byte	FRM channels reverse control (default is 0xff) Bit0: no meaning Bit1: no meaning Bit2: Multi low(digital zoom/stop track) 1:1100us 0: 1900us Bit3: Multi high(start track) 1:1900us 0: 1100us Bit4: shoot 1: 1100us 0: 1900us Bit5: record 1:1900us 0: 1100us Bit6: Focus out/picture in picture switch 1:1100us 0: 1900us Bit7: Focus in/color bar switch 1:1900us 0: 1100us

3.2 V Communication Configuration Status 2 Bytes----Frame ID: 0x02

This packet is feedback of U packet.

Byte No.	Name	Meaning	Note
1	Control Command	0x00: No meaning 0x02: Protocol control 0x04: Time zone 0x05: OSD 0x08: Baud rate of serial port 0x0A: Alarm value of IR camera 0x10: RC channels mapping 0xFC: Gimbal firmware number 0xFD: Gimbal model 0xFE: Gimbal S/N code	
2~23	Parameters	When control command is 02, parameter effective length is 9 bytes When control command is 04, parameter effective length is 2 bytes When control command is 05, parameter effective length is 2 bytes When control command is 08, parameter effective length is 1 bytes When control command is 0x0A, parameter effective length is 4 bytes When control command is 0x10, parameter effective length is 9 bytes When control command is 0xFC, parameter effective length is 20 bytes When control command is 0xFD, parameter effective length is 10 bytes When control command is 0xFE, parameter effective length is 22 bytes	Please refer to U packet for the parameter's type of bytes.

3.3 A1 Servo Control Commonly Used 9 Bytes

Byte No.	Name	Range
1	Servo Control	Servo Control 0x00: Motor ON/OFF 0x01: Manual speed mode <i>0x02: Follow the current geographic location (not support yet)</i> 0x03: Follow yaw 0x04: Home position <i>0x05: Azimuth scan (not support yet)</i> 0x06: Tracking mode <i>0x07: Tilt scan (not support yet)</i> <i>0x08: Point to specified target (point to a specific latitude and longitude, not support yet)</i> 0x09: Manual relative angle mode(current position is 0) 0x0A: Follow yaw disable 0x0B: Manual absolute angle mode (Home position as 0) 0x1B: 720° manual absolute angle mode (Home position as 0) <i>0x0C: Follow-up space angle (not support yet)</i> 0x0D: Manual RC mode <i>0x0E: Reserved</i> 0x0F: Do not change the servo state, the parameter is meaningless 0x10: Manual gyro heading correction 0x11: Use frame heading angle servo system only 0x12: Pitch orthographic (look down 90°) 0x13: Use frame heading speed servo system only 0x14: Use frame heading angle and speed servo system 0x15: Disable frame heading servo system
2~3	Parameter 1 2 bytes	The meaning changes with the servo state, the default is 0
4~5	Parameter 2 2 bytes	The meaning changes with the servo state, the default is 0
6~7	Parameter 3 2 bytes	The meaning changes with the servo state, the default is 0
8~9	Parameter 4 2 bytes	The meaning changes with the servo state, the default is 0

3.3.1 The Meaning of A1 Parameters

3.3.1.1 For the Servo Control Command is Motor ON/OFF 0x00

Parameter 1 Byte 2~3	0x0100: Motor ON 0x0001: Motor OFF
Byte 6~9	Meaningless

3.3.1.2 For the Servo Control Command is Manual Speed Mode 0x01

Parameter 1 Byte 2~3	Azimuth velocity, signed integer 1bit=0.01° /S
Parameter 2 Byte 4~5	Tilt speed, signed integer 1bit=0.01° /S
Byte 6~9	Meaningless

3.3.1.3 For the Servo Control Command is Azimuth Scan 0x05

Parameter 1 Byte 2~3	When parameter 3 < 32768, it is azimuth speed, 1bit=0.01°/S. When parameter 3 ≥ 32768, it is azimuth speed, 1bit=0.1°/S, signed integer.
Parameter 2 Byte 4~5	When parameter 3 < 32768, it is tilt speed, 1bit=0.01°/S. When parameter 3 ≥ 32768, it is tilt speed, 1bit=0.1°/S, signed integer.
Parameter 3 Byte 6~7	When it is < 32768, it means that the scanning range is half width, 1bit=360/65536°. When ≥ 32768 it is a circle scan. At this time, the meaning of bit14-bit0 changes. Bit14 represents the reference frame of the scan angle: 0: relative to the vehicle, 1: relative to the earth. Bit0~7 represent the normalized gain of the tilt scan, 0x00 is the maximum, 0xFF No gain. The rest bits are reserved
Parameter 4 Byte 8~9	When parameter 4 < 32768, it scans center angle, 1bit=360/65536°, signed integer. When parameter 4 ≥ 32768, it represents the follow-up angle in the direction orthogonal to the scan, 1bit=360/65536°, signed integer.

3.3.1.4 For the Servo Control Command is Relative Angle Mode 0x09 (Gimbal current position is 0)

Parameter 1 Byte 2~3	Yaw velocity, 1bit=0.1°/S, signed integer When speed is 0, adopt system default speed.
Parameter 2 Byte 4~5	Yaw angle, 1bit=360/65536°, signed integer
Parameter 3 Byte 6~7	Pitch speed, 1bit=0.1°/S, signed integer When speed is 0, adopt system default speed.
Parameter 4 Byte 8~9	Pitch angle, 1bit=360/65536°, signed integer

3.3.1.5 For the Servo Control Command is Absolute Angle Mode 0x0b (Gimbal home position as 0)

Parameter 1 Byte 2~3	Yaw angle, signed integer 1bit=360/65536°
Parameter 2 Byte 4~5	Pitch angle, signed integer 1bit=360/65536°
Byte 6~9	Meaningless

3.3.1.6 For the Servo Control Command is Manual RC Control Mode 0x0d

Parameter 1 Byte 2~3	Yaw velocity, 1bit=0.1°/S, unsigned integer When speed is 0, adopt system default speed.
Parameter 2 Byte 4~5	Yaw RC value, 1100~1900, unsigned integer.
Parameter 3 Byte 6~7	Pitch speed, 1bit=0.1°/S, unsigned integer When speed is 0, adopt system default speed.
Parameter 4 Byte 8~9	Pitch RC value, 1100~1900, unsigned integer.

3.3.1.7 For the Servo Control Command is Tracking follow click/ touch 0x0e

Parameter 1 byte 2~3	Yaw speed, 1bit=0.01°/S, unsigned int, 0= use default speed. Often use value 0.
Parameter 2 byte 4~5	Yaw coordinate, -960 ~960 unsigned int, left max=-960, right max= 960, center= 0
Parameter 3 byte 6~7	Pitch speed, 1bit=0.01°/S, unsigned int, 0= use default speed. Often use value 0.
Parameter 4 byte 8~9	Pitch coordinate, -540-540, unsigned int. up max=-540, down max=540, center= 0

3.3.1.8 For the Servo Control Command is Yaw 0 bias manual correct 0x10

Parameter 1 byte 2~3	Unsigned int, -20000 ~ 20000 Units: 0.001 of gyro sensor units
Parameter 2 byte 4~5	meaningless
Parameter 3 byte 6~7	meaningless
Parameter 4 byte 8~9	meaningless

3.3.1.9 For the Servo Control Command is Frame yaw angle servo system 0x11

Parameter 1 byte 2~3	Unsigned int, -1800 ~ 1800 Units: 0.1 degrees. Special value 0x7FFF to disable correction
Parameter 2 byte 4~5	meaningless
Parameter 3 byte 6~7	meaningless
Parameter 4 byte 8~9	meaningless

3.3.1.10 For the Servo Control Command is Absolute Angle 720° Mode 0x1b (Gimbal home position as 0)

Parameter 1 Byte 2~3	Yaw angle, signed integer 1bit=720/32768°
Parameter 2 Byte 4~5	Pitch angle, signed integer 1bit=720/32768°
Byte 6~9	Meaningless

3.4 A2 Servo Control Infrequently Used 2 Bytes

Byte No.	Name	Range
1	Servo Action 5bits bit 0~4	0x00: No action 0x01: Manual error correct of pitch angle in position calculate 0x02: Manual error correct of yaw angle in position calculate The rest bits are reserved
	Infrequently used status feedback control 1bit bit5	0: Not feedback infrequently used frames 1: Feedback infrequently used frames
	Infrequently used frame counter 2bits bit 6~7	Determined by the console/radio to check for frame loss
2	Adjustment 1bytes	8 bits signed integer

3.4.1 For the Servo Control Command is Position calculate pitch angle error correct(manually) 0x01

2	Pitch angle error correct unit, 1 byte signed int, unit=0.001°. Positive number means pitch up, negative number means pitch down.
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3.4.2 For the Servo Control Command is Position calculate yaw angle error correct(manually) 0x02

2	Yaw angle error correct unit, 1 byte signed int, unit=0.001°. Positive number means yaw right, negative number means yaw left.
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3.5 B1 Servo Status Commonly Used 6 Bytes

Byte No.	Name	Range
1	Roll angle 4bits bit0-3	Roll angle bit4~7, 1bit=180/4095°, unsigned integer
	Servo Status 4bits bit 4~7	Servo Status 0x00: Motor ON/OFF 0x01: Manual speed mode <i>0x02: Follow the current geographic location (not support yet)</i> 0x03: Follow yaw 0x04: Home position <i>0x05: Azimuth scan (not support yet)</i> 0x06: Tracking mode <i>0x07: Tilt scan (not support yet)</i> <i>0x08: Point to specified target (point to a specific latitude and longitude, not support yet)</i> 0x09: Manual relative angle mode(current position is 0) 0x0A: Follow yaw disable 0x0B: Manual absolute angle mode (Home position as 0) <i>0x0C: Follow-up space angle (not support yet)</i> 0x0D: Manual RC mode <i>0x0E: Reserved</i> 0x0F: Do not change the servo state, the parameter is meaningless
2	Roll angle Roll angle low 8 bits	Roll angle low 8 bits, 1bit=180/4095°, unsigned integer Value 0-90 correspond to 0~-90° Value 90-180 correspond to 0~+90° Roll angle is 12 bits in total, high 4 bits are at low 4 bits of byte 1.
3~4	Yaw angle	1bit=360/65536°, signed integer
5~6	Pitch angle	1bit=360/65536°, signed integer

3.6 B2 Servo Status Infrequently Used 11 Bytes

Byte No.	Name	Range
1	Servo control, total 5 bit, Bit 0~4	0x00: no action 0x01: Position calculate pitch angle error correct(manually) 0x02: Position calculate yaw angle error correct(manually) 0x08: Zero drift correct(not support yet) 0x09: Zero drift calibrate(reserved) 0xEE: Fault
	Bit 5 reserved	
	Infrequently used frame counter 2 bit total. Bit 6~7	Same with the value of the latest packet received from A2 packet in infrequently used servo control
2~3	Correct value of position calculation 2 bit signed int	1bit = 0.001°, signed int. When servo control is 0x01, it' s pitch angle error value. Positive value means pitch up, negative value means pitch down. When servo control is 0x02, it' s yaw angle error value. Positive value means yaw right, negative value means yaw left.
4~5	Roll Angle 2bytes	1bit=360/65536°, signed integer
6~7	Roll angular velocity 2bytes	1bit=0.01°/S, signed integer
8~9	Yaw velocity 2bytes	1bit=0.01°/S, signed integer
10~11	Pitch angular velocity 2bytes	1bit=0.01°/S, signed integer

3.7 C1 Optical Control Commonly Used 2 Bytes

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
LRF			Operation Command No.						Zoom Speed			Sensor			

Byte No.	Name	Range
1~2	Image Sensor Choose 3bits bit 0~2	Video Choose (tracking infrequently used commands also can be used to switch videos) 0x00: No action 0x01: EO 1 0x02: IR thermal 0x03: EO 1+IR PIP 0x04: IR+EO 1 PIP 0x05: Fusion (For fixed lens dual sensor) 0x06: IR 1 13mm (for 1352 module) 0x07: IR 2 52mm (for 1352 module)
	Operation Command 1 corresponding parameter 3bits bit 3~5	When the operation instruction 1 matches the parameter, the default is to indicate the change speed of operation instruction 1 without special instructions. For example: When operation command 1 is 0x08 or 0x09, this parameter means focus speed, 0x01 is slowest, 0x07 is fastest

	<p>Operation Command 1 7bits bit 6~12 (0x00~ 0x7F)</p>	<p>0x00: No action 0x01: Stop focus, stop zoom 0x02: Brightness+ 0x03: Brightness- <i>0x04: Contrast ratio+ (not support yet)</i> <i>0x05: Contrast ratio- (not support yet)</i> <i>0x06: Aperture+ (not support yet)</i> <i>0x07: Aperture- (not support yet)</i> 0x08: FOV+ (For discrete field of view lenses, the rising edge is valid, and the digital zoom is included when it is enabled.) Zoom out 0x09: FOV- (For discrete field of view lenses, the rising edge is valid, and the digital zoom is included when it is enabled.) Zoom in 0x0A: Focus+ 0x0B: Focus- <i>0x0C: Internal non-uniformity correction (not support yet)</i> <i>0x0D: External non-uniformity correction(not support yet)</i> 0x0E: Polarity reversal (IR white hot) 0x0F: Polarity reversal (IR black hot) <i>0x10: Gain+ (not support yet)</i> <i>0x11: Gain- (not support yet)</i> 0x12: IR Rainbow 0x13: Take picture 0x14: Start record 0x15: Stop record 0x16: Switch to picture mode 0x17: Switch to record mode 0x18: Picture and Record Mode Switch 0x19: Auto focus mode 0x1a: Manual focus mode 0x1b: IR camera Dzoom+ 0x1c: IR camera Dzoom- 0x1d: Format SD card 0x1E: Query SD card status (T/A series) 0x1F: Query SD card total capacity (T/A series) 0x20: Query SD card left capacity (T/A series) 0x21: IR color ext1 0x22: IR color ext2 0x23: IR color ext3 0x24: IR color ext4 0x25: IR color ext5 0x26: IR color ext6 0x33: Thermal camera RAW format take picture (only support in temperature measure version gimbal)</p>
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		<p><i>0x34: Thermal camera RAW format record start (not support yet)</i></p> <p><i>0x55: Thermal camera RAW format record stop (not support yet)</i></p>
	<p>Laser Rangefinder Command 3bits bit 13~15</p>	<p>0x00: No action 0x01: Laser Single Ranging 0x02: Laser continuous ranging start 0x03: Laser LPCL continuous ranging start (pro models) <i>0x04: External sync ranging (not support yet)</i> 0x05: Stop ranging</p>

3.8 C2 Optical Control Infrequently Used 3 Bytes

Byte No.	Name	Range
1	Command 1 1 byte	<p>0x00: No action</p> <p><i>0x04: Timing non-uniformity correction ON (Reserved)</i></p> <p><i>0x05: Timing non-uniformity correction OFF (Reserved)</i></p> <p>0x06: EO Dzoom ON</p> <p>0x07: EO Dzoom OFF</p> <p>0x10: Image enhance ON</p> <p>0x11: Image enhance OFF</p> <p>0x12: IR color bar ON (thermometry version)</p> <p>0x13: IR color bar OFF (thermometry version)</p> <p>0x14: Set alarm value of IR camera</p> <p>0x15: EO image upside up/ down</p> <p>0x16: Defog OFF</p> <p>0x17: Defog ON</p> <p>0x18: Sensor build-in characters ON (OSD ON)</p> <p>0x19: Sensor build-in characters OFF (OSD OFF)</p> <p>0x1A: IR image upside up</p> <p>0x1B: IR image upside down</p> <p><i>0x1C: Brightness auto ON(Reserved)</i></p> <p>0x1D: Output temperature measure data, send one command output data once</p> <p>0x1e: Set data frame interval of output temperature measure data to parameter of this package</p> <p>0x1F: Stop cycle output temperature measure data</p> <p><i>0x28: Focus auto (Reserved)</i></p> <p><i>0x2B: Stop focus(Reserved)</i></p> <p>0x4A: Near-infrared mode ON</p> <p>0x4B: Near-infrared mode OFF</p> <p><i>0x4E: Reboot / Auto-check (Reserved)</i></p> <p><i>0x50: Set brightness to the parameter value of this packet command (Reserved)</i></p> <p><i>0x51: Set contrast ratio to the parameter value of this packet command (Reserved)</i></p> <p><i>0x52: Set aperture to the parameter value of this packet command (Reserved)</i></p> <p>0x53: Set EO zoom times to the parameter value of this packet command</p> <p><i>0x54: Set focus to the parameter value of this packet command (Reserved)</i></p> <p><i>0x55: Set gain/ISO to the parameter value of this packet command (Reserved)</i></p> <p>0x56: Set thermal camera digital zoom value to the parameter in C2 packet.</p> <p>0x74: Laser control command</p>

		<i>0x75: Optical power control command (Reserved)</i> 0x76: Set package time of recording.
2~3	Command 1 2 bytes	Integer is non-dimensional, the definition changes according to command 1.

3.8.1 C2 Command Parameter Meaning

3.8.1.1 For set max digital zoom level of OE camera 0x08

2~3	Value of max digital zoom level of OE camera. 2 bytes	Unsigned int, 1bit = 0.1 zoom level
-----	--	-------------------------------------

3.8.1.2 For Reboot/Auto-check 0x14

2~3	Set temperature alarm value of IR camera 2 bytes	Unsigned int, 1bit = 1°C
-----	---	--------------------------

3.8.1.3 For Reboot/Auto-check 0x4E

bit0~1	0 No action 1 Reboot 2 Auto-check
The rest bits are reserved	

3.8.1.4 For FOV to the Parameter Value of This Packet Command 0x53

2~3	Define zoom value 2 bytes	Unsigned integer, 1bit = 0.1 time
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3.8.1.5 For set thermal camera digital zoom value to the parameter in C2 packet 0x56

2~3	Define zoom value 2 bytes	Unsigned integer, 1bit = 0.1 time
-----	------------------------------	-----------------------------------

3.8.1.6 For Laser Control Command 0x74

2	0x00: No action 0x01: Laser on 0x02: Laser off <i>0x03: Laser system auto-check (not support yet)</i> 0x04: Laser zoom out 0x05: Laser zoom in 0x06: Laser zoom auto-sync EO mode 0x07: Laser zoom manual control mode <i>0x0E: Laser elevation protection OFF (not support yet)</i> <i>0x0F: Laser elevation protection ON (not support yet)</i>
3	

3.8.1.7 For Power Control Command 0x75

0~1bit	EO 1 Power 0: No change 1: ON 2: OFF
2~3bit	IR Thermal Power 0: No change 1: ON 2: OFF
4~5bit	EO 2 Power 0: No change 1: ON 2: OFF
6~7bit	
8~13bit	Reserved
14~15bit	Laser Power 0: No change 1: ON 2: OFF

3.8.1.8 For set package time of recording 0x76

2~3	Package time setting of recording 2 bytes	Unsigned integer, 1bit = 1 minute
-----	--	-----------------------------------

3.9 D1 Optical Status Commonly Used 12 Bytes

Byte No.	Name	Range
1	Optical sensor 3 bits bit 0~2	Current video stream 0x00: EO 1 only 0x01: IR only 0x02: EO 1+IR PIP 0x03: IR+EO 1 PIP 0x04: Mix mode of FUSION 0x05: IR 1(for 1352 models) 0x06: IR 2(for 1352 models)
	Current IR thermal camera Digital zoom times 4 bits bit 3~6	IR thermal camera digital zoom times: 0x0: X1 0x1: X2 0x2: X3 0x3: X4 ... 0xF: X16
	White hot/ black hot status 1 bit Bit 7	To grayscale mode of IR thermal camera 0: White hot 1: Black hot
2	<i>Laser rangefinder counter</i> 1bit bit 0	<i>Laser Rangefinder Counter</i> <i>Every time the ranging result is updated (may contain multiple echoes), the counter is inverted, and the value range is 0~1</i>
	Reserved Bit 1	
	LRF latency 6 bits bit 2~7	Relative to the delay of the servo command received by the optical packet, unsigned integer, 1bit=1ms
3~4	Bit 0~1: Optical Record Status 2 bits	Bit 0~1 Optical Record Status 0x0: Stop Rec 0x1: Recording 0x2: Pic mode
	Bit 2~5: IR Thermal Status Extension	Bit 2~5: IR Thermal Status Extension 0x0: Grayscale mode

	4 bits	0x1: Rainbow
	Current EO camera Digital zoom times 4 bits bit 6~9	EO digital zoom (≥ 4 times) 0: X1 1: X2 11: X12
	Bit 10~15 6 bits Reserved	
5~6	RLF feedback value 1 2 bytes	RLF feedback value: 1bit = 0.1m, all 0 means invalid, unsigned integer
7~8	Current sensor vertical FOV 2 bytes	Current sensor vertical FOV, unsigned integer 1 bit=0.01°
9~10	Current sensor horizontal FOV 2 bytes	Current sensor horizontal FOV, unsigned integer 1 bit=0.01°
11~12	Current sensor optical zoom times 2 bytes	Current sensor zoom times, unsigned integer 1bit=0.1 time

3.10 D2 Optical Status Infrequently Used 5 Bytes

Byte No.	Name	Range
1	Current sensor type 3 bits bit 0~2	Current sensor type 0x00: EO 1 only 0x01: IR only 0x02: EO 1+IR PIP 0x03: IR+EO 1 PIP 0x04: EO 2 only
	Device failure Identification 5 bits, bit 3~7	Device failure Identification pending. 0 is no failure, 1~3 is laser failure. After that, every 4 fault codes correspond to one sensor
2	Whether the current sensor is the main sensor (reserved) 1 bit Bit 7	0: Yes 1: No

	Optical sensor pixel quantity 7 bits Bit 0~6	1: 1080p 2: 2K 3: 4K 4: 960 5: 720 6: 640 The rest are reserved.
3	Extend parameter 1 byte	0x01: Digital zoom
4~5	Extend parameter 2 bytes	Signed int. 2 bytes. According to the type of parameters.

3.10.1 For when sensor type is IR 01, and the type of other parameters are digital zoom 01

4~5	Signed int, 2 bytes	Unit = 0.1 time
-----	---------------------	-----------------

3.11 E1 Tracking Command Commonly Used 3 Bytes

Byte No.	Name	Range
1	Tracking source choose (Reserved) 3 bits bit 0~2	0X00: No action 0x01 ~ 0x07 Tracking source choose: 0X01: EO 1 0X02: IR 0X03: EO 2
	Parameter 1 (reserved) 5 bits Bit 3~7	
2	Basic Command 1 byte	0X00: No action 0X01: Stop 0X02: Search (Bring up the cross) 0X03: Turn on tracking <i>0X04: Switch tracking point to cross position(take placed by enable tracking)</i> 0X05: AI function ON/OFF <i>0X06: (Reserved)</i> <i>0X07: (Reserved)</i> 0X08: For AI. Auto track target once identified 0x09: For AI. Change target when click targets identified. 0x0A: For AI. Not change target when click identified targets.

		<i>0X20: 16× 16 ultra small template (reserved)</i> <i>0X21: 32× 32 small template</i> <i>0X22: 64× 64 medium template</i> <i>0X23: 128× 128 big template</i> <i>0X24: Self-adapt between small and medium template</i> <i>0X25: Self-adapt between small and big template</i> <i>0X26: Self-adapt between medium and big template</i> <i>0X28: Self-adaption between small, medium and big template</i>
3	Parameter 2 1 byte	

3.11.1 The Meaning of E1 Command Parameter

3.11.1.1 For Search Command 0x02

Parameter 1	1-15 move right 16-31 move left	To control azimuth velocity of the small cross, unsigned integer, non-dimensional
Parameter 2	1-15 move down 16-31 move up	To control tilt velocity of the small cross, unsigned integer, non-dimensional

3.11.1.2 For AI identify function ON/ OFF Command 0x05

Parameter 2	1 byte	0: OFF 1: ON
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3.11.1.3 For Adjust Tracking Velocity Coefficient 0x07

Parameter 2	1byte	<i>Tracking velocity coefficient. 0 adopt system default tracking velocity. Unit: 0.1 time. Actual tracking velocity = Coefficient * system default tracking velocity.</i>
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3.11.1.4 For Adjust Tracking Velocity 0x06

Parameter 2	1 byte	<i>Tracking velocity. 0 adopt system default tracking speed. Unit: 0.2 degree/sec.</i>
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3.12 E2 Tracking Command Infrequently Used 5 Bytes

Byte No.	Name	Range
1	Extended Command 1 1 byte	Tracking module OSD items control and tracking control 0x00: No meaning 0x01: Set OSD on 0x0A: The tracking point moves to the command position 0x0B: Rectangular tracking area, top left corner point set 0x0C: Rectangular tracking area, lower right corner point set 0x1F: Set OSD color 0x20: Turn on identify information output 0x21: Turn off identify information output
2~3	Parameter 1 2 bytes	
4~5	Parameter 2 2 bytes	

3.12.1 The Meaning of E2 Command Parameter 1 and 2

3.12.1.1 For settings of OSD 0X01

Parameter 1(2 bytes)	BIT0 0: OSD on 1: OSD hide all BIT1 0: Center cross display on 1: Center cross display off BIT2 0: Pitch and Yaw angle display on 1: Pitch and Yaw angle display off BIT3 0: Offset display on (T) 1: Offset display off (T) BIT4 0: GPS_1 display on 1: GPS_1 display off BIT5 0: Time display on 1: Time display off BIT6 0: EO FOV/Zoom level display on 1: EO FOV/Zoom level display off BIT7 0: Small font(T) 1: Big font(T) 0: Identification boundary display(A) 1: Identification boundary hide(A) BIT8 0: Don' t save settings 1: Save settings(T) BIT9 0: IR display 1: IR hide (A) BIT10 0: LRF display 1: LRF hide (A) BIT11 0: GPS use Geographical coordinates 1: GPS use MGRS coordinates BIT12 0: TF display on 1: TF display hide (A)
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	BIT13 0: Display target GPS 1: Hide target GPS (A) BIT14 0: Zoom level(T)/ Green font(R) 1: FOV(T)/ White font(R) BIT15 0: GPS data display in degrees, minutes, seconds 1: GPS data display in decimal TIP: T means for T-series products, A means for A-series.
Parameter 2 (2 bytes)	Bit0: 0: Hotspot tracking OSD on 1: Hotspot tracking OSD off Bit1~bit15 Reserved

3.12.1.2 For Tracking Point Moves to the Command Position 0X0A

Parameter 1	Tracking point yaw command position, 2 bytes signed integer, 1bit=1pixel -960~960, 0 is center point. Negative means left, positive means right.
Parameter 2	Tracking point pitch command position, 2 bytes signed integer, 1bit=1pixel -540~540, 0 is center point. Negative means up, positive means down.

3.12.1.3 For Rectangular tracking area, top left corner point set 0x0B

Parameter 1	Top left corner X. Top left corner of rectangle X value (-960-960, 0 is center, -960 is leftmost, 960 is rightmost)
Parameter 2	Top left corner Y. Top left corner of rectangle Y value (-540-540, 0 is center, -540 is top, 540 is bottom)

3.12.1.4 For Rectangular tracking area, bottom right corner point set 0x0C

Parameter 1	Bottom right corner X. Bottom right corner of rectangle X value (-960-960, 0 is center, -960 is leftmost, 960 is rightmost)
Parameter 2	Bottom right corner Y. Bottom right corner of rectangle Y value (-540-540, 0 is center, -540 is top, 540 is bottom)

3.12.1.5 For set OSD color 0x1f

Parameter 1	Color high 2 bytes
Parameter 2	Color low 2 bytes

3.13 F1 Tracking Status Commonly Used 1 Byte

Byte No.	Name	Range
1	Sensor for tracking 3 bits bit 0~2	Sensor for tracking (tracking source) 0x0: EO 1 0x1: IR thermal camera 0x2: EO 2
	2 bits bit 3~4	Tracker current status 0x00: Stop 0x01: Search 0x02: Tracking 0x03: Lost
	3 bits bit 5~7	Reserved

3.14 F2 Tracking Status Infrequently Used 15 Bytes

Byte No.	Name	Range
1~11	Reserved	Reserved
12~13	Azimuth target Pixel difference	Signed integer 1bit=1pixel
14~15	Tilt target Pixel difference	Signed integer 1bit=1pixel

3.15 S1 TGCC Control Commonly Used 14 Bytes (TarGet Calculate Control)

Byte No.	Name	Range
1	Calculation control command	0x00 No action 0x01 Gimbal to target with specified coordinate 0x02 <i>Manual (air-to-ground) (Not support yet)</i> 0x03 <i>Follow the current geographic location (Not support yet)</i> 0x04 Follow-up space angle. 0x05 Calibrate the calculated target to a given coordinate The rest are reserved.
2	Parameter	
3~14	Parameter	

3.15.1 The Meaning of Parameter

3.15.1.1 For Fixed-point Follow-up Command 0x01

Byte No.	Meaning
3~6 bytes	Point to specified target latitude 32bits signed integer Positive is north latitude Negative is south latitude 1 bit= 10^{-7} °, WGS-84
7~10 bytes	Point to specified target longitude 32bits signed integer Positive is east longitude Negative is west longitude 1 bit= 10^{-7} °, WGS-84
11~14 bytes	Point to specified target height 1bit=0.001m 0 corresponds to altitude 0m Int32

3.15.1.2 For Follow-up Space Angle Command 0x04

Byte No.	Meaning
3~6	The angle between the yaw angle that the optical axis follows and the true north direction. 0 is true north, and positive is north east. Int32, 1 bit=360/65536 degree
7~10	The angle between the pitch angle of the optical axis and the horizontal plane, 0 is horizontal, and positive is horizontal upwards. Int32, 1 bit=360/65536 degree
11~14	Reserved

3.15.1.3 For calibrate the calculated target to a given coordinate 0x05

Byte No.	Name	Range
2 bytes	Source of error calibration of yaw angle 2 bits bit0~1	0: no meaning 1: Enter yaw angle error manually 2: Enter longitude and latitude to calibrate yaw angle error automatically
	Source of error calibration of pitch angle 2 bits bit2~3	0: no meaning 1: Enter pitch angle error manually 2: Enter longitude and latitude to calibrate pitch angle error automatically 3. Enter longitude, latitude and target height above sea level
	Reserved 4 bits bit3~bit7	Reserved
3~6 byte	Given latitude 32 bits signed int. Positive means North. Negative means South 1bit=10 ⁻⁷ °, WGS-84	
7~10 byte	Given longitude 32 bits signed int. Positive means East. Negative means West. 1bit=10 ⁻⁷ °, WGS-84	
11~12 byte	When the source of error calibration of yaw angle is 1, enter yaw angle manually take effect. Int 16, unit 0.001°. Negative means left, positive means right.	
13~14 byte	The source of error calibration of pitch angle. Value=1: Enter yaw angle manually take effect. Int 16, unit 0.001°. Negative means down, positive means up; Value=2: Enter range finder feedback value to calibrate pitch angle. Int 16, range finder value, unit is m. Value=3: Enter height above sea level of target to calibrate pitch angle. Int16, height above sea level of target, unit is m;	

3.16 S2 TGCC Control Infrequently Used 5 Bytes

Byte No.	Name	Range
1	Configuration Command	0x00 No action 0x01 Set the current altitude as the takeoff altitude (Reserved) 0x02 Give the current target coordinate altitude (Reserved) 0x03 Save the current target altitude (Reserved) The rest are reserved.
2~5	Configuration Parameter	

3.17 T1 TGCC Control Commonly Used 22 Bytes

Byte No.	Name	Range
1	Target distance source type 3 bits Bit0~2	0x0 No Target 0x1 Laser Rangefinder value 0x2 Height estimate value 0x3 Radio frequency (Reserved) The rest are reserved
	GPS signal capture stage 2 bits Bit3~4	0x0 No signal 0x1 Time locked 0x2 2D Locked 0x3 3D Locked
	GPS Horizontal signal quality 3 bits Bit5~7	Reserved

2	GPS vertical signal quality 3bits Bit0~2	Reserved
	S2 packet command respond 1 bit Bit3	0: Not received 1: Responded to S2 packet command, only continued 1 frame

	N packet command respond 4 bits Bit4-7	<i>1: Gyro offset auto adjusting</i> <i>2: Gyro offset saving</i> <i>3: Gyro offset recovered to factory default value</i> <i>4: 0 angle position of AHRS adjusted</i> <i>5: AHRS attitude offset Saving</i> <i>6: AHRS attitude offset reset</i> <i>7: Calibrating gyro temperature drift</i> <i>8: Gyro temperature drift calibrated over</i>
3~6	Vehicle position: Latitude 4 bytes	32 bits, signed integer Positive is north latitude Negative is south latitude 1bit= 10^{-7} °, WGS-84
7~10	Vehicle position: Longitude 4 bytes	32 bits signed integer Positive is east longitude Negative is west longitude 1 bit= 10^{-7} °, WGS-84
11~12	Vehicle attitude: 2 bytes	Int16, 1bit=1m
13~16	Target position: Latitude 4 bytes	32 bits, signed integer Positive is north latitude Negative is south latitude 1bit= 10^{-7} °, WGS-84
17~20	Target position: Longitude 4 bytes	32bits signed integer Positive is east longitude Negative is west longitude 1bit= 10^{-7} °, WGS-84
21~22	Target attitude: 2 bytes	Int16, 1bit=1m

3.18 T2 TGCC Control Infrequently Used 18 Bytes

Byte No.	Name	Range
1	Reserved	
2~3	Date 2 bytes	Bit15~11: Day Bit10~7: Month Bit6~0: Year (+2000)
4~6	Time 3 bytes	UTC time 1bit=0.01s
7~8	GPS Yaw 2 bytes	1bit=360/65536°, signed integer
9~10	Vehicle attitude angle: Yaw 2 bytes	1bit=360/65536°, signed integer
11~12	Vehicle attitude angle: Pitch 2 bytes	1bit=360/65536°, signed integer
13~14	Vehicle attitude angle: Pitch 2 bytes	1bit=360/65536°, signed integer
15~18	Reserved	

3.19 M AHRS Sensor Output Data 1~42bytes

Note:

- 1) The data output organization of AHRS changes with the indication of byte 1 data type (bit0~4). The data output sequence is shown as follows. **When there is data lost in the middle, the following data is automatically aligned forward, so when the output data content is different, The length of the M packet is different.**
- 2) Definition of the attitude angle of the vehicle: **Look from the tail of the vehicle to the head.**
Azimuth angle: 0 is the nose pointing to true north, positive is the nose pointing east by north, and negative for west by north. Tilt angle: The angle between nose and the horizontal. 0 is horizontal, positive is upwards, and negative is downwards. Tilt angle: 0 when the fuselage is level, positive is right tilt, and negative is left tilt.

Byte No.	Name	Range	Byte No.
1	Data type 5bits Bit0~4	Bit0: Attitude_DATA Bit1: GPS_DATA Bit2: Gyro_DATA	Set to 1 to includes this data group Default 0x07
	Bit5~7	Reserved	
2~8		Reserved	
9~10	Vehicle tilt angle 2 bytes	1bit=360/65536°, signed integer	Attitude_DATA
11~12	Vehicle tilt angle 2 bytes	1bit=360/65536°, signed integer	Attitude_DATA
13~14	Vehicle yaw angle 2 bytes	1bit=360/65536°, signed integer	Attitude_DATA
15~16	Date 2 bytes	Bit15~11: Day Bit10~7: Month Bit6~0: Year (+2000)	GPS_DATA
17~19	Time 3 bytes	UTC time 1bit=0.01s	GPS_DATA
20~21	GPS yaw 2 bytes	1bit=360/65536°, signed integer	GPS_DATA
22	Position mark (reserved) 1 byte	<i>bit 0 set: New Position</i> <i>bit 1 set: Clock fix calculated this position</i> <i>bit 2 set: Horizontal coordinates calculated this position</i> <i>bit 3 set: Height calculated this position</i>	GPS_DATA
23~26	Latitude 4 bytes	1bit=10 ⁻⁷ °, signed integer	GPS_DATA
27~30	Longitude 4 bytes	1bit=10 ⁻⁷ °, signed integer	GPS_DATA
31~34	Height 4 bytes	1bit=1mm, signed integer	GPS_DATA
35~36	Ground X Speed (Latitude, positive north) 2 bytes	1bit=0.01m/s, signed integer	GPS_DATA
37~38	Ground Y Speed (Longitude, positive east) 2 bytes	1bit=0.01m/s, signed integer	GPS_DATA
39~40	VDOP 2 bytes	1bit=0.01	GPS_DATA
41~42	Ground Z Speed (Altitude, positive down) int16	1bit=0.01m/s, signed integer	GPS_DATA

3.20 ACK gimbal feedback packets after receiving data 1 byte

Byte No.	Name	Range
1 byte	Feedback frame ID received	Feedback: AA 55 DC 04 AC 1A B2

3.21 SD card query 0x5D 2 bytes

Byte No.	Name	Range
1	Control commands	0x00 no action 0x8A Format SD card 0x8B Query SD card
2	Parameters	When control command is 0x8b query SD card: 02-inquiry SD card status 03-inquiry SD card total capacity 04-inquiry SD card remain capacity 05-inquiry SD card remain pictures quantity 06-inquiry SD card remain video time

3.22 SD card feedback command 0xD5 5 bytes

Byte No.	Name	Range
1	Control commands	01-inquiry SD card status 02-inquiry SD card total capacity 03-inquiry SD card remain capacity 04-inquiry SD card remain pictures quantity 05-inquiry SD card remain video time
2~5	Parameters	

3.22.1 When control command is 01 query SD card state

Byte No.	Name	Range
2	Parameters	[bit0]: Is inserted [bit1]: Is initializing [bit2]: Is read only [bit3]: Is formatted [bit4]: Is formatting [bit5]: Is full [bit6]: Is verified [bit7]: Is invalid format
3	Parameters	[bit0]: Has error

		[bit1]: 1: Is Recording 0: not recording Others reserved
4~5	Reserved	

3.22.2 When control command is 02 query SD card total capacity

Byte No.	Name	Range
2~5	Parameters	Unit 32 Unit MB

3.22.3 When control command is 03 query SD card remaining capacity

Byte No.	Name	Range
2~5	Parameters	Unit 32 Unit MB

3.22.4 When control command is 04 query SD card remaining numbers of taking photo

Byte No.	Name	Range
2~5	Parameters	Unit 32 Unit pcs

3.22.5 When control command is 05 query SD card remaining time of recording

Byte No.	Name	Range
2~5	Parameters	Unit 32 Unit second

3.23 IP query command 0x19 1byte

Byte No.	Name	Range
1	Control command	0: query IP address

3.24 IP query command 0x29 4 bytes

Byte No.	Name	Range
1	Parameter	IP address first part (192)
2	Parameter	IP address second part (168)
3	Parameter	IP address third part (2)
4	Parameter	IP address fourth part (119)

3.25 IP query command 0x92 4 bytes

Byte No.	Name	Range
1	Parameter	IP address first part (192)
2	Parameter	IP address second part (168)
3	Parameter	IP address third part (2)
4	Parameter	IP address fourth part (119)

3.26 AI series identify state feedback 0xF3

Byte No.	Name	Range	Meaning
1	Total number of targets	0~255	Total number of targets identified
2	Total number of packets		Total number of targets/4. Add 1 if it has mantissa in result.
3	Serial number of current packet		0 1 2...
4~8	Reserved	0	
9	The type of the first target 2bit bit0~1	0x00: car 0x01: human 0x02: logo The rest are regarded as unrestricted output types	
10~11	The number of the first target	1~999 (Target number 16)	
12~ 13	Yaw coordinate of target	signed int 1bit=1pix	The offset from center to target of yaw. Negative

			means left, positive means right.
14~15	Pitch coordinate of target	signed int 1bit=1pix	The offset from center to target of pitch. Negative means up, positive means down.
16~ 17	Length of the first target	unsigned int 1bit=1pix	
18~ 19	Width of the first target	unsigned int 1bit=1pix	
20~21	The degree of dependence of first target identified	unsigned int 1bit=0.0001	Degree of dependence max: 1
22	The type of the second target 2bit Bit0~1	0x00: car 0x01: human Rest reserved.	
23~ 24	The number of the second target	0~999 (target number 16)	
25~ 26	Yaw coordinate of target	signed int 1bit=1pix	The offset from center to target of yaw. Negative means left, positive means right.
27~ 28	Pitch coordinate of target	signed int 1bit=1pix	The offset from center to target of pitch. Negative means up, positive means down.
29~ 30	Length of the second target	unsigned int 1bit=1pix	
31~ 32	Width of the second target	unsigned int 1bit=1pix	
34~34	The degree of dependence of the second target identified	unsigned int 1bit=0.0001	Degree of dependence max: 1
35~47	Information of the third target		
48~60	Information of the fourth target		

Attention: When N targets are actually identified, they will be sent in N / 4 (when there is a remainder + 1) packets. The format of sending each target' s packet from serial port is the same as that of 9 ~ 21 bytes, which will be sent in turn. Send only when detection is on and a target is detected. (Open: 55 AA DC 08 2e 20 00 00 00 00 06 Close: 55 AA DC 08 2e 21 00 00 00 00 07)

3.27 Send KLV data to video processing board 0xF4

Byte No.	Name	Range	Meaning
1	1 byte Total packets	2	Total KLV data 114 bytes(at now), send in 2 packets, 57 bytes each.
2	1 byte Serial NO. of current packet	0 1	Use value 0 and 1.
3	1 byte Effective data of current packet	1-57	0 packet and 1 packet, each 57 in total.
4-60	57 bytes Data		

Checksum:

```

uint8_t viewlink_protocol_checksum(uint8_t* viewlink_data_buf)
{
    uint8_t len = viewlink_data_buf[3];
    uint8_t checksum = len;
    for(uint8_t i =0;i < len-2;i++)
    {
        checksum = checksum ^ viewlink_data_buf[4+i]);
    }
    return(checksum);
}

```

Command ID	Command Name	Description
0x04	Time zone	Int8, -12 ~ 12
0x05	OSD hide	Uint8, detail ref: Table OSD on/hide control
0x06	magnetic_declination	Int8, unit 0.1degree
0x07	Osd type	Uint8, detail ref: Table OSD type control
0x08	Baud rate	Uint8,detail ref: table baud rate control
0x09	EO digital zoom	Uint8 0: disable 1: enable
0x0a	Temperature door 0xrs	Uint16,Temperature door for alarm (thermal camera).0xpqrs ,unit 1degree.
0x0b	Temperature door 0xpq	
0x0c	Tracking	0: disable, 1: enable
0x0d	LRF default mode	0: stop 1: continuous (with LRF model)
0x0e	Record resolution	0: 1080p 1:4k (just for Z40K)
0x0f	Target pos calculation	Uint8, Table: target position calculation byte
0x10	RC channels map mode	1,(1~7) 2,(6~12) 3,(9~15) 4,custom definition
0x11	Yaw channel	0xRL : L =yaw left ch ,R = yaw right ch
0x12	Pitch channel	0xUD: U =pitch up ch, D =pitch down ch
0x13	Recenter/Speed channel	0xRS: R= recenter ch, S = speed control ch
0x14	Zoom channel	0xIO: I = Zoom in ch, O = zoom out ch
0x15	PiP /IR color channel	0xPC: P= Picture in picture ch C:color switch ch
0x16	record /shoot channel	0xRS: R= record ch S: shoot ch
0x17	Tracking channel	0xSE: S = start tracking ch E: Exit tracking ch
0x18	Focus hold mode	For Z5S, Z6KA7
0x19	Camera type	For T-series camera type
0x1a	YPMZ invert control	Table: YPMZ invert control
0x1b	PRM invert control	Table: PRM invert control
0x1c	reserved	
0x1d	reserved	
0x1e	Tracker template size	0x3c, auto

0x1f	Pitch declination	Unit 0.01degree
0x20	Output control	Bit0 = 1, reset ip to 192.168.2.119 Bit1 = 1, output tracking date from serial port Bit2 = 1, output mavlink msg from tcp/udp port Bit3 = 1, output mavlink msg from serial port
0x21	Z40k resolution OSD	0X10 , ON ; 0X20 OFF
0x22	Z40K date OSD	0X80 , ON; 0X90, OFF
0x23	Z40K all OSD	0X40, ON; 0X30, OFF
0x24	Z40K SD remain OSD	0XB0, ON; 0XA0, OFF
0x25	Z40K record time OSD	0XC0, ON; 0XD0, OFF
0x26	Z40K record mode OSD	0X01, shoot mode; 0X00 record mode
0x27	Track pitch p	Unit 0.1
0x28	Track pitch i	Unit 0.001
0x29	Track pitch d	Unit 0.1
0x2a	Track yaw p	Unit 0.1
0x2b	Track yaw i	Unit 0.001
0x2c	Track yaw d	Unit 0.1
0x2d	Track mode select	1: high speed tracking mode 0: slow speed tracking mode
0x2e	Flip control	Bit0 = 1, EO flip off Bit1 = 1, EO flip on Bit4 = 1, IR flip off Bit5 = 1, IR flip on
0x2f	IR raw data record	Bit0 = 0 off, bit0=1 on Bit1 = 0 use IMU angle, bit1=1 use encoder angle
0x30	Interval time 0xrs	0xpqrs : Interval time for gimbal attitude output. Unit ms.
0x31	Interval time 0xpq	
0x32	Mavlink system ID	Default is 1
0x33	Interval time for shoot	Unit 100ms.
0x34	Time zone minute	Int 8, minutes

Table-A: OSD ON/ hide control byte

Bit0	0: all OSD on	1: all OSD hide
Bit1	0: cross frame on	1: cross frame hide
Bit2	0: pitch & yaw ON	1: pitch & yaw hide
Bit3	0: track point(X,Y) on	1: track point(X,Y) hide
Bit4	0: GPS on	1: GPS hide
Bit5	0: time on	1: time hide
Bit6	0: zoom/ FOV on	1: zoom/ FOV hide
Bit7	0: small size font	1: big size font

Table-B: OSD type control byte		
Bit0	0: not save OSD settings	1: save OSD settings
Bit1	0: IR digital zoom level on	1: IR digital zoom level hide
Bit2	0: LRF on	1: LRF hide
Bit3	0: format is GPS	1: format is MGRS
Bit4	0: TF on	1: TF hide
Bit5	0: target GPS on	1: target GPS hide
Bit6	0: zoom times/ Font white	1: FOV/ Font green
Bit7	0: GPS format deg/min/sec	1: GPS format degrees

Table-C: Target position calculation byte	
Bit0:	OSD GPS type 0: display UAV GPS information on OSD 1: display Object GPS information on OSD
Bit1~bit3:	reserved
Bit4:	serial data output enable/disable 0: serial port does not output data 1: serial port output data
Bit5~7:	data format of output from serial 0: v1 format 1: v2 format 2: v3 format

Table-D: Baud rate control byte	
0	Default 115200
1	4800
2	9600
3	19200
4	38400
5	57600
6	115200
7	S.BUS
8	2400
9	500000

Table-E: YPMZ invert control	
Bit0	Zoom out control 0: 1900 zoom out, 1500 zoom stop 1: 1100 zoom out,1500 zoom stop
Bit1	Zoom in control 0: 1100 zoom in, 1500 zoom stop 1: 1900 zoom in, 1500 zoom stop
Bit2	Speed control 0: 1900 for slowest speed 1: 1100 for slowest speed

Bit3	Recenter 0: 1100 for recenter 1: 1900 for recenter
Bit4	pitch up control 0: 1900 for pitch up, 1500 for pitch stop 1: 1100 for pitch up, 1500 for pitch stop
Bit5	pitch down control 0: 1100 for pitch down, 1500 for pitch stop 1: 1900 for pitch down, 1500 for pitch stop
Bit6	Yaw left control 0: 1900 for yaw left, 1500 for yaw stop 1: 1100 for yaw left, 1500 for yaw stop
Bit7	Yaw right control 0: 1100 for yaw right, 1500 for yaw stop 1: 1900 for yaw right, 1500 for yaw stop

Table-F: PRM invert control	
Bit0	RESERVED
Bit1	RESERVED
Bit2	Speed control 0: 1900 for slowest speed (from 1100 to 1900) 1: 1100 for slowest speed (from 1900 to 1100)
Bit3	Recenter 0: 1100 for recenter (from 1500 to 1100) 1: 1900 for recenter (from 1500 to 1900)
Bit4	shoot control 0: 1900 for shoot (from 1500 to 1900) 1: 1100 for shoot (from 1500 to 1100)
Bit5	record control 0: 1100 for record start/stop (from 1500 to 1100) 1: 1900 for record start/stop (from 1500 to 1900)
Bit6	Picture in picture control 0: 1900 for picture in picture control (from 1500 to 1900) 1: 1100 for picture in picture control (from 1500 to 1100)
Bit7	IR Color control 0: 1100 for IR color (from 1500 to 1100) 1: 1900 for IR color (from 1500 to 1900)

4. Example

4.1 Gimbal movement

Gimbal moves with speed 20°/s:

Left: 55 AA DC 11 30 01 F8 30 00 00 00 00 00 00 00 00 00 00 E8

Right: 55 AA DC 11 30 01 07 D0 00 00 00 00 00 00 00 00 00 00 F7

Up: 55 AA DC 11 30 01 00 00 07 D0 00 00 00 00 00 00 00 00 00 00 F7

Down: 55 AA DC 11 30 01 00 00 F8 30 00 00 00 00 00 00 00 00 00 00 E8

Stop: 55 AA DC 11 30 01 00 00 00 00 00 00 00 00 00 00 00 00 20

Angle control gimbal to yaw right to 90°, tilt down to 90°:

Angle control: 55 AA DC 11 30 0B 3F FC 3F FC 00 00 00 00 00 00 00 00 00 2A

Other controls:

Recenter: 55 AA DC 11 30 04 00 00 00 00 00 00 00 00 00 00 00 00 25

Enable follow yaw: 55 AA DC 11 30 03 00 00 00 00 00 00 00 00 00 00 00 00 22

Disable follow yaw: 55 AA DC 11 30 0A 00 00 00 00 00 00 00 00 00 00 00 00 2B

Motor ON: 55 AA DC 11 30 00 01 00 00 00 00 00 00 00 00 00 00 00 20

Motor OFF: 55 AA DC 11 30 00 00 01 00 00 00 00 00 00 00 00 00 00 20

4.2 Sensor Control

Zoom in: 55 AA DC 11 30 0F 00 00 00 00 00 00 00 02 78 00 00 00 54

Zoom out: 55 AA DC 11 30 0F 00 00 00 00 00 00 00 02 38 00 00 00 14

Stop zoom: 55 AA DC 11 30 0F 00 00 00 00 00 00 00 00 00 00 00 00 2E

Directly zoom to 20x times: 55 AA DC 0D 31 00 00 53 00 C8 00 00 00 00 00 A7

Switch pic and rec modes: 55 AA DC 11 30 0F 00 00 00 00 00 00 00 06 10 00 00 00 38

Take picture: 55 AA DC 11 30 0F 00 00 00 00 00 00 00 04 D0 00 00 00 FA

Start record: 55 AA DC 11 30 0F 00 00 00 00 00 00 00 05 10 00 00 00 3B

Stop record: 55 AA DC 11 30 0F 00 00 00 00 00 00 00 05 50 00 00 00 7B

4.3 With tracking function

Start tracking: 55 AA DC 11 30 06 00 00 00 00 00 00 00 00 00 00 03 00 24

Stop tracking: 55 AA DC 11 30 01 00 00 00 00 00 00 00 00 00 01 01 00 20

Point to track: 55 AA DC 0D 31 00 00 00 00 00 0A FF 88 01 18 58

4.4 With digital zoom (D Zoom)

IR Dzoom+: 55 AA DC 11 30 0F 00 00 00 00 00 00 00 06 D0 00 00 00 F8

IR Dzoom-: 55 AA DC 11 30 0F 00 00 00 00 00 00 00 07 10 00 00 00 39

EO Dzoom ON: 55 AA DC 0D 31 00 00 06 00 00 00 00 00 00 00 3A

EO Dzoom OFF: 55 AA DC 0D 31 00 00 07 00 00 00 00 00 00 00 3B

4.5 IR thermal camera

EO + IR White hot: 55 AA DC 11 30 0F 00 00 00 00 00 00 00 03 83 00 00 00 AE

EO + IR Black hot: 55 AA DC 11 30 0F 00 00 00 00 00 00 00 03 C3 00 00 00 EE

EO + IR Pseudo color: 55 AA DC 11 30 0F 00 00 00 00 00 00 00 04 83 00 00 00 A9

TCP command protocol

	STX	CMD ID	DATA LEN	DATA BODY	DATA CHECKSUM LSB of sum of data body
	0xEB	0x90	XX	Serial command protocol	Data body
<u>Eg.</u>	EB	90	06	81 01 04 07 27 FF	B3
				Zoom in	

For example: TCP zoom in command: EB 90 06 81 01 04 07 27 FF B3