



KINGMAX SERIAL SERVO COMMUNICATION PROTOCOL

(5th Version)

Usage rights: public

Protocol version: v5.2.0

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一、 Summary of communication protocol

This document is a protocol document (5th version) for communication control of two-wire/singlewire TTL serial bus and RS -485/RS -232 industrial serial bus series intelligent servos (or motors, hereinafter referred to as servos) developed by KINGMAX HOBBY CO., LTD Intelligent Technology.

This protocol uses half-duplex masterslave question-and-answer communication, that is, the controller acts as the host to send read and write commands to the servo, and the servo acts as a slave to perform corresponding actions or responses according to the specific situation. Multiple servos are allowed to be mounted on a bus, and each servo on the bus has a unique ID (0~250). The controller can access specific servos through the servo ID, or broadcast ID (254) Send data to all the servos on the bus. In addition, you can use the super ID (253) to send query commands to the servos on the bus, and the servos with different IDs will respond in tim-sharing.

The communication mode is serial asynchronous mode, a frame of data is divided into 1 start bit, 8 data bits and 1 stop bit, no parity bit.

二、 Command packet format

2.1、 Command format

Send frame:

Frame header	ID number	Data length	Command function	Command address	Parameter sequence	Data validation
2 bytes	1 byte	1 byte	1 byte	1 byte	N bytes	1 byte
0xF9 0xFF	id	N+3	cmd	adr	Send parameters	Checksum

Response frame:

Frame header	ID number	Data length	Command function	Command address	Parameter sequence	Data validation
2 bytes	1 byte	1 byte	1 byte	1 byte	N bytes	1 byte
0xF9 0xF5	id	N+3	cmd	adr	Response parameters	Checksum

Frame header: indicates the beginning of the command.

ID number: The sender can use super ID (253), broadcast ID (254), or target servo ID, The responder returns its own ID.

Data length: equal to the total number of bytes of [ID number +...+parameter N], that is N+3.

Command function: used to describe the function type of the command, such as read, write, firmware update, etc. See "Command Function List" for details.

Command address: The address that the command needs to be read and written, see "Servo Control Command Address List" for details.

Parameter sequence: the sending/response parameters contained in the command

Data verification: single-byte sum verification method, Checksum= ~((ID +...+parameter N)&0xFF)

Note 1: The maximum number of bytes in the command packet is 256 bytes.

Note 2: Sending the read command needs to use the super ID (253) or the target servo ID, and the broadcast ID (254) has no response.

Servo status response frame (short response frame):

Frame header	ID number	Data length	Servo status	Data validation
2 bytes	1 byte	1 byte	1 byte	1 byte
0xF9 0xF5	id	0x02	Status	Checksum

Servo state : Feedback the current status of the Servo, see "Current status of the Servo" for details.

Data validation: single-byte sum verification method, $\text{Checksum} = \sim(\text{ID} + \text{data length} + \text{device status}) \& 0xFF$

2.2. Current status of the Servo

By reading the current status of the Servo, the controller can quickly know whether the Servo is abnormal and take corresponding measures.

Data bit	State name	status description
Bit7	Running	1=Servo/motor is executing running command Automatically clear after the end of rotation or the protection is triggered to stop rotation
Bit6	Command execution result	0=success; 1=unsuccessful (usually used to judge when modifying user data) Current command is valid, automatically cleared on next command
Bit5	Command exception	Data packet verification is abnormal, or the command function is not open Current command is valid, automatically cleared on next command
Bit4	Hardware exception protection	1=under protection; 0=no abnormal protection The specific exception type can be read through the command Cannot be dismissed, only restart the servo
Bit3	Stall abnormal protection (overload protection)	1=under protection; 0=no abnormal protection Cleared after removing the protection
Bit2	Temperature protection	1=under protection; 0=no abnormal protection Cleared after removing the protection
Bit1	Current abnormal protection	1=under protection; 0=no abnormal protection Cleared after removing the protection
Bit0	Voltage abnormal protection (Low voltage/High voltage)	1=under protection; 0=no abnormal protection Cleared after removing the protection

2.3. Command function list



FunctionID	Command function name	description
0x01	Servo Ping	Ping online servos, this command does not require the command address and command parameters the servo uses "short response frame" to respond
0x02	Read command	Read " Servo Control Command Address List " data
0x82	Multi-ID read command	Read "Servo Control Command Address List" data, read data on multiple IDs at the same time in one command See "4.1 Multi-ID Read Command" for details
0x03	Write command	Write data to "Servo control command address list" If the servo response level=1: the servo uses "short response frame" to respond
0x83	Multi-ID write command	Write data to "Servo Control Command Address List", send data to multiple IDs at the same time in one command See "4.2 Multi-ID Write Command" for details, the servo does not respond on this command
0x04	Sync write command	See "4.3 Sync Write Command" for details, the servo does not respond
0x84	Sync write execution command	See "4.3 Sync Write Command" for details, the servo does not respond
0x78	Firmware upgrade command	See the file "De Sheng Smart Servo Firmware Upgrade" for details
0x7E	Factory test command	See the file "Factory Test Command Address List" for details
0x7F	Customer Custom command	See the file "Customized Command Address List" for details

三、 Servo control command address list and usage description

Note 1: The address list uses "read_command_0x02" and "writecommand_0x03" for direct read and write, does not support continuous read and write to multiple addresses

Note 2: This protocol adopts [little-endian mode] to process multibyte data transmission and reception, that is, lowbyte data is sent first, then highbyte data, such as sending 1000 (0x03E8), sending 0xE8 first, then sending 0x03.

Note 3: The Servo rotation direction is divided into positive and negative directions, the negative direction is the direction of the negative steering angle value, the positive direction is the direction of the positive steering angle value, and the positive direction corresponds to clockwise or counterclockwise depending on different products. Generally, The positive direction is clockwise (looking down on the main output shaft).

Note 4: User data can be modified and stored when power off.

Note 5: Data type description

Int8	Signed single-byte integer, data range -128~127	UInt8	Unsigned single byte integer number, data range: 0~255
Int16	Signed double-byte integer number, data range -32768 ~ 32767	UInt16	Unsigned double byte integer number, data range: 0 ~ 65535
Int32	Signed four-byte integer number, data range -2147483648 【0x80000000】 ~ 2147483647 【0x7FFFFFFF】	UInt32	Unsigned fourbyte integer number, data range: 0 ~ 4294967295 【0xFFFFFFFF】

3.1、 Read and write commands for basic parameter configuration of Servo

Command address	Command name	R/W	parameter		User data
			type	Initial value	
0	Retain				
1	Servo status	read	UInt8、 UInt8	0、 --	No
2	System restart	write	--	/	No
3	User data reset	write	UInt8	--	No
4-9	reserve				
10	product information	read	-- ^{T1}	-- ^{T2}	No
11	Protocol version	read	UInt32	--	No
12	Firmware version	read	UInt32	--	No
13-14	reserve				
15	Servo ID	Read Write	UInt8	0	Yes
16	baud rate	Read Write	UInt16	1152	Yes
17	System configuration parameters	Read Write	UInt8	0x02	Yes
18	Response waiting delay	Read Write	UInt16	200	Yes

19	0x13	Maximum output torque	Read Write	Uint16	1000	Yes
20	0x14	Maximum output current	Read Write	Uint16	--	Yes
21	0x15	Maximum rotation speed	Read Write	Uint16	--	Yes
22	0x16	Level-1 zero position ^{T3} offset	Read	Int16	--	Yes
23	0x17	Level-2 zero position ^{T3} offset	Read Write	Int16	0	Yes
24	0x18	Level-2 zero position offset accessory	write	Int8	--	No
25	0x19	Minimum rotation angle limit	Read Write	Int16	--	Yes
26	0x1A	Maximum rotation angle limit	Read Write	Int16	--	Yes
27-49		reserve				

T1: "--" In the data type, there is no fixed type or number, please refer to the detailed description below for reading and writing

T2: "--" In the initial value, it means that there is no fixed initial value, or different according to different products

T3: Zero position When the electrical zero position and structural zero position of the servo are not in the same position, it can be solved by adjusting the zero offset, or by adjusting the value to make the electrical neutral position reach the position the user wants, but if the potentiometer type For products, the zero offset angle is generally not too large, generally only $\pm 10^\circ$, otherwise it will affect the angle on both sides.

3.1.1、 Servo status read command_0x01

Read sending parameters: none

Read response parameters: [Servo status], [random number]

The random number in the response is mainly used to identify the situation when there are multiple servos with the same ID online, for example, when there are two ID1 servos at the same time, after receiving the command, the two servos have the opportunity to respond at the same time

F9 F5 01 05 02 01 00 05 xx

F9 F5 01 05 02 01 00 16 xx

Then the host can determine that there maybe multiple ID1 online at the same time by determining that the verification data is abnormal

3.1.2、 System restart write command_0x02

Write sending parameters: [0xE1 0xE2 0xE3 0xE4]

The parameter is a fixed sequence, the servo will restart immediately after receiving the command no response

3.1.3、 User data reset write command_0x03

Write sending parameters: [Parameter]

Parameter=0x01:Reset other user data except [ID, baud rate, zero position offset]

Parameter=0x02:Reset all user data

3.1.10、Product information readcommand_0x0A

To be added

3.1.11、Protocol file version read command_0x0B

Read sending parameters: none

Read response parameters: [protocol version] parameter format 0x@@##&&&&

0x@@ : Main version number, different versions may be incompatible

0x##: Small version number, high version is compatible with small version, mainly used to adjust some functions

0x&&&&: If it is not 0, it is customized version, if it is 0, it is standard version

3.1.12、Servo firmware version read command_0x0C

Read sending parameters: none

Read response parameters: [firmware version] parameter format 0x@@##&&&&

0x@@ : bootloaderVersion number, when it is 0, there is no bootloader upgrade function, such as v5.2=0x52

0x##: Hardware version number, such as v1.1=0x11

0x&&&&: Software version number, such as v1.0.02=0x1002

3.1.15、Servo ID read and write command_0x0F

Read sending parameters: none

Read response parameters: [Servo id]

Write in sending parameters: [Servo id]

When writing a new ID command, if there is a response, the response ID will use the old ID to respond, and then switch to the new ID

3.1.16、Baud rate read and writecommand_0x10

Read sending parameters: none

Read response parameters: [baud rate /100]

Write sending parameters: [baud rate/100]

The baud rate is an integer multiple of 100, and the range may vary according to different products, generally9600~1000000bps

For example, when writing 1152, the communication baud rate is set to115200 bps

Note: After modification, it will take effect aftersystem restart or power on again

3.1.17、 System configuration parameter read and writecommand_0x11

Read sending parameters: none

Read response parameters: [system configuration parameters]

Write sending parameters: [System Configuration Parameters]

System configuration parameters

Data bit	Function Description
other	retain
Bit3	Response level 0=Only theping andread command will respond; 1=The queryread and writecommandwill respond Write command response will only respond when the servo ID is used
Bit2	Direction of rotation 0=positive drection is clockwise; 1=positive direction is counterclockwise
Bit1	The output state of the servo when idle 0=Full release, no brake damping; 1=Brake damping
Bit0	The output state of the servo when power on 0=Full release, no brake damping; 1=Brake damping

Please update this parameter in a non-working state to prevent out of control

3.1.18、 Response waiting delay read and writecommand_0x12

Read sending parameters: none

Read response parameters: [Response waiting delay]

Write sending parameters: [Response waiting delay]

Response waiting delay value, used for the waiting time between the servo after receiving the command and sending the response, the unit is microsecond, eg:200us

3.1.19、 Maximum output torque read and writecommand_0x13

Read sending parameters: none

Read response parameters: [Maximum output torque]

Write sending parameters: [Maximum output torque]

That is, the PWM value of the motor drive, the value range is 0~1000, corresponding to0%~100%

Note: "Torque" in this document refers to the driving PWM of the motor, which will not be explained below

3.1.20、 Maximum output current read and writecommand_0x14

Read sending parameters: none

Read response parameters: [Maximum output current]

Write sending parameters: [Maximum output current]

The maximum current when theservo is locked, the unit is mA, the default value depends on the product

3.1.21、 Maximum rotation speed read and writecommand_0x15

Read sending parameters: none

Read response parameters: [Maximum rotation speed]

Write sending parameters: [Maximum rotation speed]

The maximum speed in the speed control mode, the unit is: degrees per second, the default value depends on the product type: 360deg/sec

3.1.22、 Level-1 zero position offset read and write command_0x16

Read sending parameters: none

Read response parameters: [zero offset]

The level-1 zero position offset value of the servo, the unit is 0.1 degree

The level-1 zero position offset is mainly used for setting when it leaves the factory. This parameter cannot be modified by the user

3.1.23、 Level-2 zero position offset read and write command_0x17

Read sending parameters: none

Read response parameters: [zero offset]

Write sending parameters: [zero offset]

The level-2 zero position offset value of the servo, the unit is 0.1 degree, the value range depends on different products

Note: Please use this command without turning and locking, otherwise the servo will turn to the updated position at full speed. If you need to adjust the zero position when the servo locking please use the "zero offset accessory ".

3.1.24、 Level-2 zero position offset accessory command_0x18

Write sending parameters: [offset increment]

The relative incremental value of the secondary zero offset of the servo, the unit is 0.1 degrees, and the value range is: -100~100

After receiving the command the servo will add [Offset Increment] to the level-2 zero position offset value, which is mainly used to adjust the zero position in continuous increments.

If it is an encoder type product, you can set the current position to zero by writing [offset increment=0]

3.1.25、 Minimum rotation angle limit read and write command_0x19

Read sending parameters: none

Read response parameters: [minimum angle]

Write sending parameters: [minimum angle]

When the product has a structural limit or uses a potentiometer, or is used in some special scenes, the minimum value of the target angle when the servo is performing angle rotation, the servo cannot exceed the minimum value, but when the parameter is 0, Means unlimited,

The value unit is 0.1 degrees, and the value range depends on different products

3.1.26、 Maximum rotation angle limit read and write command_0x1A

Read sending parameters: none

Read response parameters: [maximum angle]

Write sending parameters: [maximum angle]

When the product has a structural limit or uses a potentiometer, or is used in some special scenes, the maximum value of the target angle when the servo is performing angle rotation, the servo cannot exceed the maximum value, but when the parameter is 0, Means unlimited

The value unit is 0.1 degrees, and the value range depends on different products

3.2、Anomaly detection protection read and write command

Command address		Command name	R/W	Command parameter		User data
				type	Initial value	
50	0x32	Abnormal protection enable switch	Read Write	Uint8	0x0F	Yes
51	0x33	Abnormal protection release method	Read Write	Uint8	0x00	Yes
52	0x34	Servo state during abnormal protection	Read Write	Uint8	0x54	Yes
53	0x35	Hardware abnormal flag	Read	Uint8	0x00	No
54	0x36	Abnormal state flag	Read Write	Uint8	0x00	No
55-59		reserve				
60	0x3C	Abnormal voltage threshold	Read Write	Uint8, Uint8	--, --	Yes
61	0x3D	Abnormal temperature threshold	Read Write	Uint8, Uint8	60, 5	Yes
62	0x3E	Abnormal current threshold	Read Write	Uint16, Uint8	--, 20	Yes
63	0x3F	Stall/overload abnormal threshold	Read Write	Uint16, Uint8	600, 20	Yes
64-69		reserve				

3.2.50、Anomaly protection enable switch read and write command_0x32

Read sending parameters: none

Read response parameter: [parameter]

Write sending parameters: [Parameter]

Parameter data bit	Function Description	
other	reserve	
Bit3	Stall /overload abnormal protection	0= disable, 1= enable
Bit2	Temperature abnormal protection	0= disable, 1= enable
Bit1	Current abnormal protection	0= disable, 1= enable
Bit0	Voltage abnormal protection (Low voltage/High voltage)	0= disable, 1= enable

When the product detects an abnormality, the protection will only be executed when the abnormal protection is enabled

3.2.51、Exception protection release mode read and write command_0x33

Read sending parameters: none

Read response parameter: [parameter]

Write in sending parameter: [parameter]

data bit	Function Description	
other	reserve	
Bit3	Stall/overload abnormal protection	0=auto/command release, 1=only command release
Bit2	Temperature abnormal protection	0=auto/command release, 1=only command release
Bit1	Current abnormal protection	0=auto/command release, 1=only command release
Bit0	Voltage abnormal protection	0=auto/command release, 1=only command release

3.2.52、Servo state when abnormal protection read and write command_0x34

Read sending parameters: none

Read response parameter: [parameter]

Write sending parameters: [Parameter]

data bit	7	6	5	4	3	2	1	0
Protection item	Stall/overload protection		Temperature protection		Overcurrent protection		Voltage protection	
Protection method	0b00: Release the servo torque without brake (no damping force) 0b01: Release the torque of the servo with brake (with damping force) 0b1x: Locking at the current position							

Temperature protection and voltage protection can only be configured as 0b00/0b01.

Protection priority: voltage > temperature > current > stall/overload

The method locking at the current position can only be used in the servo mode, the servo can't be locking in the motomode

3.2.53、Hardware abnormal flag read command_0x35

Read sending parameters: none

Read response parameter: [parameter]

Parameter data bit	Function Description
Bit7	Other abnormal
Bit6	Motor abnormal
Bit5	Position sensor abnormal
Bit4	Current sensor abnormal
Bit3	Voltage sensor abnormal
Bit2	Temperature sensor abnormal
Bit1	Memory read and write abnormal
Bit0	Crystal abnormal

The hardware abnormal is only detected when the machine power on, and it is protected immediately after the abnormality is detected. The servo will not be able to perform any rotation control, but it can be read and written.

3.2.54、 Status abnormal flag read and writecommand_0x36

Read sending parameters: none

Read response parameter: [parameter]

Write sending parameters: [Parameter]

data bit	Function Description
other	reserve
Bit3	Stall/overload abnormal protection
Bit2	Temperature abnormal protection
Bit1	Current abnormal protection
Bit0	Voltage abnormal protection

The protection can be cleared and released by command with writing 1 to the corresponding bit.

3.2.60、 Voltage abnormal threshold read and write command_0x3C

Read sending parameters: none

Read response parameters: [High voltage threshold] [Low voltage threshold]

Write sending parameters: [High voltage threshold] [Low voltage threshold]

Voltage threshold unit: Volt (V), the abnormality detection time is fixed at 3 seconds

3.2.61、 Temperature abnormal threshold read and writecommand_0x3D

Read sending parameters: none

Read response parameters: [temperature threshold] [release protection temperature threshold]

Write sending parameters: [temperature threshold] [release protection temperature threshold]

Temperature threshold unit: Celsius (° C), the abnormality detection time is fixed at 3 seconds

Temperature threshold for deprotection: due to the hysteresis characteristics of temperature changes, there needs to be a certain judgment interval between triggering protection and deprotection. For example, [temperature threshold]=60, [deprotection temperature threshold]=5, and the servo is at 60°C. After protection, the protection can be released after the temperature drops to 55°C.

3.2.62、 Current abnormal threshold read and write command_0x3E

Read sending parameters: none

Read response parameters: [current threshold] [abnormal detection time]

Write sending parameters: [current threshold] [abnormal detection time]

Current threshold unit: milliampere (mA)

Time unit: 100 milliseconds, if [abnormal detection time]=20, the detection time is 2 seconds

3.2.63、 Stall/overload abnormal threshold read and write command_0x3F

Read sending parameters: none

Read response parameters: [PWM threshold] [abnormal detection time]

Write sending parameters: [PWM threshold] [abnormal detection time]

PWM threshold: the value range is 0~1000. The internal servo will use this value and other servo parameters to detect and judge the stall/overload abnormality

Time unit: 100 milliseconds, if [abnormal detection time]=20, the detection time is 2 seconds

3.3、 Servo current status parameter read command

Command address		Command name	R/W	Command parameter		User data
				type	Initial value	
70	0x46	current position	Read Write	Int32/Int16 ^{T1}	--	no
71	0x47	Current speed	read	Int16	--	no
72	0x48	existing current	read	Int16	--	no
73	0x49	Current torque (PWM)	read	Int16	--	no
74	0x4A	Current Temperature	read	Int16	--	no
75	0x4B	Current voltage	read	Int16	--	no
76	0x4C	Current position deviation	read	Int32/Int16	--	no
77	0x4D	Current rotation time	read	UInt32	--	no
78~89		reserve				

T1: A/B indicates that there are multiple types of parameters in the address, and the corresponding data type is used according to the specific situation

3.3.70、 Current position read command_0x46

Read sending parameters: none

Read response parameter: [current position], parameter unit: 0.1 degree (0.1°)

Write sending parameter: [any value]

Writing any value to this address will reset [Current Position] to 0, which is only valid for some products, mainly used for motor products

Parameter type selection: When the parameter value exceeds the Int16 type, the Int32 type will be used, and the type can be distinguished according to the command length

3.3.71、 Current speed read command_0x47

Read sending parameters: none

Read response parameter: [current speed], parameter unit: degree/sec (°/sec)

3.3.72、 Existing current read command_0x48

Read sending parameters: none

Read response parameter: [existing current], parameter unit: milliamperes (mA)

3.3.73、 Current torque (PWM) read command_0x49

Read sending parameters: none

Read response parameter: [current torque (PWM)], value range: 0~1000

3.3.74、 Current temperature read command_0x4A

Read sending parameters: none

Read response parameter: [current temperature], parameter unit: Celsius (°C)

3.3.75、Current voltage read command_0x4B

Read sending parameters: none

Read response parameter: [current voltage], parameter unit: millivolt (mV)

3.3.76、Current position deviation read command_0x4C

Read sending parameters: none

Read response parameter: [current position deviation], parameter unit: 0.1 degree (0.1°)

Real-time feedback of the position deviation from the target position when the rudder is locked and rotated

Parameter type selection: When the parameter value exceeds the Int16 type, the Int32 type will be used, and the type can be distinguished according to the command length

3.3.77、Current rotation time read command_0x4D

Read sending parameters: none

Read response parameter: [current rotation time], parameter unit: millisecond (mS)

Real-time feedback of the rotation time of the servo after receiving the rotation control command. When the rotation ends, the stop time is incremented. After the servo stop rotating, read this value to know the time taken for this rotation.

3.4、Rotation control command

Command address		Command name	R/W	Command parameter		User data
				type	Initial value	
90	0x5A	Control mode	Read Write	UInt8	0	no
91	0x5B	Current torque limit	Read Write	UInt16	--	no
92	0x5C	Existing current limit	Read Write	UInt16	--	no
93	0x5D	Current speed limit	Read Write	UInt16	--	no
95~99		reserve				
100	0x64	Servo mode torque switch	Read Write	UInt8	3	no
101	0x65	Servo mode timing control	write	Int16. (UInt16) ^{T1}	--, (0)	no
102	0x66	Servo mode constant speed control	write	Int16. (UInt16)	--, (0)	no
103	0x67	Advanced control of servo mode	write	UInt8. Int16. Int16	--, --, --	no
104	0x68	Servo mode interpolation control	write	Int16	--	no
105~109		reserve				
110	0x6E	Motor mode constant torque control	write	Int16	--, --	no
111	0x6F	Motor mode constant speed control	write	Int16	--, --	no
112	0x70	Advanced control of motor mode	write	UInt8. UInt16. UInt16	--, --, --	no
113~119		reserve				

T1: When sending a write command, the parameters in parentheses can be omitted, and the command will be executed according to the default parameter value.

3.4.90、Control mode read and writecommand_0x5A

Read sending parameters: none

Read response parameters: [current control mode]

Write sending parameters: [current control mode]

parameter	Description
0	Automatic mode: automatically select the control mode according by commands
1	Servo mode: only receive servo mode control commands
2	Motor mode: only receive motor mode control commands
other	invalid

Switch to motor mode only when the servo is idle or the torque switch is turned off

3.4.91、Current torque limit read and write command 0x5B

Read sending parameters: none

Read response parameter: [Current torque limit], that is, the maximum output PWM of the motor, the parameter range: 0~1000

Write sending parameters: [current torque limit]

The initial value of the parameter is the value of [Maximum Output Torque] in the user data. This value will be updated synchronously when the user data is updated, but update this value will not affect the value in the user data storage.

3.4.92、Existing current limit read and write command 0x5C

Read sending parameters: none

Read response parameter: [existing current limit], that is, the maximum output current of the motor, parameter unit: mA

Write sending parameters: [existing current limit]

The initial value of the parameter is the value of [Maximum Output Current] in the user data. This value will be updated synchronously when the user data is updated, but update this value will not affect the value in the user data storage.

3.4.93、Current speed limit read and write command 0x5C

Read sending parameters: none

Read response parameter: [current speed limit], that is, the maximum rotation speed of the steering gear/motor in closed-loop speed control, parameter unit: degree per second

Write sending parameters: [current speed limit]

The initial value of the parameter is the value of [Maximum Rotation Speed] in the user data. This value will be updated synchronously when the user data is updated, but update this value will not affect the value in the user data storage.

3.4.100、Servo mode torque switch read and write command 0x64

Read sending parameters: none

Read response parameters: [Servo Torque Switch]

Write sending parameters: [Servo Torque Switch]

Switch value	Description
0	Without brake closing torque (no damping force), writing this value while rotating will stop rotating
1	With brake closing torque (with damping force), writing this value while rotating will stop rotating
2	Turn on the torque and locking at the current position. Writing this value while turning will stop and locking
3	Pre-start state, when the torque is turned off, the torque is automatically turned on and the rotation is executed when the rotation command is received This value cannot be written by external commands, it is used for automatic writing inside the servo, and is generally set after the protection is triggered
other	invalid

In the servo mode, the rotation command can be executed only when the torque is turned on

3.4.101、Servo mode timing control write command 0x65

Write sending parameters: [target position angle], ([rotation time])

Target position angle value unit: 0.1 degree

Rotation time value unit: millisecond

After receiving the command, the servo will rotate from the current position to the target position in a specified time

The second parameter can be omitted, and the fastest speed will be used.

3.4.102、 Servo mode fixed speed control write command_0x66

Write sending parameters: [target position angle], ([rotation speed])

Target position angle value unit: 0.1 degree

Rotation speed numerical unit: degreeper second

After receiving the command, the servo rotates from the current position to the target position at the specified speed

The second parameter can be omitted, and the fastest speed will be used.

3.4.103、 Servo mode advanced control write command_0x67

Write sending parameters: [Control byte], [Parameter 1], [Parameter 2]

[Control byte]	
Bit7-4	Bit3-0
0: [Parameter 1] is the absolute target position angle	0: [Parameter 2] is the rotation time
1: [Parameter 1] is the relative target rotation angle	1: [Parameter 2] is the rotation speed
Other: invalidcommand	2: [Parameter 2] is the maximum output torque
	Other: invalidcommand

Absolute target position angle: the position angle value that the servo rotates to after receiving the command the unit is: 0.1 degree

Relative target rotation angle: the number of angles the servo rotates relative to the current position after receiving the command the unit is: 0.1 degree

Rotation time: the time required to complete this rotation, in milliseconds

Rotation speed: the speed of this rotation, the unit is: degreeper second

Maximum torque: this rotation rotates at the fastest speed, but the maximum motor output PWM does not exceed the parameter value, the value range: 0~1000

3.4.104、 Servo mode interpolation control write command_0x68

Write sending parameters: [target position angle]

Target position angle value unit: 0.1 degree

After receiving the command, the servo will rotate from the current position to the target position at the fastest speed

There is no acceleration and deceleration control plan inside the servo. The user sends the planned position to the servo according to a fixed frequency. The planned rotation speed needs to consider the actual fastest speed of the servo, otherwise there will be a problem that the follower cannot respond.

3.4.110、 Motor mode constant torque control write command_0x6E

Write sending parameters: [rotation torque]

After receiving the command, the servo will rotate with constant torque (PWM), the value range: -1000~1000

Greater than 0 means forward rotation, less than 0 means reverse direction rotation, equal to 0 means stop rotation

3.4.111、 Motor mode constant speed control write command_0x6F

Write sending parameters: [rotation speed]

After receiving the command, the servo rotates at a constant speed, the unit of value: degree per second

Greater than 0 means forward rotation, less than 0 means reverse direction rotation, equal to 0 means stop rotation

Only use encoder type products to support speed control mode

3.4.112、 Motor mode advanced control write command0x70

Write sending parameters: [Control byte], [Parameter 1], [Parameter 2]

[Control byte]					
Bit7	Bit6	Bit5-4	Bit3-2	Bit1	Bit0
1=stop	0	0=[Parameter 1] is invalid, keep turning 1=[Parameter 1] is the rotation time 2=[Parameter 1] is the rotation angle ^{T1} 3=[Parameter 1] is the rotation circle ^{T1}	0=[Parameter 2] is the rotating torque 1=[Parameter 2] is the rotation speed ^{T1} Other = invalid command	Status after stopping: 0=no brake 1=brake	0=Positive 1=Reverse

T1: Only use encoder type products to support fixed angle/turn/speed control mode

Stop the rotation immediately after receiving the stop command or the rotation is completed

The unit of rotation time is: 0.1 second

The unit of rotation angle is: 1 degree

The unit of rotation circle is: 0.1 circle

The rotation torque (PWM) value range is: 0~1000

The unit of the rotation speed is: degree per second($1^{\circ}/S$)

四、Description of the use of advanced command functions

Function number	Command function name	description
0x01	Servo query	Query online servos, this command does not require command address and command parameters The servo uses "short response frame" to respond
0x02	Read command	Read "Servo control command address list" data
0x82	Multi-ID read command	Read the "Servo Control Command Address List" data, read data to multiple IDs at the same time in one command See "4.1 Multi -ID Read Command" for details
0x03	Write command	Write data to "Servo control command address list" If the servo response level=1: the servo uses "short response frame" to respond
0x83	Multi-D write command	Write data to "Servo Control Command Address List", and send data to multiple IDs at the same time in one command See "4.2 Multi-ID Write Command" for details, the servo does not respond
0x04	Sync write command	See "4.3 Sync Write Command" for details, the servo does not respond
0x84	Sync write execution command	See "4.3 Sync Write Command" for details, the servo does not respond
0x78	Firmware upgrade command	For details, please refer to the "De Sheng Smart Servo Firmware Upgrade" file
0x7E	Factory test command	See the file "Factory Test Command Address List" for details
0x7F	Customer-specific command	For details, please refer to the file "Customized command address list"

4.1、Multi-ID read command _0x82

(To be completed)

4.2、Multi-ID write command _0x83

The command function is to write data to multiple target IDs at the same time in one command. It is mainly used to make multiple servos start to rotate at the same time, improve control consistency, and save time than sending commands one by one. But it should be noted that the size of each command data packet is limited (the total number of bytes is less than 256), and the total number of target IDs should be controlled.

This command function only supports the following addresses: 0x64 0x65 0x66 0x68 0x6E 0x6F

Frame header	ID number	Data length	Command function	Command address	Parameter sequence	Data validation
0xF9 0xFF	0xFE	N+3	0x83	adr	Parameters	Checksum

In the command parameter sequence, it contains the number of data bytes sent to the servo (the amount of data for each servo is the same), the target ID number, and the data to be sent. The start byte of the sequence is the number of data bytes sent, and then the target ID number + data sent to the target .

example 1: Send turn on torque command to ID1, ID2, ID3

F9 FF FE 0A 83 64 01 01 02 02 02 02 03 [checksum]

example 2: Send timing control command to ID5, ID7, ID9

F9 FF FE 13 83 65 04 05 00 00 E8 03 07 5A 00 E8 03 09 A6 FF E8 03 [checksum]

example 3: Send timing control commands to ID5, ID7, ID9, omitting time/speed parameters

F9 FF FE 0D 83 65 02 05 00 00 07 5A 00 09 A6 FF [checksum]

4.3、 Sync write command _0x04, Sync write execution command _0x84

This command is the same as "write command_0x03", the difference is that the command can only be sent using the target ID, and the servo only puts the data in the buffer after receiving the command, and will not perform the write action until it receives the "Sync write execution command_0x84".

The 0x84 command has no command address and command parameters. It is generally sent by broadcast ID, so that all servos received 'sync write command' will execute at the same time.

It should be noted that before the 0x84 command is received, the previous data will be overwritten if the 0x04 command is received again, and the data will be cleared if other functional command are received in the middle, that is, the previous command must be 0x04 command when the 0x84 command is received.

The function of this command is similar to the 0x83 command, which allows multiple servos to start executing at the same time to remove the time difference between them, but it cannot shorten the communication time by itself.

example 1: Send open torque commands to ID1, ID2, ID3

F9 FF 01 04 04 64 02 [checksum]

F9 FF 02 04 04 64 02 [checksum]

F9 FF 03 04 04 64 02 [checksum]

F9 FF FE 02 84 [checksum] ☒ Turn on the torque at the same time after receiving the command

example 2: Send timing control commands to ID5, ID7, ID9

F9 FF 05 07 04 65 00 00 E8 03 [checksum]

F9 FF 07 07 04 65 5A 00 E8 03 [checksum]

F9 FF 09 07 04 65 A6 FF E8 03 [checksum]

F9 FF FE 02 84 [checksum] ☒ start rotating at the same time after receiving the command