RGI-100 Gripper

Short Manual

Content

Revisions

Date	Version	Revised content
20200426	V1.0	First edition, write wiring instructions and command instructions
20200904	V2.0	Change some instructions , Update the description of IO mode
20201010	V2.1	The structure of gripper is modified and the structure is lengthened. Modify the picture
20210401	V2.2	-

1 Specifications

RGI-100 is an electric rotary gripper, The number represents the Maximum stroke. The gripper is equipped with a pair of parallel fingertips, which runs symmetrically during the movement. The main structure of the gripper is a cuboid structure with three installation positions, which can meet the different installation conditions of the equipment. It is equipped with an 8-core communication interface. It has the following characteristics:

Controllable force/position/speed/angle: The gripper can program and adjust the grip position, grip force ,grip speed and angle.
Multiple communication modes: The gripper supports Modbus RTU protocol and IO mode control. Other communication protocols such as USB and ETHERNET can be transferred through protocol converter.
Gripping detection: The combination of force control and position control is adopted in the gripping process.
Gripping feedback: The state of the gripper can be read by programming, and can also be judged according to the indicator of the gripper.
Fingertips can be customized: Fingertips can be replaced according to situation, which is suitable for precision machining, parts assembly, and other fields.

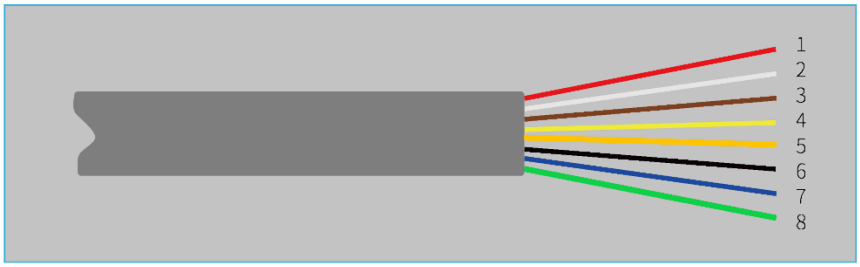
1.1 Indicator

The gripper can feed back the state of the gripper in real time. In addition to the command reading, it can also be judged on the color of the indicator:

Color description of indicator
·**Uninitialize state:** Red light blinks, other lights are off.
·**Initialized State:** the blue light is always on, indicating that it is in the operable state.
·**Received command state**: the red light blink once quickly (because the blue light is always on at this time, the gripper indicator light will looks like a purple light).
·**Object Caught state:** green light is always on, other lights are off.
·**Object dropped state:** green light blinking.

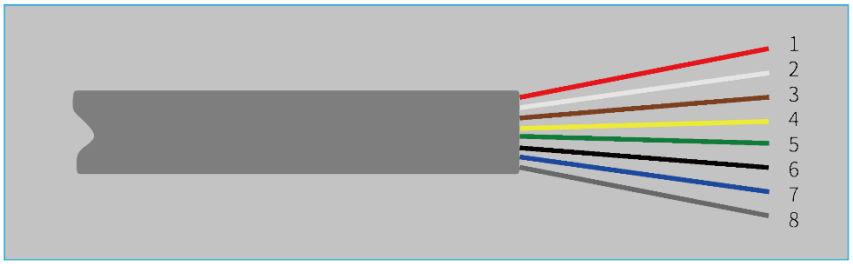
1.2 Pinout Description

The line sequence definition on the gripper body is shown in Figure 1.1(a) and 1.1(b) .（ote: RGI100 has no IO mode, unmarked and undefined）



Wire Number	The blue Wire mark corresponds to the outgoing color	Description	Explanation
1	Red	24V	Power supply DC 24V positive
2	White		
3	Brown		
4	Yellow		
5	Orange		
6	Black	GND	Power supply DC GND negative
7	Blue	485_B	Communication line negative，T/R-
8	Green	485_A	Communication line positive，T/R+

Figure 1.1 (a) The blue line marked diagram



Wire number	The yellow Wire mark corresponds to the outgoing color	Description	Explanation
1	Red	24V	Power supply DC 24V positive
2	White		
3	Brown		
4	Yellow		
5	Green		
6	Black	485_A	Communication line positive，T/R+
7	Blue	485_B	Communication line positive，T/R-
8	Grey/Pink	GND	Power supply DC GND negative

Figure 1.1 (b) The yellow line marked diagram

ote: Please distinguish the wire sequence according to the wire mark. If the wire mark is lost, dropped, or forgotten, please contact our staff to cooperate in determining the wire sequence. If you do not contact our staff, the clamping jaws will be damaged due to the wrong wiring sequence, and you will be responsible for the consequences.

2 Modbus-RTU Control

2.1 Wiring

Use the provided RS-485 to USB converter (see the schematic in Figure 2.1 below) to plug into a PC or other Controllers.

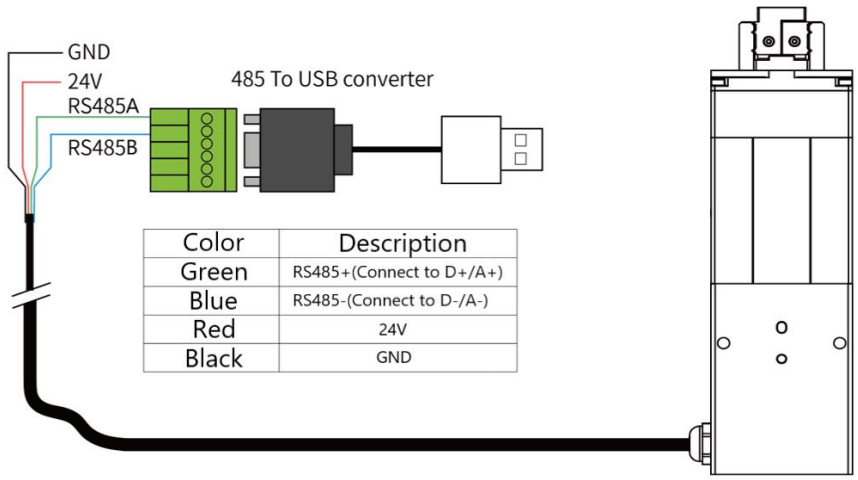


Figure 2.1 RS485 Connection

Wiring instructions
·① **:** when the device (computer) has RS485 interface, the communication can be directly connected to RS485_A and RS485_B communication lines without transferring to 485 module through USB
·② **:** in this way, other serial port debugging software (such as MODBUS poll) can be used for debugging

Software can be downloaded on the official website. Software and driver are integrated in the process of software installation, and both are installed together. It is recommended to check the create shortcut during installation.

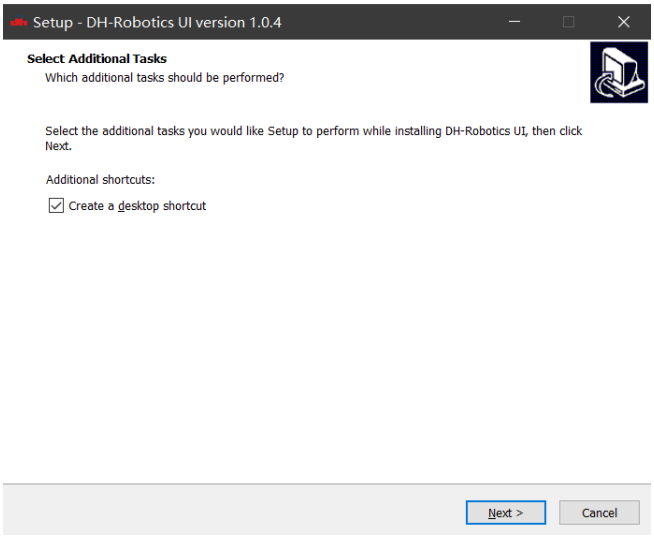


Figure 2.2 (a) installation interface 1

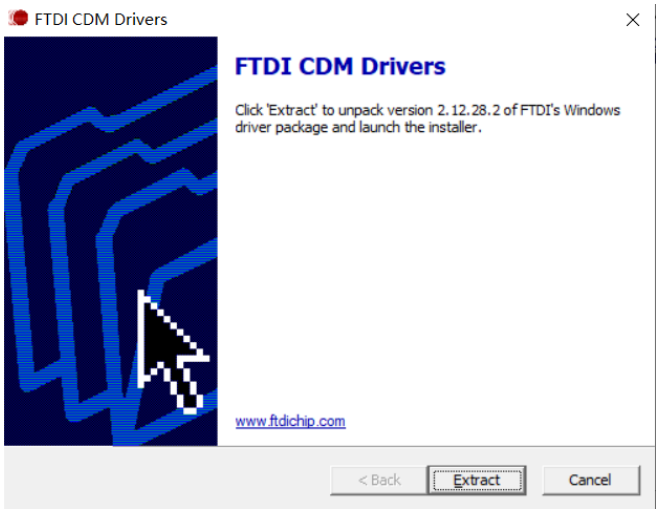


Figure 2.2 (b) driver installation interface

2.1.1 Debugging software instructions

Before use, it is necessary to connect the corresponding wiring according to the instructions. Open the software, the software will automatically identify the serial port, baud rate, ID number and other information of the gripper for automatic connection. As shown in the figure below:

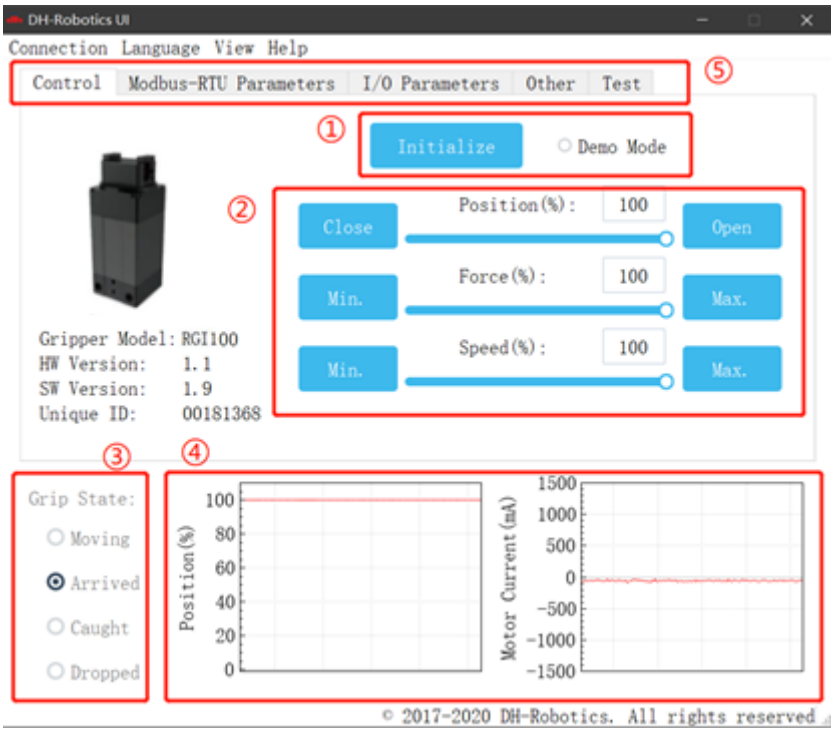


Figure 2.3 main control interface

The specific interface description is as follows:

Interface description

·① **Initialization and demonstration mode:** the gripper needs to be initialized before operation to calibrate the zero point. The demonstration mode is a cyclic program.

·② **Control interface:** it can control the position, force and speed of the gripper.

·③ **Clamping status:** real time display of clamping status of clamping claw.

·④ **Position current real time graph:** real time display position and current. The current represents the current of the internal motor, not the current actually consumed by the gripper. The current real-time graph can reflect the stability of clamping force.

·⑤ **Parameter setting:** the configuration parameters of Modbus RTU, such as baud rate and check bit, can be configured; IO mode is to configure the parameters related to IO mode;

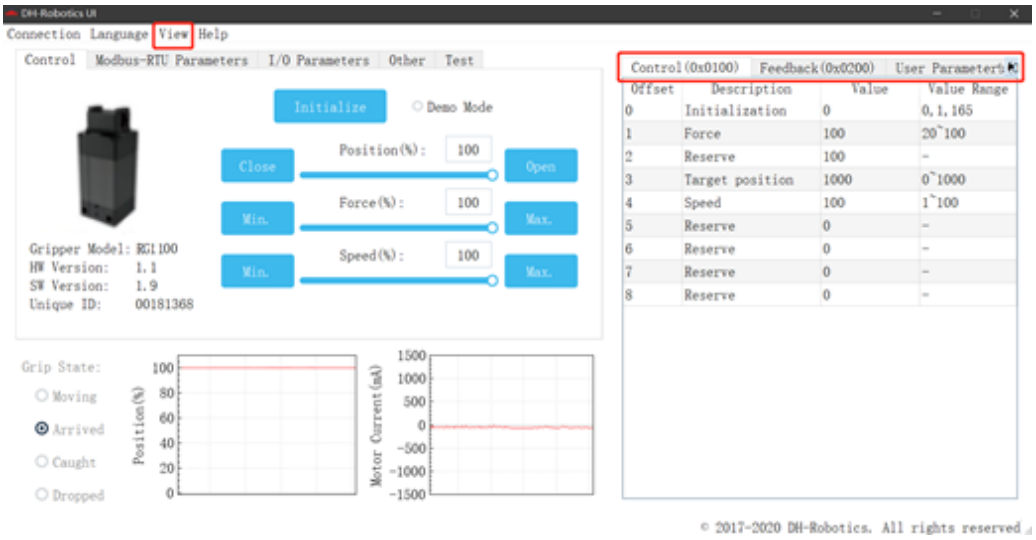


Figure 2.4 View

If there are multiple 485 devices, sometimes the baud rate and ID number of the gripper need to be modified, the parameters can be modified in Modbus RTU parameters

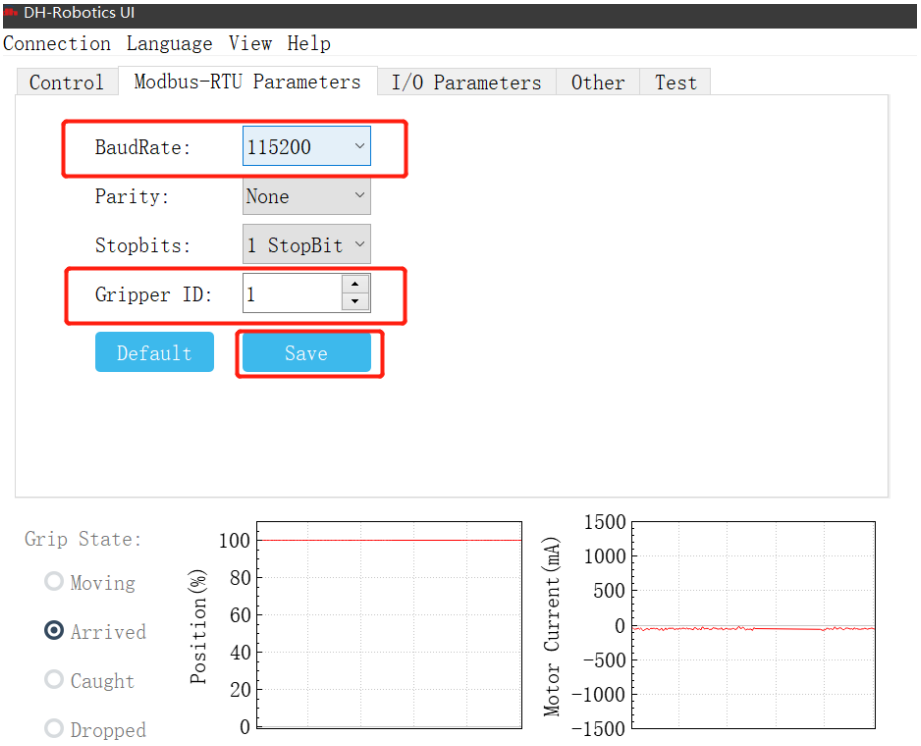


Figure 2.5 Modbus RTU parameters

2.2 Default Communication Parameters

Slave Address : 1
Baud Rate : 115200
Data Bits : 8 bits
Stop Bits : 1 stop bit
Parity : None

2.3 Modbus-RTU Description

2.3.1 RTU Framing

This gripper uses the standard Modbus-RTU protocol.
In RTU mode, the first field is the device address. The allowable characters transmitted for all fields are hexadecimal 0 ... 9, A ... F. Networked devices monitor the network bus continuously, including during the silent intervals. When the first field (the address field) is received, each device decodes it to find out if it is the addressed device.
A typical message frame is shown in Table 2.1.

Table 2.1 RTU Framing (Function Code:0x06)

Slave Address	Function	Register address	Register data	CRC
01	06	01 00	00 01	49 F6

Slave Address: The Slave address of the gripper. The default is 1, you can also modify it through write different value to Slave Address register.

Function: The Function Code field tells the addressed slave what function to perform. Includes read or write registers function.

Register address: Specifies which registers reference to be written.

Register data: Specifies which value to be written. Each register (word - 16 bits) of the Modbus RTU protocol is composed of 2 bytes (8 bits) from the Gripper.

CRC: the CRC error-checking field contains a 16-bit value implemented as two eight-bit bytes. The CRC field is appended to the message as the last field in the frame. The low-order byte of the field is appended first, followed by the high-order byte. The CRC high-order byte is the last byte to be sent in the message.

2.3.2 Supported Modbus Function Code

This griper uses MODBUS- RTU. The following function codes are currently supported:

03 (HEX): Read Holding Registers
06 (HEX): Write Single Register
10 (HEX): Write Multiple Registers

2.3.3 Register Mapping

The gripper's Modbus-RTU registers consist of two types of registers: **the basic control registers** and **the configuration registers**.

Basic control registers: initialization, force setting, reference position, speed, and some states.

Configuration registers: gripper's parameter configuration. Includes Modbus communication parameters and I/O parameters.

Table 2.2 Basic Control register map

Function	high-byte	low-byte	Description	Write	Read
Initialization	0x01	0x00	Initialize the gripper	0x01：initialization；0xA5: Fully initialization	Current setting
Force		0x01	Gripper's force	20-100 (%)	Force currently set
Reserved		0x02	-	-	-
Position		0x03	Position	0-1000 (‰)	Reference position currently set
Speed		0x04	Speed	1-100 (%)	Speed currently set
Rotation angle		0x05	Rotate to the specified angle.	-32768-32767,angle value.	Read the current setting
Reserved		0x06	-	-	-
Rotation speed		0x07	Rotate at a set speed.	1-100%	Read the current setting.
Rotation force		0x08	Rotate at a set force.	20-100%	Read the current setting.
Initialization state	0x02	0x00	Initialization state of the gripper	Read Only	0：Uninitialized；1：Initialized 2：Initializing
Gripper state		0x01	Gripper state	Read Only	0：In motion; 1：Reach position；2:object caught；3：Object dropped
Position		0x02	gripper position	Read Only	Current actual position
Rotating angle feedback.		0x08.	Feedback on the current rotation angle.	Cannot be written.	Read the current value.
Rotating initialization state feedback.		0x0A.	Feedback rotation initialization state.	Cannot be written.	0:Uninitialized; 1:Initialized successfully. 2：Initializing
Rotating state feedback.		0x0B.	Feedback rotation state.	Cannot be written.	0: In motion, 1 : reaching the angle; 2: blocking; 3: blocked during reaching the specified position.

Table 2.3 Configuration register map

Function	High byte	Low bytes	Description	Write	Read
Save Parameter	0x03	0x00	Save all the parameters	0：default，1：Write all parameters to save	0
Initialization direction		0x01	Configure initialization direction	0: Open，1:Close (default: 0）	Current setting
Slave Address		0x02	Configure gripper Modbus address	0-255 (default: 1）	Current setting
Baud Rate		0x03	Configure gripper Modbus Baud rate	0-5：115200，57600，38400，19200，9600，4800（default :0）	Current setting
Stop Bits		0x04	Configure gripper Modbus stop bits	0：1 stop bit；1：2 stop bits（default: 0）	Current setting
Parity		0x05	Configure gripper Modbus Parity	0: None parity; 1: Odd parity; 2: Even parity (default: 0)	Current setting
I/O Parameters Test	0x04	0x00	Test I/O parameters	1；2；3；4	Current setting
I/O Mode Switch		0x02	I/O control switch	0：OFF，1：ON	Current setting
I/O Parameter Configuration		0x05-0x10	Four groups of I/O parameters	position 1，force 1，speed 1 to position 4，force 4，speed 4	Current setting

2.3.4 Register Description

2.3.4.1 Initialization

This register is used to initialize the gripper.

Write: If write 1 (0x01 hex) to this register, the gripper will be initialized (fingers move to the minimal or maximum position and rotation to find the 0 degree The initialization direction depends on the value of initialization direction register). If write 165 (0xA5 hex) to this register will fully initialize the gripper(find the minimal and maximum position).

Read: if gripper need to be initialized or have initialized, this register value is 0; and if gripper is in initializing process, this register value is 1.

The register address is 0x0100. The description of this register is shown in Table 2.4.

Table 2.4 Initialization

Function	Address	Description	Write	Read
Initialization	0x0100	Initialize the gripper	0x01：initialize； 0xA5: Fully initialize	Current setting

The gripper needs to be initialized before control.

The sample command is as follows:

Initialize (write):

Send: 01 06 01 00 01 49 F6

Receive: 01 06 01 00 01 49 F6

Reinitialize(write):

Send:01 06 01 00 00 A5 48 4D

Receive: 01 06 01 00 00 A5 48 4D

2.3.4.2 Force

This register is used to set Force. It defines the current for the Gripper. If the current limit is exceeded, the fingers stop and trigger an object detection.

The address is 0x0101. The description of this register is shown in Table 2.5.

Table 2.5 Force

Function	Address	Description	Write	Read
Force	0x0101	Gripper's closing force	20-100 (%)	Force currently set

The force value range is 20-100, the corresponding value is 00 14–00 64(Hexadecimal).

Example:

Set 30% closing force (write):

Send: 01 06 01 01 1E 59 FE

Return: 01 06 01 01 1E 59 FE

Read the closing force currently set (read):

Send: 01 03 01 01 00 01 D4 36

Return: 01 03 02 xx xx crc1 crc2

2.3.4.3 Position

This register is used to set the reference position of gripper's fingers, then the fingers will move to the position immediately.

The address is 0x0103. The description of this register is shown in Table 2.6.

Table 2.6 Position

Function	Address	Description	Write	Read
Position	0x0103	Reference Position	0-1000 (‰)	Reference position currently set

The reference position value range is 0-1000 (‰), the corresponding value is 00 00 – 03 E8(Hexadecimal).

Example:

Set 500‰ position (write):

Send: 01 06 01 03 01 F4 78 21

Return: 01 06 01 03 01 F4 78 21

Read the reference position currently set(read):

Send: 01 03 01 03 00 01 75 F6

Return: 01 03 02 xx xx crc1 crc2

2.3.4.4 Speed

This register is used to set the Gripper closing and opening speed.

The address is 0x0104. The description of this register is shown in Table 2.7.

Table 2.7 Speed Instructions

Function	Address	Description	Write	Read
Speed	0x0104	Speed	1-100 (%)	Speed currently set

The speed value range is 1-100 ， The corresponding value is 00 01 – 00 64(Hexadecimal).

Example:

Set 50% speed (write):

Send: 01 06 01 04 00 32 48 22

Return: 01 06 01 04 00 32 48 22

Read the current speed (read):

Send: 01 03 01 04 00 01 C4 37

Return: 01 03 02 xx xx crc1 crc2

2.3.4.5 Rotation angle

This register is used to set the gripper angle of rotation.
The address is 0x0105. The description of this register is shown in Table 2.8.

Table 2.8 The angle of rotation

Function	Address	Description	Write	Read
Rotation angle	0x0105	Rotate to the specified angle.	-32768-32767	Read the current setting

The amgle of rotation is -32768-32767，The corresponding value is 0xF000 –0x7FFF(Hexadecimal).

Example:

Set 180% angle (write):

Send: 01 06 01 05 00 B4 98 40

Return: 01 06 01 05 00 B4 98 40

Read the current angle (read):

Send: 01 03 01 05 00 01 95 F7

Return: 01 03 02 xx xx crc1 crc2

Be careful

• Rotation angle is represented by a reverse code.

If the rotation angle is positive, the reverse code of positive number is the same as the original code.

For example, the inverse code of 360° is 0168 (0x).

Set 360% angle: 01 06 01 05 01 68 98 49

When the rotation angle is negative, the inverse code of negative number is the reverse of positive number bit by bit, and the sign bit is 1.

For example, the inverse code of - 360° is FE97 (0x).

Set -360% angle: 01 06 01 05 Fe 97 99 F9

2.3.4.6 Rotation speed

This register is used to set the speed of rotation.
The address is 0x0107. The description of this register is shown in Table 2.9.

Table 2.9 The speed of rotation

Function	Address	Description	Write	Read
Rotation speed	0x0107	Rotate at a set speed.	1-100%	Read the current setting.

The speed of rotation is 1-100(%)，The corresponding value is 0x0001 –0x0064(Hexadecimal).

Example:

Set 50% rotation speed (write):

Send: 01 06 01 07 00 32 B8 22

Return: 01 06 01 05 00 B4 B8 22

Read the current speed (read):

Send: 01 03 01 07 00 01 34 37

Return: 01 03 02 xx xx crc1 crc2

2.3.4.7 Rotation force

This register is used to set the force of rotation.
The address is 0x0108. The description of this register is shown in Table 2.10.

Table 2.9 The force of rotation

Function	Address	Description	Write	Read
Rotation force.	0x0108	Rotate at a set force	20-100%	Read the current setting.

The force of rotation is 20-100(%)，The corresponding value is 0x0014 –0x0064(Hexadecimal).

Example:

Set 50% force (write):

Send: 01 06 01 08 00 32 88 21

Return: 01 06 01 05 00 B4 88 21

Read the current force (read):

Send: 01 03 01 07 00 01 34 37

Return: 01 03 02 xx xx crc1 crc2

2.3.4.8 Initialization State

This register is used to store current initialization state of gripper, you can get the initialization state by reading this register.
The address is 0x0200. The description of this register is shown in Table 2.11.

Table 2.11 Initialization State

Function	Address	Description	Write	Read
Initialization State	0x0200	Initialization state of the gripper	Read Only	0：Uninitialized； 1：Initialized 2:Initializing

Example:

Read initialization state (read):

Send: 01 03 02 00 00 01 85 B2

Return: 01 03 02 00 00 B8 44

2.3.4.9 Gripper State

This register is used to store the Gripper state, you can get the state of gripper by reading this register. And the address is 0x0201. The description of this register is shown in Table 2.12.

Table 2.12 Gripper State

Function	Address	Description	Write	Read
Gripper State	0x0201	the gripper state	Read Only	0：In motion; 1：Reached position； 2：Object caught； 3：Object dropped

States Description
Different values indicate different states of the gripper. The descriptions of states are as follows:

- 00: Fingers are in motion .
- 01: Fingers are at reference position. No object detected or object has been dropped.
- 02: Fingers have stopped due to an object detection.
- 03: Fingers are at reference positon due to object has been dropped after the gripper caught object.

Example:

Read gripper state (read):

Send: 01 03 02 01 00 01 D4 72

Return: 01 03 02 00 02 39 85(02: object caught)

2.3.4.10 Current Position

This register is used to store the Actual position of the Gripper.
The address is 0x0202. The description of this register is shown in Table 2.13.

Table 2.13 Current Position

Function	Address	Description	Write	Read
Current Position	0x0202	Gripper actual position	Read Only	Current actual position

Example:

Read actual position (read):

Send: 01 03 02 02 00 01 24 72

Return: 01 03 02 xx xx crc1 crc2

2.3.4.11 Rotating angle feedback

This register is used to store the Actual rotating angle of the Gripper.
The address is 0x0208. The description of this register is shown in Table 2.14.

Table 2.14 Rotating angle feedback.

Function	Address	Description	Write	Read
Rotating angle feedback.	0x0208.	Feedback on the current rotation angle.	Cannot be written.	Read the current value.

Example:

Read actual rotation angle (read):

Send: 01 03 02 08 00 01 04 70

Return: 01 03 02 xx xx crc1 crc2

2.3.4.12 Rotating initialization state feedback.

This register is used to store the Rotating initialization state feedback. of the Gripper.
The address is 0x020A. The description of this register is shown in Table 2.15.

Table 2.15 Rotating initialization state feedback.

Function	Address	Description	Write	Read
Rotating initialization state feedback.	0x020A.	Feedback rotation initialization state.	Cannot be written.	0:Uninitialized; 1:Initialized. 2:Initializing

Example:

Read actual Rotating initialization state feedback (read):

Send: 01 03 02 0A 00 01 A5 B0

Return: 01 03 02 xx xx crc1 crc2

2.3.4.13 Rotating state feedback.

This register is used to store the Rotating state feedback. of the Gripper.
The address is 0x020B. The description of this register is shown in Table 2.16.

Table 2.16 Rotating state feedback.

Function	Address	Description	Write	Read
Rotating state feedback.	0x020B.	Feedback rotation state.	Cannot be written.	0: In motion, 1 : reaching the position; 2: blocking; 3: had been blocked during reaching the specified position.

Example:

Read actual Rotating state feedback (read):

Send: 01 03 02 08 00 01 04 70

Return: 01 03 02 xx xx crc1 crc2

2.3.4.14 Save Parameter

This register is used to Save Parameter.
Write 1 to this register to save all parameter, If you modified the I/O or communication parameters.
The address is 0x0300. The description of this register is shown in Table 2.17.

Table 2.17 Save Parameter

Function	Address	Description	Write	Read
Save Parameter	0x0300	Save register's value to Flash	0：default， 1：Save all parameters	0

Example:

Save Parameter (Write):

Send: 01 06 03 00 00 01 48 4E

Return: 01 06 03 00 00 01 48 4E

NOTE

• The Saving process will take 1-2 seconds, and the gripper won't response to other command during this process. The gripper will response this command after saving process finished.

2.3.4.15 Initialization Direction

This register is used to set Initialization Direction of gripper.
The address is 0x0301. The description of this register is shown in Table 2.18.

Table 2.18 Baud Rate

Function	Address	Description	Write	Read
Baud Rate	0x0301	Configure initialization direction	0: Open，1:Close (default: 0）	Current setting

The value of this register is 0 by default.
If the register value is 0, when you send the initialization command, the gripper finger will open and find the maximum position.
If the register value is 1, when you send the initialization command, the gripper finger will close and find the minimal position.

Example:

Write 0 to initialization direction register:

Send: 01 06 03 01 00 00 D8 4E

Return: 01 06 03 01 00 00 D8 4E

2.3.4.16 Slave Address

This register is used to set Slave Address of gripper.
The address is 0x0302. The description of this register is shown in Table 2.19.

Table 2.19 Slave Address

Function	Address	Description	Write	Read
Slave Address	0x0302	Configure gripper Slave Address	0-255 (default: 1）	Current setting

The value of this register is 1 by default.

Example:

Set the Slave Address to 1 (write):

Send: 01 06 03 02 00 01 E9 8E

Return: 01 06 03 02 00 01 E9 8E

NOTE

• Please make sure that no other networked device has the same slave address as the gripper.

2.3.4.17 Baud Rate

This register is used to set Baud Rate of gripper.
The address is 0x0303. The description of this register is shown in Table 2.20.

Table 2.20 Baud Rate

Function	Address	Description	Write	Read
Baud Rate	0x0303	Configure gripper Modbus Baud rate	0-5：115200，57600，38400，19200，9600，4800（default: 0）	Current setting

The value of this register is 0 by default, corresponding to a baud rate of 115200.

Example:

Set gripper baud rate to115200 (write):

Send: 01 06 03 03 00 00 79 8E

Return: 01 06 03 03 00 00 79 8E

2.3.4.18 Stop Bits

This register is used to set Stop Bits of gripper.
The address is 0x0302. The description of this register is shown in Table 2.21.

Table 2.21 Stop bits settings

Function	Address	Description	Write	Read
Stop Bits	0x0304	Configure gripper Modbus stop bits	0：1 stop bit 1：2 stop bits （default: 0）	Current setting

The value of this register is 0 by default, corresponding to 1 stop bit.

Example:

Set the gripper stop bit to 1 stop bit (write):

Send: 01 06 03 04 00 00 C8 4F

Return: 01 06 03 04 00 00 C8 4F

2.3.4.19 Parity

This register is used to set Parity of gripper.

The address is 0x0305. The description of this register is shown in Table 2.22.

Table 2.22 Parity

Function	Address	Description	Write	Read
Parity	0x0305	Configure gripper Modbus Parity	0: None Parity 1: Odd Parity 2: Even Parity (default : 0)	Current setting

The value of this register is 0 by default, corresponding to None Parity.

Example:

Set the gripper's Parity to None Parity (write):

Send: 01 06 03 05 00 00 99 8F

Return: 01 06 03 05 00 00 99 8F