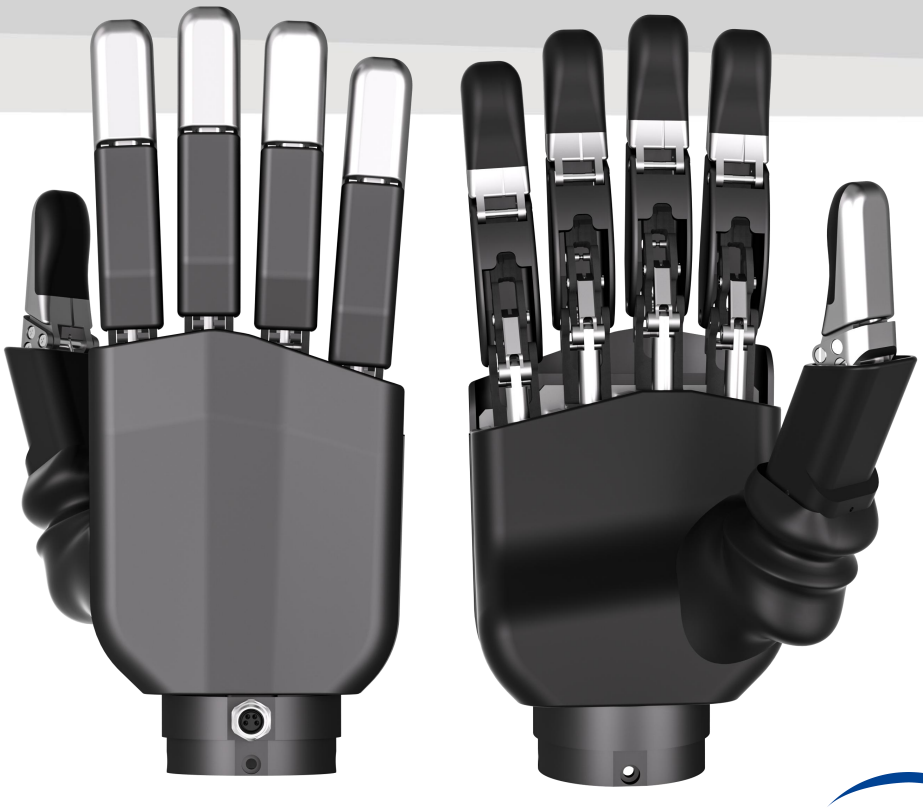
# DH-5-6 Humanoid Hand

# User Manual



DH-ROBOTICS

Version:1.01.07

# 1 Foreword

This manual introduces the specifications, interface definitions, and communication instructions for the 5-finger dexterous hand, helping customers understand and use it.

1). Write control variables/read feedback values, access the dexterous hand's register variables (zero initialization, speed, position, and force), and control the dexterous hand to complete specified actions. Read feedback values (speed, position, and current) to understand the dexterous hand's operating status.

2). **Preset Action Function**: Customize actions and send them to the dexterous hand for execution.

3). **Built-in Gesture Function:** Circularly display preset gestures, supporting the selection/deselection of individual gestures.

4). **Historical Fault Alarm Recording Function**: The dexterous hand can store recent faults and can clear all stored faults with one click.

5). Supports online upgrades using a host computer.

**Target Audience**

This manual is intended for:

Customer Engineers

Sales Engineers

Installation and Commissioning Engineers

Technical Support Engineers

## 1.1 Revision

| Version | Date | Revised content |
|---|---|---|
| V1.01.02 | 2024.12.06 | Add registers for Modbus configuration |
| V1.01.03 | 2025.01.06 | ● The open-loop force setting range is 20 ~100. Closed-loop force control is not supported.<br>● Current is in mA, with a range of -32768 to 32767. |
| V1.01.04 | 2025.02.18 | ● Added instructions for using the burn-in test command. Refer to Section 2.5.3.<br>● Updated the Modbus data frame example.<br>● Deleted the host computer instructions. For details, see the new host computer instructions. |
| V1.01.05 | 2025.04.08 | ● Updated wiring schematic, refer to section 1.3 |
| V1.01.06 | 2025.04.25 | ● Added a communication wiring diagram.<br>● Updated notes. |
| V1.01.07 | 2025.04.30 | ● Update content layout and add interface description |

## 1.2 Indicator

The indicator light on the palm reflects the current status of the Dexterous Hand.
Blue light: Indicates normal power-on operation.
Red light: Indicates IAP upgrade status, requiring a host computer to upgrade the Dexterous Hand.

## 1.3 Axis Correspondence

Table 1-1 below shows the correspondence between axis numbers and finger degrees of freedom.

| **Axis Number** | **Right Hand** | **Left Hand** |
|---|---|---|
| 01 | Move your thumb left and right | Move your thumb left and right |
| 02 | Forefinger | Forefinger |
| 03 | Middle finger | Middle finger |
| 04 | Ring finger | Ring finger |
| 05 | Little finger | Little finger |
| 06 | Move your thumb up and down | Move your thumb up and down |

Table 1-1 Axis correspondence

# 2 Content

Content

# 3 Safe Information

## 3.1 Usage Instructions

Scope of Application: This 5-Finger Dexterous Hand with 6 Degrees of Freedom (6DOF) is primarily intended for use in scientific research, assisting with specific industrial production processes, and in certain medical rehabilitation training simulation scenarios (under the guidance of professional medical personnel). Dangerous, illegal, or inappropriate uses beyond the product's design are strictly prohibited.

Installation and Connection: Before installing the product, carefully read the included installation instructions. Ensure the installation environment is stable, dry, and free from strong electromagnetic interference. When connecting the product, ensure that all wires are correctly connected according to the connector markings to avoid short circuits or device damage caused by incorrect connections. After completing the connection, perform a preliminary wiring inspection to confirm that there are no loose connections or damage.

Operational Procedure: During operation, strictly follow the action sequence and command input method specified in the operating manual. Avoid violent manipulation or forcibly changing the direction of finger movement while the device is running to avoid damage to the mechanical structure and drive system. During operation, pay close attention to the device's status indicators and feedback data, and immediately cease operation if any abnormalities occur.

## 3.2 Precautions

**Safety precautions:** During product operation, do not place any part of your body near moving finger joints or transmission components to prevent pinching or scratching. Operators must wear appropriate protective equipment, such as protective gloves and goggles. If the product is used in an industrial environment, prominent safety warning signs should be posted around the product to prevent unauthorized personnel from approaching.

**Environmental requirements:** The product should be used within the specified temperature and humidity ranges, generally between [X]°C and [X]°C, and between [X]% and [X]%. Avoid use in environments with high temperatures, high humidity, excessive dust, or corrosive gases to prevent degradation of product performance and lifespan. Also, keep the product away from strong magnetic and electric fields to prevent interference with the product's control system.

**Maintenance**: Clean the product regularly. Wipe the exterior and exposed parts with a

clean, soft, damp cloth. Avoid using corrosive cleaning agents. Lubricate and maintain the mechanical joints at the intervals specified in the product manual to ensure smooth movement. Regularly check all connections for looseness and cables for damage. Repair or replace any problems promptly. Before performing maintenance, be sure to cut off the power supply of the equipment to prevent accidental startup.

## 3.3 Disclaimer

**User Responsibility:** Our company assumes no responsibility for any product damage, personal injury, or other losses caused by failure to follow the instructions and precautions in this safety information, such as unauthorized disassembly or modification of the product, use in an inappropriate environment, or improper operation.

**Force Majeure:** Our company assumes no responsibility for product failure or damage caused by force majeure, such as natural disasters, war, or government actions. However, we will do our best to assist users in restoring product operation or providing necessary support after the force majeure event has passed.

**Third-Party Liability:** Our company assumes no responsibility for product failure or damage caused by incompatibility between software, hardware, or services provided by a third party, or improper interference with the product. Users should contact the relevant third party to resolve the issue.

Please carefully read and understand the above safety information before using this *5-Finger Dexterous Hand* 6-DOF product to ensure correct and safe use. If you have any questions, please feel free to contact our customer service team.

# 4 Product Introduction

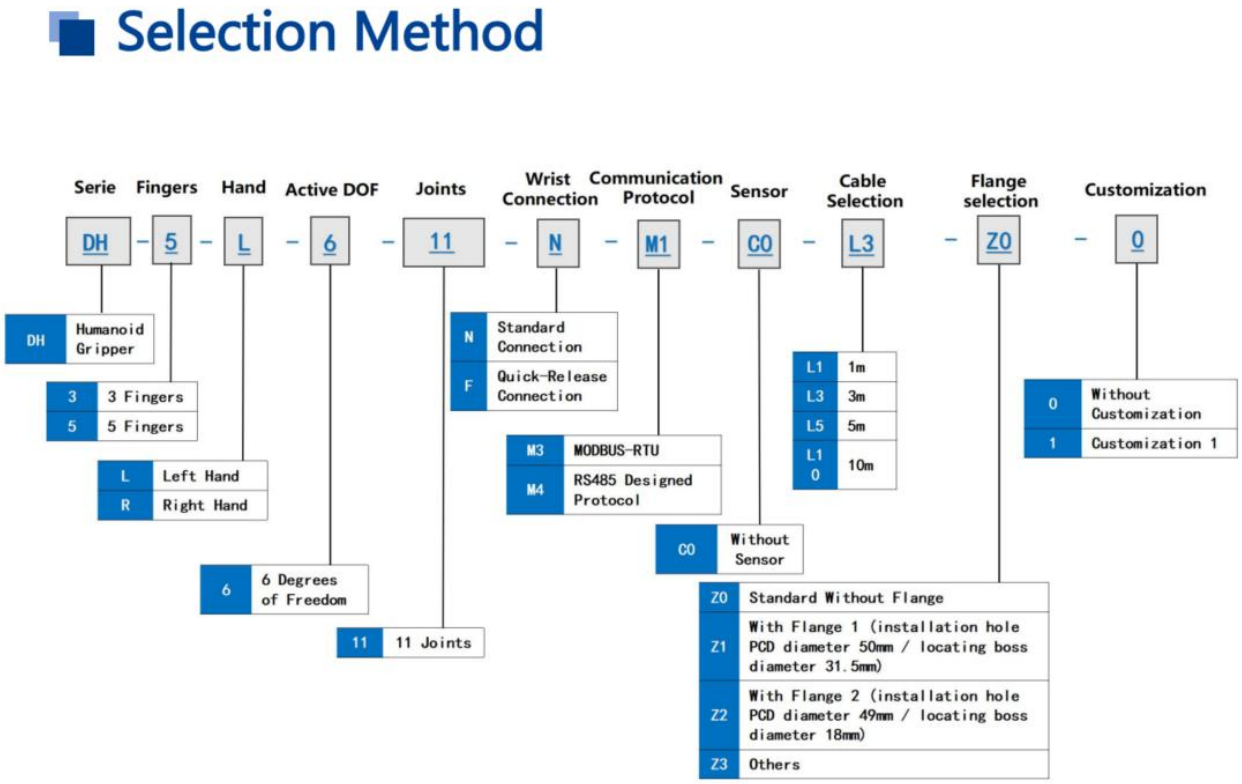
## 4.1 Product Features

- Over a million cycles of service life
- Bulk delivery, quality assurance
- Optional multi-array high-sensitivity tactile sensor
- Inner grip cushioning protection
- Core three-finger pointing function for stable grip of spherical objects

## 4.2 Product Advantages

- Industrial-grade core components
- Multimodal sensing fusion
- Highly responsive control
- Modular joint design
- API calls for easy linkage
- Scenario-specific customization

## 4.3 Model Description

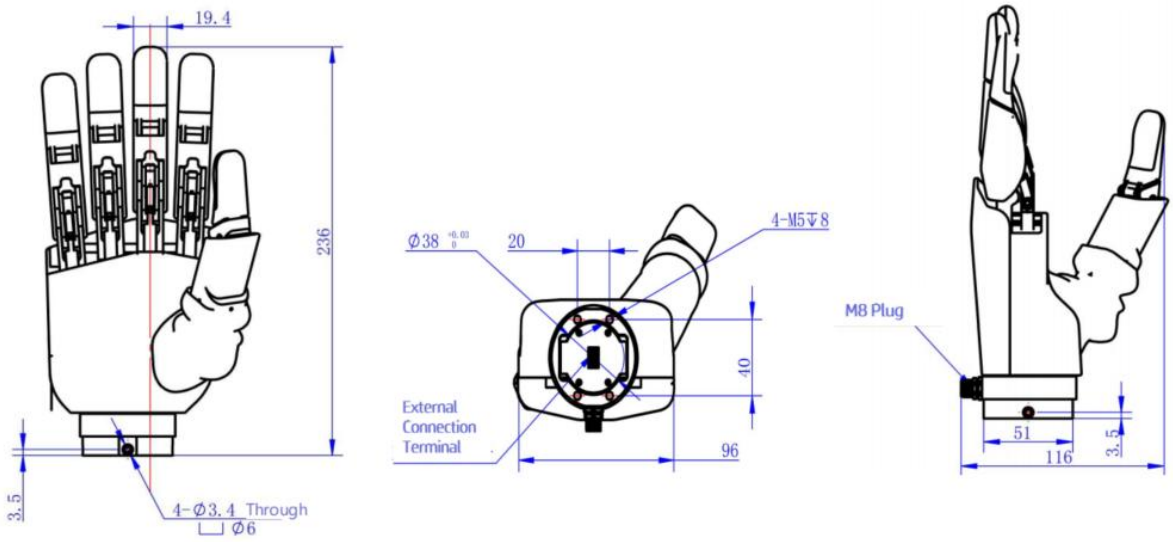


## 4.4 Specifications

| Technical Specifications | |
|---|---|
| Degrees of Freedom (DOF) | 11 |
| Actuated DOF | 6 |
| Cycle Time | 0.8s |
| Finger Bending Angle (4 fingers) | 83°+87° |
| Thumb Bending Angle | 38°+7° |
| Thumb Abduction Angle | 85° |
| Tip Force per Finger | 30N |
| Recommended Maximum Friction Load | 2kg |
| Recommended maximum structural pull load | 4kg |
| Five Fingers Total Gripping Force | 30N |
| Lifting Load Capacity | 10kg |
| Weight | 760g |
| Sensor | Multi tactile sensation (optional function) |
| Safe Function | Inner grip direction anti-collision buffer |
| Transmission Mechanism | Hollow cup motor+ planetary gearbox+ lead screw + linkage |

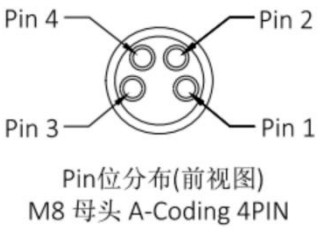
| | |
|---|---|
| Communication Protocols | Modbus-RTU/(RS485)/CAN |
| Working Voltage | 24 V DC ± 10% |

## 4.5 Structural Dimensions

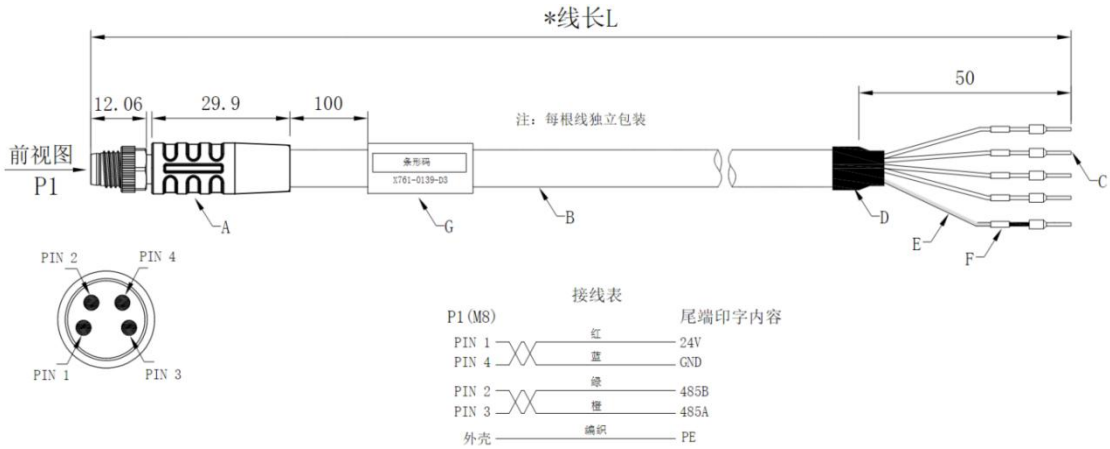


# 5 Interface Description

## 5.1 External Board Aviation Plug Interface

| Interface Type | PIN | Pin Definition | Interface Diagram |
|---|---|---|---|
| RS485/CAN | 1 | 24Vdc |  Pin位分布(前视图)<br>M8 母头 A-Coding 4PIN<br>Pin Assignment (Front View)<br>M8 Female Connector, A Coding 4 Pins |
| | 2 | GND | |
| | 3 | RS485A/CANH | |
| | 4 | RS485B/CANL | |

## 5.2 External Board End Aviation Plug Interface Line Definition



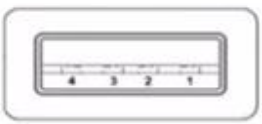
## 5.3 Internal Green Terminal Interface

| Interface Type | PIN | Pin Definition | Interface Diagram |
|---|---|---|---|
| RS485/CAN | 1 | RS485B/CANL |   |
| | 2 | RS485A/CANH | |
| | 3 | GND | |
| | 4 | 24Vdc | |

## 5.4 USB to RS485 Converter interface

| DB9 Pin | Output signal | RS_422 full-duplex wiring | RS_485 half-duplex wiring | |
|---|---|---|---|---|
| 1 | T/R+ | Send(A+) | RS-485(A+) |   |
| 2 | T/R- | Send(B-) | RS-485(B-) | |
| 3 | RXD+ | Receive(A+) | N/A | |
| 4 | RXD- | Receive(B-) | N/A | |
| 5 | SGND | Signal Ground | Signal Ground | |
| 6 | N/A | N/A | N/A | |
| 7 | N/A | N/A | N/A | |
| 8 | N/A | N/A | N/A | |
| 9 | N/A | N/A | N/A | |

USB-A Type: USB signal input and pin assignment diagram



1、VCC
2、DATA-(DM)
3、DATA+(DP)
4、GND

# 6 RS485 Communication

The communication of the dexterous hand supports MODBUS-RTU protocol and custom protocol. The dexterous hand adopts custom protocol and is debugged and upgraded with the host computer software.

## 6.1 RS485 Default Configuration

Baud Rate: 115200

Data Bits: 8

Stop Bits: 1

Parity: None

The configuration can be modified through the host computer.

## 6.2 MODBUS-RTU Protocol Description

The MODBUS-RTU protocol supports function codes 0x03 - read single/multiple holding registers, 0x06 - write single holding register, and 0x10 - write multiple holding registers.

### 6.2.1 Function Code 0x03 Read Single/Multiple Holding Registers

The format is as follows:

Request:

| Address Code | Function Code | Register Starting Address | Number of Registers | CRC Parity Code |
|---|---|---|---|---|
| 1 byte | 1 byte | 2 byte | N(1~255) byte | 2 byte |

Table 2-1 0x03 Function Code Request Data Frame Format

**Address Code:** Indicates the dexterous hand ID. The default right hand ID is 01.

**Function Code**: 0x03 Reads a single or multiple registers.

**Register Start Address**: The address at which registers are read.

**Number of Registers**: The number of registers to be read consecutively (N). Range: 1 to 255.

**CRC:** CRC checks use a 16-bit cyclic redundancy check.

Response:

| Address Code | Function Code | Number of bytes | Register value | CRC Parity Code |
|---|---|---|---|---|
| 1 byte | 1 byte | 1 byte | 2*N byte | 2 byte |

Table 2-2 Function Code Response Data Frame Format

Address Code: Indicates the dexterous hand ID. The default right hand ID is 01.

Function Code: 0x03 Reads a single or multiple registers.

Byte Count: The number of bytes in the returned register value.

Register Value: The value of N consecutive registers read. Range: 1 to 255.

CRC: CRC check uses a 16-bit cyclic redundancy check.

### 6.2.2 Function Code 0x06 Write Single Holding Register

The format is as follows, the request and response formats are consistent

| Address Code | Function Code | Register Address | Register value | CRC Parity Code |
|---|---|---|---|---|
| 1 byte | 1 byte | 2 byte | 2 byte | 2 byte |

Table 2-3 0x06 Request and Response Data Frame Format.

Address Code: Indicates the dexterous hand ID. The default right hand ID is 01.

Function Code: 0x06 Write Single Register.

Register Address: The register address to be written.

Register Value: The value in the register to be written.

CRC: CRC checksum uses a 16-bit cyclic redundancy check.

### 6.2.3 Function Code 0x06 Write Multiple Holding Register

Request:

| Address Code | Function Code | Register Starting Address | Number of Registers | Number of bytes | Register value | CRC Parity Code |
|---|---|---|---|---|---|---|
| 1 byte | 1 byte | 2 byte | 2 byte | 1 byte | N*2 | 2 byte |

Table 2-4 0x10 Function Code Request Data Frame Format

Address Code: Indicates the dexterous hand ID. The default right hand ID is 01.

Function Code: 0x10 Write Multiple Registers.

Register Address: The register address to be written.

Register Data: The number of registers to be written consecutively, ranging from 1 to 255.

Byte Count: The number of bytes in the register value to be written.

Register Value: The value in the register to be written.

CRC: CRC checksum uses a 16-bit cyclic redundancy method.

Response:

| Address Code | Function Code | Register Address | Register value | CRC Parity Code |
|---|---|---|---|---|
| 1 byte | 1 byte | 2 byte | 2 byte | 2 byte |

Table 2-5 Response Data Frame Format for Function Code 0x10

Address Code: Indicates the dexterous hand ID. The default right hand ID is 01.

Function Code: 0x10 Write Multiple Registers.

Register Address: The register address to be written.

Register Data: The number of consecutive registers to be written, ranging from 1 to 255.

CRC: CRC check uses a 16-bit cyclic redundancy check.

## 6.3 Custom Protocol Description

The function codes supported by the custom protocol are 0x69 and 0x6A. The protocol format is shown in Table 2-6 below:

| Address Code | Data frame length (including CRC) | Function Code | Data length | Data | CRC Parity Code |
|---|---|---|---|---|---|
| 1 byte | 2 byte | 1 byte | 2 byte | N byte | 2 byte |

Table 2-6 Communication Protocol Frame

Address Code: Indicates the dexterous hand's ID. The default ID for the right hand is 01.

Data Frame Length: Contains the byte length from the address code to the CRC check.

Function Code: Describes read and write operations for the dexterous hand. Currently supported are (0x69: read single/multiple registers; 0x6A: write single/multiple registers).

Data Length: Contains the data length (N bytes) and the data length (2 bytes).

CRC: The CRC check uses a 16-bit circular redundancy check.

### 6.3.1 0x6A Write Single/Multiple Parameters

| Function Code | Len | Data | | | | | Illustrate |
|---|---|---|---|---|---|---|---|
| 0x6A | 2byte | 1byte Number of parameters | 2bytes Parameter Index | 2bytes Parameter value | Nth 2-byte parameter index | Nth 2-byte parameter value | Write parameter value |
| 0x6A | 2byte | 1bytes ACK (0xFF indicates success, 0xCC indicates a data frame error.) | | | | | Response |

Table 2-7 0x6A Function Code Data Frame Format

### 6.3.2 0x69 Read Single/Multiple Parameters

| Function | Len | Data | | Illustrate |
|---|---|---|---|---|
| 0x69 | 2byte | 1bytes Number of parameters | N*2byteParameter Index | Read parameter value |
| 0x69 | 2byte | 1bytes Number of parameters | N*2byteParameter Index | Response |

Table 2-8 0x69 Function Code Data Frame Format

## 6.4 Register Configuration Table

### 6.4.1 Modbus Communication Parameter Configuration (0x03xx)

| Function Code | Modbus Address | Illustrate | Write | Read |
|---|---|---|---|---|
| Parameters Save | 0x0300 | Parameters are stored and automatically loaded at the next power-on. Write 1, and after storage is completed, it will be restored to 0 and take effect after restart. | Parameter range [0-3]<br>0: Default parameters.<br>1: Save currently modified parameters.<br>2: Restore parameters to default values.<br>3: Save automated test parameters. | Default value: 0 |
| Modbus ID | 0x0302 | Slave address, takes effect after restart. | Range: 0x01~0xFE | Current value |
| Baud Rate | 0x0303 | The baud rate setting of the serial port takes effect after restart. | 0-6: 921600, 115200，57600, 38400, 19200，9600, 4800 (1:Default) | Current value |
| Stop Bits | 0x0304 | Serial port stop bit setting | 0:1 Stop bits; 1:2Stop bits (0:Default) | Current value |

| | | | | |
|---|---|---|---|---|
| Parity Code | 0x0305 | The parity bit setting of the serial port takes effect after restart. | 0:No parity; 1:Odd parity; 2:Even parity (0:Default) | Current value |

Example:

Set baud rate:

Send: 01 06 0303 0001 B84E

Return: 01 06 0303 0001 B84E

Save parameters:

Send: 01 06 0300 0001 484E

Return: 01 06 0300 0001 484E

### 6.4.2 Parameter Setting (0x01xx)

| Function | Modbus Address | Description | Write | Read |
|---|---|---|---|---|
| Return to zero | 0x0100 | Return to origin | | |
| 1-axis target position | 0x0101 | 1 axis moves to the specified position | 0~65535, Unit 0.01mm | Read the current specified position |
| 2-axis target position | 0x0102 | 2 axis moves to the specified position | 0~65535, Unit 0.01mm | Read the current specified position |
| 3-axis target position | 0x0103 | 3 axis moves to the specified position | 0~65535, Unit 0.01mm | Read the current specified position |
| 4-axis target position | 0x0104 | 4 axis moves to the specified position | 0~65535, Unit 0.01mm | Read the current specified position |
| 5-axis target position | 0x0105 | 5 axis moves to the specified position | 0~65535, Unit 0.01mm | Read the current specified position |
| 6-axis target position | 0x0106 | 6 axis moves to the specified position | 0~65535, Unit 0.01mm | Read the current specified position |
| 1-axis force | 0x0107 | Under open-loop force control, the output force of the pushing section is set as a percentage of the rated current; | Open-loop force control: 20~100, % | Read the current percentage of the push section currently set |
| 2-axis force | 0x0108 | Under open-loop force control, the output force of the pushing section is set as a percentage of the rated current; | Open-loop force control: 20~100, % | Read the current percentage of the push section currently set |
| 3-axis force | 0x0109 | Under open-loop force control, the output force of the pushing section is set as a percentage of the rated current; | Open-loop force control: 20~100, % | Read the current percentage of the push section currently set |
| 4-axis force | 0x010A | Under open-loop force control, the output force of the pushing section is set as a percentage of the rated current; | Open-loop force control: 20~100, % | Read the current percentage of the push section currently set |
| 5-axis force | 0x010B | Under open-loop force control, the output force of the pushing section is set as a percentage of the rated current; | Open-loop force control: 20~100, % | Read the current percentage of the push section currently set |
| 6-axis force | 0x010C | Under open-loop force control, the output force of the pushing section is set as a percentage of the rated current; | Open-loop force control: 20~100, % | Read the current percentage of the push section currently set |

| | | | | |
|---|---|---|---|---|
| 1-axis speed | 0x010D | Maximum speed of the motion segment | 1~100, % | Read current setting |
| 2-axis speed | 0x010E | Maximum speed of the motion segment | 1~100, % | Read current setting |
| 3-axis speed | 0x010F | Maximum speed of the motion segment | 1~100, % | Read current setting |
| 4-axis speed | 0x0110 | Maximum speed of the motion segment | 1~100, % | Read current setting |
| 5-axis speed | 0x0111 | Maximum speed of the motion segment | 1~100, % | Read current setting |
| 6-axis speed | 0x0112 | Maximum speed of the motion segment | 1~100, % | Read current setting |
| 1-Axis Acceleration/ Deceleration | 0x0113 | Acceleration and deceleration of motion segments | 1~100, % | Read current setting |
| 2-Axis Acceleration/ Deceleration | 0x0114 | Acceleration and deceleration of motion segments | 1~100, % | Read current setting |
| 3-Axis Acceleration/ Deceleration | 0x0115 | Acceleration and deceleration of motion segments | 1~100, % | Read current setting |
| 4-Axis Acceleration/ Deceleration | 0x0116 | Acceleration and deceleration of motion segments | 1~100, % | Read current setting |
| 5-Axis Acceleration/ Deceleration | 0x0117 | Acceleration and deceleration of motion segments | 1~100, % | Read current setting |
| 6-Axis Acceleration/ Deceleration | 0x0118 | Acceleration and deceleration of motion segments | 1~100, % | Read current setting |

Table 2-9 Setting Parameters

Initialization Home Return (0x0100): **Initialization home return is required after each power cycle.**

As shown in Table 2-9, the home return method is described using two bytes, with each axis corresponding to two bits.

Axes 1-6: 01: Closed;

10: Open;

11: Find total travel;

00: Do not perform home return on the current axis.

| Reserve | Reserve | Reserve | Reserve | Axis 6 | | Axis 5 | | Axis 4 | | Axis 3 | | Axis 2 | | Axis 1 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bit 15 | Bit 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9 | Bit 8 | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |

Table 2-10 Definition of return to zero format

Example: (right hand)

Set open home position:

Send: 01 06 0100 0AAA 0e e9

Return: 01 06 0100 0AAA 0e e9

Set closed home position:

Send: 01 06 0100 0555 4b 59

Return: 01 06 0100 0555 4b 59

Set the positions of axes 1 through 6 to all 0:

Send: 01 10 0101 0006 0C 0000 0000 0000 0000 0000 0000 9a d7

Return: 01 10 01 01 0006 1037

Set the positions of axes 1 through 6 to 400, 900, 900, 900, 900, and 400, respectively:

Send: 01 10 0101 0006 0C 0190 0384 0384 0384 0304 0190 0cbe

Return: 01 10 01 01 0006 1037

Set the speed of axes 1 through 6 to 100%:

Send: 01 10 010d 0006 0C 0064 0064 0064 0064 0064 0064 fa1b

Return: 01 10 010d 0006 d034

Set the pushing force of axes 1 through 6 to 100%

Send: 01 10 0107 0006 C0 0064 0064 0064 0064 0064 0064 7cbc

Return: 01 10 0107 0006 f036

Set the position, force, and speed of axis 1: // Position 1mm, force 100%, speed 100%.

Sent: 01 000D 6A 000d 03 0101 0064 0107 0064 010D 0064 69A7

Return: 01 0009 6A 0001 FF 8BC9

Set the position, force, and speed of axis 2: // Position 5 mm, force 100%, speed 100%

Sent: 01 0015 6a 000d 03 0102 01F4 0108 0064 010E 0064 C1 A5

Return: 01 0009 6A 0001 FF 8BC9

Set the position, force, and speed of axis 3: // Position 9.5 mm, force 100%, speed 100%

Sent: 01 0015 6a 000d 03 0103 03B6 0109 0064 010F 0064 A532

Return: 01 0009 6A 0001 FF 8BC9

Set the position, force, and speed of axis 4: // Position 5 mm, force 100%, speed 100%

Sent: 01 0015 6a 000d 03 0104 01F4 010A 0064 0110 0064 34E9

Return: 01 0009 6A 0001 FF 8BC9

Set the position, force, and speed of axis 5: // Position 9.5 mm, force 100%, speed 100%

Sent: 01 0015 6a 000d 03 0105 01F4 010B 0064 0111 0064 7115

Return: 01 0009 6A 0001 FF 8BC9

Set the position, force, and speed of axis 6: // Position 9.5 mm, 100% force, 100% speed

Sent: 01 0015 6a 000d 03 0106 0000 010C 0064 0112 0064 F891

Returned: 01 0009 6A 0001 FF 8BC9

### 6.4.3 Parameter Feedback (0x02xx)

| Function | Modbus Address (hexadecimal) | Description | Read |
|---|---|---|---|
| Return to zero state | 0x0200 | Feedback of current origin status | Read the current return to zero status |
| Axis 1 operating status | 0x0201 | Feedback on the current motion status of axis 1 (including fault code, the fault code is 0 if it is in place normally) | 0:Moving, 1: Reached position; 2: Stalled |
| Axis 2 operating status | 0x0202 | Feedback on the current motion status of axis 2 (including fault code, the fault code is 0 if it is in place normally) | 0: Moving, 1: Reached position; 2: Stalled |
| Axis 3 operating status | 0x0203 | Feedback on the current motion status of the 3-axis (including fault codes, the fault code for normal operation is 0) | 0: Moving, 1: Reached position; 2: Stalled |
| Axis 4 operating status | 0x0204 | Feedback of the current motion status of the 4 axes (including fault codes, the fault code for normal operation is 0) | 0: Moving, 1: Reached position; 2: Stalled |
| Axis 5 operating status | 0x0205 | Feedback of the current motion status of the 5-axis (including fault code, the fault code is 0 if it is in place normally) | 0: Moving, 1: Reached position; 2: Stalled |
| Axis 6 operating status | 0x0206 | Feedback of the current motion status of the 6 axes (including fault codes, the fault code for normal operation is 0) | 0: Moving, 1: Reached position; 2: Stalled |
| Axis 1 current position | 0x0207 | Feedback of the current position of axis 1 | Read current position |
| Axis 2 current position | 0x0208 | Feedback of the current position of axis 2 | Read current position |
| Axis 3 current position | 0x0209 | Feedback of the current position of axis 3 | Read current position |
| Axis 4 current position | 0x020A | Feedback of the current position of axis 4 | Read current position |
| Axis 5 current position | 0x020B | Feedback of the current position of axis 5 | Read current position |
| Axis 6 current position | 0x020C | Feedback of the current position of axis 6 | Read current position |
| Axis 1 speed information | 0x020D | Feedback of the current speed | Read current speed |
| Axis 2 speed information | 0x020E | Feedback of the current speed | Read current speed |
| Axis 3 speed information | 0x020F | Feedback of the current speed | Read current speed |

| | | | |
|---|---|---|---|
| Axis 4 speed information | 0x0210 | Feedback of the current speed | Read current speed |
| Axis 5 speed information | 0x0211 | Feedback of the current speed | Read current speed |
| Axis 6 speed information | 0x0212 | Feedback of the current speed | Read current speed |
| Axis 1 current | 0x0213 | Feedback axis 1 current. Unit: mA, range: -32768 to 32767 | Read current current |
| Axis 2 current | 0x0214 | Feedback axis 2 current. Unit: mA, range: -32768 to 32767 | Read current current |
| Axis 3 current | 0x0215 | Feedback axis 3 current. Unit: mA, range: -32768 to 32767 | Read current current |
| Axis 4 current | 0x0216 | Feedback axis 4 current. Unit: mA, range: -32768 to 32767 | Read current current |
| Axis 5 current | 0x0217 | Feedback axis 5 current. Unit: mA, range: -32768 to 32767 | Read current current |
| Axis 6 current | 0x0218 | Feedback axis 6 current. Unit: mA, range: -32768 to 32767 | Read current current |

Table 2-11 Feedback parameters

Return to zero status (0x0200), the numerical correspondence is as follows:

Axes 1-6: 0: Uninitialized 00;

1: Initialized successfully 01;

2: Initializing 10

| **Reserve** | **Reserve** | **Reserve** | **Reserve** | **Axis 6** | | **Axis 5** | | **Axis 4** | | **Axis 3** | | **Axis 2** | | **Axis 1** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bit 15 | Bit 14 | Bit 13 | Bit 12 | Bit 11 | Bit 10 | Bit 9 | Bit 8 | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| | | | | | | | | | | | | | | | |

Table 2-12 Definition of zero return feedback format

Example:

Query the return-to-zero status:

Send: 01 000B 69 0003 01 0000 E51D

Return: 01 000B 69 0003 01 AAAA 1BC2

Query the feedback data from 0x0201 to 0x0217:

Send: 01 00 2B 69 00 25 11 02 01 02 02 02 03 02 04 02 05 02 06 02 07 02 08 02 09 02 0A 02 0B 02 0C 02 13 02 14 02 15 02 16 02 17 B2 63

Return: 01 00 2B 69 00 23 11 00 01 00 01 00 01 00 01 00 01 00 01 02 13 01 F4 03 B6 01 F4 01 F4 01 F4 00 13 00 03 00 0A FF F7 00 00 A9 C7

### 6.4.4 System setting parameters (0x05xx)

| Function | Modbus Address (hexadecimal) | Description | Write | Read |
|---|---|---|---|---|
| Clear current error | 0x0501 | Clear currently displayed errors | The parameter range is [0,1]. The default value is 0. Writing a value of 1 clears the current error. | Clear successfully reads the default value 0. |
| System restart | 0x0503 | Restart the software system | The parameter range is [0,1].<br>The default value is 0. Writing 1 will restart the software. | Reads as the default value 0. |
| Aging test | 0x0504 | Configure this variable and the aging test will be automatically performed after power-on. | The parameter range is [0,1].<br>The default value is 0. If you write 1, the system will automatically initialize and perform the opening and closing reciprocating motion. | Reads as the default value 0. |

Note: The aging test function needs to remain effective after power off and restart. You need to write 3 to the 0x0300 register to save the current register value.

Example:

Clear errors:

Send: 01 06 0501 0001 1906

Return: 01 06 0501 0001 1906

System restart:

Send: 01 06 0503 0001 b8c6

Return: 01 06 0503 0001 b8c6

Open aging test:

Send: 01 06 0504 0001 0907

Return: 01 06 0504 0001 0907

Turn off aging test

Send: 0106 0504 0000 c8c7

Return: 0106 0504 0000 c8c7

(If power off and restart are required, store the flag of the aging test and send the following data frame to save the parameters.)

Send: 01 06 0300 0003 c98f

Return: 01 06 0300 0003 c98f

# 7 Instructions for use of the host computer

## 7.1 Debugging Software Installation and Wiring

Connect via debugging software, essentially controlling the device via the RS485 interface. The wiring requires four wires: 24V, GND, 485_A (T/R+, 485+), and 485_B (T/R-, 485-). Power is provided by a 24V DC regulated power supply. Plug the 485's USB port into a computer's USB port. The wiring is as follows:

485A connects to the T/R+ terminal of the 485-to-USB module;

485B connects to the T/R- terminal of the 485-to-USB module;

24V connects to the positive terminal of the 24V DC regulated power supply;

GND connects to the negative terminal of the 24V DC regulated power supply.

| DB9 Pin | Output signal | RS_422 full-duplex wiring | RS_485 half-duplex wiring |  |
|---|---|---|---|---|
| 1 | T/R+ | Send(A+) | RS-485(A+) | |
| 2 | T/R- | Send(B-) | RS-485(B-) | |
| 3 | RXD+ | Receive(A+) | N/A | |
| 4 | RXD- | Receive(B-) | N/A | |
| 5 | SGND | Signal Ground | Signal Ground | |
| 6 | N/A | N/A | N/A | |
| 7 | N/A | N/A | N/A | |
| 8 | N/A | N/A | N/A | |
| 9 | N/A | N/A | N/A | |



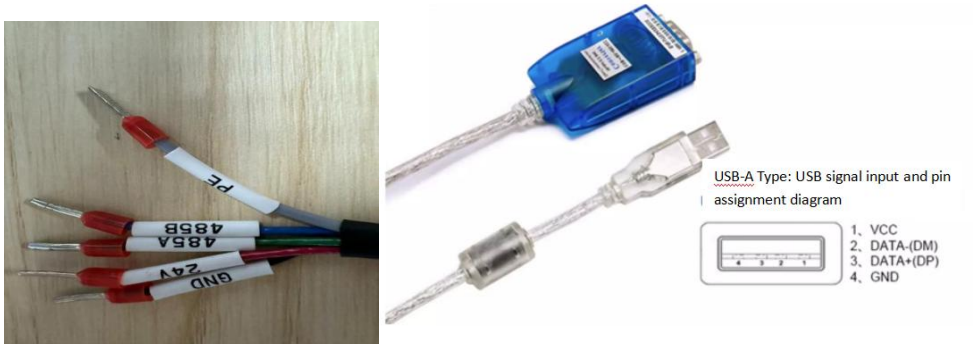



Figure 3-1 Wiring Diagram

## 7.2 Debugging Software Installation and Use

Refer to the host computer user guide. DH5 Control Studio Host Computer User Guide.

# 8 Error Code

| NO | English Explanation | Chinese Explanation | Error Code |
|---|---|---|---|
| 1 | MOTOR_OFF_MOVE_ERR | Movement command when servo is OFF | 0x80 |
| 2 | HOME_NONE_MOVE_ERR | Position movement command when origin return is not completed | 0x82 |
| 3 | HOME_NONE_CMD_ERR | Numerical command when origin return is not completed | 0x83 |
| 4 | HOMEING_MOVE_ERR | Movement command during home return execution | 0x84 |
| 5 | NO_TABLE_ERR | Abnormal position NO. during movement | 0x85 |
| 6 | PULSE_CMD_ERR | Move command when pulse train input is valid | 0x86 |
| 7 | RESET_ERR | Software reset when servo is ON | 0x90 |
| 8 | TEACH_NO_TABLE_ERR | Position NO. abnormal during teaching | 0x91 |
| 9 | MOCE_PWRT_ERR | PWRT signal detected during movement | 0x92 |
| 10 | HOME_NONE_PWRT_ERR | Homing incomplete status PWRT signal detected | 0x93 |
| 11 | DCLR_ERR | The DCLR signal is detected during the reference position movement command. | 0x95 |
| 12 | POS_DATA_ERR | Parameter data abnormality | 0xA1 |
| 13 | PARM_DATA_ERR | Abnormal location data | 0xA2 |
| 14 | CMD_INF_ERR | Position instruction information data abnormality | 0xA3 |
| 15 | PULSE_CNT_ERR | Instruction counter overflow | 0xA4 |
| 16 | PULSE_ACC_ERR | Command deceleration abnormality | 0xA7 |
| 17 | TYPE_ERR | Incompatible motor and encoder types | 0xA8 |
| 18 | MOTOR_LOCK_ERR | Excitation detection error | 0xB8 |
| 19 | SIGNAL_SNESOR_ERR | Origin sensor not detected | 0xBA |
| 20 | SIGNAL_HOME_ERR | Origin return timeout | 0xBE |
| 21 | OVER_SPEED_ERR | Actual speed is too fast | 0xC0 |
| 22 | SERVO_ERR | Servo abnormality | 0xC1 |
| 23 | OCU_ERR | Over current | 0xC8 |
| 24 | OVO_ERR | Over voltage | 0xC9 |
| 25 | OTEM_ERR | Overheat | 0xCA |
| 26 | AD_OFFSET_ERR | Current sensor offset adjustment abnormality | 0xCB |
| 27 | CTRLVO_ERR | Abnormal control power supply voltage | 0xCC |
| 28 | CTRLUNDERVO_ERR | Control power supply voltage is too low | 0xCE |
| 29 | IO_POWER_ERR | I/O 24V Power supply abnormality | 0xCF |
| 30 | DIRVE_ERR | Drive source abnormality | 0xD4 |
| 31 | HOME_NONE_POSCNT_ERR | Deviation counter overflows when home | 0xD5 |

| | | | |
|---|---|---|---|
| | | return is not completed | |
| 32 | POSCNT_ERR | Deviation Overflow | 0xD8 |
| 33 | POS_OVERLIMIT_ERR | Travel software limit exceeded error | 0xD9 |
| 34 | PUSHPOS_OVERLIMIT_ERR | Pushing range over limit error | 0xDC |
| 35 | CRASH_ERR | Collision Detection | 0xDF |
| 36 | OVER_LOAD_ERR | Over load | 0xE0 |
| 37 | ENCODER_ERR | Encoder receiving error | 0xE5 |
| 38 | ENCODER_CNT_ERR | Encoder counting error | 0xE6 |
| 39 | ENCODER_ABPULSE_ERR | Phase A and B are disconnected | 0xE8 |
| 40 | ENCODER_ABS_ERR | Battery-less ABS error | 0xEB |
| 41 | FLASH_ERR | Non-volatile memory write verification exception | 0xF5 |
| 42 | UVO_ERR | Under voltage | 0xF6 |
| 43 | LOCKED_ROTOR | Stalled | 0xF7 |
| 44 | EMC | STO Emergency Stop | 0xF8 |
| 45 | SET_PARAM_ABNORMAL | Parameter variable exceeds the boundary value | 0x20 |
| 46 | F1_COMMUN_ERROR | Right thumb moves left and right Communication abnormality | 0x21 |
| 47 | F2_COMMUN_ERROR | Right index finger communication abnormality | 0x22 |
| 48 | F3_COMMUN_ERROR | Right middle finger communication abnormality | 0x23 |
| 49 | F4_COMMUN_ERROR | Right ring finger abnormal communication | 0x24 |
| 50 | F5_COMMUN_ERROR | Right hand pinky finger communication abnormality | 0x24 |
| 51 | F6_COMMUN_ERROR | Right thumb moves up and down, communication abnormality | 0x26 |
| 52 | READ_PRAM_ABNORMAL | Abnormal travel parameter reading | 0x27 |
| 53 | OVER_VOLTAGE | Over voltage | 0x29 |
| 54 | UNDER_VOLTAGE | Under voltage | 0x30 |

Table 4-1 Fault Codes

# 9 Notes

1. If the DH5 Smart dexterous hand automatically opens and closes and reciprocates after powering on, it is operating in aging test mode. Refer to the system settings to disable aging test.
2. After clearing single-axis errors, reinitialize the axis.
3. If a single axis fails to move, rule out communication issues or mechanical stalls.