User Manual

OmniHand Pro 2025

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Language: English

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1. Important Safety Precautions

This section describes the safety requirements that must be met during the installation and operation of the OmniHand Pro 2025. As the OmniHand Pro 2025 is a semi-finished mechanical product, it is essential to carefully read this manual and fully understand the relevant safety features and potential hazards prior to first use. All relevant personnel must conduct risk assessment before each OmniHand Pro 2025 installation and strictly adhere to all instructions in this manual during operation.

1.1 Notes for Use

Do Not operate or store the OmniHand in any high-temperature or high-humidity environment.

Do Not subject the OmniHand to any excessive mechanical load or shock.

Do Not apply excessive force on fingertips.

Do Not forcibly pull or twist any finger of the OmniHand.

Do Not bring the OmniHand near an open flame or heat source.

Do Not operate or store the OmniHand in a flammable or explosive environment.

Do Not use the OmniHand in any strong electromagnetic fields, such as near high-voltage power lines or high-power machinery.

Do Not use OmniHand to grasp any object that is excessively heavy, overheated, sharp, rough or corrosive.

Do Not expose the OmniHand to any liquid (alcohol, water, beverage, etc.) or dust without proper protection. In case of accidental contact, be sure to power off immediately and contact our after-sales service technicians.

Do Not disassemble the OmniHand without authorization, otherwise, the warranty in the After-Sales Service Commitment will be voided. In case of any malfunction, please contact our After-Sales Service technicians.

Do Not operate any hazardous machinery with OmniHand. The company assume no liability for personal injury or property damage resulting from such actions.

1.2 Risk Assessment

List of Potential Hazards

Mechanical hazards: Crush injuries, abrasions, etc., caused by contact with the OmniHand or any sharp object being held.

Electrical hazards: Electric burns or electric shocks caused by contact with live parts.

High-temperature hazards: Burns caused by prolonged contact with hot surfaces of the OmniHand.

Noise hazard: No significant hazard identified.

Vibration hazard: No significant hazard identified.

Radiation hazard: No significant hazard identified.

Material/substance hazard: No significant hazard identified.

Ergonomic hazard: No significant hazard identified.

Environmental hazard: No significant hazard identified.

1.3 After-Sales Service Commitment

The OmniHand Pro 2025 is covered by a 6-month limited warranty. If any defect due to manufacturing or material flaws occurs after the product is put into use, we would provide necessary spare parts for replacement or repair. The product warranty shall be void if defects result from improper handling, failure to follow the user manual, or unauthorized disassembly of the product. Without prejudice to terms of this warranty, if the product has exceeded its warranty period, we reserve the right to charge customers for the cost of replacement or repair.

Beyond the warranty period, if the device exhibits any defect, we should not be held liable for any damages or losses incurred, including but not limited to production losses or damage to other production equipment.

1.4 Disclaimer

We are committed to continuously improving the product reliability and performance, and therefore reserve the right to make product improvements or upgrade without further notice. We strive to ensure the accuracy and reliability of this manual but shall not be held liable for any errors or omissions it may contain. Defects or malfunctions caused by the following circumstances are not covered within the scope of warranty:

1. Failure to install, wire or connect other control devices as required by the user manual;
2. Unauthorized disassembly/assembly of the OmniHand;

3. Use of OmniHand beyond the specifications or standards stated in the user manual;

4. Damage resulting from improper transportation;

5. Damage caused by accidents, impacts, or collisions;

6. Damage caused by natural disasters, including but not limited to fire, earthquakes, tsunami, lightning strikes, strong winds and floods.

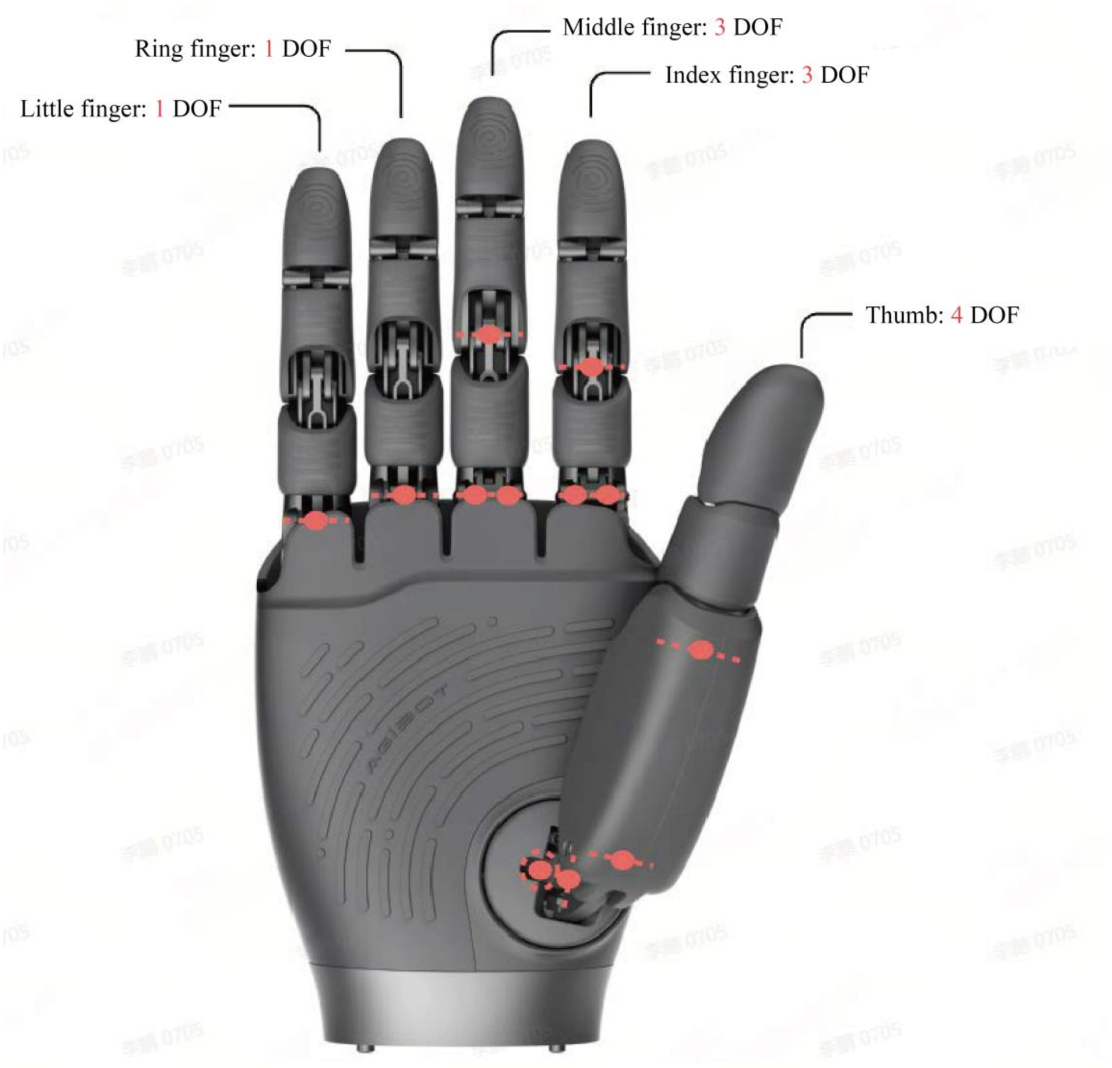
We shall not be held liable for any loss, damage, injury or expense caused by customers violating the disclaimers in this section. Customers are kindly requested to carefully read and agree to this disclaimer before purchasing and using the product.

2. Product Profile

2.1 Product Overview

OmniHand Pro 2025 is a highly integrated all-round dexterous hand with powerful sensing and exceptional capabilities.

Representing a new class of high-DoF commercial dexterous hands, it combines a compact, lightweight form factor with impressive load capacity, precision, speed, and multi-modal tactile sensing to enable intelligent task execution.



Schematic of Active DOF Motor Sequence for OmniHand Pro 2025

2.2 Features

- **Human-like dimensions:** 19 DoF, only 820g - the smallest, most lightweight and anthropomorphic dexterous hand in its class
- **Multi-tasking:** Optimized configuration for easy manipulation of tools, with a fingertip force of up to 20N
- **Superior sensing:** Multi-modal sensing (position, normal force, tangential force) with 0.1N-level high sensitivity, powered by AI algorithms

2.3 Technical Specifications

OmniHand Pro 2025		
Body Parameters	Weight	≤ 820g
	Dimension	207*98*56 mm
	Active DoF	12
	Total DoF	19
	Minimum opening/closing time (typical value)	0.7s
	Fingertip repetitive positioning accuracy (typical value)	0.4mm
	Load capacity	Five-finger grasp force ≥10kg
	Operating Voltage	8.3-35.6V
	Communication interface	CAN-FD
	Operating Temperature Range	-20~50℃
	Online Upgrade	Support OTA online upgrade
Tactile sensor	Force sensing type	3D force on fingertip
	Array resolution	0.1N
	Range of sensing	0~50N
	Maximum acceptable force (nondestructive)	1000N

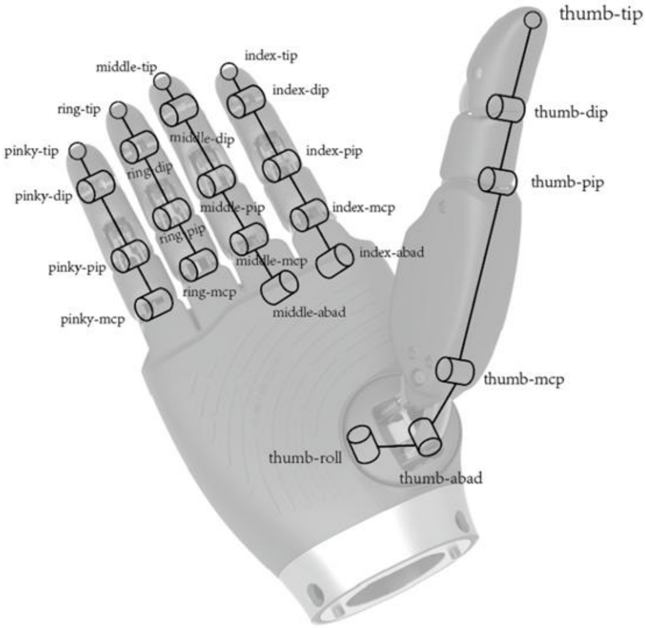
[1] The above parameters may vary in different application scenarios and model configurations, depending upon actual conditions.

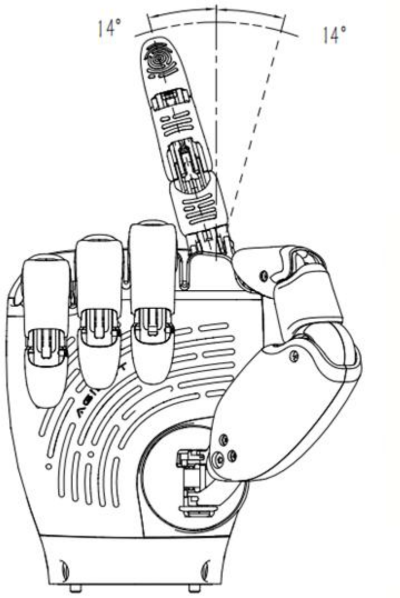
[2] The product appearance may be upgraded later, please refer to the physical object at that time.

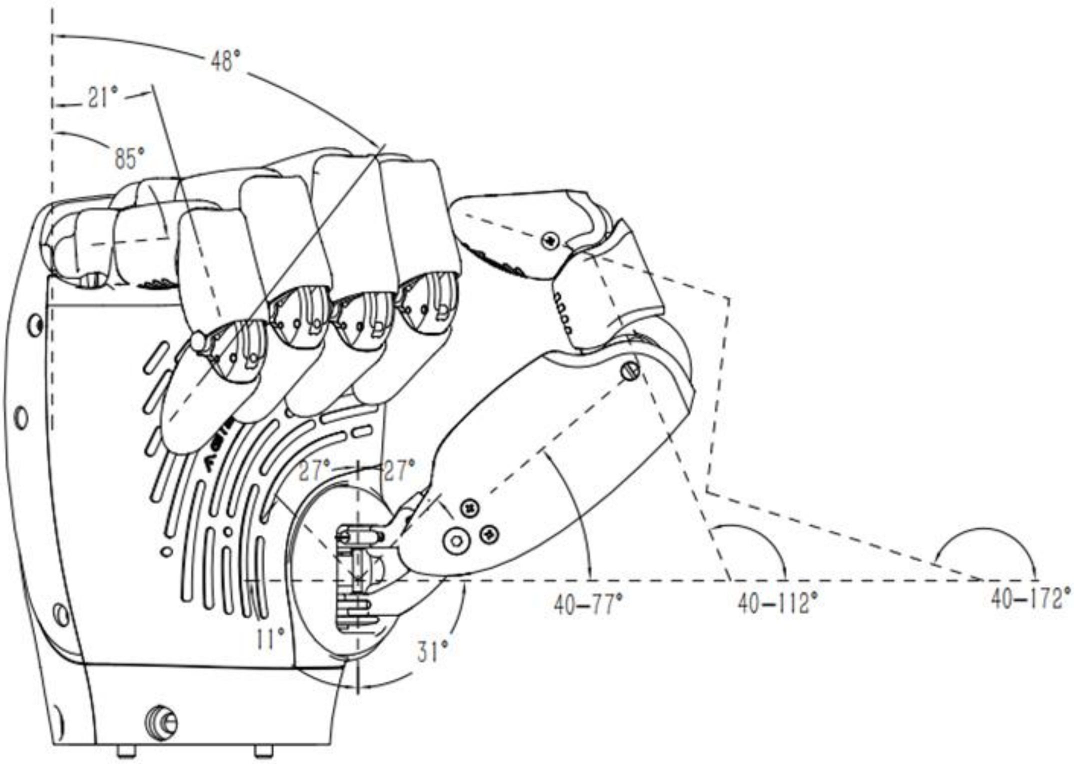
2.4 Range of Joint Angle

Fingers	Joints	Direction of motion	Minimum angle	Maximum angle
Index finger	DIP	Flexion/extension	0°	226°
	PIP	Flexion/extension	0°	157°
	MCP	Flexion/extension	0°	76°
	ABAD	Lateral swing	0°	14°
Middle finger	DIP	Flexion/extension	0°	227°
	PIP	Flexion/extension	0°	159°
	MCP	Flexion/extension	0°	77°
	ABAD	Lateral swing	0°	14°
Ring finger, Little finger	DIP	Flexion/extension	0°	228°
	PIP	Flexion/extension	0°	159°
	MCP	Flexion/extension	0°	85°
	ABAD	Lateral swing	0°	0°
Thumb	DIP	Flexion/extension	40°	172°
	PIP	Flexion/extension	40°	112°
	MCP	Flexion/extension	40°	77°

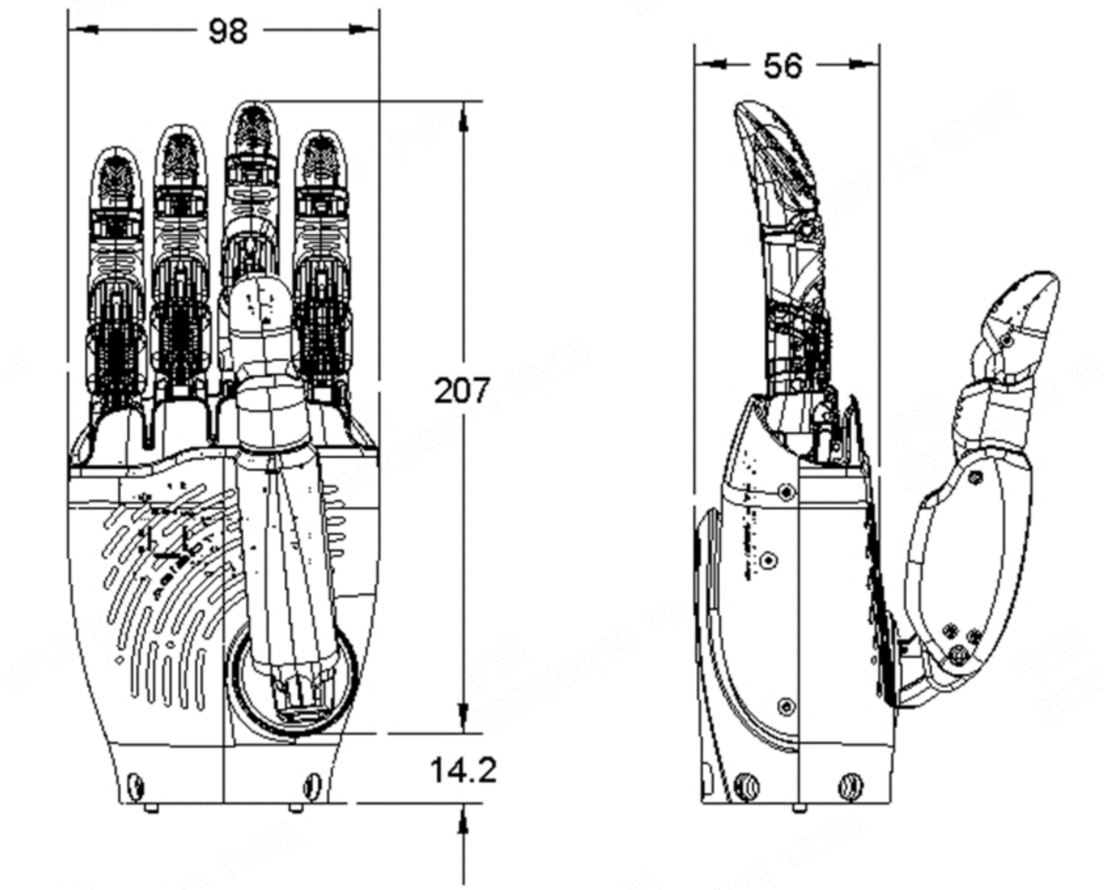
	ABAD	Lateral swing	0	54°
	ROLL	Spinning	0°	42°







2.5 Product Dimensions

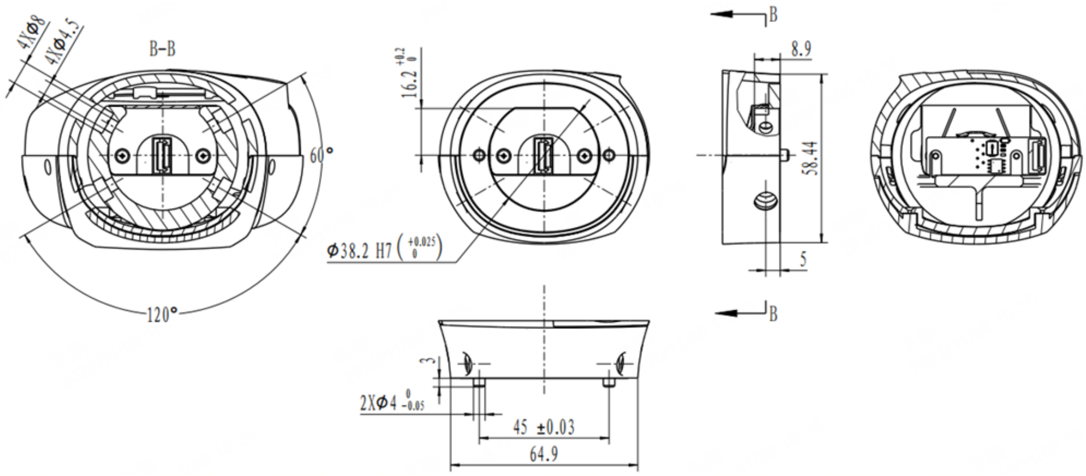


3. Product Installation Instructions

3.1 Packing List

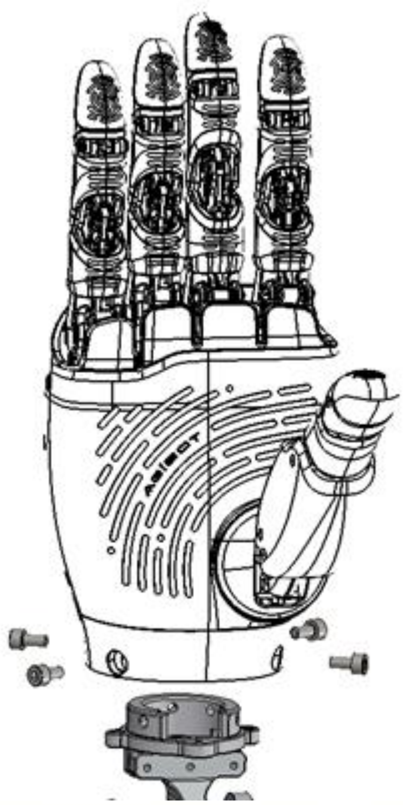
- OmniHand Pro 2025 × 1
- USB to CAN-FD communication cable × 1
- USB to CAN-FD converter × 1
- Power adapter × 1
- Product Certificate × 1

3.2 Mechanical Interface



3.3 Installation Instructions

1. Before installation, please prepare four M4*8 screws and a matching hex key.
2. Connect the communication cable as illustrated, note the latch orientation.
3. Insert the robotic arm’s end flange into the OmniHand Pro’s bottom port, secure with four M4 screws. Tightening torque: 1.1–1.5 Nm



4. For mounting the OmniHand Pro to other robots, please refer to the mechanical interface diagram and design an adapter flange accordingly.
5. It is recommended to apply threadlocker to the screws before tightening.

3.4 Electrical and Communication Interfaces

Operating voltage/current: Typical value: 24V/2A. Peak current ≤ 3.5A@24V (< 30s).

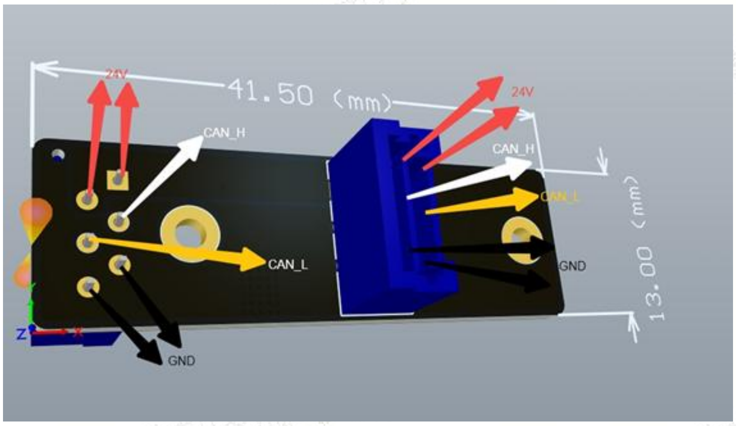
Voltage input: 12~28V, maximum withstand voltage 45V (< 1s), undervoltage (8V) and overvoltage (35V) protection disabled, shutdown current < 1mA.

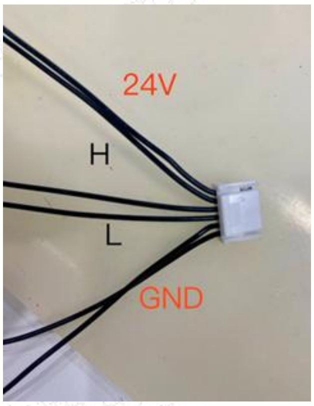
Voltage alarm setting: Configurable undervoltage/overvoltage alarm threshold, with no action upon alarm.

Communication Interface: CAN-FD with 120Ω terminal resistor.

Power Terminal Model: Socket: BM06B-ZESS-TBT, Plug: ZER-06V-S.

Terminal Signal Sequence: 1, 2--24V; 3--CANH; 4--CANL; 5, 6--GND.





3.5 Caution: Hot-plugging is NOT Supported

When the entire hand is powered on, hot-plugging of power cord or signal cable is not supported and users shall use it properly; in case of malfunction due to unauthorized hot-plugging, the customer should be held solely liable.

4. Communication Protocols

4.1 Communication Interface

Secondary development based on CAN-FD communication is supported, please check the SDK doc here https://github.com/AgibotTech/OmniHand-Pro-2025

- CAN-FD interface, default 1Mbps 80% + 5Mbps 80% extended identifier (29bit) data frame format. Disable standard identifiers and remote frame format;
- Control commands follow a question-answer mechanism, some status information can be configured for active reporting, with response timeout 50ms;
- If the sender and the responder identifiers match, read/write data is returned;

- Extended Frame Definition:
- Bit0 - Bit6: Device ID
- Bit 7: Read/write flag, 0 for read register operation; 1 for write register operation;
- Bit 8~Bit 14: Product ID;
- Bit 15: Reserved;
- Bit 16~Bit 23: Register address;
- Bit 24~Bit 28: Sub-register address;

Byte3							
bit31	bit30	bit29	bit28	bit27	bit26	bit25	bit24
x	x	x	Sub-register Address: `0x0 ~ 0x1F`				

Byte2							
bit23	bit22	bit21	bit20	bit19	bit18	bit17	bit16
Register Address: `0x00 ~ 0xFF`							

Byte1							
bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8
Reserve	Product ID: `0x01 ~ 0x7F`						

Byte0							
bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
R/W	Device ID: `0x01 ~ 0x7F`						

- Device ID Definition:
- Broadcast Address: `0x00`;
- Default Address: `0x01`;
- Device Address: `0x01~0x7F`;
- Product ID Definition:

- Fixed and unmodifiable as per the product definition;
- Data Definition: **Little-endian;**

4.2 Definitions of Register Address and Sub-Address

- Read Register will set read/write flag `Bit7` to `0` and Write Register will set `Bit7` to `1`;
- Configuration settings written to the register are automatically saved and take effect after a reboot;
- Read register commands have unrestricted length and data fields; the default data length is `0` with no data content sent.
- Write register commands must adhere to the specified register length and contain valid data, otherwise, no response will be made.
- Limited by sub-register length, maximum one-time configuration supports 32 DOF;

4.3 Definition of General Registers

No.	Register Address	Register Name	Sub-register	Sub-register Name	Register Content	Register Length	Read-Write Permissions
Pn1	`0x01`	Manufacturer Information	`0x00`	Sub-register Operation	All sub-registers under Read/Write Registers;	48Byte	Read Only
			`0x01`	Product Model	ASCII string, remaining length padded with `0x00`; Example: `SkillHand S6`	16Byte	Read Only
			`0x02`	Product SN	ASCII string, fixed length; `SSCMMVVYMXXXXX` `SS`: Product Series, a 2-bit code, where the first is	14Byte	Read Only

					encoded in base-26 (A~Z) and the second in base-10 (0~9). `C`: Product Configuration, a 1-bit code, encoded in base-32 (0~Z); `MM`: Module ID, a 2-bit code, encoded in base-10 (0~9); `VV`: BOM Version, a 2-bit code encoded in base 10 (0~9); `Y`: Production Year, a 1-bit code, encoded in base-26 (A~Z); `M`: Production Month, a 1-bit code, encoded in base-12 (1-C); `XXXXX`: Sequence Number, , a 5-bit code encoded in base-10 (0~9);		
			`0x03`	Hardware Version Information	Hardware version information; `Byte 0`: Major version number; `Byte 1`: Minor version number; `Byte 2`: Patch revision number;	4Byte	Read Only

					`Byte 3`: Reserve; `Hardware Version`: `Major.Minor.Patch`;		
			`0x04`	Software Version Information	Software version information; `Byte 0`: Major version number; `Byte 1`: Minor version number; `Byte 2`: Patch revision number; `Byte 3`: Reserve; `Software Version`: `Major.Minor.Patch`;	4Byte	Read Only
			`0x05`	Supply voltage	32-bit unsigned integer; default `12,500` (12.5V); Unit: mV; Valid Range `8000, 24000` Regulated Unit: 500mV;	2Byte	Read Only
			`0x06`	Active DoF	Example: `0x0C`, number of active DOF; valid range `1, 32`	1Byte	Read Only
Pn2	`0x02`	Equipment Information	`0x00`	Sub-register Operation	All sub-registers under Read/Write Registers;	5Byte	Read/write

			`0x01`	Device ID	Default Device ID: `0x01`; Device ID Address: `0x01~0x7F`;	1Byte	Read/write
Pn3	`0x03`	Current Threshold	`0x00`	Sub-register Operation	All sub-registers under Read/Write Registers;	Single sub-register length × active DOF	Read/write
			`0x01`	#1 Joint Motor Current Threshold	16-bit unsigned integer data; default: `1,500`; Unit: mA; 2Byte represents one joint motor; valid range `0, 65535`	2Byte	Read/write
			`0x02`	#2 Joint Motor Current Threshold		2Byte	Read/write
			...	... ...		...	Read/write
Pn4	`0x04`	Temperature threshold	`0x00`	Sub-register Operation	All sub-registers under Read/Write Registers;	Single sub-register length × active DOF	Read/write
			`0x01`	#1 Joint motor warm-up start threshold	Warm-up start threshold -8-bit unsigned integer data; default value `60`; Unit: °C; 1Byte represents one joint motor; valid range [50, overtemperature	2Byte	Read/write
				#1 Joint Motor Overtemperature Protection			

				Threshold	protection threshold - 5]		
			`0x02`	#2 Joint motor warm-up start threshold	Overtemperature protection threshold - 8-bit unsigned integer; default `80`; Unit: ℃;	2Byte	Read/write
				#2 Joint Motor Overtemperature Protection Threshold	1Byte represents one joint motor; valid range [warm-up start threshold + 5, 80]		
			...	... ...		... ...	...
				... ...			
Pn5	`0x05`	Tactile sensor	`0x01`	Thumb fingertip sensor	Little endian `byte0`: Sensor online status) `byte1-18`: Channel values `byte19-24`: 3D force (0-3000), Unit: 0.10N `byte25-28`: Self-capacitance proximity `Byte0` = 1 represents sensor online `Byte19-20` represents normal force (little-endian mode) `Byte21-22` represents tangential force	48byte	Reserve
			`0x02`	Index finger tip sensor			
			`0x03`	Middle finger sensor			
			`0x04`	Ring finger fingertip sensor			
			`0x05`	Little fingertip sensor			

					(little-endian mode) `Byte23-24` represents angential force angle (little-endian mode) Normal force: Force perpendicular to finger surface Tangential force: Force parallel to finger surface Tangential force angle: 0° when fingertip is upward, clockwise rotation; range: 0°~359°.		
			...	...	... ...	... ...	
Pn15	`0x0F`	Reserve	`0x00`	Sub-register Operation	All sub-registers under Read/Write Registers;	Single sub-register length × active DOF	Reserve
Pn16	`0x10`	Control Mode	`0x00`	Sub-register Operation	All sub-registers under Read/Write Registers;	Single sub-register length × active DOF	Read/write
			`0x01`	#1 Joint	8-bit unsigned	1Byte	Read/wr

				Motor Control Mode	integer data; Extend control modes according to product form definition, default value 0; Lower 3-bit valid `xxxx x111` `0` - Position mode; `1` - Velocity mode;		ite
			`0x02`	#2 Joint Motor Control Mode		1Byte	Read/write
			...	... ...		... ...	...
Pn19	`0x13`	Position control	`0x00`	Sub-register Operation	All sub-registers under Read/Write Registers;	Single sub-register length × active DOF	Read/write
			`0x01`	#1 Joint Motor Target Position	16-bit signed integer data; default: `0`; Unit: 1/65535 of maximum position; 2Byte represents one joint motor; valid values are defined by the product; Write register to set target position and return current position; Read register to get current actual position;	2Byte	Read/write
			`0x02`	#2 Joint Motor Target Position		2Byte	Read/write
			...	... ...		... ...	...
Pn23	`0x17`	Reserve	`0x00`	Sub-register Operatio	All sub-registers under Read/Write	Single sub-register	Reserve

				n	Registers;	length × active DOF	
...	...	...	...	...	... ...	... ...	...
Pn31	`0x1F`	Reserve	`0x00`	Sub-register Operation	All sub-registers under Read/Write Registers;	Single sub-register length × active DOF	Reserve
Pn32	`0x20`	Error Report	`0x0`	Sub-register Operation	All sub-registers under Read/Write Registers;	Single sub-register length × active DOF	Read Only
			`0x1`	#1 Joint Motor Error Information	Actively report current motor error information upon error; 16-bit unsigned integer data; error information defined as follows: `Bit0`: Stall protection; `Bit1`: Overtemperature protection; `Bit2`: Overcurrent protection; `Bit3`: Motor abnormality; `Bit4`: Communication abnormal; `Bit5 to Bit15`: Reserve; Write `0x0000` to	2Byte	Read/write
			`0x2`	#2 Joint Motor Error Information		2Byte	Read/write
			...	... ...		... ...	...

					this register and actively clear the current error information;		
Pn33	`0x21`	Temperature Report	`0x0`	Sub-register Operation	All sub-registers under Read/Write Registers;	Single sub-register length × active DOF	Read Only
			`0x1`	#1 Joint Motor Temperature Information	Write this register to configure and active report cycle time, Unit: ms; 16-bit unsigned integer data; default:`0`, not actively report; Example: actively report joint temperature at 1Hz, send: `0x03E8`; Read this register to actively get current temperature information, Unit: ℃; 16-bit signed integer data; Example: the current joint temperature is 50°C, report: `0x0032`;	2Byte	Read/write
			`0x2`	#2 Joint Motor Temperature Information		2Byte	Read/write
			...	... ...		... ...	...

Pn34	`0x22`	Current Report	`0x0`	Sub-register Operation	All sub-registers under Read/Write Registers;	Single sub-register length × active DOF	Read Only
			`0x1`	#1 Joint Motor Temperature Information	Write this register to configure and active report cycle time, Unit: ms; 16-bit unsigned integer data; default: `0`, not actively report; Example: actively report joint current at 1Hz, send: `0x03E8`; Read this register to actively get current, Unit: mA; 16-bit signed integer data; Example: if the current joint current is 1,500mA, report: `0x05DC`;	2Byte	Read/write
			`0x2`	#2 Joint Motor Temperature Information		2Byte	Read/write
			...	... ...		... ...	...
Pn35	`0x23`	Reserve	`0x00`	Sub-register Operation	All sub-registers under Read/Write Registers;	Single sub-register length × active DOF	Reserve
...	...	...	...	...	... ...	...	...

Pn47	`0x2F`	Reserve	`0x00`	Sub-register Operation	All sub-registers under Read/Write Registers;	Single sub-register length × active DOF	Reserve

4.4 Definition of Manufacturer Configuration Register

Special configuration parameters for different products, such as sensor calibration, finger joint SN, etc;

No.	Register Address	Register Name	Sub-register	Sub-register Name	Register Content	Register Length	Read-Write Permissions
Pn48	`0x30`	Reserve	`0x00`	Sub-register Operation	All sub-registers under Read/Write Registers;	Single sub-register length × active DOF	Reserve
...	...	...	...	...	... ...	...	...
Pn127	`0x7F`	Reserve	`0x00`	Sub-register Operation	All sub-registers under Read/Write Registers;	Single sub-register length × active DOF	Reserve

4.5 Firmware Upgrade Register (Reserved)

Host: Host

Device: OmniHand Pro

Byte	**Byte**

bit31	bit30	bit29	bit28	bit27	bit26	bit25	bit24	bit23	bit22	bit21	bit20	bit19	bit18	bit17	bit16
x	x	x	R/W	Sub-register Address: `0x0 ~ 0xF`				Register Address: `0x00 ~ 0xFF`							

Byte								**Byte**							
bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Reserve	Product ID: `0x01 ~ 0x7F`							Reserve	Device ID: `0x01 ~ 0x7F`						

Parameter ID	Read/write flag bit	Register Address	Register Name	Sub-register	Sub-register Name	Register Content	Register Length	Data Stream
Pn1	1	`0xF0`	OTA Data Packet	`0x00`	Data Packet	Packet Content	64Byte	Host -> Device
Pn2	1	`0xF1`	OTA-related request command	`0x00`	N/C	No response		
				`0x01`	OTA upgrade request	0 - Unsigned 32-bit integer data, firmware length; Note: Firmware length must be 2K-aligned; `1` - Unsigned 16-bit integer data, number of firmware packets (2K per packet) `2` - Unsigned 16-bit integer, reserved (default: `0`); `3` - Unsigned 32-	16Byte	Host -> Device

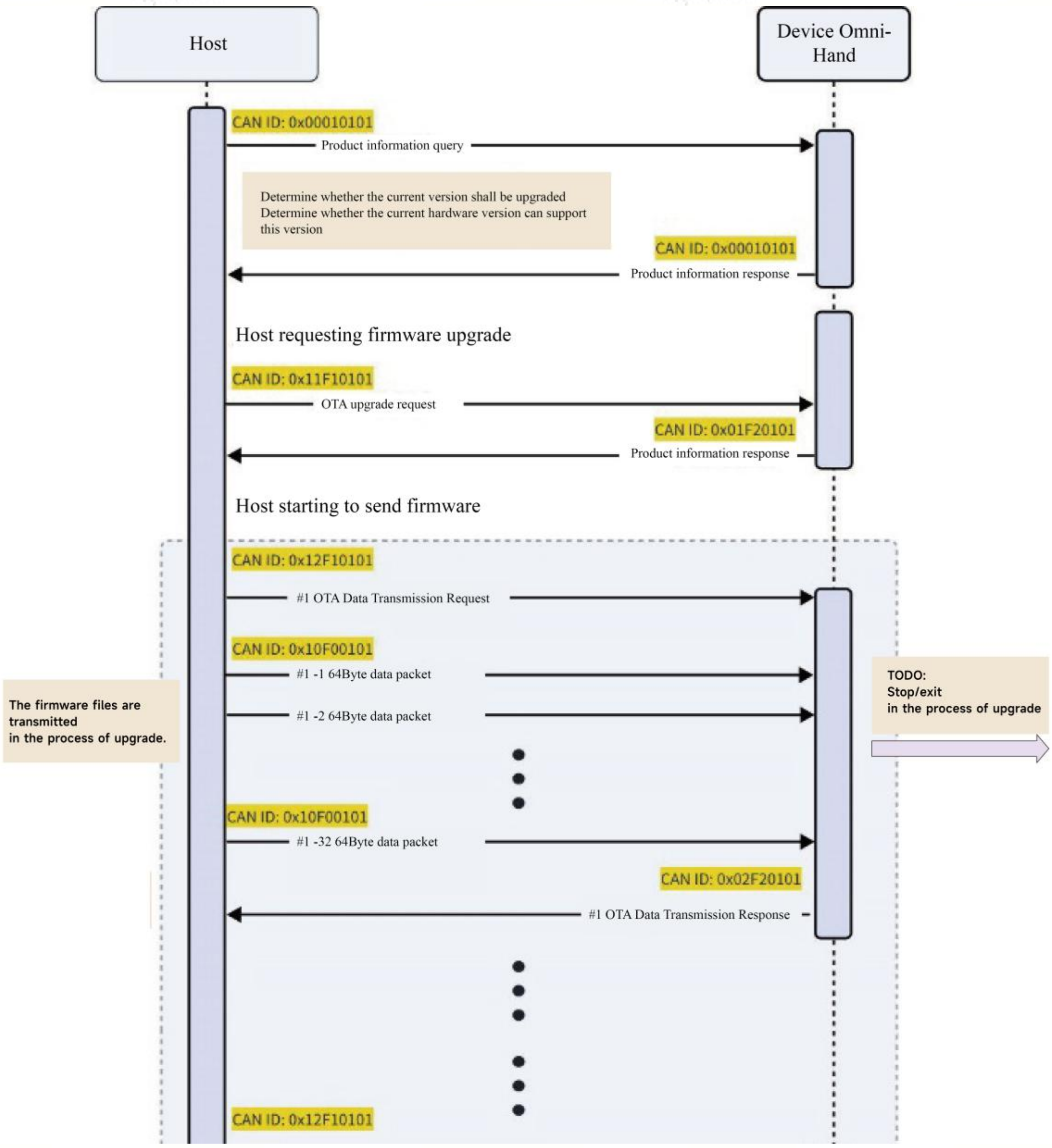
						bit integer, reserved (default: `0`); `4` - Unsigned 32-bit integer, reserved (default: `0`);		
				`0x02`	OTA data transfer request	`0`- Unsigned 16-bit integer data, firmware packet index; `1` - Unsigned 16-bit integer data, firmware packet CRC checksum; (CRC16-Modbus) Note: The packet length is defaulted by 2K; with any packet <2K padded with `0xFF`;	4Byte	Host -> Device
				`0x03`	OTA completion request	Unsigned 32-bit integer data; reserved default is `0`;	4Byte	Host -> Device
				`0x04`	OTA reboot request	Unsigned 32-bit integer data; reboot after x delay, `0` means immediate reboot;	4Byte	Host -> Device
				`0x05`	OTA result request	Unsigned 32-bit integer data; reserved default is `0`;	4Byte	Host -> Device
				`0x06`	OTA exit request	Unsigned 32-bit integer data;	4Byte	Host -> Device
Pn3	0	`0xF2`	OTA-	`0x00`	N/C	No response		

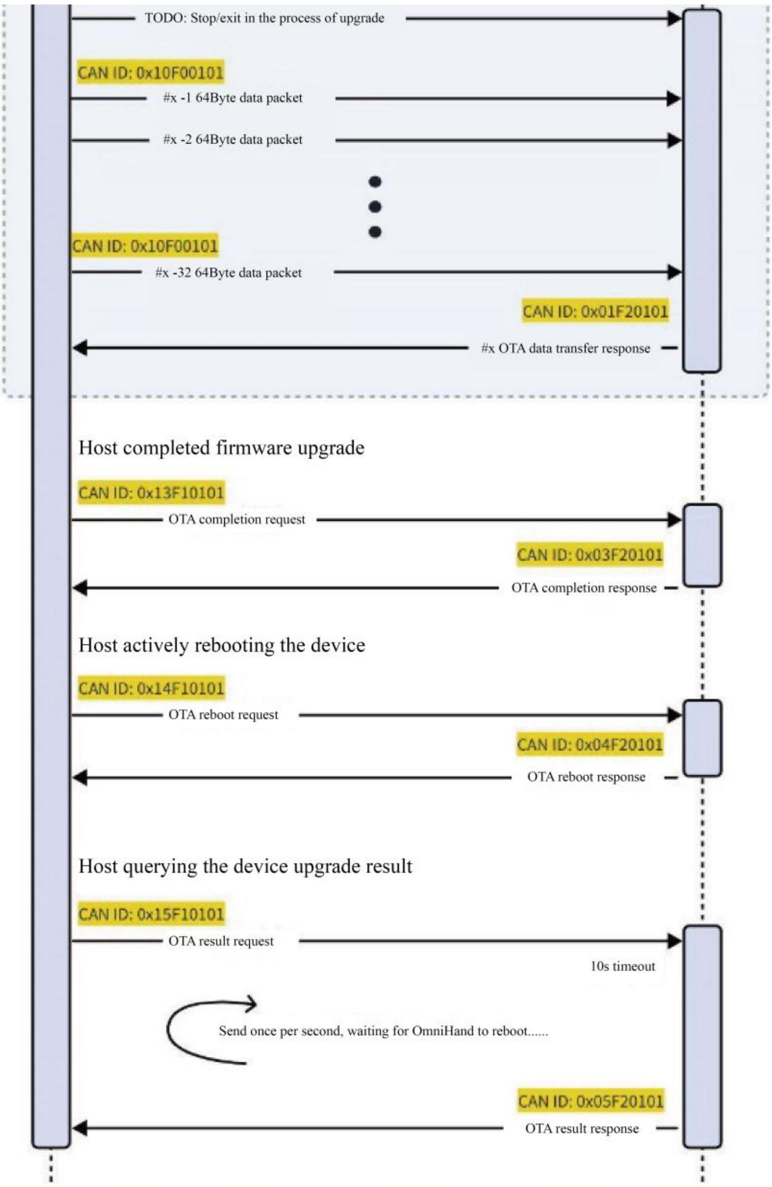
			related response command	`0x01`	OTA upgrade response	Unsigned 32-bit integer data; `0x00000000`: Normal response; `0x00000001`: Flash partition table retrieval failed; `0x00000002`: Download partition erase failed; `0x00000003`: Invalid firmware length	4Byte	Device -> Host
				`0x02`	OTA data transfer response	Unsigned 32-bit integer data; `0x00000000`: Normal response; `0x00000001`: CRC verification failed	4Byte	Device -> Host
				`0x03`	OTA completion response	Unsigned 32-bit integer data; `0x00000000`: Normal response; `0x00000001`: No OTA request; `0x00000002`: Firmware incomplete; `0x00000003`: Flash partition table retrieval failed; `0x00000004`: Upgrade flag setting failed;	4Byte	Device -> Host

				`0x04`	OTA reboot response	Unsigned 32-bit integer data; `0x00000000`: Normal response;	4Byte	Device -> Host
				`0x05`	OTA result response	Unsigned 32-bit integer data; `0x00000000`: Normal response; `0x00000001`: Unknown error; `0x00000002`: Data read error; `0x00000003`: Data write error; `0x00000004`: Firmware corrupted; `0x00000005`: Insufficient update space; `0x00000006`: Unsupported compression algorithm; `0x00000007`: Unsupported encryption type; `0x00000008`: Unsupported differential algorithm; `0x00000009`: Unsupported digital signature; `0x0000000A`: Insufficient memory; `0x0000000B`: Unsupported container type;	4Byte	Device -> Host

						`0x0000000C`: Target partition does not exist; `0x0000000D`: Flash erase failed;		
				`0x06`	OTA exit response	Unsigned 32-bit integer data; `0x00000000`: Normal response;	4Byte	Device -> Host

4.5.1 Upgrade Process





4.5.2 Firmware Packet CRC16 Verification Example

```C++
class ModbusCRC16 {
public:
    static uint16_t Calculate(const std::vector<uint8_t> &buffer)
{
        uint16_t crc = 0xFFFF;
        for (auto data : buffer) {
            crc = (crc >> 8) ^ CRC_TABLE[(crc ^ data) & 0xFF];
        }
        return crc;
    }
```

```
private:
    static constexpr uint16_t CRC_TABLE[256] = {
        0x0000, 0xC0C1, 0xC181, 0x0140, 0xC301, 0x03C0, 0x0280,
0xC241,
        0xC601, 0x06C0, 0x0780, 0xC741, 0x0500, 0xC5C1, 0xC481,
0x0440,
        0xCC01, 0x0CC0, 0x0D80, 0xCD41, 0x0F00, 0xCFC1, 0xCE81,
0x0E40,
        0x0A00, 0xCAC1, 0xCB81, 0x0B40, 0xC901, 0x09C0, 0x0880,
0xC841,
        0xD801, 0x18C0, 0x1980, 0xD941, 0x1B00, 0xDBC1, 0xDA81,
0x1A40,
        0x1E00, 0xDEC1, 0xDF81, 0x1F40, 0xDD01, 0x1DC0, 0x1C80,
0xDC41,
        0x1400, 0xD4C1, 0xD581, 0x1540, 0xD701, 0x17C0, 0x1680,
0xD641,
        0xD201, 0x12C0, 0x1380, 0xD341, 0x1100, 0xD1C1, 0xD081,
0x1040,
        0xF001, 0x30C0, 0x3180, 0xF141, 0x3300, 0xF3C1, 0xF281,
0x3240,
        0x3600, 0xF6C1, 0xF781, 0x3740, 0xF501, 0x35C0, 0x3480,
0xF441,
        0x3C00, 0xFCC1, 0xFD81, 0x3D40, 0xFF01, 0x3FC0, 0x3E80,
0xFE41,
        0xFA01, 0x3AC0, 0x3B80, 0xFB41, 0x3900, 0xF9C1, 0xF881,
0x3840,
        0x2800, 0xE8C1, 0xE981, 0x2940, 0xEB01, 0x2BC0, 0x2A80,
0xEA41,
        0xEE01, 0x2EC0, 0x2F80, 0xEF41, 0x2D00, 0xEDC1, 0xEC81,
0x2C40,
        0xE401, 0x24C0, 0x2580, 0xE541, 0x2700, 0xE7C1, 0xE681,
0x2640,
        0x2200, 0xE2C1, 0xE381, 0x2340, 0xE101, 0x21C0, 0x2080,
0xE041,
        0xA001, 0x60C0, 0x6180, 0xA141, 0x6300, 0xA3C1, 0xA281,
0x6240,
        0x6600, 0xA6C1, 0xA781, 0x6740, 0xA501, 0x65C0, 0x6480,
0xA441,
        0x6C00, 0xACC1, 0xAD81, 0x6D40, 0xAF01, 0x6FC0, 0x6E80,
0xAE41,
        0xAA01, 0x6AC0, 0x6B80, 0xAB41, 0x6900, 0xA9C1, 0xA881,
0x6840,
        0x7800, 0xB8C1, 0xB981, 0x7940, 0xBB01, 0x7BC0, 0x7A80,
```

```
0xBA41,
        0xBE01, 0x7EC0, 0x7F80, 0xBF41, 0x7D00, 0xBDC1, 0xBC81,
0x7C40,
        0xB401, 0x74C0, 0x7580, 0xB541, 0x7700, 0xB7C1, 0xB681,
0x7640,
        0x7200, 0xB2C1, 0xB381, 0x7340, 0xB101, 0x71C0, 0x7080,
0xB041,
        0x5000, 0x90C1, 0x9181, 0x5140, 0x9301, 0x53C0, 0x5280,
0x9241,
        0x9601, 0x56C0, 0x5780, 0x9741, 0x5500, 0x95C1, 0x9481,
0x5440,
        0x9C01, 0x5CC0, 0x5D80, 0x9D41, 0x5F00, 0x9FC1, 0x9E81,
0x5E40,
        0x5A00, 0x9AC1, 0x9B81, 0x5B40, 0x9901, 0x59C0, 0x5880,
0x9841,
        0x8801, 0x48C0, 0x4980, 0x8941, 0x4B00, 0x8BC1, 0x8A81,
0x4A40,
        0x4E00, 0x8EC1, 0x8F81, 0x4F40, 0x8D01, 0x4DC0, 0x4C80,
0x8C41,
        0x4400, 0x84C1, 0x8581, 0x4540, 0x8701, 0x47C0, 0x4680,
0x8641,
        0x8201, 0x42C0, 0x4380, 0x8341, 0x4100, 0x81C1, 0x8081,
0x4040
    };
};
```

4.6 General Control Example

Hybrid control example 1:

OmniHand Device ID is `0x01`, 12 DoF, with control mode of position-force, which can send target information for 12 joints at once;

- Each requested joint bag consists of: Joint ID + control mode + target position + target torque (5 bytes in total);
- Each responded joint bag consists of: Joint ID + control mode + actual position + actual torque (5 bytes in total);
- Request all current joint control modes to be position-force, target position as 1000 and target torque as 1000;
- Respond all current joint control modes to be position-force, actual position as 500 and actual torque as 500;
-

	CAN-FD ID	Length	Data (HEX)
Request	`0x00140181`	64Byte (60Byte valid)	`60 E8 03 E8 03 61 E8 03 E8 03 62 E8 03 E8 03 63 E8 03 E8 03 64 E8 03 E8 03 65 E8 03 E8 03 66 E8 03 E8 03 67 E8 03 E8 03 68 E8 03 E8 03 69 E8 03 E8 03 6A E8 03 E8 03 6B E8 03 E8 03 00 00 00 00`
Response	`0x00140101`	64Byte (60Byte valid)	`60 F4 01 F4 01 61 F4 01 F4 01 62 F4 01 F4 01 63 F4 01 F4 01 64 F4 01 F4 01 65 F4 01 F4 01 66 F4 01 F4 01 67 F4 01 F4 01 68 F4 01 F4 01 69 F4 01 F4 01 6A F4 01 F4 01 6B F4 01 F4 01 00 00 00 00`

<u>Hybrid control example 2:</u>

OmniHand Device ID is `0x01`, 12 DoF, with control mode of velocity-force control, which can send target information for 12 joints at once;

- Each requested joint bag consists of: Joint ID + control mode + target velocity + target torque (5 bytes in total);
- Each responded joint bag consists of: Joint ID + control mode + actual velocity + actual torque (5 bytes in total);
- Request all current joint control modes as speed-force , target speed as 1000 and target torque as 1000;
- Respond all current joint control modes to be velocity-force, actual speed as 1000 and actual torque as 500;

	CANFD ID	Length	Data
Request	`0x00140181`	64Byte (60Byte valid)	`80 E8 03 E8 03 81 E8 03 E8 03 82 E8 03 E8 03 83 E8 03 E8 03 84 E8 03 E8 03 85 E8 03 E8 03 86 E8 03 E8 03 87 E8 03 E8 03 88 E8 03 E8 03 89 E8 03 E8 03 8A E8 03 E8 03 8B E8 03 E8 03 00 00 00 00`
Response	`0x00140101`	64Byte (60Byte valid)	`80 E8 03 F4 01 81 E8 03 F4 01 82 E8 03 F4 01 83 E8 03 F4 01 84 E8 03 F4 01 85 E8 03 F4 01 86 E8 03 F4 01 87 E8 03 F4 01 88 E8 03 F4 01 89 E8 03 F4 01 8A E8 03 F4 01 8B E8 03 F4 01 00 00 00 00`

<u>Hybrid control example 3:</u>

OmniHand Device ID is `0x01`, 12 DoF, with control mode of position-velocity-force, which can send target information for up to 8 joints at once;

- Each requested joint bag consists of: Joint ID + control mode + target position + target velocity + target torque (7 bytes in total);
- Each responded joint bag consists of: Joint ID + control mode + actual position + actual velocity + actual torque (7 bytes in total);
- Request all current joint control modes to be position-velocity-force, target position as 1000, target velocity as 1000 and target torque as 1000;
- Response all current joint control modes to be position-speed-force, actual position as 500, actual speed as 1000 and actual torque as 500;

	CANFD ID	Length	Data
Request	`0x00140181`	64Byte (56Byte valid)	`A0 E8 03 E8 03 E8 03 A1 E8 03 E8 03 E8 03 A2 E8 03 E8 03 E8 03 A3 E8 03 E8 03 E8 03 A4 E8 03 E8 03 E8 03 A5 E8 03 E8 03 E8 03 A6 E8 03 E8 03 E8 03 A7 E8 03 E8 03 E8 03 00 00 00 00 00 00 00 00`
Response	`0x00140101`	64Byte (56Byte valid)	`A0 F4 01 E8 03 F4 01 A1 F4 01 E8 03 F4 01 A2 F4 01 E8 03 F4 01 A3 F4 01 E8 03 F4 01 A4 F4 01 E8 03 F4 01 A5 F4 01 E8 03 F4 01 A6 F4 01 E8 03 F4 01 A7 F4 01 E8 03 F4 01 00 00 00 00 00 00 00 00`

<u>Example of gesture control action choreographing:</u>

OmniHand Device ID is `0x01`, 12 DoF, setting user-defined gesture 1 to move all joints to Position 1000;

	CANFD ID	Length	Data (HEX)
Request	`0x0A150181`	24Byte	`E8 03 E8 03 E8 03 E8 03 E8 03 E8 03 E8 03 E8 03 E8 03 E8 03 E8 03 E8 03`
Response	`0x0A150101`	24Byte	`E8 03 E8 03 E8 03 E8 03 E8 03 E8 03 E8 03 E8 03 E8 03 E8 03 E8 03 E8 03`

<u>Example of gesture control action executing:</u>

OmniHand Device ID `0x01`, 12 DOF, executing the preset action of user-defined gesture 1;

	CANFD ID	Length	Data (HEX)
Request	`0x0A150101`	0Byte	
Response	`0x0A150101`	24Byte	`E8 03 E8 03 E8 03 E8 03 E8 03 E8 03`

			E8 03 E8 03 E8 03 E8 03 E8 03 E8 03

Example of cyclic control sequence choreographing:

OmniHand Device ID is 0x01, setting user-defined gesture sequence as execute `digit 1 -> delay 1s -> execute digit 2 -> delay 1s -> execute digit 3 -> delay 1s`;

	CAN-FD ID	Length	Data (HEX)
Request	0x00160181	6Byte	00 7D 01 7D 02 7D
Response	0x00160101	6Byte	00 7D 01 7D 02 7D

Example of cyclic control sequence executing:

OmniHand Device ID is `0x01`, executing user-defined gesture sequence;

	CAN-FD ID	Length	Data (HEX)
Request	0x00160101	0Byte	
Response	0x00160101	6Byte	00 7D 01 7D 02 7D

OmniHand Device ID is `0x01`, setting user-defined gesture sequence as execute `digit 1 -> delay 1s -> execute digit 2 -> delay 1s -> execute digit 3 -> delay 1s`;

	CANFD ID	Length	Data (HEX)
Request	0x00160181	6Byte	00 7D 01 7D 02 7D
Response	0x00160101	6Byte	00 7D 01 7D 02 7D

Example of cyclic control sequence executing:

OmniHand Device ID is `0x01`, executing user-defined gesture sequence;

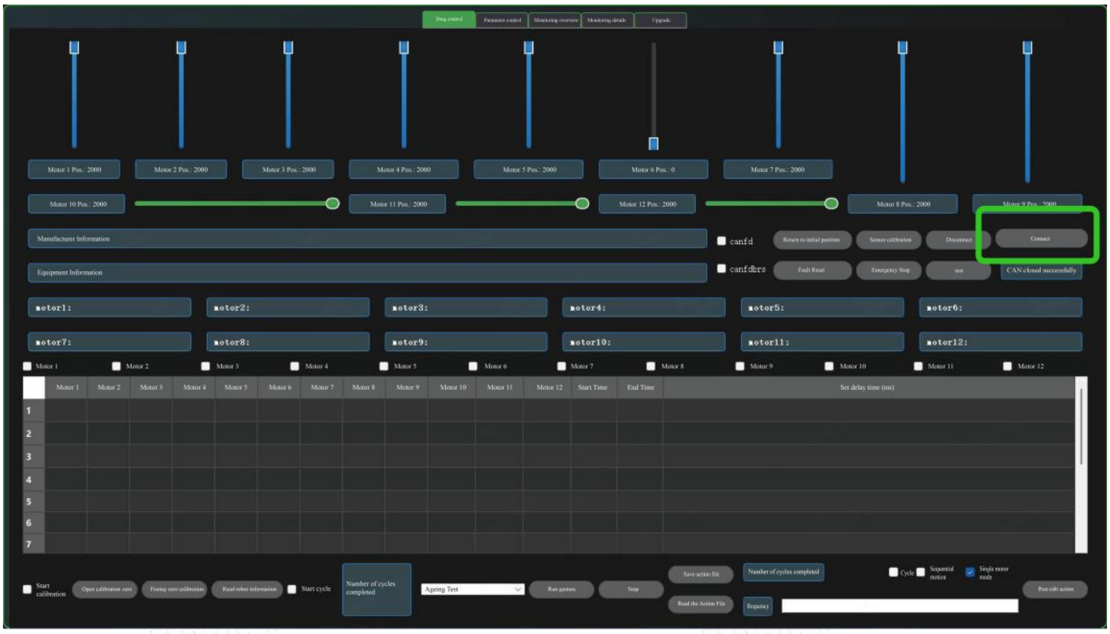
	CANFD ID	Length	Data (HEX)
Request	0x00160101	0Byte	
Response	0x00160101	6Byte	00 7D 01 7D 02 7D

5. Host Software Instructions

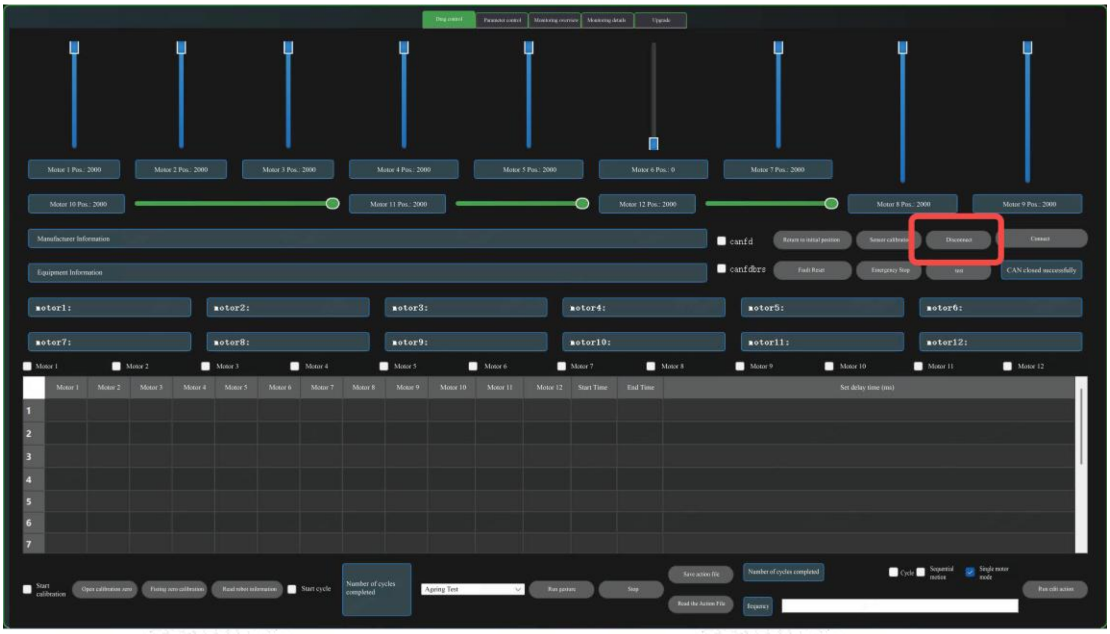
Requirements: Windows 10 and above

5.1 Connection Instructions

If you click the **Connect** button, the connection status bar will display "CAN initialized successfully".



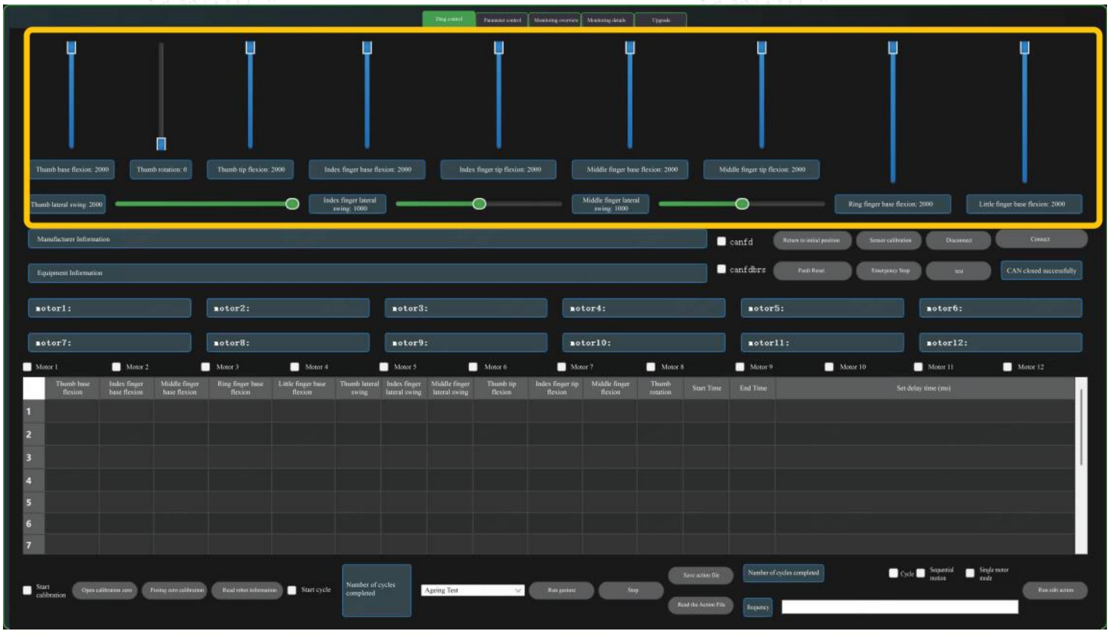
If you click **Disconnect**, the connection status bar will display "CAN closed successfully".



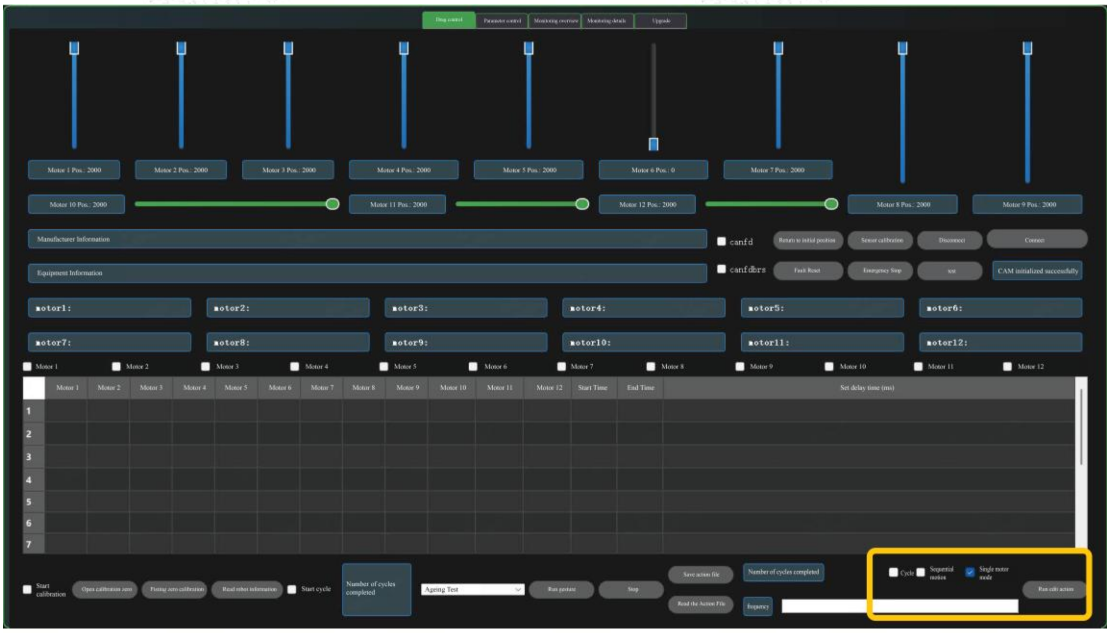
5.2 Slider Control

5.2.1 Joint Control

After connecting OmniHand Pro, corresponding joints can be controlled via sliders.



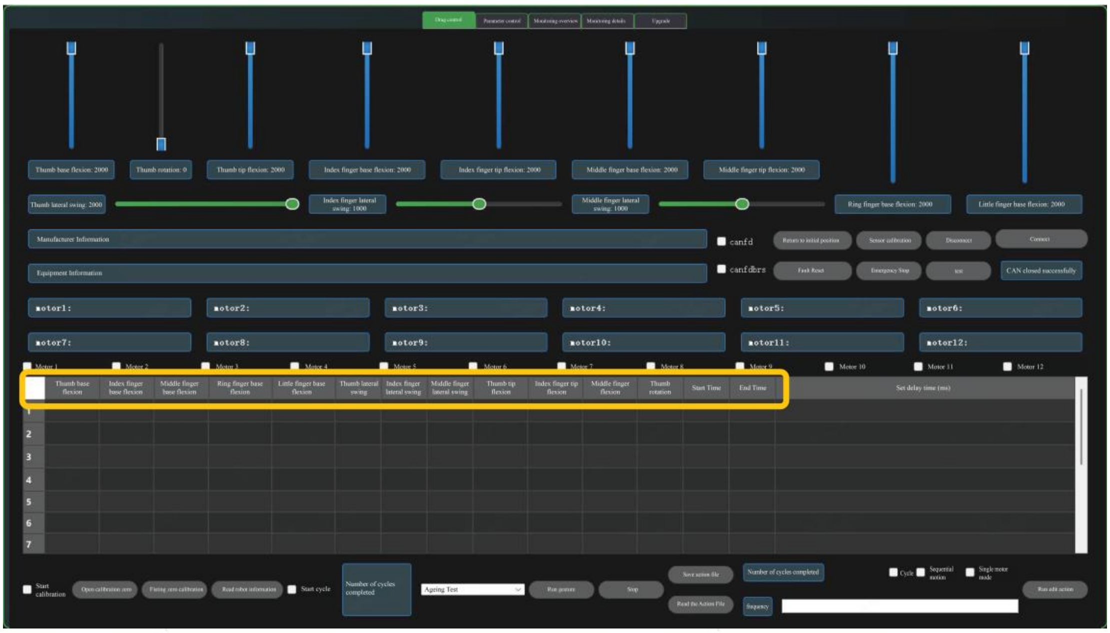
5.2.2 Single Motor Control

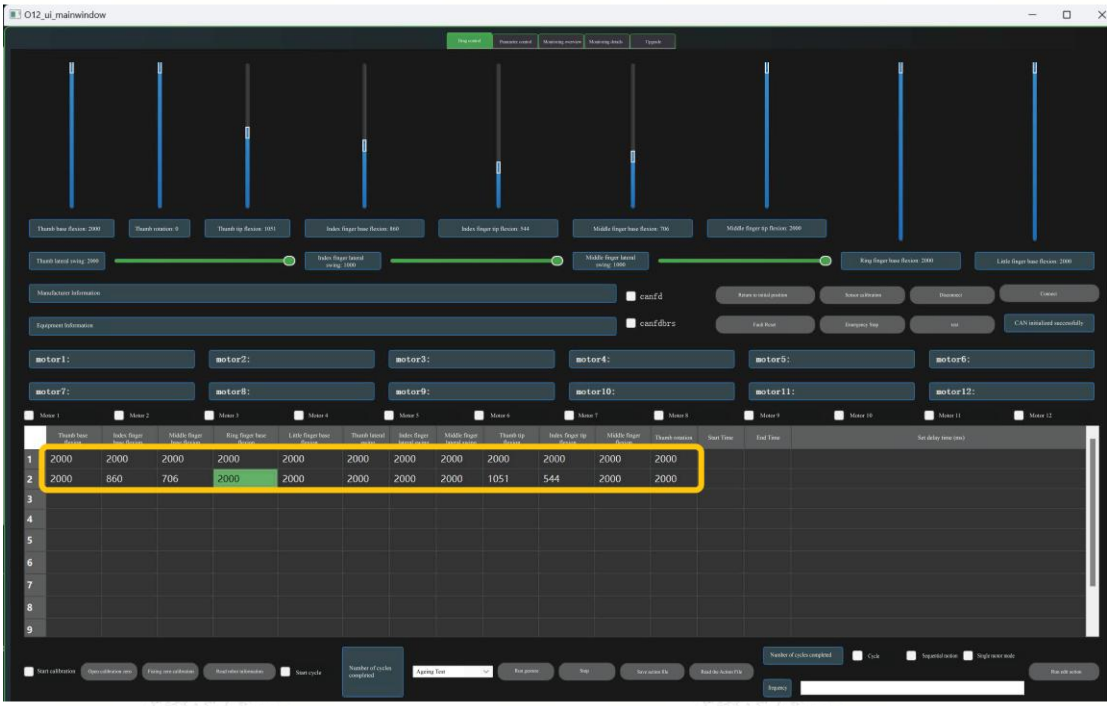


You can check **"Single Motor Mode"** to switch to individual motor control.

5.3 Control Panel

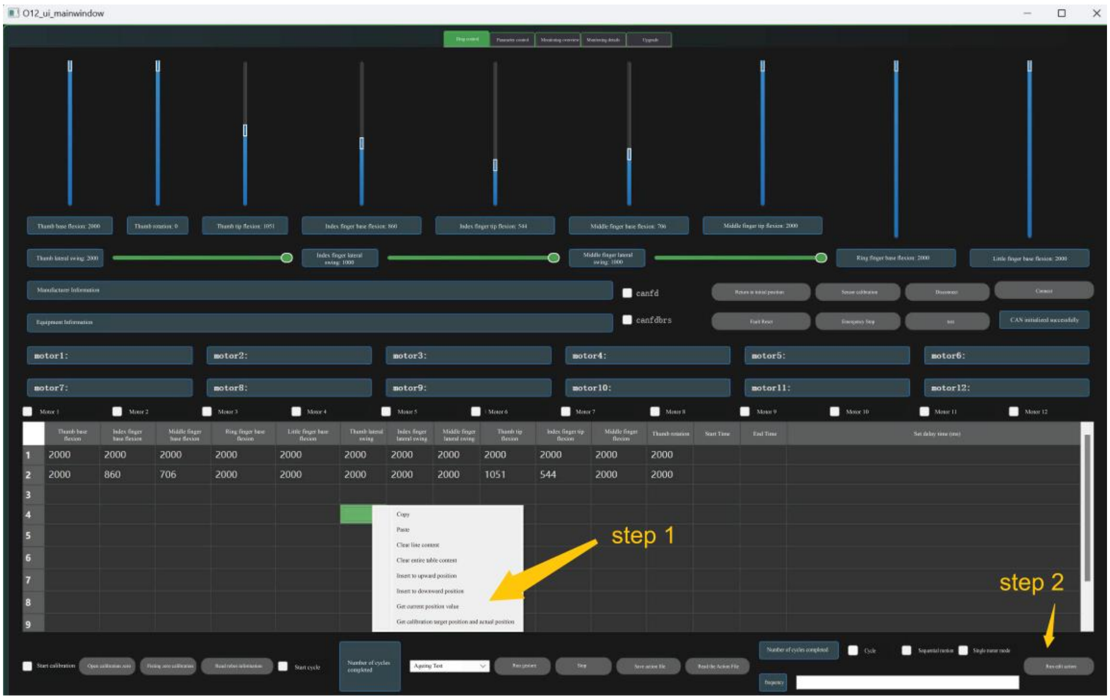
5.3.1 Joint Control





Each row in the table represents an action, where Cells 1 through 12 should be filled with numbers ranging from **0 to 2000**; Cells 13 and 14 display the start time and end time of the action execution respectively; Cell 15 is used to set a delay time, which is defaulted to 1000ms if left blank.

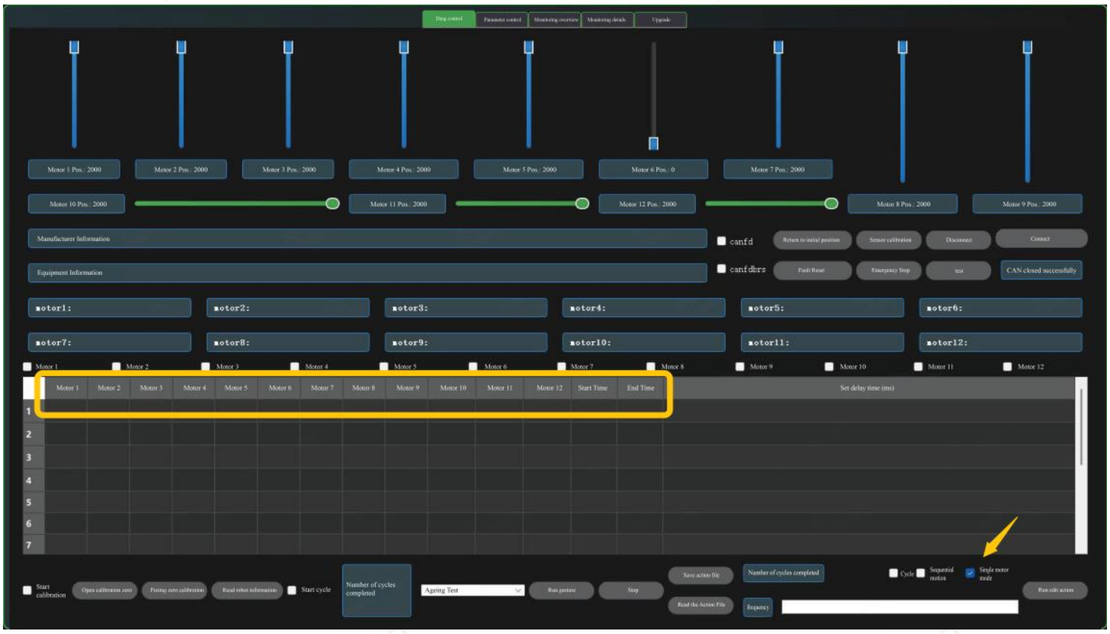
If you select the row to be filled with the left mouse button, right-click to bring up the button menu, select "Get Current Position Value" to input the slider's current position into the corresponding cell in the row. You can click the **"Run Edit Action"** button to execute the action of the selected row;



Check **"Sequence Motion"**, click the **"Run Edit Action"** button to execute all actions from the first row to the last;

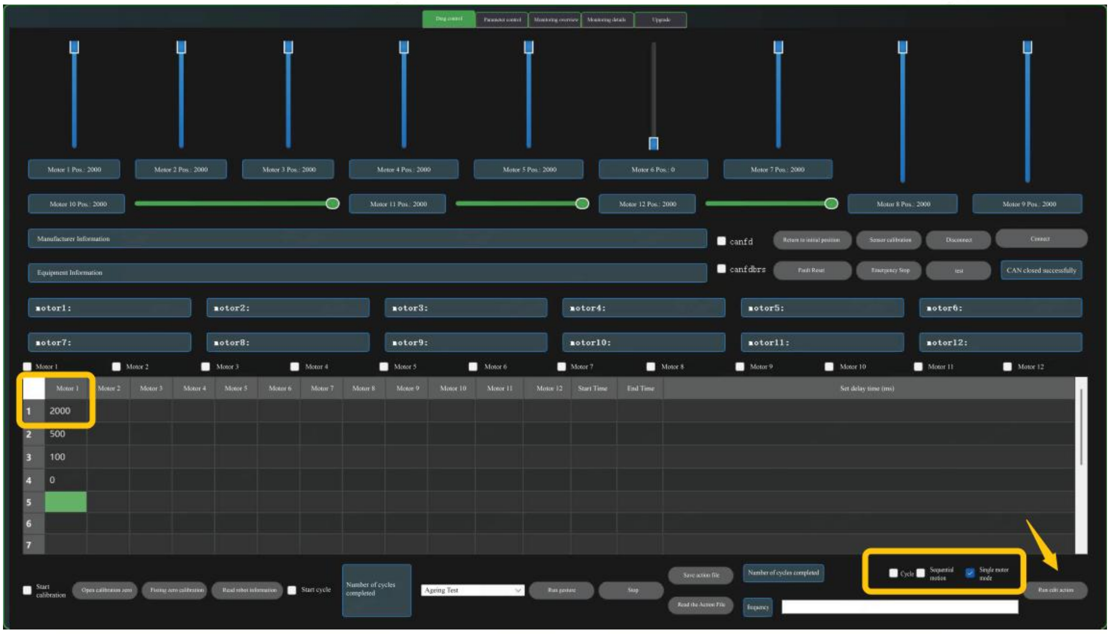
Check **"Loop"**, enter a number >0 in the count field, click the **"Run Edit Action"** button to cyclically execute all actions from the first row to the last for specified count;

5.3.2 Single Motor Control



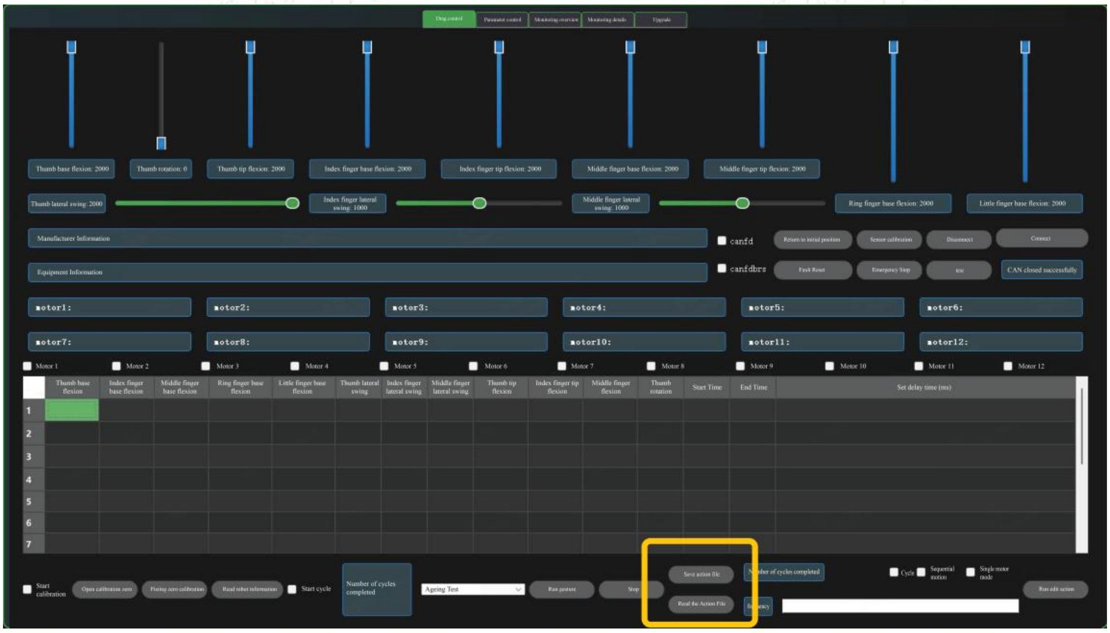
Check the **"Single Motor Mode"** to switch the table to the corresponding motor title;

First, check the box of motors to be controlled, e.g., Motor 1. In the corresponding Motor 1 column of the table, enter the target position value (0-2000), select the motion row, click the **"Run Edit Action"** button, then the corresponding motor will move to the input target position. For example, if you select the first row with the left mouse button and click the **"Run Edit Action"** button, Motor 1 will move to Position 2000.



Sequential motion, with the cycle identical to the table's joint control.

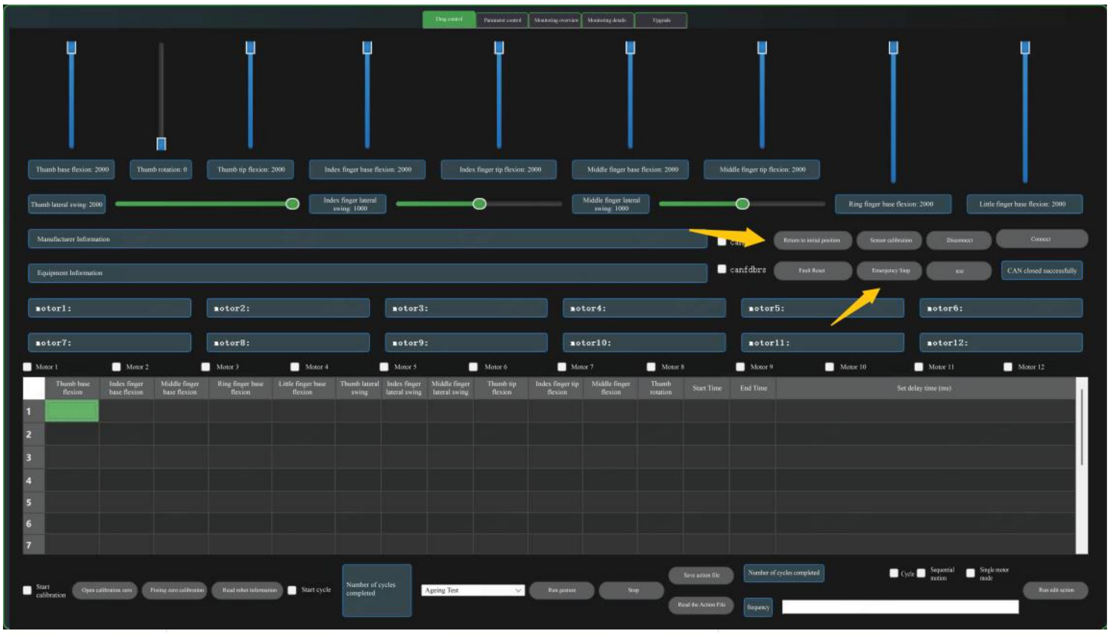
5.3.3 Action Record



You can click the **"Save Action"** button to save position data from the table to a .txt file;

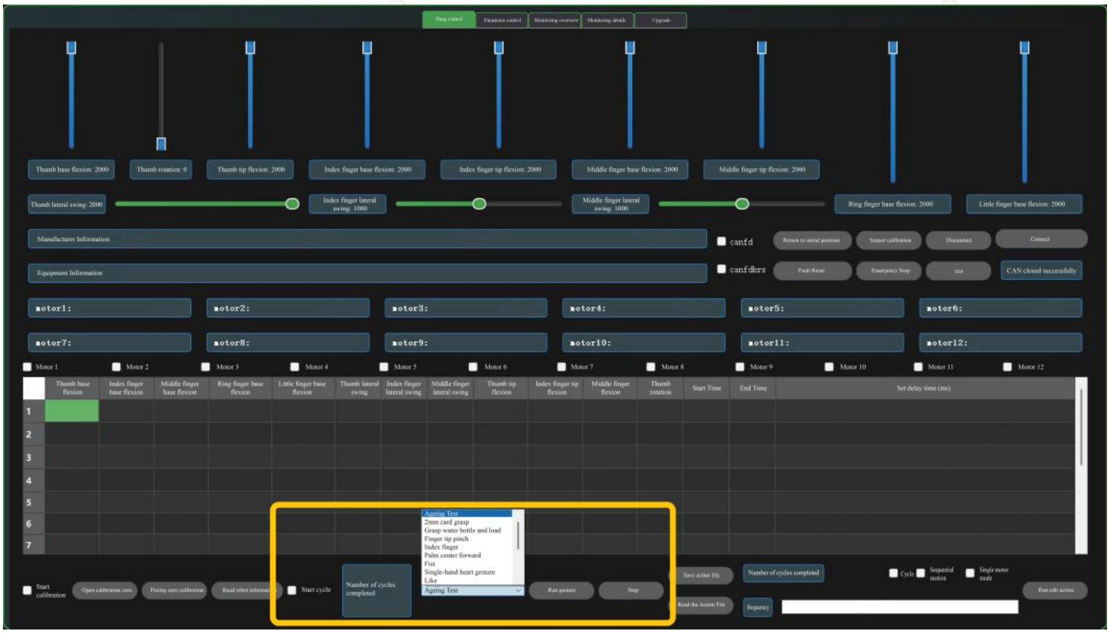
Click the **"Read Action"** button to display and execute saved action files in the table;

5.3.4 Emergency Stop



In the process of cycling, click the **"Emergency Stop"** button to stop the cycle. The **"Reset to Initial Position"** button can open the hand; **"Fault Reset"** will send a fault reset command and release the emergency stop lock.

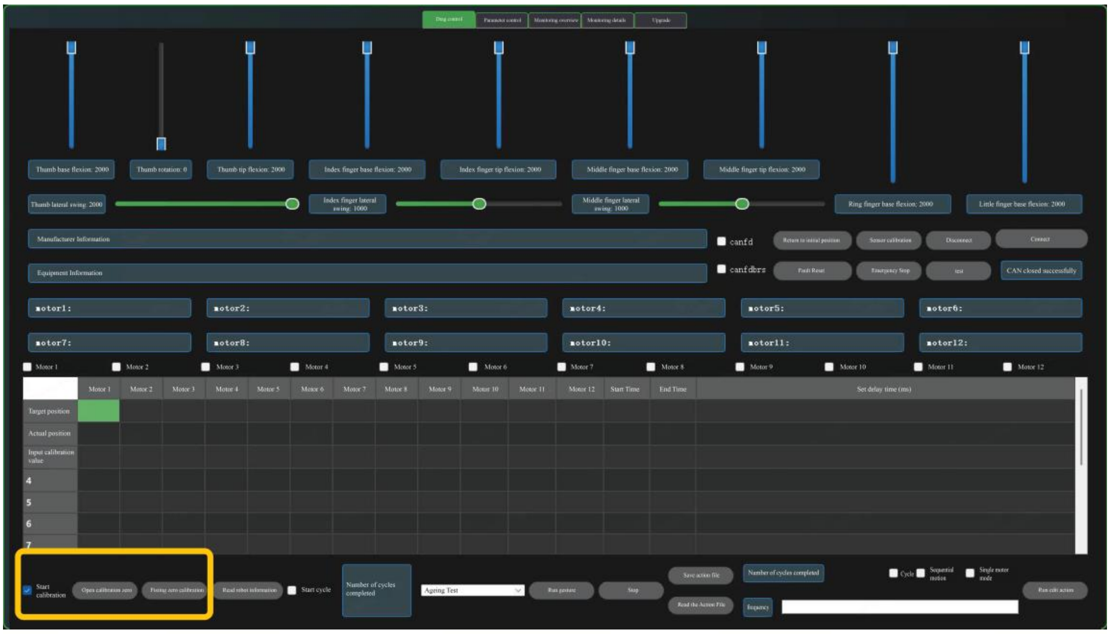
5.4 Preset Action



You can click the **"Run Gesture"** button to execute a preset gesture;

Check **"Loop"**, enter the number and then click **"Run Gesture"** to cycle through all preset gestures; Click **"Stop"** to stop the cycle.

5.5 Zero Calibration

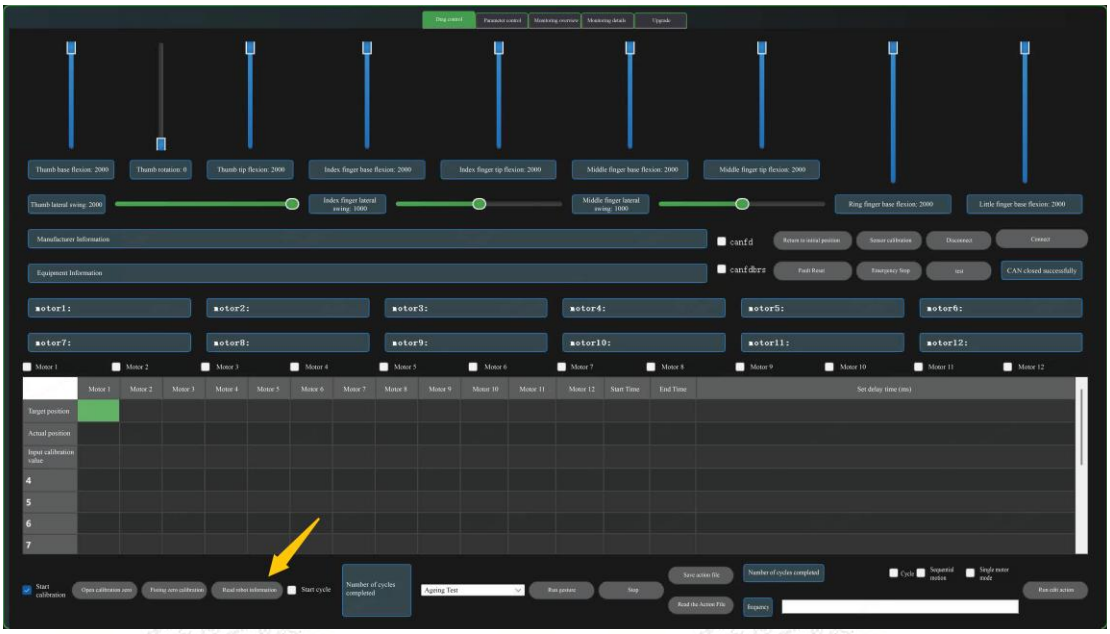


Check **"Start Calibration"** on the bottom left, right-click to get target/actual calibration positions, enter motor calibration values in the input row and check the corresponding motor checkbox.

Click **"Open Zero Calibration"** to set the open position zero point.

Click **"Fist Zero Calibration"** to set the fist position zero.

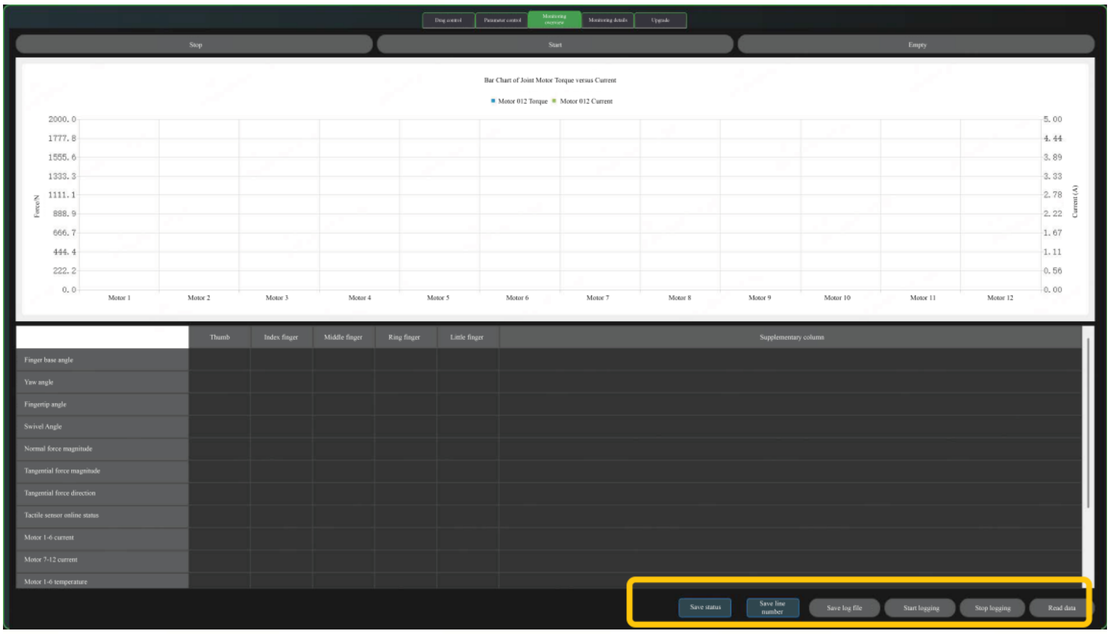
5.6 Information Reading and Fault Reporting



Click **"Read Info"** to display details in the manufacturer and device information fields.

Motor 1 to Motor 12 display fields show fault codes actively reported by the host.

5.7 Monitoring Overview

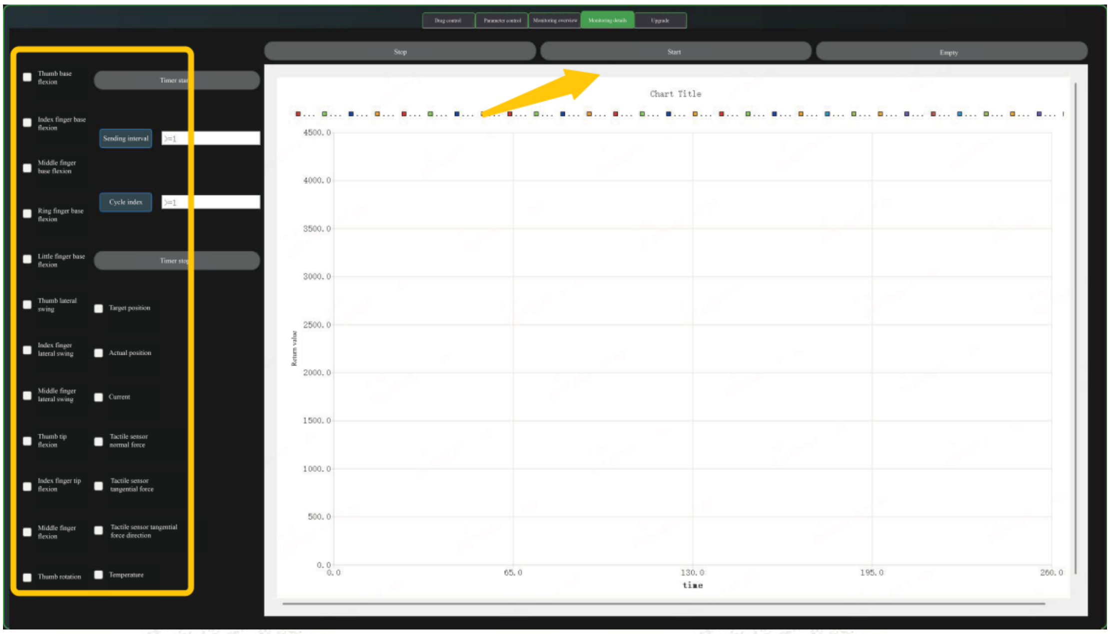


Click the **"Start"** button to display force and current values.

You can click the **"Read Data"** button to display corresponding data in the table.

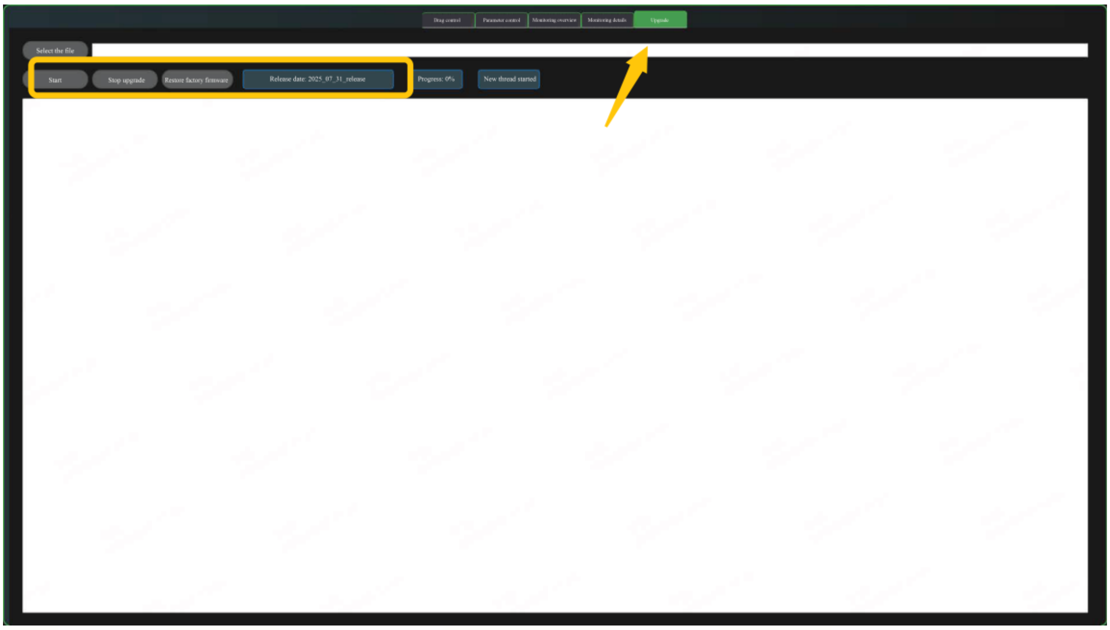
You can click the **"Start Logging"** button to record temperature, current, error code and torque value; click "**Save Log File**" to save the recorded data. If not clicked, data will be auto-saved once every 5 minutes to the host program folder.

5.8 Monitoring Details



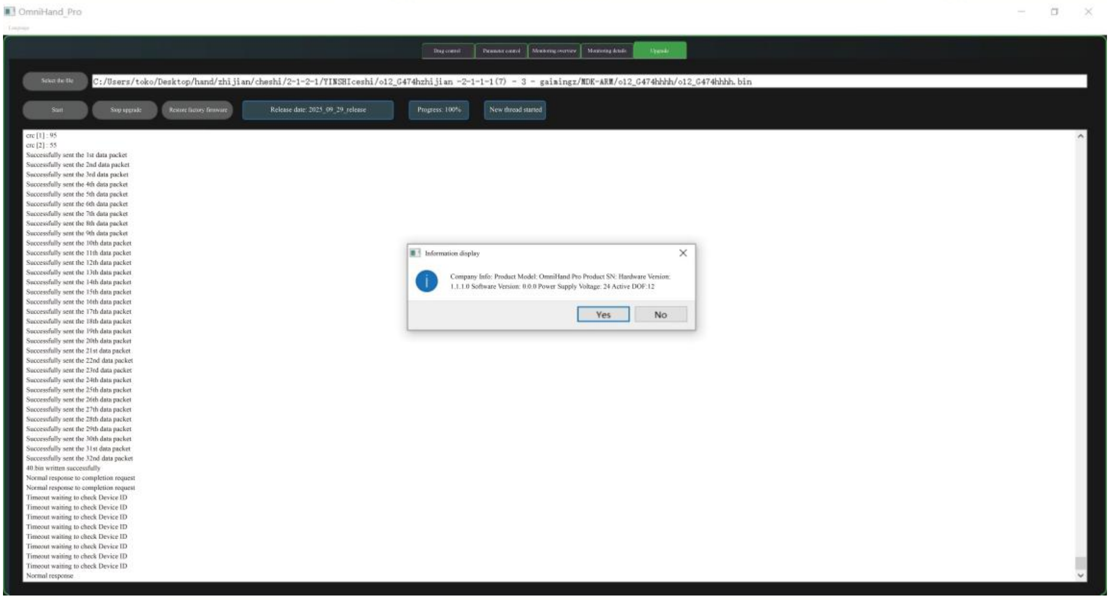
Tick the box before the type of information you want to check, then select the corresponding finger or motor and click **"Start"** to check the curve.

5.9 Upgrade



You can click the **"Select File"** button to choose the bin file for transfer.

If you click the **"Start"** button, software and hardware information will pop up. Click **"Yes"** to initiate firmware transfer. Click **"No"** to cancel upgrade.



Both "Stop Upgrade" and "Factory Reset" can be clicked in the process of upgrade or in the case of reconnection after power outage.

"Stop Upgrade" allows interrupting the upgrade process to run the previous APP.

"Restore Ex-factory Firmware" is to restore the ex-factory firmware.