HitBotDrive Software User Manual

Industrial Robot / Collaborative Robot / Electric Gripper/
Intelligent Actuator / Automation Solution

Huiling-tech Robotic Co.,Ltd.

Version Description

Version	Date	Update Content	Remark
V1.0.0	November 2, 2022	First edition.	
V1.0.1	November 18, 2022	Software interface and function enhancements completed.	
V1.0.2	December 1, 2022	1. Unified baud rate settings and selection range; 2. Fixed searching interface freezing when switching between linear actuator and gripper; 3. Optimized functionality and display of the gripper mode parameter settings button; 4. Interface icon optimization.	
V1.0.3	December 19, 2022	1. Added ESC electric suction cup control interface; 2. Added test record and cycle count setting; 3. Fixed bugs from the previous version.	
V1.0.4	December 27, 2022	Released trial version.	
V1.0.5	January 10, 2023	1. Fixed interface failures; 2. Gripping force testing optimization; 3. Enhanced logging with error and failure logs; 4. Fixed abnormal connection with gripper COM ports more than two digits; 5. Fixed automatic program startup failure during initial installation; 6. Fixed script file opening error.	
V1.0.6	March 25, 2023	1. Fixed persistence of interface connection display and text in Chinese; 2. Optimized software to automatically retrieve serial port number, connect, and search for slave device ID; 3. Optimized display of electric gripper and suction cup interface; 4. Fixed prompt of parameter successful writing for the program; 5. Enhanced manual control modes for grippers 6. Fixed the issue of delayed feedback on gripper status; 7. Fixed the issue of actuator's parameters changing after settings; 8. Added a feature for the electric actuator, which allows for the collection of speed, current, and position curves at different frequencies (up to 50Hz).	

V1.0.7	April 27, 2023	1. Fixed bugs with the following identifiers in ZenTao (#479 #478 #436 #435 #434 #433 #432 #431 #429 #428) and optimized new features (from embedded sources) ; 2. Improved the HitBotDrive software for the gripper by adding language selection and saved functionality of connection serial port number; 3. Optimized gripper HitBotDrive compatibility table, allowing for easy maintenance of additional models in the future; 4. Optimized the register table compatibility for the HitBotDrive of the parallel gripper, rotating gripper, and suction cup. Added a maintenance table for new registers in the future; 5. Improved the language switching functionality between Chinese and English in the HitBotDrive for the gripper; 6. Enhanced the initial opening of the HitBotDrive for the gripper to display the search interface and automatically scan connected serial ports. Added options to specify specific serial ports based on conditions or perform a full search, displaying search progress and results; 7. Added a feature in the connection interface to display product model images after clicking on the slave device list (currently compiled into the program, so adding new models requires recompilation); 8. Added a curve functionality to the HitBotDrive for the gripper, allowing for the collection of speed, current, and position curves at different frequencies (up to 50Hz); 9. Introduced a maximize button for the HitBotDrive for the gripper, enabling the software window to be dragged to the left half of the screen, right half of the screen, top full screen, double-clicked to maximize/restore, and freely resized for optimal adaptability; 10. Optimized the blinking of controls in the initialization interface of the HitBotDrive for the gripper; 11. Added a language selection option in the installation package, with the software opening in the default selected language (Chinese or English).	

V1.0.8	May 10, 2023	1. Optimized the functionality of the HitBotDrive's electric actuator; 2. Improved functionality by utilizing the ModbusLib library for control; 3. Enhanced the interface display for an improved user experience.	
V1.0.9	May 29, 2023	1. Fixed bugs with the following identifiers in ZenTao (#545, #544, #543, #542) and aoptimized new features (from embedded sources); 2. Streamlined the communication protocol for intelligent devices by using the ModbusLibs library for connection operations; 3. Redesigned the user interface for the HitBotDrive of intelligent devices; 4. Improved the behavior of the device interface to remain open even after disconnecting from the device (allowing device operations to be restored upon reconnecting to the serial port); 5. Enhanced the language switching functionality (added Chinese and English translations) in the HitBotDrive for the gripper, including the translation of the electric actuator interface; 6. Redesigned the online upgrade feature; 7. Added a maximize button to the software window of HitBotDrive, allowing for dragging to the left half of the screen, right half of the screen, top fullscreen, double-clicking to maximize/restore, and freely scaling the software size for optimal adaptability; 8. The installation package has added options for Chinese and English languages, with the default selection set to Chinese for opening the software.	
V1.0.10	October 4, 2023	1. Online upgrade and optimization 2. Increase the temperature display of the clamp device (click "Status Refresh" to display the current temperature); 3. The electric cylinder equipment module sets the encoder zero calibration, encoder reset, and the electric cylinder zero calibration position transfer; 4. Set parameters of the initial loading module of the electric cylinder equipment, and reload the machine when it is offline; 5. Set parameters of the initial loading module of the clamp (suction cup), and reload the machine when it is offline;	

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1. Company Overview

Huiling-tech (HITBOT) Robotic Co., Ltd, a Xiaomi ecological chain enterprise, was founded in 2015 and is a leading player in the electric gripper industry and the pioneer of direct-drive robotic arms. We focus on the research and development of core technology, adhere to product innovation, and provide industry customers with ultimate cost-effective robot products and automation solutions in an efficient, low-cost, and modular way.

We are committed to making automation simpler and have made robots more accessible to the automation industry, reducing the barriers to automation transformation from multiple perspectives such as cost and usability. Our products have been deployed in dozens of countries such as the United States, Germany, Japan, and South Korea, and have been widely applied in various fields such as 6C, healthcare, new retail, automotive, education, and have served thousands of customers such as Xiaomi, Huawei, Foxconn, and Panasonic.

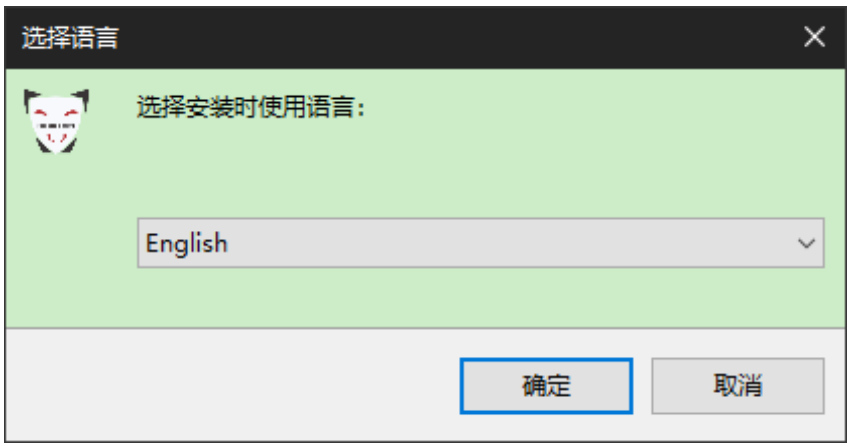
2. Software Installation Guide

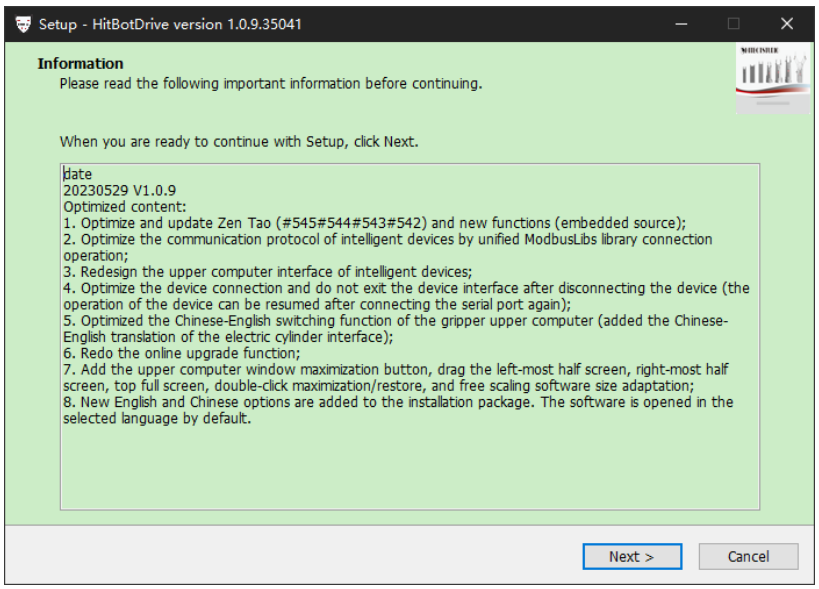
2.1 Installation of HitBotDrive

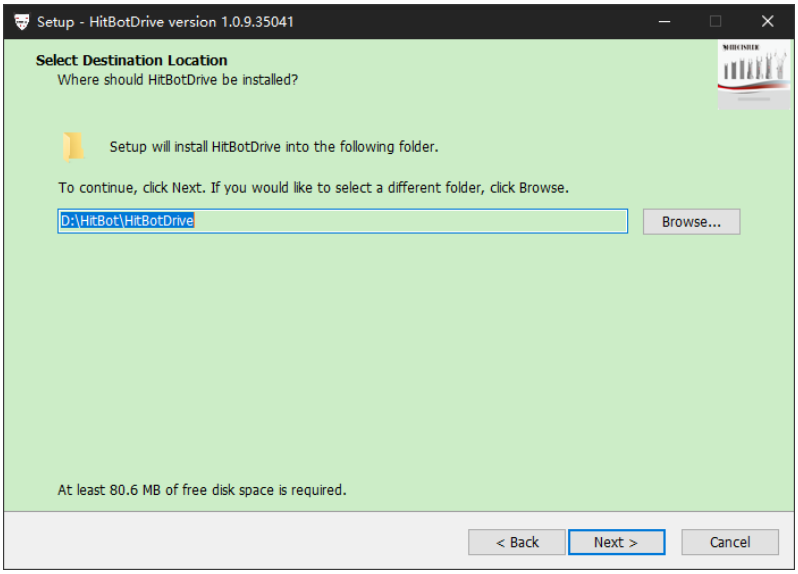
2.1.1 Click on the downloaded installation package ".exe" to start the installation, as shown in Figure 2-1.

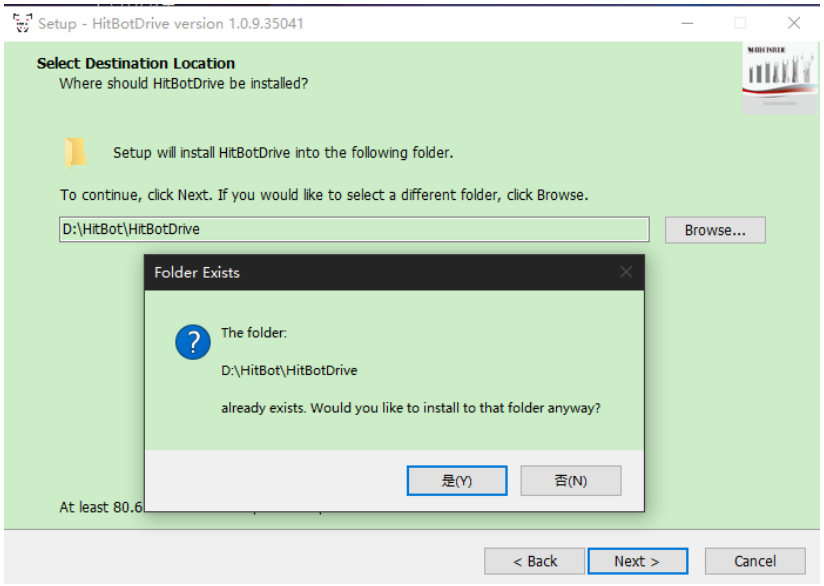
Figure 2-1 Installation package ".exe" file

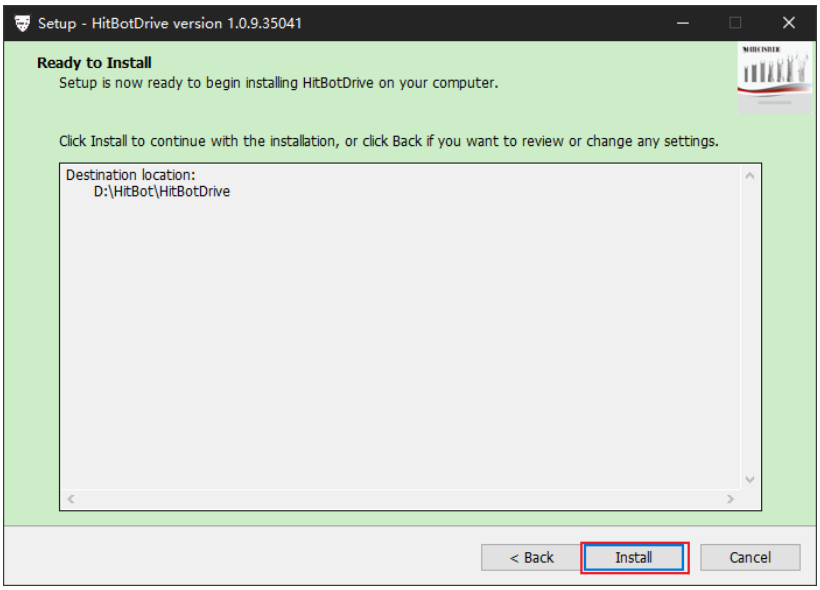
2.1.2 After opening the installation package, please follow the default installation steps, as shown in Figure 2-2.






Setup - HitBotDrive version 1.0.9.35041
Select Destination Location
Where should HitBotDrive be installed?
Setup will install HitBotDrive into the following folder.
To continue, click Next. If you would like to select a different folder, click Browse.
D:\HitBot\HitBotDrive
Browse...
At least 80.6 MB of free disk space is required.
< Back
Next >
Cancel


Setup - HitBotDrive version 1.0.9.35041
Select Destination Location
Where should HitBotDrive be installed?
Setup will install HitBotDrive into the following folder.
To continue, click Next. If you would like to select a different folder, click Browse.
D:\HitBot\HitBotDrive
Browse...
Folder Exists
The folder:
D:\HitBot\HitBotDrive
already exists. Would you like to install to that folder anyway?
是(Y)
否(N)
At least 80.6
< Back
Next >
Cancel


Setup - HitBotDrive version 1.0.9.35041
Ready to Install
Setup is now ready to begin installing HitBotDrive on your computer.
Click Install to continue with the installation, or click Back if you want to review or change any settings.
Destination location:
D:\HitBot\HitBotDrive
< Back
Install
Cancel

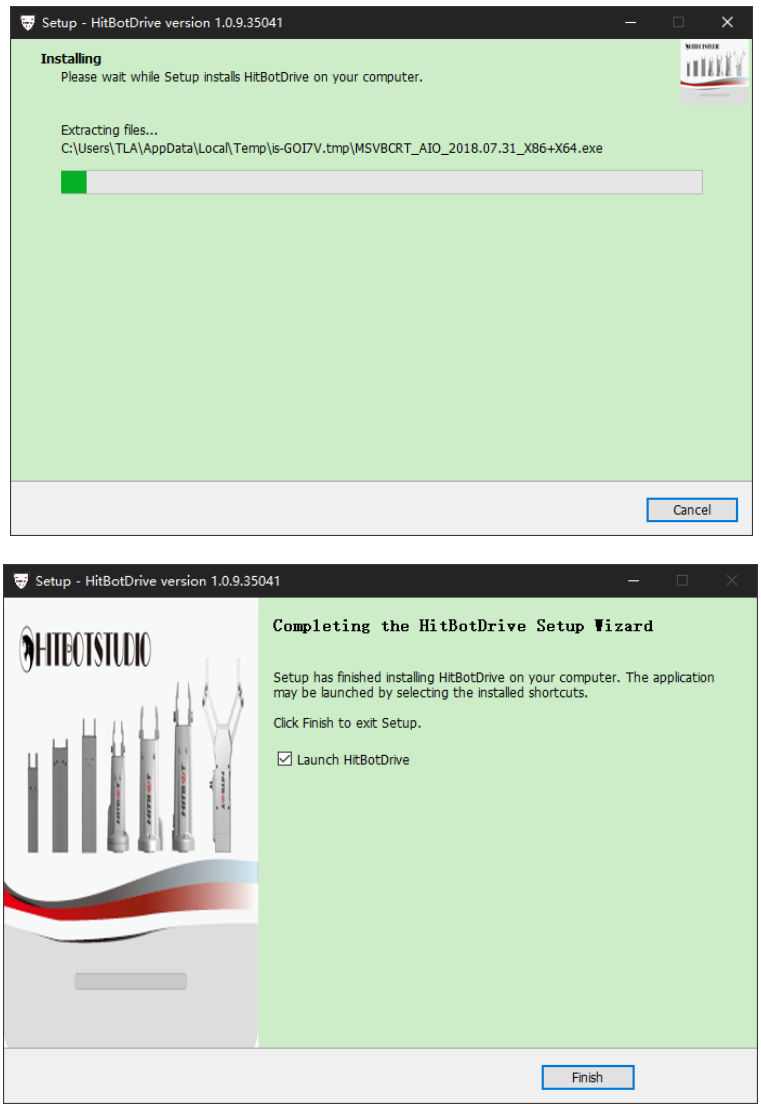


Figure 2-1 (Installation package ".exe" file)

2.1.3 After the installation is complete, a shortcut will be generated on the desktop. Double-click to open the HitBotDrive interface.

2.2 Dependencies for HitBotDrive

2.2.1 When launching the installation package, it will automatically detect the ".NET Framework 4.6.2" environment. If it is not detected, it will automatically install the ".NET Framework 4.6.2" environment.

2.2.2 When launching the installation package, it will automatically detect the dependency "Microsoft Visual C++ 2015 Redistributable x86" of VS2017 runtime library. If it is not detected, a prompt will.

3. Software Operation Guide

3.1 Instructions for Using HitBotDrive Software

3.1.1 Overview of HitBotDrive Interface

The HitBotDrive provides the following common area for all 485 cylinders and gripper products to control the cylinders and grippers. The common interface of the HitBotDrive is shown in Figure 3-1.

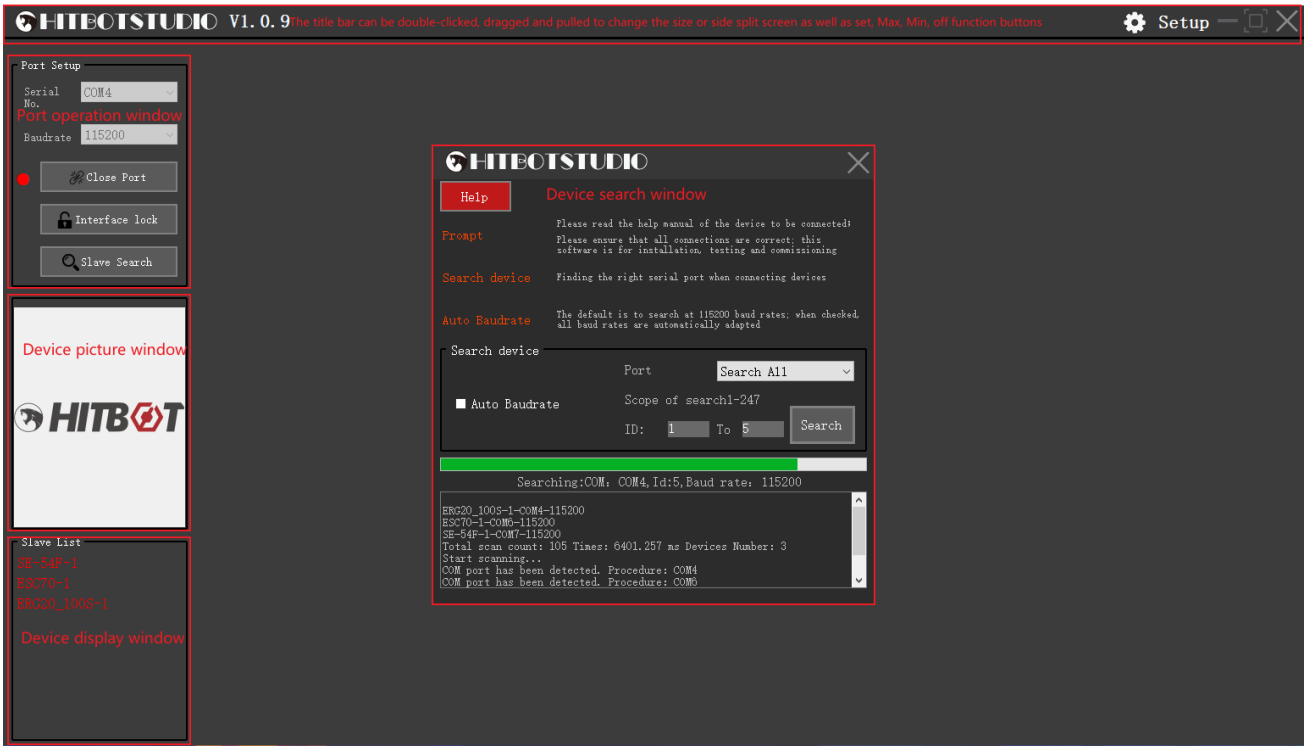


Figure 3-1

Table 3-1 provides an explanation of the functionality of the HitBotDrive common interface.

Table 3-1

Module	**Function**
Title Bar	Implement functionality for window dragging, menu settings, maximize, minimizing, and other operations.
Device Search Window	The HitBotDrive automatically opens this window and detects the availability of serial ports for the current hardware device.
Port Operation Window	It allows for connecting and disconnecting serial ports, entering device search mode, and locking the interface.

Device Image Window	The design diagrams of certain products will be displayed in this window after clicking on a device in the slave list (more product images will be added later).
Device Display Window	After clicking the search button in the device search window, the recognized devices will be displayed in this window. Clicking on a corresponding device will enter the device operation interface.
Keyboard Key "F1"	After the software is launched, pressing "F1" will open the user manual for the HitBotDrive.

3.2 Device Title Bar Module

3.2.1 Functionality Explanation of Title Bar Module

Figure 3-2 shows the title bar interface.

Figure 3-2 (Title Bar)

1. Logo icon in the upper left corner, hovering the mouse over this area will display the current version and compilation information;

2. Double-click the title bar with the left mouse button to maximize the software (double-click again to restore), clicking and dragging the software allows movement, and dragging it to the edge will split the screen display;

3. When entering the device interface, the device product information will be displayed in the blank area in the middle;

4. Maximize, minimize, and close buttons;

5. The function settings module includes About -> Online Upgrade -> Set Slave Number -> Help -> Language Switch, etc.

3.3 Port Operation Module

3.3.1 Port Operation Instructions

The port operation interface allows opening/closing the serial port, locking/unlocking the interface, entering the slave search interface, selecting the serial port number, and choosing the baud rate.

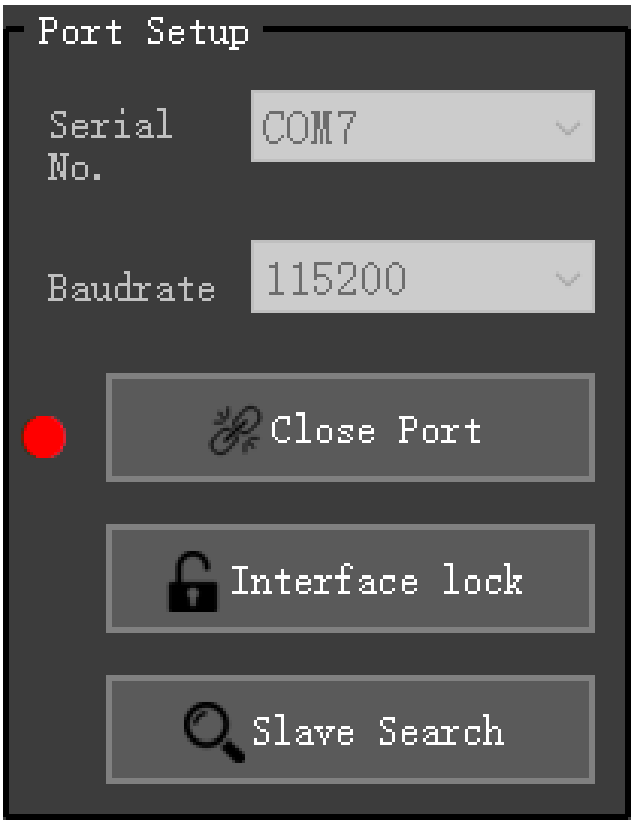


Figure 3-3 (Port Operation)

3.4 Device Image Module

3.4.1 Settings Module Operation

Clicking on the device recognized in the slave list, the **product image** will be displayed in the Window.

Figure 3-4 (Product Image)

3.5 Device Display Module

3.5.1 Display Settings Operation

After detecting a device, it will be displayed in the slave list. Clicking on the corresponding position will take users to the device operation interface.

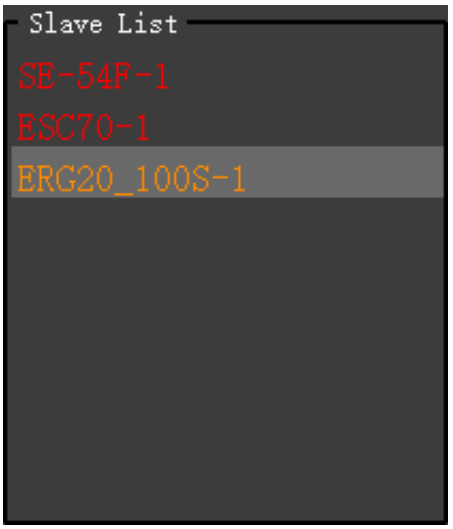


Figure 3-5 (Slave List)

3.6 Function Settings Module

3.6.1 Settings Operation

Clicking on "Function Settings" will display the function settings module interface, as shown in Figure 3-6.

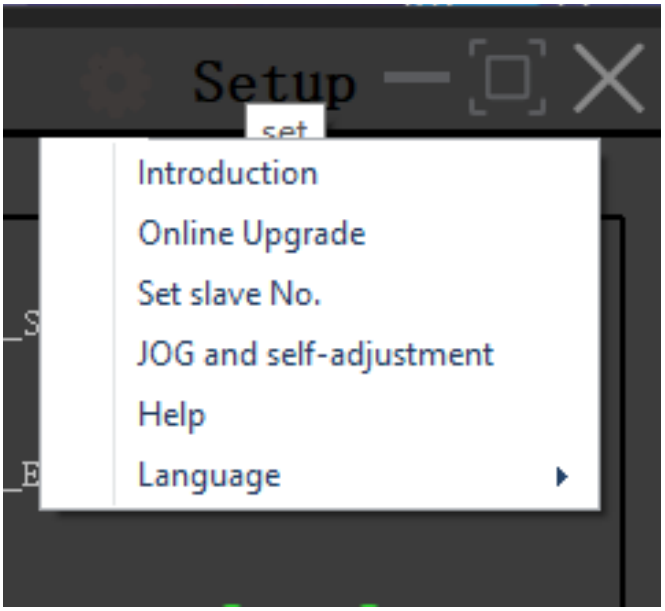


Figure 3-6 (Function Settings Module)

Figure 3-3

Description of function setting module

Module	**Function**
About	After connecting the device, clicking on "About" will display basic information such as the device model and hardware version.
Online Upgrade	Device hardware version can be updated online using upgrade files.
Set Slave ID	Once the device is connected, the slave ID can be set.
Manufacturer Permissions	Permissions can be revoked based on corresponding operations, and reopening permissions will not revoke them.
Position JOG and Auto Adjustment	Operations can be used to adjust the parameters of the actuator.
Help	Clicking on "Help" will open the user manual.

3.6.2 About

Intelligent devices need to be connected to display relevant information status. If not connected, a device not connected pop-up alarm will be displayed. Figure 3-7 shows the About Information Display interface.

Figure 3-7 (About Information Display Interface)

3.6.3 Online Upgrade

After connecting the device, click to enter the online upgrade mode, then select the corresponding upgrade program and send it. If the device gets disconnected or interrupted during the process, it needs to be restarted to re-enter online upgrade. Figure 3-8 shows the online upgrade interface and corresponding operation buttons.

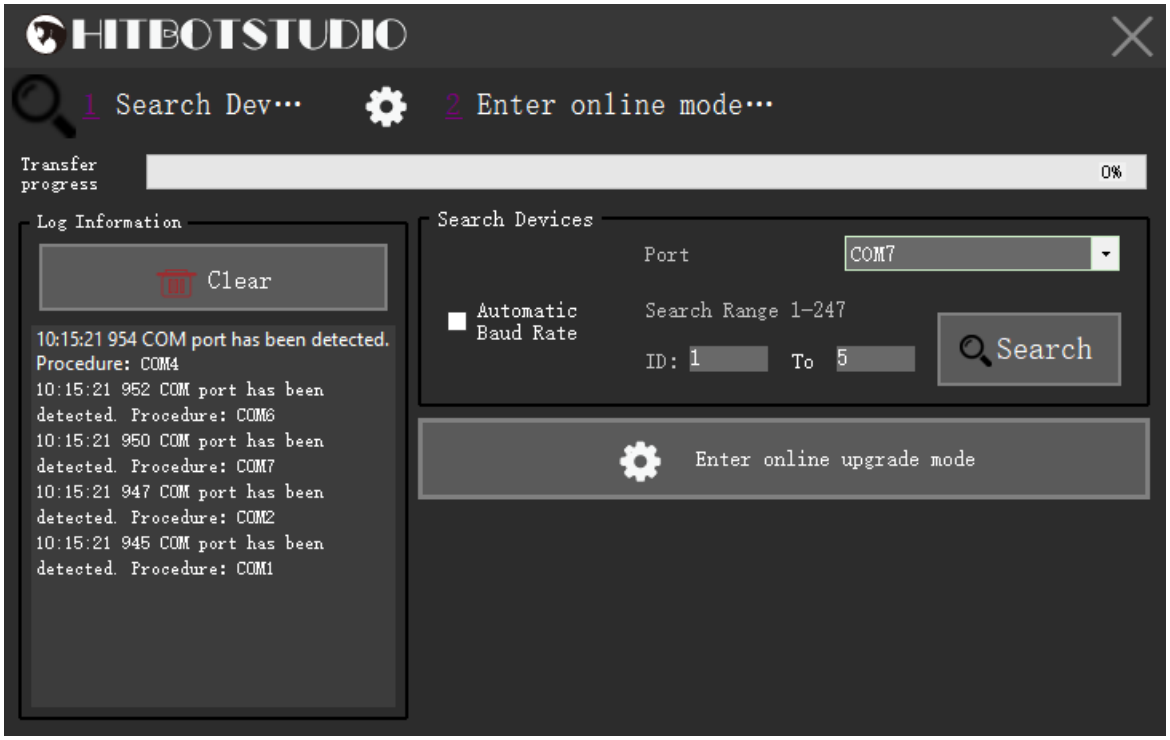


Figure 3-8 (Online Upgrade Interface)

3.6.4 Set Slave Number

By clicking "Set Value" based on the set slave ID, the corresponding device can be assigned a slave ID. Figure 3-9 shows the interface for setting the slave ID.

Figure 3-9 (Set Slave ID Interface)

3.6.5 Position JOG and Auto Adjustment

(1) Interface Explanation (This function is effective when connecting to an electric actuator) Clicking on "Position JOG and Auto Adjustment" will enter this mode, as shown in Figure 3-10.

Figure 3-10

After entering, the serial port will open automatically. The motion JOG function includes four parts: Enable ON/OFF, JOG Motion, Position Information, and Position Test Run. These functions need to be executed sequentially as shown in Figure 3-11.

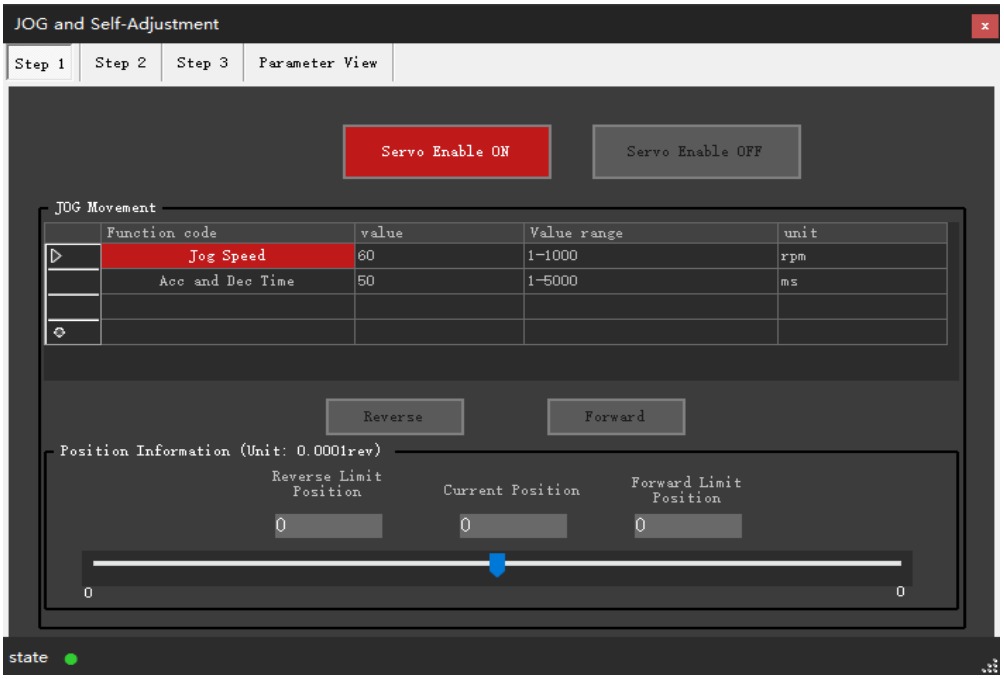


Figure 3-11 (Position JOG and Auto Adjustment Interface)

First, click on "Servo Enable ON" (if disabling is required, click on Servo Enable OFF), then enter "JOG Motion". Edit the JOG speed and acceleration/deceleration time. Clicking on "Forward/Reverse" to rotate the motor in a specific number of revolutions. After running, the limit position of the motor is defined, and subsequent movements cannot exceed this range, as shown in Figure 3-12.

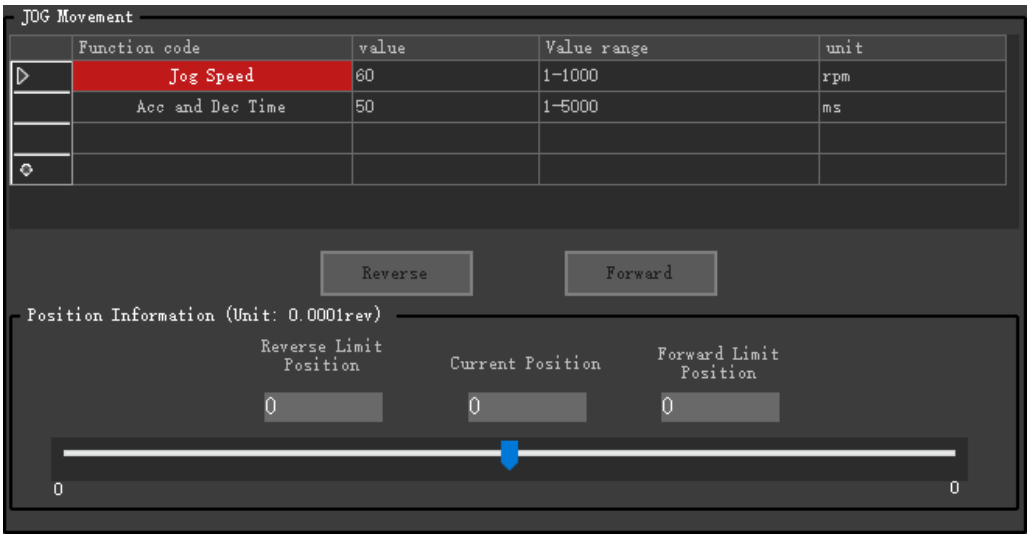


Figure 3-12

After defining the limit position, relevant function codes can be set as needed, then click "Forward/Reverse". The motor will run in "Single" or "Continuous" mode, and the motor will stop

when clicking "Pause". Figure 3-13 shows this process.

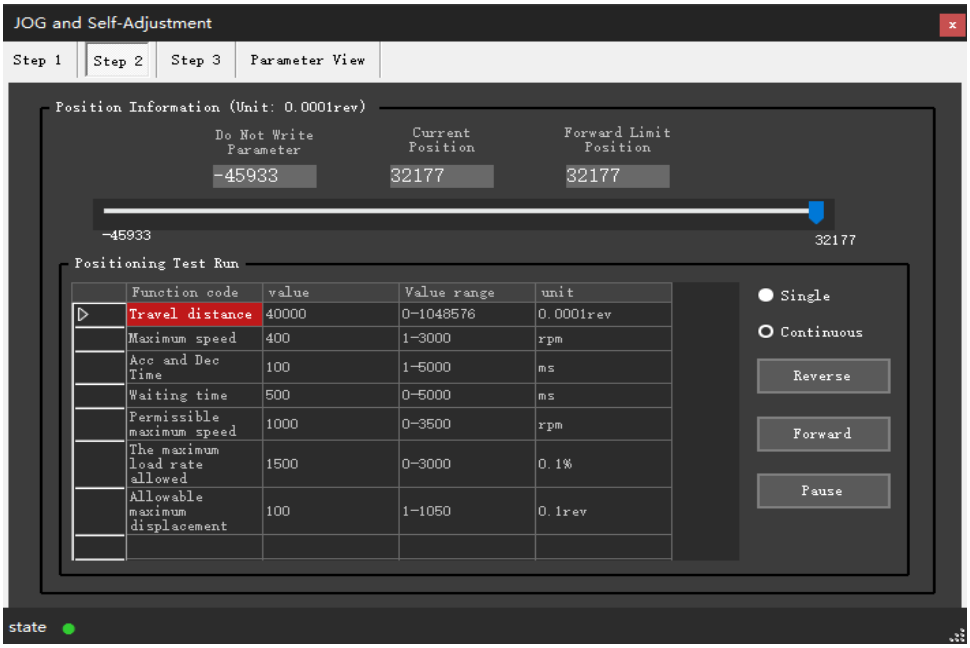


Figure 3-13

Note: In the motion of JOG function, 10,000 pulses are defined as one revolution.

The gain auto-adjustment function includes three parts: Rigid Setting, Load Estimation and Vibration Suppression, and Motion Monitoring.

In "Rigid Setting" parameters such as self-tuning mode and rigidity level can be read and written. Saving the parameters will store the self-tuned parameters in the power-off storage area. As shown in Figure 3-14.

Figure 3-14

In "Load Estimation and Vibration Suppression" parameters related to load inertia ratio and damper can be read and written. As shown in Figure 3-15.

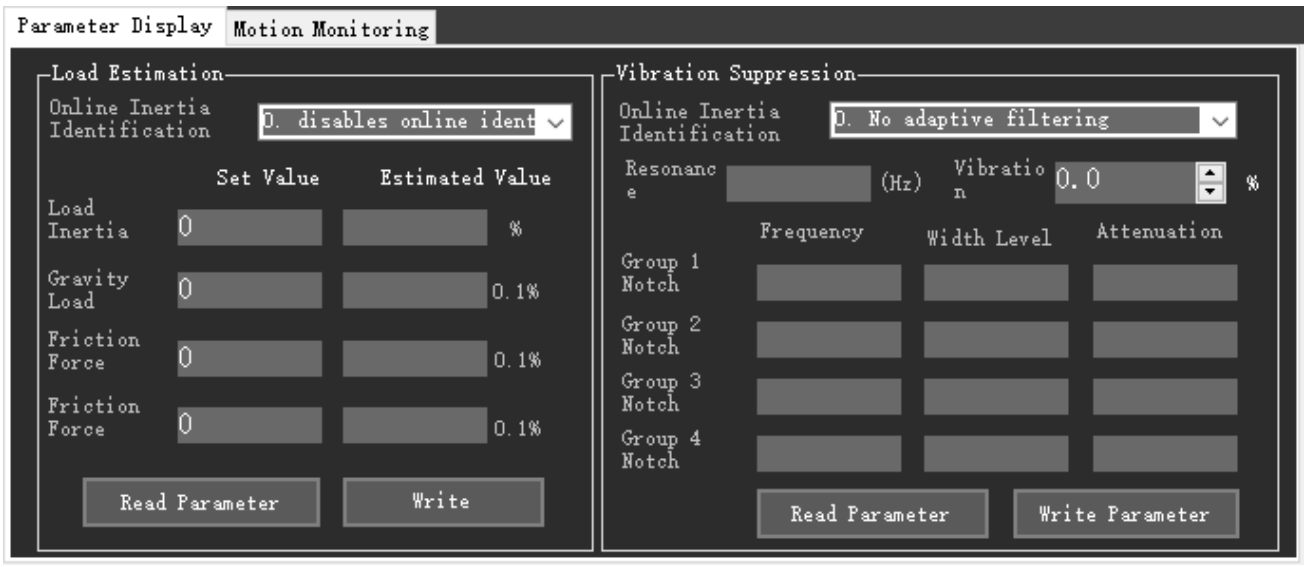
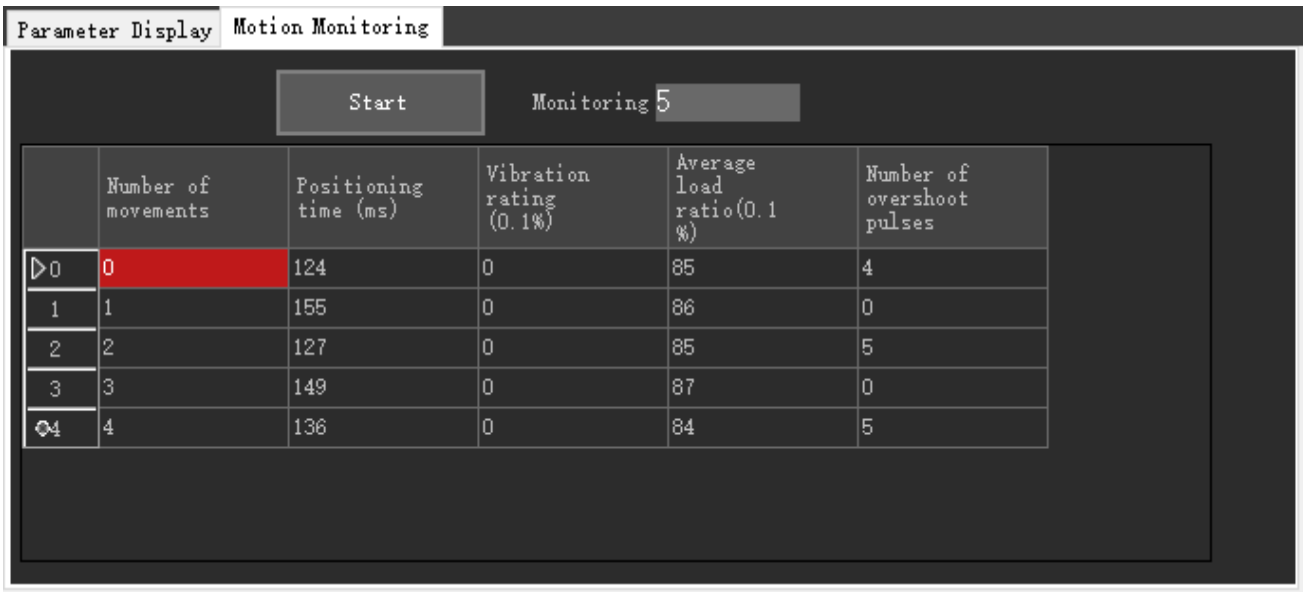


Figure 3-15

In "Motion Monitoring" some information of the motion process can be automatically displayed, such as the current motion count, positioning time, average load rate, and overshoot pulse count. The "Vibration Level" function is still under development. The "Average Load Rate" only records the load rate within the longest 20 seconds after the command is issued. If the command exceeds 20 seconds, the excess part is no longer calculated. Figure 3-16 shows this process.



	Number of movements	Positioning time (ms)	Vibration rating (0.1%)	Average load ratio(0.1 %)	Number of overshoot pulses
▷0	0	124	0	85	4
1	1	155	0	86	0
2	2	127	0	85	5
3	3	149	0	87	0
⟲4	4	136	0	84	5

Figure 3-16

(2) Auto-Adjustment Function Explanation

After entering Position Jog, the servo is in position mode.

The purpose of the first step is to perform a jog motion on the servo to determine if the servo is functioning normally and to determine the servo's limit position. Once the limit position is determined, users can proceed to the second step.

The purpose of the second step is to make the servo move a certain distance at a certain speed, which allows for identification operations related to auto-adjustment. If a failure or servo OFF occurs during motion, the system will automatically return to the first step. If everything is running normally, the motion will proceed as shown in Figure 3-17, and users can choose whether to enter the gain auto-adjustment interface, which is the third step. If users choose to enter auto-adjustment, make sure the running distance is >= 1 rev, running speed >= 400rpm, acceleration/deceleration time >= 100ms, and waiting time >= 100ms.

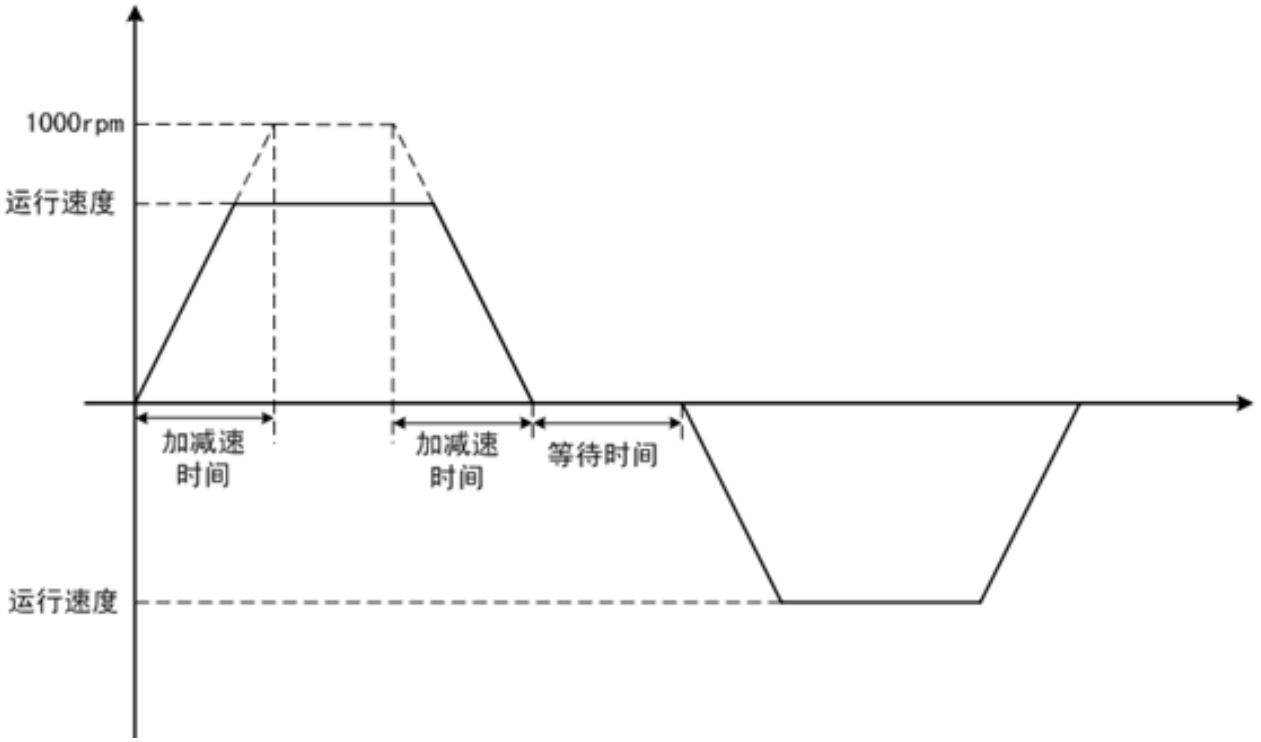


Figure 3-17

In the third step, as shown in Figure 3-18, click on "Enter Auto-Adjustment" to configure related parameters such as load operation mode. Select trajectory mode for trajectory operation or positioning mode for positioning operation. Choose high-response mode for priority response speed. If there is significant mechanical vibration, switch to medium-response mode. If the mechanical vibration is still significant, switch to low-response mode. Check the "No Overshoot" option if overshooting is not allowed. Click "Configure Parameter Writing" to enter the auto-adjustment interface.

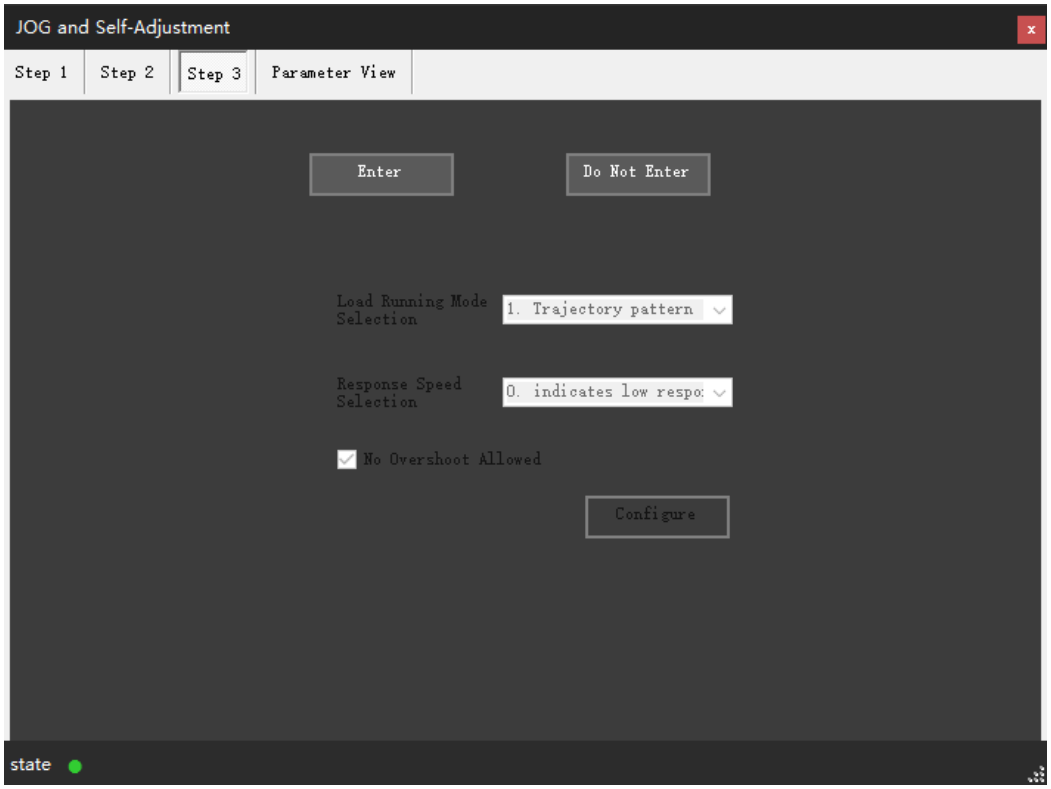


Figure 3-18

During the auto-adjustment process, clicking the "Stop" button will stop the auto-adjustment mode and disable the servo, as shows in Figure 3-19.

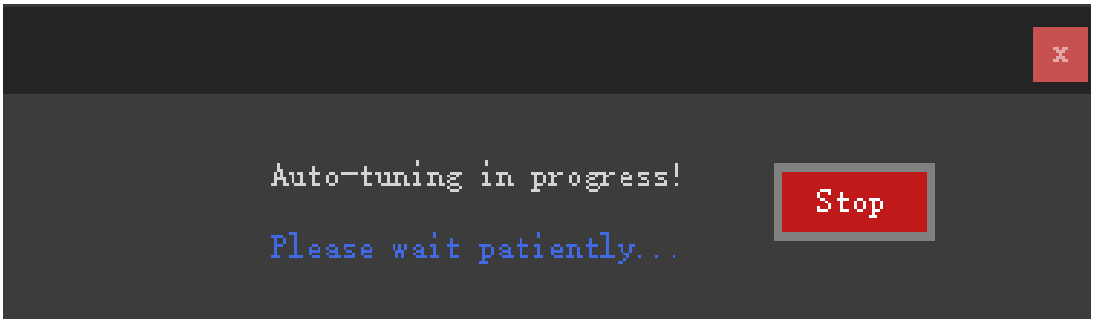


Figure 3-19

After a successful auto-adjustment, the final prompt to write the values is determined based on the previously set responsiveness and operation mode. For example, the gain switching function only appears when high-response and medium-response settings are selected. The friction compensation function only appears in the high-response mode, and both of these functions only appear in the positioning mode. However, it is not necessary to write parameters for these functions in the end. The program needs to determine if using these functions will shorten the positioning time. If there is

no improvement, it will not prompt to write parameters. To save the current recognized parameters, click on "Save Parameters" to store the self-tuned parameters in the power-off storage area, as shown in Figure 3-20.

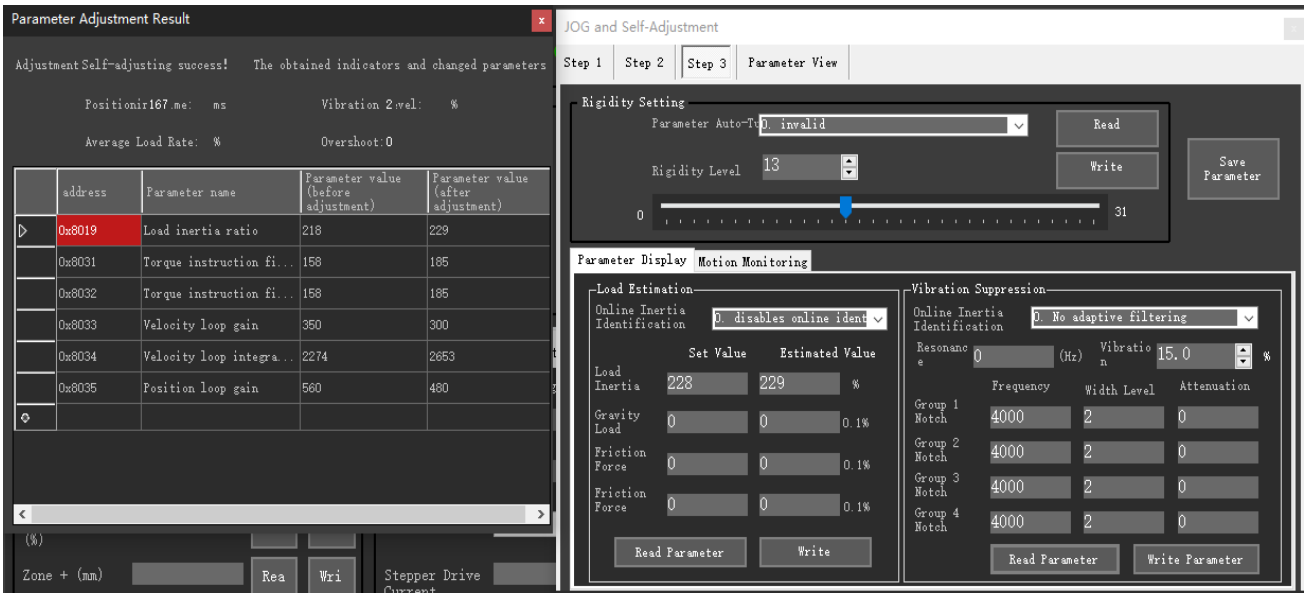


Figure 3-20

Clicking on "Skip Auto-Adjustment" will directly enter the configuration interface on the right side of Figure 3-20. The parameter refresh will be determined based on the set values. For example, when online inertia estimation is enabled, the estimated value will be automatically updated but will not be updated in the set values. If adaptive damper is selected for vibration suppression, the automatic update of the third group and fourth group of dampers will be determined by the set values. After adjusting the parameters based on the set values, save the parameters (manual adjustment of this function is currently under development).

3.7 Device Search

3.7.1 Device Search Functionality

Upon opening the software, the device search interface will automatically appear. Clicking on the "Slave Search" button in the port settings window will also lead to the device search interface. Figure 3-21 shows the device search interface.

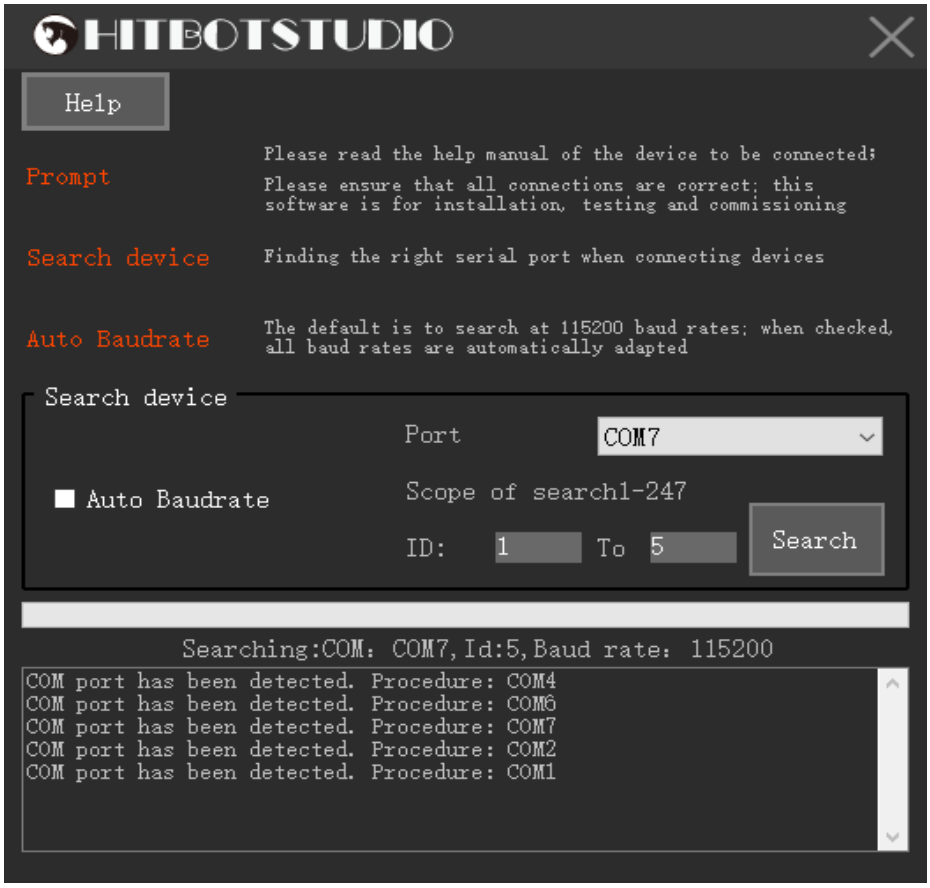


Figure 3-21 (Device Search Interface)

Help: Clicking this button will open the HitBotDrive user manual.

Auto Baud Rate: Clicking this option means that all baud rate ranges of the serial port will be automatically matched when searching for devices.

Port: The system automatically detects the serial port devices connected to the computer and displays them here.

Search Range: During device search, it will look for devices within the specified slave range.

Search: Clicking the search button will search for actuator, clamp, suction cup, and other devices in the specified or all serial ports.

The log window, progress bar, and other controls will display or print the search results and any abnormal situations in red font.

3.8 HitBotDrive Actuator Module

(1) After finding the actuator device in the device search connection module, users can click on the corresponding device in the slave list, and it will enter the actuator module interface. Figure 3-22 shows the interface when the actuator device is found.

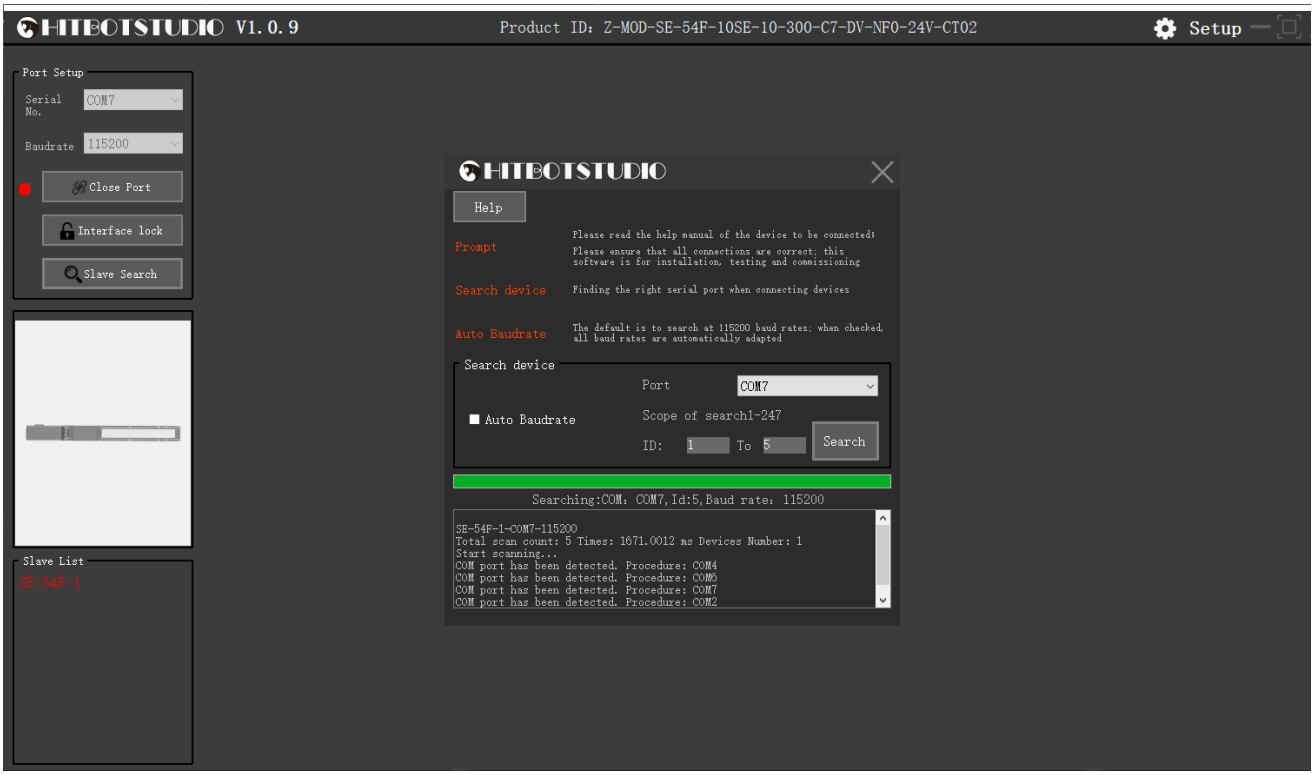


Figure 3-22 (Interface of the Actuator Device Found)

(2) By clicking on the device in the slave list, users can access the actuator module interface, which includes features such as position mode debugging, function settings, script functions, I/O settings, parameter settings, Modbus tools, manual debugging, actuator status, and IO status indicators. Figure 3-23 shows the actuator module operation interface.

Figure 3-23 (Actuator Module Operation Interface)

3.8.1 Actuator Function Button Operations

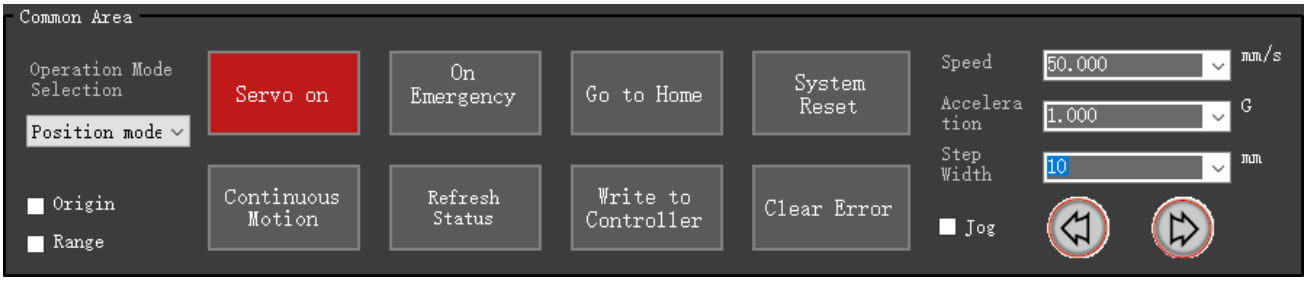


Figure 3-24 (Actuator Function)

Operating Mode: Uses can choose position mode, pulse mode, or PID debugging mode.

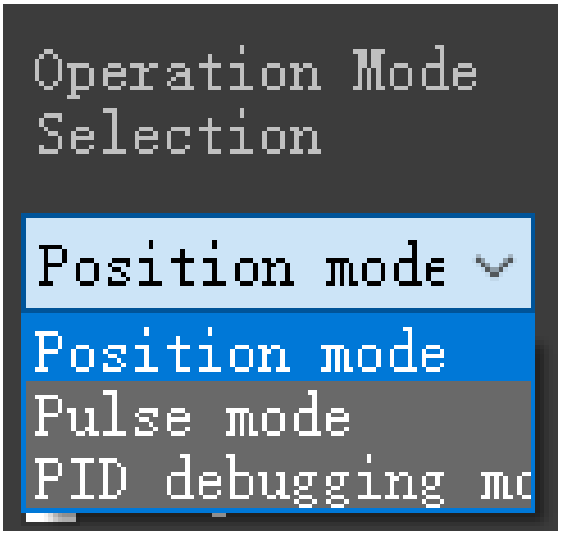


Figure 3-25 (Operating Mode)

Servo Enable: Clicking "Servo Enable" enters the servo enable mode (the button will display red when servo is disabled).

Write to Controller: Clicking "Write to Controller" writes the modified settings and data to the actuator device.

Emergency Stop: Clicking "Emergency Stop" immediately stops the actuator's movement (depending on the actual actuator model and whether an emergency stop is configured).

System Reset: Clicking "System Reset" initiates the reset procedure for the actuator.

System Reset: Clicking "Home Return" moves the actuator to the designated home position.

Clear Error: Clicking "Clear Error" clears any errors that have occurred.

Continuous Run: Clicking "Continuous Run" cyclically moves the actuator to the selected position within the specified range.

3.8.2 Actuator Jog Operation Interface

Users can select or input the corresponding speed, acceleration, and step size (an alarm will be triggered if the range exceeds the maximum value). The actuator can be moved by clicking the two directional buttons below. Figure 3-26 demonstrates the jog operation of the actuator.

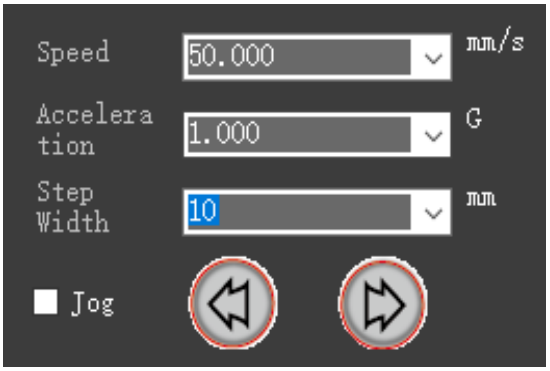


Figure 3-26

3.8.3 Actuator Status Interface

The actual actuator status is read in real-time and displayed on the interface. After entering the device interface, the program continuously reads the actuator status and monitors it on the main interface, as shown in Figure 3-27.

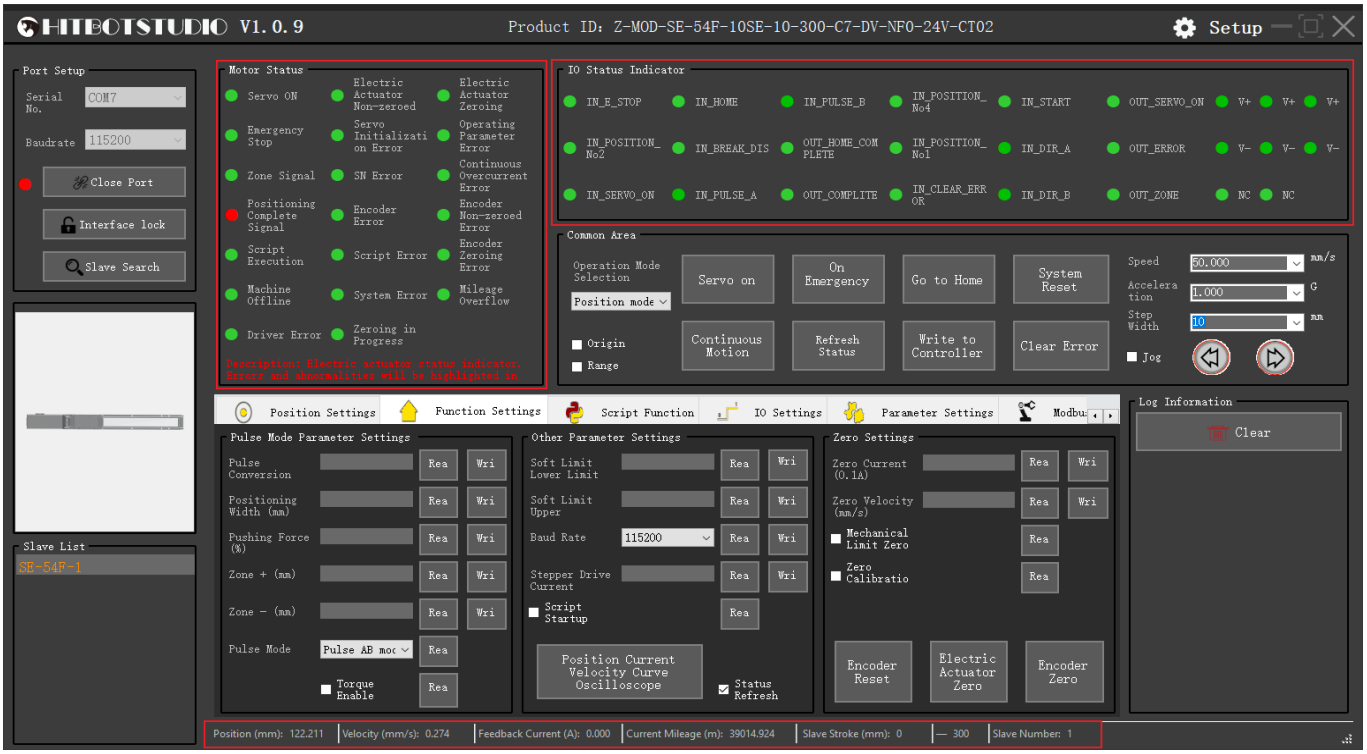


Figure 3-27

3.8.4 Actuator Position Mode Data Read/Write

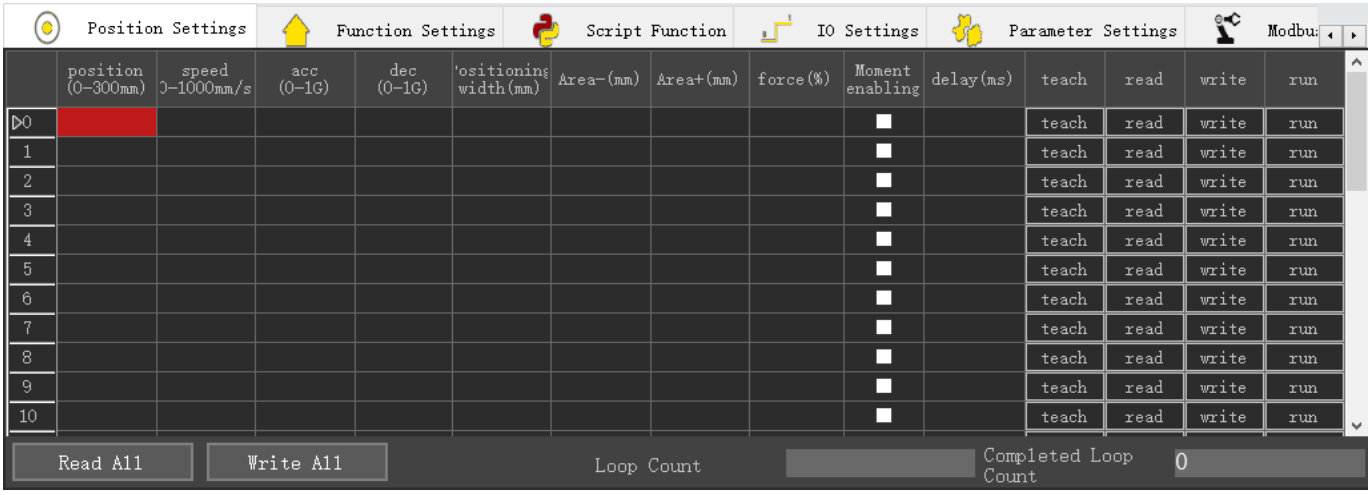
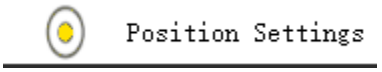


Figure 3-28

In Figure 3-28, by clicking on the data read/write icon 

in the position mode, users can clearly see the data records for 32 position points (the older version of the actuator only had 8 points). ， The records include position, speed, acceleration, deceleration, positioning width, area value, and force. In this section, double-clicking on certain cells in the table allows direct editing of the properties of the position points. Clicking the teach button in each row allows teaching the current position of the actuator.

When the torque enable checkbox is selected, the actuator operates in torque mode, and the force value ranges from 0% to 100%. When it is not selected, the actuator operates in non-torque mode, and the force value is invalid. Figure 3-29 shows the teaching process, where users can manually drag the module (servo must be disabled before manual dragging), or drag the module's 3D graphic with the mouse (the drag teaching checkbox must be selected before dragging), or stepwise jog the module to the working position and record the current position of the module in the table by clicking the teach button in that row.

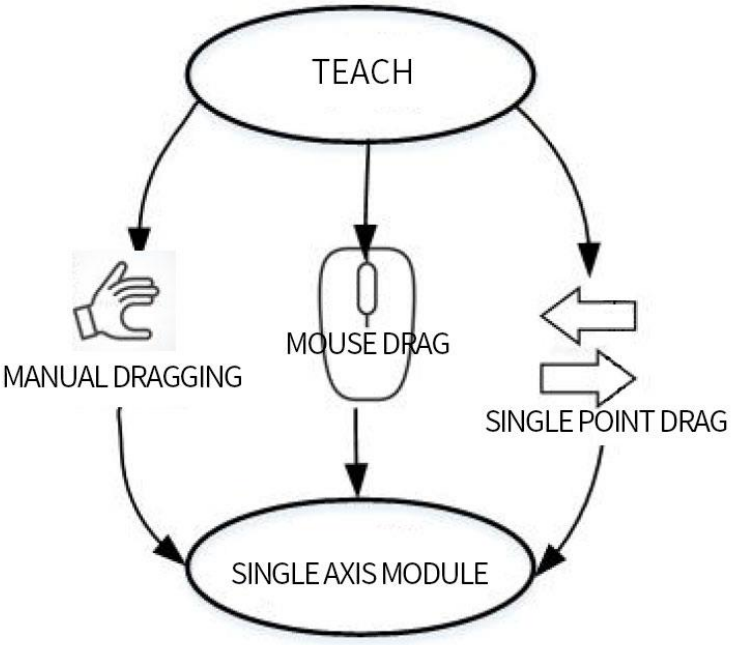


Figure 3-29

In the region table shown in Figure 3-30, clicking the read button in each row can read the corresponding register data and display it in that row. Clicking the write button in each row can write the data of that row into the corresponding register (after writing the data, it must be saved by writing to the controller, otherwise, the data will be lost after a power failure). Clicking the 'Read All' button can read the data of each row's corresponding registers. Clicking the "Write All" button can write the data of each row into the corresponding registers. Clicking the run button in each row allows the actuator to run to the position set in that row with the specified parameters.

	position (0-300mm)	speed)-1000mm/s	acc (0-1G)	dec (0-1G)	'ositioning width(mm)	Area-(mm)	Area+(mm)	force(%)	Moment enabling	delay(ms)	teach	read	write	run
0									☐		teach	read	write	run
1									☐		teach	read	write	run
2									☐		teach	read	write	run
3									☐		teach	read	write	run
▷4									☐		teach	read	write	run
5									☐		teach	read	write	run
6									☐		teach	read	write	run
7									☐		teach	read	write	run
8									☐		teach	read	write	run
9									☐		teach	read	write	run
10									☐		teach	read	write	run

复制
粘贴
上移
下移
清空
清空全部

Figure 3-30

In the region table shown in Figure 3-30, each row can be selected by clicking on its header. Right-clicking allows options such as copy, paste (the row must be cleared first), move up, move down, and clear the data of that row, or clear all data in the table.

3.8.5 Actuator Function Settings

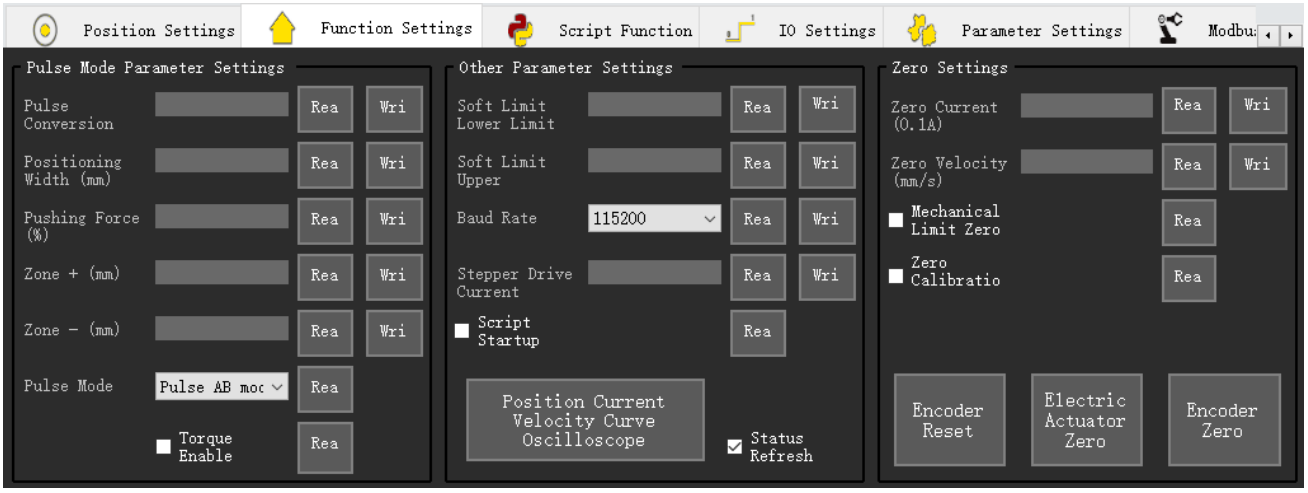
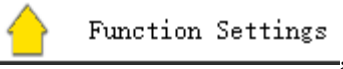


Figure 3-31

By clicking on the function setting icon 

, users can perform pulse mode parameter setting, direct position mode parameter setting, position-current-speed curve oscilloscope function, and other parameter settings, as shows in Figure 3-31.

Pulse mode parameters include pulse conversion ratio, positioning width, pressing force, area+, area-, and torque enable parameters. After selecting the pulse mode in the mode selection section, these parameters need to be set. Pulse conversion ratio: Unit: 0.01mm/pulse, the distance corresponding to one pulse; Positioning width: Unit: mm, when the actuator reaches a position within the given range of ± positioning width, it will report position completion; Pressing force: Unit: percentage, range [0, 100], represents the force limit during actuator operation, effective when torque control is enabled; Area-: Area range signal, the actuator will output the area signal when moving to [Area-, Area+]; Area+: Area range signal, the actuator will output the area signal when moving to [Area-, Area+]; Pulse mode settings can choose pulse + signal or pulse AB mode.

Direct position mode parameters include positioning width, pressing force, area+, area-, and torque enable parameters. The functions of each parameter are the same as described above.

Other parameter settings include operation mode setting, software limit setting, etc. In the operation mode setting, users can choose position mode, pulse mode, direct position mode, or PID debugging mode. When selecting the position mode, it runs using a set of position parameters selected from the position parameter module. When selecting the pulse mode, it runs by external input pulses. When switching to pulse mode, the current position must be within the upper and lower limits of the position. When selecting the direct position mode, it runs directly to the target position without velocity planning (not recommended). When selecting the PID debugging mode, it uses this mode for PID debugging. The software limit lower limit represents the minimum allowed position value of the actuator within the stroke range, in millimeters. The software limit upper limit represents the maximum allowed position value of the actuator within the stroke range, in millimeters. After setting the software limit parameters, the servo must be turned off and then back on for the changes to take effect. Reading and writing of zero current value setting. The home parameters include the home position value, home return speed, acceleration, deceleration, positioning width, and force value. Script startup setting; encoder reset, actuator zero calibration, encoder zero calibration.

Baud rate: After selecting and writing the corresponding baud rate segment, it is necessary to reconnect and select the set baud rate segment, and then write it into the controller.

3.8.6 Actuator Script Functionality

By clicking the script function icon Script Function, users can write Lua script code and configure script waypoints, as shows in Figure 3-32.

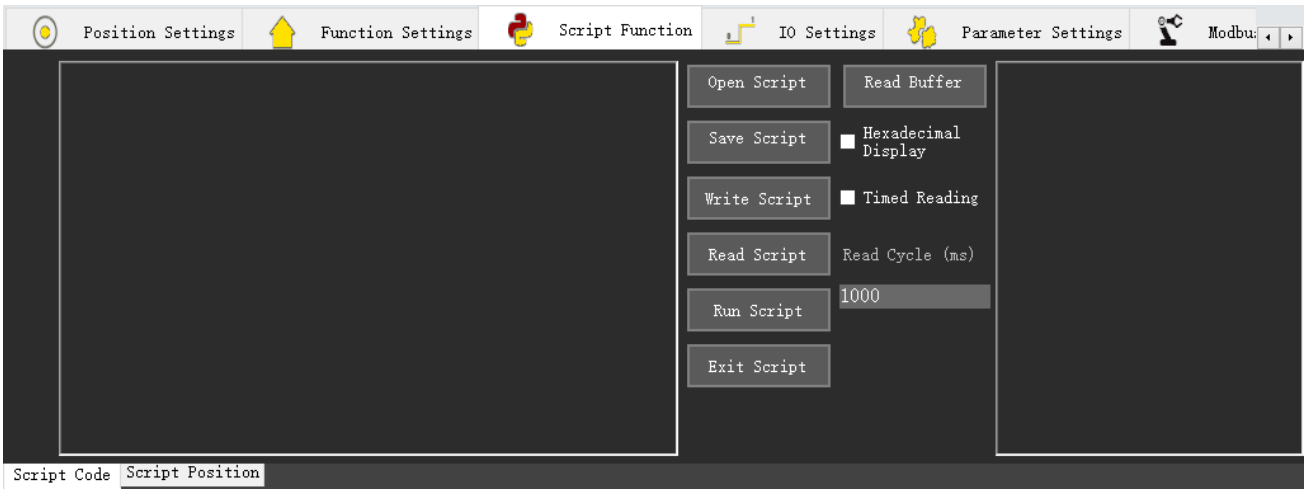


Figure 3-32

In the left editor, users can write Lua script code. Click the "Script Write" to write the prepared script code into the controller. Click the "Script Read" to read the script code written by the user. Click the "Run Script" button to execute the user-written script. Click the "Exit Script" to stop the script execution. Users can also save the script code by saving the script file or open a saved script file by clicking the "Open Script File". If an error occurs while running the script, the error message can be read from the cache and displayed in the right text display box. As shows in Figure 3-33.

Figure 3-33

Additionally, the software provides the function to add script library. By clicking the "Add Script Library", users can add or delete the corresponding script in the popped-up dialog box. The software provides 8 script library functions by default, and all functions will be automatically added under default conditions. Users can manually delete or add functions as needed. The corresponding function descriptions are as follows:

1. set_poswidth（width）

2. Set the positioning width value instruction. The input parameter is the positioning width value "width"(unit: mm)

3. set_acc_dec（acc，dec）

4. Set the acceleration and deceleration values instruction. The input parameters are the acceleration value "acc" (unit: G) and deceleration value "dec" (unit: G)

5. Servo（value）

6. Control servo on/off instruction. The input parameter 'value' is 1 to turn on the servo, and 0 to

turn off the servo.

7. move(pos,speed)

8. Control the movement of the actuator. The input parameters are the position value "pos" (unit: mm) and speed value "speed" (unit: mm/s)

9. move_pos（pos_name）

10. Control the movement of the actuator. The input parameter is the position name "pos_name" (the position name must be obtained from the script waypoints)

11. set_output_io（io_number，value）

12. Control output I/O instruction. The input parameters are the I/O number "io_number", and the value "value" is 0 to close the output I/O and non-zero to open the output I/O

13. get_output_io(io_number)

14. Get output I/O status instruction. The input parameter is the I/O number "io_number", and the return value represents the status: 0 for closed, 1 for open

15. get_input_io（io_number）

16. Refer to Figure 3-35 for getting input I/O status instruction. The input parameter is the I/O number "io_number", and the return value represents the status: 0 for closed, 1 for open

Figure 3-34 (input I/O status)

Figure 3-34 shows that in the script waypoint list, the position of the waypoints can be obtained through teaching or manual input.

Figure 3-35 shows the script programming code.

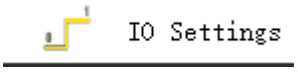
Figure 3-35

The script lines mentioned above perform the following actions:

Line 1 sets the positioning width to 0.1mm; Line 2 sets the acceleration and deceleration values to 0.1G; Line 3 controls the actuator to run at a speed of 200mm/s to the position of 50mm; Line 4 controls the actuator to run at a speed of 150mm/s to the position of 200mm; Line 5 outputs the 0th I/O; Line 6 controls the actuator to move to point p1;

Line 7 controls the actuator to move to point p2 (where p1 and p2 were pre-configured in the script waypoints).

3.8.7 Actuator I/O Functionality

By clicking the script function icon 

, the I/O of the actuator can be configured, as shows in Figure 3-36.

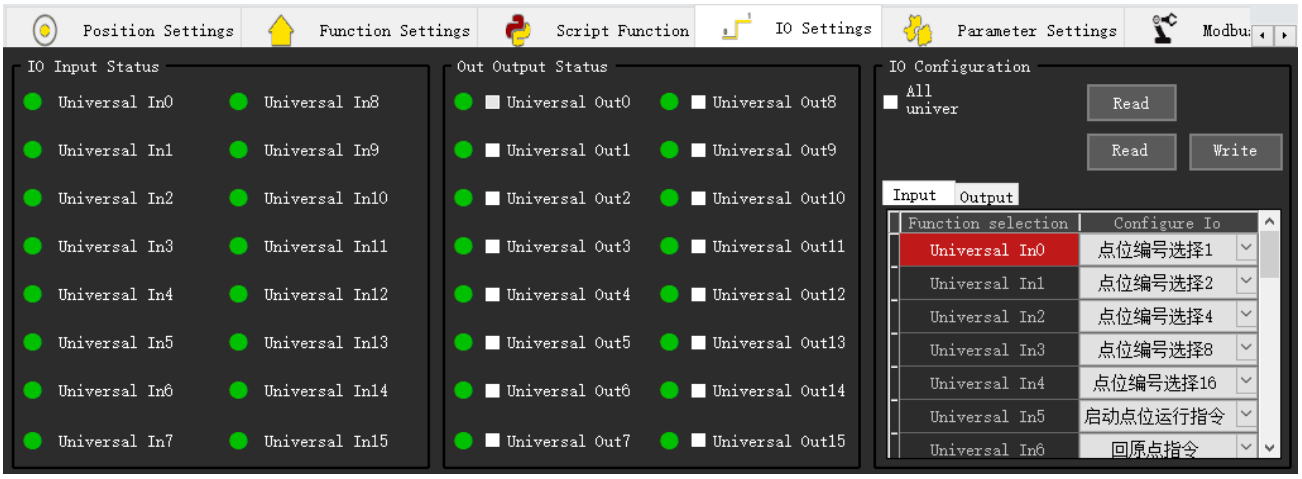


Figure 3-36

After connecting to the actuator and entering the HitBotDrive interface, the current configuration of the actuator will be read and displayed on the corresponding I/O positions in the "Input" and "Output" tables.

I/O Configuring: After the machine is connected, the current settings will be obtained and displayed. Click "Read I/O Configuration" to read the configuration.

Read Configuration: Click "Read Configuration" to read the current I/O configuration of the actuator.

Write Configuration: Click "Write Configuration" to write the configurations in the current input/output table to the connected actuator.

Input/Output Table: Input/Output Table: The "Configure I/O" column can be manually selected to configure the I/O function.

3.8.8 Actuator Status Display

At the bottom of the HitBotDrive, there is a status display that updates the current status of the actuator in real-time. Example shown in 3-37.

Figure 3-37

3.8.9 Actuator Parameter Settings

By clicking the parameter setting icon Parameter Settings, users can read and write to the registers of the actuator. As shows in Figure 3-38.

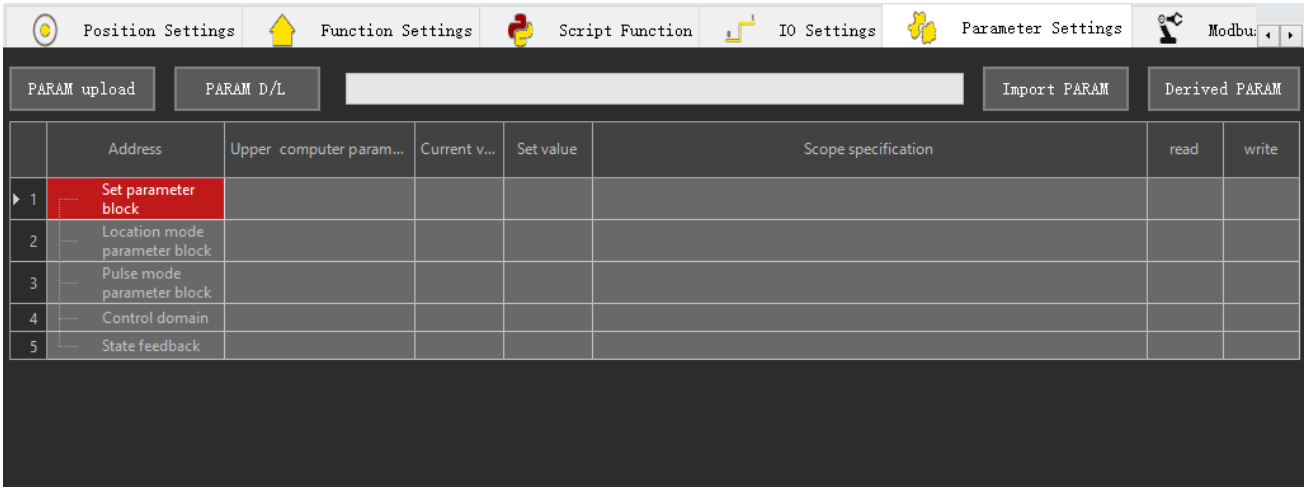


Figure 3-38

Upload Parameters: The device has a default template. After connecting to the device, clicking "Upload Parameters" will load the default version and read the values of the corresponding addresses to display in the "Current Value" and "Setting Value" columns.

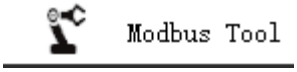
Download Parameters: Click "Download Parameters" to write the values in the "Setting

Value" column to **the corresponding addresses** for all registers with read/write permissions.

Import Parameters: Import Parameters: Click "Import Parameters" to import a saved configuration file (JSON file) and update the corresponding setting values in the table.

Export Parameters: Export Parameters: Click "Export Parameters" to save the corresponding setting values in the table as a JSON file.

3.8.10 Actuator Modbus Tool Settings

Click on the Modbus tool icon. 

. This tool provides functions for individual register read/write operations, data format conversion, and sending Modbus register operation messages. As shows in Figure 3-39.

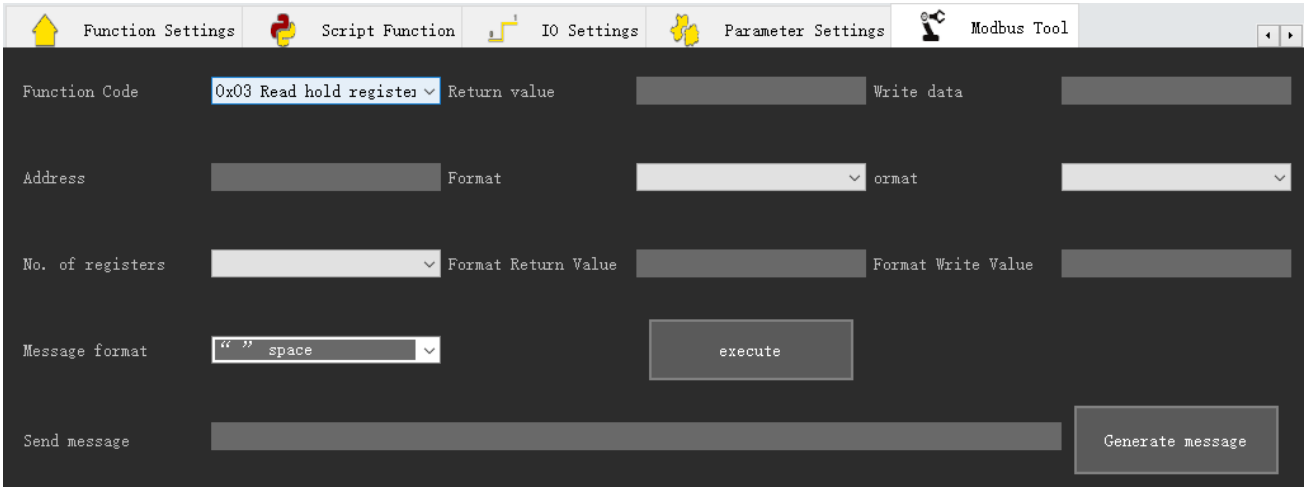


Figure 3-39

Function Code: By clicking the drop-down box, next to the function code, users can select the desired function code to operate, as shows in Figure 3-40.

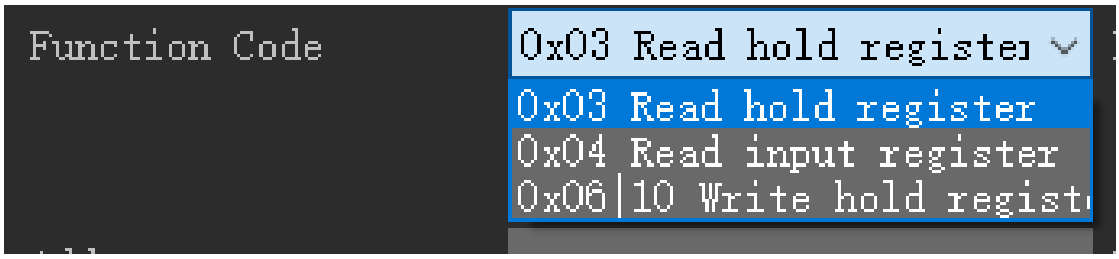


Figure 3-40

Address: Enter the corresponding register address (in hexadecimal format).

Register Count: Users can select either a single register or two registers (data types like int, float, uint that occupy 2 registers require selecting 2).

Message Format: The format between data when obtaining the return value. The displayed format of the generated message string varies depending on the selection.

Execute: By clicking 'Execute', the corresponding read/write operation will be performed based on the function code, address, and register count.

Generate Message: By clicking "Generate Message", a detailed read/write operation message will be generated based on the function code, address, and register count.

The input of the return value in hexadecimal string can be checked for the corresponding format return value by switching the format.

3.8.11 Actuator Log Information Display

Log information will be printed in the control and recorded in the local application path under ".\Log Files". Figure 3-41 shows the log information window.

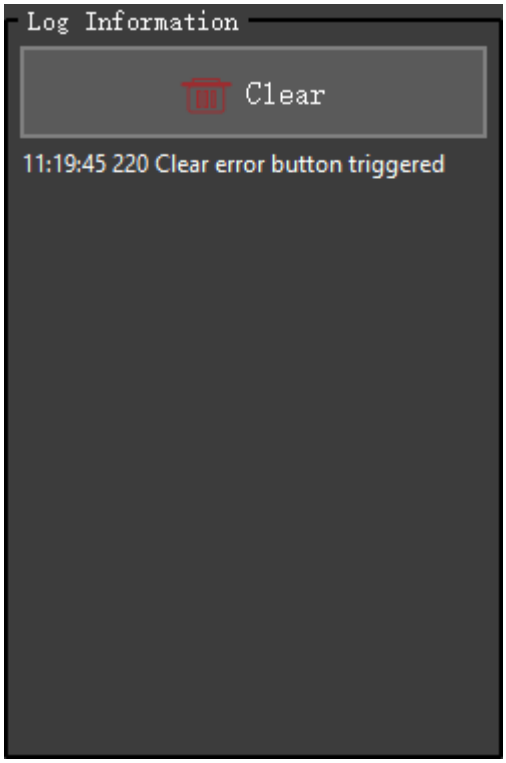


Figure 3-41 (Log Information)

3.9 HitBotDrive Gripper Module

1. After finishes searching for the gripper in the device search and connection module, clicking on the corresponding device in the slave list will take users to the gripper module interface in the HitBotDrive. Figure 3-42 shows the interface when the gripper is found.

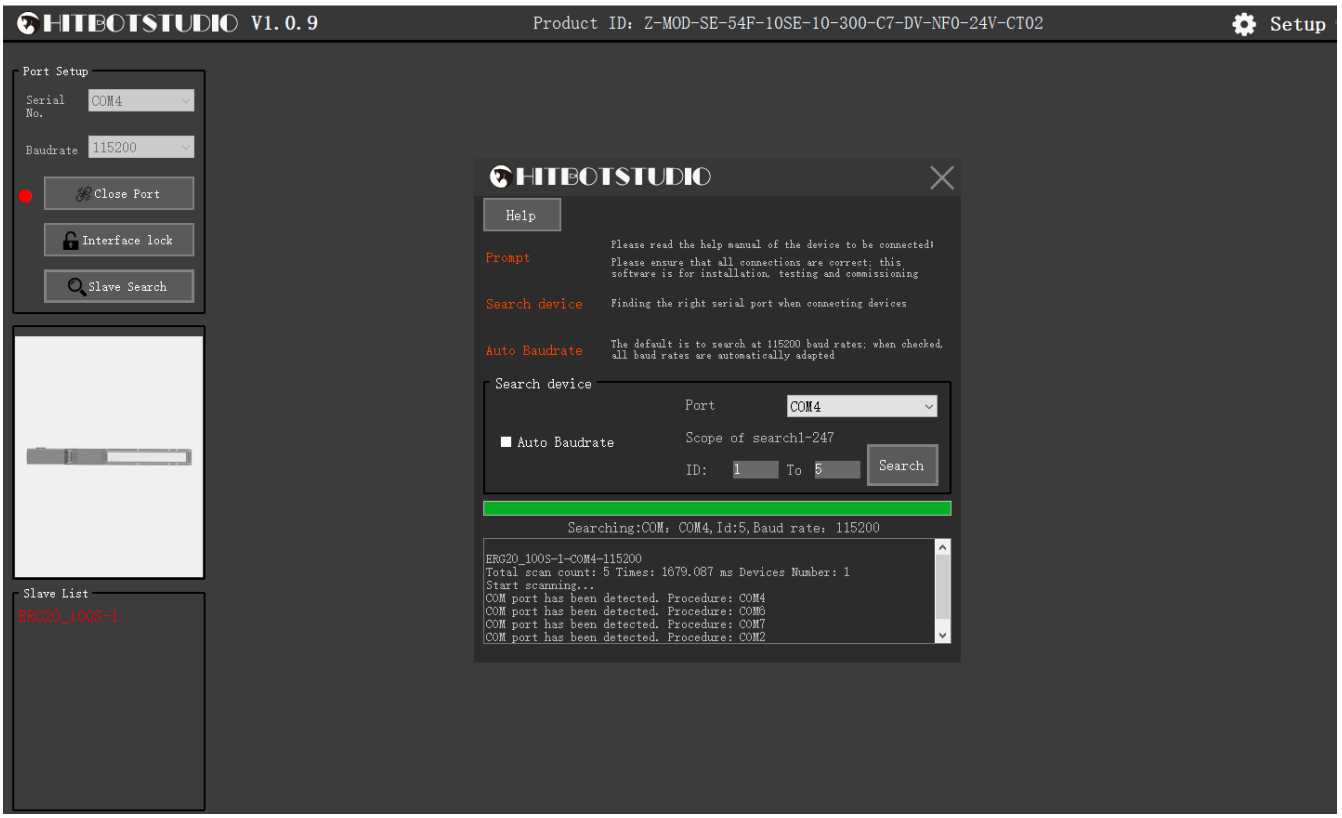


Figure 3-42

2. By clicking on a device in the slave list, where (gripper module interface) users can access functions such as waypoint setting, function setting, parameter setting, Modbus tool, and gripper status. Figure 3-38 shows the gripper operation interface.

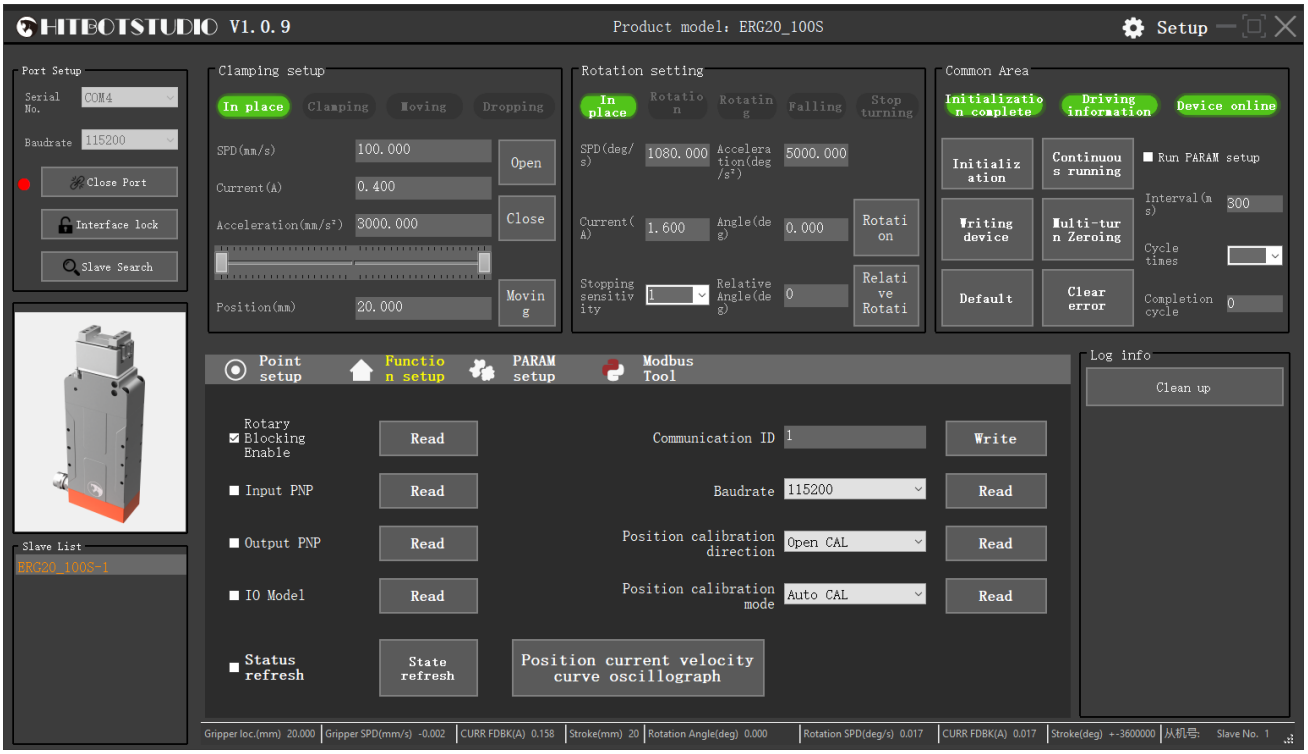


Figure 3-43

3.9.1 Gripper Common Button Operations

Figure 3-44 shows the operation of the common area for the gripper.

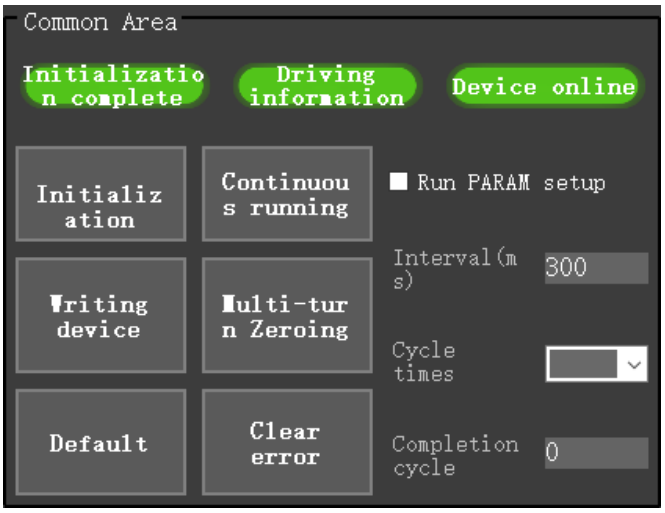


Figure 3-44

Initialize: Click "Initialize" to initiate the gripper initialization process.

Clear Error: Click "Clear Error" to clear any errors that have occurred.

Clear Multi-turn Rotation Value: Click "Clear Multi-turn Rotation Value" to reset the multi-turn rotation feedback position to within 360 degrees.

Write Parameters to Device: Click "Write Parameters to Device" to immediately write the modified parameters or settings to the gripper controller.

Restore Default Parameters: Click "Restore Default Parameters" to restore the gripper controller to its default parameter settings.

Continuous Operation: Click "Continuous Operation" to cyclically move the gripper based on the selected waypoint information.

Range Selection: Click "Range Selection" to open the range selection interface, as shown in Figure 3-40.

Interval Time: The default interval time is 300ms, which represents the time interval during continuous operation of waypoints.

Loop Count: The default is empty, indicating unlimited cycles. Entering a specific count will stop the loop after reaching the specified count.

Loop Count Accumulated: Displays the cumulative loop count after continuous operation.

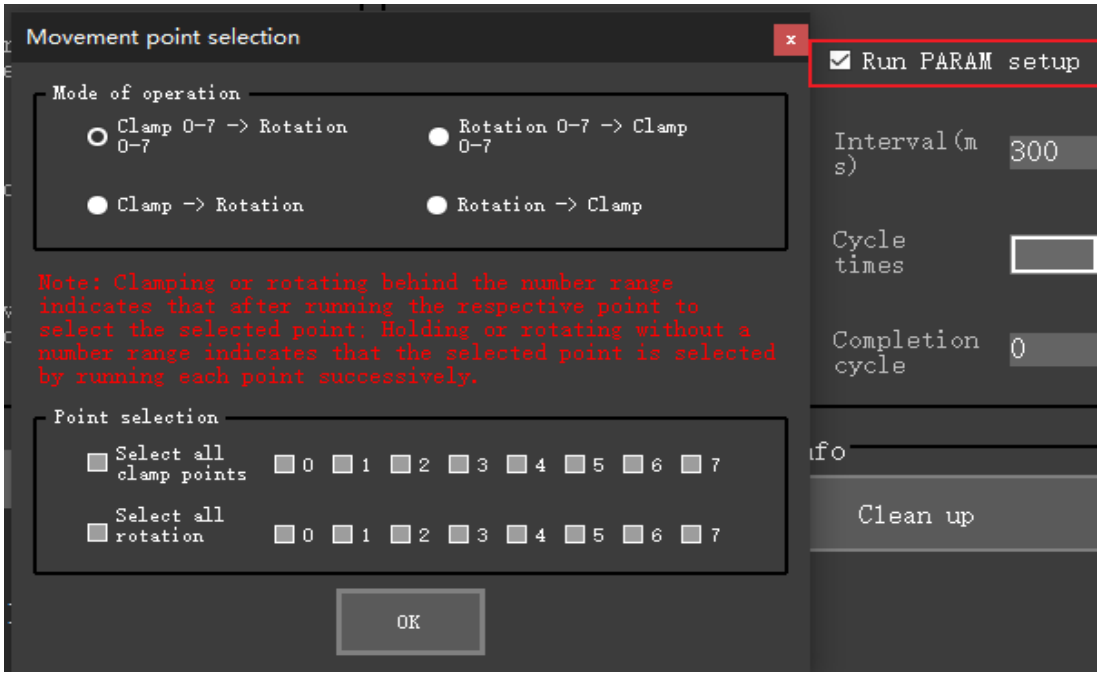


Figure 3-45

3.9.2 Gripper Holding Settings Operation Interface

Figure 3-46

Users can input corresponding speed, acceleration, and current values. Gripper motion can be controlled by dragging the sliders or clicking "Open","Close" or "Move". The status indicators above can be used to determine if the gripper has reached the desired position or is currently gripping. Figure 3-46 shows the interface for gripper gripping motion.

3.9.3 Gripper Rotation Settings Operation Interface

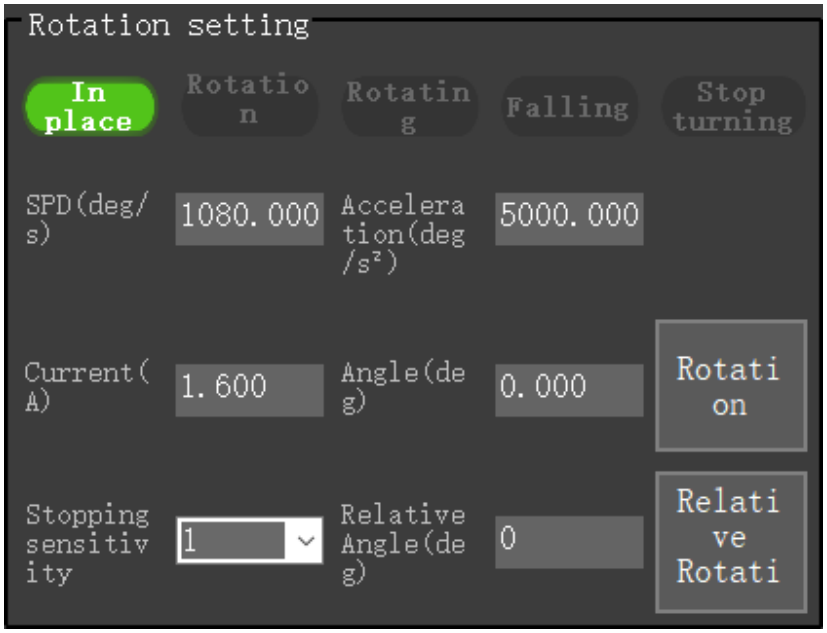
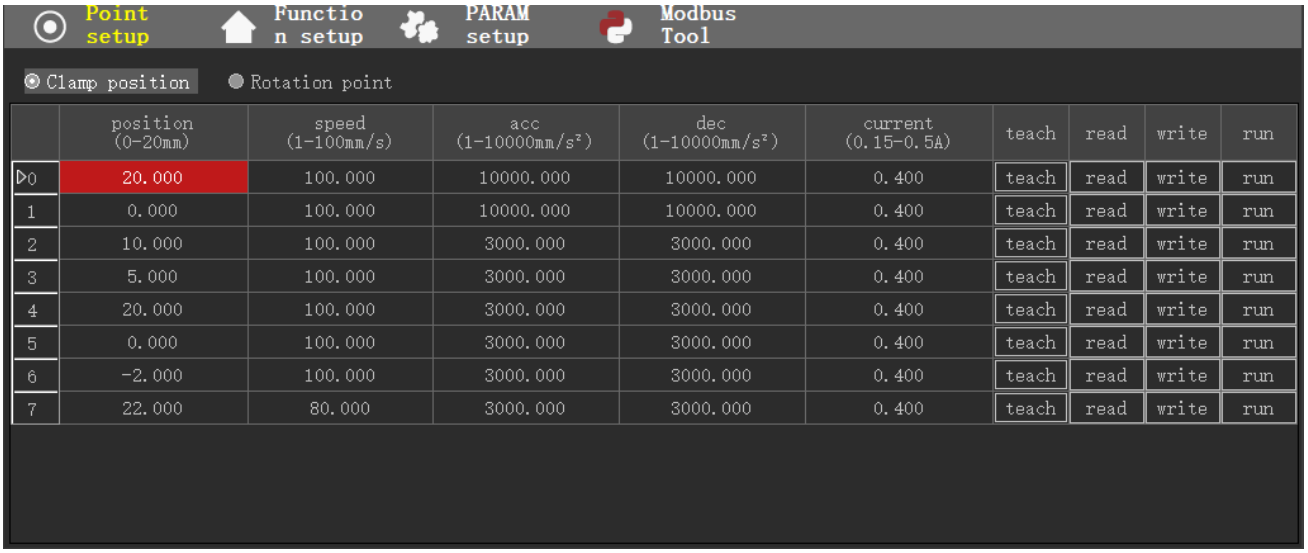


Figure 3-47

Users can input corresponding speed, acceleration, and current values. The gripper rotation motion can be controlled by clicking "Rotate" or "Relative Rotate". The status indicators above can be used to determine if the gripper has reached the desired position. Figure 3-47 shows the interface for gripper rotation motion.

3.9.4 Gripper Position Settings



	position (0-20mm)	speed (1-100mm/s)	acc (1-10000mm/s²)	dec (1-10000mm/s²)	current (0.15-0.5A)	teach	read	write	run
▷0	20.000	100.000	10000.000	10000.000	0.400	teach	read	write	run
1	0.000	100.000	10000.000	10000.000	0.400	teach	read	write	run
2	10.000	100.000	3000.000	3000.000	0.400	teach	read	write	run
3	5.000	100.000	3000.000	3000.000	0.400	teach	read	write	run
4	20.000	100.000	3000.000	3000.000	0.400	teach	read	write	run
5	0.000	100.000	3000.000	3000.000	0.400	teach	read	write	run
6	-2.000	100.000	3000.000	3000.000	0.400	teach	read	write	run
7	22.000	80.000	3000.000	3000.000	0.400	teach	read	write	run

Figure 3-48 (Position Settings)

Clicking the Position Mode Data Read/Write icon

, which is divided into Gripping Positions and Rotation Positions, allows clear visibility of the data for 8 position points (recorded positions), including position, speed, acceleration, deceleration, and current. In this section, users can double-click on certain cells in the table to directly edit and change the properties of the position points. Users can also click the teaching button in each row to teach the current position of the gripper. As shown in Figure 3-48.

In the region table shown in Figure 3-49, clicking the "Read" in each row reads the corresponding register data for that row and displays it. Clicking the "Write" in each row writes the data from that row into the corresponding registers (remember to save to the controller after writing, otherwise the data may be lost after power failure). Clicking the "Read All" reads the register data for each row. Clicking the "Write All" writes the data from each row into the corresponding registers. Clicking the "Run" in each row makes the gripper run to the position specified in that row with the corresponding parameters.

In the region table shown in Figure 3-49, users can click on the row header to select a row, then

right-click to choose Copy, Paste (after clearing the row), Move Up, Move Down, or Clear the data of that row or the entire table.

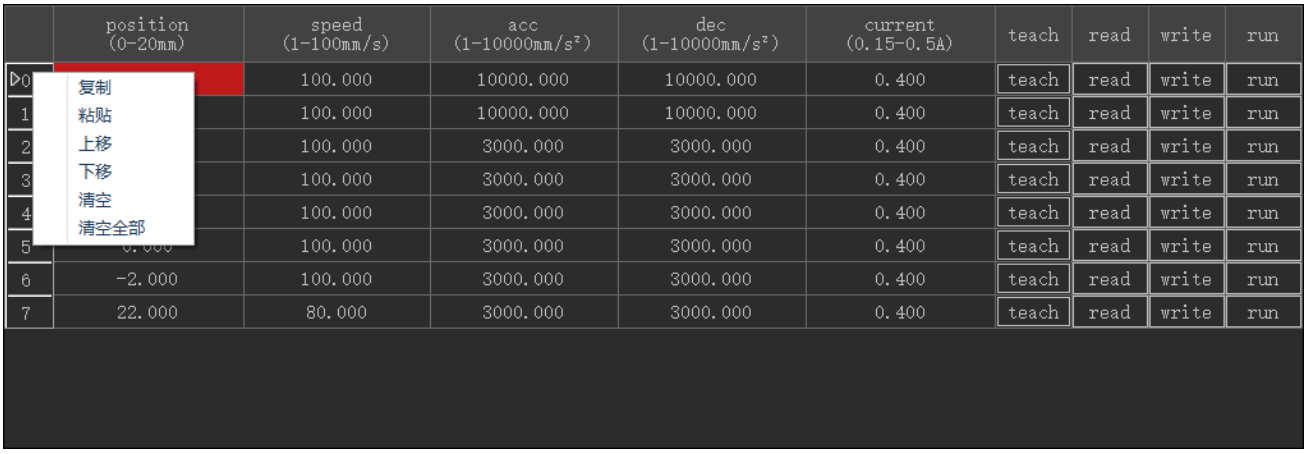


Figure 3-49

3.9.5 Gripper Function Settings

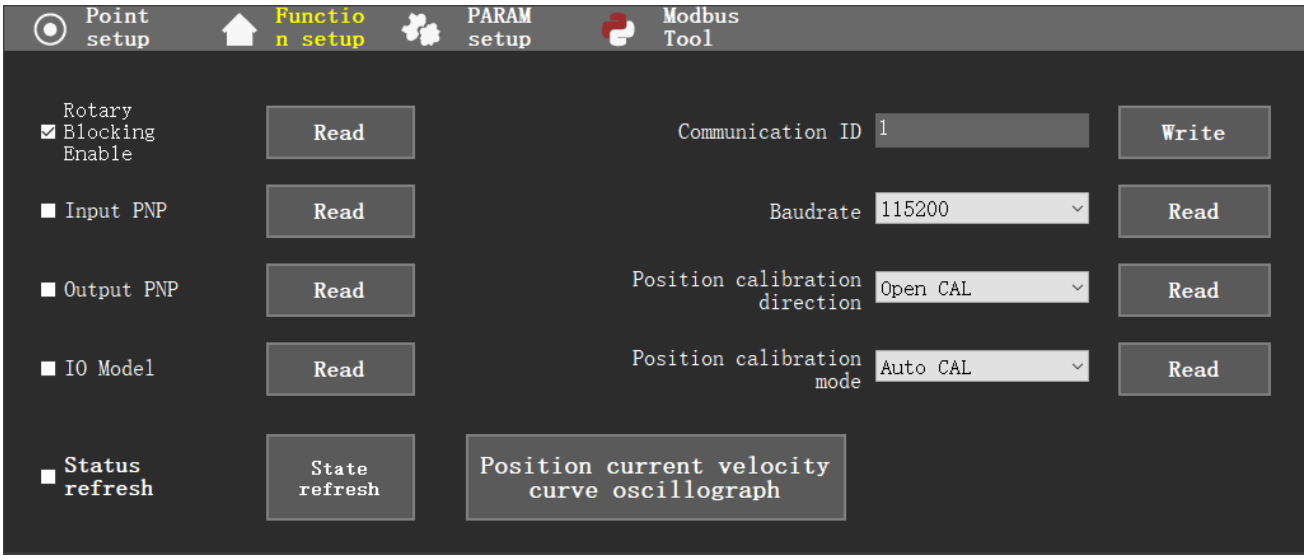
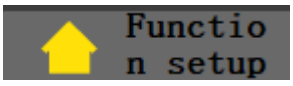


Figure 3-50 (Function Settings)

Clicking the Parameter Mode icon 

allows users to set parameters of I/O mode, rotation stall enables mode, input PNP mode, output PNP mode, position current speed curve oscilloscope, and Others. As shown in Figure 3-50.

3.9.6 Gripper Parameter Settings

Clicking the Parameter Settings icon allows users to read and write to the registers of the gripper. As shown in Figure 3-51.

Figure 3-51 (Parameter Settings)

Upload Parameters: The device has a default template. After connecting to the device, clicking "Upload Parameters" will load the default version and read the values at that address, displaying them as the current value and set value.

Download Parameters: Clicking "Download Parameters" will write the set values of all address registers with read-write permission to the corresponding addresses.

Import Parameters: Clicking "Import Parameters" allows users to import and update the current table's set values with a saved configuration file (JSON file).

Export Parameters: Clicking "Export Parameters" allows users to export the corresponding set

values in the current table as a JSON file for saving.

3.9.7 Gripper Modbus Tool Settings

Clicking the Modbus Tool icon

provides separate operations for register read/write, data format conversion, and Modbus register operation message retrieval. As shown in Figure 3-52.

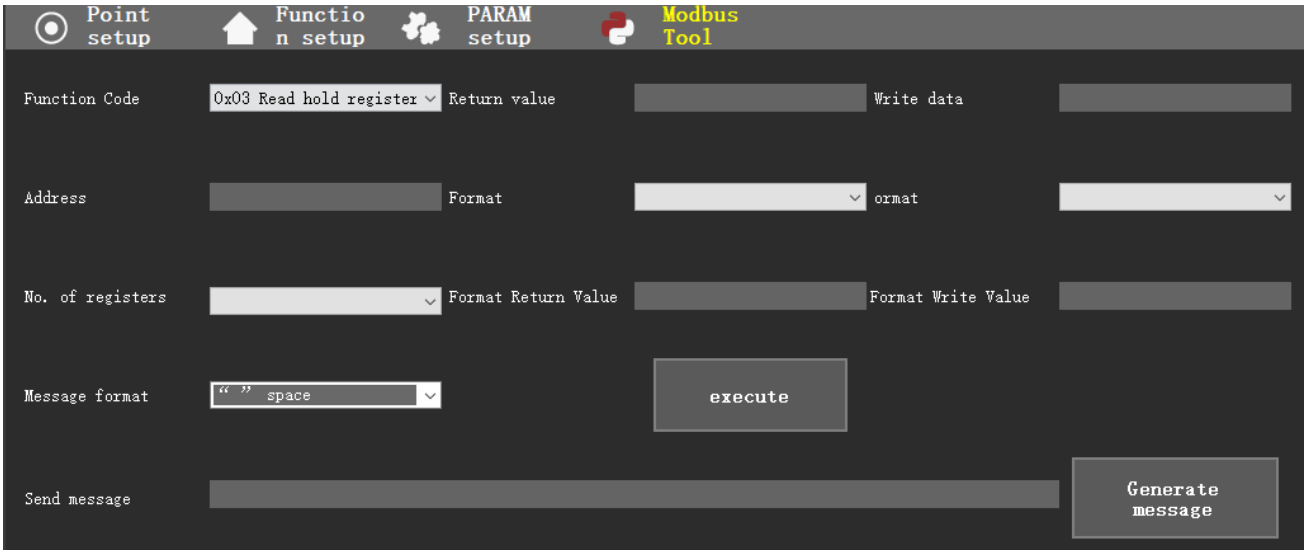


Figure 3-52 (Modbus Tool Settings)

Function Code: Clicking the drop-down box next to the function code allows users to select the desired function code for the operation, as shown in Figure 3-53.

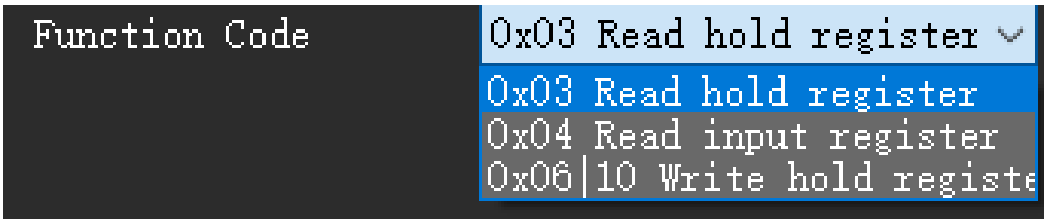


Figure 3-53 (Function Code)

Address: Enter the corresponding register address (hexadecimal address).

Register Count: Users can select single or double registers (data types that occupy two

registers such as int, float, uint require selecting 2 registers).

Message Format: The format between data when retrieving the return value. Depending on the selection, the display of the generated message string will vary, as shown in Figure 3-54.

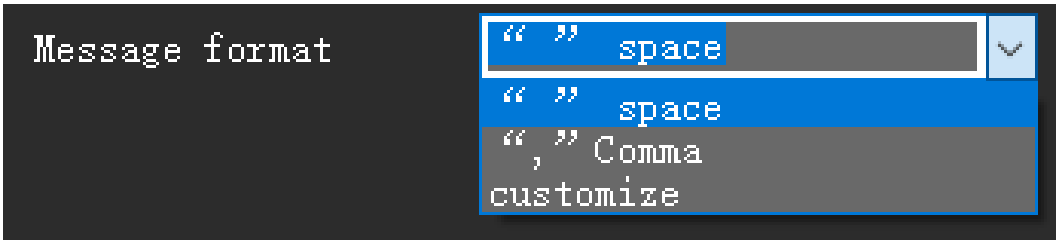


Figure 3-54 (Message Format)

Execute: Clicking "Execute" will perform the corresponding read/write operation based on the selected function code, address, and register count.

Generate Message: Clicking "Generate Message" will generate a detailed read/write operation message based on the selected function code, address, and register count.

Enter the hexadecimal string of the return value to query the corresponding formatted return value by switching formats.

3.9.8 Gripper Status Display

At the bottom of the HMI, there is a row of status display information that updates the current status of the gripper in real-time, as shown in Figure 3-54.

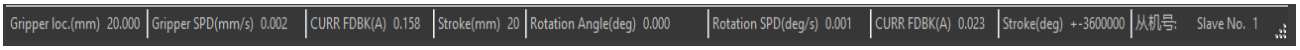


Figure 3-55 (Gripper Status)

3.9.9 Gripper Log Information Display

The log information is printed in the control widget in the lower right corner and recorded in the

local application path under ".\Log Files". Figure 3-56 shows the window of log information.

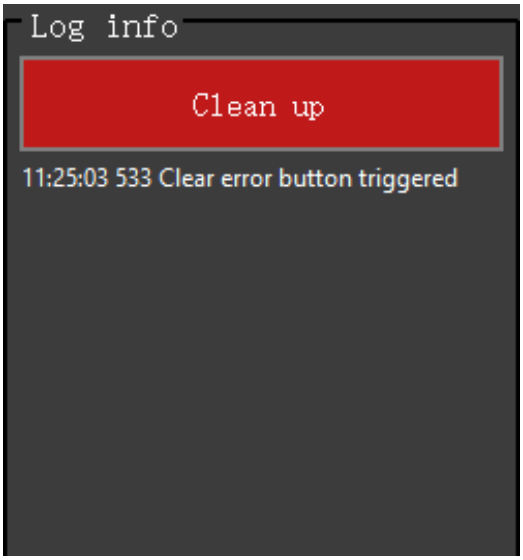


Figure 3-56 (Log Information)

3.10 HitBotDrive Intelligent Device Suction Cup Module

1. After searching and finding the vacuum device in the device search module, users can click on the corresponding device in the slave list, and the HMI will enter the vacuum module interface. Figure 3-57 shows the interface for the discovered vacuum device.

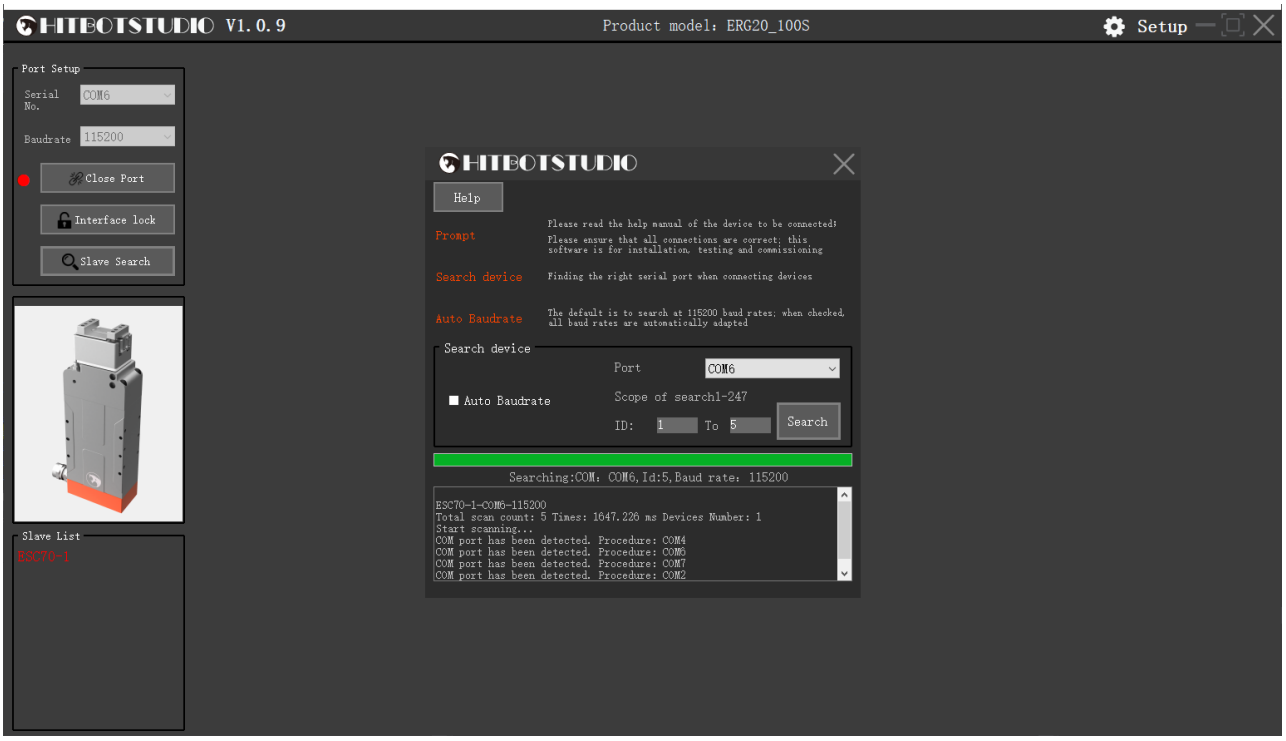


Figure 3-57 (Suction Cup Module)

2. By clicking on the device in the slave list, users can enter the vacuum module interface to perform point setting, function setting (referencing the gripper), parameter setting (referencing the gripper), Modbus tool (referencing the gripper), and vacuum status display. Figure 3-58 shows the vacuum operation interface.

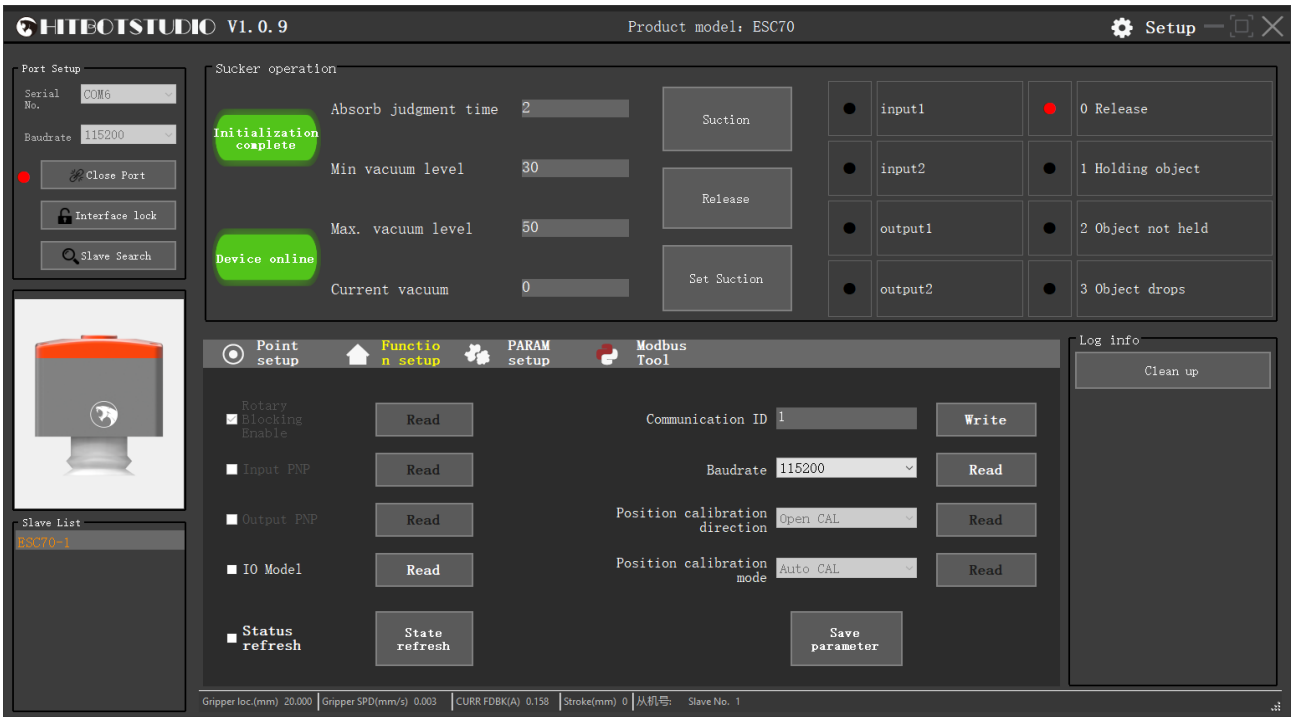


Figure 3-58 (Vacuum Operation Interface)

3.10.1 Suction Cup Operation

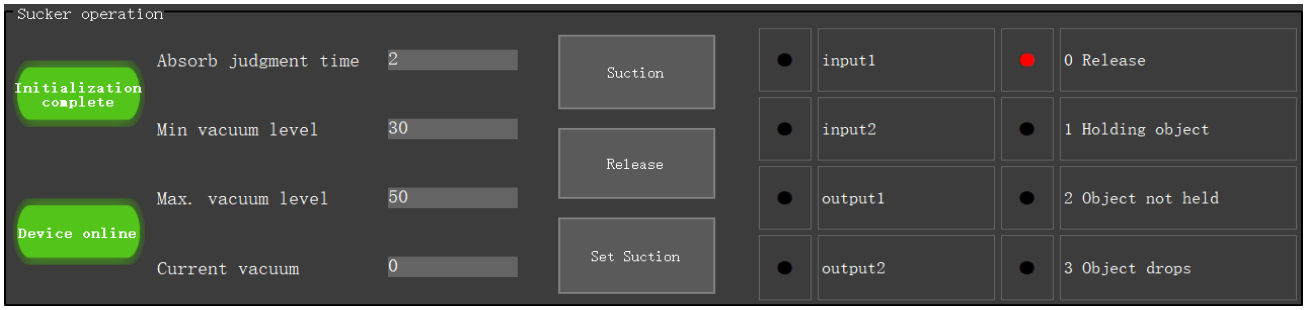


Figure 3-59 (Suction Cup Operation)

Vacuum On: Click "Vacuum On" to activate the vacuum and perform the suction action.

Vacuum Off: Click "Vacuum Off" to release the vacuum and perform the release action.

Set Vacuum: Click "Set Vacuum" to perform the suction action within the minimum to maximum vacuum range on the left.

Vacuum Judgment Time: Set the time for vacuum judgment (default: 2 seconds).

Minimum Vacuum Level: Set in conjunction with the minimum vacuum level during suction.

Maximum Vacuum Level: Set in conjunction with the maximum vacuum level during suction.

The corresponding vacuum status signals on the right will turn red when there is a signal.

3.10.2 Suction Cup Position Settings

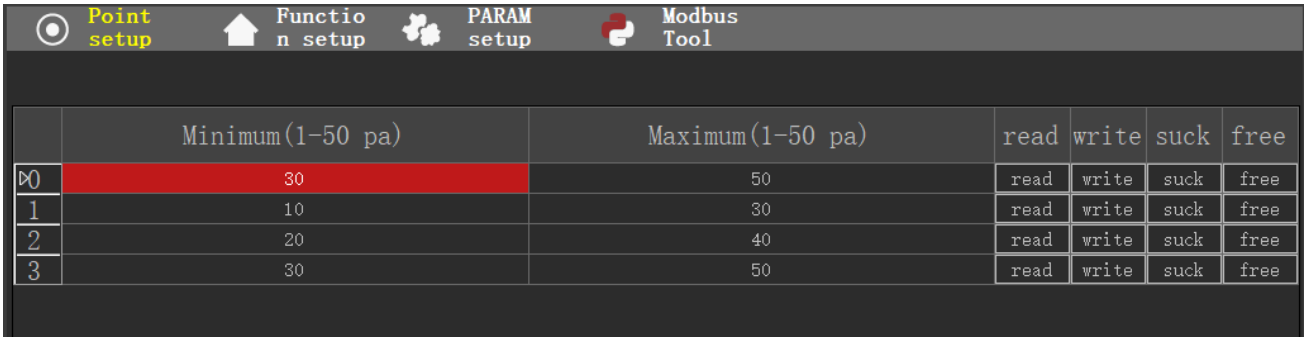
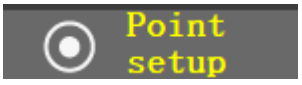


Figure 3-60 (Suction Cup Position Settings)

Clicking the Point Setting icon 

allows clear visibility of the data for 4 points (recorded points), including the minimum vacuum level and maximum vacuum level. In this section, users can double-click on certain cells in the table to directly edit and change the properties of the position points. Users can also click the "Read" in each row to retrieve the current set values of the vacuum. As shown in Figure 3-60.

In the region table shown in Figure 3-60, clicking the "Read" in each row reads the corresponding register data and displays it in that row. Clicking the "Write" in each row writes the data of that row into the corresponding register (after writing data, it needs to be saved in the

controller; otherwise, the data will be lost when power-off). Clicking the "Vacuum On/Off" in each row allows the vacuum to perform the set action with the parameters of that row (**IO mode execution needs to be set for it to take effect**).

3.11 HitBotDrive Intelligent Device Oscilloscope Function

3.11.1 Curve Oscilloscope Functionality

The function of oscilloscope allows adjusting the sampling interval by setting the sampling frequency. It can save the sampled data as a CSV file. In the waveform display interface, users can right-click to open the corresponding operation and view the curve graph. Figure 3-61 shows the curve function interface.

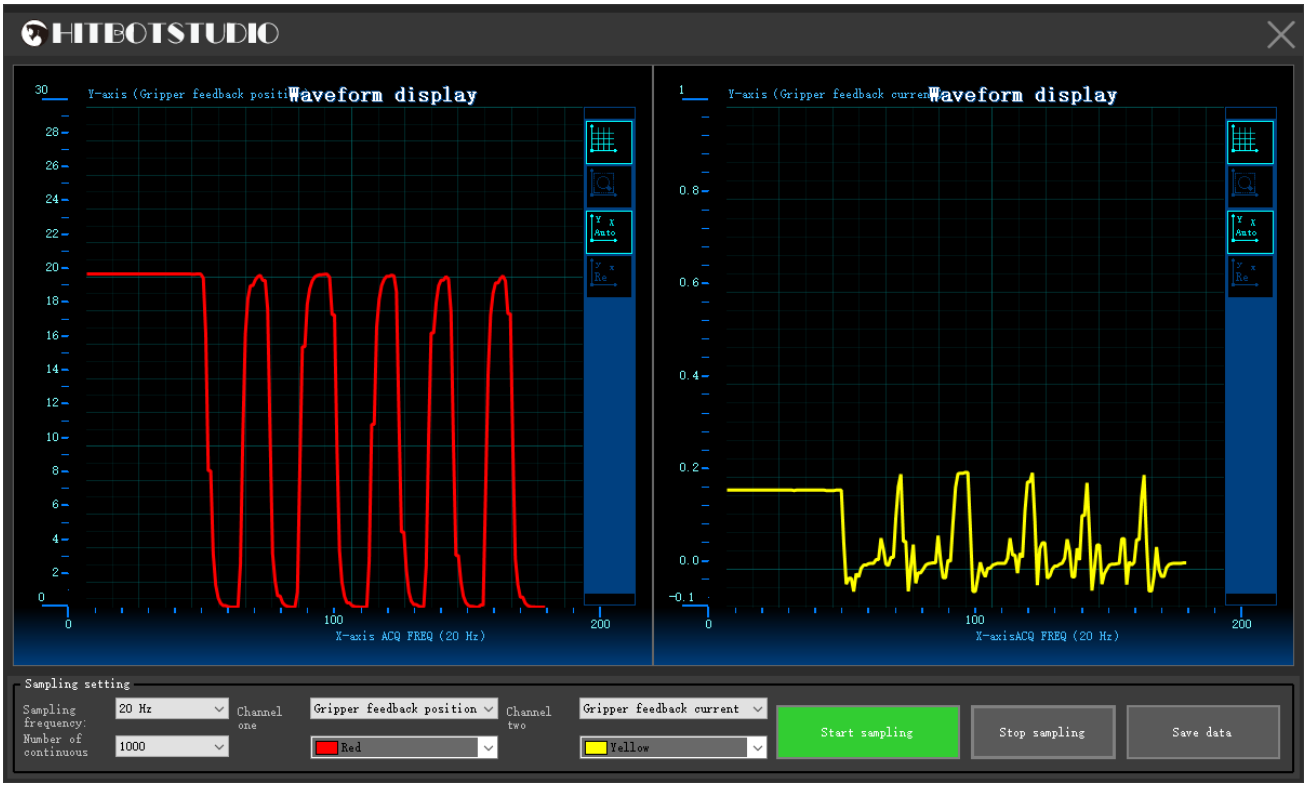


Figure 3-61 (Oscilloscope)

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