NAU Robot
Teach Pendant
V2.2.7

Introduction

As an optional part of the controller, NAU is used to control the motion of the robot, write programs, and set parameters. The *NAU Robot Teach Pendant* is designed to help readers master the various functions of the instruction.

Document version

Docu-ment	Descrip-tion	TP	Controller	Revision Date
V2.1.0	Translated	V2.1.0	V2.1.0.19.11.12	2019/11/25
V2.1.1	Translated	V2.1.8	V2.1.3.20.03.12	2020/03/12
V2.2.1	Translated	V2.2.1	V2.2.1.20.06.27	2020/06/27
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V2.2.5	Translated	V2.2.5	V2.2.5.20.10.22	2020/10/22
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V2.2.7	Translated	V2.2.7beta1	V2.2.7B	2021/03/09

Update Content

V2.2.7B		Index
Add a limit declaration about origin calibration limits	Added declaration that SCARA robot cannot calibrate J3 or J4 origin separately	5.2.1 Robot Settings
Add a description of the tool box function	Add a description of the tool box function;	5.3.5 Tool Box Setting
Modify the unit of the position monitor function	The unit of the position monitor changed from pulse value to joint position value;	5.2.8 Data monitoring function
Add [Netlog enable] setting	Add a description of the [Netlog enable] setting;	5.2.7 System Settings

V2.2.5		Index
Add instructions on no hot plugging	Added instruction that the teach pendant cannot plug and unplug when the controller is powered on;	2.4 Robot Operation Precautions
Add a description of the error	Add a description of the additional joint number in error code when the drive alarmed;	5.1.2 Information Bar/Start/Stop

code about the drive		
Add a description of the velocity profile setting	Add a description of the velocity profile mode in the robot setting;	5.2.7 System Settings
Add a description of the arrival judge setting	Add a description of the arrival judge mode in the robot setting;	5.2.7 System Settings
Modify the description of the Estop clear setting	Modify the description of the Emergency stop error clear mode in the robot setting;	5.2.7 System Settings
Adds a spherical judgement area function	Add the function of detecting the coincidence between the Box and the spherical determination area at the end of the tool;	5.2.5 Body Box Setting
Add a description for the controller network function	Add the description for the function to modify the Robot Studio communication configuration;	5.2.7 System Setting
Modify the description for the safety confirmation signal	Modify the description for the safety confirmation signal when the teach pendant is hardware version;	3.1 Component Name and Function
Add the function to change the active project	Add the ability to change the active project	5.5.1 All Programs

V2.2.3		Index
Add Body Box function	Add Body Box function to prevent the robot from entering the forbidden area;	5.2.5 Body Box Setting
Calibrate the user coordinate system with four point	Add the function of calibrating user coordinate system by selecting any four points on workpiece coordinate system;	5.3.3 Local Coordinate
Add data monitoring function	Added function for recording robot running speed, current and real-time position	5.2.8 Data Monitoring function
Added the ability to bind multiple Box to the same output port	now support to bind multiple working area to the same output port;	5.3.4 Box Area

V2.2.2		Index
Add upload all and download all function	Add the function to upload or download all project files with one click;	5.6.3 Synchronize Files

Add tools and user index	Add coordinate index for the tool and user coordinates;	5.3.2 tool coordinate 5.3.3 local coordinate
Add log out function	Add the function to logout current user;	5.4.4 User Management
Add update function	Add the function to upload controller and xml files;	5.4.3 About/Upgrade
Add Debug full speed mode	Add the full speed running function under Debug mode;	5.5.2 Current Project
Add encoder calibration function	Add the encoder calibrate function to adjust origin through reference point;	5.2.3 Origin Calibration
Add the option to distinguish different TP version	Add the setting option to distinguish different Teach Pendant hardware version;	5.2.6 System Settings

V2.2.1		**Index**
Added permission management function	The rights management function similar to Robot Studio controls the rights of users to use each function;	5.4.4User management
Added point change permission configuration function	Configure whether each point allows the user to modify the permissions;	5.4.4 User management
Add axis label when power on	In teaching mode, after the motor is powered on, the axis label corresponding to the button appears on the right side of the screen;	5.6.1 Teach
IO description modification feature added	Modify the description information of user IO in the [IO state] interface;	5.4.2 I/O Status
Add additional axis origin calibration function	How to add an additional axis to calibrate the function sum of origin;	5.2.2 SCAR calibration
Add the function of setting dynamics parameters	The ability to adjust speed planning through current load and real-time torque;	5.2.3 Motion Parameter Settings
Added the ability to view user logs	Increase the user directly open the "*.lhlog" log file function;	5.5.2 Current Project
Improve the instruction insert function	Improve the command insertion function of the program editing interface;	5.5.2 Current Project
Add sub task configuration start screen	Robot Settings to increase the configuration of whether the sub task enabled interface, if enabled, the sub task runs with the main task;	5.2.5 System Settings

Add the Home button	Add the Home button for quick return to the main interface;	5.1 Setting
Add safety loop setting interface	Set whether the controller is a controller with an added safety gate loop;	5.2.5 System Settings

V2.1.8		**Index**
Add screen calibration function	After the screen coordinates are misaligned, the screen touch accuracy is restored by five-point calibration.	5.2.5 System Settings
Added program delete mode	Press delete for 1 second delete one row of program;	5.5.2 Current Project
Optimize the opening mode of output port	Optimize the opening mode of the output port to popup and determine;	5.4.2 I/O Status
Optimize the name box of teaching circle surface point	Appropriately lengthen the text box of point name in the teaching interface;	5.6.1 Teach
Add Chinese and English toggle function	Translate all the text in the teaching device, add Chinese and English switching function;	5.2.5 System Settings
Added export logging capability	Add to upload and parse log files in the controller;	5.4.1 Log
Added export project functionality	Export the selected project to the USB disk inserted in the teach pendant;	5.5.1 All Programs
Added the ability to modify the instructional timer	Allows the user to modify the time of the trainer;	5.2.5 System Settings

V2.1.0		**Index**
First official release	The TP and this document are officially released for the first time.	

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1. Introduction

1.1 Welcome to use teach pendant

Welcome to the project management and development environment of teach pendant.

Characteristics of Teach Pendant

-TAICHI Programming Language

The programming language is powerful, simple, easy to use and similar to Lua, and it is used for Robot motion control, IO communication, network communication, and so on.

-I/O system, including standard digital I/O and extensible fieldbus I/O modules

-TCP/IP and Modbus RTU Communication

-Conveyor tracking module

Enable the robot to pick up workpieces from a moving conveyor by using vision and sensor.

-Additional axis system module

Enable you to control third party drivers and motors via field bus, such as screw modules, linear motors, and so on.

1.2 System Overview

The teach pendant communicates with the robot controller, allowing you to control the entire work unit of the robot.

1.2.1 Controller

The teach pendant can be connected to the controller to control various types of SCARA robot.

Features of the controller

-Reliability and stability

-Extensible motion control system

The motion system can simultaneously control one robot and 2 additional axes

-Extensible I/O

The controller is equipped with an I/O module with 16 inputs and 16 outputs as standard, and the number of I/O can be extended via the field bus

-Modbus RTU Communication

1.2.2 Teach Pendant

You can program the TAICHI language in the teach pendant and run it in the controllers.

1.3 Teach Pendant hardware specification

The hardware specifications, protection grade and size of the teach pendant are as follows:

Screen Size	7 inches
Resolution	1024*600
Maximum Size	550mm*210mm*50mm
Weight	0.6kg (cable weight not included)
Protection Level	IP54
Working Temperature	0~55℃
Humidity	Less than 90%
Environment	- Away from flammable or corrosive solvents and gases - Keep away from dust, lampblack, salt, metallic powder and gaseous pollutants

1.4 Version Match

Different versions of the controller and the teach pendant cannot all match. The specific matching method is as follows:

Controller	Teach Pendant	Robot Body
RC40-AAX	Not Support	All SCARA Robot
RC40-DAX	LHTP-002	All SCARA Robot
RC40A-DAX	LHTP-003	All SCARA Robot
RC40-FAX	LHTP-002	All SCARA Robot
RC60-DAX	LHTP-002	All 6-Axis Robot

2. Safety Matters

This chapter describes the safety requirements that the teach pendant and controller must follow when operating the robot. Robot and controller shall be installed by qualified professionals in accordance with regulations. Before using the robot control system, please read and comply with this chapter.

2.1 Safety Protection

In order to ensure safe operation, please use the safety protection system correctly.

The EMERGENCY connector on the controller has a safety protection input circuit connected to the controller's drive system. In order to protect the operator near the robot, please be sure to connect the emergency stop button before the controller is power-on and ensure that it works properly.

Turn Off the Safety Protection:	The safety protection input is turned on (turn off the normally closed emergency stop button), and the robot can operate normally at maximum power.
Turn On the Safety Protection:	The safety protection input is disconnected (press the normally closed emergency stop button), the robot stops immediately through dynamic braking, and the motor powers off and cannot continue to run until the safety protection device is turned off and the operation and teaching can be continued after being recovered from the alarm state.

-In the operating state of the robot, in case of abnormal movement or sudden entry into the work area, please press the emergency stop button immediately. The robot will stop the movement at the shortest distance.

-Do not use the emergency stop button when the robot is in normal condition. When the emergency stop button is used during the high-speed operation, the movement track of the robot is different from that of the normal operation, and the robot may collide with the machine or have a large mechanical impact, which not only causes the unsafety of the peripheral equipment, but also shortens the service life of the key parts such as the reducer and the electromagnetic brake due to the impact.

-When the robot is in normal operation, do not stop the robot by directly stopping the power supply of the controller, otherwise it may cause damage to the mechanical parts.

2.2 Operation Mode

Operation mode is the control mode of the robot controller, so you cannot use more than one operation mode at the same time.

The controller has four operation modes: teach mode, network start-up mode, IO start-up mode, ModBus start-up mode.

-Teach mode allows you to manually control the slow motion of the Robot with the safety protection turned off.

-Remote IO control mode and ModBus control mode allow you to run programs in the robot controller with the safety protection turned off.

2.3 Installation, Use and Test of the robot System

Installation

When installing robots and robot controllers, please follow the installation requirements and specifications of the *Controller（RC60-DAX）Instruction Manual*.

Items to be checked before power supply

-The mounting screws of the base for robot and the screws of the end load for robot shall be properly installed and tightened.

-Electrical connections shall be correct and the supply conditions shall be within the specified range (including voltage and frequency).

-Compressed air source (if applied) shall be connected correctly.

-The safety protection system is normally connected and all personnel remove from the range of motion of the robot.

-Installation environmental conditions are in accordance with the conditions specified in the manual for robot and controller.

Function test after power supply

-Power on the controller when pressing the emergency stop button, connect the controller by using teach pendant, confirm the emergency stop alarm, turn off the emergency stop switch and clear errors.

-Functions such as start/stop, select operation mode, etc. shall work correctly.

-The teach mode operates normally.

-The robot operates normally at rated load and maximum speed.

2.4 Robot Operating Precautions

General Precautions

-Before operation, the operator must be familiar with the position of the emergency stop switch.

-When entering the operating range of the robot, please make sure to turn off the power supply.

-After an emergency occurs, do not restore the emergency shutdown circuit until it is determined that safe operating conditions have been met.

-The teach pendant cannot be plugged in or unplugged when the controller is powered on, which may cause equipment damage.

Automatic Operation

Programs in the controller can only be run automatically when the following requirements are met:

-The emergency stop button is installed correctly and can work normally, and the operator can operate the emergency stop button at any time.

-There are no personnel staying in the working area of robot and no redundant objects present.

-If there is a possibility of collision in the working area of the robot, the safety area shall be set correctly.

-If someone is in the motion range of the robot, do not allow the entire robot system to operate under external control.

-Do not run the robot program at excessive speed when the program is not sure to run safely and correctly.

Teach Mode

When the robot is operated in teach mode, please abide by the following guidelines:

-Operators must be trained in the safety of robot and be familiar with the teaching operation of robot.

-Eliminate all controller errors and faults before teaching.

-Operators shall visually check for potential hazards within the range of motion of the robot.

2.5 Troubleshooting

In case of malfunction of the robot controller, troubleshooting shall be conducted outside the motion range of the robot. If troubleshooting must be conducted within the motion range of the robot, please strictly observe the following provisions:

-The operator responsible for troubleshooting shall be qualified for this job only after receiving relevant safety training.

-Establish work safety procedures to minimize the risk to operators within the range of motion of the robot.

-If possible, turn off the power supply to the controller of robot.

-If the controller cannot be powered off, ensure that the safety protection system is turned on and functioning properly, and ensure that the robot controller does not respond to any remote control signals.

3. Teach Pendant

This chapter introduces the name and function of each part, control mode and power up switch of the teach pendant.

3.1 Component Name and Function

The physical model of the teach pendant is shown in the following figure:
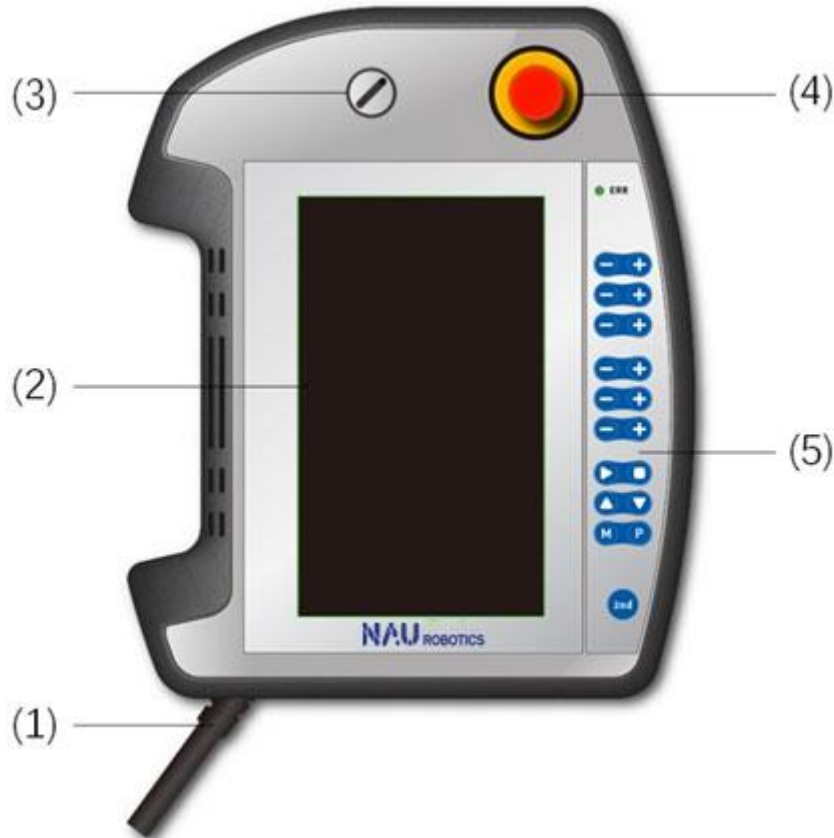
The components and functions of the teach pendant are described as follows:

（1） Connecting Cable

The connecting cable is used to connect the teach pendant and the controller, and the end of the cable is equipped with connector.

（2） Touch Screen

Touch screen includes display of all kinds of information, setup parameters, program editing and other functions.

（3） Mode Changeover Switch

The mode changeover switch is used to switch between the teach mode and the auto mode, and the key can be pulled out to fix the mode.

After switching to Auto mode, the program can be started only after turning on the "safety confirmation signal".

Connect the 35/37 pin of the controller IO interface to a normally open button as the "safety confirmation signal". When the controller is started and in the Auto mode,

ensure the safe operation of the robot and all personnel are out of the robot 's motion range, press down and hold the "safety confirmation signal" then start the robot program, release the button after the program is start running.

（4） Emergency Stop Switch

When press this switch, both the robot and the electrical side enter an emergency stop state, and then this will immediately stop the program operation, cut off the power supply of the Robot motor and stop the robot operation. In case of canceling the emergency stop state, turn the emergency stop switch clockwise first and then remove the emergency stop state in the controller by using the teach pendant.

（5） Control Panel

The control panel contains function buttons such as Teaching, Start, Stop, Speed Setup, Power Up and Clear Error.

1） Teach Button

When in teach mode and the motor is enabled, the robot can be moved by pressing each teach button.

When the step distance belongs to "short distance", "medium distance" or "long distance", click the teach button once, the robot moves one step distance, and then keep pressing the teach button, the robot will move to another step distance continually. When "Continuous" is selected, press the Teach Button and the robot will continue to move.

In joint mode, each teach button controls the movement of J1~J6 from top to bottom, while in world mode, it moves in the direction of X, Y, Z, U, V and W orderly. When switching to additional axis mode ,the first two button while be R and S.
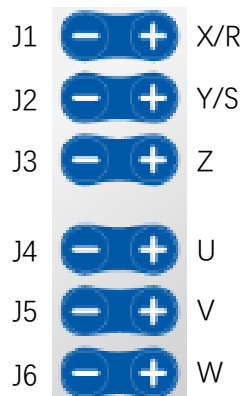
2） Program Run Button

Icon:

Automatically run programs in the controller.

After the program start running, the robot will execute from the current position to the target point by the first motion instruction. Since the starting position is not fixed, it may lead to unpredictable trajectory or collision. Therefore, it is necessary to determine the current starting position at the beginning of the program, and return to the safe

point according to different starting positions, to ensure the return to the predictable starting position before starting the normal working procedure.

3）Stop Button

Icon:

Stop the robot 's program run

4）Speed Button

Icon:

Set the speed ratio of the robot during teaching and automatic operation within the range of 1% ~ 100%, and then increase or decrease it by 5% per click.

After adjusting the running speed of the manipulator, if the end effector suction or clamping force is insufficient, it may appear that the manipulator running speed is too high and cause the workpiece to drop. So please note that after adjusting the speed, can only start the program running when all personnel are evacuated to a safe place or behind the safety partition, ready to stop the robot program through the emergency stop button at any time.

when execute the point in low speed to simulate the movement, make sure all personnel are not in the robot working range.

avoid to use points that close to the soft limit of each axis. otherwise, error might be occurred when the program running speed or acceleration are added.

5）Power UP Button

Icon:

Control all axis motors to power up and down in auto mode

6）Clear Errors Button

Icon:

Clear the error condition of controller

7）Additional Axis Teach Mode

Icon:

Switch to additional axis teach mode

When switching to the additional axis teach mode, the upper right corner of the main interface while be displayer "2nd", pressing the X/Y button while move the R/S axis.

3.2 Control Mode

There are two control states after the teach pendant is connected: auto mode and teach mode.

Auto Mode   Before running the program automatically, make sure that the teach pendant is in auto mode (whether the

	control mode is network start, IO start, or Modbus start).
Teach Mode	The teach motion robot can be manually moved or executed to the target point only in the teach mode.

Before switching to the teach mode, it is necessary to ensure that the point file "points.pt", tool coordinate system file "Tools.cr", and user coordinate file "Users.cr" in the project are same as those in the controller, otherwise, it will report the error that "files of upper and lower computers fail to match".

Switch the teach mode and auto mode by using the mode switch on the teach pendant.

After turning the switch key to "Teach", the robot can enter Teach Mode. When the running program is switched to teach mode, the program will stop running immediately.

3.3 Power On Switch

In teach mode, the power-on switch must be pressed to enable each axis motor of the robot before the teach motion or the execution of the points.

The power on switch is divided into three positions, including not pressed, intermediate position, and fully pressed:

-Only when the power on switch is in the intermediate position will the robot axis motors be enabled;

-When switched from the intermediate position to not pressed or fully pressed, the motor is switched to the out of enabling state;

-In auto mode, the power on switch does not control the enable state of motor;

-Switch to auto mode when enabled and remain enabled by releasing the power on switch;

4. Installation and Connection

This chapter mainly introduces the basic operation of the teach pendant, including Installation and Connection.

4.1 Installation

Teach pendant is used to communicate with the robot controller. You need to install the controller and robot correctly before you can use the teach pendant to develop robot programs and the control robot operation.

Installation Considerations

-Be sure to properly connect the cable between the controller and the teach pendant. Do not make the cable bear unnecessary tension. (In addition, do not put heavy objects on the cable, and bend or pull the cable forcibly.) Failure to do so may result in cable damage, disconnection, and/or poor connections, and may result in abnormal function of system.

-Ensure that pin bending is avoided when plugging into the connector. Failure to do so may result in malfunction or abnormal function of system.

Installation of Controller

The controller has been installed and tested in the factory, and the user only needs to install and connect the robot and the controller correctly according to the Operation and *Controller Manual.*

4.2 Connection to the Controller

1.After ensuring the correct connection between the teach pendant and the controller, start the controller and wait for the teach pendant to enter the main control interface;
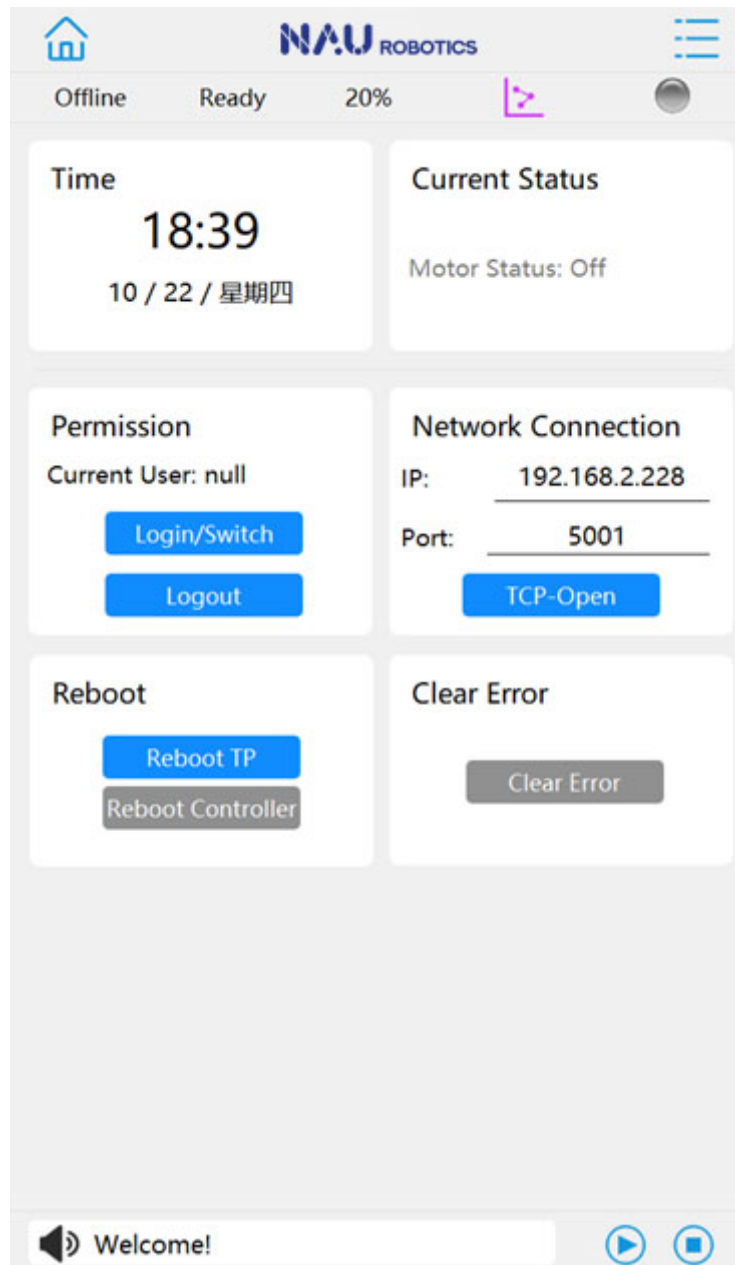
2.Click the input box of [Network Connection] and enter the IP address of the controller. The factory default value is "192.168.2.228", and then click [TCP-Open] to connect the controller;

3.When the connection is successful, the [Current Status] on the status bar switches from Not Connected to the model of the Connected Robot, such as "TM3-R400".

    4.After connecting the controller successfully, you can start to control the robot operation, teaching and so on.

4.3 Users Login

    1. The teaching device is in the state of no user when it is turned on. Please log in to your own account with corresponding authority and click to log in when doing any operation.
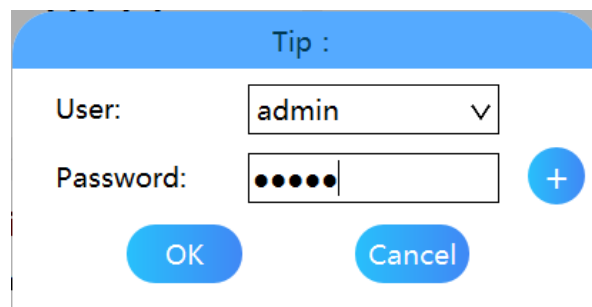
Permission

Current User: null

Login/Switch

Logout

    2. Select user name, enter password "admin", and click OK to log in.

Tip :

User: admin

Password: ●●●●●

OK   Cancel

5. Operation Interface

This chapter mainly introduces the operation interface and interactive function of the teach pendant.

5.1 Main Control Interface

Once the teach pendant is started, enter the main control interface as shown in the figure, and it includes the following functions:

-Status Bar

-Message Bar

-Menu

-Main Page
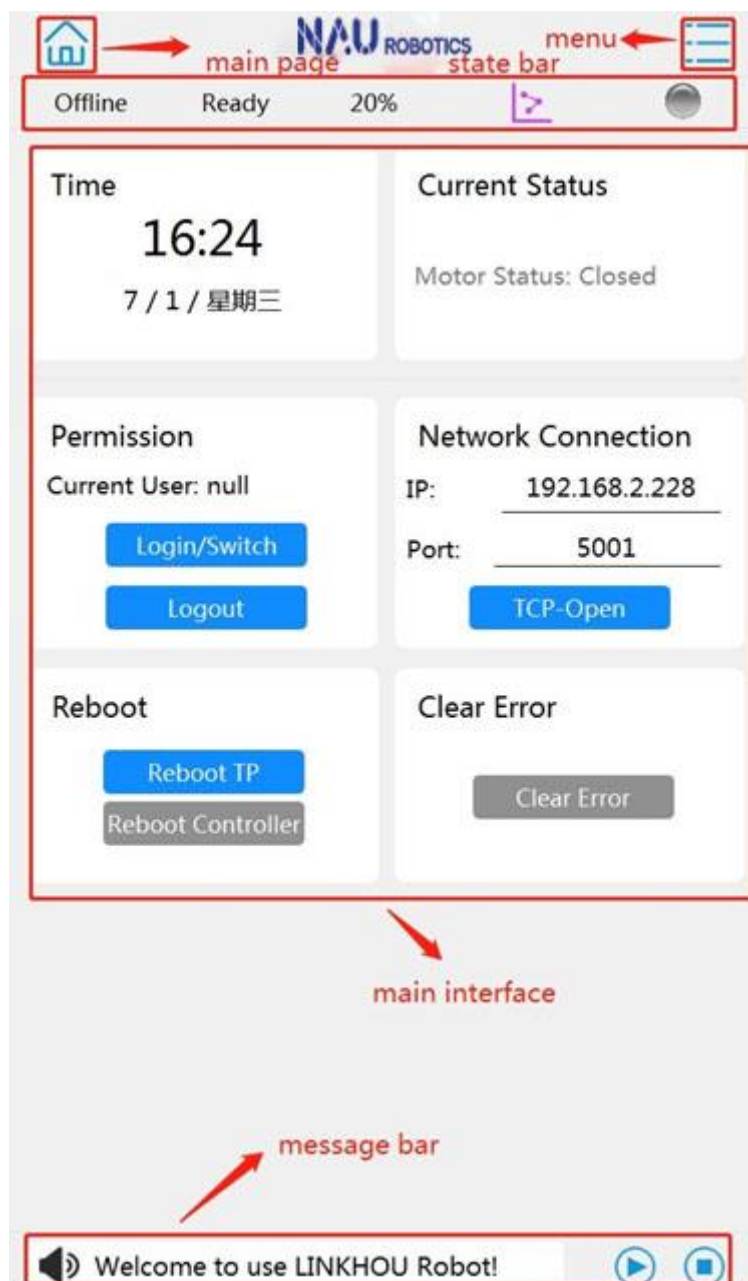
5.1.1 Status Bar

The status bar at the top of the main interface is used to display the current connection status, controller status, speed setting, teach mode, and servo status:

TM3-R400	Ready	30%		
(1)	(2)	(3)	(4)	(5)
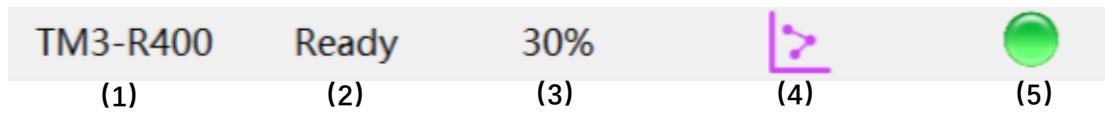
(1) Current Connection Status

The current connection status displays the connection status of the controller and the teach pendant.

Offline	No connected to the controller
Connecting ...	Attempt to connect with robot, but the connection was not successful
Robot Model	The model of the robot set by the current connected controller

(2) Operating Status

Displays the current operating status of the controller, including:

Teach	Currently in teach mode
Ready	Currently in auto mode and the program is not operating
Running	Currently in operation state, no pause and no alarm
Pause	Currently paused
Error	Currently in alert status

(3) Speed Setting

The speed setting is used to set the speed of the robot during teaching and automatic operation, and the range of speed setting is 1% ~ 100%. Per click of "-" and "+" will reduce or increase the speed by 5%. The speed also can be set by clicking the percentage of speed.
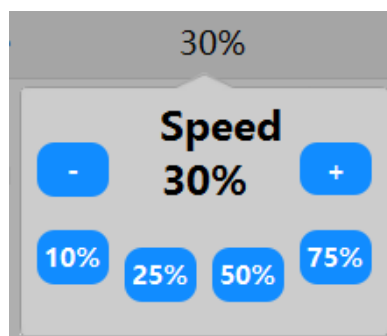
(4) Teach Mode

The teach mode is used to select method of the teach motion of robot, and the specific function is introduced in 5.6.1.
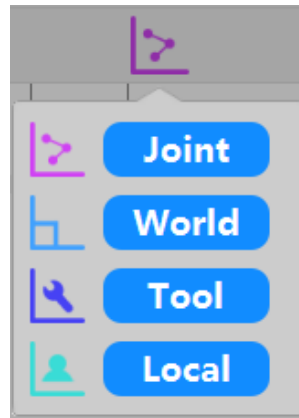
（5） System State

Current system state of the controller, offline (the teach pendant is offline), online (no alarm, display motor state), alarm (controller error, display red alarm)

🔘 The teach pendant is offline

🟡 The motor is not enabled

🟢 The motor is enabled

🚨 The controller is in an alarm state

5.1.2 Information Bar/Start /Stop

The information bar located at the bottom of the main interface is used to display operation records, prompts, syntax errors, and other information during program run.

The Start/ Stop Button, located on the right side of the bottom of the main interface, controls the start and stop of the program.
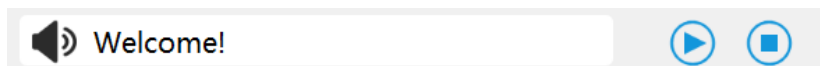
Click 🔊 view more information as shown in the following figure

The system alarm represents the algorithm alarm and interpreter alarm of the control system, etc. Such alarm does not include joint number.

When the driver alarms, the alarm joint number will be displayed at the same time. As shown in the figure above, the J3 joint drive will be alarmed at the occurrence of "Position following error out of range", and "Axis 3" will be displayed in the alarm information to indicate the joint number.

If the record information in the information bar is too much to consult, click clean to clear the history record.

5.1.3 Menu

Click the Menu Button in the upper right corner of the main interface to open the sub-menu as shown in the following figure. The sub-menu includes five function modules: Setting, Variable, Status, Program and Operation.
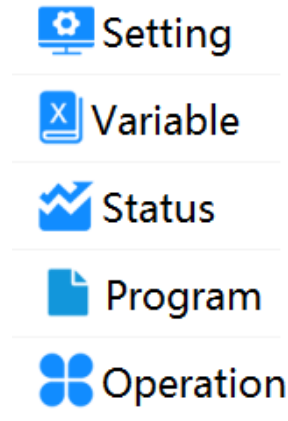
5.2 Setting

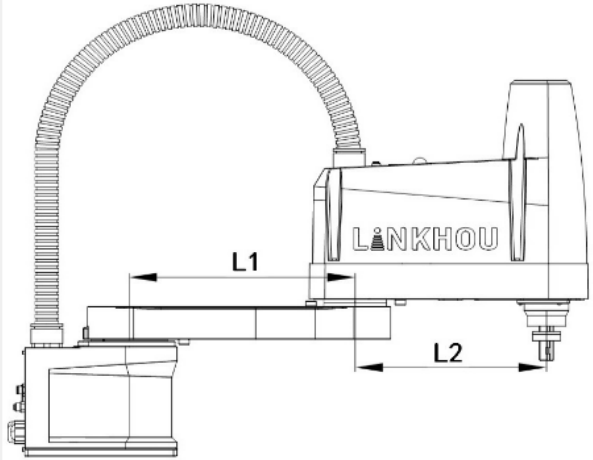The settings function module includes robot setting, motion range setting, I/O setting, system setting and additional axis setting.
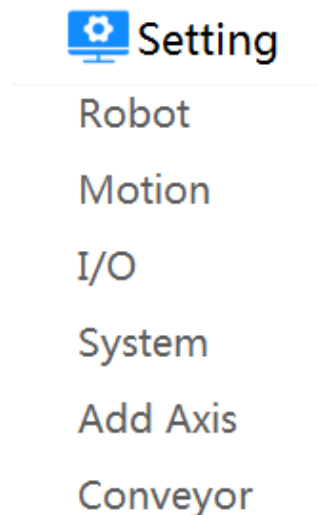
Click [Modify] in Settings. After modifying the parameters, click [Save] to save the modification. And then click [Reboot Controller] in the Settings - System Control - Other Settings. After rebooting the controller, the modified setup parameters will take effect.

5.2.1 Robot Settings

Click on the Menu-Settings-Robot Settings to set the structural parameters, origin setting and range of motion.

Structure	Zero	Motion Range	Drive

DH Parameter		Encoder Resolution	
L1	225	J1	131072
L2	175	J2	131072
L3	0	J3	131072
D1	0	J4	131072
D2	0	J5	131072
D3	0	J6	131072

According to different types of products, structural parameters, coupling ratio parameters and so on have been set and calibrated before the robot leaves the factory. Please do not modify it by yourself, otherwise it may cause equipment damage or risk. Only the origin setting you may use is introduced here.

Origin setting is used to re-calibrate the origin position of each joint of the robot. When the origin is lost due to the low voltage of the battery of the motor encoder, the origin setting function can be used to re-calibrate the origin. The calibration procedures are as follows:

1) According to the corresponding Maintenance Manual of Main Part for different types of Robots, each joint of the robot is moved to the origin calibration position, and the calibration key is inserted;

2) Click Menu-Settings-Robot Settings, open [Origin], and click [Modify];

3) Check the joints to be calibrated, click [Get Current Encoder], click [Save] after refreshing each encoder value, and click [Reboot Controller] in the Setting - System- Other, and then the new origin value will take effect after completion of rebooting the controller.

Please don't modify the encoder accuracy, otherwise it will cause the equipment damage or lead to the risk.

For SCARA robot, please don't calibrate the origin of J3 or J4 axis separately, which will lead to wrong calibration result.

5.2.2 SCARA Calibration

Click menu-Setting - Robot - Origin - Calibration, and the calibration process will enter. The selection of joints is not effective at present. Please follow the prompts to operate in turn:

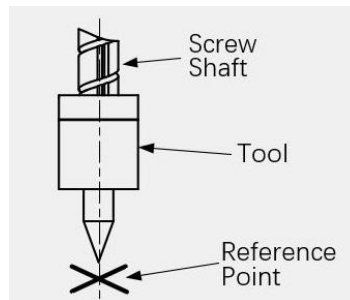1) Teach the robot until the end of the fixture is close to the rough reference point;
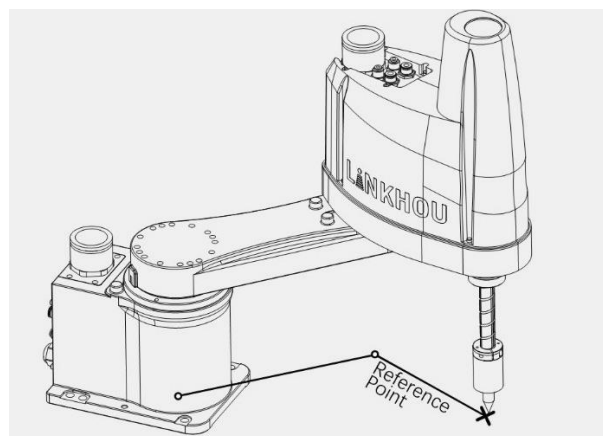
2) Select the reference point and the corresponding tool, user coordinate system, and click [Execute MOVJ], after the movement is done, click [Next].
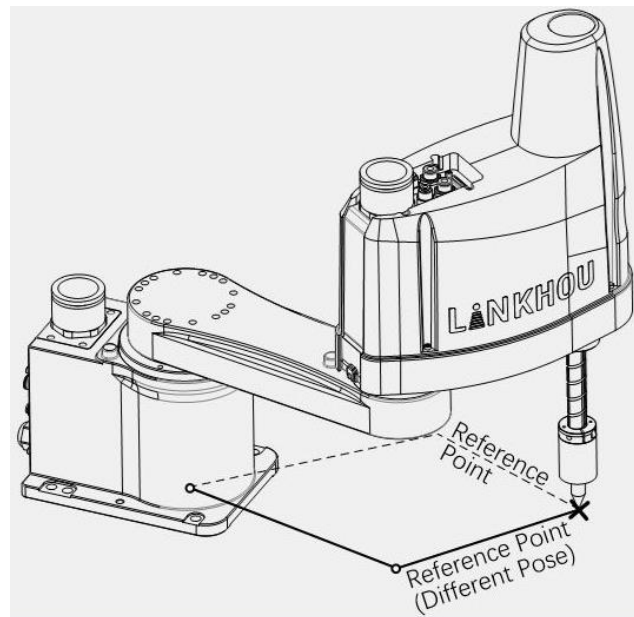

3) Precisely adjust the robot to reach the reference point.

4) Fill in the z-axis offset and z-axis limit parameters, and click "Execute JUMP" to make the robot switch the hand at the same position to improve the accuracy.

5) Precisely adjust the robot to the de Precisely adjust the robot to the desired reference point position. Click "Finish" to complete the origin calibration.

5.2.3 Origin Calibration

Before the robot leaves the factory, the DH calibration, origin position multi-turn clearing and precision calibration will be carried out, and the reference point for origin calibration will be added. The point name is "Reference", which can be used to adjust the origin after the loss of the origin caused by the low battery voltage of the encoder, without affecting the precision of the robot.

1) After the origin is lost, drag or teach the robot to the calibration position, that is, the mechanical reference position of each joint. For the calibration position of different robot bodies, please refer to the relevant mechanical manuals;

2) Accurately adjust the position of each joint and insert calibration keys into the keyways of each joint;

3) Replace the encoder battery of the alarm joint;

4) Enter the [Origin] - [Setting] interface, click "clear battery fault" to clear the encoder battery error "0xFF2A" and the encoder multi-turn value;

5) Enter the interface of [Origin] - [Setting], calibrate the origin of the alarming joint, tick the joint to be calibrated, click [Get encoder value], [Save] then reboot the controller manually, and then the controller will restart to complete the preliminary calibration.

6) After the controller is restarted, enter [Operation] - [Teach] and execute to "Reference" point. Be careful not to use any tool or user coordinate system during execution.

7) After reaching the Reference point, enter [Setting] - [Origin] - [Calibration], check the joint to be calibrated, click [Get Encoder Value],   and click [calculate], and the deviation value will be obtained by comparing the Reference point before the origin loss with the current pulse position;

	Structure	Origin	Motion Range	Drive
	Setting	Calibration	SCARA Calibration	

Robot origin calibration

	Reference pos	Current pos	Deviation
☑ J1	65535	43718	-21817
☑ J2	65535	81898	16363
☐ J3	65535	0	0
☐ J4	65535	0	0
☐ J5	65535	0	0
☐ J6	65535	0	0

[Get Encoder Value] [calculate]

[Apply]

8) After the deviation value is obtained, click [Save] to automatically add the deviation value to the current actual origin value, that is, to achieve the origin calibration, and the controller will take effect after the restart;

9) If the calculated pulse difference is too large, that is, the error value between the origin set in Step 1 and the actual origin value is too large, it shall be calibrated again;

J1 difference is bigger than limit permitted! X

10) After the controller is restarted, move the robot to the origin calibration joint position, table mounting SCARA is [-90,0,0,0] joint position, other types of robot are all joints are 0 position;

11) Observe whether the calibration reference of each joint is aligned accurately, such as the keyway between J1 and J2 joints of SCARA robot. If the calibration mechanical reference of each joint is aligned accurately, the calibration is successful;

5.2.4 Motion Parameter Settings

Click Menu-Settings-Motion Parameter Setting to modify joint speed, Cartesian speed and kinetic parameters;

[Joint] interface is used to change the Joint Speed Limit.

Stop and pause deceleration time is used to set the deceleration time of stop or pause in the movement of robot. The factory default setting is 200ms. If the deceleration time of stop is too large under heavy load, the deceleration time of stop can be ap appropriately increased.

Dynamic parameters are used to adjust the velocity planning in real time according to the mass and limiting coefficient.

After the dynamics is enabled, fill the current load at the end of the robot in the [Mass], and write the acceleration limit coefficient in the [Acc Lim]. It is recommended to set the initial value as 1.

When the robot start running program, it will predict torque based on the load, speed, acceleration, and other parameters, If the ratio of the predicted torque to the torque limit of the robot is greater than the acceleration limit coefficient, the motion acceleration will be limited in velocity planning.

$$\frac{Predicte\ Torque}{Torque\ Limit} > Acc\ Lim$$

The limit coefficient of acceleration ranges from 1 to 1.3. Please fill in the [Mass] according to the actual load.

The parameters such as Inertia X/Y/Z and torque limit are reserved parameters. They are temporarily unavailable. Please do not fill in values other than 0.

The dynamic function is currently only available for TM3-R400 robot, other models of robot are temporarily unavailable.

5.2.5 Body Box Setting

The Body Box function is used to prevent the robot body from entering the forbidden area. Currently, only the SCARA robot is supported.
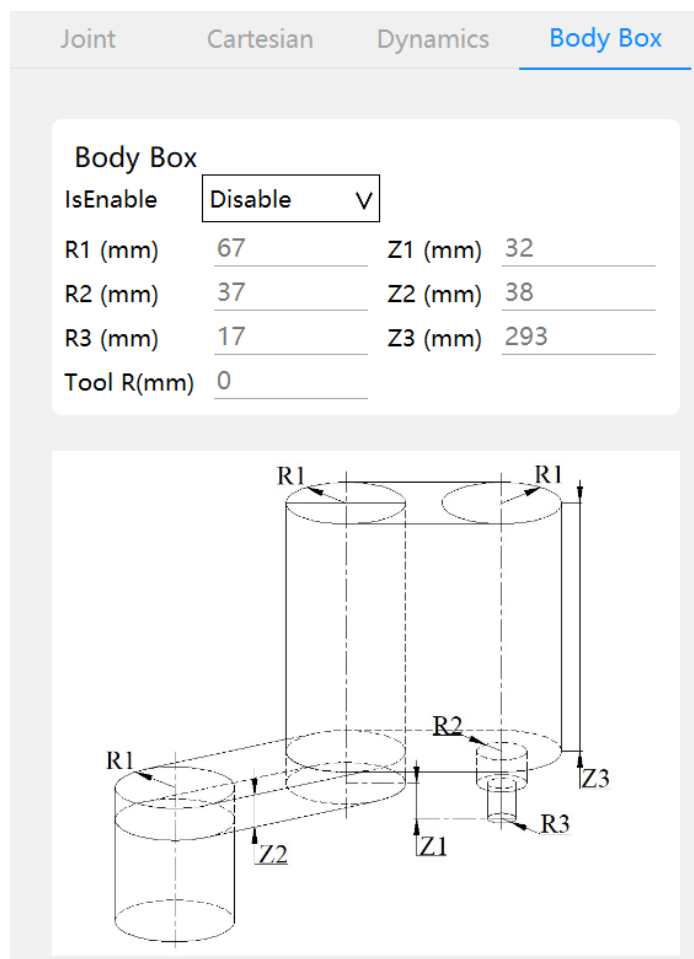
Set the Body Box parameters according to the robot dimension parameter given in the *User Manual Mechanical*. The meanings of these parameters are as follows:

Parameter	Description
R1	The cylinder radius that be able to completely encloses the first arm and second arm;
R2	The maximum radius of the screw protection;
R3	The maximum radius of the screw, recommended to be set as the maximum radius of the screw limit ring;
Z1	After move to home point, the height difference between the bottom surface of the screw rod and the bottom surface of the first arm;
Z2	Maximum height of the first arm;
Z3	Maximum height of the second arm;

In the parameter setting of body Box, if there is any problem, please contact the robot manufacturer. Incorrect setting may cause serious safety problems such as collision. Therefore, it is recommended to enter the forbidden area by teaching the robot body at low speed after setting to check whether the box is set correctly.

After the Body Box parameters are correctly set and the forbidden area is enabled, when the judgment area of the robot body Box coincides with the forbidden area, the alarm "The robot enters the forbidden area" will be triggered.
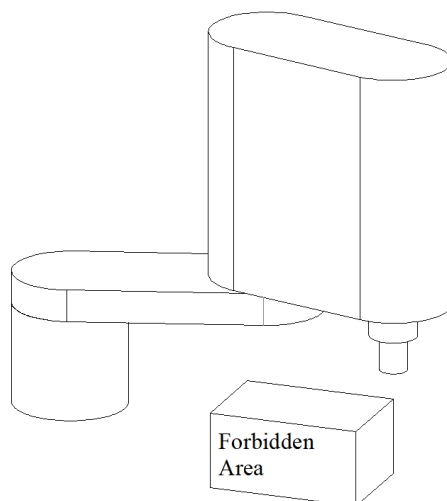
Note: When using the Body Box function, the forbidden area can only be set as inside, not outside.

Tool Radius Judgement

After filling in [Tool R], the center point of the tool currently selected will be taken as the center of the sphere, and the filling parameter is the radius to form a spherical judgment space. When the judgment space coincides with the working area or forbidden area, it will be judged that the robot has entered the working area or forbidden area, and the output port of the working area will be opened or the alarm will be triggered.

The tool radius function has nothing to do with whether the Body Box function is enabled or not, will take effect after filling the parameter.

5.2.6 I/O Settings

Click Menu-Settings-I/O Settings to change extended IO module number and assign system functions to each I/O port.

Extended IO Modules

Beside the standard IO modules in the controller, you can also add few additional IO modules.

Change the number of extended IO module in the [Additional IO], which will take effect after rebooting the controller. After rebooting the controller, the status of the additional IO modules can be displayed and controlled in the [IO Status] interface.

System IO configuration
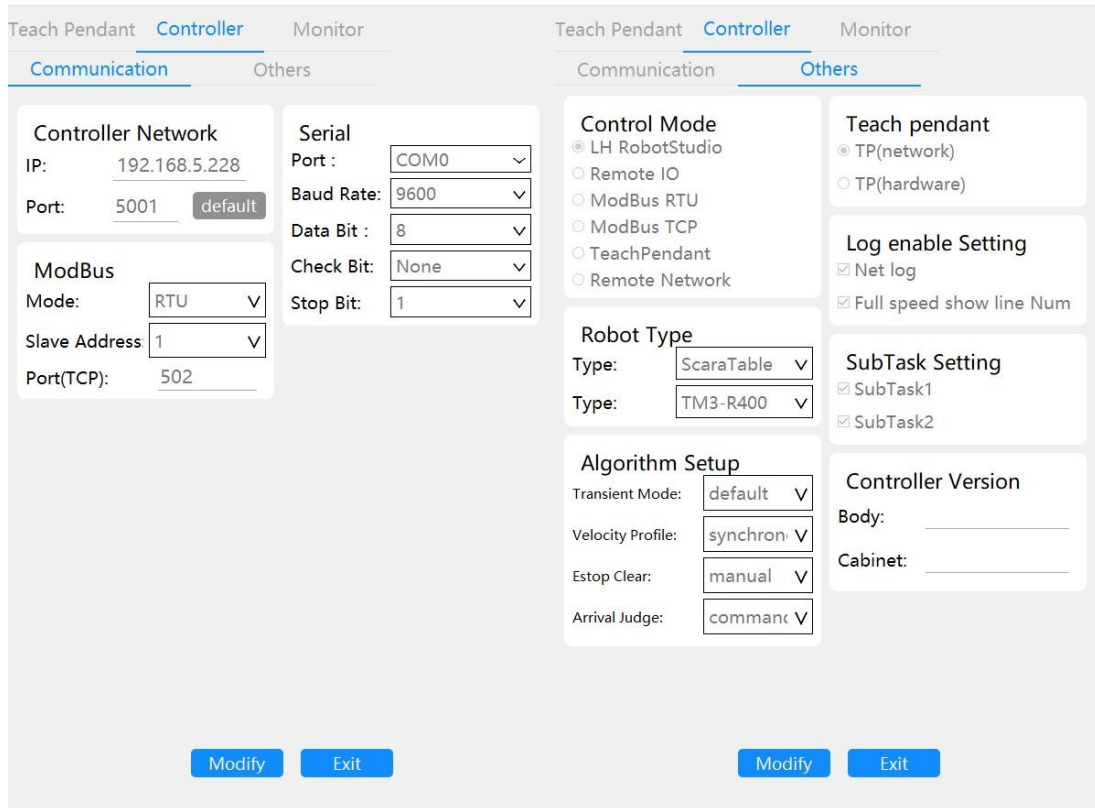
Select the index drop-down list corresponding to the IO function, and select the IO port number to be configured, and then the function of this port is modified. For the function that needs not to be used, select the "None" in the index of the function.

5.2.7 System Settings

Click Menu-Settings-System Settings to set functions for permission settings, controller settings, instructor settings, and other settings.

Controller Settings

Used to set controller IP port, control mode, algorithm, Modbus setting and serial port Settings.

1) Controller Network

Used to modify the IP address and port for the Robot Studio connection, the changes will take effect after restart the controller.

The IP address and port used to connect the teach pendant cannot be changed, therefor, you can use this function to restore the IP and port for the Robot Studio connection when it's been forgotten.

2) Control Mode

It is used to set the startup mode of the program in the controller, which means that it can be used to control the start-stop of robot program through external equipment by using communication modes such as external IO and Modbus.

Control Mode	Description
LH RobotStudio	The automatic running or debugging running of the program is carried out under the auto-run mode through LH Robot Studio or in communication with the controller.
Remote IO	The devices such as PLC and input buttons are used to control the start and stop of the robot program, control the power up and power down of the robot and clear the alarm through the input signal of the robot, and the states such as

	current operation, power up and power down and alarm of the robot can be obtained through the output signal of the controller.
Modbus RTU/TCP	On the external devices such as PLC and upper computer, the data is written to the specified holding register in the slave station of robot controller through the Modbus RTU communication or Modbus TCP communication, so as to control the robot program to start and stop, power up and power down, clear alarm, and read the current operation state, IP address and output state of the robot controller from the input register of the controller.
Teach Pendant	If you need to use the Teach Pendant to control the Robot, you need to choose [Teach Pendant] in the Control mode setting, after reboot the controller, then you can control the robot or run the program with the Teach Pendant
Remote Net Control	Through the network communication control the robot program operation, teaching, motor On/Off, clear error and execution of movement instructions and other operations, Read the API Programming Manual for more details.

3) Serial Port and ModBus

The serial port and Modbus setting interface are used to set the parameters related to Modbus TCP/RTU communication. In Modbus RTU communication, the serial number shall be 0 and the address of slave station shall not be set to 0. In Modbus TCP communication, the IP shall be the same as the controller IP and the port number shall be fixed at 502.

4) Robot Type

The controller supports a variety of robot types, factory Settings have default, do not need to change.

5) Algorithm setting.

The algorithm can set the transition mode, planning type and emergency stop mode of the robot.

6) Log Enable Setting

After the [Net log] is checked, and the NetSetting function is written in the program, the network communication data will be written in the log file.

[Display line number while running at full speed] option is not in effect, please do not operate.

7) SubTask setting

The robot comes with two sub tasks, which can be enabled or not enabled.

When enabled, sub tasks run with the main task runtime.

8) Algorithm Setup

[Algorithm Setup] is used to set the mode of velocity profile, Emergency Stop error cleaning and motion command arrival judge, the transient mode is not available now.

Velocity Profile

There are two strategies for velocity planning：

synchronous: All the axes accelerate and decelerate synchronously. One integral motion contains three motion periods generally (acceleration, constant-speed, deacceleration). During synchronous motion, all the axes stay in the same motion period at the same time.

Nonsynchronous: All the axes interpolate independently based on the same motion time.
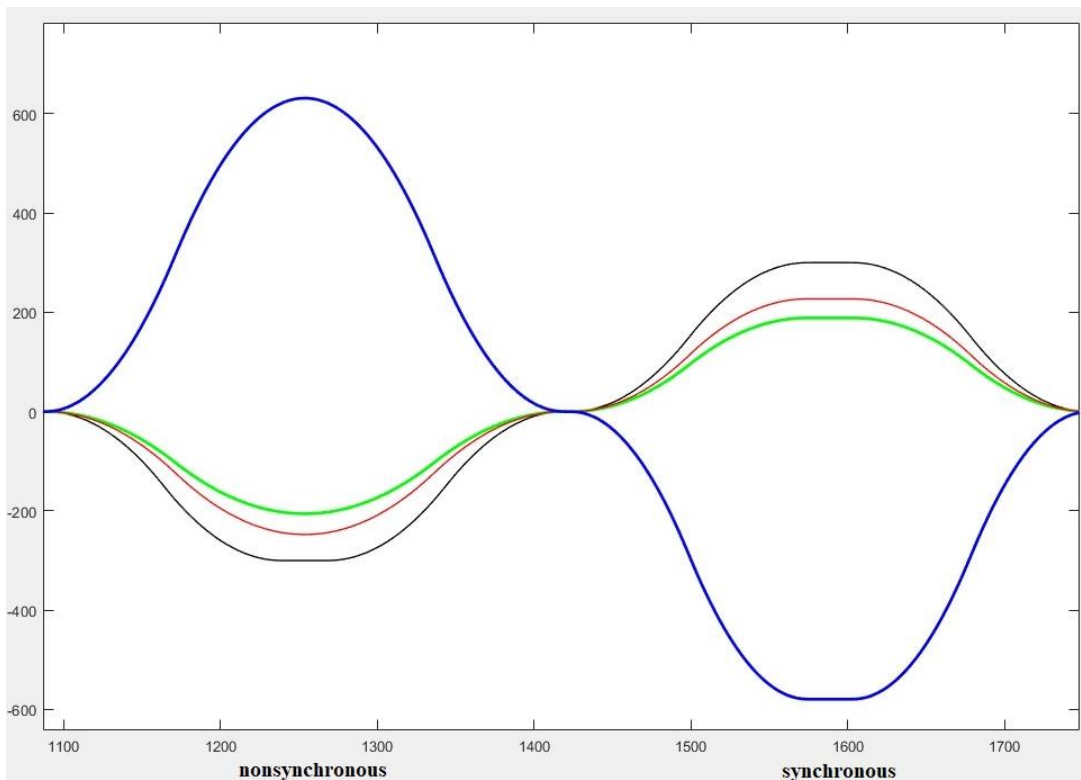
Estop Clear

When the [Estop Clear] is set to [Manual], the error clearing command takes effect in a non-blocking mode, that is, if the error clearing command is sent when the emergency stop button is pressed (click error clearing through Robot Studio or remote control), and then spin out the emergency stop button, the error will not be cleared at this time, you need to click the [clear error] or send clear error command again.
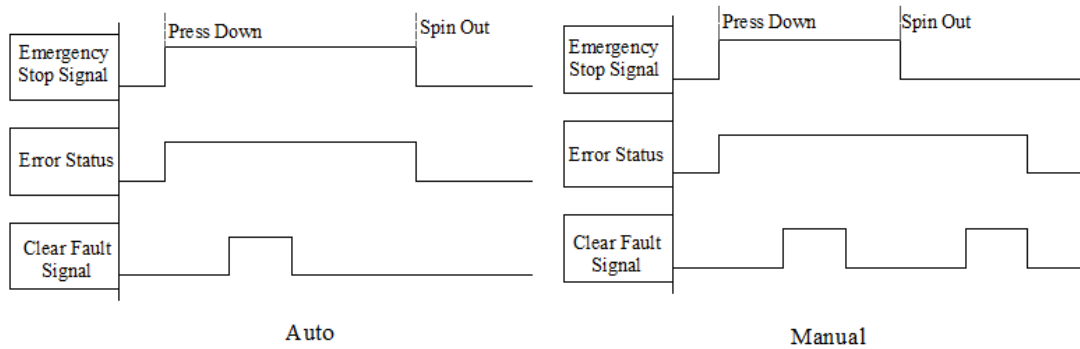
Figure 8. 1 Emergency Stop Clear

When set to [Auto], the error clearing command takes effect in the blocking mode. When the emergency stop button is pressed, the error clearing command is sent. After the emergency stop button is spin out, the emergency stop alarm will be automatically cleared, and there is no need to clear again.

Arrival Judge

The arrival judge method is used to set the arrival judge condition of motion instruction, include command and pulse.

when the [arrival judge] is set to [command], the motion command complete when the command is completely dispatched.

when set to [Pulse], means that when the joint pulse of the robot and the actual pulse of the target position is consistent, the motion target is arrived. Using pulse arrival judge method will affect the cycle time of the robot, please use it carefully.

9) Teach Pendant Setting

Set the current hardware version of the teach pendant. The network control version is to control the switching signal of the teach pendant mode and the power on switch signal through network data, and the hardware control version is to set the signal through hardware. This parameter will be set correctly before leaving the factory, please do not modify it at will. Meanwhile, different versions of teach pendant cannot be mixed.

The Controller version before V2.2.2 does not support the hardware controlled teach pendant.

Teach Pendant Setting

Modify the IP, switch of the teach pendant in Chinese or English, calibrate the screen and modify the system time.
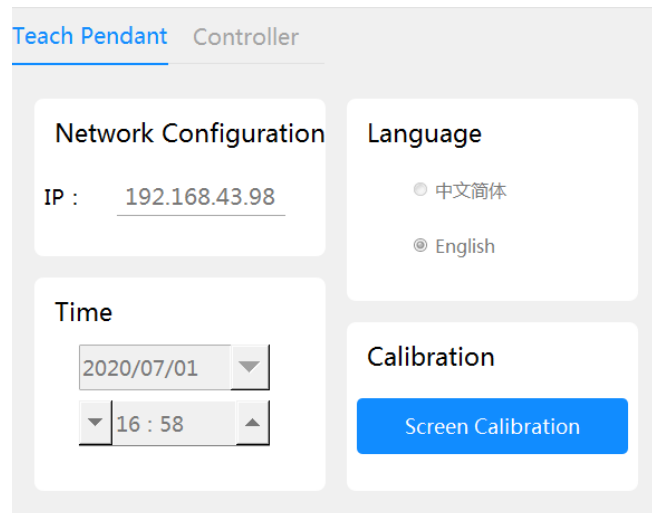
1) Modify IP

Set the IP address of the teach pendant in the dialog box. The factory default IP address of the teach pendant is 192.168. 2.113, and it shall be in the same network segment as the interface of teach pendant of the controller.

2) Modify Time

The time and date can be modified by clicking the date selection menu and the plus or minus button. It is suggested to unify the time of the Teach Pendant and same as the controller.

3) Change Language

Support Chinese and English bilingual switch.

4) Screen Calibration

The calibration screen function is used to correct the screen when the teacher cannot accurately click the screen of the teacher.

Click [Screen Calibration] to enter the screen calibration process, and accurately click the cross box in the upper right corner, lower right corner, lower left corner, upper left corner, and the center of the screen in turn. Click the indicator to restart automatically after completion, and the calibration result will take effect after restart.

Use this feature with caution. A wrong click can cause the screen to skew significantly or fail to recalibrate. When this serious problem occurs, press the shortcut key [2nd up down up down up up down down];

5.2.8 Data monitoring function

The data monitoring function is used to record the speed, position or current of the robot in real time and write it to the log file.
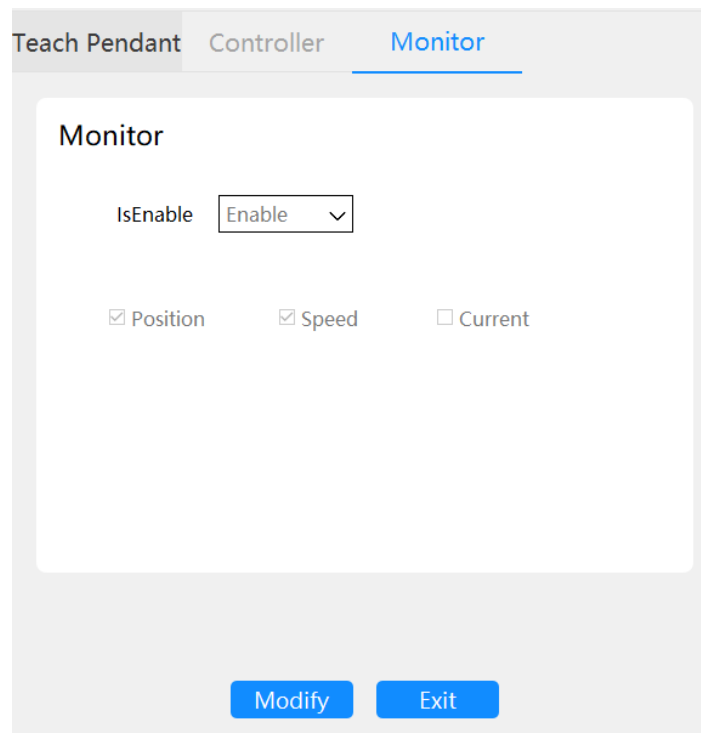
Data units are as follows:

Position   Joint position, each joint value of the robot;

Speed   Degree per second, the robot joint speed, not motor speed;

               For example: take the TM3-R400 robot as an example, the maximum speed of J1 joint is 600°/s, when the manipulator runs J1 joint at 10% speed, the recorded data is 60;

Current   Kilocalories of current actual current relative to motor maximum current;

After the robot enabled the data monitoring and starts the program running, a record file named "Motion_00.lhlog" ~ "motion_11.lhlog" will be written in the controller.

Each data is separated by Spaces, and at most, two types of data can be recorded simultaneously. The first four columns and the last four columns are two types of data respectively

```
1    -2825043.000000 -1207573.000000 -239703.000000 713757.000000 -60.000000 -60.000000 33.333333 133.333333
2    -2823948.000000 -1206486.000000 -239428.000000 713211.000000 -60.000000 -60.000000 33.333333 133.333333
3    -2822858.000000 -1205405.000000 -239154.000000 712668.000000 -60.000000 -60.000000 33.333333 133.333333
4    -2821771.000000 -1204321.000000 -238880.000000 712118.000000 -60.000000 -60.000000 33.333333 133.333333
5    -2820683.000000 -1203236.000000 -238608.000000 711567.000000 -60.000000 -60.000000 33.333333 133.333333
6    -2819596.000000 -1202151.000000 -238337.000000 711013.000000 -60.000000 -60.000000 33.333333 133.333333
7    -2818502.000000 -1201061.000000 -238067.000000 710459.000000 -60.000000 -60.000000 33.333333 133.333333
8    -2817409.000000 -1199970.000000 -237798.000000 709906.000000 -60.000000 -60.000000 33.333333 133.333333
9    -2816314.000000 -1198874.000000 -237532.000000 709357.000000 -60.000000 -60.000000 33.333333 133.333333
10   -2815215.000000 -1197776.000000 -237266.000000 708806.000000 -60.000000 -60.000000 33.333333 133.333333
11   -2814119.000000 -1196681.000000 -237000.000000 708253.000000 -60.000000 -60.000000 33.333333 133.333333
12   -2813020.000000 -1195593.000000 -236736.000000 707701.000000 -60.000000 -60.000000 33.333333 133.333333
13   -2811922.000000 -1194501.000000 -236471.000000 707153.000000 -60.000000 -60.000000 33.333333 133.333333
14   -2810824.000000 -1193404.000000 -236205.000000 706604.000000 -60.000000 -60.000000 33.333333 133.333333
15   -2809732.000000 -1192303.000000 -235937.000000 706056.000000 -60.000000 -60.000000 33.333333 133.333333
16   -2808640.000000 -1191204.000000 -235670.000000 705506.000000 -60.000000 -60.000000 33.333333 133.333333
17   -2807553.000000 -1190103.000000 -235401.000000 704955.000000 -60.000000 -60.000000 33.333333 133.333333
18   -2806463.000000 -1188999.000000 -235130.000000 704406.000000 -60.000000 -60.000000 33.333333 133.333333
19   -2805371.000000 -1187902.000000 -234856.000000 703855.000000 -60.000000 -60.000000 33.333333 133.333333
20   -2804280.000000 -1186799.000000 -234582.000000 703297.000000 -60.000000 -60.000000 33.333333 133.333333
21   -2803193.000000 -1185691.000000 -234307.000000 702744.000000 -60.000000 -60.000000 33.333333 133.333333
22   -2802097.000000 -1184582.000000 -234032.000000 702188.000000 -60.000000 -60.000000 33.333333 133.333333
23   -2801000.000000 -1183481.000000 -233757.000000 701641.000000 -60.000000 -60.000000 33.333333 133.333333
24   -2799905.000000 -1182377.000000 -233482.000000 701089.000000 -60.000000 -60.000000 33.333333 133.333333
25   -2798812.000000 -1181271.000000 -233206.000000 700540.000000 -60.000000 -60.000000 33.333333 133.333333
26   -2797719.000000 -1180175.000000 -232931.000000 699994.000000 -60.000000 -60.000000 33.333333 133.333333
27   -2796627.000000 -1179084.000000 -232658.000000 699449.000000 -60.000000 -60.000000 33.333333 133.333333
```

Figure 8. 2 Data Monitoring File

The sampling interval of data records is fixed at 1ms, the maximum data volume of each file is 5000 lines, the maximum number of files is 12, the record files are written in turn from 00 to 11.

5.2.9 Additional Axis Setting

Click the [Menu] – [Settings] – [Other Axis] Settings, you can set the additional axis homing setting and other parameters for functional Settings

Home Setting

According to the actual connection of additional axis, set the number of connected additional axis, and set the parameters of additional axes in priority according to the order of R axis and S axis.

According to the parameters of the additional axis, set the type of the additional axis, the type of the encoder and the accuracy of the encoder, set the parameters (speed, acceleration, deceleration) of the Homing action, and set the sensor input signal of the positive limit, origin, and negative limit of the additional axis.

To set the absolute origin of the absolute encoder, move the additional axis to the selected origin and click "get the encoder value" to write the current encoder coordinates of the additional shaft motor into the absolute origin setting.

Homing Action

When the encoder type is relative encoder, after the controller is rebooted, the operation [To Home] shall be used to return to the origin. After entering the teach mode, click [To Home] after the motor is powered on to begin the reset process.

Parameter Setting

The speed, deceleration ratio, equivalent ratio, motion direction and working range of the additional axis are set according to motor parameters and mechanical configuration.

Setting	Parameter

Max Vel:
- R(mm/s) 0
- S(deg/s) 0

Reduction Ratio:
- R: 0
- S: 0

Max Accel:
- R(mm/s²) 0
- S(deg/s²) 0

Couple:
- R: 1
- S: 1

Max Decel:
- R(mm/s²) 0
- S(deg/s²) 0

Direction:
- R: ☐ Reverse
- S: ☐ Reverse

Range:
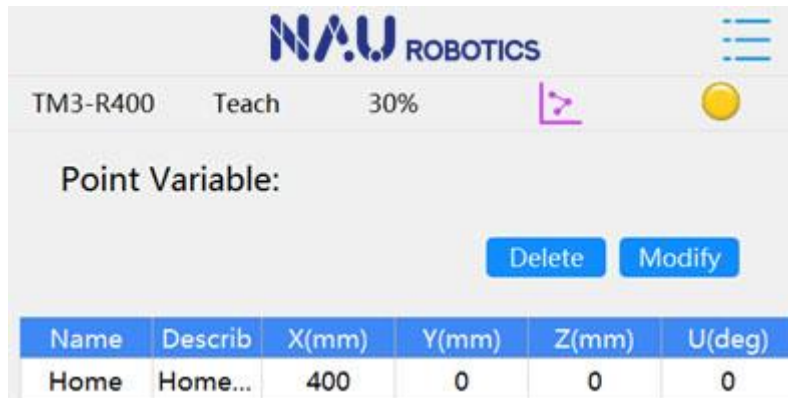- R(mm) From 0 To 1
- S(deg) From 0 To 1

5.3 Variable

The variable function module includes position variable, tool coordinate and local coordinate function.
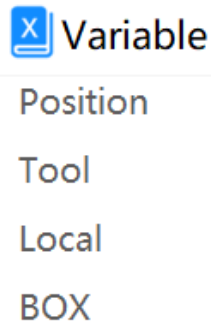
5.3.1 Position Variable

Click Menu-Variable-Location Variable to delete and modify the position information.

Point variable is generated when teaching the points. This interface can only delete or modify points.

Delete Points

In teach mode, select the point to delete, click [Delete], and then click [OK] to delete the point from the point file.

Modify Point

Select the point to be modified in teach mode, click [Modify] to enter parameters in the pop-up dialog box, and then click [OK], and the point can be modified successfully.

5.3.2 Tool Coordinate

Click Menu-Variable-Tool Coordinate to modify and calibrate the Tool Coordinate.

The [Tool] interface allows you to add, modify, delete, and calibrate tool coordinates. It supports up to 16 tool coordinates, which cannot be deleted, but can only be modified and calibrated.

Modification

Modify the tool coordinate system, select the coordinate system to be modified in [Tool], click [Modify], modify the parameters in the pop-up window, and then click [OK] to successfully save the modification of the coordinate system.

Calibrate Tool Coordinate System

When there are no accurate parameters in the tool coordinate system, the tool co-ordinate system calibration function can be used to obtain the parameters.

Before starting calibration, make sure that the end tool of the robot is installed correctly and the tool is with reference points for calibration, and then select an external reference point on the plane within the range of motion of the robot to start calibration.

Before the teaching point is located, make sure that the calibrated or modified tool coordinate system is not selected in [Teach], otherwise the calibration result may be incorrect.

Tool coordinate calibration:

Modify | Calibrate

Index	Name	escriptic	X	Y	Z	U	V	
T001	tool1	Tool	0	0	0	0	0	
T002	tool2	Tool	0	0	0	0	0	
T003	tool3	Tool	0	0	0	0	0	
T004	tool4	Tool	0	0	0	0	0	
T005	tool5	Tool	0	0	0	0	0	
T006	tool6	Tool	0	0	0	0	0	
T007	tool7	Tool	0	0	0	0	0	
T008	tool8	Tool	0	0	0	0	0	
T009	tool9	Tool	0	0	0	0	0	
T010	tool10	Tool	0	0	0	0	0	
T011	tool11	Tool	0	0	0	0	0	
T012	tool12	Tool	0	0	0	0	0	
T013	tool13	Tool	0	0	0	0	0	
T014	tool14	Tool	0	0	0	0	0	
T015	tool15	Tool	0	0	0	0	0	
T016	tool16	Tool	0	0	0	0	0	

1) Select the coordinate system to be calibrated in the list of tool coordinate system, and click [Calibrate];

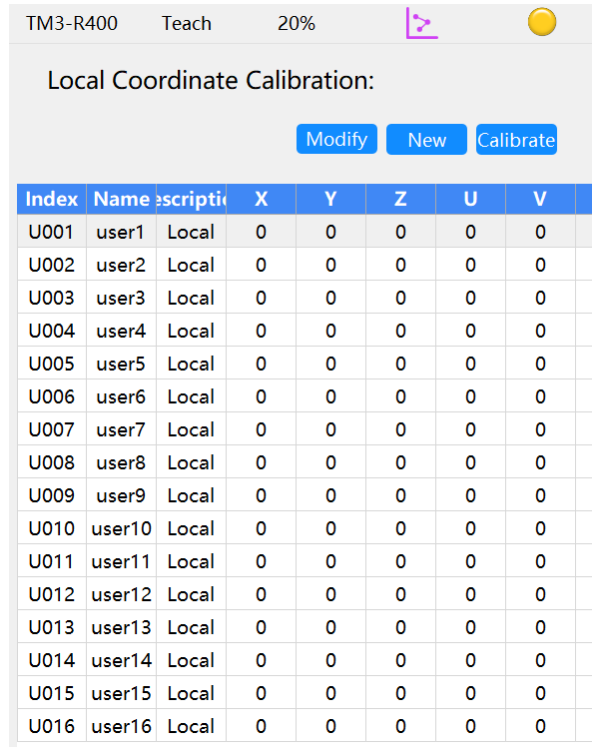2) Complete the calibration procedure according to the prompt;

3) After completing the calibration procedure, the tool coordinate parameters will be calculated through the coordinates of the two reference points, and then click [OK] to save the calibration result to the calibrated tool coordinate system.

After the calibration of the tool coordinate system is completed, it can be used in the teach mode and the robot program. After using the tool coordinate system, the end reference point of the Robot will move from the default world center to the new tool center point.

If the two points used in the calibration tool coordinate system are in the same robot system or the data is abnormal, the calibration will fail because the correct tool coordinate system cannot be calculated.

5.3.3 Local Coordinate

Click Menu-Variable-Local to modify and calibrate user coordinate system.

Index	Name	escriptio	X	Y	Z	U	V
U001	user1	Local	0	0	0	0	0
U002	user2	Local	0	0	0	0	0
U003	user3	Local	0	0	0	0	0
U004	user4	Local	0	0	0	0	0
U005	user5	Local	0	0	0	0	0
U006	user6	Local	0	0	0	0	0
U007	user7	Local	0	0	0	0	0
U008	user8	Local	0	0	0	0	0
U009	user9	Local	0	0	0	0	0
U010	user10	Local	0	0	0	0	0
U011	user11	Local	0	0	0	0	0
U012	user12	Local	0	0	0	0	0
U013	user13	Local	0	0	0	0	0
U014	user14	Local	0	0	0	0	0
U015	user15	Local	0	0	0	0	0
U016	user16	Local	0	0	0	0	0

Modification

Modify the user coordinate system, select the coordinate system to be modified in [Local], click [Modify], modify the parameters in the pop-up window, and then click [OK] to successfully save the modification of the coordinate system.

New Local Coordinate System

When there are no accurate parameters in the user coordinate system, the user co-ordinate system calibration function can be used to obtain the parameters.

Before starting calibration, make sure that the end tools of the Robot are installed and calibrated correctly and the tool is with reference points for calibration. Select the origin, direction of X-axis and Y-axis on the user coordinate system to be calibrated, and then the calibration process of user coordinate system can be started.

Before calibrating, please make sure that the user coordinate system calibrated or modified is not selected in the [Teach] interface, otherwise the calibration results may be incorrect.

1) Select the coordinate system to be calibrated in the user coordinate system list, and click [Calibrate];

2) Complete the calibration procedure according to the prompt;

3) After completing the calibration procedure,click [OK] to save the calibration result to the calibrated user coordinate system.

If the three points used in the calibration of the local coordinate system cannot form a correct right hand cartesian coordinate system or the accuracy is insufficient, the calibration will fail because the correct user coordinate system cannot be calculated.

After the calibration of the user coordinate system is completed, the user coordinate system can be used in the teach mode.

Calibrate User Coordinate System

The user coordinate system calibration function can accurately calibrate the user coordinate system through four workpiece.

1) Select the user coordinate system to be calibrated in the user coordinate series table, and click [Calibration] to pop up the window shown in the figure below.
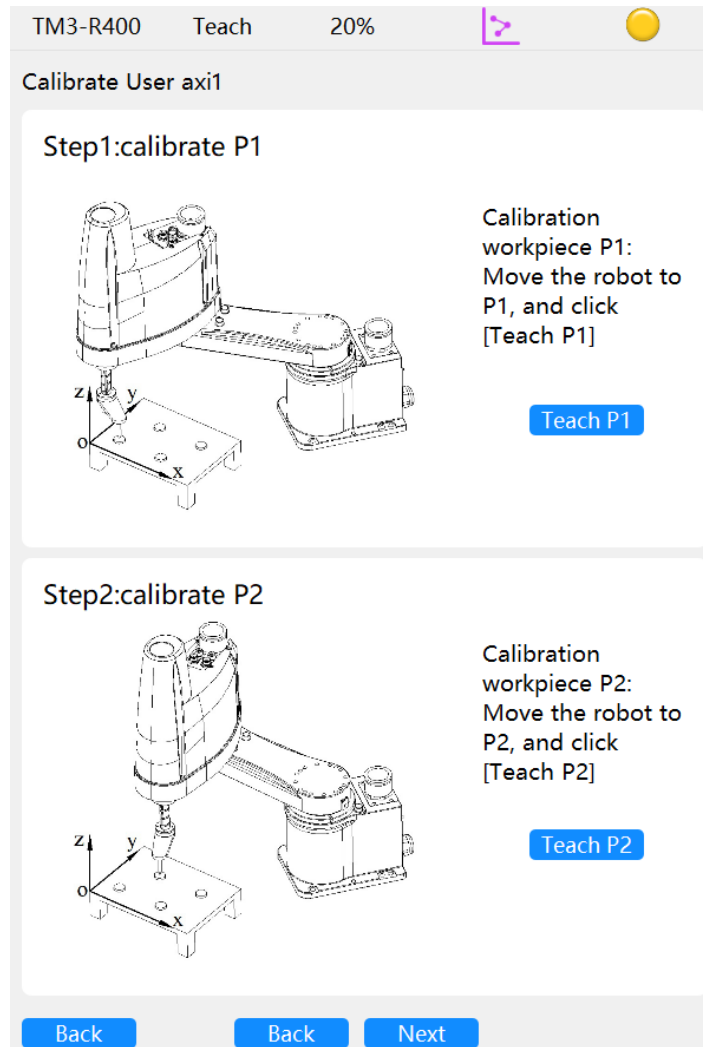
2) Teach move the robot until the center point of the tool coincides with the workpiece center, click [Teach P1] to save the current world coordinate value.

3) Teach the coordinate positions of the four workpieces in turn according to the steps, and try to increase the interval between the selected points.

Calibrate User axi1

Step4:calibrate 4 points

P1.x	0	P1.y	0	P1.z	0
P2.x	0	P2.y	0	P2.z	0
P3.x	0	P3.y	0	P3.z	0
P4.x	0	P4.y	0	P4.z	0

Apply

Manually calculate the coordinate values of the four points on the workpiece coordinate system corresponding to the workpiece, and fill in the corresponding positions in sequence\n. Finally, click the [apply] button to save the calibration results\nFour points can not be in the same line.

Back   Back   Finish

4) After completing the four points teaching, manually calculate the coordinate values of the four points on the workpiece coordinate, and fill in the corresponding positions in sequence. Click [Apply]-[Finish], then save the calibration result.

This function is often used to calibrate user coordinate system according to other references when there is no accurate reference of the origin or the X axis of the user coordinate system.

User coordinate system calibration does not support spatial user coordinate system temporarily, only supports user coordinate system parallel with XOY plane.

5.3.4 Box Area

This interface is used to set the working area and forbidden area of the Robot

After entering the teach mode, open the interface of [variable] - [Box], select one of the box to be modified, click [modify], set the range, polarity and output port of each coordinate, and then click [save] to take effect.

The system output port cannot be used in the work area. If the system output is used in the enabled work area, an alarm will be raised when the program is running automatically.

Box:	Index:	0		MIN :	MAX :
	Enable:	Close ∨	X :	0	0
	Polarity:	Inside ∨	Y :	0	0
Modify	User:	0 ∨	Z :	0	0
Cancel	Output:	0 ∨			

Number	Enable	Polarity	Output	Local	X MIN	X MAX	Y
0	Close	Inside	0	0	0	0	
1	Close	Inside	0	0	0	0	
2	Close	Inside	0	0	0	0	
3	Close	Inside	0	0	0	0	
4	Close	Inside	0	0	0	0	
5	Close	Inside	0	0	0	0	
6	Close	Inside	0	0	0	0	
7	Close	Inside	0	0	0	0	
8	Close	Inside	0	0	0	0	
9	Close	Inside	0	0	0	0	
10	Close	Inside	0	0	0	0	
11	Close	Inside	0	0	0	0	
12	Close	Inside	0	0	0	0	
13	Close	Inside	0	0	0	0	
14	Close	Inside	0	0	0	0	
15	Close	Inside	0	0	0	0	

After the end of the robot enters the forbidden area, it should be pushed out manually after power down.

Multiple work areas can be bound to the same output port.

When the program is running automatically, if the SetBox instruction is used to modify the work area, it will only take effect when the program is running. When the program stops running and enters the teaching mode, the parameters set in [BOX] will be effected.

5.3.5 Tool Box Setting

The [Tool Box] is used to set the tool determination area which is effective at the end of the robot. When the tool Box coincides with the Box area, the IO of the working area or the forbidden area will be triggered.

Number	Enable	Type	Z1	H1	R1	Tool1	T
0	disable	Single...	0	0	0	NULL	N
0	disable	Single...	0	0	0	NULL	N
0	disable	Single...	0	0	0	NULL	N
0	disable	Single...	0	0	0	NULL	N
0	disable	Single...	0	0	0	NULL	N
0	disable	Single...	0	0	0	NULL	N
0	disable	Single...	0	0	0	NULL	N
0	disable	Single...	0	0	0	NULL	N
0	disable	Single...	0	0	0	NULL	N
0	disable	Single...	0	0	0	NULL	N
0	disable	Single...	0	0	0	NULL	N
0	disable	Single...	0	0	0	NULL	N
0	disable	Single...	0	0	0	NULL	N
0	disable	Single...	0	0	0	NULL	N
0	disable	Single...	0	0	0	NULL	N
0	disable	Single...	0	0	0	NULL	N

Tool Box function can only be used when the robot body type is SCARA. After entering Teach mode, select a Tool Box, and click [Modify] to enter the setting interface of the Tool Box.

ToolBox: 0

Enable: disable   Tool Axis 1: NULL

Type: Single Cylinder   Tool Aixs 2: NULL

Z1: 0   R1: 0

H1: 0

Fig1:Single-Cylinder(type =0)   Fig2:Double-Cylinder(type=1)

Save   Exit

Tool Box Type

The type of tool Box includes single-cylinder and double-cylinder. By combined with the two types of tool Box, the tool configuration of most application scenes can be achieved.

Single-Cylinder: A single cylindrical judgment area, the selected [Tool1] as the center of the circle, R1 is the radius, H1 is the height, Z1 is the relative position that the upper face of the area is in the end screw coordinate of robot. If the upper face is higher than the lower face of the screw, Then Z1 is positive and vice versa.

Double-Cylinder: With [Tool1] and [Tool2] as the center of the circle, R1 as the radius and H1 as the height, the judgment space is formed by connecting the two cylinders in the tangent direction. Z1 is the relative position that the upper face of the area is in the end screw coordinate of robot.
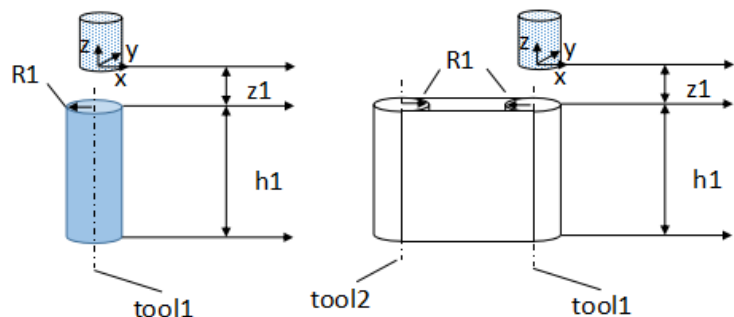
Fig1:Single-Cylinder(type =0)   Fig2:Double-Cylinder(type=1)

5.4 Status

The status function module includes log, I/O status, about/upgrade and permission functions.

5.4.1 Log

Click [Search] to check error log, warning log and event log in the controller.

5.4.2 I/O Status

Click Menu-Status-I/O Status to monitor the current status of all input and output of the current controller and to control the status of user output;

System IO and User IO

power down, error clearing and other operations in external IO control mode. The output status of the system can not be manually modified in the [I/O status] interface or robot program.

All of them are user IO except system IO. User input can be connected to external sensors and buttons etc. to obtain feedback signal. User output can be connected to external loads such as solenoid valves and indicator lights to control their status. User output can be manually modified in the [I/O Status] interface or manipulated by command in a Robot program.

Click the user IO label to modify the user IO label.
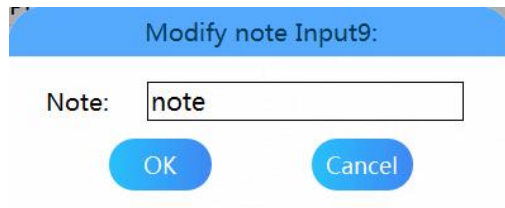
Click the status indicator icon of the user output then click [OK] to turn it on/off.

The [I/O Status] interface includes two states, i.e. input and output.

- 🟡 Yellow Close
- 🟢 Green Open
- ⚪ Grey Disconnect

Additional IO Modules

After adding the additional module, updating the EtherCAT configuration file and setting the number of additional modules, the IO status interface can view and operate the extended IO status.

5.4.3 About/Upgrade

Click on the Menu-Status-About to view the version number and the upgraded teach pendant version.
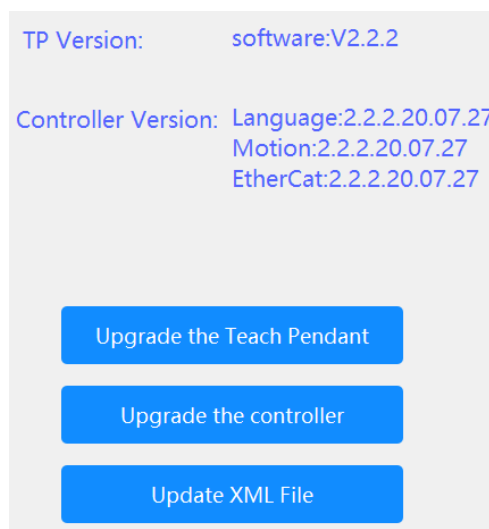
Upgrade the Teach Pendant

Copy the update file " qt_teachbox " provided by the technical service personnel to the USB flash disk, insert it into the USB interface on the back of the teach pendant, and click "Upgrade teach pendant" to upgrade the teach pendant system automatically and reboot it.

Upgrade the controller

Copy the controller update file "sys.bin" to the USB flash disk and insert it into the USB interface on the back of the teach pendant. Click "Upgrade the controller" to upgrade the controller system and restart automatically.

Update the XML File

Copy the bus configuration file "IO. xml" to the USB flash disk, insert it into the USB interface on the back of the teach pendant, click "Update XML File", and then download the XML file on the USB disk and restart automatically.

Each update function needs to ensure that the file name is correct and case sensitive, the file should be copied to the root directory of the USB stick, avoid the use the USB flash disk with multiple partitions.

5.4.4 User management

Click menu-Status-User management to modify the view of user permissions, bring user admin, password: admin. User Admin has permissions for all permissions.

Click [Delete User] to delete the user selected in the drop-down box on the right. Admin user cannot be deleted.

Click [Switch User] to switch to other users. If you want to exit the current user, please switch to the main interface, and click [Log out].

Click [Add User] to create a new user, fill in the corresponding user name and password on the right side, and click [OK]The username must be the new username, and the password must be the same twice, otherwise the user creation fails. The specific permissions on the bottom side are also highlighted for configuration options.

Permission Details

Robot	View and modify the robot parameters, including robot Settings, motion speed Settings, I/O Settings, additional axis Settings, belt Settings.
System	View and modify the parameters of the trainer and controller, system Settings
Point(all)	View and modify all points
Point(part)	View all points, but modify only some of the configured points
Modify Tool	View modify tool coordinates
Modify User	View modify user coordinates
Modify Box	View the modify Box information
Project File	Modify, upload, and download project files
Start/stop	Run, stop the program
Teach	In teaching mode, move the robot
New point	Adds a new point of teaching to the point position file
Modify point	Replace the selected point with the new teaching store
Permission	View each user's permissions
User admin	Add and remove users
IO status	View the current IO status
Log	Viewing the robot log

5.5 Program

The program function module includes all program and current project functions.

Program

All Programs

Current PG

5.5.1 All Programs

Click Menu-Programs-All Programs to create and delete the project.
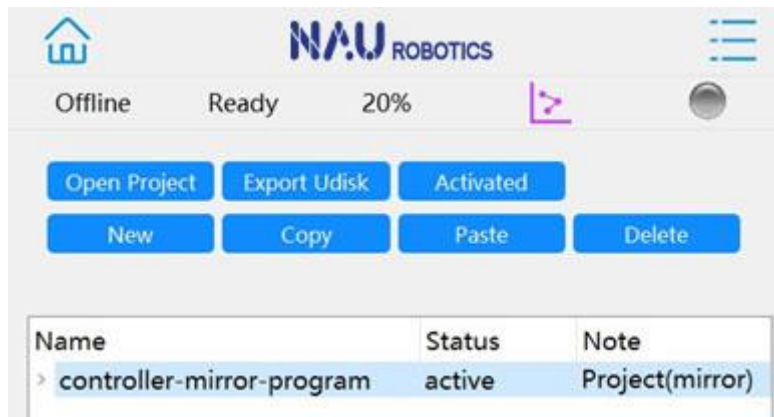
Open Project	Select an item or file and click [Open Project] to open the target item
Export Udisk	After inserting the USB drive into the USB port of the Teach Pendant, click "Export Udisk" to export the project files to the USB drive;
	Note: The [export Udisk] function can only be exported to a storage device whose file system is FAT32;
Activated	Set the current selected project as active project
New	Click [New Project] to enter a new project/file name in the pop-up window to create a new project/file
Copy and Paste	Select a file, click [Copy], then select another item, and click [Paste] to copy and paste the file into the target item
Delete	Select an item/file and click [Delete], and then click [OK] in the pop-up window to delete the item/file. If you want to cancel the delete operation, click [Cancel] button.

5.5.2 Current Project

Click Menu-Programs-Current PG to program, download, and save.

Double click Main.lh in the project file view interface to open the file and enter the program editing interface.

The Menu Bar includes return, copy and paste functions, details are as follows:

Return

Menu Bar: ↩

Return to the interface of [All Programs]

File View

Menu Bar: ☰

Display the view of project file in the main interface

Log Information View

Menu Bar: 🗒LOG

Display the view of Log information　in the main interface

Save and Download

Menu Bar:

Save and download. After the program editing interface is modified, click [Save and Download] in the menu bar directly, and click [Yes] in the pop-up window, and then the modified program files can be saved and synchronized to the controller.

Copy

Menu Bar:

Copy the currently selected content to the clipboard.

Paste

Menu Bar:

Paste the contents of the clipboard into the cursor position.

Revoke

Menu Bar:

Revoke the changes to the current program file

Rework
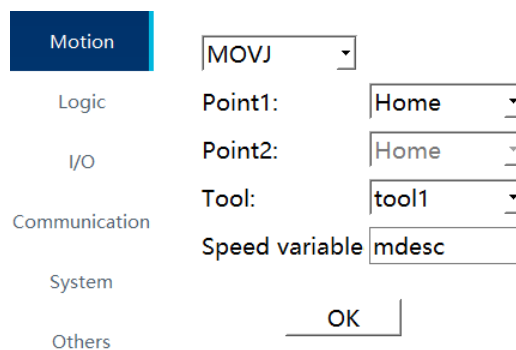
Menu Bar:

Revoke before recovery

Insert Instruction

Menu Bar:

Insert instructions include motion, logic, IO, system, communications, and other instructions for quickly inserting instructions and logic into TAICHI.

Motion	MOVJ ▾
Logic	Point1: Home ▾
I/O	Point2: Home ▾
Communication	Tool: tool1 ▾
System	Speed variable mdesc
Others	OK

Click [Insert Instruction] in the cursor position of editing window, select the instruction to insert and fill in the parameters, then click [OK] to insert the target instruction.

Keyboard

It is used to enter text in the edit window.

Double click at the cursor position of the program editing interface to open the keyboard and write the program.
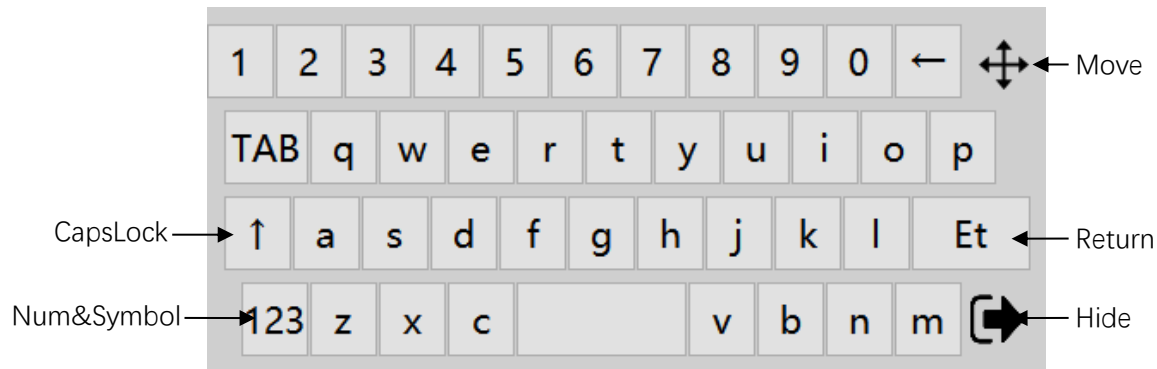
Debugging and Operation

Menu Bar: ☑ 👨‍🔧

In auto mode, after selecting Debugging and Operation, click the operation button to run the program, and press 🔽 of the control panel button to run the program in the controller line-by-line.

After starting the debugging run, press the run button again, and the debugging run will start at full speed. At this time, the running speed will be the same as the automatic run, and the current running line number will be displayed.

Pause

Menu Bar: ⏸

Pause the Program Operation of robot

Adjust Font

Menu Bar: ⊕ ⊖

Adjust the word size

Create New File

Menu Bar: ✏️

Create a new program file. Enter the file name in the pop-up window and click [OK] to create a new program file

Delete

Menu Bar: 🗑

Delete the selected files

5.6 Operation

The operation module includes functions of teach, main control, and synchronize file.

Operation

Teach

Main Control

Sync Files

5.6.1 Teach

The teach interface is used to view the current coordinates of the robot, teach and execute points.

You can conduct teach motion of robot in world mode, joint mode, tool mode, user mode, or perform joint motion, linear motion, or circular motion for moving to the target point.

Only in the teach mode, the teach motion of robot can be conducted manually or executed to the target point.

The teach mode is used to select method of the teach motion of robot.

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World	Make the robot to linear motion along the X, Y, and Z axes of the default world coordinate system and rotate the U-axis around the center of the tool.
Joint	Each joint and mode of motion of the robot under teach motion are not concerned with the tool and user coordinate system, and the motion only belongs to single joint motion.
Tool	The robot of teaching is in linear motion along the X, Y, Z axes of the coordinate system defined by the current tool, and it rotates the U axis around tool center point.
Local	The teaching robot moves linearly along the X, Y, Z axes of the current user coordinate system and rotates the U axis around tool center point.

(1)User and Tool

The User and Tool drop-down list is used to select all the tools and user coordinates for the demonstration.

User:

NULL ⌄

Tool:

NULL ⌄

(2)Position Information

Display the current coordinate values of the Robot, the Robot system, and joint flag.

Position					
User: NULL ⌄	X(mm)	400.000000	J1(deg)	-90.000000
	Y(mm)	0.000000	J2(deg)	0.000000
Tool: NULL ⌄	Z(mm)	0.000000	J3(mm)	0.000000
	U(deg)	0.000000	J4(deg)	0.000000
Hand: Righty	V(deg)		J5(deg)	
Elbow: Up	W(deg)		J6(deg)	
Wrist: Flip	R(deg)		O1(deg)	
J1:0 J2:0	S(deg)		O2(deg)	
J4:0 J6:0				

World Coordinate	When the coordinate position of the tool center point is in the current coordinate system, the current coordinate

system can be either the default world coordinate system or the calibrated user coordinate system.

Joint Coordinate	Display the coordinate value of each joint of the current robot.
Hand	J2 joint angle greater than 0 is a right robot system, less than 0 is a left robot system, equal to 0 is a singular point without any robot.

(3)Jog Distance

The Jog Distance module contains text boxes that modify the step distances of each axis, and radio buttons that step distances such as "Continuous", "Short Distance", "Medium Distance", and "Long Distance".

When continuous motion is selected, the robot will move in continuous mode. After pressing the power up switch and button for the next step, it will move continuously, and when release the button of next step, it will stop immediately. When the stepping distance is short, medium, or long, you can modify the stepping distance value in the text box.

Distance	Settable Value	Default Value
Short Distance	0 to 50	0.1
Medium Distance	0 to 50	1
Long Distance	0 to 50	10

When the teach mode is changed, the unit of stepping distance changes automatically between millimeters (mm) and degrees (deg).

(4)Point Teach and Point Execute

Teaching points and execute point are used for adding, modifying, and executing motion to target points.

Point Teach
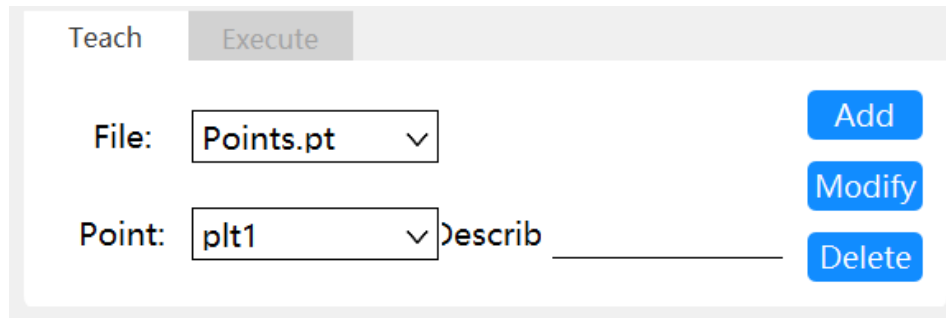
Point Teach includes adding ,modifying and deleting point.

Teach   After teaching the motion robot to the point to be recorded, click [Add], enter the point name and description in the pop-up dialog box, and click [OK] to save the current point-to-point list.

Modify   In the [Point] drop-down menu, select the point to be modified, teach the robot to the position to be modified, click [Modify], click [OK] in the pop-up window to modify the coordinate value of the selected point to the current position.

Delete   Select the point bit to be deleted from the [point] drop-down menu, click [delete], and click [ok] in the pop-up window to delete the selected point from the point file.

Point names cannot begin with a number and cannot contain special symbols.

Point descriptions cannot contain special symbols.

After the point is added or modified in Teach mode, it needs to be simulated and executed to the point in low speed mode before it can be used in the program running or executed at high speed. In the simulation process, pay attention to use the same starting point as in the program to simulate the correct trajectory of action.

Point Execute

The point executive motion includes MOVL linear motion, MOVJ joint motion, MOVC arc motion and JUMP door-shaped motion.
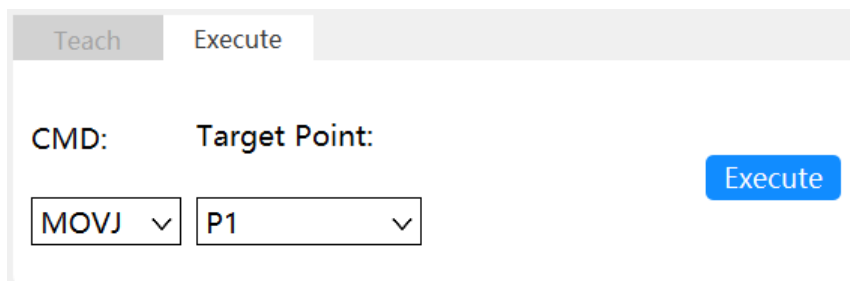
Follow these steps to perform the motion:

1) Click [Execute] to switch to the execution mode.

2) Select the target point to be executed in the [Target Point] drop-down list. If MOVC motion is executed, select the middle point of the arc in the middle point drop-down list, and select the end point of the arc in the drop-down menu of the target point .

3) Select the motion instruction to be executed in the [CMD] drop-down list.

4) Press the power up switch.

5) Click [Execute] and click [OK] in the pop-up window to start moving to the target point.

Each execution instruction is described as follows:

MOVL From the current position, the robot moves to the target point in a linear trajectory. The current robot system must be the same as the target robot system, otherwise it cannot move straight to the target.

MOVJ The robot starts from the current position and moves to the target point in a straight path. The current robot system and target point robot system must be the same, otherwise they cannot move straight to the target point.

MOVC The current point is the starting point, and the selected intermediate point and the target point are three points to form a circular arc track, and the robot moves along the track to the target point of the arc. The implementation of circular motion needs to ensure that the current point, the intermediate point, and the end point are all in the same robot system, and the arc angle formed by the three points shall not be more than 180 degrees.

JUMP The Z axis is raised from the current point to the height set by [Z axis limit], the horizontal joint moves to the top of the target point, and then the Z axis is lowered to the target point.

Note: When performing JUMP motion, make sure that the current point and target point Z-axis height is less than the height set by [Z-axis limit], and [Z-axis limit] will not reach the Z-axis positive limit.

If [Z-axis offset] is used, the actual position to be run is the value set by the target point plus [Z-axis offset].

(5)Additional Axis Teach

Press the "2nd" button in the hardware panel to enter the additional axis teaching mode, move the additional axis through the X/Y button, and then click "2nd" button again to return to the normal teaching mode. The value of the additional axis point position can be saved in the same point position as the value of the robot position.
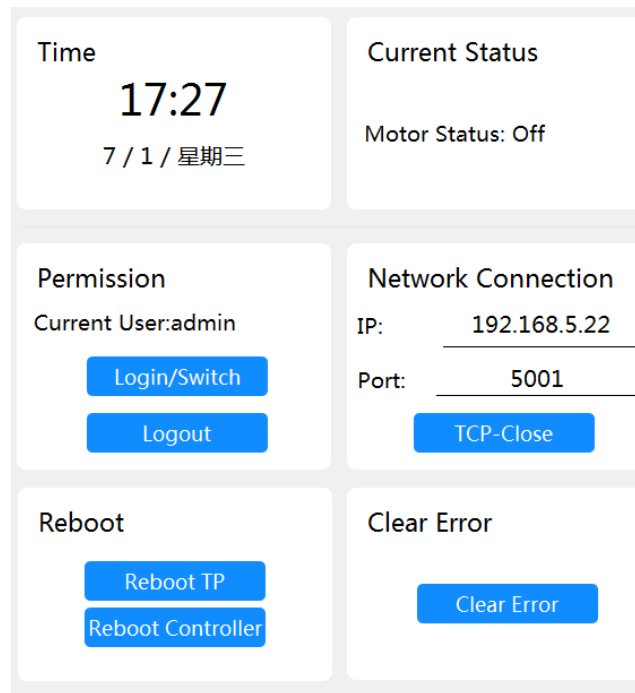
(6)Servo ON label

When the robot is in teaching mode and is powered on, a row of labels with mov-able axis will appear on the right side of the screen:
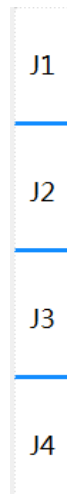
5.6.2 Main Control

Click Menu-Operation-Main Control to log In/Out, connection, reboot, clear errors etc.

The Main Control interface includes the following functions:

Time	View Time and Date
Permission	Log in/switch or log out of the current user
Restart	Restart TP or controller
Current Status	View Motor Status
Network Connection	For the connection and disconnection of the robot, the default IP of the teach pendant connection controller is 192.168.

2.228, and then click "TCP-Open" to connect, and disconnection can be completed by clicking "TCP-Close"

5.6.3 Synchronize Files

Click Menu-Actions-Syn Files to synchronize files in the teach pendant and controller.
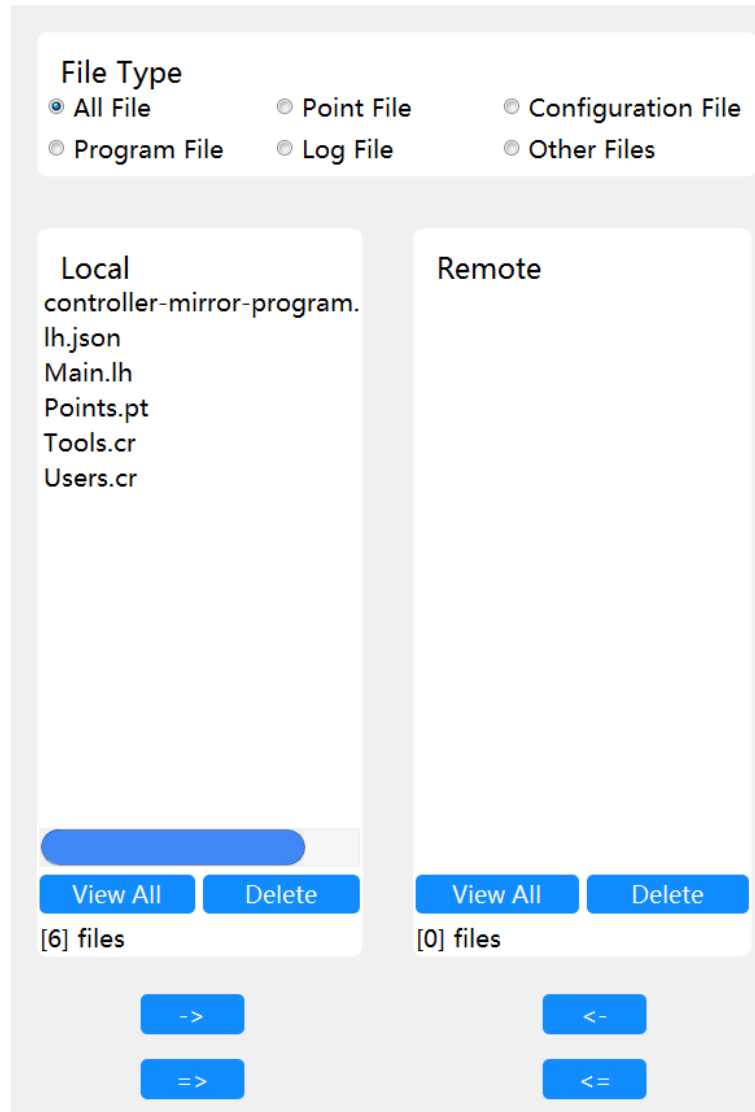
Overview of File Synchronization

After the program files are modified, the modified files must be synchronized to the controller before the program can be run.

Before entering teach mode, make sure that the local project's point file, Points.pt, tool coordinate system file, Tools.cr, and user coordinate system file, Users.cr, are the same as in the controller.

Before entering the teach mode or auto mode, the local active project will be compared with the files in the controller. For example, if the "upper and lower computer files do not match" is alerted, please check whether there are unsynchronized files, and the match the upper and lower files by downloading and uploading.

View All

After connecting to the controller, the local project and the project files in the controller are not displayed in the [Local] and [Remote] boxes. Click [View All] to refresh the contents displayed in the box.

Delete

Select a project file in the [Local] or [Remote] file box, and click [Delete] to completely delete this file from the local or controller.

Be careful because this operation is not recoverable.

File Download

Select a file from a local project in the [Local] box, click the Download File Button `->` , and then click [Yes] in the pop-up window to download the selected file to the controller. Button `=>` is used to download all files.

Since the files are downloaded, the files in the controller will be overwritten, make sure the file in the controller is not the file you want to keep.

Files Upload

Select a file in the controller in the [Remote] box and click the Upload File button `<-` to upload the file in the controller to the local current project folder. Button `<=` is used to upload all files.